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73 Magazine for Radio Amateurs

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The TEMPO S-2

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W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

WARC RESULTS

By the time this gets into print, the WARC results will probably be known—such are the delays of the magazine biz. This is being written considerably before the event in order to set the record straight.

One of the questions which came up during my recent visit to the Philadelphia Area Repeater Association meeting in Valley Forge was my opinion of what would happen at WARC. My answer has not changed in the last couple of years . . . I have no opinion on what will happen . . . there are just too many unknowns involved. I know that I would feel a lot more positive about it if I had seen any significant evidence that amateur groups were doing something in preparation to meet some of the problems which were evident.

In my editorials and talks, I have given the facts on events which have happened which I think are pertinent and which could influence the WARC results. I try hard to make amateurs understand that these are facts of history and not my opinions. It is a fact that amateur radio went into the ITU conference on satellite frequencies with allocations for over 100,000 MHz above 500 MHz and came out with zero . . . nothing. This is not opinion, and it is verifiable in the most revered of sources: *QST*. The ARRL people admitted that they had not done their homework and this was the reason for this catastrophic loss. I think I am not exaggerating when I categorize the loss of virtually the entire future of amateur radio by satellite as catastrophic. Below 500 MHz, we also lost 90% of the 450-MHz band and 100% of the 220-MHz band for satellite use.

The maritime ITU conference in 1972 resulted in another terrible loss of frequencies by white nations as the African and Asian countries banded together, ignoring all technical recommendations, to grab their "share" of the frequencies . . . no matter any intended use or not. This again is not opinion, it is a fact.

If the Third World countries get off this kick of getting everything they can at ITU meetings, we may come out okay, so when I'm asked for my predictions of what will happen, I can't be optimistic . . . nor can I say that I think we will lose 40m, etc. I do say this: If we do lose frequencies, we know where to place the blame for it . . . on those who had the responsibility to protect these frequencies and did so little in that line. Oh, they knew what had to be done, but they just didn't do it. They learned nothing from their debacle in 1971.

Should amateur radio come out with everything we have at present . . . plus a couple of extra bands, no one will cheer more loudly than I. And no one will be luckier than the League. I still won't be able to honestly give them one bit of credit because they have gambled with our future by not doing everything reasonably prudent to try to preserve it. Just hoping for a lucky break hardly constitutes providing the service we expect of them and pay them for.

AN ACCOUNTING

Once this is over, I think the members should flatly demand an accounting of the funds spent in Geneva. The last I heard, they had $140,000 in their wallet and were sending out more letters begging for money for the WARC "crew." Many angry members sent me copies of an August 31st letter . . . a bit late in the game for hat-passing, I'd say.

It may be almost time for League members to stop ignoring what is going on and start asking questions.

MONSTER GREEN

Rather than come up with figures to show that I was wrong in my questions about the ARRL living it up at the expense of the deluded members, they've chosen to attack me personally. "Green is anti-amateur radio," I hear. Or "Green is egotistically trying to torpedo ARRL participation at WARC 79."

I suggest that the facts be brought out. Either I am right about the $100,000 fund for protecting amateur radio or I am not. And all anyone has to do is read the yearly ARRL report. Whitewashed as it is, the fund is right in there for anyone to see. If I am wrong about the fund, then I think a lot of members are due an explanation of why the fund is listed (and has been for years) in the annual reports.

Let's suppose that eventually they will admit to the fund. How then can they justify the hat-passing for more cash? This strongly suggests that they intend to spend more than $100,000 at Geneva! How much can a couple of people spend in a few weeks? Sure, Geneva is expensive, but even at the finest hotel, which I am sure they have engaged, and at the most expensive restaurants, which I'll bet they are patronizing, it should be difficult to spend *that* much money in so short a time.

Say, I'm willing to bet $100 cash that not one of the ARRL members will be able to get a list of the monies which have been spent from that $100,000 fund since it was set up. It has been brought back to strength each year by the directors, and no report has *ever* been made that I have seen on where the money went which was spent. The first person to come up with a list of the expenditures, by whom, for what purpose, and when, gets my $100. Boy, am I safe on *that* bet. I *know* what some of the money was spent for and I *know* it will never be made public.

My apologies to ARRL insiders for stirring up skeletons in closets, but when the directors go out to clubs and start trying to smear me, as a cover-up for their crimes of omission and commission, then I speak up.

Me anti-amateur, huh? And pro what? Let's put it this way . . . I will say flatly that there is not one official of the ARRL at any level who can even come close to my background in amateur radio. For those new readers who might get taken in by a director, let me give just a brief resumé of some of my ham activities.

In the DX field, I've got well over 300 countries confirmed . . . have visited almost 90 countries and operated from over 40. I've been active on OSCAR and have some 30 countries worked through the satellite. On 10 GHz, I have the world's record for states worked: seven. I was one of the pioneers of RTTY and wrote several of the early books on the subject. I also was an early experimenter with slow scan and forget how many countries I've worked on that mode. I had one of the early repeaters and pioneered multiband repeating . . . with my first work on repeaters being in 1949, thirty years ago.

How about contests? If you look back, you'll find that I've won my section several times in the Sweepstakes, DX, VHF, and other contests. Love 'em. The rarest countries I've worked from? Probably Afghanistan as YA1NSD, Nepal as an op at 9N1MM, Tahiti with my FO8AS call, Fiji as VR2FD, and Jordan as JY8AA. I will have been on from Korea as HL9WG and from Hong Kong, with call as yet unknown, in October.

These days I'm active mostly on 20, 15, 10, 2, 1¼ meters, and 10 GHz. But then, I lead a fairly busy life and haven't time for everything. Anti-ham? How many ARRL HQ people have you heard on the air? I haven't heard 'em and I drive right through Hartford every now and then operating on two meters.

FCC BEING PUT DOWN

Not only hams are getting sick of the FCC. I see more and more newspaper clippings from readers about the FCC, none complimentary. Having attended more hearings at the FCC than I like, I can see why the outfit is constipated. Some of my petitions for rule changes have been in the works for ten years and are still hanging around waiting for action.

We might be able to put up with this glacial speed if the results were well considered and fair. They are anything but. Politics is the rule of the day, along with temporary expediency.

One of the major problems at the FCC is that it is being run by seven people, none of whom have the background needed to make decisions on the complex matters involved. This means that every problem has to be explained in tedious detail, written for the complete novice, and it also means that the writer of these details can sway legislation easily by biasing the position papers.

The FCC is trying to handle a wide range of regulations, each requiring a technical background which the commissioners do not have. The result is that some of the commissioners realize the futility of their jobs and just sit back, voting whichever way seems best, but not even trying to make sense of the situations. Some virtually sleep through the long boring hearings.

If the FCC is going to be able to make any intelligent decisions, they are going to have to find some way to get career people with the needed background into the job—not uninterested political appointees. No one can have all of the background needed, so some splitting up of the divisions is needed, with separate heads. The present system of endless oral hearings must be curbed in some way. It is just too much of a waste of time for too many people.

I think it was about a year or so ago that a reader (an old friend who used to work for me) wrote, suggesting that he start a movement to get me appointed to the FCC as a commissioner. I wrote back and said no way. I wouldn't last a week in that bureaucratic environment. I believe that the shortest distance between two points is a straight line, even if it bisects the White House and two other commissioners.

No rational body would have come up with the ten-meter linear ban, which doesn't make any sense. And now that CB sales have dwindled off to where there is virtually no problem with HFers or illegal CBers of any magnitude, I would expect the Commission to go right ahead with plans for dealer registration of ham equipment . . . the requirement of a ham license to buy, etc. The molasses speed of the FCC forces it to provide rules long after the need for them has gone away. Remember the repeater rules, if you will . . . totally unneeded when they arrived because amateurs had already solved the problems which had originally brought on the request for the rules years earlier.

Part of the trouble lies with hams. All too often I see petitions to the FCC intended to solve some temporary problem . . . and I know that years in the future this petition may well cause great mischief. And then we have hams who are afraid to go ahead and experiment with something. They want to make sure that it is all okay with the FCC before they go ahead. The result of that is that the bureaucrats at the FCC are not about to open themselves to any possibility for criticism, so they say no. If the damned ham would just go ahead, but shut up about it, the chances are good that nothing would happen and then we could point to a year or two of operation using the experimental system with success and, at that time, get it okayed. Bureaucrats say no . . . they have to if they want pensions.

If I could see examples of our government providing benefits to us, I might be less critical. I suppose the police system we have is better than none at all, but, at times, I am not sure of this. I see people quitting work because they can make almost as much on welfare and not have any responsibility. After a couple years of that, who will ever hire them? And so it goes . . . many books have been written about this mess we've gotten outselves into . . . and no one has even a hint as to how to get out of it.

About the only good thing you can say about our government is that, crummy as it is, we don't know of a better one anywhere.

WHICH ONES WORK?

Unless you are brand new to *73 Magazine*, it should come as no great surprise to you that I have a considerable interest in 10 GHz . . . and this even extends to the neighboring band of 10.5 GHz, where the police have set up a great little moneymaker by zapping motorists. This nets them well over $3 billion a year in cash for their municipalities, making it possible for a $1,500 radar unit to pay for itself in a weekend!

The *73 Magazine* mobile office and portable laboratory has four different radar detectors mounted across the top of the front window. This is not so much because the lumbering Dodge van is operated above 55 mph as it is to test the ability of these units to detect signals of importance and reject those of insignificance.

The four units currently in test in the van are the Bearfinder, the Fuzzbuster, the Super Snooper, and the Radio Shack Micronta unit. Up here in New Hampshire, we have no shortage of radar in the hands of police . . . In fact, virtually every state police car has one and many of the town cars sport them. A simple trip to Manchester, some 35 miles away, can often supply three or more tests of the detection devices.

One of the best we have tested recently has been the Radio Shack Micronta unit. It looks very much like the Super Snooper unit in the ads, but when ours arrived, we were surprised to find that though the shape was quite similar, the size was substantially smaller. The Micronta generally advises us of a lurking bear a second before the Fuzzbuster, which has come to be a good standard to use.

I'm partial to the Fuzzbuster for a couple of reasons . . . firstly, because it does always give the alert in time to check speed and slow down a hair, if needed. Secondly, this firm, Electrolert, has been by far the most active in fighting illegal laws put through to limit the use of these radio receivers.

As I've mentioned before, on most of the larger highways and turnpikes, the traffic tends to run from ten to fifteen miles per hour over the 55 limit, which means that the bears have a field day when they set up shop. The use of CB and an ear on channel 19 can save you a stiff fine, the hassle of coming back to some crummy place for a court hearing a week or two later, and an increase in your insurance premiums. It may also save your driving license.

I had a very good friend who used to go with me on sports car rallies. A cop. He said that his friends would give almost anything to get parkway duty, since this meant an added nontaxable income of several hundred dollars a day. The patrol cars kept track of commuters in expensive cars and stopped them about once a month for speeding. Unless the motorist was particularly dense, there would be a $50 bill neatly folded within the driving license. The police would look at the license and hand it back, less the $50.

The radar detectors are handy because it is all too easy to go along with the traffic and find yourself a few miles over the speed limit. You're not going fast enough to get there any sooner, but it is fast enough for

NBVM

Because of some late developments, we were unable to present in November the article on NBVM mentioned in "Never Say Die." Tim Daniel N8RK's report will be featured in our January, 1980, issue.

a ticket, court appearance, fine, and insurance increase. When the detector sounds off . . . which is a cacophony in the van, with four going at once . . . I have about one second to hit the brakes before the police radar units can read out my speed. Their radars have to read the incoming Doppler audio tone and change it to miles per hour. This takes a couple of seconds. If the target car is changing speed, the radar unit can't get a fix on it, so you always have time to slow down, if you are properly warned.

If it wasn't for the 55 mph speed limit, I doubt if I would even have the van. It burns gasoline ridiculously, averaging about 11 miles to the gallon. But it has a 36 gallon tank, so we have a range of nearly 400 miles with it. When someone else is driving, I can read manuscripts, answer letters, keep up with literature, and things like that . . . all without the constant interruption of the telephone.

For faster trips, we generally use the Mazda RX-7 . . . which we like very much. There are only three radar detectors on it normally . . . a Fox, a Whistler, and a Bearfinder. The Whistler sometimes sounds off when within twenty feet of a radar transmitter and on the more severe bumps . . . but that's all. The Fox and Bearfinder are about even. The RX-7 burns less than one gallon of gas for every 20 miles when driven at speed (80 mph), even with air-conditioning and automatic shift.

The Fox and the Micronta are pretty close when I plug a Fox into the van system for a comparison. It is difficult to see any real difference in sensitivity . . . both are very good.

Like many other gadgets, once you get used to the warnings from a radar detector, you feel worried without it. Since I'm often chatting away on two meters while I'm driving, generally keeping up with traffic unless I am in a hurry for an appointment, I don't keep my eye on the speed at all times. The warning buzz is appreciated and often saves me a brush with the government.

JAMMING—CAN ANYTHING BE DONE?

Who can fail to get angry when they hear amateurs trying to jam out an emergency net during an earthquake or hurricane? Sure enough, right in the middle of a recent extended period of critical traffic handling, there were some jammers making life miserable for everyone. I understand that the FCC was called and, using their sophisticated direction-finding equipment, quickly located the scoundrels.

Jamming is certainly nothing new in amateur radio and perhaps it is past time to bring it out in the open and stop pretending that it isn't happening. By discussing it, we may be able to better come to grips with the problem . . . and also come up with some plans for dealing with it.

Though there are obviously some common causes and common remedies which apply to jamming, we may be able to tackle the phenomenon better if we break it down into categories. We have the jamming of emergency nets, probably one of the worst types of jamming. Then there is the jamming of what we term service nets . . . such as the Eastcars, Midcars, and Westcars nets. We also have jamming of just plain nets. We have jamming of special modes such as RTTY and SSTV, a sort of specialized breed of jammer. And most of us are familiar with the kerchunker on repeaters . . . and we've even heard the bad-language fan lousing up repeaters.

In addition to those jammers, we have a whole host of jammers working in our DX bands . . . and I'm not speaking about commercial or military stations which are intruding. I'm talking about your sanctimonious DX chaser who slams his signal into a pileup, knowing full well that it is flatly against the law to intentionally interfere with another operator. In this case, jamming is not only condoned, it is a way of life, complete with high-powered amplifiers and giant antenna arrays, all set up with the sole purpose of being able to jam the hell out of several dozen other stations who are trying to reach a choice DX station. Choice, did I say? I've heard pileups on a YV or even a DL when there is nothing rarer to fight over.

WHY?

In some cases, there is obviously a screw loose in a ham's head. They don't give tests of sanity when they hand out ham tickets, so we have our share (and more) of loonies. I've heard more than one ham wife claim that all hams are nuts and, after forty years of this and knowing several thousand hams personally, I'm in no shape to argue the point. I know there are hordes of hams who would sign commitment papers for me if they were passed around.

But let's get down to the nitty-gritty . . . *why* this happens. I'm immediately reminded of a time when I was operating from Curacao (PJ3) and I checked the band carefully for a relatively empty spot . . . found one . . . asked twice if anyone was using it . . . called CQ and got into a contact. About five minutes into the QSO, a woman from Florida broke in on the channel and demanded that I get off the frequency immediately, saying that I had one hell of a nerve operating there, since this was the YL International Phone Net channel. Without giving me a chance to say anything, she proceeded to make a ten-minute call for net members to gather . . . and got some. If ever I wanted to jam a net, that was it.

There is no question but that there are times when a repeater control operator is unobtrusive and considerate and the repeater still gets jammed, but in every case I've heard personally, this was not the case. I've heard dozens of jammings of repeaters, but I've also heard some of the stuff that precipitated the jamming . . . usually a very arrogant control op who has made someone mad. In other cases, I've heard whole groups join in to aggravate a poor situation and make it impossible.

Something happens to many (if not most) people when they get power over others, even if it is so insignificant as being a net control or a repeater control operator. They seem to immediately forget what it is like for the other chap, and they start throwing what weight they have around. This often calls for retaliation . . . and we have jamming. I'd be surprised if 90% or better of the jamming hasn't been instigated by an officious operator who has a severe personality problem . . . like a well-deserved inferiority complex . . . who irritates someone else beyond their capacity of acceptance. Oh, I know the feeling . . . for instance, when someone comes on a repeater where I've been talking for a while and says in an official voice that it is an FCC regulation that I identify my station.

WHAT TO DO

For many amateurs, the first port in a jamming storm is a call to the FCC for help. Then they get all bent out of shape when they find that the FCC boys have better things to do than help us find some yo-yo we've irritated who is busy "getting even."

Speaking of nets, it may come as a rude shock and chilling news, but the FCC has a rule which is fairly explicit . . . no ham, or even net, has a claim to a frequency. The fact that a net has used the same channel daily for fifty years is not an excuse for running roughshod over any stations who are using it come net assembly time. I would suggest that one or two stations be designated to act as peaceful

Continued on page 229

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TS-180S FEATURES:

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OPTIONAL ACCESSORIES:

- DF-180 digital frequency control (for TS-180S without DFC).
- YK-88CW 500-Hz CW filter.
- YK-88SSB second filter for dual-filter system.

MC-50 PS-30 SP-180 TS-180S VFO-180 AT-180

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TS-120S FEATURES:

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- Transceives on 80 through all of 10 meters, and receives WWV on 15 MHz.
- 200 W PEP/160 W DC input on 80-15 meters, and 160 W PEP/140 W DC on 10 meters. LSB, USB, and CW.
- Digital frequency display (standard) shows actual frequency. Backup analog subdial also included.
- IF shift (passband tuning) to eliminate QRM.
- Advanced PLL circuit, with improved stability and spurious characteristics on transmit and receive.
- Effective noise blanker.
- Built-in cooling fan, which activates automatically when final-amplifier heatsink temperature rises to 90° C.
- Protection circuit for final transistors.
- VOX.

OPTIONAL ACCESSORIES:

- YK-88CW 500-Hz filter.
- MB-100 mobile mount.

PS-30 SP-120 TS-120S VFO-120 MC-50

AT-120

AT-120 antenna tuner with mobile mounting bracket included. Features SWR meter and matches 50-ohm input to 20-300 ohms unbalanced output. Handles 150 watts (120 watts on 80 meters).

TS-520SE

SP-520 TS-520SE W/DG-5 VFO-520S

The TS-520SE is an economical version of the TS-520S ... the world's most popular 160-10 meter Amateur transceiver. Now, any Amateur can afford a high-quality HF transceiver for his ham shack.

TS-520SE FEATURES:

- Covers 160-10 meters and receives WWV on 15 MHz.
- 200 W PEP input on SSB and 160 W DC on CW.
- CW WIDE/NARROW bandwidth switch, for use with the optional CW-520 500-Hz CW filter.
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- Speech processor, effective in DX pileups.
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The TS-520S is still available, with DC (mobile) operating capability (with the optional DS-1A DC-DC converter) and transverter terminals, which were eliminated from the TS-520SE.

OPTIONAL ACCESSORIES:

- CW-520 500-Hz CW filter.
- AT-200 antenna tuner.

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R-820/TS-820S

SP-820 R-820 TS-820S

R-820

The R-820 is a highly sophisticated HF receiver for the Amateur who wants the highest quality with the most operating features. A combination of the R-820 and TS-820S provides the ultimate HF operating system.

R-820 FEATURES:

- Full transceive operation with TS-820S, providing full frequency control with either unit.
- Covers 160-10 meters, as well as WWV (15.0-15.5 MHz), and four shortwave broadcast bands (49, 31, 25, and 16 meters).
- Receives SSB, CW, AM, and RTTY modes.
- Double-tuned RF stages and improved dynamic range.
- IF shift (passband tuning).
- Variable bandwidth tuning (VBT).
- Very sharp, deep notch circuit... In 50-kHz IF.
- Provisions for extra-sharp 455-kHz IF filters.
- Noise-blanker with variable threshold level.
- Digital frequency display, with backup analog dial.

OPTIONAL ACCESSORIES:

- YG-88C 500-Hz CW filter, for first IF.
- YG-88A 6-kHz AM filter, for first IF.
- YG-455C 500-Hz filter, for second IF.
- YG-455CN 250-Hz filter, for second IF.

TS-820S

The TS-820S is a very popular 160-10 meter SSB/CW/RTTY transceiver, preferred by DX operators and other particular Amateurs. It employs a single-conversion PLL circuit.

TS-820S FEATURES

- 200 W PEP SSB/160 W DC CW, 100 W DC FSK input on 160-10 meters.
- Digital frequency display, with backup monoscale analog dial.
- IF shift (receiver passband tuning) to eliminate interference.
- RF speech processor.
- Effective noise blanker.

OPTIONAL ACCESSORIES:

- CW-820 (YG-88C) 500-Hz CW filter.
- DS-1A DC-DC converter.
- AT-200 antenna tuner.

SP-820 TS-820S VFO-820

ACCESSORIES FOR TS-820 AND TS-520 SERIES

TV-502S (not for TS-520SE) TV-506 AT-200

AT-200 antenna tuner handles 200 W, 160-10 meters.
TV-502S 2-meter transverter covers 144-146 MHz. (Not intended for TS-520SE.)
TV-506 6-meter transverter covers 50-54 MHz. (Not intended for TS-520SE.)

TL-922A

The TL-922A linear amplifier for all Kenwood HF equipment provides maximum legal power on the 160-15 meter Amateur bands, employing a pair of EIMAC 3-500Z high-performance transmitting tubes.

TL-922A FEATURES:

- 2000 W PEP (SSB)/1000 W DC (CW, RTTY) input power on 160-15 meters, with 80 W drive.
- Excellent IMD characteristics.
- Safety protection.
- Blower with automatic delay circuit.
- Variable threshold level type ALC.

SM-220

The SM-220 Station Monitor is capable of various monitoring functions, and performs as a wideband oscilloscope, and is expandable for pan-display operation.

SM-220 FEATURES:

- Monitors transmitted SSB and CW waveforms from 1.8 to 150 MHz.
- High-sensitivity wide-frequency-range (up to 10 MHz) oscilloscope.
- Monitors received signals in IF stage.
- Tests linearity of linear amplifiers (provides trapezoid pattern).
- Allows observation of RTTY tuning points (cross pattern).
- Built-in two-tone (1000-Hz and 1575-Hz) generator.
- Expandable to pan-display capability for observing the number and amplitude of stations within a switchable ±20 kHz/±100 kHz bandwidth.

OPTIONAL ACCESSORIES:

- BS-8 pan-display module for TS-180S and TS-820 series.
- BS-5 pan-display module for TS-520 series.

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...pacesetter in amateur radio

...for the discerning Amateur who demands quality.

R-1000

SP-100 R-1000

The R-1000 is a highly advanced communications receiver. Up-conversion. PLL circuitry and other new technology provide optimum sensitivity, selectivity, and stability from 200 kHz to 30 MHz. Featuring easy-to-operate single-knob tuning and digital frequency display, it's perfect for listening to shortwave, medium-wave, and long-wave bands. Even SSB signals are received perfectly. Included is a quartz digital clock and timer.

R-1000 FEATURES:

- Continuous frequency coverage from 200 kHz to 30 MHz.
- 30 bands, each 1 MHz wide.
- Five-digit frequency display and illuminated analog dial.
- Quartz digital clock and ON/OFF timer.
- Multi-modes . . . AM (wide and narrow), SSB (USB and LSB), and CW.
- Three IF filters . . . 2.7 kHz for SSB and CW, 6.0 kHz for AM narrow, and 12 kHz for AM wide.
- Effective noise blanker.
- Built-in speaker.
- Three antenna terminals.
- RF step attenuator.
- Tone control.
- Recording terminal.
- Remote terminal, for access to timer relay ON/OFF circuit and muting circuit.
- SSB sensitivity of 0.5 μV from 2 to 30 MHz.
- More than 60 dB IF image ratio.
- More than 70 dB IF rejection.

R-300

R-300 FEATURES:

- Continuous frequency coverage from 170 kHz to 30 MHz, in six bands.
- Multi-modes . . . AM, SSB, and CW.
- High sensitivity, selectivity, and image ratio.
- 500-kHz marker.
- Three-way power supply (AC/batteries/external DC), with automatic switching from AC to DC in the event of AC power failure.

The R-300 all-band communications receiver covers 170 kHz to 30 MHz in six bands. It's ideal for listening to foreign broadcasts and other exciting transmissions throughout a wide range of the radio spectrum.

TR-7600

TR-7625

The TR-7600 and TR-7625 are Kenwood's popular synthesized 2-meter FM mobile transceivers. Combined with the RM-76 Microprocessor Control Unit, several memory and scanning capabilities are provided.

TR-7600/TR-7625 FEATURES:

- One memory channel.
- Mode switch for simplex or repeater operation. Repeater mode shifts the transmit frequency + 600 kHz or − 600 kHz or to the memory frequency.
- Full 5-kHz coverage from 144.000 to 147.995 MHz.
- Adaptable to any one MARS simplex or repeater channel between 143.7 and 148.3 (with modification kit).

RM-76

ADDED FEATURES WITH RM-76:

- Six memories.
- Automatic memory scan.
- Automatic scan up the band in 5-kHz steps, with selectable upper and lower frequency limits.
- Manual scan up or down the band in single or fast continuous 5-kHz steps.
- ± 1 MHz transmitter offset as well as ± 600 kHz and memory offset for repeater operation.
- MARS operation on 143.95 MHz simplex.
- Versatile digital display of transmit and receive frequencies, and operating functions.

KPS-7

The KPS-7 is a matching AC power supply for the TR-7600 and TR-7625. Output is 13.8 VDC at 7 A ICS (50% duty cycle).

TR-2400

The TR-2400 synthesized 2-meter hand-held transceiver features a large LCD frequency readout, 10 memories, scanning, and much more.

TR-2400 FEATURES:

- Large, illuminated LCD digital frequency readout. Readable in direct sunlight, and a lamp switch makes it readable in the dark. Shows receive and transmit frequencies and memory channels, and indicates "ON AIR", memory recall, battery status, and lamp switch on.
- 10 memories, with battery backup.
  - Automatic memory scan, for "busy" or "open" channels.
  - Mode switch for simplex, ± 600 kHz transmit repeater offset, and memory-frequency ("M 0") transmit repeater offset.
  - REVERSE momentary switch.
  - Built-in 16-button Touch-Tone generator.
  - Keyboard selection of 5-kHz channels from 144.00 to 147.995 MHz.
- Up/down manual scan and repeater or simplex operation from 143.900 to 148.495 MHz in single or fast continuous 5-kHz steps.
- Two lock switches to prevent accidental frequency change and accidental transmission.
- Subtone switch (subtone module not Kenwood supplied).
- More than 1.5 W RF output.
- High-impact plastic case and zinc die-cast frame.
- BNC antenna connector.
- Standard accessories included with the TR-2400 are a flexible rubberized antenna with BNC connector, ni-cad battery pack, and AC charger.

ST-1

OPTIONAL ACCESSORIES:

- Attractive leather case.
- Model ST-1 base stand, which provides 1.5-hour quick charge, trickle charge, and base-station operation with microphone connector and impedance-conversion circuit for using MC-30S microphone.
- Model BC-5 DC quick charger.

TOP CONTROLS

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TS-700SP

SP-70 TS-700SP VFO-700S

The TS-700SP is an all-mode (SSB, FM, CW, and AM) solid-state transceiver covering the entire 2-meter band, including repeater operation on all subbands. It's the perfect rig for the serious 2-meter Amateur.

TS-700SP FEATURES:

- All modes...SSB (USB and LSB), FM, CW, and AM.
- VFO tuning from 144 to 148 MHz in four bands.
- Seven-digit readout of receive frequency, with 100-Hz resolution. (Last digit can be eliminated automatically in the FM mode.)
- Simplex and repeater operation, including all repeater subbands. Switchable to REVERSE mode.
- Built-in receiver preamplifier.
- AC/DC capability, for fixed or mobile operation.
- 44 fixed channels with 11 crystals.
- Multifunction meter...S-meter on all receive modes, zero-center meter on FM receive, and RF transmit.
- High-low power switch (10 W/1 W).
- RIT for both VFO and fixed channels.
- Effective noise blanker.

TS-600

SP-70 TS-600 W/VOX-3

The TS-600 is an all-mode (SSB, FM, CW, and AM) solid-state transceiver covering the entire 6-meter band. It's the ideal transceiver to enjoy the many exciting propagation conditions on 6 meters.

TS-600 FEATURES:

- All modes...SSB (USB and LSB), FM, CW, and AM.
- VFO tuning from 50 to 54 MHz in four bands. Main dial graduated at 1-kHz intervals.
- AC/DC capability, for fixed or mobile operation.
- 20 fixed channels with five crystals.
- Effective noise blanker.
- 100-kHz marker.
- Multifunction meter...S-meter on all receive modes, zero-center meter on FM receive, and RF on transmit.
- RIT for both VFO and fixed channels.
- 20 W PEP input on SSB, 10 W output on CW and FM, 5 W output on AM.

OPTIONAL ACCESSORY:

- VOX-3, to provide VOX and semi-break-in CW operation.

TR-8300

TR-8300 FEATURES:

- Covers 445.0-450.0 MHz (transmit) and 442.0-447.0 MHz (receive).
- 23 channels, three supplied (446.0 MHz simplex, 446.5 MHz simplex, and 449.10 MHz transmit/44.10 MHz receive).
- Five-section helical resonator and two-pole crystal filter in receiver IF for improved intermodulation characteristics.
- Call channel switch, for user-desired function (such as subtone).
- High-low power switch (10 W/1 W).
- Monitor circuit, to allow listening to modulation while making frequency adjustments.

The TR-8300 mobile FM transceiver operates in the 70-cm band, on 23 crystal-controlled channels (three supplied). Transmitter output is 10 watts, and a very sensitive and selective receiver is provided.

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OPTIONAL ACCESSORIES

PC-1 phone patch.

MC-50 dynamic dual-impedance (50 kΩ/500Ω) desk microphone.

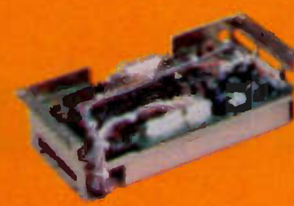
MC-30S (500Ω) dynamic noise-cancelling hand microphone. Also available, MC-35S (50 kΩ).

MC-45 Touch-Tone (with automatic transmit) microphone.

HS-5 deluxe 8Ω headphone set.

HS-4 8Ω headphone set.

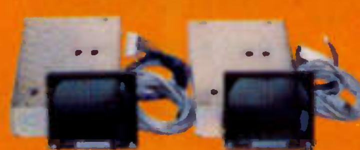
MB-100 mobile mount for TS-120S.



DF-180 digital frequency control for TS-180S without DFC.

DG-1A digital counter/display for TS-820.

DS-1A DC-DC (mobile) converter for TS-820S/TS-520S (not for TS-520SE).



BS-8 (for TS-180S and TS-820S) and BS-5 (for TS-520 series) SM-220 pan-display

YK-88CW 500-Hz CW filter for TS-180S/TS-120S and YK-88SSE IF SSB filter for TS-180S dual-filter system.

CW-820 (YG-88C) 500-Hz CW filter for TS-820S/R-820. CW-520 500-Hz CW filter for TS-520 series.

YG-88A 6-kHz AM filter, YG-455C 500-Hz CW filter and YG-455CN 250-Hz CW filter for R-820.

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TRIO-KENWOOD COMMUNICATIONS INC.
111 WEST WALNUT, COMPTON, CA 90220

Reader Service—see page 259

LETTERS

GODBOUT

Recently, due to failure of one or more RAM chips in my TRS-80, which had been purchased from Godbout (Bill Godbout Electronics) 10 months previously, I returned all eight chips to Godbout under the terms of their one-year's warranty. I requested that they test these chips to determine which were defective and replace as required. I offered to pay for the testing, if necessary, as I was not equipped to do so.

I was pleasantly surprised to receive within a week a complete eight-chip RAM kit from Godbout—no charge whatsoever, and postage paid! Now, I am sure that all eight original chips were not defective and can conclude only that once again Godbout is performing in their characteristic "the-customer-must-be-pleased" manner.

This attitude will go far to ensure the future success of this outstanding supplier.

Arch Wicks W6SWZ
Agoura CA

DAVID

Here is some updated material regarding the emergency operation of the Florida Crown Net (Jacksonville) and the Florida Midday Traffic Net (FMTN) during hurricane David Sept. 2-5th.

Local Red Cross Director Buck Willocks of Jacksonville praised the amateurs saying, "If there was any one group who shined during the emergency, it was the amateur radio operators of this community." He was referring to the 55 operators who volunteered to link the 16 Red Cross evacuation shelters to Red Cross HQ. Personal commendation certificates are being given to each participant. In addition, stations were set up at Civil Defense HQ, the Weather Bureau, WTLV-Channel 12 studios, and the Mayor's office.

Jacksonville Mayor Jake Godbold and his staff also expressed their deep appreciation and it is reported that the Mayor will attempt to visit at least two local amateur clubs, The North Florida Amateur Radio Society (NOFARS) and the Jacksonville RANGE Assn., to express his thanks personally. City officials monitored the transmissions on two meters to get the latest evacuation count.

Telephone lines at Red Cross were completely jammed and the only communications were via amateur radio.

On the statewide level, complimentary reports continue to pour in concerning the operation of the Florida Midday Traffic Net on 40 meters (day) and 75 meters (night). The net stayed in session for over 55 continuous hours providing the only coverage of the entire state. At least three major Weather Bureau offices in Florida were linked together by FMTN.

Ironically, the FMTN was kicked out of the ARRL last month because, after 23 years of operation, they refused to accept the SCM's wish to dissolve the net administration and have all officers appointed by him. Please see the following for additional information.

Billy Williams N4UF
Assistant Manager, FMTN
Jacksonville FL

STATE ARRL OFFICIAL KICKS FLORIDA MIDDAY TRAFFIC NET OUT OF LEAGUE

On August 11th, ARRL South Florida Section Communications Manager (SCM) Woodrow "Woody" Huddleston informed Florida Midday Traffic Net (FMTN) Manager Al Suhr WB4AID that FMTN was no longer a part of the American Radio Relay League (ARRL).

In his letter, Huddleston gave no other reason for the revocation of the ARRL section of Florida's largest traffic net other than to say that the "FMTN does not qualify as either a section net or a local net in the ARRL National Traffic System. The net and its management have steadfastly refused to respond to the wishes of the ARRL Administration within this section. Therefore, I cannot justify expending ARRL funds issuing certificates to FMTN members," said Huddleston.

This last statement is considered enlightening because most FMTN members are ARRL members.

To summarize, after 22 years of operation, the FMTN was asked by Huddleston to hand over control of the net and the frequency to him last September. He said that he felt uncomfortable with so many nets operating in "his" section. The FMTN members voted 55 to 2 for rejecting Huddleston's demands.

Shortly thereafter, Huddleston was instrumental in establishing a new net just four kHz up in frequency at the same hour. Evidently, he was hoping to use his influence and the ARRL's prestige to lure FMTN members away since most FMTN members belong to the League. Most officials expected this to happen, but, surprisingly enough, the opposite occurred. The new net, called the Combined Florida Net (CFN), created more hard feelings by "clearing" its 7,251 kHz frequency at net time by just opening up on top of stations already in QSO. It seems that Huddleston and CFN underestimated the strength of those upon whom they tried to trample, because after two rocky ineffective months in which several sessions were cancelled, the CFN was forced to move just to survive.

Despite the move, CFN continued to falter as daytime traffic operators rallied behind FMTN and its democratic stand. FMTN has been the top net of any in Florida for the last 11 months running, based on official statistics in *Florida Skip*, in messages per session handled. The long anticipated wilting of FMTN was not to be, as many operators became incensed about losing their right to elect their own manager and not have it dictated by Huddleston. CFN went begging for traffic while people waited in line to pass messages on FMTN. A telephone campaign by some Florida ARRL officials to recruit CFN members also was a dismal failure.

When the latest *Skip* statistics showed FMTN on top again last month, it must have been more than Huddleston could take. After failing to get FMTN cut out of the national nets, he sent the letter expelling FMTN from the ARRL because they wouldn't let him take over.

For the 70 FMTN members, reaction was immediate. Included among the members are several club presidents and officers statewide. Comments ranged from "dumb" to "smacking of a dictatorship" describing Huddleston's action.

The big sting came last December when one member of the then-new CFN net was told by a North Florida ARRL official that he couldn't eat at 5 pm any more because he was needed to make the new system of nets work in conjunction with linking CFN with a later net. A lengthy shouting match occurred on the CFN frequency with the poor soul saying he just wanted to continue eating at 5 o'clock as he had done for the last 25 years. Fortunately, it's all on tape so it can't be denied.

We have no reaction from North Florida ARRL officials on Huddleston's mass ejection, but they have backed him up in the past to the point that some have said that the statewide policies are all made by Huddleston in Largo and rubber-stamped in the rest of the state. It will be interesting to see if this holds true now.

Meanwhile, Florida Midday Traffic Net officials have declared themselves an independent net whose members operate on the legal basis of their FCC licenses and not through the sanction of the ARRL. Meanwhile, the controversy continues about the tactics involved and daytime operators continue to support FMTN in growing numbers.

This may be one case where David rises up and slaps Goliath!

From NOFARS *Balanced Modulator*, September, 1979

DRIVEL

Although I have long been an admirer of you and *73 Magazine*, one who has enjoyed your growling and caustic comments, all of which put amateur radio on its toes, made us aware, and stirred amateurs into thinking for themselves, I wonder what has happened to *73* et al this past year. I am really doubting the values and goals some of your articles are exhorting. Also, it sure seems as if you are dumping the average amateur, the guy without the megabucks, for the manufacturer and big interests. Maybe you no longer need the individual ham as long as you have the big or seemingly big, the manufacturer, and the guy who calls building a ham station or minicomputer an assembly of components. It sure looks like the so-called builders merely plug in boards and equipment according to many of your articles (or build power supplies).

Another trend in *73* that is really disturbing has been Pasternak, and his trying to foist on us control of FM and amateurs by clique-appointed committees with power to have yea or nay over other hams. Let's leave California and its dubious means of operation on the earthquake side of the mountains. Also, I object to his begging support of HFers as he tries to tell us how wonderful they are.

Then we get articles on jamming police radar and the re-

Continued on page 226

"THE INFLATION FIGHTER"

Top Performance For The Budget-Minded Amateur

Analog Model FT-101Z

If economy is an important consideration, and you don't need the frequency counter and digital display, then choose the FT-101Z. The precision VFO gear mechanism is coupled to an easy-to-read analog display, providing resolution to greater than 1 kHz. All other features—the variable IF bandwidth, RF speech processor, superb noise blanker, VOX—are identical to the FT-101ZD. Yaesu gives you greater choice, so that you don't have to pay for what you don't need! The counter and digital display can be added to your FT-101Z at a later date, if you wish.

Specifications : FT-101Z

GENERAL

Frequency coverage: Amateur bands from 1.8—29.9 MHz + WWV/JJY (receive)
Emission types: LSB, USB, CW
Power requirements: AC 100/110/117/200/220/234 volts, 50/60 Hz, DC 13.5 volts, negative ground (with optional DC—DC converter installed)
Power consumption: AC 85 VA receive (73 VA HEATER OFF) 330 VA transmit, DC 5.5 amps receive (1.1 amps HEATER OFF) 21 amps transmit
Case size: 345(W) x 157(H) x 326(D) mm
Weight: Approx. 15 kg.

RECEIVER

Sensitivity: 0.25 μV for S/N 10 dB
Selectivity: SSB 2.4 kHz at −6 dB, 4.0 kHz at −60 dB. CW (with optional CW filter: 600 Hz at −6 dB, 1.2 kHz at −60 dB)
Image rejection: Better than 60 dB (160—15 m), better than 50 dB (40 m)
IF Bandwidth: Continuously variable from 2.4 kHz to 300 Hz, using two 8-pole IF filters
Audio output: 3 watts at 10% THD into 4 ohms.

TRANSMITTER

Power input: 180 watts DC
Carrier suppression: Better than 40 dB
Unwanted sideband suppression: Better than 40 dB (14 MHz, 1 kHz modulation)
Other spurious radiation: Better than 40 dB down
Third order distortion products: Better than 31 dB down
Transmitter frequency response: 300 — 2700 Hz (−6 dB)
Antenna output impedance: 50—75 ohms, unbalanced.
Microphone input impedance: 500—600 ohms (low impedance)
Note: FT-101Z (analog) cannot be used with the FV-901DM, as there is no frequency display.

Price And Specifications Subject To Change Without Notice Or Obligation

YAESU

✓Y1

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Looking *West*

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

On Saturday, September 22, 1979, it was announced that the nation's second oldest repeater, currently operating under the callsign WA6KOS/RPT on Mt. Wilson, would be permanently terminating operation on or about October 13. The announcement came in the form of a letter from system equipment owner/sponsor Burt Weiner K6OQK, in which it was stated that after 18 years of continuous operation, he had proven to himself that he could make a system function and do so at the extreme limits of the state of the art available. Further, that due to the increasing amount of willful and malicious interference, with him as a prime target of it on a personal level, he had reached the decision that it was time to terminate the operation and proceed in other directions.

The system now known as WA6KOS/RPT started life as WA6TDD in 1962. It was put into service as an open repeater and has remained such ever since. Dockett 18803 caused a callsign change in 1972 and WA6TDD became known as WR6ABE. In 1976, Burt Weiner bowed out of the responsibility of licensee of the repeater, turning that obligation over to Bob Thornburg WB6JPI. At that time, the system became known as WR6AMD. Some 10 months ago, Bob bowed out of the position of licensee and the reins went to David Faraone WA6KOS whose callsign now appears on the system. Throughout these latter years, Burt Weiner has remained as equipment owner and has maintained the system's high technical standards for the licensees who followed him.

In his letter to Faraone and the repeater's users (about 450), he stated that though he has tried to remain a disinterested party in the operation of the system, he could not, and with the increasing amount of personal abuse being hurled at him, he realized that the only way to solve the problem was for him to take the system out of service and disappear from the scene entirely. He hopes that, in time, those now abusing both him and his equipment will forget that he ever existed.

In commenting on the demise of WA6KOS, Faraone also stated his intention to establish a new repeater and to commence operation when Burt removes his system from service. The new repeater, again under the callsign WA6KOS/RPT, is to be located atop Santiago Peak in South Orange County at 5800' MSL. However, it is rumored, though not confirmed, that opposition to the new system from politically powerful remote-base owners who want no part of an open two-meter repeater on that hill is mounting. WA6KOS operates with a transmit frequency of 146.40 MHz. With 146.46 MHz being the recognized national remote-base intertie frequency, the remote owners fear that the overall ambient noise factor of the band will be raised by the new device and impede communications on .46. It should be mentioned that not all remote owners seem to feel this way. At least three have offered Faraone help in establishing the new system and technical assistance in clearing up any interference problems that might ensue.

Also unconfirmed are rumors that a number of major southern California repeaters, fearful that the same type of abuse that has caused the demise of KOS will descend on them, are planning to "private out" and turn toward selective usership operation. The political climate is viewed as being that should two or three major systems make this move, it would initiate a domino effect that would write an end to open repeater communication in the southwest in short order. More next month.

THE GOOD GUYS WEAR WHITE HATS DEPARTMENT

In the old western movies, the ones made in black and white and prior to the advent of television, it was easy to tell the hero from the villain. Heroes always wore white hats and rode white horses. Your friendly local neighborhood villain usually wore black clothing, a black hat, and rode a black horse. Maybe these were not the actual colors, but who could tell? You went to a flick to cheer the hero and hiss the villain. Wasn't it easy in those days?

Villains are not supposed to be good guys and vice versa. Unfortunately, something has run amok in our society that, at times, causes the tables to be turned. Suddenly, a villain appears to be a hero and is able to build support for a position that appears totally wrong to the majority. In a nutshell, this describes a situation now running rampant on many Los Angeles two-meter repeaters. A small but highly-vocal group of people have come to demand their "right" to utilize any form of language they may desire, regardless of how offensive such utterances might be to the rest of the area amateur community. They defy anyone, including the FCC, to stop them, claiming that any action in that direction would be a direct violation of their First Amendment rights. There even appear to be a few in this group who are not even amateurs, but who have amateur equipment and use it on the air. Their claim seems to be that since the "airwaves" belong to the "people," they have a right to operate a radio without subjecting themselves to the will of any government or agency thereof.

This group believes that anything goes, anything said is "right," and anyone they wish to abuse on the air is fair game. It is quite interesting that they only seem to inhabit busy wide-coverage open repeaters, where there exists a vast audience for their rhetoric. They rarely bother the smaller local systems, and I have yet to hear a report of them "taking on" a private repeater's usership, though many super-wide-coverage "privates" do abound. Two things are evident. First, to exist, they require a large audience to fulfill their egos, and second, they probably live in fear of the reprisals they might endure if they assailed a private system. It's no secret that the history of this area in relation to protecting one's domain, especially in regard to the sanctity of private repeaters, is one of retaliation for any such attack. So, they continue to feed their egos on the "average" amateur who operates on the "average" open repeater.

For many years, I have wondered how a situation such as this could possibly develop. Many theories have come forth, but few were very conclusive, and, until now, none offered any real solution. Recently, I had the opportunity to meet and speak with Russ Andrews K6BMG. Russ is not new to the amateur fraternity. He holds a General class license and has been a ham for over 25 years. Like myself, he has witnessed the move toward lawless operation and disrespect for the will of the majority by the aforementioned minority. He has taken the time to develop a short thesis on the subject that we now present for your approval and commentary.

LAWLESSNESS ON THE HAM BANDS

What follows is one man's opinion. It is based on over 25 years as a licensed ham and on my observations and understanding of human nature and foibles. In part, it takes the form of a scenario. Its purpose is to possibly give a wider view of the problems on the ham bands and stimulate thought, discussion, and, ultimately, a solution.

How Did We Get Where We Are?

1. There is, in society today, a general disrespect for government, bureaucracy, and authority.

2. The creation of the CB band resulted in such an explosion of personal radio activity that the FCC resources were overwhelmed. This inability to provide needed policing resulted in the "lawless" nature of CB the FCC is now struggling to overcome.

3. This CB lawlessness soon spread to the creation of HFers, operating on non-CB frequencies.

4. Many of these CBers and HFers found out about ham radio and moved up (either legally or by various illegal methods).

5. Other hams simply became corrupted, or fearless, and allowed their negative sides greater rein.

Why Has the Traditional Self-Policing of Ham Radio Failed?

Self-policing is based on three things:

1. Respect for the privileges and for others who have earned similar privileges. This factor has been weakened in several ways:
   - •Eased entry requirements.
   - •Examinations "given" by other hams—and falsified.
   - •Bootleggers.

2. Peer pressure. The new breed of offender is immune to peer pressure from the general ham fraternity.
   - •They have a different set of values.
   - •There are enough of them now to form their own subculture, or peer group, that *supports* them in their lawlessness.

3. Fear of exposure. They have built a rationalization which convinces them that they are in the right and the rest of the fraternity is wrong. So, why should they be afraid of being exposed, if they believe they are right? In addition, the prevailing opinion is that even if exposed to the FCC, the FCC will do *absolutely nothing*; therefore, why should they fear being "turned in" by other hams?

Where Are We Now?

We have a growing group of antisocial, lawless individuals whose governing force is an ego-driven desire to have power through the use of radio technology. This group is self-stimulating, that is, it encourages within itself increased technical competence toward jamming

Continued on page 224

The following are excerpts from unsolicited letters and registration cards received from owners of the new TEN-TEC OMNI transceiver.

"I sold a Yaesu to buy this and am very impressed" —WB5ULA

"My first QSO with OMNI-A was LA1SV on CW and second was EA8SK on SSB." —N2CC

"Excellent rig, just as advertised." —WB5TMD

"Very pleased with performance. QSK feature very slick." —WB0ELM

"This is my 5th TEN-TEC transceiver in less than 2 years. I loved them all and still have 3." —WB0VCA

"Through the years I have had complete Drake and Collins stations. I tried a 544 Digital and liked it the best so decided to purchase the 546 OMNI-D Digital." —WA4NFM

"Your OMNI is the best rig I have had in 20 years of haming." —K4IHI

"As a owner of Collins rig, your OMNI-D is the best." —K9JJL

"I already have an OMNI-A, 544 and a TRITON IV. You may ask why I own so many TEN-TEC rigs. In case there is a great RF famine, I want to be ready!" —WD4HCS

"You guys really know how to turn on an old timer!" —K8ELS

"Best operating & most conveniences of any transceiver I've ever used." —W6LZI

"I like CW. Compared OMNI against IC701 (rcvr) and OMNI won hands down. XYL WD6GSB really enjoys rig on SSB. Finds rig is very stable and digital readout accurate." —AC6B

"Have checked it out on both modes from "top band" (160) all the way to 29 MHz. Terrific!!!!" —W4DN

"Works well, parts layout and design much better for any possible servicing than other ham gear. The Japanese hybrid sets can't compare to TEN-TEC for audio. Audio reports excellent without special speech processors, etc., to distort the signal." —AG8K

"I have been using the S-Line over 15 yrs and never thought anything could outperform it. I got the biggest surprise and THRILLED with this OMNI-D even though I have been a ham since 1936." —KV4GD

"This must be the greatest. I've spent enough money on final tubes to almost pay for this." —KA4BIH

"This transceiver was recommended to me by old time hams (Xtras) whom I have known for 40 yrs. Has excellent break-in." —N6AVQ

"Best package job I've ever seen! First licensed 6AAV in 1926. Now in operation—a sweetheart!" —W7LUP

"From a 32V2/SX115 to an OMNI is a big step!" —K6YD

"Receiver prominent—transmitter likewise—working comfortable—pleasing design." —OE1FAA

"First new rig for me in 10 years but seems to be very good." —W5GBY

"The best transceiver I ever used or owned." —W3TS

"I wouldn't swap my OMNI for anything on the market, regardless of price." —WD0HTE

OMNI/SERIES B FEATURES

All solid-state; 160-10 meters; Broadband design; Standard 8-Pole 2.4 kHz Crystal Ladder I-F Filter + Optional 1.8 kHz SSB Filter & 0.5 kHz 8-Pole CW Filter; 3-Bandwidth Active Audio Filter; Choice of readout — OMNI-A (analog dial), OMNI-D (digital); **Built-in VOX and PTT, Selectable Break-In, Dual-Range Receiver Offset Tuning, Wide Overload Capabilities, Phone Patch Interface Jacks; Adjustable ALC; Adjustable Sidetone; Exceptional Sensitivity; 200 Watts INPUT; 100% Duty Cycle, Front Panel Microphone and Key Jacks; Zero-Beat Switch; "S"/SWR Meter; Dual Speakers; Plug-In Circuit Boards; Complete Shielding; Easier-to-use size:** 5¾"h x 14¼"w x 14"d; **Full Options:** Model 645 Keyer $85; Model 243 Remote VFO $139; Model 252MO matching AC power supply $139; Model 248 Noise Blanker $49; Model 217 500 Hz 8-Pole Crystal Ladder CW Filter $55; Model 218 1.8 kHz 8-Pole Crystal Ladder SSB Filter $55.

Model 545 Series B OMNI-A . . . $949
Model 546 Series B OMNI-D . . . $1119

To add your name to the fast-growing list of OMNI owners, see your TEN-TEC dealer, or write for full details.

TEN-TEC, INC.
SEVIERVILLE, TENNESSEE 37862
EXPORT: 5715 LINCOLN AVE., CHICAGO, ILL. 60646

OMNI OWNERS SAY:

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

I made a mistake. Now, now, don't try to talk me out of it or minimize it. I made a mistake! Let's call it an error of omission. You see, a few months ago I listed articles on "silent RTTY," grouped by system types. I said that the list was complete. Well, I was only partially right; I inadvertantly left out reference to articles appearing in *73*'s sister magazine, *Kilobaud MICROCOMPUTING*.

Fig. 1 is an attempt to correct this error. As you can see, several types of articles have been published in *Kilobaud MICROCOMPUTING*, encompassing many computer families. Rather than list them strictly by type, the figure includes a brief statement on each article's content so that you may guide your search accordingly.

Interest in microcomputer-assisted RTTY is running quite high and clearly constitutes the majority topic in mail received. One correspondent, Victor C. Johnson from Minneapolis, Minnesota, is interested in the Heath H-8 RTTY program. I hope the program printed in the June, 1978, issue of *Kilobaud MICROCOMPUTING* is of use to him.

Victor also is looking for a Teletype™ Model 28, receive only, and is apparently having a hard time finding one in the Minneapolis - St. Paul area. Anyone in that region who might help him is asked to drop a line to him, in care of this column; I will forward it along to him. As far as commercial sources go, Victor, we have covered several sources in the past, but, as always, checking with local hams for reliable sources is the best way to go.

I have been quite upset over the number of complaints received about several of the known firms dealing with Teletype equipment. While most of the complaints center around unanswered inquiries (several of which I have also suffered) or prolonged shipment times (ditto), there is also the occasional, as pointed out over the past few months, paid-for order which is never heard from again. Incidentally, no work yet on the problem source noted last month.

Dave Phillips W7GZ writes that he will be coming up on the air soon with a Kleinschmidt machine and home-brew TU. This is to be replaced in short order by a 6800 microprocessor system and CRT terminal. Quite an order of magnitude difference! Dave is in need of wiring diagrams or maintenance manuals for his Kleinschmidt model TT-99. He notes that he has Teletype Model 28 ASR/KSR data available for the costs of postage and reproduction. If anyone is interested, contact Dave at 802 S. Eli Drive, Tucson, Arizona 85710.

A letter received from Wayland Osborn W0RRG poses a "big question." Wayland asks, "Are you aware of any RTTY gear, other than the Microlog system, which can be used to key the Kenwood TS-820 in transmit utilizing its built-in FSK feature?" My first inclination is to suggest using one of my favorite devices, a reed relay, in the loop to key the transmitter. It occurs to me, however, that you may be using only a CRT setup, without a conventional loop. In that case, you would have to adapt some form of on-off switching to the system, and I can appreciate your problem. Readers with similar systems are invited to drop a line and tell Wayland, and all of us, how *you* solved it!

Wayland also touches on the reported rf sensitivity of the Microlog system and my note last year that information promised me was yet to be seen. Well, as of this writing, one year has passed, and I still have received zip. This is not unique to Microlog, however. In fact, several companies, visible and well advertised, have promised to send various data sheets and literature in the past; not one has followed up on the offer. I don't know why—oh, well!

The final letter this month comes from Jim New WA4DHD, a newcomer to RTTY, as he puts it. Jim is using the TRS-80 with a Model 19 for hard copy and is having great fun on the air. He wants to know where most RTTYers hang out. Well, starting on 80 meters, you might try 3620 kHz, and 14080 kHz on 20. Forty-meter RTTY is an iffy thing, and other bands frequently depend on conditions. Twenty and 80 are pretty well populated, and a QSO is almost always available.

Yes, I do have a station, for those of you who have asked, but I have not been on the air much. I promise to try, so that those of you who think that I am but a pseudonym for Wayne Green will learn better. I know that I exist, and I hope to be more visible.

March, 1977—"Using The '$50' Terminal," James Brown. The author presents, in flowchart fashion, ASCII-to-Murray conversion. No particular microprocessor is mentioned.

November, 1977—"SC/MP Goes Baudot," Benjamin Blish. An SC/MP microcomputer is used to interface a Murray machine to an SWTPC 6800. Both software and hardware are presented.

June, 1978—"Baudot . . . er . . . Murray, Meet The H8," Howard L. Nurse. Interfacing to the Heath H8 is covered with full source listing and hardware needed. A solid article.

June, 1978—"ASCII to Baudot . . . er . . . Murray (the Hard Way)," John A. Lehman and Ray Graham. A tale of an experience with one supplier's conversion board.

September, 1978—"Baudot Interface Cookbook," J. R. Haglund and W. B. Reed. A scheme for interfacing to an 8080 based microprocessor. A note states that the program has been tried on and runs well on a Z-80 system.

August, 1979—"Teleprinter Output for TRS-80," David G. Morr. A hardware and software scheme for using a Murray-encoded printer as an output device. Full listings and hardware are covered for this Z-80 system.

September, 1979—"Make PET Hard Copy Easy," Dr. James M. Downey. Interfacing both ASCII and Murray-encoded machines to the PET IEEE bus through use of a UART and specially encoded ROM. This is a hardware modification with no software requirements. The machine is used strictly as a printer.

Fig. 1. Articles from Kilobaud MICROCOMPUTING *on computerized RTTY.*

Corrections

In my article, "Dual-Band Smokey Detector," which was published in the May issue, two errors in the drawing dimensions slipped by me when I reviewed the proofs.

On page 49 of that issue, the last paragraph calls for the circular waveguide to be made from ½-inch water pipe. It should be ¾-inch water pipe.

The dimensions shown on the rectangular waveguide E plane view on page 51 should show the hole for the circular waveguide as 7/8 of an inch in diameter (or the outside diameter of a piece of ¾-inch copper water pipe). The horn mounting hole is also shown as ½-inch; this descrepancy can be easily rectified by making the tab cuts deeper so that they can be bent to fit the o.d. of the circular waveguide. All hole cuts into the circular waveguide retain the same dimensions. One thing not described in the article, however, is the fact that the WR42 guide must be trimmed on the inside of the circular guide to be flush with the inside wall of the pipe.

I have also received many calls regarding the omission of the value of the series resistor shown where the 12-volt feed is located; this resistor is rated at 10 Ohms. It connects to the junction point where it feeds the main dc into the two 741 ICs and a 390-Ohm resistor. The point marked +12 volts on IC5 should also tie to the same junction point since that resistor serves as part of the filter from the source.

I have found a supplier for waveguide and other microwave components where amateurs can get small quantities. This supplier has an excellent catalog and offers it to the public for the asking—no microwave experimenter should miss it. The company is Lectronic Research Laboratories, Atlantic and Ferry Avenues, Camden NJ 08104. Ask for Sales Bulletin 107.

Stirling Olberg W1SNN
Waltham MA

Ham Help

I was an amateur, but lost my license because I could not construct my own transmitter and operate. I am trying to again get my license, but also I am badly in need of some equipment to continue with my other experiments. Unfortunately, this equipment is not available in India.

If anyone can send me construction details, along with circuit diagrams, etc., of a Van de Graaff electrostatic generator, a Wimshurst electrostatic generator, and biofeedback machines, I would be most grateful.

Any names of books and their publishers, from whom I can buy those books, also would be appreciated. Thank you very much.

Hemant K. Patel
1008 Nilanjana, 10th Floor
Marve Road
Malad-West
Bombay 400064, India

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Awards

Bill Gosney WB7BFK
2665 North 1250 East
Whidbey Island
Oak Harbor WA 98277

This past fall we announced for the first time our new amateur radio awards program. Featured in a two-part series in the September and October issues, we outlined a total of eight *73 Magazine* achievement awards available to amateurs the world over. Since then, letters of support have been received from all parts of the globe, each showing dedicated interest in pursuing the challenges our awards program has to offer.

This month, we offer two new awards, each of which is very unique in its own right.

THE Q-5 AWARD OF EXCELLENCE

This award, sponsored by the editors of *73 Magazine*, is available to amateurs throughout the world possessing any class license who operate periodically in the American Novice band.

To be valid, all contacts must be made on or after January 1, 1980. Likewise, all contacts must be made using only the CW mode on those frequencies assigned to the American Novice. Maximum power allowed will be limited to 250 Watts input. There are no band restrictions for this award.

To qualify, the applicant must work all ten US call districts and receive no less than a Q-5 report. A qualifying RST might be, for example, 559, 539, 579, etc., while an RST of 449, 349, 479, would not qualify the applicant for the award.

This award is not meant to be an overnight accomplishment. Stations meeting the challenge of these requirements will be proud to display this unique award depicting the excellence and superiority of their station's transmitted signal.

To apply for this award, the applicant must prepare a list of all claimed contacts, logging each contact in order of the US call district. Indicate the station worked, the date and time in GMT, the frequency utilized, and, most important, the RST report as noted on your confirmation card. Also required is a brief description of the station equipment and antenna system used to complete this award.

Do *not* send QSL cards! Have your list verified by two amateurs, a local radio club secretary, or a notary public. Enclose your verified list along with the award fee of $3.00 or 8 IRCs to: Bill Gosney WB7BFK, *73* Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island WA 98277 USA.

A significant number of amateurs throughout the world find their primary interest in the operation and development of specialty-type communications. It is the efforts of these many pioneers in their field which have created many state-of-the-art improvements which we know today. The editors of *73* wish to recognize those amateurs who make positive steps toward expanding the use of their respective mode or type of amateur operation. As a result, in the paragraphs to follow, you will learn of our latest communications award dedicated to "communicator specialists."

SPECIALTY COMMUNICATIONS ACHIEVEMENT AWARD

Sponsored by the editors of *73*, this award is dedicated to amateurs worldwide who take pride in active participation in the field of specialty communications.

To be eligible for this award, some very rigid requirements must be met. First of all, contacts must be made on or after January 1, 1980. In addition, only communications via SSTV, RTTY, EME (Earth-moon-Earth), and/or OSCAR will be recognized for this award. Contacts between stations on OSCAR or EME may be made using any mode authorized in your country. Applicants must be cautioned, however, that mixed-mode contacts will not be valid.

This award will be offered in two levels of operating achievement, each a worthy award in itself:

Class A requires applicant to work all 50 US states.

Class A-1 requires applicant to work a minimum of 10 DX countries from the WTW DX Countries List.

To apply, the applicant must prepare a list of claimed contacts. For the Class A award, this list must be arranged in alphabetical order by US state; for the Class A-1 award, prepare the list of contacts in order by callsign prefix. Either list must also include the date and time in GMT, the band and mode of operation, and a signed declaration of the type and description of equipment and antenna systems used to make your contacts.

Do *not* send QSL cards! Have your list verified by two amateurs, a local radio club secretary, or a notary public. Enclose each list with an award fee of $3.00 or 8 IRCs to: Bill Gosney WB7BFK, *73* Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island WA 98277 USA.

Should any readers of this column care to possess our new awards program booklet, you are urged to send for your free copy now while the supply lasts. The only requirement is that you send a large business-size SASE when making your request. At the same time, I would like to encourage you to write any comments you may have about this column or our awards program being offered.

Traveling abroad as we do every month, I wish to share a very unique series of awards being offered by the Swedish Amateur Radio Society (SSA—Sveriges Sandareamatorer).

Karl Friden SM6ID wrote to inform us about the WASM II achievement award and sent along this very attractive diploma which is issued upon successful completion of the award requirements.

WORKED ALL SM LAENS WASM II

The WASM II, awarded by SSA, is available to amateurs throughout the world. Class A is for amateurs located in those countries with prefixes LA, OH, OZ, and SM. The Class B award is for amateurs in the rest of the world.

To be valid, all contacts must be made January 1, 1953, or after. Any one of the amateur bands is allowed and contacts made in CW or phone or any combination of both are allowed, providing it is not cross-mode.

Amateurs in Class A areas must submit proof of having established two-way communications with each of the 25 laens (counties) on two different bands (50 QSLs). Amateurs in Class B areas must submit proof of having established contact with each of the 25 laens without any band restrictions.

Sweden is divided into 25 laens or counties:

A—City of Stockholm (SM5 and SM0)
B—Stockholm laen (SM5 and SM0)
C—Uppsala laen (SM5)
D—Södermanland laen (SM5)
E—Östergötland laen (SM5)
F—Jönköping laen (SM7)
G—Kronoberg laen (SM7)
H—Kalmar laen (SM7)
I—Gotland laen (SM1)
K—Blekinge laen (SM7)
L—Kristianstad laen (SM7)
M—Malmöhus laen (SM7)
N—Halland laen (SM6)
O—Göteborg och Bohus laen (SM6)
P—Älvsborg laen (SM6)
R—Skaraborg laen (SM6)
S—Värmland laen (SM4)
T—Örebro laen (SM4)
U—Västmanland laen (SM5)
W—Kopparberg laen (SM4)
X—Gävleborg laen (SM3)
Y—Västernorrland laen (SM3)
Z—Jämtland laen (SM3)
AC—Västerbotten laen (SM2)
BD—Norrbotten laen (SM2)

Application for the WASM II must be accompanied by a verified list of claimed contacts. This list may be verified by two amateurs, a local club secretary, or a notary public. Enclose this list with 7 IRCs or US stamps of equivalent value and send to the attention of: Karl O. Friden SM6ID, Awards Manager SSA, Pl. 1084, Morup, 310 56 Langas, Sweden.

And, while speaking of the Swedish Amateur Radio Society, I received a very nice letter from Kjell Edvardsson SM0CCE who is awards manager for the WASM I award being offered by this national organization. It is very unfortunate that a sample of this award is not available for reproduction. This is due to the fact that the award is a very large cloth depicting scenic highlights of this beautiful and picturesque country and personalized to display the identity

Continued on page 228

When quality counts

Do not be fooled by the low prices, these brand new lab quality frequency counters have important advantages over instruments costing much more. The models 7010 and 8010 are not old counters repackaged but 100% new designs using the latest LSI state-of-the-art circuitry. With only 4 IC's, our new 7010 offers a host of features including 10 Hz to 600 MHz operation, 9 digit display, 3 gate times and more. This outperforms units using 10-15 IC's at several times the size and power consumption. The older designs using many more parts increase the possiblity of failure and complexity of troubleshooting. Look closely at our impressive specifications and note you can buy these lab quality counters for similar or less money than hobby quality units with TV xtal time bases and plastic cases!

Both the new 7010 and 8010 have new amplifier circuits with amazingly flat frequency response and improved dynamic range. Sensitivity is excellent and charted below for all frequencies covered by the instruments.

Both counters use a modern, no warm up, 10 MHz TCXO [temperature compensated xtal oscillator] time base with external clock capability - no economical 3.579545 MHz TV xtal.

Quality metal cases with machine screws and heavy guage black anodized aluminum provide RF shielding, light weight and are rugged and attractive - not economical plastic.

For improved resolution there are 3 gate times on the 7010 and 8 gate times on the 8010 with rapid display update. For example, the 10 second gate time on either model will update the continuous display every 10.2 seconds. Some competitive counters offering a 10 second gate time may require 20 seconds between display updates.

The 7010 and 8010 carry a 100% parts and labor guarantee for a full year. No "limited" guarantee here! Fast service when you need it too, 90% of all serviced instruments are on the way back to the user within two business days.

We have earned a reputation for state-of-the-art designs, quality products, fast service and honest advertising. All of our products are manufactured and shipped from our modern 13,000 square foot facility in Ft. Lauderdale, Florida.

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MODEL 7010 600 MHz

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7010 * 7010.1	145.00 225.00	600 MHz	9	5-20 mV	10-30 mV	20-40 mV to 600 MHz	1-10 mV	(3) .1,1,10 SEC	.1Hz	1 Hz	10 Hz 600 MHz	1 PPM 0.1 PPM	10 MHz	YES OPTION $25	YES OPTION $15
8010 * 8010.1	325.00 405.00	1 GHz	9	1-10 mV	5-20 mV	10-25 mV	1-10 mV	(8) .01-20 SEC	.1 Hz	1 Hz	10 Hz 1 GHz	1 PPM 0.1 PPM	10 MHz	YES STD	YES OPTION $39

* Has precision 0.1 PPM TCXO time base.

MODEL 7010

#7010 600 MHz Counter - 1 PPM TCXO $145.00
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#EC-70 External Clock Input 10 MHz $ 25.00
#CC-70 Carry Case, Padded Black Vinyl $ 8.95

MODEL 8010

#8010 1 GHz Counter - 1 PPM TCXO $325.00
#8010.1 1 GHz Counter - 0.1 PPM TCXO $405.00
#8010.1-13 1.3 GHz Counter - 0.1 PPM TCXO $495.00

OPTIONS

#Ni-Cad-801 Ni-Cad Battery Pack & charging circuitry Installs inside unit $ 39.00
#CC-80 Carry Case, Padded Black Vinyl $ 9.95

ACCESSORIES

#TA-100 Telescope Ant with Right Angle BNC $ 9.95
#P-100 Probe, 50 ohm, 1x $13.95
#P-101 Probe, Lo-Pass, Audio Usage $16.95
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Leaky Lines

Dave Mann K2AGZ
3 Daniel Lane
Kinnelon NJ 07405

Some irritations are of great importance; others are of relatively less concern. Since it is in the very nature of the incorrigible malcontent to nitpick, I decided a long time ago to leave significant questions for others to discuss. I deal with those niggling little matters that produce heartburn rather than peptic ulcers. If you seek the earth-shattering exposé, the juicy scandal, or the noble crusade, move on; you will not find it here. Let others pursue man-eating sharks and tigers . . . I swat flies and mosquitoes.

A case in point: Here, I think, is one of those small insanities that's right up my alley. It calls for some protest, however slight. I would have hoped that Newington, Connecticut, would have registered some opposition, but none was forthcoming. There are times, I suppose, when the lamb will willingly lie down with the lion.

The present system of callsign allocations is an abomination. It more closely resembles some sort of random selection than a structured plan which could clarify grade of license, seniority, or geographical location. The unfortunate inclusion of a great number of garbled prefixes has botched up the whole thing but good.

There is no longer any dependable way, short of asking directly (which somehow goes against the grain), to know whom you are working or whether your contact has been licensed for sixty years or for sixty days. It is claimed that this arrangement will tend to democratize the ham bands, but it will not. It will merely produce an element of uncertainty in an area once highly organized. One used to know beyond peradventure that the KA he hooked up with was a member of the U.S. military stationed in Japan; now he may be some guy right around the corner . . . there's no way to tell just from the prefix.

I'm not disturbed merely by the confusion. I simply dislike the idea of creating equality where it really has no place. Don't misunderstand me. I am one hundred percent in favor of political, racial, sexual, and social equality . . . a true advocate and champion of democracy. But it has no more place in ham radio than it has in any other such avocation . . . photography, stamp collecting, gardening, woodworking, astronomy, or Sunday painting. What is this sudden impulse to create equality everywhere? I believe that those who have been around for a very long time deserve to flaunt the distinction to some extent. No human endeavor in which skill is a factor should be subjected to some artificial leveling process. I speak not of reward, but of simple recognition. And if this should happen to consist of a distinctive callsign, as it used to, what's so terribly wrong with that?

The simple truth is that, in the words of an old adage "When everybody is somebody, nobody is anybody."

By all means, reward diligence, talent, and industry. But not by taking something away from somebody else. They've now removed the distinction of the preferred callsign, the only thing that differentiated the old-timer from the Johnny-come-lately. I rise to my hind legs and bay loudly at the moon. The new callsigns are lousy!

But things might have been far worse. I read a proposal that would have utilized the 3-letter, 3-digit system presently employed in the assignment of some state's auto license plates. If our present callsign system is bad, that one would have been infinitely worse. Some other joker got the brilliant idea that because Social Security numbers, like snowflakes and fingerprints, are unique . . . no two alike . . . they should be used to replace the standard callsigns. Don't expect me to analyze the logic that prompts such suggestions; I'm no expert in abnormal psychology.

It may be that the present revision of the callsign structure was designed for the convenience of the FCC monitoring stations, so that they could more easily determine who may be operating illegally in the restricted subbands.

This notion presupposes that these monitors are doing a conscientious job of policing in the first place . . . staying on top of the situation and nailing violators with swift efficiency. But they are not. A recent incident confirms the very opposite. The monitor at Anchorage, Alaska, issued notices of violation to a number of amateurs who had contacted Thailand stations. Obviously, the monitor labored under the mistaken impression that there still exists a banned countries list.

We have not had such a list for a very long time. This misadventure reminds me of the great flap that occurred when police were issuing summonses to hams who were transmitting while driving, despite a change in the law. This took place some fifteen years ago, and notwithstanding the repeal of the measure which had formerly prohibited such transmissions, these misguided minions of the law were highly reluctant to accept the change. Hams were advised to carry copies of the new regulation so they could show them to arresting officers. Despite all this, there are still some cops who attempt to hand out tickets to this day! To be sure, such cases are thrown out of court. But those who receive the summonses must answer them . . . a needless inconvenience. In like manner, those who have received these notices of violation from the FCC are being penalized. They have been informed that they "must respond to the citation in the manner outlined in 97.137, and the reply must be sent via registered or certified mail." (See *QST*, August, 1979.)

What would happen if one of these cited amateurs were to fail to reply to the notice? Bureaucratic conceit and self-conferred omnipotence being what they are, it would not be at all strange if they were to face actual revocation of license. Such is the nature of bureaucracy . . . agencies of the government are known to foul up from time to time.

Not only do these erroneous citations demonstrate that a bureaucracy can be wrong, but they also confirm a persistent conviction held by many that even when they are wrong, they pretend that they are right, and they insist upon having everyone else take part in the pretense, too.

Would it have been so embarrassing for the FCC to have issued a simple statement to the effect that all persons who had received the citation should simply ignore it? Why couldn't they acknowledge that there had been an inadvertent human error? Would this have been such a terrible humiliation?

It appears that the Commission is committed to the perpetuation of a grand illusion; it must maintain an aura of infallibility. Perhaps even more important, licensees must constantly be made aware of the awesome power of Big Brother.

Phooey and double phooey!

If the FCC were one-tenth as capable as it would have us believe, it would long since have succeeded in cleaning up the horrendous mess on CB . . . it would have been able to do something significant about the "woodpecker" that has plagued and bedeviled operations on the DX bands . . . it would have been able to nail all the CW intruders on fishing trawlers who constantly appear on unauthorized frequencies within our allegedly sequestered portions of the amateur spectrum. It would have been able to deal with the problem of unauthorized linear amplifiers on 27 MHz without having to eliminate 10-meter capability from amplifiers intended for use among legitimately licensed amateurs . . . it would have been capable of devising some nationally applicable regulation which would, once and for all, take uncompromising precedence over community zoning restrictions on radio tower installations. It would also have been able to force manufacturers of home entertainment devices to install adequate filtering so that TVI and BCI would be minimized, if not eliminated altogether, thus lifting the burden of ostracism and public condemnation from the shoulders of thousands of blameless amateurs and placing it where it rightfully belongs.

The fact is that there's nothing perfect in this all-too-imperfect world. But this has its compensations. It's great for the likes of me . . . a guy who derives personal satisfaction in pointing out foibles and flaws. How could I function if this were a world without faults? Yet, somehow I have the feeling that even if it were perfect, we grumblers and groaners would still manage to find something to gripe about.

Ham Help

I need a parts list and assembly and tuning instructions for a Telrex TC-99 triband beam antenna. Will copy and return.

A. McGinnis WA2DTQ
55 Patton St.
Iselin NJ 08830

I am in desperate need of a schematic and alignment instructions for a National NC-300. I would really appreciate any help.

Bob Amos
607 N. Madden
Shamrock TX 79079

I would like some help in studying for the General exam. Any person or group in the Bronx area interested in helping me?

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4-80BL	1-4	4	80	10
4-160BL	1-4	4	160	20
15-40 BL	5-15	15	40	5
15-80BL	5-15	15	80	10
15-160BL	5-15	15	160	22
45-160BL	15-45	45	160	18

MODEL NUMBER	POWER (watts) USEABLE	POWER (watts) IN (max)	OUT (min)	AMPS @ 13.5 VDC
"BC" Series 220-225 MHz				
4-70BC	1-4	4	70	10
15-60BC	5-15	15	60	8
15-120BC	5-15	15	120	25
45-120BC	15-45	45	120	15
"C" Series 420-450 MHz				
4-40CL	1-4	4	40	10
15-40CL	5-15	15	40	5
15-110CL	5-15	15	110	20

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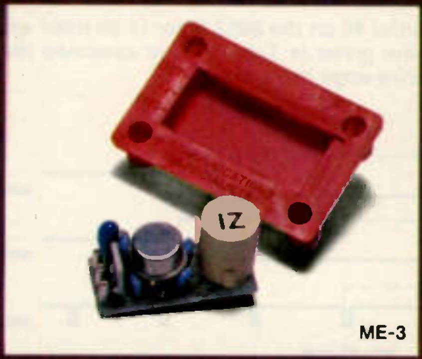
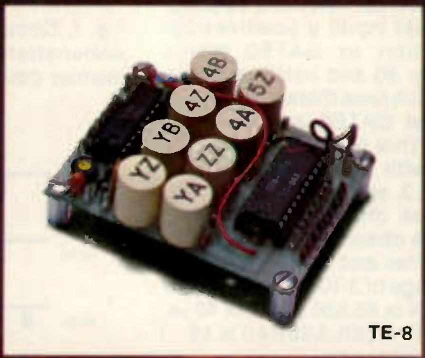
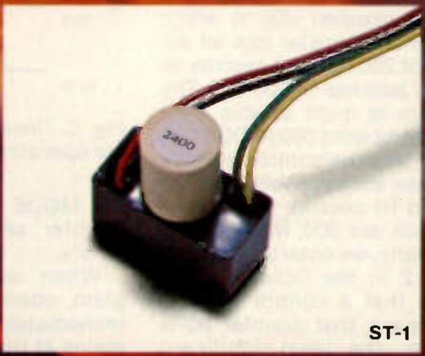

1Z
ME-3


4B
5Z
4Z
YB
4A
ZZ
YZ
YA
TE-8


TE-12


2400
ST-1

Microcomputer Interfacing

David G. Larsen
Peter R. Rony
Jonathan A. Titus
Christopher A. Titus

The characteristics of the Intel 8253 programmable interval timer were introduced in our October column. This 24-pin chip is very useful in counting and timing operations. This section will discuss two test programs for the 8253. One is a demonstration program that illustrates the various modes of operation of the timer, and the other is a program that demonstrates the reading of counter data "on the fly."

The counter is wired to an 8080A-based microcomputer, as shown in our October column. The details of the test circuit are provided in Fig. 1. Although the use of an oscilloscope is handy to monitor output signal OUT0 from counter #0, it has been found just as useful to provide a single 7490 decade counter chip to detect negative-edge transitions at OUT0. The 25-kHz input clock frequency, which has a period T of 40 µs, is input at CLK0.

Before the 8253 chip is used, the nature of output signal OUT0 must be understood as a function of the six different modes of operation, MODE 0 through MODE 5. We have found the manufacturer's literature to be somewhat confusing, so their diagrams have been simplified by omitting all signals other than OUT0. This permits all six modes to be compared simultaneously, as shown in Fig. 2. Note that MODES 0 and 1 provide a negative monostable clock pulse of duration NT; MODE 2 provides a series of negative clock pulses of pulsewidth T and period NT; MODE 3 provides essentially a square wave of period NT; and MODES 4 and 5 provide a single strobe pulse of pulsewidth T at a time NT after a trigger pulse has been applied to counter #0. The quantity N is a 16-bit timing byte initially loaded into counter #0. In our program, the timing byte is 000 000, which corresponds to the decimal number 65,536.

At this point, it is appropriate to comment on the two possible actions of the GATE0 input:

1. GATE0 functions as a *gating* input; when at logic 0, pulses input at CLK0 do not reach counter #0 and no counting occurs. This type of behavior occurs with MODE 0, MODE 2, MODE 3, and MODE 4.

2. GATE0 functions as a *trigger/reset* input; a positive-edge transition at GATE0 resets counter #0 and initiates counting. Each time there is a positive edge at GATE0, counter #0 is reset. This type of behavior occurs with MODE 1, MODE 2, MODE 3, and MODE 5.

These different actions can best be observed with the aid of a counter and a value of NT in the range of 3-10 seconds. In our case, N is 65,536 and T is 40 µs, so $NT = (65{,}536)(40 \times 10^{-6}) = 2.62$ seconds.

The program used to test the 8253 chip is provided in Table 1. Note that we have employed memory-mapped I/O, in which the control register has an address of 200 003 and counter #0 has an address of 200 000. The program is quite simple. First the control word 060 (MODE 0) is output into the control register. Next, we successively load the LO and HI counter bytes, both of which are 000, into counter #0. Finally, we enter a wait loop. Table 2 in the October issue shows that a control word of 060 means that counter #0 is chosen; the least-significant byte is loaded first, then the most-significant byte. Observe the MODE 0 operation of the counter and count down in binary.

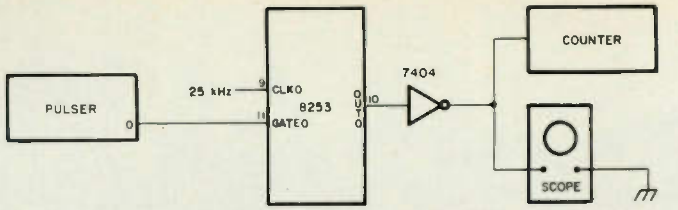


Fig. 1. Circuit for counter #0 on the 8253 timer to be used with the demonstration program given in Table 1. It is assumed that the counter counts negative-edge transitions.

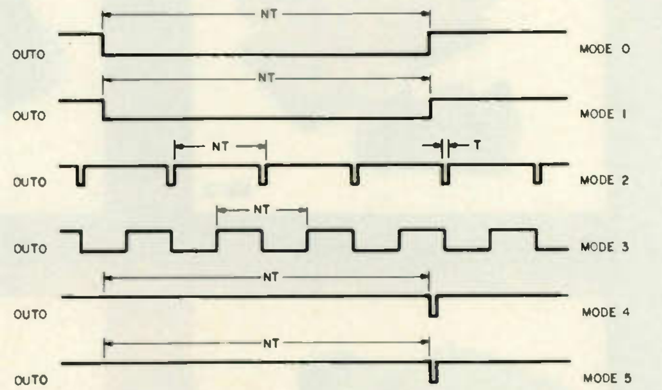


Fig. 2. Timing diagrams for the OUT0 output signal for each of the six operating modes of the 8253 timer.

When executing this program, observe that OUT0 goes immediately to logic 0 and remains at this logic state for NT seconds, after which it returns to logic 1. This behavior can be repeated only by executing the program a second time, starting at memory address 003 000.

If the control word is changed at location 003 001 to 062 (MODE 1), the execution of the program begun, and the pulser

Continued on page 225

003 000 076	TIMER,	MVIA	/Move control word into accumulator
003 001[a] 060		060	/Mode control word
003 002 062		STA	/Store it within control register
003 003 003		003	/in 8253 interval timer chip
003 004 200		200	
003 005 076		MVIA	/Move LO counter byte into accumulator
003 006 000		000	/LO counter byte
003 007 062		STA	/Store LO byte in counter #0
003 010 000		000	
003 011 200		200	
003 012 076		MVIA	/Move LO counter byte into accumulator
003 013 000		000	/HI counter byte
003 014 062		STA	/Store HI byte in counter #0
003 015 000		000	
003 016 200		200	
003 017 303		JMP	/Wait
003 020 017		017	
003 021 003		003	

If you wish to observe the counting process on a pair of output ports, replace the last program instruction by the following sequence of instructions:

003 017 076		MVIA	/Move new control word into accumulator
003 020 000		000	/Move control word to read counter #0
003 021 062		STA	/Store it within control register
003 022 003		003	
003 023 200		200	
003 024 072	RPT,	LDA	/Read LO counter byte into accumulator
003 025 000		000	
003 026 200		200	
003 027 323		OUT	/Output LO counter byte to Port #2
003 030 002		002	
003 031 072		LDA	/Read HI counter byte into accumulator
003 032 000		000	
003 033 200		200	
003 034 323		OUT	/Output HI counter byte to Port #0
003 035 000		000	
003 036 303		JMP	/Continue to output the counter bytes
003 037 024		RPT	
003 040 003		0	

[a]The control word at address 003 001 is changed to demonstrate the behavior of the different modes of operation.

Table 1. Demonstration program for the 8253 interval timer.

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DX

DXPEDITION TO MT. ATHOS BY SV1DC, SV1IW, AND SV1JG

This expedition to Mt. Athos was the outcome of long discussions with the community of the Holy Mountain and great efforts on the part of all concerned. The operators were notified on July 20, 1979, that they would be permitted to transmit from Mt. Athos; they departed Athens on Monday, August 6.

SV1DC drove twelve straight hours, and the group was on the air at 1430 UTC, August 7. Since getting to the operating spot involved walking and hand-carrying, only a 12AVQ Hy-Gain vertical was taken; no antennas were available for other than 20, 15, and 10 meters. A Kenwood TS-520 with external remote vfo and a Honda E300 generator rounded out this field operation.

In 70 hours, over 8000 contacts were logged, including a thousand on CW by SV1IW. Most operation was on 20 and 15, with 10 meters being its usual obstinate summer self. In general, conditions were OK except toward Asia—only a few stations from Asia got through.

The Mt. Athos operation shut down at 0200 UTC on August 11; SV1IW and SV1JG along with SV1KP (Ms. SV1IW) proceeded to the island of Crete for a "vacation-style" expedition. In ten days, the three made 6000 more contacts, including many by Natasha, who signed SV9YL. During this period, propagation reversed itself, with conditions being better toward Asia than to North America.

The operators of this Mt. Athos and Crete expedition express their appreciation to all who called in and made their trip a successful one. We, in turn, thank them for putting two new countries in so many logs around the world.

On Crete (l-r), SV1IW, SV1KP, and SV1JG.

SV1IW works SSB from Mt. Athos, while SV1DC observes.

NOVICE CORNER

Let's talk about the perennial Novice, the one who never seems to learn. This is a rare case, actually, as most amateurs advance to being reasonably competent operators as they gain experience. Today's topic is how to work through a pileup on CW while causing minimal interference to others.

This morning, VQ9MR was working the US on the long path at 14,036 kHz, using relatively high-speed CW. The stations he was working were all about one kHz higher in frequency. That is, VQ9MR was "listening up one" without saying so, enabling those who grasped the pattern to easily have a quick QSO. One poor K4 station insisted on calling exactly on VQ9MR's frequency, which was bad enough; that same K4 also seemed inclined to transmit at the worst possible times, like when VQ9MR was also sending. What boggles the mind is that our K4 friend has been a ham for over twenty years! It was 8:00 am, so maybe he was asleep at the key?

First, our K4 person slowed down the whole operation by causing many to miss their report from VQ9MR; indeed, often one could not hear the Chagos come back through those still calling. This is not an uncommon problem. But if one particular K4 caller had had his act together, with the strong signal he had, he surely could have worked the DX on one or two calls, and he would have been gone, instead of fouling up the works for a long period of time.

The procedure for handling a situation such as this is simple and the rewards are great, especially with an excellent CW operator like VQ9MR handling the pileup. The goal, of course, is to transmit to the DX off fre-

Continued on page 223

New Products

SWAN ASTRO 150 SSB TRANSCEIVER

Swan is back! After a several year hiatus, during which little was heard from the company, Swan has returned to amateur radio with an impressive array of all-new, state-of-the-art equipment.

Swan, for those who have short memories, was a dominant force in amateur gear in the late '60s and early '70s. I was one of thousands of young hams of that era who yearned to own a Swan rig, but my high school and college finances never gave me that opportunity. That's one reason I jumped at the chance to put one of Swan's new breed, the Astro 150 SSB Transceiver, through its paces.

The Astro 150 bears scant resemblance to the transceivers of that earlier time. If you haven't shopped for an allband rig in the last five or ten years, you'll be amazed at just how compact and convenient they are.

General Description

The Astro 150 is a five-band SSB and CW rig covering 10-80 meters. A sister model, the Astro 151, covers 15-160 meters. The frequency coverage on each band extends well beyond the upper and lower limits of the amateur allocations, making the 150 a fine choice for MARS operation. With the bandswitch in the 20-meter position, for example, the transceiver tunes from 13.8 to 16.0 MHz. The other bands offer a similar overlap.

While the 150 is designed for SSB and CW operation, the owner's manual advises that SSTV and RTTY operation is possible if you take precautions. It recommends providing a small cooling fan for the heat sinks of both the transceiver and its power supply. In addition, the mike gain control should be used to reduce output to 50 Watts or less. A rear panel RCA jack is provided for inputting AFSK or SSTV signals.

Inside the 150

This transceiver is a ruggedly built modular rig. Virtually all components, including most of the front-panel controls, mount on printed circuit boards. Connections between the boards are mostly of the plug-in variety, so removing a board for service should not be difficult. A profusion of heavy metal brackets and plates provides rf shielding as well as mechanical rigidity. My lone reservation about the construction of the 150 is that a few of the metal brackets inside the rig have sharp edges which *might* erode the insulation on nearby wires. Admittedly, this is a minor point, as an enormous amount of abuse and vibration would be necessary for such damage to occur. A couple of well-placed pieces of plastic tape would set my mind completely at ease. Unless you plan extensive mobile and portable operation with your Astro 150, it is not cause for concern. This rig will last.

Swan's Astro 150 SSB Transceiver.

Despite its small size (3.75" H x 9.75" W x 11.75" D), the 150 weighs in at a hefty 13 pounds. The companion PSU-5 Power Supply/Speaker is of similar size. Both the transceiver and its power supply have their own on-off switches, a nice feature for those who don't like to connect a "hot" lead to any piece of equipment.

With few exceptions, there is no shared circuitry between the receiver and transmitter. The receiver is a single-conversion design with a 9-MHz i-f. The claimed sensitivity is .35 uV for 10 dB (S + N)/N. For CW operation, a 300-Hz i-f filter can be selected, or you can opt to use the SSB filters.

The transmitter is of a broadbanded design with an output power of 100 Watts PEP. As with most "no tune-up" transmitters, a low swr is important. The 150 will perform up to specifications only if it is operated into an swr of 2:1 or better. At higher ratios, the transceiver protects itself by automatically reducing output power so that the final transistors do not overheat. For this reason, Swan recommends using an antenna tuner to keep the swr, as seen by the transceiver, as low as possible.

The 150 offers full break-in (QSK) on CW, something found on few rigs at any price these days. Break-in is accomplished by leaving the final amplifier always connected to the antenna through the low-pass filters. In the receive mode, the final power transistors are biased off, effectively creating an open circuit on the transmitter output transformer. The receiver input is coupled to the secondary of this transformer via a high-speed reed relay.

Perhaps the most unique technical feature of the Astro 150 is its method of frequency selection and tuning. This transceiver is one of a small handful of amateur HF rigs incorporating true digital frequency synthesis. Much of our 2-meter equipment (and even some CB gear) has used synthesizers for several years, but only recently has it become available in multiband HF radios.

Incidentally, just because a transceiver has a digital display, this does not necessarily mean that it's synthesized. In many rigs, the operating frequency is determined by conventional vfo circuitry, and a frequency counter is used to produce the digital display. The principle of synthesized frequency control is completely different, as we shall see.

Swan's design uses a pair of phase-locked loops (PLLs) to provide precise crystal-controlled reference frequencies to six voltage-controlled oscillators (vco's). Five of these are designated as "band" vco's. The outputs from the band vco's are divided by a diode-programmed divider so that band vco frequencies are variable in steps of 500 kHz. The transceiver's bandswitch selects the proper vco and diode program for each band. The 7-32-MHz output of the selected band vco is summed with the 5-7-MHz output of the sixth or "tuning" vco to produce a local oscillator frequency in the 12-39-MHz range. The local oscillator is thus always about 9 MHz above the operating frequency, and indeed, the Astro 150 uses a 9.0165-MHz i-f.

Directing traffic inside the synthesizer is an 8048 microprocessor chip, a device from the same family as the popular 8080 chip found in thousands of microcomputer systems. A small amount of read-only memory stores a program containing the instructions which allow the 8048 to control this complex radio.

The microprocessor accepts as inputs the band and mode you have selected, along with signals from the tuning controls. It uses this data to produce signals which determine the frequency of the tuning vco. The 8048 also sends the proper information to the readout board to enable it to display the correct frequency. The microprocessor and its program also carry out other functions which would otherwise require much additional logic. For example, as long as power to the 150 is not interrupted, the microprocessor will remember the last frequency used on each band. If you want pileups on five different bands simultaneously, the Astro 150 can do it!

With this high-technology frequency-determining scheme, you wouldn't expect the 150 to

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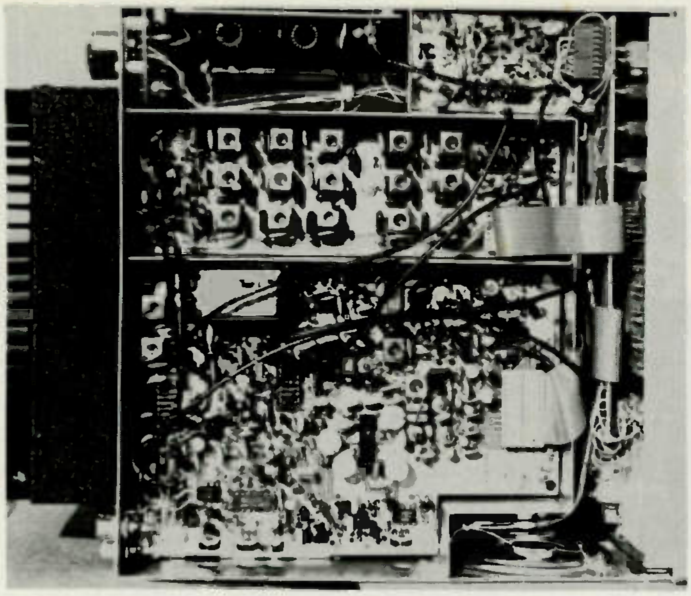
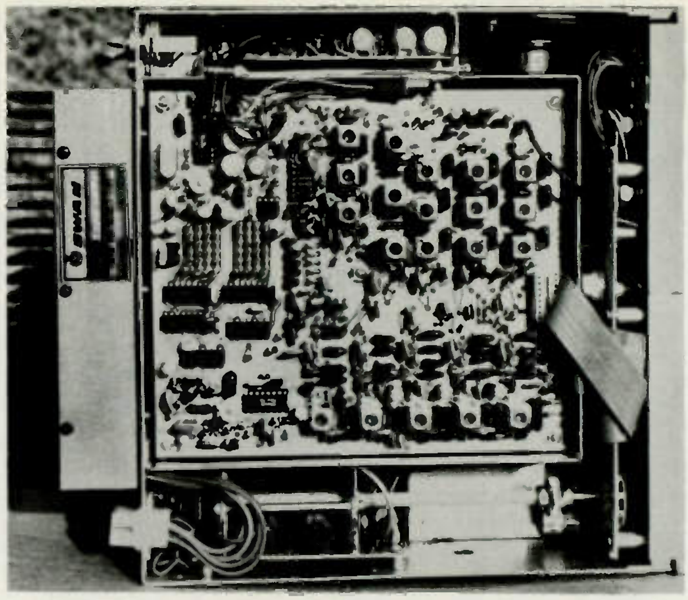


Top view of Astro 150 chassis.



Bottom view of the Astro 150 (with metal shield removed).

have a conventional tuning knob . . . and it doesn't. The main tuning control is called the VRS (variable rate scanning) knob. The shaft of this knob is attached to a cam which actuates either of two microswitches, depending on which way the knob is turned. When actuated, these microswitches send signals to the 8048 microprocessor. For example, when the VRS knob is rotated clockwise from its neutral 12 o'clock position, the left-hand microswitch is tripped, sending a signal to the 8048, which then issues commands causing the transceiver to begin scanning upward in 100-Hz steps. If the VRS control is turned counterclockwise, the right-hand microswitch is tripped, and the transceiver begins tuning downward in frequency. A potentiometer attached to the VRS knob shaft determines the scanning rate. The further the knob is rotated from the neutral 12 o'clock position, the faster the frequency changes. Once the desired frequency is reached, the VRS knob is returned to the neutral position, and the scanning stops. Scanning control is also available via up/down push-buttons on the included hand-held microphone, making mobile operation safer and more convenient.

Other front-panel controls include both RIT and Fine Tuning. RIT changes only the received frequency (up to ±300 Hz), while the Fine Tuning control alters both transmit and receive

Continued on page 218

INTERNATIONAL 160 METER PHONE CONTEST

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DATES & TIMES....... 0000Z 19 January 1980 to 2400Z 20 January 1980.

OBJECT................. To work as many stations as possible on 160 meter phone in a maximum of 30 hours of allowable contest operation. Multi-operator stations may operate the full 48-hour period.

ENTRY CATEGORIES... (1) Single operator, single transmitter, phone only; (2) Multi-operator, single transmitter, phone only.

EXCHANGE............ Stations within the continental 48 US states transmit RS report and US state; all others transmit RS report and DX country.

POINTS................. All contacts score FIVE (5) POINTS each. The same station can only be worked once for contest points.

MULTIPLIERS.......... ONE (1) multiplier point is earned for each US state worked within the continental US; THREE (3) multiplier points are earned for each DX country worked outside the continental US.

FINAL SCORE.......... Total QSO points times total multiplier points equals claimed score.

CONTEST ENTRIES..... Each entry must include logsheets, dupe sheet for 100 or more contacts, a summary sheet, and a multiplier checklist.

ENTRY DEADLINE..... All entries must be postmarked no later than 20 February 1980.

DX WINDOW........... All stations are expected to observe the DX window from 1.825-1.830 MHz as mutually agreed upon by top-band operators.

DISQUALIFICATIONS... Contest disqualification may result if contestant omits any required entry forms upon submission of results; operates in excess of legal power limitations or frequency allocations within his given area; manipulates operating times to achieve a score advantage; or fails to omit duplicate contacts which would reduce the overall score more than 2 per cent.

AWARDS............... Contest awards will be issued in each operator category in each of the continental US states and DX countries.

CONTEST ADDRESS.... Those wishing contest information or entry forms or who desire to submit a contest entry should enclose an SASE and write to:

Dan Murphy WA2GZB
Post Office Box 195
Andover NJ 07821 USA

Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

TOPS CW CONTEST
Starts: 1800 GMT December 1
Ends: 1800 GMT December 2

General call is "CQ QMF" and entry classes include single- or multi-operator. Use 3.5 to 3.6 MHz, USA Novices between 3.7 and 3.75; all contacts must be on 80 meters, CW only.

EXCHANGE:
RST and QSO number from 001.

SCORING:
Contacts with own country score 1 point. Each call area in A/K/N/W, VE/VO, VK, and UA, etc., counts as a separate country. Contacts with stations in the same continent are 2 points, other continents are 5 points. Contacts with HQ station, GW8WJ or GW6AQ, score 25 points. It is hoped to have a special station, perhaps GB2TAC, for another 25 points. Total score is total QSO points times number of prefixes worked (prefixes as per WPX award).

ENTRIES:
Send logs to: Peter Lumb G3IRM, 14 Linton Gardens, Bury Saint Edmunds, Suffolk IP33 2DZ, United Kingdom. Logs should be sent no later than January 31st. Contest results will be sent to all stations except eastern Europeans, which will be sent via the bureau. Due to postage costs, stations are asked to help by enclosing IRCs.

NORTH CAROLINA QSO PARTY
Starts: 1900 GMT December 1
Ends: 0100 GMT December 3

This contest is sponsored by the Alamance Amateur Radio Club. Suggested frequencies are plus/minus 10 kHz:

CW – 3560, 7060, 14060, 21060, 28060.

Novice – 3720, 7120, 21120, 28120.

SSB – 3900, 7270, 14290, 28590.

EXCHANGE:
Out-of-state stations send RS(T) and state, province, or country. NC stations send RS(T) and NC county.

SCORING:
Out-of-state stations count 1 point per NC contact. The same station may be worked on different bands, modes, or in different NC counties. Multiply QSO points by number of different NC counties worked for final score. NC stations count 1 point per QSO and multiply by total number of states, provinces, or countries for final score. NC mobiles use the number of counties operated from for an additional multiplier.

ENTRIES AND AWARDS:
Your log must be signed; none will be returned. Logs must show RS(T)s, bands/modes, time (GMT), state, province, country, or NC county. On a separate sheet, please show name, call, and mailing address plus your total score and where operated from. In the case of multi-operator stations, this sheet must also list the call of the operators. Awards will be issued as usual. Logs must be postmarked no later than January 10th and sent to: Alamance ARC, Inc., 2822 Westchester Drive, Burlington NC 27215.

CONNECTICUT QSO PARTY
Starts: 2000 GMT December 1
Ends: 0200 GMT December 3
Rest period from 0500 to 1200 GMT December 2

The Candlewood ARCA invites all amateurs to participate in this year's contest. Phone and CW are the same contest. Stations may be worked once on each band and mode including OSCAR (and RS) as a separate mode. Novices will please identify themselves by ?n. W1QI, the club station, will operate CW on odd hours and SSB on even hours. Connecticut mobiles working in other than their home counties will receive special certificates provided they make at least 20 out-of-state QSOs. Mobiles count as a separate station in each county.

EXCHANGE:
Send QSO number, RS(T), ARRL section for out-of-state stations, and Connecticut county for Connecticut stations.

FREQUENCIES:
Suggested frequencies are 40 kHz up from the bottom of the CQ bands plus 3927, 7250, 14295, 21370, and 28540 for SSB. Watch for Novices on 3725, 7125, 21125, and 28125.

SCORING:
Each completed QSO counts 1 point, 2 points if with a Novice, and 3 points if via OSCAR. Also, contacts with W1QI count 5 points. Only one DX multiplier is allowed although all DX QSOs count for QSO points. Out-of-state stations multiply QSO points by the number of Connecticut counties worked (8 max.). Connecticut stations multiply the number of QSO points by the number of ARRL sections worked plus a maximum of 1 DX multiplier.

ENTRIES AND AWARDS:
Certificates for the top station in each ARRL section and each Connecticut county if the winner has at least 5 QSOs. Certificate to top-scoring station in each DX country. A Worked All Connecticut Counties certificate will be awarded to each station working all 8 counties during the contest. Logs must show all QSO info plus band, mode, and single- or multi-operator class. Entries must also show QSO points and claimed score. Enclose a large SASE for results. Logs must be postmarked no later than January 2nd and sent to: Skip Paulsen W1PV, 2 Ryders Lane, Danbury CT 06810.

Continued on page 228

Results

RESULTS OF 1979 NEW JERSEY QSO PARTY

NEW JERSEY		
Atlantic	K2NJ/2	50
Bergen	N2CR	1584
Burlington	W2XQ	11352
Camden	WA2MNO	9540
Cape May	K4FFM/2	176
Cumberland	K2OG	2599
Essex	WA2LWT	1060
Gloucester	AB2E	4011
Hudson	K2NJ/2	70
Hunterdon	KA2EGO	490
Mercer	W2ZQ*	14202
Middlesex	WA2NPP*	94599
Monmouth	AF2L	24939
Morris	WB2POG	8621
Ocean	K2NJ/2	78
Passaic	WA2OVE	27264
Salem	WA2RAN	18232
Somerset	K2PF	114
Sussex	W2RQ	26400
Union	WB2RMI	15288
Warren	K2NJ/2	84
OUT-OF-STATE		
Maine	N1PL/1	846
Conn.	WA1TZY	585
N.H.	K1KA**	1470
E NY	WB2THN	1380
W NY	N2ARG	496
Del.	K3UEI/3	25
E Pa.	K3NB**	3591
W Pa.	AD8J	63
Ga.	AI4X	18
Tenn.	WB4WHE	30
La.	W5WG	1445
East Bay	WB6IYS	64
Los Ang.	N6HE	16
Wash.	WB7QEL	60
Ohio	WA8ZNC	704
W Va.	W8UI	1660
Ill.	W9QWM	240
Wisc.	K9GDF	9
Kans.	WD0HAP	120
Ont.	VE3DAP**	2268

* = multi-operator
** = worked all 21 counties

Calendar

Dec 1-2	ARRL 160 Meter Contest
	TOPS CW Contest
Dec 1-3	North Carolina QSO Party
	Connecticut QSO Party
Dec 8-9	ARRL 10 Meter Contest
	Garden City Contest
Dec 22-23	Teenage Radio Sprint
Jan 5-6	QSL Exchange Contest
Jan 12-13	International Island DX Contest
Jan 19-20	North and South America RTTY Flash
Feb 2-3	South Carolina QSO Party
Mar 9-10	Europe and Africa RTTY Giant Flash

H. Paul Shuch N6TX
Microcomm
14908 Sandy Lane
San Jose CA 95124

Low-Cost Receiver for Satellite TV

— this modular design uses readily available technology

Author's Note: This article was originally presented by the author as part of the professional program, "Satellite TV and the Private User," at WESCON/79 in San Francisco CA on September 20, 1979. WESCON, the annual Western Electronics Show and Convention, is a large-scale trade show which features films, exhibits, and professional sessions related to all facets of the electronics industry.

The technological revolution which is making possible the distribution of television programming via satellite has been discussed in both popular and technical publications and at conferences and seminars.[1] In this article, I will explore the trade-offs involved in designing a wideband, tunable FM video receiver for processing and displaying DOMSAT (Domestic Communications Satellite) signals.

It should be recognized that there are at least as many conflicting receiver design philosophies as there are microwave engineers, and no claim is made that the concepts presented here are necessarily superior to any other approach. Nevertheless, this receiver does provide adequate performance at low cost, and the trade-offs encountered are typical of those with which others have had to deal. It is hoped that documenting this effort will help to dispel some of the mystique of microwave receiver design.

Video Carrier	
Channels	24
Adjacent channel spacing	40 MHz
Orthogonal channel spacing	20 MHz
Frequency band	3.7-4.2 MHz
Peak deviation	10.25 MHz
Max. video frequency	4.2 MHz
Pre-emphasis curve	CCIR 405-1
Audio Subcarrier	
Frequency	6.8 MHz
Peak deviation	75 kHz
Max. audio frequency	15 kHz
Pre-emphasis time const.	75 usec
Energy Dispersal	
Waveform	Triangular
Frequency	30 Hz
Peak deviation	750 kHz
Composite	
EIRP	+65 dBm
Path loss	−196 dB
99% power bandwidth	36 MHz
Received spectral density	−206 dBm/Hz

Table 1. Typical DOMSAT signal characteristics.

Signal Characteristics

Unlike the vestigial-sideband AM video standard used for terrestrial TV broadcast, DOMSAT video incorporates a wideband FM format, with audio multiplexed onto a subcarrier prior to modulating the composite. The resulting wideband channel (see Table 1) affords considerable "FM advantage" (signal-to-noise enhancement for a given carrier-to-noise ratio); however, the bandwidth and format tend to complicate the receiver design task.

Were a signal consisting of vestigial-sideband AM video with intercarrier narrowband FM audio available from the satellites, receive processing

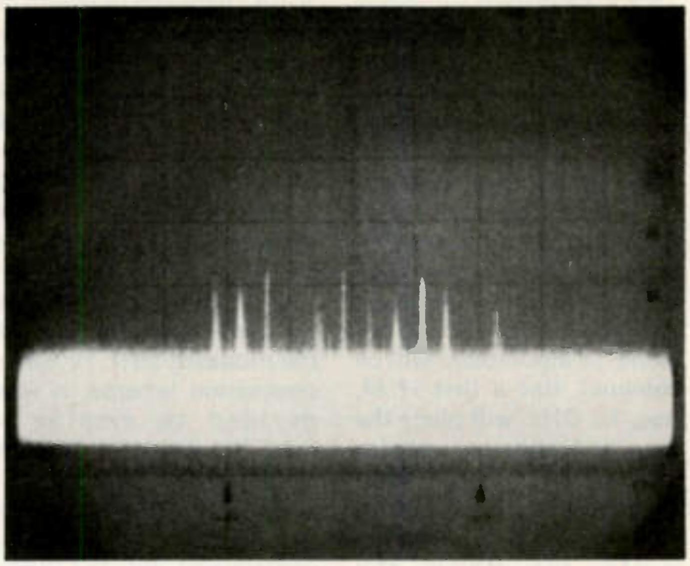

Fig. 1. Spectral display of a 4-GHz DOMSAT downlink recovered on a 4.7-meter antenna and amplified by a GaAs FET Low-Noise Amplifier (LNA). Horizontal deflection is 100 MHz/div, and vertical sensitivity is 10 dB/div. Eleven video carriers, along with their associated FM sidebands, are visible. Note that the fourth channel above the bottom of the band is vacant. Otherwise, channel spacing is 40 MHz and carrier-to-noise ratio appears to be on the order of 10 dB.

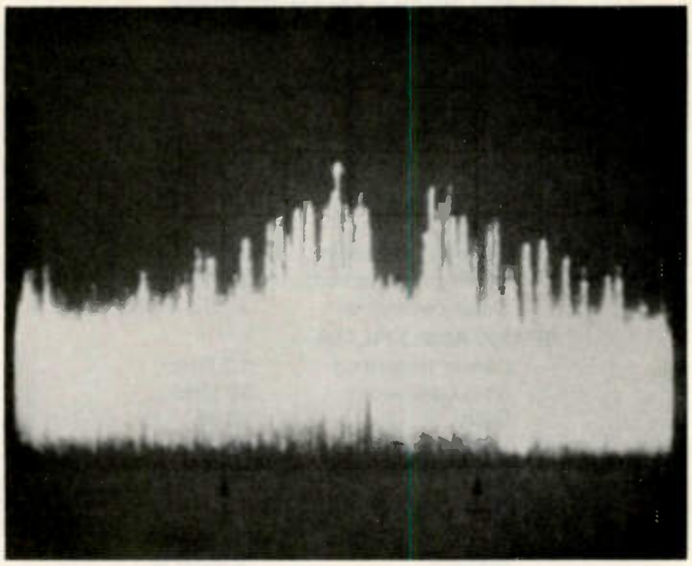

Fig. 2. Spectral display of a single wideband FM video channel after dual-downconversion to a 70-MHz second i-f. Horizontal deflection is 3 MHz/div. and vertical sensitivity is 10 dB/div. This is the composite FM signal from which video and audio are to be demodulated.

would involve merely heterodyning the selected channel in the 4-GHz transmission band against a stable microwave local oscillator (LO), and applying the VHF difference signal directly into the tuner of a conventional TV set. Unfortunately, with DOMSAT signals as they are currently formatted, such a downconversion process would merely spread unintelligible sidebands across six adjacent TV channels.[2] Thus, it becomes necessary to design a complete receiver, including heterodyne conversion stages, demodulators, and video and audio processing circuitry, to recover and display satellite TV.

Frequency Agility

It will be noted from Table 1 that the downlink band used by most North American DOMSATs is 500 MHz wide, and that for a given antenna polarization there will be present up to twelve video carriers, spaced 40 MHz apart (see Fig. 1). That these signals are of extremely low amplitude complicates the design of the Earth station's antenna[3] and low noise preamplifier,[4] but we will assume for the moment that an adequate signal-to-noise ratio exists at the input of the receiver to permit signal recovery. The problem at hand, then, is to select a particular 40-MHz wide channel from among 12 such signals in a 500-MHz wide band, while adequately attenuating the adjacent channels.

A Tuned Radio Frequency (TRF) approach, with detection occurring directly at the downlink frequency, would require readily-tunable bandpass filters of high Q (to accommodate the 1% or so channel bandwidth) and skirts steep enough to reject adjacent channels. Tuning requirements rule out both LC and resonant cavity filters, suggesting the use of Yttrium-Iron-Garnett (YIG) sphere resonators for channel selection.

Although YIG filters can readily be bias-tuned, their cost and the complexity of the required driving circuitry tend to rule them out for private terminal applications. Furthermore, it is far easier to tune a single oscillator than a bank of filters. This suggests heterodyne-downconverting a selected channel into a fixed intermediate frequency, at which demodulation may take place.

I-f Selection

The selection of intermediate frequencies for superheterodyne receivers involves careful attention to the required and realizable mixer bandwidths, image rejection criteria, demodulator circuit capabilities, and tuning constraints. These various considerations tend to be mutually exclusive, but it has been shown[5] that for narrowband systems, a reasonable compromise is achieved by selecting an intermediate frequency approximately one-tenth the frequency of the incoming signal. Although DOMSAT video hardly qualifies as a narrowband service, we can use the one-tenth rule of thumb to establish a starting point. For a 4-GHz input signal, this suggests a UHF i-f. However, the various demodulator circuits compatible with wideband FM video (quadrature detector, ratio detector, Foster-Seely discriminator, phase-locked loop and the like) are all most readily realized in the lower portion of the VHF spectrum. An obvious solution is to utilize dual downconversion, with first and second i-fs near 400 and 40 MHz, respectively.

In fact, numerous experimental DOMSAT video terminals have adopted the above frequency scheme, many employing UHF TV tuners for the second downconversion. The drawbacks to such an approach include the typical UHF tuner's restricted channel bandwidth, relatively high noise figure, and poor local oscillator stability. Nevertheless, when cost is the primary design constraint, these problems can be circumvented.

Not so readily resolved is the input filtering requirement which such a frequency scheme imposes. Assuming low-side first LO injection and top-channel reception, the first conver-

MX-4200 DOUBLE-BALANCED MIXER	
Input frequency	3.7 – 4.2 GHz
LO frequency	2.5 – 3.0 GHz
Intermediate frequency	1.2 GHz
Isolation	20 dB
Conversion loss	7 dB
LO-3000 VOLTAGE CONTROLLED OSC	
Output frequency	2.5 – 3 GHz
Output power	+ 7 dBm
Spurious rejection	20 dB
Tuning voltage range	3 – 10 V dc
Supply potential	+ 13.5 V dc
RF-1200 AMPLI-FILTER	
Center frequency	1.2 GHz
3-dB bandwidth	50 MHz
Gain	15 dB
Noise figure	2 dB
Supply potential	+ 13.5 V dc
LO-1270 LOCAL OSCILLATOR	
Output frequency	1270 MHz
Stability	± 0.001%
Power out	+ 7 dBm
Spurious rejection	40 dB
Supply potential	+ 13.5 V dc
MA-1200 MIXER-AMPLIFIER	
Input frequency	1200 MHz
LO frequency	1270 MHz
Intermediate frequency	70 MHz
Conversion gain	20 dB
3-dB bandwidth	40 MHz
Supply potential	+ 13.5 V dc
Isolation	20 dB

Table 2. Typical parameters for conversion modules.

sion will generate an image frequency which falls a mere 300 MHz below the bottom edge of the downlink passband. An input filter capable of providing adequate passband flatness and minimal insertion loss over the 3.7- to 4.2-GHz band is unlikely to provide adequate image rejection if a 400-MHz first i-f is utilized. One may wish to raise the first i-f high enough to separate the image frequency band well away from the downlink passband, thus simplifying input filtering.

In fact, if the Low-Noise Amplifier (LNA) which precedes the receiver utilizes a waveguide input, then an image filter already exists. Rectangular waveguide is a high-pass transmission line. If low-side first LO injection is used and the first i-f is carefully selected, the LNA's waveguide input will itself reject the image frequency.

Most commercial LNAs utilize an EIA standard WR-229 waveguide input. This guide has a lower $TE_{1,0}$ cutoff frequency near 2.5 GHz. This cutoff frequency is about 1.2 GHz below the bottom edge of the receiver's required passband, so input losses will be minimal. But a first i-f of, say, 1.2 GHz, will place the image frequency as far *below* cutoff as the input passband is *above* cutoff. The image thus ends up quite far down the waveguide high-pass filter's skirts, and may effectively be ignored.

True, the fixed 1.2-GHz first i-f requires that the first LO be tunable, but we mentioned earlier that it's far easier to tune a single oscillator for channel selection than a bank of filters. And even at the top of the downlink passband, where the first LO must be tuned up to 3 GHz, the image at 1.8 GHz is sufficiently far below cutoff so that a 12-cm long input waveguide will afford on the order of 60 dB of image rejection.[6]

Another signpost pointing to the selection of 1.2 GHz as a first i-f is realizable amplifier Q. The 3-dB bandwidth of the i-f amplifier string must be greater than or equal to the 20-dB channel bandwidth in order to avoid unduly attenuating significant sidebands. Assuming a channel bandwidth of 40 MHz and an i-f of 1.2 GHz, this dictates an effective first i-f Q of 30. This value is readily realized with microstripline circuitry.

Despite the obvious economic advantages of the modified UHF TV tuner conversion scheme, it was decided to employ a 1.2-GHz first i-f in the Microcomm DOMSAT video receiver. But what of the second i-f—is it similarly constrained by the wide downlink passband? Actually not. With channel selection occurring in the first downconversion, the second i-f need only be wide enough to accommodate a single video channel. Downconverting the 1.2-GHz first i-f to any desired VHF frequency will allow ample second-conversion image rejection with simple i-f filtering while providing adequate bandwidth to pass the 40-MHz composite.

Since the communications industry has long utilized 70 MHz as a standard i-f for microwave links, it was decided to employ a 70-MHz second i-f in the DOMSAT video receiver. This makes it possible to utilize any of the readily available 70-MHz wideband FM i-f strips to demodulate the video information.

Gain Distribution

Gain partitioning for the DOMSAT video receiver depends upon the available power from the satellite, the threshold sensitivity of the demodulator circuitry selected, and the gain of the receive antenna utilized. It has been shown that for the illumination contours typical of most North American DOMSATs, an optimum private-terminal antenna will exhibit on the order of +41-dBi gain.[7]

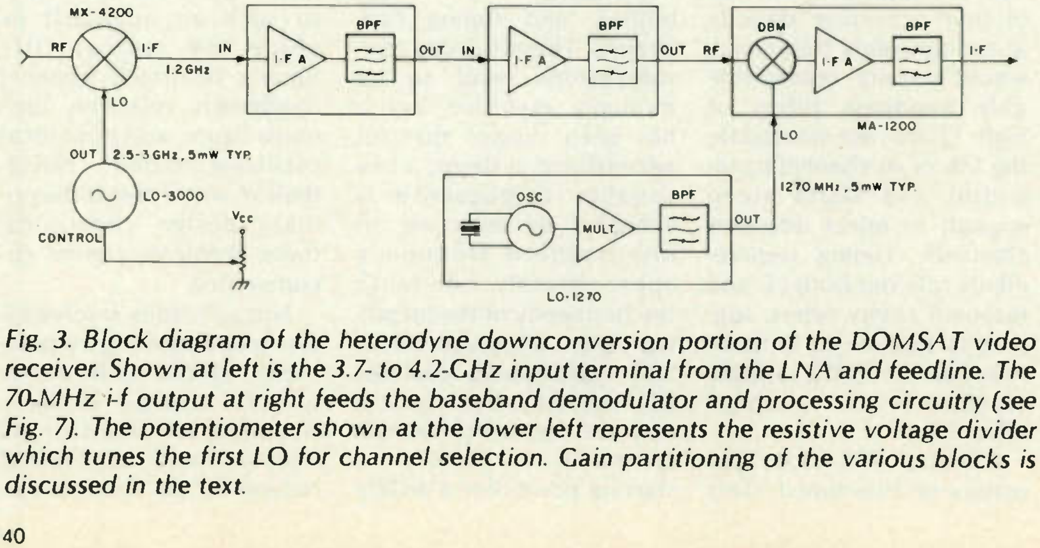

Fig. 3. Block diagram of the heterodyne downconversion portion of the DOMSAT video receiver. Shown at left is the 3.7- to 4.2-GHz input terminal from the LNA and feedline. The 70-MHz i-f output at right feeds the baseband demodulator and processing circuitry (see Fig. 7). The potentiometer shown at the lower left represents the resistive voltage divider which tunes the first LO for channel selection. Gain partitioning of the various blocks is discussed in the text.

Given the EIRP and path loss numbers listed in Table 1, it appears that the signal level available to the LNA will be on the order of −90 dBm.

The input threshold for a typical phase-locked loop (PLL) integrated circuit operating as an FM demodulator at 70 MHz is on the order of −20 dBm. This suggests that between the antenna and the demodulator, roughly 70 dB of conversion gain is required.

There are three sources of gain available between the antenna and the PLL. These include the LNA and first and second i-f amplifiers. There are, similarly, three sources of loss in the system: the insertion loss of the transmission line which connects the LNA to the receiver, and the conversion loss of the first and second mixers. For a typical home installation, the feedline insertion loss may be on the order of 6 dB, and if double-balanced diode mixers are used for the two frequency conversions, it is safe to assume that the conversion loss of each will be on the order of 7 dB. This suggests that the overall gain of the LNA, first, and second i-f amplifiers will need to total 90 dB for adequate DOMSAT video reception.

In the interest of maximizing system stability and dynamic range, it is desirable to distribute the required 90 dB of gain uniformly between the rf and two i-f frequencies. A 30-dB gain LNA is clearly feasible at 4 GHz and would require three stages of GaAs FET amplification. This amount of LNA gain is sufficient to adequately mask the noise temperature contribution of the feedline and receiver, allowing the low-noise temperature of the FETs to predominate.[4] Similarly, it is practical to achieve the desired 30 dB of 1.2-GHz gain by cascading two stages of ion-implanted silicon bipolar transistor amplification. At 70 MHz, the required gain is readily available from thin-film wideband gain blocks produced by a number of different vendors.

A block diagram for the dual downconversion portion of the DOMSAT video receiver, partitioned in accordance with the foregoing discussion, is shown in Fig. 3.

Construction of Conversion Circuitry

During the initial system-development phase of any new product, it is common practice to build a number of different amplifier, mixer, filter, and oscillator circuits, each connectorized for coaxial input and output and with each circuit separately boxed and shielded. A modular developmental system provides the engineer with the flexibility of changing one or more circuits without having to disrupt the rest of the system. Microcomm's earlier efforts at modular receiver development have been documented previously.[8]

But modularization has advantages for a production system as well. If every function represented by a block in Fig. 3 is implemented in a separate, shielded module, then isolation between stages is maximized and the crosstalk and stability problems associated with stray rf coupling can be eliminated entirely. Further advantages are realized in the area of maintainability. Should a receiver fail, fault isolation by module sub-

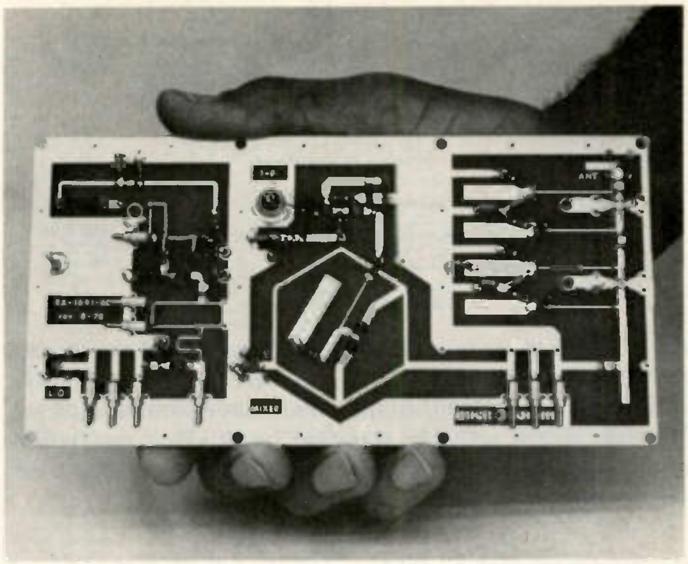

Fig. 4. Typical microstripline circuit module used for satellite video downconversion. Each module in the receive system is mounted in its own shielded enclosure, and all are interconnected via coaxial cable as discussed in the text.

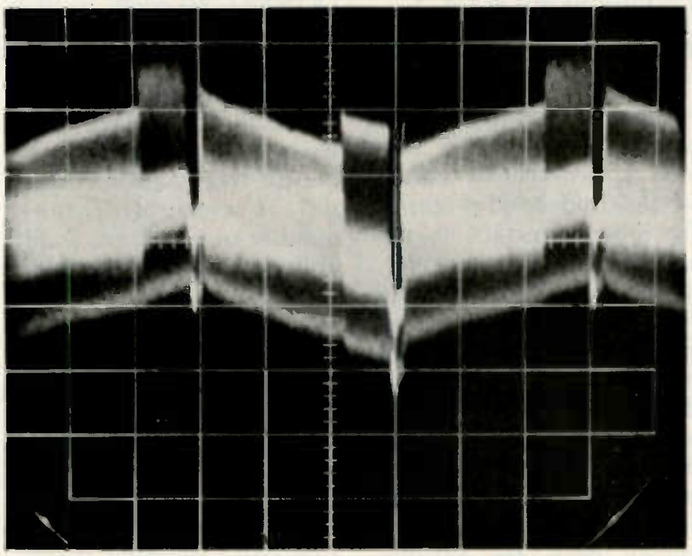

Fig. 5. Baseband output of the PLL demodulator. Presence of the energy dispersal waveform on the video composite is evident.

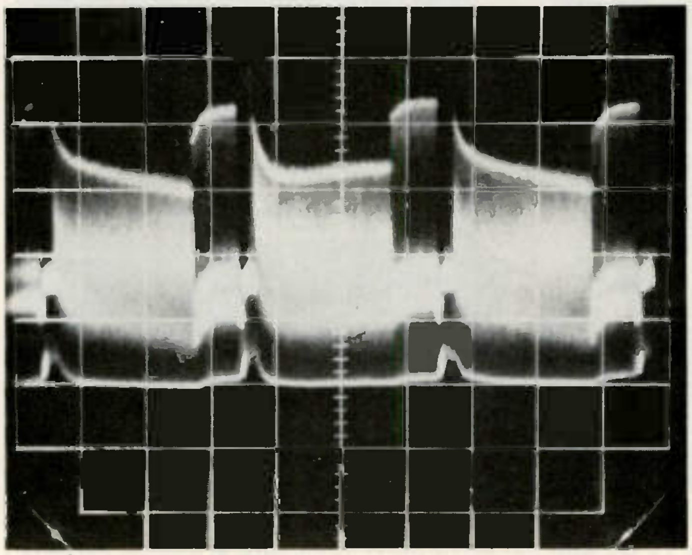

Fig. 6. The dc restorer is simply a diode clamp circuit which removes from the video waveform any vestiges of the energy dispersal waveform seen in Fig. 5.

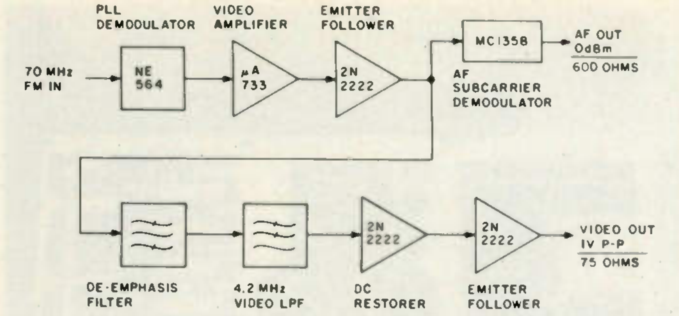

Fig. 7. Block diagram of the complete baseband processing portion of the DOMSAT video receiver. The above circuitry is driven by the output of the downconversion module set (see Fig. 3), and provides standard 1-volt video and 0-dBm audio outputs to an external modulator, studio monitor, or video tape deck.

stitution becomes a viable troubleshooting technique. And, of course, a modular system maximizes user flexibility by allowing customers to assemble from standard modules a custom system designed to meet their precise needs.

The specifications of the modules developed to implement Fig. 3 appear here as Table 2. Each of these modules employs microstripline construction, as shown in Fig. 4, to minimize component count and assure duplicability.[9]

Baseband Processing

Before the wideband FM composite shown in Fig. 2 can be displayed, several processing steps are necessary. The 70-MHz i-f signal will, of course, be demodulated first, and this may be accomplished readily by using a monolithic PLL in a standard circuit.[10] The output waveform from the PLL will contain both the video waveform and the modulated audio subcarrier, but superimposed on these will be found the 30-Hz triangular energy dispersal waveform added to all DOMSAT downlink signals as an interference reduction technique. This waveform is evident in the oscilloscope display in Fig. 5.

Prior to attempting to remove the energy dispersal waveform, it is desirable to amplify the rather feeble video level available from the PLL demodulator, and this may be accomplished using a single monolithic TV video-amplifier IC. Next, an emitter-follower permits splitting off the 6.8-MHz audio subcarrier for demodulation in a standard TV sound i-f microcircuit, whose associated circuitry is modified slightly for compatibility with the higher carrier frequency and peak deviation used on satellite audio.

After passing through a de-emphasis filter and passive video low-pass filter, the video waveform may finally be applied to a diode clamp circuit which will remove the energy dispersal waveform (see Fig. 6). An emitter-follower then establishes the desired 75-Ohm video output impedance to drive recording or display circuitry, as required.

A block diagram for a complete baseband processing subsystem is shown in Fig. 7. This circuit can be constructed on a single printed circuit board and incorporated into a complete DOMSAT video receiver by simply interfacing it to the downconversion circuitry shown in Fig. 3.

Fig. 8. The video output of the baseband unit, displayed on a TV set with the aid of the rf modulator in a video cassette recorder. Most DOMSAT viewers find the clarity and resolution of satellite video clearly superior to network video which is distributed by multiple terrestrial microwave hops.

Display Options

An ideal DOMSAT video receiver for the home Earth-station market would provide an intercarrier audio, vestigial sideband rf output for direct interface to the user's VHF TV receiver. Such an rf output may readily be realized by using any of the available video modulator microcircuits developed for the TV game and home computer industries. In fact, the video and audio levels available from the baseband unit shown here are entirely compatible with such modulators.

Unfortunately, incorporating an rf modulator in a commercial DOMSAT video receiver would subject the entire receiver to FCC type acceptance in the United States. As more than one home computer manufacturer has discovered, the type-acceptance procedure is burdensome in the extreme, with bureaucratic delays often precluding a timely market entry. In addition, the resolution and clarity of most of the available low-cost video modulators leave quite a bit to be desired, and rf modulation would tend to degrade overall video quality noticeably.

A possible solution would be to provide the user with simply a video and audio output from the DOMSAT receiver and allow him to display the receiver's output on a studio-quality TV monitor. However, few videophiles possess such a monitor, and the cost is prohibitive.

Fortunately, most videophiles do possess a videotape recorder (in fact, the owner of a home satellite Earth station would most likely find it impossible to function without one!) and the average video recorder contains an extremely high quality rf modulator. Allowing the user to interface his DOMSAT receiver to the TV via a video recorder provides an ideal solution to the type-acceptance dilemma. And those users who have no recorder are, of course, free to add an external rf modulator, any number of which are available in kit or assembled forms.

Equipment Availability

Once priced in the tens of thousands of dollars, DOMSAT video receivers are now being brought within the reach of the American consumer. The conversion modules shown in Fig. 3, for example, have, since late 1978, been available to the experimenter at $1000 complete, and to the OEM at significantly lower prices in production quantities.

It is expected that by the end of 1979, a complete, fully tunable DOMSAT video receiver, utilizing the above conversion modules and a baseband unit such as that blocked out in Fig. 7, will be available to the consumer for under $2000. This receiver will be fully packaged and assembled, including power supply, tuner, control circuitry, and inter-connecting cables. Such a receiver promises to make possible for the first time a complete, consumer-grade Earth station, including antenna and LNA, for under $4000. We can only begin to guess at the price breakthroughs which may follow! ■

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10. "Signetics Phase Locked Loop NE564," *Signetics Corp. Applications Note*, March, 1978.

A Simple 2m/10m Crossband Repeater System

—work the world with an HT!

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With the rules relaxation concerning the crossband repeater operation and the clearance of the Technician license holder to be retransmitted on an HF frequency (tnx to the OSCAR program), we have a terrific opportunity to use HF links on our two-meter repeater systems with not too much effort and one heck of a lot of fun. A whole new world can be opened up to those who really haven't gotten a taste of the HF bands as well as those of us who are out just to experiment and enjoy all the benefits from such a hookup.

MARC Does It!

The Marissa Amateur Radio Club, Inc., in southwestern Illinois, has a three-site, two-meter repeater which has three receivers, a quarter-kW transmitter, 50 voice-ID tapes, a time machine, and an open autopatch and gives a good 100-mile coverage on two meters with rubber duckies! The idea was generated when I listened to Carlos TI2CF with his ten-meter auxiliary link. The interface to do this with WD9GOE/RPT was begun. A Pace 1000M CB SSB rig was converted to 10 meters with the American Crystal Company kit. This worked out fine and gave us a good little 15-Watt rig tied to a TA 33 antenna. Next, we needed to build a COR (carrier operated relay) that would be activated by the Pace squelch, to key the two-meter transmitter. At the same time, a spare keying line had to be pulled off the two-meter repeater COR so that when the two-meter signal was received, it would key up both the two-meter repeater transmitter and the ten-meter transmitter. Simple. Really! (See Fig. 1.)

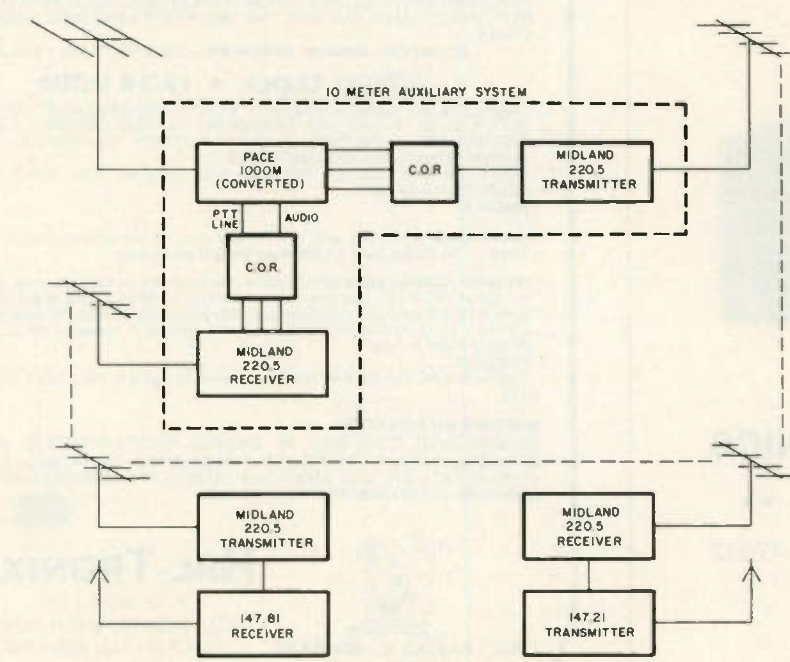

Fig. 1. Block diagram.

Not a Ten-Meter Repeater

One point that should be noticed is that this system is not a ten-meter repeater. That is to say that the ten-meter signals received are *not* retransmitted on another ten-meter frequency. The ten-meter signals are repeated *only* on two meters at the same time that the normal two-meter signals are repeated on two meters, so, in actuality, we have a simple ten-meter auxiliary link between two-meter and ten-meter receivers and transmitters.

220 Link

The MARC group had a special problem that may not be relevant to most systems. This section may not really apply to your group, therefore, but it will show that this system is capable of a lot more, should your group want to carry it out further. The main receiver site for the 81/21 system is located 5 miles southwest of Marissa on a 250′ coal silo. The two-meter signals are relayed back to the 250-Watt transmitter, located in Marissa, over a 220-MHz link system using the Midland 13-509 equipment. The actual ten-meter link of WD9GOE/RPT is located at the home of K9EID. The reason for this was two-fold. The ten-meter system should be at the transmitter site, not at the receiver site, due to desense, etc., and the MARC group felt that very close tabs should be kept on the ten-meter link so that it was not abused. A Midland 13-509 transceiver was taken apart for link use, therefore (a great piece of gear for this service!), and used ahead of and behind the Pace 1000M so that all signals would pass from ten to 220 then to the two-meter repeater, and reverse. It sounds complicated, but it was very easy to do. Follow the block diagram and you can see how simple it really is.

If your group has a repeater system using cavities and duplexing, you can skip all the 220-link activities and wire the Pace straight through (see Fig. 4). One thought about the 220 link is that it also gives WD9GOE/RPT a 220-MHz link that 220 operators can get in and out of just as the ten meter operators are able to do, so we really got a lot of mileage from doing the extra link thing. It is not unusual to dial up the Marissa system and hear a QSO going on: one station operating on 147.81/21, another on 220.5, while another can be 1000 miles away talking to both of them on 29.590! That's communication! What is interesting is that some club members have only a 220 rig, some have only ten-meter equipment, and some have only two-meter equipment. All three of these can communicate very readily with no problem, and should you listen on any of the three frequencies, 99% of the time you would not be able to tell who was operating where or what mode they were operating. One thing that is interesting is that the SSB signals from ten meters come through the 220 and two-meter FM system, and you are hard-pressed to tell that that signal is not FM! Likewise on ten meters, it is *impossible* to detect that the SSB signal you are listening to is an actual FM signal except for one thing—the squelch tail! That sounds crazy on ten-meter SSB! (We recently modified the Motran receiver so that that blasted squelch tail is GONE!) The ten-meter link is no longer disturbed by the crashes!

Audio Coupling

The audio coupling has been done passively. An active limiter could be used here, but it was decided to try the passive route just for simplicity; so far, it has worked without any inherent problems. You perhaps will have to make minor adjustments of values to achieve linear audio response between the two outputs. Care also was taken at the audio inputs of both transmitters so that rf would not enter and cause undue problems. Bypass these audio leads with very small, .001 capacitors and, of course, use good shielded wire throughout.

COR Operation

The really good point about the Pace 1000M when used in this application is that it has a squelch circuit that works with the agc line and, therefore, will operate on SSB signals; this is something that most of the CB rigs will not do. Since the squelch does work on SSB signals, it makes it very simple to pull off a reference voltage, drive a simple COR, and use that to key up the two-meter transmitter. An interesting side effect of the Pace squelch is that since it does get activated via the agc line, a slight delay is noticed with the squelch, and that becomes our 2-second delay tail. It works well and was found to be adequate; delay circuits were not required to achieve the necessary hang time to allow things to switch over. (See Fig. 2.)

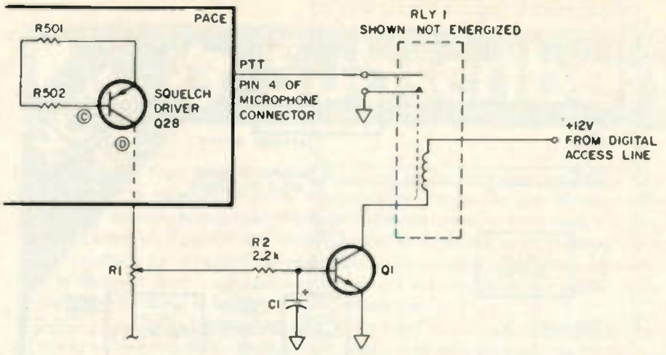

Fig. 2. COR for the ten-meter Pace.

A worthwhile project for the two-meter repeater is a timer-reset beep. Without it, it is difficult for the two-meter operator to tell when the ten-meter signal dropped out (or turned the transmission over). With a reset timer "beep tone," the two-meter system is aware when the COR of the ten-meter receiver has been dropped. Because of the slight delay that the agc introduces, the timing is such that the COR does not drop out when the ten-meter SSB operator pauses for a breath between words. Pace certainly made things easy for us!

Choose Your Mode

As you can see quite easily, you can select the frequency and mode the ten-meter link will operate on simply by adjusting the Pace to those requirements. The MARC group at Marissa has chosen USB on 29.590. After spending much time and effort in checking with groups such as the 10-10 club, etc., 590 seemed out of everyone's way and has worked out well. The unit has, on occasion, been used on ten-meter AM further up the band. It would be an easy task to remote this procedure should you desire. With the great increase of CB conversion to ten-meter 29.6 FM, it might even work out for your group to use this mode if you have lots of ten-meter FM activity.

One of the interesting facets of the SSB mode is the absolute clarity when listening on two-meter FM. At first, one might ask, "How do you tune the ten-meter receiver?" The answer is that the repeater *never* is adjusted. It transceives (hopefully!) on the exact same frequency. The two-meter FM signals are patched to the Pace microphone input and are, of course, transmitted on ten-meter upper sideband. The ten-meter operator simply will tune in this USB signal as he normally would and, when it is his turn, merely transmits on the same frequency which the Pace receives and patches back through the two-meter FM transmitter. Easy.

CB-to-Ten Conversion

The first thing that you will have to do is get the Pace, or similar rig, working where you want it on ten meters. MARC used the American Crystal (American Crystal Supply, PO Box 638, W. Yarmouth MA 02673) conversion, and it

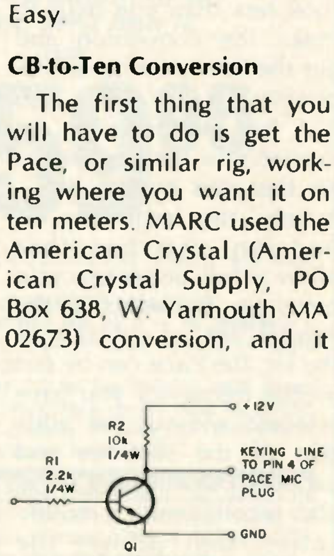

Fig. 3. Electronic keying.

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Audio Booster for Mil-Surplus Receivers

—a must for headphone haters

One of my biggest pet peeves with military surplus radio equipment is the low audio output of some sets. And that is the one big problem with the R-648/ARR-41 radio receiver that I converted recently. (See "Another Surplus Treasure," *73 Magazine*, November, 1978.) This receiver worked fine with headphones, but not when the output transformer was changed for a speaker. If you have done much work at all with surplus radio equipment, you know what I am talking about!

After studying the schematic of the audio stages, I saw that the best route would be to change the 5686 output tube to something heftier—like a 6AQ5. You could do it but for one

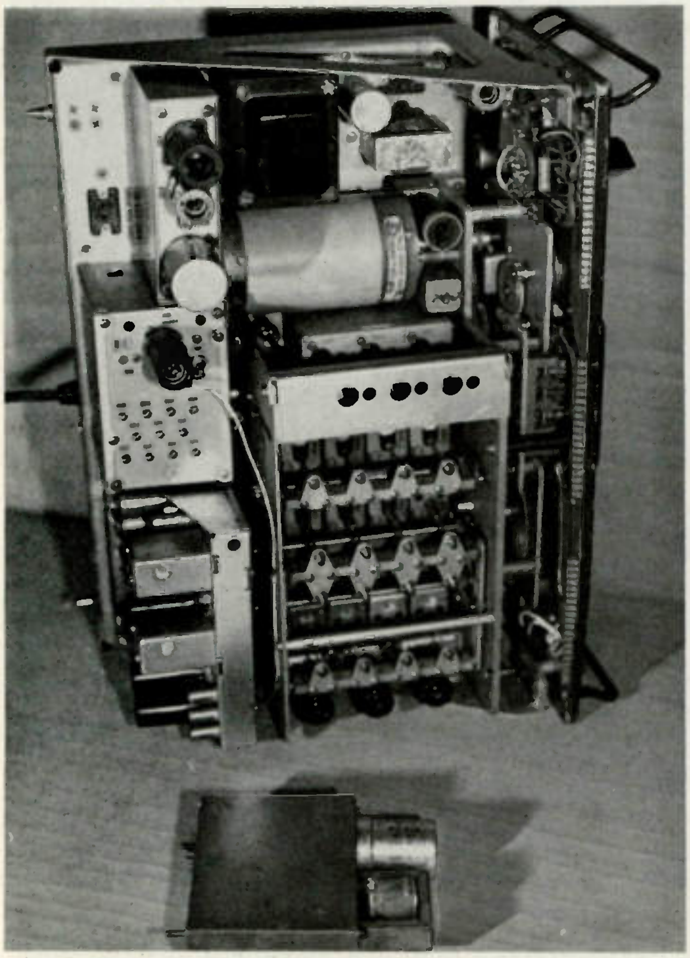

Photo A. Plug-in audio amp with rig.

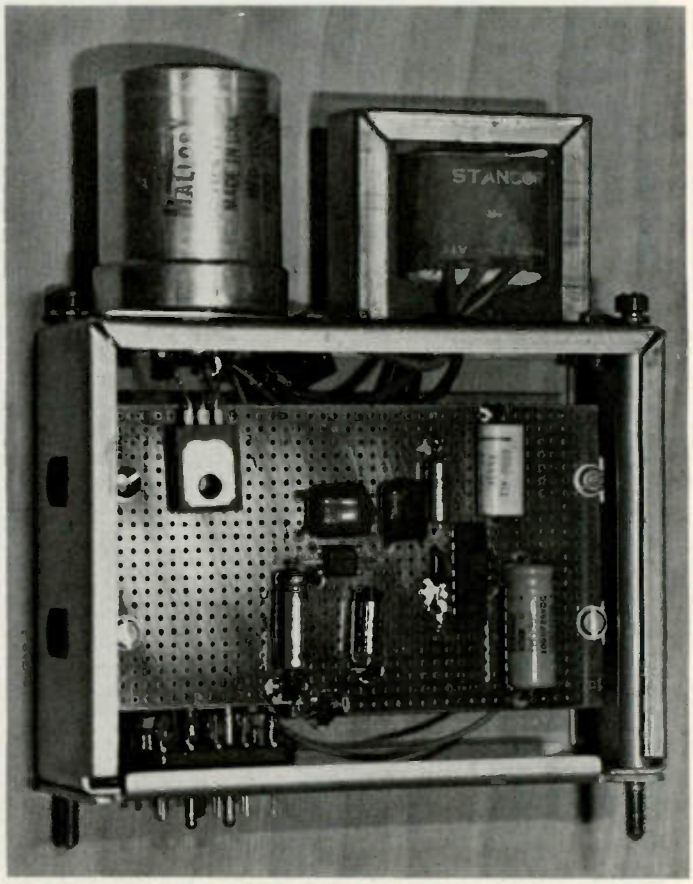

Photo B. Interior view of amplifier.

thing: Mounting the tube could create a height problem with the case. Also, you would upset the filament string in this series string set. So that was out.

The next best thing turned out to be a whole new audio amplifier, built from the ground up. This turned out to be a fairly easy job; an IC "building block" amplifier was pressed into service. It was possible to mount all parts in the module case, too, and the whole thing makes up a neat plug-in package. Oh yes, there is plenty of volume with a speaker now!

If you are working with other surplus sets and need an audio boost, this amplifier may do it for you. It is cheap to build, takes little room, produces little heat and creates a heck of a lot of volume. You are welcome to try it in your own unit; in this article, however, I will concentrate on the R-648 receiver conversion.

Before getting started with the actual wiring, let's take a look at what is being modified in the R-648. If you check out Fig. 1, you will see a simplified diagram of the receiver's audio section. Basically, you have two stages of gain (5814) and a stage of power (5686). The 5686 tube is the bottleneck here. The tube just won't draw enough plate current for any real power output, and is a poor choice for an audio output, especially since it sits there and draws 300 mA at 6.3 volts. It's a better heater-dropping resistor than output tube!

Note particularly the cathode connection of the first audio stage. Resistor R1305 is in series with the tube cathode and a pot on the front panel. This is the volume control. It is unique in that no audio signals pass down it, preventing hum pickup, yet making shielded cable from the volume control unnecessary. This is called a "dc volume control" and is used widely in IC-generation TV sets today. It is important to us because we are going to use it in our modification.

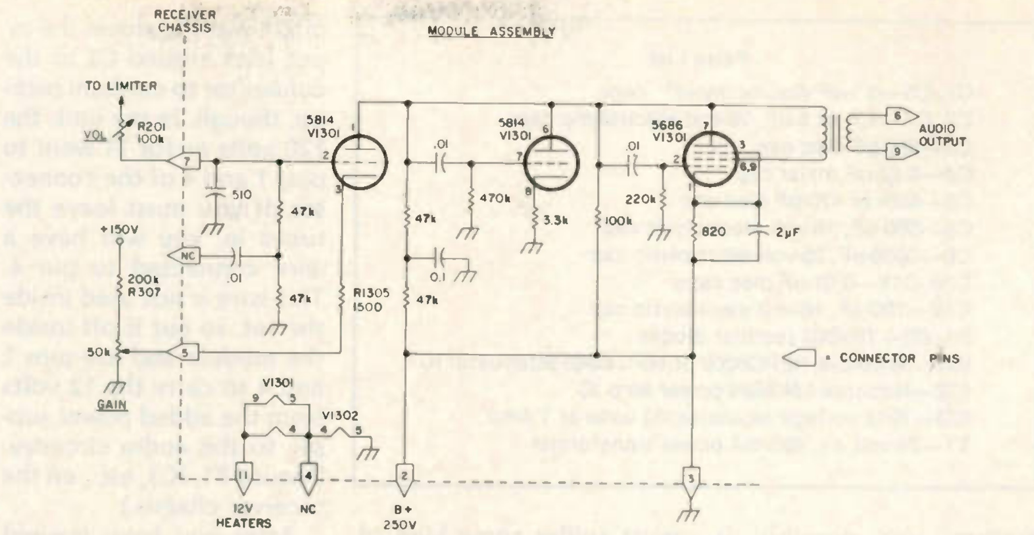

Fig. 1. Existing audio section of R-648.

The schematic shows what goes in place of the two tubes: two low-cost ICs. One IC you are probably familiar with—the National LM-380. This is the 2½-Watt power amplifier job. It is a natural for this job. The other one is a little less known, and that's too bad, because it is very useful. This IC is the Motorola MFC-6040 or Motorola HEPC6009. It is an electronic attenuator. It attenuates a signal when either a resistor to ground or voltage is applied to a control pin. There is no gain added, just attenuation. A simple 12-volt power supply rounds out the modification.

Construction is easy. I would suggest, however, that if your R-648 still has the tube filaments wired for 24 volts, leave the tube filaments in the audio module wired up. This will make sure that the other tubes get the proper voltages. One good advantage, besides the fact you eliminate several power resistors, is that the tubes can be bad. Just the filaments have to be good.

The photos and the schematic tell the construction story pretty well. I must add that I rewired the filaments in my receiver for 6.3 volts, so I was able to mount all parts in the schematic on the original module. This made a neat package. If you leave in the tubes, as required for the old 24-volt filament string, you will have to mount the power transformer elsewhere. I might add, at this point, that I tried a half-wave rectifier and filter directly from the 24-volt filament supply, but I had to supply a huge amount of filtering, and I had to drop the voltage to IC3 (voltage regulator) because it exceeded the chip's ratings. In the long run, a separate transformer for the audio amp power supply takes up less space, reduces construction frus-

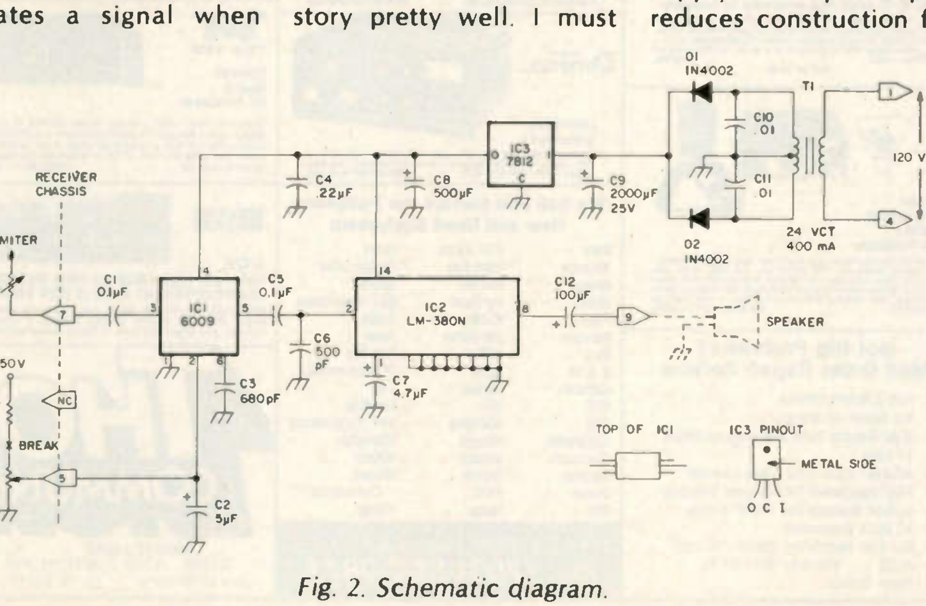

Fig. 2. Schematic diagram.

Parts List

C1, C5—0.1-uF disc or mylar® caps
C2, C7—4.7- or 5-uF, 16-volt electrolytic caps
C3—680-pF disc cap
C4—0.22-uF mylar cap
C6—500- or 470-pF disc cap
C8—500-uF, 16-volt electrolytic cap
C9—2000-uF, 25-volt electrolytic cap
C10, C11—0.01-uF disc caps
C12—100-uF, 16-volt electrolytic cap
D1, D2—1N4002 rectifier diodes
IC1—Motorola HEPC6009 or MFC-6040 attenuator IC
IC2—National LM380N power amp IC
IC3—7812 voltage regulator; 12 volts at 1 Amp
T1—24 volt c-t, 400-mA power transformer

tration, and possibly is cheaper.

I started construction by removing all components from the audio module, save the connector. Inside, I mounted a piece of copperclad "ground plane" perfboard, which serves as shielding and a heat sink for IC2. You don't have to duplicate this method of construction—copperclad perfboard is rather expensive—but at the least you must solder some kind of heat sink to the *grounded* leads of IC2. Two pieces of shim brass cut to size will do fine.

IC3 does not have to be heat-sinked, as its power dissipation is very low. You can see this IC in my unit mounted upside down under the filter capacitor.

The rest of the construction is noncritical and needs little comment. You might want to shield the input lead around C1 to the connector to cut hum pickup, though. In my unit, the 120 volts ac for T1 went to pins 1 and 4 of the connector. If you must leave the tubes in, you will have a wire connected to pin 4. This wire is not used inside the set, so cut it off inside the module and use pins 1 and 4 to carry the 12 volts from the added power supply to the audio circuitry. (Mount T1, IC3, etc., on the receiver chassis.)

After you have rewired the module, you will have to make a few additions on the main chassis. In my case, I ran 120 volts ac to pins 1 and 4 of the audio module chassis socket. If you kept the tubes in as ballast resistors, you will have to build the 12-volt power supply externally, and feed in the regulated voltage through the proper pins. After that is done, you must make one more change. Resistor R307 on the front panel must be disconnected or the attenuator IC will receive B+ through the *gain* control. This should be very easy. Unlatch the front panel and look at the rear section of the gain control. In my receiver, there was a yellow wire tied to the CW or far left-hand lug on the control. I cut it and I was home free.

After these modifications were complete, the receiver worked fine, and with room-filling volume! I haven't tried this modification on other surplus sets, but it should work if the proper power-supply voltages are available. And, oh yes! This conversion has other benefits, too. Besides a dramatic increase in volume, and less heat, the dc volume control can be switched and used as part of a squelch or noise blanker scheme. Or, how about a Selcal system? ■

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✓127

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Working with FETs

—part II: experiments with gain and supply voltage

In part I of this article, I began a discussion of audio amplifiers which use the FET, the transistor that thinks it's a tube. Let's continue by examining more of the functions these devices can be made to perform.

The triode FET small-signal voltage amplifiers are probably the all-time easiest circuits for a tube person to work with. This is one place where your tube-thinking will fit right in almost without change, and yet you will be working with solid state.

The circuits are straightforward, easy to duplicate, and the testing is nothing out of the ordinary. For basics, as with some of the other articles in this solid-state series, a microphone, audio signal generator, VOM, and scope are what you need.

It will help if you have a good junk box of small parts or a resistance sub box. Part of the fun on this one is watching what really happens when you play around with the values.

Here goes. Fig. 1 shows a basic triode tube voltage-amplifier stage. Notice that there is no cathode resistor. This stage would be a common first stage for a mike amplifier in an SSB rig. There are other uses for such a stage, too, but the important thing to note is the absence of the cathode resistor.

In theory, it looks as though the stage is running without any grid bias. There is a tiny smidgen, however; it is caused by "contact potential." The stage is able to get away with it because the input signal is assumed to be so small that the stage is still operating on a linear portion of its tube curve. The amplified signal is sent to the next stage, which is very similar but usually has the cathode resistor.

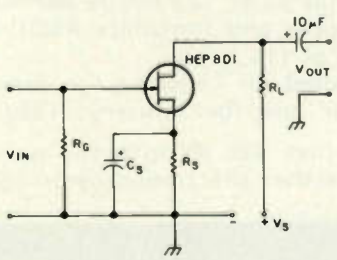
Our tube stage has a few other points about it. It is high impedance. (A tube is voltage-operated, that is, high impedance.) Notice that the grid resistor is 1 megohm. The load resistance of such a stage is often in the 100k to 220k range. A high signal output voltage is developed across the output resistance, but this is at very low power. The current may be on the order of a few mils or so.

Fig. 2 shows the same amplifier with an FET as the triode. This test circuit uses the Motorola HEP801. This is an "N" channel FET. That means it is roughly the same as the NPN bipolar transistor, as far as bias polarity goes. In fact, you hook up the voltage the same as for the tube; you just use less of it and only one supply.

The specs say a maximum of 20 volts between any of the elements. The maximum drain current is 15 mA. That's not much in the way of power, but it's not meant for power. While it can go to 20 volts at the drain, this series is geared to 12 volts, so we have some built-in safety margin.

There is one other mechanical oddity with the 801 which should be mentioned. There is a fourth pin which connects to the case. This is for shielding. For test use you can ignore it. If you want to be fancy, ground it or connect it to the source pin. You will do this anyway if you use it in an IC matrix board as I did.

Here's where the fun starts. Usually with solid state you have to fuss about the parts' values. This is the gizmo that thinks it's a tube. Let it think that. Use the same 1-meg resistor at the gate, since this is not critical at all. As with a tube circuit,



	R_G	R_S	R_L	C_S	V_S	V_{IN}	V_{OUT}	GAIN	Db
A	1M	NONE	2.2K	NONE	12VDC	1.5 P-P	6V P-P	4	12
B	1M	2.2K	15K	NONE	12VDC	<1.5P-P	6V P-P	4.6	13.2
C	1M	2.2K	15K	10μF	12VDC	0.4 P-P	6V P-P	15	23.5
D	1M	2.2K	15K	10μF	20VDC	0.2 P-P	6V P-P	30	29.5

Table 1. Circuit performance test results.

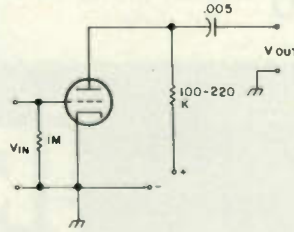


Fig. 1. Triode tube voltage amplifier stage.

250k on up would be common, and the circuit will work with much more and much less.

The next thing to fuss with is the drain load resistor. Use your substitution box and click your way down. With the mike input, at some point you will begin to get it to work. Then watch the scope and prune for best results. You might put your VOM in the drain circuit to watch the current; it's educational. The circuit should only draw a few mils. By the time you start to draw much current, you can see the performance fall off on the scope.

The drain resistance is not that critical, and a wide range of values wiJl work. This is a wide-range circuit. When it was tested above and below 12 volts, it worked from 5-20 volts. It might work at even less, although my supply would go down only to 5.

If you work at it, you may be able to get clipping with the mike, but here is a nice time to try adding an audio signal of some sort, and it would be nice if it was adjustable—or you can add a standard tube-type volume control as in Fig. 3. Just keep the input signal to less than 20 volts p-p.

I started with the theory that the operation would be quite similar to the tube version, but there was quite a surprise when I started comparing the data. With the simple circuit, your only variable is the load resistor. This gets adjusted for most output voltage. This may not be clipped. Once you get the most output, adjust the input signal until the output is undistorted. That will be your best value. Check a few resistance values on either side to make sure, though.

With my HEP801, this worked out to a 2.2k-Ohm

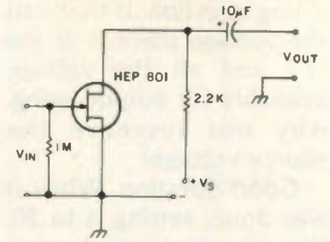


Fig. 2. FET triode circuit.

load resistance at a 12-volt source voltage. It gave a 6-volt p-p output. Then I added the source resistor. I had to go back and readjust the drain load. The values are not critical, but I settled on a source value of 2.2k and a drain value of 15k (Fig. 4).

This also got me an output of about 6 volts p-p. I had hoped for a clearer parallel to tube operation, but I don't really see it on the scope. With the tube, a cathode resistor would allow for more input voltage swing before distortion, but I really saw little difference between the two FET circuits. The scope values were about the same. The input distortion point was about the same, and I could get the same general output. So much for theory.

The oddest effect was when I added the bypass capacitor (Fig. 5). With a tube, this would have increased the bias and the output. It did increase the output to about 10 volts p-p, but it was clipped. All I could get was about 6 volts peak-to-peak from the circuit, but the resistor-capacitor circuit had more gain. What it did was lower the input distortion point. In other words, I could not have as high an input signal,

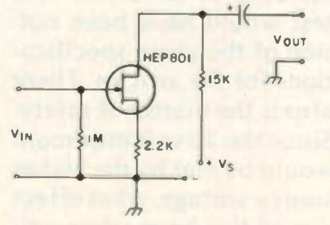


Fig. 4. Source resistor added.

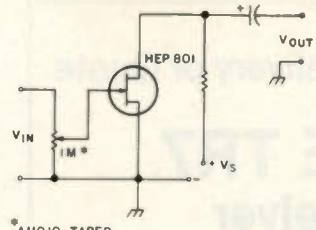


Fig. 3. FET volume-control circuit.

but the circuit would give me the same output with less input.

Rough scope measurements placed it at over 9 dB gain over the other two circuits. Thus, it is far more sensitive, but easier to overload. I used a 10-uF capacitor, but a higher value would be better, something from 20 to 100 uF.

The statistics of these circuits are somewhat alarming. They don't behave quite the way I would have expected. Table 1 shows a chart of various operating conditions. The first three have an operating voltage of 12 volts at the source; the last is 20 volts at the source. For this test, the input voltage was adjusted for an output of 6 volts peak-to-peak, and then the input voltage was measured p-p.

The output was divided by the input and the gain figured and converted into dB. In each case, the circuit was optimized for output in each configuration, with the circuit values shown being chosen. The no-resistor circuit would take a higher input, but needed a high input to get the 6 volts out. Its gain was

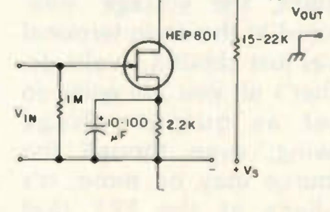


Fig. 5. Highest sensitivity and gain circuit.

only four.

The unbypassed resistor circuit was only slightly better. The bypassed resistor circuit not only had the best sensitivity to a weak signal, but also had much better gain. When the voltage was raised, the output voltage could have been more, but even holding to our present value, the actual gain of the circuit increased even at the lower levels. I was surprised at the difference in gain figures between the no-resistor and bypassed-resistor circuits. The other tests, such as for total output and distortion from overload, did not show up such a wide difference in actual circuit performance.

The low-gain high-input circuits would be the choice where you had gain to spare and needed high input capability. For most uses, you will probably want the bypassed circuit so you get some actual gain in signal and the ability to be sensitive. It was also unexpected that the gain of the circuit would increase with the increase in voltage to it. It was not just a matter of more possible output; the circuit worked better at the higher voltage when it was optimized for it. Still, I would have to recommend staying at the 12-volt or so level so as not to throw away your safety margin.

In actual fact, these circuits are not really optimum circuits as far as gain goes. They are useful when you want the FET capabilities, but other transistors can perform the gain function better.

These rough tests may not show the whole story. After all, it was a high-level input signal I was using, but these were intended to be rough-and-ready circuits to work with. There might be reason to use the source resistor even if the capacitor was not required. This would not be the highest gain, but would be the most stable. Besides being the best as far as input overload, you also have the stabilizing effect of the extra resistor. It will prevent any problem with the drain circuit trying to draw too much current. It's unlikely, but it will give protection. It also may help stabilize the stage and even out operating variations as a tube does—but it just doesn't show on the scope.

I chose the 801 because it is commonly available. There are plenty of other audio FETs which should work with these circuits, and you may want to, or have to, prune values for best results. The same techniques will work with any FET. You should keep in mind that there is a built-in brick wall. After a certain point, you cannot have any more output voltage. In theory, you would run out of supply voltage to provide output, but you don't even get the full supply voltage swing, anyway. Past a certain point you are going to clip the peaks off because there is no additional voltage available to become output voltage swing.

The fact is, a lot of what you think ought to be available voltage just isn't there. Your output voltage swing is only what you have at the drain itself. These circuits are centered on 12-volt source voltage. That's at the power input, not what's at the FET drain. Even though the current is slight, the voltage measured at the drain terminal was just about 5.5 volts dc. That's all you are going to get as output voltage swing; even though the source may be more, it's what's at the FET that counts.

This brings up an interesting question. If that's all the voltage there is at the FET and all the voltage available for output swing, why not increase the source voltage?

Good question. When it was done, setting it to 20, the circuit worked even better, but the FET drain voltage was still only about 12 volts, which means an output voltage swing of even less than that.

What about increasing the source voltage until the drain voltage as measured reaches 20 volts, the maximum allowable?

Here, you face several design decisions. As a practical matter, if you wanted to try it, you would start with this circuit and increase the source voltage while measuring the drain voltage and current. When it reached the desired value, you would probably want to go back and try some different values at the load resistor. You would have to get a new best value for the higher voltage. This would mean some resetting of the resistor and the voltage, back and forth. You would arrive at the best values for your 20-volt drain voltage, though, if you use the method described here. It is likely that you would get increased performance, too, but there are drawbacks.

The first is the higher source voltage. You would need somewhere around forty volts. This series was geared to 12, since most equipment these days wants to use batteries if possible.

It also might be mentioned that my supply goes up only to 20 volts. This test would have been outside of the given specifications for the articles. There also is the matter of safety. Since the 20-volt maximum would be met by the higher source voltage, what effect would this have when you really started pushing out a 20-volt peak-to-peak audio signal? You would be running close to the ratings, which is not the best way to design.

Still, if the test setup is available and you are willing to risk a bargain FET or so, go ahead and try it. The basic monitoring procedure should tell you what is going on, and the test will give you an even more complete picture of the full capability of the FET. As to applying it in a circuit, that would depend on how you were going to power the final circuit.

Trouble with small-voltage amplifiers accounts for a great deal of the distortion problem in equipment. Input overload is common. Depending upon the type of amplifier, it may be biased to accept a certain input level and start to clip a peak because the bias is wrong for a higher level. That's why you find some circuits designed to handle a high-level input, even though it is intended for a lower-level use.

Musical instrument amps often have that feature. A guitar might work fine, but one with a built-in preamp would distort if the amplifier input circuit couldn't handle it. After that, it's a question of your output voltage swing. You may have lots of gain, but how much can you use before you get up to all the output voltage you can have and start clipping?

If you are looking for distortion, you can see these effects with your scope in a circuit. If you are building, you can build to take care of some of them.

Still, without even trying, we have opened the door to further developments of this simple circuit. They are easy to implement and have their own place in practical usage. We'll discuss them in part III of this article. ■

✓ Reader Service—see page 259

Gary McClellan
2500 N. Harbor Blvd.
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Build this $50 Mini-Counter

—three-IC design goes to 135 MHz

Sooner or later, anyone who does much work with communications equipment discovers the need for an accurate frequency counter. Let's face it, crowded communications channels make knowing your frequency more important than ever. This is where this counter project comes in.

Would you like to have a counter that measures frequency up to 135 MHz and beyond—one that is pocket-portable with battery power to make accurate measurements simple anywhere? Of course you would! The Model 304 Communications Counter has these features and much, much more: a low price tag of about $50, easy, one- or two-evening construction, and a superior sensitivity from 4-mV rms at 27 MHz to 12-mV rms at 135 MHz with input protection.

The 304's battery drain is low enough (130 mA) that you get long hours of operation on a set of charged nicads. You get a frequency range of below 1 MHz to over 135 MHz, covering ham, CB, commercial, radio control, and TV frequencies. And, best of all, you can measure the frequency to within 100 Hertz of what the transmitter is putting out. If you are in a hurry, you can select a reading to within 1 kHz, and get five readings per second versus one reading per 2 seconds on the 100 Hz range. Accuracy can be up to ± 0.002% ±1 count if the counter is calibrated on a frequency standard. Now that you know what this counter can do, go out and look at units selling from twice to three times as much as this one. One wonders why no one has thought of this design before.

Construction of this project will be a pleasant surprise because it is very

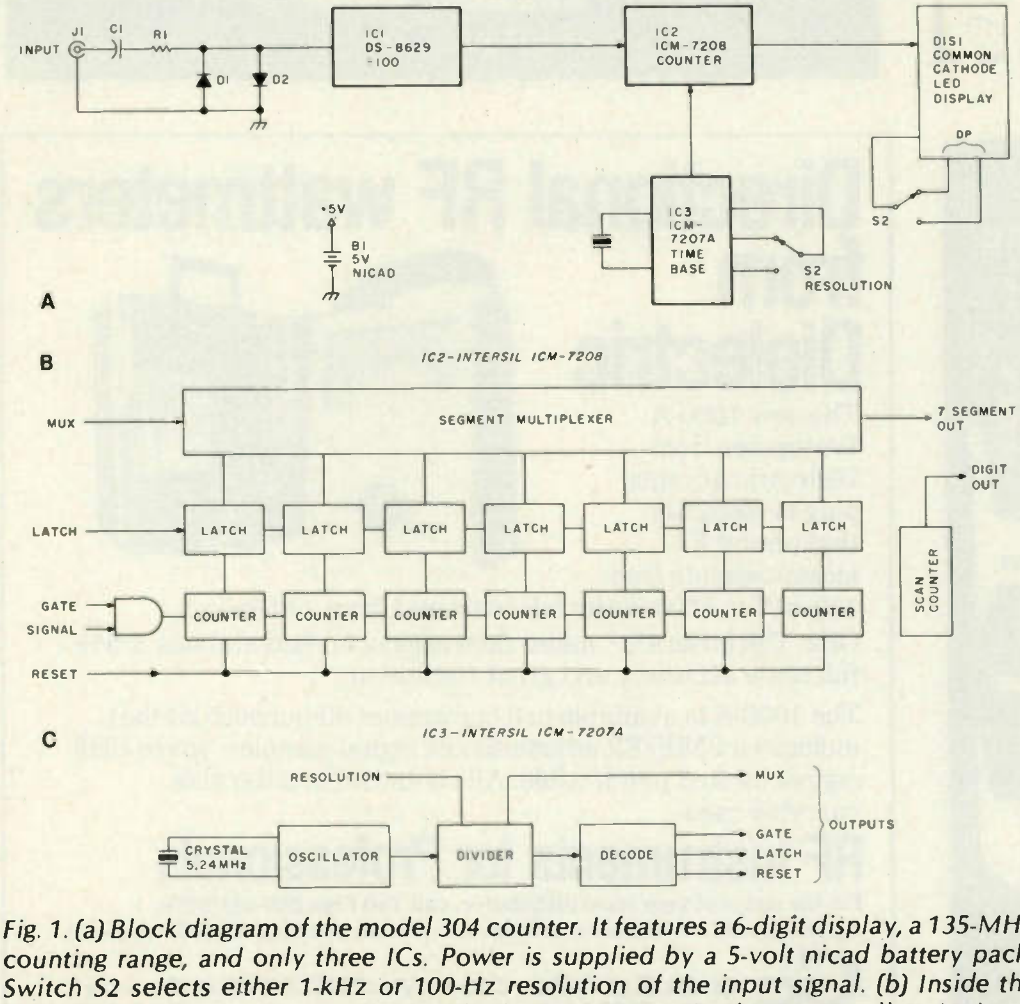
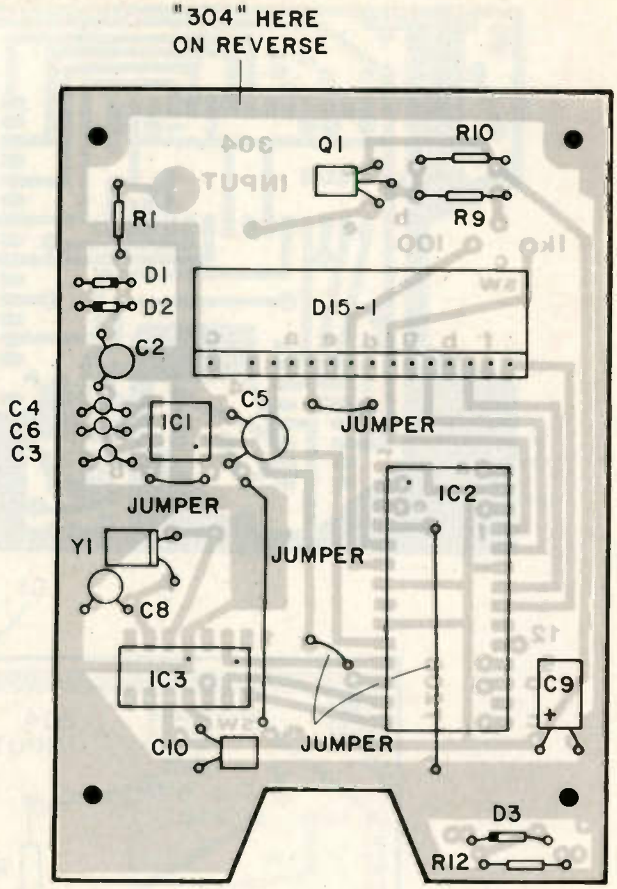


Fig. 1. (a) Block diagram of the model 304 counter. It features a 6-digit display, a 135-MHz counting range, and only three ICs. Power is supplied by a 5-volt nicad battery pack. Switch S2 selects either 1-kHz or 100-Hz resolution of the input signal. (b) Inside the ICM-7208 (IC2) counter array. (c) Inside the ICM-7207A timebase controller. An input connected to the divider section controls the gate time, and thus the resolution of the signal being counted by IC2.

Fig. 2. Component side of the board. Be sure to get all jumpers installed before the sockets go in.



easy. Thanks to a clever PC board layout, this project uses only a single-sided PC board, making duplication from the pages of this magazine a snap. There are only six wire jumpers in the board—for those of you who hate to install jumpers. There are sockets for all ICs and a minimum number of components. Since there are only three ICs and one transistor, your construction time for the board should be about four hours of casual work. Add another evening for the cabinet work and you are all set.

The parts in this counter should be easy to get. The two main CMOS chips have been on the market for nearly three years, and the prescaler chip has been used for well over one year. The rest of the parts are not too critical. All parts are available from the surplus houses. To assist you, however, I am including addresses of typical suppliers of the key parts, plus the addresses of the manufacturers who make the ICs. If necessary, you can write for a local dealer's name and address.

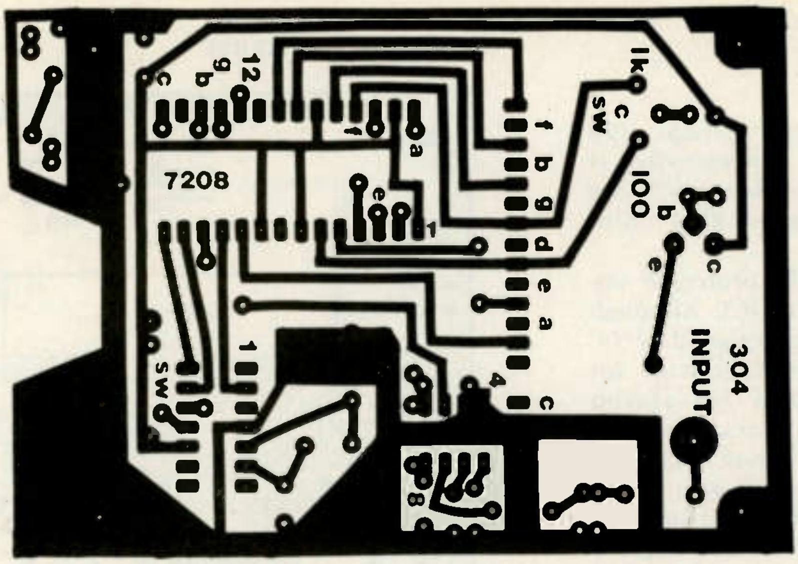
How It Works

This counter project is based on three ICs: One amplifies and divides the signal by 100, another counts it up and displays 7 digits of information, and the third generates precise timing signals to control the second chip. Check Fig. 1 for details as you read.

Input signals applied to J1 first encounter a protection network composed of C1 (which blocks dc), R1 (which limits input current) and D1-D2 (which limits input signal). The purpose of this network is to protect the counter from "real world" overloads such as an accidental dose of excessive dc voltage, 120 volts ac, and excessive rf signal. This keeps IC1, the preamp/prescaler chip, safe.

Next, the protected signal goes to IC1. Although this IC was designed by National Semiconductor for synthesized FM stereo radios, it works great in a counter. It has a preamp stage for high gain which has sensitivity of up to 4 mV at 27 MHz, then a series of ECL (Emitter Coupled Logic) and low-power Schottky TTL dividers. It divides the input signal by 100, so 100 MHz in equals 1 MHz out. This is necessary because the counter-display chip to be described won't count a TTL signal much beyond 2 MHz.

The divided signal enters IC2, a CMOS/LSI chip that counts it and displays the results on an LED display. Fig. 1 shows a general overview of this chip. The signal from IC1 passes through seven decade counters. They count up the signal. After it is counted, the data is passed on to the display via the latches (one per decade counter), through the multiplexing circuitry, and on to the display. Actually, the multiplexing circuitry consists of a big data selector at the output of the latches, squeezing 7 digits (at least 4 lines each) into a single set of 7-segment lines. The latches hold the signal while the decade counters are reset to zero and count up the signal again. The latches are then opened allowing the new reading to pass through to the display. This prevents the rapidly changing decade-counter outputs from reaching the display and causing a blur of numbers. The sequence in which the count-latch-dis-



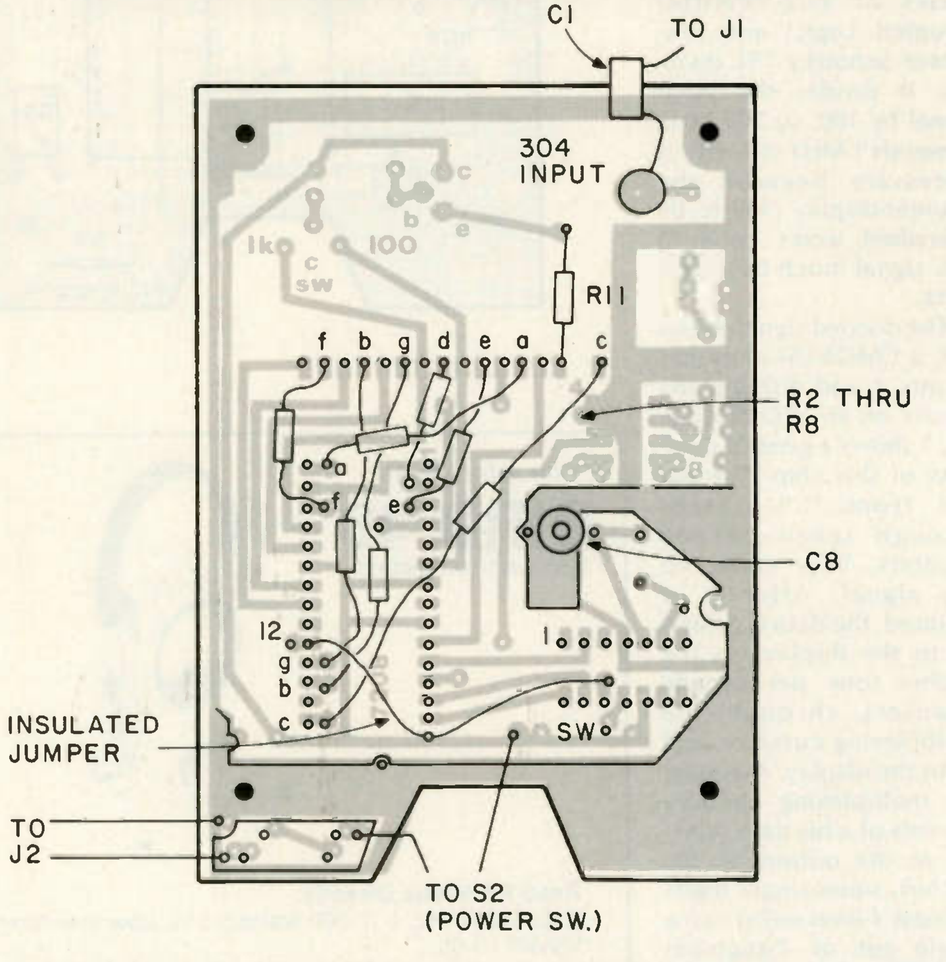


Fig. 3. Foil side of the board. Take your time and install those resistors correctly!

play-reset cycles occur is determined by the third IC.

The third IC generates the key signals necessary for IC2 to count the input signal properly. Fig. 1 shows a block diagram of this chip. A 5.24-MHz crystal connected to IC3 is the source of the proper frequency. It drives a Pierce-type oscillator inside the chip, which has the advantage of very high stability. (The circuit isn't much like the old 6AG7 tube Pierce oscillators of days gone by, but it accomplishes the same result.) The output drives a divider chain composed mostly of binary devices, and then the output drives a series of gates generating the precisely-timed gate, latch, and reset pulses needed by IC2. Also, an input connected to the divider chain controls its length—or number of stages—and selects a 1-second gate time or a 100-ms gate time. An output from IC3's divider chain also carries the multiplex signal for IC2. This signal determines when a digit will be scanned by IC2's multiplexer, and is just as important as the other signals.

Construction Guide

The first step is to round up the parts. If you are lucky, you can probably scrounge most of them from your junk box, but more likely you will have to buy at least the ICs. All of them have been available to the industry for nearly three years, and they are starting to pop up in the ads.

The LED display is commonly used in low-cost calculators, and can be almost any such unit; the pinouts have been pretty much standardized by various manufacturers. We have used National NSB-188, Litronix DL-94 displays, and others with success. The HP unit specified is recommended because of its superior appearance, but its $12 price tag may drive you to scrounging a junk calculator instead. Order any parts you need, plus the crystal. If my own experience is any indicator, you should order the crystal first. They are custom made, and take time to get.

The next step is to obtain or make the PC board. Luckily, this one is a single-sided type, and can be made at home using the G-C "Lift It" kit, or the newer printed circuit transfer films such as PCP type A, which is carried by Tri-Tek, Inc. (See distributor list for address.) It might be wise to silver-plate the finished board to improve high frequency performance, but that is up to you. While the improvement will be slight, the appearance will be considerably better. Drill all holes with a number 64 drill, and then drill out the four corner holes with a 1/8" drill. Now let's start the wiring.

You should install the jumpers and IC sockets before doing anything else. Refer to Fig. 2, which shows

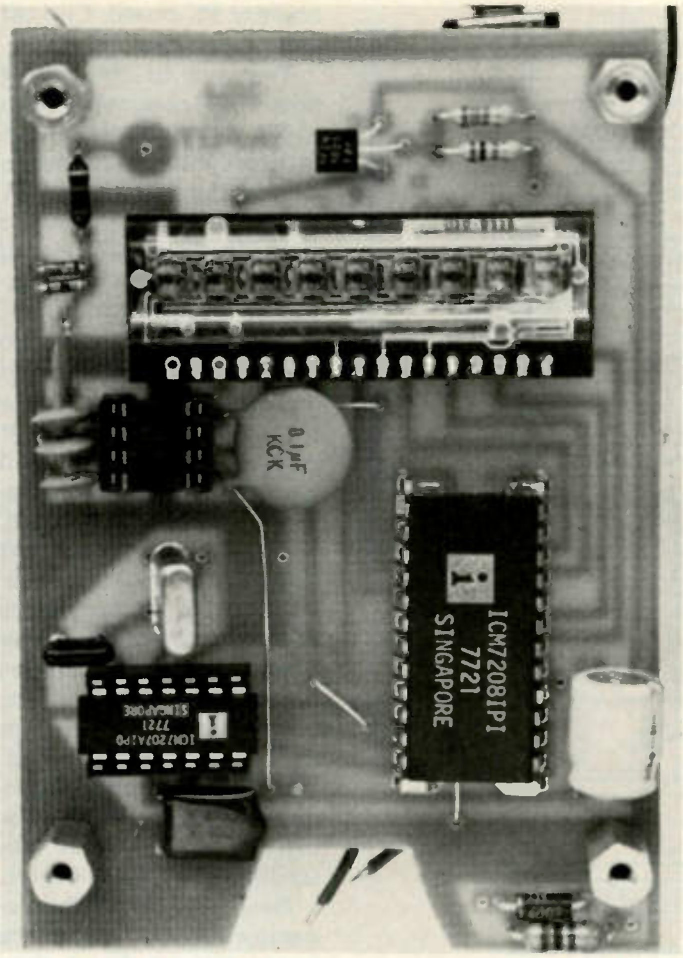


Fig. 4. Completed component side of the circuit board. Your finished board will look like this.

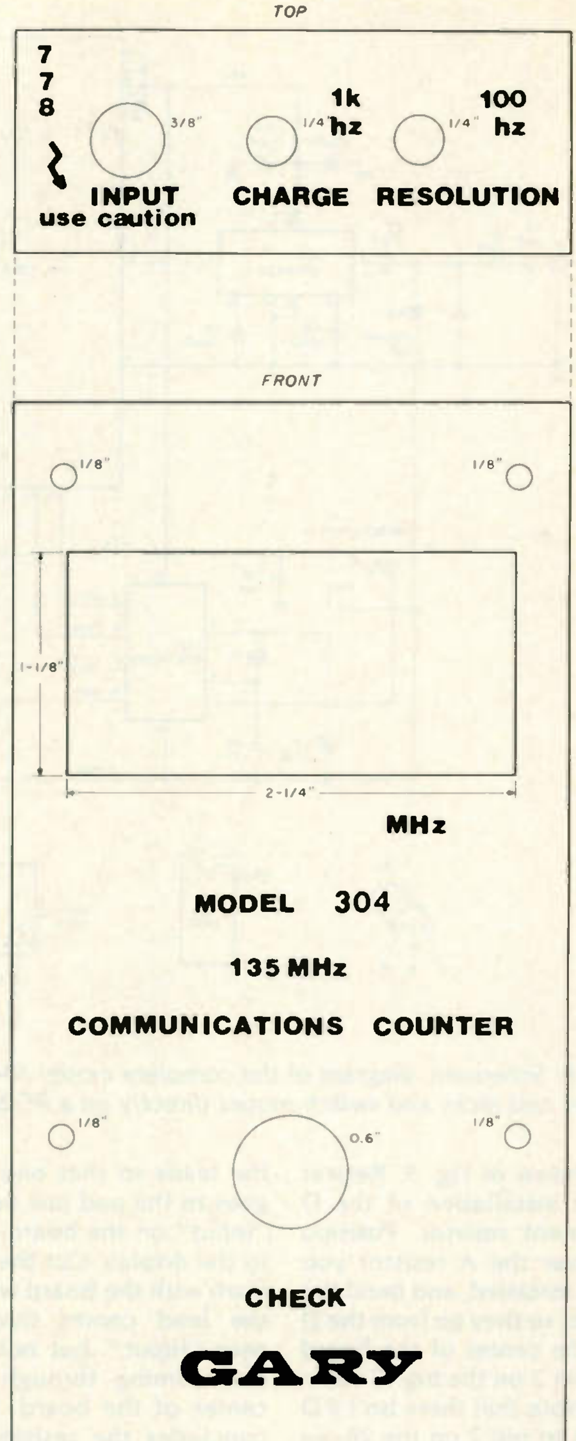


Fig. 5. Cabinet drilling template.

the component side of the board. Cut up three 1" pieces of no. 28 solid wire or resistor leads. Then cut two 2" pieces of wire. Install one 2" wire between the two holes near the right center of the board, as shown in Fig. 2. Install the other 2" jumper between the two holes near the left center of the board. Install a 1" jumper near the bottom of the board at the cutout. Move up to the center of the board, and install the remaining two 1" jumpers. Be sure to get the jumper nearest the left center of the board in the proper holes. An 8-pin IC installs next to it. When done, check to be sure all connections are soldered. Also, trim away the PC board at the bottom to form the trapezoid-shaped cutout, if you haven't already done so.

Next, install the 8-pin low-profile IC socket in the top left corner, next to that small jumper. Move down from it and install a 14-pin low-profile socket near the bottom edge. Finally, install the 28-pin socket next to the right edge of the board. I recommend the use of low profile sockets because they make later installation in the cabinet easier. Molex® pins will suffice, however. Check for solder bridges, fix, and flip the board over. Cut a 1¾" piece of insulated hookup wire, strip, and solder one end to pin 12 on the 14-pin socket, and the other end to pin 19 on the 28-pin socket. This wire shows up on Fig. 3. (Note that there is a "1" to identify pin 1 on each socket.)

The next step is to install the eight segment resistors on the foil side of the board. About ¼" of each resistor lead appears on the other side of the board for mounting the display, so don't trim the leads off from the row of wires in the center of the board. Start with the A segment resistor, R2. Lay the resistor against the board between the A on the socket (28-pin) and the A pad in the center of the board. Pass the resistor end through the A pad, so that the lead comes through the hole in the center of the board. Remember that this is for the display, so don't trim it. Solder to the pad. Bend the resistor body so that the other lead won't touch any other foil but the A pad on the 28-pin socket.

This process is identical for the other resistors, and

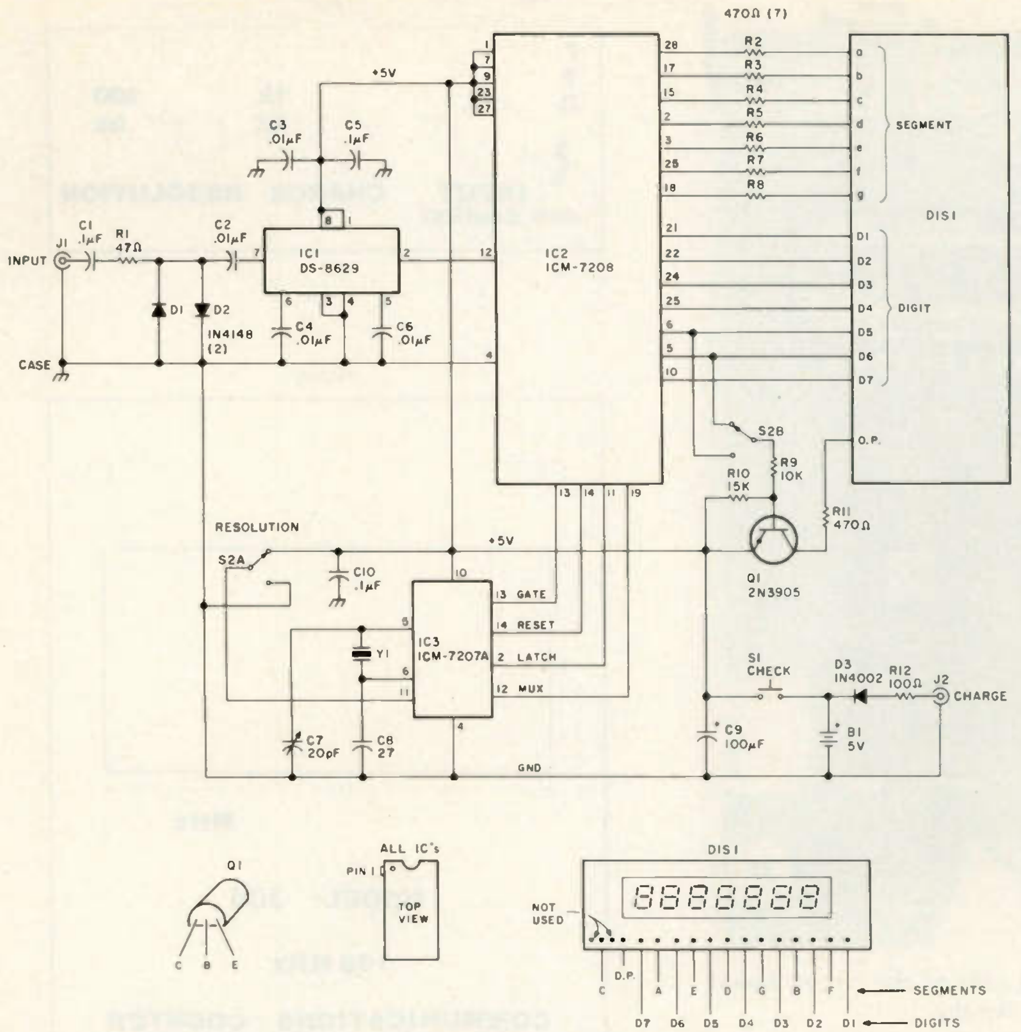


Fig. 6. Schematic diagram of the complete model 304 counter. All parts except the batteries and jacks and switch mount directly on a PC board.

is shown in Fig. 3. Repeat with installation of the D segment resistor. Position it over the A resistor you just installed, and bend the leads so they go from the D in the center of the board to pin 2 on the big IC socket. Note that there isn't a D next to pin 2 on the 28-pin socket. (There wasn't room for it.) Continue by installing the E segment resistor in the same manner, leaving at least ¼" of lead sticking through the center of the board to mount the display. Continue with the F, G, B, and one end of the C resistors. Attach a piece of bare wire to the other end of the C resistor, slip a piece of insulating tubing over it, and solder the wire to the C pad on the big IC socket. Pick up another 470-Ohm resistor and bend the leads so that one end goes to the pad just below "Input" on the board, and to the display. Cut the end flush with the board where the lead comes through near "Input," but not the one coming through the center of the board. That concludes the resistor installation for the display.

Continue by cutting up seven 1" wires for use as jumpers. These jumpers tie the digit leads from IC2 to the cathodes on the display. Heavy wire, just large enough to fit the display holes, might work better here, but the wire size you use is up to you. Bend one end of each wire into a small right angle, so that the wire looks like the letter L. Pass a wire through the foil side of the board, and place the short arm against the foil pad. Solder carefully. Put a wire in each pad that doesn't have a resistor. Use patience and care to prevent the wires from touching the adjacent resistored pads. This concludes the hardest part of the project.

Turn the board over to the component side and very carefully clip the 15 wires down to about ¼" above the board. Place the display over the wires, being sure to leave the hole on the the far *left* side of the display open. All holes on the *right* side must be used. Do not leave a hole open here or the counter won't read right. Press the display down flush against the board, and solder quickly. Use a minimum of heat to avoid loosening the wires soldered to the counter PC board. Clip off the excess wire.

The rest of the wiring needs no comment; refer to Fig. 4 for details. Install resistors R9 and R10 at the top of the board and R1 along the left side. Move to the bottom right and install R12. Now you have installed all resistors.

The semiconductors go in next. Install Q1 at the top center of the board, as shown in Fig. 4. For your convenience, the E, B, and C were marked on the reverse side of the board. Move over to the top left side of the board and install D1/D2 in the spaces near R1. Note that the bands on these diodes point in opposite directions. Move to the bottom right corner of the board, and install D3. That completes the semiconductor installation. The IC installation will follow later.

Now let's install the capacitors on the front of the board. Refer to Fig. 4, then turn to the top left side of the board. Install C2-C3-C4-C6 as close as possible to the board. Jump over the 8-pin socket and install C5 as close as possible to the board. Bend it flush with the board before soldering. Move down the left side next to the 14-pin socket and install C8 near it. Then jump over the socket and install C10 as shown. Bend it flush with the board before soldering. Skip over to the bottom right side of the board and install C9. Be sure the negative terminal faces the outside edge of the board. That completes capacitor installation on the front of the board.

While you are working with the front, dig out Y1 and install it next to C8. Also, bend the crystal over against the board edge before soldering. The photo shows it standing up, but this is not normal practice.

Flip the board over to the foil side so that you can install the remaining ca-

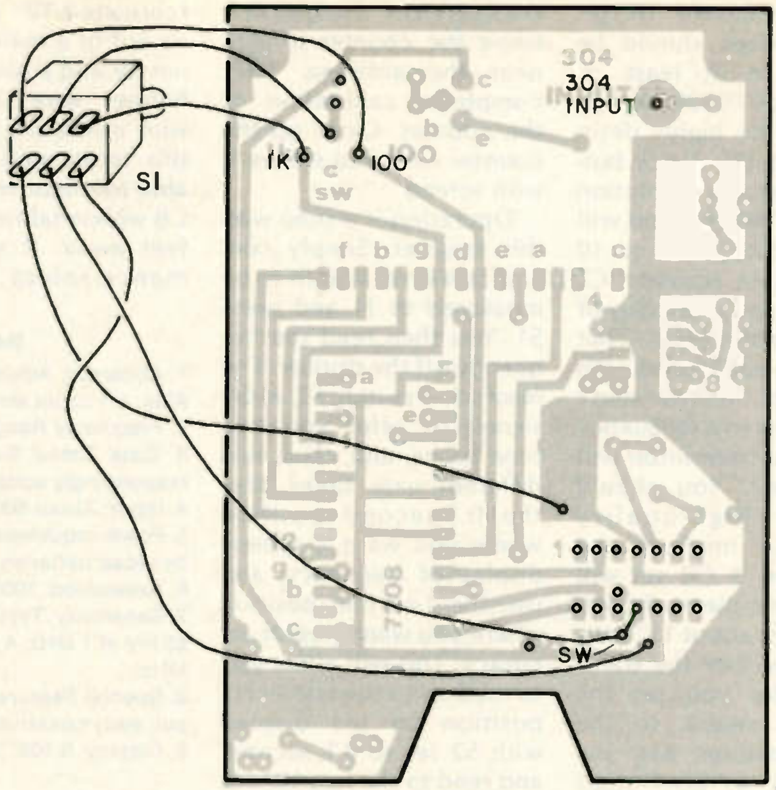


Fig. 7. Rear view of PC board showing switch wiring.

pacitors. Install C1, standing on end, at the input pad. Leave the other end free. Install C7 in the spot near the center of the board. Note that on most trimmers there are three leads. The two closest together go to the heavy ground foil on this counter, while the third goes to the crystal and IC3. That completes capacitor installation.

Next, the switch and mounting hardware are installed. Attach six 3" wires to the terminals of S2. Then wire up this switch as shown in the schematic and Fig. 4, cutting the wires to size as you go along. Install four spacers in the corners with 4-40 hardware and lockwashers. Note that the spacers are on the front side.

That just about wraps things up on the module. Finish by installing the ICs. Be careful about pin 1 orientation. Remember, pin 1 is identified on the PC board if you get confused. Then cut two 1" pieces of hookup wire, strip both ends, and install at the bottom of the board near the cutout. See Fig. 3. Also, cut a 5" piece of the same wire and attach near the end in the bottom left corner of the board. That completes the module assembly. It can be tested by applying 5-volts dc to the wire off the bottom center of the board.

Now you get to work the case. Fig. 5 shows a drilling template for the front of the box. Drill out the box and nibble the display hole. Clean up the box, label it with press-on transfers, and spray it with clear acrylic spray to preserve the finish.

Complete the assembly by installing the module in the box and wiring it up. First, install J1 and J2 in the top of the box. Then slip the module into the box and secure it to the front with screws and lockwashers. Mount S2 on the top of the box, too. Snap in S1 and wire it up. Install the battery pack and wire it up to the other side of S2 and ground. Finish up the job by wiring up J2 and C1 to J1. Don't close up the box until you finish calibration. Charge up the batteries and you are all set!

Calibration and Operation

There are several ways to calibrate your counter, with the simplest being to measure a known frequency. This is how I calibrated the model 304 counter. Connect a signal of 50 mV or so at 10 MHz from a fre-

Supplier List

Item	Factory	Distributor
IC1-National DS-8629	National Semiconductor 2900 Semiconductor Dr. Santa Clara CA 95051	Tri-Tek, Inc. 7808 North 27th Ave. Phoenix AZ 85021 (602)-995-9352
IC2-IC3 Intersil ICM-7208IPI and ICM-7207AIPD. Note: These parts come as a set	Intersil, Inc. 10900 Tantau Ave. Santa Clara CA 95014	Poly Paks, Inc. PO Box 942 S. Lynnfield MA 01940 Stock #92CU4079 (617)-245-3828
Y1—5.24288 MHz crystal	JAN Crystals 2400 Crystal Dr. Ft. Meyers FL 33901 (813)-936-2397	JAN Crystals
DIS1—H-P display	Hewlett-Packard, Inc. Optoelectronics Div. 1501 Page Mill Rd. Palo Alto CA 94304	Poly Paks, Inc.
C7—20 pF trimmer cap	Sprague, Erie, etc.	Tri-Tek, Inc. Stock# CAP9308
Case—LMB-CR-531	Heeger, Inc. 725 Ceres St. Los Angeles CA 90021	

Note on the "Factory" column: These people should be contacted *only* for a local distributor; only JAN Crystals will sell small quantities of parts to individual users.

quency standard to J1. Your standard should be accurate to at least ±0.001%; ±0.0005% or better would be highly desirable. Press the check button and set the resolution switch to 100 Hz. You will get a reading close to 10 MHz. Adjust trimmer C7 until you get a reading of exactly 10.000 MHz. That completes calibration with a standard. If you don't have access to a frequency standard, a transmitter will do as well. You should have a high-quality counter to measure the transmitter. A CB set will do. Attach a piece of coat-hanger wire about 12" long to J1. Then key the transmitter after you set the resolution switch to the 100-Hz position. Key the transmitter in brief steps and do not modulate it. A walkie-talkie is ideal for this since little power is necessary. Adjust C7 until the counter reads the exact transmitter frequency when the counter is held near the antenna. That completes calibration of the counter. Close up the counter case and secure it with screws.

Operation is a snap with this counter. Simply connect low-level signals to be measured to J1 and press S1. You then read the frequency off the display. The resolution switch, S2, is designed to offer you two time bases, and, thus, two different gate times. Use the 0.1-second position where you want a speedy display of frequency, and use the 1-second position where you want greater accuracy. This will allow you to read up to the last 1 kHz position on the display with S2 set to 0.1 second, and read to the last 100 Hz position with S2 set to 1 second. As you can see, each has advantages.

A few tips on using this counter: You might want to fabricate a 12" whip antenna out of a male BNC connector and a piece of coat-hanger wire. Epoxy the wire inside the plug. With this setup, you should be able to measure a 100-mW CB walkie-talkie at least 15 feet away. If you performance-select IC1, this counter will cover the 2 meter ham band. Finally, whenever you measure a transmitter or signal generator, be sure to operate it in the unmodulated mode, or SSB units in the CW mode. This will give you maximum accuracy in your measurements. ■

Model 304 Counter Specifications

1. Accuracy: Adjustable to up to ±0.0002% or better, short term. Also ±1 count error on all measurements.
2. Frequency Range: From below 1 MHz to over 135 MHz.
3. Gate Times: Switched 1 second or 0.1 second. Display correspondingly updated 2 seconds or 0.2 seconds respectively.
4. Input: About 500 Ohms at low signal levels (below 0.5 volt).
5. Power requirements: 5 V dc at 130 mA, no signal. Power supplied by nicad batteries.
6. Resolution: 100 Hz and 1 kHz of the measured frequency.
7. Sensitivity: Typical rms sine wave sensitivity for stable count is 55 mV at 1 MHz, 4 mV at 27 MHz, 5 mV at 50 MHz and 12 mV at 135 MHz.
8. Special Features: Hand-held portable unit. Diode-protected Input, easy construction, long battery life, etc.
9. Display: 0.105" LED calculator-type with 7 digits.

PC Boards

The PC board (stock #STGM-279) for this project is available for $5.60 (drilled) or $4.00 (undrilled) from O. C. Stafford Electronic Development, 427 South Benbow Rd., Greensboro NC 27401. Add $1.00 for shipping.

Parts List

B1—4 "AA" Nicad batteries in square holder
C1—0.1-uF, 200-volt Mylar capacitor
C2, C3, C4, C6—0.01-uF, 50-volt disc capacitors
C5, C10—0.1-uF, 25-volt disc capacitors
C7—6-to-20-pF trimmer
C8—27-pF mica capacitor
C9—100-uF, 6.3-volt electrolytic
D1, D2—1N4148 diodes
D3—1N4002 rectifier diode
IC1—National DS-8629N VHF prescaler
IC2—Intersil ICM-7208IPI counter chip*
IC3—Intersil ICM-7207AIPD timebase controller chip*
J1—BNC connector, UG-1094, Amphenol 31-221
J2—RCA jack
Q1—2N3905 PNP silicon transistor

Resistors: All resistors ¼-Watt film except for R12.

R1—47-Ohm resistor
R2 through R8, R11—470-Ohm resistors
R9—10k resistor
R10—15k resistor
R12—100-Ohm, ½-Watt resistor
S1—SPST Push-button switch
S2—DPDT miniature toggle switch
DIS-1—Hewlett-Packard 5082-7441 9-digit LED display, "Industry Standard" calculator LED display, Poly Paks 92CU2954, or similar.
Y1—5.24288 MHz crystal in HC-18/U holder with wire leads. Loading capacitance is 12 pF, accuracy is ±0.005% at room temperature.
Misc.—9-volt ac/dc battery charger with RCA plug, PC board, Bezel, 3/8" spacers (4 each), LMB CR-531 case, 4-40 screws, wire, etc.
*Available from Poly Paks as a set. Stock #92CU4079.

✓ Reader Service—see page 259

A Versatile, Variable Active Filter

—dc switching and 8-pole response make this one a winner on RTTY or CW

Eric J. Grabowski WA8HEB
30312 Arnold Road
Willowick OH 44094

Recently, my interest in RTTY operation was rekindled. The thought of using the existing tube-type terminal unit, however, was not a pleasant one. A rework of the terminal unit seemed appropriate.

A good place to start was replacing the bulky LC filters with active filters. Although many active filter circuits have been described in previous articles, none was exactly what I needed. Consequently, the circuit presented here was developed. The application is not limited to RTTY; with some value changes it can be used for CW reception or other uses where it is desired to pass a single frequency while rejecting all others.

Design Goals

After some initial brainstorming, the following list of objectives was prepared:

1. Ultimate selectivity should be less than 100 Hertz, but some intermediate choices should be available.
2. Minimize power consumption. Single supply operation. Operation consistent over a wide range of supply voltage.
3. Some type of dc-switching technique should be used for selectivity selection to simplify wiring and provide for future control by microprocessor.
4. Capability to bypass the filter altogether.

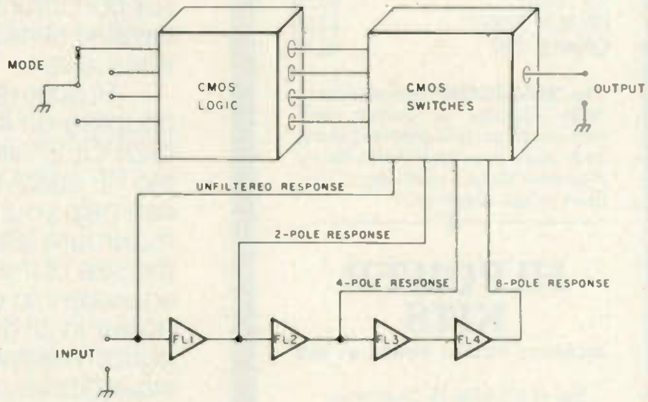
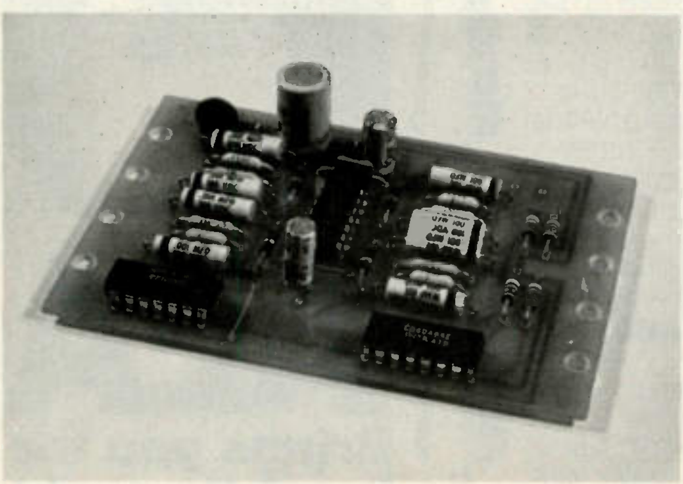


Fig. 1. Block diagram illustrating the concept of dc switching. Wires to the remote mounted switch carry dc levels only. Stray currents induced into these wires will not degrade the filter performance.



Active filter.

Center Frequency	R1—R4	R5—R8	R9—R12	Comment
2975 Hz	220k	430k	6.8k	RTTY Space (850 Hz shift)
2295 Hz	270k	560k	9.1k	RTTY Space (170 Hz shift)
2125 Hz	300k	620k	10k	RTTY Mark
750 Hz	820k	1.8 Meg	27k	CW

Table 1. Active filter resistor values.

Filter Circuit

The LM324 quad operational amplifier was selected for the filter circuit. Each of the op amps is configured as a two-pole active filter and cascaded in a daisy chain fashion. Each stage has a Q of about 4, unity ac gain, and a center frequency determined by the R and C values chosen. The outputs of all op amps except the third are applied to the switching circuitry. The decision not to use the third output was arrived at experimentally, and experience has proved this to be a wise choice.

Table 1 identifies the values of resistors used for the RTTY mark and space frequencies. Values are also shown for a CW filter centered at about 750 Hertz. (C1 − C8 = 0.001uF)

For best results, the frequency-determining capacitors should be a high-stability type. Cornell-Dubilier series WMF is a good choice, and they are readily available.

If you want to use the filter on some other frequency, the R and C values will have to be calculated from formulas. Since there are more standard resistor values than capacitor values to choose from, it is usually more convenient to arbitrarily select a capacitor value and then use the nearest standard value resistors.

Dc Switching Circuit

Two complementary MOS integrated circuits comprise the dc switching circuit. A CD4049 hex inverter is used to drive the control inputs of the CD4016 quad analog switch.

A pull-up resistor normally holds each hex inverter input at the positive supply voltage. This forces the inverter output and the associated control input to ground potential. As long as the control input is grounded, the switch appears open. A four-position rotary switch is used to select which switch is closed by grounding the appropriate pull-up resistor.

Since there are only four switches in the IC package, and the unfiltered input uses one of them, one of the filter outputs had to be sacrificed. The output of the third filter seemed to be the least useful; consequently, it was deleted

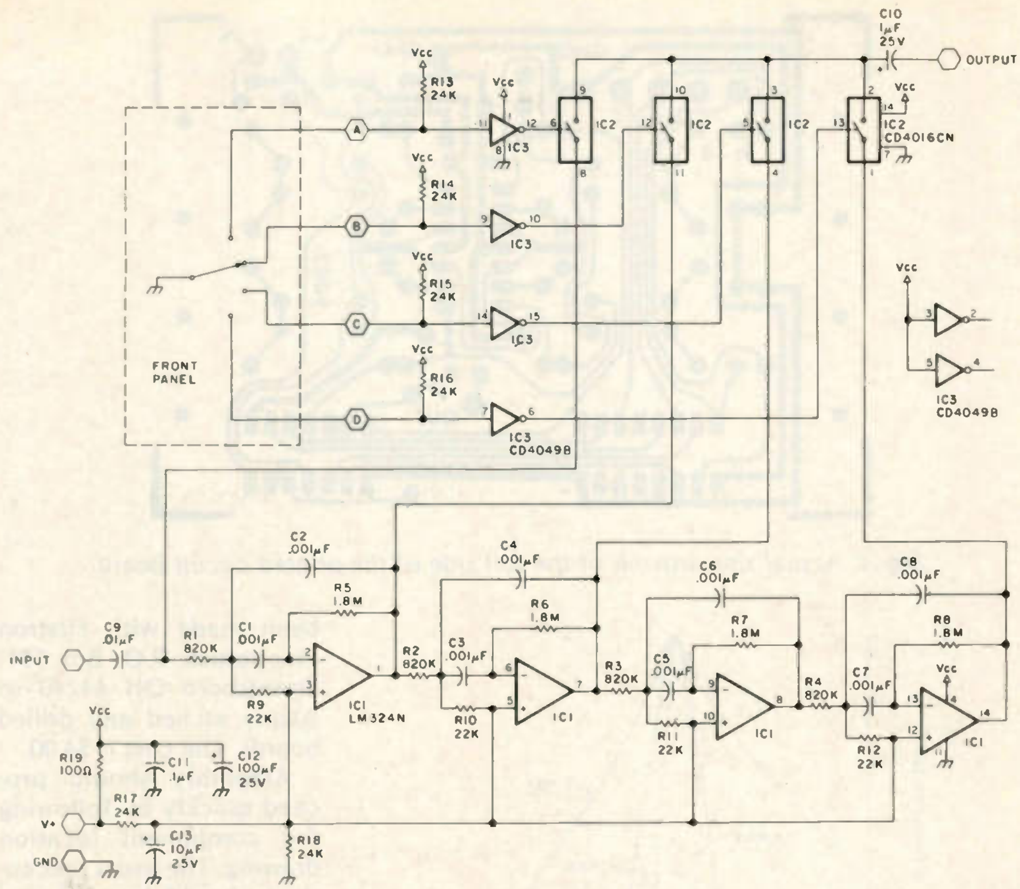


Fig. 2. Schematic of the active bandpass filter using dc switching for bandwidth selection. See table for values of frequency determining components.

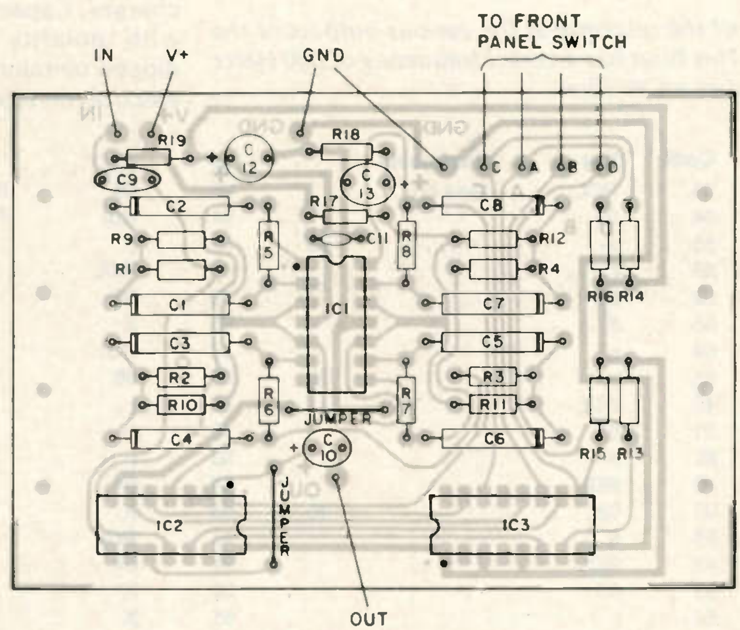


Fig. 3. Component placement drawing. A dot is placed near pin 1 of all integrated circuits for identification.

Construction

The circuit was built on a printed circuit board 3-5/8 by 2-1/2 inches from the artwork shown. For those of you unable to roll your own, arrangements have

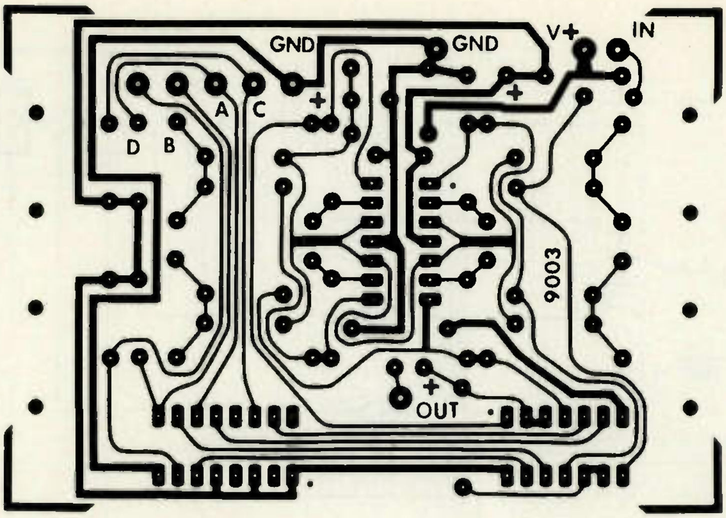


Fig. 4. Actual size artwork of the foil side of the printed circuit board.

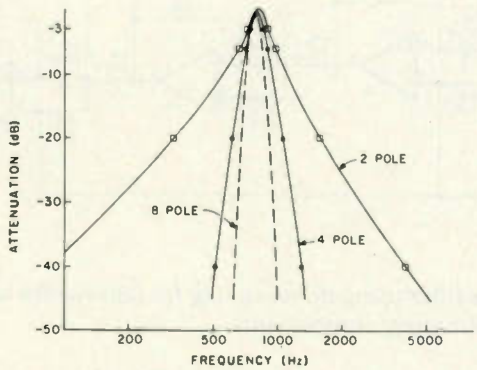


Fig 5. Graph of the response at the various outputs of the active filter. This filter has a center frequency of 800 Hertz and was used as a CW filter.

been made with Firstron Electronics, P.O. Box 151, Streetsboro OH 44240 to supply etched and drilled boards. The cost is $4.00.

Assembly should proceed quickly by following the component location drawing. The usual precautions should be observed when handling the CMOS integrated circuits to prevent damage by static charges. Capacitors shown with polarity are either dipped tantalum or vertical electrolytic types.

When the assembly phase is over, double-check the polarity of polarized capacitors and make sure there are no solder bridges across adjacent foils.

Operation

The dc power supply voltage is not critical. Any voltage between 3 and 15 volts will suffice. With power applied, check the voltage on pin 3 of the LM324. It should be very close to half of the supply voltage. If it is not, the output waveform will be clipped, causing distortion.

Both the input and output of the filter are ac-coupled, so there is no need to worry about disturbing the bias voltages of the preceeding and succeeding stages of the equipment the filter is used with. In order to maintain a linear response though, the level of the input signal must be less than the dc supply voltage. For example, if a 12-volt supply is used, the peak-to-peak input voltage must be less than 12 volts.

For RTTY operation, two circuit boards are required. One for the mark frequency and another for the space frequency. If desired, a ganged rotary switch can be used to select the bandwidths of both channels simultaneously.

Conclusion

The graph illustrates the

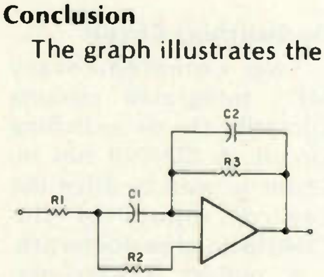


Fig. 7. Program description. Given center frequency (f), gain (A), desired Q (Q), and capacitance (C1), find values for R1, then R3, then R2. Equations: C1 = C2; R1 = Q/2πfAC1; R3 = 2AR1; and R2 = R1R3/4Q²R1 − R3.

Loc	Code	Key	Comments
0	43	RCL	Find R1
	04	04	
	55	÷	
	53	(	
	02	02	
5	65	X	
	89	π	
	65	X	
	43	RCL	
	01	01	
10	65	X	
	43	RCL	
	02	02	
	65	X	
	43	RCL	
15	03	03	
	54	)	
	95	=	
	42	STO	
	05	05	R1
20	91	R/S	Find R3
	65	X	
	02	02	
	65	X	
	43	RCL	
25	02	02	
	95	=	
	42	STO	
	06	06	R3
	91	R/S	Find R2
30	53	(	
	43	RCL	
	05	05	
	65	X	
	43	RCL	
35	06	06	
	54	)	
	55	÷	
	53	(	
	04	04	
40	65	X	
	43	RCL	
	04	04	
	33	X²	
	65	X	
45	43	RCL	
	05	05	
	75	—	
	43	RCL	
	06	06	
50	54	)	
	95	=	
	42	STO	
	07	07	R2
	91	R/S	END

Fig. 6. TI-58/59 program coding for determining the frequency dependent components.

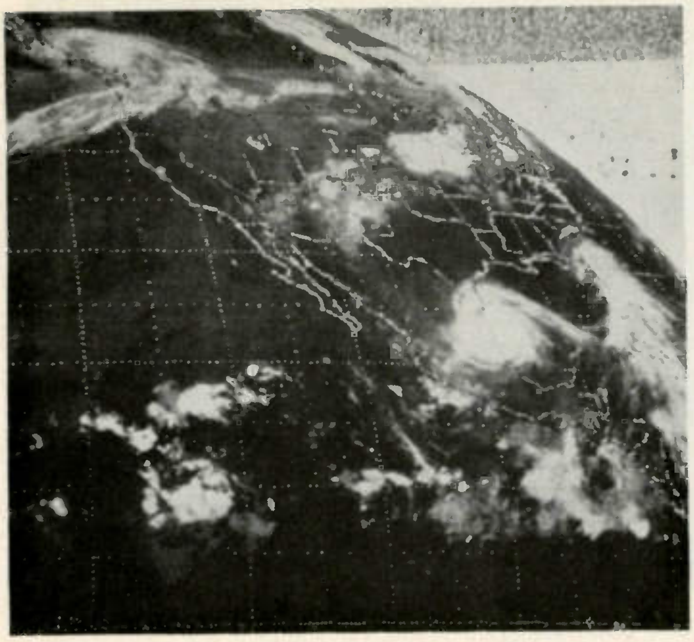
Step	Procedure	Enter	Press	Display
0	Initialize			
1	Load program			
2	Enter center freq in Hertz	f	STO 01	f
3	Enter gain in units	A	STO 02	A
4	Enter capacitor value in uF	C1	STO 03	C1
5	Enter value for Q in units	Q	STO 04	Q
6	Find R1; STO·05		RST R/S	R1 megohms
7	Find R3; STO·06		R/S	R3 megohms
8	Find R2; STO·07		R/S	R2 megohms

Fig. 8. User instructions.

0	Not used
1	f
2	A
3	C1
4	Q
5	R1
6	R3
7	R2

Fig. 9. Data registers.

bandwidths obtained and the selectivity achieved. Ultimate bandwidth is about 80 Hertz, which satisfied the design goal. All the other goals were met as well. Current draw is about 2 milliamperes. Since all audio signals are contained on the board, long, unshielded hookup wire can be used between the board and the switch without degrading the performance.■



The blur at the top of this picture is a dramatic indication of the effects of tuning. At the start of the transmissions, the receiver was not tuned on the incoming signal. The noise disappears abruptly when the receiver is tuned. This is especially evident in the grey-to-white transition at the upper right.

stand, the tuning range of the crystal was "skewed" downward somewhat. (I suspect this may have been due in part to the crystal's holder capacitance, which I overlooked in my simplistic analysis in Fig. 6.) By purchasing a crystal cut to receive 25 kHz high in the band, this circuit gave me accurate center-frequency calibration, and plus-and-minus 30-kHz tuning.

Since this vxo circuit worked for a Vanguard receiver, I later tried it in a Drake 2 meter transceiver. With a single crystal for 146.55-MHz reception, I am now able to tune the three popular simplex frequencies of 146.49, .52, and .55.

Modification Procedures

The following procedure applies specifically to the Vanguard Model FMR-250-11 receiver. Of all low-cost receivers, this is perhaps the one most widely used for weather satellite work. The procedure will no doubt be similar for other receivers, although the layout will differ. Those readers modifying Vanguard receivers will be aided by the accompanying photographs.

(1) Remove crystal selector switch S1. (This assumes that single-channel plus-and-minus-tuning performance will be acceptable.)

(2) Remove all twelve "netting" capacitors (5-to-30-pF trimmers) and all twelve 10-pF ceramic disc capacitors located adjacent to the crystal sockets.

(3) Cut away the front of the printed circuit board behind S1 to accommodate the tuning capacitor. Note that two power traces at the very front of the circuit board are eliminated in the process.

(4) Using insulated stranded wire, reconnect the power by jumpering around the traces just cut. Leave the wires long enough to be routed around the tuning capacitor, well behind the front panel.

(5) Install the 3-to-30-pF tuning capacitor in the hole formerly occupied by S1.

(6) Wire from the base of the oscillator transistor directly to one of the remaining crystal sockets. Install the two miniature rf chokes between the other pin of the crystal socket and the stator of the tuning capacitor. (See Fig. 7.)

(7) Order a 42.275-MHz third-overtone crystal in an HC-25 package, specifying series resonance and ±.003% tolerance. Plug in the crystal, and enjoy 137.5 MHz (±30 kHz) tuning!

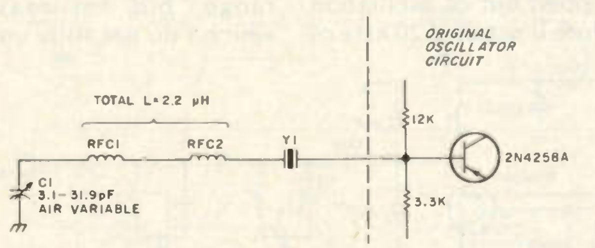


Fig. 7. Vxo circuit for the Vanguard VHF-FM receivers. An added component: Y_1 = 42.275-MHz series-resonant, .003% tolerance, third-overtone crystal, with HC-25 holder (Sentry scanner crystal, cut for 137.525 MHz reception). C1 = E. F. Johnson 1-60-130 air-variable capacitor, 3.1 to 31.9 pF. Rfc_1 = 1.2-uH miniature inductor; rfc_2 = 1.0-uH miniature inductor.

Acknowledgment

Amateurs helping me to evaluate the requirement for tuning flexibility on weather satellite receivers included Ralph Taggart WB8DQT, Dale Hauck W6YFT, John Prigg WA7JIO, and Bob Schloeman WA7MOV. Each of us approached the problem in a different way.

Ralph designed his own VHF-FM receiver from the ground up, with a design which included frequency tuning. Although his circuit employs a tuning varactor diode, it's not too different from mine. He is currently producing the receiver commercially, and from all indications, it should significantly benefit weather satellite enthusiasts.[16]

Dale first tried tuning the microwave LO chain, suffering the very phase noise problems I mentioned earlier. He has since ordered one of Ralph's tunable receivers.

John ordered a synthesizer to go with his existing VHF receiver. The synthesizer gives him fixed-tuned coverage in 5-kHz steps, which is adequate for keeping the received signal rather close to the center of the receiver's passband.

Bob has been using ice cubes, blankets, and lots of luck to try to keep the temperature constant on his microwave downconverter! Though this is certainly the least costly solution of the temperature stability problem, he admits that it does have its weaknesses. By the time this appears in print, the chances are that he will have modified his Vanguard receiver for variable tuning. ■

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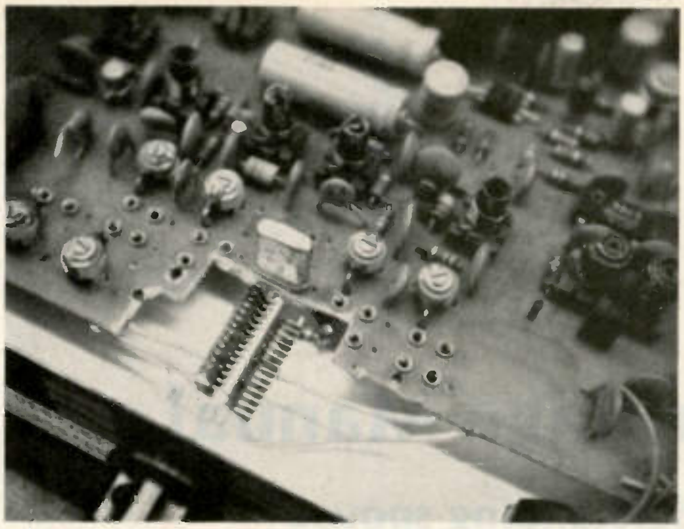
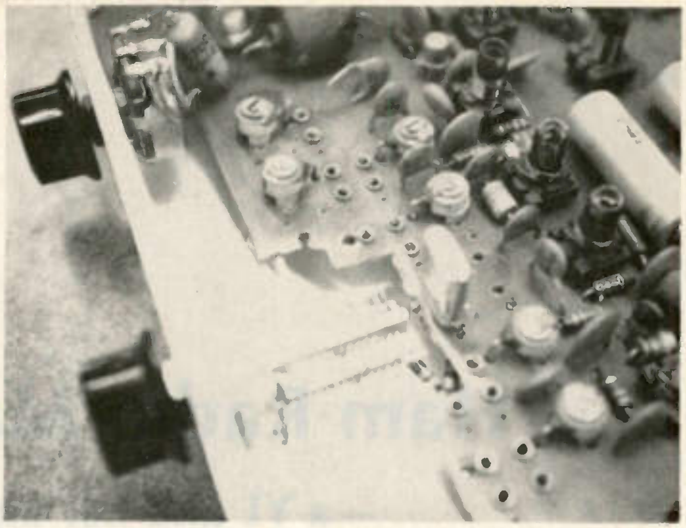
7. Ralph Taggart WB8DQT, "A





These two pictures show the component side of the modified Vanguard receiver. Note the surgery mercilessly performed on the PC board, to allow for the mounting of the tuning capacitor. The rf chokes are visible behind and below the air-variable capacitor.

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15. H. Paul Shuch N6TX, "A Cost-Effective Modular Downconverter for S-Band WEFAX Reception," *IEEE Transactions on Microwave Theory and Technique*, December, 1977, p. 1127.

16. Model GR1-IF; available from Metsat Products, Box 142, Mason MI 48854.

17. Model RX-1691; available from Microcomm, 14908 Sandy Lane, San Jose CA 95124.

Laura Simank WB5YVE
Box 5514
Ingleside TX 78362

Ham Radio Marriage Manual

— a YL and her understanding spouse

My reason for writing this article is the tone of surprise or, in some cases, absolute amazement in the voices of my contacts when they learn that I am married to a non-ham.

Not only is the OM not a ham, he doesn't seem to have any desire to be. Since a ham ticket has to be earned at the expense of the individual who wants it, I can not and will not try to push him. He returns this respect by not trying to force on me the—to me, questionable—joys of fishing. The result is that we view each other's hobbies with a kind of head-shaking fascination.

Upon learning that Roger is not a ham, my contacts always ask the obvious question: "How in the world did *you* ever get interested in radio?" The answer usually goes something like this.

There has been a streak of ham in me for years—more years, in fact, than I care to count. It tickles me to remember back to my first year in high school, when my mother and the guidance counselor had to threaten me to get me to take my first speech course. I have silently thanked both of them many, many times since. That first involvement with speech led to what developed into a real love—communicating with people. By the time I finished high school, I was hooked, and it came as no great surprise to my parents that I chose to major in Radio and Television Communication Arts. It was my intention, at that time, to make broadcasting history and revolutionize the communications industry.

Before I finished college, however, and certainly before I had time to gift the broadcast industry with my presence, I married my high school sweetheart. In the years that followed, we traveled around the country at the request of Uncle Sam. Roger was in the Army at the time, and when Uncle Sam invited, it was not an invitation that one could refuse. Of course, our beautiful daughter, who is now nine years old, came along. I never lost my love of people and the enjoyment of exchanging ideas and thoughts.

In 1971, I met Marie WB5OKV, who later became my "Elmira." She was not a ham, but her OM, at the time, was. A few years after we became friends, she began studying for her license. By this time, we were close friends, and I wanted to help her if I could. About the only way I could help was to read her the questions from the license manual. I had no idea what I was reading, but after a while managed to be able to gather whether or not she was right. Most of the time, she would know if she was right or not when I would say, "It says here . . ." At any rate, she told me it was a help to her—maybe she was just being nice.

At this point, I still had not been bitten by the bug. Naturally, after getting her ticket, that's all she talked about. She suggested that I might enjoy ham radio and offered to help me study. At first, of course, I thought I'd never be able to understand all that theory and the code, but after a few months, it finally dawned on me that an amateur radio license was my passage to anywhere I wanted to go. With the cost of living index going up faster than my weight (a phenomenon in itself) and no end to inflation in sight, the only way I could ever see all the places I wanted was through the eyes of the people living there.

So I took Marie up on her offer of help, borrowed her study material, and set out upon what would become a long journey.

I told Roger what I wanted to do, and he said he thought it was a fine idea. The code was the worst thing I had ever tried in my whole life, and theory was about as clear as mud. After a while I became very discouraged, which I have learned since is quite natural. All of you who have ever been in that position will remember. First, you think to yourself, it's not that important, anyway. After all, you've gotten this far in life without it. Right? Then we all realize that we do want it, and the deep-down want-to takes over again and we decide that we will get it no matter how long it takes.

After weeks of study, worry, code practice, sweat, and tears, I took the Novice test, administered

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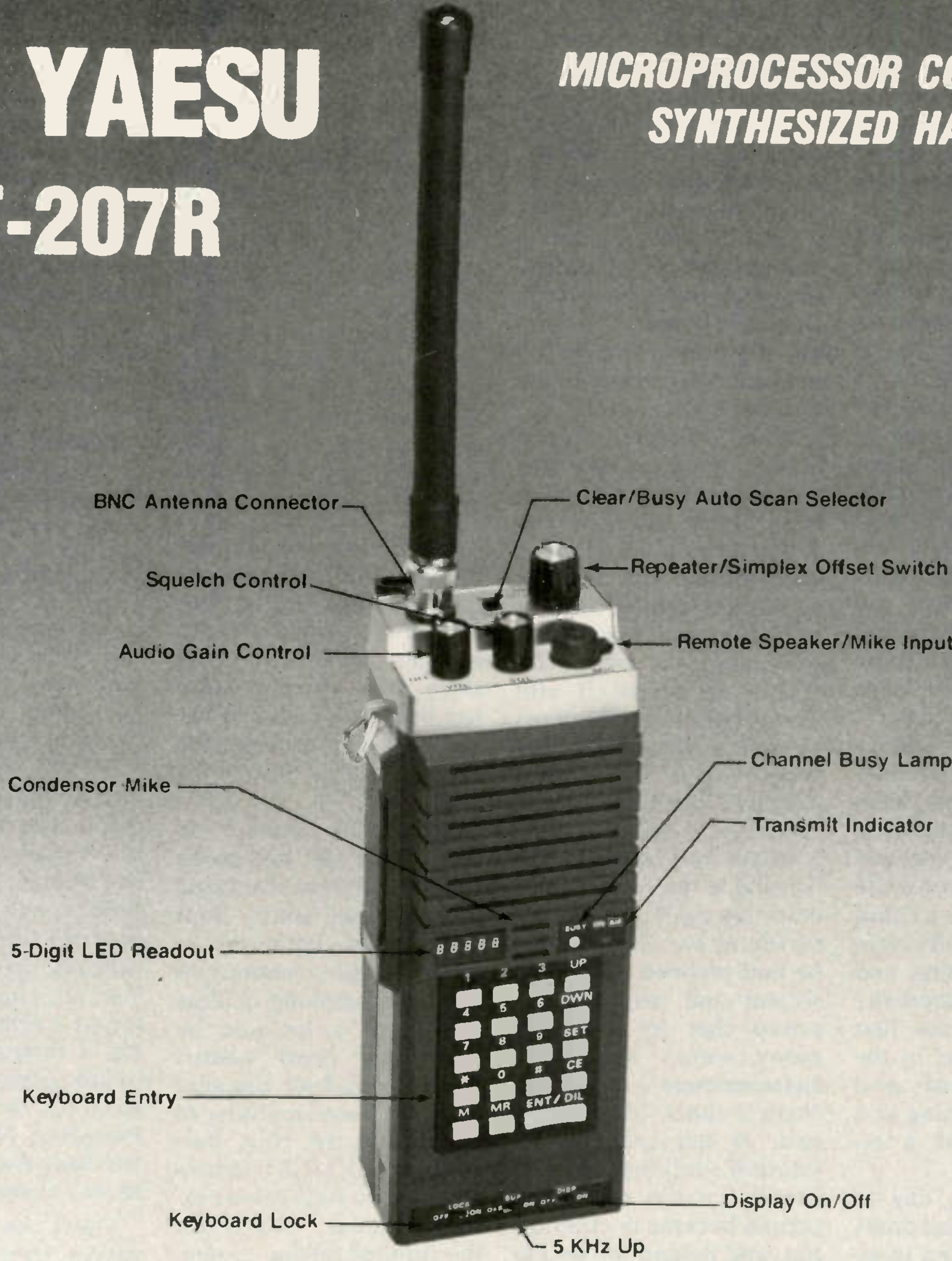

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by none other than my Elmira, of course. I felt that I had passed, but was nonetheless amazed and overjoyed a few weeks later when the license came in the mail. Marie understood my excitement, and Roger was happy that I was happy.

After that, I studied with a new dedication for that coveted General ticket. During this time, Roger was patient and tried to be cooperative, but he simply didn't understand how important it had become to me. Marie gave me great moral support, listened to my code, and went over theory points with me whenever I asked her to.

In spite of where my mind was, the usual domestic chores had to be kept up with. So, in order to keep pace with both, I would prop the license manual in the window above the sink while doing dishes, and I listened to a tape recording of me asking theory questions while I ironed. There was a list of formulas on the wall above the washing machine, and Roger's patience was really put to the test the first morning he looked in the bathroom mirror and found himself looking at a block diagram of a receiver.

Finally, the big day in February of 1977 was drawing near. I was going to go to San Antonio for the test since the FCC did not come to Laredo. Plans were made for Marie to help watch my daughter while I made the overnight trip. Test time was 8 am, and I knew better than to think I could get up at 3 am, drive 150 miles, and still have an even chance of passing. So I went the evening before and spent a restless, almost sleepless, night. Every time I closed my eyes, I saw swr rushing at me, and when I tried to run, I kept falling over the formula for inductive reactance. Ultimately, I was taken prisoner by an army of capacitors in series.

The next morning, bleary-eyed and battle-weary, I went to the test. The next couple of hours are a blur in my memory, but I left the examination room clutching a form, signed by the examiner, saying that I had passed the required elements for a General license. Believe me, the tires of my car did not touch pavement all the way back to Laredo!

When I pulled up in Marie's driveway, she was seated in front of her radio. (Her shack was in the garage.) Her blank stare of questioning anticipation was transformed into a smile that went from ear to ear when I gave the thumbs-up signal. I still wonder what her neighbors thought as we yelled at the top of our lungs and jumped around like kids on Christmas morning.

Roger was pleased for me and a few weeks later made me a gift of a 2 meter rig for my car. By this time, he had realized that I was serious and was not surprised that for the next many weeks my every spare moment was spent in Marie's shack listening to and, at her gracious invitation, talking to, her friends on the air. These people became my friends, too, and helped me locate a used Swan 500C that was in good shape at a reasonable price.

Of course, even a reasonable price presented a problem for me. Since the household budget was strained to the breaking point, the $300 I needed sounded like the national debt. The only answer was a part-time job. That was no easy task, either, since I had not worked in years. I was able to find one, however, and being aware of my dilemma, the ham from whom I bought Charlie (the name I gave the rig) offered to let me use it while I paid him for it. Heaven doesn't have a corner on the angel market!

We put up my 40/80 meter doublet well in advance of Charlie's arrival, and I spent the rest of the waiting period fixing up the closet of the guest room, which was to be my ham shack. I had decided that the garage was too hot in the summer and too cold in the winter. Besides that, the closet location would allow me to close the door and keep the rig out of sight of small children who might come to visit.

On the evening of October 3, 1977, Marie and I met Charlie at the bus station and rushed home to get him on the air. Ever since then, amateur radio has been a big part of my life and has brought me many, many hours of pleasure.

Thanks to amateur radio, I have met and made friends with some fantastic people. I've spent hour upon hour listening to other people, sometimes not even breaking in. One can learn a lot just by listening (and about theory, too). Even though I may not have anything to contribute to that particular QSO, I still find it interesting to hear others exchange ideas. I have felt the thrill of talking to people in some of those places I may never see and have known the warmth of helping people find out about loved ones.

Do you have any idea how large a child's eyes can get when he talks to Santa Claus on the radio? (Thanks, J.R.) Some of the people I've met on the air I have had the pleasure of eyeballing and some I have not, and there are others whom I have met that I will never see again because they have become silent keys. I will always cherish their memory.

To me, there is a very real sense of accomplishment in being a ham. Everyone needs to feel the satisfaction that comes from achieving, regardless of age. For me, amateur radio has offered me an avenue of accomplishment, achievement, and pure enjoyment that I have not found anywhere else. I have only regret—and that is that I did not find it sooner.

When I came home after finally passing my Advanced test (suffice it to say that I did not pass it the first time I took it), Roger asked me if I was finished yet. He isn't usually given to such foolish questions!

The bottom line to all this is that if you want a ham ticket, hang in there. For some, the code and theory come more easily than for others. But there is one thing true of every ham in the world—none of them was born with a knowledge of electronic theory, and I assure you that not one of them ever said his first word in CW. We all had to learn it. When I first began studying, I thought ac was the brand name for a spark plug, dc was where the President lived, and CQ was duty that the OM used to pull in the Army!

Don't be dissuaded if you're living in a home without a ham. When you do get your ticket, you will be able to count yourself special because you had more obstacles than most. In any case, don't be scared off by thinking amateur radio is no place for a woman. There are hundreds of us girls on the air. Of course, there are a few guys around who still think that amateur radio is a man's world, but they are few and far between. Ninety-nine point nine percent of the time you'll be welcomed with open arms, as I was. ■

Lowell J. Burnett W7DJB/6
8696 Jackie Drive
San Diego CA 92119

The Space-Saving Square Vee Antenna

—a directional radiator for cramped quarters

Photo A. The 10-meter square vee supporting a nine-year-old helper.

Want an electronically rotatable array, but can't afford the vertical height required for a sloper system[1] or a perverted double vee?[2] Don't have an extra acre or two for a good radial system on your phased verticals? Maybe the DJB Square Vee is for you.

Here's an antenna only a quarter-wavelength high, supported by a single mast, that doesn't depend on a good ground system for efficient radiation. It is electronically rotatable, doesn't require an antenna tuner, doesn't require retuning as the pattern is rotated, and has both high- and low-angle lobes useful for both local and DX work. This is an antenna that could be tacked to the side of an apartment house or, on the high frequencies, easily could be made collapsible for portable or field day operation. Interested? Read on!

Design

The heart of the system is the 3/8-wavelength dipole.[3] A diagram of this dipole, which is 25% shorter than a normal half-wave antenna, is shown in Fig. 1.

The dipole is formed from two $3\lambda/8$ sections of 300-Ohm twinlead. The first section is connected to the second with a 1.5-inch-long piece of twinlead, twisted as shown. The ends of the dipole are at a voltage maximum and must be separated by cutting the ½-inch space shown in Fig. 1. The feedline, a $\lambda/4$ coaxial matching section discussed later, is attached directly to the antenna feedpoint.

The $3\lambda/8$ dipole has not been used widely in the past by amateurs. In part, this is due to its odd radiation resistance (about 200 Ohms) and to its physical complexity. The square vee takes advantage of both of these apparent drawbacks.

In the square vee, two 3λ/8 dipoles, each bent in the shape of a vee, are mounted vertically with the feedpoints spaced a quarter-wavelength apart. For high frequencies, the antenna can be mounted on a wooden cross, as shown in the schematic of Fig. 2. At lower frequencies, a mast can be used for vertical support with guy wires pulling the feedpoints apart.[2]

The two dipoles are connected in parallel at the phasing control box, which is located in the station operating room. This device is used to adjust the relative rf phase between the dipoles by changing the length of their feedlines. The pattern control box, therefore, allows the pattern of the antenna to be rotated in the same manner as an array of phased verticals.[4,5]

Construction

An example of a ten-meter square vee supported by a wooden cross is shown in Photo A. Each crosspiece is cut slightly longer than a quarter wavelength. The two pieces are joined at the center, and the feedpoints of the two dipoles are connected near the ends of the horizontal crosspiece, as shown in Fig. 2.

Of course, it doesn't really matter whether you use a cross-type support or a simple mast with guy wires. Remember, though, for *all* types of vertical directional arrays, use a nonconducting support such as a wooden mast. A metal mast in the plane of the radiating elements can strongly influence the electrical behavior of the antenna, and may result in disappointing performance. The square vee has a real advantage over the sloper array or the perverted vee in this regard, as it requires only a quarter-wavelength mast rather than a half wavelength or so. On 40 meters, this means the difference between a 34-foot mast, required for the square vee, and the 50- or 60-foot masts required for the other systems.

Using 300-Ohm twinlead makes construction of the 3λ/8 dipole simple. Two sections of 300-Ohm twinlead are cut to 3λ/8. The wires, but not the insulation, are cut at the centers to form the interconnections, as shown in Fig 1. A 1.5-inch piece of twinlead is used to connect the first section to the second. Be certain to separate the wires at the ends of the dipole, and leave about half an inch of space between the ends of the wires (see Fig. 1).

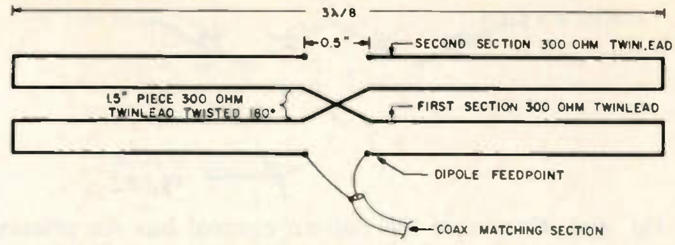

Fig. 1. Schematic drawing of the 3/8-wavelength dipole.

For each dipole, the first section of twinlead is mounted on one side of the horizontal crosspiece, and the second section is mounted on the other side. The 1.5-inch connection at the center (see Fig. 1) feeds through the horizontal support as shown in Photo B. This method of mounting keeps the wires of the dipole properly spaced. The ends of the twinlead can then be attached to the top and bottom of the vertical mast. I used small wire brads tacked through the center of the twinlead near the end. Before the ends are permanently attached, however, it is best to secure them temporarily with tape and check the antenna tuning.

Tuning

For maximum performance, it's very important that the two dipoles be electrically equivalent. Beg, borrow, steal, or perhaps even buy a grid-dip meter or similar instrument and trim the lengths of the dipoles to resonance at the desired frequency. I found that the length had to be slightly shorter than three-fourths of the length predicted by the traditional formula $L(\lambda/2) = 468/f$ (MHz), where $L(\lambda/2)$ is the length of a half wave in feet. Two factors probably accounted for this. First,

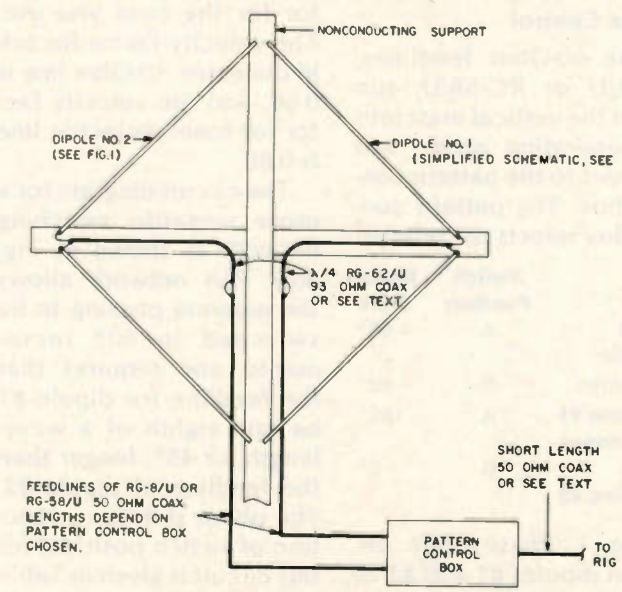

Fig. 2. The square vee antenna supported by a mast and crosspiece. The pattern control box is located inside the operating room near the station.

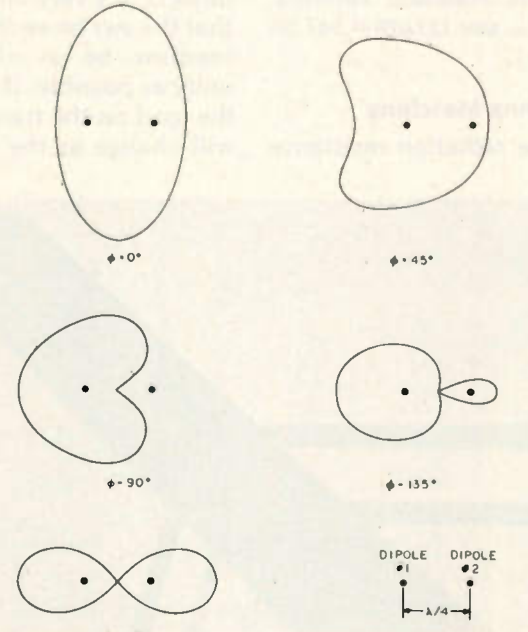

Fig. 3. Antenna radiation patterns in the horizontal plane for two vertical dipoles spaced a quarter wavelength apart.

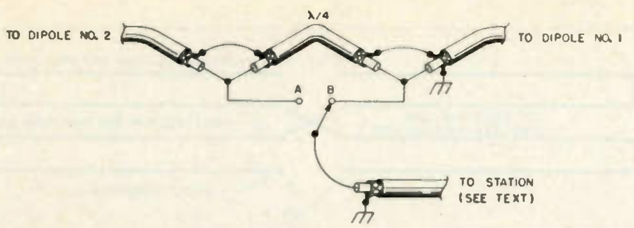

Fig. 4(a). Circuit of the pattern control box for phasing steps of 180°.

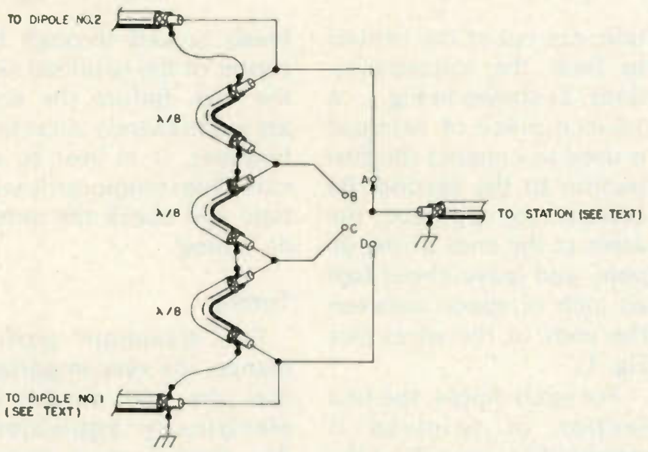

Fig. 4(b). Circuit of the pattern control box for phasing steps of 90°.

the formula doesn't include the one-inch interconnection between the two twin-lead portions of the dipole, Fig. 1, and, second, the formula is good for a linear dipole and not a dipole in the shape of a vee. You probably won't go too far wrong if you cut the dipole length 1% shorter than that given by the standard formula; that is, use $L(3\lambda/8) = 347.5/f$ (MHz).

Antenna Matching

The radiation resistance of a linear $3/8\lambda$ dipole, measured high above a perfect ground, is about 225 Ohms.[3] In the configuration shown here, I found the radiation resistance to be closer to 175 Ohms. The radiation resistance of the antenna was lowered both by its vee shape and by its proximity to surrounding objects. It's very important that the swr on each dipole feedline be as close to unity as possible. If it's not, the load on the transmitter will change as the pattern is rotated, and the transmitter will have to be retuned for every direction. What's more, a mismatch here will probably require a matching network between the transmitter and the antenna for proper operation.

A quarter-wave matching section of 93-Ohm coax, such as RG-62/U, makes a good match between the 175-Ohm antenna resistance and 50-Ohm coax feedline. We calculate this from the formula $Z_1 = Z_o^2/Z_r = (93)^2/175 = 49.4$ Ohms,[6] where Z_o is the impedance of the quarter-wave matching section, Z_r is the radiation resistance of the antenna, and Z_1 is the impedance at the feedpoint of the quarter-wave matching line.

Instead of the quarter-wave coaxial matching network shown in Fig. 2, a 4:1 balun transformer (Amidon Associates kit) could also be used.[7] The balanced, high impedance side of the balun would be connected to the antenna feedpoint, and the low impedance side to the 50-Ohm coax feedline. This should work especially well in installations where the radiation resistance of the dipoles appears closer to 200 Ohms than to 175 Ohms.

Phase Control

The 50-Ohm feedlines, RG-8/U or RG-58/U, run down the vertical mast into the operating room, and connect to the pattern control box. The pattern control box selects the relative rf phasing between the two dipoles and allows the directivity of the antenna to be changed. Fig. 3 shows the horizontal antenna patterns that can be expected from two dipoles a quarter wavelength apart, as θ, the rf phase angle between them, is changed. Of course, the shape of these patterns depends upon the incident angle of the incoming radiation, and the expected performance is modified further by the vee shape of the individual dipoles.

	Switch Position	Phase Shift
Equal Length Feedlines	A	+90°
	B	−90°
Feedline #1 90° Longer Than Feedline #2	A	180°
	B	0°

Table 1. Phase shift between dipoles #1 and #2 as a function of switch position for the pattern control box of Fig. 4(a).

Fig. 4(a) shows an elementary switching network that can be used to select between the 0° and 180° patterns, or between the +90° and −90° patterns. (The −90° pattern is the reverse of the +90° pattern.) For the 0° and 180° patterns, the feedline of dipole #1 must be a quarter wavelength, or 90°, longer than that of dipole #2. For the ±90° patterns, the feedlines must be equal length. Table 1 shows phase shift versus switch position for the difficult feedline lengths.

In calculating the electrical length of the feedlines, be sure to measure the physical length very carefully, and include the effect of the velocity factor for the coax you use. The velocity factor for solid dielectric 50-Ohm line is 0.66, and the velocity factor for foam dielectric line is 0.80.

The circuit diagram for a more versatile switching network is shown in Fig. 4(b). This network allows the antenna phasing to be switched in 90° increments, and requires that the feedline for dipole #1 be one eighth of a wavelength, or 45°, longer than the feedline of dipole #2. The phase shift (as a function of switch position) for this circuit is given in Table 2.

If desired, a more complex network employing an

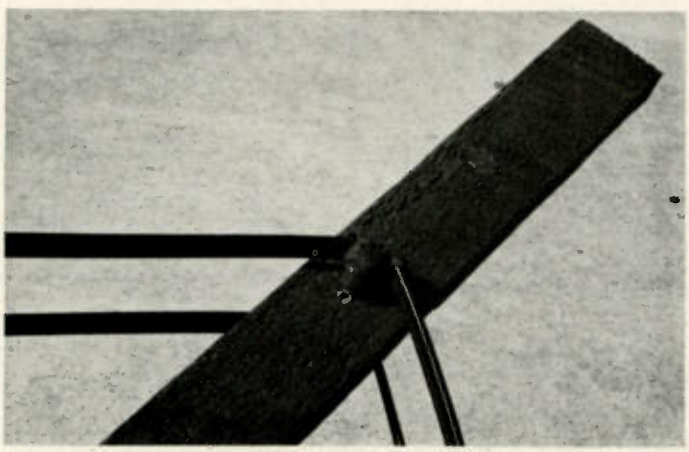

Photo B. Closeup of the dipole feedpoint near the end of the crosspiece. The coaxial line feeds through the wooden crosspiece to connect to the dipole.

eight-position switch could be used to select antenna patterns at 45° intervals. This would require that the feedline of dipole #1 be 22.5° longer than that of dipole #2, and would require one sixteenth of a wavelength of coax (22.5°) between each switch position.

Station Matching

If the dipoles have been carefully matched to the line, the termination impedance at the end of each feedline will be very close to 50 Ohms. When the two dipoles are connected in parallel at the pattern control box, the feedpoint impedance at that point will be 25 Ohms. There probably are a number of ways to match this 25-Ohm resistive load to your transmitter. If the output circuit is capable of matching a 25-Ohm resistive load, you can couple it directly to the pattern control box through a *short* (compared to a quarter wavelength) piece of 50-Ohm coax. Or, you can connect the pattern control box and the transmitter with a half-wavelength of 50-Ohm coax. The latter solution is better at the high frequencies; even though the swr on the line is about two, its short length prevents significant losses.

The technique I used was to connect a quarter wavelength of 73-Ohm RG-59/U from the pattern control box to the transmitter through a balun step-down network. The quarter-wavelength of 73-Ohm line transforms the 25-Ohm feedpoint at the pattern control box into a 213-Ohm load. We see this from the equation used previously, $Z_1 = Z_0{}^2/Z_r = (73)^2/25 = 213$ Ohms. At the transmitter end of the quarter wavelength, I used a 4:1 balun with the low impedance side connected to the transmitter to transform this in- to a 53-Ohm resistive load. This is a little bit more trouble, but provides an excellent match to pi networks designed to operate on 50- to 75-Ohm resistive loads.

Performance

I built my first square vee for the 10-meter band and used the pattern switching arrangement shown in Fig. 4(b), i.e., phasing steps of 90°. I mounted it on the roof approximately 20 feet off the ground, underneath a 40-meter inverted vee. The antenna required only minor retuning of the transmitter as the pattern was rotated, and I found that with about 100-Watts output, I could work almost anyone I could hear. A large number of European, East Asian, and Oceanic stations were contacted on both SSB and CW with a call-per-contact ratio for DX of about 80%. In other words, it works.

The big advantage of the antenna, however, lies in its directional performance. A large number of tests were performed on both receiving and transmitting, and it was found that the front-to-side ratio between the 0° and 180° phasing positions was about four S-units. As the patterns are not symmetric, the front-to-side ratio between the 180° and 0° patterns is different—and this was found to be about two S-units. The front-to-back ratio between the +90° and −90° phasing positions also was found to be about two S-units.

As an example of the directional performance, let me describe an actual contact with this antenna. With the 0° phasing pattern, I had maximum gain to the northeast, and was listening to a W8 station at S6. In between pauses, I heard a weak station, at about S3, calling CQ. Rotating the pattern to 180° phasing knocked the W8 down to S2 and brought in the other station at S5. It was an RAØ, and one call to him made the contact. Play with this for a couple of hours and you'll never go back to an omnidirectional antenna.

Switch Position	Phase Shift
A	180°
B	90°
C	0°
D	−90°

Table 2. Phase shift between dipoles #1 and #2 as a function of switch position for the pattern control box of Fig. 4(b).

Summary

Here's an electronically rotatable antenna that's 44% smaller in area than a single quad loop, stands only a quarter-wavelength high, and doesn't require retuning as the pattern is rotated. Of course, this antenna won't outperform a full-sized yagi/tower combination on the high frequencies, or an array of phased verticals with an extensive ground system in an open field on the low frequencies. And, like all electronically rotatable arrays, the shape of the pattern changes with the direction chosen. But at moderate heights, and with no special ground preparation at all, it appears to do a first-class job. ■

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License Upgrading—A Plan of Attack

—you need not fail!

You've done all of your studying, and you've got your code speed up to the point where it should be. You're ready to upgrade! You may be a Novice on the way to Technician or an Advanced ready to take on the Extra class exam. The only thing that stands between you and the exalted status of that higher class license is the FCC examination. Pass that examination and you're home free.

But as you arrive at the FCC examination place, you start to feel queasy. Your heart beats a little faster, your stomach stirs, and your mind feels strangely vacant. You know that you know your stuff, you know that you can copy code at the required speed, but now you have to *prove* it to the FCC. Why do you feel so mentally disjointed?

It's a natural feeling. *Everybody* feels that way going into an FCC examination, and you are no exception. Perhaps it's a throwback to childhood days when schoolmates—or perhaps the teacher—indicated that tests are terrible things, something to be avoided or feared. Tests offered the possibility of failure, of looking bad. Our attitude toward tests was formed early, and that attitude is hard to shake even though we may now be approaching the status of senior citizen.

The purpose of this article is to help you pass your next FCC examination. It isn't easy, but it isn't hard. Thousands of people pass these examinations every month. There are a number of tips that can be followed to let your next FCC examination be a matter-of-fact check of the knowledge and skills you have developed—nothing traumatic, nothing depressing—simply a routine hour or so at the FCC office with the opportunity to leave with a higher class ticket.

This article is based on my 17 years in adult education, with heavy experience in test formulation and test-taking, backed up by my own progress through four classes of amateur radio licenses. There are techniques to follow which can ease your way through this process. Once you know these techniques and put them to use, you should find that your next FCC exam is much easier to take—and to pass.

The Code Requirement

Since the code test is the first hurdle at the FCC office, we'll consider it first. Let's assume that you're a Novice who has to copy code at 13 words per minute for the General ticket, and then you have to pass the written examination on technical information and regulations. How do you guarantee that you can pass the 13 wpm test?

The best way to copy code at 13 wpm per minute *under test conditions* is to have a slightly higher code speed. That is, if you want to copy leisurely at 13 wpm, be able to copy code at 15 or 16 words per minute. Don't stretch your abilities when copying 13 wpm. Be able to copy a few words per minute more than you will be required to do.

Let's say that you arrive at the FCC office and, through some miracle, the examiner tells you that the code requirement has been changed. You don't have to copy at 13 wpm; the requirement has been changed to 9 wpm. How would you feel? Obviously, you'd feel great! You can copy at 13—now they want only 9 wpm. Beautiful. Bring on the test.

The same principal applies when you arrive at the examination site being able to copy several words a minute more than the actual requirement which is, of course, 13 wpm. If you're able to copy at 16 wpm (and getting to that level isn't that much harder), 13 wpm is a piece of cake. Who cares if you miss a letter because of nervousness? Who cares if your mind strays for a second or so? No problem when you can copy a few words a minute more than you have to.

Can you pass the code test at 13 wpm when that is your ultimate limit? Yes, you can. But you're taking a chance. You'll be taxing your reflexes under test conditions, and this is the worst time to test them. The mind is a strange device. It relaxes when asked to perform at a rate lower then it is used to performing at. It tightens up when asked—under test conditions—to perform at a level at which it is just capable of performing.

Here's another tip for solid copying. Be relaxed and refreshed when you arrive at the FCC office. One way to do this is to get a good night's sleep and to do no practicing or cramming that morning. I have gone to a number of professional as well as radio amateur examinations and remember seeing students standing in the halls before the exams going over slips of paper to impress on their minds important points which might be covered on the exam. I have heard them saying they arose at 5 am to practice their code. This is nonsense.

The best asset to bring to your FCC examination is a relaxed mind. The best way to assure this is to go to bed early the night before and to do nothing of a technical nature upon awakening. No code practice, no last-minute peek into a textbook, no checking out of cram slips. Instead, have a relaxing shower, a good breakfast, a look at the morning newspaper—anything but ham radio. In this way, you arrive at the examination site with a mind that is capable of leisurely comprehending the code that will be sent to you.

The Written Exam

Let's say that you've taken the code examination, you've been told that you passed, and now you can take your written examination. This is all there is between you and your higher class license. What tips can I offer to help you pass this portion of the exam?

Here are a number of things to keep in mind as you prepare for—and take—the written examination. Follow them and your success is virtually guaranteed.

1. Know your stuff. Very few people get through the exam if they don't know the material. You should get the necessary textbooks and study the material. Become as expert as you can with the technical side, operating procedures, and regulations.

2. Get as much practice as possible working on multiple-choice questions. Most textbooks offer sample questions and answers to give you experience in answering FCC-type questions. Study as many of these questions as possible *after* you've studied the material. Don't use the questions as a method of studying; use them to help you check on your understanding of the material studied.

If you've done steps 1 and 2, you're ready for all those that follow.

3. You now arrive at the FCC office. If you follow the advice given above for passing the CW portion of the exam, you'll be refreshed and relaxed. This condition is as important for passing the theory portion as it is for the CW portion. No last-minute cramming, no peeking into the text to look up that formula one more time, no carrying of sheaves of paper to refresh your memory at the very last minute. Shut off the studying before supper the night before. Let your mind relax.

4. Bring a calculator. This saves mental wear and tear and helps ensure correct answers to mathematical problems.

5. When you are entering the examination room, you will be given the printed test, the answer sheet, and a blank piece of paper for calculations and scribbles. As you sit down, take out the two pencils you've brought along, and for the moment put aside the test booklet and answer sheet. Now, while your mind is still relaxed, write on the piece of paper every formula you feel you may have to use. Write down every item that may be a little shaky in your mind. As long as these formulas and items come from your mind, everything is perfectly proper and legal. Why do this? Because your mind is relaxed and it's easier to recall, say, what the formula is for capacitors in parallel than it is to recall the formula when faced with an actual question. That's how the mind works. Ohm's Law can take on some interesting variations in the mind of a ham who is wading feverishly through an exam.

6. Once you've put on paper all your necessary formulas, open up the test booklet and see what the number of the first question is. Why do this, you ask? Don't all tests start with number 1? Not at the FCC, they don't! This test may start with 1, but it may start with 51, or 101. As soon as you see which number it starts with, take the answer sheet and mark the corresponding number with your pencil. This is where you start to answer questions on the sheet. Basic, you say? Obvious, you think? Yes, but we don't know how many aspiring hams (who knew their theory cold) failed the FCC exam because they gave beautiful answers to questions 51 through 100 in the spaces on the answer sheet marked 1 through 50. In short: Answer the question asked in the booklet at the exact spot on the answer sheet where the answer will be graded.

7. You're now ready to attack the first question. Here's the technique to follow: Read the first part of the question, the part before the multiple choices, but *do not* look at the five answers offered. See if you can mentally determine what the correct answer is before looking at the five choices. For example, if the question says, "The 'Q' signal for 'I am being interfered with' is . . . ," your mind should pause and mentally seek the correct answer—QRM. Once thought, write it down on the sheet of scrap paper. If you don't do this, you are now faced with a confusing array of Q signals from which you must make a choice: QRS, QSK, QRQ, QRM, and QNX. In the pressure of an examination, you might make the wrong choice when faced with this selection. So, for each question, don't look at the answers first. Mentally determine what the correct answer should be, write it down on your scrap paper, and then check the answers supplied to see if your answer matches one of the exam's answers.

8. Having picked out the right answer, indicate it on the answer sheet, and be sure that you put the answer in the right spot (a, b, c, d, or e) and at the right answer number. Don't put a "b" answer in the "c" slot, and don't answer number 73 in the space for number 74. Be alert.

9. Continue this process with each question. At some point, you'll come across a question which you can't answer in your mind. Now what do you do? At this point, look at the "a" answer *only*. Does it seem to be the right one? If so, write "a" on the scrap sheet. And then go on to b, c, d, and e, seeing if a "better" answer appears. If it doesn't, write "a" on the answer sheet in the appropriate spot. If another answer appears that seems to be just as correct, you have to make a judgment as to which is more correct. Once you've done this, write the answer in the appropriate spot. Continue on through the exam.

10. Let's say you come across a question that you can't answer. You review the five answers and none seems appropriate. At this point, write the number of the question on your scrap sheet and go on to the next question. Don't fret. Don't worry. The FCC gives you quite a margin for error in the exam. One question doesn't make much difference. The main thing is to keep your mind at ease, relaxed, and happy. Go on to the next question and let your subconscious mind take over. While your conscious mind is scanning the next question, your subconscious mind will be poring over the question you just passed. At some mo-

Muffin Fan Mania!

—a compendium of knowledge about electromechanical air movers

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The increasing price and rarity of vacuum tubes and other components in your ham rig make it imperative that it run as cool as possible. Have you ever wondered when those poor, hot components in the rig will finally melt into oblivion? The heat generated by the power-handling parts of the transmitter should be directed well away from the rig, preventing a possibly expensive episode in radio self-annihilation. Fortunately, there's an easy way to alleviate the woes of an overheated goodie in your station.

An electromechanical air mover, commonly called a fan, can be employed to keep things cool when thermal overload becomes imminent. In fact, the electronics industry is utilizing these gems in a variety of configurations more and more frequently as component densities escalate and enclosures shrink. One estimate puts the number of miniature air movers at the all-time high of 80-million dollars worth just last year.[1] With all this expensive hot air blowing around, there must be some good reasons for you to consider installing an auxiliary cooling device in your station.

There are indeed several good reasons for helping your rig stay cool: Components and tubes last much longer, frequency stability is improved with less thermal expansion of coils and coil forms, and smoked capacitors and resistors due to simple overheating just don't occur.

The fans I'll be discussing in this article are the so-called tubeaxial fans, normally known as Muffin™ fans (EG & G Rotron trademark). These things usually

Photo A. A typical collection of fans available at flea markets for under $10. Visible are Pamotors, a Feather, Centaur, Caravel, and Boxer fans.

Photo B. A couple of fine-running Pamotor fans from Germany.

have square or circular housings with an "inside-out" motor—the shaft part of the motor is the fan hub with the moving blades attached. They're by far the most popular and useful fans available to the radio amateur.

Almost all ham rigs today have a well-designed natural air ventilation system called "convection cooling." This simply means that the warm components in the rig heat up the air nearby, causing it to rise and draw cool air in from the bottom of the case. This works great, but the idea (and cooling effect) is tremendously enhanced by placing a fan in the right spot on or by the rig. The result is a much cooler running operation.

Choosing a Fan

I've compiled a list of the most common fans you'll find at a swapfest or surplus store in Table 1. These are the Rotron trademark names, listing the amount of air moved (in cubic feet per minute, or cfm), and some very dated 1970 prices so that you can get an idea of their original market value. Other fine fans are made by Pamotor, of West Germany, and the Boxer fan from IMC Magnetics. Be sure to inspect

Trademark Name	Cfm	Comments	Price
Sentinel	100	Stainless steel ball bearings	$25.00
Centaur CT3A2	100	Sleeve bearings, 15 Watts	16.90
Mark IV Muffin	100	Very popular	12.05
Whisper	65	Super quiet, 6 Watts	12.05
Sprite	35	3½"-square, 11 Watts	14.95
Spartan	110	Military, stainless steel BB	45.50
Feather	270	SS BB	36.85
Saucer	280	SS BB	70.40
Caravel	575	BB	29.70
Tarzan	350	BB	46.65

Table 1. EG & G Rotron fans, with 1970 prices.

your purchase for dented or bent blades, and also spin the blades a bit to make sure they turn very freely.

Let me emphasize at the outset that you don't need much in the way of cfm to cool an already well-designed rig. The important operating factor to consider is the noise generated by the mechanical beast. The key to quiet success is a slow motor speed. For example, I put a little 50-cfm Pamotor 4800A (very quiet) on top of a normally frying-hot 17-tube Polycomm 2-meter rig, and the transceiver ran ice-cool thereafter.

So, pick a fan which doesn't take much power (therefore, it will be running slower) and which doesn't have more than about 75 cfm or so of cooling power. However, flea markets and surplus stores often don't have fans which meet such stringent requirements. If you do get a fast, noisy fan, there are easy ways to slow it down, as I'll mention later.

By the way, 220-V fans are ideal for ham applications—they run beautifully on 120 V, retaining 60% of their original air-moving power with only 20% of their original noise, and they're cheaper, too. Surplus companies often offer these at reduced prices because they were not originally specified for the 120-V line. Best buys here are the 220-V Feather, Saucer, and Sentinel, or equivalents.

Mounting a Muffin

The easiest way to determine what part of your rig gets hottest is simply to turn it on, let it warm up, and feel the top of the case for hot spots. Obviously, the area on top of the finals will be warmer than the rest of the radio, so that should be your priority target. If there are other heat-producing components in the rig, you can place the fan so it pulls the most air past the finals and gets the rest of the rig with somewhat reduced air-flow. A larger-diameter fan, properly slowed and quieted, is better for application in all-tube transmitters, while smaller fans do nicely in "all solid-state except the finals" rigs.

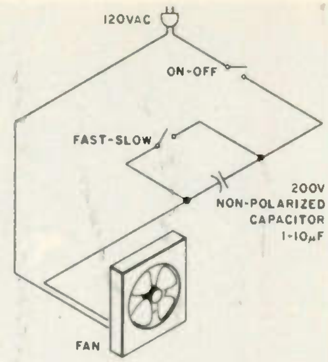

Fig. 1. Schematic of method to slow down a fan with a series non-polarized capacitor, 1 to 10 uF, at 200 WV minimum.

I don't recommend putting fans on receivers. They aren't necessary in a decent rig because there just isn't enough heat generated by its low-power components to warrant auxiliary cooling. If you want to cut down heat in an old-

Photo C. This Muffin fan sits over the finals and is mechanically damped by four felt feet.

Photo D. A friend's setup with the fan bouncing merrily on four pads of foam rubber.

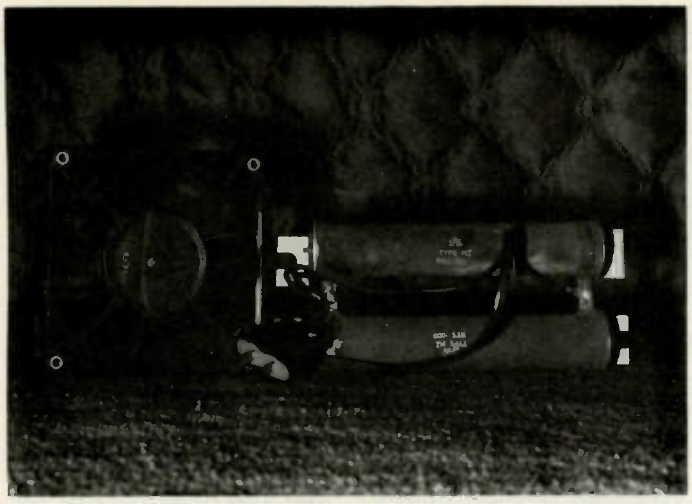

Photo E. The unclassy method of slowing down a fast, noisy fan, with power resistors. These two units need to be mounted in a well-insulated box, or be replaced by a much more elegant capacitor.

er tube-receiver, replace the rectifier tube with its solid-state equivalent (with suitable dropping resistors), and put in an LM-380 audio IC instead of those push-pull 6V6s.

When you mount the fan on your transmitter or transceiver, it's always best to place it on top of the rig so that it aids the natural tendency of hot air to move up and out. Don't try to blow air through the rig—just pull the hot stuff up and away. This makes it imperative that you keep the radio elevated on its mounting feet (don't take them off to save space), and that the area beneath the rig is kept as dust-free as possible. A too-powerful fan will suck dust and debris into your transmitter's innards, and a mild airflow is really all you need to keep the radio cool and clean.

You can kill potential mechanical vibration problems by sticking some foam rubber tape or thick felt under the fan. There's no need for an airtight connection between fan and case; just put something between them as a mechanical damper. The Pamotor I use has four felt pads glued to its underside, one in each corner, which work fine.

Quieting All That Coolness

As I mentioned above, the number one requirement for your fan is that it run quietly. In fact, plenty of air will circulate at the minimum noise level when the fan is running just a little faster than the rpms necessary to keep it going. How do you accomplish this with an ordinary Muffin?

There are two ways. First, you can put a 350-Ohm power resistor in series with the fan, experimenting with the values until it runs the way you like. This, however, generates heat—an advantage only if you have a cold basement shack and need a footwarmer! You should be very careful to thoroughly insulate the resistor from the outside world lest a shock hazard be created. Put it in a bakelite box with vent holes—and no, you don't need another fan to cool the resistor.

The second way is slightly more elegant, generating no heat. Simply put a 1-to-10-uF (again, experimenting with the values) non-polarized capacitor in series with the fan. Those old Pyranol non-polarized metal-cased capacitors clunking around in your junk box will work fine; you need at least a 200-V rating here. Don't use electrolytics—they aren't made for pure ac work. If you like to play with numbers and simple math, it's an easy matter to calculate how much capacitance you'll want. You need to know Ohm's law, the formula for capacitive reactance, how much power your fan draws, and how much voltage you want it to run on. For me, however, it's easier to slap in a few microfarads and see how fast she goes.

Fig. 1 shows a simple schematic of the fan and capacitor; I've added a switch across the capacitor so that you can zoom to full speed when you want to cool yourself off after a hot day's work at the rig. Again, be sure to put the capacitor and switches in a well-insulated box so that there's no chance of a shock. Be careful when you're experimenting with values—there's 120 V floating around on your connections.

Of course, if you have a 220-V fan, chances are it'll run slow and quiet by simply plugging it into 120 V. Just add some felt or foam padding to its mount, plop it on top of the rig, and be amazed how coolly the station runs.

The accompanying photos show evidence of a friend's mania for collecting these wonderful fans. Oddly, he never replaces tubes or other components in his well-used equipment. You'll have the same fantastic results when you simply and easily cool off the overheated parts in your own rig. ■

References

1. *Electronic Buyer's News*, February 27, 1978, pp. 26ff.

Other articles on the topic of Muffin fans have appeared in *Ham Radio*, November, 1972, and *CQ Magazine*, May, 1966.

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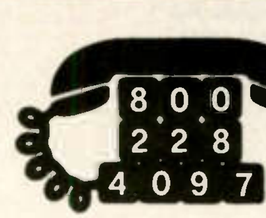

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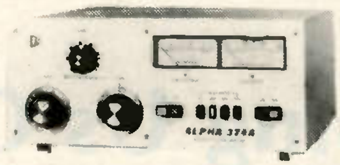

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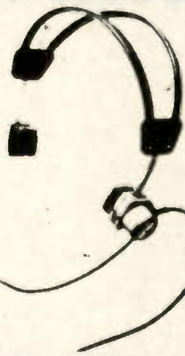

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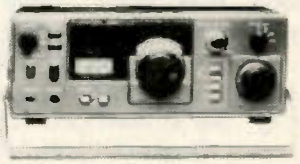

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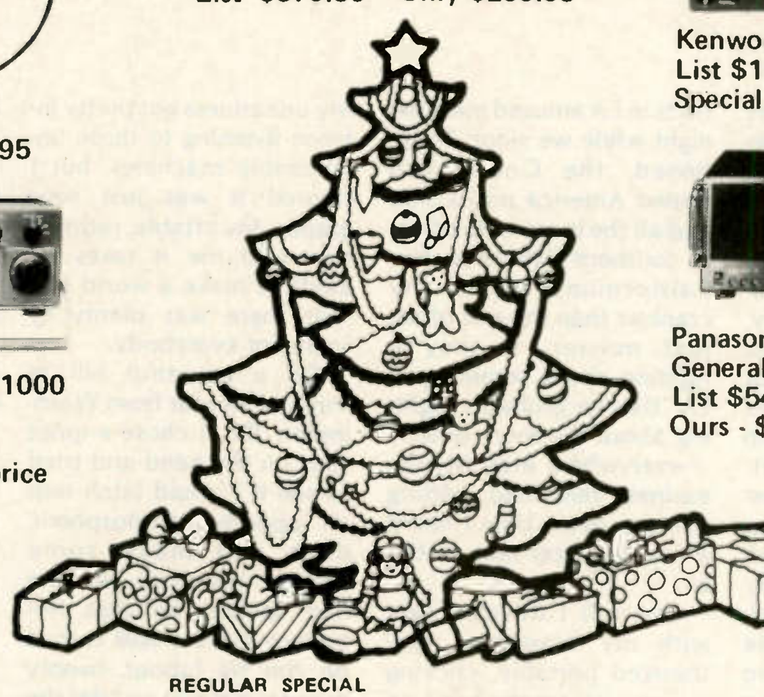

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Are Repeaters Ripping Us Off?

—some thoughts about open access to scarce frequencies

Something has always bothered me about repeaters. It's never been anything like hatred or even a serious gripe. I've only felt a vague uneasiness when reading about them, thinking about them, or, lately, when using one. It's as though something were not quite right, and as hard as I've tried, I've never been able to put my finger on it.

I came up in hamdom from the Novice ranks using junky eighteenth-hand gear, and it was not until recently that all those classy multi-hundred-dollar FM portable transceivers fell within reach. So it still strikes me as odd that people will earnestly ask, "QRZed the frequency?" when no living soul is calling them on *any* frequency. Each new country has its own language, I guess, and I decided my uneasiness was only the acclimatization lag time of a stranger in a strange land.

The tales of repeater wars and users'-rights conflicts in LA amused me. One night while we slept, I supposed, the Good Lord tipped America on its side and all the loose nuts fell into southern California. No, Californians aren't any crankier than the rest of us, just noisier. If they're fighting about someting in LA, they're probably fighting about it—more quietly—everywhere else. My uneasiness remained, getting stronger every time I heard a new repeater take to the air.

Last fall I traveled east with my brand-new synthesized portable, clicking my way across the band on those marvelous magic thumbwheels. Repeaters were everywhere, and I talked on quite a few. There were many more which just didn't seem to hear me, regardless of how close I was. By the additional magic of PL™, they had shut themselves off in a world of their own, occupied by a few dozen calls and no more.

My uneasiness got pretty intense listening to those unreachable machines, but I figured it was just sour grapes. My affable, rational side told me it takes all kinds to make a world and that there was plenty of room for everybody.

On a beautiful hill in Virginia, not far from Washington DC, I chose a quiet spot on the band and tried to see if I could latch into an apparent tropospheric duct and make some 2-meter distance. No one had spoken on that frequency since I had turned on the rig (about twenty minutes before), so I did the unthinkable and called "CQ 2 meters." A "good ol' boy" voice came back immediately and told me to kindly get off his private repeater input.

I'm used to 20 meters, perhaps a little more than I should be. When somebody says, "This frequency is in use," I apologize and scram. So, standing on my beautiful Virginia hilltop, I apologized and scrammed. It didn't hit me until late that night, while in the shower with a cold spray on my face, that my hilltop frequency had *not* been in use for at least twenty minutes. "Cool off, Chief," I told myself. "After all, it *was* his frequency." *His* frequency?

Like hell!

Suddenly, everything which had ever bothered me about repeaters became as clear as cocktail ice. I laid hands on a license manual and thumbed frantically until I found the paragraph in the rules which had eluded my thinking:

> 97.63. Selection and Use of Frequencies. (a) An amateur station may transmit on any frequency within any authorized amateur frequency band.

That seems pretty plain to me. Every ham who sweats his way into possession of a license shares all frequencies permitted his license class. Nobody can stake out a point on the radio dial and defend it against all comers. 'Tain't legal, friends.

One outcome of Repeater Appreciation Day in LA was the demonstration of the fact that a repeater is an extension of the repeater licensee's home station. The only user with any rights is the repeater owner. Everybody else is a guest in the man's shack, and the owner may set any rules for guests which he desires. This seems to include limiting guests to whichever group the owner desires to have use the machine. That seems to make sense. After all, he paid for the repeater, and he keeps it running.

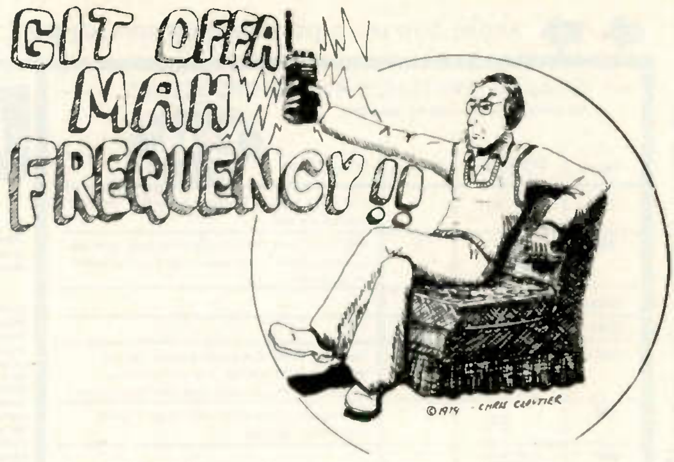
So much for the machine itself. But what about the *frequency*? A great many repeaters in urban areas now operate twenty-four hours a day. That means that, in effect, one man's ham station is sitting on a pair of frequencies for what may turn out to be years, with breaks for maintenance only. If I did that on 20 meters, they'd lock me up and throw away the key.

Of course, a repeater's carrier is not on at all times. But every ten minutes, like clockwork, comes the little announcement of callsign, location, local time, temperature, and God knows what else. In the wee hours of the morning, the repeater may not be keyed up for hours on end. But you can bet that, should a friend and I attempt to work simplex on the repeater's input frequency on any regular basis, a gang of DF-loaded station wagons would descend on us, loop antennas twirling, threatening to beat the both of us to marshmallow cream. The ham bands belong to all hams—says so right on the label.

This problem hasn't arisen until recently because, until recently, repeaters were something of a novelty. They were the new kids on the band, one here, one there, with lots of room in between and no objections from any of them to the ham who just wanted to jump in and say hello. Then the baby-boom babies grew up, bought Icoms, and started planting repeaters across the band like so many Johnny Appleseeds. We now have wall-to-wall repeaters, with more hams than all of them can handle. Hams, I've found, are incredibly courteous. If they find they're interfering with someone, they'll gladly slide up or down the band. But these days you can't take one step on 2 meters without stubbing your toe on somebody-or-other's repeater. Even more commonly, those repeaters are closed to the general hamming public. Do we have a problem? We sure do!

I now see the LA users'-rights crazies in an entirely new light. Out in the State of Excess, with more of everything per square inch than anywhere else, free space on the 2-meter band is probably pretty scarce. I have a hunch that the screamers are motivated by a feeling, just beneath the surface of rational expression, that the people who operate repeaters owe them something for the airspace that the repeaters take up.

In this new world of scarcity, nobody gets anything for nothing. We hams occupy our little sliver of God's good frequency spectrum because we provide free communication in times of national and international need. Have you forgotten that already? You shouldn't, because it's the only card we hold among the high rollers at WARC. A repeater cannot slide around the bands at will, the way that a man with a transceiver can. If a repeater effectively monopolizes a pair of frequencies, where's the justification?



At the present time, there isn't any. A repeater is an extension of a ham's private station, to do with as he pleases. My reading of the rules is pretty plain: A frequency pair is no man's own. If repeaters are to continue to sit on increasingly scarce frequencies, they must do what all the rest of us do for our country and our world—provide a service.

If a visiting ham slides into town and gets lost, he can key up a repeater and ask directions, right? Maybe, maybe not. If some drunk plows into him, he can key his HT and summon an ambulance on a repeater, right? Well, maybe. . .if he has the right PL. Otherwise, he'll just have to listen to the locals jaw about how soon they'll reach the work QTH while the drunk bleeds to death.

Rendering a worthwhile service may be no more complicated than keeping a repeater open to all incoming carriers, regardless of whether the incoming station is a club member, financial contributor, or somebody nobody has ever heard of.

I can already hear the gnashing teeth of repeater operators wondering how they'll support their machines if people aren't required to support them. Well, when I decided I wanted a transceiver, I saved my nickels and dimes until I got one. I did it because I *wanted* to. If a repeater club can't rake in enough voluntary support to keep its repeater running, maybe that repeater should be run in a less expensive location, or with reduced power, or without autopatch. Or maybe not at all. Does anyone else get the impression that there may be a few too many repeaters floating around?

Certainly, I see no justification at all for closed repeaters. They provide a service to only those few who are required to pay financial support, and still deny use of the frequency to licensed hams who do *not* want to use the repeater. This is a double violation of the rules that really ought to be looked at a little more closely. The users of repeaters have no rights to the machine, but they do have a right to an equal crack at the airspace. Or, perhaps, on the other hand, if the repeater keeps all rights to the frequency, then all hams deserve an equal crack at the machine. Does anyone agree? It's something we should talk about before we all become strangers on 2 meters, shouting vainly at repeaters which choose to hear only their favored few. ■

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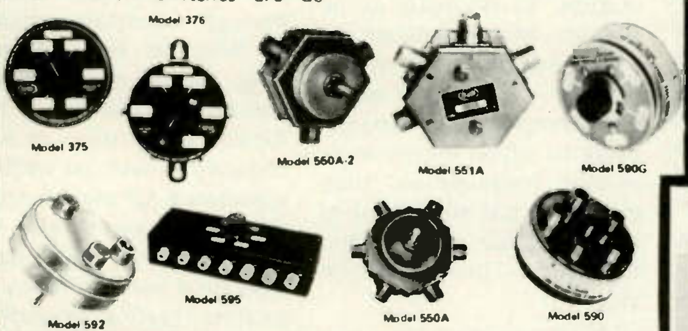

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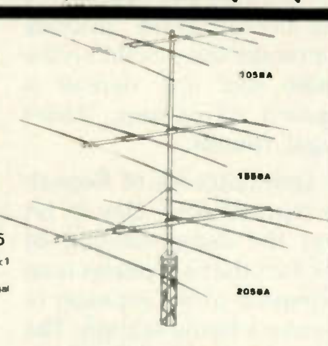

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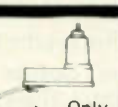

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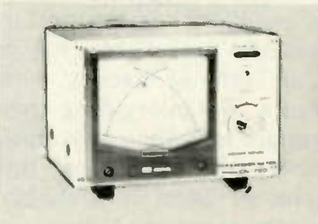

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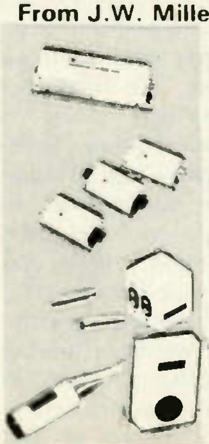

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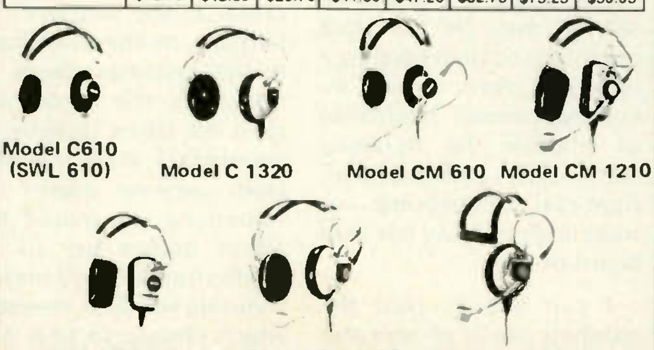

My TRS-80 Is Here . . . Now What?

—first steps in programming your computer

Allan S. Joffe W3KBM
1005 Twining Road
Dresher PA 19025

You unpacked the large box, examined the contents, and carefully plugged it all together . . . and it works. By now, you have read the excellent book that comes with the TRS-80 or, if you are lucky enough to have Level II BASIC, then you had two books to read . . . and digest.

The nicest thing for any beginning programmer is no different from the nicest thing for the beginning ham: a starting point to get from the superregenerative receiver to the superheterodyne. Both problems relate in this fashion. A complex radio is really nothing more than a collection of properly associated simple circuits which make up the whole. A whipper-doodingbust-golly-gee computer program is more of the same. The trick is to grab a firm hold of the elements from a simple starting point.

For purposes of illustration, I have chosen to work over a nice program in the TRS-80 level I BASIC book which sets forth a 24-hour clock program.

Taken verbatim from the book:

```
10 CLS
20 PRINT AT 407, " H M S "
30 FOR H = 0 TO 23
40 FOR M = 0 TO 59
50 FOR S = 0 TO 59
60 PRINT AT 470, H; ":" ;M; ":" ;S
70 FOR N= 1 TO 500: NEXT N
80 NEXT S
90 NEXT M
100 NEXT H
```

When entering this program and running it, you see the hours, minutes, and seconds start to count from 0:0:0.

With this much as our starting point, we can operate upon the basic program a bit at a time, so we do not byte off so much that we eschew it.

Like any sensible person, if you bought a timepiece at the local emporium, got it home and found you had no way to set the time, you could rightly work up a bit of indignation. Well, this clock so far is in that fix, but you can program it into practicality with the following few steps. Remember, we are listing new or revised lines to the fundamental program as we go.

```
52 X=X +1
54 IF X = 1 THEN 110
72 CLS
105 GOTO 30
110 INPUT H,M,S
120 GOTO 60
```

Now if you enter the program and run it, a header will appear as before, but this time there will be a "?" showing along with the header. The computer is saying, tell me what time you want me to start counting from. You enter the requested information by typing 3,0,0, which could be three am or three pm, depending on your life-style. Now when you hit ENTER, the clock starts keeping time from the entered data. You have added a knob to "set the hands."

What the whole process really amounts to is educational self-help. Working a bit at a time to alter programs means you will master the skill of programming. After all, you did not buy the machine to use someone's canned programs for the sheer thrill of getting typing practice.

So much for the philosophy. How about another small change? This time, let's humanize the program by changing it from a 24-hour clock to the usual 12-hour variety. This takes one more change to the program. Line 30 now becomes:

```
30 FOR H = 1 TO 12
```

You probably are not too happy with that vertical string of zeroes in the original program or any stray

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zero on the left side of the screen. We can de-zero the display by changing the contents of two lines in the program, namely lines 20 and 60. They now become:

```
20 PRINT "H M S"
60 PRINT H ; ":" ;M; ":" ; S
```

Now that we have de-zeroed the display, just a word about clock accuracy. The book suggests the number 500 in the timing loop in line 70. With the particular machine I had before me, 300 seemed to give a country-fair minute.

So far, we have a rather conventional clock which, without too much effort, can be turned into a conventional down-counting timer. With these changes, you have a timer that starts from a predetermined starting time of your choice, starts counting at the push of a button, and stops counting when it reaches zero.

These are the program changes to make the timer:

```
30 FOR H = 11 TO 0 STEP -1
40 FOR M = 59 TO 0 STEP -1
50 FOR S = 59 TO 0 STEP -1
105 END
```

The first three lines shown here reverse the order of counting from up, as needed for the regular clock, to down as desired for the advertised down-counter. The final change (line 105) makes the counter stop when the count has wound down to zero.

Small programs like this may not have the oomph of Lunar Lander or Star Trek but they lend themselves to piece-by-piece manipulation on a somewhat intuitive basis. (Reading the books that came with your computer also helps.) This is one way to achieve familiarity with the programming language that you must master if your computer is going to be more than a large, expensive paperweight. ■

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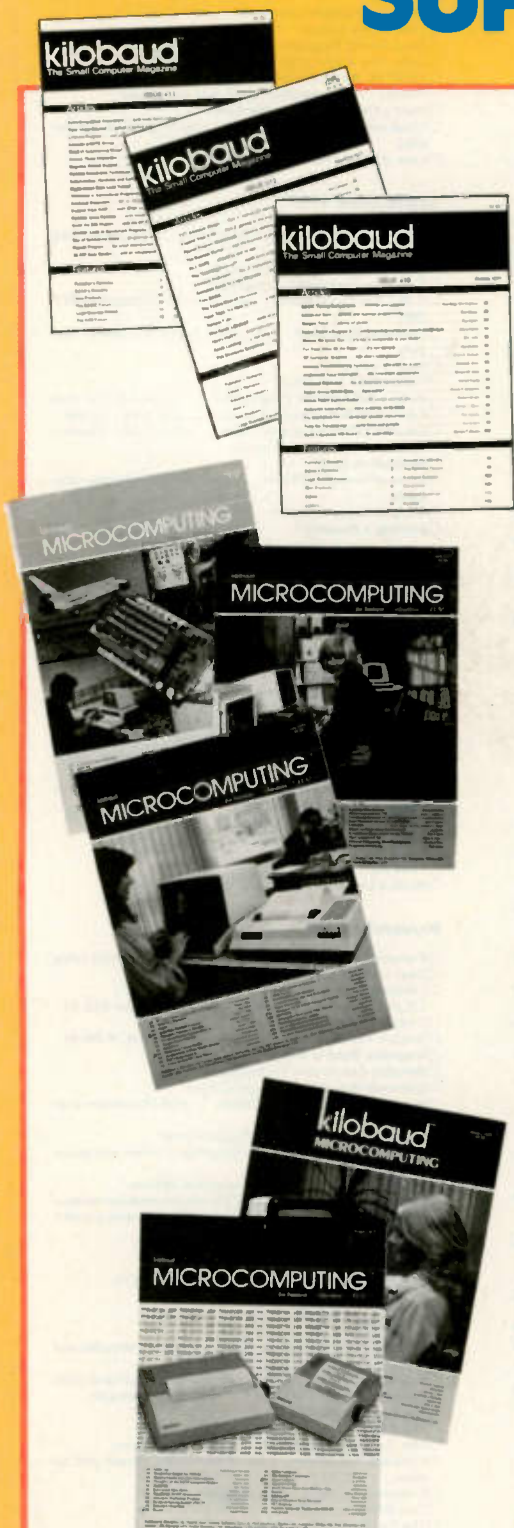

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Teaching Your Micro to Count

— two methods for adding counter capability to your 6502 machine

Sam Creason K6EW
2940 Arlington Ave.
Fullerton CA 92635

One of the handier pieces of test equipment for digital circuits is a counter. If it's used to troubleshoot or design systems which involve a microprocessor (μP), it need not be expensive, since it need not count at a rate faster than a few MHz. Then, too, if it's used with an already-existing μP system, it is simple to construct, since the μP system can replace some of the hard-wired logic that is normally required.

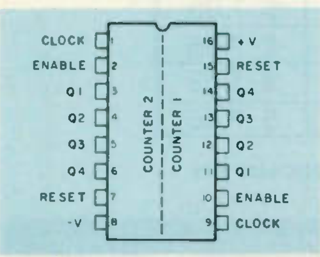

Fig. 1. Pin connections of 4518 dual BCD counter.

In the context of a μP system, we can implement a counter in more than one way. The first is straightforward, involving ICs which do the counting. The second way is also straightforward, but rather unconventional. The implementation consists almost entirely of a program, and we need add little or no hardware at all to our system. By comparing the two implementations, we can learn a little about replacing hardware with software and see what trade-off is involved. Our primary goal, though, is simply to add a useful piece of equipment to our system. As we'll see later, the conventional implementation produces a more versatile counter, so we'll consider it first.

Q_4	Q_3	Q_2	Q_1
0	0	0	0
0	0	0	1
0	0	1	0
0	0	1	1
0	1	0	0
0	1	0	1
0	1	1	0
0	1	1	1
1	0	0	0
1	0	0	1

Fig. 2. Response of counter to square wave.

The Counter IC

The principal component of our first counter is the 4518 dual BCD counter. Its pin connections are shown in Fig. 1. As its name implies, there are two independent BCD counters within the IC. There is no particular significance to the designations "1" and "2" in the figure.

Each counter has a RESET input. Applying a high level to this input forces outputs Q_1, Q_2, Q_3, and Q_4 to 0. Applying a high level to the ENABLE input and a low-to-high transition to the CLOCK input then advances the count from $Q_4Q_3Q_2Q_1 = 0000$ to $Q_4Q_3Q_2Q_1 = 0001$. As long as we hold the ENABLE input high, each successive low-to-high transition advances the count by one until a count of nine (1001) is reached. The next transition returns the count to 0000. Similarly, if we hold the CLOCK input low and apply a high-to-low transition to the ENABLE input, the count will advance.

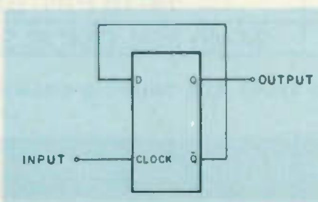

Fig. 3. Conditioning circuit.

If we want to determine the fundamental frequency of a square wave, and we know that it's between one and nine Hz, we can make at least an approximate measurement by applying the square wave to the ENABLE input and carrying out the following sequence of operations:

1. Take CLOCK input high.
2. Reset counter.
3. Take CLOCK input low for one second.
4. Take CLOCK input high.

At the end of this sequence, the count is numerically equal to the frequency of the square wave in Hz, give or take a Hz.

Alternatively, we could accomplish the same thing by applying the square wave to the CLOCK input, taking the ENABLE input low, resetting the counters, and taking the ENABLE input high for one second.

A Multi-Digit Counter

To make useful measurements, we very often need a counter which can count beyond nine. For this, we can use the output of one counter to drive an input of a second counter, and so on. Since the digital display of my system has six digits, I used a total of six counters (three 4518s).

Although the waveform which we want to measure can be applied to either the CLOCK or the ENABLE input of the first counter, we have to be careful about the way in which we interconnect the remaining counters. As successive cycles of the waveform toggle the first counter, the outputs of that counter change as shown in Fig. 2. Each time the count changes from 9 to 0, the next counter should be toggled once. That is, as the count in a particular counter goes from 9 to 0, that counter should generate a carry for the next counter. For this purpose, we can use the Q_4 output of the counter. As the count goes from 9 to 0, that output makes a high-to-low transition. Thus, we need only tie the Q_4 output of the first counter to the ENABLE input of the second counter, and tie the CLOCK input of the second counter permanently low. We can add as many more counters as we like, in a similar way.

Measuring a Frequency—The Timebase

At this point we have a multi-digit counter, but we need a way to enable or disable counters so that we know how much time was spent accumulating a particular count. That is, we need a timebase. A ½-Hz square wave is a reasonable choice, since it's high for one second, low for one second, and so on. If we apply such a square wave to the CLOCK input of the first counter and apply the waveform which we want to measure to the ENABLE input, the first counter will count for one second, stop counting for one second, and so on. Since the first counter won't generate carries when it's not counting, the five remaining counters will count and stop also. To make a measurement, we let the counters count for one second and then process and display the count during the next second.

If we use a ½-Hz square wave as a timebase, the count which is accumulated during one counting period is numerically equal to the frequency in Hz of the unknown waveform. Since our counter has six digits, 999,999 Hz is the highest frequency which it can measure under these conditions. We can extend that range by a factor of ten if we use a 5-Hz square wave as a timebase, since such a square wave is low for only a tenth of a second at a time. During that time, a 9.99999-MHz waveform will produce a count of 999999, which our display can accommodate. In this case, the count is numerically equal to the frequency in Hz/10.

Since the CMOS counters which we'll use can't be toggled faster than about 2-3 MHz (when a 5-volt power supply is used), we have no immediate need for a timebase which is higher in frequency than 5 Hz.

At this point, then, we have in hand the necessary ingredients to make measurements of frequency. Before we turn our attention to the hardware itself, however, let's consider one additional topic.

Measuring a Period

We've seen that measuring a relatively high-frequency waveform isn't all that difficult, but what if the unknown waveform has a frequency of, say, 10 Hz? If we use a ½-Hz square wave as the timebase, then 10 counts will be accumulated at a time, and our measurement will be accurate to only one part in ten. For many purposes, that's adequate. However, if we want to count long enough to take full advantage of our counter, we'll have to use a 1/20000-Hz square wave as the timebase. Of course, that means that the counter will count for about five and one-half hours at a time!

There is a better way, and it involves using the unknown waveform as the timebase while the counter counts cycles of a waveform for which the frequency is known. For example, if the known frequency is 1 MHz, and a count of, say, 97,350 accumulates during one "on period" while using the unknown waveform as the timebase, then the "on period" is 97,350 micro-

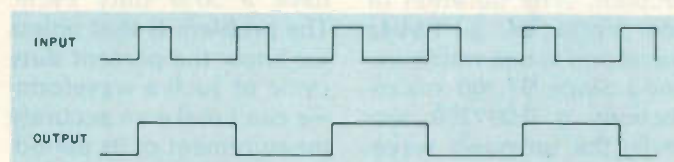

Fig. 4. Effect of conditioning circuit.

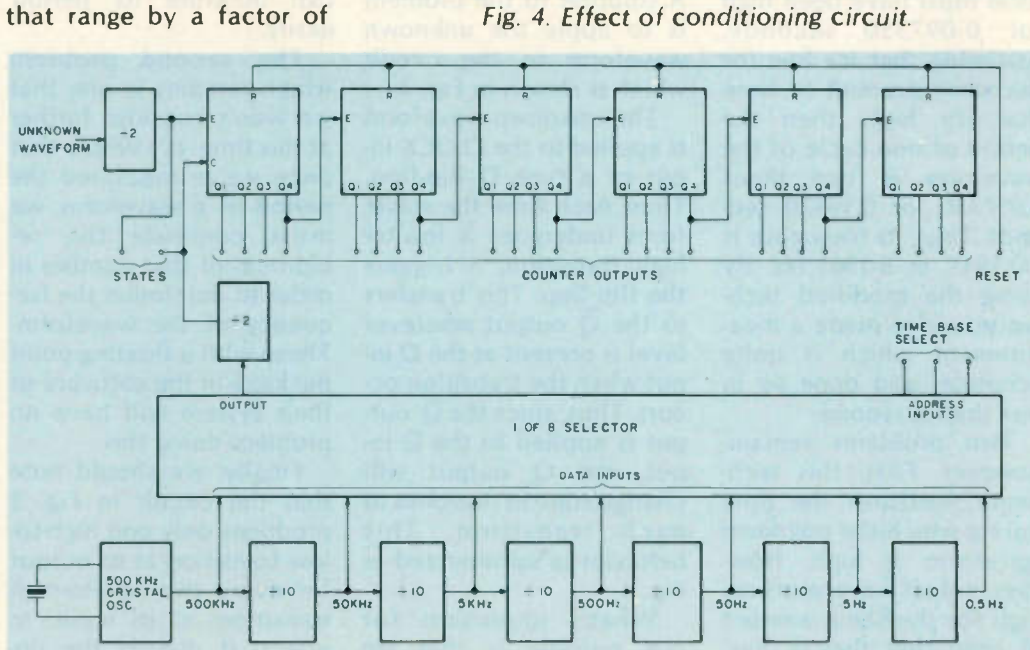

Fig. 5. Block diagram of counter.

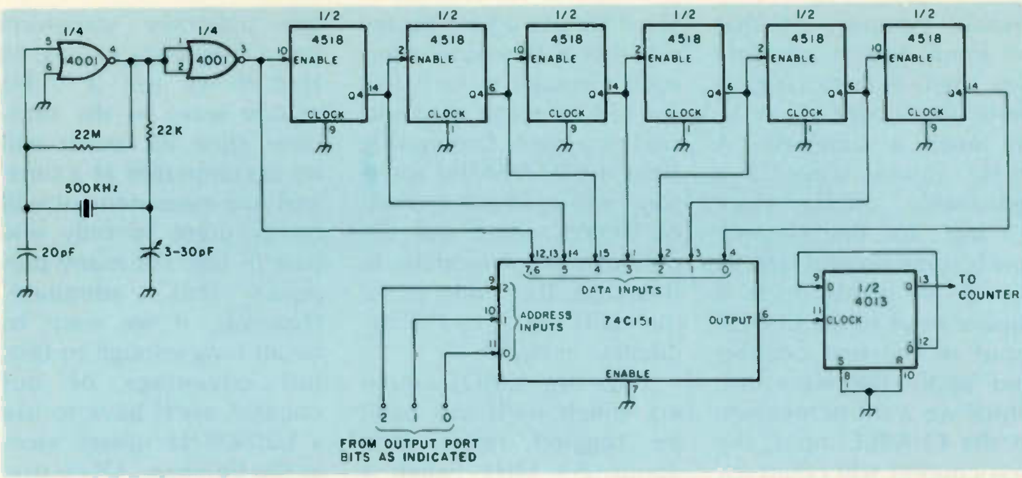

Fig. 6. Timebase for counter. Note: Ground reset terminals of 4518s (pins 7 and 15).

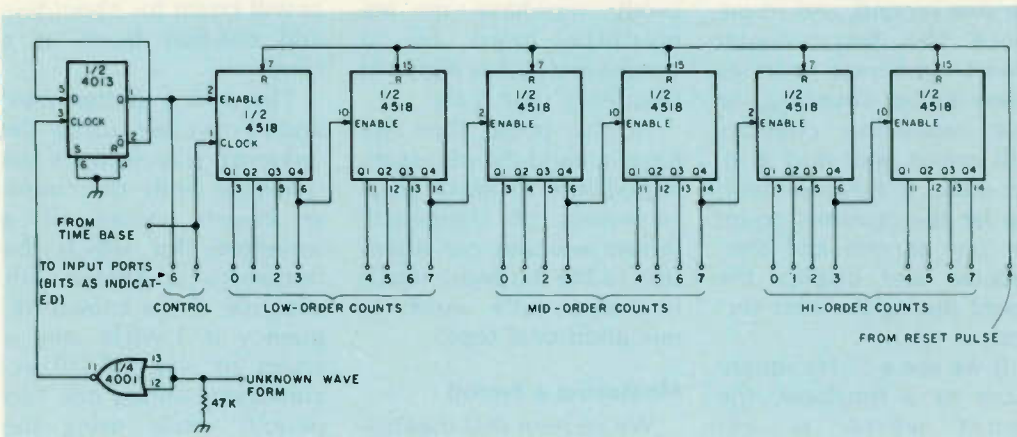

Fig. 7. The counters. Note: Unless otherwise specified, ground clock terminals of 4518s (pins 1 and 9).

seconds. (The duration of one cycle of a 1-MHz waveform is one microsecond.) Since 97,350 microseconds is 0.097350 seconds, the unknown waveform must have been high for 0.097350 seconds. Assuming that it's low for the same amount of time that it's high, then the period of one cycle of the waveform is two times 0.097350, or 0.19470 seconds. Thus, its frequency is 1/0.1947, or 5.1361 Hz. By using the modified technique, we've made a measurement which is quite accurate, and done so in less than a second.

Two problems remain, however. First, this technique measures the time during which the unknown waveform is high. However, not all waveforms are high for the same amount of time that they're low. That is, not all waveforms have a 50% duty cycle. The problem is that unless we know the percent duty cycle of such a waveform, we can't make an accurate measurement of its period. A solution to the problem is to apply the unknown waveform to the circuit which is shown in Fig. 3.

The unknown waveform is applied to the CLOCK input of a type D flip-flop. Thus, each time the waveform undergoes a low-to-high transition, it triggers the flip-flop. This transfers to the $\overline{Q}$ output whatever level is present at the D input when the transition occurs. Thus, since the $\overline{Q}$ output is applied to the D input, the Q output will change state in response to each transition. This behavior is summarized in Fig. 4.

What's important for our purpose is that we have a waveform which is high for one period of the unknown waveform, low for the same amount of time, and so on. That is, the derived waveform has a 50% duty cycle and we can measure its period easily.

The second problem which remains is one that we won't consider further at this time. It's simply that once we've measured the period of a waveform, we must compute the reciprocal of that number in order to determine the frequency of the waveform. Those with a floating-point package in the software of their system will have no problem doing this.

Finally, we should note that the circuit in Fig. 3 produces only one high-to-low transition at its output for every two low-to-high transitions at its input. In effect, it divides the unknown frequency by two. Thus, if we make the circuit a permanent part of our counter, we must take this into account. An easy way to do this is to halve the frequency of the conventional timebase so that the timebase is high for two (or 0.2) seconds and low for the same amount of time.

A Block Diagram

At this point, we can rough out a block diagram of at least part of our counter, as shown in Fig. 5.

The unknown waveform is applied to a divide-by-two circuit which, in turn, drives the first of six BCD counters (each is half of a 4018). A 500-kHz crystal oscillator generates the timebase. It drives the first of six BCD counters (each is half of a 4018). Since each counter counts to nine and generates a carry, we can view each as a divide-by-ten circuit as well as a counter.

The lowest available frequency which is available from the timebase is 0.5 Hz. A little arithmetic will show that, in this case, that value will produce a count which is numerically equal to half the frequency in Hz of the waveform—but we'll soon remedy that. A one-of-eight selector passes the selected timebase on to the input of a divide-by-two circuit. In turn, that circuit drives the CLOCK input of the first counter, and our problem is remedied.

We could use a 250-kHz crystal and dispense with the divide-by-two circuit, but 500-kHz crystals are less expensive, and the flip-flop IC which we'll use (4013) contains two flip-flops.

The Interface

To interface the counter to a μP system, we need four input ports and an output port. In addition, we need a pulse which is similar to a

WRITE pulse, to reset the counters. Such a pulse can be generated by using one line of a second output port. Writing 0-1-0 onto the line produces a positive-going pulse.

Three of the input ports are used to read the contents of the counters. The fourth is used to monitor the states of the CLOCK and ENABLE inputs of the first counter. Depending on which counting technique is used (frequency or period), the state of one or the other of the inputs indicates whether or not the counters are counting.

The output port is used to apply a number to the address inputs of the one-of-eight selector, to choose the timebase.

The Timebase

The circuit of the timebase is shown in Fig. 6.

Two gates from a 4001 quad two-input NOR IC, a 500-kHz crystal, and a few passive components make up the timebase generator. The output of the oscillator drives a chain of three 4518 dual BCD counter ICs. The outputs of the six counters are applied to the DATA inputs of a 74C151 one-of-eight selector. Depending on the number which is applied to the ADDRESS inputs of the 74C151, a particular timebase is passed on to the counters via a divide-by-two circuit.

The Counter

The circuit of the counters is shown in Fig. 7. The unknown waveform is applied to the input of a 4001 NOR gate which acts as a buffer. (Good practice dictates that lines which originate off the board should not be connected directly to the CLOCK input of a flip-flop, in the interest of immunity to noise.) The NOR gate drives half of a 4013 type-D flip-flop IC which is configured as a divide-by-two circuit. The output of that circuit drives the ENABLE input of the first of a chain of three 4518 dual BCD counters.

Using the Counter With the BMPS

The counter was originally designed for use with a beginner's microprocessor system based on the 6502 μP. That system is described in detail elsewhere.[1] Those who have built such a system may use the counter by adding the interface which is shown in Fig. 8. (Of course, the interface is not needed if the builder has expanded the basic BMPS to provide additional I/O parts.) Those who will use the counter with other than the basic BMPS should ignore the next two paragraphs.

A circuit which provides the necessary control signals is shown in Fig. 8(a). It consists of a 4514 decoder, a 4011 quad two-input NAND gate, and a 4081 quad two-input AND gate. Address lines A_0, A_1, A_2, A_{14}, and A_{15} are applied to the inputs of the 4514. Four READ signals are generated by ANDing the R/W line with outputs of the 4514. Two pulses are generated by NANDing the $\emptyset_2$ line with other outputs of the 4514. One of these is a WRITE pulse of the sort which we've used before. The remaining pulse is complemented and used to reset the counters. When we want to reset the counters, we use a STA, STX, or STY instruction in the program. No port exists which will accept the operand of the instruction, but the pulse is generated. The address of each READ and WRITE signal is as shown in Fig. 8(a).

A circuit which provides the I/O ports is shown in Fig. 8(b). A latch (4042) and solid-state switches (4016) are used as described in Reference 1.

Construction

The foil side of the PC board and the component layout are shown in Figs. 9 and 10, respectively. Those who will not use the counter with the basic BMPS may prefer a more compact layout which does not include the unnecessary portion of the I/O circuit.

The timebase should be checked out first. If the oscillator does not start reliably when power is applied, the values of one or more passive components should be varied slightly. With the oscillator working, we then check the 74C151 selector. Writing a number from 000 through 111 to its address inputs should tie the output of the selector to the designated one of its seven inputs. We then add the 4518s to complete the timebase. When that's done, writing a 000 to the address inputs should produce a 0.25-Hz square wave at the output of the 4013. That frequency is low enough to be observed with a logic probe.

When the timebase is working properly, we can use it to check the counter ICs. To do this, we temporarily remove the 4013 from its socket. We then

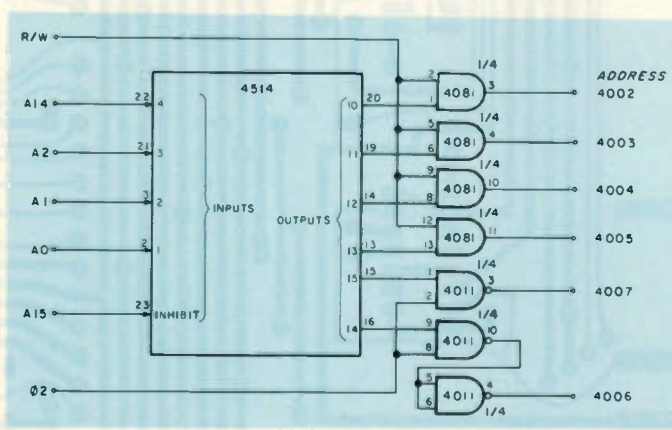

Fig. 8(a). Partial schematic of interface to BMPS.

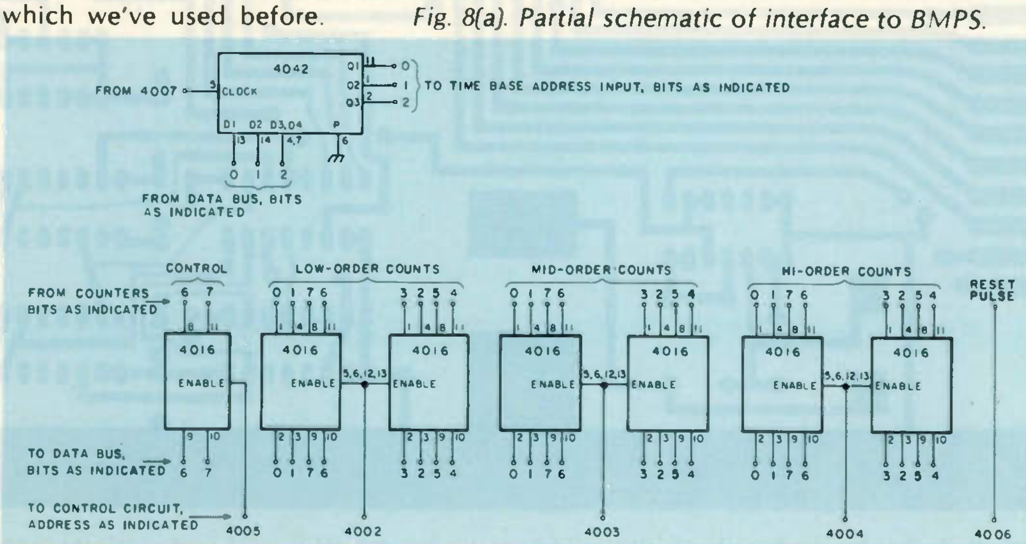

Fig. 8(b). Partial schematic of interface to BMPS.

connect the output of the timebase to the ENABLE input of the first counter and ground the CLOCK input of that same counter. The net result is that the timebase toggles the chain of six counters. Those using

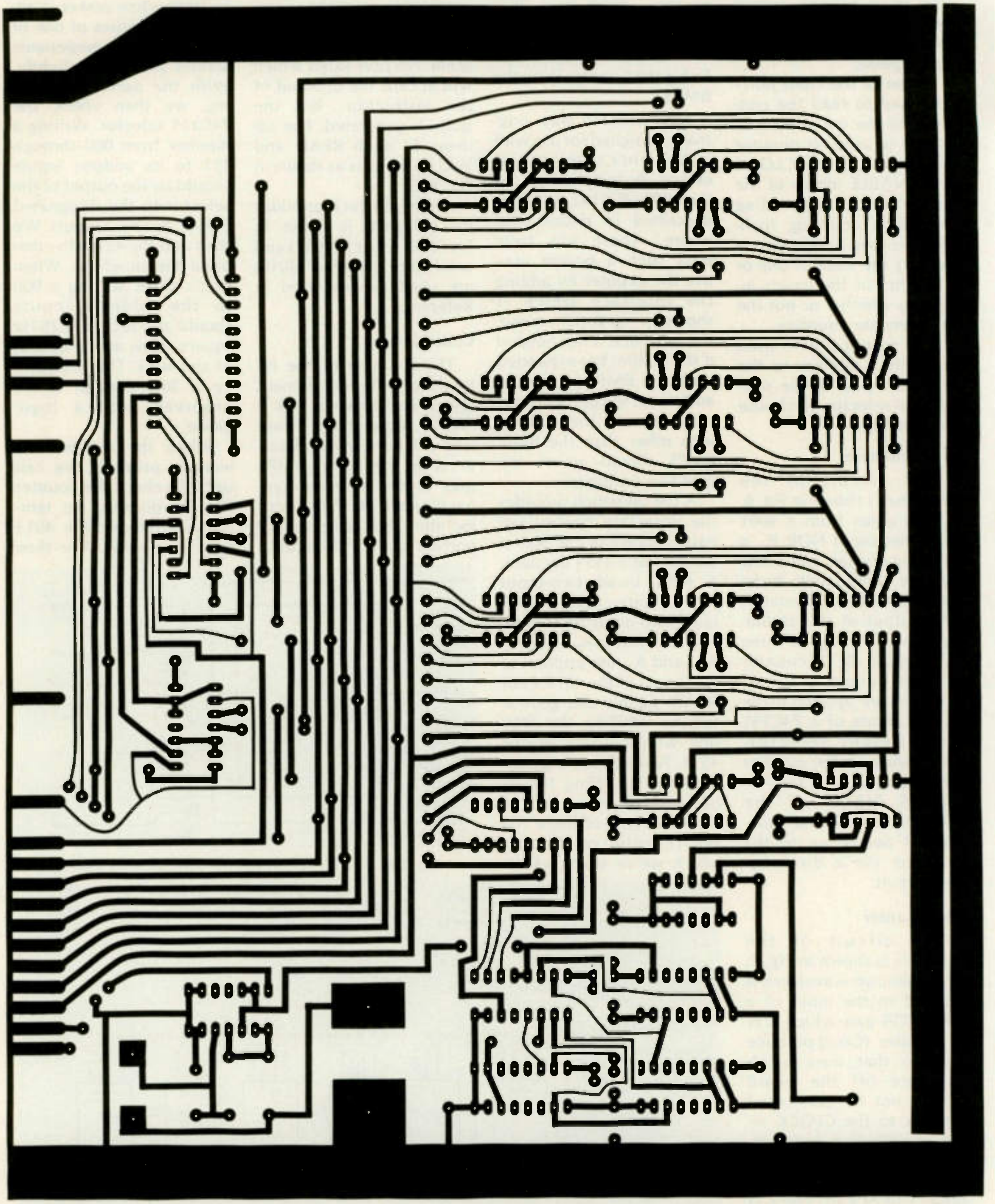

Fig. 9. Foil side of printed circuit board for counter. Install crystal socket on this side. Install a 0.1 μF disc ceramic capacitor across power pins of each 45189 and 4013.

the basic BMPS should load the program which is shown in Fig. 11 and monitor output port 8200. In this way, the outputs of any one of the pairs of counters can be observed. Others can check the outputs of the counters with a logic probe. Finally, we restore the 4013 and disconnect all temporary connections.

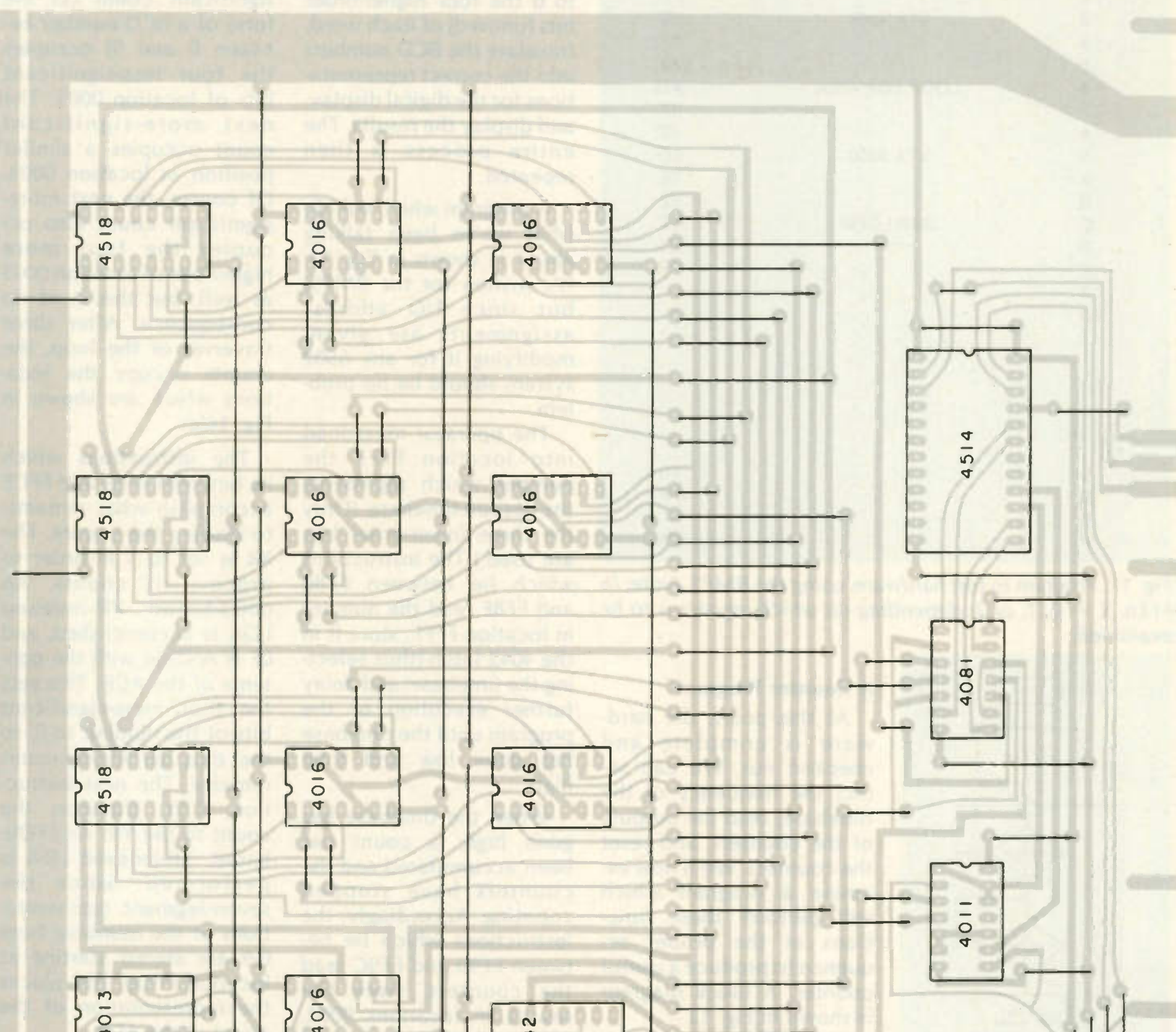

Fig. 10. Component side of printed circuit board.

Location	Instruction	Contents
FFE0	LDA TBASE	AD
1		FF
2		FF
3	STA 4007	8D
4		07
5		40
6	LOOP LDA 400X	AD
7		0X
8		40
9	STA 8200	8D
A		00
B		82
C	JMP LOOP	4C
D		E6
E		FF
F		--
FO		--
1		--
.		.
.		.
.		.
.		.
C		F0
D		FF
E		--
F		F8

Fig. 11. Program to test hardware, using the BMPS. Note: In FFE6, X = 0, 1, or 2, depending on which register is to be examined.

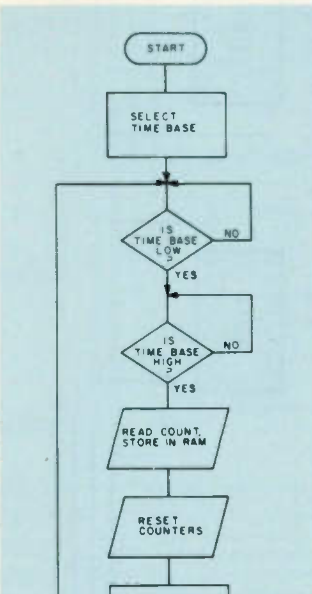

Fig. 12. Method to capture, process, and display counts.

A Counter Program

At this point, the hardware is complete and checked out. We can select the frequency of the timebase, read the outputs of the counters, and reset the counters. We'll now examine a program which will perform these functions in the proper sequence to produce a useful counter. A block diagram is shown in Fig. 12.

The first step is selection of a timebase. Nothing of significance happens then until the output of the timebase is first low (counters counting) and then high (counters not counting). We then read and reset the counters. Once this happens, we have in memory three eight-bit numbers which represent the counts that were accumulated by the six counters. Each eight-bit number consists of a pair of BCD numbers "side by side." Accordingly, the next order of business is to "unpack" the numbers so that each BCD number is in the four lower-order bits of its own individual location in memory. We then reset to 0 the four higher-order bits (unused) of each word, translate the BCD numbers into the correct representations for the digital display, and display the results. The entire process is then repeated.

A program which will do what we've been talking about is shown in Fig. 13. It's written for the BMPS, but since I/O address assignments are given, modifying it for any 6502 system should be no problem.

The operator must load into location FFFF the number which represents the desired timebase. (Only the three lower-order bits are used.) The instructions which lie between FF80 and FF8F read the number in location FFFF, store it in the 4042 latch (thus selecting the timebase) and delay further execution of the program until the timebase has gone low and then high.

When the timebase has gone high, a count has been accumulated and the counters have stopped counting. Accordingly, the instructions which lie between FF90 and FF9C read the counters, store the results in locations 0002, 0001 and 0000, and reset the counters in anticipation of the next count. At this point, the counts are stored as shown in Fig. 14(a), and they must be transformed for display as shown in Fig. 14(b).

The first step in the process is to unpack the BCD digits. The instructions which lie between FFA0 and FFB5 accomplish this. The XR and YR are each set to 0. A 0000-based, YR-indexed LDA and a 0003-based, XR-indexed STA are then performed. The contents of the ACR are shifted right four places, the XR is incremented, and a 0003-based, XR-indexed STA is performed. At this point, the least-significant count (in the form of a BCD number between 0 and 9) occupies the four less-significant bits of location 0003. The next more-significant count occupies a similar position in location 0004. Of course, the next more-significant count also occupies the four more higher bits of location 0003 as well, but this is of no consequence. After three traverses of the loop, the counts occupy the locations which are shown in Fig. 14(c).

The instructions which lie between FFB9 and FFCE accomplish what remains: to display the counts. The XR is set to 5 in order to process six counts. An 0003-based, XR-indexed LDA is accomplished, and 0F is ANDed with the contents of the ACR. This sets the four more-significant bits of the number to 0, so that only the desired count remains. The next instruction, TAY, transfers the count to the YR. An FFD0-based, YR-indexed LDA is performed. Since the seven-segment representations of the numbers from 0-9 are stored starting at location FFD0, this places the representation of the count in the ACR.

The final step is to store the representation in the appropriate display element. Since the addresses of the display elements don't fall in the same order as the addresses of the source locations, we use a somewhat roundabout method to accomplish this. An FFDA-based, XR-indexed LDY is performed. This places in the YR the least-significant hexadecimal digit of the address of the appropriate display element. Performing an 8000-based, YR-indexed STA then accomplishes what we desire.

Fig. 13. Program to implement counter. Note: In FFF0, X = 3, 4, 5, 6, 7, or 8, depending on which register is to be examined. In FFFF, X = 1, 2, 3, 4, 5, 6, or 7, depending on which timebase is to be used.

Location	Instruction	Contents
FF80	LDA FFFF	AD
1		FF
2		FF
3	STA 4007	8D
4		07
5		40
6	LOOK1 LDA 4005	AD
7		05
8		40
9	BMI LOOK1	30
A		FB
B	LOOK2 LDA 4005	AD
C		05
D		40
E	BPL LOOK2	10
F		FB
90	LDX #2	A2
1		02
2	FETCH LDA 4002,X	BD
3		02
4		40
5	STA 0000,X	95
6		00
7	DEX	CA
8	BPL FETCH	10
9		F8
A	STA 4006	8D
B		06
C		40
D	NOP	EA
E	NOP	EA
F	NOP	EA
A0	LDY #0	A0
1		00
2	LDX #0	A2
3		00
4	LOOP1 LDA 0000,Y	B9
5		00
6		00
7	STA 0003,X	95
8		03
9	INX	E8
A	LSR	4A
B	LSR	4A
C	LSR	4A
D	LSR	4A
E	STA 0003, X	95
F		03
B0	INX	E8
1	INY	C8
2	CPY #3	C0
3		03
4	BNE LOOP1	D0
5		EE
6	NOP	EA
7	NOP	EA
8	NOP	EA
9	LDX #5	A2
A		05
B	LOOP2 LDA 0003,X	B5
C		03
D	AND #F	29
E		0F
F	TAY	A8
C0	LDA REPS,Y	B9
1		D0
2		FF
3	LDY DISPS,X	BC
4		DA
5		FF
6	STA 8000,Y	99
7		00
8		80
9	DEX	CA
A	BPL LOOP2	10
B		EF
C	SEC	38
D	BCS LOOK1	B0
E		B7
F		--
D0	REPS	24
1		77
2		1C
3		15
4		47
5		85
6		84
7		37
8		04
9		07
A	DISPS	06
B		05
C		01
D		02
E		03
F		04
FFF0	LDA 000X	AD
1		0X
2		00
3	STA 8200	8D
4		00
5		82
6	JMP FF86	4C
7		86
8		FF
9		--
A		--
B		--
C		80
D		FF
E		--
F		FX

Location	Type	Contents
0000	memory	counts 1,2
0001	memory	counts 3,4
0002	memory	counts 5,6
0003	memory	count 1
0004	memory	count 2
0005	memory	count 3
0006	memory	count 4
0007	memory	count 5
0008	memory	count 6
4002	input port	counts 1,2
4003	input port	counts 3,4
4004	input port	counts 5,6
4005	input port	control bits
4006	output port	reset
4007	output port	timebase
8001	output port (display)	count 3
8002	output port (display)	count 4
8003	output port (display)	count 5
8004	output port (display)	count 6
8005	output port (display)	count 1
8006	output port (display)	count 2

		Most-Significant Count		
Location	0002	XXXX	XXXX	Contents
	0001	XXXX	XXXX	
	0000	XXXX	XXXX	
		Least-Significant Count		

Fig. 14(a). Location of counts in memory.

Location	Contents
8004	Most-Significant Count
8003	.
8002	.
8001	.
8006	.
8005	Least-Significant Count

Fig. 14(b). Destination of counts.

Traversing the loop six times stores all six counts.

The remaining instructions (CLC, BCC) cause the program to branch to location FF86, and the process starts again. To change the timebase requires a reset.

The NOP instructions which are located in FF9D-FF9F and FFB6-FFB8 serve no useful purpose and may be omitted. (Change the operand of the BRANCH instruction at FFCD, if done.) However, if either set is replaced with JMP FFF0, the short program which starts at FFF0 will store a selected pair of counts into the output port which is located at 8200. This is convenient when checking out the program.

Finally, if measurements of period rather than frequency are to be made, ASL instructions should be inserted between LOOK1 LDA 4005 and BMI LOOK1, and between LOOK2 LDA 4005 and BPL LOOK2, so that the proper bit is examined. Then, too, BMI LOOK1 should be changed to BPL LOOK1, changed to BMI LOOK2, to take into account the difference in the way the bits must be interpreted.

Location	Counts
0008	- 6
0007	6 5
0006	- 4
0005	4 3
0004	- 2
0003	2 1

Fig. 14(c). Location of counts after unpacking.

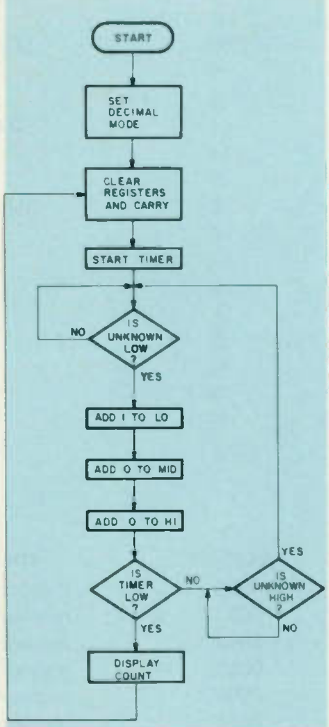

Fig. 15. Software implementation of counter function.

Location	Instruction	Contents
FF80	SED	F8
1	START CLC	18
2	LDX #2	A2
3		02
4	LDA #0	A9
5		00
6	LOOP1 STA 0000,X	95
7		00
8	DEX	CA
9	BPL LOOP1	10
A		FB
B	STA 8100	8D
C		00
D		81
E	LOOP2 LDA 9000	AD
F		00
90		90
1	BMI LOOP2	30
2		FB
3	LDA #1	A9
4		01
5	ADC 0000	65
6		00
7	STA 0000	85
8		00
9	LDA #0	A9
A		00
B	ADC 0001	65
C		01
D	STA 0001	85
E		01
F	LDA #0	A9
A0		00
1	ADC 0002	65
2		02
3	STA 0002	85
4		02
5	LDA A000	AD
6		00
7		A0
8	BPL AHEAD	10
9		08
A	LOOP3 LDA 9000	AD
B		00
C		90
D	BPL LOOP3	10
E		FB
F	JMP LOOP2	4C
FFB0		8E
1		FF
2	AHEAD LDA 000X	A5
3		02
4	STA 8200	8D
5		00
6		82
7	JMP START	4C
8		81
9		FF

Fig. 16. Program to implement a counter in software. Note: In FFB2, X = 0, 1, or 2, depending on which register is to be examined.

Doing It the Easy Way

The counter which we've just discussed is a useful and versatile addition to almost any system. However, if we can tolerate a limitation in speed, then we can have a counter just by using the system itself, provided it has a timer and a digital display. We can write a program to simulate the action of a counter. The basic principle involves using the timer as a timebase and counting the number of high-to-low (or low-to-high) transitions which the unknown waveform makes while the timer is "on." What's involved in the context of the BMPS is shown in Fig. 15. Using the technique with other systems should be straightforward.

The first step is to set the 6502 μP to the decimal mode. This means that in any operation which involves an ADC or SBC instruction, the μP treats the eight-bit numbers which are involved as pairs of BCD digits. The next step is to clear the carry bit and three locations (registers) in the RAM. We designate the locations as LO, MID, and HI to indicate which pair of counts each holds.

We begin counting by starting the timer. We then check to see if the unknown waveform is low. If so, we add 1 to LO, 0 to MID, and 0 to HI. (Adding 0 to a number adds the carry, if any, from the next less-significant count.) If the output of the timer is still high by this time, we wait until the unknown waveform goes high and then low, and again modify the registers as appropriate. The process is repeated again and again until the output of the timer goes low. At that time, we process the counts in exactly the same way as if they had come from the counter board.

Only a few connections to the BMPS are necessary in order to implement the counter. The WRITE pulse for the output port at location 8100 is used to start the timer, while the most-significant bit of the input port at location A000 is used to monitor the output of the timer. The unknown waveform is tied to the most-significant bit of the input port at location 9000.

A program which will provide the function of a counter is shown in Fig. 16. Little comment is necessary, since it closely follows the flowchart.

The instructions which lie between FF80 and FFB1 in this program perform essentially the same function as the instructions which lie between FF86 and FF9C in the previous program. In each case, the counts are stored in locations 0000, 0001, and 0002. Thus, the portion of the previous program which processes and displays the counts clearly should be usable with this program, although I've not tried it. The instructions which lie between FFB2 and FFB9 in the present program provide a simple way to examine the contents of any of the registers. All that's necessary is to monitor the output port at location 8200.

Once we've implemented the counter in this way, all we need do further is to adjust the period of the timer until it's some convenient value, such as 1 second.

The price we pay for doing it the easy way—substituting software for hardware—is a loss of speed. In this case, the time between low-to-high transitions of the unknown waveform must be longer than the time which is required for the μP to traverse the inner loop of the program. This means that the frequency of the unknown waveform must be less than a few kilohertz.

A Preamplifier

Either counter is directly usable as is on CMOS-compatible signals. Those who will use the counter on other types of signals should add a signal-conditioning preamplifier of the sort shown in Reference 2 (substitute a 4049 CMOS hex inverter for the 7404, for example). There is room at the upper left corner of the PC board to do this. ■

References

1. Creason, *How to Build a Microcomputer*, 73, Inc., 1979.
2. Moraller, "Latest K2OAW Counter Update, *73 Magazine*, May, 1975.

✓ Reader Service—see page 259

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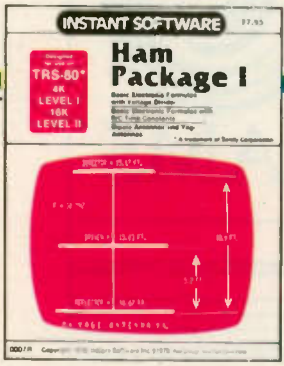

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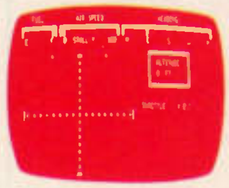

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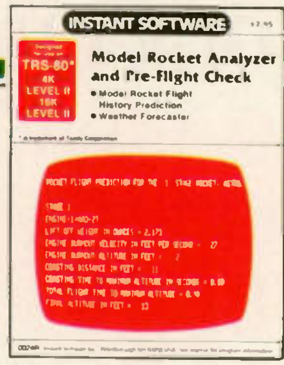

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Operation Santa!

—spread holiday cheer with this super club project

Photos by K8ZIS and W8WN

Photo A. Even without the red suit and long, white beard, Dave W8IFK looks and sounds like Santa.

"Santa's on television and wants to talk to you!"

How could that be? Well, once again old Santa made an appearance for the kids at McLaren Hospital in Flint, Michigan, to try to cheer up those who would be confined to the hospital over the holidays. Nothing unusual about that? This electronic Santa came to them via radio, color television, and (it is reported, perhaps with some imagination) via a multiple relay of stations all the way from the North Pole.

Santa has been coming to hospitals for many, many years, and amateurs have been able to let the kids in other hospitals talk to Santa "way off at the North Pole" via amateur radio for more years than most of us can remember. But a year ago, McLaren Hospital, in Flint, apparently was one of the first hospitals in the nation to go one step further. It initiated the practice of having Santa also appear on the in-house color TV system so that the kids (and anyone else in the hospital who wished to tune in) could not only hear the old gent, but also could see him in living color as he replied to their questions and requests.

"Operation Santa" for 1978 began as WD8KQI (Dr. Dan Bonbrisco, D.O.) and a couple of other members of the Genesee County Amateur Radio Emergency Service let the kids at the Flint Osteopathic Hospital talk with Santa via the 147.87/.27 Flint Hainer repeater. Meanwhile, Santa, also known as W8IFK, was across the street at McLaren Hospital trying to talk with the kids and get into his Santa suit at the same time.

After everyone in the pediatric ward at FOH had talked with the resident of the North Pole, the telephone operator at McLaren announced over the PA system that Santa would be on a certain TV channel in a few minutes to talk to the children there. Color bars were punched up, amateurs and hospital technicians made sure the TV sets in the pediatric sections were tuned and working properly, and all the children who could walk or be moved were taken to the sun rooms.

When all was ready, W8UPV put out a call over the Hainer repeater for Santa Claus. He didn't get him, but he did get another amateur "near Greenland" who said he could relay the traffic. Two more relays, including one "from an amateur at a DEW line radar post," got them close to the North Pole, but Santa didn't seem to be available. An autopatch, though, brought an answer from Santa's private secretary, who said that Santa was in his workshop but would be arriving momentarily. Meanwhile, slides of various operators at their shacks, the OSCAR satellites, etc., were being shown on the TV screen.

The screen suddenly went to color bars again (to allow the camera to be pivoted 180° in a very crowded photographic studio there in the hospital), and then came alive and focused on a large chair in front of a deep blue background just as a jolly, white-haired fellow, carrying a TR-22 and an extra mike, came in and sat down. Santa had arrived, and he said he wanted to talk with boys and girls in the hospital there in Flint, Michigan!

After a few minutes of getting himself composed, while describing the work he had been doing in the workshop, Santa asked to talk to the first little boy. But before the first one had even said anything over the mike of the HT down in the sun room, Santa had already called him by name and said he was sorry he had to be in the hospital; he even named the exact illness the boy had!

This was very mystifying—how could Santa know who was going to talk first? The same thing happened with all the other children—Santa knew names, illnesses, ages, and sometimes other facts about each one of them. One little boy became very excited. It seems that he had talked with "Santa" in one of the stores a couple of weeks earlier and had given him his name. "He remembered me!" the boy shouted, causing a great deal of merriment among the hams and nurses.

Since the children were busy watching the child who was talking and watching the TV screen to see Santa as he replied, most did not notice the other amateurs in the back of the room getting advance information on the next child and relaying it via .52 simplex to the photographic studio upstairs. Neither could they see the large chalkboard, just behind the TV camera, where names, ages, and illnesses were being written down (next to a permanent list of Santa's reindeer team, without which old Santa seemed to experience his one memory lapse).

Did you ever wonder just how Santa can listen to the requests kids make and give an answer that satisfies them without putting too much pressure on parents? This is a talent in itself. The requests run from the simplest, a doll, to the more expensive and elaborate, such as a real racing car or a diamond ring. Santa would laugh and compliment the child on his wanting reasonable things (if that were the case), or on how big his ideas were (for some of the more unreasonable ones). He would admonish them to be good, tell them that he would see what he could do, and that he thought he could find something that they would like (while never saying that he would give them what they actually asked for).

Photo B. "Santa" (W8IFK) talks to the kids via his TR-22 and the in-house color TV system while WA8IUS mans the camera. Note the second mike cord going under Santa's beard.

Many children, of course, just wanted to get out of the hospital in time for Christmas. For these, Santa had especially kind words, also reminding them to follow the doctor's instructions. One teenage boy was especially depressed—he had just broken both legs while skiing. While his injuries were not really serious, it was a bleak holiday season for that young fellow.

After talking with all the children in each of the sun rooms, the operators visited the rooms of the children who could not join the group. Invariably, they came upon nurses who were watching the TV screen but could not leave to see what was actually happening. Often they surprised the nurses with the opportunity to talk with Santa (much to the delight of Santa!), and he would then proceed to identify them and talk with them, also to the delight of the

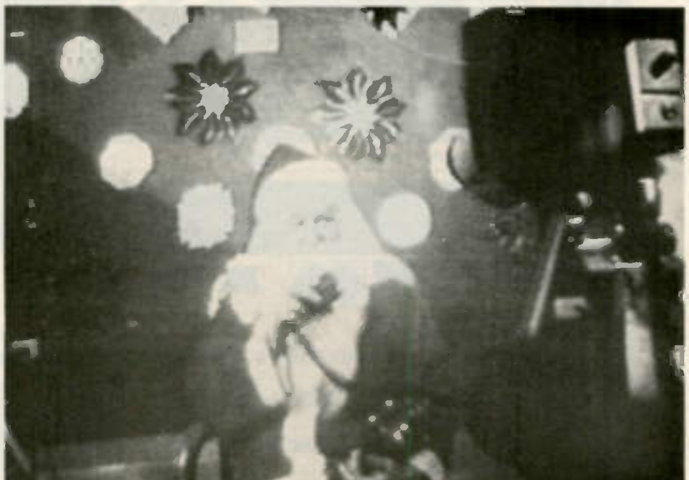


Photo C. This is how Santa looked on the TV screen during a newscast which gave a little extra PR for amateur radio.

children, doctors, nurses and all who were watching.

After talking with all the children (and some of the nurses) in McLaren, as the TV operation was being closed down, Santa talked with the grandchildren of several amateurs who had been monitoring. A news photographer from one of the local TV stations had arrived and filmed the scene in one of the sun rooms, so "Santa" had to get set again while a little newsreel footage was filmed.

"Operation Santa" had been done several times in Flint in the past, but in 1977, K8ZIS, medical photographer at McLaren Hospital, suggested that it be put on the newly-installed in-house TV system. Apparently, two other hospitals in other parts of the country also had the same idea at about the same time, and this has provided much pleasure for the children in those hospitals. But not only for the children—it has been noted that the adult patients, nurses, and doctors seem to enjoy watching the show as much as the kids themselves. It was not unusual to find sun rooms and wards all over the hospital crowded with patients, nurses, and interns watching their local "Operation Santa" on their own TV channel.

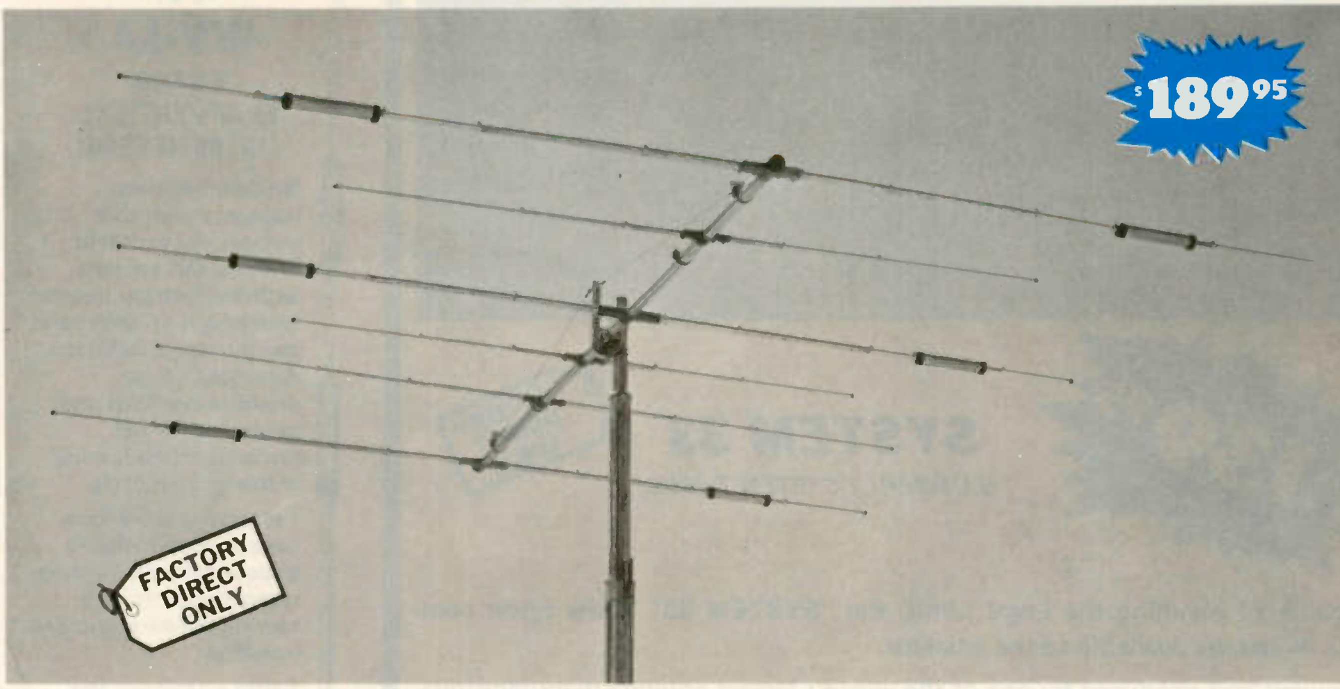
The Genesee County ARES provides emergency communications for the seven area hospitals as well as for a number of other groups. "Operation Santa" is hardly an emergency, but it is one of those little public service events that brings pleasure to someone else while improving our public relations. With the closed-circuit TV system, amateur radio is even more visible than ever.

Photo D. Santa's "memory" of the names of children was updated on this off-camera blackboard.

Operators who took part in the 1978 "Operation Santa" in Flint were W8IFK (who makes a magnificent Santa, even without the bright red suit), K8ZIS (medical photographer at McLaren who originated the TV idea locally), W8UPV, WD8JCN, WD8KQI WA8IUS, K8XN, W8YCN, WD8LMP, WD8CCG, and WA8ZQM. The operation was sponsored by the Genesee County Amateur Radio Emergency Service, Inc., the Hainer Repeater Association, and McLaren Hospital. ■

✓ Reader Service—see page 259

WILSON SYSTEMS, INC. presents the SYSTEM 36



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Gain (dBd)	Up to 9 dB	Longest element	28'2½"	Feed method	Coaxial Balun
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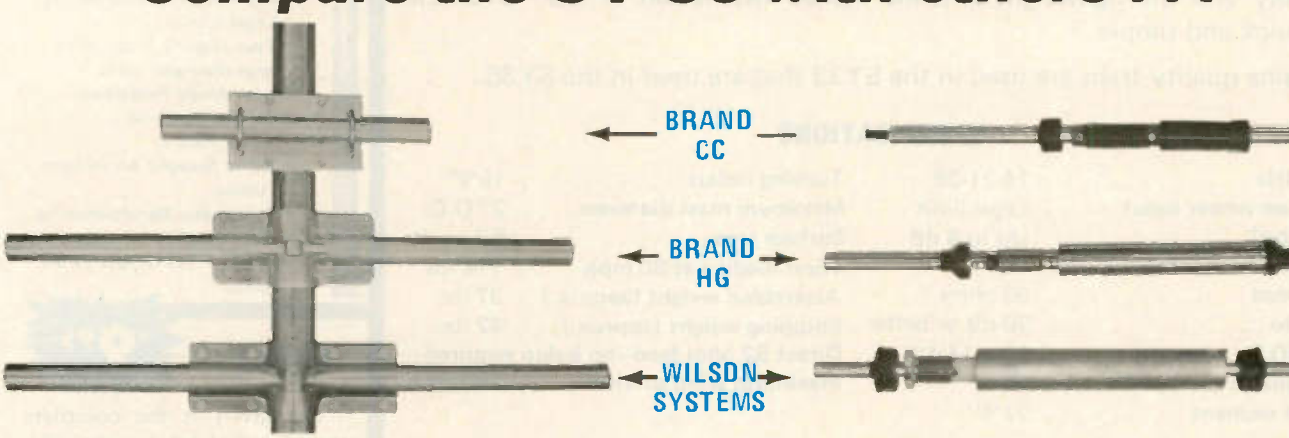

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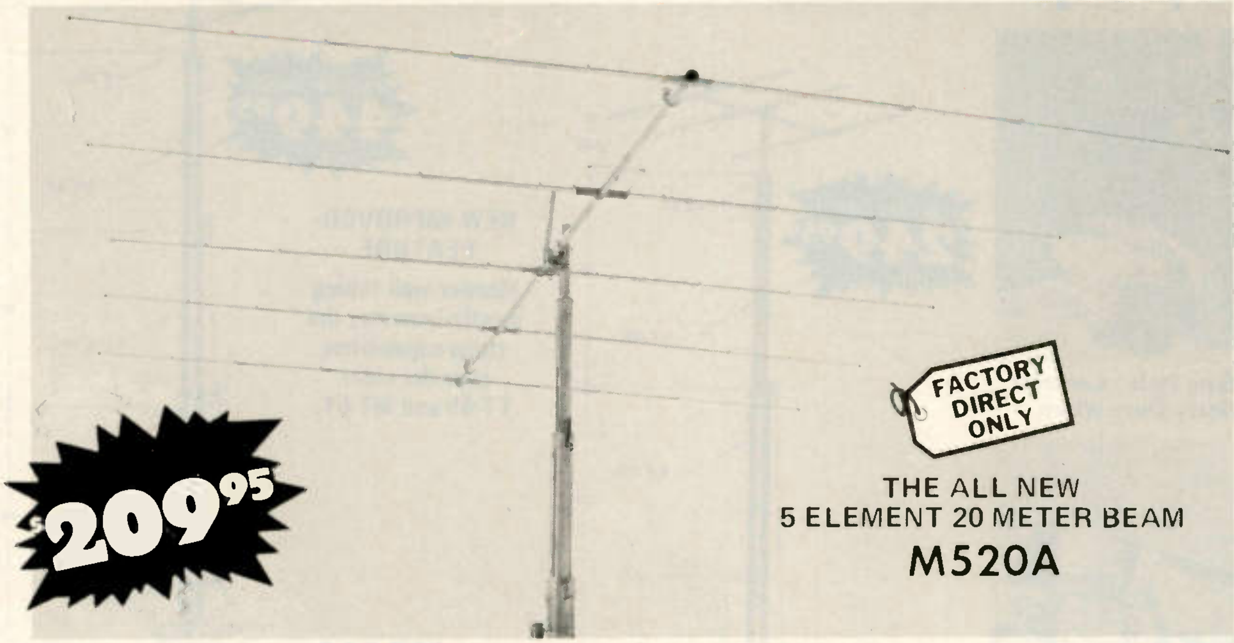

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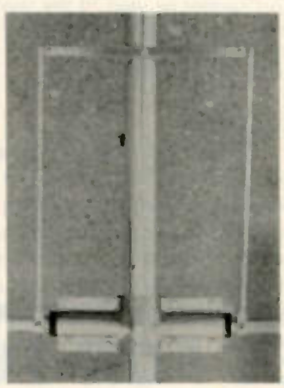
With the Wilson Beta-match method, it is a "set it and forget it" process. You can now assemble the antenna on the ground, and using the guidelines from the detailed instruction manual, adjust the tuning of the Beta-match so that it will remain set when raised to the top of the tower.



Wilson's Beta match offers maximum power transfer.

The Wilson Beta-match offers the ability to adjust the terminating impedance that is far superior to the other matching methods including the Gamma match and other Beta-matches. As this method of matching requires a balanced line it will be necessary to use a 1:1 balun, or RF choke, for the most efficient use of the HF Monobanders.

The Wilson Monobanders are the perfect answer to the Ham who wants to stack antennas for maximum utilization of space and gain. They offer the most economical method to have more antenna for less money with better gain and maximum strength. Order yours today and see why the serious DXers are running up that impressive score in contests and number of countries worked.

SPECIFICATIONS

Model	Band Mtrs	Gain dBd	F/B Ratio	Bandwidth @ Resonance 2:1 VSWR Limits	VSWR @ Resonance	Impedance	Matching	Elements	Longest Element	Boom O.D.	Boom Length	Turning Radius	Surface Area (Sq Ft.)	Windload @ 80 mph (Lbs.)	Maximum Mast	Assembled Weight (Lbs.)
M520A	20	11.5	25 dB	500 KHz	1.1:1	50 Ω	Beta	5	36'6"	2"	34'2½"	25'1"	8.9	227	2"	68
M420A	20	10.0	25 dB	500 KHz	1.1:1	50 Ω	Beta	4	36'6"	2"	26'0"	22'6"	7.6	189	2"	50
M515A	15	12.0	25 dB	400 KHz	1.1:1	50 Ω	Beta	5	25'3"	2"	26'0"	17'6"	4.2	107	2"	41
M415A	15	10.0	25 dB	400 KHz	1.1:1	50 Ω	Beta	4	24'2½"	2"	17'0"	14'11"	3.1	54	2"	25
M510A	10	12.0	25 dB	1.5 MHz	1.1:1	50 Ω	Beta	5	18'6"	2"	26'0"	16'0"	2.8	72	2"	36
M410A	10	10.0	25 dB	1.5 MHz	1.1:1	50 Ω	Beta	4	18'3"	2"	12'11"	11'3"	1.4	36	2"	20

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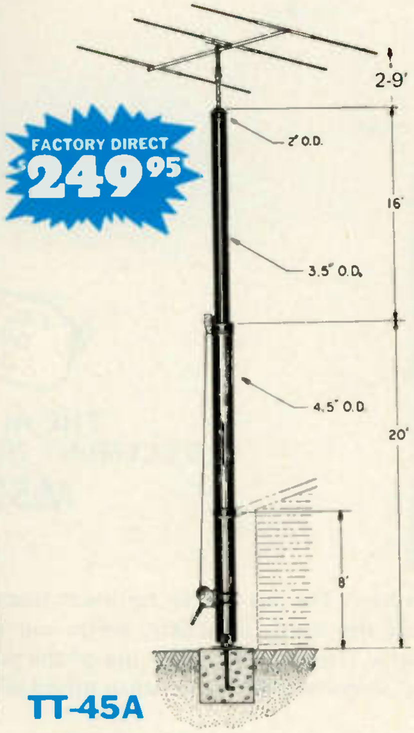
New, Improved Wilson Towers

Hinged Base Plate - Concrete Pad, Heavy Duty Winch

Mounting the House Bracket

The Hinged Base Plate allows tower to be tilted over for access to antenna and rotor from the ground.



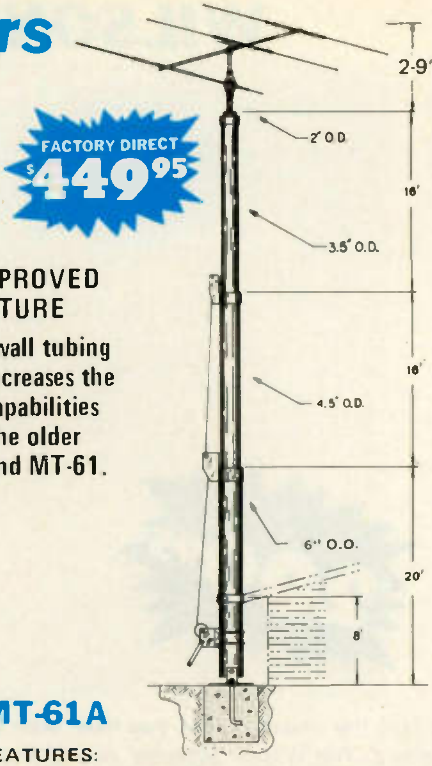
TT-45A

FEATURES:
- Maximum Height 45' (will handle 12 sq. ft. at 38') @ 50 mph
- 1200 lb. winch
- Totally freestanding with proper base
- Total Weight, 243 lbs.

The TT-45A is a freestanding tower, ideal for installations where guys cannot be used. If the tower is not being supported against the house, the proper base fixture accessory must be selected. (Requires 12"x12"x36" of concrete.)

NEW IMPROVED FEATURE

Heavier wall tubing greatly increases the stress capabilities over the older TT-45 and MT-61.



MT-61A

FEATURES:
- Is freestanding with use of proper base
- Maximum Height is 61' (will handle 12 sq. ft. at 53') @ 50 mph
- 1200 lb. brake winch
- 4200 lb. raising cable
- Total Weight, 400 lbs.

Recommended base accessory: RB-61A, FB-61A.

The MT-61A is our largest and tallest freestanding tower. By using the RB-61A rotating base fixture the MT-61A is ideally suited for the SY33 or SY-36. If you plan to mount the tower to your house, caution should be taken to make certain the eave is properly reinforced to handle the tower. If not, one of the base accessory fixtures should be used. (Requires 18"x18"x48" concrete.)

GENERAL FEATURES

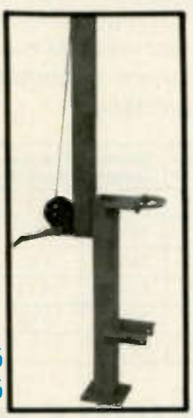
All towers use high strength heavy galvanized steel tubing that conforms to ASTM specifications for years of maintenance-free service. The large diameters provide unexcelled strength. All welding is performed with state-of-the-art equipment. Top sections are 2" O.D. for proper antenna/rotor mounting. A 10' push-up mast is included in the top section of each tower. Hinge-over base plates are standard with each tower. The high loads of today's antennas make Wilson crank-ups a logical choice.

TILT-OVER BASES FOR TOWERS

FIXED BASE

The FB Series was designed to provide an economical method of moving the tower away from the house. It will support the tower in a completely free-standing vertical position, while also having the capabilities of tilting the tower over to provide an easy access to the antenna. The rotor mounts at the top of the tower in the conventional manner, and will not rotate the complete tower. (Requires 3'x3'x5½' of concrete.)

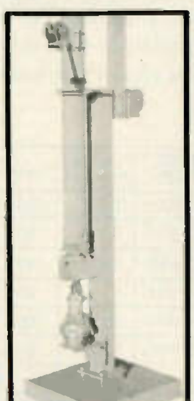
FB-45A . . . $ 99.95
FB-61A . . . 129.95



ROTATING BASE

The RB Series was designed for the Amateur who wants the added convenience of being able to work on the rotor from the ground position. This series of bases will give that ease plus rotate the complete tower and antenna system by the use of a heavy duty thrust bearing at the base of the tower mounting position, while still being able to tilt the tower over when desiring to make changes on the antenna system. (Requires 3'x3'x6' of concrete.)

RB-45A . . . $139.95
RB-61A . . . 199.95



Tilting the tower over is a one-man task with the Wilson bases.

(Shown above is the RB-61A.) (Rotor not included)

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Toll-Free Order Number 800-634-6898

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6 METER BEAMS

Model M68

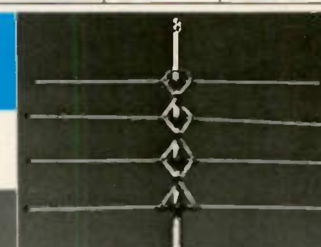
As low as $27^{95}

8 elements W - I - D - E spaced on a L - O - N - G 37' boom . . . for those long hauls to JA and VK land! Choose 4, 6 or 8 elements to put you in the action on six meters.

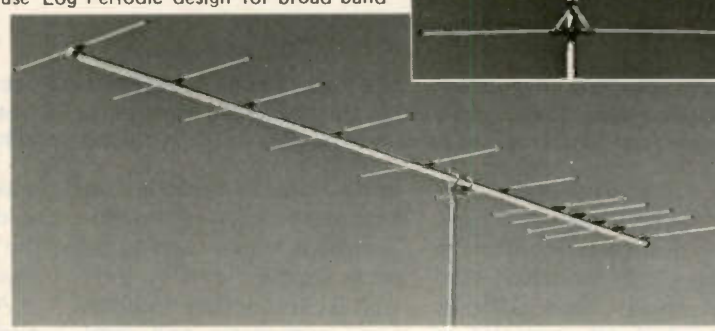
SPECIFICATIONS	MODEL M68	MODEL M66	MODEL M64
Band MHz	50	50	50
Maximum Power Input	4 Kw	4 Kw	4 Kw
Gain (dB)	13.5	13.0	10.0
VSWR (at resonance)	1.1:1	1.1:1	1.1:1
Impedance	50 ohms	50 ohms	50 ohms
F/B Ratio (dB)	26	26	25
Boom (O.D. x Length)	2" to 1½" x 36'10"	2" x 25'8"	1½" x 11'6"
No. Elements	8	6	4
Longest Element (Ft.)	9'8"	9'8"	9'8"
Turning Radius (Ft.)	19'0"	13'10"	7'6"
Mast Diameter	2" O.D.	2" O.D.	1½" O.D.
Boom Diameter	2" to 1½" O.D.	2" O.D.	1½" O.D.
Surface Area (Sq. Ft.)	5.8	4.5	1.5
Wind Loading @ 80 mph	145	112	37
Assembled wght. Approx.	34 lbs.	26 lbs.	11 lbs.
Shipping wght. Approx.	39 lbs.	31 lbs.	13 lbs.
Matching Method	Gamma	Gamma	Gamma
PRICE	$84.95	$54.95	$27.95

Starting at $19^{95}

2 METER BEAMS



Wilson's new 2 meter series combines the ultimate in design and quality materials. These top performing beams feature 7, 9 or 11 aluminum elements held to the heavy walled boom with the exclusive molded Lexan® boom to element mounting. The four driven elements use Log Periodic design for broad band characteristics providing full 144-148 MHz coverage with less than 1.2 to 1 VSWR across the band. Universal mounting is provided for vertical or horizontal polarization.



SPECIFICATIONS	M27	M29	M211
Band MHz	144-148 MHz	144-148 MHz	144-148 MHz
Gain (dB)	11 dB	13.7 dB	14.5 dB
VSWR	Less than 1.2:1 across band	Less than 1.2:1 across band	Less than 1.2:1 across band
Impedance	50 ohms balanced	50 ohms balanced	50 ohms balanced
Number of Elements	7	9	11
Boom (O.D. x Length)	1" O.D. x 5'4"L.	1" O.D. x 10'0"L.	1½" O.D. x 12'6"
Longest Element	40"	40"	40"
Surface Area (Sq. Ft.)	.8	1.5	2.8
Assembled wght Approx.	3.5 lbs.	5 lbs.	6 lbs.
Shipping wght. Approx.	6.5 lbs.	8 lbs.	9 lbs.
Turning Radius	38"	64"	78"
PRICE	$19.95	$24.95	$29.95

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Las Vegas, NV 89103 — (702) 739-7401

FACTORY DIRECT ORDER BLANK

Toll-Free Order Number
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WILSON SYSTEMS ANTENNAS

Qty	Model	Description	Shipping	Price
	SY33	3 Ele. Tribander for 10, 15, 20 Mtrs.	UPS	$139.95
	SY36	6 Ele. Tribander for 10, 15, 20 Mtrs.	UPS	189.95
	WV-1A	Trap Vertical for 10, 15, 20, 40 Mtrs.	UPS	44.95
	GR-1	Ground Radials for WV-1A	UPS	9.95
	M-520A	5 Elements on 20 Mtrs.	TRUCK	209.95
	M-420A	4 Elements on 20 Mtrs.	UPS	139.95
	M-515A	5 Elements on 15 Mtrs.	UPS	119.95
	M-415A	4 Elements on 15 Mtrs.	UPS	79.95
	M-510A	5 Elements on 10 Mtrs.	UPS	84.95
	M-410A	4 Elements on 10 Mtrs.	UPS	64.95
	WM-62A	Mobile Antenna: 5/8 λ on 2, 1/4 λ on 6	UPS	19.95
	M-86	8 Elements on 6 Mtrs.	UPS	84.95
	M-66A	6 Elements on 6 Mtrs.	UPS	54.95
	M-46	4 Elements on 6 Mtrs.	UPS	27.95
	M-112	11 Elements on 2 Mtrs.	UPS	29.95
	M-92	9 Elements on 2 Mtrs.	UPS	24.95
	M-72	7 Elements on 2 Mtrs.	UPS	19.95
		ACCESSORIES		
	HD-73	Alliance Heavy Duty Rotor	UPS	109.95
	RC-8C	8/C Rotor Cable	UPS	.12/ft
	RG-8U	RG-8U Foam-Ultra Flexible Coaxial Cable. 38 strand center conductor, 11 guage	UPS	.21/ft.

WILSON SYSTEMS TOWERS

Qty.	Model	Description	Shipping	Price
	TT-45A	Freestanding 45' Tubular Tower	TRUCK	$249.95
	RB-45A	Rotating Base for TT-45A w/tilt over feature	TRUCK	139.95
	FB-45A	Fixed Base for TT-45A w/tilt over feature	TRUCK	99.95
	MT-61A	Freestanding 61' Tubular Tower	TRUCK	449.95
	RB-61A	Rotating Base for MT-61A w/tilt over feature	TRUCK	199.95
	FB-61A	Fixed Base for MT-61A w/tilt over feature	TRUCK	129.95

NOTE:
On Coaxial and Rotor Cable, minimum order is 100 ft. and in 50' multiples.
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A. A. Wicks W6SWZ
30646 Rigger Road
Agoura CA 91301

Tools and Techniques for Wire-Wrapping

—an excerpt from 73's new book

Editor's note: This article is an excerpt from 73's new book, *Tools and Techniques for Electronics*, by A. A. Wicks W6SWZ. The book is a comprehensive guide to construction practices, from soldering to PC boards to metalworking. It's available from 73's Radio Bookshop, Peterborough NH 03458. The price is $4.95 (plus $1.00 for shipping and handling).

As experimenters and hobbyists become more and more involved in integrated circuitry and equipment that utilizes these and other miniature devices, a technique that has been used in industry for many years becomes attractive to use. Although originally developed in the early 1950s, a solderless interconnection technique known as wire-wrapping did not immediately gain popularity within industry until automatic and semi-automatic wire-wrapping equipment, for the most part using programmed tape equipment, provided a low-cost, rapid method of making thousands of these solderless connections on the "back panel" of component boards.

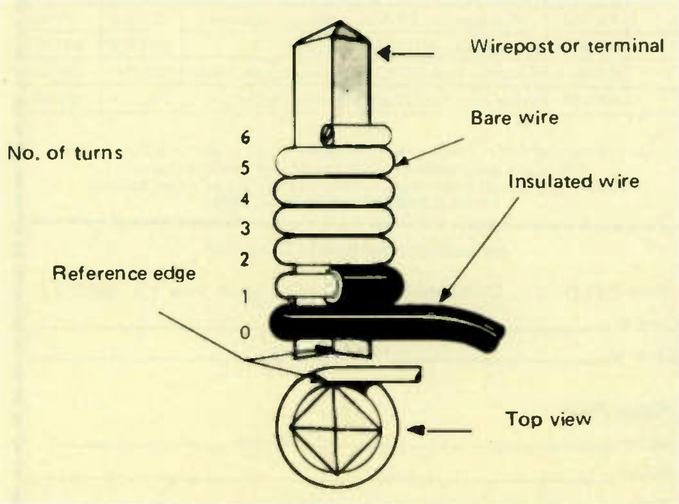


Fig. 1. Wire-wrapped terminal and references.

A wire-wrapped connection is shown in Fig. 1. It is exactly that—a wire, "wrapped" around a terminal post several turns, which provides an absolute metal-to-metal, gastight connection. At first, these connections were made by using a hand-operated tool. Then, speed was gained by driving this tool with an electric motor in the form of a "gun" in which the tool was inserted and locked. This technique continued to be used industrially, even with the advent of programmed machinery which, point-by-point, moved the electric tool over a back panel, at which point a human operator inserted a pre-cut and pre-stripped length of wire in the tool, lowered it over the wire terminal post, made the wrap, then allowed the tool to move to its next location. This technique continues to be used today, but in more sophisticated applications of mass production, the whole operation is programmed and automatic.

While this was going on, the engineering laboratories were involved in prototype production, but, as is obvious, prototypes do not warrant the expense of specialized programmed equipment worth tens of thousands of dollars.

Therefore, back in the lab, engineers and technicians continue to use hand wire-wrapping tools, both manual and electric. And it is to this level, the prototype level, that we, as experimenters and hobby work-ers, direct our interest.

The techniques of wire-wrapping are especially desirable in place of printed circuit boards (frequently called "cards"), when only one unit is to be produced. Printed circuit layout and preparation for one assembly, although creative fun and very effective, is more work than enjoyment in many instances, especially for the person anxious to have a circuit completed and ready for operation quickly. (A combination of printed circuit and wire-wrapping will be discussed later in this section.)

The information provided here is directed for the most part to those who have never performed wire-wrapping. A person already involved in this type of construction is usually extremely enthusiastic about its time-saving and "second-chance" possibilities (a printed circuit is *very* difficult to change, once etched). Before proceeding, we should mention some of the terms of wire-wrapping and what they mean, so that you may discuss the equipment and tools with your supplier.

First of all, there are two styles of wire-wrapping in use, as far as serially-connected terminals are concerned. One "daisy chain" is shown in Fig. 2(a). "Level-ordered" is shown in Fig. 2(b). Daisy-chain wiring is not recommended, as a moment of study will show that if you wish to change the wiring on two terminal posts (or wire-wrapping terminals) that have been daisy-chained, you may have to remove six wires (the maximum number of wire levels being three), whereas with level-ordered wiring, four would be maximum.

Wires placed on posts by level order are identified as levels 1, 2 and 3, with level 1 being the wire nearest the component board (Fig. 3).

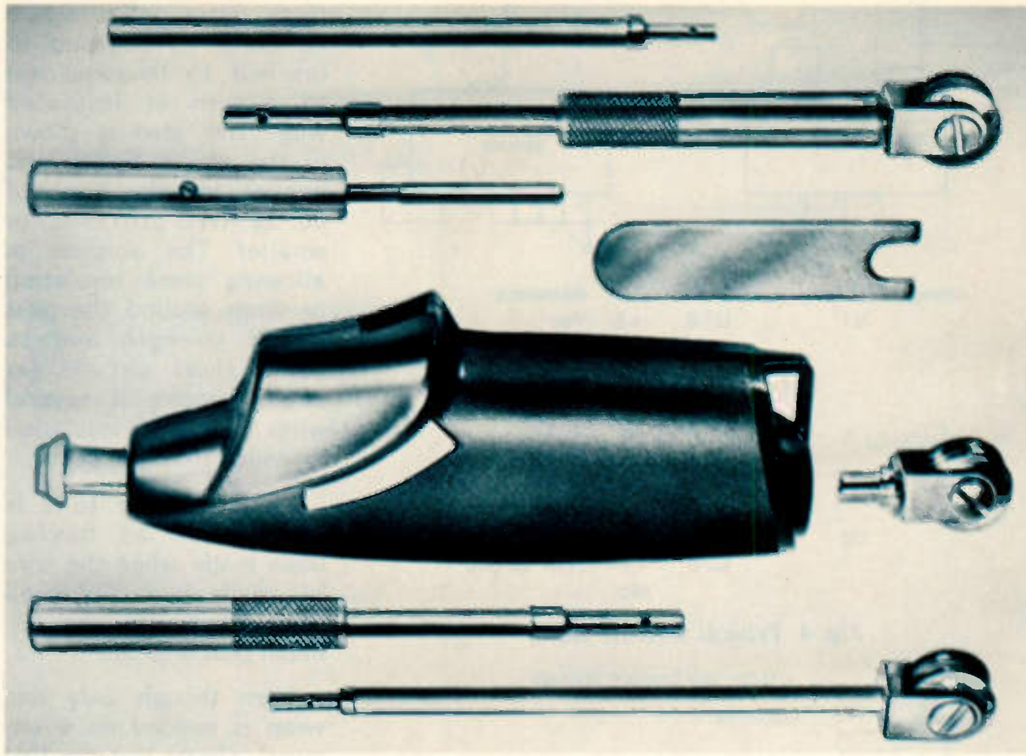


Photo A. Low-cost manual and electric wire-wrapping tools.

Ordering of Wiring

Although not absolutely essential, especially on a smaller project, it may be desirable to "order" your wiring prior to commencing the actual job. That is, you must consider that certain wires will go on level 1, certain others on level 2, and so on. The only real reason for this, of course, is for later corrections, modifications, and additions. With all three levels full, and density wiring, it is of immense help to *know* that the wire you wish to remove is on "terminal post 6, IC23, level 2," for instance. This information can be part of your "wire list" prepared directly from the circuit diagram. If you have a good wire list, you can rapidly wire a back panel using wire-wrapping techniques, without reference to the schematic. In fact, electronics laboratories have persons skilled in wire-wrapping, but unskilled in electronics, doing this constantly.

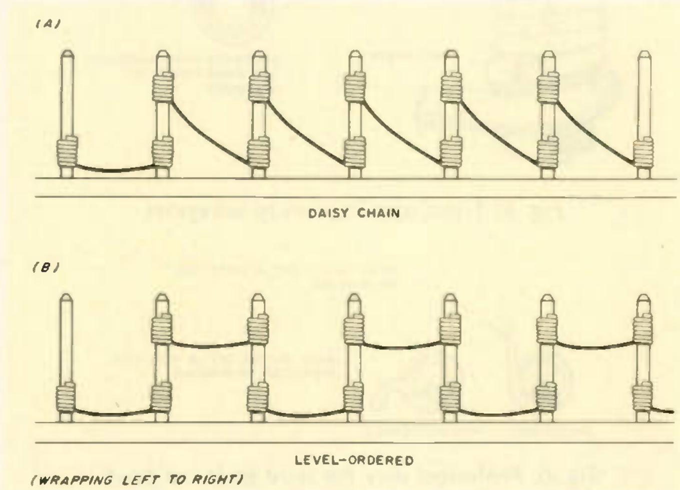


Fig. 2. Daisy-chain and level-ordered wiring.

Wire-listing

Whether or not you level order your wires, do plan on wire-listing your connections as mentioned above when wiring complex circuitry. Make up a wire-list table, as shown in Fig. 4, and, working from the schematic, such as that shown in the figure, draw a line through the schematic as you enter the information on the wire list.

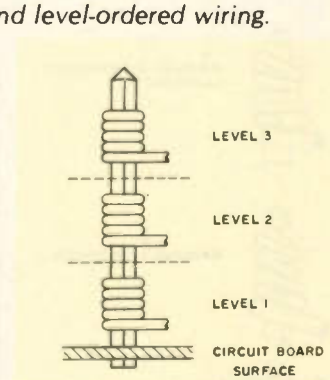
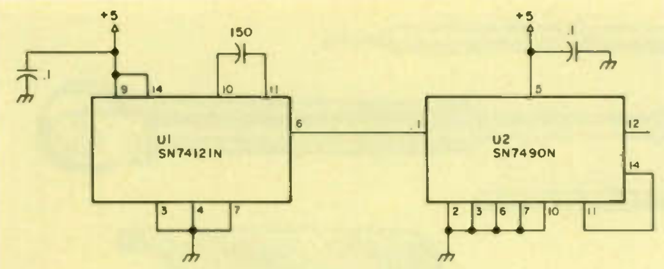


Fig. 3. Level orders of wire-wrapping.

Check this over, and your chances of wiring error are minimal. If you do mis-wire, locating your error is done quickly.



Component Reference	From	To	Remarks
U1	U1-9	+5	Vss
	U1-9	U1-14	
	U1-9	.1	.1 uF to gnd
	U1-10	150 pF	150 pF to U1-11
	U1-3	G	Chain
	U1-4	G	Chain
	U1-7	G	Chaln
	U1-6	U2-1	
U2	U2-5	+5	
	U2-5	.1	.1 uF to gnd
		etc.	

Fig. 4. Typical wire-list table.

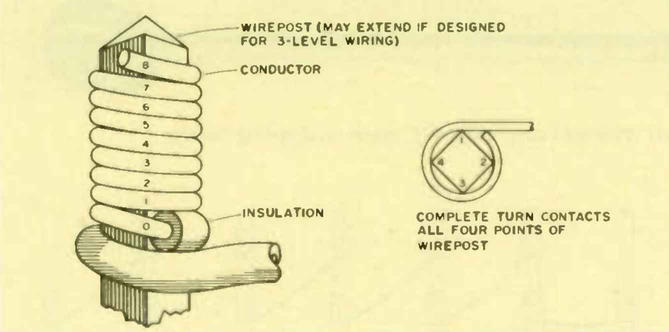


Fig. 5. Turns application to wirepost.

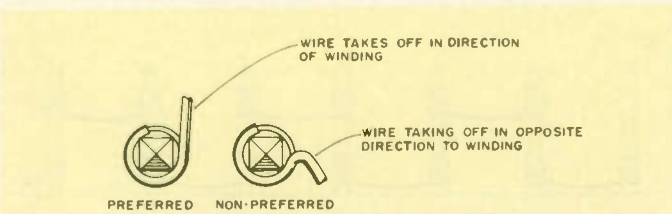


Fig. 6. Preferred way for wire to leave post.

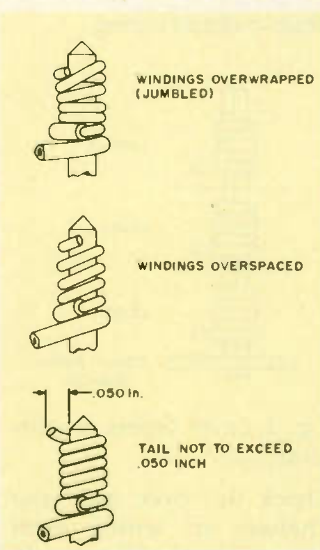


Fig. 7. Three types of unsatisfactory wraps.

Wire Application

Using conventional wire-wrapping tools, whether electric or manual, is the same, as far as the wiring on the post is concerned. We say "conventional," because later on we are going to describe some newer tools that have been produced with you, the at-home constructor, in mind.

Wires wrapped on a post should look like the greatly enlarged sketch in Fig. 5. The number of wire turns should be six of bare wire (plus two turns, minus one turn as a variable), in addition to one-half to three-quarters of a turn of insulated wire. This also is shown in the above figure, and applies to wire sizes of no. 26 AWG (0.0159-in.) or smaller. The purpose in allowing some insulation to wrap around the post is for strength and to avoid short circuits (as could happen if several wires bared of insulation extended from the posts).

A completed turn is considered as having been made when the wire has made contact with all four corners of the terminal post (Fig. 5).

Even though only one wrap is needed on a terminal, always put the first wrap at level 1. If you find it necessary to unwrap a wire from a post, never attempt to reuse it, but remove the other end also, and discard the wire. Once applied and removed, wire is structurally damaged so that it is totally unreliable for reuse. Caution should also be used in attempting to reuse terminal posts too many times. After ten or so wraps and unwraps, inspect the post closely, with a magnifier if possible, for damage such as loss of plating, corrosion, nicks, and structural weakness. This is more important if a powered wrapping tool has been used, as manual use is not so likely to apply as many stresses.

Route your wires rather openly from terminal to terminal. It is not unusual to loop the wires in an upward direction and dress them carefully later. Do not draw them tightly around other posts or parts, and never kink or sharply bend the wires. As long as electrical factors such as rf, hum, choke effect, etc., are not a consideration, multiple loops are acceptable in order to take up slack if the lead is too long. Always inspect the wires as the work progresses for any bare spots that may have been made in the insulation of the wire between wiring points. Never repair; always replace, if any are found.

Whenever possible, have the wire wrapped on the post in an orientation that allows the wire to leave the post without any tendency to unwind, as in Fig. 6. This means that you should always look ahead to see where the next post is that is to be connected.

With most tools, you cannot make other than perfect wraps. However, a non-perfect wrap, should it occur, is one that has the wires "jumble-wound" (a wire on top of itself in a spiral) or a wire that has too much space between each turn (should not be more than one-half the wire diameter). Last—but certainly very important because of short-circuit potential—do not permit the end of the wire resulting from the last turn to project out from the post more than .05 inch (1.3 mm). Spacing between two of these wire ends should be a minimum of 1/32 inch (.08 cm). See Fig. 7.

All of the preceding makes wire-wrapping sound difficult and complex—which is far from being true—but these hints are merely ways to do the job well. Now let us consider some of the tools that make the job easy.

A wire-wrapping tool used in a power-operated device is known as a bit, just as for a drill. Bits are provided to accommodate various sizes of bare wire, e.g., no. 22-24, 24-26. A sleeve, customarily used, is insulated and protects adjacent terminals. The bit rotates within the sleeve. Photo A shows several wire-wrapping tools.

A tool for manual operation is known generically as a wire-wrapping tool—sometimes as a hand-wrapping tool. A number of trade names are in use. We also have "unwrapping" tools, discussed later.

The basic tool is composed of a handle, as a screwdriver has, and a narrow cylinder about two inches long. The operating end is approximately .070 inch (1.8 mm) in diameter to permit easy working between terminal posts. These tools are usually made of metal, although one manufacturer produces a low-cost tool made with fiberglass filled nylon. A tool manufactured by Vector Electronic Company, Sylmar, California, uses a hardened beryllium copper bit, and can easily wrap multilevels. This particular tool will accept no. 26 through 30 gauge wire, and has the unique capability of accepting bare wire through the top end for continuous wiring.

The bit end of the tool accepts the bared end of insulated wire or the end of uninsulated wire. The principle of inserting the wire and wrapping is similar. The enlarged view of the bit end shown in Fig. 8, through the courtesy of Vector Electronic Company, Inc., is used here for illustration.

The wire to be inserted should be held in one hand with your thumbnail 1.3 inches (3.3 cm) from the end of the wire. The side of the bit that has the wire tunnel may be identified by the probe hole on the side of the tool tip.

Holding the tool horizontally, or with the tip elevated slightly, insert the wire end into the tunnel. If the position of the wire probe hole has been noted, there should be no problem. But if you have inadvertently inserted the wire into the wirepost hole, the wire will not enter as far as your thumbnail holding the wire. Therefore, remove the wire and try again. Once it is inserted correctly, remove the wire about half of its length, bend it slightly and reinsert it. This will hold it securely. Now, releasing the wire, bend it at 90° at the tip.

Place the tool down over the wire-wrap post, and route the other end of the wire toward the next terminal post to be wrapped. Hold the loose end of the wire to the board with a firm but soft tool (an alignment tool is good for this, or a small screwdriver with a piece of heatshrink tubing on the end), make one clockwise turn using no downward pressure. Continue, using slight downward pressure, for the full number of turns. If the amount of insulation removed is correct for the number of turns, the tool should release itself. But if you continue to turn and exert downward pressure, jumblewrap (or overwrap) will result.

Wires may be stripped as you wire, using standard wire-stripping tools (they must be for the small wire sizes used, of course), or you may strip ahead of time. Considering the relatively minor cost involved, this rather irksome task may be avoided by purchasing your wire pre-cut and pre-stripped. The Cambridge Thermionic Corporation (Cambion®), for instance, supplies kits of 25 pieces each of 1.5-, 2.5-, 5.0-, and 7.0-inch (3.81-, 6.35-, 12.7-, and 17.78-cm) no. 30 AWG kynar-insulated wire. Each length is stripped one inch (2.54 cm) on each end.

Unwrapping may be done by carefully gripping the wire with needlenose pliers and unwinding the spiral. But this is tedious and time-consuming if many unwindings are to be made. An unwrapping tool, manually operated, is very low in cost and should be on hand.

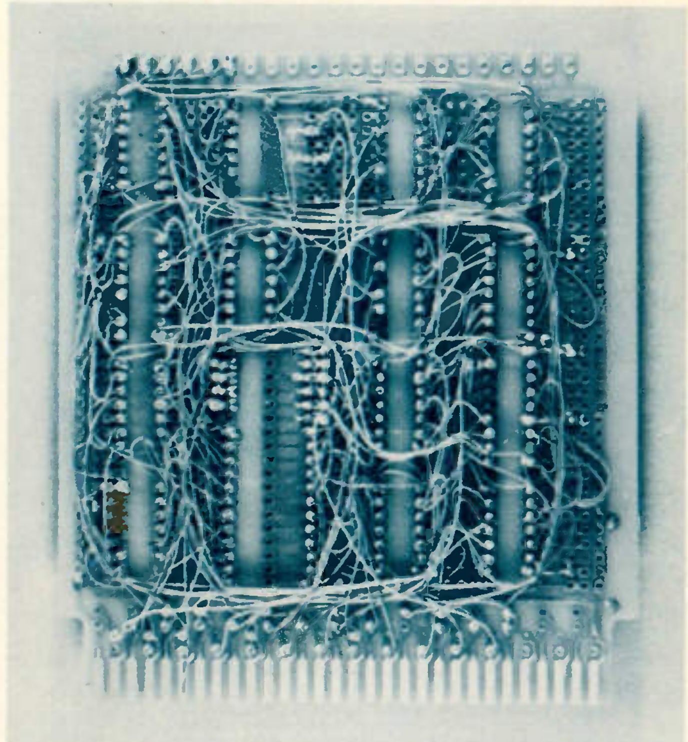


Photo B. Typical wire-wrapped circuit board. This board is of "universal type" with printed circuitry on opposite side.

In order to unwind a wrap, all that is necessary is to place the tool over the post, press it down slightly, and turn it counterclockwise. As previously mentioned and again emphasized—discard the wire.

One rather innovative approach to prototype wire-wrapping has been made by Vector. The tool used for this purpose is the Model P180, and has been designated "Slit-n-Wrap." A Motor-driven model, the P160-4T, is also available, but utilizes the hand tool as a driving bit, thus permitting you to upgrade your initial purchase if you desire.

The wire normally used for this tool is no. 28 AWG, nylon-polyurethane insulated, but it is also possible to wrap using standard no. 28 or no. 30 gauge pre-stripped and pre-cut wire. The wire may be obtained in clear, red, green, or blue, and is run from a spool attached to the top of the tool.

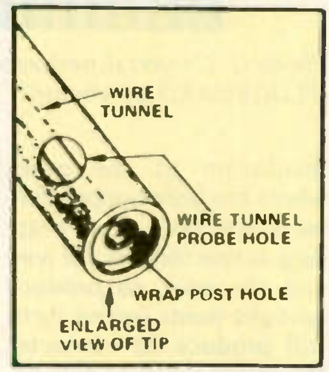


Fig. 8. Wire-wrap (Vector).

The system has been designed so that six turns provide extremely low resistance connections, each contact being approximately 0.003 Ohms. The secret to the success of this tool is in the removal of insulation from the wire as it passes over a narrow sharp edge in the bit. As the tool is rotated, the wire rolls along a path from this sharp edge to the wire post, which further opens the slit in the

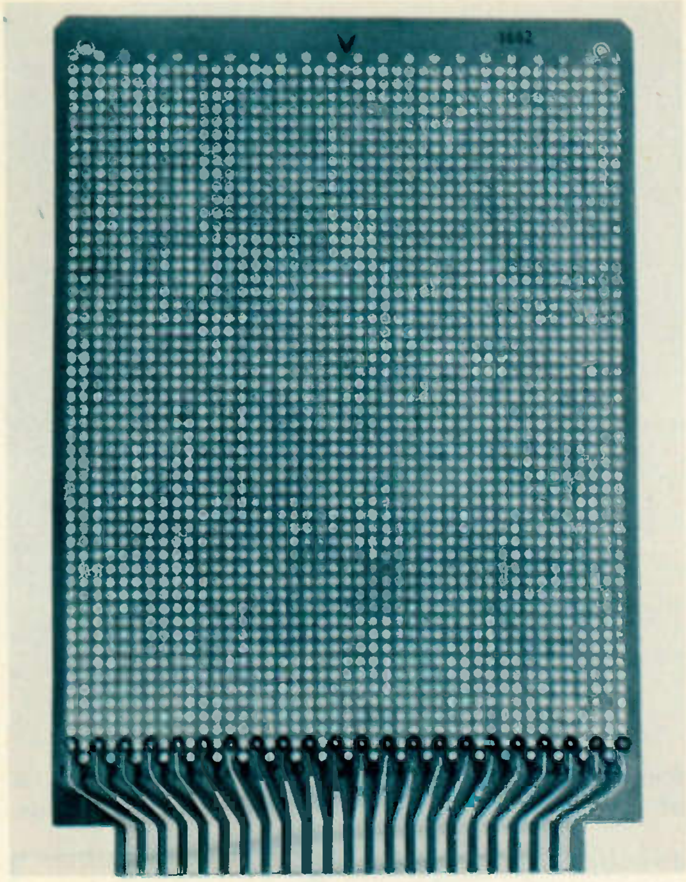


Photo C. Universal perforated board with end connectors (PLUGBOARD by Vector).

Fault	Probable Cause
Spiral or spread out wraps	Lifting tool during wrapping
Overlapping (jumble) turns	Excessive downward pressure during wrap
End tail too long	Removing tool before sufficient rotations have been made
Insufficient turns	Insulation not stripped back far enough. Wire not inserted fully into bit
Excessive turns	Too much insulation stripped

Table 1. Wire-wrapping problem guide.

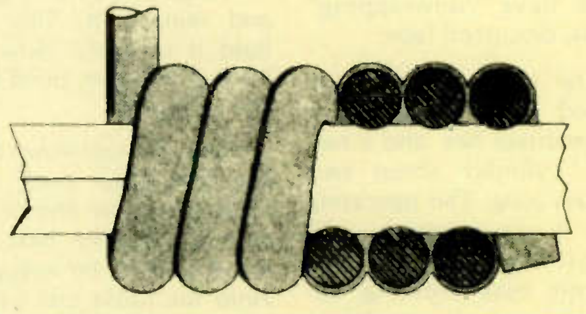


Fig. 9. Cross-section of "Slit-n-Wrap" connection (Vector).

insulation at the point where the bare copper contacts the post. The wrapping action indents the wire and the post, to produce gastight joints (seven turns will produce 28 contacts). Insulation removal only occurs when wrapping takes place, not when wire is removed from the tool.

Fig. 9 shows a cross-section of how the wire wraps on the post. Any insulation that is displaced reforms in the space between the wire turns. Wire is held close to the board (when starting or moving to the next terminal) using a dull wireholder. No looping is necessary, and this type of wiring is amenable to daisy chaining. Wire is not cut until the end of a run or until a circuit path is reached.

Circuit Boards for Wire-wrapping

You may design and make your own PCB that will permit you to use wire-wrapping techniques. You may purchase "universal" PCBs (Photo B) that allow complete flexibility of design using wire-wrapping. And you may purchase component boards containing prepunched holes for mounting parts to be connected by wire-wrapping.

The technique of wire-wrapping is the same in each case. However, with a board etched for a specific project there is little or no flexibility, which is intended.

Universal-type wrappable boards have an overall grid of 0.042-inch-diameter (1.1-mm) holes on 0.1-inch (2.5-mm) centers, and use tinned interleaved buses. Any one or more Dual In-line Package (DIP) sockets may be installed anywhere on the boards. If parts such as resistors and capacitors are placed on the board, they should be installed using component carriers in order to take full advantage of wire-wrapping shortcuts (or, the circuit paths may suffice). A component carrier looks like an IC with the "lid" off, has wire-wrap terminals in this case, and on the open top surface has solder terminals to accept resistors, etc.

Sockets are also available for SCRs, transistors (all cases), and other components.

At least one manufacturer produces these boards with card connector terminations on one edge. This makes each board a separate entity within a system, with only the edge connector receptacle wiring between boards needed to complete the system.

End connector boards, by the way, frequently develop open circuits between the card and the connector. This can usually be corrected by removing the card and then reinserting it. If this doesn't work, the edge connections should be cleaned with alcohol, or even with a soft pencil eraser.

Component boards, made up of either epoxy paper or epoxy glass, use no copper etching paths except possibly as an edge connection. Typical of these boards is the one shown in Photo C, again manufactured by Vector under the name "PLUGBOARD." As in the case of etched boards, this carrier has 0.042-inch holes on 0.1-inch centers. A great deal of flexibility can be used in making prototypes with these boards, as parts of any reasonable physical size may be placed on them. They also have the advantage of being less costly than etched boards.

Wrapped-wire-type square pins are obtainable to insert into the holes on component boards or to use as parts holders or connecting points.

Wire-wrapping Problem Guide

Causes and cures for wire-wrapping problems have been mentioned throughout the preceding paragraphs. These have been summarized in Table 1. If you encounter difficulties in your initial wire-wrapping endeavors, check the table to analyze your problem. ■

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Working with Transistors

—useful knowledge begins where gobbledygook ends

Author's Note: This article was about to be sent in to *73* when an excellent article, "*73* Reveals Bias," by Carl C. Drumeller W5JJ, appeared in the September, 1978, issue of *73*, p. 136.

He used a method very similar to mine to determine transistor component values. There are differences in our approaches, though, and this article also covers material which he did not present. So, after talking with *73*, it was decided to go ahead with this one, too.

I recommend that you compare the two approaches to the problem and particularly note the different choices we each made in circuitry as well as the similar pragmatic answers.

Some years ago, I was able to take the Navy's "two-pound" course in basic electronics. It starts with "this is an electron," and ends up with "this is a computer."

There was a full section on transistor theory and application. This was good, as I didn't know anything about transistors.

By some fluke, I completed that part of the course with a high score. I also came away with one other important piece of information: I still didn't know anything about transistors.

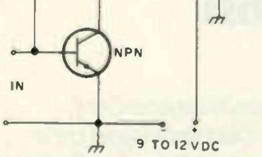

Fig. 1. Basic transistor voltage amplifier.

This was not the fault of the course or my lack of application. The information was centered on having total control of specifications and technical information on the devices being used.

Out in the real world, the slide-rule approach simply would not work at all. I never could get all the info needed to work the formulas, and I still did not have a firm grasp of what I was trying to do.

Contrast the almost religious devotion to the slide-rule approach to transistors with the usual way one learned about tubes, as I was introduced: Here is a tube (a type 30). It has a filament, a grid, and a plate. You connect three volts and a rheostat to the filament, like this, and the B battery to the plate circuit and one side of the filament, like this. Now, here's how you hook it up to make a radio (a one-tube regenerative set). Don't hook up the B battery backwards and don't connect the B battery to both sides of the filament or you'll burn it out.

That and a book of old tube circuits was about it as far as the theory was concerned. Then I was in business. The time required from start to finished product was the better part of an afternoon. If there was such a thing as the electron theory, parameters, and other assorted drivel, it was not mentioned and was not missed for some years.

A slight amount of reflection should yield the following: The 30 took two voltages. A transistor only takes one. Therefore, a transistor should be easier to work with than a tube. Why isn't it?

Basically the problem is gobbledygook—too many words got in the way. The transistor had to be sold as something new and different and an entire mythology was created to obscure everything about the transistor. You can hardly make head or tail of the little beasties. The nice thing to remember about transistor mythology is that most of it is bunk. What's needed is some how-do-you-use-it information and this is much easier to get than is commonly thought.

First of all, we need some parameters. What's a parameter? That's a catch-all phrase to cover all of the operating conditions of your pampered little transistor.

Tubes have parameters, too, only they don't know it. They have a maximum voltage for the filament, one for the plate, voltage limits between other elements, a maximum current, maximum signal input, etc. With tubes, it's no big deal, but with a transistor, everything gets a fancy title. Let's try and isolate what we need from the rest.

Transistors can work with one voltage. This is the supply voltage. It has a maximum value which the device can take. As with any device, but particularly with a transistor, you don't even want to come close to this. Figure a design maximum of 12 to 18 volts for most uses. The maximum rating is usually more. They also have a maximum current rating just like a tube does, but instead of the plate glowing cherry red and giving you a chance to shut it off, transistors go pffft the first time. Dead transistors are nature's way of telling you not to do that again.

While there are a myriad of transistor parameters available, the only other one that you need to know right now is the maximum voltage which can be applied between various elements. The next biggest cause of a terminal pffft, after too much collector current, is too high of a signal being applied to the base or emitter junctions. Too much signal will blow them. In time, you may want more parameters to play with, but those are enough for the cut-and-try experimenter.

There are reams of equations for determining all the resistance values in a simple transistor amplifier circuit. Since you probably won't have the information you need for them, there has to be another way. At least this is what I thought after sitting and staring at my collection of unknown transistors. I had come through the course in fine shape but I sat there without the faintest idea of what to do. A few basics came to me. I had little information, my transistors were unknown, and what was the worst thing that could happen? I could blow out a nickel transistor. That's not too bad for some experience. But, as I worked on just how to do it, some of the course material trickled through to the top.

It is these cut-and-try basics which I will try to present as an organized approach to starting to experiment with transistors.

Transistors are of two main types, PNP and NPN. This refers to the polarity of the internal material. This is theory, but there are theoretical and pragmatic considerations which are important about this.

In many of the older types you might work with, the NPN version of an identical PNP type might have a higher frequency range than the PNP transistor. This might be important in some circuits. Also, the polarity of the device determines how the polarity of the supply hooks up. The NPN is the one which hooks up with the same polarity that you are used to with tubes.

The B+ goes to the collector (plate) and the minus goes to the emitter (cathode). This makes it easy to get it right. Also, a pragmatic effect which I noticed was that, in many cases, the identical circuit was far more stable using an NPN rather than a PNP. There is one mechanical disadvantage to working with NPN power transistors; this is heat sinking. Here the voltage polarity works against you. It's nice to be able to work with the same voltage polarity as with tubes, but you pay for it when compared to the PNP.

With a PNP, the collector gets the minus voltage. With most power types, the collector is also connected directly to the case. With a PNP transistor, you can then mount the transistor directly on the chassis and also make the chassis be ground for your supply. A heat sink may or may not be needed, too, but it also can be grounded to the chassis directly.

With an NPN, you can't just do this. The usual method is either to use a transistor mounting kit with a mica washer and insulated hardware so that the transistor can still be mounted to the chassis, or to insulate the heat sink from the chassis.

I never was too happy with the washer method, and prefer the separate heat sink, but there is still a disadvantage to this: There then becomes a voltage difference between the chassis and the heat sink or transistor which might be a safety hazard. The best bet here is to shield the heat sink so that direct contact with it is avoided. You can connect the transistor directly to the chassis if you make your plus voltage the one which is grounded and leave the minus floating. If there is an internal supply for the unit, this is not hard to do. However, it is confusing, to say the least, and if there is other equipment connected to the unit, you may have conflict between various ground connections and power supplies.

For most breadboard use, I just used the transistor mounted on a big heat sink by itself. Connections were made by sloppy clip lead, anyway, so the problem of mounting the transistor in equipment never came up. It worked for test purposes. If I wanted to produce a finished circuit, I would go for the insulated heat sink and shield it mechanically so that there would be no shock hazard.

There may be times when a special purpose needs a PNP transistor, but for starting out and most uses, divide your transistors first by NPN and PNP. Then put the PNP transistors away where you will not be tempted to use them. The remaining NPN types can be roughly divided into three important main categories. These categories reflect both a basic application and a rough measurement of their power-handling abilities. The three categories are: small signal—up to 10 mA of current, general purpose—10 to 100 mA, and power types—100 mA and up.

This disregards the distinction between audio, rf, switching, or other special-purpose types. It does, though, give a rough guide for immediate application and to introduce a way of thinking. Your two basic immediate needs are to see that the device does not have its ratings exceeded, and to see that it is not overdriven.

To start with a mostly-unknown transistor, assume that it is a small-signal type. By the way, many large-signal or higher-power devices can also be used for small-signal use, and do a very good job. The basic transistor amplifier circuit is usually

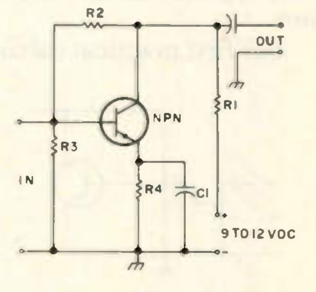

Fig. 2. Complete textbook circuit.

a small-signal application, both in audio and rf. It makes an ideal place to start.

Some equipment will be needed for experimentation. Besides the usual transistor hardware and parts, you will want an oscilloscope, a VOM, a resistance substitution box or handful of potentiometers or resistors, and a signal source.

Start with a microphone. It's safe. An FM tuner or audio signal generator would also be nice for further testing. An adjustable amplitude is highly desirable. The simple one-stage small-signal transistor voltage amplifier is a fiend to design by formula but it is quite easy to do pragmatically. This is where some of what the course taught me really helped. The basic circuit is shown in Fig. 1. R1 and R2 are the two key resistance values in the circuit. They will have to be arrived at experimentally but it is quite easy to do once you get the hang of it. The important thing is the safety of the device. Protecting the transistor is what takes up your time at the start and makes it seem a little clumsy to do.

According to theory, a class A transistor amplifier will draw half its allowable current at rest (no signal). The output signal goes above and below the midpoint. This gives us two assumptions. The first is that we are using a small-signal device (even if we are not). This also means that we are limited to 10 mA.

Our first practical calculation is a resistance value which will limit the current to 10 mA in the worst case, that is, if the transistor were a dead short. This gives you a value of R1. This is not critical, so pick the next highest resistance which you have if you can't get the exact value. Remember, this will not be the actual final value, but a working load resistance to start with which will protect the device.

In most cases, the actual value for best results will probably be much higher—similar to a triode tube voltage amplifier which usually has quite a high load resistance. However, start with the value derived in that manner. Hook up your VOM to measure the actual current at the collector. At this point, with one resistor, there should be no current. Without some form of bias to the base, the transistor should be cut off and no current should flow.

Now, take your resistance substitution box and, starting with the highest value at R2, click your way down until the transistor just starts to draw some current. At this point, there should be some indication that the circuit is functioning. Use your mike and a sensitive range on your scope, and watch the waveform. I also used the output from an FM tuner. Even at these low levels, I got an indication of circuit function and could see obvious distortion or clipping. The circuit should work, but not too well. Here is where the fun starts.

Replace the substitution box with a fixed value at R2. Put the substitution box in place of the fixed value at R1. Starting at the original R1 value, increase it and see what effect it has on the signal. You should get more amplification and less distortion up to a point. If you don't, try going a few clicks in the other direction, but watch the meter. When you get better results, replace the box with the appropriate fixed value and go back to R2 with the substitution box and see what effect changing that will have. A simple circuit like this should have quite a range of practical values over which it will work. It should only take a few back and forth trips to make an optimum choice.

At this point, you have a working amplifier. Usually there are a few more resistors which get put in the circuit for stability or other reasons. These get put in last. They are shown in Fig. 2. R3 is not critical. There is a simple formula for doing it by math: R3 is usually about 1/10 the value of R2. R2 and R3 act as a voltage divider and also help to tame the base-emitter circuit by providing a load to help limit current flow in the circuit.

When you have the basic circuit going, just hook up the substitution box and see what effect different values of R3 have to the actual signal. Start high, and as you click down, the signal will begin to be attenuated by the resistance. At that point, or a little lower, is the point at which you want to stop.

R4 is another matter. It is something like a cathode resistor but it doesn't work the same way. It also has a stabilizing effect on the transistor circuit, and helps limit the current of the stage. It also may have the effect of permitting a wider range of input signal without distortion. That doesn't mean you can exceed the element-to-element rating, but, as with tubes, the added bias can place the signal on a more-favorable part of the current curve.

Use your scope and a variable input. The values are quite similar to the tube values, several hundred Ohms, with 1000 and 2200 Ohms used quite commonly. Watch the scope and see at what point your signal starts to distort or clip. Put in the resistor and see what effect the values have on the signal. If there is an improvement, increase the signal to get the distortion again. Try different values and see what that does. You may want to go back and try some new values for R1 and R2 at this point, too. However, R4 will probably be a minor factor in the overall amplifier circuit.

As with vacuum-tube cathode resistors, the emitter resistor is usually bypassed. This is a husky electrolytic often in the same range as those used with a tube. 20 uF on up to a few hundred uF are common values. When the resistor is not bypassed, it also has some degenerative effect. The output will be less, but you will also get the stabilizing effect of an emitter which is not bypassed. You can see the difference on the scope as you try different resistance values or bypassing. Just play around with a few electrolytic values and watch what happens.

The main killer of transistor circuits is heat. They have the habit of drawing more current as they warm, which makes them warmer and they draw even more current, and pffft. If you work well within the ratings, you should have little trouble. Most devices are run too close to what they can handle.

The only other thing is to keep it from becoming externally heated. Don't put the transistors right over the power transformer. Allow room for ventilation. If you avoid extremes of both heat and cold, you should get reliable results with this circuit. The only way to assure operation at temperature extremes is to test

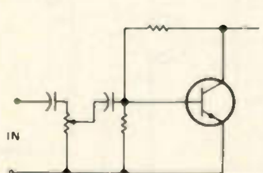

Fig. 3. Transistor volume control.

your circuit at the temperature extremes which you will normally encounter. Use husky transistors and parts and derate them for extremes. With care, this should not be any great problem.

Input and output circuits provide little problem with this stage. Capacitor coupling is easy and common with such a circuit. The value is not critical. 10 uF, or so, is a common value.

The real stinker is the volume control. You can't just hook up an audio-taper pot in place of R3. When you turned it down, it would become a dead short across the emitter-base junction. A circuit such as that shown in Fig. 3 will do the job. A few extra parts are quite cheap at transistor power levels.

You can use one or two stages which are similar for an audio amplifier, depending on how much amplification is needed. The output will be high impedance and will drive a high-impedance pair of headphones with sufficient volume. More stages can lead to troubles such as feedback or motorboating. There are two things at work here. The higher gain of cascade stages is a troublemaker and the additional wiring picks up anything.

Driving a speaker is not hard to do either, if you are not overly squeamish. Much attention is given to proper impedance matching with transistors. If you can just ignore that urge, you should be okay.

Start with the circuit of Fig. 4. The transformer should be a medium-to-low-impedance transformer. It probably should be critical, but I have used anything from a 48-Ohm c-t transistor output type to a replacement tube type. Use the 8-Ohm output and whatever primary you have to start with. Here you just do the same thing that you did with the load resistance procedure. Adjust R1 with one eye on the VOM, and listen to the output.

It would be assumed that you would start with an audio power type, not a small-signal type. Then start drawing some current and listen for what you get. This circuit will not be the most efficient, but you will be surprised just how loud even a small amount of audio can sound.

I found that an amplifier in the range of 200 mW to a Watt, or so, was quite practical with this sort of set up. In fact, I even hooked the speaker coil in alone in place of the transformer. I don't recommend the practice, though. It's too easy for the steady dc current to exceed the rating of the speaker winding, and burn out an expensive speaker. It does improve the frequency response, though. With care, even with a junk-box transformer, there will not be any serious loss for communications use, and even music may be acceptable.

It is always stressed that the transistor is a current-operated device; you always get current ratings but little is said about voltage. Your total output power is the signal voltage times the current through the impedance which you are using. The value can be found by Ohm's Law.

For example, the measured output voltage across the speaker winding divided by the impedance gives you the current (ac). The voltage is again used to calculate your power output. Or, even easier, use $P = E^2/R$.

It usually is thought that you get more output if you can get the transistor to deliver more current to the speaker coil. It's a nice theory, but just drawing more transistor current doesn't automatically deliver more output. As effective output goes up, so does the output current and the output voltage. At no point can the effective output voltage exceed the actual supply voltage to the transistor. It usually will be somewhat less. While your formula sounds great that 12 volts at 2 Amps would give you 24 Watts, at twelve volts, the transistor may not deliver that two Amps.

Enjoy the extra safety margin. You can get enough from just a simple power stage to hurt your ears at close range. Here, too, watch the scope for distortion. Measuring your output voltage values will give you the full story. When you drive the transistor to its supply voltage, you get clipping and distortion.

A common thing with transistor amplifiers is direct coupling between transistors. This is one of the all-time headaches to design and debug. Or repair, if it comes to that. Without going into convulsions on how to do it, there is one basic circuit configuration which is easy to play with, shown in Fig. 5.

Q1 and Q2 can be small-signal types. Q3 is shown as a 2N3055, which is quite common. I have used three 2N3055s and a number of oddball combinations. Try for some sort of method to your choice.

There is one important consideration you should keep in mind when working with power transistors. They are very rugged current-wise when compared with the smaller ones, but many of them can only accept a small input voltage without damage. Many which I worked with would only take about four volts between emitter and base. Many small-signal types would take 35 volts between emitter and base. That's a very strong case for using small-signal types to drive the power stage for you. Also, in many cases, the small-signal type will be more sensitive to weaker input signals.

An FM tuner is a high output signal source. So may be the output from a detector in a receiver. However, in a simple set, the audio stages may have to supply some of the small-signal gain needed for the set. Try some combinations when you work with these circuits so that you get a feel for different operating conditions.

I have worked with many sets which had impressive bench test specs, but on-the-air tests with weak signals showed the importance of real sensitivity to weak signals and the effect small amounts of change in distortion, clarity, and other conditions have. You just do not notice these effects without real on-the-air testing.

R1 is chosen the same way as in the first amplifier: first for the current, and then for the sound. This amplifier is about the simplest "complex" amplifier that you can build. The first two stages are working as voltage amplifiers and the last is the power output stage. This circuit will also work well with just two transistors if less preamplification is needed.

I did not build these circuits into any equipment. I just used these circuits to learn on. However, I found even the simple circuit like Fig. 5 to be quite stable. I had it running on the bench for hours at a time as an amplifier for an FM tuner, and most of the other successful circuits worked

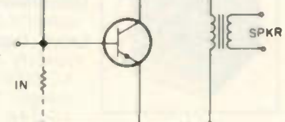

Fig. 4. Basic transistor power amplifier.

well with no problems. Even without all the resistors which a classic circuit is supposed to need for stability, they just sat there and worked for hours on the bench.

I think the key is to pick husky transistors and run them very conservatively. The power amp only draws a few hundred milliamps resting, if that, and the first stages use a tiny amount of current. However, as stated earlier, many of these stages were tried with the PNP transistors which were exact equivalents, and there was trouble. It appeared to be thermal runaway. The stage would start drifting into a higher-current condition and then I would get distortion and other problems.

There did not appear to be an easy fix for this condition. Even though the circuit could be stabilized so that it would not draw dangerous current, it was not tame, which means it's not reliable. And yet the same circuit with NPNs was a joy to work with. Stay away from PNPs. They will lead you into trouble.

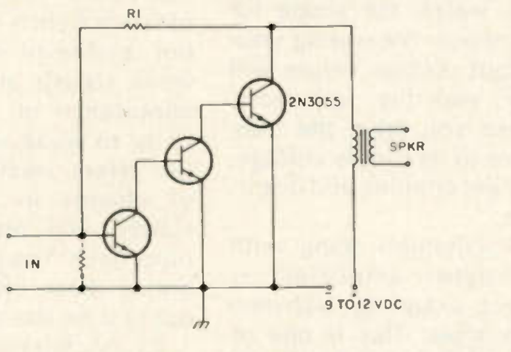

Fig. 5. Simple multi-stage power amp circuit.

There are a number of other simple configurations which can be done with just a few transistors. Any good transistor manual should have a number of basic circuits which can be tried.

There are also combination circuits using both NPN and PNP transistors tied back to back. Stay away from the more complex direct-coupled circuits with lots of components, dual power supplies, and the like. You get into servicing and reliability problems which you really don't need.

I found that none of the other simple combinations which I tried really gave me anything which these simple circuits didn't. There were differences in operation, but they were not significant for any normal use which I wanted to make of the circuit.

By the time you have played for a few weeks or a month with these simple circuits, you should have gotten over the fear of transistors. Then you will have built-in safety procedures to use when you are breadboarding, and it should not be hard to progress to more specialized simple circuits such as i-f amplifiers or rf circuits.

If you play by the important transistor rules and ignore many of the rest at first, you can learn a lot about the exact function of the circuits, how to get them going without formulas, how to deal with parts substitutions, and how to get wide operating tolerances.

You will learn to see what is actually happening inside the circuit as you make changes. The faults you find will also help you to debug other circuits which you may work with. ■

A Digital Clock with Analog Readout

— this is progress?

G. Windolph W9IEA
PO Box 3305
1901 N. 18th St.
Quincy, IL 62301

The clock described here brings you the best of two worlds — the digital and the analog. It combines the reliability of the no-moving-parts, all-electronic clock with the instant readability of a clock with hands.

I built this clock for two main reasons. In the first place, I wanted an all-electronic clock that I could read from a distance of three or four feet in the dark without my glasses. If you happen to be as myopic as I am, you know that the ordinary digital clock might as well be just a night light after you have retired and have put your glasses on the shelf. This clock face can be as large as you wish.

In the second place, I wanted a clock that gives the instant readout of the old-fashioned clock with hands. One swift glance at an old-style clock and you know immediately how close you are to that 1:00 deadline. With the ordinary digital clock reading 12:53, it takes a bit more than a quick look to tell you that you've got seven minutes left. There's something about a clock with hands that makes 8:20 look like "twenty *after* eight" and 8:40 look like "twenty *to* nine." This visual shift doesn't occur with a digital readout. I suspect that this is one reason why Texas Instruments has come out with an analog readout on a digital watch. I predict that the clock-makers will follow suit. Even if you're not a nearsighted clock-watcher, you may find this project to your liking.

General Description

Two concentric circles of discrete light-emitting diodes form the "hands" of this clock. The outer circle is for the minute hand; the inner circle, with a diameter about three-fourths that of the outer one, is for the hour hand. One LED in each circle is on at any given time. Another, LED5, is on continuously at the center of the circles to act as a visual point of reference so that the eye somewhat automatically constructs each hand of the clock out of the central LED and the peripheral minute or hour LED. As additional reference points, particularly for nighttime viewing, there are blinking LEDs (1-4) of a different color located at 12:00, 3:00, 6:00, and 9:00. They show that the clock is running. They also are used in setting the clock, as is explained later.

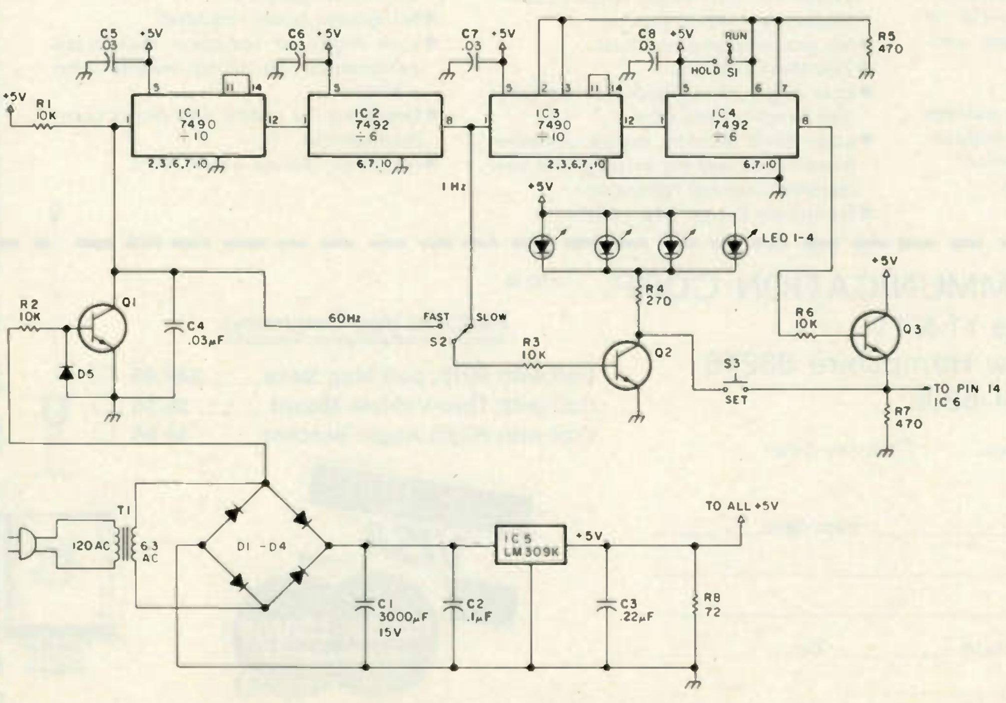

Fig. 1. Power supply and timing circuit.

A one-pulse-per-minute signal operates the clock. A one-pulse-per-second signal shows that the clock is running and, along with a 60-Hz signal, is used to set the clock. The 60-Hz signal is obtained from the collector of Q1, which squares up the sine wave to operate the TTL integrated circuits. This frequency is divided by 10 in IC1 and by 6 in IC2 to give a 1-Hz signal. This is again divided by 10 and 6 in IC14 and IC15 to produce the one-pulse-per-minute signal that operates the clock.

The 74154 integrated circuit is a 4-line-to-16-line decoder. For any binary number from zero to fifteen on input pins 20 to 23, one of the sixteen outputs goes low and turns on one LED. Since there are 60 LEDs for the minute hand, we need four of these ICs. Only one of them is enabled at a time, by a low on pins 18 and 19. the other three are turned off by a high on pin 18 or 19. The 7493 counter, IC6, puts out the binary numbers from 0 to 15 in sequence when pin 14 is pulsed once per minute by IC4. Q3 isolates IC4 from the setting signal. The binary numbers are fed to all four decoder ICs. The one which will give a readout is determined by the 7476, IC7. This is a dual J-K flip-flop which is made to flip every time a negative-going pulse comes from pin 11 of the 7493. This pin contains the most-significant bit of the binary output, and it drops to zero when the output goes from 15 (1111) to 0 (0000). The 7476 puts out a low on the following pairs of pins in sequence: 11 and 15, 11 and 14, 10 and 15, and 10 and 14. These pairs then enable IC10 to IC13 in sequence, and one LED lights up as determined by the binary number on pins 20 to 23. The other 74154s are inactivated since they have a high on pin 18 or 19.

With 64 outputs but only 60 minutes per hour, the last four outputs are unused, and the minute hand would disappear for four minutes if IC13 were enabled for its full count. To prevent this, IC6 must be reset to zero after the 59th minute. The low appearing at the 60th minute on pin 14 of IC13 is inverted by one section of a 7400 and fed to pins 2 and 3 of IC6. This resets IC6 so that its output goes from 1100 back to 0000. The negative-going pulse on pin 11 clears IC7 so that pins 11 and 15 are both low again and IC10 is enabled to begin the first minute of the next hour.

The hour hand functions similarly but we don't need as many LEDs. Twelve would not suffice since there would be a period of ambiguity depending upon when the hour hand jumped to the next hour. One could, of course, use 60 LEDs. I settled for 24, which is sufficient to prevent any ambiguity. When the clock is set on any hour, the hour hand stays on the hour until the beginning of the 16th minute after the

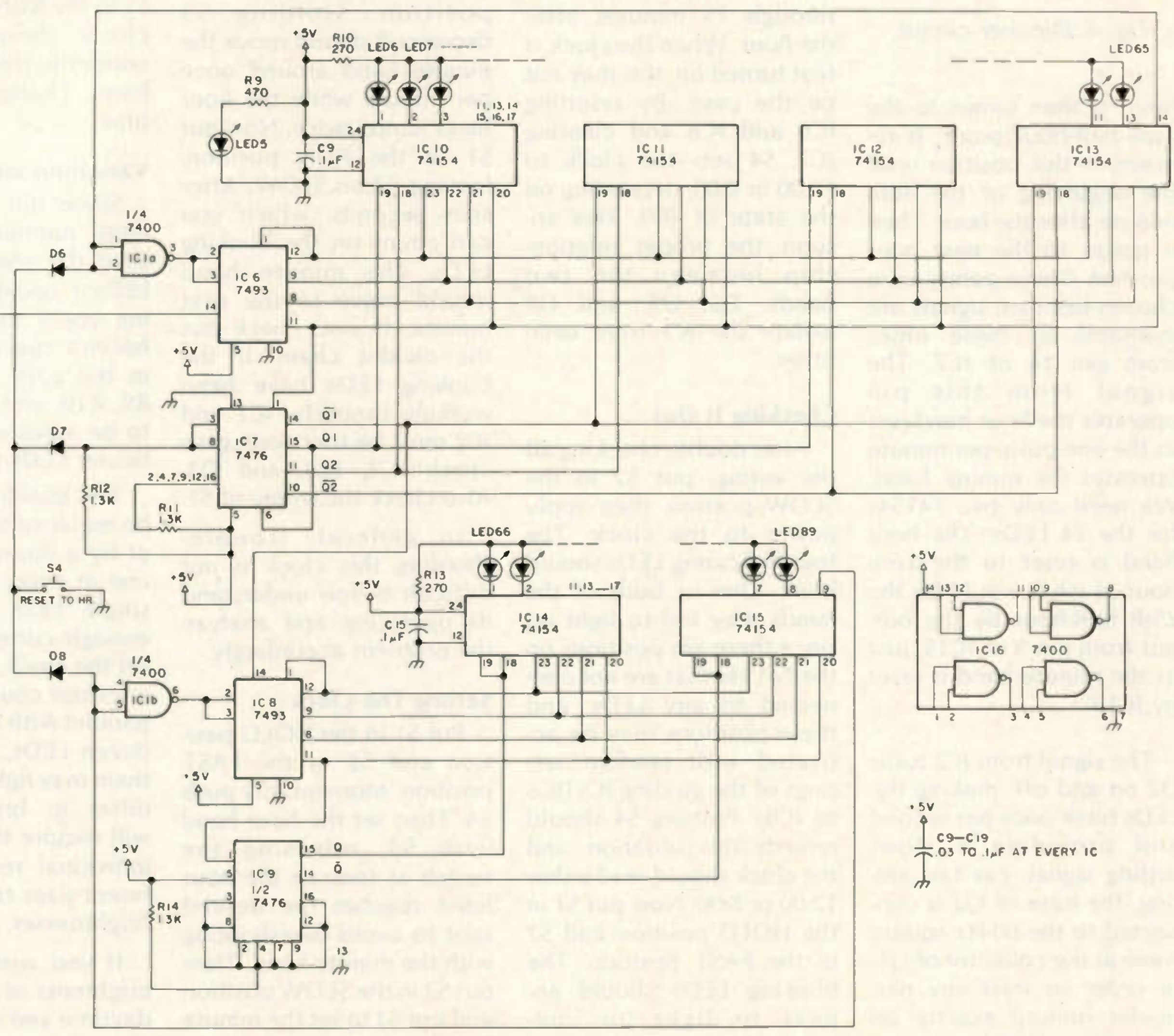

Fig. 2. Readout circuit.

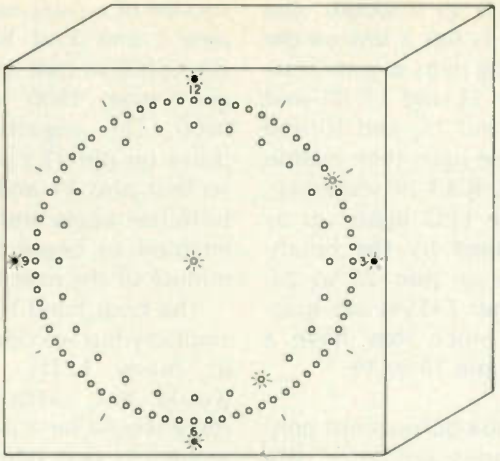

Fig. 3. Face layout.

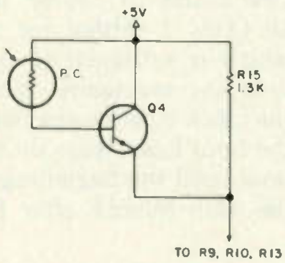

Fig. 4. Dimmer circuit.

hour. It then jumps to the next half-hour point. It remains in this position until the beginning of the 48th minute after the hour. Then it jumps to the next hour position. These points were chosen because signals are available at these times from pin 14 of IC7. The signal from this pin operates the hour hand just as the one-pulse-per-minute operates the minute hand. We need only two 74154s for the 24 LEDs. The hour hand is reset to the zero hour at what would be the 25th half-hour by the output from pin 9 of IC15, just as the minute hand is reset by IC13.

The signal from IC2 turns Q2 on and off, making the LEDs blink once per second and providing a slow-setting signal. For fast setting, the base of Q2 is connected to the 60-Hz square wave at the collector of Q1. In order to start any particular minute exactly on time, IC3 and IC4 are set to zero by S1 which puts a high on reset pins 2 and 3 and 6 and 7, respectively. This keeps the output of IC4 low so that the setting signal from Q2 can pull pin 14 of IC6 low.

The hour hand should be on the hour from 12 minutes before the hour through 15 minutes after the hour. When the clock is first turned on, this may not be the case. By resetting IC6 and IC8 and clearing IC7, S4 sets the clock to 12:00 or 8:00, depending on the state of IC9. This ensures the proper relationship between the two hands. D6, D7, and D8 isolate the ICs from each other.

Checking It Out

After double-checking all the wiring, put S2 in the SLOW postion, then apply power to the clock. The four indicating LEDs should blink. One or both of the hands may fail to light up since there are positions on the 74154s that are not connected to any LEDs, and these positions may be activated with random settings of the guiding ICs (IC6 to IC9). Pushing S4 should remedy this situation, and the clock should read either 12:00 or 8:00. Now put S1 in the HOLD position and S2 in the FAST position. The blinking LEDs should appear to light up continuously since they are now blinking at 60 Hz. Pressing the set button, S3, should make the minute hand revolve once per second and the hour hand jump twice per second. The latter should jump as the minute hand passes from 15 to 16 minutes after and from 13 to 12 minutes before the hour. If either hand doesn't go continuously around but skips whole sections, this would indicate a defect associated with one of the 7476s since they should sequentially enable the 74154s. If either hand disappears temporarily before the 12:00 point, this would indicate that the reset signal is not getting back to the 7493s. Check for a defective IC16, IC6, or IC8. I had a 7493 that counted beautifully but would not reset.

Now put S2 in the SLOW position. Holding S3 depressed should move the minute hand around once per minute while the hour hand jumps twice. Now put S1 in the RUN position, leaving S2 on SLOW. After sixty seconds, which you can count on the blinking LEDs, the minute hand should move to the next minute. If not, check out the divider chain. If the blinking LEDs have been working properly, IC1 and IC2 must be functioning, so check IC3, IC4, and Q3. Also check the wiring of S1.

In general, troubleshooting this clock is not difficult if you understand its operation and analyze the problem accordingly.

Setting The Clock

Put S1 in the HOLD position and S2 in the FAST position. Momentarily push S4. Then set the hour hand with S3, releasing the switch as soon as the hour hand reaches the desired spot to avoid overshooting with the minute hand. Then put S2 in the SLOW position and use S3 to set the minute hand to the next minute. In setting the minute hand, you probably will find that the hand jumps a number of minutes when you first depress S3 or when you release it. This is due to bounce in the switch contacts. It can be prevented by watching the blinking LEDs and depressing and releasing S3 only when the LEDs are *on*. When the LEDs are on, the collector of Q1 is low and, since pin 14 of IC6 is also low when S1 is in the HOLD position, the setting switch cannot send in a series of pulses when it bounces. This method of setting is not difficult, but it takes a bit of practice since you have to watch the blinking LEDs and the moving minute hand at the same time. When your reference clock reaches the next minute and zero seconds, immediately put S1 in the RUN position. The clock should now run correctly with the minute hand changing right on time.

Variations and Options

Since this clock uses a large number of LEDs, I used the cheapest bargain LEDs I could find. Assuming you'll do the same, I haven't specified the type in the parts list. Resistors R9, R10, and R13 will have to be adjusted for the particular LEDs you use.

The blinking LEDs could be replaced by a single one, or by a dozen, if you want one at every hour point. A single LED may not let enough current through to set the clock, in which case a resistor could be added in parallel with it. If you use a dozen LEDs, only some of them may light, or they may differ in brightness. This will require the addition of individual resistors of different sizes to even out the brightnesses.

If you wish to vary the brightness of the hands for daytime and nighttime, add a resistor from +5 V to the common connection of R9,

R10, and R13. It should be large enough to make the clock as dim as you want it for nighttime. Then use an NPN transistor and a photocell as in Fig. 4. As light falls on the photocell, its resistance drops, feeding more current to the transistor, which then partially shorts out the nighttime dropping resistor.

In my first version of this clock, I used a 5316 clock chip for the timing signals, eliminating IC1 to IC4 and Q1. It was a bargain chip because the alarm was defective. If you happen to have one of these chips in your supply and would like to use it, I can furnish the circuit diagram on request. Please send an SASE!

If you find the fast-set signal a bit too fast at 60 Hz, you can connect the fast contact on S2 to the output of IC1, which will give you a 6-Hz setting signal.

Construction

There is nothing critical about the construction, but the TTL ICs can cause erratic operation if they are not properly bypassed. Each IC should have a capacitor connected right at the IC from the +5 V input to ground. The LEDs are wired so that pin 1 of IC10 and pin 1 of IC14 go to the LEDs at the 12:00 location on the clock face; the other pins go to the LEDs that follow, clockwise around the face. I used wire-wrap technique for part of the clock and point-to-point soldering for the rest.

Parts list

R1, R2, R3, R6—10k, ¼ W
R4—220 Ohms, ½ W
R5, R7, R9—470 Ohms, ½ W
R8—720 Ohms, 2 W
R10, R13—270 Ohms, ¼ W
R11, R12, R14, R15—1.3k, ¼ W
C1—3000 uF, 15 V
C2—.1 uF
C3—.22 uF
C4-C19—.03 to .1-uF bypass disc capacitors from +5 V to ground at every IC (not all drawn on diagram)
T1—120 V ac/6.3 V ac, at 2 A
IC1, IC3—7490 counter
IC2, IC4—7492 counter
IC5—LM309K 5-volt regulator
IC6, IC8—4-bit binary counter
IC7, IC9—7476 dual J-K flip-flop
IC10-IC15—74154 4-line-to-16-line decoder
IC16—7400 quadruple NAND gate
S1—SPST toggle or slide switch
S2—SPDT toggle or slide switch
S3, S4—NO push-button switch
Q1-Q4—2N718 or similar small-signal NPN transistor
LED1-LED4—any small yellow or green light-emitting diode
LED5-LED89—any jumbo red LEDs
PC—VT133L or similar photocell

The face of the clock can be made as large as you desire. If it is large enough, the ICs can be mounted on the face itself. A black sheet of cardboard can be used to cover the electronics, or you can cover the whole face with a dark red plastic sheet. I used a dry letter transfer kit to put white numbers on the dark face of the clock. I built a case for the clock out of wood. If you are good at carpentry, you can make this clock into a neat and functional piece of furniture that you won't want to keep hidden in the bedroom. ■

Reader Service—see page 259

✓ Reader Service—see page 259

Turn Off Repeater Windbags

—HT mod brings welcome relief

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At last a nifty circuit is available that can be used in the Wilson 1402 to make it a monitor (automatically).

Perhaps you are one of those people who really like to monitor the repeater, but find that there are always those few hams around chewing the rag so that continuous monitoring is more trouble than turning off the rig. Well, cheer up, Bunky, I have just what you need—a time-delay circuit that lets the Wilson operate normally for about 10 seconds after the squelch opens and a call is made or a conversation is started. After the 10 seconds has elapsed, the circuit mutes the speaker until the call in progress is over. No more will you have to listen to all of those dull, long-winded conversations just to be sure that you won't miss a call, and the circuit is automatically disabled when you need to get in on the conversation.

Circuit Details

The circuit uses the 0-to-4½-volt transition when the squelch opens in the Wilson 1402, as a trigger to set the timing in motion. This voltage is picked off the top of the end-mounted 6.8k-Ohm resistor which is directly above the LD 3030 audio driver IC on the printed circuit board. This makes all wiring connections available on the top of the board for ease in construction. The basic circuit design is that of a switching transistor with a timing circuit and an audio gate transistor tied to it.

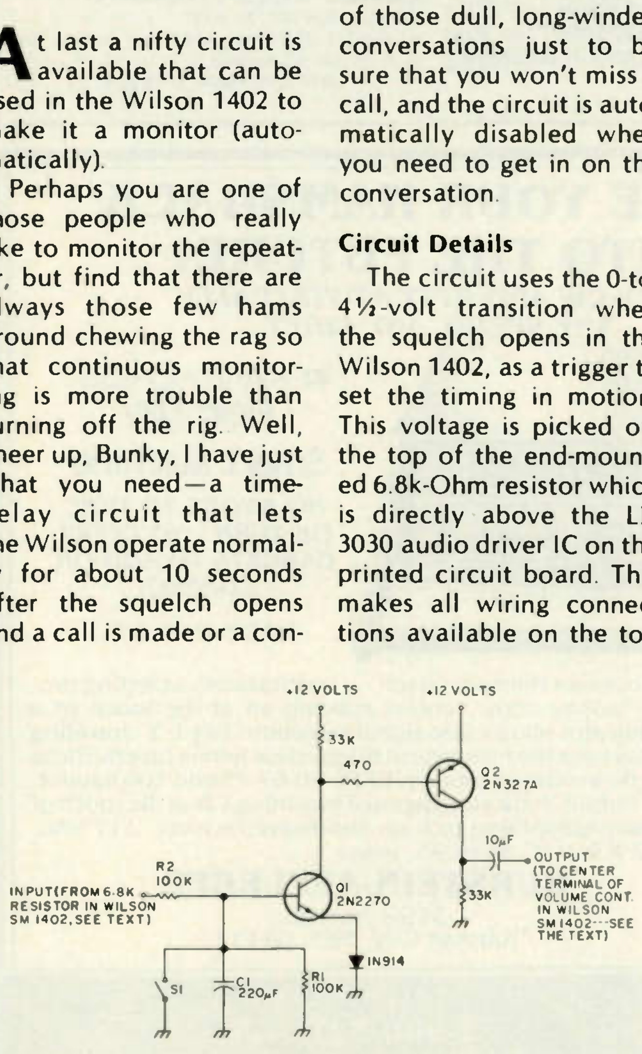

Fig. 1. Schematic of automatic muting circuit.

Circuit Operation

When the squelch opens, a voltage at the 6.8k resistor goes from 0 to around 4½ volts. This voltage is applied to the circuit to start charging the R1C1 combination through R2. As soon as about 1.2 volts is attained on the base of Q1, Q1 switches on which in turn switches on Q2. Q2 is provided as an audio gate, and also to isolate the timing switch from the audio switch. When Q2 is switched on, it gates the audio that normally would have been fed to the audio driver IC from the center tap (wiper) of the volume control pot to ground.

Anyway, I guess it goes to ground, since it works. It might be going through the batteries, but wherever it sends the audio, it effectively shorts whatever audio is available to operate the driver IC to ground and kills all the audio output from the speaker. This takes about 10 seconds for the choice of resistors and capacitors I used.

When the 1402's squelch closes, the voltage at R2 goes to zero and C1 is discharged through R1 until Q1 switches off, which switches off Q2 and restores the audio to a squelched receiver ready for the next call. This takes about 6 seconds for the values that I used. The measured current draw for this circuit is less than 1 mA, and if you are running the audio level fairly loud (volume control at ½ maximum or louder) the circuit also will function as a battery saver. This is because the circuit clips the audio on extended conversations to zero, which reduces the radio's current draw to that of minimum specs for unsquelched operation.

The switch S1 can be any kind of an SPST switch, but since I didn't want to drill a hole in the radio, I used a mercury tilt switch similar to the one in most residential wall-mounted heating thermostats which I found in my adequately-stocked junk drawer. The switch is positioned inside the radio so that when the radio is lying on a table, the switch is open and will let the capacitor, C1, charge. When the radio is picked up and held in the vertical hand-held operating position,

the switch is closed, which holds capacitor C1 permanently discharged for the normal two-way operation of the radio.

Construction Hints

I built all the components in the area at the top of the radio around the volume and squelch controls. This was done with hard wiring since space is limited, and also since there really isn't much to wire. The largest component was the capacitor, and it fit nicely in the small recess beside the S-meter. The resistors were ¼-Watt jobs, and the mercury switch was one that I had which was larger than necessary, but fit nicely in the gap between crystals in the crystal deck. I adjusted the mercury switch so that the mercury ran away from the contacts when the radio was lying flat.

After connecting all the items as shown, the unit can be checked out by holding it in the horizontal position and breaking the squelch. After about 10 seconds, the audio will mute and will remain that way until the squelch is closed or until the unit is picked up and held in the vertical position.

In closing: An idea that I didn't try out, that came to me after I built the circuit, is to use a LED instead of the 1N914 diode which would give a visual indication of a muted radio. Also worth noting is that I tried several transistors for Q2, but found that with some, as soon as they were connected, a loss in the radio's audio occurred. This was not the case with the 2N327A, and I heartily recommend being careful of substitutes in this area. ■

Build a $5 Coax Switch

— why pay more?

$3.47 or $5.02.

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OH 43160

A two-way coax switch is a real convenience for switching between two antennas, or for grounding an antenna, or for switching one antenna to another rig. Take a small minibox, Bud #5A30005 or #5A3014, and with a 5/8" drill or a Greenlee punch cut three holes as shown in the drawing in Fig. 1. These are cut on the three sides of the U-section.

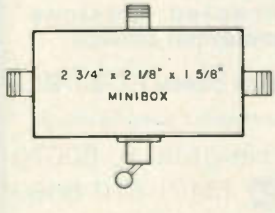

Fig. 1.

Mount three SO-239 connectors on the three sides of the U-shaped section. Then punch a ½" hole in the other section and mount a heavy-duty toggle switch—SPDT. I used a DPDT and strapped the two sections together to take heavier current.

Connect as shown in Fig. 2. Use a flexible piece of coax shield from RG-58/U for connection to the "common" connector so that the box can be put back together easily.

Use #12 wire or the center conductor from RG-8/U coax for the other connections.

The total actual parts cost was $5.02, saving about $35 over a commercial switch of the same type.

The same idea can be used without the toggle for an emergency T connector, by connecting all three SO-239s together. Cost: $3.47. ■

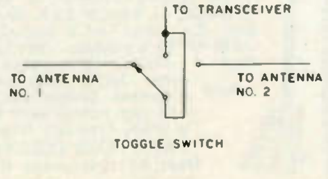

Fig. 2.

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Owosso MI 48867

Hamdom's Evangelical Crusade

—born-again ops, arise!

I have given up trying to explain ham radio to my wife. And who can blame me? Last time I mentioned that something was wrong with my keyer, she called a locksmith. And how could I try to explain *that* to someone who thinks TVI is what you get when you sit too close to the television set?

So, I've decided to keep my thoughts in that area to myself. Except for the Tuesday-night gathering of hams at our place (at which my wife, by the way, chews us out for always talking about OSCAR but never having the courtesy to invite him over), I've pretty much regressed into a domestic ham fantasy-world.

Which is not all too bad, actually—it beats trying to explain the thrill of operating 160 meters to someone who thinks it's an Olympic running event.

Take last Thursday night, for example: The XYL and I, having finished the dinner dishes, had settled down for an evening of the all-American, middle-class, intellectual challenge—watching television, of course. I sat in the easy chair, fiddling with a 450 MHz handie-talkie, which my wife proudly tells her friends is "an expensive CB."

Like I said, who can blame me?

My wife had long since given up on what channel I want to watch, since I usually mumble something about "20 meters" (unless the band happens to be a total disaster, in which case I grumble something about "the gang on two"). So as I sat fiddling with a stubborn battery pack, she flipped to the "Billy Graham Crusade."

She settled herself on the couch and picked up her knitting. "Is that alright with you, dear?" she asked. "Mfgpht," I said. She went back to her knitting and I went back to my battery pack. Finally, I got the thing in place. I stuck an earplug in the jack, fiddled with the squelch control a bit, and then turned the channel selector to the local repeater. With that odd combination — Billy Graham in the right ear and some guy testing an autopatch in the left — I sat back in the chair and promptly fell asleep.

What was it that Freud said about people who were depressed by daylight — that all their secret thoughts revealed themselves in dreams? Anyway, the last thing I remember thinking is, "Wouldn't it be great if we had someone who could do the same thing for ham radio that Billy Graham is doing for religion?" Then, I had my first glimpse of a frustrated ham's vision.

Madison Square Garden. The Astrodome. The Hollywood Bowl. It didn't matter; the scene was the same every time. Hundreds of thousands of people stream into the nation's gathering places to learn about ham radio. CBers, SWLers, and even stereo freaks crowd the auditoriums and stadiums of the nation to hear the world's greatest spreader of the ham's way of life. Suddenly I awoke with a start, sat up in the chair, and said aloud:

"Ham. Elmer Ham."

My wife put down her knitting and stared at me quizzically. "What was that, dear?" she asked.

"Nothing," I said, and then I pointed to the handie-talkie. "Just thought I heard a friend of mine." I knew it was pointless to say any more, because trying to explain ham radio to my wife usually resulted in disaster. Last time I'd spoken of inductance in her presence, she'd called the Pentagon and begged them not to draft me.

She shook her head. "Honestly, dear. I'd swear all you ever think about is your silly little radios."

"Mfgpht," I said cheerfully. Before long I was asleep again, and the vision returned.

The Astrodome. Thousands pour into the stadium; millions more watch on television. Elmer Ham doesn't appear immediately, of course — they save him for the last while they warm up the audience. Maybe they will play tapes of rare DX QSOs over the stadium PA system, or have a choir chanting in CW — something like that. Ushers pass out Novice-class study guides as the curious throng floods through the doors; attendants begin circulating straight keys and antenna tuners throughout the audience as the stadium fills. And then Elmer Ham takes the stage.

He's a dynamic, charismatic man, and the audience responds enthusiastically as he extols the virtues of ham radio. An attendant in a white lab coat wheels up a cart full of equipment, and Elmer Ham goes through the rounds of explaining the mysteries of hamdom to a hundred thousand gaping neophytes. They "ooohhh" at SSTV. They "aahhh" at DX and RTTY. And they

"wowww" as Elmer effortlessly copies CW at 65 wpm.

After a good hour, he makes the big pitch: Would anyone in the audience be interested in obtaining a ham license? Thousands raise their hands. Elmer warns them that they'll be required to learn their code and theory, that the battle won't be won without a little study and dedication. Some of them are afraid, but others have made up their minds that they're going to do it—and at Elmer Ham's invitation, they flock down to the stage where attendants sign them up for code and theory courses.

"Beautiful," I said aloud. Then I opened one eye. Billy Graham had been pre-empted by some commercial about a lady plumber, and my wife was still working at her knitting. And, of course, the gang was still jabbering away on the local repeater.

"What happened to Elmer Ham?" I asked.

"Who?"

"Billy Graham. I meant Billy Graham."

"Oh, him. He's all over, and you missed the best part. It was so exciting," she said.

"I know." I continued to fiddle with the handie-talkie until the next program—a rerun of "I Love Lucy"—hit the air.

"This all right with you?" my wife asked methodically.

"Mfgpht," I said, and settled back into the easy chair. This one, I mused, would require a little more thought. How about a Cuban bandleader who keeps in touch with his crazy redheaded wife through 2 meters? Hmmmm . . . ■

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The Memorizer Flies Inverted

—something Yaesu never told you

The popular Yaesu FT-227R Memorizer presented me with a hidden capability one evening. I had always envied those who could instantly "go inverted" with one flick of some super-switch thoughtfully provided by some brilliant designer. It was a great pleasure to discover that this was an unspecified option in my own transceiver! It was even more fun to think that I had discovered something that even the designers on this unit hadn't thought of.

This operating procedure, which requires no physical modifications at all, causes the transceiver to exchange 600-kHz-offset transmitting and receiving frequencies with one click of the function switch. It is accomplished by using a not-obvious combination of control settings which is not mentioned in the instruction manual.

The following steps specify how to memorize the lower frequency, set to the higher frequency, energize the memory recall, and utilize the MEM and +600 positions of the function switch.

1. Release M (Memory) and MR (Memory Recall) switches.
2. Set the frequency display to the *lower* of the repeater input and output frequencies.
3. Press M switch.
4. Set the frequency display to the *higher* of the repeater input and output frequencies.
5. Press MR switch.
6. Set function switch to the MEM or +600 position.

The frequency display now indicates the receiving frequency. Choose the frequency you want to listen to, the repeater input or output. When the transceiver transmitter is keyed, the output frequency will be offset 600 kHz *up* or *down* as required to effect the desired operation.

For normal operation on repeaters with a low-side input frequency, use MEM. In this position, the transmitter is forced to be the memorized (lower) frequency and the MR switch function is defeated so that the received frequency (higher) is what is set into the dial. When you set to the +600 position to go inverted, the MR becomes effective so that the memorized (lower) frequency is recalled and the transmitter is offset up by 600 kHz.

For normal operation on repeaters with a high-side input frequency, use +600 and switch to MEM to go inverted.

As long as the memorized frequency is not lost, the transceiver can be used on other frequencies with any offset you want and returned to this special mode by following steps 4 through 6.

If you have to ask what this type of operation is good for, I'm surprised you have read this far. In truth, I don't know of much practical use unless your favorite repeater frequently goes off the air due to time-out failure. At least it is fun to be able to use all of the capability of the equipment.

See you on the output—direct! ■

Double-Duty Decoder Project

— listen to SCA and tune in RTTY

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Here are two projects that I've had in mind for a long time. Since they are very similar in design, I am combining them into one article divided into two parts. Part One covers the SCA decoder, and Part Two covers the FSK decoder.

Part One

For a long time I have been wanting to receive the background music that many FM stations broadcast. I had read several construction articles describing decoders, but they were all too complicated. I wanted something simple and easy to build. I knew that a 565 PLL could be used to decode SCA broadcasts, so out came the *Signetics Data Book*. A schematic shown in Fig. 1(a) is included, along with the specifications on the IC. Another schematic (Fig. 5) demonstrated that FSK decoding is possible. Since the two circuits were very similar, I designed a printed circuit board to permit constructing either circuit by installing the appropriate parts.

SCA is uninterrupted background music transmitted by some FM stations for use in offices and commercial businesses such as department stores. The SCA signal is on a 67-kHz subcarrier of the regular FM channel, and is only ten percent of the total signal. The subcarrier is frequency-modulated, and has a bandwidth of plus and minus 7 kHz.

An input signal greater than 50 mV is required by the 565 to be able to operate properly. A resistive voltage divider is used to establish the correct operating bias for the inputs, and a high-pass filter is used to attenuate the regular FM channel audio. The 67-kHz operating frequency of the 565's vco is set by the RC constant of R6 and C3. The vco requires only approximate tuning, as it will lock over a range of plus and minus 30 percent. However, a test point is provided so that the vco may be set exactly with a frequency counter. A low-pass filter and de-emphasis network is formed by resistors R7, R8, and R9, along with capacitors C6, C7, and C8. This filter removes most of the bias that usually accompanies the SCA signal.

The audio output from the 565 is approximately 30 to 50 mV and may be fed into your receiver's stereo demodulator. Most receivers today utilize an IC as a stereo demodulator and can distinguish between mono and stereo signals. A mono signal lacks a 19-kHz pilot signal, and the demodulator will automatically apply the same audio to both output channels. Coincidentally, these ICs also require about 50 mV of audio signal at the input. Most of these ICs also include the proper de-emphasis network for the regular FM signal.

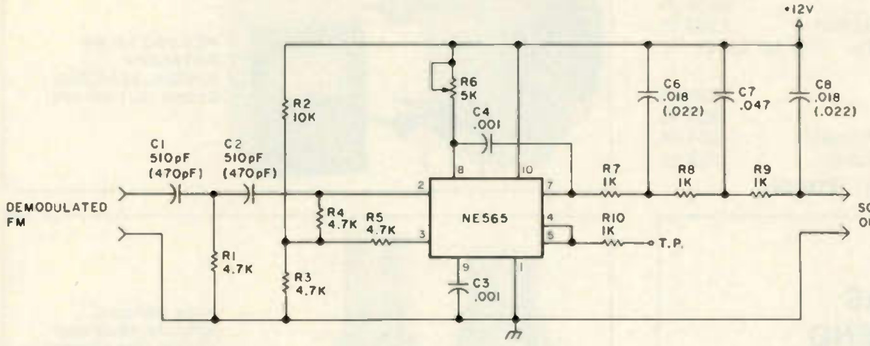

Fig. 1(a). Schematic of SCA decoder. Values in ( ) are acceptable substitutes. Adjust R6 for 67 kHz at TP.

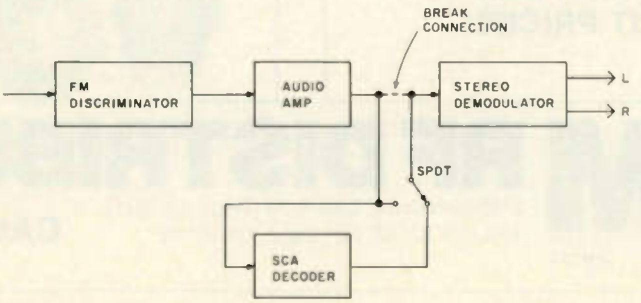

Fig. 1(b). Typical connection for decoder.

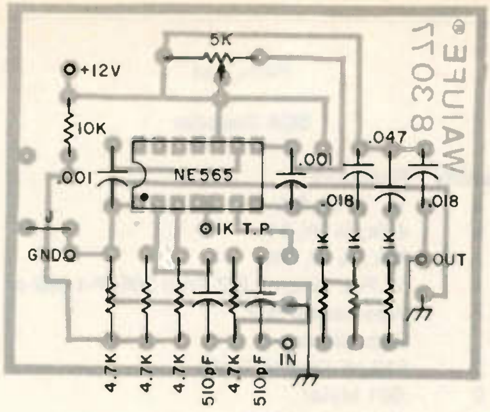

Fig. 2(a). Parts layout of decoder.

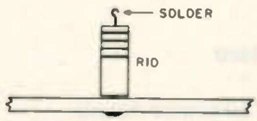

Fig 2(b). R10 TP. Mount vertically and form top lead into a loop.

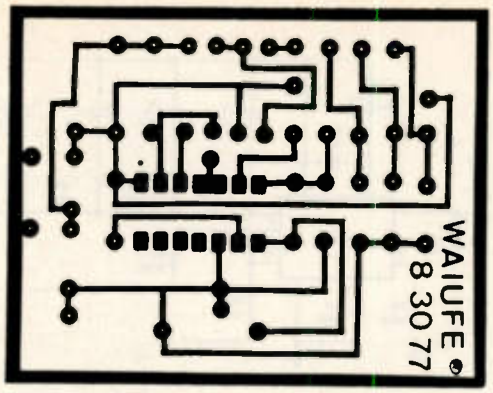

Fig. 3. SCA/FSK decoder board. Board is 2" x 2½". Foil side view.

The input of these ICs is usually preceded by a transistor-amplifier whose input comes from the receiver's discriminator. This signal contains both the SCA audio and the FM multiplexed audio. The demodulator normally eliminates the audio signal above 50 kHz. Fig. 1(b) shows a typical connection scheme for installing the SCA decoder. It may be to your advantage to obtain the schematic for your receiver to locate the proper connection point.

I installed an SPDT switch so that I could alternate between the regular channel and the SCA signal. This also makes it easy to locate a station in your area that transmits SCA. Just tune to each station, and flip the switch. It may be necessary to increase the volume control due to the low level of the SCA signal.

Use ¼-Watt 5% resistors and Mylar™ capacitors, except for C1 and C2, which may be disc type. If you have difficulty obtaining exact values, acceptable substitutes are noted in parentheses. These are the values I used, and I encountered no trouble in the operation of the decoder.

Also, use shielded audio cable if the decoder is to be mounted more than a couple of inches away from the tie-in point. This will reduce the possibility of hum being picked up and amplified. Power consumption is about 8 mA, so a power switch should not be needed. Just find a point in your receiver where you can obtain +12 volts and wire the decoder to it.

Part Two

The FSK decoder is a little more difficult because of the dual power supply requirement. Both plus and minus 5 volts and 12 to 15 volts are needed. Fig. 9 shows a schematic for a suitable power supply.

Fig. 4(a) shows an audio processor stage to supply an approximate 50 mV signal to the input of the 565. These two amplifiers have a gain of .1, so you'll need more than 500 mV of audio input. You should be able to tap off from your receiver's headphone jack.

Fig. 4(b) is the digital processor stage. The signal from the 565 output and reference is applied to IC2a which buffers the signal. The output from this amp is a distorted square wave. IC2b further conditions the signal, and the 200k potentiometer is adjusted for a 3-volt peak-to-peak signal at TP1. IC3 converts this signal to a clean square wave. Pin 3 of IC3 should be set at −.2 volts for proper symmetry of the output signal. However, this is only an approximate setting. Due to differences in components, it may be necessary to align this stage.

There are two methods of aligning this stage. The first requires the use of a general-coverage receiver capable of tuning RTTY signals. Start by tuning in a good strong FSK signal. Try one of the RTTY net frequencies. Connect the output of the decoder to the keying circuit of your page printer, and be sure that the printer is set properly for the speed of the signal being received. Use a high-impedance voltmeter between pin 3 of IC3 and ground, and adjust the resistor while watching the printer for the best copy. Take note of the reading for future reference.

The second method is for all you purists who have everything. You will need: frequency counter, oscilloscope, square wave generator with variable baud width and amplitude controls, and a voltage-controlled sine wave generator with amplitude control.

Set the sine wave gen-

For Figs. 4(a), 4(b): IC1, IC2—uA747, 14-pin DIP. Pins 9, 13 — +15 V, pin 4— −15 V. IC3—uA741, 8-pin DIP. Pin 7— +15 V, pin 4— −15 V.

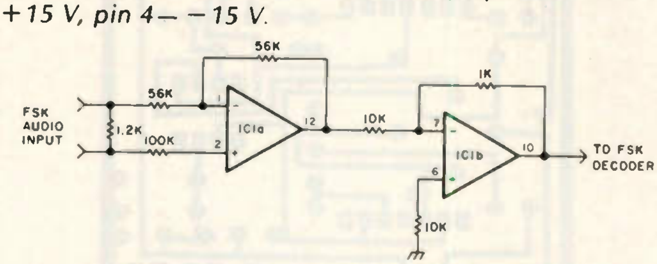

Fig. 4(a). Audio processor. Audio input>500 mV ac.

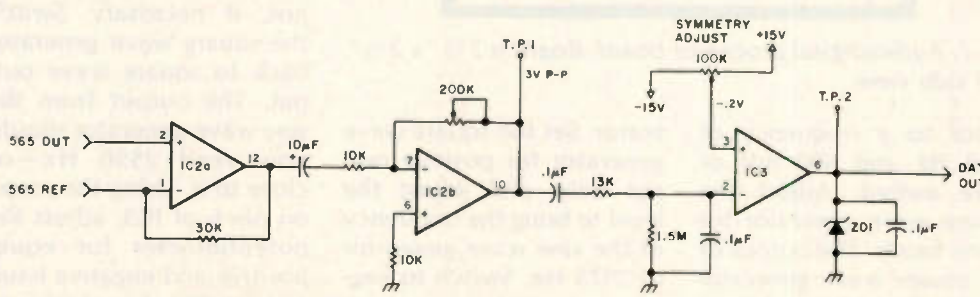

Fig. 4(b). Digital processor. Choose ZD1 for maximum output voltage required.

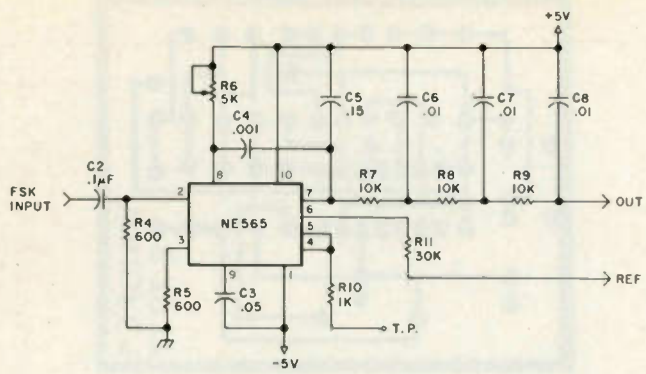

Fig. 5. Schematic of FSK decoder. Uses same board shown in Fig. 3. Adjust R6 for 2550 Hz with no input signal, for operation at 2125 Hz to 2975 Hz, 850-Hz shift.

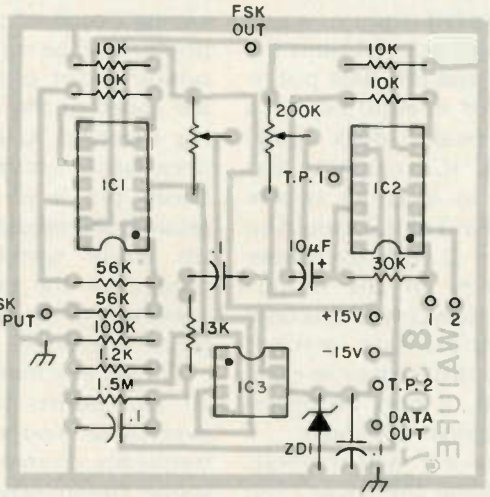

Fig. 6. Parts layout. Audio/digital processor. Pin 1, IC2: 565 reference input. Pin 2, IC2: 565 output input. Be certain that both decoder and processor boards have common ground when used together.

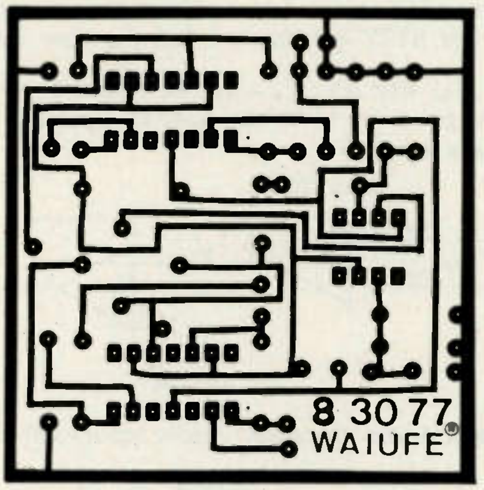

Fig. 7. Audio/digital processor board. Board is 2½" x 2½". Foil side view.

Parts List

SCA Decoder

Quantity	Resistors
4	1k, ¼ W, 5%
4	4.7k, ¼ W, 5%
1	10k, ¼ W, 5%
1	5k Pot. Bourns E-Z-Trim 3067P-1-502 or Weston 43P502
	Capacitors
2	510 pF Disc (470 pF)
2	.001 Mylar
2	.018 Mylar (.022)
1	.047 Mylar
	ICs
1	NE565
	Processor Board
	Resistors
1	1k, ¼ W, 5% (unless otherwise noted)
1	1.2k
4	10k
1	13k
1	30k
2	56k
1	100k
1	100k Pot. Bourns E-Z-Trim 3067P-1-104
1	200k Pot. Bourns E-Z-Trim 3067P-1-204
1	1.5M
	Capacitors
3	.1 uF Mylar
1	10 uF 25 V Tantalum Electrolytic
	ICs
2	747 dual op amp
1	741 op amp
	Misc.
1	Zener Diode (see text)
	FSK Decoder
	Resistors
2	600 Ohm, ¼ W, 5% (unless otherwise noted)
1	1k
1	5k Pot. – same as SCA Decoder
3	10k
1	30k
	Capacitors
1	.001 uF Mylar
3	.01 uF Mylar
1	.05 uF Mylar
1	.1 uF Mylar
1	.15 uF Mylar
	ICs
1	NE565

erator to a frequency of 2550 Hz and 500 mV or more output. Adjust the square wave generator for 11 ms bauds. The output of the square wave generator goes to the voltage control input of the sine wave generator. Set the square wave generator for positive output only, and adjust the level to bring the frequency of the sine wave generator to 2975 Hz. Switch to negative output only, and adjust the level for a frequency of 2125 Hz. Recheck the positive level again, and adjust, if necessary. Switch the square wave generator back to square wave output. The output from the sine wave generator should now read 2550 Hz—or close to it. Using the scope on pin 6 of IC3, adjust the potentiometer for equal positive and negative baud widths. The board should now be aligned, and operate properly with FSK RTTY signals.

Fig. 5 is the schematic for the FSK decoder. Note the differences in values for the change in operating frequency. Use ¼-Watt 5% resistors and Mylar capacitors here, also. R6 sets the vco frequency to 2550 Hz for 850-Hz shift RTTY. This circuit is capable of decoding down to 150 Hz shift, although for narrow shift

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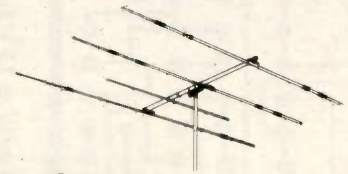

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A144-20T	2 Mtr. "Twist" 20 ele.	62.95	52.95
A147-20T	2 Mtr. beam	62.95	52.95
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A432-20T	430-436 Mhz. Beam	59.95	49.95

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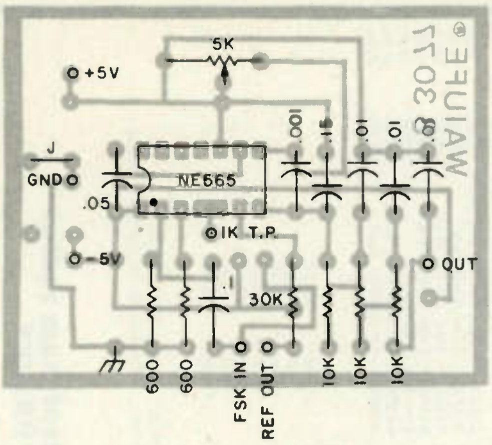

Fig. 8(a). Parts layout for FSK decoder.

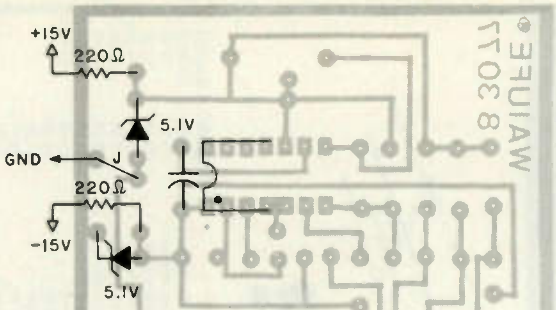

Fig. 8(b). Alternate layout for use with ±15 V supply only. Mount 220Ω resistors vertically.

RTTY, it may be necessary to add a 10k resistor between pins 6 and 7 of the 565. This will narrow the lock range, and improve the tracking of the vco. Always tune the vco for a frequency halfway between the upper and lower limits of the signal you wish to decode, with no input applied to the decoder.

Choose the zener diode at pin 6 for the output voltage required for your application. For TTL circuits, use a 1N751, 5.1-volt zener. A 1N757 will give you 9 volts.

I haven't tried it yet, but it would seem that if the FSK decoder is tuned to 1800 Hz, it may operate for decoding audio tapes using the Kansas City Standard of 1200-2400 Hz. If it does, tape decoding for microprocessors is possible, and that makes this a three-in-one project. ■

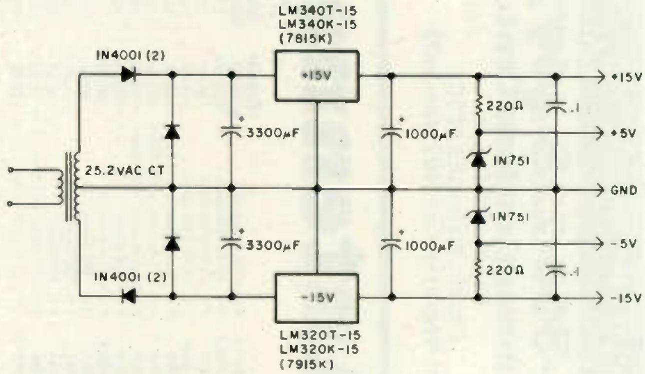

Fig. 9. Power supply for FSK decoder and processor.

Reader Service—see page 259

Reader Service—see page 259

Bob Buckman W6SMJ
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Santa Maria CA 93454

Build a Simple HT Charger

—doubles as a 12-V supply

When I acquired my Standard handie-talkie in 1972, I went all out—leather case, rubber ducky, mini mike, fistfull of crystals, and a shiny black charger.

The SCH HUC1 charger was prone to losing its filter capacitors (bad lot or something) without giving any indication of malfunction except that a full charge would last only a few hours. Since Standard chose to use a voltage quadrupler circuit, that loss required four new 100-uF capacitors.

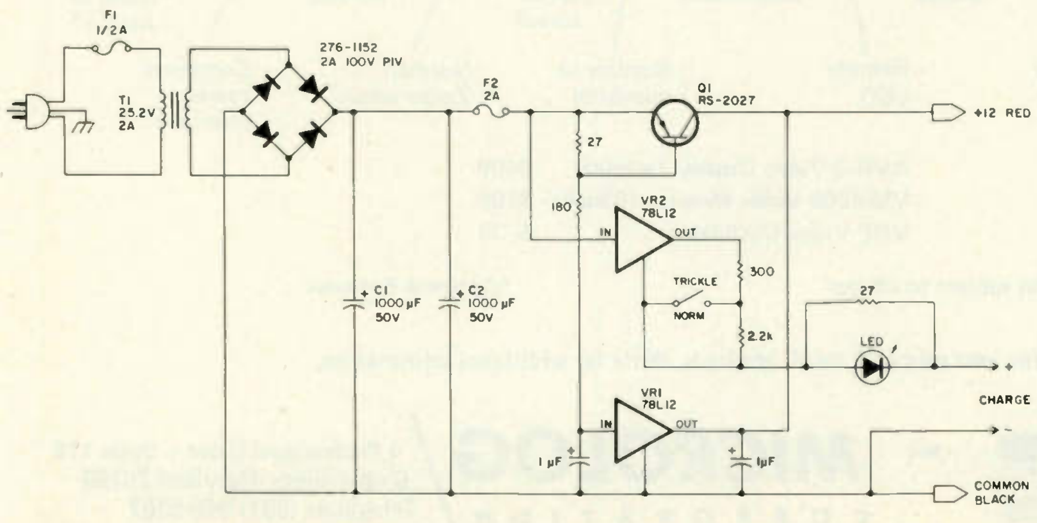
Recently, I bought a Heathkit 2 meter 10-Watt amplifier for use with the handie-talkie on trips and in rental cars. The amp takes about 100 mA in transmit. I decided to build a 12-volt two-Amp power supply in the charger case and replace the charger circuit with one of the new three-terminal regulators in a constant current mode.

The circuit is easy—all the parts are available at the friendly neighborhood Radio Shack. When you open the charger, take *everything* out. The slide switch is too big with the new transformer in place and you have to drill some holes anyway, so take everything out and drop the remains in the junk box. You will use only the line cord and the cabinet. The chassis is the S-shaped piece of steel surrounded by the outside shell.

I used banana jacks ¾ of an inch apart for output terminals and a small piece of P-type vectorboard to hold the small parts. If you use the existing switch hole for one end of the transformer, there is just enough room for the two 1000-uF filter capacitors to be crammed lengthwise against the transformer frame. There is not much room, but underneath the capacitors, is a five-terminal phenolic terminal strip bolted to the other mounting hole of the transformer. This terminal strip holds the four-terminal bridge rectifier, the positive ends of the filter capacitors, provides a ground contact, and connects the secondary of the power transformer.

I tried to use a 12-volt rms transformer, but, with only 2000 uF in the filter, the output voltage under load drops to about 8 or 9 volts. Using a higher voltage transformer allows the regulator circuit to handle the ripple dynamically, since the dc instantaneous value never drops below 14 volts.

Output ripple under load was measured at under 30 millivolts; no hum is detectable without instruments on the rf carrier. The pass transistor is bolted to the bulkhead inside the charger case. Install it with a mica washer and be sure that there is no short between the collector and the case. Note the fuse in the schematic for short-circuit protection. It



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The fantastic new Avanti 2 meter Mobile Antenna – mounts on your car window glass! 3 DB gain. Neat and compact installation!
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Amateur Radio Supply of Nashville, Inc.

was hard-wired into the lead from the bridge to Q1, and its ends were covered with tape.

Because the open circuit charging voltage is over 25 volts, be *sure* your handie-talkie's external power jack is wired so that the nicads are always connected to the charger pads and disconnected from the radio power bus when the external jack is plugged in.

The constant-current regulator, VR2, maintains the regulator voltage across the series resistance. To find the resistance value for any constant current within the regulator's power range, divide the regulator voltage by the desired constant current.

With the switch in the normal charging position, the regulator delivers a constant 43 mA (just like the Standard circuit was supposed to) even into a short circuit with no ill effects. I connected two battery packs in series and the current was still just 43 mA. The LED gives positive indication of charging current—43 mA will never hurt the nicads. The trickle-switch position reduces the charge current to around 7 mA and is used when the handie-talkie gets only infrequent use. The 27-Ohm resistor across the LED shares the current in the normal charge mode to prevent burning out the LED. In the trickle mode, not enough current is left to illuminate the LED. The normal/trickle switch is installed in one of the rivet holes from the old slide switch; the LED is spot-epoxied into the other rivet hole.

I now have a charger I'm sure of and a utility 12-volt supply as well! ■

Charles Willson K2GMZ
505 East Main St.
Palmyra NY 14522

Do-It-Yourself Carrying Case for Wilson HTs

—save $14.88

I'm the proud owner of a new Wilson Mark II HT, which I had the good fortune to win at the 1978 Syracuse hamfest. This little gem came complete with .52-.52 xtals, rubber ducky antenna, and a wall charger for the nicad battery pack.

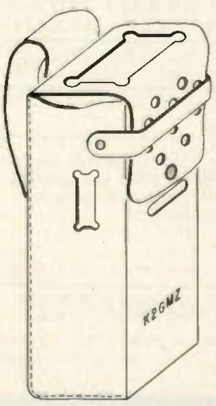

Fig. 1. Instamatic camera case—after surgery.

The first thing I did, after I came down to earth, was to fire off an order to a *73* advertiser for crystals for several local repeater frequencies.

Next, I needed a carrying case. Ouch. The Wilson (no relation, unfortunately) leather case lists at $18.95. Seemed like an extravagant outlay for a case to carry around an HT which merely cost me the price of a dollar raffle ticket!

An alternative which came to mind was, "Can a nearsighted, middle-aged ham with two left hands consisting of ten thumbs cut out and sew a leather or vinyl case which would have enough class to house this fabulous HT?" The painfully obvious answer to this question was a resounding "No!"

While wandering through the camera department of a local discount department store (K-Mart), I spotted a top-grain cowhide leather Instamatic-type camera case which had the exact dimensions I needed. Cost? $4.07 plus sales tax.

A few minutes worth of surgery using an X-acto knife as a scalpel, and *voilà*, a case which could compete with the high-priced spread. In addition to the openings shown in Fig. 1, I punched a hole in the bottom which allows me to plug in the charger without having to remove the unit from the case. ■

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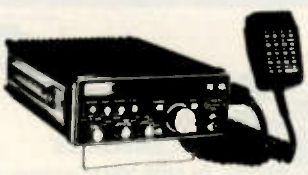
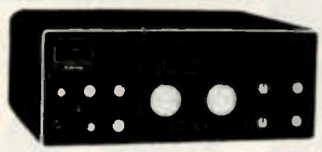


YAESU CPU-2500RK



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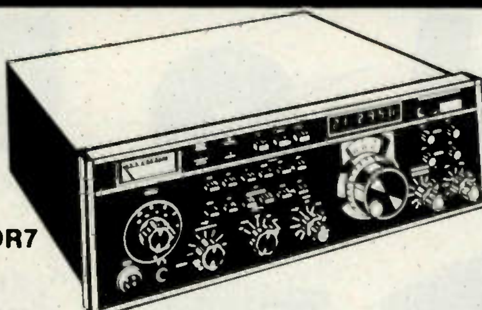

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DRAKE TR/DR7
Solid state synthesized HF transceiver

Covers 160 thru 10 meters, reception from 1.5-30 continuous, 0-30 MHz with optional AUX-7, modes: USB, LSB, CW, RTTY, AM. True pass and tuning, RIT, built-in RF wattmeter/SWR bridge, SSB 250 watts PEP, CW 250 watts, AM 80 watts. Power supply required for AC operation, PS-7 120/240V power supply available.

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DRAKE

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RRM-7 plugs in for receive	7.50
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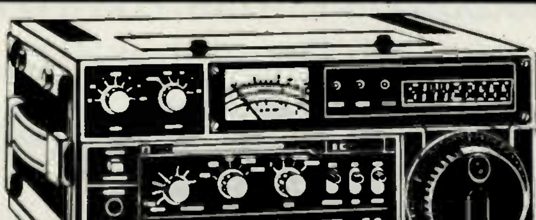
7077 deck mic. Modes: push to talk or VOX, dynamic, high impedance, freq. res.: 300-5000 Hz, 4 pin connector 45.00



ICOM IC-551 50 MHz all mode transceiver

An all mode, 6 meter unit with multipurpose scanning. Either memory scan (monitor 3 different channels) or program scan (scanning between 2 programmed frequencies). It also features built-in dual VFO's, built-in AC/DC power supplies, digital readout, 10 watts, noise blanker, high quality crystal filter, and scans the 6 meter band. Options include EX-108 (pass band tuning), EX-106 (FM board) and EX-107 (VOX).

489.95 Call today.

YAESU FT-227RB 2m FM transceiver

With 4 memory channels, a remote scan for mic, can select to scan clear or busy channel, a frequency coerage of 144 to 148 MHz, 800 channels, power requirements: 13.8 VDC at 2.5 amps continuous, RF output: 10W hi/1W lo, tone burst ± 600 KHz repeater offset. Complete with YM-22 touch tone mic.

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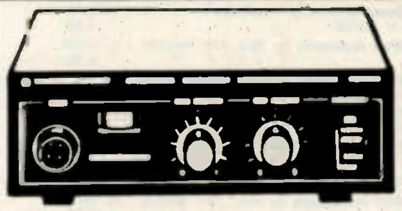

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A matching phone patch for Kenwood equipment. It has NULL contorl, RX gain control and TX gain control. It may be connected between a transceiver and phoneline.

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200 Watts PEP!
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TS-180S
solid state
HF transceiver
with Digital Frequency Control
With 4 memories, manual scanning, tuning in 20 Hz steps with recall of stored frequency. Cover 160 to 10 meters. Needs no tune up. Built-in microprocessor, digital display, IF shift, selectable bandwidth, tunable noise blanker, RF AGC, dual RIT, improved speech processor, 13.8 VDC operation. Adaptable to proposed bands.

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KENWOOD
PS-30
power supply
Designed to match the TS-180S/TS-120S, this unit supplies regulated 13.8 VDC at 15A continuous, 20A intermittent load with complete ease and safety due to the use of generous heat sinks and an automatic reset electronic overload trip.

139.00 Call for quote.

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200 WATTS PEP!
KENWOOD
TS-120S
All solid state
HF SSB transceiver
No tune up! Miniaturized circuits, solid state construction, built-in digital dislay, IF shift, final transistor protection, VOX, noise blanker, 25 KHz marker. Frequency range is 80 to 10 meters and WWV, modes: SSB and CW, power requirements: RX-0.7A 13.8 VDC, TX-18A 13.8 VDC. 3½"Hx9¼"Wx13½"L. Weight: 11.7 lbs.

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KENWOOD MC-50
dynamic desk mic
This mic has dual impedance, 50 ohms or 50K ohms. Compatible with Kenwood equipment.

45.00 Call today.

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FT-101Z
high performance
HF transceiver
Covers 160 thru 10 meters plus WWV, modes are: LSB, USB, and CW, built-in power supply, built-in RF speech processor, built-in noise blanker, variable IF bandwidth, analog frequency readout, 6146 final tubes with RF negative feedback, heater switch, VOX, attenuator 10 dB or 20 dB selectable, Power requirements: 100/110/117/200/220/234 volts AC 50/60 Hz.

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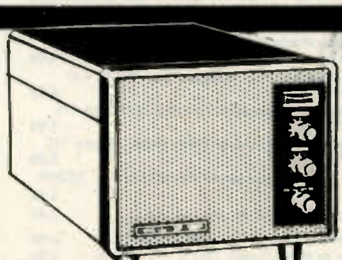

SP-901P speaker/patch
A speaker/phone patch to match the FT-901 series. The unit has full metering and level controls.

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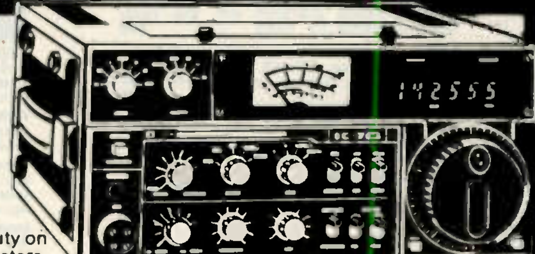
ICOM

ICOM IC-701 HF transceiver
All solid state, 100W continuous duty on all bands, all modes. 160 thru 10 meters, dual built-in digital VFO's for split frequency operation, VOX, semi-break-in CW, RIT, AGC, noise blanker, and built-in speech processor. IC-701 PS needed for AC operation. Power supply requirements: DC 13.6V negative ground



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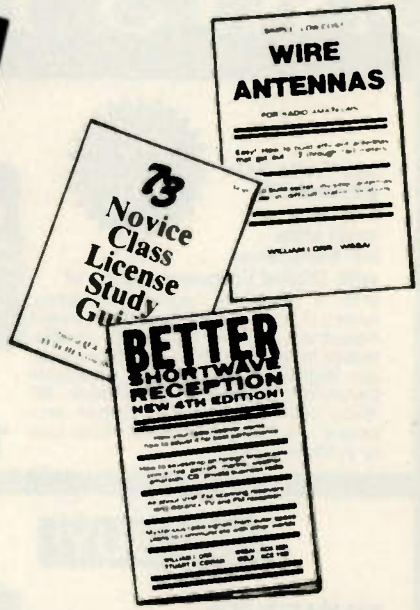

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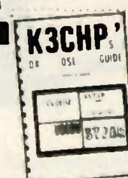

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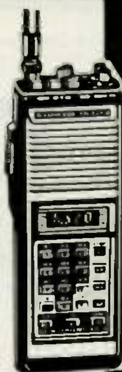

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143.900-148.495 MHz, 10 memories, up/down scanning for busy or clear ch., mode switch for standard non-standard repeater splits, LCD digital readout, built-in touchtone generator. 1.5 watts RF output. With flex antenna with BNC connector, NiCad battery pack & charger.

Call today.

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SHURE 444 desk mic
Has PTT switch, adjustable head. Freq. 300 to 3000 Hz. Omnidirectional with controlled magnetic mic element for SSB. High impedance: 50K ohms.

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YAESU FT-207R synthesized Handie-Talkie
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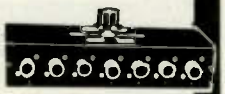
399.00 Call today.

B&W 595 coax switch
Features: 6 outputs, a power rating of 2 KW PEP, VSWR of less than 1.2:1 up to 150 MHz, grounds all unused antennas.



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B&W 593 3 position coax switch
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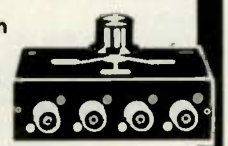

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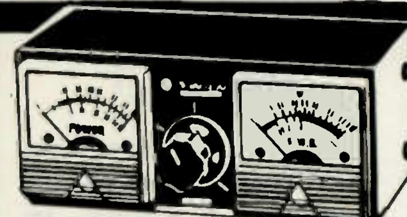

SWAN SWR-1A power meter and SWR bridge
Frequency range: 3.5 to 150 MHz. Compact and light weight for portable or mobile use. Capable of handling 1,000 watts RF and measures 1:1 to infinity VSWR.

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KENWOOD HS-4 headphones
You can wear these comfortable headphones for hours. Adjustable and lightweight.

19.50 Call today.

YAESU

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The YH-55 headphones are light in weight, and an extra-soft cushion makes for many hours of comfort. The audio response is shaped to match that of your transceiver.

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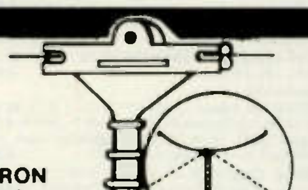

DENTRON All band doublet antenna
Covers 160 thru 10 meters and has a total length of 130' (14 ga. stranded copper). It may be made shorter. It is center fed through 100' of 470 PVC covered balanced transmission line. Assembly is complete. Antenna tuner required. Tunes 160 thru 10 with 1 antenna.

24.50 Call today.

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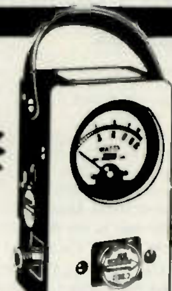

BIRD Model 43 Thruline® watt meter
50 ohms nominal impedance, permits direct reading of full scale power from 100 Mw to 10,000 W. Shock mounted.

130.00 Call for yours today.

BIRD plug-in elements

Frequency Bands in MHz

Power range	2-30	25-60	100-250	200-500	400-1000
5W		5A	5C	5D	5E
10W		10A	10C	10D	10E
25W		25A	25C	25D	25E
50W	50H	50A	50C	50D	50E
100W	100H	100A	100C	100D	100E
250W	250H	250A	250C	250D	250E
500W	500H	500A	500C	500D	500E
1000W	1000H	1000A	1000C	1000D	1000E
2500W	2500H				
5000W	5000H				

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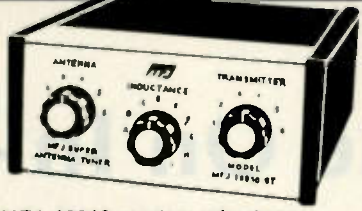
MFJ 949 Deluxe Versa Tuner II
A 300 watt antenna tuner with features like dummy load, SWR, forward and reflected power meters, antenna switch and balun. It matches every thing from 1.8 thru 30 MHz, coax random wires and balanced lines.

119.95 List. Call for quote.



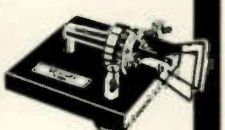
MFJ-16010 random wire tuner
Operate on all bands with a simple random wire. Up to 200 W RF output. Ultra compact 2" x 3" x 4". Match high and low impedances by interchanging input and output. SO-239 connectors.

29.95 List. Call today.

MFJ-941B Versa tuner II
This accurate unit has SWR and dual range wattmeter, antenna switch, built-in balun, 300W RF output. Matches everything from 1.8 thru 30 MHz. You can use just one antenna and increase the useable bandwidth. Has SO-239 connectors. Mobile mounting bracket.

79.95 List. Call today.

BENCHER BY-1
Iambic paddle
The Ultimate iambic paddle. Features solid silver contact points, full range adjustment, non-skid feet and heavy steel black textured base.



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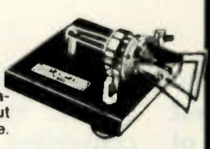

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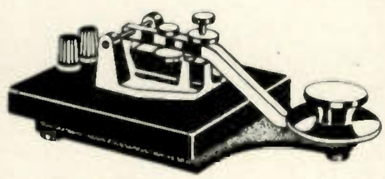

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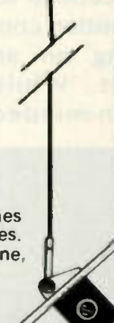

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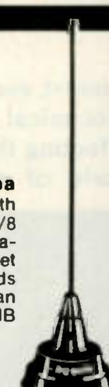

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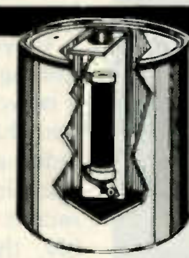

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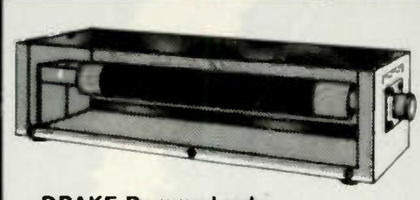

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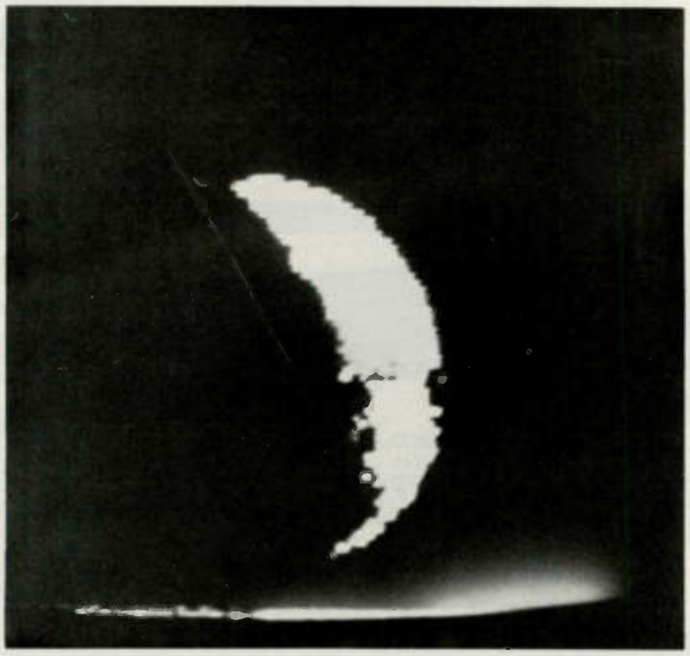
Come On In— The Viewing Is Fine

—an update on trends and developments in SSTV

Dave Ingram K4TWJ
Eastwood Village, #1201 South
Rte. 11, Box 499
Birmingham AL 35210

The interest, excitement, and technical advancements affecting the fascinating world of slow-scan TV during recent times have been a phenomenal experience. Newcomers and old-timers alike are enjoying the pleasures of visual communications as this amateur frontier continues expanding on an unlimited basis. While some operation-minded amateurs are visually sharing their lives and interest with SSTVers thousands of miles away, others are diligently pursuing new developments—many of which may be perfected before this article appears in print. This enthusiasm, devotion, and progress are prime indicators of the sheer fun awaiting all amateurs seeking new communication horizons.



Voyager II, *150,000 miles from Earth, looks back and acquires this crescent-shaped view of home. This picture was transmitted on 20-meter SSTV by Dick K6SVP.*

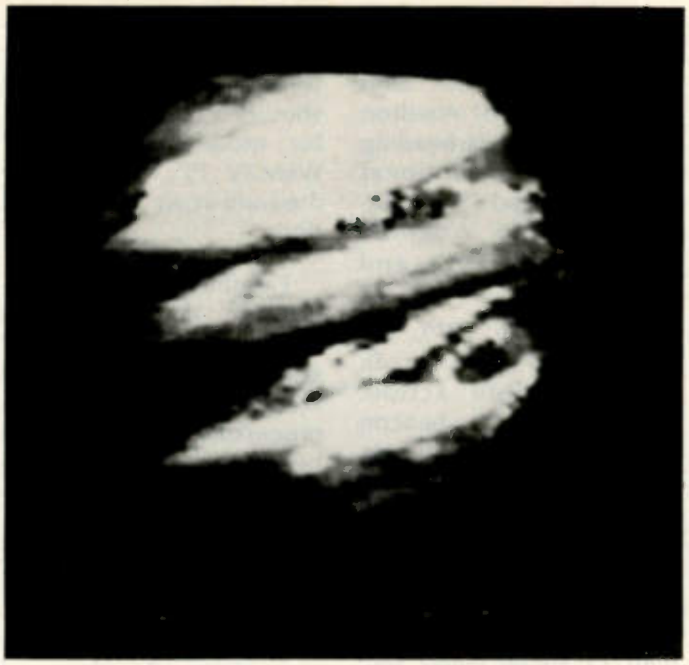
As an updating account, this article will describe some of the latest happenings in SSTV.

If you are thinking of joining our ranks, if you're a newcomer to SSTV, or if you haven't been overly video-active, this information should update you on recent innovations. Possibly, this article will send you racing back to the shack, anxious to share in the fun of slow-scan TV activity.

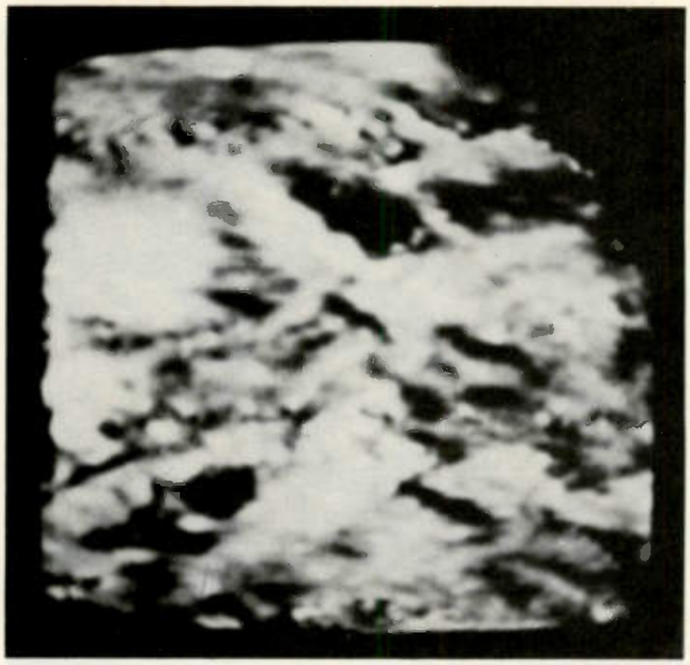
Trends and Innovations

Large numbers of SSTV newcomers continue to grace the airwaves, and their popular choice of gear is the Robot 400 system. Home-brew scan converters have dwindled in popularity due to their complexity and high cost, compared with the Robot or Thomas Engineering units. While the cost-per-bit of memory chips is somewhat expensive as this article is being written, a substantial change is expected in the near future. Indeed, the introduction of single memory chips capable of 65,000-bit storage may soon open new possibilities for inexpensive and compact home-brew scan converters.

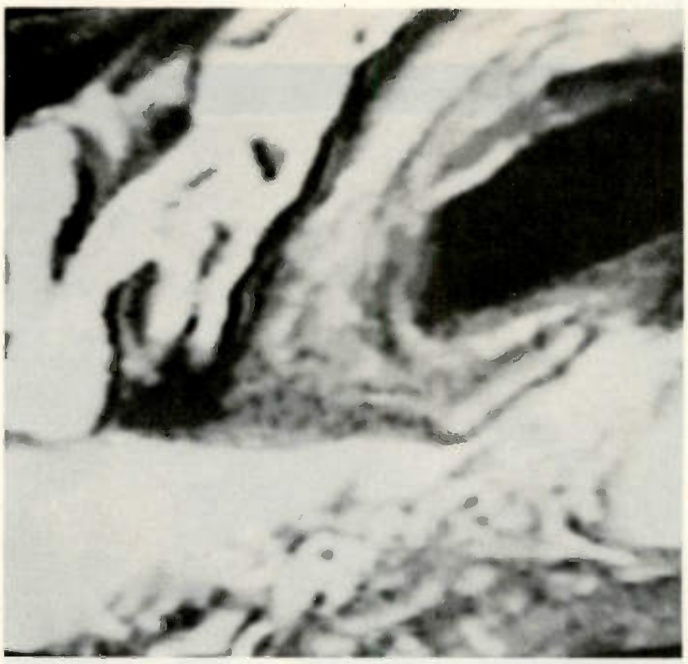
Surprisingly, the interest in digital scan converters hasn't created a large open market for used P7 SSTV gear. While many slow-scanners retain their P7 equipment when progressing to a digital scan converter, others sell their P7 gear directly to an awaiting SSTV newcomer. The recent interest in medium-scan TV appears to be another major reason for continued P7 monitor popularity.



This W6VIO-retransmitted view of Jupiter shows multiple layers of ammonia ice crystal clouds surrounding the planet. The shadowing effect of the sun prevents full view of Jupiter. The phenomenal "red spot" is visible in the lower right of the picture. This view was obtained with a 1500-mm telescope aboard Voyager II. *The spacecraft was approximately 50 million miles from Jupiter at the time.*



View of Jupiter's atmosphere in an area not far from the noted "red spot." This picture was acquired by Voyager II *on March 5, 1979, and also retransmitted by W6VIO during their March "Commemorative" operations.*



Extremely close view of Jupiter's "red spot" reveals a boiling storm with electromagnetic radiation equivalent to several atomic bombs.

Many slow-scanners consider using their freed equipment for this new 10-meter frontier.

Interest in SSTV keyboards appears to be declining, compared with a couple of years ago. Likewise, lengthy transmissions of pure text are being replaced by actual in-shack scenes and operator views. This aspect definitely indicates the ability to use SSTV rather than just prove that "the box works."

A second SSTV net recently began operating on 14,230 kHz, and its support has been extremely good thus far. This net begins at 2330 GMT each Thursday night. Net Controls are Tom N7AON and Stan WD4DCW. The prime objective of this net is providing technical assistance and SSTV newcomer guidance. A large number of fascinating SSTV pictures is exchanged during each net session, so that Thursday nights are becoming a very exciting time for all active SSTVers.

DX SSTV Drive

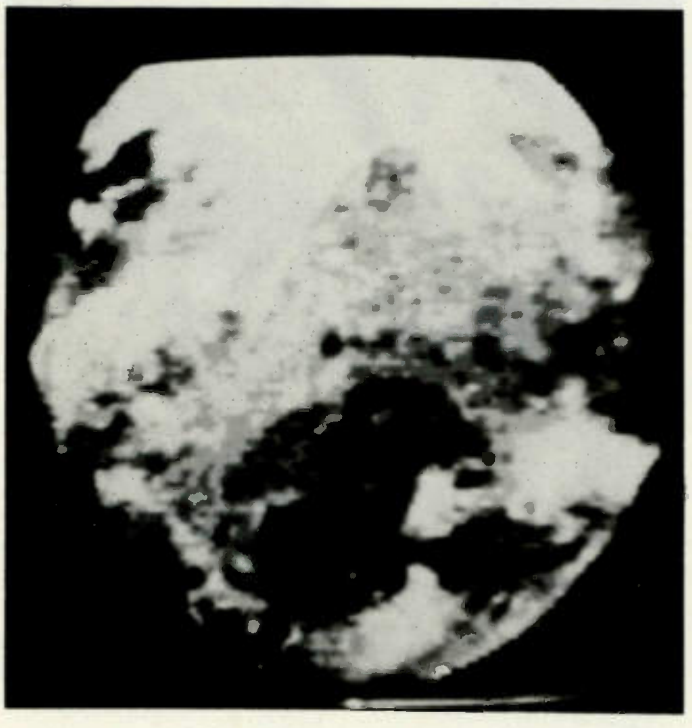
During the latter part of 1978, word was received in the United States of the extreme enthusiasm of two outstanding DX stations to operate SSTV. These stations were Tom Christian VR6TC, of Pitcairn Island, and VK9RH, of Norfolk Island. Soon thereafter, an appeal was introduced, both on the air and via magazine articles, and gear for both stations was acquired. The concern and support among slow-scanning amateurs is a phenomenal situation! As this information is being written, donors of SSTV equipment for VR6TC and VK9RH desire to remain anonymous. Their reasons for anonymity are quite simple: The donors do not desire special considerations of prima donna titles.

The *Yankee Trader* left Florida en route to Pitcairn during February, 1979. A part of the vessel's cargo was a Robot 400 system, complete with camera and monitor. Soon thereafter, a Robot 70 and 80 system was shipped to VK9RH on Norfolk Island. The Northern California DX Foundation assisted in this operation. Truly, this DX SSTV drive was one of amateur radio's most outstanding accomplishments during 1979.

MSTV

An expanded frontier of SSTV development which is rapidly gaining widespread popularity is in the area of medium-scan TV. Essentially, the concept of MSTV permits limited-motion, long-distance TV

Classic picture of Jupiter's moon, Io, in front of the gigantic planet. That's Jupiter's atmosphere in the background. This was one of the most popular pictures relayed by W6VIO.



Jupiter's moon, Ganymede, as viewed by Voyager II *from 1.6 million miles away and retransmitted on 20-meter SSTV by W6VIO.*

communications in a 35-kHz frequency spectrum. This limited motion is accomplished through the use of scanning rates which are faster than slow-scan but slower than fast-scan. Special Temporary Authorization has been granted to several amateurs to allow their medium-scan TV transmissions on the high end of 10 meters. Any amateur with appropriate equipment may join the fun of viewing these transmissions. Don Miller W9NTP, of Waldron IN 46182, is spearheading this project. Additional supporters and STA stations include WØLMD, W3EFG, W6MXV, and WB9LVI.

During early 1979, the first phase of medium-scan TV swung into action. W9NTP placed a beacon transmitter on 29,150 kHz to check channel communications capability. The beacon was reliably received throughout North America and Europe, thus ensuring that a medium-scan TV signal could successfully be utilized on the 10 meter high end. As this information is being written, the second phase of medium-scan TV is approaching initiation. This phase will involve using modified P7 SSTV equipment for medium-scan TV operation. Ultimately, the P7 gear will be replaced with microprocessors and digital scan converters designed to the established MSTV parameters.

Modifying conventional P7 slow-scan gear for medium-scan TV requires a reasonable amount of experimentation, but the final results make all effort definitely worthwhile. Medium-scan TV will use a 5-field-per-second interlaced format with a horizontal line rate of 317 Hz. These sync signals must trigger a monitor's sweep driver circuits, which in turn must produce a MSTV raster. The horizontal ramp-generating capacitor must thus be decreased in value by a factor of 317/15 while the vertical capacitor must be changed from 1/8-field per second to 5 fields per second. The SSTV monitor's front end should be bypassed, and the approximately 20-kHz video signal should be wideband-amplified to an appropriate level and applied to the cathode ray tube. The previous concept should prove successful for modifying Robot or W6MXV P7 monitors for medium-scan TV operation.

The final phase of medium-scan TV development will consist of replacing P7 gear with converted digital scan converters and microprocessors. This phase will bear a close resemblance to the present scan converter evolution with SSTV. The medium-scan project is a rigorous undertaking, and success isn't absolutely guaranteed. True amateur spirit and widespread dedication are two essential ingredients which need additional emphasis at the time this report is being written.

The Voyager Spacecrafts and SSTV

Alert and sharp-eared SSTVers have some exciting times in store for them during future months and years. Members of the Jet Propulsion Lab Radio Club have been providing "ringside seats" during high points of the *Voyager* space mission, and views thus far have been fantastic. This deep space mission began during August, 1977, and it is projected to continue until approximately late 1986. A brief outline of the events of *Voyager I* and *Voyager II* are as follows.

Voyager II was scheduled to fly by Jupiter during July, 1979. As *Voyager I* passes Jupiter, a slingshot effect hurdles it on toward Saturn. Its estimated flyby of Saturn will be during August, 1981. During this pass, *Voyager I* will move to within 2500 miles of Titan, Saturn's largest moon. Titan is the only one of Saturn's moons which has an appreciable atmosphere. Assuming everything is then progressing

successfully, *Voyager I* will continue toward Uranus. Its estimated time of flyby is January, 1986.

Voyager II was approaching Jupiter as this report was being written, and the views were truly breathtaking. Most Voyager and/or JPL activity is on 14,235 or 28,680 kHz. The usual times of operations are during weekends and early evening hours. The JPL club station call is W6VIO (W6 Viking In Outerspace). Don't miss the upcoming views!

Looking Forward

A number of technical and operational advancements are due to affect the SSTV world favorably during the near future, and now is the opportune time for amateurs to prepare for these exciting times. Several SSTV contests, QSO parties, etc., are being planned, while on-the-air slow-scan activities are also beginning to reflect progressive ideas and personal interests.

AMSAT's Phase III satellites also should provide some unique SSTV capabilities, provided all satellite operators discipline their operating techniques. EME, transequatorial propagation, and packet radio communications are some other examples of future horizons which, if combined with data compression techniques, can provide unlimited video capabilities.

If you would like to fully renew your interest in amateur radio, try the fascinating frontier of slow-scan television. The cost of visually equipping an existing setup is truly negligible compared with the unlimited pleasures it affords.■

Michael Black VE2BVW
16 Anwoth Road
Montreal, Quebec
Canada H3Y 2E7

Rack 'Em Up

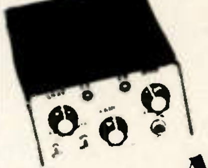
—glass jars and orange crates are "where it's at" for parts storage

Over the years, many methods have been described for storing parts, including just about everything from shoe boxes to old tin cans. Perhaps, though, most popular is the ordinary food jar. The common jar is great as a parts container since it has a lid, is transparent, is easily available, and is inexpensive. Now, I use old jars to store my parts which I don't use too often, and while that is not too interesting, I feel that the method of storing these jars is.

A favorite way of storing jars full of components is to place them standing up on a shelf, but that has a couple of disadvantages. If you have a deep shelf and a number of rows of jars, the problem is that it is hard to see what is in the jars in the back, and you have to remove the front rows in order to get at those in the back. To alleviate this situation, you could have only one row of jars, but then you use up a lot of wall space with your jars. The solution is rather simple. When you put your jars on the shelf, lay them on their sides. That way, you can just slide out the jar you want. As for the problem of identification, you can put a label on the top of the jar. If you actually want to see what's in the jar, just put it on the shelf backwards so you can look through the bottom.

Now for some details on what I'm using. For jars, I've got tall and narrow iced-tea jars, with a rated capacity of 13 ounces. For the shelves, I'm using old orange crates stacked on top of each other. These crates are about 8″ × 11″ × 6″ and they're just about perfect for my jars. I can fit two rows of four jars and another row of three jars in there and there's just a bit of wasted space in the top two corners. I used what I had on hand but it shouldn't be too hard to throw together some sort of box for your jars. Don't make your boxes too big, since the jars might have a tendency to roll around. Also, I'd suggest that when you're picking your jars, find something which is tall as compared to its diameter.

So that's the story. The jars in their box sort of remind me of wine bottles in their rack. When you pull out a bottle from a bottom layer, the top layers drop down, so keep a hand on the jar immediately above the one you're taking out. Now, isn't that better than a bunch of old tin cans?■



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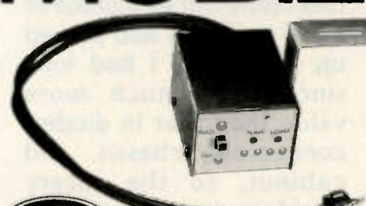

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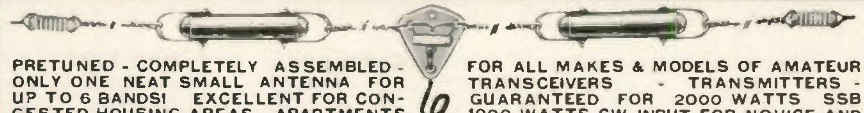

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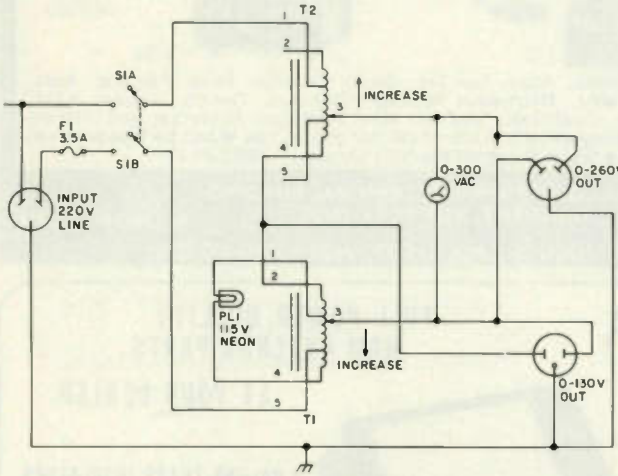
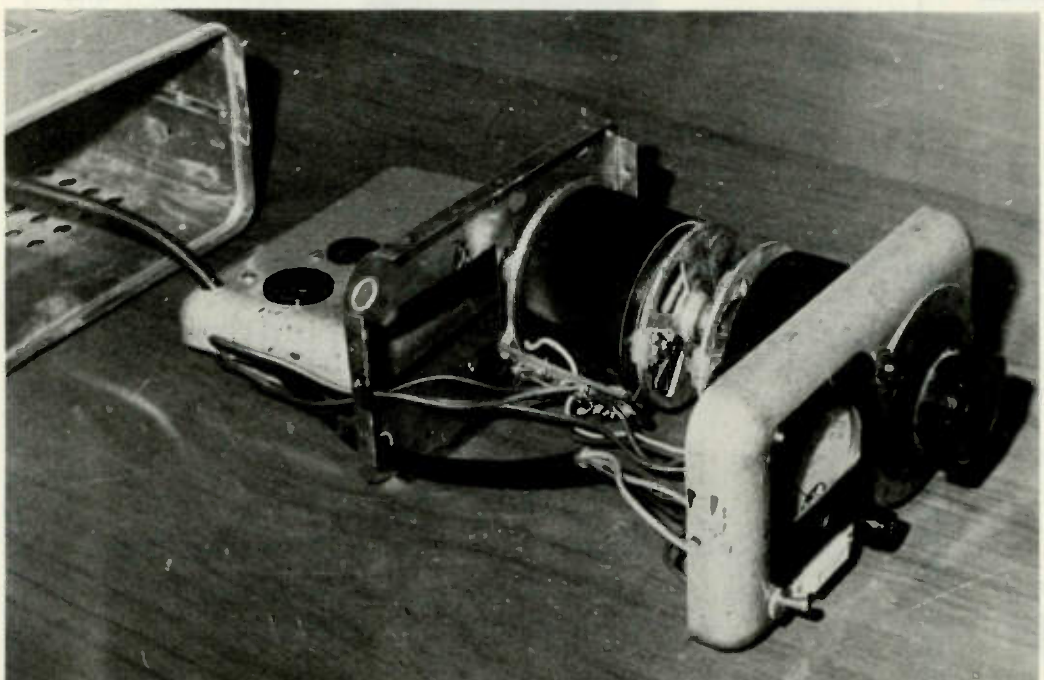


Fig. 1. Variable 0-260 volt ac supply.

William P. Winter, Jr.
WB8JCQ/LU1AKO
530 College Ave.
Ashland OH 44895

Need and the lack of money are the parents of home brew, it seems—at least in my case. I had a need to test plate transformers for power output under varying load conditions. I was trying to test various 220-volt primary transformers which were available to me for use in a linear amplifier. I had a 0-150 volt, 500-Watt supply which I used with a 110-220 volt auto transformer, but things began to saturate at about 700 Watts.

It occurred to me that two variable transformers hooked up in series might do the trick. I knew that I had tucked back in the junk box two Ohmite VT-4 rotary transformers which had come out of a piece of $2.50 surplus I had picked up years ago. I had long since used much more value than that in diodes, connectors, chassis, and cabinet, so the rotary transformers were just lying there for free.



I checked them out with clip leads to make sure everything worked OK. Then back to the junk box; out came a 0-300 volt ac meter of unknown origin, a large vibrator inverter supply which had long since given up the ghost, plugs, receptacles, switch, fuse holder, and a pilot light. Inspection showed that everything would fit snugly inside the old inverter cabinet. A few hours of work resulted in a nice in-

strument capable of more than 1000 Watts intermittent output.

The schematic (Fig. 1) shows the hookup and terminal numbers for the Ohmite units I used. Other models may be different. The two units must be coupled mechanically back to back. In my case it was necessary only to loosen the shaft setscrews and slide the shafts back enough to couple the two shafts together. I drilled out an old shaft coupler to fit the two shafts, then mounted a sheet metal support on the other end to support the rear transformer. The pilot light was hooked between 115-volt fixed taps, and a 0-130 volt output was taken from one of the variable transformers.

It should be noted that the hooking back-to-back is the only way to get one transformer to rotate clockwise (looking from the front) and the other to rotate counterclockwise. Otherwise, a set of gears would have been necessary. It can be seen from the schematic that the slider on T1 goes down to increase voltage output as the slider on T2 goes up to increase voltage output. If the two transformers were hooked up in tandem, the sliders would only track back and forth with a fixed 110-volt output.

Need a variable 220-volt supply for connecting to the 220-volt line? Can't find one available at a cost you are willing to pay? Do as I did and have the satisfaction of home-brewing something not too complex—and the best bonus of all for me was the cost—$0.00. You can't beat that! ■

Scrounger's Special: Used Dental Tools

—your DDS throwaways make dandy PCB drills

J.E. Corwin WA7OYX
1511 E. Third Street
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Did you ever get to the middle of a PC project and find one of the holes too small to accept that end of tinned stranded wire? Or that square LED lead? Did you then get out your trusty drill and bit and proceed to accidentally damage either the PC board or a component or both?

If so, dear reader, perhaps your friendly dentist can help you.

Over the past years, I have paid out to my dentist about as much as I have contributed to the IRS welfare and pension funds, and have thus been able to help him maintain his private airplane and a pair of matched quarter horses. Dentists, like most people, are more than willing to explain what they are doing and how the procedure is performed. As a result of a recent visit and the usual question and answer session, my dentist gave me a set of conventional root-canal reamers he had discarded for no longer being sharp enough to be used on human teeth.

Root-canal reamers are similar to the familiar twist drill, come in various diameters, and have a knurled knob at the top end to permit the reamer to be twirled with the fingertips. The set given to me (in a plastic box about the size of a book of matches) contains six reamers, sized from about 1 mm to 2 mm. The reamer shanks are 1" long and the knurled knobs are 1/2" long by 1/8" in diameter. It is a simple matter to select the proper size reamer and enlarge the PC hole to accommodate the wire or component with just a few twirls of the fingers—and without damage to other components, PC board, or foil.

The next time you see your dentist, ask him to save his throwaways—they do come in handy around the shack. ■

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2N5179	.43
2N5177	20.70
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Reader Service—see page 259

First Look at Latest Radio Laws

—the official work

Read from right to left.

John W. Bailey KB5AO
Route 9, Box 279
Sour Lake TX 77659

1. All rules and regulations are printed in reverse order. They should be read from right to left for maximum comprehension.

2. Any section of Part 97 conducive to good operating procedures will be changed on the next FCC docket.

3. The FCC encourages all amateurs to improve their skills toward the goal of being allowed to operate in the 27.405-28.000-MHz band.

4. Propagation characteristics of HF signals are influenced mainly by the distance (in meters) between the transceiver and the nearest wall.

5. Propagation forecasts may be ignored, as they are formulated by those who understand the subject.

6. Minimize interference to other services by disconnecting the microphone (or key) from the transmitter. Note that in some cases, additional shielding may be required.

7. Wideband F3 emissions are not allowed below 50 MHz.

8. Wideband F3 emissions are not allowed above 50 MHz.

9. Average power is 1.5 times unmodulated power, which is 4 times the modulating power (1.717x) as related inversely to PEP/average ratio of 2 to 1 or 4 to 1, as the case may be.

10. Resistors and inductors are identical, and those of like values may be interchanged (see Ohm's Law). Capacitors react inversely and must be installed backwards.

11. Ohm's Law is an unproven theory which changes, depending on whether one reads *QST* or *73*. Note: *QST* takes the conservative view.

12. In ACs (audio circuits), black wires must be connected to black wires and red wires must be inductively coupled to red wires of the same gauge.

13. Circuits oscillate because of insufficient neutralization of tuned circuits. This leads to degeneration of the entire circuit. Such a condition may be prevented by careful adherence to #12 above.

14. Vacuum tubes are sacred instruments of the gods and should not be adjusted internally under any circumstances.

15. Transistors (and ICs) are instruments of the devil and should be left alone.

16. Semiconductor diodes are the source of many electronic problems, as they pass current in only one direction.

17. Toroidal inductors create a magnetic field and are very useful in picking up small items dropped into the rig. In normal operation, these devices attract metal. By reversing the leads (and thus the magnetic field), plastic and mica are attracted.

18. Resonant circuits in rf amplifiers cause a hollow, tinny sound in the transmitted signal. Key clicks may also be observed if a scope is attached.

19. The transmission line must be of a length sufficient to reach from the rig to the antenna. Insufficient length leads to nonresonance and reduced signal output.

20. If an antenna stays up, it is too small. (This information was obtained from other sources and is subject to personal verification.)

21. The oscilloscope is valuable in observing radio phenomena such as wavelength, resistance, impedance, and the size of the outer conductor.

22. "You can't work 'em if you can't hear 'em." (Illustrates the need for a receiver in all shacks.) ■

Reader Service—see page 259

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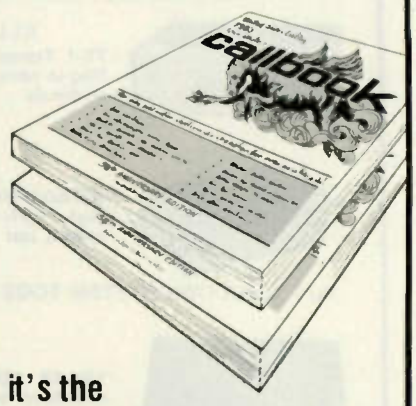

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Reader Service—see page 259

The Induction Relay: Self-Powered Switching

— this unusual actuator doesn't require a separate control voltage

Waldo T. Boyd K6DZY
P. O. Box 86
Geyserville CA 95441

A standard relay requires a separate source of low-voltage current to pull in the armature, usually supplied by either a step-down transformer or a low-voltage dc supply. There's an interesting and potentially very useful way of controlling remote equipment without need for a separate low-voltage source: The induction relay.

An induction relay is particularly appropriate when a mechanical function such as opening a detent is needed.

In Fig. 1, a laminated core, such as an old transformer "E" core, is wound with the main or primary winding on one outside leg. The other outside leg is sawed off and used as the armature. A secondary winding of a few turns of heavier wire is placed around the center leg of the "E" to form the control winding.

The primary winding is connected across the 115-V supply line. With the control winding open, the primary winding induces a magnetic flux that flows through the path of least magnetic reluctance, the center leg of the "E", leaving the armature unaffected. When the remote switch shorts the control coil, the major portion of the flux shifts to the longer circuit path that includes the armature, pulling it in to close that magnetic circuit. Thus, only a minimum holding current flows through the control winding and external switch circuit.

The value of the open-circuit voltage is not important, but can be determined easily since it bears the same relationship to the source voltage as the turns-ratio relative to the primary. In essence, the signal transformer is incorporated in the relay itself.

Variations of remote control may be had by substituting mechanical linkages for the relay contacts, or by using both.

Representative winding data might be, for instance, 400 turns no. 26 or 28 for the primary, and 50 turns no. 18 for the control winding. Actual numbers are not critical, and minimum needs are a function of core cross-sectional area. However, the number of primary turns required would be roughly one and one-half times the number on the original transformer primary winding because the core area is reduced when the primary winding is transferred from the center of the "E" to the end. If all the original primary wire is rewound onto a smaller coil form, the number of turns will come out just right.

In the example above, the control voltage would be about 14 volts, open circuit, just right for a no. 18 bell wire pair, provided the run (distance from relay to shorting switch) is not excessive. ■

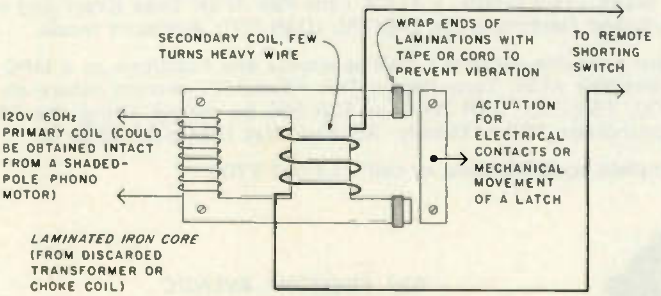

Fig. 1.

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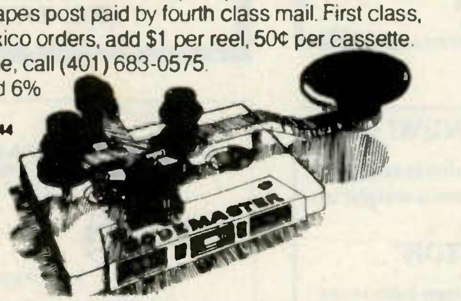

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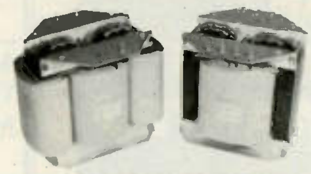

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✓ Reader Service—see page 259

Herb Schoenbach AD9K
6724 Briargate Drive
Downers Grove IL 60515

The Further Adventures of Keycoder

—simplified wiring for the toroidal cores

In the July, 1976, issue of *73 Magazine*, there was an article about Keycoder I, a Morse code generator using a typewriter-style keyboard. This article by WA9VGS caught my eye. I had seen other circuits in the past, but this one seemed simpler. Besides, I'd just about had it with paddles and electronic keyers. I tried single paddles, dual paddles, finger keying, dot memories, dash memories, iambic, etc. Even with the Accu-Keyer,[1] I made too many mistakes. So this would be the answer.

Let me point out that progress is very slow in my ham shack, and, so, the October, 1976, issue of *73 Magazine* arrived. Here was another article by WA9VGS describing a CMOS version of the Keycoder I. This one was still simpler; no power supply was needed—just a 9-volt battery. I was determined to build one!

By late 1978, I got around to it! I built not just one (with a few modifications, of course), but several more, for friends. Two other friends, AB9J and WB9ROU, also built them. We all think they are the greatest.

Since just about everyone is familiar with the aforementioned Accu-Keyer, a comparison is in order: The Accu-Keyer takes 7 ICs plus an ac power supply, miscellaneous parts, and a fairly expensive paddle; the CMOS Keycoder takes 7 ICs, miscellaneous parts, a 9-volt battery, and a keyboard. A new keyboard can be obtained for about the price of a paddle. But even surplus, used, or homemade keyboards will give excellent results. So, for less than the cost of an Accu-Keyer, you can have a code typer. Keyboards should become very popular for CW even for those who don't own computers.

Now, if I've convinced you to build a code typer, here are some ways to simplify the keyswitch wiring. Whether you build the

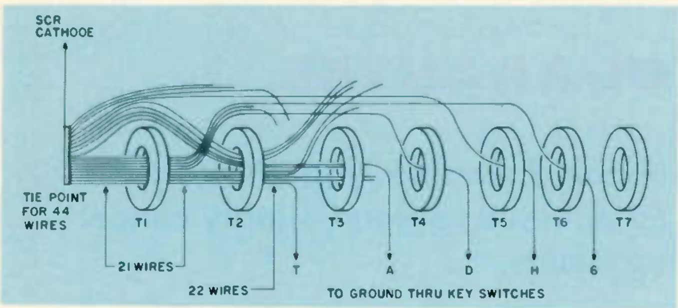

Fig. 1. Typical wiring. Note that only five characters are shown here, for simplicity.

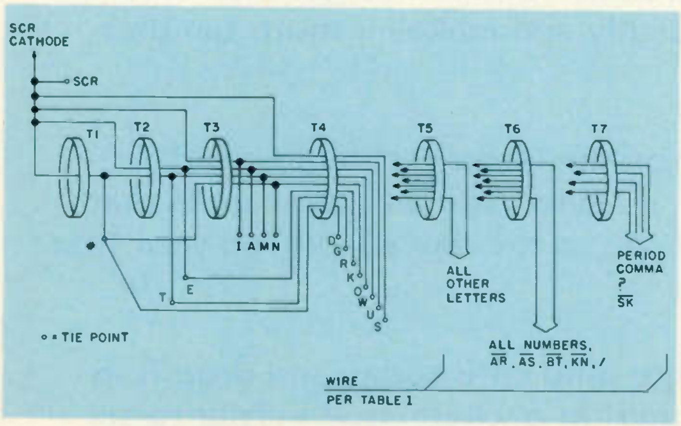

Fig. 2. Eliminate unnecessary duplicate wiring with tie-points. Follow Table 1 to complete the wiring.

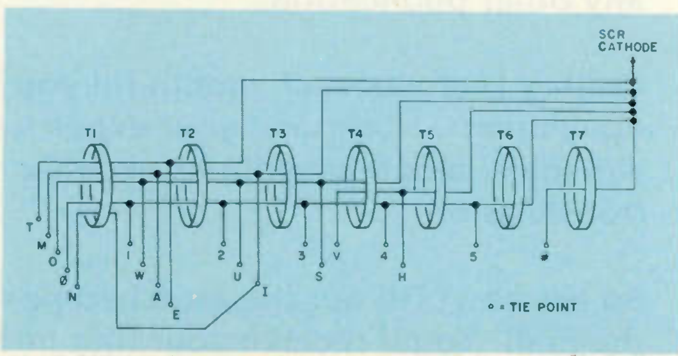

Fig. 3. Wiring for opposite polarity (SCR line at T7). Follow Table 2 to complete the wiring.

TTL or CMOS version, or any other using five to eight toroidal transformers, these principles can be applied.

First, to refresh your memory, keyboard encoding is done with the very simple but clever idea of passing wires through toroidal cores. This idea has been around so long I forget where it originated. Each core has a secondary winding of about ten turns which sets (or resets) an associated flip-flop when a wire passing through the core (the primary) is pulsed. A wire going outside the core has no effect.

Phasing Is Important

The pulses produced on the secondaries must be the correct polarity for your circuit. Phasing (or polarity) of windings can be determined experimentally during construction. Some designs may have enough "ringing" in their secondary circuit that they will work either way. My circuit boards were built with T1 on the left and T7 on the right. My SCR line was brought out just to the left of T1. Each keyswitch wire was started at the SCR line and run toward T7, passing through and outside the proper cores to encode that particular letter, and then run directly to the corresponding keyswitch. This was not difficult with #30 magnet wire, but resulted in as many as 23 wires going through some cores.

Simplification

By using tie-points for some or all of the characters, it is possible to reduce the number of wires considerably: one wire through T1, two wires through T2, four wires through T3, and eight wires through T4. If you put a connector between the circuit board and the keyboard, the connector terminals can be the tie-points. Looking at the original wiring table, or Fig. 1, it is seen that about 21 wires pass through T1. These could all be tied together between T1 and T2 with no change in operation—so replace them with just one wire! The bundle of wires passing through T2 (about 22) can be broken into two groups: One group came through T1, and the other group came around T1 from the SCR tie-point. So, only two wires are needed passing through T2. By the same logic, only 4 need pass through T3; 8 through T4. By the time you get to T5, the saving is still 4 wires.

Fig. 2 shows the pre-wiring, using tie-points for 14 characters. Notice that tie-point "#" is not a character but just a tie-point designation. This pre-wiring can be done with plastic insulated wire. That means a lot less scraping of magnet wire. Table 1 lists the routing of the remaining wires. These may go to additional tie-points or directly to the corresponding keyswitches.

I would advise you to get your complete circuit board wired and operational before starting the keyswitch wiring. Keep power on the circuit and have a sidetone oscillator connected to the output. This allows you to check each wire before soldering to be sure it produces the correct character. It also will show up any mistakes in my list as well as printer errors (such confidence!), and it gives you the last check on correct phasing.

Now, if your phasing is reversed or you wish your SCR line to enter from the T7 end, Fig. 3 shows pre-wiring for 18 characters. Route the remaining wires according to Table 2.

My hope is that this article will encourage many of you to build code machines and that my wiring will make it just a little easier. ■

Reference

1. Garrett, "The WB4VVF Accu-Keyer," *QST*, August, 1973.

Character	Through Cores:	To Tie-Point:
B	T5	#
C	T5	N
F	T5	I
H	T5	SCR
J	T5	W
L	T5	E
P	T5	A
Q	T5	G
V	T5	S
X	T5	D
Y	T5	K
Z	T5	T
1	T6, T5	W
2	T6, T5	U
3	T6, T5	S
4	T6, T5	SCR
5	T6	SCR
6	T6	#
7	T6	T
8	T6	M
9	T6,	O
0	T6, T5	O
AR	T6	R
AS	T6	E
KN	T6	K
BT	T6, T5	#
/	T6	D
PERIOD	T7, T6	R
COMMA	T7, T6, T5	T
?	T7	U
SK	T7, T6	S

Table 1. Wiring for Fig. 2 (SCR line at T1). Go from keyswitch or terminal through cores indicated from right to left.

Character	Through Cores:	To Tie-Point:
B	T1	H
C	T1, T3	H
D	T1	S
F	T3	H
G	T1, T2	S
J	T2, T3	V
K	T1	U
L	T2	H
P	T2, T3	H
Q	T1, T2	V
R	T2	S
X	T1	V
Y	T1, T3	V
Z	T1, T2	H
6	T1	5
7	T1, T2	5
8	T1, T2, T3	5
9	T1, T2, T3, T4	5
AR	T2, T4	5
AS	T2	5
BT	T1, T5	5
KN	T1, T3, T4	5
/	T1, T4	5
PERIOD	T2, T4, T6	#
COMMA	T1, T2, T5, T6	#
?	T3, T4	#
SK	T4, T6	#

Table 2. Wiring for Fig. 3 (SCR line at T7). Go from keyswitch or terminal through cores indicated from left to right.

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All About Ground Rods

—getting connected to Mother Earth

Ground rods are usually used in amateur installations for grounding purposes related to lightning protection. However, they are also the only choice one may have when using a short vertical antenna which requires a good ground. The use of buried radials is certainly preferable to establish a ground screen for a vertical antenna, but an elaborate radial system may require more space than is available, or it may be impossible to lay down such a screen because of obstacles. Usually, vertical antennas are used because of space restrictions. Having the best ground for them, even if it is only a grounding rod, cannot help but improve their efficiency.

Whatever the application one may have for ground rods, it is useful to take a detailed look at how they work. The effectiveness of ground-rod usage can vary widely depending on how they are installed, and sometimes a few simple measures can vastly improve their performance.

Basic Principles

One of the basic factors affecting ground rod performance is the nature of the soil in which it is placed. The relative resistance of a ground connection using a ground rod can vary from 2 Ohms in a clay-type soil to over 2700 Ohms in a very sandy soil. As shown in Fig. 1, it is mainly the resistivity of the soil closest to the ground rod, however, that determines the overall effectiveness of the ground connection. Ninety percent of the total grounding effectiveness is determined by the soil characteristics within a radius of about 6 feet around the ground rod.

There is nothing one can do about the nature of the soil in a given location, of course, but a general awareness as to whether the soil has a high clay content, is a mixture of moist clay and sand (loam), or is mostly sand and gravel, will act as a general guide for the elaborateness needed for an effective ground rod installation.

The moisture present in a given soil can have a marked effect on its resistivity. Fig. 2 gives an illustration of this for common red clay soil. Note how sharply the resistivity increases when the moisture content of the soil falls below 20%. Again, in reality, there is not much one can do to control this factor, but it is useful to be aware of it since, depending on seasonal rainfall conditions, the effectiveness of some ground connections using ground rods can vary widely.

Temperature is another factor influencing ground rod performance. Offhand,

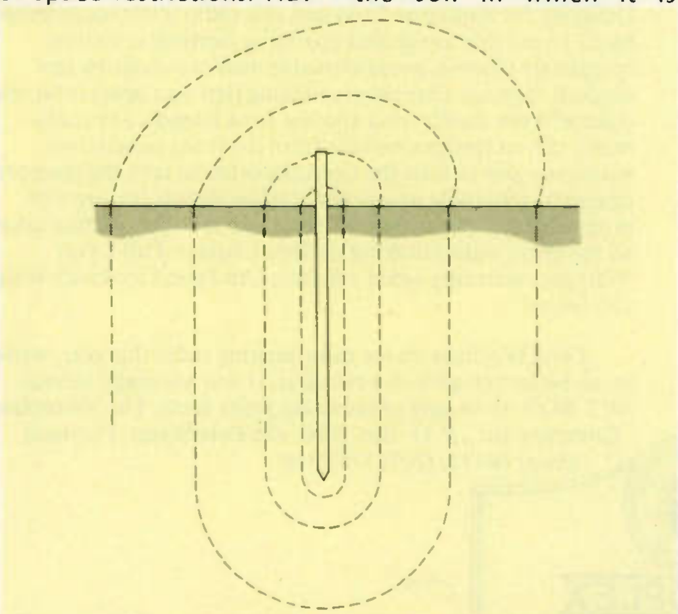

Fig. 1. One can visualize a ground rod as being surrounded by shells of soil. The shells nearest the rod mainly provide the rod's connection to the earth.

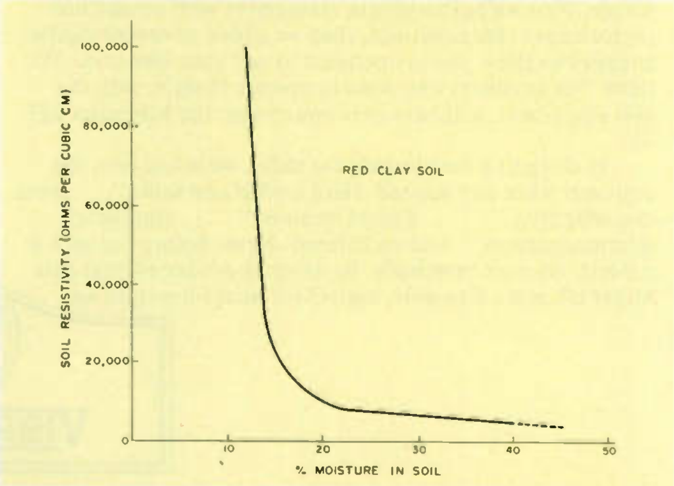

Fig. 2. The percentage of moisture in a soil can have a significant effect upon its resistivity.

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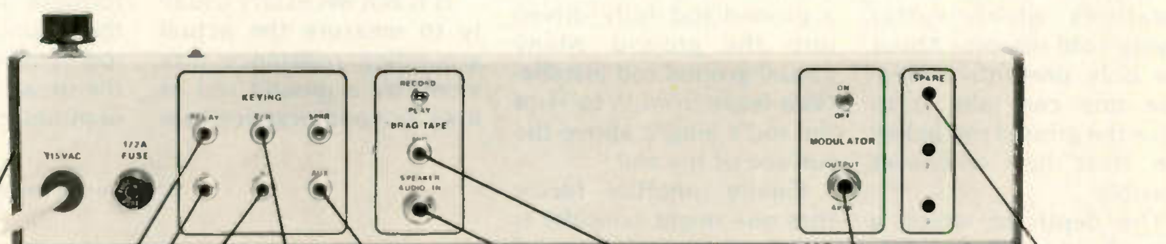

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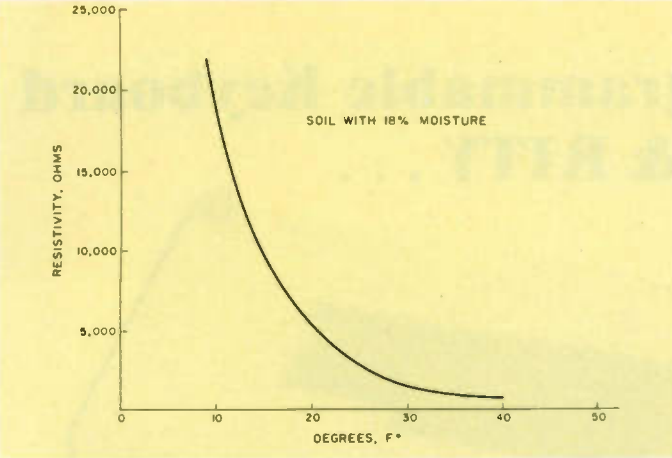

Fig. 3. Temperature also can have a sharp effect on soil resistivity.

one might be inclined to think that the colder it gets, the better the ground rod should perform, since we associate coldness with rain or snow. The opposite is true, however, when just cold temperatures are considered. When the earth freezes to any depth, the water in the soil freezes, moisture is lost, and the resistivity of the soil increases. Fig. 3 shows the sharp effect decreasing temperature can have on soil resistivity. So, again, seasonal weather changes regarding temperature can severely affect ground rod effectiveness in some localities which suffer severe cold seasons. About the only preventive measure one can take is to drive the ground rod below the frost line whenever possible.

The depth to which a ground rod is driven also is important, as shown in Fig. 4. This illustration shows the calculated ground connection resistance with regard to the depth of a ground rod, under what might very broadly be termed "average" soil conditions. The illustration assumes uniform moisture and soil resistivity at all depths. In reality, soil resistivity usually decreases with depth since the few feet near the surface are subject to alternate wetting and drying, depending on rainfall, while the moisture content of deeper soil is more stable. For ground rods more than a few feet long, therefore, performance is usually better than that indicated by Fig. 4.

The greatest reduction in ground connection resistance is obtained by driving a ground rod to between 6 and 8 feet down. Although there may be particularly moist soil conditions in certain locations and at certain times of the year where a 3-foot rod is effective, this generally is not the case. Note also that the illustration is based on a ground rod fully driven into the ground. Many casual ground rod installations leave from ⅓ to ½ of the rod's length above the surface of the soil.

Finally, another factor that one might consider is the diameter of the ground rod used. Intuitively, one would think that the larger the diameter of the ground rod used, the better the earth connection. As it turns out, however, diameter plays a negligible role in improving the ground connection. This has been confirmed by various tests done by the former Bureau of Standards and the Underwriters Laboratories. Whether one uses a ½", 1", or even larger diameter rod can be based on mechanical strength factors,

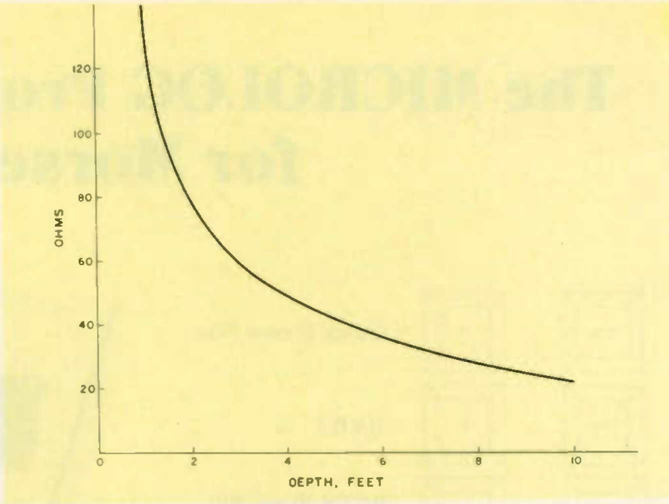

Fig. 4. Ground connection resistance for a single ground rod driven to different depths.

therefore—that is, a size large enough to be driven into a particular type of soil without bending.

The metal the rod is made out of is not important except for the factor of corrosion. Steel rods are commonly used, although if one can obtain Copperweld grounding rods, they are ideal for the purpose. They have a steel core for strength and an exterior of copper for corrosion resistance.

Measuring Grounding Resistance

It is not necessary usually to measure the actual grounding resistance provided by a ground rod as long as good practices are used in installation of the rod. If one is curious about the approximate grounding resistance achieved, however, it can be measured fairly easily by the three-point method shown in Fig. 5. In this illustration, A represents the actual ground rod and B and C represent two temporary ground rods of two- to three-foot lengths. The temporary rods should be placed about 6 feet from the actual ground rod and from each other. The resistances between rods are measured and used in the formula shown to obtain the grounding resistance of rod A. One can try doing the measurements with an ohmmeter, but usually bet-

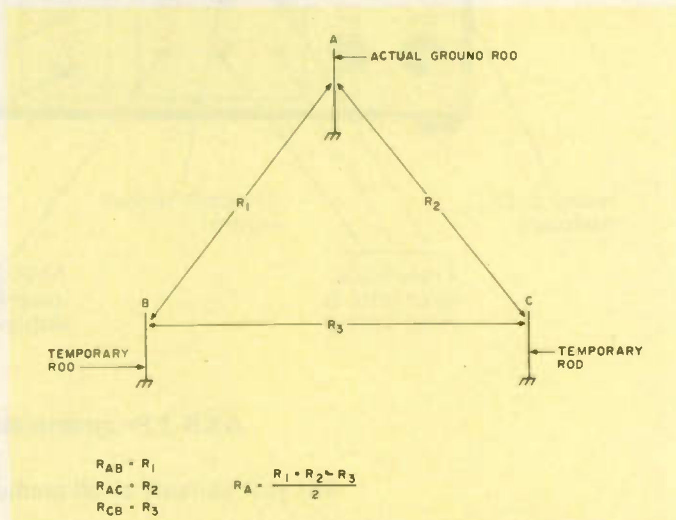

Fig. 5. By installing two temporary ground rods and taking some resistance readings, one actually can measure the ground connection resistance of a ground rod.

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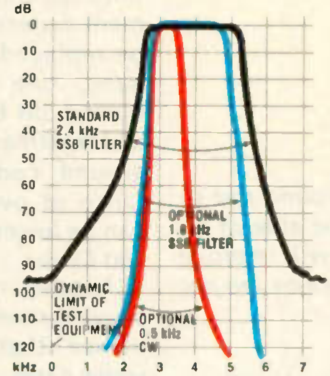

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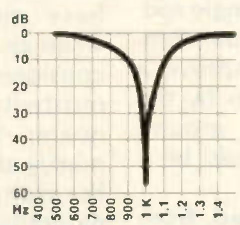

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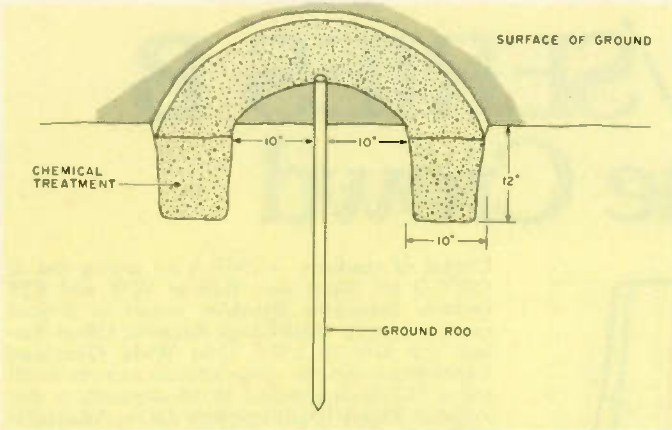

Fig. 6. Construction of a trench around a ground rod to hold a chemical treatment. The rod should be at least six feet into the ground, although the treatment will improve the performance of shorter rods also. Dimensions are not at all critical.

ter results are obtained if one goes the old-fashioned voltmeter/milliammeter route, using some low voltage ac or dc as a voltage source.

Improving Ground Rod Performance

There are several methods one can use to improve ground rod performance if it is felt that a simple ground rod installation is inadequate. One of the simplest methods is to use multiple ground rods. If the rods are spaced 6 to 10 feet apart, they act very much like resistances in parallel. So, two rods will effectively cut the ground connection resistance in half, and so on. It is very important to maintain the spacing between the rods.

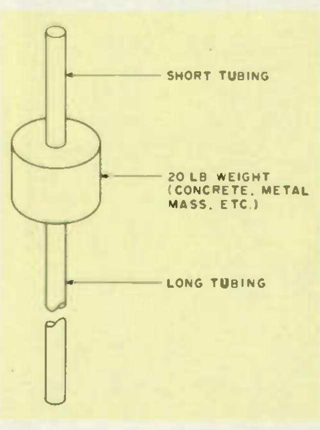

Fig. 7. A home-brew tool for driving ground rods. (See text.)

A few rods clustered closely together will be no more effective than a single rod. A practical maximum number of rods to improve a ground connection by the use of multiple ground rods probably would be 4 to 6.

The ground lead from each rod should be run directly to the base of the vertical antenna in the center of the ground rod array. There should also be one directly underneath the base of the antenna to act as a central ground rod. There might be some value also to running interconnecting wires between adjoining ground rods, but this is not as important.

Another fairly simple method to improve a single or multiple ground rod installation is to treat the area around the rod chemically, as shown in Fig. 6. This is not complicated to do since one does not have to dig a very deep trench around the rod. The treatment material can be magnesium sulphate, copper sulphate, or even ordinary rock salt. All are about equally effective; the only advantage of magnesium sulphate is that it is the least corrosive.

Note that the treatment material does not have to touch the ground rod — nor should it. With the passage of time, the treatment material will seep towards the rod and corrode it, however, and rain will wash it away. The result of all this is that within a period of perhaps 2 to 3 years both the rod and the treatment material may have to be replaced. On the other hand, one accomplishes quite a bit by using chemical treatment. Typically, a ground connection resistance of over 1000 Ohms can be lowered to less than 100 Ohms.

Another method to improve ground rod performance that is useful in some cases is to drive the rod particularly deep. This method probably doesn't have much applicability when an antenna ground is considered, since it is soil resistivity and grounding nearer the surface that mostly affects antenna performance. Also, it is naturally hard to accomplish in many soils without specialized equipment. Nonetheless, in some soils, particularly sandy ones which start to have a clay base further down, it can be very effective from the viewpoint of lowering the ground connection resistance. For example, by using a 20-foot sectionized ground rod as compared to a 6-foot one, the resistance might be reduced by a factor of 6 or more.

Installing Ground Rods

Any number of methods of installing ground rods have been devised, and this is pretty much an area where one's own ingenuity has to come into play. The sledgehammer approach will suffice in a great many cases. Another method which some amateurs have found successful with hollow tubing used as ground rods is to insert a garden hose in the tubing and let the water pressure wash away the soil slowly as the tubing is pushed into the ground.

Another approach to consider, especially if one is going to drive several rods, is to construct a simple home-brew driving tool such as is shown in Fig. 7. This tool is made around a central weight mass of about 20 pounds. A short piece of tubing is affixed on one side and a longer piece of tubing on the other side. The tubing is chosen so that it is just large enough to slip over the ground rod. The length of the two sections will depend on the length of rod — three- and one-foot sections, for instance, are used for a 6-foot ground rod. In use, the long end of the tool is slipped over the ground rod and used initially to pound the rod into the ground. As the rod gets driven further in, the short side of the tool is slipped over the rod and used to complete pounding the rod into the ground. The advantage of this tool is that the tubing over the ground rod prevents the rod from bending, and the pounding force exerted by the tool is exactly in line with the axis of the ground rod.

Ground Rod Connections

All the effort exerted in placing a ground rod can be wasted if a dependable low-resistance connection is not made to the rod. The ideal case would be to have all metals the same: a copper-plated rod using a copper clamp and copper wire. Such items and fittings can sometimes be purchased through electrical contractor supply houses. In most cases, however, one will be using dissimilar metals for the rod, clamp, and ground wire. In this case, one must be sure only that all connecting surfaces are clean and tight. Covering the clamp and rod junction with some weatherproofing compound also would be advisable. ■

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					17° - 40°C	0° - 40°C	100 Hz - 25 MHz	50 MHz - 250 MHz	250 MHz - 450 MHz	No.	SIZE IN INCHES	.1 SEC	1 SEC
DSI INSTRUMENTS	100 HH	$ 99.95	50Hz-100MHz	TCXO	1 PPM	2 PPM	25 MV	NA	NA	8	.4	100 Hz	10 Hz
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CSC‡	MAX-550	$149.95	1kHz-550MHz	Non-Compensated	3 PPM @ 25°C	8 PPM	500 MV*	250 MV	250 MV	6	.1	NA	1 kHz
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* 1 KHz - 50 MHz ‡ Continental Specialties Corp.

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Courtesy of AMSAT

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

OSCAR 7 Orbital Information

Orbit	Date (Dec)	Time (GMT)	Longitude of Eq. Crossing °W
23068	1	0050:49	79.5
23081	2	0145:06	93.1
23093qrp	3	0044:26	78.0
23106	4	0138:43	91.5
23118X	5	0038:04	76.4
23131	6	0132:20	90.0
23143	7	0031:41	74.8
23156	8	0125:58	88.4
23168	9	0025:18	73.3
23181qrp	10	0119:35	86.9
23193	11	0018:55	71.7
23206X	12	0113:12	85.3
23218	13	0012:32	70.2
23231	14	0106:49	83.8
23243	15	0006:09	68.6
23256	16	0100:26	82.2
23269qrp	17	0154:43	95.8
23281	18	0054:03	80.7
23294X	19	0148:20	94.2
23306	20	0047:40	79.1
23319	21	0141:57	92.7
23331	22	0041:18	77.5
23344	23	0135:35	91.1
23356qrp	24	0034:55	76.0
23369	25	0129:12	89.6
23381X	26	0028:32	74.4
23394	27	0122:49	88.0
23406	28	0022:09	72.9
23419	29	0116:26	86.5
23431	30	0015:46	71.3
23444qrp	31	0110:03	84.9

OSCAR 8 Orbital Information

Orbit	Date (Dec)	Time (GMT)	Longitude of Eq. Crossing °W
8862Jbn	1	0008:41	49.7
8876Jbn	2	0013:49	51.0
8890Abn	3	0018:58	52.3
8904Abn	4	0024:06	53.6
8918X	5	0029:14	54.9
8932Abn	6	0034:23	56.2
8946Abn	7	0039:31	57.5
8960Jbn	8	0044:39	58.8
8974Jbn	9	0049:48	60.1
8988Abn	10	0054:56	61.4
9002Abn	11	0100:04	62.7
9016X	12	0105:12	64.0
9030Abn	13	0110:21	65.3
9044Abn	14	0115:29	66.6
9058Jbn	15	0120:37	67.9
9072Jbn	16	0125:45	69.2
9086Abn	17	0130:53	70.5
9100Abn	18	0136:02	71.8
9114X	19	0141:10	73.1
9127Abn	20	0003:04	48.6
9141Abn	21	0008:13	49.9
9155Jbn	22	0013:21	51.2
9169Jbn	23	0018:29	52.5
9183Abn	24	0023:37	53.8
9197Abn	25	0028:45	55.1
9211X	26	0033:53	56.4
9225Abn	27	0039:01	57.7
9239Abn	28	0044:09	59.0
9253Jbn	29	0049:17	60.3
9267Jbn	30	0054:25	61.6
9281Abn	31	0059:33	62.9

FCC

Reprinted from the Federal Register.

Amateur Radio Service; Modifying Procedures for Notifying the Commission of Name and Mailing Address Changes; and To Give a 5-Year License Term to All Licenses Issued

AGENCY: Federal Communications Commission.

ACTION: order.

SUMMARY: The Commission amended §§ 97.13 and 97.47 to delete provisions which allowed Amateur licensees to notify the Commission of name and mailing address changes by letter. All future Amateur license modifications must be requested by filing the appropriate application form. The Commission also amended § 97.59 to provide that all Amateur licenses will be given a five-year term.

DATES: The effective date of the Order is November 12, 1979.

ADDRESSES: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT: Maurice J. DePont, Private Radio Bureau, (202) 254-6884.

SUPPLEMENTARY INFORMATION:

Order

Adopted: September 27, 1979.
Released: October 5, 1979.

By the Commission: Commissioner Lee absent.

In matter of amendment of §§ 97.13, 97.47 and 97.59 of the Commission's rules.

1. Sections 97.13 and 97.47 of the Commission's rules set forth the procedures to be followed by amateur licensees who wish to renew or modify their amateur radio license. In each instance, the request must be made by submitting an FCC Form 610 (or 610-B in the case of a club or military recreation station) to the Commission's office in Gettysburg, Pennsylvania. However, these rule sections also provide that a change in the licensee's name or mailing address may be accomplished by notifying the Commission by letter.

2. The provision concerning notification by letter has apparently led to confusion on the part of many amateur licensees and has unnecessarily increased the workload of the Commission's application processing staff. Most letter requests for address change fail to specify that it is only the licensee's mailing address which has changes. Therefore, the staff is required to ascertain whether or not the station location has also changed. In the majority of cases, the station location has indeed changed. In such a situation, § 97.47 requires a formal modification of the license. Therefore, it is necessary that the licensee file an application.

3. In order to eliminate the confusion among amateur licensees as to when an application need be filed, and to lessen the burden on the processing staff, the Commission is amending §§ 97.13 and 97.47 to delete the provisions concerning letter notice. Henceforth, all amateur license modifications must be requested by submission of the appropriate application form.

4. The Commission is also amending § 97.59 to provide that modified licenses will be issued for a five-year term commencing on the date of the modification. Currently, that section provides that modified licenses shall bear the same expiration date as the license being modified.

5. Since the amendments herein ordered are procedural in nature, they are excepted by Section 553(b) of the Administrative Procedure Act from the requirement of prior public notice and comment.

6. Accordingly, it is ordered, effective November 12, 1979, that Part 97 of the Commission's rules is amended as shown in the Appendix attached hereto. Authority for this action is found in Sections 4(i) and 303 of the Communications Act of 1934, as amended.

7. For further information on these rule changes, contact Maurice J. DePont, 254-6884.

(Secs. 4, 303, 48 stat., as amended, 1066, 1082 (47 U.S.C. 154, 303))

Federal Communications Commission.

William J. Tricarico,
Secretary.

Appendix

Part 97 of Chapter I of Title 47 of the Code of Federal Regulations is amended as follows:

§ 97.13 [Amended]

1. In § 97.13, paragraph (e) is deleted.

§ 97.47 [Amended]

2. In § 97.47, paragraph (c) is deleted.

3. Section 97.59 is amended to read as follows:

§ 97.59 License term.

(a) Amateur operator licenses are normally valid for a period of five years from the date of issuance of a new, modified or renewed license.

(b) Amateur station licenses are normally valid for a period of five years from the date of issuance of a new, modified or renewed license. All amateur station licenses, regardless of when issued, will expire on the same date as the licensee's amateur operator license.

(c) A duplicate license shall bear the same expiration date as the license for which it is a duplicate.

Ham Help

I would like to meet other amateurs who are avid bridge players. Perhaps we could form a net and discuss bridge hands, conventions, tournaments, and the possibilities for bridge-playing computer programs over the air. I am an experienced tournament player, but would be happy to talk to anyone interested.

Mike Marmer KB8GH
2749 Symphony Way
Dayton OH 45449

I'm a disabled amateur and could really use some help with the following:

1. I need someone to use my acetate film and their transfers, lines, etc., to make negatives from which I can expose sensitized PC boards myself. Any layout from my specs would be acceptable; their name, call, or whatever can go on the board.

2. I also need manuals for the BC-1306, RT-70, and VRC-19. I especially need a "Surplus Schematic Handbook" to copy. It is black with red letters and a white schematic on the front.

3. I am looking for a Knight-kit signal tracer (circa 1960) with an rf-af probe.

4. I also need someone to construct projects, at cost or a little over, from my diagrams and their/my parts.

John C. White WB6BLV
560 N. Indiana St.
Porterville CA 93257

1979 Index

DIGITAL

GADGETS

HISTORY

HUMOR

IC

I/O

MISCELLANEOUS

MOBILE/PORTABLE

OPERATING

Ham Help

I need a manual for a Heathkit model IM-32 VTVM. I will gladly reimburse reasonable duplicating and mailing expenses, or I will duplicate on receipt and send back by return mail. Thanks.

Lawrence Young W1YVW
54 Samuel Ave.
Pawtucket RI 02860

I have a Pride HFL-125 Billnear Amplifier and I need a schematic and information on the finals. Specifically, what replacement numbers could I use? I will pay for the postage and copy. Thank you.

Fritz Zingel KA2FCG
341 72nd St., Apt. B
North Bergen NJ 07047

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION (Required by 39 U.S.C. 3685) 1. Title of publication, 73 Magazine. 2. Date of filing, Sept. 25, 1979. 3. Frequency of issue, Monthly. A. No. of issues published annually, 12. B. Annual subscription price, $18. 4. Location of known office of publication (Street, City, County, State and ZIP Code) (Not printers), 73 Pine Street, Peterborough, Hillsboro County, N.H. 03458. 5. Location of the headquarters or general business offices of the publishers (Not printers), 73 Pine Street, Peterborough, Hillsboro County, N.H. 03458. 6. Names and complete addresses of publisher, editor and managing editor. Publisher (Name and Address), Wayne Green, Pine Street, Peterborough, N.H. 03458. Editor (Name and Address), Wayne Green, Pine Street, Peterborough, N.H. 03458. Managing Editor (Name and Address), Jack Burnett, Pine Street, Peterborough, N.H. 03458. 7. Owner (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual, must be given.) Name, 73, Inc., Peterborough, N.H. 03458. W. Sanger Green, Rt. 3, Littleton, N.H. 03561. 8. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities (If there are none, so state) Name, none. 9. For completion by nonprofit organizations authorized to mail at special rates (Section 132.122, PSM). The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes (Check one) Not applicable. 10. Extent and nature of circulation. (X) Average No. copies each issue during preceding 12 months. (Y) Actual No. copies of single issue published nearest to filing date. A. Total No. copies printed (Net Press Run) (X) 87,000 (Y) 86,000. B. Paid circulation 1. Sales through dealers and carriers, street vendors and counter sales (X) 13,500 (Y) 13,450. 2. Mail subscriptions (X) 67,500 (Y) 66,750. C. Total paid circulation (Sum of 10B1 and 10B2) (X) 81,000 (Y) 80,200. D. Free distribution by mail, carrier or other means samples, complimentary, and other free copies (X) 1,200 (Y) 1,200. E. Total distribution (Sum of C and D) (X) 82,200 (Y) 81,400 F. Copies not distributed 1. Office use, left over, unaccounted, spoiled after printing (X) 4,300 (Y) 4,050. 2. Returns from news agents (X) 500 (Y) 550. G. Total (Sum of E, F1 and 2—should equal net press run shown in A) (X) 87,000 (Y) 86,000. 11. I certify that the statements made by me above are correct and complete. Signature and title of editor, publisher, business manager, or owner. Robert R. LaPointe, Business Manager.

Social Events

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received two months prior to the month in which the event takes place.

HAZEL PARK MI
DEC 2

The Hazel Park Amateur Radio Club will hold its 14th annual swap & shop on December 2, 1979, from 8:00 am to 2:00 pm, at the Hazel Park High School, Hazel Park, Michigan. Admission is $1.00 at the door, and main prize tickets are also $1.00. There will be food, plenty of free parking, and door prizes. Featured will be computer demonstrations of the Apple II, PET, TRS-80, and more. Talk-in on .52 simplex. For information, send an SASE to the Hazel Park Amateur Radio Club, Robert Numerick WB8ZPN, 23737 Couzens, Hazel Park MI 48030.

LORAIN OH
DEC 8

The Northern Ohio Amateur Radio Society will hold its annual Christmas banquet on Saturday, December 8, 1979, at Gargus Hall, Lorain, Ohio. There will be many excellent door prizes and an RCA TV, Regency scanner, and liquor prizes will be given away at a benefit raffle (tickets are $1.00). Tickets for the banquet are $9.00 and available on an advanced-sale-only basis. The deadline is December 6, 1979. Talk-in on 146.10/.70. For tickets and complete details, send check or money order to NOARS, PO Box 354, Lorain OH 44052.

SOUTH BEND IN
JAN 6

A hamfest swap & shop will be held on January 6, 1980, at New Century Center, on US 31 by the river, South Bend, Indiana. Tables are $3.00 each. Food service, automobile museum, and art center are in the same building as the hamfest. Talk-in on 146.52/.52, .13/.73, .34/.94, 147.99/.39, .87/.27, and .69/.09. For information, write the Repeater Valley Hamfest committee, Wayne Werts K9IXU, 1889 Riverside Drive, South Bend IN 46616, or phone (219)-233-5307.

RICHMOND VA
JAN 13

The Richmond Frostfest III, sponsored by the Richmond Amateur Telecommunications Society, will be held Sunday, January 13, 1980, at the Bon Air Community Center. There will be a home-brew contest with four awards: most original idea, best electrical work, best mechanical work, and most deserving work, and prizes. FCC exams start 10:00 am and completed Form 610s must be received in the Norfolk Office of the FCC at 870 North Military Highway, Bank of Virginia Bldg., Norfolk VA 23502, no later than January 9th. Admission is $3.00, indoor flea market tables are $3.00, and tailgaters are $2.00. Talk-in on .28/.88 and .34/.94. For further information, contact the Richmond Amateur Telecommunications Society, PO Box 1070, Richmond VA 23208.

SHARON PA
JAN 19

The third annual Mercer County Amateur Radio Club seminar will be held at the Holiday Inn, West Middlesex, Pennsylvania, off I-80, from 9:00 am to 5:00 pm. Come to hear speakers on your favorite amateur radio topics. Advance admission is $2.00. There will be door prizes. For further details, write K3LA, PO Box 673, Sharon PA 16146.

ARLINGTON HEIGHTS IL
JAN 27

The Wheaton Community Radio Amateur Club will hold its Wheaton Hamfest Portable Nine on Sunday, January 27, 1980, at the Arlington Park Expo Center, Arlington Heights Race Track, Arlington Heights, Illinois. Doors will open at 8:00 am sharp! 300 free flea market tables will be available, plus 100 commercial booths. There will also be hourly door prizes. Tickets are $3.00 at the door and $2.00 in advance. For information, send an SASE to WCRA, Box QSL, Wheaton IL 60187.

LIVONIA MI
FEB 17

The Livonia Amateur Radio Club will hold its 10th anniversary Swap 'n Shop on Sunday, February 17, 1980, from 8:00 am to 4:00 pm, at the Churchill High School, Livonia, Michigan. There will be plenty of tables, door prizes, refreshments, and free parking available, plus reserved table space of 12-foot minimum. Talk-in on 146.52. For further information, send an SASE to Neil Coffin WA8GWL, c/o Livonia Amateur Radio Club, PO Box 2111, Livonia MI 48150.

DAVENPORT IA
FEB 24

The Davenport Radio Amateur Club will hold its ninth annual hamfest on Sunday, February 24, 1980, from 8:00 am to 4:00 pm, at the Davenport Masonic Temple, Highway 61 (Brady Street) and 7th Street, Davenport, Iowa. Tickets are $2.00 in advance; $3.00 at the door. Tables are $3.00 each, no limit, with a $2.00 additional charge for ac electrical hookup. Talk-in on 146.28/.88 W0BXR repeater. Advance tickets can be purchased by writing to club treasurer Clarence Wilson WA0OEW, 1357 W. 36th Street, Davenport IA 52806.

LANCASTER PA
FEB 24

The Lancaster Hamfest will be held on February 24, 1980, at the Guernsey Pavilion, located at the intersection of Rtes. 30 and 896, east of Lancaster, Pennsylvania. General admission is $3.00, except children and XYLs. Doors will open at 8:00 am. All inside spaces are available by advance registration only and are $3.00 each for an 8-foot space, which includes a table. There will be free tailgating in a specified area outside, if the weather permits. There will be a two-hour Dutch Country tour by an advance registration of $4.00. Food will be served at the hamfest. Also, there are excellent restaurants and accommodations in the area. Talk-in on .01/.61. For information, write Sercom, Box 6082, Rohrerstown PA 17603.

STERLING IL
MAR 9

The Sterling-Rock Falls Amateur Radio Society will hold its 20th annual hamfest on Sunday, March 9, 1980, at the Sterling High School field house, 1608 4th Ave., Sterling, Illinois. Advance tickets are $1.50; door tickets are $2.00. Over $2,000 worth of prizes will be given away. A large indoor flea market will be restricted to radio and electronic items only. There will be plenty of free parking, lots of bargains, and plenty of good food. Talk-in on .25/.85 (WR9AER). For tickets, write Don Van Sant WA9PBS, 1104 5th Avenue, Rock Falls IL 61071.

VERO BEACH FL
MAR 15-16

The Treasure Coast Hamfest will be held on March 15-16, 1980, at the Vero Beach Community Center, Vero Beach, Florida. Featured will be prizes, drawings, and a QCWA luncheon. Admission is $3.00 per family in advance; $3.50 at the door. Talk-in on 146.13/.73, 146.04/.64, and 222.34/223.94. For information, write PO Box 3088, Vero Beach FL 32960.

FORT WALTON BEACH FL
MAR 22-23

The Playground Amateur Radio Club will hold its 10th anniversary swapfest on Saturday and Sunday, March 22-23, 1980, from 8:00 am to 4:00 pm each day, at the Okaloosa County Shrine Fairgrounds, Fort Walton Beach, Florida.

TIMONIUM MD
MAR 30

The Baltimore Amateur Radio Club will hold its greater Baltimore Hamboree and Computerfest on March 30, 1980, at the Maryland State Fairgrounds, just off I-83, 2 miles North of I-695, Timonium, Maryland. There will be plenty of space for dealers, displays, tables, and commercial exhibits. Special events, lectures, and demonstrations will be held. Food service will be provided. There will be acres of space for tailgate sales. Door prizes will be awarded throughout the day. Admission is $3.00 and tables are $5.00. Talk-in on the BARC repeaters, 146.07/.67 and 146.34/.94. For additional information, tickets, and space reservations, please write to Joseph A. Lochte, Jr., 2136 Pine Valley Drive, Timonium MD 21093, or for a recorded message, dial (301)-HAM-TALK.

ST. CLAIR SHORES MI
APR 13

The South Eastern Michigan Amateur Radio Association will hold its 22nd annual hamfest on April 13, 1980, from 8:00 am to 3:00 pm at South Lake High School, 21900 E. Nine Mile Road (at Mack Ave.), St. Clair Shores, Michigan.

ST. LOUIS MO
MAY 24-25

The ARRL Midwest and Central Divisions will hold their amateur radio and computer hobbyist convention on May 24-25, 1980, at the Cervantes Convention Center, St. Louis, Missouri. Featured will be prominent speakers, information forums, equipment displays and demonstrations, and an indoor flea-market sale. Friday night, May 23rd, will be "Amateur Radio Night" at Busch Memorial Stadium, where the St. Louis Cardinals will play the San Diego Padres. On Saturday night, May 24th, the convention banquet and dance will be held on the riverboat *Admiral*. On Memorial Day, May 26th, there will be an all-day visit to Six Flags Over Mid-America. For more information, write to Gateway Amateur Radio Association, Inc., Box 68, Marissa IL 62257.

Ham Help

We are interested in contacting amateurs who are Oral Roberts Partners.

Amateur Radio Outreach Club
Oral Roberts University
Box 2564
Tulsa OK 74171

I am in need of schematics, operation manuals, service manuals, etc., for a Knight T-60 transmitter and a Lafayette 99-2501 vfo. I would also like to find an Eico 722 vfo and an Eico 730 modulator, preferably with documentation.

Peter A. Bergman KA0CRX
114 NW 6th Street
Rochester MN 55901

Anyone not wanting to keep the postage stamps from DX QSL envelopes can send them along for a private collection my son and I are starting.

Joseph R. Kovac W3IVG
705 W. 12th Street
Hazleton PA 18201

I need a schematic and/or operating manual for a Utica 650 6-meter transceiver and a schematic for a Utica V650 vfo. I will pay a reasonable price or can copy and return if necessary.

John W. Daugherty WB8DEG
7500 N. Oliver
Tucson AZ 85704

I'm looking for a Heathkit HW-20 2-meter AM transceiver (the Pawnee) in working condition.

Al Gordon
1726 Spreckels Lane
Redondo Beach CA 90278

I would like to contact amateurs in the Chicago area who are experimenting with MDS microwave TV.

Steve Martin WA9MQF
178 Trailwood Lane
Northbrook IL 60062

RIPPED OFF?

If you have a serious problem with a ham firm, send them a letter with all the facts in detail, plainly and simply . . . and send a copy to Wayne Green W2NSD/1, c/o 73 MAGAZINE. 73 protects its readers more than any other magazine.

Corrections

Several minor errors crept into my article, "Add Digital Display for $50," which appeared in the June, 1979, Issue of *73*.

In column two of page 28, 5445 kHz should read 5455 kHz (twice), and 4995 kHz should be 4955 kHz.

The crystal frequency in Fig. 1 should be 5455 kHz.

The "5" or "9" switch position indications in Fig. 3 should read "9" or "4".

The reset line for the 7490 is missing in Fig. 3 and should connect to pins 2 and 3 of the 7490. Pin 3 should not be grounded.

S1 and S2 are push-button switches.

I would suggest using 74LS components in the counter since they should substantially reduce power and heat.

I have had many requests for circuit boards, but unfortunately they are not available at this time. Also, my address has changed since the article was published.

Richard C. Jaeger K4IQJ
727 McKinley Avenue
Auburn AL 36830

J. C. Pinckney WB2VNM has pointed out a mistake in my article ("Experimenter's Corner: The MM5369N") which appeared in the September Issue. In the article, I stated that 3.579545 MHz divided through three MM5369Ns gives you 1 Hz every 1.88 years. Joe is correct in pointing out that 1 Hz is one cycle per second and that what you indeed get is one cycle every 1.88 years. I managed to miss that correction during my proofreading and apologize for the error.

Charles B. Patten
Andrews AFB MD

New Products

from page 34

frequencies (±75 Hz). A minor annoyance here is that these two controls do not possess a detent or click-stop to indicate when they are in the neutral position. Both controls are always active and cannot be switched off.

Instead of the usual rf gain pot, the Astro 150 has an i-f gain control. When receiving strong signals, reducing the i-f gain eliminates much of the normal background noise. The proper use of this control can substantially reduce the fatigue that sets in after several hours of listening.

The front-panel meter does double duty as a conventional S-meter and as a power output meter. In the transmit mode, it functions as a peak-reading wattmeter. It is accurately calibrated at the factory.

There are a host of other controls and adjustments which are accessed either through small holes in the transceiver's side panels or by removing the top and bottom covers. There are separate adjustments for VOX and CW delay (when semi-break-in is used), VOX gain, VOX antitrip, sidetone level, S-meter calibration, AGC threshold, and microphone scan rate.

On the Air

Getting the Astro 150 out of the box and on the air is a five-minute job. It's simply a matter of plugging in the power supply, speaker, and mic cables, attaching the antenna of your choice, and flipping on the power supply and transceiver power switches.

When you first apply power, the speaker is quiet for 10-15 seconds, while the PLLs lock on. The frequency display places a decimal point after each digit while this is going on so you'll know what's happening. When the decimal points blink off, the speaker springs to life, and you're set to go.

It took me a couple of days to evolve my own favorite technique for using the 150's tuning controls. A Swan representative told me that others have come to the same conclusions I did. I found the VRS knob best suited for fairly large excursions across a band, say 25 or more kHz. Then, when I was in the vicinity of my desired frequency, I switched to the push-buttons atop the microphone. At first, this might sound like an unwieldy method of tuning, but it becomes quite natural once you've done it a few times. The push-buttons make it easy to tune up and down from your chosen spot while leaning back in your operating chair—a sort of remote control.

Dozens of contacts on every band produced many good comments about the audio quality of the rig. I ran most of the time without a linear amplifier and had no problem making plenty of DX contacts.

I had never used full break-in before checking out the 150. For most operation, I'll probably stick with the more familiar semi-break-in. When using QSK, one hears what's happening on the frequency between each dit and dah. Thus, it's possible to hear QRM while you are still transmitting and to cut your transmission short, in order to avoid competing with the QRM. Of course, experienced traffic handlers often find QSK a must. When both the sending and receiving stations are so equipped, the receiver can immediately interrupt the sender if he misses a portion of the message. I find QSK operation to be a little bit distracting after years of operating CW in silence. The break-in on the Astro 150 performed flawlessly.

Conclusion

The Astro 150 (and 151) carries a suggested price of $925, making it the least expensive synthesized HF rig I've seen. The PSU-5 Power Supply/Speaker is $179.95. The rig is worlds apart from the majority of transceivers available today, both on the outside and on the inside. Swan has taken a very different approach to transceiver design, starting from square one to produce a radio that takes full advantage of modern digital technology. The only allegiance to the past would seem to be the single conversion receiver, something Swan has long favored.

If you would rather operate than twiddle with a lot of knobs, and you want to go with thoroughly modern technology, the Astro 150 is an awfully attractive value. For further information, contact *Swan Electronics, 305 Airport Road, Oceanside CA 92054; (714)-757-7525.* Reader Service number S44.

Jeff DeTray WB8BTH
Assistant Publisher

THE WILSON SYSTEMS, INC., SYSTEM 33 TRIBANDER

Until now, the antenna farm at my QTH consisted of a monoband yagi for 20 meters on a Rohn BX-32 tower and a Wilson WV-1 vertical roof-mounted on the roof of the garage. Both antennas have performed well for both CW and SSB operation, but with the increase in sunspot activity, it has been my desire to replace the monobander with a good triband yagi beam. Lot size and tower limitations have precluded erection of the larger "DX" tribanders, so it was decided to investigate the three-element variety of beams.

Consulting with other amateurs who own tribanders and comparing the published swr curves of the various manufacturers, I finally opted for the Wilson Systems, Inc., System 33 (formerly System Three). After having purchased a Wilson WV-1 four-band vertical, I have come to accept that Wilson's swr curves were not only the most desirable, but also the most believable. The published curves indicate that the System 33 is a reasonable compromise for the amateur who wishes to work both the CW and phone portions of the 10-, 15-, and 20-meter bands.

Mechanical Construction and Assembly

Like the WV-1 vertical, the System 33 is well constructed mechanically. The boom is 14' 4" long, 2" in diameter, and comes in three sections which fit together and are held in place with heavy-duty zinc-plated muffler clamps. From the consumer's point of view, the three-piece boom is a blessing; it allows for a compact shipping carton which can be reasonably handled by UPS (truck shipments of other beams have cost twice as much to ship for about the same weight class).

When assembling the boom, I would advise that the simple addition of a bolt or heavy sheet-metal screw at the junction of each boom section be made. This should be done in order to keep the boom from twisting in heavy winds, as the muffler clamp U-bolts are not threaded far enough to snug the sections together adequately. The center section of the boom which clamps to the mast is double-wall aluminum tubing and a striking example of Wilson's mechanical overkill. The boom is attached to the mast (not supplied) with a ¼"-thick aluminum plate and 8 heavy muffler clamps.

Unlike other moderately-priced beams, the System 33's elements are heavy-duty, tapering from 1¼" where the elements meet the boom to ⅝" at the ends. The dual-section traps are affixed to the elements at approximately 32 inches from the ends of the elements. Despite their large size, there is very little droop to the elements. Each trap is clearly identified with a sticker which indicates director, driven element, or reflector and has an arrow to indicate the direction toward the boom (little chance for error here). The director and reflector are attached to the boom with a unique one-piece extruded aluminum clamp which fits around the boom. When the clamp is tightened, equal pressure is applied in all directions around the boom so that boom

20 Meters		15 Meters		10 Meters	
MHz	swr	MHz	swr	MHz	swr
14.025	1.3:1	21.025	1:1	28.025	1.1:1
14.100	1.1:1	21.100	1.1:1	28.500	1.9:1
14.200	1.1:1	21.275	1.3:1	28.600	2.1:1
14.250	1.3:1	21.350	1.3:1		
14.300	1.5:1	21.445	1.4:1		

Table 1. Swr readings for the System 33 adjusted for the CW portion of the bands.

Band (MHz)	14, 21, & 28
Maximum power input	legal limit
Gain (dBd)	8 dB
Vswr at resonance	1.3:1
Impedance	50 Ohms
F/B ratio	20 dB
Boom (o.d. x length)	2" x 14'4"
No. of elements	3
Longest element	27'4"
Turning radius	15'9"
Maximum mast diameter	2" o.d.
Surface area	5.7 sq. ft.
Wind loading at 80 mph	114 lbs.
Assembled weight (approx.)	37 lbs.
Shipping weight (approx.)	42 lbs.
Maximum wind survival	100 mph

Table 2. Manufacturer's specifications.

flattening does not occur. The clamp which holds the split-dipole driven element in place is similar to the clamps used on other popular beams and seems more than adequate mechanically and electrically.

Element sections are joined by one-piece aluminum clamps which provide for good electrical bonding and effective mechanical holding ability because the element sections will dimple slightly when tightened. The dimples will prevent element sections from sliding out of place.

The antenna is fed at the center of the split-dipole driven element with 50-Ohm coaxial cable such as RG-8/U, and there are no matching sections to adjust or stubs to tune. Resonance is set by adjusting the length of the driven and parasitic elements according to the dimensions given in the instruction manual. A balun (1:1 impedance ratio) may be used if one wishes, but it is not necessary.

Electrical Characteristics

A definite advantage of the System 33 over other triband beams is the broadband response of the antenna. It is possible to work almost all of the CW and phone portions of the three bands while maintaining a reasonably low standing-wave ratio. My primary interest is CW and the lower portion of the phone band for DX purposes, so the antenna was adjusted for the CW setting. Table 1 illustrates the swr response for the System 33 at 33' above ground. With regard to swr, the results obtained were better than the data published by the manufacturer. See Table 1.

Although it has not been tried at my QTH, I believe that the response values listed in Table 1 could be improved by shortening the dimension of the adjustable part of each element by about 1 to 2 inches less than the CW setting. Despite the somewhat high swr on ten-meter phone, it appears that the beam is more broadbanded than most of the tribanders I have had the opportunity to own or work with.

Results and General Conclusions

On-the-air results have been gratifying. With regard to forward gain, results indicate that gain is at, or near, the published 8-dB value. The subjective difference between the System 33 and my three-element monobander for 20 meters is minimal. The front-to-side ratio is excellent, with a clear null heard when the antenna is positioned 90 degrees off the desired heading. The only major difference between the System 33 and the monobander is in the area of front-to-back ratio. The front-to-back ratio is at least as good as other triband beams, though.

All things being considered, I can highly recommend the Wilson System 33 for its superior mechanical construction, the ease with which it can be assembled, and its true broadband response. The System 33 is an excellent value and a wise choice. *Wilson Systems, Inc., 4286 S. Polaris Avenue, Las Vegas NV 89103, (702)-739-7401; toll-free order number is 1-(800)-634-6898.* Reader Service number W33.

Lawrence W. Stark K9ARZ
Saint Charles IL

New Bearcat® 300 Service Search.

NEW BEARCAT® SCANNER HAS OVER 2,000 FREQUENCIES IN MEMORY

The development of a new scanning monitor radio with over 2,000 pre-programmed frequencies, plus 50 user-programmable channels, has been announced by Electra Company. Named the "Bearcat® 300 Service Search," the new radio features the convenience and simplicity of advanced programmed scanner technology. By pushing a single button, the radio will search the actively assigned frequencies for the service selected. This feature completely eliminates the need to know in advance the frequencies for the most-listened-to services. The Service Search has 11 different services: police, fire, marine, "ham," mobile phone, emergency, government, forestry, business, ground transportation, and even air-to-ground aircraft channels. In all, there are 2,138 frequencies pre-programmed into the Service Search memory to ensure that the active channels for any local area are covered.

In addition to Service Search, the new Bearcat scanner also features the flexibility of a user-programmable memory. The frequencies for up to 50 channels can be stored or changed in this memory by simple keyboard entry. These frequencies can be in any mix from the 7 VHF and UHF frequency bands covered by the radio, including the AM aircraft band. Lockout, scan delay, and automatic activation of accessories (such as an alarm) can also be individually entered for each of the 50 channels. Arranged in banks, these channels can be activated or locked out in groups of 10 with a single push-button. Many other operating features are also included in this deluxe radio, including "search" between operator selected frequency limits, hold and resume controls, direct channel access without the need to "step through" channels, scan speed control, plus provisions for a priority override channel.

The clean, professional look of the new Bearcat 300 Service Search scanner features a die-cast front panel which is accented by a vacuum fluorescent digital display. The display, with bright/dim control, offers excellent readability under all lighting conditions. It not only displays the frequency being received, but also automatically shows accurate digital time when the radio is switched off. (If desired, the time can also be viewed when the radio is receiving calls by simply pushing the "time" button.) The radio measures 12¼" wide by 3⅞" high by 7" deep, permitting easy shelf or vehicle installations. Electra Company believes the radio will add a new dimension to the rapidly expanding market for scanner radios, which have already penetrated approximately 5% of US households. The radio is expected to appeal not only to sophisticated scanner users, but also to those who appreciate a unique entertainment product combining complex technology with simplicity of operation. Complete details are available from Bearcat scanner suppliers or by writing directly to *Electra Company, PO Box 29243, Cumberland IN 46229.* Reader Service number E40.

CHECKING OUT THE CLEGG AB-144 ALL-BANDER

I'm a sucker for every new transceiver add-on, accessory, and gadget. My most recent acquisition of this nature is the Clegg AB-144 All-Bander receiving upconverter, which I purchased for use with my two fixed-station 2-meter multimode transceivers.

The AB-144 is a novel frequency-range extending device that should be of interest to amateurs who would like to expand the coverage of their VHF set. The Clegg unit converts your present ham-bands-only transceiver to a continuous-coverage receiver that spans the spectrum from LF (100 kHz) to 30 MHz with no gaps. Because it works ahead of the set's rf and i-f stages, it covers this frequency range with sensitivity, selectivity, tuning rate, calibration accuracy, and mode selection (SSB, AM, CW, etc.) essentially as estab-

Band	Tuning Range
1	0.1-4 MHz
2	3.0-7 MHz
3	7.0-11 MHz
4	11.0-15 MHz
5	14.0-18 MHz
6	18.0-22 MHz
7	22.0-27 MHz
8	26.0-30 MHz

Table 1. Tuning ranges.

lished by your existing rig.

Although the unit was not yet available when the first ads appeared in early spring, it took Clegg less than one week to get the AB-144 to me by UPS when I placed my order this summer. Upon unpacking the 2-lb. unit (which came in a securely wrapped and padded box), a quick scan of the 3-page operating manual provided all the instruction needed to connect the upconverter to my Yaesu FT-221R transceiver.

A 110-volt, 100-mA, plug-in, ac-adapter-type power supply is furnished, and it's more than adequate to supply the 12 V dc @ 30 mA required by the AB-144, though you can also tap into the transceiver's dc supply if you like. I found that two additional connections, in addition to the power supply cable, had to be made. The first was the output line to the transceiver, which was made by means of a short length of RG-58 cable terminated in PL-259 connectors (user-supplied). A jack is also provided on the rear panel to connect a suitable LF/HF antenna. (A single wire will normally do fine, or if your transceiver has a separate antenna/receiver jack, you may be able to use it as a handy spot to feed in the upconverter's output.)

Hooking up the two rf cables and the power cord put the AB-144 in operation. There was one final step, however. I took the precaution of removing the microphone from the transceiver to prevent the accidental pumping of 2-meter rf into the AB-144—an easy thing to do if you later forget that the unit is connected. Although the upconverter is internally protected against such an unfortunate occurrence, this added measure will prevent possible damage to either piece of equipment.

I found that the Clegg unit did what the advertising literature claimed it would do. It nicely extended the range of my FT-221R down to 100 kHz, making the purchase of a high-quality all-band communications receiver of marginal value, especially considering the relatively low cost of the Clegg upconverter ($129.95) and the high cost of top-quality receivers in today's market.

Specifically, the specs call for 0.3 microvolt sensitivity (on SSB and CW) and a ±3 kHz (±1 kHz typical) frequency calibration accuracy. Selectivity is equal to that of the transceiver with which it is used. While I did not measure the sensitivity, it seemed to be at least equal to my Tempo 2020 on the ham bands and my Yaesu FRG-7 over the full range of 100 kHz to 30 MHz. Calibration accuracy was found to be close to the ±1 kHz figure. Frequency stability was excellent; no trace of drift or instability was noticed with movement of the cabinet.

Overall results you can expect to obtain with the AB-144 depend almost completely on the transceiver you feed with the upconverter's output. When using the unit with my FT-221R, which is also equipped with an outboard YC-221 digital readout display, it was a real convenience to have both analog and digital frequency display on all bands, especially the crowded AM broadcast and shortwave bands. FM and SSB reception was excellent, mainly because the Yaesu transceiver is primarily designed for these modes. CW reception was broad, as expected, due to the transceiver's i-f passband characteristics, though addition of a sharp active audio filter (such as those sold by MFJ, Autek Research, Datong, and others) would easily narrow the effective passband for better CW reception. AM reception results were marginal because the FT-221R's i-f filters are designed for SSB, having a too narrow 2.4-kHz bandwidth. The narrow AM selectivity results in some distortion, bassiness, and low audio recovery on received signals. While AM reception was usable on my transceiver, this problem might prove detrimental to avid broadcast-band and shortwave listeners. Again, this is not a problem of the converter, but of the transceiver with which it is used. If you intend to use the AB-144 with your present VHF gear, you may want to modify the set's i-f passband to broaden its AM response curve.

It also took a little "getting used to" and some rapid mental gymnastics to calculate how each of the eight band segments are upconverted to 144-148 MHz. Each band is 4 MHz wide (corresponding to the width of the 2-meter band), except the first band, which is only 3.9 MHz wide—remember, the set only goes down to 100 kHz, not 0 kHz. The bottom of each of the upconverter's eight bands is heterodyned up to 144 MHz by means of eight separate crystal oscillator circuits; the conversion process is worked upwards from there. For example, to receive a BC-band station at 1060 kHz, set the bandswitch on the AB-144 to band 1 (.1-4 MHz) and tune the transceiver

Clegg's AB-144 All-Bander.

to 145.060 MHz. Or, to receive a 3900-MHz signal, set the switch to band 2 (3-7 MHz) and dial in 144.900 MHz on the transceiver. This process *can* be confusing, with either analog or digital displays (especially the latter) until you get the hang of it. The complete tuning ranges are shown in Table 1.

I also tried out the AB-144 with my KLM 2700 transceiver, which has both a vfo (with an analog display) and a digital readout controlled by a 3-knob digital synthesizer. I found the analog display easy to work with on this set, especially since the 2-meter band was split into four 1-MHz ranges which coincided nicely with the upconverter. But the digital synthesizer—with its 3-knob tuning divided into 1-MHz, 100-kHz, and 10-kHz frequency increments and its resultant inability to directly dial in frequencies other than in 10-kHz steps—was just "too much" to get used to. However, the synthesizer was great for BC-band DXing, where most channel separations in North and South America are pegged at 10 kHz; you can set up the synthesizer and whip through the band at exact 10-kHz intervals with ease.

SSB and CW reception was good on the KLM 2700, about the same as on the FT-221R, and AM was a little better on this rig. (Some transceiver manufacturers recognize the AM reception problem and make available information on how to improve reception. KLM, for example, has issued a technical bulletin on the 2700 which shows how to broaden the AM-mode response curve for improved AM signal quality. The modification they suggest for the 2700 involves only two components, a resistor and a capacitor. I installed the modification on my set and found reception quite acceptable on the standard and shortwave broadcast bands.) Clegg mentions that the AB-144 is designed for use with the FT-225, TS-700, and IC-211, in addition to the two transceivers with which I used my unit.

What was inside the attractive 5¼" × 2½" × 6" Ten-Tec-style enclosure? The instruction manual didn't provide a clue, and no schematic diagram or servicing procedures were included (Clegg warrants the unit for 1 year and expects that you'll send the device back to them for repair). I was disappointed in not having been provided a diagram, so I peeked inside and found a small rectangular circuit board holding a 10-transistor circuit, with separate oscillators for each of the eight bands. Although it's not necessary to perform any internal adjustments or alignment unless components have been replaced and repairs made, I managed to touch up each oscillator's tuning slug to bring the frequency calibration accuracy under 1 kHz on all bands and to slightly peak up the unit's output. In examining the AB-144, I found workmanship to be good throughout.

Is it worth it? Yes, especially when compared with the alternatives of buying a separate general-coverage receiver or another of the recently-introduced upconverters designed to capture this wide-open market. I was impressed by the Clegg unit's very few birdies and images, its good calibration accuracy and resettability, and its reasonably consistent performance over each band and from band to band. You *do* have to be careful with overload, however. Cross-modulation is not as much of a problem (though there was a trace on some close-by BC stations), but overloading the transceiver on strong signals was. This is because there is no tie-in with the transceiver's agc circuit. This means that you do have to do some manual rf gain control riding, espcially on SSB and AM, for best results. Also, I found that the external ac adapter power supply furnished with the AB-144 produced a small amount of hum on stronger signals; hooking into the transceiver's dc supply cured the problem. Too, I would recommend that Clegg add a small LED indicator to let you know that the unit is on; unless you're hooked into your set's power supply, it's easy to forget to turn off the upconverter when you turn off your rig.

Finally, you need to be careful not to zap the converter with a healthy dose of rf from your set, as I've indicated. Installing a coax switch at your transceiver's output connector will allow you to conveniently switch from converter to normal transceiver operation. A coax relay could also be used, but that would require going inside the AB-144 to arrange switching.

All in all, the Clegg people have produced a handy, useful accessory to be used with the thousands of all-mode VHF transceivers in operation today. I should also mention that Clegg has now introduced a similar upconverter, known as the MD-28-9, which transforms your ham-bands-only HF transceiver or receiver to a wide-range 100-kHz-to-18-MHz unit. With this unit, the received signals are heterodyned to the 10-meter band rather than to 2 meters.

In my opinion, the AB-144 is a real jewel that is well worth its price tag. It's an especially attractive purchase for the ham newcomer who entered the hobby from CB radio and who invested first in a 2-meter rig, rather than a shortwave set. Besides providing a good auxillary receiver for my shack, the Clegg unit will be a welcome addition on my vacation trips to enable me to monitor HF with the 2-meter rig. *Clegg Communications Corp., 1911 Old Homestead Lane, Greenfield Industrial Park East, Lancaster PA 17601; (717)-299-7221.* Reader Service number C3.

Karl T. Thurber, Jr. W8FX/4
Ft. Walton Beach FL

RADIO SHACK CORDLESS TELEPHONE

Now available from Radio Shack is the DuoFone ET-300 Cordless Push-button Telephone with an operating range of up to 300 feet from the base unit. It has a universal dial system for compatibility with both electronic push-button and mechanical dial telephone systems.

The ET-300 can be installed simply by plugging the base/recharger into a 120 V ac outlet and a modular phone jack—no other wiring is required.

A special feature of the phone is Auto-Redial, for one-button redialing of the last number called if it was busy or did not answer. A call push-button lets you signal the handset from the base with a tone signal.

To answer or make a call on the cordless handset, flip the talk switch and raise the antenna. To hang up, lower the antenna.

Radio Shack's ET-300 Cordless Telephone.

Trac's TE284 Deluxe Message Memory Keyer.

The base/recharger is $8\frac{5}{8}$" x $7\frac{1}{8}$" x $2\frac{3}{4}$" and includes a built-in modular jack for your regular phone. The handset is $2\frac{1}{2}$" x $6\frac{3}{4}$" x $1\frac{1}{4}$".

For further information, contact *Radio Shack, 1300 One Tandy Center, Fort Worth TX 76102.*

TRAC DELUXE MESSAGE MEMORY KEYER

Trac Electronics, Inc., has introduced a new, completely CMOS, state-of-the-art, Deluxe Message Memory Keyer, the Model TE284. Containing all CMOS integrated circuitry, the Deluxe Message Memory Keyer contains three choices of message storage: two-message capacity (50 characters each), four-message capacity (25 characters each), or one 50-character message and two 25-character messages. The keyer can record at any speed and the message can be replayed at any speed. A memory operating LED tells when the keyer is in the memory function. The three choices of memory operation make the Model TE284 ideal for both daily QSOs and contests. In addition to the message functions, the keyer contains both dot and dash memory keying, iambic keying, 5-50 wpm, speed, volume, tune, tone, and weight controls, as well as a sidetone with speaker. The Model TE284 keys both negative- and positive-keyed rigs. *Trac Electronics, Inc., 1106 Rand Building, Buffalo NY 14203.* Reader Service number T18.

ICM INTRODUCES NEW GROUND STATION SATELLITE RECEIVER

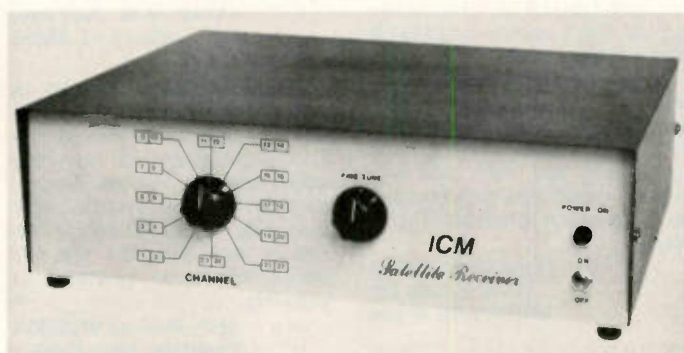
A new low-cost satellite receiver, covering all channels 3.7-4 GHz, is now being manufactured by International Crystal Mfg. Co., Inc., Oklahoma City.

The TV 4200 receiver is fully tunable and provides standard dual audio outputs of 6.2 and 6.8 MHz, with other outputs available. The receiver has a built-in LNA power supply, and output levels are compatible with video-monitor or VTR input.

For further information, contact *International Crystal Mfg. Co., Inc., 10 North Lee, Oklahoma City OK 73102.* Reader Service number I48.

RAPID MOBILE CHARGER

With the current trend toward using hand-held transceivers for mobile operation, keeping the hand-held batteries charged has become a problem. DebTed Engineering has solved this problem with a new line of 12-volt-operated rapid chargers for amateur and commercial use. Available exclusively through Debco Electronics, the rapid charger units are equipped with a cigarette lighter plug on the in-



ICM's satellite receiver.

Debco's Rapid Mobile Charger.

put side and an appropriate charging plug on the output side. Models are currently available for the Tempo S-1, Wilson Mark II, and Wilson Mark IV. The charger will rapidly charge a fully discharged good battery in 4-6 hours and may be used during transmit, receive, and off periods. Furthermore, it will not damage batteries if left connected for prolonged periods of time, due to automatic shut-off circuitry. *Debco Electronics, PO Box 9169, Cincinnati OH 45209.* Reader Service number D68.

HAMTRONICS' UHF FM EXCITER KIT

Continuing in their tradition of making professional quality transmitter and receiver modules, Hamtronics, Inc., has announced a new UHF FM Exciter Kit. The model T450 is rated at 1 Watt for continuous duty, which makes it an ideal unit for repeater and control link service.

Features include low-impedance dynamic mic and receiver audio inputs; crisp, clear modulation; low spurious output; and built-in test points for easy alignment. The unit is designed on a 3" x 5¼" PC board and uses both individual coil shields and compartmental shielding. Double-tuned circuits are used for low spurious output, and decoupling uses ferrite beads and resonant bypasses for stability.

For further information, contact *Hamtronics, Inc., 65F Moul Rd., Hilton NY 14468; (716)-392-9430.* Reader Service number H16.

NEW KEYER USES OPTOISOLATORS

An advanced-design electronic keyer employing optoisolators for key isolation has been introduced by Curtis Electro Devices, Inc. Based on the popular 8044 single-chip circuit, the EK-480M features a direct meter readout of code speed in wpm. Measuring only 7" x 4½" x 2½", the unit features dot and dash

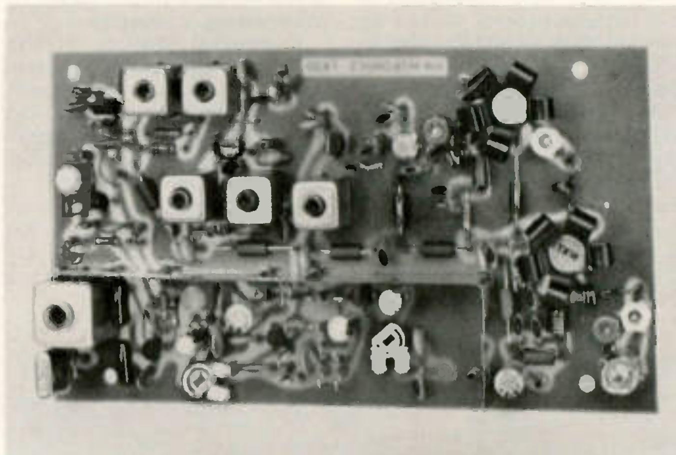
The EK-480M keyer from Curtis Electro Devices.

memories, iambic or standard mode operation, internal 117 V ac or battery supply, internal sidetone and speaker, front-panel volume, pitch, weight, and speed controls, and an accessory socket for soon-to-be-announced message memory, Instructo-Keyer, and keyboard keyer add-on units. The unit will key ± 300 V dc at up to 200 mA.

For additional information, contact *Curtis Electro Devices, Inc., Box 4090, Mountain View CA 94040; (415)-494-7223.* Reader Service number C90.

THE ISOPOLE™ CONT.

We should have noted in our October issue (p. 167) that AEA's new ISOPOLE™ is indeed a VHF antenna. Versions are available for 2m and 220 MHz.



Hamtronics' UHF FM Exciter.

Ham Help

I have recently come into possession of an Elmac receiver, Model PMR-6A. I have not been able to find any info on this unit. I do not have the power supply, but I understand that it was a mobile unit.

I need a schematic for the unit and a list of the voltages needed for operation so a power supply can be assembled. I will appreciate any help and will happily reimburse copying and postage costs involved. Thank you.

Paul Uhlig K0MD
1342 Estate Ct.
Wichita KS 67208

I have an xtal XCB-4 AM CB radio and I would like to convert it to 10 meters. Has anyone made this conversion? Can anybody help?

John S. Lee KA4EPR
17401 N.W. 20th Ave.
Miami FL 33055

Carthage High School is organizing a club, and we desperately need any junk or articles collecting dust. Anything would be appreciated: books, magazines, spare parts, wire, coax, old repairable transmitters or receivers, etc. We will gladly reimburse postage or shipping.

Jerry Reeves WD5IMA
Carthage High School
PO Drawer D
Carthage TX 75633

I am in need of a circuit diagram and manual for an Allied A-2515 receiver. I would certainly pay any copying costs, and it will help a future ham get on the air.

Robert Napoli K2LGO
Box 158
Riverhead NY 11901

The Wells High School Amateur Radio Club is a new organization that needs help. We have a group of interested students, three co-advisors, and not one speck of equipment.

The group is now raising money for an equipment fund and working on a vocational education grant application, but we are wondering if someone might be willing to either donate old gear or place gear with the club on loan, until the club can afford to buy its own rig.

The club would be more than willing to pay shipping costs or, if practical, pick up equipment in the coastal Boston/Portland area.

David W. Rotthoff
Amateur Radio Club
Wells High School
Wells ME 04090

I would like to find out about the existence of any Bible study nets or round tables to help my study of the word of God. Thank you.

Gary L. Anderson WB0GWP
1528 34th St. S.E.
Cedar Rapids IA 52403

I would like to hear from someone who has successfully interfaced the IF-1 regenerative repeater (*73*, November, 1978, p. 254) to an ST-6000.

A. Ustal WB4TRJ
180 Arlington Rd.
West Palm Beach FL 33405

DX

from page 30

quency, that is, on the frequency of his last station worked. Either a remote vfo on your transceiver, RIT (receiver incremental tuning), or a separate transmitter and receiver is required. Any of these setups will accomplish the goal.

First, tune in the DX operator and listen while he works one or two stations, to establish in your mind what his operating pattern is. Books and articles have preached this simple rule for decades. When your radios are warmed up and tuned up (off the air, naturally), get ready to put your transmitter on the proper spot. When the DX turns it over to someone, find that someone and put your signal just slightly off his frequency—off a matter of Hertz, *not* kilohertz!

That's all there is to it. When you call, your signal should be right where the DX station's receiver is tuned, and he will hear you without touching his receiver tuning knob. If the DX operator is getting calls by carefully listening for "tail-enders," you have no choice but to play his game and tail-end yourself. Tail-ending means giving your call, or just your suffix, at the very end of the transmission of the station who is signing off with the DX. A very skilled operator can pick out parts of callsigns from tail-enders and can keep a string going without ever saying "QRZ?" or whatever. Mostly, however, tail-ending degenerates into a mob scene. *Never* use the technique unless the DX station encourages it, and even then only if it is working.

It's difficult to not feel smug after finding a pileup, observing the poor slobs who call and call but never figure out what is happening, then make one or two quick calls yourself, exchange reports, and tune away looking for more rare QSOs, while the same pileup goes on and on. There's something more training classes should teach: It's called using your head. Put yourself in the shoes of the DX station you want to work. Think like he does and you will invariably call at the right time on the right frequency. Otherwise, you can call all night.

160 METERS

December is the time to talk about our lowest frequency band, since the winter months are to 160 as the summer months are to sporadic "E" skip on VHF. Many modern rigs cover 1.8 MHz, and the amateur magazines have had their share of tips the last couple of years on how to put a signal on 160 when only modest real estate is available. A dipole is 270 feet long, a fact which constrains most of us. But there are ways!

Many have become interested in 160 since the hundred-country barrier was broken a couple of years ago. As we recall, W1BB actually had the magic century figure some time before, but a few of the countries were "pre-War" and didn't count when the ARRL decided to offer a 160 endorsement to DXCC. By 1979, several have made this achievement level. Now most expeditions to rare spots include 160-meter coverage, as well as 6 meters and OSCAR. When one has worked his fill of Europeans or JA stations on 80, 160 becomes the natural band to which to gravitate for more thrills.

DX on 160 is found primarily in the "window," 1825-1830. *Do not* transmit in this segment unless you are outside of the US and Canada. The DX will specify a listening frequency around the bottom edge of the band, 1800-1805. Pacific Island stations such as Hawaii will transmit near the top edge of the band, as will JA stations. Send an SASE to the ARRL and ask for their special chart of 160-meter allocations, which includes information on how much power you can use at various times of day and night in different regions of the US.

Six-Band DXCC, anyone? (It's been done!)

MAILBAG

KV4FZ reminds us that he was the first operator outside the 50 states to make WAS on 160 meters; PY1RO, mentioned in this column last July, was the first station outside North America to accomplish the feat. Herb KV4FZ has also confirmed 100 countries on six different bands, 160-10 meters.

A nice letter came from Cliff Sides KX6SC, who, along with Ed Williams KX6SA, has been keeping the Kwajalein Atoll active. They have been on 6 meters, with consistent openings to Japan, Hawaii (2000 miles NE of KX6), Guam, the Solomon Islands, Papua-New Guinea, and Jordan. Some openings to Australia and New Zealand have also occurred.

Their best time on 50 MHz, where they hang out around 50.110, has been 0900 to 1200 UTC. If you can hear KH6 stations this winter, you may work a real rare one if the skip runs to KX6.

Here's how Cliff summarizes the low-band openings:

10 Meters: Open from Kwajalein sunrise to sunset (1800-0600 UTC); Europe comes in first, followed by stateside and VK, then Japan at night between 0600 and sunrise.

15 Meters: Open sunup to sundown, very similar to 10.

20 Meters: Best openings to the US occur between 0300 and 0800 and again between 1100 and 1500. Europe is very good between 0500 and 2200.

80 Meters: Propagation to the US peaks about 1400, Europe slightly later. East-coast US stations have the best shot at this part of the world at their sunrise on the east coast, about 1200 UTC in the winter.

The first expedition to VK9 (Cocos-Keeling) in some time took place September 18 and 19, 1979. VQ9s JJ, KK, and MR (yes, the same one mentioned in Novice Corner) started out by having their plane delayed 24 hours. They finally arrived on Cocos Island (about 1500 miles from their homes on Diego Garcia) and fired up at 0830 UTC on the 18th.

Their next problem was dead bands. Our active sun, responsible for the excellent propagation on the bands these days, greeted the Cocos group with the residual effects of a solar flare. The bands came back to life a little toward the end of their two-day stay, but working them from stateside, for example, was no picnic.

In 30 hours, the trio did manage some 2200 contacts, almost all on 15 and 20 meters. For those who missed this one, there's good news: VQ9JJ and VQ9TR are talking about going back early in 1980, with a beam antenna this time.

August, 1979, was a banner month for expeditions. Manihiki (Northern Cooks chain) Island was represented by no less than two different groups. KØSVW provided a report on one, which signed ZK1AM. Other operators were WØWP, KØEVE, and ZK1DR; they made 15,000 contacts on 80-10 meters. WØWP is handling QSLs, which were supplied by Collins Radio.

ZK1AM was on the air August 18-25, using a pair of IC-701s, an FTDX-400, and loaned TH3 Hy-Gain beams and DenTron amplifiers. Expenses for the operation, including a six-day boat ride each way, totaled twelve thousand dollars, which was paid by the participants. If your group is interested in seeing the slide show and talk on this interesting adventure, contact Dr. Steve Towle KØSVW, 214 N. 34th Avenue East, Duluth MN 55804.

September's Hurricane David devastated the island of Dominica in the Caribbean. David wiped out all communications there except for amateur radio. J7DAY was all alone for the first few days and provided all government-to-government communications for relief operations.

J7DAY was joined by KP2A (American Virgin Islands) and WØDX. They set up at a Red Cross headquarters first as KP2A/J7 and then as J73A. W4UY joined them later. As things got in order, J73A was able to do some casual operating; if you worked them and would like the special QSL card, send yours with an SASE to K2TJ.

As you read this, the Indian Ocean-Africa expedition by N2KK, K5CO, and N5AU should be in full swing. Their itinerary includes 3B7 and 3B9, Glorioso and Juan de Nova, and then Mayotte and 5R8 (Malagasy Republic). After that, N2KK hopes to get into Somalia (6O) solo.

Dave N2KK is a professional photographer who has traveled extensively throughout the world (to more than 100 countries). He will be taking many photos during the expedition and will undoubtedly be prepared for the "convention circuit" upon his return.

If you worked KP4AM/D (Desecheo) last spring, you might want to send your QSL now to David Novoa KP4AM, PO Box 50073, Levittown PR 00950.

VE3FXT should be operating from Thailand by now, after getting in some air time from HS4AMA while awaiting his own callsign. Also active from there, of course, is Fred Laun HS1ABD. Fred listens for stateside and Canada on 3517 at 1130 daily.

The December issue of *CQ* magazine, a publication which has been quite DX-oriented over the years, is the first under the new management of K2MGA, K2EEK, and W2LZX. Among other things, *CQ* has sponsored the Worldwide DX Contest, the WPX (prefix) contest, and a 160-meter contest, not to mention an awards program, including the USA-CA (US counties) award. It is expected that *CQ*'s emphasis will continue mostly unchanged, at least for the time being.

With the departure of Chuck Stuart N5KC as editor of this column, new authorship begins with this issue of *73*. Please send your input c/o *73*, Peterborough NH 03458. And thanks from all DXers to Chuck Stuart for the excellent work he has done with the column during the past year!

Most of the information for this column came from *The DX Bulletin* (Vernon CT 06066). Thanks.

from page 18

and other "radio tricks" and increased lawlessness.

Where Are We Headed?

As this lawless group becomes larger and more powerful, it will become more fearless. It will also become more sophisticated in the "art" of raising hell via radio technology.

Please realize that the driving force of this group is an ego trip based on the power they can apply to other parts of society. Also, be aware that this sort of ego trip *can never be satisfied.* That is to say, once they have their way with the ham bands, they will begin to turn their eyes (egos) to other targets.

What targets might these be? What with scanners in abundance, targets are very easy to find. What about mobile radio services, taxis, fire, police, etc.? I can imagine thinking like the following:

"Wouldn't it be a lot of fun to study the fire frequencies and learn how to get around their security systems and send half of the LA Fire Department out on a wild-goose chase? Wow! That was fun. Next week, let's fake LAPD into another Watts riot!" Or, "Let's talk to a 747 pilot coming into LAX and burn his ears!"

The technology is not too difficult for this group of lawless people. They already know how to put a synthesized 2m transceiver well outside its design band limits. They know the frequencies that many services and individual agencies use. They know a great deal more.

I don't wish to be disrespectful of the FCC and its abilities, but I feel it would take quite a while to nail someone who is doing the things I project above. Meanwhile, the FCC receives a tremendous black eye, and society will pay a large bill in monies, property, and maybe lives.

What To Do?

It seems to me there are several choices:

1. Do nothing. Result:
•Eventual anarchy within the whole radio spectrum.
•FCC in total disgrace.

2. Vigilante action. Result:
•People hospitalized.
•Houses burned.
•Innocent parties hurt.
•"Good" people (vigilantes) sued and hurt.
•FCC gets black eye.

3. FCC participation in restoring law and order to the ham bands. Result:
•Stop anarchy before it spreads further into the non-ham parts of the spectrum (where the FCC would not have a vast army of hams to help with the clean-up).
•Cooperation from those of us hams who have developed RDF skills and equipment. This will aid the FCC in its work.
•Restoration of what is probably the most effective weapon of all—peer pressure in the form of fear of exposure to the FCC.
•FCC gains respect and stature.

* * * * *

The only question left is: "When will the tide begin to change back in the direction of collective decency?" Maybe the shift has already begun.

BYE-BYE, MISS AMERICAN PIE DEPARTMENT

On September 6th, the FCC acted to suspend, pending revocation action, both the operator's and station license of Scott Lookholder WB6LHB of Los Angeles, California. Earlier this year, Lookholder had entered a guilty plea in federal court on a number of counts in an indictment charging him with the use of "foul and abusive language" while operating on the two-meter amateur band. Allegedly using the callsign W6JAM, Lookholder spent many hours making life miserable for the usership of many Los Angeles area repeaters, especially the Mt. Lee WR6ABN repeater.

Ironically, Lookholder was even a member of the DFing committee set up to catch W6JAM, and it was only due to some rather phenomenal detective work by another member of that same committee that he was caught at all. Even after they were sure that Lookholder was their man, they found it hard to believe and spent many hours trying to disprove their "find" before turning their evidence over to the authorities.

The rest you already know. Scott Lookholder was given his day in court, admitted to the charges against him, was sentenced to pay a fine, and was placed on probation. He was also ordered by the judge not to utilize his amateur equipment during the term of the probation. However, though a number of letters were sent to the Commission by area amateurs requesting that Lookholder's license be pulled, the FCC took months to act on the matter. Infuriated, many amateurs charged the FCC with running scared of anything that even remotely smelled of First Amendment. Letters to the Commission have gone unanswered, including my own.

Congressman James Corman (left) with Attorney Joe Merdler N6AHU. Both care a lot.

In the meantime, the inaction by the Commission on this and other regulatory violations issues helped worsen an already highly volatile situation. The kooks have realized that the FCC is seemingly powerless in this type of matter and have made a field day of it. Filth, racial slurs, character assassination, and hate have replaced normal day-to-day operation on many repeaters. It's even been reported, though not confirmed, that at least one "jamming" club has been formed to further wreak havoc. Carrying their banner of "our way or no way," the kooks have been growing in number and strength. No longer would they hide behind the anonymity of their microphones. Rather, they were proud of who they were and what they were doing. They declared open war on Joe Ham, and Joe was hard put to fight back.

Not every Joe was inclined to sit still and accept the decaying situation, nor every "Jay" for that matter. In what might be considered one of the finest political moves ever initiated within the ARRL, League Southwestern Division Director Jay Holladay W6EJJ convinced the Board of Directors that a *bad* situation did exist and was able to get the Board to pass a resolution which instructed ARRL General Counsel Bob Booth to contact and develop a working guideline with the FCC in handling this type of problem. Jay's next step was to appoint Los Angeles Attorney Joseph Merdler N6AHU as a Special Assistant Director, charged with advising Jay in methods to eliminate this ever-growing maliciousness that was, by this time, threatening to destroy normal amateur operation.

Through Joe, a meeting was arranged with US Congressman James Corman, Democrat from Van Nuys, California, which Jay and Joe attended. Congressman Corman was briefed on the deteriorating situation, the problems with FCC inaction on these cases, and given a basic education about the amateur service itself. As a result of this meeting in August, Congressman Corman agreed to support the amateur community in its internal house-cleaning effort and said that he would see what could be done through Washington. About two weeks later, I personally interviewed Congressman Corman, and what follows is the text of that interview.

Q: Congressman Corman, what led to your decision to get involved in this matter?

A: All of us who have had little contact with amateur radio are still aware of its importance. I'm occasionally aware due to news items of amateurs who have performed important services during times of disaster, maybe an individual disaster or something that affects a whole community. I was not, until recently, aware that there were some problems. Those problems involve the use of false call letters, interference with the normal use of the airwaves, and some serious cases of obscenity. I have discovered that the FCC appears to be doing little to police the use of the airwaves for amateurs and is potentially diminishing this service which the amateur operator can give to his community.

Q: Congressman, now that you are involved, what direction do you intend to take?

A: Joe Merdler (N6AHU), who is a good, long-time friend of mine and the new president of the Personal Communications Foundation, has given me tapes to show me what is happening on the airwaves, and I'm going to be sure that the FCC hears those tapes. I hope that will generate some action from them. Also, I'm going to be working with Congressman Van Deerlin, who heads the Communications Subcommittee, which has jurisdiction in this area, to see whether or not we need some statutory change, to make certain that the FCC is doing a responsible job of policing the airwaves.

Q: Do you feel that the FCC is doing its job in this matter?

A: Evidence I have at the moment would indicate that they are not! For instance, a man was convicted in a court of law of using both false call letters and obscenities, very serious ones interfering with the normal legal use of the airwaves, and yet the FCC was reluctant to take action against him. He may be punished in a civil court or criminal court, but as long as he has the *ability* to continue to interfere with the normal legal use of the airwaves, then the FCC is not doing its job and I want to find out why.

Q: I assume you are speaking of the Scott Lookholder matter?

A: Yes.

Q: Do you feel that the Commission may be running scared of First Amendment issues in this matter?

A: I'm sure that the FCC feels controlled by the First Amendment, but there are things here that go well beyond First Amendment rights, having to do primarily with interference with other people's use of the airwaves, and clearly there are obscenities that go far beyond one's constitutional right. I know Chairman Ferris and plan to contact him and ask if that's what they're (the FCC) worried about; I want to sort it out and get some legal opinions as to whether or not they can move. It may be that it's something else, and I suspect that something else may very well be that they just get bogged down in the normal bureaucracy and that nobody has paid close attention yet. Maybe I'm wrong and it is something else, but we will find out what it is and try to get to the bottom of it.

Q: Are you going to bring the Lookholder matter to their attention and try to get action on it?

A: Yes. I want to be sure that it is before the chairman of the Commission. He may have a valid reason for not proceeding. I want to know what that reason is. If it is a valid reason, I will come back and report it to the people involved. If it's not a valid reason, I'll try to see that action is taken.

Q: What if some of these alleged "bad guys" charge you with violation of their First Amendment rights? Will you still stand behind the amateur community in its housecleaning efforts?

A: The point is that the courts will protect the First Amendment. There is no First Amendment right to falsifying call letters. There's no First Amendment right to blasting obscenities on the airwaves. Admittedly, obscenity is a difficult thing to determine under the First Amendment, but aside from that, assuming that they are saying something very proper, if they're falsifying call letters and if they are intentionally interfering with the normal use of the airwaves, then it's my suggestion that it is *not* their First Amendment right. I believe very strongly in freedom of speech. Clearly, when you think about the airwaves and their importance, there is the necessity for using them in some reasonable and rational way for all. To use them irrationally, to intentionally jam them, has nothing to do with First Amendment rights in my book.

Q: I understand that you are going to be coordinating your efforts with the American Radio Relay League through its General Counsel, Bob Booth. Would you care to elaborate?

A: I asked if I could see Mr. Booth as soon as I get back to Washington. I'm hoping that Mr. Merdler will be able to come back as well. For one thing, there are 435 of us in the House of Representatives and we don't want to be running in 435 different directions. That's why it's so important that the association (ARRL) quarterback what's going on, so that we are all moving in the same direction. We need to coordinate a good reference.

* * * * *

Less than two weeks after my interview with Congressman James Corman, word reached us that the FCC had acted on the Lookholder case, and since that time, the FCC has apparently been quite busy helping us clean house, not just on two meters, either. Could it be that an overall cleanup of the amateur bands has become an FCC priority? The rumors of almost daily "busts" run rampant, but the FCC refuses to say anything. Following up on such a rumor just this week, Westlink Correspondent Alan Kaul W6RCL called FCC Field Engineer In Charge Larry Guy at the Long Beach field office. How far did he get? Read his final "air copy" here:

NEWS ITEM: THE WESTLINK AMATEUR RADIO NEWS EDITION #106

"In Los Angeles last week, another FCC raid was made on an amateur station allegedly involved in illegal transmissions. Officials from the Long Beach field office took part in the action. In a capsule, here's what happened: A signal from an amateur transmitter was jamming a two-meter repeater in the Los Angeles area. Direction-finding equipment led to the location, but no one was home. Westlink has learned that the jamming operation was done by remote control, and that the owner of the station was activating the transmitter by telephone.

"The FCC refuses to confirm or deny the report, and will say only in terse governmentese: 'An inspection was made on Monday, September 10th, but the results of that inspection are not public information.'

"So, we don't really know what happened and can't really be sure who the ham involved was, but it looks like the score from Los Angeles is FCC 2, jammers nothing."

If there is real validity to the rumors, and I have good reason to believe that such is the case, then it looks as if a cleanup of our amateur bands is our Christmas present to ourselves, with a bit of help from the FCC. The only ones who won't appreciate the gift are the foul-mouthed, the carrier-throwers, and jammers in general. Why? Because the gift they get will probably be notification that they are no longer licensed amateurs; *good riddance*. You see, the "good guys" who wear white hats and ride white horses can win a fight — even today!

Happy holidays!

Microcomputer Interfacing

from page 28

shown in Fig. 1 pressed, a negative pulse of duration 2.62 seconds will also be observed. If you fail to press the pulser, however, and thus do not apply a positive edge at GATE0, no monostable pulse is observed. On the other hand, if you repeatedly press and release the GATE0 pulse at time intervals less than 2.62 seconds, the monostable pulse can be prolonged indefinitely. In this way, a *retriggerable monostable multivibrator* output can be produced.

With a control word of 064, the behavior depicted for MODE 2 in Fig. 2 can be observed. By repeatedly generating positive edges at GATE0 at time intervals of less than 2.62 seconds, counter #0 is repeatedly reset and the appearance of the short negative clock pulses is prevented. The same purpose may be accomplished by allowing GATE0 to remain at logic 0 after a positive edge has been applied. The GATE0 input thus exhibits both gating and trigger/reset behavior.

MODE 3 behavior (control word of 066) is similar to that for MODE 2, except that a nearly symmetrical square wave is produced. Deviations from symmetry occur when the counter byte is an odd number and are most pronounced when the counter byte is very small.

In MODE 4 (control word of 070), the positive edge of the WR pulse (which is applied at pin 23 of the timer when the STA instruction at 003 014 is executed) initiates counting that culminates in the production of a negative clock pulse of pulsewidth T. The time duration between the positive edge and the pulse is 2.62 seconds. The GATE0 input acts as a gating input, with a logic 0 inhibiting the counting process.

Finally, in MODE 5 (control word of 072), a positive edge at GATE0 initiates counting. By repeatedly generating positive edges at GATE0 at time intervals of less than 2.62 seconds, counter #0 is repeatedly reset and the appearance of the single negative clock pulse is presented.

It should be noted that in all modes, counter action begins on the first negative clock transition after WR (pin 23) or GATE0 goes to logic 1, and that WR can initiate counting in all modes except MODE 1 and MODE 5.

Although in many applications of the 8253 timer the primary interest will be to generate the proper signal at OUT0, as shown in Fig. 2, you can also read the contents of the 16-bit counter *without affecting the counting operation*. By inputting a control word of 000, 100, or 200, you latch the 16-bit count of either counter #0, counter #1, or counter #2, respectively. As shown in the memory-mapped I/O example in Table 1, the two bytes can then be read into the 8080A chip, with the LO byte first and the HI byte second.

LETTERS

from page 16

sultant squeal from various troopers to your magazine. I noticed some of the biggest squeals around here came from police who have linears in their patrol cars on CB and they own amateur gear for a home CB station. One local community police department is almost entirely involved in overpower on CB. In fact, in this particular area, a county of maybe 7,000, there are 15 to 18 Yaesus and 7 Siltronix, and linears in autos and home are almost commonplace. Only one Yaesu is owned by a licensed amateur.

Then we see an article printed by a completely illegal, overpowered, out-of-band HFer (Peters) trying to convince us he is just a good ol' guy trying to do his thing, fellas, so please give us HFers some consideration and kindness as they operate like hams and are really good guys. Horse cocky! He is an illegal bootlegger using illegal equipment and should be in jail on a criminal conviction, not being published in an amateur magazine.

Then we have the article that, merely because a ham was a Conditional or Tech, says it was justifiable and cute for an Advanced-type ECM engineer to break the law in dozens of ways to "teach him a lesson." All because the so-called offender was a Conditional whose comments the hot-shot engineer didn't like. I'd rather see ads by Trigger.

In the past, your mag always had the best of amateur radio, every article seemed to be informative, and construction articles for amateurs were of the accepted *ham* type, i.e., licensed and law-abiding. Other than the abovementioned drivel, though, you still have the best mag published and someday you will get back to the average amateur and make us feel we are with you on a one-to-one basis as we read your editorials.

Joe Feagans W9HCI
Tallula IL

EGYPTIANS

Now the "other side" has had its say in the pages of *73*, with the word of Bess Nelson (September, 1979, page 156) pitted against the earlier letter of Tania Miller (August, 1978, page 8) in regard to the situation prevalent at the Egyptian Radio Club, Granite City IL. It is one of the oldest, strongest, and most prestigious clubs in the nation, whose chief accomplishment seems to have come 40 years ago, within a decade of its founding, when it won ARRL's Field Day three years in a row.

When I saw Tania's letter, I thought it a bit hasty in remonstrance against an admitted problem, but now I think she, not Bess, had the better perspective on things there.

At present, Mrs. Nelson is editor of the club's newsletter, a journal I had the honor to publish several years ago. Her latest edition, besides containing two unsigned letters—something most of the rest of us editors stopped airing quite a while back—gives the news that the club's regular membership stands at 126, with the obvious implication that the membership is *up* to this figure. The true picture is that club membership must be *down* to 126, following the mass exodus of 29 former members, according to my sources, who walked out the door, led by old-timer Harry Turner (holder of world record for sending code on a straight key—35 wpm—see *73 Magazine*, Jan., 1976, page 5), who turned his back in disgust and dropped not only his membership, but also his position as club treasurer, a post he had held for more than a quarter century.

Up until early this summer, I had felt sure that "our" problems would soon be resolved and we would all be back in the same boat again. But I now no longer think this is possible. The arrogant and supercilious behavior of a small knot of hierarchical dictators within the club has made any broadly-based "aura of good feeling" an impossibility. Oh, not that disagreements are ever expected to end, but they need not break up the party. To be sure, old traditions and ideas must and will be changed, and I never particularly agreed with the notion that women should not be members of the club. But it was not this issue that was at the heart of the troubles—rather like the issue of slavery, destined to be the most memorable point of the American Civil War, but which was not really the cause of it all. The more likely situs of the ERC problem is exactly what Bess points to: feelings of power on the part of a chiefly self-appointed elite within the club.

Oddly enough, my strongest disagreements have been with Harry Turner himself, who once walked out of a board of directors meeting because I was there although not a member, but at the invitation of that body. But Mr. Turner and I can stick to our positions responsibly and still keep our composure and our friendship—as we have continued to do. With the 27 others, I must agree, there's little point in continuing the animosity; I just walked away from it, too. But I don't like to see in print an appearance that the "good guys" won, when they didn't.

Harry Church W0KXP/9
Lebanon IL

ATV

On the night of September 4, 1979, all hell broke loose on ATV. At eight thirty pm, VE3IWP, who lives in Toronto, informed me via two meters that W9ZIH from Chicago was coming in on his screen. I fired up my TV station, and sure enough, there he was. I just couldn't believe that I was receiving an ATV picture all the way from Chicago (Hickory Hills) IL about four hundred twenty miles away, while my normal range is about seventy to eighty miles. He was working VE3EYR in Brantford, Ontario.

After that contact, he worked W3POS in Erie PA, approximately four hundred miles between the two stations. At ten pm, I got ahold of W9ZIH myself; we worked both ways, live on camera as well as sound. He received me P4, and I received him P5 (broadcast quality). I nervously took some pictures and made a video recording for future reference. W9ZIH was on for several hours, not just a few minutes as might be expected. VE3EYR, VE3IWP, and myself were in contact with each other on two meters. There were times when I would almost lose W9ZIH, and VE3IWP, who is fifty miles from me, would see him P5, and sometimes conditions would be reversed.

After I finished my ATV QSO with W9ZIH, I picked up N9AB from Mundelein IL, which is four hundred forty-one miles from me. We only flashed our logos at each other for a while; he came in P2 at times. We also saw K9KLM from Oak Creek WI once; he was P3 on my screen and is four hundred eight miles away. Later on that night, W2RPO in Lockport NY and VE3AHS in Welland, Ontario, also saw W9ZIH. Needless to say, I had a sleepless night after all this. I don't know who holds the world record for DX on fast scan, but we might be close to it. Ron W9ZIH was running five hundred Watts out on 439.25 MHz video, and one hundred fifty Watts on 443.75 MHz sound; his antenna on video had one hundred seven elements up sixty-five feet. I was putting out forty Watts on video and ten Watts on sound with a forty-eight element antenna on video and twenty elements on sound. My converter and preamps are home brew as well as my transmitting equipment. I am not trying to take any credit; we were all active in this and were very enthusiastic. We all hope that what has happened to us might spark some interest in others. I have been a ham since 1959, but after the initial excitement of the first several years wore off, I lost interest in the hobby. After getting involved in amateur fast scan TV, I got my old spirit back again. There is no better way that I can think of for old-timers who are getting stale to rejuvenate the interest in our wonderful hobby. ATV has got all the excitement of the early days of radio, with lots of room for experimentation.

John Vander Ryd VE3CYC
Hamilton, Ontario

EUREKA!

Re: 890-960 MHz Machine-to-Machine CB

Eureka!

It now looks fairly definite that the new proposed amateur band in the 890-960 MHz band will not remain vacant due to the lack of equipment.

Our Canadian Department of Communications, through its Director General of Regulations, is proposing a 5-MHz portion be set aside for CB operation. They are proposing a wide-open mode of operation including man-to-machine and machine-to-machine. Comments on band plan, modulation schemes for voice and data, and, most important, eligibility requirements are being requested from the public.

My opinion is that the DOC feels that the big boys, G.E., Motorola, etc., are not being aggressive enough in their development in this area for the private commercial user. The commercial manufacturers keep screaming for more spectrum rather than developing improved technology to communicate within the spectrum they now have.

Motorola has developed a DVP Digital Voice Privacy System along with Harris and possibly others. This appears to have been developed only for the purpose of privacy. I feel the big "M" and others are going to be left out in the cold unless they and other *domestic* manufacturers join in on the development of this proposed new band, if it is approved.

Of course I am excited because this brings new and inexpensive technology to the amateur portion of the band.

Paul Cassel VE3AVY
Kitchener, Ontario

Well, unless we somehow manage to get a lot more licensed amateurs than we have now, I'm not sure that we will have enough people to do much pioneering on a new band. Of course, the availability of relatively inexpensive equipment would help a lot and might take some of the pressures off 450 MHz as a repeater control band. But remember that we have a 1215-1300 MHz band which is virtually unused... primarily because it is so difficult to make the necessary equipment.

The 900-MHz band might be one where amateur TV fanatics could set up a series of repeaters and make it possible for that mode to cover more ground. — Wayne.

THINK TANK

I'm not writing to bitch or complain about anything. As a matter of fact, I'm writing to obtain my copy of "How to Write for *73*." Hopefully, we can strike up a mutual agreement whereby I give you excellent articles for publication and you give me money!

I also want to comment on *73 Magazine* in general. I've been a reader of *73* since I was first licensed in 1963. I've followed your magazine's growth from "just another ham rag" to the best ham magazine currently being published. *73* gets in my mailbox first (most of the time) and gets read the longest. The articles are, by far, the most practical and fairly easy to duplicate. The articles also provide an excellent base for "think-tanking" my own projects.

I was delighted with the letter from K8DNV about "Wayne Green's Lair" in the July, '79, issue. Doug DeMaw W1FB has long been one of my favorite authors. Unfortunately, the rest of the senior ARRL staff don't share his opinion.

Several hams here in England are in the process of forming a G5 Amateur Radio Club for all licensed G5 operators. The unofficial G5 calling frequency is S19 (no relation to the CB counterpart) or 145.475 (simplex) MHz. No HF net has been set up as yet. So far, we have about 10 interested hams. Once we get a few more together, we'll have election of officers, formation of a G5 awards program, and all the other things that go into the makings of a ham club. So, any G5 licensed ham who would like to get in on the ground floor of the G5 ARC, please contact G5CSU at 10 Apple Close, Lord's Walk Estate, RAF Lakenheath Camp, Brandon, Suffolk, IP 279 PJ (my British mailing address), or come up on S19 to get full details.

One more item: 29.6 MHz FM is alive and well. G5BRB has a rig on 29.6 FM and I'll have an old Motorola L41 on as soon as the crystals come in, so look for some G5 activity on 10 FM from Jolly Old England.

That's about it for now. Once the G5 ARC is formed and the awards program is adopted, I'll provide you with the details. Keep up the good work in *73* and *Kilobaud MICROCOMPUTING.*

Richard H. Arland G5CSU
APO New York NY

THANKS, HARRY

I would like to comment on the article, "The 80 Meter Coax L," by Harry Pardue in your August, '79, issue.

Even though Fig. 1 is in error to the extent that the feedline braid is not connected to the ground rod as it should be (and as it is described in the text), the article is a fine contribution to our hobby and I wish to thank Harry and *73* for its publication.

My version of it, which runs 20 feet on the vertical to a chimney bracket and then slopes down about 5° to anchor to a nearby tree, shows an swr of about 1.2 and required no trimming whatsoever! First contact was Oklahoma City to St. Louis, which approaches 600 miles; at 3:00 pm, that's not bad (80m Novice CW).

Clarence H. Dollmeyer KA5EKM
Edmond OK

VINTAGE QSLS

I purchased the following QSLs at a local stamp and coin dealer. He had purchased them at an estate sale and was selling them to stamp and postcard collectors. If any of the following hams are still active and would like to have the QSL, send me your name and QTH and I'll send you the card.

W1BYF—'33; W1BFP—'31; NU1VT—'28; NU1WV—'28; W2AMM—'29; 2AON—'27; 2BBC—'26; U3BNU—'25; 3LB—'28; U3QW—'25; U3VF—'26; 4AG—'23; 4EE—'25; 5PE—'22; 5WK—'25; 6ACH—'26; W6AIF—'32; W6AIY—'31; 6ARW—'25; 6ASL—'28; 6AZZ—'26; 6BDW—'28; W6BMH—'31; 6CZU—'26; 6DAQ—'25; 6DOG—'28; 6DTP—'28; W6EBV—'29; W6FOC—'34; W6QY—'29; 6RJ—'25; 8AIB—'21; 8AVZ—Sept., '26, "Been on air week hr"; 8CTD—'24; W8ESG—'55, "ex-W8AKV"; 9AIG—'21; 9ASK—'22; 9ASN—'21; 9BEW—'24; 9BHB—'24; 9BOB—'24, "ex-9BDQ"; 9BQZ—'25; 9BVK—'24; 9DAE—'27; 9DHJ—'24; 9DMX—'24; W9FTR—'31; 9HO—'22; W9LAY—'33; U9WK—'27.

Is there a radio museum which would be interested in a donation of unclaimed cards from the above?

Gary Payne WD6BJK
1347 E. Dakota
Fresno CA 93704

SHINGLE POWER

Without a doubt, WB6AAM (September Letters) is right in urging hams to get busy and power their rigs with solar and alternative forms of energy. Considering the momentum that Jane Fonda and the "hate nukes" society is gaining, blackouts are coming. If you like the gasoline shortages of the '70s, you will love the electric power shortages of the '80s and '90s. (For more information, write to Department E, National Rural Electric Association, 1800 Massachusetts Avenue N.W., Washington DC 20036.)

If anyone can come up with a solar cell that can be used instead of shingles for a roof, it will be welcomed across the nation (even by power companies). Power companies need some support.

TMI was the worst nuclear disaster in history—yet no one was hurt. Oh, yes, it is claimed that there may be one to ten more cases of cancer in the next decade, but peddlers of hysteria fail to mention that over 325,000 cases are expected anyway. Yes, TMI was a tragedy. It set back nuclear power 20 years. Yes, there are risks involved with nuclear power, but these are small compared to others that we take.

For more eloquent thoughts on the subject, readers are referred to A. Hailey's new book, *Overload.* It provides sober food for thought.

Russell C. W. Crom AG9N
Mt. Prospect IL

MALICIOUS FOOLS

This will no doubt be one of many letters to you highly commending the fantastic job done by the hurricane watch during the recent hurricanes, David and Frederic.

I cannot commend too highly the excellent work done by all those running the net and most particularly by Ellie K4RHL and Lynne WA1KKP. So many people who benefited from information received by their tireless efforts will hold them in warm regard, and for those of us who sat on the sidelines during the long hours, their patience and fortitude under difficult conditions was more than admirable.

The difficult conditions were unfortunately made doubly so by some sick pranksters or malicious fools who persisted in heckling and attempting to block vital transmissions with all manner of QRM. It is hoped that the FCC is in a position to take positive action. I think that every ham who heard the QRM deplored it and would love to have been in a position to throttle the bastards.

George Benson GY5GB
Kingston, Jamaica

Ham Help

The Cincinnati Area UFO Net has been active Thursday evenings on 28.8 MHz (alternate frequency 28.795 MHz) at 0100 UTC. A Saturday afternoon section will be inaugurated beginning January 5, 1980, at 2000 UTC. Stations in the western, southwestern, and southern states with UFO traffic or interest are cordially invited to check in on or about 28.8 MHz at that time. Net control will be KA8BVO, with K8NQN providing assistance and liaison with the Mutual UFO Network nets which meet in the morning on 40 and 75 meters.

Information relating to UFO movies shown to radar specialists in the military service during the 1950s is of particular importance. If you or someone you know has seen such movies, please contact Mick Georgin KA8BVO, 8788 Mockingbird Lane, Cincinnati OH 45231, in confidence. His landline is (513)-729-3430. Thank you.

David L. Dobbs K8NQN
6612 Pleasant Street
Cincinnati OH 45227

If anyone has any information on any organized net of Masons on the amateur bands, please drop a line to Bill Williams, Box 419, Philmont NY 12565. Thank you.

Arthur Roraback III
RD 1, Box 87
Chatham NY 12037

Awards

from page 22

of the amateur receiving this award.

WORKED ALL SM
WASM I

This award is offered by the Swedish Amateur Radio Society as tangible evidence of the proficiency of foreign amateurs in making contacts with the various call areas of Sweden.

The award may be claimed by any amateur in the world who has fulfilled the following qualifications. Swedish amateurs will not be eligible.

European amateurs must work two stations in each of the eight Swedish call areas. These areas are SM1 to SM7 inclusive and SMØ. The contacts may be made with SM, SK, and SL stations, and all stations have to be land-based. All contacts must be made after World War II. Non-Europeans need only contact one Swedish station in each of the required call areas.

The contacts may be made using any authorized amateur band and any type of emission. No endorsements for work on any certain band or for phone work will be given.

The applicant must submit a list of claimed contacts which may be verified by two amateurs, a local radio club secretary, or a notary public.

To cover expenses for this award, which is cloth and beautifully designed, there is a fee of 11 IRCs. Applicants are to send this fee and list of contacts to: SSA Diploma Manager, Ostmarksgatan 43, S-123 42 Farsta, Sweden.

Join us again next month as we span the globe looking for additional incentives to make those new contacts worthwhile. Continue to forward award information as it becomes available. Perhaps your own radio club sponsors an awards program. Why not share it with our readers worldwide?

Contests

from page 35

GARDEN CITY CONTEST
Starts: 1200 GMT December 8
Ends: 1159 GMT December 9

The Visvesvaraya Industrial and Technological Museum, Bangalore, and the Bangalore Amateur Radio Club cordially invite all amateurs to participate in the VU2DX Contest. There will be two groups of operation, with one group operating both 20 and 40 meters and the other group operating only 40 meters. Log sheets regardless of score will be of definite interest to all concerned along with any photographs of the shack and contestants. The contest is open to all amateurs but restricted to CW only and single operators. The station must be manned by the individual amateur contesting without receiving any assistance from any other persons for log-keeping or spotting, etc., during the entire period of the contest. Stations may be worked once per band and valid points can be scored by contacting stations not in the contest provided complete RST exchanges are made and logged.

EXCHANGE:

RST and serial QSO number in three digits or more.

SCORING:

Each completed QSO counts 1 point with the following multipliers: VU station contacting Asia = multiplier of 1, contacting Europe, Africa, and Australia = multiplier of 2, and contacting North and South America = multiplier of 3.

ENTRIES AND AWARDS:

All entries to the contest must be postmarked no later than December 31st and sent to: The Convenor, Garden City Contest 1979, Visvesvaraya Industrial and Technological Museum, Kasurba Road, Bangalore 560 001, India. There is no entry fee and the entries must be a true copy of the actual log for the contest period. All DX stations who contact 20 or more VU2 stations will be issued a "Garden City Certificate."

TEENAGE RADIO SPRINT
Starts: 0000 GMT December 22
Ends: 2400 GMT December 23

Sponsored by the Twin City Teenage DX Club, the contest's purpose is to promote teenage amateur operators and to help friendship with other teenagers. All hams over 21 years of age must work only stations under 21 years of age. Stations under 21 may work all stations. To show under 21, put "/T" after your callsign. General call will be "CQ TNGE TEST."

EXCHANGE:

RS(T) and age; if over 21 and you don't want to send your age, simply send xx in place of the age.

SCORING:

Score 2 points per QSO in one's own country, 4 points for all DX QSOs. Double QSO points (4 and 8 points) for QSOs on 160, 80, or 40 meters. Multiplier is number of different prefixes worked on each band and mode. No crossband contacts except via OSCAR.

FREQUENCIES:

CW—40 to 60 kHz up from bottom of band, 10 kHz up for Novice.

SSB—near or around 3975, 7275, 14275, 21375, 28575.

6 and 2 meters may also be used.

ENTRIES AND AWARDS:

Awards will be given depending on the activity! Entry classes include single-operator, all band; multi-operator, single transmitter; and multi-multi. Also, special classes for CW only, SSB only, or mixed. A summary sheet is requested and a sheet with scoring and contact totals along with the usual contest information signed by the operator is requested. All logs must be sent to Greg Deuhs KBØCV, 1945 Ashland Avenue, St. Paul MN 55104.

12TH AUSTRALIAN JAMBOREE
December 29, 1979—
January 7, 1980

The vast distances and small potential of people power do not deter Western Australians from thinking big. Although covering one third of the Australian continent, making it the biggest state in the world, the West has only 8% of its population at about 1.2 million people.

1979 is the state sesquicentenary (150th anniversary) year, so many years ago the W. A. Scout Branch applied for the regular three yearly Australian Jamborees always previously held in the populous eastern seaboard states. This was agreed and the Jamboree becomes the final event in a year-long birthday party embracing the whole population from all towns, utilizing all activities which could be imagined.

World Scout Bureau gave it regional status as the 4th Asia-Pacific Jamboree. Subsequently, with the postponement of the 1979 World Jamboree in Teheran, Iran, it became one of the 1979 World Jamboree Year Camps. About 8000 scouts from eastern states and over 1000 from 30 overseas countries will mix with 2000 locals for eight days of camping, activities, sight-seeing, shopping, trying new skills, fraternization, and fun.

Because amateur radio amplifies many of these Jamboree concepts, e.g., new skills, fraternization, and fun, local amateurs are preparing one of the biggest VK6 stations ever mounted. Facilities will include:

- a high-frequency station on 20 or 15 meters operating round the clock beaming the world, including eastern states;
- a high-frequency station on 15 or 10 meters operating all day beaming eastern capitals;
- a high-frequency station on 40 or 80 meters operating as required with dipole aerials favoring north/south;

Results

RESULTS OF 1978 TOPS CONTEST

Winner was HA5NP—Robert Soket of Budapest, Hungary
No. of contacts—549 | Number of points—1014
No. of prefixes—115 | Total score—116,610
FT-250 at 200 Watts

Second was HA9RU—Janos Pokker of Miskde, Hungary
No. of contacts—480 | Number of points—851
No. of prefixes—130 | Total score—110,630
FT-250 at 200 Watts

Third was YU1OCV—Vojislav Kapun of Kikinda, Yugoslavia
No. of contacts—386 | Number of points—810
No. of prefixes—118 | Total score—95,580
FT-200 and amplifier at 500 Watts

•a RTTY station operating most of the time as signals are available;
•amateur TV F/S on UHF with special receivers located in subcamp fraternity areas;
•three or more VHF stations on 2 meters and 6 meters and perhaps other bands; and
•a workshop where, under the supervision of amateurs, the scouts will be able to build a simple electronic working project.

In addition, a broadcast band radio station on 1610 kHz is in preparation so that items of news, happenings, instruction, and music can be conveyed quickly to all scouts for their entertainment.

It is expected that the stations will be busy with amateurs in contact and that the special Jamboree Badge QSL Card will be in demand. It is hoped also that scout groups and units with radio amateur capabilities or friends will make a special time to get together during the Jamboree to make contact. Further, it is expected that many groups around the world will want to make contact to find out how the Jamboree and their particular people are progressing. To assist these contacts, skeds will be accepted for a particular frequency, date, and time. Mail to: Scout Amateur Radio VK6SH, 12th Australian Jamboree, Box 467 P.O., West Perth, Western Australia 6005.

To test propagation conditions as far as it is possible, all skeds will be acknowledged by trying all contacts with one of the VK6 amateurs on the organizing team exactly four weeks to the day and hour on which the contact is asked for. If that sked does not work, another will be tried a week later—three weeks from the Jamboree. The sooner that skeds are requested, the better can the arrangements be.

The Jamboree is being held at Perry Lakes Stadium and associated grasslands—an international track and field site established for the Empire Games in Perth in 1962. The radio station is to be sited on the top floor of the stadium building using most of an area 250 feet long by 11 feet wide.

For further information, contact: (Jamboree) Mr. Alex Shaw, The Scout Association of Australia (W. A. Branch), Box 467 P.O., West Perth, W. A. 6005, phone 321-7217 (Mr. Doug Napier); or (Radio) Mr. Peter Hughes, Asst. Branch Commissioner, 58 Preston Street, Como, W. A. 6152, phone 367-1740 (mornings 364-7588).

CANADIAN CHRISTMAS QSO PARTY

Starts: 0001 GMT Saturday, December 30
Ends: 2359 GMT Saturday, December 30

This contest is sponsored by the Canadian Amateur Radio Federation and is open to all amateurs. Everybody may work everybody on all bands, 160-2 meters, CW and phone combined. Entry classes are single-operator allband and single-operator single band.

EXCHANGE:

Exchange signal reports and consecutive serial numbers, e.g., 599001. VE1 stations also send province.

SCORING:

Stations may be worked twice on each band, once on CW and once on phone. Score 10 points for each contact with Canada, 1 point for contacts with others. Multipliers are the number of Canadian provinces and territories worked on each band and mode (12 provinces/territories times 8 bands times 2 modes for a maximum of 192).

FREQUENCIES:

CW—1810, 3525, 7025, 14025, 21025, 50100, 144100 kHz.

Phone—1810, 3770, 3900, 7090, 7230, 14150, 14300, 21200, 21400, 28400, 28600, 50100, 146520 kHz. Suggest phone on the even hours GMT, CW on the odd hours.

ENTRIES:

Entries, with dupe sheets and summary sheet, must be mailed by January 31, 1980, to CARF, Box 76752, Vancouver BC, Canada V5R 5S7.

OOPS

Hope we didn't cause any problems, but there was a slight typo error in the September contest calendar write-up on the 89'ers Run. Certificate applications should go to WB5YKD and not WB5TKD as listed.

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 6

emissaries a few minutes before a net is scheduled to open. They can get on, check around, and, if the net frequency is in use, find a spot for the users to move, if they can be coaxed into it. Most hams are like me, they will do almost anything for you if you ask nicely . . . and will fight to the death if told what to do.

If the chaps are obstinate . . . or if one of the net people trying to get a clear channel is less than diplomatic, there should be an understanding that the net can move up or down a few kilohertz to keep peace in the family. Blessed are the peacemakers for they are the first to get killed when war starts.

FINDING THE JAMMERS

Little has been written or even done about trying to find the jammers. We are a whole generation behind in working on the problem. The FCC and other agencies have gone years beyond us in the design of sophisticated equipment for searching out jammers . . . while we are still out waving loop antennas around, chasing off in the opposite direction at top speed.

I've heard that the FCC is able to get a fix on a jammer within one or two seconds . . . or is it milliseconds? As I've mentioned before, I'd sure like to have some articles in *73* on how to build some modern DF equipment. The Happy Flyers in California have run up an impressive record of tracking down repeater kerchunkers and jammers by plane, but I should think that we might be able to go beyond that before long.

We could use articles on techniques for identifying stations by looking at their keying patterns. This means freezing the leading edge of a kerchunk and looking at it on a scope. I understand that every rig may have its own identifiable pattern. We want to know more about triangulation via receiving both the signal on the repeater input frequency and the repeater output. If pairs, or more, of operators could get a net going to do instant triangulation, that might be worthwhile. Let's start tackling this.

AFTER YOU FIND 'EM

In most cases, a ham will shut up once he knows he's been discovered. In those cases where the ham is blatant about it, stronger measures are needed. I've heard that massive visits from concerned local amateurs can have a settling effect on strong-willed jammers. It is impressive when a hundred hams drive up and come to your door to reason with you . . . particularly if they have sticks in their hands.

There are a lot more articles needed on ways which have worked to calm down hard-core jammer cases. I doubt if broken arms are necessary—just some powerful reasoning.

THE WORST WAY

Amateur radio has a reputation of being self-regulating. We try, as much as the FCC will permit, to generate our own rules and we have an enviable record of sticking to them. I can't think of a case yet where FCC-generated rules have been nearly as well suited to our work as our own rules. Amateurs are very considerate of each other, most of the time, and tend to go overboard in the protection of special interests more than in putting them down.

So, in view of this image of self-regulation, every time we turn crying to the FCC over some interference problem, we are hurting our image with the outfit where our image is the most important. We should move heaven and Earth to handle our own problems and not keep calling up the FCC every time some idiot lets loose.

WHAT'S NEXT?

Until we get a lot more information on direction-finding and have a few dozen stations set up for instant fixes, there isn't much we can do. Swinging a three-element 20m beam is hardly the way to try to locate some idiot in Nebraska who is raising hell with hurricane communications. We need to be able to pinpoint the trouble quickly and have things organized enough so we can get in touch with a net in the specific area which can get action.

Clubs which get set up to participate in direction-finding can let me know and I'll try to run a list so other groups will know whom to contact when a problem arises. I should get contact call letters and phone numbers, together with some idea of the bands which can be DFed, etc.

Let's get going on this . . . with articles and organization.

COOL THE HAMFESTS

The *QST* editorial suggesting that hamfests be cut back sure wasn't given much thought before being put to paper. Sure, there are major problems for some of the ARRL conventions . . . there have been real bummers. But this doesn't mean there is anything wrong with hamfests. The Milwaukee Central Division Convention, after two solid years of planning and work, featuring Harry Dannals as speaker, brought in eight exhibitors and a crushing

400 in attendance. The National, in Baton Rouge, also featuring Harry, was another disaster.

Let's compare that with the first-time hamfest in St. Louis (boycotted by the ARRL) which drew about 2,500. There were over 1,500 put to sleep by my talk alone. This year, the St. Louis crowd is loaded for bear . . . they've rented the largest riverboat on the Mississippi for the banquet . . . seven decks and a capacity of 3,500 . . . two orchestras . . . and some entertainment by Wayne Green. I understand that there is a possibility that Arthur Godfrey may be able to make it . . . he's been sick lately, so we don't know yet. And there will be a lot more entertainment.

You may be sure that every exhibitor from last year will be back . . . they cleaned up from the money-waving crowds. I predict there will be many more ham and computer dealers and manufacturers exhibiting this time.

The fellows down in Maryland are cooking up a big event for the spring . . . again featuring me. Why do I draw crowds? Well, I say exactly what I think about things . . . and I'm able to say a lot at talks like this that I would never be able to print. Perhaps I go too far sometimes and say things, which, though true, shouldn't be let out of the bag.

A lot of people come to see what Wayne Green is really like . . . since I aggravate the hell out of them in my editorials . . . and they usually find that after 40 years around this hobby and 27 years of publishing, I really do know what I'm talking about.

No, there's nothing wrong with hamfests except the stifling effect of the League trying to keep the truth from getting out. Boy, do those fellows remind me of the Kremlin!

WHAT'S DOING AT 73?

With the ham field in the doldrums, we're not indulging in many expansion plans for *73*. It is doing well, obviously, but the growth is mainly in the microcomputing end of things. *Kilobaud MICROCOMPUTING* has been growing steadily. We have a new magazine, *80-MICROCOMPUTING*, for the TRS-80 owners, starting in January (out before then). The *Industry Newsletter* has grown into a magazine of its own . . . now pushing 60 pages a month, and with no end in sight. The Instant Software publishing is now perking along, with over 100 program packages already in publication and a couple thousand in various stages of production. Since this division has only been in serious production since the first of the year . . . and since it takes about six months to process and publish a program, the project is doing surprisingly well.

Instant Software is now being distributed all through Europe, in several hundred outlets in the US, in South Africa . . . and will soon be distributed in Asia. It's going in Australia and is getting started in South and Central America. Programs are being produced in German, Italian, French, Spanish, and even English.

A headquarters building and the seed staff for still another magazine has been organized in Boston. This will be a magazine devoted to leisure in that area. If it works well, it might expand to similar magazines for other cities, just as the New York, Philadelphia, and Boston magazines have proliferated. This is scheduled to kick off early next spring.

Having had dozens of hobbies and interests, the leisure magazine idea seemed a natural to me. I've been heavily into horseback riding and horse training, flying, skin diving, skiing, gourmet cooking, sports car rallies and gymkhanas, boating, water skiing, mountain climbing, hamming, hobby computers, car racing, spelunking, restauranting, and more things which don't come to mind immediately, so what better than to do a magazine about all of the activities which are possible in and around greater Boston? It will be fun.

DECEPTIVE ADVERTISING?

Every time I see an ad for the Little Giant antenna in *Ham Radio Magazine*, I laugh. From my viewpoint, this piece of garbage is a pure rip-off and I feel that no reputable publisher should accept an ad for it.

In addition to knowing enough antenna theory to recognize that the contraption is useless, I've also tested the silly thing. It first popped up around 1958 when I published an ad for it. I got in touch with the "inventor," a very nice chap, Stan Byquist . . . K0AST, I think was his call. I looked over his literature and tried to figure out some way . . . any way . . . that it could be more effective than a piece of window screen. I failed, so I got Stan to send me one.

Sure, I could tune it up . . . heck, you can make almost anything load . . . but it was no more effective than an old window screen. Stan said he was getting good results . . . but when he said he had to keep the feedline away from his tower to get good reports, I knew what was happening . . . it was the feedline which was radiating and the intricate (and expensive) lump on top was a weird loading coil, in effect.

I talked it over with Sam Harris W1FZJ and he agreed. But, just to make sure, he borrowed the kludge and tried it every way possible . . . he felt that it was *inferior* to a window screen. I passed the bad news along to Stan and told him we would accept no more advertising. A short while later, I noticed an order from Stan for an 8JK antenna handbook coming in to Radio Bookshop. I hope Stan read the book . . . but I somehow doubt it.

By 1960, Stan had moved to Ohio as K8VRM and had put aside his Little Giant antenna (oh, I forgot to mention . . . that was my idea for the name of the dumb thing). He took on *73 Magazine* as a rep for the Ohio area and did a bang-up job of getting sales with electronics stores. Stan is a very nice guy and did a great job as a rep.

In the 60s, he got involved with hardware for CBers . . . switches, power meters, etc. Then, for some reason, the Little Giant got going again and I see ads for it in *Ham Radio* every now and then. I've talked with 'em at *HR*, so they know the antenna doesn't work. Perhaps they feel that the ad, which says that the antenna "may not outperform a full-sized beam," is warning enough to the wise. That is a true statement. I would not expect the antenna to outperform a full-sized beam, even if it were lying broken on the ground.

Shouldn't there be some responsibility on the part of publishers to protect the unwise from being sucked in on bummers? I have a whole list of firms which I won't permit to advertise in *73* . . . though most of them have gone back into the woodwork. I haven't seen a Dycomm ad in a while. And we shut down ads for EBC, Ebka, Processor Tech, Swlvitek, Valpey Fisher, SAROC, etc.

The ARRL makes a stab at trying to protect the *QST* readers, but they permit rip-off advertisers that I would never let run. I do enjoy their bragging about what few they do avoid.

Let me repeat something I keep repeating: If you feel ripped off over any ham gear, please let me know the details. I prefer you write a letter to the perpetrator with all details and send a copy to me.

1980 ASPEN CONFERENCE

Ham manufacturers are always looking for some new concept which might permit them to bring out ham equipment which would make all past rigs obsolete, thereby triggering a massive buying of new equipment. Since we're talking about something on the order of $1 billion or more in sales, this is not to be treated lightly.

Oddly enough, hams, too, are looking for exactly the same thing . . . something new. It is fun to buy a new rig, but the expense is a major one and not to be made unless there is a darned good reason.

I think I have two breakthrough ideas which together could make all existing rigs completely obsolete . . . and that includes both low-band gear and FM equipment! It will be possible to use these new modes of operating with add-on units for starters, but I suspect that most amateurs will want to opt for equipment with these new modes built right in. These concepts will, I think, make it possible for us to see profound changes in amateur radio over the next few years.

The first public unveiling of these ideas will be at the Aspen Ham Industry Conference, January 12-19th. The admission fee will be a signed non-disclosure contract for one percent of the wholesale price of any equipment sold using the concepts I shall divulge.

It is too late now for us to make reservations for you, so if you are going to attend the conference (which includes a lot of skiing), you'll have to handle the reservations yourself. Please do let Sherry know if you are going to be there so we can include you in the activities and workshop session (Sherry Smythe, *73 Magazine*, Peterborough NH 03458). The main group will be staying at the Limelight, in downtown Aspen.

AUGUST WINNER

Amassing the largest total vote ever recorded in our Most Popular Article contest, "You Can Watch Those Secret TV Channels" walked away with August's award. Authors Jim Barber K0JB and Jevon Lieberg K0FQA will be splitting the $100 prize. If you have a favorite article in this issue, be sure to use the Reader Service card ballot to let us know what it is.

Ham Help

I need a schematic, manual, or data sheet on an Instrument Corporation of Florida very low frequency receiver, model R-500. This fixed-tuned 5-channel receiver was part of a Cubic Timing Systems network.

Harry A. Weber
2605 West 82nd Place
Chicago IL 60652

ATTENTION ELF OWNERS: QUEST SUPER BASIC

Quest, the leader in inexpensive 1802 systems announces another first. Quest is the first company worldwide to ship a full size *Basic* for 1802 systems. A complete function Super Basic by Ron Cenker including floating point capability with scientific notation (number range ±.17E[38]), 32 bit integer ±2 billion, Multi dim arrays, String arrays, String manipulation, Cassette I/O, Save and load, Basic, Data and machine language programs and over 75 Statements, Functions and Operators.

Easily adaptable on most 1802 systems. Requires 12K RAM minimum for Basic and user programs. Cassette version in stock now. ROM versions coming soon with exchange privilege allowing some credit for cassette version.

Super Basic on Cassette **$40.00**

Tom Pittman's 1802 Tiny Basic Source listing now available. Find out how Tom Pittman wrote Tiny Basic and how to get the most out of it. Never offered before. **$19.00**

S-100 Slot Expansion **$9.95**

Coming Soon: Assembler and Editor; Elf II Adapter Board. High resolution alpha/numerics with color graphics expandable up to 256 x 192 resolution for less than **$100**.

16K Dynam. RAM bd. expand. 32K; less than $150.

RCA Cosmac Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded with additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during and after executing** instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high** and **low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game.

Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and research and development.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95**. Expansion Cabinet with room for 4 S-100 boards **$41.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for $12.00 per year.

Tiny Basic Cassette **$10.00**, on ROM **$38.00**, original Elf kit board **$14.95. 1802 software;** Moews Video Graphics **$3.50**. Games and Music **$3.00**, Chip 8 Interpreter **$5.50.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow you to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed**. EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatible cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. The Super Monitor is written with subroutines allowing users to take advantage of monitor functions simply by calling them up. Improvements and revisions are easily done with the monitor. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports with full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $12.50 for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply below).

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12 option. ±5v, ±12v are regulated. Kit $29.95. Kit with punched frame $37.45, $4.00 shipping. Woodgrain case $10.00, $1.50 shipping.

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, IC, crystal, resistors, capacitors and trimmer.

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax. BankAmericard and Master Charge accepted. Shipping charges will be added on charge cards.

P.O. Box 4430M Santa Clara, CA 95054
For will call only: (408) 988-1640
2322 Walsh Ave.

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7430N	.20
7442N	.50
7445N	.69
7447N	.60
7448N	.69
7450N	.18
7474N	.35
7475N	.49
7485N	.88
7489N	1.65
7490N	.43
7492N	.43
7493N	.43
7495N	.69
74100N	.90
74107N	.35
74121N	.34
74123N	.59
74125N	.45
74145N	.69
74150N	.95
74151N	.69
74154N	1.00
74157N	.69
74161N	.87
74162N	.87
74163N	.87
74174N	.96
74175N	.90
74190N	1.15
74192N	.87
74193N	.85
74221N	2.00
74298N	1.65
74365N	.66
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74367N	.66
74LS00 TTL	
74LS00N	.35
74LS02N	.35
74LS04N	.35
74LS05N	.35
74LS08N	.35
74LS10N	.35
74LS13N	.55
74LS14N	1.10
74LS20N	.35
74LS22N	.35
74LS28N	.41
74LS30N	.35
74LS33N	.75
74LS38N	.55
74LS74N	1.25
74LS75N	1.00
74LS90N	.85
74LS93N	.70
74LS95N	1.10
74LS107N	.45
74LS112N	.45
74LS113N	.35
74LS132N	.89
74LS136N	.45
74LS151N	.85
74LS155N	.85
74LS157N	.85
74LS162N	1.15
74LS163N	1.15
74LS174N	2.00
74LS190N	1.06
74LS221N	1.95
74LS258N	.87
74LS367N	1.35
LINEAR	
CA3045	.90
CA3046	1.10
CA3081	1.80
CA3082	1.90
CA3089	2.95
LM301AN/AH	.35
LM305H	.87
LM307N	.35
LM308N	.89
LM309K	1.50
LM311H/N	.90
LM317T/K	3.75
LM318	1.35

LM320K-5	1.50
LM323K-5	5.95
LM320K-12	1.50
LM320K-15	1.50
LM320T-5	1.60
LM320T-8	1.60
LM320T-12	1.50
LM320T-15	1.60
LM324N	1.15
LM339N	1.55
LM340K-5	1.35
LM340K-8	1.35
LM340K-12	1.35
LM340K-15	1.35
LM340K-24	1.35
LM340T-5	1.25
LM340T-8	1.25
LM340T-12	1.25
LM340T-15	1.25
LM340T-18	1.25
LM340T-24	1.25
LM343H	4.50
LM350	7.50
LM370	1.15
LM377	3.00
LM379	5.00
LM380N	1.00
LM381	1.60
LM382	1.60
LM703H	.40
LM709H	.28
LM723H/N	.50
LM733N	.87
LM741CH	.35
LM741N	.32
LM747H/N	.75
LM748N	.35
LM1303N	1.75
LM1304	1.10
LM1305	1.27
LM1307	2.00
LM1310	2.75
LM1458	.47
LM1800	1.75
LM1812	7.50
LM1889	3.00
LM2111	1.75
LM2902	1.50
LM3900N	.60
LM3905	1.75
LM3909N	.89
MC1458V	.50
NE550N	1.00
NE555V	.39
NE556A	.85
NE565A	1.00
NE566V	1.50
NE567V	1.00
NE570B	5.00
78L05	.80
78L08	.60
78M05	.85
75108	1.75
75491CN	.50
75492CN	.55
75494CN	.89
A to D CONVERTER	
8038B	4.50
8700CJ	13.95
8701CN	22.00
8750CJ	13.95
LD130	8.95
9400CJV/F	7.40
ICL7103	9.50
ICL7107	14.25
CMOS	
CD34001 Fair.	.50
CD4000	.16
CD4001	.28
CD4002	.28
CD4006	1.10
CD4007	.28
CD4008	.28
CD4009	.45
CD4010	.45
CD4011	.28
CD4012	.28
CD4013	.39
CD4014	1.00
CD4015	1.00
CD4016	.45
CD4017	1.05
CD4018	.94
CD4019	.45
CD4020	1.02

CD4021	1.25
CD4022	1.10
CD4023	.28
CD4024	.75
CD4025	.28
CD4026	2.00
CD4027	.66
CD4028	.85
CD4029	1.02
CD4030	.45
CD4035	1.02
CD4040	1.02
CD4042	.85
CD4043	.85
CD4044	.85
CD4046	1.67
CD4049	.45
CD4050	.49
CD4051	1.13
CD4060	1.42
CD4066	.71
CD4068	.40
CD4069	.40
CD4070	.50
CD4071	.28
CD4072	.28
CD4073	.28
CD4075	.28
CD4076	1.45
CD4078	.40
CD4081	.28
CD4082	.28
CD4116	.47
CD4490	5.50
CD4507	1.00
CD4508	4.25
CD4510	1.02
CD4511	.94
CD4515	2.52
CD4516	1.10
CD4518	1.02
CD4520	1.02
CD4527	1.51
CD4528	.79
CD4553	3.50
CD4566	2.25
CD4583	4.50
CD4585	1.10
CD40192	3.00
74C00	.28
74C04	.40
74C10	.28
74C14	2.10
74C20	.28
74C30	.28
74C48	1.95
74C74	.75
74C76	1.40
74C90	1.15
74C93	1.40
74C154	3.00
74C160	1.44
74C175	1.35
74C192	1.65
74C221	2.00
74C905	6.00
74C906	.75
74C914	1.95
74C922	5.50
74C923	5.50
74C925	6.95
74C926	6.95
74C927	6.95
INTERFACE	
8095	.85
8096	.65
8097	.65
8098	.65
8T09	1.25
8T10	4.50
8T13	3.00
8T20	5.50
8T23	3.10
8T24	3.50
8T25	3.20
8T26	1.69
8T28	2.75
8T97	1.69
8T98	1.69
MOS/MEMORY RAM	
2101-1	3.95
2102-1	.95
2102AL-4	1.25
2102AN-2L	1.60
21L02-1	1.18

21L02-1	1.18
21F02	1.25
2104A-4	4.95
2107B-4	3.75
2111-1	3.75
2112-2	3.95
2114L-1	7.40
2114L-3	7.90
4116	10.95
25138	6.30
MM5262	.40
MM5280	3.00
MM5320	9.95
MM5330	5.94
PD411D-3	4.00
PD411D-4	5.00
P5101L	13.95
4200A	9.95
82S25	2.90
91L02A	1.50
HD0165-5	8.95
MM57100	4.50
GIAY38500-1	9.95
MCM6571A	9.95
9368	3.50
4100	10.00
416	16.00
CLOCKS	
MM5314	3.90
MM5315	4.00
MM5369	2.10
MM5841	14.45
MM5865	7.95
CT7001	5.80
CT7010	8.95
CT7015	7.25
MM5375AA/N	3.90
MM5375AG/N	4.90
7205	16.50
7207	7.50
7208	15.95
7209	4.95
DS0026CN	3.75
DS0056CN	3.75
MM53104	2.50
MICROPROCESSOR	
6800	17.50
6802	18.75
8080A	8.95
8085	27.00
Z80	14.75
Z80A	19.75
8212	2.90
8214	8.00
8216	2.90
8224	2.90
8228	5.35
8251	8.50
8253	15.00
8255	9.25
8257	19.50
8259	19.50
1802CP plas	13.95
1802DP plas	17.95
1861P	11.50
CDP1802CD	19.95
CDP1802D	25.00
CDP1861	12.95
6820	9.95
6850	12.95
6502	12.50
6504	18.50
6522	13.60
UART/FIFO	
AY5-1013	5.50
AY5-1014	7.50
3341	6.95
PROM	
1702A	3.95
2708	10.50
271671	29.50
2716 Intel	48.00
2732	115.00
2758	22.50
8741A	85.00
8748	75.00
8748-8	60.00
8755A	65.00
N82S23	2.95

Part	Price
N82S123	3.50
N82S126	3.75
N82S129	3.75
N82S131	3.75
N82S136	8.75
N82S137	8.75
DM8577	2.90
8223	2.90
CONNECTORS	
30 pin edge	2.50
44 pin edge	2.75
100 pin edge	4.50
100 pin edge WW	5.25

IC SOCKETS

Solder Tin Low Profile			
PIN	1 UP	PIN	1UP
8	.15	22	.30
14	.14	24	.35
16	.16	28	.42
18	.27	36	.58
20	.29	40	.57

2 level 14 pin ww .20

WIRE WRAP LEVEL 3

PIN		PIN	
14	.32	24	.86
16	.33	28	1.00
18	.57	40	1.23

Part	Price
CRYSTALS	
1 MHz	4.50
2 MHz	4.50
4 MHz	4.25
5 MHz	4.25
10 MHz	4.25
18 MHz	3.90
20 MHz	3.90
32 MHz	3.90
32768 MHz	4.00
1.8432 MHz	4.50
3.5795 MHz	1.20
2.0100 MHz	1.95
2.097152 MHz	4.50
2.4576 MHz	4.50
3.2768 MHz	4.50
5.0688 MHz	4.50
5.185 MHz	4.50
5.7143 MHz	4.50
6.5536 MHz	4.50
14.31818 MHz	4.25
18.432 MHz	4.50
22.1184 MHz	4.50
KEYBOARD ENCODERS	
AY5-2376	$12.50
AY5-3600	17.95
74C922	5.50
74C923	5.50
HD0165-5	6.95
D Connectors RS232	
DB25P	2.95
DB25S	3.95
Cover	1.50
RS232 Complete Set	6.50
DE9S	1.95
DA15P	2.10
DA15S	3.10
TRANSISTORS	
2N1893	.40
2N222A	.27
2N2369	.30
2N2904A	.20
2N2907A	.25
2N3053	.40
2N3638	.25
2N3643	.25
2N3904	.18
2N3906	.18
2N3055	.69
2N4400	.25
2N4401	.75
2N4402	.20
TIP31	.60
TIP33A	1.00

RESISTORS ¼ watt 5%
10 per type .03 — 1000 per type .012
25 per type .025 — 350 piece pack
100 per type .015 — 5 per type 6.75
½ watt 5% per type .05

KEYBOARDS	
56 key ASCII keyboard kit	$67.50
Fully assembled	77.50
53 key ASCII keyboard kit	60.00
Fully assembled 70.00 Enclosure	14.95
LEDS	
Red T018	.15
Green, Yellow T018	.20
Jumbo Red	.20
Green, Orange, Yellow Jumbo	.25
Cliplite LED Mounting Clips	8/$1.25
(specify red, amber, green, yellow, clear)	
CONTINENTAL SPECIALTIES in stock	
Complete line of breadboard test equip.	
MAX-100 8 digit Freq. Ctr.	$128.95
OK WIRE WRAP TOOLS in stock	
Portable Multimeter	$18.00
SPECIAL PRODUCTS	
MM5865 Stopwatch Timer	9.00
PC board	7.50
Switches Mom. Pushbutton	.27
3 pos. slide	.25
Encoder HD0165-5	6.95
3 Digit Universal Counter Board Kit Operates 5–18 Volt DC to 5 MHz typ .125" LED display	10.50
Paratronics 100A Logic Analyzer Kit	$224.00
Model 10 Trigger Expander Kit	$229.00
Model 150 Bus Grabber Kit	$369.00
Sinclair 3½ Digit Multimeter	$59.95
Clock Calendar Kit	$23.95
2.5 MHz Frequency Counter Kit	$37.50
30 MHz Frequency Counter Kit	$47.75
TRANSFORMERS	
6V 300 ma	3.25
12 Volt 300 ma transformer	1.25
12.6V CT 600 ma	3.75
12V 250 ma wall plug	2.95
12V CT 250 ma wall plug	3.50
24V CT 400 ma	3.95
10V 1.2 amp wall plug	4.85
12V 6 amp	12.95
12V 500 ma wall plug	4.75
12V 1 amp wall plug	6.50
12V 3 amp wall plug	8.50

DISPLAY LEDS

MAN1	CA	270	2.90
MAN3	CC	125	.39
MAN72/74	CA/CA	300	1.00
DL704	CC	300	1.25
DL707/DL707R	CA	300	1.00
DL727/728	CA/CC	500	1.90
DL747/750	CA/CC	600	1.95
DL750	CC	.600	1.95
FND359	CC	357	.70
FND500/507	CC/CA	500	1.35
FND503/510	CC/CA	500	.90
FND800/807	CC/CA	.800	2.20
3 digit Bubble			.60
4 digit Bubble			.80
DG8 Fluorescent			1.75
DG10 Fluorescent			1.75
5 digit 14 pin display			1.00
NSN69 9 digit display			.60
7520 Clairex photocells			.39
TIL311 Hex			9.50
MAN3640	CC	.30	1.10
MAN4610	CA	.40	1.20
MAN4640	CC	.40	1.20
MAN4710	CA	.40	.95
MAN4740	CC	.40	1.20
MAN6640	CC	.56	2.95
MAN6710	CA	.60	1.35
MAN6740	CC	.60	1.35
MA1002A			8.95
MA1012A			8.95
102P3 transformer			2.25

Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. $375.00. 4K version $450.00. 4K Assembler $85.00, 8K Basic Interpreter $100.00. Power supply assy. in case $60.00. AIM 65 in thin briefcase with power supply $485.00.

Not a Cheap Clock Kit $14.95

Includes everything except case. 2-PC boards. 6-.50" LED Displays. 5314 clock chip, transformer, all components and full instructions. Orange displays also avail. **Same kit w/.80" displays.** Red only. **$21.95** Case **$11.75**

Video Modulator Kit $8.95

Convert your TV set into a high quality monitor without affecting normal usage. Complete kit with full instructions.

S-100 Computer Boards

8K Static RAM Kit Godbout	$135.00
16K Static RAM Kit	265.00
24K Static RAM Kit	423.00
32K Dynamic RAM Kit	310.00
32K Static RAM Kit	$475.00
64K Dynamic RAM Kit	470.00
8K/16K Eprom Kit (less PROMS)	$89.00
Video Interface Kit	$139.00
Motherboard $39. Extender Board	$8.99

79 IC Update Master Manual $35.00

Complete IC data selector, 2500 pg. master reference guide. Over 50,000 cross references. Free update service through 1979. Domestic postage $3.50. No foreign orders.

Auto Clock Kit $17.95

DC clock with 4-.50" displays. Uses National MA-1012 module with alarm option. Includes light dimmer, crystal timebase PC boards. Fully regulated, comp. instructs. Add $3.95 for beautiful dark gray case. Best value anywhere.

Stopwatch Kit $26.95

Full six digit battery operated. 2–5 volts. 3.2768 MHz crystal accuracy. Times to 59 min., 59 sec., 99 1/100 sec. Times std., split and Taylor. 7205 chip, all components minus case. Full instructions.

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Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$7.25**

PROM Eraser

Will erase 25 PROMs in 15 minutes. Ultraviolet, assembled **$34.50**

Hickok 3½ Digit LCD Multimeter

Batt/AC oper. 0.1mv–1000v. 5 ranges. 0.5% accur. Resistance 6 low power ranges 0.1 ohm–20M ohm. DC curr. .01 to 100ma. Hand held, ½" LCD displays, auto zero, polarity, overrange. $69.95.

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Indoor and outdoor. Switches back and forth. Beautiful. 50" LED readouts. Nothing like it available. Needs no additional parts for complete, full operation. Will measure −100° to +200°F, tenths of a degree, air or liquid. Beautiful woodgrain case w/bezel **$11.75**

FREE: Send for your copy of our NEW 1979 QUEST CATALOG. Include 28¢ stamp.

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Special price — limited quantity

$150.00/pair

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Standard Signal Generator
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Calorimetric power meter
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$125.00

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1.8 to 4.2 GHz
only $399.00

MODEL 618B
3.8 to 7.6 GHz
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A Model $299.00

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50 kHz to 65 MHz
.1mV to 3V into 50 ohms
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MODEL 683C
2 to 4 GHZ
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MODEL 612A
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MODEL TS510/U HP608D
10 MHz to 420 MHz
.1V to .5V
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Wave Analyzer and Sweep Drive
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This fan is super quiet, efficient cooling where low acoustical disturbance is a must. Size 4.68" x 4.68" x 1.50", Impedance protected, 50/60 Hz 120 volts AC
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TRW BROADBAND AMPLIFIER MODEL CA615B
Frequency response 40 to 300 MHZ

Gain	300 MHZ 16dB MIN.
	17.5dB MAX.
	50 MHZ 0 to − 1dB from 300 MHZ
Voltage	24 volts DC at 220ma MAX

only $19.95

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Size	Price	Size	Price
35	$2.15	58	$1.85
42	$2.15	59	$1.85
47	$2.15	60	$1.85
49	$2.15	61	$1.85
50	$2.15	62	$1.85
51	$2.15	63	$1.85
52	$2.15	64	$1.85
53	$1.85	65	$1.85
54	$1.85	66	$1.90
55	$1.85	1.25 mm	$1.85
56	$1.85	1.45 mm	$1.85
57	$1.85	3.20 mm	$3.58

MICROWAVE DIODES

H.P. 2835	2.20
MA4882	5.00
MBD101	1.89
MBD102	1.98
1N831	8.00
1N5711	2.20
1N5712	3.45

INTEGRATED CIRCUITS

MC1303L	$2.00	MC1463R	$5.15
MC1461R	6.90	MC1469R	3.55
MC1469G	2.05	MC1560G	10.20
MC1550G	1.50	MC1563R	10.00
MC1560R	12.40	MC1568L	5.00
MC1568G	5.31	MC1590G	6.50
MC1569R	8.15	MC1648L	4.70
MC4024P	3.82	MC1648P	3.75
MC6820P	6.95	MC68B21P	12.00
2513	6.95	TMS4060	6.95
8080A	3.95	TMS4024	13.90
2716TI	29.95		
MC1460R	5.40		

ALL CRYSTALS $4.95

19.2 kHz	2.4 MHz	3.1545 MHz	5.604 MHz	7.79850 MHz	23.25 MHz
37.35	2.42	3.158	5.61482	7.80150	23.575
49.710	2.4375	3.1585	5.619	7.81	25.9
70	2.44275	3.1615	5.6115	7.926667	25.99961
81.9	2.4495	3.1625	5.6265	8.00769	26.66667
96	2.45	3.166	5.62963	8.075	26.8965
225	2.46125	3.16975	5.6415	8.15571	26.9
250	2.482	3.177	5.64444	8.364	26.958
285.714	2.486	3.181	5.6715	8.820	27.70
576	2.5	3.1825	5.675	8.8285	27.77778
720	2.51375	3.18475	5.680	8.837	27.845
1.0000 MHz	2.56	3.1885	5.695	8.8455	27.9
1.2288	2.581	3.2035	5.7	8.854	28.728
1.3047	2.604	3.20725	5.70370	8.8625	28.88889
1.455	2.6245	3.2105	5.7105	8.871	28.9
1.689600	2.618	3.2165	5.733333	8.879500	28.93888
1.7	2.62825	3.2175	5.74815	8.888	29.896
1.76375	2.633125	3.2315	5.80741	8.905	29.9
1.77125	2.639	3.23275	5.83704	8.9135	30.0000
1.773125	2.63575	3.2365	5.85185	8.9305	30.9
1.78675	2.64325	3.23775	5.8968	8.939	31.0000
1.80224	2.646	3.2385	5.92593	8.956	31.11111
1.81875	2.647	3.238875	5.95556	9.0265	31.66667
1.845125	2.650750	3.23925	6.00	9.203906	31.9
1.84375	2.6545	3.24	6.155	9.37491	32.0000
1.845625	2.65825	3.24025	6.16296	9.545	32.22222
1.84575	2.660	3.2405	6.210	9.555	32.6
1.846	2.662	3.241	6.22222	9.565	32.9
1.84825	2.66575	3.2425	6.25185	9.585	33.0000
1.84975	2.6695	3.244	6.28146	9.65	33.33333
1.8575	2.677	3.248875	6.31111	9.7	33.9
1.908125	2.68075	3.24925	6.321458	9.75	34.0000
1.925	2.681	3.24975	6.37037	9.8	34.4444
1.925125	2.6845	3.2515	6.380416	9.85	34.44444
1.927	2.68825	3.253625	6.380833	9.9	35.0000
1.932	2.69575	3.255	6.381041	9.934375	35.55555
1.982	2.702	3.256125	6.381666	9.95	36.0000
1.985	2.704	3.258625	6.382291	9.999	36.21750
1.9942	2.71075	3.261	6.382916	10.0000	36.66667
1.995975	2.715	3.261125	6.384166	10.010	37.00000
1.964750	2.716	3.266125	6.384791	10.020	37.2175
2.0000	2.723	3.268625	6.383541	10.021	37.385
2.0285	2.730	3.271125	6.385416	10.040	37.460
2.05975	2.7315	3.273625	6.40000	10.20833	37.77777
2.125	2.73225	3.3	6.427083	10.80375	38.00000
2.126175	2.732625	3.3345	6.42963	11.0000	38.33333
2.12795	2.733	3.4045	6.45	11.13	38.77777
2.1315	2.737	3.4115	6.45926	11.1805	38.77778
2.133275	2.73975	3.4325	6.47	11.228	38.88888
2.13505	2.742125	3.4535	6.4711	11.2375	38.88889
2.136825	2.7425	3.4675	6.48889	11.27	39.00000
2.1425	2.744	3.4815	6.510	11.2995	39.160
2.144625	2.7445	3.5	6.537	11.3565	39.51851
2.14675	2.74475	3.579545	6.567	11.705	39.55555
2.148875	2.746875	3.64	6.57778	11.750	39.592593
2.151	2.751	3.656	6.582	11.755	39.629630
2.153125	2.754	3.80	6.60741	11.805	39.666667
2.15375	2.75525	3.803	6.612	11.855	39.703704
2.155	2.762375	3.805	6.6645	11.905	39.74071
2.15525	2.7735	3.860	6.66667	11.955	39.777778
2.157375	2.776625	3.901	6.673	11.96125	39.81481
2.1595	2.78	3.908	6.693	11.965	39.851852
2.16375	2.790	3.9168	6.7	12.70666	39.88888
2.165875	2.814	4.0000	6.705	12.8666	39.92592
2.170125	2.817	4.011	6.723	12.925	39.962963
2.17225	2.8225	4.126666	6.7305	12.93	40.00000
2.174375	2.835	4.194	6.738	13.102	40.037037
2.1765	2.85	4.26	6.75125	13.2155	40.074074
2.17925	2.854	4.3	6.753	13.2455	40.111111
2.18475	2.854285	4.57	6.7562	13.2745	40.14814
2.18575	2.865	4.6895	6.7605	13.2845	40.18518
2.194125	2.868	4.6965	6.7712	13.2945	40.222222
2.207063	2.8725	4.7	6.77625	13.3045	40.25925
2.208313	2.876875	4.7175	6.68148	13.3145	40.29629
2.209563	2.887	4.7245	6.81482	13.3245	40.33333
2.210812	2.889	4.7315	6.84444	13.3345	40.37037
2.210813	2.894	4.765	6.87407	13.3445	40.407407
2.212063	2.910	4.89	6.880000	13.3545	40.444444
2.214562	2.920	4.90370	6.90370	13.395	40.48148
2.214563	2.925450	4.93333	6.910	14.315	40.51851
2.215625	2.92545	4.96296	6.93333	15.016	40.555556
2.217938	2.931	5.000	6.940	15.020	40.59259
2.21975	2.94375	5.13125	6.96296	15.036	40.62963
2.222125	2.945	5.139585	6.97778	16.39074	40.66666
2.22325	2.94675	5.147917	7.0057	16.39166	40.703704
2.22675	2.952	5.164583	7.17333	16.51111	40.740741
2.22875	2.966	5.21482	7.186666	16.75185	40.77777
2.23725	2.973	5.25926	7.193333	16.965	40.814815
2.2395	2.980	5.30370	7.34350	17.00925	40.85185
2.24075	2.981	5.33333	7.35	17.01018	40.88888
2.241	2.98325	5.34815	7.36296	17.015	40.925926
2.246	2.987	5.348400	7.37778	17.065	40.96296
2.2475	2.9989	5.426636	7.390	17.115	41.00000
2.2925	3.001	5.436636	7.42222	17.165	41.037037
2.2975	3.0235	5.456	7.443	17.215	43.33333
2.30000	3.045	5.4675	7.45850	17.280	45.0000
2.320	2.049	5.4990	7.4615	17.8710	47.48
2.326	2.053	5.5065	7.4685	17.9065	48.50000
2.32625	3.062	5.1111	7.4715	17.9165	49.84166
2.32825	3.067	5.515	7.473	17.9265	49.95
2.3525	3.074	5.5215	7.47850	17.9365	50.0000
2.35256	3.1125	5.52593	7.4815	17.9465	53.45
2.368	3.126	5.544	7.49850	17.9665	57.45
2.374	3.137	5.5515	7.5015	17.975	59.45
2.375	3.13975	5.559	7.62963	17.9735	60.45
2.38725	3.1435	5.5665	7.65926	17.9935	61.95
2.395	3.144	5.574	7.67407	18.290	66.66667
2.396875	3.145	5.5815	7.68889	18.330	70.0000
	3.151	5.58519	7.71852	19.100	72.855
		5.589	7.77778	20.1	75.185

Prices are subject to change. Some items are in limited quantity.

76.66667 MHz
82.75
83.0000
84.0000
90.833
93.1346
93.535
93.9353
94.3
95.35
106.850
146.64
147.09
165.5

Polorad Model 1206
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GHz signal generator
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3N128	$1.00
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MPF102	.45
MPF121	1.00
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AA NICADS
Used/pull out of calculators
79¢ each or $59.00/100

TUNNEL DIODES

TYPE	PRICE
TD261A	$10.00
TD263A	10.00
1N2930	7:65

E.F. Johnson tube socket #122-0275-001
for 3-400Z, 3-500Z, 4-125A, 4-250A, 4-400A
$29.95/pair

2300 MHz CONVERTER KIT

PC board and assembly instructions
$25.00
PC board with 13 chip caps - assembled
$44.50
PC board with all parts for assembly
$79.95
PC board assembled and tested
$119.95

RF TRANSISTORS

TYPE	PRICE						
2N1561	$15.00	2N5184	2.00	MM1552	50.00		
2N1562	15.00	2N5216	47.50	MM1553	56.50		
2N1692	15.00	2N5583	4.43	MM1601	5.50		
2N1693	15.00	2N5589	4.60	MM1602/2N5842	7.50		
2N2857JAN	2.45	2N5590	6.30	MM1607	8.65		
2N2876	12.35	2N5591	10.35	MM1661	15.00		
2N2880	25.00	2N5637	20.70	MM1669	17.50		
2N2927	7.00	2N5641	4.90	MM1943	3.00		
2N2947	17.25	2N5642	8.63	MM2605	3.00		
2N2948	15.50	2N5643	14.38	MM2608	5.00		
2N2949	3.90	2N5645	11.00	MM8006	2.15		
2N2950	5.00	2N5764	27.00	MMCM918	1.00		
2N3287	4.30	2N5842	8.65	MMT72	.61		
2N3294	1.15	2N5849	19.50	MMT74	.94		
2N3301	.75	2N5862	50.00	MMT2857	2.68		
2N3302	1.05	2N5913	3.25	MRF245	31.05		
2N3304	1.48	2N5922	10.00	MRF304	43.45		
2N3307	10.50	2N5942	46.00	MRF420	20.00		
2N3309	3.90	2N5944	7.50	MRF450A	10.35		
2N3553	1.45	2N5945	10.90	MRF476	1.38		
2N3818	6.00	2N5946	13.20	MRF502	.49		
2N3866	1.09	2N6080	5.45	MRF504	6.95		
2N3866JAN	2.70	2N6081	8.60	MRF509	4.90		
2N3866JANTX	4.43	2N6082	9.90	MRF511	8.60		
2N3924	3.20	2N6083	11.80	MRF901	5.00		
2N3925	6.00	2N6084	13.20	MRF5177	20.70		
2N3927	11.50	2N6094	5.75	MRF8004	1.44		
2N3950	26.25	2N6095	10.35	PT3539B	3.00		
2N4072	1.70	2N6096	19.35	PT4186B	3.00		
2N4135	2.00	2N6097	28.00	PT4571A	1.50		
2N4261	14.60	2N6136	18.70	PT4612	5.00		
2N4427	1.09	2N6166	36.80	PT4628	5.00		
2N4429	7.50	2N6265	75.00	PT4640	5.00		
2N4430	20.00	2N6266	100.00	PT8659	10.72		
2N4957	3.50	2N6439	43.45	PT9784	24.30		
2N4958	2.80	BFR90	3.00	PT9790	41.70		
2N4959	2.12	BLY568C	25.00	PT9847	26.40		
2N4976	19.00	BLY568CF	25.00	SD1043	5.00		
2N5090	6.90	HEP76/S3014	4.95	SD1116	3.00		
2N5108	3.90	HEPS3002	11.30	SD1118	5.00		
2N5109	1.55	HEPS3003	29.88	SD1119	3.00		
2N5160	3.34	HEPS3005	9.95	TA7993	75.00		
2N5179	.49	HEPS3006	19.90	TA7994	100.00		
		HEPS3007	24.95	40281	10.90		
		HEPS3010	11.34	40282	11.90		
		HEPS5026	2.56	40290	2.48		
		MM1500	32.20				
		MM1550	10.00				

MHZ ELECTRONIC KITS:

kit #1
Motorola MC14410CP CMOS Tone Generator
CMOS Tone Generator uses 1MHZ crystal to produce standard dual frequency dialing signal. Directly compatible with 12 key Chomeric Touch Tone Pads. Kit includes the following:
1 Motorola MC14410CP Chip
1 PC Board
And all other parts for assembly — **NOW ONLY $15.70**
with 1 MHz crystal — $20.65

Kit #2
Fairchild 95H90DC Prescaler 350MHZ.
95H90DC Prescaler divides by 10 to 350 MHZ. This kit will take any 35MHZ Counter to 350 MHZ. Kit includes the following:
1 Fairchild 95H90DC Chip
1 2N5179 Transistor
2 UG-88/U BNC Connectors
1 PC Board
And all other parts for assembly. — **NOW ONLY $24.95**
Less 95H90 chip — $10.95

FAIRCHILD VHF AND UHF PRESCALER CHIPS

95H90DC	350MHZ Prescaler Divide by 10/11	$ 9.50
95H91DC	350MHZ Prescaler Divide by 5/6	8.95
11C90DC	650MHZ Prescaler Divide by 10/11	16.50
11C91DC	650MHZ Prescaler Divide by 5/6	15.95
11C83DC	1GHZ Divide by 248/256 Prescaler	29.90
11C70DC	600MHZ Flip/Flop with reset	12.30
11C58DC	ECL VCM	4.53
11C44DC	Phase Frequency Detector (MC4044P/L)	3.82
11C24DC	Dual TTL VCM (MC4024P/L)	3.82
11C06DC	UHF Prescaler 750MHZ D Type Flip/Flop	12.30
11C05DC	1GHZ Counter Divide by 4	74.35
11C01FC	High Speed Dual 5-4 Input NO/NOR Gate	15.40

CRYSTAL FILTERS: Tyco 001-19880 same as 2194F
10.7MHZ Narrow Band Crystal Filter
3 db bandwidth 15khz minimum 20 db bandwidth 60khz minimum 40 db bandwidth 150khz minimum. Ultimate 50 db: Insertion loss 1.0db Max. Ripple 1.0db Max. Ct. 0 + – 5pf. Rt. 3600 Ohms.
NOW ONLY $5.95

TUBES

2E26	$5.00	4X150G	70.00
3-500Z	90.00	100TH	144.00
3-1000Z	225.00	572B	39.00
3B28	5.00	811A	12.95
3X2500A3	150.00	813	29.00
4.65A	54.50	5894	39.00
4-125A	68.75	6146A	5.25
4-250A	80.00	6146B	6.25
4-400A	81.50	6159	10.60
4-1000A	255.00	6293	18.50
5-500A	145.00	6360	7.95
4CX250B	38.50	6907	35.00
4CX250F	53.50	6939	9.95
4CX250G	53.50	7360	10.60
4CX250K	72.00	7984	10.40
4CX250R	48.00	8072	45.00
4CX350A	60.00	8156	7.85
4CX350FJ	70.00	8226	127.70
4CX1000A	289.00	8295A/PL172	328.00
4CX1500B	285.00	8458	25.75
4CX15000A	400.00	8560AS	50.00
4X150A	37.00	8950	5.95

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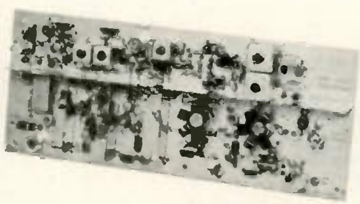
GET ON PHASE THREE FOR MUCH LESS THAN YOU THINK!

These Low Cost SSB TRANSMITTING CONVERTERS

Let you use inexpensive recycled 10M or 2M SSB exciters on UHF & VHF!

- Linear Converters for SSB, CW, FM, etc.
- A fraction of the price of other units; no need to spend $300 – $400!
- Use with any exciter; works with input levels as low as 1 mW.
- Use low power tap on exciter or simple resistor attenuator pad (instructions included).
- Link osc with RX converter for transceive.

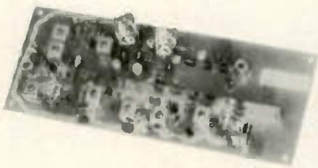


HAMTRONICS DOES IT AGAIN!

NEW XV4 UHF KIT – ONLY $99.95

28-30 MHz in, 435-437 MHz out; 1W p.e.p. on ssb, up to 1½W on CW or FM. Has second oscillator for other ranges. Atten. supplied for 1 to 500 mW input, use external attenuator for higher levels.

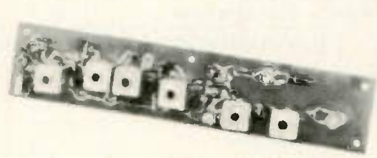
Extra crystal for 432-434 MHz range $5.95



XV2 VHF KIT - ONLY $69.95

2W p.e.p. output with as little as 1mW Input. Use simple external attenuator. Many freq. ranges available.

MODEL	INPUT (MHz)	OUTPUT (MHz)
XV2-1	28-30	50-52
XV2-2	28-30	220-222
XV2-4	28-30	144-146
XV2-5	28-29 (27-27.4 CB)	145-146 (144-144.4)
XV2-7	144-146	50-52



XV28 2M ADAPTER KIT - $24.95

Converts any 2M exciter to provide the 10M signal required to drive above 220 or 435 MHz units.

Easy to Build FET RECEIVING CONVERTERS

Let you receive OSCAR and other exciting VHF and UHF signals on your present HF or 2M receiver

VHF KIT STILL ONLY $34.95

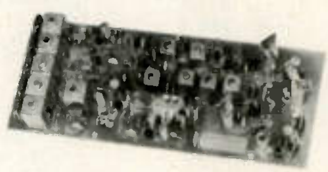
MODEL	RF RANGE	OUTPUT RANGE
C28	28-32 MHz	144-148 MHz
C50	50-52	28-30
C50-2	50-54	144-148
C144	144-146	28-30
C145	145-147	28-30
or	144-144.4	27-27.4 (CB)
C146	146-148	28-30
C220	220-222	28-30
C220-2	220-224	144-148
C110 (less xtal)	Any 2MHz of Aircraft Band	26-28 or 28-30

UHF KIT ONLY $34.95

MODEL	RF RANGE	OUTPUT RANGE
C432-2	432-434	28-30
C432-5	435-437	28-30
C432-4	432-436	144-148
C432-9	439.25	61.25

Professional Quality VHF/UHF FM/CW EXCITERS

- Fully shielded designs
- Double tuned circuits for spurious suppression
- Easy to align with built-in test aids



T50-50	6-chan, 6M, 2W Kit	$49.95
T50-150	6-chan, 2M, 2W Kit	$49.95
T50-220	6-chan, 220 MHz, 1½W Kit	$49.95
T450	1-chan, 450 MHz, 1W Kit	$49.95

See our Complete Line of VHF & UHF Linear PA's

- Use as linear or class C PA
- For use with SSB Xmtg Converters, FM Exciters, etc.

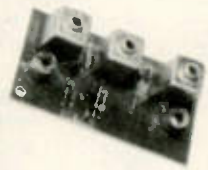
LPA 2-15 VHF PA, 2W in/15-20W out. Solid-state t/r switching. Kit $59.95

LPA 2-45 VHF PA, 2W in/40-45W out. Can also be used with 8-10W drive. Kit $109.95

LPA 4-10 UHF PA, ½W-1W in/8-10W out. Kit $79.95

FAMOUS HAMTRONICS PREAMPS

Let you hear the weak ones too! Great for OSCAR, SSB, FM, ATV. Over 14,000 in use throughout the world on all types of receivers.



P9 Kit $12.95
P14 Wired $24.95
Specify band when ordering

- Deluxe vhf model for applications where space permits ● 1½" x 3" ● Models available to cover any 4MHz band in the 26 to 230 MHz range ● 12 Vdc ● 2 stages ● Ideal for OSCAR ● 20 dB gain

P8 Kit $10.95
Specify band when ordering

- Miniature vhf model for tight spaces–size only ½ x 2 ⅜
- Models available to cover any 4MHz band in the range 20 to 230 MHz ● 20 dB gain ● 12 Vdc

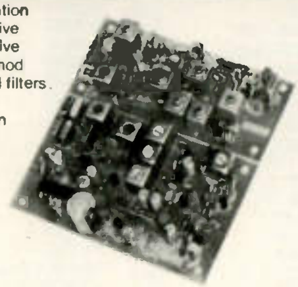
P15 Kit $18.95
P35 Wired $34.95

- Covers any 6 MHz band in UHF range of 380 to 520 MHz ● 20 dB gain ● 2 stages ● 12 Vdc

NEW VHF/UHF FM RCVRS

Offer Unprecedented Range of Selectivity Options

- New generation
- More sensitive
- More selective
- Low cross mod
- Uses crystal filters
- Smaller
- Easy to align



R75A* VHF Kit for monitor or weather sattelite service. Uses wide L-C filter. -60dB at ± 30 kHz $69.95

R75B* VHF Kit for normal nbfm service. Equivalent to most transceivers. -60dB at ± 17 kHz, -80dB at ± 25 kHz ... $74.95

R75C* VHF Kit for repeater service or high rf density area. -60dB at ±14kHz, -80dB ±22kHz, -100dB ±30kHz $84.95

R75D* VHF Kit for split channel operation or repeater in high density area. Uses 8-pole crystal filter. -60dB at ±9 kHz, -100dB at ± 15 kHz. The ultimate receiver! ... $99.95

* Specify band: 10M, 6M, 2M, or 220 MHz. May also be used for adjacent commercial bands. Use 2M version for 137 MHz WX satellites.

R85( ) UHF FM Receiver Kits, triple conversion, include C432 UHF Front End Module. Add $20 to above prices. (Add selectivity letter to model number.)

A13-45A 6-Channel Adapter for receivers $13.95

IT'S EASY TO ORDER!

- Write or phone 716-392-9430 (Electronic answering service evenings & weekends)
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FREQUENCY COUNTER KIT

Outstanding Performance

Incredible Price $89^{95}

CT-50

The CT-50 is a versatile and precision frequency counter which will measure frequencies to 60 mHz and up to 600 mHz with the CT-600 option. Large Scale Integration, CMOS circuitry and solid state display technology have enabled this counter to match performance found in units selling for over three times as much. Low power consumption (typically 300-400 ma) makes the CT-50 ideal for portable battery operation. Features of the CT-50 include: large 8 digit LED display, RF shielded all metal case, easy pushbutton operation, automatic decimal point, fully socketed IC chips and input protection to 50 volts to insure against accidental burnout or overload. And, the best feature of all is the easy assembly. Clear, step by step instructions guide you to a finished unit you can rely on. **Order your today!**

SPECIFICATIONS:
Frequency range: 6 Hz to 65 mHz, 600 mHz with CT-600
Resolution: 10 Hz @ 0.1 sec gate, 1 Hz @ 1 sec gate
Readout: 8 digit, 0.4" high LED, direct readout in mHz
Accuracy: adjustable to 0.5 ppm
Stability: 2.0 ppm over 10° to 40° C, temperature compensated
Input: BNC, 1 megohm/20 pf direct, 50 ohm with CT-600
Overload: 50VAC maximum, all modes
Sensitivity: less than 25 mv to 65 mHz, 50-150 mv to 600 mHz
Power: 110 VAC 5 Watts or 12VDC @ 400 ma
Size: 6" x 4" x 2", high quality aluminum case, 2 lbs
ICS: 13 units, all socketed

CT-50, 60 mHz counter kit	$89.95
CT-50WT, 60 mHz counter, wired and tested	159.95
CT-600, 600 mHz scaler option, add	29.95
CB-1, Color TV calibrator-stabilizer	$14.95
DP-1, DC probe, general purpose probe	12.95
HP-1, High impedance probe, non-loadir	15.95

CAR CLOCK

The UN-KIT, only 5 solder connections

Here's a super looking, rugged and accurate auto clock, which is a snap to build and install. Clock movement is completely assembled—you only solder 3 wires and 2 switches, takes about 15 minutes! Display is bright green with automatic brightness control photocell—assures you of a highly readable display, day or night. Comes in a satin finish anodized aluminum case which can be attached 5 different ways using 2 sided tape. Choice of silver, black or gold case (specify).

DC-3 kit, 12 hour format	$22.95
DC-3 wired and tested	$29.95
110V AC adapter	$5.95

Under dash car clock

12/24 hour clock in a beautiful plastic case features: 6 jumbo RED LEDS, high accuracy (1 min/mo.), easy 3 wire hookup, display blanks with ignition, and super instructions. Optional dimmer automatically adjusts display to ambient light level.

DC-11 clock with mtg. bracket	$27.95
DM-1 dimmer adapter	2.50

PRESCALER

Extend the range of your counter to 600 mHz. Works with any counter. Includes 2 transistor pre-amp to give super sens, typically 20 mv at 150 mHz. Specify ÷ 10 or ÷ 100 ratio.

PS-1B, 600 mHz prescaler	$59.95
PS-1BK, 600 mHz prescaler kit	49.95

OP-AMP SPECIAL

741 mini dip	12/$2.00
BI-FET mini dip, 741 type	10/$2.00

VIDEO TERMINAL

A completely self-contained, stand alone video terminal card. Requires only an ASCII keyboard and TV set to become a complete terminal unit. Two units available, common features are: single 5V supply, XTAL controlled sync and baud rates (to 9600), complete computer and keyboard control of cursor. Parity error control and display. Accepts and generates serial ASCII plus parallel keyboard input. The 3216 is 32 char. by 16 lines, 2 pages with memory dump feature. The 6416 is 64 char. by 16 lines, with scrolling, upper and lower case (optional) and has RS-232 and 20ma loop interfaces on board. Kits include sockets and complete documentation.

RE 3216, terminal card	$149.95
RE 6416, terminal card	189.95
Lower Case option, 6416 only	13.95
Power Supply Kit	14.95
Video/RF Modulator, VD-1	6.95
Assembled, tested units, add	60.00

CALENDAR ALARM CLOCK

The clock that's got it all. 6- 5" LEDs, 12/24 hour, snooze, 24 hour alarm, 4 year calendar, battery backup, and lots more. The super 7001 chip is used. Size: 5x4x2 inches.
Complete kit, less case (not available)
DC-9 $34.95

30 Watt 2 mtr PWR AMP

Simple Class C power amp features 8 times power gain. 1 W in for 8 out, 2 in for 15 out, 4 W in for 30 out. Max output of 35 W. Incredible value, complete with all parts, less case and T-R relay.

PA-1, 30 W pwr amp kit	$22.95
TR-1, RF sensed T-R relay kit	6.95

FM MINI MIKE KIT

A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electret mike. Kit includes case, mike, on-off switch, antenna, battery and super instructions. This is the finest unit available.

FM-3 kit	$12.95
FM-3 wired and tested	16.95

CLOCK KITS

**our Best Seller
your Best Deal**

Try your hand at building the finest looking clock on the market. Its satin finish anodized aluminum case looks great anywhere, while six .4" LED digits provide a highly readable display. This is a complete kit, no extras needed, and it only takes 1-2 hours to assemble. Your choice of case colors: silver, gold, bronze, black, blue (specify).

Clock kit, 12/24 hour, DC-5	$22.95
Clock with 10 min. ID timer, 12/24 hour, DC-10	27.95
Alarm clock, 12 hour only, DC-8	24.95
12V DC car clock, DC-7	27.95

For wired and tested clocks add $10.00 to kit price.

Hard to find PARTS

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324	1.50	723	.50
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556	.85	7905	1.25
566	1.15	7812	.85
567	1.25	7912	1.25
1458	.50	7815	.85
3900	.50	**TTL ICs**	
CMOS ICs		74S00	.35
4011	.20	7447	.65
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4049	.40	74196TI	1.35
4518	1.25	**SPECIAL ICs**	
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24 pin	4/2.00	**FERRITE BEADS**	
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40 pin	3/2.00	6 hole balun	5/1.00

Ramsey's famous MINI-KITS

FM WIRELESS MIKE KIT

Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added sensitive mike preamp stage.
FM-1 kit $2.95 FM-2 kit $4.95

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Converts any TV to video monitor. Super stable, tunable over ch. 4-6. Runs on 5-15V, accepts std. video signal. Best unit on the market!
Complete kit, VD-1 $6.95

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A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2 W rms output, runs on 6 to 15 volts, uses 8-45 ohm speaker.
Complete kit, BN-9 $5.95

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See music come alive! 3 different lights flicker with music. One light for lows, one for the mid-range and one for the highs. Each channel individually adjustable, and drives up to 300W. Great for parties, band music, nite clubs and more.
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A complete tone decoder on a single PC board. Features: 400-5000 Hz adjustable range via 20 turn pot, voltage regulation, 567 IC. Useful for touch-tone decoding, tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts.
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POWER SUPPLY KIT

Complete triple regulated power supply provides variable 6 to 18 volts at 200 ma and + 5V at 1 Amp. Excellent load regulation, good filtering and small size. Less transformers, requires 6.3V @ 1 A and 24 VCT.
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An interesting kit, small mike picks up sounds and converts them to light. The louder the sound the brighter the light. Completely self-contained, includes mike, runs on 110VAC, controls up to 300 watts.
Complete kit, WL-1 $6.95

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Produces upward and downward wail characteristic of a police siren. 5 W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker.
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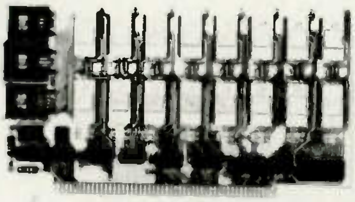
16K EPROM CARD-S 100 BUSS



$59.95 KIT

OUR BEST SELLING KIT!

USES 2708's!

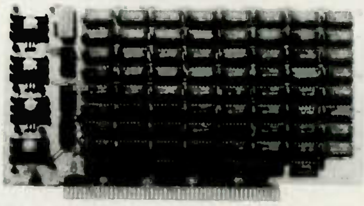
Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. All parts (except 2708's) are included. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450NS 2708'S ARE $8.95 EA. WITH PURCHASE OF KIT

ASSEMBLED AND FULLY TESTED ADD $25

8K LOW POWER RAM KIT-S 100 BUSS

SALE



PRICE CUT!

$119.50 KIT

(450 NS RAMS!)

Thousands of computer systems rely on this rugged, work horse, RAM board. Designed for error-free, NO HASSLE, systems use.

KIT FEATURES:

1. Doubled sided PC Board with solder mask and silk screen layout. Gold plated contact fingers.
2. All sockets included.
3. Fully buffered on all address and data lines.
4. Phantom is jumper selectable to pin 67.
5. FOUR 7805 regulators are provided on card.

Blank PC Board w/Documentation $29.95
Low Profile Socket Set...13.50
Support IC's (TTL & Regulators) $9.75
Bypass CAP's (Disc & Tantalums) $4.50

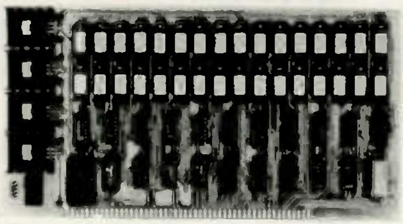
ASSEMBLED AND FULLY BURNED IN ADD $30

16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

$279 KIT

FOR 250NS ADD $10



FULLY STATIC, AT DYNAMIC PRICES

WHY THE 2114 RAM CHIP?

We feel the 2114 will be the next industry standard RAM chip (like the 2102 was). This means price, availability, and quality will all be good! Next, the 2114 is FULLY STATIC! We feel this is the **ONLY** way to go on the S-100 Buss! We've all heard the HORROR stories about some Dynamic Ram Boards having trouble with DMA and FLOPPY DISC DRIVES. Who needs these kinds of problems? And finally, even among other 4K Static RAM's the 2114 stands out! Not all 4K static Rams are created equal! Some of the other 4K's have **clocked** chip enable lines and various timing windows **just as critical** as Dynamic RAM's. Some of our competitor's 16K boards use these "tricky" devices. But not us! The 2114 is the ONLY logical choice for a trouble-free, straightforward design.

KIT FEATURES:

1. Addressable as four separate 4K Blocks
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 2 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA—$33
LOW PROFILE SOCKET SET—$12
ASSEMBLED & TESTED—ADD $30
SUPPORT IC'S & CAPS—$19.95

16K STATIC RAM SS-50 BUSS

PRICE CUT!

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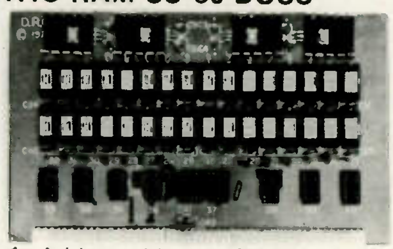

FULLY STATIC AT DYNAMIC PRICES

KIT FEATURES:

1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Runs at Full Speed
4. Double sided PC Board. Solder mask and silk screened layout. Gold fingers.
5. All Parts and Sockets included
6. Low Power: Under 2 Amps Typical

FOR SWTPC 6800 BUSS!

ASSEMBLED AND TESTED - $30

BLANK PC BOARD—$33
COMPLETE SOCKET SET—$12
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S-100 Z80 CPU CARD

ASSEMBLED AND TESTED! READY TO USE! Over 3 years of design efforts were required to produce a **TRUE** S-100 Z80 CPU at a genuinely bargain price! **4 MHZ! $159.95**

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* 2 or 4 MHZ Operation.
* Generates MWRITE, so no front panel required.
* Jump on reset capability
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Perfect For OEM's

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These are the most sought after 2114's, LOW POWER and 250NS FAST.
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ALSO SAME AS T2300D.

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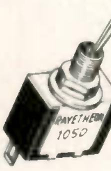

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CLOCK MODULE OPTIONS
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Switches and pot for all options.
Includes:
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Alarm Parts (including high impedence transducer). Much more efficient than a speaker. — $1.50

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16K X 1 Bits. 16 Pin Package. Same as Mostek 4116-4. 250 NS access. 410 NS cycle time. Our best price yet for this state of the art RAM. 32K and 64K RAM boards using this chip are readily available. These are new fully guaranteed devices by a major mfg.

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#STK-054. 23 WATTS SUPER CLEAN AUDIO. 20 HZ to 100 KHZ ± 2 DB. HYBRID, SILICON, SELF-CONTAINED MODULE. ONLY 1¾ x 2½ IN. WITH DATA.

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Uses MM5369 CMOS divider IC with high accuracy 3.579545 MHZ Crystal. Use with all MOS Clock Chips or Modules. Draws only 1.5 MA. All parts, data and PC Board included. 100 Hz, same as above, except $5.95.

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"COLOSSUS JR." JUMBO CLOCK MODULE

MA1013 BRAND NEW!

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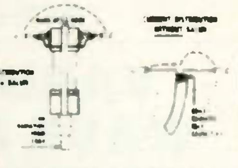

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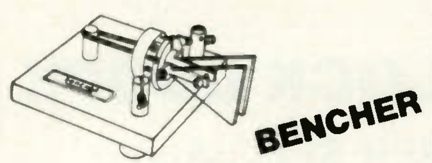

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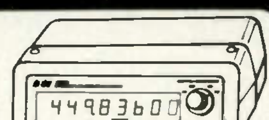

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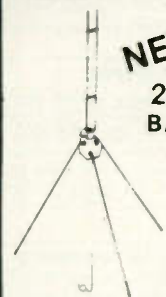

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ARX2K Adapts 2M Ringo to Ranger . 16.95 b
A147-4 4 ele 2M FM beam ant . . . . . . 24.95 b
A147-11 11 ele 2M FM beam . . . . 36.95 c
A147-20T 10 ele 2M vert/horz twist . . . 62.95 d
A144-7 7 ele 2M CW/SSB beam . . . . . . 26.95 c
A144-11 11 ele 2M CW/SSB beam . . . . 36.95 d
A144-10T 10 ele Twist OSCAR ant . . . 42.95 c
A144-20T 20 ele Twist OSCAR ant . . . 62.95 d
A220-7 7 ele 220MHz beam . . . . 26.95 c
A220-11 11 ele 220MHz beam . . . . 34.95 c
A449-6 6 ele UHF FM beam . . . . 24.95 c
A449-11 11 ele UHF beam . . . . 34.95 c
A432-11 11el 432MHz SSB/CW beam 34.95 c
AFM4D 144-148MHz Four Pole . . . . . . 69.95 c
AFM24D 220MHz Four Pole . . . . 64.95 c
AFM44D 435-450MHz Four Pole . . . . . 64.95 c
ASQ-2 2M Squalo horiz ant . . . . 19.95 b
LAC-1 Coax lightning arrester . . . . 4.95 a
LAC2- Coax lightning arrester . . . . 4.95 a
ATB34 ★ 4 ele 20-10mtr beam . . . . . 219.95 ★
ATV3 20-10mtr trap vertical . . . . 49.95 e
ATV4 40-10mtr trap vertical . . . . 69.95 e
ATV5 80-10mtr trap vertical . . . . 89.95 e
A50-3 3 element 6 meter beam . . . . . . 39.95 d
A50-5 5 element 6 meter beam . . . . . . 59.95 e
A28-3 ★ 3 element 10 meter beam . . 69.95 ★
A432-20T 432MHz 20 ele twist . . . . 59.95 d

AVERAGE SHIPPING COST GUIDE

(Continental U.S.) Items sent UPS whenever possible.

Please estimate the shipping charges for your order. Any excess payment over 25c will be refunded or credited. Underpayment will be billed or sent collect. For insurance add 25c for each $100.00 value over the first $100.00.

	W/K CALL AREA			
WEIGHT	1,2,3,4,5	6,7	8,0	9
1 lb	.90	1.00	.90	.85
5 lbs	1.50	2.00	1.35	1.20
10 lbs	2.26	3.20	1.95	1.70
20 lbs	3.80	5.80	3.20	2.60
30 lbs	5.30	8.05	4.40	3.50
50 lbs	8.40	12.90	6.80	5.35

ESTIMATED WEIGHT CODING

After the price of each item you will find a letter, i.e., 19.95 a. To make it easier to figure shipping costs, these letters indicate the approximate weight of the item as follows:

a. Less than 1 lb
b. 1-3 lbs
c. 4-6 lbs
d. 7-10 lbs
e. 10-20 lbs
f. 20-30 lbs
g. 30-40 lbs
h. 40-50 lbs

NOTE: INTERNATIONAL ORDERS write for Proforma Invoice. ITEMS MARKED ★ will be sent truck collect.

2M BASE ANT. PACKAGE

Here's what you get:

- Cushcraft AR2 Ringo South River.
- PFM71 Roof mount.
- A125-5P 5' alum mast.
- Lag bolts.
- 50' 8U foam coax.
- PL259 coax conn.

$59.95

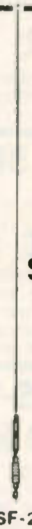
Wt. 16 lbs.

FINCO

The most rugged 6 & 2 meter beams we've seen yet!!

A 2-10 10 ele, 2M beam . . . . $44.95 d
A 2-5 5 ele, 2M beam, 9.5db gain . . . . . 27.95 c
A 2-2 10 ele, 2M dual polarization . . . . 46.50 e
A62 6&2M antenna on one boom . . . . 74.95 e
A6-5 5 element 6M beam, 11db . . . . . . 46.50 e
A6-3 3 ele 6M beam, 7db gain . . . . 30.00 d
A 1¼ 220MHz 10 ele, 13.8db . . . . 32.95 d

HUSTLER



$9.95 "BUCK-BUSTER" SF-2 ANTENNA

Fits all Hustler deluxe mobile mounts. 3/8"x24 base. 5/8" wave two meters, 3.4 db gain. SWR at resonance adj. to 1.5:1 or better. Bandwidth 6 MHz, 2:1 or better SWR. 100 watts max.

$79.95 NEW 4-BTV VERTICAL

One setting covers 10, 15, 20, 40M. Space restricted or unlimited, you get top signal reports, consistent contacts and complete coverage. Add 5th band with a 75M resonator. Use one feedline, any length. Requires no switching or matching devices. 15 lbs.

SF-2 4-BTV

MO1 Mobile mast . . . . $22.95 c
MO2 Mobile mast . . . . 22.95 c
RM10 10 Meter resonator . . . . 6.95 b
RM15 15 meter resonator . . . . 7.95 b
RM20 20 Meter resonator . . . . 8.95 b
RM40 40 Meter resonator . . . . 14.95 b
RM75 75 Meter resonator . . . . 16.95 b
RM80 80 Meter resonator . . . . 17.95 b
RM10S 10M resonator 2KW PEP . . . . 11.95 b
RM15S 15M resonator 2KW PEP . . . . 12.95 b
RM20S 20M resonator 2KW PEP . . . . 13.95 b
RM40S 40M resonator 2KW PEP . . . . 16.95 b
RM75S 75M resonator 2KW PEP . . . . 31.95 b
RM80S 80M resonator 2KW PEP . . . . 31.95 b
CG144 5.2db 2mtr ant 3/8 x 24 stud . . . 26.95 b
CGT144 Same but trunk lip mount . . . 42.95 c
SF2 3db 2mtr ant 3/8 x 24 stud . . . . . . 9.95 b
SF220 3db 220MHz ant 3/8 x24 stud . . 11.95 b
4BTV 40-10mtr vertical . . . . 79.95 e
G6-144 2mtr base ant 6db . . . . 79.95 d
BM1 Bumper mount 3/8 x 24 thread . . . 15.95 d
RSS2 Mobile resonator spring . . . . 5.95 a
QD1 Quick disconnect 3/8 x 24 . . . . . . 16.95 a

hy-gain

VERTICAL ANTENNAS

Model 14AVQ/WB — SAVE $10.00! List $69.95

- 40 thru 10 meters
- Wide band performance
- New Hy-Q traps

Self-supporting, automatic band switching vertical antenna. Omni-directional performance. Favorable L/C ratio. High-Q. True ¼ wave resonance on all bands. Low angle radiation pattern. Taper swagged seamless aluminum construction. 12" double-grip mast bracket. Full circumference compression clamps at tubing joints. Weight: 8.2 lbs.

Model 14AVQ/WB 59.95

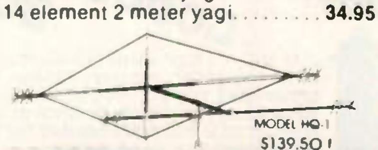
Model 18AVT/WB — SAVE $18.00 list $105.00

- Automatic band switching
- Completely Self-Supporting
- Omni-Directional Performance

Three beefed-up Hy-Q traps permit automatic switching 5 band capability. Favorable L/C ratio. Top loading coil. Across the band performance with one furnished setting for each band (10 thru 40). True ¼ wave resonance on all bands. SWR of 2:1 or less at band edges. Low angle radiation pattern. Extra heavy duty tapered swaged seamless aluminum tubing with full circumference, corrosion resistant compression clamps at tubing joints. Antenna can be mounted without guide wires. 25' high. Weight: 10.7 lbs.

Model 18 AVT/WB 87.00

BN86 Ferrite balun for 80-10mtrs . . . $15.95 a
155 Center insulator for doublet . . . . . . 5.95 a
156 End insul. for doublet (pair) . . . . . . 3.95 a
18HT ★ HyTower 80-10M vertical . . 289.95 ★
18V Economy 80 tru 10M vertical . . . . 29.95 c
12AVQ 20-10mtr trap vertical . . . . 39.95 c
14AVQ 40-10mtr trap vertical . . . . 59.95 d
18AVT/WB 80-10mtr trap vertical . . . . 87.00 d
2BDQ Trap doublet for 80 & 40mtr . . . 49.95 d
5BDQ Trap doublet for 80-10mtrs . . . . 89.95 e
TH3 MkIII ★ 3 ele 20-10 tribander . . 189.95 ★
TH6DXX ★ 6 ele 20-10M tribander . . 264.95 ★
TH3 Jr 3 ele tribander (750W PEP) . . 149.95 e
HY QUAD ★ 2 ele quad 20-10 mtrs . . 229.95 ★
103BA 3 element 10Mtr beam . . . . 64.95 e
153BA ★ 3 element 15mtr beam . . . . . 79.95 e
204BA ★ 4 element 20mtr beam . . . 214.95 ★
402BA ★ 2 element 40 mtr beam . . . 204.95 ★
64B ★ 4 element 6 meter beam . . . . . 49.95 b
270 6db fiberglass 2M antenna . . . . . . 49.95 b
203 3 element 2 meter yagi . . . . 21.95 b
205 5 element 2 meter yagi . . . . 17.95 c
208 8 element 2 meter yagi . . . . 29.95 c
214 14 element 2 meter yagi . . . . 34.95 d



MODEL HQ-1
$139.50 !

CRAMPED FOR SPACE?

Mini-Products, Inc.

Then you want the antenna that's known around the world for its small size and superior performance . . . The Multiband HYBRID QUAD for 6-10-15 & 20 meters

- WING SPAN-11 FT.
- BOOM-54 INCHES LONG
- WIND AREA-1.5 SQ. FT.
- 1200 WATTS P.E.P. INPUT TO FINAL
- FEED LINE-50 OHMS

MFJ

GIVE US A TRY ON YOUR MFJ NEEDS. MANY TIMES WE CAN GIVE QUICKER DELIVERY THAN WHEN YOU ORDER DIRECT.

Reader Service—see page 259

prime products at popular prices

MA1003 CLOCK MODULE $16.50

MATCHING CASE $5.95
SPECIAL! CLOCK & CASE COMBINATION $19.95

Here is a clock module designed specifically for mobile applications. No external timebase necessary; a built-in timebase, accurate to .01%, provides the timing accuracy you need. We don't use wash-out prone LED displays, either; instead, you get blue/green flourescent readouts that are as beautiful as they are readable. No time consuming, tedious assembly; just add two time setting switches, attach 12V DC, and you're ready to go (order our matching case mentioned below for a truly professional look). Additionally, our applications sheet tells you how to take maximum advantage of this module in mobile situations, including how to hook up the display so that it dims at night, and blanks to conserve power when the ignition is off.

Also available: Matching case with mounting hardware, and an optical filter that brings out the best in the clock readouts, for $5.95.

This clock is not only an excellent addition to your car, van, boat or home, but also makes a great gift. Order now — you'll have it ready to go in plenty of time for holiday giving.

12 VOLT, 8 AMP POWER SUPPLY KIT $44.50

The original hefty 12V supply, and still going strong . . . one look at the specs will tell you why this has been our longest-running kit. Handles 8A continuous, and 12A (!) with a 50% duty cycle. Features foldback current limiting, crowbar overvoltage protection, RF suppression, adjustable output 11-14V, heavy-duty custom wound transformer, and much more.

Applications? This supply powers mobile transceivers (ham or CB) in the home, as well as other automotive/home accessories (tape players, radios, TVs, etc.). It also makes an excellent bench supply, or can power bunches of floppy disc drives.

Assembly is about as simple as we can make it: All parts, except for transformer/power diodes/filter capacitors mount directly on the circuit board — including power transistors and heat sinks.

This supply is available from stock. Please include extra postage for this kit, as the transformer adds quite a bit of shipping weight.

NEW! The Godbout Box is here!

At last — a high quality, industrial grade home for your computer. Includes power supply. Use for either desk or rack mount. Check your local computer store for details, or write us direct . . . this is a product that has been needed for a long time, and we're filling that need in style.

TERMS: Cal res add tax. Allow 5% for shipping, excess refunded. VISA®/Mastercharge® call our 24 hour order desk at (415) 562-0636. COD OK with street address for UPS. Prices good through cover month of magazine. Thanks for your business!

GODBOUT

GODBOUT ELECTRONICS
Bldg. 725, Oakland Airport, CA 94614

FREE CATALOG: This ad is way too small to tell you all the things you need to know about our products, and why we feel they're second to none in the business. Send for our free catalog today.

✓ G4

NEW S-100 COMPUTER PRODUCTS!

S-100 machines are flexible, professional level systems that are easy to upgrade, modify, and adapt to specific applications. Over the years the S-100 buss has proven to be the ideal choice for commercial, industrial, and scientific applications.

We're expanding the options for S-100 systems by using the experience we've acquired in the past, mixing in the best technology offered by the present, and building products for the future . . . products that meet, and often exceed, the demands of the new wave of S-100 professional users. For example . . .

NEW! HIGH-PERFORMANCE S-100 MOTHERBOARDS

19 slot: $174 unkit*, $214 assm
12 slot: $129 unkit*, $169 assm
6 slot: $89 unkit*, $129 assm

*"Unkits" have edge connectors and termination resistors pre-soldered in place for easy assembly.

These 3rd generation motherboards are shielded, terminated, and designed to work with the latest 5 and 10 MHz CPUs coming on line. Fits in Godbout, Vector, IMSAI, TEI, and similar enclosures. These high quality products are a welcome addition to any system — or the start of a great one.

2S "Interfacer" S-100 I/O Board
$189 unkit, $249 assm, $324 CSC**

Dual serial port with 2 full duplex parallel ports for RS-232 handshake. Crystal timebase, Baud rates up to 19.2 KBaud selectable for each port, much more.

NEW! 3P + S "Interfacer II" S-100 I/O Board
$189 unkit, $249 assm, $324 CSC**

Incorporates 1 channel of serial I/O (with all the features of a port from the 2S "Interfacer"), along with 3 full duplex parallel ports with attention/enable/strobe bits for each parallel port and individual interrupts. The versatility of each port contributes to a very versatile, and extremely flexible, I/O board.

NEW! S-100 "Memory Manager" Board $59 kit, $85 assm, $100 CSC**

Add bank select and extended addressing to older S-100 machines — boost memory capacity beyond 64K, up to ½ megabyte! Use our new extended addressing memory boards, or retrofit existing memories that have phantom or extra qualifier lines.

NEW FOR THE H8

The latest in add-on memory: **16K Econoram XV-16** and **32K Econoram XV-32**. Both are fully static, high density/low power boards, designed from the ground up for full electrical and mechanical compatibility with the Heath H8 computer. They feature full buffering, sockets for all ICs, excellent thermal design, and a bank select option for implementing memory systems greater than 64K. 1 year limited warranty. If you've been looking for dense, cost-effective memory for the H8 . . . you don't have to look any longer.

Econoram XV-16 $329 unkit*, **$395** assm and tested
Econoram XV-32 $599 unkit*, **$729** assm and tested

*Sockets and bypass caps are pre-soldered in place for easy assembly.
"Econoram" is a trademark of **Godbout Electronics**.

Season's Greetings and a Happy New Year!

WE'RE BACK WITH OUR WORLD FAMOUS INFLATION FIGHTIN'

'ONE CENTERS"

Only $14.99 2 FOR $15
DIAL DESK TELEPHONE
Cat. No. 92CU5653

HY - GAIN ONE ARM BANDIT MIKES

Only $14.99 2 FOR $15

Take one hand command of your mobile or base rig with Hy-Gain's One Arm Bandit Mike. ON/OFF, VOLUME, SQUELCH, CHANNEL SELECTOR, SPEAKER, and DIGITAL DISPLAY are all conveniently located where your fingers do the talking. Comes with 6 ft. multi-conductor, color coded, coiled cable, (separate) for easy integration into any type of rig. Size: 4½" x 2½" x 1⅛". Wt. 9 oz. No. 92CU5886

40 CHANNEL CB BOARD

$12.50 WITH SWITCH 2 FOR $12.51

Poly Paks buys up factory close-out from Hy-Gain ... so you gain! Boards have Heatsinked 9 Watt Amp Chip, RF and Mod. Transistors, and Motorola MC series PLL. May be used for 10 meter conversion, (see continuing series "CB to 10" in 73 magazine). The parts alone make it an offer you can't refuse. Wt. 9 oz Cat. No. 92CU5554

LEDS! LEDS! LEDS!

YOUR CHOICE 5 for $1.29
1¢ SALE 10 for $1.30

Cat. No.	Type
1788	MICRO TOPHAT RED
1802	MICRO SINGLE PIN RED
1948	MICRO YELLOW
2135	JUMBO RED
2136	JUMBO TAPER RED
2137	MICRO RED
1944	Jumbo Yellow
2138	Jumbo Green

6 AMP EPOXY "BULLET" RECTIFIERS

Order by Cat. No. 92CU6095 and Voltage

PRV	PRICE	SALE
50	$.39	2 for .40
100	.49	2 for .50
200	.59	2 for .60
400	.69	2 for .70
600	.79	2 for .80
800	.99	2 for 1.00

25 AMP BRIDGE RECTIFIERS

PIV	SALE	2 FOR
☐ 25	1.25	1.26
☐ 50	1.95	1.96
☐ 100	2.25	2.26
☐ 200	2.95	2.96
☐ 400	3.50	3.51
☐ 600	4.25	4.26
☐ 800	4.95	4.96

Order No. 2273 & voltage

sorry, no choosing

ULTRASONIC TRANSDUCER

$3.98 2 for $3.99

Perfect for dozens of projects, including remote control devices, alarms, etc. Sends and Receives! 1" diameter, ¾" deep, with standard RCA type phono jack. Wt. 2 oz. Cat. No. 92CU8375

FANTASTIC? YOU BET IT IS! LOOK WHAT YOU GET FOR 1¢ MORE!

☐ 1-LASCR OPTO COUPLER, type H11C3, mini dip, (#5700)	1.29	2 for 1.30
☐ 3-LINE CORDS, 6 ft. 18 gauge, 2 cond. white w/plug, (#3787)	1.29	6 for 1.30
☐ 15-SINGLE PIN MICRO RED LEDS, 100% material, 3 volts @ 10 mils, (#5896)	1.29	30 for 1.30
☐ 40-FEEDTHRU CAPACITORS, used for hams, RF, UHF circuitry, (#5668)	1.29	80 for 1.30
☐ 40-PLASTIC TRANSISTORS, asst'd untested and hobby, (#2604A)	1.29	80 for 1.30
☐ 6-6V INDICATORS, w/leads, test lamp manufacturers excess, (#5893)	1.29	12 for 1.30
☐ 40-METAL CAN TRANSISTORS, asst'd types, hobby, untested, (#2603A)	1.29	80 for 1.30
☐ 10-UPRIGHT ELECTROS, 100% asst'd values and voltages, (#5900)	1.29	20 for 1.30
☐ 40-SEMI-CON SUPRISE, zeners, rectifiers, transistors, etc, U-test, (#2226)	1.29	80 for 1.30
☐ 65-STABISTORS, axial, for regulators & computers, U-test, (#3140)	1.29	130 for 1.30
☐ 40-SQUARE PC COILS, uprights, assorted values, for PC applications, (#3188)	1.29	80 for 1.30
☐ 50-1 AMP ZENERS, 3.3,8,10,12,15V, etc., double plug, untested, (#1964)	1.29	100 for 1.30
☐ 4-ROCKER SWITCHES, DPDT, solder eyelet terminals, (#3302)	1.29	8 for 1.30
☐ 60-LONG LEAD DISCS, 100% prime, marked capacitors, (#5899)	1.29	120 for 1.30
☐ 6-MINI TRANSFORMERS, asst'd outputs, interstage & audio, 1" sq. (#3295)	1.29	12 for 1.30
☐ 1-TV/AUDIO SHIELDED CABLE, 2 cond. 15 ft. w/RCA phone plugs, (#5812)	1.29	2 for 1.30
☐ 25-DATA ENTRY KEYCAPS, ⅝" sq. #'s & functions, asst. colors, (#4013)	1.29	50 for 1.30
☐ 2-GE 3W AUDIO AMP, type PA-263 IC chip, mono, (#1522)	1.29	4 for 1.30
☐ 1-MERCURY TILT SWITCH, N.C. rated 24VDC @ .05A, w/leads, (#5686)	1.29	2 for 1.30
☐ 6-POWER TAB TRIACS, 100% prime, 100V, TO-220, (#5888)	1.29	12 for 1.30
☐ 6-POWER TAB SCR's, 100% prime, 100V, TO-220, (#5904)	1.29	12 for 1.30
☐ 2-WATCH LCD's, 3½ digit, asst. types, size: 1" x 1½" (approx.) (#5066)	1.29	4 for 1.30
☐ 4-TV INTERLOCK JACKS for TV/power mt. ctr, solder tab terms., (#5519)	1.29	8 for 1.30
☐ 4-MOS FETS, 3N128, by Fairchild & RCA, TO-18, some duals, (#1686)	1.29	8 for 1.30
☐ 4-PHOTO ELECTRIC DARLINGTON TRANSISTORS, 2N5777, (#3276)	1.29	8 for 1.30
☐ 6-AC "UTILITY" OUTLETS, for 1¼" mt. ctr., solder lugs, (#3582)	1.29	12 for 1.30
☐ 15-NE-2 LAMPS, neon red, for 110VAC, less resistor, (#1435)	1.29	30 for 1.30
☐ 20-1N4148 SWITCHING DIODES, 4nS, 100V @ 10mA, axial 100%, (#3000)	1.29	40 for 1.30
☐ 2-4 AMP SILICON BRIDGE RECTIFIER, 200V, block style, (#5928)	1.29	4 for 1.30
☐ 4-VARACTOR DIODES, var. tuner capacitance, 20-50 pf. (#5887)	1.29	8 for 1.30
☐ 50-PRECISION RESISTORS, ½, 1, & 2 watts, 1%, assorted types, (#363)	1.29	100 for 1.30
☐ 60-CERAMIC CAPS, asst'd val. & styles, incl; tubulars, NPO's, etc., (#590)	1.29	120 for 1.30
☐ 25-PLASTIC SCR's, incl; 200V, untested, high yield, TO-92, (#3192)	1.29	50 for 1.30
☐ 40-MOLDED CAPACITORS, tubular, asst'd volt. to 1 mf. axial leads (#348642)	1.29	80 for 1.30
☐ 60-MICRO ZENER & RECT. KIT, asst'd voltages, only 1/8" sq. U-test, (#1251)	1.29	120 for 1.30
☐ 1-LINE CORD, 8 ft. 2 cond, 16 gauge, vinyl molded plug & grommet (#3661)	1.29	2 for 1.30
☐ 6-SPDT MICRO SLIDE SWITCH, only 3/7" cube, for PC mount, (#3429)	1.29	12 for 1.30
☐ 10-PR.-RCAPLUGS & JACKS, for audio, speakers, etc., (#402)	1.29	20 for 1.30
☐ 5-2N3055 HOBBY TRANSISTORS, TO-3, (#3771)	1.29	10 for 1.30
☐ 10-ZENERS, 1 watt 9.1 volts axial leads 100% (#5370A)	1.29	20 for 1.30
☐ 40-1N4148, 4 NANO, SWITCHING DIODE, axial leads untested (#5923)	1.29	80 for 1.30
☐ 2-RELAYS, BABCOCK 6VDC, SPST, plastic case (#5807)	1.29	4 for 1.30
☐ 1-25 AMP BRIDGE RECTIFIER, 50 volts, 100% (#5948)	1.29	2 for 1.30
☐ 2-QUADRACS, 10 amp 200 PRV, TO-220 100% (#5915)	1.29	4 for 1.30
☐ 60-MINI RESISTORS, 30-1/2W, 30-1/4 watt, axial, color coded, (#5922)	1.29	120 for 1.30
☐ 12-SCRS-TRIAC-QUADRACS, asst. volts. TO-220 case (#2087)	1.29	24 for 1.30
☐ 10-BULLPLATES, asst. resistor/capacitor networks, various styles, (#5880)	1.29	20 for 1.30
☐ 2-AIR TRIMMER CAPS, alum. plates, ½" shaft, panel mt. solder lugs, (#5658)	1.29	4 for 1.30
☐ 30-MOLEX CONNECTORS, nylon, asst'd styles, colors, & # of cond. (#5835)	1.29	60 for 1.30
☐ 1-3 CONN. LINE CORD, 8 ft. flat, w/ring terminals, 2 AC, 1 GND, (#5703)	1.29	2 for 1.30
☐ 4-12 VOLT LAMPS, w/leads, popular voltage, 100's of uses, (#5942)	1.29	8 for 1.30
☐ 25-TTL IC's, untested, asst'd gates, flip flops, etc. 14-16 pin, (#5955)	1.29	50 for 1.30
☐ 20-1000 PIV GLASS AMPS, micro-mini, axial, silicon, rated @ 1A, (#5903)	1.29	40 for 1.30
☐ 1-12 VCT 200 mA TRANSFORMER, 115 V prim., PC mount, (#5977)	1.29	2 for 1.30
☐ 20-400 mW 15V ZENERS, micro-style, asst. epoxy & glass, 100%, axial, (#5914)	1.29	40 for 1.30
☐ 100-UNMARKED CAPS, popular values, mylars & polystyrene, 100%, (#5892)	1.29	200 for 1.30
☐ 60-ONE WATT ZENERS, assorted voltages, glass pak, dbl plug, U-test, (#5947)	1.29	120 for 1.30
☐ 50-MICRO ZENERS, 1 watt, 2-30V, DO-7 & micro epoxy, axial, 100%, (#5905)	1.29	100 for 1.30
☐ 500pc-HARDWARE SURPRISE, asst screws nuts & washers, (#5891)	1.29	1000 for 1.30
☐ 60-GLASS AMPS, up to 1KV, 1N4000 series, glass encased, untested, (#5982)	1.29	120 for 1.30
☐ 200-PC BOARD PARTS, boards loaded w/100% parts, hobby bonanza, (#5946)	1.29	400 for 1.30
☐ 6-RF NPN TRANSISTORS, type-2N1059, BVcbo: 40V, TO-22, 100%, (#5895)	1.29	12 for 1.30
☐ 2-BRASS DOOR LOCKS, w/key, for doors windows, etc. 2-1/8" mt. ctr. (#5949)	1.29	4 for 1.30
☐ 1-PUSH-PUSH CB SWITCH, DPDT, 1 x ¾ x 3/8", 100's of uses, (#3463)	1.29	2 for 1.30
☐ 30-"CRIMP-ON" TERMINALS, rings and spades, for # 12-20 wire, (#3955)	1.29	60 for 1.30
☐ 50-ONE-WATT RESISTORS, popular assort, some 5%ers, 100's of uses, (#3844)	1.29	100 for 1.30
☐ 50-METALLIC FILM ½ WATTERS, asst. values, marked, axial leads, (#1605)	1.29	100 for 1.30
☐ 4-RIBBON CABLE CONNECTOR, single-sided, 9 contacts, PC leads, (#5967)	1.29	8 for 1.30
☐ 3-"SUPER" 2N2222, NPN, ICBO:60V, hfe:100 1W @ 2A, TO-92, 100%, (#5952)	1.29	6 for 1.30
☐ 1-12 VDC MINI BLOCK RELAY, spdt, 1 x 3/4 x 5/8", 175 ohm, 1A, (#5937)	1.29	2 for 1.30
☐ 10-1.5V GRAIN-o-WHEAT LAMPS, 5/16", w/10" leads, lens: RED, (#6002)	1.29	20 for 1.30
☐ 10-IF-FM OP AMPS, by RCA, FM-UHF circuitry, TO-5, 10 leads, (#5951)	1.29	20 for 1.30
☐ 10-NPN SWITCHING TRANSISTORS, asst'd gen. audio & switching, (#2595)	1.29	20 for 1.30
☐ 1-12 VDC SOLENOID, similar to Guardian 16-P, w/plunger, ⅛" stroke, (#6013)	1.29	2 for 1.30

☐ 10-HUMBUCKER CONTROLS W/KNOB, for TV vertical, horiz., etc. (#5882)	1.29	20 for 1.30
☐ 50-CAPACITOR SPECIAL, discs, mylars, and more, (#3775)	1.29	100 for 1.30
☐ 4-HOBBY VOLTAGE REGULATORS, LM-309, 320, 340's, TO-3, (#3330A)	1.29	8 for 1.30
☐ 12-PANEL SWITCHES, assorted slides, rotaries, modulars, etc. (#295)	1.29	24 for 1.30
☐ 60-RESISTOR SPECIAL, ¼ to 1 watt, carbons, carbo-films, etc. (#35896)	1.29	120 for 1.30
☐ 65-HALF WATT RESISTORS, asstd. carbons, carbo-films, various values, (#454)	1.29	130 for 1.30
☐ 6-LM340T VOLTAGE REGULATORS, 5 to 24 volts, TO-220, (#5897)	1.29	12 for 1.30
☐ 40-POLYSTYRENE CAPACITORS, asst'd values and voltages, (#1052)	1.29	80 for 1.30
☐ 15-THERMISTORS, resistors that change with the temperature, (#2048)	1.29	30 for 1.30
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☐ 15-VOLUME CONTROLS, asst. values, audio, and switch too! (#592)	1.29	30 for 1.30
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☐ 60-GLASS ZENERS, 400mW, untested, better than 50% yield, (#5889)	1.29	120 for 1.30
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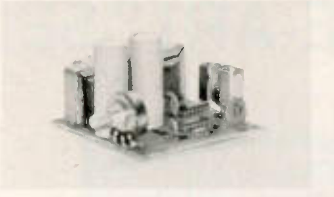

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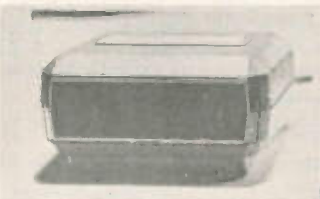

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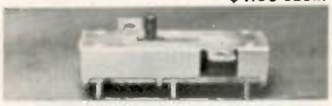

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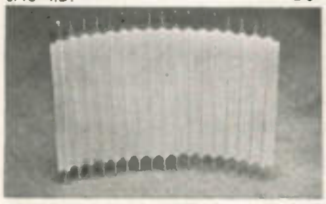

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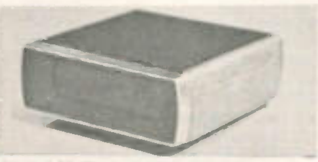

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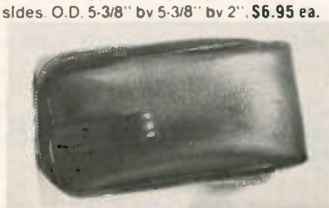

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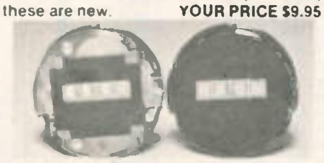

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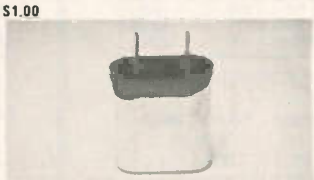

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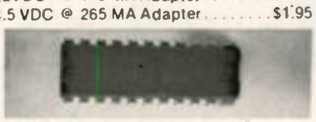

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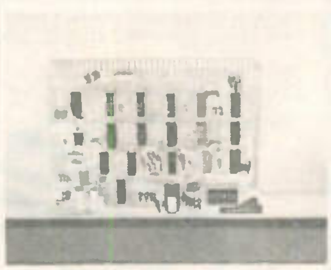

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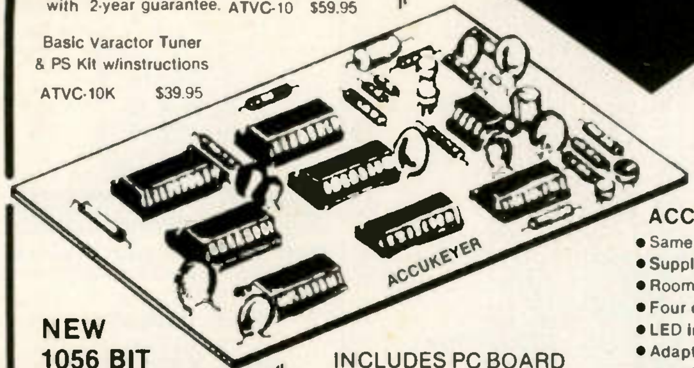

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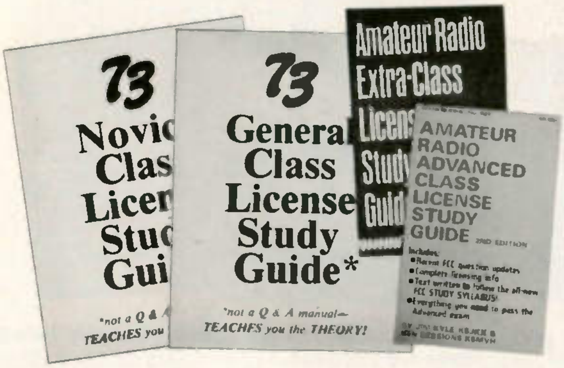

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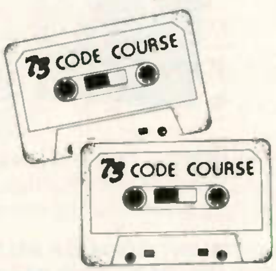

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13+ WPM—CT7313—Code groups again, at a brisk 13 per so you will be at ease when you sit down in front of the steely-eyed government inspector and he starts sending you plain language at only 13 per. You need this extra margin to overcome the panic which is universal in the test situations. When you've spent your money and time to take the test, you'll thank heavens you had this back-breaking tape.

"COURAGEOUS"

20+ WPM—CT7320—Code is what gets you when you go for the Extra class license. It is so embarrassing to panic out just because you didn't prepare yourself with this tape. Though this is only one word faster, the code groups are so difficult that you'll almost fall asleep copying the FCC stuff by comparison. Users report that they can't believe how easy 20 per really is with this fantastic one hour tape.

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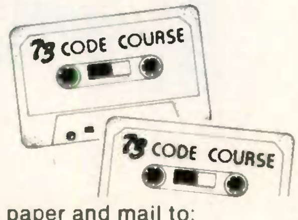

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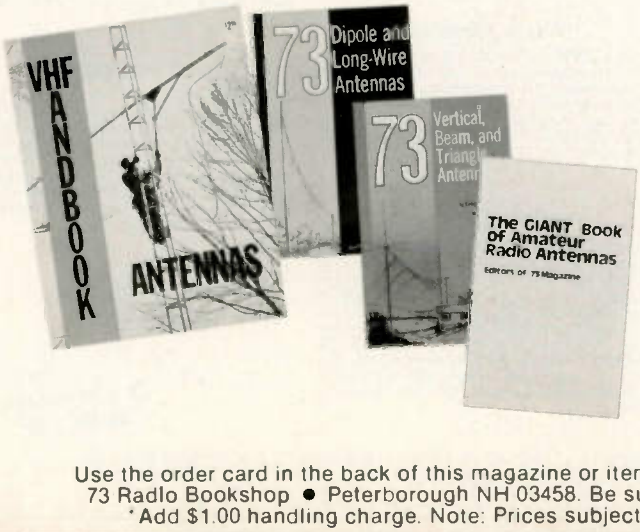

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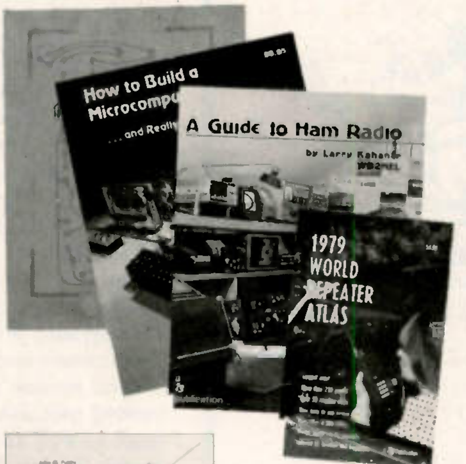

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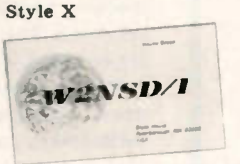

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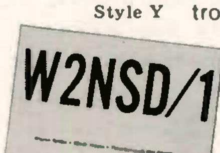

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HAWAII	21	14	7B	7	7	7	7	7	14	21	21A	21A
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JAPAN	14A	14	7B	7B	7	7	7	7B	7B	7B	7B	14
MEXICO	14	14	7	7	7	7	7	14	21A	21A	21A	21
PHILIPPINES	14A	14B	7B	7B	7B	7B	7	7	7B	7B	7B	14
PUERTO RICO	14	7	7	7	7	7	14	21	21A	21A	21	14
SOUTH AFRICA	14	7B	7	7	7B	14	21	21A	21A	21A	21	21
U. S. S. R.	7	7	7	7	7	7B	14	21A	14	7B	7B	7
WEST COAST	21	14	7	7	7	7	7	14	21A	21A	21A	21A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	7	7	7	7	7	14	21	21	21A
ARGENTINA	21	14	7A	7	7	7	14	21	21	21A	21A	21A
AUSTRALIA	21A	14	14B	7B	7	7	7B	7B	14	21	21	21A
CANAL ZONE	21	14	7A	7	7	7	14	21	21A	21A	21A	21A
ENGLAND	7	7	7	7	7	7B	7B	14	21A	21	14B	7B
HAWAII	21A	14	14B	7	7	7	7	7	14	21	21A	21A
INDIA	7	7	7B	7B	7B	7B	7B	14	14	7B	7B	7B
JAPAN	21	14	7B	7B	7	7	7	7	7B	7B	7B	14A
MEXICO	14	14	7	7	7	7	7	14	21	21A	21A	21
PHILIPPINES	21	14	7B	7B	7B	7B	7	7	7	7B	7B	14
PUERTO RICO	14	14	7	7	7	7	14	21	21A	21A	21A	21
SOUTH AFRICA	14	7B	7	7	7B	7B	14	21	21A	21A	21	21
U. S. S. R.	7	7	7	7	7	7B	7A	14A	14	7B	7B	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	7	7	7	7	7	7	14	21	21A
ARGENTINA	21	14	14	7A	7	7	7B	14	21	21A	21A	21A
AUSTRALIA	21A	21	14A	7B	7	7	7B	7B	14	21	21	21A
CANAL ZONE	21	14	7A	7	7	7	7	14	21A	21A	21A	21A
ENGLAND	7B	7	7	7	7	7B	7B	14B	21A	21	14B	7B
HAWAII	21A	21	14	7A	7	7	7	7	14	21	21A	21A
INDIA	14	14	14B	7B	7B	7B	7B	7	7	7B	7B	7B
JAPAN	21A	14A	14B	7B	7	7	7	7	7	7B	14	21A
MEXICO	21	14	7	7	7	7	7	14	21	21A	21A	21
PHILIPPINES	21A	21	14B	7B	7B	7B	7B	7	7	14B	14B	21
PUERTO RICO	21	14	7	7	7	7	7	14	21A	21A	21A	21
SOUTH AFRICA	21	14B	7	7	7B	7B	7B	14	21	21A	21	21
U. S. S. R.	7B	7	7	7	7	7B	7B	7B	14	7B	7B	7B
EAST COAST	21	14	7	7	7	7	7	14	21A	21A	21A	21A

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

december

sun	mon	tue	wed	thu	fri	sat
						1 F
2 G	3 G	4 G	5 G	6 G	7 G	8 G
9 F	10 F	11 G	12 G/SF	13 F/SF	14 P/SF	15 F
16 G	17 G	18 F	19 G	20 G	21 G	22 G
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A24	B8	D23	H2	J2	M57	Q3	S81	U9	
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A40	C3	D29	H8	K14	M76	R8	S125	V24	73
A46	C6	D68	H16	L9	M92	R27	T3	V29	MICROCOMPUTING
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			Add $1.00 shipping & handling:	
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Bill: ☐ American Express ☐ BankAmericard/Visa ☐ MasterCharge

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"It's A Cut Above The Rest"

*** OPTIONAL DIGITAL MEMORY SHIFT ("DMS")**
12 discrete memories. Stores individual frequencies or use as 12 full coverage VFOs (500 kHz each)

- Solid State
- 240 watts DC SSB/CW
- 160-10 meters, WWV
  (2 auxiliary band positions are available for future expansion)
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- Built-in SWR Meter
- Excellent Dynamic Range
- Audio Peak/Notch Filter
- Variable Bandwidth
- Full Line of Accessories

The FT-107 has been created as a result of a blending of technologies — computer, solid state and RF design. By careful utilization of these disciplines and the experience gained from our FT-301 series, YAESU has achieved an HF transceiver which offers unique features (e. g. "Digital Memory Shift"), efficient operation and a level of performance that has been previously unattainable.

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Image Rejection: 60dB except 10 meters (50dB)
IF Rejection: 70dB
Selectivity: SSB 2.4 kHz at −6dB, 4.0 kHz at −60dB.
CW 0.6 kHz at −6dB, 1.2 kHz at −60dB.
AM 6 kHz at −6dB, 12 kHz at −60dB
Variable IF Bandwidth
20dB RF Attenuator
Peak/Notch Audio Filter
Audio Output: 3 watts (4-16 ohms)
Accessories: FV-107 VFO (standard not synethized)
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SP-107 Matching Speaker
FP-107 AC Power Supply

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80 watts DC AM/FSK
Opposite Sideband Suppression: Better than 50dB
Spurious Radiation: −50dB.
Transmitter Bandwidth 350-2700 hz (−6dB)
Transmitter: 3rd IMD −31dB neg feedback 6dB
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less than 100 hz after 30 min.
Antenna Input Impedance: 50 ohms
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