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OCTOBER 1997
ISSUE #445
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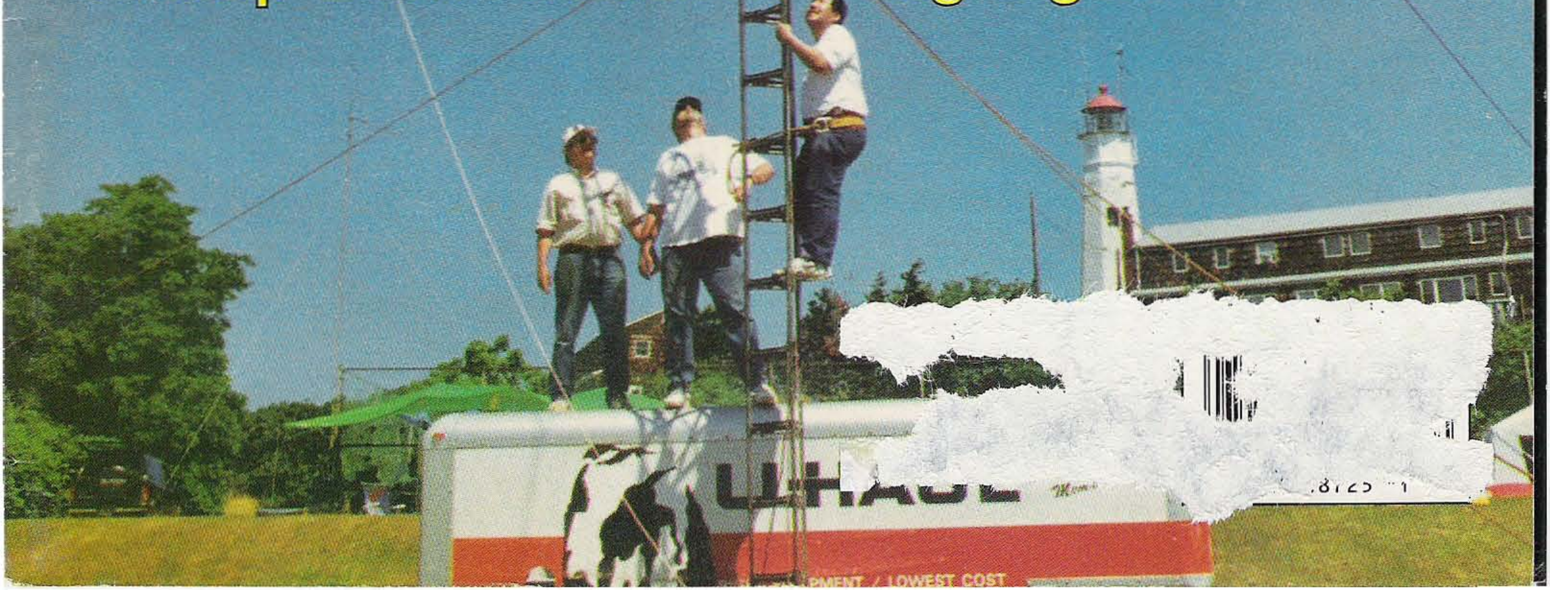

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SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

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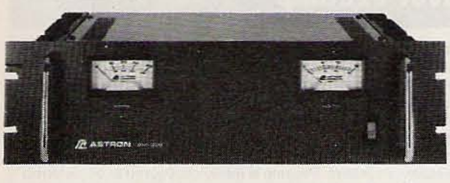
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES



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MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

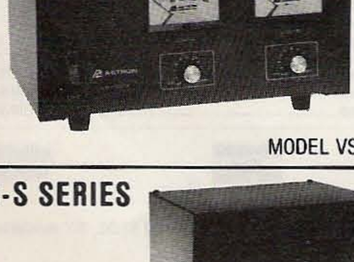
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A		•	37	50	6 × 13¾ × 11	46
RS-70A		•	57	70	6 × 13¾ × 12⅛	48

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

VS-M AND VRM-M SERIES

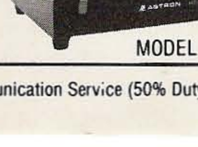


MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
VS-70M	67	34	16	70	6 x 13¾ x 12⅛	48
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES



MODEL RS-12S

• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

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On the cover: Don Halmy KB2PVT, John Milligan N2NPU, and George Sau WB2ZTH check out the six-element tribander used at WB2QBP, club station of the American Red Cross Emergency Communications Service. Field Day 1997 photo taken at Eaton's Neck Coast Guard Station, Northport, LI, NY, by George Pataki WB2AQC. Next month: *73* greets November with one of its all-time greatest cover shots, sent in by ... *you?*

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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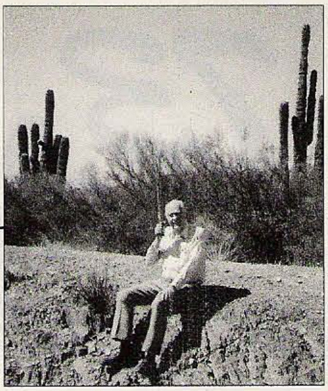
NEVER SAY DIE

Wayne Green W2NSD/1



Addiction

Quiz: What's the most addictive drug? Is it heroin, cocaine, crack, opium, or nicotine? You probably saw that one coming and picked little ol' nicotine. Right. Research reports tell us it is four and a half times as addictive as the next in the list. The heroin- and cocaine-addicted can go cold turkey and be through with the withdrawal symptoms in a week to 10 days. Smokers can suffer for up to two years. No wonder the recidivism rate is so high!

With stopping so extremely difficult, and with the tobacco companies well aware of this, their efforts have been centered on getting the youngsters started. And they get a whole lot of help from parents who, as role models, are smoking.

I was fortunate in one respect. My father not only beat the hell out of me when he got angry, but he also was unable to communicate. We never were able to talk or share any father-son experiences. His nightly battles with my mother, whom he'd knock down when he was drunk, which was a good deal of the time, further estranged us. In addition to smoking several packs of Camels a day, he also drank constantly.

The fortunate part was that this generated a highly negative interest in my being like him, so I didn't smoke or drink, even when my fraternity brothers at college were having beer busts, drinking until they puked and then drinking more. My dad loved fishing, so I still have no interest in it. Oh, I did enjoy spear fishing, but that was like hunting, only in three dimensions. These days I do my hunting with cameras, above and below the water.

My dad was a pioneer aviator, so it wasn't until I was around 35 that I started flying and bought a plane.

So you have a choice in training your children: Either provide a good positive role model or, if you are a smoker, you can use my father's approach and be such a bastard that your kids will avoid doing anything you enjoy. Your choice.

Why Doctors Are So Bad

It's logical, if you'd ever stopped to think about it. Let me put this in simple terms. Back in 1963 the ARRL, in a move which they expected to be controversial, and thus get hams talking about the League and joining, proposed to the FCC that around 90% of the hams have to take a new license test in order to continue to use phone on the HF bands. They called this beaut Incentive Licensing. The unintended result was that at least 50,000 hams went ballistic, squealing like ... er ... stuck pigs, saying they weren't about to memorize a whole big bunch of damned questions and answers again to be able to keep talking. They were really mad. So, being convinced that the ARRL would get their petition passed into law, they put their rigs up for sale for whatever they could get for them ... which was often about 10¢ on the dollar.

This resulted in three things. One, the 11% per year growth the hobby had had for the previous 17 years stopped dead, with a huge net loss of licensees over the next few years. Second, most of the ham clubs around the country blew away ... particularly the school radio clubs which had been providing us with new young hams. Indeed 80% of our new hams had been teenagers. Third, it put almost 90% of the ham stores out of business in one year, since the sale of new equipment totally stopped. And three-A, this, in turn, put virtually all our American ham manufacturers out of business, and our American ham industry has never recovered. It was a mess, and all because tens of thousands of hams panicked over being re-examined. The FCC fiddled around with this hot potato for five years and finally cut the baby in half, taking away half of the phone bands from the Generals instead of all, as requested by the ARRL.

Let me put this another way. If you're a college graduate, how'd you like to be called in to retake your final exams in every course you passed several years ago? You'd find that you've forgotten around 90-100% of everything you once "knew." Well, it's the same with doctors. They have forgotten at least 90% of what they "learned" in medical school. Worse, few of them have the time to read the medical journals, so they don't even know what's going on that's new. They get almost all of their new information from "detail men," the salesmen for the pharmaceutical companies. And their whole purpose in life is to get the doctors to use their company's patented drugs.

Doctors are taught virtually nothing in medical school about how to keep people healthy, only what drug, knife or Band-Aid™ to use when certain symptoms show up. They know almost nothing of eliminating the causes of illness, just what to do to patch up the resulting problems.

Yes, this is a repeat of stuff I've been writing over and over. Well, I'm going to keep hammering until I get you over your blind trust in institutions and start thinking for yourself. We're in the middle of an unholy mess, all caused by you and your parents going to sleep at the switch. Our medical industry is a mess, as are our schools, courts, Congress, and so on down the line. The AMA, NEA, FDA, NIH, and all the rest of the alphabet are as crooked as hell, serving themselves, not the public they're supposed to help.

Those Darned Fluorides Again

Just in case you are still, despite my warnings, drinking water laced with fluorides or using fluoride-laced toothpaste, or even allowing your dentist to put fluoride on your or your children's teeth, maybe you'd better find out the real story.

Yes, in this best of all countries in the best of all times, your meats are laced with hormones, plus salmonella in your chicken. Your water has government-added fluorides and chlorine, plus God knows what else, such as dioxin, which has seeped into our country's aquifers. The air in your cities is poisoning your lungs.

Under pressure from the fluoride suppliers, our cities have added this carcinogen to your drinking water. The excuse is that it is supposed to help children's teeth. A study of 480,000 children showed that it doubled their tooth decay. Researchers have estimated the fluorides in our water are causing about 60,000 people to die of cancer every year that otherwise wouldn't.

Recently the EPA and National Research Council (NRC) okayed 4 ppm of fluoride in our drinking water, despite the evidence from double blind studies that even 1 ppm causes severe allergic reactions and destroys immune cells. If you do some homework you'll find that the EPA has gone to extremes to hide the facts of fluoridation from the public. It's a fascinating, but not particularly surprising, story of corruption.

Change

While resting for a few minutes after a very brisk walk down the dirt road that goes past our farm, watching the ever-changing display of wildflowers along the road and in our fields, I got to thinking about change. Even if I remembered everything I was "taught" in college, virtually all of it is meaningless in today's world. The stuff we had to commit to short-term memory for the endless quizzes is all out of date. The old economic theories have been shown to be in error. Ditto what we were taught in psychology, physics, and so on. Quantum theory was never even mentioned. The atom was, then, the smallest particle. The Earth had been formed when another star passed close to the sun and sucked material off which condensed into the planets. The concept of plate tectonics was crazy.

The problem with all this is that change is accelerating. It no longer takes 50 years for what you commit to short-term memory in college to become obsolete. The downside of this is what we call the establishment, which can't deal with change, so they fight it every inch of the way. People tend to form bureaucracies as a way to fight change. Bureaucracies are comfortable for the worker bees — the drones — and holy hell for leaders. Alas, we don't know why some people are born leaders and others are born followers (a.k.a. sheep). Fortunately for society there are very few leaders and an abundance of followers.

Leaders tend to become entrepreneurs, preferring not to have to take orders from others. And leaders tend to welcome change and take advantage of it, which may explain why so few successful entrepreneurs bother to finish college ... if they even go. Until college gets re-invented it's a bummer for leader-type people, but a benefit to the followers who want to work in a bureaucracy, and bureaucracies just love credentials. They help establish pecking order.

Leaders seem to be born, not made. And it has nothing to do with intelligence. I know hundreds of Mensa members and the Mensa groups are just as hard up for leaders as any other group. Like your ham club, for instance.

Bureaucracies have a couple of serious problems. First, they tend to be rigid. They're able to deal with a fixed set of situations (the rule book), but if some factor changes, they're very slow to respond. Like never, if possible. Secondly, the norm is for promotion to work from the bottom up, depending more on seniority than skills. The fastest way to be blackballed and never be promoted is to be creative and try to change things. The end result of this is that the top management is made up of workers who have never had a creative idea and who have spent their working lives protecting the status quo ... resisting change.

And the same rules apply to our military, which is a humongous bureaucracy. Congress made Rickover an Admiral, not the Navy. He pushed for nuclear-powered ships, which the Navy brass fought against bitterly. Just as the Army fought air power a generation before, with the famous court martial of Captain Billy Mitchell, who did his best to initiate change. So they wanted to put him in prison to shut him up. My dad, by the way, knew Mitchell and was stationed at Langley Field with him at the time of the court martial.

Don't make waves is the rule for workers. CW forever, right?

Can 200 Million Americans Be Wrong?

You bet your sweet bippy they can! A recent poll reported in *USA Today* said that 80% of Americans believe that the government is hiding information on alien contacts. Well, I agree with the 80%, but my problem is that about 79% of the people believe this for the wrong reasons. I doubt that 0.01% of the public has done much homework on the subject. There are some excellent books available, and a ton of trash.

Well, that's one of the big problems with the Internet. There's a lot of valuable information available on it, but these gems are so buried in garbage that they're almost impossible to find. Are there any garbage sifter volunteers out there?

I'm doing my share of the grunt work, reading books highly recommended by the *73* readers (and Art Bell listeners), sifting for gems. I've found about a hundred really important books so far and they're reviewed in my guide.

Our beloved government is involved in keeping secrets on so many levels that it's no wonder there are so many conspiracy theories flying around. With at least 22 known government intelligence (?) agencies, all with seemingly unlimited black budgets, and all seeming to be busy keeping secrets from us, it's easy for the unwary to buy into almost any weird theory.

The only conspiracy I personally know about is the Amelia Earhart one, and the government is still keeping the lid on that after 60 years. There should be some sort of sundown law on secrets. Isn't it about time for the Navy to admit that, yes, Amelia was on a spy mission for them when she got lost. And that she was captured by the Japanese and executed as a spy. Case closed.

Now, about those pesky aliens. As I've opined before, there is a lot of credible evidence that the critters are not only here, but have been here for a long, long time. Perhaps thousands of years. There's also evidence that there are a couple dozen different species involved. And since their technology is at least thousands of years ahead of ours, there is no good reason for their coming out of their closets.

Hey, I can cook up conspiracy theories too. Could Laurence Rockefeller and the Rothschilds be alien entities? They are the small group that has gained and kept control of the world's money supply. Well, that concept might help bring the New World Order and the alien invader conspiracy groups together. And it makes sense. Once we know that ETs are here it's only logical for them to set up a secret system which would give them control over us. And this is one that's been going on for a couple of hundred years or more.

Murdering Millions

We're all well aware of the five million Jews Hitler and company erased. And we've heard about Stalin doing a number on his people, plus Pol Pot in Cambodia, Mao in China, and the Hutus in Rwanda, etc.

A recently remaindered 1993 book by Zbigniew Brzezinski (*Out of Control*) fleshed out the numbers for me. We're now finishing up the bloodiest century in history, by a wide margin. The two world wars consumed 8,500,000 and 19,000,000 military lives, respectively. Other wars added another 6,000,000 plus to the total, plus another 13,000,000 civilian lives lost in WWI and about 20,000,000 in WWII. Then there were about 15,000,000 deaths in the Sino-Japanese war. And another 6,000,000

Continued on page 40

LETTERS

Number 6 on your Feedback card

From the Ham Shack

Laird Wilcox KBØRDL. I have been a licensed ham for a little over two years now although I've followed the hobby for some years. I really enjoy the friends I have made with my two-meter HT and mobile and I have joined three clubs in the Kansas City area. I have chosen to remain a no-code technician because I have found the Internet to be a more reliable and useful method of long-distance communication. I am a writer by profession and one of my many correspondents is in Stockholm, Sweden, and another is in Barrow, Alaska. I can communicate with them easily and almost instantaneously with my computer, which requires no license and no Morse code proficiency. We can send a volume of information back and forth with the Internet that would be impossible with HF radio under the best of circumstances. Most of the other new hams I know feel the same way and are not interested in "upgrading" for reasons I will explain.

What I have found most fascinating about amateur radio, however, is not the theory or application of wireless communication, but the fact that a single organization has an iron-fisted grip on its future. I am, of course, referring to the ARRL. Even this would not be alarming if it were more in touch with the modern world. But such is not the case. My general sense is that the ARRL is primarily interested in keeping ham radio as it has always been, rather than taking into account new technologies such as cellular phones and the Internet, both of which do much of what ham radio does — without the expense, difficult examinations or requiring a proficiency in an increasingly irrelevant 19th century art: Morse code.

The simple fact is that new hams — and without new hams amateur radio is doomed to extinction within a generation — find themselves burdened by examinations that assume one needs to be proficient in radio construction in order to operate VHF radios that are less complicated than their stereos. To use an analogy, if one needed a similar level of proficiency to operate an automobile one would need to know all about metallurgy, the theory of the internal combustion engine, the hydrodynamics of transmission fluid and the chemistry of emission controls just for starters. Obviously, one should know enough radio theory to avoid interfering with others and to obey the FCC rules, but I have spoken to Extra Class hams who have never had any practical need for 75% of what they had to memorize in order to get licensed, and who have never used Morse code except to pass the test. They bought their radios off the shelf, installed their antennas according to the instructions, and were in business.

***Photo A.** Athens, Greece, Hamfest '97.*

The argument goes that if we lighten the burden of entrance to the hobby then it will become "just like CB" or "any idiot could become a ham." Well, I've listened to 40 meters and at times it's worse than CB. By no means have we kept the idiots out.

As for the Morse code, by the end of this century most countries will probably drop it as a requirement for licensing hams. Fewer and fewer emergency services even monitor it and those extremely rare instances where it may possibly be useful hardly justify requiring it for licensing. Both advances in radios and the prevalence of communication satellites have dramatically lessened the usefulness of CW. We might as well require proficiency in Flemish or Tagalog on the assumption that we might possibly have to assist somebody from Belgium or the Philippines in an emergency.

One of the uses I've found for VHF radio is to function as a trained storm spotter for the county Emergency Preparedness office. What I think is beginning to dawn on people, however, is that improvements in weather radar and other developments in forecasting are lessening the need for large numbers of spotters, and that cellular telephones would suffice in most instances.

The simple fact is that cellular telephones have made one of the primary justifications for amateur radio — emergency communications — increasingly irrelevant. At our recent Field Day I watched as ham operators contacted people in Germany and Australia, in some cases using Morse code, and I had to wonder how useful that would be in case of a tornado or other natural disaster here, or even over there. Don't get me wrong — everybody had a good time, including myself. I think it's a good way for hams to get together and have fun. It reminded me a lot of Boy Scouts toiling away to get merit badges while enjoying hot dogs and soft drinks. As for keeping the hobby the exclusive province of an elite select few with the various "gatekeeper" requirements, this runs counter to modern social trends whether we like it or not. I'll have to admit that I feel a little pride at having passed a difficult test in order to use my VHF radio, but this is offset by the knowledge that much of the test I had to pass was unnecessary to make me a responsible radio operator. Why do I need to know what a microfarad is? However, I can think of one "gatekeeper" requirement that makes sense and that is charging a significant fee for a license — say $50 per year. If this were done, then perhaps the FCC could actually afford to police amateur radio operators who misbehave and the hobby would have a little financial clout when it comes to keeping its frequencies.

If all this sounds heretical and revolutionary, that's too bad. In a way, I wish some of these facts weren't true myself. I would agree with those who say the pace of change is disorienting and worrisome at times. At 54, I'm certainly among those with a taste for nostalgia, but reality is reality and I think it's time the oligarchy that runs amateur radio pulls its head out of the sand and faces that reality whether they like it or not.

OK, Laird, by golly, you've convinced me. When are you going to start getting petitions signed to get the FCC to bring the amateur radio exams into the latter 20th century? ... Wayne.

Nicolas Cassimis SVØCY/KD2IR. After relocating in Greece, the one thing that I missed the most was the US ham flea markets. Visiting a hamfest was the best way to spend a weekend to get together with old friends and bring home some bargains. The Athens Hamfest was born in 1993 and has become an activity that most Greek and European radio amateurs look forward to every year. It is not a Dayton, but it is certainly a ham activity that has everything. It takes place once a year in the end of May at Papagou, only five miles from Athens. In 1993 the turnout was poor, but now amateur groups from all over Greece visit the hamfest every year. This year, with more than 50 sellers, the buyers had a ball! Greece is not only a paradise in archaeological sites, but in electronic antiques also. For many years the high cost of amateur equipment forced Greek amateurs to home-brew their own equipment. Now only a few amateurs construct their own transceivers. I saw some wonderful bargains in antique radios this year, and picked up a couple beauts for peanuts. So, what are your plans for next May? A trip to Greece will add some extra pounds—the moussaka and souvlaki are delicious—and you might bring back to the States a good antique souvenir at a bargain price.

David Kemmer, Oronoco MN. Another great editorial ... DON'T let them talk you into exclusively writing about amateur radio. I, for one, buy the magazine because of your editorials and not because of ham radio. I have a music, piano, and electronics background and could easily be a ham enthusiast, but I won't allow it because of the time constraint. The reason for writing is your mentioning the transmutation of the elements. I have seen a video and read about an experiment with a flock of hens that were carefully fed a diet totally lacking in calcium and rich in potassium. Potassium [#19] is one number below calcium [#20] on the periodic table of the elements and quite different from calcium. The hens continued on their merry egg-laying way, producing full-strength egg shells that were rich in calcium with no evidence of surplus potassium in spite of the diet. The experiment went on for months ... to the point that the hens should have ended up with weakened bones if they were robbing their body calcium to continue to produce eggs. There was no evidence of depletion of body calcium. Therefore the only logical deduction was that the hens were transmuting potassium [#19] "up" one number to calcium [#20]! And they were doing all this chemistry without a college degree! Keep writing those editorials!

Skeptics have obviously not read either The Secret Life of Plants *by Bird & Tompkins — which is in my guide to books you should read — or Louis Kervran's* Biological Transmutation, *which probably should be listed in my guide. Kervran did some outstanding work in this field, even with men, showing that many or all living things are constantly transmuting elements as they are needed. For more information on elemental transmutation read Michio Kushi's* The Philosopher's Stone *— which is in my guide — and René's* The Last Skeptic of Science. *My message for skeptics is simple: For heaven's sake, do your homework. I do. ... Wayne.*

Alfred Pedneau K5HKG. Wayne, what do you think about the conspiracy with the large oil companies and the automobile/truck companies? Do not see why you haven't written something about this in your magazine a long time ago. One of my sons has a '97 Dodge Dakota with a V8 engine. This truck averaged only 17-1/2 miles a gallon on a drive up to Yellowstone National Park from here in central Louisiana. You know something is wrong if the scientists and engineers we have here in the USA can send a man to the moon, build and use the Hubble Telescope and send a probe to Mars. Why then can't these same people develop an engine that is much more fuel efficient? I have always said the large oil companies have paid off lots of people who have developed much more efficient engines. I know there are engines out there now that could be installed in our vehicles which would save the general public millions of dollars a day. If we use less fuel then we would not have to import as much oil as we do now. We are sending millions of our hard-earned dollars every day to those sheiks who already have more money than they know how to spend.

Alfred, OK, let's say you're right about the conspiracy. Step 2: What can be done about it? You didn't go to Step 2. But I have. Fighting multi-billion dollar industries on their turf is grade-A stupid. The public is asleep — ballgames, beer, sitcoms — and doesn't want to be bothered, so why tilt at windmills? My approach has been to find an alternative to gasoline and promote that. The alternative that holds the most promise is cold fusion, which has been proven to work. It is non-polluting, will cost about a tenth as much as gas or oil, will not deplete our natural resources, and will put the oil, coal and natural gas companies out of business, as well as the electric power generating and distributing companies — which largely use oil and coal. How's that for an end run around the conspiracy? How much do you know about cold fusion? Stop bitchin' and start pitchin'. For $5 — plus $3 s/h — I'll send you #22, the latest issue of Cold Fusion, *which has the complete Patterson patent, the NASA lab report confirming the cold fusion generation of excess heat, and a theory article explaining exactly the physics of cold fusion. ... Wayne.*

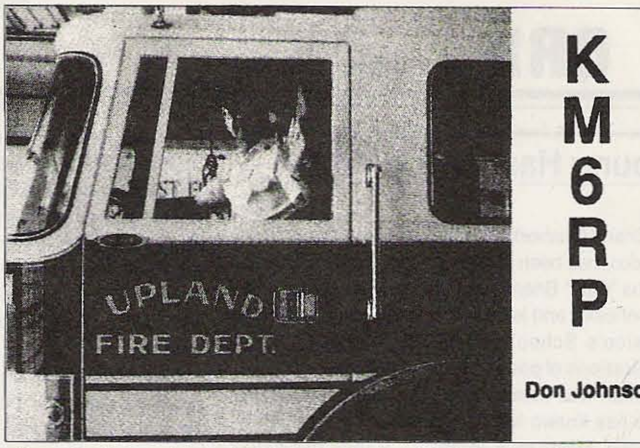
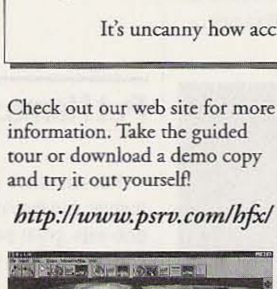


***Photo B.** Don Johnson KM6RP sent news of his club's Field Day.*

To Don Johnson KM6RP: *Many thanks for sending the two-page big 10-4 ham article from the* Inland Valley Daily Bulletin. *To the rest of you: So where was* your *club PR officer on Field Day? ... Wayne.*

Frank Wright VK4SE. I enjoy reading your editorials in *73 Magazine* and look forward to my copy each month. I am also very interested in the bioelectrifier and silver colloid generators. I have made several of them and they all work like a charm. My doctor has two patients suffering with AIDS and I have got him interested in doing

Continued on page 18



QRX . . .

Young Ham of the Year

Brian Mileshosky N5ZGT, of Albuquerque, New Mexico, has been chosen as the1997 "Young Ham of the Year." Brian is the son of Janet and Patrick Mileshosky, and is attending the University of New Mexico's School of Engineering with career aspirations of possibly joining the Astronaut Corps.

Brian was nominated by Jay Miller WA5WHN, who has known Mileshosky since he was first licensed. Miller calls Brian: "... a truly dedicated young adult who uses his amateur radio hobby as a service to benefit his fellow man."

Joe T. Knight W5PDY, the ARRL Section Manager for New Mexico, wrote to the selection committee that he had had an opportunity to know and observe Brian "... in his enthusiastic quest for knowledge and learning in the varied areas of amateur radio, engineering and science ... and his support of youth all over the state of New Mexico." He further related that Brian has "... been involved in many search and rescue missions, as well as public service events. He has also established a packet radio user's group, and controls a packet relay station which he maintains 24 hours a day."

As a General Class licensee, first licensed at the age of 12, Brian is active on all bands and modes with the exception of SSTV, satellites, and microwave. He has a particular affinity for QRP, and has been part of record-setting long-distance QSOs. As *Worldradio Magazine's* Youth Columnist, Brian has encouraged other young people to find their own place in the hobby, and has served as "Elmer" to many younger boys and girls.

The Boy Scouts of America has played a large part in Brian's life. He is an Eagle Scout, and a member of the Order of the Arrow. In addition to serving as Post President, he was Senior Patrol Leader in the 1997 National Jamboree Troop.

In addition to scouting and amateur radio, Brian does have time for other interests. Astronomy is one of them. His high school's science club is another. There he participated in the construction of a deep-space radio telescope.

There is also varsity track and field, and we can't forget his 40-plus in-service hours working for Habitat for Humanity. The list of accomplishments for this young man is a long and distinguished one.

Annual presentation of the *Newsline* Young Ham of the Year Award is made at the Huntsville Hamfest Banquet, in Huntsville, Alabama. The presentation of the award as a regular feature of this prestigious amateur radio convention has been made possible through the generosity and kindness of the Huntsville Hamfest Planning Committee and its chairman, Scotty Neustadter W4WW.

The *Newsline* Young Ham of the Year award program (formerly the *Westlink Report* Young Ham of the Year), now entering its 13th consecutive year, is presented annually to a licensed radio amateur who is 18 years of age or younger and has provided outstanding service to the nation, his community or the betterment of the state of the art in communications through amateur radio.

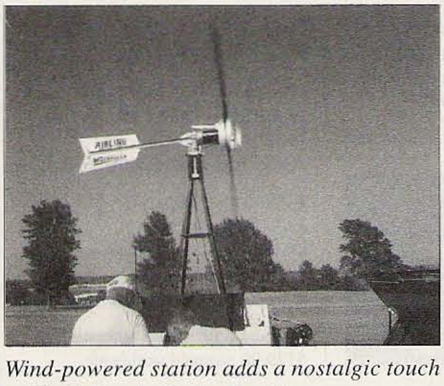
Past recipients of the Young Ham award include Shawn Alan Wakefield WK5P, of Bartlesville, Oklahoma (1986); David Rosenman KA9PMK, of Muncie, Indiana (1987); Jonathan Binstock NK3D, of Potomac, Maryland (1988); Erin McGinnis KAØWTE, of Topeka, Kansas (1989); Mary Alestra KB2IGG, of Staten Island, New York (1990); Richard S. "Sammy" Garrett AAØCR, of St. Louis, Missouri (1991); Angela (Angie) Fischer KBØHXY, also of St. Louis (1992); Kevin Boudreaux N5XMH of New Orleans, Louisiana (1993); Allison Daneen Zettwoch KD4CKP of Louisville, Kentucky (1994); Adam Weyhaupt N9MEZ of Alton, Illinois (1995); and Toby Metz KB7UIM of Boise, Idaho (1996).

TNX Bill Pasternak WA6ITF.

Not Just Hot Air

A neat 1938 Wincharger was employed to operate a two-meter simplex station at the Cedar Valley ARC Field Day event. Contacts were made from the Kirkwood Community College FD site, Cedar Rapids, Iowa, to Minnesota, 100+ miles away, with 10 W on FM. Amateur Radio Explorer Post 1085 helped out.

TNX for the photo to Jim Covington AAØXJ.



Wind-powered station adds a nostalgic touch to Field Day in Cedar Rapids.

Pet Hams: Care and Feeding

Pet hams are so intelligent that they often seem human, but they can be difficult to raise. Only someone with great patience should attempt it. In case you do decide to take the risk, here is a short guide to the basics.

Living Area: A pet ham needs a private nesting area—an entire room where it will not be disturbed. Your pet ham will spend many happy hours alone there with its treasures—boxes, wires, bits of metal, glass, plastic, paper, etc., that it will bring home after it ventures out. You will want to encourage your pet ham to confine its activity to this room, to prevent the entire house's being subjected to noise, clutter and boring of holes in the walls.

Expenses: Keeping a pet ham is expensive, but unlike most pets, a pet ham can be trained to work outside the home for a few hours each day. It may even bring in enough money to offset its expenses.

Feeding: A well-behaved pet ham will eat with the family occasionally, but it will usually feel more comfortable and secure taking its meals in the nest room. You must be sure that your pet ham is well supplied with food and drink during the long periods it spends alone in there, even if it does not beg or whine.

Housekeeping: Most pet hams can be trained to use the family toilet facilities, but a few require a toilet or portapotty in the nest room.

Obedience Training: A pet ham can be trained to perform simple tricks, the most common being *sit* and *speak*. Do not be alarmed if it practices them for hours at a time in its nest room.

Health Problems: The pet ham typically suffers lower back pain and minor throat irritations from too much sitting and speaking, but health maintenance costs tend to be minimal.

Travel: Your pet ham will happily travel in the family car or even by air if allowed to bring along certain familiar items from the nest room. Most pet hams enjoy trips to places where they meet pet hams from other families.

Breeding: If you plan to breed your pet ham, you should do so as soon as possible after you get it. As a pet ham matures, it becomes more increasingly reluctant to engage in activities not associated with its nest room collection.

Behavior: If you plan to disturb or try to talk to your pet ham while he is talking, be prepared to be snapped and growled at, especially if he is in the contest mode.

Lifted freehandedly from the July 1997 edition of *The Repeater*, newsletter of the Alamo Area Radio Organization, who acknowleged that *they* had borrowed it from somebody else's newsletter.

Ten Tips for More Effective Public Service

1. Make sure your radio is in top operating condition. Small problems (such as loose antenna connections, bad microphones, intermittent operation, etc.) may be just annoying in casual operation, but will cause major grief under the continuous/server service of net/emergency operations. *Hint: Listen to someone else using your radio to hear how it sounds! I hear lots of people with crummy signals and almost no one comments on them. Be a friend, tell the other person that they have a noise/hum/buzz/rattle. Offer to let them use your rig while you use theirs—and get about a mile apart for the test.*

2. Don't operate your HT with it hanging from your belt. Using the radio while it's strapped to your waist reduces your effective radiated power by more than 10 dB. That's a 90% reduction in power! Hold your radio in your hand, with the antenna in the clear. *Hint: You can buy speaker mikes that also have antenna jacks on them. This*

allows you to have the radio on your belt, but keeps the antenna in the air.*

3. Regarding antennas, those three-inch rubber "dummy loads" may be cute, but you're throwing away 3 to 6 dB of power when using one. A telescoping half-wave antenna has gain as much as a 10 dB improvement over the three-inch ones. One dB can mean the difference in whether a message gets through. *Hint: Telescoping or long dual-band rubber duckies are fairly cheap, and really help when you are away from the repeater.*

4. Have charged batteries and spare battery packs! If you have a dry cell battery case make sure you have plenty of alkaline or recently-charged batteries to put in the case. Buying a spare pack makes lots of sense, while one is charging, you can be talking on the other one. *Hint: Take a look at NiCd or metal nickel hydride battery packs as an alternative.*

5. External microphones/headphones. In noisy environments such as parades, runs, and special events, putting on some "walkman"-type headphones will enable you to hear your radio (after all, you are there to communicate). A speaker mike is handy, but tends to amplify the ambient noise. *Hint: the Heil headset/microphone combos are great at noise reduction and are focused on the human speech range of audio frequencies.*

6. Speak slowly and clearly when transmitting. Net control has to sort out all manner of voices. Speaking too fast or mumbling just serves to confuse, can cause messages to be repeated multiple times, and adds no value. *Hint: When calling net control, be sure that you key down for a half-second and talk slowly and clearly.*

7. Check your ability to use simplex. Most of us have the local repeaters programmed but sometimes we use simplex for events, or for secondary nets. *Hint: Be familiar with your rig(s) and know how to program in simplex and/or repeaters with PL tones.*

8. Listen to net control. Be sure to direct all communication through net control. Identify your station when calling net control and keep all communications direct and to the point. *Hint: Net control needs to instruct the net members as to what net control wants to hear (medical emergencies, first/last runner, etc.) AND the net members need to pay attention.*

9. If you MUST leave the radio or your assigned area, seek permission. You are there to provide communications, so don't just walk away. Let net control know you are leaving and when you plan to return. *Hint: Bring a backpack with drinks, some munchies, a cap, and a small towel, along with spare batteries, etc.*

10. Project a good image to the non-hams around you. When you are using amateur radio in public you represent Amateur Radio as a whole. *Hint: If you have the time (free from duties), explain what's going on, and how to become a ham.*

From the *ARRL Field Forum*, reprinted—with KA5GLX's hints—in CLARC's *Radio Amateur Gazette* (TX), April 1997. 73

Surface Mount Devices

Everything you didn't want to—but should—know.

Hugh Wells W6WTU
1411 18th Street
Manhattan Beach CA 90266-4025

Anyone opening a recently-built piece of electronic equipment will notice the very small parts. In most cases, they are mounted on both sides of the printed circuit board. The process for assembling boards using these small parts is called *surface mount technology* (SMT) and the devices used are *surface mount devices* (SMD). **Fig. 1** shows the shapes of three typical SMDs.

Although specialized assembly equipment has been developed for placing and soldering SMDs in high-speed industrial operations, ham experimenters can take advantage of the small parts using a manual assembly process. There are a number of SMD project kits and individual parts being made available for hams, encouraging project construction. Though the assembly process is slightly different from (and more tedious than) conventional through-hole parts, it is within the capability of most experimenters. The manual assembly will result in the same reliability as the industrial process.

With the availability of inexpensive SMDs, it is desirable to use as many of them as possible in ham projects, even though it may be necessary to mix SMDs with through-hole parts to achieve a desired circuit function. The circuit function remains the same, regardless of the part size. However, the smaller physical profile of the SMD lends itself to VHF and UHF operations.

A few specialized tools aid the manual assembly process, but a steady hand is most valuable. Aside from that, the most important tools for a manual assembly process are: PC board holding fixture; sharp, sturdy tweezers; a soldering iron with a tip diameter in the range of 0.012–0.015 inch; 0.015-inch-diameter rosin-core solder; liquid rosin soldering flux; and a large lighted magnifying glass.

Get a soldering iron capable of 25–37 watts, providing a tip heat range between 650 and 750 degrees Fahrenheit. Because components are very sensitive to *electrostatic damage* (ESD), it is a good idea to equip the assembly station with a wrist strap tied to the iron and circuit board being assembled—cheap insurance against the loss of a part during an assembly/rework process.

The *caveat* to the manual assembly process is in the removing of a misplaced or defective part. In most cases a few SMD parts can be saved, but many will be destroyed during removal.

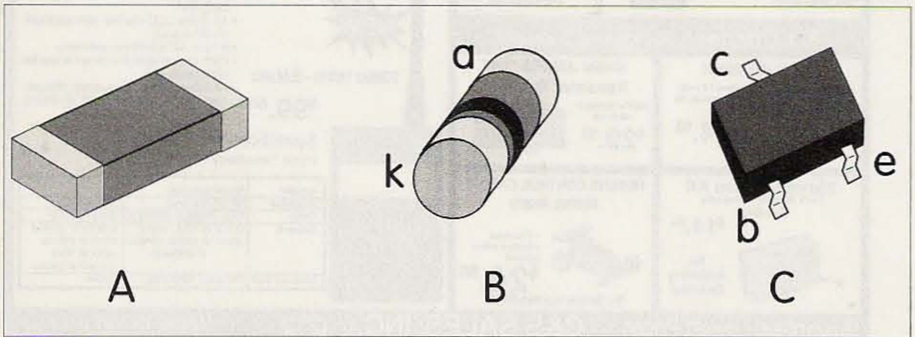


Fig. 1. Typical surface mount components: (A) resistor and capacitor; (B) round diode; (C) SOT 23 transistor.

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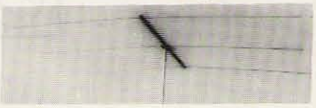
6 Meter Antennas

MFJ 3 element 6 Meter Yagi



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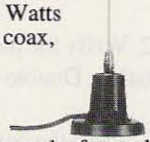

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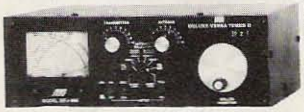

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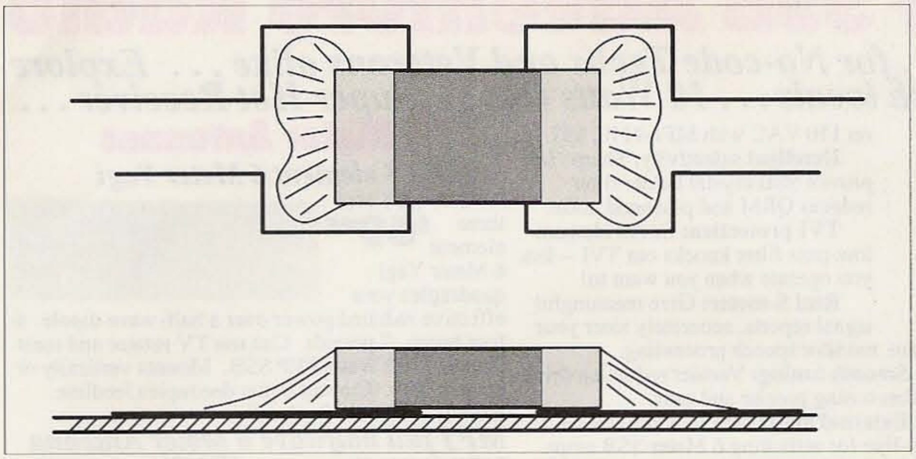

Fig. 2. Correct solder wetting between the pad and SMD.

Therefore, it is vital to verify the part and placement *before* soldering.

Soldering

There are only a few simple steps:

1a. On a board with untinned solder pads, clean the pads, add soldering flux, and tin using a minimum amount of solder.

1b. On a board with tinned pads, add a small amount of solder to only one pad for the part to be mounted.

2. Verify the part to be placed and its orientation. Double-check before soldering.

3. Place the part and hold it in place with tweezers. Again, verify the position.

4. Touch the iron tip to the solder and carry a small amount to the SMD component lead over the solder pad. As the solder melts, the SMD may move toward the board. Be sure it's positioned exactly where you want it before removing the iron.

5. With the tweezers, press the part against the board while soldering a pin on the opposite side of the SMD.

6. Solder each additional pin by heating the joint and adding a small amount of solder. The tip and solder must touch only one pin at a time, to prevent solder bridging.

7. Inspect each solder joint.

8. Place the next part and repeat steps 2 through 7 until all parts are mounted.

Cleaning

Following assembly, the circuit board must be cleaned thoroughly with denatured alcohol to remove all traces of flux. It is best to clean the flux while it is soft, following each component mounting. Although post-heated rosin flux is considered to be inert, leakage paths do develop over time and may cause problems, particularly in VHF and UHF circuits. Therefore, remove as much of the flux as possible. The techniques for removing flux vary with each project, but typically, a stiff horsehair brush and lots of alcohol are what it takes. If possible, the board should be immersed in the alcohol, but very vulnerable components should just be washed with large amounts of alcohol.

One of the tests for sufficient board cleaning is to wash the board and allow it to dry in a vertical position. If flux streaks appear, clean the board again, and repeat as many times as necessary. Use fresh alcohol for each cleaning to prevent re-contamination.

Component removal

Surface mount devices may be removed and salvaged from circuit boards manually, but there is a risk of losing the part and/or damaging the pads. The process is tedious and difficult so be careful. Again, a wrist strap tied to both the board and iron will reduce the possibility of electrostatic damage.

Here are some handy tips for removing SMDs:

• Use Solder Wick™ to remove as much solder as possible from each SMD terminal. In some cases it may help to add a small amount of liquid flux to the solder joint.

• Use a damp sponge to keep the iron tip clean.

• Use a pointed-tip instrument, such as an X-Acto™ knife. Slip the edge of the knife under a lead and apply heat, allowing the lead to lift slightly. Remove more solder, if necessary, to free the lead.

• Move to each lead consecutively until all are free and the part is removed. Ceramic and glass SMDs use plated-on terminals. During a solder removal operation, the terminal plating may be removed, destroying the part. If the part must be salvaged, the use of silver-bearing solder instead of tin-lead will reduce the loss of plating, during both assembly and part removal. To remove, flow the heat with silver-bearing

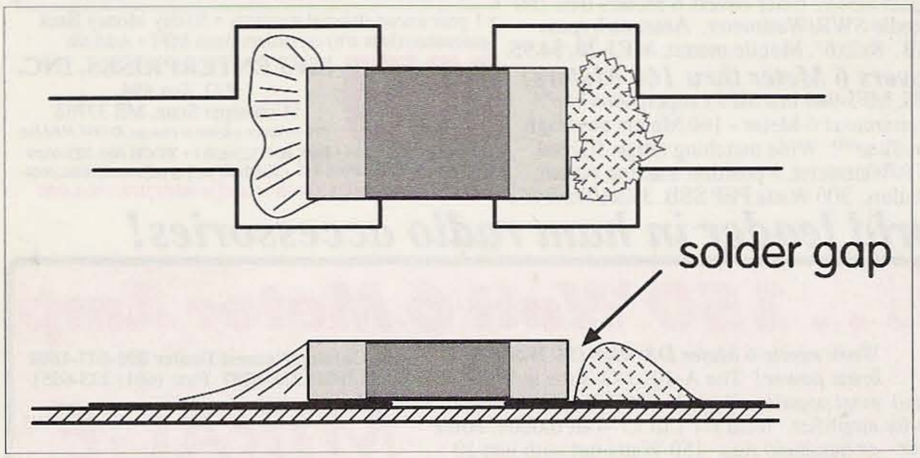

Fig. 3. Absence of a solder joint. There is no solder wetting of the SMD. The lack of wetting may also occur at the pad to create an open or intermittent connection.

solder to both terminals (of a two-terminal device) and "float" the part off the pads. If another part is to be mounted on the same pads, clean up the pads with Solder Wick and follow the steps indicated in the soldering process.

As an alternative removal process for a known defective component, cut each lead close to the part body and remove the part body. Grasp each lead with tweezers, then heat and remove the lead. Use Solder Wick to remove the excess solder from the pads before placing the new part.

Soldering criteria

The assembly and soldering criteria for SMDs differs slightly from through-hole parts. SMDs are totally dependent upon the solder joint for physically holding the part in position and for proper electrical connection. Improperly mounted parts, such as chip capacitors, may not have a fully soldered terminal if the part is skewed on its pads. This is particularly important in RF circuits where the connection impedance may be higher than expected, creating an unpredictable circuit function.

For SMDs, a solder joint must join each terminal to the appropriate board pad where the solder joint has three important features:

1. Solder wetting of the component terminal area.
2. Solder wetting of the pad.
3. A smooth solder fillet joining the two mated wetting surfaces.

Inspection criteria involve placement of the correct part, orientation, and a proper solder fillet. Broken and damaged parts are unacceptable and must not be used.

Correct solder wetting between the pad and SMD should resemble **Fig. 2**. Look closely at a full solder fillet from the pad to the top of the SMD terminal. Solder fillets on the side of the SMD terminal are optional.

Fig. 3 shows proper wetting on one end of an SMD while the opposite end exhibits improper terminal wetting. The lack of wetting may create an open or intermittent connection. The lack of wetting may occur at the interface between the solder and either the terminal or pad. The correct terminal wetting solder fillet for a round SMD is shown in **Fig. 4**.

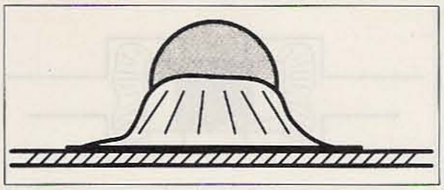

Fig. 4. Correct wetting for round SMDs.

Fig. 5 shows a skewed SMD. Although the SMD terminal may be soldered to the pads, the wetting is insufficient and the SMD should be repositioned to achieve the lowest connection impedance.

Chips and similar mechanical damage to the ceramic, glass, or plastic body of the SMD are unacceptable (**Fig. 6**). Although the part may function while damaged, its value may be altered and it may perform unreliably. Cracks in the part body (**Fig. 7**) are unacceptable.

Used SMDs

As a cautionary note, used ceramic and glass SMDs that have been removed from circuit boards with Solder Wick may suffer from terminal plating loss. Ceramic and glass SMDs have terminals of thinly plated-on silver, and during solder removal, some or all of the plating may be removed, preventing the terminal from accepting solder again (see definition of *leaching*). The use of silver-bearing solder reduces the risk of plating loss.

Glossary

Active flux: A chemically active agent that speeds the wetting process of metals with molten solder. When heated, the flux will remove oxides but will not remove oil, dirt, or fingerprints. Upon cooling, rosin flux becomes relatively inactive, but the residue must be removed completely.

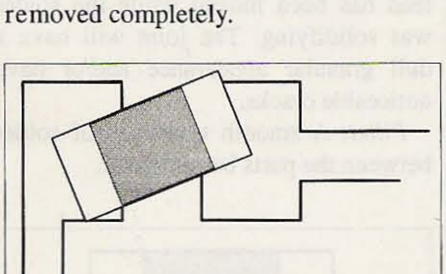

Fig. 5. Although the SMD terminals may be resoldered to the pads, the wetting is insufficient and the SMD should be repositioned.

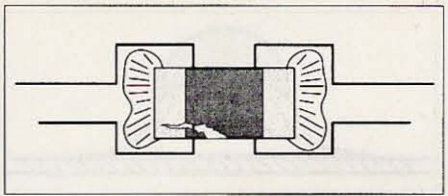

Fig. 6. Chips and similar mechanical damage to the ceramic, glass, or plastic body of the SMD render it unacceptable.

Bridging: The formation of an undesired conductive path between conductors.

Cold solder connection: The required metallic luster is missing and generally the solder joint has the appearance of rough, piled-up solder with a granulated surface. It may also appear chalky and frosted.

Component: Any electrical or mechanical device (resistor, capacitor, integrated circuit, etc.) which has electrical characteristics used in an electrical circuit.

Component terminal: Wires, solid terminal protruding from the body of a component.

Conductor: A single conductive line or area forming an electrical connection between terminal areas.

Connection: The means by which electrical contact is made to the conductive circuit.

Contamination: A material such as oxide, oil, dirt, or fingerprint which is not intended to be part of the process.

Corrosive: A substance is considered chemically reactive or corrosive if it has the ability to degrade a conductive pattern electrically and/or mechanically.

De-wetting: Characterized by solder not completely covering the surfaces to be bonded. Solder may appear as droplets or balls having withdrawn from previously wetted adjacent pads.

Disturbed joint: A joint in which the lead has been moved while the solder was solidifying. The joint will have a dull granular appearance and/or have noticeable cracks.

Fillet: A smooth transition of solder between the parts being joined.

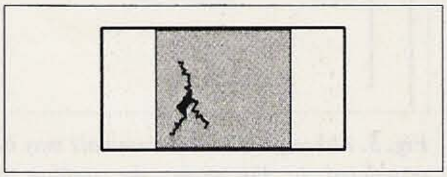

Fig. 7. Cracks in the ceramic body of the SMD are unacceptable.

Flux: See *Active flux.*

Fractured joint: May be identified as a disturbed solder joint exhibiting a dull granular appearance and/or have noticeable cracks.

Granular solder: Solder appearance with a coarse, large grain structure, lacking in metallic luster.

Leaching: A condition where SMD end cap metal disappears as a result of repeated solder operations. Leaching appears as a series of holes or areas where the base metal has been removed from the device end cap.

Non-wetting: A condition whereby a surface has contacted molten solder, but has had little or none of the solder adhering to it.

Oxidation: A form of contamination which prevents proper solder wetting (caused by unprotected metal being exposed to air).

Pad: The portion of a printed circuit or wiring used for making an electrical connection to a component or wire.

Plating: The process consisting of the chemical or electrochemical deposition of metal on all or part of a component terminal or board pad.

Printed circuit: A pattern composed of printed wiring or circuitry formed on a common rigid or flexible base.

Residue: Substance remaining on a circuit board after soldering and cleaning, such as flux, oil, or salts.

Solder: Ordinary soft solder is a fusible alloy consisting of essentially tin and lead used for the purpose of joining two or more metals at a temperature below their respective melting points.

Solderability: The measure of the ability of a metal surface to be wetted by solder.

Terminal: A solder area such as a solder pad where a component lead/terminal will be attached.

Terminal leaching: See *Leaching.*

Tinning: The process of coating conductive parts or terminal areas (pads) with solder for the purpose of increasing solderability.

Void: The absence of a specific metal from a certain area. Voids such as pinholes or blowholes may result from the formation of gas pockets in the surface being soldered.

Wetting: The free flow and spreading of solder on conductive paths and terminals to form an intermetallic bond. ■

Number 15 on your Feedback card

El Cheapo

Rub shoulders with the big boys on 20 meters, without shelling out megabucks!

Ron Gang 4X1MK
c/o *73* Magazine

The forgotten collinear will do the trick for you. All you need is a single mast to raise it at the center (inverted-vee style) and a couple of trees to tie the ends to. A bit of real estate is necessary as well, but the 20m version is three-quarters the length of an 80m dipole. Of course you can't rotate it, but those receiving your big signal will never know (unless you tell them).

I say "forgotten," as information about this skywire appears in old handbooks and magazine articles, but in the last 20 years I've seen no mention of it. Of all the stations I've contacted, nobody on the other end of the QSO has reported using a collinear. A few old-timers do know what I'm talking about when describing the antenna, but that's it. So, in the interest of exploiting the past and possibly adding something to it, I take pleasure in re-presenting the horizontal collinear antenna for HF.

The collinear is used widely today in its vertical version for VHF and UHF applications, such as the Ringo Ranger™ and other base and mobile antennas that combine more than one radiating element in line with another (col-*linear*) to give a radiation pattern to the sides with little radiation at the ends. The vertical jobbies have a low angle of radiation, concentrating the signals at the horizon, with little wasted into the sky above while maintaining an omnidirectional pattern—but that's another story.

Fig. 1 shows a diagram of the single-band three-element collinear. (The center section is interrupted in the middle by an insulator and becomes the feedpoint.)

The phasing stubs delay the current in the end elements by 180 degrees from that flowing into it from the center element, so that all three half-waves are working in phase. That causes their wavefronts to join together, making a very strong broadside radiation pattern. Thus the antenna radiates with excellent directivity at right angles to it, receiving consistent signal reports equal to those received with a three-element yagi. Whereas the yagi is unidirectional with a theoretical three-dB lobe of 60 degrees' width, the collinear is bidirectional with two 36-degree three-dB lobes.

My collinear is stretched from the northeast to the southwest, giving me major lobes to the northwest (for great signals into Europe, North America and long path to VK/ZL) and southeast (for South Asia and Oceania). For DXers in North America, I'd recommend stretching it from the northwest to the southeast for good sigs to Europe and the Mid East in one direction and VK/ZL in the other. Of course, your wants will determine how you hang it.

Feeding the antenna

The feedpoint impedance for a three-element collinear is around 300 ohms. It may be fed with a 4:1 balanced-to-unbalanced balun into coax for simple single-band operation, for the band for which it was cut.

For multiband operation, use a balanced feedline directly from the feedpoint of the collinear into the balanced output terminals of an antenna tuner in the shack. In this configuration, a 20m antenna tunes like a breeze for 20, 17, 15, 12, and 10 meters, and has been also successfully tweaked to work

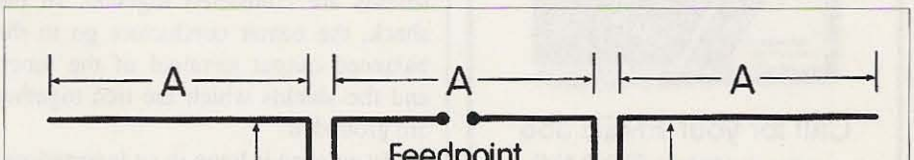

Fig. 1. Construction diagram.

acceptably on 30, 40 and 80. My 20m collinear also gave excellent results on 17 meters into North America. Although on other bands I felt no advantage, the antenna functioned well—at least as well as a simple dipole or random wire. But there was nothing spectacular on those bands for which it wasn't intended. On those bands it is what used to be called a centerfed zepp.

I highly recommend the use of a balanced coaxial transmission line instead of open-wire feeders (see **Fig. 1**). The advantages of the balanced coaxial transmission lines over open-wire are:

1. No extraneous radiation, thus less TVI, BCI, and other "I"s.

2. Less pickup of extraneous signals from computers, TV sets, and the like.

3. The feedline, unlike the open-wire feeders, is not affected by precipitation or proximity to metal objects like your tower, etc.

4. Ease of construction: There is no need to keep the conductors at a constant distance from each other. For aesthetic reasons you may wish to tape the two coaxial cables together at intervals, but this is not necessary.

The balanced coaxial transmission line is constructed from two *equal length* coaxial cables, the shields of which are electrically connected to each other at each end. Any cable will do, no matter what impedance. Incidentally, the impedance of the line is twice the impedance of the individual cables. That means that if you're using 50 ohm coax, the feedline will have an impedance of 100 ohms. But since you're using an antenna tuner, it will take care of such mismatches. At the antenna end, each center conductor of the coax is connected to one of the legs of the collinear. The shields are connected together. In the shack, the center conductors go to the balanced output terminal of the tuner, and the shields which are tied together are grounded.

My antenna is hung in an inverted-vee fashion, with the center at the top of a 10-meter mast on top of a seven-meter-high roof. At the top of the mast is a clothesline-type pulley with plastic-coated steel cable which I use to raise and lower the wires, a great tip for antenna experimenters who don't want to hassle with climbing or raising and lowering masts. The ends droop down to about eight or 10 meters above ground, the extended wires from the end insulators tied onto conveniently located trees.

This configuration may be not quite theoretically ideal, and the antenna might operate possibly better if the ends were be higher up. But I don't think the effort is worth it, judging by the good comparative reports on 20m over the last few years of operation with this wire. After all, 20m is a crowded band, and here the men and women are really separated from the boys and girls.

This antenna costs next to nothing to construct. All you have to do is measure accurately, and hoist it up. I've used various very long wires and vee beams over the years, but on 20m, this baby beats them all. No longer do I feel in the back seat on that band—in the final analysis, it can be truly said that the wire collinear antenna for HF delivers the biggest bang for the bucks!

Adding collinears in parallel

I was quite satisfied with the performance of this skyhook on 20m, the band of my preference for long-haul QSOs; for the forays into the other bands, it worked acceptably. Nonetheless, I found I wanted better performance on 15m, and thought of adding a 15m version at the feedpoint. In all the literature at my disposal I found nothing about connecting antennas of this sort in parallel.

The time had come to be a true ham, and experiment. A 15m version was constructed and connected at the feedpoint, drooping below the 20m antenna somewhat. Since both collinears were made of insulated wire, there was no problem where the phase-delay stubs crossed the 15m wires. It is a bit tricky hanging one under the other, and it's important that the wires of the two collinears don't twist around each other at any point.

The wire I use is stranded copper in a PVC jacket, the cross-sectional diameter being 1.5 square millimeters, roughly equivalent to AWG #18 wire, the type which is used in automobile wiring. I like this wire because it does not kink as does solid wire, and always stretches straight, easily. In North America, I would think that stranded copperclad wire for antennas is readily available, which doesn't slowly stretch over the years as does the soft copper that I use. It's possible that there just may be an ad or two in this magazine for companies selling antenna wire.

The results were rewarding: It worked fine on 15, just as expected. However, there is a certain amount of interaction between the two antennas, and here the antenna tuner and balanced line proved their worth. I don't know how you'd make out here with just a 4:1 balun and a single coaxial line for dual-band operation. I expect it would work, but with poorer SWR.

Stub construction

The multiplicity of ladderline-type stubs (four of them now), is rather a bit unsightly (even in a ham's eye) and makes it rather awkward to manage. A single-band collinear is easier to manage with but two stubs, but when there are high winds, the 15m and 20m stubs have been known to tangle with each other. Twinlead stubs should be more manageable, but you might have to experiment with the length as the velocity factor will be somewhat different than what I used here.

Incidentally, in order to duplicate my stubs, I used the same 1.5-square-millimeter PVC-jacketed stranded copper spaced 2.5 cm (one inch) apart with home-fabricated Plexiglas™ spacers. I constructed the stubs by stretching the two wires between two points, then moving the spacers along the line, fabricating the ladder as it were. Then I dropped epoxy cement at the points where the wires go through the holes in the spacers and let the glue set thoroughly before removing the wires from between their temporary stretching points. However, if you can locate ladderline or twinlead, save yourself the time wasted reinventing the wheel. It's just that in my neck of the woods ladderline is not available.

What's left to be done

In my mind, the stubs are the downside of this skywire. There must be a better way of doing it. Possibly substituting a tuned circuit to effect the 180-degree delay, or maybe hanging pieces of coaxial cable like RG-58 or -59 shorted at the far end instead of the ladderline stubs. The coax, having a 66% velocity factor, should be around 70% the length of stubs I used. No doubt a collinear without the droopy stubs would be more aesthetic in the eyes of a non-ham. (Any antenna is a work of fine art in ham's view!) I'd love hearing from anybody with experience in the stub business in order to further refine this skyhook!

Suggested reading

Dick Silberstein WØYBF, "Collinear Antenna for 20 Meters," *Ham Radio,* May 1976.

ARRL Antenna Handbook, 1972.

John S. Belrose VE2CV, "Tuning and Constructing Balanced Transmission Lines," *QST,* May 1981.

LETTERS

Continued from page 7

some research. I would like to see an article on the construction of the magnetic pulse generator. Even though it is quite easy for some of us to make them without detailed instructions, there are many who cannot get them going. I took my flash gun to a camera technician who made a neat connection to the zener tube without wrecking the gun. I did wreck another flash gun and mounted the PC board and a more powerful zener tube into a neat case and I drive it with a six-volt power pack. It kicks a washer two feet into the air. An excellent method of cleaning the silver electrodes is to use a soft pencil eraser. It polishes and shines them quickly and easily. Keep up the good articles on health in your editorials. I have been a health nut for 50 years and now at age 79 I look no older than 55, and am still as fit as a teenager. On the question of Morse code, I love it. Anyone who takes the time to master Morse code will also be hooked on it—ask any CW buff.

Sure, Frank. I love raw liver, so let's make a law requiring everyone to eat raw liver. Anyway, how about some articles on pulse units? ... Wayne.

APRS Network Guidelines

20 tips for increasing efficiency.

Richard Parry P.E. W9IF
13842 Deergrass Court
Poway CA 92064-2276

The Automatic Position Reporting System (APRS™, a trademark of Bob Bruninga WB4APR) network is significantly different from regular amateur packet networks used for communication. Virtually all amateur packet radio communication uses the connection-oriented form of AX.25, which provides error-free communication. However, APRS uses the connectionless form of AX.25, which is an unreliable protocol in which lost packets are not detected. Therefore, to help ensure reliable communication, operating practices play an important role.

The AX.25 protocol has its roots in the X.25 international standard. However, the commercial version does not meet all requirements of the amateur radio community. A critical limitation of X.25 is the protocol's insistence on knowing the source and target address. For amateur radio, this would make it impossible for a station to call CQ since the destination station at the time of transmission is unknown. To solve this problem, the *unnumbered information* (UI) frame was added to the protocol. It allows the transmission of packets without a unique destination address and does not require an acknowledgment.

Over a decade of packet radio has come and gone, but it was not until fairly recently that the UI packet gave birth to this new type of network. The APRS network is built entirely on the transmission of UI packets. Both fixed and mobile stations broadcast their position at intervals from once a minute to once an hour using UI frames exclusively. However, since there are no acknowledgments for UI frames, lost packets are undetected. In addition, if good practices for APRS networks are not followed, packets are more likely to collide and result in inefficient use of the available bandwidth. Therefore, much of the challenge of reliable communication in these networks is selecting and using good operating practices to accommodate the wide variety of uses, while keeping within the limitations of the protocol.

APRS can report the position of a float in the Rose Bowl parade, the Olympic torch as it travels throughout the United States, or a Boston Marathon runner. It can broadcast their positions across town, and across the country. However, it would be impossible for the network to support position reporting of the daily commute to and from work for all amateurs.

The APRS networking protocol requires users to cooperate to ensure efficient use of the available bandwidth. With these limitations in mind and the need to foster cooperation, the APRS community has developed some generally accepted practices. The guidelines listed below are the result of my operating experience and discussions via the APRS mailing list. An examination will show that many of the guidelines are common sense. However, some are more subtle and require a better understanding of the network.

Lastly, remember that these are guidelines, not rules. For example, a good digipeating path for one station may be bad for another. Factors such as your location and the amount of traffic in your area will play a major role in determining what works for you and your network.

APRS operating guidelines

1. Always use the *minimum* digipath necessary to maintain communications to minimize channel loading and QRM. Remember, the APRS protocol uses UI frames, which does not assure reliable delivery of packets.

2. Fixed stations (e.g., home APRS stations) should not beacon very frequently. Intervals from 20 to 60 minutes are common.

3. Fixed stations which broadcast weather-related information may transmit at frequent intervals. The present standard is every nine minutes.

4. Mobile stations (e.g., moving APRS vehicles) may beacon as frequently as once per minute for special events or

three to five minutes for routine mobile operation. Care should be exercised, with local network conditions taken into account.

5. When a mobile station changes to a fixed station, such as when the station arrives at its destination, the beacon should be stopped or the rate adjusted to meet the new designation as a fixed station.

6. Use APRS VIA WIDE for your path if you are in a metropolitan area where you can hear a WIDE. Better yet, if possible, specify a unique digi (callsign).

7. Use APRS VIA WIDE, WIDE for regional coverage. In a metropolitan area with an active APRS community, you should get coverage up to 100 miles. Better yet, specify a fixed callsign in place of the second WIDE to get better coverage.

8. Fixed stations may set a path of APRS VIA RELAY, WIDE if the WIDE cannot be reached directly. Then when you find out who your local RELAY is, you should specify a unique callsign for the first digi.

9. If you have information for a national audience, use APRS VIA WIDE, GATE to reach an HF gateway. However, this is for rare occasions. The 300 baud HF data rate limits the number of mobiles nationwide to approximately 20. This path may also be used by long-distance travelers with emergency or priority traffic who are near a GATEway.

10. Never use APRS VIA WIDE, WIDE, WIDE since it has the potential to totally saturate a channel with 27 copies of each packet. If you are in a remote area, this may be your only option, so the "never" may be changed to "seldom." Again, use a fixed callsign as the first digi if possible.

11. Although APRS supports keyboard-to-keyboard contacts, extended use of this communication technique is discouraged, especially on the HF where the information rate is 300 baud.

12. All fixed stations should set the TNC's MYALIAS to RELAY. This will vary between various manufacturers' TNCs, but some form of an alias should be set to RELAY. This is true even for mobile stations.

13. Mobile stations should use RELAY, WIDE or RELAY, WIDE, WIDE as a digipeating path for citywide coverage.

14. Do not enable the GATEWAY function of your TNC unless you are the only GATEWAY near your local WIDE. Before setting the GATEWAY function, local coordination with other GATEWAYs is encouraged. This is especially true when an existing GATE already serves your network.

15. Never digipeat on HF unless both stations attempting to pass data cannot hear each other but are known to be online. If you must digipeat on HF, use only one hop. This is typically for emergency or priority traffic only.

16. Whenever possible, use a direct path to chat.

17. If a direct path is not practical, use a specific digipeater callsign in lieu of a generic path such as RELAY or WIDE.

18. When events, information, or data are intended for a specific area, utilize a specific path by designating the exact callsigns of the digipeaters necessary for reliable communication.

19. As APRS popularity continues to grow, the potential for long-range VHF coverage is possible. Ask yourself if your information is of interest to someone a hundred miles away. If not, restrict the path.

20. Consult local experts or experiment to find the best route for your application. Remember, these are guidelines and numerous exceptions exist.

The intention of these guidelines is to provide a working background for the development of efficient APRS networks. Despite the network's apparent simplicity, some of the practices may not be so obvious, even to the advanced user. Most of the guidelines are straightforward when one understands how the network functions and its limitations. Many others are not so obvious and still others may be the point for further discussion. When in doubt, ask the local APRS expert. If you have access to the Internet, the APRS mailing list is an excellent source of information. All you have to do is send mail to the [aprssig@tapr.org] mailing list where you will typically get an answer within hours from a large group of "Elmers" ready, willing, and able to help you. To join the APRS mailing list, send E-mail to [listserv@tapr.org] with subscribe aprssig FirstName LastName in the body of the message.

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Dimse, Steve, "javAPRS: Implementation of the APRS Protocols in Java," *ARRL and TAPR 15th Digital Communications Conference Proceedings*, Seattle, Washington, September 1996.

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Horzepa, Stan, "APRS Tracks," *Packet Status Register*, Spring 1996, Issue #62.

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Parry, Richard, "Position Reporting with APRS," *QST*, June 1997.

Phased Trapped Verticals for HF

Simple ideas, simple to build.

Laurence C. (Curt) Raynes KD7FY
2150 Laura St. #85
Springfield OR 97477

A lot is known about phased antenna arrays—the math for them is well documented, but the little bit I once knew I've pretty much forgotten. Thankfully, for ham use, not much math is needed, and the answers will come quickly by experimenting.

To set up this small array, a pair of Butternut HF6s were mounted on 10-foot poles beside a mobile home with their base feedpoints near the edge of the metal roof, which was used as a ground plane. They were mounted so the line of the antennas was on a north-south axis and were spaced 18 feet apart, which is about 1/8 wave on 40m. Identical lengths of coax were used from each antenna's feedpoint to the phasing box in the shack. To maintain about the same impedance when reversing the pattern, extra care was taken in tuning the trap verticals so they had the same section lengths and dip frequencies. Of course, any like pair of antennas can be used. Different style antennas can also be nulled, but they give less satisfactory pattern reversal.

RG-8/M coaxial cable was used for the feedlines because of availability and price, but any good coax will serve, if the phase delays of the two feedlines are the same. If they are an electrical half-wave in length, they will repeat the antenna base impedance in the shack, but this isn't necessary for good operation—only for measuring convenience.

Simple ideas

Starting with two equal antennas and two equal feedlines, if Line 1 is made longer, then Line 2 is shorter than Line 1. Making Line 2 even shorter increases the difference between their lengths. So if there is a coax delay line retarding the phase of the power to Antenna 1, the antenna-to-antenna phase difference can be made greater by advancing the phase of the power to Antenna 2.

The phase delay to one antenna, plus the phase advance to the other, plus the space phase, which is the free-space distance expressed in degrees between the two antennas, should add up to 180° for an endfire array.

Ideally you should have equal radiation from the two antennas with phase relationships that will subtract in one direction and hopefully add in the other. Operationally, you hear a station, reverse the array pattern and null it, then reverse the pattern again for best reception and transmission. This sounds pretty simple, and it is, but there are a few nice-to-know things when using endfire arrays at high frequencies.

There will be a delay…

The classic example of ham endfire arrays is usually constructed with one delay line. The free-space distance of a half-wave at 7.03 MHz is about 70 feet, and the distance-to-phase relationship is about 0.389 feet per degree; a quarter-wave separation between two antennas is 35 feet, which is 90° of space phase. The antennas will be out-phased to 180° with an additional 90° coax delay line in series with one of the antennas' two equal feedlines.

To make a coax delay line, the coax velocity factor, VF, is needed. The VF is the relationship between free-space velocity and the propagation velocity of coax cable. Tables list the VF for RG-8/M at 0.75, but the RG-8/M I have measures to be 0.73. To find the VF, dip a quarter-wave piece of coax and compare its electrical length to its measured length. Using 0.73, the length-to-phase relationship is 0.284 feet per degree at 7.03 MHz. A 90° delay line of RG-8/M is 25.6 feet long (0.284 x 90 = 25.56).

Such a delay line does not compensate for HF skywave communications, because the effective space phase distance between the two antennas decreases as the skywave angle increases and a longer delay line is needed to make up the difference. For example: The cosine of a 30° radiation angle is 0.866, so the adjusted space phase distance between two antennas with a physical separation of 90° becomes 78° (90 x .866 = 78), and 12° more delay line is needed for a total of 102°. This equates to about 29 feet of RG-8/M for such a delay line.

You could make a switch to add in five-degree increments to a basic delay line. This would be pretty simple and a reasonable way to go, but a five-degree line for 40m becomes a 10° line at 20m, and suddenly you need a whole bunch of switch points that will handle real power.

I'll take the mismatch caused by the unknown impedance of a variable phase advancing Tee network to get cancellation because the impedance of the array changes with phasing anyway, and all unknowns become moot when you match the system to 50 Ω resistive. Besides this, Tee network phasing works well on other bands too.

The system here is wired so that with the antenna switching relays relaxed, both antennas are connected in phase to the delay line. With one relay coil energized, the Tee phase advance network is connected to one of the antennas, and the coax delay line is connected to the other. This sets up the antennas for an endfire pattern. Opening that relay, and closing the other, reverses the pattern.

This array was a simple north or south system at first and then it was decided to take advantage of a broadside connection for an east and west pattern. In this mode the Tee network is not used and RY3 disconnects it. The delay line is left in the circuit as its loss is minimal. The endfire and broadside impedances are quite different, so the array must be rematched with the antenna tuner when changing between endfire and broadside patterns.

The patterns are quite wide, so a station that is due east or west will not null, and it will come in at about the same signal strength when the endfire pattern is either north or south. This makes you wonder if something has happened to the system. Thankfully, the broadside east and west pattern is better on such stations—especially if they are far away.

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A few words about the Tee network

A split stator dual capacitor with its rotor connected through a spinner coil to ground will allow a wide range of phase advances. However, if you are really a diddler, you'll want a small differential dual capacitor connected in parallel with the split stator. It will allow tweaking control over magnitude along with the phase control for the two antennas. My split stator capacitor is about 200 pF per section with 1/10-inch spacing.

This system really works on 40, 30 and 20m. On 40 meters I use a 13-foot delay line and the Tee network makes up the difference. The same line works on 30m. On 20m the antennas are a quarter wave apart and need a little more than 90° of delay, and the Tee network gets it easily. A Tee-type high-pass antenna tuner will function as a Tee phase shifter if it has a spinner coil.

If you live in an area where bad power line or industrial noise is pretty much in one direction, you can null out quite a bit of it with this kind of antenna by setting the null on the horizon towards the noise source. I get about 20 dB of noise reduction from a bad HV line south of me, and can still work high-angle stations in this direction. Also, touch and glow lamps are a pest, and often these can be nulled. You can't work 'em if you can't hear 'em and this antenna lets me hear 'em.

A small 1:1 transformer is used to isolate the 115 VAC used by the switching relays. These relays have low coil-current requirements which makes possible the use of good old-fashioned 2.5 mH, segmented RF chokes to isolate the relay coils from ground and allow them to switch higher voltages. They hold OK at a kilowatt. The RF chokes are not needed at the 100 W level.

The relays are split-core, and are DPDT with 10 A contacts. They are inexpensive and work well, but I do pull off their caps and dress the leads away from their metal frame before using them.

This project is high fun for a tinkering ham, and if in the past you have worked as an AM broadcast tech, you'll find it kind of neat to own your personal directional array. 73

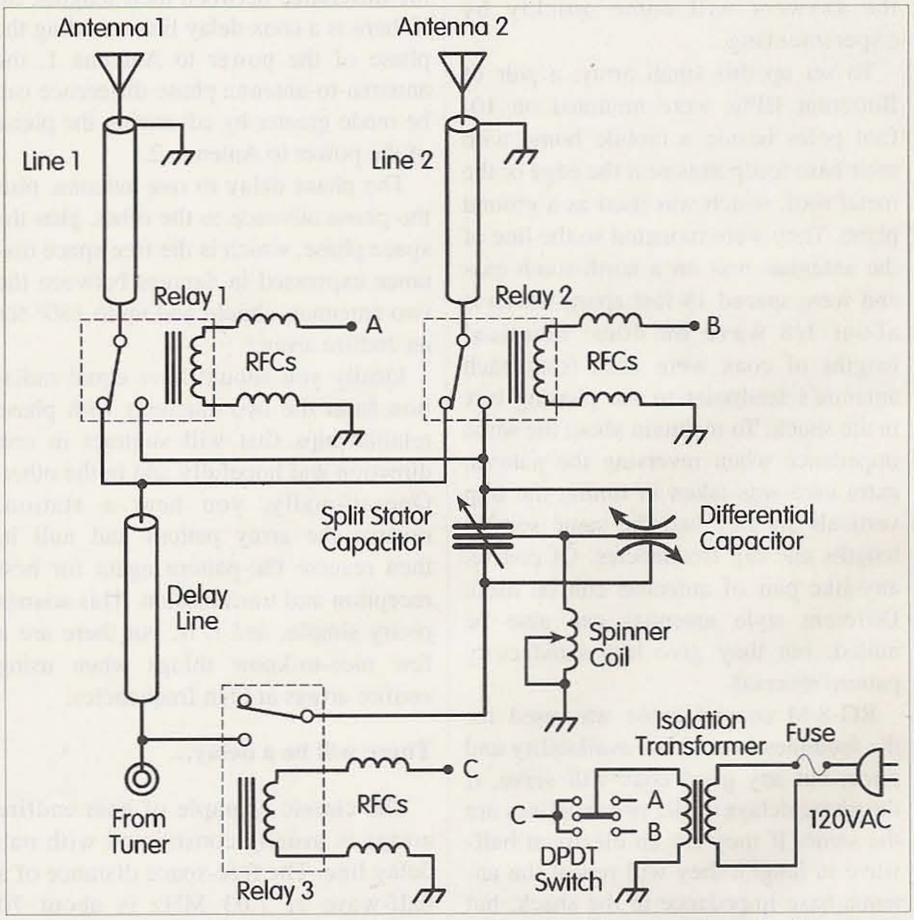

Fig. 1. Circuit diagram of the variable phase advancing Tee network used with two trap verticals.

Simple Signal Injector/Tracer

Troubleshooting made easy.

J. Frank Brumbaugh W4LJD
P.O. Box 30 - c/o Defendini
Salinas PR 00751-0030

Over time, resistors can change value. Capacitors can leak, or develop shorts or opens. Transistors, ICs, and diodes can be damaged by voltage spikes. A cold solder joint can open, or become a poor diode junction. In home-brew equipment, the chance of a wiring error or the right part in the wrong place is often the cause of poor or no operation. Mono and stereo amplifiers get a lot of use, as do the audio circuits in SSB transmitters. Because, after your antenna, your receiver is the most important part of your ham station, it is imperative that it operate as properly and consistently as possible, no matter its age or history.

Signal injection and tracing is the simplest way to locate and isolate a defective or inoperative stage in both audio equipment and radio receivers. These techniques allow rapid troubleshooting and repair. The simple circuit described here will allow you to isolate any problem to a specific stage in your equipment, from the antenna connector in your receiver or the audio input to your stereo to the speaker or headphone jack. It uses just two inexpensive integrated circuit chips (ICs) and a couple dozen common parts. It can be constructed in two or three hours at a cost of less than 10 dollars, even using all new (surplus) parts, and much less if you have even the beginnings of a junk box. It is cheap insurance to keep all your equipment "on its toes."

The circuit

Fig. 1 is the schematic diagram of the Signal Injector/Tracer. Power is supplied by BT1, a 9-volt battery, and controlled by S1, a 2-pole 4-position (wafer) switch. S1 allows use of either the injector or tracer circuit alone, or both at the same time, depending upon circumstances. LEDs illuminate to indicate which circuit is in use.

U1, a 555 timer IC, is connected as a square wave oscillator operating at about 1,000 Hz. This signal is routed from pin 3 to a probe containing C10, and a 0.01 μF ceramic capacitor which isolates the DC voltage on pin 3 from the equipment being checked, as well as isolating its voltage from this instrument. Because the signal generated is a sharp square wave, it contains many harmonics throughout much of the radio spectrum. This makes it useful to inject signals from RF through audio.

U2, the signal tracer, is an LM386 audio amplifier IC configured for maximum gain. Input from the equipment under test is applied through a probe containing a 0.01 μF monolithic isolation capacitor, C11, and a shunt diode detector, D1. This allows tracing a signal from RF through audio frequencies. Signal level is controlled by LEVEL control R3, a 10k audio taper potentiometer. Output from U2 is routed to headphone jack J1 and to an optional 8-ohm speaker, LS1.

Construction

Except for the two probes, this instrument should be constructed on a small piece of perfboard, or one of the general-purpose printed circuit boards available from Radio Shack™. An enclosure should be used in the interest of neatness. An aluminum or plastic box, or one made of printed circuit board material, can be used.

Lead lengths and parts placement are relatively unimportant except as follows:

C5 (10 μF electrolytic) should be mounted at the end of U2 where pins 1 and 8 are located.

C7 (470 μF electrolytic) should be mounted as close to the body of U2 as possible, with minimum lead length to pin 6.

C4 (470 pF ceramic disc) should be mounted for minimum lead lengths to pins 2 and 3 of U2. Its function is to prevent U2 from picking up stray RF,

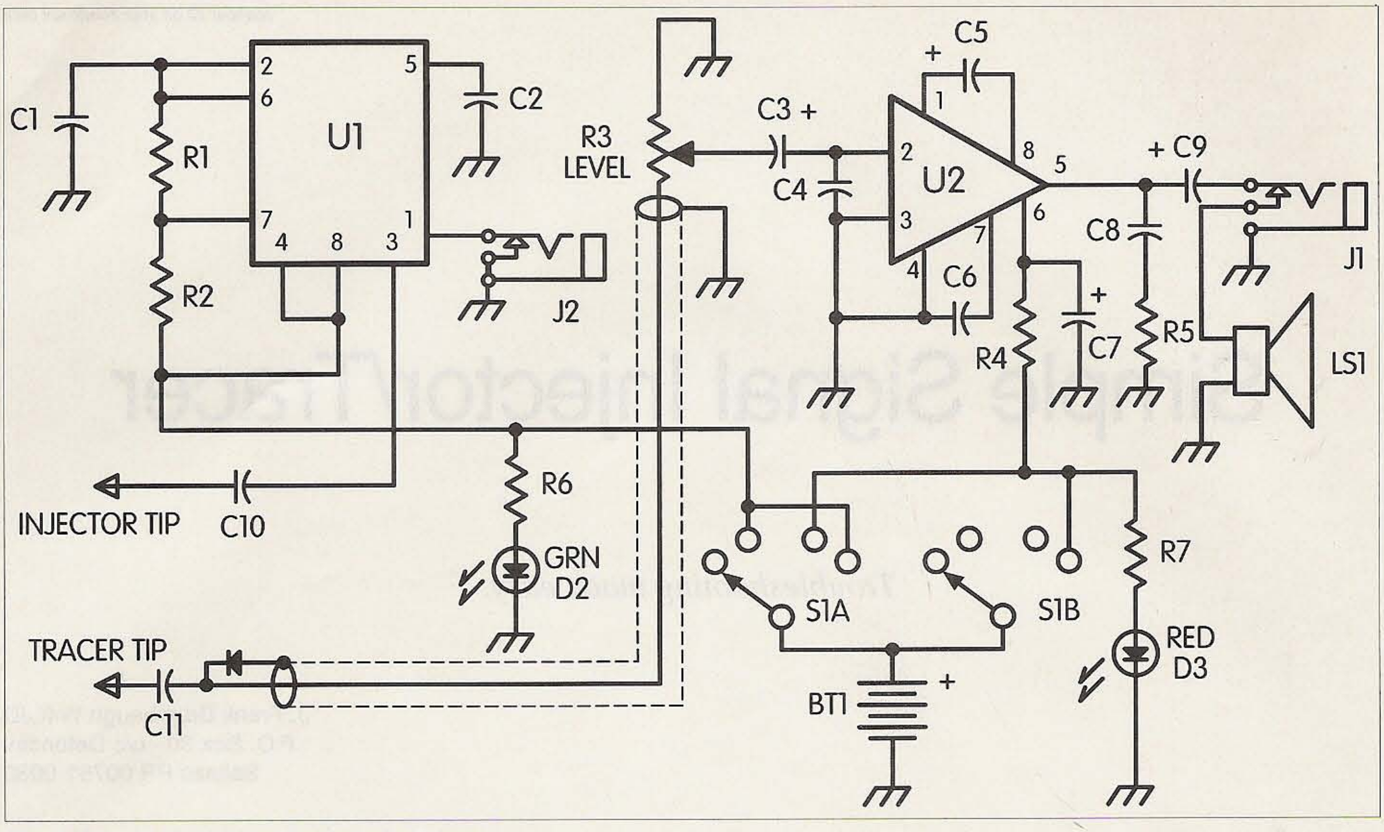

Fig. 1. Signal Injector/Tracer, schematic diagram.

including that from local AM broadcast stations.

Jacks J1 and J2; LEDs D2 and D3; switch S1; LEVEL control R3; and speaker LS1 if included, should be mounted on the panel. Probe cables should enter the enclosure through grommeted holes in the panel and are hard-wired into the circuits.

Probe bodies are specified as test prods, but you can make similar probes from old ball-point pen bodies as long as you have a strong metal tip. Test prod bodies are easiest to use. Connect C10 (0.01 µF monolithic) to the open end of the injector probe wire, which is a stranded insulated wire. Remove the tip from the test prod P1. Insert the probe wire and C10 through the probe body and connect the lead from C10 to the probe tip. Secure the probe tip into the probe body. To prevent pulling the probe wire loose from the body, inject some hot glue or silicone rubber into the probe body where the wire emerges, and let it sit to solidify.

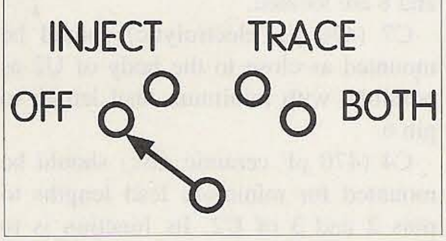

Fig. 2. Identification of switch positions.

Because the tracer probe uses shielded wire, strip back the outer insulation about a half-inch and strip the inner conductor 1/8-inch. Solder one end of C11 (0.01 µF monolithic) to the center conductor. Remove the probe tip. Slide the shielded wire and C11 through the probe body. Now solder the cathode of the D1 germanium diode to the junction between C11 and the inner conductor of the probe cable. Hold the diode lead with needlenose pliers or an alligator clip while soldering and until the joint has cooled. Now solder the diode anode lead to the shield of the probe cable. Clip off excess leads. Inspect it closely to ensure the diode is not shorted out. It must have its body snugged up against the probe cable so it will fit within the probe body. Secure the probe tip to the body. Inject some hot glue or silicone rubber into the probe body where the cable emerges and set it aside to solidify.

Battery BT1 can be mounted in a clip inside the case, or a strip of self-adhesive hook-and-loop strip such as Velcro® can be used.

Operation

This instrument provides three modes of operation. It can inject a signal into a powered piece of equipment which contains a speaker, or with headphones plugged in. It can also trace an existing or injected signal through powered equipment. It can also both inject and trace a signal through a powered but defective or non-operating receiver or amplifier. Both signal injection and tracing will be discussed separately, below.

Caution

Although the procedures described here are the same whether the equipment being checked is powered by a battery, a separate low voltage DC power supply, or a vacuum-tube type whose line cord plugs into the household 120 VAC service, you must be extremely careful when working on any equipment powered by the AC line.

Signal injection

Open the equipment to be checked, to provide access to all stages from input to output. Turn the equipment on. Check with a voltmeter that operating voltage is present and is correct. Rotate any gain controls fully clockwise, or slide controls to maximum gain. If the equipment has a speaker or if you are using headphones, you may hear some noise—possibly signals if it is a receiver. What you hear may be weak, or you may hear nothing at all.

If the equipment contains vacuum tubes, connect a 0.1 μF 500 V capacitor to the probe tip and use the other lead of the capacitor as a probe. This is necessary to protect this instrument from excessive voltages higher than the working voltages of the isolation capacitors in the probes.

Turn S1 to INJECT. The green LED will illuminate. Touch the injector probe to the output of the audio amplifier. You should hear the signal in the speaker or earphones. If the speaker does not reproduce the signal, it is either defective or a connection has come loose.

Touch the probe to the input of the audio amplifier. You should hear a loud signal. If none is heard, or if it is very weak, the stage is defective.

Touch the probe tip to the input of the preceding stage. If this signal is ahead of the volume control, it is good. Adjust the volume control to reduce signal level. If the volume control does not reduce the signal it probably requires replacement.

Continue these steps, touching the probe tip at the input to each stage from output to input, reducing the equipment's volume control as required. Where volume drops, is intermittent, or there is no signal at all, you have found the defective stage.

The above procedure assumes the equipment being checked exhibits some life but is not functioning properly. If a stage does not seem to amplify, or will not pass a signal as you work from output to input, you will then use normal troubleshooting procedures to isolate and replace the defective component. It will usually be easiest to replace suspected components one at a time, checking with the signal injector after each is replaced, until the problem is solved.

Signal tracing

With the equipment powered up and proper operating voltages present, rotate all gain controls and slide controls to maximum gain. Be extremely careful if the equipment contains vacuum tubes! It is assumed that if the equipment seems "dead," there is no audio output. However, if a 60 or 120 Hz hum is heard, especially in vacuum tube equipment, at least one problem could be defective power supply filter capacitors.

Connect an antenna if you are checking a receiver, or a source of audio if checking a mono or stereo amplifier, to the input. Set S1 at TRACE. The red LED will illuminate. Touch the probe tip to the output of the first (input) stage, and adjust R3 as required. If the signal is heard, touch the probe tip to the output of the next stage. Continue checking stage by stage until you locate the defective stage. It should be necessary to increase the setting of R3 as each stage is checked, to maintain the same audio levels in LS1 or the headphones. A stage which exhibits a very low or distorted output, or none, contains the source of the problem. Again, normal troubleshooting procedures as described earlier will enable you to locate and fix the problem.

Signal injection and tracing

Very often it is easiest to both provide the signal and trace it through the equipment to be checked. Set S1 at BOTH. Follow the procedures described in the preceding paragraphs, injecting and tracing the signal through the circuit to isolate the defective stage.

In a pinch, with a receiver operating correctly, it is possible to inject a signal at the antenna connector with the antenna disconnected, and tweak the IF transformer tuning for maximum output to the speaker or headphones. This will result in maximum receiver gain.

A bonus

If you installed J2 in the lead from pin 1 of U1 to ground, you can use this instrument as a code practice oscillator. Turn S1 to BOTH. Connect both probe tips together—you can use a clip lead. Plug a key or keyer into J2.

Comments

You should, of course, possess the schematic diagram for the equipment you are checking out. Also, having the service manual will make your job easier because it describes how each stage functions when operating properly. It also provides the nominal DC voltages normally present at selected points in each stage.

In solid state equipment, if neither the schematic nor service manual is available, the following tips may be of assistance.

The input to a transistor is usually to the base or gate, but may be to the emitter or source in some circuits. The output will usually be from the collector or drain, but in some cases may be from the emitter or source. You must know the pinout of transistors. Pre-1995 *ARRL Handbooks* provide many pinout diagrams. Manufacturers' databooks, although very expensive, will also suffice, but most electronic equipment uses semiconductors from many manufacturers.

Many older vacuum tube radios and audio amplifiers often have a schematic diagram pasted inside the cabinet or on a baseplate. An old *RCA Tube Manual*, which a few older hams may still have, provides pinouts for many different receiving tubes. Also, the pre-1995 *ARRL Handbooks* illustrate many vacuum tube pinouts.

Input to vacuum tubes is almost always to the control grid—the grid closest to the cathode or filament. In a very few cases, especially with triode tubes, the input can be to the cathode. Output is normally from the plate, although occasionally it will be the cathode when the plate is bypassed for AC.

It is impossible to generalize about integrated circuits (ICs). There is very little standardization, necessarily because each contains a large number of transistors, diodes, resistors, etc., and are manufactured for specialized purposes in the main. Other than manufacturers' databooks, the best sources are schematic diagrams in recent *ARRL Handbooks*, as well as in the ham magazines and books and magazines devoted to construction of electronic circuits, all of which provide pinouts of all semiconductors used in their schematics.

Although signal injection and/or tracing can easily isolate the malfunctioning stage—and very rarely will more than one stage be affected—you will still have to locate what component or components associated with the stage caused the problem.

In vacuum tube equipment it is usually a defective coupling or bypass capacitor, or possibly a resistor which has changed value. In a few cases the tube may simply be worn out, a short or open may have developed internally, or the tube may be gassy. If a vacuum tube does not glow when power is applied, it is likely that the heater or filament is open—burned out. In an AC-DC radio receiver in which *none* of the tubes glow, the likeliest problem is an open heater in one tube, because all tube heaters are wired in series in these radios. Pull one tube at a time and check between the heater pins for continuity with an ohmmeter. An indication higher than just a few ohms indicates an open heater. The tube will have to be replaced.

In solid state equipment a shorted coupling capacitor can destroy a transistor or IC, and may also overstress associated resistors. An open coupling capacitor will prevent the following stage from functioning. Film dielectric capacitors are notorious for developing opens, but no type of capacitor is immune. A resistor which has been stressed can change its value, which can affect transistor bias or allow excessive current to flow, which can destroy a transistor or IC. Diodes can also develop opens and shorts which can adversely affect operation and, in some cases, overstress resistors or destroy other semiconductors.

In all types of electronic equipment, open or shorted bypass capacitors can cause all kinds of difficulties. Screen grid and cathode bypass capacitors in vacuum tube equipment which go open will prevent normal operation, as will a shorted cathode bypass capacitor. A shorted screen grid bypass capacitor will halt all operation immediately.

In solid state equipment open bypass capacitors can cause poor or no operation. Shorted bypass capacitors not only affect or halt operation, they will result in overstressed resistors and excessive base bias in the following stage, probably destroying the transistor and overstressing other resistors.

When replacing defective components, use identical parts if at all possible, especially semiconductors. In most cases you can replace a resistor with one whose value is within ten percent of the original as long as it has the same or higher wattage. Capacitors should have the same nominal value but especially be of the same type with the same or higher voltage rating. It is especially important to replace a capacitor with one having the same dielectric.

However, generally speaking, silver mica and film dielectric capacitors can be substituted for each other. So can NPO and COG capacitors. The common ceramic disc and monolithic capacitors can generally equally be interchangeable. When substituting an aluminum electrolytic capacitor for a tantalum capacitor, the value of the aluminum capacitor must be at least ten times that of the replaced tantalum, and of the same or higher working voltage. However, the aluminum capacitor will be considerably larger physically than the tantalum it replaces, and there may not be room for it. ■

Part	Description
BT1	9 V alkaline battery
C1, C8	0.1 µF ceramic disc
C2, C6	0.01 µF ceramic disc or monolithic
C3	1 µF 16 V electrolytic
C4	470 pF ceramic disc or monolithic
C5	10 µF 16 V electrolytic
C7, C9	470 µF 16 V electrolytic
C10, C11	0.01 µF monolithic
D1	Germanium diode: 1N34, 1N60, 1N90, 1N270, etc.
D2	Green LED
D3	Red LED
J1, J2	Closed circuit phone jack, builder's choice
P1	Black test prod
P2	Red test prod
R1, R2	6.8k 5% 1/4 W
R3	10k audio taper potentiometer
R4	22 Ω 5% 1/4 W
R5	10 Ω 5% 1/4 W
R6, R7	2.2k 5% 1/4 W
S1	2-pole 4-position rotary (wafer) switch
U1	555 timer IC
U2	LM386 audio amplifier IC

Miscellaneous:
Flexible insulated wire for injector probe
Shielded wire or RG-174U for tracer probe
2 grommets
4 rubber feet
1 battery clip
Enclosure
LSI speaker (optional)

Table 1. Parts list for Signal Injector/Tracer.

Where's the Manual?

Tracking down those vintage gems.

David L. Thompson K4JRB
Resource Solutions
4166 Mill Stone Court
Norcross GA 30092

Watching the messages on the various Internet reflectors or just listening to those who acquire "mature" equipment, the biggest need is to get a manual or schematic (or both). Whether the equipment is old tube-type or modern solid state the question is: How do we get a manual?

There are several ways. Usually the first is asking a friend if you can make a copy of his or her manual. Next we put a request on the swap net, local bulletin board, or Internet reflector or newsgroup—but even if you do find someone with the desired manual, the results are unpredictable, depending on the copier and the price. Jack Hill W4PPT/W4KH, who runs the Internet boat anchor reflector, made an astute observation after he saw my request for a copy of a manual. He said, "A (photo)copy can be much more expensive than an original." The Collins R-388 manual is 125 pages front and back, before 15 or 20 pages of fold-out schematics. The copy alone would cost $25 before any shipping, handling, or trying to find a copier for the larger pages. Most agree that an original is the best approach if one is available. Perhaps someone has a copy he no longer needs and you can buy it. This can be a lengthy search, and all the while the equipment is sitting there waiting. If you don't want to wait, then try one of several sources that provide high quality reprints or reasonably-priced bound copies. Sometimes they even have original manuals.

Obtaining a manual from a manufacturer like Drake, Collins or Heath requires you to know more than just the equipment model number (for Heath, hopefully you've read the articles on their manual numbering schemes in recent issues of *Electric Radio*). The newer manufacturers only offer manuals for about three to five years after the product is obsolete, but fear not—there are numerous firms that offer manuals for specific manufacturers.

Brock Publications is the primary source for all Swan, Cubic, Siltronix, and older Atlas gear. Surplus Sales of Nebraska has a complete line of Collins manuals. Maximilian Fuchs KA1OC supplies National Manuals, Robert Fowle specializes in Hammarlund, and ARDCO Electronics has Hallicrafters service manuals. ARTSCI, Inc., even publishes a book called *Lost User's Manuals*. In response to the market, a number of general manual providers have grown up in the past few years. These include W7FG Vintage Manuals, Hi-Manuals, and The Manual Man, Pete Markavage.

Schematics are often more important than the actual manual. Hopefully the manual you obtain will have the schematic, but if not, don't panic. There are sources for schematics, too. Puett Electronics and Radio/TV/Ham Schematics provide schematics for most equipment from 1920 to 1970. Puett has a regularly-updated catalog, and Alton Bowman W2ZUX, of Radio/TV/Ham Schematics goes so far as to say that if he doesn't have it (the schematic), "You probably don't need it!"

Military and test equipment manuals are in demand, too. Fair Radio Sales, Rainy Day Books, and Frank Lee stock manuals for military equipment, but it's hit or miss. Some, such as Rich Mish of MILTRONIX, specialize in R390A. The Government Printing Office and the Center for Legislative Archives are sources, too. Many hams are restoring and using old military gear (KWM-2, R390, SP 600, and AR-88s). Test equipment to help restore this equipment may have been replaced by digital in commercial shops, but amateurs have provided a second wind to VTVMs, analog generators, and even tube testers. Daniel Nelson specializes in the popular TV-7 tube tester and provides upgrades, as well as manuals.

So, if your equipment did not come with a manual and/or a schematic don't despair—just use the Internet, the phone, or the mail and get that manual! Here's a handy source list to aid you in your quest.

Manuals: Operating & Service

A.G. TANNENBAUM
A.G. Tannenbaum WB2BTB
P.O. BOX 386
Ambler PA 19002
(215) 540-8055; 24-Hour FAX (215) 540-8327
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US Army Technical Manuals for radio equipment manufactured from 1940 to 1979. Photocopies for 25¢/page, $6.00 minimum order. A booklet titled *Indexes and Lists to Army Technical and Administrative Publications 1940-1979*; *The National Archives Microfilm Publications Pamphlet Describing M1641*, describes how to determine the proper Army technical manual number.

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Trees Are for the Birds

The ham's secret weapon—PVC!

Peter A. Bergman NØBLX
3517 Estate Dr. SW
Brainerd MN 56401

When I moved from a trailer court to a house on a half acre in the country, I thought that all my HF antenna problems were solved. I had been using a 40-10 trap vertical clamped to the hitch on the mobile home but now I had room and I had trees. I could hang all the wire antennas I wanted from the tops of those lovely trees.

Well, sort of. For one thing, all the larger trees are at the back of the lot and the tallest tree in the front of the house is still only eight feet tall. I think we have all heard the joke about the elephant and the acorn, but I wasn't willing to wait twenty years.

After one particularly frustrating afternoon spent trying to shoot a line over the top of my tallest tree, I knew that something else had to be done. Slingshots are for kids and trees are for the birds.

What I wanted was something that was readily available, easy to work with, durable, and cheap. Since I am involved in Civil Air Patrol communications, I wanted to produce a mast that was easy to store, transport, and set up. And cheap. With that in mind, I started to experiment.

I was already using a mast made of two sections of three-inch schedule 40 PVC to support the feedpoint of a pair of inverted vee dipoles. It worked, but I wasn't happy with it. I wanted more height and I wanted it to be stronger and straighter. The sections were joined with a standard pipe coupling. It seemed that no matter what I did, the top wanted to lean one way or the other—sometimes both ways at the same time! I had joined the coupler to the pipe sections with bolts and large sheet metal screws instead of PVC cement because I didn't want to have to use a saw to take it apart. A few too many trips to the Saint Solenoid Day Festival and all I'd have is a lot of short pieces.

I decided to continue working with PVC, but needed a better method of joining the mast sections. I had tried telescoping successive sizes but that didn't seem to work very well either. Finally I hit on two methods that I really like.

First, I cut some scrap three-inch-diameter ABS pipe I had in the junk box and split it lengthwise with a saber saw. A table saw would have worked better, so use it if you have one. Then I measured the length to find and mark the middle. Joiners less than one foot long don't seem to do the job, but more than two feet seems wasteful. Next comes the

Photo A. Joint detail.

Photo B. Strong but flexible.

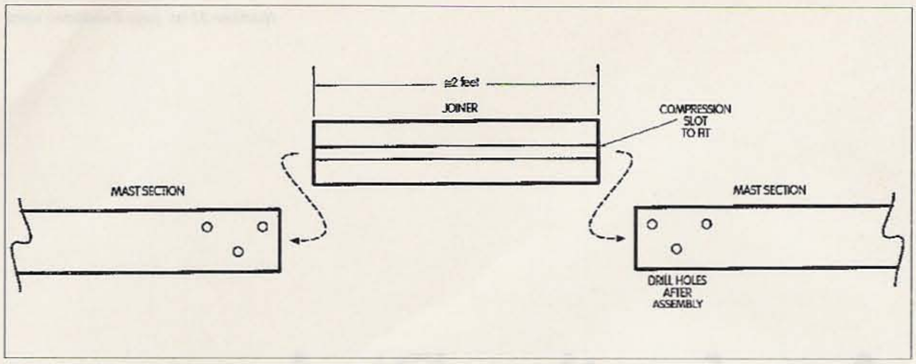

Fig. 1. Internal joint.

tricky part: sliding the joiner over the mast sections.

For its weight, schedule 40 PVC is strong and very springy. The best tool I found for that job was a Stanley Wonder Bar™, which is one of those small handyman-style pry bars that are available almost anywhere that sells tools. Insert the short leg of the bar into the saw cut a couple inches from the end of the joiner pipe. Then rotate the long leg parallel to the pipe. The width of the bar is just about right to spread the joiner pipe to slide over the end of the mast section.

After you have slid the joiner to the mark you made earlier, secure it with a hose clamp. Then use the Wonder Bar to spread the other end of the joiner so you can get the next mast section started.

Once you have the second section slid in against the first, you can install the other two hose clamps (**Photo A**). Be very careful when spreading the joiner pipe. If your spreading tool slips, you could find yourself trying to drive to the emergency room with a foot or two of pipe clamped very painfully to some part of your anatomy. Using this method costs about two dollars per joint, but these joints are strong and reusable while retaining some flexibility (**Photos B** and **C**).

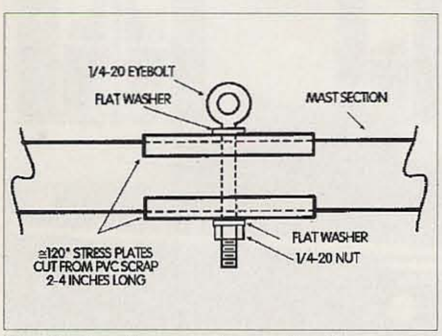

Fig. 2. Guy line attachment detail—antenna attachment similar.

The other method I'm using is a sort of inversion of the one just described. Start by splitting a two-foot length of PVC lengthwise as before, but remove enough additional material so that the joiner can be compressed and slid inside the mast section. Use a hose clamp to compress the first few inches of the joiner. Once the joiner is started into the mast you can move the clamp to facilitate the rest of the operation.

Once you have the joiner inserted halfway, lock it in place with two or three #6 or #8 sheet metal screws. Then you can use the clamp to get the next mast section started. This method is about a buck and a half cheaper per joint than the other and is very strong and flexible. I have a 30-foot mast I built of inch-and-a-half schedule 40 PVC—it has performed very well supporting one end of my G5RV (**Photo D**).

After a particularly nasty ice storm last winter, I was dismayed to find that the inch-and-a-half mast had almost been tied in an overhand knot. Somewhat disheartened, I went out and started knocking the ice off the guys, antenna, and mast. As the weight was removed, I was pleased to see the mast trying to straighten itself. Once the top of the mast was out of my reach a spare mast was used to push the top higher where it finally toggled upright. Since retensioning the guys, the mast has served me well. The three-inch mast at the other end of the antenna has given no trouble despite being guyed only at the top.

Late last winter I woke one morning to find that, overnight, we'd had five inches of very wet snow, the kind that weighs about a metric ton to the shovelful. The antenna was still up and the inch-and-a-half mast was just fine, despite the fact that with the sticky snow,

Photo C. The three-inch by 30-foot mast at work.

the guy lines and antenna had grown to almost the diameter of the mast.

PVC pipe is readily available, inexpensive, and durable. If you need a mast for permanent or portable use, you might want to consider the ideas I've presented here. Even if you use three-inch pipe, you can produce a 30-foot mast that is strong, inexpensive, and easy to transport and erect.

Have fun, and be careful out there... 73...

Photo D. The 1-1/2-inch by 30-foot mast (photo by Chandra KBØYXB).

The Silent Killer

Voltage anomalies: out of sight and out of mind—but very real.

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

It's seldom seen, yet it can be one of the most important considerations to address when setting up a ham station, computer operating position or any other expensive electronic installation. It's a transient protection device.

Whether you call them spikes, surges, glitches, or transients, voltage anomalies in the form of high-energy, short-duration pulses can be (and often are) one of the most destructive forms of "gremlins" that can beset the average electronic equipment user.

We often don't even know it. They're usually one of those "silent killers," the ones that inflict their harm without much fanfare or hoopla. They're also very real, and can happen at virtually any time to any one of us. But there is a measure of protection available to even the average amateur, and it probably won't break your budget either.

A hard sell

Security is one of the hardest concepts to sell people—that is, until they've been victimized. That's probably due in part to the tendency we all have of thinking that really bad things only happen to others. And even if catastrophe does strike, we mistakenly think that it can't happen again ... the law of averages and all that. The cold truth is: Misfortune has no memory. We're just as likely to be victims *again* as we were the first time.

Another factor in selling security may also lie in the fact that overstatements seem to abound in the industry itself. Sometimes it's difficult to separate the truth from the hype. You can be pretty certain that you'll only be told what the salespeople want you to hear. And finally, let's face it—protection equipment and devices just aren't very much fun! In the "new toys" department, protection add-ons have probably the very least payback in terms of enjoyment, so we all tend to put them off.

Other dangers

This article will deal primarily with protection devices to guard against those spikes or transients mentioned in the beginning, since they're probably the most common source of destructive "voltage events" that the majority of us will run into. There are others: long-term power line overvoltages, short-term voltage sags, and longer-term brownouts. But generally, these are not the norm for most areas in the US (folks in other parts of the world may not be quite as lucky). Most of the power line problems that we face in our home environments come in the form of those short-duration, high-voltage transients or spikes that we've traditionally associated with thunderstorms and lightning.

Lightning is a major factor. Most people are surprised to learn that there are over eight and a half *million* lightning strikes on the average day—not over your QTH, of course, but somewhere over the globe. That works out to somewhere around 100 strikes per *second*, on average, a frequency considerably greater than the 60Hz power line frequency! It's not nearly as difficult to imagine that there's a federal agency that actually counts them (but I'll bet you already guessed that!).

Voltage transients can enter the commercial power grid from direct lightning hits (usually catastrophic), or by induction from a nearby hit (less spectacular). Either event, of course, can send a spike into your home or mine many times greater than the normal 120V AC power that we expect to inhabit our household wiring [the 120V(RMS) AC sine waves actually have close to 170V peaks, both positive and negative]. In truth, any wire can have a transient induced into it. We often "hear" them on the MF and HF shortwave bands in the form of static crashes, sometimes hefty enough to numb our receivers for a few seconds until the receiver's AGC circuits have had time to recover! Lightning energy extends all the way into the upper VHF frequencies, as evidenced by flashes on our television screens when we watch off-the-air VHF TV.

We know that our antennas should be transient-protected, and perhaps even disconnected from our station equipment and grounded, when lightning-generating thunderstorms are nearby. But what about other forms of long wires? The telephone lines are a case in point. Telephone lines are certainly "long wires," and they too can pick up transient spikes just as power lines and ham antennas do, transferring that energy into the customer's home and into any customer-installed telephone-line goodies inside. That includes the telephones themselves, FAX machines, amateur radio phone patches, home intercoms (that use the internal telephone wiring for their distribution), and today, our computers, via the telephone modem and serial port.

I've had some personal experience with high-energy transients entering my home via the power lines and the telephone cable; it took way too much of my time, money and energy to put things back to normal after that incident to make me want to go through it again. The only reason that it wasn't actually worse was because I did have an approved protection device across the incoming 240V AC power line, and the internal wiring in my home is pretty well shielded [being inside of grounded thin-wall EMT (conduit) throughout]. Some of my telephone line devices did take it pretty hard, though, and they kept me out of trouble for quite a while, finding all of the problems that were initiated. Only my 2m transceiver and "brick" amplifier (that were on continuous monitoring) were among the casualties in the ham gear category (though they too were eventually repairable), and (fortunately), I didn't have a computer or telephone line modem at the time. I now have considerably more transient protection in-line; once is enough.

The glitch goes on

What's the best approach to protection from voltage spikes and power line glitches? As you've probably already guessed, that question has no simple answer. Much like for other home security, there is a fairly wide range of choices available today. Also, as with other things, you generally get what you're willing to pay for. So perhaps the better way of approaching the matter is to look at what the basic systems consist of, and then look at what you can reasonably expect to get for your investment. You won't end up with complete protection (if that even exists), but if you view it from the standpoint of "whatever I add, it's better than having nothing," you'll probably be being more realistic. And unfortunately, there's no accurate way to test a voltage transient protection system. You'll likely only find out if it's working (and enough) after a nearby lightning strike! Let's hope you never do fully "test" it!

I've talked about transients resulting from lightning, but that's not the only source (though it's usually the most obvious and most deadly one). Motors, pumps, air conditioners, appliances, even fluorescent lighting fixtures, can generate noise pulses (the way we describe transients when we hear them on our ham gear). If those transients are robust enough (and they sometimes can be), they can have a negative effect on sensitive equipment operating from the same power mains lines.

Here's something I ran across recently that I wasn't really aware of in the past: Even line transients that don't cause catastrophic failures, in some equipment, can erode the device's reliability over time. How's that again? Semiconductor devices, especially microprocessors and other high-tech, high-speed devices, can suffer gradual deterioration over time from the onslaught of continually being subjected to overvoltage transients—like termites eating away at a structure, little by little, until eventually it gives way.

Apparently, erosion takes place at the junction barriers inside semiconductors in a similar manner. So just because a piece of gear made it through a tough voltage overload or transient, doesn't mean it did it completely unscathed.

This gradual erosion is thought to be responsible for some of the sudden, unexplained equipment failures that I'm sure we've all run into. It can also be responsible for some of the strange happenings that occur only occasionally in some gear: memory loss, hang-ups, etc. At least this is what some researchers currently believe. The obvious solution, of course, is to apply some measure of continual protection against potentially harmful transients. Consider it an insurance policy.

Two approaches

What's available in the transient insurance market? The field roughly boils down to two basic approaches to the problem: parallel mode suppression and series mode suppression/isolation. Let's look at parallel suppression first, since it's the most common approach. Remember, absolute or complete protection may be beyond the reach of the average person—in fact, beyond the boundaries of current suppression technology.

Parallel suppressors

The parallel transient suppression approach consists primarily of installing transient voltage absorbers/bypass devices across the AC line (or telephone line), in the hope that they'll act fast enough, and with enough absorptive power, to trap out, swamp, or shunt to ground the high-voltage spikes on the incoming power mains (see **Fig. 1**) or telephone lines. Electricity travels very quickly, so any parallel suppression device has to operate very quickly—presumably before the transient has had a chance to do any damage.

That may be asking quite a bit. The parallel suppressor must react on the leading edge of the transient's waveform, before it reaches its highest, most destructive potential. MOVs (metal oxide varistors), and other fast-acting solid-state devices, are most often used; many will operate in the low nanosecond (billionth of second) to the picosecond (trillionth of a second) timeframes. How fast they act, and with what level of endurance, is important, because the suppression device has to be able to withstand the full transient "hit" without failing.

Here's another factor to keep in mind. It's also possible for transient suppressors to eventually fail from continually having to dissipate large voltage spikes, resulting in a gradual depletion of their robustness over time. So they shouldn't be looked upon as being permanent. There is, again, no real way to check them for remaining life, so until the industry can give us a better handle on that factor, it's no doubt best to err on the conservative side and replace any suppression devices thought to have taken a hefty hit or two.

Fortunately, there are some standardized specifications for transient suppression equipment today, and it's a good idea to look closely at what you're considering buying. Underwriters Labs® and others have set up standards for rating

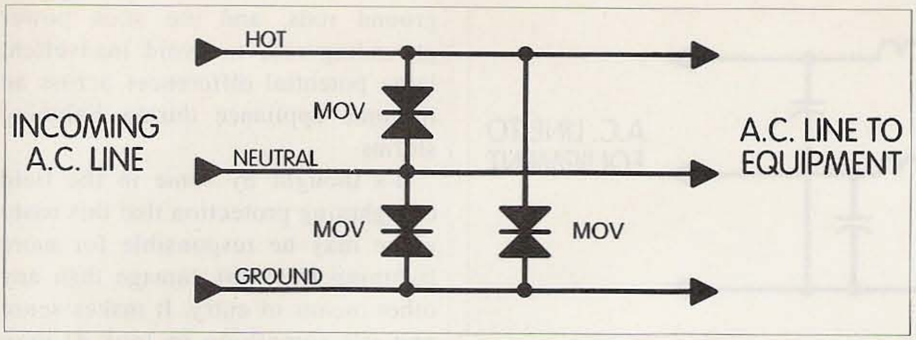

Fig. 1. Typical parallel transient protection utilizing MOVs (metal oxide varistors). Parallel protection depends upon a fast-acting device that will bypass or short the transient to ground before it reaches the protected equipment.

such devices, and any reputable manufacturer should have the test data (to which his device complies) clearly defined on the packaging. It's usually understandable, so you might want to take a look at it.

It's also probably best not to buy anything of this sort used, at hamfests or flea markets, since you'll have no way of knowing what the device has already been through during its lifetime! A protection device that's not going to protect you when you need it is more than just a loss of the money that you paid for it—you'd also have to calculate and add in how much damaged equipment will cost to repair because the device didn't do its job. The final figure could indeed be hefty.

That's why many manufacturers of transient suppression devices also spell out how much they will guarantee in insurance coverage, against damage from covered incidents, when their product is in use. It's called a Connected Equipment Warranty. You may end up having to jump through too many hoops to ever actually collect on the warranty, but it probably indicates that at least the manufacturer has gone through approved testing of the device, just to be able to offer the insurance in the first place. Most of these guarantees only cover the actual cost of repair, not the money lost due to downtime if your computer happens to be essential to your business endeavors. Hopefully, and if you've chosen wisely, you won't be forced into the position of having to collect on it.

The second approach

So far, we've looked only at parallel transient suppressors, and basically how they work in diverting and dissipating power line surges to ground (and/or the neutral wire in the power mains circuit), but there's another school of thought on transient suppression: series mode devices. Series implies that the protective circuitry is in-line (in series) with the protected equipment, effectively isolating the load (your electronic gear) from the mains. Advocates of series-mode protection point out that it may not be a good idea to divert high voltage transients into the ground or neutral wires of the power mains at all, because these diverted spikes can often end up in the signal circuits of the equipment by default.

Why? Because most complex communications and computer setups today use ground as the reference for data and other signals (as in the case of our receiver antenna inputs, for example). Deliberately diverting the transient spikes to this common ground bus could very likely be simply adding to the potential destructive effects of the very spikes and transients that we're trying to get rid of! There's good logic behind that statement.

All ground systems have some resistance and inductance in them. There's no such thing as the perfect conductor in real life ... not yet, anyway. Any voltage drop (transient or otherwise) and any ground loops that exist (almost always), pave the way for many complicated and potentially damaging paths to be set up in a complex modern system. It may be simply spreading the problem to other areas that wouldn't have been affected otherwise—a little like spilling a can of paint, then spreading it around to other non-affected areas in the process of cleaning it up!

The series-mode proponents take a different approach toward keeping the spikes and transients out of the protected equipment. We know from our radio experiences that any series-connected, frequency-selective filter circuit will prevent the passage of energy at the frequencies to which the circuit "looks" like a high impedance. Harmonic filters that are installed in a transmission line are one example; they'll prevent the passage of unwanted harmonics up to the antenna and thus cut down on harmonic radiation from our station.

This is usually accomplished with a classic pi-network filter, an inductor in series and an input and output capacitor (in parallel) to ground. Series-mode transient protectors often take the same approach as shown in **Fig. 2**. An inductor resists the sudden change in voltage through its windings and dissipates energy as heat. Capacitors will bypass a portion of the high frequency energy to ground or neutral, but they also temporarily store some of it and release that energy in a more controlled manner—with less harmful impact.

The result, of course, is that the protected circuitry on the other side of the filter sees only the normal power sine wave and none (or very little) of the transient spike. It's an interesting approach, though quite a bit more expensive to implement than the parallel suppression concept, due to the size and cost of the series components.

The series circuit has to be able to safely pass the normal operating current of all of the protected equipment on the secondary side, along with a measure of overhead current for safety's sake. That requires more costly, heavier-duty parts throughout, as well as a more substantial housing to contain those parts. It's also just possible that whatever transient energy isn't dissipated in the series pi-network could end up going to another branch of your home's AC wiring system to affect something else—similar to the way we usually think in terms of RF energy as "seeing" a high-impedance circuit, and avoiding it. That could impose a negative impact in other branch circuits.

Keeping the objective in focus, however, we see that the series-mode filter probably does protect the equipment that it's supposed to protect more effectively. The components in the series filter are also not as prone to the gradual depreciation over time, as mentioned before, as those in the parallel transient

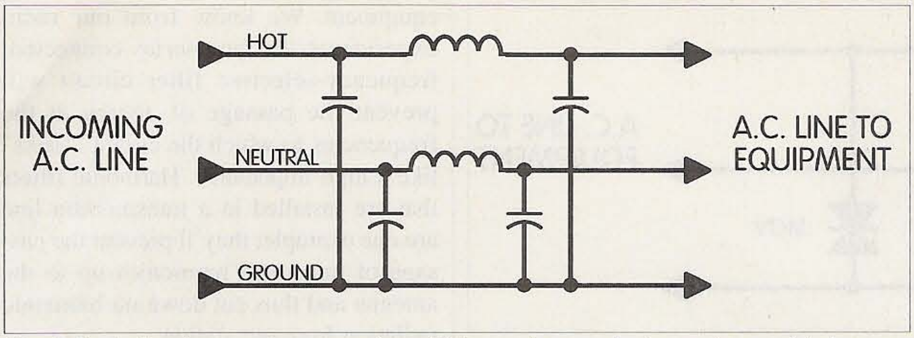

Fig. 2. Typical series transient protection utilizing a pi-network of capacitors and inductors to help to isolate the protected equipment from the transient by either not allowing its passage through the network, or at least greatly reducing its destructive effects.

protection circuits often are, provided that their series ratings aren't exceeded by any sizable amount.

Ground considerations

Finally, here's a possibility that most of us in radio communications probably haven't thought of, yet it's very important to consider. When thunderstorms are in the area, it's possible for very large voltage gradients to occur at different points along the surface of the ground, even over what might seem like a short distance. Remember that lightning bolts between the Earth and clouds create very large currents through the Earth's surface itself (which has resistance and therefore voltage drop).

A lightning bolt is, after all, an attempt by nature to equalize a potential difference between the clouds and the ground. For an instant then, until the ground potential has been allowed to equalize once more, a portion of these potentials can appear across an item of ham gear, for instance!

How? If the antenna ground rod is not directly bonded (via a short heavy cable) to our home's main power ground rod, then the piece of ham equipment will become that direct bond by default, since it's connected to the antenna ground via the transmission line's shield and to the AC mains power ground via the grounding pin on the power cord.

In fact, the revised 1993 National Electric Code has set up requirements for the bonding of all communications antenna grounds, television antenna grounds, and CATV system grounds to the main power ground. The code requires the use of a number 6 (minimum) copper bonding conductor (flat 1-1/2-inch-wide copper strapping is even better) between any separate ground rods, and the main power grounding rod, to avoid inadvertent large potential differences across an in-home appliance during lightning storms.

It's thought by some in the field of lightning protection that this route alone may be responsible for more lightning transient damage than any other means of entry. It makes sense and it's something to look at very seriously.

Continued

What To Look For

Even though the market in surge and transient protection hardware is complex, with many brands and models competing with one another for your attention, it is navigable. Underwriters Laboratories' *UL 1449* describes the testing and specifications that manufacturers must follow for parallel-mode surge suppressors in order to claim *UL 1449* compliance. If you have access to the Internet, there's a wealth of information for the asking (perhaps even more than you'll want to know) by using the keyword "UL 1449" in your favorite search engine. By the way, *UL 1449* covers several categories of testing, so all 1449-compliant suppressors don't necessarily have exactly the same specifications. You still have to read the specs and compare.

Here are some points that you might consider in comparing suppressor units:

•*Test clamping voltage:* Test results listed under the lowest test clamping voltage will give you greater protection. Suppressor specifications can be gathered under several clamping voltage levels and still be UL 1449-compliant.

•*Maximum surge dissipation rating in joules:* The larger the rating in joules, the more robust the unit will be.

•*Maximum surge suppression in amps:* the higher, the better.

•*Response time:* The closer to zero nanoseconds, the better.

•*Maximum spike protection voltage:* The higher, the better.

•Does the unit have *RJ11 modular jacks* (the standard telephone company modular jacks) built into it, for inputting and outputting to and from your computer modem or FAX machine, to protect it as well? Buying a separate suppressor for your modem, FAX, or other telephone-line-connected equipment is generally more expensive than buying a unit that already has this feature built in.

•Does the unit have a fast-acting *catastrophic surge fuse* built in as well? It's better if it does—the fuse will help to protect the protector.

•Are there *enough outlets* on the unit to power everything you'll need to power? Are all of the outlets protected? Is the power cord on the unit long enough? You could add a separate outlet strip, but that's added expense and clutter.

•Does it have *status lights* to let you know when there's a problem with the unit itself? If it doesn't, how would you ever know if it isn't all right?

•Will it *handle your expected current or wattage demands?*

•Does it have any *EMI/RFI filtering* built into it? Some do, some don't, but that may be an important factor, especially in a ham shack environment. If it does, how many dB down will the RF be over a specified frequency range (such as: -40dB from 150kHz to 20MHz)?

Each of these items will add some expense to any transient suppression unit, but if you do your homework carefully, you'll probably find some models that have more of what's desirable, for the same or less outlay, than other models.

The market is constantly changing, so what your buddy bought last year may not be the best deal for the money this year. You'll have to educate yourself, to some degree, in order to maximize your purchasing dollar against your value received.

Incidentally, there's a whole lot more good information coming up soon in my "Ham To Ham" column, here in *73 Magazine*, on the subject of lightning protection for our ham station installations. It will be in the form of an ongoing monthly series (for several months running), and was put together by a pair of experts in the field of commercial radio transmitting station lightning protection ... watch for it!

As you no doubt can see, the playing field for adequate transient protection is still a little muddied, each school of thought promoting its own advantages and pointing out the shortcomings of the other. Perhaps the real answer lies in a mix of the two technologies ... or maybe in some new technology. New ideas and products are being tested every day.

The bottom line seems to be that we've not seen the one cure-all yet, which is why it's impossible to recommend any single approach as the final answer in every case. But don't let that discourage you from implementing some form of transient protection right now. The way I see it, for my own equipment, I'd rather have *some* protection than none at all, even if it isn't absolutely perfect in all possible scenarios. Few things in life offer complete protection. Come to think of it, I remember hearing somewhere that the only guarantee is that there are no guarantees! 73

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73 Review

Small Wonder Labs' GM-30 Transceiver Kit

Build it for under $100!

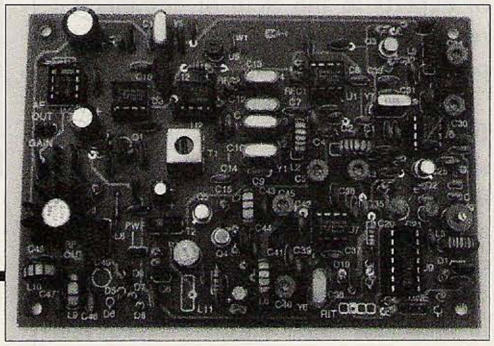

Photo A. Stuffed PC board.

Jeff M. Gold AC4HF
1751 Dry Creek Road
Cookeville TN 38501

It really seems amazing to me that, for less than a hundred dollars, you can put together a transceiver that will allow you to talk to people all over the world. And not only can you do this fantastic feat, but the receiver sounds about as good as the expensive commercial rigs.

Not too many years ago, if you wanted to use a radio you built yourself, you might start by building a transmitter, and then a separate receiver. This approach had the advantage of allowing you to learn how simple circuits work, and maybe even how to read a schematic. The down side was that when you were finished building, you were going to have to really work to make contacts.

Many of the earlier kits were crystal-controlled. This meant that you were stuck on a single frequency, or maybe if you built a VXO (variable crystal oscillator), you could change to very close frequencies. You also had to switch manually between transmit and receive, or build additional switching circuitry.

Most of the kits currently on the market are full transceiver kits with solid state transmit/receive switching. They have superheterodyne receivers and other desirable features. The truly amazing fact is that the vast majority of kits are being manufactured by small companies. Ten-Tec has recently started building kits and now offers a low power (QRP) transceiver kit.

There are two overall qualities on which I judge a kit: The first is how much fun it is to put the kit together. Quality of parts, lack of ambiguity in instructions, and completeness of instructions are all important aspects of the building experience.

The second quality, how well the rig performs on the air, is also very important. The receiver performance, transmit/receive changeover, sidetone, and "feel" of the rig contribute to its performance. I want to be able to hear weak signals, separate out signals that are close together, enjoy listening to the sound of the rig, and know that when I think I am right on a station's signal and transmit, both the other person and I are on the same frequency.

The bottom line on the Small Wonder Labs Green Mountain (GM) 30-meter kit is that I had fun building it, and even more fun operating it. I am amazed each time I turn on the rig, which I power with a small gel cell. I use a Gap vertical antenna with an LDG AT-11 autotuner in order to get it to work on 30 meters. I have checked a number of times, and if I can hear a signal on my Kenwood TS-930, I can hear it on my GM-30. I have operated it with no problems during times of high atmospheric noise and times of crowded conditions.

The design

Dave Benson NN1G was the designer. His original project, the NN1G, was a twenty-meter transceiver that put out about 1.5 watts. The project design appeared in the 1995 *ARRL Handbook*. The GM series is an improved version of the SW transceiver series. The SW series of transceiver kits is what got Dave to give up his day job and spend full time in the "lab."

The SW series was first introduced by the New England QRP Club in 1994 as the "40-40." The transceiver was designed to be a compact, low-cost, superhet kit that would be sold just as a board and its parts. The builder would provide a case and connectors. This project was covered in the November 1994 issue of *QST* and various other QRP publications.

The main design feature of the GM series is an improved heterodyne local oscillator. This part of the circuit was designed with extra complexity to provide improved performance on the high bands. It employs a Colpitts oscillator that runs at approximately 3.8 MHz and is then mixed with a crystal-controlled oscillator running at 14.318 MHz. The output is then bandpass-filtered to yield the desired 18.1 MHz injection frequency.

The front-end filtering uses a pair of tuned circuits. This is a more complex arrangement than in the predecessors, but yields a lot better image rejection performance. The T/R switch also uses a series of resonant tuned circuits to further improve the passband filtering. The audio output stage uses the 8-pin version of the LM380, which is rated at 0.6 watts output, to improve audio quality.

I really like the way the rigs sound. The LM380 draws a little more current than the usual LM386, but provides better audio quality. The radio also has RIT with an on/off switch. I find the RIT very useful on 30 meters.

For QSK, the audio frequency mute function is done by an FET switch. In the "key-up" condition, the FET is "zero-biased" and acts like a resistance of several hundred ohms. In the "key-down" condition, the FET is in cutoff and acts like an open circuit, preventing audio from getting to the audio final stage. The rig has a pleasant sidetone.

The kit

The printed circuit board is commercial-quality double-sided stock, solder-masked and silk-screened. The board is compact in size (three and a half inches by five inches). Parts are all high quality, and my kit did not have any missing parts.

The manual is excellent. It is printed on quality paper with very high quality laser printing. The manual starts with basic information for you to be familiar with before you start to work on the kit. It clarifies what soldering iron to use and parts identification, what is meant by a turn in winding a toroid, and other essential information. I highly recommend reading *all* of the material before starting.

I've built a number of kits. The only problem (and it was a small one) I had with building this kit was caused by not reading the directions. I should know better by now.

Please make sure you read the note about capacitors on the bottom right of page 3 of the manual. It is important to put the right type of capacitors in the LO section. It is quite easy to place the correct value, wrong type.

A further note of caution: As I mentioned, the board is very high quality, double-sided and with plated-through holes. This makes for a very good radio when you are done, but it also makes it hard to unsolder if you make mistakes. I found that desoldering braid was the only effective way to get parts off. I sometimes used my Radio Shack™ "solder-sucker," but had much better results with the wick. It is much easier to put the parts in the correct place the first time. I checked all resistors with a meter before installing them on the board.

I don't consider this kit to be a true beginner's kit. I want to clarify this because I do believe a beginner can build this kit and get it working the first time. There are only three pages of building instructions. There are twelve toroids to wind. They are easy to wind, but some beginners don't like to do this.

There is a recommended assembly sequence, but no part-by-part checkoff. You can request a step-by-step building list that was written by Chuck Adams K5FO. I checked out his instructions and they worked very well. The sheets describe the parts and give the color codes of the resistors. This made it much easier for me in parts picking and placement.

The diagrams and schematics in the manual are all excellent. The schematics have voltage measurements in order to troubleshoot, if necessary. I found that although the silk screen on the board has the parts identifications, it was not exactly clear in some places which parts went where. This was not a problem, as there is an oversized blowup of the parts placement included. I ripped it out of the manual and used it. I did not have any problems using the diagram to find parts placements. Some parts of the board are fairly densely populated. This isn't much of a problem either, but I think a first-timer or beginner might want to be aware of this.

The kit is a boards-and-parts-only kit. Small Wonder Labs gives the name of a company from which you can directly buy a black-anodized extrusion enclosure, or it will provide an enclosure at extra cost upon request (ask Small Wonder about price). There are also no plugs or jacks included.

For many builders, this scheme is a real plus. This allows Small Wonder Labs to sell the kit for $75. Many hams already have a wide assortment of connectors and cabinets. I used a small computer A/B switchbox for an enclosure and had many of the connectors in my parts boxes. I spent only another six dollars.

I don't like headphones, so I always put in small speakers. I used an eight-ohm, two-inch Radio Shack speaker (about $3, but you can get them at hamfests for $1 or less). There are no jumpers on the board and all controls are connected through provided 0.100-inch gold-plated headers. The kit provides pre-assembled connector harnesses. I found the harnesses made it much easier for me to do the final wiring.

First things first

The first section you build is the heterodyne LO. After you build it, you align it. The best way to do this is to use an oscilloscope. You attach the scope and adjust two trimmer capacitors for maximum amplitude. If you don't have a scope, Small Wonder Labs includes an extra envelope of parts that allows you to build a test circuit. Using this circuit, you need only a multimeter to align the oscillator. You next adjust the frequency. The recommended piece of equipment for this is a frequency counter. If you don't have a counter, the directions explain how to use a general coverage receiver or ham band transceiver to do this job.

You then finish building the rest of the kit. After getting the parts on the board, you align the receiver. This involves adjusting an IF transformer (mine had a very sharp peak), then three other trimmer caps. You adjust for maximum atmospheric noise. This was very easy to do and took only a couple of minutes.

To align the transmitter, you make sure you have a 50-ohm dummy load attached, and you can use either an oscilloscope or wattmeter capable of measuring QRP levels. For the first tune-up, I used my wattmeter in order to get the rig on the air. There are two trimmer caps you tune for maximum signal strength. I checked the radio the next day using my scope and found I had adjusted the transmitter correctly and was getting very clean output. There is a pot for adjusting power. I adjusted mine just below full clockwise while observing the waveform on my scope in order to get peak efficiency, as suggested in the manual.

The manual contains a section on troubleshooting both the transmitter and receiver. If you still have trouble and can't find the problem using the information on the schematic, you can contact Dave Benson by mail, phone, or E-mail. I have noted that hams on the QRP Internet mailing list report good results getting help from Dave. I have had excellent results contacting him and getting quick responses. If all else fails, troubleshooting/alignment is available at a reasonable flat-rate fee.

On the air

I had a great time putting this rig together. All the parts in the kit were good quality, and building and aligning were straightforward.

I usually go through a period of anxiety doing the "smoke test." I had already aligned the oscillator, and felt very confident when I powered up the rig. The radio worked the first time. The time between completion and aligning and testing was very short. I chose not to put the rig on the air until I had it in the case. I had prepared the case before finishing the alignment in order to minimize my usual propensity for messing things up at the last minute (like putting a finished board on the work bench and having a stray metal wire short something out).

I have to admit doing my own cases is my least favorite part of building. The case I used was made of steel. I managed to break a drill bit in making my holes, but I got the case ready to go with all the case wiring done. I put the board in the case and attached the two ground wires to the board.

I brought the rig over to my bench and hooked up the antenna, key, and power. I tuned my Gap vertical to 30 meters and was raring to go. I searched around the band. The band did not appear to be in great shape. I heard Frank KD2IX calling CQ. I answered and we had a good QSO. He was in Carmel NY and also QRP. I took this as a great sign, because I really enjoy QRP/QRP contacts. I next worked Dick W6OV in Nebraska. Next, I worked another QRPer in Tucson AZ.

I spent quite a bit of time all weekend testing out the new rig. During the evening I worked Karel OK2FD, in the Czech Republic. By the end of the weekend, during very bad and not-so-good conditions, I worked all over the United States and some DX—all with a small gel cell battery and a Gap vertical antenna. The Gap wasn't even designed for 30 meters, so I had to use my LDG-11 auto tuner for 30.

I found the receiver to be very quiet. It is also quite sensitive and selective. I could hear about anything that was out there, and was easily able to tune to signals and separate them out. The VFO seems very stable. The sidetone was pleasant to listen to and I really enjoy the audio quality of receive signals. The QSK works great. I get about two watts and don't intend to do anything to change the way the radio is working. I really enjoy operating this little rig. It's already one of my favorites. In comparing it to the large number of rigs I have built, it comes out at the top of the list. The VFO easily covers the whole 30-meter band.

I would recommend this kit to anyone. If you are a beginner and can get some help, go for it. Experienced hams will really enjoy both building and operating this kit.

For further information, contact Dave Benson NN1G, Small Wonder Labs, 80 East Robbins Ave., Newington CT 06111; (860) 667-3536; [bensondj@aol.com].

NEVER SAY DIE

Continued from page 5

civilian deaths in other wars such as the Spanish Civil War, the Italian invasion of Ethiopia, India-Pakistan's two wars, the Korean "police action," Nigerian war, Vietnam, Iraq-Iran, and so on.

Zbig estimates that wars have extinguished at least 87,000,000 lives in this century.

Additionally, Hitler had about 17,000,000 people put to death. Lenin is credited with about 8,000,000 and Stalin, who did his best to wipe out the Russian intelligentsia, managed about 25,000,000 ... teachers, military officers, and so on. This brings the total to about 175,000,000 killed. That's about two-thirds of the population of the US, and the killing is still going on in a bunch of countries.

In view of the massive massacres that have been going on all around us I can understand why so few people seem to care about cigarettes prematurely killing an estimated 400,000 Americans a year, or hospitals killing 300,000 a year as a result of errors. Heck, we probably have about 3,000,000 Americans dying every year as a result of poisoning or poor nutrition, and we never even blink. With some attention to healthy nutrition and an end to legalized poisoning, we'd have around a million fewer deaths every year. Of course that would raise hob with Social Security, our medical industry and insurance companies, so never mind. Let's forget the whole thing.

Those Pesky Crop Circles

Yes, I saw the TV program showing the two British farmers making crop circles with boards. But I also saw a program where investigators had set up cameras to try and catch the circle makers in the act. They showed a large pattern in a hay field being formed in seconds. Further, a close inspection of the hay showed that, unlike the fake circles, where the hay was broken, the

Continued on page 49

SOS ... SOS ... *Titanic!*

Radio operators' courage still inspires amateurs.

Mario Garcia
534 Travis
Port Lavaca TX 77979

In 1910, the government required all ships to have a wireless telegraph. Yet by 1912, fewer than 400 ships were equipped with Marconi wireless. It was the *Titanic* disaster, just off the coast of St. John's, Newfoundland, which finally proved the value of wireless to the world. This article is about the *Titanic*'s fateful day and the two wireless operators, John Phillips and Harold Bride, who performed their duties with valor and honor.

Hard work

Working on the *Titanic* was serious business and hard work for senior telegraphist John George Phillips, 24, and junior telegraphist Harold Sidney Bride, 22. Although signed on with the crew as telegraphists, the two men were actually employees of Marconi International Marine Communications Company, Ltd. Ship-to-shore wireless transmission was in its infancy and viewed more as a convenience than an integral part of the ship's command. The operators were under the captain's command, but only with regard to receiving and transmitting messages of importance to the ship. Their main job was taking care of the passengers' telegrams while at sea. The ship's weather reports and ship-to-ship telegrams came second, as they weren't paying customers. Under its agreement with the Marconi Company, the White Star Line, owner of the *Titanic*, was provided with free wireless messages between the ship and its owners or other ships regarding navigation, safety, or the ship's business, provided the messages did not exceed a 30-words-per-day average. Excess words were charged to the ship's owner at half the usual tariff rates. In return, White Star was to provide the Marconi operators with their meals and lodging. The Marconi Company, in turn, paid John Phillips and Harold Bride approximately $23 per month and $12 per month, respectively.

The fateful Sunday

On Sunday, 14 April, 1912, Phillips and Bride had been busy receiving, logging, and transmitting passenger messages. Wireless transmitting and receiving ranges increased markedly at night, and night signals from the powerful British land station at Poldhu (call letters MPD) relayed by intermediate ships had included news, stock reports, and some personal messages. There had been daily traffic messages to and from *Titanic*'s passengers. The ship's 1.5-kilowatt wireless transmitter, among the most powerful afloat, had a 400-mile daytime transmitting range. This range increased significantly at night, but during the day, particularly now in the North Atlantic, its functions were limited to ship-to-ship messages.

Signals were transmitted and received on closely adjacent standard frequencies, with two, three, or even more signals being sent or received at the same time. Much of the operator's skill involved being able to discriminate and select the particular messages addressed to his station. To assist operators, each station had its particular identifying call letters. With few exceptions, call letters from British ships generally began with M, while those of German ships started with D, and United States naval vessels with N. *Titanic*'s call letters were MGY.

The long hours and tedious work made the job very stressful for Phillips and Bride, but fortunately for them they would work in shifts to help each other at the Morse key. In 1912, laws did not require two operators or 24-hour watches on the ship's wireless. Many passenger liners and all freighters had single wireless operators who rested or slept when they could.

Ice!

Wireless operators were supposed to intercept for their captain's attention all messages relating to the navigation and safety of his vessel. Phillips and Bride received several messages concerning ice conditions in an area toward which the *Titanic* was directly heading. At 9:00 a.m., a message from the *Caronia* was taken immediately to the bridge, where it was posted for the officers' attention. Another message was received from *Athinai* via the *Baltic:*

Captain Smith, Titanic

Greek steamer Athinai reports passing

icebergs and large flotation of ice field today.

This message placed icebergs within a few miles of *Titanic*'s track. It was taken to Captain Smith. The message was not posted on the bridge nor entered in the scrap log until 7:15 p.m.

As daylight turned to dark, the cool air began to turn cold. At 7:00 p.m., it was 43 degrees. Because of the day's wireless messages, an iceberg watch was ordered. By 7:30 p.m., atmospheric temperature had dropped to 39 degrees.

At this time a message from the *Californian* to the eastbound freighter *Antillian* was overheard by the *Titanic*'s wireless operators. Harold Bride delivered the message to the bridge and handed it to an officer. The *Californian* message reported ice about 18 miles north of *Titanic*'s track. By 8:40 p.m., the air had fallen to 35 degrees as the *Titanic* steamed full ahead at 21 knots. Around 8:50 p.m., Captain Smith was briefed by his officers about weather conditions and the ice and about the precautions that had already been taken.

More warning

It was 9:40 p.m., and in the wireless shack Harold Bride had turned in for a nap before working the busy late-night traffic. John Phillips was manning the transmitter alone when a message was received from the westbound *Mesaba:*

To Titanic and eastbound ships:
Ice reports. Saw much heavy pack ice and great number large icebergs.
Also field ice. Weather good, clear.

The land station at Cape Race, Newfoundland (call letters MCE), was in range now and John Phillips was very busy transmitting messages which had accumulated during the day. Unable or unwilling to leave his key unattended, he ignored the *Mesaba*'s ice message which described ice directly ahead for *Titanic*.

The message never did get to the bridge. With lights from the ship's decks seemingly guiding the way, *Titanic* sped with determination through the night at 21 knots. The sea was so calm that one officer on the bridge made the comment that in all his years on the sea he had never seen it so flat. The stars shone brightly in the moonless sky.

As 10:30 p.m. approached, the steamer *Rappahannock*, passing on an opposite course, signaled the *Titanic* with its Morse lamp:

Have just passed through heavy field ice and several icebergs.

Titanic replied by signal light:

Message received. Thanks. Good night.

Titanic continued on her course, speed undiminished. In the wireless room, John Phillips was very busy with Cape Race traffic as well as sending and receiving messages to and from other ships. A few minutes before 11:00 p.m. he was interrupted by a very strong signal from a nearby ship, the freighter *Californian*, twenty or so miles away to the north:

I say old man we're stopped and surrounded by ice.

She was so close that she almost blasted Phillips' ears off. Annoyed by the intrusion interrupting his traffic, John Phillips curtly responded:

Shut up. Shut up. I am busy. I am working Cape Race.

Californian's wireless operator, Cyril Evans, rebuffed by John Phillips' curt message, listened for several more minutes to Cape Race traffic. Then, around 11:30 p.m., he turned off his equipment and turned in.

Doomed

On the *Titanic*, two crewmen in the crow's-nest swung their arms in an effort to keep warm in the freezing air. Their eyes strained into the night's darkness ahead. They had wished they had their binoculars to help them see better. Somehow, the binoculars had been misplaced the day before.

Suddenly, without a word, one of the crewmen hunched forward and peered intently into the black, moonless night. He immediately reached for the bell lanyard and gave three sharp pulls to signal an alarm. He then picked up the phone piece and called the bridge: "Iceberg right ahead."

The warning was too late. The officers in the bridge stopped and reversed engines and averted a head-on collision with a large iceberg, but the huge iceberg managed to strike a glancing blow on the *Titanic* fifteen feet above her keel. The gash extended for 300 feet along her side, flooding five of her compartments. The *Titanic* was designed to float with three or four flooded compartments, but not five. She was doomed.

Carpathia to the rescue

By 12:05 a.m., the *Titanic*'s front compartments were rapidly filling with water and all engines were stopped. Captain Smith, realizing the ship was sinking, personally went to the wireless room and instructed the wireless operators to order a call for assistance. "You had better get assistance," Captain Smith told his wireless operators.

John Phillips set the frequency on the multiple tuner to 600 meters, adjusted the spark gap for maximum range, and sent out the standard CQD distress call (some operators called it Come Quick, Danger) from *Titanic*'s huge antenna. Later that night, Harold Bride decided to use the new distress signal, SOS, which was just coming into use. *Titanic*'s wireless operators sent one of the first SOSs from a ship in distress:

SOSSOSCQDCQD–MGY.

This was a call for help to save over 2,200 lives on a ship that only had enough lifeboats to save 1,178.

By 12:45 a.m., several ships and land stations had responded to Harold Bride's and John Phillips' distress calls. The *Carpathia* was 58 miles from the *Titanic* at the time of collision and responded immediately. *Carpathia*'s captain turned his ship around and raced to the rescue.

Opportunity lost

Although the *Carpathia* was close to the distressed *Titanic*, there was another ship that was much closer—but it never heard the *Titanic*'s wireless distress calls. The wireless operator on the *Californian* had turned off his wireless and gone to bed after John Phillips had told him not to interfere with his commercial traffic. The *Californian* could have saved the lives of all the *Titanic*'s passengers if only the operator had not shut off his wireless and turned in for much-needed sleep.

Abandon ship!

On the *Titanic*, Captain Smith ordered loading of the lifeboats with women and children first. By 1:30 a.m., *Titanic*'s bow was distinctly down and she listed heavily to port. The slant of the ship's deck was becoming steeper and people were having trouble keeping their balance as they moved toward the stern. Lifeboats were being lowered into the calm sea 60 feet below the ship's deck. Although the lifeboats were capable of carrying 65 passengers, some boats were filled with fewer than 20 people.

Signs of panic began to appear. In the wireless shack, John Phillips and Harold Bride were still at their posts, their distress calls becoming increasingly desperate:

Engine room getting flooded.

At 1:45, another distress call:

Engine room full up to boilers.

Every man for himself

By 2:05 a.m., most of the lifeboats had been lowered (except for the collapsibles) and had moved away from the *Titanic*. More than 1,500 people still remained aboard. With the boats all gone, hundreds of passengers left behind stood quietly on the upper decks. A quiet calmness set in. Captain Smith made his way to the wireless room and told John Phillips and Harold Bride that they had done their duty. Now it was every man for himself.

Into the sea

As the ocean water filled one compartment after another, the water's weight pulled the *Titanic*'s bow completely under. The great ship's immense bulk started a catastrophic arc into the star-filled sky. As the *Titanic* upended, hundreds and hundreds of people were thrown into the sea. The water temperature of the North Atlantic was about 28 degrees Fahrenheit. As energy from the generators faltered, the last wireless signal spluttered to a halt.

At 2:20 a.m., the liner started its nearly vertical descent downward into the sea. Not yet completely under the surface, with a load roar the sinking hull broke in two near an expansion joint and engine room shaft. The forward section of the ship began its drop to the ocean floor over two miles below, while the stern section remained afloat a few seconds more before it, too, plummeted to the bottom.

Down with the ship

Almost immediately, the silent night was filled with the calls of floating survivors, growing in number until there was almost a continuous wailing chant. Hundreds of people cried for help as they struggled in the icy cold water. Some of the ship's 1,500 passengers managed to reach some of the lifeboats, but most did not. Long before dawn, hypothermia had claimed the lives of most of the floating survivors. The rescue ship, *Carpathia*, arrived around 4:00 a.m. and started to take on survivors from the lifeboats that held mostly women and children. Everyone was still in shock, not only from the horrendous experience they had just witnessed, but also from the bitter cold that engulfed them. In all, 711 passengers survived the ordeal. Captain Smith did not survive. He went down with his ship.

Constant duty

Of the two wireless operators on the *Titanic*, only Harold Bride survived the tragedy. Even after his subsequent rescue by the *Carpathia*, he continued to perform his duties as a wireless operator. The ship already had a wireless operator named Harold Cottam, but he had not slept for many hours and was totally exhausted. Bride had to be carried from the dispensary, where he was treated for severely frostbitten feet, to the wireless room where the exhausted Cottam was working. Once Bride began to transmit, Cottam got a few hours of precious sleep. Both Cottam and Bride ignored all information requests from private and public sources even as the *Carpathia* sailed full steam to America.

Once the *Carpathia* reached New York, Bride was carried ashore on the shoulders of two *Carpathia* officers. Among the last of the survivors to be brought ashore, Bride had been almost constantly on duty since boarding the ship from an overturned collapsible boat and now, totally exhausted, he was taken to a nearby hospital for treatment of crushed and frostbitten feet.

Inquiry

At the *Titanic* inquiry, several proposals were made:

1. Lifeboats required to have increased capacity, a seat for each person aboard, and adequate manning.
2. Wireless stations required to have 24-hour manning.
3. Amateur interference banned.
4. All ships required to provide reliable auxiliary power sources.
5. Wireless operators required to maintain secrecy of all messages.

These wireless recommendations resulted in the Radio Act of 1912, which required all ships to carry wireless stations. The Act also contributed to the Marconi Company's extraordinary financial success.

"The last I ever saw of him ... "

The wireless operators of the *Titanic*, John G. Phillips and Harold Bride, went into the history books as two young men who heroically stood at their post, bravely transmitting distress signals until moments before the huge ship sank. John Phillips' body was never recovered. Harold Bride said of his coworker, "Phillips ran aft and that was the last I ever saw of him."

Harold Bride kept a very low profile in the years following the *Titanic* disaster. World War I found him as a wireless operator aboard the steamer, *Mona's Isle*. Later in life he became a salesman before returning to Scotland, where he died in 1956.

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Which Band's Best for QRP?

Some are better than others for low-power operation.

J. Frank Brumbaugh W4LJD
P.O. Box 30 - c/o Defendini
Salinas PR 00751-0030

Doing more with less—using no more than five watts PEP—has made CW the preferred mode for QRP. CW signals are narrow, putting all five watts into a bandwidth only a few Hz wide, which enables the use of narrow filters in receivers. This fact alone provides the "oomph" that allows worldwide QSOs when conditions are good.

When I received my first General Class license in 1949—it was called "Class B" then—there was no 15 meter band, and 40 meters was CW only. Times have changed; phone proliferated, especially SSB, and various digital modes became available, necessitating changes in the band plans, squeezing CW into narrower and narrower segments, further aggravated by "Incentive Licensing" which took most hams out of the lower 25 kHz of most of the HF bands. However, this was not all bad, because it tended to concentrate most of the QRO DX-chasers into that 25 kHz segment, eliminating a lot of QRM in the rest of the CW segments.

The 40m band has long been the all-time favorite band for most hams, especially when using CW. It provided QSOs with almost every CQ. Many were with other US hams, but at night the band provided DX with good signals. Best of all, conditions were pretty much the same regardless of the solar cycle. The band hasn't changed, but occupancy has. Of course, QRP has little chance in the QRO-dominated bottom 25 kHz. Digital extends down to 7.070 and often slips as low as 7.060. Worse, foreign SSB can often be heard as low as 7.035, effectively leaving just 10 kHz for CW at night. This band has the most crowded CW segment of any HF band, and QRM is extremely high. It is no longer the best all-around band for CW, especially QRP.

The low bands, 80 and 160 meters, are usually very noisy, and useful antennas require more real estate than most hams have available. These bands are usually useful only at night because of high D-layer absorption and thunderstorm static during the days.

Blame it on Ol' Sol

The 20m band, long considered the DX workhorse band, is still that, of course. It is an excellent band for QRP CW operation, and there is plenty of DX to be found, both rare and ordinary. The QRO DXers stay mostly in the lower 25 kHz, and digital extends down only to 14.070, leaving a span of 45 kHz for CW. Right now this band is open primarily during daylight hours, closing shortly after sunset. In a few years it will open earlier and close much later, sometimes remaining open all night.

Thirty meters is probably the best all-around band for QRP CW, regardless of the time of day, year or sunspot cycle. There is very little variation in propagation conditions over time on this band. D-layer absorption is very low, much lower than on 40m and below, and the daytime distances workable are higher as well. Thirty meters is always open to somewhere in the world, with nights providing most of the DX. Because the maximum power allowed on this band is only 200 watts PEP, your five-watt signal is only 16 dB down, about 2-1/2 S-units, so there are no "California Kilowatts" to drown out the peanut whistles.

Thirty meters is only 50 kHz wide, and the lower 30 kHz are CW only. Most DX will be found between 10.100 and 10.115, with rag-chews and casual QSOs from there to 10.130, where digital modes have the upper 20 kHz. There is no ham SSB allowed on this band. Occasionally but rarely, the MUF may fall below 10 MHz on some DX paths at night, but other paths are apt to be open. This condition can only occur around the lowest point in the solar cycle. Antennas for the 20 and 30m bands are much smaller than for 40m, and thus are easier to hide where this is necessary or desirable.

The increasing number of capable, inexpensive, monoband transceivers, in both commercial and kit form, is indicative of the growing interest in the challenge and fun of QRP operation. Most of these transceivers are CW only, and single band, but some also provide for SSB operation, and a few are multi-band rigs. RF output, which depends upon the particular transceiver, will be from one to more than five watts PEP, and most, if not all, allow easy power reduction into the milliwatt range of power output.

"When 10 meters is open, you can hear two wires being scraped together on the other side of the world!"

Most of these rigs are easy to take along on trips or camping, and their generally low current requirements make battery operation easy. For sensitivity and selectivity, they are equal to pricier equipment. Of course, there are few, if any, bells and whistles added—these are basic radios intended to be used for communications—but most of the extra features provided on the big-bucks rigs are seldom used in normal operation. You don't need them to have lots of interesting and enjoyable QSOs!

So, tune around the bands, noting what you hear and where the signals are coming from. Do this for a few days, and also for a few nights, to get a better "feel" for the band. Tune especially around the internationally recognized QRP calling frequencies.

For CW, these are, in MHz: 1.810, 1.843 (Europe), 3.560, 7.040, 7.030 (Europe), 10.106, 21.060, 28.060.

For QRP SSB: 1.910, 3.985, 7.285, 14.285, 21.385, 28.385. There are not yet established calling frequencies on 17 and 12 meters.

Pick a band you like, and if you have a loaded multi-kilobuck rig, crank the power down to no more than five watts PEP and make a few QSOs. If you lack such a big rig, order one of the many QRP transceiver kits, put it together in an evening or two and get on the air. You are guaranteed to enjoy yourself. If you don't hear anyone, call CQ on the calling frequency. There is likely another QRPer tuning and listening. Accept the challenge of "doing it with less," and above all, have fun! 73

Special Events

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the January 1998 issue, we should receive it by October 31. Provide a clear, concise summary of the essential details about your Special Event.

OCT 4

BELTON, TX The Temple ARC Ham Expo will present a "Fall 'Fest" at the Bell County Expo Center, starting at 8 a.m. Admission $1.00. Handicap accessible. Indoor tailgate arena, spaces $10 at the door. Tailgate setup begins at 6 a.m.; free electricity. Tables $10 each (only at the door). Commercial vendor spaces with tables, $20 each, or with Fri. night early setup, $25 each (reserve by Sept. 22); free electricity. Send deliveries to 1802 S. 13th St., Temple TX 76504. Write to *Temple ARC, P.O. Box 616, Temple TX 76503;* or call *Mike LeFan WA5EQQ, (254) 773-3590. E-mail [mlefan@vvm.com]. Expo netpage [http://www.tarc.org].* Talk-in on 146.820 MHz, pl 123.0 Hz.

TEANECK, NJ Bergen ARA will hold its annual Fall Hamfest at Fairleigh Dickinson University. Buyer admission $3, with XYLs and harmonics free. Seller admission $10. Special features include plenty of parking, and VE exams. Take Rte. 4 east/west to the River Road exit. Follow the signs into the hamfest area. Talk-in on 146.790(-600). For more info, call *Jim Joyce K2ZO at (201) 664-6725, before 10 p.m.*

WARRINGTON, PA From 8:30 a.m.–9 p.m., the Mt. Airy VHF Radio Club (Pack Rats) will present the 1997 Mid-Atlantic States VHF Conference at the Horsham Days Inn, 245 Easton Rd. (Rt. 611 one half mi. above the Willow Grove Exit #27 of the PA Turnpike). For room reservations, call (215) 674-2500. Reg. is $12 per person at the door, which includes an admission ticket for "Hamarama," being held the following day. Contact *John Sortor KB3XG, 1214 N. Trooper Rd., Norristown PA 19403. Tel. (610) 878-5674;* or *E-mail [johnkb3xg@aol.com].*

OCT 5

WARRINGTON, PA The Mt. Airy VHF Radio Club (Pack Rats) will hold its annual "Hamarama" at the Bucks County Drive-In, Rt. 611 (4 mi. above the Willow Grove Exit #27 of the PA Turnpike), between County Line Rd. and Street Rd. Doors open to vendors at 6 a.m. for outdoor tailgating spaces; $8 each (plus general admission charge). Sellers of new and used amateur radio equipment, electronic components, and computer hardware/software vendors are invited to participate. Open to the public at 7 a.m. Donation $5. Talk-in on 146.52 simplex. For more info, contact *Brian Taylor at (215) 257-6303 between 7 and 9 p.m.*

WEST LIBERTY, IA The Southeast Iowa Hamfest will be held 7 a.m.–2 p.m. at the Muscatine County Fairgrounds. Adm. $5, children under 12 free. Free parking. Tables for commercial vendors inside main buildings. For reservations and info, call *Rob Boorman KBØMRZ at (319) 351-3399, or Bud Pitt WBØMEW, (319) 264-1788.* Outside flea market space free with gate ticket. Handicapped accessible. VE exams at 10 a.m., walk-ins accepted but pre-reg. preferred; please contact *Tom Kramer KØVSV, (319) 264-3259.* Overnight camping, electrical hookup $5. Pre-hamfest weiner roast on hamfest grounds, Sat., Oct. 4th at 6 p.m. Adults $3, children $2. See the *Web site at [http://soli.inav.net/~icarc/].* Talk-in on 146.850(-).

OCT 11

EVANS, GA The Augusta Hamfest will be held at Evans Middle School in Evans GA. Setup Fri., 6 p.m.–9 p.m.; Sat. 6 a.m.-9 a.m. VE exams start at noon. Contact *Frank KS4OC,* or *Rhonda KE4DIM* at *(706) 560-9600;* or write to *P.O. Box 3072, Augusta GA 30914.*

BREMERTON, WA Kitsap County Fairgrounds' President's Hall, at the NW corner of Fairgrounds Road, at Nels Nelson Road, is the site for a Special Event being sponsored by the North Kitsap ARC. Admission $4 for 12 and over, under 12 free. New and used equipment. Tables $15 ea. (incl. 1 free admission) until Sept. 30th; $20 ea. after that deadline. Commercial spaces $30. Contact *Susan Johnson AB7MD, P.O. Box 1226, Poulsbo WA 98370. Packet [AB7MD@N7WE.#WWA.USA.NOAM]; E-mail [sujohnso@linknet.kitsap.lib.wa.us].* Talk-in on 145.31(-) offset KC7FA rptr., or 146.52 simplex.

TAMPA, FL The Egypt Temple Amateur Radio Assn. will host a hamfest in the Unit Building at 4050 Dana Shores Dr. Admission $5, children under 10 admitted free. Tables w/2 chairs, $10 ea. plus admission. Electricity will be available, but customers must supply their own cable. Tables, tickets, can be obtained from *J.F. Strom K9BSL, 233-34th Ave. North, St. Petersburg FL 33704-2241. Tel. (813) 822-9107.* Talk-in on 146.94. No food and drink will be allowed except that sold by Egypt Temple members.

OCT 11 &12

MEMPHIS, TN "MemFest '97," the Greater Memphis Amateur Radio and Computer Show, will be held by Greater Memphis amateurs at Big One Expo Center, 2585 North Hollywood at I-240. Times: Sat., 8:30 a.m.–4 p.m.; Sun. 8:30 a.m.–2 p.m. Admission $5 at the door. Non-ham activities, ladies' activities and forums. VE exams Sat. and Sun. 9 a.m.–10 a.m. Flea market tables, 8', $25 ea. for the weekend. Contact Walt Heald *WB4GIJ, (901) 829-3712, FAX (901) 829-2214.* Exhibitors, contact *Mary Moore AC4GF, (901) 758-0661, FAX (901) 751-6717.* For general info, contact *John Lovett KD4EUH, (901) 388-8745, FAX (901) 937-8660.* Send correspondence to *1997 MemFest, P.O. Box 751841, Memphis TN 38175-1841.* Talk-in on 147.03/147.63.

OCT 12

DURHAM, CT The 1997 Nutmeg Hamfest and Computer Show will host the 5th annual ARRL Connecticut State Convention at the Fairgrounds in Durham, 9 a.m.–3 p.m. Campsite and vendor setup on Sat., beginning at 4 p.m. The featured speaker is John Hennessee N1KB, ARRL Regulatory Specialist. Flea market, commercial displays, VE exams, contact Joel Curneal N1JEO, (203) 235-6932 (register in advance); free parking, reserved overnight camping (limited elec./water), demos, seminars. General admission $5, children under 12 free. Vendors, contact *Gordon Barker K1BIY, 9 Edge Wood Rd., Portland CT 06480; (860) 342-3258. Packet inquiries, [W1KKF@W1NRG.CT.USA.NA]; E-Mail [sbicycle@connix.com].* The Nutmeg Hamfest is a cooperative venture of Meriden ARC, Middlesex ARS, and Shoreline ARC. Talk-in on 147.36/.96 MHz rptr.

MASON, MI The LCDRA and CMARC Hamfair will be held 8 a.m.–1 p.m. at the heated Community Center in the NW corner of the Ingham County Fairgrounds. Admission $4 per person. Tables $10 ea., trunk sales $5. Overnight camping available. Vendor setup at 6 a.m. Contact *Chuck McNease N8CM* or *Linda McNease KC8DPZ, at (517) 694-2757;* or *LCDRA, P.O. Box 80106, Lansing MI 48908.* Talk-in on 145.390.

OCT 17, 18 & 19

HOUSTON, TX The 3rd Annual Gulf Coast Ham Convention will open with commercial displays, 9 a.m.–5 p.m. Sat., and 9 a.m.–1 p.m. Sun. Setup will be Fri., Oct. 17th. To make booth reservations, please call *(800) 563-4598 and select option 2* when the voice mail answers. You may also call the Commercial Exhibitor Chairman, *Jim Lane N5DC, at (281) 358-0051.*

OCT 18

GRAY, TN The 15th Annual Tri-Cities Hamfest will be held at the Appalachian Fair Grounds, located off I-181 in Gray. A large drive-in indoor and outdoor flea market space is available. RV hookups. Admission $5. The hamfest will be sponsored by the Kingsport, Bristol, and Johnson City Radio Clubs. Mail inquiries to *Tri-Cities Hamfest, P.O. Box 3682 CRS, Johnson City TN 37602.*

OCT 18–19

EL PASO, TX The International Hamfiesta will hold their annual hamfest at the Texas National Guard Bldg., Sat., 8 a.m.–5 p.m., Sun. 8 a.m.–1 p.m. VE exams both days. Admission $5 advance, $6 at the door. Tables $10 in advance, $12 at the door. QCWA Breakfast. Seminars and tours. Talk-in on 146.88 rptr. RV parking, no hookups. Contact *Clay Emert K5TRW, P.O. Box 23010, El Paso TX 79923* or call *(915) 859-5502. E-mail: [cemert@dzn.com].*

OCT 19

CAMBRIDGE, MA The MIT Electronics Research Society, the MIT Radio Society, and the Harvard Wireless Club will hold a Tailgate Electronics, Computer and Amateur

Radio Flea Market 9 a.m.–2 p.m. at Albany and Main Sts. Admission $4. Free off-street parking. Tailgate room. Sellers $10 per space at the gate, $9 in advance (includes 1 admission), setup at 7 a.m. For space reservations or info, call *(617) 253-3776.* Mail advance reservations before the 5th to *W1GSL, P.O. Box 397082 MIT BR., Cambridge MA 02139-7082.* This event will be held rain or shine. Covered tailgate area available for all sellers. Talk-in on 146.52 and 449.725/444.725 pl 2A—W1XM rptr.

SALEM, IL The Centralia Wireless Assn., Inc., will hold its annual hamfest at the Salem Community Activity Center, East Oglesby St., Salem IL. Setup is at 6 a.m. The hamfest will open at 8 a.m. Flea market tables are available on a reserved-in-advance basis; contact *Daisy King AA9EK, at (618) 532-6606.* Admission $2 each or 3/$5 and may be purchased in advance or at the hamfest. Mail ticket orders with an SASE to *Centralia Wireless Assn., Inc., Hamfest Tickets, P.O. Box 1166, Centralia IL 62801.* Talk-in on 147.27/.87.

KALAMAZOO, MI The 15th annual Kalamazoo Hamfest will be held starting at 8 a.m. at the Kal. Cty. Fairgrounds. Setup at 6 a.m. For info, call *(616) 657-4482;* or *E-mail [amcneil@net-link.net];* or SASE to *Al McNeil K8CRH, 816 East Michigan Ave., Ste. 102, Paw Paw MI 49079-1215.*

NEWTOWN, PA "Tradefest '97" will be sponsored by the Penn Wireless Assn., and held at Bucks County Community College, Swamp Road. VE exams. Free parking. Admission $5, under 12 free w/adult. Spaces, $10 outdoor, $15 indoor. Tables available on request—reserve early. Contact Steve at *(215) 752-1202.* E-mail to *[sewall@erols.com]* or send to *PWA Tradefest '97, P.O. Box L-734, Langhorne PA 19047.*

OCT 25

ST. PAUL, MN The Twin Cities FM Club will sponsor the 13th Hamfest Minnesota & Computer Expo at the St. Paul Civic Center, Kellogg and 7th Sts. There will be Fri. night VE exams. Flea market, educational seminars, more. Admission is $5.50 in advance, $7 at the door. Flea market setup is on Fri. night. The event will be open to the general public, 8 a.m.–4 p.m. For info and tickets, write to *Hamfest Minnesota & Computer Expo, P.O. Box 5598, Hopkins MN 55343;* or call the Hamfest Minnesota hotline at *(612) 535-0637.*

RICKREALL, OR The Mid-Valley ARES will present its 3rd Annual "Swap-Toberfest," ARES/RACES Convention, 9 a.m.–3:30 p.m. at the Polk County Fairgrounds. Self-contained RV spaces available. Handicapped hams who have pre-registered may enter at 8 a.m. through the East Door; one pre-registered assistant per handicapped ham may accompany to offer a helping hand. Features include swap tables, commercial dealers, meetings and seminars. Additionally, emergency communications vehicles will be on display from Marion and Polk County Emergency Management, Civil Air Patrol, American Red Cross, Intel, and others as available. For more info, contact *Garry Zinn KC7BSX, (503) 838-2008.* To download a copy of the flyer and pre-reg. form, surf the net for *[http://www.teleport.com/~n7ifj/swaptobe.htm].* Talk-in on the 146.86 rptr.

SUMTER, SC The Sumter ARA's 11th Annual Hamfest, Computer Fair, and ARRL State Convention will be held at Sumter County Exhibition Center, 700 W. Liberty St. Doors open 8 a.m.–4 p.m. Contact Steve Bregger *KD4HTS, P.O. Box 52302, Shaw AFB, SC 29152-0302; Tel. (803) 983-4251.* Or contact *Dee Brown NØZTV, P.O. Box 52141, Shaw AFB, SC 29152-0141; E-mail [deebrown@sumter.net]; Tel. (803) 499-6315.*

OCT 26

DES MOINES, IA "Hamfest Iowa '97" will be hosted at the Iowa State Fairgrounds' 4H Building, by Tikva Tracers ARC. Adm. $5. 1st table $10, add'l $8. Electric $8. VE exams at 9:30 a.m. Seminars and "Ask the Experts" will be featured. Contact *Randal Lees NØLMS, 1575 Northwest 78th St., Clive IA 50325-1255. Tel. (515) 279-4241; E-mail [rclees@raccoon.com].* Talk-in on 146.22/.82.

SELLERSVILLE, PA The RH Hill ARC will present their Hamfest at the newly rebuilt Sellersville Fire House, Rt. 152, 5 mi. S of Quakertown and 8 mi. N of Montgomeryville. Admission $5. VE exams 10 a.m.–1 p.m., all classes. Bring documents. Indoor spaces $12 (table included); outdoor $6, bring tables. Contact *Linda Erdman, 2220 Hill Rd., Perkiomenville PA 18074. Tel. (215) 679-5764.* Talk-in on 145.31.

NOV 1

WAUKESHA, WI The Milwaukee Repeater Club will sponsor the 13th annual "6.91 Friendly Fest" 8 a.m.–1 p.m. at the Waukesha County Expo Center Arena Forum, N1 W24848 Northview Rd. in Waukesha WI. Setup at 5:30 a.m. Tickets $5, 4' tables $5. Please call *Burt N9VBI, (414) 328-0535.* Send SASE with payment to *The Milwaukee Repeater Club, P.O. Box 2123, Milwaukee WI 53201. Web page [http://www.execpc.com/~mrc/friendlyfest.htm].* On-site VE exams. Talk-in on 146.91 (-) (The Friendly Repeater) and on 146.52.

NOV 8

MONTGOMERY, AL The Montgomery ARC will host the 1997 Alabama ARRL State Convention and the 20th annual Montgomery Hamfest and Computer Show in Garrett Coliseum at the South Alabama State Fairgrounds located on Federal Drive in the NE section of historic Montgomery. Adm. $5, free parking, all indoors including the flea market. Setup 3 p.m.–8 p.m. Fri., Nov. 7th; and 6 a.m.–7:30 a.m., Sat., Nov. 8th. Doors open to the public 8 a.m.–5 p.m. CST. VE exams on site beginning at 8 a.m. Bring original and a copy of your current license, picture ID and $3. Talk-in on 146.24/.84, call W4AP Ragchew 146.32/.92 (with phone patch, *up/#down), 147.78/.18, and 449.50/444.50. Flea market reservations are encouraged. Kickoff banquet Fri. evening at Bonnie Crest Country Club, with ARRL national staffer Rick Palm K1CE. Contact *Patty at (334) 567-7195,* or *E-mail to [prolan@juno.com]* for reservations. ARRL QSL card verification for all awards (WAS, DXCC, etc.) on site. For more info or table reservations, write to *Hamfest Committee, c/o 2141 Edinburgh Dr., Montgomery AL 36116-1313;* or phone *Phil at (334) 272-7980 after 5 p.m. FAX (334) 365-0558;* or E-mail *[WB4OZN@worldnet.att.net].*

SPECIAL EVENT STATIONS

OCT 5

PITTSBURGH, PA The Breezeshooters ARC will operate station W3XX from the submarine *USS Requin,* docked at the Carnegie Science Center of Pittsburgh PA, 1400Z–2100Z. The station will operate vintage CW equipment in the 40-meter Novice band and in the Novice portions of the 10- and 15-meter bands, if conditions permit. Phone operation will be in the General class segment of 20m and 40m. For a certificate and QSL card, send QSL and an 8 1/2" x 11" SASE to *Jack Buzon KA3HPM, 47 Grubbs Rd., Cheswick PA 15024.*

OCT 18–19

NUTLEY, NJ W2GLQ will be operated by the Nutley ARS from the Nutley Red Cross Building, to celebrate "Annie Oakley Day." Operation will be 1400Z Oct. 18th–2300Z Oct. 19th, on 3940, 7240, and 14240. For a certificate, please send QSL and a 9" x 12" SASE, to *N.A.R.S., c/o Nutley Red Cross Bldg., 165 Chestnut St., Nutley NJ 07110.*

OCT 31–NOV 1

BREVARD, NC The Transylvania County ARC (KE4ZIS) will sponsor their 9th annual "Halloween Fest" at the Devil's Courthouse, located on the famous Blue Ridge Parkway in Brevard. The station will be on the air 1800 GMT Oct. 31st–0200 GMT Nov. 1st. Frequencies: 7.237, 14.295, 21.305, 28.335, 146.25 MHz (+/-10 kHz for QRM). Certificate available with large SASE to *TCARC, P.O. Box 643, Brevard NC 28712.* 73

Number 48 on your Feedback card

New Products

2m Hand-held Tester

The MFJ-224 Two Meter FM SignalAnalyzer™ may be the most useful two meter hand-held test instrument you'll ever own. Measure signal strength over a 60 dB range; check and set FM deviation; measure antenna gain, beamwidth, front-to-back ratio, sidelobes; analyze audio quality with an oscilloscope, and much, much more!

Plug in any scope and the FM SignalAnalyzer becomes a service monitor. It lets you visually analyze modulation waveforms, and measure audio distortion, noise and instantaneous peak deviation.

You can tune in any signal between 143.5 and 148.5 MHz. A built-in discriminator meter function makes accurate tuning simple and easy. You can also evaluate antenna performance, compare antennas, check real-world performance of experimental antennas against computer predictions, document end-to-end cable loss in dB, plot field strength patterns for repeater or packet nodes, position your antennas to the best possible spot, measure preamp gain, track down hidden transmitters, check the speech quality of your radios … and on and on.

The MFJ-224 uses a 9 V battery, measures 4 x 2-1/2 x 6-3/4 inches, and of course it comes with MFJ's "No Matter What" one-year unconditional warranty—and it's only $159.95!

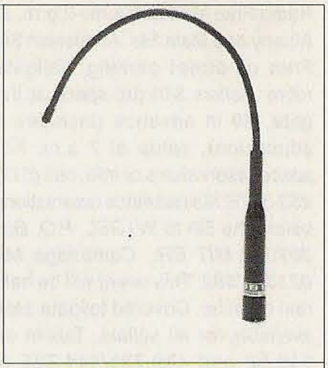
For the name of your nearest dealer or to order, call (800) 647-1800; FAX (601) 323-6551; or write to MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville MS 39759.

Repeater Maker *Plus*™

CES Wireless Technologies Corp. has developed a new, enhanced version of the popular Repeater Maker, called the Repeater Maker *Plus*, Model RM-20. This all-new device allows users to make a repeater out of two transceivers or separate transmitter and receiver modules. The RM-20 provides a built-in four-user CTCSS tone panel, supporting any four of 50 CTCSS tones as well as cross-tone encoding. Among many standard features are Morse code CWID with programmable "send" states, and an "auxiliary relay" for remote control.

The RM-20 is programmed using a DTMF telephone locally, or remotely, over the air. This unit accepts the optional CES Voice Delay module for customization of application timing. The RM-20 features compact size, rugged housing, and is plug-and-play compatible with the CES 4700VP telephone interconnect. See your dealer.

Whip It



The new Comet SBB-1/SBB-1NMO is a 2m/70cm mobile antenna designed to solve the problems associated with mounting antennas on high-profile and sport utility vehicles. The whip is flexible and rubber-coated, similar to a rubber ducky HT antenna. It's rigid enough to stay vertical while driving but flexible enough to hit trees and other temporary obstacles without breaking.

The black anodized SBB-1/SBB-1NMO radiates a 1/4 wave on VHF, and a 1/2 wave on UHF. It's 16 inches tall and is available in the two most popular mounting styles—the SBB-1 has a PL-259 connector, and the SBB-1NMO has an NMO-type connector.

Both versions are now available from amateur radio dealers. For more information, contact NGC Company at (800) 962-2611 or visit the Comet Web site: [www.cometantenna.com].

"Bond. Conductive Bond."

Master Bond Inc. has introduced a two-part, silver-filled, electrically conductive adhesive that cures rapidly at room temperature. They call it EP77M-F, and it has an easy-to-use 1:1 mix ratio, by weight or volume. It'll set up at ambient temperatures within five to seven minutes, even when mixed in small amounts. EP77M-F develops a high bond strength of 1500 psi tensile shear when fully cured at room temperature, and electrical conductivity develops rapidly and is noted within 30 to 40 minutes.

Master Bond EP77M-F is 100% reactive and contains no diluents or solvents. It can be applied with very little sagging or dripping, even on vertical surfaces, and adheres to metals, glass, ceramics, vulcanized rubbers and many plastics. Bonds are resistant to chemicals (including oil), water, and most organic solvents. For more information, contact Master Bond Inc., 154 Hobart St., Hackensack NJ 07601. Call (201) 343-8983 or FAX (201) 343-2132.

Track It Down

The Futuretech Sourcebook, by Larry Ball, is an innovative directory of 147 mail-order vendors. The book's 394 useful, entertaining categories range from capacitors to lasers, fog machines, and personal radar guns. Tables make it easy to compare each company's product lines, and may eliminate the need to place orders with multiple vendors when building your next project.

Along with a description and listing of what each company sells, the book includes each vendor's name, address, phone numbers, Web site, and whether they take credit cards or require a minimum order. The 63-page *Futuretech Sourcebook* is available for $11.95 plus $3.00 s&h (Florida residents add 7% sales tax) from Futuretech, P.O. Box 6291, Gulf Breeze FL 32561. For more information or to order call (850) 932-9682.

NEVER SAY DIE

Continued from page 40

true circles just bent the hay, thus not really damaging it. No one has been able to figure out how to do this yet. Also, on true hay field patterns, there are no signs of the hay being disturbed by anyone walking into the field.

These patterns have been observed in hay fields all around the world, with over a thousand appearing in British fields in one year. Many are very intricate patterns. The question arises in more inquisitive minds: Why is who going to all this trouble? Surely there must be some reason for all this. The variety of patterns and their complexity certainly hint that some non-trivial intellect must be involved. Mother Nature may be capricious, but She doesn't have any known mechanism for instantly bending the hay in fields into weird fractal patterns.

One chap, piqued by these questions, started doing what the rest of us had failed to do: he started thinking. Doug Ruby has, as a result, written a book explaining what he has discovered. Fascinating book.

Early on, after making some cardboard models of the patterns, he decided that they must be two-dimensional representations of three-dimensional somethings. When he constructed cardboard models on this basis everything began to fit into place. What emerged, Doug is convinced, is the model for building a space ship, along with some strong hints on making a drive unit powered by element #97, Berkelium-247.

How much does our beloved government know about all this? When the figures "E97+" appeared in a Kansas wheat field one morning in 1991 government agents quickly moved in and eradicated them. This could lead some of our more alert people to start thinking, Hey, why would the government do *that*? Which of those 22 secret government agencies did it? What else have they been covering up? Why are they doing all this in secret? Well, perhaps it's better if we just go to back to watching TV soaps or seeing who's on the repeater and resume our sleep through life.

If you're interested in reading the well-illustrated book, *The Gift, The Crop Circles Deciphered* by Ruby, it's ISBN 1-878398-14-8, 174pp, 1995, Blue Note Books, 110 Polk #3, Cape Canaveral FL 32920 (800-624-0401). Copies are $33 postpaid in the US. No, I don't sell the book.

At the least the book will give you something else to talk about on the air other than your weather ... and give your friends more reason to suspect your sanity. It backs up what I find most credible, that the aliens (ETs, visitors) have been here for a long, long time and mean us no harm.

I found out about the book when Ruby was interviewed by Art Bell W6OBB one night on his "Coast-to-Coast" radio talk show. How a radio show at that unholy time of night has attracted the fourth largest radio talk show audience is weird. I set my VCR to record the five hours broadcast by a Philadelphia station on 1210 and listen to it in the kitchen when I'm fixing my meals or assembling the pages of my booklets on the counter. Well, it's at the right height and it's large enough.

You feed the output of a radio into the audio-in jack of the VCR and set it to record "line." This makes it easy to fast forward through the roughly 50% news and commercials interspersed in Art's show, taking more like two and a half hours to hear the whole five hours. It's on around 360 stations, so you should be able to hear it. The weakest area is the northeast corridor, from Philadelphia to Maine. The show runs from 1-6 a.m. EDT.

You'll hear stuff about the Pyramids, UFOs, contactees, and even me, every few weeks, talking with Art about ham radio, cold fusion, how anyone can be healthy, wealthy and wise, and so on.

So who's this guy Ruby? He started as an Air Force pilot and then flew for 24 years as a commercial airline pilot.

His conjecture certainly fits in with the scenario in the movie *Contact*, where they got the spaceship plans via radio signals from space.

Crash!

Have you done anything at all about getting your ARRL director on the stick to get our hobby growing, or are you just enjoying the usual exchange of less than nothing on the air as a way to get through this life without having made the slightest difference?

Yes, I'm being rotten. Well, unless your pressure on the League is visible in some way, like even the slightest mention in a club newsletter, or a copy to me of your efforts to prod your director to get the ARRL to do what it is supposed to do — support the hobby — then I'm not far off base in assuming that you've done nothing.

What am I grousing about? Well, I took another look at the latest FCC license numbers. Get out a pencil and draw a graph for yourself and see where things are going. Starting in 1985, 60.9% of us were General Class and above. By 1990 it was down to 55.7%. In 1993 is was 49.7%. And this year it went down to 43.7% by midyear. Now, if you'll continue the curve what you'll see is a remarkably straight line that'll hit 0% General and above by 2021.

The question that comes to mind is how long the ARRL is going to wait before taking action. Will it take another five or 10 years for the directors to figure out that their fanaticism over maintaining the code barrier may be misplaced?

Our low bands are already less crowded. In another 10 years we're going to have to hunt around for someone to talk with. There won't be many more DXpeditions, because most of the DXers will be trying to get the hang of their silent keys by then (if I can't take my mike with me, I'm not going), so what few pileups there are will mostly be the JA youngsters.

By 2021 I'll be 99 and hanging in there, keeping the curve from going below zero. Will I be the last ham on 20 m? Well, I was one of the first when they opened the band after the war. What a melee that was! Thousands of hams were on there a day or two before the official opening, using CB-type names for calls.

If you are still convinced that the FCC should maintain the code barrier to upgrading, then I hope you enjoy watching our hobby sink out of sight. Draw the graph

Continued on page 74

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041-0099
[carrjj@aol.com]

Finding antenna dimensions by scaling

Designing most standard antennas requires no great effort. For example, most hams know that the overall length of a half wavelength center-fed dipole is $468/F_{MHz}$ feet or $143/F_{MHz}$ meters. For example, if we want to design a dipole for, say, 14.250 MHz, we know that the length is 468/14.25 = 32.84 feet long. But this method falls down a bit when we try to design antennas that are more complex. For the sake of simplicity, however, let's look at the dipole problem first ... and, in the process, discover a simplified method for designing antennas.

Our simplified design problem is based on a simple procedure: *frequency scaling*. We find a design that meets our needs, but is at the wrong frequency, and then scale it. Scaling can be done by dividing the design frequency by the desired frequency, and then multiplying each of the lengths and spacings by this figure. For example if α is the scaling factor, we state that $\alpha = F_{DESIGN}/F_{DESIRED}$ and then multiply each length and spacing by α.

Consider our sample design of 14.25 MHz and 32.84 feet. Suppose we want to scale the antenna to 21.2 MHz? We can use the equations or we can scale it. For our example:

$$\alpha = F_{DESIGN}/F_{DESIRED}$$

$$\partial = 14.25\ \text{MHz}/21.2\ \text{MHz} = 0.6722.$$

To find the length of the desired antenna we need only multiply the length of the known antenna by α:

$$L_{NEW} = L_{KNOWN} \times \alpha$$

$$L_{NEW} = (32.84\ \text{feet})(0.6722)$$

$$L_{NEW} = 22.08\ \text{feet}$$

In the trivial case of the dipole we can easily check the result:

$$L = 468/21.2 = 22.08\ \text{feet}$$

Rule: When using the scaling method, scale all dimensions and spacings of the antenna. In scaling a beam, for example, it does no good to scale the element lengths but not the spacings. *All* lengths and *all* spacings must be put through the scaling process.

The usefulness of scaling becomes apparent when you want to design complex antennas such as quad or yagi beam antennas. You often find successful designs in magazines and handbooks, but they are not on the frequency that you wish to use—or they might be on a completely different band. The answer is to use scaling. Let's consider an example. Bill Orr's (W6SAI) *Radio Handbook 18th Edition* (an oldie!) gives the dimensions for a two-element cubical quad antenna (**Fig. 1**) as follows.

For 21.250 MHz:

L1 = 11.8 feet
L2 = 12.1 feet
S = 5.56 feet

In the case of the cubical quad beam all four sides of each element are equal, so the circumference is four times L1 or L2. Now let's suppose we get our wildest wishes and are able to put up a 75-meter band cubical quad. The dimensions for 3.750 MHz can be found from scaling. The factor $\alpha = F_{DESIGN}/F_{DESIRED} = 21.250\ \text{MHz}/3.750\ \text{MHz} = 5.667$.

L1 = 11.8 feet x 5.667 = 66.87 feet
L2 = 12.1 feet x 5.667 = 68.57 feet
S = 5.56 feet x 5.667 = 31.51 feet.

The yagi beam antenna is very popular, and on some bands is relatively easy to build (on lower bands it might be easier to buy one, given the nature of the metalwork needed to make a safe and reliable antenna).

The basic three-element yagi antenna is shown in **Fig. 2**. Although three elements are shown here, it is also possible to build a two-element yagi or a yagi with more (even many more) elements than three. The reason for looking at the three-element version is that it provides a look at all three classes of elements: *driver* (or *"driven element"*), *reflector* and *director*. The driven element is a half-wavelength dipole, and is the only one that is connected to the transmission line from the receiver or transmitter. Because only one element is fed, the other elements are called *parasitic elements,* and the antenna is sometimes called a *parasitic beam* to distinguish it from *phased array beams* in which all elements are driven.

The gain achievable by the yagi depends on several factors, but in general, the following values are realized relatively easily:

No. of Elements	dBd	dBi
2	5.2	7.4
3	6.8	8.9
6	10.5	12.6

Table 1. Gain achievable by the yagi.

The driven element is little more than a half-wavelength dipole, fed in the center by coaxial cable. The

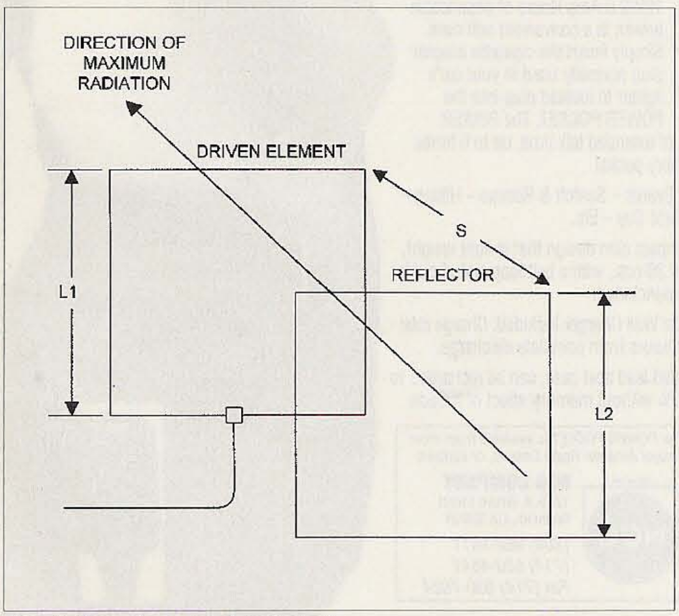


Fig. 1. Two-element cubical quad.

ELEMENT	ELEMENT LENGTH (λ)	POSITION (λ)
Reflector	0.49531λ	0λ
Driven Element	0.48598λ	0.13754λ
Director	0.46257λ	0.27508λ
$\lambda = 984/F_{MHz}$ feet or $\lambda = 300/F_{MHz}$ meters (Boom position uses reflector as reference, so sets position at zero)		
SPACING (S = ΔX) S1 0.13754λ S2 0.13754λ		

Table 2. Three-element beam spacing factors.

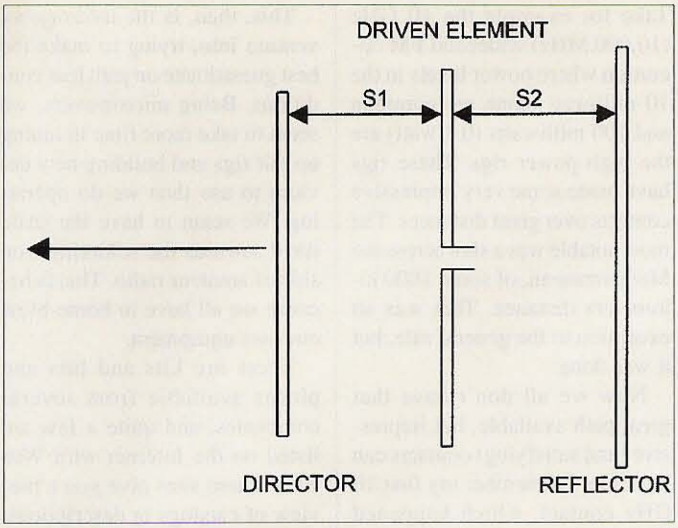


Fig. 2. Three-element yagi.

transmission line divides the driven element into two quarter-wavelength halves. The reflector and director are also half-wavelength, but being parasitic elements are not fed in the center or any other point. The parasitic elements are spaced (S) from the driven element about 0.131λ to 0.271λ (specific spacing is in **Table 2**).

The driven element is about half a wavelength long. The reflector is a few percent longer than the driven element, while the director is a few percent shorter. In some multi-element designs, additional reflectors or directors may be added to increase gain. As with all such yagi antennas, the directivity is towards the direction of the smallest element. In the example of **Fig. 2**, the directivity is from the driven element towards the director. In that direction, received signals are louder, and transmitter signals appear stronger to distant receivers.

Increasing the number of elements will increase the gain and narrow the beamwidth of the yagi antenna. Although there is a limit to the optimum number of antenna elements that can be fitted on a given size boom, the general rule is "the more the merrier." **Fig. 3** shows the layout for a very large beam of 19 elements laid out on a boom of about 5.6 wavelengths (λ). It is derived from one published in *The ARRL Antenna Book*. The gain is on the order of 15 dBd. It has an azimuthal beamwidth of 26 degrees, and an elevation beamwidth of 28 degrees. The feedpoint impedance is about 30 ohms.

This beam is designed using the scaling method. All elements and element positions (which also set the spacings) are related to a

Element	Length Factor (L)	Position Factor (P)
Reflector	1.087A	0P
Driven Element	1A	0.327A
Director D1	0.9989A	0.468A
Director D2	0.976A	0.732A
Director D3	0.959A	1.095A
Director D4	0.949A	1.552A
Director D5	0.939A	2.08A
Director D6	0.933A	2.673A
Director D7	0.929A	3.317A
Director D8	0.925A	4.01A
Director D9	0.920A	4.74A
Director D10	0.916A	5.507A
Director D11	0.911A	6.298A
Director D12	0.906A	7.106A
Director D13	0.902A	7.923A
Director D14	0.897A	8.746A
Director D15	0.893A	9.575A
Director D16	0.889A	10.41A
Director D17	0.885A	11.25A
Boom Length	11.25A	

Table 3. The normalized lengths of the elements and their positions relative to the reflector element.

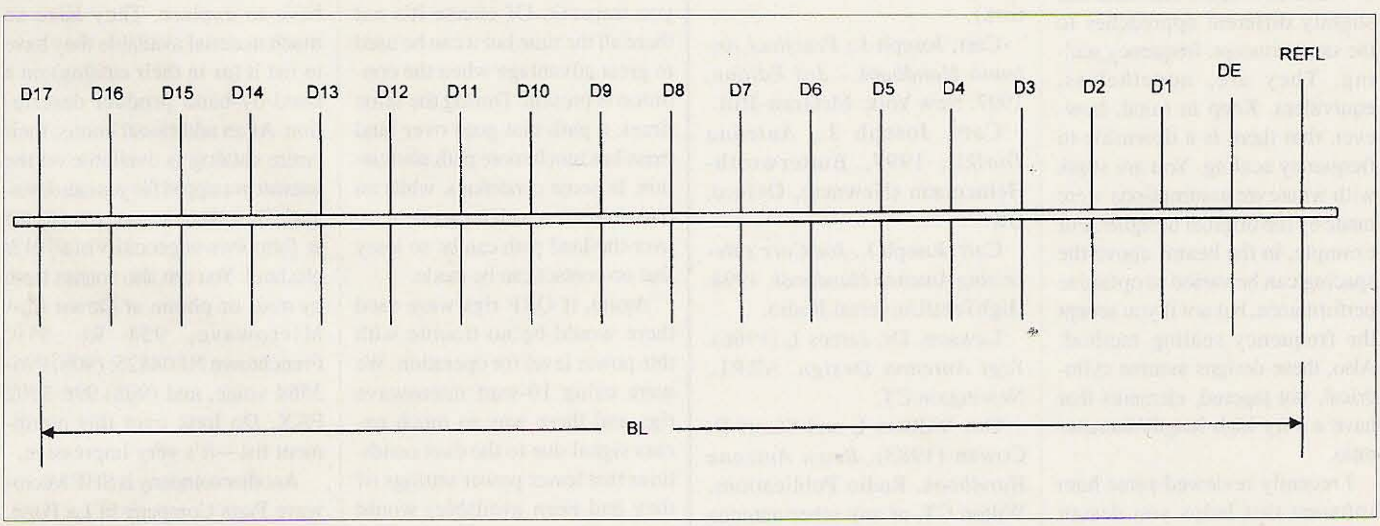


Fig. 3. Nineteen-element beam.

Number 52 on your Feedback card

Above & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119
[clhough@pacbell.net]

QRP microwave rigs

QRP on the microwave bands? You bet!

Most of the communications that is carried on in microwave operation is with QRP rigs constructed from surplus materials. QRP operation is not limited to just the HF bands and small CW transceivers. QRP operation is the normal mode of operation, for the most part, as high power is very expensive and can be hard to locate.

Most of the component parts used to construct converters for frequencies above 1000 Hz have come from surplus material obtained at swap meets, flea markets and commercial surplus dealers. While there are kits available for those who want a package deal, most converters are of the QRP level. Costs can increase sharply for accessories for these QRP kits—higher power means higher price.

Don't scoff at QRP operation on the microwave bands; quite impressive contacts can be made with relatively low power rigs. Take for example the 10 GHz (10,000 MHz) wideband FM operation where power levels in the 10 milliwatt range are common and 100 milliwatts (0.1 watt) are the high power rigs. These rigs have made some very impressive contacts over great distances. The most notable was a shot across the Mediterranean, of some 1800 kilometers distance. That was an exception to the general rule, but it was done.

Now we all don't have that great path available, but impressive (and satisfying) contacts can be made. I remember my first 10 GHz contact, which happened within the confines of my garage. Later, distance increased to a city block, and within a week we were up to 20-mile contacts between hilltops. Power used was 10 milliwatts transmit power and a 30-inch dish with about 30 dB antenna gain.

Yes, we have lots of hilltops here in California, where an easy contact can be over 150 miles. The mountainous terrain of the west coast poses some interesting locations to shoot between and some very difficult locations to try to shoot over. However, some notable contacts have been made from Baja California to just above Santa Barbara, California, for distances of just under 600 kilometers. These shots take advantage of water vapor ducts formed near sea level on this entirely-over-the-ocean shot.

This sea level shot was like shooting fish in a barrel, as the water vapor forms a very low loss waveguide-like duct into which you transmit. Of course it's not there all the time but it can be used to great advantage when the condition is present. During the same times, a path that goes over land mass has much more path attenuation. In some conditions, while an over-the-water path is excellent, an over-the-land path can be so lossy that no contact can be made.

Again, if QRP rigs were used there would be no trouble with this power level for operation. We were using 10-watt microwave rigs and there was so much excess signal due to the duct conditions that lower power settings (if they had been available) would have sufficed.

This, then, is the territory we venture into, trying to make the best guesstimate on path loss conditions. Being microwavers, we seem to take more time in tuning up our rigs and building new devices to use than we do operating. We seem to have the scale tilted towards the soldering-iron side of amateur radio. This is because we all have to home-brew our own equipment.

There are kits and bits and pieces available from several companies, and quite a few are listed on the Internet with Web sites. These sites give you a preview of catalogs in descriptions, some with photos of the actual kits. There are many different sources for materials, and at various levels of experience, from beginner to the very serious top-of-the-line high-power UHF operator.

Of course the top-of-the-line stuff and its high price tag are the same in this hobby as in any other realm. If you're buying a Ford or Chevy, compare those numbers to a Lamborghini or Ferrari—the price scale is relative. Be prepared to invest in your equipment if you want to get very serious with high power and associated station adjuncts. They'll cost you a bundle.

Here's a short list of suppliers of microwave materiel for all levels of interest. These suppliers all are listed on the Internet and have Web sites that you can visit to get up-to-the-minute details about availability.

A great supplier to the amateur community is Down East Microwave, located in Frenchtown, New Jersey. This is a site that you have to explore. They have so much material available they have to list it (as in their catalog) on a band-by-band product description. As an additional bonus, their entire catalog is available on the Internet in a zipped file you can download. Their Web site can be contacted at [http://www/geociti.Vista/7012/ghz.htm]. You can also contact them by mail or phone at Down East Microwave, 954 Rt. 519, Frenchtown NJ 08825; (908) 996-3584 voice, and (908) 996-3702 FAX. Do look over this equipment list—it's very impressive.

Another company is SHF Microwave Parts Company in La Porte, Indiana. This site specializes in

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scaling factor ("A") that is related to the size of the driven element. The value of "A" is:

$A = 138{,}189/F$ millimeters (mm).

Where:

A is the scaling factor
F is the frequency in megahertz (MHz).

Table 3 shows the normalized lengths of the elements and their positions relative to the reflector element. The reflector is a position zero (0), and all others are at the position factor (P) locations.

These two beam antennas use slightly different approaches to the same concept: frequency scaling. They are, nonetheless, equivalent. Keep in mind, however, that there is a downside to frequency scaling. You are stuck with whatever assumptions were made by the original designer. For example, in the beams above the spacing can be varied to optimize performance, but not if you accept the frequency scaling method. Also, these designs assume cylindrical, not tapered, elements that have a very high length/diameter ratio.

I recently reviewed some ham software that helps you design antennas. Some of that software might be reviewed in these pages in the future. It became apparent looking at one program that frequency scaling was being used. The giveaway was a data file containing what I calculated were scaling factors using the Lawson method (see "Suggested reading").

If you want to delve deeper into the topic of antennas, let me recommend the books below (not to be immodest, but some of which are my own).

Suggested reading

ARRL, *The ARRL Antenna Handbook 17th Edition*. Newington CT: 1997 (check for later edition).

Carr, Joseph J., *Practical Antenna Handbook - 3rd Edition*, 1997, New York: McGraw-Hill.

Carr, Joseph J., *Antenna Toolkit*, 1997, Butterworth-Heinemann (Newnes), Oxford, UK.

Carr, Joseph J., *Joe Carr's Receiving Antenna Handbook*, 1994, HighText/Universal Radio.

Lawson, Dr. James L.(1986). *Yagi Antenna Design*. ARRL, Newington CT.

Orr, William I, and Stuart D. Cowan (1983). *Beam Antenna Handbook*, Radio Publications, Wilton CT, or any other antenna book by Bill Orr W6SAI. 73

Gunn diode material for the 10 and 24 GHz bands. He also has various PC board adjuncts to support the Gunn diode units for operation on wideband FM (WBFM), and video operation. His Web site is [http://www.shfmicro.com/]. If you can't get on the Web contact SHF by mail or FAX at 7102 W. 500 S., La Porte IN 46350. FAX (219) 785-4552.

A supplier of high-end 1296 MHz equipment is KB2AH. His Web site is [http://www.SignalONE.com/kb2ah/]. This URL lists some impressive photos of dish antenna structures and high-end amplifiers for both receiving and transmitting. There are water-cooling adapters that are used on commercial versions of the old reliable 2C39 microwave tubes for 1296 MHz.

Don't forget Hamtronics, 65D Moul Rd., Hilton NY 14468-9535; (716) 392-9430. While Hamtronics doesn't have microwave items, it does an excellent job of supplying kits for converting your 10m HF equipment to VHF for use with a microwave converter, saving you the cost of a 2m multimode rig. I have tried their 10 to 2m receiving and transmitting converters; they're good—and priced right.

Whatever route you embark on, study your path carefully, and shop wisely. Look for key items in your search, for equipment some of us refer to as "unobtainium." This term (unobtainium) is how I refer to mixers, relay switches, and basic amplifier components for the microwave region—component parts that commercially cost an arm and a leg, but for amateur operations, parts you don't have to mortgage the farm to buy. Put your efforts into the construction of a simple QRP microwave rig for your band of interest.

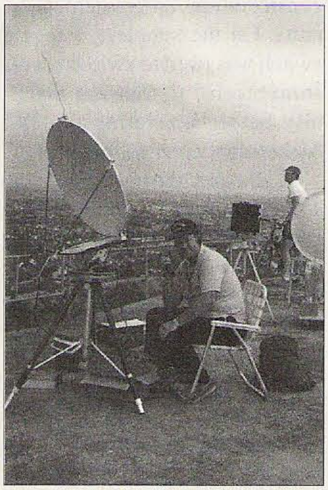

Photo A. WB6IGP on top of Mt. Soledad, San Diego, with my 10 GHz 50 mW wideband FM transceiver.

Where can you locate component parts from surplus?

Well, I would try surplus sales at flea markets and swap meets first. Then explore your local commercial markets to see what's available. Talk to TV and satellite TV technicians about the junk old units they have taken in trade or just removed from service. Try your local cable TV head end operations plant for your local CATV company. See if they will part with some materiel—and explain to them that this is to be torn down for parts for amateur operations, not put back into CATV use.

1296 MHz

Well then, what approaches did I take to construct a rig for each of our bands above 1000 MHz to 10 GHz? Let's start off with the 1296 MHz rig description. Having Qualcomm surplus material to experiment from made this job easy, in that I used the component cases for each rig, along with power supply and synthesizer components for each system. The 1296 MHz rig uses a receiver amplifier PC board for the main RX amp and a TX IF board for transmit. This basic unit was described in the January column. Essentially it is a synthesizer whose output is at 1152 MHz and is controlled by a very stable 10 MHz tcxo reference oscillator. The LO injects directly to the mixer at the +10 dBm drive level and couples the A filter and the switchable RX/TX preamplifiers. Currently transmit power is +10 dBm output. This stage will drive a one-watt amplifier from Fujitsu. This part of the project is under development.

2304 MHz

Material for this band was obtained from an old microwave Gunn diode system used for

Photo B. Top of Mt. Laguna, eastern San Diego County, 5500 feet. White dish 100 mW SSB system from Ed W6OYJ. Left: Jerry pictured with his SSB system. Lots of contacts from this lofty peak, even one Arizona station, that all came through during the 10 GHz contest.

digital communications over short ranges. Being in the right place at the right time, I took the junk and boxed the entire system. Taking the entire system was a major factor here. If I had cherry-picked the parts I wanted, it would have not been made available; but by agreeing to take the scrap with the parts I *wanted* I got the deal. I removed filters, an RX preamp, and TX 100 mW amplifier, and tossed the remaining 150 pounds of junk. I fitted a Qualcomm synthesizer to output 2160 MHz (144 MHz IF frequency) for 2304 MHz operation.

Directional couplers, RX preamp filters, and TX amplifier with relay manual switching finished the package. Not a powerhouse, as I could have added a power amplifier from military surplus that will put out four watts. I found operation at the 100 mW level to be very good, especially coupled with my 30-inch dish antenna. Besides, at QRP levels, the battery-operation current draw being reduced with low power means longtime use on the 12-volt battery source.

3456 MHz

The rig for 3456 MHz took some great thought before it could be constructed. I was thinking of using a crystal-controlled Frequency West brick-type

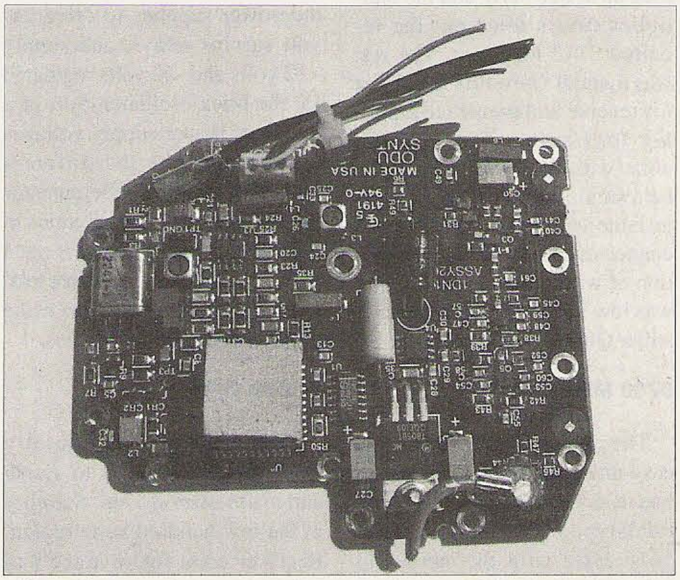

Photo C. An early version of the Qualcomm 3036 synthesizer that made our microwave rigs' construction possible.

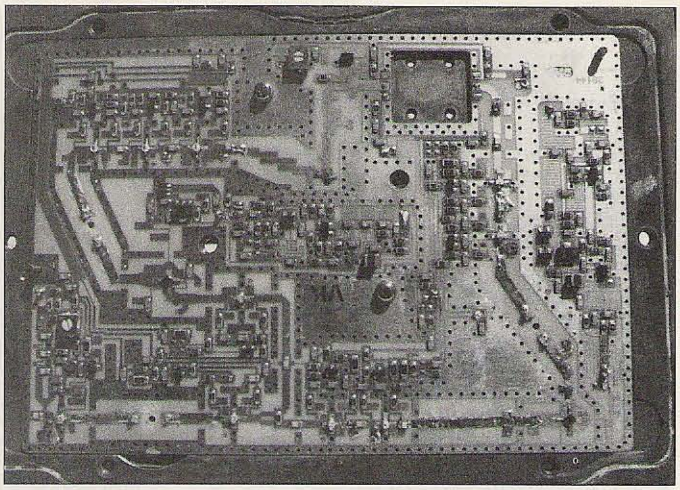

Photo D. The tiny Qualcomm transceiver for 10 GHz, originally part of a 12 GHz receiver and 14 GHz transmitter. Board contains all GaAsFET circuitry, 30 dB gain RX preamp, 30 mW TX, RX/TX IF amps, LO multiplier (x 4) from 2556 MHz driven from external synth board, LO distribution GaAsFET amplifiers and both RX and TX 10 GHz mixers. Physical size is six and a half by four and a half inches.

oscillator, but the units I had were all defective in one way or another. Where to find a local oscillator for 3456 MHz with a 144 MHz multimode as an IF system as used in all rigs? Where to come up with a 3312 MHz injection local oscillator?

I tried a synthesizer from a CATV head end receiver that proved to be stable for video, but not at all suitable for SSB—it had large phase noise products. The solution came when I married a low frequency Qualcomm synthesizer—similar to the one used in the 1296 MHz rig—and the multiplier unit from a Frequency West brick. The synthesizer was set to lock up at 828 MHz and the multiplier (times four) put the required 3312 MHz out. The rest was a small GaAsFET amplifier for receive and two-stage amplifier for transmit. Filtering was done with a simple waveguide below cutoff mode filter, one adjustable capacitor and two coax connectors, and a three-inch section of waveguide. Power output was low in the +10 dBm range—still a QRP rig to be sure.

5760 MHz

The rig for 5760 MHz was an easy unit to construct, because I had a 6 GHz Frequency West brick-type oscillator running at 5616 MHz with the same 144 MHz IF. Coupling that to a mixer and preamps for RX and TX gave me a nice system. I had a power amplifier that had one watt output and was quite small. Relay switching to transfer RX to transmit was accomplished by an RF detection circuit and switching delay sequencer. The relay sequence would turn off the receive contacts before making the transmit switch. This prevented turning on the transmit before the receive preamplifier was out of the circuit.

Frequency West brick oscillator, junk box double-balanced mixer, interdigital tuned surplus filter, relay switching automatic on RF detection, and two amplifiers complete this rig. Well, add the power supplies to drive 24-volt surplus relays, and supply +12 volts and -20 volts regulated for the brick oscillator. Sort of a jungle of power supply voltages to accommodate the different parts that required different supply voltages. Finding all items in the same voltage polarity is not a problem, as power supplies are relatively easy to construct—so make do with what you find surplus.

10.368 GHz

Well, the rig is totally Qualcomm from start to finish and synthesizer-driven. Stability in the few hundred hertz region. Receiver noise figure in the 1 to 2 dB NF range, gain 30 dB. The transmitter is one watt output with external amplifier or run barefoot at 30 mW power output. At this 30 mW power level, I have made many contacts and signals are strong. There is quite an improvement when the one-watt amp is switched in or its big brother the 10-watter.

The synthesizer is run at 2556 MHz and multiplied times four for a final local oscillator injection of 10,224 MHz. Again, the 144 MHz IF. I used the same RF detect transfer circuit and coax relay switching circuit that I used in the 5760 MHz rig.

All in all, these rigs show that parts and pieces from different manufacturers and military and commercial surplus can be combined to construct a microwave QRP rig. The answer is the same, no matter what frequency you want to construct for. Local oscillator, mixer filter and amplifier. Then come power supply considerations and switching circuits. On the simplest, a toggle switch was used to switch relays from receive to transmit manually before activating the 144 MHz transceiver to transmit.

In all cases, the power from the 144 MHz driving source was held to less than +15 dBm to prevent mixer burnout from RF power. You don't need lots of driving power to be applied to a transmitting mixer. Hope you have lots of fun locating those choice parts or putting together the kits that are available to construct for QRP microwave rigs. Best 73 for now. For questions please send an SASE or contact me on the Internet at [clhough@pacbell.net]. 73

Number 54 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153
[ajr@ari.net]

A few months ago, I mentioned the old RTTY pictures we all used to send on the air. Constructed of individual letters, patterns of letters, and overstrikes, these works varied from simple line drawings to shaded masterpieces.

Well, I received a message from John Sheetz K2AGI, in New Jersey, who passes along the following:

"Don Royer WA6PIR and I were the ones who used to run the RTTY Picture Contest for several years. I have over 1400 RTTY picture tapes but have not run any of them for several years. I do have a complete Teletype model 28 setup and an ST-6 demodulator. At the moment, I am active only on two meters. The request in your column is the second one I have seen in the past year. I might consider reactivating my picture tape sourcing. I always had the idea of getting it all transferred to floppy disk or comparable but have never done it. The biggest problem of which I am aware is the inability for most printers to do overprinting. Of course, you cannot do it on the CRT screen in any way! My tapes were all originally 5-level Baudot, but I was in the process of converting them to 8-level ASCII when the whole world went to computers. With the demise of the *RTTY Journal,* I am afraid that the hobby is going to die completely. Maybe by the time it all becomes a nostalgia item, like tube-type hi-fi, we might have some renewed interest in the good old RTTY mode. I do have the means to reproduce the paper tapes if all of the equipment still works—haven't tried it in years! I also have a good supply of raw tape on hand, so that is not a problem. I wonder if there [would] still [be] any interest in [my] distributing the old pix tapes or [the] contests."

To illustrate to the uninitiated just what John is talking about, **Figs. 1** and **2** show some of the work he and Don circulated in the halcyon years of radio teletype. Although these are necessarily reduced, I think you can appreciate some of the work that went into their production.

Continued

Well, folks, what do you all say? Is there still any interest in paper tape, rolls of paper, and greasy printers? Or has just about everyone gone computer? I look forward to your comments on this one!

As long as we're dwelling on older technology, let's entertain another question.

Ted Bear W6RHB, passes along the following:

"I read your column in *73* all the time and really enjoy your many good ideas and references to RTTY. But now I have one question that's a bit away from RTTY ... namely, CW. Maybe you could help me ... ?

"I just finished building a nice QRP rig ... Simple, but works!! But it is CW *only!* Now, what I am looking for to bring it up to date is a *nice CW receive and transmit program* for my little RatShack laptop that I rebuilt. The thing is pretty old and unsophisticated, using only a 750K disk. No hard drive, etc., and uses a V20 CPU ... so-o-o slow-w-w ... But does use MS DOS 3.0 or some such archaic DOS ... Anyway, the program has to be pretty small ... and simple!

"I found a couple of nice programs that transmit but do not have a receive function. Hamcom[m] 3.1 is only one that I found that has both. But it requires an SSB rig and won't use a plain ol' CW rig; so the question is, maybe you might know the name of a program ... or maybe even *have* such a program??? It sure would be nice, as I would like to take the rig out for Field Day in some boondocks area and play."

Ted, this is one I cannot help you with. The old V20 chip, like its cousin the Z80, is poorly supported at this time. I imagine that an old BASIC language program might be of value to you, if one still exists for that computer. Otherwise, we'll see what comes of this posting in the column. Let me know how you are doing with this endeavor.

I enjoy all of the comments and questions you all have been asking about the multiple programs available to help run RTTY and other digital modes on computers. The latest addition to the RTTY Loop Software Collection, Disk #17, contains the following programs described in recent months:

FTV-DEMO.ZIP: WEFAX, FAX, SSTV, RTTY, and CW reception; FAX and color SSTV transmission with Soundblaster™ and compatible cards.

RAFT201.EXE: RadioRaft, a multimode radio data decoder. Supports the Hamcomm interface or an external modem. 9 ARQ modes, 10 FEC, CW, packet, RTTY... Automatic decoding of any mode at any speed. Frequency meter and baud meter included. Modes are: Baudot, ASCII, SITOR-A/B, ARQ-E, ARQ-M2/4, packet, ARQ-E3, RUM-FEC, FEC-A, SI-ARQ, SWED-ARQ, ARQ-6/90 and 98, CIS11, SPREAD11/21/51, CW, AUTOSPEC, SI-FEC, ARQ-N, HNG-FEC.

RITTY206.ZIP: RTTY and Pactor using a Soundblaster card.

SBPMORSE.ZIP: Morse program using a Soundblaster card.

SSTVBL.ZIP: Slow-scan TV using a Soundblaster card.

How can you get copies of these programs? Just by sending US $2, a blank 3.5-inch disk for your PC, and a self-addressed stamped mailer to the P.O. Box address at left. Since this is Disk #17, those of you who just came in can assume correctly that there are sixteen other disks in the collection. A list can be yours for a self-addressed, stamped envelope, sent to that same address. Or, those of you who are cyber-connected can visit the RTTY Loop Home Page at [http://www2.ari.net/ajr/RTTY/] and view the entire list. You can also find some, although not all, programs to download. Unfortunately, server space considerations prevent me from keeping more than a few programs online at any one time. If there are particulars that you would like to see, though, drop me an E-mail at the address at top and I'll see what I can do.

My desire is to hear from you. By mail, by E-mail, or however you get them to me, I look forward to your comments.

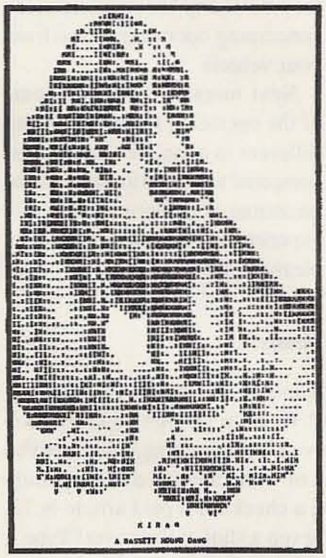

Fig. 1. "Hiram, a Bassett Hound Dawg." Originated by Don Royer WA6PIR, art by XYL Maxine.

Fig. 2. "Peace Through Victory." Also by the Royers.

Number 56 on your Feedback card

On the Go

Mobile, Portable and Emergency Operation

Steve Nowak KE8YN/5
15475 Summerwood Avenue
Baton Rouge LA 70817

HF mobile

While the vast majority of portable or mobile operations are in the two-meter or 440-MHz bands, one of the most fun types is working the HF bands. Imagine ragchewing without worrying about hitting the edge of the repeater coverage, or even when in an area not covered by a repeater. Imagine talking with Moscow or Alaska from the lower 48 while making an otherwise boring drive across miles and miles of miles and miles.

Perhaps the biggest reason that there is not more interest in HF mobile operations is because many people believe it is too difficult or too expensive. While there is some additional equipment required, it may not be as difficult as you may believe.

For HF, as for any other amateur radio station, you'll need a radio, an antenna, and a source of power. The source of power is relatively easy, of course, since most rigs require approximately 12 volts (actually 13.8 volts), the same as the car's electrical system. For any rig running over 10 watts, it is virtually imperative to run a cable of adequate size directly to the car battery, and to keep this power cable as short as possible. Keep the power cable away from the high voltage circuits to prevent interference from ignition noise.

Good practice dictates that the rig be turned off before switching on the car to avoid problems caused by spikes produced while starting the engine. However, many people add a relay that is used to shut off power to the rig when the ignition is switched off. In any case, don't forget to include an adequate fuse in the positive line.

The cables that come with many rigs are appropriate for mobile use—they're of the proper size and include an appropriate fuse. Most transceiver owners' manuals include recommendations for mobile operation, so check your manual for additional requirements.

The types of antennas suitable for mobile use are somewhat limited. Almost everyone uses a vertical antenna, although there are many variations on this theme. The biggest choice is between a multiband system or a monoband system. Multiband systems may either have resonators for each of the bands you plan on using, or they may be adjustable by having a plug which is moved to a different socket for each band.

Some people purchase several single-band antennas, one for each band to be worked. If each has a standard threaded base, it is easy to unscrew one mast and screw in another. Keep a wrench of the proper size in the car. By using the wrench to tighten or loosen the antenna, you minimize the chance that someone will be able to remove the antenna from your parked car and walk off with it. Make certain that the antenna and the coax are of the correct impedance for the radio you will use, or else you'll need an antenna tuner.

Unlike UHF and VHF antennas, a magnetic mount is not the optimum solution. In most cases a ball mount, which is permanently attached to the car fender, or a bumper mount is preferred. The ball mount will leave a hole in the side of the car which may be a concern when it comes time to sell it, but there are plastic plugs specifically designed to cover the hole when the mount is removed.

Bumper mounts were once very popular, but with so many plastic bumpers these days, it is necessary to ensure that the bumper will support the weight of the antenna; don't forget that the antenna will place more stress on the mount when the car is moving because of the wind load on the antenna. If you have a trailer hitch, you can mount the antenna next to the trailer hitch, but slightly offset.

It is a good idea, in any case, to mount the antenna at the rear of the car and keep it as far from the engine as possible to minimize interference by electrical noise. It is also important to keep the antenna away from other antennas you may have on the car. I prefer the left rear fender, because this helps avoid low-hanging tree branches. A spring at the base will help the antenna deal with unexpected obstructions. Finally, make certain that the mount is making good electrical contact with the car body, since the body provides the counterpoise for the antenna system.

The most fun decision, of course, is picking an appropriate rig. Most people will opt for single sideband, although some people do like FM on six or 10 meters. There are some folks who successfully operate CW while mobile, but for me that takes too much concentration away from driving.

There are a number of rigs that appear to be specifically designed for mobile or portable operation. Those with full features and 100 watts of output, such as the Kenwood TS-50S, are priced close to any full-sized, full-featured transceiver. Other units such as the 50 W Ten-Tec Scout Model 555 are priced a bit lower. Finally, the MFJ 20-meter SSB Travel Radio is a single-band, single-mode radio which is priced even lower.

On the other hand, it is very easy to use any number of other rigs for HF mobile operations. In the past I have used a Ten-Tec 580 Delta and a Kenwood TS-120 very successfully. If you run across a reasonably priced used HF rig, you may want to think about it for mobile operations. The biggest issue is to make sure that it will fit in your vehicle.

Unlike a two-meter rig, most HF rigs won't mount easily under the dashboard in most cars, especially with the way cars are designed these days. In the past, I've used a hump mount for the HF rig and mounted my dualband two-meter, 440-MHz rig right on top of it. I've also seen people mount their rigs on a plywood base which sits on the floor in front of the passenger's seat, oriented so it faces the driver. This is fine if you're traveling without a passenger, and can be easily moved when someone is sitting in the passenger's seat. Of course, unless your passengers are other hams, they tend to expect you to talk with them rather than on the radio anyway. In any case, you want to have the radio placed where you can see it easily, without it being a distraction from your driving.

Two words of warning are required. First, as my instructor used to remind me when I was learning to fly, the first thing to do is to fly the plane. When driving and operating mobile, the first thing is to drive safely.

Second, in today's automobiles many of the engine operations are controlled by a computer. That computer may be susceptible to RF interference. Check with your car manufacturer to determine if they have any recommendations concerning operating radios from your vehicle.

Next month I'll discuss some of the operating habits which are different in a mobile operation as compared to a fixed location. In the meantime, if you have any ideas or experiences with mobile operation, please let me know. 73

Calling All Hams!

Tell us about yourself! We at *73* are insatiably curious (OK, nosey) about our readers. So c'mon, spill it! Write to us—let us know who you are, what you do, how long you've been hamming, what got you involved, anything else you can think of—and include a sharp picture or two! Why bother? It *could* get you a check for a paid article in *73*, your photo in the magazine—maybe even a shot at the cover! Type it up, put it on a floppy (Mac format is always best) if you have a computer—don't forget to send a hard copy along with the diskette—and send the whole works to: **73 Editorial Department, 70 Route 202 N, Peterborough NH 03458.**

Hams with Class

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Dayton HamVention '97

I dipped into the resource pool of the most talented hams I know, and came up with a winning combination of guest speakers for the Instructors' Workshop at Dayton this year. It was a pleasure dealing with every one of these people, because besides being good friends, they each excel at what they do.

The purpose of this forum is to give creative ideas to teachers and instructors about recruitment and about how to give highly motivational ham radio lessons. It was impossible not to get a ton of good ideas from these speakers.

Bob Grove WA4PYQ is a longtime friend who has shared many a podium at radio conventions with me. Bob is the publisher of *Monitoring Times* and *Satellite Times* magazines. His talk was on "Using Shortwave Radio in the Classroom." Listening to international broadcasts can open the door to lessons in geography, history, current events, culture, and foreign languages. Being a former teacher, Bob is very well aware of the value of using radio to motivate kids to learn about their world.

Bob Heil K9EID always enthralls the audience whenever he speaks about his two favorite topics, ham radio and teachers. Bob is the author of several books about sound systems. He is a world class expert on this topic. His demonstration on how to teach about phasing brought the house down. Bob exemplifies everything a good teacher or instructor should be. He is dynamic and creative, and obviously feels he owes a lot to ham radio for being so instrumental in his chosen career.

Seth Foote KC8BUD and David Force KB8TDB are two delightful students from Troy High School and Troy Jr. High School respectively. The entire audience was so impressed with them both. They spoke about "Working Emergency Radio Stations" and "How To Establish A School Station." They gave excellent pointers to teachers in the audience about how to approach school administrators. They even had a videotape presentation of the principal who enthusiastically endorsed their management of the school's ham radio station.

Henry Feinberg K2SSQ (**Photo A**) is a noted inventor, writer-director, and creator of the ET communicator. His talk was "Creativity 101—From Foxhole Radios to Imagineering." Henry dragged his Rube Goldberg creation in a suitcase all the way from New Jersey. He had a most unusual demonstration for us. The point of showing his elaborate concoction that eventually boils water for coffee at the end was to discuss "functional fixedness" as an educational concept. In order to stimulate students to be creative and inventive, a teacher should encourage projects like Henry's which force you to use commonplace objects in ways other than what they were intended for. He really made his point very well.

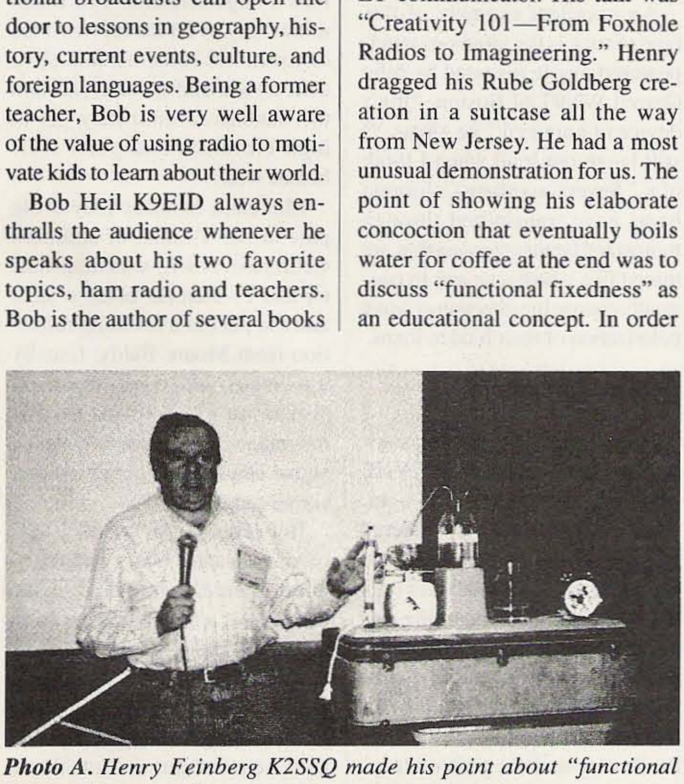

***Photo A.** Henry Feinberg K2SSQ made his point about "functional fixedness" very well.*

Dave Bell W6AQ (**Photo B**) is a Hollywood director and world-class DXer. He spoke about "Effective Uses of Dxing in the Classroom."

Dave brought along some of his more exotic QSL cards and suggested ways of using them on display to motivate kids to want to make distant contacts. The application of geography and social studies skills to radio contacts was discussed. Bringing in guests from foreign countries who were just voices on the radio is a fun activity, too.

***Photo B.** Dave Bell W6AQ spoke about the effective use of DXing in the classroom.*

Bill Pasternak WA6ITF is the producer-writer of "Amateur Radio Newsline." He spoke about one of his favorite enterprises, the "Young Ham of the Year" award. If any of you are aware of an accomplished young ham radio operator who might make a good candidate next year, please get in touch with Bill for an application form. He can be reached at [BillWA6ITF@aol.com].

The workshop was a big success simply because so many folks in the audience asked great questions and were able to walk away with some excellent, fresh ideas for the classroom. My thanks to all the terrific speakers. 73

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P. O. Box 2508
Fullerton CA 92837
E-mail: [Homingin@aol.com]
Web: [http://members.aol.com/homingin/]

Creativity runs rampant

Ham radio is a wonderful outlet for creativity. From simple circuits to complex systems, such as linked repeaters and APRS networks, hams use imagination to design and implement novel solutions to communications needs. Nowhere is ham radio creativity more useful than in the sport of finding hidden transmitters, often called foxhunting or T-hunting.

Seldom will you find two hams with identical radio direction finding (RDF) installations. Each setup is the result of the ingenuity of its owner. Creativity also comes into play when ham clubs decide what kind of T-hunts to hold. The basic format in the USA calls for all teams to drive as close as they can to the transmitter, then finish the hunt on foot if necessary, but no two groups have identical hunt rules. They differ in number of transmitters, boundary size, signal timing, scoring method, common starting point, if any, and restrictions on location and movement of the transmitter. Some hunts are highly structured, while others are virtually "no holds barred."

Photo A. This hidden transmitter lived up to the name. Darryl Widman KF6DI hollowed out a thick telephone book to conceal his handie-talkie and battery pack. This book was in plain sight under a pay phone at a hamfest, but many hunters ignored it completely while T-hunting only with their eyes.

The greatest opportunity for creative expression comes when it's your turn to "hide the fox." Within the rules of the hunt and the constraints of equipment and wave propagation, your mission is to befuddle and amaze your fellow hunters. For a hunt that will be remembered and talked about for a long time, make sure it has a surprise ending. A bit of deception is ideal, so long as it is within the rules and done in good taste.

There are four basic ways to add to the difficulty of your hunt:

- Deceptive signal parameters
- Indirect signal paths
- Apparent inaccessibility
- Concealment and camouflage

You probably won't want to use all these elements at the same time. After all, you don't want the hunt to go on forever, right? Consider the temperament of your local hams. Some take a dim view of hunts that are "too hard" or "too long," while others expect nothing less than your most devious efforts. A series of very hard hunts might discourage fledgling hunters and decrease the number of future participants. On the other hand, no hider wants everyone to show up in half the expected time, demanding that someone go out and hide another fox.

One continuous transmission with constant power and antenna polarization is easiest for hunters. Changing any or all of these signal parameters, if allowed by the rules, adds to the difficulty and lengthens the hunt.

In many parts of the country, short infrequent transmissions add spice to RDF contests. When the signal is on for only 15 or 30 seconds every three to five minutes, hunters tend to scurry around and hunt with their eyes on first-finisher-wins hunts. But when the winner is determined by lowest elapsed mileage, they may sit and wait for transmissions, making the hunt unnecessarily long.

For RDFers using beams and S-meters to get bearings, short transmission bursts can be very difficult to track. Amplitude variations make it even harder. The most difficult signal I ever had to track with a beam/S-meter setup was on a hamfest hunt when the hider switched the T on and off every half second, and every burst was at a different randomly-selected power level. Of course if everyone in your group hunts with Dopplers, this stunt won't slow them down much.

Dopplers aren't invincible, though

Depending on the Doppler array design and local terrain, they can be flummoxed by horizontally polarized or moving signals. How about switching between two separated transmitting antennas, or having a big chunk of metal or foil moving about near the transmitting antenna? The switching or motion should be rapid to fool Doppler hunters, or slower to bollix the beam turners.

An excellent example of this type of trick is the infamous wind-powered dipole invented by John Garrett WN9T of Boston. "It's a device of pure evil," he gloats. "I still laugh out loud when I think of it." Several southern California hams have transmitted through motorized beam antennas that are turned like a barbecue spit to constantly change the direction or wave polarization of their hidden foxes.

Bounce that signal

As you learned when you studied for your ham license, VHF radio waves travel line-of-sight. They are scattered and reflected by hard objects bigger than a few wavelengths. Your RDF gear tells the direction of the incoming signal, but a good hider can use these properties to see to it that the direction of the signal isn't constant and isn't necessarily the same as the direction of the transmitter.

Putting your foxbox downtown among tall buildings may give fits to hunters as they try to separate the direct signal from the bounces. Pointing a beam at heavy traffic or a busy railroad yard adds fluctuating levels to the reflections. The effect is even more pronounced when the hunt is on the 223, 440 MHz and higher bands.

"Those metal block buildings in industrial parks really scatter the RF," says David Croll KT1X. "Also high power and a beam near a river can cause a hunter on the opposite shore to receive strong signals and lots of reflections. You can get some hunters to spend a lot of time looking for the fox on the wrong bank when the signal is so strong that they can hear it without an antenna on the radio. Of course it is best done when there is no nearby bridge!"

If you live near the mountains, you can really think big. A snow-covered peak is an amazingly good VHF reflector. Many of them bounce signals pretty well without snow, too. Brian Mileshosky N5ZGT, winner of the 1997 Newsline Young Ham of the Year Award, reports from Albuquerque that the Sandia Crest plays a big part, so to speak, on their T-hunts. Though far to the east outside the hunt boundaries, he says, "We use it as a huge reflector. The transmitter may be on the far west side of town, but some hunters (I've done it) will end up hiking around the Sandias ... until they get to high elevation and point their beams west."

Mountain bounces play a big part in the T-hunts of southern California. A two-watt transmitter and 11-element beam is all it takes to put out a booming reflection from Mount Baldy. Usually it is impossible to hear the direct signal unless you go up the mountainside or go away from the signal bearing and get into direct signal range.

Bob Thornburg WB6JPI tells of long-distance hunts with transmitters near Bakersfield or in the desert over a hundred miles from the Los Angeles starting point on the other side of a mountain range. He wrote, "The hider places a long horizontally-polarized beam about a foot above ground on a very flat piece of land, like a big field. The beam is pointed at an 8000-foot mountain from 10 to 20 miles away. The signal illuminates the top of the mountains and diffraction ensures that it will be heard on the other side.

"Of course the signal is quite loud from the reflection off the mountains on the transmitter side," he continues, "but except for a range of about five miles around the transmitter, the direct path is over the horizon and quite weak. If the mountains have access roads, hunters will go up there and get good direct bearings. If not, they just mill around the base of the mountains, quite confused."

You can't make a transmitter completely inaccessible without breaking the rules, but perhaps you can make hunters think it is. A favorite trick of southern California hiders is to find an out-of-the-way fire road or truck trail in the hills. Of course it's not on the map and the entrance to the road is miles from the transmitter in a direction where there is little or no signal to encourage hunters to take the road.

WB6JPI recalls one Los Angeles hunt where the rules called for the transmitter to be within 20 feet of a paved road. It was indeed just 18 feet away, but the only way to reach it was to enter the Los Angeles River five miles away and drive down the paved riverbed to a parking place underneath the Pasadena Freeway. This channel is nearly dry during the summer months—it's even used for bus driver training. But was that really a T-hunt, or just a road hunt?

Hard-to-reach foxes are a specialty of hiders in Melbourne, Australia. "One was at a small pedestrian walkway built under a freeway," writes Bruce Paterson VK3TJN. "It dangled on a rope from a walkway just above the junction of a creek and a river. Hunters arrived on each of the three possible river banks, only two of which had access to the walkway, one going through a school."

It's possible to take inaccessibility too far. WB6JPI tells of a T that was under the rear bumper of a California State Police car parked outside the downtown office. "The engine was running, but the car was unoccupied," he says. "Whenever anyone got near the car, the police would run out of the office and shoo them away. The bearings from the dozen hunters all pointed at that car, but no one could approach it. By some prearranged signal, the police came out and turned off the engine. Then we could approach the car and quickly found the transmitter." Some groups like this sort of T-hunt, but others try to avoid them by writing rules that call for the transmitter to be in a place that is readily accessible to the public and where persons can get to it safely.

Hide in plain sight

Transmitter hunting is an RDF exercise, not an eye test. Good hunters have trustworthy gear that will find the signal source no matter how well you conceal it. Still, it's lots of fun when the transmitter is cleverly disguised.

The T-hunters of Melbourne are masters of camouflage and concealment. VK5ZCF writes, "We got a large sheet of cardboard and glued old Coke™ cans, newspapers, and other junk to it. We positioned the transmitter and live operator inside a dumpster with the cardboard on top. We even had a few rotting banana skins atop the mess to discourage anyone from digging deeper. Many teams circled the bin ten or twelve times and still did not find us."

VK3TJN adds, "One team built a mini-fox into a brown plastic duck. They controlled the duck's movement through a flock of real birds using underwater string. Another team put a foxbox in the briefcase of a well-dressed businessman standing at the bus stop in a busy shopping center carpark.

"In Melbourne, there is a trendy place called Lygon Street with many restaurants and coffee shops," Bruce continues. "The fox was a fake traffic counter chained to a light pole. The antenna was RG8 coax laid across the busy street pretending to be the air hose. It was very amusing to watch as we sipped our coffee nearby. One team parked on top of the coax and dropped a runner who took off somewhere and was not seen before the end of the hunt. Things were wonderfully confused by the fact that a Met bus stopped on top of the coax just as the teams started to arrive."

Just as with inaccessibility, it's possible to get carried away with concealment. A hider in southern California left his T in a crowded entertainment area of the Disneyland Hotel complex, much to the rage of security officers. Tom Geletka N9CBA of Chicago says, "One joker put his foxbox in the middle of the audience at a large fireworks display, which encouraged hunters to jostle and step among the seated crowd." Tricks like that take the fun out of the hunt. They aren't good public relations for ham radio, either.

Another way to conceal a transmitter is to make it one of a large number of similar objects. KT1X recalls a fox in a company rental car, a new Ford, parked neatly in row of similar new Fords at a dealer on a divided highway on one of the busiest roads in Massachusetts. If necessary, make the similar objects yourself. Bruce Paterson tells of a T buried under sand on the beach. "There were also about forty other antennas of various shapes and sizes, yagis, quads, halos and verticals, all sticking out of the sand in a small area. Each antenna had coax, or wire that looked like coax, attached to it and buried under the sand. Only one went to the transmitter."

Bruce also reminisces about a mobile hunt in an car unknown to the hunters. "The rule for the hunt was that the teams had to flash their lights at the hider's car and announce their callsign on the liaison channel. We would penalize them if we heard a call but saw no flashed lights. What we didn't tell them was that we had three other decoy cars, all bristling with antennas, circulating in the area. Of course every hunter fell for it and was penalized."

I have barely begun to list all the devious ways to add fun to foxhunts in your area. I have some more excellent examples of deception that will have to wait until next month.

How will you use your creativity when it's your turn to hide? Just remember that as you are scoring the hunters, they are judging you. When you think you've figured out the ideal hiding spot and deception plan, stop and ask yourself: Is it clever? Is it fair? Is it safe? Is it *legal*? Will the hunt be fun for all?

Some of the tales in this month's "Homing In" came from a recent discussion of sneaky hiding tricks on the Internet fox-list reflector. (Thanks, folks!) To find out how to get on this list and to learn about T-hunting opportunities in your area and everywhere else, visit the "Homing In" site on the World Wide Web. The URL is at the beginning of this article. Then E-mail news and stories of your hunt activities to me, or you can mail your stories and photos to my post office box in Fullerton. 73

Photo B. *Would you suspect that a "bag lady" in a mall parking lot could be on the hiding team? Christie Edinger KØIU gave a performance worthy of an Oscar. Her transmitting gear is under the junk in the cart.*

Number 60 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Color it successful!

For months now, we've been exploring video. It's been fun writing about this intricate topic, and I hope you've been enjoying the exploration as much as I have. This month, we're going to wrap it up. Last time, we were about to delve into the specifics of color recording and playback on a modern VCR. Let's get to it:

When we left off, we'd seen how the chroma subcarrier was simply heterodyned down to a lower frequency to enable putting it on tape without requiring lots of bandwidth. I should have mentioned one detail, though, regarding the phase of the heterodyning (local) oscillator. In early "color-under" video recorders (so called because, after heterodyning, the frequency of the color was *under* that of the FM luminance carrier), the crystal oscillator used for the local signal was left to simply free-run; its phase wasn't considered important. The result was that the phase of the chroma signal applied to the tape was essentially random; it slowly drifted with respect to the horizontal sync on which its reference portion (the color burst) would eventually ride.

In fact, broadcast standards specify a consistent phase, so that the color burst starts and ends at exactly the same point in its waveform after each horizontal sync pulse. TV sets, though, don't really care much about that as long as the phase is continuous within itself (in other words, it has no interruptions), and phase-incoherent color works quite well. Although broadcast engineers always sneered at phase-incoherent machines, they served their market just fine, and ignoring the phase issue kept the cost of the recorders down, albeit not all that much. The only drawback was that editing in color was never perfect, as there could be a severe enough discontinuity in the phase at the edit point that a TV might flash a moment of bad color while it re-locked. Then again, given the helical machines' poor dynamic timebase stability (timing accuracy while the tape was moving), perfect editing was never *expected* anyway.

No such luck

While color-under recording was clearly the right choice for a home video recorder, it just didn't work with the new "azimuth" approach to lower tape consumption, in which the video heads' azimuth was deliberately misaligned between adjacent tracks. Why not?

Azimuth recording depends on the short wavelengths, relative to the head gap size, of the recorded signals; the more of them that fit into the wider-appearing gap of the misaligned head, the more they will average out to zero and effectively disappear. The upshot is that the canceling effect increases with frequency. In an audio recorder, the highs disappear first as you turn the azimuth screw on the head mount away from its proper position, and the bass notes pretty much never go away. It acts like a variable low-pass filter.

In a color-under video recorder, the lowest frequencies recorded are the converted color signals! While the luminance FM carrier may have frequencies ranging from perhaps 2 to 10 MHz, color is recorded in the 600 to 700 kHz range. It's the video equivalent of those bass notes. Compounding the problem is the fact that the color is recorded as a sideband signal, not FM, in order to save gobs of bandwidth (and to simplify the process). Sideband is a form of AM, so it has none of that lovely capture effect of FM; weaker interfering signals don't just disappear. The result is that the deliberate azimuth misalignment made for great luminance—but dirty, interference-laden color.

This problem was the final hurdle to the home video recorder.

A new approach

Sony solved the problem in the Betamax™ format, which paved the way to its tremendous success as the first true home VCR. The answer lay in manipulating the heterodyning oscillator's phase. No longer could the phase be considered inconsequential. By drawing the video heads' tracks on a piece of paper, it could be seen that the positions of the horizontal sync pulses lined up pretty closely next to each other on the tape. By alternating the converted chroma's phase every other line, much as in PAL-format TV signals, and then reversing the whole process on every other field, the adjacent tracks, which typically had pretty much the same instantaneous phase at any given point (since, from field to field, TV signals usually change slowly), could be made to mostly cancel out. It wasn't perfect, but it was pretty good, and the eye's tendency to average noise over time, combined with the averaging effect of the TV's phosphor persistence, made it even better. It was good enough; the color looked clean. (By the way, if you want to see what the signal-to-noise ratio of a typical video signal *really* looks like, take a good look at a still frame. It sure doesn't look anywhere nearly as good as when the tape is moving, does it?)

When JVC developed its VHS format, Sony already had a patent on the phase-alternating scheme, so they had to find another way to do it. The result was VHS's four-phase alternating system, which is similar but rotates the phase through 90-degree shifts from field to field. The visual result is about the same.

The great war

Speaking of formats, the great Beta vs. VHS war illustrates the power of marketing over quality, much as the war between computer operating systems has done in recent years. Although the basic principles of the two formats were essentially the same, Beta was designed to significantly higher video specifications, including wider luminance bandwidth (due to a bigger head drum and thus higher writing speed), more chroma bandwidth (for the same reason), and tighter timebase stability (less wobble), which resulted from the "beta" wrap that put more tape between the supply reel and the start of the head drum. VHS's marketing, particularly in the video rental arena, clobbered Beta. Its longer time on each tape helped, too, because cassettes were very expensive back then, around $18 each, compared to today's $2. Beta fought back with the first hi-fi VCR sound, which was accomplished by putting two FM subcarriers for the sound on the video tracks, along with the video signals. It helped for a while, but VHS soon countered with its similar hi-fi system, and the war was over. People snicker at Beta today, but it *was* a higher-quality format. Many videophiles still prefer it.

Playback

OK, so the now-complex, phase-shifting color-under signal was on tape. How to play it back? Again, heterodyning was used. Here's where the PLL came in. The timing problems were caused by mechanical variances induced by everything from tape wobble to thermal expansion and contraction of the tape itself. The exact timing wobbles were not predictable. How the heck could you compensate for that all the way down to the nanosecond level?

Luckily, there was one aspect of the timing errors that was known: They didn't happen very fast, because the mass of the spinning head assembly provided a flywheel effect that kept things smooth over the short haul. At least, the errors weren't fast relative to the speed of video signals! So, it was a reasonable assumption that the amount of timing error over a single, 62.5-microsecond horizontal line was next to zero; errors were much more gradual than that.

In the early days of color-under machines, various techniques were used to provide a reference signal that could be used to compensate for the errors. Some machines put a "pilot tone" on the tape, along with the other video signals. That signal would, of course, contain all the same timing errors as everything else, and it could then control the PLL circuit to compensate for them. It worked, but the extra signal took extra bandwidth, and it sometimes caused visible interference to the video signal.

In modern machines, the horizontal sync pulses of the luminance signal are used as the reference, so no extra signals are required. Like everything else on the tape, they contain the same timing errors as does the chroma signal. But how could they be used to correct the color?

Mix it UP!

Remember how a balanced mixer works? It produces the sum and difference frequencies of the signals that go into it. Well, if both of the frequencies wobble, say, up a few kHz, what happens? The difference frequency won't, because the changes cancel each other out as long as the incoming frequencies have changed by the same amount. So, the trick is to control the local oscillator, using a PLL driven by the horizontal sync pulses, to make it wobble up and down in frequency, in step with the wobbles of the horizontal sync itself. The local oscillator will then be tracking the tape errors, and mixing it with the chroma signal coming off the tape will produce a stable, corrected, color signal, ready for the TV set.

This crazy scheme works, only because re-correction occurs every 62.5 microseconds, at the beginning of every horizontal line, and nothing much in the way of errors occurs within a given line. In a real VCR, though, it gets pretty complicated. Remember, all those phase shifts deliberately introduced to keep adjacent tape tracks from trashing each other have to be removed, which requires the local oscillator's phase to be shifted in the same manner and at the same time. Also, two loops are required for good

THE DIGITAL PORT

Jack Heller KB7NO
712 Highland Street
Carson City NV 89703
E-mail: [jheller@sierra.net]

BayPac™ portable helps diagnose

Last month's column concerned getting the BayPac BP-2M to work with some of the aging and newer equipment in my shack. At the conclusion, the BP-2M was happily speaking digital to the local PBBS through my mainstay Pentium™-based computer. This was fine, but unfortunately that computer resists going portable.

After I worked around certain other obligations, I tackled the IBM laptop conundrum. Why doesn't this thing speak through comm port 2 to the outside world? In the earlier days (before Windows 95™) there was a neat little diagnostic utility that came up in DOS when you typed *MSD*.

Those days are gone since the entry of my new automated operating system. But just for good measure, before the planned call to IBM, I looked at the directory on the hard drive for clues. Nothing remotely resembled a diagnostic helper, but there, in the corner of the screen, was a [readme.txt] file I hadn't read.

A message from on high

Believe it or not, this file was planted there by a sage computer god who knew that I would open it one day—and why. In very plain language, it stated something to the effect that I could not activate serial or parallel ports and several other devices from DOS—I had to go to Windows. The only thing missing that would have made it more personal was my name (and possibly an opinion of my intellect), although I have mentioned this restriction to others and it was news to them, too.

To make a long story short, I followed the procedure to the Device Manager and sure enough, it indicated I needed to check a box to get the port going and then reboot. As I mentioned, the BayCom software is very fussy about having plenty of room to maneuver. It is necessary on startup to hit the F8 function key when the operating system displays that Windows 95 is starting.

This produces a menu from which you can choose plain vanilla DOS. From there you go to the BayCom directory and run BPMODE. This program searches for the modem and tells you which port it is connected to. Voilà! It said the connection was on port 2. This exercise was beginning to make me wonder: How close is the day when the intelligent computer will take us by the hand and solve all of life's problems?

This was great. I now had a laptop that conversed with a modem attached to a handheld, a very portable packet station. (See **Photo A.**) I had wanted one for years. I connected to the local PBBS, read my mail, sent a message of my own, and scanned the bulletins. The radio-digital life was looking up.

Search for a Windows program

But it wasn't quite enough. I could live with this, but I use the computer for activities such as writing this column, and just about everything else I do uses Windows applications. I needed a Windows program that could speak the BP-2M language, at least for packet. I have had a few inquiries about such combinations and felt some responsibility to provide the answer.

In a newsgroup a week or so ago, I ran across an opinion that nothing worked with these little modems (not even DOS). There was a posted answer that appeared very complicated, but if that was what it would take, I was prepared to take the plunge. However, there were some simpler avenues to follow first.

I had experimented using several programs with the BP-2M. The next step was to look to see if one of them would be successful before embarking on another long journey. In the laptop's hard drive there was a program I had downloaded in a directory that is self-explanatory, WINTNC. The program is available on the TigerTronics™ Web page.

Upon bringing this up and checking it, all the parameters were in order, so I connected the BP-2M to the radio and applied the antenna. In my shack's location, one and a half watts doesn't make it out without an outside antenna. The *Connect* command keyed the radio and the little station was on the air with a Windows program.

One little problem

The PBBS didn't respond, so I assumed it was down. I sent a connect to a node that is thirty miles off in the other direction off the back of the yagi and it came up. Not bad. Just to be sure it wasn't a fluke, one-time-only acknowledgment, I worked a few of the commands on the node and even connected to another node. It was real—the little station is a success.

Then the plot began to thicken. The next day, I decided it was time to experiment with the HF rig. After all, this BP-2M is a multimode unit. If it is working in one area, it should easily expand into RTTY and AMTOR and the

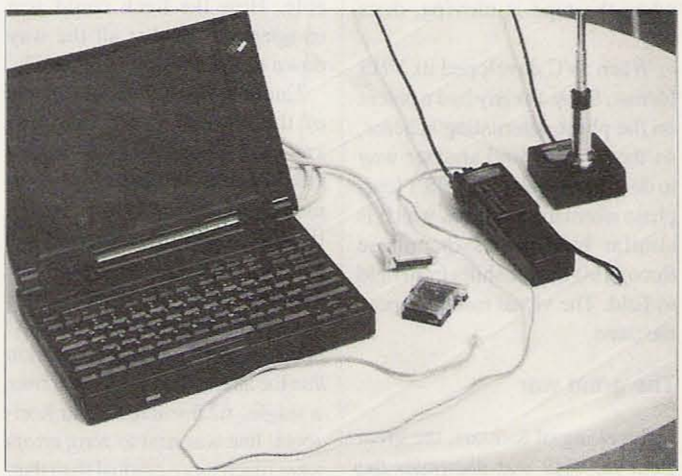

Photo A. The KB7NO portable packet station, ready to plug and play. The BP-2M is only slightly smaller than the cable end that plugs into it. The cable to the radio is regular phone cable and uses the same plug into the BP-2M as connects to a standard telephone. Power source for the BP-2M is the serial port. With a good 12-volt source and a Radio Shack™ inverter for the computer, the station can stay on the air indefinitely.

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color. The first is a frequency-correcting loop that fixes the gross frequency errors induced, for instance, by scanning the tape through those pesky commercials, or by large temperature variations. The second loop is a phase-correcting loop which corrects the small errors caused by tape wobble and such. Luckily, all this mess now comes on a chip or two, rather than the big board full of hundreds of parts it once took.

Now that we've delved into its depths, I hope you can see why the home VCR was such a monumental achievement. When first conceived, the technology of the day simply couldn't support such a product. The demand was there, so technology was forced to catch up. And it's been catching up, faster and faster, to the demand for more and more complex gadgets—from nearly wearable, full-featured micro HTs to digital camcorders to gigabyte hard drives that fit in notebook computers (not to mention the notebooks themselves). We owe a great deal of the advancement in our consumer electronics to this one amazing product. And you can get 'em cheap at hamfests!

Next time, something different. Until then, 73 de KB1UM.

other modes. It didn't take long to make a cable to match up to the accessory jack on the back of the ICOM 735. It only takes four wires for the connection, and the socket on the BP-2M accepts a regular telephone connector. I seemed to remember having a few of those around the shack.

The software supplied with the modem is Hamcomm™ shareware and it, too, runs in DOS with the same restrictions about Windows not running. I can live with that; this will be a snap. I printed the manual and scanned through it for warnings and specific hazards to avoid. There is a configuration file to edit; it is straightforward with the instructions imbedded. Got that done and it was ready.

Applied power, tuned around 20 meters for signals, and heard nothing in the modes this would copy. There were a few PACTOR signals and a little CW. If all is quiet, it is time to make a little noise of our own. The program appears to work, there are correct sounding signals for RTTY and FEC coming from the computer speaker, but the radio PTT is never keyed (grounded). Jumping the PTT terminal to ground keyed the rig.

I checked the other connections and remembered an item I had passed up. This modem is not quite as magic as a PK232. It is necessary to bring up BayCom's BPMODE and change the mode from packet to multimode. That done, there was still no action on the PTT. Just couldn't get the signal on the air.

Possibly, I had mutilated the little modem. It wouldn't take much. Anything that will function on the power available from the serial port is pretty fragile. So I went back to the mode that worked, packet, after resetting the modem to that mode. I brought up the local PBBS and breathed a sigh of relief. At least the problem wasn't toasted hardware.

The Windows enigma

Then I realized that since I had followed the natural scheme of getting packet up and running, the computer was using the DOS program. I was curious about whether there was a problem when running Windows. After shutting down the computer and bringing up Windows 95, I found that the WINTNC program functioned, but there was no connect.

Watching the radio closely, I saw the transmit LED light, but there was no receive action whatsoever. For some reason, the PBBS system, where there had been a rock-solid connection just a few minutes previously, would no longer acknowledge my connect requests. Same hardware, just a different operating system and program.

Several possibilities occurred to me. If possible, I like to do a little overkill with stubborn problems. I took the laptop, handheld, modem, and connectors out to the van in front of the house. The van has an auxiliary battery with 12-volt outlets for just such use. With everything hooked up, the handheld gets a boost from the 12 volts. So the real differences were five watts and a whip antenna.

The PBBS responded the same way from that location. The next step was to move into a line of sight position within a mile of the station. Still the same. Experimenting with some of the parameters, there was one fragile connect made, but after a disconnect, it could not be duplicated with the Windows program.

It would seem that about everything had been eliminated except that possibly the Windows program wasn't sending a clear tone. So I tried the node that is off in the next county with the Windows program. After a few retries the connection was made. It was a little shaky because of the path and it was fairly busy.

Taking advantage of mobility

Driving the nicely portable packet station to the other side of the hill knocked off about five miles and made the remaining 25 miles a straight path. The node came up first try and responded like it should.

There are a number of unanswered problems here. I guess I should feel glad that these little challenges keep tracking me down. They certainly make life interesting. I didn't throw in one other confusing parameter. When the packet connection doesn't

Continued on page 78

Number 64 on your Feedback card

Ham Radio Fun

Communications Simplified, Part 22

Peter A. Stark K2OAW
P.O. Box 209
Mt. Kisco NY 10549

Previously, we said that telephone companies use µ-law compression to provide 13-bit accuracy with just 8-bit data. This varies the step size, to give small audio signals better resolution. Unfortunately, this converts some incoming digital data into voltages so small that they are corrupted by noise. To avoid this problem, the ISP (*Internet service provider*) sends 7-bit data, rather than 8-bit data. This results in 128 voltage steps rather than 256, eliminating the 128 smallest voltage levels—the ones that cause the most problem with noise. Alas, this reduces the data rate from 64k bps to 56k bps. (Actually, because of limits on maximum allowed signal levels, the actual speeds are closer to 53k bps.)

What if you want to go faster than 53k or 56k bps? If eliminating the analog signal at one end of the circuit speeded us up to 56k bps, how about eliminating analog from both ends? Now we're on the right track.

Let's examine the POTS a bit more closely to see how this can be accomplished.

Your telephone set

Also called a subscriber set (part of the CPE or *customer premises equipment*), your telephone is an analog instrument which converts between sound and electrical signals. In addition to the microphone and earphone, the telephone set also contains the dial (either a pulse dial or a tone dial which emits DTMF—*dual tone multiple frequencies*) and a bell (called a *ringer* in telephone parlance). **Fig. 1** shows a bit more detail.

When you are not using the telephone, the hook switch (switch hook in telephone talk) is open, and only the ringer is connected to the line. A capacitor in series with the ringer prevents DC current flow through the line; the telephone company rings your phone by sending an AC ringing voltage of 100 volts at 20 Hz. When you pick up the handset to answer, the hook switch closes, and DC current can pass through the telephone. This tells the telephone company that you are there, so they turn off the ringing signal and complete the talk circuit.

The local loop

The local loop is the two-wire twisted pair of copper wires which goes from your house to the telephone company. At your end, the wire typically ends at a demarcation jack, which is the boundary between the inside wire (which you generally own) and the outside line (which belongs to the phone company).

At the other end, this wire generally enters the telephone company's central office or CO, which is where "The Switch" is. More on this later.

Most often, the local loop goes all the way from your house to the CO, although it may not be one continuous piece of wire. There are probably quite a few splices along the way, where your single twisted pair connects into a small multi-conductor cable, and then perhaps to larger and larger cables (containing hundreds of other pairs) before it reaches the CO.

But there are a number of other possibilities. A large cable, and the work involved with installing and splicing it, is quite expensive. Quite often, especially in large office or apartment buildings, or in housing subdivisions, part of the connection is through an optical fiber. In that case, the copper-wire local loop may go just part of the way toward the CO, at which point it enters a multiplexer which combines your signal, along with those of many others, into a single optical signal on a fiber.

One of the current buzzphrases is "fiber to the curb," which implies that the fiber may go directly to your street or neighborhood before it is split up into copper-wire local loops to individual homes or offices. Telephone companies are installing fibers partially to lower costs, but also partially because they are looking to the future. Optical fiber has vastly larger bandwidth, and can be used to provide all sorts of new services in the future without requiring that the entire neighborhood be rewired. There is also another reason—copper is expensive, and in some neighborhoods, often stolen. Fiber cable, on the other hand, has no value to thieves and will (hopefully) last longer.

But back to the local loop. The copper side of it is an unshielded pair of (generally) 24- or 26-gauge wires. It is a balanced and twisted pair; the balanced connection helps to reduce the pickup of

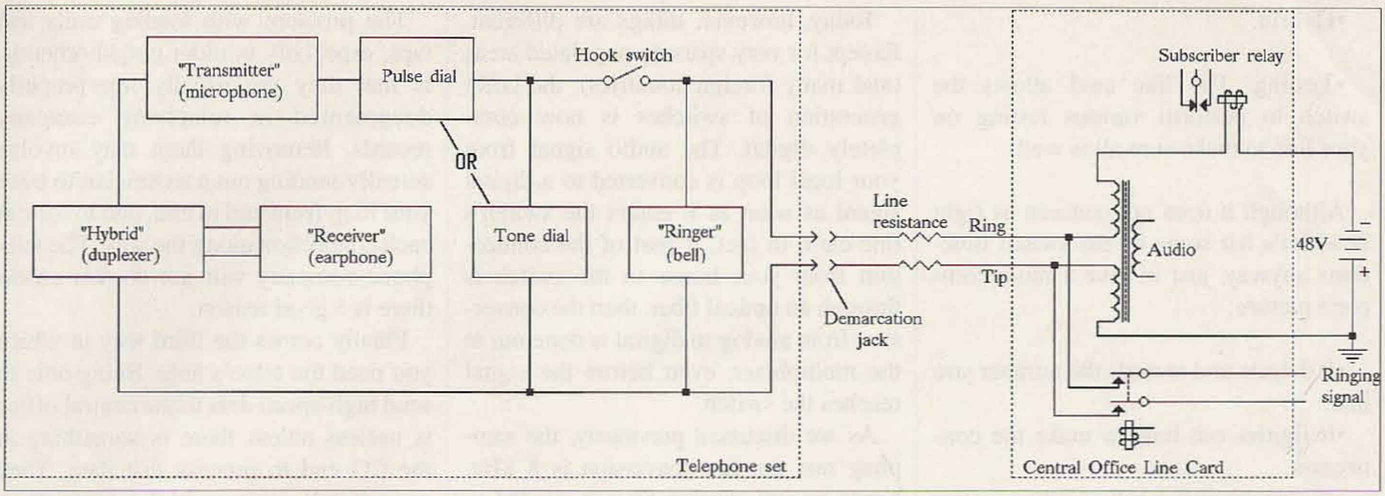

Fig. 1. How your telephone company connects to the CO.

outside noise and hum, as well as crosstalk from other, adjacent wire pairs. The loop is balanced only for AC signals; in terms of DC, it is not balanced because the positive side of the battery is grounded at the central office. But it is the AC balancing that is effective in cutting down noise and interference.

Because the wires are thin and close together, there is a sizable capacitance between them. This makes the circuit into a low-pass filter, which reduces the high-frequency response. Even with short cables, at just 3000 or 3500 Hz these high frequencies are attenuated and result in a noticeable lack of treble. The curve labeled "plain line" in **Fig. 2** shows the typical frequency response of a local loop several thousand feet long.

In order to improve the high frequency response, the telephone company therefore often inserts loading coils into the local loop. These are toroidal inductors, most often 44, 66, or 88 millihenrys, which are connected in series with the line. These are not as common in large cities, where the distance from your phone to the nearest CO may be fairly small, but appear quite often in the suburbs or out in the country.

The loading coil is also sometimes called a peaking coil; it resonates with the line capacitance and produces a peak in the frequency response somewhere between 3,000 and 4,000 Hz; this increases the high-frequency response of the line, as shown in the "with loading coils" curve in **Fig. 2**. But you can see that, although the loading coil improves the frequency response in the high audio range up to about 3,500 Hz or so, it actually makes things worse above that. (It also affects the phase of signals.) Signals above 4,000 or 5,000 Hz have almost zero chance of getting through now. Thus pure digital signals (with rapidly rising edges and plenty of harmonics) have no chance of getting through either. From a voice point of view, this is just fine, however.

The central office

The central office is just the beginning of the path through the POTS system; we have already showed a very simplified picture in **Fig. 1**.

In the central office, the hybrid and the two analog/digital converters reside in "The Switch." The switch is the device which directs your call either to other phones serviced by your local CO, or to trunk circuits, which send it out to other telephone companies or other central offices. Years ago, switches were electromechanical monsters; today's switches are specialized computers.

Most of the circuitry in the switch is common to all users, but some circuitry must be duplicated for each line. As a result, all the incoming local loops terminate in line cards, which handle just a small number of subscribers each. For example, the circuitry on this card monitors your line to see when you pick up your phone. **Fig. 1** shows a simplified picture of how this is done—a subscriber relay, connected in series with your line, detects the current that flows when you pick up your phone; it then signals the switch that your line needs attention. Likewise, a relay connects the ringing signal to your line when needed. The typical line card also has a transformer which couples the audio to and from your line.

But **Fig. 1** does not show the circuitry on the other side of this transformer. This circuitry includes primarily a hybrid, which separates the incoming and outgoing audio paths; an anti-aliasing filter and analog-to-digital converter, which converts your voice into PCM coding; and a digital-to-analog converter which converts incoming digital data into the audio that is sent to your phone.

Technicians often use the word **BORSCHT** to remind themselves of all that the line card does. These letters stand for the following:

•**B**attery. It provides -48 or -50 volts DC to your line.

•**O**vervoltage protection, to protect the switch from lightning, short circuits to power lines, and similar problems.

•**R**inging. It provides the 100-volt 20 Hz ringing signal to ring your bell.

•**S**upervision. It monitors the DC current through your line to determine when you pick up your phone.

•**C**oding. The analog-to-digital and digital-to-analog converters, as well as the necessary anti-aliasing filters.

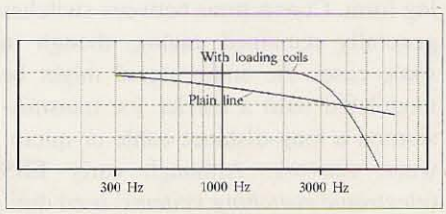

Fig. 2. Effect of loading coils on loop response.

•Hybrid.

•Testing. The line card allows the switch to perform various testing on your line to make sure all is well.

Although it does not concern us right now, let's list some of the switch functions anyway, just to give a more complete picture:

•It detects and records the number you dial.

•It figures out how to make the connection.

•It connects your call to other parties or circuits.

•It keeps a record of the calls you make.

•It provides extra functions, such as call waiting, call forwarding, or caller ID.

The switch belongs to your local telephone company (which is now called the LEC or *local exchange carrier*). It is located in the central office, and can typically handle several tens of thousands of lines.

When you make a call, the switch analyzes the number you dial, and passes your call on. If you dial someone who is also served by the same switch (typically someone else in your neighborhood), the switch simply connects your call to that line. Otherwise, the switch connects you to other switches. These will generally be owned by the same LEC (for calls within the area served by the LEC) or an IXC (an *inter-exchange carrier* who handles long-distance calls).

The effect on digital signals

The reason for this discussion is that it has an effect on how digital data can be sent through the telephone network.

Years ago, the switches were all electromechanical. The analog signal on your local loop went directly to the switch, which kept the signal in its analog form. Connections between switches generally remained analog, though in some cases the audio signal might be modulated onto a carrier for transmission on a long-distance cable or microwave network. Although early ESS (*electronic switching systems*) used digital computers for control, they still kept the signals in their analog form.

Today, however, things are different. Except for very sparsely populated areas (and many foreign countries), the latest generation of switches is now completely digital. The audio signal from your local loop is converted to a digital signal as soon as it enters the switch's line card; in fact, if part of the connection from your house to the switch is through an optical fiber, then the conversion from analog to digital is done out at the multiplexer, even before the signal reaches the switch.

As we discussed previously, the sampling rate for this conversion is 8 kHz; hence an anti-aliasing filter is needed to absolutely remove any audio signal above 4 kHz before it hits the analog-to-digital converter. It typically removes any audio above about 3,400-3,500 Hz. Thus there is no way that any fast digital signal will get past the line card—which explains why you need a modem to call another computer.

But ... the copper wire part of your local loop can carry signals above 3500 Hz. How high a frequency depends on the distance—a number of business-type multi-line telephones send a high-frequency carrier signal through existing telephone lines to provide an intercom function between phones in an office. There are also several commercial products which use the telephone wiring in your house to send 4 MHz video bandwidth signals from room to room.

In fact, it is possible to send high speed digital data over the local loop from your house or office to the telephone company's central office (or their multiplexer, if they use an optical fiber part of the way), as long as the distance is not too great (up to about three or four miles). The catch is that this requires your local telephone company's cooperation in three ways:

First, any loading coils in the local loop will kill the digital signal, so they must be removed.

Second, any extra taps (sometimes called stubs or bridges) on your line must also be removed. Telephone wires are often shuffled from customer to customer, reused when circuits are changed, or swapped when bad weather causes corrosion, with the result that there are often portions of open-ended lines connected across (bridged across) working lines. While they do not interfere with normal audio, they do reflect digital pulses, and thus cause errors.

The problem with loading coils and taps, especially in older neighborhoods, is that they are usually not properly documented in telephone company records. Removing them may involve actually sending out a technician to trace your loop from end to end, and to look at each connection along the way. The telephone company will not do this unless there is a good reason.

Finally comes the third way in which you need the telco's help. Being able to send high-speed data to the central office is useless unless there is something at the CO end to process that data. They must install some special equipment at their end to accept that data.

For a price, telcos offer several such services. One of these is ISDN; to bypass the anti-aliasing filter and analog-to-digital converter, which would normally destroy high speed data, the telco can install a special line card which omits these components and passes your digital data directly into their digital network.

ISDN

ISDN—*integrated services digital network* is a purely digital connection from the customer to the central office. It has been around quite a few years, is always on the verge of becoming popular ... and may already be on the way *out*.

As you remember, the normal audio telephone network sends analog audio from your telephone, through the local loop, to the central office, where it is sampled and converted into a digital signal. It is carried digitally from then on, at a rate of 64k bps, until it is converted back to an analog audio signal in the central office at the other end, just before it is sent to the person you are speaking with. The sampling is done at an 8 kHz rate, with an 8-bit analog-to-digital converter, for an effective rate of 64k bps.

ISDN changes the picture a bit by moving the sampling and A-to-D conversion (if you use it for voice) from the central office back to your home or office. It is still done, but it is now the job of your equipment to do it. The local loop then carries only digital data back and forth.

There are two kinds of ISDN: *basic rate interface* or BRI, and *primary rate interface* or PRI.

Basic rate interface ISDN

BRI is intended for the home or small office. It provides two 64k data paths (called *bearer channels*) and one 16k bps *data channel* (plus some overhead bits), all over one pair of wires just like a normal local loop. The system is often called 2B+D for that reason.

The D or data channel is used for signaling between your system and the central office, such as for dialing a number or ringing the phone, but can also handle digital data. Each of the two B or bearer channels can carry one 64k bps voice signal, which makes it attractive from the telephone company's point of view. They can now provide two telephone circuits over one pair of wires.

From a user point of view, there are a number of advantages. Foremost is that, if you call from your ISDN line someone else that also has an ISDN line, the 64k bps data you send out is delivered completely unchanged to the person you called. In other words, you need not use this channel just for voice—it can also be used for computer-to-computer or fax-to-fax communications, or for any other purpose that requires a direct data transfer. If 64k bps is not fast enough, you can bind the two D channels together; that is, you can use the two channels together to get 128k bps data transfer. (But note that this requires that you place, and pay for, two telephone calls, one for each channel. It also requires some additional equipment.)

NT-1 and the U reference point

Fig. 3 shows how a BRI ISDN line can be used. Shown on the right side is the connection between the central office switch and a *network terminator 1* called an NT-1. This is a two-wire line—just like a normal local loop, except that loading coils and any taps must be removed because it carries pure digital data (although short taps are sometimes permissible).

This part of the circuit is called the U reference point or U interface. The line may be up to 18,000 feet (approximately three and a half miles) long. This may create some problems in outlying areas, but there are repeaters that can be inserted to lengthen the line.

The NT-1 terminator primarily terminates the line, converts the two-wire U line to a four-wire system, and protects

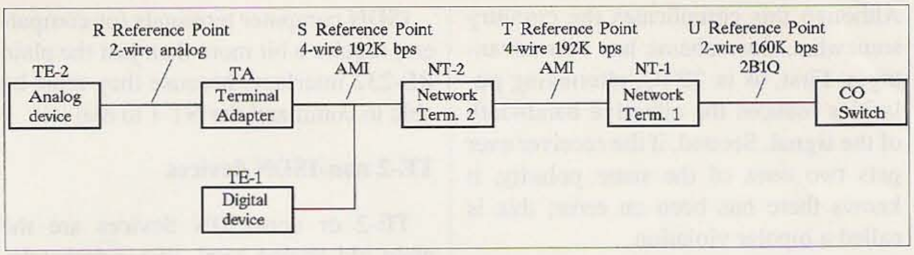

Fig. 3. BRI ISDN circuit.

your equipment against lightning and other faults. It does require power, though, and here is an interesting aspect of ISDN: Normal analog POTS lines are powered from the central office (where the telephone company maintains sizable batteries and diesel generators), and generally work even when there is a power failure in your neighborhood. ISDN lines, on the other hand, do not provide power to your equipment (except in Europe). You must provide your own power to the NT-1 as well as all other equipment at your end. Fortunately, much ISDN equipment provides battery backup for use in emergencies, but this seldom provides much running time. Hence it is not a good idea to rely on ISDN service for your only telephone.

Sending 160k bps digital data through a local loop (especially one approaching 18,000 feet) is not easy, so the designers use a technique similar to that of modems—carrying two bits on each symbol. Each symbol has four possible values, and so the system is called 2B1Q—two bits on one quaternary symbol. In this case, however, the data is sent in pure digital form, with the four symbols being four different voltage levels:

1 0 = +3 volts
1 1 = +1 volt
0 1 = -1 volt
0 0 = -3 volts

Fig. 4 shows an idealized 2B1Q signal on the U interface; it is actually quite distorted by the time it travels down the line. Further, since the U connection is bidirectional, there are two of these signals traveling on the line at the same time. The NT-1 and the corresponding circuit at the CO side, called an LT or *line terminator*, rely on duplexers to separate the signals in opposite directions, and provide echo suppression as well.

Remember that the data rate on the U interface is 160k bps; the 2B1Q method reduces that to 80k baud; that works out to an effective 40 kHz, which is more manageable. You can see this in **Fig. 4:** the first four bits of data effectively define one cycle of the signal; the waveform therefore has one quarter as many cycles as bits.

Worldwide, there is some confusion as to the U signal because it was never specified in the CCITT/ITU—T standard. In the US, the NT-1 is to be provided by the customer, and so the U interface is the demarcation between the telephone company and the customer. In other parts of the world, the NT-1 is provided by the telco, and the demarcation between telco and user comes after the NT-1; the U interface is considered proprietary by the telco. Because of this lack of a U standard, early US ISDN systems used incompatible U interface standards, and so some early NT-1 units do not work on modern systems.

NT-2 and the S and T reference points

The duplexer in the NT-1 splits the 2-wire U signal into a 4-wire system, with one pair in each direction, called the T (or S/T) reference point. At this point, the signal is a 192k bps AMI signal.

AMI stands for *alternate mark inversion*. Here, a 0 is represented by 0 volts, while a 1 is 1 volt; but the ones alternate polarity. That is, one 1 may be +1 volt, while the very next 1 would be -1 volt, and the following again +1 volt. Thus alternate ones (marks) are inverted.

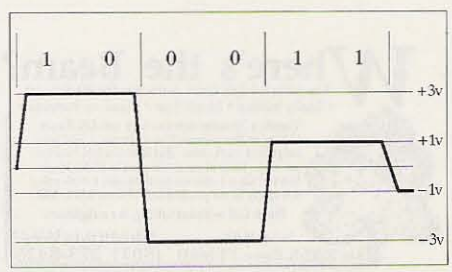

Fig. 4. 2B1Q signal on U interface.

Although this complicates the circuitry somewhat, this scheme has two advantages. First, as in 2B1Q, alternating polarities reduces the effective bandwidth of the signal. Second, if the receiver ever gets two ones of the same polarity, it knows there has been an error; this is called a bipolar violation.

The NT-2 *network terminator 2* is simply a splitter, which splits the T signal into a number of S signals for use by several devices. If the ISDN line is used for only one purpose, the NT-2 can be omitted, since the S and T signals are otherwise the same. In that case, the output of the NT-1 is called the *S/T reference point*.

TE-1 ISDN devices

A number of actual devices can be connected to the S or S/T signals—voice phones, faxes, computer terminals, etc. These break down into two types: ISDN devices are called *terminal equipment* type 1 or TE-1, while non-ISDN devices are *terminal equipment* type 2 or TE-2.

TE-1 devices have a digital interface, and can directly talk to the S or S/T interface. For example, a TE-1 telephone would be a digital phone, which does its own a-to-d and d-to-a conversion.

ISDN fax machines can also be used; as opposed to ordinary analog (group 3) fax machines, the TE-1 machine is called a *group 4 fax*, and it is purely digital. ISDN fax machines are still rare and expensive, but are five to six times faster than an ordinary analog fax machine.

ISDN computer terminals (or computers) require a bit more than just the plain RS-232 interface, because they must be able to command the NT-1 to dial out.

TE-2 non-ISDN devices

TE-2 or non-ISDN devices are the plain old analog kind, like a desk telephone or analog fax machine. Since these cannot talk to a digital S or S/T interface, they need external conversion to and from the digital world. The TA or *terminal adapter* in **Fig. 4** does this job.

There is obviously no advantage in using an ISDN line plus a TA just to use the same analog devices that could be used on a plain POTS line. Still, the TA is useful during the transition from analog to all-digital. It is also potentially useful if the telephone company can only provide one line, yet you need two circuits.

Multiple devices

The 2B+D ISDN line uses just one physical line to connect to the central office, but has three actual logical channels. Each of the two B channels can be used for a separate call (or they can be bonded together for higher speed), while the D channel, although normally used for controlling the B calls, can also be used as a separate data channel for packets. It can therefore handle up to three simultaneous calls.

But the S or S/T interface can handle up to eight different devices. Moreover, from the central office point of view, each of these can have a different telephone number. That is possible today (with distinctive ringing on one line and a corresponding switch box), but ISDN carries it further with more options.

The phrase "multiple devices" has another meaning as well. Although **Fig. 3** shows the TE1, TE2, TA, NT1, and NT2 as separate boxes, a number of vendors are combining them in various combinations. For example, Motorola makes a device called a BitSurfr Pro™, which combines an NT1, NT2, and two TAs into one package. It hooks up to the ISDN line at one end, and provides an S interface plus two analog lines.

Primary rate interface

Unlike BRI, which is two 64k bearer channels and one data channel and is designed for home or small office applications, PRI has twenty-four 64k channels, of which 23 are B channels, and one is a 64k D channel. As with BRI, the D channel is used for control purposes, such as sending dialing data or receiving a ringing signal. PRI is designed for users who need a large bandwidth, or who intend to parcel out the bandwidth to individual users. For example, a common application of PRI is to connect a PBX—a *private branch exchange*, a local switchboard which services a number of telephones—to the central office.

PRI ISDN uses 24 x 64k bps, or 1,536k bps, plus an additional 8k bps for some control information, for a total of 1,544k bits per second. This is too fast for a local loop, and is thus provided over a special connection called a T1 line. As a result, PRI ISDN is generally a service for business, not individuals.

Both BRI and PRI have some interesting characteristics. Unlike a normal analog telephone local loop, where dialing is done with either a rotary dial or a DTMF tone dial (DTMF stands for *dual tone multi-frequency*), an ISDN device dials by sending digital dialing information to the switch via the D channel. At either 16k bps (for the BRI system) or 64k bps (for the PRI system), this is much faster than analog dialing. Combined with the speed of today's digital switches, this means that the typical call can be established within a second or two. Moreover, when ISDN is used for digital data, all of the time delays normally associated with modems (where two modems may spend 10 or 20 seconds negotiating what speed and protocol they will use) are not required. Hence it only takes a second or two from the time you place a call until you're ready to send data. It thus becomes practical to hang up a connection, and dial again the next time you have something to send. You therefore need not pay for a call when nothing is being sent.

Likewise, when the switch rings your phone, it does not send the normal AC ringing signal to ring a bell. Instead, it sends a digital code via the D channel. This code not only tells your equipment to answer, but also identifies the type of device it wants to talk to. For example, on a normal analog line, when an incoming call comes in, your phone, your modem, and your fax machine all ring. On an ISDN line, only the device being addressed responds, and does so right away. Again, no delays. 73

Oscillator Basics, Part 3

Frequency synthesizers and you.

Hugh Wells W6WTU
1411 18th St.
Manhattan Beach CA 90266

Although frequency synthesizers were developed about 1930, they were complicated, expensive, and impractical. The advent of digital ICs made synthesizers readily usable. Frequency synthesizers get their name from being able to generate a great number of discrete frequencies with the stability of a quartz crystal while using only a small number of crystals—most modern synthesizers use fewer than three.

The basic principle behind the synthesizer is the Phase-Locked Loop, referred to as PLL. The purpose of the PLL is to operate a self-excited oscillator (voltage-controlled oscillator, referred to as a VCO) at a frequency different from that of a crystal oscillator, yet lock it to the crystal oscillator in such a way that it will have the same stability as the crystal oscillator regardless of the VCO frequency.

Fig. 1 illustrates a basic PLL function by using a VCO operating at the frequency of the crystal and under the direct control and stability of the crystal. Control of the VCO is through the application of a DC error voltage, which is referred to as a "steering voltage." The frequency of the VCO will follow the change in the applied DC steering voltage, which is obtained from a phase detector that provides an output voltage. The output voltage is proportional to the phase angle difference between its two input signals (reference oscillator and VCO). A 90-degree phase difference occurring between the two input signals indicates the VCO is "in lock."

Please note the use of a low pass filter in the steering voltage circuit. The purpose of the filter is to increase the time constant of the voltage applied to the VCO. Without the filter, the steering voltage would move abruptly, resulting in a fast change of the VCO frequency; the phase detector would output a corresponding correction of the shift in frequency. The result would be a wild oscillation of the steering voltage and the VCO frequency. Filtering the DC voltage dampens the oscillation, allowing the steering voltage to provide smooth control over the VCO without overcontrol—keeping loop jitter to a minimum.

When the PLL is used without a "divide-by-N" as in the modified PLL (**Fig. 2**), the VCO must operate at the frequency of the crystal. However, adding a divide-by-N allows VCO operation at any frequency (which can be divided by a whole number) to a frequency which is equal to the reference oscillator frequency as applied to the phase detector. Again, the two signals presented to the phase detector must be at the same frequency and at a 90-degree phase difference to maintain a phase lock.

Fig. 3 goes a little bit further. Add a frequency divider following the reference oscillator to obtain a low frequency, one that will be equal to the incremental frequency steps desired between synthesized frequency changes in the output. A 1 kHz frequency is used as the reference which allows the output frequency to be stepped in 1 kHz steps across the selected frequency band, and in this example, 1 kHz steps across the band from 1 to 10 MHz.

Many schemes have been developed to obtain synthesized frequencies and

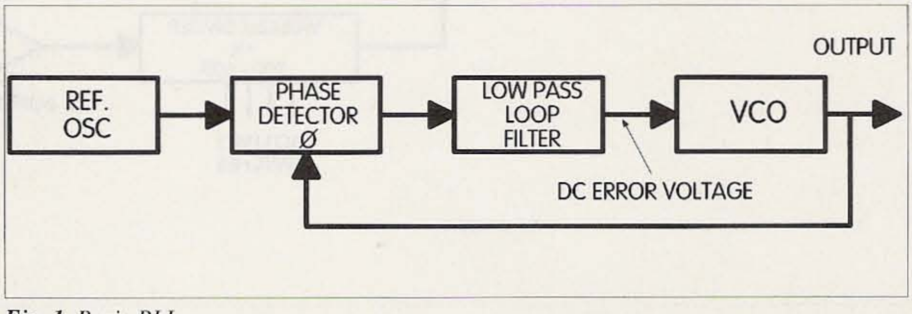

Fig. 1. Basic PLL.

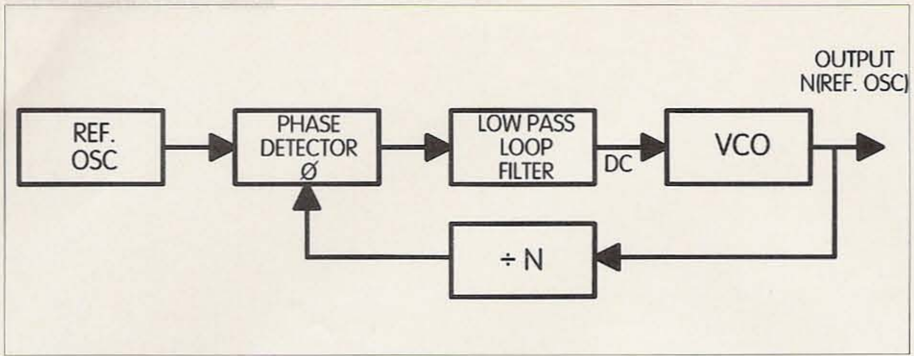

Fig. 2. Modified PLL.

narrowly-spaced steps. One technique is to use a dual modulus synthesizer, which allows over 1,000 discrete frequencies to be generated, while utilizing only one crystal oscillator. The dual module PLL system overcomes the problems of high-speed programmable division by providing near jitter-free control of the VCO while operating at frequencies up to 500 MHz.

Fig. 4 follows the more conventional synthesizer approach, yet is capable of accommodating the frequency offset for operating both a transmitter and receiver on the same simplex frequency. The output of the synthesizer is in the 18–25 MHz range and is expected to be multiplied to the desired operating frequency. Having a 1.66667 kHz PLL increment, the operating frequency step function could be 5 kHz at the desired operating frequency.

Regardless of the synthesizer design, the objective is to lock a VCO to a crystal oscillator in order to obtain the stability of the crystal, but at the desired VCO frequency. The PLL accomplishes its control by comparing the signal from the crystal oscillator to that of the VCO and then steering the VCO frequency to maintain a phase lock which places the VCO at the desired frequency. The frequency of the step function is determined by PLL control frequency applied to the phase detector. 73

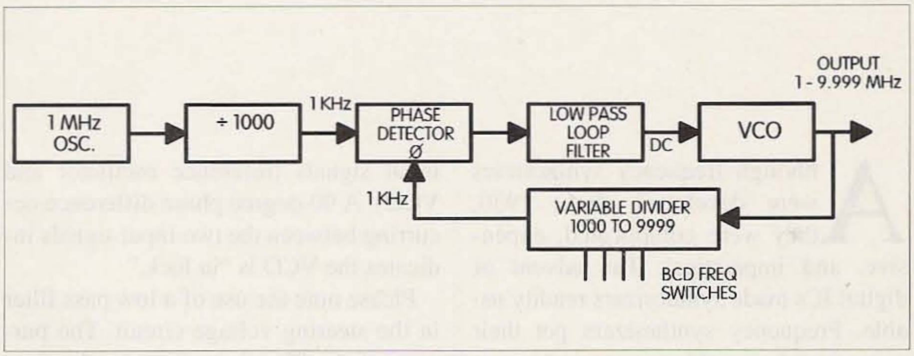

Fig. 3. Basic synthesizer.

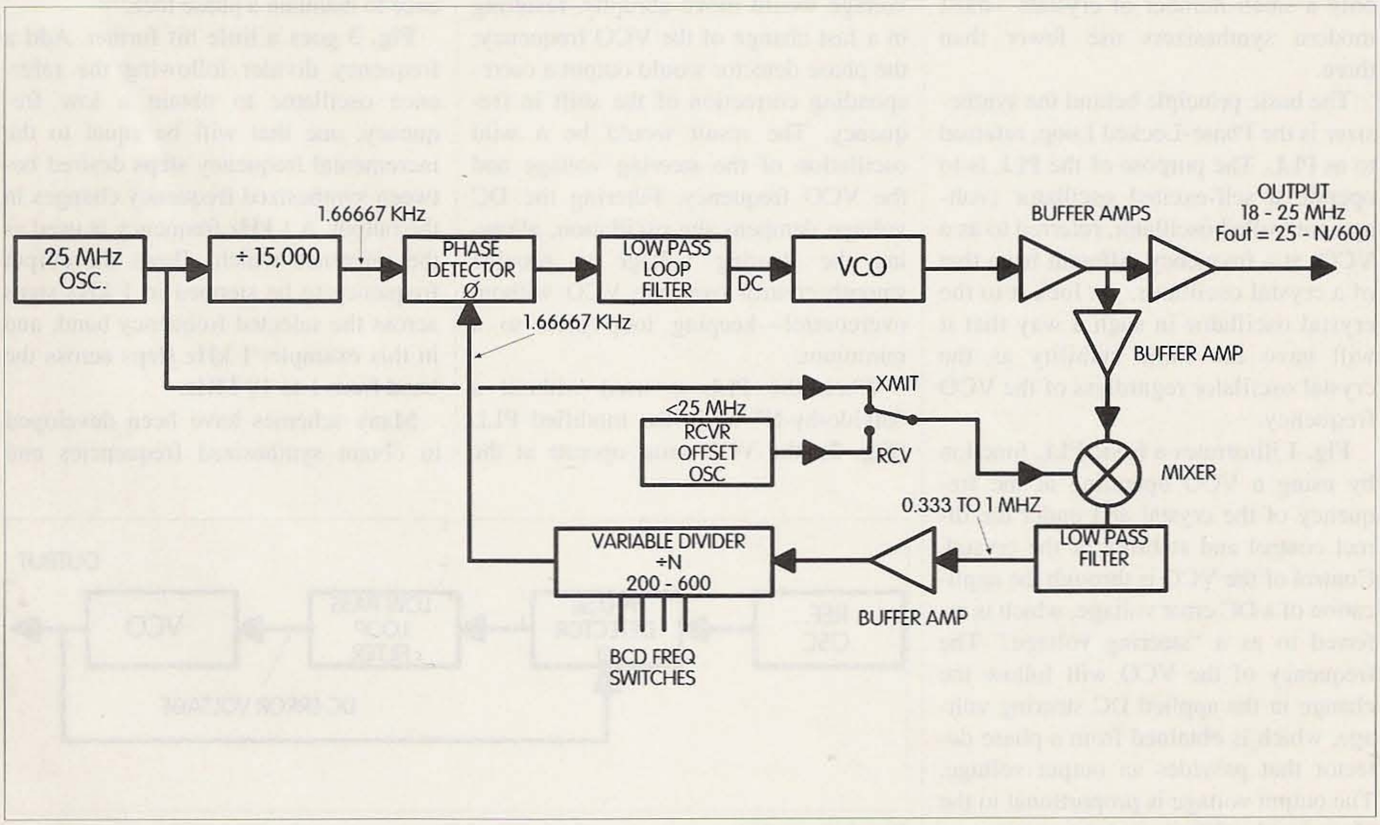

Fig. 4. Basic synthesizer with TX/RX offset.

Still a Great Hobby

Are you *a ham yet?*

Arthur R. Lee WF6P
106 Western Court
Santa Cruz CA 95060

There is a lot of hype these days over beepers, cell phones, E-mail and—ah, yes—Internet chat rooms. It isn't any secret that these great modern means of communications have arrived upon us like an avalanche of fresh new snow. There's no challenge to checking into a chat room and forming an alliance with a person of like interests, and you don't need an FCC license. A simple computer, a modem and a modest monthly fee is all that is required. Throw in a few hours of "how to" indoctrination and you're on your way. There are horror stories, however, as well as exciting tales of meeting and (even) marrying chat-room acquaintances. With Internet communications, there is a certain "let the operator beware" caution that is inherent with meeting strangers on-line. These strangers have no responsibility to be who they claim to be.

So what about the hobby of ham radio? Let me say that amateur radio is alive, well, and kicking. Nearly every ham operator I know of has an array of communications devices, and uses them all—OK, so we can exclude semaphore and smoke signals!

Still a viable hobby

We hams can and do use everything we can to get our hands on to communicate. CW operators are still around, as are those interested in packet and amateur television (ATV). Recently I was in one of our daily CW QSOs with Marsha Messer AB7RJ, in Washington state. I was transmitting from my daughter's station in Sacramento CA. She has a 100W Kenwood TS-440S transceiver and I needed to send a couple of important messages to other hams. As my daughter's computer was not connected to the Internet, I sent an old-fashioned National Traffic System (NTS) type of message to Marsha. It went like this: "Please pass to AA6ZG in Santa Cruz CA. Will you call so-and-so and tell him that I will not be able to help in the forthcoming VE test session ... " Marsha gave me a QSL, repeated the three-paragraph message, and immediately sent it out over E-mail. My friend Leon Fletcher received the E-mail and made the several telephone calls requested. I received a QSL in return via the same communications route. Exciting? Yes, to me. Practical? Yes, to those involved. Could I have used other means of communication? Certainly, but I didn't have telephone numbers or a list of E-mail addresses with me.

What have we got left?

The hobby is a great and satisfying way to do more than punch keys on a keyboard. The no-code license has brought a rush of new energy into our pastime. Ham radio, formally the domain of electronics technicians, experimenters, engineers, or military and professional operators, is now easily available to the broad spectrum of lay persons. With only a few hours of study, a VHF/UHF ham license can be obtained and a callsign issued, sometimes within days.

Hello to the repeater world!

Almost instantly, by checking into a few repeaters, the new ham can acquire hundreds of new friends. A net directory

Photo A. On 80 meters, a ham license aspirant carries on a conversation with Joyce KN6RR, in Sacramento CA. The control operator was the author, WF6P.

will make a cross-country trip an adventure of interesting contacts. A few years ago, while driving our motorhome through Idaho, my XYL (Donna AB6XJ) and I missed our turnoff to Yellowstone National Park. We were engaged in a fascinating 2m QSO with a local rag-chewer!

Links between repeaters permit long-range communications. I once talked to my Navy son-in-law in San Diego from my QTH in Santa Cruz. I used a 2m rig, linked from our local repeater to a string of coastal repeaters. A phone patch connected me to his telephone on his end. Currently, the Condor Net, a 220 MHz link-up, exists and is regularly in use by Gary Baker N6ARV. When on trips he uses it to talk to his XYL, Cathy N6TGL, from Riverside to Watsonville CA, a distance of about 400 miles.

High frequency (HF) and the world

So how about extending our range—and our fun? If that's what you're looking for, old-fashioned HF, whether SSB voice or CW, is the thing for you. Do you like to rag-chew with foreign hams? I have always enjoyed DXing with operators in far away places. Russia? Japan? Europe? Pacific Islands? Antarctica? Ham operators are there just waiting to talk to you. Tune around the dial, send out a CQ, and see what turns up. Better still, listen around the band, pick up a DX station, and respond with your call. For this type of extended communication we will have to get some code (CW) under our belt. Why code? Because it is still required as part of international agreements, and—now get this—it really is fun!

Fear of the code

So what's the hang-up on learning the code? My daughter-in-law, Cybele KC6ZQS, learned the code over a weekend while in our garage retouching the paint on ceramic dolls. OK, so she is a fast learner—but learning the code isn't that hard. With a few hours of concentration, the letters and numbers can be learned. Code tapes or on-the-air listening over American Radio Relay League (ARRL) station W1AW can help speed things up. (Contact ARRL Headquarters, 225 Main St., Newington CT 06111-1494, for times and frequencies.) Code software such as Super Morse© is available for computers. These programs really shorten the learning process.

Testing: easier than ever

So what's left? Volunteer Examiners devote their time to helping hams and hams-to-be upgrade or obtain their licenses. These exams are administered by fellow hams in school classrooms, churches, public meeting rooms, and private homes. For a fee of about six dollars, the examinee can take all the tests from Novice to Extra class in one sitting, if desired. Most of us break the series of exams down into increments, biting off a small chunk of the process each time. Studying for the exam is part of the fun of hamming. Each higher license class is a step to greater learning about the hobby and skills of ham operators. The recognition given by fellow hams as higher license classes are achieved is part of the excitement of the hobby. We have all been through the study phase.

Cost of hamming

Believe it or not, getting into ham radio is actually less costly than getting into computers. These days, most of us purchase a ready-built ham rig, either used or new. Used HF rigs in the cost range of from $300 to $500 can provide years of fun at minimal cost. Throw in another $50 for antenna wire, a couple of insulators, some coax cable, and a ground rod. With these basic materials, a simple dipole can be erected in an afternoon. Other than a negligible increase in your monthly electric bill, that's it! You're in business.

Getting on the air

After receiving your callsign, you're ready to put out some signals. Initially, you may feel some (very natural) apprehension about this. Listen in to other hams chatting away. The communication habits you will pick up shouldn't be too far off the mark. Remember, hams don't bite! Actually, identifying yourself as a new ham is good. Hams love to help people, especially new inductees into the amateur radio fraternity. After a few hours of on-the-air contacts, you will begin to relax and sound just like the rest of us. When will I hear *you* on the air? 73

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and see if you can argue with that nice straight-line curve into oblivion.

Hamfest Report

A note from Dennis WB8QWL of Dentronics, who gets to nearly 50 hamfests a year, suggests lowering the admission price in order to attract more of the general public. He suggests a mailing be made to all local hams, with much or even all of the cost being covered by piggyback ads from vendors. As it is, many hams just don't get the word. Tell 'em to come and explain why they're going to have a great time.

Dennis also suggests that hamfest chairmen start spending money to bring in interesting speakers to discuss antenna design, slow scan, DXpeditions, packet, RTTY, etc. My specialty is "etc."

To attract the public you need to get some of your better talkers on local TV and radio shows, and get as much newspaper coverage as you can. It takes plenty of exposure to make the public aware of both amateur radio and the hamfest. And, when they get there, will they be entertained? What kind of a show is going to be put on for them?

How about the hamfest committee? Are they a group of hams who have a solid record of making things happen? You don't need any "We've never done that before" mentalities. Hamfests are show biz.

Covering It All Up

With all the ado and jokes over the Roswell 50th anniversary, where do *you* stand (or sit) on UFOs? Well, you know where I am on the matter. Between a series of recent TV shows interviewing the citizens and military who were there and are still alive, and their children telling us what their parents told (and showed) them, there's been a steady stream of consistent reports of an Army cover-up of a crashed UFO (or UFOs). This merely confirms the years of UFO reports, as well as the stories from hundreds of contactees.

If Paul Shuch and his SETI group want to find extraterrestrial intelligence, they don't need to listen to their radios, they just need to start reading some of the many books on the subject.

The most recent and best book I've read is Col. Corso's *The Day After Roswell* (which is now on the best-seller list). Here we have the inside story from a high Pentagon official who was the man put in charge of the technology the army retrieved from Roswell (and possibly other UFO crashes). He also personally saw one of the ETs and read the medical autopsy report.

From everything I've read, the visitors (ETs, EBEs, aliens) are eons ahead of us in technology. Corso explains how some of the stuff he had from the Roswell crash helped us develop fiber optics, lasers, integrated circuits, night vision, and stealth planes.

It is interesting that the UFO had no provision for food, water, or waste elimination. It was more like a reconnaissance craft than a space ship. Further, the ETs had no digestive system, voice mechanism or ears. Their ship had no controls or instruments, apparently controlled via headbands worn by the occupants, who were a part of the navigation system.

Since their civilization is very far ahead of ours it might just be that the ETs we've been seeing reported are more like androids, designed as living creatures for this special application. This could also explain the strange contactee reports of the ETs having a hive-like mentality and relatively slow reaction times.

Just as we first sent a robot to explore the Moon, and now have one exploring Mars (I think), perhaps the ETs are using advanced types of "robots" to visit Earth. That could help explain the lack of a digestive system, lungs and other organs which we see in all of our living things.

Corso said the army viewed the extraterrestrial biological entities (EBEs) as hostile, mainly because their ships were keeping such close track of our space program and nuclear weapons developments.

Their lack of a vocal system would explain why contactee reports all claim to have been via mental communication. We have a long way to go in that field, with our researchers seriously hobbled by ridicule, prejudice and little funding.

I've had enough personal experiences with ESP, so no amount of skepticism can convince me that it isn't real. Then there's the amazing research reported by Cleve Backster in his work with plants and then with human cells, showing that in some way our two trillion or so cells are in communication with us, no matter how far separated. This also explains why people with organ transplants and even blood transfusions report memories from the original owners.

You'll get a lot more interesting information on all this if you set up a VCR to record the Art Bell (W6OBB) show every night. He's on from 10 p.m. until 4 a.m. PDT on AM radio. I tape him every night, as I've mentioned, and then listen to the show while collating my booklets and other such grunt work. In that way I'm able to skip all the commercials, cutting down the five hours broadcast I can get here in NH (1210 out of Philly) to half that.

If we were going to design a robot for dangerous missions and able to withstand high accelerations, we sure wouldn't bother to build in a need to provide it food. We would give it a brain so it could think, and enough of a body to move around.

If you are still skeptical about the visitors having been here for a long time, you haven't done your homework.

The military have a vested interest in viewing the visitors as hostile. That gives them the excuse to spend money on more and more advanced weaponry, and money is the lifeblood of any bureaucracy. Why all the secrecy? How are they going to explain the 50 years of lies and cover-up? How can they explain that yes, they think the visitors are hostile, but they have no way to fight against their advanced technology?

Of course there's the FD&H (fat, dumb and happy) approach to dealing with the ineffable. Ignore it and hope it will go away.

How reliable is Col. Corso? Art Bell has had some sterling character references on his program attesting to the fact that Corso was in charge of the army's foreign technology department, and had an unimpeachable reputation. Why has he waited 50 years to blow the whistle? He made a promise to the general who gave him the alien technology artifacts that he would keep the secret until after the general had died. Which Corso has done.

Goldbrick or Lead Balloon?

Have you been goldbricking it through life? Well, that's a lead balloon as far as your learning anything or being at all successful. Yet that's the culture of almost all large corporations and *all* government bureaus, including the post office and all branches of the military. Shut up, don't make waves, and figure out how to do a minimum of actual work.

One of the reasons the Dilbert cartoons and books are so popular is Scott Adams' exploitation of this theme.

In thinking back over the couple of thousand employees I've had over the last 40-some years, I can't think of many who really made an effort to learn and grow. Most people come in to work, minimally do their jobs, and then go home to watch TV. Or bowl. Or even go to or rent a movie.

When I got out of college all of my classmates were busy being interviewed by the big corporations, which were offering great starting salaries. I wanted no part of that baloney, so I went to work as a radio engineer-announcer at WEEB, a small radio station in North Carolina. But instead of settling in to a life of reading commercials and the news, I developed a morning-show format, got busy selling ads, and wrote the copy for shows. I learned how to do every job in the place. But I got tired of getting paid $45 for working 90-hour weeks and went to New York, where I got a job with WPIX-TV (Channel 11) as an engineer. I started out as a sound engineer, but quickly worked into technical directing, and then to chief cameraman. My next stop was with KBTV in Dallas as a producer-director, and then WXEL in Cleveland directing their network show originations.

So, how about you? Are you just another goldbrick in a lead-balloon career path? Or are you using your job as a way to learn and grow? Are you a royal pain in the ass to your boss with your ideas for improving things?

When I was working in radio I didn't have to sell ads or write shows, I could have done like everyone else around me and done a minimum to get along. Ditto when I was working in TV.

It's exciting to learn new things, yet somewhere around 99+% of the people I've worked with and for have avoided this. If a person were to read one book a week from my guide to "books you're crazy if you don't read," within a couple of years they'd be very well educated. Two a week, which is a snap once you get the hang of reading, and it would only take a year.

Under our guidance and example, our kids are hanging around malls, cruising, and watching an average of 50 hours of TV a week instead of reading and learning. They're just following in your footsteps. Or, more likely, seat cushions.

You have the opportunity to use your job as a way to learn many things. And amateur radio provides a wealth of learning opportunities. I was one of the first with NBFM, sideband, slow scan, repeaters, and so on. I've worked a ton of DX, won most of the contests, and DXpeditioned from a bunch of rare spots. You can put all that down to Wayne's ego, or maybe look on it as an example of what anyone can do with the opportunities that amateur radio provides. I've used every job and every interest I've had as learning opportunities.

There's a fantastic world of things to learn and do out there if you'll get off your duff.

Science, Hard and Soft

An amusingly high percentage of what I was taught in school as science fact has turned out to be science fiction. Well, science theory, since discredited. Quantum mechanics, as I've mentioned, wasn't even mentioned in college. The sad part is that even our scientists haven't been able to learn from experience. They're still, for the most part, firmly intellectually anchored to what they were taught as fact in college, and most of them vigorously resist new theories.

For instance, our physicists have been constructing ever-larger atom smashers in an effort to find out what atoms are made of. For some reason the Holy Grail is imagined to always be just a tiny bit out of reach. But, as I've suggested, perhaps the Universe isn't as simple as it looks. Perhaps matter is made up of elements, which are made up of atoms, and atoms are made up of quarks, and quarks are made up of what? Sub-quarks, of course. So what are sub-quarks made of? Let's build a really BIG atom smasher so we can blow the quarks to smithereens and see what the smithereens look like.

I've suggested that this may be a lot like scientists trying to find out what basic elements go to make up a house. So they blow it up and say, aha! The basic elements are wood, bricks, wire, pipe, and so on. Case closed. Well, maybe there are sub-smithereens. And even sub-sub-smithereens.

What I'm suggesting is that a bunch of what we consider hard science isn't all that hard.

And then we come to what I call soft science. Here we're way out in left field with things like auras, reincarnation, dowsing, the fundamentals of life, consciousness, crop circles, alien visitors, UFOs, magnetism, past lives, ghosts, psychics, time travel, heaven, all religions, God, spoon bending, clairvoyance, psychokinesis, ESP, the cause of diseases, immunization, the value of fluorides in our public water supply, NDEs, OBEs, demonic possession — and what have I missed?

How real is dowsing? It's as real as your information on the subject. If you have done no research and read no books, you can shrug it off and ridicule those who have done their homework. In my book guide I recommend Owen Lehto's *Vibrations*. Read it, try it, and see what kind of a skeptic you are about dowsing then.

Along the same line you really should read Margaret Chaney's *Red World, Green World*. She's W8ONS, by the way. She uses a dowsing technique to find out which foods are good for you, and which are bad. And eating food that's bad for your body type sure ain't good.

How real are past lives? It depends on how many well researched books you've read. I've found that under a hypnosis I'm able to regress almost anyone to a series of their past lives, complete with an amazing amount of detail. Further, I've often found that traumatic past deaths can heavily influence people's current lives.

Unless you read a book about Royal Rife and his incredible microscope you may not know what he discovered about the most basic element of life. He was able to watch live cells under his 17,000-power microscope and found what he called protids, which were almost indestructible. The book about Gaston Naessens and his microscope tells about his discovering the same thing, which he called somatids. And Pierre Béchamp, 150 years ago, discovered them and called them microzymas. The FDA destroyed all of Rife's microscopes and put him in prison. Their Canadian counterpart tried to do the same to Naessens. It's a fascinating story.

It seems that just about every soft science I look into turns out to have been carefully researched and looks real.

But then I've always enjoyed anomalies, seeing them as clues to things that should be investigated, not ignored. Yes, I know, it's *all* swamp gas. Do I have some sort of genetic disorder that makes me curious? I notice that most people are not only not curious, they will go to remarkable lengths to avoid thinking. Well, I suppose that's why we have bars and other such entertainment to kill the time that might otherwise be spent reading and learning.

Yes, I been there, done that with bars too. That was when I was in the Navy and went into San Francisco every night to the Irisher bar with my shipmates while our boat was being refitted at the nearby Mare Island shipyards. We had a lot of fun and I sure managed to get really drunk a few times.

Anyway, the next time you think Uncle Wayne has been conned on some sort of soft science, you let me know and I'll cite some darned good references to back up my opinions. Since even the solidest of science seems to be ever-changing, I haven't formed much in the way of entrenched beliefs, but I have a bunch of well-formed opinions and a load of questions.

Timing ...

... they say, is everything. An article in *Fortune* (8/4/97) on the record industry disaster, where most of the large record store chains (Wherehouse, Strawberries, etc.) have gone bankrupt, taking with them thousands of mom-and-pop independent record stores, didn't come as a big surprise to me. I got into the music business at just the right time, just before its meteoric rise in the mid-'80s, and got out of it at the right time (1992), just before it crashed and burned. And I told you in my editorials about the opportunities for taking advantage of this high-growth field at the time.

Those of you who have been reading *73* for over 20 years know that I predicted the personal computer's astounding growth. And I took advantage of it. I also recognized when the industry had matured and got out at just the right time (1983).

It's a whole lot easier to grow a high-growth industry company by getting in early, so if making a lot of money is a priority for you, why not take the easiest path? I don't get involved with the goal of making money — I get my kicks from helping new industries get started.

In a mature industry you have to fight the vested interests, and they have everything going for them, so it's a long, hard fight. In a new industry there is so much growth that "a rising tide lifts all ships."

In the personal computer field Bill Gates was there first with BASIC software for the Altair 8800 and Steve Jobs was there with the first single-board computer. So, where were you? I suspect you were busy working for someone else instead of starting your own company, commuting to the daily grind. Hey, I've been-there-done-that, so I know what it's like. The longest I ever worked for someone else was when I was the editor of *CQ*, which lasted for five years. I was having so much fun that if they hadn't fired me, I'd probably still be there.

I started in 1955, leaving a very successful loudspeaker manufacturing company I'd built from scratch. *CQ* was in terrible financial shape, losing a ton of money. Six months later I had it in the black and got it to where it was making millions. I did what you'd probably do: I bought a yacht, an airplane, an Arabian horse and *two* Porsches. And I traveled, going on scuba diving trips to the Bahamas, Mexico, and the Virgin Islands. Then there was a DXpedition to Navassa (KC4AF), where we darned near got killed a couple of times. And, by 1959 I was in Geneva as an official US representative at the ITU Plenipotentiary Conference. Later that year Bill Leonard W2SKE and I flew around the world, operating a sideband ham station from the plane, and visiting hams in 22 countries.

Luckily I got fired in 1960 and that forced me to start my own magazine. I sold my horse, boat, plane, and newest Porsche, getting just enough money to print the first issue of *73*. The magazine took off and even managed to survive the almost total destruction of the ham industry in 1964–65. Well, I've written enough about how the ARRL caused that disaster, one from which the American ham industry has never recovered.

In 1969 I saw 2 m FM and repeaters as a possible way to get amateur radio growing again. I organized repeater conferences around the country and published hundreds of articles, a bunch of books and a special magazine on the subject. Soon 2 m became the biggest growth aspect of amateur radio. Here we are 28 years later and 2 m is still our most active ham band, by a wide margin.

It was my success with repeaters and 2 m that got me to thinking I could do it again when the first personal computer kit was put on the market in January 1975. In my *73* editorials I told you what I saw ahead. I got big snickers when I predicted that the computer industry would one day rival the auto industry. Today computers are the third largest industry in the world.

Since I didn't know anything about computers I started searching for an editor for a magazine to help this new field grow. By May I'd found one and work started on *Byte*. The *73* staff did most of the work and the first issue of *Byte* went to the printer in July, just six weeks after we started on it. In that short time I rounded up a few thousand subscribers, the needed advertisers, organized national newsstand sales, and got the ham stores to carry the magazine. It was a busy six weeks.

I did my best to get the *73* readers to take advantage of this new industry. A few did and did very well. But most readers never budged. By 1983 I could see that the industry had matured, that the days of 235% a year growth were past. So I sold all my computer magazines and my software company to IDG, the publisher of *Computerworld*. Alas, none of the magazines kept up with industry changes and all eventually blew away.

In 1982, when the first compact discs were announced, I saw a new growth industry ahead as the world converted from LPs to CDs. That meant that everybody would have to start over and build new record collections. So I started *CD Review* in 1983 and rode the rising tide. The magazine soon became the leading American music magazine and helped sell billions of dollars of CDs.

By 1992 I could see that the major growth period was over. LPs were long gone and by then record collections had been rebuilt with CDs. Worse, there was no outstanding new music being written. No hit Broadway or movie musicals. Even the classical music field had dried up, with nothing new I could find worthy of one listen, much less buying. So I sold the magazine to IDG, where it quickly sank out of sight as the industry collapsed.

So what's the next big growth industry going to be? Hey, I've been telling you about that for the last three years. It's going to be cold fusion, as low energy (and non-polluting) nuclear power replaces the oil companies, gas stations, coal, the power companies and their transmission lines, and so on. We're talking trillions this time. I predict that within 20 years this is going to be the largest industry in the world, with a bunch of new billionaires. You have the choice of watching it grow or being a part of the action. The ground floor still has plenty of open areas.

Will the oil companies be as blind to this new technology as the mainframe manufacturers were when minicomputers came along at 10% of the cost and ate their lunch? And then, not having learned, the minicomputer companies ignored personal computers, which blew them away, again at 10% of the cost, but with comparable performance. That's what history tells us will probably happen.

This is a whole new industry. No more oil drilling. No tankers (and spills). No pipe lines (and spills). No refineries (and pollution). No gas stations uglying street corners and stinking up the neighborhood. No local oil companies. No home oil burners. No coal-fired generating of electricity. No electric meter in your home. No natural gas for our stoves, not when cold fusion can supply energy at 10% of the cost of using fossil fuels.

The *73* readers laughed at me when I predicted that they would be seeing TV commercials for computers. In a few years we'll be seeing ads for home heaters, home and business power generators, and so on. A huge new manufacturing industry will grow, along with sales and service. And that's the way you turn bucks into megabucks — and then gigabucks. Electric cars? Har-de-har! Well, perhaps, but with cold fusion power plants generating the electricity. Or perhaps we'll see the rediscovery of the steam car.

I have a tape of me describing today's laptop computers at my talk at the 1976 Atlanta HamFestival. If you kvetch until your hamfest chairman gets me on the program, I'll tell you more about what I see as the opportunities for new industries you can grow with. All I cost is travel expenses for Sherry and me.

Getting back to the music industry, I'm kinda glad to see the record store chains getting their comeuppance. The whole industry is so crooked that it is pathetic, and it has been protected by our easily bribable Congress. When I got involved I found that six record giants controlled 96% of all record sales. Five were foreign-owned. Worse, as an article in *Forbes* pointed out, only about 2% of the performers on these labels ever were paid any royalties. I found that there were several thousand small independent record companies making up the 4% of sales. I thought that situation stunk, so I started a journal to help the indies organize, and put out sampler CDs with the best track from each of their new CD releases. I put out about 125 of these samplers, each with about 15 tracks, and distributed millions of them. Even though the majors were spending about $100 million a year to make sure that only their music got played on the bigger radio stations, between the reviews I published of indie music in *CD Review*, the samplers, and my pushing independent record stores to sell indie music through *Music Retailing*, which I also published, the sales of indie music went up to 14%, a gain of over a billion dollars a year in CD sales.

To give you an idea of how thoroughly the record business collapsed, when I sold *CD Review*, I had an option to use six pages a month to advertise my CDs. In 1992 these ads were bringing in around 10,000 orders a month. By 1996 the same ads were pulling about 50 orders a month.

Well, when I found that the indies were getting screwed by the majors I saw an opportunity to do some good. And I did well — plus I had a lot of fun doing it. Did I tell you about the time I had an opportunity to conduct an orchestra? Wow, was that ever fun!

Keep your eyes open for opportunities. New technologies are a wonderful way to get started without a lot of investment. When home security products started coming on the market I advised my readers to get into the business. A few did and did very well. I heard from a ham recently who said it was my editorial that got him moving. He's made millions in the security business as a result.

Instead of me telling you all the time, how about you keeping an eye on *Popular Science*, the business magazines and newspapers and telling me what new industries you see that might be developed.

For instance, our 2 m repeaters were so much fun that I knew right away this would be a technology that the general public would go for. Back in 1969 I had my HT with me wherever I went, talking with local hams while skiing in Aspen or on our NH mountains. I remember the old Gronk Network, which allowed me to stand on a street in Las Vegas with my HT and talk in a roundtable with hams in San Francisco, Phoenix, and San Diego. Now I'm seeing people in almost every country in the world making phone calls on the streets and from their cars with the modern counterpart of our old HTs.

Kick-start your imagination.

Viva Dilbert!

I enjoyed Scott Adams' *The Dilbert Principle* so much that I quickly bought his next book, *The Dilbert Future, Thriving on Stupidity in the 21st Century*. It was well worth the $25, though I probably should have waited for the paperback edition to save a few bucks.

There's nothing like a hilarious book to ease the day's stresses when I finally hit the sack at night, and Dilbert really delivers.

But much to my surprise Adams snuck in some thinking material at the end of the book. First, he got physical, delving into some of the weirder aspects of quantum physics. And then he got metaphysical, but with a message that will benefit anyone who reads it and applies his principle. What he says is that if you envision some desired goal and really want it to happen, events will, in some serendipitous way, make it happen.

Well, this ties in with some thoughts I've had (and, of course, written about) having to do with the influence of consciousness (for the lack of a better term) on lifeform mutations. I suspect that Darwin was partly right with his "survival of the fittest" concept, but that consciousness in some way also acts as a powerful force when it comes to guiding evolution.

Scientists get deep into speculation (and solidified beliefs) when it comes to how life started. The timetable astronomer Fred Hoyle proposed, which makes a lot of sense, requires a Universe that's a lot older than the Big Bang theory poses. But then, Eric Lerner shoots a lot of big holes in the Big Bang theory in his book. You really should have read both of these chaps' books by now. I've reviewed these books in my editorials and included them in my guide. What more can I do to get you off that couch and educating yourself? It'll sure help make you a lot more interesting to talk with on the air. Your education shouldn't stop when you leave school. The fact is that around 99% of the stuff they made you memorize to pass those useless tests is long gone from your memory by now, but even if you had 100% retention, little of it would be relevant to your present life.

All life has some degree of consciousness, even trees. Oh, you haven't read *The Secret Life of Plants* yet? Forsooth! Hie thee to Barnes and enNoble your mind. We know very little about consciousness. If you've read Stone's book on our cells you know they're somehow in contact with us, no matter where they or we are. And this probably has something to do with my mother sensing one of the most stressful moments of my life and calling me at the moment from 120 miles away to ask what was wrong.

Now, getting back to Scott Adams, he recommends that you decide on something practical that you really want. Write down this wish on paper. Make it very specific. And then watch as it somehow comes about. Oh, heck, read his book. You'll get a barrel of laughs, plus some valuable philosophy.

HIV Update

Tom Miller WA8YKN has been hearing from a Bioelectrifier user whose viral count has been going down by 50% every time he's been tested. It's now gotten below the threshold of the test, so the guy is ecstatic. That's a nice reprieve from an AIDS death sentence.

Tom also heard from a chap who'd been told that a secret government agency was about to unleash a deadly mutation of the bubonic plague in order to kill off 75% of the population. The only protection from this would be the use of silver colloid, which the same source had available at a very high price.

Tom explained that with the government some $15 trillion in debt (two-thirds of it off the books), the last thing the government would want to do is kill off taxpayers. They're

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Number 78 on your Feedback card

Ham to Ham

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108
E-mail: [dmiller14@juno.com]

From J. Frank Brumbaugh W4LJD: Here's a tip that parallels his article on gel cell batteries, in the February 1997 issue of *73*.

"Here's a very simple way to keep tabs on your gel cell battery when it's powering a QRP rig, emergency setup, Field Day station, etc. It's an inexpensive expanded-scale charge-status-meter that can be left connected across the gel cell during the entire time of operation, since it draws only microamps from the battery that it's monitoring. **Fig. 1** shows the easy-to-reproduce circuit in schematic form. The actual part values will depend upon what your own junk box yields, what might be obtainable at the next hamfest, or which surplus outlet you might tap for the least amount of cash outlay on your part. M1 in the schematic is a surplus microammeter, which may be 50 µA, 100 µA or 200 µA full scale—whatever you can find. The smaller the full-scale reading of the meter, the less current will be drawn from the battery you wish to monitor for a given mid-scale reading. D1 can be any garden-variety silicon diode (such as a 1N4001). Its main purpose is to prevent any possible damage if you happen to inadvertently reverse the plus and minus input leads. ZD1 is a 1N4739, 9.1 V, 1 W zener diode. Any combination of lower-voltage zeners in series that adds up to about 9.1 volts will also work. Due to the extremely low current drain, the wattage rating of the zener diode is not particularly important. R1 is an inexpensive 'set and forget' trimpot, whose value will be dependent upon the actual sensitivity of the final meter that you might end up with. For a 50 µA meter, R1 can be a 100k ohm trimpot. Just wire everything in series, with the polarities shown as shown in the schematic, and you're all set.

"As mentioned before, this is an extremely low-drain, expanded-scale voltmeter circuit. Anything over about 9-1/2 V will give you a reading, and you can place the meter's needle wherever you'd like it to be on the meter's scale, by using the trimpot. You can mark the meter's scale with actual voltage figures, or simply with an 'OK range' and a 'STOP range'.

"If you intend to treat your 12-volt gel cells with the care and respect that they deserve, 11.5 volts is generally the point at which you'll want to stop discharging them, and this simple metering circuit will tell you when to do it."

Moderator's note: Nice idea for a handy battery monitoring circuit, Frank. By the way, you can modify the circuit to accommodate any battery voltage that you'd like to monitor (6 V, 9 V, etc.), just by altering the choice of zener diode (ZD1) in Frank's schematic. Choose a zener diode (or combination) whose zener-voltage rating is a volt or two below the stop-discharge-potential of the battery pack that you're using. Everything else should stay pretty much the same.

More power to you

From Stephen Reynolds NØPOU: "I've always wanted a dedicated power feed into my ham shack, but my power service panel wouldn't support the needed breakers and capacity. It would have been possible to have a new power service entrance panel professionally installed, of course, but that was beyond what I wanted to allocate from my already limited ham budget.

"A previously unseen opportunity presented itself, however, when our electric stove finally gave up and we decided to replace it with a gas unit instead. I now had a 240 V, 40 A circuit on my current fuse panel that was available for other usage, namely my ham station! I ran #8-gauge wires to a new sub-panel in my shack, being careful to follow all of the electrical codes for my area, and I now have plenty of power conveniently available for just about anything imaginable, of either a 240 V or 120 V nature.

"If your own fuse service panel is currently filled to capacity, and you have an electric stove, electric clothes dryer, or electric water heater, you might be able to utilize any of those circuits for your ham shack simply by replacing that older electric appliance with a new gas-fired model—without the extra expense of a whole new entrance panel. Be familiar with and always follow your own local electrical codes to the letter, if you decide to implement this idea yourself. And seek out the help of a licensed electrician if you don't have the experience or inclination to do it yourself. Now where did I see the ad for that super-duper linear amp?"

Moderator's note: As Stephen mentioned, don't involve yourself with your home's 240 VAC service unless you're absolutely confident that you know all of the proper procedures for dealing with that level of electrical power. 240 VAC is deadly!

Plug potpourri

From David Hyman KBØONF: "If the AC power cords in your ham shack, computer station or test bench seem to be a jumble of unidentifiable cords and plugs, you're not alone. Here's an idea that you might try, to at least put some measure of order back into that maze of plugs.

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take place, the other transmissions from that station are still copied to my monitor. It isn't simply a weak signal or some other receive problem.

My conclusion after all this is that the BayCom software does the job. It is the secret of running the bare-bones BayPac modem. I am sure that eventually the local PBBS will get tweaked, so it will make the connection easier. It appears that the Hamcomm software will do the job once I find another ham who has had the same experience. Those things take a little time and this is, after all, a hobby.

I don't think I would suggest this combination to someone as their first venture into digital hamming. It is much easier to use one of the bigger magic boxes and the simpler software that isn't so "trick." I am quite impressed with all the products and am sure they work for those who have labored so many hours to perfect them. And they will for any of us who persist.

One of the things that makes it difficult to use the multimode software is the fact that the once crowded AMTOR and RTTY spectrum is now fairly dominated by PACTOR. There are not many remaining hams to contact with those modes. There is an upgrade of the Hamcomm software that copies PACTOR. This should mean that there will be full-fledged communication available by that mode with the BP-2M one day in the future.

As for CW, it is fascinating to watch a computer copy the code. CW is one of my all-time favorites. When I was first licensed in 1949, that was all my money and other circumstances would permit me to use. And as all of us from that era will attest, it is still the most dependable low-power medium under adverse conditions. Under such conditions it would be difficult to expect a computer to pull code out of surrounding noise and make it readable. The error-correction capabilities of the new modes would be able to get through up to a point.

At this time, I am satisfied to have a portable packet station up and running. The cable and the shirt-pocket-sized modem altogether weigh about two ounces. That is a barely noticeable addition to what I usually carry with me when I travel.

If you have questions or comments, E-mail me at the address at top or at CompuServe [72130,1352]. I will gladly share what I know or find a resource for you. On packet, when you get a chance, drop me a line at [KB7N@ N7NPB.#NONEV.NV .USA.NOAM]. 73

"Stick a small square of white vinyl tape on each plug, and mark the tape with an easily-read identifier, such as the type number of the item of equipment that it powers. Make sure that when the plug is inserted into its socket, the tape will be in a position that's readable ... since most plugs are polarized these days and they can only be inserted one way. Also be sure to use vinyl tape, because it tends to be more compatible with the rubber or plastic surface of the typical AC plug than other varieties. Vinyl tape is generally available at automotive supply stores because it's been shown to hold up against the rigors of an automotive environment better than others, and it will do the same behind your operating table or test bench."

Moderator's note: If there isn't enough room on the tape for a full identifier, you can simply use a single number. Make the number large enough to read and clear enough so there's no mistaking what it says. Now make up a list on a card or sheet of paper that identifies each number with the item of equipment that it represents. Keep that card somewhere handy so you'll have it when you need to ferret out a particular plug for removal. A good idea from KBØONF.

Tight fit

From William Thim N1QVQ: "Mobile antennas that screw into their mounting bases often have a tendency to loosen up over time. If your antenna's manufacturer hasn't supplied some type of lockwasher for use between the antenna radiator and the mobile mount, then you might consider backtracking and installing your own. The 'wavy' washer shown in **Fig. 2** works nicely, applying pressure between the radiating element and the mount itself at several points around its perimeter. You should be able to locate these washers at your local hardware store or home center. One (or even two) will usually guarantee that your mobile antenna will stay good and tight in its mounting, if the antenna is snugged down correctly to start with. In place of the wavy washer, you might be able to use one of the older split-ring types of lockwashers, though the split-ring types only provide one primary point of pressure per mating surface (top and bottom). Whichever lockwasher system you choose, make sure that the metal that it's made of is compatible with the metal used in your particular mobile antenna and mount. Electrolytic action between dissimilar metals can often defeat any gain made by keeping the mounting tight, especially in areas of high humidity and/or salt air, such as might be encountered along coastal areas. Also recheck your SWR after adding any lockwashers to a VHF or UHF antenna to make sure that it hasn't changed appreciably, trimming the radiator's length slightly if necessary."

Moderator's note: I've experienced the antenna loosening that Bill mentions on my own mobile installation. I have the feeling that it's probably due to a combination of road vibration and wind against the antenna, along with the continual changes in temperature that our mobile antennas are subjected to. The result, of course, is that, over the course of time, the antenna radiator can make poorer and poorer contact with its screw-on mounting stud, leading to intermittent and unpredictable signals on both receive and transmit. In the worst of cases, the transceiver's finals could even be damaged by the quickly varying loads reflected back into the radio. Bill's solution is a good one, along with routinely checking the tightness of the antenna in its mount as a regular maintenance item. A coat or two of your vehicle's touch-up paint around the mobile mount/lockwasher/antenna joint will also help to protect against weathering and electrolytic action, as well as serve as a visual indication of loosening if the paint shows any significant fracture lines.

Murphy's Corollary: Feeling completely satisfied is generally a temporary aberration.

That's it for this month and the first column of our third year on the pages of *73*. Many thanks to all of those who've made contributions to the column in the past two years, and as always, to those who've sparked the ideas featured in this month's edition, including:

J. Frank Brumbaugh W4LJD
P.O. Box 30
c/o Defendini
Salinas PR 00751

Stephen Reynolds NØPOU
510 S. 130 Street
Omaha NE 68154

David Hyman KBØONF
1455 Edgcumbe Road
St. Paul MN 55116

William Thim, Jr. N1QVQ
50 Miller Road
Broad Brook CT 06016-9676

Also, be sure to check out the Ham To Ham column's home page on the World Wide Web at: [http://www.rrsta.com/hth].

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of 73 and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or 73 for any equipment damage or malfunction resulting from information supplied in this column.

Please send any ideas you would like to see included in this column to the moderator at the address at top. We will make every attempt to respond to all legitimate ideas in a timely manner, but please send any specific questions, on any particular tip, to the originator of the idea, not to this column's moderator nor to *73*.

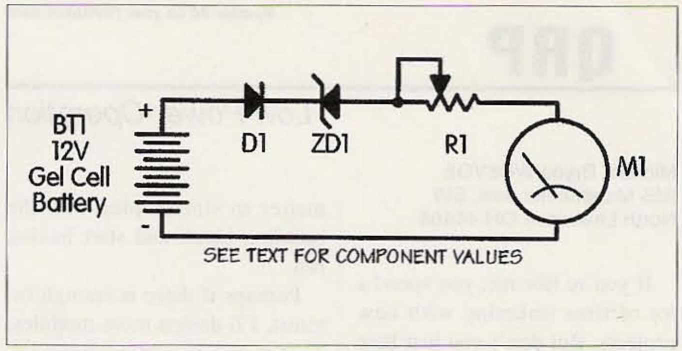

Fig. 1. W4LJD's gel cell battery voltage monitor. See text for additional details as well as for all component values.

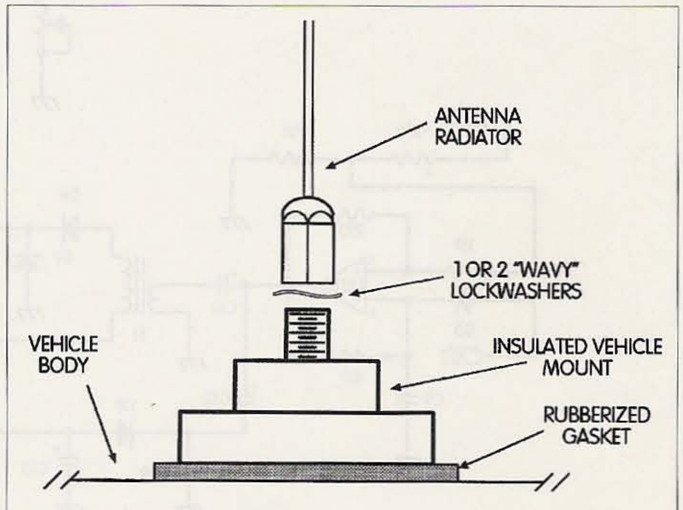

Fig. 2. N1QVQ's suggestion of using a "wavy" lockwasher to ensure a snug fit between a mobile vertical antenna and its vehicle mount.

QRP

Number 80 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
955 Manchester Ave. SW
North Lawrence OH 44666

If you're like me, you spend a lot of time tinkering with new projects. But don't you just hate building and rebuilding the same basic building block circuits over and over? I sure do. I know of no one who enjoys reinventing the wheel.

Normally, I use one or two basic circuits to power my latest creation. It takes time to build and rebuild these building blocks, so I've decided to assemble several of my favorite circuits on one PC board. It then becomes a simple matter to simply plug into the building block and start having fun.

Perhaps if there is enough interest, I'll design more modules. That way, you can put more effort into fine-tuning a design instead of reworking old circuits.

The power control module

This module provides several different operating voltages. It also supplies a highly stable reference voltage. The power control module will also generate a negative reference voltage, very useful if you're dealing with microprocessor and/or ADC chip sets.

Fig. 1 is the schematic for the power control module. If you look closely, you'll see four distinct subcircuits. These are the main voltage regulator, the +5 volt regulator, the reference diode and its buffer, and, finally, the charge pump generator.

The main voltage regulator is a very simple circuit. In fact, I lay no claim to it. This circuit has been around for a long, *long* time. What makes it so slick is its ability to accept a very high input voltage. I needed this requirement, as I have been working on an FET amplifier running from a 28-volt supply.

There are several items of interest in this circuit. Notice the two 47 µF caps in series at the input. By using the caps like this I was able to raise the working voltage, but without spending money on 50-volt units.

There are two inputs to the main regulator. One is labeled "+BATT," and the other, "AUX." A 1N4002 diode in each leg steers either source into the regulator, but without connecting the sources together. On the other hand, if you require more than the one amp of current from the main regulator, you can connect the AUX and +BATT leads together. This effectively puts both diodes in parallel.

The voltage is set by zener diode D4. Change D4 to increase the output voltage. With the values shown, the output is 12.0 volts with very good regulation. I've pulled 500 mA out of the main regulator with no trouble. A heat sink is required on the pass transistor, Q1.

The +5-volt regulator

Since more and more microprocessors are finding their way into our transceivers, I decided I just had to have a five-volt supply. In this case, I decided to go cheap and simple. A 7805 one-amp regulator is pressed into service. Once again, the circuit is very simple. Capacitors on the input and output leads keep the regulator stable. If you have to have more than 150 mA from this regulator, a heat sink will be required.

Remember, the total current flowing from the +5-volt regulator must also pass through the main regulator. The limit on the +BATT diode is one amp, unless you connect the AUX line to the +BATT line as I mentioned.

The reference diode and buffer

I work with op amps and voltage comparators a lot. So, I required a very stable voltage reference voltage. I also wanted to be able to move this reference around a tad.

To accomplish this task, an LM336ZA-5.0 precision diode is used. To vary the output of the diode, a voltage divider consisting of R6, R7, R8, and trimmer V1 is used. With this arrangement, you can set the diode's

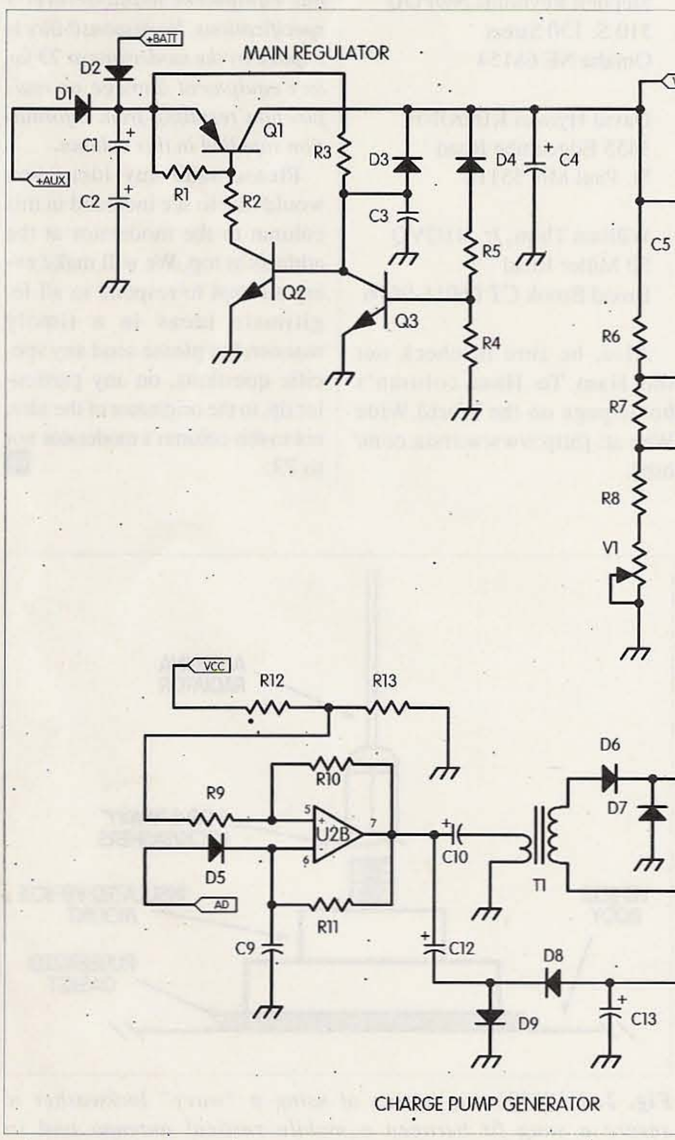

Fig. 1. Schematic for the power control module.

output from 5.00 to 4.12 volts. The output of the diode is fed into one section of an LM358 op amp. This section buffers the diode's output and allows one to draw up to 20 mA of current.

The charge pump

Since I do a lot of work with power MOSFETs as high-side switches, I needed a voltage source at least ten volts higher than the supply. The charge pump takes the output from a free-running oscillator and dumps its energy into a transformer. This energy, combined with the +BATT voltage, is available at the VBOOST output. With +BATT at 14 volts, the VBOOST voltage can exceed 50 volts with a 12-volt input!

Take a closer look at the oscillator, which used the other half of our LM358 op amp. The label AD is used to turn off the oscillator. By applying a positive signal to this input, the oscillator stops. When the oscillator is not running, VBOOST will drop to +BATT. Or from about 50 volts down to 14 volts.

Take one more look at the output of the transformer. If you remove the +BATT lead from D2, and run the main regulator from the AUX input, you also can stop the charge pump. So, in effect, you have two ways to control the output of the charge pump.

On the output of the oscillator, there is a simple voltage doubler. This doubler produces the -5 volts. Unloaded, the voltage hovers around -10 volts. As with the charge pump, applying + volts at the AD input will turn off the -5 volt output.

Nothing set in stone

With the exception of the voltage divider used for the reference voltage, there are really no "don't touch" components. Feel free to change values to suit your junk box or your requirements.

Building the power control module

I designed the module to be assembled on a PC board. A Circad file has been uploaded into the HAMNET library in the "QRP" section. File is called powermd.zip. The PC board is correct and several have been built.

The power module PC board is double-sided, with plated-through holes. If there is enough interest, a very short run of PC boards may be made. There is no reason why you can't hard-wire a module if you want to.

The PC board input and output lines are on 0.156-inch centers. This allows me to use a single module for several projects. The plug is hard-wired to the project under construction. This plug goes into the power module. I can change designs or start another project by simply "plugging in" to the power module.

The main pass transistor and the 7805 each require a heat sink. I found one from Hosfelt™ for less than a quarter. The PC board was designed around this heat sink.

Though it's not shown in the schematic, I put in four LEDs to monitor the main output voltages and the two input voltage sources. A DIP jumper allows you to turn off the LEDs if you desire. I find these very useful. It sure speeds up troubleshooting a VXO when it helps you discover that you have yet to put the juice to the module. Not that I've ever done anything like that, mind you.

Changes

You can change the 7805 to a 7806, -08 or -09 regulator. You can't use a 7812. There's not enough overhead from the main regulator to allow a 7812 regulator to operate.

Any of the popular dual op amps available will work for U2. You might try one of the low-noise ones on the market.

If you need a negative voltage other than the -5, add a zener diode of up to 10 volts at the output of C13 and D8. Since there is little current available, the zener will clamp the voltage to its rating.

I found the power module to be very handy. I hope you do, too. I plan on at least two more modules. One will be a power audio amplifier with AGC and the second a BFO/IF amplifier.

QRP ARCI membership

Unfortunately, I'm no longer able to be the membership person for the QRPARCI. Overworked and underpaid. Please *do not* send your renewals to me. Right now, send them to Ken Evans, 848 Valbrook Court, Lilburn GA 30047.

Parts List

C1, C2, C4	47 µF 25 V
C3, C9	.01 µF
C5, C6	.1 µF
C7	100 µF 16 V
C8, C12, C13	47 µF 16 V
C10	22 µF 16 V
C11	47 µF 50 V
C14	.47 µF
D1, D2, D7	1N4002
D3, D5, D6, D8, D9	1N914
D4	1N753A
Q1	TIP42A
Q2	MPSA06
Q3	2N4401
Q4	LM336Z-5.0
R1, R9, R10	100 kΩ 1/4 W
R2	2.7 kΩ 1/4 W
R3, R12	10 kΩ 1/4 W
R4	510 Ω 1/4 W
R5, R7, R13	4.7 kΩ 1/4 W
R6	2.2 kΩ 1/4 W
R8	16.9 kΩ 1/4 W
R11	47 kΩ 1/4 W
L1	1 µH choke
T1	Mouser™ 10 k to 1 k driver transformer
U1	7805
U2a	LM358a
U2b	LM358b
V1	5 kΩ trimmer

***Table 1.** Parts List for the power control module.*

NEVER SAY DIE

Continued from page 77

not dumb enough to kill the golden goose.

Getting back to the Bioelectrifier, if you've built or bought one, please let me know of any successes with it, okay? Or failures. I've had quite a few letters on successes, but none on failures yet.

Good-O

Thanks KC4RIB for copies of the six Field Day notices which appeared in the Atlanta area newspapers inviting visitors to watch the North Fulton Amateur Radio League at work. How much PR did *your* club get out of Field Day? Or did you keep the whole exercise a secret from the public? Tsk.

QuickQSKer

Build a "full break-in" controller for your rig/amp.

Laurence C. "Curt" Raynes KD7FY
2150 Laura Street #85
Springfield OR 97477

Many of us who like to operate with QSK have set aside old amplifiers because they couldn't function that way. Here is an inexpensive way to put that old friend back to work. This started as a CW project, but the speeded-up amplifier reaction time works fine with SSB and Amtor, and its low-current DC input will no doubt work safely with your transceiver.

The circuit

Fig. 1 shows how. Relays Ry1 and Ry2 switch the amplifier input and output. These relays are small, inexpensive, and—as AC split-core relays used with DC—very fast. There is good current capability, as they have 10-amp contacts and are DPDT. They have adequate insulation to work directly at the 100-watt RF level, and they can switch a kilowatt if their coil leads are isolated with RF chokes. They have small current requirements, so the voltage drop across the RF chokes is not significant. I have never had one of these relays arc down, but I do take off the plastic cover and dress the coil leads away from the metal frame.

The transistor control amplifier is the simplest. With key-up, Q1 is conducting maximum current which is limited by R3 to about 3.5 mA. Its collector voltage is much less than a volt; this holds Q2 cut off, and the relays in the receive position. With key-down, Q1 is cut off and Q2 is saturated. This puts the full supply voltage of about 125 VDC across the relay coils, which really snaps them closed, each getting about 30 mA of current. The transistors do run cool because when conducting current, their collector voltages are very low. Feel free to substitute parts, as none of the values are critical.

The relays are cold-switched. My transceiver has 14 milliseconds from keydown to RF output, and the relays close easily inside this time. A check

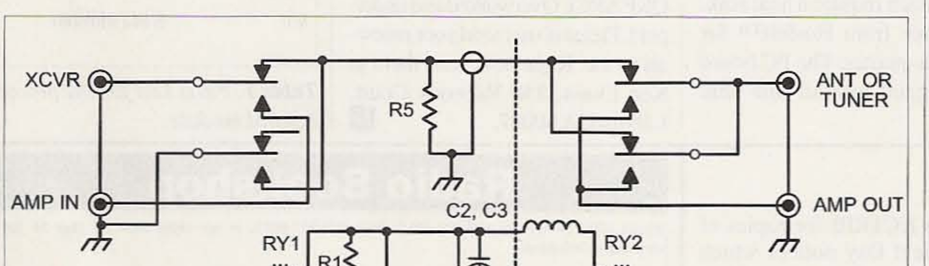

Fig. 1. Schematic.

with my scope showed that the relay bounce time was very short, and over long before the RF gets there.

My transceiver continues its RF cycle for eight milliseconds after key-up. The relays are held closed through this end of the transmit cycle by capacitor C1. On-the-air checks with people I know to be good technicians have confirmed there are no key clicks on the QSKer system when it is used with a modern transceiver. To my knowledge, the QSKer has worked well with an ICOM 751A, an ICOM 761, a Kenwood 140, and a Ten-Tec Omni D.

Relay chatter can be minimized by mounting the relays inside soft foam plastic holders. Make a block of foam sized to a secure fit inside a box or under the chassis of the amplifier. Carve a hole in it to make a snug fit for the relay and socket with the terminals sticking out. Make short interconnects of small braided or twisted wire in an S configuration to minimize sound vibrations telegraphing to the chassis, as it will act as a sounding board. If needed, the foam can be cemented to a metal surface, but do check your adhesive. Some will melt foam plastic.

Parts

Parts are mostly available from neighborhood electronics hobby stores. 2.5 mH, segmented RF chokes are not as common as they used to be, but there are still a few around. You can test them for this application by putting them across a 500 W, 50 Ω load at the frequencies on which you intend to operate. If they stay cool or mildly warm, they're OK. 300 V transistors can be found at an electronics supply house. One-to-one small power transformers are not common now, but two identical low-voltage transformers back-to-back work fine.

Currently, with my Heath HL2200 amp, I'm using its +120V hold-off voltage to run the QSKer, which is built inside it and replaces the original antenna relay. I have a friend who didn't want to modify his old but beautiful Henry amplifier. We built his QSKer in a box, self-contained, and he sets it on his receiver and runs interconnecting coax. Either way, they work great.

These relays have good longevity. I used them for several years before I had the first sticky relay. Not bad for a seven-buck item. Costwise, the QSKer can be built for about 60 bucks—or less, if you have a good junk box. Compare that to the cost of just one vacuum relay.

Performance

This circuit has been used some at the kilowatt level with no apparent problems. There have been a number of these built, and all that I have known about have worked well. At 20 wpm, I hear between the dots. Faster, I catch a BK but I don't hear much between the dots. With my ICOM, the RCA jack labeled "relay" on its back side supplies switching information for the QSKer to run CW, SSB, or Amtor. If this isn't available with your transceiver, parallel the CW key contacts with the QSKer input.

Remember, there is *lethal* high voltage inside the cabinet of your amplifier, and Murphy lurks everywhere. If you're not experienced with high voltage, it's best to build this project in the company of a friend who is. 73

Item	Description	Radio Shack #
Ry 1, Ry 2	125 VAC, DPDT, 10 A	275-217
Relay socket		275-220
C1	0.1 μF, 200 VDC	272-1053
C2, C3	0.01 μF, 500 VDC ceramic	272-131
C4	40 μF, 200 VDC electrolytic	
R1	390 Ω, 1/2 W	271-1115
R2	220k Ω, 1/2 W	271-1132
R3	33k Ω, 1 W (sub. 3 100k, 1/2 W, in parallel)	271-1131
R4	1000 Ω, 1/2 W	271-1118
R5	10k Ω, 1/2W	271-1126
D1	200 piv silicon diode	
D2	400 piv bridge rect.	276-1173
Q1	2N2222	276-2009
Q2	NTE-171 or any similar NPN 300 V transistor	
F1	1/2 A fuse	270-1003
	Fuse holder	270-1281
T1	1:1 ratio 115 V power transformer (sub. a pair of 24 V transformers)	273-1366
RFC	2.5 mH segmented RF chokes or similar inductors	

Table 1. Suggested parts list.

For Computer Illiterates Only

Take a trip through your PC ...

Bob Shrader W6BNB
11911 Barnett Valley Road
Sebastopol CA 95472
[w6bnb@aol.com]

Amateur radio today is becoming more and more dependent on computers. We find them being used in such applications as sending and receiving CW, RTTY, AMTOR, and PACKET; keeping logs; substituting for *Callbooks;* computing antenna dimensions; and solving many other mathematical problems. They are very valuable, fast acting, complicated devices. But what's inside of one of these things?

First off, if you know much about computers, this explanation is not meant for you! On the other hand, if you feel that you know little or nothing about what is in a computer, you may find that this description of one reasonably complete Personal Computer (PC) will give you a basic idea of how one might be put together.

The block diagram of the PC shown is the result of some doodling done one day while I was thinking over the "486 CPU" type of computer my son assembled for me out of some spare parts he had lying around. He has been working for IBM for many years, but as a hobby he builds his own PCs. He has advanced from a 286 to a 386 to a 486 and finally to a Pentium™ CPU computer—hence all the spare parts he had on hand.

Actually, my knowledge of computers is pretty limited. The block diagram I have drawn up was originally done in hope of bettering my own understanding of how my machine works. I have found that I comprehend something a lot better if I put down on paper what I am trying to learn about it. This diagram illustrates the basics of my IBM-clone PC. Let me say right here that although there is probably no other PC in the world exactly like mine, there are millions of them that may be very similar in many ways.

In the block diagram, the outside case and the chassis of the computer are indicated by the dotted-line rectangle. Features shown on the right side of the rectangle are on the front of the chassis (the front panel), which also has some pilot lights and other switch buttons we will not discuss. All connections on the three other sides of the rectangle would be found on the back surface of the chassis and case.

The little female Vs shown on the chassis, or on other component edges, and their mating male arrowheads, represent cable or other plug-in connections. They are not all installed male and female as they have been diagrammed here for simplicity. Also, each single connecting line on the block diagram may represent anything from a two-wire pair to a 50-wire ribbon cable, or even a multi-contact plug-in board. We will not be getting too specific and authoritative—this is just going to be the basic ideas of what possibly might connect to what, and perhaps why.

Outside the dotted-line chassis and case are the peripherals—the video monitor, the printer, the keyboard, the mouse, and so forth. Inside the case, on the bottom surface of the chassis, and plugged into a very complex "motherboard," is the brains of the PC, the Central Processing Unit (CPU), in the form of a plug-in integrated circuit (IC). There are other circuits, mostly in IC form, that are also plugged into, or mounted, on the motherboard.

Let's start the explanation at the top left and move around clockwise. When the cable of the TV-like screen of the monitor is plugged into the fitting for it at the back-surface of the computer chassis, it couples to an internal electronic-circuit plug-in "interfacing" display card which in turn plugs into the motherboard as shown.

The three-wire male connector at the end of the AC line cord from the monitor unit plugs into a female AC receptacle on the back chassis surface of the computer (shown below the monitor). This female fitting is directly connected to the equipment side of the main AC on-off switch of the PC. The female end of an AC line cord is plugged into a male fitting connected to the line side of the PC's main on-off switch. With this circuitry, the monitor turn-on and turn-off is controlled by the computer's AC line switch, which is handy. Many PCs require their monitors to be plugged into a separate AC outlet and therefore require a second switch operation. While this may be no big deal, the single-switch scheme is a

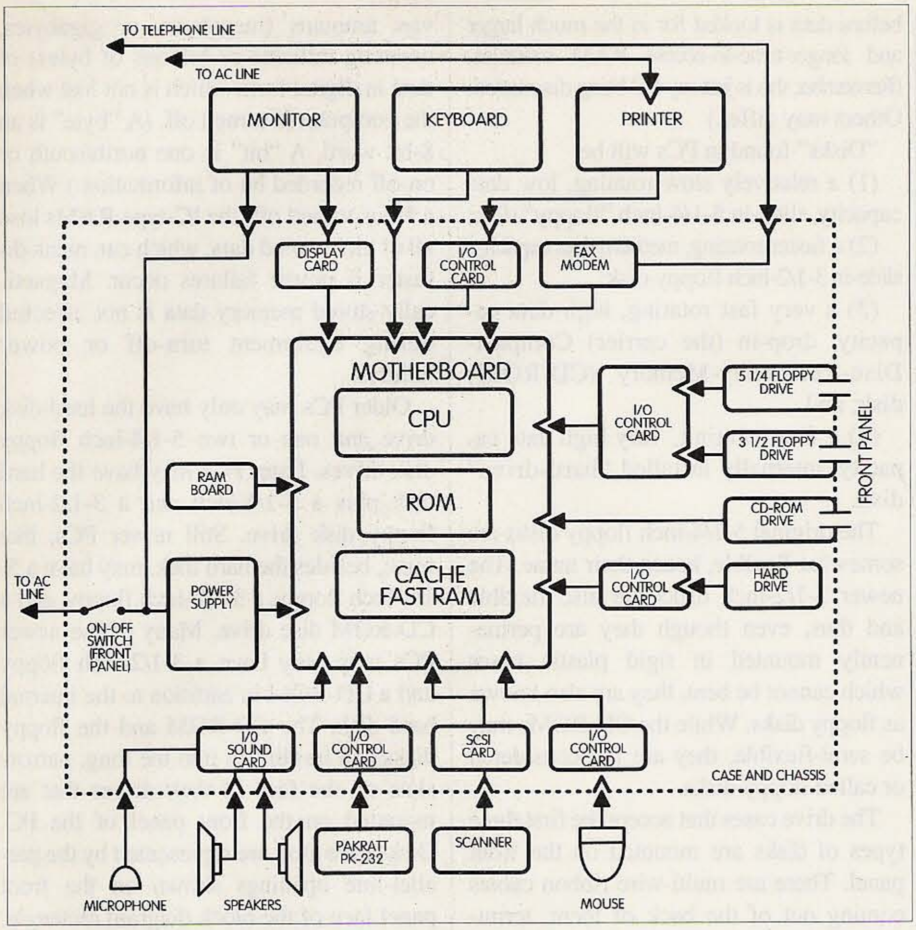

Fig. 1. Block diagram of the author's 486 CPU computer.

little nicety. Of course, a single-switch control is also possible if all computer units are plugged into an AC power strip and its switch is used to turn on and off all equipment plugged into it.

When the printer is plugged into the computer, it couples through a parallel-type input/output (I/O) controller card which in turn couples to the motherboard. Since a printer is not always turned on when a PC is in use, it is coupled to an AC line outlet with its own line cord and uses its own separate on-off switch.

When being used, the keyboard's electronically generated digital data signals are fed directly into the motherboard. From there data can go to memory banks where it may be stored or accessed when needed, or it may be fed to other destinations in the computer.

If a telephone line is coupled to the motherboard, it is done through a facsimile/data (FAX) modem (*mod*ulator-*dem*odulator) device. The modem stores in its memory the very fast 8-bit ASCII on-off, or 1-0, coded characters developed in the PC. However, the fast ASCII data must be changed to a much lower-frequency data stream in order for handling by the limited bandwidth (speed) capabilities of telephone lines and their circuits. My internally mounted modem plugs into the motherboard. In many computers, the modem is a peripheral device and is located outside the computer.

A movable, finger-operated control device, called a "mouse," can be moved around on the top surface of the operating position. It is used to move the arrowhead or the little blinking "cursor" dash which appears on the monitor screen. The arrowhead is used to point to whatever may be the next step in computer activity and the blinking cursor shows where the next typed character will be. Two switches on the top of the mouse (sometimes three) can control most of the computer's activities. The mouse is shown coupled to the motherboard through a serial-port I/O controller card. Many modern PCs may have series/parallel I/O controller cards built into the motherboard, so the mouse might be cabled directly to one of these serial ports.

If a scanner is used, it picks up digital picture signal bits (pixels) from any picture, or written page, that it scans line by line. The pixels are coupled to the motherboard through a "Small Computer System Interface" (SCSI—pronounced "scuzzy") card. With these signals the computer can transmit FAX picture signals into the motherboard, to memory, or to the monitor, or send them through the modem to the telephone line. FAX pictures can also be received through the modem to be held in memory, and then be shown on the monitor or printed in black and white or color on the printer.

When my Pakratt PK-232 peripheral device, which I use to transmit and display CW, RTTY, and other signals, is plugged into the computer, it couples to and from the motherboard through a serial-port I/O controller card.

An external loudspeaker (or two for stereo sound) can be coupled to an I/O sound card that couples to the motherboard. In some computers a single small loudspeaker may be mounted on the front or back surface of the chassis. I happen to have two external speakers for stereo, but one is really all that is needed for normal PC operation. A microphone, or an AF line, may also be plugged into the sound card to send voice or other audio frequency signals out through the modem to the telephone line or to be recorded on disks.

The AC line, through the main on-off switch on the front chassis panel, is connected to a power supply that converts the 120 V AC to the 5 to 15 V DC required to run the motherboard and the various inside-the-case devices. In many older and some newer PCs, the main on-off switch is placed in a hard-to-get-to position, such as far back on the right side of the case, so it cannot be inadvertently turned off and thereby wipe out a lot of RAM data. My front panel switch is fairly difficult to press in, so inadvertent turn-off is unlikely.

On the motherboard, among other things, will be the Read-Only-Memory (ROM) ICs, Random-Access-Memory (RAM) plug-in sockets, and some very fast RAM-type "cache" memory ICs. The data instructions that are recorded in the ROM are used to start, or "boot-up," the computer and keep it operating. The RAM memory holds much of what is typed on the keyboard after the PC is booted up. The cache RAM memory ICs hold only recently entered keyboard information. When working on a file (program of some type), the cache memory is searched first before data is looked for in the much larger and longer-time-to-access RAM modules. (Remember, this is just my PC being discussed. Others may differ.)

"Disks" found in PCs will be:

(1) a relatively slow rotating, low data capacity, slide-in 5-1/4-inch "floppy" disk;

(2) a faster rotating, medium data capacity, slide-in 3-1/2-inch floppy disk;

(3) a very fast rotating, high data capacity, drop-in (the carrier) Compact-Disc-Read-Only-Memory (CD-ROM) disk; and

(4) a fast rotating, very high data capacity, internally installed "hard-drive" disk.

The original 5-1/4-inch floppy disks are somewhat flexible, hence their name. The newer 3-1/2-inch disks are also flexible and thus, even though they are permanently mounted in rigid plastic cases which cannot be bent, they are also known as floppy disks. While the CD-ROMs may be semi-flexible, they are not considered or called floppy disks.

The drive cases that accept the first three types of disks are mounted on the front panel. There are multi-wire ribbon cables coming out of the back of them, terminated with plug-in connectors that plug into I/O controller cards, unless the I/O circuits are built into the motherboard. (Note that all components normally added inside a computer are always either plug-in or screw-driver connected, requiring no soldering of circuits.)

All disk drive cases contain little internal motors that rotate the disks when they are inserted. Each floppy drive has a "read" head to pick up digital data from the tiny north/south magnetized areas laid down on concentric-circle tracks on the rotating disk surfaces. Their "write" heads can lay down north/south magnetized areas on the same tracks if the disks are "formatted" (data erased). Present CD-ROMs are recorded with tiny high-low pits that get their on-off data by reflecting light or not, instead of having magnetic north/south recorded areas to produce their on-off signals. The pits on CD-ROM spiral tracks do not allow re-recording on them.

The hard-drive disk with its rotating mechanism and magnetic RAM-type read/write heads are in a rectangular metal box mounted somewhere on the chassis inside the computer case. It is plugged into an I/O controller card with a 34-wire, or more, ribbon cable and then into the motherboard. A hard-drive disk can store vast amounts (megabytes or gigabytes, meaning millions or billions of bytes) of data in digital form which is not lost when the computer is turned off. (A "byte" is an 8-bit word. A "bit" is one north/south or on-off recorded bit of information.) When a PC is turned off, the IC-type RAMs lose all of their stored data, which can mean disaster if power failures occur. Magnetically stored memory data is not affected during equipment turn-off or power failures.

Older PCs may only have the hard-disk drive and one or two 5-1/4-inch floppy disk drives. Later PCs may have the hard disk plus a 5-1/4-inch and a 3-1/2-inch floppy disk drive. Still newer PCs, like mine, besides the hard disk, may have a 5-1/4-inch floppy, a 3-1/2-inch floppy, and a CD-ROM disc drive. Many of the newer PCs may only have a 3-1/2-inch floppy and a CD-ROM in addition to the internal hard disk. The CD-ROM and the floppy disks can be slipped into the long, narrow slots on the face of their drives that are mounted on the front panel of the PC. Disk-drive slots are represented by the parallel-line openings shown on the front panel face of the block diagram rectangle. It is into these slots that the thin, round plastic disks inside their square handling holders are inserted. These disks must be mechanically locked in before they will operate.

As I stated before, this explanation has been just a basic PC discussion. There are many other things in PCs, such as oscillators, timing circuits, etc., that have to be in there, but have not been mentioned. There may be many other types of PCs that are equal to or better in some respects than the IBM clone discussed here. Every day it seems something new comes out regarding PC hardware (devices). New amateur radio applications and programs (software) are continually being dreamed up. Trying to remember all of the things that must be done just to operate even a simple PC properly is a major challenge. This is particularly true for those poor souls who fit into the category of being from one of the older generations! (Your writer was first licensed in 1931 and knows whereof he speaks.) Besides my son Douglas, two ham friends, George Littrell W6ABU and Wil Senior K6SEZ, were kind enough to give me some valuable comments and corrections on the explanations I have provided here. These were all greatly appreciated.

PROPAGATION

Jim Gray W1XU
210 E Chateau
Payson AZ 85541

The best days (G) for propagation this month are likely to be the 5th through 9th, the 18th and 19th, and 28th through 31st. The worst days (P) are likely to be the 10th through the 12th, and the 23rd through the 26th. The remainder of the days ought to be fair (F) or trending as shown on the calendar. Look for possible geophysical upsets such as unusual weather, or earthquakes and volcanism around the 10th and 25th.

10–12 meters

Generally Poor, except for occasional transequatorial propagation with F2 openings on the best days—most likely South and Central America.

15–17 meters

DX to Africa and Latin America on the Good days possible, with short-skip out to about 1,000 miles or so in the US.

20 meters

Your best band for DX openings around the world from dawn to dark, and openings to the Southern Hemisphere after dark in evening hours. You can expect excellent short-skip during the daytime to 2,500 miles or so.

30–40 meters

These bands ought to be open for DX from just before sunset to just after sunrise. Signals from the east should peak until midnight, and after midnight to other areas. Daylight short-skip of about 500 miles will be possible, and nighttime short-skip to 1,500 miles or more will be available.

80 meters

Occasional DX to various areas of the world should be possible between sunset and sunrise when QRN levels permit on Good (G) days (see calendar). Short-skip during darkness to 1,500 miles or more.

160 meters

Following the usual summertime slump, this band ought to begin to come alive again during the hours of darkness when QRN permits. Try the days marked G on the calendar for best results. DX toward the east until midnight, and to other areas afterwards until dawn. Short-skip to 1,500 miles will prevail when the band is quiet. 73

OCTOBER 1997

SUN	MON	TUE	WED	THU	FRI	SAT
			1 G	2 G-F	3 F	4 F-G
5 G	6 G	7 G	8 G	9 G-F	10 F-P	11 P
12 P-F	13 F	14 F	15 F	16 F	17 F	18 F-G
19 G	20 G-F	21 F	22 F	23 F-P	24 P	25 P
26 P-F	27 F-G	28 G	29 G	30 G	31 G	

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
RUSSIA (C.I.S.)							20	20				
SOUTH AFRICA									15	15	15	
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
RUSSIA (C.I.S.)								20	20			
SOUTH AFRICA										15	15	20

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA										15	15	
EAST COAST		80	80	40	40	40	40	20	20	20		

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Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

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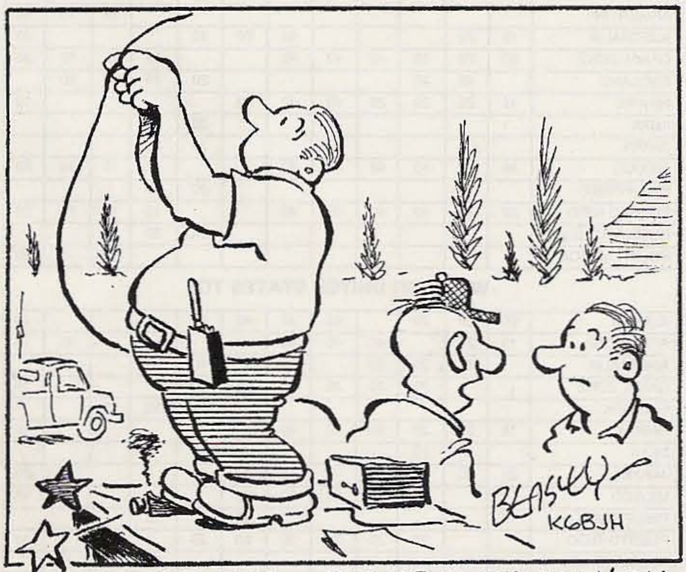

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