ET/D

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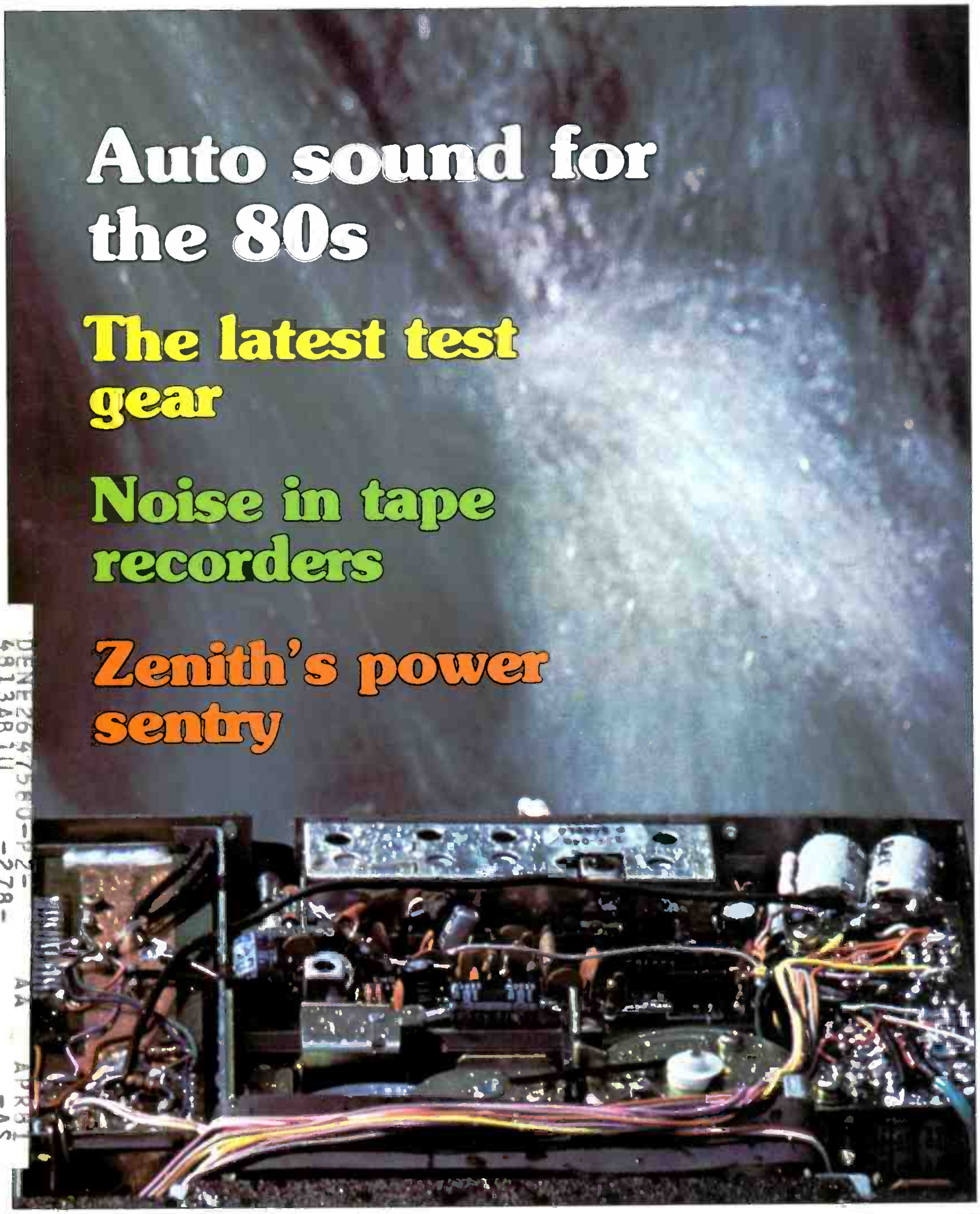
ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS



Auto sound for the 80s

The latest test gear

Noise in tape recorders

Zenith's power sentry

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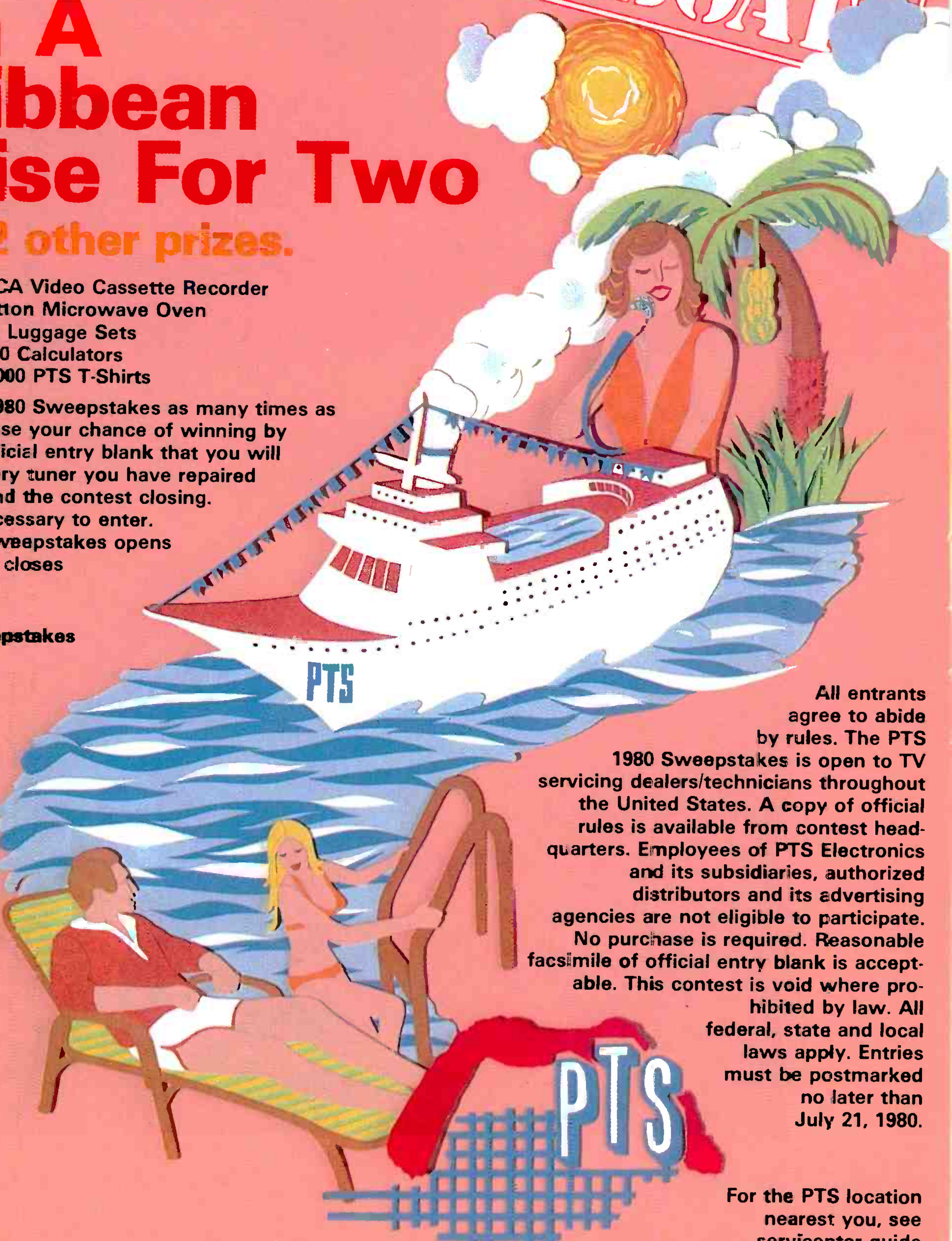

PTS
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INDUSTRY REPORT

Industry Spokesmen Voice Views on Franchise Concept

Industry reaction to the announcement that Tronics 2000—a franchise organization aimed at the independent consumer electronics service industry—would soon be offered to shops nationwide (see ET/D, June, p. 1) generally has been supportive.

The general concensus of the comments reported to ET/D is that any effort which results in better organizational coordination between what largely is still a "mom and pop" business structure, could not fail but bring beneficial results. But, most contacted also said the job of convincing independent operators their futures might be better served through such an organization would be the most difficult task.

As Frank Moch, NATESA's Executive Director, put it: "Even in associations we have one hell of a time convincing people that there are certain things they should be doing and should not be doing for their own benefit. We're really independent independents."

J.W. Williams, chief executive of NESDA: "It might possibly fly but it's sure going to be a lot of work and a lot of headaches. If a guy has the $5,000 it would require for him to become a franchise holder, the chances are he could make it for himself...Of course the Radio Shack deal has been a very good thing for the dealers who have gotten into it, so a lot of it will depend on how much money they spend at the local level for advertising."

Bob Villont, NESDA President: "The potential is there...There certainly are a lot of operators out in the field who are more technically proficient than they are in terms of being managers. Certainly anything we can do to uplift the image of the service industry can only be helpful to everyone and, done right, they can do it.

"They're probably going to do things right and this is going to make people look at their own operation. If they come over as professionals and their intent is there, it has got to help lift the image of the industry."

Dick Glass, Executive Director of ETA-I: "I would think that if something like this did go it would be beneficial for the industry. If you have 50 stores around the country doing things on a routine basis they would realize they couldn't give service away. Everyone who goes into business as an independent thinks that for the first 10 years he's got to give his service away and then all the rest of the world will come to him because he's a nice guy. That's the attitude that puts everybody out of business.

"I believe a franchise type thing would eliminate that and they would have to pay their technicians a decent wage...I would think they would go ahead and try to hire the better technicians if they had any money."

Robert J. Liska, Director of Marketing for VIZ Manufacturing: "It's a damn good idea but boy to get these guys off a dime is not easy (because) the attitude has been—'I'm doing all right the way I am so leave me alone.'..Yet I think that any type of uniformity in the service area could only have a good effect on the industry. I think the consuming public is more prone to go to a larger, or known, or franchised, service organization...witness Sears service, and RCA service and GE service where people literally buy the product because of the service."

Ray Guichard, Director of Service and Consumer Affairs for Magnavox: "It would be one way of helping the small independent shop owner get by. It's the sort of thing you really can't knock because it's happened in the fast food industry and so many other places, even in appliance repair. Basically it's a way of allowing the small operator to continue to operate without having all of the headaches of trying to run his own business—and of getting some support from a national organization."

NESDA Finalizes Convention Schedule

ET/D's annual golf tournament will kick off a week of educational and social activities at this year's National Electronics Service Convention August 18-23 at Louisville, Ky. Sponsors of the event are NESDA, ISCET, and the Kentucky Electronics Service Association.

Business management sessions will be featured on Tuesday, the second full day of activities, headquartered this year at Louisville's Galt House Hotel. The trade show will be the featured event on Thursday, the 21st and as of this writing sponsors included: ET/D, Sony, Panasonic, PTS Electronics, Magnavox, GTE Sylvania, General Electronics, RCA Service Company, Sharp, Throdarson Meissner, Zenith, and Howard W. Sams Company.

The convention will wind up Saturday August 23 with the annual Electronics Hall of Fame Dinner and the installation of officers.

Sylvania Unveils New Training Center

Sylvania Product Services Division has unveiled its brand new technical training center at its Batavia, N.Y., headquarters. The center, completely equipped with audio/video capabilities for entertainment or educational purposes, has

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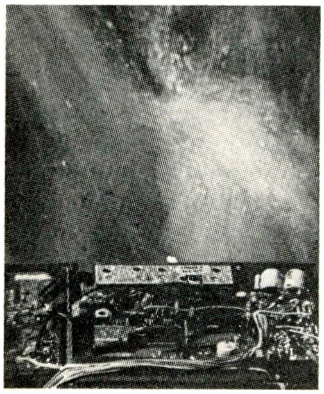

On the cover: The Marantz digital readout and electronically tuned auto radio shown on our cover typifies an industry undergoing rapid technological change. For a first hand look at the newest in car radio tuning systems see our feature on page 18.

FEATURES

DEPARTMENTS

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102A	.40	135A	.40	171	2.25	231	4.90	298	1.10	381	3.10	720	1.50	791	2.80	975	1.60	1036	3.20
103A	.80	136A	.40	176	1.30	233	.80	299	.75	382	1.00	721	3.80	793	3.20	978	1.60	1037	3.00
104	2.00	137A	.40	176	1.10	234	.40	300	.70	383	1.10	722	1.50	801	2.00	987	1.40	1040	1.40
105	3.90	138A	.40	177	.25	235	1.60	302	1.30	390	1.10	723	1.50	802	8.80	990	4.80	1041	1.20
106	.40	139A	.40	180	4.60	236	1.80	306	1.30	391	1.10	724	2.80	803	8.80	992	1.80	1042	2.40
107	.80	140A	.40	181	3.40	237	2.40	307	.50	500A	12.40	725	1.50	804	2.90	1002	1.20	1043	3.90
108	1.20	142A	.40	182	3.20	238	3.35	308	7.40	506	1.50	726	3.50	805	3.20	1003	1.20	1045	2.60
109	.20	143A	.40	183	3.75	276	7.90	310	7.40	523	18.80	728	3.80	806	3.80	1004	2.40	1046	3.20
110	.40	144A	.40	184	1.30	277	7.80	312	.60	525	1.35	729	4.20	807	3.20	1006	2.20	1049	3.90
113	.55	145A	.40	185	.90	279	7.40	313	.80	526A	18.80	731	1.50	814	4.00	1009	2.20	1050	2.00
116	.20	152	1.30	186A	.60	280	3.40	315	1.00	551	2.00	737	3.80	815	3.80	1010	2.20	1051	5.90
117	.20	153	.90	187A	.80	281	4.60	320	10.60	601	.30	738	4.80	818	3.80	1011	2.25	1052	1.00
118	.90	155	2.90	190	1.80	282	2.00	321	3.60	605	1.65	739	3.20	823	1.20	1014	1.90	1053	2.70
121	2.75	156	.60	192	.45	283	4.60	323	2.20	612	.35	740A	2.60	824	2.50	1016	2.20	1054	1.70
123A	.35	157	1.50	193	.55	284	4.30	324	2.50	613	.40	742	4.20	904	6.90	1019	1.20	1055	2.70
124	2.00	158	.40	195A	2.00	285	6.20	325	29.20	703A	1.50	743	3.80	905	4.50	1020	2.20	1056	2.80
125	.20	159	1.10	196	1.30	287	.70	333	19.00	708	1.50	744	5.20	912	2.40	1021	2.20	1057	3.10
126	.80	160	1.80	197	1.50	289	.60	334	19.00	709	1.50	746	3.80	917	3.20	1024	4.20	1058	1.95
127	2.95	161	1.20	198	1.50	290	.60	335	26.00	710	3.00	748	2.80	923	1.30	1025	5.90		
128	1.40	162	4.60	199	.60	291	1.30	336	26.00	712	2.25	749	2.90	925	7.80	1027	4.90		
129	1.20	163A	4.60	220	1.60	292	1.50	373	2.50	713	1.50	778A	1.80	941M	.90	1028	10.40		
130	1.30	165	3.35	221	1.40	293	1.00	374	2.60	714	2.80	780	3.20	955M	1.40	1029	2.60		
131	1.00	166	1.45	222	1.60	294	1.10	375	1.50	715	3.20	783	2.60	966	1.30	1030	3.60		
132	.60	167	1.45	229	.80	295	.60	376	2.25	718	1.50	788	1.50	973	1.80	1032	2.90		
133	.60	168	1.45	230	4.60	297	1.00	380	3.00	719	1.50	790	2.80	973D	2.00	1035	4.60		

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coaxial antenna connection jacks surrounding the room and easily accessible to all workbench stations. Any number of video patterns may be connected to the outlets from the center's master control room. Sylvania unveiled the center for the first time this May with the introduction of its 1981 consumer product lines before its distributors.

Digital Repair Service—A New Classification?

Will the letters "DRS" soon be an acronym for a new classification of electronic certification. Maybe yes! Maybe no! But, they definitely should be, according to the marketing manager for Global Specialties Corporation, Martin B. Weinstein.

According to Weinstein, the revolutionary spread of digital circuitry throughout the entire electronics industries, from military, to industrial, to consumer, has already created the need for a concerted educational effort by manufacturers, educators and others to upgrade the repair industry into the digital era.

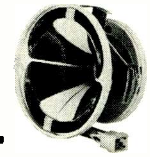
Consider the ramifications of the recent announcement, Weinstein said, that Montgomery Ward has joined Sears in offering retail distribution of "home" computers. Who will fix them, he asked, once the weight of massive distribution precludes the present practice of simply board swapping by manufacturers' agents? "Undoubtedly, some combination of franchised repair center or retailer operated repair center will shortly appear."

Other devices headed into this digital jungle, Weinstein said, are appliance controls for washers, dryers, microwave ovens, food processors, intelligent thermostats and ranges. "Home entertainment is the next important category," he said. "Top line television sets are doing digital tricks, tuners, remote controls, time and channel displays. Video recorders have a lot of digital inside...the newest trend in audio is totally digital. Video discs are digital, as are garage door opener codes."

According to Weinstein, these trends have created the need for special recognition for the professional trained in digital. The need for a "digital" shingle—perhaps under the acronym "DRS" for Digital Repair Service should be used to identify in the minds of the public a business qualified in digital repair work.

The idea is not unlike, Weinstein said, the concept behind the Certified Electronics Technician (CET) designation.

"What we are encouraging," he added, "is a coordinated, concentrated effort to help a new type of business appear in our industry, a type of business which is key to promoting a greatly increased proliferation of digital electronics throughout the homes and stores of America." ET/D

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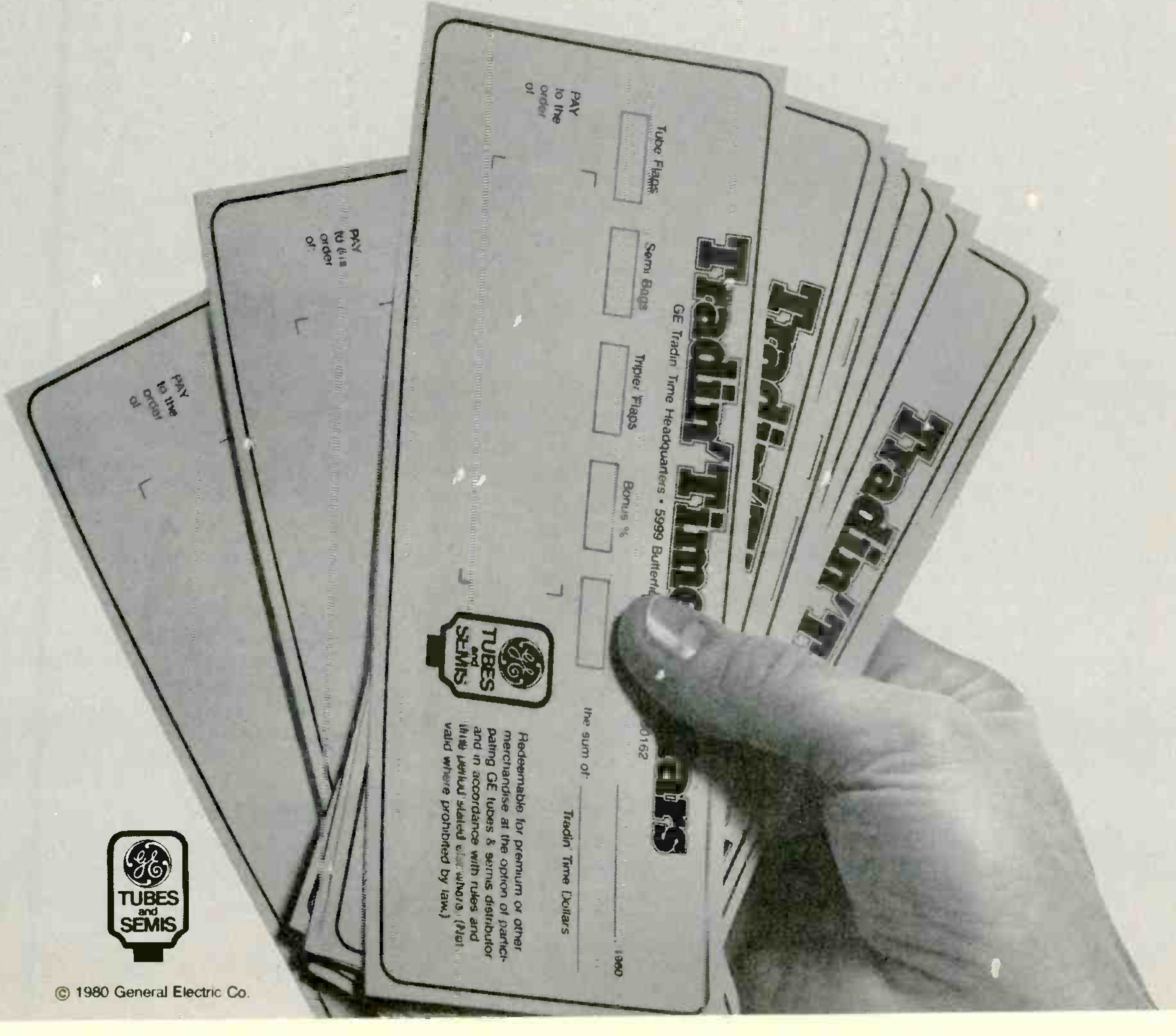

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NEWSLINE

TURNER'S CABLE NEWS NET BOWS. Atlanta sportsman Ted Turner's Cable News Network has begun operation. Turner is already well known to TV homes in the United States as the owner of Atlanta's WTBS which is broadcast across the country via satellite. With his new Cable News Network, Turner's group expects to capture some 2.5 million homes initially. The network also started with 17 sponsors for its initial broadcast, including the Wall Street Journal, Campbell Soup and Quaker Oats.

NEW VIDEO DISC FORMAT ON HORIZON. In a surprise announcement last month, General Electric, Matsushita Electric, Victor of Japan (JVC), and England's Thorn EMI, Limited, announced a cooperative venture to support the introduction of another video disc system in the U.S. market. Plans call for a joint manufacturing company to be operated between GE, Matsushita, and JVC with all four partners cooperating in an artistic production company to provide software.

WILL USE MATSUSHITA FORMAT. Until such time as the manufacturing company gets underway, video disc units will be purchased from Matsushita and JVC. The system proposed, called VHD, is a grooveless capacitance pickup system developed by JVC, one of Matsushita's subsidiaries. The entry of VHD undoubtedly will slow consumer acceptance of video disc technology, since consumers will now have three incompatible systems to choose from.

OHIO SCIENTIFIC OFFERS SERVICE MANUAL. Ohio Scientific, a manufacturer of business computer systems, announces the availability of a new 183 page service manual for its Challenger III model. The service manual is in conjunction with Howard W. Sams Photofact series--already well known in consumer electronics. The Challenger III service manual is part of Ohio Scientific's documentation for its entire line--including the Challenger 1P and Challenger 4P systems.

ZENITH WANTS DUMPING SETTLEMENT STOPPED. Zenith Radio Corporation has filed a new suit -- in U.S. Customs Court -- aimed at overturning the U.S. government's compromise settlement with Japan over the dumping of foreign made TVs in this country at prices under what they sell for in their home countries. Zenith claims the $76-million negotiated settlement is illegal.

SAMPO GOES TO ATLANTA. Nationalist China TV maker Sampo is the latest to move production facilities to this country. Announcing plans for a production facility in Atlanta, Sampo says it hopes to start out making 12,000 19-inch color sets a month. Sampo reports U.S. color sales of $50 million which is only 1.3 per cent of the market.

Facts from Fluke on low-cost DMM's

Is this any way to treat a $139 multimeter?

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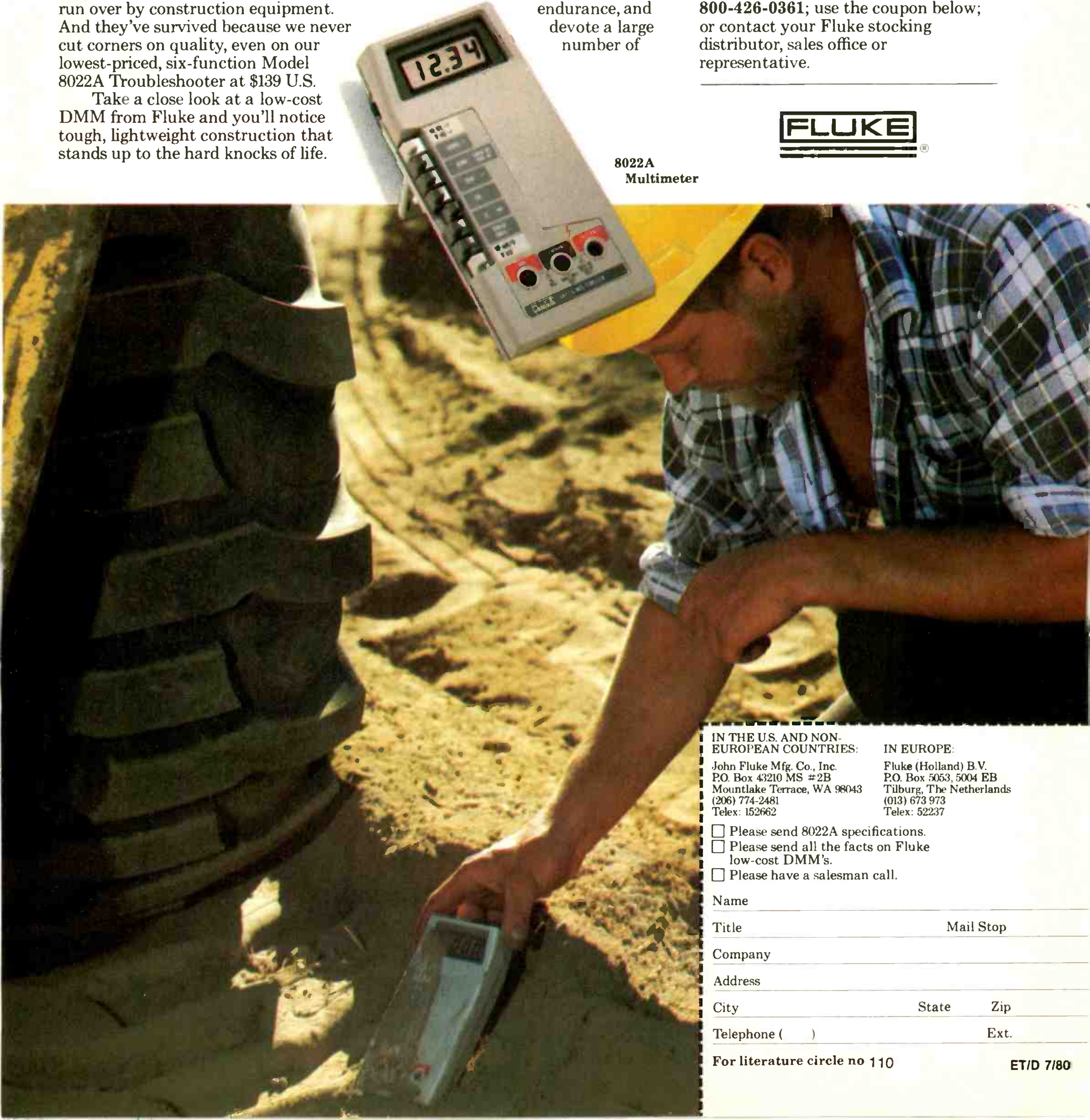

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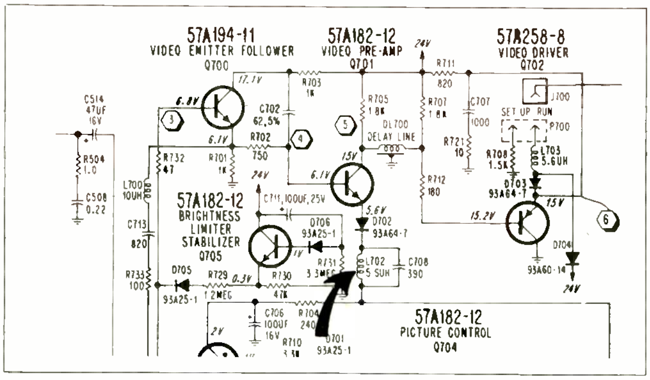
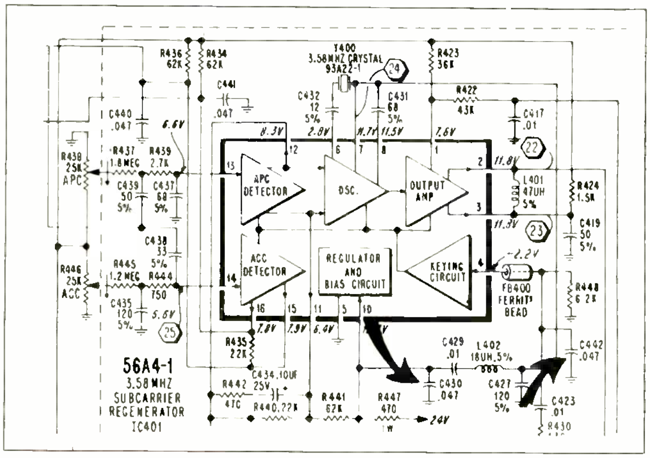
M46/M55

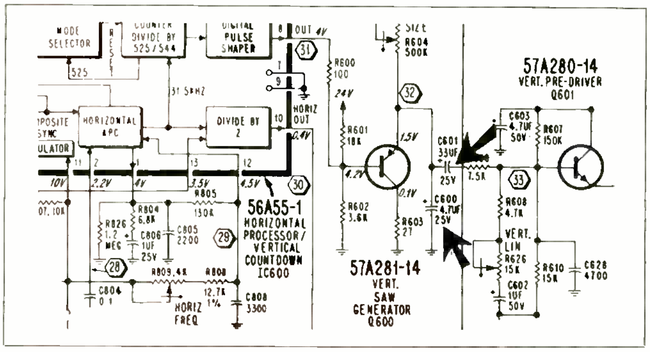
1. **Intermittent flashing across screen, video and color fades.** Possible Cause: Intermittent L702. M46-5.6µh coil (73A53-343) M55-5.6µh coil (73A55-89).



2. **Intermittent and/or no color sync.** Possible Cause: Defective C430 or C442, M46-C430: .047mfd, 50V, 20% (64A86-16). M46- C442: .047mfd, 50V, 10% (64A85-16). M55-C430, C442: 047mfd, 50V, 10% (64A85-16).

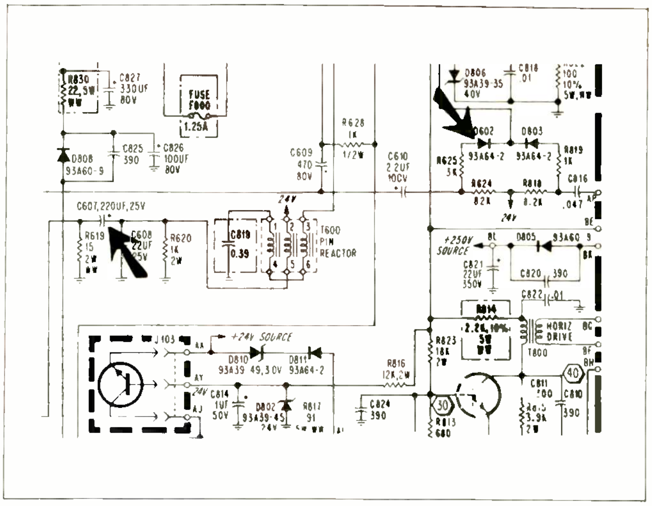


3. **Slow vertical roll.** Possible Cause: Defective C600, 4.7mfd, 25V (67A202-479-66).



4. **Vertical foldover with drive lines.** Possible Cause: Defective C601, 33mfd, 25V (67A201-330-4).

5. **Insufficient vertical sweep at bottom.** Possible Cause: Open C607, vertical output collector bypass and pincushion, 220 mfd, 25V (67A201-221-4).



6. **Dark at top, light at bottom, no brightness control.** Possible Cause: Defective D602 (93A64-2).

RCA

CTC 96, 97, 99, 101, Magnetic tape beam bender. D line models equipped with any of the Unitized Chassis series (CTC 96, CTC 97, CTC 99, CTC 101) may use either the conventional beam bender or a magnetic tape beam bender. The new type beam bender consists of a length of metal-impregnated rubber tape attached to the picture tube neck in place of the conventional beam bender. Then, during instrument assembly, the metal-impregnated tape is permanently magnetized as required to obtain proper purity and static (center) convergence.

In the event picture tube or deflection yoke replacement is required, the magnetic tape beam bender must be removed prior to sliding the deflection yoke off the picture tube neck. The beam bender is attached to the picture tube neck by mylar tape and is secured with a nylon tie. Cut the nylon tie, then carefully peel the beam bender off the neck. The magnetic tape beam bender is not adjustable nor is it reusable. After reassembling the picture tube and yoke, install a conventional beam bender, stock number 145381, and adjust it to set proper purity and static (center) convergence per appropriate Service Data instructions.

Because removal of the picture tube or deflection yoke does require replacement of the magnetic tape beam bender with a conventional type, field technicians should add a beam bender to their parts caddy. Stock number 145381 beam bender can be used to replace the magnetic tape beam bender in any "D" line model.

The magnetic tape beam bender precludes any need to reset purity/convergence due to transportation induced beam bender movement or inadvertent misadjustment while servicing. However, purity can be checked by: 1) Loosen two ¼-inch yoke clamp screws, one on the picture tube neck, the other on the plastic yoke housing. 2) Slide the yoke all the way forward; then slowly move the yoke towards the back. Stop immediately when overall purity is obtained. This is defined as the "front porch" of purity. With the yoke set at the front porch of purity, any further thermal-induced drift will not degrade purity. **ET/D**

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FROM THE EDITOR'S DESK

Traditionally, this is the time of year when the consumer service industry hits its doldrums, patiently awaiting the arrival of Fall, a new television season, the world series, football, an end to family vacations, and everything else that seems to contribute simultaneously to the slowness in your service business.

It's the time of year when many take off on that long awaited fishing trip, family vacation, or just dig in and begin patching the wear inflicted to the house over the past winter. In short, its a time for catching up, some relaxation, and perhaps even some serious thought on the future.

There's no question there has been plenty to keep each and everyone of us busy during the past 12 months. There has been the inrushing tide of new technology in the form of digital worlds wrapped into the ever more popular microprocessor devices which have become commonplace in consumer electronics products.

There is the additional demand fostered by the ever increasing appearance of new types of consumer products appearing in your market area. I'm talking of the VCRs, the video cameras, the new and ever increasingly sophisticated security devices, even microprocessor controlled home appliances, automobiles, and home computers. Is there no end?

Then too, there remain the demands constantly being made on the smaller serviceshops to stay abreast of the competition in the field of efficient business management practices. Sometimes the burden, I'm sure, seems overwhelming.

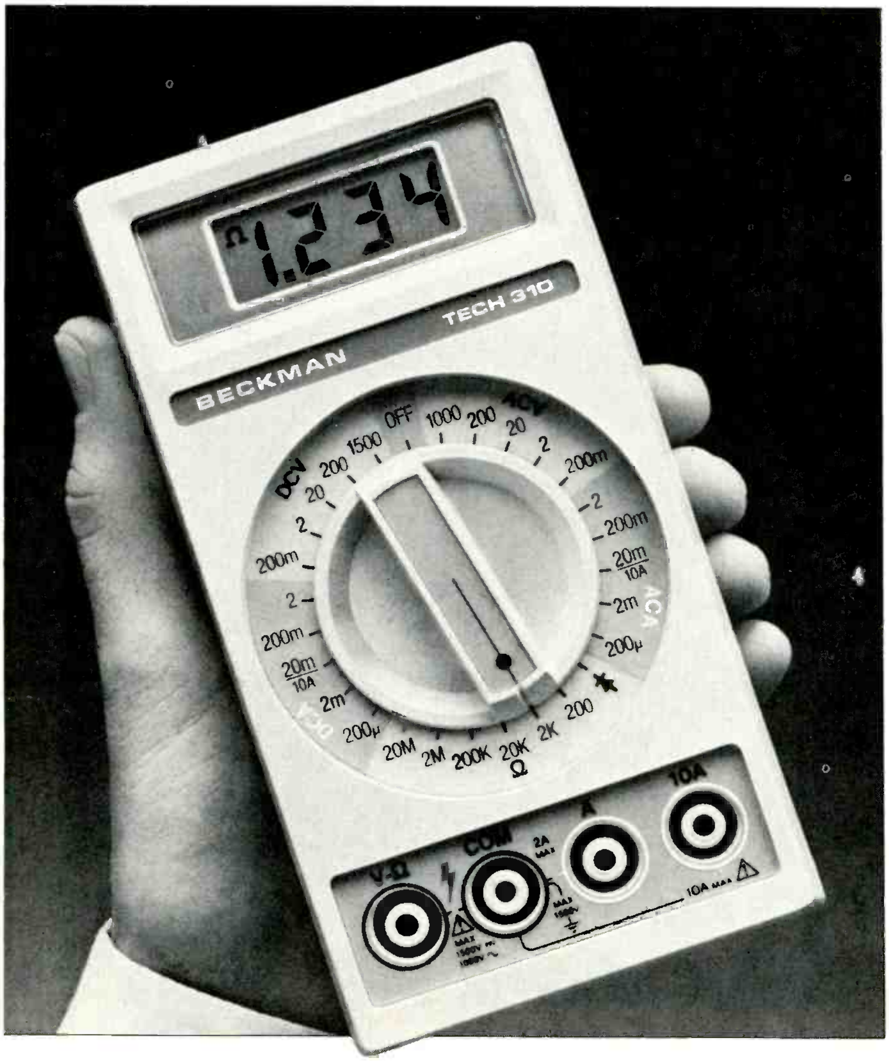
The reason I'm bringing this up is simply to make the point, if you are not solidly into digital electronics at this point in your career, you are really going to have severe problems staying in the industry as a professional technician.

If you happen to be a serviceshop owner, if you haven't allowed your technicians to acquire the digital skills necessary for survival in today's electronics world, and if you have not taken the time to plot new strategies for gaining customers and acquiring new product service lines for your business, you too are not long for this modern electronics world as a businessman.

It's very late in the ballgame. It seems to me that many people in the world around us are dozing through this lazy summer of 1980. Are you among them?

Sincerely

Richard M. Lay



LETTERS

HELP NEEDED:

I need a schematic and operating manual for a telephone answering unit which carries the following inscription on the front panel in bold letters: 24 HOUR TELEPHONE ANSWERING SERVICE, PH 332, MADE IN USA. The unit has no manufacturer identification. The four PC boards carry the label BELAIR. Hope someone can help.

Frank J. Rosato
12 Bluberry Lane
Lexington, MA 02173

Need Sams MHF23. Will purchase or copy and return. Will assume all shipping charges.

Charles Trainor
Trainor Sales
618 Van Alstyne Rd.
Webster, NY 14580

I need a schematic on "Advance" Model #SCR 4000 Portable AM/SW/FM MPX Stereo Radio Cassette Recorder.

Augustine's TV & Radio Service
530 N. 9th Street
Reading, PA 19604

HELP RECEIVED:

Am writing to thank you for your efforts in helping me obtain a FLY-144. I got several responses in reference to my letter you published and have since procured the item I needed. All of the shops that responded were more than fair in their asking price and one gent even shipped one with only a request that I reimburse him for the UPS charge. Rest assured, I always research my assets when I see something someone else may need in the "Letters" column.

C. V. "Chet" Cox
Chet's Repair Service
2260 Central Ave.
Spring Valley, CA 92077

TEKFAX

I enjoy your magazine very much and find the information contained very valuable. A check for 3 years subscription is enclosed. I would be very interested in obtaining copies of TEKFAX previous to 114. If any of your readers could help in obtaining them or if you plan any reprinting, I would be glad to pay for them.

Ed Ranalli
P.O. Box 461
Wildwood, NJ 08260 ET/D

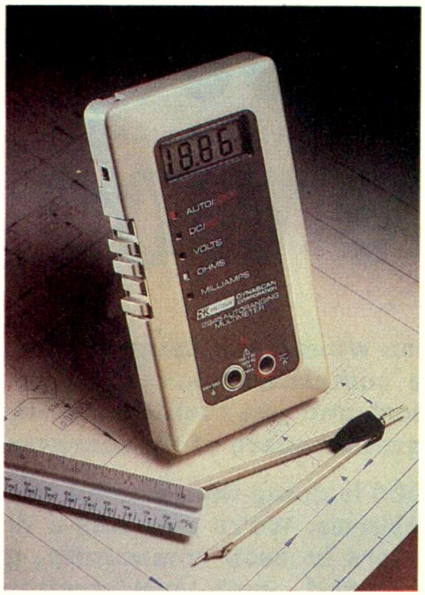
SPECIAL REPORT

Test gear of the 1980s

New products from the EDS

Large scale integrated circuit technology has invaded the test instruments field en masse, spawning a new breed of test gear with functional abilities undreamed of outside of a laboratory setting just a few short years ago. For a rundown on some of these newest units for your test bench, here's a look at the 1980 version of the Electronic Distribution Show.

By Richard W. Lay, Editor


B&K Precision's 2845. Circle no. 140

While the Electronic Distribution Show (EDS) is certainly not the largest show on the electronics circuit, the 1980 version—held recently in Las Vegas—displayed characteristics which made it one of the more important events this year—at least in relation to the consumer electronics service industry.

From the standpoint of industry, the announcement of a franchise organization—aimed at independent serviceshops (see related story page 3)—provided the conversational undertone of the event.

From the standpoint of test equipment, the 1980 version of EDS marked a definite trend on the part of manufacturers to deal with the real world of electronics as it has evolved to this point—a world of digital characteristics.

While digital multimeters have long led the rush of new test gear in sheer numbers alone, the fact they again outnumbered the new equipment shown at the show should not mask the fact that several have evolved well past the role generally assigned to, or expected of, the traditional DMM.

In other areas too, notably a new dual trace 15MHz scope from Simpson, a logic monitor from Global Specialties Corporation, and a new function generator from Simpson, the trend was clear that a growing number of eyes are focused on attacking the service problems associated with the revolutionary growth of digital/microprocessor technology.

The very important world of analog was not, however, neglected. Beckman Instruments showed its newest hand held true RMS DMM designed for working with complex waveforms up to 20KHz.

The award for the most innovative piece of DMM technology evolving out of EDS for 1980, has to go to Hickok for that company's introduction of a combination DMM/Logic state analyzer for which it really has no name. Actually more than just a DMM, it's called the MX333—and I'm quoting from company literature now—"DMM, Vari-pitch, Logi Trak."

Over and above the usual ohms/volts/diode test functions, the *Vari-Pitch* feature provides an audible tone which changes pitch in proportion to the ohms, volts, current, or diode test input level. This, Hickok says, will permit troubleshooting by ear without taking your eyes off the circuit being analyzed.

Combined with the *Logi-Trak,* the MX333 can be used for digital circuit troubleshooting. Just connect a 10:1 high frequency scope probe to find high and low logic levels and positive or negative pulses, as narrow as 5nSec, according to the manufacturer. With a basic .1% accuracy and a 10 amp range, the MX333 is priced at $235.

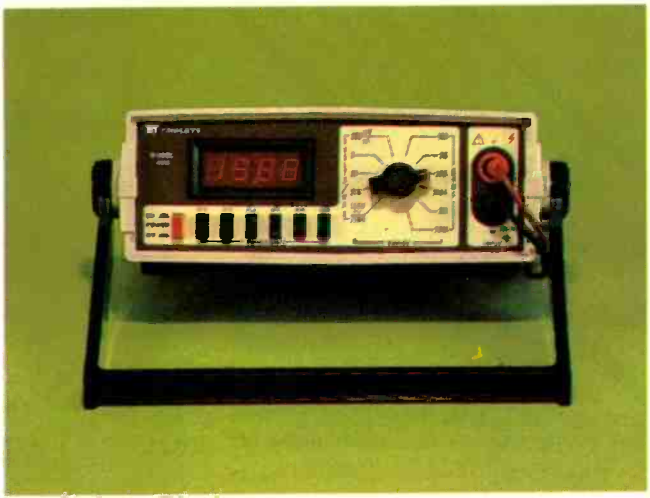
NLS, meanwhile, is out with a completely "touch" operated DMM which they call the *Touch Test 20.* This unit measures 10 electrical parameters, has 20 functions and 45 ranges.

Included are temperature readouts for Fahrenheit and centigrade, conductance, and capacitance. The meter incorporates membrane switching.

B & K Precision's newest entry into the field is an autoranging hand-held that the manufacturer says is the industry's first microcomputer-controlled DMM at a price comparable to that of conventional DMMs.

The model 2845 is designed around a four-bit microcomputer chip. All the user does is select volts, ohms, or milliamps

Hickok's MX-333. Circle no. 141



Model 4000 by Triplett. Circle no. 143

The WD 747 from VIZ. Circle no. 142

operation and the 2845 does the rest. The unit connects to the circuit under test where the input signal is converted into a scaled DC voltage for processing by the A/D circuit. The converted information is then stored in RAM, permitting the microcomputer to analyze the data and select the proper range that will provide the greatest display resolution. Additionally the 2845 has a special range lock feature permitting the user to remain in a given range. Should overrange occur, the unit automatically provides an indication.

Another of the truly innovative hand helds shown in the DMM category is VIZ's WD-747. What makes this device especially noteworthy is a transistor gain function. By activating this function and placing a transistor into the front panel socket, a direct digital readout of the gain on the LCD display is obtained. For $89.95 the bright orange unit has side buttons for one-hand operation, resolution to 100 microvolts, accuracy of .8%, dc input impedance of 10 Megohm, auto polarity, auto decimal and full overload protection.

Another noteworthy DMM has entered the field from Beckman Instruments. Beckman has extended its Tech 300 series to the Tech 330, a 3½ digit unit similar in packaging and function to the Tech 310, but oriented toward work with complex waveforms and directed toward audio applications.

This unit which sells for $200 carries a basic .1% accuracy and a 22 megohm input resistance. The instrument is designed to measure true RMS voltage on non-sine waves as might be found in switching power supplies, motor speed controllers, SCR regulators or digital systems.

The manufacturer reports all AC voltage ranges have guaranteed accuracy specified to 20KHz for signals with crest factors of 1:1 to 5:1. Measurement accuracy is said to extend from plus or minus .6% of reading at 45Hz to plus or minus 2% of reading at 20KHz.

Triplett Corporation has announced a brand new bench top—yet light (3½ pound)—3½ digit multimeter. Designed for AC operation, the Model 4000 carries .43 inch LED display, overload protection to 1000 volts on all ranges, six functions with a basic .2% accuracy, 31 ranges and selectable hi and lo power ohms on all ranges.

The meter is pushbutton operated with a single rotary range selection switch and only two recessed input jacks. It retails for $235.

Contending closely with Hickok's MX333 for honors for product innovation is an instrument impressive both because of its basic features and its expansion capabilities, International Instrumentation's μ-C-Probe. The basic instrument, priced at $299.95 is a microprocessor controlled capacitance meter with a measurement range of from 0.1pf to 100F—that's right 100 Farads, if you can find any capacitor that large—and 0.1% accuracy. It also measures dielectric absorption and leakage and is auto ranging. When options are added, up to 16 sets of tolerance limits can be used simultaneously for sorting, making it particularly useful for incoming inspection and quality control. International Instrumentation also offers the lower priced C-Probes I and II which are used to make capacitance measurements with frequency counters.

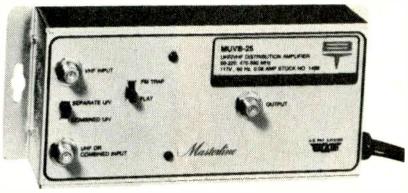
The Simpson Electric Company introduced two new products at the Show, the Model 454 15MHz dual trace scope and the Model 420 function generator.

The scope, which retails for $675, is a state of the art unit with IC components. Differential vertical amplifier stages give it wide bandwidth which the company says provides a smooth roll off through 30MHz. The unit displays channel A, B, A and B, and has add and subtract capabilities. A .5V 1 KHz square wave is used for calibration purposes.

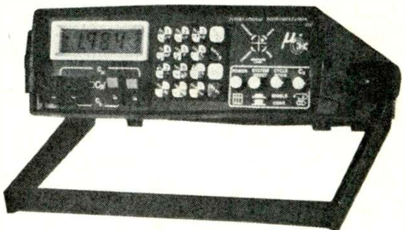
Simpson's Model 420D is a function generator designed for AC or DC (four "C" size batteries) operation. This unit, retailing for $210, provides sine, triangle and square wave outputs, plus DC and TTL logic over a frequency range of .1Hz to 1MHz. Signal amplitude is 10V p-p into a 600 ohm load with continuous attenuation from zero to 30db. A fixed attenuator selects 0 or minus 30db.

Global Specialties Corporation also showed two new pieces of test gear at the show, the Model 4401 Frequency Standard for calibration purposes and its Model LM-3 Logic Monitor, which Global Specialties says fills the need for digital test instrumentation less complex than

The model 420 generator from Simpson. Circle no. 144

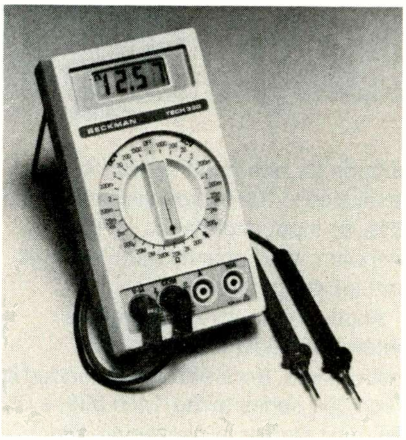


Blonder-Tongue's Masterline series. Circle no. 145

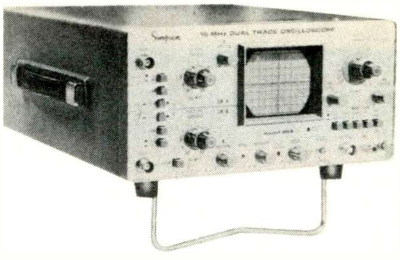


International Instrumentation's μ-C Probe. Circle no. 146

A solid state power supply from Sylvania. Circle no. 147



Bechman's Tech 330. Circle no. 148



Simpson's new dual trace, the 454. Circle no. 149

logic analyzers, yet still more than the traditional logic probe.

The frequency standard, Global Specialties says, can be used as a time or frequency standard for timebase calibration or as a clock source for microprocessors. It sells for $199 and provides a continuous 10MHz output, or 24 selectable outputs from .1Hz to 5MHz. It also has standard TTL square waves that can drive 10 loads and is designed to be short circuit proof.

The LM-3 Logic Monitor is really a new type of test gear totally dedicated to the digital environment. Global Specialties has been a pioneer in this field for several years now and I think it is safe to say this is the type of equipment we are going to see more and more of as we move further into digital device worlds.

The Logic Monitor is a 40 channel "policeman," capable of monitoring 40 selectable logic points simultaneously. Its three operating modes permit it to follow data, latch on the first trigger only, or to latch and then update succeeding triggers. The logic high threshold voltage is selectable and can be varied from -5V to +10V. Global Specialties says this unit is capable of capturing 100nSec. speeds.

Connection to the circuit under test is via clips attached to a 40 conductor ribbon cable that plugs into a front panel connector. The unit's trigger input is via BNC connector and a slope switch permits the user to trigger on either the rising or falling edge of a pulse train.

PTS Electronics showed an engineering model of its soon to be released field strength meter. The meter features 13 position detent VHF tuning and 70 position detent UHF. Designed for either AC or DC operation, the unit, called the Mark 12, has a detachable AC line cord and self contained nicads that automatically recharge whenever the unit is plugged in. It also features an automatically damped meter and is calibrated in both microvolts and decibels.

Among the items shown by RCA's Distributor and Special Products Division was the Mini State TV antenna system for homes and vehicles. The saucer shaped 21 inch diameter radome is an undirectional UHF/VHF antenna system. A weather and dust proof antenna rotates inside the radome and a remote control unit is provided to search out the strongest signal.

Blonder Tongue Laboratories showed its new Galaxy series of preamps for home use, its Masterline Distribution amplifiers for small to medium signal distribution systems, and its Starfire series.

The Galaxy series consists of mast mounted preamps and indoor post amplifier/power supply. Masterline has an internal FM trap and Blonder Tongue's patented inductively coupled emitter feeback circuit for increased input capability. The Starfire series is intended for home or showroom use.

GTE Sylvania showed its SYL-OS-3AR power supply. The unit is a 12 volt supply rated at three amps. Designed for use in powering vehicular amateur radios, tape players, AM-FM radios, CB and other similar equipment. It features darlington outputs, full wave bridge rectification and is fully protected against overload conditions through a ¾ amp primary fuse in the rear panel.

Also on display by Sylvania was an updated version of its Solder Sucker, introduced last year. The Model SS100 is a self contained power vacuum desoldering system and comes with the vacuum hose and replaceable filter, power cables, dual 40/20 watt iron with in-hand vacuum switch, an iron cradle, and two replaceable tips.

Pace also showed its newest desoldering unit, the D-Sodr System. The 7½ pound unit contains a variable AC output for temperature control, a vacuum supply, dual filtration system and the plug-in filter with an auxiliary ground lug. The D-Sodr is designed for footpedal controlled operation. **ET/D**

Hand-held computer power is here!

An autoranging DMM breakthrough from B&K-PRECISION.

B&K-PRECISION's new microcomputer controlled Model 2845 is a major advance in digital multimeter technology. At a price comparable to ordinary manually operated units the 2845 brings microcomputer intelligence to a handheld portable DMM. When applied to a circuit, its computer selects the range providing maximum resolution without the slow "hunting" action characteristic of many bench-type autoranging DMM's.

The 2845 is certainly the most user oriented hand-held DMM available. No other DMM can match its speed and simplicity of operation. With tilt stand, large display and optional AC power adapter, it becomes a remarkable inexpensive bench DMM.

- Microcomputer autoranging speeds operation and stabilizes readings
- Auto-skip program for best resolution in least time
- Easiest, fastest-to-use DMM available
- 0.1% basic DC accuracy
- 3½ digit, 0.5" LCD display
- Continuity test "beeper"
- Range-lock, holds selected range
- Measures AC/DC voltage; AC/DC current; resistance
- Meets tough U.L. 1244 safety standards

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Auto sound: The new breed of tuners

They're all electronic now

If you haven't looked inside an auto radio lately you're in for a big surprise. No more PTM inductance tuning, the new breed is all electronic. And that's not all, they even have computerized features that place them in the ranks of high technology electronics.

By Joseph J. Carr, C.E.T.

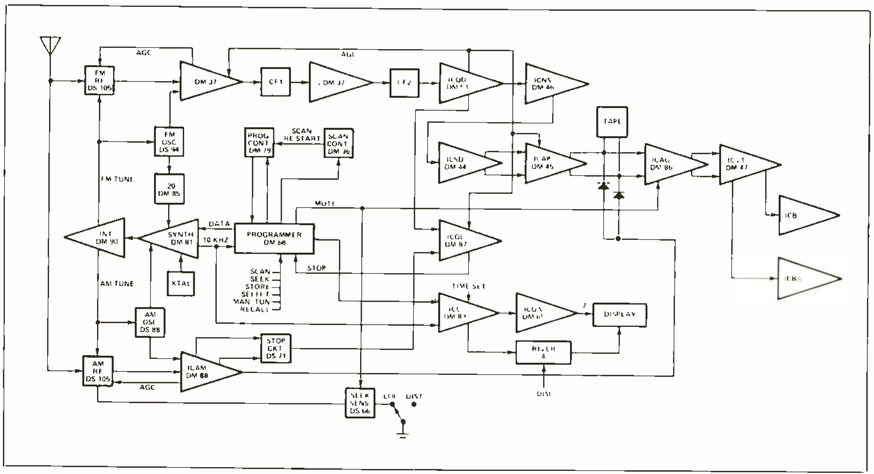


Fig. 1 Block diagram of an all electronic signal seeker car radio by Delco.

Auto radio tuners have been mechanical for several decades. The typical car radio made since the end of World War II has used a *permeability tuning mechanism* (PTM) in which the capacitance portion of each LC tank circuit was fixed, and the inductance was varied as the radio was tuned. This is exactly the opposite of the method used in home radios. The PTM was adopted because of the ease of making a pushbutton system work. The straight line motion of the coil slugs was easier for the pushbutton tuner designer to tame than was the rotating motion of a variable capacitor.

But the auto electronics industry today has changed. The newer technologies are catching up with old designs, and car radio technicians are seeing some startling and interesting circuits. Once regarded as simple devices, requiring little special training or knowledge, the car radio of today is a high technology product that can complete complexity-wise with anything on the market.

One of the first stabs at designing an electronic tuner came a few years ago from Philco-Ford. They designed a varactor (i.e. variable capacitance diode) tuned FM circuit. The tuning voltage was derived from an oscillator operating in the range between 100 KHz and 500 KHz. The inductor for this oscillator varied the frequency, and it was part of the PTM used for the AM section. There was a circuit in those radios that would rectify the VLF oscillator output and convert it to a DC voltage that varied more or less linearly with the frequency of the oscillator. This voltage, then, could be used to tune the radio.

Varactors are now available in production quantities that will tune the AM, as well as FM, band. This, coupled with the availability of some high technology MSI and LSI integrated circuits, has led to the all electronically tuned auto radio. Both Chrysler and General Motors offer these models.

Figure 1 shows the block diagram for the Delco all-electronic signal seeker (SS) car radio. The old mechanical SS radio used a PTM, and a traveling rack mechanism to drive the tuning cores forward. This seeking tuner contains no moving parts, and is all-electronic.

The FM section of the all-electronic radio uses a DS-105 MOSFET RF amplifier transistor, followed by a DM-37 balanced mixer IC. The local oscillator signal is generated by the DS-94 bipolar transistor. The FM IF amplifier section is also contained within the DM-37 IC. FM IF bandwidth filtering is provided by ceramic filters CF1 and CF2. Delco has been using such filters for about a decade, and were one of the first manufacturers to do so. The FM demodulator is the DM-51 IC quadrature detector.

The AM section is also based on an IC: the Delco DM-88 IC AM radio chip.

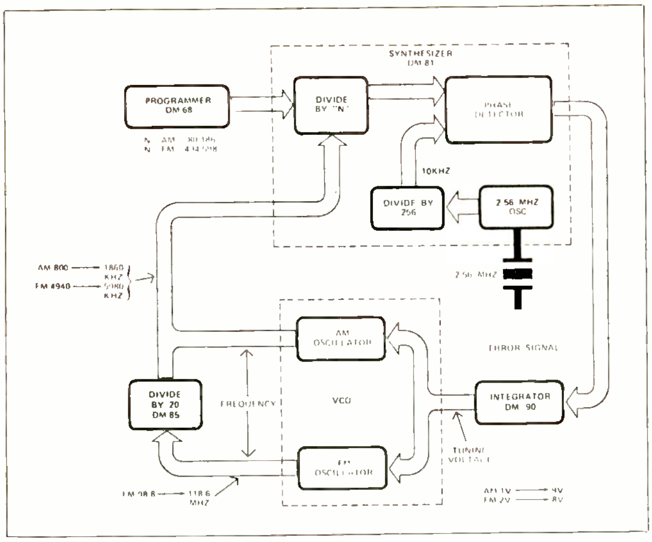


Fig. 2 The tuning system block diagram

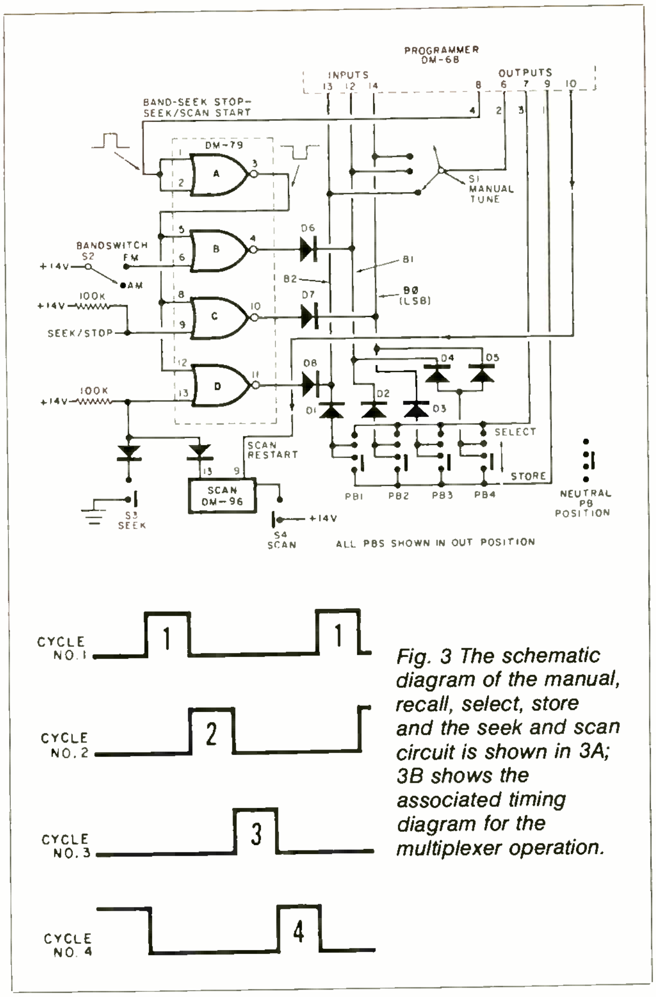


Fig. 3 The schematic diagram of the manual, recall, select, store and the seek and scan circuit is shown in 3A; 3B shows the associated timing diagram for the multiplexer operation.

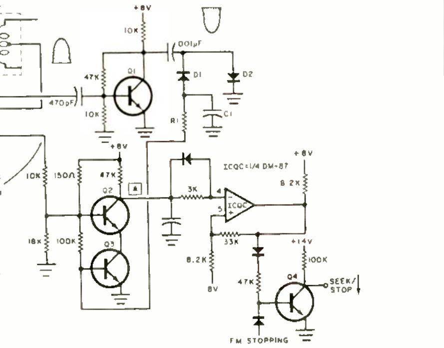


Fig. 4 Schematic of the FM stop circuit

The AM RF amplifier is untuned.

Tuning control for both AM and FM is controlled by a phase locked loop (PLL) and a *digital programmer* IC that thinks it's a computer.

Electronic signal seeking

Figure 2 shows the block diagram for the all-electronic signal seeking tuning system used by Delco. There are four main sections to this circuit: the digital programmer (DM-68), the synthesizer (DM-81), the integrator (DM-90) and the AM/FM local oscillators. These local oscillators are voltage controlled oscillators (VCOs). The DC tuning voltage is generated by the DM-90 integrator using the output of the DM-81 synthesizer. The integrator output is 1 to 9 volts on AM and 2 to 8 volts on FM.

The DM-81 contains a phase detector, divide-by-N counter, a divide-by-256 counter, and a 2.56 MHz crystal oscillator. The divide-by-256 circuit reduces the 2.56 MHz oscillator signal to 10 KHz, and this signal becomes the reference for the PLL, against which samples of the AM and FM local oscillator signal are compared. The AM local oscillator signal is applied directly to the divide by N stage in the DM-81, but the FM LO signal is first divided by a factor of 20 in a DM-85 IC. The input to the divide-by-N counter, then, will be 800 to 1860 kHz on AM, and 4940 to 5980 kHz on FM.

The purpose of the divide-by-N stage is to divide the input frequency from the VCO's down to the 10 KHz range so that it can be compared with the 10 KHz reference signal. When the radio is perfectly tuned, these frequencies will match. The division ratio N is determined by the DM-68 programmer, and is sent to the synthesizer in the form of a binary code. This binary code is created by the tuning commands given to the programmer by the user. But more of that later. If the output of the divide-by-N counter and the reference frequency (10 kHz) are the same, then the phase detector's output is near zero. When the station is changed, the DM-68 programmer responds by generating a new N-code and the output of the divide-by-N counter will no longer by 10 kHz. The phase detector will then begin to output pulses with a width that is proportional to the difference between the reference frequency and the divide-by-N counter output. These phase detector output pulses are integrated by the DM-90. The integrator output voltage will now change in a direction that will pull the VCO to the new frequency.

All tuning in this radio is controlled by the DM-68 programmer IC. It will recognize and respond to the following modes of operation: manual tune, select, store, seek, scan and recall.

The manual-tuning mode allows the operator to select a station manually with the knob on the radio's front panel.

The recall mode affects only the digital display. Ordinarily, the station frequency is displayed only on initial turn-on, when a new station is selected, and when the *recall* button is pressed. At all other times, the digital clock data is displayed.

The select and store modes have to do with pushbutton operation. The store mode stores in a register in the DM-68 the N-code of the station being received. When one of the four selector buttons is pressed, the N-code stored in the register for this button is recalled and fed to the divide-by-N counter in the PLL to tune the radio to the selected station.

Seek and scan

Seek and scan are similar functions; both are automatic seeking tuner modes. In the seek mode, the tuner will advance to the next higher frequency station and stop. In the scan mode, on

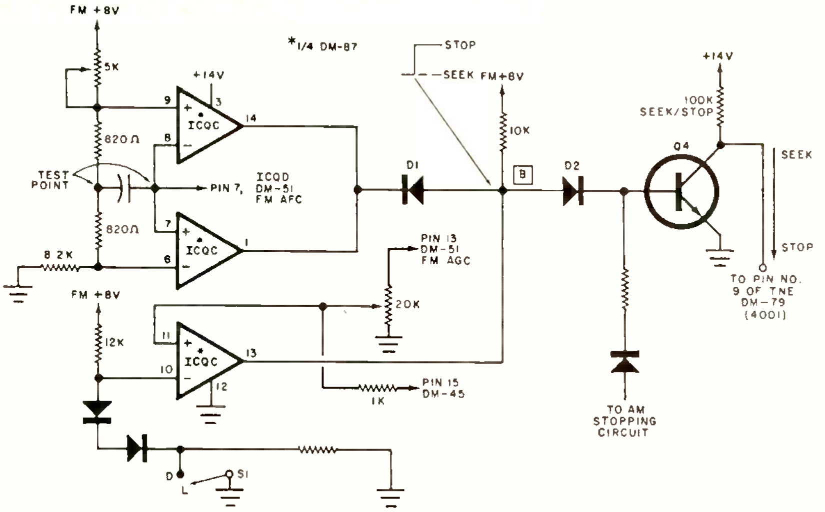


Fig. 5 Schematic of the AM stop circuit

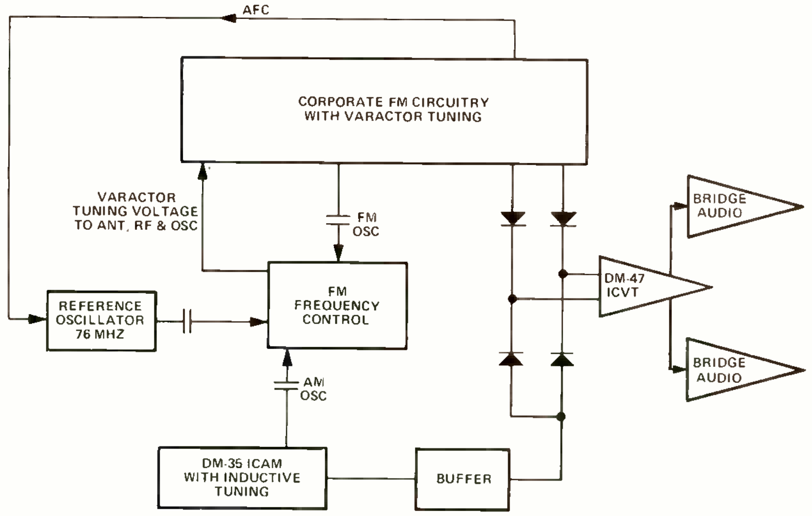


Fig. 6 This diagram of a low cost electronically tuned system uses a local AM oscillator to derive the tuning potential for the FM section.

the other hand, the tuner stops at each active station for about 5 seconds and then goes on to the next station unless the scan command is cancelled by the operator. This mode allows the operator to survey all of the stations in his reception area before deciding on the one to listen to.

The DM-68 control circuits that provide these different modes of operation are shown in Fig. 3. There are two data buses for the DM-68: a 3-bit input bus and a 4-bit output, or control, bus. The output bus lines are normally LOW, and will go HIGH when active. Each line will become active in sequence (Fig. 3B) at an 80 Hz rate. Each of these cycles, numbered 1-4, controls one of the four tuning modes.

Cycle No. 1 controls the operation of the front panel pushbuttons in the store mode. When a pushbutton is pulled out, a switch will engage the store function. Pressing the button all the way in activates the select function. When the button is neither pressed in, nor pulled out, the button is dormant.

The DM-68 knows what to do by monitoring the data applied to the input bus during each cycle of operation. If a station is to be stored on, say, pushbutton PB2, then the operator will pull out PB2. When output line No. 1 goes HIGH, a HIGH condition is passed through isolation diode D2 to bit 2 of the input bus. The DM-68 sees an input code of 010. which it decodes as a command to store the N-code of the station presently being received in the register that is set aside for PB2. The store codes for the different pushbuttons are: 100 (PB1), 010 (PB2), 001 (PB3) and 011 (PB4).

Cycle No. 2 controls the manual tuning of the radio. This radio does not have a PTM, all tuning is electronic. The manual tuning shaft on the front panel rotates a specially designed three-prong switch (S1) that is always connected to at least one of the input lines. Different positions of S1, however, will create different codes on the three input lines. When output line No. 2 goes HIGH, the DM-68 will examine the three-bit input line to see if the data is the same as it was on the immediate previous cycle No. 2 period. If no change has taken place, then the DM-68 will take no action. But if the current cycle No. 2 code is different from the preceding code, then the DM-68 sees a new data word. It will then decrement or increment the N-code delivered to the PLL, depending upon the *direction* of the change made by the tuning knob. This examination by the DM-68 takes place in 4/80 (50 mS) second, so it is unlikely that the operator can "outrun" the DM-68 by turning the tuning knob too fast!

Cycle No. 3 is the opposite of cycle No. 1. It selects the stations stored in the registers of the DM-68 if one of the pushbuttons is selected. Again using pushbutton No. 2 (PB2) as the example, if PB2 is pressed, the code that appears on the input bus during cycle No. 3 is 010.

Cycle No. 4 controls the bandswitching between AM and FM, and all of the automatic seeker functions. This cycle is controlled by a DM-79 CMOS NOR gate (which is probably a 4002 in a Delco package). Each section of the DM-79 is a two-input NOR gate, and there are four sections. Section A inverts the DM-68's cycle No. 4 pulse and applies it to one input of each of the remaining gates. This enables the gates during cycle No. 4. When the inverted cycle No. 4 pulse goes LOW (i.e. active), it enables sections B, C and D of the DM-79/4002.

AM or FM

Different N-code ranges are required for AM and FM operation. Bandswitch S2 makes the remaining input of gate B high for FM, and LOW for AM. The DM-68 tells which is selected by looking at input line B1 during cycle No. 4. If B1 is LOW, FM is selected. But if B1 is HIGH, then AM is selected.

Seek and scan functions are controlled by gate D. The input (pin 13) of this section is normally HIGH. If it drops LOW, then the DM-68 initiates seeking action. The scan circuit also causes pin No. 13 to drop LOW. But it contains a 5 second RC timer to produce the scanning action described earlier. The DM-68 initiates a seek/scan if B2 is high during cycle No. 4.

Seeker stopping is controlled by gate C of the DM-79/4002. This gates remaining input (pin No. 9) is normally held HIGH, but will drop LOW if the stop circuitry indicates that a station is tuned in. The DM-68 recognizes this command by a HIGH on input B during cycle No. 4.

The AM and FM stop circuits are shown in Figs. 4 and 5, respectively. In both cases, transistor Q4 is the seek/stop switch that is connected to NOR gate C in the previous figure. The collector of Q4 is pulled up to +14 volts DC. This means that the collector of Q4 will be HIGH when Q4 is turned off, and LOW when Q4 is biased on. The collector of Q4 is HIGH normally, and will drop LOW when a stop command is to be issued.

The AM stop circuit uses an IC comparator whose noninverting input (+) is biased by a +8 volt DC power supply. Two signals, the 262.5 KHz AM IF signal and a DC AGC voltage, are used here. Transistor Q1 amplifies and inverts the IF signal, which is then rectified by diodes D1 and D2 and filtered to a DC level by the RC network of R1 and C1. The DC voltage from R1 is applied to the base of transistor Q3.

Transistors Q2 and Q3 operate as an AND gate, which means that *both* transistors must be forward biased for *either* to conduct. The collector of Q2 (point A) remains HIGH unless both Q2 and Q3 are turned on. The AM AGC voltage turns on Q2, and Q3 is controlled by the voltage from R1. When both of these conditions are met, point A goes LOW and forces the output of the comparator HIGH. The HIGH output of the comparator turns on Q4, stopping the seeking action.

FM stop circuit

The FM stopping circuit is shown in Fig. 5. This circuit uses the three remaining sections of the quad comparator. Two sections of the comparator are used in the classic "window comparator" circuit that requires the input voltage to remain within certain limits, or an output is generated. The window comparator examines the FM AFC voltage generated by the FM detector. The AFC must be within the window, indicating that the radio is tuned to the center of the FM station. If the AFC criterion is not met, indicating incorrect tuning, then the cathode end of diode D1 (B) is held LOW.

Point B is also controlled by the FM AGC through the last comparator section. If the station has insufficient signal strength, then reception will be noisy, and the stereo decoder may drop in and out, creating a disturbance familiar to owners of FM car radios. The AGC voltage on pin No. 11 of the comparator must exceed the reference potential on pin No. 10. If this condition is not met, then the output of the comparator (pin No. 13) remains LOW, and this will keep point B LOW also. A local/distance switch (S1) changes the reference on the comparator to allow for differences in average signal strength on the highway and in closer to cities.

If both the AFC and AGC conditions are met, then the outputs of all three comparators are HIGH, forcing point B to go HIGH also. This condition will forward bias diode D2 and turn on switching transistor Q4. The collector signal from Q4 is the stop signal applied to pin No. 9 of the DM-79 NOR gate.

The Delco all-electronic tuners, and all-electronic signal seeker radios, were built beginning in 1978 and will probably be around for the 80s.

There is one other class of electronically tuned car radio in Delco's line. The Chevette radio block diagram shown in Fig. 6 is a low cost electronically tuned system. It is similar in philosophy to the early Philco-Ford design. But instead of deriving the tuning potential for the FM section from a special VLF oscillator, it uses instead the AM local oscillator. There is a 76 MHz reference oscillator, and a PLL frequency control section. The FM LO is compared with the correct frequency from the reference, and is corrected by the varactor tuning voltage. This radio can be identified in Chevettes because the AM and FM dials on the front panel do not exactly overlap, as they normally would in totally PTM tuned radios.

I do not usually like to use these pages to "plug" any one manufacturer, but Delco Electronics does such a good job of preparing a service manual (*very* welcome in any case, but especially in high technology products like the ETR) that it deserves recognition. It is my recommendation that you contact the Delco Wholesale parts distributor in your area and buy a Delco service manual for the radios being serviced. These manuals are usually moderately priced for non-Delco warranty stations, and are well worth the investment. **ET/D**

Interpreting service management data

The raw material for profit

Collecting the raw material from a service business and putting it to effective use is the service manager's responsibility. For an inside look at how to collect it, how to manipulate it, and how to squeeze greater efficiency out of your operation, here are some tips from one of the recognized experts in the industry.

By John Gooley

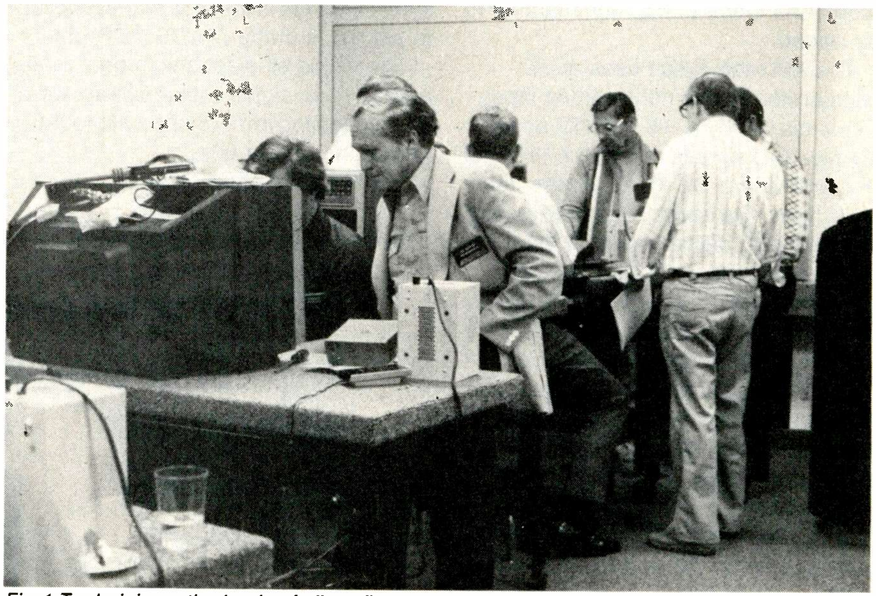


Fig 1 Technicians, the basis of all profits generated in a service environment. Gathering and interpreting the data generated by them is the key to your success as a manager.

All of the wealth in the service industry is created by the technician working on equipment for money. Parts sales are incidental, they come as a matter of course. The real key to success . . . virtually the only key . . . is the productivity of technicians.

This is a basic concept, and a simple concept. Yet I am disheartened by how few managers make this concept a vital part of their lives. The profitability of the operation, the satisfaction of the customers, the continued existence of the business, the morale of the organization, and the economic well being of each employee and every member of his family is directly dependent upon how much time the technician spends productively.

The concept of productivity is like the concept of wrestling alligators. When you climb into the pool with an alligator, your concentration is going to be intense. Every factor of your well being well be riveted on that monster. You look for every advantage, parry his every move. If you don't, you will die.

This is the kind of concentration the manager must give to productivity. He must be alive to every aspect of it, looking for every advantage, parrying every move. Otherwise, the business will die. This is not new to anyone. We all know that productivity is important, that the money comes from technicians making calls and working at the bench. It's just that most managers regard this as the technician's job, when in reality, it is the manager's job.

Most managers—more than half—do not keep any record of productivity.Not at all! They don't know how many calls were made, don't know how much time was spent, don't know how much money was spent, don't know how many calls were lost. They don't know, accurately, which men are good producers and which are poor.

When we fail to gather this type of information, we are getting into the alligator pool without knowing anything about the enemy we are facing—anything about his speed, anything about the power of his jaws, anything about his lethal tail.

Measuring productivity

In order to know what we are dealing

with, we have to measure the work that the technicians do. Without accurate measurements, we are guessing. And since there are more ways to be wrong than ways to be right, guessing doesn't even leave us with a 50-50 chance. Precise knowledge of the activities of the men is essential.

What You Need

A certain amount of the information that is required is plain, raw data. Among the required information is the following:

Number of calls completed
Demand calls
Warranty bill backs
Calls against warranty reserves
Calls for house warranties
Calls charged to sales department
Calls for service contracts
Shop jobs
Antenna installations
Deliveries
Calls done under contract
Minutes spent on jobs
Minutes spent for travel to jobs
Minutes lost
Labor income produced
Cost of labor (wages)
Parts income produced
Cost of parts
Not home calls
Lack part calls
Call backs

All of this information, with the exception of labor and parts costs, is immediately and easily available at the time the call is made. Most if not all of it appears on the service ticket. But the service ticket is not an easily used control instrument. Within a matter of hours, the service ticket is going to be put in a filing cabinet, and is of little use except for occasional reference.

To be useful, the information must be extracted from the service ticket and summarized. The summary is a *business control.*

The control, or summary, will tell you that your six-man crew, for instance, made 256 demand calls, 72 warranty calls, 13 calls for service contracts, 41 calls chargeable to the sales department, and 8 others. Total completes, then, were 390. In addition, there were 20 not home calls, 25 lack part calls, and 12 call backs. The total of the incompletes was 57. Total of all calls was 447. We also learn that 19,374 minutes were spent productively, 32,326 minutes were spent unproductively, out of a total of 51,700 minutes available.

It would be nice, of course, if we could have this information separately for each technician. It really doesn't matter how the information is gathered or how it is presented. It makes no difference whether the technician gathers the information or whether it is gathered by the dispatcher, or the girl that works for you, or the service manager (if you don't have better ways to spend your time), or the service manager's wife. Just so you know that the men did 390 completed calls and about 60 per cent of them were demand calls.

The raw data

This information is pure, raw data; it is the result of a series of additional problems; and is known as "Primary Data" or "Primary Source Data."

Primary Data answers some questions, like "How many calls did we make last month?" "Did John make more calls than Jim?" "Which technician put in the most time?" There are times when you may want to know these things, but Primary Data does not lend itself to easy comparison. For instance, if you by chance had access to the Primary Data of the RCA Service Company, it would be hard to draw conclusions between your experiences and theirs. What you measure in dozens, they measure in millions.

In addition, Primary Data is always isolated. When you look at number of calls completed, you see the number, but it does not tell you anything about the time involved in making those calls. When you look at time, it tells you the number of minutes, but says nothing about the number of calls made in those minutes. And those numbers tell you nothing about the amount of income generated by those calls and during those minutes.

In order to evaluate more completely and compare more readily, we turn to Secondary Data. For practical purposes, we are talking about division problems, and they are often called ratios. We take one Primary Datum and divide by another Primary Datum and we get a Secondary Datum. So if we take a Primary Datum like productive minutes and divide by another Primary Datum like completes, we get a Secondary Datum like minutes per call. (See Chart 1.)

Secondary data

There is a great deal of secondary data that is of value to the service manager, and in the area of technician productivity this includes: completion ratios, demand call ratios, warranty call ratios, service contract call ratios, sales call ratios, not home ratios, call back ratios, lack parts ratio, gross profit ratios, completes per day ratios, minutes per call ratios, and gross labor ratios.

Now the data is no longer isolated, nor is it difficult to use for comparison or evaluation purposes. If you were to have RCA Service Company's secondary data, you could easily compare your results with theirs on such items as completes per day, or call backs, or productive time.

You can compare one man in your crew to another man in your crew on the basis of any of these ratios (or indeed, any ratio that you compute). But please don't evaluate on the basis of just a single ratio. It could be very misleading. For instance, John may have a better Not Home Ratio than Jim, but if John is a bench man he shouldn't have any Not Homes at all—and similarly, his Lack Part Ratio should be better, his Productive Time Ratio should be better, and so on. The ratios do not do your evaluation for you—you still have to think.

You can compare any one man with the average of the crew. If one man is regularly and significantly poorer than the others in the crew, this constitutes a signal flag and should be investigated.

You can compare against industry averages. Such industry averages are available (for instance from NARDA, the trade association). If your figures are worse than industry averages, you may start wondering what you are doing wrong.

You can compare one man to his own past history. If a man has a good history for months, and then starts turning in poor numbers, you will probably want to know why. Does he have marital problems that are affecting his ability to concentrate? Does he have health problems? Is his nose out of joint because of a series of reprimands? Is he mad at his boss? Has the state of the art passed him by, so that he now needs training? You can compare a man to standards that you have set for him; more about that in a moment.

If it is of any consolation to you, most service managers do not get all of this data. There are three basic reasons for this:

1. The manager really doesn't anticipate using such data for managerial purposes. For those who may be faced with hiring a service manager, make sure your candidate is eager for controls.
2. The manager views the work of obtaining the controls as being overly burdensome. That's understandable too. Depending on the number of technicians, we may be talking about 1000 calculations

or more. But a thousand calculations would represent a crew of 30 technicians or more and a firm that big already cranks out this kind of data, probably on its own computer. For the smaller firm, a capable person with an electronic calculator can work these up in short order. Beyond that, a computer program has been designed and is in place right now. It will do all these calculations for you and more for just $9 per month per man. If interested, contact NARDA, 2 North Riverside Plaza, Chicago, Illinois 60606.

3. The manager is scared to death to see the results. He knows that a program like this doesn't point the finger at the technicians. It points the finger at management—and he's management.

The fact remains, you can't drive a railroad spike with a tack hammer. Productivity controls are essential for anyone who is trying to do an effective job as a service manager.

Setting goals

Once we have measured the performance of technicians and acquired a body of knowledge, the next step is to establish standards. Employees would like to do a good job, if only they knew what a good job is. A good job is based on the accomplishment of goals. The goals are set by the service manager. The goals are not meant to be left to the technician.

Seemingly, it is very easy to neglect the function of setting goals. This is not to say that there won't be any goals—it simply means that management does not want to bother to set them. So the technician sets them for himself. Since the technician's objectives are often different than management's objectives, the goals may seem a little strange: Never start a job after 3:30 in the afternoon; Always have lunch at Cal's Diner where the hot little redhead works; Never do a job for Mrs. Ogilvie because she is a crab; Always pull the chasis on a hard job and let the benchman sweat over it; Anytime you want to go to the ball game, tell the boss the customer wasn't at home.

The technician impresses the boss (and thereby keeps his job) by telling the boss what a hard day he had, asking detailed but unnecessary questions about technical aspects of the work, and telling everybody how good he is. So long as his work is, or at least appears to be, somewhat better than average, the technician's job is safe.

Goals are set by taking three factors into consideration. First, the number of calls that have to be done in order to satisfy customer demand. Second, the amount of business that must be done in order to cover the expenses and provide a profit. Third, the level of performance that may reasonably be expected of the technician.

All three of these require knowledge, which is to say, setting up the controls. The measurement of past demand will certainly provide the outer limit of the number of calls to be budgeted. Budget is not a four-letter word, but rather one of those beautiful six-letter words like income, profit, assets, tenure, and safety. While it is fairly easy to measure maximum demand, it is a little harder to measure minimum demand—because sometimes the good folks get angry and don't do business with us any more.

The measurement of required income is another budgeting process. Sorry about that. But budgeting is not really hard once you recognize that all those people who told you that "you really don't have to do those things" were wrong.

You can't expect a man to do more than he is capable of. The one thing you can depend on, though, is that he will do less than he is capable of. If he does less than he is capable of, it is not his fault, it is yours!

CHART 1

Completion ratio = $\frac{\text{completed calls}}{\text{total calls}}$

Demand Call ratio = $\frac{\text{Demand calls}}{\text{total calls}}$

Warranty call ratio = $\frac{\text{warranty calls}}{\text{total calls}}$

Service contract ratio = $\frac{\text{contract calls}}{\text{total calls}}$

Sales calls ratio = $\frac{\text{sales calls}}{\text{total calls}}$

Not home ratio = $\frac{\text{Not home calls}}{\text{total calls}}$

Call backs ratio = $\frac{\text{Call backs}}{\text{total calls}}$

Lack Parts ratio = $\frac{\text{lack parts calls}}{\text{total calls}}$

Productive time ratio = $\frac{\text{Productive Time}}{\text{total time}}$

Cost per call ratio = $\frac{\text{wages}}{\text{No. of completes}}$

Income per call ratio = $\frac{\text{labor income}}{\text{No. of completes}}$

Gross profit ratio = $\frac{\text{gross profit on labor}}{\text{No. of completes}}$

Completes per day ratio = $\frac{\text{completes}}{\text{days worked}}$

Minutes per call ratio = $\frac{\text{Productive minutes}}{\text{completes}}$

Gross labor ratio = $\frac{\text{labor income}}{\text{wages}}$

Performance levels

The capable manager will take each of the Secondary Data and establish three levels of performance:

Acceptable. If the technician fails to reach this level, you should congratulate him on his early retirement. It is not every man who can retire at the age of 26. If his work is acceptable, he gets to hang around the big boys, but nobody is going to cry when he leaves.

Normal. If he reaches this level, he is doing his job. The company will make money and so will he. The work will get done and customers will be satisfied. The boss would hate to lose a man like this.

Outstanding This is what is is all about. The man has not only the complete confidence of the boss, but of many customers as well. He serves as a fine example to all the others in the crew.

Losing a man like this is like losing a right arm.

We are not quite done yet. The goals become part of the job. If the goals are not accomplished, the job isn't done. So you make the goals a part of the job.

This means, first of all, that the goals are written into the job description. From the day of the first interview, the candidate knows what is expected of him. If a man cannot, or will not, work to these goals, he is quite free to go look for another sucker to hire him.

Though it should not be necessary to mention this, the manager must constantly measure the men against the goals. Some items are measured daily —number of completed jobs, for instance, or amount of labor income generated. Some are measured weekly.

But all of them are measured monthly. Of course. Technician time is priceless. If something has gone awry, you need to know it promptly, so you can begin taking the steps necessary for improvement. Communicate the comparisons to the men . . . but not for the reason you are likely thinking. The technician himself is responsible for a minimal amount of productivity. If he is wasting time one way or another, that is something that will pull down productivity, and it is entirely within his province to correct. So remind him.

Most of the failure to produce stems from poor management. It is the manager's responsibility to see that the truck is stocked right to avoid Lack Part calls, the manager's responsibility to train technicians in order to reduce Call Backs, the manager's responsibility to reduce Not Homes, the manager's responsibility to route and dispatch properly.

We share our comparisons in order to get feed back, so that basic problems can be corrected, so that the technicians have a climate in which they can become productive.

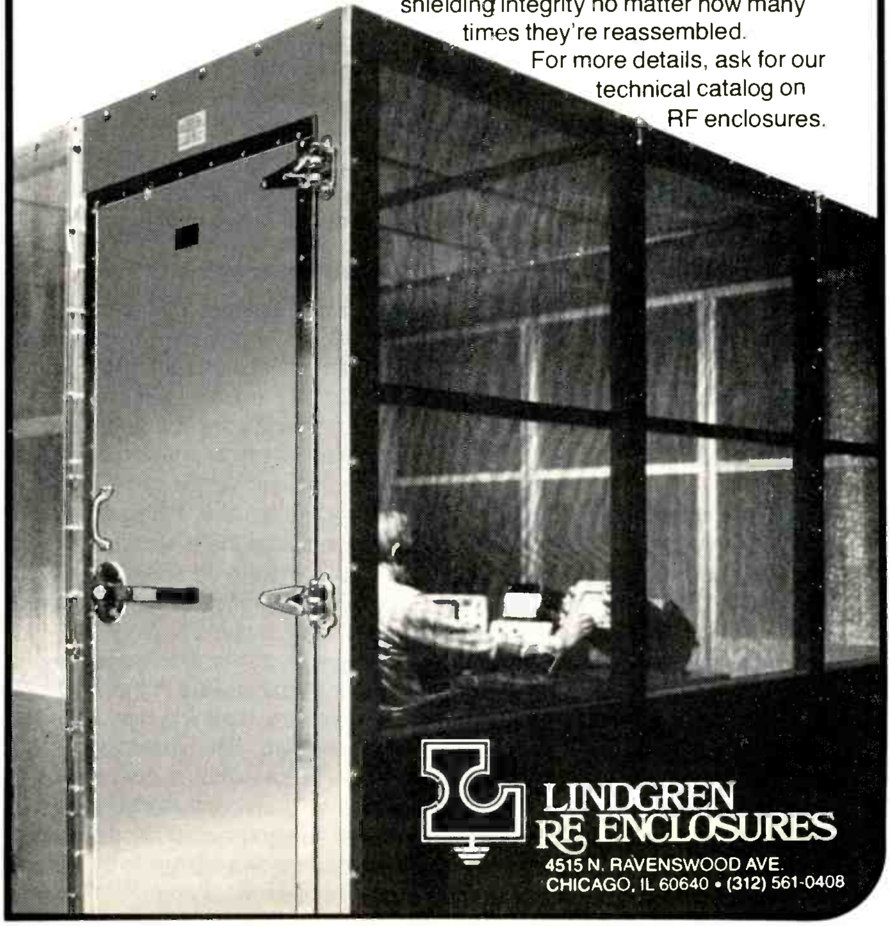
If a man doesn't work up to the standard, we let him know that we noticed, that we are aware. And we probe for additional knowledge. We ask him, "What happened on that Novak job?" or "How long has it been since we looked at your parts stock?" Most of the time, when the technician fails to meet goals, there is something that management could be and should be doing.

We post the results on the bulletin board, so that everybody can see what is going on. That's a good idea, right? Everybody will see how he stands and he will be embarrassed into doing a little better. Right? And that's fine. But remember, the manager's performance is right up there in those same figures, letting the whole world know what his performance is too. The figures do belong up there, but I guess it is only fair that you know why.

Finally, you counsel with each man, individually and privately. There are a lot of things that go on in such a conference, but one of the main ones is to evaluate performance and decide how the two of you, working as a team, are going to improve performance.

Oops . . . for those of you who report to top management, there is one more thing. The evaluations go up there, too. The boss is going to be reviewing the department's performance, and his service manager's performance. Remember, the measurements, the standards, the performance against standards, are the language between the service manager, and top management.

One of the more effective writers in the field of management, a fellow by the name of Ralph C. Davis, opened one of his books with a statement that can give us all food for a great deal of thought: "The adequacy of the group is measured by its ability to accomplish its objectives." **ET/D**



Zenith's power sentry and sweep systems

New circuits for old tasks

Zenith's System 3 9-160 module carries some very unique circuitry to accomplish the tasks of high voltage regulation and horizontal deflection. The key is a pulse width modulator that reacts to line voltage variations. Here's how it works.*

By Robert L. Goodman, CET

All of these new Zenith circuit features are located on the 9-160 module that can be repaired or the module can easily be replaced. The 9-160-03 module is used in the 13, 17, and some 19 inch screen size sets. The 9-160-04 module is found in most 19 inch sets and all 25 inch screen size receivers. As we look at and see how to troubleshoot some of these very complex and unique circuits you may wish to refer to the complete diagram of the 9-160-03 module that is shown in (Fig. 1). This self-regulating horizontal sweep and power system provides AC line and load regulation without using a power transformer and is thus called an ELECTRONIC POWER SENTRY.

A block diagram of this ELECTRONIC POWER SENTRY system is illustrated in (Fig. 2). A line operated 150 Volt DC power supply provides the energy to a horizontal pulse locked chopper. The chopper regulates the voltage and drives the sweep and High Voltage transformer with a constant pulse. The HV transformer also supplies all the regulated voltages to the rest of the set with a scan rectification scheme.

The "key" to the new regulation system is the pulse width modulator (PWM). The line and load voltages are sensed by the PWM which controls the chopper rate by varying the "on time" of the chopper, and therefore, the supply voltage.

The main point to keep in mind when servicing this chassis is that the voltages for operating the entire set are derived from the sweep transformer. The necessary voltage for the set's initial operation is +15 volts DC which is derived from the AC line via the bridge rectifiers and is supplied until the horizontal sweep stage starts up.

Circuit operation

As the block diagram indicates, the 150 volts DC B+ is regulated by the pulse width modulator and horizontal output transistor: As the B+ increases, the PWM decreases the "on time" of the horizontal driver, decreasing the stored energy and keeping the sweep voltages constant. As the B+ decreases, the PWM increases the driver "on time," increasing the stored energy and maintaining a constant voltage at the sweep stage outputs.

As we look at (Fig. 3) let's see how the chopper circuit is used in the electronic power system. Note the basic chopper circuit diagram. The block diagram shows a pulse-width-modulated energy storage step-up converter/regulator. The AC line connected bridge rectifier and filter provide a voltage to the primary of the chopper transformer TX3301. The horizontal output transistor, QX3326, which is in series with the primary of TX3301, controls the stored energy by varying the "on time" inversely to changes in B+. If the B+ increases, the "on time" must decrease, to maintain a constant current level. For a constant energy, current must be constant. The secondary winding of the transformer provides the step-up and phase inversion. During conduction of the transistor QX3326, the polarity across the secondary is minus to plus. The negative voltage at the anode of the load diode CR3308 prevents its conduction.

After the QX3326 transistor turns off, the voltage on the primary reverses. Thus, the secondary voltage also reverses, forward-biasing the load diode CR3308 and charging the load capacitance. The voltage at the load capacitance is sensed and fed back to the Pulse Width Modulator (PWM) ICX3301. The PWM varies the base drive inversely proportional to the load voltage variations. This in turn provides the regulated load voltage. The peak "off" voltage of the transistor is also inversely proportional to the "on time."

Self-regulated sweep

The circuit shown in figure 4 is a simplified representation of the self-regulator.

In the combined circuit, the transistor is removed from the sweep circuit, and will now operate as a chopper transistor. The load diode CR3308 is returned to the retrace capacitance. Since the driver power is supplied by the load diode, the B+ at the sweep decoupling capacitor, C3321, is not required. Since the chopper and sweep operate through a

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Illustrations 1 through 7 Courtesy Zenith Radio Corporation

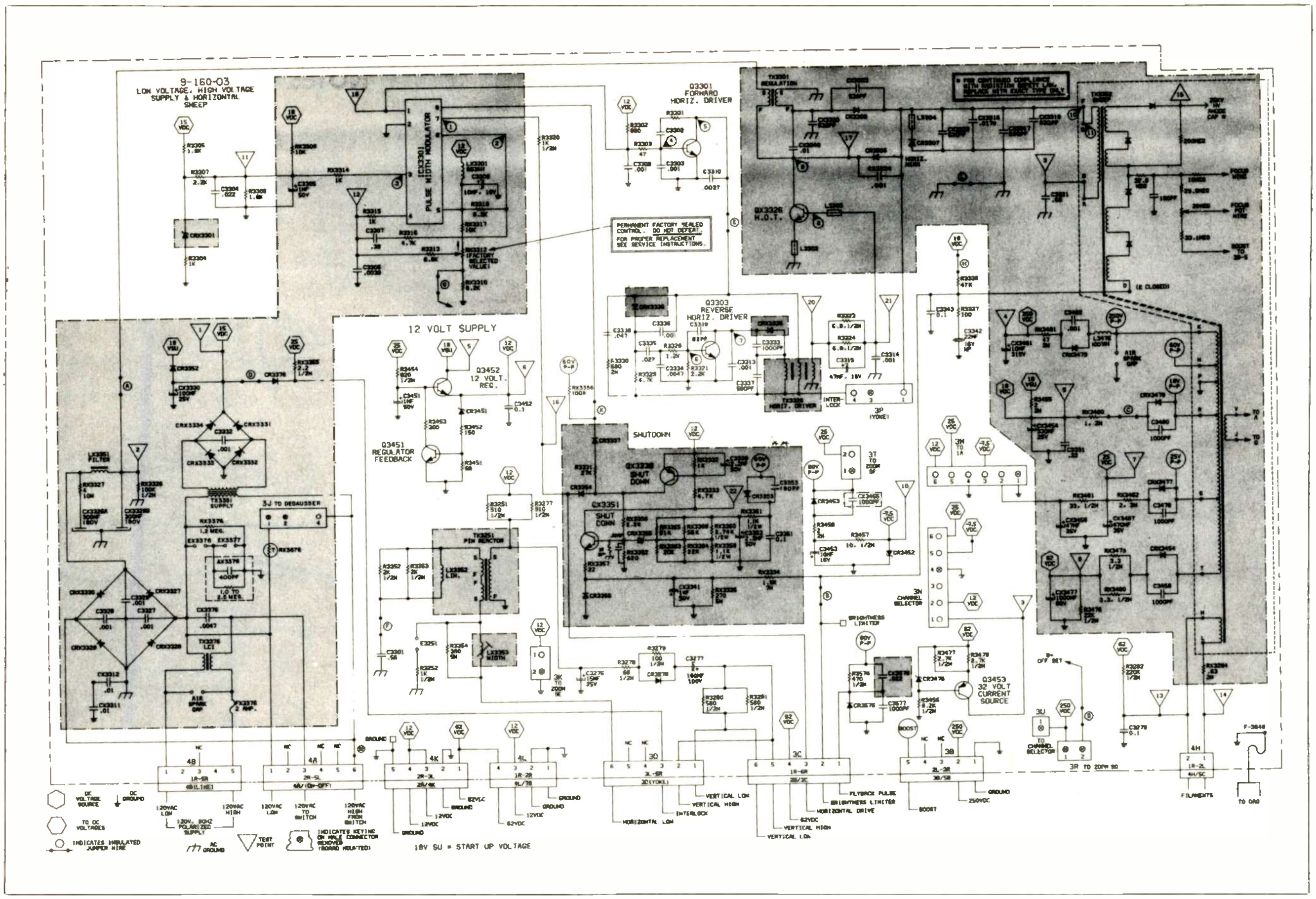

Fig. 1 Schematic diagram of the 9-160-03 module

common transistor, there must be isolation during damper time. The isolation is provided by a diode CR3306 between the damper diode CR3307 and the transistor QX3326, the horizontal output. After the completion of retrace time, the PWM is prepared to decide how soon the transistor will "turn on," to begin the energy storage process mode. For normal operation, the transistor turns on about 18 microseconds after retrace time, until the end of the trace. The "turn-on" time will vary from 5 to 30 microseconds after retrace. This "time" variation compensates for AC line to load variations as they occur.

The transistor QX3326 is "on" for the chopper operation during damper time. The diode CR3306 from the damper to the transistor, called the blocking diode, is reverse-biased until the damper is off. When the damper cathode goes positive, the blocking diode is forward-biased, clamping the yoke voltage via the transistor QX3326. The current through the transistor is a composite of the chopper current and positive yoke current. The transistor "turn-off" starts the retrace time.

The drawing in (Fig. 5) shows the start of retrace. The transistor, QX3326, damper, and blocking diode are "off." The voltage at the collector of QX3326 rapidly goes positive due to the inductive kick of the regulator transformer. The polarity reversal for the primary of the regulating transformer is also seen on the secondary. The positive voltage at the anode of the load diode CR3308, referred to as the injection diode, forward-biases the diode into conduction.

The retrace is produced by the resonant circuitry in the deflection circuit. The injection diode CR3308 is forward-biased because the anode voltage is increasing faster than the cathode voltage. The injection current aids in charging the retrace capacitance to a constant peak voltage level which helps to add the lost power. Also, the injection circuit continues to supply energy during retrace time. Thus, the injection diode CR3308 continues to conduct until the pulse width modulator restarts the transistor with a requirement for more power.

The in-phase driver

The drivers in conventional sweep circuits are part of an out-of-phase system. For example, when the driver is on, the output transistor is off, and vice versa. This system has an energy storage circuit; storing energy during conduction, and supplying output base drive during the off time of the QX3326 transistor.

In the self-regulation-system, the driver is part of an in-phase system. When the forward driver Q3301 turns on, the output transistor also turns on. The driver circuit is powered by the 25 volt supply, which allows for a low resistance primary winding on the driver transformer TX3326. The closely-coupled secondary winding is directly driven by a current ramp. The inductive impedance and low resistance provide for a very efficient driver circuit. The direct-drive produces a constant drive level independent of the duty cycle. The conventional sweep circuit with the out-of-phase drive system requires a minimum "on time" to turn the output transistor "on" at low line voltages, and produces excessive drive current at high line voltages.

One disadvantage is the negative drive current which is unacceptable for a fast fall time in the output transistor. To maintain a fast fall time in the output transistor, a reverse driver transistor Q3303 is added to this circuit design. The forward driver transistor Q3301 is driven by the pulse width modulator IC and the reverse driver transistor Q3303 is driven by the collector voltage of Q3301.

A diode CRX3336 and resistor R3329 form a clamp circuit which clips (or clamps) the peak of the collector voltage

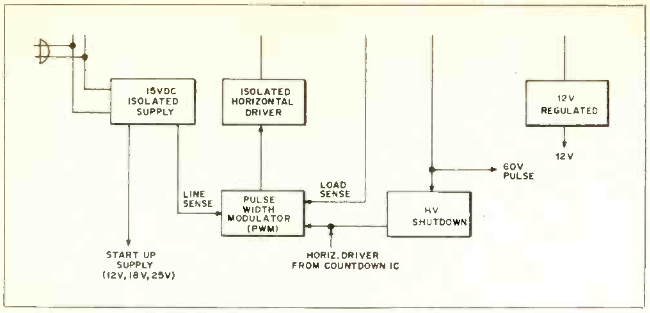

Fig. 2 Block diagram of the electronic power supply

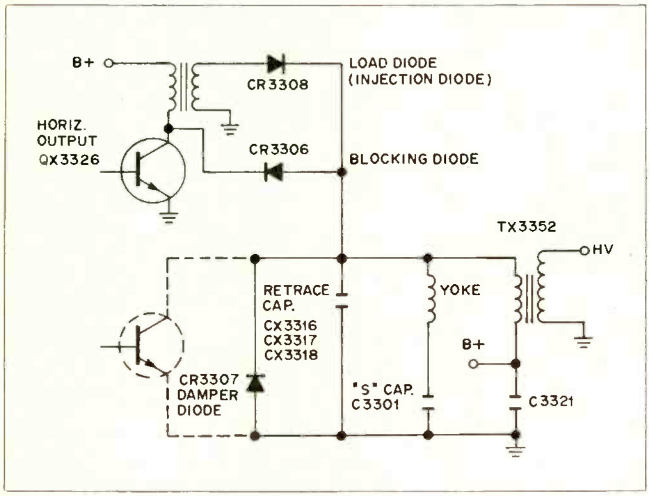

Fig. 4 The self-regulating sweep system

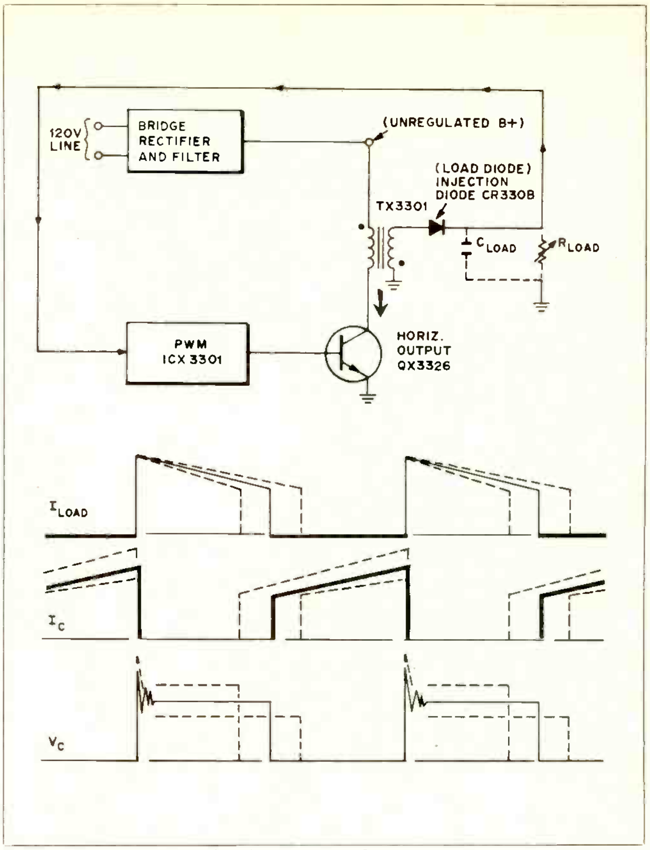

Fig. 3. The chopper circuit and waveforms

of Q3301. The waveform is decoupled by capacitor C3335. A capacitor C3334 and resistor R3328 form an integrating network which shapes the signal that drives the base of Q3303. Transistor Q3303 turns "on" after Q3301 turns "off." The current through Q3303, flowing through the primary of TX3326, drives the base of the output transistor, QX3326, negative, providing a "clean" output pulse to switch QX3326 in about .5 microseconds.

Pulse width modulator

Now, let's look at (Fig. 6) which shows the schematic of the pulse width modulator and the internal circuit of the PWM IC. Pin 3 is connected to a reference voltage, while pin 4 is driven with a triangle waveform. When the triangle wave reaches a larger amplitude than the reference voltage, Q9 and Q10 will steal current from Q11 and Q12 from the current source Q13. The action of Q10's conducting will cause Q6 and Q7 (a positive feedback switch) to snap on. Transistor Q5 is an in-phase current mirror of the Q7 collector current. Therefore, Q5 will also turn on, feeding a large current into the base of Q3 which, in turn, will also over drive Q1, the output device. The result will be a square wave output, starting and ending where the triangle waveform crosses the reference voltage applied to pin 3 (Fig. 7A and B).

Let's dig in a little further now and see how this is used in the electronic regulator system.

Going back to figure 6, note that pin 7, of the PWM IC receives the "H" drive pulses from the "countdown IC" 221-103 located on the M2 module. When troubleshooting this sweep system this is a good scope check-point to look at to see if these "H" pulses are present and correct. These pulses (note correct waveform in Fig. 8) are coupled to the base of Q14, an overdriven amplifier, which amplifies and clamps the "H" pulses between ground and B+, producing a 12 volt P-P square wave. This square wave exits the PWM at pin 6 and is then shaped by R3316, C3307, and C3306 to a triangle and coupled to pin 4, along with a DC reference voltage from R3317, R3312, and R3310 to the same point. On the other half of the differential comparator (pin 3) a sample of the voltage from the 15 volt, 60 Hz. power supply, and a sample of the 18 volt sweep derived power supply are mixed. If either supply varies, the resultant square wave output will vary in duty cycle, providing pulse width modulation.

To visually illustrate the action of the pulse width modulator, refer to the dual trace scope pattern in (Fig. 9). These waveforms were taken at the base of the forward driver transistor Q3301 which is indicated as scope check point 4 on the full schematic shown in (Fig. 1). The top trace occurred when the AC line voltage was at 130 VAC and you will note the pulse is narrow. Now the bottom trace widens out as the AC line voltage goes down to 75 VAC. Thus, a good example of the PWM in action.

Now, once again, return to diagram in (Fig. 6) pin 8 of the IC, which is marked "Flyback Pulse." This input can stop the square wave from appearing at the output of the PWM at pin 1. It is used to prevent the PWM from turning on the driver and, hence, the horizontal output transistor from turning on, during flyback when the collector voltage is high. This input is also used to shut down the system if the High Voltage becomes too high.

Line power and kick start

This system has a 150 volt unregulated power supply and a 15 volt DC isolated power supply. All power for the receiver operation is derived from the unregulated AC line connected 150 volt B+. This also includes the CRT filament. Don't try to measure any of the AC supplies from the sweep transformer. However, the DC voltages can be easily measured during any troubleshooting procedures.

The term "line-connected" B+, or "line-connected" ground, indicates no isolation from the AC line.

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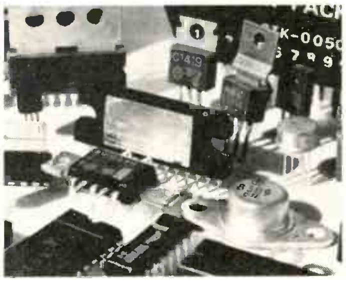

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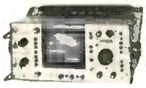
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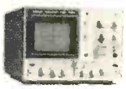
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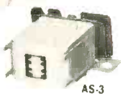
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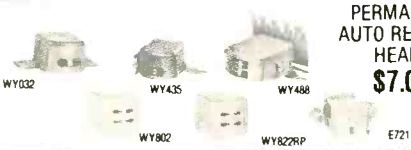

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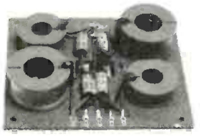

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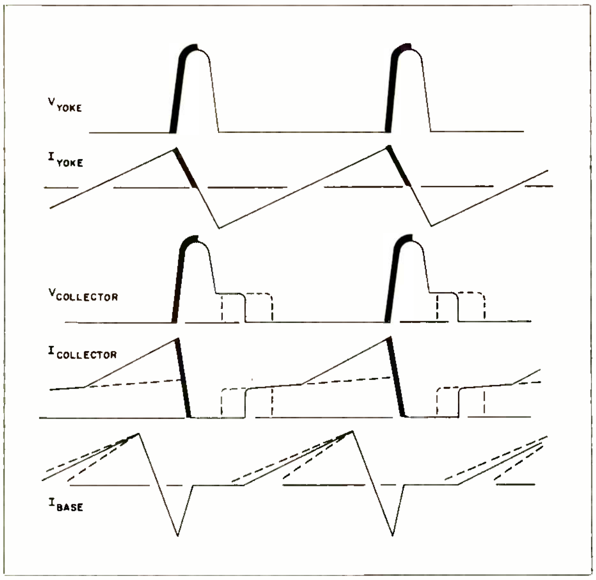

Fig. 5 Waveforms for start of retrace

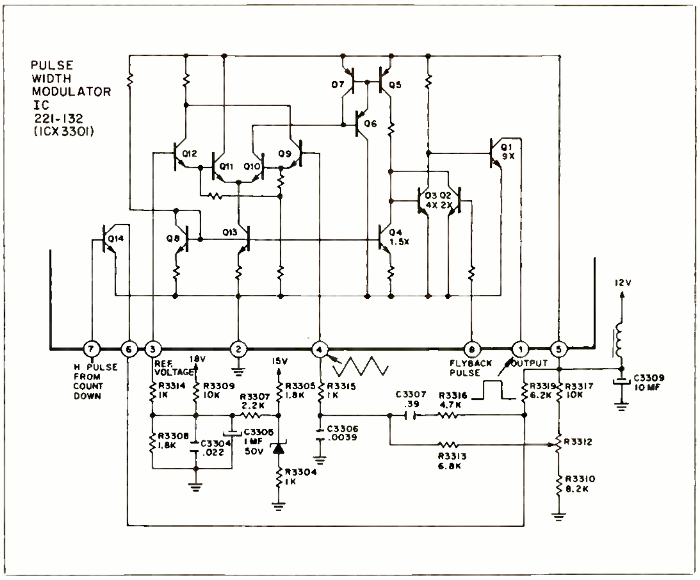

Fig. 6 Schematic of the pulse width modulator IC

used only as a reference of the 60 Hz supply line voltage by the PWM at pin 3. The 15 volt supply is isolated from the AC line by transformer TX3351.

The power supply section is protected against lightning spikes or surges with an air spark gap, and a fuse for any short circuits that may develop.

High voltage shut-down

A shut down circuit is used for X-ray and HV sweep breakdown protection and goes into operation only if the high voltage increases by 4 to 6 Kilovolts. Also, if an excessive load (current) exists or if the potential difference between the "hot" and "cold" grounds become excessive, its effect is to shut down the entire receiver by cutting off the horizontal stages.

This module contains a 12 volt regulator, a 32 volt current source, scan rectification circuits that produce 62 volts DC, 25 volts DC, 18 volts DC, 250 volts DC and voltage for the picture tube filaments.

Horizontal output transistor circuit modification

Remember, when a 9-160 module fails there can be various causes of horizontal output transistor failures other than a defective transistor.

In one case, which is probably the most common, is intermittent loss of base drive. This may well be caused by poor contacts of the intermodule connector plugs or other component failures such as the 221-105 IC (loss of the 503 KHz oscillator), 221-103 IC (loss of the count down process), or 221-132 (faulty PWM IC), or even components associated with these IC's.

Since this type of failure can be due to any one of several other faults, a new circuit has been incorporated in the 9-160 module which protects the horizontal output transistor. However, if a horizontal output transistor has failed, check for an intermittent contact of the inter-module connector plugs.

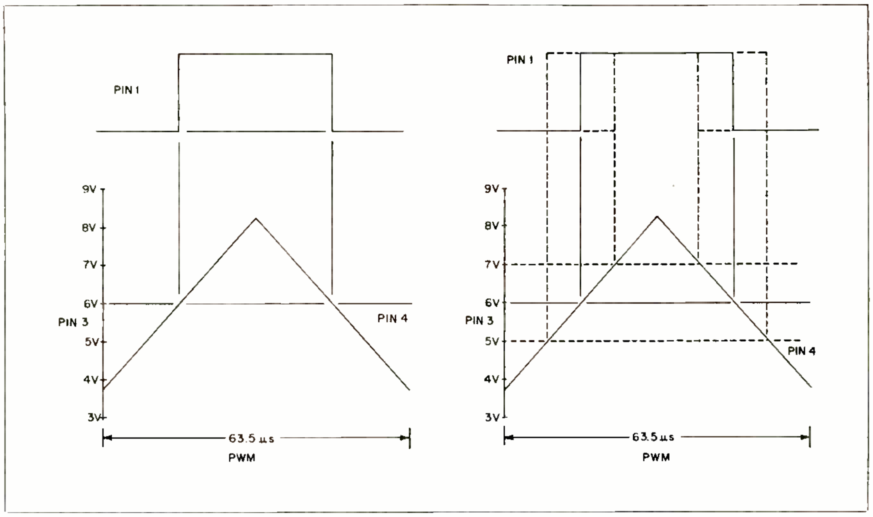

Fig. 7 (A) Transfer characteristics of the pulse width modulator. (B) Variations of the transfer characteristics

In this new circuit, a transistor (121-973) is placed across pin 8 of the pulse width modulator (PWM) IC 221-132 to ground. The transistor turns on when an 8.2 Zener diode conducts. Thus, pin 8 is grounded, through a 47K resistor, once start up has occurred. If the horizontal drive signal should lost, the horizontal sweep circuit will squeg at a safe rate and will prevent overstress of the horizontal output transistor.

Another cause of horizontal output transistor failure is a loss of "off drive" which is the signal or current necessary for a fast cut off time, incorrect or loss of the base current. The base current of the horizontal output transistor is due to the function of the reverse driver stage. When a horizontal output transistor is replaced, the base drive signal should be checked. The primary reason for loss of base current is a faulty reverse driver transistor or a reverse driver base clipper diode CR3336. It may be difficult to check the base current when the horizontal output transistor has been changed. So, it is important that at least the base voltage waveform be checked for correct shape and amplitude as the system may function properly for long periods of time before the horizontal output transistor fails again.

Another cause of output transistor failure may be a breakdown of the heat transfer grease. In some cases when some black arc track marks are visable, the horizontal output transistor may be good and only the grease has broken down.

In one case where the output transistor shorted and blew the fuse, a customer removed the back of the set and shorted across the fuse and turned the set back on to watch his special

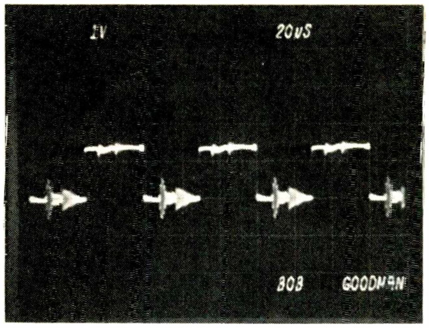

Fig. 8 Correct horizontal pulse to the PWM I C

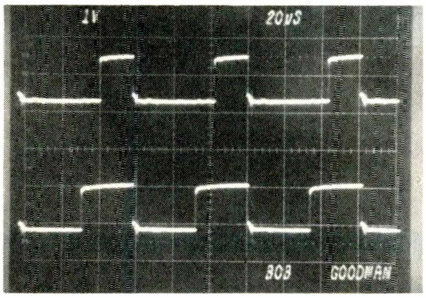

Fig. 9 Waveforms of the PWM action. Top trace shows pulse width with 130VAC while bottom trace was recorded with 75 VAC.

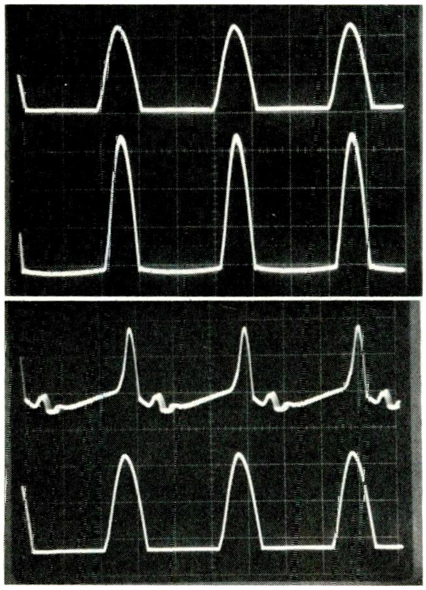

Fig. 10 (A) Top trace indicates shorted yoke compared to good one.
(B) Top trace indicates an open yoke taken at 250 volt pulse winding of sweep transformer. Good yoke trace is shown on bottom.

program. However, not for long, as a loud noise made him pull the plug, quick. This shorted transistor caused the C3315 capacitor to blow up and also burnt up the 6.8 µhm R3323 resistor.

Service procedures

Use the following procedures for isolating the faulty module that will cause loss of (H) signal.

*Turn the set on and check for presence of the 503 KHz (H) oscillator signal at pin 4 of connector 1B located on the 9-151 module. This will be a 1.5 volt P-P signal riding on a 2.5 volt DC level as viewed on the scope.

If this signal is incorrect or missing, replace the 9-151 module.

*Now verify that the horizontal drive signal is present at pin 4 of connector 2B on the 9-152 module. This will be a 2 volt P-P signal riding on a 1 volt DC level.

If this signal is incorrect or missing, replace the 9-152 module. If all tests and modules have been OK up to this point then the 9-160 module is faulty.

Set inoperative

When the fuse is blown on the 9-160 module, the cause could be the module or a short somewhere else in the receiver. A few checks with the ohmmeter should help locate the difficulty quite easily.

Make a resistance check on the Q3226 horizontal output transistor. From the collector (case) to the heat sink you should have a reading of 3K ohms or more. A very low or zero reading indicates a shorted device. Before repairing this module, make sure a failure of this output transistor was not caused by a defective 9-151 or 9-152 module.

Ohm meter readings can vary due to a number of factors, such as the ohm meter range used, the lead polarity, etc. Always reverse the leads and use the LO Ohms scale to make these resistance readings.

Excessive brightness

The cause of this symptom is usually the loss of the +250 volts on the 9-160 module (probable faulty diodes) or a defective 9-155 (RG B video module). In some instances a defective 9-155 module will also damage the 9-160 module. A faulty picture tube will also give about the same symptom.

To prevent damage to a new 9-160 module, make the following checks before module replacement.

*Check for the presence of +250 DC at pin 3 of connector 3C on the 9-160 module. If the voltage is OK, check for +250 volts at pin 2 of connector 5B on the 9-155 module.

*If the voltage is correct, then replace the 9-155 module.

*If no voltage is found, turn the set off and measure the resistance of R3481, a 47 ohm resistor. If the resistor is good, replace the 9-160 module. If you find the resistor open, replace both the 9-155 and 9-160 modules.

Deflection yoke checks

Should the horizontal windings on the

continued on page 44

Noise in stereo tape players

Tracking it down

Noise in tape players, and other audio equipment may be from a single source or the result of interraction between components, electronic and mechanical. Here are noise tracing techniques.

By Homer L. Davidson

Noise found in stereo tape players may be electronic or mechanical or sometimes a combination of both. Defective transistors, IC's and capacitors produce most of the electronic noise—while a defective motor, relay or solenoid may cause mechanical noise. You may even find a defective motor causing electronic noise in the amplifier section and producing mechanical noise as well.

Types of noise

Suspect a noisy transistor or IC when you hear a popping, cracking or possibly frying noise in the speaker, with the volume turned down. Mica coupling and bypass capacitors generally found in the high gain stages of the amplifier may cause this frying noise.

Excessive 60 cycle hum may be caused by poor filter capacitors in the power supply. With poor power supply filtering, the output voltage may be several volts lower than normal. You may find the program changing solenoids or relays will not then function.

A high-pitched hum may be produced in the amplifier input stages. Check for poor ground or component bonding terminals. A broken volume control ground terminal may also cause hum problems. Microphonics or a high-pitched squeal may be caused by insufficient or poorly grounded shielding in the audio input circuits. A defective transistor may be microphonic. . Outside interference may be the cause when the noise is tuneable and is found only when the radio is operating.

Vibration or mechanical noise may be caused by a defective motor bearing or solenoid. Check for loose shields separating the amplifier section and phono motor. If such a shield is not securely held in place, and is located near the phono motor, the magnetic field of the motor may cause it to vibrate. Excessively worn relays or solenoids may chatter when engaged.

Although mechanical or vibration noise may be located by sight and sound, electronic noise in the audio circuits is more difficult to localize. The voltmeter or transistor tester is not effective in locating such noise. Isolation tests or using a separate amplifier to signal trace is much faster. Substitution

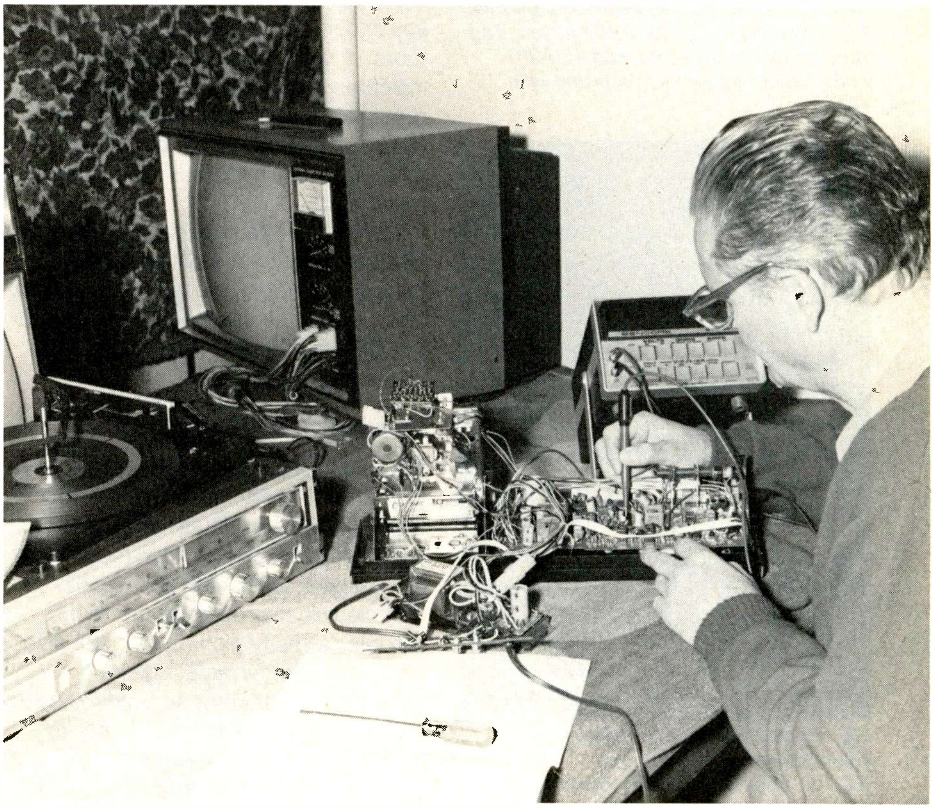

Fig. 1 Servicing the AM-FM-MPX tape player

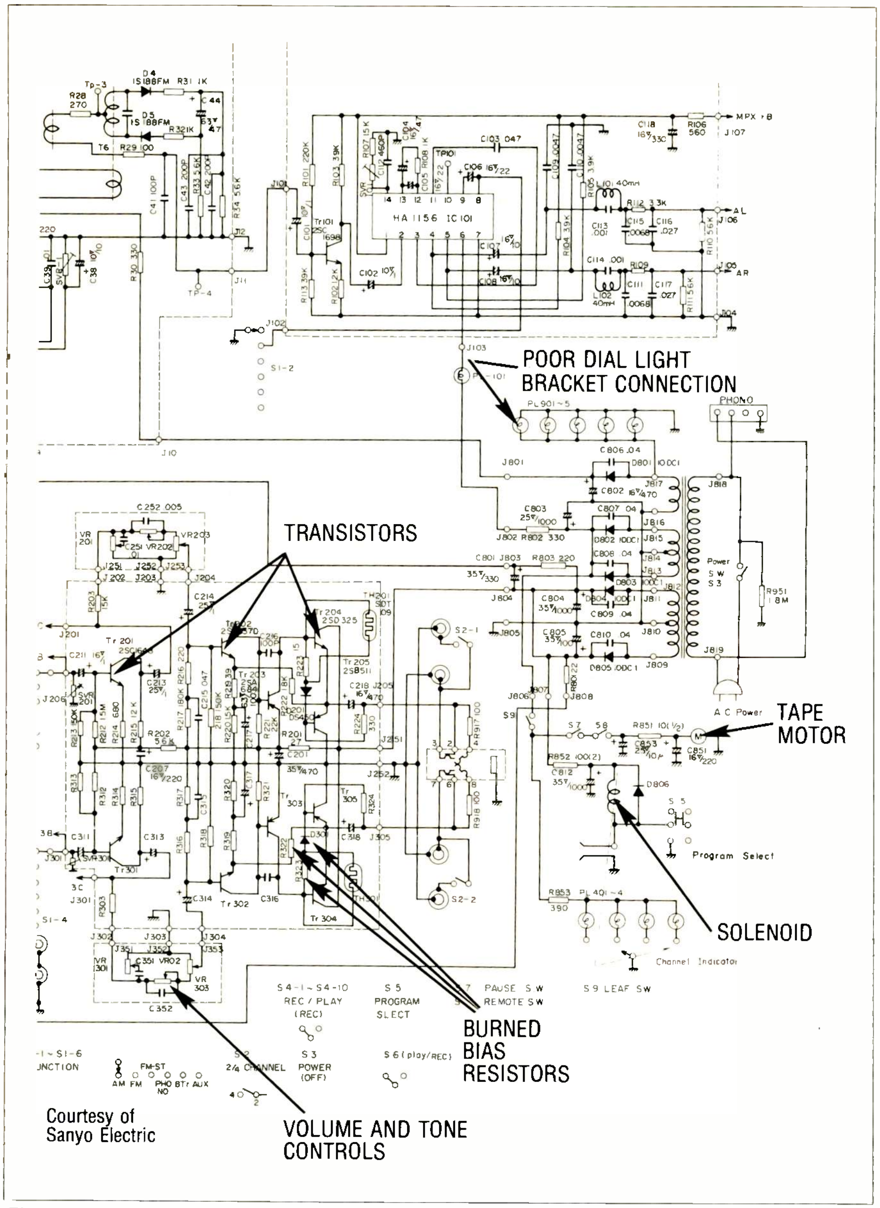

Fig. 2 Here are the various areas in the electronic circuit where hum or noise may be generated by a defective component.

of various components is helpful but takes too much time. Likely sources of noise in a stereo tape player are shown in Fig. 2.

A hum or two

First, determine if the hum noise is coming from both speakers. A 60 or 120 cycle hum may be caused by filter capacitors in the power supply. If 60 or 120 cycle hum is common to both channels, check the filter capacitors. In many of the lower priced stereo players you will find a very large single filter capacitor (2200 µfd or higher). Always shunt the suspected capacitor with an equal or larger valve for test. If the capacitor is 1000 µfd, shunt 1000 or 2000 µfds across it. Turn the unit off to prevent transistor damage, and connect the test capacitor with clip leads or tack it in place. If the hum disappears, replace the defective capacitor.

When a high-pitched hum is heard, determine if it is present in both channels. Can the noise be controlled by the volume control? If so, the noise is generated in the front end of the amplifier. Check for poor grounds from pc wiring to chassis. (Fig. 3).

Noisy transistors

Any audio transistor may cause noise. Isolate the noise to either channel. Turn the volume control down. If the noise disappears, the defective transistor is ahead of the volume control. When the noise is still heard with the volume control turned down, the noise is being generated following it.

After isolating the noise to a specific area, the noisy transistor may be located by removing it from the circuit, shorting the base and emitter terminals together or possibly by applying heat or freeze spray. Since removing and replacing transistors takes valuable service time, the shorting of base to emitter or cold spray are more effective. Start at a driver transistor to cut the section in half.

If the noise is present when the base and emitter terminals of the driver are shorted suspect a noisy output transistor. There is little alternative here; substitute for the suspected transistors.

Sometimes a noisy transistor may be found by applying heat or chiller spray to the body of the transistor. If the transistor becomes noisy after operating for several minutes, apply chiller spray to see if the noise disappears. To speed up the process initially, apply heat.

In very difficult situations, where the noisy transistor can't be located, you may want to remove the collector lead or transistor from the circuit. Of course, this method takes more time, but in cases where more than one transistor is noisy, it may be the only way. You may find noisy amplifier and output transistors in the same channel. When popping or crackling noise is found in both channels, suspect the same stage in each. Geranium transistors appear to be more noisy than silicon types.

Popping IC's

Audio output ICs can create quite a bit of noise. (Fig. 4). First, determine which channel is noisy. You can easily trace the speaker terminal lead to the output coupling capacitor and the IC. If in doubt, use a separate amplifier and signal trace the input and output terminals of the suspected IC. Turn the volume control completely down to isolate the input circuits. If the noise turns down with the volume control, suspect a noisy capacitor or transistor ahead of the output IC. You may want to apply heat or cold spray to see if the IC will really act up. Since removing and replacing the IC is more difficult than removing and replacing a transistor, make certain the chip is defective.

Components soldered into a PC board are easily removed with solder-wik or similar material. Be very careful when inserting the new IC; make sure each terminal is in the correct hole. Check for terminal guide, pin one. Use a low wattage soldering iron to solder the IC into the circuit and double check each terminal. Check for poorly soldered pins or solder bridges.

The frying by-pass

Suspect a noisy bypass or coupling capacitor when all transistors and ICs have been eliminated. Use an outside audio amplifier to signal trace each audio stage. You may find these small

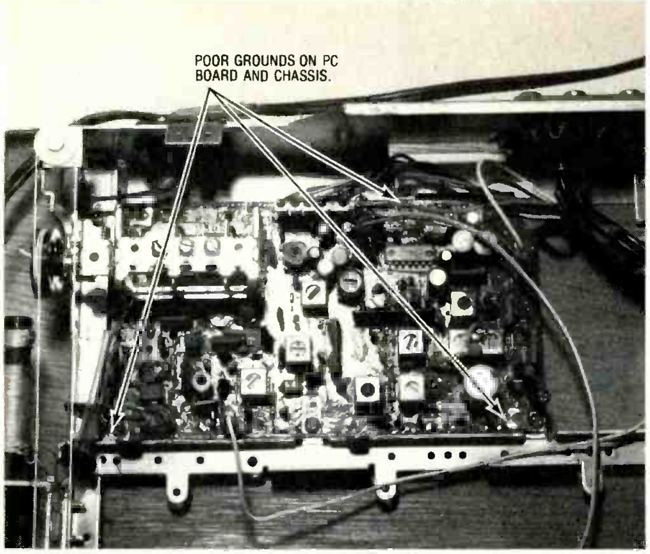

Fig. 3 Check for poor grounded terminals between PC board and chassis ground. In audio circuits, you may have to tie all the ground cables together to prevent hum.

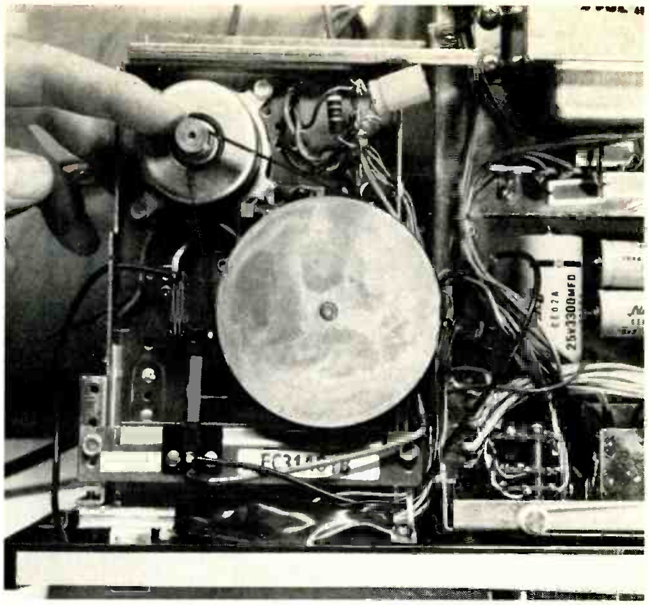

Fig. 5 A defective motor may create both mechanical and electronic noise. Replacement is the correct solution to noise generated in the amplifier by the motor.

noisy capacitors are more difficult to locate than a transistor. Generally, the noisy capacitors are located in the input stages. In most cases dc voltage is applied to one side of the capacitor.

Start at the driver stage, then proceed towards the preamp. Go from collector to base of each transistor. When the noise disappears, back up a component or two. You may find the noisy capacitor to be noisy on one terminal and not on the other.

Remove one end of the suspected capacitor and temporarily tack in another one. If the frying noise disappears, solder in the good replacement. Sometimes, you can locate noisy capacitors with chiller spray. When chiller spray is applied, the noise may cease or become louder.

Warbling noise

A warbling or whistling noise may be caused by a mechanical or electronic component. Suspect mechanical problems when the noise appears after inserting a tape cartridge. Move the cartridge around to determine if the noise is created by the capstan/flywheel; uneven tape speed may produce a warbling sound. Tape wrapped around the capstan may also produce a warbling or higher speed sound.

Check for proper cartridge seating tension. Push in on the tape to prevent tape slippage. If the tape speed resumes to near normal, either the capstan is worn smooth or improper cartridge tension exists. Clean off the capstan drive area with alcohol. Notice if the drive area is bright. Replacement of the capstan/flywheel may be necessary to cure speed problems or warbling noises.

When inserting a cartridge, in record position, you may hear a warbling or motorboating sound which sometimes may only occur for a second or two after the cartridge is inserted. Simply clean all the contacts of the record/play switch. You may have to insert the long nozzle of the spray can down inside one end of the record/play switch to get at all of the dirty contacts. Work the switch assembly back and forth to clean the various contacts.

Noisy motors

A defective motor may cause noise in the audio amplifier or mechanical noises because of a worn bearing (Fig. 5). To determine if the noise is caused by a worn bearing, simply remove the belt and stop the motor. Sometimes a drop or two of light machine oil will cure it. If not, replacement is the cure.

When the motor brushes become excessively worn and arc, you may hear the noise in the audio amplifier. Sometimes, only slight motor noise may be heard. If so, remove the motor drive belt and note if the noise speeds up. You can probably control the noise by slowing down the motor pulley with your fingers.

You may be able to eliminate such noise by shunting a 470 µfd electrolytic capacitor across the motor terminals. If the noise disappears, install the capacitor permanently. If the noise remains the motor must be replaced. Occassionally you will find the noise is so intense that motor replacement is the only answer to the problem.

Other noisy components

Intermittent or transitory noises may be caused by poor contacts. A plopping or frying noise may be caused by dirty contacts of the ac on/off switch. A frying noise occurring when the program switch is engaged, may be caused by dirty program or solenoid switch contacts. (Fig. 6). The phono motor switch may also cause a momentary noise. Simply cleaning the contacts may solve these noise problems.

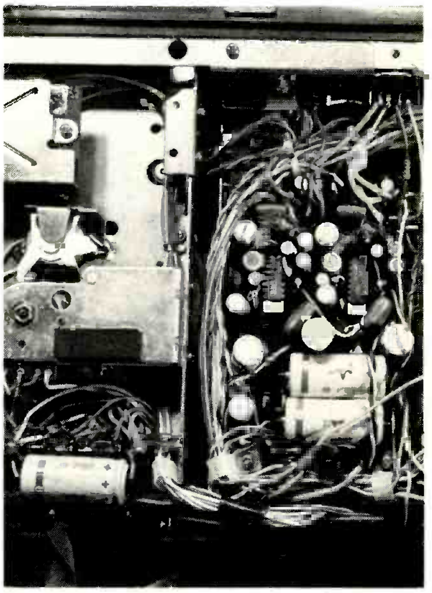

Fig. 4 The audio IC output circuits create a lot of popping or frying noise in the audio channels. It's possible to have two noisy IC components. Be sure and isolate since they are more difficult to remove.

Sometimes, however, these sounds may be the beginning of excessive arcing which in turn may produce smoke and fire. Check the switch contacts and insulating material for burn marks. If excessive arcing is noted, replace the switch assembly.

Occasionally you may find a defective IF transformer producing noise in a radio, (Fig. 7). The noise may be caused by the small fixed capacitor across the

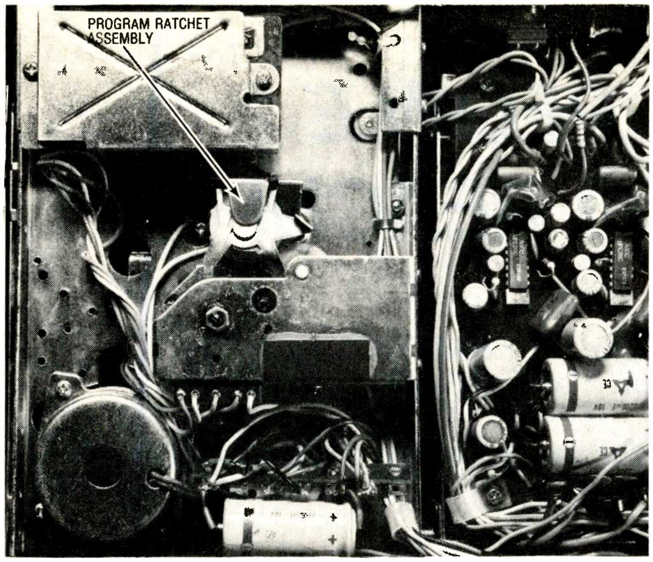

Fig. 6 A clicking or popping noise may be caused by a noisy solenoid or poor wiring connections of the solenoid ratchet assembly.

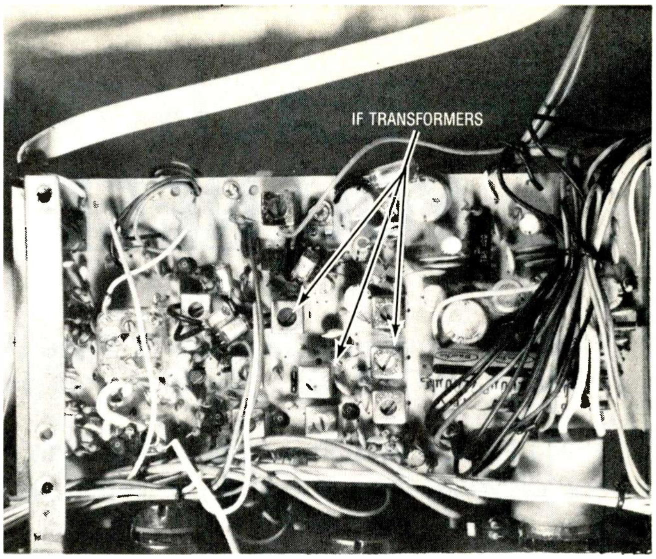

Fig. 7 A noisy IF transformer may be found in some AM-FM-MPX tape player chassis. Isolate the various stages or use signal tracing methods to locate the defective IF transformer.

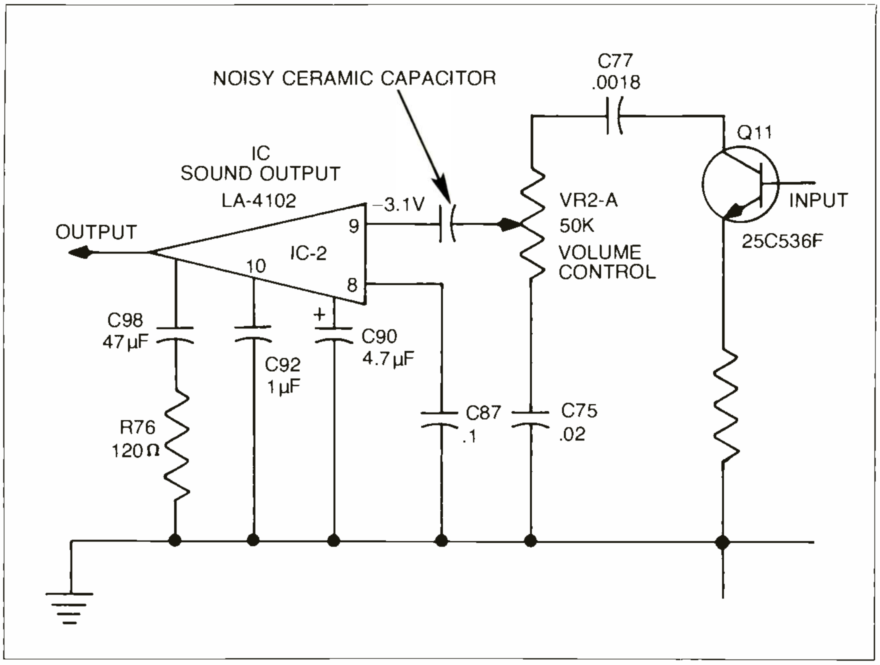

Fig. 8 The noisy amplifier circuit was produced by a defective ceramic coupling capacitor, C84 in a Penney's model 3877.

primary winding, poor soldered connections or arcing between the windings. To locate the noisy stage, short the base and emitter terminals of each IF transistor. The noise should stop when each transistor is turned off. If not, you are ahead of the noisy component. A voltage check on both windings may detect the noisy transformer.

Controls may become noisy when worn or dirty. They can be cleaned with contact cleaner to temporarily, (or permanently), solve the problem. An excessively worn control should be replaced.

A noisy right channel

In a Sony AM-FM-MPX cassette player, Model HP-319, the right channel was very noisy. Sometimes touching the record/play switch would cause the noise to occur. The noise could be caused by touching or moving the cables from the front panel to the chassis. At other times stressing the chassis would cause the noise to appear. After several applications of contact cleaner to the record/play switch, the noise disappeared. Dirty switch contacts may cause a variety of noise problems in any tape player.

A noisy left channel

Only the left channel was noisy in a J.C. Penney AM-FM-MPX portable tape player, Model 3877. (Fig. 8). The noise was present with the volume turned completely down. A first guess was the audio output IC (LA4102). Since audio ICs have been notably noisy, input terminal (9) was shunted to chassis ground with a 50 μfd 16 volt capacitor; the noise disappeared which indicated the IC was normal.

Upon checking the schematic, drive transistor (Q11) was noted as a suspect. The noise was still present when its base and emitter terminals were shorted. This indicated the noisy component was between the output IC and the driver transistor.

Since the noise could not be turned down with the volume control, capacitor C77 was suspected. An audio signal tracer was connected to capacitor C77 (.0018). The noise was louder with the volume control at the top of its range; C77 was replaced, but the noise was still present.

Pin 9 of the output IC was then checked. Excessive noise was found here. One end of capacitor C84 was removed and the noise disappeared. C84 (.1mfd) capacitor was replaced, solving the problem. The volume control did not eliminate the noise created by the capacitor, since another bypass capacitor was in the lower leg of the 50K volume control.

Locating the noisy IC

The right channel of a Soundesign AM-FM-MPX cassette player was noisy. A frying noise was heard with the volume control turned completely down. The whole audio output circuit is contained in one IC, a STK435. This IC component contains both left and right output amplifiers.

To make sure the IC was defective, the input terminal was shunted to chassis ground with a 50 μfd capacitor.

continued on page 44

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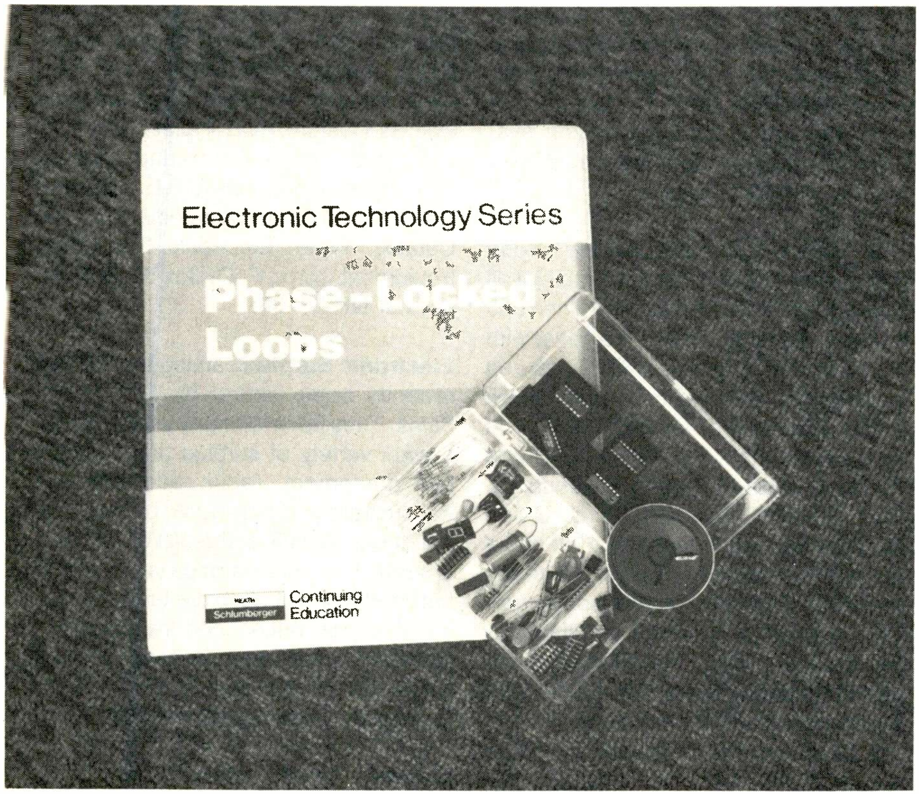
CONTINUING EDUCATION REPORT

Phase-Locked Loops

More fun from Heath

By Walter H. Schwartz



For more Information circle No. 151 this issue

As I hope you've noticed, phase-locked loops are currently being used in a variety of applications in consumer electronics where they, a short time ago, were common only in television color AFPC and horizontal oscillator frequency control systems. Phase-locked loops are used as part of the frequency synthesis system of television and FM tuners, they are used in FM demodulators, AM detectors, SCA decoders, and other applications as well as in new and sophisticated ways to control TV sweep and color oscillators.

The phase-locked loop is quite simple in concept; it may get very involved in execution. A voltage controlled oscillator frequency and a reference frequency are compared in a phase detector. The phase detector output varies proportionately with the frequency difference and pulls the VCO into lock with the reference. This, of course, simply gives you one oscillator locked to another which has limited usefulness. So the output frequency of the VCO can be hetrodyned, divided or multiplied before being applied to the phase detector to allow almost any relationship between the VCO and the reference and still allow locking them together.

This whole process is what Heath's Phase-Locked Loops is all about. It explains the principles of digital phase detectors (and touches upon analog phase detectors), the design of voltage controlled oscillators, the importance of the loop filter, and then covers the operation of digital frequency synthesizers. A number of phase-locked loop IC's are examined and their applications are explained.

This material is covered in six lesson units; appendices cover the derivation of basic phase-locked loop mathematical formulas and contain data sheets on popular phase-locked loop IC's.

Fourteen experiments are described step by step. Approximately fifty parts are included with which to perform the experiments. In addition to the parts included, an oscilloscope, a dc voltmeter, some sort of breadboard and +5V and + and -12V power supplies are needed. A dual channel scope and an audio generator are useful. As with the other Heath programs, the experiments are well presented and are important to a full understanding of the material. And, they are quite fascinating; the things that are going on inside those chips ....

Unit Six is perhaps the most interesting of the lesson units. It is the one which covers actual phase-locked loop ICs and applications and offers experiments which can really be useful. (See Table I.) For instance, Experiment 5 produces a phase-locked-loop frequency multiplier used for improving the resolution of frequency counters at low audio frequencies.

Unit 6 — Monolithic ICs and Applications

A. The 560 Series
   1. 560B Phase-Locked Loop
   2. 561B Phase-Locked Loop
   3. 562 Phase-Locked Loop
   4. 565 Phase-Locked Loop
   5. 567 Tone Decoder

B. 4046 CMOS Phase-Locked Loop
   Experiment 1, FSK Generator and Demodulator Using 565
   Experiment 2, 567 Tone Decoder
   Experiment 3, 4046 Phase-Locked Loop
   Experiment 4, 4046 PLL with Lock Indicator
   Experiment 5, 4046 Prescaler
   Experiment 6, 4046 Synthesizer

Each of the six sections has a unit examination and a final examination, which entitles the successful student to 3 Continuing Education Units (CEUs).

The catalog price of the Phase-Locked Loop program is $49.95. The program and the ET-3300 breadboard, which of course is useful for other programs and breadboarding projects, are priced as a package at $129.90. ET/D

BULLETIN BOARD

ET/D just received a number of recently published books from *TAB*. Included were two on microcomputers and several on test equipment and troubleshooting.

The Complete Microcomputer Systems Handbook, by Safford, TAB Books/ No. 1201, examines microcomputers, operation, programming and troubleshooting and repair. It covers evaluating computers to suit your needs, how computers work, computer languages, how to write and use programs and computer problems and how to analyze them—how to make tests and use test equipment. $9.95 paper, $15.95 hardbound. *The Giant Handbook of Computer Projects*, by the editors of 73 Magazine, is about 500 pages of things to do with and for a computer. The first two chapters consider the basic microcomputer, its capabilities and operation and the microprocessor in a microcomputer. Chapters three and four cover memories and I/O devices. There is a chapter on computers in the ham shack and another on computer games, as well as a long section covering a dozen or more miscellaneous applications.

Troubleshooting Microprocessors and Digital Logic by Robert Goodman is a basic guide to digital logic techniques, microprocessors and their troubleshooting with the oscilloscope, and logic probes. Goodman also discusses logic monitor test clips, the handling of MOS devices, a number of specific ICs found in consumer products, and their associated circuitry, TV electronic tuning systems, the TRS-80 microcomputer and a number of video games.

Off on another track is Joe Carr's latest book, *How to Troubleshoot and Repair Amateur Radio Equipment*, TAB No. 1194. The author discusses basic test equipment, troubleshooting and alignment techniques and their application to amateur radio transmitters and receivers. Many of these techniques are applicable to other equipment as well making the book generally a useful, basic troubleshooting text. Included are also some hints on selecting test equipment and rejuvenating old test or radio equipment.

Bob Goodman has another troubleshooting book, *Practical Troubleshooting With the Modern Oscilloscope*, (TAB Books No. 1162) which covers the tricks of using triggered sweep scopes effectively in TV service; understanding the basic scope, use of the dual trace scope, checking the various stages of the TV receiver and using the VITS and VIRS for test purposes. The concluding chapter explains some uses of the oscilloscope for stereo service.

One last book for the moment. *Practical Electronics Math* by Veley and Dulin seems to cover just about any *practical* basic application of electronics math imaginable. From ohms law to transmission lines and even pulsed radar systems, it's all here and is presented in an understandable manner.

The 1980 GE Semiconductor Cross Reference Guide is now available at all local GE distributor locations. "The 1980 Guide is bigger and better than ever with 90 additional pages of MRO types and specification information," said Chuck Liddic, manager of semiconductor and special product sales for the GE Tube Products Department in Owensboro. The 1980 GE Semiconductor Guide features an interchangeability list and a complete reference section. IC's are presented in chart form grouped by varying application headings and listed by decreasing power dissipation. The GE parts numbering system gives the user full replacement information readily. For details and a copy of the GE Semiconductor Guide, see your local GE distributor.

The inagural issue of Who's Who in Cable Communications™, 1979 Edition, is now available from the publisher, Communications Marketing, Inc., 2326 Tampa Avenue, El Cajon, California 92020. Bonnie Saiz, Senior Editor and Director, states that the 192-page book is hard-bound and gold-stamped and contains over 1,400 biographical sketches, making it the finest reference work of its kind available anywhere. The introduction is made by U.S. Congressman Lionel Van Deerlin and the publication was dedicated to the memory of Walter Kaitz.

A new **1980 hand tool and assembly aid** Catalog 180 is available from *E.P.E.* Included are the complete E.P.E. expanded and improved line of Electronic Handtools for cutting and forming component leads, as well as stripping, crimping, etc. Line includes the original Micro-Series Flushcutters as well as E.P.E.'s new line of Super-Shear Flushcutters announced late in 1979. Also shown are the additional Models of Bent-Nose Pliers added to the thin, economical Macro-Nose Pliers. Other Electronic Production Equipment and Aids are described in full: Thermal Wire Stripper, Micro-Strip 30 GA Stripper, Soldering Aids such as — Freehand Wire Solder Feeder — Solder-Mate Spool Dispenser — Hand Flux Dispenser — Spot-Mask Liquid PCB Hole Mask — Scrub-It Solvent Dispenser with Brush — Fast-Mask PCB Fingers Masking Fixture. E.P.E.'s new Slide-Along Assembly Station — and Flip-Rack Instruction Sheet Organizer, as well as Custom PCB Pallets, are fully explained. Those requesting Catalog 180 will also receive the E.P.E. Industrial Price Schedule for all products in the Catalog. Write: Electronic Production Equipment Corp., P. O. Box 5238, Manchester NH 03108.

Electronic Surplus catalog WS-80 has recently been issued by *Fair Radio Sales*. They have for many years offered a wide variety of surplus parts, tubes, test equipment, radio receivers and transmitters and hardware; believe it or not there is still some WWII surplus around. Fair lists perhaps a couple of hundred types of obsolete tubes at reasonable (fair) prices, odd transformers, and even dynamotors. Write: Fair Radio Sales Co., P. O. Box 1105, 1016 E. Eureka Street, Lima, OH 45802

Meters, Meters, Meters; the latest *Simpson Electric* catalog has just been issued. Catalog 5000 features the latest version of the 260 (Series 7), the 260 XL (which has low power ohm scales, unusual for a VOM), many other models of analog VOMs, digital multimeters, FET analog meters, temperature meters, insulation testers, sound level meters, light meters, analog panel meters, digital panel meters, oscilloscopes and other test instruments and accessories. See your Simpson distributor or write: Simpson Electric Co., 853 Dundee Ave., Elgin, IL 60120.

A series of **Audio-Visual Equipment repairs seminars** is being held throughout the remainder of the year by the *Association of Audio-Visual Technicians*. These three-day seminars which cover Power and Electrical Safety, Audio Topics, Motion Picture Equipment-16 mm, Magnetic Audio Formats, Video Signal Standards, and Video Systems Troubleshooting are being presented at ten cities around the country. For further information contact: Seminars; Association of Audio-Visual Technicians, P.O. Box 9716, Denver, CO 80209. **ET/D**

TEST INSTRUMENT REPORT

Bird's 4381

A digital RF power analyzer

By Walter H. Schwartz

The new Bird 4381 RF Power Analyst. Circle number 150 on the reader service card for more information.

After reportedly more than 100,000 Model 43 Thruline™ wattmeters in the last 25 years Bird apparently decided to try to do something exciting in the RF power measurement field. (Not that the Model 43 wasn't a fine instrument, but we all were just completely used to it.) The 4381 does just about everything a RF wattmeter could be expected to do and a few things perhaps not so expected.

First, the 4381 is a digital readout wattmeter. It is also a little different from a Model 43 in that it uses two plug-in elements, one for forward power and one for reflected power (they *are* the same elements as the Model 43 uses). Pushing the FWD CW or the RFL CW keys gives you the appropriate reading. But while that's about all the Model 43 will do, the Model 4381 is just beginning.

Push key number three and you can read SWR neatly calculated by a microcomputer. The 4381 can also indicate return loss which is the same as SWR converted to dB. The foregoing applies to readings of CW power (single tone SSB transmissions, FM transmitter carriers, etc); the same functions are available for PEP, peak envelope power, for two-tone SSB measurements. Rated accuracy can be expected with modulation frequencies of from 50 to 10,000Hz and minimum pulse signal parameters of 50µ second pulse width, 100pps repetition rate and 1% duty cycle. Related to other peak type readings is the percent modulation function. The 4381 measures modulation, within the power range of the plug-in elements, from zero to 99.8%. In fact, it is sensitive enough to detect the amplitude modulation (1.5%) caused by the residual power supply ripple, hum, present on the carrier of the FM transmitter we used when checking it. Over modulation is indicated as 99.9%.

The 4381 also measures power, both reflected and forward, in dBm (dB relative to 1 milliwatt). An interesting feature here is the 6dB (400%) overrange capability. This means in an emergency you can use a 100 watt element to measure to 400 watts by the use of the dBm function.

When making any measurement, the 4381 continuously monitors and holds the highest and lowest readings ob-

continued on page 44

Specifications

POWER RANGE[1]
100mW to 10kW full scale using Bird Plug-in Elements. Accuracy not guaranteed with components not supplied by Bird.
USABLE OVER-RANGE
To 120% of scale on CW, PEP, SWR and return loss functions. To 400% of scale (PEP) on dBm and % modulation.
FREQUENCY RANGE[1]
450kHz to 2.3 GHz
SAMPLING RATE
2 to 3 readings per second
DISPLAY
3½ digit, .3" LED—strobed
ACCURACY
Power Readings
±5% of full scale
SWR
±10% of reading
% Modulation
±5%[2]
Return Loss
±0.3dB to corresponding SWR value
MODULATION FREQUENCY[3]
30-10,000Hz
IMPEDANCE
50 ohms
INSERTION SWR
1.05 max to 1000MHz (32.3dB return loss)
WEIGHT
4.0 lbs. (1.8kg)
BATTERY LIFE
(Rechargeable) 8 hours approx.
A.C. POWER
(Using Adapter) 115V, 50-60Hz
6W, 230V, 50-60Hz 6W

[1] Frequency band and power range is determined by Plug-in Element selected. See Bird Catalog for availability. Some modes require two Elements in a 10:1 power ratio.

[2] For CW power levels greater than one third of full scale, accuracy of the % modulation mode is ±5% from 0 to 90% and +10% from 90 to 100%.

[3] For pulse modulation the minimum parameters are: 50 micro-seconds pulse width, 100 pps repetition rate and 1% duty cycle. **ET/D**

NEW PRODUCTS

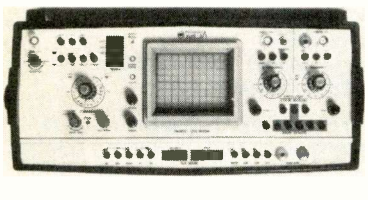
"Grabber" Ohms Probe

Circle No. 125 on Reader Inquiry Card

The hand-size Model 30 Clamp-on AC Voltmeter/Ammeter from *Triplett,* now has extended versatility with the new Model 32 Ohms probe accessory. The plug-in probe permits in-the-field or lab continuity checks on fuses, switches, circuit wiring, indicators, motor windings, checking open and shorted junctions of many semiconductor devices and a myriad of resistance checks on electronic/electrical components or circuits. The Model 30 probe features thumbwheel zeroing and measures from 0-1000 ohms with 10 ohm center. It's overload protected up to 600 volts with a ¾ Amp/600V fuse. Price of the probe is $14 and the Model 30 "Grabber" is $65.

DMM/Frequency Counter/Oscilloscope

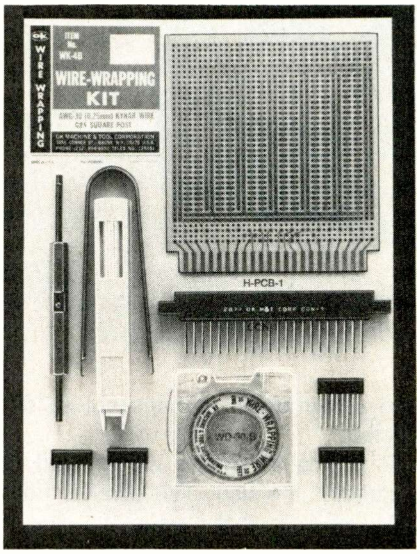
Circle No. 126 on Reader Inquiry Card



Vu-Data's new mini-scope, the 25MHz Model 2521 is now available with an optional multimeter and frequency counter. The DMM can automatically read voltage directly from the scope input and its 3½ digit meter measures dc and/or ac to 1000 volts full-scale, and resistance to 1.999 kohms. If CH1 input to the scope is ac coupled, the meter reads the rms value of the CH1 signal so the operator need not make the mental calculation of p-p to rms. Range and polarity selection are automatic. The counter reads to 25MHz and digitally displays the input frequency of either CH1 or CH2. It is unique in that it operates from the scope trigger circuit, therefore requiring as little as 2.7 millivolts to trigger. Internal connections between scope inputs and DMM/Counter are selected by front panel pushbuttons. Both multimeter and counter can accept external inputs, thereby operating as separate, standalone instruments, each having its own LED display. Vu-Data offers this multimode feature on all scopes in their line, from 25MHz to 50MHz. The price of the 2521 is $1,785.00; without DMM/Counter it is $1,395.00.

Wire-Wrapping Kit

Circle No. 127 on Reader Inquiry Card

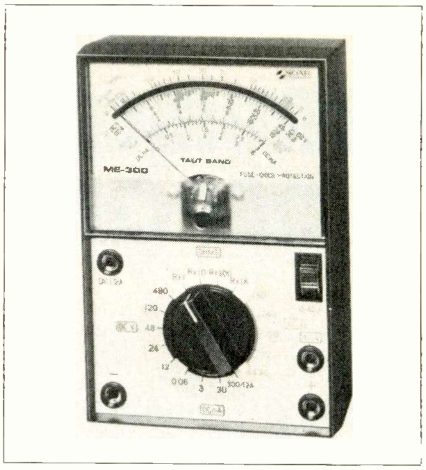


The new WK-4B Kit from *OK Machine and Tool Corporation* reportedly features a complete range of tools and parts for prototype and hobby applications. The kit includes a universal PC board, an edge connector with wire-wrapping terminals, two industrial quality 14-pin wire-wrapping DIP sockets, two 16-pin sockets, a DIP inserter, a DIP extractor, a unique wire dispenser with 50 ft. of wire, and a new wire wrapping and unwrapping tool.

Analog Multimeter

Circle No. 128 on Reader Inquiry Card

The new reportedly drop-proof battery-operated ME-300 analog multimeter from *Soar Electronics* has a dc sensitivity of 30,000 ohms per volt and an ac sensitivity of 10,000 ohms per volt.



Its taut band movement is made in the United States. Other features include: centerscale readings of 6, 12, and 24 volts, a meter deflection angle of 95°, a mirrored scale and five function modes (dcV, acV, dc mA, ac mA, and Ohms). The ME-300 multimeter has a voltage measurement range to 480 Vdc and 480 Vac, a current measurement range to 12 amps dc and 6 amps ac, and a resistance measurement range to 3 megohms. It is powered by two 1.5 volt AA batteries and has a rated accuracy of ±4% ac and ±3% dc. The meter movement and the PC board are protected against burnout by diodes, a fuse, and a fusable link. The price is $38.00

Video Pattern Generator

Circle No. 129 on Reader Inquiry Card

New from *Hickok Electrical Instrument Company* is a compact, video generator suitable for VTR, CCTV and monitor applications as well as TV adjustment and repair. Designated as the Hickok Model 240, it features both a video and adjustable RF output, 10 step gray scale staircase and 3 and 10 bar gated rainbows. Also included are a trigger output for use with scopes and built-in battery check position. The ten step gray scale stair-

case simplifies detection of video compression, poor band-width and other problems in almost any stage. The three bar gated rainbow permits fast, easy chroma checks and is particularly useful on vectorscope measurements. Other features of the new Hickok Model 240 Video Generator include adjustable chroma levels from 0-125%, crystal controlled chroma and timing oscillators for stability from −20°to 125°F and non-skid rubber feet that prevent marring of the work surface.

Complete Audio Measurement System

Circle No. 130 on Reader Inquiry Card

This new audio analyzer from *Hewlett-Packard* reportedly makes complicated audio measurements with a single keystroke and is designed for use in audio test and transceiver test applications. Model 8903A combines a low distortion audio source with a highly flexible analyzer in one instrument which measures dc volts, ac volts, distortion, signal to noise, SINAD (signal to noise and distortion) and audio frequency from 20Hz to 100kHz. Using a microprocessor-controller, the 8903A does tedious routines of complicated quantities such as signal to noise. With a single keystroke, it controls and gates the audio source, then measures and computes the ratios of the resulting signals from the transceiver under test.

The audio source section provides 0.6mV to 6V open circuit from 20Hz to 100kHz with frequencies and levels set by keyboard. Log sweeps can be programmed as well as frequency increment changes, with single keys. Front panel frequency display resolution is 5 digits, while the amplitude display is 4 digits.

An X-Y recorder can be driven directly. Y-axis output is scaled to 0-10V for the units selected by keyboard entry, and measurements can be absolute or dB and percent relative to a prior measurement or a key-entered number.

For general audio testing the 8903A measures frequency response, swept distortion, hum and noise, gain, and power output. For ac level and distortion tests, a true RMS detector provides best accuracy. Distortion measurements can be made to typically 0.003% (-90 dB) between 20Hz and 20kHz. AC level accuracy is specified at ±0.5% from 20Hz to 20kHz.

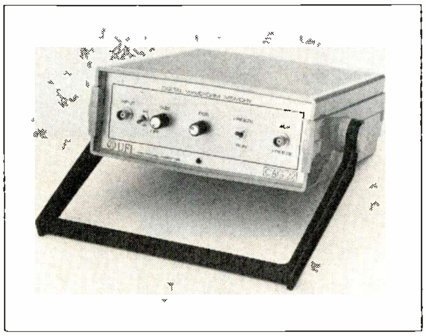
In transceiver test applications, the 8903A source is used to modulate the test transmitter while the demodulated output of a companion 8901A Modulation Analyzer is measured for distortion and frequency response. An internal psophometric filter allows testing to CEPT recommendations, the counter measures squelch tones, while other filtering rejects squelch tones for the audio tests. Since both SINAD (FM receivers) and signal-to-noise (AM receivers) test sequences involve noisy readouts, special digital smoothing takes place in the microprocessor to prevent "jumpy" displays and to deliver a digital reading that is known to be valid.

The analyzer section accepts signals up to 300V at dc and 20Hz to 100kHz. In the automatic mode it autotunes to the distortion or level function range for best accuracy and resolution. The U.S. price of the 8903A is $5800.

Digital Waveform Memory

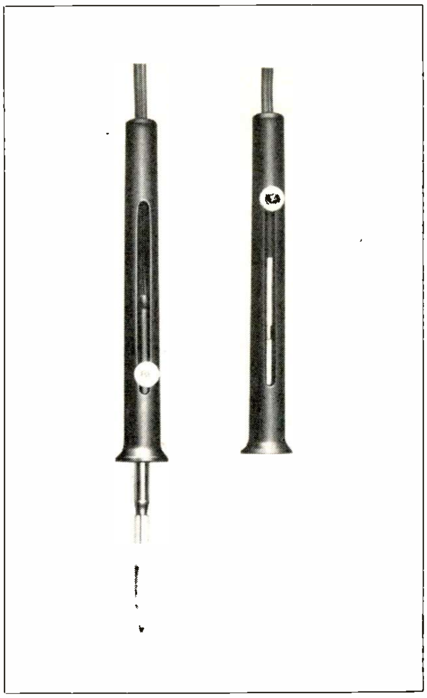
Circle No. 131 on Reader Inquiry Card

UFI's CAG 22 is a digital storage device which reportedly converts any triggerable oscilloscope into a low-frequency memory or "freeze" display. Featuring a flicker-free presentation of analog data, it may be used to capture "once only" transients for research, analysis, or teaching. It also has application to vibration and noise analysis, audio studies, biofeedback, medical instrumentation, or any other instance where it is desirable to use a "bouncing ball" oscilloscope to freeze time. The price is $495.00 with a one year warranty.



"Slide-Away" Soldering Iron

Circle No. 132 on Reader Inquiry Card

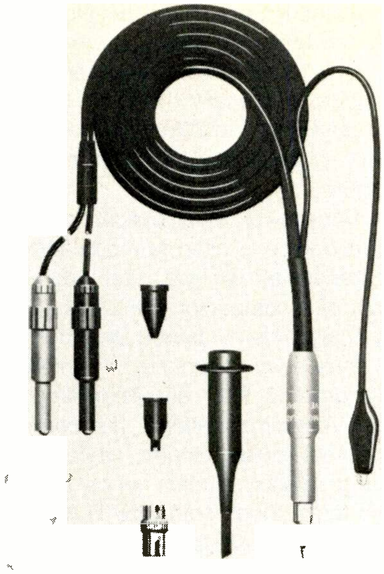


A new soldering iron which can reportedly be packed away into a tool box, attache case—even a pocket—immediately after use while the iron is still hot has just been introduced by *Electronic Tool Co.* For safety and convenience, the Aster Soldering Iron has a thumb-operated, on/off sliding switch in the handle. Move it forward and it simultaneously turns power on and exposes the tip, ready for soldering. When the job is finished, slide the switch back; power is turned off and the hot tip recesses into the heat-resistant handle, which means the soldering iron can be placed into a tool box hot without waiting for it to cool down. A 40-watt iron, the Aster "Slide-Away" soldering iron uses thread-on tips and comes with a 3-wire cord.

Inexpensive RF Probe

Circle No. 133 on Reader Inquiry Card

A new, inexpensive RF probe, the DP750TP, is now available from *Test Probes, Inc.* It allows the user to read the RMS voltage value of signals from 100kHz to 750MHz on a wide variety of DMM's and VOM's. The DP750 provides a 1V dc output with a 1V rms input for instruments having a 10 Mohm input resistance. It has a wide working voltage range from 250mVp-p to 100Vp-p. Features include retractable safety sleeved banana plugs that fit standard banana jacks and a 200V (dc & peak ac) maximum input voltage. Specially designed insulated female/female adaptor sleeves are also available for use with instruments such as the Triplet model #630VOM. The DP750TP comes com-



plete with sprung hook, BNC adaptor, I.C. tip and insulating tip and lists at $45.00. The optional adaptor sleeves list for $3.00 per set, one red, one black.

Deviation Meter

Circle No. 134 on Reader Inquiry Card

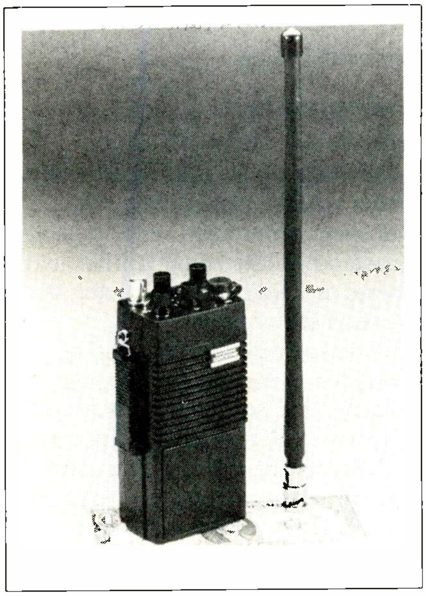
Automated Industrial Electronics' Measurements Division's Model 920 Standard Deviation Meter is a portable, self-contained instrument designed to measure the peak frequency deviation of frequency modulated communications transmitters, particularly for mobile radio servicing. It comes equipped with a built-in charger and holders for a 12-volt portable rechargeable battery for use where normal power is not available. For light duty portable operation, 9 "D" size cells will supply power for up to 50 hours. This deviation meter contains an linear, counter-type discriminator and a peak-to-peak volt-meter. The conversion oscillator reportedly has low inherent residual frequency modulation. The range of this instrument can be extended below 25MHz by using an external oscillator to heterodyne the transmitter frequency to the 100kHz intermediate frequency. The output system includes a 750 micro-second deemphasis network which allows the Model 920 to be used as a standard test receiver meeting the require-ments of EIA Standard RS-152-A. The price of the Model 920 is $630.00.

Work Benches

Circle No. 135 on Reader Inquiry Card

Production Industries offers two new series of modular benches for electronics assembly or test. The lower cost Val-U-Line benches are a standard bench with a wide range of accessory shelves, panels and drawers. The Can-T-Lever benches offer, as the name implies, open space without front legs where desired. **ET/D**

DEALER'S SHOWCASE



Low-Band Hand-Held

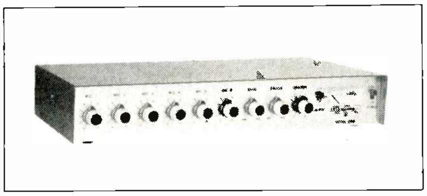
Circle No. 136 on Reader Inquiry Card

A new, small, 2 watt hand-held portable low-band FM radio has just been introduced by *Tamaphone*. Measuring 5 inches high by 2-½ inches wide by 1-¾ inches thick and reportedly weighing just over one pound, the MT-42 offers up to four channels (with a maximum spread of 3MHz), 12.5 or 25 kHz channel spacing, and, reportedly, a receiver sensitivity of 0.5uv for 20dB quieting. Battery drain is, according to the manufacturer, 12 ma in standby, 70ma in receive and 500ma in transmit. Battery life is up to 8 hours on a charge. A wide variety of accessories is available. The list price is $720 with a one year warranty.

Six-Input Mixer-Preamp

Circle No. 137 on Reader Inquiry Card

Lear Siegler's Bogen Division has announced the CDM, a new six-channel, professional quality mixer- preamplifier. Suitable for a wide range of applications, the CDM reportedly offers the over-the-counter sound buyer features and performance usually found only in high-priced professional equipment. This all solid-state mixer-preamp features six low-impedance balanced and transformer-isolated microphone inputs as well as the studio-equipment technique of active mixing. It has a transformer-isolated output rated at 18dBm into a 600-ohm load with less than 1% harmonic distortion, 20-20,000Hz. Each of the six inputs has its own front- panel gain control and is preceded by a fixed attenuator pad, switch-selectable on the rear panel. This feature allows Channels 1 through 4 also to accept 0dBm, 600-ohm line inputs or high-level instrument microphone inputs of up to 1 volt rms. Channels 5 and 6 can accept high-impedance auxiliary signals, such as a ceramic cartridge, tuner or tape player. Channel 6, in the phono position, is RIAA compensated and accepts the input of a turntable with magnetic cartridge. Active mixing in the CDM eliminates interaction between channel gain controls, minimizes residual mixing bus noise and provides constant preamp gain and input sensitivity as channels are added. Residual noise level is 57dB below the rated input. Separate bass and treble controls allow up to 12dB cut or boost at 50Hz and 15,000Hz. Other features found in the CDM are an illuminated professional VU meter with a range switch to set the zero VU indicator at either 4dBm or 10dBm, six 3-pin microphone receptacles, provision for remote control of the master volume level and a built-in circuit to give precedence over Channels 5 and 6. This circuit also can be used for remote volume control of these channels. An equalizer link and a 600mV booster level output for high-impedance booster inputs are included. The rear panel incorporates phono jacks for these and the mag phono input, as well as terminal strips for 600-ohm outputs and auxiliary dc power connections. Bogen's CDM can stand alone or be rack-mounted. It will operate from either 120/240vac,50/60Hz or 24/28vdc sources.



Energy Conserver

Circle No. 138 on Reader Inquiry Card

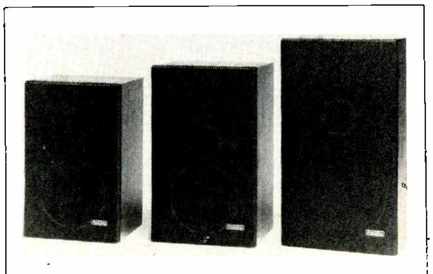
EnerCon Inc. has introduced Dr. Watt, an energy conserving device utilizing patented NASA technology. Dr. Watt reportedly cuts the Power required for induction motors by 10 to 60%. Products with continuous running induction motors include: washers, gas dryers, refrigerators, air conditioners, furnaces, etc. By plugging Dr. Watt into a wall socket and then the appliance into Dr. Watt, the unit measures the power needed to do the job and delivers only that amount to the motor. The motor continues operating, but when it doesn't require full power, as in small washing machine loads, Dr. Watt estimates and delivers the minimum power required thus conserving the unrequired extra power.

NASA developed the patented device used in Dr. Watt to achieve the greatest possible efficiency from motors which would operate on solar energy. EnerCon, under licence from NASA, modified this principle for use with home appliances which have induction motors of ¼ horsepower or less. Depending on the function of the motor, the consumer, it is stated, can conserve 10 to 60% motor power. Dr. Watt has a built-in safety fuse for line protection, and energy booster circuits for clutched-in loads such as dishwashers and washing machines. Dr. Watt is priced at $29.95 with a money back guarantee.

Mid-size Speaker Line

Circle No. 139 on Reader Inquiry Card

Altec Lansing International has introduced a new generation of mid-size high-fidelity speaker systems at the Summer Consumer Electronics Show. The three models in the new series incorporate sound reproduction technology that was, reportedly, previously available only in larger, more expensive floor model and professional speakers, as well as brand new engineering developments that are stated to deliver lower distortion, increased efficiency and truer reproduction. The series consists of Model 4, a 10-inch two-way system;



Model 6, a 10-inch three-way system and the top-of-the-line Model 8, a 12-inch three-way system. All three models feature Altec's Mantaray horn and Tangerine radial phase plug, plus LZT (lead zirconate titanate) ultra-high-frequency compression drivers. LZT is a space-age semiconductor material that directly converts electrical energy to physical motion, replacing the conventional magnet and voice coil. Other features new to this size range according to Altec are their exclusive Automatic Power Control, which prevents power overload, and anechoic damping, an acoustically absorbent baffle covering that reduces difraction distortion.

ZENITH

continued from page 31

deflection yoke become shorted, the screen will go black, the H V will drop to about half value and the 2 amp line fuse will blow. At first it may appear as a faulty 9-160 module. One quick check is to remove the 3P yoke plug and jump a clip lead from pin 4 of the 3P plug to pin 3 of the 3D yoke plug. Now turn on the set and the high voltage will go up and you will see a thin white vertical line of the screen if the yoke was defective.

With the yoke plugged in and a scope connected to pin 1 of the plug 3D (hot lead) and the ground lead of the scope to pin 6 of the 3D yoke plug. The waveforms taken at this point by the scope can be used as comparisons to give you an indication of the yoke's condition.

The bottom trace in figure A is for a good yoke while the top waveform indicates an open yoke winding condition. While in figure 10B the bottom trace is for a good yoke and the top trace indicates a faulty yoke that has shorted windings and has loaded down and detuned the sweep output stage.

Another place where you can make a scope check is on the 250 V DC supply pulse winding that is tap K on the TX3352 sweep transformer. A good pick-up point on the board is at the L3476 choke coil. An open yoke will produce a pulse as shown in the top waveform. A shorted yoke will give a very low amplitude pulse at this test point.

HV shut-down check

To determine if the 9-160 module is in the shutdown mode, a quick and simple check can be made. Measure the DC voltage at pin 3 of connector 3C on this module. If the 9-160 module is in the shutdown mode a voltage of +8 to +9 volts will be measured at this pin. The normal DC voltage is +.9 to +1.2 volts DC. **ET/D**

TAPE PLAYERS

continued from page 35

The noise *was* still there. Replacement of the entire IC component solved the noisy output stage.

A noisy motor

The noise in a Sharp RD-474AV cassette tape deck could be controlled with the volume control. When the control was turned up a whining noise was heard in the background. The motor belt was removed from the motor; the noise was still present.

The noise could be controlled by slowing the motor down or stopping it manually. This indicated the motor was arcing internally and feeding the noise into the amplifier circuitry. Since the noise was quite annoying, the motor was replaced. Noisy motors should be replaced to prevent future call-backs.

Conclusion

When a tape player comes in with a noise problem, try to isolate the noisy section. Determine if the defective component produces electronic or mechanical noise. Isolate the radio circuits from the audio section by turning the volume control down. Signal tracing techniques are valuable in isolating suspected transistors or ICs. Remember, voltage or resistance measurements are generally ineffective in locating noise. **ET/D**

TEST INSTR. RPT.

continued from page 39

tained. Either of these can be recalled by holding depressed the MAX or MIN key.

The upper right corner key marked Δ (delta) blanks the least significant digit of the display and replaces it with a right facing arrow if the measured quantity is increasing and a left facing arrow if it is decreasing. There is no arrow if there is no change. To find a peak, adjust in the direction which produces a right arrow and continue until the arrow turns around. To make sure the peak has not been passed depress the MAX key. If the maximum reading and the current reading are the same, you have the peak.

The 4381 offers a unique package of functions. Now if Bird could just sneak an eight digit counter and a deviation meter into the same package . . . .

The price of the Model 4381 RF Power Analyst is $590. **ET/D**

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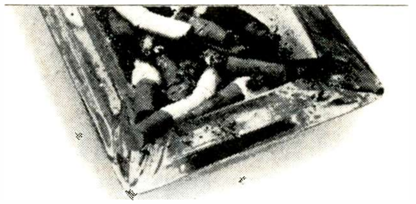

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115	Lindgren RF Enclosures	25
122	MCM Audio Inc.	3
116	Mallory Dist. Prod. Co.	Cov 3
117	Optima Electronics	31
109	Ora Electronics	29
102	PTS Electronics Inc.	Cov 2, 1
120	Sperry Tech Inc.	21
118	Test Probes Inc.	31
111	Thordarson Meissner Inc.	4
104	Triplett Corp. (for info)	Cov 4
105	Triplett Corp. (for demo)	Cov 4
119	Tronics 2000	13
121	Wahl Clipper Corporation	42

FEATURES *TEST GEAR*

Circle No.		Page No.
140	B & K Precision/Dynascan Corp.	14
141	Hickok Electrical Instrument Co.	15
142	Viz Mfg. Co.	15
143	Triplett Corp.	15
144	Simpson Electric Co.	16
145	Blonder-Tongue Labs. Inc.	16
146	International Instrumentation Inc.	16
147	GTE Sylvania, EGC Consumer Renewal	16
148	Bechman Instruments	16
149	Simpson Electric Co.	16

CONT. ED. RPT.

Circle No.		Page No.
151	Heath Co., The	37

TEST INSTR. RPT.

Circle No.		Page No.
150	Bird Electronics Corp.	39

NEW PRODUCTS

Circle No.		Page No.
125	Triplett Corp.	40
126	Vu-Data Corp.	40
127	OK Machine and Tool Corp.	40
128	Soar Electronics	40
129	Hickok Electrical Instrument Co.	40
130	Hewlett-Packard	41
131	UFI	41
132	Electronic Tool Co.	41
133	Test Probes, Inc.	42
134	Automated Industrial Electronics Measurements Div.	42
135	Production Industries	42

DEALER'S SHOWCASE

Circle No.		Page No.
136	Tamaphone	43
137	Lear Siegler Inc.	43
138	EnerCon Inc.	43
139	Altec Lansing International	43

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

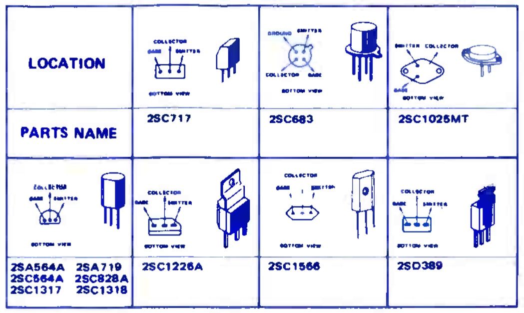
	SCHEMATIC NO.		SCHEMATIC NO.
PANASONIC B&W TV Model TR545	1851	TOSHIBA Color TV Models C990/C990C	1854
TOSHIBA Color TV Models C098/C099/C099C	1852	WARDS B&W TV Model GEN11159A	1855
TOSHIBA Color TV Models C398/C399/C399C	1853		

1851

PANASONIC
B&W TV Model
TR545

JULY • 1980

TRANSISTOR BASE INFORMATION



LOCATION			
PARTS NAME	2SC717	2SC683	2SC1025MT
2SA564A 2SA719 2SC564A 2SC828A 2SC1317 2SC1318	2SC1226A	2SC1566	2SD389

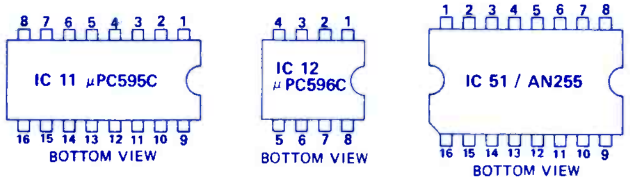
NOTE

1. RESISTOR
   All resistors are carbon 1/4W resistor, unless otherwise noted the following marks.
   Unit of resistance is OHM (Ω) (K=1,000, M=1,000,000)
   - △ : Solid resistor
   - ● : Metal oxide resistor
   - ▢ : Wire wound resistor
   - Thermistor
   - Fuse resistor
2. CAPACITOR
   All capacitors are ceramic 50V capacitor, unless otherwise noted the following marks.
   Unit of capacitance is μF, unless otherwise noted.
   - M : Polyester capacitor
   - S : Polystylene capacitor
   - Electrolytic capacitor
3. COIL
   Unit of inductance is μH.
4. TEST POINT
   - Test point position
5. VOLTAGE MEASUREMENT
   Voltage is measured by a volt ohm meter with DC 20K OHM/V receiving normal signal, when all controls are set to the maximum position.
   The voltage in parenthesis is measured when the power switch is set to "off" position.
6. Number in red circle indicates waveform number.
7. When arrow mark (↗) is found, connection is easily found along with the direction of an arrow.

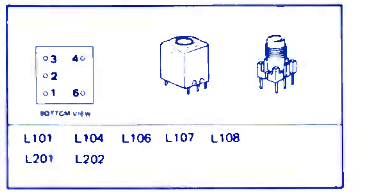
IMPORTANT SAFETY NOTICE

THE SHADED AREA ON THIS SCHEMATIC DIAGRAM INCORPORATES SPECIAL FEATURES IMPORTANT FOR PROTECTION FROM X-RADIATION, FIRE AND ELECTRICAL SHOCK HAZARDS. WHEN SERVICING IT IS ESSENTIAL THAT ONLY MANUFACTURER'S SPECIFIED PARTS BE USED FOR THE CRITICAL COMPONENTS IN THE SHADED AREAS OF THE SCHEMATIC.

IC TERMINAL INFORMATION

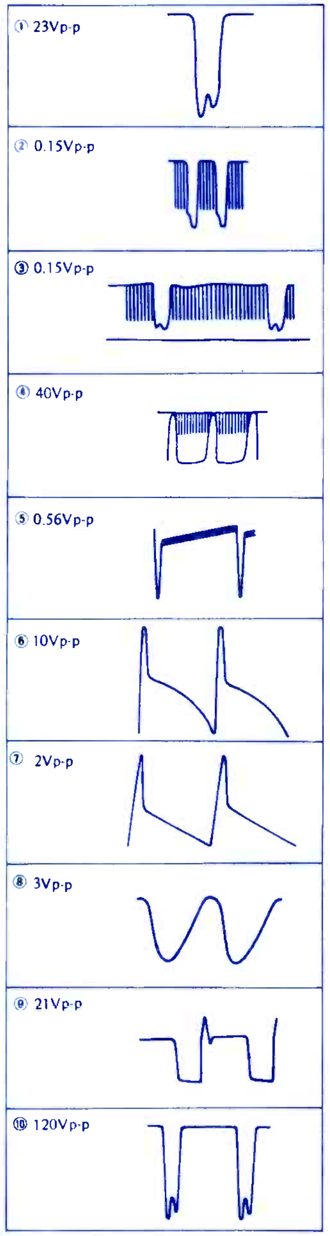


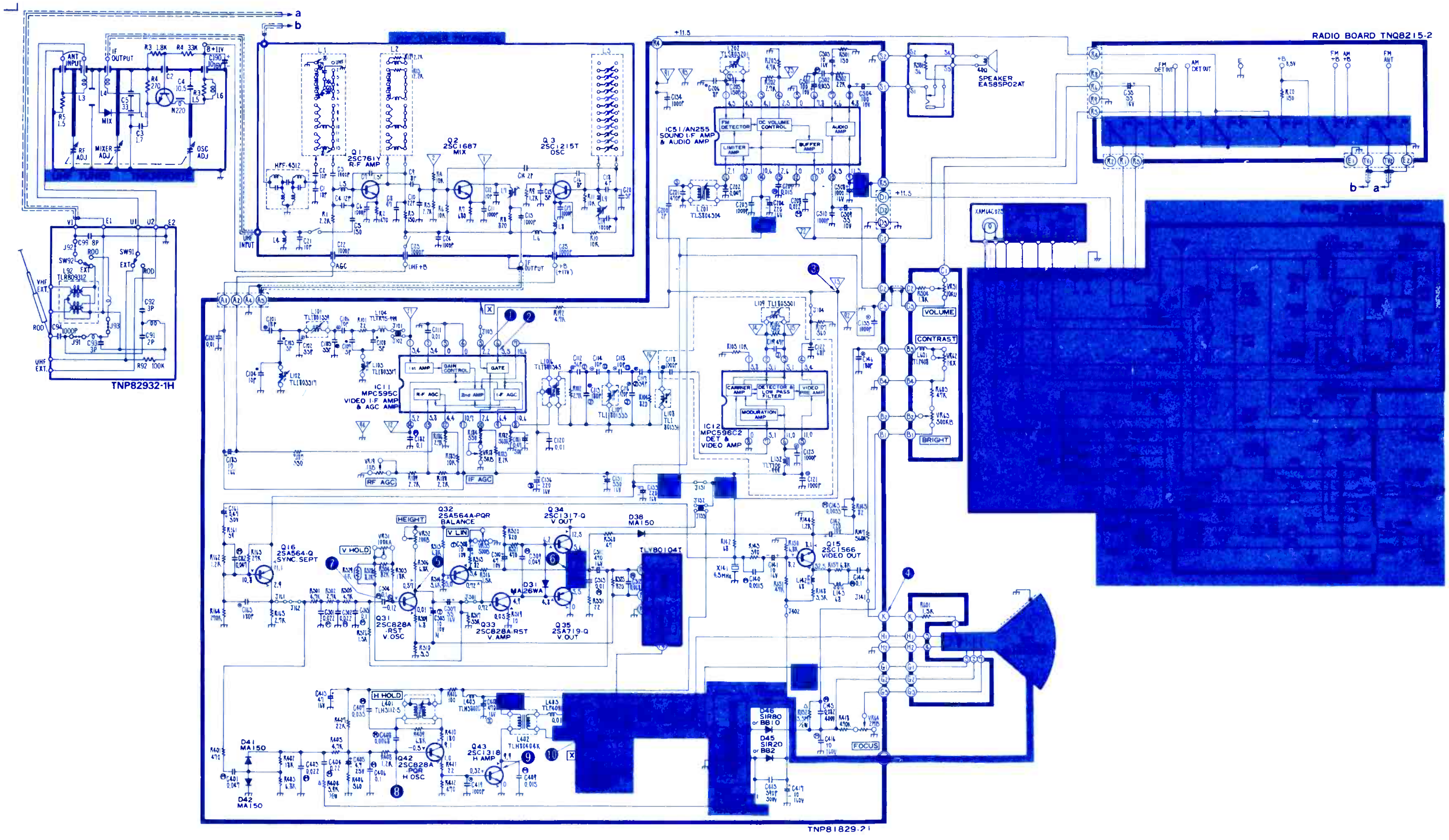
TRANSFORMER TERMINATION INFORMATION



WAVEFORM PATTERNS

These waveforms were taken with normal signal.
The peak-to-peak voltage were taken with brightness and contrast controls set for maximum position.





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1852

TOSHIBA
Color TV Model
C098/C099/C099C

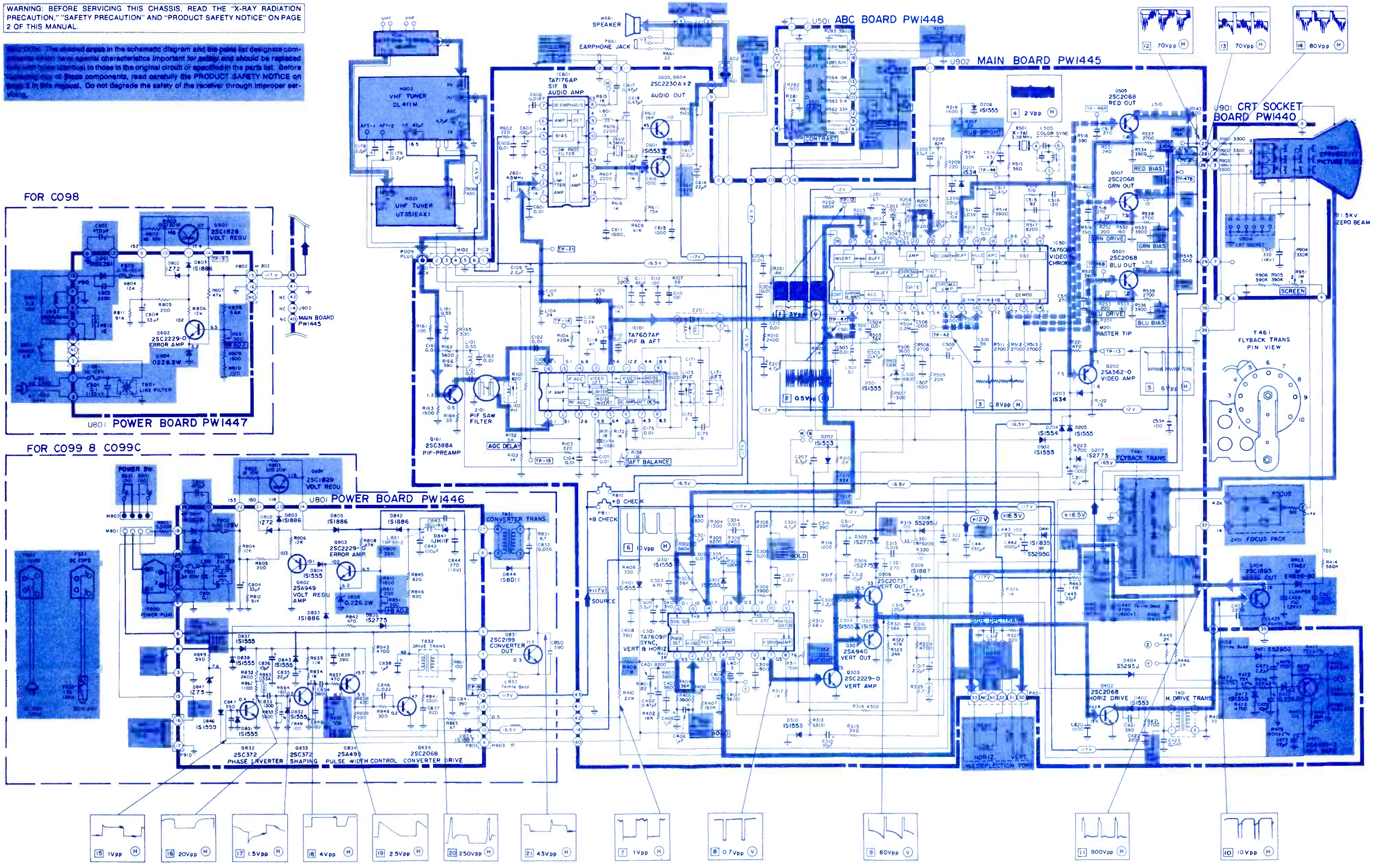
JULY • 1980

ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

NOTE:
1. Resistance is shown in ohm. k=1,000 M=1,000,000.
2. Unless otherwise noted in schematic, all capacitor values less than 1 are expressed in mfd, and the values more than 1 in pF.
3. Unless otherwise noted in schematic, all inductor values more than 1 are expressed in μH, and the values less than 1 in H.
4. Voltages read with "VTVM" from point indicated to chassis ground, using a color bar signal with all controls at normal, line voltage 120 volts.
5. The color amp. control of the color bar generator is set to obtain 0.6 vp-p chrominance signal on oscilloscope when observing waveform of terminal TP-12.
6. Waveforms 1-11 and 15-21 are taken with an air signal and waveforms 12-14 are taken using a color bar generator.
7. Voltage readings shown are nominal values and may vary ±20% except H.V.

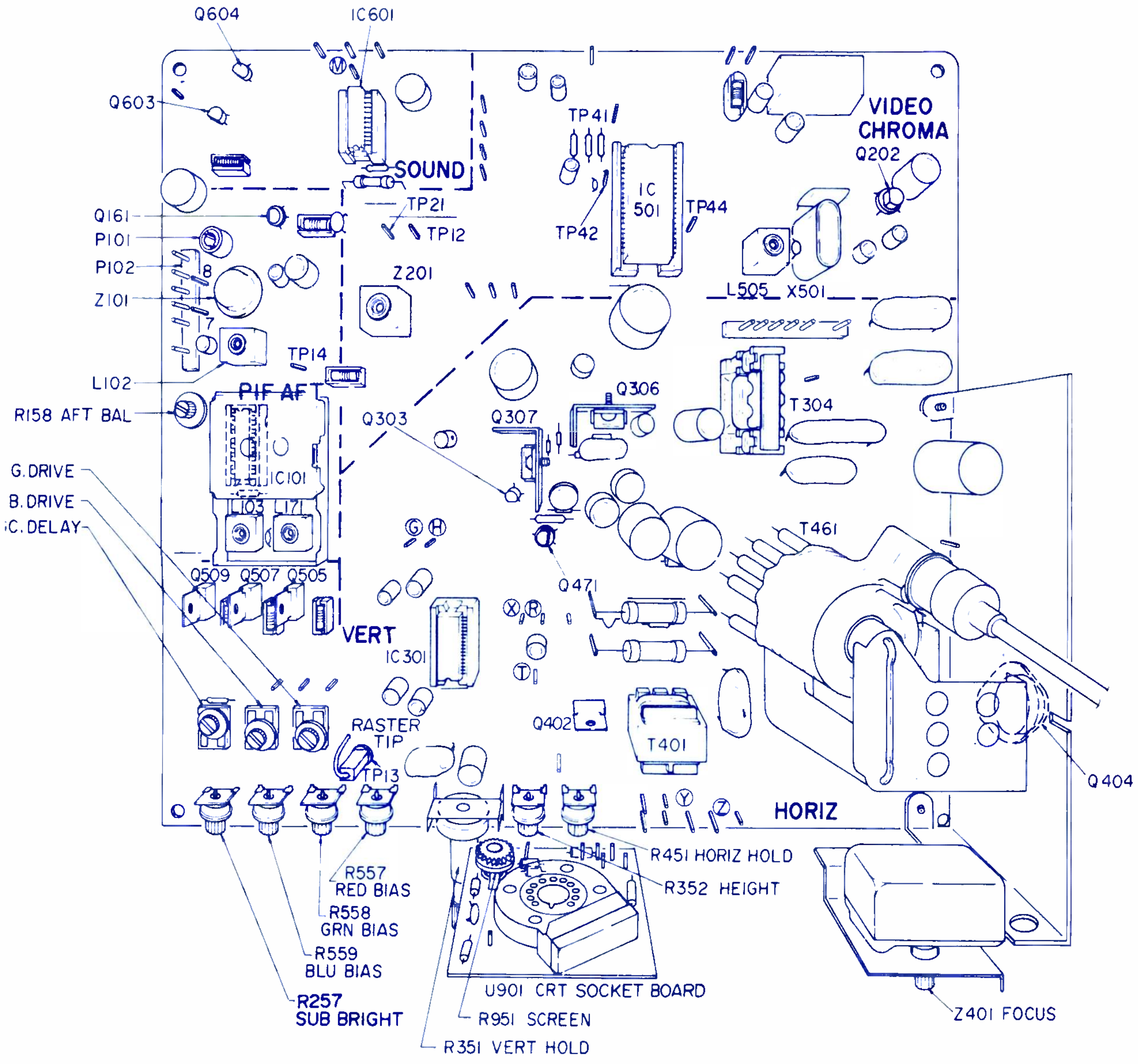
WARNING: BEFORE SERVICING THIS CHASSIS, READ THE "X-RAY RADIATION PRECAUTION," "SAFETY PRECAUTION" AND "PRODUCT SAFETY NOTICE" ON PAGE 2 OF THIS MANUAL.

CAUTION: The shaded areas in the schematic diagram and the parts list designate components which have special characteristics important for safety and should be replaced only with types identical to those in the original circuit or specified in the parts list. Before replacing any of these components, read carefully the PRODUCT SAFETY NOTICE on page 2 in this manual. Do not degrade the safety of the receiver through improper servicing.

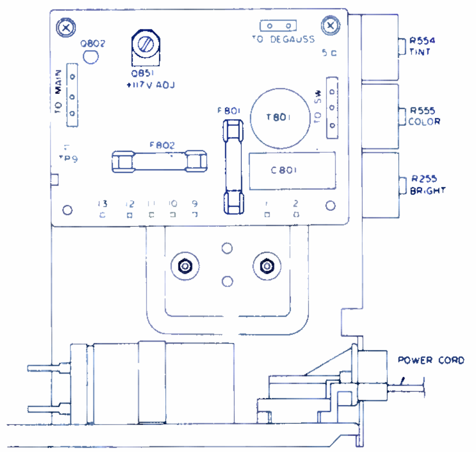


TOSHIBA
Color TV Model
C098/C099/C099C

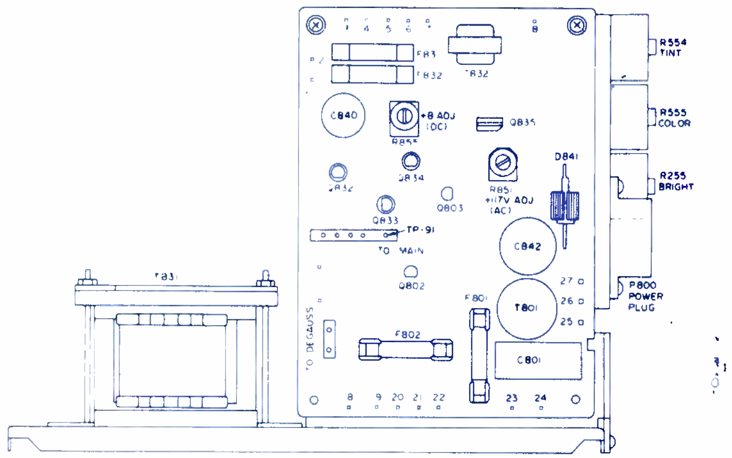
CHASSIS TOP VIEW



POWER BLOCK VIEW



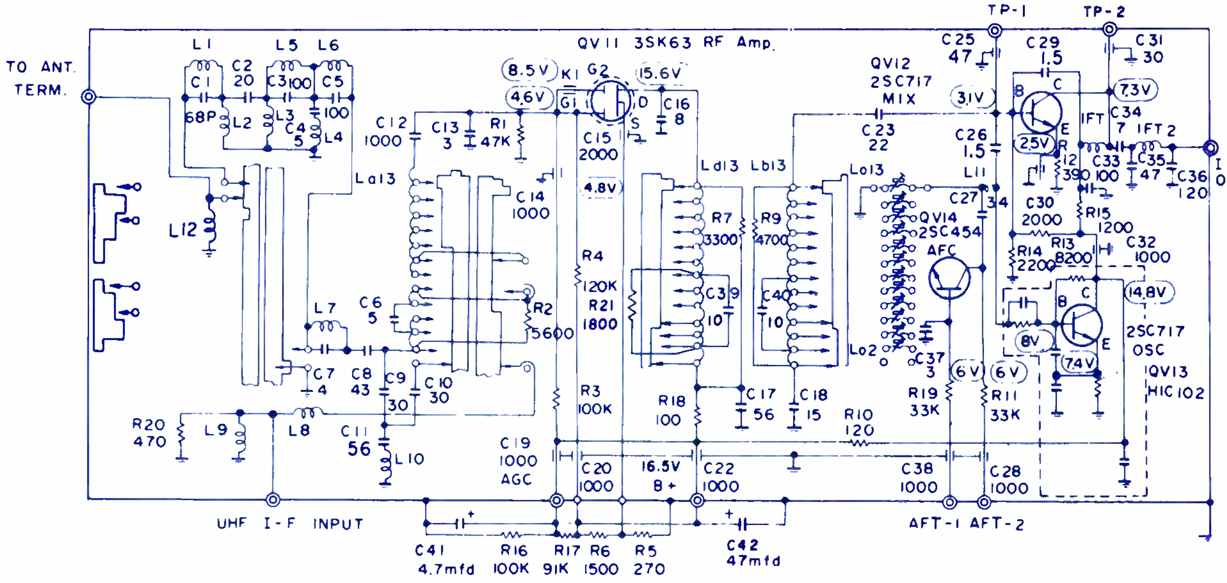
Model: C098

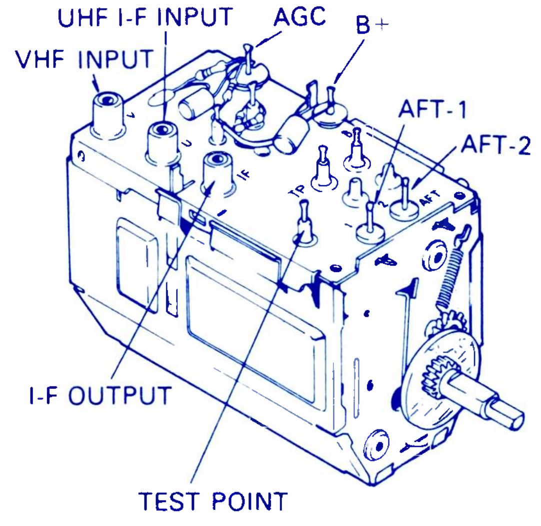


Models: C099 and C099C

WARNING: BEFORE SERVICING THIS CHASSIS, READ THE "X-RAY RADIATION PRECAUTION", "SAFETY PRECAUTION" AND "PRODUCT SAFETY NOTICE" ON PAGE 2 OF THIS MANUAL.

VHF TUNER INFORMATION (DL411M)





VHF TUNER REPLACEMENT PARTS LIST

LOCATION NUMBER	PART NUMBER	DESCRIPTION
H002	**23121914**	**VHF Tuner, DL411M**
QV11	A6053001	MOS-FET, 3SK63, R-F Amp.
QV12	23114341	NPN Transistor, 2SC717, Mixer
QV13	23119954	VHF OSC. Assembly, HIC102, with a Transistor 2SC717
QV14	23114342	NPN Transistor, 2SC454, AFT

NOTES: All switches are in channel 13 position.
Voltage readings shown above are nominal value with no input signal.

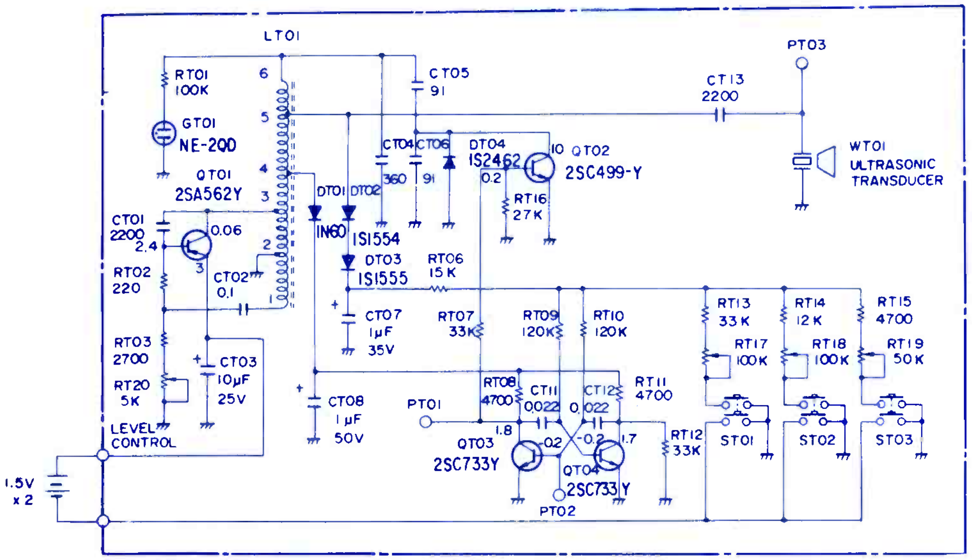
1853

TOSHIBA
Color TV Models
C398/C399/C399C

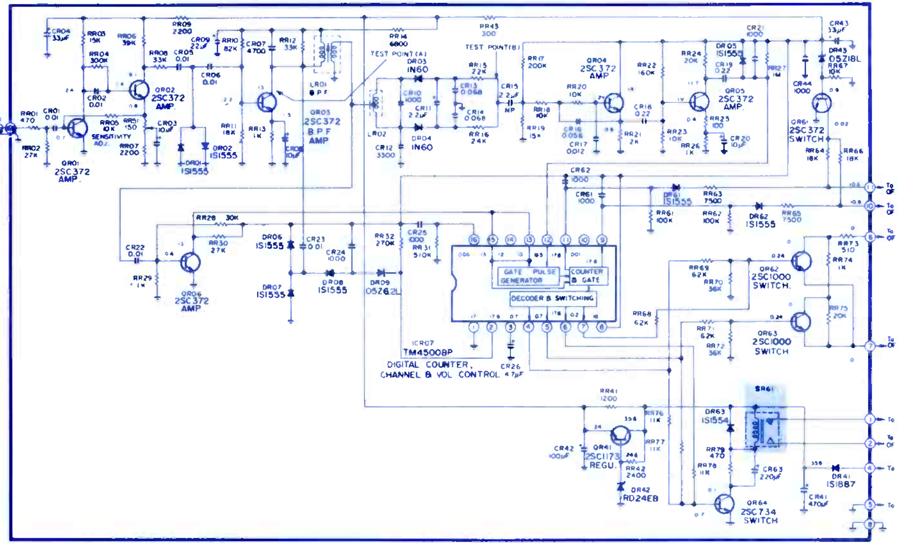
JULY • 1980

ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

UT01 REMOTE CONTROL TRANSMITTER BOARD PW1645



UR01 REMOTE CONTROL RECEIVER BOARD PW1559



WARNING: BEFORE SERVICING THIS CHASSIS, READ THE "X-RAY RADIATION PRECAUTION," "SAFETY PRECAUTION" AND "PRODUCT SAFETY NOTICE" ON PAGE 2 OF THIS MANUAL.

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NOTES:
1. Resistance is shown in ohm. k=1,000. M=1,000,000.
2. Unless otherwise noted in schematic, all capacitor values less than 1 are expressed in mfd, and the values more than 1 in pF.
3. Unless otherwise noted in schematic, all inductor values more than 1 are expressed in μH, and the values less than 1 in H.
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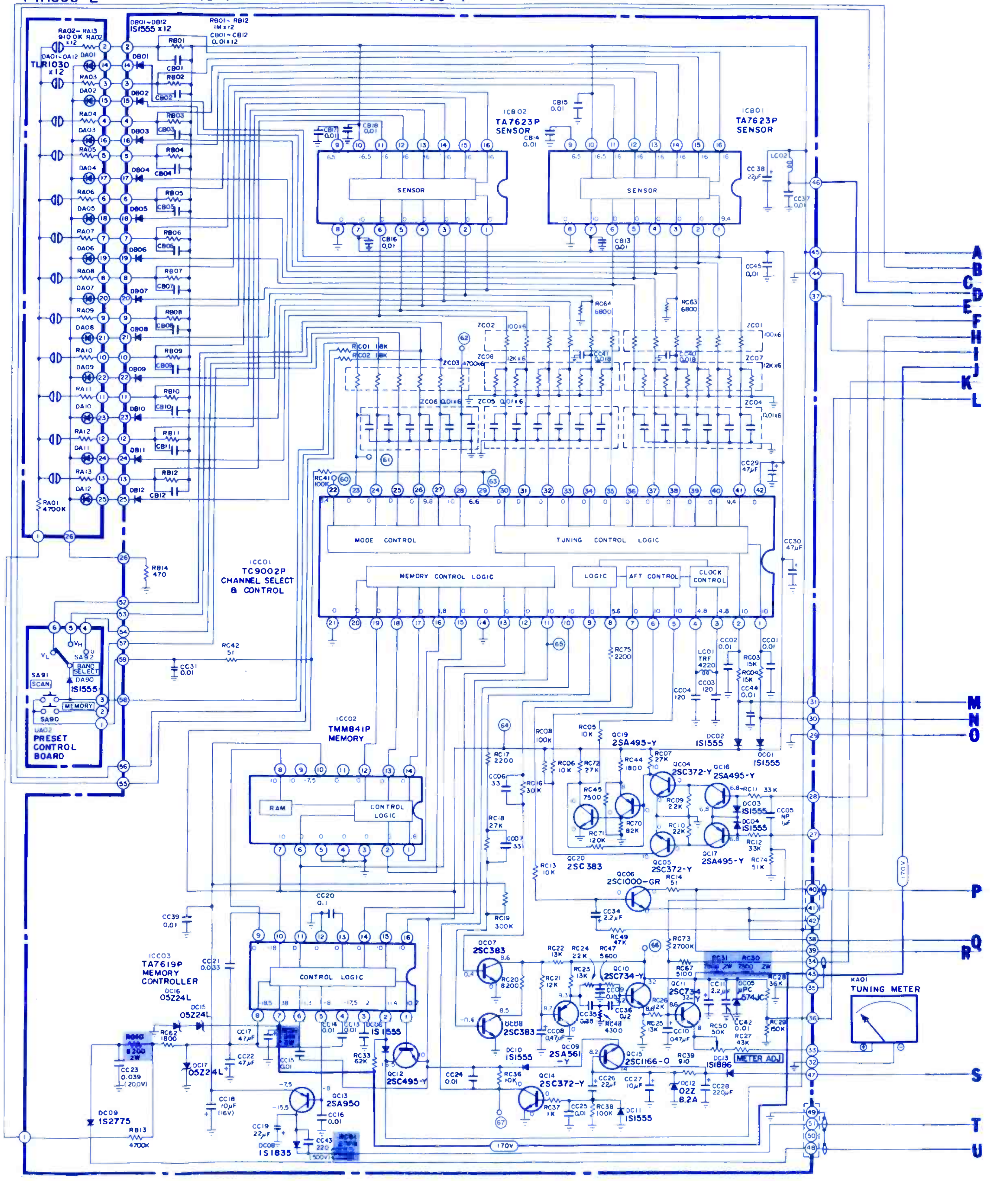
5. The color amp. control of the color bar generator is set to obtain 0.6 vp-p chrominance signal on oscilloscope when observing waveform of terminal TP-12.
6. Waveforms 1-11 are taken with an air signal and waveforms 12-14 are taken using a color bar generator.
7. Voltage readings shown are nominal values and may vary ±20% except H.V.

UB03 INDICATOR BOARD PW1500-2

UB02 SELECTOR BOARD PW1500-1



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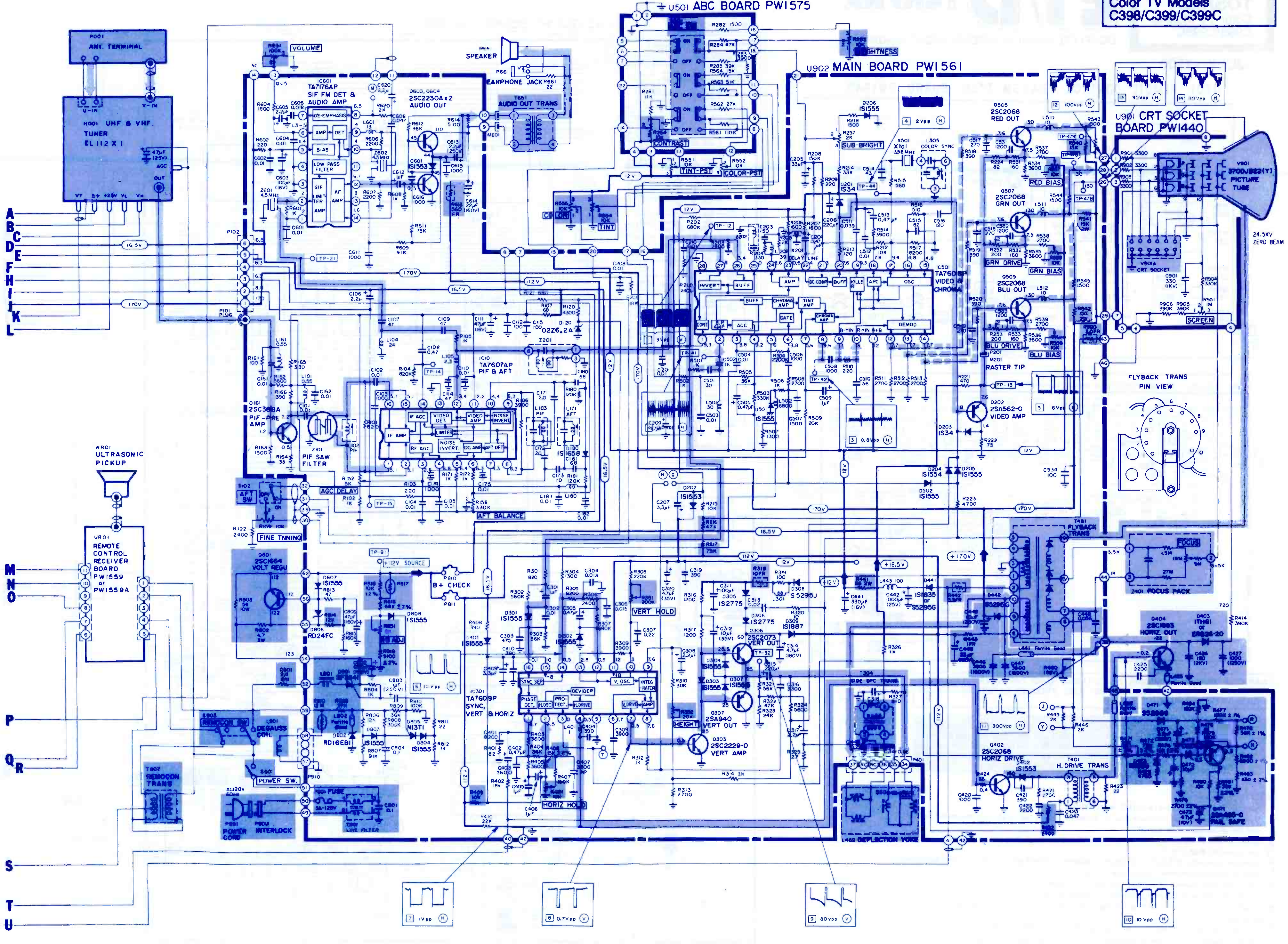
TOSHIBA
Color TV Models
C398/C399/C399C



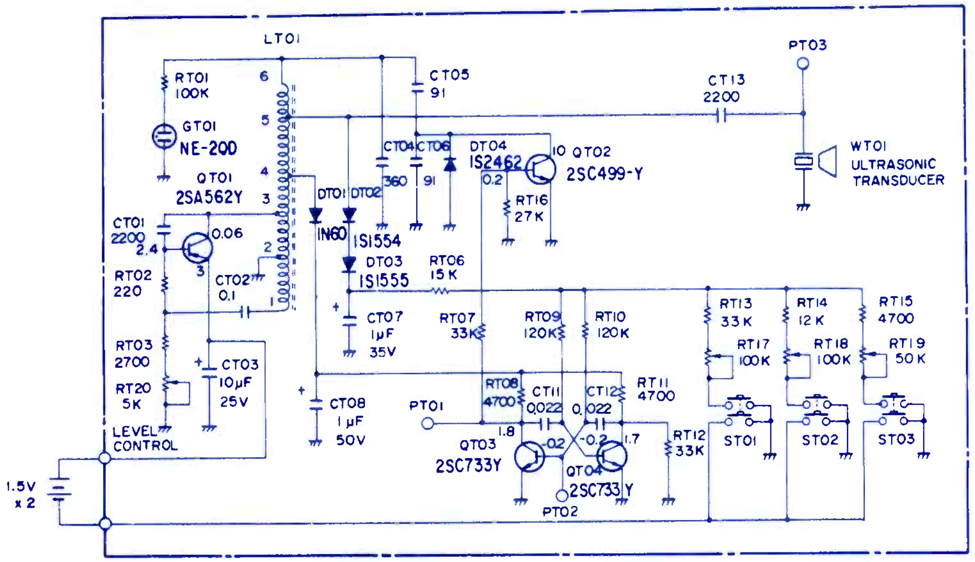
1854

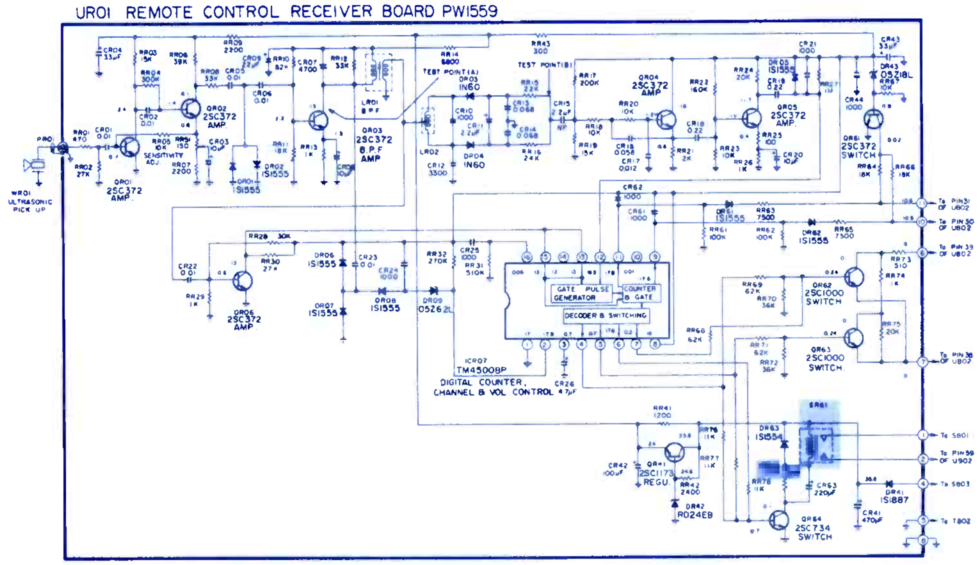
TOSHIBA
Color TV Models
C998/C998C

ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

JULY • 1980

UT01 REMOTE CONTROL TRANSMITTER BOARD PW1645





WARNING: BEFORE SERVICING THIS CHASSIS, READ THE "X-RAY RADIATION PRECAUTION," "SAFETY PRECAUTION" AND "PRODUCT SAFETY NOTICE" ON PAGE 2 OF THIS MANUAL.

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NOTES:

1. Resistance is shown in ohm. k=1,000. M=1,000,000.
2. Unless otherwise noted in schematic, all capacitor values less than 1 are expressed in mfd, and the values more than 1 in pF.
3. Unless otherwise noted in schematic, all inductor values more than 1 are expressed in µH, and the values less than 1 in H.
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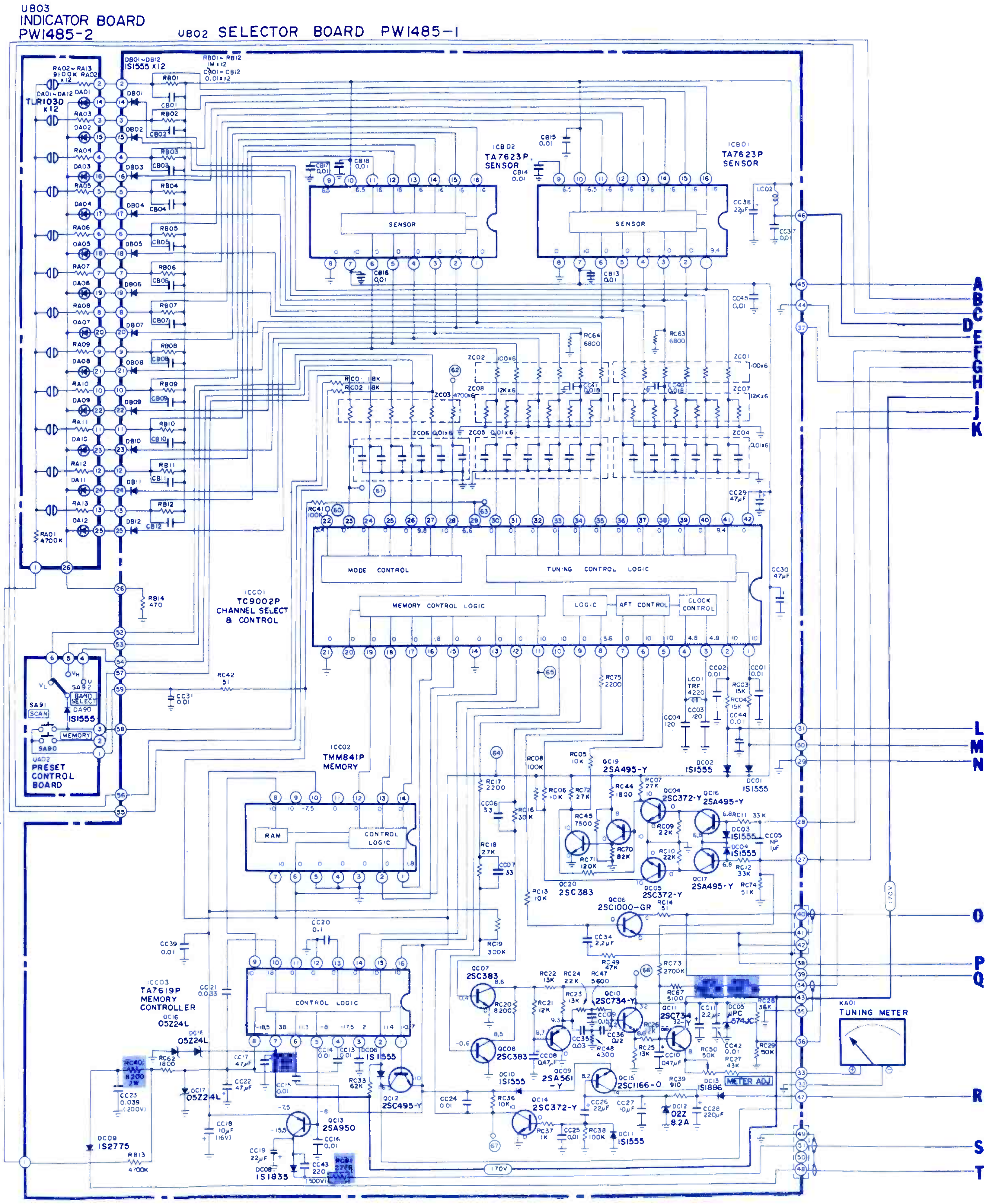
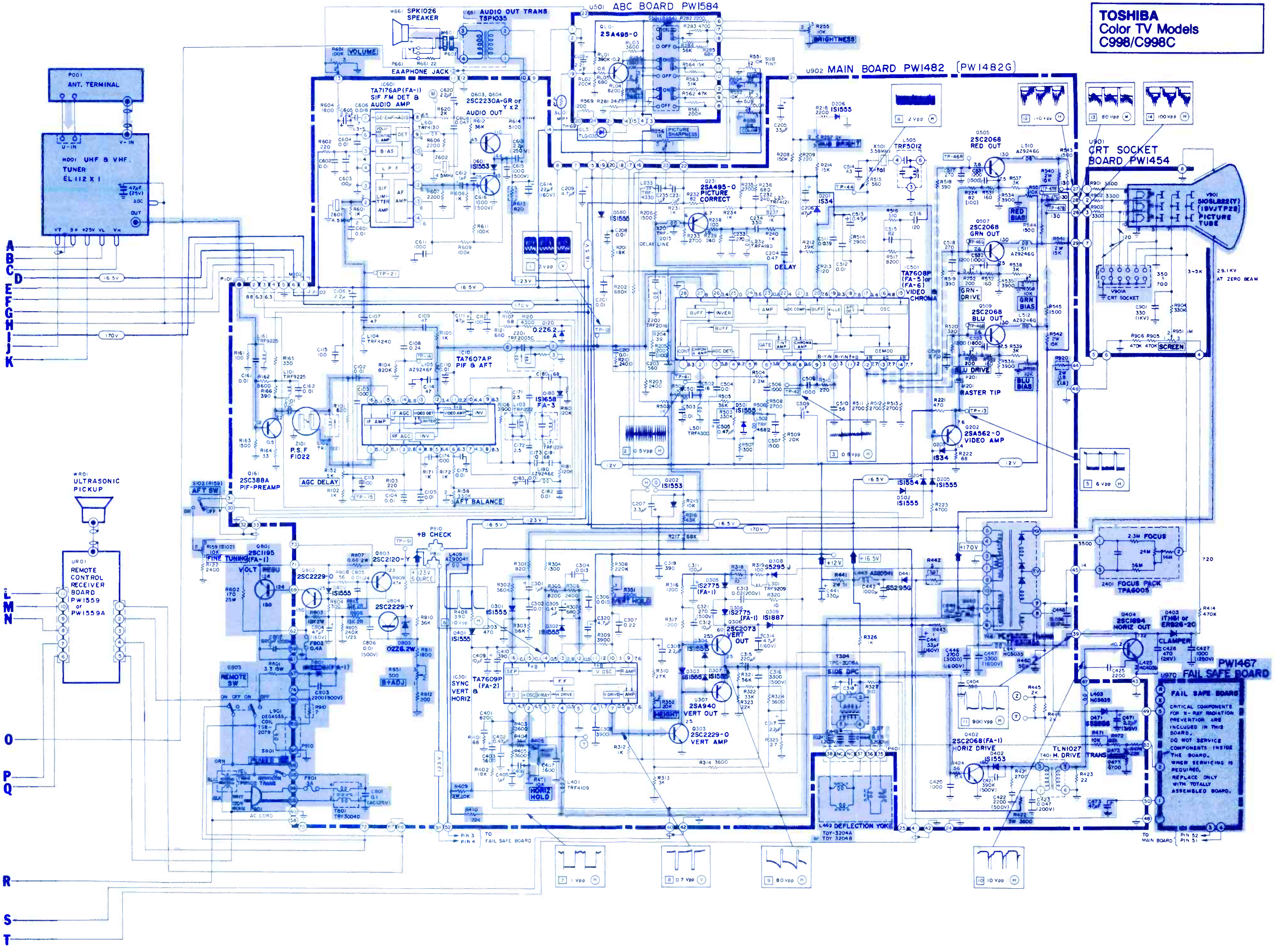
5. The color amp. control of the color bar generator is set to obtain 0.6 vp-p chrominance signal on oscilloscope when observing waveform of terminal TP-12.
6. Waveforms 1-11 are taken with an air signal and waveforms 12-14 are taken using a color bar generator.
7. Voltage readings shown are nominal values and may vary ±20% except H.V.
8. Value in brackets [ ] are applicable for the sets with chassis number TAC890A.



TOSHIBA
Color TV Models
C998/C998C



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1855

WARDS
B&W TV Model
GEN11159A

JULY • 1980

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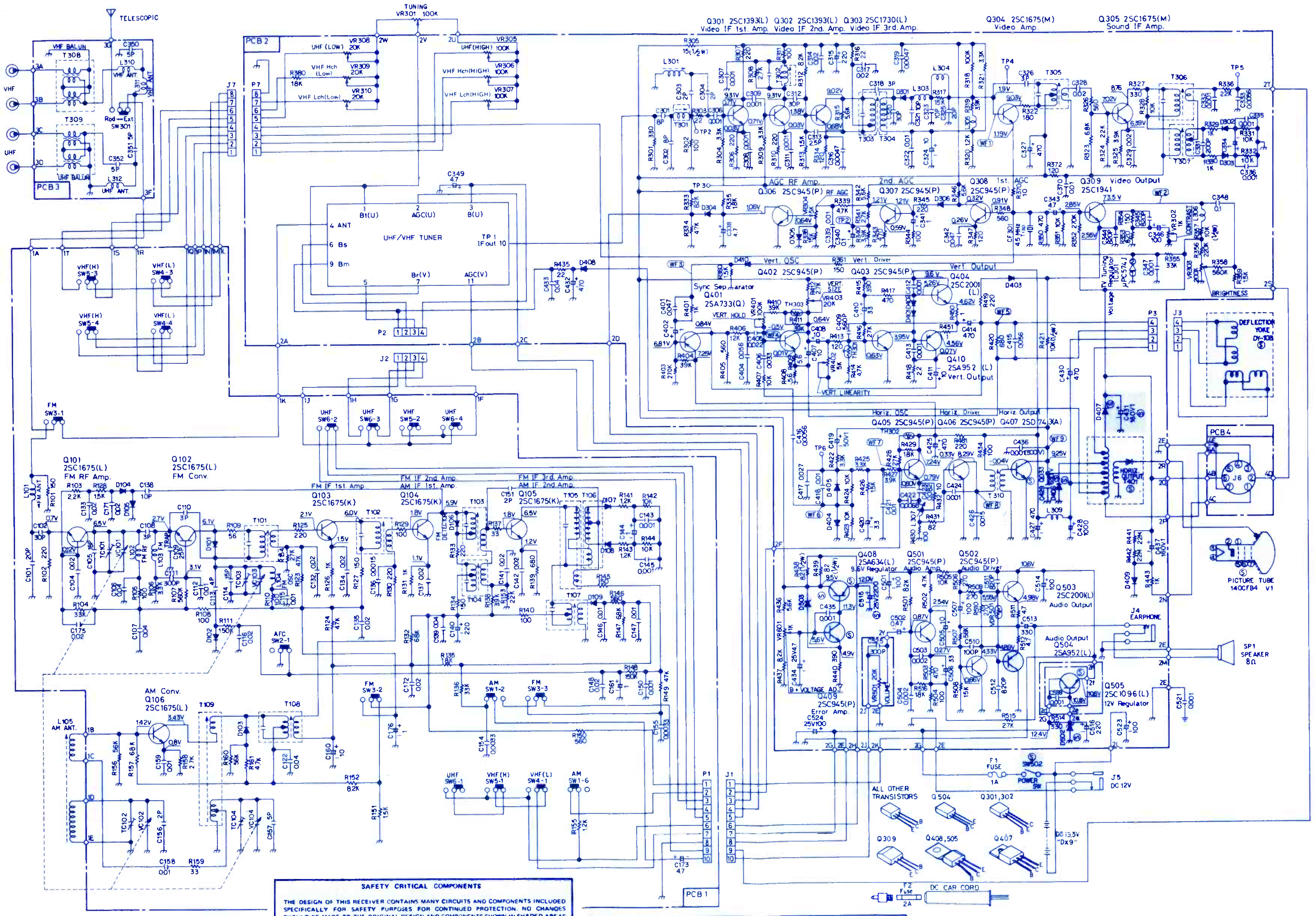
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

Waveforms shown were produced using a Keyed Rainbow Color Bar Generator with its Color Control Set to 100% or normal and a wideband Oscilloscope with low Capacity Probe to prevent loading. Receiver Operating Controls were adjusted to produce Normal Color Bar Display on its CRT Screen.

Oscilloscope Sweep was set at 2ms for Vertical Waveforms and 10 µs for Horizontal Waveforms. Peak-to-Peak Voltages indicated may vary depending on calibration of Test Equipment, Chassis Parts Tolerances and Control Settings.



SAFETY CRITICAL COMPONENTS

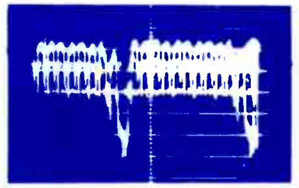
THE DESIGN OF THIS RECEIVER CONTAINS MANY CIRCUITS AND COMPONENTS INCLUDED SPECIFICALLY FOR SAFETY PURPOSES FOR CONTINUED PROTECTION. NO CHANGES SHOULD BE MADE TO THE ORIGINAL DESIGN AND COMPONENTS SHOWN IN SHADED AREAS ON THE SCHEMATIC SHOULD BE REPLACED WITH EXACT FACTORY REPLACEMENT PARTS. THE USE OF UNAUTHORIZED SUBSTITUTE PARTS MAY CREATE A SHOCK, FIRE, X-RADIATION, OR OTHER HAZARD SERVICE SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY.

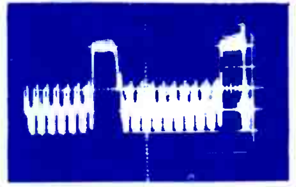
RELIABILITY AND PERFORMANCE

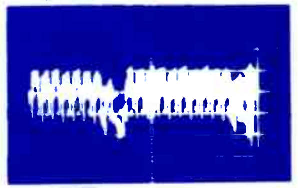
FOR CONTINUED RELIABILITY AND PERFORMANCE EXACT FACTORY REPLACEMENTS ARE RECOMMENDED FOR ALL OTHER PARTS REPLACED. IF A SUBSTITUTE MUST BE USED, BE SURE ITS QUALITY AND SPECIFICATIONS ARE IDENTICAL TO THE ORIGINAL PART

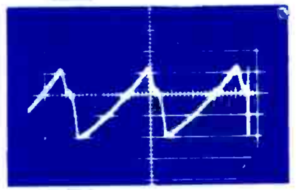
VOLTAGE MEASUREMENTS

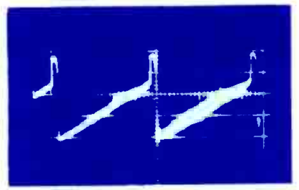
DC VOLTAGES TAKEN WITH VTVM, WITH RESPECT TO COMMON GROUND (B-). DC VOLTAGES, WAVEFORMS AND P-P VOLTAGES TAKEN WITH 120V AC INPUT. VOLTAGES TAKEN WITH VHF ANTENNA TERMINALS SHORTED, CHANNEL SELECTOR SET ON UNUSED VHF CHANNEL, VOLUME CONTROL MINIMUM, BRIGHTNESS AND CONTRAST CONTROLS AMXIMUM. ALL OTHER CONTROLS IN NORMAL OPERATING POSITION

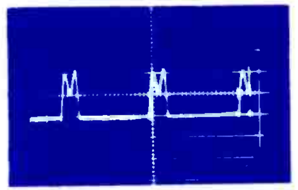

WF 1 0.55V, H

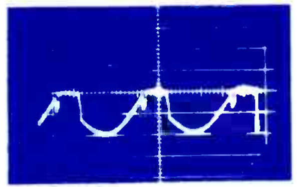

WF 2 20.0V, H

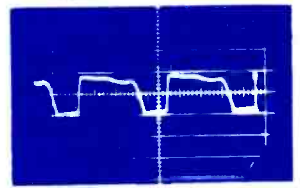

WF 3 0.32V, H

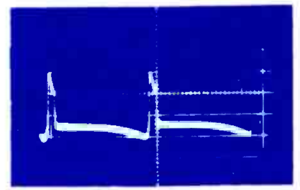

WF 4 1.6V, V


WF 5 8.0V, V


WF 6 4.0V, H


WF 7 10.0V, H


WF 8 10.0V, H


WF 9 45.0V, H

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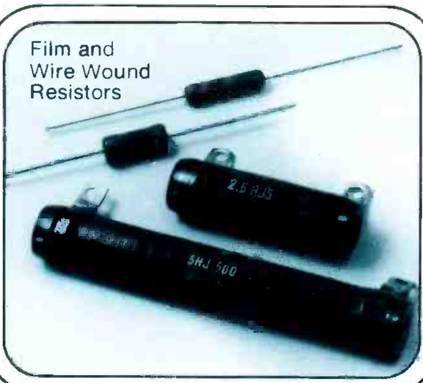
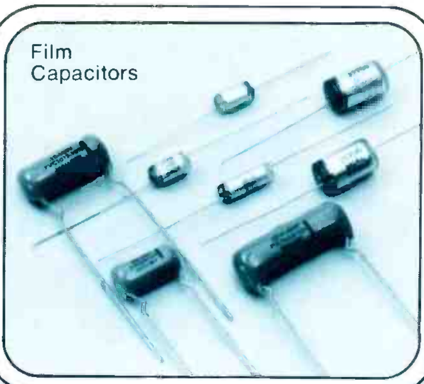
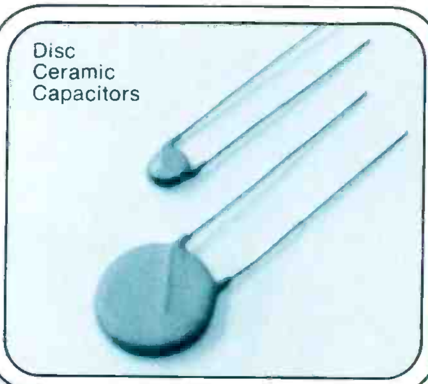
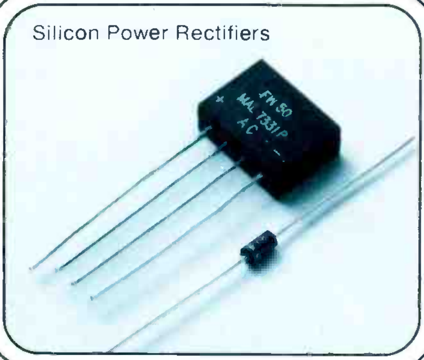
Get to know the convenience and economy of simplified single-source buying. To deliver exactly what you want in parts, quality, and quantity. Immediately from stock on hand, or in most cases within 24 hours from the factory. Your Mallory distributor goes all out for his Number 1 VIP...you. Get in touch with him soon. Mallory Distributor Products Division, Mallory Components Group, Box 1284, Indianapolis, Indiana 46206. (317) 636-5353.

MALLORY
ELECTRICAL/ELECTRONIC GROUP
EMHART

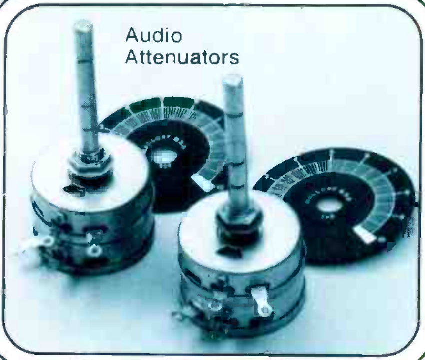

Film and Wire Wound Resistors

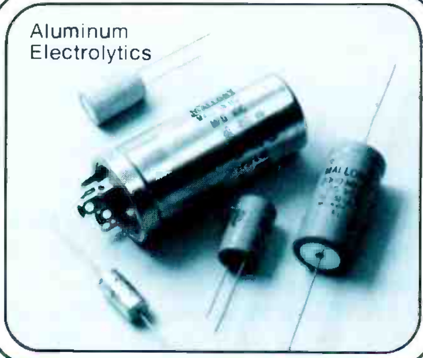

Film Capacitors

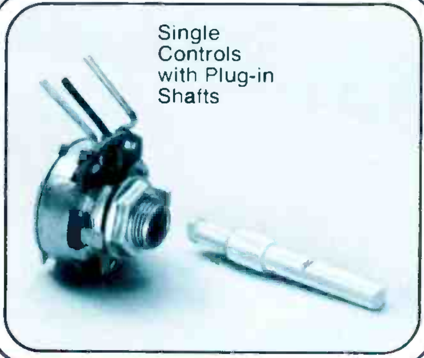

Disc Ceramic Capacitors

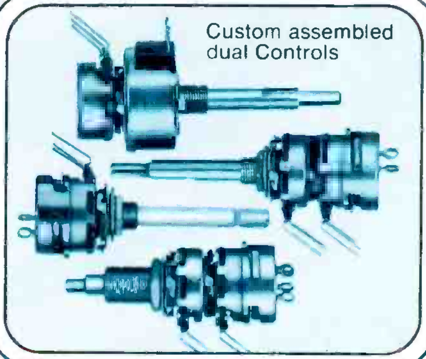

Silicon Power Rectifiers


Plastic Fastening Devices


Audio Attenuators


Aluminum Electrolytics


Single Controls with Plug-in Shafts


Custom assembled dual Controls

MALLORY

Circle No. 116 on Reader Inquiry Card

THE NEW

performer.

. . . TAKES A BIG LOAD OFF YOUR MIND.

The Model 4000 is overload protected on all ranges up to 1000V.

ONLY
$235
from stock

Forget about zapping this new digital multimeter. It's overload protected on **all** ranges up to 1000V . . . and it's RF shielded, too. The sturdy bench stand also doubles as a handy carrying handle.

1. **OVERLOAD PROTECTION** — Multiple fusing to 1000V on all ranges with safety designed test leads, RF shielded, auto-zero, auto-polarity.
2. **SIX FUNCTIONS** — 0.2% accuracy, 31 ranges with selectable Hi and Lo power ohms, 3½ digit .43" LED's.
3. **EASY OPERATION** — Single range selection switch with only two recessed input jacks and convenient pushbutton function selection.

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