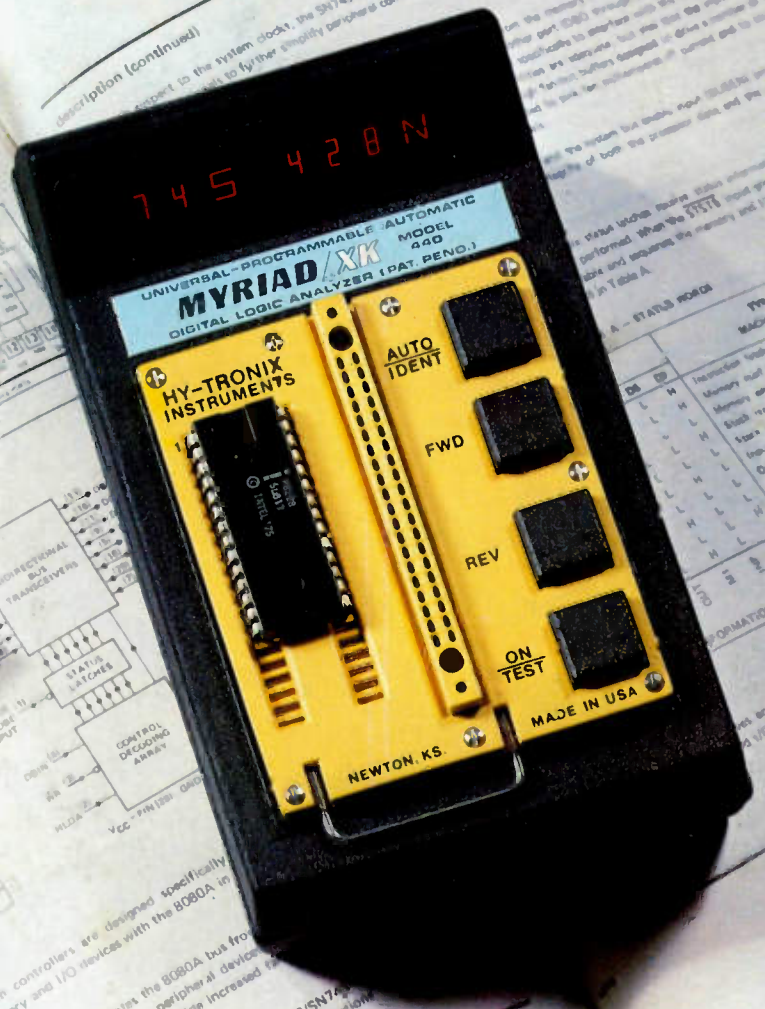


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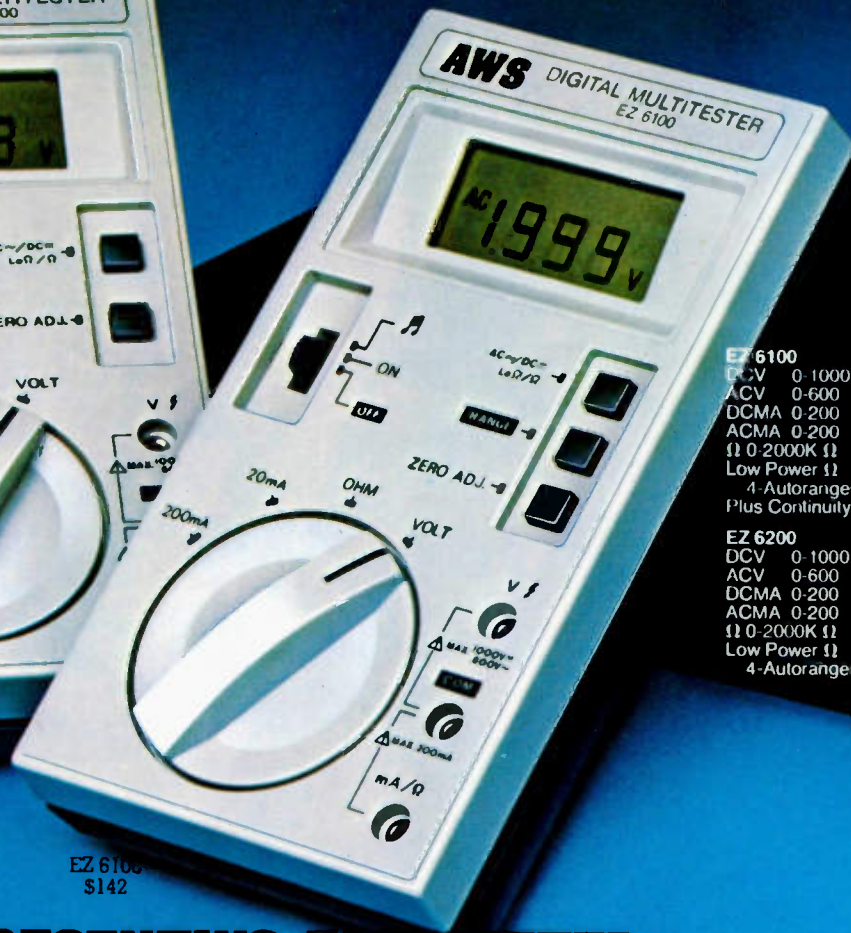
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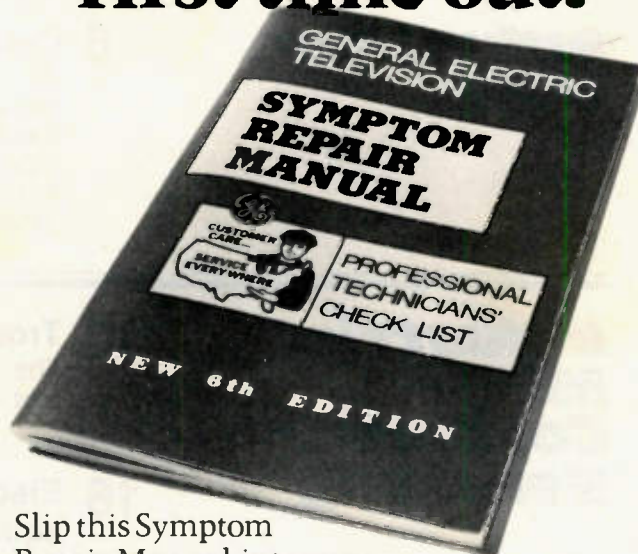
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Electronic Servicing

Industrial MRO

- 6 Case study of a factory maintenance center**
An interview with John Mensing, customer service manager, Wulfsberg Electronics, Overland Park, KS
Electronic Servicing takes a look at the maintenance/repair center at Wulfsberg Electronics, manufacturers of Flitefone aircraft radiotelephones, land-mobile units and other communication systems.

Industrial MRO & Consumer Servicing

- 13 Troubleshooting digital equipment**
The MYRIAD XK model 440, a new hand-held LSI device test instrument, is described.
- 16 Electronic Servicing for the '80s—test equipment requirements**
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- 21 Reports from the Test Lab**
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- 23 New Zenith features**
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The Zenith model SM1973 is analyzed in this series on modular solid-state color TV receivers.
- 28 Repairing GE 19Q horizontal sweep**
By Homer L. Davidson
Test methods and component failures in the horizontal sweep section of the GE 19Q solid-state color television are discussed.

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About the cover

Shown is the MYRIAD XK model 440 digital logic analyzer, which is featured in *Troubleshooting digital equipment*, page 13.

Photograph courtesy of Hy-Tronix Instruments, Newton, KS.

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SYLVANIA

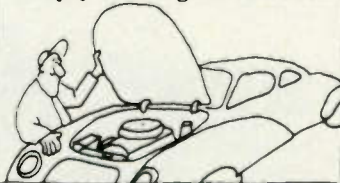
GTE

HOW TO GET BETTER MILEAGE FROM YOUR CAR...

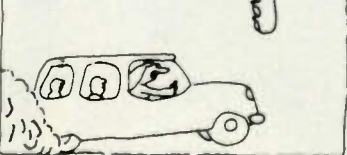
Obey the 55 mph speed limit.



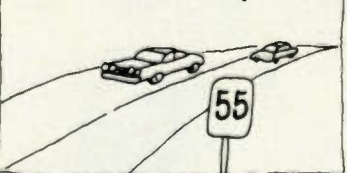
Keep your engine tuned.



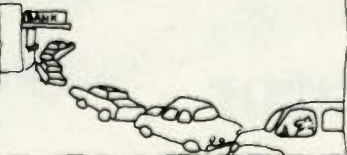
Avoid hot rod starts.



Drive at a steady pace.



Don't let the engine idle more than 30 seconds.



And when buying, don't forget the fuel economy label is part of the price tag, too.



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electronic scanner

news of the Industry

Thordarson requests clear return addresses

The response to the reply card program established in September by Thordarson Meissner has been outstanding, according to John Evans, marketing program manager. The replies have ranged from product compliments to problems, on which Thordarson has taken appropriate action. Some cards, however, have not had a clear return address.

"We want to help service technicians who have valid inquiries about our flybacks and yokes," Evans said. "When a card has a question that requires a reply, a clear return address, either printed or typed, must be given."

The postage free reply cards are packed with each Thordarson flyback and yoke. The card asks several questions about installation, replacements and comments about the product. Technicians who purchased Thordarson products and did not receive reply cards may obtain them by writing to John Evans, Thordarson Meissner Inc., Electronic Center, Mt. Carmel, IL 62863.

EDS announces new distributor mailing procedure

A new mailing procedure to avoid duplicate invitational mailings to distributors to attend the Electronic Distribution Show has been announced by the Electronic Industry Show Corporation.

Individuals and companies on the distributor mailing list will receive a letter from the Show Corporation asking if they wish to continue to receive news about the show. Those who request information will be retained. Those who request removal, or who do not return the form, will be removed from the mailing list, unless they have registered for and attended the show in 1978, 1979 or 1980.

The Show Corporation will automatically send brochures, whether or not the clean-up mailing is returned, to those who have attended recent shows. In addition,

any distributor personnel who request complete information packets from the show office will receive them.

If you don't receive the brochure and badge application, call or write Joann Wallace in the Electronic Industry Show Corporation office: 222 S. Riverside Plaza, Suite 1606, Chicago, IL, 60606; (312) 648-1140.

GC Electronics announces industrial distributors

GC Electronics has announced the addition of seven distributorships to its authorized industrial distributor program, bringing the total of participating companies to 21.

The seven new distributors are: Argile Electronics, New York; CAM/ RPC, Pittsburgh; Dalis Electronics, Phoenix; J&M Electronics, Rockford, IL; R.S. Electronics, Livonia, MI; Radio Supply, Wichita, KS; and York Radio, Decatur, IL.

Vidaire and Amperex win first choice space for EDS '81

Vidaire Electronics Manufacturing and Amperex Electronic Corporation both benefitted from the 1981 Electronic Distribution Show exhibit Space Drawing. Vidaire had first choice of its exhibit booth and Amperex had first choice of a conference unit for EDS '81, scheduled for May 5-7 in Atlanta.

Both companies rated highly on the other first choice qualifying factors: seniority (how many years in the show), priority (contracts received by the Oct. 31st cut-off date) and EIA/DPD membership status. The drawing was conducted by the Electronic Industry Show Corporation's Arrangements and Registration Committee.

EDS '81 space sales are far ahead of space sales for EDS '80 at the same time last year. As of November 7, 165 participating companies had reserved 226 exhibit booths, 11 conference units, 64 executive suites at either the Hilton, Regency, or Marriott hotels. □

NEW!

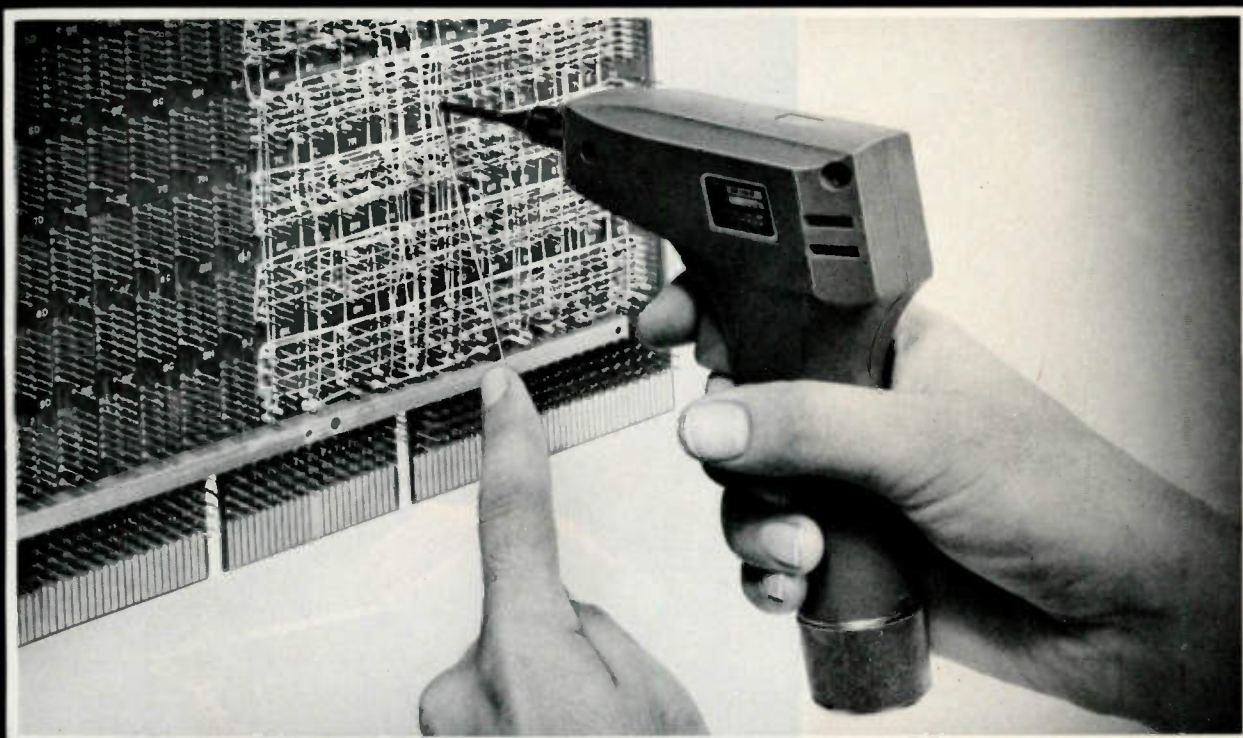
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Industrial MRO

Case study of a factory maintenance center

An interview with John Mensing, customer service manager, Wulfsberg Electronics, Overland Park, KS



Synthesizer module is tested by a Wulfsberg technician.

ES: How long has your maintenance shop been in operation?

JM: The company started business in 1970. There were no radios being built and sold at that time. The president and vice president were doing design and research work. In 1971, we started manufacturing, selling and maintaining the units. We celebrated our 10th anniversary in September with the grand opening of our new building. Our sales for this year are going to be more than 8 million dollars. We've had a steady growth of approximately 40% each year since we started.

ES: How has the maintenance/repair shop changed?

JM: In the early days, the shop consisted of one or two production test technicians who did all of the production testing and repair. We kept it that way until a year ago when it was getting too big to handle. There was a lot of conflict at that time between production schedules, getting the new merchandise shipped on schedule, and

taking time out to repair the warranty work. The company has always had a lot of pride in the fact that warranty work comes first. The problem we ran into was that the warranty came first, but at the same time we needed to get all of the production work out. It became a conflict of interests, so we split customer service and the test department apart a year ago. What that amounts to now is that we have dedicated people who work on the production test bench. They have no other interests except their production schedules. We also have dedicated people who do only customer service work.

We tried to keep it all one in the same for a long time because we feel that the technicians who work on the same units day after day know them better than anybody else. After you work on a lot of them you know them inside and out. Those are the people who can talk to a person in the field who has a problem. Nine times out of 10 when someone says, "I've got this

problem," our technician can tell them what to check or fix. The way we do it now is the people who work in customer service come back to the test department to help out, learn new units and help out on the old units—just to work and keep their hand in.

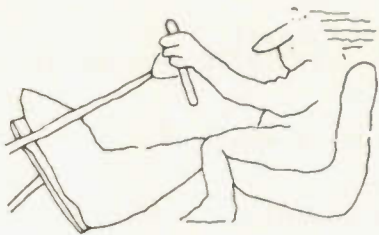
ES: How many people are in each department?

JM: We have 15 full-time technicians in the production test department, and six rework people. In customer service, we have three technicians.

ES: What does a rework person do?

JM: A rework person is specialized in changing complicated parts in half the time it would take a technician. Our technicians can change their own parts; we don't take their soldering irons away from them by any means. If it's a transistor, and that's what they think it is, it's faster for them to take that part out and replace it

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January 1981 *Electronic Servicing* 7

Case study

than it is to set it over and explain to a rework person that process. Also, in the case where it might not be the right part, they know immediately that they made the wrong guess and they can go from

there. We do send most of them through a soldering school that we have here at the factory. We train them how to solder and how to unsolder so that whenever they do change a part they don't mutilate

it. We are just starting a program where we are promoting a couple of rework people up to a position called tester. It's like a technician assistant position. A lot of boards

WULFSBERG ELECTRONICS, INC. OVERLAND PARK, KANSAS

Model: WMC-100-3
Part No.: 400-0074-003
Control No. 1234/Serial No. _____

Date: 12-12-1980
Page 1 of 2
Operator: _____

--GUARD RECEIVER FREQUENCIES--

Guard 1: 171.4000 MHz Guard 2: xxxxxxxx MHz

--CICSS TONE FREQUENCIES--

Tone	Freq(Hz)	Tone	Freq(Hz)	Tone	Freq(Hz)
0	100.0	1	110.0	2	120.0
3	130.0	4	140.0	5	150.0
6	160.0	7	170.0		

--MODULE COMPLEMENT--

Module	Ser. No.	Mod	Module	Ser. No.	Mod
Chassis	1234	2	Pwr Supl	1892	5
Synth	1234	2	R/T	1005	0
Audio	2055	5	Timer	2001	1
Tone	1264	1	Guard	1025	3

SAMPLE TEST DATA

TRANSMITTER FREQUENCY

Freq(MHz)	Error(Hz)	Freq(MHz)	Error(Hz)	Freq(MHz)	Error(Hz)
150.0000	40	150.0025	-20	150.0050	-130
150.0075	-230	159.0025	170	159.9925	160
159.9950	210	159.9975	250	160.0025	-10
160.0050	-100	160.0075	-210	164.6650	70
169.9925	180	169.9950	220	169.9975	250
173.9975	-10				

MAIN RECEIVER SENSITIVITY (dB Sinad at 0.5uv input)
150.0950 MHz: 12 dB 164.7400 MHz: 16 dB 173.9325 MHz: 15 dB

MAIN AUDIO OUTPUT POWER
20.1 Watts at full volume (9.0 volts across 4 ohms)

MAIN RECEIVER HUM & NOISE (at 150.0950 MHz)
0.12 Vrms (34.1dB below 10.0 watts audio power)

MAIN RECEIVER DISTORTION
1.7 percent at 10.0 watts audio power

MAIN TIGHT SQUELCH
19 dB Sinad at tight squelch opening point

CICSS SQUELCH (All Tones)
Squelch open with 300 Hz deviation
Squelch closed with 50 Hz deviation

GUARD RECEIVER SENSITIVITY (dB Sinad at 0.5uv input)
Guard 1 (171.4000 MHz): 19 dB Guard 2 (xxxxxxx MHz): 19 dB

Part of a sample test data printout from the Hewlett-Packard 8950 Transceiver Test System. The 8950 provides distortion, frequency error, modulation and high-low power checks. Used in radio repair for diagnostic testing, Wulfsberg has used the unit for one year, and plans to add one more. The unit is utilized full-time. Cost is \$90,000-\$100,000.

that we have are pretty basic and simple, but they have to be tested. If there is no problem, it's a waste to have a trained tech sitting there saying, "Yes, it's good, Yes, it's good." The testers will be trained to run tests on these boards. If they have one that has a problem, they can set it aside and a technician can troubleshoot it.

ES: *Is there one brand, from the test equipment you have, that you use the most?*

JM: Tektronix is over and above our main supplier of equipment. We use their oscilloscopes and analyzers. We also use various brands for whatever suits our purpose. We use the Coaxial Dynamics and Bird wattmeters. We use Keithley DMMs. We have many power supplies—Trigon and Hewlett-Packard. We find there is quite a bit of duplication now. Most equipment manufacturers supply power supplies, scopes, etc.

Usually we find something that suits our purpose and we stick with it until something new comes along. For example, our spectrum analyzer—Hewlett-Packard has come out with a model now that is comparable to what we have been buying in the past from Tektronix. It does a lot of the same things, and for our day-to-day use it's just what we need, and I think it's about \$2000 cheaper.

Don Cockran, test equipment manager, is in charge of the calibration department. He is responsible for buying new equipment, going out for quotes and keeping in touch with what's available. Since he also does the calibration, he usually likes to stay with what we already have. That way, we have duplicate equipment that we can swap positions with when ones goes down. Also, once he has to repair one, he knows a little bit more about that piece of equipment.

ES: *How have you handled equipment replacement?*

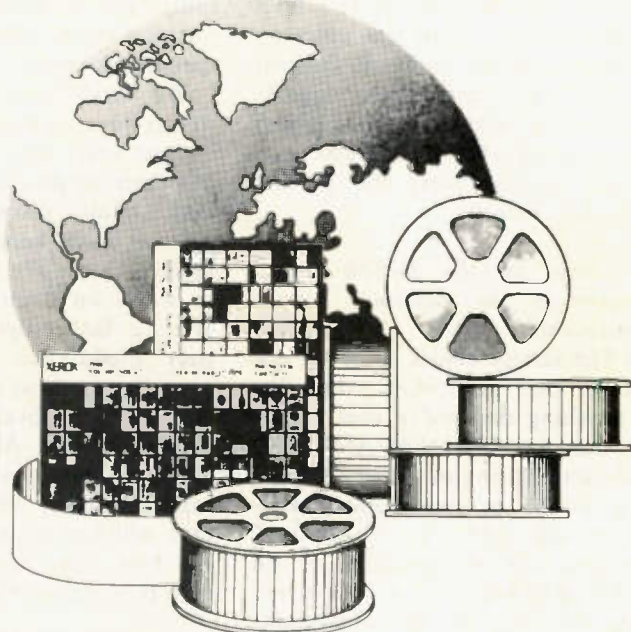
JM: In the past, we've pretty much stayed with the same equipment. Because of the growth we're going through, we've started experimenting more than we have been. There are so many new things on the market—we bought our first modulation meters years ago because they were the only thing available. The next time we went out to buy a couple more, the Booton model had come out, which was automatic, with no dialing in the circuitry; it was much better. So we went ahead and bought that, and from now on, when we buy a modulation meter, we'll buy the Booton, unless there is something that we can justify being better.

ES: *How great is the workload for each department?*

JM: We do approximately \$800,000 of business every month from our production test department. That

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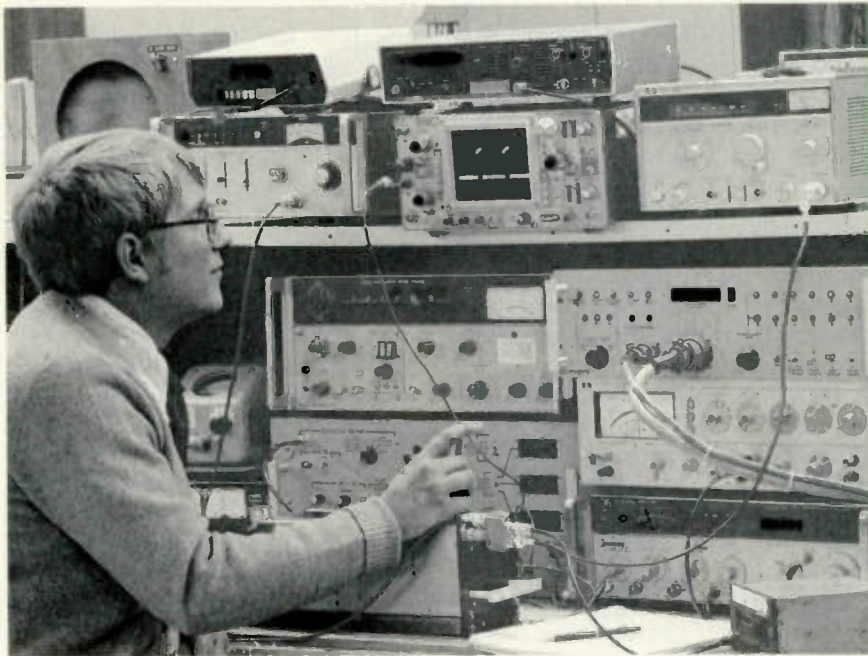


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Case study



Greg Triplett, project engineer, works on an RT 9600 synthesized aircraft FM radio.

department works on the new units coming from the assembly department. The units go through pre-test—all the chambering and tests are done there. Then the units go to finished goods and are shipped out. In the customer service department, we're charged with support of everything they've shipped out. We do approximately 200 to 300 units each month.

ES: *How is the bench setup different in the customer service department?*

JM: The service bench is set up not only for one particular radio, but for anything that we've ever made. We use an IFR FM/AM 1000 communications monitor. Everything we do is communications—FM or AM—and it's a synthesized type that will go anywhere in the frequency bands we cover. So in my setup, this gives me all the modulation monitoring, it gives me the signal generator output, and it does everything we really need to do for two-way radio. We have a Wavetek signal generator and a Marconi automatic distortion analyzer. We have combined test panels in a lot of cases where we can have one test panel that does what two or three of the production test panels do,

the whole idea being that we want to be flexible here. I can go over and on any shelf pick up something, put it down here and start working on it without gathering up special equipment.

We have two Hewlett-Packard distortion analyzers that were bought years ago, and rather than put them in production and have a nonstandard piece of equipment, we use them here because we are used to them. We have a fast scope to work on digital synthesizers. With a fast scope you can check your modulation by keying into your dummy load or wattmeter. We do a lot of calibration, usually once or twice a day. All the technicians in this department will get on the same frequency with their monitors. One will key up a transmitter and see how close they are, to make sure they all are checking the same.

ES: *What is the typical turn-around time for repairs in the customer service department?*

JM: We try to keep a goal of three days from the time the unit comes in to when it is shipped out. We stick pretty close to that.

ES: *How much repair work do you do in the field?*

JM: About once a month, one of our two experienced technicians will go out to repair anything that can't be sent in or taken care of over the phone. Our other repair technician works over the phone with people in the field. The biggest part of our traveling is for training. In California, for example, they buy a lot of our land-mobile units, so we told them that we would provide them with a free school. We conduct a one-week training school to teach them how to operate and repair the radios. We also spend a lot of time explaining the basic theory of the units.

We require that if our distributors want to buy and sell our products, they have to be able to maintain them. As such, we sell them spare boards; they have them in stock so when a radio comes in, they isolate it down to a board, then replace it, check it out and, if it looks good, they put it back in the car or aircraft, and they send back the bad board. In our manuals, we give part numbers, descriptions and sources for a lot of our components. If they can get it locally, it's better for us because it means we would have to buy one more to keep in our inventory, plus it saves a lot on down time. □

Troubleshooting digital equipment

The rapid rise in digital equipment to replace traditional analog systems marks an evolution in electronic instrumentation. Packages are smaller and significantly more rugged; accuracy, in most cases is higher; prices are comparable; and speed in usage is improved.

But servicing has also been changed. The complexity of LSI and microprocessor devices places great strain on field servicing. In servicing a failed system in the field it is now common to replace a faulty board and later decide to troubleshoot the board back at the plant or to return it to the equipment manufacturer for service or replacement.

Equipment to fully check LSI and microprocessor devices conventionally has involved heavy capital investments in computer hardware and software—plus a skilled staff to operate the equipment. But as the evolution in instrumentation continues, greater sophistication in test equipment can be expected.

The following article describes a new hand-held instrument for testing LSI devices in the field or service lab. This instrument, the MYRIAD/XK model 440, is being introduced for in-circuit fault isolation of failed ICs with up to 40 pins. The 440 is presented here as part of **Electronic Servicing's** emphasis on test equipment for the '80s. It should be noted that **ES** has not field tested the 440 and that the capabilities and specifications have been obtained from the manufacturer.* This article does not constitute an endorsement by **ES** of this system, and normal caution should be exercised in purchasing the 440, as with any major piece of test equipment.

The MYRIAD/XK model 440 portable miniature digital logic analyzer is a new piece of automatic test equipment (ATE) that offers the convenience and portability of a pocket calculator. It features a programmable interface controlled by its own microcomputer. The field-alterable internal memory has sufficient capacity to store the

*Hy-Tronix Instruments Inc., P.O. Box 827, Newton, KS 67114. Telephone (800) 835-1005. In Kansas, dial (316) 283-5730.

Digital

automatic identification and qualitative test procedures for more than 10,000 RTL, DTL, TTL, HTL, HiNlL, MOS, CMOS, Schottky devices and other complex integrated micro-circuits (ICs) such as JAN (QPL), the European PRO-ELECTRON and popular industry standards including its own self-diagnostic capabilities. Although the 440 comes programmed to test more than 10,000 silicon IC chips, the applications are innumerable. Naturally, it will serve equally well as a PROM verifier, and it can be economically custom programmed to test anything from other TTL compatible computers and black boxes to special systems. Its principal application is in-circuit fault isolation of failed integrated circuits with up to 40 pins, such as those used in industry, the military, and aerospace electronics.

The 440 is designed to test most digital circuits. It also handles many types of modules, integrated circuits, circuit boards, SEMs (stan-

dard electronic modules), SEEMs (support electronic equipment modules), SHPs (standard hardware packages), SAMs (standard avionic modules) as well as special military packages.

One significant breakthrough is its size: the 440 replaces equipment that could cover the wall of a large room and weigh 2000 pounds in a package no larger than an ordinary pocket calculator. The instrument measures approximately 5x3x2 inches and weighs 15 ounces.

In the '80s instruments such as the 440 may become as universal as tube testers were in the vacuum-tube era. Like the tube tester, this equipment requires no in-depth knowledge. An operator simply inserts the IC into a universal, zero force insertion, custom tooled socket capable of handling any dual in-line/flat-pack configuration, including staggered pins, or simply applies an extender cable with a multi-contact test clip to the in-circuit IC to be tested and presses one

button. In less than a second the device is tested and the qualitative condition (including failed pin numbers, whether output or input) of the device is automatically displayed in English on an eight-character alphanumeric display. If the IC is good: the 440 beeps, flashes A-OK and displays the generic part number, even for private labeled and non-labeled ICs.

Controlled by four calculator type push-buttons, the unit is one-hand operational. A key factor is its portability. Service personnel can find problems in a piece of malfunctioning equipment in seconds after gaining access to the internal portion of the equipment. Repairs can be performed without having to bring the equipment back to a central repair facility.

Generally, costs to find faults gain an order of magnitude with each production step. To find a faulty IC at incoming inspection may cost 30 to 50 cents. At the board test level the cost may climb

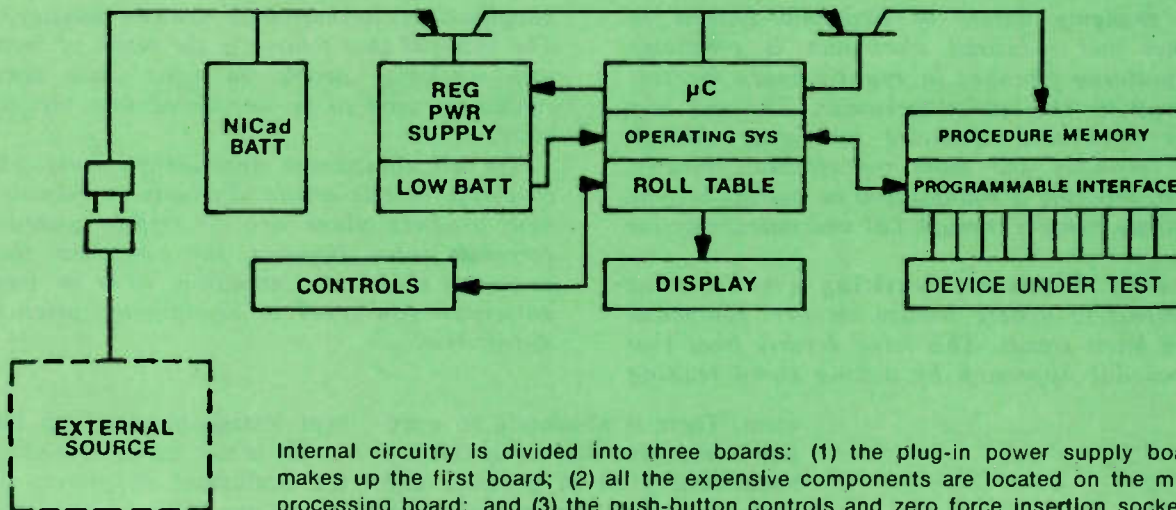
440 Display

Once the desired name/number of the device under test is located, pressing *ON/TEST* applies the appropriate power to the device under test and starts the automatic test procedure. A typical procedure takes 1/10 second. A test procedure is always concluded by power being automatically removed from the device under test and a short diagnostic message being displayed such as those listed below.

1. **A-OK/74LS424N**
Successfully completed test procedure
2. **FAILED/IN 13 L/OUT 8 H**
Failed to complete test procedure. For diagnostic purposes, the offending pins are identified by number, input or output and stuck logic Low or logic Hi.
3. **SHORT**
Device under test power leads are shorted.
4. **Low Batt**
Battery voltage too low for reliable testing
5. **NO TEST PLAN**
No test plan in memory



Internal circuitry



Internal circuitry is divided into three boards: (1) the plug-in power supply board makes up the first board; (2) all the expensive components are located on the main processing board; and (3) the push-button controls and zero force insertion sockets, are all on the field-changeable interface board.

to \$3-5 to find each faulty IC. The increased cost is generated by more sophisticated and expensive test equipment, longer test times and higher labor costs stemming from the use of more talented labor. At the systems level, the cost of finding a faulty IC rises another 10-fold to \$30-50. Finally, a field service call may cost \$300 or more, excluding the customer's downtime.

Modes of operation

Either of two methods of operation may be chosen to operate the 440. In the test procedure, which uses FWD and REV push-buttons, names such as 74LS574N or 4068B scroll through the eight-character, alphanumeric display. Single momentary actuations of the push-buttons cause the scroll to advance or back up one test procedure at a time. However, holding the push-button down progressively quickens the automatic scrolling action from slow to fast. The second procedure, which uses the AUTO/IDENT push-button, automatically generically identifies and tests the device (providing that the test procedure is embodied in the memory covering the more than 10,000 ICs or circuit

boards). The device under test is identified and tested in less than a second.

Obviously, the second mode will be the most popular approach because electronic equipment manufacturers often remove the standard identification marking on integrated circuits, electronic modules and circuit boards or use only in-house identification codes. This practice is usually defended as being a requirement for production control or design integrity. In many cases, however, this scheme is simply a means of hiding the identity of standard parts in equipment so that a proprietary design may be kept secret or so that a customer will have to come to the manufacturer for parts and service, thereby creating a guaranteed aftermarket for expensive boards. This practice makes field repair difficult for a customer because the generic identity of components has traditionally been well hidden.

Of particular interest in the 440 is an unusual voltage regulator that includes the microcomputer as part of its control loop, thereby assigning the designated voltages as required. Although the 440 can

operate from varied external sources up to and including 28VDC, it is powered normally by a NiCad rechargeable battery. At the conclusion of each test, a diagnostic message is posted on the display indicating A-OK and part number, Failed, Short, No Test Plan or Low Batt. Displayed with a fail message is the offending pin ID in the test procedure. The unit also beeps if the IC is good.

Residing within the firmware operating system is a custom interpreter that decodes and executes each individual command from the test procedure. Changing test procedures is so simple that additions and updates can be accomplished in the field at very little cost. Additional features are full short circuit protection and automatic Power Down to extend the life of the rechargeable battery.

Price and delivery

The introductory price for the 440 is impressive: less than \$3900, including charger and extender cables with in-circuit test clips for 16, 24, and 40-pin ICs. Delivery is stock-to-120 days and will vary with back orders. □

Electronic servicing for the 80s: test equipment requirements

The changing nature of electronic systems in consumer and industrial electronics is producing corresponding changes in requirements for test equipment for the service technician. The end user benefits from this advancing technology through higher reliability and more cost-effective features. However, servicing is handicapped as systems become increasingly complex through LSI and microprocessor devices.

Typically, **Electronic Servicing** uses its news departments to update readers on new equipment and the latest trends. This issue departs from that conventional approach by asking some leading

manufacturers to share their views on industry trends. The material that follows is the result of interviews with marketing people, in some cases discussing equipment soon to be introduced into the marketplace.

Not all companies approached were able to cooperate in this article development because their new product plans are so tightly guarded by corporate rules. However, the companies that did cooperate shed some interesting views on trends to anticipate—in types of equipment, pricing and distribution.

B&K Precision

Ken Rolnicki, director of marketing, B&K Precision/Dynascan, Chicago, took a look at several areas of instrumentation and technology trends.

ES: What do you see in overall market trends?

KR: In terms of product trends, we see a move toward test instruments that are multi-functional in nature. In other words, equipment not to measure just one function. The industry of the future wants combination DVM frequency counters, logic analyzers, signature analyzers etc. They'd like to have all of that combined into one product.

ES: How about quality and durability?

KR: Quality and durability are extremely important key words. The customers we've approached are willing to pay additional money for these features. Some people are even looking for the second and third year product repair warranty, and are willing to pay for it.

Also, local repair servicing seems increasingly important.

ES: What's expected in equipment trends?

KR: We see a definite need for logic and signature analysis equip-

ment. There is absolutely no question in my mind that for us this is a spearhead kind of product and marketing effort. We are identifying the market, finding the proper channels of distribution to market it and creating the business direction.

And take a look at the impact of microprocessors in our business. The increased use of microprocessors is going to cause a corresponding increase in test instruments.

ES: What's coming in the area of product simplicity or versatility?

KR: I mentioned the multifunction test instruments. At recent major shows we've seen a strong interest in portability. Ac/dc portability, not just smallest in size is important in test instruments. A surprise was that our small oscilloscope (attache size, ac/dc, 30MHz) was as popular as our 100MHz scope.

ES: Will cost of equipment go up or come down?

KR: Definitely up. I don't think there is any question on that. Material and labor costs increase even as solid-state components become cheaper. But, in terms of multi-functional products, they will be more cost-effective. The customer will be paying a higher price for a higher-quality multi-functional, cost-effective test instrument.

With our comprehensive marketing plan, we're very optimistic toward 1981 and beyond.

An interesting by-product of re-

cent instrumentation and business trends is the higher role played by the traditional purchasing department—now often designated procurement. This department now plays a strong role in keeping costs down and making sure that we receive high quality products for design and manufacturing.

Manufacturers must be aware of the changing aspects of the market

—Chuck Newcombe, Fluke Mfg.

ES: What about pricing of logic and signature analyzers?

KR: Roughly, under \$3000, end-user price.

Fluke

Chuck Newcombe, business unit planning manager, John Fluke Manufacturing Company, Mountain Terrace, WA, discussed shifts in the market and possible improvements in meter displays.

ES: How do you see the industry as a whole?

CN: My perspective of electronics in the consumer industry is that we haven't seen the beginning of the explosion yet. One of the major problems that people are going to be facing in servicing is products that are more and more integrated,

based on something like VLSI, for example, rather than discreet semiconductors. The days of sockets and swapping components in troubleshooting are going away.

There's an interesting trend in the TV repair industry as manufacturers go the modular route instead of replacing components. Customers haven't been too happy with the prospect of paying several hundred dollars for a service call, and then not getting a repair either. Some shops are now field troubleshooting at the complex component level to repair the modules.

There are shops that are effectively operating that way. However, it is difficult to find technicians capable of operating in that mode. The problem here is that a good technician can probably make better money in industry. Somehow, test instrumentation itself coming out in the next few years must help solve this problem. Thus, manufacturers must be aware of the changing aspects of the market and produce equipment that satisfies its needs.

ES: *What effect do you expect from microprocessors?*

CN: As others have undoubtedly observed, the microprocessor is creeping into everything. We see searching within our industry for how best to use the capabilities provided by serial processing devices. One of the things that seems to be developing is the opportunity to take a basic technology, understanding and capability of a processing system and apply it to many different, rather than specific, tasks. That means test equipment specifically designed for each industry.

You can expect equipment to become more versatile

—Joe Keithley,
Keithley Instruments

ES: *Do you expect changes in product distribution?*

CN: I can't speak for the industry as a whole, but we're moving into a different type of distribution in the form of a dealer program.

ES: *How about pricing of future test instruments?*

CN: That depends upon who you ask. A recent story being circulated is that technological advances are slowing and prices have about bottomed out. I submit that's one path that may be followed as markets and technologies mature. I'm not convinced that there isn't a lot more room in test instruments for improved performance at even lower prices.

ES: *What role will displays have?*

CN: As you probably know, we were instrumental in helping the industry develop the first rugged, reliable, LCDs for hand-held multimeters that would withstand wide temperature and humidity environs. We're still heavily involved in LCD applications.

I think LCDs are still in their infancy in terms of developments, with a lot of room for improvement. I have no vision that it's going to remain that way, or that electrochromics or something else may not take its place. What probably is more likely is the development of things like colors and the combining of microcircuits onto the display substrate. So I'd say it's applied technology changes at this point and not innovation in terms of whole new physical devices.

Other possibilities lie in the areas of pattern recognition, speech recognition and speech synthesis rather than just numbers. The technician of the future could be using a wide range of color scales, flashing lights and varying pitch tones in routine service jobs. Nobody can predict what display technique may emerge as the winner for the late '80s. But I'm sure one will emerge, and it may not be one we recognize today. But it could involve a word processor synthesizing a verbal description of the failed device or system.

—Keithley—

At Keithley Instruments, Cleveland, OH, **ES** talked to two marketing people: Joe Keithley, commodity marketing manager, is concerned about marketing the company's service-oriented products

and with immediate marketing strategies. Bob Erdman, market planning manager, is concerned with long-term marketing and the more complex instruments for industry and research.

ES: *How would you describe equipment trends in general?*

BE: First of all, the microprocessor-based things are going to require test equipment. And most equipment is just too big and cumbersome to use as a portable service tool. I don't know exactly what form it will take but somebody is going to come out with a pocket DMM-size instrument that will be able to test microprocessor-based systems at least to the level that you can tell if a given board is bad or if a signal is there.

Right now technicians typically have at least a DMM, a scope and a batch of specialized equipment. A pocket-sized instrument during the next few years could do most of those functions. You could go down a 24-pin connector and look at each pin sequentially and determine whether or not that part of the equipment is running correctly.

JK: You can expect equipment to become more versatile, especially as microprocessors become more extensively used. You can provide the instrument with information, for example, that can let it read out temperature and other data. Also, in many field service jobs newer instruments may replace scopes, an advantage in cost, weight and portability.

ES: *Would this be a dedicated instrument for each microprocessor, or be programmable or have separate plug-in chips as microprocessors proliferate?*

BE: It may not even get down to the level of the microprocessors. I still feel that most people today are servicing at the board level in the field, and then the boards are fixed at the depot level. I don't know if that's going to change because the main effort is going to continue to be to get the customer up and running with minimum down time. So I'm talking about troubleshooting at the PC board level, and I think that a big collection of

Test equipment

specialized instruments plus DMMs scopes and counters is too much to lug around.

ES: *Will future instrument costs or costs per function increase or decrease?*

BE: Costs have come down, and will probably continue to come down of a given function. Manufacturers are putting more effort into sorting out what are the most useful functions to have in the instruments and to keeping the prices level. Thus, the cost-per-function should decrease and the equipment should be more useful. In essence, the end user can expect a better performance/price ratio.

ES: *Will using microprocessors in test instruments help make them more cost-effective?*

BE: Certainly. Maybe not so much in service-type instruments, but at least in R&D instruments. As an example, I think only one hand-held DMM uses a microprocessor.

I'm not sure that the microprocessor is really cost-effective in the \$100 class instrument. As you get toward the \$200-\$300 class, it begins to help. So it depends on the price level you're talking about, and this could shift in time.

ES: *As a manufacturer, how do you plan the introduction of new features?*

BE: We focus strongly on the kind of generic functions needed and on how to provide them at the lowest cost. I think that kind of situation is where you end up having exactly what the customer needs. The bulk of the applications may be handled at the depot level rather than in the field.

JK: We refer to this focus as price/performance: how much the customer is looking at in a given meter. Frequently we find he wants to accomplish several tasks. And if he gets a bell or a whistle added to his meter, fine. But he isn't going to buy for that bell or whistle. He's got a set of concepts in his mind; he wants the lowest price to get that job done. So we design our instruments around a set of tasks. The key is to make sure that your

concept is *satisfying* the customers need rather than trying to think what he *might* need. You've got to go out there and test it.

ES: *Will instruments have better ruggedness and reliability?*

JK: Take a look at the digital multimeters. Our model 130, as an example, has been dropped repeatedly from 6 feet without damage—something you wouldn't dare do with its analog counterpart in the past.

The other thing we did with that unit was make it easy to use. We used a front panel overlay where all the information was printed from the back side. If a technician had oil or grease on his hands he could rub off the smears without damaging the meter.

So in future instruments we can expect improvements in ruggedness, convenience, cleanliness, and reliability plus higher accuracy and input impedance.

ES: *To what extent does component availability affect your instrument design?*

JK: The capabilities to do things with meters, for example, are largely going to be a function of what can be done by component manufacturers. The reason we're able to introduce our meter at its low price is that we use an A-to-D package made by Intersil. In itself it has low power consumption, good stability, and the resolution and the accuracy needed. Thus, advances in the LSI technology benefits equipment manufacturers in terms of features and price. We work very closely with companies such as Intersil to help them develop products around our design needs. It also lets us incorporate their component in our product.

Leader

George Zachmann, marketing manager, Leader Instruments, Hauppauge, NY, discussed some industry trends as seen by his company.

ES: *Do you see an increasing number of manufacturers making test equipment available to the marketplace?*

GZ: Absolutely, especially so in digital multimeters, frequency counters, etc. And that will probably mean lower prices for the end user, at least for the same generic instrument and capabilities.

ES: *What trends are seen in oscilloscopes?*

GZ: That's a major line for us. Again, I see more competition and better prices for the end user. There also will be an increased trend toward digital scopes, to some extent replacing the traditional analogy scopes. With greater usage prices should come down into the \$1000-\$1500 range.

ES: *Any other trends?*

GZ: Look for a lot of new equipment for the CATV and nonbroadcast video market as the demand for program distribution increases through cable and pay TV.

I see more competition and better prices for the end user

—George Zachmann,
Leader Instruments

Non-Linear Systems

Ben Fisher, general manager, Non-Linear Systems, Solana Beach, CA, notes a strong trend toward "smart" test instrumentation.

ES: *As an overview, how do you see the test equipment market moving?*

BF: For one thing, there's a strong trend toward smart instrumentation—microcomputers and microprocessor-based equipment having computational capabilities as well as sequencing and control features. And that means that the increased use of microprocessors, in general, will spin off into new capabilities in test equipment.

Then, as the century progresses, I think we'll see equipment with a wider range of functions and equipment designed to serve specific industry segments. There will undoubtedly be advances in displays and controls, but these will not be major changes in the near future.

ES: *How do you see field testing of*

components as compared with board replacement?

BF: We expect to see field equipment to evaluate microprocessors. A lot of people will want to service equipment inexpensively rather than carry around a lot of spare boards.

There's a strong trend toward smart test instrumentation

—Ben Fisher, Non-Linear Systems

Sperry

Dennis Carroll, national sales manager, A. W. Sperry Instruments, Hauppauge, NY, says that his organization is seeing a number of significant industry changes.

ES: How about new features in test equipment?

DC: We see a trend in the industry toward making instrumentation safer for the end user. Such innovations are our 600V fuses as opposed to the smaller sizes, especially in regard to the application of the clamp-on test instruments.

Autoranging, we also feel, is something that is going to become almost standard in digital multimeters. The trend is going toward ease of operation and simplicity of use, and that really ties into autoranging.

In the highly competitive test equipment market, the companies that are going to make the most progress are the ones most responsive to the end user's needs. We'll see a greater emphasis on market studies and the designing of instruments that meet specific applications.

ES: What changes are expected for industrial servicing vs. consumer servicing?

DC: We see definite market shifts. In fact, it's one of the things that our company is quite pleased about. In the last few years we've seen a general direction change from the consumer-type marketplace to the industrial marketplace, and that is an area where our company is extremely strong.

Also, I see electronic instrument companies diversifying into electri-

cal-type instruments—instruments that will be used by plant maintenance, MRO, if you will.

ES: Will the computer industry and home hobbyist markets continue to grow?

DC: I think there is going to be almost an explosive evolution in the number of companies and products in video games, home computers, and custom microprocessor systems. We don't see the home hobbyist specifically as a market for test equipment, but certainly the facilities that service these systems are viable clients.

Tektronix

The wide diversification of products from Tektronix, Beaverton, OR, makes it almost impossible for **ES** to cover the company's equipment trends as seen by its many product line managers. For the purposes of this article, **ES** concentrated on trends in portable oscilloscopes and talked to Walt Kaline, product marketing manager for these products.

ES: As an overview, how do you see the portable scope market?

WK: Let's look briefly at history. As we ended the '70s, a number of new things started to happen relative to oscilloscopes. We saw things like programmability and digital storage coming into oscilloscopes. We also saw different technology going into the scopes themselves.

At the same time, there were people saying that oscilloscopes were passé, to be displaced by some wondrous new things.

Well, it turns out that really didn't happen; in fact the sales growth rate of oscilloscopes has been excellent over the past five years. There continues to be a need in field servicing to make basic waveform measurements. Everybody still wants to see what's going on in those little black boxes.

With that in mind and knowing that a lot of technology has come along—like programmability, digitalization and new components—there is a new confidence in this market. You're going to see a lot of new products in the '80s.

The benefactors of this effort are the customers. They'll have a wider choice of instruments having added capabilities.

This new generation of equipment is especially important for the changing service industry. The young generation of technicians from trade schools have limited hardware experience, and simplicity in instrumentation is a key to their success.

ES: Do you see microprocessors helping in this area?

WK: Yes, because microprocessors basically represent intelligence, and they'll do some of the thinking and internally check the controls.

ES: How many scopes on the market have microprocessors?

WK: A very small fraction. As the decade of the '80s progresses the professional grade scope (the high-performance instruments with the most features) will essentially all be microprocessor driven. However, there will always be low-cost scopes with simple manual operation.

The trend is going toward ease of operation

—Dennis Carroll, A. W. Sperry

ES: Do you see microprocessors penetrating the portable scopes?

WK: No. Portables are built for performance-to-price, size-to-weight effectiveness. There is a trend in portables to be willing to pay, at the trade off in size and weight, for some of the extra bells and whistles.

In high-performance oscilloscopes you'll see much more IC technology. We've seen our products progress that way. For example, last year when we upgraded the 465 scope to the 465B, we replaced a lot of individual transistors and resistors with either monolithic ICs or hybrids.

ES: Do you expect any advances in the CRTs?

WK: Yes, we're doing some work in that area. We did the 7104 again last year and that got us very high bandwidth, and high performance. But there are some things that

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we're doing in portable scopes relative to improvement in trace quality and ruggedness in the CRT itself.

ES: *Because of microprocessors, will instruments become programmable, more versatile?*

WK: Of course with microprocessors and instruments with intelligence you have firmwear/software considerations. So they will go the way of computers. For example, firmwear borders on the fact that you could alter the performance or features set on a scope by changing an ROM. And that could have some interesting possibilities. We do that, for example, in the 468 digital scope with an ROM that plugs into the instrument for self-servicing. Thus, firmwear and software become important considerations.

ES: *How will mechanical packaging change?*

WK: We're doing a lot of things in the way of mechanical design. Basically scopes are all starting to look alike. We're taking that mechanical package and considering ways to make it more portable, rugged and reliable because people are carrying them around to more places. A scope today must survive being thrown into the trunk of a car or bouncing around on a bus in New York City.

That also includes a wide range of thermal and humidity stability. Our component vendors are struggling to meet our needs as we increase range of usage in new equipment.

Performance-to-price ratio will be improved

—Walt Kaline, Tektronix

ES: *What demands will be made for improved ruggedness in the '80s?*

WK: Customers are requiring more reliability in their service instruments. They don't need down time in the equipment being used for service. That's an area the whole industry is working on. I think you will see some things that are a quantum leap in ruggedness.

ES: *Do you expect bandwidth capabilities to increase?*

WK: As performance increases, higher bandwidth goes without saying; things are just getting faster and faster. It's a necessity to meet customers' needs. Classic scope users are office equipment manufacturers—computers, typewriters, word processors, etc. Their equipment is getting faster. Because they use oscilloscopes to service and maintain their equipment in the field, they want a higher bandwidth. Those people in the '70s could get by with a 25 or 30MHz instrument, but in the '80s they want 80 to 100MHz.

The change in the market will push the manufacturers a bit

—David Fuhrman,
Weston Instruments

ES: *What are these advances going to cost the end user?*

WK: Pricing is going to be competitive, obviously. But the whole inflationary situation is strange. With the 20% interest rates and the cost of manufacturing and labor it's going to be tough to hold the line on price.

However, the performance-to-price ratio will be improved. For example we talked about the oscilloscopes that satisfied the office equipment people and the bandwidth shift going up. The customer will effectively get an improved bandwidth without a price increase. If he previously used an instrument that had 35MHz performance, in the '80s he'll be able to get a 50MHz instrument in essentially the same price bracket.

Weston

David Fuhrman, digital product manager, Weston Instruments, Newark, NJ, touched on some trends in the market as his company sees them.

ES: *As an overview, how do you see future trends?*

DF: I think, in general, we see the pricing structure leveling off. Rather than the continued decrease in

selling price for these instruments, we see more capability being offered for roughly the same kind of prices in the industry. That includes higher performance levels in terms of accuracy, resolution, ranges that are available and/or special functions that can enhance the usefulness of the instrument for specific applications—things like peakhold and temperature measurement capabilities incorporated within the instrument.

Another trend might be features that are more effective in showing data than conventional digital displays. Some people already use bar graphs as indicators. In the audio area, we see continued exploration of instantaneous audio signals for measurements that used to require a visual indication.

ES: *How about ruggedness and reliability of the equipment?*

DF: I don't see great changes in that area. Our digital multimeters have been drop-proof for several years. Designs may well have reached a plateau in terms of ruggedness, reliability and accuracy unless the semiconductor people come up with a different package design or something that would improve reliability.

Another improvement might be the display—something that could extend the temperature range not possible with current LCDs.

ES: *Do you see any significant changes in marketing and distribution?*

DF: I think we're seeing a conversion from the very diverse market as seen by the conventional multimeter market to specialized users who are converting over to the newer digital meters. We think we reach those users through very broad distribution cutting across a variety of industries, well beyond traditional electronics OEM.

Another important facet we see is that the change in the market will push the manufacturers a bit, forcing them to be more responsive to customer needs. The technology is one thing but the key is to put it in a form that's readily and easily usable. And what the user wants, I think, is going to cause the principal changes of the '80s. □

Reports from the test lab

By Carl Babcoke, CET

B&K-Precision model 2845 digital multimeter

Several functions of the model 2845 B&K-Precision digital multimeter (Figure 1) are made possible by a 40-pin microcomputer IC that contains a microprocessor, RAM memory and ROM memory banks. Other features include: autoranging over four or five ranges for each

Each report about an item of electronic test equipment is based on examination and operation of the device in the **ELECTRONIC SERVICING** laboratory. Personal observations about the performance, and details of new and useful features are spotlighted along with tips about using the equipment for best results.

function; an *auto-skip* mode for faster dcV readings; effective overload protection; RF shielding; auto polarity; auto zeroing; range identifier decimal; continuity buzzer; 3½-digit LCD readout; and push-button selectors with function indicators. Range lock holds any selected range.

Dc-voltage specifications

Accuracy of the four dc-voltage ranges ($\pm 2V$, $\pm 20V$, $\pm 200V$ and

$\pm 1000V$) is $\pm 0.1\%$ or reading ± 1 least-significant digit (LSD). Input impedance is $10M\Omega$ for each range. Metal-oxide varistors and a fuse protect the input from damage or overvoltages.

Autoranging for other functions begins with the 2V (or 2K) range and steps through successive ranges until a reading without overrange is reached. For the dcV function, however, the auto skip feature immediately jumps to the 200V range when the dcV input exceeds 25V. Therefore, readings of higher dc voltages are obtained faster.

The 2V range of all digital meters actually measures up to 1.999V and then overranges for all voltages of 2.00V or higher. Model 2845 changes from the 2V range to the 20V range at 2.00V. (one count above 1.999V). In the same way, the 20V range changes to the 200V range at one count above 19.99V. When coming from a higher voltage to a lower reading, downranging occurs at 179.9V, 17.9V and 1.79V.

Negative voltages produce a minus sign before the digits, while positive readings have no indication.

Ac-voltage specifications

Ac-voltage ranges are the same as those listed for dcV, except the maximum input voltage is limited to 750V RMS. Input impedance is $10M\Omega$ for all ranges. Autoranging operates as described before but without the auto skip feature.

Frequency response is average for DMMs. At about 1.8V RMS on the 2V range, -1dB was at 18kHz, and -6dB was measured at about 25kHz. Approximately 0.6V on the same 2V range showed the -1dB point at 15kHz with the -6dB reading obtained at about 34kHz. On the 20V range with a signal of slightly above 2V RMS, the -1dB point was 3.5kHz and the -6dB reading was obtained at 18kHz. On the same 20V range but with a 7V RMS signal, the -1dB point was 3.8kHz and the -6dB point was about 27kHz. Evidently, the response changes according to the range and the section of the range. Perhaps the response at high audio frequencies varies with the individual meter.

High-frequency response of the B&K-Precision model 2845 is about



Figure 1 B&K-Precision model 2845 3½-digit LCD-readout multimeter features computer-controlled autoranging and 0.1% dcV accuracy. Function pushbuttons are side mounted for convenient hand-held operation. Indicators show switch positions. Only two test-lead jacks are needed. All functions are protected from damage by overloads.

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average for all digital meters tested so far. A similar change of response according to acV range has been found with most other DMMs. If a multimeter is to be used for frequency-response measurements over the 20Hz-20kHz audio band with an accuracy of 0.1dB, then the meter should be tested and a correction chart made for all ranges. For general servicing measurements, however, model 2845 has satisfactory frequency response.

Accuracy for frequencies up to 200Hz is $\pm 0.5\%$ ± 3 LSD for the 2V and 20V ranges, and $\pm 1\%$ ± 3 LSD for the 200V and 750V RMS ranges.

Dc-current specifications

Four ranges of $\pm 2\text{mA}$, $\pm 20\text{mA}$, $\pm 200\text{mA}$ and $\pm 2000\text{mA}$ are provided for dc-current readings. Accuracy of $\pm 0.75\%$ of reading ± 1 LSD is specified for all ranges. Polarity is indicated automatically, and circuits are protected by diodes and a 2A fuse. Autoranging and range lock operate for these current readings.

Ac-current specifications

Specifications for ac-current readings are almost identical to those for dc-current, except for the accuracy and frequency response. Accuracy is rated at $\pm 1\%$ of reading ± 3 LSD between 50Hz and 1000Hz. Frequency response above 1000Hz should be similar to that of acV readings.

Resistance-measurement specifications

Five ranges (2K Ω , 20K Ω , 200K Ω , 2000K Ω and 20M Ω) can be selected by the autoranging. A K Ω or M Ω indication is activated automatically in the readout.

Accuracy is $\pm 0.3\%$ of reading $\pm 0.6\%$ of reading ± 1 LSD.

All ranges are the low-power type. Maximum voltage across the test leads (with a 10M Ω meter as the only load is $\pm 0.74\text{V}$ on the lowest range. Voltage at a full-scale reading is about 0.1V. This is not sufficient to cause any silicon-diode or transistor-junction conduction. Therefore, readings made in circuits with solid-state junctions should be very accurate.



Figure 2 A plastic tilt stand is attached for bench operation. The stand can be moved so it becomes a bail for hanging the multimeter. Autoranging makes possible efficient operation with just a few push-buttons and two test-lead jacks. One on/off switch and five push-buttons (one left side) are the only controls.

Continuity audio-tone

Resistance measurements of less than 179 Ω can produce an audible tone. First, the OHMS function must be selected by push-button, and the instrument must be locked in the lowest resistance range. This can be done by shorting together the test leads, waiting for the decimals to indicate the lowest range and then pushing in the auto/lock button. Or, the power can be turned off, the auto/lock button pushed to lock, and the power turned back on for the tests.

An audio tone cannot begin for $\frac{1}{2}$ to 1 second after continuity is established, and it does not become silent until about $\frac{1}{2}$ second after the continuity is broken. The audio tone is not very loud.

An audio indication of continuity (or low resistances) is helpful when a technician cannot watch the digital readout.

Other features and comments

Model 2845 is powered by one 9V battery. Average alkaline battery life is 100 hours. A LO-BAT indicator is displayed in the LCD readout when 25% of the battery life remains.

Push-buttons select five functions, 21 ranges, and range-locking. Side-mounted push-buttons (Figure 2) allow one-hand operation. The white and red indicators that can be seen through square holes in the front panel show the button positions.

The 0.5-inch LCD readout includes three decimal points, K Ω and M Ω indicators, and a LO-BAT indicator that are controlled automatically. As autoranging occurs, the decimal points appear and disappear to show the range in use. Overrange flashes the two incorrect decimals while the correct decimal is continuously visible.

Two test-lead jacks are provided, and this simplifies the operation. Jacks are recessed and test-lead plugs are insulated so it is not possible for an operator's finger to touch either wire at the meter. The positive test probe has a raised barrier that prevents fingers from touching the metal tip. These are important safety features.

A plastic tilt stand is included. It can be moved to serve as a bail for hanging the instrument for storage. Optional ac-power adapter and a carrying case are available. \square

New Zenith features

By Gill Grieshaber, CET
Gill's Color TV Service

Zenith model SM1973 is the subject of detailed analysis in this new series about modular solid-state color-TV receivers. The following information should be helpful to those technicians not already familiar with Zenith's model-numbering and identification system.

An "S" at the beginning of a model number signifies a remote-controlled receiver. *Space Command* is the Zenith term for remote control. Other color models have a "C" as first number. The second letter reveals the model year. "K" stands for 1979, "L" indicates 1980 and "M" identifies 1981 models. Picture tube size is shown by the first two numbers; the next two numbers are identification of that particular model. Cabinet color or finish is shown by a single letter at the end. "E" is oak, "M" is maple, "W" is walnut, "X" is white and "P" is pecan.

The *Triple-Plus Chassis* has modules without a conventional chassis pan. Plastic brackets support the modules; all interconnections are made with cables having edge-connector plugs and sockets. Labels show the proper connections and destinations. This method is said to require fewer interconnections, thus increasing the reliability.

System-3 combines the *Tri-Focus*

EFL-type Picture Tube, a *Triple-Plus Chassis* and the *Color-Sentry system*. The *Color-Sentry* feature includes eight automatic color and picture subsystems.

Therefore, model SM1973P is a remote-controlled 1981 19-inch color TV with a pecan finish. (Figure 1).

Tuning systems

Several types of tuning systems are offered in the Zenith "M" line. No. 175-5108 has 18 channels selected by manual rotation of a switch that provides proper tuning voltages for the varactor tuners. No. 175-5107 is similar, but has motorized rotation for remote operation. Conventional rotating lighted tabs display the channel in use. Number 175-5103 has a vertical row of push-buttons for 14 preset (but adjustable) channels. These channels can be either VHF or UHF in any sequence. An illuminated tab beside each button displays the channel number. Some smaller receivers have 175-5113 tuning systems that provide continuous and stepless tuning with the channel numbers displayed on rotating drums.

No. 17505112 is a manually operated direct-access tuning system incorporating a digital keyboard, a prescaler and a microprocessor. This system does not have a remote control.

In addition, two new tuning systems are controlled by a more

powerful microprocessor. No. 175-5124 has up/down scanning of channels with provision for skipping inactive channels. Programming for adding or deleting channels is performed only by the TV panel controls, although the remote control also can scan up or down. Channel numbers and the time in hours and minutes are displayed on-screen at the lower-right corner of the raster (Figure 2). These digital numbers and letters are provided for several seconds following power-on and channel-change functions. Also, they can be displayed for several seconds anytime the CH/TIME RECALL button on remote or receiver panel is pushed.

No. 175-5117 has all previously listed functions plus volume up/down and direct-address of all channels from remote or television receiver.

Tuning system 175-5130 is similar to No. 175-5117 with the addition of COLOR-SENTRY and SPACE-PHONE features. It is part of the Zenith model SM1973P that will be analyzed in detail later.

Modules

The M1 module includes a combination UHF-VHF tuner, a surface-wave integrated filter (SWIF) IF channel, synchronous video demodulator, AFC, AGC, audio circuits, sync separators and the horizontal master-scan oscillator. No. 9-151-03C M1 module is

Zenith

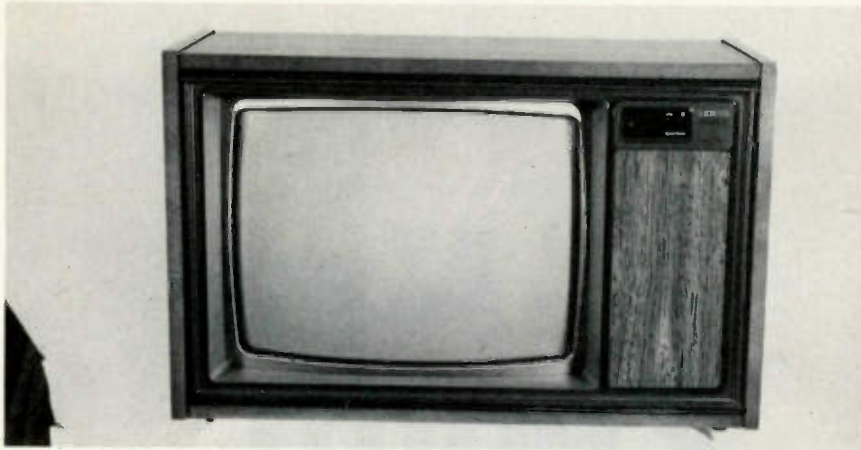


Figure 1 Zenith model SM1973P is a 19-inch color receiver with many new features, including electronic tuning, remote control, comb filter and Space Phone for answering incoming phone calls.



The Space Command remote-control unit performs 18 functions.

used in all 1981 Zenith color TVs except hospital and motel models.

Each M2 module has luminance circuits, chroma IFs, color oscillator, color demodulators, vertical countdown and power-output stages and various interconnections. No. 9-152-01 M2 module also has a comb filter for better separation of chrominance and luminance signals. *Peak-Resolution Picture* (PRP) circuit is Zenith's name for its comb filter that is said to extend the luminance bandwidth by 25%.

A 9-155-01D M5 module has a luminance-drive transistor and three power transistors. These power transistors supply matrixed red, green and blue signals to the picture-tube cathodes.

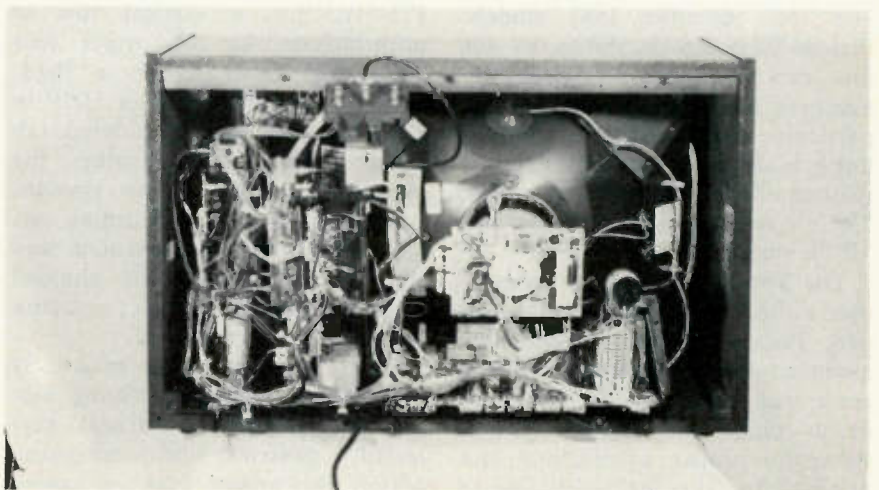
The 9-160 M10 module includes low-voltage hot power supply, horizontal-sweep and high-voltage circuits, and several scan-rectified voltage supplies. Variation of the horizontal-output transistor's duty cycle provides regulation.

In addition to these four basic modules, each 1981 Zenith has other modules according to specific features. Remote models have separate modules for remote power-supply and remote circuits. A small module is provided for the secondary controls.

Various 1981 models are designed around appropriate modules and their interconnecting cables and plugs. There are four M10 variations, four different remote power-supply modules, two or more kinds of secondary-control modules,



Figure 2 The channel in use and the digital time can be displayed on the TV screen. The channel/time readout has a black background for good visibility. The digits are white but tinted by whatever color is in that area.



System 3 Zeniths have no conventional chassis. Instead, brackets hold the modules, which are connected by cables and plug/connectors. All modules can be replaced in the customer's home, if necessary.

Zenith

shown in Figure 4, these 10 buttons are part of the cluster that includes on-and-off power buttons, up-and-down volume buttons, channel-scanning buttons and a combination ENTER/RECALL button. A block with channel number and digital time is displayed for several seconds in the picture each time the ENTER/RECALL button is pushed. It also has other functions.

Although the remote-control unit has these same functions, the physical layout is different, with the direct-address buttons in two vertical rows. Also, a single OFF/ON button is provided. When the TV power is off, one push turns on the power. A second push turns off the power.

Faster and more convenient up-and-down channel scanning is possible when the system is reprogrammed to skip all those stations without sufficient signal strength or those the customer does not watch. This is programming for favorite channels.

Channels skipped by up-and-down scanning can be selected by direct access from either the remote or the receiver. However, a distinction needs to be made. Selecting a skipped channel from the remote does not change the programming. But selecting a skipped channel

from the receiver panel results in cancellation of the skip. In other words, the channel then is selectable by remote and receiver up-and-down scanning.

Cable systems with signals on all or most VHF channels allows fewer options. Some viewers will not want any VHF channels skipped. Also, most cable systems convert UHF channels to VHF (or perhaps there are no UHF stations in the area). For those conditions, all UHF channels can be skipped during scanning, but each channel must be reprogrammed individually.

Skipping or recalling channels

Two basics must be made clear before any reprogramming is done: The tuner control system is a phase-locked loop (PLL) type, so no channel memory is erased or eliminated when a channel is skipped; and reprogramming can be done *only* by buttons on the TV-receiver panel.

When first unpacked, Zenith receivers with Computer Space Command-3500 remote-control systems are not programmed to skip any channel. In fact, all 82 TV channels and 23 cable channels can be selected. Undesired channels must be eliminated from up/down scanning by a simple procedure.

But first, normal selection should be explained. For direct-address selection, push the channel-number and the ENTER/RECALL buttons in that order. When the first channel number is pushed, the channel-and-time block appears in the picture. If a second number is pushed, it too appears on the screen. However, the channel remains the same. The channel is not changed until the ENTER/RECALL button is pushed; then the channel change occurs instantaneously. This is correct operation both for the remote unit and for the TV receiver.

Incidentally, it is not necessary to add a zero before channel numbers under 10. For example, push button 4 (not buttons 04) for channel 4. However, if a zero is pushed before a single-digit channel, there is no error. The incorrect zero appears in the channel/time block at first, but when the valid digit is pushed, it replaces the unwanted zero. If a mistake is made or a wrong

channel number selected, merely change to the correct one before the ENTER/RECALL button is pushed. Also, if no channel numbers have been selected, pressing the ENTER/RECALL button makes the channel/time block visible in the picture.

Reprogramming for skip—It is easy to change the programming so undesired channels will be skipped during up or down scanning. First, the unwanted channel is selected by scanning or direct address on the television panel. Then the CHAN/SKIP button is pushed before the channel/time block disappears from the picture. (This CHAN/SKIP button is on the television panel; the remote cannot perform reprogramming.) Notice that the channel number is replaced by the letters "PO" when the CHAN/SKIP button is pushed. This PO means programmed out, and it indicates the system will skip over that channel in the future.

Each undesired channel can be skipped by this same method, which can be done rapidly. If all UHF channels are to be skipped, for example, scan to channel 14, press the CHAN/SKIP button, scan to 15, press the CHAN/SKIP button, and so on.

When a skipped channel is to be reprogrammed for inclusion in the scanning mode, just push the channel number or numbers on the television-receiver panel, and quickly (before the channel/time block disappears from the picture) push the television ENTER/RECALL button.

After any reprogramming, all channels should be tested by scanning up and then down while noticing the displayed channel numbers.

Tuning comments

A short time delay has been designed into the remote-control action to prevent false operation from spurious signals. Therefore, the remote direct-access buttons should be pushed firmly for a fraction of a second each time. The on/off function has a longer time delay.

When an up or down channel scanning button is pushed, the



Figure 4 The layout of the pushbutton controls on the TV panel.

channels are changed at the rate of two or three per second as long as the button is held down. This is helpful when scanning through many channels. However, a change of only one channel requires removal of pressure from the button immediately when the previous

channel is blanked-out.

The tuning and remote systems appear to be immune from errors or damage from controls or buttons that are operated incorrectly.

Audio volume is varied in 128 steps, so the volume changes appear to be continuous. Volume variations

continue until pressure is removed from the up-volume or down-volume button.

Adjusting digital time

Near the bottom of the television-receiver panel are two time set pushbuttons. Set the correct time while pressing continuously on the ENTER/RECALL button. Push on the HR (hour) button until the hours digits indicate the proper hour. Then maintain pressure on the MIN (minutes) button until the minutes digits are correct. The hours digits increment to 12 and then jump back to 1, while the minutes digits increment to 59 and back to 00. If a reading is exceeded, just hold the button down and wait until the digits increment full circle back to the desired reading.

The clock time and the volume setting are not disturbed by turning the television on or off by the panel or remote switches. However, a loss of power by a tripped line-power breaker or an unplugged power cable produces minimum sound volume and a time reading of 00:00 when the power is restored.

Other features

Five seldom-used controls are behind the front door beside the programming buttons (Figure 6). Holes for screwdriver adjustments of black-level, color level, and tint settings (for the Color Sentry preset button) are near the adjustable controls. No horizontal-hold or vertical-hold controls are needed.

Below these components is the remote-control receiver microphone.

Another convenience for connection to MATV or cable systems is the coaxial cable (Figure 7) that can be slid into a mating male plug when rabbit ears are used, or screwed to the usual male coaxial-cable connector.

Comments

Preliminary operation of Zenith model SM1973P shows excellent performance and no problems. The Space Phone telephone feature is unique and convenient. Several of the new circuits (such as the regulated power supply and the comb filter) should be very interesting when they are analyzed in detail during the next few months. □



Figure 5 All front panel controls are visible when the door is open.

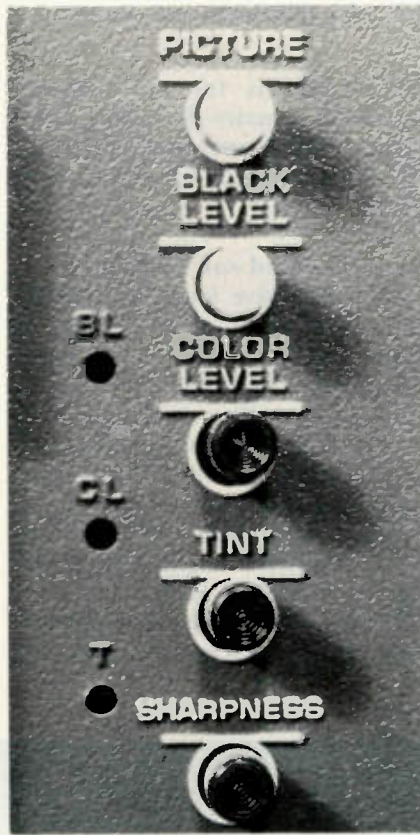


Figure 6 These five rotary controls allow viewers to adjust the picture.

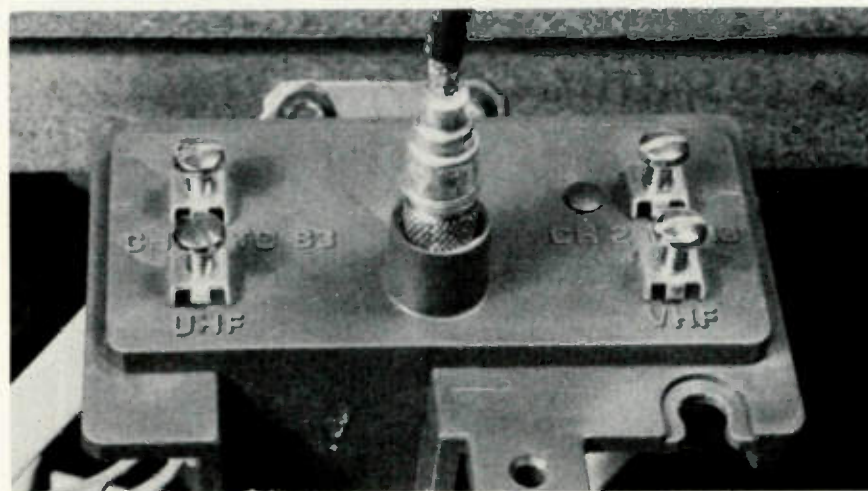


Figure 7 In addition to the capability of tuning in 105 channels without an extra converter, the System-3 Zenith has a 75 Ω cable connector for MATV and CATV systems. The connector slides easily into a mating connector when 300 Ω antennas or rabbit ears are used.

Repairing GE 19Q horizontal sweep

Test methods and typical component failures in the horizontal-sweep section of General Electric 19Q solid-state color televisions are discussed.

By Homer L. Davidson,
Davidson Radio & TV, Ft. Dodge, IA

One common service trouble in solid-state horizontal-sweep systems is failure of the output transistor. Of course, a shorted transistor is easy to find and presents no problems. However, many replacement transistors fail because the original defect (that ruined the first transistor) was not repaired. If the defect remains, all replacement transistors will fail also. This can become expensive.

The solution is in several parts. First, typical component failures must be known, and definite troubleshooting steps should be taken. The specific information in

this article is for the General Electric 19Q series (Photofact 1388-3). Some JC Penney and Montgomery Ward models have the same chassis.

No sound and no raster

Most excessive loads in the 19Q horizontal-output stage (Figure 1) cause fuse F404 (0.9A) to blow; F404 should be tested first. If it is open, don't replace it but measure the resistance between the horizontal transistor's case and common ground. Usually a normal circuit measures more than 100K Ω , but a leaky transistor might reduce the reading to around 5K Ω .

If the resistance measurement is near zero or excessively low, the

R246

FOCUS CONTROL

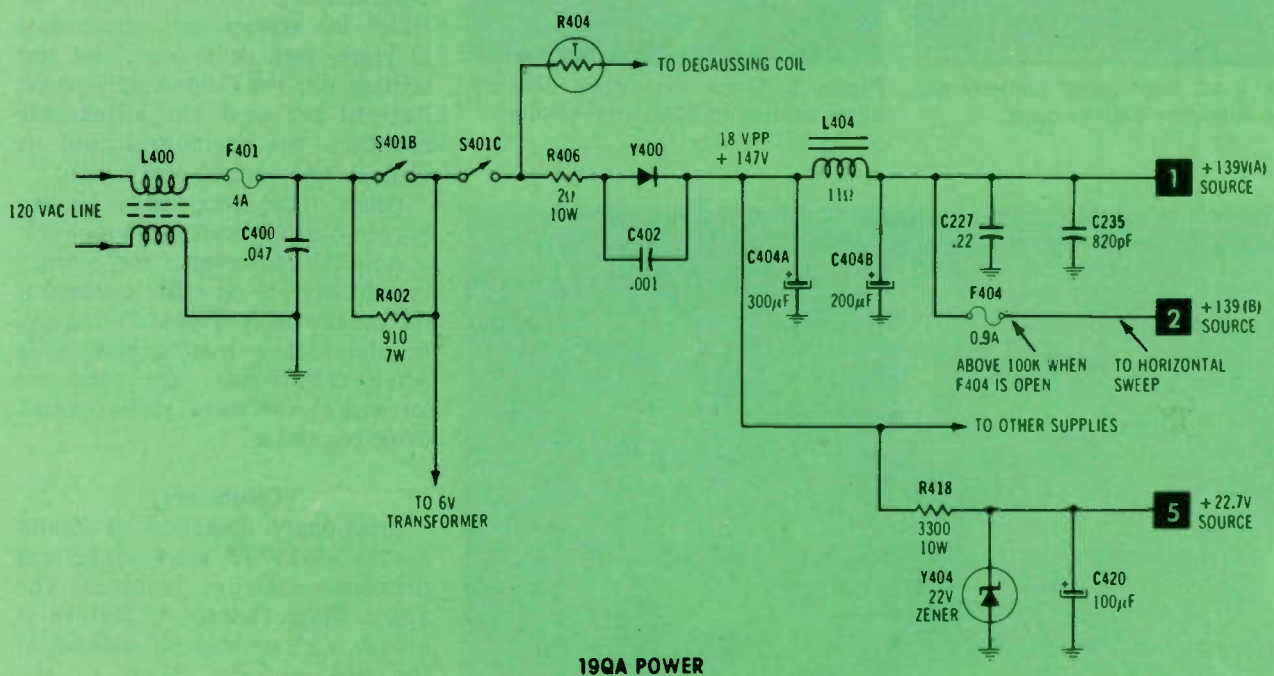
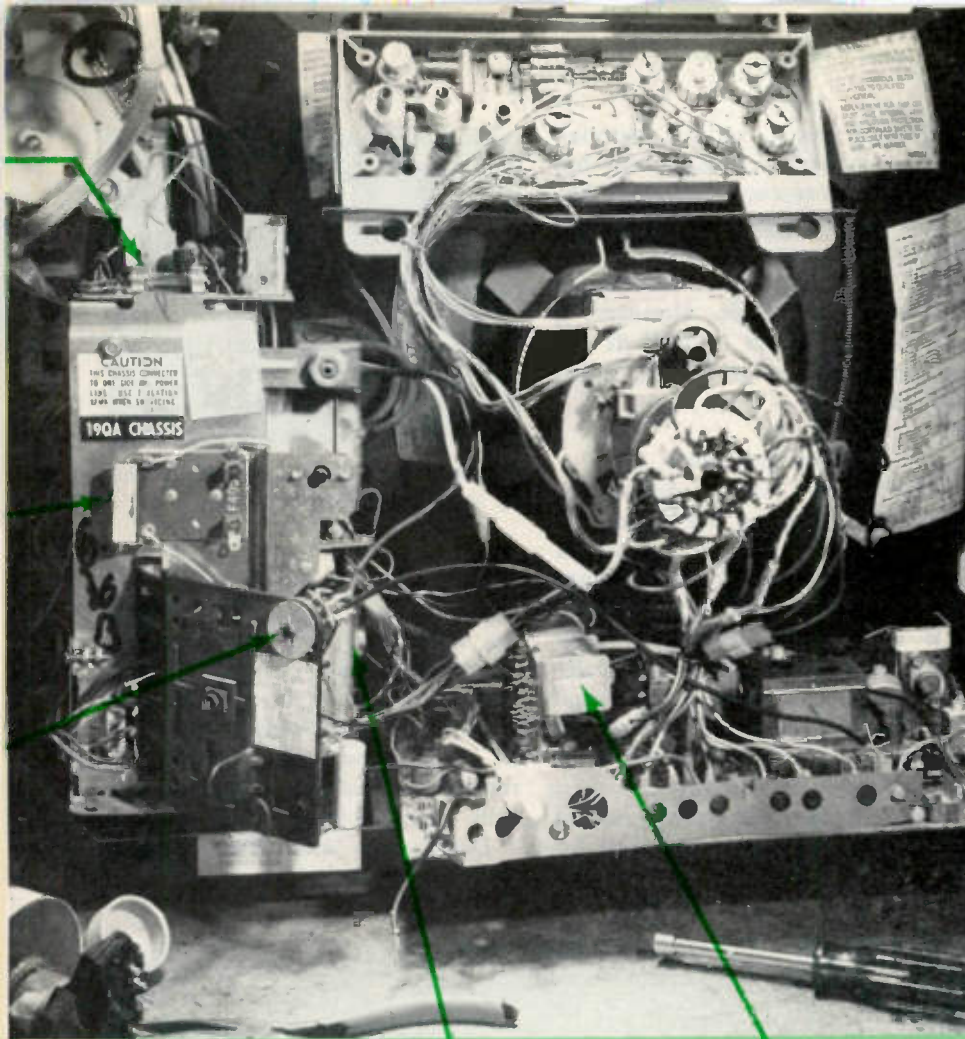


Figure 2 Fuse F401 usually blows when the power supply has an overload; fuse F404 blows when the horizontal-sweep circuit draws too much current. Other +22V sources come from Q400 regulator and dc power rectified from horizontal sweep.



Q206 OUTPUT VERTICAL BOARD

Figure 1 The rear view of a GE 19QA chassis (Photofact 1388-3) shows several horizontal and power-supply components.

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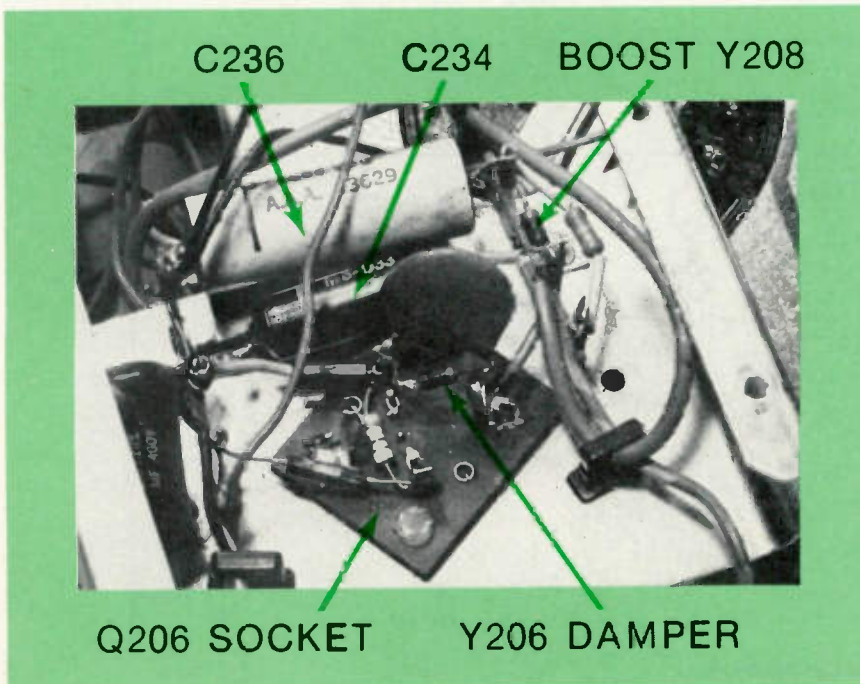


Figure 3 The horizontal-output socket with transistor and other components are on a separate metal chassis mounted on the right side of the HV cage. When replacing the output transistor, check the Y206 damper diode and C234. Defects in them can ruin replacement transistors.

GE 19Q

output transistor should be removed for out-of-circuit tests. While it is out, the resistance from fuse to ground should be checked. Double troubles are not impossible.

A GE-38 or RCA SK-3111 can be used for replacement when an original type is not available.

After a new replacement transistor has been installed, the cautious approach is to operate the receiver with low line voltage during preliminary tests. If the fuse does not blow, but no deflection or high voltage is obtained, the Q206 collector voltage should be checked at the transistor case. Zero dc voltage might be caused by an open T204 flyback primary winding, and open F404 or an open R250 (10 Ω —7W in Figure 5). R250 is a large resistor behind the high-voltage cage. This resistor opens

during any heavy overload, especially if a higher amperage fuse has been used to replace the 0.9A F404.

The +139V supply for the output transistor is not regulated. Therefore, it is rare for defects to increase this voltage. However, it will rise to about +155V if the horizontal-output transistor draws little current.

When fuses blow

When F404 blows repeatedly, suspect problems in the horizontal-sweep system. But, if fuse F401 (Figure 2) blows, the low-voltage power supply should be suspected.

If F404 blows continually after the flyback, yoke and output transistor have been checked and found normal, disconnect one end of the damper diode (Y206) and test it for leakage or a short (Figure 3).

Shorted yokes can destroy output transistors and blow fuses. Test for

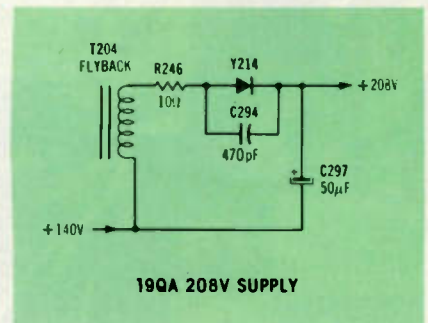


Figure 4 The +208V supply is powered by rectified horizontal sweep.

a bad yoke by disconnecting one end of the red wire that is between the horizontal yoke coil and the output-transistor collector. Apply power to the receiver and note whether the fuse holds or blows. If it holds, the yoke should be replaced. Failure of a second fuse calls for more tests.

Defects in the 208V supply

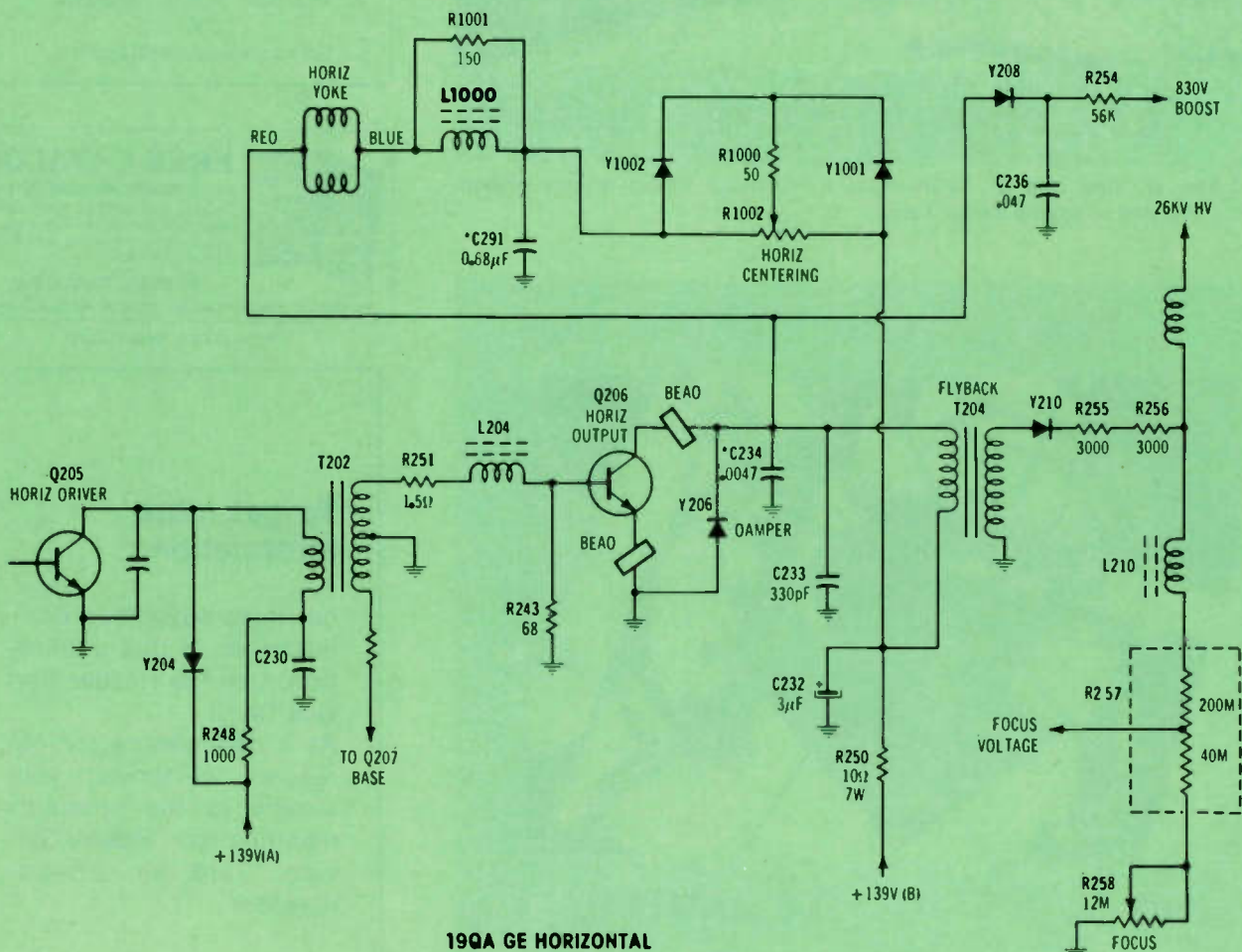


Figure 5 Horizontal-output transistor, flyback, yoke and high-voltage circuits. Asterisks indicate that C234 and C291 must be checked and replaced with care, since their characteristics are critical.

(Figure 4) can ruin the output transistor and blow F404. A short in diode Y214 or in C297 filter capacitor is the most likely.

Other defects that ruin replacement output transistors are an incorrect horizontal-oscillator frequency or insufficient drive signal at the output-transistor base. Remove the transistor and examine the base-to-ground waveform. Remember, without an output transistor, the base waveform should have excessive amplitude while the wave-shape is changed to square waves. An insufficient drive signal is proved by amplitude equal to or less than the schematic value.

An output transistor that runs hot before it shorts (or the fuse blows) indicates a drive problem. Measure the winding resistance of the driver transformer and visually examine all soldered joints at the transformer. Replace the driver transformer if the resistance is too low, which can indicate shorted turns.

Another cause of mysterious repeated failures of the output transistor is an open in the capacitor that tunes the sweep system. In the 19Q chassis, this is C234, a 0.0047 μ F 1200V capacitor (Figure 5). If possible, use an original-type capacitor for replacement. Otherwise, select one carefully. Capacitance value, dielectric material and minimum voltage are all critical. Do not deviate from that capacitance, and use the same or a higher voltage rating.

C234 can develop intermittent defects, resulting in multiple call-backs. Therefore, when an output transistor is replaced, it is recommended that this capacitor be replaced at the same time.

Shorted flyback transformers or triplers (HV rectifiers) ruin output transistors, also. Check the flyback by a ringing test or flyback tester. If possible, disconnect the tripler or HV rectifiers. With low line voltage applied, scope the horizontal-output transistor's collector waveform. In case the waveform has higher amplitude and a better waveshape than before the tripler was disconnected, a defective tripler is indicated.

Flyback replacements require considerable time. Therefore, carefully check these other possible causes of transistor failure before

installing a new flyback.

Replacing flybacks

Flyback transformers can have burned spots from arcs or can develop shorted turns in a winding. Shorted turns sometime heat one area of the flyback windings, if the power can be applied long enough without fuses blowing. For example, when the high-voltage doughnut winding runs hotter than the others, it is likely the shorted turns are in the doughnut. But, if the doughnut is cooler than the area of the other windings, then these other windings might have shorted turns.

Open windings usually do not produce overheating, or cause output-transistor failures. Resistance readings can find open windings easily.

When a flyback replacement seems called for, don't remove any wiring until a drawing is made of the terminals and the color of wires at each terminal. Save this drawing to guide the connection of a replacement flyback (Figure 6).

Construction of the flybacks allows removal of the HV doughnut winding from the frame without replacing the entire flyback. Remove all screws from the small mounting plate so the flyback can be pulled through one end of the HV cage. Then remove the HV winding, being careful not to lose the small pieces of insulation that are installed in the gaps between the core sections. They must be replaced properly.

When soldering or resoldering terminals on the flyback, be certain to finish with round, smooth balls of solder on each lug. Soldering joints without sharp points tend to discourage unwanted arcs. Recheck the wiring before applying power to the chassis.

Low-voltage supply problems

Problems in the low-voltage power supplies can produce insufficient picture width or low HV. One of the first tests should be a measurement of the dc voltage at the output-transistor collector (case). Voltages significantly lower than +139V probably indicate a low-voltage power supply defect, although excessive current drain in the output transistor can also reduce the voltage.

Compare voltages of the +139V

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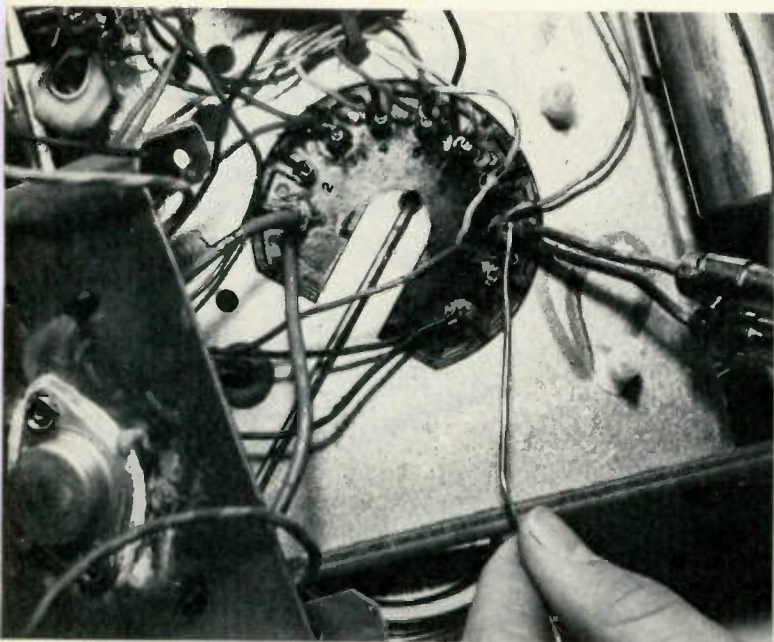
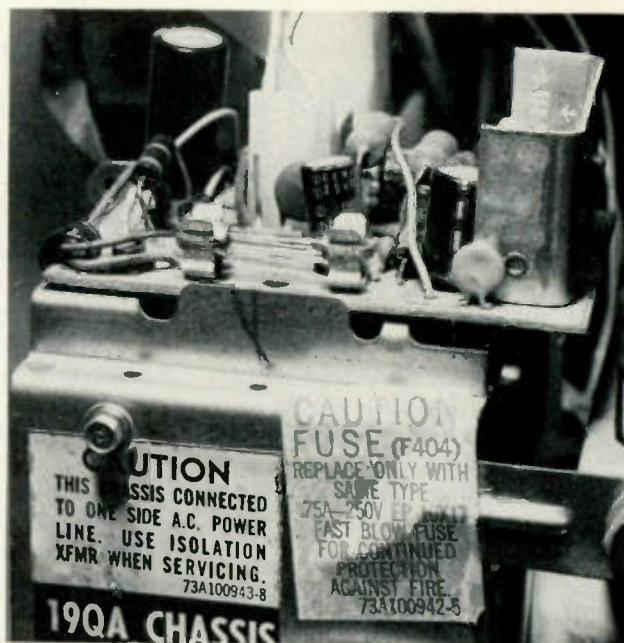


Figure 6 Before unsoldering wires from the flyback transformer preparatory to replacement, make a diagram of the terminals and the color of each wire. When soldering flyback terminals, use sufficient heat to form a round, smooth soldering joint that minimizes arcs.



Fuse F404 and several components of the Q400 +22V regulator circuit are on a circuit board above the HV cage.

GE 19Q

(B), +140V and +120V supplies at CircuiTraces 2, 3 and 4. If the voltage of one supply is lower in proportion than the others, that supply might have excessive current. Resistance readings should be used first to find any reason for the extra current. If that method does not find the increased load, one circuit at a time can be disconnected. The one that raises the voltage most probably has the leakage.

Increased resistance of surge resistor R406 (see Figure 2) can lower all power-supply voltages. Can-type filter capacitor C404 either can begin leaking or have reduced capacitance. Leakage decreases the dc voltage while increasing the ripple. Reduced capacitance in C404A greatly increases the sawtooth ripple at its terminal while decreasing all dc voltages. In contrast, a reduced capacitance in C404B does not decrease the dc voltages. But, the ripple on the +139V (A) and (B) sources is increased because the bypassing effect is reduced.

Voltage for the audio circuits comes from the 120V source. A reduced voltage there can eliminate or reduce the sound volume.

A few L404 filter chokes have developed shorted turns because excessive current from defects in other circuits has caused hot operation. A few shorted turns do not change the resistance reading very much, but they reduce the inductance to almost zero. When in doubt, substitute a test choke externally by temporary wiring. If the test choke minimizes the ripple or hum that is visible in the picture, the L404 choke should be replaced.

Insufficient width

As stated previously, narrow width can be caused either by reduced supply voltage or a problem in the horizontal sweep. Low HV and narrow width frequently are symptoms of the same defect.

When the horizontal-centering control (Figure 5) is burned and frozen until it cannot be rotated, or there is evidence that the control has overloaded previously, check yoke-coupling capacitor C291 (0.68 μ F). Leakage in C291 can produce low HV and narrow width. Or it can blow fuse F404 when shorted.

Excessive loads on the horizontal-sweep system from defects in one of the two boost circuits also can affect width and HV. The +208V

supply (Figure 4) provides power for the three color-output transistors and the current-limiter transistor. If this supply has low voltage, check for an increased value of R246, a leaky Y214 diode or excessive leakage in C297 filter capacitor. Also, excessive current in Q600, Q604 or Q606 blue, red and green color-output transistors (wrong bias or internal shorts) overloads the +208V supply, giving the same narrow-width and low-HV symptoms.

About +830V is obtained by rectification of the horizontal pulses at the Q206 (output transistor) collector. Very low current is needed, for only the picture-tube screen grids are supplied by that source. Leakage in diode Y208 or filter capacitor C236 can reduce the HV and picture width.

Of course, any voltage change in these two power sources also changes the brightness. A reduction of the +208V source increases the brightness, while a similar reduction of the +830V supply decreases the picture brightness.

Separate positive and negative voltage supplies for the vertical-output transistors are rectified from horizontal-sweep power. Therefore, defects in those supplies can affect the width and HV adversely.

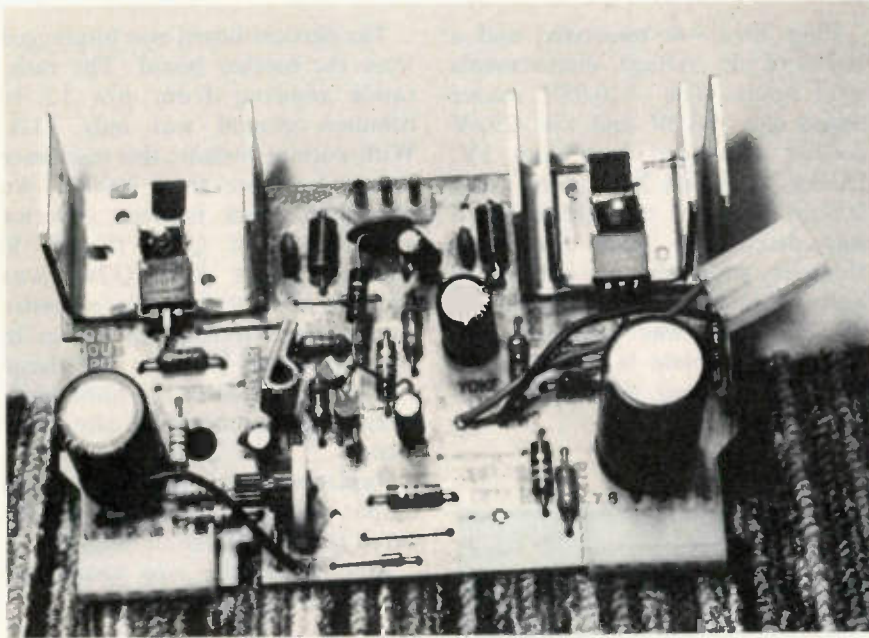


Figure 7 Vertical-output transistors (Q267 and Q268), Y268 and Y270 diodes (that rectify horizontal sweep) and both filter capacitors are on a circuit board that plugs into the mother board. Remove the board for out-of-circuit testing or replacement of defective components.

Focus vs. high voltage

Normal variations of high voltage do not change the focus, because the focus voltage is adjusted by R257 and R258 (voltage-divider resistors) to the percentage of the high voltage that gives best results. Therefore, high voltage and focus voltage vary up and down in the same degree. Only a large change of HV vs. focus voltages produces poor focus. Both voltages should be measured.

If the HV is normal, but variation of R258 (Figure 5) cannot restore proper focus, resistors R257 and R258 are the first suspects. Focus control R258 should vary the focus voltage from 4500V to 5700V. If the measured range of voltages is less, the picture-tube focus pin should be examined for dirt or corrosion. Of course, a weak picture tube sometimes appears to have no point of focus, because the beam splatters and fills in the spaces between scanning lines. With those receivers, focus for the best picture detail; it's the best focus possible.

When the high voltage is lower than 20kV, it is not possible to obtain best focus because of beam splatter at reduced voltages. Let the width be the major symptom in such cases. Repair the width and the focus probably will be corrected.

An unusual case history

The symptoms with this 19QA GE receiver were: almost-normal height, full width, normal sound, but very poor focus. Usually a slight lack of height indicates a problem in the vertical circuit, and poor focus points to a defective HV or focus circuit, while the full width and good sound prove the horizontal sweep is operating correctly.

Perhaps two problems were causing the two symptoms.

The height reduction appeared to be minor, so the focus problem was first priority. High voltage measured only 18.5kV. To eliminate any load of the picture tube, the CRT socket was removed. The HV changed little.

All high voltage and focus components appeared to be normal. At the horizontal-output transistor, the collector voltage had decreased to +127V, while the transistor temperature was normally cool. The base drive waveform was also normal. All boost voltages obtained by rectification of horizontal-sweep power were low, but not enough to indicate overloads.

Resistance measurements of the yoke and flyback windings showed nothing wrong, but the flyback was suspected of having shorted turns. Before starting the time-consuming

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GE 19Q

task of removing and replacing the flyback transformer, each load on it was disconnected, one at a time. Several disconnected circuits made no change, but when the vertical power-source plug (Figure 7) was removed, the high voltage increased to almost 27kV. This proved an excessive load in the vertical sweep or its power source was the problem.

Plug S012 was reinserted and a series of dc voltage measurements were made. The +10.95V source tested only +3.3V and the -29.6V source measured less than 1V. Diodes Y268 and Y270 were warm (almost hot) and the circuit board was discolored from the heat. However, they were not shorted or leaky. Resistor R294 (mounted on the HV cage) was extremely hot. After the problem is solved, R294 must be replaced (Figure 8 schematic).

The vertical board was unplugged from the mother board. The resistance reading from pin 13 to common ground was only 23Ω. With normal circuits, this resistance should be more than 2000Ω. An ohmmeter check between collector and emitter of Q268 (Figure 9) showed about 2Ω. Q268 was shorted, and the resulting excessive current was reducing the voltage in both supplies. In turn, the large current loaded down the horizontal-sweep system causing the poor focus.

Replacement of the leaky Q268 output transistor with an SK3083 cured the slight lack of height.

Both symptoms were caused by the defective Q268 transistor.

Summary

Servicing the horizontal-sweep section of a 19Q-chassis General Electric can be condensed to these steps:

- Check for normal +135V at the case (collector) of horizontal-output transistor Q206.
- Remove and test the output transistor for leakage, shorts or opens.
- While the transistor is out of the circuit, check to be certain the correct low voltage is at the output-transistor socket collector terminal.
- Inspect the horizontal section for any obvious defects, such as blown fuses or burned resistors.
- Measure dc voltages and waveforms at the horizontal oscillator, and the output-transistor base waveform.
- When replacing a leaky or shorted horizontal-output transistor, always replace C234.
- When the symptom is poor focus or insufficient width, measure the high voltage at the picture tube. Insufficient high voltage often accompanies both.
- Check both boost supplies for leaky diodes, burned resistors or leaky capacitors.
- Before removing the flyback transformer, disconnect all circuits that can load down the horizontal transistor and flyback. If disconnecting any circuit relieves the overload, check that circuit.
- If the flyback is replaced, use an original replacement or an exact replacement. □

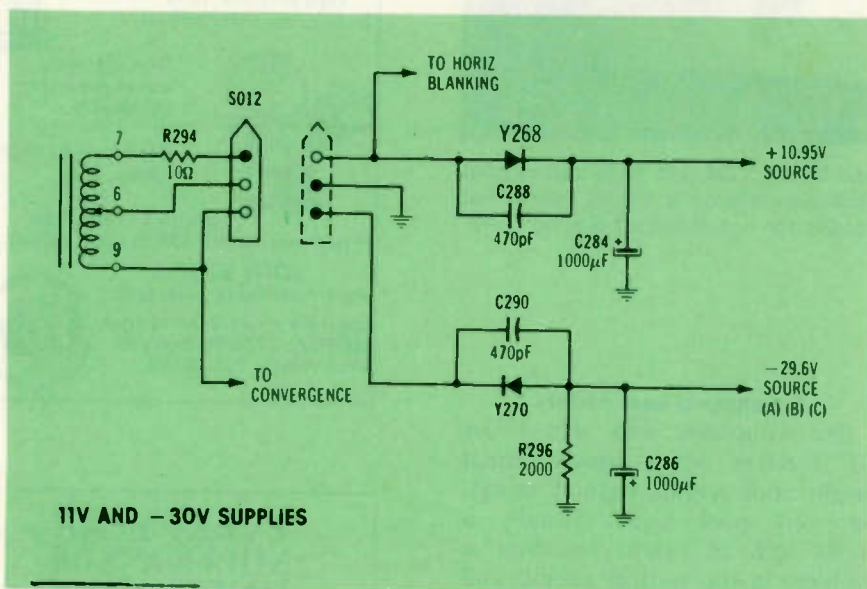


Figure 8 Leaky or shorted diodes in the voltage sources for the vertical-output transistors can produce low-HV and narrow-width problems by loading-down the horizontal sweep. Remove plug S012 during tests of these diodes and filter capacitors.

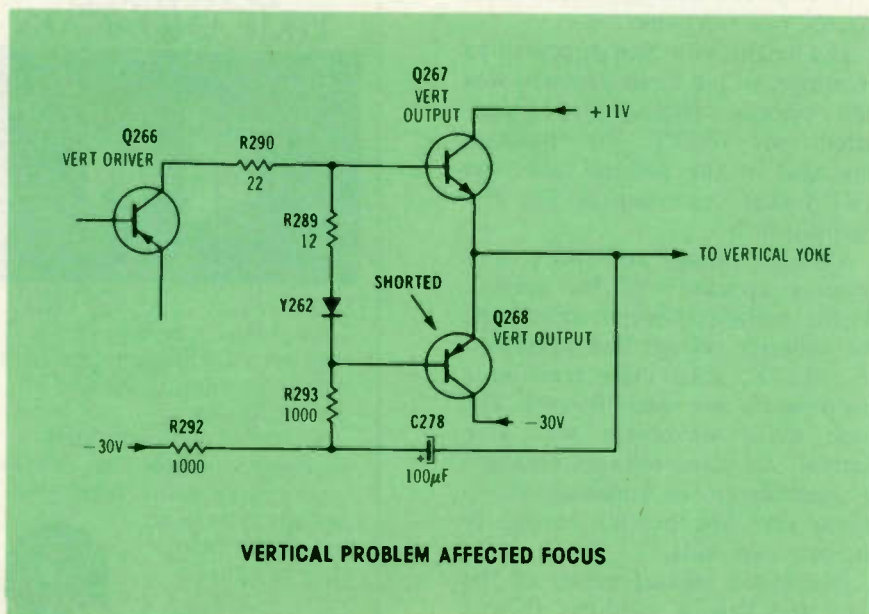
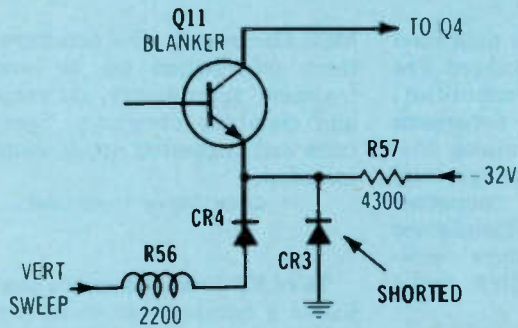


Figure 9 A leaky vertical-output transistor in one GE 19Q chassis gave the symptoms of poor focus and a slight loss of height at the top. High voltage measured only about 18kV.

Chassis—RCA CTC96
PHOTOFACT—1870-2

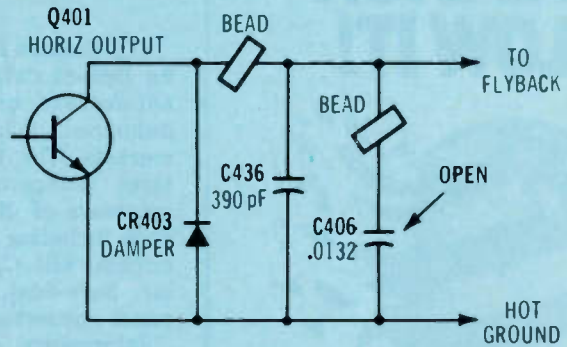
1



Symptom—Black bars at right edge of raster
Cure—Check all blanker diodes, and replace any shorted ones

Chassis—RCA CTC91
PHOTOFACT—1783-2

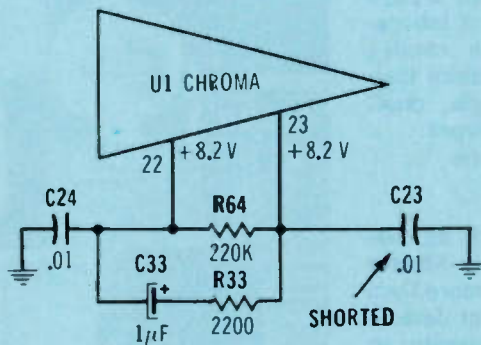
4



Symptom—Q401 shorts at turn-on
Cure—Check capacitor C406, and replace it if open

Chassis—RCA CTC96
PHOTOFACT—1870-2

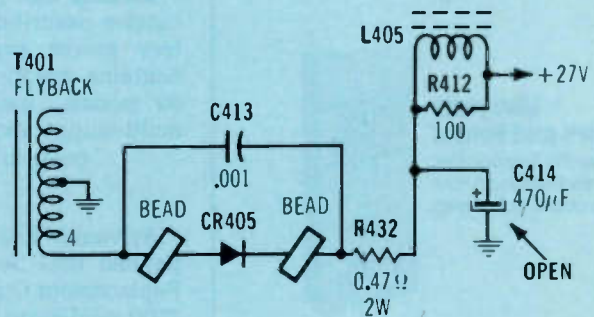
2



Symptom—No color
Cure—Check C23 and C24, and replace if shorted or leaky

Chassis—RCA CTC92
PHOTOFACT—1788-2

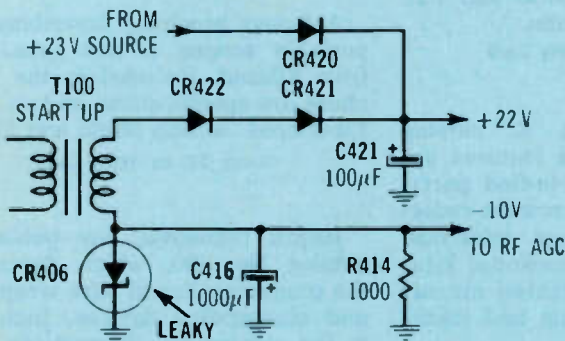
5



Symptom—Left side of raster is dark and no color
Cure—Check filter C414, and replace it if open

Chassis—RCA CTC101
PHOTOFACT—1896-2

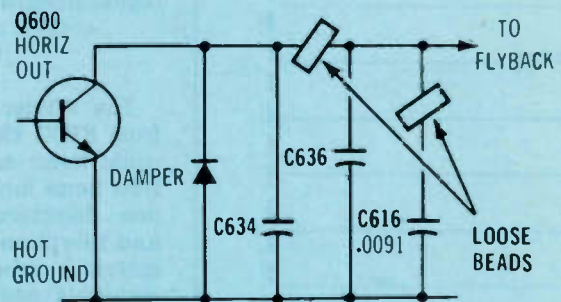
3



Symptom—Degraded picture quality; hint of AGC overload
Cure—Check -10V supply, and replace zener CR406 if leaky

Chassis—RCA CTC93
PHOTOFACT—1810-2

6



Symptom—Excessive 15,734Hz whistle
Cure—Check for loose ferrite beads in horizontal system. Tighten, or apply rubber cement

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catalogs literature

ITT Cannon Electric has published its 1980-81 catalog of standard line connectors used in commercial, industrial, military and aerospace markets. The 233-page catalog features photographs, drawings and cutaways of 20 different connector lines including KJ/KJL subminiature circular MIL-C, PV miniature circular, Sure-Seal, VE and DPK rack/panel connectors.

Information about connector applications, contact arrangements, electrical and mechanical data, materials and finishes, dimensions, performance test results, cross-reference guides and ordering instructions are included.

Circle (26) on Reply Card

Kikusui has published an 8-page catalog describing its line of laboratory power supplies. The catalog contains specifications on more than 50 models, including single, dual, multi-output and bi-polar types.

Circle (27) on Reply Card

Sylvania has published an expanded ECG Semiconductor Master Replacement Guide listing more than 2500 solid-state replacement devices used as substitutes for domestic or foreign units in entertainment, commercial and industrial equipment. The 432-page book includes listings for high noise immunity logic families, microprocessor devices, random access memories, bi-polar and RF transistors, industrial rectifiers, high voltage devices, linear integrated circuits and CMOS and TTL digital integrated circuits.

Circle (28) on Reply Card

The Winter 1980-81 "K" catalog from **ETCO Electronics** features unusual items and hard-to-find parts. New items include microwave radiation detectors, wireless intercoms and telephones, educational kits, metric hardware, printed circuit materials and receiving and transmitting tubes.

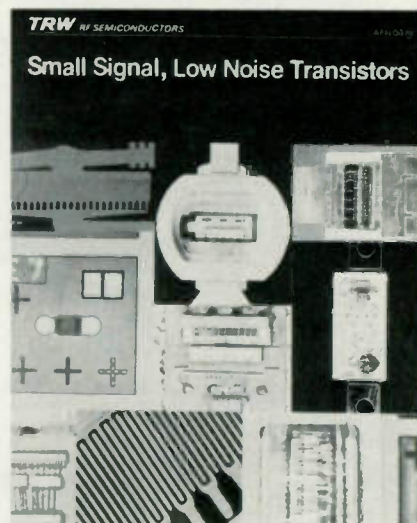
Circle (29) on Reply Card

An eight-page brochure of over-voltage protection components for ac and dc circuits is available from

MCG Electronics. The brochure contains information on ac and dc transient suppressors, dc crowbars and clamping crowbars. Specifications and suggested applications are included.

Circle (30) on Reply Card

TRW RF Semiconductors has published a catalog containing detailed information on its family of 15 small signal, low noise transistors. Designated Catalog 80, the 52-page booklet contains specifications, perfor-



mance graphs, photographs, circuit diagrams, package drawings and dimensions. All devices in the catalog are NPN silicon bipolar transistors with gold metallization.

Circle (31) on Reply Card

A 6-page brochure describing six portable scopes is now available from **Kikusui**. Included in the brochure are specifications on two new Kik-scopes, models 5650E and 5531.

Circle (32) on Reply Card

Jonard Industries has published catalog No. 350, which describes the company's line of wire wrapping and unwrapping devices. Included in the catalog are illustrations and descriptions of Jonard's hand wrapping tools, hand unwrapping tools, manual wrapping and unwrapping guns and accessories, and wrap and unwrap tool kits.

Circle (33) on Reply Card

people in the news



Bernard Appel has been promoted to executive vice president, marketing, at Radio Shack. He was previously senior vice president, merchandising and advertising.

Also at Radio Shack, **Robert Keto** has been named executive vice president, operations. He was previ-

ously senior vice president, USA stores.

Martin Siskel has been promoted to vice president, operations, Blonder-Tongue Laboratories. Siskel was previously materials manager. □

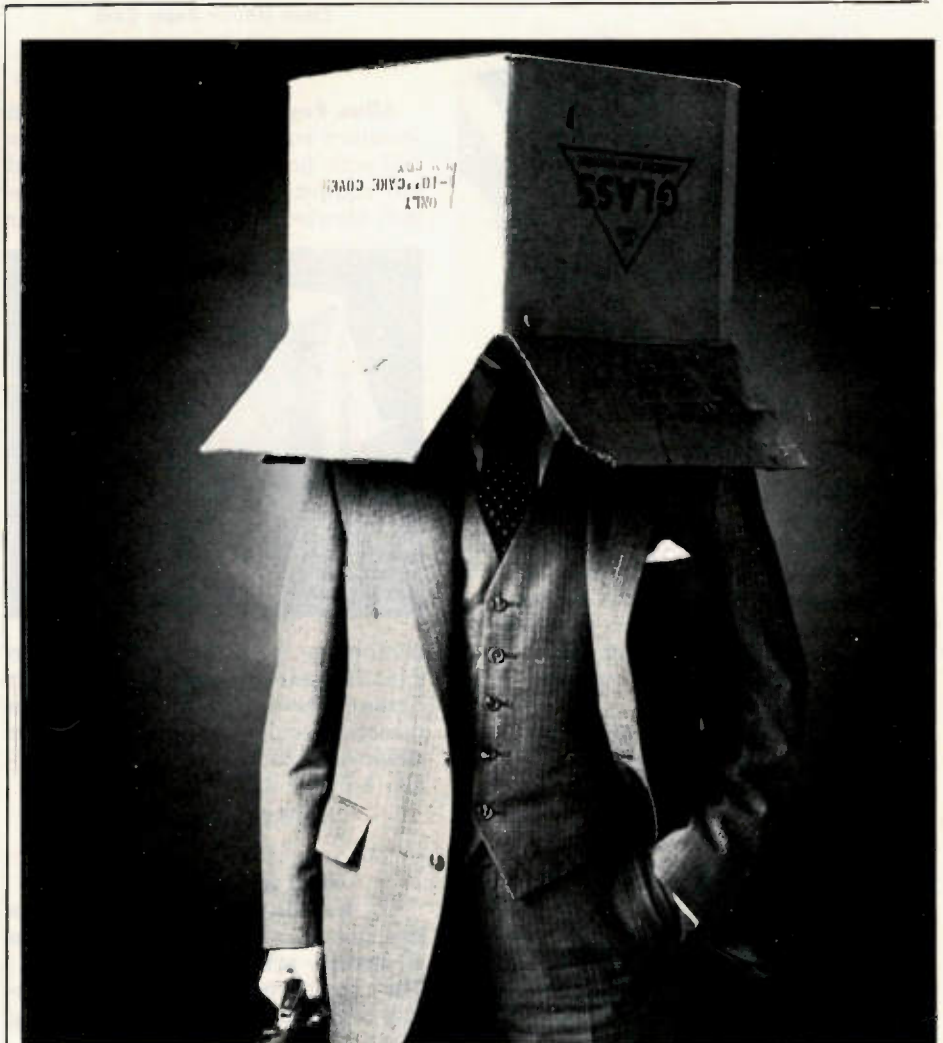
Brian F. Eckl has been named B&K-Precision/Dynascan advertising and sales promotion manager. Eckl will be responsible for advertising, sales promotion and public relations activities in the national and international promotion of B&K-Precision electronic test instruments. He also will supervise the company's agency, Stral Advertising.

Before joining B&K-Precision, Eckl was advertising manager, Bell and Howell MicroDesign Division.

Mark Naber has been appointed national sales manager of Kings Electronics, Tuckahoe, NY. Previously, he was subcontracts administrator with the Bendix Corporation.

Daniel O. Hulse Jr. has been promoted to marketing manager, industrial products unit, for ITT Cannon Electric. Hulse joined the company in 1966 as sales engineer at the Dallas sales district, and has worked as senior sales engineer, senior product specialist, and product manager, consumer products group.

Henry V. Golden, CET, EHF, was inducted into the Electronic Hall of Fame at the NESDA convention in Louisville, KY. His work with industry associations has included the formation of the ISCET Technical Clearing House. Golden has also served as an ISCET test administrator in the Kansas City area.




WHAT THE WELL STRESSED MAN IS WEARING THESE DAYS.

Ah, we're a funny breed, we humans. Seems like we've got this crazy notion that the best way to deal with a problem—at home or on the job—is to shut-up, clam-up, back-off, or hide-out.

Instead of talking our problems over, we think it's better to shut the whole world out, to "keep things to ourselves."

But that just causes a lot of unnecessary stress... and makes the problem a lot worse.

This isn't a lecture, or a sermon. It's just a simple reminder: let's keep our options open by keeping our mouths—and our ears—open. Because, when we shut others out, we only box ourselves in.

And that's a *real* problem.  concern counts

**WHEN YOU SHUT OTHERS OUT,
YOU ONLY BOX YOURSELF IN.**

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product report

Microfiche reader

Micro Design has developed the Micro Forty Four, a personal-size microfiche reader for use by service industry personnel for field reference to repair instructions, parts pricing, schematics, diagrams and other types of information. The hand-held unit measures 10¾-inches long, 4½ inches wide and 3



inches high and weighs less than 2½ pounds. It features a self-contained optical system that projects a bright, clear image on the 5½-inch diagonal rear projection screen.

The unit operates on a variety of power sources: battery pack, cigarette lighter of any vehicle or a standard wall outlet.

The suggested list price is \$150.

Circle (15) on Reply Card

Metric Allen set

Moody Tools has announced the addition of three metric Allen sets



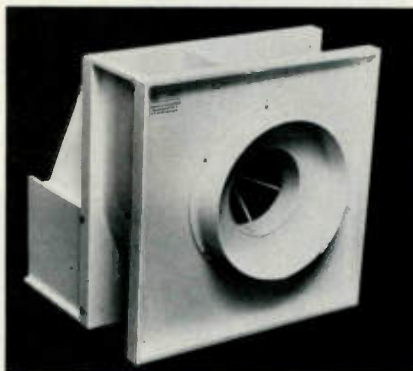
to its Acu-Min line. The sets are designed for precision industrial applications. The Economy Set (58-

0158) contains six Allen drivers and one solid locking, chuck-type, knurled Swivltop handle. The Standard Set (58-0159) includes six Allen drivers and six handles. The Deluxe Set (58-0160) contains six drivers, six handles and six spare drivers. All sets include hardened steel Allen drivers sizes 0.7mm, 0.9mm, 1.27mm, 1.5mm, 2.0mm and 2.5mm.

Circle (16) on Reply Card

Blower

Allen Engineering has designed a standard component-type blower for use with printed circuit boards and lab equipment. The corrosion-resistant blower is designed to move air



containing particles and corrosive gas. The unit features direct or belt driven drive, variable discharge direction and clockwise or counter clockwise blade rotation. Two models, 6-B and 12-B, are available.

Circle (17) on Reply Card

Wire wrapping system

O. K. Machine and Tool has introduced a semi-automatic wire wrapping system, model SW-101. The microprocessor-controlled system features a 20 x 20-inch wiring



area, 10ips traverse speed, high resolution stepper-motor design with .0025-inch increment, full operator display complement and a 40-tube

wire bin. The SW101 offers software flexibility and reads tapes in either ASCII or EIA code.

The SW101 is priced at \$4995.

Circle (18) on Reply Card

Static eliminator

Micro Electronic Systems has introduced Ion-Lite, which generates white fluorescent light and a conductive air flow in an overhead



module to prevent dust attraction and static build-up on microelectronic devices, film and plastic materials. Designated model 1426, Ion-Lite operates from 110V, 60Hz. A Polyamid, throwaway filter is included.

The 1426 Ion-Lite is priced at \$495.

Circle (19) on Reply Card

Package opener

B&G Enterprises has introduced a cerdip and cerpac package opener, model B&G 00-032. Designed for use in failure analysis of dual in-line



cerdip and cerpac packages, the glass-to-lid interface can be aligned

precisely with the hardened knife edges by adjusting the height of the center pedestal. Turning the knob removes the lid, leaving the package leads and bond wires undisturbed for microscopic examination.

Circle (20) on Reply Card

Amperage extender

A. W. Sperry Instruments has announced the development of the Multi-Tran model MT-1000 amperage extender, designed to improve



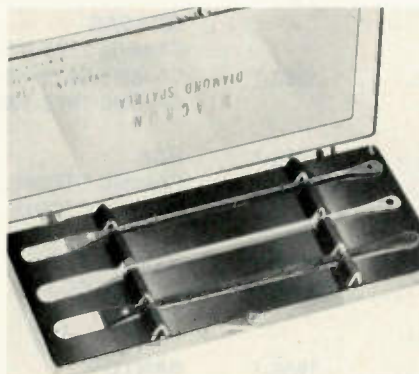
the versatility and flexibility of its Miniprobe, Snap 5, 6, 60, 8 and 9 series Snap-arounds. The MT-1000 extends amperage readings by 10 times, to 1000Aac, when a maximum of 100Aac is read. The unit features insulated tapered jaws and handle, and is complete with operating instructions and a six month limited warranty.

Circle (21) on Reply Card

Burnisher/cleaner

Jonard Industries has introduced

a diamond burnisher/cleaner for use on contact and relay points. The tool consists of abrasive diamond



particles, and features a flexible plastic shaft. Three types are available for every application.

The burnisher/cleaner is priced at \$6.70. A set of three tools is priced at \$19.20.

Circle (22) on Reply Card

Wire stripper

O.K. Machine and Tool has introduced a manual wire stripper,



model ST-300, with an adjustable stop for consistency in wire strip lengths. The tool strips 14-22 AWG solid and stranded wire, Kynar, polyethylene, rubber, neoprene and irradiated vinyls. The blades can

cut through and remove up to 3/4-inch of insulation.

The ST-300 is available for \$9.95.

Circle (23) on Reply Card

Reversible screwdriver set

Vaco Products has introduced its dual-blade reversible screwdriver set No. DU42. The set contains two reversible blades and Comfordome handle packed in a vinyl pouch. Two screwdriver styles are on each



blade, including 1/4-inch slotted, #2 Phillips, 3/16-inch slotted and #1 Phillips.

Circle (24) on Reply Card

Mica capacitors

A new line of high temperature (300°C) high Q capacitors is available from K D Components. A wide selection of capacitance and voltage values is available. Features include low dielectric absorption, stability, repeatability and moisture protection.

Circle (25) on Reply Card

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Chassis 4M46-1D5/-2D5 1961-1

CITEK

Chassis ECC-20331 1958-1

GENERAL ELECTRIC

Chassis AC-B 1925-1
Chassis YME 1949-1

HITACHI

K-2400 1957-1
Chassis NP80SX 1958-2

JC PENNEY

685-1007-10 1955-1
685-1028E, -00 (855-1772),
685-1029E, -00 (855-1764) 1959-1
685-1034E, -00 (855-1806) 1960-1
685-2026-10/-20 (855-1640) 1962-1

KMC (K MART)

KS1976 1927-1

MGA

CS-1392 1923-1
CS-2593 1925-2
C1335-13C23B 1950-3
CS-1733, CS-1933 1954-3
CS-1902, A 1956-1

MIDLAND

15-052 1926-1
15-170 1962-2

PANASONIC

CT-309/329 1924-1

QUASAR

Chassis 13TS-971 (Run A-00) 1922-1
Chassis D5TS-491 1956-2
Chassis 19TS-498 1957-2

RCA

Chassis CTC89E 1926-2
Chassis CTC91E 1951-1

SAMPO

Chassis CS-9A 1951-2
8505 1955-2

SANYO

31C30 1924-2

SEARS

562.42281900 1953-1

SHARP

3T57A 1921-2
19D72/74 1922-2
13C23A, 13D34 1924-2
9D18 1927-2
C1335, 13C23B 1950-3
C1935 1959-2
XR-3013 1960-2
13D38A 1961-2

SONY

Chassis SCC-204E-A, E-B 1921-3
Chassis SCC-204F-A 1923-2
Chassis SCC-265B-A, C-A 1954-2
Chassis SCC-265D-A 1955-3
Chassis SCC-274A-A 1958-2

SYLVANIA

Chassis A12-27 1926-3
MQ9014GY 1927-3
MT9022W 1949-2
Chassis A16-23, A19-24 1952-3

TEKNIKA

Chassis ECC-20326 1922-3

TRUETONE

GEC4019C-03 (24-4019-6) 1953-2

WARDS

GEN-11169A 1949-3
GGY-11940A, B 1953-3
GGY-12210A/220A 1954-3
GGY-11169A 1956-3
GGY-16205A 1957-3
GGY-16350B 1959-3
GGY-12920C 1960-3
GGY-16210C 1961-3

ZENITH

Chassis 12KB4X 1962-3

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Needed: Schematic and/or service information for DuMont type 301-A oscilloscope. *Kevin Mattson, Box 4531, Lincoln, NE 68504.*

Needed: Sams Photofact volumes TR-28, TR-46 and TR-117. *Charles Huth, 146 Schonhardt St., Tiffin, OH 44883.*

Needed: 50KHz oscillator high voltage transformer for a dual-trace triggered scope type OS-121C/USM-140. Hickok part No. 20800-321/TF5RX9ZZ. Alternate part No. (mfg. unknown) P50439054 and No. HP9982. *Gordon D. Fulp, Rt. 3, Box 572A, Placerville, CA 95667.*

Needed: Power transformer for Wards Airline model GTM-2514A. Part No. 410V054H01. *John Osborne, Winthrop Electronics, Town Hall Lane, Winthrop, ME 04364.*

Needed: Hickok oscilloscope model 770 in good condition. *Paul Capito, 637 W. 21st St., Erie, PA 16502.*

Needed: Meter movement for RCA master voltohmyst model WV87B in working order. Please quote price. *T. W. Sallmen, 3545 Dolbeer St., Eureka, CA 95501.*

Needed: Heathkit tube tester adapter model B-16. Please quote price. *Kermit Clark, 4965 Northland, St. Louis, MO 63113.*

Needed: Schematic for a control panel built by Texas Instruments for model 56-8888 O'Keefe & Merritt microwave oven. Panel has a TMS1100 microprocessor. *Lynn Weigle, Traviss TV, 3621 Beaver, Des Moines, IA 50310.*

Needed: Solid-state Heathkit 10MHz oscilloscope with accessories and manual, working or not. Variable ac power supply. Variable dc power supply. *James L. Young, Box 2297, A.P.O. NY 09021.*

Needed: Audio playback head for Roberts 1000 audio/video tape recorder, (same as Akai X-500CT). Roberts part No. RX-1115. New or used. *Danny Brou, 212 Wainwright Rd., Pineville, LA 71360.*

Needed: Schematic for a Bendix (Ford) auto radio model F8TBF (Photofact AR54). *J. R. Chaves, 9768 Michaels Way, Elliott City, MD 21043.*

A Century in America



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Highlights of Salvation Army History

March 10, 1880—A group of Salvationists, seven women and one man, landed in New York City. Their first act was to kneel and pray on the cobblestones. Then they set to work, helping the needy and preaching the Gospel.

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Today—There are over 1,000 Salvation Army corps community centers—in middle class suburbs, inner-city ghettos, and small-town main streets. To some, The Salvation Army is their church home. To others, a social service center which helps in times of need. To youngsters, an after-school recreation center. To all, an open door for anyone who needs its spiritual or practical ministries.



the marketplace

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UNIVOLT'S DT-810 DIGITAL MULTIMETER

The unique space age digital multimeter with transistor gain (hFE) measurement capability should be the only multimeter you own.

Ora Electronics has offered in the past many fine Digital Multimeters (D.M.M.'S). We still sell the famous D.M.M.'S such as Beckman, Fluke, Hickok, and others. We have always followed the advance in technology used in D.M.M.'S, and we always wanted to supply our many good customers with the most Ideal Multimeter, at a price they can afford. In the past we had to sell good, but expensive Multimeters, expensive but "fair" Multimeters, and plain "cheap" Multimeters.

WE FOUND IT!

Several months ago, a famous Test Equipment Manufacturer, walked in to our headquarters with a Prototype of a Digital Multimeter. We were very impressed it had almost everything we wanted plus a bonus, the only question remaining was "how expensive is it?" When we heard the answer, a big smile appeared on our faces. After several improvements we are proud to offer it. After you read the features (and price) I am sure you are going to order one or more, of these fine D.M.M.'S that we call the "UniVolt".

LCD DISPLAY.

The unit has a 3.5 Digit liquid crystal display. The sharp digits are 14mm high and have a viewing angle of 140°.

HIGH ACCURACY.

The basic D.C. accuracy of the UniVolt is 0.5% of reading +1 digit, which makes it one of the more accurate instruments in its class. The input impedance is very high, 10 mega- Ohms (10,000,000) Ohms, which helps in measurements of low voltage and high frequency signals.

MEASUREMENT RANGES.

The UniVolt has D.C. voltage range of 100uv to 1000V in five steps, A.C. voltage range of 100mV to 1000V, current measurement range of 100mA to 10A (DC) and resistance range of 1 to 2,000,000 Ohms.

CONTINUITY & DIODE TEST.

A fast and accurate continuity test mode utilizes a built-in buzzer to indicate continuity. The same mode is used to check diodes and their approximate forward voltage.

EASE OF OPERATION.

The UniVolt is small, it measures 6 1/2" x 3 3/8" x 1 1/4". It's light weight, only 9.87 oz. including battery! It utilizes push buttons, for easy one-hand operation and the front panel has a unique color coding for reduced errors.



OVERLOAD PROTECTION

The unit has an extensive overload protection on all ranges. On D.C. current ranges it uses a .5A GMA type fuse. A spare fuse is supplied with the unit at no extra cost.

MAINTENANCE FREE

The heart of the UniVolt Multimeter is a 40 pin L.S.I. chip, the Intersil ICL710G. This space ages chip has proven to be one of the most sophisticated and reliable micro-electronic circuit in use, it is supported by minimum amount of external parts, which are over specified to insure failure safe instrument. Of course, Ora Electronics stands by this instrument and guarantees it for one year (See specific warranty information).

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OTHER FEATURES

It uses one 9 volt carbon battery (included), which last approximately 200 hours of continuous use. Its sampling time is 0.4 seconds, operating temperatures of 30°F to 104°F, and operating humidity of less than 80% R.H.

BONUS!!

We left the best to the end. The UniVolt DT-810 has something unique. It has a transistor gain (hFE) measurement mode! This unique feature enables you to measure hFE values of 0-1000 of either P.N.P. or N.P.N. transistors.

SPECIAL PRICE

We had originally decided to sell the unit for \$119.95, but in order to promote the new advancement in D.M.M. design, represented by the UniVolt, for a limited time only you can buy this incredible unit for only \$99.95 including: standard red & black test leads, a fresh 9v carbon battery, a spare 0.5A GMA type fuse and an instruction manual.



FREE CASE

We have worked long on the UniVolt project and we hate to see scratches or bad looking units. So we decided to go all the way, when you buy the UniVolt DT-810 Multimeter (and for a limited time only!) we will give you absolutely free a hard vinyl leatherette, carrying case, with felt padding and a compartment for your test leads. The regular selling price for this case made CC-01 is \$8.00.

ACCESSORIES AVAILABLE.

The only two accessories available are: UP-11, hFE probe with special plug and 3 color codes alligator clip, and the UP-12 I.C. clip adaptor, which will help you hook your multimeter to any I.C. pins. (You can buy both probes for only \$6.00, but only when you purchase the UniVolt DT-810 now.)

ORDER NOW!

It's very easy to order your UniVolt DT-810 multimeter. Send \$99.95 (California residents add 6% sales tax) plus \$2.50 delivery charge to the address below, if you want the optional accessories, please add \$6.00 (California residents add 6% sales tax). A cashier check or money order will help speed your order. Credit card holders (master card or visa) can call our toll free number (800) 423-5336, in California it's (800) 382-3663. C.O.D. orders will be accepted, but you must pay by cash or money order and a C.O.D. charge of \$1.40 will be added. If you decided to buy another brand of Multimeter, please call us too, we carry many other types of multimeters and test equipment at low prices.

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