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NOVEMBER 1980 • $1.50

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
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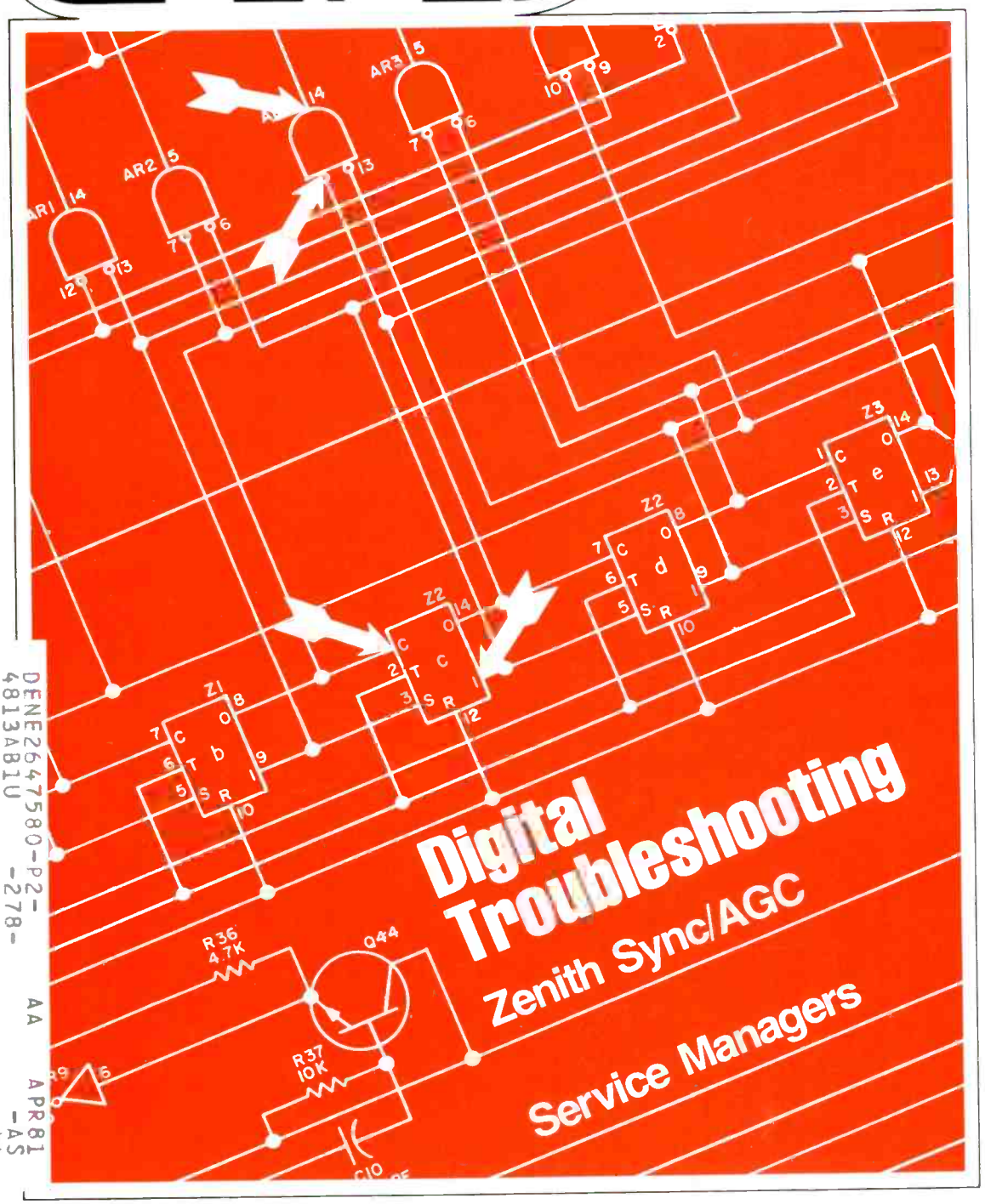

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION

A New Arrival

Name: Mezzer Mark-12
Weight: 4½ pounds
Length: 10 inches

A second generation of profit-building, time-saving test instruments from PTS is being introduced. First arrival is the Mezzer Mark-12 UHF/VHF Field Strength Meter used with accuracy and ease on the bench or in the field.

The rugged, compact (8½" wide x 10" long x 3¾" high) Mezzer Mark-12 features 12-position detent VHF tuning and 70-position detent UHF tuning. Designed for AC or DC operation, the Mark-12 has a detachable AC line cord and self-contained nickel-cadmium batteries that automatically recharge anytime the unit is plugged in. The Mark-12 meter is electronically damped for reading stability under all conditions. See the Mark-12 and other PTS test instruments at your nearest PTS servicenter or PTS stocking distributor.

PTS

PTS ELECTRONICS, INC.
The Only Name You Need To Know

For the location nearest you, see Servicenter Guide on next page.

INDUSTRY REPORT

July Video Sales Strong

The television receiver and video equipment industry appears to be relatively recession resistant; total U.S. unit-sales to retailers of home VCR's increased in July and in the first 30 weeks of 1980, compared to the same period last year, and sales to retailers of color television remained relatively stable, according to figures compiled by the Marketing Services Department of the Electronic Industries Association's Consumer Electronics Group.

Home video tape recorder sales to retailers amounted to 50,313 units in July 1980, a gain of 107.8 percent over July 1979. Home VCR sales to dealers in the first 30 weeks of 1980 increased to 336,914 units, up 64.6 percent over the same period a year ago.

July color TV sales to retailers of 648,007 units were down 5.6 percent from the same month last year. Color television set sales in the first 30 weeks of 1980 reached 4,923,470 units, a decline of 7.4 percent from 5,314,973 in the same period of 1979. Monochrome television receiver sales to retailers totaled 338,791 units in July 1980, down 8.8 percent from July 1979. Monochrome TV sales in the first 30 weeks of 1980 were 2,775,523 units, a decrease of 11.3 percent from the first 30 weeks of last year.

Zenith Signs Independent Parts Distributor

Zenith Radio Corporation recently announced Blueline Marketing of Wallingford, CT, as its first authorized independent independent distributor of Zenith parts and accessories, covering Connecticut and three counties of Massachusetts and distributing the full line of Zenith direct replacement parts, Zenith general replacement parts, tubes and semiconductors, and Zenith accessories, to independent service dealers.

Training Emphasized at Yamaha Audio Service Conference

Yamaha Audio hosted some 245 professional electronic technicians from across the United States and Canada at its 1980 National Service Conference Sept. 9-12 at Rockton, Ill.

Three days of training seminars covering a wide range of subjects affecting the professional technician and service dealer environment were the subject of in-depth panel discussions, audio video presentations and instructional sessions. The required "core" subjects were: Service Profile, a look at four model electronic serviceshops; New Product Technology, a review of the new Yamaha circuitry and products; Customer Relations, which dealt with PR problems faced by the independent serviceshop; and Career Development, a seminar that featured a look at the development and growth of the consumer electronics service industry and provided a general review of the demand and opportunities that will open to professional service industry technicians during the 1980s.

The elective courses, two of which had to be taken by each conference participant, were on Instrumentation; Troubleshooting Techniques; Sales Support; Service Management I and Service Management II; and Merchandising Consumer Electronic Service.

According to Geoffrey L. Power, National Service Manager for the Yamaha Audio Division, the 1980 conference attempted to provide a brief, yet comprehensive view, of what consumer electronic service will be in the 1980s and to help the technician adapt to the new environment currently affecting the industry through the wide variety of complicated electronic productry entering the consumer service environment.

"Yamaha audio appreciates the commitment shown by the dedicated professionals who demonstrated their concern for the future of the industry by their participation in this conference."

France Begins Video Text Telephone Directory

Some residents of France's popular coastal resort area of Saint-Malo no longer "let their fingers do the walking." Instead, their electronic telephone directory promptly displays the number they need on a screen in their home or office. Rather than searching through the pages of a telephone directory, they will "instruct" the electronic directory by typing the required information on an alphanumeric keyboard.

Dozens of Saint-Malo residents and businessmen this summer have become pioneers in the first large-scale test of France's plan to completely eliminate conventional telephone directories and the telephone "information" service. This electronic directory, says the French telephone company, is easier to use, faster—and cheaper.

In lieu of telephone directories, the phone company will provide every customer—private or business—with an electronic terminal. Over the next ten years, it expects to distribute more than 30 million free terminals which will still be cheaper than publishing conventional telephone directories and up-dating them yearly, says the French telephone company, PTT. It will also be more efficient, because the electronic directory will always be up-to-date.

The electronic directory terminal, a

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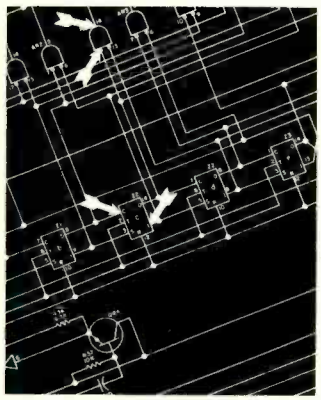
NOVEMBER 1980, VOL. 102, NO. 11



On the cover: Digital troubleshooting—in simplest terms, pulsing the input of a gate with a logic pulser and monitoring the output with a logic probe or a current probe—is the subject of our cover and our major feature.

FEATURES

DEPARTMENTS

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ELECTRONIC TECHNICIAN/DEALER [ISSN 0192-7175] is published monthly by Harcourt Brace Jovanovich Publications. Corporate offices: 757 Third Avenue, New York, New York 10017. Advertising offices: 757 Third Avenue, New York, New York 10017 and 111 East Wacker Drive, Chicago, Illinois 60601. Editorial offices: 111 East Wacker Drive, Chicago, Illinois 60601. Accounting, Advertising Production and Circulation offices: 1 East First Street, Duluth, Minnesota 55802. Subscription rates: one year, $11; two years, $18; three years, $24 in the United States and Canada; all other countries: $30. Single copies: $1.50 in the United States and Canada; all other countries: $3.50. Controlled Circulation postage paid at Dansville, New York 14437.

POSTMASTER: Send Form 3579 to ELECTRONIC TECHNICIAN/DEALER, P.O. Box 6016, Duluth, MN 55806.

SPEAKER TRUCKLOAD SALE!

We bought raw woofers, tweeters and midranges by the thousands for this sale. Some are Grade A surplus items we may never have again. At these prices, they're going to go fast — better stock up while they last!

mcm

PIEZO TWEETER

$6.80 (10-up)

PZ-2 $7.80 (1-9)

- 2" × 5" Horn Type
- 35-50 Volt Capacity
- No Crossover Required

PIEZO TWEETER

$5.40* (10-up)

PZ-1 $7.40 (1-9)

- 35-50 Volt Capacity
- 4K to 40K Response
- No Crossover Required

* Price good through Dec. 31, 1980

HI-FI TWEETER

$4.40 (10-up)

MT-34 $4.80 (1-9)

- Phenolic Ring
- 3 oz. Magnet
- 8 Ohm, 10 Watt

HUGE SAVINGS on surplus raw speakers made to the specs of a prestige New York audio manufacturer.
We can't mention the brand name — but these raw speakers were used in systems that retailed for over $300 each!

12" WOOFER

$24.40 (4-up) $26.40 (1-3) SPW12M

- Extremely high compliance
- Made for air-sealed enclosure
- 80 Watts, 8 Ohms
- 30-500 Hz. Response
- 2" Voice Coil
- Rolled Foam Surround
- 30 oz. Magnet

10" WOOFER

$17.00 (8-up) $22.00 (1-7) 10W18C

- High Compliance
- Made for Air-Sealed Enclosure
- 50 Watts, 8 Ohms
- 35-500 Hz. Response
- 1½" Voice Coil
- Treated Cloth Surround
- 18 oz. Magnet

HIGH FREQUENCY TWEETER

- Cone Type for Smooth Response
- 2000-20,000 Hz. Response

$3.80 (4-up) $4.20 (1-3) MTR25HFC

SEALED BACK MIDRANGE

- Completely air sealed back
- 4½" Diameter
- 30 Watt, 8 Ohm
- Heavy Duty Construction, Dissipates Heat Quickly
- 500-2400 Hz Response

$9.80 (4-up) $10.80 (1-3)

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Becker is an OEM for several audio manufacturers. Call MCM on the toll-free line for quotations on Becker PA and Musical Instrument Loudspeakers.

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$80.00 EA

- 108 oz. Magnet
- 250 Watts IEC, 8 Ohm
- 50-5500 Hz

15" WOOFER

$84.00 EA

- 108 oz. Magnet
- 250 Watt IEC, 8 Ohm
- 40-3200 Hz

18" WOOFER

$104.00 EA

- 108 oz. Magnet
- 250 Watt IEC, 8 Ohm
- 30-4000 Hz

SOFT-DOME MIDRANGE

$23.50 (10-up) $25.60 (1-9)

904A195

- Soft Synthetic Dome
- 26 oz. Magnet
- 8 Ohms, 150 Watts
- 700-7000 Hz. Response

903A162

SOFT DOME TWEETERS

$14.50 (10-up) $16.90 (1-9)

- Mylar Dome
- 2000-20K, 6 Ohms
- 100 Watts

903A164

$12.20 (10-up) $13.60 (1-9)

- Polymerized Dome
- 2000-20K, 6 Ohms
- 80 Watts

Save on popular phono cartridges during the MCM speaker truckload sale.

SHURE

M700EX (M70EJ)	$7.50 (10-100)	$8.50 (1-9)
M705EX (M75ED)	$16.90 Get one free with each 10 you buy.	
M905EX (M95ED)	$22.50 Get one free with each 10 you buy.	

AUDIO TECHNICA

AT1110 (AT-10)	AT1111E (ATS11E)	AT1112XE (AT12XE)	AT1113E (AT13E)
$6.20 (10-100) $6.95 (1-9)	$9.20 (10-100) $9.90 (1-9)	$17.90 (10-100) $19.90 (1-9)	$19.90 (10-100) $22.90 (1-9)

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Circle No. 115 on Reader Inquiry Card

nine-inch black and white screen connected to the telephone, is linked to the data base through the regular telephone line. Customers will obtain the requested telephone number by typing the requested name on the keyboard to enter the system—the number will appear within seconds on the screen.

The Saint-Malo test, begun in mid-July and scheduled to run through early fall, is the first of several throughout France. By next year, some 250 terminals will be installed in the Ille et Vilaine region around Saint-Malo. PTT has just requested quotations from four hardware manufacturers to supply the terminals for the Ille et Vilaine trial. The companies were also asked to submit quotations for the production of the 2 million sets eventually to be used in the country-wide project, with manufacture beginning in 1985.

The electronic directory is one of several new telecommunications projects being developed under a national program known as Telematique. All projects, including two-way facsimile service for the home and office, a free form telewriting system, smartcard technology and complete teleconference facilities for corporations, will be mass marketed at a relatively low cost as a result of new developments in microprocessors and digital technology. ET/D

ET/D

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Duluth, Minn., 55802.

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NEWSLINE

GTE TO SELL SYLVANIA-PHILCO TO NORTH AMERICAN PHILIPS. GTE and North American Philips have reached an agreement under which, barring problems with the Justice Department, GTE will sell its consumer electronics business to North American Philips, the parent company of Magnavox. The sale would involve the Sylvania-Philco labels, eleven US, one Puerto Rico plant, and a plant in Juarez, Mexico. It would involve the receiving tube plants, picture tube operations, and ECG semiconductors; the facilities at Batavia, New York would be leased to North American Philips.

SEPTEMBER TV SALES TO DEALERS SOAR. The last week in September set records in color TV, VCR and B&W TV sales to dealers making a 10 million color set year yet possible in 1980. According to Television Digest, sales to dealers in '80's 39th week were 348,500 units of color TV, 28,000 VCR and 254,000 B&W TV, making it the best such sales week in history.

MINIMUM DBS REGULATION. Direct satellite broadcasting would be treated as a new service with minimum regulation if the proposals of a task force of FCC policy and science advisors were carried out. According to Television Digest, DBS would be only one competitor in the video market place and would not be considered a broadcaster or a common carrier and consequently would have maximum freedom to develop independently.

HI-HI-HI-FI AMPLIFIER. Determined to produce an amplifier which hi-fi enthusiasts could not fault, Professor E.M. Cherry of Morash University, Clayton, Victoria, Australia developed a mathematical theory which reportedly permits negative feedback far beyond the accepted theoretical limits. Application of this theory is said to have resulted in an amplifier with an astonishing 0.0008% distortion. The purists who claim to be able to hear 0.1% distortion will nevertheless undoubtedly hear something wrong.

NEW TECHNOLOGY FOR TWO-WAY RADIO? An inquiry to determine if the rules governing land mobile radio could be amended to permit spectrum saving technologies was recently opened by the FCC. Suggesting that single sideband and other technologies requiring less bandwidth than current FM techniques could be used voluntarily without immediately displacing FM, the FCC expects initial comments by March 1, 1981.

Facts from Fluke on low-cost DMM's

Three good reasons to buy your handheld DMM from Fluke.

Ask yourself what you're really looking for in a handheld DMM, and then take a good long look at ours.

CHOICES? The Fluke line of handheld DMM's now offers three clear performance choices. There's the 8022A Troubleshooter, a solid value for basic voltage/current/resistance measurements that offers 0.25% basic dc accuracy. The 8020A Analyst is the world's best-selling DMM and first to offer conductance for high-resistance measurements to 10,000 Megohms — now with accuracy improved to 0.1%. And the new 8024A Investigator, a powerful instrument also with 0.1% accuracy that boasts three unique capabilities: *logic level/continuity detection* with an audible "beeper" for instant continuity testing, and slow-speed logic checking, *peak hold* to lock onto elusive transient signals, and *direct temperature readings* to 1265°C via K-type thermocouples.

CONVENIENCE? Pick one up and you'll know what *true* one-hand operation means — tough, lightweight, palm-size packages designed with in-line push buttons for quick range and function changes.

RELIABILITY? Count on it. A substantial number of components are used exclusively to insure reliability and to guard against overloads. Calibration is traceable directly to the National Bureau of Standards.

LOW COST? Compare these U.S. prices: $139 for the 8022A, $179 for the 8020A and $219 for the powerful 8024A.

Fluke standards of quality and customer service, of course, are uncompromising — for our line of handheld DMM's and all our products. For more facts call toll free **800-426-0361**; use the coupon below; or contact your Fluke stocking distributor, sales office or representative.

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For technical data circle no. 110 *ET/D 11/80*

SERVICE SEMINAR

GENERAL ELECTRIC

The following information comes from GE TV's Symptom Repair Manual, 6th edition (a 7th edition may now be available) from Product Service, Television Business Department, College Boulevard, Portsmouth, VA 23705. This book of a little over 100 pages covers the more common problems of all GE chassis of the last ten years or so, and can be a great time saver.

19JA, QA, QB Chassis

SYMPTOM	MOST LIKELY CAUSE
No video, dim-out of focus raster. Looks like bad CRT.	Q268 PNP Vertical output Y270 Vertical B-Rectifier Q267 NPN Vertical output Y268 Vertical B+ Rectifier Vertical Module
No video, sound OK	IC501 Chroma demodulator Q600 Blue Amp Q604 Red Amp
	Q606 Green Amp Y600 Arc protection Y602 Arc protection Y604 Arc protection Q109 Video driver Q110 Video amp R408 220 ohm, 2W R183 56 ohm, ½ W L117 Delay line
No vertical sweep or partial vertical	Q268 PNP Vertical output Y270 Vertical B– Rectifier Q267 NPN Vertical output Y268 Vertical B+ Rectifier Q266 Vertical Driver Vertical Module Q260 Vertical Oscillator
Dead, CRT filament	F401 4 amp fast blow F404 B+ Fuse 19JA, QA .75 amp 19QB .9 amp Bad connection on AC switch and AC interlock AC Cord
No horiz. sync or weak sync No raster/with or without audio	Q202 Horiz. reactance Q201 Sync Separator Q268 PNP Vertical output Y270 Vertical B– Rectifier Q267 NPN Vertical output Y268 Vertical B+ Rectifier Vertical Module F404 B+ Fuse 19JA, QA .75 amp 19QB .9 amp Y404 22V Zener Q205 Horiz. Driver Q206 Horiz. Output Y210 HV Rectifier Q203 Horiz. Oscillator Q400 22V Regulator Q402 Preregulator T202 Horiz. Driver Xfmr. T204 HV Xfmr. Picture Tube shorted, filaments to cathode Note: Do not replace CRT. Replace 3 lead CRT filament Xfmr with 4 lead Xfmr.
Weak video Sound may be weak distorted, or good	RF and IF AGC controls misadjusted IC101 IF amp, AGC Bad connections on VHF tuner VHF Tuner Q109 Video Driver Q110 Video Amp.
Video overload	Check C116 for proper polarity, negative to ground C116 .68uf, 35V
Intermittent color	Color Killer control misadjusted IC501 Chroma Demodulator
No sound or weak distorted sound, video OK	IC301 Audio Detector and Amp Q301 Audio output
Colored raster with or without video	Q600 Blue Amp Also check Y600 and R602, 390 ohm, 1/2W Q604 Red Amp Also check Y602 and R606, 390 ohm, 1/2W Q606 Green Amp

	Also check Y604 and R610, 390 ohm, 1/2W Also check Q109, R408, R183, And IC501
Picture smeary or blurry	Focus control misadjusted Sharpness control misadjusted
Weak video, not enough contrast, or snowy	RF AGC control misadjusted IF AGC control misadjusted
Too much brightness	Brite Centering control misadjusted C234 .0047uf, 5%, 1200V
Too little brightness	Brite Centering control misadjusted C236 Boost Filter 19JA, QA .047uf, 1.6KV 190QB .1uf, 1.6KV
Too much color or too little color	Auto Color control misadjusted Note: Control is located near the manual color control
No video, no sound	IC101 IF amp, AGC VHF Tuner T102 IF Xfmr.
No color, wrong Color, screen red, green, or blue	IC501 Chroma Demodulator Q600 Blue Amp Q604 Red Amp Q606 Green Amp Y600 Arc protection Y602 Arc protection Y604 Arc protection ACC Module
No UHF	Bad connection in UHF to VHF coax UHF tuner
Herringbone	1. Remove 1 screw from Power Supply Board, Tilt It Upward 2. Install A .01 µf Disc Cap From the Emitter of Q402 To Ground
QB chassis only Intermittent color gain and/ or tint changes phase when changing channels or screen to screen	View H.V.T. Pulse Winding From Bottom of Set A. Early Production: Pulse Winding Has No Mark Or Has Black Mark On It But Has 11 Turns. Add A 33K ohm, 1/2W resistor across C507. Adjust Horizontal Hold. B. Late Production: Pulse Winding Has A Red Color Code Mark On It And Has 15 Turns. Add A 1K ohm, 1/2W resistor across C511. Adjust Horizontal Hold.

13Y, 17YA, 19YA, 19YC Chassis

No raster, no audio CRT filament not lit	F900 4 amp, fast blow F910 B+ Fuse 13YA, 17YA, 19YA 1 amp. fast blow 19YC 1 1/8 amp. fast blow Y912 B+ Rectifier, Located on power supply module Q702 Horiz. output Y646 Scan Rectifier. Located on vertical module Y642 Scan Rectifier. Located on vertical module
	Y701 Damper Y704 Boost rectifier Y701 and Y704 located on Horiz. output heat sink. R904 Surge resistor 13YA, 17YA, 19YA 2 ohm, 10W 19YC 2 ohm, 15W
No raster, no audio	F910 B+ Fuse 13YA, 17YA, 19YA 1 amp. fast blow 19YC 1-1/8 amp. fast blow Q702 Horiz. output T710 Horiz. output Xfmr. Y701 Damper Y704 Boost rectifier Y701 and Y704 located on Horiz. output heat sink.
	Q640 Vert. output. Located on vertical module. Q635 Vert. Driver. Located on vertical module. Y646 Scan rectifier. Located on vertical module. Y642 Scan rectifier. Located on vertical module.
Arcing/corona	HV Rectifier cup
No video/ audio OK	Chroma/Video module contacts dirty. Clean contacts with spray cleaner (EP90X11) then reinsert module. Poor solder connections at module socket on Chroma/ Video module. Check and resolder. **ET/D**

FROM THE EDITOR'S DESK

At the time of writing this, my first editorial for ET/D I find I have been forced to momentarily stop and survey my strengths and weaknesses relative to the various activities at ET/D. And while *I'm* doing this, when is the last time you stopped to survey yourself (and your shop which in many cases is an extension of you) for your strengths and weaknesses.

A good technician, an adequate technician, should have a proper grounding in electronics fundamentals: an associate degree or its equivalent. This equivalency can come from many sources. You may be entirely self-taught, but you must have this basic knowledge and you must maintain it; I know I find myself having to refresh my memory on things I do not use often but which are very important when I need them. This thorough understanding of basics makes you more adaptable to new equipment, new techniques, new service fields.

You must thoroughly understand your specialty. Television, audio, autosound, two-way radio, etc., or perhaps an even more narrow specialty such as turntables or reel-to-reel tapedecks. Here again do not lose sight of those basics: who would have thought a few years ago of the complexity of some modern turntable controls?

And then there is that perpetual bane of the technician in a small shop: business management, service management. Do you know the condition of your business? When did you last evaluate your costs relative to your various charges? I know I always put off this sort of thing, and lost money thereby.

Have you recently looked at your test equipment? When is the last time the calibration of your favorite analog or digital multimeter was checked? You do have a good accurate DMM don't you? Any meter need periodic calibration. What condition is your scope in? Is the sweep time and amplitude calibration accurate? Nothing can be more confusing than an out of calibration instrument. Also if you are limping along with an old recurrent sweep scope you are fooling yourself; you are wasting a lot of valuable time. In all instances you need modern, accurate, test instruments to efficiently do your job.

Along these lines—we at ET/D are going to continue to needle you a bit. We have a series of features on basic electronics for service technicians which may help fill in some weak spots. We will have features on digital troubleshooting; you are not going to be able to escape it in any case. We will hopefully have features on advanced test equipment applications. We hope to have study material on the Certified Electronic Technician examinations and FCC license examinations. And we hope to continue to offer useful material for the day to day troubleshooting of color TV, stereo and the other things that pay the way right now.

Sincerely

Walter W. Schurtz

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Circle No. 116 on Reader Inquiry Card

SECURITY VIEWPOINT

By Ray Allegezza

This month's column will examine general and specific types of insurance that the service oriented technician of security products and services should be aware of.

First on the list is personal injury insurance. In the event your customer should trip on some wires you are in the process of installing while in his home or business, you would be covered.

Next you should make some provisions to be covered against claims of damage to the subscribers personal property. Could you afford to make reparations to the subscriber in the event one of your installers accidently knocked over and broke a valuable Ming vase?

The first two types of insurance mentioned are fairly general and broad based. There are special types of insurance in addition to those which have been designed especially for alarm companies.

One is commonly referred to as manufacturer's and contractor's liability. Basically, it protects the alarm dealer/installer as he conducts his normal day to day operations.

Manufacturer's and contractor's liability is worth looking into according to Ron Anderson, of the Anderson Insurance Agency. He said that "considering the nature of the dealer's work, this type of insurance is almost a prerequisite to entering the field."

Anderson also said that any dealer worth his salt will try to protect himself as much as possible by the inclusion of certain disclaimers written into the contract. This would include such things as Acts of God, power failures, etc. But keep this in mind. A singed contract even with disclaimers is often not enough. In the event a subscriber suffers a loss due to burglary and brings the case to court, you could be faced with some very real problems. If the case does go to court, the jury ultimately decides the outcome, and in an age of recognizing the rights of the consumer, the trend has been to decide in favor of the consumer.

Before you start deciding on an alternative career, take heart. The manufacturer's and contractor's insurance mentioned earlier has been designed to protect you from some of these very pitfalls.

It is usually broken down into three specific areas of coverage and include the installation, the completed operations and a third clause giving the dealer some protection against product liability.

The first two areas are fairly self-explanatory; they protect the dealer against any problems that may occur during and after the installation. The third clause protects the dealer in the event the subscriber suffered a loss due to burglary where malfunctioning equipment was to blame.

Many dealers decide to install the XYZ company's ultrasonic detector. They will spend great lengths of time to understand how the particular piece of equipment works, but little or no time to see if the manufacturer will stand behind the equipment should there be problems with it. This is why the product liability clause can be critical. Admittedly, insurance is something we tend not to think of until we need it. But it is a fair assumption to say that if you wait until you need the insurance, you have waited a bit too long.

Another type of insurance should also be mentioned at this time. It is called errors and ommissions insurance. What it does is offer the dealer protection against subscribers who claim they suffered losses due to negligence on the part of the dealer. The extent of coverage varies depending on the insurance company. The following is a hypotetical situation that would be covered by an errors and ommissions policy. One of your subscribers notifies you on Monday morning that his alarm system doesn't seem to be working properly. For some reason, your dispatcher doesn't mention this to you until Tuesday. In the interim, the subscriber's residence is burglarized. If you had made provisions for errors and ommissions insurance you would have been covered. If not, this one mistake could have put you out of business. To generalize, errors and ommissions insurance is to the alarm dealer/installer what malpractice insurance is to the doctor.

While Ron Anderson, of the Anderson Agency admitted that many insurance companies are reluctant to write this type of policy, it is available; you just may have to make a few phone calls to find out which insurance companies will write this type of policy for you. And since it's your business, and your livelihood we are talking about, isn't it worth the time and effort? ET/D

BULLETIN BOARD

V. W. Eimicke Associates has announced the availability of its new 72-page **Comprehensive Forms and Office Products Catalog.** This 72-page, 8½ × 11, full-color catalog contains detailed descriptions and practical, helpful hints on how to use the internationally copyrighted Eimicke Personnel Forms, Laurel Office Aids, and "snap 'em apart" forms. There is also an expanded section on special products. One section of the catalog describes the Eimicke Personnel Forms. There is a personnel form available for handling every kind of employee situation—Employee Evaluation Form, Employee Attendance Record, Employee Warning Record, Personnel Envelo—File®, several types of Application Forms, etc. Another section is devoted to Laurel Office Aids—a line of forms designed to help a business person accomplish more in less time with less effort—in bookkeeping, inventory and inventory control, credits and collections, shipping, receiving, purchasing, sales and general office work. The line contains several forms professionally designed for work and time organizing. The third section describes Eimicke's comprehensive line of business "snap 'em apart" forms including a complete line of Tax Forms. The fourth section describes Eimicke's line of special products including such items as desk-top organizers, literature storage organizers, floor mats, paper shredders, scheduling/charting devices, stationery and business cards, filing supplies, typewriter ribbons, etc.

Circle No. 152 on Reader Inquiry Card

ITT Pomona Electronics has published its 1980 catalog of **electronic test accessories,** 100 pages with three color photos, 562 black-and-white photos, and 115 drawings. Products covered include banana plugs, jacks and patch cords; phone tip jacks, plugs and connecting cords; test clips, probes, and holders; binding posts, black boxes and sockets; molded patch cords, cable assemblies, test socket adaptors; ¾" spaced molded accessories, molded test leads and connecting leads. Special features of the catalog are a product index, two pages of new products, conversion tables of temperatures, metric conversion chart, BNC and triaxial cable procedures, a cross index of connector mil numbers, and a quantity price discount schedule.

Circle No. 153 on Reader Inquiry Card

A new catalog of storage products has recently been made available by *AKRO-MILLS*, illustrating its line of steel frame, polystyrene drawer modular cabinets. Ten different drawer sizes are avialable molded in either transparent or grey plastic in standard size stackable cabinets. Akro-Mills also offers a line of economy cabinets, utility boxes, and a series of storage bins which can be used in shelves, stacked or hung from lowered panels. See your Akro-Mills distributor.

Circle No. 154 on Reader Inquiry Card

A new 8-page catalog (No. 0380) describing their low cost **RFI shielded cases, RF transfer switches and accessories** is available from *Compac*. This illustrated catalog contains photos and drawings describing a variety of blank cases, standard size cases and a custom series. It also describes the Compac RFT series which is stated to offer greater shielding effectiveness through closer spacing of 0-80 screws tapped directly into the sidewalls. Compac cases are reportedly effective from 60 to ≥ 100dB at 100MHz and are available with an optional nickel plate finish. Various configurations are noted in the numerous outline drawings. Accessories described include circuit boards, feed-throughs, RF connectors, test cables, adapters, coaxial terminations, attenuators and a line of RF transfer switches. The Compac RF transfer switches are DPDT and SPDT types with standard BNC connectors. A series of die cast boxes and a comprehensive group of gaskets to solve shielding problems are also shown.

Circle No. 157 on Reader Inquiry Card

An updated and expanded edition of the Power-Devices Directory, PTD-187G, is available from *RCA Solid State Division*.

This new 80-page edition provides descriptive data on the broad spectrum of solid-state power devices currently available from RCA. It covers standard commercial products and military-specification types and is intended as a guide to circuit and system designers as to the breadth of the RCA line of solid-state power devices and in the selection of the optimum types for specific applications. Selection matrices, ratings and characteristics data, and package in-

formation are shown for RCA power transistors, rf power transistors, power hybrid circuits, silicon controlled rectifiers (SCR's, GTO's and ITR's), triacs, diacs, and silicon rectifiers. The power-transistor data are grouped according to generic class (hometaxial-base, epitaxial-base, high-voltage, high-speed-switching, and Darlington) with a brief introductory text on features, capabilities, and recommended applications provided for each class. The high-voltage types data features RCA's new line of SwitchMax transistors, which are characterized for operation at 25° C and at elevated temperatures and are intended for use in offline switching power supplies, converters, pulse-width modulators, and similar applications. In addition, the RCA lines of high-speed-switching and Darlington transistors, silicon controlled rectifiers, and triacs have been expanded. Copies of the RCA Power-Devices Directory, PTD-187G, may be obtained by writing RCA Solid State Division, Box 3200, Somerville, NJ 08876.
Circle No. 155 on Reader Inquiry Card

A new 100-page catalog with specifications for more than 5,000 **coils, filters and communications essentials** is now available from the *J. W. Miller Division of Bell Industries*. Catalog 81 includes the new automatic antenna tuner, direct reading SWR/Power meters, speech processor and coaxial switches. Included also is the broad line of high pass, low pass, audio and AC power line filters. Detailed specifications are given for all coils, chokes, filters and related communications components. To assist in selection, coils are categorized by frequency from 0 through 500MHz in the table of contents. Schematic diagrams for all shielded and unshielded coils, showing adjustment accessibility are given.
Circle No. 156 on Reader Inquiry Card

A new cross reference guidebook for "universal" semiconductor replacement parts has recently been announced by *Zenith Radio Corporation*. The new cross reference guide lists a line of semiconductor devices which replace more than 158,000 devices now used in electronic products. The rapid growth in semiconductor use by the consumer electronics industry has created many different numbering systems for the same replacement device.

Zenith states that its line of semiconductors does not add a new numbering system to the many redundant systems that presently exist. The new Zenith industry cross reference guide is composed of a one-number system of exact and selected semi-conductor replacement parts. The Zenith Universal Replacement Guide reportedly allows a service technician to use Zenith semiconductors in a wide range of consumer electronic products such as color and black-and-white television sets, stereo systems and radio, personal and business computers, etc. Zenith is also expanding its current line of semiconductor replacements transistors, integrated circuits and diodes.
Circle No. 158 on Reader Inquiry Card

Quick Rental® Instruments, a catalog of test instruments for long or short-term lease is available from *General Electric*. GE leases a wide range of test instruments from many manufacturers; oscilloscopes, sound and vibration instrumentation, recorders, temperature and pressure instruments, generators, logic analyzers, meters and others, from 48 different locations. Instruments can be rented from one week to one year and over. Purchase credit is available if prearranged on extended rentals. ET/D
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04A

Troubleshooting Zenith Sync/AGC

Made easy

The 9-87 series module, utilizing the 221-45 video processor IC was used in several model years of Zenith color TV receivers, in fact the 221-45 IC was used in non-modular receivers also. While not unusually troublesome it is complex. Here is a thorough explanation of its operation and some troubleshooting procedures.

By Robert L. Goodman

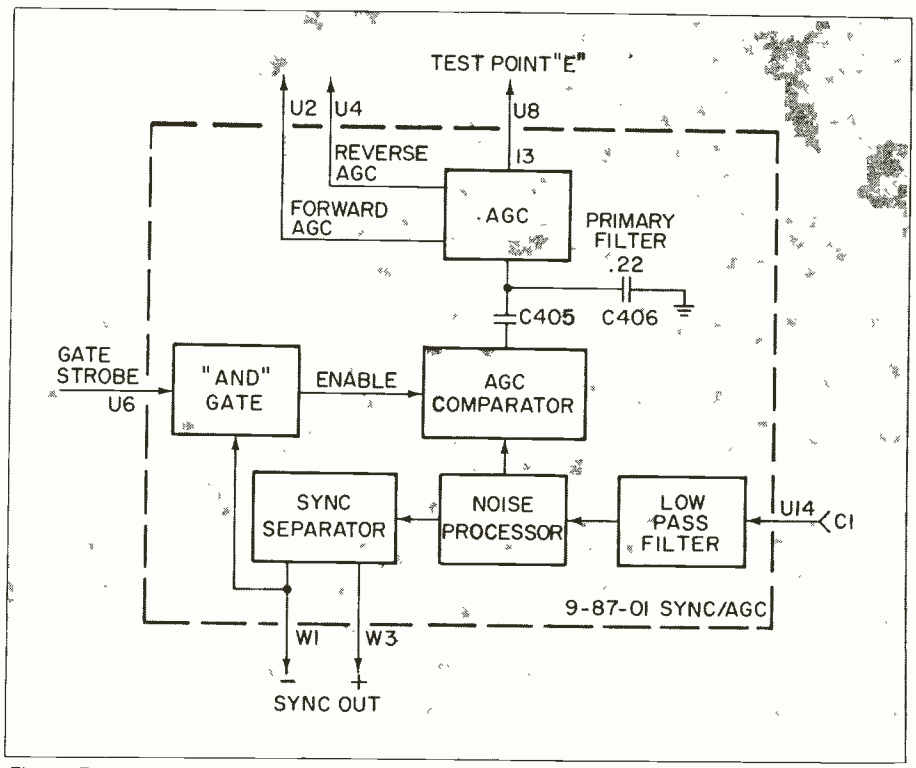

Fig. 1. Functional block diagram of the 9-87 module.

Because of the tremendous TV signal variation and interference found in the "real world" reception, some complex IC circuitry has been designed in order to produce a stable picture. This, of course, is referred to as the sync/AGC circuitry. In the Zenith sets this sophisticated "chip" is known as the sync/AGC processor.

Briefly, the AGC circuit senses the amount of signal received by the TV set after it has been amplified by the tuner and IF stages. A dc control voltage developed by the signal strength is then fed back to the tuner and IF amplifiers to adjust for proper output signals. In order to have a good signal-to-noise ratio, the gain of the IF amplifiers is reduced before the tuner gain is reduced.

To help you see the total picture for this processor "chip" operation, refer to the block diagram in (fig. 1) of the complete sync/AGC system which is contained on the 9-87 plug-in-module.

The video information that the TV station transmitter broadcasts is, of course, AM, amplitude modulated. This AM video signal will vary according to picture information and cannot be used as a reference to produce the AGC voltage. Because the horizontal sync pulse does not vary, except for changes in signal strength, it is compared to an internal-reference to develop the AGC correction voltage.

The AGC circuitry uses the horizontal sync pulses which are removed from the composite video signal by the sync separator-circuit. They are then processed through a dual-time constant network to produce both horizontal and vertical sync pulses that are used to lock-in the vertical and horizontal oscillators. The complete video signal enters the processor chip and the sync separation function is performed from within.

In this article we will take a close look at the Zenith processor IC, how to troubleshoot around it and its associated components, plus review some actual case-history problems.

Circuitry operation

The heart of the 9-87 plug-in module is the 221-45 video processor chip. Two signals are fed into the IC401 chip. One is the composite video signal from the IF

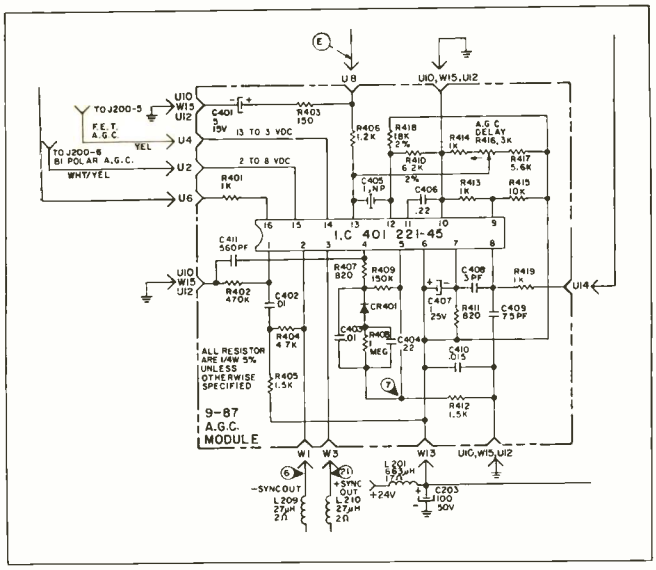

Fig. 2. The 9-87 module circuit.

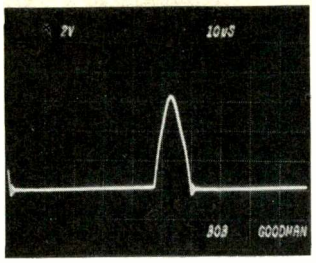

Fig. 3. Horizontal keying pulse.

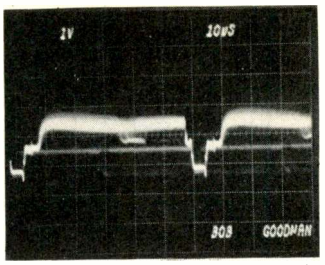

Fig. 4. Composite video signal.

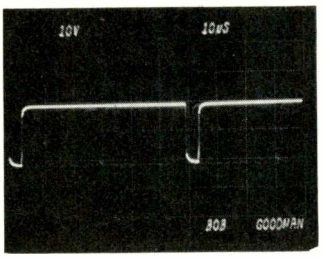

Fig. 5. Horizontal sync pulses.

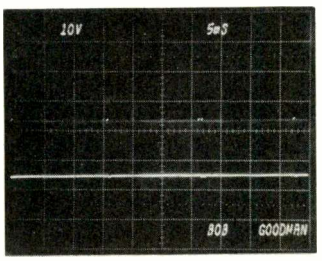

Fig. 6. Vertical sync.

module and the other is the gating pulse from the horizontal circuit. The IC processor uses these two inputs to develop AGC voltage and sync information as well as performing noise gating and sync-limiting. As we look at the various processor operations refer to the 9-87 module circuits in fig. 2 and associated waveform check points. The correct scope waveforms (input and output signals) will appear as shown in Fig. 3, Fig. 4, Fig. 5, and Fig. 6 when all receiver systems are go.

Negative going composite video at test point C1, goes via a high frequency filter network formed by choke coil L211 and capacitor C220 to pin U14 on the 9-87 module. The function of this filter network is to remove high frequency components on the composite video signal, which could in poor reception areas interfere with normal sync limiting action. These filter components could be prime suspects should you encounter poor sync locking action and a replacement module does not solve the problem.

The composite video signal enters the IC at pin 8 via a 1k resistor. The chip at this point (note block diagram) performs the noise processor function. When noise pulses beyond sync tip level appears at pin 8, IC 401 cuts off the AGC and sync functions for the duration of the noise pulse. Turning off the sync function prevents the noise pulses from tripping the vertical and horizontal oscillators.

An in-depth analysis

Within the sophisticated 221-45 chip, is an AGC comparator which is "gated" so that fast slew rates can be utilized with good noise immunity. You will note in the (fig. 3) noise protection block diagram that two "gates" are used. In order for the AGC filter to be charged or discharged, two inputs to the comparator must be present. As with other, discrete AGC systems, the keying pulse must be present but additionally, the negative going separated sync pulse from the video signal must be present. Coincidence of the two pulses will result in AGC action if the detected signal level changes. If, however, the sweep oscillator is out of step, no AGC action can occur until the keying pulse coincides with the signal sync pulse.

As the noise cancelled video signal leaves the IC at pin 5 it enters a dual time-constant network of C403, C404 and diode CR401. THis network provides the sync limiting stage with immunity to aircraft signal flutter.

After passing thru the dual time-constant network, the noise cancelled video signal enters IC401 at pin 4 and the sync limiting function is performed. Note sync separation location in the block diagram. Internally, IC401 separates the video information from the sync and amplifies only these pulses. A positive going sync pulse appears at pin 3 of the IC and is the vertical sync. At pin 2 a negative going pulse is used to sync in the horizontal sweep oscillator.

The negative-going sync information at pin 2 is returned to pin 1 thru R404 and C402. The sync pulse is coupled to a gating circuit within the chip. Also, a positive-going horizontal gating pulse is coupled from the horizontal circuit thru R401 to pin 16 of the IC. Both the negative-going sync pulse and the gating pulse are needed to Key on the gating stage. AGC voltage can only be developed when sync is present which is during the retrace interval. This action occurs in the block diagram along the enable line from the "AND" gate to the AGC comparator stage.

Since AGC voltage can be developed only when sync is present, AGC voltage must be maintained during scan time. Capacitor C406 at pins 10 and 11 of the IC functions to hold this voltage. Also, if noise is present during the sync interval, the sync output will be cut off and C406 will hold the AGC voltage until the next gating pulse.

With no signal present, maximum IF AGC gain is set by the voltage divider comprised of R410 and R418. This divider sets close to +6 volts at pin 12, which in turn sets up a bias on a portion of IC401 that results in about +4.8 volts at pin 13. The +4.8 volts is added to the +dc voltage set by the AGC delay control. The resultant voltage is coupled thru R406 to the IF AGC output voltage at pin U8 of the module. (On some sets this is flagged as test point "E".) When a strong TV station is tuned in, the internal circuitry of the IC increases the output voltage at pin 13 until maximum gain reduction occurs. This voltage is about +7 volts and is determined by the adjustment of the AGC delay control.

In addition to the IF AGC voltage, the IC produces two RF AGC voltages. The AGC voltage at pin 14 is for the field effect transistor (FET) RF stage in the VHF tuner. The AGC voltage present at pin 15 is used by the NPN bipolar transistor RF stage in the UHF tuner. These dc voltages on pin 14 and 15 will vary according to signal strength and type of tuners used in the set. You will not find an AGC level or gain control on chassis that have the 221-45 IC. This is because of the IC processor design and tight component tolerances in the 9-87 module.

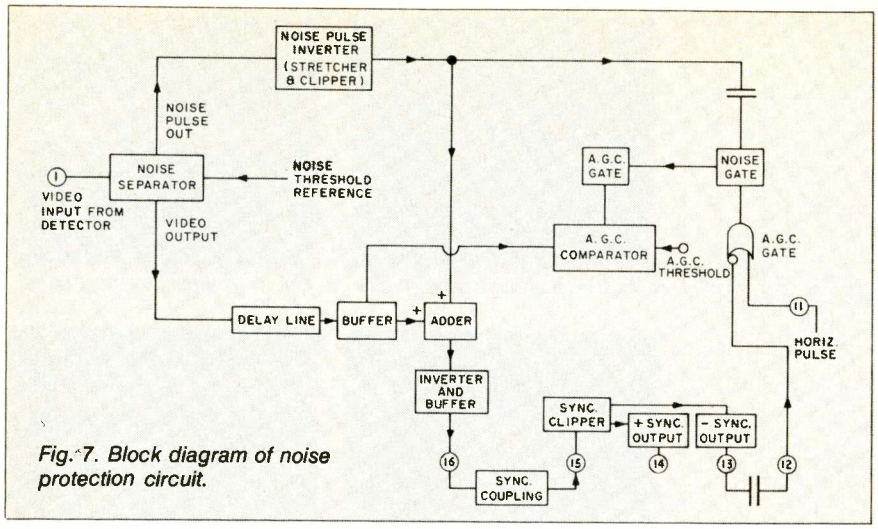

Fig. 7. Block diagram of noise protection circuit.

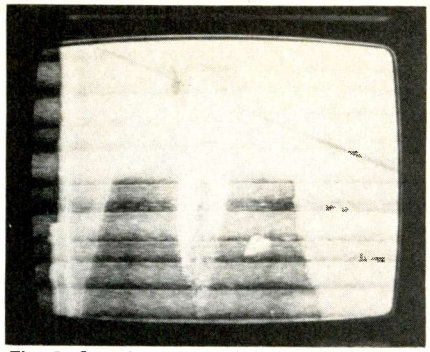

Fig. 8. Streaks caused by open filter capacitor at +24 volt input at pin W13.

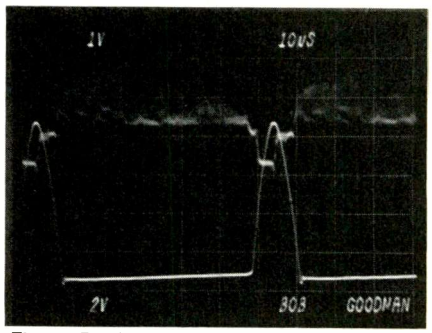

Fig. 9. Dual-trace scope indicates correct timing of the horizontal keying pulse.

Troubleshooting

In this section we will not dwell on repairing the 9-87 module (a new or rebuilt one can easily be plugged in) but rather in checking the module's associated components, voltages and pulse waveforms. As we now look at these various troubleshooting tips and case history problems, refer back to the 9-87 module circuit in Fig. 2 along with the key scope waveform check points for reference information.

Sizing up

When you have a symptom that appears to be a sync/AGC problem, some circuit checks and observations must first be performed in order to get a handle on the situation. The first step is to determine if the problem is actually caused by a fault in the AGC and/or sync circuitry. Symptoms of weak video, loss of video, or distorted picture, as well as loss of vertical and horizontal sync can be caused by faults in the tuner, IF stages, AGC/sync stages or power supply. The best way to start checking these sets is to determine if the sync/AGC stage is defective by subing a good module for the one in question and then adjusting the AGC delay control. If this does not correct the problem, then go to the tuner and IF circuits for video problems and the vertical and horizontal circuits for sync problems. Also, check for +24 dc at pin W13 and correct horizontal keying pulses at pin U6 of the 9-87 module. Should you not have a good substitute module, a variable dc power supply can be used to clamp the tuner and IF amplifier AGC voltages to normal operating levels. Consult the service data for this information. If a near normal picture cannot be restored, the defect may very well be in the tuner, IF stages or video circuits. At this point a tuner "subber" will help you pinpoint the fault quickly, too.

Lets now look at some "real world" problems with this sync/AGC module and IC.

The picture symptom

In this Zenith 19FC45 color chassis the picture would roll intermittently and tend to twist. On some channels several wide bands or streaks (see Fig. 4 photo) would go across the screen horizontally. This picture trouble may or may not be of an intermittent nature. The top of the raster may also be of a lighter shade.

The problem area, in this case, was found to be around the 9-87 sync/AGC module's associated circuits. To pin down this problem, several scope checks were made at various +24 volt input, module pins, around the chassis. When the symptom occurred, the scope indicated a lot of hash at pin W13, +24 volt input terminal of the 9-87 module. The hash (horizontal pulses from HV sweep stage) was due to loss of filtering because of an open C321, 100 MFD by-pass filter capacitor. A replacement filter cleared up this picture problem.

For normal operation at all points where the +24 regulated voltage enters the various modules, the scope trace should be a smooth line even at high vertical scope amplifier gain. If you find hash or spikes on the scope look for open filter and by-pass capacitors or trouble in the 24 volt regulator circuits, such as a faulty Zener diode or regulator transistor. Also, make sure that the +24 volt line measures 24 volts dc. A problem in the regulator circuit can lower this a few volts and cause a picture symptom that looks like an sync or AGC trouble.

No sound or picture

This is a very common and simple problem but can be overlooked very easily. If module replacements do not restore operation, check for +24 volts at pin W13 of the 9-87 module. If no voltage is found, check for an open LX311 filter choke coil in the 24 volt line. This is a small 663 µh coil that may open up or at times will become intermittently open. Loss of voltage could also be caused by a shorted C321 filter by-pass capacitor.

Dual-trace scope phase comparison

A rare but tough to locate AGC problem can be caused by a phase shift in the horizontal keying pulse. An easy way to locate this type of trouble is to use the dual-trace scope for simultaneously viewing the AGC keyer pulse, (strobe), and horizontal sync pulse for correct timing. This will allow you to make an exact analysis of the two superimposed pulses. To check for this phase shift problem connect the triggered channel of the scope (usually the A channel) to pin 14 of the 9-87 module (video signal) and the "B" scope channel to pin U6, the horizontal keying pulse. Set the scope at the horizontal sweep rate and adjust its triggering for a solid lock-in of the two pulses. The dual-trace scope photo in Fig. 5 illustrates the correct timing for a normal operating set. The horizontal sync pulse and strobe pulse must line up precisely.

A mis-timed keying pulse can be cause by some defect in the horizontal phase detector stage or any pulse coupling components. The dual-trace

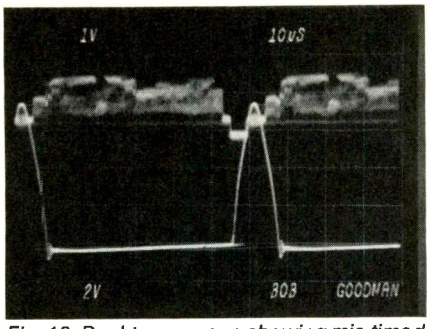

Fig. 10. Dual-trace scope showing mis-timed pulse.


Fig. 11. Picture weave and roll symptoms found only on local cable channels received via satellite.

scope waveforms in Fig. 6 readily illustrate this out-of-time condition. Note that the keying pulse is actually in time with the 3.58MHz color burst signal.

Another good point is to take note of the keying pulse width. If the pulse is too wide, some video or 3.58MHz color burst information may be sampled instead of the horizontal sync pulse level and this could cause the wrong AGC dc voltage to be developed. The symptoms would be picture overload, perhaps some bending or a washed out-picture.

Another point of service is to check for proper filtering of the dc AGC control line. If a filter capacitor opens on this line the scope will show some hash. An open AGC line filter will cause various AGC picture problems such as overloading, bending and streaks across the screen.

Bending, weaving and rolling

This intermittent picture problem (it appeared as an unstable sync or AGC fault) would occur on the local cable TV system in our area only on channels that were picked up via the satellite system such as Home Box Office, etc. This picture weaving symptom (see Fig. 7 photo) would only occur in Zenith color sets using the sync/AGC modules with the 221-45 video processor chip. A new or rebuilt module has always corrected the problem. However, just replacement of the 221-45 chip will not always eliminate the unstable picture on these cable channels.

All that I have found to date is some

continued on page 44

Digital computer memories, part II

Getting in and out

In this second installment of our memories feature, we examine the various ways in which memories can be organized and the means of writing into, and reading out of them.

By Bernard B. Daien

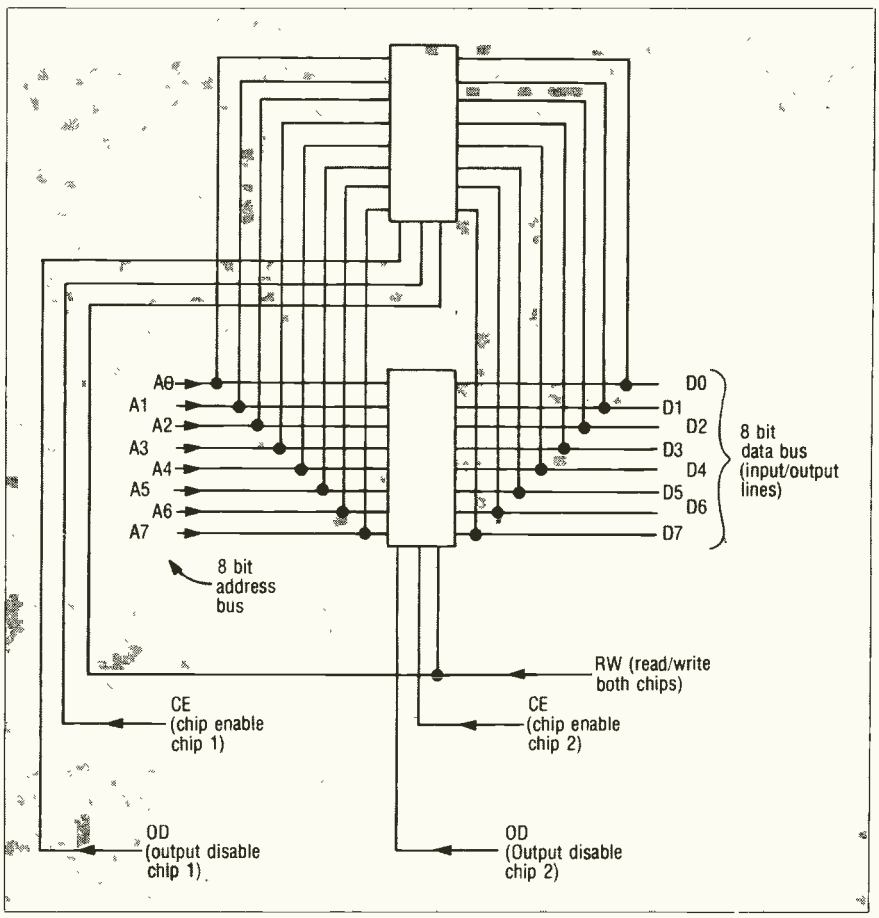

Fig. 1. A logic block diagram of a 512 × 8 RAM organized with two 256 × 8 RAMs. The "output disable" on each chip controls the tristate logic output of that chip. The "chip enable" input enables, or disables, the chip, and is used for chip selection. The "read/write" pin input determines whether we are reading, or writing, data.

We have seen that a memory can be organized in many different ways, all totaling the same number of bits. For example, we can use several memory chips in order to achieve a 1K × 8 RAM (1024 words of 8 bits each). This would total over 8000 bits (8 K). A common way of doing this would be to use four, 256 × 8 RAMs . . . but that would lead to a problem. How would the desired memory chip know when it was needed? Remember, the 1024 words are now located on four different chips. Obviously we need some means of specifying not only the word we want on each chip (memory addressing), but we must also now have a means of indicating which chip we are going to use. Thus we have to be able to state, "I want the word stored in the tenth location on the second chip." As you can see, we now need not only address lines, to specify the word address on the chip, but we also need "chip select" lines, which enable us to select the desired chip.

Figure 1 shows a simple block diagram illustrating the use of address lines, plus chip select lines. In order for this system to work, the memory manufacturers have included a "Chip Select" pin on the memory chip. When a proper binary signal is applied to the chip select pin, that particular chip is enabled, while all the other chips are inoperative. Of course it is possible to organize a memory so that more than one chip may be enabled (selected) at a time. An example of this might be if we were using eight, 256 × 4 memories, instead of four, 256 × 8. In such a case, we would obtain a four bit word from each chip, and therefore we would need two chips active to form an 8 bit word, by combining two four bit words. Each 256 × 4 chip would have 4 input/output lines. Placed side by side, two chips would provide 8 output lines, yielding an 8 bit

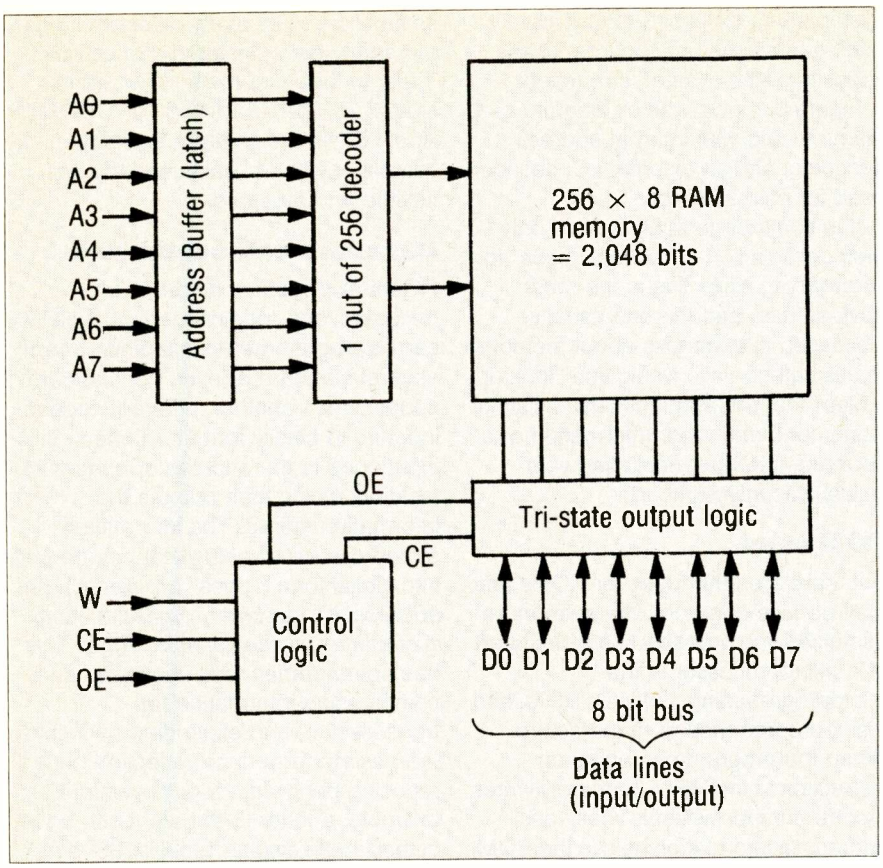

Fig. 2. Block diagram of a memory with full decoding and tri-state logic outputs. Note: "W" denotes read/write input; "CE" is chip enable input; and "OE" is tristate output enable input.

parallel data bus (input/output bus).

This results in a system which has an address bus for word selection, and also requires a chip select bus for selection of the chip, or chips, desired. Since microprocessors do not have a chip select bus, we use a little common sense, and make the 16 bit memory address bus (16 parallel wires) do the entire job. Let's see how this is accomplished. Sixteen binary bits yield over 65,000 different combinations in the decimal system, which indicates we can address over 65,000 different words with a 16 bit memory address bus. In this case we only need to address 256 different words, therefore we need only 8 bits for addressing.

Since there are 8 unused bits in our addressing capability of 16 bits, it is common to use these bits for chip select purposes. Thus, the microprocessor address bus sets the limit on the number of address bits possible, because of the 16 bit address line, but it is the MPU user who decides how to divide the 16 bits among address lines and chip select lines. It is this fact that gives the user so much freedom in memory organization! Or, saying the same thing backwards, the memory organization used determines how the address bus will be divided into chip select lines, and memory address lines. The entire address, consisting of word select lines, and chip select lines, will be handled on the 16 bit memory address bus.

In the case just mentioned (utilizing the four, 256 × 8 chips) we require 8 bits (lines) for word addressing the 256 different word locations on each chip, and then we need 2 bits (lines) for selecting one of the four chips. This totals 10 bits (lines) required for complete addressing. The end result will be the same as if we had used one memory chip with 1024 words of 8 bits each, since it would take ten binary bits to yield 1024 different word locations! Remember, the memory address may be either a word address, or a combination of word address, and chip selects, but either way, the result is the same. It all depends upon the memory organization. If you ever have to troubleshoot a practical MPU system, with external memory, you must know this!

Tristate data lines

Digital logic comes with a variety of output configurations . . . open collectors, common collectors, and tristate . . . and more. Basically, the older logic either had the collector of the output stage on the chip brought out to a terminal directly, and the user had the option of using it any way he wanted to, or else, the collector resistor(s) were internal. In recent years the advent of tristate logic has given us a powerful tool for using a single input/output (data) bus to do the job of the two buses formerly required. Tristate logic can be at a "one" or a "zero" output state, or at a third state, which can best be described as "apparently disconnected." Thus many chips can be connected to the same bus, but only the active ones will be on the bus, while the others act as if disconnected.

Since MPUs use "bidirectional" tristate data buses, the memory connected to them should also be tristate for compatibility. In addition, the use of a tristate data bus system permits greater flexibility in memory organization, since many chips can be connected to the same output bus (data bus), and selected as needed by the select lines. As a result of these advantages, many of the memory chips are now using tristate output stages on the chip. In order to control the tristate circuitry, an "output disable" pin is included on tristate memory chips. (It might as well have been called an "output enable" since its function is to enable, or disable the output stage feeding the tristate data bus.) This pin simply performs the same function that occurs with other tristate logic chips. The main advantage of tristate logic is that it makes possible the use of the "bidirectional bus system" so prevalent in microprocessor architecture. Figure 2 also shows the pin outs, and their use, on a typical tristate memory chip.

Decoding

Up to now we have merely made the statement that the 16 bit address bus has the capability of addressing over 65,000 different memory locations. This derives from the fact that 16 binary bits yield over 65,000 different combinations (decimal numbers). If you think about it . . . you will realize that it would be impractical to interconnect 65,000 different lines to the memory chip . . . as a matter of fact, due to the limitation of physical size, the number of pins on a memory chip are severely restricted. But, if we are to have the advantages afforded by a large amount of memory, there must be some way of getting around this problem. Think of how great the problem becomes when you talk about 250,000 bit memories! The solution lies in the use of decoders. Decoders are circuits which accept a binary input bus, and yield the desired

output, in some other number system, as, for example, a binary to decimal decoder, which might have 8 input lines, coded in binary, yielding 256 different combinations. The output would be arranged to result in a decimal number between zero and 255, or could be one of 256 different output lines in a chip variation of the decoder, called a "selector."

It is necessary to use a decoder between the 16 bit memory address bus (or several decoder chips if needed), to perform the function of taking the binary data off the 16 bit address bus and using it to actually select one of 65,000 different words! Some memory chips have part of the decoding right on the chip, and are termed, "partially decoded" . . . while others have ALL of the decoding required right on the chip, and are called, "fully decoded" memories. Actually, these decoded memories really have a "chip within a chip" so to speak. The end result is that all you need to do is hook them up to the address bus, and they do all the digital logic necessary, using many hundreds of transistors, and lo, the right word is selected out of thousands of possible words.

Earlier we had been discussing the importance of memory speed . . . and you must now understand that all this decoding tends to slow up the memory . . . especially in the case of a large memory. Signals have to pass through so many different transistors that the cumulative delays become large enough to slow the memory by a factor of twenty times, or more, as compared to a small memory without decoding. This factor must be considered when the user sets up the memory organization.

Memory boards

The decoder inside a memory chip does the decoding for *that chip only!* If you organize a memory using several chips, you *must add external decoding,* since external decoding is required for the purpose of chip selection. In the case of a few chips, discrete transistor logic is often adequate, but when many memory chips are organized into more complex configurations, the use of integrated circuit "decoders" or "selectors" is advantageous. Sometimes several such decoders are used. It is common practice to assemble the memory chips, decoders, and on-board fixed voltage regulator I.C., on one printed circuit board designed to fit into an edge-board connector. This is then sold as a package, ready to hook up to a suitable power supply and the MPU. Such systems can be expanded by merely adding more memory boards, till the capacity of the system is reached.

Figure 3 shows a block diagram of a memory chip with internal address decoding, and an external I.C. decoder used for chip selection.

It is common to think of read only memory as a sort of "storage place" for information, since this is the most obvious use, and the one usually discussed in textbooks about memory. In this category we would find "look up tables" that are frequently used, lists of customers, and other information of a permanent nature, (including your Social Security number!).

ROM uses

But there are other uses for ROMs that may be less apparent, but even more useful. As you probably know, the heart of a microprocessor is the microprogramming, held in a ROM, and mask-programmed at manufacture. When the programmer inputs an instruction to the MPU, he merely writes a code number which is really an address to information held in the ROM. The ROM then outputs all the little directions needed to cause the various operations which, in total, result in the execution of the desired instruction.

Thus, if we wish to add two numbers, the instructions "ADD" will cause the ROM to output a series of steps such as . . . take one number off the bidirectional data bus and transfer it into the accumulator . . . then, take the other number held in the external RAM and add it to the number held in the accumulator, via the internal bus . . . then take the result of the addition and store it in the accumulator. Now all these little steps, called "microinstructions" are held in the ROM. Each of the programmers instructions are made in accordance with the microprocessors "instruction set" (the instruction vocabulary of the particular model of MPU). The instruction set is recognized, because it has been programmed into the ROM.

Now if you think about it, the ROM has made calculations possible, replacing "digital logic." In the trade, the saying is "Software replaces hardware," meaning that programming is used to replace circuits. We do not have to build one set of circuits to add, another to subtract, etc. "OR gates," "AND gates," and all the other common digital logic used to perform digital operations can be replaced by one microprocessor *with ROM.* The MPU with ROM becomes a magic circuit board, which can change its function, to do many different things, by merely being instructed to do so. Thus, in this, and many other ways, *ROMS REPLACE LOGIC CIRCUITRY!* And, ROMs are cheaper for fairly complex systems, because they are flexible and reusable.

Decoders and converters

ROMs also replace a variety of decoders, and code converters. A ROM can be programmed to output any one of several standard or even nonstandard codes, when another, different code is inputted in binary format. In effect, the input code is the address of a memory location, which then outputs the information stored. The information stored can be anything that can be put into digital form ("ones" or "zeros"). *An address of a few binary digits can result in outputting sixteen or more digits!* This has some tremendous implications for compressing information for transmission, and expanding back into the desired form upon reception, thus reducing bandwidth requirements! For example, a letter of the alphabet, on a cathode tube display, requires 35 "dots" (each dot requiring one bit of information), in a common 5 by 7 dot matrix display. By storing the information in ROM, a six bit address will result in all of the 42 bits needed for any standard character in the 5 × 7 format.

The reason we use a six bit address is that we wish to have a total of 64 characters, including 26 letters, 10 numbers, punctuation marks, and symbols. (If we were content to use only letters, spelling out the numbers and punctuation marks, we could get by with only 26 letters, and thus require only five bits of input!) You can see that for any transmission speed, we need transmit only a fraction of the number of bits per second, thus reducing the bandwidth required for transmission accordingly. This application of ROM is called "character generation."

Other advantages of ROM

ROM also affords another tremendous advantage when it comes to a visual display on a CRT, which is one of the most common forms of readout for word processing, instrumentation, etc. The CRT image must be repeated, usually 30 times per second or faster, in order to appear to be steady and free of flicker. This means that whatever is on the CRT screen must be repeated over, and over, continuously, for as long as the viewer desires. This in turn, implies that the information must be stored, so that it can be held for the time period needed, and

read out as frequently as needed, but the information must not be destroyed during the read out. What does that mean to you? ROM, of course! ROM character generators come in English, and all common foreign languages, even Japanese! So, you see, ROMs can be decoders, code converters, or character generators. They can also be used to replace logic circuitry, but that's only the beginning.

Some other uses of ROMs include "voice synthesizers" in which the ROM is programmed to duplicate the characteristics of human voice. The ROM can be used to match up an unknown pattern, such as the noise of an enemy submarine propeller. Or, how about error correction? If you have a sensor with a reproducible error, such as a wind speed indicator that is nonlinear, the ROM can be programmed to put in a correction factor for every speed on the calibrated dial, correcting out the reproducible error. And, those electronic door locks . . . if they use 16 bits of binary data either on a coded card, or on a keyboard . . . yield the 65,000 possible combinations we have been talking about all along! If we assume someone is trying to break the code on such a lock, dialing 4 full combinations a minute (about one digit per second), it would take 18 days, dailing for eight hours per day, to have an even chance of breaking the code!

As a matter of fact, the uses of ROMs are proliferating so fast, that the author is hard pressed to keep up with new applications. This should not be hard to understand, when you consider that the "learning" or educational process, which we humans must go through, is largely a matter of committing to human memory (ROM), a great amount of data for use in many different ways!

The "secret" codes

ROMs are quite similar to RAMs, except that they do not need a "write" input signal, and instead of having chip selects, they are often provided with two or more "enable" inputs, which control the outputting of data. One of these "enable" inputs can be used for the chip select function. It is just a matter of nomenclature (buzz words, definitions). There is not much consistency, (or logic either) in the entire field of digital logic. Since the field of digital logic came into existence long after the science of electronics was well established, there is no good reason for most of these vagaries, which must be attributed to the human desire to keep one's expertise a well kept secret. The Venetian mirror makers guarded their secrets with a death sentence, physicians still write prescription in Latin, and so our digital friends have also contrived some rather pathetic obstacles to the dissemination of their not-too-difficult skills. A word of advice . . . if you ever find a digital textbook confusing, try another author. The same things will often have totally different names, for example, and suddenly become quite understandable. There is even confusion as to the definition of the words "byte" and "word," with different books defining these elementary words in different ways!

Memories are perhaps the most confusing of all. For example, in microprocessor literature, memories can be registers, accumulators, pointers, and a host of other names, yet all be identical circuits. The name changes with the use to which the memory is put, and not in a consistent manner, since each manufacturer freely uses whatever name he chooses, despite what name other manufacturers use for the same circuit! You will often have to piece together what words mean, depending upon the context in which they are used.

As noted at the beginning, there has been little introductory level material, written for the technician, about memory organization, and the other matters we have discussed pertaining to memories.

Hopefully, this introductory level dissertation will enable you to understand the memory trade literature, available from the major semiconductor manufacturers. Studying the various memory product data sheets, application notes, etc., will increase your knowledge very quickly. (Particularly, study the truth tables, descriptions, and electrical specifications!)

Now you are on your own, with a bit more insight, as you stroll down "memory lane." Good luck. **ET/D**

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Small Computer Business Applications

Emitter Followers

Specialized digital test equipment

Time and trouble savers

Trouble in digital circuitry can be analyzed with conventional test equipment but certain special test instruments will let you do the job more easily and much more quickly.

By John E. Cunningham

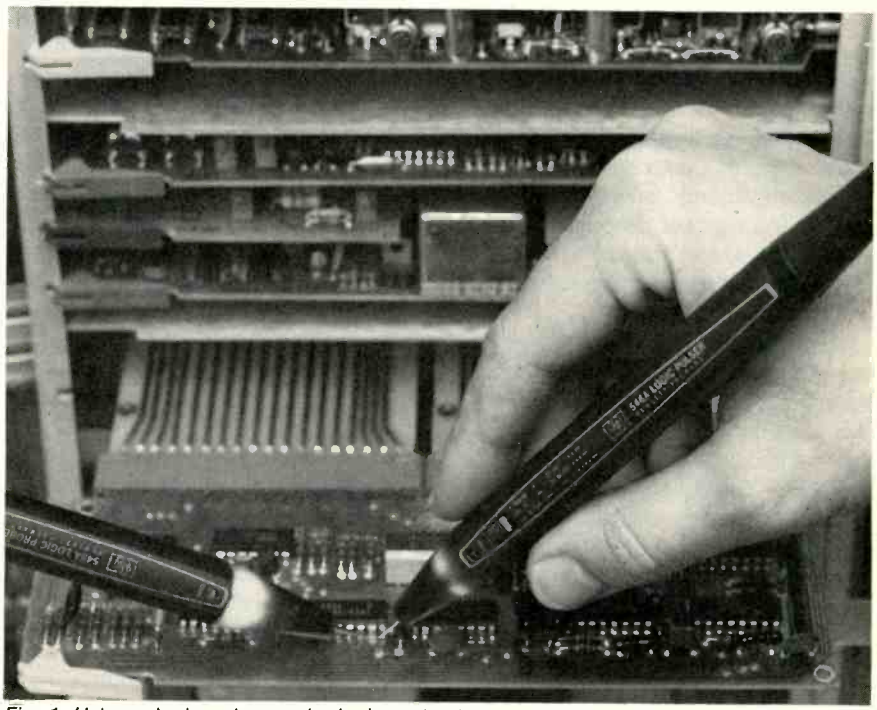


Fig. 1. Using a logic pulser and a logic probe (courtesy of Hewlett-Packard).

Although it is possible to troubleshoot digital equipment using conventional test equipment such as the VOM and the oscilloscope, there are many disadvantages to the practice. Most of the test points in a digital system are the pins of digital ICs which are spaced only 1/10 of an inch apart. Placing a test probe on one of these pins without causing a short to a neighboring pin requires careful attention. If two pins are shorted together one or more of the ICs may be damaged. With either a VOM or an oscilloscope, the technician must momentarily look at the instrument to note its indication. It is during this period that the test probe is most apt to slip, causing further problems.

In addition to the risk of shorts, conventional instruments require interpretation of the indication to determine whether the logic level is high, low, or at a "bad" level between the two.

To overcome these limitations, many highly specialized digital test instruments have been developed. These instruments are easier to use than conventional instruments and their indications require little if any interpretation. This saves time, and the amount of time spent in locating faulty components can spell the difference bewteen profitability and loss in a Digital Repair Service operation.

Some of the new digital test instruments, such as logic analyzers, are both very sophisticated and at present very expensive. Their cost can only be justified in situations where a large number of very complex digital systems are repaired on a regular basis.

Fortunately, there are many other specialized digital test instruments, such as those shown in Fig. 1, that are priced reasonably and will considerably simplify the servicing of digital equipment. Often instruments of this type will pay for themselves in time saved on the first job.

Faults in digital systems

Before we consider how to use specialized test equipment, let's take a look at the kinds of faults we are likely to encounter in digital systems. Of course, there can be faults in the wiring,

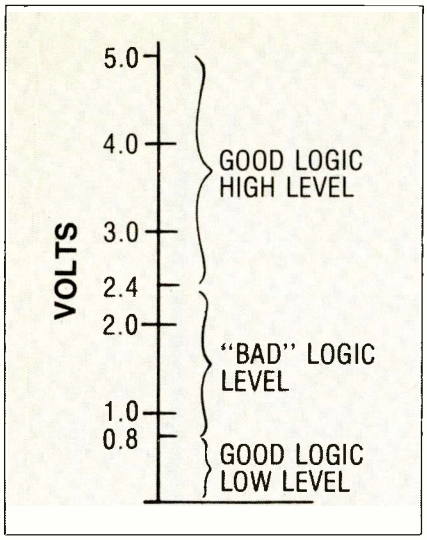


Fig. 2 High, low, and "bad" TTL logic levels.

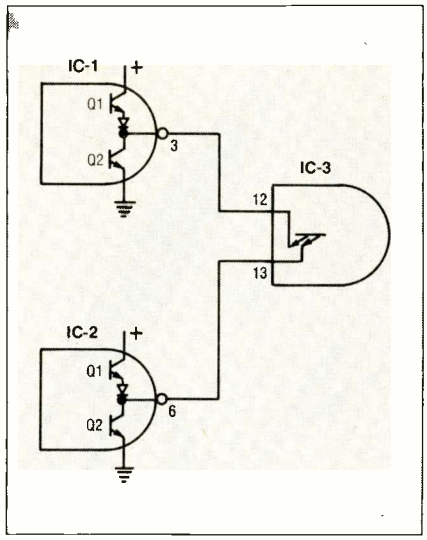


Fig. 3. Connecting circuitry between gates.

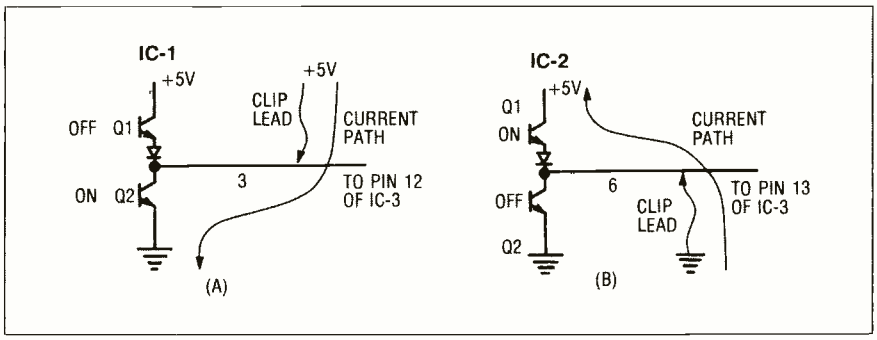


Fig. 4. Problems in trying to force an IC pin high or low.

connectors or PC boards, These faults are either open circuits, or shorts due to things like solder bridges, but most of the hard to locate faults are actually inside digital ICs. There is no way that we can get inside an IC to find trouble, so in most cases we never know the exact nature of the fault in a system.

Fortunately, we don't need to know the exact nature of a fault in a digital IC. We can classify all of the faults that we might encounter in terms of what we observe at the pins of the IC. Almost all of the faults in a digital IC are classified into three categories:

1. *Open pins.* If an input pin is open, it will follow any signal applied to it, but the IC will act as though the pin were open and the signal applied to it never actually reaches the inner circuits of the IC at all. Of course, the actual fault may not be an open pin, but we don't care. All that we care about is that *the IC behaves as though an input pin happened to be open.*

We can also have an output pin that behaves as though it were open. In this case, the voltage at the pin will not change when the voltage at the inputs of the IC are changed. If the pin is connected to the input pin of another TTL IC, it will drift to a bad level, too high to be a regular logic low, and too low to be a good logic high. Again, we don't care at all what the actual fault might be.

If along with open pins of ICs we include open circuits on a PC board or a connector, we will account for about 75% of all of the faults we will find in digital systems.

2. *Shorted or "stuck" pins.* With this type of fault an input our output pin will behave as though it were "stuck" at a certain level. Nothing we do will change the logic state of the pin. Faults of this type include a pin being permanently stuck at either a high or a low level, or being shorted to another pin.

3. *Pins at a Bad Level.* Here one or more of the pins of an IC will be at a level that is neither high nor low, but somewhere in a no-man's land in between. Fig. 2 shows what we can consider low, high, and bad levels in TTL logic.

Categories 2 and 3 above account for about 25% of all of the faults that will find in digital systems.

The actual troubleshooting procedure consists of forcing the input pins of the various ICs to high or low levels while monitoring the logic level at the corresponding output pins. Two of the most useful instruments for this purpose are the *Logic Pulser,* and the *Logic Probe.*

The logic pulser

One of the problems in troubleshooting digital systems is that we often have little or no control over the state of the pins of the various ICs that we wish to test. Some systems are driven by a high speed clock and the various pins will follow the clock signal. Others are inactive, and some of the IC pins don't change state at all. In order to check the performance of an IC we need to be able to force the various input pins either high or low while we are watching the state of the corresponding output pins. Of course, we could always disable a clock signal, but we still are faced with the problem of forcing the various input pins to the desired logic state.

This isn't as easy as it might seem to be at first glance. The reason is that although a forced high or low signal will not harm an input pin, most input pins are connected to the output pins of other ICs as shown in Fig. 3. Attempting to force an output pin to another state than that in which it happens to be can cause serious problems. In Fig. 3, we show two ICs driving the input pins of a third IC. Note particularly the totem pole arrangement in the output stages of IC-1 and IC-2. With this arrangement, which is common to all TTL Logic, either transistor Q1 or transistor Q2 is turned on and the other is turned off. This means that at all times there is a low resistance path from the output pin to either the positive supply voltage or to ground.

Suppose, for example, that pin 12 of IC-3 happened to be at a low level and that for test purposes, we wished to force it to a high level. Our first approach might be to merely connect a jumper from pin 12 to the positive supply voltage to force it to a high level. Fig. 4A shows what would happen. As shown, transistor Q2 in the output of IC-1 is on. This is what forces the output pin to a low level. When we connect the jumper, we provide a very low resistance path between the positive supply voltage and ground through Q2 of IC-1. A heavy current will flow through this path and will destroy IC-1 in a very short period of time. If this IC happened to be good before we started testing, it would certainly be bad before our test was completed.

A similar situation prevails if we try to force a pin in the opposite direction. Going back to Fig. 3, suppose that pin 13 of IC-3 happened to be at a high

Fig. 5. B&K-Precision's logic pulser.

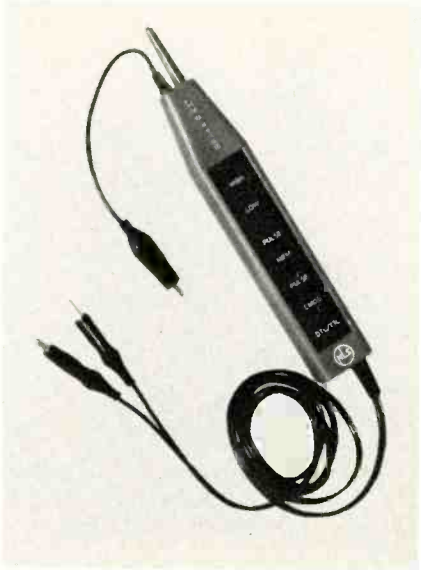


Fig. 6. A logic probe by Non-Linear Systems.

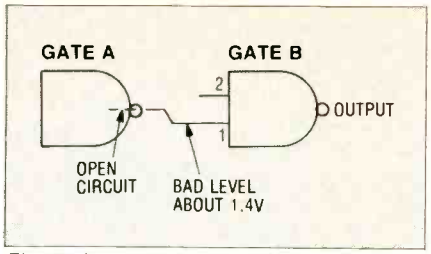


Fig. 7. An open output pin.

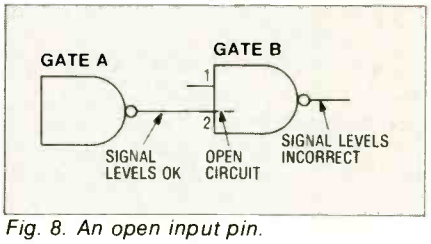


Fig. 8. An open input pin.

INPUTS		CORRECT OUTPUT	OBSERVED OUTPUT
1	2		
0	0	1	1
0	1	1	1
1	0	1	0
1	1	0	0

Fig. 9. Correct and observed output levels for the circuit of Fig. 8.

logic level and we wanted to force it to a low level. Again, our first approach might be to connect a jumper wire between this pin and ground. Looking at Fig. 4B we see that we will have a similar problem. Pin 13 of IC-3 happens to be connected to pin 6 of IC-2 which is an output pin. Once we connect our jumper wire we will establish a low resistance path from ground, through Q1 of IC-2 to the positive supply voltage. Again, we will undoubtedly damage IC-2.

What we really need in order to force an input pin to a desired state is some device that will supply enough current to force an output stage to the opposite state, but not enough current to damage the output stage. The way to do this is to apply a pulse that is current limited and also of short duration. A pulse of this type will force a pin to the opposite state, even if it happens to be connected to an output pin, but will be of such short duration that it will not have enough energy to damage the output transistors of another IC. A device that will do exactly this is called a *logic pulser*.

A typical logic pulser is shown in Fig. 5. There are many different logic pulsers on the market and they differ primarily in such things as the pulse rate that is available, the number of different logic families with which they can be used, and in the extra features that are offered. Some have an accessory that permits pulses to be applied to several places in the circuit simultaneously.

Most logic pulsers derive their operating power from the circuit being tested which eliminates the need for batteries or a separate power supply. Many logic pulsers also detect the logic level of the circuit and automatically pulse it to the opposite level. All are designed so that they will not destroy the circuit being tested.

The logic probe

Now that we have a way to safely drive the input pins of ICs to the desired state, we need some way to monitor the output pins so that we can see if the IC is working properly. The logic probe, shown in Fig. 6, is an ideal instrument for this purpose. The logic probe is a self-contained instrument that looks much like a logic pulser. As with the logic pulser, there are several different logic probes on the market and they differ primarily in the features that they offer as well as in the number of different logic families with which they will work.

One of the most useful features of most logic probes is the fact that they will distinguish between various logic levels at the tip of the probe. There is usually a different indication for not only high and low levels, but also for pulse trains and "bad" levels. Many logic probes have memory circuits that will enable them to "latch on" to a single pulse and provide an indication until the circuit is reset. This feature is very useful in checking circuits where pulses only occur occasionally and might otherwise be missed. It is also helpful in detecting occasional spurious pulses.

Inasmuch as the various logic probes that are available commercially differ in some of their features, it is important for the technician to become thoroughly familiar with the particular probe that he is using. Technicians need not look away from the point where the tip of the probe is applied. This, in turn, lessens the likelihood that the tip of the probe will slip causing a short circuit between the pins of an IC.

Although the logic probe is an ideal companion to the logic pulser, it definitely is not restricted to this application. It can also be used to check the logic level of any part of a circuit. It is much easier to use than a VOM because the intensity of the light will disclose whether the signal is high, low, or at a bad level. This eliminates the need for constantly interpreting the indication of a meter.

Most logic probes have some provision for indicating when a pulse train is present at the point where the probe is applied. In some units, the indicator lamp will glow dimmer with a pulse train than with a constant level. In others the indicator light will blink at a fixed rate of about ten flashes per second when a pulse train is present, regardless of the pulse repetition frequency.

Finding open output pins

Fig. 7 shows a diagram of a gate with an open output pin connected to the input of another gate. This is a very easy fault to locate in common TTL logic circuits using only a logic probe and if necessary a logic pulser. The clue is that the voltage at the open output pin is neither a good high level, nor a good

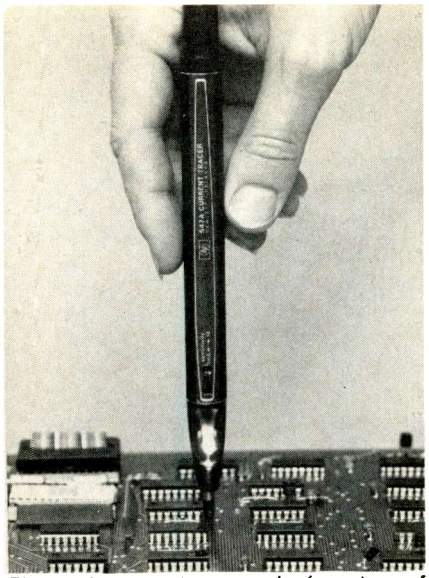


Fig. 10. A current tracer probe (courtesy of Hewlett-Packard).

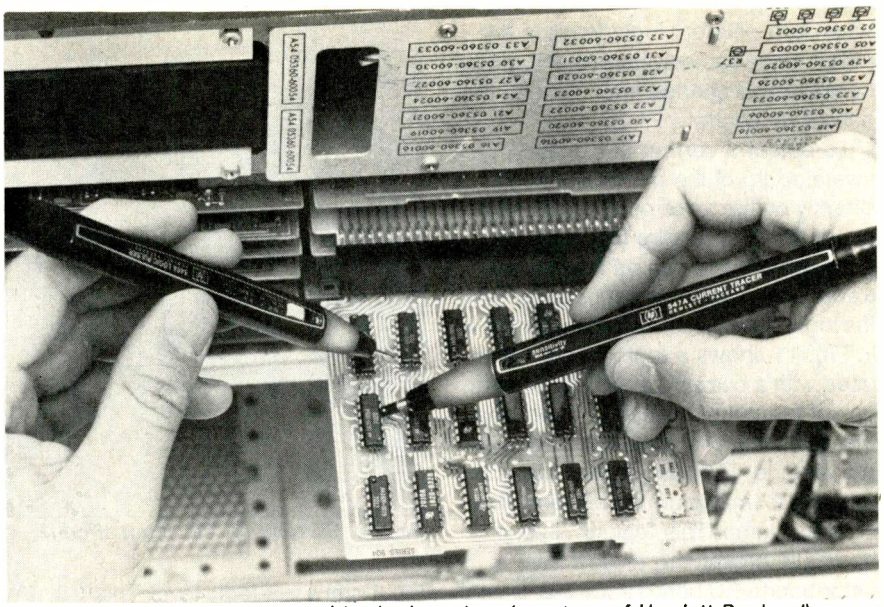


Fig. 11. Using a current tracer with a logic pulser (courtesy of Hewlett-Packard).

low level. If the output pin is connected to the input pin of another gate, which it usually is, the level will be about 1.4V. As shown back in Fig. 2, this is neither a good high nor a good low level. The reason for this level is that if the input pin of a gate is left floating with no signal applied, it will drift to a bad level. It is interesting to note that the gate itself will always interpret this bad level as a high level and will behave accordingly.

Finding an open input pin

Fig. 8 shows a sketch of a gate with an open input pin. Note that the open circuit is inside the IC where we can't get at it. As far as the pin is concerned, it will follow any signal that we apply to it. If we connect the pin to a high level, it will go high, and if we connect it to a low level, it will go low. The trouble is that the circuits inside the IC will never see this signal.

When troubleshooting digital ICs it is very handy to have a copy of the proper truth table for the IC being tested. These tables are rather obvious in the case of simple gates, and are usually published in the manufacturer's literature. For example, Gate B in Fig. 8 is a two-input NAND gate. Fig. 9 shows the correct truth table for this gate, together with the outputs that we might measure when troubleshooting the stage. Note that when the gate is operating correctly, the only time that the output will be at a low logic level is when both inputs are high. Note that while forcing the inputs to various levels we observed that the output behaved as shown in the last column of Fig. 9. The problem is shown in the third line of the table. Here according to the table, only one of the input pins was at a high level. Thus the output should also be at a high level. The output is actually at a low level, meaning that as far as the gate itself is concerned, it considers input 2 to be high, even though we know that the pin itself was at a low level. The only conclusion that we can arrive at is that the circuit connected to the pin is open and the gate input inside the IC is floating.

In our examples we have only used simple two-element gates. The same principles can be applied to gates of any complexity, as well as to other types of ICs such as flip flops, counters, and registers. The essence of the approach is to force the input pins to known levels while observing the outputs, and comparing these outputs with what they should be accordingly to the truth or state table for the device.

The technique can also be used to trace signals through the foil on printed circuit boards and the wiring through connectors. The logic pulser is applied to one end of the circuit and the logic probe is used to detect the presence or absence of the signal at the other end of the path.

Current tracing

Current measurements have never been very popular in trouble-shooting and since the advent of printed circuit boards they have been practically nonexistent. The reason is not that current measurements would not be helpful in troubleshooting. They would be very helpful. The problem is that until now, it has been necessary to open a circuit in order to measure a current. Usually, this means either cutting the trace on a PC board, or lifting one pin of an IC. Both of these procedures are time consuming at the least and may easily lead to additional problems if they are not performed correctly.

The instrument that has changed all this is the Hewlett-Packard 547A Current Tracer. This instrument, shown in Fig. 10 looks very much like a logic probe, but here the resemblance ceases. At the tip of the Current Tracer is a very small (0.01 inch diameter) sensing coil. This coil senses any change in magnetic flux, and hence any change in current in the vicinity of the tip. The output of the sensing coil is stretched and amplified and drives a light located at the tip of the probe. There is a small knob on the side of the probe that adjusts the sensitivity to the desired range. The tracer can detect current pulses from as small as 300 uA to over 1A.

The current tracer is self contained in a hand held probe and operates on 4.5 to 18V dc. Thus it can be powered by the system which is being tested. Best of all, it is priced less than a good oscilloscope and will save much more troubleshooting time.

Using the current tracer

The Current Tracer is very easy to use. First a reference current is selected for setting the range of the tracer. This is usually the output of a driver stage that is known to be operating properly. The sensitivity control is then set for medium brightness. Then higher current pulses will cause the lamp to glow brighter and less current will result in a dimmer glow. This setting is usually then adequate for trouble-shooting the system. It is only

when two different logic families are mixed in the same system, that it will be necessary to change the setting of the sensitivity control.

To detect a current pulse, the insulated tip of the tracer is placed directly on the trace of a PC board, the pin of an IC, or a wire leading to a connector. Inasmuch as the current tracer only detects changes in current, the logic pulser is an ideal companion to it. Fig. 11 shows a logic pulser being used with a current tracer. The sensing coil of the current tracer is directional; that is, if the top is rotated the indication will change. Thus the probe should be oriented for maximum illumination of the indicator lamp. This feature is very helpful in preventing pickup from a neighboring PC board trace that is very close to the one where current is being traced.

Currents in digital circuits

Most of us became familiar with digital circuits from the point of view of voltage levels. We learned that voltages above a certain level were considered to be logic highs and lower levels were considered to be logic glows. We rarely gave any thought at all to the levels of current that might be flowing in the circuit except when we wanted to calculate power dissipation. Of course, this wasn't much of a problem because current measurements were very difficult to make anyway.

Now that logic current indications are within the reach of the average technician, current levels in digital circuits assume new importance. Fig. 12 shows the input circuit of a typical TTL gate connected through a current meter to a high or low source. In Fig. 12A we have connected the input at a high logic level. Inasmuch as the input is actually an emitter of a multiple-emitter transistor, it will draw nearly zero current when it is held at a high logic level. As shown in the figure the only current that flows is the leakage current which will amount to only about 40 uA. The direction of this current is shown by the polarity marks on the meter.

In Fig. 12B the input of a TTL gate is connected through a meter to a low logic level, in this case, to ground. Note that now current does flow—about 1.6 mA—and the direction is opposite to that of the leakage current shown in Fig. 12A.

Thus, we can for all practical purposes say that no current flows in the input of a gate when it is held at a high level, but about 1.6 mA flows when the

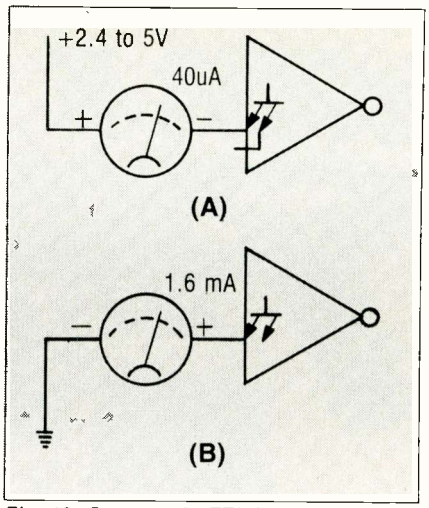


Fig. 12. Currents in TTL input circuits.

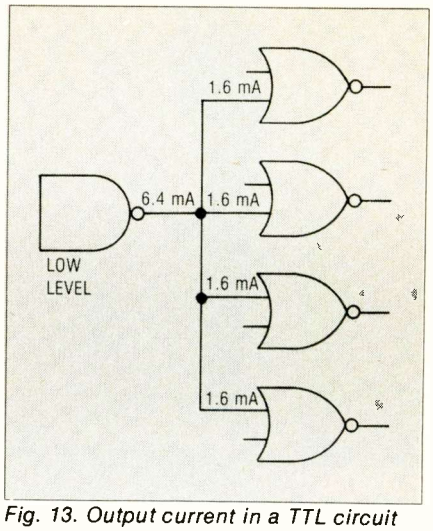


Fig. 13. Output current in a TTL circuit

input is at a low logic level. This 1.6 mA is well within the sensitivity of the current tracer and will provide a good indication.

At the output of a TTL gate, the situation may be much different because the output may be driving several inputs as shown in Fig. 13. In this case, the current will still be very small when the output is high, but when it is at a low level, there will be 1.6 mA for every input that is driven from this particular output. Thus a current of more than about 1.6 mA at the output of a gate doesn't necessarily indicate the presence of a fault.

Fortunately from the troubleshooting point of view, fault currents are usually much higher than the currents normally found in a digital circuit. A properly operating TTL output stage can drive between 50 and 60 mA into a short circuit. So currents in this range usually mean that something connected to an output pin happens to be shorted. If the output stage itself is shorted either to ground or to the positive supply voltage, higher currents may be found.

Finding shorts or stuck pins

In the past, short circuits in digital circuits have been very elusive and hard to locate. The reason is that while it is quite easy to establish the fact that a short circuit exists, there are often so many different things connected to the point in question that it is hard to find just where the short is located.

Fig. 14 shows a typical circuit where one gate drives the inputs of several other gates. Suppose that we determine with a logic probe, or voltmeter, that the output of IC1 remains at ground potential, even if we pulse it. It is rather obvious that something connected to this point is shorted to

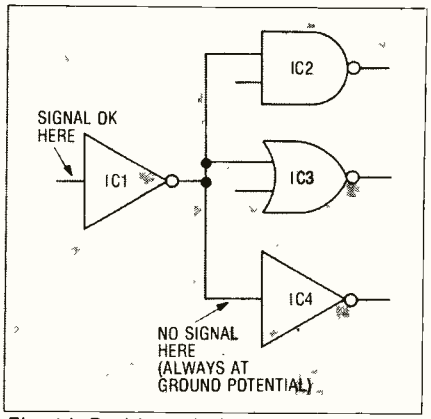


Fig. 14. Problems in isolating a short circuit.

ground. The question is, "Just where is the short located?" Without some form of current tracing ability, about all that we can do is to begin to remove components, one at a time, until we locate the short. This is indeed time consuming, and often causes additional problems.

With a current tracer, we can start at the output of IC1. If there is no current activity at the output of this gate when the inputs are being pulsed properly, the short is obviously inside IC1, and it must be replaced.

What we often fail to think about is the fact that if there is a short in something connected to the output of IC1, there will be current activity at its output. There won't be any voltage that we can detect with a meter or logic probe, but the gate may be pumping a great deal of current into the short. This means that we can use a current tracer to follow the current from the output of IC1 directly to the short circuit.

Fig. 15 shows the situation. Here have indicated the current magnitude by the width of the current line, but not to scale. Note that the current at the output

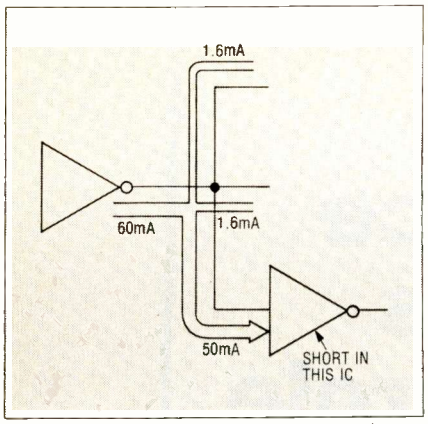


Fig. 15. Current tracing to a short circuit

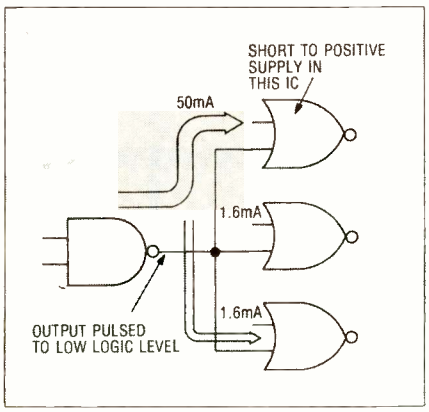


Fig. 16. Locating a short to the positive supply line.

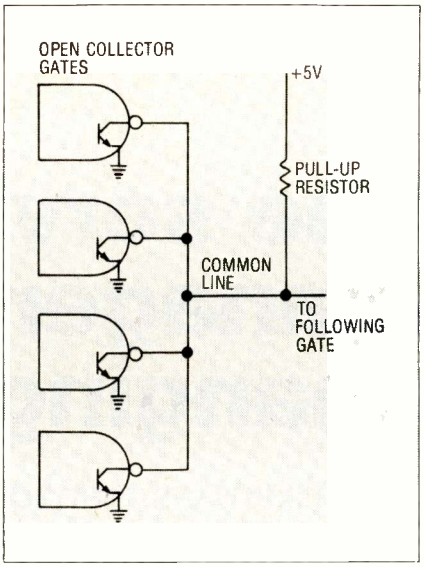


Fig. 17. The "Wired OR" circuit.

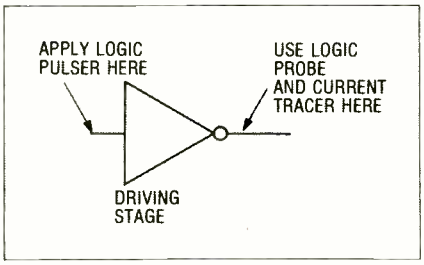


Fig. 18. Using a logic probe and a current tracer.

of IC1 is quite heavy for a digital circuit probably in the order of at least 60 mA. The currents into the individual inputs are only in the order of 1.6 mA. The sensitivity of the current tracer is set so that the current at the output of IC1 causes the lamp to glow at about medium brilliance. At this setting, the normal currents into the gate inputs will cause no, or very little indication. The current along the path to the short circuit will, however, cause regular brilliance of the lamp.

To one tracing current for the first time, the phenomenon is almost uncanny. It is like getting an X-ray view into what is actually happening in the circuit.

Fig. 16 shows the opposite situation. Here one of the input pins of an IC is shorted to the positive supply voltage. The result is that everything connected to the output pin of IC1 will remain at a positive potential. Usually, this situation is quite easy to recognize because the voltage at the output of IC-1 is higher than normal TTL high level. The usual TTL high is somewhere around 2.5v. In a case like this, the level is apt to be as high as 4 or 5v. There is still the question of just where the short is located. Again, with a current tracer we can follow the current directly to the faulty component.

"Wired OR"

Fig. 17 shows what is called such names as a "wired OR" or a "wired AND" circuit. It is used widely because normally we can't connect the outputs of TTL stages in parallel. In this arrangement, the gates have an "open collector" configuration. This means simply that the top transistor in the totem pole output of the stage is missing. The gate can pull the output to a low level, but the only way that the output can go to high level is by means of the pull-up resistor shown in the figure. This arrangement is quite popular, because it makes it possible to connect the outputs of several drivers to a common input. It is also one of the most difficult arrangements to troubleshoot.

The "wired OR" cofiguration, by its very nature has several things connected in parallel. The result is when the common line is stuck at either a high or a low level, we have no way of knowing where the short is actually located. The time honored way of troubleshooting such a circuit has been to disconnect the various drivers one at a time until the short cleared. Again, this means cutting the traces on a PC board which is always a potential cause of additional problems. With a current tracer the fault can be located very quickly.

In summary, current tracing adds a new dimension to troubleshooting. As one becomes familiar with the instrument, additional applications suggest themselves regularly.

Combining techniques

Once the technique of current tracing is mastered, it can be combined with regular voltage level measurements to make it possible to locate just about any kind of fault in a digital circuit. The two instruments required are a logic probe and a current tracer. Of course, a logic pulser is an ideal addition, because it lets us drive an input or output to the level that we desire. The system being tested may not provide this capability.

Fig. 18 shows a typical interconnection point in a digital circuit. With our logic probe and current tracer we can distinguish four different conditions at this point.

1. The voltage and current may both be normal. The circuit is O.K.

2. The voltage levels shown on the logic probe may be normal, but the current tracer may tell us that there is no current activity in the circuit. This means that there is an open circuit somewhere that prevents the normal current from flowing. The open circuit may be in a connector or its wiring, in the trace on a PC board, or in a following IC.

3. The current activity may be present, but we may be unable to find the proper voltage levels with a logic probe. This means that there is a short either in the circuit or in a following IC.

4. Finally, we may find neither current activity, nor voltage levels at the point. This means that the IC that is driving the point is faulty.

The examples and general rules given in this series have shown that three modern specialized test instruments, which altogether cost less than a good scope, make it possible to isolate just about any type of fault that might be found in any digital circuit. We have used logic gates as circuit elements in our own examples, but the techniques can be applied equally well to other ICs such as flip flops, registers, and counters.

With a little experience with these instruments, the technician will find that troubleshooting digital systems, far from being a mysterious activity, is usually easier than troubleshooting the more familiar analog circuits. ET/D

The service manager's changing role

Technicians as managers

Every shop has a service manager and his problems are legion. Even if you have a one man shop you are its service manager and your problems may differ in emphasis but not in kind. You must understand the immense importance of the various aspects of service management. While the following does contain a plug for NARDA's College of Service Management this point is well made.

By John Gooley

It is a myth that the role of service management has changed. It has not. The need to manage has always been present. The body of knowledge as to methods, objectives, and controls has existed for decades. All that has changed is an increasing awareness of that body of knowledge...that it exists...that it must be put into effect.

The methods of management have always existed and have always been effective, and have largely been unknown or ignored by those who manage service departments. All the principles of good service management are known...they are easily learned...but very few people put them into effect.

In no other segment of business that I am aware of is such ignorance allowed to flourish as it does in consumer electronics management.

There are vast numbers of books on such subjects as sales, production, quality control, marketing.

There is not one book on the subject of the principles of service management.

In our colleges, there are courses on personnel management, office management, money management, labor management.

There is not one single hour of study on service management.

Indeed...the government even steps in, establishing minimum requirements in the field of accounting and engineering.

No such requirements exist in the field of service management.

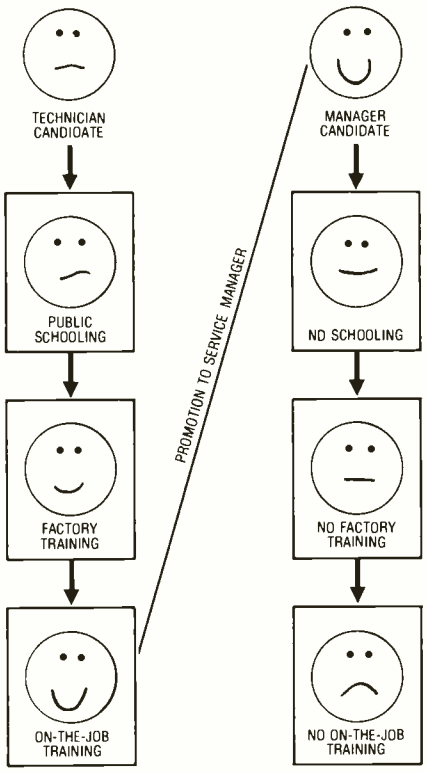
This total void is thrown into even sharper perspective when viewed against repair service itself. There are thousands upon thousands of books on making repairs. Books on "reading schematics" alone would fill a long shelf. There are movies, there are film strips. There are video tapes.

And of course, there are training courses on repair. Millions of dollars are spent on thousands upon thousands of hours of repair training.

The ultimate objective of the industry is customer satisfaction. In the total spectrum of customer satisfaction, the wrench and pliers make up only a small part.

The neglect of the study of service management has bitter consequences, as follows:

A. Poor service management results in reduced profits or actual losses at the retail level. This weakens the retail store and reduces its total marketing capacity.

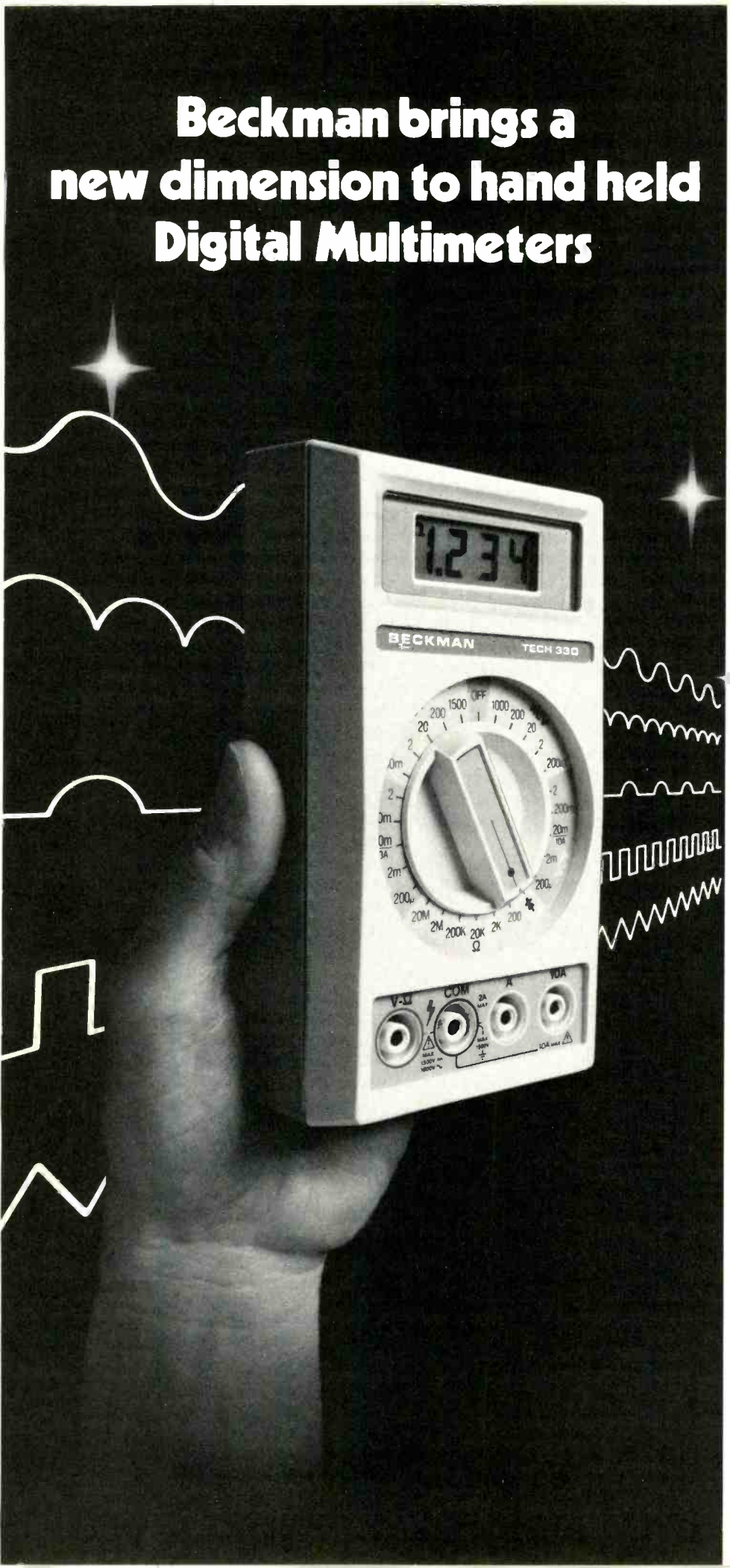


Stores that are under-capitalized (due to service losses) do not contribute to market penetration.

B. Poor service management can result in business failure of retail stores. These stores might otherwise have been well placed in the marketplace in terms of selection, display, delivery, salesmanship, and credit.

C. Poor service management can lead to losses which lead to even poorer service. Due to lack of capital (needed for parts stock, vehicles, instruments, literature, training) the quality of repair

Beckman brings a new dimension to hand held Digital Multimeters



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The TECH 330 also accurately measures the entire audio band up to 20 kHz. But that's not all you can expect from Beckman's top-of-the-line multimeter.

Measurement Comparison Chart

Waveforms (Peak = 1 Volt)	Average Responding Meter	Beckman TECH 330	Correct Reading
Sine Wave	0.707V	0.707V	0.707V
Full Wave Rectified Sine Wave	0.298V	0.707V	0.707V
Half Wave Rectified Sine Wave	0.382V	0.500V	0.500V
Square Wave	1.110V	1.000V	1.000V
Triangular Sawtooth Wave	0.545V	0.577V	0.577V

You also get 0.1% basic dc accuracy, instant continuity checks, 10 amp current ranges, a separate diode test function, 22 megohm dc input impedance, and an easy-to-use rotary switch.

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work and customer satisfaction deteriorates to the detriment of the consumer, the dealer, the distributor, and the manufacturer.

D. When a retail business fails, the proficient crew is disbanded, with the crew often going into other fields of endeavor...lost forever.

E. Poor service management can result in lack of productivity, which is made up for by higher prices. It is the customer who pays.

F. This same lack of productivity, causing these same higher prices, results in higher prices for warranty work. It is the warrantor who pays.

G. Lack of productivity, resulting in lower profits or losses, ultimately also results in lower pay for technicians, sometimes driving skilled technicians out of the industry.

H. Poor service causes complaints. It takes longer to handle a complaint than to make a service call...and with no pay. Distributors and manufacturers also handle those complaints, also with no pay. And the final result is consumerism.

I. Good service, resulting from good management, provides a major marketing benefit from the dealer, as opposed to mass merchandisers, a bone fide reason for customers to patronize the store.

J. Unsatisfactory service causes dissatisfaction with the product, which is to say the brand, with resultant brand switching.

All of these hazards can be minimized through good product service, stemming from good service management. Professional service managers must command skill areas and knowledge, as follow:

Ability to measure productivity:

How to set up measurement controls on completed calls, and incomplete calls, productive time, calls per day, minutes per call, ratio of labor income to wages, and how to develop standards for comparison.

Ability to manage parts stock:

How to measure the cost of stocking parts, measure the expense of lack part calls, optimum inventory formula, methods of reducing swollen inventories, IRS rules on inventory write-offs, methods of perpetual inventory control.

Ability to manage truck stock:

How to decide what goes on the truck, how to keep a standard truck stock record, when to re-stock, who should do the re-stocking.

Ability to establish the service call rate:

How to use the burden ratio in setting rates, how to figure the productive hourly requirement, how to set incremental charges, how to set trip charges, how to determine mileage charges, flat rates.

Ability to route and dispatch:

How to measure efficient dispatching, how to eliminate the "morning circus", one-call-at-a-time dispatching, patterns of dispatching.

Ability to establish incentives for technicians:

How to establish incentive plans, contests and competitions, non-money incentives, psychological motivation.

Ability to use support personnel:

How to relieve technicians of work they should not be doing, how to assign work to other employees, how to measure the effectiveness of support personnel.

Ability to invest in proper equipment:

How to tell what equipment is needed, determine the proper amount to invest.

Ability to manage call taking:

How to hire and train the right call takers, how to respond to the customers real needs, measuring customer satisfaction.

Ability to understand the operating statement:

How to properly account for income, account for expenses, using ratio analysis, analyzing by past results, by pre-determined standards, by industry averages.

Ability to understand the balance sheet:

How to tell if the company is going bankrupt, is becoming insolvent, analyze return on investment, inventory turns, working capital turns.

Ability to understand and employ controls:

How to measure productivity, how to measure profitability, how to measure customer satisfaction, how to set goals so everyone knows what is expected of them.

Ability to understand how repairs are made:

How to diagnose problems, how to determine the right tools to use, find the quick way to get the job done, how to train men for the job, how to tell whether they have done a good job.

These are skills and abilities required of a professional service manager. Most men in service management positions do not have these abilities or have them to a sufficient degree. These abilities can be acquired...quickly and easily, at the NARDA College of Service Management. Or at a similar school, if there was one.

Otherwise, where would you find such a professional? Basically, you don't!

You do the best you can. You take a technician and make a service manager out of him. At least he knows how repairs are made. He probably has picked up some ideas about dispatching. And he may know a little about parts. This is the man you are almost forced to use. Let's take a good look at him.

When he was a young boy, he liked to take things apart to see what made them work. There was probably a time when he had the rings from a coaster brake scattered all over the sidewalk, and he really did get them back together again. He knew there had to be a way and he found it.

In high school, there were some subjects that he liked and some that he didn't like. He hated poetry. "Ode to a Grecian Urn." He couldn't understand what it meant, and when he found out it wasn't supposed to mean anything, that struck him as being dumb. He didn't like Shakespeare—"why didn't he write so we could understand him." He didn't like Latin—"what good is a dead language."

On the other hand, he did like math, physics, chemistry, shop. He still like the idea that there were real answers to real problems.

So when he graduated, he looked for a job that had "real answers to real problems." These jobs are found in technology, so he became a technician.

He became a very good technician. He was doing things that he liked to do and he was very good at them. He was a happy man.

Then what happened? In desperation, the boss made him a service manager. He was wrenched out of a life he knew and forced into a life that he knew nothing of at all, and with no preparation and no help.

As a technician, there were real answers to real problems. In management, he found that the problems were hard to define and there were few if any definitive answers.

As a technician, he had a background of knowledge to fall back on. And when the problems proved too sticky, he could find the answers in a book or he could ask someone. As a manager, he had no background, there were no books, and there was no one to ask.

As a technician, he used tools that he was familiar with and liked. As a manager, his only tool was a pencil, and he hated pencils.

No schooling. No books. No factory training. No on-the-job training. Small wonder that he was "all at sea."

With all that is at stake here...isn't it a shame? ET/D

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TEST INSTRUMENT REPORT

The BPI Model 7000A Audio Analyzer: For more information circle number 150 on the Reader Service Card. For information on ORA Electronics Test Cassettes circle number 151 on the Reader Service Card.

The BPI 7000A Audio Analyzer

Everything in one package

By Walter H. Schwartz

BPI's Model 7000A is a multi-purpose instrument capable of making most of the special measurements for the troubleshooting and repair of a wide variety of audio systems; home stereo, auto-sound and tape play/record equipment.

To make these tests the 7000A includes a number of functions. It contains an audio oscillator with fixed frequencies of 50, 400, 1000 Hz and 3 and 15kHz. The frequency accuracy of the 3kHz output is ±0.25%. The others are ±2.0%. The oscillator output level is a maximum of 3.0 volts into 600 ohms and the THD is 0.015%. The 7000A will read output power in watts, directly into an 8 ohm load, over a range of 1mW to 1kW and a frequenty range of 20Hz to 20kHz, and its ac voltmeter has ten ranges in 10 dB steps from 10 mV to 300V with 3% accuracy and a frequency response from 20Hz to 50kHz.

The 7000A will measure total harmonic distortion at 50Hz, 400Hz, 1000Hz and 15kHz. Its distortion ranges are 0.03 to 100% in eight steps and its rated residual distortion is less than 0.015%.

The wow and flutter meter function of the 7000A has ranges of from 0.03 to 100% with a weighted frequency response of −6dB at 0.8Hz and 20 Hz and an unweighted frequency response of from 0.5Hz to 200Hz. Its specified residual noise is 0.01% unweighted and 0.005% weighted. The 7000A's speed and drift meter has a range of 0 to +5% or −5% with an accuracy of ±10% of full scale.

The panel layout is convenient and logical and the test procedure outlined in the manual permits a methodical and efficient check out of amplifiers or tape equipment. (Audio clinic chart pads are available as an accessory.)

For complete amplifier/tape deck checkout two other things are necessary; test tapes and an audio load. For our test ET/D used a set of Ora Electronics test tapes which furnish precision level and frequency signals for a wide variety of tests with an instrument such as the Model 7000A and an oscilloscope. These five tapes provide tones for level and balance tests, for signal to noise tests and wow/flutter measurements, head alignment and phasing, for all aspects of tape deck performance and they or something similar are a must for serious cassette deck service.

A note on audio dummy loads: noninductive resistors are highly recommended. Wirewound resistors have an appreciable inductance. For example the 10 ohm, 10W, square ohm you might pull from stock for a quick test (on a low power unit) has about 0.5 mh inductance, which is not much at low frequencies but has a reactive component about equal to its resistance at 20kHz. You may get away with it but I don't know what might happen if the amplifier under test had an ultrasonic parastic oscillation. (Other wirewound resistors in the 4 to 16 ohm range that we checked had similar inductances.)

The Model 7000A would be an excellent instrument for the auto-sound bench. It and proper cassette and eight-track tapes and a audio load should be all the special equipment necessary for almost any such work. It also would be a good back up instrument for general stereo service and unless you do high end audio performance verification it should be adequate for *all* your audio work. (A good test record would be necessary for turntable tests.)

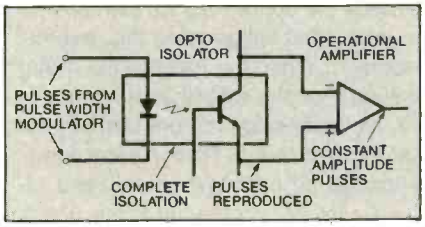
The quality of construction of the 7000A appears to be excellent; the panel layout is logical; the meter is easy to read; all details seem to have been considered. The present (preliminary) operators manual covers operation and use; it does not include instrument maintenance information. The price of the 7000A is $1295. A dual (stereo), 100 watt dummy load, Model 110, is $95. All BPI instruments carry a 1 year warranty on all parts and workmanship. ET/D

Replace three power supplies with the one that tracks

Almost anyone can build three power supplies in one box, but B&K-PRECISION has built one power supply capable of *outperforming* three separate supplies. An exclusive automatic tracking circuit is the reason.

The B&K-PRECISION 1650 multiple-output power supply was designed for use with both linear and digital circuitry. For digital requirements, the unit offers a 5 volt DC, 5 amp output; and two separate A & B 0-25 volt DC outputs at 0.5 amps for analog circuits. The exclusive automatic tracking circuit allows the B output to precisely track voltage changes of the A supply, while maintaining complete electrical output isolation. As a result, any combination of outputs may be connected in series or parallel, or be totally isolated.

The heart of B&K-PRECISION's automatic tracking circuit is a tiny LED opto-isolator. A pulse-width modulated light beam is transmitted through this device, providing a control signal which directs proportional control of the B supply when the A supply output is varied. For example, if the B control is set at 100%, the same voltage level will appear at both the A and B outputs. If the B control is instead set to a 50% position and the A output is set for 10 volts, the B output will deliver 5 volts.



Auto-tracking makes the 1650 the ideal power source for breadboard and prototype digital circuits. It can provide two simultaneously varying test voltages, or positive and negative voltages for operational amplifiers. The 1650 is a money-saving alternative to separate power supplies with features that can't be met by separate supplies. **For additional information and the name of your local B&K-PRECISION distributor, call toll-free 800-621-4627.**

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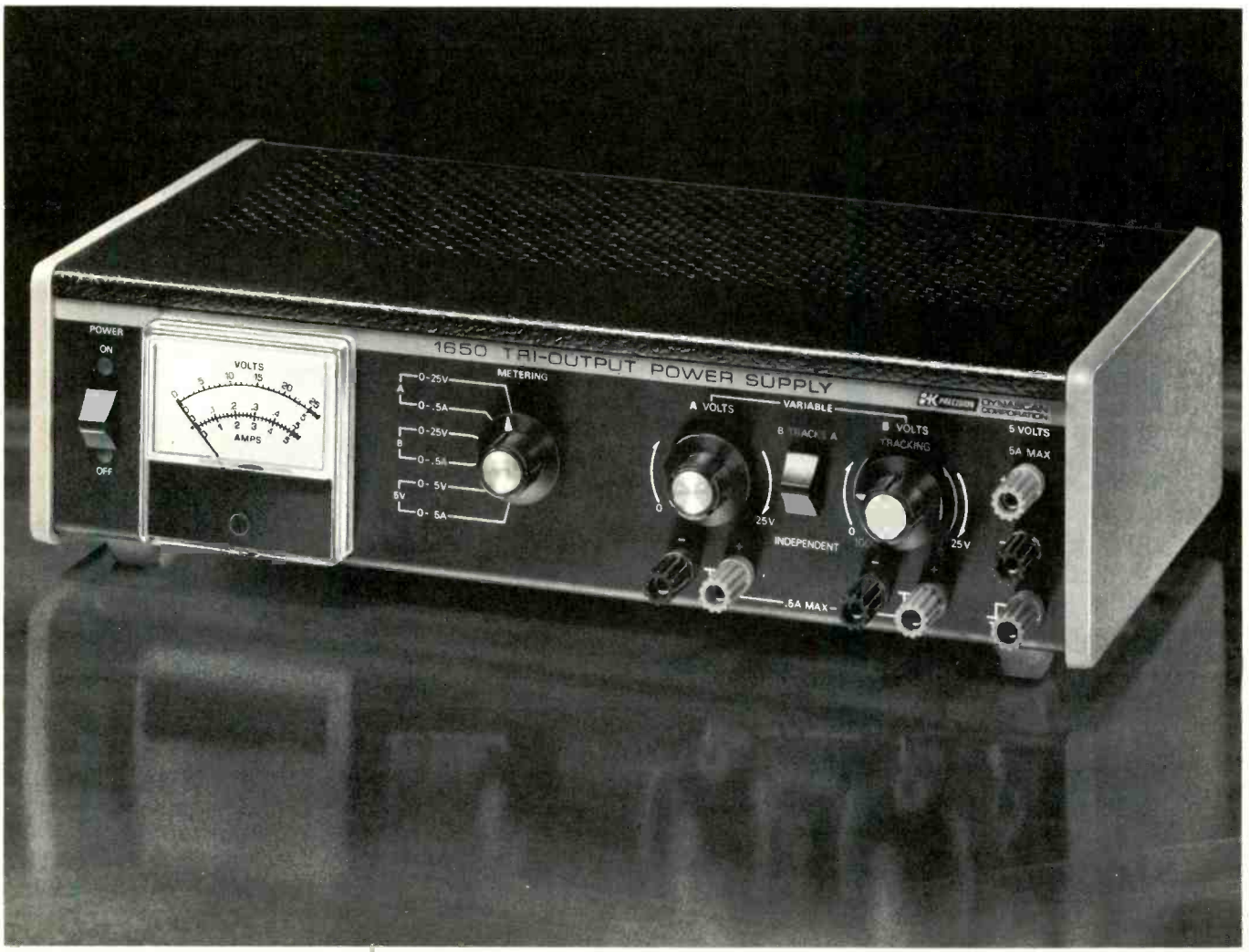
from $125



Circle No. 109 on Reader Inquiry Card

NEW PRODUCTS

Autoranging DMM

Circle No. 160 on Reader Inquiry Card

B&K-Precision has just announced the introduction of a new microcomputer-controlled, hand-held, autoranging DMM, the Model 2845. The 2845 is reportedly the industry's first such unit to offer microcomputer-controlled autoranging at a price comparable to conventional DMMs. The microcomputer of the 2845 is said to automatically select the proper range without the slow "hunting" action common on early bench-type autoranging meters. Similar in size and price to conventional DMM's, the 2845 offers the exclusive time-saving advantage of computerized automatic range selection. After the user has selected the appropriate function and connected the 2845 to the circuit under test, the microcomputer instantly analyzes the applied signal; then selects the range that will provide the greatest resolution. When the input to the meter reaches a level greater than the range in use, an "auto-skip" feature skips to the next highest range. Range selection is performed by ultra-low power reed relays. Basic DC accuracy for the unit is 0.1% with readings displayed on a 0.5 inch LCD display. The 2845 measures dc and ac volts; dc and ac current; and resistance. For time saving continuity measurements, the 2845 offers a built-in audible tone generator that eliminates the need to look up at the meter. Other features include a "range lock" control, to hold any automatically selected range, and comprehensive protection against accidental overloads. In the ohms range, where this protection is needed most, it resists overloads of up to +1000 and -450vdc or 300 vac. Ac and dc voltage ranges are protected to 1000vdc or ac peak. The 2845 is intended for applications ranging from design engineering to assembly line and field service. Optional accessories are available, including probes, a carrying case and a ac adapter for bench use. The 2845 autoranging portable DMM is now available at local distributors at a user price of $170. The unit complies with UL1244 and is supplied complete with safety-designed test leads, built-in tilt stand, detailed operating manual and spare fuse.

Miniature Soldering Iron

Circle No. 161 on Reader Inquiry Card

An industrial grade soldering iron with a rapid heat-up time for working with delicate circuitry is available from *M.M. Newman Corp.* of Marblehead, MA. The Antex Model G/3U is a lightweight, miniature soldering iron that reaches operating temperatures in just 45 seconds. Featuring a balanced, proportioned handle, it has replaceable 3/32" Dia. tips that slide directly over the

heating element for efficient power usage. The Antex Model G/3U has a flexible, 3-wire, 6 ft. cord. Weighing ¾ oz. the 6½" non-charring plastic handle reportedly remains cool even with tip temperatures of 725°F. 41 tips from 0.012" to 3/16" Dia., and a soldering stand are optional. The Antex Model G/3U is priced at $14.95 (retail); stand is $5.50.

Digital Multitester

Circle No. 162 on Reader Inquiry Card

Universal's DM100 reportedly provides fast, accurate test information with measurements displayed on an easy to read .5" LED display. The DM100's basic accuracy is ± 0.1% and it offers 25 ranges. Other stated features of the DM100 include a battery test switch, automatic polarity to eliminate lead changing, au-

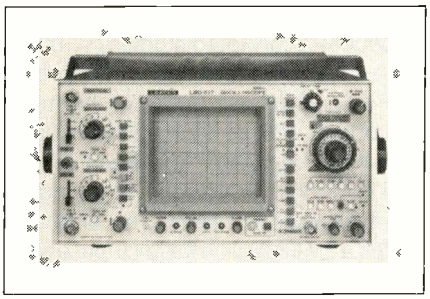
tozeroing, protected OHM circuit and rugged construction for use in the field. The DM100 has 4 acV ranges (0-2, 20, 200, 1000); 4 dcV ranges (0-2, 20, 200, 1000); 5 ohms ranges (0-200, 2K, 20K, 200K, 2000K): 1 dcmV (0-200); 1 dcμA (0-200); 4 dcmA (0-2, 20, 200, 2000); 1 acmV (0-200); acmA (0-2, 20, 200, 2000); 1 acμV (2-200). The DM100

has a one year warranty and a suggested trade price of $99.95.

50MHz Oscilloscope

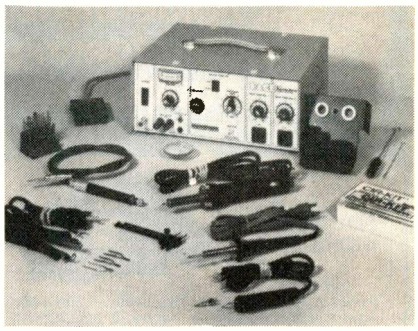
Circle No. 163 on Reader Inquiry Card

Leader's new LBO-517 50MHz dual-trace, delayed time base oscilloscope incorporates a range of features and capabilities reportedly previously available only in much more expensive laboratory instruments. These features include a calibrated delayed time base which permits accurate measurements and observations of complex waveforms or long pulse trains. The main and delayed time bases can be displayed simultaneously for both input channels, resulting in convenient display showing both the complete waveform and an expanded section simultaneously. An alternate triggering mode permits comparison and measurement of two signals which are unrelated in frequency. This feature is useful in servicing computer peripherals and asynchroneous data communications devices. The triggering waveforms for both the main and delayed time bases can be observed using the LBO-517's third and fourth trigger view channels. These two inputs can also be used as third and fourth auxiliary channels to display clock pulses, timing markers or other waveforms not requiring vertical calibration. The LBO-517 provides 1 mV sensitivity up to 10 MHz and 5 mV up to 50 MHz. Sweep rates range up to 5⁄8 ns/cm using the ×10 multiplier. Both vertical amplifiers are equipped with delay lines to permit viewing the triggering edges of fast rise time pulses. A variable trigger hold-off control facilitates stable triggering on complex waveforms and a "B-ends-A" position increases the display brightness of low frequency signals by increasing the sweep repetition rate. The LBO-517 employs a recently developed dome-mesh, internal graticule CRT with 20 kV accelerating potential which reportedly produces bright, clear traces at all sweep speeds. The suggested user net price is $1,950.00 including two probes.



Bench-Top Repair Center

Circle No. 164 on Reader Inquiry Card



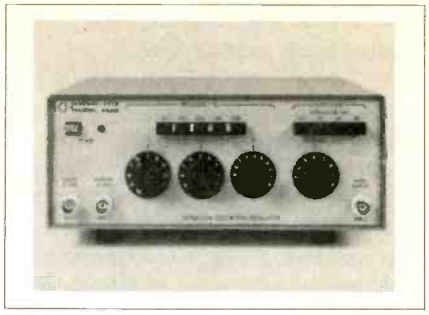
Pace, Inc., has introduced a new Bench-Top Repair Center for printed circuit boards, the Model PRC-151, reportedly a fully spike-free system incorporating a full line of standard work accessories. Intended for use in rework and repair depots, the PRC-151 is provided with a full range of function accessories for desoldering; soldering; precision drilling, grinding and abrasion; reflow soldering; conformal coating removal; conductive tweezer heating, resistance tweezer heating, and thermal wire stripping. As such, it is also useful in development labs for the prototyping, modification and construction of new electronic modules. The system's zero power switching feature is said to pro-

vide full spike-free operation of all electrical functions, making it safe for use with all MOS-type components. All electrical functions are front panel controlled, and conveniently arranged in optimized control groupings for simplified operation. A 2-position foot pedal enables convenient on-off control of the function accessories. Also included is the Pac Cir-Kit™, which permits repair and replacement of damaged or missing pads and tracks on PC boards. Both domestic and export versions are available, and domestic unit list price is $1,175.00.

Ultra-Low Distortion Oscillator

Circle No. 165 on Reader Inquiry Card

Krohn-Hite's Model 4400 covers the frequency range from 1Hz to 110kHz, and produces a very low distortion (< .001%) sinewave for measuring audio preamplifier and power amplifier harmonic distortion. With its flat response (.05dB) the 4400 eliminates the need to constantly monitor voltage level during frequency response tests. The 4400 provides a 7V RMS sinewave output and a 3 position, pushbutton attenuator calibrated in 20dB steps, along with a 30dB



vernier to provide total dynamic range of 90dB. Precise frequency selection is possible with the 3 digit tuning selector. Simultaneous inverted (180°) and quadrature (90°) outputs also are provided. Each output is 7V RMS with 600 ohm source impedance. When combined with a distortion analyzer, such as the Krohn-Hite 6800 series, it provides a complete distortion measurement system. The 4400 is priced at $550: availability is 60 days.

"Inject-A-Pulse"

Circle No. 166 on Reader Inquiry Card

The new "Inject-A-Pulse" hand-held digital logic pulse generator Model 215 and the Model 215-K just released by *Triplett Corporation,* provides a convenient method of stimulating a logic state change in DTL, TTL, MOS, CMOS and Microprocessor IC's. When the probe's pushbutton is actuated, a single Hi-going or Lo-going 2 microsecond pulse is delivered to the IC mode under test. If the switch is depressed and held, a series of 20 pulses per second will be delivered. If a mode is Lo, it will automatically be pulsed Hi, and vice versa. The "Inject-A-Pulse" probe automatically senses the proper pulse threshold when its leads are connected to the IC circuit's power supply. The low duty cycle of the pulse reportedly will not damage the IC under test, even when used continuously. Power supply re-

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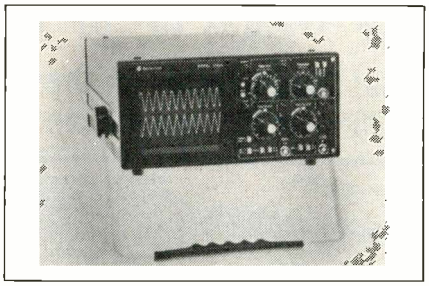
Circle No. 117 on Reader Inquiry Card

verse polarity protection is featured, and the hand-held probe is said to cause very little circuit loading. The Model 215 "Inject-A-Pulse" comes complete with one year warranty, detachable 6′ coiled cord with mini-alligator clips, instruction manual and clear plastic carrying case for $71.50. The Model 215-K kit sells for $81.00 and also includes a high voltage adapter Model 70-465, for 15 to 25 volt circuit applications, and Model 79-466 coiled cord with miro-hooks for direct IC pin attachment.

Bench/Portable Scope

Circle No. 167 on Reader Inquiry Card

Ballantine's Model 11032 dual-channel oscilloscope weighs only 15 lbs. and will fit under an airplane seat, with a 25MHz bandwidth, the 1032A measures 5¼″H × 11-1/3″W × 15½″D and offers pushbutton selection of the ac/dc input coupling and of the input coupling for the trigger circuit. Another feature is the full and active TV sync stripper which makes the 1032A easy to use in servicing computer display terminals and in general TV troubleshooting and maintenance of cameras, monitors, receivers, etc. To make for simple operation, the filters in this new circuit are selected by switching logic on the sweep range control to provide automatic synchronization on either TV line or frame, depending on the sweep range selected by the operator. The Model 1032A costs $945, and features ten trigger modes including the exclusive Indepen Dual triggering for simultaneously viewing two asynchronous signals. This switching scheme in



which each input channel has its own independent trigger circuit results in the simultaneous viewing of the two signals, as if they were being displayed on a scope with a dual-beam CRT. The 1032A uses an 8×10 cm advanced mono-accelerator CRT with high brightness and small spot diameter. Performance specifications include a 3 dB passband of dc to 25MHz; a risetime of 17.5 nsec; a total of ten trigger modes (including Independent-Dual); calibrated vertical sensitivities from 5 mV/div to 20 v/div (50 V/div uncalibrated) and calibrated sweep speeds from 0.5 sec/div to 1 μsec/div.

50 Hz-1.2GHz Frequency Counter

Circle No. 168 on Reader Inquiry Card

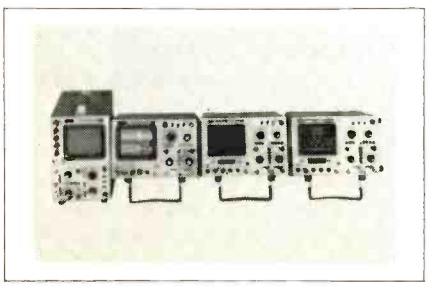
Reportedly covering measurement requirements all the way from low-level audio signals up into the over one-gigahertz region of the high-frequency spectrum, the 50 Hz-1.2 GHz Model 5612 announced by *DSI Instruments, Inc.* is stated to be the first ultra-high accuracy instrument with its range, to be offered at $240. The new Model 5612's readings are specified to be accurate to within 0.2 PPM, due to a 10 MHz Proportional Oven Time-Base, over the 10°C to 40°C temperature range. Its sensitivity is typically 10 mV-15mV over

a range from 100 Hz to 250 MHz and 15 mV to 50 mV up into the 450 MHz region. It has a 0.5" 9 digit 7 segment LED display featuring zero blanking and automatic decimal point positioning. LED status indicator lights for "Standby," "Oven-Ready" and "Gate-Time" are included in the readout array. Readout resolutions ranging from 0.1 Hz up to 1.0 KHz are push-button selectable on the front control panel. The user can also push-button select either the 512 MHz or the 1.0 GHz range, depending on measuring requirements. Additionally, an RF pre-amplifier and prescaler control are included. Two BNC input connectors are also located on the front control panel—50 Hz-50 MHz and 50 MHz-1.2 GHz. Provision for an optional audio multiplier input that can provide resolutions up to 0.001 Hz, has been located on the back of the instrument (the AM-56 0.001 Hz resolution audio multiplier sells for $34.95). The unit operates from a 8.2-14.5 vdc power source —an internal NiCad rechargeable battery pack, including a charger and 115 vac adapter, are optionally available for $29.95. The model 5612 is encased in a high impact, molded cabinet. Its combination carrying handle-stand can be positioned at various angles to facilitate readability and portability. Its dimensions are 9½-inches wide × 3¼-inches high × 9-inches deep (including the battery compartment). The 5612 sells for $239.95, in single-unit quantities, available from domestic as well as Canadian and international outlets, and carries a full one-year limited warranty.

Portable Oscilloscopes

Circle No. 169 on Reader Inquiry Card

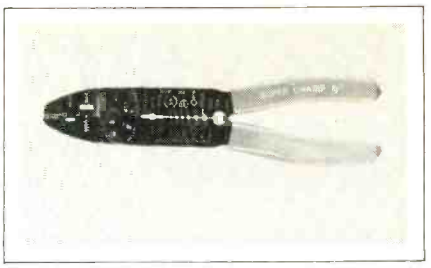
Soltec's new 500 Series line of portable Oscilloscopes reportedly features high performance and reliability at a low cost. The series consists of models ranging from 12MHz to 60MHz, including: 60MHz triple-trace, alternate sweep. 40MHz triple-trace, alternate sweep. 40MHz triple-trace, versatile trigger, with built-in counter/timer. 40MHz triple-trace, versatile trigger, with built-in digital multimeter. 12MHz dual-trace triggered sweep, parallax-free graticule. 12MHz single-trace triggered sweep, parallax-free graticule. Special features include light weight, with a data readout option. New free 4-color brochure available.



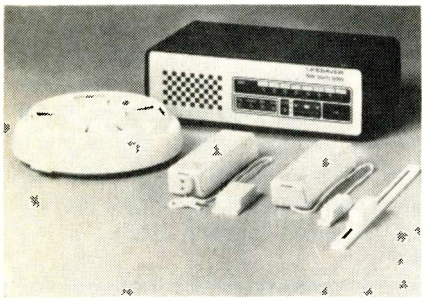
Metric Hand Tool

Circle No. 172 on Reader Inquiry Card

The metric version of *Amp's* popular Super Champ crimping tool is now available. It crimps insulated and uninsulated terminals and splices, in wire sizes 0.5-6.0 mm². The wire barrel and insulation barrel on insulated terminals and splices are crimped in the same die, making the tool faster and easier to use. Color-coded dies in the tool nose correspond to colors on terminal insulation sleeves to insure proper die selection. This tool also features a wire cutter, bolt cutter, stud gauge, wire stripper and universal ignition crimping notch.



SECURITY PRODUCTS



Wireless Home Security System

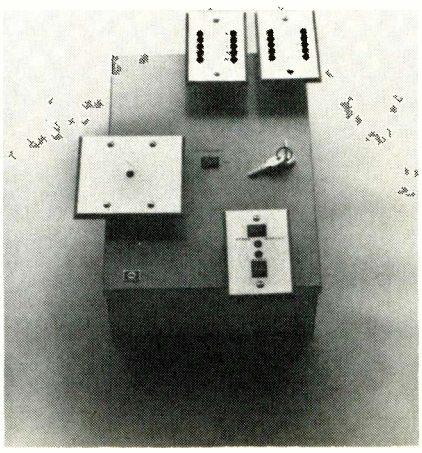
Circle No. 130 on Reader Inquiry Card

Reliable Fire Equipment Company has announced the availability of the Fyrnetic livesaver wireless, 4/channel-8 zone home security system. The Lifesaver home security system features perimeter intrusion and fire protection and is asserted to be the most technologically advanced intrusion and fire protection system ever to hit the market. The all new Livesaver home security system with a patented "brain" has 4 separate channels to monitor and distinguish intrusion, fire, emergencies, and miscellaneous, but also has, additionally, 8 zones of indication on the unit to immediately pinpoint the location or area of intrusion, fire, emergencies or special maintenance problems . . . each channel has its own audio and visual signal to indicate an alert. When a signal from any of the various wireless transmitters is received at the central receiver unit, it will sound an audible alarm and one of the four diode indicators on the central receiver will light up indicating the type of alarm while simultaneously lighting one of the 8-zone diode indicators to pinpoint the area affected. The Lifesaver home security system includes the "heart" of the system . . . a portable ac powered central receiver with battery back-up that accepts any number of transmitting devices per channel or zone, as long as they are within the 200 foot range (under normal conditions) . . . and individually tailored quantities of wireless transmitting units to meet the requirements of each customer. All wireless transmitters are individually powered by 9-volt batteries and are easily installed. Output terminals on the central receiver permit easy connection for external horns, bells or sirens, external beacons or strobes, as well as automatic telephone dialer to alert fire and/or police departments. The capabilities of the home security system are enhanced through the use of these wireless battery operated transmitters: 1) fire, smoke . . . ionization smoke detector transmitters, and thermal detector transmitters (heat sensors) (for recommended use in the garage, kitchen or furnace room); 2) intrusion security . . . door alarm transmitters, window alarm transmitters, auto alarm transmitter (plugs into auto cigarette lighter housing and sends an alarm signal to the central receiver when the car door is opened or the engine of the car is started), general purpose transmitter (used with window tape, glass bugs or pressure sensitive pads to detect intrusion), and panic alert transmitter (hand-held warning device that actuates alarm system in the event of personal fear of intrusion being perpetrated); 3) emergency . . . emergency hand-held transmitter (to signal for help in an emergency for aged, handicapped or bedridden persons); 4) miscellaneous maintenance . . . maintenance alarm transmitter that can detect rising water, high water levels or sudden unexplained water conditions (used in sump pump applications or around basement drains. Optional accessories available that can be utilized in the home security system through the central receiver are: external horns, bells or sirens, external beacons or strobes, as well as automatic telephone dialers.

Annunciator System

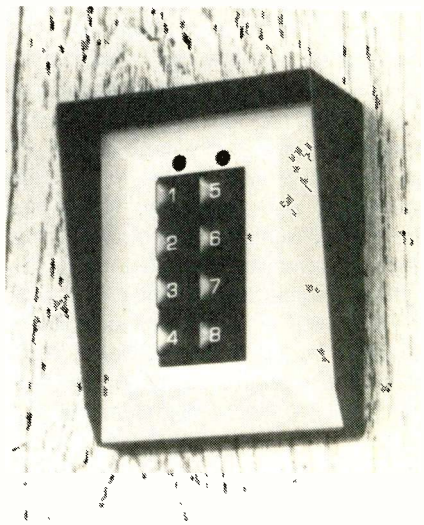
Circle No. 131 on Reader Inquiry Card

The DS 6210 and DS 6220 annunciator system controls by *Detection Systems* provide up to 10 and 20 zones of individual protection respectively. Non-shielded quad conductor cable allows for easy installation of the Zone Ultrasonic Transceiver, Flush Mounted Transceiver, Separate Head Transducers, and Zone Interface Module or any combination of each. The Ultrasonic heads provide individual signal processing, built in cover tamper switch, walk light LED and end of line resistors for cable and head supervision. The circuit board is attached to the enclosure base permitting the cover to be off while adjusting their 30 foot range and voltmeter testing the background noise level. The Zone Interface Module delivers the professional look with its brushed aluminum construction which allows the zoning of any combination of NONC Perimeter contacts. LED operation not only indicates a past stored alarm with a pulsing LED, but also indicates a present alarm with an overriding "on" LED for effective guard and service response.



Access Control Keyboards

Circle No. 132 on Reader Inquiry Card

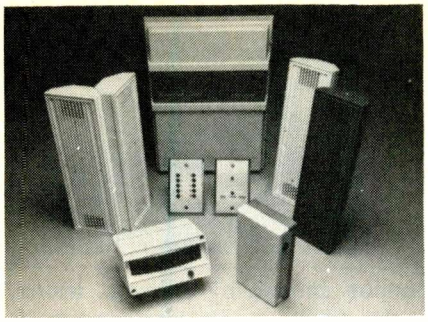


SenDEC "Push Button Key" line of digital keys feature decorative protective covers or spy shields which make it difficult for unauthorized personnel to view the code number sequence. The keyboards operate electric door strikes directly and provide on/off control of security systems and may be used as zone shunts in multizone systems. The keyboards are operated by a 5 digit code. The code is field programmable by changing a wire jumper matrix.

Multi Sensor System

Circle No. 133 on Reader Inquiry Card

The *Aritech* 230 is an intrusion detection system that is available with a wide variety of sensors. It has only one interconnecting cable. The installer selects the most appropriate sensor for each of the areas (maximum 15) to be protected;

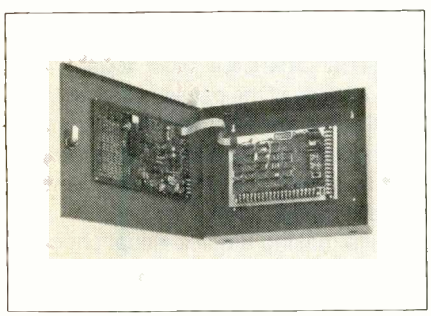


ultrasonic or passive infrared, transceiver or range expander, wall or ceiling mounted, surface or flush mounted, wide angle or long range, or a universal interface sensor that connects any NO or NC device to the quad cable. An LED light on each sensor and on an optional central annunicatior panel indicates which sensor is in alarm. This permits walktesting, quick trouble-shooting, and maximizes subscriber confidence. Each of the sensors has independent signal processing. Background disturbances in one room do not affect detection in another room. This results in increased reliability and freedom from false alarms. There is no need to vacate the whole building to set-up and walktest the Aritech 230. Each sensor has independent signal processing, so one can be tested while normal activity goes on at other sensors.

System Control Panel

Circle No. 134 on Reader Inquiry Card

Adcor Electronics', Sentinel System has all alarm functions contained in one central panel, with all features built in, including a power supply, lightning protection, two zones burglary, (delayed and instant), supervised fire alarm, audible or silent personal emergency, relay



contact or electronic siren driver outputs, entry-exit delay, fire trouble and other features.

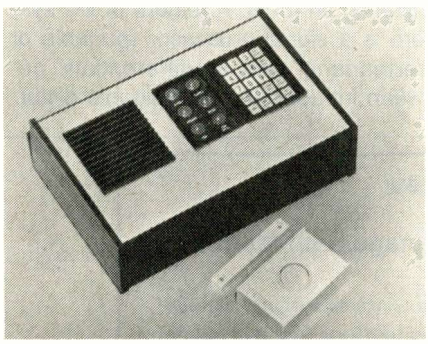
With the optional plug-in telephone communicator, the Sentinel System not only rings a bell or sounds a siren in case of fire or attempted break in, but can call for help by telephone.

The system may be armed from the wood-grain finish master remote station which provides visual indication when the system is armed or circuits are closed. Slide switches provide on-off control of interior zones, entry delay and the "sentinel" feature, which converts the system to a door annunciator when not armed. An ac power indicator, personal emergency push button and alert control (audible or light) are also included.

Computer Wireless Alarm System

Circle No. 135 on Reader Inquiry Card

Universal Security Instruments, Inc. has recently introduced Perim-A-Tron™, reportedly the first wireless home alarm system to employ microcomputer technology for maximum flexibility plus ease of installation and use. The manufacturer states that no other wireless alarm package offers the user a combination of programmable sophistication and 2-channel operation, allowing the owner to customize a security system for almost any need. Personal programming allows the user to set entry/exit delay



times from 5 to 45 seconds and to program his own 3-button keyboard disarm code. Alarm transmitters mounted at various entry points can be switched to operate on either of the 2 alarm channels and can also be switched to use or omit the programmed entry delay. The household being protected can be divided into 2 alarm zones, each represented by a different alarm sound. For example, the house might be on alarm channel 1 and the garage on alarm channel 2, or the doors might be channel 1 and the windows on channel 2. The user can also mix delayed and instantaneous alarm transmitters on each channel. For example, the transmitter at the main entry door might send a delayed alarm signal and a less used door's transmitter would be set to send an instantaneous alarm signal. Universal has reportedly designed the system with specific "feedback" features to assure the user that the system is working. These include an automatic "system test" which informs the user if a door or window has been left ajar and a full set of system status indicator lights. There are also automatic signals to indicate battery failure. Other features include an automatic timer to silence the alarm after sounding for 10 minutes and to reset it to detect another intrusion or an entry point left open. The Perim-A-Tron also offers audio output to drive an external PA horn speaker for outdoor alarm sound. Perim-A-Tron is installed with the self-adhesive transmitter mounting material supplied. Extra magnetic contacts can be added to enable the same transmitter to protect several windows in the same room. Suggested retail is $149.95 for a basic package of the receiver and one transmitter. Additional packages will be offered to include: the receiver, 3 transmitters and an outdoor horn speaker at $199.95; or the receiver, 5 transmitters, a special "Panic" transmitter and an outdoor horn speaker at $269.95. Additional transmitters are only $29.95. The outdoor horn speaker retails separately for $19.95.

Vehicle Security and Pocket Pager

Circle No. 136 on Reader Inquiry Card

Page Alert Systems, Inc., has recently introduced a new deluxe model—the *PAGE ALERT 4444*. The Model 4444 has reportedly, been designed to be more than just a superior vehicle security system. A special "PAGE and SECURITY Switch" has been added to the transmitter along with 2 small lights (L.E.D's) on the receiver, making the *PAGE ALERT 4444* into a low-cost immediate area communications and emergency alert system for the home, office and factory, as well as a theft warning device. For vehicle security, the 4-watt page alert transmitter sends an individually coded radio signal to a small pocket pager which will beep its warning of a "theft in progress." The Model 4444 is stated to have a range of more than 2 miles with excellent penetration through buildings and other obstacles. Transmission range depends upon antenna, terrain and atmospheric conditions. For instant communication, the switch on the front of the Model 4444 transmitter

and the LED's on the receiver give it a dual message capability. When the switch is pushed down to the "PAGE" position, a radio signal is sent to the pocket receiver (beeper). The beeper then sounds its signal while the LED marked "PAGE" on the receiver lights up. In emergency alert situations, the transmitter switch may be moved to the "SECURITY" position causing the receiver to beep and the LED marked "SECURITY" to light up. PAGE ALERT's two-tone sequential coding system is stated to have over 10,000 individual codes which virtually eliminate false triggering.

Electronic Siren

Circle No. 137 on Reader Inquiry Card

Electronic siren, model 59 from *Emergency Products*, features an extremely loud sound equal to 120dB at 12vdc. The siren is also suitable for 6vdc applications. No separate driver module is required for installation and the siren is capable of producing two distinct sounds—a pulsing signal or a steady tone. This dual channel capability makes the model 59 useful on combination burglar/fire systems. The model 59 is weather-resistant but may also be had mounted in a steel cabinet with or without mounted strobe lights, where extra security is desired.

Outdoor Security System

Circle No. 138 on Reader Inquiry Card

Intrusion Detection Systems, Inc. is marketing a new version of its outdoor buried seismic security system which includes an audio listen-in capability. The concealed, all-weather, all-terrain detection system utilizes seismic sensors and discriminators (permanent or temporary) of a type which are buried out of sight in earth, asphalt/concrete, or installed on roofs. A feature of the system is a signal processor (portable or permanent) said to differentiate between intruder and unavoidable disturbances caused by animals, trains, trucks, freeways, air compressors, or sonic booms, thereby preventing false alarms. After eight years of installations in most countries of the world the company claims to have never had a sensor fail in the field. The listen-in capability now permits security personnel to identify the cause of alarm signals in any number of zones. Applications include major plants, nuclear center, utility companies, auto and truck dealers, trucking lines, schools, prisons, estates, etc. It is said the system drastically reduces false alarms while providing an exceptionally high degree of protection. IDS distributes nationally. ET/D

ZENITH

Continued from page 19

very fine and faint noise pulses that appeared to be mixed with the horizontal sync pulses and were detected on a very wide-band scope. Could this be some type of interstelar noise from outer space? If any one out there has any ideas on this phenomenon, please let me know.

Perhaps these fine pulses were activating the noise protection circuit in the chip (due to one or more off-value components on the module and/or within the chip) and caused the IC's logic circuits to "gate-out" most of the sync pulses.

Module checks and tips

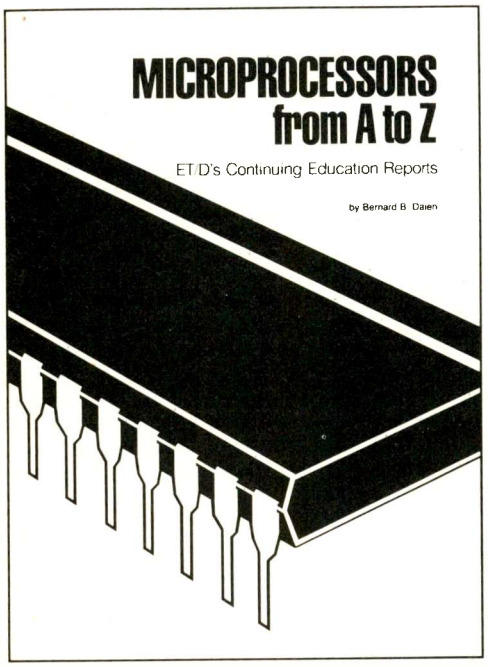
In about 90% of the cases a new 221-45 IC will solve any trouble that occurs with this module. As the circuit indicates this module does not contain very many discrete components.

While making a quick visual check of this module, be on the alert for burnt or discolored resistors. Then use an ohmmeter to check for any off value resistors. You may then opt to check out the capacitors and the one diode.

For any intermittent problems on this module look for poor solder connections and cracks in the PC runs. Alwyas clean and tighten all of the terminal pin spring contacts before the module is re-installed. Also, check and clean pins on the main chassis where the module plugs in. ET/D

MICROPROCESSORS from A to Z

by Bernard B. Daien



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MATV-CATV INSTALLERS Get lowest prices on antenna accessories, fastest service from **ANTSCO CORPORATION.** Call collect, ask for catalog & prices. All orders shipped same day. Sierra Madre, CA 91024. 213-355-2510. 11/80

19" COLOR TV'S, used commercial models. RCA XL-100 and others. 10 lot minimum. Kamcor, Ltd., 88 S. Washington Ave., Bergenfield, NJ 07621.

VARACTOR UHF TUNER, Super Sensitive, Tunes, Channels 14 thru 83. $34.95 each PP. Also decoder PC Boards, Parts, etc. Catalog free. Les Gaskell Enterprises, 11852 S. Hawthorne Blvd., Hawthorne, CA 90250. Tel. (213) 675-2335.

ANALOG MM SWAP DIGITAL MM Send me your old, beat up, used Analog, Multimeter and a check for $180.00 and I will send you a new 3 ½ Digital DMM 3020 Digital Multimeter the same day. Kontron Electronic, Inc., 700 So. Claremont St., San Mateo CA 94402, Jack Frye, (415) 348-7291 11/80

HEWLETT PACKARD Distortion Analyzer 333A $595, Leader Scope LBO-505 15MHz Dual $395, B & K Curve Tracer 501A $140, Leader AC Millivolt Meter LMV-87A $135, Powerstat Vari-transformer 50 amp $150, 10 amp $50, all excellent condition. TESTEK, 6910 Hayvenhurst, Van Nuys, CA 91406, (213) 786-6890.

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AD INDEX

BULLETIN BOARD

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NEW PRODUCTS

SECURITY PROD.

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

SCHEMATIC NO		SCHEMATIC NO.	
QUASAR B&W TV Chassis TS-498	1869	PANASONIC B&W TV Model TR779	1873
RCA B&W TV Chassis KCS205	1870	ZENITH B&W TV Chassis 22LB2X	1874
PANASONIC B&W TV Model TR659A	1871	SYLVANIA B&W TV Chassis A19-24	1875
PANASONIC B&W TV Model TR5040P	1872		

1869

QUASAR
B&W TV Chassis
TS-498

NOVEMBER • 1980

1. VOLTAGE MEASUREMENTS: EXCEPT WHERE NOTED, TAKEN FROM POINT INDICATED TO CHASSIS WITH AN ACCURATELY CALIBRATED VTVM.

AC INPUT TO RECEIVER 120V. CONTROLS AT NORMAL SETTING. SOME VOLTAGE READINGS WILL VARY WITH ASSOCIATED CONTROL SETTINGS AND SIGNAL STRENGTH.

WHERE TWO (2) VOLTAGES ARE SHOWN, THEY REPRESENT VOLTAGE WITH AND WITHOUT SIGNALS AS FOLLOWS:
00V – ZERO SIGNAL (TUNER BETWEEN CHANNELS).
01V – AIR SIGNAL

2. ALL WAVEFORMS TAKEN WITH A WIDEBAND SCOPE AND A PROBE WITH LOW INPUT CAPACITY (10 TO 1). SHAPE AND PEAK-TO-PEAK AMPLITUDES MAY VARY DEPENDING ON CALIBRATION, TYPE OF TEST EQUIPMENT USED, AND CONTROL SETTINGS.

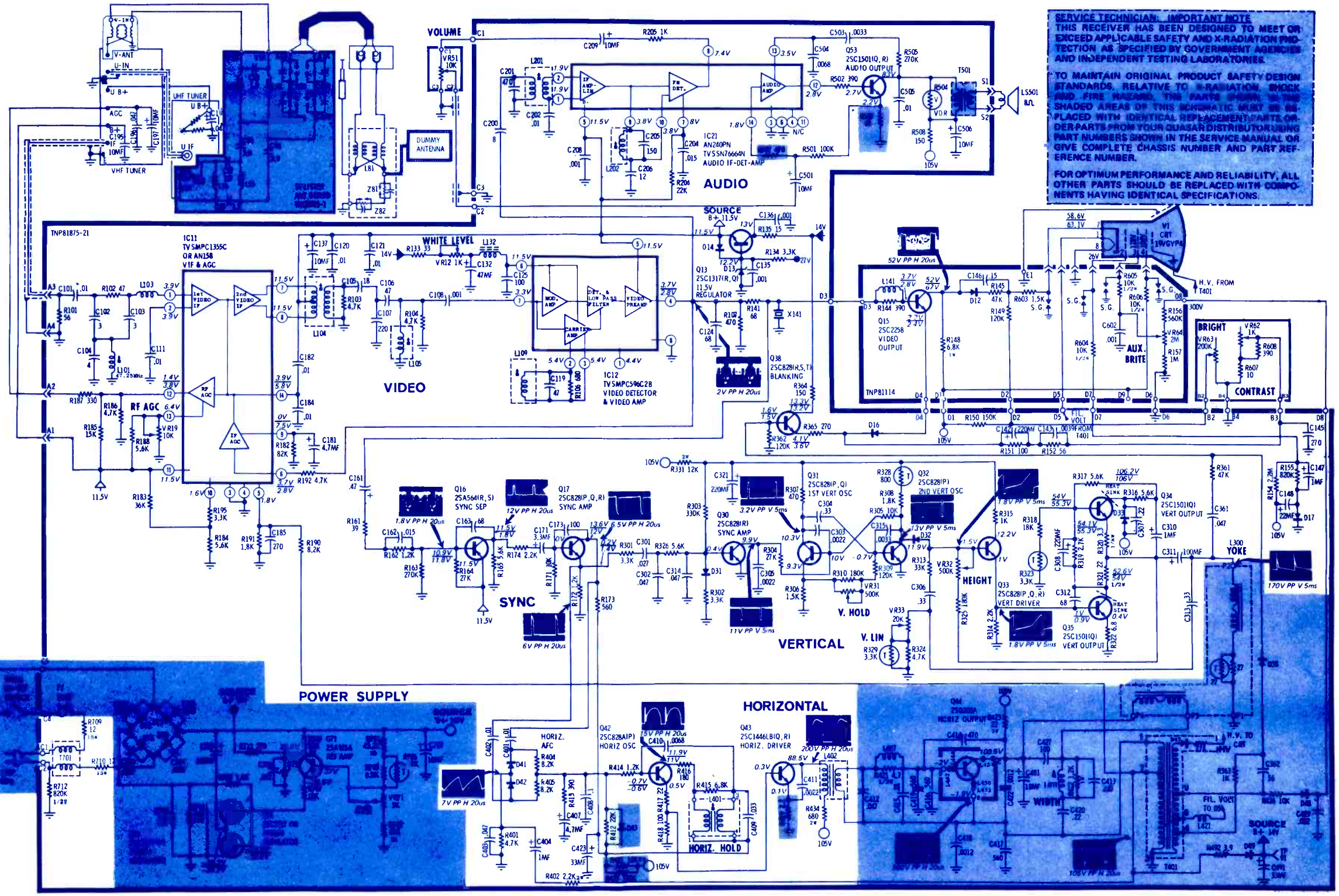
3. UNLESS OTHERWISE SPECIFIED: RESISTORS ARE 1/4W 5%. CAPACITOR VALUES LESS THAN ONE IN MF, ALL OTHERS IN PF. CAPACITANCE VALUES ONLY ARE SHOWN ON SCHEMATIC DIAGRAM. FOR COMPLETE DESCRIPTION OF CAPACITORS, REFER TO PARTS LIST.

SERVICE TECHNICIAN: IMPORTANT NOTE

THIS RECEIVER HAS BEEN DESIGNED TO MEET OR EXCEED APPLICABLE SAFETY AND X-RADIATION PROTECTION AS SPECIFIED BY GOVERNMENT AGENCIES AND INDEPENDENT TESTING LABORATORIES.

TO MAINTAIN ORIGINAL PRODUCT SAFETY DESIGN STANDARDS, RELATIVE TO X-RADIATION, SHOCK AND FIRE HAZARD, THE PARTS SHOWN IN THE SHADED AREAS OF THIS SCHEMATIC MUST BE REPLACED WITH IDENTICAL REPLACEMENT PARTS OR OEM PARTS FROM YOUR QUASAR DISTRIBUTOR USING PART NUMBERS SHOWN IN THE SERVICE MANUAL OR GIVE COMPLETE CHASSIS NUMBER AND PART REFERENCE NUMBER.

FOR OPTIMUM PERFORMANCE AND RELIABILITY, ALL OTHER PARTS SHOULD BE REPLACED WITH COMPONENTS HAVING IDENTICAL SPECIFICATIONS.



1870

RCA
B&W TV Chassis
KCS205

NOVEMBER • 1980

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

PRODUCT SAFETY NOTE

SHADED COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY. BEFORE REPLACING ANY OF THESE COMPONENTS READ CAREFULLY THE PRODUCT SAFETY NOTICE ON PAGE 2 OF THIS SERVICE DATA. DO NOT DEGRADE THE SAFETY OF THE SET THROUGH IMPROPER SERVICING.

NOTES:
1. RESISTOR VALUES ARE IN OHMS. K = 1000
2. CAPACITOR VALUES GREATER THAN 1.0 ARE IN pF THOSE 1.0 AND LESS ARE IN µFD. UNLESS OTHERWISE DESIGNATED.
3. VOLTAGES MEASURED WITH RESPECT TO ⏚ USING A "VOLTOHMYST". NO SIGNAL CONDITION, AND SHOULD HOLD WITHIN ±20%
4. ALL RESISTORS ARE 1/4 WATT AND 5% TOLERANCE EXCEPT WHERE OTHERWISE INDICATED.

⏚ INDICATES GROUND

** INDICATES 2% TOLERANCE

*** INDICATES 1% TOLERANCE

[ ] RELATES TO ZONING ON PERIMETER OF DRAWING

( ) VOLTAGES MEASURED WITH SIGNAL

TECHNICIAN X-RADIATION WARNING — KCS 205 (16 INCH)
THIS TV CONTAINS CRITICAL PARTS TO PROTECT AGAINST X-RADIATION. NOMINAL 2ND ANODE VOLTAGE IS 18.5kV AT 120VAC AND MUST NOT EXCEED 23.0kV UNDER ANY VIEWABLE CONDITION. TO MEASURE — SET BRIGHTNESS FOR VERY DIM PICTURE — USE A HIGH IMPEDANCE METER. CONNECT (-) TO CHASSIS GROUND AND (-) TO 2ND ANODE.
THIS INSTRUMENT CONTAINS NO HIGH VOLTAGE ADJUSTMENT.
SEE SERVICE DATA FOR REPLACEMENT PARTS AND INFORMATION.

TECHNICIAN X-RADIATION WARNING — KCS 205 (19 INCH)
THIS TV CONTAINS CRITICAL PARTS TO PROTECT AGAINST X-RADIATION. NOMINAL 2ND ANODE VOLTAGE IS 19.0kV AT 120VAC AND MUST NOT EXCEED 23.0kV UNDER ANY VIEWABLE CONDITION. TO MEASURE — SET BRIGHTNESS FOR VERY DIM PICTURE — USE A HIGH IMPEDANCE METER. CONNECT (-) TO CHASSIS GROUND AND (+) TO 2ND ANODE.
THIS INSTRUMENT CONTAINS NO HIGH VOLTAGE ADJUSTMENT.
SEE SERVICE DATA FOR REPLACEMENT PARTS AND INFORMATION.

MONOPOLE ANTENNA
ANT TERMINALS
ANTENNA ISOLATION ASSEMBLY
GROUND TO TMA
300 OHM
VHF/UHF SPLITTER
R-F (UHF) 300 OHM
UHF TUNER
VHF TUNER
R-F (VHF) 300 OHM
+18VDC FROM SOURCE [11-C]

SOUND I-F
REFER TO SERVICE DATA FOR DETAIL
IC 201
T201
T102
Q101 AUDIO OUTPUT
SPEAKER 3.2 3W
VOLUME R108 40K
+140VDC FROM SOURCE [4-E]
4.5MHz SOUND

PICTURE I-F
Q403 PIX PREAMP
Q404 2ND PIX I-F
Q405 3RD PIX I-F
VIDEO DETECTOR
SHIELDED AREA
L401 47.25MHz TRAP
T401
T402
T403
T404
T405 4.5MHz TRAP

AGC
Q401 AGC AMP
Q402 R-F AGC
Q407 AGC GATE
AGC ADJ
NO SIGNAL 2.12V
STRONG SIGNAL (4.0V)
R-F AGC
35V P-P FROM C424/C427 [11-C]

PW2000A, C

Q408 VIDEO DRIVER
SYNC
Q701 SYNC
VIDEO
TP201
TP303
+18VDC FROM SOURCE [11-E]

POWER SUPPLY
120VAC 60Hz
GROUND TERMINAL OF POLARIZED PLUG
F101 1.0A SB
S101
R101 2.2 MEG 1/2W
TO DIAL LAMPS
NOT ON ALL MODELS
R801 6.8 7W
R802 1.0 MEG 1/2W
C801 .01 (x1)
C112 680
CR801 CR802 CR803 CR804
R803 56, 7W
TP101
+140V SOURCE
C101A 180µF 175V
C101B 310µF 175V

1871

PANASONIC
B&W TV Model
TR659A

NOVEMBER • 1980

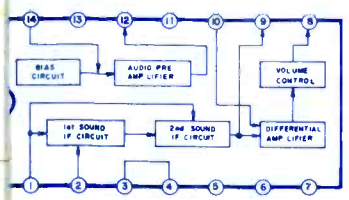
ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

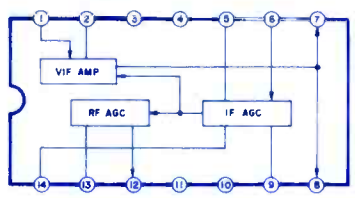
IMPORTANT SAFETY NOTICE

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

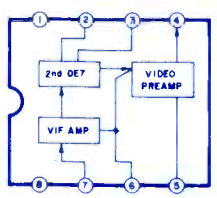
IC21 AN240D



IC11 MPC1355C



IC12 MPC596C2



TRANSISTOR BASE INFORMATION

TVSMPC596C2	AN240PN TVSMPC1355C	2SA564 2SC828A 2SC1317	2SC1446LB 2SC2317 2SD876

TRANSFORMER TERMINAL INFORMATION

L101, L104, L105, L109
L201, L202

NOTE

1 RESISTOR
All resistors are carbon 1/4W resistor, unless otherwise noted the following mark.
Unit of resistance is OHM (Ω) 1K=1,000 M=1,000,000
Solid resistor
Wire wound resistor
Fuse resistor
Metal oxide resistor
Thermistor

2 CAPACITOR
All capacitors are ceramic 50V capacitor, unless otherwise noted the following marks.
Unit of capacitances is μF, unless otherwise noted.
Polyester capacitor
Electrolytic capacitor
Polystyrene capacitor
Tantal electrolytic capacitor

3 COIL
Unit of inductance is μH.

4 TEST POINT
Test point position

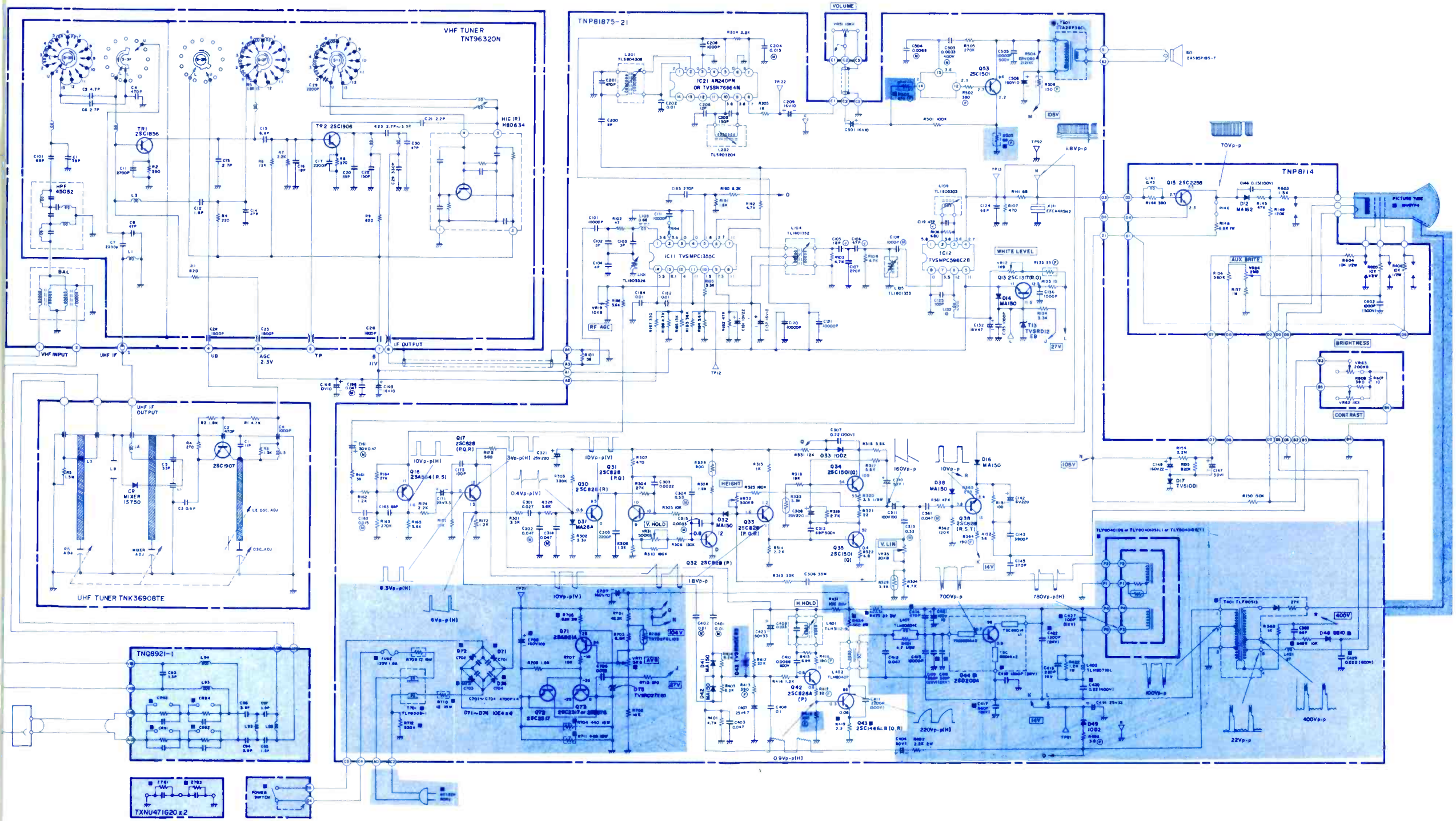
5 VOLTAGE MEASUREMENT
Voltage is measured by a VTVM receiving normal signal, when all controls are set to the maximum position.

6 Number in red circle indicates waveform number.

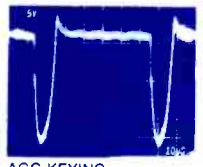
7 When arrow mark (→) is found, connection is easily found along with the direction of an arrow.

8 When schematic diagram of a board is described in more than two places, they are encircled with dotted line (- - - -).

9 This schematic diagram is the latest at the time of printing and subject of change without notice.

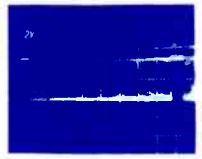


RCA B&W TV Chas KCS205

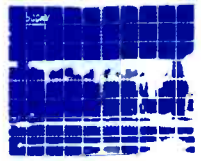


AGC KEYING PULSE
H. RATE 35V P-P
(1)

TP201 4.5 MHz SOUND
V. RATE 2.0V P-P
(2)

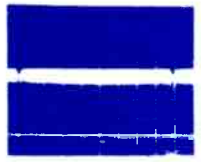


Q408 COLLECTOR
V. RATE 4.7V P-P
(3)

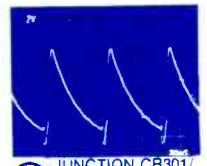


Q408 EMITTER
V. RATE 2.0V P-P
(4)

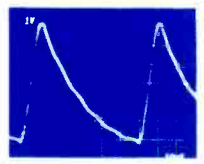
(5) HORIZONTAL SYNC
H. RATE 17V P-P



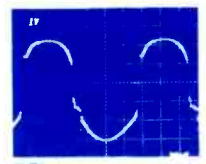
(5) VERTICAL SYNC
V. RATE 17V P-P



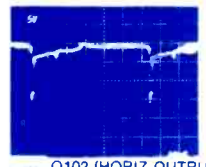
(6) JUNCTION CR301/CR302
H. RATE 10V P-P



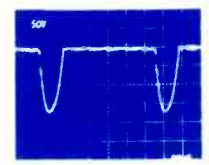
(7) HORIZ FEEDBACK
H. RATE 6.0V P-P



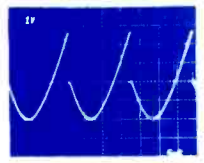
(8) Q301 (HORIZ OSC)
BASE
H. RATE 5.5V P-P



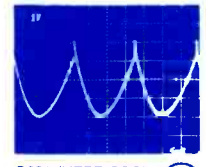
(10) Q102 (HORIZ OUTPUT)
BASE
H. RATE 15V P-P



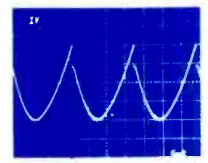
(11) HORIZ PULSE
H. RATE 175V P-P



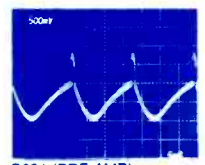
Q601 (VERT OSC)
EMITTER
V. RATE 4.7V P-P
(13)



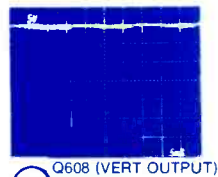
Q601 (VERT OSC)
COLLECTOR
V. RATE 4.0V P-P
(14)



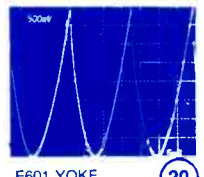
Q603 (PRE AMP)
BASE
V. RATE 4.0V P-P
(16)



Q604 (PRE AMP)
BASE
V. RATE 1.8V P-P
(17)

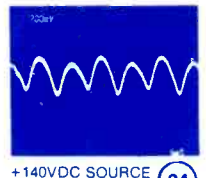


(19) Q608 (VERT OUTPUT)
EMITTER
V. RATE 27V P-P

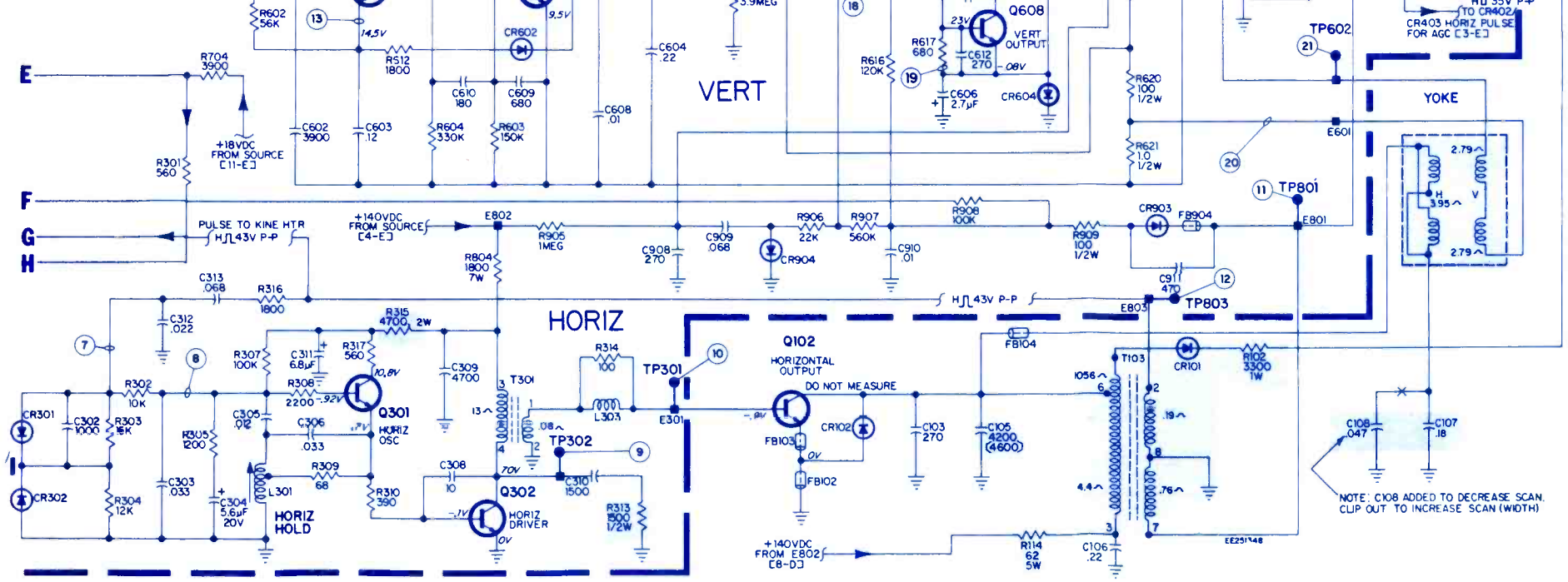


E601 YOKE
V. RATE 4.0V P-P
(20)

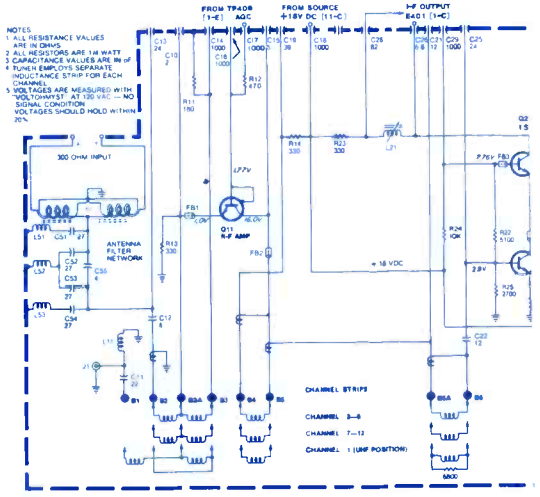
+18VDC SOURCE
V. RATE .125V P-P
(22)



+140VDC SOURCE
V. RATE .5V P-P
(24)



VHF Tuner

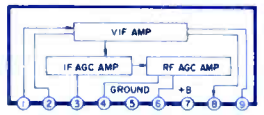


ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

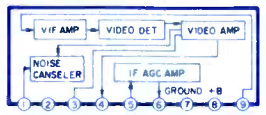
1872
PANASONIC
BW& TV Model
TR5040P

NOVEMBER • 1980

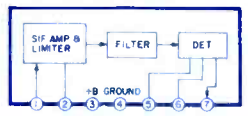
IC11(AN5710) VIF RF AGC



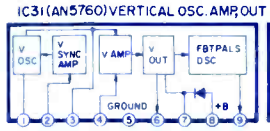
IC12(AN5720) VIF & VIDEO



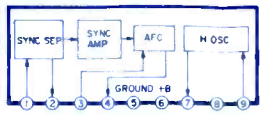
IC21 (AN5730) SOUND



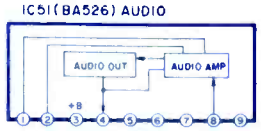
IC31(AN5760)VERTICAL OSC.AMP.OUT



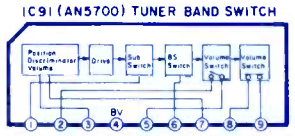
IC41(AN5750) SYNC. HORIZ



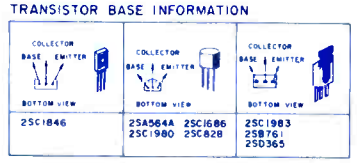
IC51(BA526) AUDIO



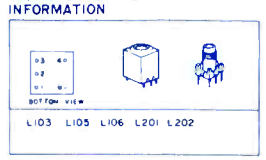
IC91 (AN5700) TUNER BAND SWITCH



TRANSISTOR BASE INFORMATION



TRANSFORMER TERMINAL INFORMATION



IC91 Terminal Voltage

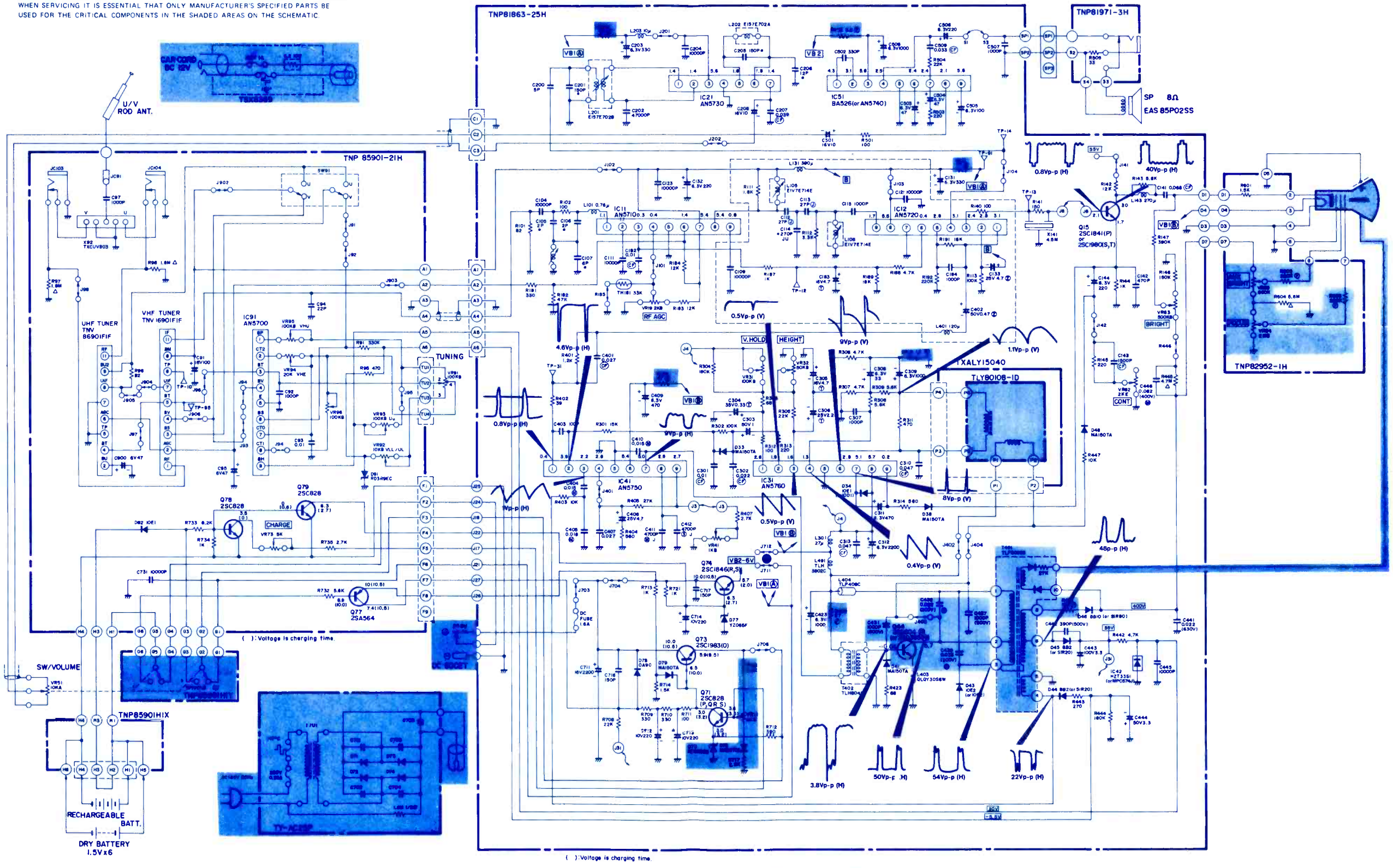
TV Band \ Terminal No	1	2	3	4	5	6	7	8	9
V_L	33	26		5.7	0	−5.1	25	33	33
V_H	33	10.5		5.5	0	4.1	3	3	34
U	24	8		0.2	0	−5.2	7.9	7.8	34

IC91 Terminal No. 3

Channel	2	3	4	5	6	7	8	9	10	11	12	13
V	−5.1	3.3	5.5	11.2	17.4	5.6	7.1	8.5	9.7	11.2	12.9	16.1
Channel	14	20	30	40	50	60	70	80	83			
U	0.6	2.0	4.8	7.8	10.0	12.4	15.0	18.6	20.0			

IMPORTANT SAFETY NOTICE

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



1873

PANASONIC
B&W TV Model
TR779

NOVEMBER • 1980

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

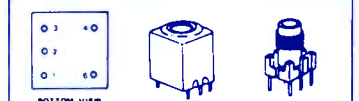
IMPORTANT SAFETY NOTICE

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

NOTE

1. RESISTOR
   All resistors are carbon 1/4W resistor, unless otherwise noted the following marks.
   Unit of resistance is OHM (Ω), (K= 1,000, M= 1,000,000)
   △ : Solid resistor ● : Metal oxide resistor
   □ : Wire wound resistor : Thermistor
   : Fuse resistor
2. CAPACITOR
   All capacitors are ceramic 50V capacitor, unless otherwise noted the following marks.
   Unit of capacitance is μF, unless otherwise noted.
   Ⓜ : Polyester capacitor S : Polystylene capacitor
   : Electrolytic capacitor T : Tantal capacitor
3. COIL
   Unit of Inductance is μH.
4. TEST POINT
   ▽ : Test point position
5. VOLTAGE MEASUREMENT
   Voltage is measured by a volt ohm meter with DC 500K OHM/V receiving normal signal, when all controls are set to the maximum position.
6. Number in red circle indicates waveform number.
7. When arrow mark (↗) is found, connection is easily found along with the direction of an arrow.
8. When schematic diagram of a board is described in more than two places, they are encircled with dotted line (– · –).
9. This schematic diagram is the latest at the time of printing and subject to change without notice.

TRANSFORMER TERMINAL INFORMATION



L106 L108 L109 L201 L202

VHF TUNER TNT9632ON

UHF TUNER TNK3692S1

SW701 TSE80704

TNP85910H1X

TNP85910-21H

TNP82527-21H

TNP81886H1Y

TNP81886H1Z

TNP81886HIX

TLY80334D OR TLY80334A

TNP81886-21H

SP EAS85P02AT 4Ω

IC11 MPC1355C

IC12 MPC596C2

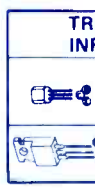
IC31 AN295

IC51 AN355 (4.5MHz)

Q15 2SC1573NC

D38 MA150 or IS2473

TRANSISTOR BASE INFORMATION



2SA564	2SC1318
2SB621ANC	2SC1359
2SC644	2SC1383
2SC828A	2SC1573NC
2SB761	
2SC1983	
2SD772B	

( ) : Voltage is charging time.

ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

1874
Zenith
B&W TV Chassis
22LB2X

NOVEMBER • 1980

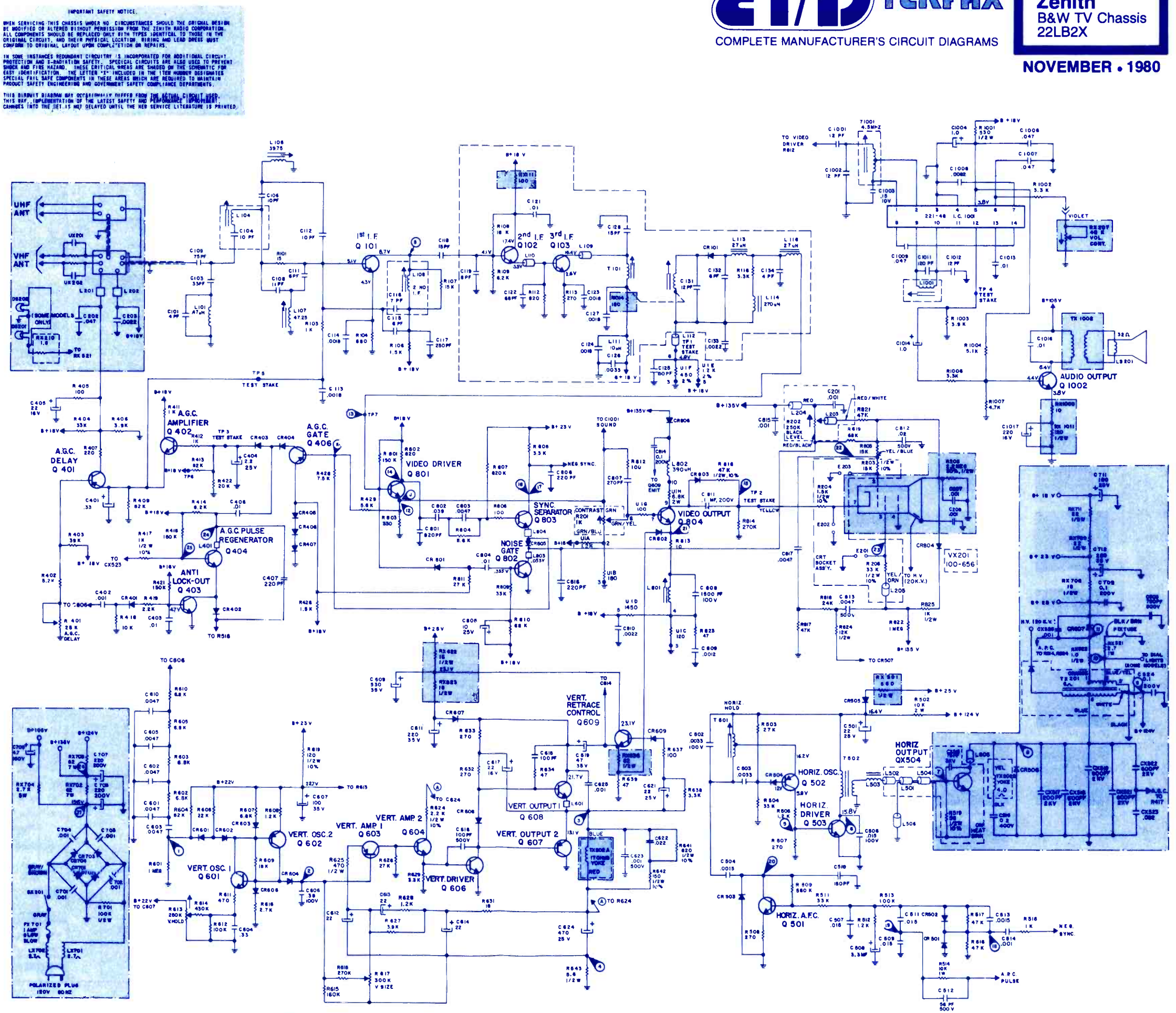
IMPORTANT SAFETY NOTICE.

WHEN SERVICING THIS CHASSIS UNDER NO CIRCUMSTANCES SHOULD THE ORIGINAL DESIGN BE MODIFIED OR ALTERED WITHOUT PERMISSION FROM THE ZENITH RADIO CORPORATION. ALL COMPONENTS SHOULD BE REPLACED ONLY WITH TYPES IDENTICAL TO THOSE IN THE ORIGINAL CIRCUIT, AND THEIR PHYSICAL LOCATION, WIRING AND LEAD DRESS MUST CONFORM TO ORIGINAL LAYOUT UPON COMPLETION OR REPAIRS.

IN SOME INSTANCES REDUNDANT CIRCUITRY IS INCORPORATED FOR ADDITIONAL CIRCUIT PROTECTION AND X-RADIATION SAFETY. SPECICAL CIRCUITS ARE ALSO USED TO PREVENT SHOCK AND FIRE HAZARD. THESE CRITICAL AREAS ARE SHADED ON THE SCHEMATIC FOR EASY IDENTIFICATION. THE LETTER "X" INCLUDED IN THE ITEM NUMBER DESIGNATES SPECIAL FAIL SAFE COMPONENTS IN THESE AREAS WHICH ARE REQUIRED TO MAINTAIN PRODUCT SAFETY ENGINEERING AND GOVERNMENT SAFETY COMPLIANCE DEPARTMENTS.

THIS CIRCUIT DIAGRAM MAY OCCASIONALLY DIFFER FROM THE ACTUAL CIRCUIT USED. THIS MAY BE DUE TO IMPLEMENTATION OF THE LATEST SAFETY AND PERFORMANCE IMPROVEMENT CHANGES INTO THE SET. IS NOT DELAYED UNTIL THE NEW SERVICE LITERATURE IS PRINTED.

1. 6.7V P-P 60Hz
2. 6.4V P-P 60Hz
3. 46V P-P 60Hz
4. 3.8V P-P 60Hz
5. 0.8V P-P 15.75kHz
6. 38V P-P 15.75kHz
7. 21V P-P 15.75kHz
8. 960V P-P 15.75kHz
9. 28V P-P 15.75kHz
10. 44V P-P 15.75kHz
11. 210V P-P 15.75kHz
12. 2.8V P-P 60Hz
13. 2.8V P-P 60Hz
14. 8V P-P 60Hz
15. 125V P-P 60Hz
16. 22.5V P-P 60Hz
17. 22.5V P-P 15.75kHz
18. 8V P-P 15.75kHz
19. 11V P-P 15.75kHz
20. 12V P-P 15.75kHz
21. 12V P-P 60Hz
22. 2.8V P-P 60Hz
23. 80V P-P 60Hz
24. 125V P-P 15.75kHz
25. 16V P-P 15.75kHz
26. 600mV P-P 60Hz
27. 6V P-P 60Hz



1875

SYLVANIA
B&W TV Chassis
A19-24

NOVEMBER • 1980

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

ALL TUNERS ARE INTERNAL VIEWS & HAVE TRANSISTORS SOLDERED

UHF - 54-41450-4

VHF 54-50398-2

Q1	13-10321-73	RF
Q2	13-10321-91	MIXER
Q3	13-10321-91	OSC

ALT. UHF-54-41528-2 Q1 UHF OSC 13-10321-91

Chassis Transistor Layout

CAUTION—FOR CONTINUED PROTECTION AGAINST FIRE HAZARD, REPLACE WITH SAME TYPE 1.5A 125V SLO-BLO FUSE.

— IMPORTANT —
DO NOT REMOVE OR INSERT TRANSISTORS OR IC'S WITH POWER APPLIED

REPLACE ALL TRANSISTORS WITH ORIGINAL TYPE ONLY

TRANSISTOR ELEMENT LEADS
B-BASE C-COLLECTOR D-DRAIN
E-EMITTER G-GATE S-SOURCE

PIX TUBE 19VBNP4 OR 19VFUP4 OR 19VGXP4

VHF Tuner Schematic Diagram

NOTES:
1. ALL CAPACITORS ARE IN MICROFARADS.
2. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
3. ALL SWITCHES ARE SHOWN IN THE CHANNEL 13 POSITION
4. ARROWS ON SWITCHES INDICATE DIRECTION OF ROTATION SHOWN IN SEQUENCE OF THE FRONT WITH REAR SECTIONS
5. ALL VOLTAGES ARE TAKEN WITH NO SIGNAL APPLIED, MEASURED FROM GROUND WITH A VTVM +5V DC WAS APPLIED TO AGC TEST POINT

BOTTOM VIEW BASINGS

NOTES:
1- ALL CAPACITORS ARE IN MFD, 500V UNLESS OTHERWISE SPECIFIED.
2- ALL RESISTORS ARE 1/4WATT, 10% UNLESS OTHERWISE SPECIFIED.
3- ARROWS ON CONTROLS INDICATE DIRECTION OF CLOCKWISE ROTATION.
4- SQUARE WIRE PINS (X) ARE TEST POINTS AND WIRE WRAP CONNECTIONS.
5- SCHEMATIC SYMBOLS (V) ARE TEST POINTS.
6- SCHEMATIC SYMBOLS (3) ARE WAVEFORM TEST POINTS.
(S) - CRITICAL SAFETY COMPONENT.

— BOTTOM VIEW TRANSISTOR BASINGS —

NOTE:
ARROWS DESIGNATING POINTS NOT CONNECTED - POINT IN THE DIRECTION OF THE COMPONENT OR TIE POINT WHERE THEY ARE TO BE CONNECTED.

EXAMPLE:

* HORIZONTAL HOLD CONTROL MUST BE PROPERLY ADJUSTED.

WAVEFORMS

1	2 VPP Vert.	2	60 VPP Vert.
3	* 5 VPP Horiz.	4	1.9 VPP Vert.
5	4.5 VPP Vert.	6	1.2 VPP Vert.
7	70 VPP Horiz.	8	2.5 VPP Vert.
8	.4 VPP Vert.	10	.7 VPP Vert.
11	.7 VPP Vert.	12	42 VPP Vert.
13	43 VPP Vert.	14	30 VPP Vert.
15	30 VPP Horiz.	16	8 VPP Horiz.
17	19 VPP Horiz.	18	8 VPP Horiz.
19	9 VPP Horiz.	20	170 VPP Horiz.
21	4.8 VPP Horiz.	22	Depends on amount of sweeping
23	3 VPP Vert.	24	.1 VPP Vert.
25	23 VPP Vert.	26	9 VPP Vert.
27	22 VPP Horiz.		

Good news for you and your customers. NESDA/ISCET rates RCA serviceability:

'Excellent'

"The RCA CTC 108 and CTC 109 chassis have earned the highest possible serviceability rating category... <u>Excellent</u>... by incorporating serviceability features required in the ISCET Serviceability Rating Form.

"RCA's many years of cooperation with ISCET's Serviceability Committee has helped produce excellent results."

—Dean R. Mock, Chairman, NESDA/ ISCET Serviceability Committee

ISCET's 92% (CTC 108) and 93% (CTC 109) ratings were good news to us. Because they mean that some of the most demanding critics in the industry agree that we've succeeded in designing chassis that not only give your customers a first rate picture, but are easy to repair too. Here are some reasons why they think so:

All subassemblies plug into chassis. No tools are needed to remove chassis (main circuit board). Just remove the cabinet back, unplug subassemblies and the chassis is ready for removal.

Roadmapping on both sides of the board. Although the XL-100 chassis use single-sided circuit boards, double road-mapping means you can easily trace circuits from either side.

Circuits and voltages directly identified. Major circuit areas as well as power supply source and key pulse voltages are labeled by name on the board. So you can find them fast.

That all means that when you do have to repair our new XL-100 chassis, in most cases you can fix them quickly and easily.

And you won't have to waste your valuable time trying to find out where to go to fix what you already know is wrong.

Because to us that's what really counts. Making your job easier and your customers happier.

RCA

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