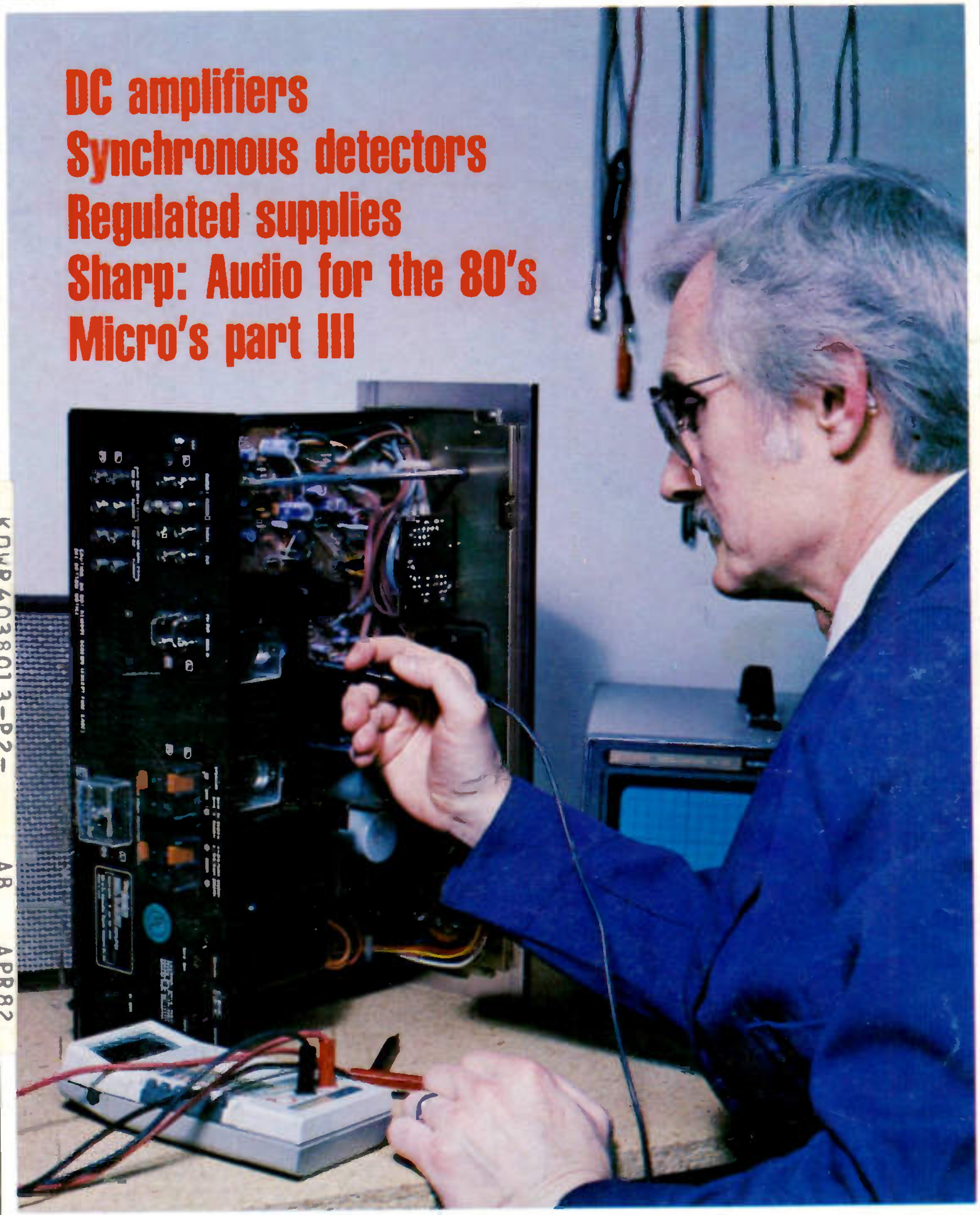
ET/D

JANUARY 1980 • $1.00

ELECTRONIC TECHNICIAN/DEALER

LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS



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INDUSTRY REPORT

Winter CES is Sellout

Anyone with doubts about the strength and dollar potential of the U.S. consumer electronics market might be interested to note that this year's Winter Consumer Electronics Show (CES) was a complete "sellout" as of early October.

The show, scheduled this year to run from Saturday January 5 through Tuesday January 8th, has attracted more than 750 exhibitors who will take up all the space at Las Vegas' Convention Center complex, the show facilities at the Las Vegas Hilton Hotel, and the Jockey Club—located crosstown from the other two facilities.

The winter show last year for the first time drew over 50,000 attendees and no doubt will repeat this year with even more expected. This year also, the National Association of Retail Dealers of America (NARDA) will hold their annual convention in Las Vegas beginning January 8.

Special events scheduled thus far include a retail merchandising exhibition for display of superior programs in retail print advertising, direct mail, and radio and television advertising. Special seminars on marketing prospects in 1980 in all areas of consumer electronics are scheduled during the five days of the convention/exhibition.

Zenith Introduces New Stereo Components; Raises TV Prices

Zenith Radio Corporation has unveiled a new integrated stereo system as part of its 1980 line. The new system, Model IS4090, provides 15 watts per channel at eight ohms and is said to carry a bandwidth of 40-to-20,000 Hz.

Total harmonic distortion, Zenith says, is less than .5 per cent. Features of the new tuner-amplifier-phono unit, which carries front-load cassette tape player/recorder, includes tuned RF on FM; high and low filters; automatic frequency control; FM mute; mono/stereo switch; and function indicator light emitting diodes.

Zenith reports the new integrated stereo system, with a suggested retail of $500 with speakers, compliments their six current Series I and Series II integrated systems, which range in price from $290 to $500.

Also in the consumer electronics field, Zenith—which raised color TV prices $10 across the board as of December 1—now says another price hike is in line "to recover a portion of the double digit inflationary cost increases the company has absorbed in the last several months.

"Combined, the effect of the two color TV price moves will increase color television revenue at the factory level about 2.5 per cent, with a more modest increase planned for most black and white TV models," Zenith said.

Zenith said 1979 is expected to be its best color TV year in history in terms of units sold, while on an industry-wide basis 1979 should be the second best color TV period.

Microwave Oven Sales to Reach 3-Million

Litton Microwave Cooking Products, a manufacturer of microwave ovens, says previous sales forecasts for the microwave industry for 1979 appear to be too low and sales will exceed previous expectations by some 25 per cent.

Litton previously had forecast industrywide sales for 1979 at the 2.4 million units mark. However, actual experience during the first 10 months of the year have caused analysts to revise that forecast to at least 3-million units by year's end.

According to Litton President Wayne Bledsoe, Litton's third quarter sales were 26 per cent above last year. "We believe the momentum continues in spite of gloomy economic predictions because consumers are attracted by the energy saving potential and the flexibility of home cooked meals quickly."

Christian Broadcasting is Nation's Largest Satellite Broadcaster

Television Digest, a trade publication for the commercial broadcasting industry, reports that the Christian Broadcasting Network (CBN), with an estimated 6.2 million viewing outlets, is reported to be the largest satellite programmer.

Reporting on a survey of satellite distributed programming, the publication said CBN emerged a step ahead of Ted Tuner's WTBS which captured an estimated 6.1 outlets. The largest pay-cable satellite broadcaster was reported to be Home Box Office, which did not—at 3 million viewing outlets—even match 50 per cent of the viewing audience of the first two largest satellite broadcast distributors.

According to *Television Digest*, other satellite broadcasters, and the estimated number of American homes which they serve were: C-SPAN, 5 million; ESPN, 4.2 million; Trinity, 2.5 million; Modern Talking Pictures, 2.1 million; Thursday Baseball, 2 million; and PTL, 1.5 million.

ETA-I Announces Business Evaluation Service

The Electronic Technicians Association - International (ETA-I) has announced a new service for both members and non-members. According to ETA-I, the association is prepared to "run" com-

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On the cover: The DC coupled power amplifier is the subject of our lead story this month. The high power ratings of these devices and their associated circuitry require special handling to avoid what can turn out to be some embarrassing moments on the service bench.

FEATURES

DEPARTMENTS

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2SC1308K Sanyo Horizontal Output Transistor Equivalent to ECG 238

(ECG is a registered trade mark of the Sylvania Corp.)

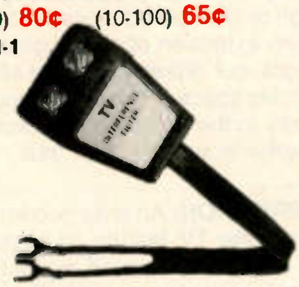
2.45

Minimum order of 10

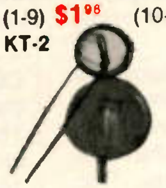
Stock up on these popular TV parts while prices are low!

Sony Trinitron Dual Antenna
Sony AN16
(1-9) **$7.40** (10-100) **$6.80**
MAN-16

TV Interference Filter
(1-9) **80¢** (10-100) **65¢**
TVI-1

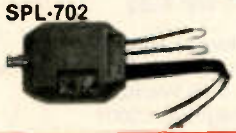


Universal Globar Resistor Kit
2 Universal Globars for color TV automatic degauss circuit. Contains a thermistor and a varistor. Fits many famous make color TV's
(1-9) **$1.96** (10-100) **$1.85**
KT-2



UHF/VHF/FM Splitters
300 OHM
(1-9) **$1.39** (10-100) **$1.19**
SPL-701

75 Ohm
(1-9) **$1.45** (10-100) **$1.30**
SPL-702



75 Ohm to 300 Ohm Converter
(1-9) **65¢** (10-20) **55¢**
TVT-1

F-59 Connectors with Ferule
14¢ ea.
(on minimum order of 100)

High Voltage Tripler
Equivalent to ECG-500A
(1-9) **$12.40** (10-100) **$11.80**
HVT-500A

There just isn't enough room . . .

Limited space prevents the listing of the many hundreds of TV & Stereo parts we stock. This page contains just a few of the low, low priced replacement parts we keep in our huge inventory, **at the lowest prices you'll ever find!** For our complete parts listing, call our toll-free number listed below, or write for our free 24-page catalog.

Tube Number	10-up	1-9	Tube Number	10-up	1-9	Tube Number	10-up	1-9
1V2	.95	1.10	6EL4	2.75	3.15	8AW8	2.45	2.65
2AV2	1.15	1.35	6FQ5	2.15	2.35	8FQ7	1.10	1.25
3A3	1.50	1.70	6FQ7/ECG7	1.15	1.30	8CG7	1.10	1.25
3AW3	1.50	1.70	6GF7A	1.95	2.25	12AU7A/ECC82	1.15	1.30
3CY3	1.60	1.85	6GH8A	1.15	1.35	12AV6	1.10	1.25
3DB3	1.60	1.85	6GM6	1.55	1.80	12AX7/ECC83	1.15	1.30
3HA5	1.40	1.60	6GU7	1.55	1.80	12GN7	2.10	2.35
3HM5	1.40	1.60	6HA5	1.45	1.60	12HG7	2.10	2.35
5GH8A	1.75	1.95	6HB7	1.45	1.60	13GF7A	1.95	2.20
5U4	1.20	1.40	6HM5	1.45	1.60	17BF11	2.85	3.10
6AQ5	1.20	1.40	6J10	2.30	2.60	17JZ8	1.60	1.85
6AU6	1.20	1.40	6JE6	3.10	3.50	24JE6	3.05	3.95
6AW8A	1.60	1.90	6JS6	2.80	3.10	24LQ6	3.05	3.45
6BA11	1.85	2.05	6KD6	3.20	3.60	31JS6	2.75	3.10
6BK4	2.75	3.15	6L6GC	2.30	2.60	33GY7	2.45	2.80
6BL8/ECF80	1.05	1.20	6LB6	3.00	3.45	38HE7	2.80	3.15
6CJ3	1.40	1.60	6LQ6	3.10	3.50	38HK7	2.75	3.10
6DW4	1.40	1.60	6MD8	2.20	2.50	40KD6/36KD6	3.15	3.55
6EJ7/EF184	1.40	1.60	6Z10	2.30	2.60	50C5	1.15	1.30

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parative business analysis of a service business establishment to allow the owner to compare the profitability of his operation with the profitability of comparable operations.

An ETA-I statement said the audit, called Management Success Institute, is essentially a one-time financial and operational audit of the service business under study. It is conducted in a confidentail manner, primarily by mail and telephone, and is aimed primarily at service establishments with from one to 10 employes.

The service, ETA-I reports, is available to members for $50 and $75 for nonmembers. Further information is available from ETA-I, 7046 Doris Dr., Indianapolis, Ind., 46224.

Midcon Show Attendance Increase

More than 17,000 electronics professionals attended the second Midcon show held in Chicago last November. Compared with two years ago, the last time the show was held in Chicago, attendance was almost three times greater.

Midcon, a high technology show, for engineers and technicians interested in the latest developments in technology in electronics instrumentation, alternates between Chicago and Dallas, Tex. Midcon/80 is scheduled for Dallas next Nov. 4-6.

According to Midcon officials, the 1970 Chicago show hosted more than 300 exhibitors plus some 30 technical program sessions on various aspects of electronics technology ranging from space satellites computer systems.

National to Second Source Motorola VLSI Array

Motorola and National Semiconductor have announced an agreement under which National will manufacture and distribute bipolar VLSI circuits derived from the Motorola Macrocell Array.

According to spokesmen for the corporations, National plans to go into early production of the chip for its own computer production lines and will also take orders from external sources.

The Macrocell Array is a subnanosecond, high density (about 12,000 transistors per chip) ECL array built through oxide isolated process. It is said to be an extension of earlier gate array concepts, but represents more efficient use of chip space while maintaining user flexibility in the placement of circuit arrays within a specific chip. ET/D

CORRECTION: An error occurred in the satellite TV feature on page 20. The maximum received signal level should have been -160dBw, i.e. 160dB below 1 watt, not a meaningless -1600Bw as printed.

ET/D

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NEWSLINE

RCA MAKES VIDEO DISC MOVE. RCA President Edgar Griffiths has announced that the RCA capacitance pickup video disc system will be marketed in every major U.S. city for under $500 sometime during 1981. Griffiths told distributors it is the start of an annual $7.5 billion industry.

GE TV SALES SURGE. General Electric reports 1979 estimated color TV sales of over one million is its most successful effort in 32 years and clearly marks the company as the nation's third largest TV producer. In announcing GE's results, a spokesman said the television replacement market now constitutes 60 per cent of all sales.

TV's CABLE SEGMENT GROWS. Television Digest reports there are now 4,044 cable television systems operating in the United States and they serve over 10,000 communities. By comparison there are 1,010 television stations on the air...515 of them are commercial VHF and 218 commercial UHF.

HOME EARTH STATION PROJECT UNDERWAY. Tele-Communications, Incorporated, a pay TV and cable operator, is reportedly now marketing home earth station systems. The primary target is affluent farm families. The basic charges are $3,000 installation and $150 a month rental on system.

HEWLETT-PACKARD TO ENTER PERSONAL COMPUTER MARKET. Hewlett-Packard is expected to announce shortly its entry into the personal computer market. The huge electronics firm is said to be readying a $3,200 unit to rival Radio Shack's $3,400 TRS 80 with Level II BASIC.

RCA MAKES 100 MILLIONTH TV PICTURE TUBE. RCA says it has manufactured its 100 millionth television picture tube making it the first manufacturer to reach that milestone. Regarding color picture tubes, RCA says the annual world-wide market is 32 million and will expand to 37 million by 1984.

COMPUTER "SOFTWARE" MARKET EXPANDS RAPIDLY. Frost and Sullivan, marketing research analysts, reports the small business computer software market--now running at a $241 million a year level -- will expand to $700 million annually by 1988. F&S says the microcomputer level holds the biggest potential accounting for 78 per cent of the potential market (in units).

NAMES IN THE NEWS...Arnold Valencia, formerly President of RCA Sales Corporation, has been elected EVP of Marketing Operations and President of RCA Distributing Corporation. As EVP he succeeds Jack Sauter who becomes Chairman of the Board. R. Eugene Eddy continues as Vice President of Warranty Programs and Training...

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: $129 for the 8022A, $169 for the 8020A and $199 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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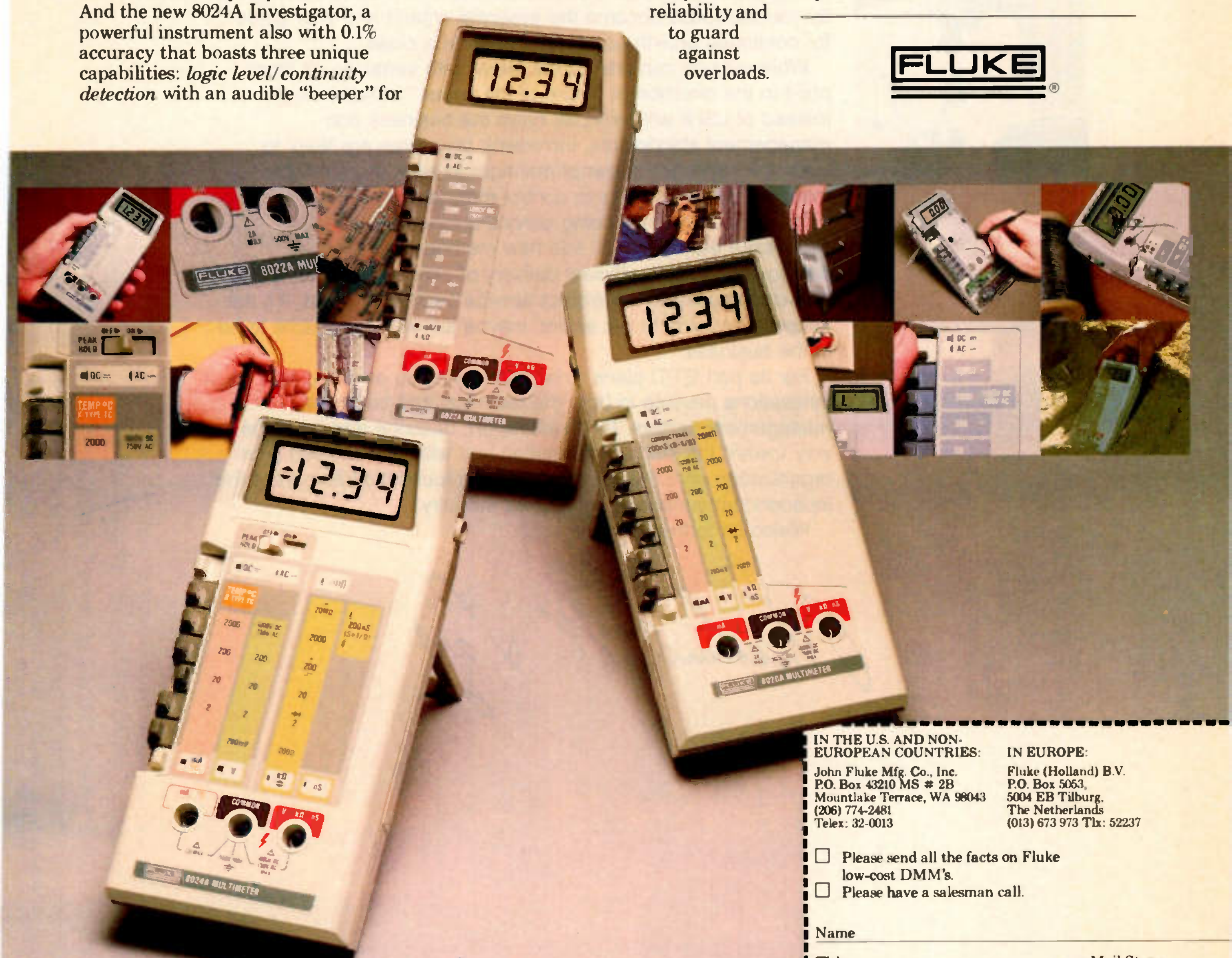

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☐ Please have a salesman call.

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Company
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City State Zip
Telephone ( ) Ext.

For technical data circle no. 112. ETD 1/8

FROM THE EDITOR'S DESK

Welcome to the new decade!

If you managed to survive the '70s—and you did if you kept pace with the fast moving technologies in both electronics and business—you are positioned for what I personally believe will be one of the most awsome explosions in the history of consumer electronics from the standpoint of sheer numbers of products in the field.

The 1970s set the stage, of course. Not only integrated circuits, but large scale integration entered the consumer products which you service and brought you swiftly into the age of digital/computer technologies, *overnight*.

More reliably built television receivers made the astute serviceshop seek—and find—other outlets of electronics service to supplement and add to diminishing revenues from the TV side. Modern business management techniques were adopted by the aggressive, profit oriented consumer electronics organizations across the United States. No longer was it feasible to manage through intuition. The hard, cold statistical information generated by your business became the essential criteria and your guide for continued growth as the '70s drew to a close.

While no one can predict the future with certainty, all signs point in the direction of "more of the same." In technology, instead of LSI it will be VLSI. From the business and management standpoints, increasing pressures are likely to force the serviceshop owner/manager to seek more reliable measurement yardsticks to control more precisely the profitability of the expanding service business.

I believe the 1980s will see new methods and systems developed for more efficient delivery of service in the consumer and small business electronics service sectors. In short, it's not necessarily going to get easier..maybe just more profitable to be in the business.

For its part ET/D plans to be there with you as these new innovations develop in both the technical and business management sectors. ET/D will report, describe and point the way toward the kind of information you will need to keep your organization on a steady, profit making foundation as part of the independent consumer electronics industry.

Welcome to the 80's.

Richard W. Lay

FUJI VIDEO HEAD CLEANING CASSETTE
VCL-30
CASSETTE
VHS
FUJI

STRICTLY BUSINESS

Thomas Jefferson taught us that there are certain truths that are self evident. That is, so true that any fool can plainly see them. If Mr. Jefferson were among us now, we wonder, would he hold the following truths to be self evident:

THAT...it is the manufacturer who offers the warranty. It is the manufacturer who is making the promise to his customer. And the reason he is making the promise is to improve his position in the marketplace. Simply, he is trying to sell more product.

THAT...as the manufacturer has made the promise...and the manufacturer has enjoyed the benefits of having made the promise...then the manufacturer should pay for the keeping of the promise.

THAT...in the great majority of cases it is not the manufacturer who keeps the promise, but rather it is some retail company or retail service department which goes to the customer and performs the service, thus protecting the manufacturer's fair name in the marketplace.

THAT...in all too many cases, the retail servicer who is keeping the promise for the manufacturer, is not being properly compensated for the technician's time spent to keep that promise (that is, not being paid his own going rate).

THAT...in practically all cases, he is keeping the promise by using parts from his own stock, parts he has paid for and parts which he has spent money to keep on hand, and for which he gets no payment except an exchange at some indeterminate future date.

THAT...the manufacturer has made a promise which he keeps only in part, and the retailer has not made a promise but must bear the financial responsibility for keeping the promise.

One thing we are very sure of. Due to the nature of the American language in the 18th century, Mr. Jefferson would not have referred to this situation as "dirty pool." But many of us in the 20th century most certainly do.

John Gooley

Mgr., NARDA's Service Division

If you don't see your kind of electronic pliers here,
look again,
Xcelite® makes them all.
Xcelite, long acknowledged as the world's first family of electronic hand tools, now includes a greatly expanded line of solid joint pliers and cutters. All the pliers you'll ever need, and more. Because new designs are continually added as new electronic products are born.
The present range extends through 38 patterns and sizes including 13 new models for miniature electronics. Made in U.S.A. by the latest technology and quality controls, in one of the world's most modern electronic hand tools plants, Xcelite pliers set the standards for the industry. Yet the same advanced production techniques make them competitively priced.
Typical of the features that single out Xcelite quality are coil spring openers, polished heads, cleanly milled and perfectly aligned jaws, hand-honed and mated cutting edges, exceptional strength and performance provided by forged alloy steel construction, precision machining and scientific proportioning. Handles are designed for maximum leverage and convenience, with plastic coated "Cushion-Grip" for added comfort.
Styles? What else could you possibly need: standard, midget, and taper nose diagonals; standard, very fine and extra thin needle nose; long and short nose; long, short and midget chain nose, with and without side cutters; side cutting; short flat nose; round nose; tip cutter wiring; cutting and looping; short nose tip cutting; thin bent nose; midget semi and full flush cutting; diagonal full flush cutting; and stainless diagonal cutting.
You don't know what you can do with pliers until you know what Xcelite pliers can do for you. See your distributor and let him update you.
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Circle No. 109 on Reader Inquiry Card

LETTERS

FROM AN IRATE INDEPENDENT:
Dear Fellow Dealer:
I am sure by now we have all felt the competitive pressures in retailing home entertainment products. In some recent instances, we have seen this type of merchandise retailed lower than distributor prices that are sold to the independent dealers.

How long are we expected to stand idly by and try to compete with mass merchandisers, buying groups, oil companies, discount and discount catalogue stores, when they are able to purchase products and sell lower than what we purchase these products for.

I believe this market deterioration came about with the demise of fair trade, a network of independent dealers willing to back-up the manufacturer's warranty programs, unrealistic franchises, unfair manufacturer representation and distribution of their products.

The hand-writing is on the wall, the time has come when the independent dealers must band together for reform in this industry or face the inevitable demise of many of us. We must work together with people in our industry and also in associated industries that face these same problems to keep independent business alive and growing in our country. In our industry we must insist on better representation from manufacturers, their representatives and distributors, better franchising and competitive prices that will allow us to compete. The manufacturers cannot have their cake and eat it, too. Those who refuse to recognize us and our needs, should not be recognized by us, the independent dealer.

We should seek out those manufacturers and distributors that are willing to work with us and represent their products. It is a fact that without the independent dealers' support and knowledge, the home entertainment industry would not have gotten near what it is today.

It is not too late–the future is before us, the home entertainment products of the eighties will be unsurpassed by anything that we've seen, we will be called upon again to promote, install and back up these products with our servicing people.

We must work together to overcome deterioration of independent business. Call upon your associates, your association, distributors, manufacturers, and their representatives and put an end to unfair competition.

Very truly yours,
Nick Grasso
Melody Radio and TV
2163 Polk St.
San Francisco, CA 94109

P.S. Enclosed is a copy of our warranty policy that we recently enacted in our store. It is self-explanatory. We will no longer be a tool for unfair competition and unfair manufacturers. Since this sign has been posted, our sales have increased.

WARRANTY POLICY

All warranted merchandise not purchased at this store, or associated member stores will be charged a warranty handling charge.

Merchandise that is not a current model, damaged, purchased as is, or from a discount store, or a non-franchised dealer will not be accepted at this store. No merchandise will be accepted under warranty without a copy of bill of sale.

TEKFAX:
I would like to obtain the following volumes of TEKFAX: 100, 1, 2, 3, 4, 5, 6, 7, 8 and 9.
Luis Pena, Eng.
P.O. Box 954
Montevideo, Uruguay

I have TEKFAX from 1 through 1300 for sale to anyone who wishes to make an offer.
Alan Iverson
333 Church St.
Albion, NE 68620

THANKS:
I would like to thank all replies to my needs. The first two letters filled my request. Thanks again.
D&R TV
1004 Commercial
Jensen Beach, FL 33457

EDITOR: We are very pleased that your request got you the help you needed. We welcome all letters for assistance in obtaining obsolete parts or information as well as comments on the state of the industry, etc. Send them to ET/D, Managing Editor, 1 East First St., Duluth, MN 55802.

HELP NEEDED:
I would like to ask if anyone knows who the distributors are for Cariole. I have a unit which needs a power transformer. It has no model number but has a code number 19228 and a number HPT-OK which could be a chassis number.
Jims Radio & TV
8408 Maymeadow Ct
Baltimore, MD 2120

I am enjoying your magazine and would like to see more articles about TV repair and articles on antique radios. Please put this request in your Letters column. Needed: a power transformer for an old Zenith radio model 210/220/221.
Richard Sanderford
6400 Andy Dr.
Raleigh, NC 27610

I am in need of service data or information on a 100 watt adjustable power supply (12V CB type) manufactured under the name of "Power Plus" Super Star Power Base 100, sold by Communication Modification Inc. Anyone please?
Mel Hinton
5309 E. Consul Ave.
Las Vegas, NV 89122

We need a vertical output transformer for a Webcor Model TV 5018. Webcor is out of business. The part has a Sanyo number TW39 on it. Does anyone have it?
Delman Television Company
651 East Park Ave.
Long Beach, NY 11561
(561) 432-7373

SERVICE SEMINAR

INDUCTIVE AUDIO PROBE

If you have ever had to tear down a tape deck to see if the erase oscillator was running or dropping out, this little gimmick may be of interest to you.

Secure an erase head from a junk cassette and attach it to the end of a ten inch piece of coat hanger. Then use a 2 or 3 foot length of audio cable to connect the "sample head" to your scope. To test the erase or bias, place the sampler close to the play or erase head in the equipment under test. If the response on the scope collapses or the gain changes, you have a little more insight to the problem and you haven't even taken a screw out of the unit yet.

Some tape deck calibration procedures call for a bias oscillator frequency check and/or an adjustment before setting the bias traps, (and the record bias) which is easily done by connecting a frequency counter to the vertical output of the scope (or if a scope is not available, connect directly into the frequency counter). This can often avoid a very difficult circuit connection.

This probe can also be used as a "signal sniffer" at the oscillator coil. In addition, it is great for injecting signals into the playback head. Simply connect the probe into the headphone jack of a bench amplifier. This is a good test of playback electronics when there are problems with the tape transport. The same technique can be used to check out the condition of a head that has not been installed in a machine. As well as being a condition check, it will help determine the phase of the winding terminals. Courtesy of Lee Handley and Mike Hardwick and the *Pacific Northwest Electronic News*.

MAGNAVOX

T809/815 Color TV Chassis—Purity Adjustment Procedure

1. Remove the cabinet back, turn the receiver on and allow a few minutes for warmup.
2. Degauss the entire instrument and check Center Static Convergence.
3. Unplug the IF Cable from the IF Module to obtain a blank raster.
4. Turn the Red Background control maximum CW and the Green and Blue Background controls maximum CCW.
5. Loosen the four yoke positioning screws located on the yoke mounting ring until their rounded tips just protrude through the yoke mounting ring. This will allow maximum movement of the yoke toward the bell of the CRT.
6. Loosen the yoke mounting clamp and push the yoke *forward* until it touches the CRT. Turn the purity magnet knob to center the red portion of the screen.
7. Slide the deflection yoke back until a completely red raster is *just barely* obtained. The yoke must be at the extreme forward edge of its purity range. If necessary, readjust the purity magnet knob slightly until a pure field is obtained with the yoke as far forward as possible.
8. Plug the IF cable back into the IF module and apply a crosshatch pattern. Rotate the yoke, if necessary, to obtain a level raster.
9. Tighten the yoke mounting clamp *as tightly as possible*

by hand. Do not fear overtightening. This clamp must be tight!

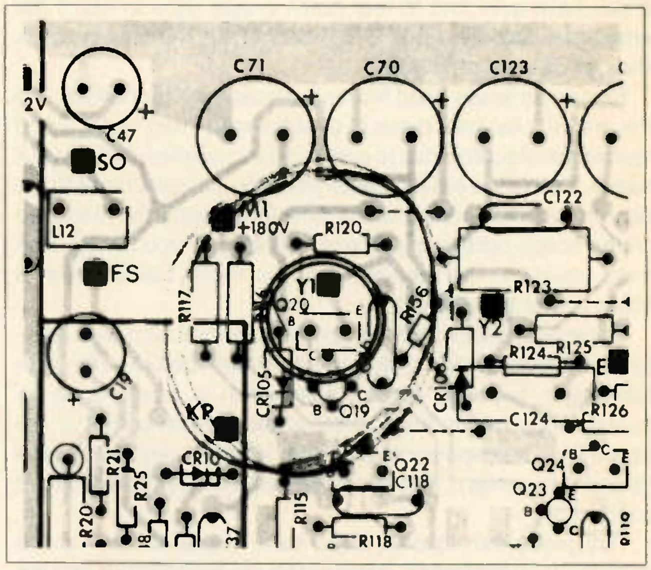
10. Refer to the adjustment procedures in the Service Manual to perform the White Balance, Static Center, and Edge Convergence adjustments.

NOTE: Edge Convergence requires adjustment of the yoke positioning screws and should be performed so minimum back pressure is exerted on the yoke by these screws. The four yoke positioning screws should not be tightened to the point of placing pressure on the deflection yoke. All four screws should start out in the backed off position (per step 5). There are 2 screws used to converge the vertical lines. The screw at the top of the yoke ring and the screw at the bottom. Only one of these screws will need to be adjusted to obtain edge convergence. For example, if the screw at 12 o'clock is adjusted to rotate the red vertical lines CW and the blue vertical lines CCW, then the screw at 6 o'clock will only need to be tightened until it *just* touches the bell of the tube. Likewise, only the screw at 3 o'clock *or* the screw at 9 o'clock will need be adjusted for edge convergence.

T815 Color TV Chassis—Broken Picture Tube Replacement If you encounter a picture tube that is broken in the neck area, proceed as follows so the replacement tube will not be damaged in the event of a chassis fault.

1. Replace picture tube, but *do not connect* CRT socket board.
2. Disconnect CRT focus leads at tripler.
3. Turn on set and measure each of the RGB output collector voltages at W3, W4, and W5 of the CRT Board. They should be about +180V. Measure the vertical output DC voltage at pin 5 of the yoke plug on the pincushion module. This voltage should be 0V ± 3V.
4. If the vertical output or any of the RGB circuits do not check OK, the fault must be corrected prior to energizing the new picture tube.

RCA



CTC 97/96—Q3020 (Vertical Retrace Switch) lead identification. Vertical retrace switch transistor Q3020 emitter and base leads are identified incorrectly in early production. The top and bottom "road maps" have the B&E designations reversed. This has been corrected in later production. Service data 1979 C-1 is reversed; 1979 C-5 is correct. ETD

Circle No. 122 on Reader Inquiry Card

High power DC audio amplifier repair

How to stay out of trouble

High power audio amplifiers frighten many technicians. Trouble seems to compound itself all too easily when servicing them. Here are rules and procedures to keep you out of trouble.

By James Sims, CET

In the past several years, and in ever increasing numbers, the high powered dc coupled amplifier has been accepted for uses ranging from the home audio system to large rock bands. Here we will discuss the most safe and sure ways to execute repairs.

Basic rules

These repairs can be time consuming and expensive if a few golden rules on servicing techniques are not followed. Let's assume that a large high powered amplifier is brought into your shop for service with the complaint "it blows fuses as soon as it is switched on."

Rule No. 1: Never attempt to power up the amplifier before removing the covers and giving the amplifier a good visual inspection. Look for signs of over-heating. Also check for wiring modifications, possibly for handling extra speakers. Examine the printed circuit boards for signs of cracking. Some amplifiers which are used by rock'n roll bands are thrown around a lot.

Rule No. 2: Never switch on the amplifier with any kind of load on its output stage. If you can't see anything wrong after a visual inspection, power it up slowly with NO LOAD. After initial power-up, measure the dc voltage on each speaker terminal and check to insure that both positive and negative power supplies are balanced. If you find that the supplies are unequal, or any part of that supply on either speaker terminal, switch it off immediately!!

Rule No. 3: When replacing components, be sure that the component you select has the correct characteristics required for the circuit you install in into.

A typical amplifer

Shown in Fig. 1 is an example of a high powered dc coupled amplifier with its covers removed. Notice the split power supply for both positive and negative feed for the output stages. In this case, the power transformer is a toroid. This type of transformer can deliver more power much more efficiently from the source and is usually smaller in size. Filtering is done primarily by one large electrolytic capacitor for each supply line.

The output stage consists of 12 output transistors, two driver transistors, and two output resistor boards. Six T0-3 power transistors are (as shown) on the top heat sinks and six are below. One driver transistor is mounted on each output resistor board. Notice the two cooling fans. Again, this allows for a reduction in heat sink area and cuts down total amplifier size. Usually these fans are temperature controlled and do not turn on until a preset heat sink temperature has been attained. At that point, the added forced air cooling allows for maximum power dissipation with a reduced risk of thermal runaway.

Equipment and procedures

The test equipment that is required should be found in any service shop.

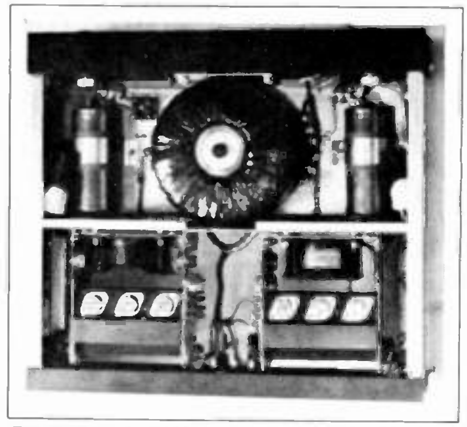


Fig. 1–A typical high power audio amplifier.

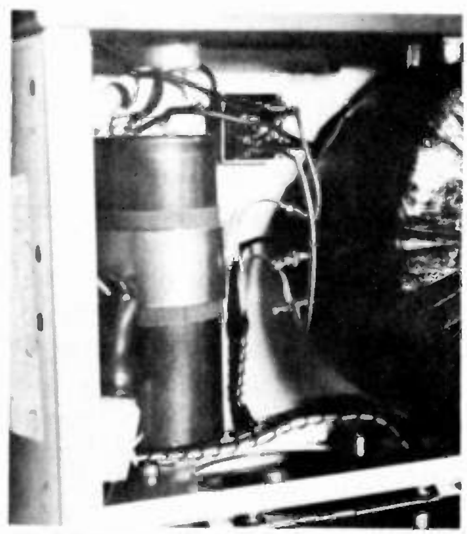


Fig. 2 A corner of the amplifier power supply showing the bridge block.

Here are the essentials needed.

1. Digital volt meter.
2. Variable ac supply with meters [0 Vac to 130Vac].
3. Oscilloscope—single or dual beam.
4. Four 4 ohm load resistors wire-wound at 100 watts each. Connect

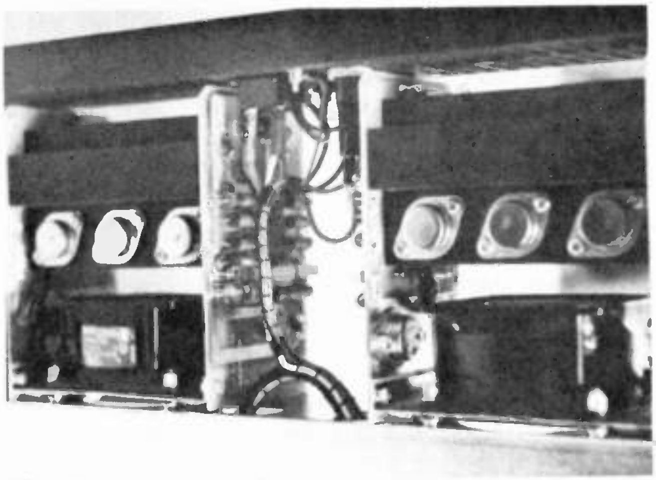


Fig. 3 The amplifier output stages.

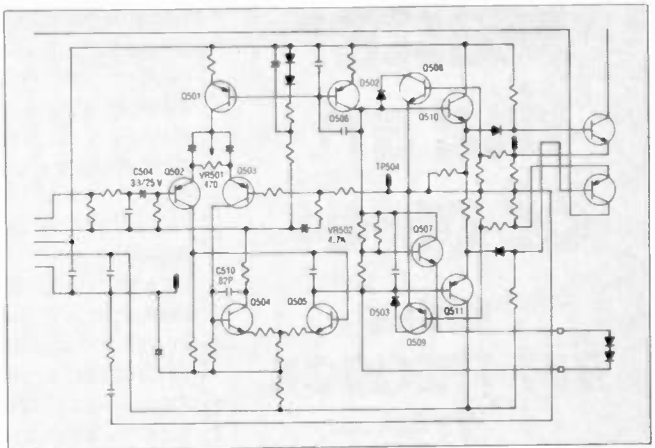


Fig. 5 Typical direct coupled driver stages for a moderately high power output stage.

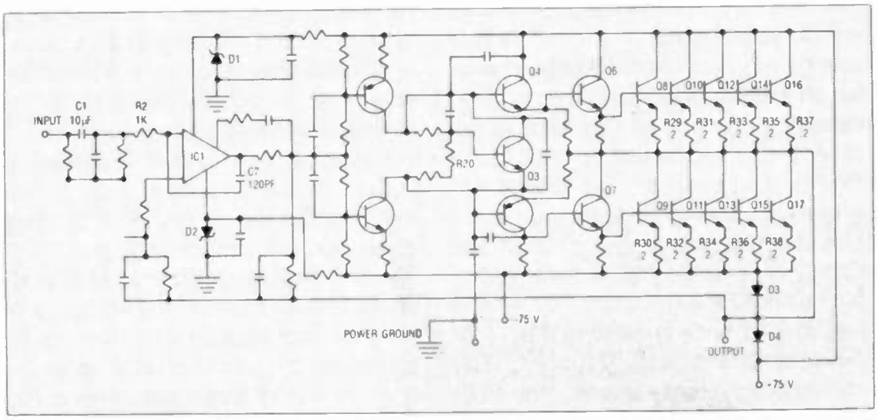


Fig. 4 A high power single channel amplifier, the output stage of which uses ten power transistors.

for 200 watts per side at 8 ohms.

5. Low distortion audio sine-square generator.

6. A VOM with a good low ohms scale

The easiest method of servicing would be to break up the amplifier into four basic parts:

1) Power supply;
2) Output stages;
3) Driver boards; and
4) Shutdown section.

First of all stabilize all the dc operating conditions, then pass a signal through the amplifier. This may require further troubleshooting with respect to the ac operating conditions. Plug the amplifier into the variable ac source and insure that it is switched off and set at zero.

Power supply

Usually power supply faults are obvious and do not consume much time. Generally, the components found here are designed to handle great amounts of power and are fairly rugged. If fuses are blowing in the power supply section, check the bridge rectifier block (Fig. 2). Use your VOM on RX1 and check for shorted diodes. It may be advisable at this time to locate and disconnect any supply line leads which go directly to either output stage. A shorted output device can sometimes cause the supply to appear shorted. Check for signs of extensive heating or burned wiring. The odd time you may run across a defective electrolytic, but this is very rare. Finally, check for poor solder contacts, especially on common grounds. Where grounds are made through a mechanical connection, insure that these are tight.

Output stage

The output stage is responsible for supplying the great amounts of power required for the load (Fig. 3). Shown are six parallel devices on top and another six on the lower portion of the heat sink. Make sure that all supply connections and output connections are tight. A schematic diagram of an even larger output stage is shown in Fig. 4. Notice that all the output devices are in parallel to insure maximum current. These output transistors are Q8 through Q17. Any one of these devices may be shorted or "leaky;" so if you change one, make sure you also change its adjacent device. When selecting replacement power transistors, check for differences in gain characteristics and insure that power dissipation and breakdown voltage specifications are adequate. Resistors R29 through R38 must be carefully inspected for signs of overheating and/or cracking. Use your VOM to check that each resistor is close to its specified value. Insure that both back swing clipper diodes D3 and D4 are not shorted. A biasing voltage is supplied by Q3 which is attached thermally to the heat sink.

Driver

Next, we look at the driver boards. This is the heart of the amplifier. The driver board is direct coupled to the output stage and usually trouble on one means trouble on the other. (See Fig. 5.) Shown is an excellent example, for it contains most of the commonly used circuitry. There are several important functions of a driver circuit other than the amplification of the input signal.

a) It insures zero dc voltage at the center point (speaker terminals) under normal operating conditions.

b) It supplies the correct amount of dc bias current to the output stage. This normally tracks directly with output stage operating temperature.

c) In most cases, some form of over current shutdown is also employed.

Insure firstly that all power supplies are fully discharged. Next, with your VOM, check the forward and reverse resistances of all diodes, resistors under 1K ohm and transistor junctions. If you have an in-circuit transistor checker, check ALL semiconductors dynamically. If you are using a VOM, check for shorted collector-emitter junctions or open base-emitter junctions. When changing bad diodes, make sure your replacement is exact. In many cases, diodes in a shutdown circuit are vastly different from those used in biasing circuits. When changing a differential amplifier transistor, always change both, even if the adjacent device is found to be undamaged. One of those devices could be partially damaged from the original fault and go into "second breakdown" after initial run-up, which would surely cause a second repair equal to the first. It is not worth sacrificing reliability for the cost of one or two more transistors. Assuming the output stage is now repaired, switch the variable ac supply on and slowly increase the line voltage until approximately 50% of full supply. Watch for excessive primary supply current and overheating. If either of these two conditions occur, reduce your supply voltage to the point at which input current is reasonable or switch off the power and reassess; you may have overlooked something obvious. While running at 50% of the supply, it should enable you to make all necessary dc voltage measurements. Firstly, check for an excessive amount of dc on the center point or speaker terminal. In this case, that would be test point 504 (see Fig. 5). If an excessive dc voltage is present, its source could be a defective output device, driver device (Q511 and Q510), or defective differential amplifier, here being Q502 and Q503. To help find just which device is causing the problem, determine the dc polarity. This should point directly to either the PNP side or the NPN side of the driver board. On this driver board (Fig. 5), you are able to make small dc offset voltage adjustments by varying VR501. This pot is found across the two emitters on the input or differential amplifier. A defective bias transistor or bias pot, here Q507 and VR502, could cause overheating of the output stage. If this occurs, switch the amplifier off and replace the bias transistor.

Your attention can easily be distracted working on the input, while a brand new output stage goes up in smoke. This is precisely the reason for not applying a load across the amplifier or running at full line voltage.

One other common driver circuit is that of Fig. 4. Here an operational amplifier is used as an input amplifier. This introduces many benefits to the circuitry, such as improved slew rate, stable dc offset and source current limiting, which are all features of most operational amplifiers. Here it is best to start at the input. Check both dc supplies for the operational amplifier. These are zener diodes D1 and D2 (Fig. 4). Also check to see that there is no dc voltage present on the inverting input on the op amp via C1 and R2. Transistors Q1 and Q2 provide the voltage gain, while Q4 and Q5 supply the current gain.

To insure proper signal performance, it is necessary to look at both the output stage and driver boards together. After replacing all of the defective devices and checking all of the remaining ones, run your supply up slowly to 100%. Try to pass a 1Khz signal. Watch for premature clipping on one side of the wave. This would also indicate a dc offset voltage present on the speaker terminal. If this is the case, a driver, buffer or output transistor could be breaking down under load, yet check out properly in the quiescent state. When this occurs, a great deal of supply current is drawn and this may blow supply line fuses or actuate any current limiting or shutdown curcuits. To help establish just where the current is being sourced, use your digital volt meter and check for excessive voltage drop across any of the output emitter resistors (see Fig. 6). If this does not reveal the source, check the driver transistor currents while passing a signal. It may be necessary to defeat any current sensing circuits in order to find the defective device (see Fig. 5). Here disconnect one end of D502 and D503. This will disable transistors Q508 and Q509. Remember that you will lose any driver or output stage current limiting, so slowly run the amplifier back up to one-half supply only. Again, refer to Fig. 5. Transistor Q501 serves as a constant current source for the input amplifier. Insure that this device is not damaged.

If the signal is reasonably symmetrical, yet disturbed, check the collector of Class A driver Q505. This transistor supplies signal for the driver and output stages, and should indicate the source of any distortion. The base of Q505 should also be checked. A severe loss of voltage gain here will certainly produce a poor low level output. Check Q506; this transistor serves as a constant load for Q505.

If the problem is no signal at all, insure that the input amplifier is operating and a signal is being passed via C504. It is possible that excessive voltage was applied directly to the input causing damage to this capacitor and possibly the differential amplifier.

High frequency oscillation could be caused by a loss of any RF suppression capacitors, such as C510 across Q504. Or, as in Fig. 4, C7 from the output to the inverting input of the operational amplifier. Be careful of high level, high frequency oscillations for they tend to cause excessive drive, thermal runaway, and eventual breakdown. Also check for open path of ground foil on the driver PCB or open feedback lines which in turn will cause excessive circuit gain and possible oscillation.

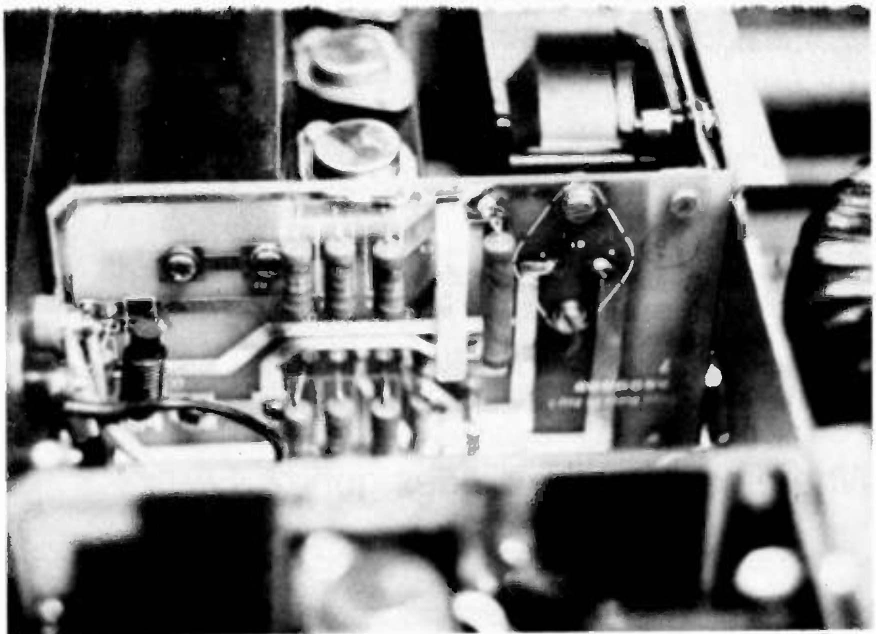


Fig. 6 This circuit board mounts the individual emitter resistor for each of the paralleled output transistors.

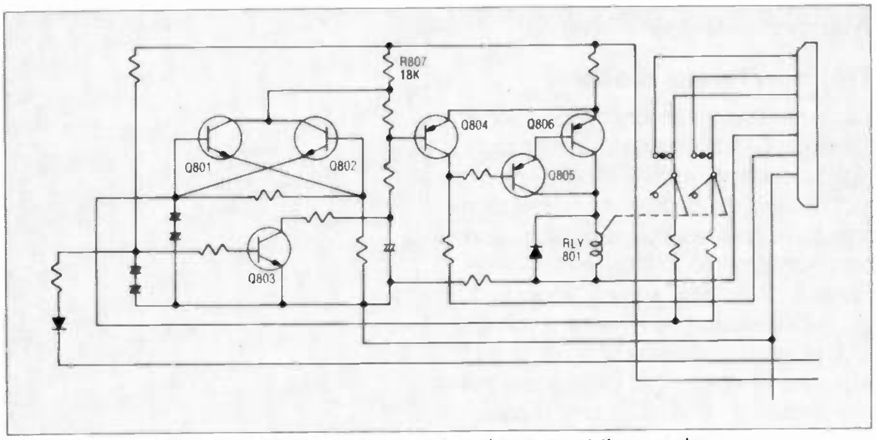


Fig. 7 An overvoltage shutdown circuit, employed to protect the speakers.

After you are satisfied that the amplifier is operating properly, establish its total RMS output power into an eight ohm load with both channels operating. Watch for a decrease in input line voltage as your power output increases. Correct for this by resetting the variac to 120Vac. If you do not have any specifications at hand, total output power can be established by measuring either the positive or negative dc supplies. Take this measurement with both channels running just before clipping and use this formula $(B+^2/8)/3$. Remember, this will give you a good close estimate and not an exact specification. For example, when measuring the positive supply voltage with the amplifier nearly at clipping, you will read positive 50vdc. $50 \times 50 = 2500 \div$ load impedance or 8 $= 312.5 \div$ (converts to approximate RMS value) $= 104.16$ watts RMS.

In most circuits, there are provisions for setting the center point or output offset voltage and the idle bias. These settings should be checked after the amplifier has warmed up. Set your audio generator to 1kHz and run the amplifier at approximately 45% of full RMS output. Then make these adjustments *slowly* and with *no* input signal.

Protection circuits

The primary function of these circuits is to protect internal components and external loads after the normal operating parameters of the amplifier have been exceeded. This is done in several ways.

1) Fuse protection. These fuses can be found in the primary of the power transformer, in the secondary ac side or after rectification as B+ and B- fuses. Fuses may also be found directly in series with each main audio output line. This limits maximum signal current and protects both output stages and speakers.

2) Over voltage shutdown. (See Fig. 7.) If an excessive dc voltage is produced at the speaker terminal, it enters at the base of Q801. When this voltage is positive, Q801 becomes conductive, and when it is negative, Q802 becomes conductive. As a result, a current runs in R807, decreasing the base voltage of Q804, causing it to become conductive. This, in turn, shuts Q805 off and the speaker relay opens, insuring that no dc reaches the load. A turn on time delay is also incorporated here to protect the speakers from any high level transients.

3) Over current shutdown. (See Fig. 5.) This is probably the most widely used form of protection. The transistors involved are Q508 and Q509. If a specific value of resistance is placed in series with each base (Q508 and Q509) and the center point, networks R and R'; any increase in output current would cause a proportionate voltage increase across the resistance. This value of resistance is set so as to cause 600mv on each base at maximum specified output current. Q508 and Q509 then become conductive bypassing current from each driver transistor Q510 and Q511. In actuality, both driver bases are pulled together and the output stage current is severely reduced.

Many different variations of these circuits are also used. However, the most protected amplifiers employ all three kinds, as mentioned above. For example, if a shorted speaker were to be used on a dc coupled high power amplifier, the protection would reduce the risk of internal circuit breakdown. Firstly, the turn on time delay would prevent any high power transients from damaging internal components. Secondly, when the output relay closed and connected the shorted load across the output stage, overcurrent limiting would reduce the risk of exceeding any maximum current specifications. However, if one or more power or drive transistors did become shorted, full supply would be felt at the speaker terminal. At this point the over-voltage shutdown would immediately open the output relay and disconnect the load completely. One should remember that these protection devices will not always prevent amplifier failure, but will make the circuitry much less susceptible to human error and component failure.

Finally, when the repair has been completed, explain to the customer that the amplifier is operating now, but will not continue to do so if proper operating procedures are not followed at his end. Suggest to this customer that he check his speakers and cables, for it is too often that an amplifier is returned repaired and used again under the same set of conditions that caused the original failure.

You can see that by following a few simple precautions and familiarizing yourself with service procedures, a more reliable and profitable repair can be accomplished. **ET/D**

Synchronous video detectors

Where have all the diodes gone?

The proliferation of ICs has brought into vogue another kind of detector circuit that helps eliminate many of the troublesome problems associated with alignment and trap settings. For a rundown on this "new" way of doing things, read on.

By Bernard B. Dalen

In the past, the word "detector" in electronic literature was considered synonymous with "diode." Other detectors (demodulators) have been used occasionally, each offering advantages for certain applications, but they were all more complicated, used more components, and cost more, than the simple diode.

With the advent of low cost integrated circuits, other detectors became more prevalent. For example ... single sideband has been used in commercial and amateur transmission, but lately it got a big boost when Citizens Band (CB) transmitters adopted it too. Since single sideband (SSB) transmissions have no carrier, it is necessary to reinsert a carrier at the receiving end. In this application, the "product detector" offers significant advantages over a simple diode, and integrated circuit product detectors are now in common use.

More recently, the "synchronous detector" has enabled the use of simpler, more economical, TV intermediate frequency amplifier strips. In most cases, many of the troublesome trap circuits have been eliminated! The result is increased use of the synchronous detector as a trend. If you wish to know more about the synchronous detector ... read on!

The non linear diode

You know that the theory of operation of the diode detector is that it functions as a high frequency rectifier. Ideally any rectifier should conduct in one direction only, have zero reverse conduction, and zero voltage drop in the forward direction. Also, you already know that the silicon diode has a forward voltage drop of about six tenths of a volt ... and when you consider that the diode is not going into full conduction until it gets over half a volt input, you suddenly realize that this is putting quite a burden on the I.F. amplifier.

If we assume a signal of 100 microvolts is useable at the antenna terminals, then the I.F. amplifier would have to deliver almost 80 db of gain in order to deliver enough signal to just turn on the silicon diode detector! To get around this, many circuits employ germanium diodes as detectors, since germanium goes into conduction at about two tenths of a volt (one third the forward threshold voltage of silicon).

Furthermore, in the region of low level operation, the diode is very non-linear, i.e., the voltage drop across the diode is *not* proportional to the current through the diode. Instead the diode has a logarithmic response. Nonlinear devices are good *frequency mixers* (which is exactly why the diode is used as the mixer in UHF TV tuners). The result is that all frequencies fed into the diode detector mix with all the other frequencies to produce sum and difference frequencies. In the case of the video detector in a TV set we have several frequencies that are present, including the picture carrier, the sound carrier, the adjacent picture carrier, adjacent sound carrier, and the color signals. These different frequencies, beating together, produce interference frequencies which are visible in the picture because the video amplifiers are broad band circuits and pass the spurious frequencies.

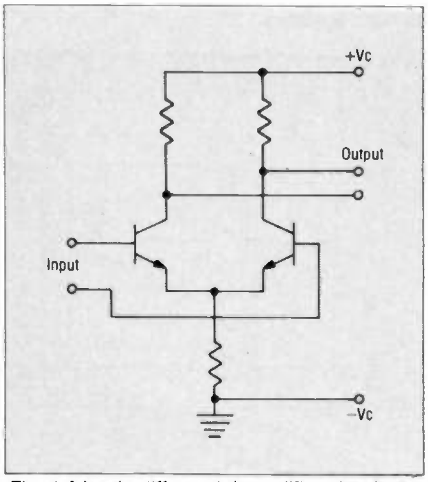


Fig. 1 A basic differential amplifier circuit, the backbone of the synchronous detector.

In order to prevent this, traps are incorporated in both the video IF and the video amplifiers to reduce the unwanted signals. In the video IF, by trapping out unwanted signals *before* they reach the detector, the mixing action is prevented. In the video amplifier, traps reduce the *effects* of signals which have already been mixed in the detector. But ... if the detector were linear, there would be no mixing action, and the traps would not be required.

Fewer stages

Also, if the detector could be designed to function more like an amplifier, the input signal to the detector could be reduced, thus less gain would be required from the IF strip. Putting all of this together, a high class TV set could be built with one less IF stage, and fewer traps. That is

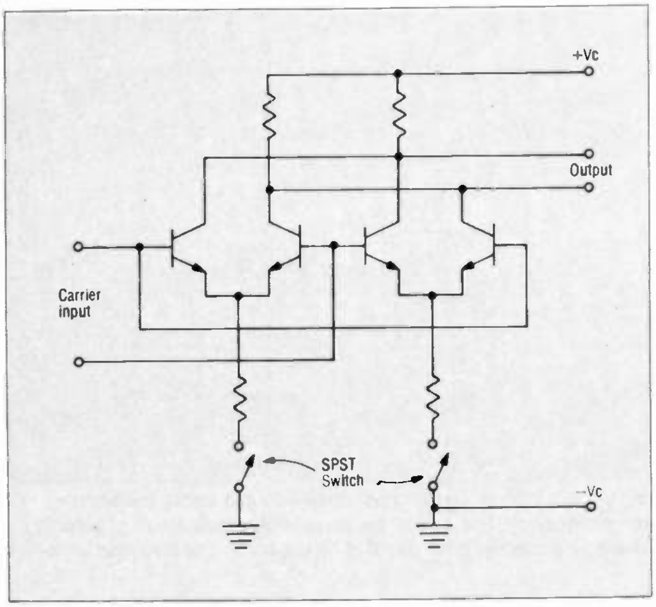


Fig. 2 A dual differential amplifier with outputs in parallel and inputs in push-pull arrangement.

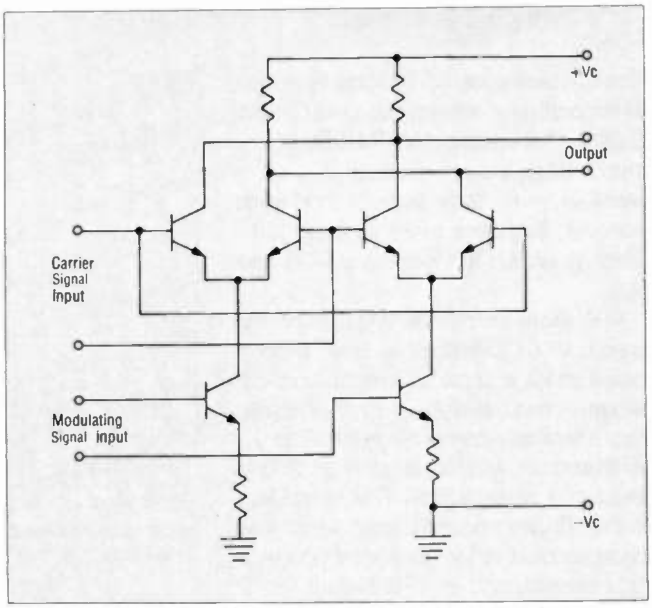


Fig. 3 A double balanced demodulator for use in synchronous detection circuits.

exactly what the synchronous detector does. Stated another way, a diode detector has a loss between input and output, while the synchronous detector circuit has substantial gain. There is *no* mixing action in the synchronous detector.

Since the synchronous detector does not mix, there are no sum and difference frequencies produced. With the diode the difference frequencies are the ones that appear on the TV screen ... since they are low frequencies. The sum frequencies are quite high, and they can radiate back into the front end and the antenna of the set, or nearby sets. This is particularly annoying since it entails mechanical shielding, electronic filtering, and critical parts placement ... which means extra size and cost in set design. Federal regulations concerning radiation are very strict, and *must* be complied with ... so you can see that the synchronous detector overcomes some very severe problems inherent in the good old diode detector. Sorry to disillusion you, but the old diode detector that you have become so familiar with over the years, is no longer a friend!

Here's the bad news ...!

At this point you are probably saying, "I'm sold. Let's use the synchronous detector. I'm ready ..!" No, you're not!

While it cannot be disputed that the synchronous detector is a technological improvement, there are "growing pains" associated with it. As you will learn later in this article, the synchronous detector requires *two* inputs, just as the product detector requires a substitute carrier for SSB reception, in addition to the input signal ... so does the synchronous detector require a carrier generator input.

The concept of two inputs to a demodulator is nothing new in color TV. The color demodulator requires an input signal (chroma), and a restored carrier (color reference signal) derived from the color burst. Further, you will recall that there are two popular methods of generating the phase syfchronized color reference signal ... by using a free running 3.58 MHz oscillator locked to the color burst by means of an AFPC circuit, ... or, by using the color burst to ring a crystal, then limit the amplified ringing to produce a constant amplitude signal.

We do exactly the same thing with a synchronous detector ... we derive the reference signal from the transmitted picture carrier in the video IF, in one of two ways ... the first is by using a phase locked oscillator ... the second is by amplifying the carrier itself, and limiting it to assure constant amplitude. Doesn't that sound familiar? It should be!

This requirement for a reference signal is where the pain comes in. Your old sweep generator won't hack it for alignment, because it puts out a single, constantly varying frequency. The synchronous detector needs a fixed, stable, carrier. (An ordinary TV video signal has a *carrier with sidebands*. The carrier is stable, the sidebands vary in frequency and amplitude, and phase relationships.)

You can add the output from a marker generator at the video carrier frequency, and it would work, providing you adjust the amplitude with care. Unfortunately many sweep generators of modern design do not inject the marker generator *into the IF* along with the sweep. (There are several other ways to generate a marker display on a scope screen, and they are used more frequently than direct IF marker injection.) So you may have to either modify your present generator, or buy a separate crystal controlled generator for the carrier frequency, or buy one of the new generators made for use with synchronous detectors, AND LEARN HOW TO USE IT!

Most of us have never really felt we were masters of alignment, now we have to learn another way of alignment! But that's the price of progress ... some of us simply drop out with each new technological advance, but fortunately, most of us go back to the books.

"Low level" detectors

The synchronous detector has been around for quite some time, even in integrated circuit form. Motorola has been selling it as the MC1330, and the MC1331, labeled "'Low Level Video Detector." They replace one IF stage, the detector, first video amplifier, and first AFC stage. In addition, the MC1331 also incorporates the sync separator and sound detector! So you probably have been looking at the synchronous detector for some time without realizing it.

Motorola also makes the MC1496 and MC1596, "Balanced Modulator and Demodulator," a very flexibile IC which can be used an an AM modulator, suppressed carrier modulator, FM detector, phase detector, product detector, or synchronous detector! RCA makes the CA3136, "TV Video IF Phase Locked Loop Synchronous Detector."

This IC also has an AFT circuit. National Semiconductor makes the LM273 and LM274, "Monolithic AM/FM/SSB IF Strip" which incorporates an IF amplifier, multimode detector, and other features. Signetics makes the N5596 which is similar to Motorola's 1496 and 1596.

And, there are others. The fact that the synchronous detector has been hidden inside an IC, as a part of a multi-function circuit, or has been given another name, has effectively camouflaged it. The synchronous detector is really an oldie in need of a press agent! This is similar to the "Phase Locked Loop," which has been around in TV horizontal phase lock circuits, and in AFC circuits for many years. For those of you who are old timers in the TV business ... think back to the early 1950's ... remember the Philco TV sets (black and white of course), with AFC? That was a very important feature in those days, since the early TV sets did not use the "inter-carrier Sound System," and you had to tune the fine tuning knob ever-so-carefully for the *sound*. If you mistuned a bit, the sound vanished.

Thus AFC was an effective means to prevent the sound from drifting clean out of hearing! That was an example of a basic form of phase locked loop, although no one called it that at the time. We do go through these "rediscovery cycles" periodically in electronics. The semiconductor was in use in 1923, in the form of the crystal detector, using silicon diodes (called "carborundum" at that time), lead sulphide (called "galena"), and the copper oxide rectifier. Yet the semiconductor was "rediscovered" with amazing regularity in the form of the selenium rectifier in the 1940's, germanium, also in the 1940's, and silicon in the 1950's. So do not be discouraged by this apparently new development.

How it works

We can explain how the synchronous detector works with the aid of a few simplified basic schematic diagrams. Figure 1 is a conventional differential amplifier, consisting of two identical transistors with a single emitter resistor. The input signal is applied between the two inputs (bases), and it only takes about 30 millivolts difference between the bases to turn one transistor fully off, and the other fully on (saturation). Thus, with a signal greater than 30 millivolts, the differential amplifier becomes an electronic switch.

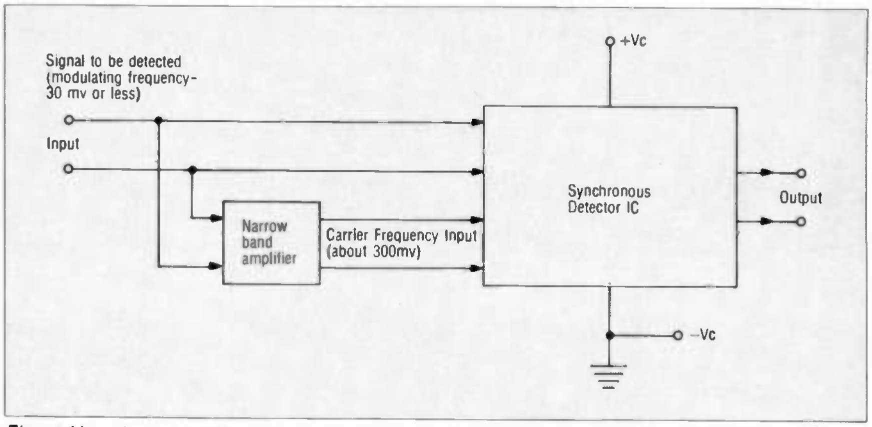


Fig. 4 Here is one method of obtaining a carrier frequency with the same frequency and phase as the modulating frequency. The carrier frequency becomes much greater in amplitude than the modulating frequency after passing through the narrow band amplifier.

In Figure 2 we have two identical differential amplifiers, with the *outputs in parallel,* and the inputs connected *phase opposing* (push-pull inputs, parallel outputs). We have also added a switch in series with the emitters of each differential amplifier. If we now apply an RF signal to the inputs of the differential amplifiers, at the terminals marked, "Carrier," with both switches *closed,* we will get NO OUTPUT. Remember, the inputs to the two amplifiers were out-of-phase, and therefore the outputs will be out of phase on the two amplifiers, and cancel each other out. (Those of you who are familiar with single side band will recognize this circuit as a "balanced modulator" used to suppress the carrier in SSB.) If we now open one of the emitter switches, we will disable one of the amplifiers, and output will appear since the cancelling action will be defeated.

If we *alternately* open and close the switches *in sequence,* the output will appear and disappear ... but remember, the output is an RF signal at the carrier frequency. Now let's go one step further, if we can synchronize the switches with the carrier frequency, as the phase of the output tries to change due to carrier going positive to negative, and vise versa, the switches will also be changing, and the result will be full wave rectified DC. This circuit is called a "double balanced modulator," and depends upon balancing due to identical components in all circuits. This is why the synchronous detector really became practical only after integrated circuits were developed. Since all the components in an IC are made at the same time, of the same materials, in the same way, they can be made very closely alike. To build a double balanced modulator out of discrete parts would require careful matching, plus the generous use of trimmer pots ... very costly in labor.

Current regulators

Now let's look at Figure 3. We have now replaced the switches with transistors, which can not only turn on and off, but also act as variable current regulators, limiting the current flow to each differential amplifier in accordance with the input signal labelled "modulating signal" ... because that is exactly what these transistors do, they modulate the current flowing to each of the differential amplifiers in accordance with the moldulating input signal. Now here is an important point ... the carrier signal is deliberately maintained at a level which *exceeds* 30 millivolts, therefore the differential amplifiers function as switches. The bottom transistors are operated in the linear mode, as current amplifiers, and therefore the output from the differential amplifiers is modulated by the modulated signal input. *If the carrier and the modulating frequency are identical in frequency and phasing,* the output will contain only the sum and difference frequencies between the carrier, and the modulating frequency's sidebands.

Remember, *any modulation on the carrier frequency will not appear in the output so long as the carrier level is well over the 30 millivolt level.* Thus we try to keep the carrier level around 300 millivolts, and we keep the modulated signal level under 30 millivolts.

At this point you may be asking, "How do we get a carrier that is exactly on frequency, and in phase with the modulating frequency?" (The modulating frequency, as you have probably already figured out, is the frequency we are "detecting.") If you will examine Figure 4, you will see that the carrier frequency is derived from the modulating frequency. We simply run it through another amplifier stage to insure that the signal level is high enough to exceed the previously mentioned 30 millivolt level.

Since we are only interested in the carrier, this can be a typical narrow band tuned amplifier centered on the carrier frequency. Such an amplifier has considerably higher gain than a broadband amplifier, and is much simpler and cheaper to make. Some circuits amplify, then clip this signal to remove most of the amplitude modulation, in a manner similar to the FM IF limiter stages used with the better FM broadcast receivers. Other circuitry often used simply insures that the carrier signal is so much larger than 30 millivolts that the differential amplifiers act as saturated switches, and therefore do not respond to variations in the amplitude of the carrier (modulation), as described previously.

Fewer traps

Stated another way, the carrier frequency supplies only the switching action, while the modulated frequency supplies only the modulation. Any modulation of the carrier frequency does not appear in the output, ... and *the carrier of the modulated frequency* is rectified to DC. As you can readily see, an interfering signal would not meet the requirements previously set forth for output from the balanced modulator. More important, the double balanced modulator *does not mix "other" signals to produce sum and difference frequencies,* as does the ordinary diode detector. Therefore there is no "beating" with undesired carriers, as is usually the case with the adjacent channel signals and the desired signals.

This ability to discriminate against unwanted signals reduces, or eliminates completely, the need for trap circuits in the TV video IF. It *also greatly reduces the need for very precise tuning* of the *tv receiver,* since the troublesome beats that used to appear on the screen when the signal moved out of the proper trap frequencies, are no longer so obvious. Those of you who recall the early days of TV before intercarrier sound was developed, still remember that tuning was accomplished by adjusting the dial for the best SOUND, and it was super critical. With the advent of intercarrier sound IF, tuning became a magnitude

continued on page 47

Microprocessor basics part III

Inside the MPU

In his third article, the author discusses the transfer of electronic signals (digital data) within the MPU chip itself. The concepts behind locating, storing, and manipulating of the data are explained and illustrated.

By Bernard B. Daien

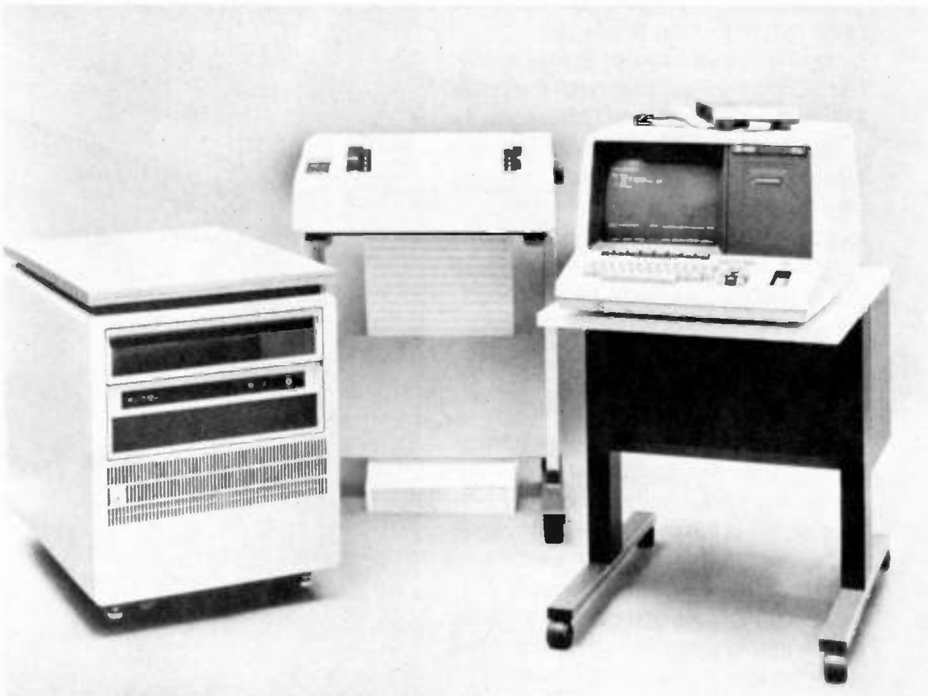


Fig. 1 Representative of the avalanch of microprocessor controlled devices now invading every segment of electronics from industrial to consumer applications is this Model 64000 Logic Development System from Hewlett-Packard. With such devices design engineers and programmers are able to move more rapidly from project definition to production all of the microprocessor based products which they design. This unit is used in design, debugging, and troubleshooting situations.

The previous article covered "talking to the MPU"...the various "languages" we can use for inputting data and instructions, and the reasons why we use them. Logically then, we should ask, "What happens next? What does the MPU do with the information in the language used?" This article endeavors to provide that next step in continuity.

We mentioned in Part II that some MPUs operate with a four bit byte...most of the current MPUs use an eight bit byte, and some of the newest machines are going to a 16 bit byte. A four bit byte has only 16 possible combinations, an eight bit byte has 256 combinations, and the 16 bit byte has 65,536 combinations! It is obvious that an eight bit byte machine can handle more information, and is capable of handling a larger memory, than a 4 bit byte machine. Since a byte is generally also a "word," a given program can be achieved more easily on the 8 bit machine because fewer words are needed. The trend is therefore toward MPUs with longer bytes...but there are some disadvantages in the use of longer words...

Serial versus parallel

Depending upon the originating source, information may be either "serial" or "parallel" form. The word serial means that the information is delivered one bit at a time, the way sentences are formed using a typewriter. Each letter follows the previous one in time, and you must wait for each word to be completed. Parallel indicates that all eight bits of a word are delivered simultaneously, the way a rubber stamp imprints all the letters at the same instant in time. Obviously, an eight bit word would take longer to deliver than a four bit word, in serial format, thus slowing the operation of the MPU system.

In order to avoid this slowdown, MPUs are designed to operate with parallel format, since it takes only one operation to handle all 8 bits of a word. This implies that all the internal operations of the MPU are done on eight parallel wire connections called "buses." Some buses handle data (data bus), others handle memory locations, (these are often two 8 bit buses, or a 16 bit bus, to handle the larger number of addresses which may exist in external add-on memory). These will be covered in greater detail later in the series. For now, we need only know that computers are generally rated in "computing power," which is the ability to handle information per unit of time. The faster a machine is, the more "powerful" it is said to be...a figure of merit in comparing computers. Some of the larger machines are so fast, that many customers share them, thus increasing profitability.

Some information sources generate serial formats, and this necessitates the use of an interface device which is able to accept information in serial form, *storing it* bit by bit until an entire word is completed, and then delivering the entire word, in parallel format, to the MPU. Obviously this requires some form of memory...which brings us to the point where we must *mention* memories. However, we will discuss them in depth later.

Registers and latches

Different names are applied to memory devices which provide temporary, short term storage of information. The name may be dependent upon the use the device is put to, rather than upon the device itself. Often this leads to confusion. In general, we say that any device capable of storing binary information is a "memory"...whether it be magnetic tape, magnetic disc, or an integrated circuit. For now we will talk about integrated circuits only.

If such a device is used for short term storage, as, for example, during the short time interval needed to transfer data from one part of the MPU to another, it is called a "register." The registers in an MPU are organized to handle one or more 8 bit bytes, so that *information moves about in word length chunks*. (There are some memory devices that handle only one bit, and these are called "latches." A latch is nothing more than a flip-flop, a bistable multivibrator, which can be set in either a 1 or a zero state, and will hold that state until reset.)

If you think about it, a register is really nothing more than eight latches in one device, each latch handling one bit, with some common control terminals to facilitate handling all 8 bits simultaneously. If we use a register which can handle 8 parallel lines (one for each latch), we can interface any device, serial or parallel, with the MPU.

There are a variety of specialized interface devices available, each better suited for the many different interfaces required, all with the capability of providing parallel input to the MPU. For example, we may wish to accept information from a teletype machine, or from a telephone line, or from another computer..these are illustrations of what we meant in the first part of this series when we referred to the need for interface devices. (Often interface devices are referred to as "Input/Output" devices, or simply I/O devices, since they are part of the family of I/O.)

The "clock"

Since serial information is delivered at a slower rate than parallel information, the element of time is involved. In a general sense then, an interface device often provides the capability of connecting together two different circuits running at different speeds. (When two circuits run at the same speed, locked together, they are said to be "synchronous." If they run at different rates they are "asynchronous.") System speed rate is determined by an oscillator (pulse generator), called a "clock." The clock is generally frequency controlled by a quartz crystal for stability...the circuit is usually a crystal controlled multivibrator. Often two outputs are taken from the clock, 180 degrees out pf phase, in which case it is said that we have a "two phase clock."

One device frequently used to interface systems running at different clock rates is the "Asynchronous Communications Interface Adapter" or, simply ACIA. This very useful little integrated circuit converts serial information to parallel, parallel information to serial, and is capable of doing this on circuits with different clock speeds! Since incoming data from telephone lines, teletypes, etc., is serial, the ACIA enables these devices to talk to the MPU, which demands parallel format.

On the other hand the ACIA is also able to convert the parallel output of the MPU into the serial format required for transmission over the telephone lines. Thus the ACIA is a versatile, complex, I/O interface device, necessary for use with the MPU in a great many applications. There are many other specialized interface chips available for other uses...but one example will suffice for the purposes of this series, at the moment.

Control instructions

Now that we know what a clock is, what a register is, and what a bus is (among other terms just discussed)...we can proceed to put the pieces together in order to obtain an overall view of what the MPU does with the information we input to it.

In order to do this we will take a step backwards and ask a question. "How does the MPU know what to do when we give it an instruction?" Well, how does a child know what to do when we say "It's time to eat." Or, "Go to bed." Of course a child is not born with this knowledge...someone had to teach it...to implant in the child's memory the procedures to be followed when the child recognizes that phrase. So it is with the MPU. The MPU has a limited amount of memory right inside the MPU chip, and this memory is permanently programmed during manufacture with the ability to initiate certain operations upon command. The control process is as follows.

Encoding and decoding

Upon receiving an instruction from the program, the MPU looks up that instruction in its internal memory, and discovers it is an order to perform certain operations. This look-up process, and translation into orders for operations is called "decoding." *The operations which have been ordered from the memory built into the MPU are based on microinstructions*. Microinstructions are the instructions which we just discussed, those which were built into the MPU at the time of manufacture. There are about 70 of these basic instructions in the vocabulary of most current MPUs, and they are called "the instruction set" for the particular MPU, because, in fact, they are a set of basic instructions. By combining instructions, we can make the MPU do many different things.

To differentiate between the instructions which are part of the MPU (built in), and the instructions in the program, program instructions are called "macroinstructions." (Micro means small, macro means large.) Thus the microinstructions are for the many small basic operations the MPU must perform to accomplish any task...for example, the moving of information from one part of the MPU to another internal part of the MPU via an internal bus. When we tell the MPU to accomplish this, by means of a macroinstruction..which indicates, "Place the following data in Register A" (there are several registers in an MPU)...of course the data must first be placed on a bus, then the bus must transfer the data to Register A, then the bus must stop transferring data so that unwanted data is not also jammed into Register A.

It is the microinstructions which indicate, step by step, the transfer of data onto the bus, and off the bus, in order to carry out the order of the macroinstruction. The macroinstruction does not spell out all these little details..and indeed it is not desirable for it to do so, otherwise we sould be repeating all these little microinstructions in *every* macroinstruction, making programming an extremely long, tedious process.

A closer look

Let's look at these events even more

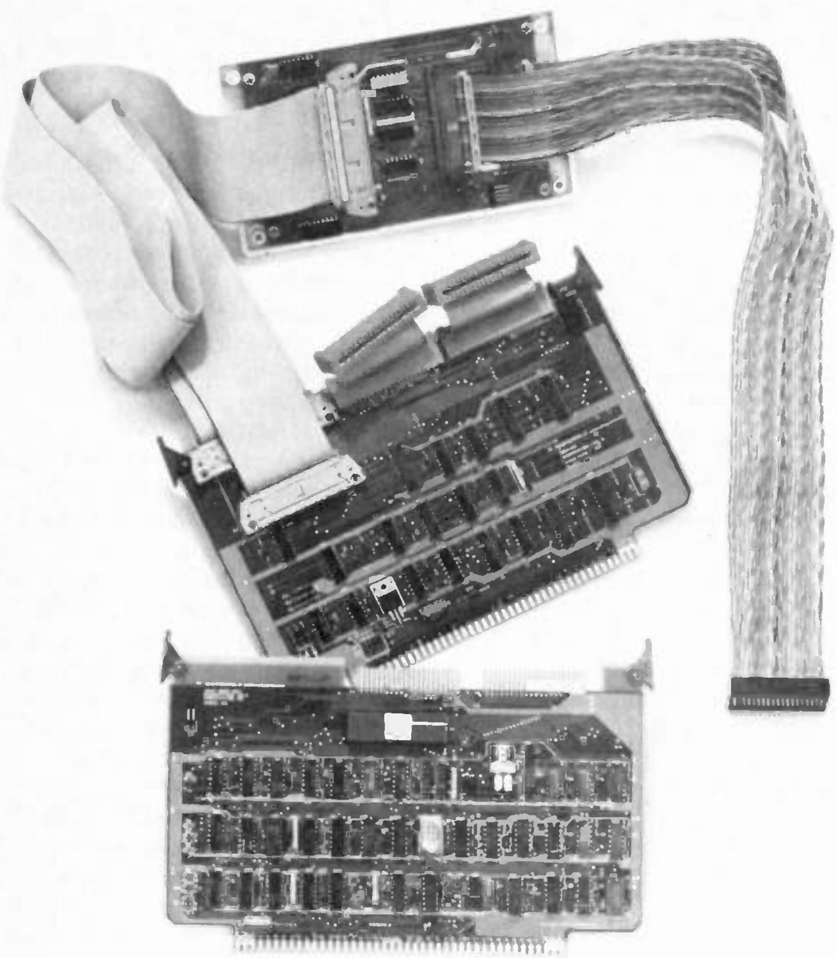


Fig. 2 Add on memory and logic boards, such as these from Motorola Microsystems, Permit Expansion of existing hardware systems. In addition to providing users with expanded memory (RAM) locations such "plug in" boards also permit users to increase functional capabilities.

closely. How does the MPU know exactly when it can put information on the bus, take it off the bus, or even just plain stop because the operations indicated in the microinstructions have been completed? Well, the clock plays a role in this. Information moves in little jumps, rather than a steady stream. If we are using a 1MHz clock, there will be a million pulses a second from the clock, and each pulse can initiate some form of action in the MPU, therefore things will jog along at a million operations per second, or *less*. (Some operations take several clock pulses to complete.) The MPU will have to wait for a clock pulse before anything at all can move...and if it has to wait several clock pulses for a more complex operation to complete, the data may have to be temporarily put into one of the registers so that it is not lost while waiting. The microinstructions tell the MPU all it needs to know, in order to do this, and relieve the programmer of much tedious work. It's like baby training. Once the baby is trained to the point where it can speak, the tough part is over.

As a matter of fact, the programmer, using machine code, (usually hexadecimal) is merely inputting a number from zero to 255 (remember an eight bit word has 256 possible combinations), and that number is the "address" (location), in the MPU's internal memory, which contains the instructions for the operations to be performed. The MPU looks up that address, and performs the instruction located at that address (decoding). The hex number put in by the programmer is part of the MPUs instruction set. Got it now?

Add on memory

By using a series of program instructions (macroinstructions), in the proper combination, we can input data, instructions on what to do with the data, etc....in short, "programming." But what if we want to do things that are not in the "microinstructions" built in at time of manufacture? In that even we can add on extra memory, with more information. At this time we should mention that microinstructions are held in "read-only" memory (ROM) and that means exactly what it says. We can read information out of the memory, but we cannot alter, add to, nor erase the memory. It is just like a book, although we use it, we do not change its contents in the process.

External add on memory can also be read-only if we wish it to be permanent, like the microinstructions. On the other hand there are times when we may wish a memory that can be altered, or even erased and reused...and such memories are known as "read-write" memories because we can not only read out of them, but we can also write new information into them. (Another common name for read-write memory is "random access" memory (RAM).

To make sure that you are getting a clear understanding of these basic MPU operations, we will look at a simple example. Suppose you wish to add two numbers together. You will have to provide the necessary data, and instructions, in a program, written in a language the MPU can understand. We are going to add the numbers 5, and 10. (Data.) We must also include the word "Add" (Instruction). We will also need to make sure that the computer has been cleared of any previous data and instructions which it may still have in its various sections, (Initializing). You do this with a pocket calculator when you press the "Clear" button before starting a new calculation, remember? And you will have to make sure that the machine stops calculating at the end, so you need to input that information too.

Step by step

The MPU will put the first data entry, 5, into a register, to store it temporarily, while it goes on to your next data entry, 10, which is also stored in another register, while it goes on to look at the instruction, "add." Add is a microinstruction which, decoded, says that the two data numbers will be added together, and the result is then stored in another register until it is called for, or erased from memory. (Of course each of these instructions required routing information on the bus to the proper register, etc., but that was understood because it was part of the microinstruction previously discussed.)

continued on page 47

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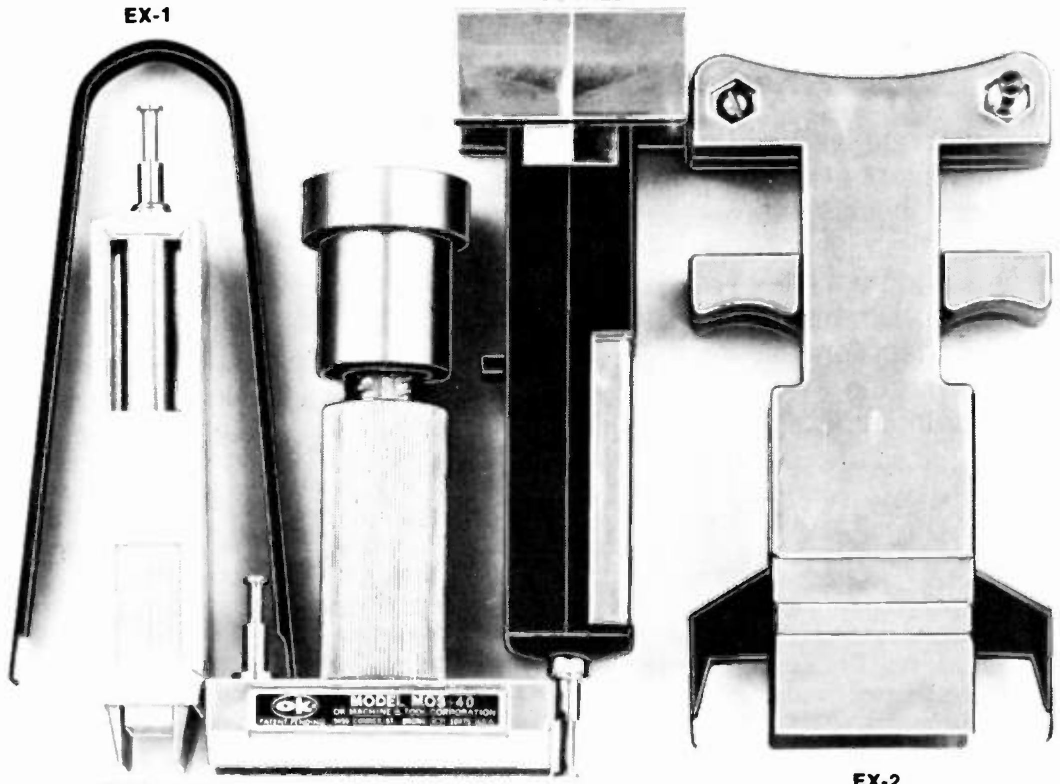

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A look at hourly rate labor pricing

How to compute those charges

Hourly versus flat rate labor pricing, which is best? In this article the author reviews the pros and cons of both labor pricing systems and then lets you make up your own mind. Either way their effectiveness depends entirely on the accuracy of your input data.

By William Joseph

Perhaps you work for a big company and thus have no responsibilities for setting service rates. If so, you may skip this article and congratulate yourself for your good fortune. At the same time, you may want to extend sympathies to your boss. Setting service rates is a tricky business.

Of course, there are a number of owners and managers who feel they have solved the problem nicely. They simply find out what the guy down the street charges and set their own rates accordingly. The trouble is that he may well have set his rates the same way and both of you may find yourself going broke together.

Setting the price for labor is a vital part of the service business; it must be done professionally.

When you sell a repair part to a customer, determining how much to charge for it is a relatively easy job. Every part in your inventory came to you at a specific cost. Arriving at the selling price is just a matter of applying the mark-up that you have decided to work with, or of referring to the recommended list prices widely available, through the latter practice can be dangerous.

By comparison, deciding the right price to charge for your labor is infinitely more difficult and exacting. When you or your technician complete a repair job, there is no invoice to tell you the precise cost of the finished product; yet this cost must be known if you are to establish the proper selling price.

And that's not all. Even after you develop expertise in determining your costs for labor and overhead, your pricing dilemma will be just beginning.

Factors that have no bearing on your own costs will rudely inject themselves into your computations. For example, the fellow down the street. What he charges for his labor will inevitably place limitations on the prices that would have solved all your income problems. Such are the joys of our free enterprise system.

Finally, we must consider the thoughest part of the entire problem—the customer. No one, absolutely no one, enjoys paying for intangibles, and service is probably one of the least tangible products in our marketplace today. That last automobile you bought may have left a permanent scar on your financial hide, but it was your free choice. Now, you have several thousand pounds of steel and shiny chrome that you can show off to your neighbors. When you pay a labor charge for a repair job, all you can show for your money is the same article you had before the repair became necessary. The skill and time spent in completing the repair is but a fleeting memory, and it cannot be seen, heard, or held in the hand.

Price determines profit

Despite these problems, or perhaps because of them, your ability to set the correct prices for your labor will be one of your most important skills as a service dealer. The service dealer buys and sells the labor of skilled technicians. In today's marketplace, the price that must be paid for such skills is high. Once you have paid this price, you must re-sell at a professionally determined price.

There is a tendency for many service dealers to set their rates on the basis of past practice and what competition charges. These are valid considerations, but they cannot stand alone. To be sure, this may seem to be an easy way to solve a tough problem, but please don't let yourself do it.

One of the earliest lessons that you have probably learned in this matter is that there is nothing even approaching uniformity among service dealers when it comes to setting service rates or in describing them to the customer. Home service, for example, has given birth to a dazzling array of ways to quote service rates. There are trip charges, minimum charges, visitation charges, basic charges, flat rates, *ad infinitum*. Shop work is not much better with some dealers using flat rate pricing, some time and material, and others some combination of these.

Obviously, then, there is no one format for labor charges with which everyone agrees. In this article, we'll discuss the most popular of the systems in use and then step back to allow you to reach your own conclusions.

Let's talk first about the original format, and still one of the most popular methods for labor rates, the hourly charge.

As with every other system for setting rates, the hourly method has both advantages and disadvantages. From the viewpoint of the service dealer, it can be quite attractive. It assures the company of a known income for each *productive* hour of its technicians. The charge to the customer is computed simply by applying the fixed hourly rate to the time spent on the job.

Of course, this system can produce some interesting inequities. An inexperienced or inept technician can take much longer than necessary to do a given job. In such a case, the customer pays a premium to underwrite on-the-job training. The dealer, in turn, is protected against unusual physical circumstances that can greatly lengthen the time needed to do an otherwise simple job.

Some advantages

With all these advantages accruing to the service dealer, one could assume that knowledgeable customers would be opposed to the hourly rate. Well, some are and some aren't. There is at least one advantage to the customer that is considered significant in many quarters.

Under the hourly rate, the customer has use of the technician's time for the full period charged for. This is viewed by many people, both in and out of the industry, as a sort of discipline that tends to keep things on the up-and-up. Perhaps this is why the hourly rate retains its popularity.

Let's say that you have chosen the hourly rate method for your operation. Congratulations, you have completed the easiest part of the job. Now, how do you decide exactly what that hourly rate should be?

Remember, the first step in determining how much to charge for your labor is learning how much it is costing you to supply it.

The first part of that cost is obvious enough. For each hour worked by your technicians, you must pay them their hourly wage rate. This, as you know, is only a part of your total cost. All of the other costs of doing business must be added to your technical payroll in order to determine your full cost for each hour of technical productivity. One popular method for doing this requires that you determine your overhead ratio (or burden ratio as it is sometimes called).

Here's how

Select a period of time upon which to base your calculations. Three months is a minimum and six months or a year would be better. For the period selected, add together *all* expenses for the business except technical payroll. Be sure not to overlook any expenses in this step. Include managerial and supporting payroll, occupancy expenses, advertising, depreciation, everything that is not direct technical payroll. The only exception that should not be included is the direct expense that can be identified with the parts portion of your business: cost of parts, payroll devoted exclusively to parts, etc.

Once you have determined your total overhead expense, divide that figure by the total technical wages paid during the exact same period (be sure to include any paid vacations or paid illnesses). The result will be your overhead ratio.

Depending on the size and the efficiency of your business, your ratio may be as low as .8 or .9, or it may run as high as 1.5 or even higher. If your overhead expenses were exactly the same as your technical payroll, your overhead ratio would be 1.0. Get the idea?

Let's examine some figures from the hypothetical ABC Service Company.

Total overhead for the period	$13,860
Technical payroll for the period	$12,600

13,860 divided by 12,600 = 1.1

ABC's overhead ratio of 1.1 simply means that for every dollar paid to technicians, an additional $1.10 is needed to pay for overhead costs.

Take the average

The next figure we need is the *average* hourly wage paid to technicians. Let's say ABC pays one man $7.00 per hour, another $7.50, and a third $8.00. The average wage for the three men is $7.50. Assuming that its technicians average an eight hour day, the average daily rate is $7.50 × 8 = $60.00. In other words, on the average, ABC pays its technicians $60.00 for a day's work.

We have already determined that ABC has operating expenses amounting to $1.10 for each $1.00 paid to technicians (an overhead burden of 1.1). In order to get the total cost burden daily for each technician, we need only to add his average daily wage to his average daily burden ratio.

Technician daily wage average	$60.00
Technician daily cost burden (60 × 1.1)	$66.00
Total technician burden	$126.00

That total of $126.00 represents the average cost to ABC for each technician working a full day. Put another way, it is the technician's breakeven point. If ABC's technicians went out and averaged $126.00 per day in labor charges to the customer, the company would break even.

Of course, that's not the idea. Your job is to establish rates that will generate a fair profit. If the service manager at ABC has set a 10% labor profit as his goal, he must divide his breakeven point by .9.

$126.00 divided by .9 = $140.00

Now we're getting down to brass tacks. Using the figures above we now know that each technician must generate service charges of $140.00 per day in order for ABC to make a 10% profit on labor. Computing the hourly rate is now easy. All we have to do is divide the $140.00 by eight. Right?

Wrong!

Determine productive time

To do so would be to assume that each technician is doing productive work for the entire eight hours of his working day. That, of course doesn't happen. There are such things as coffee breaks, travel time, training time, shop clean-up, checking paper work, and on and on. Industry studies indicate that only about 55% of the average technician's eight-hour day is spent actually doing repair work. That comes to about 4½ hours. In some especially efficient or highly specialized operations that efficiency figure may run as high as 80 or 90%. For the purpose of our illustration, let's say that ABC's technicians are productive 70% of the time. That works out to about 5.6 hours per day.

$140.00 divided by 5.6 = $25.00 per hour

For each full hour spent on the job, ABC must charge $25.00. Usually, this will be broken down into quarter hours or tenths of an hour increments. In this example, each quarter hour would be billed at $6.25.

For home service calls, most dealers will further refine the hourly rate to arrive at a minimum or basic charge which will cover up to a certain amount of time, after which the hourly rate applies.

In reading back over the example used, you will note that the productive time of the technicians is a factor that must be known. You can't hedge on this step. If you don't already know the productive time of your technicians (or even yourself) be prepared for a shock.

In order to compute productive time you'll need to add up the actual time spent on jobs as compared to the hours paid over a representative period of time. Don't use industry averages or guesswork for this step, it's too vital to your financial success.

Flat rate pricing

Incidentally, reducing the non-productive time of your techs will allow you to charge a lower rate to your customers, or to enjoy a higher profit margin, or some combination of both.

The flat rate system for labor charges represents an entirely different concept. With flat rates, the labor charge for every type of repair is calculated in advance and remains the same regardless of the time required to do the job.

Proponents of the flat rate system point out several advantages over the hourly rate. On the surface, at least, there would appear to be advantages for both the customer and the service dealer in flat rate systems.

From the customer's standpoint, flat rates offer good insurance against surprises. The customer knows precisely how much his repair job is going to cost him even before the work is done.

The service dealer, too, enjoys some advantages in flat rates. Every repair job results in a known and fixed income. An additional benefit accrues to the dealer as a result of the technician not having to spend time making a record of starting and ending times and computing time spent on the job.

Tracking statistics

As you might imagine, preparing your own table of flat rate prices is no mean task. The job requires an immense amount of statistical analyses and, for all practical purposes, may be beyond the means of all but the largest service dealers. At least two different means of solving this problem have been put to use in recent years.

In one system, only a handful of prices need be set. All repair jobs are classified as home or shop, and each of these is further identified as major or minor. Fixed rates are based on overall averages and assigned to each of these four categories. In some cases, an additional price or two may be listed for special jobs such as picture tube replacements.

This is obviously the easiest form of flat rate pricing, but it is also the least professional and may be the most difficult to defend against flat rate critics.

Another format that is gaining acceptance is the commercially available flat rate manual patterned after the system originally developed in the auto repair industry. The use of this form of manual offers the dealer the advantage of a much more extensive and detailed analysis of average times than could be developed locally. There is also a certain psychological advantage in having the customer see the technician referring to an "official-looking" manual for his prices.

One of the most popular of these pricing systems developed especially for the electronic service dealer is the Sperry Tech labor pricing guide. Information can be obtained by writing to the company at P.O. Box 5234, Lincoln, Nebraska 68505. (Also see ET/D, May 1979, P. 32.)

While it is true that flat rate systems are becoming increasingly popular for pricing labor in the electronic servicing industry, you will be well advised to remember that not everyone is enchanted with the idea.

Pricing by the book

It is in the auto repair field that the concept came into its own, and that is where the sharpest criticisms are still being aimed. Pricing from "the book" is so widespread in the auto industry that shopping around for the best price on a given repair job may well net the customer nothing more than six identical estimates and some extra miles on the speedometer.

Whether they are right or wrong, critics of the auto repair flat rate manuals claim that the average mechanic can and usually does complete jobs in less time than the manuals list. One well-known consumer organization claims to have performed its own repairs on a wide variety of autos and repair types and compared the actual time spent with the times listed in one of the most widely used flat rate manuals in the industry. The test, it is said, showed that the times listed in the manual were, on the average, 25% longer than the time actually spent by the mechanics during the test.

In fairness, this could mean that the mechanics used in the test were simply 25% faster than average—or it could mean that the times listed in the book do not represent a realistic expectation of the time needed by a reasonably competent mechanic to do the work.

In any case, you will want to keep yourself aware of the obvious risks and criticisms that may come your way if you adopt a flat rate program. If the times used in the listings have not been scrupulously and fairly computed, the flat rate system can indeed become unfair to the customer.

A reasonable option

Properly prepared and administered, the flat rate system of pricing is a reasonable option to the electronic service dealer. It is up to the dealer, however, to handle it in such a manner that the customer receives a fair deal. It is, after all, comforting for a customer to know exactly what a repair job is going to cost before the work is done. Whether the customer receives a fair deal is less a matter of the choice of pricing formats than of the integrity of the service dealer involved.

If you are using or are planning to use some form of flat rate pricing, there is one simple check that will help to satisfy you of its fairness: Jobs that require more time than listed should be in evidence as often as jobs that are completed in less time.

Remember, the basic premise of flat rate pricing is that every customer pays for the *average* time to complete a given repair job. If the average time is properly and accurately computed, neither the customer nor the dealer need have any surprises and both will have been treated fairly in the vast majority of cases.

As a closing note, let me remind you that the increasing militancy of consumer organizations makes it more important than ever that service dealers use a pricing system that is understandable to the customer, and

continued on page 47

Servicing regulated power supplies

Background and case histories

Proper operation of the low voltage power supply and low voltage regulators is basic to many units of entertainment electronics. The technician must avoid being sidetracked into other areas of circuitry when the power supply is at fault.

By Homer L. Davidson

Fig. 1–Here a TV technician is servicing the voltage regulator circuit of a portable color TV.

Sometimes it's easy to overlook low voltage regulator circuits and spend useless hours in other circuits. The dead or intermittent TV chassis[1] trouble may be caused by the voltage regulator circuits in the power supply. Other symptoms caused by low voltage in the power supply may be insufficient width, poor sound, poor sync or no color.

The purpose of the low voltage regulated power supply is to stabilize the voltage applied to critical circuits. If the power line voltage changes from 115 to 132 volts, its regulated output voltage will remain constant, providing protection to the TV or radio circuits. In most TV circuits, with some type of voltage regulation, the dc output voltage is set at a certain voltage for correct circuit function. When the dc output voltage varies only 3 or 5 volts, the HV applied to the CRT may change several kilovolts.

The low voltage regulator circuit may be used in TV, radio or stereo chassis. You may find in the TV chassis, a separate voltage regulator for critical stages. While in the stereo chassis, the whole B+ source may be regulated. A single zener diode may provide voltage regulation in the radio. Here we will show you how to service defective voltage regulator systems.

A simple regulator circuit

The simple voltage regulator circuit may consist of a zener diode or a couple of transistors (Fig. 2). In this circuit only one APF transistor is used for a regulated 12 volt source. The output voltage is varied with VR-3. Any voltage change from the power supply will be absorbed by the transistor circuitry.

You may find the simple voltage regulator circuit in a separate section of the TV chassis to supply the tuner and IF sections. The entire B source of a stereo compact may be controlled by a simple regulator circuit, while the auto stereo 8-track player motor supply may be regulated by a very simple zener diode circuit. Generally, the simple voltage regulator circuit is easy to service, but in some TV chassis you may find rather complicated circuits.

A deluxe regulator circuit

Here in a Panasonic portable color ETA-3 chassis, we find a more complicated voltage regulator circuit with 5 transistors, a thyristor and several diodes. This same chassis may be found under J.C. Penney and other TV labels. This voltage regulator circuit can be serviced with a VTVM and scope (Fig. 3).

The full-wave rectifier waveform is applied to the base of TR801. TR801 is a pulse amplifier and sawtooth generator. The output pulse from the collector of TR801 is converted into a sawtooth waveform by R806, R808 and C807 and is fed to the base of TR802.

Changes in the emitter voltage of TR802 results in a changing phase of the pulse at the collector terminal of TR802. Here, we find a square waveform. This squarewave voltage is differentiated by C808 and R811.

The collector of TR804 is connected to the emitter of TR802 through R813 (560). TR804 is a detector to compare the output voltage with a zener diode in the emitter circuit. Adjustment of R816 (500) in the base circuit of TR804 will adjust for an operating voltage of 115 volts at the load.

C808 (.01) couples the differentiated waveform to the base of the pulse amplifier TR803. The sharp positive pulse from the collector of TR803 is fed to the primary winding of transformer T801. The secondary winding of T801 is connected between the gate and cathode of thyristor TR805. If a parabolic waveform is applied to the anode of the thyristor and the voltage is lower than the cathode-gate voltage, no current flows into the thyristor gate and the thyristor ceased to conduct. Thus, TR805 keeps a constant voltage applied to the large filter capacitor C853 and the active power filter (APF) circuits.

The ripple voltage across capacitor C853 is undesirable and must be filtered. The active power filter (APF) circuit transistors TR806 and TR851 are employed to eliminate ripple. This filtering prevents the TV picture from fluttering due to an abrupt change of the ac line voltage.

Although this voltage regulator circuit may be a little more difficult to repair, it does a great job regulating the dc voltage source.

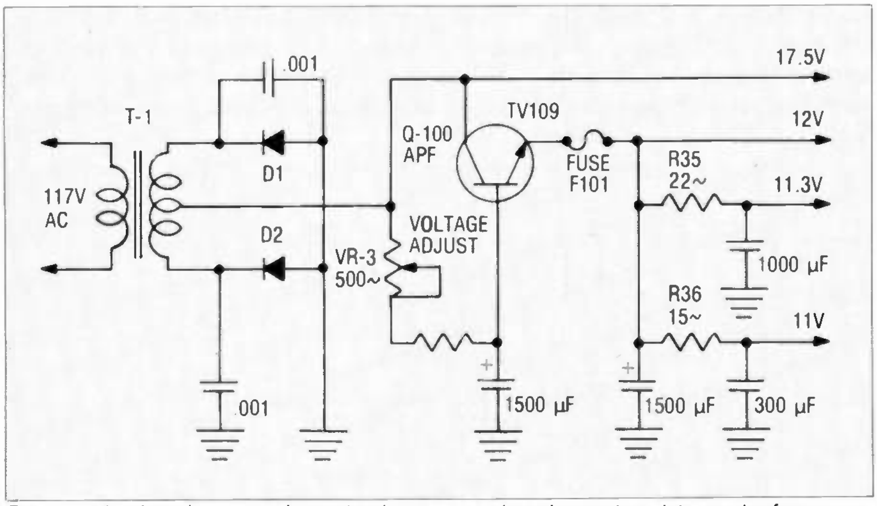

Fig. 2–A simple voltage regulator circuit may contain only one transistor and a few components.

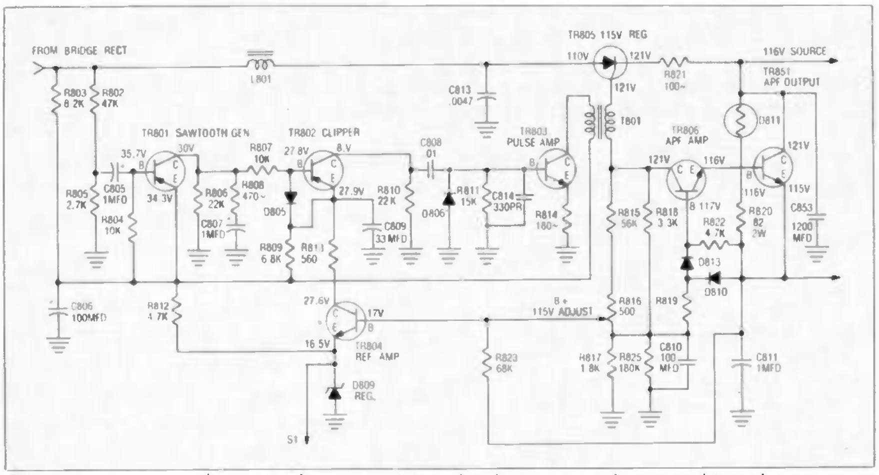

Fig. 3–A more complicated voltage regulator circuit may contain several transistors, diodes and other components.

General troubleshooting

In a TV chassis, the symptoms caused by the low voltage regulated power supply may be insufficient width, intermittent raster or a completely dead set (Fig. 4). A defective regulator circuit

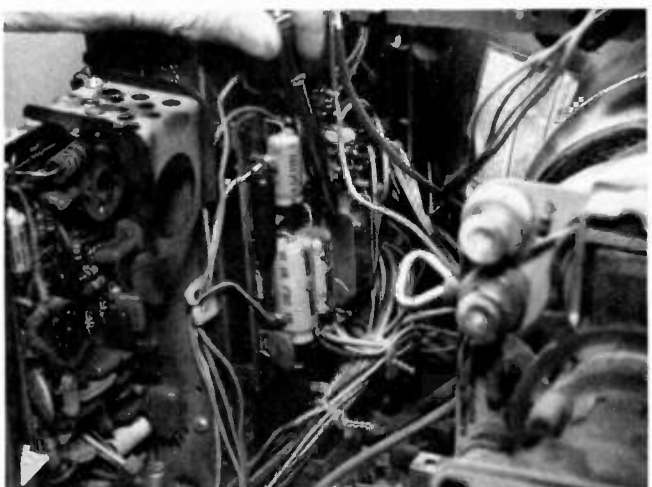

Fig. 4–You may find the voltage regulator circuitry packed or tacked in any place in a Japanese TV receiver. Some of them may be a little difficult to get at for servicing.

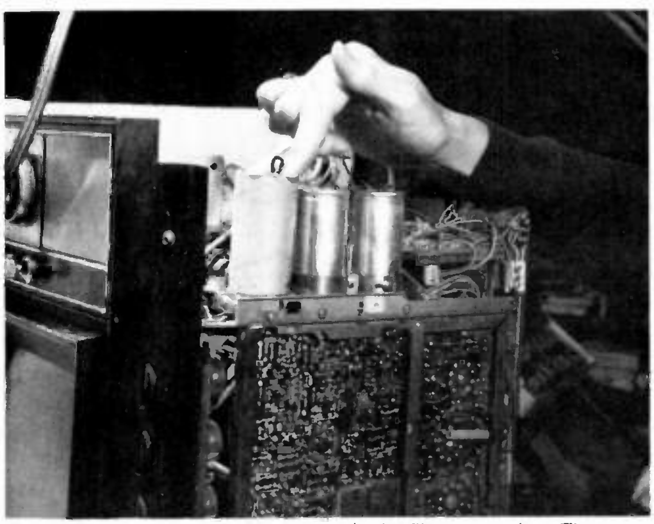

Fig. 5–Don't overlook a dried-up or leaky filter capacitor. These capacitors range from 220 to 1500 mfd.

in a stereo chassis may cause weak or no FM or AM reception. When the voltage regulator circuit in a car stereo-8 track chassis is defective, you may encounter fast or slow motor speed or a dead unit.

First, determine if the problem lies in the power supply or another circuit. Measure the regulated dc output voltage. If the voltage is normal within 5 volts, suspect trouble in other circuits. When the voltage is very low or cannot be varied with the voltage adjustment control, suspect problems in the power supply. To make sure, disconnect the low voltage source from the other circuits. Normally, you will see an increase of less than 5 volts at the output.

We must remember the failure of a voltage regulator transistor may be caused by an overload caused by other circuits. Be sure and check the horizontal output transistor and damper diode for leakage. Measure the resistance between the collector terminal of the horizontal output transistor and chassis. If the resistance is below 1K, remove the output transistor and check it out of the circuit. While the transistor is out of the circuit, check the damper diode for leakage.

A dead chassis may be caused by a blown line fuse or silicon rectifier diode. Check for dc voltage at the cathode terminals of the diodes or bridge rectifiers. If there is no voltage, check for applied ac voltage at the diode anode. No voltage at this point may be caused by an open fuse, fusible resistor or defective off/on switch. An open power transistor in the low voltage regulator circuit may produce a dead set.

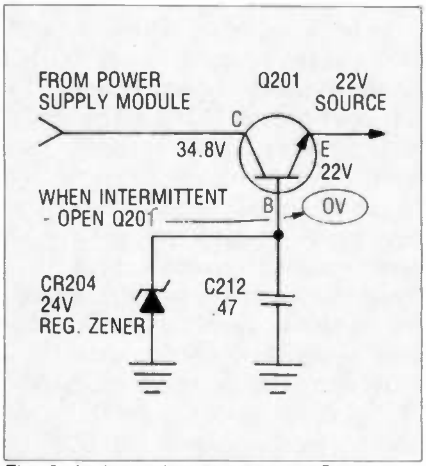

Fig. 6–An intermittent raster in a Zenith color TV chassis 23HC45 was caused by a voltage regulator transistor opening up.

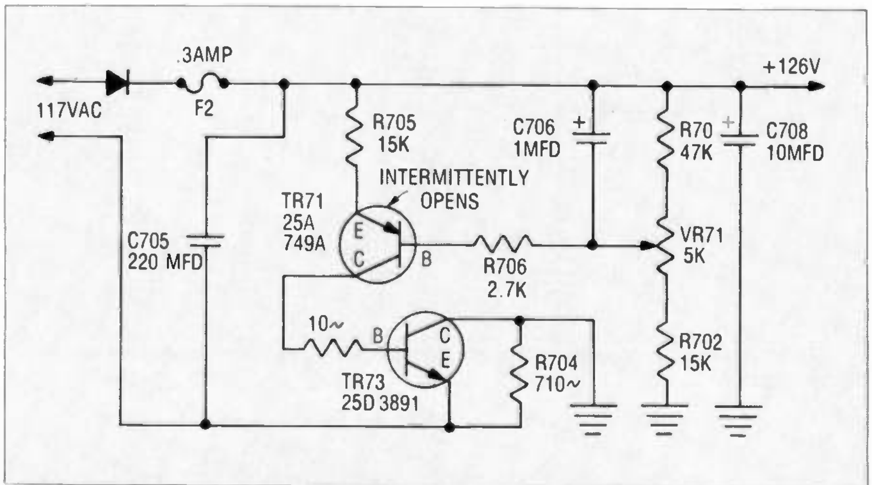

Fig. 7–Intermittent width problems are more difficult to locate. In this Penneys' model 1022, TR71 would open up causing a low dc voltage.

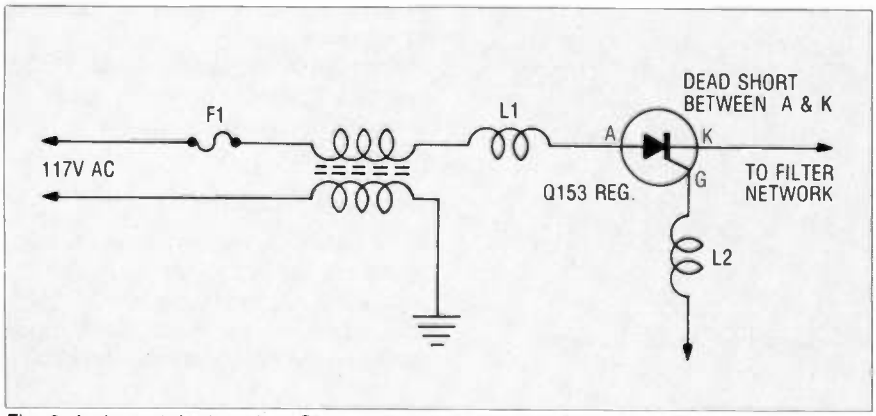

Fig. 8–A shorted thyristor in a Sears 528-42022506 chassis caused the fuse to blow immediately, each time it was replaced.

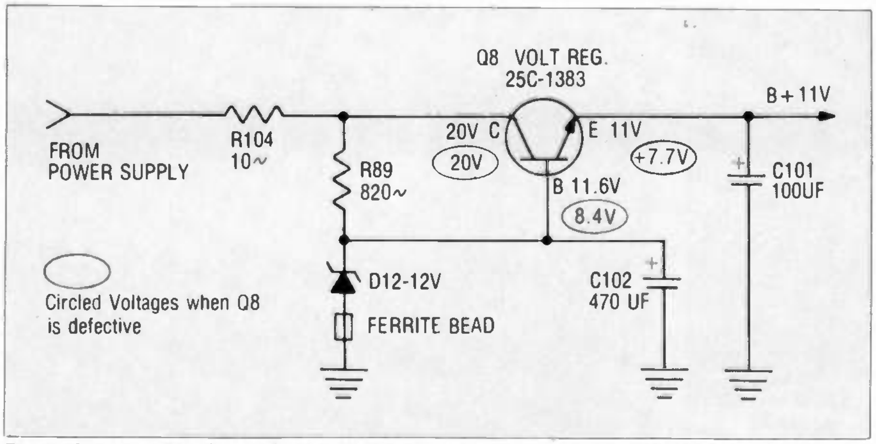

Fig. 9–Output only a few volts low in this Monteverdi model CG-001-0014 caused weak FM and choppy AM reception.

Improper voltage applied to the APF power filter transistors may cause low output voltage. Burned or changed tolerance of resistors produces improper voltage. Generally, open or leaky regulator transistors cause low output voltage. Don't overlook the main filter capacitor for low output voltage. A leaky zener diode may produce insufficient voltage to the various circuits.

No sound—no raster

When the solid-state TV chassis appears dead, measure the voltage at the low voltage source output or at the collector of the horizontal output transistor. Generally, the case of the horizontal output transistor is the collector and is easily located. If the voltage is normal at the horizontal output transistor, you may assume the trouble lies in the horizontal circuit. When the dc voltage is low at the horizontal output transistor, the problem may be caused by it or by the low voltage power supply.

Measure the low voltage supply at the source. If it is low, remove the horizontal output transistor to determine if the horizontal circuits are loading it down. Generally, only a couple of chassis screws need to be removed to pull the suspected transistor. You may find the horizontal and audio output transistors operate directly from the highest low voltage source. If the dc voltage source returns to a little higher than normal with the horizontal output transistor removed, the trouble is in the horizontal circuit.

In case the dc output voltage is still too low or is absent, suspect a defective low voltage power supply. If no voltage is found at the output point, go directly to the silicon rectifiers. No dc voltage at the cathode terminals may indicate an open diode or open line fuse. Check for ac voltage applied to the anode of the low voltage rectifiers. No ac voltage may indicate an open fuse or fusible resistor. Don't overlook an open large wattage filter resistor in a dead TV.

Narrow TV picture

Poor width in the TV picture may be caused by low voltage from the power supply. Compare the measured voltage with the schematic. Adjust the low voltage source. Check the low voltage regulator circuit if the voltage will not increase or adjust.

Take voltage measurements of all transistors and zener diodes. A lower voltage at the cathode of a zener diode may indicate leakage. Feel the diode for overheating. Remove one end of the suspected zener diode and test with the ohmmeter. You should measure under 10 ohms one way and infinity with reversed test leads. A leaky diode may read in both directions.

Improper voltages found at active filter transistors may indicate opens or leakage. These active filter transistors are large current carrying transistors and some run fairly warm to the touch. Remove the transistors from the circuit to test for leakage and opens.

Burned or broken bias resistors may cause low voltage in the regulated power supply. Check for resistors that show signs of overheating. You may find one end melted out of a soldered connection on the pc board. Large wattage resistors have a tendency to open up or to increase in resistance. Don't overlook a dried-up filter capacitor which also may produce insufficient width of the TV raster (Fig. 5).

Intermittent width

Intermittents in the power supply may take a little longer to find than no or low voltage. Monitor the output voltage at all times. When the supply acts up, you can see the variation of the output voltage. The voltage may go to zero for no raster or as low as 80 volts for a narrow picture. Between the two, the intermittent raster is easiest to locate.

Most intermittents are caused by transistors and resistors. You may also encounter a defective electrolytic capacitor. Try not to disturb any component until you have located the defective one. First suspect open transistors. Check for zero voltage at the emitter (Fig. 6), especially if the power active filter transistor is the flat type. These transistors are noted for internal opens. Wiggle the transistor terminals and see if the transistor "pops" on. Suspect coupling capacitors in thyristor type circuitry. A pulsating raster may be caused by a large electrolytic filter capacitor (800 mfd or larger). The B+ voltage may go below 80 volts in an intermittent width situation. In simple voltage regulator circuits, suspect a power transistor. A power filter transistor may open causing the narrow raster.

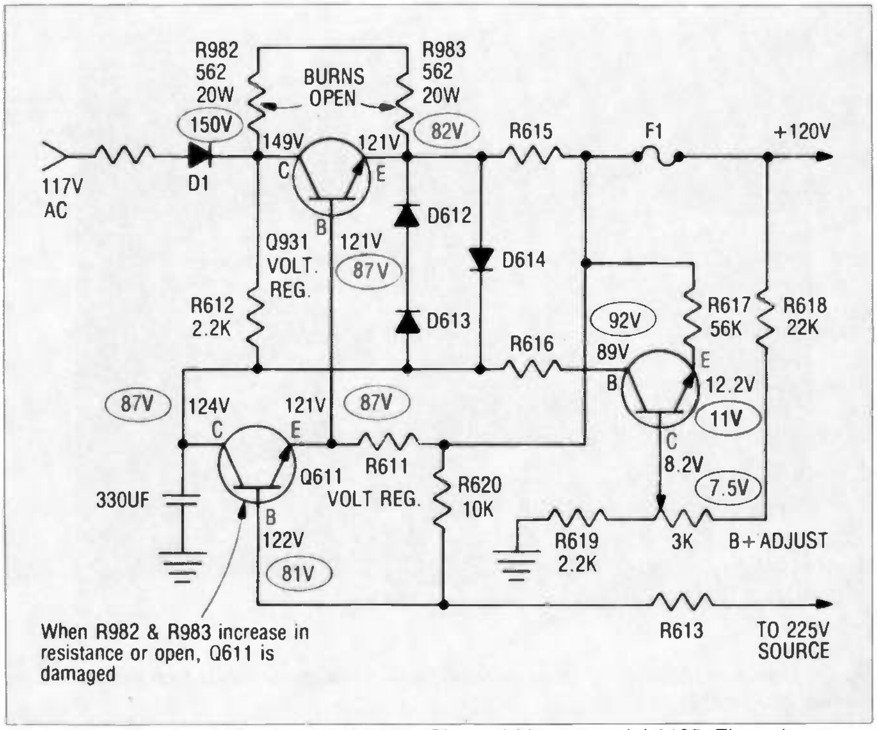

Fig. 10–Insufficient width was noted in this Channel Master model 6125. The voltage adjustment would not pull the raster out to fill the screen.

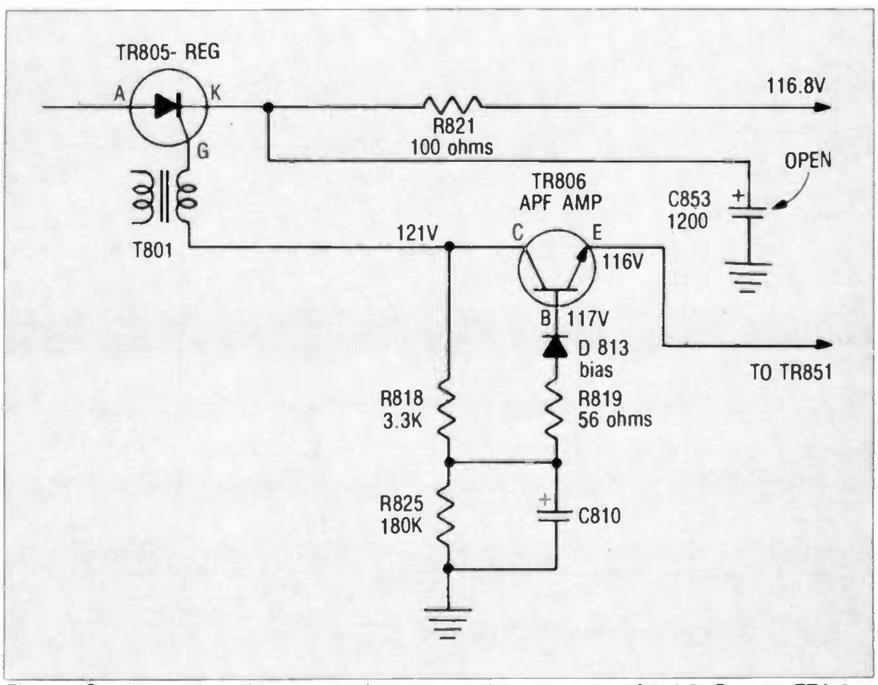

Fig. 11–Good sound, and a narrow picture were the symptoms of a J.C. Penney ETA-3 chassis. Only 98 volts was present at the low voltage supply output

Check for overheated resistors and poor pc board connections. The wiper contact of the voltage adjustment controls have been known to be intermittent.

Keeps blowing fuses

If the main fuse blows each time a new one is inserted, suspect an overload caused by outside circuits or within the power regulator circuit. Sometimes a fuse is found in the output voltage load circuit. If this fuse is not blown, suspect the power supply. Generally, the load fuse will blow first, if an overload occurs in the horizontal output circuits.

A constant blowing of the main fuse may be caused by low voltage rectifiers. In bridge rectifier circuits, unsolder one lead of each diode for leakage tests. Suspect a shorted thyristor or SCR when one is used in the voltage regulator circuit. A direct short between terminals A and K will automatically blow the line fuse (Fig. 8). Also, check for a leaky active power filter transistor.

Leaky filter capacitors may cause the line fuse to open. These capacitors can either dry up or short internally. Check for low resistance reading across the suspected capacitor terminals. Remove the positive lead to determine if the capacitor is leaky. Always choose equal or higher capacitance when shunting another electrolytic capacitor across the suspected one.

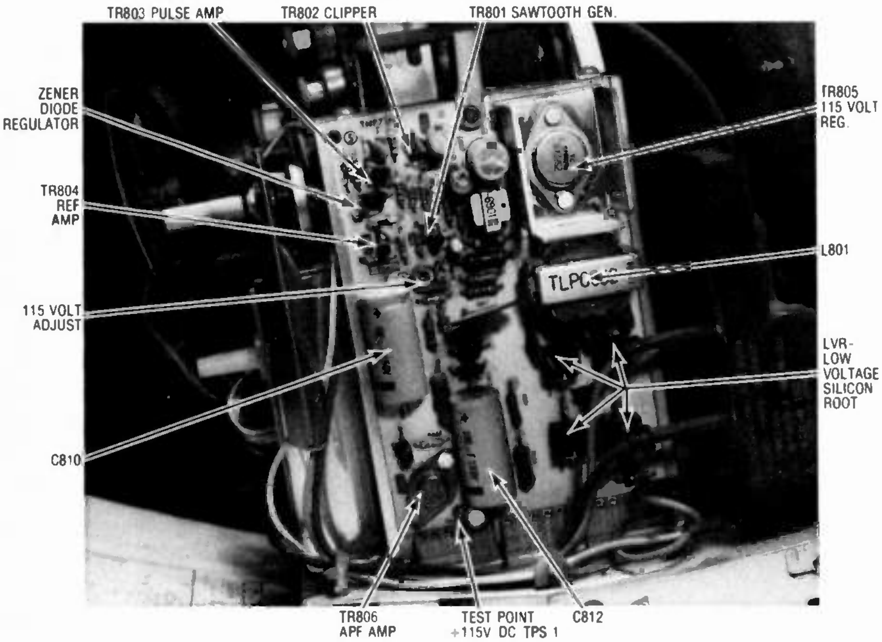

Fig. 12–Here is a photo layout of a Panasonic ETA-1 chassis which is found under J.C. Penney and other labels.

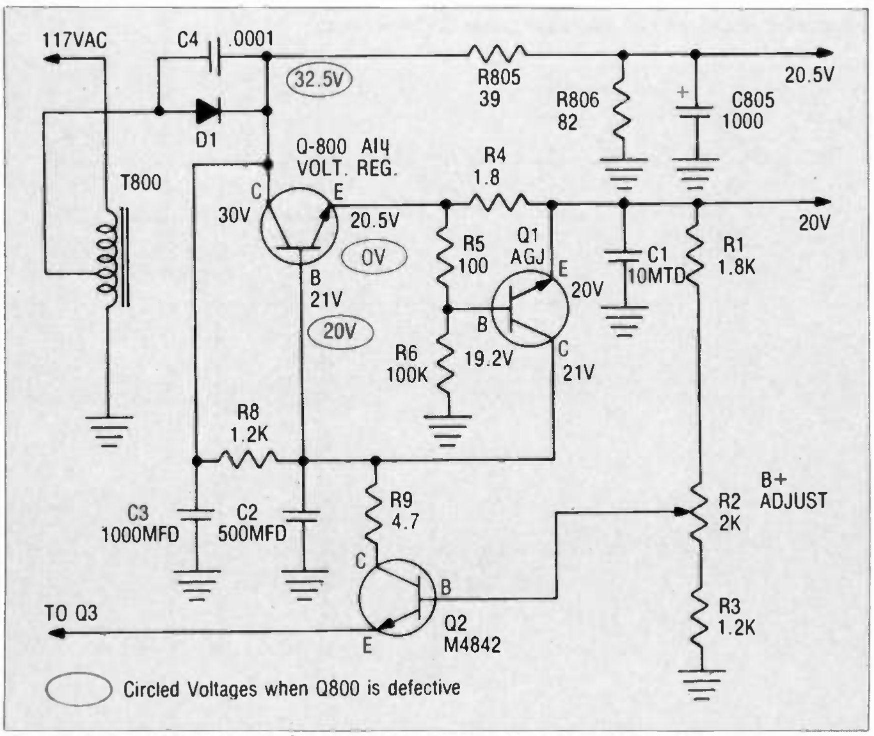

Fig. 13–A dead Motorola 18TS-929 hybrid chassis came in with the main relay not energizing because of an open pass transistor in the low voltage regulator.

Weak FM—choppy AM

A Monteverdi model CG001-0014 radio came in with weak FM and choppy AM. Sometimes the local AM stations would not tune in at all. We noticed the RF transistor (Q1) and FM-AM IF IC (AN277) had both been replaced.

All voltages on the AM and FM RF transistor and the IC were from 1 to 3 volts lower than indicated on the schematic. Checking back into the supply, we found only +7.7V where we should have found around 11 volts (Fig. 9). Here we suspected a defective voltage regulator transistor Q8 (2SC1383). Voltage measurement found the collector voltage normal (20V) but the cathode and base terminal voltages were about 3 volts too low.

The voltage regulator transistor was removed and found leaky. But, replacement of Q8 did not solve the whole problem. The 12 volt zener diode was found leaky. When it was replaced, the voltage source measures 11.5 volts. Replacing the voltage regulator and zener diode restored the FM reception. Readjustment cured the choppy AM reception.

Insufficient width

The right side of the raster was pulled in about ¼ of an inch in a Channel Master 6125 TV model. The voltage adjustment in the low voltage power supply had no effect upon the narrow raster (Fig. 10). HV measured normal. The low voltage source, however, was only 89 volts, while it should have been about 120 volts.

First, all transistor voltages were recorded on the schematic. They were all low except the voltage (150V) on the collector of Q931. Since the voltages were all low and quite close, Q611 was suspected of being defective. It was removed from the circuit and found to be leaky, and replaced with an RCA SK3124.

The output voltage came back up to 120 volts but after two minutes the narrow raster was back again. We found Q611 too hot to touch. A closer examination of the pc board turned up R982 and R983 (20W) resistors as possible suspects. These resistors run quite warm and sometimes melt the solder upon the pc board. If either one opens, Q611 will be destroyed. Both resistors were removed, checked and replaced with retinned leads.

Replacement of both resistors and Q611 solved the narrow raster problem. When large wattage resistors are found across the voltage regulator transistor, remove them and check for correct tolerance. Also, reset the voltage control to the correct voltage.

Good sound—narrow raster

Besides funny lines in the picture, this J.C. Penney 2877 model had a narrow raster (Fig. 11). The sound was normal. Only 98 volts was found at the supply output. The 115 volt adjustment (R816) would vary the voltage source about 5 volts. The horizontal output transistor (TR551) was removed to eliminate the possibility of an overload caused by the horizontal section.

In this particular chassis R819 (56Ω) was burned beyond recognition. After R819 was replaced, it ran too hot to touch. The active power filter (APF) amp (TR806) was removed and tested good. While it was out of the circuit, diode D813 checked normal. The APF output transistor (TR851) was removed and tested okay. When capacitor C853 (1200μf) was shunted, the raster returned to normal. It solved the overheating of R819.

There have been many other problems occurring in this same Panasonic power supply. When the circuit breaker keeps kicking out, suspect a shorted or leaky thyristor TR805 (2SF248) in a Panasonic ETA-1 chassis. Check for a high leakage or a short between terminals A and K with it out of the circuit. A good thyristor will measure above 50 megohms between A and K. You may find 50 ohms between K and C terminals; this is normal.

When no output voltage is found at S4 (+115V) suspect problems in the regulator system (Fig. 12). Measure the voltage at the anode terminal of TR805 which should be around 107.5 volts. If no voltage is found at the cathode (K) terminal, go directly to the sawtooth oscillator (TR801) with the scope.

Check for a sawtooth waveform at the collector terminal of TR801. Take voltage measurements when an improper waveform is found. You may notice the voltage at all terminals of TR801 are the same. A leaky TR801 will not oscillate and will apply incorrect voltage to TR802. When TR801 is leaky, the base and emitter voltage will increase to the 38.5 volts of TR802 and there will be zero voltage on the collector terminal. Use the scope to locate the defective stage and back it up with voltage measurements in this type of voltage regulator.

A dead Motorola

There was no life in this Motorola hybrid chassis, 18TS0929. In this model a dc relay must close to apply operating voltage to the circuits. Since the relay did not energize, the dc voltage source (20V) was traced back to the low voltage regulator circuits (Fig. 13). Adjustment of the B+ control R2 would not help the situation.

Voltage measurements were taken upon the voltage regulator transistor (Q800). The collector voltage was normal, but 20 volts on the base and zero volts on the emitter were noted. Q800 was removed since it was suspected of being open. It tested good. Since these flat type transistors have a tendency to open up internally, a SK3054 transistor was installed and solved the problem.

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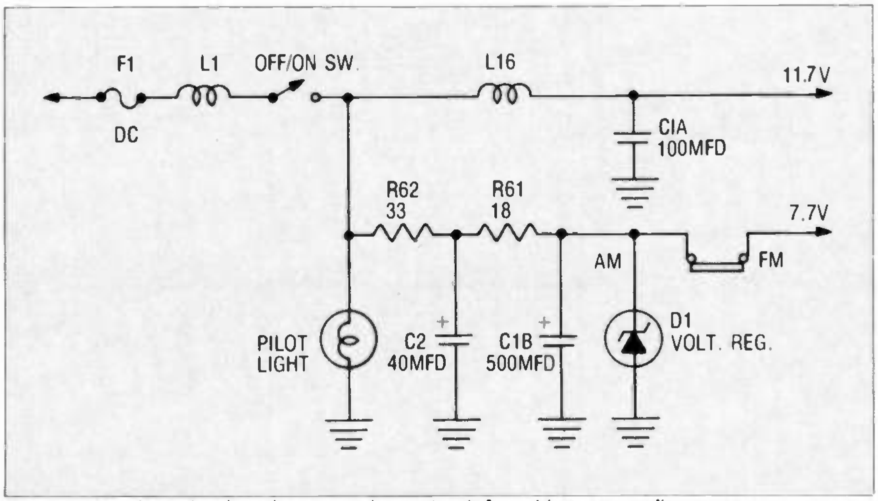


Fig. 14–Here is a simple voltage regulator circuit found in a car radio.

The Sharp SC-8000 MKII

More microprocessor control

Control systems of audio equipment as well as those of TV sets are becoming quite elaborate. "The tail is beginning to wag the dog," in the words of the old proverb.

By Walter H. Schwartz

About a year and a half ago (April '78), ET/D mentioned in a microprocessor article Sharp's then new microprocessor controlled cassette deck. The use of microprocessors has expanded and at present Sharp and Optonica (another brand name used by Sharp for an extensive line of audio components) have several cassette decks and receiver/cassette deck combinations using microprocessor control of tape functions.

The Sharp Model SC-8000 MKII is typical of these units. It is a 20 watt per channel (RMS) receiver/cassette combination using 55 discrete transistors, and 13 IC's, plus the control microprocessor and a Hall effect IC.

The microprocessor control system, not the internal workings of the microprocessor, will be described here as will be some features of the receiver circuitry. The heart of the system is the LI-3013 LSI microprocessor which receives information either from the manual controls or from certain sensors and using this information starts and stops the motor, finds a specific location on the tape and performs other functions

The latest, the new Optonica RT-6905 with four memories, remote control, and repeat function.

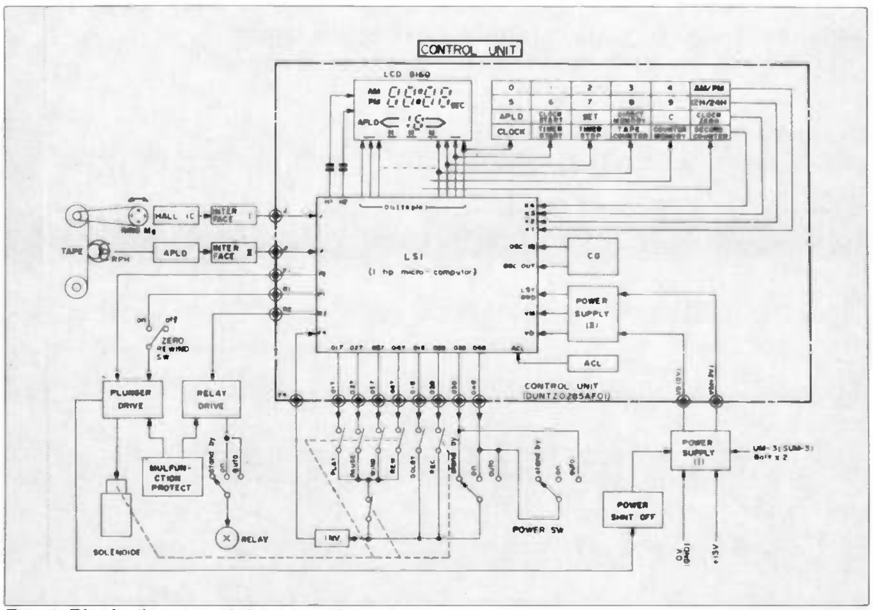


Fig. 1 Block diagram of the control system.

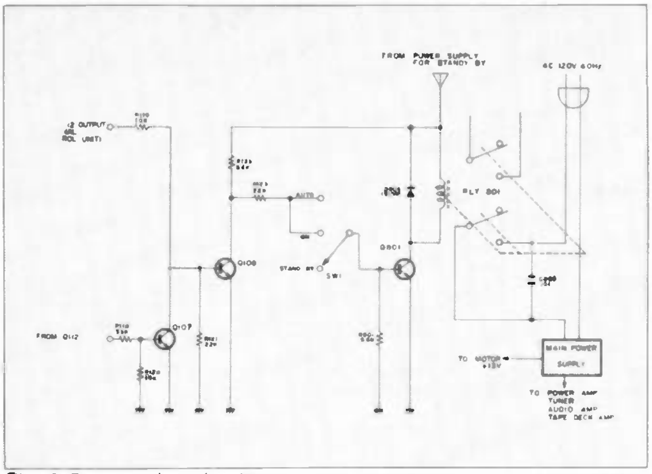


Fig. 2 Power relay circuit.

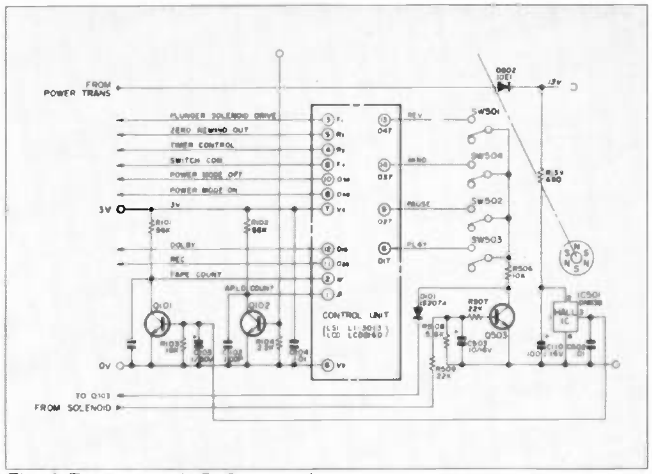


Fig. 3 Tape count/APLD control.

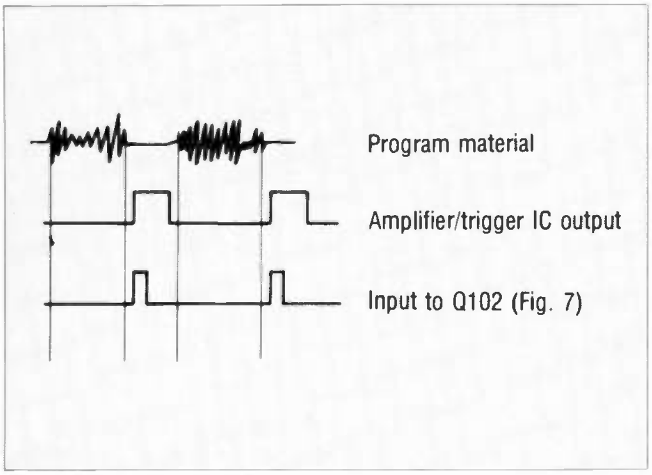


Fig. 4 APLD pulse waveforms.

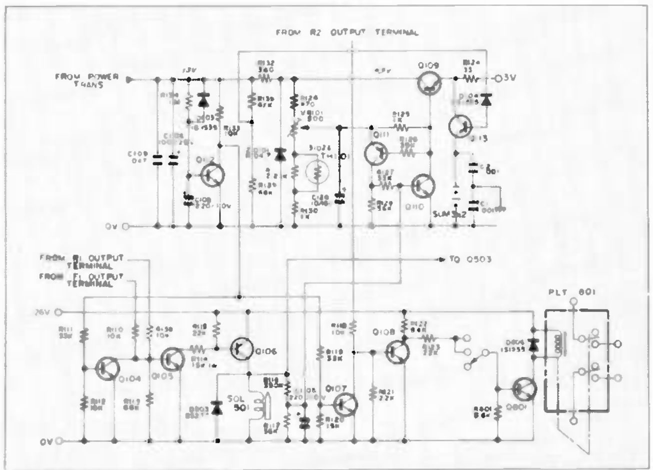


Fig. 5 Solenoid drive/output protection circuits.

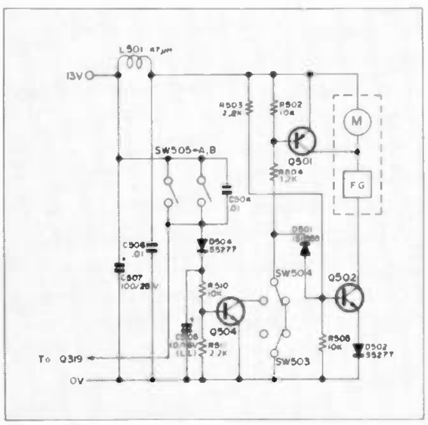


Fig. 6 The motor control/brake circuit.

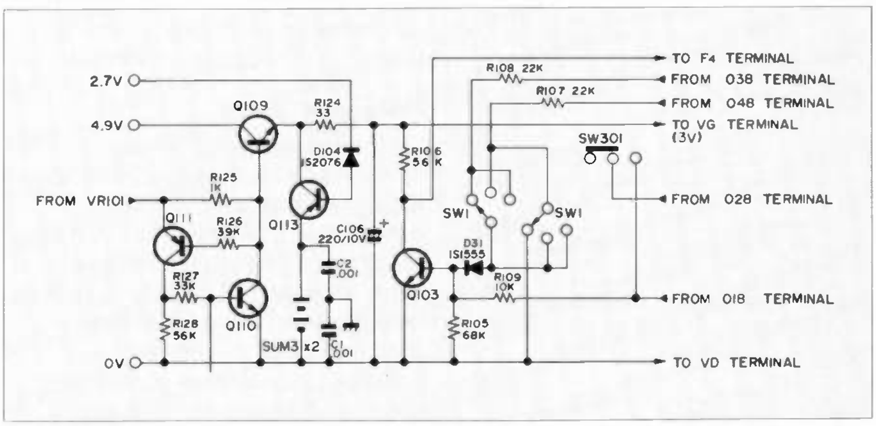


Fig. 7 Power supply.

as called for (Fig. 1).

Motor control and brake

The motor stops when Q502's base is grounded through D501 and SW504 and SW503 (the rewind and play switches, Fig. 6). If the play switch SW503 is opened, Q502's base is biased on through R503 and the motor can run. If the fast forward or rewind switches are operated, SW504 is opened (connected to the collector of Q504, which is turned off at this time), and again, Q502 is turned on and the motor can run.

To stop the motor, brake/motor switch SW505, which is electrically interlocked with the mechanical function keys, closes, turning off Q502, shutting off motor power and turning on Q501 shorting, and electromagnetically braking the motor.

Main power control

When the unit is at "Stand-By" (effectively off), Q801 and RLY801 are off (Fig 2). When the power switch is "ON" the output terminal R_2 of the microprocessor (Fig. 7) is low, Q108, is off, Q801 is on and RLY801 closes applying power to the main supply. When "AUTO" is used, R_2 output can change high or low, depending on the timer requirements. When timer start is commanded, R_2 is low and the power is turned on. When timer stop is commanded, R_2 goes high and the power is off.

Tape count generator

Tape position is indicated by electronically counting the rotation of the take up reel. A magnet rotates with this reel and produces by means of a Hall device IC three output pulses per

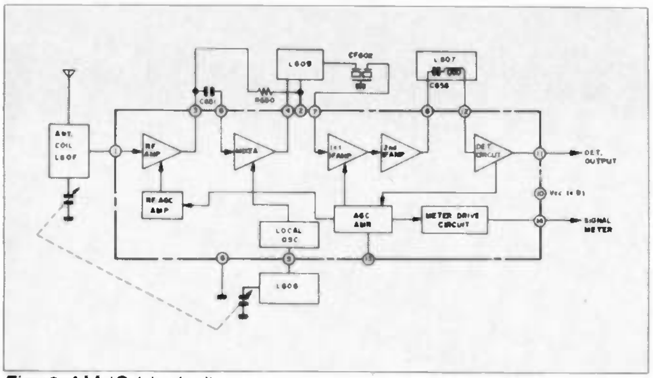


Fig. 8 AM IC block diagram.

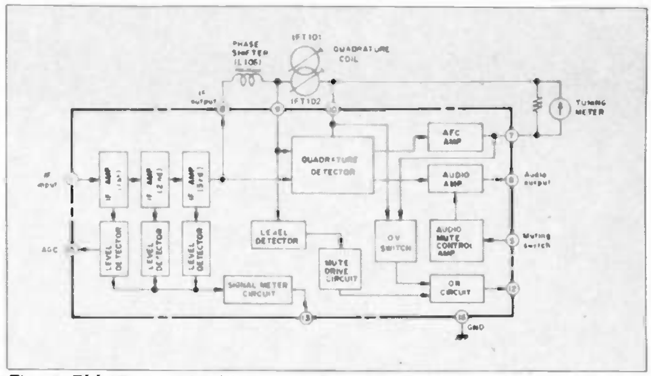


Fig. 9 FM IF amplifier/detector IC block diagram.

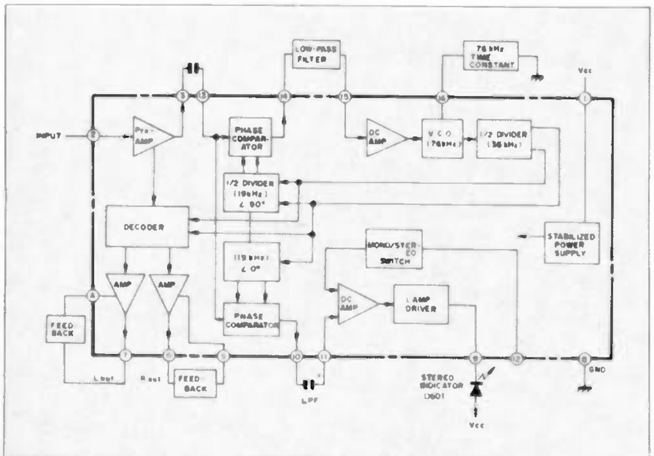


Fig. 10 Block diagram of the stereo demodulator IC.

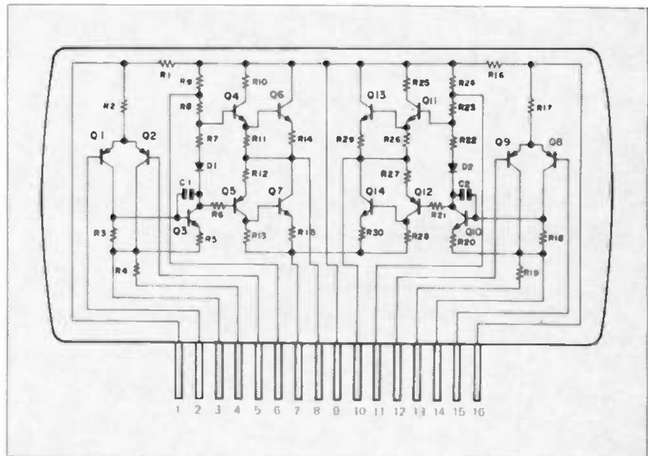
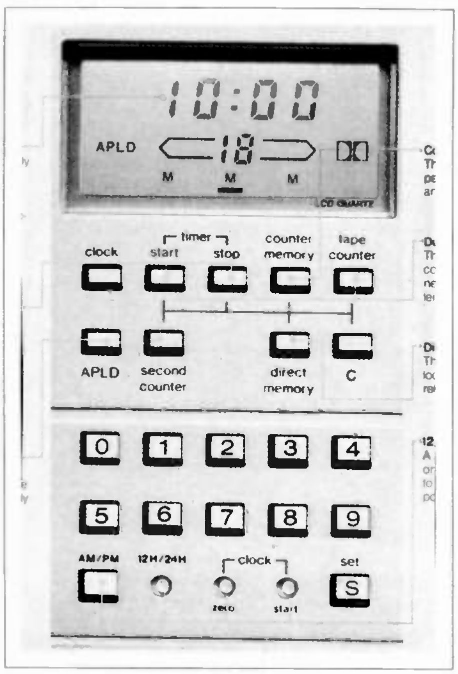


Fig. 11 Output, hybrid, IC schematic.



revolution (Fig. 3). Q101 is an interface between the Hall IC and the microprocessor since they are not directly compatible. The microprocessor divides the tape count pulses by five and supplies a display signal for the LCD.

APLD

The APLD, Automatic Program Locate Device, looks at the output of the preamplifier IC's in playback and counts the pauses between programs (Fig. 4). Appropriate circuitry forms and shapes pulses to be counted down by the microprocessor to fast forward over program material preceding the number selected (0 to 9).

Solenoid drive

The control pushbuttons in the SC-8000 command the microprocessor instead of functioning mechanically, as in a conventional tape deck. The mechanical functions they would perform are carried out by a solenoid (Fig. 5). Control pulses from outputs R1 and F1 of the microprocessor turn on Q106, as required to operate the tape deck. F1 supplies pulses for counter memory, auto stop, APLD and timer start mode pulse cancel while R1 supplies zero rewind pulse.

Multifunction Protection

The function protection circuit holds off all these pulses for about ten seconds after plug in to allow the system to stabilize (Fig. 5). This time is set by the charging time of C108, keeping Q112 off and consequently the relay open for the ten second period.

Power supply

The power supply is temperature compensated and incorporates an automatic changeover to battery power in case of power failure (Fig. 7). In normal operation the control unit obtains 13 volts from the main power supply. These 13 volts are regulated to 4.7V by a Zener and applied to Q109, which regulates it to 3.1V for the microprocessor. Q113's base normally is connected through a diode to 2.7V from the main supply and is turned off. A power failure turns Q113 on and connects a three volt battery supply to run the clock. Part of the reference divider for the base of Q109 (the series regulator) is a thermistor. When the room temperature falls, the output of Q109 rises to maintain a uniform LCD intensity.

Receiver circuitry

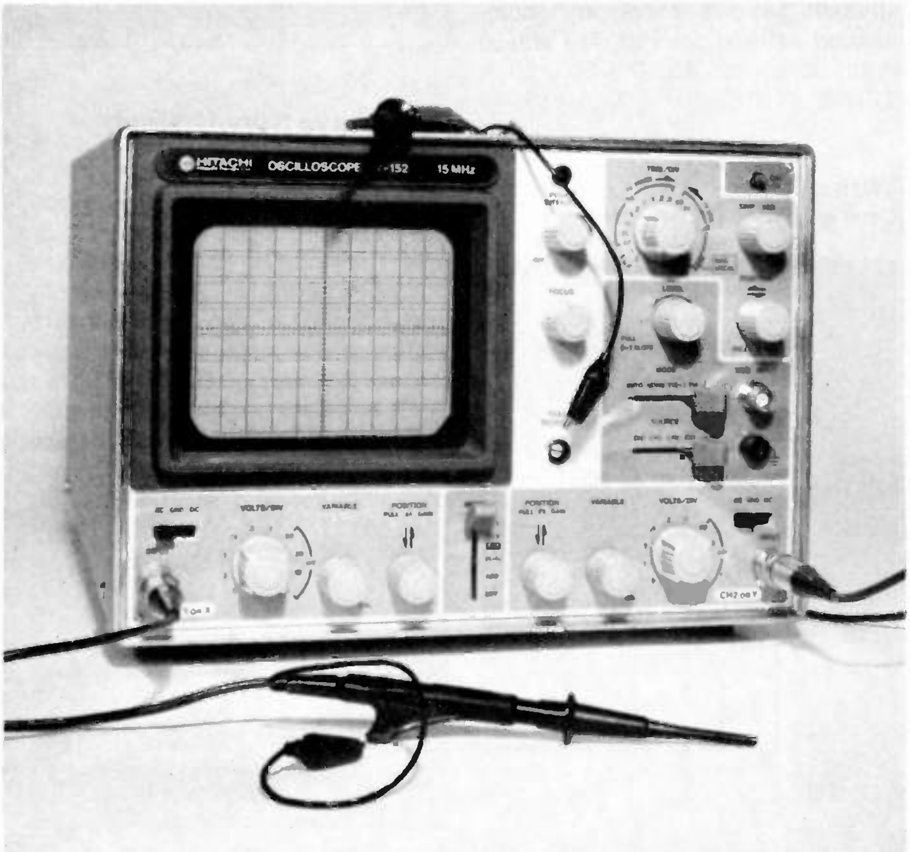
The receiver circuitry makes extensive use of integrated circuitry. While the FM tuner is quite conventional, the entire AM section is contained in one IC (Fig. 8). The HA1151 contains an RF amplifier, mixer, local oscillator, two IF stages, a detector and AGC circuits, requiring only tuning components to be external.

The FM tuner uses an FET RF stage and bipolar oscillator and mixer transistors. The mixer is followed by a bipolar preamplifier stage which is coupled through a ceramic bandpass filter to the IF IC. This device contains

continued on page 47

TEST INSTRUMENT REPORT

Hitachi recently began marketing in the U.S. a series of moderately priced 15MHz and 30MHz oscilloscopes. These include the V-151, a 15MHz single trace model; the V-152, a dual trace 15MHz model; and V-301, a 30MHz single trace model; and the V302, a dual trace 30MHz model. These are all quite similar in appearance and



For more information about this instrument, circle 150 on The Reader Service Card in this issue.

Hitachi's V-152 Oscilloscope

One of a new series

By Walter H. Schwartz

appear to be similar electronically as well. All use 5 inch round CRT's with 8 by 10 division display areas; the 151 and 152 have about 2kV HV on the CRT, while the V-301 and V-302 use 4kV; all have deflection sensitivities of 5mV/div to 5V/div and have X5 amplifiers with 5MHz (-3dB) bandwidths. The input voltage rating of each is 600V p-p or 300 VDC + AC peak. All offer X-Y operation.

All models offer sweep speeds from 0.2 μsec/div to 0.2s/div in 19 steps (calibrated) and a X10 magnifier for a maximum speed of 100ns/div. Trigger modes are Auto, Normal, TV + and TV-, and each has a 0.5V ± 3%, 1kHz, calibrate output.

A significant feature of the V-301 and V-302 is the signal delay line, now becoming more common in servicer's scopes, to allow viewing the leading edge of pulse waveforms.

ET/D received a V-152 for evaluation. This is the dual trace, 15MHz model. As we have noticed with other scopes recently, the manufacturers are quite conservative with their bandwidth specs. Our scope had full gain at 15MHz; the -3dB point was far beyond 20MHz.

Display modes include Channel 1, Channel 2, Dual (chopped or alternate, changeover between 1mS/div and 0.5mS/div), Add (algebraical addition of Ch 1 and Ch 2), and Differential (channel 2 inverted and algebraically added). As noted earlier, a X5 gain function is available, activated by a pull switch on each respective vertical position control.

Triggering capability also exceeded specifications. The V-152 is specified to trigger on signals up to 15MHz, and it did. Trigger sensitivity is stated to be 0.5 division, 20Hz to 2MHz, and 1.5 divisions 2 to 15MHz; while it varied (decreased) as the frequency increased, it was always somewhat better than specified; in fact, it actually triggers at reduced sensitivity way out to 30MHz.

The panel layout is similar to many other scopes. In fact, it is for many, almost standard to have the two input channels below the CRT and sweep to the right. The panel is kept quite uncluttered by the use of push/pull switches on some of the controls and lever switches for other functions.

The V-152 measures 275 by 190 by 400mm and weighs 8.5kg. In other words, it measures about 11 by 7½ by 15½ inches and weighs about 19 lbs, as do the others of the series. They are supplied complete with one or two probes, as appropriate, and are accompanied by a good instruction manual, but, unfortunately, without maintenance and repair information.

The V-151 is priced at $545, the V-152 at $695, the V-301 at $745, and the V-302 is priced at $995. Each of the series of Hitachi scopes appears to offer its features at very competitive prices.

V-152 Specifications at a glance.

CRT: 5 inch round, 8 × 10 divison display.

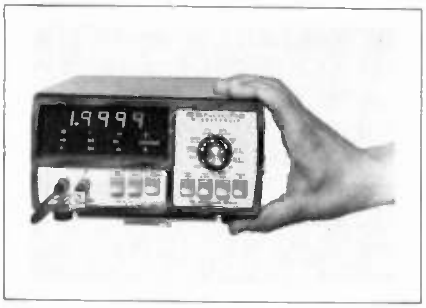
Vertical: 5mv to 5V/div, dc to 15MHz (-3dB).
X5 amplifier 1mv to 1V/div dc to 5MHz (-3dB).
24nS rise time.
1 megohm 30pfd input impedance
Ch 1, Ch 2, Dual, Add, D, FF, and X-Y display modes

Horizontal: 0.2μsec. to 0.2 sec/div sweep speed, X10 magnifier Auto, normal, TV+ and TV− trigger modes.

Calibrator: 1kHz square wave 0.5V ±3%

Power: 100/120/220/240V, 50-60Hz, 40 watts. ET/D

NEW PRODUCTS



Microprocessor DMM

Circle No. 130 on Reader Inquiry Card

Sencore's new DVM 56 Microranger, is a 4½ digit auto ranged DMM with a stated dc voltage accuracy of .075% ± 5 counts. Basically a 4½ digit instrument the user can select 3 or 4 digit readout for faster readout and increased stability. The microprocessor performs the automatic range switching, dropping to the next lower range if the reading is less than 10% of full range, to maintain full resolution. It also remembers lead resistance to eliminate lead error in measurement of small resistances. The Microranger has four dc voltage ranges to 2KV, 3 ac voltage ranges to 1KV, ac and dc current ranges to 2 Amps, six high power and five low power ohms ranges, 100 Megohms and 2 Megohms respectively, and dB, peak-to-peak and true RMS ranges. The DVM56's input impedance is 15 Megohms; a 10KV (X10) probe multiplies this to 150 Megohms for minimal loading in critical circuits. The price of the Microranger, DVM56 is $695.

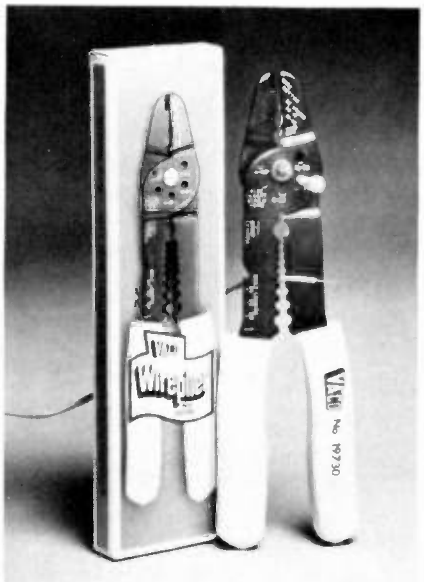
Video Tape Head Cleaners

Circle No. 131 on Reader Inquiry Card

Head cleaning tapes for both VHS and Beta video cassette/recorders have been introduced to the U.S. market by *FUJI*. The VCL-30 is a 30-foot tape intended for use with VHS machines; the BCL-20 is a 20-foot tape for cleaning Beta format machines. Recommended use is a ten second run which reportedly pletely. A second run, necessary in a few cases, is said to remove even the most stubborn residue. Maximum recommended use is 90 cleanings. The VCL-30 is priced at $25.00. The BCL-20 is $18.50.

Wiring Tool

Circle No. 132 on Reader Inquiry Card

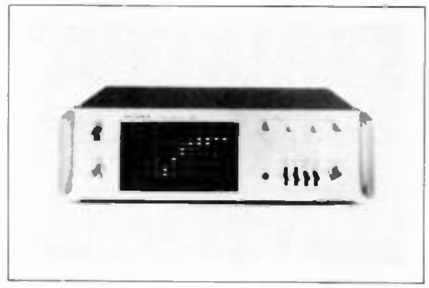


A new wiring tool, the No. 19730 Wire Plier, has recently been introduced by *Vaco*. This tool will crimp both insulated and noninsulated terminals, cut and strip wire and cut machine screws. It has longer handles for easier operation; all functions are labeled.

Audio Analyzer

Circle No. 133 on Reader Inquiry Card

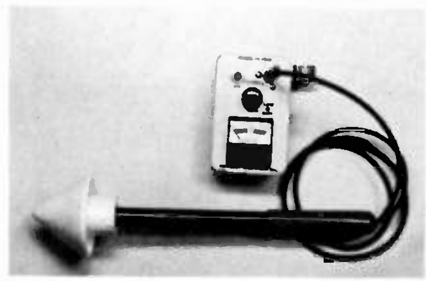
An audio analyzer for making equipment comparisons and checking speaker placement and room acoustics, has recently been released by *Scott*. By driving the audio system with the analyzer's oscillator and monitoring the system output with the analyzer's microphone, its display will indicate in octave bands the performance of various speakers, their placement in the listening room, and room acoustics, as well as the effect of tone controls, filters, equalizers and other equipment. A dealer can evaluate and equalize a customer's equipment for his listening room. The 8302 Audio Analyzer has a suggested retail price of $599.95.



Microwave Survey Meter

Circle No. 134 on Reader Inquiry Card

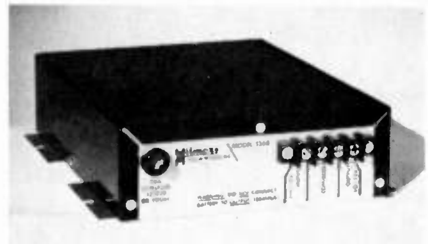
A new low cost microwave survey meter has been developed by *Holaday Industries*. The Model HI-1800 uses the same probe head as the HI-1501, permanently connected by a shielded cable to a slightly smaller meter unit with a single range of 0-10mw/cm². It operates on two 9 volt batteries, has a push to operate switch and a low battery indicator and comes complete with batteries, carrying case, beaker and instructions, for $169.00.



Polarity Inverter

Circle No. 135 on Reader Inquiry Card

To permit the use of negative ground radio equipment in positive ground vehicles, *Wilmore Electronics* has introduced its Model 1360 polarity reversing DC-to-DC converter. Conversion efficiency is as high as 80%; the Model 1360 can provide 10 amperes output continuously or 15 amperes on 20% duty cycle. Output voltage variation is reportedly only ±0.35 volts over the range of .5 to 12 amperes; the unit is short circuit and input polarity reversal protected. It weighs only 2.8 lb and the price is $165 in quantities of ten.



Cordless Soldering Gun

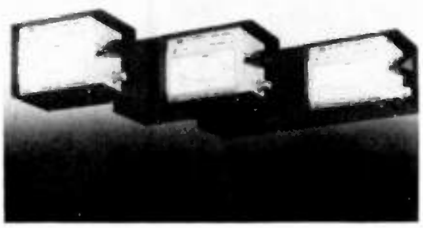
Circle No. 136 on Reader Inquiry Card

Wahl Clipper Corporation has developed a cordless rechargeable soldering gun with a solder feed feature; solder is fed from a supply at the rear of the gun through a tube to the tip when the trigger is fully depressed, permitting one handed soldering. The gun will solder up to 125 connections on a single charge. A charge will take three and one half to four hours. A wide choice of tips is available. The gun comes complete with a supply of solder and a recharger.

Absorption Wattmeters

Circle No. 137 on Reader Inquiry Card

A new line of absorption wattmeters has recently been introduced by *Racal-Dana*. Covering the frequency range from 1MHz to 1GHz, the 9100 series are reportedly accurate 50 ohms loads down to DC and feature a low level attenuator output for counters or oscilloscopes. Model 9101 has 1 and 3 watt scales; the 9102 has 10 and 30 watt scales; the 9103 has seven ranges from 300mw to 300 watts full scale.



Hi-Pot Tester

Circle No. 138 on Reader Inquiry Card

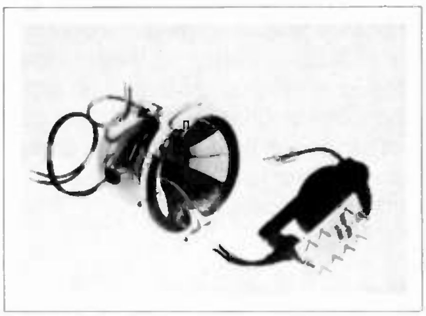
The Model M500 Series is the most recent addition to the *ROD-L Electronics* line of Hi-Pot testers. All models reportedly offer output of 0-5000Vac at 0-500mA with a controlled rise time to over one second, electronically controlled shutdown in 2ms for nondestructive testing and operator safety, and electronically

controlled test time of one second to 1.5 minutes. Other features include front panel test receptacle, automatic test cycle, audible and visual failure alarms, and metering of voltage and current. Price is $1,970.

CRT Terminal Yokes, Flybacks

Circle No. 139 on Reader Inquiry Card

Triad-Utrad has introduced a new line of deflection yokes and flybacks for use in CRT terminals, to be available from stock at local Triad-Utrad distributors. It was stated that off-the-shelf yokes and flybacks for CRT video display were created to eliminate both the high cost of specially built samples and long delivery times.



Beep/Alarm DMM

Circle No. 140 on Reader Inquiry Card

An audible alarm on over voltage and a beep when checking continuity allow the user of the *DATA Precision* Model 936 to keep his eyes on his work. The 936 is a 3½ digit multimeter of a stated 0.1% accuracy, intended for field use. It offers a liquid crystal display, high and low power ohms, twenty-nine ac and dc, current and resistance ranges and reportedly will operate on a 9v alkaline battery for up to 200 hours of continuous use. The price is $159.00.

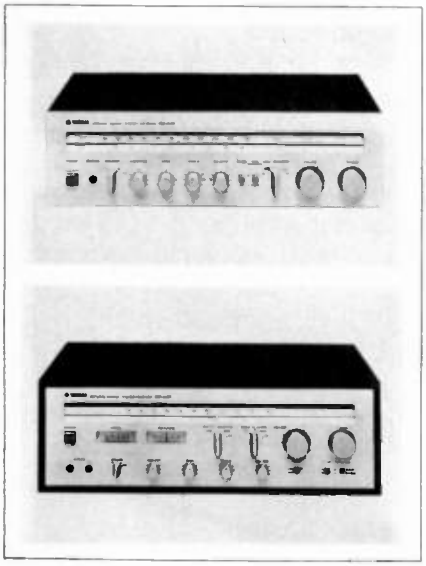
Oscilloscope

Circle No. 141 on Reader Inquiry Card

Dartron Instruments has recently announced a new post-deflection-acceleration dual beam oscilloscope, Model D12. The D12 has X-Y capabilities, Z modulation input, an 8 × 10 cm dis-

play and sweep speeds from 1 μ sec/cm to 1.5 sec/cm. The vertical amplifier bandwidth (−3dB) is 17 MHz; both vertical channels can be cascaded for a X10 (1mv) sensitivity and a 10MHz bandwidth. The price in $795. ETD

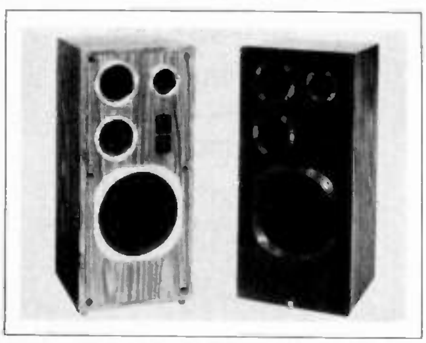
DEALER'S SHOWCASE



Popular Priced Receivers
Circle No. 142 on Reader Inquiry Card

Two new popularly priced receivers have been introduced by *Yamaha* to round out its receiver line. Model CR-240 is rated at 20 watts per channel (minimum RMS output, 8 ohms, 20hz-20Khz) with a total harmonic distortion of not more than 0.02%. The suggested retail price is $250. Model CR-440 similarly rated at 30 watts, is priced at $320. Other Yamaha receivers are priced to $1500. Both receivers have all basic features; dc amplifiers, bass and treble controls, loudness control, phono and auxiliary inputs, tuning meter (the CR-440 has two tuning meters) and the same sensitivity and signal to noise ratio as the higher priced CR-640.

Hi Fi Speakers
Circle No. 143 on Reader Inquiry Card

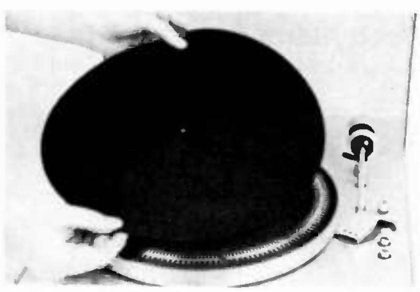


A new line of high fidelity speaker systems has been introduced by *Audio Electronic Systems*. Several new models are offered. The AES28 is a two-way bass reflex system with an eight-inch woofer and a two-inch tweeter and is rated at 30 watts maximum music power input and a frequency range of 50-15,000Hz. The AES31 has a ten-inch woofer, one and one half inch soft dome midrange and a two-inch tweeter and it is rated at 50 watts maximum music power in input with a frequency range of 40-17,000Hz. The AES32 and AES50T are air suspension systems. The AES32 uses 3 speakers and is rated at a maximum of 60 watts music power input and a frequency range of 35 to 17,000Hz while the AES50T uses 4 speakers and is rated for 125 watts music power and a frequency range of 25 to 20,000Hz.

New TV Remote Control
Circle No. 144 on Reader Inquiry Card

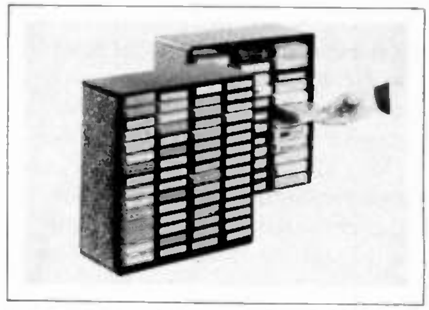
The TRC-82 television remote control from *TACO/Jerrold Distributor Sales Division* provides instant random access and selection of all available VHF and UHF channels, the company says, and features built-in AGC. The AGC, along with the high gain of the varactor tuner is said both to improve picture quality and to provide shielding against CB interference. A built-in channel switch allows consumer selection of output on either Channel 3 or Channel 4, and UHF custom tuning can be done through access holes in the unit, eliminating the need to remove the cover.

Record Cushion
Circle No. 145 on Reader Inquiry Card



An electrically conductive turntable mat that reportedly removes static electricity to improve sound quality and promote record life is being introduced by *Charleswater Products, Inc*. The Charleswater STATFREE™ Record Mat is a lightweight electrically conductive foam cushion that dissipates static electricity to keep dust away. Only ⅛ inch thick, it should not interfere with delicate cuing and tracking mechanisms. Brushes, cleaners and other devices are stated to be eliminated. The Charleswater STATFREE™ Record Mat sells for $4.95 (retail). Dealer inquires are invited.

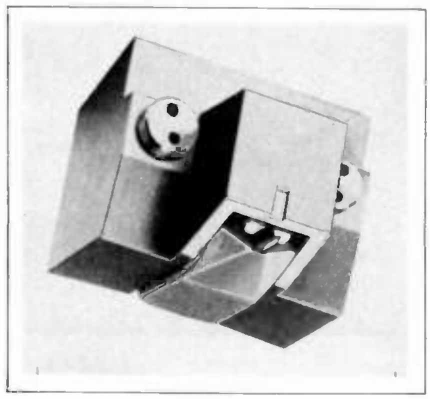
Storage Cases
Circle No. 146 on Reader Inquiry Card



Intended for storage of cassette and 8-track cartridge tapes these leatherette, burlap, denim, or woodgrain textured cases are offered by *Jesse Jones Industries*. A 60 cassette size has a list price of $16.95; a 30 cassette size is $11.95. A 36 cartridge 8-track model is $14.25; a 24 cartridge model is $10.50.

Moving Coil Cartridges
Circle No. 147 on Reader Inquiry Card

Dynavector has recently introduced a series of four new moving coil cartridges, reportedly of exceptional dynamic range, frequency response and channel separation. Top of the line models are the DV-100 Karat and the DV-100 Ruby having diamond and ruby cantilevers respectively. Frequency response is stated to be 20Hz to 50kHz for the Ruby and to 70kHz for the Diamond. Resonant frequency of the cantilever is greater than 50kHz; rubber damping has been eliminated. The two lower priced cartridges use tapered aluminum or straight berllium cantilevers and have frequency response of 20Hz to 20kHz.



45 RPM Spindle Adapter
Circle No. 148 on Reader Inquiry Card

"Omnidaptor" by *Aldshir Manufacturing Co.* is a universal 45 RPM adapter which in its latest version reportedly will fit over 90 percent of the changers found in American homes, and will do so with a single locking adjustment. ET/D

VIDEO DETECTORS

continued from page 25

less critical. The synchronous detector makes things still easier for tuning purposes. As a matter of fact, some of you may have to become accustomed to it!

As previously mentioned, a separate amplifier is used to boost the carrier level, *and is often incorporated in the IC,* but the tuned circuit for this narrow band amplifier is not, and therefore must be external. Thus some synchronous detector ICs have an extra tuned circuit, often labeled "Limiter."

There are some detector ICs which use a different method of doing essentially the same job. Instead of obtaining the carrier, or "reference" via a separate amplifier, a phase locked oscillator is used, in much the same manner as a phase locked horizontal sweep oscillator, or a phase locked color oscillator. Since this is part of a phase locked loop, the oscillator may have a tuned circuit, labelled "Reference," or "Oscillator." This oscillator must be set so that it is close to the desired frequency, in order to insure "lock in," in much the same manner as any phase locked oscillator. The limiter is simply peaked up on the carrier frequency.

Some sets have a "zero" adjustment, which is an ordinary potentiometer that adjusts the DC output level from the detector IC to match the requirements of the following video amplifier chain. In any event, these adjustments, which vary from set to set, are covered in the alignment instructions that apply to the particular set, and are no more complicated than adjusting the sound alignment on any color TV set.

Now, until a new development comes along, you are (temporarily), "up to date" ... again! ET/D

POWER SUPPLIES

continued from page 39

Comments

Today, in line-operated ac chassis you may find service problems in the low voltage power supply. A quick voltage check may indicate that the trouble lies in the regulator circuits. Always try to adjust the low voltage adjustment control and set it to the required operating voltage. You may find leaky or open regulator transistors cause most of the problems. Suspect out of tolerance large wattage voltage dropping resistors in the power supply circuits. Isolate the horizontal output section to determine if the trouble lies in the low voltage regulator system. ET/D

LABOR PRICING

continued from page 32

that satisfies the "disclosure" legislation that is being enacted in more and more communities around the country.

In my view, a service dealer has every legal and moral right to set his prices at any level that he wishes, so long as the customer is made aware of what he is paying and what it is for. You cannot cheat a customer simply by charging high prices. If your prices are too high for the service that you are offering, the wonderfully effective forces of our free enterprise system will soon provide a solution to the problem; your customers will simply go elsewhere.

There are, of course, any number of service dealers who choose to charge premium prices for what they feel to be premium service. While my personal preference is more moderate, I know of no consumer organization or government agency that will dispute this right; so long as the customer is not misled and the rates are set forth in a clear and straightforward manner. ET/D

MICRO-PROCESSORS

continued from page 28

The macroinstruction often calls out which register we want data held in, but the process of getting the signals into that register is determined by the microinstructions. It's like traveling on a superhighway. You may decide the destination, but the road has already been laid out, so that you merely follow the road instruction signs (microinstructions) through the various interchange loops, until you come to the proper exit. You do not have to mark your road map (programming) with each interchange, because it already has been done for you. That makes finding your way on a superhighway much easier than trying to get to the same place on the state or local highway systems.

The sequence

The MPU will take your instructions in the order in which you number them, *and it does this automatically.* When it completes one step in the program, it goes on to the next step, and this too is the result of microinstructions! So you see, the MPU needs, and uses, both microinstructions, and program instructions (macroinstructions). An important part of this process involves the temporary storage of information and, as a result of this need, modern MPUs have a dozen or more registers, with various titles, such as, "accumulator," "stack," "index register," etc., depending upon the use to which the register is put. This is very confusing to the student trying to comprehend what goes on inside the MPU, because the same thing may have a different name, when it performs a different function! (Part IV of this series will be devoted to clarifying that situation.)

Summary

This article covered serial and parallel formats, and explained the need for buses, and memories. Synchronous and asynchronous operations were defined, as was the term "clock."

Interface adapters were covered. Micro and macro instructions were delineated. Some of the movements of of information inside the MPU were traced. The foundation for further coverage of the internal workings of the MPU was laid. ET/D

SHARP

continued from page 42

three IF stages, a quadrature detector, AFC and other accessory circuits (Fig. 9).

The second IC in the FM receiver section is the stereo demodulator (Fig. 13). This simplified (externally) phase locked loop demodulator uses an RC time constant VCO divided by four and phase locked to the 19kHz pilot carrier. The only alignment adjustment is one variable resistor (rather than several coils).

The audio output stage(s) for both channels are contained in a single hybrid IC, a SI-1125HD (Fig. 11). For a good explanation of this typical OTL amplifier, see Daien, "Output Transformerless Amplifiers" in December ET/D.

So here we have another example, along with some of the newer TV tuner controls, where the elaborate, sophisticated control circuitry, although simplified by IC's begins to over-shadow the actual signal circuitry in complexity.

And more

And now just about the time this was written, a product announcement was received from Optonica announcing the new RT-6905 cassette deck with infrared remote control and programmable timers, four memories, the ability to memorize program locations on the tape, to repeat play, microprocessor adjusted tape tension and tape deck features, such as metal tape compatibility and double Dolby system, as well. ET/D

CLASSIFIED

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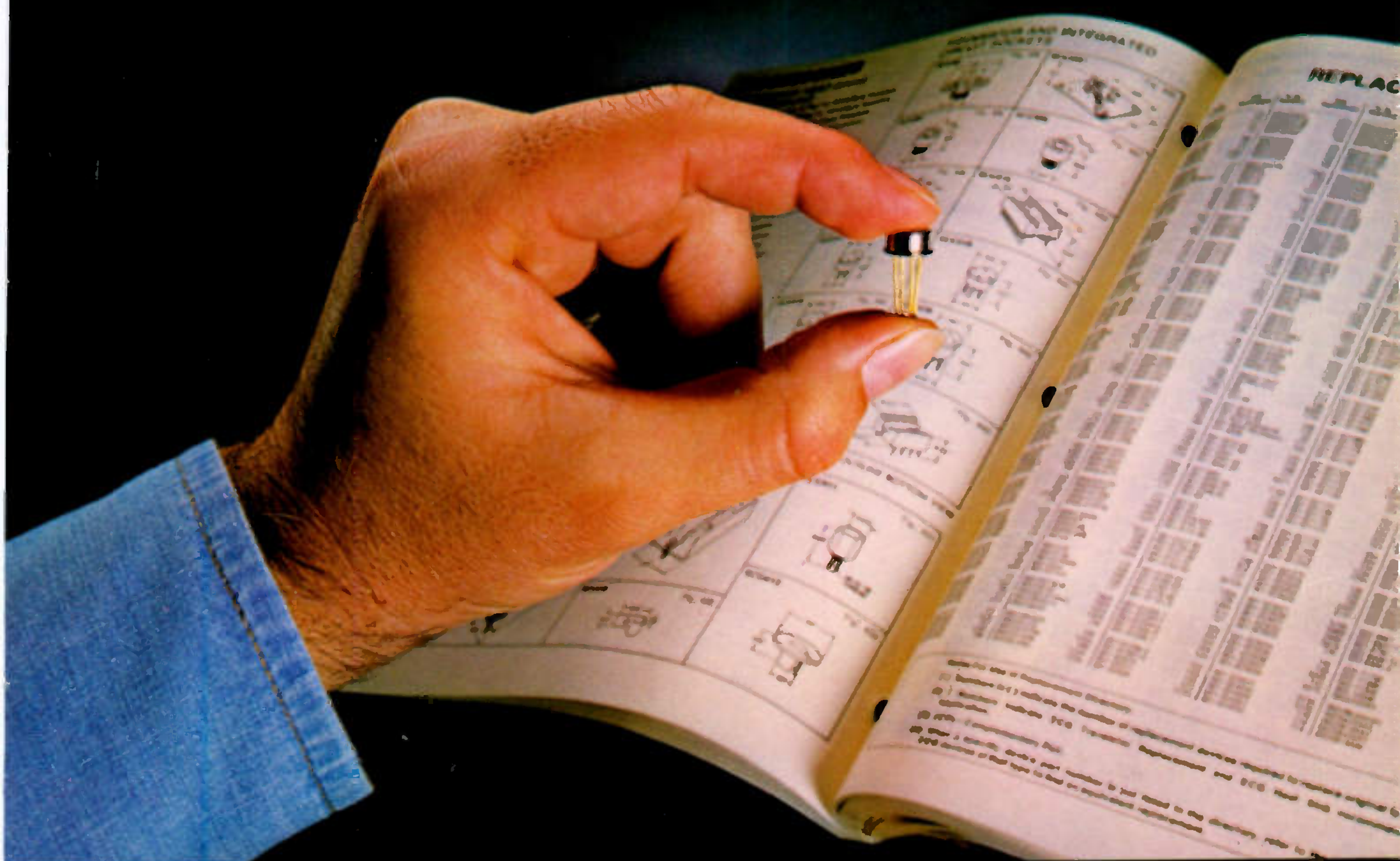

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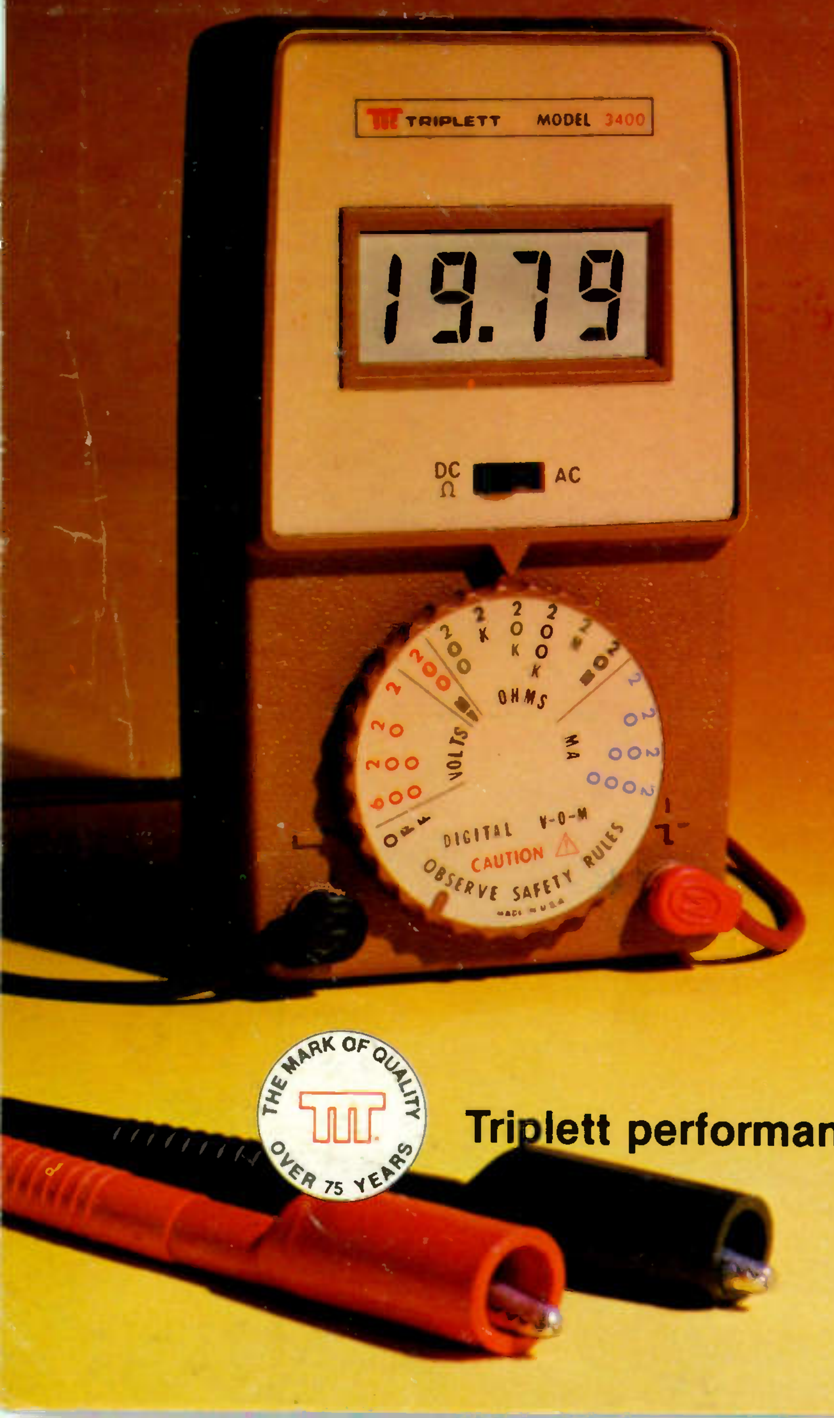

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