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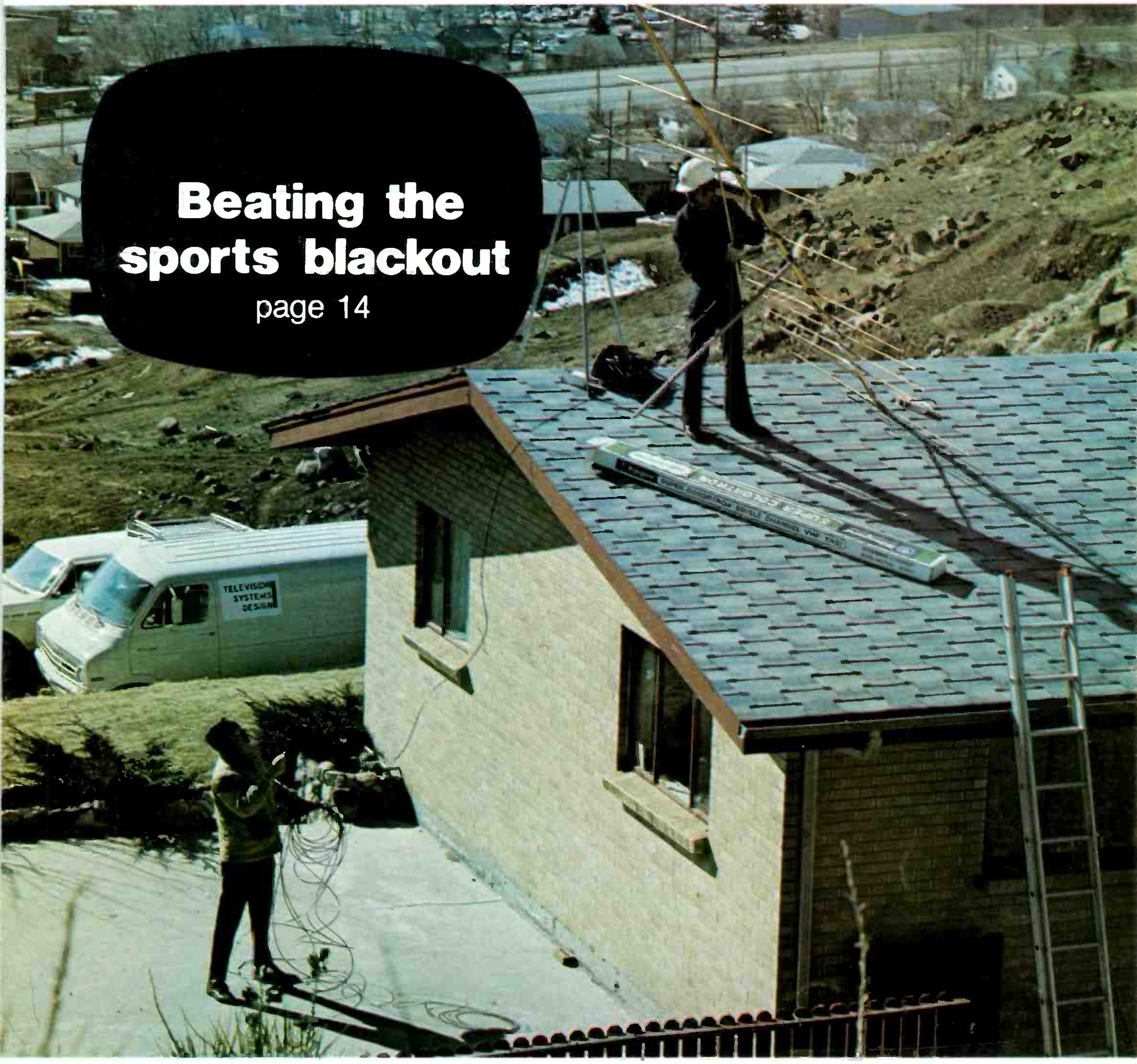


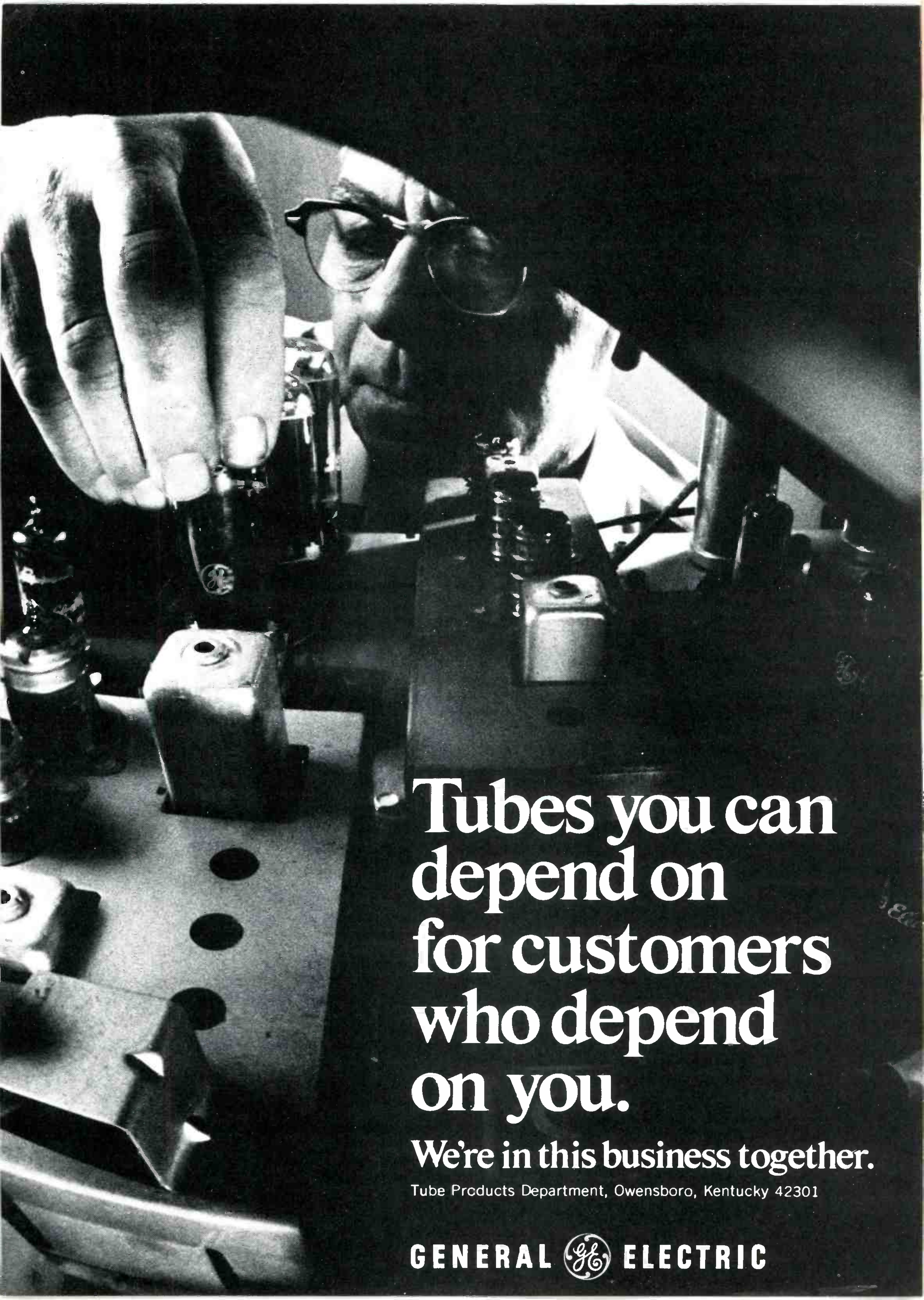
Beating the sports blackout

page 14

Employees Affect Your Success

Ups and Downs of Vertical Deflection

Signature Patterns for Solid State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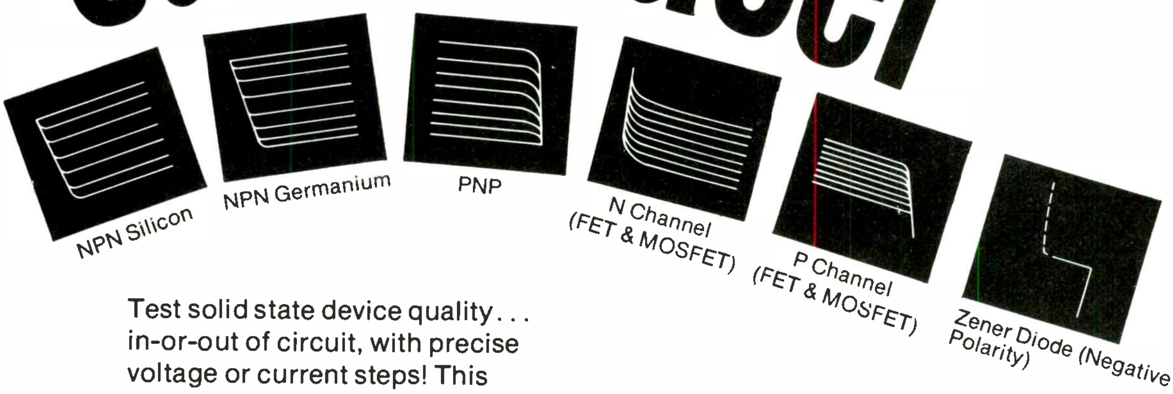

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For More Details Circle (4) on Reply Card

April 1973 □ Volume 23, No. 4

Electronic Servicing®

in this issue...

DEPARTMENTS

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Robert E. Hertel, Publisher

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electronic scanner

news of the industry

Wall-sized, picture-thin TV screens might someday be developed from an "electro-optical effect" patented in January by two University of Mississippi scientists. Dr. Theodore J. Klingen, chemistry professor, and Dr. John R. Wright, post-doctoral research associate were granted the patent titled "Optical Switching And Video Devices Using Organo-substituted Carborines", which has been assigned to the University of Mississippi The basic idea behind the patent is that certain chemical compounds in their solid state can be transparent to polarized light. If an electric field is imposed on these compounds or crystals, however the molecules will order themselves in such a manner that polarized light will not pass through the material. In the Klingen-Wright process, the molecules re-order themselves at speeds of about one-trillionth of a second. As a replacement for color picture tubes, it is expected a practical TV screen would consist of a light source and small cells of the light-controlling material mounted in a frame of perhaps one to three inches in thickness.

Engineers from China have been studying the relative merits of the three major color-TV systems, according to an article in **Japan Electronic Industry** magazine. The implication is that China intends to start color broadcasting. Only the U.S.A., Japan, and a few advanced countries of Europe now broadcast in color. Therefore, it is extremely important to the manufacturers of equipment for the rival television systems which one is selected for adoption by the next countries. The three competitive systems are NTSC (National Television System Committee—U.S.A.), PAL (Phase Alternation by Line—West Germany), and SECAM (Sequentiel a Memorie—France).

Although it might be a blow to our American pride, statistics show the percentage of color sets versus b-w in Japan exceeds that here. According to the **Japan Electronic Industry** magazine, the market penetration for color TV's in Japan is 77 percent, as of the end of 1972. An estimate in **Radio & Television Weekly** states that approximately 60 percent of U.S. households have color receivers.

The 4-channel stereo battle rages unabated. CBS, leader of the matrix adherents, and RCA, pioneer of the discrete system, are equally positive their type of stereo records will be adopted as the standard. As reported in **Home Furnishings Daily,** Walter Dean, executive vice-president of CBS records says, "Unless those companies espousing the discrete 4-channel approach to records are able to solve their technical problems within the next year or two, forget it. We'll be so far ahead, there'll be no catching up." Dean also says CBS is developing a "para-matrix" system to be available around the end of 1973. The system is compatible with present matrixing systems. Opposing all this is the statement of Rocco Laginestra, president of RCA Records, who says, "It will be a discrete world by the end of this year." RCA plans to have a total of 21 Quadradiscs released by the end of March, 1973, as promised last year.

(Continued on page 6)

A new 15-inch in-line color picture tube has been introduced by RCA Corporation. This is the most radical change RCA has made in their picture tubes since 1954. Deflection and convergence components are permanently attached to the neck of these tubes, which have vertical phosphor lines instead of dots on the screen. There is no convergence board, and up to twelve convergence adjustments have been eliminated. RCA undoubtedly will apply this principle to other CRT sizes, but just now is using the 15-inch size in the Projecta (ES-354 model) which is said to be their lowest-priced XL-100 solid-state color receiver. ELECTRONIC SERVICING will give you all the technical details next month in a full-length article.

Teledyne Packard Bell gradually will phase-out the "Packard Bell" part of its brand and corporate names, according to **Home Furnishings Daily.**

The new Consumer Affairs Department of the City of Cleveland, in an effort to uncover unethical practices, **might begin testing the shops of local dealers by sending them "doctored" TV receivers or refrigerators for repairs,** reports the **Home Furnishings Daily.** Herman Kammerman, Director of Consumer Affairs, said in a speech that he also is interested in investigating bait-and-switch advertising, licensing of TV repairmen, and open-dating of dairy products. Two other announced goals, said to be too drastic for enaction into laws at the present time, were limiting the markup of goods (say to 20 percent of the wholesale price) and the posting in all stores of the wholesale prices of all items selling for more than $10.

The old and the new of auto-radio systems are shown by Anne Konantz (left) and Febie Williams, employees of the Delco Electronics Division of General Motors. Anne displays a radio with a built-in speaker from a 1946 Chevrolet (first Delco-built car-radio speaker) while appropriately garbed in the fashions of that year. Febie, dressed in today's styles, holds a new AM/FM-stereo radio and one of four speakers for the system to be installed in a 1973 General Motors Car. □

Courtesy of Delco.

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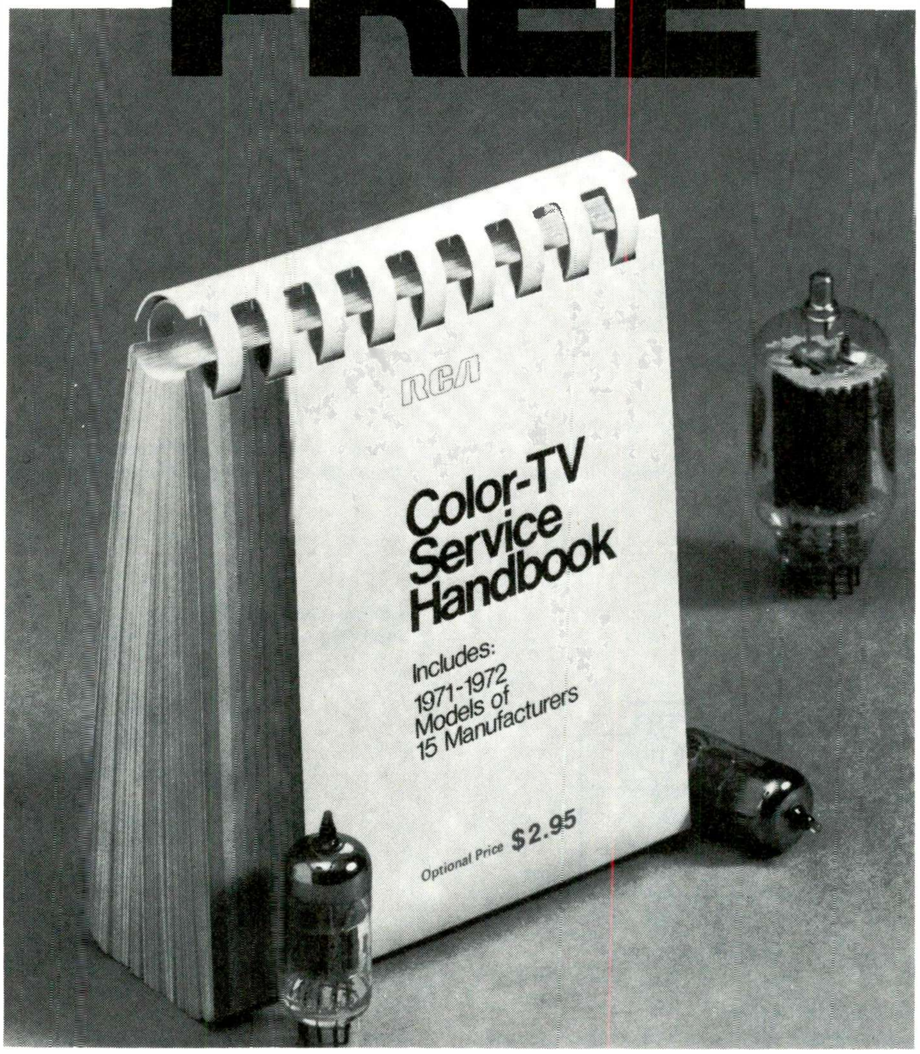

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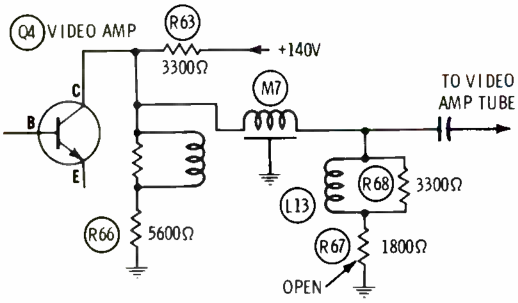
RCA

For More Details Circle (41) on Reply Card

symcure

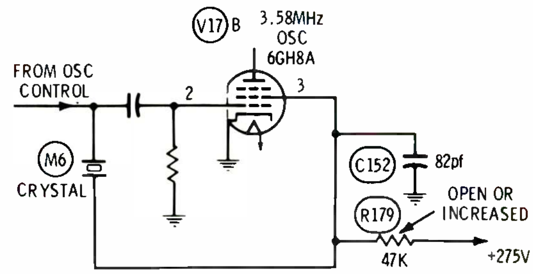
Symptoms and cures
compiled from field reports
of recurring troubles

Chassis—Packard Bell 98C19
PHOTOFACT—1019-1



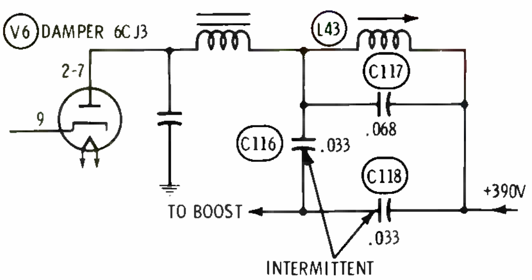
Symptom—Q4 video amplifier transistor runs hot; some ghosting
Cure—Check R67 and replace, if open or increased in value

Chassis—Packard Bell 98C19
PHOTOFACT—1019-1



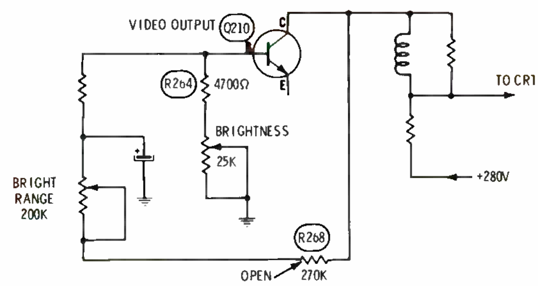
Symptom—No color, or intermittent color
Cure—Check R179 and replace, if increased in value

Chassis—Packard Bell 98C19
PHOTOFACT—1019-1



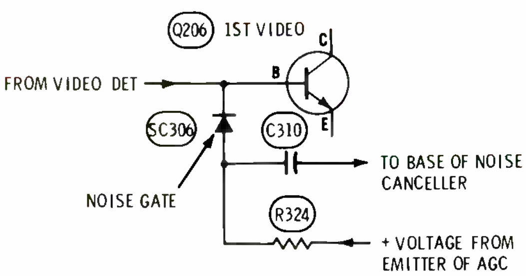
Symptom—Intermittent high voltage
Cure—Check for intermittent C116 or C118; replace both if one is bad, then readjust L43

Chassis—Sylvania D16
PHOTOFACT—1178-3



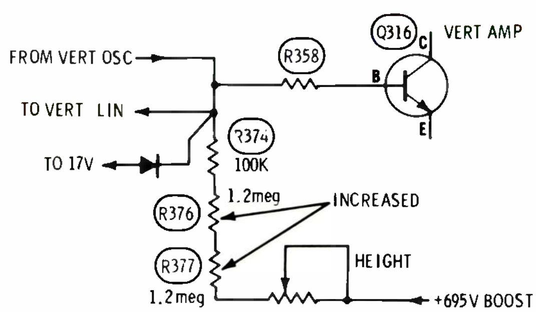
Symptom—No raster, high voltage okay
Cure—Check R268 and replace, if open

Chassis—Sylvania D16
PHOTOFACT—1178-3



Symptom—Horizontal bending, poor AGC action
Cure—Check for leakage in SC306 noise gate diode

Chassis—Sylvania D19
PHOTOFACT—1269-3



Symptom—Insufficient height
Cure—Check R376 and R377 and replace, if increased in value

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GTE SYLVANIA

reader's exchange

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Needed: *An RCA VHF tuner model KRK97F, RCA part No. 109793, for color TV model 211CD886-U or equivalent.*

Walt Gasior
1104 Rodman Road
Endicott, New York 13760

Needed: *Knobs for a Pilot model TV-37 TV set. These knobs have a ships-wheel design on them. I also need some WD-11 tubes and any pre-1930 radios, tubes, parts, or literature.*

Alvin Heckard
R. D. 1, Box 88
Lewistown, Pennsylvania 17044

Needed: *Schematic and parts list for custom-made hi-fi unit that contains a Fisher tuner model 80R. I have tuner schematic, but need information on the amplifier which is marked Stedman Radio Labs and uses a Stancor A3851 output transformer.*

John Carpenter
Sandhills Community College
P.O. Box 1379
Southern Pines, North Carolina 28387

Needed: *Schematic and operating or calibrating information for a Franklin model 400A digital multimeter.*

Servtronics
9808 Montauk Avenue
Bethesda, Maryland 20034

Needed: *Power transformer for a Zenith Radio Model 7S-530, transformer number 95-705N, also service information or schematic.*

Bernard Grupe
3012 Highland Drive
Cary, Illinois 60013

Needed: *A copy of the tube set-up chart or manual to use with Model TD-55 tube tester, manufactured by the Superior Instruments Co. of New York.*

Thomas J. Zorumski
819 Greeley Avenue
Webster Groves, Missouri 63119

Needed: *To know the tube lineup of an old Atwater Kent radio model 35. Can you help me locate some old cathedral radios?*

Donald O. Patterson
1220 Meigs Street
Augusta, Georgia 30904

Needed: *Schematic for a Caral Kilowatt KPL guitar amplifier manufactured by Danelectro Corp.*

Bill Mollenhauer
335 Boulevard
Pitman, New Jersey 08071

Needed: *Schematic for a Fischer (not Fisher) 8-track stereo tape and AM-FM multiplex unit. No model number is on this unit; however, the amplifier chassis has the number TRP-A05 on it. No country of origin can be found on the set, but most of the components are Japanese. I will send a dollar to the first reader who sends me a copy of the schematic.*

Peter Burnside
303 Wellington Road
Mineola, New York 11501

Needed: *Schematic and parts list with numbers for 16-mm sound projector Moviemite 63LMB.*

Joe's Radio & TV
65 Plainfield Avenue
Shrewsbury, Massachusetts 01545

Needed: *Schematic or operating manual for a Model 701 Roland & Boyce TV picture-tube tester.*

R. Chlupsa
45-56 189 St.
Flushing, New York 11358

Needed: *Schematic for a Teneyck T440 guitar amp made by Mid Eastern Industries, Ashbury Park, New Jersey, 07712.*

Bill Mollenhauer
335 Boulevard
Pitman, New Jersey 08071

Needed: *Source of a 1RPM motor for Longine Symphonette Model LCR 550 Japanese-made digital clock radio. Original marked "OMRON 1RPM 60 Hz Japan".*

Bernard H. Serota
2502 S. Philip Street
Philadelphia, Pennsylvania 19148

Needed: *Adapter No. A001 with A & B settings for use with the Mercury tube tester model No. 201. State price.*

Edmund Owsiany
Box 307 RD 2
Leechburg, Pennsylvania 15656

Needed: *Power transformer part No. 30042 for an EICO model RP100 tape recorder. I will consider purchasing a used RP100 for the parts.*

Rudolph Natoli
Rudy's Electronics
2614 31st Street
Santa Monica, California 90405 □


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HTA-DD (3/16" Quick-Connect Terminals)
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HLD Visual-Indicating Fuseholder
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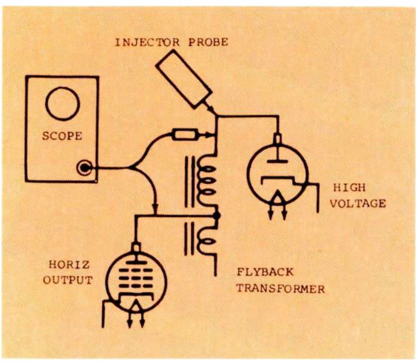
Simplified ringing test
For use with any tube-type horizontal circuit

Most technicians know about ringing tests for diagnosing shorted turns in flyback transformers and yokes. I have used the method for years and liked the results, but found the tests required quite a bit of time to connect a square-wave generator. Also, occasionally the conclusion was not definite if I used a sample of the scope's sweep voltage to ring the circuit. I experimented with variations of the general method.



The schematic shows a faster way of ringing horizontal-sweep circuits by obtaining the pulses from a signal-injection probe. I use my EICO PS-1, although other models also probably would work.

A sweep circuit without shorted turns reduces the amplitude of the ringing sine waves to about ¼ in 10 or 11 cycles. One shorted turn in a coil or transformer reduces the amplitude to ¼ in 3 or 4 cycles, a very distinct difference.

If the ringing indicates shorted turns, disconnect each component in turn until the ringing becomes normal. The last component disconnected before the ringing improved probably is the defective one.

J. E. Trent
Co-Op TV
Rhinebeck, New York

Distorted audio, then no sound
General Electric C4506F clock radio

Tests by signal tracing localized the intermittent sound to the audio output stage. In-circuit, the output transistor checked okay, and only slightly leaky out-of-circuit. Gain was low, but appeared to be within tolerance. In fact, I thought the transistor was normal.

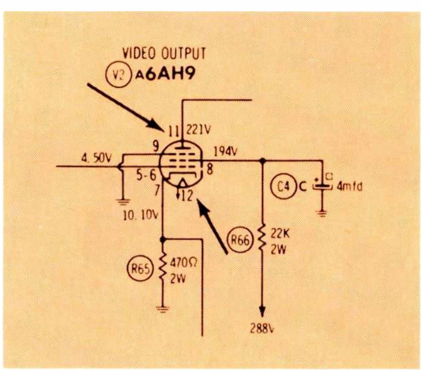
But when I heated the transistor slightly by holding a soldering iron near it, the transistor opened completely. Apparently, the leakage was sufficient to raise the operating temperature and trigger the open circuit.

Don Waltner
Waltner Electric
Moundridge, Kansas

Intermittent raster
Zenith color receiver chassis 12A10C15 (Photofact 1067-2)

The complaint about the Zenith 12A10C15 color chassis I repaired recently was that the raster would disappear every few seconds.

The usual tube replacements didn't help, and the high voltage checked normal only when the anode button was removed from the picture tube.



DC voltages at the picture-tube socket revealed an excessively-low voltage on pin 11, and also at the plate (pin 11) of the 6AH9 video-output tube.

Removal of the 6AH9 didn't increase the plate voltage enough, which indicated the tube and its voltages were not responsible. A visual examination of the components of the 6AH9 plate circuit and the cathode circuits of the picture tube showed a carbonized area between pins 11 and 12 of the 6AH9 socket. Because pin 11 is the plate and pin 12 is one of the grounded heaters, this leakage was reducing the plate voltage, increasing the brightness, and causing a loss of high voltage.

A new replacement socket was not available, so I drilled out the carbonized portion between the two pins of the socket. The receiver is still working okay.

J. M. Thurston
Thurston Electronic Service
Fort Wayne, Indiana

Horizontal oscillator dead
Emerson 30M20 color chassis

The second time this new color set was turned on it popped and cracked, then had no sound, no picture, and no raster. Tests showed the 1-ampere fuse F900 had blown.

After the new fuse was installed, the sound came on but there was no raster and the plate of the 6LW6 horizontal-output tube began glowing red. These symptoms are typical of horizontal-oscillator failure.

I checked for horizontal drive at the grid of the 6LW6 and found none. Voltages at the pins of the 6JW8 horizontal oscillator were all wrong. The screen grid (pin 3) was only 30 volts, the plate of the oscillator was high (290 instead of 190), grid of the control tube was +25 (should be near zero), and the control cathode was +30 (should be about +3).

(Continued on page 26)

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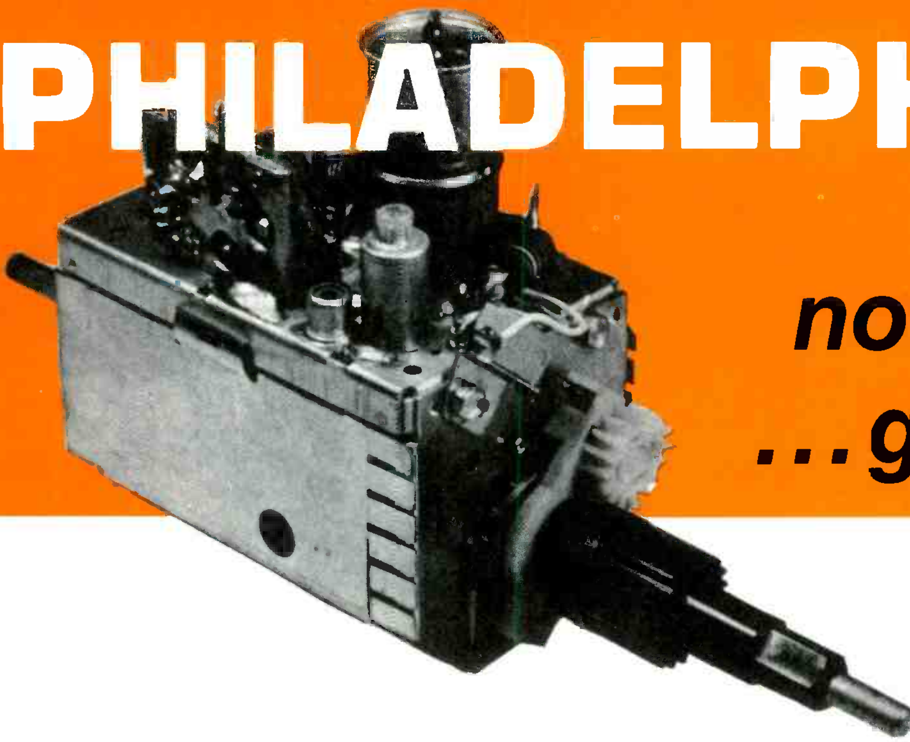

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For More Details Circle (5) on Reply Card

Make money beating the sports "Blackout"

By Donald K. Collins
Technical Editor of
the Winegard Company

As each sports season arrives, so do the requests for antennas to "beat the blackout". Unfortunately, the usual antenna system can't amplify the signal enough, or else the weak signal is buried under stronger local ones. If any antenna system will let the fans watch those games, it is the one described here.

Research and experimental time for you to design an antenna system that will produce acceptable picture quality from stations outside the blacked-out zone of live sports events is much too expensive. At least that's true for just one installation. And then there's the uncertainty that the results would be acceptable in different locations.

But suppose you had a standardized design that would work okay in one particular section of town, and do it consistently. Could you make money installing such a system? You just bet you could!

Apply Mass-Marketing Techniques

The only way you can get this business (and make sure it's profitable) is to use some modern mass-marketing techniques. And those techniques are based on several assumptions:

- That you're willing to take some time, perhaps a day or a day and a half, away from your regular work to do some research;
- That you can develop a standardized antenna system that will bring in an acceptable signal from a game-carrying station outside the blacked-out area;
- That you're willing to "knock on doors" to contract for as many of these systems as possible in the district that you've surveyed during your research.

In this way, your research costs for each job will become negligible. Each installation should require only tweaking to achieve optimum results.

Getting Started

Let's say that you know the station you want to bring in, its direction and the distance. Next, choose a target district where the reception conditions should be favorable. For example, a section in a higher part of the city away from excessive electrical noise.

This way, you are choosing your customers and their location, instead of letting them pick you. Essentially, you are saying: "Here is a group of 500 homes, all with about the same reception potential. Somewhere among these 500 homes, there are probably 50 sports fanatics who will pay well for an antenna system that will bring them the games they want to watch."

About now, you'd better get answers to some important questions. What is the average signal strength of the selected channel in the target area? Is the channel between two stronger adjacent ones? Is it VHF low band? Is it coming from the same direction as stronger signals, or from an opposite direction? Is the direction as much as 35 degrees from the direction of the nearest transmitter?

Three Sides Of The Problem

Stated simply, the problem is to pull in a signal from a distant transmitter (perhaps 150 miles away), clean it up, and amplify it to the level required to produce an acceptable picture.

Of course, the process might not be quite that simple. Any one of three basic factors can prevent a satisfactory picture; but whip them and you've got a workable system.

Distance

RF signal strength is inversely proportional to the square of the distance from the source. That is, doubling the distance cuts the signal strength to one-fourth. In addition to this basic attenuation, there is a frequency effect that makes high frequencies weaken faster than the lower frequencies. So, for the same signal strength to begin with, low-band VHF will be strongest, and UHF will be the weakest.

At higher frequencies, broadcasters compensate for this effect by using

... r ... is ... of ... fre- ... the ... the ... hill or ... HF, for ... between a ... UHF one, ... band signals ... ings and hills. ... receivers have ... sensitivity at ... of interference that you need worry about comes from adjacent channels whose signals are stronger because their transmitters are closer. When trying to bring in a weak signal on channel 3, for instance, you might find channel 2 audio and channel 4 video overwhelming the distant signal. If possible, pick a channel having no local adjacent-channel stations.

Clutter

The typical suburban antenna peers through a haze of radiated "garbage" ranging from power-line and auto-ignition noise to reflections and delay paths from buildings, hills and water towers. This signal pollution often reaches to 40 or 50 feet above ground level. There's only one way of getting your desired signal away from this zone: raise the antenna above it.

These three—distance, interference and clutter—are the biggest obstacles to distant-signal reception. Compensate for them in your standardized design, and you've taken a giant step toward your goal.

Doing Your Homework

Perhaps the simplest way to find out if there's a signal worth going after is to take an outdoor broadband antenna located in your target area and aim it at the signal you want to receive. Maybe you have a good customer in that area who wouldn't mind your

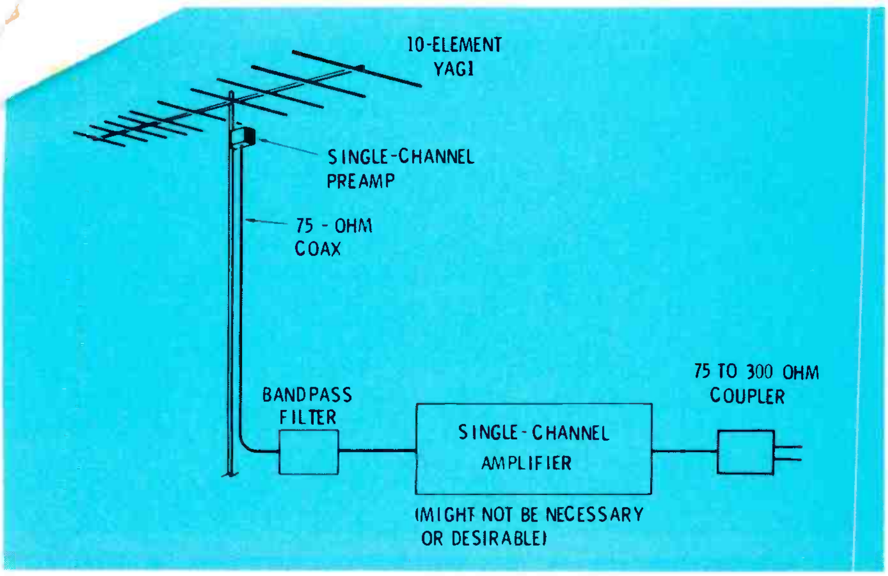
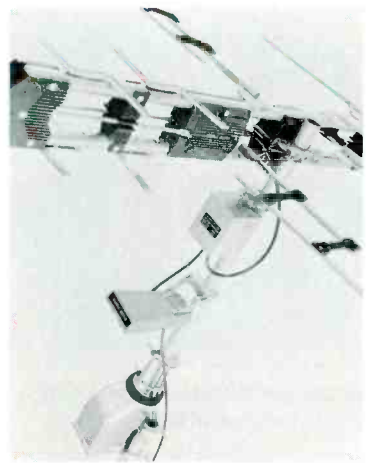


Fig. 1 A typical antenna system for amplifying the desired signal and rejecting adjacent channels is shown here in block-diagram form.



One example of a Channel Master Sportenna system includes the antenna, tuned trap, single-channel preamplifier and rotator. **Courtesy of Channel Master**

Approximate specifications for antennas and heights

Distance From Station	Channels 2-6	Channels 7-13
75 miles	5-element Yagi 40-50 feet high	10-element Yagi 40-50 feet high
100 miles	10-element Yagi 40-50 feet high	10-element Yagi 60 feet high
125 miles	stacked 5-element Yagis, 50-60 feet	stacked 10-element Yagis, 60 feet high
150 miles	stacked 10-element Yagis, 60 feet plus	quad-stacked 10-element Yagis, 60-70 feet high

Here are some examples of typical equipment and retail prices for "Beat The Blackout" antenna systems from the Winegard catalog. Prices and specifications from other manufacturers will deviate somewhat from these.

Antenna (SCX Yagi, low-band VHF)	44.00
Bandpass Filter (CPF 2-60)	14.55
Pre-amplifier (AC series single-channel)	80.65
Coaxial Cable (50 feet at 10 cents per foot)	5.00
Miscellaneous Hardware	5.00
Mast	40.00
	$189.20
Single-channel Amplifier (DSX 2-6) (if needed)	45.65
	$234.85

experimenting with his antenna and receiver.

Wait until the early evening hours when TV reception is generally best, then see if you can obtain any kind of image on the channel you want. If there is something on the screen, no matter how faint or unstable, it's probable that a better system would produce an acceptable picture.

Steps Of System Design

Assuming that the preliminary test was encouraging, you must next make a full-scale system. The steps follow in order.

Antenna

There's little argument over the best type of antenna to use. It should be a cut-to-channel yagi, preferably a high-gain 10-element kind. A yagi is frequency selective, directionally selective, and has high gain plus a high front-to-back ratio of pickup. Typical specifications might be a beamwidth of no more than 45 degrees at the half-power points (channel 6, for example) and a front-to-back ratio of about 30 dB.

I recommend you get an antenna that has a built-in weatherproof housing for the attachment of a preamplifier.

A yagi's natural characteristics often eliminate problems before they arise. Surprisingly, the antenna might turn out to be the cheapest part of your syst… expe…

Antenn…

The tri… the antenn… to raise it a… above the grou… or a from-the-g… tion. Both requ… lead-in than roof-… some localities, … might require a buildin…

Whatever means of r… tenna you settle on, ma… installation is substantial guyed. It should be protecte… lightning, because it might wel… tallest structure in the neighbor…

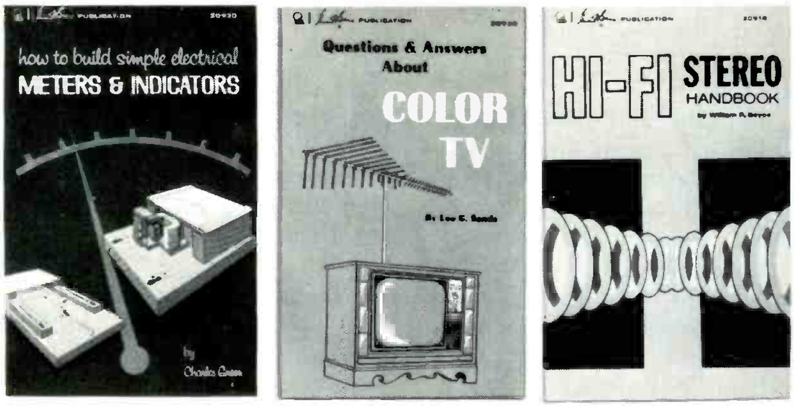
…though you buy the most …our distributor carries. …d of getting …zone is …ore)

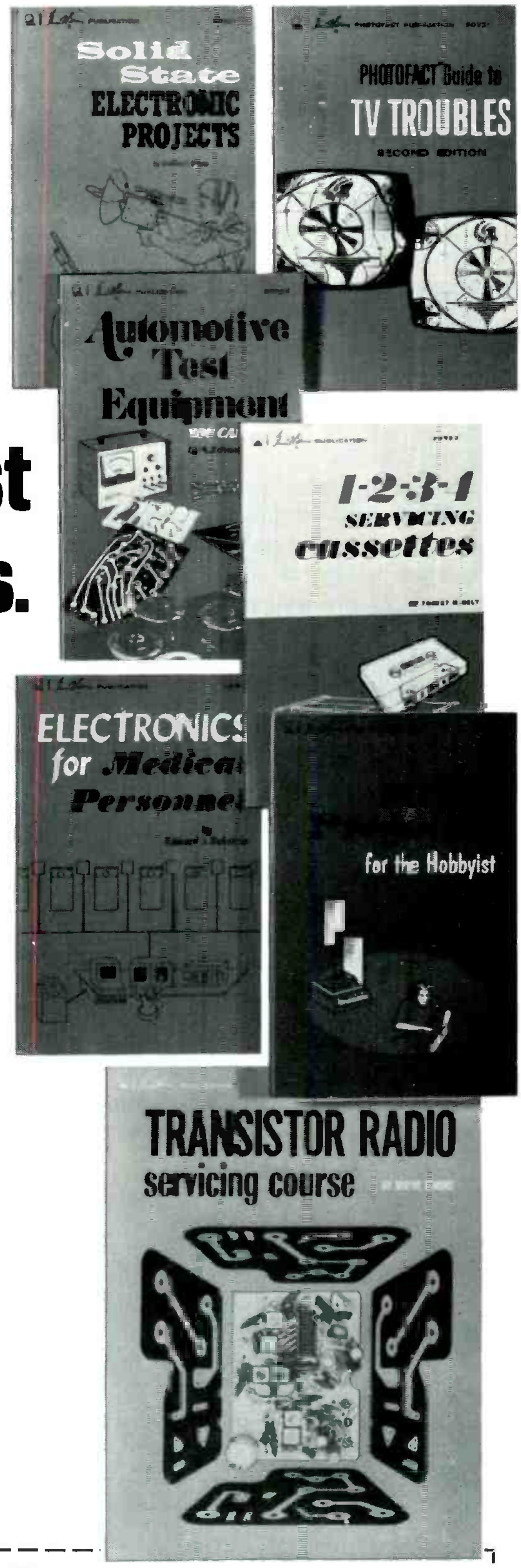
Single-channel bandpass filter model G-542 by Finco. **Courtesy of Finco**

Jerrold Model JTL-5 5-element Yagi antenna. **Courtesy of Jerrold**

Equipment	Winegard	Finco	Jerrold	Blonder-Tongue	Channel Master	JFD (Riker)
10-element low-band VHF Yagi antenna	SCX series	Y10 series	JTL-5 or JTH-10	YH series	1522 series	10Y series
Bandpass Filter	CPF 2-69	G542	PBF	BPF	7300 series	8200 series
Single-Channel Pre-amp	AC series	G-20	DSS series	CMAB series	Sportenna	SP2800 series
Single-Channel Amplifier	DSX 2-6	G-122	SMA	Hot Shot	7400 series	SL3000 series

Note: the single-channel amplifier is optional, and sometimes not desirable. It should be used only to compensate for loss in long runs of cable. Great care must be taken not to overload it or the pre-amplifier with either on-channel or adjacent-channel signals.





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Eliminating All But One Channel

At this point, you're gathering signal with an antenna designed to receive best on one channel. However, if there are transmitters nearby, the antenna can't help picking up some of their radiations, particularly if they're broadcasting on adjacent channels.

Thus the task becomes one of refining the signal you want, and blocking as much extraneous signal as possible. You want to end up with that one 6-MHz-bandwidth signal and NOTHING ELSE.

Start the trimming process with a single-channel preamplifier which amplifies only the frequency you want to receive. Make sure it matches the impedance of the antenna and has an output impedance of 75 ohms so coaxial cable can be used for the downlead. Then mount the preamp in the weatherproof housing under the boom.

Single-Channel Preamplifier

Single-channel preamps are made up of two stages: a band-pass filter and an amplifier. It's necessary to amplify the weak signal enough so it can survive the trip through the losses of the downlead and maintain an acceptable signal-to-noise (SN) ratio. But if the undesired signals were amplified along with the wanted one, they likely would drive the next amplifier into cross-modulation. And that's trouble you don't need!

The band-pass filter will reduce adjacent-channel signals perhaps 20 dB, while the amplifier boosts your wanted signal by about 20dB. So, if the antenna has 500 microvolts of wanted signal plus 10,000 microvolts from an adjacent channel, the output of the preamp might be 5,000 microvolts of wanted signal and 1,000 microvolts of undesired signal. That's only about 14 dB difference, and something approaching 40 dB is needed. More filtering must be used inside the house.

Coax Downlead

Why coax when other types of downlead cause less attenuation of the signal? It's more durable, for one thing, and it is not sensitive to the nearness of metal, so you can tape it to the mast instead of having to use standoffs. And coax doesn't cause instability when it moves in the breeze. The most important reason, though, is that coax's inherent shielding prevents pickup of both signal and local noise. Twin-lead, on the other hand, acts as a small antenna. And at this point of the system, we're concerned with keeping signals out, not receiving them.

Another Band-Pass Filter

Next, inside the house, use another band-pass filter to reject the remainder of the adjacent-channel signal. By this time, everything outside the 6-MHz bandwidth of your desired channel should be down about 40 dB, which is about the discrimination capability of most TV receivers.

Installation of a Winegard "Beat The Blackout" system. Courtesy of Winegard

A Single-Channel Amplifier

If the signal following the second band-pass filter is not strong enough to override the internal snow of the receiver, add a single-channel amplifier. Select one with manual gain control. Or better yet, one with good AGC action. This will prevent overload and crossmodulation of the receiver while helping to keep the fading signals strong enough.

Use coax cable at the output of the single-channel amplifier, also. Finally, install a matching transformer at the input terminals of the receiver.

Precautions

Whatever you do, don't get miserly with the components specified, else you might blow the whole thing. It's tempting, for instance, to substitute a lower-priced broadband amplifier for the more-expensive single-channel amplifier in the last stage of the system. Don't do it!

It goes without saying that well-made connections of the coax, and careful workmanship throughout the system, are imperative. The last thing you want is interference generated within the system by mismatch, unwanted signal pickup causing ghosting, or standing waves.

Orienting The Antenna

There's one last thing to do to the antenna system: get up on the roof and turn the mast until you have the best picture that can be obtained.

Tips For Selling

Don't use the sales method of the inventor of the better mousetrap who waited for buyers to come to him. You know by now that the system you designed works, and you know the cost of materials. This can give you confidence in selling your system, even though you don't think of yourself as a salesman. Try some of these tips for selling.

Mail

Send each homeowner in the target district a simple mail piece, stating that you have designed and installed a system in his area that brings in blacked-out sports on Channel X.

Names and addresses can be obtained from the city directory, and about $20 should cover the cost of printing by your local instant-print shop. For 500 letters, postage will cost $40. This makes a total of $60, and you should be able to recoup that much on the first sale.

Door-To-Door

Assuming that you're too busy at the shop to knock on doors yourself, the next best thing is to hire an earnest young man (or two) to canvass the district for you. Arm them with contracts for antenna installation, and a supply of your business cards to hand out to those who don't sign up on the spot.

Straight commission probably is the best way to pay your canvassers. Alternately, you might pay a flat fee for every home owner they sign up.

Instruct your representatives to be cautious about making extravagant claims. Impress on them that the system will bring in ONLY the channel for the blacked-out games, and that the picture quality will not be as good as normal reception of local channels. Make sure, in their sales presentation, they avoid anything except the minimal claim that the owner will be able to see the games.

Telephone

If your city has an ordinance prohibiting door-to-door solicitation, there's always the telephone. Although that's so overworked these days, you just might get a negative reaction.

Discount Plans

A good practice is to give a discount to homeowners who have previously purchased one of your systems, if he brings in other sales. Rabid fans usually know others, and this arrangement can benefit both of you. After all, there's no reason he should play host to the local fan club every Sunday afternoon!

Make Conservative Claims

Suppose you have finished an excellent job of engineering the weak-signal antenna system, and have successfully installed similar systems for other customers. It's a great temptation to brag about this to potential customers. Okay, but use some caution.

Whatever they say about a woman scorned, it's also true that: "Hell hath no fury like an ex-fullback who has paid his money without having a game picture to show for it!" A few feet of antenna height, a power-pole transformer with an internal arc, or other unpredictable local conditions can ruin the signal for any kind of reception. Leave an escape hatch in your promises. Perhaps you might offer a no-obligation deal in which you check reception with the equipment wired in temporary fashion, and then remove it if reception proves to be unusable.

Of course, after you have installed some systems which produce excellent results, the word-of-mouth advertising will make unnecessary any promises on your part.

Add To The System

As long as you have already taken the big step of installing a mast as part of the "black-out" system, why not mount a broad-band antenna below the yagi to provide better local reception?

Just make sure the broadband antenna is positioned properly below the yagi by a distance equal to one-half the yagi's frequency. Then run a separate downlead with a selector switch at the receiver so the homeowner can choose which antenna to use.

Stacking Yagis Horizontally

If you have tried orienting and positioning a single yagi and still can't eliminate all the ghosts, try this suggestion.

Mount a pair of identical yagis on a redwood or cypress crossarm secured to the mast. Horizontally, separate the booms of the yagis by one wavelength. Cut phasing lines to equal length, connect to a coupler and feed the combined signal to a preamplifier.

This arrangement narrows the beamwidth by nearly one-half, thus helping to select the desired signal directly while avoiding the reflected signals that cause ghosts. A fringe benefit is the extra gain (averaging 3 dB) obtained compared to a single yagi. □

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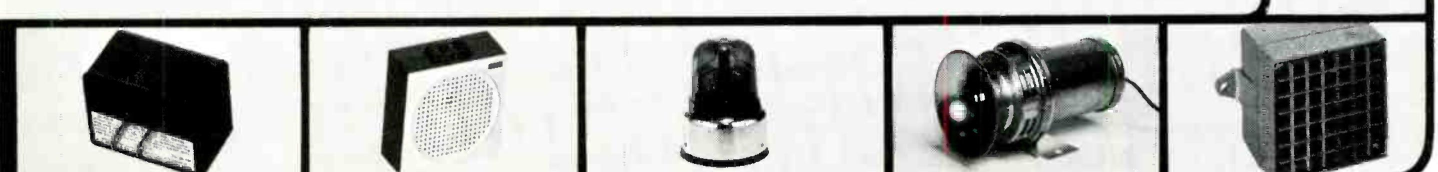

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Fig. 1 Sound Technology model 1000A FM Alignment generator offers all the signals for conventional RF and IF sweep alignment, and for multiplex adjustments. In addition, "Dual Sweep" makes possible true distortion measurements from the antenna terminals to the output of the discriminator, and no distortion meter is required. Essentially it is a high-performance FM transmitter.

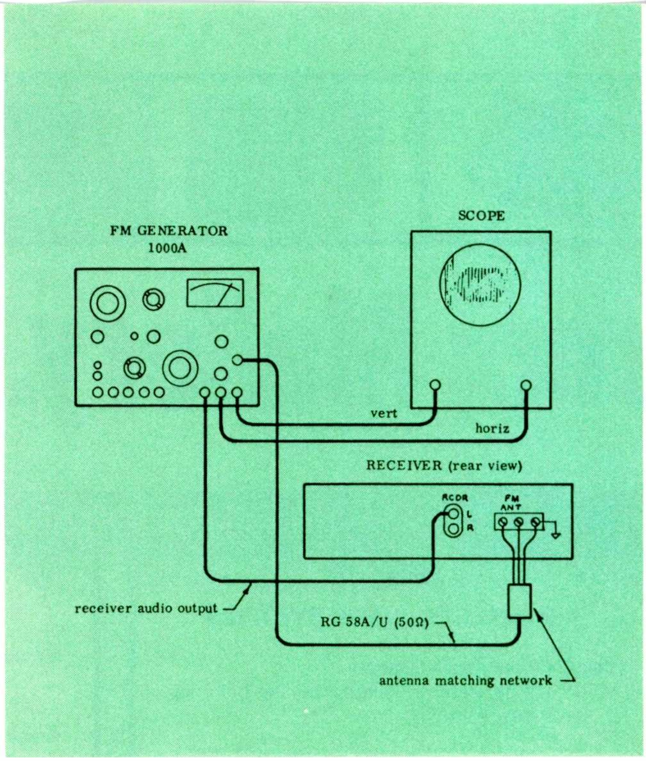

Fig. 2 Although this setup of receiver, generator and scope are primarily for measuring dynamically the overall distortion, IF alignment also can be performed.

A faster way to align FM receivers

By Robert A. Andersen,
President of Sound Technology
and Frank Burkhard,
of the Frank Burkhard Company

Although the following article has been distributed privately by Sound Technology, ELECTRONIC SERVICING believes the technique and equipment explained here merit a more widespread coverage. Reprinted and re-edited by special permission of Sound Technology.

Here's a technique that lets you check RF and IF alignment and the overall distortion of an FM receiver using just a scope and a special generator, the Model 1000A by Sound Technology (Figure 1). No distortion meter is needed, and you don't have to tune in a station and do some final tweaking to make the receiver "sound right".

Connecting To Measure Distortion

The first step of any alignment job is to determine if alignment is actually needed. So, let's look at how simple and fast it is to check the overall distortion of a receiver.

To start, you merely connect the generator, the receiver or tuner, and a scope as shown in Figure 2. The RF output of the generator is connected to the antenna terminals, audio from the receiver (perhaps from the tape-recorder output jack) goes to the generator and then on to the scope.

When the power is turned on and the receiver and generator are tuned to the same RF frequency, you'll get a scope pattern like that in Figure 3A.

This unusual alignment pattern is produced by a generator function called "Dual Sweep" and filtering in the generator. In addition to the usual carrier which is swept across the receiver bandpass at a 60-Hz rate, there is added a small-amplitude constant-deviation FM signal of about 10 KHz. At the output of the discriminator, this 10-KHz signal, now detected, will be superimposed on the familiar S-curve shown in Figure 3B.

Now, if the S-curve of the receiver is exactly linear over its useful frequency range, the detected 10-KHz signal will have constant amplitude across the S-curve. But, if the S-curve is not linear, the amplitude of the 10-KHz signal will vary according to the position on the S-curve.

However, at the discriminator output, as viewed in Figure 3B, small changes of the 10-KHz amplitude cannot be seen; the large 60-Hz component is overpowering. Therefore, before the 10-KHz signal can be evaluated, all other parts of the waveform present at the discriminator must be removed. This is done by filters inside the generator, and that is the reason for routing the audio through the generator. The result is the waveform of Figure 3A, in which the amplitude can be measured. The envelope is a plot of the small-signal 10-KHz signal gain versus the carrier frequency.

Before this generator was developed, many discriminators were adjusted for lowest distortion by technicians who monitored a distortion meter connected to the audio output signal. Although such adjustments were time consuming and required extra equipment, they were necessary because visual analysis of the S-curve linearity

(Continued on page 24)

"Off-hand, I'd say you've been watching too many soap operas!"

"...then, check Q2 in the AGC system!"

"What happened to the vitamin bottle that I had transistors stored in?"

The all NEW

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We've come up with a way to let the transistor tell you. For dead-certain, without ever taking the transistor out of the circuit. (In fact the circuit isn't even on.)

Our way is the transistor curve tracer you see above. It sweeps a transistor with pulses of DC voltage. And presto, the transistor starts talking.

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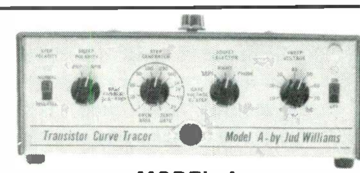

MODEL A

Another thing.

Transistor manufacturers make lots of essentially identical transistors. But each manufacturer uses different numbers, so you don't know the transistors are identical.

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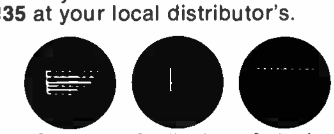

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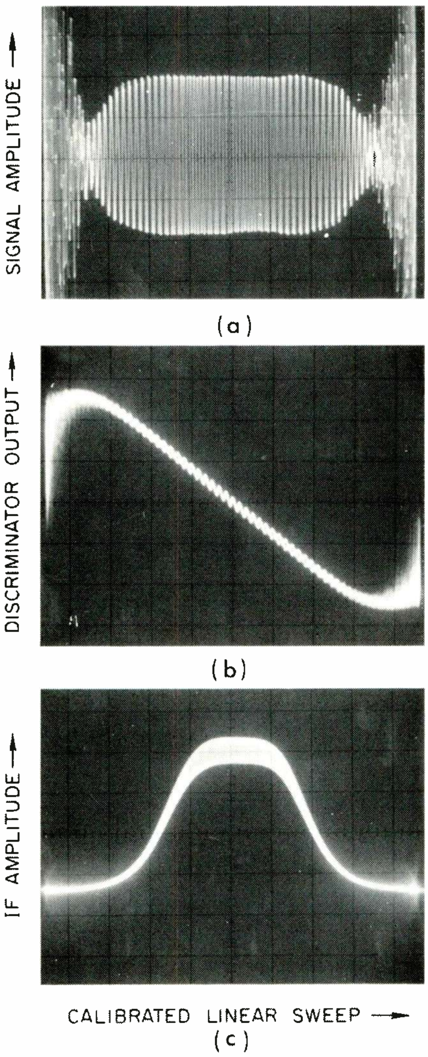


Fig. 3 Some of the curves obtained by use of the generator. **(A)** Poor alignment causes humps or abrupt drop-offs which cause distortion and incorrect tuning. **(B)** Output from the discriminator is the typical S-curve, except the small-amplitude 10-KHz extra FM modulation appears as small sine waves on the curve. Filters in the generator eliminate the 60-Hz S-curve component of the waveform to give the picture of (A). **(C)** Sweep alignment pattern obtained by the more-conventional method. Sweep width is about 750 KHz to show the skirt response.

without the 10-KHz signal is not accurate enough to indicate minimum distortion.

The Envelope Shows Intermodulation Distortion

Intermodulation distortion is the unwanted modulation of a high-frequency signal by a low-frequency one. In this case, intermodulation is shown by the amount of amplitude modulation (height change) of the 10-KHz signal which is produced by the 60-Hz S-curve of the discriminator. It's a very sensitive method of measuring distortion, and the results are not confused by the de-emphasis of high frequencies in the receiver, as would be the case with measuring the total harmonic distortion. In addition, it is essentially a sweep test (usually faster than others), and requires a minimum of time to change to IF-alignment sweep (Figure 3C).

How To Measure Distortion

Non-linearity of the S-curve caused the uneven amplitude of the envelope of 10-KHz in Figure 4. A perfectly-linear S-curve would provide a ruler-flat plateau across the top and bottom. The 10-KHz signal is measured across a 150-KHz portion of the center envelope and corresponds to 100-percent modulation.

The amount of distortion is the ratio of the amplitude of the unevenness across the top of the envelope to the amplitude of the entire envelope. Because the amount of amplitude change in Figure 4A is not easily distinguished, we have enlarged it five times by increasing the vertical gain of the scope by 5X (see Figure 4B).

Now, the ripple is about .06 volt p-p (.1 V/CM), and the center of the envelope is 6 CM high at .5 V/CM or 3 volts p-p. Therefore, the distortion is .06/3 or .02 (which is 2-percent). Simple and easy!

A Very Sensitive Test

Notice that the measurement is in **peak** Intermodulation Distortion (IMD), and not RMS or average intermodulation. In fact, plain IMD tests

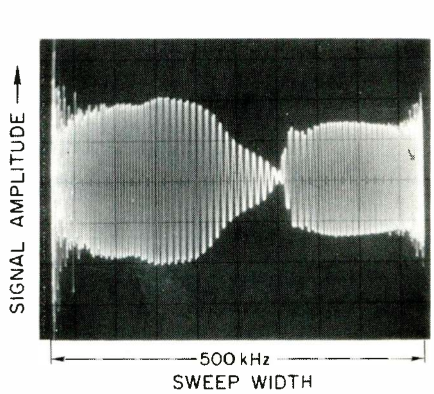


Fig. 5 A mis-aligned receiver might produce this alignment pattern having two plateaus. The station can be tuned-in at two dial points, the tuning will be critical and often distortion will result.

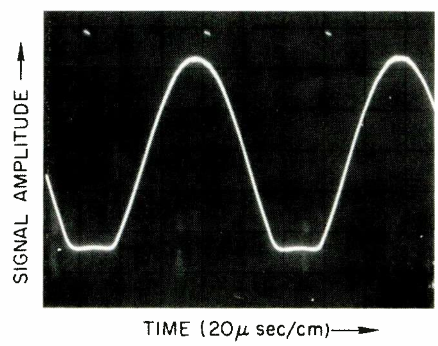


Fig. 6 The tuning of Figure 5 cause clipping of one peak of the modulating sine wave. This is one kind of distortion caused by narrow bandwidth and a high-degree of modulation.

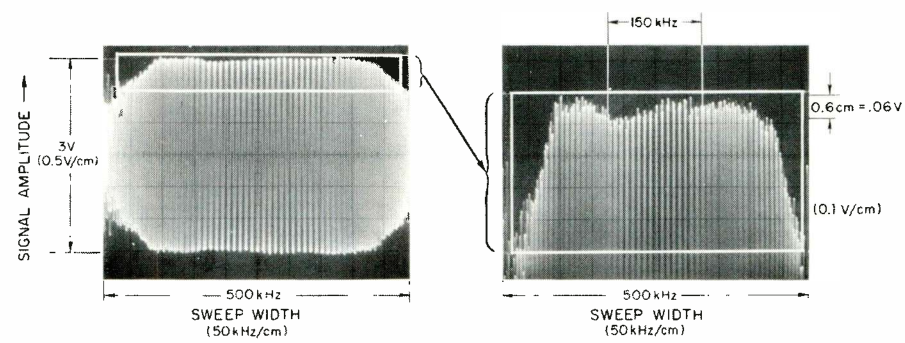
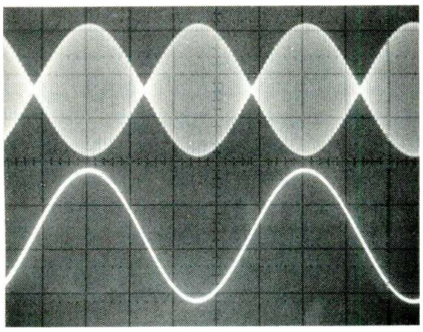
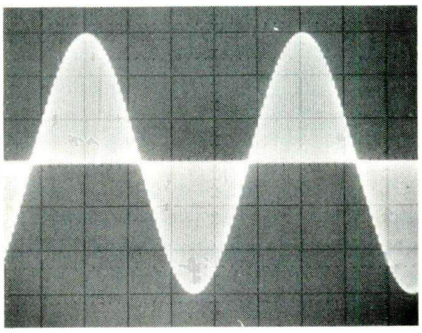


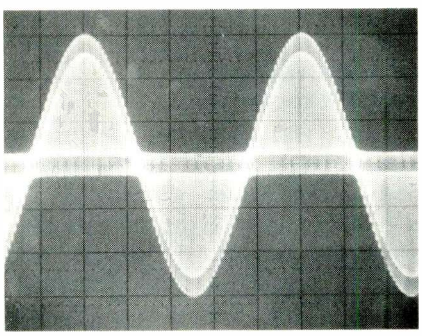
Fig. 4 To make reading the distortion easier, the top of the pattern at the left **(A)** has been magnified by increasing the scope's vertical gain by five times to give the pattern of **(B)** at the right. Distortion is the ratio of the "ripple" at the top to the total envelope; in this case 2%.



(a)



(b)



(c)

Fig. 7 Some of the signals for the alignment of multiplex stereo circuits. (A) Upper trace shows the L-R signal, while the lower trace is the L+R signal (both 1 KHz) from the generator. (B) Right only (or left only) composite test signal without pilot. (C) Same conditions as in (B) except the 19-KHz pilot is added.

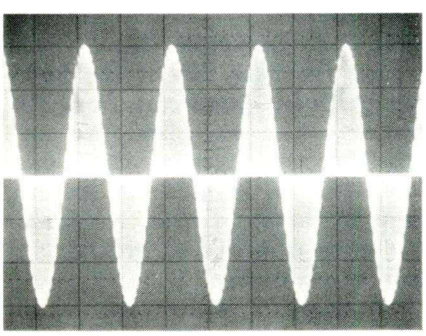


Fig. 8 The flatness of the base line shows the excellent channel separation (50 dB) in the generator.

are superior to Total Harmonic Distortion (THD) measurements, and peak IMD is better than plain IMD.

Incidentally, you can approximately convert a peak IMD reading to THD by dividing the peak IMD value by 5. However, this assumes that the harmonic-distortion measurement is made on a signal of sufficiently low frequency that the receiver de-emphasis doesn't reduce the higher harmonics. Otherwise, the THD measurements will be incorrectly low.

Just to prove the relationship between peak IMD and THD, we measured the THD of the receiver that produced Figure 4, using the best-grade of laboratory equipment. It measured .37-percent THD. Notice that a 2-percent peak IMD divided by 5 gives .4-percent THD, so the correlation is very close.

Reading Receiver Bandwidth

You can read the receiver bandwidth directly from the scope patterns of Figures 3 and 4. That's because the horizontal scale is linear, and the deviation meter on the alignment generator is calibrated to show accurately the p-p sweep width, which is adjustable with a panel control. For example, the sweep width in Figure 4 is 500 KHz p-p (50 KHz/CM). Normally, the receiver is tuned to the center of this pattern, and the signal you see there is swung 250 KHz on either side of center.

Receiver Alignment

The alignment method we've described allows you to quickly align a receiver for what the designers call optimum linear bandwidth. A wide linear bandwidth is essential to prevent distortion on peaks of the FM modulation, and is especially important for stereo because the stereo sidebands are so much more widely separated from the carrier than are those of mono.

In aligning with this method, you should strive for an envelope that is symmetrical and has smooth rounded edges with a flat central plateau. If the plateau is not flat, the audio from the receiver will be distorted. If the plateau has appreciable humps or abrupt drop-offs at the edges, the receiver will be difficult to tune.

Abnormal Patterns

Abnormal patterns produced by wrong alignment or circuit defects come in all shapes. As you gain experience, each one will begin to point to the source of the trouble. But rather than confuse you now, we will show only two.

First is the pattern of Figure 5, which is often found when a discriminator is aligned using a FM broadcast station or a conventional signal generator as the source of signal. The discriminator produces two plateaus. When the receiver is tuned to the plateau on the right, the audio sounds fairly good because the plateau is somewhat flat.

But, notice that the station can be received at two adjacent points on the dial because there are two plateaus. And each of the two will be rather hard to tune because of the narrowness of the plateau.

Also, the narrow plateaus, although they might barely accommodate 100-percent modulation, will give excessive distortion on modulation peaks that so frequently exceed 100-percent.

Figure 6 shows the excessive distortion caused by the alignment of Figure 5.

Sweep Alignment of IF's

The test signals, including markers, needed for RF and IF alignment by conventional sweep methods (Figure 3C) are supplied by the Model 1000A Sound Technology generator.

Alignment of Multiplex Stereo

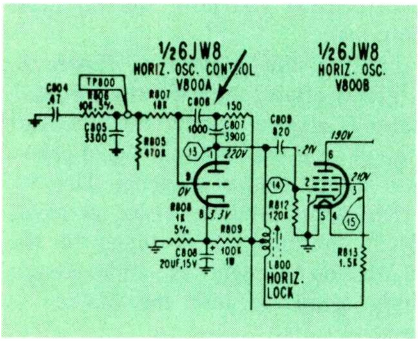
In addition, the generator fulfills all the requirements for testing and aligning the multiplex section of a stereo receiver. The signals include L, R, L+R and L-R with a separation of 50 dB between channels. Also, an adjustable-level 19-KHz pilot and an internal 67-KHz source of modulation for the adjustment of SCA traps are supplied. Figures 7 and 8 show some of the signal waveforms.

Such features as an RF level continuously adjustable from .5 microvolt to 30,000 microvolts, and .2-percent overall distortion at 100-percent modulation make the generator suitable for use as a laboratory instrument, as well as a workhorse for service-shop-type alignment. □

troubleshooting tips

(Continued from page 12)

After studying these voltages and concluding that something was leaking B+ to the grid circuit of the oscillator-control tube, I checked the components there and found C806 to have nearly a dead short.



Courtesy of Emerson Television Sales Corp.

Here is the explanation: the screen grid of the oscillator obtains its voltage from the same point that supplies the plate of the oscillator control. C806 is approximately between plate and grid of the control tube, so when it shorted it placed B+ on the grid. This raised the cathode voltage, and decreased the plate voltage, which in turn, decreased the screen voltage of the oscillator. The oscillator tube was cutoff, so the plate voltage increased.

The question is why the symptoms before the fuse blew, and those after it was replaced, were so different.

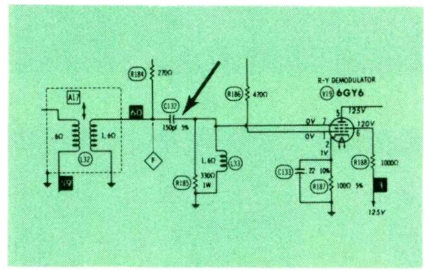
Donald Lewis
Lewis Radio & TV
Central City, Nebraska

No reds in color picture Magnavox T924 color TV Chassis (Photofact 956-2)

Only blues and greens appeared in the color picture, and there were no red bars in a color-bar display.

Substitution of tubes in the chroma circuit didn't help, so I started checking resistors, capacitors and voltages in the R-Y demodulator and R-Y amplifier stages. DC voltages were normal.

Scope readings showed a 3.58-



MHz carrier on one end of C132 and none on the other. Replacement of the capacitor brought the reds back to the picture.

Harry deBruyn
De's TV
Colorado Springs, Colorado

No high voltage B-W TV receivers

If high voltage is lost because of arcs through a hole in the insulation of the heater winding of the HV rectifier tube, the usual symptoms are odors of ozone and burning insulation, plus sometimes a visible arc around the flyback transformer.

However, if the customer has operated the receiver too long in this overloaded condition, it's very possible the area around the arc has carbonized. In that case, the bad spot becomes a permanent short circuit without odor, sound or light to draw attention to it.

The boost voltage and the plate voltage of the horizontal-output tube will be low, and the output tube will heat.

There is one good clue. If you remove the base cap or the high-voltage anode connector from the picture tube (to eliminate any possibility of excessive CRT current), and the high-voltage rectifier tube continues to heat, a carbonized path from HV to ground is a definite possibility.

James O. Woodward
Woodward TV & Changer Repair
New Castle, Indiana □

book review

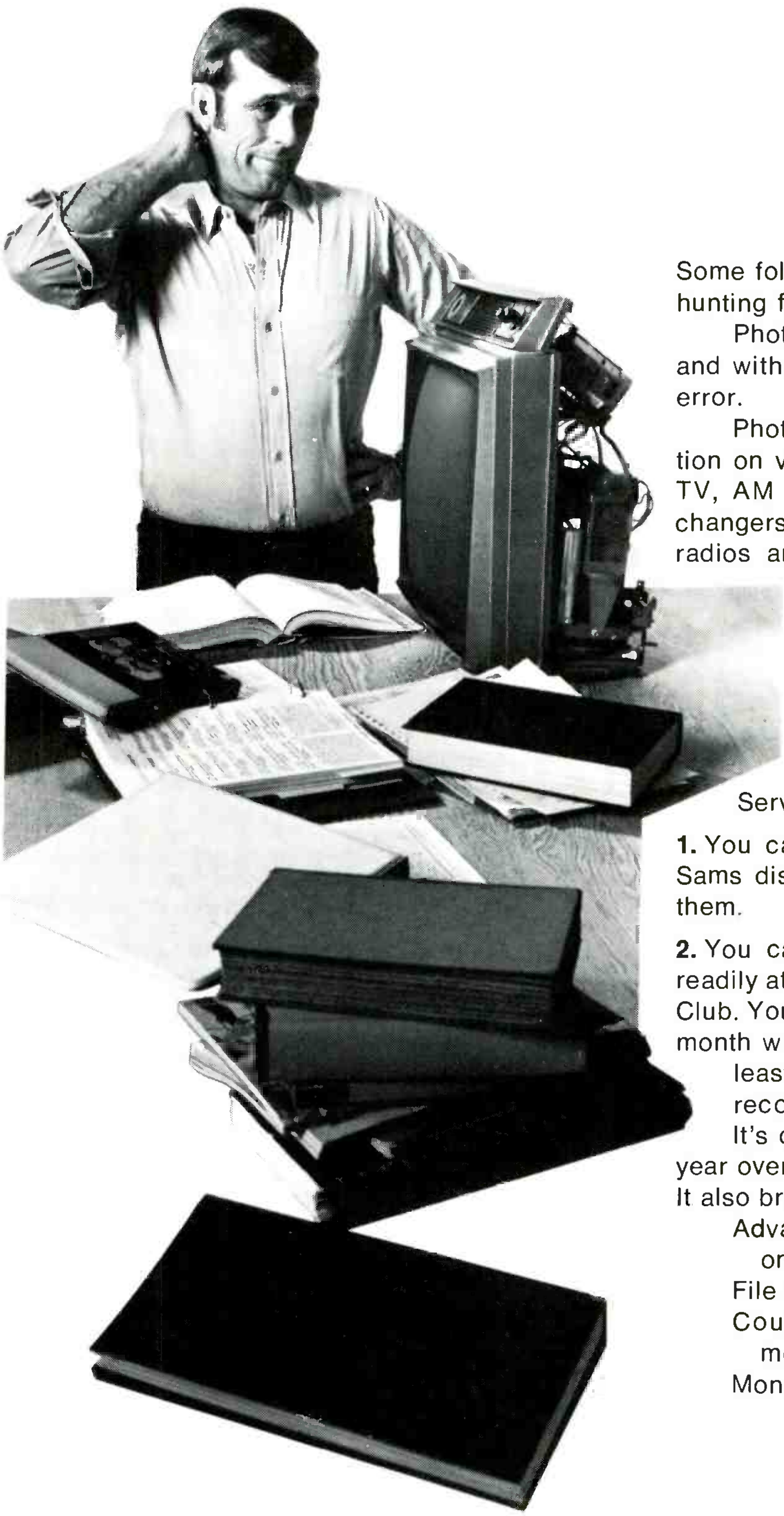
Tube Substitution Handbook, Sixteenth Edition
Author: The Howard W. Sams Engineering Staff
Publisher: Howard W. Sams & Co., Inc., Indianapolis, Indiana
Size: 5-1/2 inches X 8-1/2 inches, or pocket-size "Piggy-back" volume; 96 pages
Price: Softbound $1.75; regular and "Piggy-back" volumes $2.25

The **Tube Substitution Handbook** has kept pace with the rapid expansion of tube substitution by listing over 12,000 direct replacements for all types of receiving and picture tubes on the market. For convenience, this handy guide is divided into seven informative sections. Section 1 presents a cross-reference of all American receiving tubes, and Section 2 lists picture tubes and their recommended substitutes. Section 3 contains a cross-reference of subminiature tubes, while the fourth section consists of industrial substitutes for receiving tubes. The fifth section is a substitute listing for communications and special-purpose tubes. The final two sections feature cross-references of American and foreign tubes. There are easy-to-follow instructions accompanying each section that help you make proper tube substitutions and that explain how to cross-reference between sections for other substitutes. This guide fills the need of service technicians or audiophiles who desire quick and accurate information for making suitable tube substitutions.

How To Wire Hi-Fi Extension Speakers
Author: Len Buckwalter
Publisher: Howard W. Sams & Co., Inc., Indianapolis, Indiana
Size: 5-1/2 inches X 8-1/2 inches; 96 pages
Price: Softbound $3.95

Only a basic knowledge of electronics and simple tools are needed to take advantage of the suggested innovations in this book. The text has step-by-step instructions about how to design and install a particular extension speaker system to meet a special need. The book is broken down into ten sections, each dealing with a particular phase of extension speaker wiring. Some of the many items covered are: speaker selection, hardware and accessories, basic circuits, switching and controls, practical circuits, installation, and troubleshooting. Both tube-type and solid-state amplifiers are discussed. Numerous economical ways in which extension speakers can multiply the value of hi-fi equipment are explained. This information would be helpful to anyone interested in expanding the listening area of hi-fi equipment. □

Replacement Parts? You can guess, hope, hunt...



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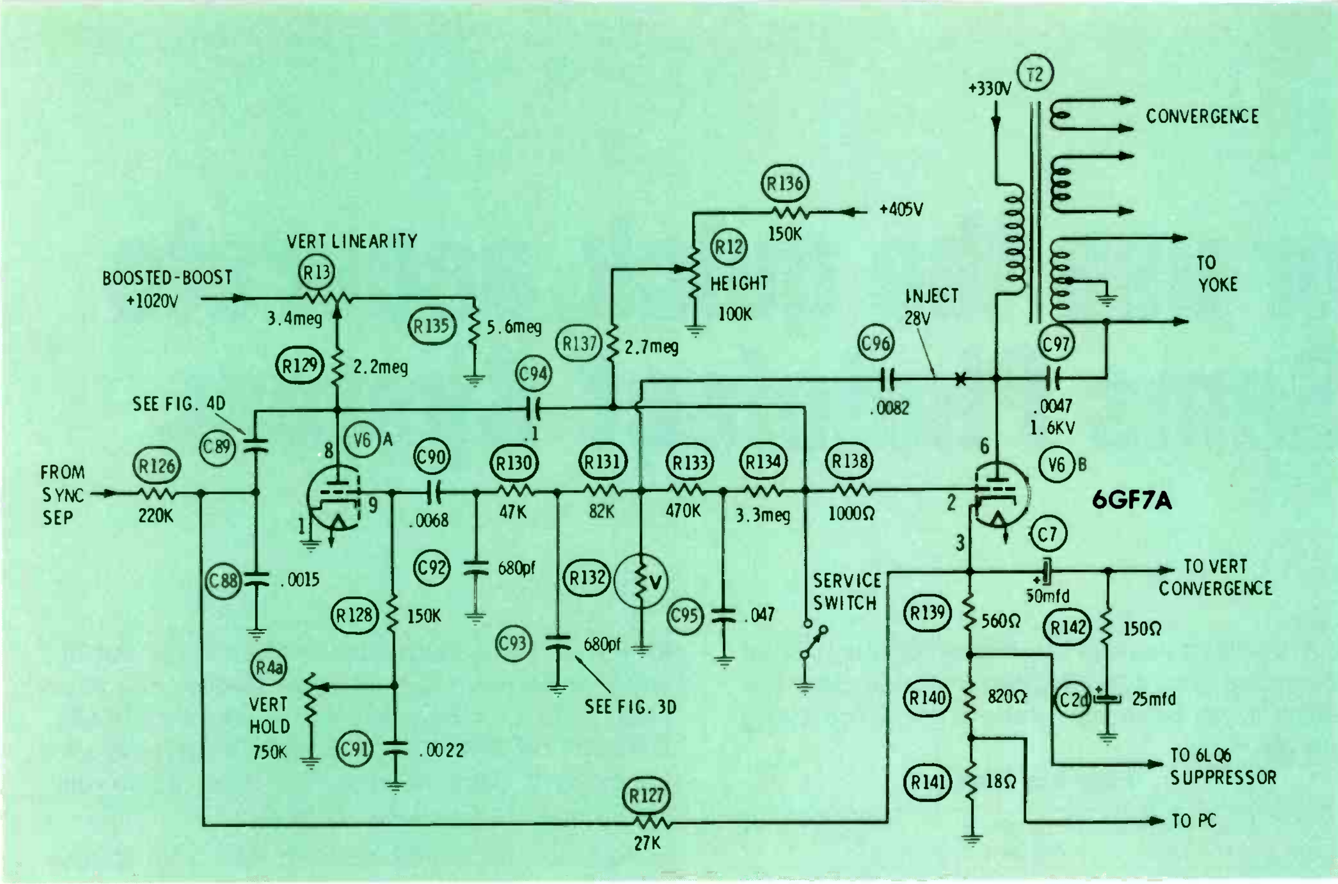


Fig. 1 Schematic of the vertical sweep circuit of the RCA CTC39 chassis.

The ups and downs of vertical deflection

By Bruce Anderson

When it's working correctly, a vertical-sweep circuit appears to be very simple. But, it's also devilishly complicated when there's a defect. Although the circuit has relatively few components, you can waste a lot of time on "shotgun" troubleshooting. Efficiency (spelled MONEY) demands that we use methods to reduce troubleshooting time.

Basic Vertical Defects

The basic troubles which can occur in a vertical sweep circuit are:

- no height, or insufficient height;
- poor linearity; and
- grossly-incorrect frequency.

All of these faults can be isolated by use of the procedure to be described here.

There is one additional fault possible in vertical sweep systems: loss of locking. In that case, the picture can be made to roll slowly either upward or

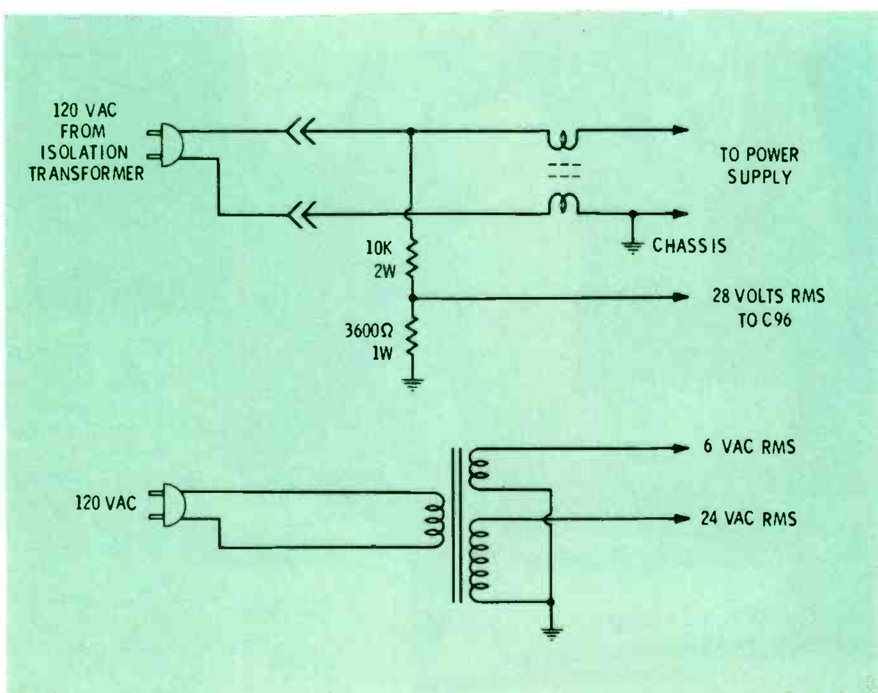


Fig. 2 Alternate sources for the 28-volt RMS sine waves used for a test signal. The 28-volt transformer is preferred.

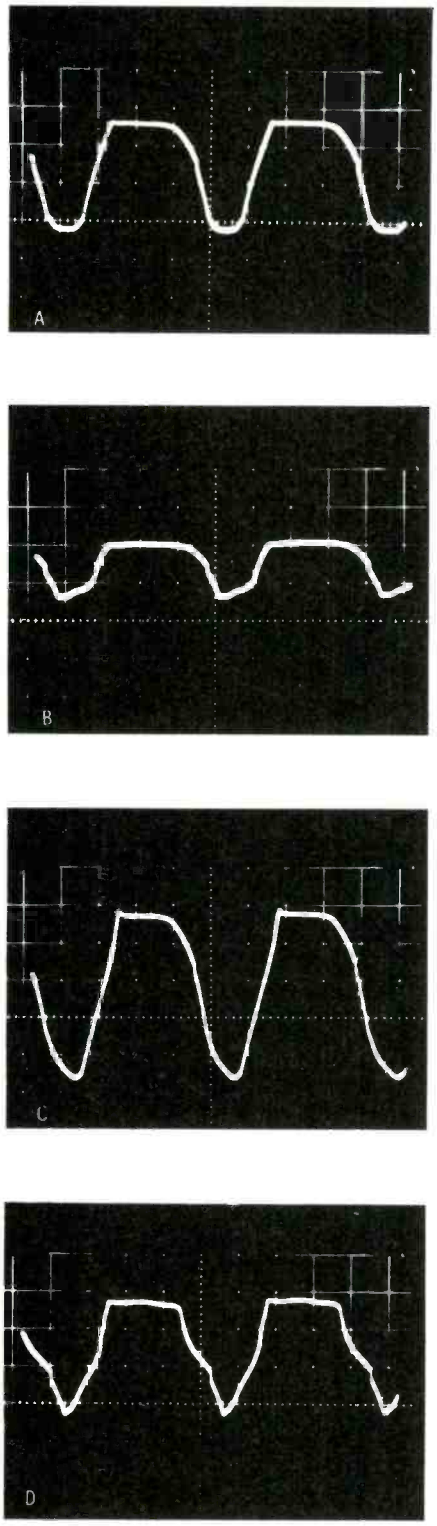


Fig. 3 Waveforms at the grid of the oscillator tube when the test signal is used. **(A)** Normal 15-volt waveform, 5V/CM. **(B)** Hold control set to minimum, or C91 shorted, 5V/CM. **(C)** Hold control set to maximum resistance, 5V/CM. **(D)** Waveform resulting from a 100K leakage across C93, 2V/CM.

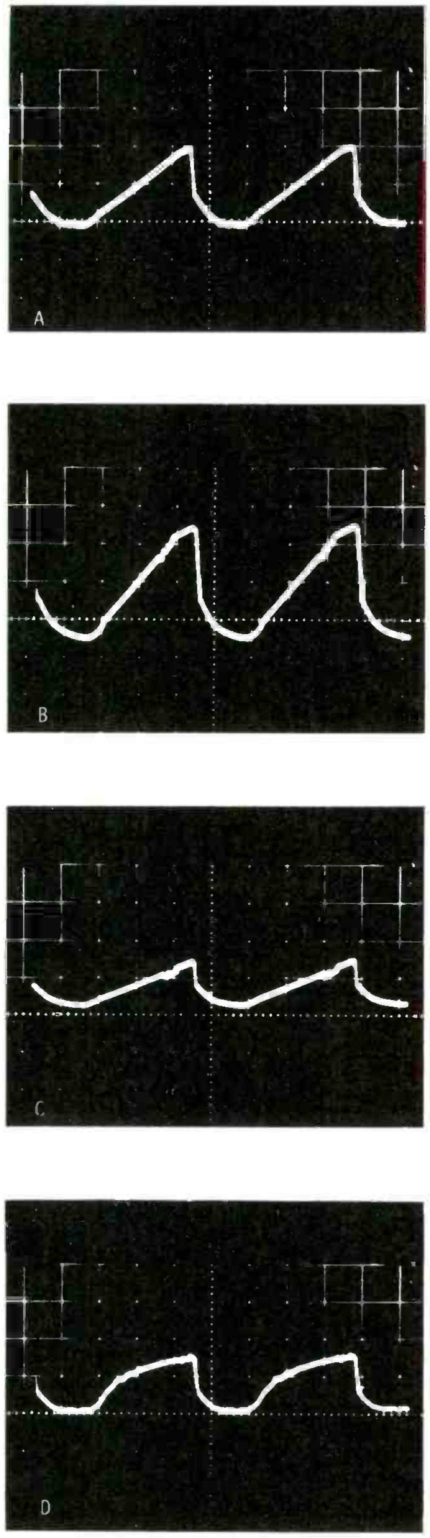


Fig. 4 Waveforms at the plate of the oscillator when the test signal is used. Scope is adjusted for 50V/CM. **(A)** Normal 100-volt signal. **(B)** Linearity control adjusted fully CCW. **(C)** Linearity control adjusted fully CW. **(D)** Waveform caused by 100K leakage across C89.

downward without any locking. This shows that the oscillator frequency is correct, and the defect normally lies outside the sweep circuit itself.

A Typical Vertical System

Many vertical-deflection systems are very similar, and the same troubleshooting techniques will apply fairly well to them. Our example is taken from the RCA CTC39, whose vertical circuit is shown in Figure 1.

It's All Oscillator

In our TV jargon, the low-level half of the vertical-sweep tube is called the oscillator, and the high-level half which drives the yoke is called the output. Actually, the entire circuit is an oscillator. Specifically, an unbalanced-multivibrator type. But, rather than confuse the issue, we'll continue to call them by the usual names, oscillator and output.

Unfortunately, simplifying the names doesn't make servicing any less difficult, because any oscillator is a closed loop. **If a defect occurs in any part of the circuit, the voltages and waveforms throughout the entire circuit will be affected.** For example, loss of B+ to the vertical-output transformer removes the input signal from the oscillator tube, which, in turn, changes the AC and DC voltages there and eliminates the waveform.

For this reason, the normal voltages and waveforms given in service data are often of little value. When the system is working okay, they aren't needed; when it isn't, all the voltages and waveforms are abnormal anyway.

Service Each Stage As An Amplifier

The preceding problems of troubleshooting don't occur in ordinary amplifier stages, with the exception of DC-coupled stages. Each stage is a separate entity, unaffected by the others. Logically, then, the stages of a vertical-sweep system should be easier to analyze if we can change them into amplifiers.

Any oscillator becomes an amplifier, if the positive feedback from output to input is disconnected. In Figure 1, the feedback passes from the plate of V6B through C96 and on to the grid

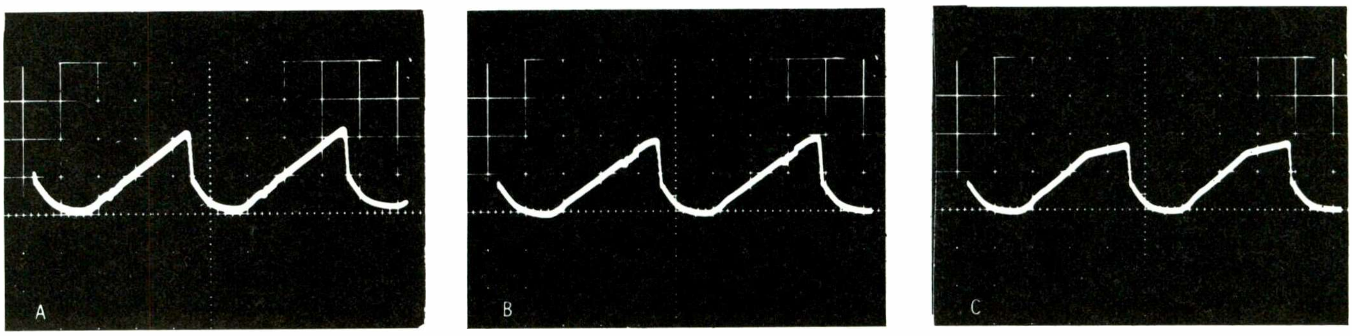


Fig. 5 Waveforms at the grid of the output tube. Scope vertical sensitivity is 50V/CM. (A) Normal 100-volt signal. (B) Height control fully CW. (C) Height control fully CCW.

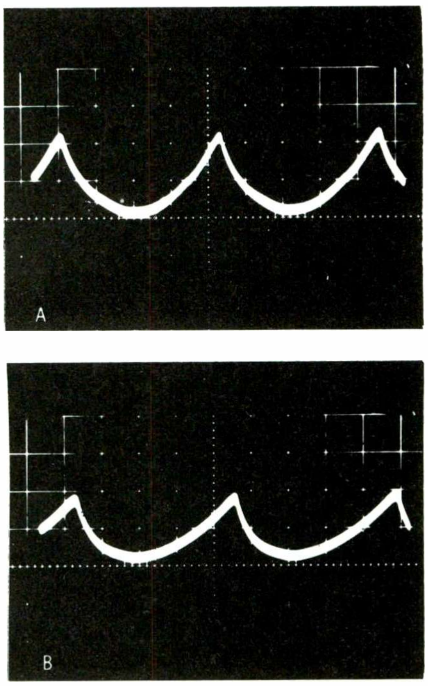


Fig. 6 Waveforms at the cathode of the output tube. Scope sensitivity is 10V/CM. (A) Normal 20-volt parabolic waveform. (B) Little change is produced by a shorted C2D.

of the oscillator. Disconnecting C96 stops the oscillation.

Injecting a 60-Hz sine wave to the free end of C96 provides a test signal which can be used for signal tracing the newly-formed 2-stage vertical "amplifier" circuit.

A 28-volt RMS driving signal produces about the normal amount of vertical deflection. The linearity is slightly compressed at the top and expanded at the bottom of the screen. And, of course, it rolls slowly downward.

As shown in Figure 2, filament transformers with a 28-volt winding are ideal sources of the test voltage. Also, the test voltage can be obtained from a voltage divider across the 120-volt input terminals, if an isolation transformer is used for protection from shock, and one side of the line is grounded (Figure 2A).

Signal Tracing The Oscillator Stage

Using a scope, the first point of the signal tracing is the grid of the oscillator. Although the test waveform is a sine wave, don't expect to find one at the grid (Figure 3). The grid draws current on the positive peaks, so the top half of the sine wave is clipped off. Also notice that varying the resistance of the hold control changes the waveform. This is normal; but to make the test more definite, judge the waveform when the hold control is in the center of its range.

The waveform of Figure 3D shows the distortion caused by a 100K leakage across C93, which is in the positive feedback path. Although it is impractical to show the waveforms produced by the many possible component defects, these examples should give you a starting point for your own analysis.

Before going on to the next step of checking the plate waveform, set the hold control to produce the correct waveshape at the grid, and don't readjust it for the remainder of the test series.

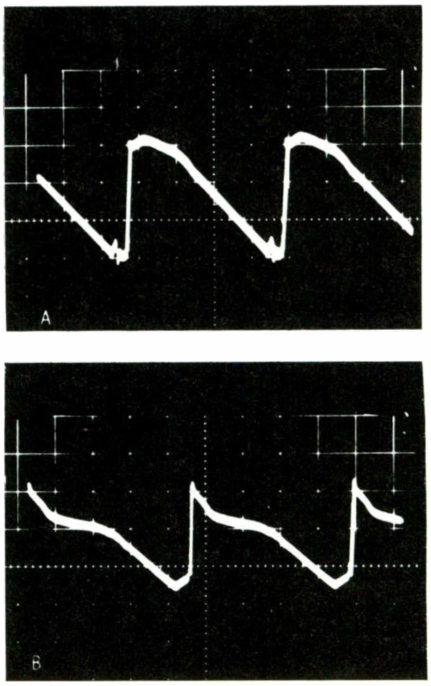


Fig. 7 Waveforms at the plate of the output tube, at 100V/CM. (A) Normal 300-volt waveform of the test signal. (B) Distorted waveform caused by a 10K leakage across C97.

Plate Waveforms

The normal test waveform (Figure 4) approaches a sawtooth, and the amplitude should be about six or seven times that at the grid. Naturally, the setting of the linearity control will affect the waveform. However, if the waveform is correct at any setting, assume that all is well so far; although the most desirable point is near the center of the range. If the waveform is not correct at any setting, perhaps one of the three resistors in the plate circuit is out of tolerance, or a capacitor is leaky.

Output Grid Waveforms

Next to be checked is the test signal at the control grid of the output tube. This waveform (Figure 5) checks the coupling circuit between the plate of the oscillator and the grid of the output, and it will be modified by the setting of the height control.

Because the service switch connects to the junction of R134 and R138, a shorted service switch removes the signal at the grid.

Cathode and Plate Waveforms

The waveforms at the plate and cathode of the output tube are somewhat interdependent. For this reason, measure the cathode-to-ground resistance if either waveform is abnormal. It should be about 1400 ohms.

Notice that an open in R140 or R141 would not eliminate the vertical sweep, because of conduction through the screen-grid circuit of the horizontal-output tube. This can be quite confusing. Sometimes, the symptom is vertical sweep for a second, then a collapse to a horizontal line, then vertical height, then a line, etc.

A shorted C7 or C2D changes the cathode waveform very little. However, an open C7 will produce a large pulse at the cathode and a serious loss of height.

After the cathode waveform is checked, the test-signal waveform at the plate of the output tube should be observed.

Some authorities recommend that the AC and DC voltages at the plate of the vertical output tube should not be measured, evidently because of the possibility of damage to the scope or meter from the high peak voltages there. However, you will note in Figure 7 that the test waveform is less than 300 volts p-p. There is no danger to your test equipment during this type of troubleshooting.

Of course, normal grid and cathode waveforms and abnormal or low-amplitude plate signals point to a defect in the output stage, such things as the output transformer, yoke, and the convergence system.

After you find the component causing the problem, re-connect C96 and adjust all the controls for normal locking and scan.

Summary

One of the short-cuts used by many technicians is to inject 6.3 volts RMS through a .1 capacitor to either the output control grid or the oscillator grid to prove amplification beyond that point. This method does work, to a degree.

But better results, which include testing of more components under nearer-normal conditions, can be obtained using the method detailed here. For example, many problems originate in the positive feedback network, which is not tested by use of the short-cut method.

All in all, we can say as does the man in the commercial: "Try it, you'll like it!" □

Your *employees*... a major factor in *your* success

By
Robert G. Amick

Much has been said and written about Customer Relations. But the equally important shop owner/employee relationship is often neglected.

How much time and thought have you given lately to your employees and their importance to your business success? Probably not enough, if they goof-off too much, talk-back to customers, are indifferent to mistakes and waste, or indulge in other business sins.

If your employees seem to be liabilities as well as assets, it just might partially be your fault. Perhaps, some of the following examples of destructive attitudes are exaggerated, but they should be useful for your self-evaluation.

Your Attitudes Become Evident

"Why should I care what those guys back at the bench think? If their ideas amounted to anything, they'd be the boss and giving orders instead of taking them." Have you ever made a remark like this? Probably not, especially not where your "help" could hear you. But you don't have to express such an idea aloud; how you treat them will say it for you.

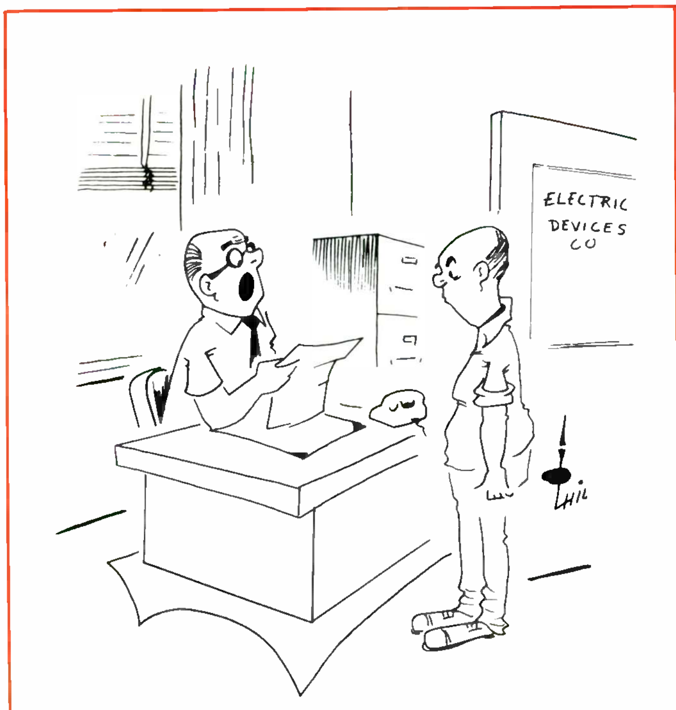
If you believe that employers are superior to employees, that your success is all due to you, that employees are more trouble than they are worth, and if you brush-off complaints or suggestions from those employees, they will get the message strongly and clearly.

Morale—Good Or Bad

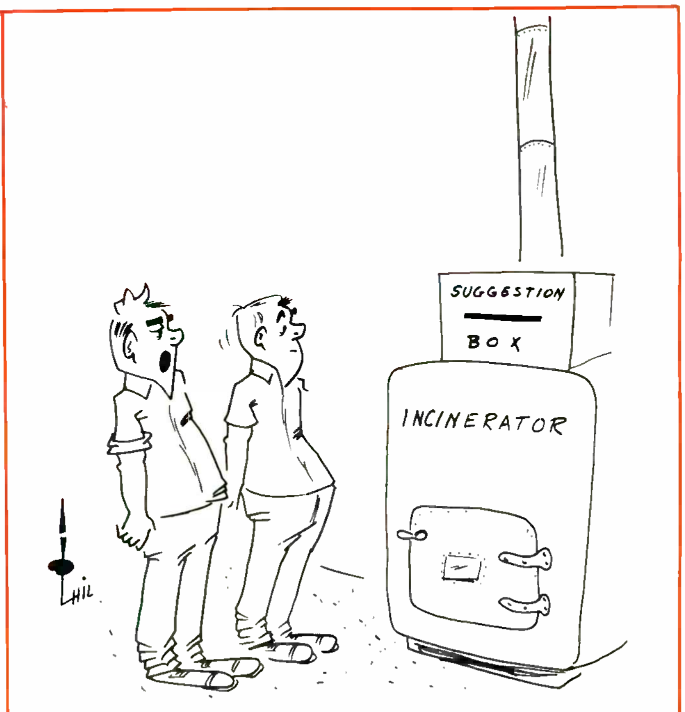
One of the messages you might radiate unknowingly is: "This is the end of the line: if you were any good, you wouldn't be working here." When your employee senses the message, his natural answer is, "If I'm that bad, how comes he keeps me?" Any such unspoken dialog cripples morale.

Employee relations should be aimed at just one goal: building and maintaining high morale among your people.

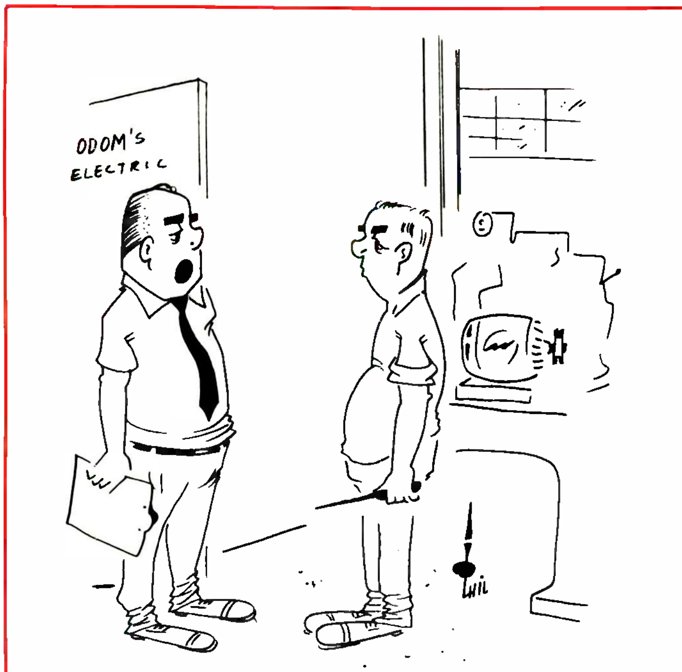
Why should you want high morale? To eliminate problems? Right. To boost profits? Yes. To smooth contact among those sharing so much of your time? Right, again. To increase the satisfactions you get from your work? Certainly. To ease the strains on your digestive and nervous systems? Still right. Or, to lighten your own work load so you'll have more time to enjoy



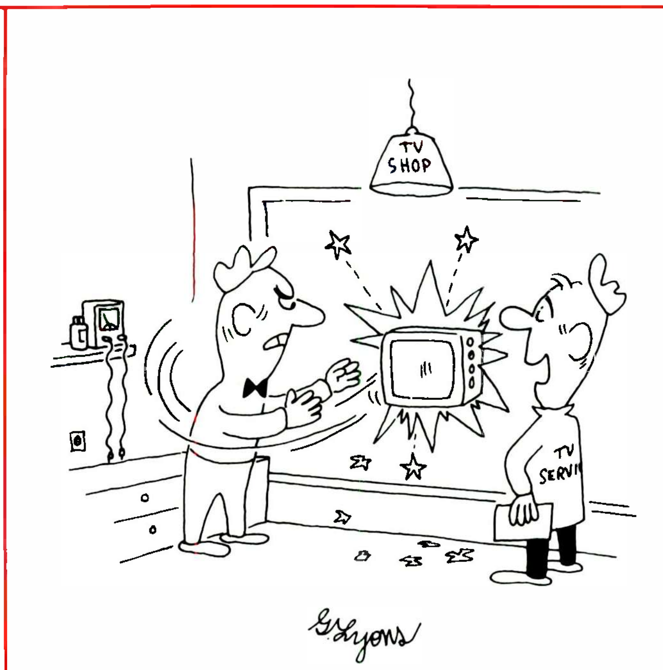
"Haskins, I was thinking about giving you a raise, but then I started thinking about your production!"



"We have a great system of communicating around here!"



"No, I don't go along with the idea that no work means zero defects!"



"Temper, temper!"

life and the rewards of success? Right on all counts. But if the morale is poor, just forget about these desirable morale-produced benefits.

Morale is pride

Morale shows up as pride in what you do and how well you do it. Also, as pride in the people who work for you. On the other side of the picture, your employees should have pride in their jobs and their competence to do the work.

It's doubtful a business can reach its full potential of success without the boost of excellent morale.

Ways To Improve Employee Relations

Some people believe that better employee relations can be obtained only by trying elaborate contests or gimmicks, bonuses, longer vacations, or high-pay-for-little-work. In most cases, any slight morale boosts received from such plans won't last very long. Notice that most of these factors are concerned only with material rewards.

Money isn't everything

Most studies made of worker's attitudes toward their jobs show at least two or three factors rating consistently higher than financial rewards. The old joke that says money is far ahead of whatever's in second place just isn't true when it comes to jobs.

Pleasant working conditions, job satisfaction, and long-term prospects for advancement generally are given preference over money. Although these are general terms with quite a bit of overlap between them, their importance to employees tells us something. Although most people must work for a living, few of them are willing to trade their feeling of personal worth for money alone.

Too often we express the employer/employee relationship by saying, "I work for him", or "You're working for me." But, actually we find, when analyzing the motivation at a deeper level, that people work for themselves. Of course, they might do the work you tell them to, and they might be paid by you for that work, but the **living** they are after is **theirs** not yours. We should all admit this fact and accept the interdependence clearly shown: **You make a good living when they do, and they prosper as you do.**

Workable Employee Relations

All good relationships with your employees begin with trust. But trust is a two-way street: They expect you to trust them; you must earn **their** trust. Do you level with them? Do you conduct yourself in ways that let them know they can expect you to act openly, fairly, honestly and considerately?

Suppose one of your people comes to you with a minor complaint. You know what's coming and, when he asks to see you, you say, "Not now. Haven't time. Ask me later." Does the man have reasons to believe you mean what you said, that in fact you will talk to him later? Or, does he have doubts that "later" will ever come?

I once worked briefly for a man who said "No" to everything. He treated me (or any other employee) as a disloyal child if I brought him a complaint or asked about a raise in pay. I trusted him, alright, but in a negative way. Consequently, I shortly found another job paying a little less money, but having a more pleasant atmosphere. It's funny, though. I almost didn't get to quit, because when I went to tell him I was leaving, he tried to avoid me.

Security and growth

A man gets satisfaction from his work because he does something that meets a need, because he does it reasonably well, because his efforts and abilities are appreciated by the people he works for, and because he feels reasonably secure in his job.

Favorable long-term prospects include a continuation of his job-security, but also must provide for **growth**. Progress of proficiency, responsibility, and recognition are the most important things, not so much coffee-breaks and fringe benefits. But every employee needs to know his boss is aware of and approves of this growth. Your actions might broadcast the message, but it's too important to leave to chance.

Communications Are Essential

Everyone needs direction and reassurance; ideally in a small company, by informal talks between shop owner and employee.

Every employee who's interested in his job (and most are) has some questions he'd like answered. "How am I doing?", "What is the condition of the business?", "Is there anything new I should know?", and "What can I expect in advancement and raises?" are some possible questions.

It's best if the questions are answered before the employee's desire for an answer becomes critical. This means talks that take place more or less regularly. Most employees become very unhappy with a manager who tells the man nothing, until he makes a mistake and must be reprimanded. They're right; that's very poor psychology.

Next, the answers you give to the questions (either spoken or silent) must be consistent with your actions during the remainder of the time. Nothing is so demoralizing as two sets of signals giving opposite indications.

Be sure you really mean any words of praise or reassurance. On the other hand, don't use them instead of a raise. Even though money is not the most important factor, praise for technical progress that is not rewarded by additional money might arouse doubt about your intentions.

"How am I really doing?"

Don't wait until the thought accidentally crosses your mind, and does so when the time seems ideal, before you tell each employee privately what you think of his work and progress. Mark your calendar ahead, say three to six months, for a regular time of review. Then take care of it without fail each time.

There are several advantages to this method. The most obvious one is that you will do the review rather than put it off. Remember, the times between seem longer to the employee than to you.

Secondly, a periodic review forces you to notice and evaluate the performances of your employees. After all, even bosses get busy and fail to do all they should.

Maybe the biggest plus is that the employees will come to regard this evaluation as a normal thing to be anticipated. Also, constructive criticism given calmly at a scheduled date is more likely to be accepted without resentment than is an off-the-cuff remark.

It's even better, if you make these regularly-scheduled evaluations a time for consideration of cost-of-living or increased-productivity raises.

"How is the business doing?"

Conditions of your business directly affect your employees. Keep them constantly informed, in general terms, about gains or losses, seasonal promotions, expansions, new equipment, remodeling, or other changes. You might be amazed at some of the excellent suggestions they would make if they knew your plans in advance.

Also, your frankness should keep them from believing any false rumors.

"What's in it for me?"

A worker whose abilities are growing appreciates a paycheck that is growing to match. But he also appreciates a growing sense of satisfaction in meeting bigger challenges and responsibilities, of learning more about his job, and of making greater use of his abilities by contributing more to the success of the business. Many a good man has moved on, despite a record of steadily-increasing income, simply because he was saddled with a job that didn't give him this sense of growing.

You should be able to spot such dissatisfaction and deal with it before it becomes critical.

Promoting A Climate Of Growth

Despite some cliches, all men are not created equal, except in being free to choose some things for themselves. In this case, a man can choose to work for you or decide not to, to trust or mistrust you, to give you his maximum effort or just barely get by. If you create a helpful "climate of growth", it's likely the decisions will be favorable to you.

We've already discussed praise and reassurance, and they certainly are important to a climate of growth. But there's a reverse side. What do you do about mistakes, poor attitude or incompetence? How do you discipline?

Personality clashes—even sharp ones—don't call for discipline so much as for mediation or adjustment. Most mistakes don't require discipline. No, the only things requiring prompt, decisive disciplinary action are dishonesty, troublemaking, or a severe lack of interest.

If action is necessary, the first step should be a quiet talk alone with the employee, defining the problem, and letting him know that immediate improvement is expected. If the problem is very serious, the admonition can be a warning: "Straighten up, or else."

Of course, if all other actions fail, dismissal is in order, unless your organization is large enough that you can transfer him to another job not subject to the same problems.

I don't think much of dismissal as a disciplinary action. You can use it only once, and I see it as only slightly more respectable than beating a man. But it's the only solution for the really bad apples; the dishonest, the habitual troublemakers, or the man who deliberately refuses to do his assigned job (of course, make sure his problem is not caused by your wrong judgement). If not eliminated, these few can destroy the high morale you're trying to build.

On the other hand, don't be too quick to dismiss a man who's slow, or doesn't seem as smart as you'd like. If he is honest, doesn't make trouble, and gives you whatever best he has, it might be easier to help him build up his confidence, knowledge and proficiency than to find a better man.

Successes And Failures

Your failures in the field of employee relations are apt to be very clear and dramatic. An open feud between men, an outside man caught stealing tubes because he believes himself to be badly treated by you, an excessive turnover of employees, or an organization with low morale are some of the possibilities.

On the other hand, your successes are more likely to be of the quiet type, such as learning from a job applicant that his friend works for you and recommended that he apply. Or, having employees who willingly learn more about the techniques of servicing and of dealing with customers, and who stay with you for years.

We might say that the more cooperation and the less tension in the business, the more work gets done with less friction between employees and customers. The end result is that far less of your limited supervisory time is needed. That's a valuable return just for treating your employees with the consideration due them as human beings. □

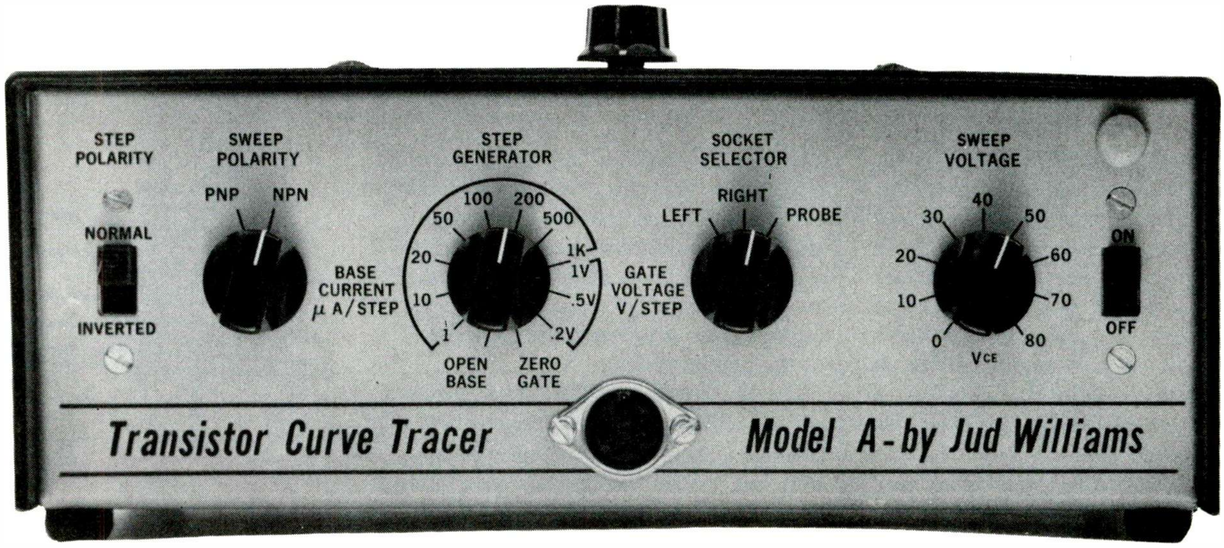


Fig. 1 The improved version of the Jud Williams Transistor Curve Tracer Model A.

Using "signature patterns" to service solid state

By Jud Williams

In the 1971 February and March issues of ELECTRONIC SERVICING we described transistor curve tracers and some of the techniques for using them to find defective solid-state components, both in-circuit and out-of-circuit. Most of the major test-equipment manufacturers now have curve tracers for sale, and we feel the time is right for an update on methods of in-circuit testing by the use of Signature Patterns which have been developed by Jud Williams–Editor.

Have you ever unsoldered a transistor, found it to be defective when tested out-of-circuit, but then wondered if it had been ruined by the removal?

On the other hand, if the transistor tested okay, there were the supposedly-simple, but actually difficult, jobs of getting the leads back to the correct holes in the board, and resoldering without damaging either the transistor or the board. It would be very helpful if the transistor could be checked without removal.

In-circuit transistor tests (if they could be depended upon to give complete and truthful answers) would eliminate these problems and, as a bonus, save considerable time. Here's where "Signature Patterns" come into the troubleshooting procedures.

What Are Signature Patterns?

"Signature Patterns" are scope waveforms obtained by using a transistor curve tracer for in-circuit testing of a transistor, or other solid-state component. (Editor's note: the name "Signature Patterns" is copyrighted by Jud Williams, and should not be used as a generic term to describe all such waveforms.) The improved version of the Jud Williams Model A curve tracer is shown in Figure 1.

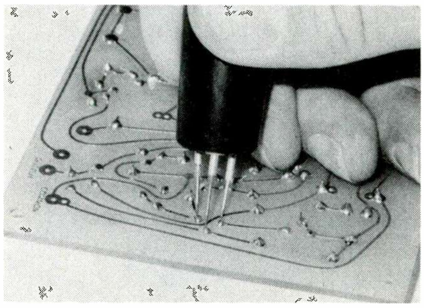


Fig. 2 Probe for use on circuit boards has three swiveling needle-pointed prods which are spring-loaded to maintain solid contact.

In some cases, the in-circuit (Signature Pattern) waveform is nearly identical to the waveform obtained by curve tracing the same transistor out-of-circuit. In other cases, the Signature Pattern might be barely recognizable as a family of curves.

However, here is the important discovery I made while checking many chassis: the same general waveshape will be produced time after time by a non-defective transistor in the same stage of the same model of machine. Also, I found that defective transistors change the Signature Patterns so drastically there can be little doubt whether or not they are bad. Borderline cases occur very rarely.

Standard Signature Patterns Are Needed

There are only a few limitations to the use of Signature Patterns. For one thing, the pattern of an audio-driver transistor will be completely different from that of a sound-IF transistor. What's more, the pattern of the color-oscillator transistor in a Zenith might show little similarity to that obtained from the color-oscillator stage of an RCA.

In other words, although similar circuits often produce slightly-similar Signature Patterns, any highly-accurate diagnosis demands a sample pattern for **each** solid-state component in **each** model of chassis.

So, it follows that published Signature Patterns for all models and brands would help technicians troubleshoot faster and better.

editorially speaking

The attention of our industry continues to center around the proposed merger of NATESA and NEA. But, at the time I am writing these comments, the merger plans are stalled. How can this be? After all, the memberships of both associations voted overwhelmingly for the merger, and the members of the merger committee are known also to be in favor of the merger.

Is it a question of clashing personalities or unreasonable demands from the staff members presently employed? I think not, although some such problems have been reported. No, perhaps there is a more basic problem: a lack of factual information about what any merger, and this one in particular, really involves.

One type of merger could combine everything, both the good with the undesirable. In this case, all of the current programs of both organizations would be retained, as would the present staffs in two cities. Only the constitution and bylaws would be different. Obviously, this is not the way to go. Either extreme inefficiency would result, or one organization would devour the other.

We should learn from business mergers in which wasteful duplications are eliminated, while programs, talents and finances are pooled.

There is one hopeful sign. Frank Moch of NATESA and Dick Glass of NEA are meeting of their own volition in Champagne, Illinois on April 9th to see if there is anything they personally can do to break the log-jam. We wish them and the merger committee [headed by M. L. Finneburgh, Sr.] every success. □

Carl H. Babcoke
Managing Editor

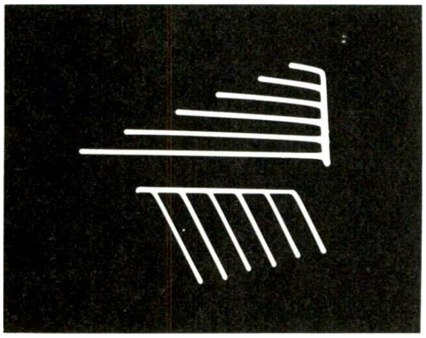
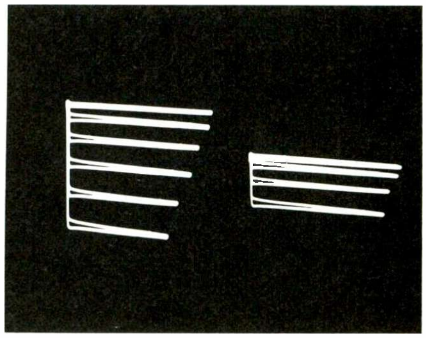


Fig. 3 Lower waveform is the false comb-like waveform obtained by operating a PNP germanium transistor with the polarity switch set for NPN and a base current of 200 microamps. Above is the normal waveform for comparison.



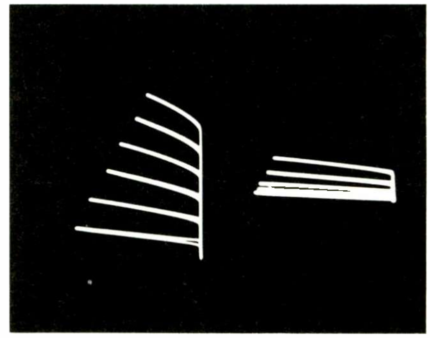


Fig. 5 Leakage between base and emitter reduces the height of the waveform and might eliminate some of the curves. In the left-hand picture, the normal pattern of a silicon-type NPN is shown on the left, and on the right a 10K base/emitter leakage has eliminated two curves. The pattern of a normal PNP germanium transistor is on the left edge of the right-hand picture. On the right edge, a 3.3K base/emitter leakage has eliminated some of the curves. Obviously, silicon transistors are affected more by loading than are germaniums.

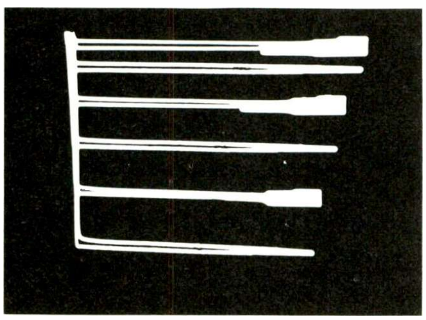


Fig. 4 RF envelopes are sometimes added to the pattern by specific combinations of circuit and scope. These should be ignored.

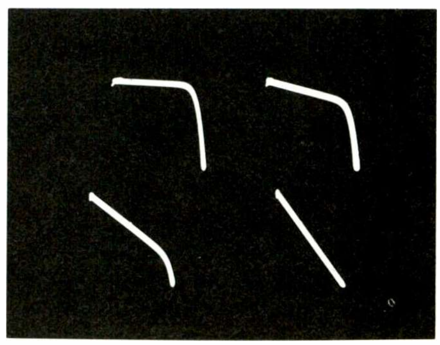


Fig. 6 Testing the base/emitter and base/collector junctions as diodes is relatively unaffected by circuit loading, and can be used if the resistance is too low to permit curves. Upper left shows a diode without a load. Upper right is 1000 ohms, lower left is 330 ohms, and lower right is 180 ohms of loading resistance.

Published Signature Patterns

Sylvania has said their schematics eventually would include Signature Patterns.

Starting next month, ELECTRONIC SERVICING will print in each issue the Signature Patterns for one model of chassis. We advise you to collect them and keep them handy for use whenever you need Signature Patterns.

Servicing Without Standard Patterns

You certainly don't want to delay your use of Signature Patterns until all models are covered; you can and should start now.

Here are some suggestions for using and analyzing the patterns when you don't have the Signature Patterns for that particular model:

• Disconnect all power from the chassis (the curve tracer supplies all the voltages needed).

• If the transistor is located on a module or plug-in circuit board, remove it from the chassis, thus disconnecting any chassis loads that might distort the pattern.

• Preset the scope and curve tracer by setting the collector voltage to 30 volts, then checking an out-of-circuit transistor of the same polarity by inserting it into one of the sockets on top of the curve tracer. This way you will have a minimum of adjustments to make when checking the in-circuit transistor.

• Use the probe that has the three needle tips (Figure 2) to prevent slipping while making a firm contact through coatings or flux to the foil islands on the bottom side of the circuit board.

• Operate the probe by touching first the two longer tips to the board (yellow to collector and blue to emitter), then tilt the probe sideways so the green (base) tip touches the base island, and apply a slight extra pressure to insure a good contact. Only then look at the scope screen and touch-up the adjustments of scope and curve tracer.

• The beta of a transistor cannot be tested accurately in-circuit. So, it is not necessary to calibrate the scope. Just adjust it as necessary to obtain a waveform of the height and width of the usual scope waveform.

• At certain curve-tracer adjustments, fewer than six curves will be seen. Higher base-current settings obliterate some of the curves, but higher collector-voltage adjustment tends to

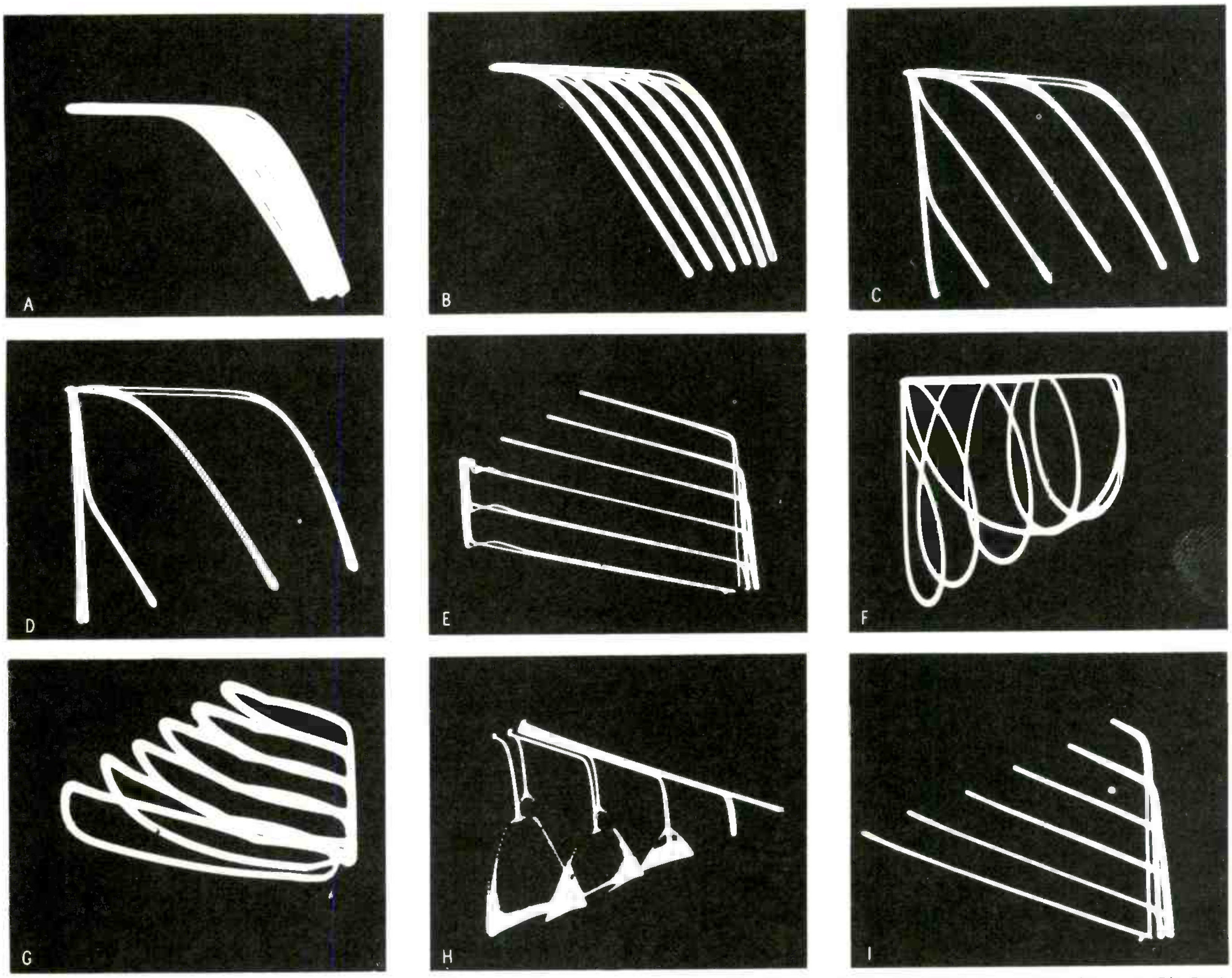


Fig. 7 Examples of normal Signature Patterns. (A, B, C, and D) The effect on an NPN transistor when the base current is increased from 10 up to 100 microamperes. The higher the current the fewer the curves that can be seen. (E) Pattern of a PNP audio-driver. The extra line connecting the tips of the three curves is caused by base conduction of the transistor in following stage. (F and G) Both paralleling resistances and capacitances are indicated. (H) PNP oscillator transistor in a radio produced these parasitic envelopes of RF when the polarity was switched to NPN. (I) The normal Signature Pattern of the transistor of (H).

bring them back. Of course, do not exceed the voltage rating of the collector just to show all six curves. As few as two or three will tell the story.

• If the sweep-polarity switch is turned for the wrong polarity, and the base-current control advanced too far, a false comb-like curve (see Figure 3) can be obtained. Try this effect for yourself using an out-of-circuit transistor, so you will know how to recognize it when it happens in actual testing. Although the waveshapes change considerably as the controls are adjusted, the distinctive differences from normal curves are that the lines extend from a **horizontal** line, and the lines are more nearly parallel than the curves are.

• Some circuits having tuned circuits or inductances cause oscillations which appear as pips or envelopes at the tips of the curves (Figure 4). Usually, these parasitic patterns can be eliminated by connecting a capacitance of between 50 and 2000 pf across the base/collector junction of the transistor under test. This effect is different with various types of scopes.

• After you have replaced a transistor, use the curve tracer to make sure a correct Signature Pattern is possible. This is a crosscheck against wrong wiring and damage to the component occurring during the installation.

Circuits Not Producing A Signature Pattern

If the resistance of the circuit between base and emitter is too low, for example where an inductor is used, the staircase base signal will be shorted out, and no Signature Pattern will be observed.

Intermediate values of shunting resistances either reduce the height of the waveform or eliminate some of the

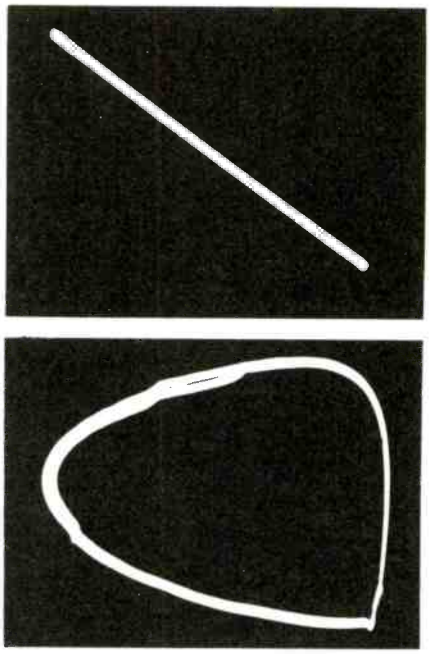


Fig. 8 When the transistor is open and there is a paralleling resistance, the Signature Pattern will be a single slanted line. Some variation of a circle or oval will result from the capacitive load across an open transistor.

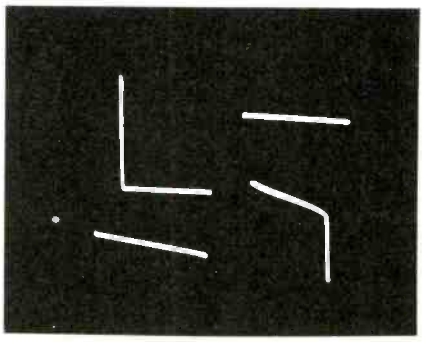


Fig. 9 An open base lead shows a diode waveform during sweeping of the collector/emitter junction. The upper left waveform is that of a NPN silicon transistor with 70 volts applied to the collector, but the polarity switch adjusted for the wrong PNP polarity. Zero conduction is shown in the upper right waveform when the polarity is correct. Lower left is the zero conduction of a PNP germanium with 70 volts applied to the collector and the polarity switch set for NPN. Normal PNP polarity produces the leaky diode corner shown in the lower right waveform.

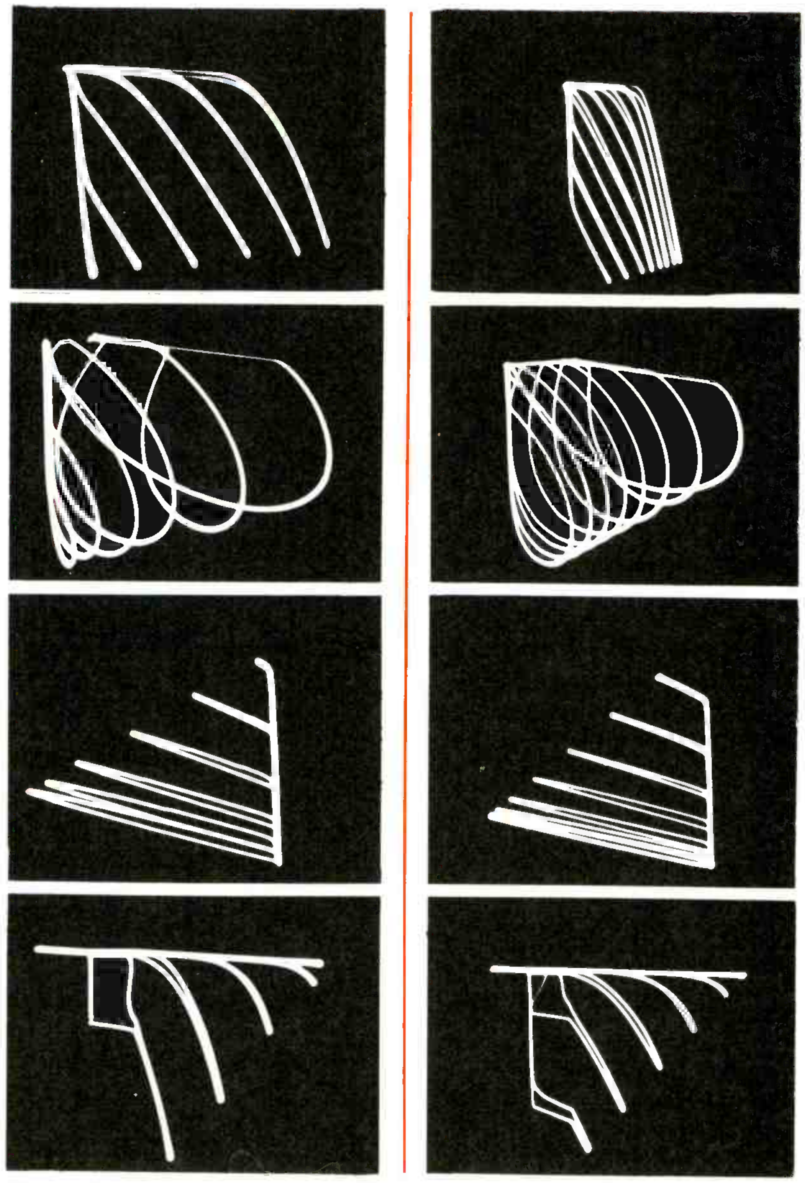


Fig. 11 The Signature Patterns of a Williams curve tracer are similar enough to those produced by another brand of tracer to indicate that published Signature Patterns could be used with other brands.

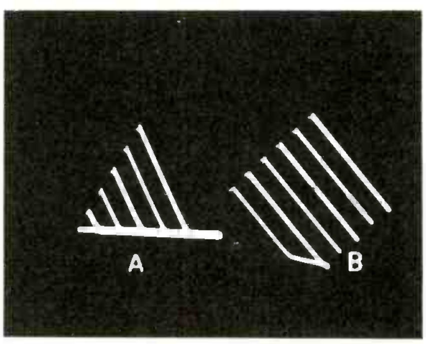


Fig. 10 Diagonally-sloped combs are created out-of-circuit when the emitter lead is open. The waveforms change greatly with variations of collector voltage. (A) Comb waveshape when the collector is not shorted to the emitter. (B) The waveshape of (A), but with a collector/emitter short.

curves nearest the base line (Figure 5).

In such cases, the transistor can be tested in-circuit only as two diodes, for that test is relatively immune to loading effects. Apply the sweep voltage (probe tips yellow and blue) to the base/emitter or base/collector junction, and analyze the waveform at each position of the polarity switch. As shown in Figure 6, either the zener-diode pattern (silicon-type base/emitter) or the diode waveform should be obtained. The presence of either pattern indicates that the junction is okay.

Normal Signature Patterns

Some examples of normal Signature Patterns are shown in Figure 7. Generally speaking, circuit resistances tilt the curves, and capacitances make loops of the curves.

The important point is whether or not ANY curves are produced, regardless of the shape.

Signature Patterns Showing Defects

An open transistor removes all normal-type curves (although extreme misadjustment might give comb or other false curves), and the waveform shows the characteristics of the connecting components.

For example, resistances produce a single slanted line, while capacitances and inductances cause a single loop (Figure 8). Open elements produce results that depend upon which one is open.

An open base and a normal collector/emitter junction will show some variation of the diode corner. Examples taken out-of-circuit are shown in Figure 9.

A shorted collector/emitter or open collector eliminates all curves, leaving a vertical line for shorts and a horizontal line for opens.

When the emitter lead is open and the base current is adjusted much higher than usual, some false curves are created (Figure 10). However, it's probable that the small-amplitude comb curves would be obscured by circuit impedances, and thus are of little value.

Using Other Brands Of Curve Tracers

The waveforms of Figure 11 show a comparison of the in-circuit transistor tests using a Jud Williams Model A and another brand of curve tracer. Although the other model has eight curves versus six for the Williams, the patterns are much alike.

From this we conclude that the Williams Signature Patterns, when published, will also be useful as standards for those of you having other brands of curve tracers. □

Curve tracers revisited

By Carl Babcoke

About two years ago, ELECTRONIC SERVICING published a two-part series about methods of using the Jud Williams and Eico solid-state curve tracers. Several additional manufacturers now are offering their versions for sale. This article is intended to bring the out-of-circuit curve-tracing technique up to date, and serve as background material for the article this month on Signature Patterns. We believe the curve-tracing method is valid and worthy of increased acceptance in our industry.

Any family of curves reveals the maximum amount of information in a minimum amount of space. Such informative curves of solid-state components (see Figure 1) are provided by a dynamic transistor curve tracer, teamed with an oscilloscope to display the waveform. Some of the characteristics of transistors tested are: leakage, gain (beta), linearity, polarity (PNP or NPN), silicon or germanium types, avalanche point, and maximum voltage rating. In fact, only bandwidth and noise are not measured.

The method provides accurate readings when they are desired, or it provides moderately-accurate tests at large savings of time when exact calibration isn't needed. Many of the tests can be used in-circuit; but, that usage is given in a companion article.

Inside Curve Tracers

Although the complete schematic of a curve tracer is moderately complex, the basic concept is simple. A preset amount of base current is applied to the transistor being tested, and this current is maintained at a constant rate during the time the collector voltage increases to a preset maximum and returns to zero. When viewed on a scope, the collector/emitter current produced becomes one curve. Next, the base current is

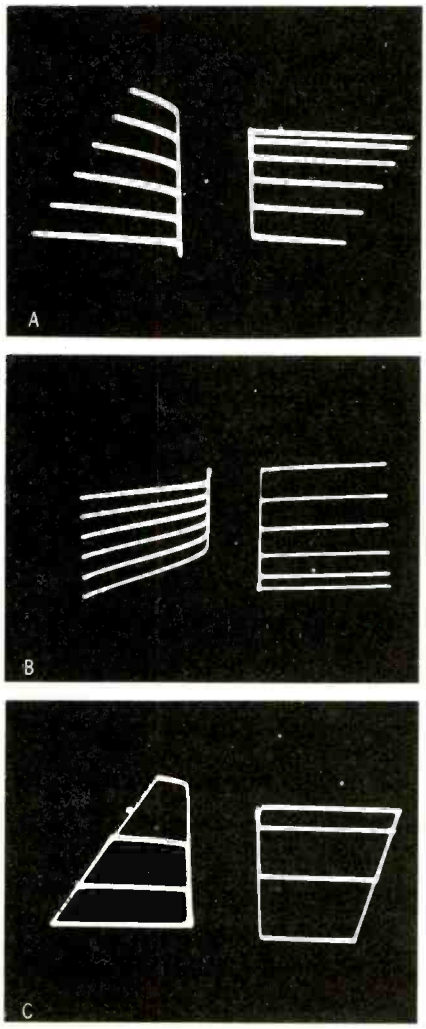


Fig. 1 A comparison of the curves produced by three different brands of curve tracers when testing the same two transistors. All the curves on the left are of an audio-type PNP germanium, and the ones on the right are of a switching-type NPN silicon. (A) Curves produced by a Jud Williams Model A. Output is taken from the emitter resistor. Therefore, the pattern is inverted. (B) Curves produced by a B&K Model 501. Output is taken from the low side of the voltage supply for the collector, so the pattern is not inverted. (C) Curves produced by an Eico Model 443. Because of the design, the patterns are inverted.

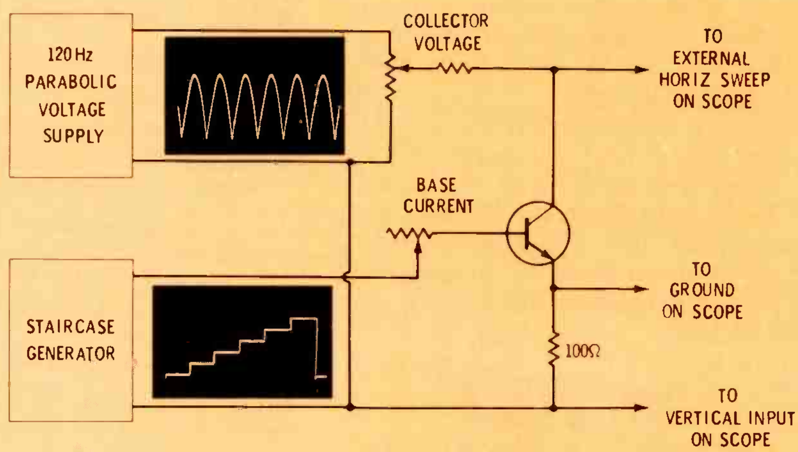


Fig. 3 A parabolic 120-Hz DC voltage is supplied to both the horizontal sweep of the scope and the collector of the transistor in the Williams Model A tracer. A "staircase" of DC base current is provided to bias-on the transistor. Voltage drop across an emitter resistor is used to show the collector/emitter current when applied to the vertical amplifiers and viewed on the scope.

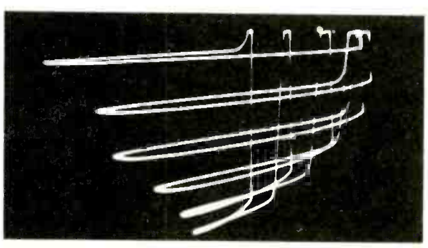


Fig. 2. The path of the scope beam when tracing six curves is made visible by adding a small capacitor between the tracer and the external horizontal input of the scope.

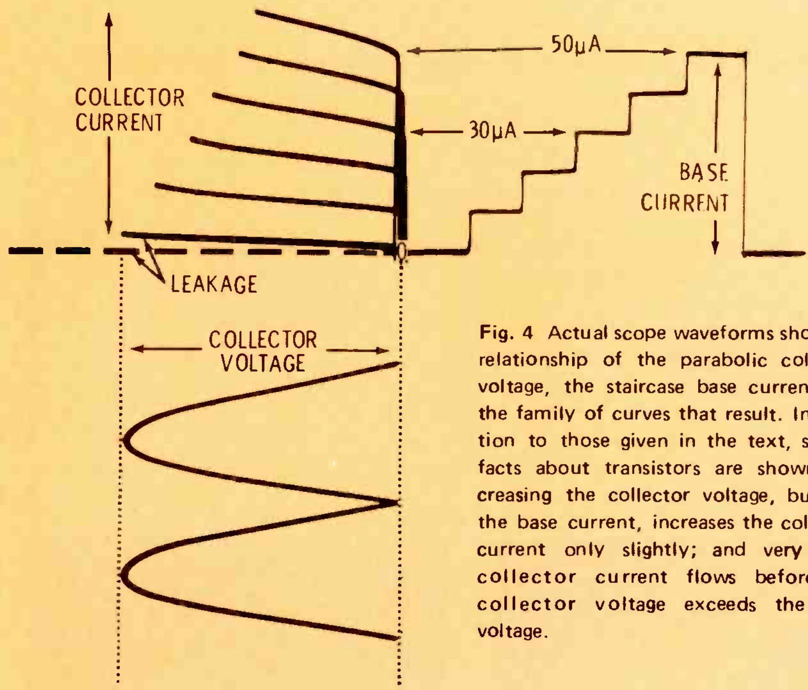


Fig. 4 Actual scope waveforms show the relationship of the parabolic collector voltage, the staircase base current and the family of curves that result. In addition to those given in the text, several facts about transistors are shown: Increasing the collector voltage, but not the base current, increases the collector current only slightly; and very little collector current flows before the collector voltage exceeds the base voltage.

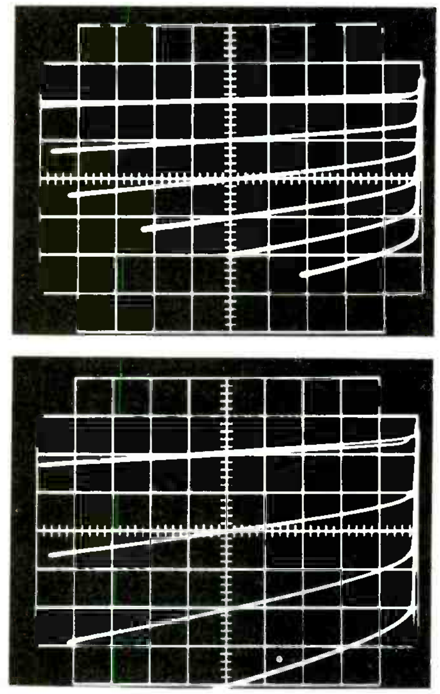


Fig. 5 DC beta at the collector voltage and base current you choose can be measured fairly accurately. In the upper picture, the collector voltage was 20 volts so the desired 10 volts would be in the horizontal center of the screen. Base-current-per-step was 20 microamperes, and the base current desired was 40 microamperes, so the collector current was shown by the third curve from the top. Scope gain was .1V/CM, so the collector current was 1 milliamperes per CM, and base current 40 microamperes giving a DC beta of 50. Conditions of the lower waveform are the same, but the scope gain has been doubled to .05V/CM to make it easier to obtain an accurate reading. It's of no importance that the fifth and sixth curves are not visible.

increased by the preset amount and kept there while the collector voltage is cycled to maximum and back to zero. This produces another curve at a higher point on the scope screen. Again, the base current is increased during the cycling of collector voltage, and the sequence is repeated until the final curve is made at maximum base current. Then the base current is reduced to zero for one cycle of collector voltage. Following that, the whole thing is repeated again and again (Figure 2).

Figure 3 shows the parabolic collector voltage, the staircase base signal, and the connections to transistor and scope. Depending on the brand of curve tracer, either the collector or emitter current is measured by scoping the voltage drop across a collector or emitter resistor. In the Jud Williams Model A, the drop across an emitter resistor is used, while the B&K scopes the low side of the collector supply voltage.

The relationships between base current, collector voltage and the resulting collector/emitter current are shown in Figure 4.

Measuring gain and leakage

One brand of curve tracer provides four curves, another gives eight, and the others show six. Regardless of the number of curves, the one that doesn't move when the base current is changed is the one without any base voltage or current. (In most cases, this curve will be the longest one.) Each succeeding curve is increased by the amount of current selected by the base-current switch.

DC beta is the ratio of base current to collector current. The collector current (or emitter current, normally the difference in reading is very small) can be measured by the vertical calibration of the scope versus the value of the dropping resistor. If the resistor is 100 ohms (as in the Model A), one milliampere produces a voltage drop of .1 volt. Each step of base current is determined by the setting of the base-current switch. This is all the basic information we need to measure DC beta.

As an example, suppose we want to know the DC beta of a certain PNP germanium transistor at 10-volts DC of collector voltage and a base current of 40 microamperes (see Figure 5). The collector voltage supplied is 20 volts p-p (same calibrations as DC), so 10 volts will be the horizontal center of the zero-base-current curve. A base current of 40 microamperes can be obtained by setting the switch to 20 microamperes-per-step and observing the current at the third curve. Calibrate the vertical gain of the scope for .1-volt-per-centimeter (.1 V/CM), move the center of the zero-base-current curve to the center of a calibration line near the top of the graticule, and measure the number of graticule lines between the zero-base-current curve and the second one down (40 microamperes).

In this case, there are two CM lines of .1 volt each (or 1 milliampere each of collector current).

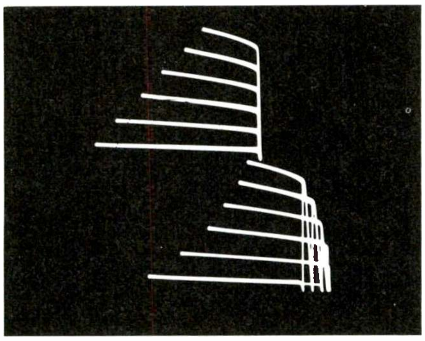


Fig. 6 Upper waveform is the normal one when the horizontal sweep of the scope is fully DC coupled. When a .1 capacitor was added between tracer and the external horizontal input to simulate a scope with AC-coupled horizontal, the waveform moved to the right (DC shift) and the various zero-collector-current vertical parts of the curves were displaced horizontally. This does not affect the authenticity of the waveforms, but accounts for the different waveforms obtained with different scopes.

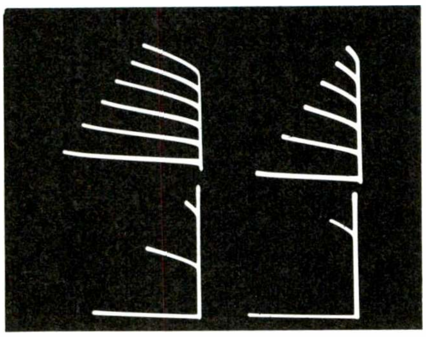


Fig. 7 The amount of base current affects the number of curves visible. Upper left waveform shows a PNP germanium transistor tested in a Williams tracer using 10 uA of base current. Upper right is the same transistor with 20 uA, lower left with 50 uA, and lower right with 100 uA of base current.

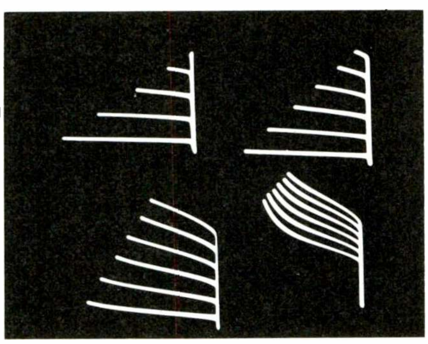


Fig. 8 Collector voltage also affects the number of curves. Upper left is 10 volts, upper right 18 volts, lower left 30 volts and lower right 70 volts of collector voltage. Operation for a time with 70 volts caused heating which increased the "stem" height of the zero-collector-current part of the waveform.

Solid-State Curve Tracers

B&K Division of Dynascan Corporation	Model 501-A
Eico Electronic Instrument Co., Inc.	Model 443
Tektronix, Inc.	Model CT71
Testline Instruments Co.	Model 101
Leader Instruments Corporation	Model LTC-905

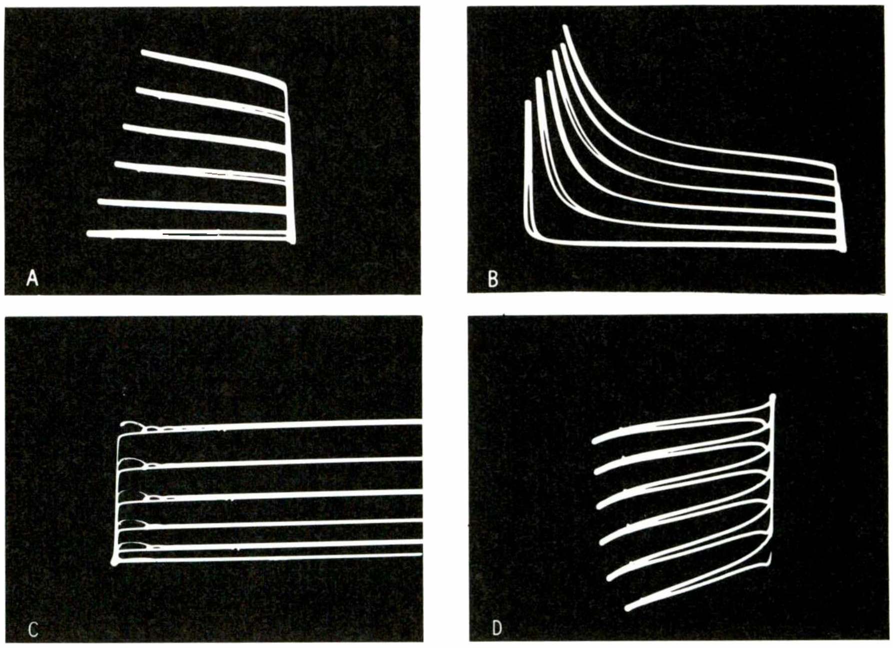


Fig. 9 Normal curves from different types of non-defective transistors.
(A) A 2N411 germanium PNP with a collector voltage of 20 volts and a base current of 10 uA per step gave this normal curve.
(B) The same transistor as (A),but with the collector voltage increased to 70 volts shows avalanche leakage at about 50 volts. Therefore, the collector voltage should never exceed about 40 volts.
(C) Loops in the trace sweep of the curves are caused by internal capacitance effects. Only half the width of the pattern is shown to expand the size of the loops.
(D) Separate trace and retrace lines of each curve are hysteresis effects produced by internal heating, especially in germanium power transistors.

So, 40 microamperes of base current has produced 2 milliamperes of collector current, and dividing 40 into 2,000 gives a DC beta of 50.

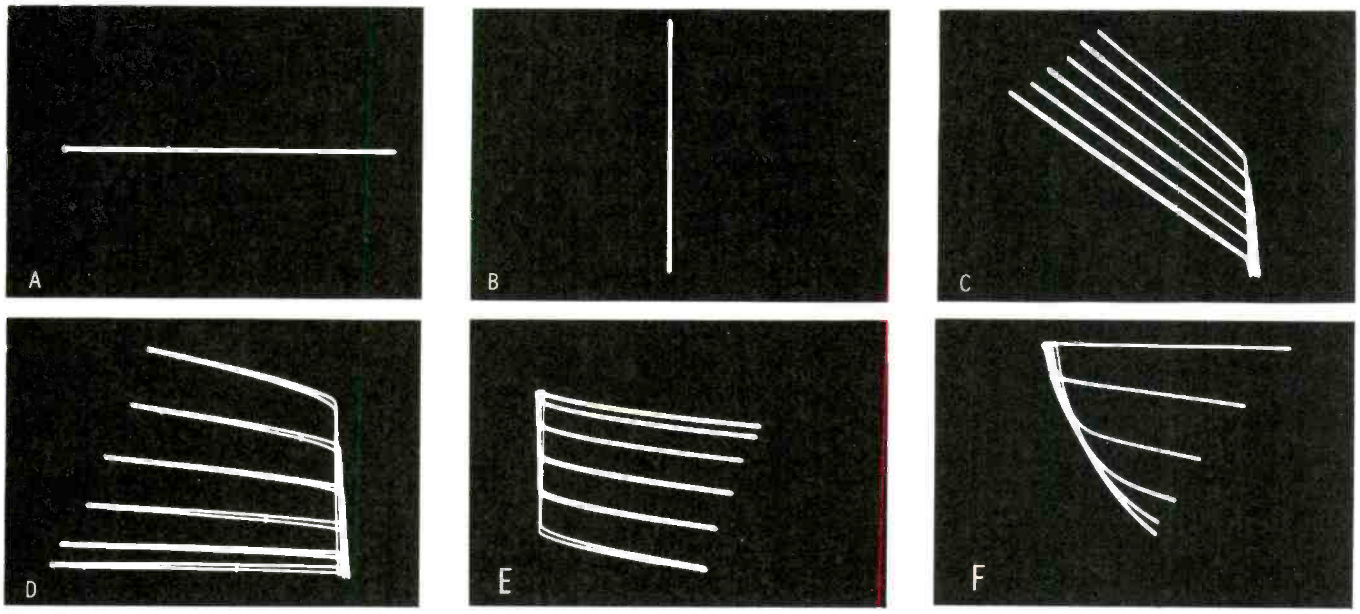
If you find it difficult to measure the distance between the curves, then increase the sensitivity of the scope, as shown in Figure 5B. It's not necessary to have all the curves visible at the same time, just the zero-current curve and the one you're measuring are sufficient.

Practical Operation Of A Curve Tracer

Width of pattern

Because the collector voltage also is used to furnish horizontal sweep at the scope, any adjustment of the collector-voltage control also changes the width of the waveform.

There is no right or wrong width of the waveform (unless you need precise calibration for some reason), so just use the horizontal width



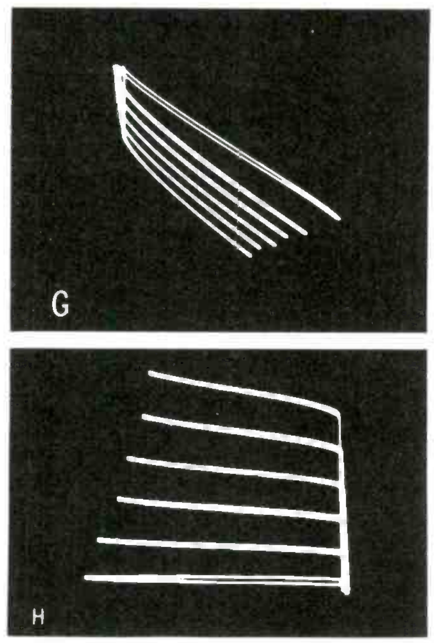


Fig. 10 Examples of curves from defective transistors.
(A) A single horizontal line is caused by a base/emitter short, or an open element. False curves often can be obtained by excessive base current adjustment when a junction is open.
(B) A single vertical line is caused by a base/collector or collector/emmiter short.
(C) Pattern of a germanium transistor with a 1.8K short between collector and emitter, or a 180K short between base and collector. Notice the tilt of all the curves, including the no-base-current one.
(D) Non-linearity near the zero-base-current curve of a germanium transistor was caused by a 10K base/emitter leakage.
(E) Similar non-linearity of a NPN silicon transistor was caused by collector/emitter leakage of 20K forward-polarity voltage or 24K reversed voltage when measured on an ohmmeter.
(F) Beta and leakage were normal, but an ohmmeter test showed about 1000 ohms more resistance in the base/collector junction than that of the base/emitter junction.
(G) Low gain and severe leakage are shown by this set of curves. Resistance of the collector/emitter junction was 1300 ohms forward and 3000 ohms reversed-polarity collector voltage.
(H) Although this seems to be a perfectly normal curve, the collector and emitter leads were interchanged thus lowering the gain. The base required an excessive 100 uA to produce the set of curves.

control on the scope to select the width you want.

DC Coupling of the horizontal

Whether or not the horizontal-sweep circuit of your scope is direct coupled determines whether the "trunk" (low collector-voltage saturated portion of the curves) appears as one line or as several. The two waveforms of Figure 6 show the differences in waveform and vertical centering caused by the addition of a .1 capacitor between the curve tracer and the external-horizontal-sweep input of the scope.

Horizontal overload

Some scopes might be overloaded at large collector-voltage settings. Others, particularly solid-state models, might have protective zeners to clip-off excessive horizontal-input voltages.

In either case, the tips of the curves might be laterally compressed, or show abnormal right-angle ends. Don't mistake such effects for transistor avalanche or "reach-through" conditions. Scope overload usually can be noticed first on the zero-base current curve.

The cure is easy, just connect a resistor between the curve tracer and the horizontal external-input connector of the scope. Use a value (usually 100K to 1M) which eliminates the overload at maximum settings of the collector-voltage control.

Effects of collector voltage and base current

The amount of base current changes the height of the pattern, as we might reasonably assume. But, in addition, it also is one of the factors determining the number of curves that are visible. The higher the base current, the fewer curves can be seen (see Figure 7).

Effects of collector voltage changes are just the opposite; the lower the collector voltage the fewer curves are present, as shown in Figure 8.

Normal Variations Of The Curves

Examples of the families of

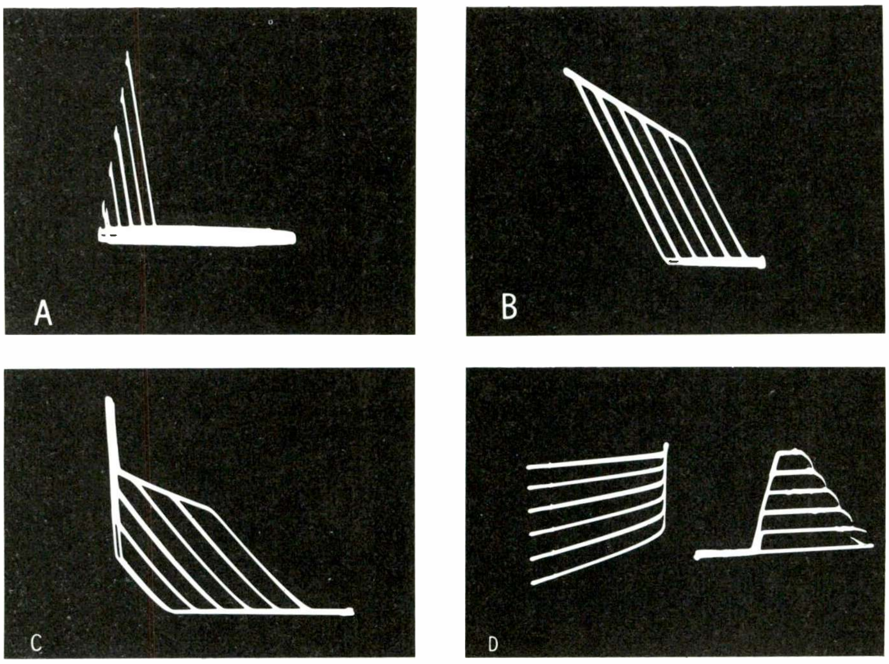


Fig. 11 Some of the many possible false curves.

(A) A NPN transistor having an open emitter lead tested as a NPN gave this comb pattern when the base current was 100 uA.

(B) The same transistor tested as a PNP with a huge base-current setting of 500 uA gave this waveform. Closing of the end changed with base-current adjustments.

(C) This corner was produced by a NPN silicon power transistor tested as a PNP type when the base current setting was 500 uA.

(D) During a routine test of a small PNP audio-type germanium transistor, the base lead opened internally and removed the set of curves. However, when the base current was increased to 500 uA, the waveform shown on the right was produced.

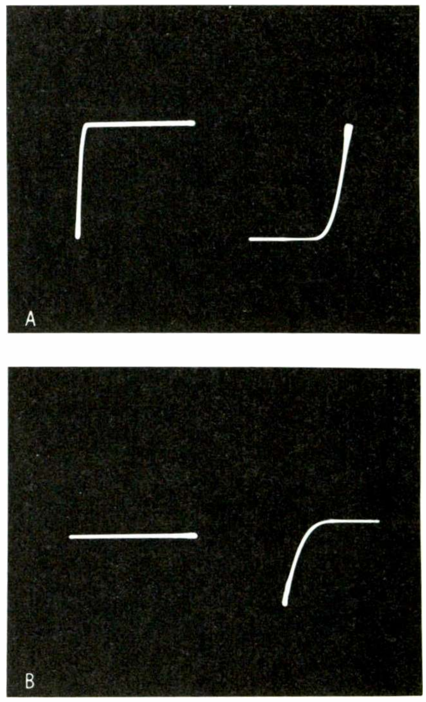


Fig. 12 These diode waveforms can be used to identify germanium or silicon types of non-defective transistors.

(A) Zener action of the base/emitter junction proves the transistor is a silicon. The right-angle corner of the waveform at the left was caused by tracer polarity of PNP giving reverse polarity when the base was connected to the collector pin of the tracer and the emitter was connected normally to emitter. The horizontal width must be narrowed to prevent excessive width and the collector voltage adjusted high in order to obtain this waveform. Switching to NPN and increasing the horizontal gain of the scope gives the normal-diode corner shown on the right, because the junction is forward biased.

(B) This transistor is a PNP with the base connected to the collector pin of the tracer and the emitter connected normally to the emitter pin. The horizontal line on the left indicates no conduction with the polarity switch set for reversed-polarity NPN, while the normal-diode corner shown on the right is produced by the correct PNP polarity. Increased scope horizontal gain is necessary to widen the corner.

curves possible from different kinds of non-defective transistors are shown in Figure 9.

One thing, which distinguishes these curves from the false ones, is the increased collector/emitter current shown at the higher collector voltages. Also, the common "trunk" from which all normal curves originate must be present.

Curves Of Defective Transistors

Although the family of curves for a bad transistor can be distorted in many different ways, many defects produce patterns that are distinctive and can be identified readily. Some of these are shown in Figure 10.

We must keep in mind that some apparent defects are normal for the application. For example, a waveform indicating non-linearity at low base currents might be entirely normal if the transistor is a switching type, but would certainly indicate a defect if the transistor is an audio type.

The same uncertainty applies to transistors with low betas. Normal transistors might be rated at a beta of 20 or a beta of 400; they all look the same. In such cases, a standard is needed, perhaps the original specifications, or a replacement for comparison.

False Curves

It's possible to obtain false patterns by wrongly connecting the leads of the transistor, or just by trying too hard to obtain a curve from a defective transistor (Figure 11). Most such patterns resemble "combs", and the lines are too regular to be curves. Any out-of-circuit transistor requiring more than 50 uA of base current to show a family of curves probably is defective.

Other Components Can Be Tested

Curve tracing is not limited to transistors. Many FET's, unijunction transistors, tunnel diodes, zener diodes, power supply and video diodes, SCR's and triacs can be tested in similar fashion.

Diode tests by curve tracing also provide a way of positively identifying silicon-type transistors (Figure 12). The method is based on the little-known fact that the base/emitter junction of a silicon transistor has zener characteristics, but germanium junctions do not. □

News from the

SERVICE ASSOCIATIONS

The following resolution was adopted on December 9, 1972 by unanimous vote of the Board of Directors of the Virginia Electronics Associations:

"Be it resolved *that, effective the month of August, 1973, the Virginia Electronics Associations shall henceforth cease to recognize both the National Electronic Associations (NEA) and the National Alliance of Television and Electronic Service Associations (NATESA); and* **Be it further resolved** *that the Virginia Electronics Association and its local affiliates shall wholeheartedly support, affiliate with, and/or cooperate with that national association which is created by or formed upon the studied recommendations of the Combined Merger Committees of NATESA and NEA and Chairman/Moderator Mr. M. L. Finneburgh, Sr."*

The editors wish to commend the VEA for having courage equal to their convictions. We can appreciate the many difficult problems requiring solution before a fair and equitable merger can become a viable reality. At the same time, it's true any project can be smothered under an excessive amount of talking. Perhaps more shocks like the VEA resolution might be necessary to get the job done.

A meeting of the NATESA Executive Council was held February 3-4 at the Muehlebach Hotel in Kansas City, Missouri. TESA-Kansas City hosted the meeting, which was combined with a tour of the Crown Convention Center where the August convention will be held. It was resolved that the second annual joint-associations convention would be held August 24-26, 1973 at the Crown Center Hotel in Kansas City, Missouri. Some of those attending were: President Leo P. Shumavon, Vice President Charles Varble, Secretary General Earl Gove, Treasurer Phillip E. Holt, Convention Chairman Nolan B. Boone, and Merger Committee Chairman LeRoy Ragsdale.

Announcement of the new Philco warranty-compensation program has precipitated a large storm of controversy, especially among the members of the service associations. Space doesn't permit us to list all of the flat-rate charges and procedures, which were explained at a press briefing by John W. Miller, general parts and service manager for Philco, recently in New York City. Mixed with praise for many features of the program were criticisms that allowances for driving times for dense traffic or long calls in the country were not sufficient. NATESA's Frank Moch is reported to recommend a market-by-market pricing instead of a national flat-rate schedule.

NEA, in an open letter to the industry, makes these points:

- NEA commends Philco for 100% use of independent service dealers as agents.
- NEA believes the Philco warranty-registration system is a step in the right direction.

- Elimination of useless parts handling (no defective parts need be returned to the factory), a single form for parts and labor reimbursement, pre-paying of freight charges on parts, incentive parts-stocking discounts, and speeding parts orders are welcome actions by Philco, although the associations have been asking for them for years.

- Payment for in-warranty "No parts required" service is a good step; one which should have been taken years ago.

- NEA thanks Philco for using the NEA TV Service Time Study of January, 1972 as the basis for the flat-rate billing. BUT, NEA believes the $12.50 per-hour billing rate is not sufficient. Figures obtained from NEA's "Profitable Service Management" schools show a one-man service shop must charge nearly

A committee was elected by the New Iberia chapter of ETA to conduct a raffle benefiting the Retarded Children's Association. Listed left to right, members are: Gene Wilson, ticket co-chairman; Wade Broussard, finance chairman; Father Gary Schexnayder, co-chairman, Alton Rodrigues, co-chairman; Harry Mouton, chairman; Carrol Broussard, ticket chairman; and Clarence Oliva, ticket co-chairman.

$13.00 for each hour of productive work to cover the following:

- **Salary of the technician/dealer at $5.00 per hour;**
- **overhead;**
- **profit;**
- **return on investment.**

However, the $13 per-hour rate was calculated by including income from parts sales. Without parts income, the one-man shop must charge $18.61 per hour. This is about $6 more per hour than the Philco allowance.

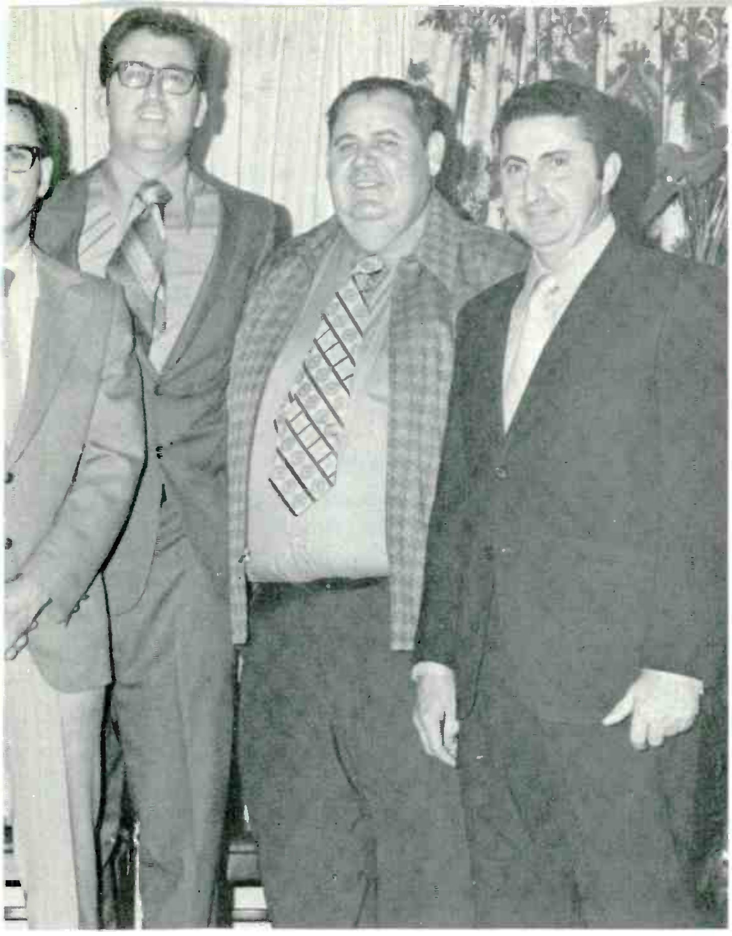
Additionally, the NEA figures were based on costs before January of 1972, and costs have risen since that date.

Because of all these reasons, NEA believes Philco should recalculate the flat-rate billing fees.

This picture of Henry C. Smith, president of the Louisiana Electronics Technicians Association, appeared in the November 12 edition of the Sunday Iberian of New Iberia, Louisiana. The article gave the history of ETA and the struggle necessary for passage of the technicians-licensing law for the state.

As a special project, the New Iberia, Louisiana chapter of ETA has sponsored a raffle intended to finance a new $20,000 school for retarded children. This activity has received much favorable publicity in the local newspaper.

The editors of ELECTRONIC SERVICING wish to congratulate the Florida and Louisiana NEA-affiliated organi-



Henry C. Smith, owner of the H. C. Smith TV And Radio Service in New Iberia, Lousiana was the first president of the New Iberia chapter of ETA, and now is president of the Louisiana Electronics Technicians Association, Inc.

zations for their effective and valuable helps to their local areas. Plus a second hearty congratulation for obtaining news coverage of their activities.

Imagine the improved public relations, and the better image service shops would have, if this kind of activity and publicity was done in every city and state! You might want to refer to "Be a 'Good Guy' and Brighten Your Image" starting on page 14 of the November issue for some suggestions for additional good deeds.

Let's hear from the other 48 states. Send facts and photographs to: Electronic Servicing, 1014 Wyandotte Avenue, Kansas City, Missouri 64105. □

catalogs literature

Circle appropriate number on Reader Service Card.

100. GC Electronics—features nearly 5,000 items in seven different product lines in the **FR**-73-74 general-line catalog. The 312-page catalog has lists under the following product divisions: GC Electronics, Walsco, Electrocraft, Ultron-Magic Color, Telco, Audiotex and Calectro.

101. ITT Cannon Electric—announces a technical brochure on CATV connectors. The 12-page CATV-1 includes 33 photographs, outline drawings, and technical specifications for ITT Cannon's new line of seized-center-conductor series, cable-feedthrough series, adapters, and miscellaneous fittings.

102. Russell Industries, Inc.—has available a 9-page catalog No. AC-73 giving some illustrations for antenna rods and assemblies plus an application chart. A cross-referenced center fold-out lists replacement rods for portable AM/FM radios and TV's, walkie-talkies, indoor FM, UHF, automobiles and scanners.

103. ARIES, Inc.—has released a 10-page catalog describing their do-it-yourself kits in the following categories: audio, computing, hobby, test instruments, timing, and general. An order blank and shipping information are included.

104. The Mura Corporation—has an information brochure on low-voltage low-current miniature lamps. The four-page brochure contains photos, diagrams, and complete specifications for such "Muralites" as standard lamp assemblies, Bi Pin assemblies, lens caps, fuse type, pigtail type, neon, and high-brightness lamps.

105. Diamond Tool and Horseshoe Co.—is distributing a full-line 28-page tool catalog No. W30. It details over 300 styles of hand tools, including pliers, snips, wrenches, nippers and specialized tools for electronics, refrigeration, automotive and industrial uses. The most popular tools are mounted on skin-pack cards for retail selling, and six new dealer displays for these cards are described.

106. Raytheon Company—introduces a pocket-size guide about the "Sizzling 66" line which provides direct replacement for over 5000 solid-state components in foreign-made TV's, stereos, AM/FM radios, tape decks and cassette players. Each foreign semiconductor is listed along with its Raytheon RE replacement. The guide also contains specifications, outline drawings, and terminal arrangements for each RE unit.

107. Simpson Electric Company—features a complete line of instruments in a new 16-page catalog No. 369. The instruments include digital-electronic counter/timers, digital VOM's, solid-state electronic multimeters, a variety of miniature strip chart recorders, multi-range chart recorders, an RLC Bridge, low-cost secondary standards, multi-range precision milliohmmeters, and multi-range DC standards.

108. International Correspondence Schools – has available a catalog describing its new home-study Electronics Technology Programs. Specially-developed training aids and instruments including a wide-band oscilloscope, VOM, transistor projects, electrical/electronic measurement set-ups, and training in the use of an oscilloscope are provided for students in the programs. Students may choose from several areas such as Broadcast/Communications, Industrial, Computer, Telephone, CATV/MATV, Hi-Fi/Stereo, Solid-State/IC Electronics, Television Service Technician and FCC Radiotelephone License. The FCC License Program prepares students for the 1st, 2nd, or 3rd Class FCC Radiotelephone License.

109. Jerrold Electronics Corp. – explains the patented Jerrold J-Jacks system which permits distribution of UHF, VHF, FM, closed circuit video, and audio signals simultaneously throughout a school or hospital. They also have 2-way signal-carrying capability. The circuitry is on modular plug-in units, providing flexibility in modifying the function of a particular outlet by plugging in a new module. The 12-page brochure covers the designs and installations of J-Jacks systems. □

"I had it going long enough for a distinct bow-wow sound...then I knew I had a dog!"

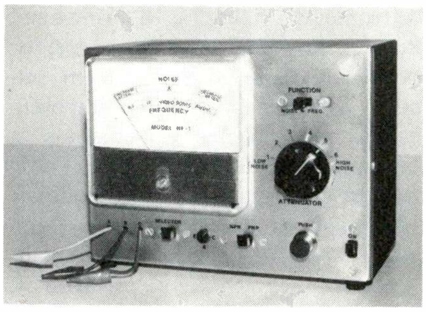
test equipment report

Features and/or specifications listed are obtained from manufacturers reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

Transistor Noise and Frequency Tester

Product: Model NF-1 Transistor Noise and Frequency Tester by the Jud Williams Company, Inc.

Features: This dual-purpose instrument checks the relative noise of transistors and zeners, and indicates the relative frequency response of transistors and signal diodes. The unit is said to be the first one capable of testing these two extremely-important characteristics without the need for expensive laboratory equipment. Defective resistors can cause hissing or crackling noises sounding the same as transistor noise. Therefore, an out-of-circuit transistor-noise test can be very useful. Also valuable is a simple test for high-frequency response. This is particularly critical with tuners and other high-fre-



quency circuits. Tester operation merely requires the technician to select the mode of operation, depress a test button and then read the meter. For noise readings, an attenuator switch adjusts the null point of the meter.

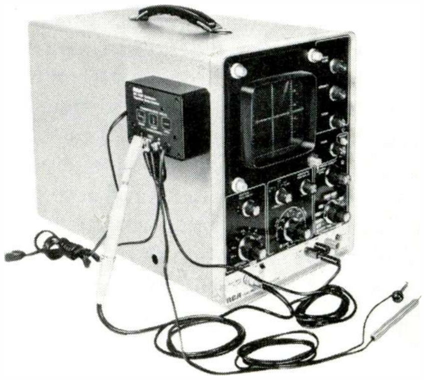
Size and Weight: The dimensions are 8 X 6 X 4-½ inches, and the weight is 4 pounds.

Price: Model NF-1 is priced at $149.95.

For More Details Circle (45) on Reply Card

Transistor-Diode-Checker

Product: WC-528B by RCA Electronic Components.



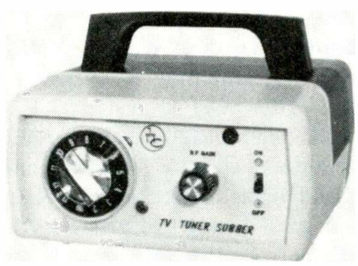
Features: The WC-528B is a Quick-tracer transistor-diode-checker which attaches to an oscilloscope. It permits quick in-circuit or out-of-circuit checks of transistors (except FET's),

diodes, and zener diodes.
Price: Quicktracer WC 528B is listed at $14.75.
For More Details Circle (46) on Reply Card

TV Tuner Subber

Product: TV Tuner Subber Mark IV by Castle Television Service, Inc.

Features: In practice, the Mark IV TV Tuner Subber probably will be used less for substituting the tuner than for substituting the 40-MHz IF signal at any point in the IF chain, up to the final IF stage. By injecting the signal after the AGC controlled stages, the technician is free to analyze the AGC system without the usual confusion. A normal picture is obtained without overriding the AGC line by using a fixed bias supply. Tests then can be made on the defective AGC system with none of the defects masked by the false biasing from the override bias box. The low-impedance output circuit matches older bandpass coupled IF inputs, late model link-coupled inputs and any point in the IF chain including the final IF stage. Signal level is high, and the bandwidth is maintained so that color is not lost due to mismatching. The gain-reduction capability is a high 60 dB, which is required by the high output level and increased gain. Battery consumption is low. The unit is self-contained in a molded case and comes complete with test cables, 9v batteries, and instructions.



Price: Mark IV TV Tuner Subber is priced at $45.95.
For More Details Circle (47) on Reply Card

Multimeter

Product: WV-529A Volt-Ohm-Milliammeter by RCA Electronic Components.

Features: WV-529A includes voltage, current, and resistance measuring ranges to suit modern electronic needs. It has a 5000-volt DC range for servicing TV receivers, a front-panel polarity-reversal switch for testing semiconductor devices, a panel-mounted overload fuse, and full-scale AC and DC ranges based on 0.5 and 1.5 scale factors. For durability it has a taut-band meter movement, recessed panel controls, and diode protection against burnout of the meter movement. Measurement functions include positive and negative DC volts, AC volts, resistance, direct current, and decibels. The AC frequency-response rating is ±1 dB to 100 KHz.
Price: Model WV-529A is priced at $53.50 which includes test leads, batteries, spare fuse, and instruction booklet. □
For More Details Circle (48) on Reply Card

antenna systems report

Features and/or specifications listed are obtained from manufacturers' reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

VHF/FM Amplifier

Product: Model CVB-45A by Blonder-Tongue Laboratories.

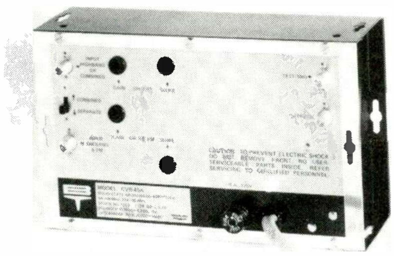
Features: This solid-state VHF/FM broadband amplifier is designed for large VHF MATV systems. It has separate high and low band amplifiers with individual gain controls. Gain of low and high bands can be separately varied over a range of at least 18 dB, which permits the user individually to balance both bands to compensate for the higher cable losses of high-band service. The dual-amplifier design prevents low-band harmonic interference with high-band signals. The lightning-protected input circuitry can be fed from either a single wideband VHF antenna or from two separate VHF antennas designed for channels 2-6 and 7-13. The input choice is switch-selectable. A total of 14 semiconductors are used.

Specifications: Full gain is typically 45 dB for all TV channels and FM, when the low-band and high-band gain controls are fully open. Seven channel output capability is 59 dBmV (0.9 volts) for each low-band channel and 54 dBmV (0.5 volts) for each high-band channel. Input and output impedances are 75 ohms, and the noise

figure is typically 8 dB.
Price: Model CVB-45A is net-priced at $123.50.
For More Details Circle (49) on Reply Card

Antenna Amplifiers

Product: Spartan Series antenna amplifiers by Channel Master.
Features: The Spartan amplifiers are designed for safety from lightning, freedom from overload and FM interference, low noise, and improved temperature stability. Low-noise solid-state components including up to 3 transistors are used. There are 11 models in all, covering VHF/FM and UHF/VHF/FM for fringe and near-fringe reception areas. High-voltage surge protection has been provided by a component layout that prevents static charges from arcing through the circuit, and by twin-diode energy absorption circuits that stop the flow



of static energy from the amplifier's input terminals into the unit itself. Although Spartan amplifiers are high gain units featuring flat gain up to 20 dB, they are protected against overload. Most models incorporate both switchable and tunable traps that reduce FM interference. A 3-section rejection filter that attenuates the FM band by about 25 dB can be switched in. An additional sharply-tuned trap provides more attenuation wherever needed within the FM band. Use of the traps will still permit FM reception if desired. Special feed-back circuitry improves stability in temperatures ranging from minus 22-degrees F. to plus 140-degrees F. The Spartan is easily mounted on either the antenna crossarm or the mast, and the power supply unit can be mounted near the set. All amplifiers are available in both 300-ohm and 75-ohm models.
For More Details Circle (50) on Reply Card

TV Coupler

Product: Model SC42-730 by JFD Electronics Corporation.
Features: The 2-set coupler is designed to distribute signals from one standard MATV or CATV coaxial cable to two television sets. It splits one 75-ohm coaxial output into two 300-ohm twinlead outputs. This feature makes the SC42-730 useful in homes having two TV sets. An insta-mount adhesive strip permits easy press-on indoor installation. Sawtooth washers eliminate the need for stripping or cutting of twinlead insulation. An "F" connector is included for use with the coaxial cable.
Price: Model SC42-730 lists for $4.70. □
For More Details Circle (51) on Reply Card

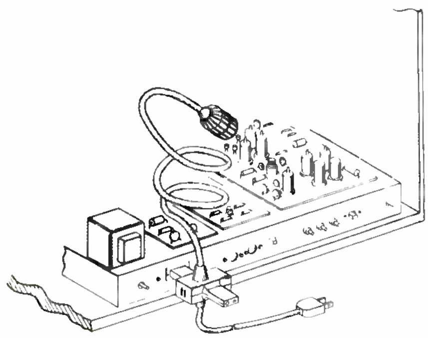
product report

for further information on any of the following items, circle the associated number on the reader service card.

Power Cable With Light

Product: RANGE 73 by Michelin International.

Features: RANGE 73 includes a powerful and flexible spotlight mounted on a rigid poly-sources body with standard and polarized interlocks.



When plugged into a TV or any other chassis, it provides AC power to the set and automatically supports itself, illuminating any part of the chassis being repaired. It eliminates the need for flashlights and standard or polarized cheater cords. This unit also includes a built-in AC outlet for a soldering iron or test equipment. As the entire unit is made of high-voltage insulating materials, it allows operation near high-voltage areas of a TV chassis. When not plugged into a chassis, it can be used in any position, or twisted, looped, hung or inserted in almost any place by the special head, neck or body. Its compactness and safety designs allow inspection of transistorized and IC components, or even "x-raying" solid-state printed circuit boards.

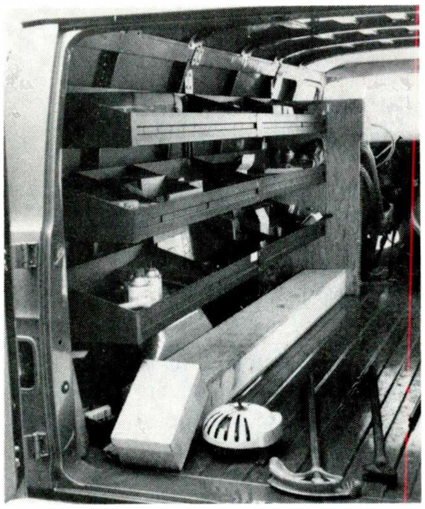
Price: RANGE 73 is priced at $9.95.

For More Details Circle (55) on Reply Card

Adjustable Shelving

Product: Add-A-Shelf System by Parts Systems, Inc.

Features: The Add-A-Shelf System is a new and flexible steel shelving system



in kit form for late-model compact van trucks. The system solves a wide variety of small-parts storage problems. The shelf units are adjustable up and down the mounting tracks by simply loosening four screws per shelf. Each shelf unit also has divider slots on four-inch centers, allowing up to nine compartments in a 36-inch unit and twelve compartments in a 48-inch unit. Each kit consists of two vertical-mounting tracks, two shelf units, two shelf dividers, and all necessary hardware plus instructions. Cantilever-type shelves eliminate restrictive braces and corner supports. Up to four Add-A-Shelf units can be stacked on one pair of mounting tracks.

Sizes: Add-A-Shelf units measure 12 inches from front to back with 8-inch-high shelf backs and 4-inch-high shelf fronts.

For More Details Circle (56) on Reply Card

Riveter

Product: Pow'Riveter No. 495 by Vaco Products Company.

Features: This tool features a reversible head for use on 1/8" and 5/32" Pow'rivets (blind rivets). The handle is offset which allows for riveting on flat surfaces without skinning the operator's knuckles. The chrome-plated tool applies rivets to metal, plastic, fiberboard, or other hard material in seconds with access to one side only. Pow'riveter also can be used for maintenance and repair of sheet metal, wrought iron work, household appliances, recreational equipment, and so on.

Price: Pow'Riveter No. 495 lists at $5.95 and includes a supply of 1/8" and 5/32" Pow'rivets. ☐

For More Details Circle (57) on Reply Card

audio systems report

Features and/or specifications listed are obtained from manufacturers reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

Cassette Storage Unit

Product: Model 3220 by the Dynasound Division of Audiovox Corporation.

Features: Audiovox has introduced a new Dynasound Stow-A-Way cassette storage unit model 3220. The Stow-A-Way stores thirty-two cassettes. It has a rotating base, stackable capabilities, and a contemporary design.

Price: The list price of Model 3220 is $9.95.

For More Details Circle (52) on Reply Card

Stereo Alignment Tape

Product: AT-820 8-track stereo alignment tape by the Recorder-Care Division of Nortronics Company, Inc.

Features: This alignment tape permits rapid test and adjustment of the most important functions of the 8-track cartridge players used in many homes and automobiles. Cycle playing time is approximately eight minutes. Tests on the tape include: program and channel identification by voice; track height; azimuth; frequency response and speaker phasing; and tape speed. Other tests provided by the AT-820 include wow and flutter, switching and crosstalk. Four programs of stereo music permit testing overall machine performance. Each tape is supplied with detailed instructions of all test tracks and frequencies. □

For More Details Circle (53) on Reply Card

The MARKETPLACE

This classified section is available to electronic technicians and owners or managers of service shops who have for sale surplus supplies and equipment or who are seeking employment or recruiting employees.

Advertising Rates in the Classified Section are:

- 25 cents per word (minimum $3.00)
- "Blind" ads $2.00 additional
- All letters capitalized 35 cents per word

Each ad insertion must be accompanied by a check for the full cost of the ad.

Deadline for acceptance is 30 days prior to the date of the issue in which the ad is to be published.

This classified section is not open to the regular paid product advertising of manufacturers.

ELECTRONIC SERVICING is **your** magazine!

If you would like to see an article about a particular subject directly related to servicing consumer or communications electronic products, send us your suggestion.

We value your comments and criticism.—Ed.

FOR SALE

UNUSUAL SURPLUS electronics and parts catalog, thousands of items. $1. ETCO, Dept. ES, Box 741, Montreal, Canada. 2-73-10-t

PICTURE TUBE & FLYBACK HIGH VOLTAGE TESTER ONLY $1.98 SCHEK TV WAND CO. 8101 Schrider St., Silver Spring, Maryland 20910. 2-73-6t

TV & ELECTRONIC SALES AND SERVICE business in growing southern city of 15000, city limits to permanent military installation. 16 years in same location. Only one other major shop in city. Owner has responsible position with state, is 63 years old and retiring. Excellent potential. Moderate investment. Address "Personal," J. H. W. Belcher, Belcher Electronics, 33 W. Downtown Mall, Ozark, Al. 36360. 4-73-1t

WAHL BATTERY OPERATED SOLDERING IRONS. In stock at Audiotechniques Inc, 142 Hamilton Ave, Stamford, Ct. 06902 (203) 359-2312 4-73-2t

RCA WR-52A Stereo FM Signal Simulator $175.00, B&K 415 Sweep/Marker Generator $300.00. Both new. Clifford Shaw 321 Dawn Court Ridgecrest Ca 93555 4-73-1t

CRT-REBUILDING VERTICAL LATHE. $200. Excellent condition. Warren Ohio, phone (120) 856-3337. 4-73-1t

TV & RADIO TUBES 36c EA.!! Free color catalog. Cornell, 4221 University, San Diego, California 92105 4-73-5t

RCA MARK III color test jig 10J103 plus color TV test tube. Good opportunity. For information write to "Soto" 30-05 30th. Avenue - Astoria, New York 11102. 4-73-1t

TV BUSINESS. Retiring. Only shop, 19 years, city of 5000, near major industrial complex, and big city in N.E. Okla. Leave stock, operating equipment, lease. Sam's to 1957. $12,500 cash. Write Dept. 502, Electronic Servicing, 1014 Wyandotte St., Kansas City, Mo. 64105 4-73-1t

USE YOUR SCOPE (any model, no rewiring) to test transistors in/out circuit. Simple instructions $1.00. Schek Technical Services, 8101 Schrider St., Silver Spring, Maryland 20910. 2-73-8t

FOR SALE: If you are tired of the hustle and bustle of big city life, then come to God's country—New Hampshire. Yes, we have an established T.V. business and home for sale. The price of this business with 1900 accounts and the home is $75,000. Stewart Nelson & Company, Concord Realtors, offers a unique opportunity to combine the purchase of a business and a home. This highly profitable business grossed over $150,000 last year. It is ideally located on a U.S. highway, yet privacy is at an optimum with three acres of land included. All this in New Hampshire's capital city, Concord. This sale includes a three bedroom home with fireplace and fully applianced modern kitchen. Dealer owned inventory, test equipment, two repair trucks, & office equipment. In addition to the owner, two full time T.V. repairmen are employed. One employee earns $120 per week, a newer employee earns $105 weekly. The owner is willing to stay on for a period of time to help the new owner. Robert W. Wiita, Manager, Stewart Nelson & Company - Realtors, 4 Park Street, Concord, New Hampshire 03301. Telephone: (603) 225-2762 4-73-1t

EDUCATION INSTRUCTION

REPAIR TV TUNERS—High Earnings; Complete Course Details, 12 Repair Tricks, Many Plans, Two Lessons, all for $1. Refundable. Frank Bocek, Box 3236 Enterprise, Redding, Calif. 96001. 1-73-4t

advertisers' index

SAMS PHOTOFACT / Supplement to 1973 ANNUAL INDEX

Covers PHOTOFACT Set Numbers 1290 thru 1307 and Specialized Volumes AR-134 thru AR-141, CB-43, CB-44, MHF-33 thru MHF-35, TR-112 thru TR-119, TSM-140 thru TSM-142 Released.

JANUARY thru MARCH 1973

This Supplement is your Index to new models covered by PHOTOFACT since December 1972. For model coverage prior to this date see the 1973 PHOTOFACT Annual Index. Use this Supplement with the Annual Index—together they are your complete Index to PHOTOFACT coverage of over 91,000 models.

Set No. Folder No.

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●BS-125 ....1296–POM
●BS-135 ....1296–POM
●BT-122 ....1296–POM
★CH-160 ....1296–POM
★CH-190/-191 ....1296–POM
★CS-130 ....1290–POM
★CS-170 ....1290–POM
★CS-192 ....1302–POM
★CS-195 1289–1
RPF-30 ....TSM–140
RPF-35 ....TSM–141

NOTE: ● Denotes Television Receiver. ★ Denotes Color Television Receiver. # Denotes Out Of Print. **AR** Denotes Auto Radio Series Volume. **CB** Denotes CB Radio Series Volume. **HTP** Denotes Home Tape Player Series Volume. **MHF** Denotes Modular Hi-Fi Series Volume. **PCB** Denotes Production Change Bulletin. **POM** Denotes Photofact-of-the-Month Package—Not Available On Request. **SD** Denotes Scanner-Monitor Servicing Data. **SED** Denotes Special Equipment Data. **TR** Denotes Tape Recorder Series Volume. **TSM** Denotes Transistor Radio Series Volume.

Set No. Folder No.

MIDLAND
(Also See Auto Radio and Recorder Listings)
For CB Models
Midland Communications Co.
For All Other Models
Midland International Corp.
13-855 .... CB-44
●15-010 1304-1
●15-110 1306-1
●15-112C 1301-2
●15-129B 1300-1
★15-215 .... 1296-POM

MONITORADIO (RADIO APPARATUS)
(Also See Auto Radio Listing)
Regency Electronics, Inc.
TM-H1/-H1T/-H2/-H2T/-L1/-L1T/-L2/-L2T .. 1294-SED

MORSE/ELECTROPHONIC
(Also See Recorder Listing)
Morse Electro Products Corp.
T-4600 .... MHF-34
4DT411 .... MHF-35

MOTOROLA
(Also See Auto Radio, Record Changer and Recorder Listings)
Motorola, Inc.
★TL9121JW (Ch. ATS-938) .1299-2
★TL9123JS (Ch. ATS-938) .. 1299-2
★TL9125JP (Ch. ATS-938) .. 1299-2
TP30HE TSM-142
TP58FE TSM-141
★TRR-11 (Color TV Remote Control Unit) 1299-2-B
★TRT-9 (Color TV Remote Control Unit) 1299-2-B
★TT687HW, HWC, HWM, HWMC, JW (Ch. ATS-938) 1299-2
★TT934HW, HWC, HWM, HWMC, JW (Ch. ATS-938) 1299-2
★TU905HW, HWC, HWM, HWMC, JW (Ch. ATS-938) 1299-2
★TU944HW, HWC, HWM, HWMC (Ch. ATS-938) .. 1299-2
★TU945HS, HSC, HSM, HSMC (Ch. ATS-938) ... 1299-2
★TU946HK, HKC, HKM, HKMC (Ch. ATS-938) ... 1299-2
★TU9107JW (Ch. ATS-938) . 1299-2
★TU9109JP (Ch. ATS-938) .. 1299-2
★WT685HW, HWC, HWM, HWMC, JW (Ch. TS-938) 1299-2
★WT688HW, JW (Ch. TS-938) 1299-2
★WT933HW, HWC, HWM, HWMC, JW (Ch. TS-938) 1299-2
★WU904HW, HWC, HWM, HWMC, JW (Ch. TS-938) 1299-2
★WU906HW, HWC, HWM, HWMC (Ch. TS-938) .. 1299-2
★WU907HS (Ch. TS-938) .. 1299-2
★WU908HP, HPC, HPM, HPMC (Ch. TS-938) 1299-2
★WU9106JW (Ch. TS-938) .. 1299-2
★WU9108JP (Ch. TS-938) .. 1299-2
★WU9114JS (Ch. TS-938) .. 1299-2
★WU9116JP (Ch. TS-938) .. 1299-2
★YTT687HW, HWMC (Ch. YATS-938) 1299-2
★YTT934HW, HWMC (Ch. YATS-938) 1299-2
★YTU905HWM, HWMC (Ch. YATS-938) 1299-2
★YTU944HWM, HWMC (Ch. YATS-938) 1299-2
★YTU945HSM, HSMC (Ch. YATS-938) 1299-2
★YTU946HKM, HKMC (Ch. YATS-938) 1299-2
★YW904HWM, HWMC (Ch. YTS-938) 1299-2
★YWT685HWC (Ch. YTS-938) 1299-2
★YWT688HW, HWC (Ch. YTS-938) 1299-2
★YWT933HWM, HWMC (Ch. YTS-938) 1299-2
★YWU906HWM, HWMC (Ch. YTS-938) 1299-2
★YWU908HPM, HPMC (Ch. YTS-938) 1299-2
★Ch. ATS-938 (Code A-01 thru F-12) 1299-2
★Ch. TS-938 (Code A-01 thru F-12) 1299-2
★Ch. YATS-938 (Code A-01 thru F-12) 1299-2
★Ch. YTS-938 (Code A-01 thru F-12) 1299-2

O

OLYMPIC
(Also See Record Changer and Recorder Listings)
Olympic International, Ltd.
★CC329 (Ch. CTC16) (Similar to Chassis) 673-2
★CC341/342 (Ch. CTC16) (Similar to Chassis) 673-2
★CK351/352/353 (Similar to Chassis) 673-2
★CK357 (Ch. CTC16) (Similar to Chassis) 673-2
★Ch. CTC16 (Similar to Chassis) 673-2

P

PACE
Pathcom, Inc.
123, 123A CB-44
2376A CB-43

PACKARD BELL
(Also See Record Changer and Recorder Listings)
Teledyne Packard-Bell Electronics
★CRW-422 (Ch. 98C17) 1023-1
★CRW-472 (Ch. 98C17) 1023-1
★CRW-504A (Ch. 98C15) .. 884-2
★CRW-606A (Ch. 98C15) .. 884-2

PACKARD BELL—Cont.
★CRW-804A (Ch. 98C15) .. 884-2
RPC-61 (Ch. 15TU3) (Similar to Chassis) 907-7
RTS123 (Similar to page 79) MHF-25
●19T38 (Similar to Chassis). 811-3
★21CC18/20 (Ch. 98C8) (Similar to Chassis) 744-3
●23DK7, U (TV Ch. Only—88-15G) (Similar to Chassis) 692-3
★25CC8/10/12 (Ch. 98C9) (Similar to Chassis) 854-3

PANASONIC
(Also See Auto Radio, Record Changer and Recorder Listings)
Panasonic Service
Panasonic Consumer Parts Div.
★CT-210 1306-2
★CT-301 .... 1296-POM
★CT-392/C, CT-394/C 1306-2
★CT-771 1294-1
RD-708MC TSM-140
RF-511 .... TSM-141
RF-581 .... TSM-142
RF-581C TSM-142
RF-708 .... TSM-140
RS-253S MHF-35
SE-840 .... MHF-34
SE-850 .... MHF-33
SG-610 .... TSM-140
●TR-003/-003C 1303-1
●TR-005 1290-3
●TR-005C 1290-3
●TR-465R 1284-1
TY-702 1294-1

PEARCE-SIMPSON
Pearce-Simpson Inc.
Puma 23 .... CB-43

PENNCREST
(Also See Auto Radio, Record Changer and Recorder Listings)
J. C. Penney Co., Inc.
●1317 1307-2
●1412 1293-2
1702 .... MHF-34
1841 .... TSM-141
1872 .... TSM-142
●2320 1285-1
★2868 .... 1302-POM
★2870A 1292-3
★2881A (Similar to Chassis) 1067-1
★2888 .... 1302-POM
★2889 1302-3
★4856A/57A 1296-POM
★4897A, B 1290-POM
★4899A 1296-POM
★4921A 1296-POM
★4922A, B 1290-POM
★4923A, B 1290-POM
5484 (Similar to Chassis) .. 909-4
5910 .... MHF-35
6912A MHF-33
★685-2889 1302-3
★855-0725 1292-3

PHILCO-FORD
(Also See Record Changer Listing)
Philco-Ford Corporation
●B414BBL, BTG (Ch. 3BL23) 1277-1
★C7300BWA (Ch. 2CY80/80A) 1297-1
★C7310AWAB-1 (Ch. 2CY80) 1297-1
★C7320AWAB-1 (Ch. 2CY80) 1297-1
★C7320BWA (Ch. 2CY80/80A) 1297-1
★C7321BMA (Ch. 2CY80) .. 1297-1
★C7322BPC (Ch. 2CY80A) .. 1297-1
★C7330BWA (Ch. 2CY80A) . 1297-1
★C7331BMA (Ch. 2CY80A) . 1297-1
★C7332BPC (Ch. 2CY80A) .. 1297-1
★C7337BPC (Ch. 2CY80) .. 1297-1
★C7430BWA (Ch. 3CY90) 1296-POM
★C7441BMA (Ch. 3CY90) 1296-POM
★C7442BPC (Ch. 3CY90) 1296-POM
★C7461BPN (Ch. 3CY90) 1296-POM
★C7462BPC (Ch. 3CY90) 1296-POM
★C7472BLK (Ch. 3CY90) 1296-POM
★C8202BLK (Ch. 3CY90) 1296-POM
★C8212BLK (Ch. 3CY90) 1296-POM
★C8222BLK (Ch. 3CY90) 1296-POM
★C9552BPC (Ch. 3CY90) 1296-POM
M3760U (Ch. T70STS) ... MHF-35
M4760U (Ch. T70STSR) .. MHF-35
Ch. T70STS MHF-35
Ch. T70STSR MHF-35
Ch. 2CY80/80A 1297-1
★Ch. 3CY90 .... 1296-POM
★Ch. 20QT74 (PCB 1285-4) 1161-2
★Ch. 20QT75 (PCB 1285-4) 1161-2
★Ch. 20QT76 (PCB 1285-4) 1161-2

PILOT
Pilot Radio-Television Corp.
R1100 .... 1298-SED

POLYTRONICS (POLY COM)
American Electronics Distributing Co.

R

RCA
(Also See Changer and Recorder Listings)
RCA Sales Corporation
For Auto Radio and CB
RCA Electronics Components and Devices
●AQ181W (Ch. KCS171XA) (Similar to PCB 1216-4) . 1061-1
●AR059Y (Ch. KCS191A, RC-3029) 1290-POM

RCA—Cont.
●AR092W (Ch. KCS189A, B) 1302-2
●CR227W/228S (Ch. KCS183F) 1286-1
★FR505W (Ch. CTC48A) ... 1300-2
★FR505WR (Ch. CTC48B) .. 1300-2
★FR510WEN (Ch. CTC48A) . 1300-2
★FR520W (Ch. CTC48A) ... 1300-2
★FR520WR (Ch. CTC48J) .. 1300-2
★FR520WZ (Ch. CTC48H) (Similar to Chassis) 1300-2
★GQ867WR (Ch. CTC54A) . 1254-2
★GQ877MR (Ch. CTC54A) .. 1254-2
★GR530W (Ch. CTC48A) ... 1300-2
★GR534L (Ch. CTC48A) ... 1300-2
★GR538D, S (Ch. CTC48A) . 1300-2
★GR544L, A (Ch. CTC48A) . 1300-2
★GR548D, S (Ch. CTC48A) . 1300-2
★GR670W (Ch. CTC39XBJ) (Similar to Chassis) 1284-2
★GR674L (Ch. CTC39XBJ) (Similar to Chassis) 1284-2
★GR678D, S (Ch. CTC39XBJ) (Similar to Chassis) 1284-2
★GR710W (Ch. CTC48H) ... 1300-2
★GR710WR (Ch. CTC48J) ... 1300-2
★GR714 (Ch. CTC48H) 1300-2
★GR714LR (Ch. CTC48J) ... 1300-2
★GR718D, S (Ch. CTC48H .. 1300-2
★GR718DR, SR (Ch. CTC48J) 1300-2
★GR723W (Ch. CTC48H) ... 1300-2
★GR723WR (Ch. CTC48J) .. 1300-2
★GR729W, WR (Ch. CTC48H, J. CRK18A) (Similar to Chassis) 1300-2
★GR734L (Ch. CTC48H) (Similar to Chassis) 1300-2
★GR738D, S (Ch. CTC48H) (Similar to Chassis) 1300-2
★GR750W (Ch. CTC48H) ... 1300-2
★GR754L (Ch. CTC48H) ... 1300-2
★GR758D, S (Ch. CTC48H) . 1300-2
★GR770W (Ch. CTC48H) ... 1300-2
★GR774L (Ch. CTC48H) ... 1300-2
★GR778D, S (Ch. CTC48H) . 1300-2
★GR780W (Ch. CTC48H) ... 1300-2
★GR790W (Ch. CTC48H) ... 1300-2
★GR792F (Ch. CTC48H) ... 1300-2
★GR794L (Ch. CTC48H) ... 1300-2
★GR794LR (Ch. CTC48J) ... 1300-2
★GR795H (Ch. CTC48H) ... 1300-2
★GR798D, S (Ch. CTC48H) . 1300-2
★GR798DR, SR (Ch. CTC48J) 1300-2
★GR800A (Ch. CTC48H) ... 1300-2
★GR802W (Ch. CTC48H) ... 1300-2
★GR804L, B (Ch. CTC48H). 1300-2
★GR808D,G,S,Y (Ch. CTC48H) 1300-2
★GR820W (Ch. CTC48H).... 1300-2
★GR830W (Ch. CTC48H) .. 1300-2
★GR832F (Ch. CTC48H) ... 1300-2
★GR834L (Ch. CTC48H) ... 1300-2
★GR836F (Ch. CTC48H) ... 1300-2
★GR848D,S (Ch. CTC48H). 1300-2
★GR854LR (Ch. CTC54B) .. 1301-3
★GR858DR, SR (Ch. CTC54B) 1301-3
★GR860WR (Ch. CTC54B) .. 1301-3
★GR864LR (Ch. CTC54B) .. 1301-3
★GR868DR,SR (Ch. CTC54B) 1301-3
★HR901A,W (Ch. CTC48A) (TV Ch. Only) 1300-2
★HR902W (Ch. CTC48U) (TV Ch. Only) 1300-2
★HR904L (Ch. CTC48R) (TV Chassis Only) 1300-2
★HR908D,S (Ch. CTC48R) (TV Chassis Only) 1300-2
★HR910W (Ch. CTC48P) (TV Chassis Only) 1300-2
★HR920W (Ch. CTC48P) (TV Chassis Only) 1300-2
★HR924L (Ch. CTC48P) (TV Chassis Only) 1300-2
★HR928D,S (Ch. CTC48P) (TV Chassis Only) 1300-2
★HR930M (Ch. CTC48T) (TV Chassis Only) 1300-2
RK329C MHF-33
RK-332B (Amp Only).... 1296-4
RK335A MHF-34
RLM21E (Similar to Page 53) TSM-92
RZC375W 1304-4
RZC379W 1306-4
RZM140T TSM-140
RZM171T TSM-142
RZM195E TSM-141
RZS467T 1307-5
RZS473R 1307-5
RZS477Y 1307-5
RZS486L 1307-5
RZS490D 1307-5
RZS494F 1307-5
TCT801 .... MHF-34
VQP59B (Ch. RS-264C) ... 1287-4
VQT30W/31L/32S/33F (Ch. RC-1239K, RS-252J) 1296-4
VRP59B (Ch. RS-264B) 1287-4
VS3000 .... MHF-33
VS6025 .... MHF-34
YZT30W/31L/32S/33F (Ch. RC-1239K, RK-332B, RS-252J, TC-604) 1296-4
★Ch. CRK14C (TV Remote Control) 1301-3-A
★Ch. CTC48A/B/H/J/P/R/T/U 1300-2
★Ch. CTC53A, AI (PCB1305-4) 1201-1
★Ch. CTC53B (PCB1305-4) 1201-1
★Ch. CTC53XP (PCB1305-4) 1201-1
★Ch. CTC54A 1254-2
★Ch. CTC54B 1301-3
★Ch. CTP20A (TV Remote Control) 1301-3-A
●Ch. KCS171XA (Similar to PCB1216-4) 1061-1
●Ch. KCS189A,B 1302-2
●Ch. KCS191A 1290-POM
Ch. RC-1239K 1296-4
Ch. C-3029 .... 1290-POM
Ch. RS-252J 1296-4
Ch. RS-264C 1287-4
Ch. TC-604 (Amp Only).. 1296-4

REALISTIC
(Also See Auto Radio and Recorder Listings)
Radio Shack
TRC-23B (21-128) CB-44
TRC-50 (21-136) CB-43
TRC-101 (21-137) CB-43
12-632 .... TSM-142
21-128 .... CB-44
21-136 .... CB-43
21-137 .... CB-43

REALTONE
(Also See Recorder Listing)
Soundesign Corp.
2410 .... TSM-142

S

SANSUI
Sansui Electronics Corp.
500 (AM-FM Stereo Receiver) 1299-SED

SANYO
Sanyo Electric, Inc.
DCX2500K MHF-35
★21C10 1288-2
★31C35 (Ch. WS-35000) 1290-POM
★51C51R (Ch. WS-51R003) 1290-POM
★91C57 .... 1290-POM
★Ch. WS-51R00 .... 1290-POM
★Ch. WS-35000 .... 1290-POM

SEARS SILVERTONE
(Also See Auto Radio, Record Changer, Recorder Listings)
Sears, Roebuck & Company
171.32664200 1288-4
171.32664201 (Similar to Chassis) 1288-4
528.31803200 (Similar to Chassis) 1175-6
528.31804200 (Similar to Chassis) 1175-6
528.31805200 (Similar to Chassis) 1175-6
528.31813200 (Similar to Chassis) 1175-6
528.31815200 (Similar to Chassis) 1175-6
★528.40950007 thru 528.40950021 1291-1
●528.50160200 .... 1284-POM
●528.51031200 thru 528.51031210 1294-2
548.74201200/1201 (Similar to Chassis) 1240-4
★562.41910200 .... 1290-POM
●562.50270100 .... 1284-POM
●562.50271200 (Similar to Chassis) ... 1247-2
●562.50700000/001 .... 1298-SED
●562.50710000/001 .... 1298/SED
★564.40050100/101/102 .. 1303-2
★564.40580200 .... 1284-POM
●8145, 8146, 8147 (Ch. 456/528/564.71150, 528.71151) 1305-SED
●Ch. 456.71150 .... 1305-SED
●Ch. 528.71150/151 .... 1305-SED
●Ch. 564.71150 .... 1305-SED

SHARP
(Also See Recorder Listing)
(Sharp Electronics Corp.
★C-1921 1291-2
★C-2011 1289-3
★C-2031 1289-3
★C-9310 1286-2
★C-9311 1284-3
FX-111A TSM-141
FX-163 .... TSM-142
●IT-10U 1285-2
★RCV-42 (Remote Receiver) 1286-2-A
★XCMD-36 (Remote Transmitter) 1286-2-A
●2U-121S (Similar to Chassis) 1256-2

SINGER
Singer Corporation
HE-4020 .... MHF-33
●HE-7040 1291-3
★HE-8020 1286-3
★HE-8030 1287-3
★HE-8040 1296-1

SONY
(Also See Recorder Listing)
Sony Corp. of America
HP-450A (UL, CSA) MHF-33
HST-230A MHF-34
HST-330 .... MHF-35
MR-9700W TSM-141
TFM-1600B TSM-142
TFM-8200W TSM-140
3F-85W TSM-140
7FA-70WA TSM-142
8FC-69W.WA (Similar to Chassis) 1128-6

SOUNDESIGN
(Also See Recorder Listing)
Soundesign Corp.
2223 .... TSM-141
2439-2(8) TSM-140

SYLVANIA
(Also See Auto Radio, Record Changer and Recorder)
GTE Sylvania Inc.
CR275WX (Ch. R48-3) ... 1295-4
★CX79P-2 (Ch. D14-18) ... 1272-3
★HTC-2 (Ch. 19-8) (Similar to Chassis) 1269-3
MM8W-1 (Ch. P62-2) (Similar to Chassis) 1203-3
MS50W-1 (Ch. P64-2) (Similar to Chassis) 1210-5
MS150WX (Ch. P55-2) (Similar to Page 116) ... MHF-4
MS220WX,WX-1 (Ch. R48-55) 1295-4
MST235WX (Ch. R48-57) . 1295-4
MST2734 (Radio Ch. Only—R33-8) (Similar to Page 115) MHF-27

SYLVANIA—Cont.
●MW1043W (Ch. B14-1) (Similar to Chassis) 1202-3
SC453P,P-1 (Ch. R48-1) .. 1295-4
SC454C,C-1 (Ch. R48-1) .. 1295-4
SCT2611/2612/2613 (Ch. R32-11) (Similar to Chassis) 1258-5
★Ch. D19-8 (Similar to Chassis) 1269-3
Ch. R32-11 (Similar to Chassis) 1258-5
Ch. R33-8 (Similar to Page 115) MHF-27
Ch. R48-1 1295-4
Ch. R48-3 1295-4
Ch. R48-55 1295-4
Ch. R48-57 1295-4

SYMPHONIC
(Also See Record Changer and Recorder Listings)
Symphonic Radio & Elec. Corp.
1123B MHF-34
1123G MHF-34
1323CR,T MHF-33
1324, 1324CR,T MHF-33
2123 .... MHF-34
2223 .... MHF-34
Ch. R-840 .... MHF-34
Ch. R-845 .... MHF-34

T

TEABERRY
Teaberry Electronics Corp.
Mini-T II CB-44

TELEFUNKEN
(Also See Record Changer and Record Listings)
T201 .... MHF-35

TOSHIBA
(Also See Recorder Listings)
Toshiba America, Inc.
★C41A (Ch. TAC-4361) (PCB1285-4) 1138-2
★C51A (Ch. TAC-4372) (PCB1285-4) 1138-2
★C721 (Ch. TAC-7720) . 1302-POM
★C924 (Ch. TAC-7710) . 1302-POM
SM-350 .... MHF-33
●T0921 (Ch. TAT-6014). 1302-POM
★Ch. TAC-4361 (PCB1285-4) 1138-2
★Ch. TAC-4372 (PCB1285-4) 1138-2
★Ch. TAC-7710 .... 1302-POM
★Ch. TAC-7720 .... 1302-POM
●Ch. TAT-6014 .... 1302-POM

TOYO
Toyo Co. of America, Inc.
CRH-661 .... MHF-34

TRUETONE
(Also See Auto Radio Record Changer and Recorder Listings)
Western Auto Supply Co.
DC1055 .... MHF-35
DC3159 .... TSM-140
DC4920 .... CB-44
●EIS3920C-86 1296-2
★GEC-4310A-37 .... 1284-POM
MIC1055A-07 .... MHF-35
MIC3159A-17 .... TSM-140
●MIC3220A-27 1297-2
●MIC3919D-17 (Similar to Chassis) 1254-3
★MIC4219A-27 1293-3
MIC4920B-37 .... CB-44
DC1055 .... MHF-35
DC3159 .... TSM-140
DC4920 .... CB-44
●2DC3220 1297-2
●2DC3631 (Similar to Chassis) 810-4
●2DC3919D (Similar to Chassis) 1254-3
★2DC4219 1293-3
★2DC4310 .... 1284-POM

V

VANTAGE
Kay Jewelers
●29-0435 (Similar to PCB972-4) 838-2

W

WARDS AIRLINE
(Also See Auto Radio, Record Changer and Recorder Listings)
Montgomery Ward & Co.
GAI-2123A (Radio Ch. Only) (Similar to Chassis) 1219-6
★GAI-12643A 1303-3
★GAI-12653A 1298-3
★GAI-12863A, B 1305-2
★GCI-17922A 1284-POM
★GCI-17932A 1284-POM
★GCI-17942A 1284-POM
★GCI-17952A 1284-POM
●GEN-11741B 1305-SED
●GEN-11961B,C 1300-3
★GGV-12813A 1295-3

WEBCOR ELECTRONICS
(Also See Changer and Recorder Listings)
Webcor Electronics
350 .... MHF-35

WESTINGHOUSE
(Also See Record Changer and Recorder Listings)
Westinghouse Electric Corp.
Consumer Electronics Div.
●BP21A78A (Ch. V-2487-6) (Similar to Chassis) 812-4

WESTINGHOUSE—Cont.
●BP90A78A (Ch. V-2487-6) (Similar to Chassis) 812-4
●H-P9071A,B (Ch. V-2496-1,-2,-3) 1275-SED
RPM5150A (Ch. V3033C01) TSM-142

WINEGARD
Winegard Company
AC-14 thru AC-69 (Single-Channel UHF Preamp) 1287-SED
AC-913 (TV Preamp) .. 1284-SED
AC-982 (82-Channel TV Preamp) 1289-SED
BC-782 (TV Distribution Preamp) . 1284-SED
BC-830 (Two-Set TV Booster Amp) 1289-SED

X

XAM
Korvettes Division of Arlen Realty & Development Corp.
●16BW73 1299-3
●122D 1305-3
●1272 1305-3
★1672 1294-3
★1872 1297-3

Z

ZAYRE
The Zayre Corporation
★ZM272C, ZM373C 1304-2

ZENITH
(Also See Record Changer and Recorder Listings)
Zenith Sales Corp.
C472W 1292-4
C472W1,W2,W3,W4 (Similar to Chassis) 1292-4
D535L (Ch. 1WDA10) 1290-4
D546W 1293-4
★D2940L6 (Ch. 19DC22) .. 1296-3
★D2967W (Ch. 23DC14) .. 1306-3
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★D3722W,W3 (Ch. 14DC16) 1304-3
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★D4024W6 (Ch. 19DC22) .. 1296-3
★D4026W1 (Ch. 19DC21) . 1307-3
★D4026W6 (Ch. 19DC22) .. 1296-3
★D4030W3 (Ch. 19DC11) .. 1307-3
★D4509W (Ch. 23DC14) .. 1306-3
★D4512W2 (Ch. 23DC14) .. 1306-3
★D4514W2 (Ch. 23DC14) .. 1306-3
★D4516M2 (Ch. 23DC14) .. 1306-3
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★SD2350R (Ch. 23DC14) .. 1306-3
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★T2852W2 (Ch. 23DC14) .. 1306-3
★T2854DE2/P2 (Ch. 23DC14) 1306-3
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★Ch. 14DC15 1304-3
★Ch. 14DC16 1304-3
★Ch. 19DC11 1307-3
★Ch. 19DC21 1307-3
★Ch. 19DC22 1296-3
★Ch. 23DC14 1306-3

AUTO RADIOS AND TAPE PLAYERS

A

ADAM II
(See Kraco)

AMERICAN MOTORS
(Also See Rambler)
American Motors Corp.
1HT2212 .... AR-136
8992861 .... AR-136

ASTROLINE
(See Boman Astrosonix)

AUDIOVOX
Audiovox Corporation
C-405 .... AR-138
C-463 .... AR-135
C-480 .... AR-136
C-505 .... AR-137
C-520A AR-138
C-540 .... AR-136
C-563 .... AR-135
C-577 .... AR-136
C-920 .... AR-134
C-965 .... AR-134
C-975 .... AR-138
C-980 .... AR-139
VW-71-FM AR-136

AUTOMATIC
Automatic Radio Mfg. Co., Inc.
SPA-5000B, SPB-5001B .. AR-141

BOMAN ASTROSONIX
Boman Astrosonix Div. of California Auto Radio, Inc.
BM-911 .... AR-141
SP-190 .... AR-137

BUICK
United Delco Distributors
34AFP1, 34AFPK1 .... AR-140
34APB1, 34APBK1 .... AR-139
34APBT1 .... AR-138

NOTE: ● Denotes Television Receiver. ★ Denotes Color Television Receiver. # Denotes Out Of Print. AR Denotes Auto Radio Series Volume. CB Denotes CB Radio Series Volume. HTP Denotes Home Tape Player Series Volume. MHF Denotes Modular Hi-Fi Series Volume. PCB Denotes Production Change Bulletin. POM Denotes Photofact-of-the-Month Package—Not Available On Request. SD Denotes Scanner-Monitor Servicing Data. SED Denotes Special Equipment Data. TR Denotes Tape Recorder Series Volume. TSM Denotes Transistor Radio Series Volume.

Set No. — Folder No.

BUICK—Cont.
34BFP1 .... AR-140
34BPB1 .... AR-139
34BPBT1 .... AR-138
7930134 .... AR-139
7935004 .... AR-139
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C

CADILLAC
United Delco Distributors
36CFMT1 .... AR-139
9341876 .... AR-139

CHEVROLET
United Delco Distributors
31APB1, 31APBK1 .... AR-137
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31BPB1, 31BPBK1 .... AR-137
31BPBT1 .... AR-139
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7933291 .... AR-137
7933301 .... AR-138
7933641 .... AR-137
7935021 .... AR-137
7936011 .... AR-138
7939071 .... AR-139

CHRYSLER
(Also See Mopar)
Chrysler Corporation
3501013 (Similar to Page 73) ... AR-122
3501163 (1CH1210 or 2CH1210) AR-136

D

DODGE
(Also See Mopar)
Chrysler Corporation
3489650 (1DT1214 or 1DT1244) AR-135
3501013 (Similar to Page 73) AR-122
3501501 (1PD2208), 3501502 (1PF2205), 3501503 (1PD2207) ... AR-135
3635069 (1DT1215) ... AR-137

F

FORD
Ford Motor Company
D2HA-18806 .... AR-138
D2OA-18806 .... AR-138
D2UA-18806 .... AR-138
D27J-18806 .... AR-138
D3AA-19A241 .... AR-137
D3DA-19A241 .... AR-137
D3DA-18806 .... AR-136
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D3TA-18806A AR-138
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D3ZA-19A241 .... AR-137
D32A-18806 .... AR-136
1FD4217 (D2AA-19A242-AE) AR-135
1MZ4218 (D2ZA-19A242-AF) AR-135
1TB4211 (D2SA-19A242-AH) AR-135

H

HAMMOND
(See Boman Astrosonix)
HD-501 .... AR-141

I

INLAND-DYNATRONICS
Inland Dynatronics, Inc.
AT-830 .... AR-135
ATK-830 (See Page 71) ... AR-135
RA-04 .... AR-140
RA-05 .... AR-139
S-100 .... AR-141

K

KRACO
Kraco Tape Products
KS-425 .... AR-141

L

LEAR-JET
Lear Jet Industries, Inc.
A-25 .... AR-141
A-140 .... AR-140

LINCOLN
Ford Motor Co.
D2OA-18806 .... AR-138
D3SA-19A241 .... AR-137
1LN4213 (D2VA-19A242-AD) AR-135
1TB4211 (D2SA-19A242-AH) AR-135

M

MARQUIS
(See Kraco)

MERCURY
Ford Motor Co.
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D3AA-19A241 .... AR-137
D3DA-18806 .... AR-136
D3DA-19A241 .... AR-137
D3ZA-18806 .... AR-136
D32A-18806 .... AR-136
1CP2235 (D2RJ-19A241-BA) AR-135
1FD4217 (D2AA-19A242-AE) AR-135
1MZ4218 (D2ZA-19A242-AF) AR-135

MUNTZ/STEREO
Muntz-Stereo-Pak, Inc.
M-860 (PU-428A-01) ... AR-134
M-880 (PU-427B-02) ... AR-134
M-884 .... AR-136
M-886 (PU-421A-01) ... AR-134
M-940 (PU-809A-01) ... AR-141

O

OLDSMOBILE
United Delco Distributors
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33APBT1 .... AR-140
33BFM1 .... AR-139
33BPBT1 .... AR-140
7935043 .... AR-140
7937953 .... AR-139
7937963 .... AR-140
7937983 .... AR-139

OPEL
United Delco Distributors
30LPB1 .... AR-139
7930254 .... AR-139

P

PANASONIC
Panasonic Consumer Parts Division
Panasonic Service
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CR-143EU AR-138
CR-514EU AR-140
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PENNEYS-PENNCREST
J. C. Penney Co., Inc.
981-0100 .... AR-134
981-0115 (985-6907) AR-141
981-0165 .... AR-137

PLYMOUTH
(Also See Mopar)
Chrysler Corp.
3501013 (Similar to Page 73) ... AR-122
3501501 (1PD2208), 3501502 (1PF2205), 3501503 (1PD2207) ... AR-135

PONTIAC
United Delco Distributors
22BPB2A, 22BPB2KA ... AR-138
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32APB2, 32APBK2 ... AR-138
32BFP1, 32BFPK1 ... AR-137
32BPB1, 32BPBK2 ... AR-140
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32GPB2, 32GPBK2 ... AR-138
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7935002 (1973 1/2 Prod.). AR-138
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7935012 (1973 1/2 Prod.). AR-138
7935022 .... AR-137
7935032 .... AR-137
7939102 (1973 Prod.) ... AR-140
7939102 (1973 1/2 Prod.). AR-138
7939112 (1973 Prod.) ... AR-140
7939112 (1973 1/2 Prod.). AR-138
7939122 .... AR-137
7939132 .... AR-137
9342522 (1973 Prod.) ... AR-140
9342522 (1973 1/2 Prod.). AR-138
9342532 (1973 Prod.) ... AR-140
9342532 (1973 1/2 Prod.). AR-138

R

RCA
RCA Electronic Components & Devices

RANGER
Ranger Auto Radio
RR-56T AR-141

REALISTIC
Radio Shack
12-1833 .... AR-141

S

SPORT
(See Boman Astrosonix)

T

TOYOTA
Toyota Motors Distributing, Inc.
TO-71-FM AR-135
TO-71-PB AR-135

TRUETONE
Western Auto Supply
DC4050C AR-136
ID17002A-27 .... AR-134
ID17105A-27 .... AR-134
ID17140A-27 .... AR-136
MED7208A-37 .... AR-134
MIC4050C-17 .... AR-136
MIC7012A-17 .... AR-134
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4DC7002 .... AR-134
4DC7012 .... AR-134
4DC7105 .... AR-134
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4DX7140 .... AR-136

V

VOLVO
Volvo Distributing, Inc.
28FMVO AR-135
38FMVO AR-135

RECORDERS AND TAPE PLAYERS

A

ADAM II
(See Kraco)

ADMIRAL
Admiral Corporation
National Service Div.
Chassis 885 .... TR-112
CTRF581 .... TR-112

AKAI
Akai America, Ltd.
CR-80 .... TR-113
CR-80D TR-113
1700 .... TR-112
1710 .... TR-112
1800 .... TR-112

AMPEX
Ampex Consumer Equipment Division
Micro-28 .... TR-114

ARVIN
Arvin Industries, Inc.
40L43-19 (Ch. 1.01011) .. TR-115
Ch. 1.01011 .... TR-115

ASTROLINE
(See Boman Astronsonix)

AUDIOVOX
Audiovox Corporation
C-920 .... AR-134
C-975 .... AR-138
C-980 .... AR-139

AUTOMATIC
Automatic Radio Mfg. Co., Inc.
SPA-500B,SPB-5001B AR-141

B

BOMAN ASTROSONIX
Boman Astrosonix—Div. of California Auto Radio, Inc.
BM-911 .... AR-141
SP-190 .... AR-137

BUICK
United Delco Distributors
34APBT1 .... AR-138
34BPBT1 .... AR-138
7930134 .... AR-139
9341634 .... AR-140

C

CADILLAC
United Delco Distributors
36CFMT1 .... AR-139
9341876 .... AR-139

CHEVROLET
United Delco Distributors
31BPBT1 .... AR-139
7939071 .... AR-139

CONCORD
Benjamin Electronics Sound Corp.
F-104 .... TR-115
F-128 .... TR-114
F-150 .... TR-119

G

GENERAL ELECTRIC
General Electric Company
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M8450A TR-119
M8450AP TR-119

H

HAMMOND
(See Boman Astrosonix)
HD-501 .... AR-141

HITACHI
Hitachi Sales Corporation of America
KCT-1231 .... TR-116
TRQ-257(A) TR-114
TRQ-257(W) TR-114

I

INLAND DYNATRONICS
Inland Dynatronics, Inc.
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ATK-830 (See Page 71) .. AR-135
S-100 .... AR-141

J

JVC
JVC America, Inc.
1660 .... TR-113
1660-2 .... TR-113

K

KRACO
Kraco Tape Products
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L

LAFAYETTE
Lafayette Radio Electronics Corp.
RK-166 (27-01159L) TR-116
RK-225 (99-16016L) TR-113
RK-520 (99-15943) TR-112
27-01159L TR-116
99-15943 .... TR-112
99-16016L TR-113

LEAR-JET
Lear Jet Industries, Inc.
A-25 .... AR-141
A-140 .... AR-140

M

MAGNAVOX
The Magnavox Company
1V9041 .... TR-118
2K8871 (Similar to Page 29) TR-107
2V9029 (Similar to Page 79) TR-106

MARQUIS
(See Kraco)

MORSE ELECTRO PRODUCTS
Morse Electro Products Corp.
TD51A TR-115

MUNTZ/STEREO
Muntz-Stereo-Pak, Inc.
M-860 (PU-428A-01) AR-134
M-880 (PU-427B-02) AR-134
M-884 .... AR-136
M-886 (PU-421A-01) AR-134
M-940 (PU-809A-01) AR-141

N

NORELCO
Norelco Service, Inc.
3170 .... TR-117

O

OLDSMOBILE
United Delco Distributors
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33BPBT1 .... AR-140
7935043 .... AR-140
7937963 .... AR-140

P

PANASONIC
Panasonic Consumer Parts Div.
Panasonic Service
RE-6600 .... TR-117
RF-7280 .... TR-115

PENNEY'S-PENNCREST
J. C. Penney Co., Inc.
981-0100 .... AR-134
981-0115 (985-6907) AR-141
981-0165 .... AR-137
3230 .... TR-112
3535 .... TR-119

R

RCA
RCA Sales Corporation
RK-332B (Amp Only) 1296-4
YVB607G TR-116
YZB522S TR-113

RCA—Cont.
YZB523E TR-117
YZB524S TR-118
YZB533Y TR-119
Ch. TC-604 (Amp only) ... 1296-4
Ch. TCT-801 .... MHF-34

RANGER
Ranger Auto Radio
RR-56T AR-141

REALISTIC
Radio Shack
CTR-12 (14-869) TR-114
SCT-28 (14-890) TR-116
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14-869 .... TR-114
14-890 .... TR-116

ROBERTS
Rheem Manufacturing Co.
Califone-Roberts Div.
111 (Similar to Page 95) .. TR-104

S

SEARS SILVERTONE
Sears, Roebuck & Company
400.34172200 .... TR-118
528.96050000 .... TR-115

SHARP
Sharp Electronics Corp.
RD-406 .... TR-114

SONY
Superscope, Inc.
CF-100 .... TR-119
CF-200 .... TR-114
CF-200B TR-114
CF-200H TR-114
CF-200Y TR-114
TC-45 .... TR-115
TC-55 .... TR-113
TC-134SD TR-117
TC-140 .... TR-112
TC-161SD TR-118
TC-353 .... TR-116

SOUNDESIGN
Soundesign Corp.
7718 .... TR-118

SPORT
(See Boman Astrosonix)

SYLVANIA
GTE Sylvania Inc.
CT90BK TR-112
CT170W TR-114

T

TRUETONE
Western Auto Supply
ID17002A-27 .... AR-134
ID17105A-27 .... AR-134
ID17140A-27 .... AR-136
MED7208A-37 .... AR-134
MIC7012A-17 .... AR-134
MIC7305A-37 .... AR-134
4DC7002 .... AR-134
4DC7012 .... AR-134
4DC7105 .... AR-134
4DC7208 .... AR-134
4DC7305 .... AA-134
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W

WARDS (AIRLINE-RIVERSIDE)
Montgomery Ward & Co.
GCI-2011B (See Page 109) . TR-89

WESTINGHOUSE
Westinghouse Electric Corp.
Consumer Electronics Div.
TMC8014A (Ch. V-5006-C02,-03) TR-113
Ch. V-5006-C02 .... TR-113
Ch. V-5006-C03 .... TR-113

Z

ZENITH
Zenith Sales Company
C608C TR-116
C608J TR-116
C609J TR-117

NOTE: ● Denotes Television Receiver. ★ Denotes Color Television Receiver. # Denotes Out Of Print. **AR** Denotes Auto Radio Series Volume. **CB** Denotes **CB** Radio Series Volume. **HTP** Denotes Home Tape Player Series Volume. **MHF** Denotes Modular Hi-Fi Series Volume. **PCB** Denotes Production Change Bulletin. **POM** Denotes Photofact-of-the-Month Package—Not Available On Request. **SD** Denotes Scanner-Monitor Servicing Data. **SED** Denotes Special Equipment Data. **TR** Denotes Tape Recorder Series Volume. **TSM** Denotes Transistor Radio Series Volume.

ADDRESS CHANGES

American Electronics Distributing Company
Trinity and West Seventh Street
Piscataway, New Jersey 08854

Bailey Electronics
2718 Niagara Street
Niagara Falls, New York 14303

Benmar Division
Computer Equipment Corporation
3000 W. Warner
Santa Ana, California 92704

Boman Astrosonix
California Auto Radio, Inc.
9300 Hall Road
Downey, California 90241

Emerson Television Sales Corp.
National Service Parts Department
16th & Cole Streets
Jersey City, New Jersey 07312

Fortune Star Products Corp.
1207 Broadway
New York, New York 10001

Philips Electronics Industries, Ltd.
156 Vanderhoff
Toronto 17, Ontario, Canada
For Auto Radio Parts:
Barr Radio Co.
5314 Coal S.E.
Albuquerque, New Mexico 87108

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2000 Clements Bridge Road
Deptford, New Jersey 08096

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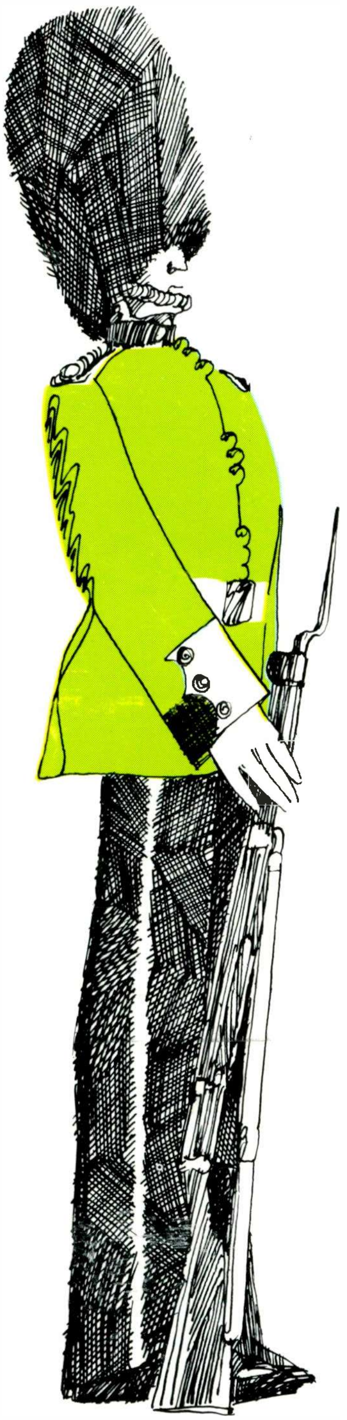

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