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Electronic Servicing

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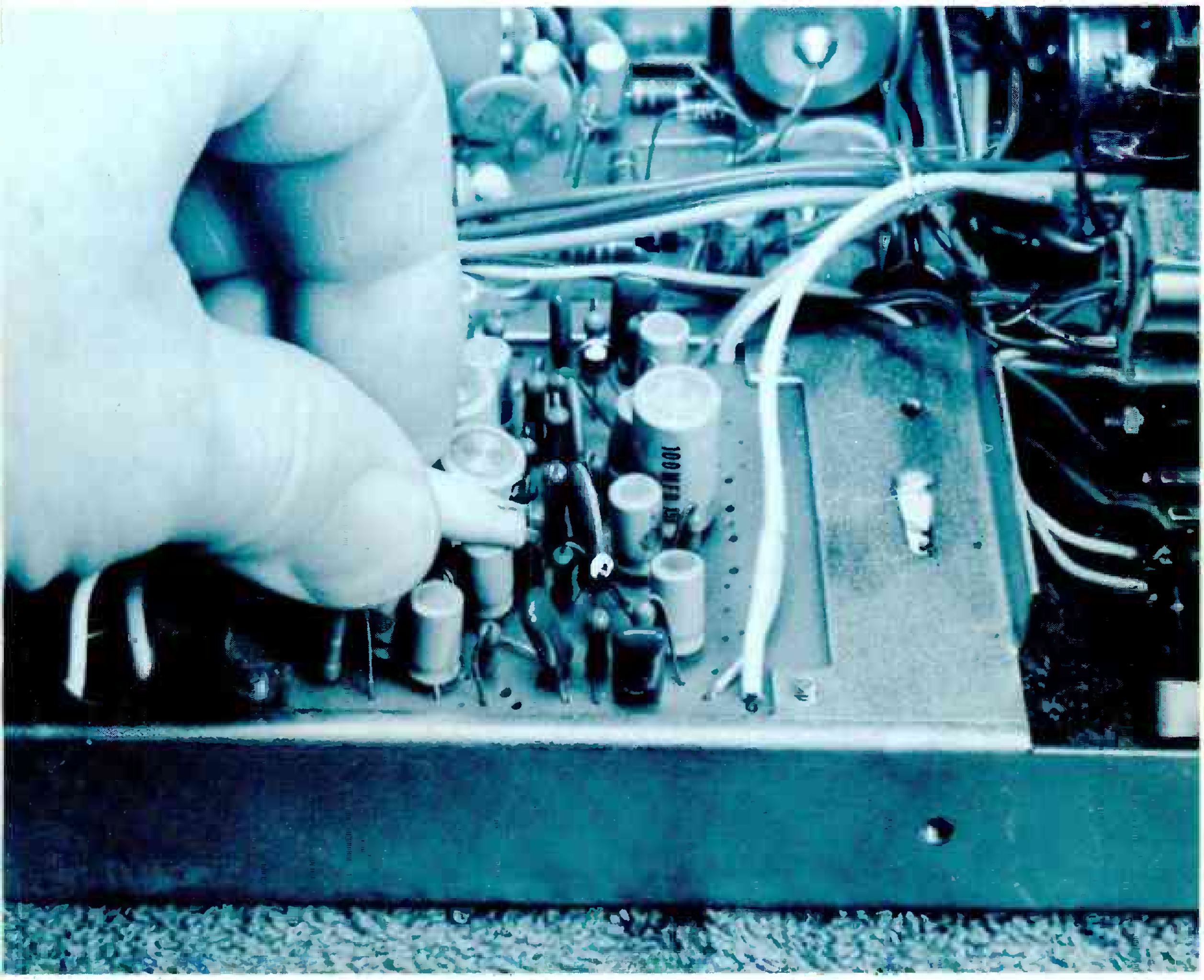

Servicing solid-state audio

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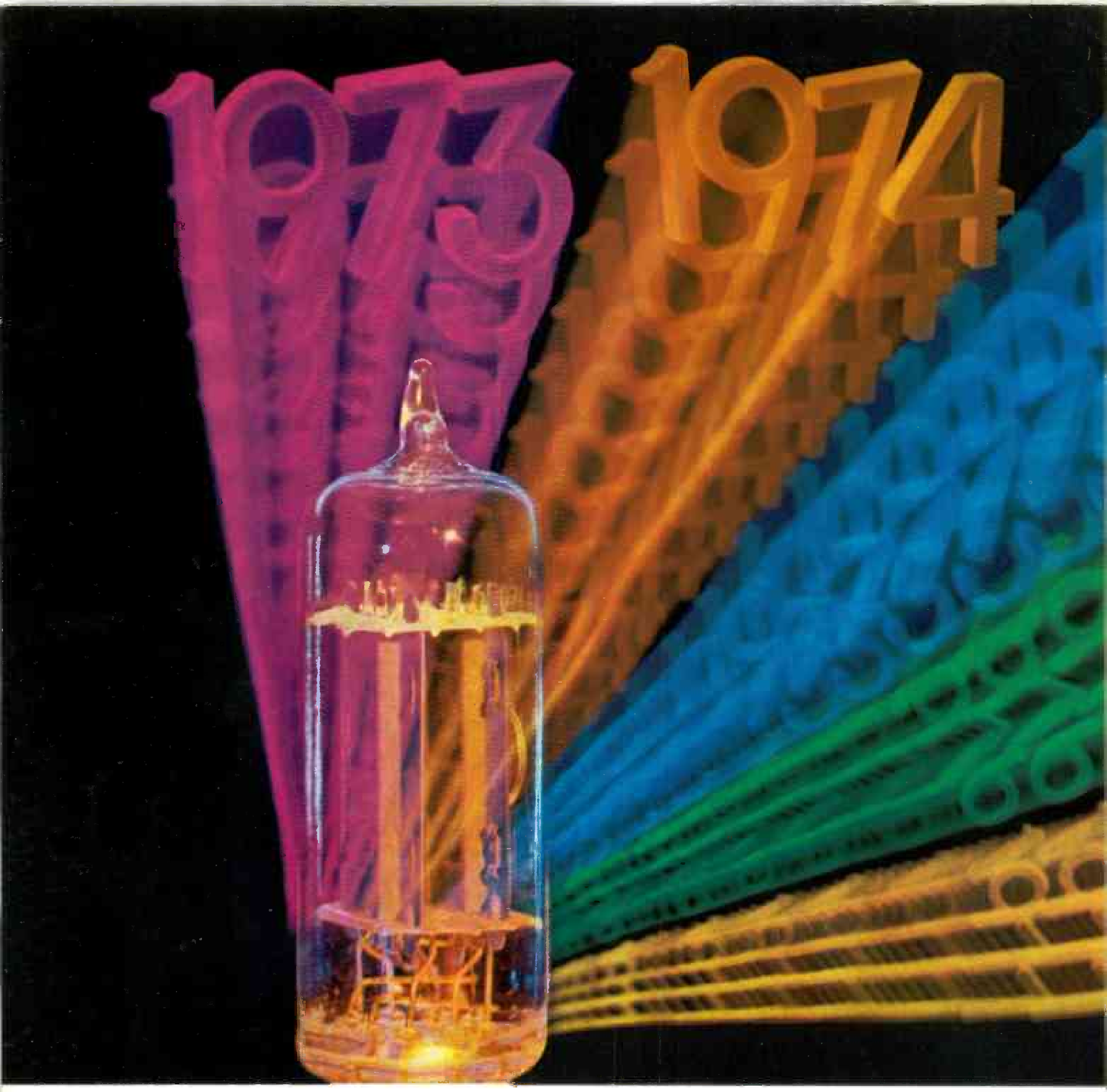
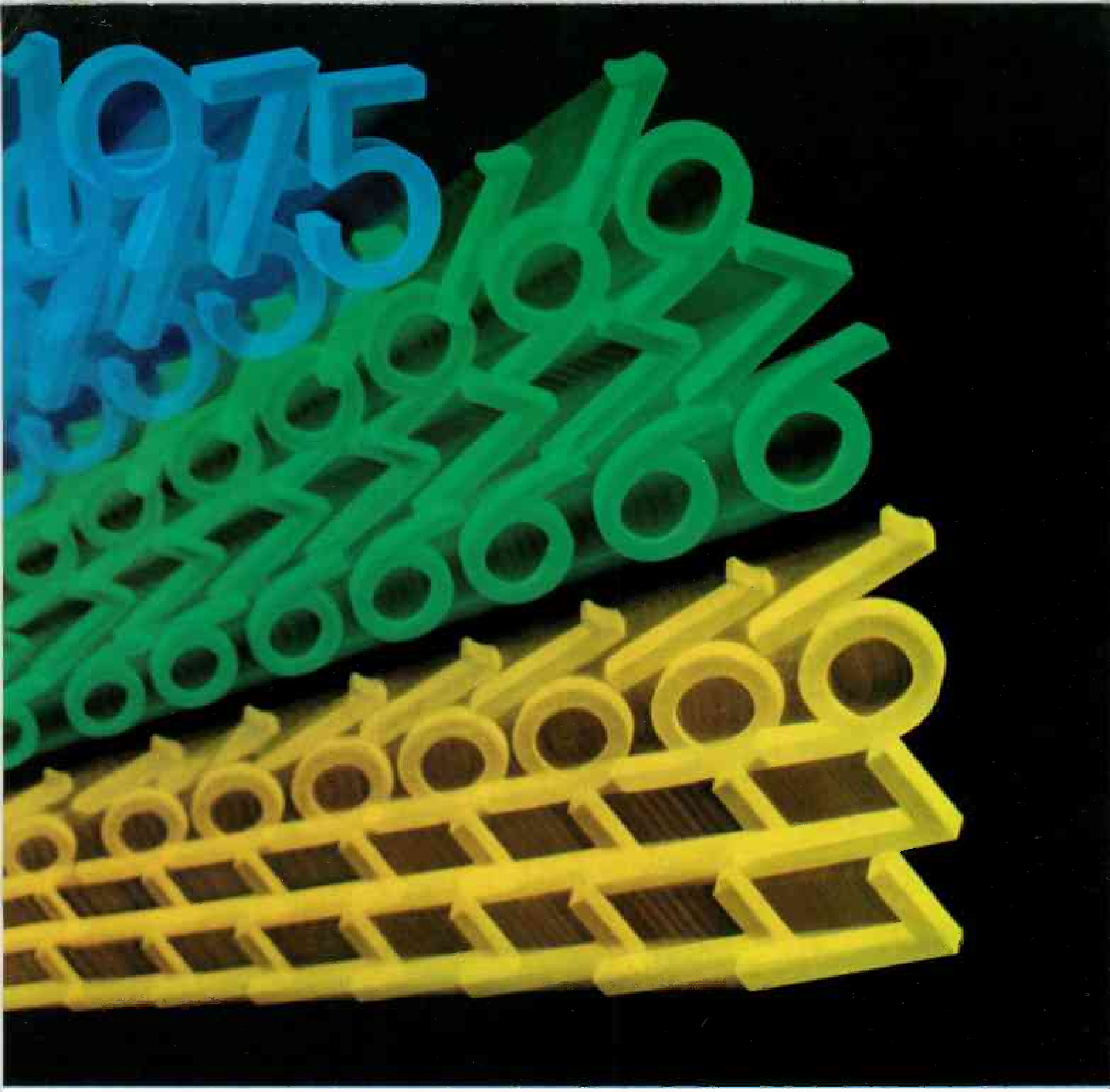
Digital Logic, Part 3

Servicing SCR-Deflection



Look ahead to a $428



July 1973 ☐ Volume 23, No. 7

Electronic Servicing®

in this issue...

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Robert E. Hertel, Publisher

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Sylvania Electronic Components, 100 First Avenue, Waltham, Mass. 02154.

GTE SYLVANIA

electronic scanner

news of the industry

RCA Electronic Components demonstrated at the NEW/COM Show in Las Vegas May 2-4 a "Frame-Freeze" video-storage tube. Two picture tubes and one b-w video camera were used to give the viewer a stationary picture of himself. One picture tube showed the scene continuously, and a viewer could position himself in front of the camera. Then the mechanism would go "click" and the scene would be frozen on the screen of the second picture tube. It remained there until the display cycled for a new picture. Technically, the frame freezing was done by feeding the output of the video camera to an RCA C22041 silicon-target storage tube. If the beam is turned off after the information is stored, the target will hold the data for as long as 43 days. However, to read-out the picture, a low-velocity beam is used to scan the target, recovering the video stored there. If erasure is desired, a stronger beam is used. Sharpness of the picture was about equal to that obtained from a standard television receiver. RCA expects this method to replace the more-complex digital-storage and translation equipment now used with graphic-computer systems.

An inaugural telephone call May 4 between Generalissimo Franco of Spain and General Medici of Brazil officially started operation of the first undersea telephone cable linking those two countries. This 160-channel cable, called BRACAN-1, was designed and installed by a British subsidiary of International Telephone and Telegraph Corporation. The direct-telephone cable was installed to complement existing satelite links, assuring continuity of communication.

MicroAcoustics is introducing a new phonograph cartridge capable of playing both matrix discs and CD-4 discrete 4-channel discs. The cartridge is said by **Home Furnishings Daily** to be neither magnetic nor ceramic, but electronic in nature. Three interchangeable styli tips will be offered to suit the listener's needs. Tips used in the recording of master records are manufactured by MicroAcoustics for about 30% of the discs cut.

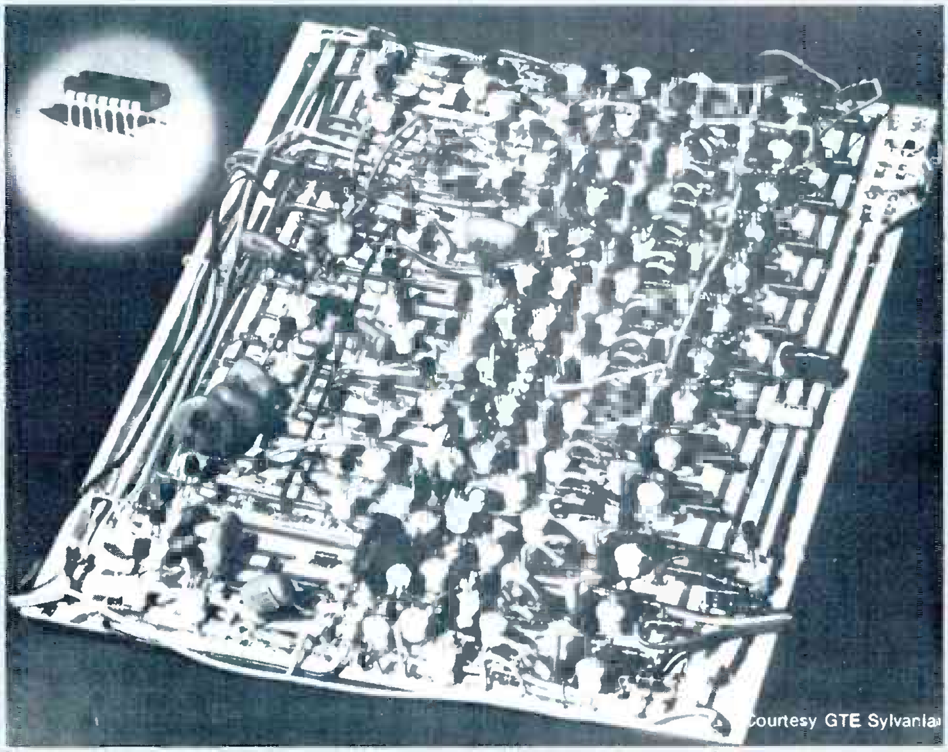
Warner Cable Corporation has been awarded two patents for devices providing either two or four additional channels of program material for cable TV operation. These devices are said to be the most simple units of their kind on the market. The Plus 4 converter adds four channels, and the Plus 2 converter adds two channels. Gridtronics, a subsidiary of Warner, is currently using Plus 2 converters to provide first-run motion pictures in seven Warner cable-television systems. Plus 4 convertors incorporate a scrambler to prevent the unauthorized use of pay material.

International Rectifier Corporation has announced a "top-of-the-line" program of semiconductors selected for replacement use in Zenith solid-state television. These 23 semiconductors, including transistors, IC's and diodes, can be obtained in a kit with a cabinet, cross-reference guide and an application slide rule.

(Continued on page 6)

RCA has announced the introduction of their line of all-solid-state color sets which can be used either with antennas or cable systems. This new line of XL-100 color receivers has optional features of AFT, instant picture and wireless remote control. No separate converters or selectors are required to receive off-the-air signals or 24 cable channels. The CableGuard shielded tuning system is said to eliminate ghosts on cable caused by stray pickup of off-the-air signals.

GTE Sylvania in May introduced their first modular color chassis. These new GT-Matic™ all-solid-state chassis are used in 33 of the 52 color receivers in their new line. Three units using plug-in transistors and plug-in circuit boards are said to eliminate most customer-adjustable control knobs by automatically compensating for most deficiencies of broadcast transmission, voltage fluctuations and electrical interference. Some of the models have a 20-button varactor-tuned channel selector. Perhaps the most interesting electronic feature is the elimination of the vertical hold control. An IC having the equivalent of 120 conventional transistors is used in a "vertical countdown" digital circuit to provide vertical locking from the horizontal sync. Four IF stages are incorporated, and the bandwidth changes with signal strength to give best color reception for all channels. Another feature (not explained yet) is aperture correction, giving added picture sharpness. □



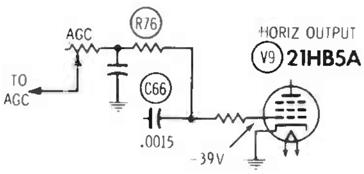
troubleshooting tips

Send in your helpful tips—we pay!

Decreasing contrast
Zenith b-w chassis 14B38Z
(Photofact 1156-3)

Gradually decreasing contrast that can be corrected by adjustment of the AGC control is a fairly common symptom in this model TV.

The first one I encountered required quite a bit of time to find. First, voltages in the AGC system were measured and found to drift with temperature in the set. Next, clamping of the AGC voltages proved the changing contrast was an AGC problem, because operation was normal when clamped.



Tracing back through the circuit, I found the negative voltage at the AGC control was changing. This attracted my attention to the unusual method of obtaining this negative voltage from the grid of the horizontal output tube.

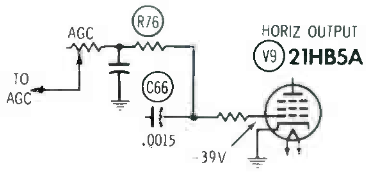
Finally, although the width and HV were good and the grid voltage measured nearly normal negative voltage, I changed the horizontal output tube and the AGC trouble was cured. Apparently the tube was slightly gassy, although it checked okay in a tester.

Since that time, I have found several TVs of the same model with the same drifting AGC caused by the horizontal output tube.

Thomas H. Small, Jr.
Linden, Alabama

Decreasing contrast
Zenith b-w chassis 14Z33, 34 or 43
(Photofact 964-3)

The picture on this b-w portable would slowly fade in contrast and finally lose locking after about 30 minutes. Tubes in the tuner, IF, and AGC sections were replaced



without any improvement. A thermal condition affecting the AGC seemed to be indicated.

Clamping the AGC line cured the contrast change, thus proving the basic problem. Voltages at the AGC tube were within tolerance, except for the suppressor grid, which was slightly low.

Because the negative voltage for the suppressor grid of the AGC keyer is obtained from the control-grid circuit of the horizontal-output tube, I checked there and found the voltage to be slightly less than -30 volts.

Installation of a new horizontal-output tube solved the problem of changing contrast. Leakage or gas in the tube evidently was the defect.

Zachary Zuro
Chicago, Illinois

Editor's note: The preceding two tips are for the same symptoms and the same basic cause. And yet the receivers are about three years different in the time of introduction on the market. This illustrates the many cases in which a tip intended for one specific model applies equally well to another set having a similar circuit. Always keep this in mind as you read the tips.

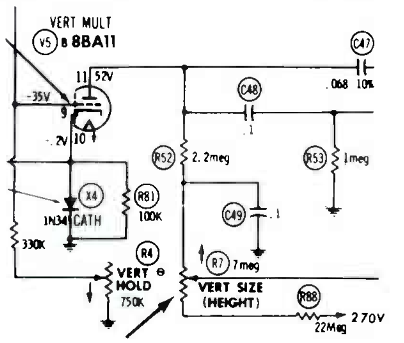
Vertical roll
Zenith 14B38Z
(Photofact 1156-3)

If one of these TVs starts rolling a few minutes after turn-on and no defective capacitors can be found in the vertical sweep circuit, suspect

(Continued on page 8)

troubleshooting tips

(Continued from page 7)



the vertical size control of internal leakage from the element to case.

The amount of leakage often is very small, and ohmmeter tests are not very conclusive. Perhaps the best test is to temporarily replace the control.

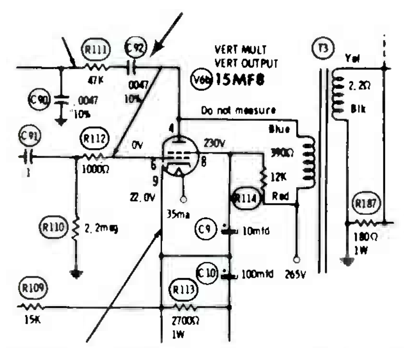
Thomas H. Small, Jr.
Linden, Alabama

Two complete pictures
Zenith 14CC16 chassis
(Photofact 1233-3)

Two complete pictures, one above and another below, appeared on the screen. This meant the vertical sweep circuit was running at 30 Hz rather than the correct 60 Hz.

Such a large change of frequency usually involves the time constant in the grid circuit of the oscillator where the hold control is located.

The resistors and capacitors in the grid circuit checked okay, so I worked back through the positive-feedback path. The coupling capa-



citor C92 was found to have excessive leakage, and this was the reason for the wrong sweep frequency.

Stanley F. Gutt, Jr.
Bayonne, New Jersey

Safety precaution
All "hot-chassis" sets

In our shop we have both CATV and an outside antenna for on-the-air TV tests. All TV portables of the "hot-chassis" type have capacitor/resistor filters in the antenna leads to prevent excessive current flow. So, over the months, we had gotten careless because no problems of shorts had occurred, although we knew isolation transformers should be used.

But in this case when I clipped on the CATV lead to a portable, ZAP! And a small smoke ring curled up from the tuner.

We investigated and found that another bench man also had been using one of the CATV outlets, but the clip had been touching the chassis. Then when I connected my clip, I accidentally touched the tuner-mounting bracket. It was pure bad luck the TVs were plugged in so the two chassis were 120 volts different in polarity of line voltage.

The results? Two open splitters, and two wiser technicians!

Virgil Cross
Flint, Michigan

Flashes of color
General Electric MA chassis

With the color turned down, the screen would flash magenta, yellow or cyan when the set was jarred slightly.

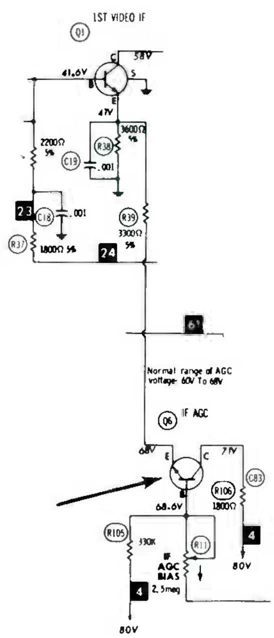
The RGB-amplifier board was the most sensitive to gentle tapping, indication the trouble was on that board or its connections. Moving the picture-tube cathode wires where they attached to the board would cause the intermittent screen color. No bad connections were found around the male prongs on the RGB-board, so the female connectors were suspected.

In such cases, I recommend that the cathode wires be soldered to their respective female connectors. The plastic insulators which are around the female connectors can be removed by inserting a thin, narrow knife blade from the wire side to hold down the plastic locking tab while the insulator is removed.

Roger Redden
Beaver, West Virginia

Intermittent locking
and contrast
RCA CTC38 chassis
(Photofact 1092-3)

The symptoms were many and confusing. First, there was a normal picture for about five minutes after turn-on. Then the picture would start to roll and go out of horizontal lock. Contrast, at that time, appeared to be normal. Next, the contrast would fade out and stay low several minutes before coming back with normal locking, where it remained for several hours.



From all appearances, the problem involved a DC-voltage AGC condition. I checked the DC voltages on the AGC keyer tube and the IF-AGC transistor while the set was cold and there was no signal. After it had operated for a time, I rechecked the same voltages and found the keyer voltages about the same, but the DC voltages at the IF-AGC transistor had all changed by about two volts.

To make a long story short, I changed Q6 (IF-AGC) transistor and the intermittent was eliminated. Evidently the chassis heat was changing some leakage inside the transistor.

W. John Sopicki
Lackawanna, New York

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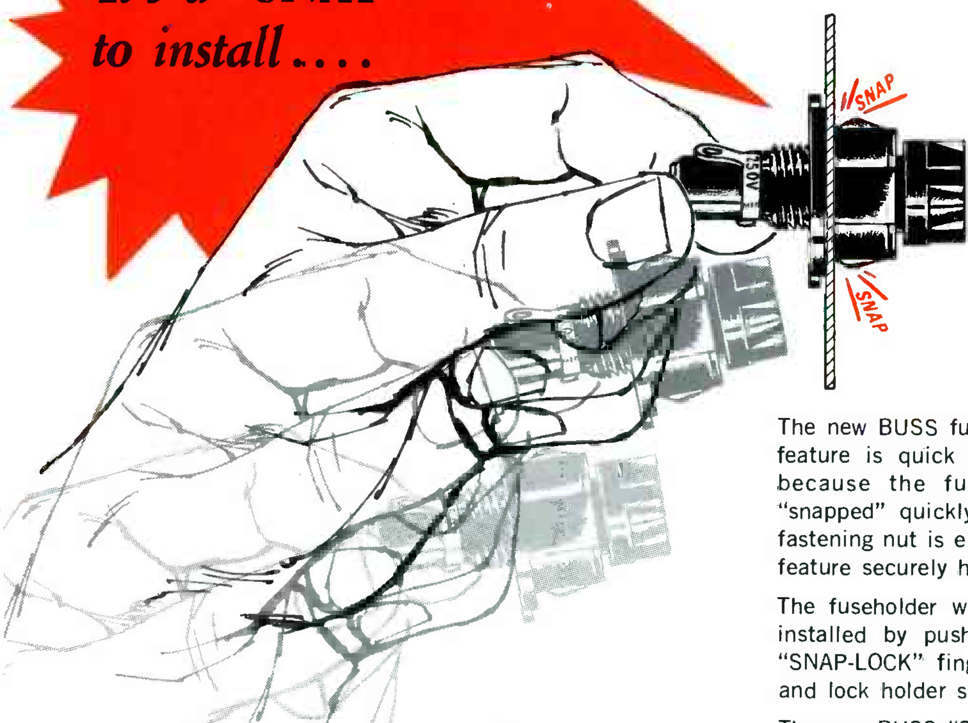

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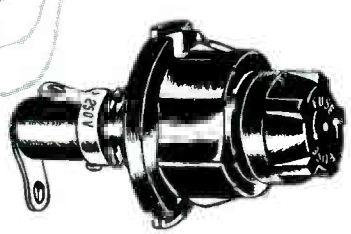
Symbol HKP-00, Standard Fuseholder.

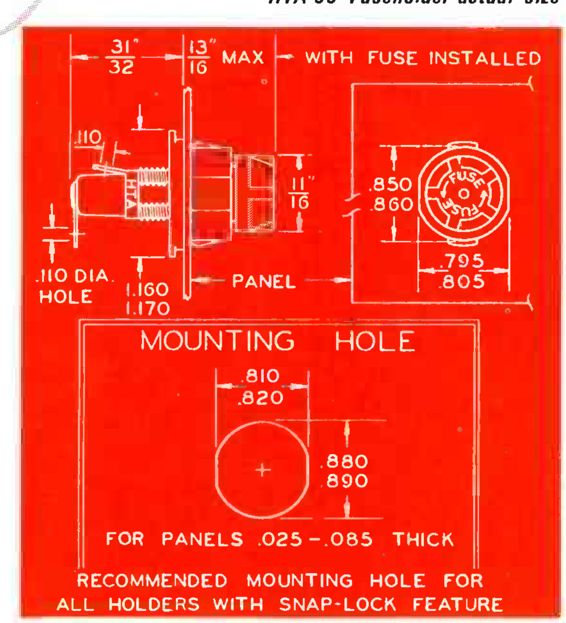
to take ¼x1 inch fuses:

Symbol HJM-00, Standard Fuseholder.

All are available with quick connect terminals, if so desired.



HTA-00 Fuseholder-actual size



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Earl D. Kent
Box 182
Neah Bay, Washington 98357

Needed: *Schematic for a Cable Hound Model 71-620-00 cable locater made by Continental Telephone Electronics.*
Walter Handke
Dunlap, Iowa 51529

Needed: *Audio output transformer part No. 32B112 for Bell Sound Model No. 2445.*
Hammersmith TV
Route 1
Sister Bay, Wisconsin 54234

Needed: *Schematic and parts list, two No. 77 tubes and speaker for Philco Radio chassis 84, code 121. Also need two 6F7 tubes for another radio.*
Fred Pfeffer
625 Evergreen Avenue
Pittsburgh, Pennsylvania 15209

Needed: *Parts [such as bubblers], accessories [such as wall boxes] and especially literature for a 1946 Wurlitzer juke box, model 1015.*
Daniel Meijer
1438 Geranium Street, N.W.
Washington, D.C. 20012

Needed: *Schematic and other service data for RCA Radiola 44 Model AR-594. I will pay for schematic or will copy and return.*
Charles Fanning
6613 Wichita Drive
Vancouver, Washington 98661

Needed: *Instruction manual for genometer or signal generator Model TV-50A, Superior Instrument Company.*
Magdalene Tyler Ramos
572 Eagle Avenue Apt. C-1
Bronx, New York 10455

Needed: *One RF coil and IF transformers for Philco model 46-421 small portable radio set. Philco parts numbers are: RF coil-32-3595, and IFs are 32-3962 and 32-4014. Meissner numbers for IFs are 16-6658 and 16-6670.*
James S. McIntyre
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Pettus, West Virginia 25153

Exchange: *Tektronix 511AD oscilloscope in good operative condition to trade for a good sweep generator.*
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Needed: *Many 1754 and 1718 lamps. Please state type and amount.*
Thomas J. Sidlovsky
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Mt. Pleasant, Pennsylvania 15666

Needed: *One each 27 and 26 old-type tubes for an Atwater Kent radio model 46.*
Wayne R. Kienzle
9500 Sherman Church Avenue, SW
East Sparta, Ohio 44626

Needed: *Power transformer for EICO resistance-capacitance-comparator Bridge Model 950B.*
Thomas J. Amerson
3800 Leisure Lane
College Park, Georgia 30349

Needed: *Schematic for FM "Pilot" tuner, Model T601.*
Walt Opalach
982 Planetree Place
Sunnyvale, California 94086

Needed: *One 2EP4 picture tube (6 volt 145/MA) for Philco battery-operated TV. State price and condition.*
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1359 Northumberland Drive
St. Louis, Missouri 63137

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Virginia Beach, Virginia 23455

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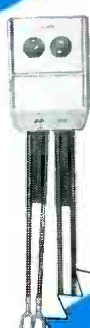

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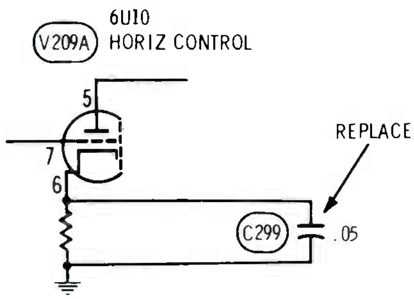
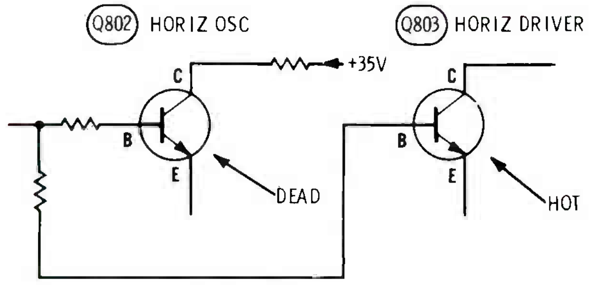
Symptoms and cures
compiled from field reports
of recurring troubles

Chassis — Zenith 14DC15 and 14DC16
PHOTOFACT — 1272 POM



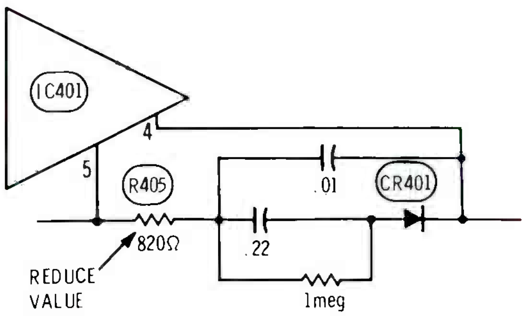
Symptom — Hook at top and picture bends
Cure — Check C299, and replace if defective

Chassis — Zenith 25DC56 (solid state)
PHOTOFACT — 1312-3



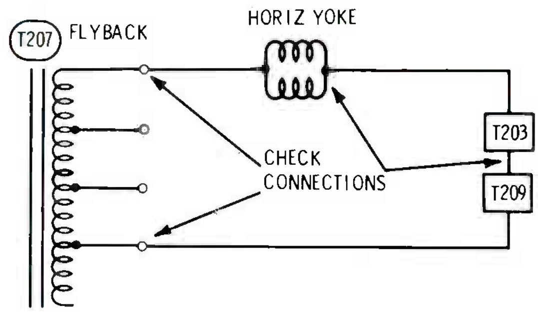
Symptom — No high voltage, horiz driver transistor hot
Cure — Replace horiz oscillator transistor, or check for dead osc

Chassis — Zenith 25DC56
PHOTOFACT — 1312-3



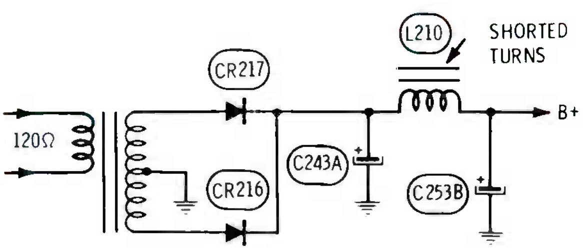
Symptom — Vertical jitter on cable signals
Cure — Try an 829-ohm resistor in parallel with R405

Chassis — Zenith 25DC56
PHOTOFACT — 1312-3



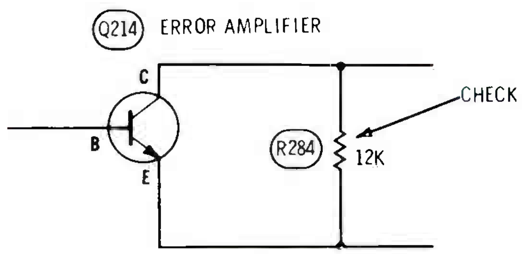
Symptom — One vertical line in center (no horiz deflection)
Cure — Check for open in yoke plugs, PC transformers and yoke

Chassis — Zenith 25DC56
PHOTOFACT — 1312-3



Symptom — Double bend moves up the picture
Cure — Check L210 filter choke, replace if it has shorted turns

Chassis — Zenith 25CC55 and 25DC57
PHOTOFACT — 1266-3



Symptom — Loses HV during channel changes
Cure — Check R284 and replace if it is low in value □

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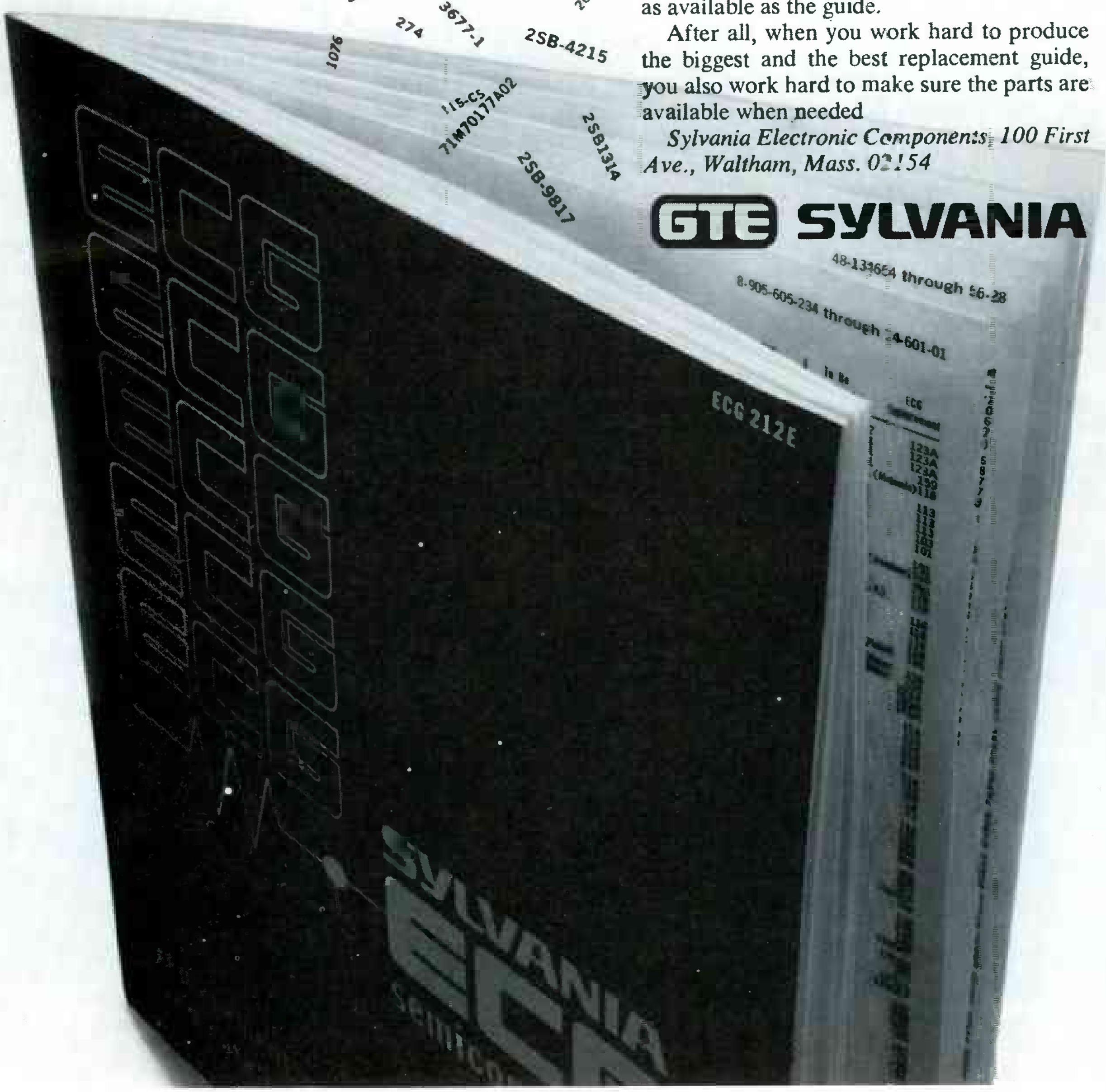


Tips for servicing solid-state low-level audio

By Wayne Lemons

Would you rather work on tube-equipped sets than on solid-state ones? Here are practical tips that should take away some of the lingering fear of transistorized circuits.

Transistors have been with us for many years now, but it's not unusual to find technicians who are a bit squeamish about tackling solid-state equipment. Probably, this is more true of those of us who "grew up" with tubes and still "wish they had left well-enough alone."

One reason for this attitude is the necessity for "upside-down" thinking. Not only are there two polarities of bipolar transistors (NPN and PNP), but the DC power supplies can have either a positive or a negative ground.

Power Supply Polarity

Shown in Figure 1 are two identical circuits, except for the polarities of the power sources. One is negative ground and the other is positive. Consequently, the voltage readings appear to be completely different. But, to the transistor, there is no difference at all.

For example, in schematic A the emitter voltage is .48 volt to ground, and in B it's — 8.52. But the voltage across the emitter resistor is the same .48 volt in both cases.

Now, take a look at the base bias voltage. In A, the + .95 volt at the base is .47 volt more positive than the .48 volt at the emitter. In B the — 8.05 volts at the base is .47 volt more positive than the — 8.52 volts at the emitter. Also, look at the collector voltage, which is 3.82 volts more positive than the emitter in both circuits.

The misleading thing is that the voltages are measured to ground or chassis.

Measure from the emitter

This confusion of readings can be clarified by always using the emitter as a common test point for reading the base and collector voltages. Or, alternately, use the negative side of the power supply as the common for the meter, regardless of whether the negative is "hot" or grounded, as shown in Figure 2.

Visualize a transistor as being a resistor

When no input signal is applied, a transistor in the circuit acts simply as a resistor; a resistor whose value is determined by the DC bias between base and emitter. Across the 4.7K resistor in Figure 1 there is a drop of 4.7 volts indicating the current is 1 milliampere. Because the voltage drop across the transistor is 4.3, it follows that the transistor is acting as a 4.3K resistor.

Therefore, one of the fastest ways of checking a transistor in a low-level audio stage is by measuring the voltage drop across it. If the voltage drop either is zero, or is the same as the supply voltage, the transistor is defective or the bias circuit is malfunctioning. On the other hand, if the voltage drop is about the center of the power-

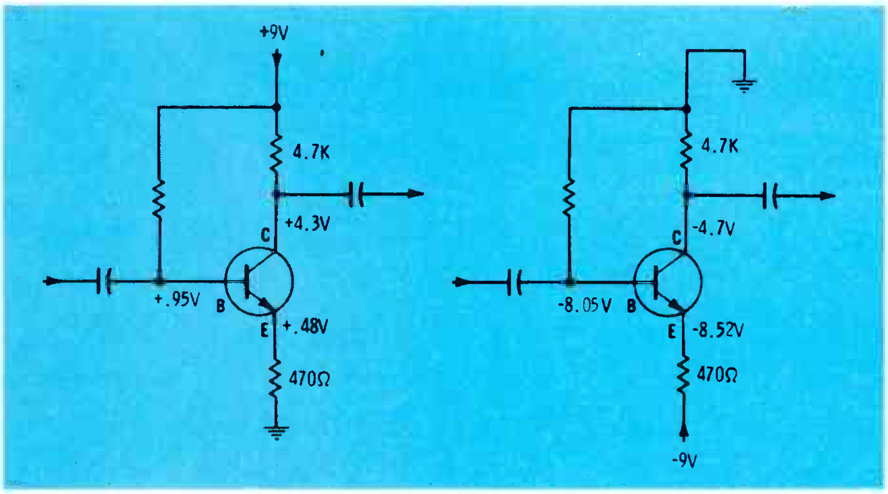


Fig. 1 The voltages on these two transistors appear to be very different. Actually they are identical. The difference is that A has the negative terminal of the power supply grounded, while B grounds the positive terminal.

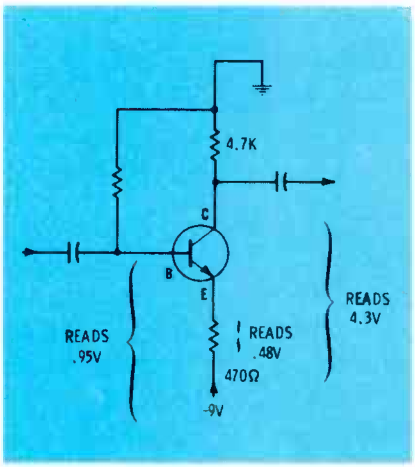


Fig. 2 Measuring from the negative terminal removes most of the confusion. Alternately, all measurements could be made from the emitter.

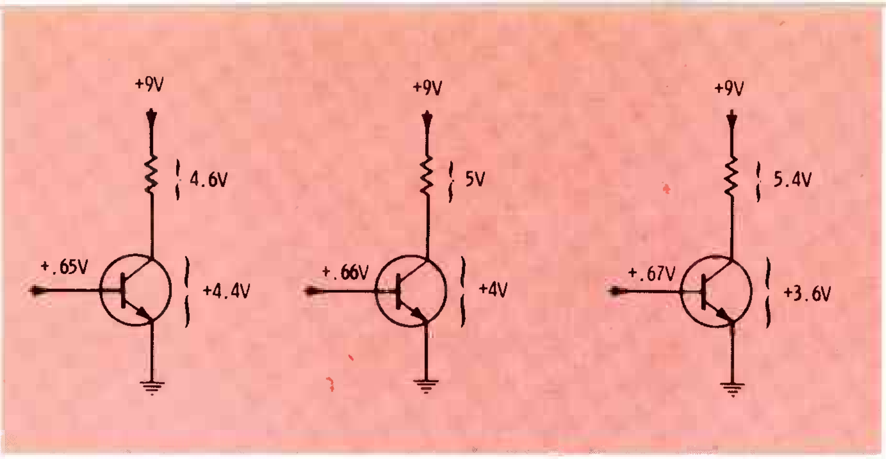


Fig. 3 Small changes of base forward bias change the collector/emitter resistance, thus changing the voltage drop across the transistor versus the drop across the collector resistor. Often the collector/emitter voltage should be 25% to 50% of the supply voltage.

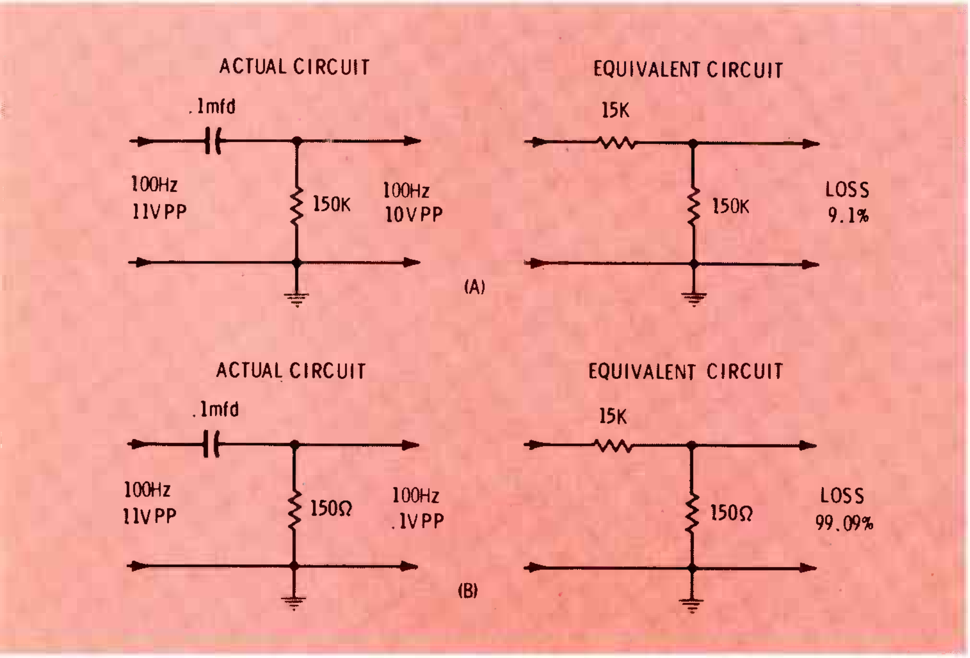


Fig. 4 The low input impedances of most transistor stages require a larger base coupling capacitor to prevent loss of bass (low-frequency) response. (A) An input impedance of 150k and a coupling capacitance of .1 mfd produces only 9.1% loss of signal at 100 Hz. (B) An input impedance of 150 ohms and the same .1-mfd coupling capacitance gives a loss of 99.09% at 100 Hz.

supply voltage, it's a good sign the transistor and its bias are normal.

If the transistor is a NPN, increasing the forward bias by raising the positive voltage at the base reduces the resistance of the transistor, and so decreases the voltage drop between collector and emitter. (Figure 3). The values given are typical, and you can see that small bias changes make large changes in the collector/emitter voltage drop. Amplification occurs when the signal alternately adds and subtracts from the bias. In the collector circuit, the varying current changes the magnetic lines of force in a transformer, or causes a varying DC voltage drop across a collector load resistor. This varying voltage can be coupled through a capacitor to the next stage. However, that brings up another possible problem.

Coupling Impedances

Perhaps you've wondered why transistorized circuits often use 10-mfd coupling capacitors, when tube circuits get by very nicely with .01 to .1. The answer lies in the greatly-different impedances in transistor circuits compared to tube ones. At the grid of a tube, the impedance is about that of the grid resistor alone. It's a different story at the input of a transistor.

Although the base/emitter resistance changes with bias, it usually remains between the limits of perhaps 150 ohms to several thousand (in some audio circuits). Figure 4 shows the actual versus the equivalent circuits at both high and low impedances. This makes clear why a .1 capacitor would pass very little bass in a transistorized circuit.

Higher input impedances

The low-input impedance problem can be skirted by the use of circuits which increase the impedance. One such circuit is the emitter follower (Figure 5), in which the output signal is taken from the emitter. Because this constitutes 100% feedback, the voltage gain is just about 1. But the same voltage is available at a much lower impedance so this represents a gain in power . . . . a useful feature, when driving a following low-impedance base circuit.

Figure 6 shows how an emitter-follower can be wired in direct coupling to drive a common-emitter amplifier stage. Not only is the input impedance quite high, but the direct coupling gives flat low-frequency response right on down to DC. The addition of a small emitter resistor in the second stage raises the input impedance even more.

Low input and low output impedances

A two-stage amplifier with a low-impedance input and also a low-impedance output is shown in Figure 7. The stability against heat changes is good, because the bias for Q1 is taken from the emitter of Q2.

Q1 gives extremely high gain since it's collector feeds the high-impedance base circuit of Q2. In other words, Q1 gives very high gain, and Q2 gives a gain of 1. And

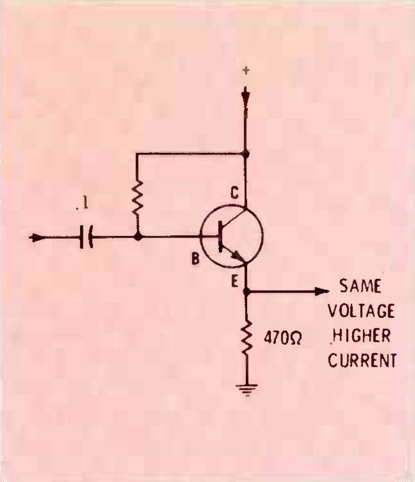


Fig. 5 An emitter follower has a voltage gain of 1, but there is a large gain of power because of the differences of impedance. An emitter follower has high-input impedance and very-low output impedance.

the output is low impedance, which is an advantage in many circuits that follow.

Low input and medium output impedances

Two low-impedance direct-coupled stages (Figure 8) give very high gain. However, it is not as high as a person might believe, although both stages amplify. The reason is that the output of Q1 feeds the low-impedance input of Q2. This loading of the collector circuit reduces the gain of Q1. Also, the gain of Q2 depends in part on the impedance that loads its collector.

Take a long, thoughtful look at this loading problem, because it is the reason many transistorized circuits give far less than the theoretical amount of gain.

Stability of the circuit is quite good because the base bias for Q1 is obtained from the bypassed

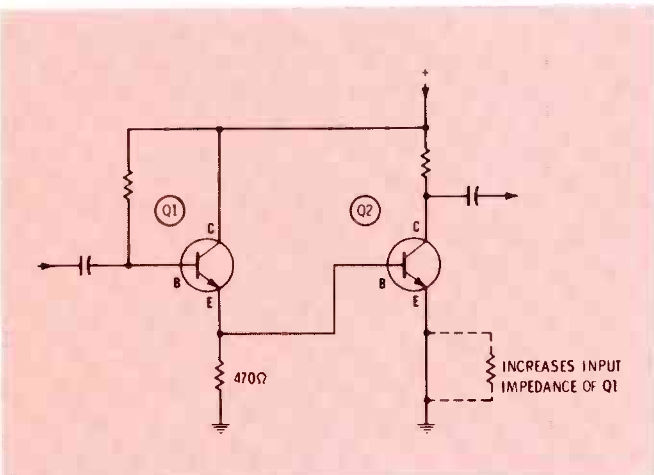


Fig. 6 The first stage is an emitter follower giving high input impedance, and the output is from the collector of Q2 giving medium impedance. Q1 produces no gain, but Q2 has extremely-high gain. Adding an emitter resistor to Q2 increases even more the high input impedance of Q1.

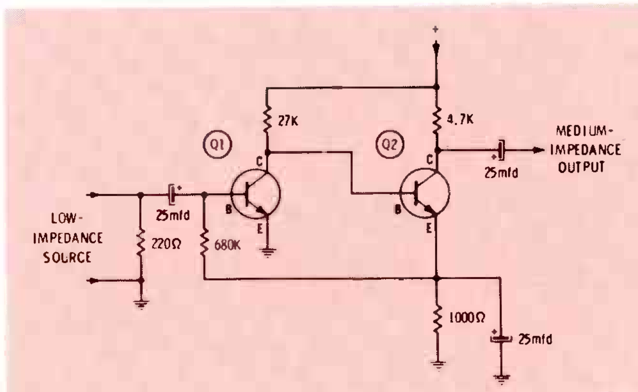


Fig. 8 Higher gain with moderate output impedance is obtained by operating Q2 as a common-emitter stage. Thermal stability is good because of the path between the base of Q1 and Q2's emitter.

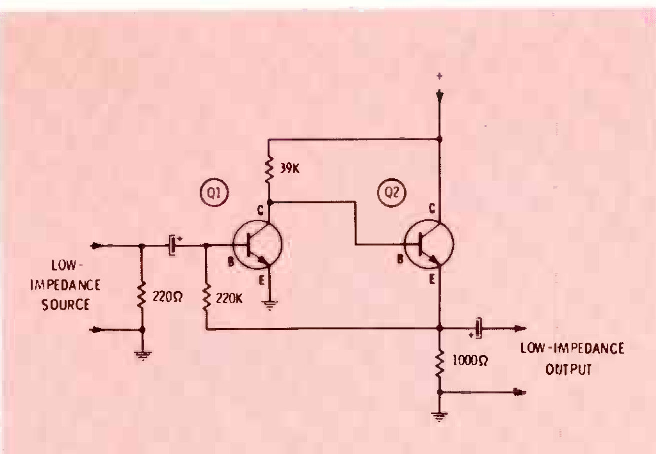


Fig. 7 High gain and a low output impedance are produced by these two stages. Direct coupling between stages provides better low-frequency response, and good thermal stability is obtained by taking Q1's base bias from the emitter of Q2.

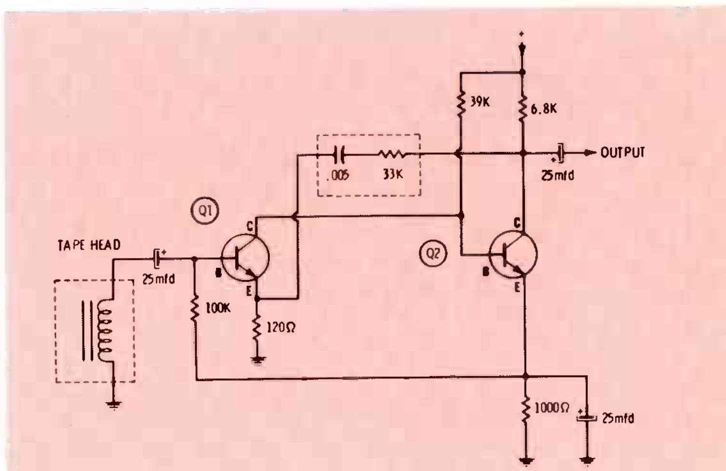


Fig. 9 The input impedance is raised by voltage feedback from the collector of Q2 to the emitter of Q1. This also reduces the gain, which is restored at low frequencies by the .005 capacitor in the feedback path. Input impedance, therefore, is low at low frequencies where it's of no importance, and high at high frequencies, where it's necessary to prevent loss of high frequencies from the tape head. Both a higher input impedance and bass boost are provided by the one feedback path.

emitter of Q2. For example, assume that a higher ambient temperature increased the current through Q1. The collector voltage of Q1 (and the base of Q2) would decrease, and with it the emitter current of Q2. Less emitter current produces less voltage drop across the 1K emitter resistor and, because the base bias of Q1 is taken from that point, the forward bias of Q1 is reduced to decrease the Q1 collector current. Therefore, the circuit stabilizes the collector current of Q2.

Negative feedback

Circuit impedances can be raised by the application of negative feedback. This same feedback also can be used to shape the frequency response. Both benefits are obtained by the circuit of Figure 9.

Because tape-playback heads are inductive components, a low-impedance load across them greatly reduces the high-frequency response. For this reason, the load impedance needs to be about 50,000 ohms or so. An emitter follower would permit such a high impedance but might cause noise. By using frequency-selective negative feedback over two stages the input impedance is raised and the bass-frequencies are boosted. (The bass boost is necessary because the magnetic head impedance falls at low frequencies.)

Feedback from Q2's collector to the emitter of Q1 is correct in phase to reduce the gain, and the gain reduction at high frequencies is determined by the 33K resistor. The higher this value, the higher the gain. Therefore, to boost the bass it is necessary only to add a capacitor of the proper size in series. The feedback is reduced at low frequencies giving increased gain there.

Of course, the input impedance of Q1 is reduced at the low-frequencies because the feedback is rolled off. But the input impedance loading the head is important only at high frequencies, so all is well.

If you measure the gain of these two stages, you will find the feedback reduces the gain of Q1, while Q2 has normal gain.

Summary

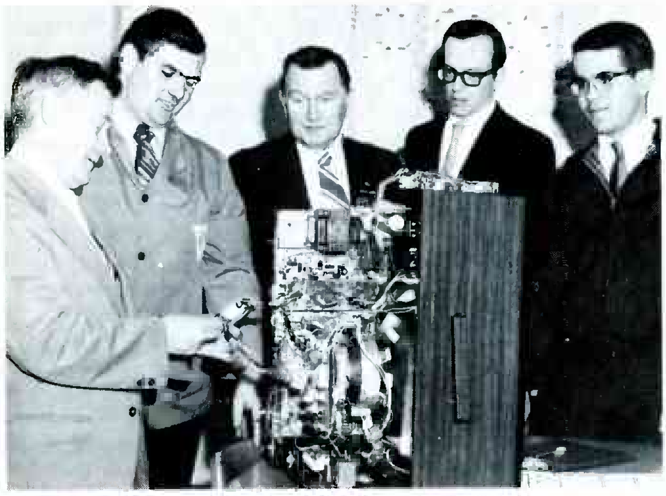
In low-level solid-state resistance-coupled stages, we usually expect to have 25% to 50% of the supply voltage dropped across the transistor. If the collector/emitter voltage is near zero, the transistor is shorted or has excessive forward bias. On the other hand, a collector/emitter voltage equal to the supply voltage means the transistor is open or has insufficient forward bias.

The gains of transistors depend not only on the beta reading, but also on the exact amount of forward bias (either too much or too little causes low gain), any intended or accidental negative feedback, the loading across either the input or output caused by another stage, and the type of circuit (emitter follower or common emitter). □

News from the

SERVICE ASSOCIATIONS

Pictured are five members of the International Society of Certified Electronic Technicians (ISCET) making an official serviceability inspection of a Sylvania EO-5 chassis at the Sylvania plant in Batavia, New York. The various manufacturers request these inspections, and pay the cost of transportation and housing for the team members.



Left to right, are Lew Edwards, Tom MacDonald, Warren Baker, John Kozubal, and Martin Brown.

On April 2nd, Richard Glass of NEA and Frank Mock of NATESA met alone at Champaign, Illinois to discuss the proposed merger of their organizations. Their meeting was completely amicable. However, according to NATESA, these are some of the demands by NEA that are blocking merger:

- Mr. Glass would automatically become the permanent Executive Director.
- Mr. Moch would have a secondary position under the President and subject to his dismissal.
- All present NEA programs would be continued without vote of the members.
- Many NEA members pay dues monthly as opposed to NATESA's one-year plan.
- NEA asks for the termination of the NATESA SCOPE.
- NEA asks for a new association now by absorbing NATESA, with the bylaws to be adopted later.

At this time, NATESA appears to believe a merger is not possible.

June 15 and September 15 have been selected as the 6th and 7th CET Test Days. Inquire of NEA or your editor for the location nearest you. Ron Crow, Executive Director of ISCET, reports that 4,875 technicians have successfully passed the written CET test. In California alone there are 1,132 CET's. Internationally, CET's are found in 14 foreign countries.

The NATESA Executive Council met in conjunction with the Florida State Director's Conference at Vero Beach, Florida May 4-6. A report of the meeting between NEA's Richard Glass and NATESA's Frank Moch was accepted as a major item of the merger discussions. Plans for the 1973 Simultaneous Convention in Kansas City were discussed. Many hours were spent examining and implementing provisions of the suggested by-laws submitted by Chairman W. S. Harrison of the NATESA By-Laws Committee. The final version provides that voting memberships be limited to business entities, with dues payable one year in advance for the full fiscal year. Provision also was made for technicians and other members, but they would not have individual voting rights. The Executive Council would be expanded to 13 men, including the President, Secretary, Treasurer and regional Vice-Presidents. The Council would engage, under contract, one or more Executive Officers to conduct the day-to-day affairs of the association. Merger Chairman LeRoy Ragsdale was instructed to submit the proposed by-laws to the entire Merger Committee for study.

JESUP (Joint Electronics Service Upgrading Program of NEA) received its first test March 19-20 at Stouffers Inn in Indianapolis, Indiana. Ten manufacturers (Admiral, Sony, Sylvania, Philco, General Electric, Zenith, Panasonic, Magnavox and RCA) supplied teams and equipment for this marathon series of meetings. Of the 175 men attending these meetings, 130 were students, electronics instructors or full-time technicians. They generally expressed praise of the type of meetings, and asked that the idea be extended. The most appealing part of the school seemed to be the instruction covering ten brands. Dick Glass, Executive Vice-President of NEA, believes this is the correct approach for schools to supplement the manufacturer's one-brand training program.

Admiral instructor, Mr. T. Tully, instructing one of the classes of the initial JESUP school. □

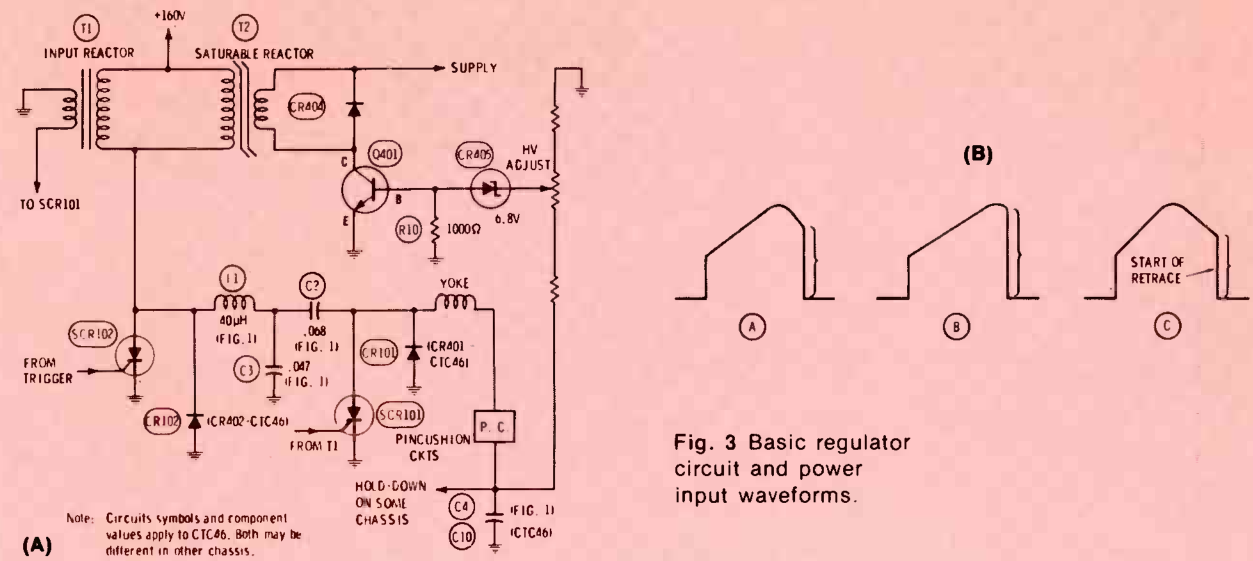


Fig. 3 Basic regulator circuit and power input waveforms.

TABLE 1

Chassis (year)	HV Rectifier	Hold-down Diode	Hold-down Transistor	Normal HV 120V line, zero beam I
CTC 40 (68)	3CZ3	none	none	26.5 KV
CTC 44 (70)	Quadrupler	yes*	none	26.5 KV
CTC 46 (71)	Quadrupler	yes**	yes**	26.5 KV
CTC 47 (69)	Quadrupler	none	none	26.5 KV
CTC 48 (72)	Tripler	yes**	yes**	26.5 KV
CTC 49 (70)	Quadrupler	yes*	none	20.1 KV#
CTC 54 (71)	Quadrupler	yes**	yes**	26.5 KV
CTC 58 (73)	Tripler	yes**	yes**	26.5 KV
CTC 59 (71)	Quadrupler	yes**	none	22.3 KV#
CTC 62 (73)	Tripler	none	none	fixed #
CTC 64 (73)	Tripler	yes**	yes**	31.0 KV
CTC 68 (73)	Tripler	yes**	yes**	31.0 KV

*Connects between C4 and Gate of SCR 102 in Figure 1.
**Connects between C5 of Figure 1 and horizontal hold control.
#Portable instrument.

reduce the high voltage.

When the basic symptom is excessive horizontal scanning frequency, the problem can be in any of the usual subsystems such as the oscillator or AFC circuit. It can be a problem in the regulator, it can be an open trace diode, or it can be a defective component in the hold-down circuit itself. If there is going to be any money made on the job, it's necessary to find out where the problem is, and do so fast.

Again, the first step is to cancel as much of Murphy's Law as possible. Specifically, be sure that some ding-a-ling hasn't simply misadjusted the coarse-hold control on the horizontal-oscillator module. Set the front-panel hold control to its center and try the coarse control. If the hold-down circuits are operating, it will be impossible to sync the raster at any position of these hold controls.

Next, try grounding the test point labeled TP2. It and TP1 are located near the horizontal-oscillator module. If this restores horizontal sync (coarse and fine controls returned to their normal settings) the probable fault is in the high-voltage regulator and the high voltage is excessive. If it does not restore sync, either the oscillator module itself is open, or there is a fault in the hold-down circuitry.

If soldering equipment is at hand, a sure way to eliminate the possibility of a defective hold-down system is to disconnect the collector of the hold-down transistor and the anode of the hold-down diode. If a known-good oscillator module is at hand, installing it will also isolate the trouble. Once isolated, the trouble is usually not difficult to correct.

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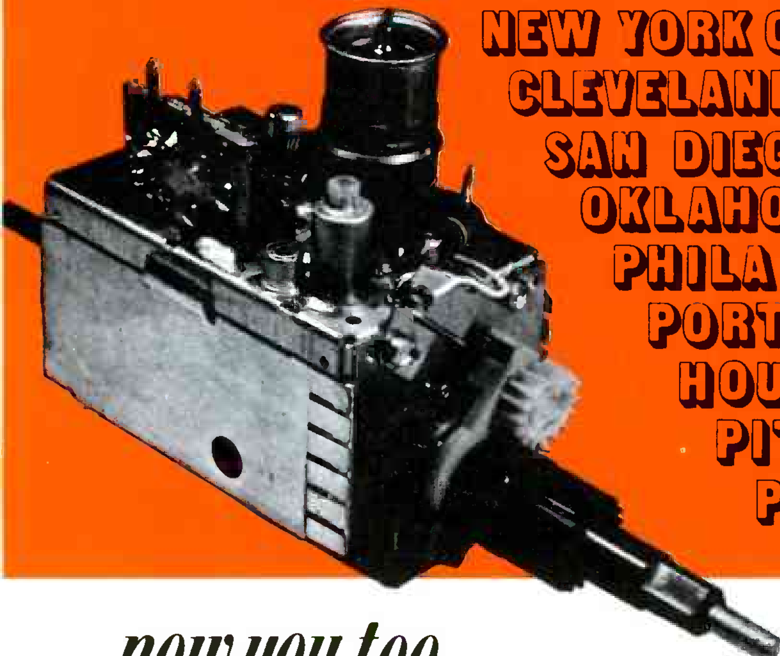

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check operation of the hold-down circuit by shorting together TP1 and TP2. This should throw the horizontal oscillator off frequency. If it does not, either high voltage is very low or there is a fault in the hold-down circuit.

High Voltage Adjustments And Hold-Down Circuits

Table 1 indicates the normal high voltage, the points to which the hold-down circuits are connected, and the type of high-voltage rectifier used. The number in parenthesis following the chassis designation gives the year in which the chassis was introduced. Several chassis were used more than one year. Several other chassis have been introduced in these same years, but they do not use the SCR deflection system.

In the table, the points to which the hold-down circuits are connected are indicated. The references to C4 and C5 refer only to Figure 1 in this article. The capacitors used in these circuit locations in actual instruments have various symbol numbers and values of capacitance.

High Voltage Regulators

With the exception of the CTC62, all of the chassis in Table 1 use a high-voltage regulator. They all are basically the same, but circuit details and the sampling points of high voltage differ. Figure 3 shows the basic circuit configuration. The variations will be discussed later.

The amplitude of the voltage at the top of C4 is, of course, proportional to the high voltage being generated. A sample of this voltage is conducted, via the high-voltage adjustment potentiometer and bleeder, to the regulator circuit. CR405 is a zener which eliminates a fixed amount of the control voltage. Whenever the control voltage exceeds the drop of CR401 and the barrier potential of Q401, the transistor will conduct. Thus, the collector current of Q401 is directly proportional to the high voltage being generated by the deflection system.

The collector current of Q401 is the control current of the saturable reactor, T3. A saturable reactor is constructed so that changes in the control current cause the inductance of the main winding to change. Thus, an **increase** in the control current causes the inductance between terminals 1 and 2 to **decrease.**

In the first article of this series, it was pointed out that the power input circuit, consisting of T1, C2 and C3, is series resonant. This allows the actual voltage across C2 and C3 to rise to nearly twice the supply voltage. Now, we see that the main winding of T3 is in parallel to T1, so that its inductance also is part of the resonant circuit. If the inductance of T3 is made greater by decreasing the control-winding current, the inductance of the series resonant circuit is increased and the resonant frequency is lowered. Therefore, the voltage across C2 will be greater when the next retrace cycle begins, and the high voltage is increased accordingly. (See waveforms A and B of Figure 3.)

Conversely, an increase in high voltage (due to changing scene content, line voltage, etc.) causes more collector current in Q401, a decrease in the inductance of T3, and an increase in frequency of the resonant power-input circuit. As illustrated in waveform C of Figure 3, this causes less voltage to be impressed across C2 at the start of the next retrace cycle, and a corresponding decrease in high voltage.

It follows that high voltage will go to maximum if Q401 is open (and the CRT current is low). In those chassis which have the hold-down transistor, the result is to drive the horizontal oscillator off frequency. Although an open regulator transistor is probably the most likely fault to cause this symptom, any other fault which cuts off Q401 will have the same effect. Shorting CR404 or opening the control winding of T3 also drives the high voltage to maximum.

Obviously, an undesired increase in the control current of T3 will drive the high voltage too low. In the earlier chassis, CTC40, 44, 46, 47, 49, 54, and 59, the supply voltage for Q401 comes from the flyback transformer. The supply impedance was high enough that shorting Q401 did not overload anything, but the high current through the control winding of T2 forced the high voltage down to about 20 KV. In later chassis, the regulator is supplied from the same source which supplies the vertical deflection system. In these, shorting the regulator transistor trips the circuit breaker.

Summary

In this installment we have seen how the SCR system is prevented from generating too much high voltage under fault conditions. Because of the nature of the system, two hold-down circuits are necessary in some chassis (a diode circuit and a transistor circuit). The table that is included shows which circuits are used in each chassis and the points to which they are connected.

Since faults in the high-voltage regulator are a logical thing to suspect when high voltage is either too high or too low, this is the next part of the system to examine. The basic operation of the regulator was presented here and some of the common failures were noted. In the next article of this series, we will consider some of the variations of the regulator and also examine the linearity and pincushion circuits. ☐

Index of 1972 content

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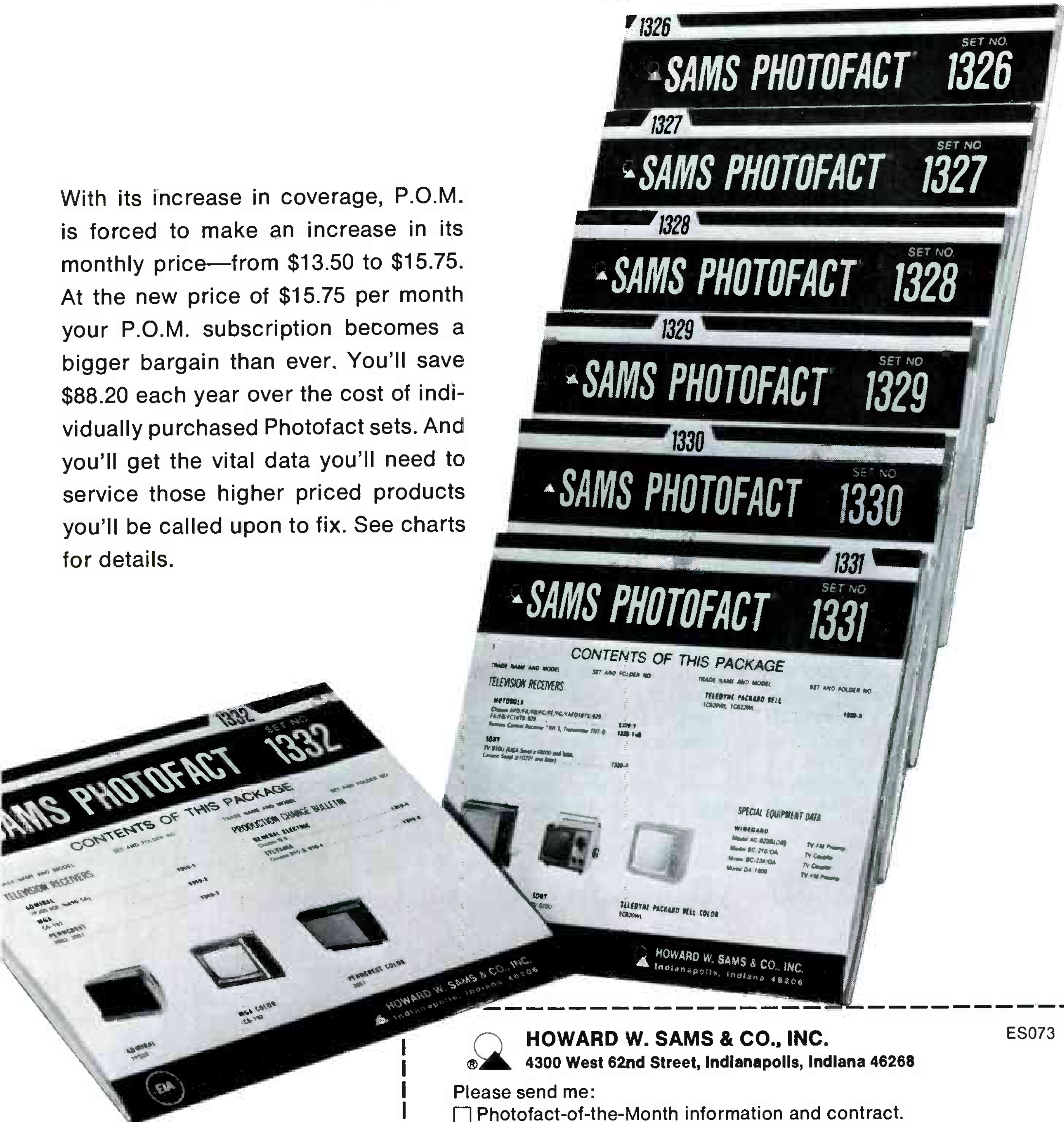

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Digital Logic Part 3

By Joseph J. Carr, CET

In the first two installments of this series, we developed the vocabulary and basic circuit elements used in digital electronics. In the final part, we will take a look at some of the circuits and actual equipment offered by digital manufacturers.

Decade Counters

One of the last circuits considered in Part 2 was the simple decade counter. That circuit is limited to simple frequency scaling because it is very difficult to design an accurate, yet inexpensive, decoder for the readout. Decoding allows us to read the "state" of the counter at that instant.

The counter circuit shown in Figure 1 allows simple decoding through the use of Binary Coded Decimal (BCD) outputs. In this numbering system each output represents a specific digit with a fixed "weight". These are arranged in a 1-2-4-8 sequence. With only these four digits, used in combination, any of the ten digits between 0 and 9 can be represented.

In a practical circuit, a digit is said to "exist" only if a positive DC voltage is present on the appropriate BCD line. If, for example, the "1" line and the "4" line were high while the other two lines were low, or grounded, the coded decimal digit represented would be 4+1=5. Through this manner we can represent all ten of the decimal digits with only four binary digits.

In Figure 2, the counter is a similar decade design that is unique to a popular IC line. This circuit, available as one IC, is part of the very popular TTL series-7400 line now being sold at rock-bottom prices through various mail-order houses as type SN7490P (called MC7490P by Motorola). Such circuits are basically "biquinary" counters because they consist of a divide-by-five stage preceded by a divide-by-two. Depending upon external connections this IC will be able to divide by two, five or ten.

The SN7490P has been the heart of many electronic counter circuits produced in the past several years. Prices on the SN7490P have fallen from well in excess of ten dollars to less than a dollar in only a couple of years. The low price of the SN7490P is a powerful incentive to use it in various useful shop-test equipment projects.

An example of a multiple divide-by-ten frequency scaler is shown in Figure 3. The upper frequency limit on such scalers is around 20 MHz. High-speed TTL IC's are available with upper limits to 50 MHz or so at a bit higher price.

The type SN7490P is not just used only for simple scaling. It may also prove very useful in a BCD-output decade counter.

Figure 4 shows one of several possible circuits for such an application. Although by no means the ultimate in decade counter design, this circuit represents an easy-to-duplicate design for relatively good performance.

In Figure 4 we see the SN7490P

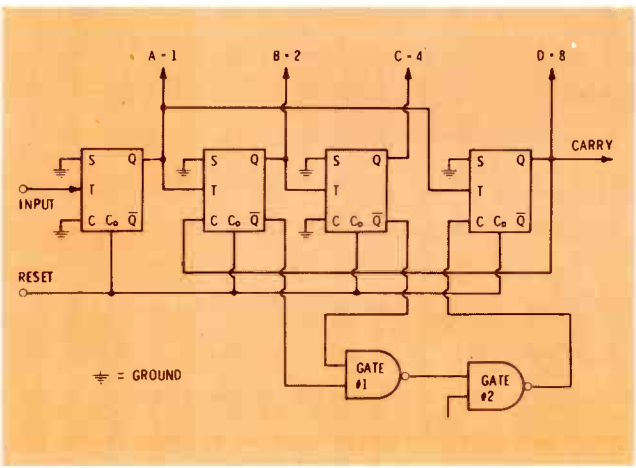

Fig. 1 Decade counter circuit designed to permit easy readout decoding. This particular design calls for BCD output using the code 1248 to represent the ten decimal digits between 0 and 9. The individual circuit elements are J-K flip-flops and NAND/NOR gates.

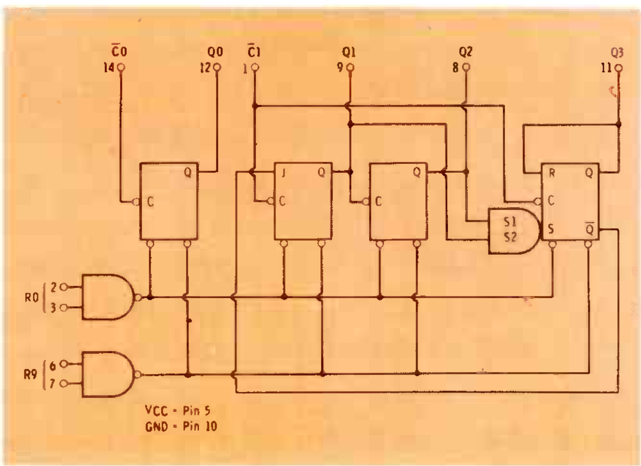

Fig. 2 Internal circuitry shown as logic symbols for the SN7490P decade counter IC. This chip is available through a number of sources including the Motorola HEP line.

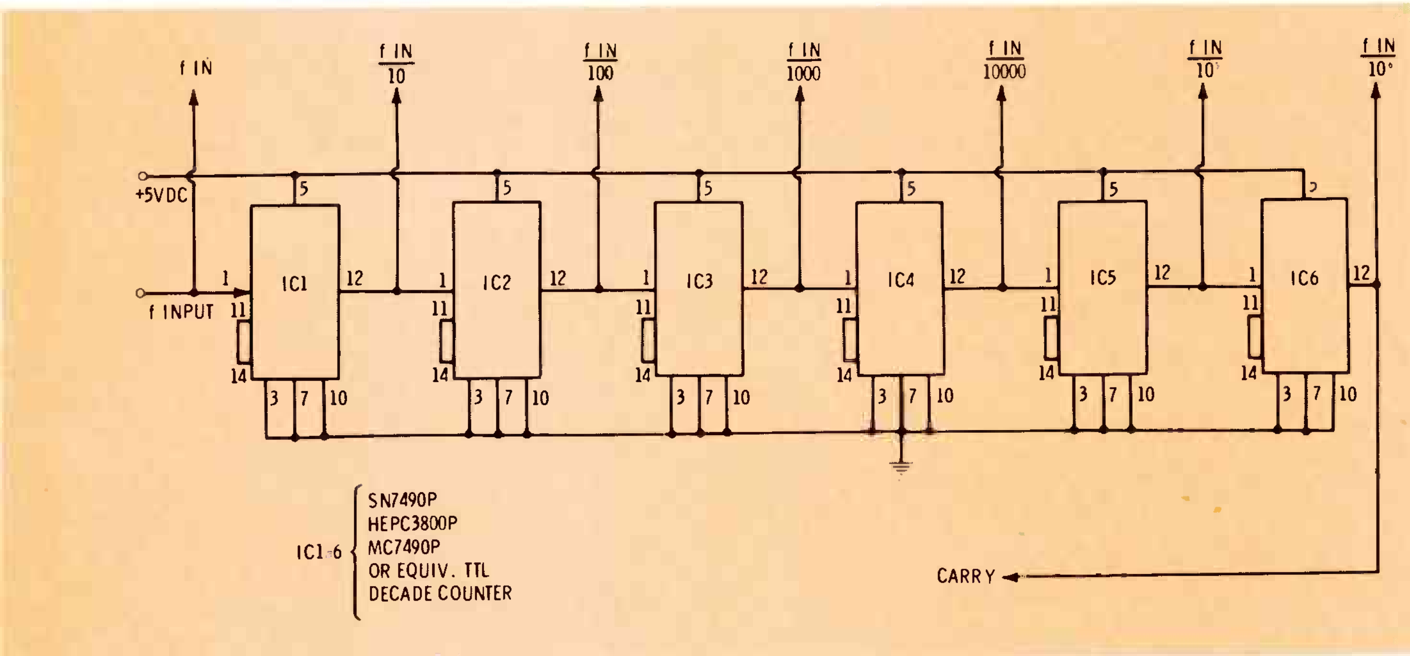

Fig. 3 A decade scaler using type SN7490P dividers. This circuit allows frequency division of five-volt squarewaves in decades up to a million-to-one ratio.

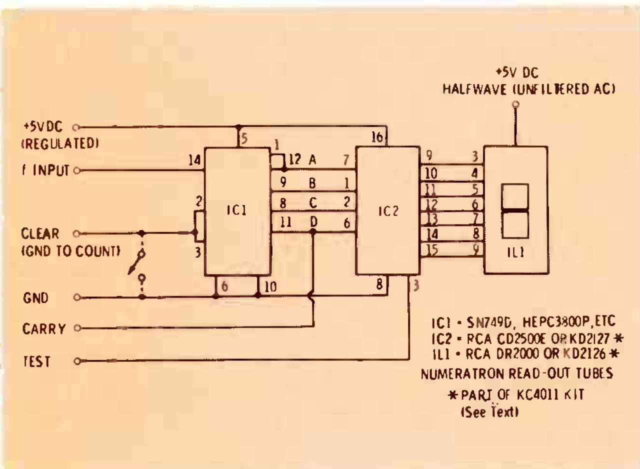

Fig. 4 Decimal-counting unit with readout using the SN7490P. The decoder IC and the RCA Numeritron readout tube are part of kit KC4011 available through RCA distributors.

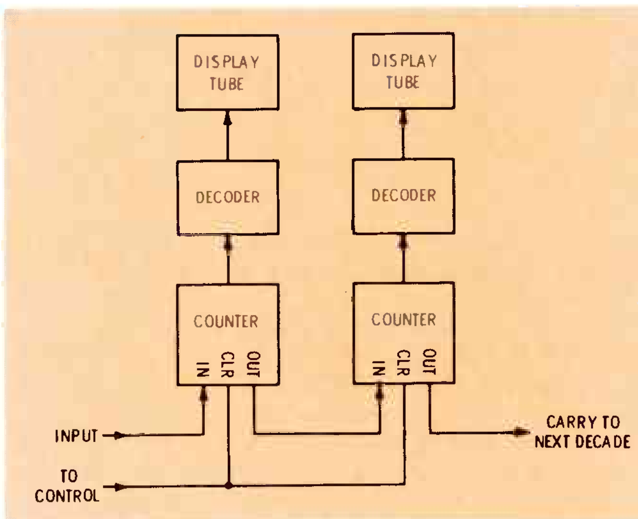

Fig. 5 General method of cascading decimal-counting units to count higher orders of magnitude.

connected in the usual decade-counting configuration. The four BCD output lines (carrying the digits 1,2,4 and 8) are connected to another TTL or TTL-compatible IC that has the designation "BCD to Seven-Segment Decoder".

Although this is only one of many possible decoder IC's that are usable, the author has chosen this number, the RCA type CD2500E/KD2127, because it is easily available through those RCA distributors who carry the SK semiconductor line. The IC is part of a digital display kit (part number KC4011) that includes the decoder and a "Numeritron" seven-segment readout tube. These tubes have seven incandescent filaments arranged in a "square-figure eight" pattern (see IL1 in Figure 4). These segments can be illuminated to form all of the digits between 0 and 9 plus

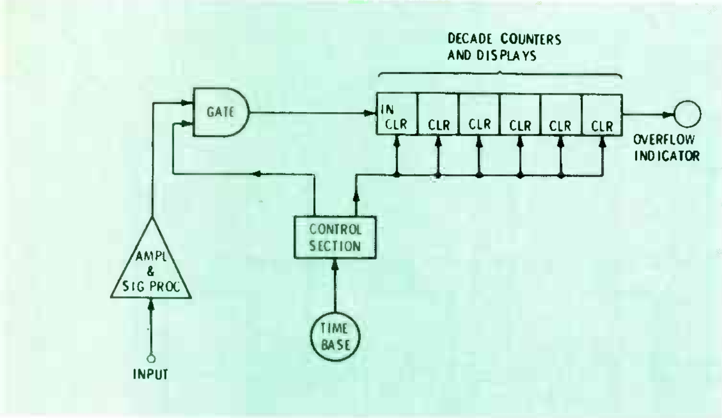

Fig. 6 General block diagram of a frequency counter.

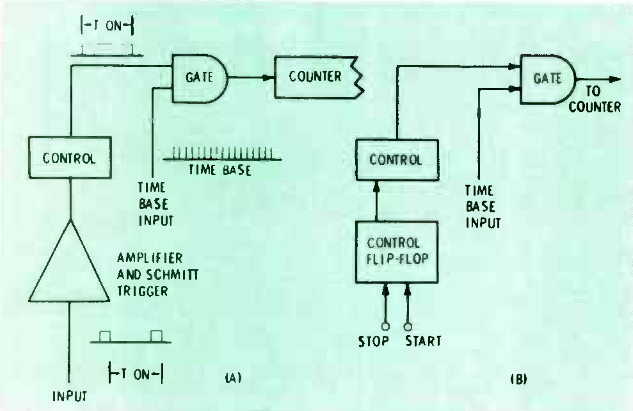

Fig. 7 General block diagram of a period counter.

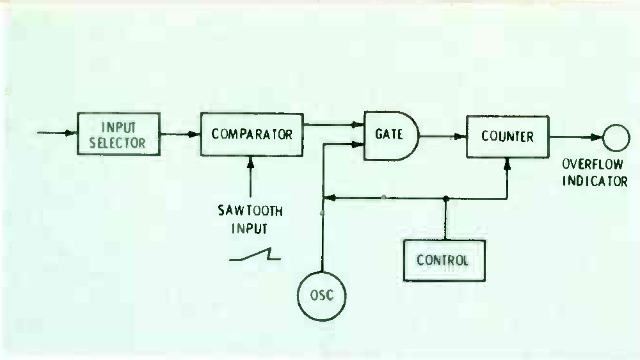

Fig. 8 General block diagram of a low-cost digital voltmeter. Counter registers the number of pulses that are generated by the reference oscillator during the time when a sawtooth begins and when it reaches a level equal to that of the unknown voltage.

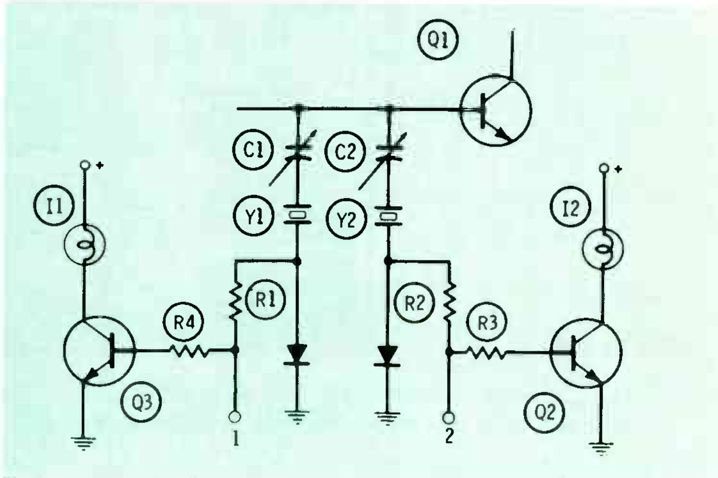

Fig. 9 Front-end local-oscillator circuitry of a VHF scanner receiver. The proper crystal is grounded when a positive DC voltage is applied to the switching diode.

several alphabetical characters. They are housed in 9-pin miniature glass envelopes.

When an appropriate input signal is fed to this stage, the 749OP IC will count. The CD2500E continuously will examine the four output lines and quickly decipher their states also on a continuous basis. Such stages can be cascaded so that higher orders of magnitude can be counted.

In a typical arrangement (see Figure 5), the input of the second counter will be connected to the output of the first. (The output, by the way, is often called the "carry".) Separate decade counters will be used for the units, tens, hundreds, thousands, and so forth. More expensive high-frequency counter circuits offer from five to eight decades with readouts. If the IC's are fast enough, an eight-digit counter will count without overflowing up to 99,999,999 Hertz (that's just one Hertz short of 100 MHz).

Control Circuitry

Typical control circuitry for a frequency counter is shown in Figure 6. The decade counters and display sections are similar to those of Figures 4 and 5. A gate circuit is used to allow the input signal into the counter for a precise amount of time. This makes the counter an Events-Per-Unit-of-Time (EPUT) device. EPUT, of course, is frequency. The front end of the counter is taken up by amplification and signal processing. The decade counter likes to be fed by square waveforms, while the signal from the outside world will be anything but square. To overcome this problem, the signal is amplified then fed to a Schmitt trigger in the signal-processing circuit.

Timing in an EPUT counter is a function of the control circuit and the time-base section. The function of the control circuit is to clear the decade counters and open the gate in response to commands from the time-base circuit. The time base is merely a crystal oscillator, such as the type we saw in Part 2, operating as a "clock". In most frequency counters, the crystal will operate at a frequency of either 1 or 4 MHz. This frequency will be divided down to whatever is required for the job at hand.

A common arrangement is to use a 1-MHz crystal divided by decade counters to 1 Hertz, so that the gate can be turned on for intervals of precisely one second. More-expensive counters allow a selection of time-base intervals by using a switch to tap off the signal at the respective junctions of the decade counters.

Other Counters

EPUT is not the only type of counter available. There are others that are more suitable for certain applications. One of these is the totalizing counter. Other categories include both period counters and a related type called the electronic stop watch.

In a totalizing counter, there is no gating at all. The gate is turned on permanently. The counters will accumulate all input pulses until told to cease by being turned off or reset. An example of an analog totalizing counter is the electrical power watt-hour meter outside of your building.

In the period counter, the input signal is used to turn the gate on and off. The counter is actually used to count the pulses from the time-base circuit as illustrated in Figure 7. An initiating event from the input amplifiers will cause the control circuit to turn on the gate. A second event, arriving at a later time, will cause the control circuit to turn off the gate. In the meantime the counters have been tallying the pulses generated by the time-base circuit. If, as an example, the time base is supplying a 1000-Hertz signal, the counter will see 1000 pulses per second. This means that each successive pulse represents 1 millisecond. If the counter receives, say, 453 pulses between the times when it receives start then stop commands, the two events which generated those commands were 453 milliseconds apart.

An alternate system, shown in the inset of Figure 7, is to use external switches to start and stop the action of the counter. In reality, of course, those switches are pulses from one-shot multivibrators used so the bad effects of switch-contact bounce are eliminated. When wired in this manner, the counter can act as an electronic stop watch.

Digital Multimeters

Figure 8 shows the block diagram of the approach taken by some manufacturers of low-cost digital voltmeters. In this design, the counter totals the output of an internal reference oscillator. The signal is fed into the counter through a type of comparator circuit. One input to the comparator is the unknown DC voltage being measured while the other is the locally-generated sawtooth (ramp). The sawtooth is linear, and has a set duration.

The counter is used to count the number of local reference-oscillator pulses that are produced between the initiation of the ramp function's upward slope and the point where it's amplitude matches that of the unknown DC voltage. When this level is reached the counter display tubes show a number that is proportional to the unknown voltage. If the sawtooth is linear and has the proper duration and if the correlation between local-oscillator frequency and some known and approved unit of voltage is correct (milliseconds to millivolts is popular) then the readout can be made directly with no need for any interpolation from a chart.

Multichannel Scanners

The current trend in VHF monitor receivers is toward crystal-controlled multichannel scanner designs. In these receivers, a digital logic scan circuit causes the receiver sequentially to sample all of the channels for which the set has provided crystals. These receivers have found great popularity especially where it is deemed necessary, advisable, or interesting to monitor several channels at the same time.

Figure 9 shows how the local oscillator in the front end of the VHF receiver might appear. In a typical receiver there might be upwards of eight crystals for as many channels. This particular design uses diode switching, but others might substitute transistor switching. When a positive DC voltage is applied to either point 1 or point 2 the respective diode will be forward biased creating a short to ground

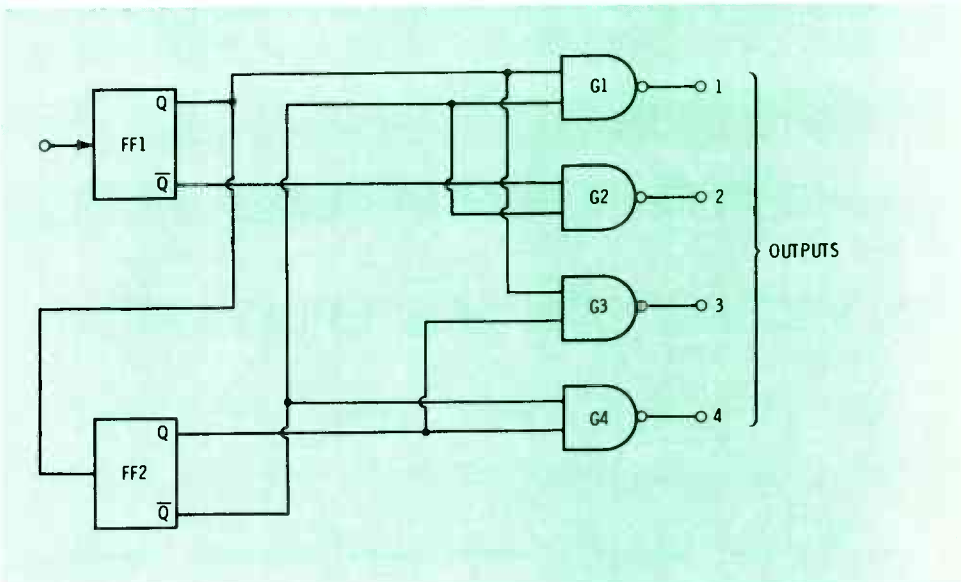

Fig. 10 Logic circuitry for a sequential scanner used with a circuit such as in Figure 9.

for that particular crystal. Whenever a particular control line has a voltage applied, the crystal tied to that line will have control over the receiver.

An additional line, branching from the control line, will cause a transistor to conduct and turn on a lamp that indicates which channel is being scanned.

The RF amplifier in these type receivers must, of course, be either broadly tuned or voltage tuned. In the latter case a separate potentiometer for each channel would be used to peak up the RF tuning for that channel.

This concept, by the way, eliminates one major problem that plagued all early scanner designs. Those receivers required all channels to be within five to ten megaHertz of each other. In modern designs, however, it is possible to cover a much wider portion of the spectrum. In fact, one model uses two separate front ends with appropriate switching. You can have it set up for either low- and high-band VHF or high-band VHF plus UHF.

The basic design of the logic section for a four-channel scanner is shown in Figure 10. This circuit uses two J-K flip-flops and four NAND gates. The first, or input, J-K FF is used to drive the second. The two complementary outputs of FF1 are designated "Q1" and "$\overline{Q1}$", while the outputs of FF2 are designated "Q2" and "$\overline{Q2}$". Figure 11 shows the waveforms appropriate to this circuit. The two respective waveforms from each flip-flop are, of course, inverted with respect to each other. The frequency of the second output is exactly one half that of the first.

Remember that the NAND gate will give us a high-output level only when both inputs are at a ground potential low state. During period T1, only Q1 and $\overline{Q2}$ are low; all other lines are high. We can, therefore, use this combination to fire gate #1. This will, in turn, fire the diode connecting the proper crystal to ground and will energize the transistor that ignites the proper indicator lamp or Light Emitting Diode (LED) for that channel. At period T2, both $\overline{Q}$ lines are low while the others are high. In period T3 we can similarly use Q1 and Q2. During the fourth period we can use both of the FF2 outputs to fire gate #4. One of the interesting things about digital electronics is that most circuits, even those that appear complex, can be figured out using graph paper or a straightedge to map the waveforms.

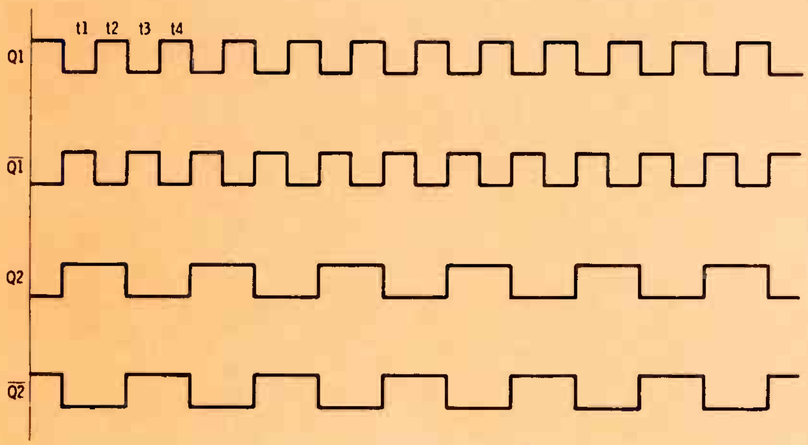

Fig. 11 Flip-flop waveforms for the circuit of Figure 10.

Servicing Digital Electronics

Digital electronics servicing generally requires less equipment than does even the simplest of TV service. Of course, a VOM or VTVM is helpful. Of critical importance, however, is a good triggered-sweep oscilloscope with a vertical amplifier bandpass high enough to prevent deterioriation of the pulse waveforms at the highest pulse repetition rate anticipated. Most of the modern 10-MHz-or-better TV service scopes will be sufficient for servicing all but the fastest digital circuits. If feasible, the oscilloscope used by the digital electronics technician should be a dual-trace type. Since so many defects could result from the failure of two events to coincide (gate openings, etc.) it is helpful to be able to view two traces simultaneously.

You can expect to see an increasing number of digital devices in your service work. Such circuitry has already invaded the consumer-equipment world, and can be expected to make even more headway in the future. You can also expect to see certain devices that were formerly the province of the so-called industrial-electronics technician. As the industry expands many smaller companies that cannot support an effective field service group enter the field. These companies will either turn to existing shops at the local level or face the unpleasant possibility of competitive disadvantage by maintaining only "ship back" service! **You** can make extra profits servicing this equipment, if you understand how the circuits operate. ☐

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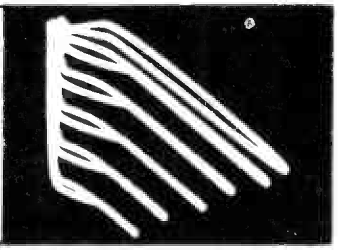
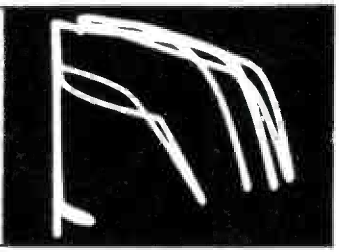
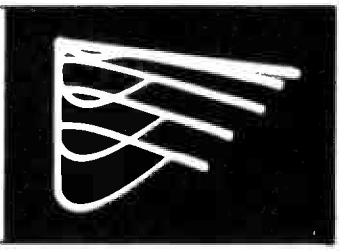
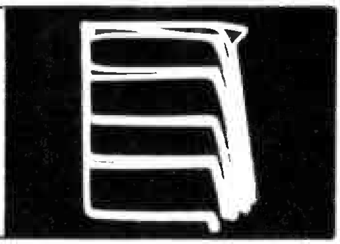
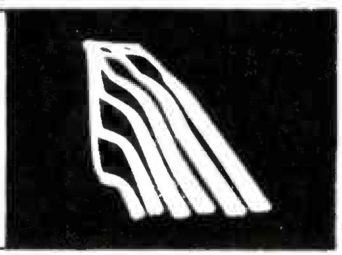
Q1P 1ST INT **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 20 uA	
Q2P 2ND INT **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 100 uA	
Q3P AND GATE **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 20 uA	
Q4P AND GATE **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 20 uA	
Q1 1ST COLOR IF **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 20 uA	

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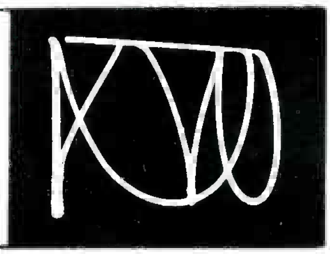
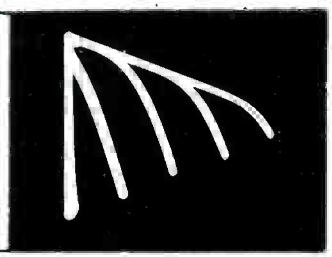
Q2 2ND COLOR IF **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 20 uA	
Q3 2ND VIDEO **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 100 uA	
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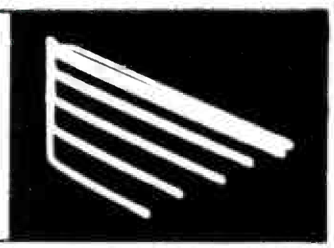
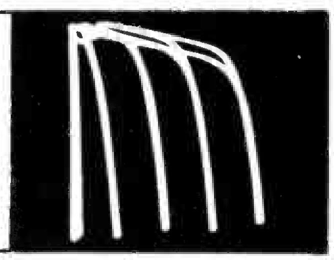
Q5 PULSE INVERTER **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 20 uA	
Q6 BURST GATE **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 20 uA	

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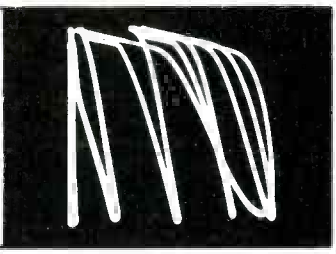
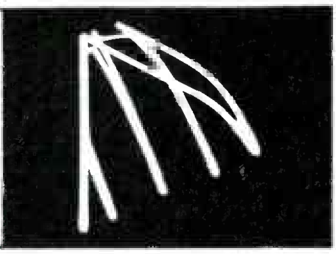
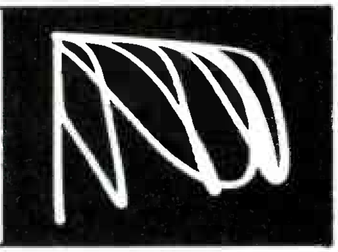
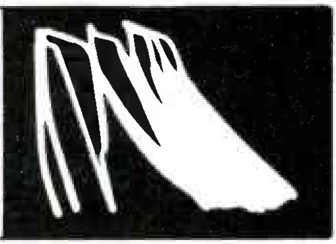
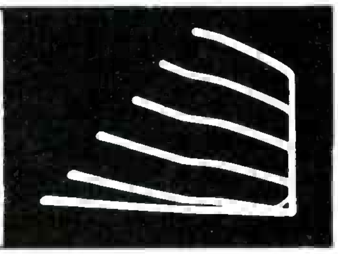
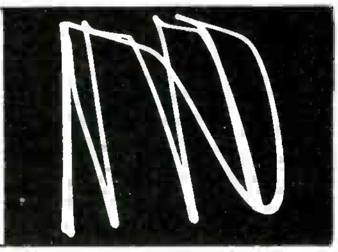
Q7 XTAL DRIVER **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 50 uA	
Q8 XTAL AMP **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 50 uA	
Q9 ACC amp **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 10 uA	
Q10 XTAL OSC **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 50 uA	
Q11 COLOR KILLER **POLARITY** PNP **SWEEP VOLTAGE** 30 V **BASE CURRENT** 10 uA	
Q12 PHASE SPLITTER **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 50 uA	

MANUFACTURER MOTOROLA	MODEL OR CHASSIS CA29D PANEL
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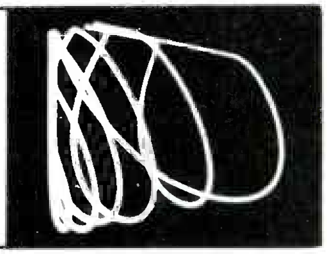
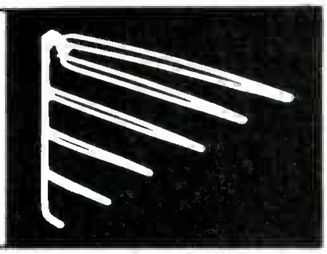
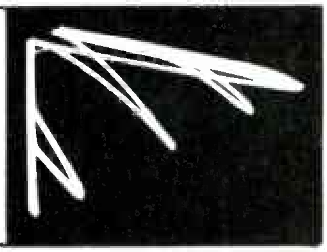
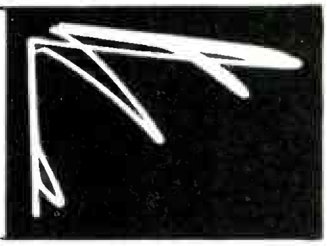
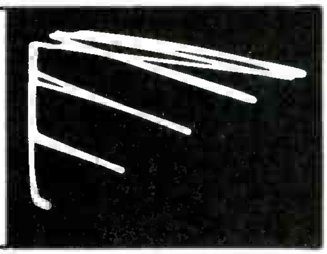
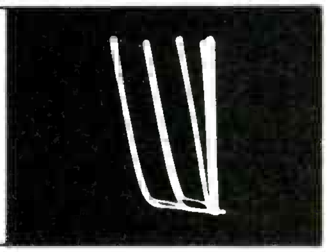
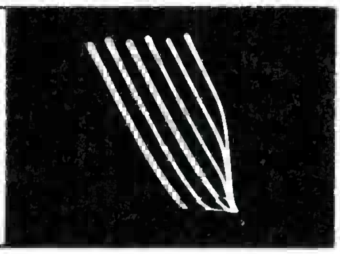
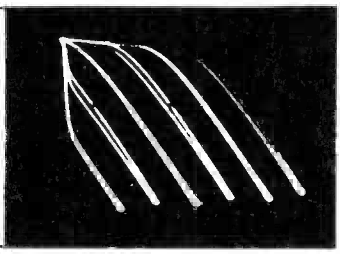
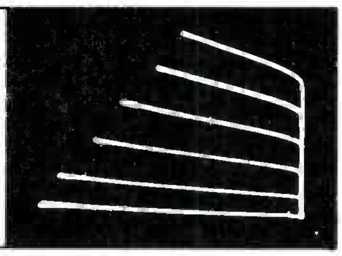
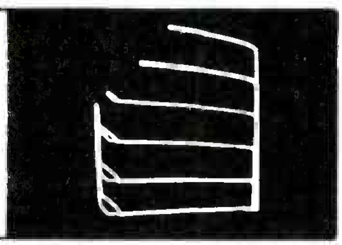
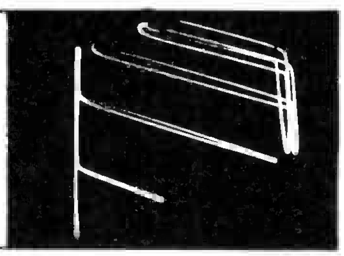
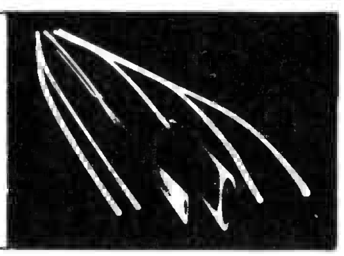
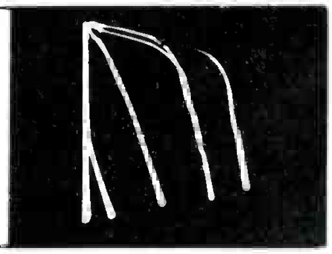
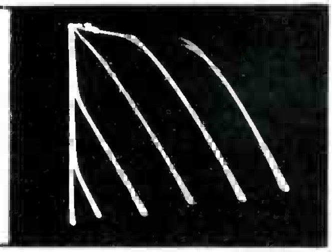
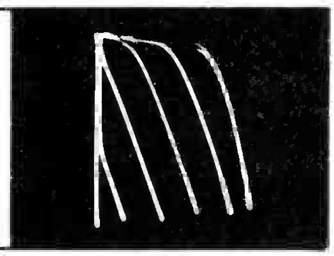
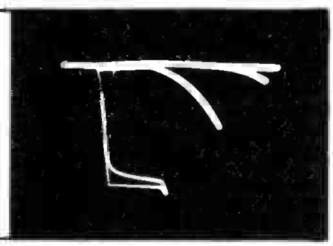
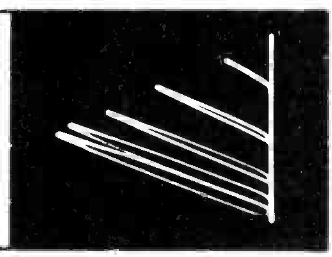
Q13 PHASE SHIFTER **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 10 uA	
Q14 LIMITER **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 10 uA	
Q15 BLUE VIDEO **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 50 uA	
Q16 GREEN VIDEO **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 50 uA	
Q17 RED VIDEO **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 100 uA	
Q18 SYNC & AGC **POLARITY** PNP **SWEEP VOLTAGE** 30 V **BASE CURRENT** 100 uA	

MANUFACTURER MOTOROLA	MODEL OR CHASSIS BA15 PANEL
TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	**SIGNATURE PATTERNS**
Q1 RF AGC **POLARITY** PNP **SWEEP VOLTAGE** 30 V **BASE CURRENT** 20 uA	
Q2 AGC AMP **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 20 uA	
Q3 AGC GATE **POLARITY** PNP **SWEEP VOLTAGE** 30 V **BASE CURRENT** 10 uA	
Q4 AUDIO DRIVER **POLARITY** PNP **SWEEP VOLTAGE** 30 V **BASE CURRENT** 10 uA	
Q5 AUDIO OUTPUT **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 50 uA	
Q6 1ST IF **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 100 uA	

MANUFACTURER MOTOROLA	MODEL OR CHASSIS BA15 PANEL
TRANSISTOR IDENTIFICATION & CURVE TRACER SETTINGS	**SIGNATURE PATTERNS**
Q7 2ND IF **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 200 uA	
Q8 3RD IF **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 200 uA	
Q9 1ST VIDEO **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 50 uA	
Q10 AUDIO AMP **POLARITY** NPN **SWEEP VOLTAGE** 30 V **BASE CURRENT** 100 uA	
Q11 AUDIO OUTPUT **POLARITY** PNP **SWEEP VOLTAGE** 30 V **BASE CURRENT** 50 uA	
POLARITY **SWEEP VOLTAGE** **BASE CURRENT**	

Advanced servicing for CB radio part 2

Learning about typical difficulties and adjustments takes the mystery (and non-profit) out of CB transmitter repairs.

By Forest H. Belt

Once you own the quality test equipment described in the first of this three-part series, the only thing between you and profitable CB servicing is knowledge. Or maybe, lack of it. The transmitter gives CB-service newcomers more aggravation than the receiver. It shouldn't. The transmitter, even for single-sideband, is simple.

This second installment concentrates on commonly misunderstood portions of modern CB transmitters. These include the frequency synthesizer, the balanced modulator for single sideband, the final stages of the transmitter and their tuning, and how to "load" a CB transmitter into its antenna. None of these is difficult to understand. But lack of information and a flood of misinformation have left the uninitiated wondering.

Emphasis rests on using that top-grade test equipment to examine what's happening in a section or stage. This approach expands your knowledge of transmitter operation. You can see the effects of troubleshooting or adjustments. Your goal is quick diagnosis and correction of whatever fault exists. That's the road to profit in CB servicing.

Building RF Power

CB radio communication requires that an RF signal be generated and modulated. The transmitter must then build up the modulated RF signal before the electromagnetic waves are radiated by the antenna.

Some CB transmitters handle the entire RF job with a mere three transistors. Others, such as in Figure 1, use more transistors and don't work them so hard. You have more adjustments to worry with, but they're less likely to need frequent attention.

Operation is straightforward. The RF signal, already at transmitter frequency in the second synthesis mixer, gets resonant boost from T8. Two RF amplifiers, Q24 and Q25, with interstage transformer T9, supply voltage amplification.

T10 couples the signal to driver Q26. The primary of T11 is in the Q26 emitter circuit. This connection tells you that Q26 offers current amplification along with voltage amplification resulting in power amplification. The final stage, too, is common-collector (emitter follower), signifying power gain.

Notice the B-plus connection for the Q26 and Q27 collectors. They go to "modulated B-plus" instead of to a regular DC line. That means the DC voltage for both power amplifiers has the modulator transformer in series. Audio power thus modulates the collectors of the two transistors while RF power drives their bases.

Modulating two stages this way—rather than just one as in older amplitude-modulation (AM) trans-

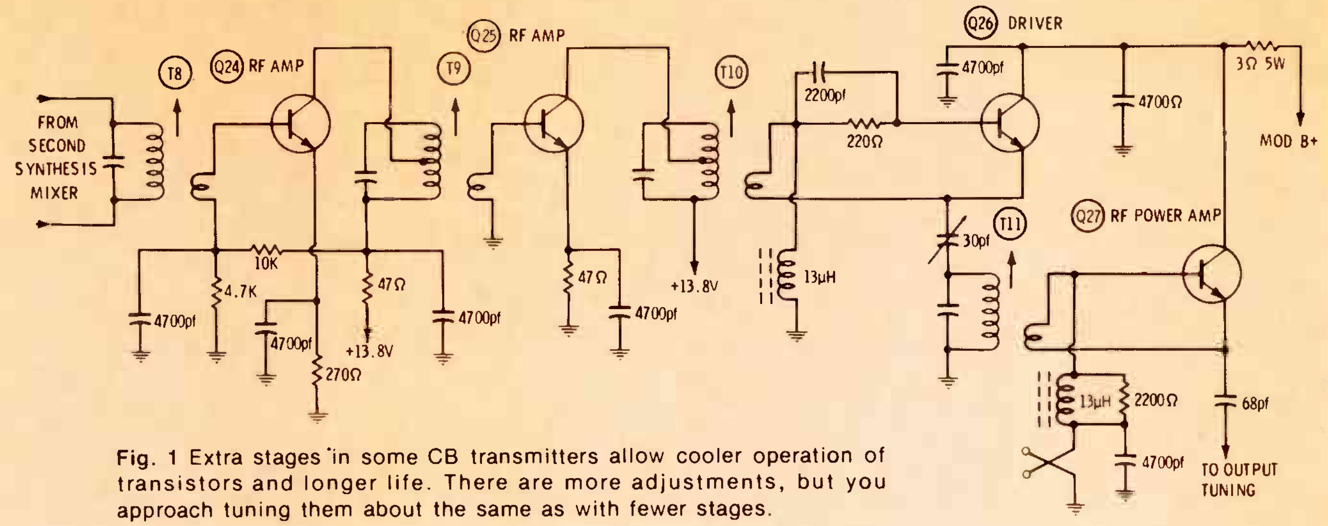


Fig. 1 Extra stages in some CB transmitters allow cooler operation of transistors and longer life. There are more adjustments, but you approach tuning them about the same as with fewer stages.

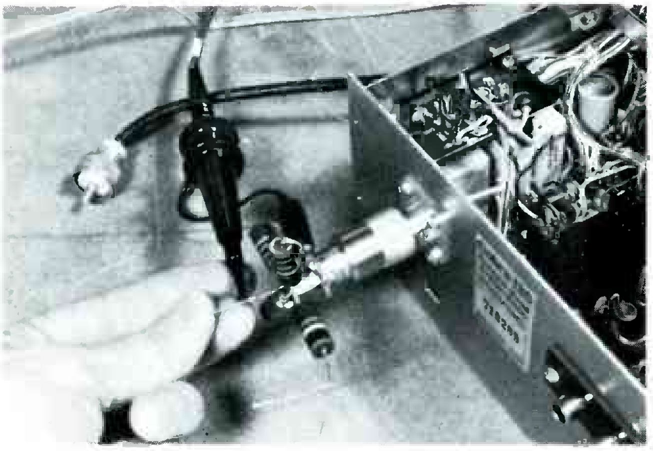


Fig. 2 Your homemade dummy connector (building instructions in first installment) makes a convenient place to connect your scope.

Fig. 3 Readout shows zero on the frequency counter when there's no input. Keying the transmitter, with input hooked to outer tip of 10K resistor in homemade dummy load, causes frequency to appear.

Fig. 4 Citizens radio RF signals on the screen of a 30-MHz scope.

(A) Clean RF signal; no distortions, no modulation.

(B) 1000-Hz modulation, at 100%

(C) Modulation at 50%

mitters—delivers greater modulation efficiency. But this high/low modulation technique also introduces a trouble possibility that can't develop in simpler designs. Let's go through an alignment procedure and see what happens.

Connect your dummy load (described in Part 1) at the output connector (Figure 2). Clip the ground lead of the 30-MHz scope to the dummy-load shell. The scope probe goes to the center wire of the dummy load. That puts the scope vertical input across the transmitter output. Set the scope input attenuator for 5 volts per division. Set time base at about 500 microseconds per division. Triggering can be left on Internal Automatic, so you see a base line even when there's no input signal.

Also connect your frequency counter to the dummy load. Clip its probe to the tip of the 10K resistor. That reduces counter input and prevents overloading.

T8 through T11 should all be peaked for maximum RF transfer near the center of the twenty-three CB frequencies. Channel 12, at 27.105 MHz, is about the center.

Key the transmitter (push the mike button). Note frequency on the counter (Figure 3). It should not register above 27.1063 nor below 27.1037. That's because the tolerance is .005%, which comes out to about 1300 Hz. That much above 27.105 MHz or that much below is all the FCC rules allow.

If the transmitter crystals have

Fig. 5 Key the microphone with the same hand that holds the 1000-Hz signal-injection speaker. You can tune coils with your other hand. Modulation helps you see what's really happening to signals in the transmitter, and reveals troubles that occur.

trimmers, even 1300 Hz is too much. You should be able to correct the frequency to within 200—300 Hz. Then the counter might read as high as 27.1053 or as low as 27.1047.

If crystals are not adjustable, you can only record the actual frequency on the frequency sheet. A crystal that produces a signal further from the assigned frequency than 1300 Hz must be replaced.

One important point, if the transceiver is a combination AM/SSB unit: a knob on the front panel allows slight frequency warping, to help clear up voices in the single-sideband mode. It's called Voice Lock, Clarifier, or some such label. This control affects frequency in the AM mode too. Make sure it is set fairly near the center of rotation when you check frequency. Otherwise, the frequency could appear off as much as 600 Hz.

Next, look at the scope screen, but don't modulate the transmitter. The RF signal should be clean as in Figure 4A. If the band of RF is too thick, increase the scope voltage-per-division setting. If too thin, decrease the setting.

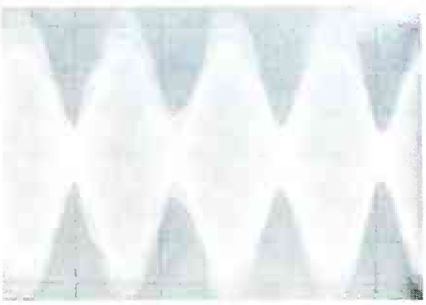
Feed at least 1 volt of audio signal to a 2-inch speaker. Hold the speaker over the microphone as shown in Figure 5. You can key the mike as you hold the speaker in this position, modulating the transmitter with the 1000-Hz signal.

The scope display should now look like Figure 4B. Vary the audio generator output up and down for exactly 100% modulation. That's when the top sine envelope just meets the bottom one in the RF waveform. (Figure 4C shows what 50% modulation looks like.)

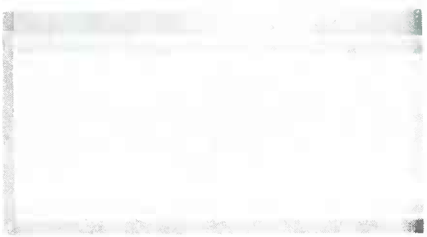
With the mike on and with modulation, adjust the cores of T8 throuth T11. Try for maximum height of the pattern on the scope. If you upset the adjustment of the modulated stages, you may get the distorted pattern of Figure 6A. Here is where the scope is indispensable. You couldn't see this upset on an RF wattmeter. Nor would it be visible without modulation, unless it became very bad (Figure 6B). You couldn't hear it on another receiver transceiver, except perhaps as mildly distorted modulation.

Even here you can't "see" all the

Fig. 6 Scope waveforms expose parasitic oscillation caused by maladjustment of coils in transmitter RF amplifiers. You couldn't detect this kind of fault with a wattmeter—only with the scope.



(A) Slight misadjustment upsets modulation envelope.



(B) Strong parasitic shows up even without modulation.

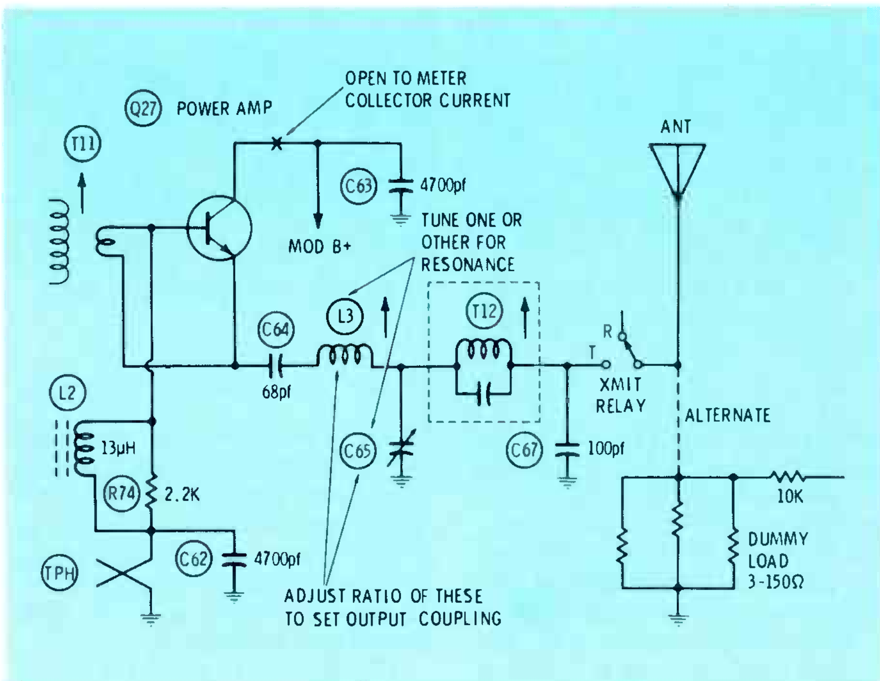


Fig. 7 Tuning the final amplifier and the output coupling are the two most-misunderstood adjustments CB servicing offers. You DO NOT tune either adjustment to cure high VSWR on the antenna line; that can only be cured by adjusting the antenna or fixing whatever difficulty has developed in the transmission cable.

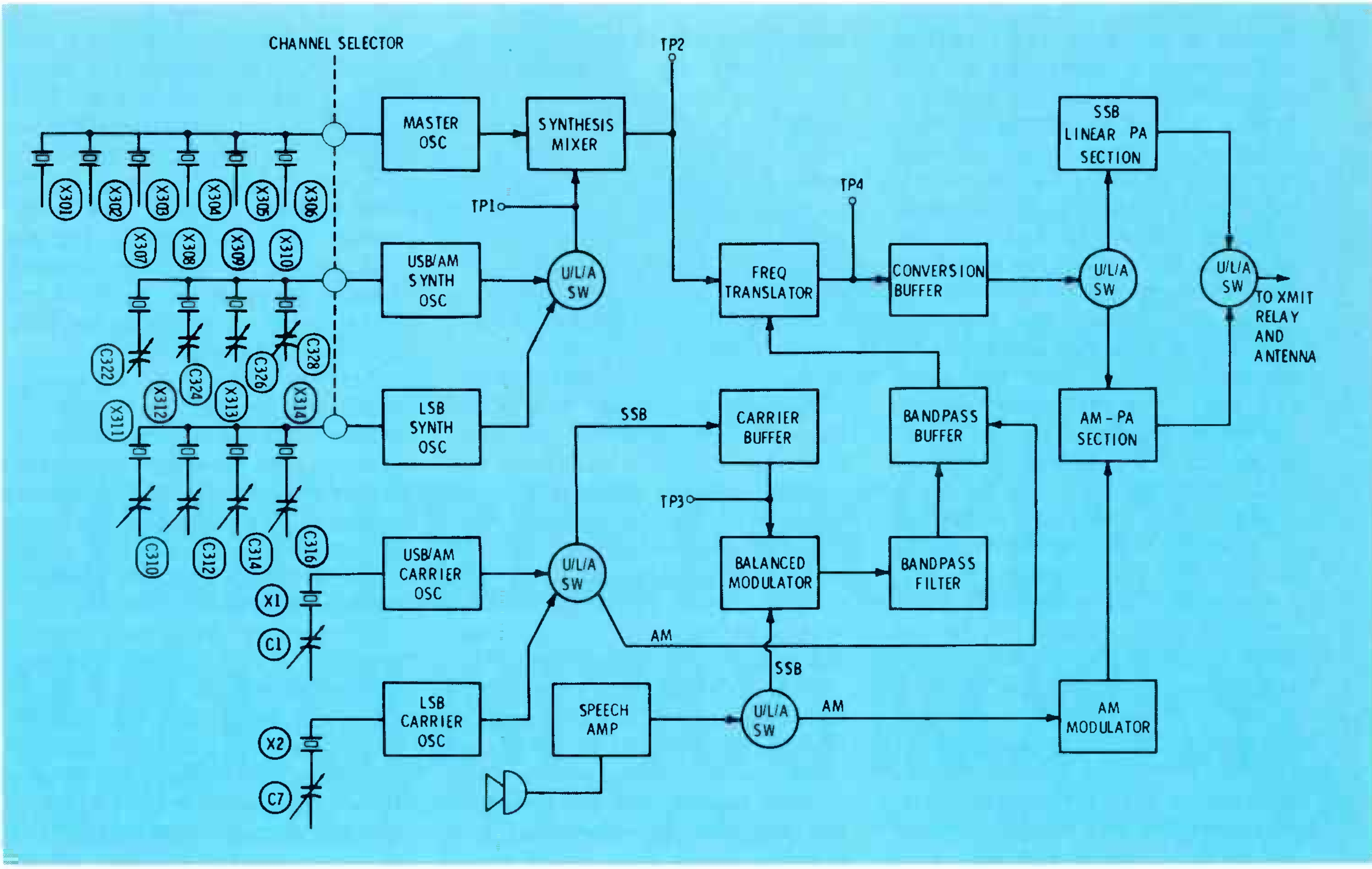


Fig. 8 Frequency synthesizer combines signals from a few crystals to produce transmit (and receive) frequencies to cover entire CB spectrum. Crystals in two of the three oscillators are tunable. So are the crystals that control the two carrier oscillators.

trouble being caused. Spurious RF radiations result from parasitic oscillations like this. They interfere all over the band and can even cause disruption to other communications services. Radiations such as this maladjustment cause are highly illegal—yet you wouldn't notice them unless you were running a panoramic analyzer (or happen to be the party interfered with).

With the 30-MHz scope, you can see your adjustment effects. Result: an easy job of transmitter alignment.

Loading Out the Transmitter

The final transmitter stage, the one that gives the RF its main power boost, introduces unique tuning procedures. The stage itself must be carefully tuned for peak efficiency. And then, the load (antenna or dummy load) must be critically coupled to the stage; otherwise, maximum power transfer can't be achieved.

The FCC adds a couple more requirements. The rules for CB say DC input to the final stage must not exceed 5 watts. In another approach to the same limitation, the rules forbid output RF power to exceed 4 watts. Hence, even if the transmitter can put out more than 4 watts RF, you must limit its output to that amount by your adjustments. Exactly how this is done goes widely misunderstood by communications neophytes.

There are two major steps. The first is called **PA (power amplifier) tuning.** In this step, you adjust the tuned tank in the collector or emitter circuit for exact resonance. You can detect this point by a **dip** in DC collector current. Or, you can tune for maximum RF output. Remember, though, you are adjusting only the tuned-circuit that is part of the RF output stage itself.

The second major step is **output loading.** Coupling to the antenna (or dummy) can be tight or loose. If loose, only some of the RF power in the output stage reaches the load. Tightening the coupling (increasing the loading) sends more of the available RF energy to the load. In CB transmitters, loading is adjusted most commonly by varying the **ratio** of inductance to capacitance in the output-tuning circuit.

As an example, look at Figure 7. L3 and C65 form the resonant tank for Q27 in the emitter circuit of Q27. (Ignore T12; it's a TVI trap.) The collector is grounded for RF by C63. You adjust L3 and C65 for resonance at the center of the Citizens Band (about 27.1 MHz).

This first adjustment is best made with antenna (or dummy) disconnected. Connect a DC milliammeter in series with the collector. The schematic shows where to break the wiring and insert the meter. Adjust C65 for a **minimum** milliammeter reading. This is called "dipping the final." With no load connected, the dipped reading

TABLE 1 - CRYSTAL FREQUENCIES AND PURPOSES

Adjustment	Crystal	Frequency	Channels Covered
		MASTER OSCILLATOR	
None	X301	11.705 MHz	1 - 4
None	X302	11.755	5 - 8
None	X303	11.805	9 - 12
None	X304	11.855	13 - 16
None	X305	11.905	17 - 20
None	X306	11.955	21 - 23
		UPPER-SIDEBAND/A-M OSCILLATOR	
C322	X307	7461.5 kHz	1, 5, 9, 13, 17, 21
C324	X308	7471.5	2, 6, 10, 14, 18, 22
C326	X309	7481.5	3, 7, 11, 15, 19
C328	X310	7501.5	4, 8, 12, 16, 20, 23
		LOWER-SIDEBAND OSCILLATOR	
C310	X311	7458.5 kHz	1, 5, 9, 13, 17, 21
C313	X312	7468.5	2, 6, 10, 14, 18, 22
C314	X313	7478.5	3, 7, 11, 15, 19
C316	X314	7498.5	4, 8, 12, 16, 20, 23
		CARRIER OSCILLATORS	
C1	X1	7798.5 kHz	Carrier osc for upper sidebands and a-m
C7	X2	7801.5	Carrier osc for lower sidebands

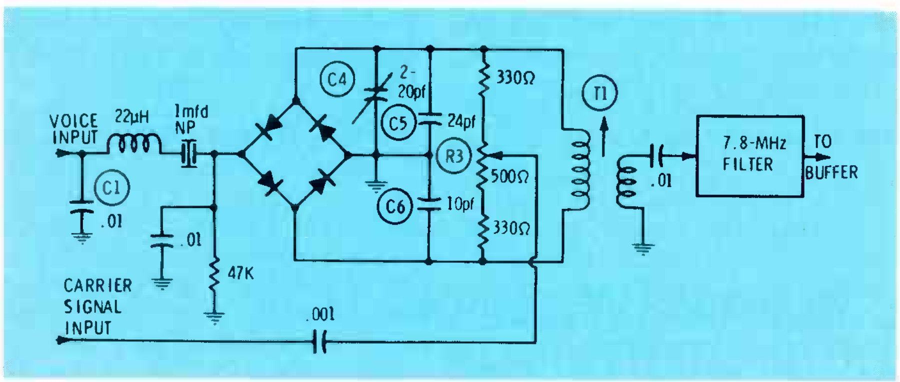


Fig. 9 Balanced modulator accepts carrier RF and microphone audio, and turns out double-sideband suppressed-carrier signal. Filter that follows does away with one of the sidebands—which one depending on what crystal furnishes the original carrier.

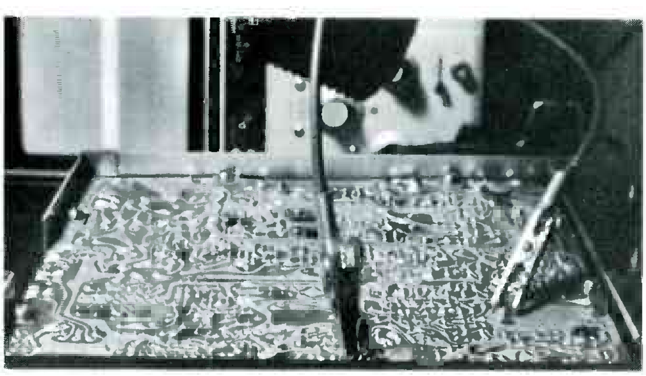


Fig. 10 Scope waveforms are your best clue to how much RF is being allowed to creep through the balanced modulator. When the adjustments are ALMOST right, the amount is too small to appear on a wattmeter. Use sensitive position of scope input attenuator.

Change the mode switch to LSB. The counter should read 7.80150 MHz from the LSB carrier oscillator, controlled by X2. If not, adjust C7.

Finally, measure output frequency at Test Point 4. Or, clip the counter probe to the dummy load and key the transmitter. Mode should be AM, and the Voice Lock (or Clarifier) knob approximately centered. Output frequency for Channel 1 should read 26.9650 MHz. For the FCC rules, upper acceptable limit would be 26.9663; lower limit, 26.9637.

Suppose you want to check output frequency in the lower sideband mode? It's not necessary. You've covered this indirectly already. But here's how. Set the channel selector at 12 (for example). Put Mode in LSB. Check the frequency of your audio generator with the counter probe: set the generator dial for precisely 1000 Hz. Feed the audio signal into the microphone (Figure 5) and key the mike. Across the dummy load the counter should indicate an accurate 27.1040 MHz. That's the lower-sideband RF generated by 1000-Hz modulation; it's exactly 1 kHz (0.001 MHz) below the assigned frequency for CB channel 12, which is 27.105 MHz.

The Voice Lock control should vary the output frequency over a range of several hundred kilohertz. Hence, at an AM frequency of 27.105 MHz, you can make the counter vary from about 27.1047 to about 27.1053 by turning the Voice Lock knob. If the range is less, adjustments inside let you correct it. The most important thing is the center position, which should leave the frequency right where it belongs—at the assigned frequency. The Voice Lock knob is used mainly during reception of CB signals, but you test it in the transmit function.

Modulating Single Sideband

Any mystery of this modulation system derives more from lack of understanding than from complexity. First, a balanced modulator (Figure 9) develops a double-sideband-suppressed-carrier signal from an RF carrier and a voice (audio) signal. The balanced/unbalanced inputs let the balanced output extract the two amplitude-modulated sidebands but cancel the carrier. Then, a sideband filter eliminates one sideband. Which one depends, not on the filter itself, but on the frequency the carrier was. Hence the two carrier oscillators—one for USB and one for LSB (Figure 8).

Adjustment of the balanced modulator goes far easier than the uninitiated might suspect. There are two adjustments, C4 and R3, both of which eliminate or balance out the carrier. T1, on the other hand, is adjusted for **maximum** SSB output, **with modulation.** Here's the procedure.

Complete all the AM-mode transmitter adjustments first. Then switch to the LSB mode. Feed in an accurate 1000-Hz modulating signal (Figure 5) and key the transmitter. You'll see a regular RF signal on the output scope, similar to Figure 4. Adjust T1 for maximum RF output. This must be done **with** modulation, otherwise there's no signal going through T1.

Now eliminate the modulation. To assure the mike picks up no sound, jumper-ground the input of the balanced modulator (across C1 in Figure 9). Turn the input attenuator of the scope to a more sensitive position. Key the transmitter. You should see very little RF indication on the scope. (Your wattmeter, if hooked up, probably shows no reading whatever.)

The photo in Figure 10 illustrates what happens as you turn the two balancing adjustments, C4 and R3. The no-modulation RF signal grows larger as the modulator stage becomes unbalanced. The carrier isn't being canceled as it should, and gets through to the transmitter output. Adjust both the capacitor and potentiometer for minimum RF as seen on the scope. If the adjustments were far off, retune T1 **with** modulation; then repeat the balancing **without** modulation.

In the Final Installment

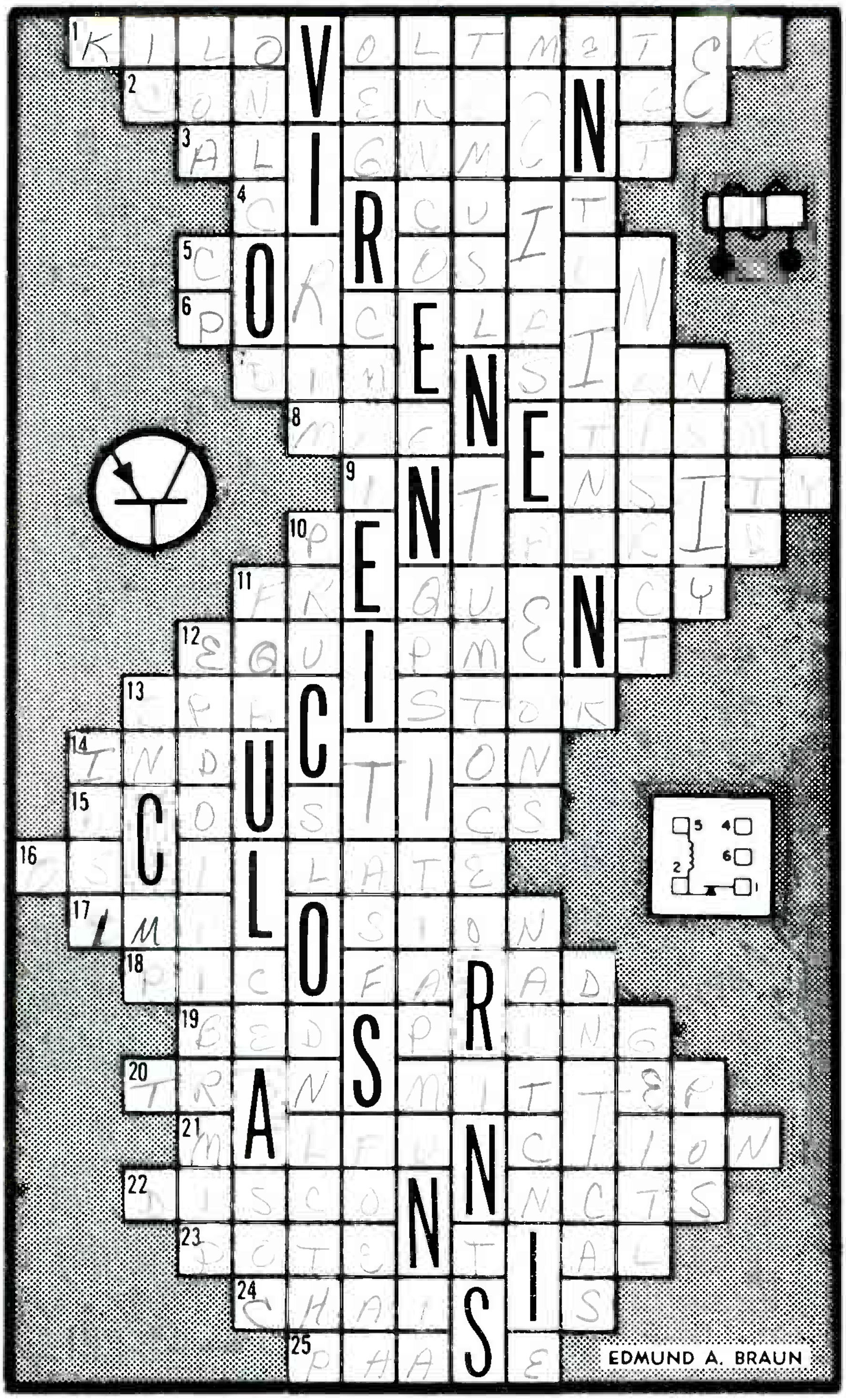
That acquaints you with characteristics unique to CB transmitters. Obviously, other circuits and stages can develop faults. Those described here in detail prove difficult to many technicians new to CB.

The next and final installment continues this approach. Critical qualities in a CB receiver are RF sensitivity, squelch-threshold sensitivity, accuracy of channel reception, audio-power output, and operation of the noise blanker (if the set has one). So, these important considerations are explained and illustrated.

You should realize by now that how fast you make tests and measurements becomes a major factor in whether or not CB repair earns you much money. I'll wrap up this three-part series by showing some bench tricks that save hours every day. They're mostly in the way you handle instruments. With your new specialized knowledge of the peculiarities of CB, and these speed-up hints, you can make CB a profitable specialty. □

Relaxing at OHM

Now that you have a few minutes to spare, try solving this Just-across-word Puzzle-Quiz based on electronics. Each word is connected to the word above and below by at least one letter. There may be more than one connecting letter but only one is shown as a clue. Each correct answer is worth 4 points; a perfect score is 100. It should prove fairly easy except perhaps for someone who thinks "tuner" is a kind of fish, or that "counterpoise" is shown by an efficient sales clerk! So make yourself comfortable and GO!



1. What is the device that measures electromotive force in units of a thousand?
2. The intersection of the electron beams of a multibeam CRT.
3. Adjustment of a system's components for proper interrelationship.
4. What term describes the complete path of an electric current?
5. Gradual destruction of metal by atmosphere, moisture, or other agents.
6. Glazed ceramic insulating material made from clay, quartz, and feldspar.
7. What term refers to any measurable extent, as length, breadth, or thickness?
8. What invisible force attracts ferrous metals?
9. What term describes the brilliance of an image on the screen of a CRT?
10. Electron tube having 5 grids plus an anode and a cathode.
11. What term means the number of complete cycles per seconds of a wave motion?
12. Articles in an outfit or kit such as apparatus, furnishings, etc.
13. Semi-conductor device with a PN junction and four electrode connections.
14. Act of a conductor setting up voltage in another body without connection.
15. What science concerns the production, transmission, and effects of sound?
16 To vibrate above and below a mean value.
17. What is the usual result of dropping a picture tube on hard floor?
18. What term means one thousand micromicrofarad?
19. Type of broadside antenna array with a flat reflector.
20. Equipment used to generate, amplify and modulate an r.f. carrier signal.
21. An incorrect operation of a computer or other device.
22. Unplugs an electrical device or appliance.
23. Voltage difference between two points of a circuit.
24. What word refers to the frame or base of a set?
25. Angular relationship between current and voltage in A.C. circuits.

Solution on Page 59.

bookreview

Simplified TV Trouble Diagnosis
Author: Robert L. Goodman
Publisher: TAB Books, Blue Ridge Summit, Pennsylvania
Size: 5-5/8 inches x 8-3/4 inches, 320 pages
Price: $8.95 hardbound, $5.95 paperback

This is a "look-and-fix" guide designed to speed the troubleshooting and repair of modern color receivers. The format is a quick-reference type listing color-TV ailments and "probable" or "possible" faults. Listings are followed by representative schematics and diagnoses of normal circuit operations. To speed up servicing time, the book contains complete details about service test points, including the settings of receiver controls to obtain the waveforms.

Contents: Vertical-Sweep Circuits—Horizontal-Sweep and HV Systems—Vertical and Horizontal Sync—VHF Tuner Characteristics—Video-Amplifier Circuitry—Television AGC Systems—Video-IF Amplifier Circuits—Color-CRT Diagnosis—Color-Sync and Associated Circuits—Modern Color-TV Crystal-Ringing Circuits—Color-Killer Circuit Operation—Chroma-Demodulator and Amplifier Circuits—Troubleshooting Flow-Chart Technique—Servicing the Sound-Detector and Audio Circuits—Low-Voltage Power Supply Functions and Checks—Index.

Transistor Substitution Handbook, 13th Edition
Author: The Howard W. Sams Engineering Staff
Publisher: Howard W. Sams & Co., Inc., Indianapolis, Ind.
Size: 8-½ inches x 11 inches
Price: Softcover $2.95 ($3.75 in Canada)

More than 100,000 bipolar-transistor substitutions are listed in this easy-to-read 13th annual edition. To provide the most accurate substitutions possible, the electrical and physical parameters described in the manufacturer's published specifications for each bipolar transistor were fed into a computer. Then each transistor was compared to all the others. Transistors which matched within prescribed limits are listed as substitutes. Section 1 contains substitutions for both American and foreign transistors arranged in numerical and alphabetical order. Types recommended by the manufacturers of general-purpose replacement transistors are included at the end of each list of substitutes. Additional data about these general-purpose types (the manufacturer, polarity, material and recommended applications) are reviewed in Section 2. □

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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.

General-Purpose Oscilloscope

Product: 3" Solid-state general-purpose oscilloscope by Leader Instruments Corp.

Features: Unusually high sensitivity and stability coupled with a wide range of applications are claimed for the new Model LBO-310, 3", solid-state oscilloscope recently introduced. The instrument offers 20 mVp-p/div vertical sensitivity at either AC or DC coupling. The recurrent-sweep frequency is in four ranges (10Hz to 100Hz), and is continuously adjustable between steps. Input impedance is 1 megohm shunted by 40pf. Direct connection to the CRT allows monitoring of waveforms to 100MHz. Vertical bandwidth is DC to 1MHz at -3dB and the screen has 8x10 markings. It can be operated from 115 or 230 volts, either 50 or 60 HZ.

Size: The scope measures 6 inches x4 inches x 13¼ inches and weighs approximately 10 lbs.

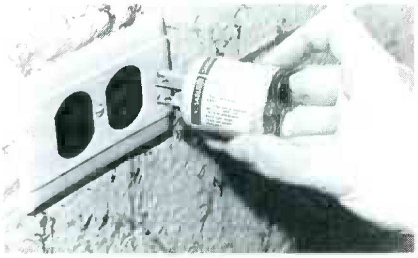
Price: Price of the LBO-310 is $199.95.

For More Details Circle (35) on Reply Card

Grounded-Outlet Tester

Product: GT-20 grounded-outlet tester by Alco Electronic Products, Inc.

Features: The GT-20 checks faulty wiring circuits in a matter of seconds. No electrical training or background is necessary to determine ground fault. There is absolutely no danger of shock. Simply plug the GT-20 into an outlet and observe the indicator lights on the device. The amber lights will show the presence or absence of power.



All operational functions are found on the label. By using a standard 3-wire adapter, the GT-20 can also be used to test two wire receptacles, following the same instructions.

Price: The GT-20 is priced to sell for $6.95.

For More Details Circle (36) on Reply Card

Electronic Frequency Counter

Product: EC-175 electronic counter by Regency Electronics Inc.

Features: This counter is designed to enable the operator to measure crystal oscillator frequencies without mathematical computation. The counter reads out frequencies ranging from 5Hz to 175Mhz. Five position range switch with gate times of 1 ms, 10 ms, 100 ms, 1 second and 10 seconds allows direct measurement of any in-range frequencies to within .1 Hz. A six-digit LED display features automatic blanking, automatic decimal-point positioning and leading-zero suppression. It operates on both 120 VAC and 12 VDC so it can be used to test frequencies on board boat, plane or in cars without having to remove the radio from the vehicle.

Size and Weight: The counter weighs 4½ lbs. and measures 6½ inches x 2 5/8 inches x 9½ inches.

Price: The counter is priced at $449.00.

For More Details Circle (37) on Reply Card

Color Generator

Product: Color-King, model CG169 by Sencore.

Features: Color-King CG169 generates all VHF and UHF channels. FET-type digital integrated circuitry permits operation in temperatures as high as 180 degrees and as low as minus 70. The low temperature operation and moisture dry-out are made possible by Sencore's temperature control that automatically comes on under 30 degrees. An RF-attenuation control allows the technician to check the color TV set down to a 100 microvolt signal.

Price: Color-King CG169 lists at $180.00.

For More Details Circle (38) on Reply Card

Portable Digital Multimeter

Product: 4½ digit DMM, Model 245, by Data Precision Corp.

Features: This DMM has 21 ranges for measuring DC volts, AC volts, DC current, AC current and resistance with 0.005 percent resolution. The Tri-Phasic™ conversion cycle reduces zero offset, drift and time-constant errors.

Price: Price of the calculator is $295.00.

For More Details Circle (39) on Reply Card

CRT TESTER

Product: "Big Mack", CRT tester from Sencore, Inc.

Features: The outstanding feature is the automatic color-CRT tracking test which enables the user to test single and tri-gun CRTs with the same simple push-of-a-button test through a computer type memory bank. All tests are made alike, whether checking black-and-white or any type of color CRT, and the customer can be shown on the 7-inch meter that the tube is bad. Shorts tests also are shown on the meter, rather than with neon lights, and the socket assemblies have been replaced with plug-in replaceable sockets for easy updating.

Price: $190 which includes a certificate that is good for the next two sockets if they should ever be needed. ☐

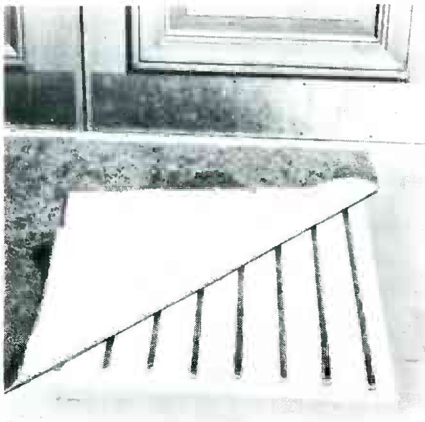
For More Details Circle (40) on Reply Card

product report

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

Floor-mat Switches

Product: Secur-step from Recora Company, Inc.



Features: These floor-mat switches, available in both individual mat and long-length matting form, are designed to actuate any alarm equipment. Secur-step units can be used under rugs, carpets or other covering in homes, offices and stores. They can be used in front of doors, windows, and on stairs. The extra thin construction minimizes bulges.

Size: Two, one for general use, the other specifically designed for use on stairs. The matting is manufactured in 30-inch widths, and either 5 feet or 25 feet lengths. It can be cut to any required length.

For More Details Circle (33) on Reply Card

Solid-Tantalum Capacitors

Product: Subminiature tantalum capacitors from Sprague Products Company.

Features: The new subminiature tantalum capacitors are no larger in size than standard bare-chip capacitors. These tiny type 182D and 183D units are for by-pass, coupling, filtering, and timing-circuit applications in solid-state or hybrid circuits as well as in modular and cordwood construction. They are available with axial leads as well as with single-ended configuration.

Specifications: Capacitance values range from .01 microfarads at 50 volts DC to 220 microfarads at 3 volts.

For More Details Circle (34) on Reply Card

Project Book

Product: Build Your Own Home and Car Security (HEP-409), project book published by Motorola HEP Semiconductors.

Features: Compiled and written for the hobbyist-experimenter, the book is devoted entirely to the topics of sensors, alarms and detectors primarily for home and office use. Beginning with basic alarm theory, the manual contains illustrated construction and installation techniques for 11 safety systems. Each project includes a brief description of the system's function, a schematic diagram, suggested applications and a complete parts list. Also included are assembly hints and a photograph of the finished product.

Price: Build Your Own Home and Car Security sells for $1.25.

For More Details Circle (41) on Reply Card

Metal Cabinets

Product: Big 1 line of metal cabinets by Stack-On Products Co.

Features: Interchangeable casters and solid-steel legs provide mobility when desired, and stationary leg support at other times. The Big 1 line features add-on shelving. The series has a heavy-guage steel top and bottom, double-wall steel-side construction, steel-roller-bearing drawer guides and it is internally structured with 16-guage square tubing. When the top drawer of a cabinet is closed, all drawers become locked.

Size: The drawers are varied in height, having inside dimensions of 32-1/4 X 19-5/8 inches. Without shelving it is 57-1/2 X 36 X 20 inches.

For More Details Circle (42) on Reply Card

Security System

Product: Entraguard™ tenant-controlled security intercom system by Marlee Electronics Corp.

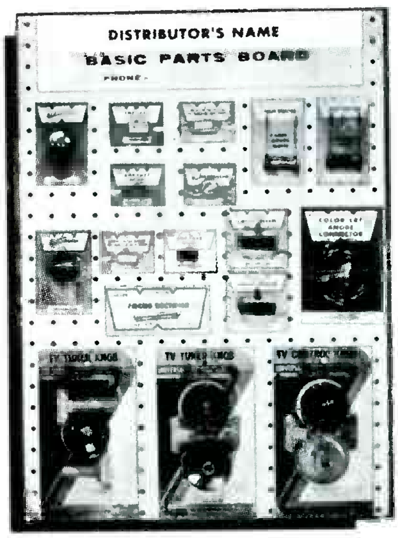
Features: This system is coupled into telephone lines already in the building, and is a mini-computer programmed by the apartment manager with each tenant assigned a code number. A telephone handset connected to the Entraguard is installed adjacent to the directory. A visitor dials the code number of the tenant and is put into direct 2-way private telephonic communication with the tenant. After identification, the tenant is able to unlock the front door by simply dialing "3" on his dial phone.

For More Details Circle (43) on Reply Card

Basic Parts Board

Product: Model BP by Workman Electronic Products, Inc.

Features: The Workman Basic Parts Board contains 62 pieces of the most-frequently-needed replacement parts used by the TV/radio service industry. Merchandise is displayed on a 17-inch X 24-inch white pegboard display.



Model BP consists of amp fuses, fused resistors, focus rectifiers, circuit breakers, CRT anode connectors, current-limiting resistors, fine-tuning knobs, control knobs, and a universal TV channel selector. Each board comes individually packaged complete with hooks and merchandise.

For More Details Circle (44) on Reply Card

Terminal Pins

Product: Terminal pins from Vero Electronics, Inc.

Features: Available now is a series of terminal pins to fit hole diameters of .025 to .052 inches. The terminals manually are pressed into holes of the board with a low cost insertion tool, which can be used at the bench, in an arbor or a drill press. The pins are most useful for production, for bread-boarding, or for quick repairs of printed circuitry. Samples are available upon request.

For More Details Circle (45) on Reply Card

Proximity Switch

Product: Alcoswitch RS-51 by Alco Electronic Products, Inc.

Features: These are basic reed switches triggered by the closeness of an Alnico 5 Magnet. Activation occurs when two units are within a distance of one inch or less. Switches can be mounted in any parallel position so long as they conform to the recommended housing-spacing distance of approximately 7/16 inches at the closed position. A major feature of the RS-51 is the absence of screw-type terminals, and wiring is simplified with push-in locking connectors. 18 to 22 AWG wire with the insulation stripped 3/8 inches can be inserted into the connectors providing ample contact and anti-pullout retention.

Specifications: Current rating: 5 amperes maximum at 100 VAC or 150 VDC. Life expectancy: over 10,000,000 cycles. Positions: normally open or normally closed.

Price: Model RS-51 (N.O.) is priced at $1.95 in single units and $.98 in units of 500. RS051(N.C.) is priced at $2.25 in single units and $1.13 in units of 500. □

For More Details Circle (46) 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.

Turntable

Product: Connoisseur BD/2 Turntable from Hervic Electronics, Inc.

Features: An integrated turntable with pick-up arm, this unit features a damped hydraulic lifting and lowering device (along with a separate arm rest) providing maximum protection to the stylus and the record. The BD/2 is fitted with anti-vibration springs and is mounted on an attractive walnut base. Additional features include operating speeds of 33⅓ RPM and 45 RPM, bias compensator (which corrects for possible "skating" effect), gimbals set at 45/45 degrees, drive motor (60 Hz synchronous constant-speed 450 RPM.

Specifications: Hum level, -80dB; rumble, -60 dB (measured with RIAA characteristics reference a velocity of 7 cm./sec. at 1 kHz; wow and flutter, less than 0.1%.

Price: Connoisseur BD/2 sells for $129.20.

For More Details Circle (47) on Reply Card

Alignment Tape

Product: AT-200 Professional Cassette Alignment Tape by Nortronics Company.

Features: Designed to verify and maintain cassette recording equipment, each tape is recorded from an original source to maintain laboratory standard accuracy of frequencies and levels. To ensure professional quality, a graph of characteristics is made for each serialized tape, and this original graph is included with each tape. The AT-200 alignment tape is divided into five sections to enable verification and testing of azimuth, reference level, frequency response, and flutter. Each section is preceded by a voice announcement describing the test that follows. Nortronics' alignment tape is packed in cassettes and recorded on professional-quality .150 magnetic tape.

For More Details Circle (48) on Reply Card

Vandal-proof Speaker Baffles

Product: Vandal-proof speaker baffles from Soundolier, Inc.

Features: Virtually-indestructible speaker baffles come in three convenient styles to fit any application; surface mount, bi-directional and recessed. These units feature a vandal-proof screw which cannot be turned without a Soundolier wrench. The solid cast-aluminum surface of the baffle body is protected from oxidation and damage by a coat of clear epoxy. The speaker grille itself consists of stainless-steel wire woven into a tight mesh and backed with a sheet of perforated metal. The speaker cone is protected from accidental or intentional damage. Adapter rings are available for mounting a variety of horns.

For More Details Circle (49) on Reply Card

Speakers

Product: Series WR-10 environment-protected speakers by Atlas Sound.

Features: These speakers have a continuous power rating of 10 watts with a full-range frequency response of 225-12,000 Hz. They feature a built-in element-protected transformer with adjustable watts/impedance switch permitting rapid line connection and sound-level adjustment by using a screwdriver, and without disassembly of the unit. The speakers are constructed of heavy-gauge alodine-treated aluminum.

Size: Each speaker measures 11-1/8" wide, 10-1/4" high and 7-1/2" deep. The speakers are provided with 12" coded cables.

For More Details Circle (50) on Reply Card

Auto Speaker Set

Product: Model A200 auto speaker set by Magitran.

Features: A heavy-duty, high-power, full-fidelity auto speaker set consists of a pair of poly-planer 10-watt RMS, high-compliance 5-¼ inch speakers requiring only 7/8-inch mounting depth. Custom snap-

on grilles are available in black padded vinyl (Model A2000V) or chrome (Model A2000C). The flat speaker is recommended for use in autos, boats, trailers and aircraft.
Price: Suggested retail is $19.95 pair.
For More Details Circle (51) on Reply Card

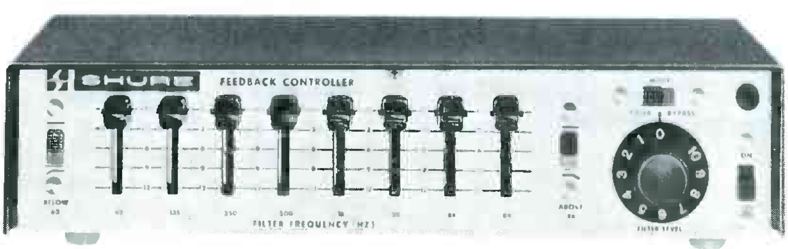
Phono Cartridge

Product: V-15 Type III phone cartridge by Shure Bros., Inc.

Features: The two new design features are laminated magnetic core structure and a stylus assembly with a 25% reduction in effective styling mass. When combined with other performance factors the core structure and stylus assembly give the Type III a higher trackability at low tracking forces, a virtually flat frequency response and an extended dynamic range.
Price: The V-15 Type III is priced at $72.50.
For More Details Circle (52) on Reply Card

Feedback Controller

Product: M610 Feedback Controller by Shure Brothers Inc.
Features: Accoustic feedback now can be reduced through the use of a new filter unit called Feedback Controller by Shure Brothers. Operation of the feedback controller requires no special skills, and it is useful for addition to existing sound systems in schools, churches, clubs, hotel and motel meeting rooms, and paging systems. The M610 is inserted in the sound system between the preamplifier-mixer and the power amplifier, or between the microphone and the preamplifier-mixer in a single-microphone system. Once the M610 is installed, its special set of variable-depth filters and roll-off switches can be used to smooth out the peaks in the system's frequency response, so system gain may be increased to significantly higher levels before the feedback threshold is reached. The user is able to "tune" the total sound system to correct for the acoustic irregularities of the room, thus achieving maximum output. Another feature is control preamplification, which allows the user to raise the overall gain of a sound system after "tuning" the room so a direct before-and-after equalization comparison can be made. The M610 is self-contained, but can be rack mounted in a standard 19-inch audio rack by use of an accessory rack-mount kit.
Size: The M610 is 2½ inches high, 12 inches wide, and 7 inches deep. Weight is four pounds.
Price: M610 is listed at $117.00. ☐
For More Details Circle (53) 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/UHF Antenna

Product: Stellar 2001 electronic VHF/UHF antenna by JFD Electronics Corporation.

Features: Heart of the Stellar 2001 is a planar printed-circuit VHF-UHF antenna whose elements are etched from conductive copper on mylar substrate. The outputs of the VHF and UHF sections are fed to filter networks which act as combiners as well as isolators. The outputs of both VHF and UHF networks are applied to the inputs of low-noise solid-state amplifiers. Interaction between the low-band and high-band signals is prevented by the filter networks. The combiners are a part of the printed circuit pattern as are the baluns that balance out mis-match between the amplifiers and the printed circuit elements. The output is fed by the VHF-UHF combining network to the coaxial cable downlead. Use of 75-ohm shielded coax prevents the pickup of unwanted TV signals and also rejects local interference. Power (12VDC) is supplied to the transistors through the same coaxial cable. Integrated in the power supply is a band-splitting network that separates the VHF and UHF signals, providing two 300-ohm outputs for the TV receivers.

Size: The dimensions are 34 x 28 x 4 inches, weight is 5 pounds.

For More Details Circle (71) on Reply Card

TV-FM Coupler

Product: Model YC-75-FM Yagi coupler by Jerrold Electronics Corporation.

Features: Matched to 75 ohms, Model YC-75-FM can be used to combine the signals from TV and FM antennas to broadband head-end amplifiers in master antenna systems. It can also be used to couple both a TV set and an FM tuner to a common coaxial feed with minimal loss to either receiver. The new units provide two separate signal paths. One path passes the entire FM band and attenuates all other frequencies by about 20 dB.

The other passes all UHF and VHF channels, and attenuates the FM band by about 10 dB. Encased in weather-proof housings, YC-75-FM couplers are complete with straps and thumbscrews for easy mast mounting. A weather boot, F connectors and an expansion tool are included.

Price: YC-75-FM lists for $11.65.

For More Details Circle (54) on Reply Card

Antenna Rotators

Product: All-weather antenna rotators by Saxton Products, Inc.

Features: The new rotators feature "Automatic Command" for precise antenna positioning to pick up weak signals or reduce ghosts. Each rotator is housed in a high-tensile strength, one-piece aluminum alloy casting, and is capable of operating in temperatures ranging from -35°F to 140°F. Added features include built-in line-surge protection, high-wind-locking system, heavy-duty motor and long-life self-lubricating gears. Rotators are available with automatic or semi-automatic indoor controls to govern antenna positioning.

For More Details Circle (55) on Reply Card

Single-Channel UHF Preamplifiers

Product: SCMA-U series of UHF preamplifiers introduced by Blonder-Tongue.

Features: Available for use on Channels 14 through 70, each preamplifier has its own low-noise figure etched on the nameplate together with the channel number. Typical noise figures are 3.5 dB for all channels from 14 through 50, with a maximum not exceeding 4.0 dB, and 4.5 dB for channels 51 through 70, with maximum not exceeding 5.0 dB. Minimum gain of each preamplifier is 22 dB for any

available channel. This series will operate within rated specifications over a temperature range from -40F to + 140°F, with a total current requirement of 60 milliamperes. The solid-state circuit is mounted on a glass-epoxy PC board and powered by -21 volts which can be duplexed on the signal cable. Each preamplifier is housed in an aluminum casting, is equipped with type F input and output-monitoring connectors, and a 0.412 inch aluminum output connector.
Size: Dimensions are 3 x 5 x 2 inches.

For More Details Circle (56) on Reply Card

Antenna Installation Accessories

Product: Rotor wire and a floating guy ring by GC Electronics, Audiotex division.
Features: The 5-conductor rotor wire is 20-guage, flat, brown insulated cable, and is available in 75-feet lengths. Easier installation is claimed for the floating guy ring which has a 1-3/8 inch inside diameter and large holes to accommodate guy-wire thimbles.
Price: Retail price for 75 feet of the 5-conductor wire (catalog number 32-157) is $4.80, and for the guy ring (catalog number 32-027) is $1.19.

For More Details Circle (57) on Reply Card

GET COMPLETE DETAILS

Use Free Reader Service Card on Page 49

Solution to:
RELAXING AT OHM.
(Continued from Page 48)

1. kilovoltmeter
2. convergence
3. alignment
4. circuit
5. corrosion
6. porcelain
7. dimension
8. magnetism
9. intensity
10. pentagrid
11. frequency
12. equipment
13. spacistor
14. induction
15. acoustics
16. oscillate
17. implosion
18. nanofarad
19. bedspring
20. transmitter
21. malfunction
22. disconnects
23. potential
24. chassis
25. phase

Start with 100 points and deduct 4 points for any part you may not have answered correctly.

Your rating:

60 - 64 Not good.
68 - 72 Not bad.
76 - 84 Good.
88 - 96 Very good.
100 - **PERFECT!**

Stop in for a pat on the back and we may even let you take us to lunch.

Catalogs literature

Circle appropriate number on Reader Service Card.

Dukane Corporation—has released a brochure entitled "Sound Systems" which offers the reader basic data for the design of sound-reinforcement systems. Path of the signal is traced from the source through components in systems that range from the elementary to the complex. System organization is depicted by flow diagrams with line drawings of actual components. Two tables assist the reader in selecting appropriate volume controls and determining correct power requirements.
For More Details Circle (59) *on Reply Card*

Eder Instrument Co.—announces release of a four-page catalog illustrating and describing the new Eder-Lite, a full line of miniature inspection lamps and accessories. The Eder-Lite has long been used for the inspection of electronic equipment, appliances, and precision instrumentation, because it permits viewing of inner surfaces and hard-to-get-at places.
For More Details Circle (60) *on Reply Card*

General Electric Co.—has available a bulletin, GEA-8429A, describing the type AK-4 and AK-5 hook-on volt-ammeters for testing maintenance of alternating current circuitry.
For More Details Circle (61) *on Reply Card*

JSH Electronics, Inc.—is distributing a price list for communication tubes which includes special purpose tubes, cathode ray tubes, receiving tubes and solid-state tube replacements. It covers major brands and is eight pages long.
For More Details Circle (62) *on Reply Card*

Mallory Distributor Products Co.—has available a brochure concerning security products which include smoke/fire alarms, car alarms, closed-circuit alarms, personal alarms and ultra-sonic alarms. This brochure, 9-654, covers over 45 security products and accessories.
For More Details Circle (63) *on Reply Card*

Motorola's HEP—offers a catalog in which 43,000 semi-conductor devices are cross-referenced to 472 HEP replacements. Included in the catalog (HMA-07) are 1N, 2N, 3N, JEDEC, manufacturers' regular and special "house" numbers and many international devices. All Motorola HEP devices are listed by type numbers and case style with a packaging index, device dimension drawings and selection guide information.
For More Details Circle (64) *on Reply Card*

Mountain West Alarm Supply Company—has in stock M-73, an 80-page catalog which describes 400 intrusion and fire-alarm products, many of which are UL listed. It features 8 pages of "application notes" for alarm equipment with some information on general alarm systems.
For More Details Circle (65) *on Reply Card*

Multicore Solders—introduces a 6-page brochure describing and illustrating in full-color photographs typical soldering problems, and the company's full line of solders, fluxes and chemicals. Among the problems illustrated are icicling, bridging, dewetting, blow-holes, contamination, insufficient and excess solder. Each is an actual photograph showing the problem related to the circuitry and solder of joints of pc boards and terminals.
For More Details Circle (66) *on Reply Card*

Nortronics—offers a new edition of their Recorder Care Manual, a 32-page manual published for users of reel-to-reel, 8-track cartridge and cassette recorders and players. The new publication illustrates how regular maintenance of recording equipment ensures continued optimum performance and longest possible recorder life. It provides detailed information of the principles of magnetic recording, magnetic heads and important maintenance operations.
For More Details Circle (67) *on Reply Card*

Pomona Electronics—announces publication of its 1973 catalog of electronic test accessories. Featured new products include a do-it-yourself "Grabber" (a version of the mini-test clip) and two molded breakout test cables. The catalog provides illustrations and complete engineering information on all products, including dimension drawings, schematics, specifications, features, and operating ranges.
For More Details Circle (68) *on Reply Card*

Sprague Products Co.—has released an 8-page short-form resistor catalog which contains 5980 catalog items with 616 different resistance values (from 0.1 ohm to 250,000 ohms) and 15 wattage ratings (from 1 to 120 watts). The catalog has basic descriptions and physical sizes, giving buyers and specifiers the data they need for fast, easy selection of resistors. Also given are complete listings of Sprague's family of wirewound resistors.
For More Details Circle (69) *on Reply Card*

Vaco Products Company—has available a 16-page publication illustrating a selection of screw-holding drivers, nut drivers, reversible drivers, offset drivers and many more. This brochure of tools and "fixin' things" is numbered SD-168.
For More Details Circle (70) *on Reply Card*

Watts Business Forms, Inc.—has a revised 1973 edition of the Watts Stock Business and Tax Forms catalog. It features newly designed forms with B-color custom-look printing at stock-form prices, custom-design letterheads, business cards and forms for every industry and use. □
For More Details Circle (72) *on Reply Card*

For More Details Circle (25) on Reply Card

For More Details Circle (28) on Reply Card

For More Details Circle (27) 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.

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

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

"BUILD A PRECISE AC VOLTAGE SOURCE for calibrating scopes and meters, with parts from junk box. Complete plans $2.00. Total Electronics, 27 Sunrise, Hawthorne, N.J. 07506." 6-73-3t

TRANSISTOR TESTER in/out circuit, attaches to any scope (no rewiring) saves valuable service time, no guess work. Simple instructions on how to build from spare parts. Send $3.00 and self addressed stamped envelope. No C.O.D.'s, please. J. Electronics, P.O. Box 5142, Beaumont, Texas 77702. 6-73-2t

FOR SALE: Complete operating 4 position tube rebuilding plant. Some training if desired. Sell as a business or equipment only. Call 1-702-322-4228 or 1-702-323-0508 Mr. Franks. 7-73-1t.

TELEVISION-RADIO SERVICE MATERIAL, Diagrams, manuals, 50-pound carton, only $14.95, postpaid. Beitman, 1760 Balsam, Highland Park, Ill. 60035 7-73 1t

WANTED

ARI TO AR 6 SERVICE MANUALS, Signal Radio Service, 41778 Fremont, Blvd., Fremont, Calif. 94538 5-73-1t

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. 5-73-5t

advertisers' index

SAMS PHOTOFACT

Supplement to 1973 ANNUAL INDEX

Covers PHOTOFACT Set Numbers 1290 thru 1325 and Specialized Volumes AR-134 thru AR-147, CB-43 thru CB-46, MHF-33 thru MHF-38, TR-112 thru TR-125, TSM-140 thru TSM-145 Released.

JANUARY thru JUNE 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 91,100 models.

Set No. Folder No.

A

ADMIRAL
(Also see Record Changer and Recorder Listings)
Admiral Corp.—National Service Div.

★Chassis K1904-1 ..... 1284-POM
★Chassis M2001-2 ..... 1302-POM
★Chassis M2004-2 ..... 1302-POM
●Chassis NA10-1A 1319-1
★Chassis T11K10-1A 1290-1
★Chassis T12K10-1B 1290-1
●Chassis TR3-2A (Similar to Chassis) 1245-1
★Chassis 2K1974-8 ..... 1284-POM
●Chassis 3G310-1,-2 ..... (PCB 941-3) 806—5
●Chassis 3G310-1,-2 ..... (PCB 941-3) 778—1
●Chassis 3G316-2 ..... (PCB 941-3) 778—1
●Chassis 3G316-2 ..... (PCB 941-3) 806—5
★Chassis 7K1885-1 ..... 1284-POM
●Chassis 8G334-2 ..... (PCB 941-3) 806—5
●Chassis 8G334-2 ..... (PCB 941-3) 778—1
●Chassis 8G346-3 ..... (PCB 941-3) 778—1
●Chassis 8G346-3 ..... (PCB 941-3) 806—5
★Chassis 8K1886-1,-2 ..... 1284-POM
★Chassis 8K1887-1,-2 ..... 1284-POM
★Chassis 14K2089-9 (Similar to Chassis) 1281-1
★Chassis 14K2093-1 (Similar to Chassis) 1281-1
Chassis 15J4 ..... TSM-143
★Chassis 16K2001,-6 (Similar to Chassis) 1281-1
Chassis 17E4 ..... TSM-140
PRF771 ..... TSM-140
PRM581 ..... TSM-143
★5AL5461W 1284-POM
★5AL5465W 1284-POM
★5AL5468W 1284-POM
★5L5401W 1284-POM
★5L5405W 1284-POM
★5L5408W 1284-POM
★5L5411/5415/5418 (Similar to Chassis) 1281-1
★5L5431/5433/5435/5438 (Similar to Chassis) 1281-1
★5L5451W 1284-POM
★5L5455W 1284-POM
★5L5458W 1284-POM
★5L5561 ..... 1302-POM
★5L5565 ..... 1302-POM
★5L5568 ..... 1302-POM
★5LS5421/5425/5428 (Similar to Chassis) 1281-1
★5ST5533 (TV Chassis Only) (Similar to Chassis) 1281-1
●7P280 (Ch. NA10-1A 1319-1
●9P239M (Similar to Chassis) 1245-1
●9P415, M (Similar to Chassis) 1245-1
●9P420, M (Similar to Chassis) 1245-1
●9P437, M (Similar to Chassis) 1245-1
●12P261M (Similar to Chassis) 1245-1
●12P275M (Similar to Chassis) 1245-1
●12P280M/287M (Similar to Chassis) 1245-1
●12P445, M (Similar to Chassis) 1245-1
●12P450, M (Similar to Chassis) 1245-1
●12P467, M (Similar to Chassis) 1245-1
●19P617CM (Similar to PCB 1263-4) 1093-1
★18T111C 1284-POM
★18T131 ..... 1284-POM
★18TS121C 1284-POM
★19T330 ..... 1284-POM
★19T331C 1284-POM
★19T511C 1284-POM
★19T518C 1284-POM
★19TS341C 1284-POM
★21L778 ..... 1284-POM
★21T758 ..... 1258-POM
★21T761C 1284-POM
★2080P 1290-1
★2080PF 1290-1
★2097P 1290-1

ADMIRAL—Cont.

★6080P 1290-1
★6080PC 1290-1
★6097P 1290-1
★6097PC 1290-1

AITC
Major Electronics Corp.

AIWA
(Also See Auto Radio and Recorder Listings)
Milovac International Co., Inc.

AR-142/H TSM-142
AR-165 ..... TSM-143

AMBASSADOR
(Also See Record Changer and Recorder Listings)
Allied Stores Marketing

PMB70 ..... TSM-140

ARVIN
(Also See Auto Radio, Changer and Recorder Listings)
Arvin Industries, Inc.

30X76-18 ..... MHF-34
50X36-19 ..... MHF-34
50X92-18 ..... MHF-33
80X76-18 ..... MHF-34
Chassis 1.00231 ..... MHF-33
Chassis 1.01141 ..... MHF-34
Chassis 1.01161 ..... MHF-34
Chassis 1.01171 ..... MHF-34

B

B & K
Dynascan Corp.

Cobra 28 ..... CB-43
Cobra 130 ..... CB-44
Cobra 131 ..... CB-45
PAC-24 ..... CB-43

BELL & HOWELL
(Also See Recorder Listing)
Bell & Howell General Service Dept.

3600 ..... MHF-36
3650 ..... MHF-37

BENDIX (MARINE)
Denmar Division

BLONDER-TONGUE
Blonder-Tongue Laboratories

B-24C (VHF TV Distribution Amp) 1287-SED
BTX-11A (UHF Conv.) 1312-SED

BRADFORD
(Also See Record Changer and Recorder Listings)
W. T. Grant Company

DWGE-55244A ..... 993—4
WTG-51151 ..... TSM-144
●WTG-51342 (Similar to Chassis) 1068-1
★WTG-51763 1323-1
★WTG-51771 1324-1
★WTG-51805A 1290-POM
★WTG-51813A 1290-POM
WTG-51839 ..... MHF-33
★WTG-51938A 1290-POM
★WTG-51946A 1290-POM
★WTG-51953A 1290-POM
★WTG-51961A 1290-POM
●WTG-53074 1278-1
●WTG-53124 (Similar to Chassis) 1068-1
WTG-53553 ..... MHF-36
WTG-53652 ..... TSM-140
●WTG-56283 (Similar to Chassis) 1132-1
●WTG-56291 (Similar to Chassis) 1132-1
★WTG-57901A (Similar to Chassis) 1013-1
★WTG-59188 1290-2
WTG-61051 ..... 1294-SED
●WTG-61077 (Similar to Chassis) 1132-1
●WTG-61085 (Similar to Chassis) 1132-1
●WTG-61150 (Similar to Chassis) 1068-1
WTG-78055A (Similar to Radio Chassis) 1210-1-A
●WTG-78626 1299-1
●WTG-91900 1301-1

BRADFORD—Cont.

●1004C30,1004D30 (Similar to Chassis) 1132-1
●1004L20,1004M20 (Similar to Chassis) 1132-1
●1007A32 1301-1
●1042A11 (Similar to Chassis) 1068-1
●1042A19 (Similar to Chassis) 1068-1
●1042A22 (Similar to Chassis) 1068-1
●1071C33 1299-1
★1104A33 1323-1
★1104A42 1290-2
★1104B43 1324-1
★1105A33 ..... 1290-POM
★1105B33 ..... 1290-POM
★1105C33 ..... 1290-POM
★1105D43 ..... 1290-POM
★1143A40 (Similar to Chassis) 1176-3
★1143D40 ..... 1294-SED
★1205A39 (Similar to Chassis) 1013-1
★1205A43 ..... 1290-POM
★1205B43 ..... 1290-POM
1305C42 (Similar to Radio Chassis) 1210-1-A
1404B40 (WTG-53553) MHF-36
1404E42 ..... MHF-33
2604C31 ..... TSM-140
2953D42 ..... TSM-144
59089 ..... MHF-34

BULOVA
Bulova Electric Products

1610,1612 ..... TSM-143
1640 ..... TSM-140
1642 ..... TSM-140

C

CAPEHART
(Also See Changer Listings)
Capehart Corp.

A-108E 1286-4
Ch. 1745C, 1745CP 1307-4

CATALINA
(Also See Recorder Listing)
White Stores, Inc.

★122-3122B (Similar to Chassis) 1269-1

CORONADO (Also See Clark)
(Also See Auto Radio, Record Changer and Recorder Listings)
Gamble-Skogmo, Inc.

RA75-5235A TSM-142
RA75-5248A TSM-144
RA75-5249A TSM-141
RA80-5259A TSM-140
★TV2-1642A 1302-1
★TV2-2074A/-2075A 1284-POM
●TV22-1031A 1311-1
★TV22-1621A 1307-1
★TV22-1631B 1295-1
★TV22-1641A 1287-1
43-5259 ..... TSM-140

COURIER
(Also See E.C.I.)
Fanon/Courier Corp.

Cadet 23 ..... CB-46

CRAIG
(Also See Auto Radio and Recorder Listing)
Craig Corp.

★6502, 6503 1258-3

CURTIS MATHES
(Also See Record Changer and Recorder Listings)
Curtis Mathes Mfg. Co.

★Ch. C51, C52 ..... 1302-POM
★Ch. CMC51, CMC52 ..... 1302-POM
Ch. 42-2 1302-4

D

DUMONT
(Also See Record Changer Listings)
Emerson TV Sales Corp.

★16DP40 (Ch. T32K10-1A) 1296-POM

DUMONT—Cont.

★16DP41WR (Ch. T33K10-1A) 1296-POM
★19DP40W (Ch. 35K18) 1290-POM
★19DP70WR (Ch. 35K18) 1290-POM
★21DT40W (Ch. 30K19) 1296-POM
★25DC40W/41M/42S (Ch. 31K19) 1296-POM
★25DC72S (Ch. 30M2002-3) 1284-POM
63C11/12/13/14 (Ch. 120862) (Similar to Chassis) 1009-4
★Ch. T32K10-1A 1296-POW
★Ch. T33K10-1A 1296-POM
★Ch. 30K19 ..... 1296-POM
★Ch. 30M2002-3 ..... 1284-POM
★Ch. 31K19 ..... 1296-POM
★Ch. 35K18 ..... 1290-POM

DYNASCAN
(See B & K)

E

ELECTRA
Electra Co.

BC-3H,-H/U SD-2
BC3-L,L/H,-L/U,-U SD-2
Bearcat III SD-2

ELECTRO BRAND
Electro Brand, Inc.

ELECTROHOME
(Also See Record Changer Listing)
Electrohome Limited

Manhattan (H18-202) MHF-37
SC420 (H18-201) MHF-37
SC421 (H19-201) MHF-36
SC430 (H19-202) MHF-36
Ch. H18-201/202 ..... MHF-37
Ch. H19-201/-202 ..... MHF-36

ELECTROPHONIC
(See Morse/Electrophonic)

EMERSON
(Also See Record Changer and Recorder Listings)
Emerson TV Sales Corp.

★12CP40 (Ch. T32K10-1B) 1290-POM
★12EP02A (Ch. T32K10-1B) 1290-POM
★16CP40W (Ch. T32K10-1A) 1290-POM
★16EP03A (Ch. T32K10-1A) 1290-POM
★18CP10 (Ch. 31K17) 1290-POM
★18CP40R (Ch. 31K17) 1290-POM
★19CP10 (Ch. 34K18) 1290-POM
★19CP40 (Ch. 36K18) 1290-POM
★19CP70W, 71WR (Ch. 35K18) 1290-POM
●19P22 (Ch. 120823B) (Similar to Chassis) ..... 800—2
★21CT40W (Ch. 30K19) 1290-POM
★23CC20W (Ch. 30K19) 1290-POM
★23CC40M, 41S (Ch. 30K19) 1290-POM
★25CC60W, 61M, 62S (Ch. 31K19) 1290-POM
★25CT10W (Ch. 31K19) 1290-POM
★29P08 (Similar to Chassis) ..... 951—1
31M25,B MHF-36
★Ch. T32K10-1A 1290-POM
★Ch. T32K10-1B 1290-POM
★Ch. 30K19 ..... 1290-POM
★Ch. 31K17 ..... 1290-POM
★Ch. 31K19 ..... 1290-POM
★Ch. 34K18 ..... 1290-POM
★Ch. 35K18 ..... 1290-POM
★Ch. 36K18 ..... 1290-POM

ETHAN ALLEN

A790A/791A (Similar to Chassis) 1279-4
A790B/791B (Similar to Chassis) 1279-4
★50-1006-212 (Similar to Chassis) 1177-2
★50-1008-212 (Similar to Chassis) 1177-2

F

FANON
(Also See Recorder Listing)
Fanon/Courier Corp.

T-707 ..... CB-43
T-1000 ..... CB-45

FISHER
Fisher Radio Corp.

125B (Serial Number 50001 and up) MHF-38
600-T (Serial 10001-19999 Inclusive) 1288-SED

FOUR STAR
Fortune Star Products Corp.

G

GENERAL ELECTRIC
(Also See Auto Radio, Record Changer and Recorder Listings)
General Electric Company

A242h (Ch. PK160) (Similar to Chassis) 1209-4
A505g/h (Ch. PK170) MHF-37
A790A/791A (Ch. PK166) (Similar to Chassis) 1279-4
★BM996EPN (Ch. KE-II) ..... (PCB 1327-5) 1177-2
C172g (Ch. PK170) MHF-37
C241h (Ch. PK160) (Similar to Chassis) 1209-4
C460g (Ch. PK170) MHF-37
C467g/h (Ch. PK170) MHF-37
C4600A,B 1317-4
C945h (Ch. PK166) (Similar to Chassis) 1279-4
C961h, k (Ch. PK160) (Similar to Chassis) 1209-4
C966g, h (Ch. PK160) (Similar to Chassis) 1209-4
●CBM400WD-D2 (Ch. D2) ..... (PCB 1305-4) 1200-1
G240h (Ch. PK160) (Similar to Chassis) 1209-4
G270g (Ch. PK170) MHF-37
G504g/h (Ch. PK170) MHF-37
G507g (Ch. PK170) MHF-37
G940h (Ch. PK166) (Similar to Chassis) 1279-4
G960h, k (Ch. PK160) (Similar to Chassis) 1209-4
G965g, h (Ch. PK160) (Similar to Chassis) 1209-4
★LB8717MD (Ch. LB) (Similar to Chassis) 1231-2
★M875EWD,M876EMP, M877EPN (Ch. KE-II) ..... (PCB 1327-5) 1177-2
★M910EWD (Ch. KE-II) ..... (PCB 1327-5) 1177-2
★M910EWD (Ch. KE-II) ..... (PCB 1327-5) 1177-2
★M961EWD,M962EWP (Ch. KE-II) ..... (PCB 1327-5) 1177-2
★M964EWD thru M967EWP (Ch. KE-II) ..... (PCB 1327-5) 1177-2
★M968EMP,M969EPN, M970EMP (Ch. KE-II) ..... (PCB 1327-5) 1177-2
★M976EMP (Ch. KE-II) ..... (PCB 1327-5) 1177-2
★M978EMP,M979EAP, M980EAG,M980EAR, M980EAW (Ch. KE-II) ..... (PCB 1327-5) 1177-2
★M982EMP (Ch. KE-II) ..... (PCB 1327-5) 1177-2
★M991EPN thru M996EPN (Ch. KE-II) ..... (PCB 1327-5) 1177-2
★M997EWD,M998EMP, M999EPN (Ch. KE-II) ..... (PCB 1327-5) 1177-2
M8550A 1323-SED
M8635A MHF-38
P365g (Ch. PK6) MHF-35
P365h (Ch. PK6) MHF-35
P572g (Ch. PK16) MHF-35
P572h (Ch. PK16) MHF-35
P774a,75g (Ch. PK170) MHF-37
P977E TSM-144
P1790 ..... TSM-141
P1791 ..... TSM-141
P1847A TSM-140
P1940A TSM-143

GENERAL ELECTRIC—Cont.

P2940A TSM-142
P4810A TSM-145
PBC4600B 1317-4
●SE3101BK, BKE (Ch. 15SE/S3) (Similar to Chassis) 1217-1
●SF1600BG (Ch. 9SF) 1296-POM
●SF1602VY (Ch. 9SF) 1296-POM
●SF2100AME (Ch. 12SE/S3) (Similar to Chassis) 1217-1
●SF2107CGE (Ch. 12SE/S3) (Similar to Chassis) 1217-1
●SF2204WDE (Ch. 12SE/S3) (Similar to Chassis) 1217-1
●TR115RTX-2 (Ch. R-2) 1292-1
V941w (Ch. T2P) 1192-4
●WM010WEB-1 (Ch. W-1) (Similar to Chassis) 1221-1
★WM201HGR-4, HWD-4 (Ch. 10HD/H-4) (Similar to Chassis) 1223-7
★WM202HBW-4, HVY-4 (Ch. 10HD/H-4) (Similar to Chassis) 1223-7
★WM205HWD-4/206HWD-4 (Ch. 10HD/H-4) (Similar to Chassis) 1223-7
★WM217HWD-4 (Ch. 10HD/H-4) (Similar to Chassis) 1223-7
★WM225HWD-4 (Ch. 10HD/H-4) (Similar to Chassis) 1223-7
★WM351NBW-2 (Ch. N-2) ..... (PCB 1322-4) 1219-1
★WM353NWD-2 (Ch. N-2) ..... (PCB 1322-4) 1219-1
★WM355NWD-2 (Ch. N-2) ..... (PCB 1322-4) 1219-1
●WM401WD-D2 (Ch. D2) ..... (PCB 1305-4) 1200-1
●WM403WD-D2 (Ch. D2) ..... (PCB 1305-4) 1200-1
●WM431WD-D2 (Ch. D2) ..... (PCB 1305-4) 1200-1
●WM444WD-D2 (Ch. D2) ..... (PCB 1305-4) 1200-1
●WM452WD-D2 (Ch.D2) ..... (PCB 1305-4) 1200-1
●XSM401-D2 (Ch. D2) (Similar to PCB 1305-4) 1200-1
★Ch HD (Similar to Chassis) 1223-7
★Ch. KE-II ..... (PCB 1327-5) 1177-2
★Ch. N-2 ..... (PCB 1322-4) 1219-1
Ch. PK6 ..... MHF-35
Ch. PK16 ..... MHF-35
Ch. PK170 ..... MHF-37
●Ch. R-2 1292-1
●Ch. 9SF 1296-POM
★Ch. 10HD (Similar to Chassis) 1223-7

GLOBE
GC Electronics Co.

Star 65-120 (CB Transceiver) 1299-SED

H

HALLICRAFTER
(Also See Echophone)
Hallicrafters Company

CR-44A TSM-141

HITACHI
(Also See Auto Radio and Record Changer Listings)
Hitachi Sales Corporation of America

CT-901 ..... 1314-POM
★CU-100 ..... 1302-POM
DPK-340 ..... MHF-37
DPK-345 ..... MHF-33
●I-29,I-49 1312-1
KH-911 ..... TSM-143
KH-933 ..... TSM-144
KH-950H TSM-142
KH-1038 ..... TSM-145
KS-1720H TSM-141
KS-1810H TSM-140
KS-2300 ..... MHF-35
SDP-2820 ..... MHF-38
SR-800 ..... MHF-36
SR-1100 (UL, CSA) MHF-34

J

JOHNSON
E. F. Johnson Company

Messenger 122 (242-0122) CB-45

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.

JOHNSON—Cont.
242-0122 ..... CB-45

JVC
JVC America, Inc.
★7310 1298-1
★7500 1292-2
★7510 1298-1

K

KNIGHT
(Also See Recorder Listing)
(Also See Allied Radio Shack)
Allied Electronics
KB-85 ..... 1297-SED
KG-250 (Stereo Amp) ..1312-SED
KG-870 ..... 1297-SED

KRIS
Echo Communications, Inc.
23+ (516-023) CB-45
516-023 ..... CB-45

L

LAFAYETTE
(Also See Auto Radio and Recorder Listings)
Lafayette Radio Electronics
Dyna Com 3B
(99-32450L) CB-46
HB-525E (99-32369WX) ... CB-43
Telsat 924 (99-32435) CB-44
40-69001Z
(Similar to Page 109) SD-2
40-69019Z
(Similar to Page 109) SD-2
40-69027Z
(Similar to Page 109) SD-2
99-32369WX CB-43
99-32435 ..... CB-44
99-32450L CB-46

LLOYD'S
(Also See Record Changer and Recorder Listings)
Lloyd's Electronics of California, Inc.
9F02-39A TSM-142
9N24-37A TSM-143
9N57-37A TSM-141
9N59-37A TSM-140

M

MAGNAVOX
(Also See Record Changer and Recorder Listings)
The Magnavox Company
FM-43 670-6
1R1231 ..... TSM-140
1R1253 ..... TSM-142
1R1264 ..... TSM-144
1R1286 ..... TSM-145
Chassis R204-18-00, R204-20-00
(Similar to Chassis) 796-5
Chassis R242-02-AA 1297-4
Chassis R242-03-AA 1297-4
★Chassis T946-01 thru -07-DB/-EB/-FB/-JB
..........(PCB 1316-4) 1182-3
★Chassis T946-71/-72/-73-DB/-EB/-FB/-JB
..........(PCB 1316-4) 1182-3
★Chassis T946-76-DB/-EB/-FB/-JB
..........(PCB 1316-4) 1182-3
★Chassis T952-06-AD, -AE,-AF 1293-1
★Chassis T952-06-ED,-EF ..1293-1
★Chassis T952-08-AD,-AF ..1293-1
★Chassis T952-10-AD,-AF ..1293-1
★Chassis T952-10-EF 1293-1
★Chassis T952-11-AF 1293-1
★Chassis T952-11-ED,-EF ..1293-1
★Chassis T952-12-AD 1293-1
★Chassis T952-12-AF 1293-1
★Chassis T952-14-AF 1293-1
★Chassis T952-14-EF 1293-1
★Chassis T952-15-AF 1293-1
★Chassis T952-15-EF 1293-1
★Chassis T952-75-AF 1293-1
★Chassis T952-75-EF 1293-1
★Chassis T952-76-AD 1293-1
★Chassis T952-76-EC,-ED ..1293-1
●Chassis T960-01-AA 1288-1
●Chassis T960-02-AA 1288-1
●Chassis T960-02-HB 1288-1
●Chassis T963-01-AA 1295-2
●Chassis T966-01-LA thru T966-06-LA 1298-2
●Chassis 968 Series ... 1296-POM
●Chassis T969-01-AA ..1302-POM
●Chassis T974-06/-07-BA,-DA 1305-1
★Chassis T974-11/-12/-13-BA,-DA 1305-1
★Chassis T974-15/-16-BA,-DA 1305-1
★Chassis T974-20-BA,-DA ..1305-1
★Chassis 704060 (Remote Control Unit) 1305-1-B
★Chassis 704061 (Remote Control Unit) 1305-1-A
★Chassis 704074 (Remote Control Unit) 1305-1-B
★Chassis 704078 (Remote Control Unit) 1305-1-A

MAJOR
Major Electronics Corp.

MARK PRODUCTS
Mark Products Co.
Lancer 23 ..... CB-46

MASTERWORK
(Also See Auto Radio and Recorder Listings)
Masterwork Audio Products
M503 ..... MHF-33
M2910 ..... TSM-142
M-3118 ..... TSM-141
M4720 ..... MHF-34

MGA
Mitsubishi International Corp.
●BB-093/-094 ..... 1296-POM
●BB-126 ..... 1296-POM
●BS-125 ..... 1296-POM

MGA—Cont.
●BS-135 1322-1
●BT-122 1321-1
★CH-160 ..... 1296-POM
★CH-190/-191 ..... 1296-POM
★CS-130 ..... 1290-POM
★CS-170 ..... 1290-POM
★CS-192 1319-2
★CS-195 1289-1
RPF-30 ..... TSM-140
RPF-35 ..... TSM-141
RPF-36 ..... TSM-144
RPF-40 ..... TSM-143
RPF-41 ..... TSM-145

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
13-856 ..... CB-46
13-922 ..... SD-2
13-927 ..... SD-2
●15-005 1314-1
●15-010 1304-1
●15-090 1317-1
●15-110 1306-1
●15-112C 1301-2
●15-126B 1316-1
●15-129B 1300-1
●15-129D
(Similar to Chassis) 1300-1
★15-215 ..... 1296-POM
★15-239 1308-1

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.
R12A MHF-37
R13 ..... MHF-36
RC-13 ..... MHF-36
T-100A MHF-37
T-600A MHF-37
T-4600 ..... MHF-34
4DT411 ..... MHF-35
1500 1323-4
Ch. 26W 1318-4
Ch. 76W 1318-4

MOTOROLA
(Also See Auto Radio, Record Changer and Recorder Listings)
Motorola, Inc.
●AP406HW (Ch. AE14TS-465) 1318-1
●BP405JW (Ch. E14TS-465) 1318-1
●BP461HW (Ch. 16TS-597,T) 1324-2
●BP462JW (Ch. C16TS-597T) 1324-2
●BP523HN
(Ch. Q19TS-597) 1324-2
●BP529HW (Ch. K19TS-597) 1324-2
●BP530HW (Ch. Q19TS-597) 1324-2
●BP531HW (Ch. 19TS-597T) 1324-2
●BP533HW (Ch. C19TS-597T) 1324-2
●BP535HW (Ch. D19TS-597T) 1324-2
★HP548HW-1 (Ch. FE18TS-929) 1320-1
★HP562HW-1 (Ch. FC18TS-929) 1320-1
★TL9121JW (Ch. ATS-938) .1299-2
★TL9123JS (Ch. ATS-938) .1299-2
★TL9125JP (Ch. ATS-938) .1299-2
TP30HE TSM-142
TP36HW,HW-1 ..... TSM-143
TP58FE TSM-141
★TP5505JW (Ch. AFD18TS-929) 1320-1
★TRR-11 (Color TV Remote Control Unit) 1299-2-B
★TRT-9 (Color TV Remote Control Unit) 1299-2-B
★TRR-11 (TV Remote Control Receiver)
..........1320-1A, 1316-2A
●TRR-12 (TV Remote Control) 1318-1A
★TRT-9 (Color TV Remote Control Unit) 1320-1A
★TT687HW, HWC, HWM, HWMC, JW
(Ch. ATS-938) 1299-2
TT694JW (Ch. ASTS-934) .1316-2
★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
★WL919HS (Ch. STS-934)
(Similar to Chassis) 1205-2
★WL919JS (Ch. STS-934) .1316-2
★WL920HP,HPC
(Ch. STS-934)
(Similar to Chassis) 1205-2
★WL920JP (Ch. STS-934) .1316-2
★WP457GN-1 (Ch. FC16TS-929) 1320-1
★WP482JU-1 (Ch. FC16TS-929) 1320-1
★WP550JU-1 (Ch. FA18TS-929) 1320-1
★WP551JW-1 (Ch. FA18TS-929) 1320-1
★WP553GN-1 (Ch. FG18TS-929) 1320-1
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(Ch. STS-934)
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★YTT934HWM, HWMC
(Ch. YATS-938) 1299-2
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(Ch. YATS-938) 1299-2
★YTU944HWM, HWMC
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★YTU946HKM, HKMC
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(Also See Record Changer and Recorder Listings)
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★CC329 (Ch. CTC16)
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RF-511 ..... TSM-141
RF-541 ..... TSM-145
RF-561,C TSM-143
RF-581 ..... TSM-142
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RF-708 ..... TSM-140
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SA-5200 ..... MHF-38
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(Also See Auto Radio, Record Changer and Recorder Listings)
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★4921A 1296-POM
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(Ch. 3BS32) 1314-POM
●B8308WA
(Ch. 21ST31V)
(Similar to Chassis) 1241-2
●B8758WA (Ch. 3BS32) 1314-POM
●B9198WA (Ch. 20ST30B)
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★C3750BWH 1311-2
★C3751AWA-1 1311-2
★C3752BWH 1311-2
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★7229AWA-1 (Ch. 2CY80B) 1314-POM
★C7231TMA-1 (Ch. 19QT87B)
(Similar to Chassis) 1026-3
★C7250AWA-1/51AWA-1
(Ch. 2CY80B) 1314-POM
★C7251TMA (Ch. 19QT87B)
(Similar to Chassis) 1026-3
★C7252APC-1 (Ch. 2CY80B) 1314-POM
★C7252TPC (Ch. 19QT87B)
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(Ch. 3CY90) 1296-POM
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★C7442BPC
(Ch. 3CY90) 1296-POM
★C7461BPN
(Ch. 3CY90) 1296-POM
★C7462BPC
(Ch. 3CY90) 1296-POM
★C7472BLK
(Ch. 3CY90) 1296-POM
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★C8212BLK
(Ch. 3CY90) 1296-POM
★C8222BLK
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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
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●AS124F (Ch. KCS188C) 1314-POM
●AS128E (Ch. KCS187B) 1314-POM
●AS151W (Ch. KCS168XF) 1314-POM
●AS193W (Ch. KCS186D) 1314-POM
●CR227W/228S (Ch. KCS183F) 1286-1
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★ES334W (Ch. CTC51K) 1314-POM
★ES338W (Ch. CTC51XAC) 1314-POM
★ES346YEN (Ch. CTC51XAD) 1314-POM
★ES354E,Y (Ch. CTC62A) 1320-POM
★ES382W (Ch. CTC52XAH) 1314-POM
★ES385W (Ch. CTC52XAK) 1314-POM
★ES403E (Ch. CTC53E) 1320-POM
★ES405W (Ch. CTC53E) 1320-POM
★ES410WEN,WENX (Ch. CTC53F) 1320-POM
★ES415W (Ch. CTC53XM) 1320-POM
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★FR510WEN (Ch. CTC48A) .1300-2
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★FS505WX (Ch. CTC58A) 1314-POM
★FS510WENX (Ch. CTC58A) 1314-POM
★FS530WX (Ch. CTC58A) 1314-POM
★FS534LX (Ch. CTC58A) 1314-POM
★FS538DX,SX (Ch. CTC58A) 1314-POM
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★GR548D, S (Ch. CTC48A) 1300-2
★GR670W (Ch. CTC39XBJ)
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★GR674L (Ch. CTC39XBJ)
(Similar to Chassis) 1284-2
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(Similar to Chassis) 1284-2
★GR710W (Ch. CTC48H) ..1300-2
★GR710WR (Ch. CTC48J) ..1300-2
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★GR714LR (Ch. CTC48J) ..1300-2
★GR718D, S (Ch. CTC48H .1300-2
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★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
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★GR798DR, SR (Ch. CTC48J) 1300-2

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.

RCA—Cont.

★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
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★GR868DR,SR (Ch. CTC54B) ... 1301-3
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★GS614L (Ch. CTC39XBJ) (Similar to Chassis) ... 1284-2
★GS618D,S (Ch. CTC39XBJ) (Similar to Chassis) ... 1284-2
★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
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Regency Electronics, Inc.

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Sansui Electronics Corp.

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★51C51R (Ch. WS-51R003) ... 1290-POM
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●Ch. 456.51818/819 (Similar to Chassis) ... 566-1
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(Also See Auto Radio, Record Changer and Recorder)
GTE Sylvania Inc.

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(Also See Record Changer and Recorder Listings)
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For audio only products: Morse Electro Products Corp.

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1324, 1324CR,T ... MHF-33
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TELEFUNKEN
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Toshiba America, Inc.

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★Ch. TAC-7710 ... 1302-POM
★Ch. TAC-7720 ... 1302-POM
●Ch. TAT-6014 ... 1302-POM

TOYO
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TRUETONE
(Also See Auto Radio Record Changer and Recorder Listings)
Western Auto Supply Co.

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DC3086 ... TSM-145
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UNIMETRICS
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VANTAGE
Kay Jewelers

●29-0435 (Similar to PCB972-4) ... 838-2

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(Also See Auto Radio, Record Changer and Recorder Listings)
Montgomery Ward & Co.

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★GAI-12243A,B ... 1308-POM
★GAI-12643A ... 1303-3
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★GAI-12883A,B ... 1308-POM
★GAI-12933A,B ... 1308-POM
★GCI-17922A ... 1284-POM
★GCI-17932A ... 1284-POM
★GCI-17942A ... 1284-POM
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(Also See Changer and Recorder Listings)
Webcor Electronics

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(Also See Record Changer and Recorder Listings)
Westinghouse Electric Corp.
Consumer Electronics Div.

●BP21A78A (Ch. V-2487-6) (Similar to Chassis) ... 812-4
●BP90A78A (Ch. V-2487-6) (Similar to Chassis) ... 812-4
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RCF9130A (Ch. V3023C01) ... MHF-38
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RPM5025A (Ch. V3034C01) ... TSM-145
RPM5150A (Ch. V3033C01) ... TSM-142
Ch. V3023C01 ... MHF-38
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WINEGARD
Winegard Company

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AC-823B(OB) (TV Preamp) ... 1320-SED
AC-913 (TV Preamp) ... 1284-SED
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The Zayre Corporation

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(Also See Record Changer and Recorder Listings)
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●B2005W2,W3 (Ch. 14B38Z) (PCB 1315-4) 1156-3
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★S-91768 (Remote Control Unit) ... 1312-3B, 1315-3B

NOTE: ● Denotes Television Receiver. ★ Denotes Color Television Receiver. **AOR** Denotes Available On Request. **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 Bonus Schematic in Photofact-of-the-Month Package—Unavailable After Month Of Issue. **SED** Denotes Special Equipment Data. **TR** Denotes Tape Recorder Series Volume. **TSM** Denotes Transistor Radio Series Volume.

Set No. Folder No.

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A

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(See Kraco)

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(Also See Rambler)
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ASTROLINE
(See Boman Astrosonix)

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C-520A AR–138
C-540 AR–136
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BM-950 AR–146
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36CFP1 AR–142
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9341876 AR–139

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CHEVROLET
United Delco Distributors
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7933641 (1973-½ Prod.) AR–145
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(Also See Mopar)
Chrysler Corporation
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3501163 (1CH1210 or 2CH1210) AR–136
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D

DODGE
(Also See Mopar)
Chrysler Corporation
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3489650 (1DT1214 or 1DT1244) AR–135
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3501501 (1PD2208), 3501502 (1PF2205), 3501503 (1PD2207) AR–135
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H

HAMMOND
(See Boman Astrosonix)
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Hitachi Sales Corporation of America
CS-1750IC AR–143

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ATK-830 (See Page 71) AR–135
FM-704 AR–144
MPT-801 AR–145
RA-04 AR–140
RA-05 AR–139
RF-06 AR–142
S-70A AR–147
S-100 AR–141
S-705A AR–143

K

KRACO
Kraco Tape Products
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KS-750 (Marquis M-750) AR–143

L

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A-40 AR–143
A-50/-55 AR–147
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LINCOLN
Ford Motor Co.
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(See Kraco)

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M-880 (PU-427B-02) AR–134
M-884 AR–136
M-886 (PU-421A-01) AR–134
M-888 (PU-423A-01) AR–143
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OLDSMOBILE
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33BFM1 AR–139
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OPEL
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(Also See Mopar)
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3501013 (Similar to Page 73) AR–122
3501501 (1PD2208), 3501502 (1PF2205), 3501503 (1PD2207) AR–135

PONTIAC
United Delco Distributors
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32AFP1, 32AFPK1 AR–137
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32APBT1 AR–145
32APB2, 32APBK2 AR–138
32BFM1 AR–144
32BFP1, 32BFPK1 AR–137
32BPB1, 32BPBK2 AR–140
32BPB2, 32BPBK2 AR–138
32BPBT1 AR–145
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12R500 AR–144
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RANGER
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R-201M AR–142
RR-56T AR–141
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REALISTIC
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S

SPORT
(See Boman Astrosonix)

T

TOYOTA
Toyota Motors Distributing, Inc.
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TO-71-FM AR–135
TO-71-PB AR–135
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Western Auto Supply
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4DC7012 AR–134
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4DX7140 AR–136

V

VOLVO
Volvo Distributing, Inc.
2BFMVO AR–135
3BFMVO AR–135

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A

ADAM II
(See Kraco)

ADMIRAL
Admiral Corporation
National Service Div.
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CTRF581 TR–112

AKAI
Akai America, Ltd.
CR-80 TR–113
CR-80D TR–113
1700 TR–112
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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
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C-975 AR–138
C-980 AR–139

AUTOMATIC
Automatic Radio Mfg. Co., Inc.
HRP-1356 TR–123
SPA-500B,SPB-5001B AR–141
SPF-5005B (Stock 105) AR–147
SSS-2595 AR–142
SST-1179 AR–145

B

BELL & HOWELL
Bell & Howell General Service Dept.
3948B,RB TR–121
2392A TR–124
2394B TR–125
3095 TR–120
4350TRM TR–123
4400TRM TR–122
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BOMAN ASTROSONIX
Boman Astrosonix—Div. of California Auto Radio, Inc.
BM-911 AR–141
BM-950 AR–146
SP-80 (Sport 88) AR–143
SP-190 AR–137

BUICK
United Delco Distributors
34AFMT2 AR–145
34APBT1 AR–138
34BFMT1 AR–145
34BPBT1 AR–138
7930134 AR–139
7935044 AR–145
9341634 AR–140
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BRADFORD
W. T. Grant Company
2104D23 (WTG-79566) TR–124
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C

CADILLAC
United Delco Distributors
36CFMT1 AR–139
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CARTAPE
Car Tapes, Inc.
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CTI-8102 AR–143
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CHANNEL MASTER
Channel Master Corporation
6318 AR–142

CHEVROLET
United Delco Distributors
31BFMT2 AR–142
31BPBT1 AR–139
7939071 AR–139
7939081 AR–142

CONCORD
Benjamin Electronics Sound Corp.
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E

EMERSON
Emerson Television Sales Corp.
ETR100 TR–106
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G

GENERAL ELECTRIC
General Electric Company
M8440A TR–118
M8450A TR–119
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H

HAMMOND
(See Boman Astrosonix)
HD-501 AR–141
HD-575 AR–146

HITACHI
Hitachi Sales Corporation of America
CS-1750IC AR–143
KCT-1231 TR–116
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I

INLAND DYNATRONICS
Inland Dynatronics, Inc.
AT-830 AR–135
ATK-830 (See Page 71) AR–135
MPT-801 AR–145
S-70A AR–147
S-100 AR–141
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J

JVC
JVC America, Inc.
1660 TR–113
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K

KRACO
Kraco Tape Products
KS-425 AR–141
KS-750 (Marquis M-750) AR–143

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
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LEAR-JET
Lear Jet Industries, Inc.
A-25 AR–141
A-40 AR–143
A-50,-55 AR–147
A-140 AR–140

LLOYD'S
Lloyd's Electronics of California, Inc.
V612B-100A TR–122

M

MAGNAVOX
The Magnavox Company
1K8840 TR–124
1K8928 TR–125
1V9034 TR–123
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MARQUIS
(See Kraco)

MIDLAND
Midland Communications Co.
12-144 TR–125

MORSE ELECTRO PRODUCTS
Morse Electro Products Corp.
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TD51A TR–115
TRD-61 TR–124

MOTOROLA
Motorola, Inc.
GA16GWRC TR–120
GA16GWRC-1 TR–120
GP12GURC TR–120
GP12GURC-1 TR–120

MUNTZ/STEREO
Muntz-Stereo-Pak, Inc.
M-860 (PU-428A-01) AR–134
M-880 (PU-4278-02) AR–134
M-884 AR–136
M-886 (PU-421A-01) AR–134
M-888 (PU-423A-01) AR–143
M-940 (PU-809A-01) AR–141

N

NORELCO
Norelco Service, Inc.
3170 TR–117

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OLDSMOBILE
United Delco Distributors
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33AFMT2 AR–144
33APBT1 AR–140
33BFMT1 AR–145
33BFMT2 AR–144
33BPBT1 AR–140
7935043 AR–140
7935053 (1973-½ Prod.) AR–144
7935053 AR–145
7937963 AR–140
7937973 (1973-½ Prod.) AR–144
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P

PANASONIC
Panasonic Consumer Parts Div.
Panasonic Service
CQ-880EU AR–146
CX-131EU AR–143
CX-601EU AR–144
RE-6600 TR–117
RF-7280 TR–115
RQ-436S TR–121
RS-261US TR–120

PENNEY'S-PENNCREST
J. C. Penney Co., Inc.
981-0100 AR–134
981-0115 (985-6907) AR–141
981-0165 AR–137
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3230 TR–112
3233 TR–125
3241 TR–123
3241A TR–123
3275 TR–124
3535 TR–119

PIONEER
U.S. Pioneer Electronics Corp.
TP-222E AR–143

Set No.	Folder No.
PIONEER—Cont.	
TP-777E	AR–145
TP-6000/G	AR–146
PONTIAC **United Delco Distributors**	
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32BPBT1	AR–145
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RCA **RCA Sales Corporation**	
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YZB522S	TR–113
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CF-200H	TR–114
CF-200Y	TR–114
CF-400	TR–120
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TC-55	TR–113
TC-90A (Similar to Page 107)	TR–106
TC-134SD	TR–117
TC-140	TR–112
TC-161SD	TR-118
TC-353	TR-116
SOUNDESIGN **Soundesign Corp.**	
7718	TR–118
7825	TR–122
7839	TR–120
SPORT **(See Boman Astrosonix)**	
SYLVANIA **GTE Sylvania Inc.**	
CT90BK	TR–112
CT170W	TR–114
CTR175W	TR–123
T	
TOYOTA **Toyota Motors Distributing, Inc.**	
86260-22010 (CX-171FUT)	AR–146
TRUETONE **Western Auto Supply**	
1DI7002A-27	AR–134
1DI7105A-27	AR–134
1DI7140A-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
4DX7140	AR–136
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
WOLLENSAK **3M Company**	
4515	TR–125
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 **H**ome **T**ape **P**layer Series Volume. **MHF** Denotes Modular **H**i-**F**i Series Volume. **PCB** Denotes **P**roduction **C**hange **B**ulletin. **POM** Denotes **P**hotofact-**o**f-the-**M**onth Package—Not Available On Request. **SD** Denotes **S**canner-Monitor Servicing **D**ata. **SED** Denotes **S**pecial **E**quipment **D**ata. **TR** Denotes **T**ape **R**ecorder Series Volume. **TSM** Denotes **T**ransistor **R**adio Series Volume.

ADDRESS CHANGES

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

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

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

Echo Communications, Inc.
One Echo Plaza
Cedarburg, Wisconsin 53012

Electra Company
Cumberland, Indiana 46229

Electro Brand, Inc.
2330 W. Nelson Street
Chicago, Illinois 60618

Elpa Marketing Industries, Inc.
Thorens & Atlantic Ave.
Garden City Park, New York 11040

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

Mark Products Company
5439 W. Fargo
Skokie, Illinois 60076

Palomar Instrument Company
563 North Citracado Parkway
Escondido, California 92025

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

RCA Electronic Components & Devices
2000 Clements Bridge Road
Deptford, New Jersey 08096

Sanyo Electric, Inc.
1200 West Artesia Blvd.
Compton, California 90220

Tennelec, Inc.
P. O. Box D
Oak Ridge, Tenn.

Unimetrics, Inc.
23 W. Mall
Plainview, New York 11803

United Audio Products, Inc.
1205 S. Columbus Ave.
Mount Vernon, New York 10553

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