RCA Service News

RADIO AND TELEVISION

A PUBLICATION OF RCA ELECTRONIC COMPONENTS • HARRISON, N. J.

Here's Your Winning Ticket to a Real Solid Future in Solid-State Servicing!
(Pages 8-13)

SUMMER
1968
Vol. 33, No. 1

Double Presentation Honors RCA For Role in Advancing Status of Independent Service-Dealers

RCA — only electronics corporation to have more than one division selected for special honors by the servicing fraternity — was again named for eminent recognition by the National Alliance of Television & Electronic Service Associations (NATESA).

Again, two separate RCA organizations were chosen to receive the annual "Friends of Service" award, which is conferred for "outstanding service" in improving the public relations and acceptance of the contributions of independent dealers and technicians toward better service and performance of electronic devices for the home. The double presentation marked the tenth and eleventh of such awards to be conferred on RCA.

For the Distributor Products organization of RCA Electronic Components, one of the two recipients, this latest honor represents the seventh testimonial since inception of the "Friends of Service" award by NATESA.

RCA Sales Corporation, other recipient of NATESA's special recognition, has been presented with four "Friends of Service" awards.

Awards were conferred at a banquet held in Milwaukee, Wisc., on April 27th, during the NATESA Spring Delegates Meeting. Joseph J. Kearney, Manager, Distributor Sales, accepted the testimonial plaque for RCA Electronic Components, and Jack K. Sauter, Executive Vice President, Sales Operations, received the plaque for RCA Sales Corporation.

The National Alliance of Television & Electronic Service Associations consists of service-dealers and technicians primarily engaged in the maintenance of home-entertainment electronic products, and is dedicated to the growth and support of expert service knowledge and facilities, as well as helping the independent service technician to attain professional stature and prominence in his community.

"Friends of Service" awards are presented annually to those companies who make outstanding contributions towards the fulfillment of NATESA's objectives.


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RCA RADIO & TELEVISION SERVICE NEWS is published in the interest of dealers and service technicians. It is written to assist them in providing better service, and to foster the growth of their business by supplying them with information on the latest troubleshooting and sales promotion techniques, sales and service aids, together with valuable data on RCA tubes, semiconductor devices, batteries, and electronic instruments.

RCA RADIO & TELEVISION SERVICE NEWS is a publication of RCA Electronic Components, Harrison, New Jersey 07029.

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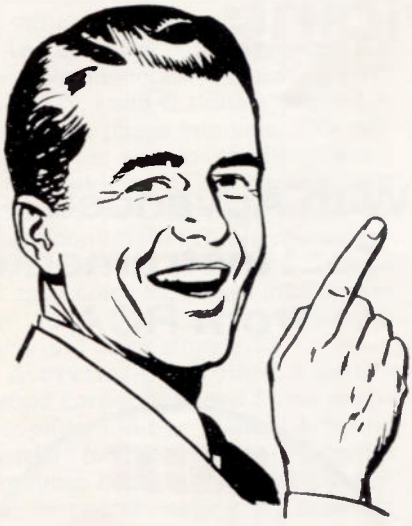


Important Customer Message in Interest of Service-Dealers and Technicians:

Special Reprints of 'TV GUIDE' Article on Television Servicing Business Now Available from RCA Tube Distributors

Do you sometimes find it difficult to explain the economic realities of service-pricing to your customers?

Admittedly, many dealers and service technicians face this dilemma, and ruefully complain that trying to "justify" a hard-earned repair fee can often become more arduous than the job itself.

That is why David Lachenbruch, a widely known authority in the consumer electronics field, has stepped forward to present the problems of the TV technician succinctly, objectively, and for all the public to know. His article, which appeared in the March 16th issue of "TV Guide," outlines in positive terms the frustrations encountered by the servicing specialist in trying to cope simultaneously with the needs of his customers, the demands of his profession, and his own economic survival. Also pointed out in this article are some of the current misconceptions and fallacies concerning servicing costs — particularly as to what constitutes a fair return for a highly skilled craftsman, ever faced with new technical complications and rising business expenditures. Here — in concise, easy-to-understand language — is helpful "ammunition" for your cause as well as enlightening information for all of your customers.

In answer to numerous requests, RCA and your RCA Tube Distributor have obtained special reprints of this article which are now available for your use. You may find some of the information valuable in reappraising your own business cost structure and requirements. You may also wish to pass some of these reprints to your customers whenever "hidden cost" factors make justifiable service billings somewhat cumbersome and difficult to explain. For complete information on how you can obtain some of these reprints, contact your RCA Tube Distributor.

Discover New Benefits of Easier Servicing

...With Advanced Test Instruments from RCA

WR-502A Solid-State Battery-Operated Color-Bar Generator

Completely portable WR-502A weighs only about four pounds and is protected by rugged, cast-aluminum case.

The instrumentation capability that produced the world-famous "WR-64B" has been combined with latest advances in solid-state design to bring you the RCA WR-502A CHRO-BAR — a revolutionary color-bar generator that will undoubtedly become the new standard of the industry.

An "instant-on" battery-operated instrument of rock-solid stability, the easily portable WR-502A measures 6½-by-7-by-4 inches, and weighs only about 4 pounds. It is attractively styled in a rugged, die-cast aluminum case.

The new color-bar generator is designed to provide the test signals required for adjusting convergence, color-phasing, matrixing, purity, and linearity of color-television receivers. Patterns generated by the CHRO-BAR include color bars, dots, crosshatch, vertical lines, horizontal

lines, and blank raster. The new crystal-calibrated solid-state circuitry is especially designed to provide stable patterns, with no flicker.

The instrument includes slide switches for shorting out the control grids of the color picture tube. This feature enables the red, blue, or green color guns to be "killed," as required in convergence and purity adjustments. Leads are provided for connection to the control-grid leads of the color picture tube socket.

The color-bar pattern provides ten bars simultaneously, including R-Y, B-Y, G-Y, I and Q signals, spaced at 30-degree phase intervals. This pattern is for use in checking color phase and matrixing circuits, and adjusting the automatic frequency phase control (AFPC). Narrow brightness pulses are added at the edges of each color bar to aid in checking the "fit" or registration of the brightness and color signals.

A crystal-controlled 4.5-MHz sound carrier is added to the color-bar pattern in the "Pattern & Sound Carrier" function. This sound carrier produces beats in the color-bar signal to permit making an accurate fine-tuning adjustment.

The dot pattern provided by the WR-502A is used primarily in convergence adjustment. The crosshatch, vertical-line, and horizontal-line patterns are for use in adjusting linearity in both black-and-white and color receivers, and as an alternate pattern for adjusting convergence. The crosshatch pattern, consisting of a fixed number of vertical and horizontal lines, can also be used to check receiver overscan adjustment.

The blank-raster function is useful for both purity and color temperature adjustments.

Two versions of the CHRO-BAR generator are available: the WR-502A provides RF output on channel 3; the WR-502A-V1 provides RF output on channel 4. The output cable connects directly to the antenna-input terminals on the side of the receiver. Simplified field-maintenance design helps assure reliable operation under varied service conditions.

The WR-502A CHRO-BAR is powered by a 4.2-volt mercury battery. As a convenience, the instrument has provision for an alternate battery that can be switched-in easily when the first battery becomes weak. A meter is provided on the panel to indicate the condition of the batteries. The generator can also be operated directly from a 120-volt AC power line by using the WG-425A Adaptor.

More Value at Less Cost!

Transistorized Version of Sine/Square Wave Audio Generator Smaller, Lighter, More Stable, and Easier to Use

Precision-engineered and factory-calibrated, the new RCA WA-504A Sine/Square Wave Audio Signal Generator features all-solid-state design, including a metal-oxide-semiconductor field-effect-transistor (MOS-FET) oscillator stage.

With an over-all volume of only 198 cubic inches and a weight of just 3 pounds, the WA-504A is far more portable and easier to handle than its predecessor-type, WA-44C, while transistorization of the instrument provides for greater stability (amplitude variation ±1.5 dB; total harmonic distortion of sine wave less than 0.25 per cent).

The new audio generator provides a tuneable AF signal ideally suited for service, industrial, laboratory, educational, and hobby use. Covering a range from 20 Hz to 200 kHz, it is also useful in testing ultrasonic equipment. Applications for this versatile instrument include the measurement of frequency-response characteristics of amplifiers, determining resonant frequencies of loudspeakers, tuning loudspeaker enclosures, finding input and output impedances, determining values of unknown inductors and capacitors, and determining the frequency or speed of rotating or vibrating objects.

Additional features of the WA-504A include:

- An attached, shielded output cable
- Switch selection of sine-wave or square-wave output
- High output voltages (10 volts rms or more with rated load)
- A ten-to-one step attenuator and continuously adjustable output control
- Brushed aluminum panel with permanently etched markings—color-coded for ease of operation

All-solid-state design of RCA WA-504A features six transistors — including an MOS-FET oscillator stage — and two diodes which produce a stable signal with an amplitude variation not exceeding ±1.5 dB from 30 Hz upwards to 100,000 Hz.

Operation of the WA-504A from a 105-130 volt, 50-60 Hz AC line is straightforward. The frequency is selected with the Frequency Range switch and the convenient single-scale tuning dial. Selection of the type of output, sine wave or square wave, and the range of output level is simplified by a concentric Output Switch and output level control.

Three New Additions Featured in RCA Line Of Test Instrument Accessories

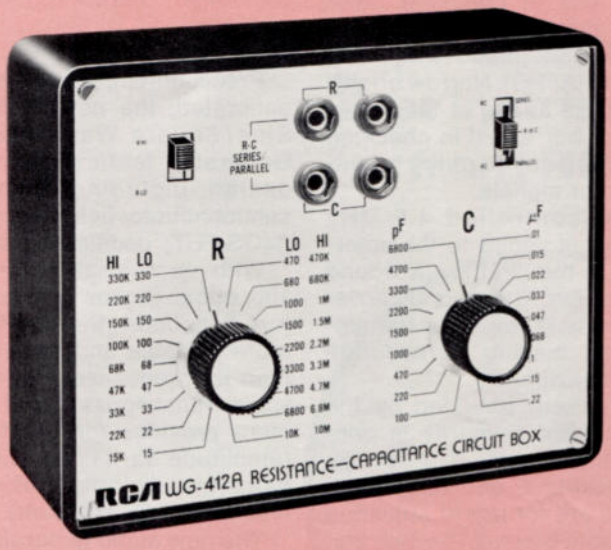
R-C Circuit Box Speeds Selection of Standard Values for Resistors and Capacitors

Convenient selection of standard resistor and capacitor values — available either separately or in series- and parallel-R-C combinations — is handily accomplished with the WG-412A, RCA's newly announced Resistance-Capacitance Circuit Box.

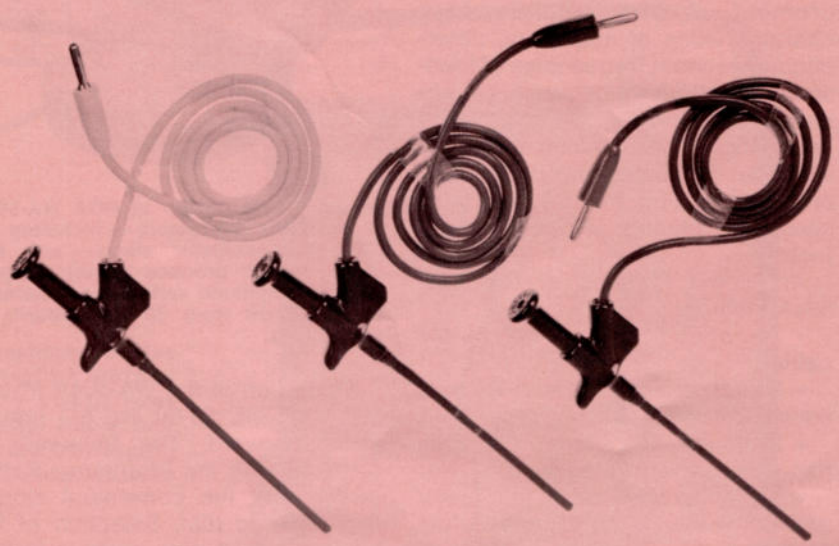
Applications of the R-C Circuit Box include component substitution in servicing or circuit-design, and the establishing of R-C circuits for checking impedance, reactance, and frequency characteristics. The WG-412A is also valuable for use in the classroom, where it can be employed for demonstrating Ohm's Law, capacitive reactance, and circuit effects caused by various resistance/capacitance combinations.

The unit includes 36 resistors (values from 15 ohms to 10 megohms) and 18 capacitors (values from 100 picofarads to 0.22 microfarad). Resistors and capacitors have a 10 per cent tolerance. The resistors have a power rating of one watt. The capacitors have a voltage rating of approximately 600 volts.

Measuring 6⅞ by 5⅜ by 2⅜ inches, the compactly designed WG-412A R-C Circuit Box has plug-in test leads incorporating convenient alligator-clip connectors.



WG-414A Probes Help Technicians 'Reach Around Corners'

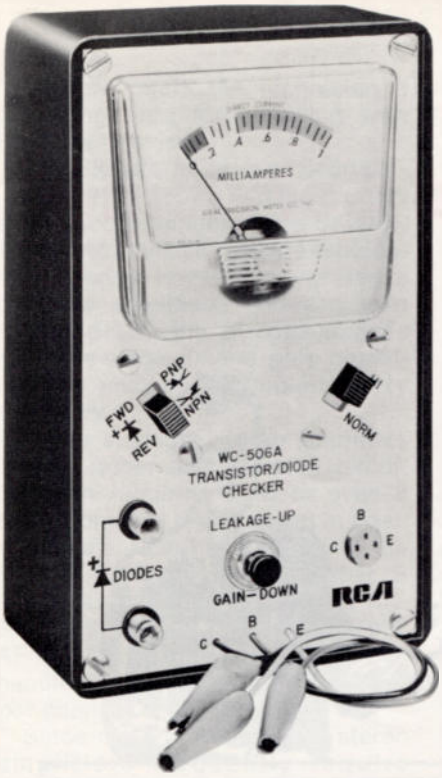


Easy access to crowded circuit boards and other out-of-the-way assemblies is now possible with the aid of a set of three probes newly developed by RCA.

Designated the WG-414A, the three-probe set is equipped with special clip-on connectors and long, thin, flexible shafts which enable service technicians to readily zero-in on circuit locations hitherto difficult to reach.

Although intended primarily for transistor testing and for use with RCA's WT-501A Transistor Tester, the WG-414A Clip-On Probes can also be used for voltage and current measurements and other applications.

Each of the three leads is provided with a "banana plug" and is color-coded for easy identification.



For Fast Test of Out-of-Circuit Devices:

RCA Announces WC-506A Transistor/Diode Checker

Weighing only 14 ounces and measuring 3¾-by-6¼-by-2 inches, RCA's newly announced WC-506A Transistor/Diode Checker offers a fast, easy means of checking relative gain and leakage levels of out-of-circuit transistors. All measurements are indicated on a large meter with a single three-color scale.

Also easy to check on this instrument are the relative front-to-back current ratios of diodes. Special spring terminals for connecting the diodes are located on the panel.

Both a transistor socket and color-coded test leads are included on the WC-506A. A panel switch is provided to select the test for either NPN or PNP transistors. Another switch adapts the test circuit to accommodate the checking of high-leakage transistors, such as most germanium power types.

Power for the readily portable and compact Transistor/Diode Checker is supplied by two 1.5-volt penlite batteries. The over-all unit is housed in a sturdy bakelite case.

RCA's Popular TV Isotap Is Up-Rated For Use in Color-TV Servicing

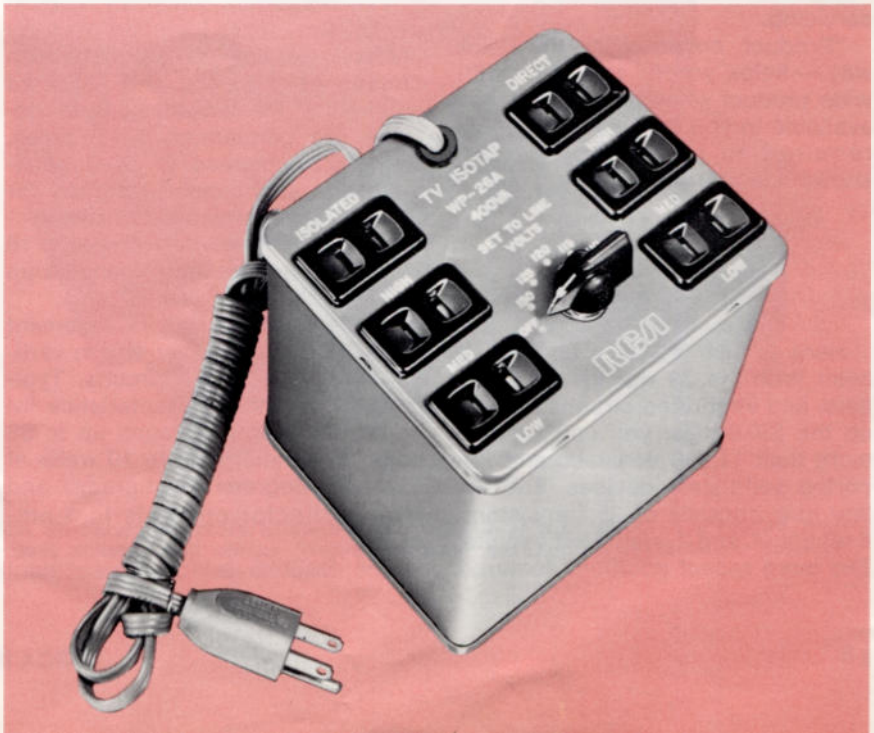
Broadening the role of the popular TV Isotap to include the servicing of color-television receivers, RCA has announced the WP-26A — an up-rated version of the WP-25A.

The WP-26A TV Isotap is designed for use as either an adjustable isolation transformer or as an adjustable autotransformer to facilitate testing and troubleshooting of radio and television receivers. It is particularly useful in the service shop for duplicating low or high supply-line voltage conditions often found in customers' homes. This feature is especially helpful in checking operation of the oscillator sections of television receivers and provides a convenient means of checking brightness and raster size under adverse voltage conditions.

The WP-26A is also useful in the service shop for speeding up the detection of intermittent troubles through use of high- and low-supply voltages, and for checking circuit operating voltages at standard line voltages when supply-line voltages are high or low. The Isotap may also be installed permanently in locations where supply-line voltage is consistently too high or too low for proper operation of radio and television receivers or other electronic equipment.

A seven-position selector switch permits adjustment of the Isotap in five-volt steps to operate from any 50-to-60 Hz supply-line voltage from 105 to 130 volts. Output voltages of approximately 105, 115, and 130 volts are provided throughout the supply-line voltage range.

Three outlets marked "Direct" are connected to the autotransformer or primary winding, and three outlets marked "Isolated" are connected to the secondary winding of the WP-26A. When the "Isolated" receptacles are used, the shock and short-circuit hazards usually associated with AC/DC and other transformerless equipment are minimized. When the "Direct" receptacles are used, isolation protection is not provided, but equipment having a heavier volt-ampere load may be operated. The receptacles accommodate a standard two-prong male power plug.



Making a 'Solid' Approach to Solid-State Servicing?

From Your RCA Distributor:

- **A select assortment of 33 "Top-of-the-Line" SK devices that can replace more than 11,800 domestic and imported semiconductor types; in radio and television receivers, tape recorders, and hi-fi equipment.**
- **Comprehensive and accurate replacement information, instructional material, and technical data.**
- **RCA Experimenter Kits for construction of a wide variety of useful control and audio circuits.**
- **Supporting test equipment and servicing aids — featuring RCA's new WT-501A Solid-State Transistor Tester for testing devices both in- and out-of-circuit.**

. . . A One-Stop Headquarters for All Your Most Important Needs in the Servicing of Solid-State Entertainment-Type Home Instruments

Accelerating progress and growing complexities in the field of consumer electronics are challenging the skills of even the most versatile technicians.

Today — more than ever — lack of some product, service aid, or data when it is needed can spell the difference betwen profit and loss, particularly in the vital and increasingly important business of solid-state servicing.

"Product coverage" — the RCA way — helps you fill this gap. With wide product selection, RCA makes available to you all the related tools required to increase servicing knowledge and proficiency.

RCA "Top-of-the-Line" SK-Series Semiconductors Replace 11,800 Devices

Here is market coverage at its best! With the 33 transistors, rectifiers, and integrated circuits making up the SK-Series, you can replace more than 11,800 domestic and imported solid-state devices. The SK line now consists of 25 transistors, 6 rectifiers, and 2 integrated circuits. The more recent additions featured in the SK-Series are two new transistor types for transistorized TV deflection circuits, six silicon power transistors, and four silicon rectifiers.

SK3034 and SK3035 Fill Wide Replacement Need In Deflection Circuits

Two brand-new transistor types in the SK-Series are intended for wide replacement use in the deflection circuits of domestic and imported solid-state TV receivers. Both devices are germanium p-n-p types, hermetically sealed in TO-3 packages and specifically designed for use in transistorized sets using picture tubes with anode voltages to 18 kV and having deflection angles up to 114 degrees.

The SK3034 is for replacement use in horizontal-driver and in vertical-deflection-output circuits. Typical performance characteristics include DC supply voltages up to 36 volts; dissipations up to 10 watts at T_{MF} = 55 degrees Centigrade; and peak collector currents to 3 amperes.

The SK3035 is for replacement use in horizontal-deflection-output circuits, and — like the SK3034 — operates at DC supply voltages up to 36 volts. Other performance characteristics include peak flyback transformer voltages up to 320 volts; dissipations up to 5 watts at T_{MF} = 55 degrees Centigrade; and typical collector currents up to 10 amperes.

The SK3034 and SK3035 can serve as replacements in the deflection circuits of receivers made by virtually all of the better known manufacturers, including Andrea, Airline, General Electric, Motorola, Olympia, Panasonic, Philco, RCA, Sears, Sylvania, Toshiba, and Westinghouse.

New Silicon Power Transistors Deliver Up to 40 Watts Output

The six newer silicon power transistors added to the SK-Series just prior to the SK3034 and SK3035 consist of types SK3024 through SK-3029, and are intended primarily for replacement use in solid-state stereo and hi-fi amplifiers. Because a large portion of the amplifiers on the market have had RCA devices incorporated into their basic designs, this

equipment offers the technician a promising area for servicing with SK-Series devices.

The SK3024 is an n-p-n complement of the SK3025, and the SK3025 a p-n-p complement of the SK3024. These two transistors serve replacement needs in low-level driver stages of audio amplifiers, and can take care of practically all combinations of single-stage drivers plus combinations involving complementary symmetry.

Power stages in stereo amplifiers involve rather sophisticated circuitry often requiring 2, 4, or even 8 transistors. For replacement in power sockets, RCA has introduced the SK3026 — for class A and class B AF-power amplifiers — and the SK-3027, a device for class B push-pull AF-amplifier stages. These types can handle output stages up to 40 watts per channel.

Since distortion specs for stereo amplifiers frequently require "matched pairs," RCA makes two matched pairs available in types SK3028 and SK3029. The SK3028 consists of a matched pair of SK3026 transistors, and is intended for push-pull class B power amplifier stages delivering approximately 15 watts output. The SK3029, consisting of a matched pair of SK3027's, is intended for push-pull class B audio power amplifier stages delivering approximately 40 watts output.

Rectifier Line Now Covers Voltage Range from 200 Volts Up to 1,000 Volts

Four recently added silicon rectifiers, together with two previously available rectifiers, offer you a wide choice of devices to fit voltage requirements of equipment under repair.

Peak reverse voltages for the SK-3030, SK3031, SK3032, and SK3033 are 200, 400, 800, and 1,000 volts, respectively, all at a DC output current up to 1 ampere. All four types are intended for replacement use in color and black-and-white TV receivers, radio receivers, hi-fi equipment, phonographs, and other entertainment-type electronic instruments.

Additional Advantages

RCA "Top-of-the-Line" SK-Series replacement semiconductor devices are precisely engineered, manufactured, and tested specifically for replacement use. These devices cover a vast area of solid-state servicing needs in equipment ranging from line- and battery-operated radios and phonographs to AF amplifiers, tape recorders, and television receivers.

With this wide-scope application comes a ready-made replacement market — a market for which RCA has paved the way through original-equipment sales to manufacturers who comprise a virtual "Who's Who" in electronics. The right "mix" of product types assures you of devices that can readily serve the replacement needs of your customers.

For your added convenience, SK-Series products are packaged in readily identifiable carton or see-through blister containers, and attractively displayed in RCA "Solid-State Centers" at the various distributor locations. A special four-drawer RCA "Top-of-the-Line" Inventory/Storage Cabinet (1L1209) — available through your RCA distributor — provides you with visible, easily accessible product types for your workbench requirements. Here, in a single small container, you can have a complete inventory of vital SK-Series devices that can launch you into the profitable business of solid-state servicing.

To take early advantage of all the benefits RCA "Top-of-the-Line" replacement semiconductors have to offer, contact your RCA distributor as soon as possible.

RCA SK-Series replacement-type semiconductors are available in either handy carton packs or easily identifiable see-through packages which are displayed on "Solid-State Center" panels at distributor locations.

RCA SK-Series Inventory/Storage Cabinet (1L1209) is constructed of rugged, high-impact styrene, and stocks "Top-of-the-Line" carton-pack replacement semiconductors in four individual drawers.

First Kit of its Kind Includes "Short Course" in Integrated Circuits

New Integrated Circuit Unit Featured in Expanding Line of RCA Experimenter's Kits

You've probably heard the exciting news already — about RCA's new KD2112 Integrated Circuit Oscillator and Amplifier Kit — first complete experimenter's kit of its kind. The facts on this amazing up-to-date electronics "package" are contained in special feature articles in the April issue of "Popular Electronics" and June issue of "PF Reporter."

In case you haven't, however, this latest addition to RCA's growing line of experimenter kits introduces you into the fascinating new world of integrated circuits with all the components you need to build a 500-milliwatt audio amplifier or a variable-tone audio oscillator.

With this kit you receive a copy of the "RCA Integrated Circuit Experimenter's Manual," a 20-page booklet of instructions which virtually amounts to a "short course" on this new device.

As an instructional aid, for example, the kit makes it easy for novices to trace the circuit, study its interconnections, and compare them with the over-all schematic through use of photographs of "chip" components included and identified in the Manual.

Key component in the KD2112 kit is RCA's linear integrated circuit CA3020, a multi-purpose wide-band audio amplifier containing the equivalent of 7 transistors, 11 resistors, and 3 diodes. A "non-operating" integrated circuit with metal case removed is also included in the kit for instructional purposes.

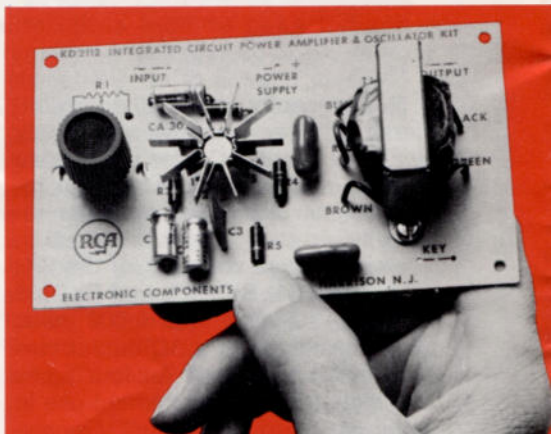
After the kit is assembled, you can connect it to a power supply and loudspeaker for use with a musical instrument, phonograph, or public address system. By adding other components supplied in the kit, you can also adapt the assembled unit for use as a code key oscillator.

Three Earlier Announced Kits Offer Choice of 24 Circuits

In addition to the flexibility offered you by the new KD2112, three earlier introduced RCA experimenter's kits give you a wide range of choice in the number and kind of control circuits you can build. With just three kits: a Basic Experimenter's Kit KD-2105; an Add-On Light-Sensor Kit KD2106; and an Add-On Heat-Sensor Kit KD2110, you can construct any of 24 useful circuits.

Detailed information on the construction of these circuits is contained in the 136-page "RCA Experimenter's Manual KM-71, which can be purchased from your RCA distributor. For example, using two KD2105's, additional passive components, and the Manual as a guide, you can build a motor speed control for AC/DC universal motors (series wound) with nameplate ratings up to 6 amperes. You can also "control" any one of many individual tools or appliances such as half-inch power drills, jigsaws, buffers, floor polishers, and mixers. Included in the Manual is complete data on circuits such as 6- and 12-volt battery chargers, lamp dimmers, audio-frequency-operated switches, and heat- and light-operated switches.

New RCA KD2112 Integrated Circuit Oscillator and Amplifier Experimenter's Kit is pictured as self-contained blister/see-through window carton display (above) and as a completely assembled unit (below). "RCA Integrated Circuit Experimenter's Manual" accompanies kit as a 20-page booklet of instructions and "primer" on the fundamentals of integrated circuits.



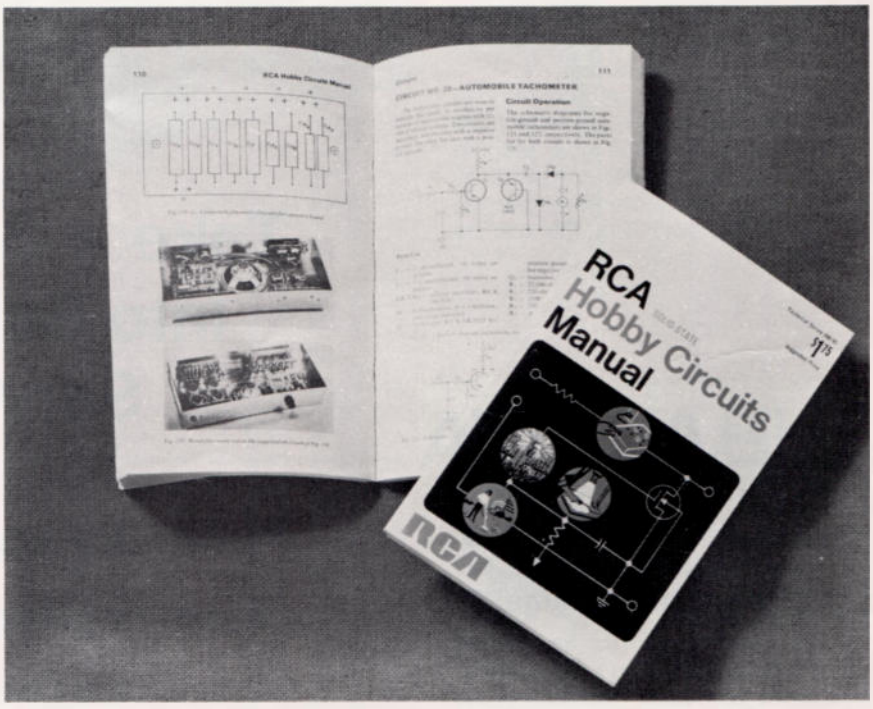
Construction of motor speed control circuits, electronic timers, electronic flashers, switches, and battery chargers is included among the myriad applications for RCA Basic Experimenter's Kit KD2105 and supplementary "Add-On" kits KD2106 and KD2110.

Two New RCA Publications Widen Coverage Of Supporting Technical Literature For Novices and 'Pro's' in Solid-State Servicing

"RCA Solid-State Hobby Circuits Manual, HM-90" Slated For Role as "Best Seller" in Electronic Hobbyist Market

A newly announced hobby circuits manual and an RCA "Top-of-the-Line" product replacement guide have been added to the wide selection of RCA instructional and reference literature available to novices and trained technicians engaged in the field of solid-state servicing.

The new publications join a list of technical manuals and booklets featuring such widely acclaimed works as the "RCA Transistor Servicing Guide" (1A1673), "RCA Transistor Manual — SC-13," "RCA Linear Integrated Circuits Manual" (IC-41), "RCA Silicon Controlled Rectifier Experimenter's Manual" (KM-71), and the "RCA Silicon Power Circuits Manual" (SP-50).



RCA's New Solid-State Hobby Circuits Manual Has Tremendous Appeal

Whether you're a beginner or an expert, the new "RCA Solid-State Hobby Circuits Manual, HM-90" presents you with the "how" and "why" of solid-state theory and application as you've never been able to digest these facts before!

The 224 pages of easy-to-read, profusely illustrated text provides complete details on functional solid-state circuits for use in the shop, the home, your automobile, and in numerous hobbies and pastimes — including amateur radio, amateur photography, and music. With this information is included 35 practical and highly useful construction projects employing integrated circuits, transistors, diodes, SCR's, triacs, MOS transistors, and light and heat detectors.

As a special aid to the novice and a "refresher" to the initiated, the text features comprehensive sections on the theory and practical application of solid-state devices, and on circuit operation, construction, and troubleshooting. Included in the introductory sections of the Manual is information on basic circuit "building blocks," construction procedure, tools required, soldering techniques, and testing.

The 35 practical circuits offered in the Manual cover the following applications:

- Automotive Circuits (temperature alarm, tachometer and automatic light minder—for positive and negative ground—and battery charger)
- Amateur Radio Circuits (fixed or variable power supplies, simple code-practice oscillator, audio oscillator, semi-automatic electronic keyer, automatic keyer, dip-wave meter, variable-frequency oscillator — VFO — a VFO calibrator, audio-frequency-operated switch, and a frequency-selective AF amplifier)
- Music Buff Circuits (audio oscillator, microphone preamplifier, audio mixer, compressor, and line amplifier, electronic "fuzz" box, phonograph preamplifier, audio amplifier, electronic metronome, and single-voice organ)
- "Home" Circuits (lamp dimmer, temperature alarm, positive action light-operated switch, moisture-con-

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trolled switch, metal detector, motor speed control, electronic flasher, and electronic time delay)

- Photographer's Circuits (battery charger, universal timer, and enlarger exposure meter)
- "Fun" Circuits (model train and slot-car speed control, electronic slot machine, electronic dice, and electronic siren)

The operation of each of the 35 circuits is described in detail. Included with procedural instructions are photographs, schematic diagrams, parts lists, and construction layouts. Full-size drilling templates accompany most of the circuits to simplify their construction.

As an electronic technician, you can gain tremendous benefits from all the information the new Manual has to offer. As an electronics technician, home and automobile owner, and hobbyist, your benefits can be tripled.

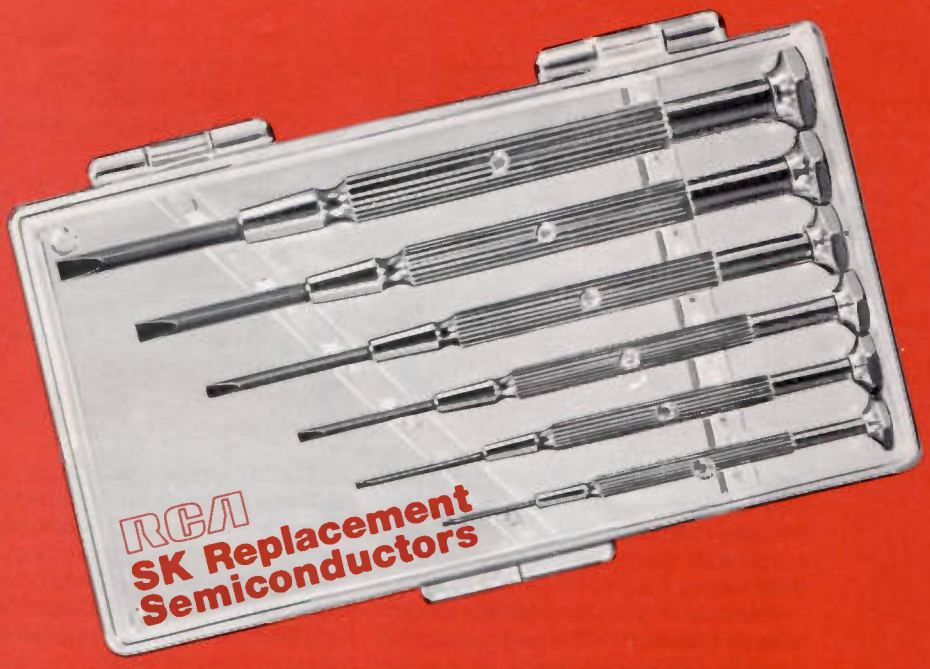
Over 2,200 New Devices Included in Latest Version of SK Replacement Guide

More than 2,200 new semiconductor devices widely used in domestic and imported entertainment-type electronic equipment have been added in the "RCA Solid-State 'Top-of-the-Line' Catalog and Replacement Guide" (SPG-202F) — just off the press.

This latest version of the Guide, which supersedes the SPG-202E, lists more than 8,600 transistor types which can be replaced by 25 RCA transistors in the SK line. Also listed are over 3,200 selenium and silicon rectifier types which can be replaced by six SK rectifier types, and many integrated circuits which can be replaced by RCA's SK3022 and SK-3023 integrated circuits.

Typical performance data and illustrations of newly added transistor types RCA-SK3034 and RCA-SK3035 are presented in the Guide, together with a brief summary of trouble-shooting techniques.

As additional aids to the technician, the 36-page Guide includes an "Applications Chart" with basic descriptions for all 33 devices in the SK line. Also included are dimensional outlines and terminal diagrams for these devices. The overall listing consists of approximately 11,800 domestic and imported semiconductor types, and the recommended RCA SK-Series replacement semiconductor for each device.



'Tooled Up' for Miniaturized Circuits?

AVAILABLE

With Your Purchases of RCA 'Top-of-the-Line' SK-Series Solid-State Replacement Devices

'Jeweler's Type' Screwdrivers Help Service Tiny Components In Tight, Hard-to-Reach Areas

Having the right tools for a job is always important — especially when the job calls for hairline precision and delicate execution in a closely confined working area.

That's why RCA and your RCA semiconductor products distributor — recognizing your special needs in solid-state servicing — have come up with a set of screwdrivers carefully selected to help you perform your work with miniaturized circuitry more quickly and efficiently, thus giving you an important edge in time factors so vital in today's servicing.

The RCA SK Replacement Semiconductor Screwdriver Set (1L1276) — available with your purchases of RCA "Top-of-the-Line" solid-state devices — is among the newer of many aids being made available by your RCA distributor to assure your progress in solid-state servicing. Consisting of six separate, varied-size screwdrivers housed in a durable, clear-plastic case, this set provides a range of blade widths from 0.8 mm to 3.8 mm (0.0315 inch to 0.1496 inch).

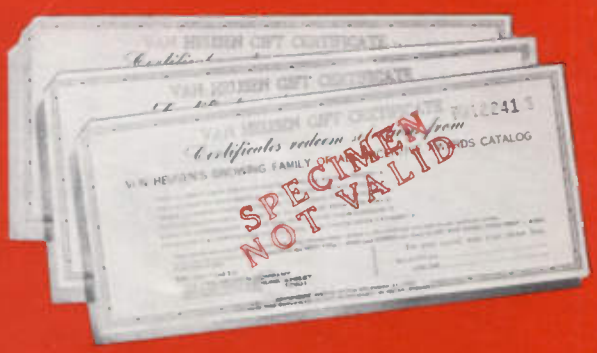
Once inserted into a screwhead, each screwdriver can be held firmly in place by pressure on its recessed top, while free-pivoting handle and blade are rotated to remove or replace the screw.

Long, slender design of the chrome-plated brass handles permits insertion of screwdrivers into narrow spaces. Hardened, rustproof blades are made of tempered tungsten-steel.

RCA Announces a Special Opportunit

With These...

Valuable Gift Certificates Available with Your Purchases of RCA Entertainment-Receiving Tubes From Participating RCA Distributors



RCA invites you to join the exclusive world of latest fashions by Van Heusen — creator of wearing apparel with the bright, smart look of distinction.

Brought to you through the cooperative efforts of RCA and your participating RCA distributor, this special offer introduces you and your family to hundreds of the newest modes in formal, informal, and recreational wear — all now available to you with your purchases of RCA entertainment-receiving tubes.

Ask your RCA distributor to show you the handsome 24-page catalog (1A1730) describing and picturing the vast array of selections in vivid, full-color detail. In six individual sections of the catalog are gift catego-

Right on target! Van Heusen Vanopress™ cotton-blend oxford button-down dress shirts are permanently pressed and never need ironing. Fine combed cotton — fortified with polyester — is soft, comfortable, longer wearing — tailored in Soilaway finish, trim "417" V-taper styling, and single cuffs.

SECTION "A"

Van Heusen Help

Here Ar
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and You

A real winner, the Arnold Palmer Jacket features handsome, permanent-press styling with a special water-repellent finish. The zip front, convertible storm collar, "action" back, and full-cut armholes assure lots of room and built-in protection for a free-swinging game. Jacket is offered in choice of four colors, sizes 36-46.

SECTION "C"

Distinctively feminine, these Lady Van Heusen Vanopress pleated shirts are styled in elegant French cuffs, smart Italian collar, and soft white, pink, and blue colors — sizes 8-18.

SECTION "B"

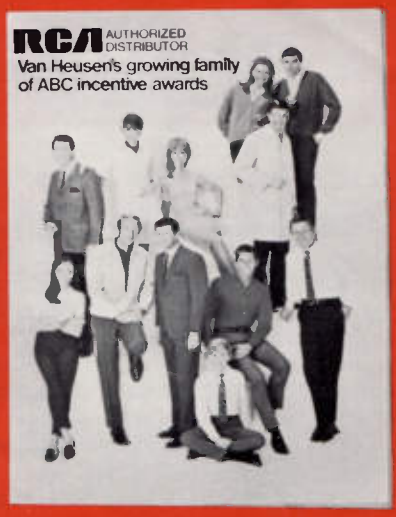
ITEM V

Section "A" — On
Section "B" — Tw
Section "C" — Th
Section "D" — Fo
Section "E" — Ei
Section "F" — Fo

ity For You to Enjoy Van Heusen Quality

You Earn...

Hundreds of Exciting Choices in Exclusive Dress and Sports Wear Featured in Six Handsome Gift Categories for the Entire Family



ries — specially arranged for your convenience — according to the number of Van Heusen Gift Certificates you earn with your purchases. Each of these gift categories contains styles, sizes, and colors to suit a wide range of preference. Many also feature distinctive selections from the famed "Lady Van Heusen" line of feminine apparel, as well as durable, attractive wear for the younger set.

Your RCA tube distributor will tell you how you can earn Van Heusen Gift Certificates with your purchases of RCA entertainment-receiving tubes. Act now — to take full advantage of this special offer during the full swing of the outdoor summer season.

os You Live in Style!

Are Some
n Selections
Hundreds
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ble to You
our Family

I VALUES

One Certificate
Two Certificates
Three Certificates
Four Certificates
Eight Certificates
Fourteen Certificates

Classic cardigan styling and super-fine detailing make these men's and women's Alpaca-blend sweaters a superb choice for all occasions. Luxury combination of 50% Alpaca and 50% wool is rich looking, lightweight, and comfortable.

SECTION "D"

"Cricketeer Hopsack Blazer" is modeled in natural shoulder styling with hook center vent, and is offered in rich, Navy Blue color. Jacket comes in "Regular" sizes 38-44; "Short" sizes 38-42; and "Long" sizes 38-46.

SECTION "E"

J & F Classic Sharkskin Suit is styled in handsome 100% wool worsted sharkskin with two-button style center vent coat. Plain front trousers of this grey classic are provided uncuffed. Suit is offered in "Regular" sizes 38-44; "Short" sizes 38-42; and "Long" sizes 38-46.

SECTION "F"

Across *the* Bench

By 'Doc'

Last night our local distributor held a service meeting. As usual, a bunch of us went out afterwards for more conversation and refreshments.

Guess I'm getting old, because I've been tired all day. But the get-together was well worth it. I'm not so old that I don't pick up a lot of useful information at a dealer meeting. Besides, it's the only real chance I get to see some of the other fellows around town and talk shop.

Even the post-meeting bull sessions can be helpful — if you're cagey enough to filter out fact from fiction. Last night, for example, Bernie came out with some interesting pointers.

Bernie works a section of town where line voltage occasionally runs wild. A couple of times, he's seen it jump to 140 volts. Now, this kind of voltage can be a real troublemaker — a fact to keep in mind when you get a set that keeps popping tubes or won't stay in sync.

Too often, though, you can check a customer's voltage and find it normal. But all you have to do is walk out the door and it changes.

When Bernie suspects line-voltage problems, he plugs in an AC-line-voltage monitor — an RCA WV-120A — and leaves it for a couple of days. He tells the customer to record the reading when it goes over 125 volts.

The WV-120A is made especially for jobs like this. It's got an iron-vane meter so it will follow fast voltage changes. It's also accurate on a noisy line.

Some TV chassis, such as RCA color models, have a 128-volt primary tap but are factory-wired for 117-volt operation. If line voltage in a customer's home is consistently high, try changing the primary tap. That little trick has cured many of the chronic TV troubles I've run across.

The subject of last night's service meeting was "TV Alignment." It's surprising how many fellows struggle along in this business without sweep gear. More than one have brought me sets they couldn't check for bandpass problems.

It takes only a few minutes to run a sweep curve, but those few minutes can sure tell you plenty. Even if you learn that there's no bandpass trouble and that alignment is perfect, you've avoided a lot of guesswork and wasted time.

More often than not, that's the case with my sweep checks. But when I *do* have misalignment, my sweep check tells me right away where to start working. And that's exactly the point the RCA field engineer was trying to get across at last night's meeting. Sweep gear is just as useful for checking and for general troubleshooting as it is for bandpass alignment.

The fellow who gave the alignment demonstration last night made some good points. Maybe I think they're good because I agree with them. For what they're worth, here they are:

Sweep and marker generators are your measuring tools; you use them as reference standards. The fellow who has a poor-quality generator is using a 33-inch yardstick.

If you're going to get a sweep generator, make sure you can use it for sweeping video and chroma circuits. That means you'll need output from about 50 kHz to 5 MHz. Not all sweeps will work that low, but you'll need one for color work.

While you're at it, make sure the sweep output is flat. If it isn't, you won't know if your sweep curve truly represents receiver bandpass response. A good sweep generator should be flat within ± 0.1 dB per MHz of sweep width. With a 10-MHz sweep width, then, you'll know that over-all output is flat within 10 per cent.

For VHF tuner work, sweep width should be 12 MHz wide so you can see a complete curve. You'll also need about 0.1-volt output on all channels so you can ram a signal through a defective tuner.

The weakest spot of all sweep generators, I've found, is the attenuator. If you have a good one, you should be able to adjust output from practically nothing upwards without tilting or distorting the response curve. If you set your AGC bias right on a tuner, for instance, you should be able to vary generator output voltage without changing the shape of the tuner curve.

My RCA generator has IF and video output all the way from 50 kHz to 50 MHz so I can use it for video, chroma, and IF-amplifier alignment. It also has output at fundamental frequencies on each of the VHF channels, plus the 88-to-108-MHz band. This comes in handy for FM tuner work.

Sweep-frequency linearity is another important generator characteristic, but you won't usually find it described in the manufacturer's specifications. If the sweep output is linear, you can be sure that each increment of the horizontal trace represents the same frequency integral. It's like a ruler divided into exactly equal parts.

You'll find some generators, however, that don't have linear traces, and a 1-MHz interval at one point on the trace is smaller or larger than a 1-MHz interval at another point. You can check your sweep-generator linearity by using a marker signal. Vary the marker frequency in 1-MHz steps all along the sweep trace. On a good sweep generator, the frequency linearity should be in the order of 1.25-to-1.0 maximum deviation. If your generator sweep exceeds this ratio, the displayed response curves may be misleading.

Most sweep generators have continuously tunable output on the RF channels. If their tuning dials are calibrated only in broad channel numbers, you'll need a marker generator signal for spotting the centers of each channel.

With my generator, however, you can quick-check the bandpass and centering of a tuner instantaneously because channel sweep frequencies are preset. All I have to do is switch from one channel to another. I can check a tuner on all channels in a few seconds — and I don't need a marker to tell me if the sweep signal is centered on the channel frequency. You can work just as fast as I can if you've got an RCA WR-69A Television/FM Sweep Generator. That's what I use.

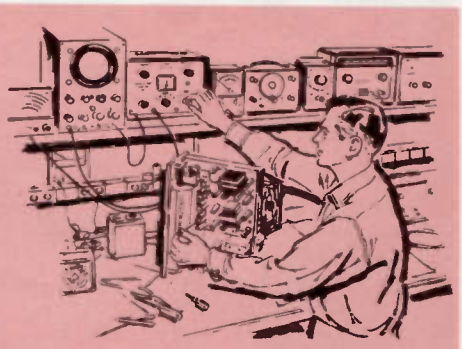
You'll also need a 300-ohm balanced output for working directly into tuner terminals. Also make sure the generator has a retrace blanking circuit. When you switch blanking in, you'll get a base line under the response curve on the 'scope. You need that for checking amplitude and gain. Either your 'scope or the generator should have a phase

control, too, so you can get your generator and 'scope sweeps to coincide.

I get a lot of use from my alignment gear. As I said earlier, I use it just as often for checking as I do for circuit adjustment. It's really a time-saver during troubleshooting. One reason I lean so much on it is because it's both dependable and accurate. I know I can trust it. In fact, a lot of TV-set manufacturers use the RCA WR-69A for the same reasons I do.

I guess I sound like that fellow who gave the talk last night. But just speaking from my own experience, I do know that my investment in sweep equipment was one of the best I've ever made. Today, I can't even remember what it cost me. Whatever the cost, though, it was worth it because the equipment has paid for itself several times over.

"Next Question, Please"



Here are answers to some of the questions radio/TV/hi-fi technicians frequently ask about RCA test instruments or the troubleshooting and servicing of equipment in general. You may find this information of particular interest or application in your own field of operations.

Q – *I have an old RCA oscilloscope which I can no longer calibrate. When I turn the vertical gain pot' all the way up, the calibration waveform is still too small. What is the matter?*

A – Make sure your line voltage is normal. If so, check tubes in the vertical amplifier. If they are old, 'scope amplifier gain may be too low to give sufficient deflection.

Q – *What is a 'scope's "Z-axis" terminal for?*

A – This terminal connects to grid No. 1 of the cathode-ray tube. An external AC signal of sufficient voltage amplitude can then be applied to blank the 'scope trace. This feature can be used to mark the trace in time or frequency increments.

Q – *I have a chance to buy a lab-type 'scope with triggered sweep at a good price. Would this be better than my regular 'scope for TV repair work?*

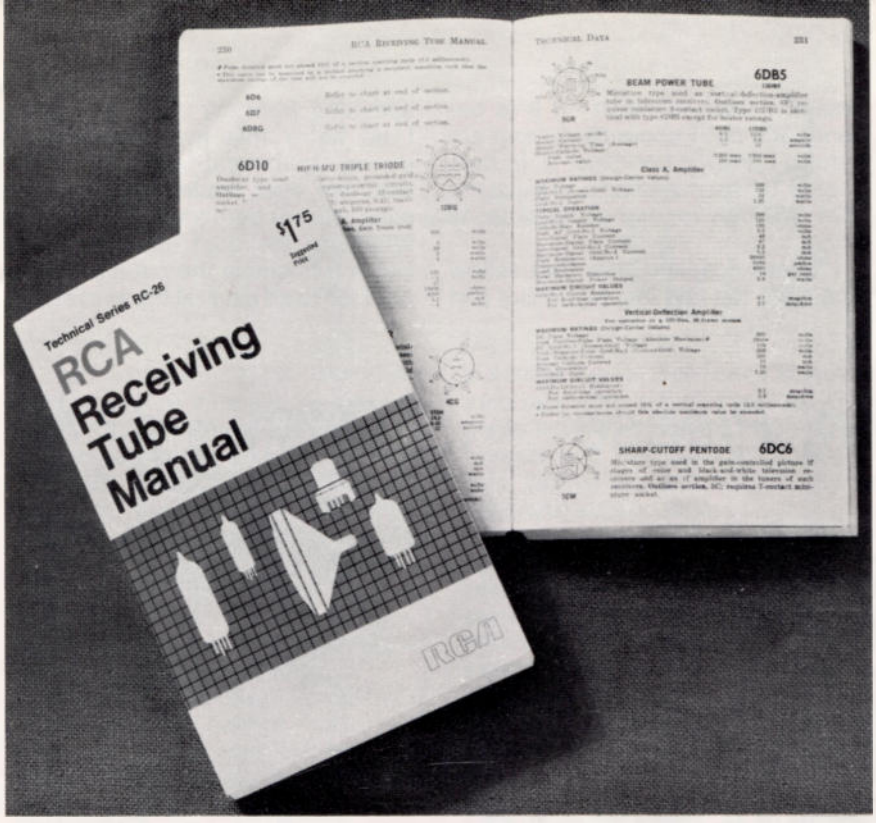
A – No. In fact, it wouldn't work as well as a good 5-MHz 'scope having old-fashioned repetitive sweep. Too often, a triggered 'scope won't lock in on a composite TV signal because sync keeps jumping between video signal peaks, and the V and H pulses.

Q – *What does "VSM" stand for? I frequently see this term in TV service notes.*

A – Video Sweep Modulation. It's a system used to modulate a CW-RF signal from a marker generator with a video frequency signal from a sweep generator. With it, you can feed the signal into the tuner of a color set and check bandpass performance all the way through the chroma section.

Q – *Why don't you put the isolating resistor in your VoltOhmyst® probe inside the instrument so you don't have to use separate DC and ohms leads on your WV-77E VoltOhmyst?*

A – The isolating resistor in the probe reduces loading on the test point by isolating the input-capacitance of the VTVM. Without the probe resistor for DC-voltage measurements, you could kill receiver-amplifier or oscillator action.



Serving Your Needs in a Brand-New Edition:

The Most Complete and Authoritative Receiving Tube Manual in the Industry!

Announcing the "RCA Receiving Tube Manual, RC-26" — newest edition of a distinguished publication regarded as the industry's best reference source for information on receiving tubes!

Bigger and better than ever, the RC-26 brings you the latest data on the complete RCA line of receiving tubes for entertainment-type equipment, picture tubes for black-and-white and color television receivers, and voltage-regulator and voltage-reference tubes.

Basic tube technology, operating characteristics, applications, ratings, and testing are discussed in easy-to-read text sections.

Featured among the remaining sections of the Manual is an extremely useful "Application Guide for RCA Receiving Tubes," which can be used for selecting an "optimum" tube type for a given circuit application.

Another highlight of the RC-26 is the expanded "Circuits" section, which has been broadened in terms of both the number of circuits included and the types of applications illustrated. Shown in this section are schematic diagrams, parts lists, and detailed functional descriptions of 36 individual circuits for AM and FM receivers, audio-amplifier systems, test equipment, and black-and-white and color television receivers. Several additional circuits illustrate the various stages of a complete color television receiver. The descriptive writeups of these circuits provide the reader with a good basic understanding of the operation of currently popular color receivers.

Included in the remaining portion of the Manual are separate sections covering "Technical Data for RCA Tube Types," "RCA Types for Replacement Use," "RCA Voltage-Regulator and Voltage-Reference Tubes," "Resistance-Coupled Amplifiers," and a "Picture Tube Characteristics Chart." Profusely illustrated throughout its entire 658 pages, the RC-26 includes basing diagrams for RCA receiving tubes and picture tubes, and a special section showing dimensional outlines for metal- and glass-type tubes.

For more convenient referencing of the latest tube types, the "Technical Data" section — providing comprehensive data and curves — has been restricted to coverage of active RCA types. Basic data for replacement and discontinued RCA tubes are presented in the "RCA Types for Replacement Use" table.

TEXT CHAPTERS IN "RCA RECEIVING TUBE MANUAL, RC-26

- **Electrons, Electrodes, and Electron Tubes (covering electrons; cathodes; generic tube types; diodes; triodes; tetrodes; pentodes; beam power tubes; multi-electrode and multi-unit types; receiving tube structure; and television picture tubes)**
- **Electron Tube Characteristics (covering "static" and "dynamic" characteristics of electron tubes)**
- **Electron Tube Applications (covering general system functions; rectification; detection; amplification; television scanning, synchronization, and deflection; oscillation; frequency conversion; and tuning indication with electron-ray tubes)**
- **Electron Tube Installation (covering filament and heater power supply; heater-to-cathode connection; plate voltage supply; grid-voltage supply; screen-grid voltage supply; shielding; dress of circuit leads; filters, output coupling devices; high-fidelity systems; high-voltage considerations for television picture tubes; and picture-tube safety considerations)**
- **Interpretation of Tube Data (covering ratings; characteristics; typical operation values; and safe-area chart)**
- **Electron Tube Testing (covering short-circuit test; selection of suitable characteristics for test; essential tube-tester requirements; and tube-tester limitations)**

From the RCA Sales Corporation:

RCA

Plain Talk

and Technical Tips

INTERFERENCE TRAPS For TV and FM Receivers

RCA Victor® television and FM receivers are specially designed to reject unwanted signals. Occasionally, however, in areas where undesirable signals are extremely strong, a problem will appear. For example, *adjacent channel interference* may occur in areas where a customer wishes to watch a distant station, and there is a local station on an *adjacent* channel. Although correct antenna orientation and selective tuning will usually help this condition, the unwanted signal may still cause interference. In such cases, a *tuned trap* will usually eliminate the problem.

RF interference is another problem t t so tim pre nts itself. This type interference usually occurs in ar s ere the set is loca " xt door" to a or FM tr itter. These particular circ s c can c e interference on several or all chan an FM receiver, rio sig s may be r eived at sev al spots on the , or in extre c , block out se ral or all FM stations.

In solving problems of an interference nature, it is en desirable to atten te (or reject) a specific fr uency or band of frequencies. In most c , this can be d e by simply stalling *absorption trap* on t anten lead-in. Such traps y quickly constructed by using a section of 0-ohm, flat-ribbon tran ission li , terminat on one end by a small trimmer c acitor. The other end of the trap is short circuited for tr ping VHF sig ls; whereas for UHF, the other end is op -circuited—as shown in Figure 1, at right.

Lengths of 300-ohm line for typical traps are as follows (tuning trimmer capacitance in all cases from 1.5 to 28 pF):

Channels	Length "L"
Ch. 2-6 and FM	8-inch VHF Type A
Ch. 7-13	3-inch VHF Type A
Ch. 14-50	5-inch UHF Type B
Ch. 51-83	3-inch UHF Type B

These traps are installed by taping them to the 300-ohm antenna lead-in. The effectiveness of the trap is controlled by several factors:

• **Position of the trap along the lead-in.** The trap sets up a standing wave at the trapped frequency in the lead-in wire to the receiver. The hnician should move t trap along the lead-in until the optimum trap placement is found, remembering to retune.

• **Physical length of the trap.** The length, "L," may be varied and the trimmer adjusted accordingly. A longer trap tends to be "broad band."

• **Coupling of the trap to the line.** For effective operation, it is necessary that the trap be installed against the flat 300-ohm lead-in. After final adjustment, the trap can be held in place by means of paper or vinyl tape. A convenient initial adjustment technique is to hold it on the 300-ohm line by means of spring-loaded plastic clothespins. The clothespins serve as convenient handles during the initial trimmer adjustment, and allow positioning along the lead-in for optimum attenuation.

For the service technician, practical utilization of the trap may fall into any of three categories.

1. A trap for narrow-band interfering signals.
2. Trapping a broad-band signal such as a television channel.
3. A means for identifying the frequency of an interfering signal in the field.

Narrow-Band Signal

For rejecting a narrow-band signal, the trap is coupled to the transmission line and adjusted to the interfering signal. The trap lengths given in the preceding table will cover the range of frequencies from 50 to 890 MHz. Remember to position the trap al g the l d-in for optimum rej ti .

(C inued on next page)

Figure 1: A rpti tr

Plain Talk and Technical Tips

(Continued from preceding page)

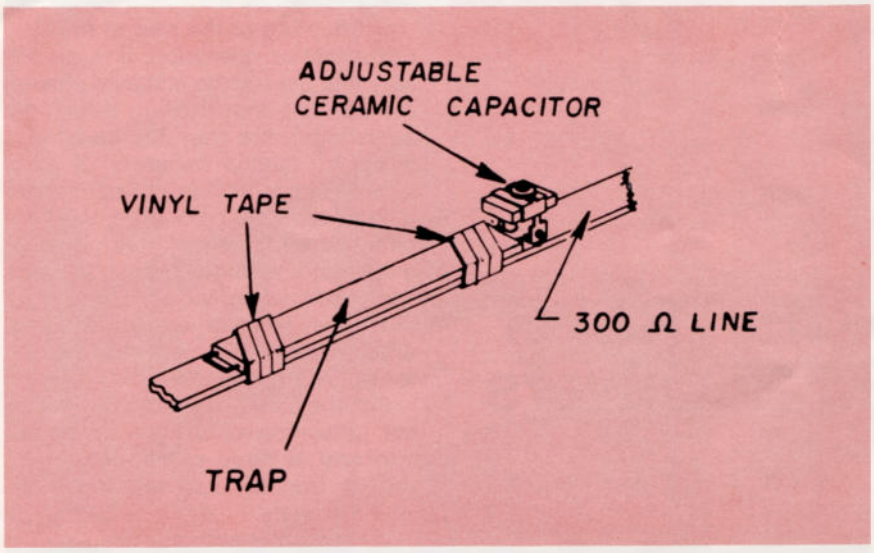


Figure 2: Correct installation

Broad-Band Rejection

Trap circuits can attenuate a *broad-band signal* (such as a strong TV channel) that is interfering with a weaker channel. Because the trap will have a pronounced effect on the channel to which it is tuned, it is very important to check the performance of the receiver on the "trapped" channel, *with* and *without* the trap in place. In particular, a color receiver should be tested with a color program. If undue effect is noticed, it may be necessary to "broad-band" the trap circuit. This may be done in one of two ways: by increasing the length, "L," of the trap and readjusting the trimmer, or, alternatively, by loading the trap with a resistor, typically 10,000 ohms.

Diagnostic Tool

In some cases of unknown interference, the signal frequency may be identified by using a series of trap circuits, taping them, in turn, to the antenna lead-in and tuning to the interference. After a rough check in the field, a more accurate identification can be made in the shop by simply measuring the resonant frequency of the trap with a grid-dip meter.

By making proper use of interference trap circuits, the service technician will find that they can be valuable working aids. Interference may be attenuated and signals of unknown frequency identified without disturbing a receiver installation.

Transistor ACC in the RCA CTC-31 Color Television Chassis

Many RCA Victor color television models for 1968 employ the new CTC-31 chassis. This chassis, while similar in many respects to the earlier CTC-24 chassis, features new chroma circuitry utilizing two bandpass amplifier stages and a transistorized color killer. A second transistor is used in the new *closed-loop* automatic chroma control (ACC) system.

The ACC circuitry in the CTC-31 (shaded area of Figure 3) functions to hold the output of the first chroma amplifier constant during changing signal conditions. Observe in the Figure-3 ACC block diagram that the first bandpass stage (gain controlled by feedback loop) processes both chroma and color sync (burst). The output of this stage contains the amplified color signal (for application to the second chroma bandpass amplifier) and amplified color sync (for the burst amplifier). An injection-locked 3.58-MHz oscillator follows the burst amplifier. DC voltage developed at the oscillator grid circuit is amplified (by a transistor), translated, and coupled to the first bandpass amplifier to control its gain. The control signal (burst in this instance) passes through the controlled stage (first bandpass), thus the *closed-loop* system.

A burst-controlled ACC system operates on the assumption that predetermined information is contained in the amplitude of the reference burst. This, of course, is determined by the FCC's color signal specifications.

The ACC concept can be likened to the familiar AGC. Television AGC systems are designed to respond to constant amplitude sync tips which represent 100 per cent transmitter modulation and are independent of video scene information (note parallel). Some signal independent of video must be used as a reference to obtain a correction control signal — AGC from sync tips, ACC from *burst amplitude*.

Transistor ACC Operation

The CTC-31 injection-locked oscillator system has an existing reference DC voltage developed in the oscillator grid circuit. This DC voltage (once adjusted for the specified level) is a direct result — and a measure of the amplitude — of the incoming burst signal. If the amplitude of the incoming burst signal can be held constant, the output voltage developed in the grid circuit will be held constant. Thus, grid bias voltage can be used to control the ACC amplifier and, consequently, the first bandpass amplifier stage. The transistor ACC stage in the CTC-31 provides high loop gain for the system.

Signal conditions which produce changes in chroma signal level also affect burst in the same way. Thus, oscillator grid voltage can be used to indicate chroma/burst amplitude changes, control the ACC amplifier and, consequently, the first band-

(Continued on page 22)

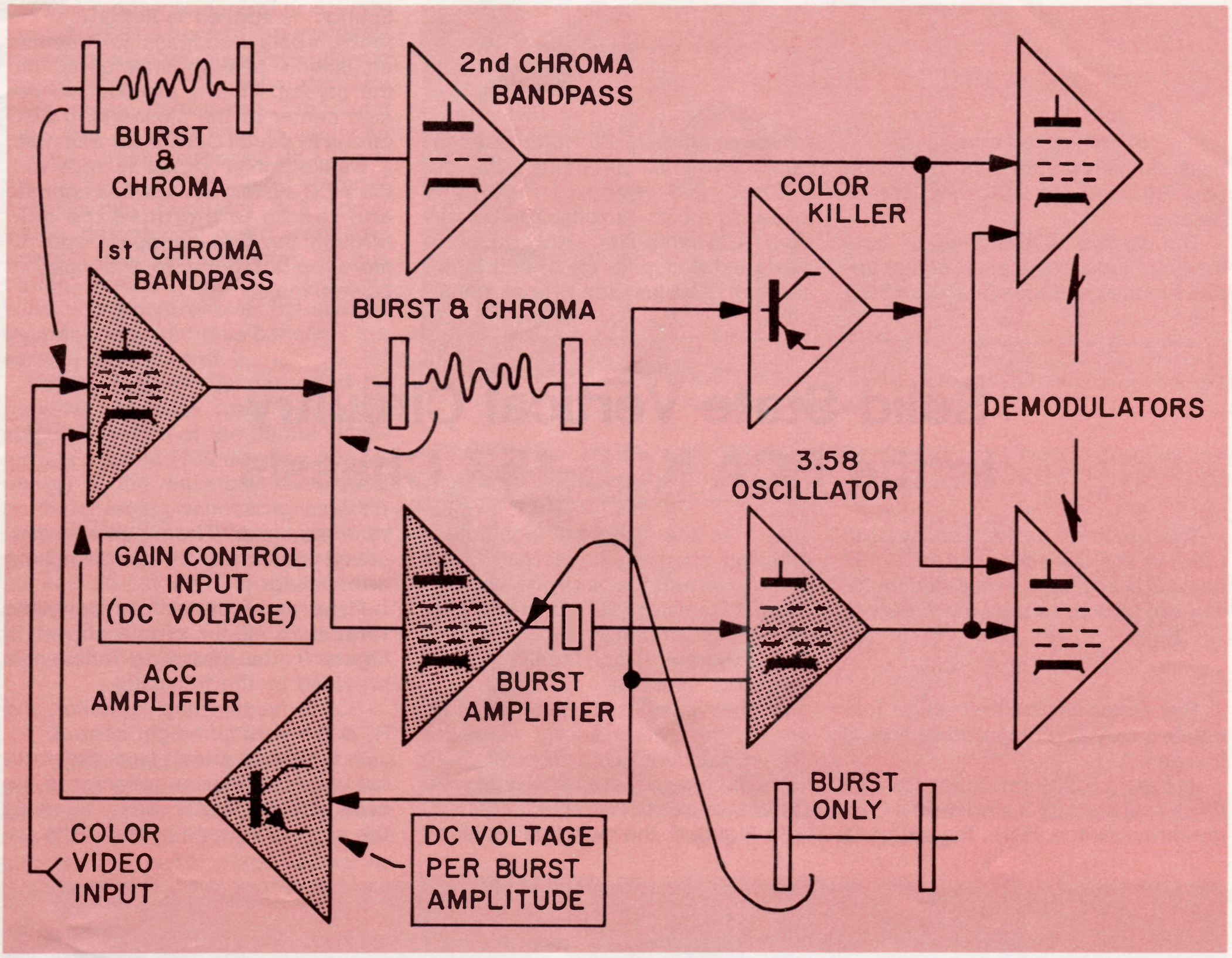


Figure 3: ACC block diagram

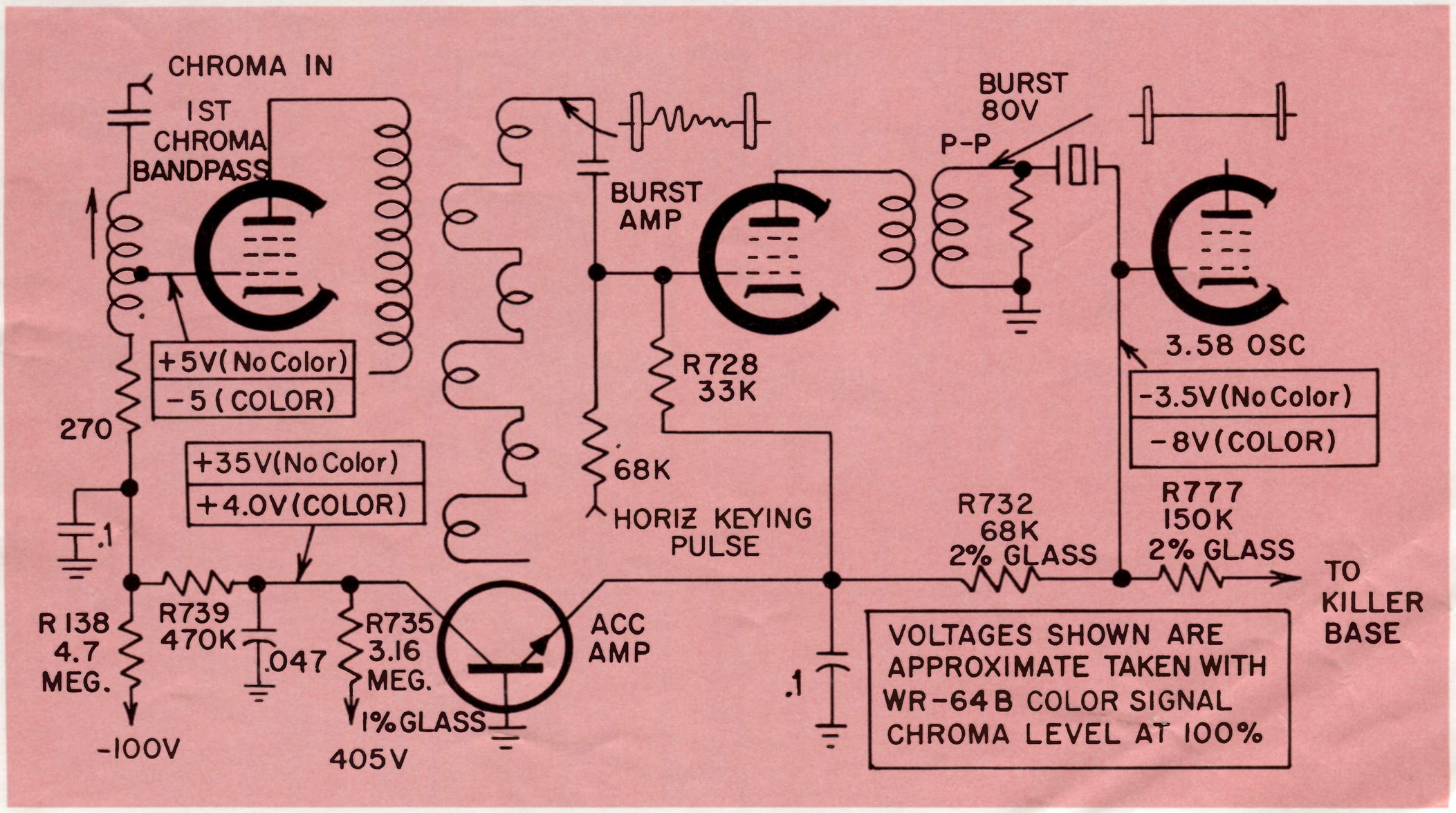


Figure 4: Simplified ACC amplifier circuit

(Continued from page 20)

pass amplifier stage. In operation (see Figure 4), the ACC functions as follows:

The system is designed to hold the amplitude of the burst signal applied to the oscillator (at the crystal) to approximately 80 volts peak-to-peak. With this amplitude, the oscillator grid voltage (ring-up) is approximately —8 volts. The DC circuit (ACC amplifier network) is so designed that, with an 80-volt burst, correct DC bias (for proper amplification) is applied to the grid of the first chroma bandpass to *maintain* an 80-volt peak-to-peak burst into the crystal. This is the nominal design center of the closed-loop ACC circuit in the CTC-31. If, for example, a weaker color signal is received, the ACC system senses this change, and reacts to increase the gain through the first bandpass and restore output burst to the nominal 80-volt value.

Solid-State Vertical Circuitry In the RCA KCS-157 Chassis

The vertical deflection system used in the transistorized KCS-157 chassis is basically a modified multivibrator circuit, as shown in Figure 5.

Vertical Oscillator

The action of the first stage (oscillator) may be compared to that of a switch.

In Figure 6, the oscillator transistor is replaced by a single-pole/single-throw switch. Here, the switch is shown in the "charge" position — allowing charging capacitor "C" to charge from the supply voltage through resistor "R." This charging voltage is amplified by the output stage, thereby supplying the vertical yoke trace current.

In the "discharge" position (Figure 7), the switch shorts capacitor "C" and discharges it. The resulting voltage change is translated as yoke retrace current.

In Figure 8, the switch is replaced by a transistor. The result is a simplified electronic vertical switching or oscillator circuit.

Referring to the more complete vertical oscillator circuit shown in Figure 9, the switching function is provided by the transistor.

"C" is the charging capacitor, and R_1 is the vertical height control.

A feedback circuit from the vertical output transistor collector to the oscillator transistor base supplies the vertical retrace pulse to the os-

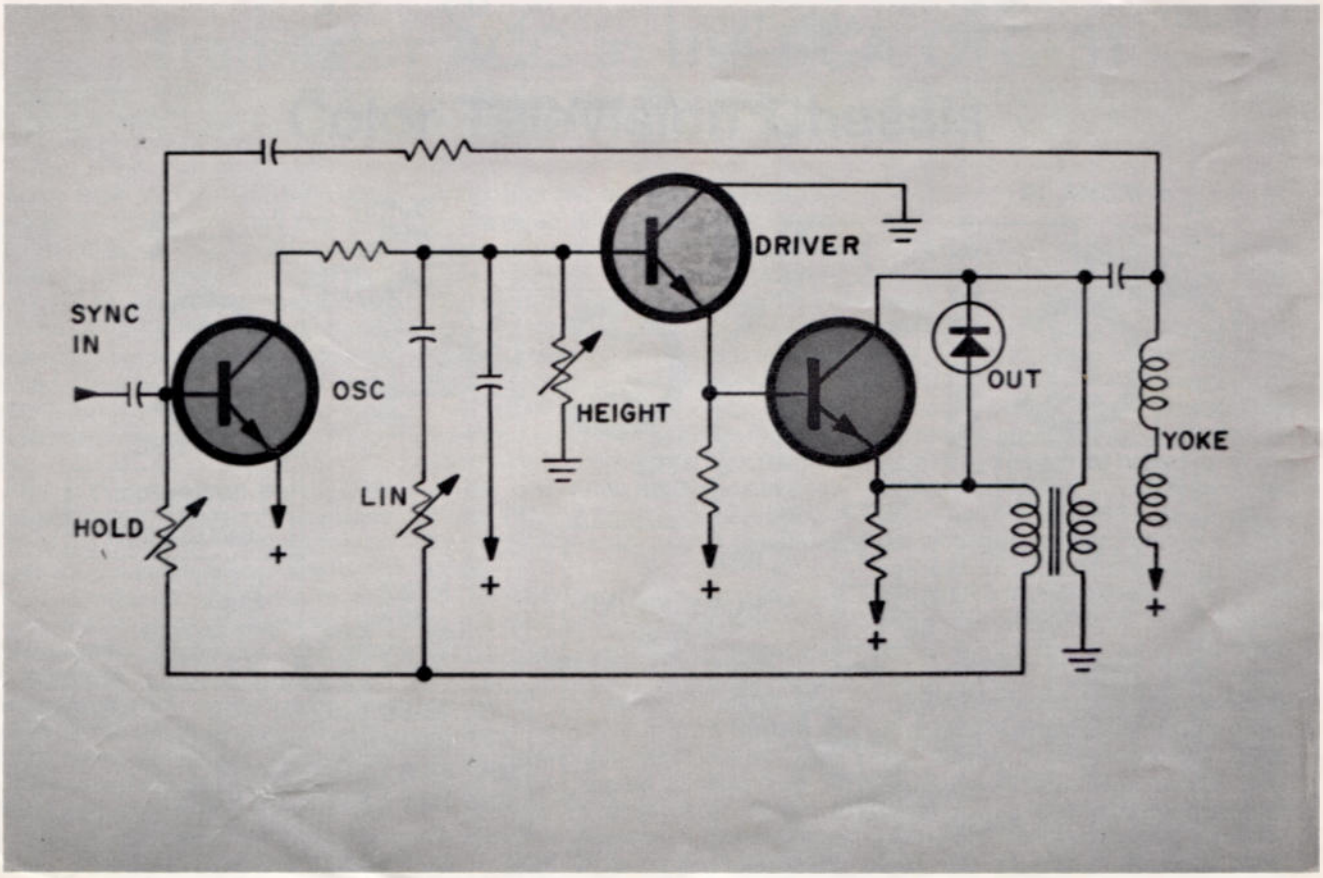


Figure 5: Vertical deflection circuit

cillator in order to control its switching action. The base of the oscillator transistor also receives vertical sync pulses from the sync separator. The sync pulse determines the exact time that the oscillator is switched "on." Another feedback path — from the emitter of the oscillator stage — controls the oscillator "off" time, which determines basic switching frequency of the oscillator. In this circuit, variable resistor "R_2" provides some control over the switching frequency and thus becomes the *vertical hold* control.

Vertical linearity is optimized by negative feedback from the output stage. A portion of the output waveform is applied (180 degrees out-of-phase) to the waveform developed on the charging capacitor, resulting in the cancellation of any waveform non-linearities at the charging capacitor. Resistor "R_3" controls the amplitude of the feedback applied to the charging capacitor, thus serving as the *vertical linearity* control.

Vertical Driver

A buffer amplifier or driver is employed to prevent the low input impedance of the output stage from excessively loading the charging capacitor. The buffer stage shown in

(Continued on next page)

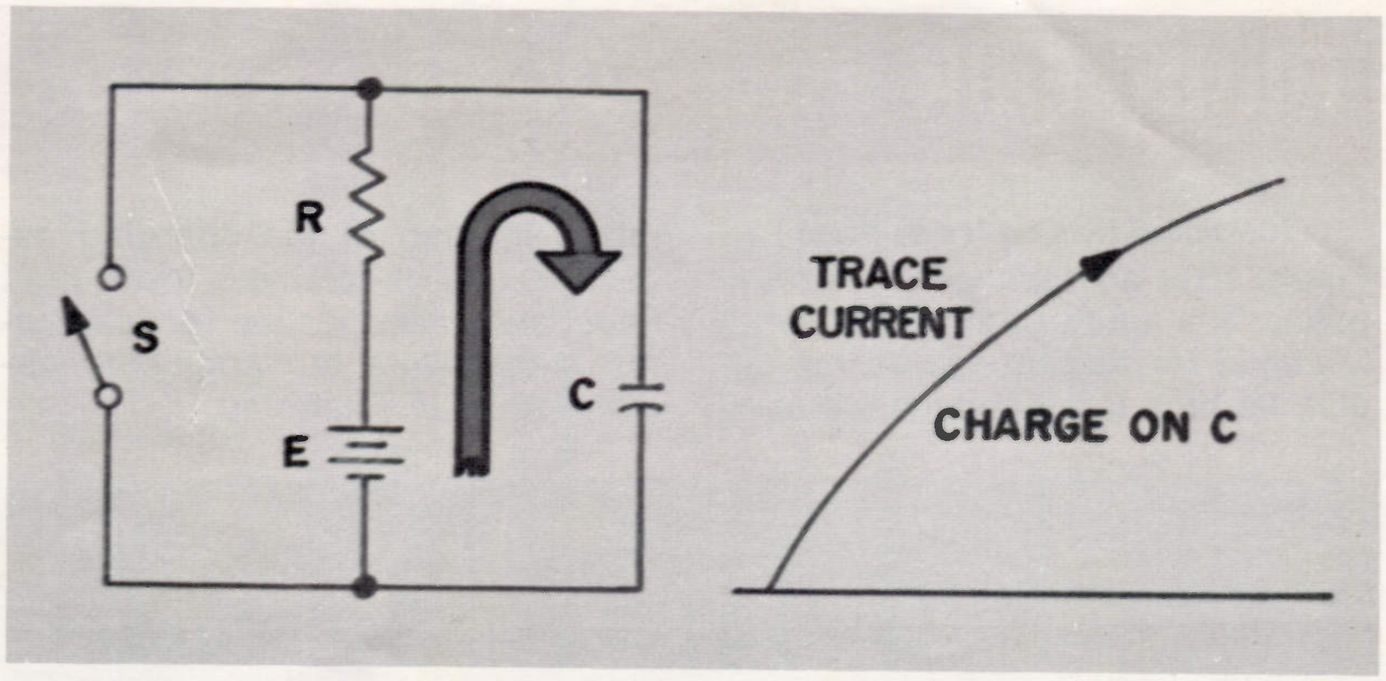


Figure 6: Switch in "charge"

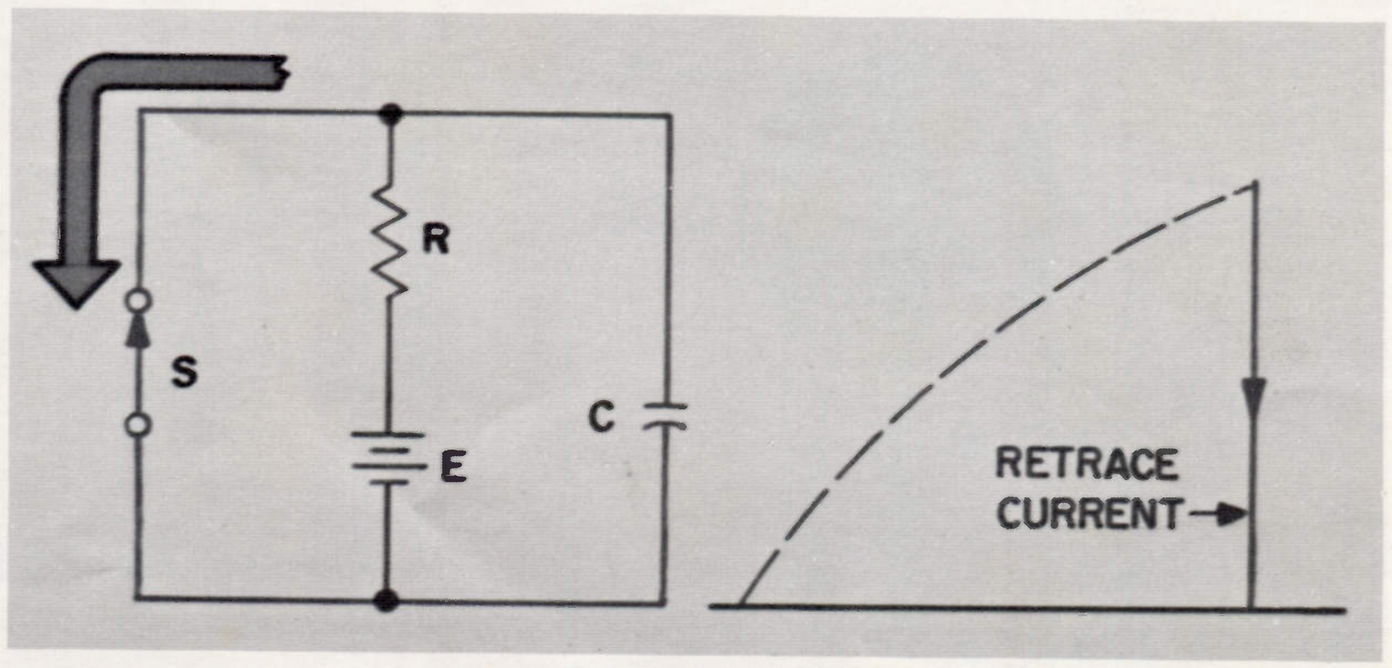


Figure 7: Switch in "discharge"

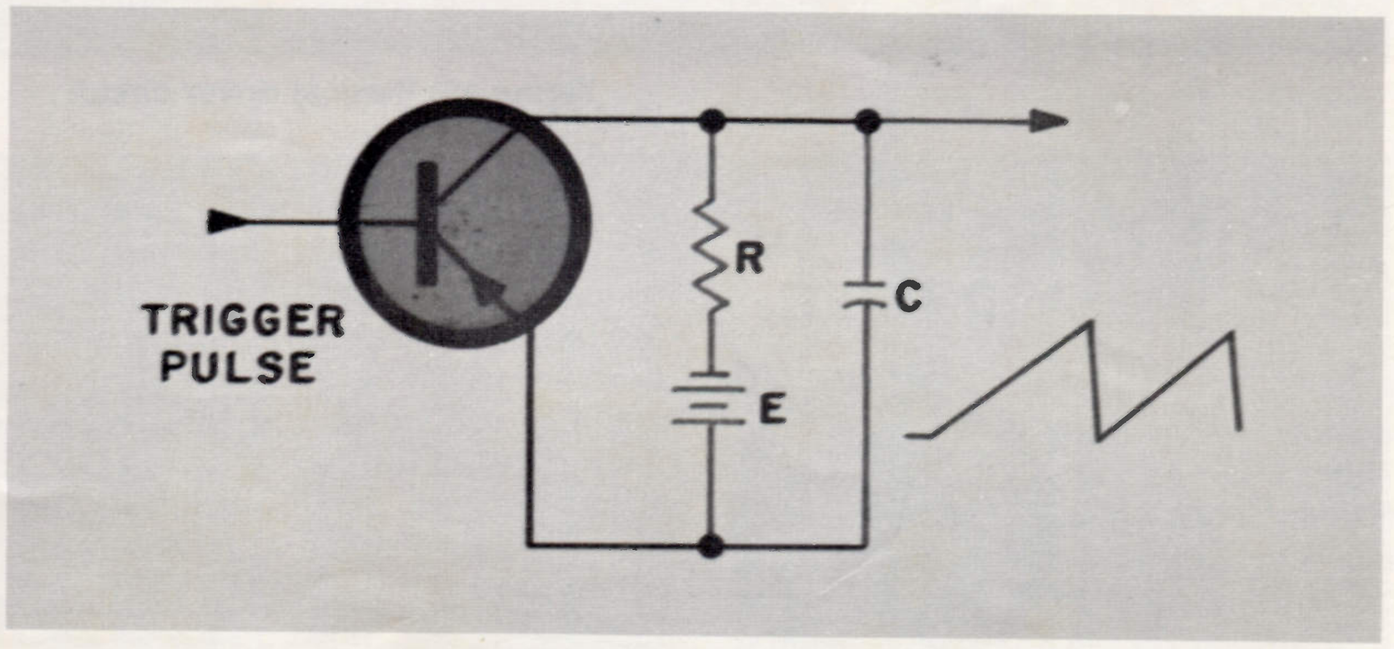


Figure 8: Vertical oscillator "switch"

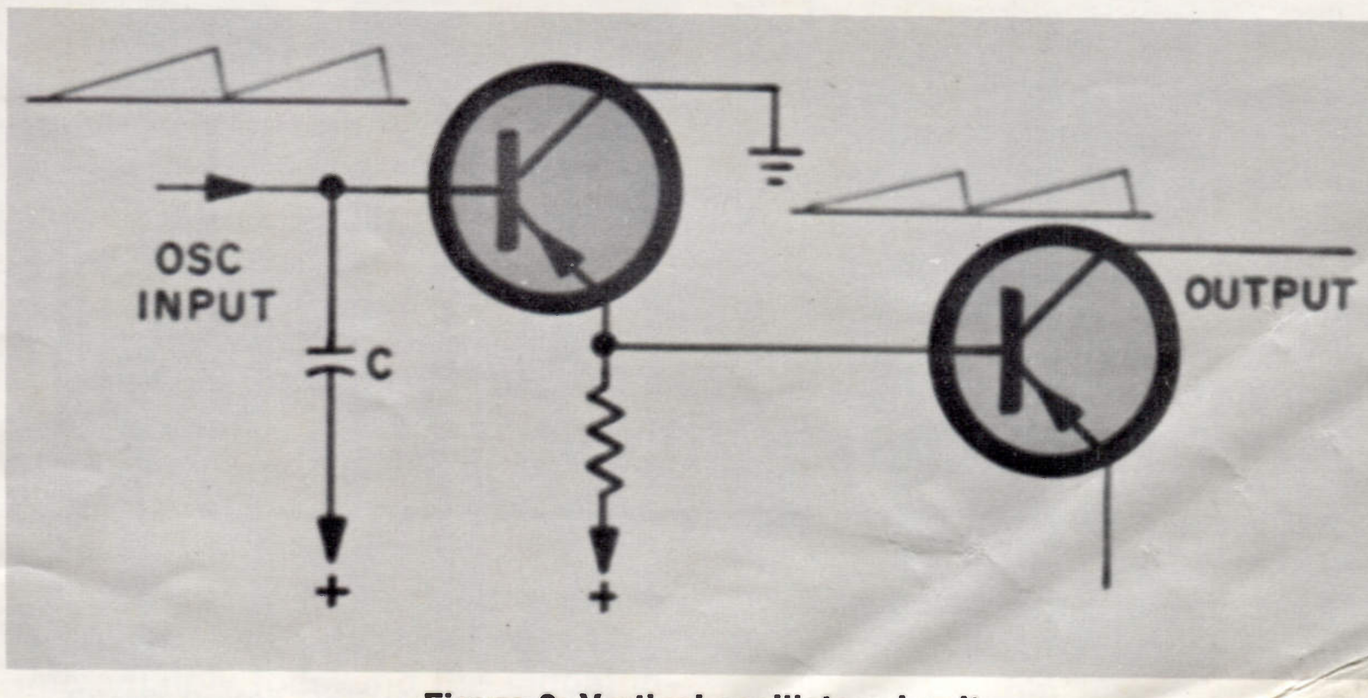


Figure 9: Vertical oscillator circuit

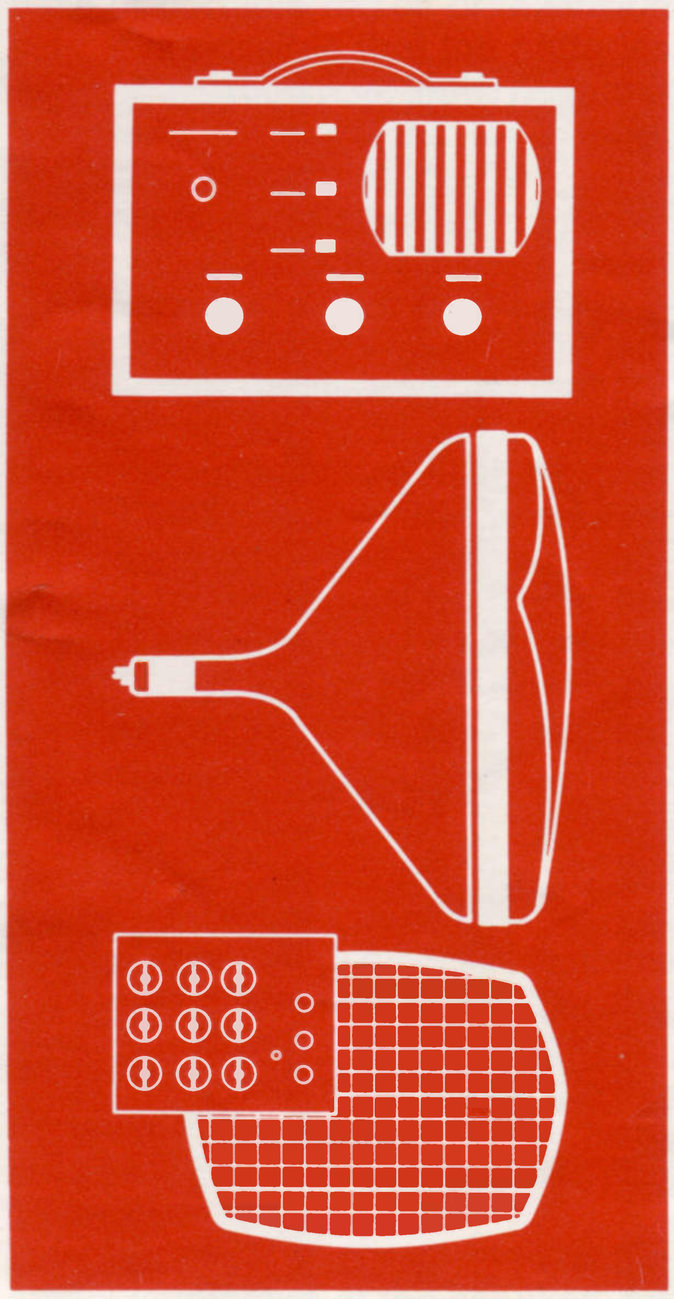


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Figure 10 is an emitter-follower amplifier. The emitter-follower is ideally suited for its purpose in this circuit. Its high input impedance minimizes loading of the charging capacitor, and its relatively low output impedance matches the vertical output stage. Note the additional circuit details in Figure 10.

The common-emitter vertical output stage (Figure 11) develops vertical sweep voltage across the vertical output choke. This sweep drives the vertical winding yoke winding via a coupling capacitor. The diode connected between the emitter and collector of the vertical output stage protects this stage from flyback transients.

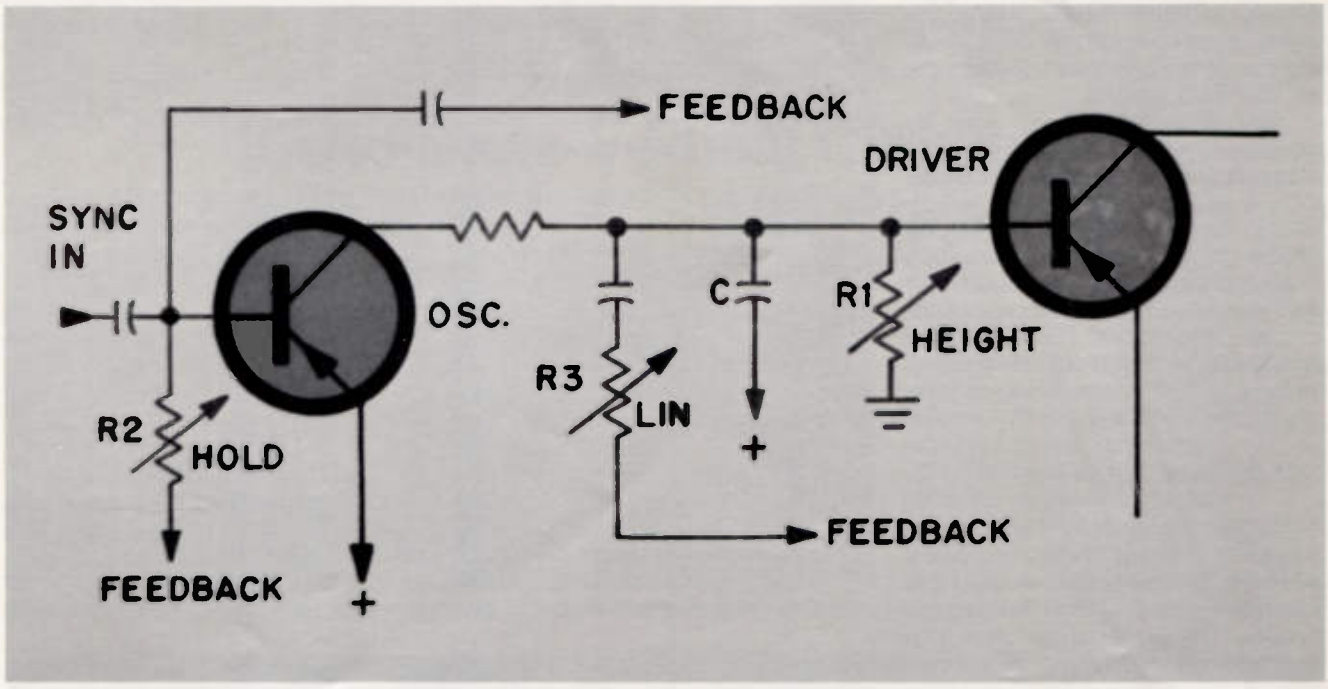

Figure 10: Vertical driver circuit

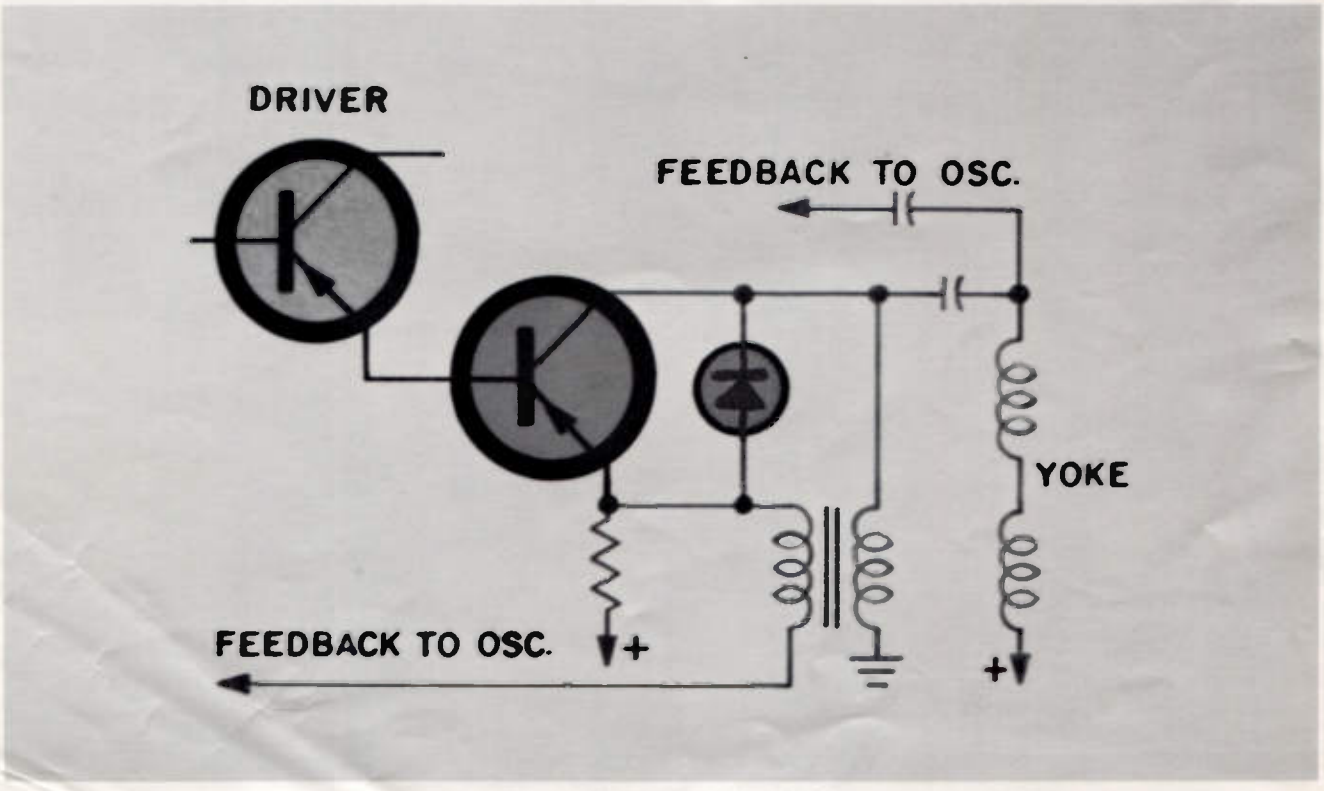

Figure 11: Vertical output circuit

Solid-State Servicing

Today's compact radio and television receivers are possible only as a result of the space and power savings offered by transistors. Because of the ever-growing importance of solid-state design in home-entertainment products, it is vital that the technician thoroughly understand all aspects pertaining to this area of equipment servicing.

In many respects, the techniques used in servicing solid-state receivers closely parallel the familiar practices used in servicing vacuum tube receivers. Some failures in transistors, however, must be expected. Generally, the transistor must be soldered into the circuit — making it somewhat harder to replace than a tube. Consequently, good service techniques involve isolating the trouble to a particular section of the receiver. Once the defective component or transistor has been isolated, it is a simple matter to replace it.

Servicing Techniques

When approaching a repair job, the first consideration should be: is the circuit receiving power? In the case of portable radios or television sets, it is possible that the batteries might be exhausted, battery terminals dirty or corroded, or a wire broken. If power is available, the problem is obviously elsewhere.

The next step is to visually inspect the chassis or circuit board. This is especially important in small radios and other portable products that are subject to being dropped. If a thorough examination of the circuit board (under a magnifying glass if necessary) should reveal any unsoldered connections, breaks in the copper conductors, or damaged components, these conditions should be corrected before proceeding further.

Signal Injection

After eliminating physical damage as a possible cause of trouble, the next logical procedure is to inject a signal. The best way to isolate the problem to a particular stage is to start at the back of the receiver and work forward.

In the case of a radio, an audio signal is injected at the speaker. An output signal clears the speaker of any suspected fault. Audio section operation is determined by applying an audio signal at the input of the audio stages. Here again, signal output from the speaker indicates proper amplifier operation. An IF signal can be inserted at the detector (output signal indicates the detector is functioning). Moving forward in the receiver, the IF stages can be cleared as a possible fault by injecting an IF signal at the input of the IF stages.

The receiver is operating properly through the IF, detector, and audio stages if an output signal is obtained. Moving forward in the chassis, an RF signal can be injected at the converter. An output signal at that point determines that the converter and all following stages are functioning properly. Finally, in receivers employing an RF stage, the signal may be injected at the input of the RF stage or radiated into the antenna.

Failure at any one point to obtain an output indicates that the stage immediately following the signal injection point is inoperative, and the trouble has been isolated to that particular stage.

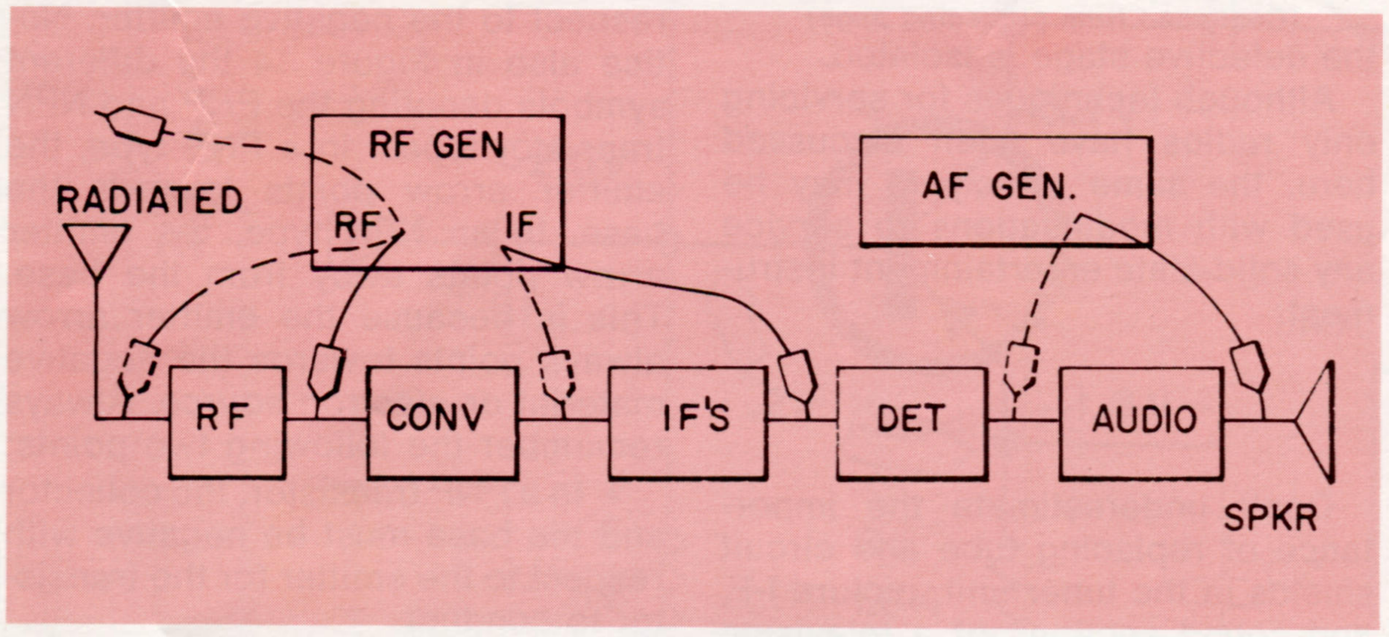

Figure 12: Signal injection technique

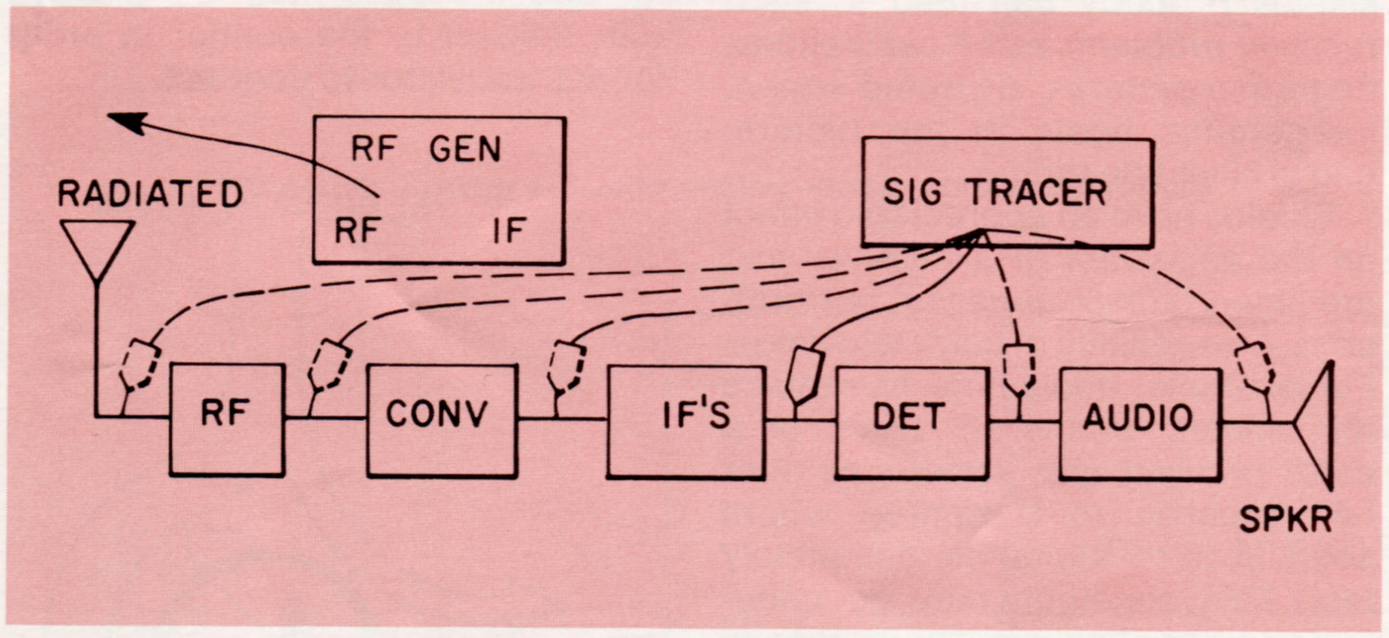

Figure 13: Signal tracing technique

Signal Tracing

Another effective way to isolate troubles within a receiver is by signal tracing. In this instance, an RF signal is radiated into the antenna and a signal tracing device, such as a demodulator probe on the 'scope, is used to determine the presence or absence of signal at various points in the circuitry.

This is best done by starting at the front of the receiver and progressing along the signal path from the antenna to the loudspeaker. Here again, the receiver should be checked section by section. First, check for signal at the output of the converter; next, at the output of the IF stages; then at the detector; and, finally, at the output of the audio stages. After locating the section of the receiver that is malfunctioning, the same technique should be employed to follow the signal through each stage within the section, until

(Continued on next page)

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the defective stage is isolated.

Although techniques for servicing only radios have been discussed here, the same principles may be used with modifications to service any solid-state entertainment instrument.

Shielding

Don't underestimate the importance of replacing tube and circuit shields in the tuner unit, picture I-F, and sound sections of a television receiver. Failure to replace or secure shields properly can lead to such receiver problems as I-F oscillations, degraded pictures, distorted sound, interference beats in the picture, and critical fine tuning.

Shields have an appreciable effect on the alignment of a receiver and are important to receiver performance — especially in color television. For example, neglecting to replace the shields on the I-F tubes of a color receiver can sometimes alter I-F response to a degree where color picture signal is completely lost. This condition may go undetected when checking a color receiver on a black-and-white program.

Always check the circuit and tube shielding after servicing a television receiver. Proper installation and grounding of all shields can prevent call-backs.

Transistor Types

After visual inspection, signal injection, and signal tracing techniques isolate trouble within a receiver to a particular stage, voltage measurements are employed to pinpoint the defective component within that stage.

Before exploring these voltage-measurement techniques, it would be well to briefly review the operating requirements of a transistor. Basically, for bias purposes, there are two transistor types — PNP and NPN.

Figure 14 shows that the first condition for proper transistor operation is that it be biased. PNP transistors are biased with the collector and the base negative with respect to the positive emitter. The converse is true with an NPN transistor, and the collector and the base are positive with respect to the negative emitter. Notice also in Figure 14 the different symbols denoting the PNP and NPN transistor types. In a PNP type, the emitter arrow points towards the base. In an NPN type, the emitter arrow points away from the base. This is because the emitter arrow always points towards the negative material or *electron source*. Always remember the following two points:

- In a PNP transistor, the collector and the base must be negative with respect to the emitter for the transistor to conduct.
- In an NPN transistor, the collector and the base must be positive with respect to the emitter in order for the transistor to conduct.

Transistor Bias

Figure 15 illustrates how the transistor is DC biased.

Here again, both PNP and NPN transistors are shown with their correct bias polarities.

In an actual circuit, the collector-to-emitter junction of the transistor is reverse biased and the base-to-emitter junction is forward biased.

Transistor conduction will not occur until a bias is applied to the base-emitter junction. The forward-biased base-emitter junction has a natural voltage drop that is determined by junction characteristics of the transistor. This means that a properly operating transistor will always have a voltage difference between the base and emitter. In the case of the PNP transistor, this voltage (V_{be}) will be approximately 0.2 to 0.5 volt. An NPN transistor, which

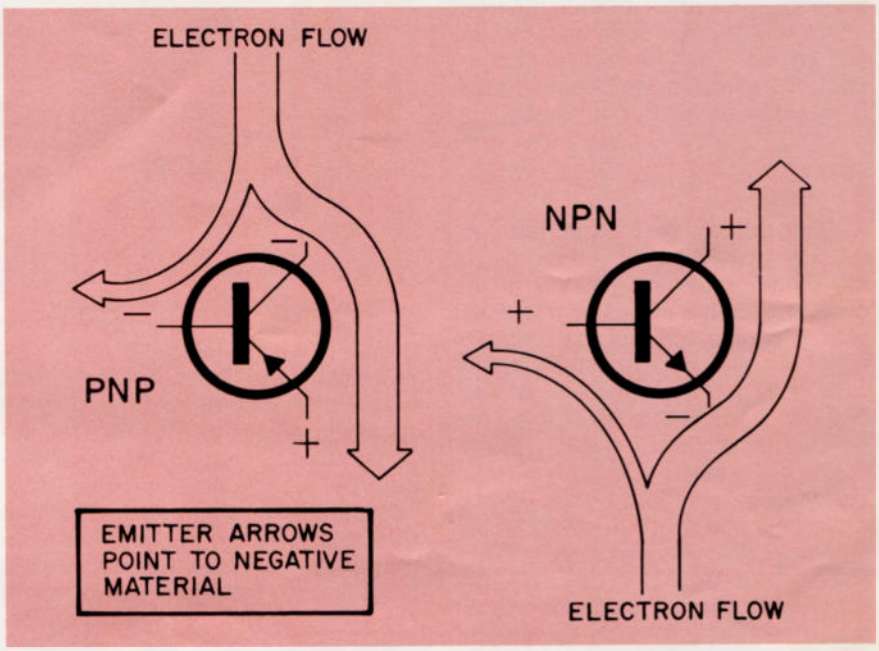

Figure 14: Transistor type comparison

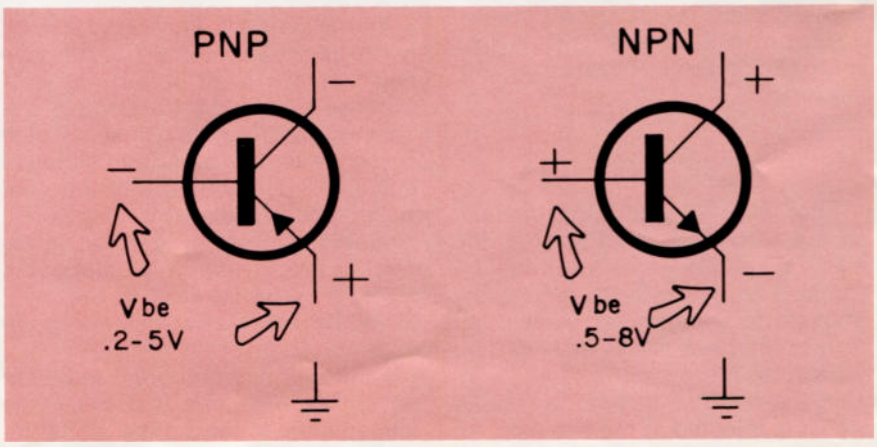

Figure 15: Transistor biasing

is generally of the silicon type, has a somewhat higher V_{be} voltage. Typical values of V_{be} for NPN transistors range from 0.5 to 0.8 volt.

Typical Circuit

Because the circuits most commonly found in radio and television receivers are the common-emitter type, this circuit will be explored in depth.

Figure 16 illustrates a typical common-emitter stage operating normally with correct bias voltages. Note that the circuit uses a PNP transistor and is supplied by negative 12 volts. The collector connects to the —12 volts via load resistor "R_L." The base is biased negative by a voltage divider comprised of resistors "R_1" and "R_2." This voltage divider is designed to establish —2 volts at the base of the transistor. Because of the offset voltage (V_{be}) between base and emitter, proper circuit operation demands that —1.8 volts be established at the emitter of the transistor. This circuit is designed to operate at 1 mA (collector-emitter current). Ohm's Law dictates that a 1.8-kilohm resistor be used as the emitter resistor. To prevent emitter degeneration from reducing circuit gain, the emitter resistor is bypassed by capacitor "C_2." Load resistor "R_L" is chosen to obtain a particular stage signal gain. With this particular "R_L," a nominal operating voltage of —5.1 volts is measured at the collector of the transistor. The voltages found at the three elements of the transistor correspond to the nominal operating voltages. In servicing, these are the voltages indicated on the service data schematic. Any radical departure from these voltages is indicative of circuit trouble.

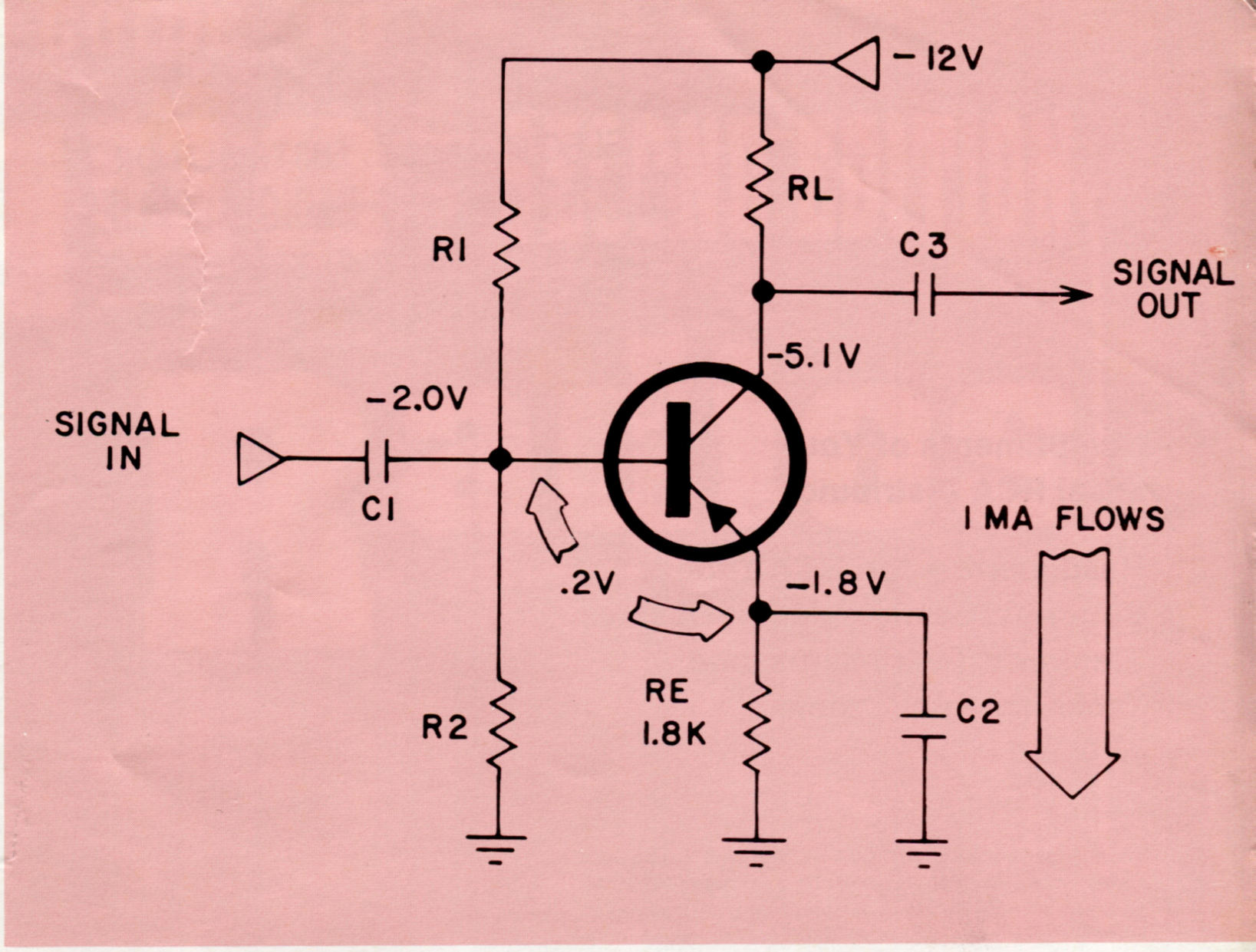

Figure 16: Typical common-emitter stage (normal operation)

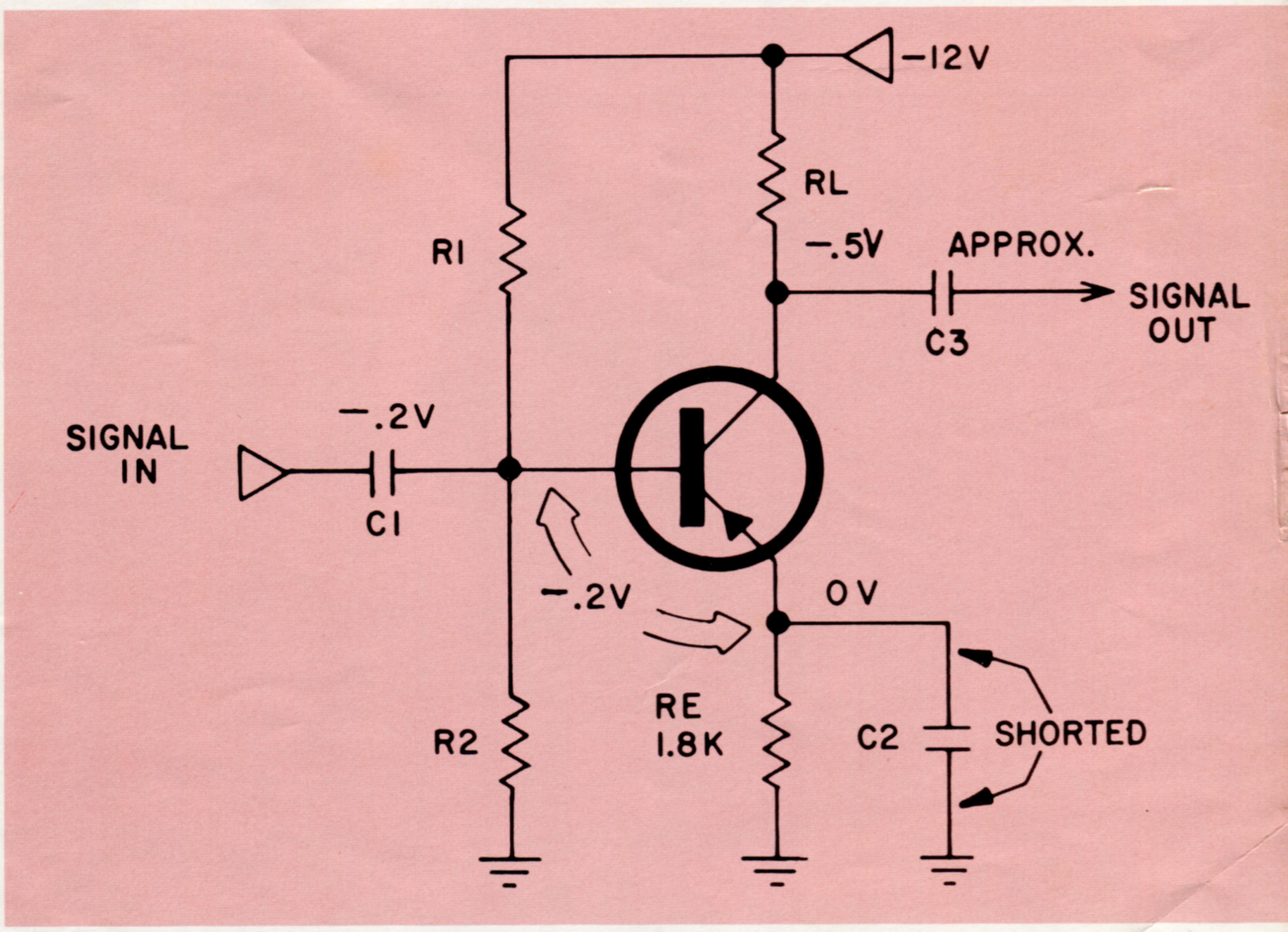

Figure 17: Typical common-emitter stage (no emitter bias)

Troubleshooting

Figure 17 shows this same circuit except that it is obvious from the voltage changes that a problem exists. When a VTVM is used to make in-circuit voltage tests (following service data procedures), it is evident that the circuit operating conditions have changed drastically. The DC voltage at the collector of the transistor, instead of measuring the nominal —5.1 volts, measures —0.5 volt. The emitter, instead of a reading of —1.8 volts, has no voltage at all. Measurement of the base potential reveals only —0.2 volt. This circuit malfunction has caused the collector voltage to fall to its minimum collector-to-emitter value. The transistor is saturated. Because the collector voltage has dropped across "R_L," it must be assumed that the stage is drawing current. This current should produce a voltage across the 1.8-kilohm resistor, but there isn't any. This indicates that the problem is in the emitter circuit.

The first component to be suspected might be the bypass capacitor, "C_2," which could be leaking or shorted. Clipping the capacitor of the circuit clears the "short" and the DC voltages are restored to normal. Thus, the capacitor should be replaced.

In subsequent articles, additional troubles will be introduced in the basic common-emitter circuit, and the DC voltages analyzed to pinpoint the causes.

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