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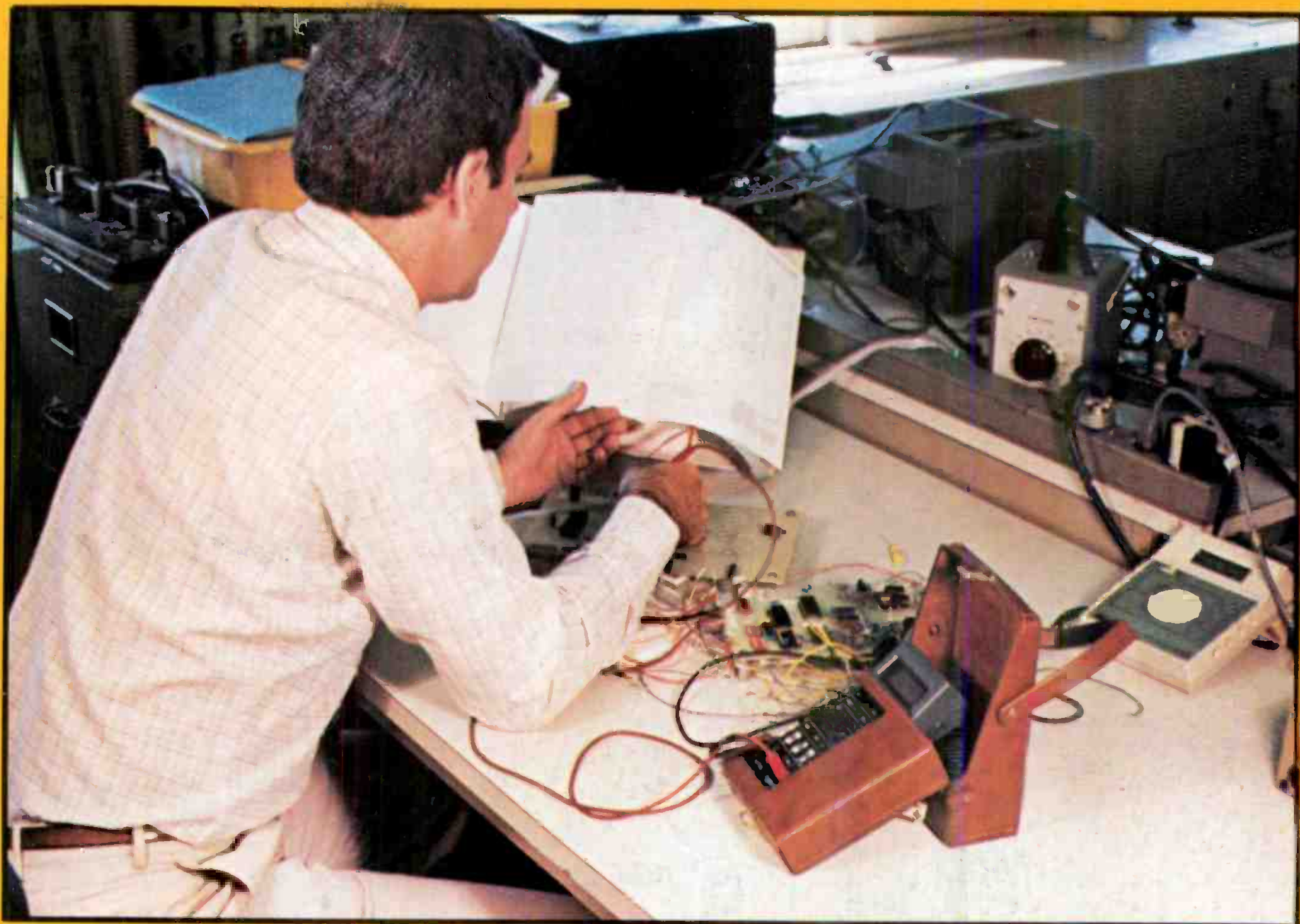
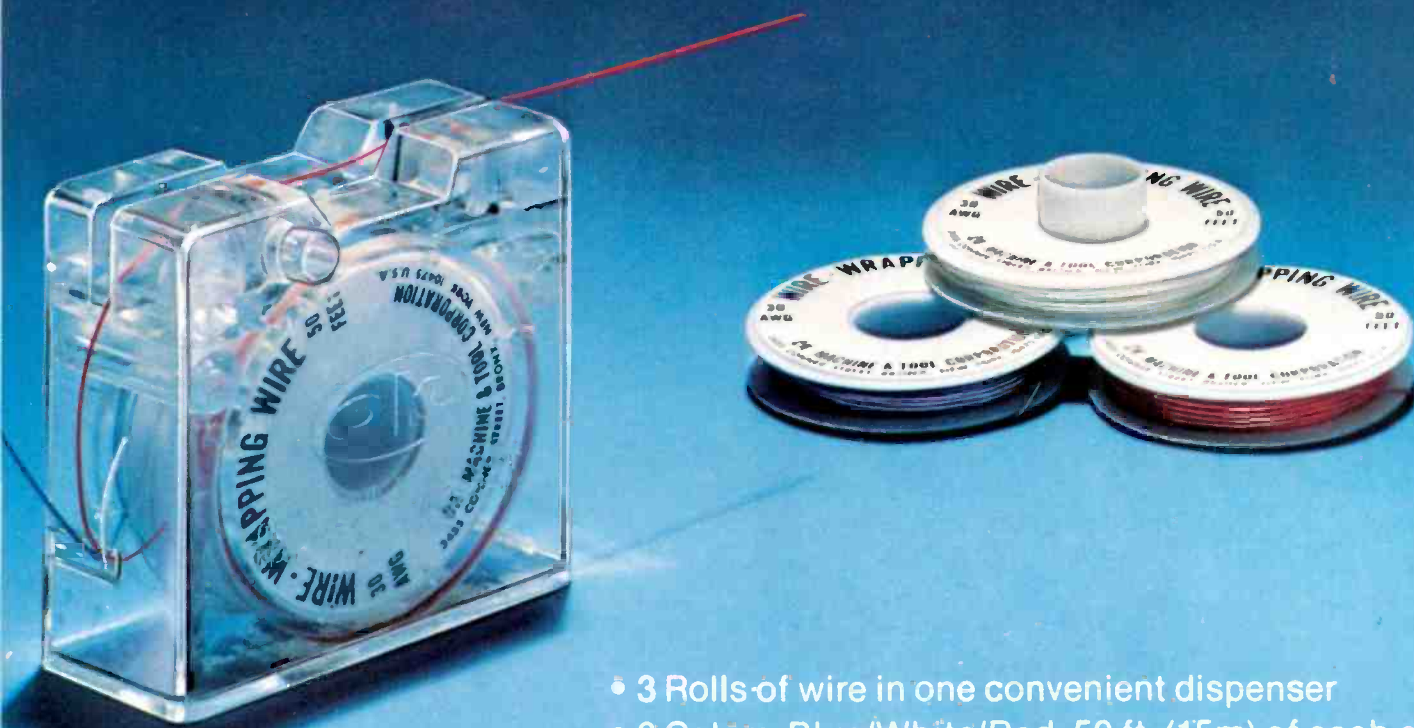
Electronic Servicing®



Special multimeter issue

Controller applications

Horizontal troubleshooting



Electronic Servicing

Editorial, advertising and circulation correspondence should be addressed to P.O. Box 12901, Overland Park, KS 66212 (a suburb of Kansas City, MO); (913) 888-4664.

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Circle (3) on Reply Card

Circle (4) on Reply Card

March, 1980 ☐
Volume 30, No. 3

Electronic Servicing®

Maintenance

Servicing

Departments

About the cover

Photograph courtesy of Weston Instruments. Graphic design by Linda Franzblau.

electronicscanner

news of the industry

Sales of color TVs to dealers in January, 1980, increased by 2.3% over those of January, 1979, while monochrome sales decreased 5.9%. Imports of color TVs for 1979 declined 50.7% from the 2,774,856 units imported in 1978.

Zenith Radio Corporation purchased the Heath Company last fall. Heath has been marketing electronic and computer kits. Since then, Zenith Data Systems has been formed to sell assembled Heath personal computers. Zenith Data also is doing market research and design planning for a home computer in the $1000 price range. This computer is to be manufactured in the Zenith color TV plants and distributed through Zenith TV distributors. Heath's present manufacturing of electronic and test-equipment kits is not affected.

Florida Electronic Service Association (FESA) is holding its 16th annual convention July 10-13 in St. Petersburg, FL. Scheduled activities include technical seminars, CET tests, business-management sessions, trade show and installation of new officers. Contact George Bluze, 13850 Walsingham Road E, Largo, FL 33540, (813) 581-3040.

The 25th annual convention of the Indiana Electronic Service Association (IESA) is scheduled for April 18, 19 and 20 at the airport Hilton Hotel in Indianapolis. Also, the Electronic Technicians Association International (ETA-I) is holding its 5th regional technical business workshops with the IESA convention. Events include technical seminars, ETA certification exams, swapping bazaar, business schools and trade show. Contact ETA-I, 7046 Doris Drive, Indianapolis, IN 46224, (317) 241-7783.

General Telephone & Electronics (GTE) plans a large expansion of the manufacturing facilities recently purchased from EMM Semi. These Tempe and Phoenix, AZ plants now are the GTE Microcircuits Division of GTE Communications Products.

Flat-panel displays for television receivers are not practical now, but many are used successfully for other applications. The most popular techniques are LCDs, electroluminescence and gas-discharge or plasma panels. Cost and color limitations are two problems. For example, one 24-inch-diagonal plasma panel sells for $45,000 with the supporting electronic equipment.

Matsushita has adopted the video-disc system developed by its subsidiary, Victor Company of Japan (JVC). Three major systems now are in the industry, and all are incompatible. Magnavox sells the Philips type of optical-tracking gas-laser machine, and RCA this year will produce a needle-tracking capacitance type. The JVC system utilizes capacitance reading of indentations, but without a groove.

US marshals have seized 464 CB RF-power amplifiers from two locations in San Diego, CA. Total value of the illegal linear amplifiers was said to be $110,000. The FCC stated these seizures were a continuing part of a nation-wide campaign to reduce RF interference.

Two new solid-state color cameras without image tubes have been introduced. Sony's camera has two charge-coupled sensors that replace conventional image-pickup tubes. It sells for about $11,000. The Matsushita camera has one image sensor. Scanning is accomplished vertically by bucket-brigade circuits and horizontally by charge-coupled devices on the chip. Neither camera has a deflection yoke. Both models weigh less than 3 lbs. each and are about ⅓ the size of conventional video cameras. A large decrease of blooming in bright lighting is the most important other feature.

Three persons in Minneapolis, MN and 53 in New York and Los Angeles have been indicted following a 30-month investigation by the FBI into illegal pornography and pirating of videotape movies. Any unauthorized duplication of copyrighted material for sale is illegal.

letters to the editor

Letters should be addressed to
The Editor, Electronic Servicing
P.O. Box 12901
Overland Park, KS 66212.
Please include company affiliation.

To the Editor:

Recently, I used the dummy circuit to replace a horizontal-output transistor during tests of a 25GC50 Zenith, and it worked like a charm. The test was proposed (page 34, March, 1975 **Electronic Servicing**) for 19EC45, but it also applies to similar circuits.

In fact, I have found this modular-TV series to be of great help. While I am writing, I would like to compliment you on the continuing excellence of your magazine. As far as I am concerned, it is the best in the industry. I have noticed it is getting slimmer, but assume it is because of the economy. If it becomes necessary to raise prices to maintain the quality, then do so, as I am sure your readers will understand.

Ralph McGinty
McGinty's Electronic Servicing
Leonardville, KS

Mr. McGinty:

Thank you for your encouragement. Some readers believe a thinner magazine indicates less technical material. That is not true. The February issue had 25 pages of articles. This compares favorably with the 22 to 27 pages when *PF Reporter* had 80 to 90 total pages.

To the Editor:

The problem with an RCA CTC46A color chassis is a jumble of lines in a narrow raster along with a high-pitched whine from the sweep section. SCR101 was shorted at first. Replacement didn't help, and the new SCR went bad also when I shorted across L1 at the gate. Can you help?

C. A. Pontillo
Laredo, TX

Mr. Pontillo:

We cannot answer individual requests for technical help, but this problem is typical of SCR sweep. Usually the symptoms are produced by an open trace SCR (usually called SCR101), an open trace diode or an open coil (L1 in your schematic) that supplies the trace SCR gate. This coil supplies a waveform change and a phase shift; the circuit will not work if the coil is open or has shorted turns. Open filter capacitors or a bad oscillator module can cause similar symptoms. For other information, refer to the RCA series in the January, February, March and April, 1976 issues of **Electronic Servicing**.

To the Editor:

In regard to J. C. Cook's explanation (in the January issue) for using a TI-30 calculator, I find it does not work properly.

Try this progression: press X and then 1; press EE and enter the proper exponent; press =; and press EE to remove the positive exponent to 00. The answer will be in standard notation.

To remove the negative component to 00, press INV and EE until the exponent is 00. The answer will be standard notation, in terms of the chosen prefix.

A. S. Freiheit
Tacoma, WA

To the Editor:

I would like to compliment Robert L. Goodman on his excellent article about Zenith TV repairs. This is the kind of information we in TV servicing need so desperately. More articles on these topics would be helpful and appreciated.

John L. Bogan
Johnny's TV
Jonesville, SC

Mr. Bogan:

Thank you for your encouragement. We will continue printing similar articles. Unfortunately, solid-state modular TVs do not allow so many general tips as was possible with older machines.

To the Editor:

Thank you for the *Repairing old TVs* article last October. I am working on a couple of RCA CTC5 P and W chassis. Do you have any tips for them?

Page Bledsoe
Knoxville, TN

Mr. Bledsoe:

The best source of practical tips for these 1957 color TVs is the Howard Sams book *Color TV Servicing Made Easy, Volume 1* by Lemons and Babcoke.

To the Editor:

As a relatively recent reader of your fine magazine, I would like to compliment you on the high degree of quality apparent in the articles, and also the wide variety of different articles. I particularly like the SYMCURE section and wonder if you have ever considered a separate publication of all the past issues. This would certainly help newcomers to the service field that don't have a lot of these short cuts to finding the problems from past experience.

Ray Brumbaugh
Master Electronics
Statesville, NC

Mr. Brumbaugh:

SYMCURE is one of ES's most popular exclusive departments. Although there are no current plans to publish a collection, the idea has a lot of merit. Thank you for your suggestion.

To the Editor:

I would like to see more articles about the use of scopes. The series last year was well worth a year's subscription. Also, I like the articles about new television circuitry. Some articles dealing with TV tuners and IFs would be interesting.

Phillip Standley, CET
Mulvane, KS

Mr. Standley:

Thank you for your kind words. More information about better uses for scopes is on the way, including our October special scope issue. Efficient troubleshooting of these new solid-state circuits demands the best test instruments and thorough knowledge of how the circuits should operate. □

Comparison of VOMs, VTVMs and DMMs

By Carl Babcoke, CET

Following are brief descriptions of basic VOMs, VTVMs and DMMs, with a list of advantages and disadvantages of each type.

Volt-ohm-milliammeter—VOMs include an analog meter with a pointer that is deflected by current alone (although some voltage is required to overcome the dc meter resistance). *This power to deflect the meter is taken from the dc or ac voltages it is measuring.* Various currents are tested by placing proper values of shunt resistors in parallel with the meter. Dc voltage is tested by reading the amount of current that flows through a series resistor of known value. The amount of undesired loading on the circuit tested is determined by the meter-current rating for full-scale readings. A 1mA meter, for example, must bleed 1mA of current from the tested circuit in order to have a full-scale reading. (That is a 1000-ohms-per-volt rating.) A 50μA meter only bleeds 50μA from the voltage source it is testing. This is called a 20,000-ohms-per-volt (or 20k/V) sensitivity, and is the most popular rating for portable VOMs.

Ac voltages are rectified by diodes into dc voltages before they are measured by the dc voltmeter action. Ac voltage ranges usually have lower sensitivity than dc.

Resistances are measured by monitoring the current drawn from an internal battery through an internal reference resistor that is in series with the external unknown resistance.

Vacuum-tube-volt-meters—VTVMs and newer transistorized multimeter or FET-meter have either tube or solid-state amplifiers with currents that operate the analog meter according to the amplitude of the input signals. The amount of meter current has no effect on input resistance. These amplifiers operate from internal batteries or power sources. Ac voltages are changed to dc by tube or solid-state diodes before they are applied to the dc input voltage divider (the same divider is used for all ranges). For resistance tests, the *voltage* across the unknown resistance is measured by the dc voltage circuit. The current to be tested produces a voltage drop across a precision resistor, and this voltage is measured by the dc-voltage function. (VOMs measure by current; VTVMs and DMMs by voltage.)

VTVM advantages—Most VTVMs have dc-voltage input resistances of 10M Ω or higher and all dc ranges have this same high resistance. A 0.5V range, for example, loads the circuit (that is being tested) by only 10M Ω. On the average, VTVMs have more ranges and can test lower voltages and resistances than VOMs. Ac voltages can be calibrated for sine-wave RMS and peak-to-peak. Bandwidth for ac readings is wide, although the stray capacitance adds loading to signals of several MHz. Resistance measurements usually can be made to 1,000M Ω. Forward-biased diodes can also be tested.

VTVM disadvantages—Loss of power-supply voltage eliminates all functions. Input resistance for ac voltages is about 1M Ω. Some zero-setting and resistance-calibration drifts occur, thus correction adjustments may be necessary. To minimize drift (which affects the meter's accuracy), some technicians run VTVMs constantly. The polarity switch setting must be changed each time the input dc signal is negative. Accuracy of measurements is average, and may be degraded by parallax.

Digital multimeters—A typical DMM uses an analog-to-digital (A/D) converter. A capacitor is charged by the input dc voltage while the A/D circuit measures the time required for the capacitor charge to reach a designated voltage. The digital signal representing the time is processed by a binary-coded decimal (BCD) integrated circuit and a display driver before it lights the required number of 7-segment decimal digits in the readout. The usual measurement functions are: dc volts; ac volts; dc current; ac current; and resistance.

Advantages of DMMs—Many digital multimeters have 10 times better accuracy of readings than VOMs or VTVMs. Accuracies of 0.25% to 0.1% for dc voltage are common, even in portable units. The readings are given in decimal numbers, and no conversion factors are needed. Input resistance for dc voltage measurements is 10M or higher. Parallax viewing errors are impossible with these readouts. Except for function and range selection, most new DMMs have no external adjustments. *They offer automatic-polarity indication, automatic decimal placement and automatic zeroing.* A few models feature *automatic ranging* (the DMM selects the best range for each measurement). Current drain is so low that many DMMs can be operated from internal batteries. Specific models feature a visual or audible indication of continuity or overvoltage, high- and low-power ohms, and special diode tests.

Disadvantages of DMMs—One common objection to DMMs is delay in obtaining a stable reading. Digital counting systems have a time of uncertainty at the beginning or end of each count. Dc voltages having ripple, pulses or other disturbances usually force a DMM to display wandering readings that

A portable VOM. (*Courtesy of Mura*)

Typical of VTVMs and FET-meters is this VoltOhmyst. (*Courtesy of VIZ*)

This DMM is portable and battery operated. (*Courtesy of B&K-Precision*)

are centered around the correct average voltage. Several years ago, several DMMs gave wildly incorrect readings when called on to measure half-wave unfiltered dc voltage. The integration evidently was not sufficient for this rare condition. Present production units do not have the problem. The ac frequency response of some DMMs is flat only to about 400Hz, with a rapid decrease above that point. This bandwidth is sufficient for line-voltage measurements, but is unsatisfactory for audio work. If wide bandwidth is needed, a few units have good response to 50kHz. Most DMMs cannot test resistances of more than 2MΩ. Ohmmeter current (even with a high-power range) often is not sufficient to show useful differences between normal forward-biased silicon junctions. Some older DMMs have been known to show wild variations of readings when near the horizontal-sweep section of color sets or in a strong RF field. Many newer models have internal shielding to eliminate interference. Most DMMs cannot follow peaks and nulls or other fast-changing signals.

For most uses, the advantages of DMMs overcome all minor shortcomings. However, *the best multimeter depends on the measurements being made and the accuracy that's needed.* □

Unique features of DMMs

By Carl Babcoke, CET

Digital multimeters have several advantages that make them superior to analog types. In the past, however, DMMs have had some limitations:

- The appreciable amount of time required to reach stable readings.
- The inability to properly handle any erratic resistance measurements or those of short duration.
- Digital readouts cannot follow peaks and nulls properly.
- The confusing, but normal, bobble of the least-significant digit.

Specific models of new digital multimeters have features that solve these problems. Descriptions of five DMMs that offer these improvements follow.

Fluke 8024A

Fast-acting arrows supplement resistance tests. An open circuit across the test leads activates an up-pointing arrow located in the readout area. After the usual delay, the overrange indication appears on the digital readout. With any resistance range, a resistance or short-circuit condition that continues for 50μS or longer activates the down-pointing arrow and sounds a 2kHz tone. After another normal delay, the resistance measurement appears on the digital readout. If the continuity time is brief, a pulse stretcher lengthens the audible tone to a 100mS burst.

The up-pointing arrow is activated by voltages higher than the +0.8V internal reference, while the down arrow is turned-on by voltages lower than the reference. Both arrows are visible when dc voltages alternately become higher and lower than the reference. This action can identify dc digital pulses or other kinds of dc-voltage variations.

A unique peak-hold feature can be switched on for any dc or ac voltage or current readings that otherwise would reach maximum and then decrease before the readout could respond. If the peak condition persists for 150mS or longer, the 8024A DMM displays the *maximum* voltage or current level. It continues to show the reading after the probes are disconnected. One digit of the reading then decays each second, allowing adequate time for the measurement to be observed. This can show various starting surges of current or the charging voltage of a capacitor (readings now attempted by the swing of analog pointers).

Fluke 8024A

Weston 6100 Roadrunner

Data Precision 936

Beckman TECH-310

Weston Roadrunner

Model 6100 was named Roadrunner because of the *beep-beep* sounds produced during resistance or dc-voltage functions in the audio-response mode. The Roadrunner is a six-function portable DMM.

Data Precision 936

The *beep* indication of continuity operates from resistances within the three lowest resistor ranges, when used in the high-power mode. At the start of continuity, a 300mS beep is emitted.

This is an indication, not a measurement. It does not interfere with conventional resistance measurements. The function is useful when it is not convenient to watch the readout.

Excessive voltage applied to any function or range produces an audible alarm signal.

Beckman TECH-310

An ohms symbol in the upper left corner of the digital readout is activated almost instantaneously after continuity (or a resistance within the selected range) is established. Rapid shorts and opens are correctly identified by this symbol, even when the signal changes too fast to permit any readout on the digital display.

Sencore DVM-56

The DVM-56 offers a choice of 4½-digits, 4-digits or 3-digits. The number of visible digits can be reduced and eliminate the bobble of the least-significant digit, when full accuracy is not required.

For voltage ranges, a pushbutton selects the peak-and-null mode which lights an up-pointing arrow for increasing readings, or a down-pointing arrow for readings that are decreasing. When a reading is steady, both arrows are activated. The low point of a null or the high point of a peak can be located easily, with the digital readout later showing the numerical result.

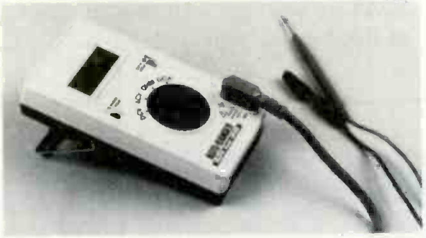
This model is microprocessor controlled, which allows an automatic cancelling of test lead resistance when low-value resistances are to be measured.

Other features include a choice of peak-to-peak, average, or true RMS ac voltage. Automatic reading of decibels is provided. □

Sencore DVM-56

Multimeter Roundup

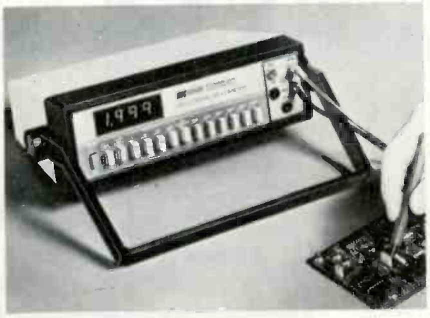
This roundup presents a photograph and brief description of one multimeter from each manufacturer. For more information, circle the corresponding number on the Reply Card.



Alco Electronic

Model 2000A is a small autoranging DMM with a 3½-digit LCD readout, auto-zeroing, auto-polarity sensing, auto-ranging (of dcV, acV, ohms and dcA), a range-hold switch and a reading-hold switch. Accuracy for dc voltages is ±0.3%.

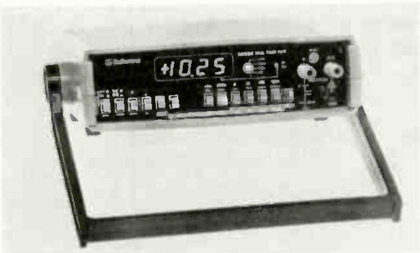
Circle (20) on Reply Card



B&K-Precision

RF shielding and ac line or optional battery-pack operation are two features of model 2830 DMM. It has a 3½-digit LED display, 0.5% dcV accuracy, auto-polarity and auto-zeroing on all ranges, plus a 10Ω resistance range that provides 0.01 Ω resolution.

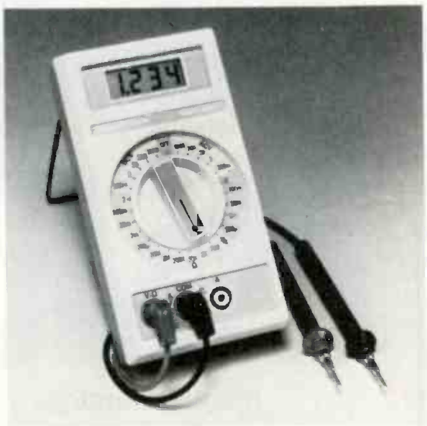
Circle (21) on Reply Card



Ballantine Labs

All standard functions and ranges have high accuracy in model 3030A, a 3½-digit LED-readout DMM. Accuracy of dcV is ±0.05% of reading +1-digit per day. True RMS, average or peak-reading ac readings can be selected. DB measurements also are RMS, and the dB reference is adjustable.

Circle (22) on Reply Card



Beckman Instruments

TECH-300 portable DMM has five functions, 3½-digit LCD readout, 22MΩ dcV resistance and an in-circuit diode test that reads voltage drop. TECH-310 has the same features plus higher accuracy and an ohms symbol that shows erratic connections during resistance readings. Models 3010, 3020 and 3030 are lab types with higher accuracy. Model 3030 has true-RMS readings for ac.

Circle (23) on Reply Card

Data Precision

One-hand operation is possible with model 935 DMM because of the edge-mounted pushbuttons. Basic dcV accuracy is ±0.1% of full scale ±1 digit. Polarity sign, zeroing, decimal and low-battery indicator are automatic. Model 935 has 29 ranges in five functions, including a choice of high-power or low-power ohms. Model 936 has similar features with the addition of an audible indication of continuity.

Circle (24) on Reply Card

DSI Instruments

True RMS ac measurements plus a dcV basic accuracy of 0.1% are features of the DSI model LC5000 DMM. It operates on one 9V battery, and has 3½-digit LCDs. Six resistance ranges allow readings to 20M Ω.

Circle (26) on Reply Card

DeForest Electronics

Model MM-200 has 3½-digit LEDs, five functions, automatic polarity, fused inputs and operation either from ac line or from an 8-hour rechargeable battery.

Circle (27) on Reply Card

Fluke

Model 8050A from Fluke is a microprocessor-controlled bench-type DMM with LCD display of 4½-digits. Other features include seven functions in 38 ranges, a dcV accuracy of ±0.03% of reading plus 2-digits, true RMS ac measurements, direct-reading decibels, an offset mode for relative readings, and several resistance ranges having higher dc voltage for diode tests.

Circle (28) on Reply Card

GC Electronics

Analog panel meters and analog VOM multitesters are offered.

Circle (29) on Reply Card

Heath

Model IM-2202 DMM *kit* has four functions and 26 ranges displayed on a 3½-digit LED readout. Accuracy of dcV is ±0.5% of reading ±1 digit. Three of the five resistance ranges have higher voltages for diode forward-conduction tests.

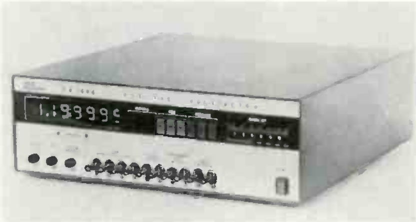
Circle (30) on Reply Card

Multimeter roundup

Hickok

Auto-decimal, auto-zero, two dcmA ranges, two acV ranges to 600V RMS, six resistance ranges to 20mΩ, and five dcV ranges to 1000V at 10MΩ input resistance and accuracy of ±5% of reading +1 digit are some of the features of Hickok model LX-304, a 3½-digit LCD-readout DMM.

Circle (31) on Reply Card



Julie Research

A multimeter with a base accuracy of 0.0001% in 6½-digits is merely part of the DM-1000 specifications. It also is a programmable voltage source for DMM calibrations, has computer compatibility and can be autocalibrated. With the addition of options, most electronic specifications can be tested with unique accuracy. Julie Research builds high-quality test instruments for laboratory calibration adjustments. Basic price of a DM-1000 is more than $6000.

Circle (32) on Reply Card

Keithley Instruments

Model 191 is a microprocessor-controlled 5½-LED-digit DMM of extreme accuracy. Three of the five dcV ranges have 24-hour accuracy of 0.004% of reading +1.5 digits, or a one-year rating of 0.010% +2 digits. Noise is minimized on low ranges by averaging eight consecutive readings. A pushbutton-selected null mode permits nulling any on-scale reading to zero, so the next measurement will be offset by the original reading. Keithley sells laboratory-quality equipment, and has just introduced a portable, battery-operated DMM.

Circle (33) on Reply Card

Leader Instruments

Model LDM-851 is a semi-autoranging DMM with a 3½-digit LED display. Accuracy of dcV is ±0.5% of reading ±0.5% full scale ±1 digit. Two VOMs (LT-70B and LV-71) and one FET-multimeter (model LEM-73) also are available.

Circle (34) on Reply Card

Mura
177 Cantiague Rock Rd.
Westbury, NY 11590

Features of the Mura model NH-63 VOM include six dcV ranges at ±3% accuracy, four ac ranges, four decibel ranges, two dc current ranges and three resistance ranges. A mirrored scale is provided to minimize parallax. Eight other VOMs (including one clamp-type for ac current) are in the line.

Non-Linear Systems

Four functions in 22 ranges are performed by model LM-353 DMM. Accuracy for dcV is ±0.5% of reading ±2-digits. One unique feature is the kilohms-divided-by-10 resistance function, which provides an additional five ranges between 100mΩ and 1MΩ full scale. The readout has 3½-LCD-digits. LM-353 is battery operated and gives up to 100 hours per battery.

Circle (35) on Reply Card

Optoelectronics

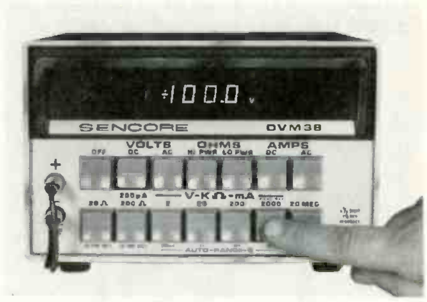
Model TRMS has a 4½-digit LED-readout DMM giving a basic dcV accuracy of 0.04% of reading ±1 digit, true RMS acV and acA ranges, a precision C/F thermometer and a choice of ac-line or battery operation.

Circle (36) on Reply Card

Sabtronics

Three Sabtronics models include 2035A and 2037A hand-held LCD readout DMMs and model 2010A bench-top LED-readout type. It has a 10A range and provisions for touch-and-hold probe.

Circle (37) on Reply Card



Sencore

Five digital multimeters in the Sencore line have 15MΩ dcV input resistances plus both high-power and low-power ohms ranges. Two autoranging models are available. One is the DVM-38 with pushbutton selection of functions. The dcV accuracy is ±0.1% of reading ±1-digit. Two extra (20Ω and 200Ω) resistance ranges are supplied. The other autoranger is new model DVM-56 which is microprocessor controlled for many unusual functions.

Circle (38) on Reply Card

Typical dcV accuracy is 0.25% with 10MΩ input resistance. Both high-power and low-power ohms are provided, and polarity, zero and overrange indications are automatic. One 9V battery powers the unit. The measurement modes are shown on the readout.

Circle (40) on Reply Card

Simpson Electric

Simpson has seven DMMs, several FET-meters, VTVMs and many VOMs such as the model 260 shown here. Model 260 has 27 ranges, including five dcV, five acV, four current ranges and four resistance ranges plus extra jacks for 10A, +1V, 1000V and others.

Circle (39) on Reply Card

Systron-Donner

DcV accuracy of 4½-digit LED-display model 7141A DMM is ±0.05% of reading ±0.05% of full scale. Model 7142B is similar except the accuracy is better. AcV measurements are true RMS, and there is a choice of autoranging or manual range selection. In models 7142A and B, the current function is exchanged for dBm measurements.

Circle (41) on Reply Card

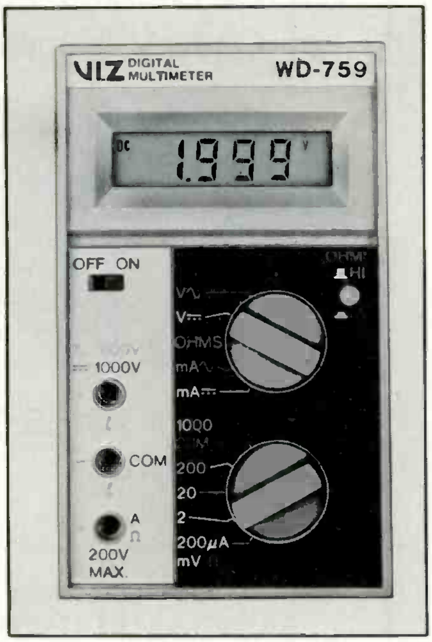
Soar Electronics

Model ME-523 is a five-function DMM with a 3½-digit LCD display.

Triplett

A clamp for ac current readings between 6A and 300A full scale, one resistance range, and three acV ranges to 600V RMS full scale are some features of model 30 for industrial or appliance technicians. In addition, Triplett has a full line of digital multitesters, VTVMs and FET-meters.

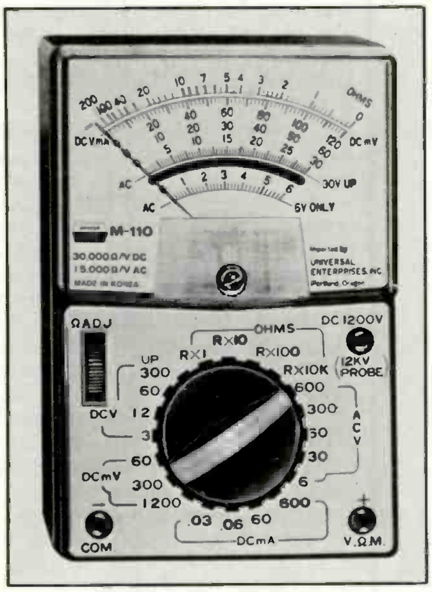
Circle (42) on Reply Card



VIZ

Model WD-759 is a 3½-digit LCD DMM with dcV accuracy of ±0.1% of reading +1 digit, five functions, 200-hour battery life, and a choice of low-power or high-power ohms ranges. The functions and values being measured are displayed on the readout along with the measurement figures. VIZ also has many VOMs, VTVMs and DMMs in the line.

Circle (43) on Reply Card



Universal

Eight dcV ranges, including a 60mV range, and 13 other ranges are supplied by model M-110, a 30K/V VOM. Universal offers other VOMs and DMMs.

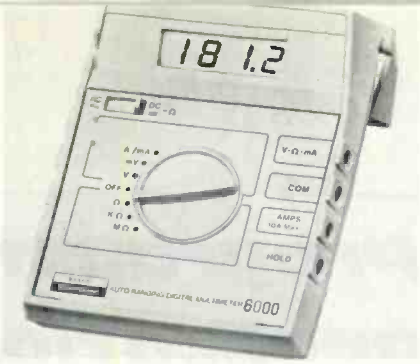
Circle (44) on Reply Card

MULTIMETERS

Manufacturer	Digital DMM or DVM	Analog VTVM FET-meter	Analog VOM
Alco Electronic	54		
B&K-Precision	55	56	57
Ballantine Labs	58	59	60
Beckman Instruments	61		
Data Precision	62		
Data Tech	63		
DSI Instruments	64		
Dumont Labs	65		
Fluke Mfg.	66		
GC Electronics			67
Heath	68	69	70
Hickok Instruments	71		
Julie Research	72		
Keithley Instruments	73		
Leader Instruments	74	75	76
Mura			X
Non-Linear Systems	77		
Optoelectronics	78		
Sabtronics	79		
Sencore	80		

Manufacturer	Digital DMM or DVM	Analog VTVM FET-meter	Analog VOM
Simpson Electric	81	82	83
Soar Electronics	84		85
Systron-Donner	86		
Triplett	87	88	89
VIZ Mfg.	90	91	92
Universal Enterprises	93		94
Weston Instruments	95		96
Workman Electronics			97

To receive more information about a specific brand and type of multimeter, circle the number on the Reply Card.



Weston

This autoranging 3½-digit LCD digital multimeter tops the Weston line of DMMs and VOMs. Other features of model 6000 include dcV accuracy of 0.35% of reading ±2 digits, a stand that doubles as a display cover, and an optional read-ing-hold jack. Many probes and accessories are available.

Circle (45) on Reply Card

Workman

Model B70-036 is a pocket-sized VOM with a leatherette case for tester and leads. Sensitivity is 20K/V for dc and 10K/V for ac measurements. Functions are dcV, acV, dcA and resistance.

Circle (46) on Reply Card

Programmable controller applications

Advantages of using programmable electronic controllers in industrial plants are discussed.

By Larry Thompson
Struthers-Dunn Corp.

Ten years ago, most plant personnel regarded the programmable controller (PC) as an alien in industrial control. "Too delicate. Too expensive. Too complicated. Takes an electronic wizard to maintain." These comments typify many an initial reaction.

But today, controllers have overwhelmingly earned their place in numerous applications in many industries including the chemical, food, rubber, metals, plastics, lumber, electrical and electronic, petroleum, paper, automotive, textile and power fields. Many have run for seven or eight years without a single failure.

In fact, the question most frequently asked today isn't, "Will they work?" but rather "Where else in our plant does the PC make sense, and how can I get more capability out of it?" The answer depends on what you want.

One surprising thing about the rapid increase PCs have made in the controller field is that the programmable controller usually is not specified mainly for its programmability. Often the decision is made because of other benefits. It's possible that modern programmable controllers are misnamed.

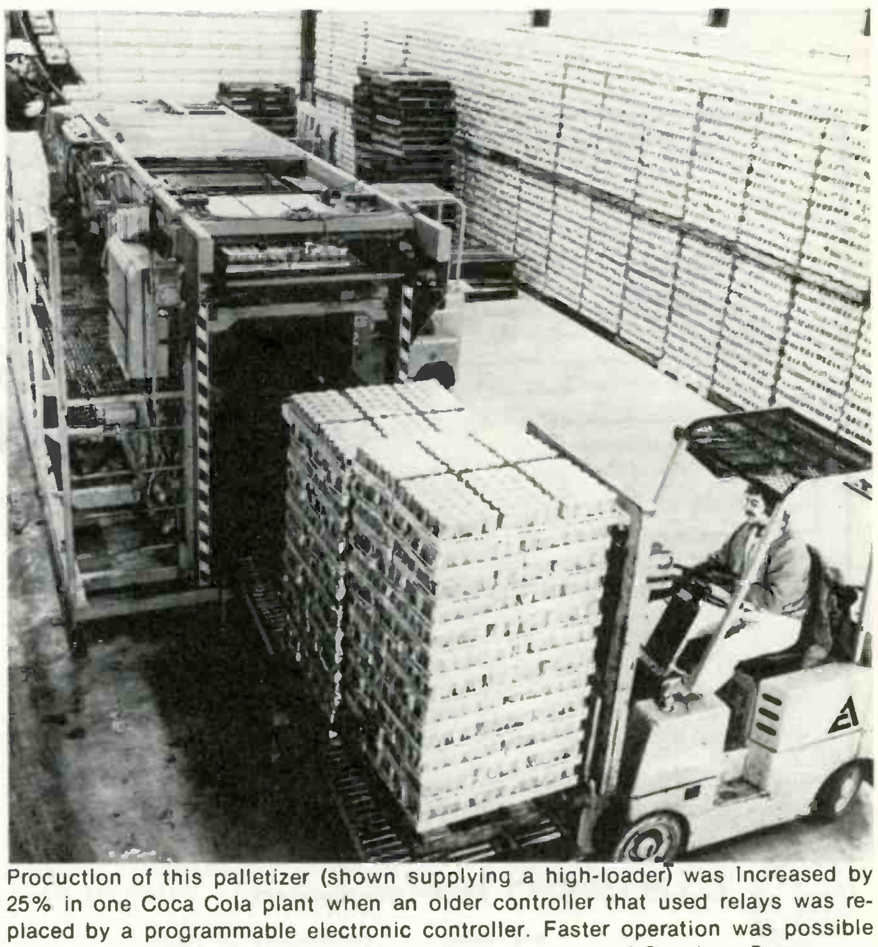
Important controller features

In today's industrial field, what is a typical programmable controller? What jobs can one do? When should it be considered for a specific application?

A strictly technical definition states that a programmable controller is a solid-state sequencing *control device that,* once programmed and wired properly to a machine or system, *will perform the exact same electrical switching sequence time after time.* The strictly technical advantages over relay-type systems lie in:

- solid-state reliability which eliminates downtime due to relay failure,
- ease and speed of programming and reprogramming—sometimes 10 to 15 minutes versus days of relay wiring,
- faster switching which speeds up production,
- space saving, and
- PCs cost less than custom relay panels.

But this strictly technical recitation is extremely limiting. It misses the programmable controller's real impact. It's like saying a computer can add or subtract faster and store more information. In a real sense, PC's enable plants to manage and



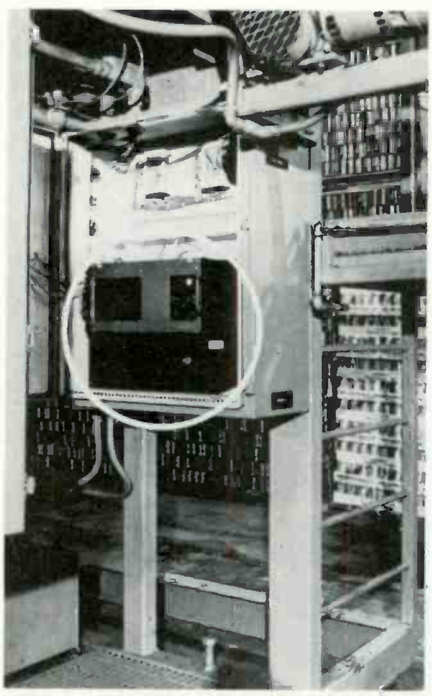
Procuction of this palletizer (shown supplying a high-loader) was increased by 25% in one Coca Cola plant when an older controller that used relays was replaced by a programmable electronic controller. Faster operation was possible without the relay-cycling time delays. *Photos courtesy of Struthers-Dunn.*

monitor the entire production operation better, much like a computer helps executives run the business better.

The reason is that, because it is electronic, the PC inherently lends itself to communicating with a supervisory controller or central computer in ways that no relay system possibly could. Thus, with PCs you not only can control individual machines better, you also can better control the interrelationship between machines. Put another way, a PC is not limited to operating machinery, it also can help supervise an entire plant.

A quick look around industry will indicate the variety of ways in which industries have capitalized on different aspects of PCs.

• **To speed production:** In a material handling and packaging line, Coca Cola of Houston has increased the capacity of existing equipment 25% by switching from relay control to programmable control. The gain stems from the inherently faster switching that is possible in solid-state control. To speed up the relay control would have started a lot of relay races, because the required sequencing rate would have exceeded the response speed of traditional relays.



Location of the programmable controller inside the Coca Cola palletizer is marked by a circle. This controller is much smaller than the relay unit it replaced, and has no downtime because there are no relays to malfunction.

• **To speed changeover:** At S&S Corrugated Paper Machinery, the new line of boxmaking machines (essentially a sequencing assembly machine) has shifted from producing one type box to another in a matter of 15 minutes instead of hours. The reason: PCs replaced relay panels in the control section.

Although the number of I/Os (or control steps, in effect) didn't seem large enough to justify PCs on an initial cost basis, the fast changeover capability in itself made the switch worthwhile. In effect, the PCs helped S&S create a new breed of boxmaking machine, the quick change machine.

In a wider variety of high-production equipment in many plants, it might have been unthinkable to try to change a line over to run another kind of product. Now it's being done in a variety of industries, and creating entire new businesses and product options.

With PCs, changeover to an entire new sequence simply involves switching program cards or *chips*. The old chip or card can be stored for the next time the job is run. New programs can be created quickly by any electrical engineer or technician familiar with traditional relay ladder-type of electrical control logic.

• **To cut capital costs:** The more relays required in a control system, the greater the chance that a programmable controller will carry a lower initial cost. The crossover point depends on the type of relays required and the installed cost that is assigned. A few facts will help figure out the economics, though. Today, PCs cost between $10 and $15 per I/O when into the 16 I/O capacity range or higher. By contrast, the installed cost of relays may vary from $10 to $100 per relay depending on the relay used and the labor rate you assign, or the control panel builder assigns.

In some cases today, PCs actually carry a lower initial cost than relay systems in controls requiring as few as 16 relays.

It's always important to consider both cost and capacity together. Reason: even if I/Os are equal, PCs can simply do so much more—in speed, reliability, space savings and communicating with other controls for overall supervision.

• **To gain reliability:** It's ironic that plant managers were suspicious about whether PCs would stand up to tough industrial environments when they were first offered as an alternative to the old relay. In reality, PCs have proven to be more reliable, because there are no moving parts to wear out and fail.

Improved reliability, in fact, is one of the main reasons that pipeline companies have, by and large, switched over to PCs for total station control at remote unmanned pumping stations. Usually the closest available maintenance man is a day's drive away. Yet the PCs must control some extremely complicated pumping sequences, reroutings or shuntings, in rain, snow, hot and cold weather, dust and electrical storms. Moreover, many must operate on either REA power or gasoline-driven generators, where even the quality of electrical power is suspect.

Newer programmable controllers have taken an even further step toward reliability and reduced downtime. The Struthers-Dunn Director 4001 PC incorporates fiber optics for remote I/Os to gain immunity from electrical interference in the plant; and a built-in self-diagnostic system to speed the identification of any defective module.

• **To minimize plant energy peak demand:** Many plants are installing PCs to monitor total plant energy demand and supervise this operation to avoid paying premiums for energy or tripping circuit breakers.

John Deere has extended the same idea to the company's steam-plant which generates heat for some processes as well as overall plant power and comfort. The effect has been more energy-efficient startups.

• **To cut lead times on new custom machinery:** Scores of special machine builders, and many company plants which prefer to build their own custom machinery for proprietary reasons, have found that PCs cut the lead times for new machinery by 50%. Reason: machine construction can proceed in parallel with control system design rather than serially. No need to design the entire control system first before mechanical assembly. Run-in and debugging time is cut substantially as well, since a control system adjustment can be made in minutes instead of hours of rewiring or relay replacement.

• **To cut costs of duplicated machine control systems:** Where many identical production machines that require the same control sequence are to be built, PCs have allowed enormous savings. Reason: once the initial program for the first machine is completed, the chips and cards for the rest of the machine controls are duplicated almost as fast as they can be photocopied. By contrast, in duplicating hardwired relay machine controls, each new control box must be built from scratch in a labor-intensive, time-consuming process.

• **To simply have one around:** In the engineering departments of many plant operations, a *spare* PC is likely to be found. It is used to develop programs without tying up production equipment or to keep a relay-based production line running when a relay fails.

This last phenomenon may be the best indication of how far PCs have come in the plant operations scene.

Another indication of how pervasive PCs have become in the industrial control scene is their appearance on the shelves of many electrical distributors and supply houses as stock items. More than 20 distributors in the more highly industrialized sectors of the country now carry some of the lower-cost PCs in stock, and they're reordering.

Which PC?

If a PC seems to make sense, which of the more than 200 models is the right one? That depends on the user's needs. The fact is, some are extremely sophisticated and can do more, but are more complex to program and more expensive. At the other end are extremely stripped-down, simple units.

Here are the key points to consider once the needs are defined, and the models that simply won't work are ruled out.

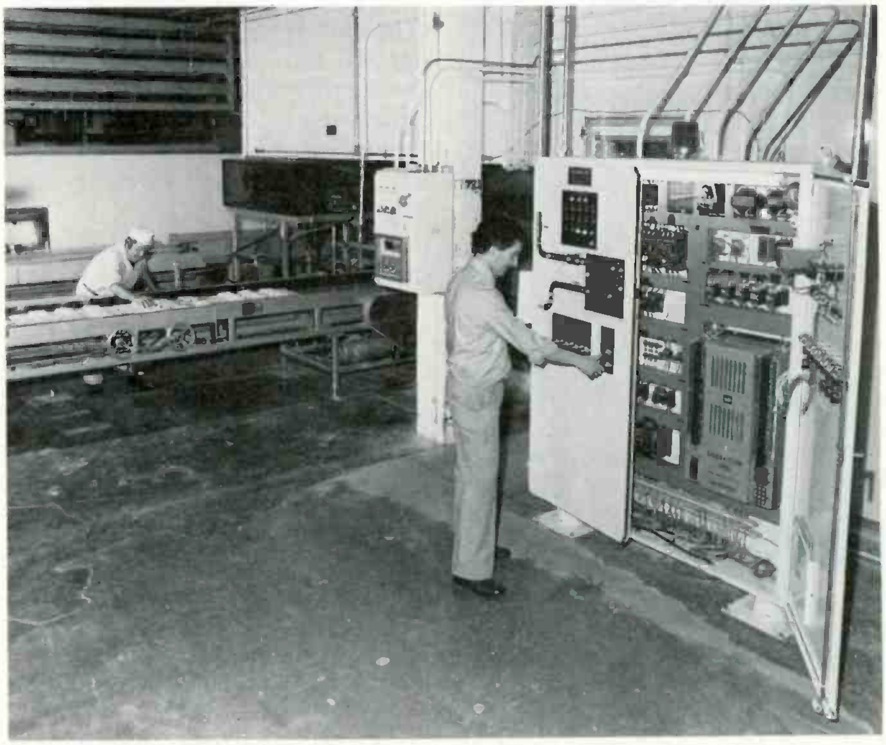
• **Cost/capacity:** Look past dollars per I/O. Many PCs have special functions (i.e. counters, timers, latches, delays, feedback and loops) that may be important for the application. To compare raw cost per I/O is misleading.

• **Ease of programming:** Some PCs need a computer programmer to program. Others are designed so that any technician or electrician familiar with relay ladder language can do the programming. Consider how much reprogramming will be needed before choosing a brand of PC. If it's the kind of application that will almost never need reprogramming, ask the supplier if he'll do the original program.

• **Ease of maintenance:** PCs fail very rarely, because they're solid-state. Look into the cost and complexity of troubleshooting and diagnostic work, particularly if a lot of programming will be done. Some newer models have totally self-contained diagnostics that would enable any plant employee to find a bad module and replace it as easily as finding and replacing a burned-out light bulb. By contrast, other models may require a separate piece of electronic diagnostic equipment to do any kind of troubleshooting.

• **Track record in your industry:** This goes for the company as well as the unit. At the rate new PCs are introduced, it would be a mistake to arbitrarily stick only with ones that have proven themselves in similar service: they could be missing an important new feature. Look at the company behind it as well. Do its engineers have experience in the field and understand the industry? Will it be there when needed? It is important to be sure the company has the resources to back its product and stay in business.

The PC is here to stay in industrial control. It can do much more than improve the operation of machines—it also can provide better operation of the entire plant. □

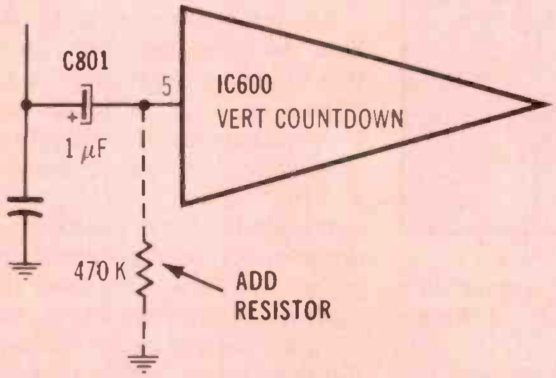


A programmable controller was installed in a bakery to prevent excessive downtime of the previous relay unit (from flour and grease). This was a good solution, although the bakery operation did not require the flexibility and additional features available from the electronic controller (a Director 3001 from Struthers-Dunn).

symcure

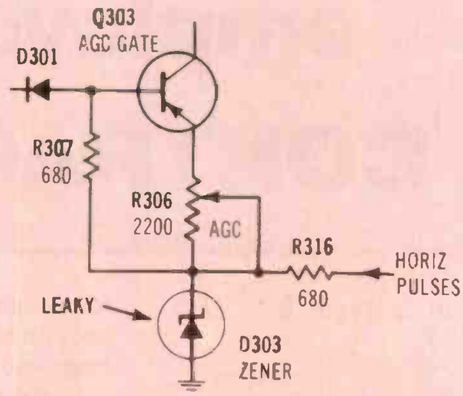
Symptoms and cures compiled from field reports of recurring troubles

Chassis—Admiral M55
PHOTOFACT—1766-1



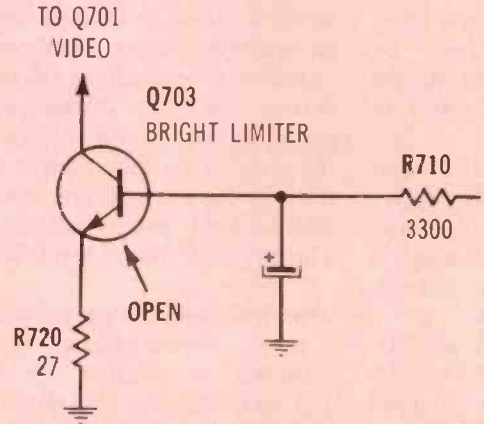
Symptom—Vertical lock is erratic
Cure—Add a 470K½W resistor from IC600 pin 5 to ground

Chassis—Admiral M55
PHOTOFACT—1766-1



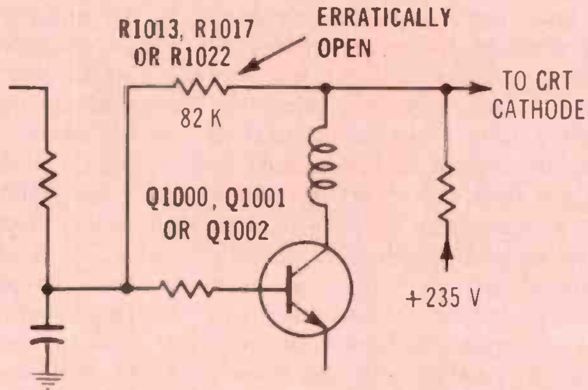
Symptom—AGC overload, might improve when TV runs warmer
Cure—Check zener diode D303, and replace if leaky

Chassis—Admiral M55
PHOTOFACT—1766-1



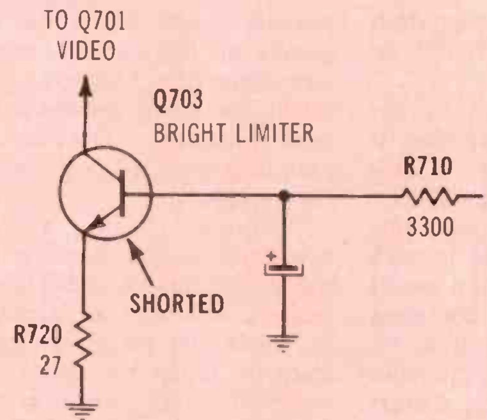
Symptom—No raster, but sound and HV are good
Cure—Check brightness limiter Q703, and replace if open

Chassis—Admiral M55
PHOTOFACT—1766-1



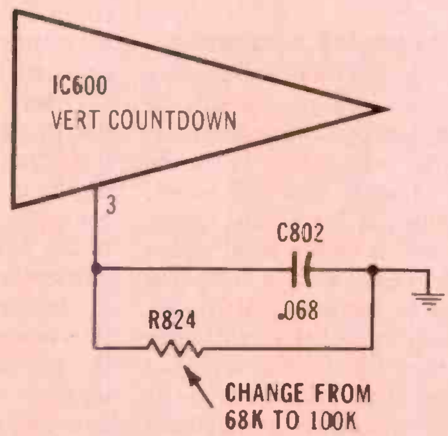
Symptom—Intermittent loss of red, blue or green from raster and color picture
Cure—Replace R1013, R1017 or R1022 with 82K metal-film type

Chassis—Admiral M55
PHOTOFACT—1766-1



Symptom—Excessive brightness
Cure—Check brightness limiter Q703, and replace if shorted

Chassis—Admiral M55
PHOTOFACT—1766-1



Symptom—Vertical instability or roll on cable signals
Cure—Increase R824 from 68K to 100K

Employer-employee CONTRACTS

By Lipman G. Feld, B.S., J.D.

Legal contracts about specific types of non-competition between businesses or individuals are somewhat rare in the electronic-servicing field. There are several reasons why this is true.

The small size and limited financial resources of the average service shop tend to discourage owners or managers from considering *any* legal contracts, especially those that might require a courtroom trial to settle any serious disagreements.

Many shop owners are not aware that non-compete agreements can be valuable for protection of their rights. If they know there are such contracts, they might be tempted to copy a complicated version out of a book of legal forms. As shown later, most of these agreements are worthless and unenforceable.

There are two types of non-compete agreements involving service shops. One deals with competition following sale of a business, while the other involves a contract of employment.

Selling or buying a business

A mutually fair and enforceable contract is essential for the sale or purchase of an operating business. The following information is for the protection of both seller and buyer.

In addition to the selling price, the terms and a listing of all items to be sold, one section often is inserted for protection of the buyer. For example, the seller might agree to be employed by the new owner for one year, and afterwards to be forbidden from direct competition in a specified area for a period of five years. This protects the buyer from unfair immediate competition and provides continuity of knowledge and skill.

In the vernacular of lawyers, this is called a *restrictive covenant ancillary to the sale of a business.*

These restrictions and terms appear outwardly to be fair to both parties, and non-legal people usually see no problems until the time for enforcement arrives. According to the number of restrictive covenants disallowed or changed by judges in past years, these judges are finding some contract terms to be too severe.

Generally, the courts have ruled that the validity of a restrictive agreement depends on its reasonability. So, a knowledge of what is considered reasonable can be helpful in preventing problems.

Test for reasonability are divided into several parts. For the restraint to be reasonable, it must be vitally necessary for the buyers protection. It cannot be based on vague fears or imaginary suspicions.

Equally important, it must not be overly oppressive to the seller or injurious to the interests of the general public. These last two considerations are the ones that most often cause contracts to be declared invalid.

Other restrictions, such as the length of time the competition is forbidden and the territorial area where it is disallowed, usually are considered by the judge according to the exact circumstances in each particular case. Perhaps the radius of the forbidden circle is too long, thus enclosing too much area. Or the restriction might be oppressive because of the population density and the exact locations of thickly inhabited neighborhoods.

Another question about possible damage to the general public hinges on whether or not there are a sufficient number of competitive stores in the area of question that can provide adequate alternate sources of supply.

Paper corporations

All restrictive covenants should bind the seller personally, in addition to any corporation he is a part of now or could be in the future. Corporations are very easy to form or dissolve. It would be worse than a cruel joke after a sale is completed, if an asset-less and dormant corporation (owned by the seller) was restricted from direct competition with the buyer, but no contract prevented the officers or directors of the selling corporation from entering into competition on a personal basis.

The following is a portion of contracts used successfully to prevent such loopholes: *"For a period of three years following the closing, Seller shall not own or have any interest, direct or indirect, or act as an employee, agent, director, representative or consultant of, or assist in any way, any organization engaged in the business of offering to the public electronic service or sales within the corporate limits or metropolitan area or adjacent to..."* The city and county are listed next.

Restrictions on ex-employees

It is advantageous for each employer to arrange for training and upgrading of all employees so they can accomplish more work of higher quality in less time. This is central to being a good manager. However, the addition of new employees, either unskilled beginners or competent technicians, also brings a potential danger that these workers might learn all of the secrets of success and start their own competitive businesses. Or they might command premium salaries from competitors because of the valuable knowledge gained from their employer.

Without exposing a business needlessly to the damage that is possible if they later become competitors, how can an arrangement be made for these employees to learn the things that allow them to work efficiently? Business survival might depend on a method or lack of one.

One way is to have each employee sign a non-compete agreement that lists specific restrictions. Samples of such agreements are available, but some are less than worthless, for most judges would declare them unduly harsh. Few judges will enforce any agreement that absolutely prohibits the former employee from working in the only field where he is trained and has competency. Reasonable geographic and time limits must be stated. These same judges also keep in mind the damage that is possible to your business if some restrictions are not allowed.

There are few trade secrets in the servicing business. If a business has actual valuable and exclusive trade secrets, then a general description should be included in a restrictive covenant signed by each employee.

However, no trade secrets are involved if a business has the same knowledge and techniques which are used commonly in other similar shops.

Lists of customers—One of the few distinctive features of a business that should be protected is a list or file of the names, addresses and phone numbers of all previous customers. Many judges will not uphold any agreement that forbids a former employee from continuing to work in his chosen field. But usually they will uphold a clause that forbids the ex-employee from stealing his former boss' clientele.

If a non-compete agreement has been drawn up, signed legally, and then later comes to court because the employee has violated the agreement, the shop owner should prepare a strong factual argument in preparation for a courtroom appearance. Proof must be given that the list of customers was actually unique, so its loss would be an extreme hardship.

In considering both sides of the case, the judge no doubt would try to find out if these customers commonly patronize the employer's competitors or if the patronage is exclusive. Only an exclusive following is likely to rate as a valuable asset. □

Sample employer/employee restrictions

• Employee acknowledges and recognizes that the Employer's customer lists are valuable, special and unique assets to the Employer's business, and were acquired at considerable expense to Employer, and that said lists are confidential and are valuable trade and business secrets belonging to the Employer.
• Therefore, the Employee agrees that he will not at any time during his employment with the Employer, or within two years after leaving such employment, for himself or any other person or company, divulge the names and addresses or any information concerning any customer of the Employer.
• Employee further agrees during said two-year period not to disclose any information obtained while in the employ of Employer, without the consent of the Employer; said restriction to include Employer's methods of conducting business; further, the Employee will not solicit or do business with any active or inactive customers of Employer, and Employee shall not influence any other Employee of Employer to quit his or her employment to work for Employee or for a competitor of Employer.
• Employee shall not publish his photograph or cause it to be published or use his name in advertising in connection with the same or similar employment.
• Employer and Employee, recognizing that irreparable damage will result to the Employer in the event of the breach of any covenant contained herein, agree that in the event of such breach on the part of the Employee, the Employer shall be entitled, in addition to other legal or equitable remedies and damages available, to an injunction to restrain the violation thereof by the Employee and all other persons acting for or on behalf of such Employee.
• It is agreed that in the event of violation of such paragraph and in the event that any court shall finally hold that the time of the restitution or territory or any other provision constitutes an unreasonable restriction against Employee, then the parties agree that the provisions of this Employment Agreement shall not be rendered void, but shall apply as to time or territory or to such other extent as such court may judicially determine or indicate, or if such court does not so determine or indicate, to the extent that any pertinent statute or judicial decision in the jurisdiction of such court may indicate constitutes a reasonable restriction under the circumstances. □

Troubleshooting RCA hot supply and horizontal

Technicians should be familiar with this important information before attempting to service power-supply, horizontal-sweep and HV sections of RCA CTC99 and CTC101 color TV receivers.

By Gill Grieshaber, CET

In RCA CTC99 and CTC101 color-TV chassis, the start-up and shut-down functions often complicate troubleshooting of power-supply and horizontal-sweep circuits. After a failure to start-up, the symptoms and dc voltages are almost identical to those following a shut-down that occurs after operation.

Efficient servicing of these receivers requires a logical sequence of tests to determine where the defect is located. Such a troubleshooting system will be proposed.

Many of the tips can shorten diagnostic time, while others might prevent destruction of components during tests. These suggestions are so vital that several are given before the main text.

Ignore previous models

Complete and complex charts have been worked out for some previous RCA chassis such as CTC87, CTC88, CTC96 and CTC97. They are based on the following: the *tic-tic* regulator sound; the short burst of sound at turn-on; and several dc-voltage measurements. When used with those models, the charts undoubtedly are very valuable.

Unfortunately, several changes in the CTC99 and CTC101 chassis make the original methods almost useless when applied to these newer models.

For example, an inoperative horizontal-output stage in a previous model would force the regulator to free-run, thus producing, around the HV section, a ticking sound of moderate volume at about two pulses per second. This usually proved the hot power supply and the regulator were operating normally.

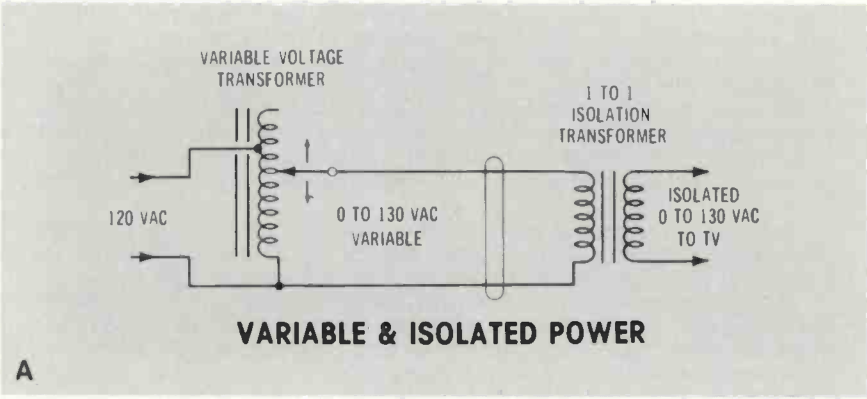
However, the CTC99 and CTC101 chassis have tic-tic sounds of about 10Hz or 11Hz (slow buzz) with volume so soft it cannot be heard unless the surrounding area is quiet.

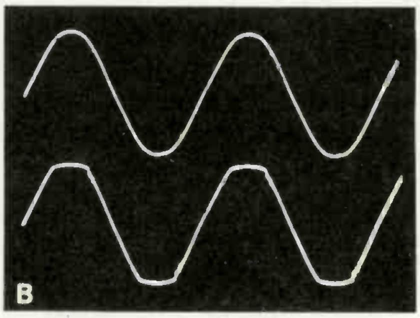
All CTC99 and CTC101 chassis have some kind of frequency-synthesized channel tuning, sometimes with remote control, and such features call for elimination of audio during the search. Therefore, no sound is heard from the speaker for perhaps a half second after turn-on. Any defect that causes shut-down immediately following start-up thus prevents any audible sound, except for a thump that is too soft to a be a good symptom. The time is too short between turn-on and shut-down to permit any quick blast of sound.

Although those two symptoms are missing from these newer chassis, the remaining tests plus a helpful analysis of dc voltages and ac waveforms are more than sufficient to pinpoint the area of any defect, and to do so accurately and rapidly.

Safety precautions

Although both CTC99 and CTC101 have cold chassis that are isolated from the ac power line, several major circuits are electrically hot, regardless of how the line plug is inserted into an outlet.





(A) An isolated and variable source of ac line voltage for servicing hot chassis or hot power-supply color receivers can be formed from two separate transformers. However, a combination of both in a single higher-wattage unit could minimize flattening of the waveshape tips. The upper waveform of Figure B shows the line voltage at a CTC99 without a transformer. It measured 335VPP or 119.6V RMS, and produced a hot supply of +154.1V. The lower trace shows flattened tips when a 150W isolation transformer was used. The voltage measured 320VPP or 122.1V RMS and produced a hot supply of only +152.3Vdc. Notice that the PP value of a sinewave 122.1V RMS signal is 345VPP. Therefore, 10VPP and 2Vdc were lost because of the distortion, even with a higher RMS voltage.

These dangerous circuits include the line-rectified hot power supply with its filter capacitor, part of the turn-on circuit, the +123V regulator with SCR, and the horizontal-output stage. Details of the power supply were given starting on page 31 in the December issue of **Electronic Servicing.**

During troubleshooting tests, many measurements must be made on both hot-ground and cold-ground power. One test connects hot and cold grounds together. Remember that many items of new test equipment are grounded automatically through the third wire of each power cable. Therefore, expensive damage (such as shorted diodes) can result from connecting grounded test equipment to the TV hot ground. An isolation transformer between line and receiver is absolutely necessary to prevent such damage. It also protects technicians from dangerous electrical shocks.

Some variable-voltage and isolation transformers add enough dc resistance to produce a distorted line-voltage waveform. If the peaks are rounded or flattened, the dc voltages in the hot power supply will be lower than they should be, and the waveforms might be slightly different than those shown in this series.

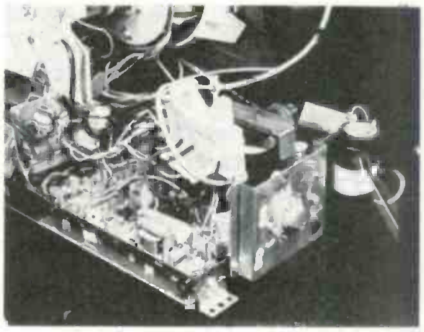


Figure 1 The only hot-supply filter capacitor, C106, is accessible because it is mounted at one side of the TV chassis with both terminals on top. Other testpoints can be reached easily except the Q407 collector. The focus/screen assembly should be unbolted and moved up to expose the transistor.

Here is one more precaution: RCA television service data numbers 1979 C-6 and 1979 C-7 (first edition, first printing) have numerous mistakes in *waveforms*. Some correct waveforms are shown at the wrong points, while other waveforms are incorrect. No mistakes have been found in the RCA schematic, during comparisons with the actual chassis wiring. Some production changes have been made, however, so the schematics and waveforms of this series are more accurate.

+155V Supply

Without start-up circuitry, the line-powered hot 155V supply is very simple and easy to troubleshoot. Four separate diodes rectify the 120Vac, and the dc power is filtered by one capacitor, C106.

Filter capacitor C106 is accessible at the side of the chassis (Figure 1); therefore, all dc and ac voltage tests of the +155V supply should start here. The dc voltage can be measured with sufficient accuracy by a VTVM, VOM, digital multimeter or a dc scope. All gave readings of about +155V. The ac ripple amplitude across a normal C106 measured by four instruments was as follows:

Scope	4VPP to 5VPP
VTVM	4VPP
VOM	0.8V RMS (on 2.5V)
Digital	1.2V RMS

The scope and the VTVM gave relatively accurate readings in peak-to-peak volts. By comparison, the VOM and the digital multimeter produced serious errors because of the non-sinusoidal waveshape. However, after a reading is taken from a normal chassis, that reading can be a standard for future tests using the same meter. A 5kΩ/V VOM always should show less than 1V (on 2.5V scale using the internal blocking capacitor) for a non-defective set. If the reading taken from one TV measures 17Vac RMS, it is certain that C106 is open. Most of the readings that follow will be listed for both a digital multimeter and a portable VOM.

Power-supply defects—If the dc voltage at C106 is zero, the defect might be an open F100 (5A) fuse, an open RF100 surge resistor, one or more shorted bridge diodes, an open in T100 start-up transformer primary, or an open in the wiring. An open in any of these components usually indicates an overload or short in another. Watch for multiple defects.

Copper wires carrying the 120V power are so small that one might vaporize and open the circuit if a grounded soldering iron or scope is connected to the hot ground when the TV is operated without an isolation transformer. Check under the circuit board (slightly toward the center from the bridge diodes) if the circuit tests open but all

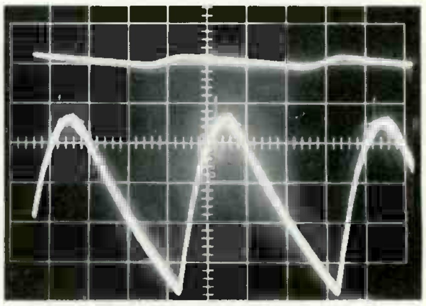


Figure 2 Top scope trace shows the normal 4VPP ripple across C106, the hot-supply filter. When C106 is open and the TV fails to start-up, the ripple increases to 64VPP (lower trace). Normal dc voltage with 120V RMS line power is +155V; when C106 is open, it measures only +139V. These ripple amplitudes and dc voltages can be dependable clues to an open C106.

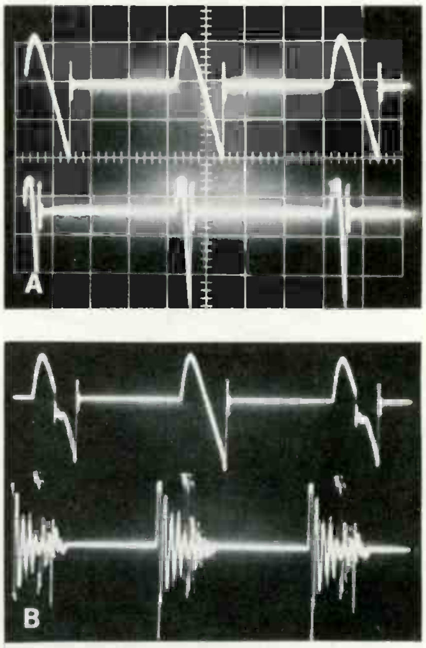


Figure 3 Three start-up conditions are shown by these waveforms. (A) Top trace is the normal 50VPP waveform at the secondary of T100 start-up transformer (later called the signal at the purple wire and CR422 anode). Below it is the compressed 7VPP waveform seen when the TV is in a shut-down condition and drawing little current. (B) The top trace is the normal 50VPP start-up waveform. The lower trace is the 4.5VPP waveform at the CR422 anode when C106 is open. Notice the ringing and low amplitude.

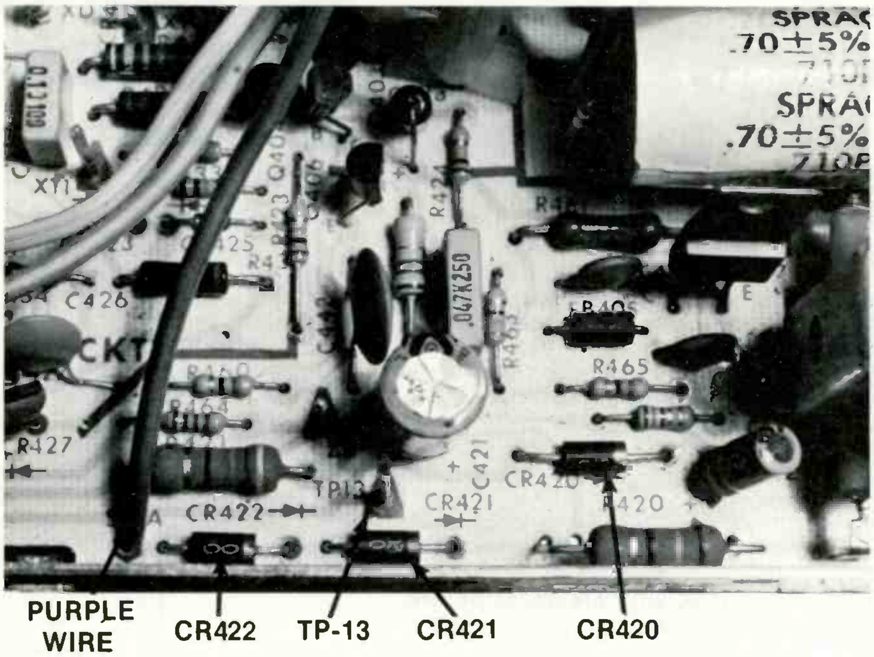


Figure 4 Arrows point to several components that are used as testpoints for servicing the start-up circuit. TP-13 is a convenient place to insert an external dc voltage (+12V to +24V) for powering the oscillator/driver circuit during tests at low voltage or for kick-starting.

individual fuses and components are good.

An open in any of the four bridge diodes reduces the dc voltage at C106 and increases the ripple amplitude while changing it to 60Hz. Low dc voltage also can be caused by reduced C106 capacitance.

An open C106—Because C106 is the only filter capacitor for the 155V supply, a total loss of capacitance reduces the dc reading and produces a huge ripple amplitude, as shown in Figure 2. The waveform indicates a small amount of peak-reading action that creates sawtooth ripple.

Although the open C106 allows sufficient voltage to operate the TV at reduced efficiency, it cannot produce start-up. Charging current to a *discharged* C106 is necessary for start-up. Therefore, all receiver voltages are zero except those fed by the +155V source. The +155V source measures about +140V on any accurate meter, while a scope shows 64VPP across C106 (a VOM reads 19V RMS).

Incidentally, the same ac amplitude and almost the same dc voltage can be found at the Q100 (output) collector. Remember Q100 has no drive or output now because the oscillator is dead from start-up failure.

Open C106 and kick-starting—When C106 is open, there is no transient surge at the CR422 anode following turn-on, and the steady signal has an amplitude of only 4.5VPP (Figure 3). This is not sufficient to produce start-up, so the TV is dead.

However, start-up can be attained by an external source of voltage that is connected to TP-13, which is located between the cathode of CR422 and the anode of CR421 (Figure 4). This external voltage should be capable of at least 200mA with good regulation and a voltage between +12V and +23V. (Actually, a voltage of +8V *under load* will kick-start the circuit, but a higher voltage is more dependable.)

After each kick-start, which produces dc voltage from all scan-

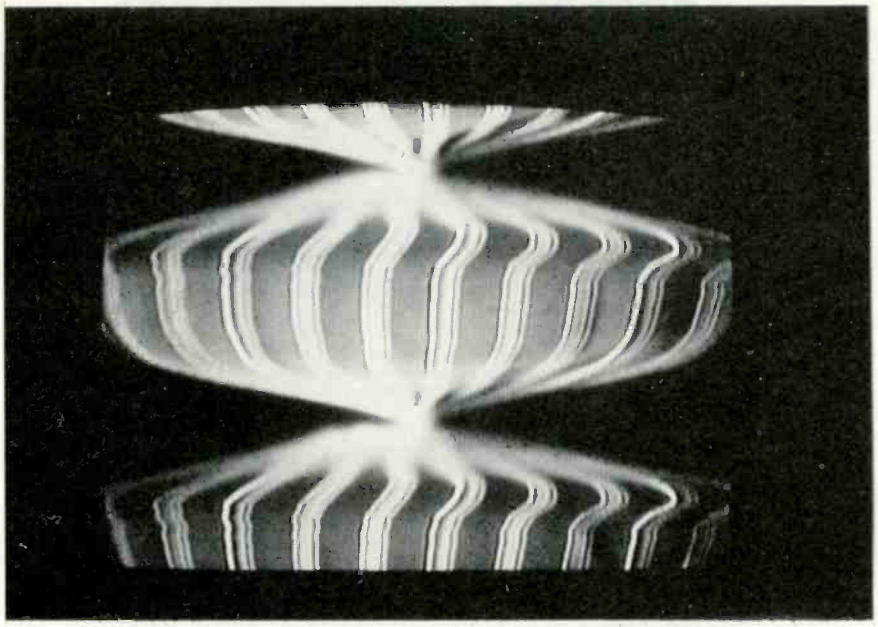


Figure 5 This color-bar pattern shows the unique 120Hz width reduction that occurs when C106 is open and the set is kick-started by an external dc voltage.

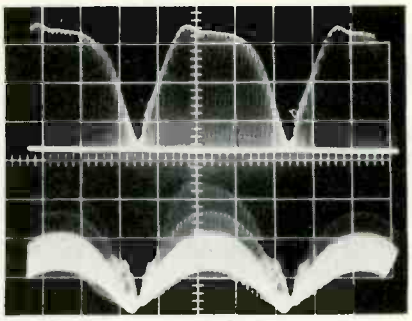


Figure 6 (Top trace) When C106 was open and the receiver was kick-started to force it into operation, the Q100 output-transistor collector signal had this waveform when scoped at the vertical rate. The lower trace shows a mixture of horizontal pulses and 120Hz hum at the terminals of an open C106.

rectified supplies (and perhaps shows a picture), the external voltage supply is disconnected from the +23V supply when CR421 becomes reverse biased. The set then runs on its own power and the external supply can be removed. (See the start-up schematic on page 32 in the November issue of **Electronic Servicing.)**

Butterfly wings—When C106 is open and the receiver is kick-started, the picture has two areas of almost zero width. Because of the hum frequency versus the vertical rate, the hum-narrowed areas move upward slowly. With some imagination, a viewer might see a resemblance to butterfly wings at times.

Without filter C106, the B+ varies from near zero to maximum at a 120Hz rate, and the picture width changes in step, as shown by the color bars in Figure 5. This is a distinctive symptom which proves that C106 is open.

Figure 6 shows waveforms of the Q100-collector and power-supply signals that produce the butterfly effect. The horizontal sweep-rate collector pulses (top trace) vary in amplitude from zero to about 1100VPP at a 120Hz rate. At maximum, the amplitude is higher than that of normal pulses without hum. This is caused by the higher dc voltage coming from the +123V supply when the filter capacitor is open (+139V versus +123V). The hum fools the regulator.

At the terminals of an open C106 appears 120VPP of 120Hz hum plus a total amplitude of 370VPP for both hum and horizontal pulses (lower trace of Figure 6) which are there because the open capacitor does not bypass them.

Testing for shut-down

Of course, shut-down can be defeated merely by grounding the anode of diode CR419 or the emitter of Q403, the X-ray switching transistor (see schematic on page 34 in the February issue of **Electronic Servicing.** After a wait for C106 to discharge, normal start-up should occur after turn-on, thus allowing normal operation of the TV if the shut-down had been caused by a defect in the shut-down circuitry.

However, if a defect in the horizontal-sweep was increasing the high voltage and the pulse amplitude (monitored by the X-ray shut-down circuit), arcing or a ruined output transistor could result from the defeated shut-down action. An open C117 can produce such a destructive increase of high voltage.

Therefore, determine the cause of shut-down without defeating the circuit.

Testing hot supply and regulator

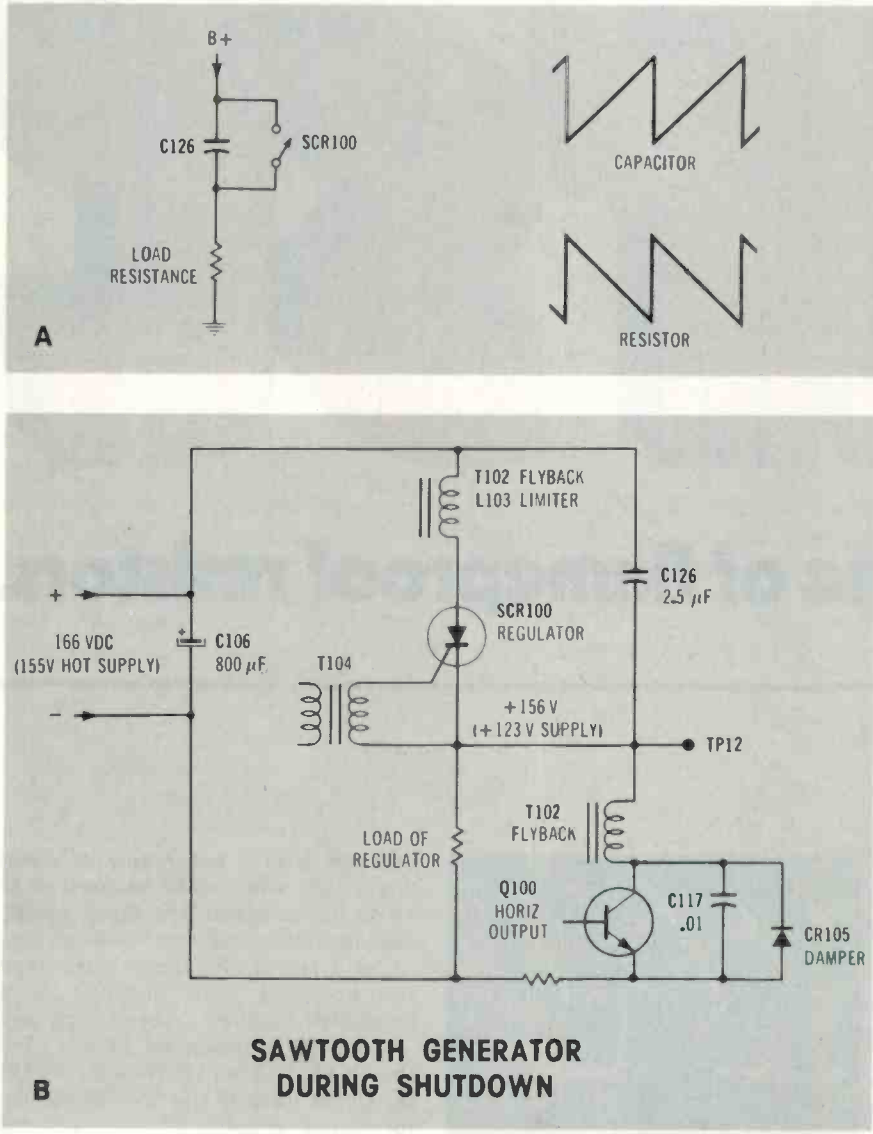
Both the hot supply and the +123V regulator can be tested together in just a few minutes. Accuracy is good enough when only a VOM is used, and it is almost infallible if a scope and digital multimeter make the measurements.

Tests of this regulator are very different from those used with regulators in most other brands. Other regulators operate with dc voltages only. They are designed to maintain a certain dc voltage at the output regardless of the current drain. If one of their horizontal-output transistors is removed from its socket (thus reducing the drain to zero and eliminating the horizontal pulses), the regulated voltage might rise a volt or two. The regulator otherwise is not affected by the zero drain.

The CTC99 and CTC101 regulators also are factory adjusted for +123V, regardless of load or line-voltage variations. However, one large difference is that *this is a keyed system.* Horizontal-sweep pulses are necessary to trigger the regulator oscillator at the proper time and to turn-off the SCR during retrace time. The pulses disappear after shut-down or a failure to start-up, and the regulator attempts to operate without those vital pulses.

When the four regulator transistors are operating from their own 33V supply (powered from the hot supply) but the SCR is open, the circuit operates at about 49kHz (about three times too fast) since the +123V supply is zero.

When the horizontal-output transistor is open, but the hot supply, regulator and SCR are normal, the circuit *tries* to regulate. With zero regulated-supply current (Q100 is open), the +123V-source voltage rises. The regulator lengthens the time between SCR conductions as it tries to turn-on the SCR later in the cycle (in normal operation this would reduce the regulated voltage). Without horizontal pulses for timing and SCR turn-off, the regulator cycles very slowly, finally reaching 11 SCR conductions per second. This is the tic-tic that was a useful symptom with previous RCAs. Obviously, the regulation is not normal; but these abnormalities can be tested to prove whether or not this is a shut-down condition.



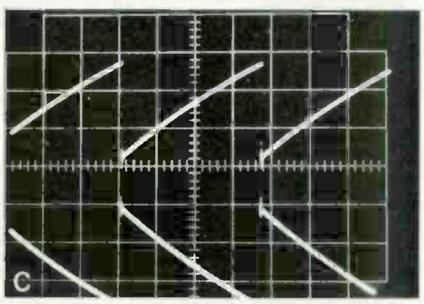


Figure 7 When the receiver is in shut-down condition but the regulator is working correctly, the +123V regulator produces 11Hz sawteeth which can be used to diagnose the performance. (A) This is the simplified circuit and the type of waveforms generated. (B) Some regulator components are lumped together to make the action clear. The total inductances of T102 and T103 have little effect on the frequency, since they are designed for 15,734Hz operation. However, the sawteeth have about 20PP larger amplitude when the inductances are not shorted out. Also, a short across CR105 damper diode does not change the operation appreciably. The dc resistance between TP-12 and the C106 negative terminal has a large effect on the sawteeth repetition rate. An 8200 Ω resistor added there increased the rep rate to about 120Hz and decreased the amplitude to about 50VPP. This is an indication the regulator is trying to work normally. It cannot do so, however, without horizontal pulses.

Dc and waveform clues—When the hot supply and the regulator were not defective, but the receiver was in shut-down, the +155V hot supply voltage increased to +166V, while the +123V supply voltage measured +156V. That was the first clue to shut-down.

Also, the regulator circuit now produced large 11Hz repetition-rate sawteeth. Figure 7A shows the equivalent circuit with a switch for the SCR and a resistor to represent the load on the +123V supply. When the switch closes (SCR conduction), C126 rapidly becomes discharged (same voltage at both terminals). Next, as the switch is opened (SCR non-conduction), C125 begins to charge from the B+ supply until the next switch closing.

In the actual regulator circuit (Figure 7B shows the essential parts), SCR100 is the switch that is paralleled across C126. At the low repetition rate of the tic-tic sawteeth, the two inductances between +166V and the SCR anode have little effect.

It is slightly more difficult to visualize the regulator load. Q100 is non-conducting from lack of base drive, and the voltage does not go negative; therefore, the damper is not forward biased. Neither does the flyback inductance versus the 0.01+μF C/E total capacitance affect the operation noticeably. In fact, the connecting wire to Q100 and these components was disconnected as a test to prove the lack of effect. The only regulator load is the current to operate CR115 zener and the four regulator transistors. It is this relatively high resistance that provides a long time constant and produces the slow 11Hz cycling rate. As the current is increased (reduced value of resistance) the repetition rate will become faster.

The Figure 7C dual-trace waveform illustrates another peculiarity of the circuit. Top trace is the tic-tic waveform across the SCR from anode to cathode, while the lower trace (SCR cathode to hot ground) is an inverted version of the sawtooth SCR waveform. Both have the same amplitude, and are identical except for the inversion. Figure 7A helps to explain these unexpected waveforms. The C126 waveform is easy to understand because it is a short section of a voltage capacitor-charging curve.

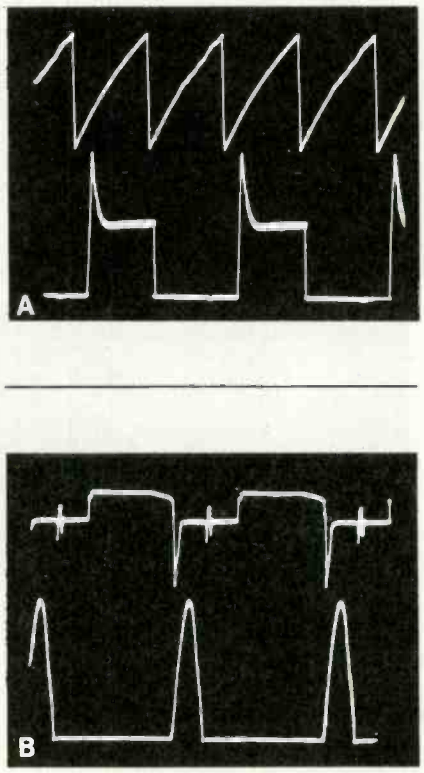


Figure 8 These are the waveforms obtained with a hot supply of about +40V and with +23V connected to TP-13 for oscillator and driver power. The regulator was not defeated because it tested alright previously, and the hot and cold grounds were connected together. Line voltage was 34V RMS, HV measured 11.6KV, and the +123V supply tested +47V. (A) Upper trace is the 3.2VPP oscillator signal at U400 pin 12, and the lower trace is the 80VPP signal at Q407 collector. This waveform loses its spikes at lower supply voltages. (B) Upper trace shows the 13VPP B/E drive at Q100 output transistor. Note: it is referenced to hot ground (the transistor mounting plate), and it will have extra wrinkles if the scope ground is connected to the hot-supply minus at C106. Lower trace is the Q100 collector 380VPP waveform. The amplitude changes slightly with a different +23V supply. It varies greatly when the hot supply and line voltage are changed. Higher voltage gives higher amplitude. All waveforms but the Q100 base signal were referenced to the cold ground at the chassis rail.

But between B+ and ground there is no signal (zero amplitude). Therefore, the other waveform must have equal amplitude and an inverted polarity so the two add to zero amplitude. In effect, the resistance waveform is subtracted from the capacitance waveform to equal zero.

In the actual Figure 7B circuit, therefore, the sawtooth waveform is produced by C126, but it's easier to measure by scope or VOM from TP-12 (+123V supply) to hot ground at C106.

Measured amplitude of these sawteeth was 75VPP in the unaltered circuit, or 55V when the SCR-anode inductances were shorted.

In summary, proof that the +155V hot supply and regulator circuits are normal, and that the receiver is inoperative because it is in either a shut-down or a failure-to-start mode is provided by these three symptoms:

- A C106 voltage of about +166V.
- A +156V reading from TP-12 (123V supply) to the hot return.
- Ac readings of 17V RMS or 75VPP from TP-12 to hot return.

A failure-to-start problem can be identified by doing a kick-start, which should produce normal operation until the power is turned off. The response indicates the start-up circuit needs repairs. A kick-start also can produce a butterfly-wings pattern to prove C106 is open. If the problem is not with starting but is a normal start-up followed by a rapid shut-down, the receiver will go into shut-down again following the kick-start, so no harm is done.

One cause of a shut-down condition might be a defect in the X-ray shut-down circuit. This function could be defeated easily, but damage to the horizontal circuit might occur if the shut-down circuit was operating correctly (to kill the sweep because of excessive HV).

Therefore, an alternate method should be used to determine whether or not an excessive-HV problem exists in the horizontal-sweep system.

Low-voltage operation

Because the picture-tube heater is operated from a flyback winding, it is not possible to show a picture at extremely low line voltages. However, there are several methods of applying low voltages to the oscillator/driver and horizontal-output stages so they operate well enough to permit analysis of dc voltages and to show trouble symptoms by the waveforms obtained.

Low-voltage operation allows all horizontal-sweep circuits to operate with little chance of damage from shorts or conditions that cause excessive high voltage. This type of test should always be done following replacement of a shorted output transistor or for cases of shut-down.

Normal start-up is impossible at such low line voltages. If the circuit is kick-started, the oscillator dou-

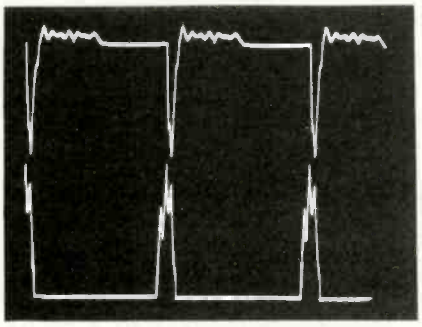


Figure 9 During waveform analysis when the Q100 output transistor is operated at low voltage to prevent damage, these waveforms are affected by an open C117. Upper trace shows ringing on both sides of the SCR100 anode pulses. Ringing clearly is visible in the lower trace (Q100 collector) when C117 is open. The pulse amplitude also is higher, 540VPP compared to the normal 360VPP. If the TV is operated at full power with an open C117, this defect would produce excessive high voltage which should activate the shut-down circuit to kill the horizontal sweep. If C/E capacitors other than C117 open, the HV also increases and ringing appears at the Q100 collector, but the effect is much less pronounced.

ble-triggers at the wrong frequency and then dies slowly. That is because the voltage at the +23V supply is not adequate for stable operation of the oscillator and driver stages which draw about 200mA at normal voltage. Therefore, an outside source of dc power must be applied to the +23V supply during these tests with low voltage.

For this test, RCA recommends that both grounds (hot and cold) should be connected together temporarily. Then the SCR is shorted out with a jumper, +8V or higher is applied to the cathode of CR422, and a line voltage of about 30Vac is furnished to the power cable. The +8V powers the oscillator and driver stages, while the horizontal-output transistor receives voltage from the hot supply, which measures about +40 at that line voltage.

The +8Vdc or higher for the oscillator/driver stages can be obtained from the TV by connecting a 1000 Ω 10W resistor between the positive terminal of C106 filter and the CR422 cathode (TP-13). Although it was originated for previous models, the method often works well. It can be attempted on service calls where an adequate external supply is not available. Waveforms and dc voltages can be obtained from all stages between the horizontal oscillator and the Q100 collector and flyback.

However, the +8.5V that is typically obtained from the 1000 Ω resistor is barely enough to make the oscillator operate. And sometimes the oscillator doesn't want to start, or it has an erratic parasitic oscillation. Unfortunately, if the dropping resistor is reduced to less than 1000 Ω in an attempt to obtain dependable operation from increased voltage, other erratic problems sometimes occur. There fore, an external source of +23V is preferred.

LV tests of horizontal

The following method of testing the horizontal-sweep system safely at low voltage has been tailored for CTC99 and CTC101 receivers. These are the steps:

1. With power off, connect the chassis rail (cold ground) to the negative terminal of C106 (hot ground).

2. Apply a regulated external +23V power source to TP-13 (cathode of start-up diode CR422). (+12V can be used, but some waveforms will be slightly different.) This supply must be capable of a continuous 200mA current.

3. With an isolated supply, connect a line voltage of about 30Vac. (Or adjust for +40V across C106 when TV is turned on.)

4. Apply both ac and dc power, then turn on the receiver. It is not necessary to disable the SCR.

5. Check for the proper waveform and repetition rate at these three major test points: U400 pin 12 for the 31.468kHz oscillator sawteeth (Figure 8); square waves at Q407 collector (metal mounting tab); and the flyback pulses at the Q100 output transistor collector. If any waveform is missing, check other intermediate waveforms at points after the last one that is present. This should identify the stage with a defect.

6. Carefully examine the Q100 collector pulses for any wrong waveshapes or extra pulses or the unique waveform that proves C117 is open (Figure 9).

7. If all tests are good and no questionable waveforms are found, it is safe to remove the jumper wire between hot and cold grounds, disconnect the external dc-voltage supply and then apply full line voltage of 120Vac.

8. If the receiver immediately goes into shut-down, the shut-down circuit probably has a defect that incorrectly is activating it when the high voltage is not excessive. With an insulated hook-type clip lead, ground either the emitter of Q403 in the X-ray shut-down circuit or the anode of CR419. Normal operation of the TV without excessive high voltage proves the shut-down circuit is malfunctioning and must be repaired.

Step 5 mentioned repetition rate. Horizontal frequency can be checked easily (and with fair accuracy) by using the calibrated time base of a triggered scope. Count the number of graticule divisions for one complete cycle. Pick out a spot on the waveform and count to the next identical point. With a 10μS time base, one horizontal cycle should occupy about 6-⅓ (6.36) divisions. If it covers more, the frequency is too low; if fewer than that figure, the frequency is too high.

Next month

Continuation of power-supply and horizontal troubleshooting includes these subjects; waveforms of specific parts defects, made at low voltage to avoid damage of the output transistor; unique pictures from the TV screen illustrating component defects; voltmeter tests of normal and abnormal start-ups; and more about regulator and shut-down circuit problems. □

Electronics Upgrading Seminars

What is a Holdoff control? Technicians not familiar with sophisticated scopes won't know the answer to that, nor can they describe how scope's Holdoff knob affects a waveform display.

This is just one sample of the knowledge acquired in November by technicians attending the first two *Electronics Upgrading Seminars* presented by LIAISON. Technicians learned how Holdoff extends retrace time between scope sweeps and remove distracting extra lines from certain signal displays. Techs actually used the Holdoff controls on various scopes.

Developing a familiar *feel* for triggered scopes took up a day of hands-on training at the seminars. A special videotape devoted to scope familiarization led off the day. Then came advanced training, such as wideband techniques; waveform analysis, analog and digital; delayed-sweep operation; and specific hints and tips for troubleshooting with a scope.

Led by test equipment expert and **ES** author Forest Belt, these scope sessions were the first step in a 3-stage curriculum designed to put technicians on top of technology.

Imagine a PNP transistor with emitter grounded, a 1000 resistor from base to +12V, and collector not connected to anything. What voltage would be measured with a digital voltmeter at the base? What voltage in the transistor were an NPN? In a nationwide test, fewer than 5% of technicians asked could answer *both* questions correctly, although several knew that the answer to the NPN question was between 0.55V and 0.7V. Some thought voltage depended on resistor value, but it does not.

Knowledge like this is fundamental to servicing anything that uses diodes and transistors—from simple radios to TV sets to industrial process controllers to intricate navcom receiver/transmitters. Thousands of technicians have overlooked or forgotten how many solid-state devices *really* work: bipolar transistors, FETs, SCRs, special diodes, diacs, triacs, and others. Troubleshooting remains slower and more uncertain than it need be.

Technicians in the *seminars* spent another day with solid-state expert and **ES** author Wayne Lemons discovering the ins and outs of today's solid-state devices, to those in the most sophisticated applications. According to comments from technicians attending, a majority took home a new outlook on practical effectiveness in solid-state servicing. The end results: greater reliability of servicing and repairs, better value for service customers or employers, and higher financial reward for technicians who can cope with tough problems in any field of electronics.

Question: What's the most direct way to test operation of a J-K flip-flop? The technique is not nearly as obscure as many might think.

Some technicians aren't sure how a J-K works. This was true of most who came to the *seminars*. But their non-understanding ended by halfway through the day on digital electronics. Digital-troubleshooting expert James R. (Bob) Manery first laid down a fast but thorough groundwork for the technicians, making sure they knew the language and basics of digital operation. Then, introducing two special training aids devised by Belt, Manery clarified operation and simplified troubleshooting of this most elaborate of simple digital devices.

The technicians spent the remainder of that day becoming familiar with applications of digital devices in real equipment. They also learned how to devise troubleshooting approaches for specific equipments: consumer entertainment, industrial, medical, or communications that use digital electronics.

The third day of the three-day seminar carried technicians up to the 80s in servicing technology and technique.

Question: What's the most complex portion of a video tape recorder to understand and troubleshoot?

A year or so ago, this query was posed to a broad sampling of technicians. Several said "all of it." But in seriousness, many technicians felt that two sections offered the toughest challenge: (1) the *servomechanisms* that slave together so intricately the speeds of the tape and of the whirling cylinder that carries the helical-scan video heads; and (2) in cassette-type machines, the tape *threading/unthreading* system, because of its interdependence on both mechanics and electronics.

To make the trip to the seminar more worthwhile, an extra day was offered on VCR servomechanisms. Conducted by Belt, this additional day concentrated on the transport and head-wheel servos in VHS-type home videocassette recorders. Live equipment was used to demonstrate fine points of operation and practical techniques for troubleshooting.

Why only VHS? According to Belt, "VHS contains a head cylinder with its own 3-phase, electronically commutated, direct-drive DC motor built in. Commutation is instigated magnetically, and transferred to a 6-stage solid-state drive section. Then, parallel/tandem servomechanisms slave the head wheel and capstan to incoming video (for recording) or to the control track of a tape (during playback). Once a technician understands all of this system, and has seen how to troubleshoot it, that knowledge applies to virtually any video tape recorder—even reel-types. We spent the final part of that day discussing Beta and other systems. But they contain nothing that isn't covered thoroughly in our analysis of the VHS servo and drive system."

More seminars

These *Electronics Upgrading Seminars 79/80* will be repeated March 31-April 13, in Pittsburgh, PA; April 13-16 in Los Angeles.

Both *1980 Upgrading Seminars* have been rearranged to accommodate industrial and communications maintenance technicians and consumer service technicians in the same sessions. "This move brings all three groups a broader, more enriching Seminar experience," said Belt. Much of the training was alike, anyway; we found nothing was gained by holding separate sessions.

"We are adding more hands-on

experience in the solid-state and digital programs, too. But our fundamental approach remains the same. These Upgrading Seminars owe their special success to the way we bring each attendee quickly to a high common standard of basic understanding in each subject."

Microprocessor orientation

Other elements seminars will be offered in 1980. Some dates have been set.

May 1, 2, and 3, in Indianapolis, Belt and Manery will conduct a 3-day *Microprocessor Orientation Seminar*. This will include hands-on familiarization with microprocessor operation; experience in testing microprocessors with a scope and other servicing aids; and preparation for troubleshooting any equipment or system that uses this versatile new device.

Home VCR seminars

LIAISON will also offer a highly specialized 3-day *Home Video Cassette Recorder Seminar* in three locations. The first of these will be in Los Angeles, June 30 and July 1 and 2. The second, in Chicago, July 17-19; and the third in Philadelphia, August 17-19.

Belt will conduct all three days of these for LIAISON. One day covers the general electronics of the two VCR formats, Beta and VHS. Belt's emphasis will be on practical troubleshooting procedures, of the type manufacturer clinics seldom cover.

Day 2 goes into the mechanics and digital electronics of cassette-tape threading and unthreading. Live machines, and test equipment, assure technicians of genuine experience with this difficult area of troubleshooting—including what to do about jammed cassettes.

The third day is very similar to the extra day of the Upgrading Seminars. Technicians learn the intimate details of digital electronics involved with driving and synchronizing the helical-scan head cylinder and capstan. VHS mechanisms and servos are featured, with followup on the differences in Beta drives, which are simpler.

More information

Registrations for these and other 1980 Seminars are under way. LIAISON advises that they have a time-prepay installment plan, and that technicians can also use Master Charge. Contact LIAISON, P.O. Box 40821, Indianapolis, IN 46240, (317) 253-7774. □

troubleshooting tips

Lack of height
Magnavox T950
(Photofact 1189-1)

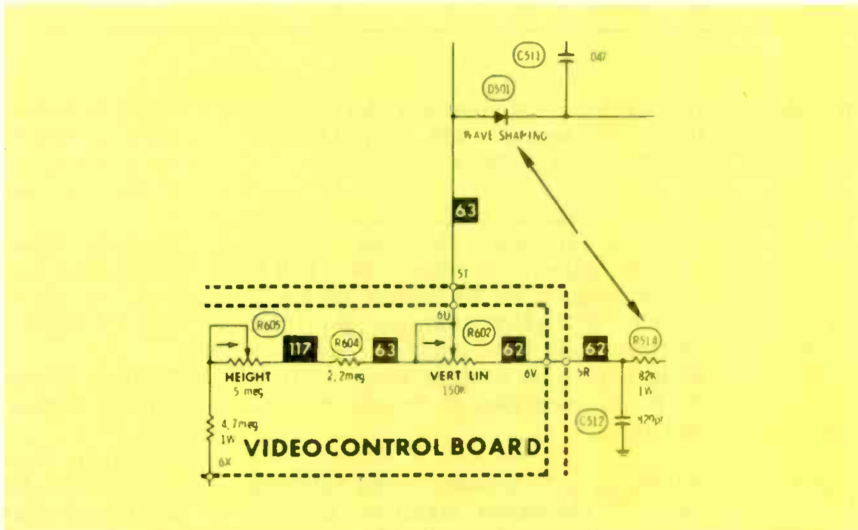
Only a horizontal line was seen on the TV screen. Voltage tests proved that R305 was open in the power supply. After the resistor was replaced, the vertical sweep was restored but the raster was nonlinear with compression at the bottom and expanded linearity at the top.

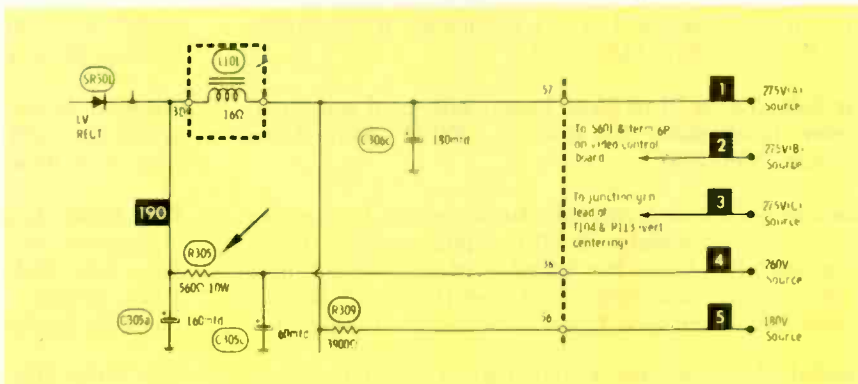
During the tests, the picture shrank vertically, became more nonlinear and the height and linearity controls had little effect. Those size and linearity changes were accompanied by a fast roll that could not be stopped with the hold control.

After many hours of testing, two separate troubles were found. Resistor R514 (that supplies the oscillator plate voltage) had increased from the normal 82K up to about 2M. Also, diode D501 was shorted.

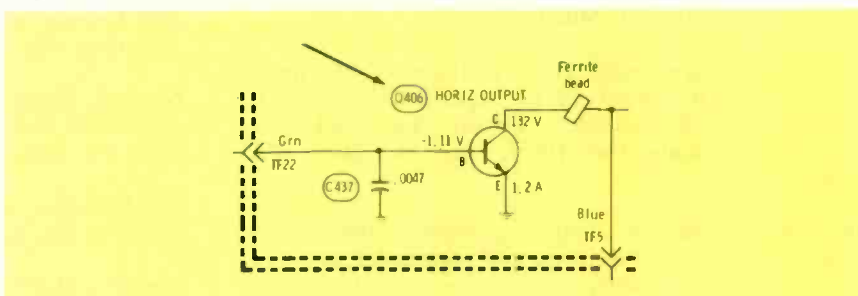
Replacement of these three parts restored proper vertical sweep and locking.

James Humphrey
Los Angeles, CA





AGC eliminated the picture
Sylvania E10
(Photofact 1477-3)



The customer reported that the color TV operated fine until a commercial began, and then the screen would go black but the sound continued. While monitoring the high voltage, I increased the AGC setting (on the deflection panel) and the high voltage instantly dropped to zero. After the power was shut off for several minutes, the receiver would operate again until stronger video or increased AGC would remove it. A soft click could be heard when the HV left.

Replacement of the deflection panel gave no improvement. The schematic showed that the regulated +120 V from Q412 supplied the horizontal-output transformer and the Q406 output transistor. These transistors are side by side on the chassis. Replacing both Q412 and Q406 cured the problem.

This intermittent HV has occurred before with these transistors, but previous cases were not triggered by AGC settings.

Charlie Jackson
Buckner, IL □

reader's exchange

There is no charge for a listing in *Reader's Exchange*, but we reserve the right to edit all copy. Due to the limited amount of space for this department, ads must show no more than *five* items. If you can help with a request, write directly to the reader, not to **Electronic Servicing**.

For Sale: Heathkit model IG-28 color-bar/dot generator. Good condition with manual, $60. *C. J. Okulicz, 326 High St., New Britain, CT 06051.*

For Sale: Radio Shack frequency counter, with custom cabinet, crystal or line time base, $55; new Clarison CD-4 demodulator with adjustment record, $45; Bell & Howell home entertainment color TV course, all books and design console, $70 plus postage; Heathkit AR-1302 stereo receiver with wood cabinet; Photofacts 231 thru 800, $1.40 each plus postage (sets of 20 or more, 10% off). *F. Longenecker, 6 Cranberry Rd., Buzzards Bay, MA 02532.*

Needed: Service data for a Telefunken model Salzburg III U console; a S-82 FM-stereo multiplex module; service manual including schematic for an old Archer globe patrol AM & 3-SW-band receiver, 3 tubes (types unknown). *F. Longenecker, 6 Cranberry Rd., Buzzards Bay, MA 02532.*

For Sale: TA-32 JR tri-band beam, $40, good condition. Prefer local sale. *G. Epstein, 200-27 46th Ave., Bayside, NY 11351.*

Needed: Schematics and information about connecting to surplus Burroughs B-7971 alphanumeric tubes. Units have two tubes per board, with driver unit, and is on a PC side-mounting board. *Ted Davis, LA Harbor College, 1111 Fieguroa Place, Wilmington, CA 90744.*

Needed: Schematic for a Hallicrafters SX-71 receiver, also audio output Xformer. Please advise of price before shipping. *Gross' TV, RD#1, Cameron Mills, NY 14820.*

For Sale: Picture tubes (almost new) 420 BCB22, and 11UP4, make offers to include shipping. *Gross' TV, RD #1, Cameron Mills, NY 14820.*

For Sale: Sencore model FE-20 multimeter, like new, $125; Heathkit model IT-12 signal tracer, $20; Heathkit IT-3120 transistor checker, $40. Both like new, with manuals. *Don Helm, Star Rt., Elton, WI 54430.*

For Sale: TV service shop equipment. None priced more than 50% of cost. Send self-addressed stamped envelope for list. *Ellery Electronics, RD 1, Bemus Point, NY 14712.*

Needed: Schematic and alignment instructions for a Grundig-Majestic model 2077USA. *M. Malone, 472 Hunter Rd., Ridgewood, NJ 07450.*

Needed: Service manual for a Hallicrafters Sky Champion short-wave receiver. Will buy, or copy and return. *Emil Rekich, 641 Nolan Ave., Glendale Hts., IL 60137.*

Needed: Instruction and service manual for a model 1274 Hewlett-Packard dual-trace scope. Will pay for any copying and mailing costs. *Robert Weathers, 3615 E. Harrison, Harlingen, TX 78550.*

Needed: Riders TV manuals 1 & 2; cabinet for SP-600-VLF receiver; sell or trade Riders TV manuals 6-12, 14, 23. *J. A. Call, 1876 E. 2990 So., Salt Lake City, UT 84106.*

Needed: Sylvania, H01-2 Scanner for D-13-2 chassis. *William Hunter, 23 Brentwood, Tuscaloosa, AL 34501.*

For Sale: Sencore CR31 color TV tube tester and rejuvenator, $200; B&K-Precision RF generator model 2050, $130; B&K-Precision 3½-digit DVOM model 282, $215; Simpson rechargable VOM model 303-3XL, with HV probe, $200; and Simpson color bar generator model 431, $100. *Frank DiMatteo, 2790 Cascade Springs Dr. S.E., Grand Rapids, MI 49506.*

Needed: Schematic for AEI model A-200 RF signal generator. Will buy, or pay to copy. *Mark Winterbottom, 3400 Ithaca St. No., St. Petersburg, FL 33713.*

For Sale: Leader HV Probe, $40; ATR battery eliminator, 6V or 12V 10A, $100; Tuner substitution box, $70; and EICO regulated power supply model 1032, 0-30V, 500MA, $90. *Frank DiMatteo, 2790 Cascade Springs Dr. S.E., Grand Rapids, MI 49506.*

For Sale: B&K-Precision model 283 3½-digit DMM with manual, probes and replacement A/D IC chip, list $185; Castle Mark V TV Signal Analyst with leads, manual and ac adapter, list $170. Will sell for best offer; Also offered for TI58, TI58C, and TI59 calculator owners, the library module for electrical engineering with manual and three specialty pakettes (mathematics, 59 fun, electronics), $35. *Gerald McKouen, 534 Pacific Ave., Lansing, MI 48910.*

Needed: Manuals and schematics for a Telequipment scope D52. Will buy or pay to copy and return. *Jerry's Color TV, 2511 Tampa Avenue, Cleveland, OH 44109.*

Needed: One 6Q7 tube. *The Lectronics Shoppe, 102 W. Main St., Everson, WA 98247.*

Needed: Operating instructions or manual for EICO tube tester model 666. Advise price. *Jerry Hoffert, 19605 Chardon Rd., Cleveland, OH 44117.*

Needed: Wire for Webcor wire recorder; also one mint-condition Webcor wire recorder. *James Fred, Rt. 1, Cutler, IN 46920.*

Needed: Servicing info on Dressen-Barnes power supply model IK-500B. *J. A. Call, 1876 E. 2990 So., Salt Lake City, UT 84106.*

For Sale: Sencore VA48 video analyzer, $700; AS29 scope, $400; CR31 picture tube tester-rejuvenator, $300; Hybrider tube-transistor tester, $150. All in unused condition. Also new tubes 25% of retail. *David Beck, Rt. 6 Box 19, Northport, AL 35476.*

For Sale: Sencore SM152 sweep marker generator, mint condition, $225; Sencore CG141 color generator, $75; B&K-Precision 1076 TV Analyst, $125; Pix-O-Scope P-1 color test jig, $100; Hickok 288X signal generator, $50. All with original manuals. *James Jannareth, 3919 Macrace, Grandville, MI 49418.*

Needed: 117.24X ballast tube for old Fada radio model 790, or will sell radio. *Thomas Collard, 610 Eastern Pkwy, Louisville, KY 40217.*

For Sale: B&K-Precision model 2810 3½-digit portable meter with ni-cad batteries, ac adapter, test leads, wire tilt stand and case, list price $157, only 15 months old. Also EMC model 801 resistance/capacitance comparator bridge and in-circuit capacity checker, list $70, only 18 months old. Make a reasonable offer plus shipping. *Gerald McKouen 534 Pacific Ave., Lansing, MI 48910.*

For Sale: Heathkit model I0-4560 5MHz scope, good condition used a few months, all cables and manual included, $135 or best offer. *Chris Demarest, 473 Turner Loop, Ft. Campbell, KY 42223.*

Needed: *Sams Color TV Service Guides* volumes 1 and 2; *Sams Color TV Servicing Made Easy*, volumes 1 and 2, good condition. *Wayne Coombs, Box 1956, San Jose, CA 95109.*

For Sale: Sony 330AD22(AB) Trinitron CRT good tube from working set, $50; Sony 1-439-060-13-26SG07 flyback, new Sony part, $17; Atwater-Kent model 165, cathedral, mint condition, fair price. *Edward N. Watson, 2808 Fisherville Rd., Coatesville, PA 19320.*

For Sale: 25 Rider's TV manuals, 3 thru 27 with index, $200 plus shipping. *Kessler's Electric Shop, RFD 2, Mt Vernon, OH 43060.*

Needed: All service data schematic and alignment data for a McMurdo Silver Masterpiece model VI 21 tube receiver. *Paul Capito, 637 West 21st., Erie, PA 16502.*

For Sale: B&K-Precision transistor Analyst; VIZ WR50C RF generator; NLS LM-3 digital VOM; Triad 20A power supply; UHF and VHF tuner subbers. All in excellent condition. Make offers. *Gary Castellini, 3567 Lincoln Ave., Vineland, NJ 08360.*

Needed: Picture-tube and rejuvenator in good condition. Will trade an Ampro Super Stylist 8/16mm movie projector. *Kenneth Miller, 10027 Calvin, Pittsburgh, PA 15235.*

Needed: Schematic and service data for 35mm E. Leitz Wetzlar film strip projector. *J.A.M. Radio-TV, Route 5, North Hatfield, MA 01066.*

For Sale: Heathkit 0-11 scope with new power transformer, manual, demodulator probe and universal probe. Sawtooth transformer, manual, demodulator probe and universal probe. Sawtooth output at jack modification. Best offer accepted. *Henry T. Fuqua, 1423 Jordan Dr. South, Salem, OR 97302.*

Reader's exchange

Needed: Latest tube chart supplement for 648-IT Jackson tube tester. Will pay for chart or a copy. *Danny's TV Sales, 922-15th Street, Portsmouth, OH 45662.*

For Sale: B&K-Precision 1077B Analyst, $300; Heath IG-57A sweep/marker, $125. Both with cables and manuals, like new, will ship prepaid on receipt of money order or certified check. *Michael Weatherford, 905 Jackson Drive, Athens, AL 35611.*

For Sale: Heathkit variable-voltage regulated power supply model PS-2 (200V to 400V) with manual, $17 with shipping. *D. Pollock, 178 Pinckney Road, Little Silver, NJ 07739.*

Needed: One each of Jensen MC8-R midrange and TH-20 horn tweeter in good condition. *L. E. McHenry, 6225 N. 20th Lane, Phoenix, AZ 85015.*

For Sale or Trade: Many antique radios, tubes, schematics and parts. Send for list and items wanted, or for sale or trade. We collect radios and tubes. *Barry Evans, 1115 E. 50th St., Kansas City, MO 64133.*

Needed: A good used 510CTB22 (or sub 510ALB22) color picture tube; will pay $25. *Alexander Minelli, 718 Michigan, Hibbing, MN 55746.*

For Sale: Complete sets of PF Reporter and **Electronic Servicing** from January, 1959 thru December, 1972, plus 10 issues of 1973 (February and December issues missing). *J. Styczenski, 1515 S. Monterey, Roselle, IL 60172.*

Needed: Operators manuals for Triplett signal generator; Simpson VOM 260 series 5; Solar Exameter CF-160. *James Humphrey, 1006 E. 28th St., Los Angeles, CA 90011.*

Needed: Schematic and picture of original cabinet for Zenith radio, model 5801, chassis 705921. Will buy, or copy and return. *Chet Kalis, 18 Highland Park Dr., West Springfield, MA 01089.*

Needed: Schematic for an Atwater-Kent model 41 radio; schematic for 115Vac adapter power supply for above. Will copy and return, or purchase. *Max Friedman, 81-47 260th St., Floral Park, NY 11004.*

For Sale: Sencore CG-12 color-bar generator with manual, $50; Sprague TO-5 capacitor analyzer, $25; commercial tube tester, GC 36-800, needs new chart, $55; GBC VR-622 TV camera with Shiba AS-101 auto-scanner, both $100; Two National 7262A new vidicon tubes, $40 each. *Danny Brou, 212 Wainwright Rd., Pineville, LA 71360.*

Needed: S meter part 082-000280 for Hallicrafters SX-100 short-wave radio. *Lenwood Williams, P.O. Box 326, Brunswick, NC 28424.*

For Sale: All or part of collection including Rider's radio and television manuals, out of print Photofacts, Supreme service manuals, and many other antique radio service material. Everything must go. No reasonable offer refused. *Lawrence Beitman, (312) 831-9330, or write P.O. Box 46, Highland Park, IL 60035.*

For Sale: Dentron model MLA-2500 linear amplifier, operating bands 160 through 10 meters, $850; Drake model TR4 CW/RIT transceiver, only 10 months old, with all accessories, $800, or best offer. *William D. Shevtchuh, One Lois Ave., Clifton, NJ 07014.*

Needed: New or used power transformer for a World Wide 9 radio. *Paul Capito, 637 W. 21st St., Erie, PA 16502.*

For Sale: Sencore PS-29 Minute Man triggered sweep, single-trace, like new, $400; Heath electronic switch (factory wired) model IO-101, excellent condition, $30; Heath IM-18 VTVM adapted to solid-state by Heath, good condition, $20; SWT function generator, good condition, $20. Money back guarantee on all. You pay postage. *William Bernstein, 215 Middleneck Rd., Bldg. 7, Great Neck, NY 11021.*

For Sale: Several RCA coin-operated 6-tube radios, AM and 25-meter bands, chrome-trimmed metal case, coin box and back locks. *L. W. Brock, 813 Madison St., Huntsville, AL 35801.*

For Sale: B&K-Precision 1076 Television Analyst with cables and manual; Heathkit IT-10 transistor tester; National radio receiver NC109; Two each of 1624 and 1619 new RCA tubes. Best offer for all or part, all in very good condition. *Barry Evans, 11115 E. 50th St., Kansas City, MO 64133.*

Needed: A triggered sweep scope such as the Tektronix 503, 561, 561A or 561B equipped with a 2A63 differential amplifier plug-in and a 2B67 time base plug in. This is the unit used in the *Use of the Oscilloscope* textbook by Charles Roth Jr. Also, need a part number 108955 oscillator coil for the RCA WE-934A(K) transistor radio Dynamic Demonstrator. *Jacob W. Ousley, RR 1 Altamont, IL 62411.*

For Sale or Trade: Riders radio manuals; Riders TV manuals. Make offers. Old and obsolete radio & TV tubes, state your needs. *Troch's Television, Radio & Appliances, 290 Main St., Spotswood, NJ 08884.*

For Sale: Supreme TV schematic books 1948-1959, $3 each; Heath TC-2 tube tester, $15; RG-62 Coax cable, 100 ft., $8; Panduit cable ties SSTIM-M20, 0-¾", 1000 for $8; Delco AM-FM's for GM 1970-77. *Al Svirmickas, 6601 S. Whipple, Chicago, IL 60629.*

Needed: One number 1SW31 3-deck, 5-position function switch for Conar model 211 VTVM. *Grant Morse, 180 Angle Rd., Walled Lake, MI 48088.*

For Sale: CB radio course, all books, $200 plus shipping; Sencore CB-42 deluxe analyzer, $700; Sencore CB-41 tester, $100; Sencore PS-43 Porta-Pak with rechargeable battery supply, $100 plus shipping. *Bill Coleman Electronics, 114 Circle Dr., Rocky Mount, NC 27801.*

Needed: One KCS-24A IF chassis for early RCA projection TV. Also need type 53 tubes. *Don Patterson, 636 Cambridge Rd., Augusta, GA 30909.*

Needed: Power transformer part number 30015 for model 460 EICO scope. *Raymond Malinchak, 600 Beckman Dr., McKeesport, PA 15132.* ☐

people in the news

Planning the 1980 Electronic Distribution Show (formerly NEWCOM) to be held in May in Las Vegas is the responsibility of **James Kaplan,** who was elected president of the Electronic Industry Show Corporation.

Myrddin L. Jones has been named president of the GTE Entertainment Products marketing organization for Sylvania and Philco brands. Previously Jones was manager of the Electrohome consumer marketing division.

Altec Lansing has appointed **Jim Newell** as national sales manager. Newell formerly was with JBL.

The appointment of **Gerald H. Weinfurther** as field marketing engineering for the Sylvania Distributor & Special Markets division has been announced by GTE.

Burnell E. Hayes has been elected a vice president of ITT Cannon Electric, where he continues to be responsible for contract administration, personnel, industrial relations, office services and real estate.

New eastern-region sales manager for Micro Switch is **Frederick V. Gabriel.** He has been with Micro Switch since 1964.

Paul P. Hoppe, Jr. has been appointed vice president of marketing/sales for Switchcraft. Hoppe previously was vice president of engineering. He is the holder of four patents.

Paul H. Roberts recently was named as new president of Gem Scientific Corporation. Roberts helped develop the Aviation Administration and Pilot Technology Programs while at Mountain View College.

Harry Silverstein, chairman of the board for Vaco Products, recently presented seven awards to sales reps who had completed 20 or more years of service. These men were honored: Bob Rowntree; Jack Reichard; Dave Huntoon; John Perkings; Joe Steinman; Dick Seidel; and Bill Stein.

At JVC **Kurt Murai** now is high-fidelity division general manager, **Harry Ellis** assumes additional duties in the hi-fi division, **Everett Wren** is vice president of market planning, and **Richard Quinlin** assumes additional responsibilities as national field sales manager of home-entertainment products.

Allen Griebel won an all-expenses-paid vacation for two to Acapulco, Mexico in the Silver Anniversary Salesperson Sweepstakes by Acoustic Research, makers of AR speakers.

North American sales manager for Javelin Electronics now is **Gary L. Carter.** Since 1968, Javelin has been a supplier of consumer products, closed-circuit TV security and surveillance systems, and night-viewing devices.

Howard K. Dicken has been elected president of Integrated Circuit Engineering. Formerly, Dicken was executive vice president of the company. Also at ICE, Kenneth G. Soucy was elected treasurer of the corporation. Prior to joining ICE, Soucy served with the US Government Defense Contract Audit Agency. Loretta Mahoney was elected corporate secretary at ICE. Formerly, she worked as manager of administrative services.

General Instrument's TACO division has appointed **Roger O'Connor** marketing manager. Previously, he was manager of the marketing staff at ITT, Communication Systems division.

Micro Switch has promoted **Richard Maiore** to the position of marketing manager for the company's line of no-touch controls. Maiore was previously sales manager for the New York branch office.

Andy Hitzelberger has joined B&K-Precision/Dynascan in the position of purchasing manager. Previously, he was vice-president and assistant to the president of Altra.

Richard R. Fidler has been named vice president, engineering, for the Sylvania systems group. Fidler will continue to serve also as vice president and general manager of the group's communication systems division. □

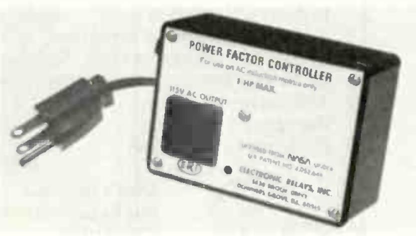
productreport

Self-instruction program

Heath Continuing Education, a division of Heath, announces a self-instruction program that covers IC timers. The program, model EE-103, includes an introduction to the common types of IC timers, how each works, what they do and where they are used. Among the types of IC timers covered are the 555 and 556 series general purpose timers, the 322 and 3905 wide range, precision, monostable timers and programmable timer/counters including the 2240 binary programmable timer/counter, the 2250 BCD programmable timer/counter and the 8260 seconds/minutes/hours BCD programmable timer/counter. The program's self-teaching text, with the assistance of review quiz questions and lab experiments, covers the use of each timer in logic functions, output drive circuits, time-delay relay circuits, wide-range pulse generators, phase-locked loops, universal appliance timers, as precise clock sources and many others.

The EE-103 self-instruction program is available for $39.95.

Circle (16) on Reply Card



Power factor controller

A power factor controller invented by NASA, and the winner of last years' *Industrial Research Award*, is now available from **Kinco**. The device is simply plugged into a standard 115V receptacle, and it is ready to reduce the power consumption of refrigerators, typewriters, air conditioners, washing machines or any device that uses a 115V electric motor. Up to 50% savings is possible with no effect on power output.

The unit is available for $30, and handles up to 1HP ac motors.

Circle (17) on Reply Card

800MHz base station antennas

Two omni-directional 800MHz base station antennas have been developed by **The Antenna Specialists** for split site repeater, satellite receiver, and multiple transmitter or receiver applications. Model ASPA970 is designed to operate on the 806-821MHz base station portion of the band. Model ASPC970 covers the 851-866MHz base or mobile transmitter portion of the band. No cutting, tuning or adjusting is required within the specified frequency ranges.

Rated at 150W maximum RF power, the antennas provide 7dB gain with a VSWR of less than 1.5:1 over a 15MHz bandwidth. Lightweight and easy to install, the antennas feature vertical collinear radiating elements protected by a weatherproof fiberglass radome. A flexible pigtail terminated with a type N male connector is provided for connection to transmission line.

Circle (18) on Reply Card

Power supply

Cincinnati Electrosystems' adjustable regulated power supply provides fully variable output voltage through the 5-15Vdc range. It operates on 105-132Vac, 50-60Hz external power, with output current of 200mA. Power regulation is precise to .1% line and .15% load, with no-load ripple of .5mV RMS. Power on is indicated by a green LED and over current warning by a red LED.

Circle (19) on Reply Card

Power amplifier

The **Grommes-Precision** G-252 is a high fidelity solid-state power amplifier consisting of two 125W channels with state-of-the-art circuitry. Features include low distortion and wide band frequency response. Heavy duty heat sinks and oversize components allow continuous operation with reliability. Output transformers provide output for 25V or 70V speaker lines. VU meters indicate power output level for each channel.

Circle (52) on Reply Card

SK guide

A 1980 edition of the **RCA** *Top of the Line Solid State Replacement Guide* is now available. The 368-page book offers 1080 solid-state replacement devices that replace more than 161,000 domestic and foreign types. The SK guide contains information on RCA's line of replacement transistors, rectifiers, thyristors, ICs and high-voltage triplers including many MRO replacements. Features include a dual numbering system that lists the SK stock number and the stock number of the numbering system used by EGC, REN and TM.

The RCA 1980 SK guide is available for $1.50.

Circle (53) on Reply Card

Educational scope film

A sound/slide film on scopes, designed for sales and technical training for electronics distributor personnel, or as an educational aid for students and hobbyists, is now available from **B&K-Precision.** The film emphasizes controls and capabilities common to almost all scopes. It is divided into five sections covering the cathode ray tube, trigger controls, vertical section, horizontal section and probes. The 25-minute film can be divided into five shorter lessons for in-depth study. The complete package includes tape and script, slides in a carousel tray, 50 booklets with slide illustrations and script, and quiz questions.

The scope sound/slide film is available for $90, and is free to schools with the purchase of any three B&K-Precision scopes.

Circle (98) on Reply Card

Screwdriver set

Vaco has introduced a 5-piece Bull Driver screwdriver set, #70600. This packaged set contains five Vaco Bull Drivers in sizes and styles including: 3/16", 1/4", 5/16" regular straight slotted and 3/16" and 1/4" Phillips drivers. The Bull Driver features a handle that is 35% bigger, delivering up to 50% extra power and comfort. The comfort-dome handle is fully fluted with chamfered edges for fatigue-free driving.

Circle (99) on Reply Card

Semiconductor replacement guide

The 1980 edition of *The Archer Semiconductor Replacement Guide*, featuring cross reference/substitution listings for over 100,000 devices, is now available from **Radio Shack**. The 224-page book is a comprehensive guide to Radio Shack's line of Archer semiconductors and includes detailed data and pin connections for ICs, diodes, SCRs, LEDs and other devices. Information is included on the care and handling of transistors and ICs, case styles and dimensions, transistor testing, display and optoelectronic devices. A glossary of words, symbols and abbreviations is also included.

The guide is available for $1.99.

Circle (100) on Reply Card

Ac line transient suppressor

PMC Industries offers a small, simple, inexpensive 3-wire ac line transient suppressor to help protect electronic equipment and instrumentation from the harmful effects of high voltage transients by instantaneously sensing and suppressing them. The unit can suppress transients of 6000A maximum, 8/20μs peak surge current with an energy absorption of 50J. Steady state voltage RMS is 130V maximum and the suppression knee occurs at 100% to 130% of the rated steady state voltage. Response time is less than 50ns. Unit is for 115Vac, 15 amp operation.

Recommended list price is $35.

For more information, contact:
PMC Industries, 1043 Santa Florencia, Solana Beach, CA 92075.

Mini speaker

The Omni-Sound home and auto mini speaker system from Audiotex division of **GC Electronics** is rated at 25W rms. The Omni-Sound (30-5020) has a 2-inch diameter, wide-dispersion tweeter and a 4-inch woofer. It features a high-temperature voice coil in the tweeter and woofer, and frequency response of 55-20,000Hz. The speaker is 7½-inches high, and includes a mounting bracket for positioning in any direction.

Suggested retail price for the Omni-Sound system is $99.95 per pair.

For more information, contact:
GC Electronics, Barry Nyquist, 400 S. Wyman, Rockford, IL 61101. □

Circle (13) on Reply Card

Circle (14) on Reply Card

the marketplace

Advertising rates in the Classified Section are 35 cents per word, each insertion, and must be accompanied by cash to insure publication.

Each initial or abbreviation counts a full word.

Minimum classified charge $3.00

For ads on which replies are sent to us for forwarding (blind ads), there is an additional charge of $3.00 per insertion to cover department number, processing of replies, and mailing costs.

Classified columns are not open to advertising of any products regularly produced by manufacturers unless used and no longer owned by the manufacturer or a distributor.

Business Opportunity

TV STEREO SERVICE BUSINESS in Port Townsend, Wash. Owner will be 75 in June, like to retire. Low overhead, will sell or lease. Call after 6:00 pm 1-206-385-1987. 3-80-1t

TV SALES AND SERVICE in sunny Florida. Same location over 20 years. $20,000 firm. Interested apply only. Send letter to shop owner, 1516 South Jefferson Avenue,. Clearwater, Fla. 33516 3-80-5t

For Sale

REPLACEMENT COLOR YOKES—DEALER ONLY. Zenith 95-2501-2532-2638-2667-S-89633 etc. $19.94. Magnavox 361380-1 $21.95. Sylvania, GE etc. $17.95 to $22.95. Request for price list on your letterhead. David Sims Enterprises, Inc., 665 Jericho Turnpike, Huntington Station, N.Y. 11746, (516) 549-3925 5-79-tf

AUTOMOBILE RADIO and tape replacement parts. Delco, Chrysler, Philco-Ford, Motorola, Panasonic and many others. Large inventory. Laran Electronics, Inc., 3768 Boston Road, Bronx, NY 10469, (212) 881-9600, out of New York State, (800) 223-8314 5-79-tf

TV & RADIO TUBES, 36 cents EA!! Free color catalog. Cornell, 4221 University, San Diego, California 92104 8-76-tf

WHO'S FIRST? Make tests, contests, quiz bowls sparkle. Tell who pushes button first...any number buttons. Ingenious, low-cost, two-wire circuit. No relays, ICs, PCs or special parts. Build public relations loan rental, sales, to teachers, ministers, coaches, club leaders, party givers, sales motivators, etc. Illustrated plans $5.00 postpaid. Wayne Lemons, Electronics Building R2, Buffalo, MO 65622. 1-80-3t

ELECTRONIC SURPLUS: CLOSEOUTS, LIQUIDATIONS! Parts, equipment stereo, industrial, educational. Amazing values! Fascinating items unavailable in stores or catalogs anywhere. Unusual FREE catalog. ETCO-011, Box 762, Plattsburgh, N.Y. 12901. 6-78-tf

TV RENTAL SYSTEMS! Complete & guaranteed. Manual or computerized. Send $2.00 for complete details. Perry's rental systems, 133 Brenda Street, Milton, Florida 32570. 2-80-tfn

PICTURE TUBE REBUILDING equipment capable of producing four high quality tubes per day. Will train to operate—$3400. Call or write Atoll Television, 6425 Irving Park, Chicago, Illinois 60634. Ph: 312-545-6667. 2-80-3t

BUY FACTORY DIRECT: TV parts, semiconductors, antennas, chemicals. Prices below wholesale. Write: Midwest Semiconductor, 4411 W. North Ave., Milwaukee, WI 53208. 2-80-4t

FOR SALE: T.V. ANTENNA INSTALLATIONS + MATV SYSTEMS + SATELLITE/PAY T.V. INCLUDED! SACRAMENTO, CAL. BASED. LARGEST COMPANY HERE. ASKING $700K + INVENTORY. WRITE VAG78B BOX 1010, WOODLAND HILLS, CA. 91365. 3-80-2t

For Sale

HEWLETT-PACKARD SCOPES: 22 mhz Dual Trace—$350 50 mhz Dual Trace—$650. Calibrated & Guaranteed. Free Catalog. 1445 N.W. 9th St., Homestead, Fla. 33030, (305) 247-6349. 3-80-2t

Wanted

WANTED: Sams folders 1400 up. Heath color generator IG-5240/SG-5240. Herbert, 410 N. Third, Minersville, PA 17954. 3-80-2t

WANTED: A Sony Model 5-305UW TV for parts. Richard R. Creed, Box 375, Upton, Mass. 01568. 3-80-1t

Advertising Services

TIME AND LABOR-SAVING DEVICES, previously unmarketed. Can increase service profits substantially. Plans range from efficient shop and van layouts to specialty tools, such as telescoping mastjacks and turntable cradles. For plans send $12.50 to Devices, P.O. Box 204, Rock Port, Mo. 64482. 3-80-3t

TV DEALERS! Computerize! Now available for the Apple II, a computerized TV management package. Includes master file—inventory, depreciation and profit analizer plus electronic checkbook. Send $2.00 for complete details and computer printout samples. Perrys' Computer Systems, 133 Brenda Street, Milton, FL 32570. 3-80-1t

HELP WANTED

TELEVISION TECHNICIANS—Experience necessary, top pay, medical benefits, paid vacations. Enjoy a new "Life Style" in a beautiful, friendly, smog free, full service desert community. Send your resume to 225 E. Ridgecrest Blvd., Ridgecrest, California 93555. Telephone 714-375-1361 ask for Service Manager. 3-80-tfn

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Greg Garrison, P.O. Box 12901,
Overland Park, KS 66212;
Phone: (913) 888-4664

NEW YORK, NEW YORK
Joe Concert, 4 West 58th St.,
New York, NY 10019;
Phone: (212) 888-1977

KANSAS CITY, MISSOURI
Helen Hull, P.O. Box 12901,
Overland Park, KS 66212;
Phone: (913) 888-4664

LOS ANGELES, CALIFORNIA
Herbert A. Schiff
3055 Wilshrie Blvd., Suite 350
Los Angeles, CA 90010
Phone (213) 387-0639

LONDON, ENGLAND
John Ashcraft & Co., 12 Bear St.,
Leicester Square, London, WC2H 7AS,
England;
Phone: 930-0525
Telex: 895-2387

AMSTERDAM, HOLLAND
John Ashcraft & Co., John J. Lucassen,
Akerdijk 150A, 1171 PV-Badhoevedorp
Holland;
Phone: 2968-6226

TOKYO, JAPAN
International Media Representatives, Ltd.,
2-29, Toranomon 1-chome, Minato-ku,
Tokyo 105, Japan;
Phone: 502-0656

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DON'T DILUTE.

When you service a Zenith in or out of warranty and require a replacement module, tuner, channel selector or sub-assembly, it simply makes good sense to insist on a Zenith repaired and reconditioned part.

Then you can be certain of a replacement from people as knowledgeable as those who made the original—a replacement not only repaired, but one reconditioned and serviced for reliability by Zenith with no dilution of the original quality.

Contact your Zenith distributor now about his exchange program for modules, tuners, channel selectors, and sub-assemblies.

It's the sure-fire way to maintain famous Zenith dependability, protect your reputation, and insure the success of your business.

Ask your distributor, too, for Zenith's latest pocket-size module cross-reference and suggested retail pricing guide.

Always insist on Zenith exact replacement parts, tubes and accessories!

ZENITH

The quality goes in before the name goes on.®

Zenith Radio Corporation/Service, Parts & Accessories Division/11000 Seymour Avenue/Franklin Park, Illinois 60131

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