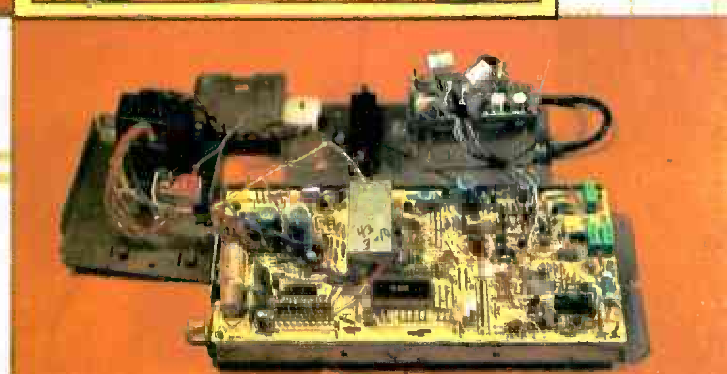
November, 1977 ☐ 75 cents

Electronic Servicing

A HOWARD W. SAMS PUBLICATION

Magnavox *Touch-Tune* Digital Circuits



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November, 1977 ☐ Volume 27, No. 11

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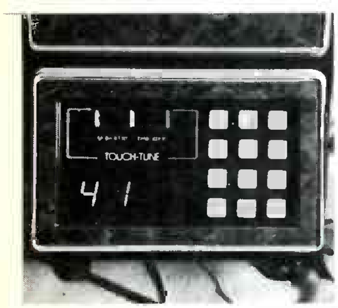

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About the cover—Many details of the Magnavox "Touch-Tune" system are shown in these pictures. No solid-state components are in the pushbutton panel assembly. Memory circuits in the control chassis "remember" the digital codes for 20 VHF and UHF TV channels.

DEPARTMENTS

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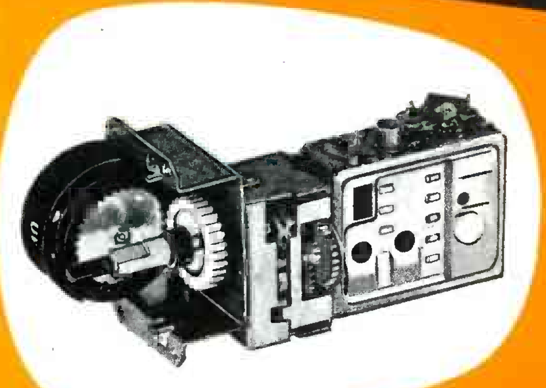

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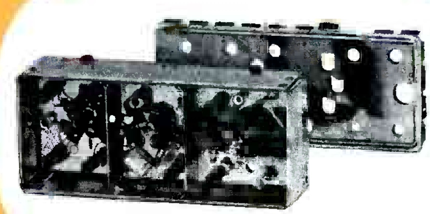

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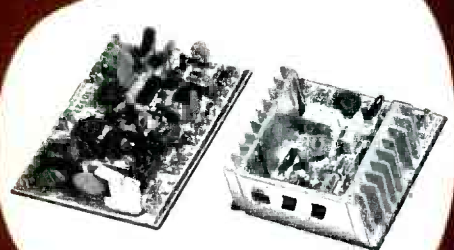

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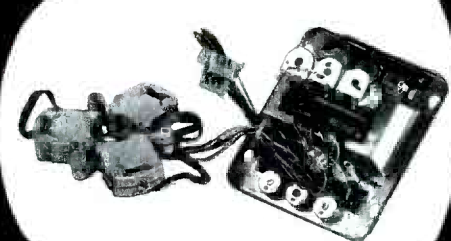

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electronicscanner

news of the industry

The International Society of Certified Electronics Technicians, the technical arm of NESDA, has moved to 310½ Main Street, Ames, Iowa 50010; (515) 232-4720. The move was necessary because Dick Glass, CET, and most of the Indianapolis staff that administered the CET and other technical programs resigned. Ron Crow will continue as executive director.

The long-term outlook for personal two-way radio equipment is excellent. However, this rapid growth probably will not occur until after a two-year slump in sales of CB radios, which might eliminate more than 25% of the present CB manufacturers. That is the conclusion of a 210-page report entitled, "CB Radio and the Future Portable Telephone," issued by International Resource Development (IRD). The report predicts a merger between the portable telephone market and the declining CB market, resulting in hand-held, vehicle-mounted or wristwatch-type two-way radios for telephone calls or CB use. IRD also projects additional UHF or VHF CB channels and cordless home telephones by 1985.

A pressing need to reduce labor and overhead costs has forced Zenith to transfer much of the module and chassis assembly operations to Mexican and Taiwan plants. This move eventually will cut about 5,600 American workers from the Zenith payroll. Stereo machines will be obtained from foreign suppliers, but the final-assembly of color receivers will be continued in Chicago, Illinois and Springfield, Missouri. The Lansdale, Pennsylvania picture-tube plant (closed since 1974) will be written off the books.

Total sales to U.S. television and radio dealers increased in August and continued to out-pace 1976 on a year-to-date basis. According to the marketing services department of the Electronic Industries Association, radio sales are up 40% and television sales are up 9.6% over last August.

Dealers are worried about the profitability and supplies of RCA's $1,000 videocassette recorder, according to *Retailing Home Furnishings*. Reports suggest that only 40,000 units will be available this year, and the dealer's markup will range from 20% to 25%.

The California State Electronics Association has asked manufacturers and distributors to stop limiting the number of service shops authorized to provide warranty work. The association says manufacturers are using the current system as economic leverage to obtain warranty work at below cost.

Two direct-to-home satellite receivers using dish antennas of less than a 2-foot diameter were displayed for the first time at the IEEE conference, *Video News* reports. The receivers, developed by Sony and Sumitoma Electric, were said to have excellent performance, including signal-to-noise ratios of about 43 dB. One engineer predicted that such systems might some day be operated in homes, with the dish located in the attic, and the amplifier-converter unit placed near a conventional TV receiver.

continued on page 8

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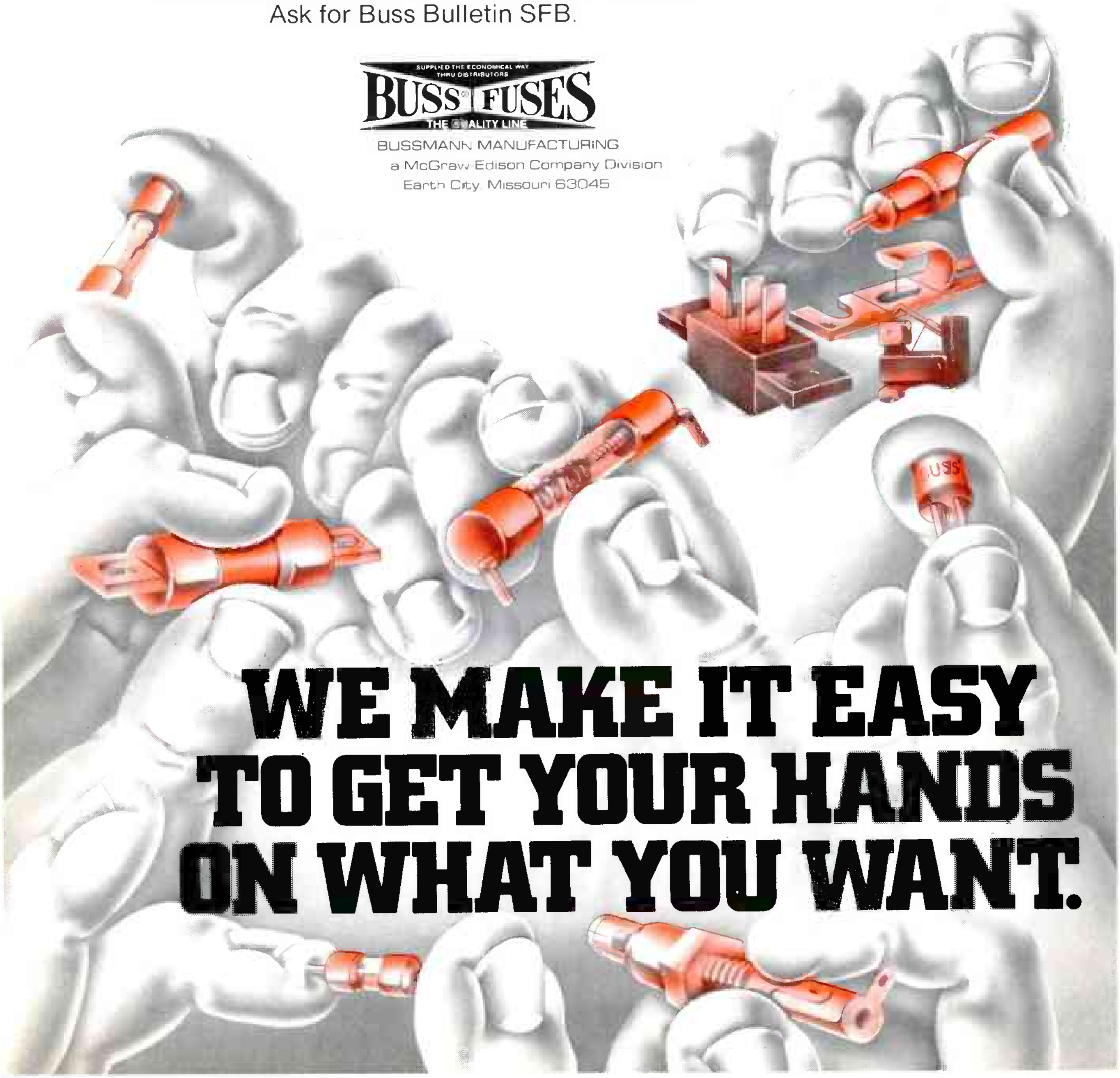


continued from page 6

A common UHF-VHF antenna will be accepted under two conditions to meet FCC requirements that manufacturers attach a UHF antenna to every receiver marketed with a VHF antenna. The request to install the antenna must be supported by measurement data showing either that the common antenna is comparable to the loop antenna, or, that a built-in splitter circuit is effectively used.

Ninety-four percent of the nation's state police organizations have CB radios for direct communication between citizens and police in emergency situations. The Electronic Industries Association reports that CB radios are installed in 48% of the police vehicles in 34 states. Six states have CB installations in 100% of their state patrol vehicles, while five states are proposing 100% installation in the near future.

In an effort to improve its communications with thousands of boaters in small crafts, the U.S. Coast Guard will begin installing CB radio equipment at its Search and Rescue (SAR) stations. The Coast Guard intends to have CB service available in time for the 1978 recreational boating season.

A "Citation of Outstanding Achievement in Engineering Development" for improving the efficiency of UHF klystron tubes was presented to Varian Associates at the third annual Emmy Award luncheon. The ABC-TV network received an engineering citation for installing and checking circularly polarized antenna systems.

Sony is offering the first pulse-code-modulation (PCM) audio unit for home use. The unit converts a Betamax or U-Matic videotape recorder into a hi-fi audiotape recorder. According to *Retailing Home Furnishings*, Matsushita will offer a similar unit soon, as well as a ¼-inch PCM tape recorder for professional use.

U.S. Marshals accompanied by FCC agents seized more than $25,000 worth of illegal CB and amateur radio equipment in Tennessee. The raids uncovered illegal CB linear amplifiers and illegally modified equipment.

Blind persons seeking careers in computer sciences now can be helped by MOUTH, a computer which uses verbal responses rather than computer printouts. MOUTH (Modular Output Unit for Talking to Humans) was developed by James Kutsch, a professor at West Virginia University, and is just one example of new electronic devices designed to assist disabled persons. The *Kansas City Star* reports that among these new devices are: a wheelchair that can stop, move, or change speed by verbal command; a sight switch activated by eye movement; a typewriter keyboard triggered by a tongue switch; and, an all-purpose system that can dial a telephone, change television channels, or turn on the radio by blowing into an air tube or flicking the tongue.

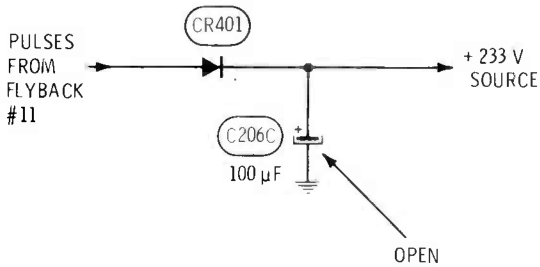
The Federal Communications Commission has been asked to extend the cutoff date for the sale of 23-channel CB radios to March 1, 1978, according to *Electronic News*. The request was made by Jules Steinberg, executive vice president of the National Appliance and Radio-Electronics Dealers Association (NARDA). The current deadline is January 1, 1978.

Fuji-Svea Enterprise now has two toll-free phone numbers for customer service and to expedite shipping. Ohio customers should call (800) 582-1630; all others call (800) 543-1607. The firm specializes in original Japanese semiconductors, FETs, ICs and diodes.

symcure

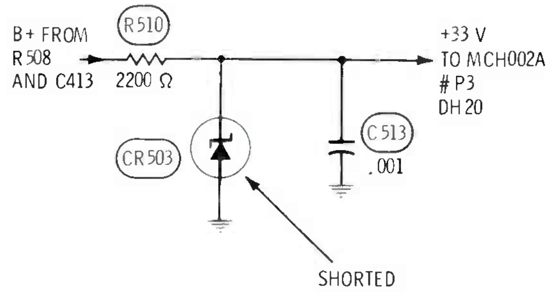
Symptoms and cures compiled from field reports of recurring troubles

Chassis—RCA CTC81
PHOTOFACT—1615-2



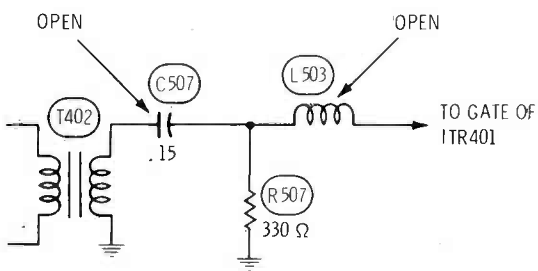
Symptom—No video, and excessive brightness with retrace lines
Cure—Check C206C, and replace it if open or low in value

Chassis—RCA CTC81
PHOTOFACT—1615-2



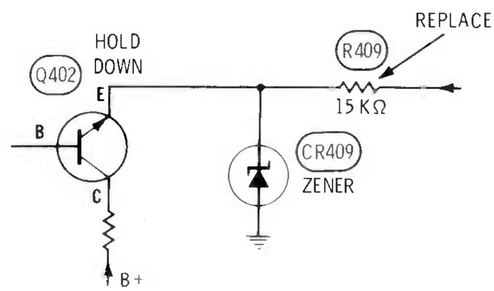
Symptom—No vertical sweep
Cure—Check CR503, and replace it if leaky or shorted

Chassis—RCA CTC81
PHOTOFACT—1615-2



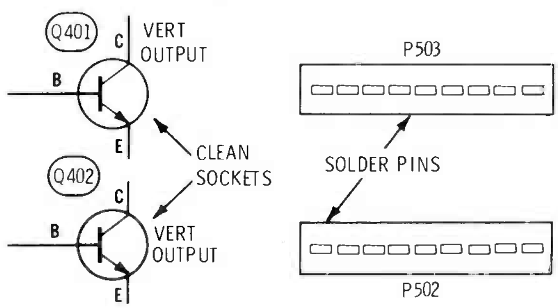
Symptom—Not locked horizontally, has squeal, and perhaps foldover with low HV
Cure—Check C507 and L503, and replace either if open

Chassis—RCA CTC58
PHOTOFACT—1365-1



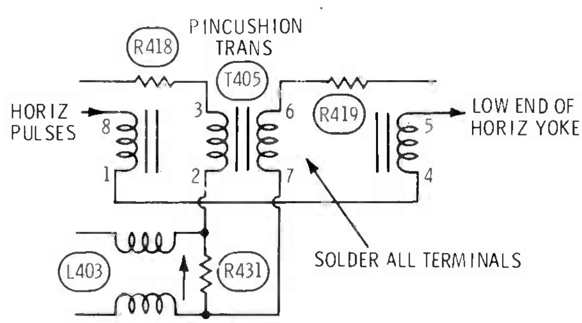
Symptom—Vertical lines at the edges are crooked
Cure—Check R409, and replace it if out of tolerance

Chassis—RCA CTC74
PHOTOFACT—1588-1



Symptom—Intermittent height, intermittent roll, or intermittent loss of vertical sweep
Cure—Clean socket contacts of Q401 and Q402; also, solder pins to spring contacts in P502 and P503 on PW500.

Chassis—RCA CTC68
PHOTOFACT—1437-2



Symptom—Vertical at right side is compressed, similar to a distorted trapezoid
Cure—Check and resolder all joints at terminals of T405

troubleshooting tips

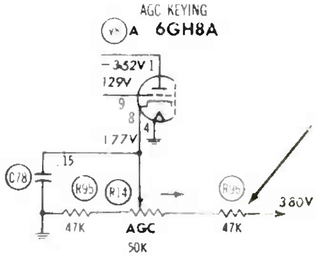
No picture
Motorola 23TS921
(Photofact 1096-3)

Only channel 10 showed a picture, and it had multiple images. At first, I suspected misadjustments, since the owner admitted moving some screws. However, better fine tuning of channel 10 cleared most of the ghosts, and my suspicions changed to the tuner.

Then I noticed that the other stations came in with snow, **when the antenna was disconnected.** But with an antenna, the screen would black out. Also, the AGC control had no effect on these symptoms.

When I checked components of the AGC circuit, I found that R95 (connected from one end of the AGC control to ground) had become open.

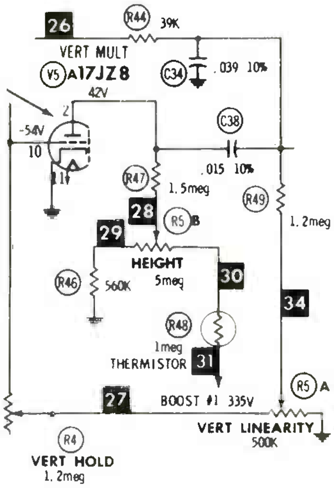
A new R95 and tuner cleaning gave good reception on all channels except channel 10. After the set warmed up, the sound became garbled. A new audio-output tube cured the distortion.



The customer was happy with the repair, for he said he had purchased the set second-hand, and channel 10 never had been very good.

James A. Warner
Pennsville, New Jersey

Horizontal bending
Admiral B&W TG2-1 chassis
(Photofact 803-1)



After I had replaced a filter capacitor and a resistor, the set was placed on time test. After a time I noticed tearing of the picture horizontally near the top of the picture.

Hours later, I had to admit not knowing what could be causing the problem. DC voltages were okay, and except for a slight jitter in the video, the waveforms were normal.

Finally, I noticed the height and linearity needed a touchup, and when I reduced the linearity so the height was short about an inch at the top, the tearing stopped.

Changing the 17JZ8 vertical tube corrected the problem. I have no idea why the tube caused the symptom, for it checked good in my tube tester.

Mark Smith, Associate CET
Greenwood, Minnesota

Tape unraveling from cartridge
Craig 3135
(Photofact AR-191)

The customer complained that his 8-track tape player unraveled tape from the cartridge; or, as he put it, the player "ate tapes."

Usually, I have found this trouble to be caused by a defective tape, which made it tempting to conclude prematurely that the problem was tape-related. But on this occasion I resisted the temptation, and connected the player on the bench.

It seemed to play fine even with the customer's tapes, which I had borrowed in order to check both the tapes and the player. After the unit played for a short time, however, I noticed an occasional hesitation in the music. The transport mechanism

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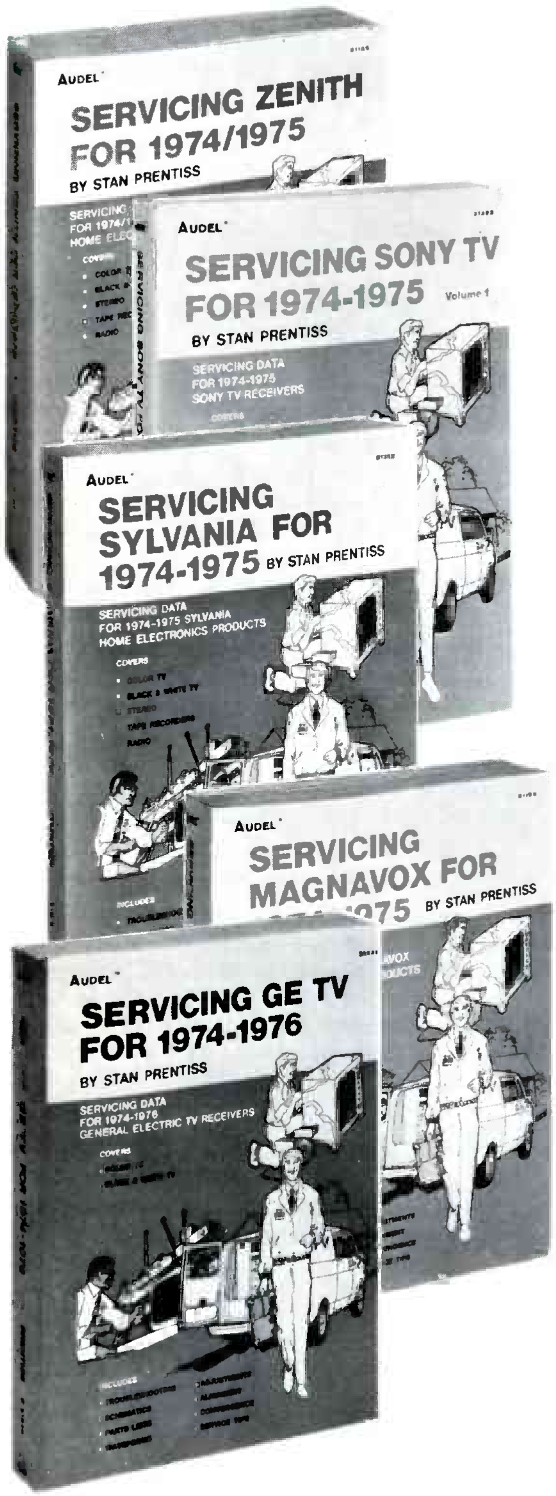

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troubleshootingtips

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checked okay; the belt was in good shape, and the capstan had not been worn smooth. Everything appeared okay, except the motor.

Connecting the motor to my regulated power supply and monitoring the current, I identified the trouble right away. The current was very erratic, jumping between 20 and 50 milliamperes, even with the belt off.

Apparently, when the motor hesitated, it allowed the slack in the tape to unwind and catch around the capstan, jamming the tape. Since replacing the motor, I've heard no complaints from this customer.

Gary Steenwyk
Hudsonville, Michigan

Intermittent sound and video Philco 22QT79

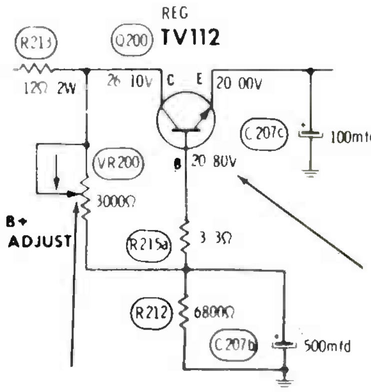
(Photofact 1239-3)

We had two different models in the shop with the same problem: intermittent sound and video.

Checking out one set, we found the raster to be okay, but there was no control of brightness when the set lost sound and video.

The transistors also tested all right, so we decided to monitor the 20-volt B+ line, which went to the tuner and was easier to get at for checking. This voltage was intermittent. After spraying canned coolant, we located the problem.

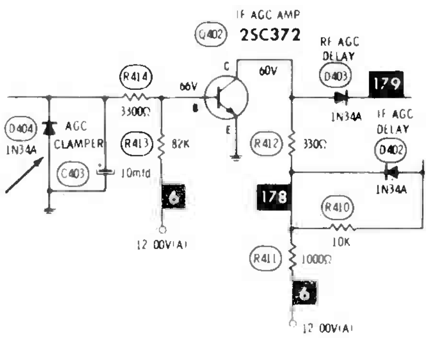
The Q200 active-filter transistor was intermittent. The same trouble was found in the other set, plus a carbonized VR200 active-filter control.



Mac Kellman
Brooklyn, New York

Loss of AGC after warmup Sharp C-6010

(Photofact 1189-2)



After replacing D202 to cure an IF AGC problem, I was surprised to see another AGC problem develop after 15 minutes of warmup.

I again removed the bottom plate and found the RF AGC voltage on the collector of Q401 slowly going negative. Using it as a heat source, I put my work light close to the bottom of the printed board, near Q401. The collector voltage went to a maximum of 18V, which cut off both the video and sound.

With the meter still at the collector of Q401, I decided to spray some components with cooling spray. When I sprayed D404, the collector voltage returned to near zero, and video and sound returned.

After a few more tries I was convinced D404 was the source of my problems. I clipped it out, replaced it with a new IN34, and everything was normal.

Al Potter
Parlin, New Jersey

Send in your helpful tips—we pay!

reader's exchange

For Sale: Regency model EC-175 frequency counter (6-digit LED readout), measures to 175 MHz, has crystal oven, FCC type approved, $300; and Sencore model TF40 transistor tester, $60. Both in mint condition. *Bob Goodman, P.O. Box 452, Alexandria, Louisiana 71301.*

Needed: Cabinet for Standardyne model B-6. Also, power transformer for Clarion Jr. model AC-60. *William Fox, Jr., 624 Jefferson Court, San Jose, California 95133.*

Needed: Schematic and instructions for a RTTA signal generator model K-7, or the name of the manufacturer. Will buy, or copy and return. *Walt Studer, 418 Walton Drive, Buffalo, New York 14225.*

Needed: Schematic and alignment data for Milovac model RA-1120 AM/FM radio/phono/8-track. Will copy, pay for use and return. *David W. Dane, P.O. Box 44, Plaistow, New Hampshire 03865.*

Needed: Service and operations manual with schematic for a Century Mark IV Multiband AM/FM/SW1/SW2/AIR/PB portable radio model CF1888, chassis numbers 001029—352. Will buy, or copy and return. *Major Norman H. Ball, USAF [RET], Box 565, 32531 Merion Drive, 1000 Palms, California 92276.*

For Sale: RCA television calibrator model 39C, mint condition, with manual and cable. Make offer. *Matt Rusk, 211 SW Madison Circle North, St. Petersburg, Florida 33703.*

For Sale: A B&K model 415 sweep/marker generator used five times, all literature and probes, $250. One Precision model EV-10 VTVM in excellent condition, $50, or best offer. One Sencore portable CG-10 color-bar/dot/crosshatch generator, $50 or best offer. Also, a Sencore transistor tester model TR-139B used little, make an offer. *Mert Albert, Clintonville Electric Service, 44 S. Main Street, Clintonville, Wisconsin 54929.*

Needed: Tube chart for model 116 tube tester by Precise Development Corp. Also, schematics for Milovac stereo tape recorder model SC-240; Aiwa stereo 5-inch reel recorder TP-1013; GE 2V wet-cell portable radio model 250; and KX Imp II wireless transmitter by Kinematix. Will buy, or copy and return. *Bob's TV Service, 8296 Portulaca Way, Buena Park, California 90620.*

For Sale: B&K model 280 3-digit DMM with manual and test leads, $55. *Jerry McKouen, 534 Pacific Avenue, Lansing, Michigan 48910.*

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reader's exchange

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Needed: Will pay $30 for a Coronado color flyback, model TV22-1611A, part #15-097079 (VZ12032A) in new condition. This 1971 flyback is unavailable from the factory. *J. Bennett, Economy TV, 617 E. Thirteenth Avenue, Denver, Colorado 80203.*

Needed: Schematic and service information for Philco radio, model 39-116. Will buy, or copy and return. *John T. Rowland, 3646 Pillsbury Avenue, Minneapolis, Minnesota 55409.*

Needed: A C6407 picture tube for Symphonic model AC-30 TPS-5050. Or an address where one can be bought. *R. L. Hallett, 65 Somerset Avenue, Pittsfield, Maine 04967.*

For Sale: Two B&K-Precision model 1076 Analysts. One in good condition for $100, and another in excellent condition, $125. Also, an Eico 460 scope, good condition, $75; one B&K-Precision 700 tube tester, good electrically but rough appearance, $35; and one Knight tube tester for $15. *R. L. Hallett, 65 Somerset Avenue, Pittsfield, Maine 04967.*

For Sale: 490 assorted receiving tubes (send for a list, or state requirements); also one B&K-Precision HV probe model HV-32. Best offer. *B. A. Harpool, Harpool's Radio & TV, P.O. Box 267, New Middletown, Indiana 47160.*

For Sale: B&K model 1077B TV Analyst with instruction book and cables; Sencore TC162/TC28 tube-transistor checker; B&K model 467 picture tube restorer/analyzer with new chart; Polaris model 651 HV probe (40KV); and degaussing ring. All equipment in excellent condition. *REO Electronics, 1175 Cling Circle, Hanford, California 93230.*

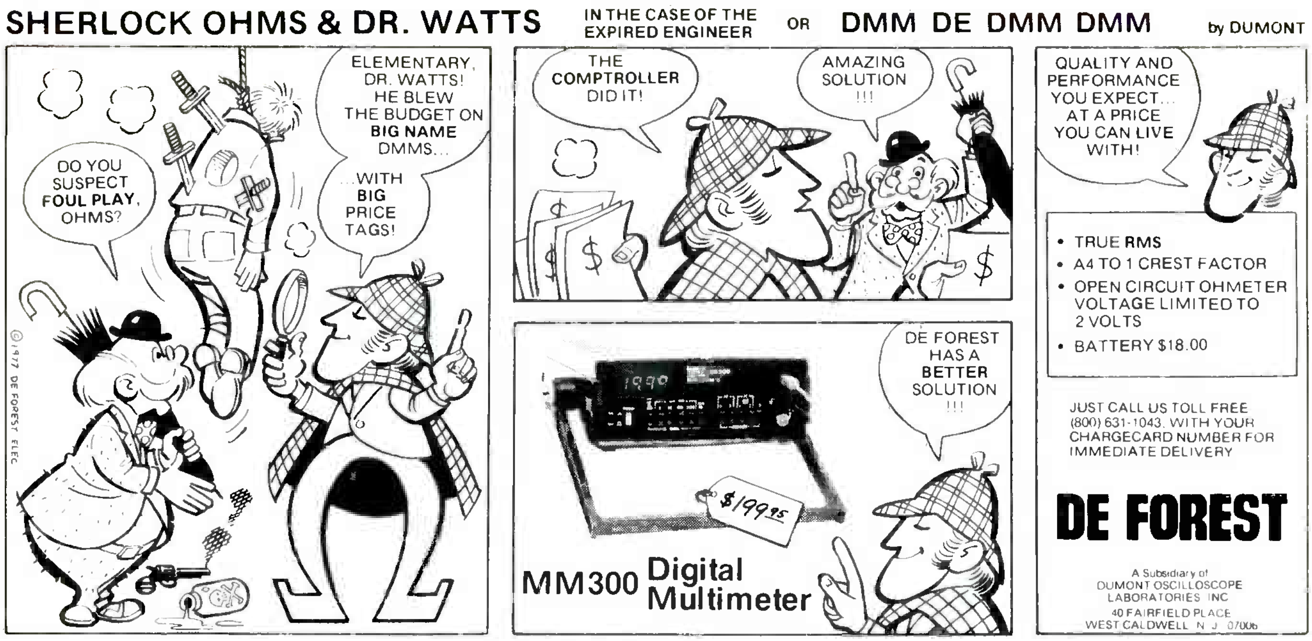
Needed: Schematics and technical data for the Everett "Orgatron" manufactured by the Everett Piano Company, South Haven, Michigan. (Wurlitzer may have bought company.) Appreciate any information, leads or suggestions. Will copy and return manuals or schematics. *L. R. Broun, Electronic Service, P.O. Box 62, Coolin, Idaho 83821.*

Needed: Back issues of *Electronic Servicing*, Rider's radio 23, any Rider's TV, or other manuals and magazines. Will buy or trade. *Donald Erickson, 6059 Essex Street, Riverside, California.*

Needed: One Precision sine and square wave generator model E-310 by Precision Apparatus. Generator does not need to be in working order. *Jim Shoemaker, 600 First Street, Leechburg, Pennsylvania 15656.*

Needed: A schematic for a Schaub Lorenz Touring T20 transistor portable radio with AM, FM and SW. *W. M. Dennehy, 14-77 160th Street, Beechhurst, New York, New York 11357.*

Needed: 16BXP4 picture tube. *Raymond W. Shirk, Radio and TV Repair, 440 Poplar Street, Lebanon, Pennsylvania 14042.*



For More Details Circle (13) on Reply Card

Needed: Schematic and service manual for Philco color-bar and dot-bar generator, model 7100. Will buy, pay for copy, or copy and return. *Roland Strauss, 11 Chieftain Drive, Creve Coeur, Missouri 63141.*

For Sale: Heath scope model IO-102, factory wired and calibrated, good condition, with low-capacity probe, $95. Also, Telematic VHF/UHF sub tuner, AC/battery operation, never used, $55. *Willis Ormes, 1420 Melrose Avenue, Fort Wayne, Indiana 46808.*

Needed: Schematic for model 98 VTVM Tektronix 512 scope. Will buy, or copy and return. *Donald C. Maeyer, 12696 Greenhall Drive, Woodbridge, Virginia 22191.*

For Sale: Heathkit video game model GD-1380. Play three games plus practice; also, two different size target practice. Target gun not included, but can be obtained from Heath. Assembled and in excellent condition; $40. *Robert C. Knapp, Box 145, Lyndhurst, Virginia 22952.*

For Sale: Two Sorensen model 1000S, 1000-watt line-voltage regulators, adjustable output voltage. Good condition, best offer. *Sam Eassa, 407 Huntclub Road, Nashville, Tennessee 37221.*

Needed: Schematic for model 240 Callmaster telephone-answering device made for Phonemaster by Altec Lansing. Will buy, or copy and return (pay for postage and handling). *Bob Williams, 1613 Lorraine Drive, Plano, Texas 75074.*

Needed: Schematic (or photocopy) and instructions on conversion of UTI-COM FM commercial xceiver to 2-meter ham band. Also, need Dow-Key coaxial antenna relay 12 VDC for TX-62; state price. *Anthony Bodo (WA9YOZ), 4380 Hayes St., Gary, Indiana 46408.*

For Trade: Sencore senior field-effect meter, model FE-149, like new. Need He-Ne Laser, 0.5 milliwatt, BRH Class II. *Dwight Miller, 901 Daggett Drive, Napoleon, Ohio 43545.*

For Sale: Hickok research and development square-wave generator model 1715A, 1 Hz to 1 MHz, 75-ohm and 600-ohm variable output levels, like new, $50. *James Ryder, 101 Clayman Road, Sandston, Virginia 23150.*

Needed: Schematic and service manual for AKAI M-10 or M-9 stereo recorder (especially interested in alignment specs). Will buy, or copy and return. *Michael Craig, 421 Fairmount NE, Warren, Ohio 44483.*

For Sale: Sencore PS148 oscilloscope/vectorscope, five-inch, wideband, high-sensitivity, never used, $200. *J. A. Robinson, P.O. Box 181, Bluffton, South Carolina 29910.*

Needed: Symphonic TV model AC-20 7PS5050. Will buy, working or not. *W. Cullen, 3701 W. First, Suite 201, Los Angeles, California 90004.*

Needed: Power transformer (part 32-10006-3) for Philco AM-FM stereo radio, model M-1666WA, new or used. State price. *John Iannelli, 1501 Saunders Cres., Ann Arbor, Michigan 48103.*

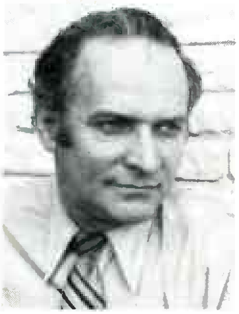
For Sale or Trade: EICO 369 TV-FM sweep and marker generator; factory wired, A1-shape, with manual. Or trade even for EICO 379 solid-state sine and square audio generator, in A1 condition. *William O'Lekas, 33650 Baldwin Road, Solon, Ohio 44139.*

Needed: Rauland RS-10A intercom units, or other Rauland items. Need not be operating; wanted for parts. *Ed Howell, Folly Beach, South Carolina 29439.*

Needed: Schematic and service information for a Detectron model DG-2, serial number E2551901-CE) geiger counter. *K & W Electronics, P.O. Box 692, South 215 Washington, Newport, Washington 99156.*

For Sale: Riders radio manuals 6-17 inclusive, without indexes, $15 each. Tubes 01A, 112, 199, etc. Want good dual-trace 15 MHz scope with probes and manual. *J. A. Call, 1876 E. 2990 So., Salt Lake City, Utah 84106.* □

Servicing Magnavox Modular Color TV, Part 6



By Gill Grieshaber, CET

No moving parts or switches are in the UHF and VHF tuners of the Magnavox Videomatic Touch-Tune system. These tuners operate with varactor and switching diodes. Such designs are not new; however, the sophisticated **digital** *circuits that control the tuners are as modern as tomorrow. Because these circuits will be used more often in the future, we strongly suggest that you study the explanations carefully.*

The most interesting and complicated circuits of the Magnavox T995 chassis are found in any model with Videomatic Touch-Tune (Figure 1), which *digitally* controls both tuners, the volume, and power on/off.

A remote-control kit can be installed in the field, without requiring modifications. Undoubtedly, this compatibility was responsible for some of the principles of the Touch-Tune designs. No motors or other moving parts are used with either the Touch-Tune station selection, or the remote-control functions.

Before starting detailed explanations of these intricate circuits, we'll tell you the general operations and purposes.

STAR Versus Touch-Tune

Magnavox has two distinct types of digital-controlled tuner systems. The STAR electronic tuning uses random-access digital logic to lo-

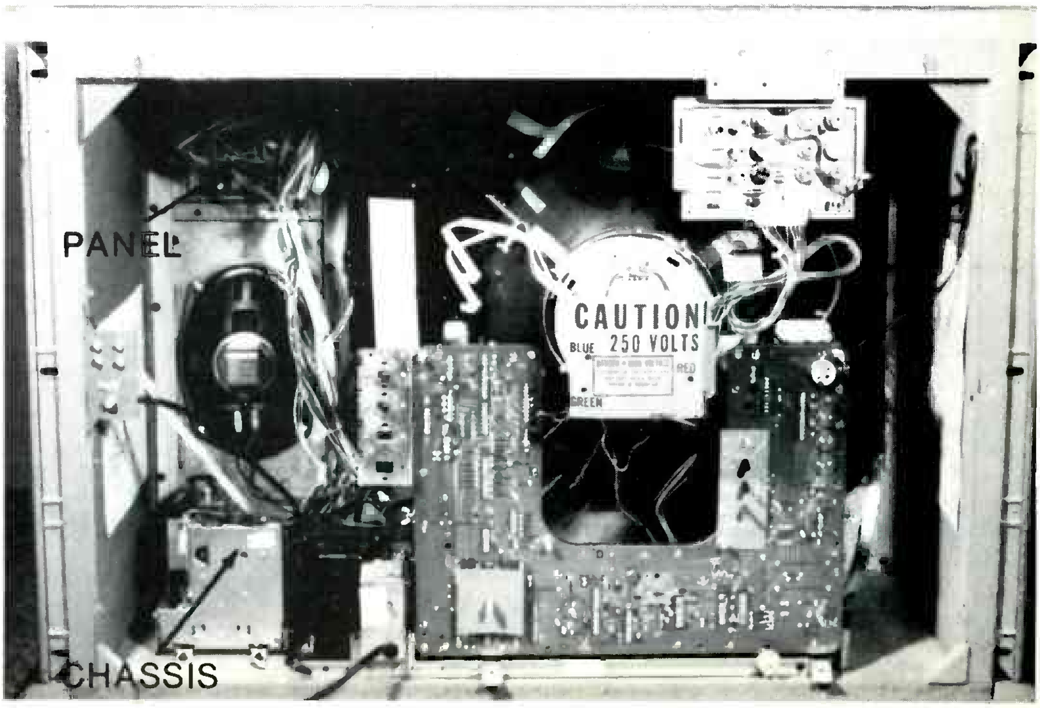


Figure 1 These are the normal in-cabinet locations of the control panel and control chassis of the Magnavox Touch-Tune system. The chassis is at the bottom.

Cables to the selector panel are long enough to permit removal of the assembly from the cabinet. The left picture shows the panel with the door closed. The same panel after the door was opened is shown at the right. Operating and programming controls are behind the door.

cate the desired channels; no programming is required. **An opposite approach is used with the Touch-Tune system, for it operates from memory circuits, and each active channel must be programmed separately.**

Other Features

The Touch-Tune front panel has no knobs or variable controls (although variable operating controls are behind the door that's over the panel). Stations are selected by pushing in two of the calculator-type buttons, in sequence. For example, channel 5 is tuned by pushing zero and 5. Channel 41 requires 4 and 1. To the left of the buttons is the two-digit display for the channel numbers. When the first button is pressed, the channel digits disappear; however, the previous channel still operates. After the second button is pressed, the LEDs light up with the new channel number, and the picture and sound come on a split second later. The action is virtually instantaneous.

Twenty VHF and UHF channels can be programmed into the memory banks. VHF channels 2 through 13 are programmed at the factory, and they should not require any additional adjustment. That leaves eight channels for UHF. All desired UHF channels must be manually programmed.

The Magnavox manual does not say so, but I believe any inactive VHF channels could be reprogrammed for UHF, if more than eight were desired.

Two volume buttons are provided. One has an arrow pointing down (for lower volume), and the other has the arrow pointing up, for louder sound. The volume gradually becomes softer or louder, taking several seconds to make large changes. Therefore, you must hold the button down until the desired level is reached. In normal operation, the circuit has a good "memory." But if the receiver is unplugged for a time, the sound level is soft when power is restored and switched back on.

A similar action occurs with the power on/off operation. The power switching is done by electronic latching circuits that activate a relay. If the receiver is off (but has power to it), one push of the on/off button switches on the power. A second push of the *same* button turns off the power. However, if the receiver is on when the power cable is unplugged, the power will be off when it is plugged into an outlet the next time. Another push of the button is necessary for turn-on.

Programming The Channels

Although the entire method of programming TV channels into the Touch-Tune system seems extremely complicated at first, it actually can be done accurately and rapidly the *second* time. A knowledge of the operation can be very helpful.

Before the UHF channels are programmed, the buttons for any channel can be pressed, lighting the LED channel number. However, only snow can be seen on the

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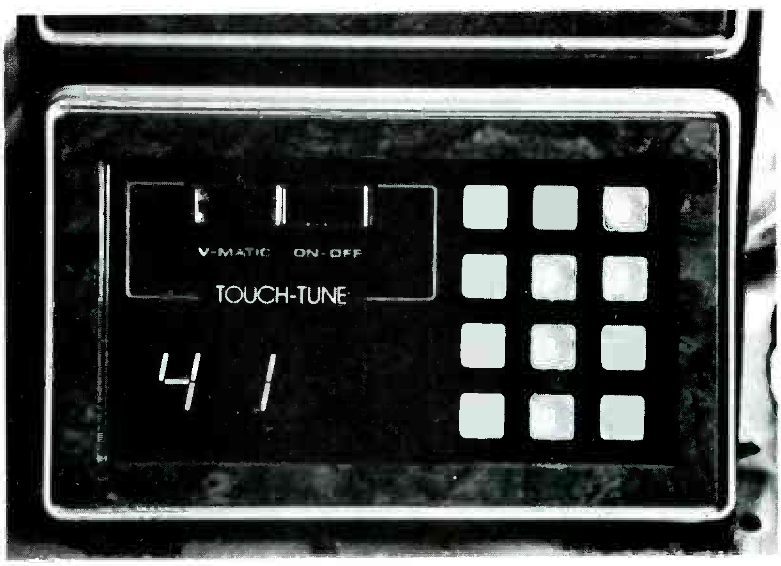

A large two-digit seven-segment red LED display shows the channel number. Above the display are the Videomatic button (gives a choice of preset or customer-operated controls) and the button for electronic on/off of the TV power. The 12 buttons are for selection of the channels, plus volume up and volume down.

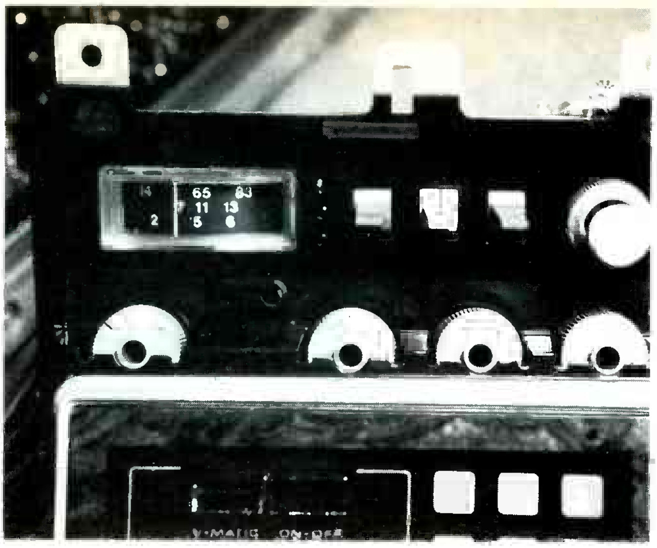

Figure 2 This closeup of the manual color controls and the programming controls show: the tuning meter that's calibrated in the channels of three bands; the band-indicating LEDs beside the meter (almost invisible in the picture); and the four programming controls. The small knob at the far right is the "yellow" knob that enables programming, the left one of the three levers is the "green" location lever, the "red" channel-number lever is in the center, and at the right is the "blue" tuning-voltage lever. Readjustment of the preset color controls can be done by inserting a small screwdriver through the center holes of the manual knobs.

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screen, and the LED readout flashes to indicate that the channel has not yet been programmed.

That's because the eight spaces have been factory adjusted for a varactor tuning voltage of zero, and for a channel readout of zero (the readout can show any number from 0 to 99). Incidentally, during remote-control operation, any channels programmed to "zero" will be skipped during the up or down search. Merely pull out the yellow knob and use the red lever to run the channel number back to zero. It's not necessary to zero the tuning voltage.

Four programming steps

Programming a zero channel to receive a UHF station is done in four steps. **Separate adjustments are provided for: the programming switch; the channel location; the digital channel readout, and the tuning voltage** required for the varactor diodes in the tuners to reach the desired channel.

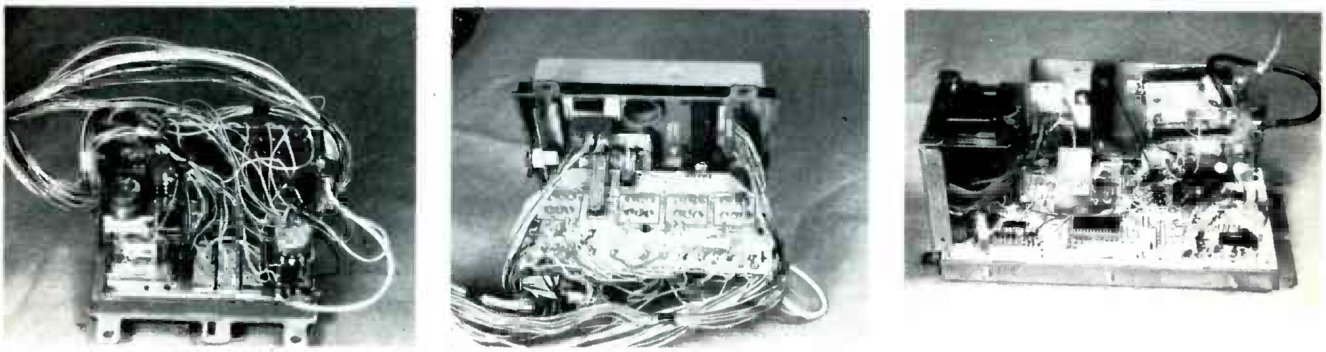
The programming controls are behind the door that's just above the channel pushbuttons. As shown in Figure 2, the tuning meter is at the left. This meter reads the varactor tuning voltage, and is calibrated in the channel numbers of three bands (2 through 6, low VHF; 7 through 13, high VHF; and 13 through 83, for UHF). Three LEDs at the right of the meter show which band is in use.

The **green lever** operates the "location" switch, which is the equivalent of the detents of a conventional tuner. Channel number of the desired station is selected by the **red lever,** and the **blue lever** adjusts the tuning voltage to receive the correct station.

At the far right are two knobs with many functions. The gray knob near the panel operates the peaking (or sharpness) control. In front of it is a smaller yellow knob that has *three* functions. When turned fully counterclockwise, the master power switch opens (this switch must be on for remote operation, or to allow power turn-on from the panel on-off button. Clockwise rotation operates the tone control, while pulling out on the yellow knob allows (enables) the other programming controls to be operated (otherwise, the programming switches don't work).

Sequence of programming

Although the Magnavox programming instructions are detailed,



The left picture shows the programming and other controls when the panel is inverted with the top nearest the camera, while the center picture shows the bottom of the circuit board and the back of the display and keyboard. All cables of the tuner-control chassis can be unplugged, and the chassis removed for testing or replacement. Six ICs and twenty transistors are used to control the two tuners. A remote-control kit can be mounted in the corner near the power transformer for a simple field installation.

there are a few peculiarities omitted. Therefore, I'll give the method, along with comments of my own.

Here are the programming steps:

• Pull out the small **yellow** knob (Figure 2) of the programming switch (this disables the AFT automatically). Note: the station, tuned in before the knob is pulled out, remains on the screen, and the channel digits do not change, but the three programming levers now can operate.

• Each flip up or down of the **green** (memory location) lever jogs the system to a new location, including the programmed channels. For example, suppose you have channel 9 tuned in. After you pull out the yellow knob, nothing apparently changes. But when you flip up the green lever, channel 10 digits are displayed, and the picture or snow (if your area does not have a channel 10 station) is on the screen. Flip it up again for channel 11, and so on. (Of course, you can flip the green lever down to jog to the next lower channel.) The next channel above 13 reads zero (remember only 2 through 13 are factory programmed). This is the first position for UHF, and it must be assigned a channel number (red lever) and a tuning voltage (blue lever).

• Push up on the **red** (digits) lever, and hold it there. The digits slowly and automatically advance from zero to 2, 3, etc. In the same way, a continued pressure downward on the red lever causes the channel digits to count down. Stop at the channel number you want programmed. (If you pause at the channel number of an active VHF station, **no picture appears.** This adjustment moves the digits only, not the location or tuning.) Both the *location* and the digital *channel number* now have been programmed into the memory.

• The **blue** lever adjusts the varactor-tuning DC voltage for the station. This tuning voltage is measured by the panel meter, which is calibrated in channels (Figure 2). Also, one of the three meter LEDs lights to indicate which of the three ranges is in use. The system varies the tuning voltage between zero and +30 volts. The voltage gradually increases when the blue lever is held in the upper position, and it slowly decreases while the blue lever is held down. If the meter is not reading the range that you want, scan to the top, where the meter suddenly returns to zero at the left, and changes to the next higher range. For example, at channel 13 the meter has been near the maximum deflection for the high-VHF range. After you use the green lever to find the first UHF location above that, the meter changes to the UHF scale with a reading of zero volts. Therefore, press up on the blue lever, holding it there for several seconds as the pointer slowly moves to the right toward the desired channel number. After you pass through the station, press down or up alternately on the blue lever, as needed to give best picture, color, and sound (just as you adjust a fine-tuning control). That completes the programming of the first UHF channel. For the next UHF channel, push up once on the

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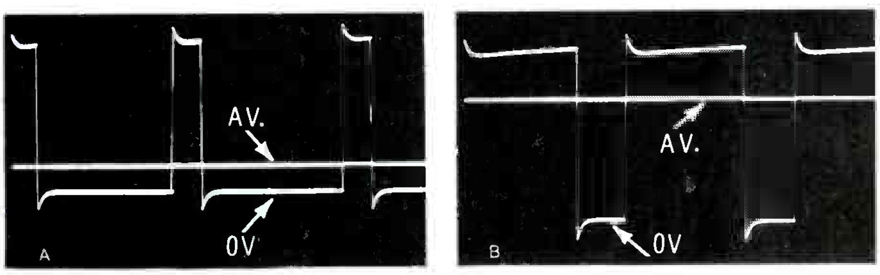

Figure 3 The bottoms of these waveforms are at zero DC volts. Therefore, each horizontal line represents the average DC voltage. The waveforms vary in pulse width (duty cycle), and thus produce different DC voltages after passing through three RC low-pass filters. The waveform on the left (A) was generated by channel 2, and the tuning voltage was +4.42; the wider pulses of the right waveform (B), channel 6, gave a tuning voltage of +21.2.

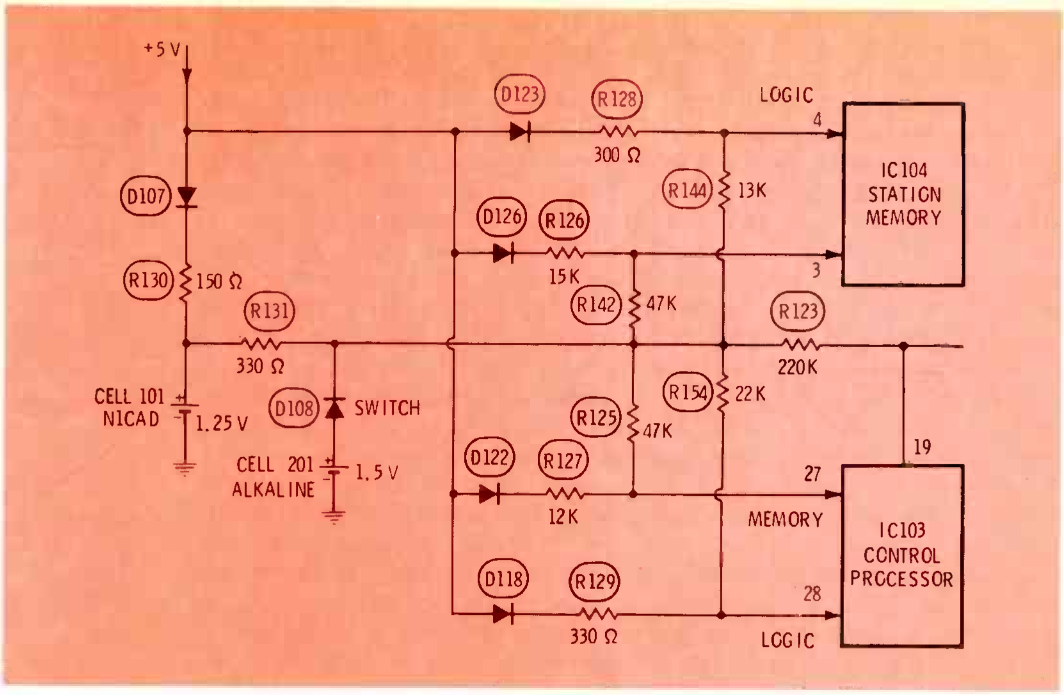

Figure 4 "Keep-alive" voltage for the memories in IC103 and IC104 is supplied by two batteries. For about 18 months after manufacture, the alkaline cell 201 supplies this voltage through D108. When the set is not plugged into the power, diode D107 prevents cell 201 and cell 101 from discharging into the +5-volt supply. With power, D107 brings in the normal operating voltage, and D108 opens to disconnect the alkaline cell. During this time, the NiCad cell 101 is being charged through R130 from the +5-volt supply. After it is charged, the NiCad cell will hold a sufficient minimum voltage for about four months to prevent loss of memory. The other diodes act as switches to prevent the ICs from being supplied by both the batteries and the normal supply. It's not likely that a loss of battery voltage ever will occur. However, in that event, all channels will require reprogramming.

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green lever to reach the next blank position. Then program it with the red and blue levers. Repeat the procedure for any other UHF channels. After all of the channels are programmed, you can operate the green lever as a channel selector to check all of the active channels. In my location, I programmed UHF channels 19, 27, and 41, which left five blank locations. In other words, when starting at channel 12 and going up, the next channel is 13, then 19, 27, 41, zero, zero, zero, zero, and zero, before starting with channels 2, 3, 4, etc.

• Push in the **yellow** knob (which activates the AFT and disconnects the programming controls), and use the regular Touch-Tune buttons to select each programmed channel, especially the UHF stations. If any one channel seems to have a borderline frequency, pull out the yellow knob, and jog the blue lever for correct fine tuning. Push in the yellow knob, then recheck all of the programmed channels. This concludes the programming adjustments.

Cable channels

CATV systems often convert UHF stations to an unused VHF channel. Also, some systems change the frequency of each station by a megahertz or so. The Touch-Tune adjustments can overcome both of these problems.

Suppose a channel 25 station is distributed on the channel 6 frequency. Merely program the channel digits for 25 (rather than 6), but use the low-VHF range and the blue lever to tune in the station on channel 6.

Cable channels with only a slight frequency shift can be accommodated easily. Push the buttons for the nominal channel frequency, pull out the yellow knob, and jog the blue lever as needed for best fine tuning. Push the yellow knob back in. That's all.

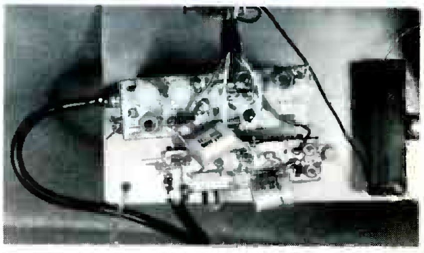
Developing The Tuning Voltage

One of the most interesting circuits of the Touch-Tune system is the method of obtaining the DC tuning voltage for the varactor diodes in the tuners.

Generally speaking, digital circuits do *NOT* operate with or produce a variable DC voltage. Digital operation works with pulses or square waves.

However, it's possible to obtain a DC voltage from pulses, when the conditions are right. First, the pulses or square waves cannot be fed through a coupling capacitor. Instead, either the top or bottom of the waveform must be at a DC voltage (such as ground or B+).

Secondly, the pulses or square



Both small tuners are mounted on a side panel of the control chassis. The alkaline cell is inside the housing to the left of the tuners.

waves are filtered in a low-pass circuit to remove the waveform, but leave the *average* DC component, which is developed by the filtering.

Given those conditions for obtaining a DC voltage from pulses or square waves, it's a small step to **obtaining a variable DC voltage by filtering pulses that vary in width** (duty cycle).

Look at the principle this way: assume an electronically driven relay that passes a B+ voltage for half of the time. **To a DC meter, this will measure the same as a steady DC voltage of one-half of the supply.** Or, change the duty cycle so the relay applies power for only 10% of the time. The DC meter will *average* the voltage and give a reading of 1/10 of the supply voltage.

Now, pulses and square waves (that are clamped to ground or B+) follow this same action. The average DC as read by a DC meter equals the DC steady voltage after the AC waveform is removed by a low-pass filter.

Therefore, **the Touch-Tune tuning voltage is developed by filtering pulses whose width is determined by the memory of the conditions that were programmed into IC104.** Refer to Figure 3, for the actual waveform and measurements from the Magnavox circuit.

Maintaining The Memory

IC103 and IC104 each contains a Random Access Memory (RAM) of 20 "locations." The data necessary for pushbutton selection of the channels is programmed into these two ICs. (Incidentally, three of the ICs use the new logic technology called Integrated Injection Logic (or I squared L). I^2L provides many components on a chip, fast operation, and low current requirements.)

Unfortunately, the RAMs can be deprogrammed by any total removal of the DC voltage from certain inputs. To prevent this problem, *two* battery cells are provided, as shown in Figure 4. Why two batteries? That takes a bit of explaining.

The control unit is operating at all times (except when the "vacation" switch is off, or when the power cable is unplugged). So, it appears that a NiCad single cell

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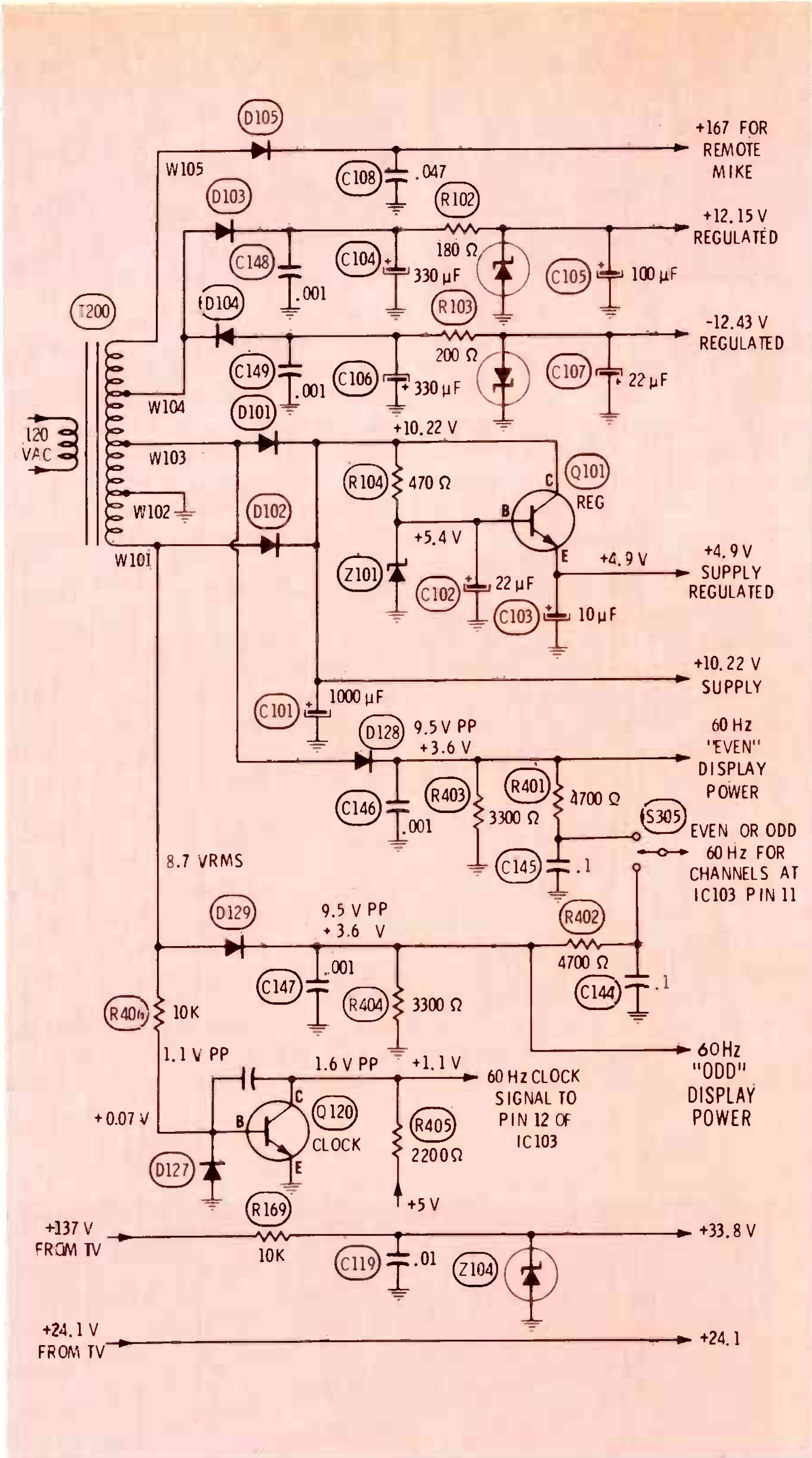
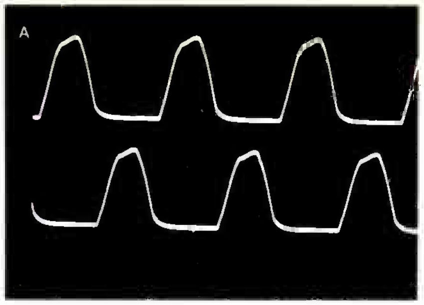


Figure 5 This complete power-supply schematic shows the sources of all tuner-control DC voltages. Notice that two come from the TV chassis. The others are present at all times when the set is plugged in and the master switch is on, even after the TV is turned off. Regulation of the 5-volt supply is accomplished by a conventional series-pass transistor, whose base bias is clamped by zener Z101. Out-of-phase clipped 60-Hz signals are needed, and they are produced by D128 and D129 (the waveforms are shown in Figure 6). The signals through R401 and R402 to S305 are delayed in phase a bit, but otherwise have the same waveshape as those at D128 and D129. Q120 has no forward bias except from the 60-Hz voltage coming through R406. Also, diode D127 clips the negative peak. Therefore, the output of Q120 at the collector consists of clean square waves (see Figure 6). This is the 60-Hz clock signal required by one of the ICs.



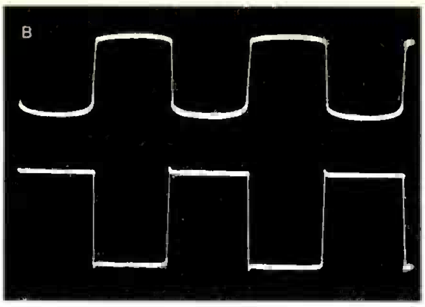


Figure 6 The top trace of photo A is the clipped output from D128, and the bottom trace is the output waveform from D129. Photo B shows the base waveform (top trace) and the collector waveform (bottom trace) of Q120, which acts as a 60-Hz clock.

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(under charge from the power supply) would be a perfect standby voltage source. But, there is a problem. NiCads discharge slowly between charges, and they are completely discharged after about four months. Even if the factory installed a charged NiCad, the charge might be gone before the TV was sold and plugged into the power. In that case, all of the programming would be eliminated, and all channels would require new programming.

The answer is to include the NiCad with a charging circuit, but also to add an alkaline battery that has a shelf life of about 18 months.

Both of the batteries and the tuner-control power supply are decoupled by diodes. The NiCad is charged when the power is on; but when the power is off, D107 prevents the NiCad from feeding the power supply. In addition, diode D108 opens when the alkaline cell voltage drops below that of the NiCad. Thus, the alkaline cell is effectively disconnected from the supply voltage, and does not require removal after it fails.

The other diodes decouple the battery voltage and the supply voltage so that only one source feeds the ICs at a time.

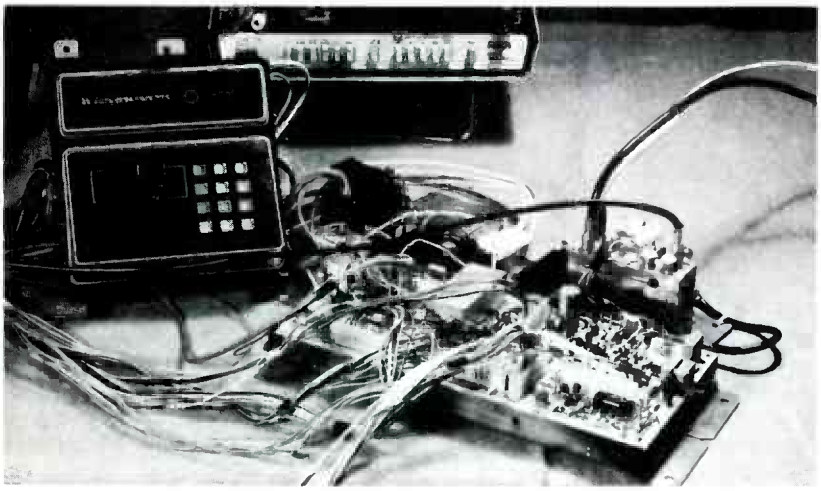
Power Supply

Figure 5 shows the complete power-supply schematic of the Touch-Tune system. Seven DC voltages are required. Also generated are a 60-Hz square-wave that functions as a clock signal, and two phases of clipped 60-Hz sine waves for the digital display. Voltages on the schematic are those measured in the chassis, while several typical waveforms are shown in Figure 6.

Two of the voltages come from the TV chassis. These become zero when the power is turned off by the on/off button. All of the other voltages are there at all times (except when the power cable is unplugged).

There are no dial lamps or tubes to glow and remind you that the circuit is operating, so it's easy to forget. You could burn up an ohmmeter by trying to check a supply voltage for shorts.

Although I knew better, I made a mistake that wasted much time. The AFT was not operating while I practiced programming, and without reading the entire Magnavox explanation, I thought that a defect had killed the AFT. (Actually, pulling out the yellow knob defeats the AFT.) Sure enough, the collector of Q107 checked about 8 ohms to ground. That's the point grounded by the Videomatic and AFT switches when in the off position. Only after I had removed C122 and Q107, plus checking everywhere for the short, did I find that *conduction* of Q107 was producing the short. The control power was on (I had forgotten that), and the yellow switch was out, so the circuit called for saturation of Q107. Well, after kicking myself for such stupidity, I studied the circuit more thoroughly. Remember my mistake, and avoid a similar one.



Most of the cables to the panel unit and the control chassis are long enough (after the cable ties are removed) to permit locating the panel and chassis on a table or bench near the TV. Only two extender cables are required, and they can be obtained from Magnavox. All components of the Touch-Tune system are easily accessible, and all functions can be operated, when the two units are removed from the cabinet.

Next Month

In this first article about the Magnavox Touch-Tune digital tuner control system, we have shown you pictures of the system, and provided a general idea of the way the circuits operate.

Next month, we will continue with detailed circuit analysis of the various control functions. □

Correction

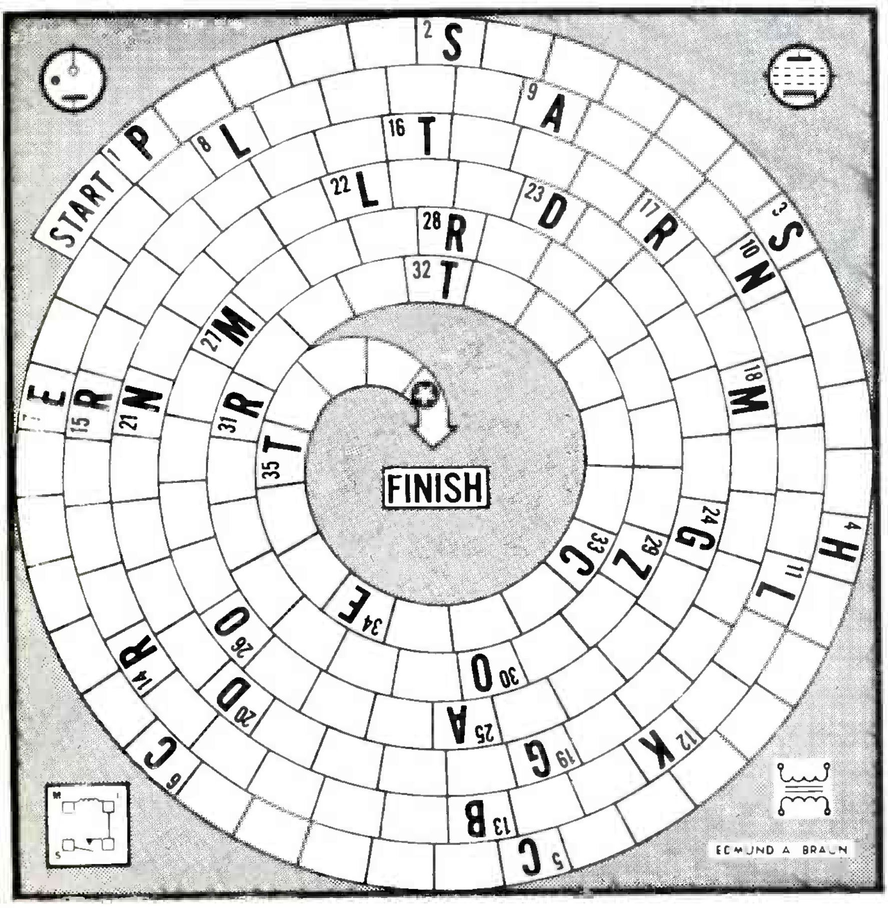
In last month's article (Part 5), the caption for Figure 5 should have read, "Major components of the **M110** color-oscillator module are identified on the photograph."

ALL AROUND OHM!

by Edmund A. Braun

Hi there! Here's a Pinwheel Puzzle guaranteed to have you going around in circles no matter how well versed you are with Electronics! The last letter of each word is the first letter of the next word. Each correct answer is worth 3 points; a perfect score is 108. A high rating should be fairly easy except perhaps for someone who thinks "gram" is a cracker, or that "loudspeaker" is an angry housewife! One good turn deserves another, so GO!

1 Sections of a switchboard.
2 Unites two or more wires to make electrical connection.
3 Device for controlling current.
4 Sinusoidal wave with frequency that's a multiple of fundamental wave.
5 Clay-like substance which, after processing, is used as insulation.
6 Receiver cabinet that stands on the floor.
7 Type of insulation that's baked on.
8 Greek letter to designate wavelength measurements.
9 To adjust components of a system to proper interrelationship.
10 The usual condition, degree, quantity, or the like.
11 An interconnection.
12 A protuberance.
13 Method of winding a non-inductive resistor.
14 Variety of electronic systems for locating, direction-finding, etc.
15 Type of variable resistor.
16 High slender structure.
17 To enlarge a hole or to bevel out.
18 Something serving as a base, backing, support, etc.
19 Connection, accidental or intentional, between earth or chassis, etc.
20 Arrangement of parts in a device to facilitate servicing or improve efficiency.
21 A hard, silver-white metallic element much used in various alloys.
22 Connection wire for testing, etc.
23 Decreasing the amplitude of oscillations, waves, etc.
24 Mineral used as detector in early radio sets of simple design.
25 The sound portion of a telecast.
26 Hard alloy of the platinum group.
27 Trade name of du Pont for a highly durable plastic film of outstanding strength.
28 Type of crystal-controlled vacuum tube oscillator named for its inventor.
29 Representing nothing at all.
30 Instrument for direct reading of resistance to flow of current.
31 A headed, malleable metal pin used to fasten pieces together.
32 Messages handled by communications or amateur stations.
33 A waterproof, insulated bundle of wires.
34 To give out; radiate; send forth.
35 Hand implement such as a screwdriver, wrench, pliers, etc.



Now turn your attention to the solution on page 48.

5 Easy Steps to Successful TV Repairs

By Terry L. Turner

After servicing TVs for many frustrating years, I've come to the conclusion that *a definite system is essential* for making rapid and successful repairs. Luckily for you, those years of hard work and inspired ideas have shown me the following foolproof system of systems.

Now, you must follow the instructions precisely, and in the proper order. It also might help to keep your tongue firmly in your cheek as you do so. Here is the amazing system:

"He likes to keep his cool when presented with a bill."

1. **Approach the ailing TV with confidence.** Swagger up to it with the attitude that you already know all possible defects, and you're slightly bored because you've done the same thing time after time.

2. **Determine the nature of the problem.** This can best be accomplished by: (A) asking the customer; (B) consulting your horoscope; (C) consulting the customer's horoscope (B and C are known to us experts as "scoping the set"); (D) or, as a last resort, turning on the power and examining the chassis.

3. **Find the solution.** After you've determined the nature of the problem, you must think of a solution. Remove the back of the TV and look to see if all those little glass bulbs are glowing. Of course, if the set is one of those newfangled models with solid-state, then proceed to step 3A.

3A. **Use double talk.** Tell the customer that his framus is shot, and probably he needs a new clavicle. This, of course, means nothing, but it sure impresses the heck out of people, who are awed by this massive display of knowledge. Your purpose for the diversion is to obtain permission to cart the set back to the shop. Who knows, maybe your wife again will point a finger toward a resistor, saying, "Those blue and purple stripes on that firecracker sure clash!" Naturally, that component will be the one giving all the trouble. Right?

"Good Heavens! If the price of a service call goes any higher, I'll be paying you more than I do my ironing lady."

4. **Make the repair.** If the repair is to be completed in the home, perform it with the flair of an artist. Pick up a screwdriver by the blade, flip it once or twice in the air, and catch it by the handle. (Note: don't reverse those instructions.) This provides a good show for the kiddies of the home, and makes for good customer relations. Of course, avoid throwing the screwdriver too hard so it sticks in the ceiling or one of the kiddies. Sometimes this curdles the customer relations.

5. **Present the bill.** You've now reached the most crucial and dangerous stage of the repair: collecting for the work. This is the time when many technicians cringe behind their color-bar generators. Fear not, TV tech, you are protected by "the system." (Note: if you are more than seven feet tall, and your hobby is ripping telephone books in half, then skip over to the actual presentation.) For the rest of us ordinary mortals, the procedure is simple. Use diplomacy. Look the customer straight in the eye and clearly quote the total price. Watch for a reaction, for your next move depends on the reaction. If he stares at you with glassy eyes and with his mouth hanging open, call for medical aid immediately; he's gone into shock. But, if the veins in his neck stand out, his face turns red, and small wisps of smoke drift up from his collar, prepare to defend yourself. *He's going to kill you!* On the other hand, if he nods slightly, and reaches for his wallet or checkbook, congratulate yourself. You have just completed the five steps and gotten paid for your knowledge and labor.

"If the Chinese can cure this way, I figured why not me!"

These five steps are all you need to know about TV repair. If, after studying these simple steps, you believe they will help you in your own business, I'd like to talk to you about some nice land in Florida, overlooking a beautiful swamp, that I've been trying to give away....er, sell. □

The picture tube is the "end of the line" for many signals and voltages, such as video, -Y chroma signals, screen voltages, focus voltage, and high voltage. Therefore, it's not surprising to learn of the many varied symptoms produced by defects in those circuits. Also, such chassis defects can mimic some picture-tube defects.

Picture-Tube Voltages... *the cause of many problems*

by Paul Shih

Picture-Tube Problems

All of the principal voltages and signals of color-TV receivers are designed to reach the picture tube. Therefore, this area is noted for the wide variety of problems and malfunctions that can occur there. If we were forced to check each of these with instruments, every repair would require an excessive amount of time. Luckily, it's usually possible to analyze the appearance of the TV screen, thereby learning enough about the problem that we can limit the number of stages needing detailed testing.

The sweep circuits and high voltage will not be discussed here; those are subjects needing a different approach. Instead, the voltages and signals that are applied to the base sockets of picture tubes will be studied.

Symptoms

Typical symptoms of problems caused by wrong voltages and signals that are applied to the base of the picture tube include: wrong or intermittent gray-scale tracking; wrong color hues or missing colors; and, excessive or dim brightness.

It might surprise you to learn that many other symptoms can begin here, including: low contrast and color saturation; loss of high voltage; elimination of the raster; color without video; and, excessive blooming. The conditions tend to be highly intermittent, and this complicates the analysis and testing.

Chassis Or Picture Tube?

Most of these visible symptoms result from defects in the chassis circuits, although a few can appear to be caused by a bad picture tube. Now, it's embarrassing, as well as damaging to your technical reputation, to have the same problem symptoms remain even after you have changed to a new picture tube. Therefore, we need definite tests to prove whether the chassis or the tube is at fault.

Although we will attempt to provide examples of most basic problems, your best source of information and inspiration is your own knowledge of how these circuits operate. We might term this as "theory in action."

Matrixing Inside The Picture Tube

Figure 1 shows the partial schematic of a typical tube-equipped color receiver. A control provides DC voltages ranging from B+ to B-boost for each of the three screen grids. Each control grid is fed by the amplified -Y chroma signal from a demodulator. In addition, a positive DC voltage is applied to each grid, often by a resistor and coupling capacitor in parallel, from the plate of the -Y amplifier. The correct -Y signal is necessary for normal colors; while the correct and *unvarying* DC voltage is essential for maintaining the desired B&W screen color.

Video signals (with pots to allow variation of amplitude) are applied to the three picture-tube cathodes. Now, the circuit would operate if

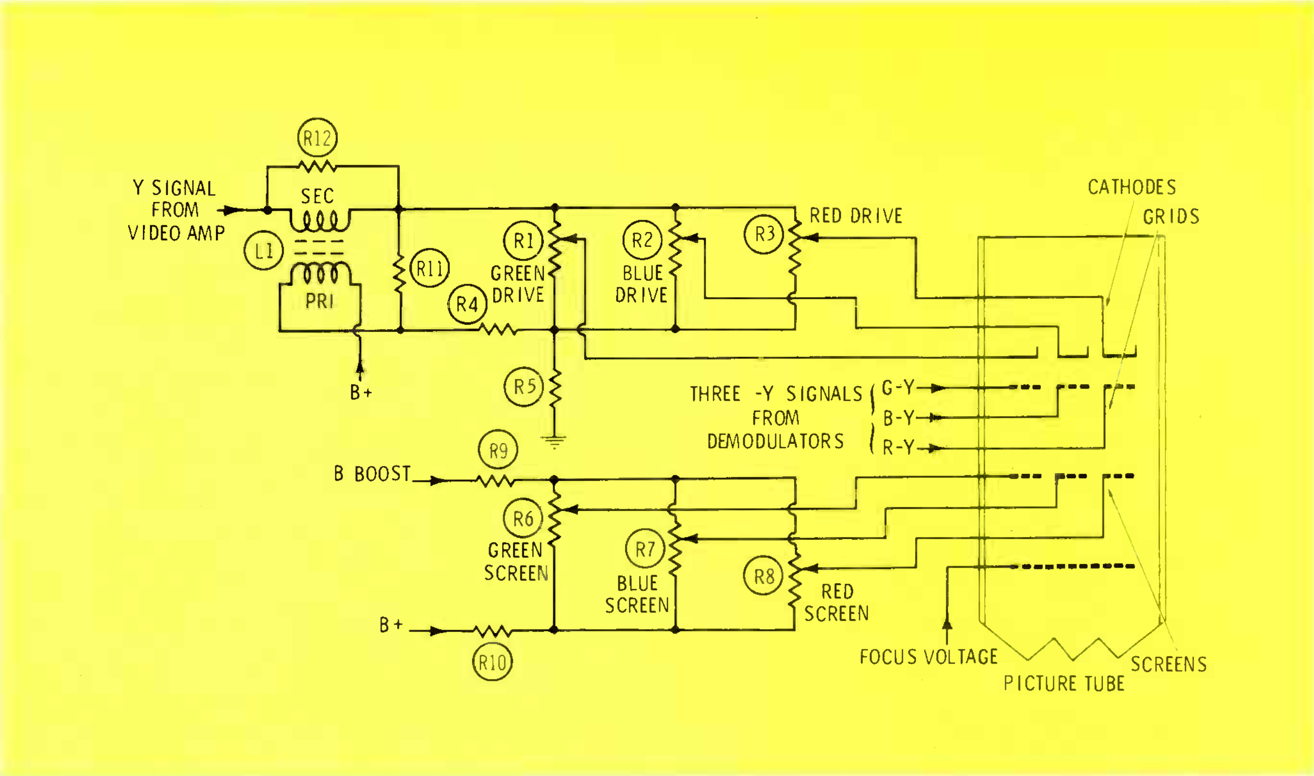


Figure 1 Almost all tube-equipped color receivers matrixed the video (Y) and chroma (-Y) signals inside the picture tube, as shown. The precise DC voltages at the control grids, screen grids, and cathodes affect the brightness or gray-scale screen color and tracking. An open in the primary winding of L1 causes excessive gun currents which kill the high voltage instantly. When the secondary of L1 opens, the contrast is reduced, white parts of the picture are compressed, and the brightness changes too easily, causing blooming.

the three cathodes were fed the same amplitude. But better tracking can be obtained when they are independently adjusted. However, the same waveform of video goes to all three cathodes.

Matrixing of the color and B&W video signals occurs inside the picture tube. Remember that **any picture tube is only a specialized type of tube.** In grounded grid (or grounded base) amplifiers, the input signal goes to the cathode (or emitter, with transistors). Although the impedance is lower and the output phase is reversed, amplification still occurs. (In color TVs, the phase reversal is cancelled by a previous phase reversal in the video circuit.) So it is with picture tubes; both the grid (chroma) signal and the video cathode signal affect the total electron current, and matrixing therefore occurs in the electron stream.

Take special note of this principle: a specific change of grid voltage affects the electron current exactly the same (although in reverse fashion) as the same change of cathode voltage. In other words, a 10-volt increase of grid voltage increases the tube current exactly the same as a 10-volt decrease of cathode voltage does.

Effects Of Bias Changes

True bias of a picture tube is the *instantaneous difference* in the voltages at each grid and its corresponding cathode; this includes both DC and AC voltages. Usually we measure the grid and cathode voltages *to ground*, and this requires subtraction of the positive grid voltage from the positive cathode voltage to give the negative grid bias. A more direct method is to measure between grid and cathode.

A DC bias change to just one gun (and no change of the other two biases) **shifts the gray-scale tracking,** and gives a red, blue, or green tint to a B&W picture.

An identical bias change to all three guns shifts the brightness, but maintains the balance of color and B&W signals. Of course, almost all TVs vary the brightness deliberately by changing the video DC level, and this change goes through the video stages to the cathodes of the picture tube.

Sometimes we forget that changes of CRT grid voltage can vary *either* the screen color or the overall brightness.

Brightness is affected also by the exact screen voltage of each gun. Increasing the positive voltage at one screen does increase the gun current and brightness of that gun (although the brightness difference per volt of change is less than for grids or cathodes). Erratic screen controls have been known to cause mysterious changes of screen color.

Next, we'll give some examples of troubles in circuits similar to Figure 1.

Low Color Saturation

Away back about 1963, one model of color receiver often seemed to have an insufficient or barely-sufficient amount of color.

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In many cases, the solution was simple: just decrease the screen voltages and retrack the B&W screen color.

You see, **brightness alone is not enough.** The beams must be modulated from full intensity to complete cutoff. This is one aspect of *contrast.*

Perhaps the idea of *visible contrast* on the screen of a picture tube being affected by the various DC voltages has not occurred to you before. But, it's true.

Think of the picture tube as if it were a small pentode audio tube. **When the grid bias is highly negative** and almost has the plate current cut off, we find that **the screen-grid voltage affects the current more** than a proportionate change of bias. **(This corresponds to low brightness with a picture tube.)**

On the other hand, **when the negative grid bias is low** and the plate current is high, the precise screen voltage is not critical, and **the bias affects the plate current more. (This corresponds to high brightness with a picture tube.)**

After we digest these facts, we can sum up the conclusion by saying: less swing of the bias is required to vary the plate current when the screen-grid voltage is low. When applied to picture tubes, the conclusion is: **a low screen-grid voltage increases the contrast.**

Of course, decreases of screen voltage can be carried too far. Picture tubes have better beam focus, and thus a sharper picture at high brightness, when the screen voltages are high.

Blank Raster

When the brightness was turned down, the action was normal until the picture became moderately bright. But, when the control was turned for *less* brightness, the B&W picture gradually disappeared, leaving just a **blank dim raster with bright vertical-retrace lines.** (Circuits similar to Figure 1 will show color when it's turned up. Pre-CRT matrixing circuits, as in Figure 2, lose both color and video.)

The cause of this symptom usually is excessive screen voltages. Here's how it happens: higher screen voltages require that the cathode voltages become more positive than usual to cut off the guns and give a black raster. Unfortunately, this higher picture-tube cathode voltage can be obtained only by applying more negative grid bias to the video-output tube, in turn increasing the plate voltage, which is coupled to the CRT cathodes. However, as the bias approaches cutoff, the tube amplification decreases, finally reaching a point of no output. Even then, the CRT cathode voltages are not positive enough for a black raster, so the screen shows a blank dim raster with vertical retrace lines (because the blanking of the video has been lost).

The solution is easy; merely **retrack the gray-scale, after reducing all three screen controls.** Incidentally, this problem often occurs after a technician has attempted to adjust the raster color without doing the whole procedure for gray-scale tracking. Or, perhaps he had adjusted the screens to the top in an effort to brighten a raster that was too dim because of a parts defect, then he forgot to reset the

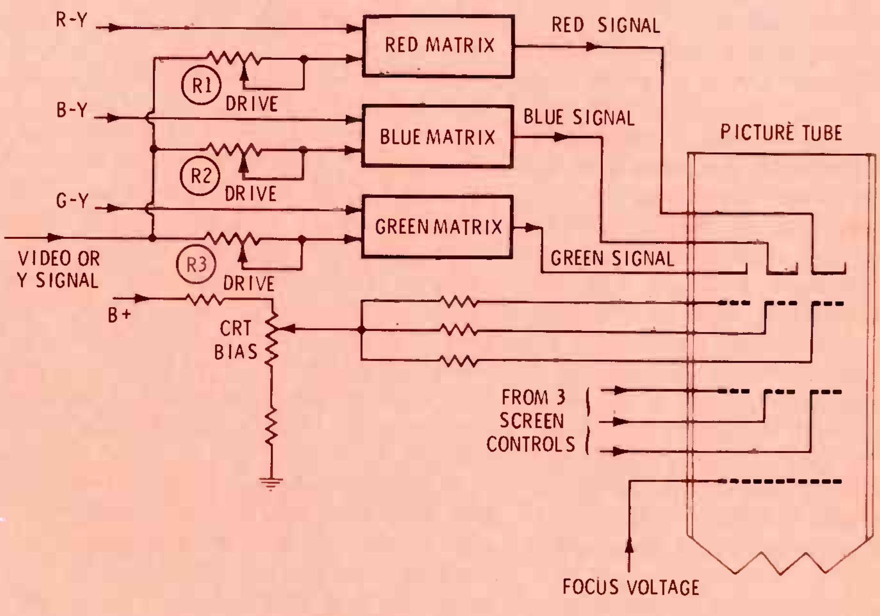

Figure 2 Many solid-state color sets matrix the video and chroma signals in power-amplifier stages that drive the CRT cathodes.

screens following the repair.

The only component in Figure 1 that can cause the same symptoms is an open in R10, which gives the same effect as misadjusted screen controls.

A B&W Picture Has Areas In Color

When some areas of a B&W picture (or a colorcast with the color turned down) **show weak and wrong colors, check the drive controls for opens, and test for heater-to-cathode shorts in the picture tube.**

Examine Figure 1, and imagine **an open at the high end of R1,** the green drive control. The green gun would have minimum video, while the blue and red usually have settings near maximum. DC bias of the green gun is not affected much (R4 and R5 are supposed to apply about the same DC voltage to the bottom of the drive controls as is applied to the top by the video circuit). Therefore, the bright highlights of the picture would have full current from the blue and red guns, but only partial current from the green gun. **This makes the highlights magenta, and the lowlights are cyan.**

Now, imagine **a short between heater and the red cathode,** when the red drive control is operated at maximum. The heater of the picture tube has a positive voltage applied to it (to minimize such H-K shorts), and it is bypassed to ground. Therefore, the red cathode now is bypassed to ground with a 0.1 microfarad capacitor, which removes all of the video from the red cathode. But that's not all. **Since the red drive is at maximum, the video is removed from all three cathodes.** The picture has only the chroma signals, which appear almost normal, except the picture is very blurred.

Not all H-K shorts remove all of the video. Imagine a short between heater and the blue cathode, when the blue drive control is adjusted about in the center. All of the blue video is eliminated, but the DC remains about the same. The video to the red and green cathodes is blurred slightly, but neither the sharpness nor the amplitude is noticeably different. However, **the picture has yellowish highlights** (red plus green) **and blue lowlights with a B&W picture.**

Although these shorts and opens also affect the color reproduction, the color degradation is more subtle. Therefore, I strongly recommend turning down the color at the beginning of your diagnosis, any time there is any suspicion of similar defects.

No High Voltage

Excessive high-voltage current through the picture tube can load down the sweep circuit and kill the high voltage. A common occurrence in some models is an open (often

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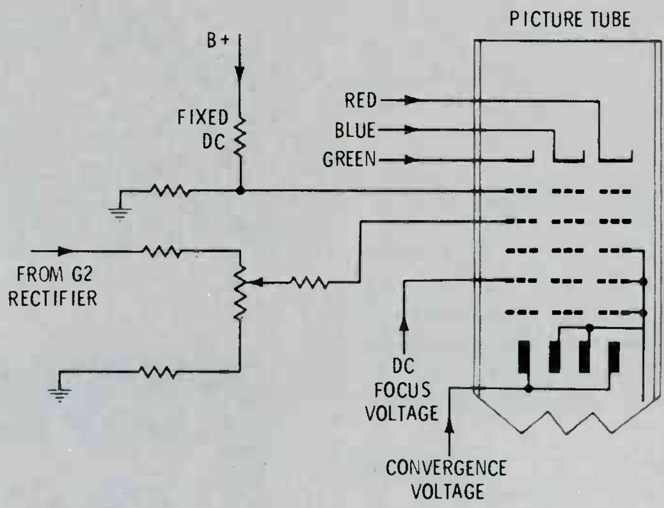

Figure 3 The Sony Trinitron has only one gun, one grid, and one screen (or G2), but there are three cathodes.

Picture Tube

continued from page 31

intermittent) in the primary winding of peaking coil L1 in Figure 1.

Notice that all of the DC voltage for the video plate comes through the coil, including the balancing DC voltage at the bottom of the drives. Therefore, **an open L1 reduces all three cathode voltages almost to zero.** At the same time the three grids might have between +120 to +170 volts. In other words, the picture-tube bias is *positive* by more than 100 volts! Of course, the guns draw a huge current for a split second before the overload kills the HV.

In intermittent cases, the HV leaves so rapidly that the screen gives absolutely no clue. Either the picture is there, or the raster is black; there is no sign of any blooming in between those two conditions.

Your best bet to find such an open coil winding is to check the DC voltages, starting with the picture-tube cathodes and working back to the resistors and the peaking coil. Ohmmeter tests are not very reliable when the open is intermittent.

Focus Voltage

Color picture tubes that require between 4 KV and 6 KV of focus voltage will not show a raster if the focus voltage is missing. In contrast, the low-voltage-focus tubes (requiring between zero to several hundred volts) show a bright raster and picture even with zero focus voltage (of course, the raster lines might be blurred). Check the schematic voltages to determine which type is used.

So, **add "missing focus voltage" to your list of things causing loss of raster.**

Incidentally, I have encountered several cases of out-of-focus pictures where all components of the focus system were normal. All of these circuits used a separate focus rectifier (either a tube or a diode). One case is vivid in my mind. I used a HV probe to monitor the focus voltage, and found the voltage to be **too high.** What's more, **adjustment of the focus transformer did not change the focus voltage at all.** After some time, I assumed the extra voltage was coming from inside the picture tube, probably from the mask or other internal parts that connect to the high voltage. This was proved by disconnecting the focus wire and finding the same voltage there. While the wire was not connected, I grounded it a couple of times until no spark could be seen. When the circuit was restored, the focus-transformer adjustment worked correctly, and good focus was obtained.

Apparently, the leakage voltage was higher than the voltage from the focus rectifier; therefore, the diode was reverse biased and could not conduct. That's why the focus transformer could not change the focus voltage.

Comments

Before we leave Figure 1, we need these facts:

- A malfunction that changes the DC voltage at the output of *one* of the -Y amplifiers, shifts the gray-scale B&W screen color. Such defects are more common than are bad parts in the drive-control circuitry. Therefore, a good tip for cases of wrong B&W raster color **is to check the components and voltages of the -Y amplifier stages.** In rare instances, an open or erratic CRT screen control can upset the balance of colors in the raster.
- Insufficient or excessive brightness can be caused either in the -Y amplifier stages (perhaps a blanker defect, or a supply voltage failure) or in the video-amplifier stages. The latter is more likely. Therefore, first **check the video stages and DC voltages for the cause of wrong brightness.**

Some exceptions have been given already, but these tips emphasize the most-likely causes of the problems.

Pre-CRT Matrixing

Many of the newer solid-state television receivers matrix the video and -Y chroma signals, and amplify them before the pure red, blue, and green signals reach the picture tube (usually to the three cathodes, as shown in Figure 2). Some models have an adjustable voltage fed to all three control grids in parallel; others apply a fixed voltage to all three.

All variations have video-drive controls and individual screen controls. The drive controls do two things. Lower resistance of a drive control applies increased video to the matrixing transistor. Also, most circuits feed the chroma -Y signals to the base of a power transistor, while the video is supplied to the emitter of the same transistor. So, decreasing the drive resistance reduces the emitter-to-ground voltage (which is an increase of forward bias). The increased bias lowers the collector voltage (connected to the corresponding CRT cathode), and increases the brightness of that one color. **Both the brightness and contrast are increased.**

In systems of this kind, **the drive controls are used for best tracking of highlights** (brightest parts of the picture), and **the screen controls** of the picture tube **are adjusted for best balance and tracking of the dark parts of the picture** (lowlights). Usually the screens are adjusted while the vertical sweep is eliminated. This represents gun currents that are much less than those giving near-black areas, and provides extreme accuracy and speed.

Comments

Most of the troubles previously discussed also apply to the pre-CRT matrixing circuits. However, the three paralleled grids stop any possibility of a single grid-voltage shift changing the raster color. Video defects are the most likely source of brightness problems.

Trinitron

Figure 3 shows the base wiring of Trinitron single-gun picture tubes. Although the theory, construction, and operation of these tubes are very different from the others, the CRT base wiring is similar. Of course, the single-gun type requires only one control-grid voltage, and one screen-grid voltage.

Therefore, both the control grid and the screen grid voltages can affect the brightness, but not the B&W screen color.

Case History #1

Two examples showing how circuit problems can be mistaken for a bad picture tube are presented next.

Symptoms

The picture on the TV that had an RCA CTC36M chassis was badly out of focus, and the colors were pale. "Bad picture tube" was the snap diagnosis. But I spoke too soon, for tube-tester checks showed the emissions of the guns to be acceptable.

During additional tests, I noticed that the high voltage and focus

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voltage became erratic at normal-to-high brightness, but were okay at low brightness. Also, each grid of the picture tube measured about 20 volts DC too high. The reduced CRT bias voltages allowed the guns to draw excessive current, and the high current was loading down the high voltage, causing poor focusing and a small amount of blooming.

Repairs

After I gave up the idea of a picture-tube defect, I located the cause of the problem within a reasonable time. **The blanker tube** (V19B in Figure 4) **was weak and gassy.**

Circuit operation

Many techs are mixed up about the operation of the blanker stage in the CTC36. One false belief is that the diode (X18 in Figure 4) passes the negative-going pulses from the plate of V15A to the picture-tube grid. That seems logical, since the tube is usually called a "horizontal-blanking" tube, and negative pulses to the grid of a picture tube *would* produce blanking. Unfortunately, it just isn't so. Of course, the sharing of a common cathode resistor (R159) with the chroma-bandpass amplifier tube *does* blank out the burst from the chroma signal. But no pulses reach the CRT grids.

Here's the correct operation:

- Resistor R186 tries to charge coupling capacitor C119 (and the grid of the picture tube) to the full +280 volts coming from the power supply;
- Opposing this climb to the supply voltage are the negative-going pulses from the plate of V15A. During the time of each pulse, the cathode of X18 becomes more negative than the anode. When that happens, the diode conducts, clamping the CRT grid voltage (and the charge in C119) to the instantaneous voltage at the tip of the pulse. Let's assume a 180-volt-peak pulse, which would set the tip at +100 volts. Therefore, the CRT-grid end of C119 would be charged to +100 volts;
- Between pulses, X18 opens, and the voltage through R186 adds to the charge in C119. (Without pulses, it would increase to supply voltage, +280 volts.) But, the time constant is long, and the charge increases only a volt or two before the next negative pulse arrives at X18, causing clamping again to the tip voltage;
- Therefore, the CRT grid voltage varies only a couple of volts.

Scope waveforms at the picture-tube grids show merely a few volts of ripple, produced by the short conduction times of the diodes. Perhaps it would help if you thought of X18 as a rectifier of the pulses, with C119 acting as the peak-reading capacitor. As you know, series rectifier circuits have a very low amplitude of ripple.

Using diode gating to reset each CRT grid voltage is necessary to prevent a shift of DC voltage because of the non-symmetrical signal waveforms there.

Comments

Failure of the bias diodes is common. But note this: **either an**

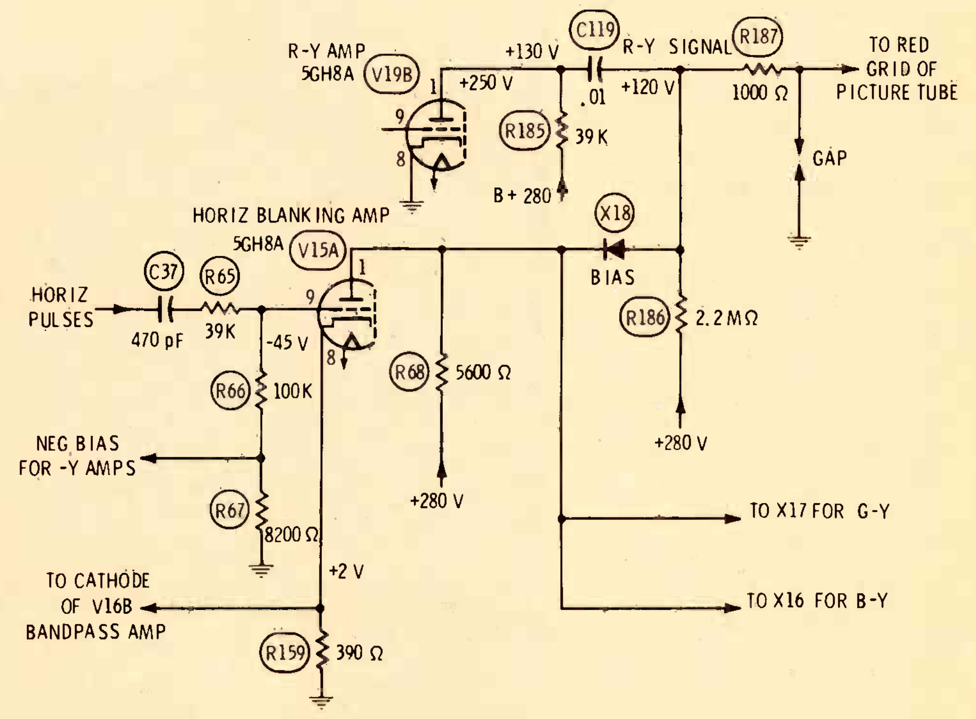


Figure 4 A malfunctioning horizontal-blanker stage in an RCA CTC36 gave symptoms of excessive brightness and poor focussing. Study the explanation for the pulses and the operation of X18, X17, and X16, as given in the text.

open diode or a leaky one drastically raises the DC voltage of the associated CRT grid. Therefore, the best test is to disconnect one end of any suspected diode and measure forward and reverse resistances by using an ohmmeter.

Case #2

No raster could be obtained on the Zenith that had a 16Z8C50 chassis, for the high voltage measured almost zero. However, the HV would return if the CRT socket was removed from the base, or if the HV lead was disconnected from the picture tube.

Another technician had diagnosed the problem as being caused by a bad picture tube. However, the HV returning when the base socket was removed pointed to wrong bias of the picture tube. Check all the DC voltages at the picture tube to verify such a suspicion.

In this case, none of the CRT cathodes had any appreciable DC voltage, but all of the grids were positive. This proved that the loss of HV was caused by positive grid bias of the CRT guns.

By a series of voltage and resistance measurements, I found **R76 was burned enough to reduce the resistance, and the 12HL7 tube had a plate-to-suppressor short** (see Figure 5). Replacement of the tube and resistor brought back the high voltage.

Comments

This case history underlines the importance of voltage measurements for proving whether a chassis defect or a bad picture tube is causing the trouble.

Also, many of the CRT base sockets now have several spark gaps internally, to prevent damage to the chassis solid-state components. These spark gaps can become leaky or shorted and simulate a bad picture tube or a defective circuit in the chassis. One quick test is to disconnect the chassis end of the socket metal ground strap, and measure the voltage between the strap and ground, with the receiver in operation. The voltage should be nearly zero. Any reading above zero is reason to suspect leakage of the spark gaps in the socket.

Suggestions

If the symptoms hint at a possible CRT problem, use a picture-tube tester to check the emission of all guns, and for possible shorts or leakage.

Emission tests should be made before the TV is operated, if possible. Weak guns sometimes drift to increased emission over a period of 15 to 30 minutes, and operation of the TV often obscures these varying emission conditions.

Another indirect test of picture tubes is to operate the TV chassis on a test-jig setup. If your test tube has good brightness and focus, and does not display the malfunction that was present with the chassis operating with its own tube, this is proof the old tube is bad.

Your DC voltmeter and scope (and particularly the DC meter) are the best test equipment to use when the symptoms point toward a wrong signal or DC voltage at the color picture tube.

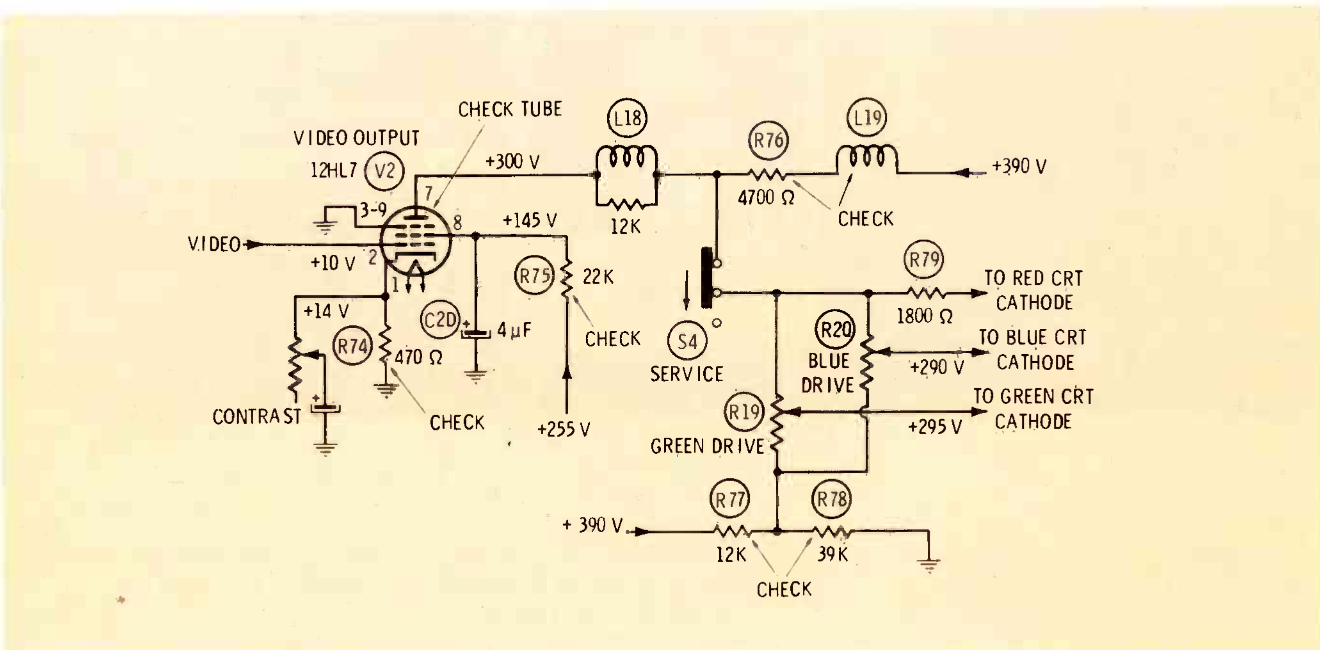
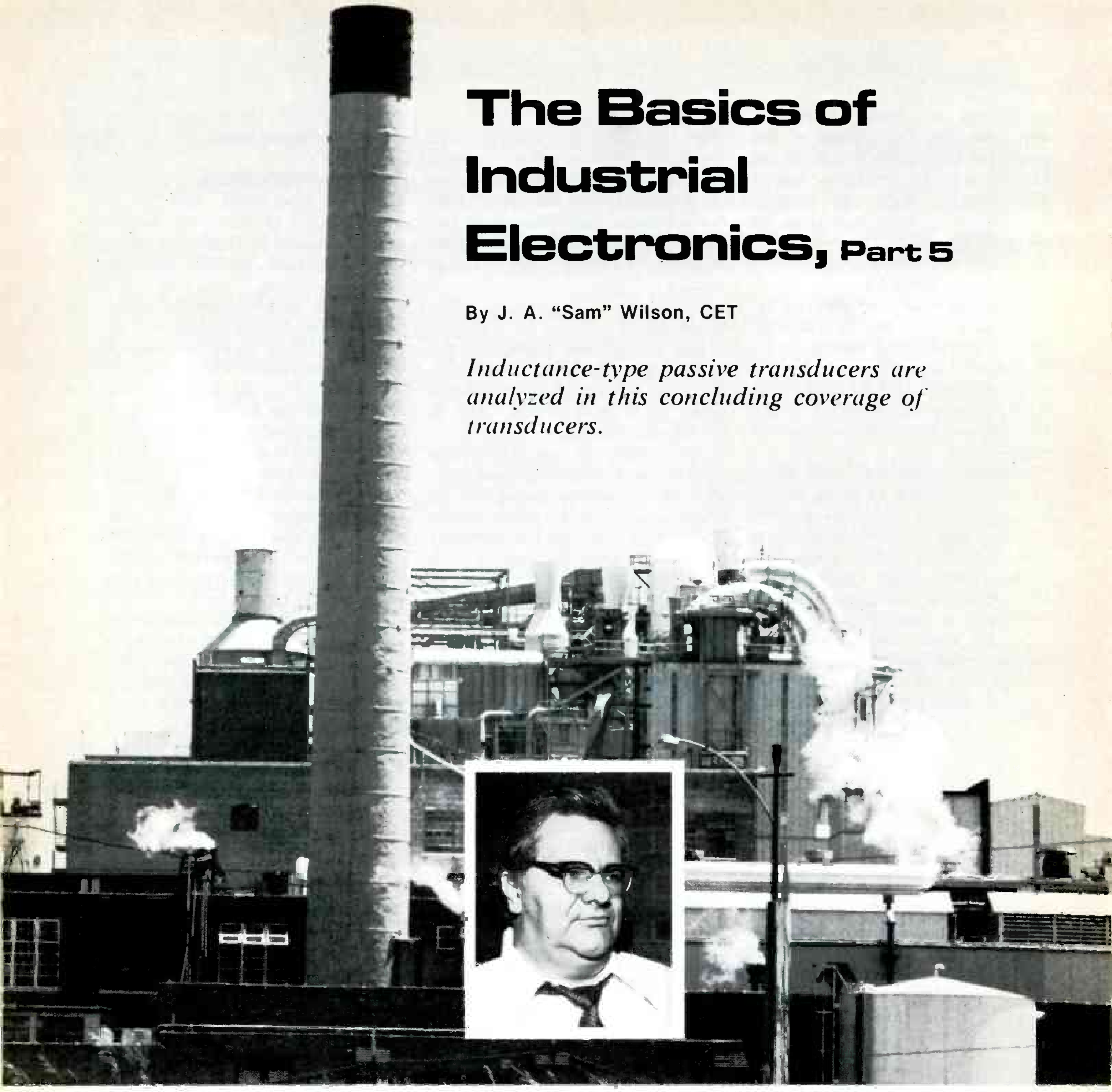


Figure 5 In a Zenith 16Z8C50, excessive gun currents had killed the high voltage. Use DC-voltage analysis to find similar problems.

The Basics of Industrial Electronics, Part 5

By J. A. "Sam" Wilson, CET

Inductance-type passive transducers are analyzed in this concluding coverage of transducers.



Resistive and capacitive types of transducers have been examined in preceding articles. In this part, the subject is transducers which change inductance according to the conditions being monitored.

Properties Of Inductance

Here are two definitions of inductance:

- Inductance of a coil causes it to oppose any change of current through it. It is the characteristic that forces an inductor to oppose or impede the flow of alternating current.
- Inductance of a coil enables it to store energy in the form of a magnetic field.

An inductor or coil operates by the magnetic field that surrounds the conductor of a current, so any change of field strength affects the operation of the inductor.

Inductive reactance

The opposition of a coil to the flow of alternating current is called **inductive reactance** (X_L), and it is expressed in ohms.

Mathematically, $X_L = 2$ pi FL. Therefore, the inductive reactance increases from an increase of frequency (F) and/or the increase of inductance (L).

With inductive transducers, the varying reactance of the inductor determines the amount of circuit current, according to the condition of the material being sensed. In other words, a change of the condition that's being monitored produces a corresponding change of the reactance, and it in turn modifies the amount of current in the control circuit.

Effect Of Cores

An iron core inserted into a coil (see Figure 1) produces an increase of inductance and inductive reactance. In practice, the core must be laminated or made of powdered iron to minimize the core losses at high frequencies, but this does not alter the basic principle. (In Figure 1, the term "soft iron" refers to iron that cannot permanently hold magnetism.)

Position indicator

One practical application of the core principle is shown in Figure 2. When the core is completely inside the coil, the inductance and reactance are maximum. Therefore, the current is low, and is not strong enough to energize the relay. The contact points are in the open position to illuminate the correct-position light.

When the material being monitored is too far to the left, the core is withdrawn from the coil, reducing the inductance and the reactance, which allows increased current. The stronger current energizes the relay, pulling down the contact and illuminating the wrong-position light.

Of course, the change of inductance and reactance is gradual, when the core is moved gradually, but the relay has a snap action so it either is on or off. For other applications, the gradual change of inductance can provide an analog-meter readout of the position or dimension of a work item.

Using a tuning wand

A copper core in a coil decreases the inductance, while a powdered-iron core increases the inductance. These two actions can be combined in a helpful tool for determining whether an inductance is too small or too large for the best operation of a circuit. The tool is a "tuning wand," illustrated in Figure 3A. As we go through the explanation, remember that the current through a series-tuned circuit is maximum at the resonant frequency.

In Figure 3B, the resonance of the tuned circuit is below the input frequency; therefore, the alternating current is not maximum, but has an intermediate value. When the copper end of a tuning wand is

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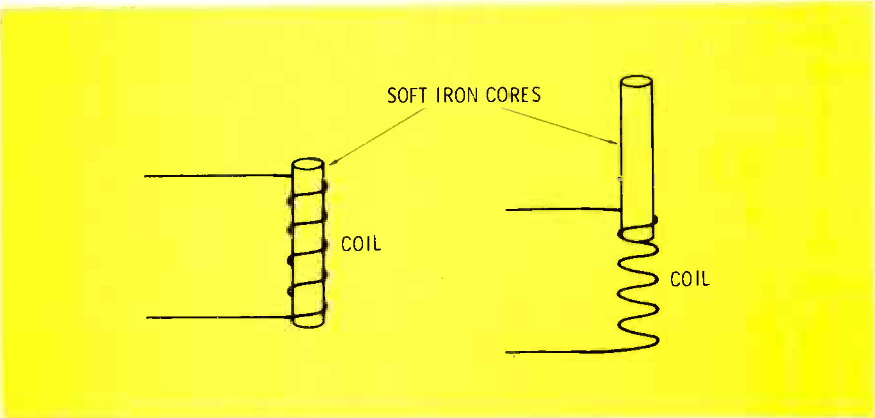


Figure 1 The inductance of a coil is increased by the addition of an iron core. For high-frequency operation, the core should be made of powdered-iron particles held in place by insulating material.

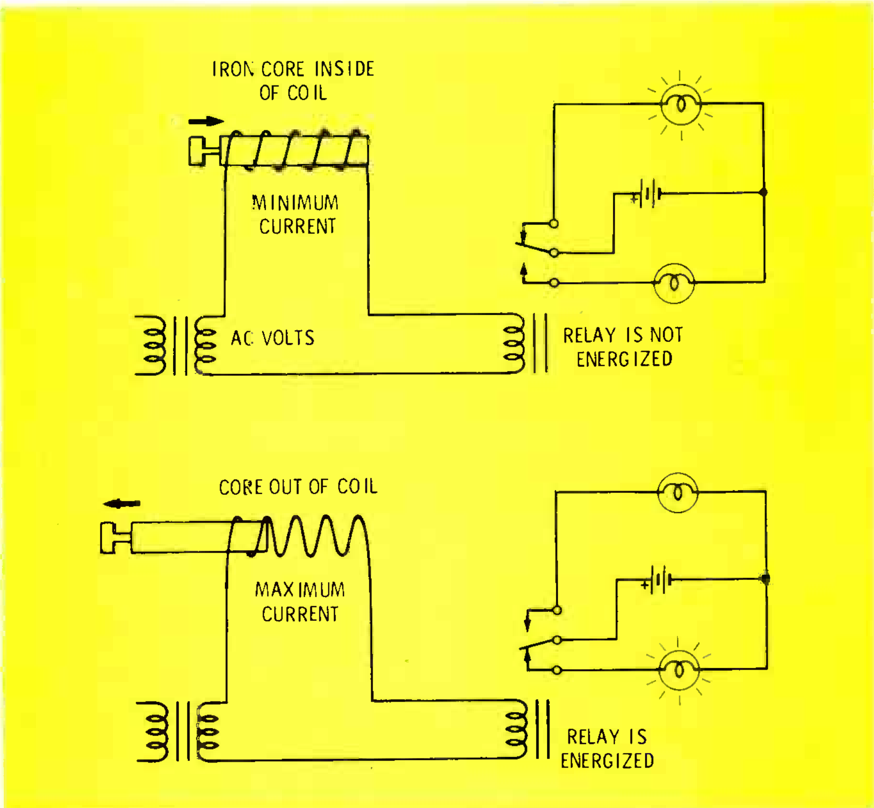
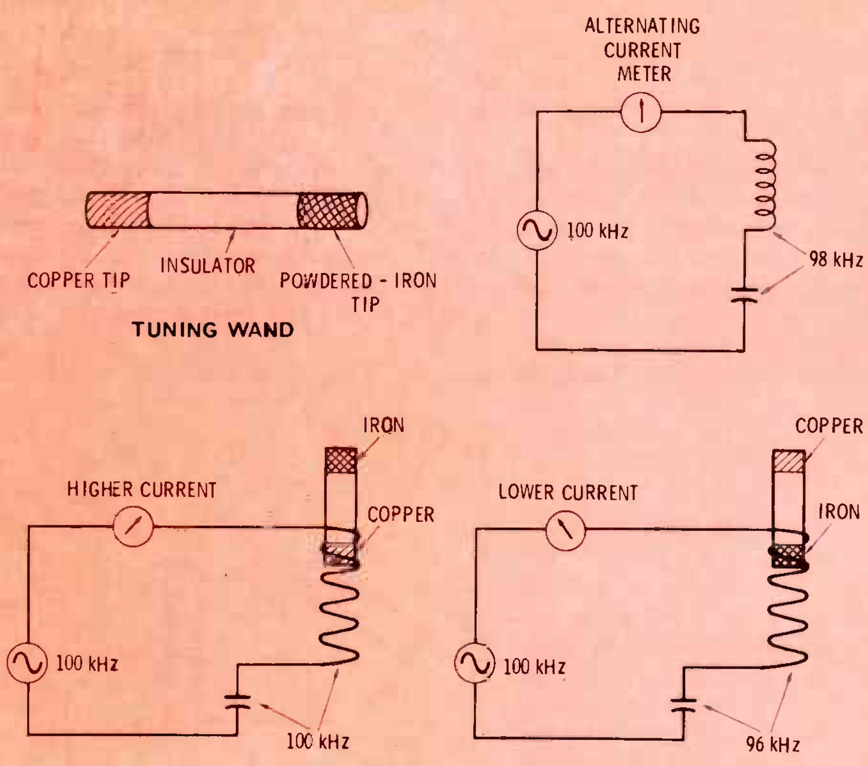


Figure 2 Position of an object can be sensed by connecting it to the core of a coil. (A) When the core is inside the coil, the coil inductance and inductive reactance are high, giving low current which does not trip the relay. (B) Withdrawing the core reduces the inductance, allowing increased current that trips the relay.

Figure 3 A "tuning wand" (A) has one tip of copper and one of iron. (B) Current is less than normal, because the LC circuit resonates below the input frequency. (C) Inserting the copper tip of the wand reduces the coil inductance, raising the resonant point to 100 KHz, and producing maximum current. (D) When the wand iron tip is inserted in the coil, the inductance is increased, lowering the resonant point to 96 KHz, which reduces the current below the original amount.



Industrial

continued from page 37

inserted into the coil (Figure 3C) the coil inductance is decreased, raising the resonant point to 100 kHz, and providing maximum current.

Inserting the powdered-iron tip of the wand into the coil (Figure 3D) increases the inductance and lowers the resonance to 96 kHz. This additional mistuning results in a small current.

With parallel-tuned circuits, the signal voltage is monitored as the two tips are inserted in turn. If both tips reduce the signal equally, the tuned circuit is adjusted to the correct frequency. If the copper tip increases the signal level, the frequency of the tuned circuit is too low. Conversely, a signal increase with the iron tip proves the frequency is too high. Of course, the amount of correction by the wand is limited, so no change probably indicates an error that's too large to be helped.

The Effects Of Turns

Additional turns of wire on a coil increase the inductance, In practical devices, it is difficult to vary the number of turns except by means of a shorting bar (Figure 4). Shorting across three turns of the coil is the same as removing three turns (except for a loading effect when the various turns have tight coupling: a lower load reduces the "Q").

Also, the dimensions and shape of the coil winding affects the inductance. All of the coils of Figure 5 have the same number of turns, but each has a different inductance. The coil of Figure 5A is used as a standard. When the diameter of the coil form is increased (Figure 5B), but the number of turns and the spacing remains the same, the inductance is increased.

But, if the diameter and number of turns are the same, a wider spacing of the turns on a longer coil form decreases the inductance.

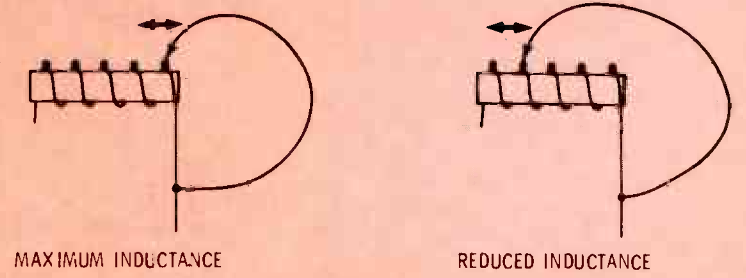


Figure 4 A shorting bar or shorting jumper gives the effect of removing turns from a coil, thus decreasing the inductance.

(Equations for inductance can be simplified by relating the inductance to the core area, rather than to the core diameter. Therefore, it is not necessary to specify the cross-sectional shape of the core.)

Magnetostriction Effect

Magnetostriction refers to the dimension change of magnetic material when it is affected by a magnetic field. The **Joule Effect** is the name given to the change in length of a magnetic material when the magnetic flux through it is varied. Also, there is a reverse effect (called the **Villari Effect**), where a change of dimension of a magnetized material in turn changes the amount of magnetization.

Magnetostriction transducer

Figure 6 shows one practical application of the magnetrostrictive effect: a transducer that converts an AC signal into high-energy, high-frequency sound waves. These supersonic sound waves clean dirty components that are immersed in a fluid. They literally shake the dirt loose and into suspension.

Other kinds of supersonic equipment are useful for testing and inspecting specific materials.

Variable-Reluctance Transducers

In diagrams, magnetic field strength usually is represented by flux lines. Stronger fields require more flux lines through a given cross-sectional area.

It is easier to establish flux lines in some materials—such as iron or steel—than it is in many other materials (such as air). **Reluctance** is the name given to the opposition that a material offers to the forming of flux lines.

The elements of magnetic circuits versus electric circuits sometimes are compared as shown in Table 1.

Incidentally, the term "electromotive force" would fit better in the table as a "cause." But the term no longer is in favor. In the new concept, a volt is a unit of **work**, and not a force. As used in science, work is equal to force multiplied by distance. A volt, then, is the amount of work done by

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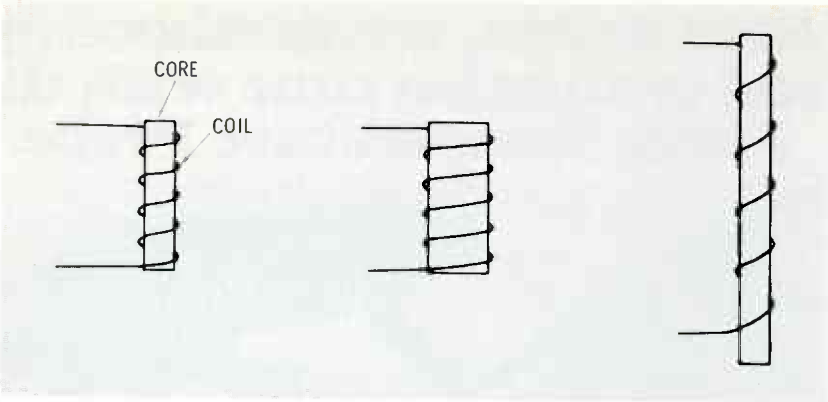


Figure 5 Changing the diameter of the coil winding and changing the spacing between the turns produces a different inductance of a coil.

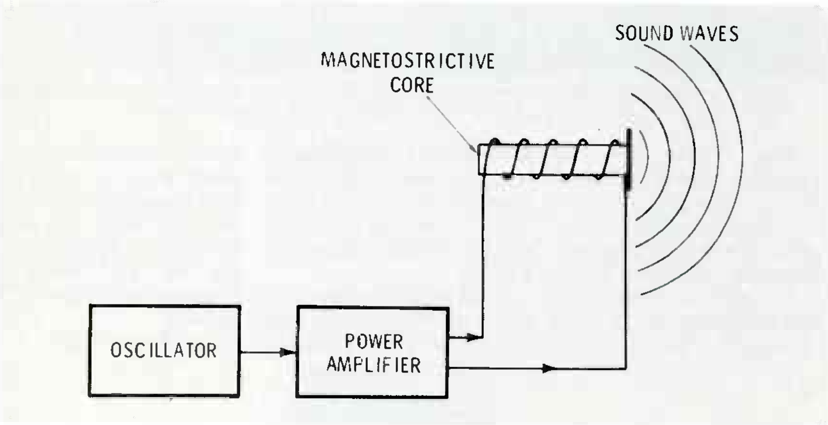


Figure 6 The magnetostrictive effect causes the length of a magnet to vary in step with the AC signal from an amplifier.

Industrial

continued from page 39

moving a unit charge around a defined circuit. Also, to be technically accurate, we must say that magnetomotive force is measured in units of work.

From Table 1, you can conclude correctly that varying the reluctance of a magnetic circuit also varies the flux.

Faraday's Law

Before studying variable-reluctance transducers, we should review the concept of Faraday's Law. It states that relative motion between a conductor and a magnetic field produces a voltage.

Transformers operate under this principle. Changes of primary current produce changes of flux around the secondary winding, which induces a voltage in the winding.

The variable-reluctance transducer of Figure 7 is designed to sense vibration. A DC current in one winding establishes a flux in the soft-iron circuit. When the

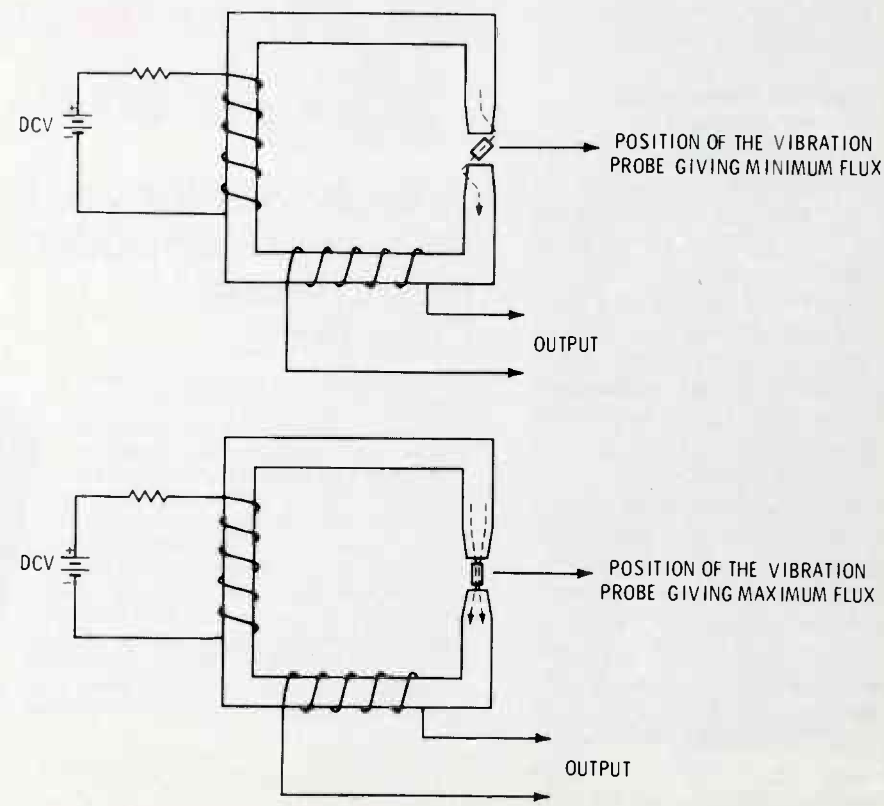


Figure 7 This variable-reluctance circuit senses vibration by the movement of a vane in the magnetic path. Position of the vane giving a large gap (A) allows only a small flux to travel around the core. When the vane bridges the gap (B), the flux is increased. Rapid movements of the probe and vane cause fast changes of reluctance and flux, producing an AC signal at the output winding.

sensor vane is at an angle to the gap (Figure 7A), the flux is at minimum because of the large air space.

Figure 7B shows the vane in line with the gap, allowing maximum flux through the low-resistance path across the small gap. Movements of the vane cause a varying flux, which produces an AC voltage at the output terminals.

Although this is an active transducer—because it emits an output voltage—it is presented because of the variable-reluctance operation.

Also, the principle, with minor modifications, applies to saturable reactors, which are passive components.

Magnetometer

Magnetic fields can be sensed by the magnetometer of Figure 8. Complex versions are used to measure the strengths of magnetic fields accurately.

Here's how it operates: When there is no external magnetic field, the core of the coil saturates equally on the positive peak and on the negative peak of the signal source. An external magnetic field adds to the coil flux during one half-cycle and subtracts from it on the following half-cycle, producing a change of waveform. Changes of waveform have been exaggerated to demonstrate the point.

Comments

When we elaborate about actual devices used in industrial sensors, one of the important types to be discussed will be the instruments that determine shaft rotation. For example, a magnet can be fastened on a rotating shaft. Each time it passes a coil of wire, a voltage pulse is produced. The repetition rate can be counted directly or it can be read-out on an analog meter. Another variation has the coil wound over a magnet, and the pulse from the coil occurs each time an iron or steel vane passes the coil.

TABLE 1 Comparison Of Electric And Magnetic Circuits

	Electric Circuit	Magnetic Circuit
Cause	voltage	magnetomotive force
Effect	current	flux
Opposition	resistance	reluctance

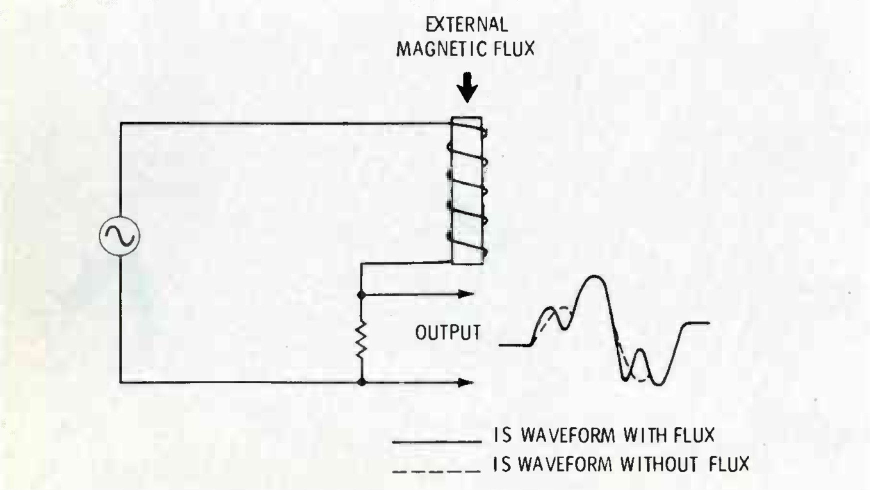
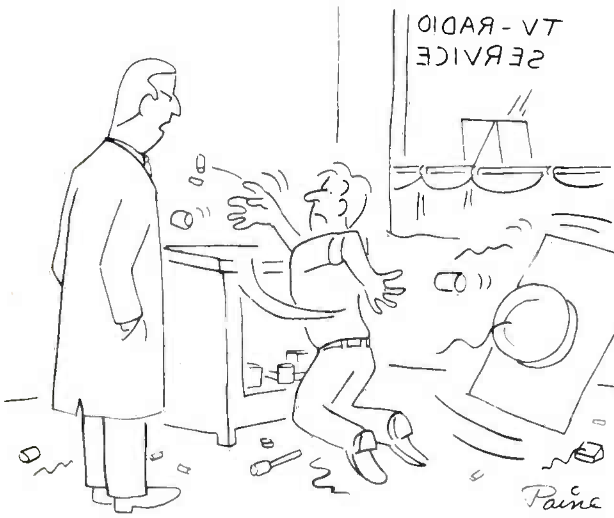


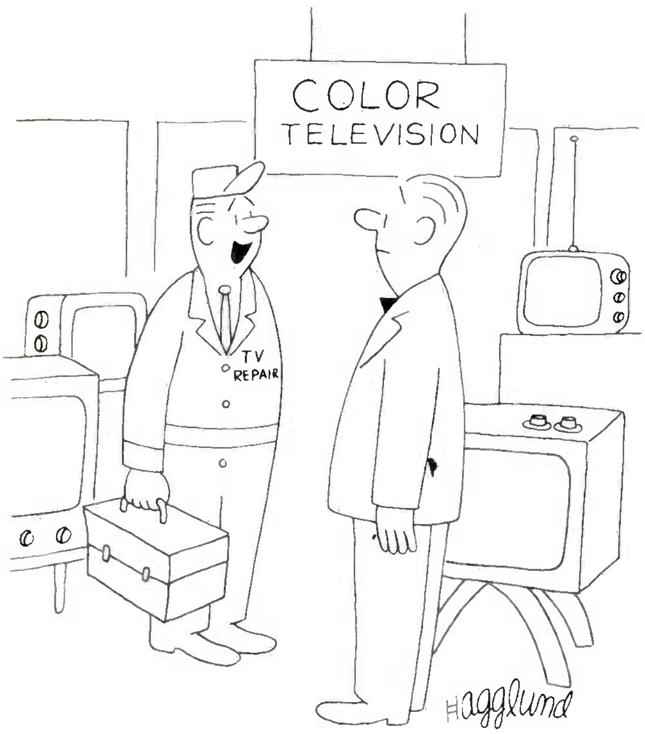
Figure 8 External magnetic fields can be detected by phase and linearity changes of the output signal. The external flux aids one peak of the input AC, but it subtracts from the opposite peak.

CARTOON CORNER



"I can't say that I approve of your troubleshooting methods, Cranby."

"Surely you can find a better way to build a one-second delay into the circuit than to use 186,000 miles of wire."



"I found their trouble. The entire family is color-blind."

"The hard part of this job is trying to keep up with all the advances in the field."

bookreview

Security Electronics

Author: John E. Cunningham
Publisher: Howard W. Sams & Co., Inc., 4300 W. 62nd Street, Indianapolis, Indiana 46268
Size: 192 pages
Price: $5.95 paperback

This second edition describes the operating principles of electronic security devices and systems, including the technical advances made since the first edition appeared in 1970. Chapters cover: a general description of electronic intrusion alarms; principles of various intrusion detection devices; object detectors; alarm and signalling devices; accessories common to all systems; practical installations; bugging and debugging; and speech-scrambling systems. Completely-new chapters cover: automobile protection; personnel-identification and statement-verification systems; and computers as integral parts of security systems. The text covers the subject in sufficient detail to enable the electronics man to apply his knowledge and experience to the security field.

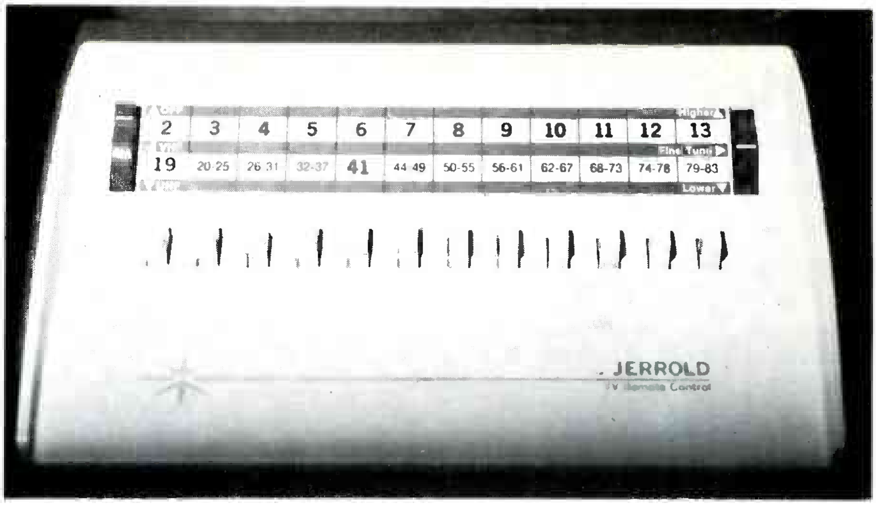
Electronic Meters: Techniques and Troubleshooting

Author: Miles Ritter-Sanders, Jr.
Publisher: Reston Publishing Company, Inc., Reston, Virginia 22090
Size: 299 pages
Price: $16.95 hardbound

Purpose of the troubleshooting guide is to bridge the gap between classroom instruction and field or shop hands-on training. The material is suitable for home study, or for junior-college and trade-school classes, and the author assumes that the reader has completed basic training in electronic theory. After a preliminary analysis of typical trouble symptoms, he gives examples of various troubleshooting techniques. The chapters progress from a brief overview of basic meter movements to color television analysis, with an additional chapter about troubleshooting scopes, CCTVs, and fuel-vapor detectors. Quantitative considerations are illustrated, and the use of mathematics has been minimized. This text is a practical guide for testing a variety of modern electronic equipment.

photofact™ bulletin

Figure 1. Twelve pushbuttons on the selector panel of the Jerrold TRC-82 TV remote control system can tune in a total of 24 TV channels, when used with the off-VHF-UHF lever switch (at the left). A variable fine-tuning control is provided for those sets that do not have AFT. The UHF channels must be adjusted at the time of installation; a simple process. Only DC-tuning and relay voltages go through the small-diameter 25' cable that connects the pushbutton and converter units.



Reports from the test lab

By Carl Babcoke, CET

Most of our test-lab reports discuss various items of test equipment. But, this report is about the model TRC-82 all-channel universal remote control system manufactured by Jerrold.

Most remote control systems are designed to be factory-installed in just a few models of each manufacturer's line of television receivers. Older versions were mechanical monsters, requiring several motors and relays, because the tuner and other controls were rotated by the remote mechanism. Modern remote controls have been improved greatly, and have few or no moving parts. However, even these only work with certain sets. One reason is that the tuning and control functions are accomplished by DC voltages from the remote circuits. Therefore, the remotes and TVs must be designed to work together as complementary units.

Only one brand of remote can be operated with any make or model of color or B&W TV: the Jerrold model TRC-82. Of course, there are a few limitations (such as no control over sound, color, or tint), but the advantages outweigh them.

The Jerrold Remote Control

Model TRC-82 (Figure 1) is the second generation of Jerrold universal remote control units. The first was model TRC-12, which tuned the 12 VHF channels only, and had 75-ohm input and output impedances. (This model was described starting on page 25 of the January, 1975 issue of **Electronic Servicing.**)

Although the remote control is a converter unit, it operates as an external voltage-tuned varactor tuner, which in effect replaces the original TV tuner. However, the TV tuner is NOT removed or modified. Instead, it is adjusted permanently to channel 3 or channel 4 (Jerrold offers a choice, depending on the channel that is not used in your area), and it becomes the equivalent of the second mixer-oscillator of a double-conversion superheterodyne circuit.

Pushbuttons provide faster and easier station selection, and the button stays down to indicate the channel that's in use. Together, the converter principle plus the pushbuttons give convenience and good performance for remote-control operation with any television receiver.

Other features

Two separate units make up the Jerrold remote-control system. The one with the pushbuttons (Figure 1)

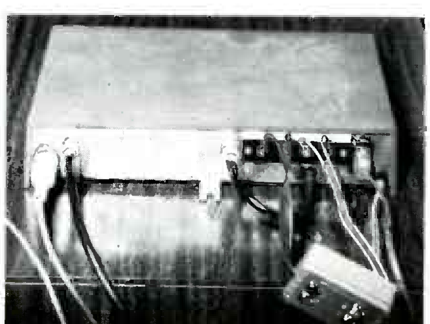


Figure 2. The converter unit usually is placed near the TV receiver. For example, on top of the cabinet, on the floor behind the TV, or fastened to the back of the TV. Power for the TV comes through the converter, and separate VHF and UHF 300-ohm inputs are provided, in addition to provision for 75 ohms.

has at the left edge of the panel a combination power on and VHF/UHF selector switch. A relay in the other unit does the actual power switching, so the TV power switch must be left on at all times.

A pointer on the lever knob shows whether VHF or UHF channels will be received. The buttons do double duty. For example, when the lever knob is down in the UHF position, the same button that selects channel 5 on VHF will tune in the assigned UHF station.

All VHF channels have been pretuned at the factory, and none in the sample needed a touchup. (Inside the unit are 24 pots for tuning in the 24 possible channels. Any or all can be adjusted, if desired.) Although the buttons are marked for several UHF channels, each should be adjusted for just one active channel. For my tests, the 14-19 button was set for an educational station on channel 19, and the 38-43 button was adjusted for channel 41. A sheet of UHF channel numbers is supplied for installation on the buttons.

At the right edge is a variable fine-tuning knob and control. A white line on the knob shows the nominal position. After the permanent antenna and remote wiring has been installed, you might want to touch up the pots so each channel will be correctly tuned when the white mark of the fine-tuning knob is in line with the arrow. Of course, TV-receiver AFT makes such accuracy unnecessary. If the receiver has AFT, but the users accidentally turn the fine-tuning knob out of the AFT hold-in range too often, you can tape the knob.

The converter-and-power unit (Figure 2) connects to the push-button box by a single small 25-foot cable. No signal voltages, AC voltages, or high DC voltages go through the cable. This new version has a plug and socket on the panel of the converter unit, and extender cables are available.

At the extreme right are the converter power cable, and an AC socket for the TV power cable. The remote power must be on at all times, and the drain is 10 watts.

Output of the converter to the TV is from an "F" coax socket near the left edge. If the TV tuner can accommodate a 75-ohm connector, the coax can be plugged in directly. Otherwise, a 75/300-ohm matching transformer must be added at the end of the coax cable, for attachment to the receiver 300-ohm-antenna terminals.

A choice of converter input impedances is provided. The "F" connector near the center should be used when a 75-ohm coax cable brings in the input signals. For 300-ohm operation, separate VHF and UHF 300-ohm inputs are furnished (in the picture, an external frequency splitter divides the VHF and UHF frequencies to the proper terminals). Then, the stub of coax that protrudes out of the panel is connected to the input "F" connector.

Comments

In the ES laboratory, we don't have the specialized equipment necessary to check all of the technical specifications of items such as this remote control. Therefore, the sample unit was installed in a home, operated in typical fashion for several weeks, and the performance and convenience results noted.

The in-home-use tests were done by a family whose color receiver did not have a UHF tuner. No problems were encountered, and the reports were favorable.

In fact, the quality of the color picture was improved by the remote control. Jerrold data indicates a gain of between 4 dB and 11 dB for the entire converter unit, and the extra signal strength can be beneficial to the older receivers.

Only a slight frequency drift was noted on channel 41, and none on VHF. This represents excellent performance.

The "testers" of the Jerrold remote-control system liked the convenience of operation, and appreciated the UHF reception (Figure 3). In fact, although they now have a modern solid-state TV which has both AFT and UHF, they would like to have the remote again. □

Figure 3. Mrs. J. H. Babcoke (my mother) is shown selecting a TV station, with the Jerrold model TRC-82 remote control.

Solution to

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9 Align	27 Mylar
10 Normal	28 Reinartz
11 Link	29 Zero
12 Knob	30 Ohmmeter
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15 Rheostat	33 Cable
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17 Ream	35 Tool
18 Mounting	

Start with 108 points and deduct 3 points for any part you may not have answered correctly.

66 or less. Ugh.
69-78 Better.
81-93 Good.
96-105 Very good.
108 PERFECT! You can't do better than that!

test equipment report

Digital Multimeter

A 3½-digit portable digital multimeter has been announced by **B&K-Precision.** The new model 2800 DMM is a full-feature instrument providing a wide range of voltage, current, and resistance measurements.

The 2800 has 22 ranges that measure as high as 1000 volts (AC of DC), or up to 40,000 VDC with optional PR-28 probe. Resolution is 1 millivolt, 1 microampere, or 0.1 ohm. Typical DC accuracy is 1%, and the imput impedance is 10 megohm. All ranges are protected against overloads.

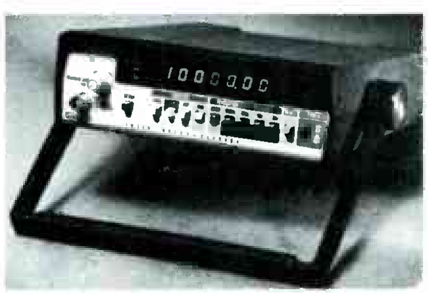
The 2800 also features autozeroing and 100% overrange reading on all ranges. Overrange reading capability allows the user to read to 1999 on a scale normally limited to a maximum reading of 1000, thus reducing frequent range changes.

The new DMM comes complete with test leads, detailed operating manual, and spare fuse. A full range of optional accessories also are available. Suggested retail price is $99.95.

For More Details Circle (30) on Reply Card

Multicounters

John Fluke Company has added two new models to its counter line: the 1910A and 1911A Automatic-Counters.



The 1910A provides a frequency range of 5 Hz to 124 MHz, while the 1911A offers 5 Hz to 250 MHz. Both counters have period, period average, and totalize capability as well as frequency measurement. A trigger-level control and attenuator provide the signal conditioning needed to make accurate measurements in the presence of noise. In addition, the 1911A offers a 50-ohm input impedance from 50 MHz to 250 MHz to allow proper matching for 50-ohm RF applications. The 1910A and 1911A feature 15-mV sensitivity across the major portion of the input range. Both units use a 7-digit LED display with overflow capability and full units annunciation.

For More Details Circle (31) on Reply Card

Triggered Oscilloscope

VIZ has introduced a high-caliber triggered scope for industrial, educational, research and laboratory applications, as well as for general-purpose service testing.

WO-527A features a special TV line-selector, which permits line-by-line display of video frames. This is an aid in broadcast-transmission monitoring, CATV testing, and servicing television, video-games, and videotape-recording.

The 5-inch scope has a vertical-amplifier frequency response to 15 MHz; the bandwidth of the horizontal amplifier is from DC to 1 MHz. A trigger-level adjustment system uses LEDs to indicate trigger polarity.

For More Details Circle (32) on Reply Card

Directional Wattmeter

Model 4431 from **Bird Electronic** is a "Thruline" RF directional wattmeter for measuring forward and reflected CW power. It also can supply an adjustable RF sample signal for scope, spectrum analyzer, or frequency counter. This sample signal is adjustable between 15 dB and 70 dB below the main signal.

Power can be measured from 100 milliwatts to 5000 watts between 2 MHz and 30 MHz, or up to 1000 watts between 30 MHz and 1000 MHz, with an accuracy of ±5%.

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antenna systems report

Mobile TV Antenna

RCA's new Mini-State TV antenna system can operate from either a 12-volt DC battery or 120-volt AC house current. The model was designed to provide sharp TV signals for recreational vehicles, vans, and boats.

Other models of the antenna system operate from house current only.

The unidirectional antenna of the Mini-State system can be rotated by a hand-held remote control unit. The UHF-VHF antenna rotates inside a weather-protected polyethelene radome, which also houses a solid-state amplifier, interference filter, and a motor-driven rotator.

The 5MS550 comes with a 30-foot coaxial cable with attached connectors combined with three-wire rotator cable; DC power cord, UHF-VHF antenna matching transformer; a stainless-steel bracket and hardware for outdoor mast mounting; tripod-type legs for indoor use; and an instruction manual. Optional retail price is $99.95.

For More Details Circle (34) on Reply Card

CB Base-station Antennas

The "Wavemaster" series, six compact ground-plane base-station antennas from **Winegard**, are engineered for 40-channel operation.

These antennas come in four basic parts, and can be assembled without tools. The units feature twist-lock sockets which hold the radiator and radial elements in place. Gain of the models ranges from 3.5 dB to 5.0 dB.

There are three aluminum models: GA-445, GA-845, and GA-885. The stainless-steel models are: BF-440, BF-840, and BF-880.

For More Details Circle (35) on Reply Card

TVI Filter

Communications Power now has a television interference filter for CB radios that absorbs harmonic emissions rather than reflecting them where they might cause other interference problems.

The FL-1 filter is said to attenuate all harmonics of 27-MHz carriers by 90 dB, or more, and dissipate up to 10 watts while passing a power of up to 650 watts.

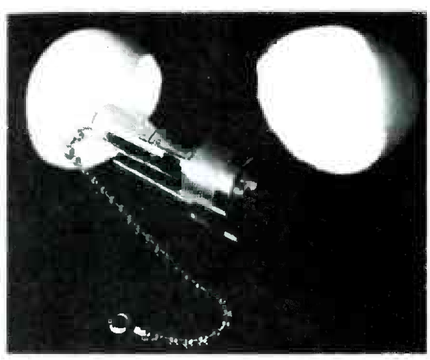
In addition, the TVI filter also serves as an antenna-transceiver matchbox. Input and output tuning controls in the FL-1 filter will match a 3:1 antenna SWR down to 1:1 at 50 ohms. Insertion loss is reduced to only 0.3 dB.

For More Details Circle (36) on Reply Card

Resistor-terminated Plug

A type-N resistor-terminated plug, model 4240, has been developed by **ITT Pomona Electronics.**

The unit, designed for terminating coaxial lines, is available in resistances of 50, 75, 93, 100, and 600 ohms.



It has a 1% 1-watt, deposited-carbon resistor, Teflon insulation, non-tarnish finish, and a gold-plated male contact. The VSWR is 1.15 maximum from DC to 100 MHz.

For More Details Circle (37) on Reply Card

CB Antenna

Wawasee Electronics' "Black Cat" factory-tuned antenna (model JB 100) has a top-loaded coil wound on a fiberglass core, and is covered with a black dielectric sheath to reduce precipitation static.

Model JB 100 is 4-feet long, constructed of resilient fiberglass. Its 3/8 by 24 ferrule is chrome-plated brass.

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MICHAEL D. KREITER
Publisher

Digital CB Transceiver

A digital-logic 40-channel SSB/AM CB transceiver now is available from **Communications Power**.

The CP-400 includes a high-power JFET mixer that minimizes overloading and intermodulation problems; a built-in logarithmic speech compressor for the power microphone; and an eight-pole crystal filter that provides adjacent channel rejection of -80 dB for both SSB and AM.

For More Details Circle (39) on Reply Card

Electronic Tools

A new "troubleshooters" tool kit for field engineers and electronic technicians is available from **Jensen Tools and Alloys**.

The kit (JTK-81) contains more than 25 tools, including pliers, cutters, screwdrivers, nutdrivers, wire strippers, hex and spline keys, soldering equipment, and hammer. The tools come in a multi-pocketed 12"x21" vinyl-covered roll pouch. A Triplett 310 VOM meter is offered as an optional accessory.

The kit without meter is priced at $75. With meter, the price is $127. Quantity prices are lower.

For More Details Circle (40) on Reply Card

TV Theft Alarm

The H1 **TV** Theft Alarm from **Mountain West** is designed for motels, hotels, hospitals, colleges and other owners of many TV sets that are vulnerable to theft. Home owners who need protection can use the same model.

The alarm is installed inside the TV cabinet. When the set is both unplugged and moved, a penetrating wail audible up to a quarter mile is set off; only an electronic key will shut it off. All solid-state alarm uses AA rechargeable NiCad batteries and a trickle charger.

For More Details Circle (41) on Reply Card

Soldering Gun

The new ISO-TIP Cordless Soldering Gun by **Wahl Clipper** provides a soldering "uni-tool" with the power to solder everything from #12 electrical connections to micro circuitry.

The gun contains a built-in refillable .062 solder spool and self-feeding mechanism that operates when the trigger is completely depressed. Solder feeds through a tube at the tip, for one-hand soldering. (A standard model soldering gun is available without the automatic feed.)

A plug-in battery charger comes as standard equipment, and it will fully recharge the nickel-cadmium batteries overnight. The tip comes up to full soldering heat within 5 to 10 seconds, and performance is said to equal a conventional soldering iron. A "lock-off" switch prevents accidental heating of the tip while the iron is in storage or during transportation.

For More Details Circle (42) on Reply Card

Midget Driver Sets

Xcelite's line of midget screwdriver and nutdriver sets and combinations come in eight assortments, each with a stand-up plastic case for bench or tool kit.

The series covers slotted, Phillips, Allen, Scrulox, hex screws, and hex nuts. Metrics are available for nutdrivers and hex socket screws.

Each set includes the "piggyback" torque-amplifier handle, which slips over the handle of the 3½-inch color-coded midget tools.

For More Details Circle (43) on Reply Card

Compact Electric Drill

Wahl Clipper has introduced a 5-inch electric drill that accommodates drills and burrs with a shank size up to .123 (1/8"). The ISO-TIP Electronic Technician Drill is designed for solder removal; lead hole cleaning; and a variety of other jobs.

The drill's compact size allows use in confined areas and within cabinetry. High impact plastic housing makes it lightweight and an extra-long 10-ft. cord provides a wide working radius. On/off switch provides both "intermittent-on" and "locked-on" positions.

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