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FOR MEN WITH IDEAS IN ELECTRONICS

SPECIAL ISSUE – COLOR TV 1973

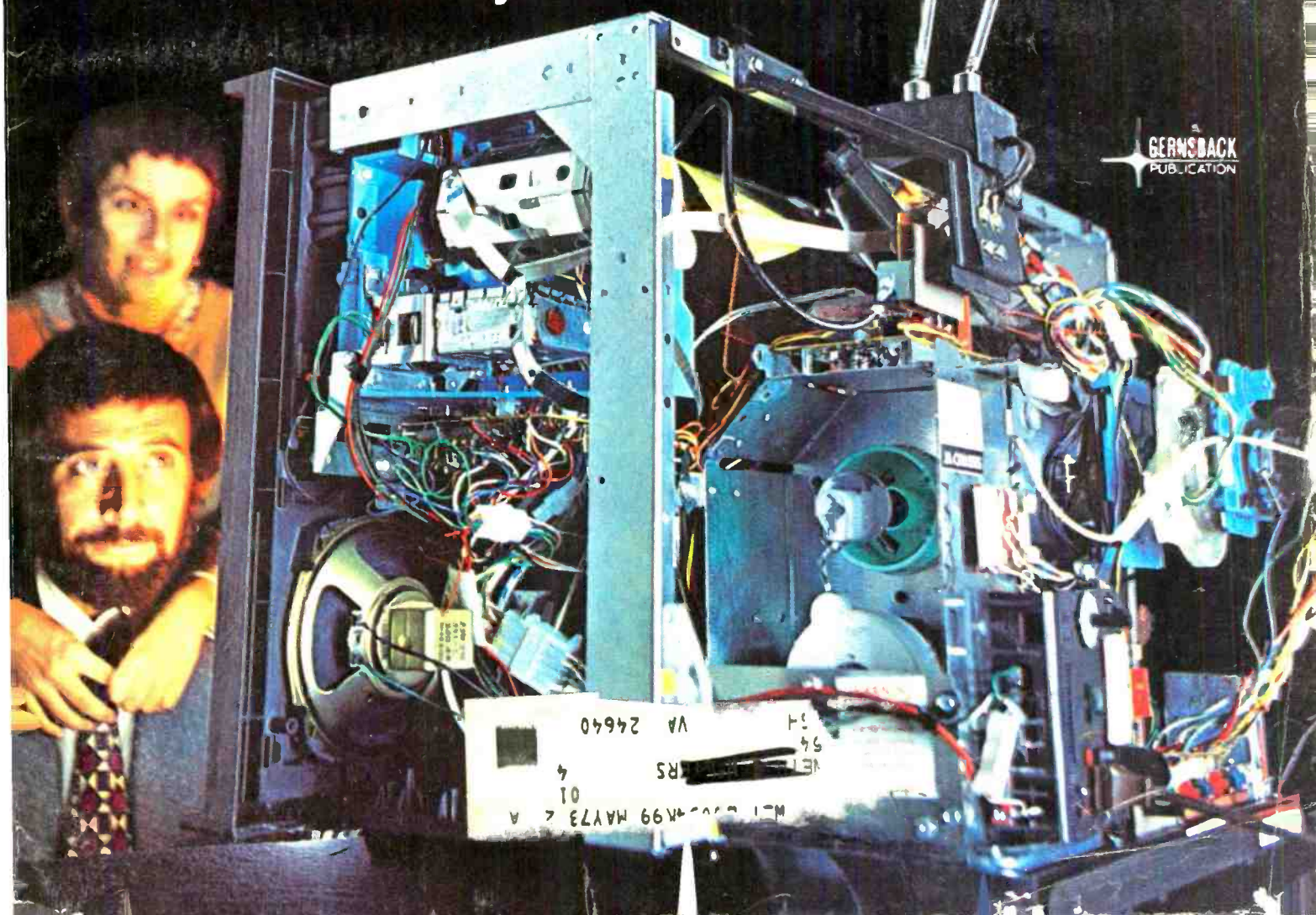
COLOR TV TEST JIGS
Leave The Pix Tube Behind

AUTOMATIC COLOR CONTROLS
See How They Work

ADD-ON DIGITAL READOUT
Tells Receiver Frequency

NEW TV CIRCUITS FOR '73
Make Color Pictures Great

COLOR TV-TOMORROW
Birds-Eye-View Of The Future



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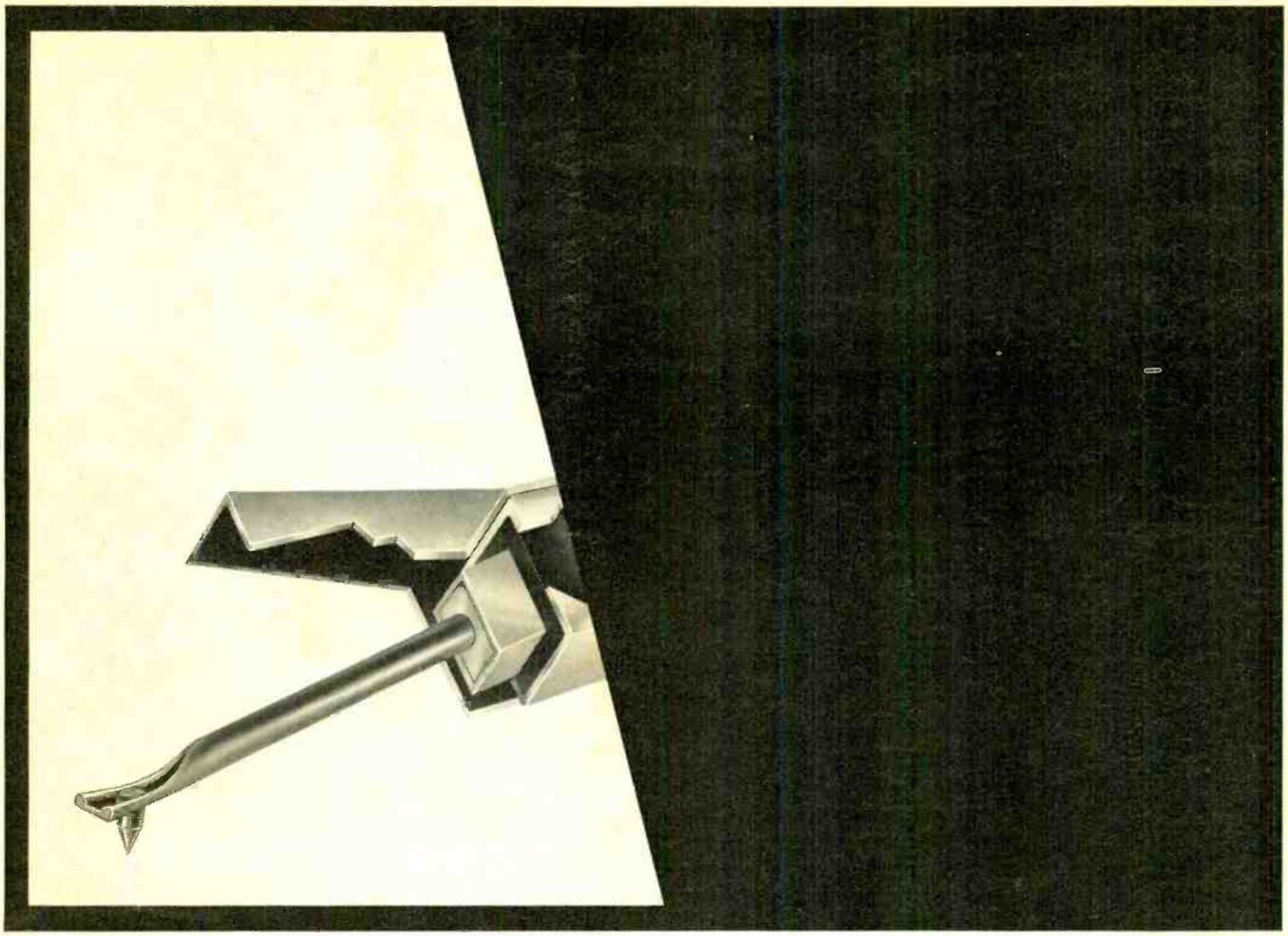
Circle 1 on reader service card



Straight talk about a stylus

Listen carefully and you can still hear some audiophiles refer to the record stylus as . . . "the needle." Although we are not about to quibble over semantics, we would like to go on record, so to speak, as observing that the stylus of today bears no more resemblance to a needle than it does to a ten-penny nail. In fact, it is probably the most skillfully assembled, critically important component in any high fidelity system. It must maintain flawless contact with the undulating walls of the record groove — at the whisper-weight tracking forces required to preserve the fidelity of your records through repeated playings. We put everything we know into our Shure Stereo Dynetic Stylus Assemblies — and we tell all about it in an informative booklet. *"Visit To The Small World Of A Stylus."* For your copy, write:

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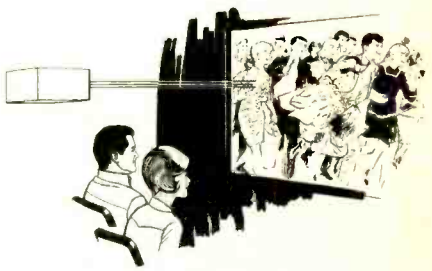
Radio-Electronics

FOR MEN WITH IDEAS IN ELECTRONICS

January 1973

ON THE COVER

HERE'S A TECHNICIAN'S-EYE-VIEW of the modern color TV receiver. The particular set shown in a G-E JA chassis table model. We feel that this photo symbolizes color TV 1973 to our readers and so we have presented it in this fashion. Obviously, we do not think anyone really sits and watches their color set with the back off.



TV IN THE YEARS TO COME is an ever intriguing subject. Take the laser projection system illustrated here. For more details on what the future might be expected to hold

.....**see page 33**

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editorial

serviceability—something for everyone

I had the honor recently of being asked to serve on a National Electronics Association (NEA) serviceability panel. I had heard about serviceability before. General Electric has used it in their color TV advertising and at various Association meetings, groups of technicians would get together to discuss serviceability problems. But this was my first experience on an actual panel.

The panel consists of a group of certified electronic technicians (CET's) who sit down with the set to be rated. There is a complete checklist that is used by the panel members and every aspect of the set that pertains to rapid, accurate service is spelled out and checked. For example, "Is more than one tool required to remove the back of the set?" "Are all service controls accessible through and identified through the back of the set and identified on the chassis? Do non-module transistors plug in? Does shielding interfere with service procedures?"

Each question has a point rating and for the set we checked—a Panasonic CT-70—a maximum total of 805 points was possible. The set received 723 for a serviceability rating of 89.8%.

But the important thing is not the rating that a particular set earns. It is the effects of the rating system that is really meaningful.

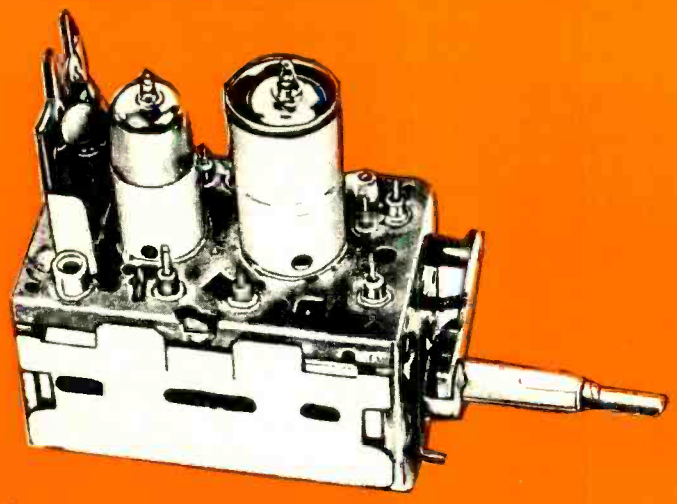
1. **The technician benefits**—every technician—the reason is simple. The manufacturer wants his his newest set to get as good a rating as possible so the technician will tell his customers how good that brand of set is. To help their ratings, some manufacturers are already making improvements and additions to chassis to enable them to earn higher ratings.
2. **The set owner benefits.** He gets a set that is easier to repair and therefore less expensive to maintain. With the current ever-increasing cost of a service call mandated by the ever-increasing expenses of operating a business and keeping proficient, trained people available; the faster the technician can do the job, the less it will cost. Cut 30 minutes off a repair job and a customer can benefit rather substantially.
3. **The set maker benefits.** He gets word-of-mouth advertising or can use the serviceability rating in his own advertising.

The end result is wider acceptance and cooperation with the serviceability program. At the October meeting of NEA's Board of Directors, ISCET, the International Society of Certified Electronic Technicians, was assigned to administer the serviceability project. ISCET will appoint a new national committee made up of 20 technicians who will perform all official in-plant inspections of TV receivers, stereo phonos, radios and other electronic products ordinarily serviced by independent service technicians.

The beneficiaries will be the consumer who gets his set back from the repair shop sooner; the manufacturer whose product is more easily repaired; and the service technician who can be more efficient and who can charge a legitimate price for the repair rather than having to charge for a lot of wasted time due to poor thought given to "how can this be repaired should it need it?" before the product was built.

Serviceability is indeed something for everyone.

—**Larry Steckler,** Editor



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WATCH US GROW

Circle 3 on reader service card

looking ahead

Report from Tokyo

A recent trip to Japan has served to reaffirm our earlier impression that that country has a very long technological lead over the United States in consumer electronic products, particularly television. Quite possibly the reason is that consumer products are the lifeblood of the Japanese electronics industry, whereas in this country products for the home are secondary to industrial and government electronics.

Whatever the reason, the mere act of watching color television in a Japanese home or hotel can be a real bringdown for an American chauvinist. Color consistency is uniformly excellent from channel to channel—and there are plenty of channels—with hardly any need to make adjustments when changing stations, and never when programs change on a single channel. The main reason for this appears to be the general high quality of transmission standards, paced by the engineering-minded tax-supported NHK network, with ultra-modern computerized equipment and a large and dedicated engineering staff. NHK paces the rival commercial networks and stations, and the competition has produced healthy results.

It's fashionable to make odious comparisons between the American 525-line NTSC color system and the 625-line PAL system used in most European countries. But the color pictures from the 525-line NTSC standards in Japan hold their own against any European pictures, including the excellent ones produced in the United Kingdom and the Netherlands.

Developments in color receivers come rapidly in Japan, and often are put into production while American manufacturers are debating the financial wisdom of adding similar innovations. For example, in 1972, almost all color sets sold in Japan's domestic market were all-solid-state, while the percentage sold by American manufacturers was just above 20%. The Japanese are now taking another step forward, to color sets coming close to 100% IC. One color set uses 17 ICs; another has 90% of its circuitry on 10 ICs.

The use of wide-angle short color tubes is spreading rapidly in Japan. Virtually every manufacturer is offering sets with 110-degree (or 114-degree, in the case of Sony) deflection, with extremely shallow space-saving cabinets. So far, in the U.S., only one manufacturer is offering one model with 110-degree deflection. The shallow set, obviously, has more sales value in Japan, where livingrooms are small.

The Japanese public is responding to quality color and innovative design. It's estimated that close to 80% of Japan's TV-equipped homes now have color sets, as opposed to a little over 60% in the United States. In 1972, the Japanese public bought about 6 million color sets and fewer than 3 million black-and-white (in the U.S., color and monochrome sales were about evenly divided). The manufacture of black-and-white sets in Japan, in fact, is rapidly disappearing. Increasingly, Japanese TV manufacturers are making or buying their monochrome sets in such lower-wage countries as South Korea and Taiwan.

As labor costs rise, production of television in Japan is becoming increasingly automated. One new Sony Trinitron TV factory we inspected near Nagoya, along with its companion picture-tube plant five miles away, is completely computer-controlled, and virtually all manufacturing processes from the unloading of components through life-testing of completed sets to loading the sets on trucks are automatic.

In 1970 and 1971, Japan was the world's leading producer of television receivers (1972 results aren't in yet). Japanese exports of sets to the United States declined sharply in 1972, because of rising costs and the revaluation of the yen, but a healthy domestic market and an increase in exports to Europe are now taking up most, if not all, of the slack.

The Japanese may have the edge in TV repair service, too. Most people work six days a week and, with the labor shortage in Japan, wives increasingly are working. In most cases, manufacturers operate their own captive service organizations. Many promise same-day TV service—and they're open 365 days a year.

Another flat picture

Zenith has demonstrated what it calls "the first matrix device to produce a TV picture of sufficient quality to warrant comparison with a cathode-ray tube." The device shown was a thin-panel gas-discharge display only 0.63 inches thick, which provides horizontal resolution of 260 lines, vertical resolution of 350 lines. It actually showed only part of a television picture, 2.4 inches wide by 6.3 inches high. The panel has 80 columns and 212 rows of gas cells which glowed in various intensities of red when excited by varying voltages.

The contrast ratio is an acceptable 40 to 1, while brightness is eight foot-lamberts, considerably below that of existing TV sets but bright enough for viewing in a normally lit room. A full line of cells is addressed at the same time, in contrast to the spot principle of cathode ray tubes. The incoming video signal is stored in 80 individual capacitors which control current sources for each column.

Is this the flat TV display of the future? Zenith's research vice president, Dr. Robert Adler, was noncommittal: "What we have learned is encouraging. However, there are many problems to be solved before these panels can be considered for product use. The present panel produces a red monochrome picture, and three colors must be generated in the panel. Each column of the display requires a driver which, in a commercial unit, would mean 1500 separate drivers. This will require integrated circuits that will handle the needed voltage. And finally, much higher luminance and better power utilization will be required."

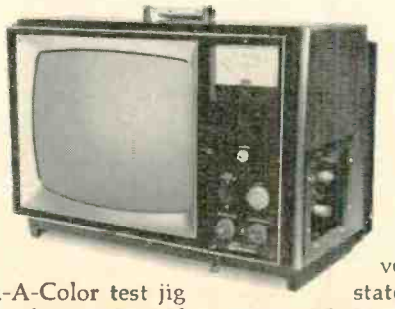
Number please

Two newly introduced sets by Sharp use the screen to provide a giant channel-number display when the station is tuned. The number occupies about half the screen. The new sets are 17 and 19 inches, and are both remotely controlled. The channel identification remains on the screen for slightly more than a second after the channel is tuned. Sharp has already hinted that it will introduce another version which gives the time in a digital display on the screen upon command. The six pre-set uhf channels are identified as U-1, U-2 etc, not by frequency.

by David Lachenbruch
CONTRIBUTING EDITOR

There must be an easier way...

There is: Sylvania's Chek-A-Color test jig.



TV servicemen were never meant to be movingmen.

But, that was before antique, modern and French Provincial units that included hi-fi, tape decks and record players were built around a large-screen color TV set.

Getting those units to the shop can be a big job.

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Regardless of the size of the original picture, Chek-A-Color lets you see it on a benchtop 14-inch (diagonal) screen. It adapts to both high and low focus voltage sets and a full line of adapters lets you test over 5,000 different models.

A front-panel switch controls a yoke programming system that gives you a range of impedances and/or deflection voltages to closely match both tube and solid-state systems.

For actual testing, a convenient meter lets you measure anode voltage and a speaker lets you check sound performance.

Since Chek-A-Color handles tube, hybrid and solid-state chassis, there won't be many complete cabinets to lug.

With a Chek-A-Color test jig all you have to take is the chassis. Get the picture? Sylvania Electronic Components, 100 First Avenue, Waltham, Mass. 02154

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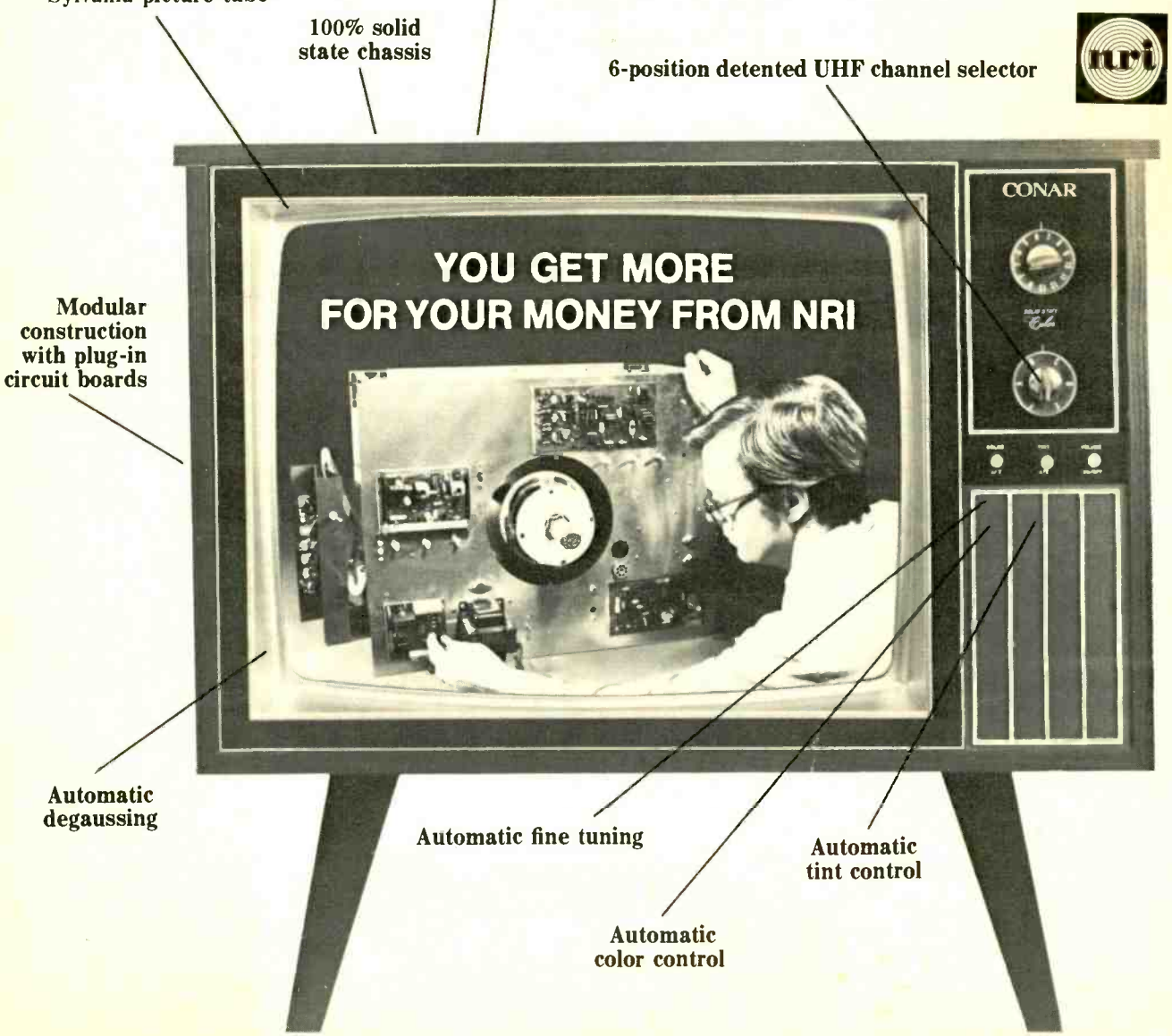

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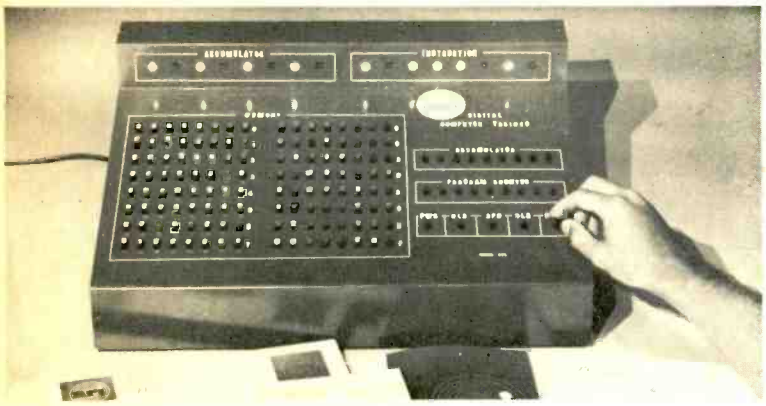

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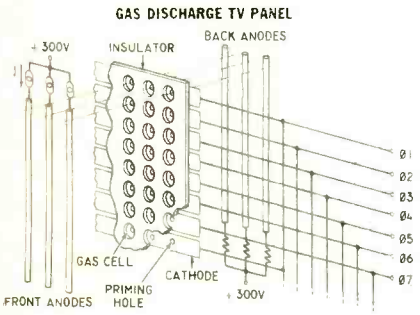
new & timely

Zenith demonstrates flat TV using a neon-tube array

A new thin-panel television display using gas-discharge tubes (tiny neons, in this case) was demonstrated by Zenith Radio at the IEEE Conference on Display Devices in New York City October last. The experimental display demonstrated is 2.4 inches wide and 6.3 inches high, and has 212 rows and 80 columns of gas tubes. Thickness is only 0.63 inch. Peak luminance is 8 foot-lamberts and usable contrast ratio 40 to 1.

Though peak brightness is lower than that of a standard TV set, the new panel produces a picture that is easily visible under normal room lighting. It is "the first matrix device to produce a TV picture of sufficient quality to warrant comparison with a CRT," Zenith's vice-president of research, Dr. Robert Adler, told the conference.



MUCH MAGNIFIED AND SIMPLIFIED view of the thin-panel television display. To get an idea of the real size, remember that there are 80 columns in the 2.4-inch width of the display.

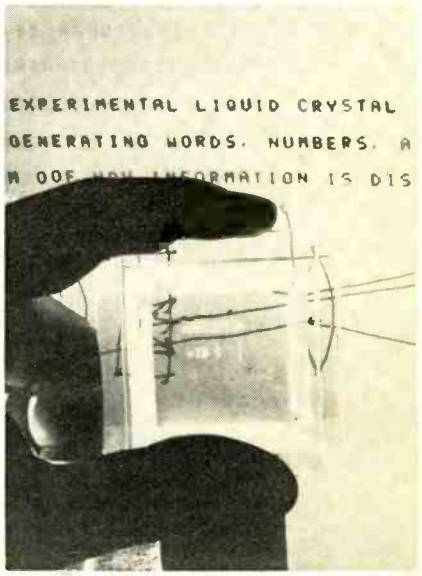
The system uses the crossbar approach, as seen in the drawing. A full horizontal line of cells is addressed at one time, in contrast to the sequential dot-by-dot lighting of the conventional picture tube. The video signal for each line is stored in each of the vertical columns. These discharge simultaneously for each line. Variation of charge in the capacitors produces a wide-range gray scale.

Dr. Adler pointed out that much remains to be done before the experimental system can be put to commercial use. The present picture is red, and panels for two more colors must be produced. Since each column requires a separate driver, a full-width display would have to have 1500 drivers. This will necessitate development of integrated circuits that can handle the required voltages. Luminance will have to be increased and better power utilization achieved, said Dr. Adler.

New display device uses liquid crystals

Laser-driven liquid crystal displays are now being considered for use at Bell Labs in an experimental remote blackboard system for exchanging handwritten information over the telephone lines.

The liquid crystal cells, or light valves, are made with two sheets of glass about the size of 35-mm projector slides. The inner surface of the glass plates is coated with a thin film of indium-tin-oxide that absorbs light from a focused laser beam and converts it to heat. The liquid crystal between the plates is of the type called cholesteric, a mixture of 90% MBBA (p-methoxybenzylidene-p-n-butylanaline) plus 10% cholesteryl nonanate.

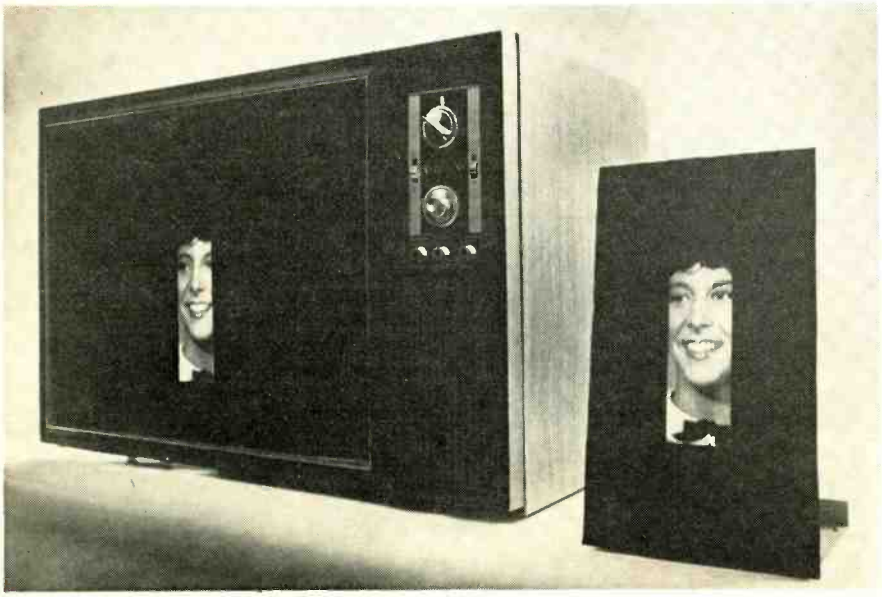


A LIQUID CRYSTAL SLIDE, containing information written by laser light. Behind is a screen on which a duplicate of the information is projected with an ordinary slide projector.

The laser beam is controlled by two devices, a scanning galvanometer that scans horizontally and an acoustic-optic deflection modulator, which supplies the vertical sweep and turns the laser light source on and off during character generation. The beam heats the portion of the light valve's metallic layer directly ahead of it, turning the area of the liquid crystal in contact with it from transparent to a frosty white. If the light valve is located in a slide projector, the frosted portion stops the light, giving a black-and-white display on an ordinary movie screen.

The images remain on the crystal for weeks, or until erased with an audio voltage (about 35 volts at 1.5 kHz) is applied via the conducting indium-tin-oxide layers.

(continued on page 14)



THE THIN-PANEL DISPLAY COMPARED with an equivalent area on a 25-inch TV set. The brightness of the TV set has been turned down to match that of the thin-panel picture.

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(continued from page 12)

Service Association Merger Makes substantial progress

The Merger Committees of NATESA and NEA met jointly Friday evening and Saturday, September 29 and 30, 1972, at the Admiral Ben Bow Hotel, Memphis, Tenn. to discuss problems associated with merging the two associations. Morris Finneburgh, Sr., acted as Chairman and Coordinator.

ment contacts and publicity, and that Mr. Glass would be in charge of internal and administrative affairs.

The Joint Committee agreed unanimously on continuation and maximum support of the CET program and development of a "shop certification" program similar to that initiated by NATESA.

A second Joint Committee meeting was set for the first week of December

THE JOINT COMMITTEE. Standing, left to right: Clifford Shaw, Gerald Hall, Paul Dontje, Edward Gorman, George Weiss and Emmett Hughes. Seated: Charles Couch, Leroy Ragsdale, M. L. Finneburgh, Sr., Norris Brown, Virgil Gaither.

Present were Leroy Ragsdale (Arkansas), Gerald Hall (Milwaukee), Clifford Shaw (Virginia), George Weiss (Chicago), and Edward Gorman (New York) of the NATESA merger committee, and NEA committee members Norris Brown (Houston), Charles Couch (Florida), Virgil Gaither (California), Emmet Hughes (Kansas) and Paul Dontje (Denver).

Plans were set up for a sub-committee to develop a package including a constitution, by-laws and procedure for the election of a board of directors and officers. The name NESDA (National Electronic Service Dealers Association) was tentatively proposed for the new organization.

It was agreed unanimously that Frank Moch of NATESA and Richard Glass of NEA would be Executive Vice Presidents of the new organization, with the suggestion that Mr. Moch would be responsible for public relations, govern-

in Denver, with Paul Dontje as host. At the time of writing, no report was available from that meeting.

"Talking feet" transmit signals for therapeutic study

Shoes rivalling the famous one used on television by Maxwell Smart are being constructed by technicians in the Royal Aircraft Establishment in Farnborough, England. Their objective differs from Maxwell's—they are making the shoes to permit doctors to measure improvements in patients with hip joint diseases. Previously this could be done only by using cumbersome walkways based on a weightbridge principle. In the newer system, the patient simply walks around while the shoes transmit data on the loads and stresses involved in walking.

The soles of the shoes are made up of flexible metal filigree sheets sand-

(continued on page 16)

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R1-73

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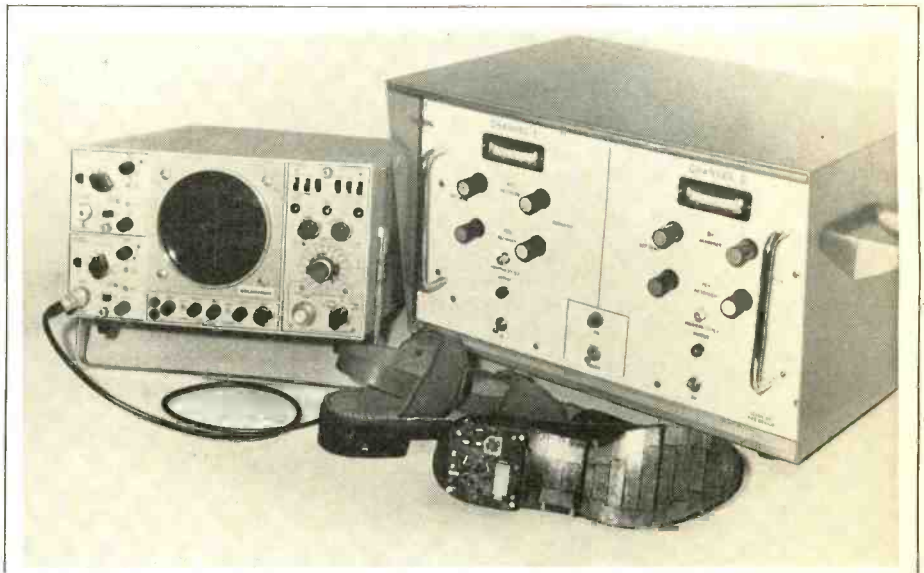
(continued from page 14)



wiched between layers of spongy rubber. When the patient walks the rubber compresses, reducing separation between the sheets. Changes in capacitance resulting from the pressure modulate an oscillatory circuit in the heel of the shoe, and the signals are coupled inductively to a pickup wire strung around the room.

The photograph shows the two receivers, one for the right and one for the left foot, and the scope on which the signals are displayed. The shoes are in the foreground. Like those of Maxwell Smart, they have all the electronics—plus the battery—in the heel (with the capacitive sensors in the sole). **R-E**

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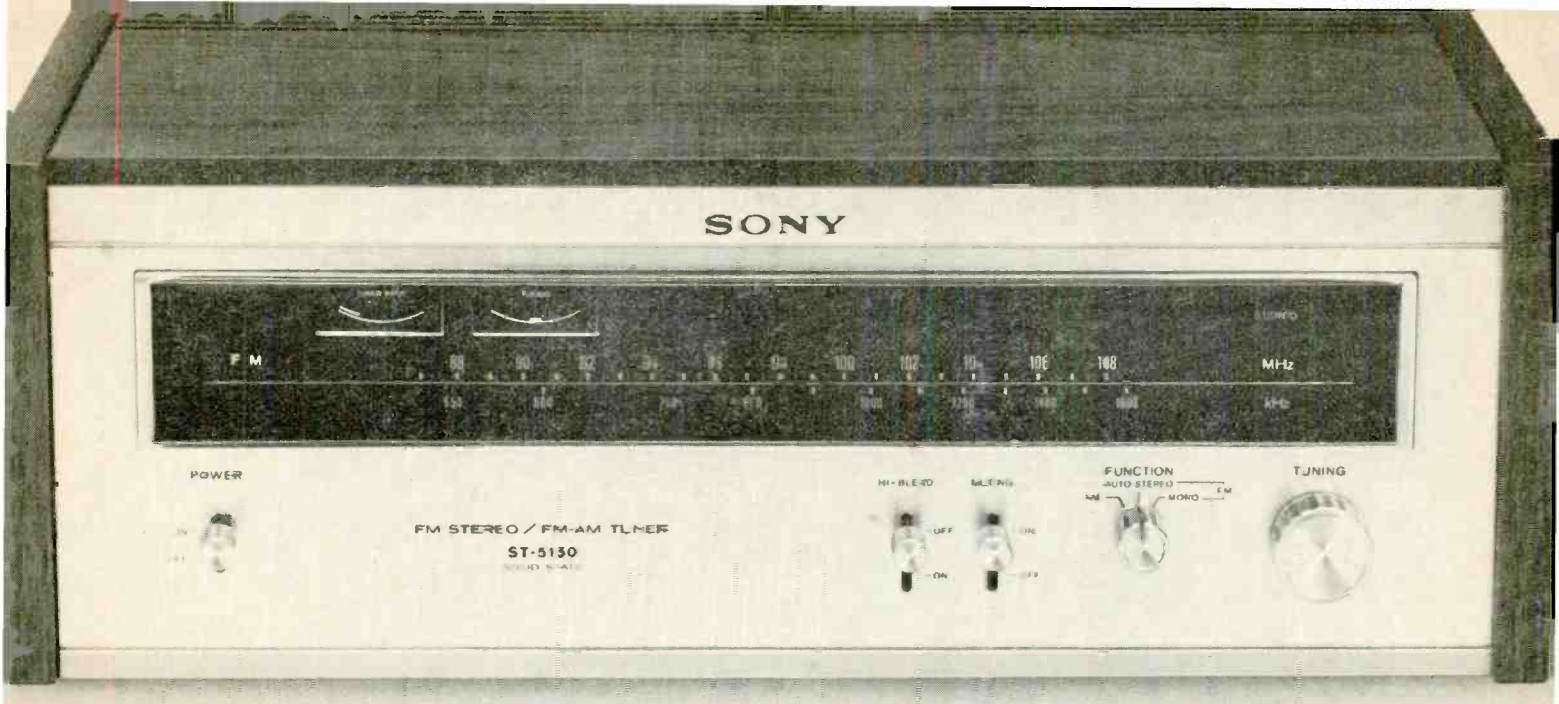

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Yet the price, (we also save you money by making our own semiconductors) is only $229.50.* The TA-1150, a superb integrated amplifier, matches the 5150's performance, appearance and price, $229.50.* Sony Corporation of America, 47-47 Van Dam Street, Long Island City, N.Y. 11101. *Suggested retail price.

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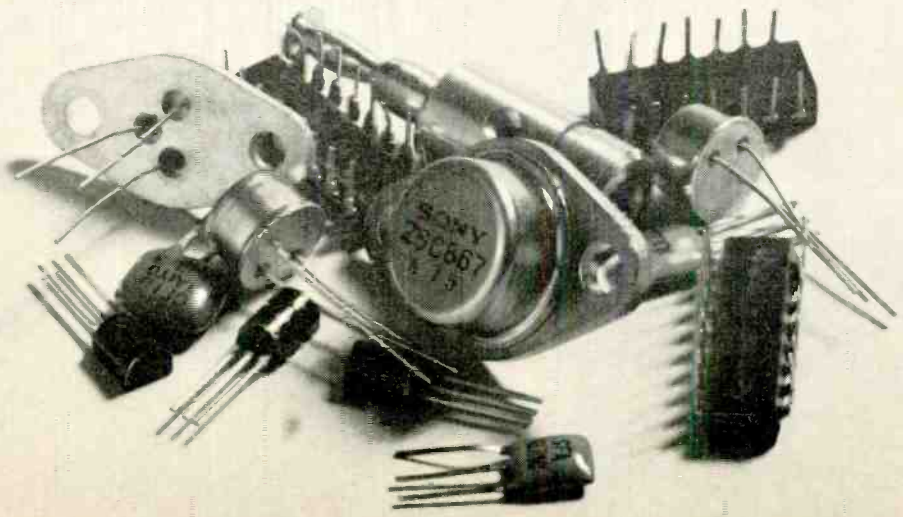

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equipment report

B&K model 501A Transistor Curve Tracer

Circle 26 on reader service card

THE TRANSISTOR CURVE TRACER IS THE latest of the laboratory instruments (the first was the oscilloscope) to turn up on the service bench. B&K has brought it out, quite literally, in a "Black-Box" it calls *Model 501A*. In engineerese, a Black-Box is any complex piece of equipment in a simple-looking box with a couple of terminals that will do a lot of things. Inside, it's very complex but it's simple to operate.

The model 501A is built in a flat, "lay-down" case. This makes it very easy to use; all controls are very accessible. All you need is any standard service scope. The 501A provides the calibration. Setting up can be done in about 30 seconds, and the scope controls aren't moved from then on. All adjustments are made with the curve-tracer controls.

Its purpose is simple: it tests transistors. It does this by "making them work," just as if they were in a circuit. The display indicates normal or abnormal operation. It will tell you instantly if a transistor is good, leaky, open, shorted, or has any other defect. It is purely a Go/No-Go test, and as useful as all of these tests are.

The 501A has two TO-5 transistor sockets with three banana jacks for each socket. The B&K FP-3 probe can be plugged into the jacks. The probe has three swiveled pins, very sharp and spring-loaded, making ideal for penetrating coatings, etc., on solder joints. It can also be used "one-handed" so that the other hand can be used to set the tracer controls.

This is the part that impresses me more than anything else. The probe lets you make valid *in-circuit* tests, a vital consideration with today's equipment. You can actually "go into" a three or four-stage transistor amplifier to get a check on *each* transistor without disconnecting anything! This is a test that has been very difficult to make in the past, and one that will be more and more necessary in the future.

Explained as briefly as possible, a curve-tracer applies a swept collector voltage to the transistor (in the 501A, up to 100 volts at 100 mA). A staircase of current steps is applied to the base, from 1.0 μA per step up to 2.0 mA per step. This causes the scope to display a "family" of curves, one for each step of base current. This is the key pattern: no family, no work.

Ac and dc beta, gain, load-lines, leakage, shorts, opens and collector voltage breakdown can be read from the family of curves. In other words, curve, GO; no curve, NO GO. Reverse breakdown voltage can also be tested and read from the scope. Diodes of all kinds—Zeners, rectifiers, detectors, switching diodes can be checked. FET's of all types (J-FET's, MOS-FET's,) plus UJT's and SCR's can all be tested the same way and with the same ease. For FET testing, voltage steps are provided on the step selector switch.

A polarity switch is mounted on the panel for testing npn or pnp transistors. Just below this is the selector switch for hooking up either the right or left transistor socket or probe-jacks. This is very useful for matching transistors of all kinds. The two transistors are plugged into the sockets, and a curve is set up on the screen for either one. The selector switch is then flipped to the other side; if the transistors match, the curve will remain the same. Even complementary-symetry output transistors (pnp/npn) can be checked for matching. All you need to

(continued on page 96)

Radio Shack Solid State Math!

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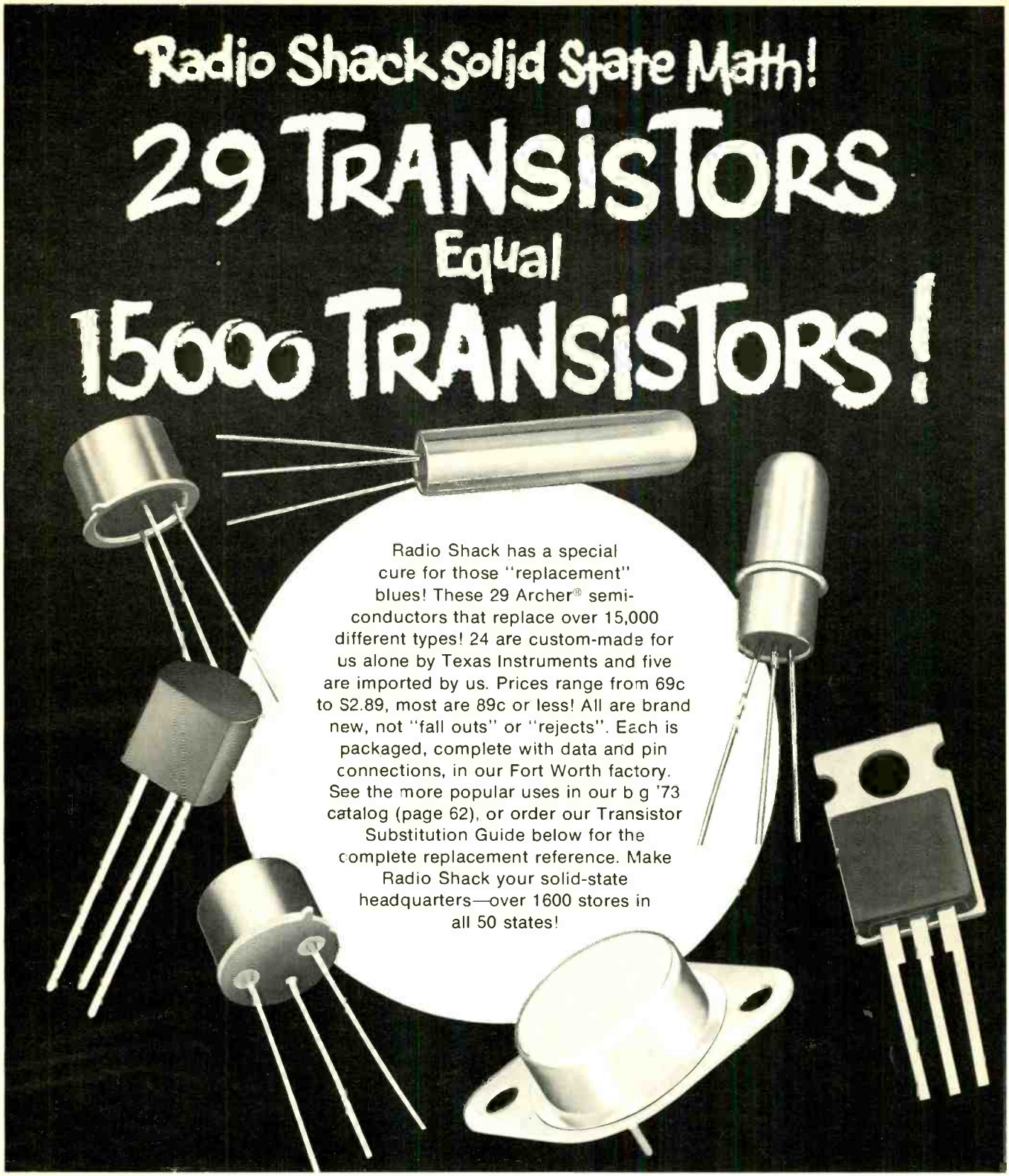

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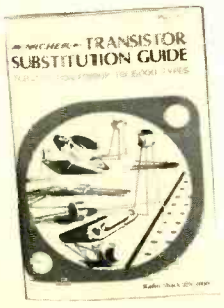

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Circle 100 on reader service card

letters

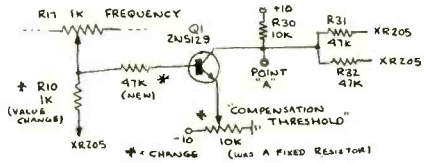
MORE ON THE FUNCTION GENERATOR

Several problems crept into the **Radio-Electronics** Function Generator story (September and October 1972). The pulse waveform is shown upside down in the photos. On the overlays, timing capacitors C11 through C16 are shown interchanged; the largest capacitor goes with the lowest frequency at the top of the instrument. The input POWER callouts should, of course, go up with the input terminals on the fuse and power transformer.

Resistor R27, the 1-megohm pulse unbalancing resistor should go to +10 volts as called out in the schematic. The PC overlay and master has this going to -10, which gives you one-third amplitude and very noisy pulse putput. Carve and jumper the PC board so that this resistor runs to +10.

There is enough linearity variation from IC to IC that you'll want to custom calibrate your frequency dial to match the particular IC you are using. A larger value resistor for R10, perhaps 1000 ohms or 1200 ohms should be used unless your particular IC will not provide enough range. This improves linearity and makes the control setting easier and more stable.

The amplitude compensator shown seems to work only with certain XR-205 chips. A better circuit looks like this:



Note that all we've done is add a series resistor to the base of Q1 and exchange the old 4700-ohm R29 fixed resistor to ground for an adjustable PC pot. This setup will work with any IC used. You adjust things so the voltage at point A stays near ground for FREQUENCY dial settings from 1 through 6. Above 6 it should start smoothly swinging positive, ending up with +8 or more when your frequency dial reads 10. For more correction at the high end, reduce R31 and R32, and vice versa. The new pot decides when in the FREQUENCY dial rotation the correction begins. Amplitude compensation only affects the sinewave distortion and the high frequency triangle and ramp size; it is bypassed in the square and pulse modes.

All of the commercially available kits have picked up all of these additions and corrections and include a slightly heavier power supply than the original called for.

DON LANCASTER
Phoenix, Ariz.

NEED SERVICE DATA

They have opened a new Radio & TV Repair Course here in high school for juniors and seniors. We are in need of a complete set of Sams Service notes from 1 to date, or we would accept 500 to date. We are also in need of used test equipment of all kinds. We will be glad to pay a reasonable price and will answer all letters.

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WHO ARE THEY?

I have a question about the article "State Of Solid State." **Radio-Electronics,** October, 1972. At one point the text mentions Signetics and Integrated Systems Inc. At another point the text mentions EXAR IC's. Are EXAR and Integrated Systems the same? I am most interested in building a low-cost speedometer and tachometer. Could you provide information on a source for IC circuits?

ROBERT N. SLEGHT
Laramie, Wyo.

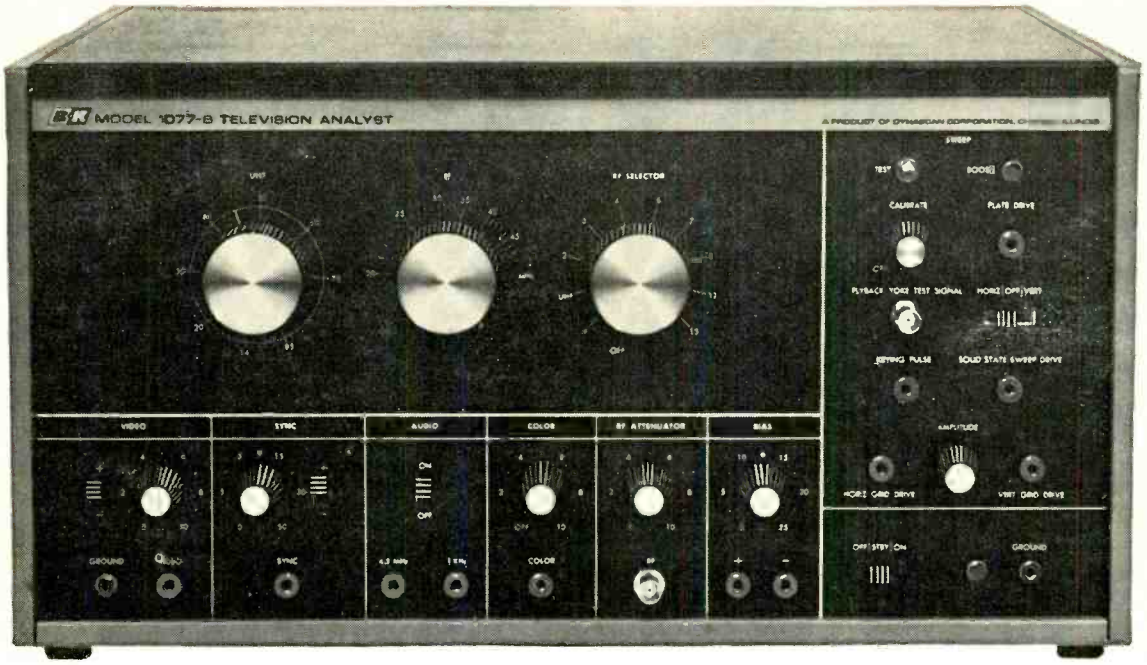
EXAR and Integrated Systems are indeed the company. The correct full name and address is EXAR Integrated Systems Inc., 733 North Pastoria Ave., Sunnyvale, Calif. 94086.

I have not, at this date, seen any circuit diagrams that would meet your needs for the speedometer. We are, however, negotiating with an author for the purchase of his article on a digital IC tachometer. Tentatively, this story is scheduled for publication in our April 1973 issue.—Editor

NO MORE SUPPLIERS?

I recently ordered some parts from Newark Electronics. Their reply to me was "We no longer accept orders from individuals. Therefore we are returning your order."

STEVEN W. RUSSELL **R-E**



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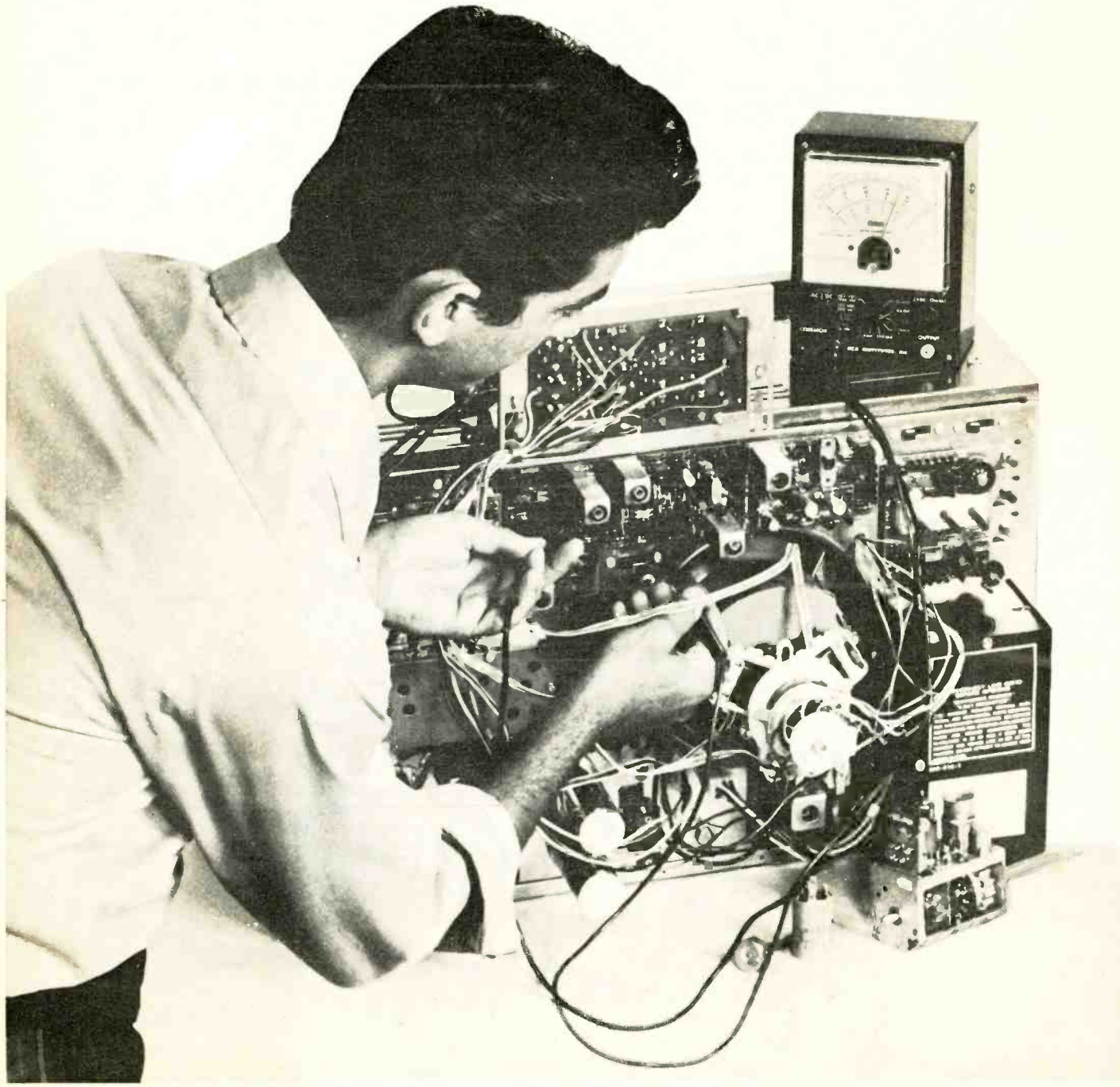

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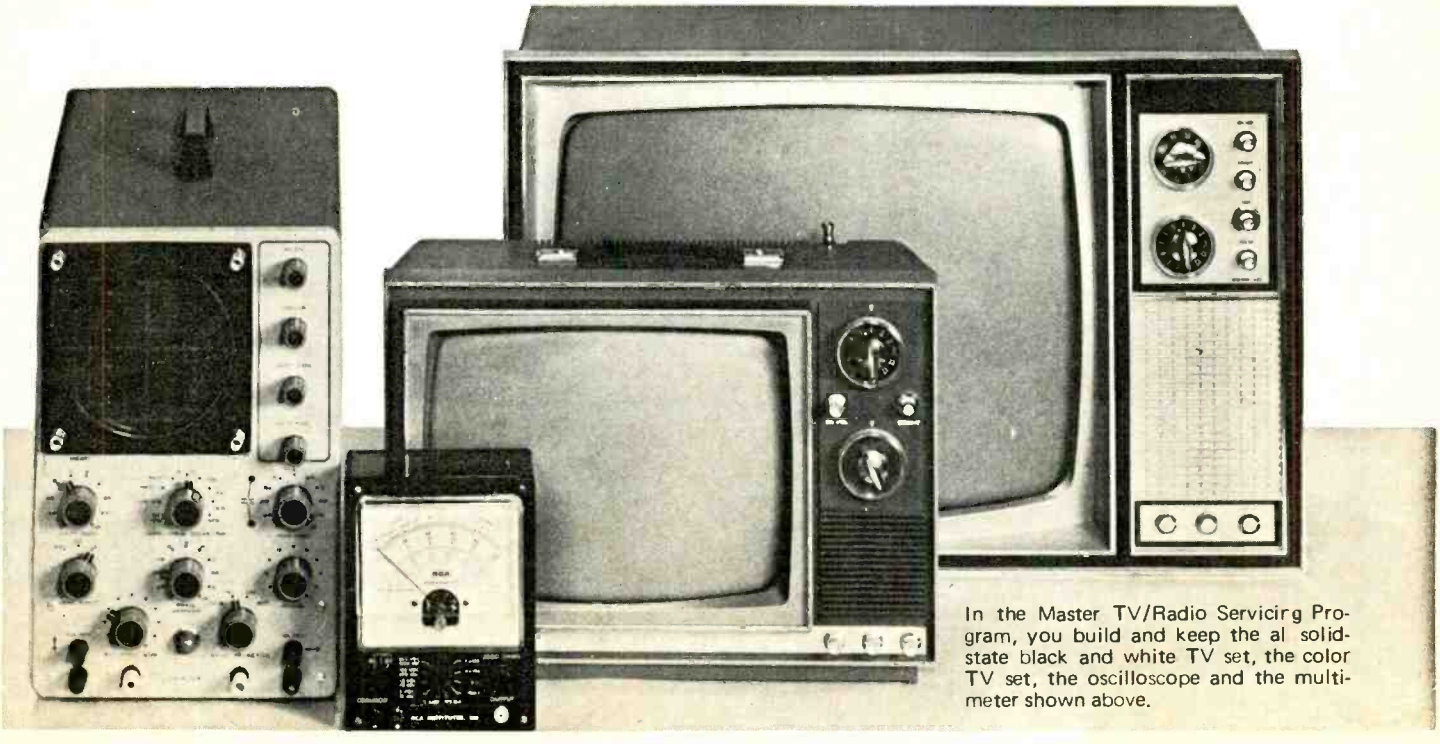

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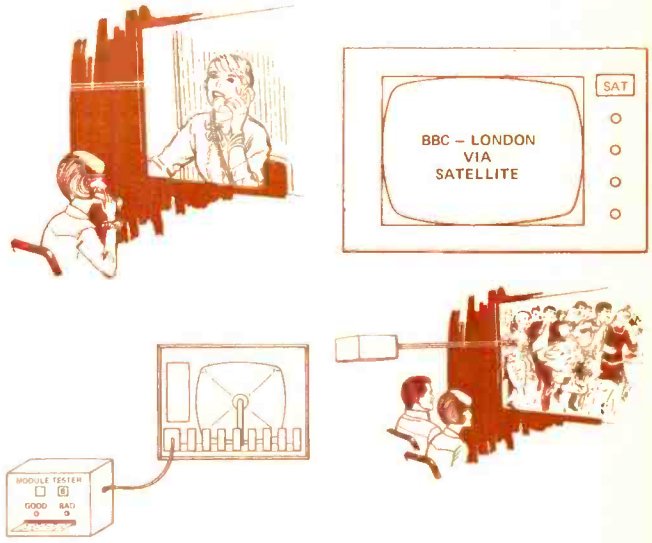
Circle 13 on reader service card

the next ten years of color TV

by BOB GERSON



Although we've seen many advances in television technology, these are nothing compared to what we see in a glimpse into the future

IN THE YEAR 1972 COLOR TELEVISION FINALLY CAME OF AGE. By mid-year more than 56% of all television owning homes in America had at least one color set. Considering all the innovations we've seen since 1964 when color had its first million-sales year wouldn't you think we've about come to the age of stability in development. Well you might think so, but you'd be wrong, dead wrong.

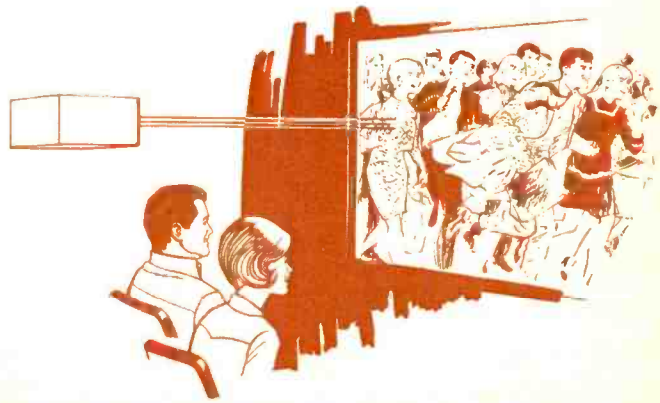
Monochrome television hit a 50% American home saturation level in 1953, just 4 years after the first million-set sales year. But far from marking an innovation plateau, that half-way mark proved to be more like a springboard. In the last 3 years alone we've seen such new concepts as the pocketable-portable, the pop-up screen and the battery portable complete entertainment center, including monochrome television-FM/AM radio-cassette recorder. For color television in the coming decade we can expect changes, innovations and improvements that will make such marvels of today as the latest versions of the black-surround matrix picture tube and one-button tuning seem pale in comparison.

wall-sized pictures with projection systems

Wall-sized television pictures, today available only for theatre use, will be commonplace in homes where the family gathers for program viewing. A trio of high performance, low-power lasers will scan in red, green and blue to provide life-size images in life-like color.

Permanent, ceiling mounted screens automatically drop down when the projector is turned on, roll back up into the recessed housing when the show is over. New, highly reflective screen coatings will afford projectors the brightness lacking in the systems of today, permit projector televiewing in normal room light.

Less pretentious but equally impressive will be rear-screen projectors offering color television pictures with four to five-foot diagonal viewing areas. In many homes the entire system will be mounted inside a wall with a mirror-prism arrangement to direct the output from high efficiency light-valve projection tubes up and out to the screen. A control on the wall-hung liquid-crystal screen will change the transparency of the screen itself so that it may, if properly installed, serve as a window (at one extreme setting) or a perfect reflecting mirror (at the other end). As an extra cost option the consumer will be able to purchase a screen which shows "an indistinguishable from the original" painting when it's not being used for TV watching.



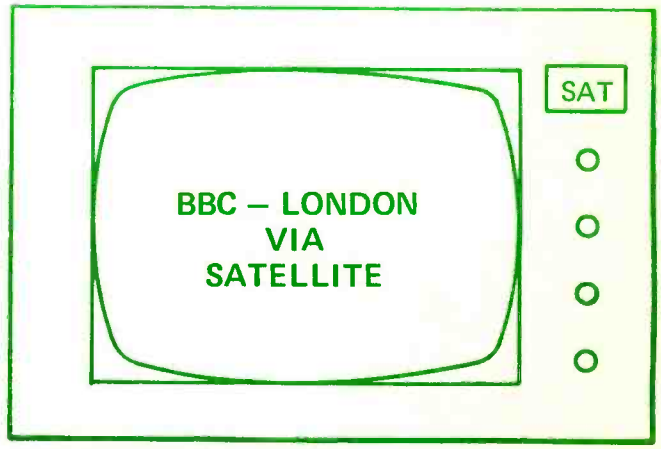
LASERS AND PROJECTION TECHNOLOGY may be combined to bring the long-awaited television "picture-on-the-wall" into the viewers' home.

shortwave television

"This is the BBC in the North American service. Tonight we take you live to Buckingham Palace where we shall watch as the Queen greets her guests at her annual birthday ball." Yes, the Queen from London, sunrise services on Easter morning from the Vatican in Rome, the Bolshoi Ballet direct from a stage in Moscow, plus, unfortunately, an endless barrage of graphs, charts and statistics showing how this or that developing country exceeded its production quotas of shoes, wheat, eggs or what have you, thanks to "The Leader's" new five-year plan.

A whole new world of visual DX'ing will open for the dedicated hobbyist as well as the knob twiddler. Virtually every major country and many of the smaller ones as well, will have direct-to-you color television transmission via satellite. For the consumer, reception will mean an investment of $50 to $500 in equipment, with the price dependent on the degree of sophistication of the equipment and the installation ability of the owner. For multi-family home dwellers an understanding landlord will be a must.

In addition to a television receiver, the shortwave viewer will need a roof-mounted steerable-dish antenna and a tuner-converter. The cost and expertise required for successful stationary satellite launching will, at first, handcuff prospective amateur ham telecasters. But enough statewide clubs will start considering such a move—one will actually put in a launching request with NASA—that the FCC will organize and oversee the placing of amateur-use satellites in strategic locations above the U.S.



TV VIA SATELLITE direct to you will require a roof-top converter fed by a dish or other high-gain antenna aimed at the fixed satellite.

display devices

There'll be no substitute for the picture tube in the decade to come, but there will be alternatives and innovations. Super-thin conventional color television receivers will have cathode ray tubes with the electron gun mounted at right angles to the screen. The result will be a 19-in. set thin enough to fit on a standard bookcase shelf. Deflection plates inside the tube will divert the electron beam, causing it to sweep across the tube face.

The "hang it on the wall" television display will get here at last. Thanks to the perfection of plasma technology the industry will realize the dream of television as a picture in a frame. The display itself will be a glass sandwich containing pockets of gas and a network of wires. The gas trapped in each nearly microscopic pocket will glow in either red, blue or green when addressed by a current from the wires running through it. Initially the screen will hang on a wall and be connected to the remotely located chassis by wires. But innovations in microelectronics will permit the insertion of all electronic circuitry in the frame itself. With power supplied by a compact microwave transmitter plugged into any convenient nearby outlet, the need for any exposed wiring will be eliminated.

random-access television

The coming combination of cable television with computer time-sharing techniques will shatter the channel number barrier, giving each television set owner a virtually limitless viewing choice.

In addition to the standard entertainment offerings available for the watching from commercial television, the viewer of the future will have access to hundreds of special interest programs, shopping & hobby guides, mini-tours of possible vacation sites, and of course first-run feature films and broadway shows.

The heart of random access television will be the touch button telephone-type keyboard accessory. By tapping in the right series of numbers, tomorrow's televiewer will be able to bring any available program offering into his living room. Every urban community will have program repositories. Some municipally run like a library, will provide this service free. Most, however, will be commercial enterprises who will charge for the programs on a per-show basis, with billing handled through the cable operator. Program viewing costs will vary greatly depending on the material, but the charge for the average new movie or stage show will run around $5. In many instances the consumer will find that his special interest programming can be dialed up for free from businesses hoping to catch its buying interest.

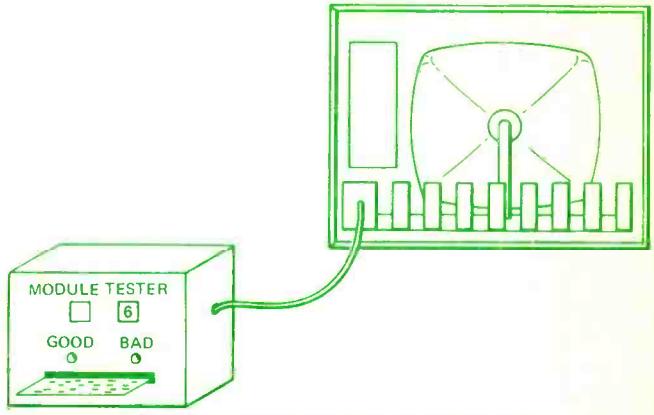
Interested in a new appliance, wardrobe, automobile or planning a family outing? Just punch in for a free, full-color run down on the latest fashions now on sale in your local department store, the hottest fastback coming from Detroit or the fun and luxury at a seaside resort.

fiddle-free TV

The button, knob and switch will be a fond relic of the 1970's as far as the television receivers of tomorrow are concerned. Except for channel changing and volume levels the television owner will have no adjustments to make. The set itself will automatically adjust its brightness to ambient room light, then compensate its contrast to the brightness. An inconspicuous sensor will constantly monitor the set's picture quality, compare it with reference signals being transmitted along with the program and adjust hue and tint accordingly. There will of course have to be an automatic mode override for the consumer who insists on exercising his preferences. But manual adjustments will be tucked well out of sight.

There'll be no need for channel indicators on the set itself. Each station will be transmitting its identification during the vertical blanking interval. The number and call letters will show up in a corner of the screen for a 6 to 10-second display, then fade. A touch on the designated spot on the electronic tuner or the remote control unit will cause the identification to reappear.

The solid-state chassis modules of tomorrow, like the receiving tubes of yesterday, will be consumer replacable. In the exceptional event that the set does malfunction, the consumer will remove suspected modules and take them out for testing. A popular accessory at $25 will be the testing computer. A 3″x5″x2″ black box, the computer plugs in to a "service" jack at the rear of all new sets. A magnetic program card gives the computer the operating parameters for each module in the set. The computer checks the modules, displays the number of the malfunctioning one on its 2-digit alphanumeric readout.



MINI-COMPUTER MODULE TESTER plugs into jack on TV set and quickly checks out all circuits and identifies weak or defective modules.

more than a program source

The prime function of a television receiver is, and probably always will be, to provide a display of entertaining and informative programming produced for mass consumption. Today this is really the only function. But tomorrow the television set will have as many uses as the ubiquitous quarter-inch electric drill has attachments and the set will be called on to do nearly as many jobs.

This revolution in utility has already started with the introduction of the Cartrivision home video tape player and the Magnavox Odyssey. Cartrivision, through rental and sale tapes, gives the consumer a personalized alternative to commercial programming. Odyssey turns a television set into a playing field for tennis, hockey and other games. But these are just the beginning.

telephone message center

Your television set will become your home message center. Your telephone will be equipped with an audio-video answering device. Using touch-tone telephones, callers to your home will be able to leave the usual recorded audio message, then follow by punching out detailed instructions, times, dates, etc. When you get home you'll play the message back on your television set, listen to the audio through the speaker and watch as the written portion is spelled out on the screen.

Advances in cable technology will permit direct interconnection of any two, or more, sets on the same system. With appropriate game attachments at each end, home owners miles apart will use their sets to match skills in games as complex as chess or as simple as tic-tac-toe. Keyboard attachments will allow housewives to swap recipes, light pens will permit direct transmissions of designs and sketches, and with a camera accessory you will be able to treat your neighbor to your family's latest theatrical experiment.

FLAT-SCREEN TV and picture phone form audio-visual message center.

other accessories

A standard accessory will be a frame snatcher, a device capable of memorizing and holding a single picture frame until erased, and displaying that frame on a television screen for an indefinite period. With a frame snatcher incoming information can be instantly recorded for intensive study while the valuable communications line itself is freed for other uses. Feeding the output from the frame snatcher into its companion facsimile printer will produce a hard copy of any of the material received by the television receiver.

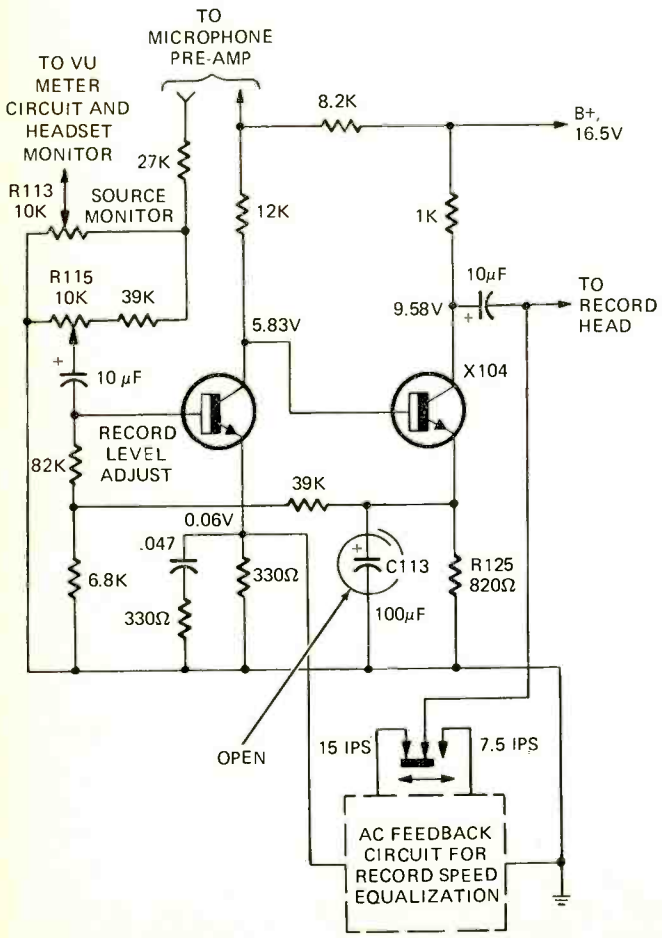
Of course the most popular attachment to your television set of tomorrow will be the video disc player, with the home video tape recorder running second. But other accessories will allow the television screen to be used as the display for a calculator, a drawing board to plan out construction projects or lay out electronic circuits. With the typewriter keyboard attachment, the television set will become a home electronic typesetter on which youngsters can write and edit school term papers. When satisfied with the drawing, building plan, schematic or thesis, the information can be transferred to magnetic tape for storage or fed to a facsimile for copying on paper.

and still more experiments

While the television transmission standard of today is adequate for most of the television miracles of tomorrow it does have its limitations. In the decade to come we will see the start of broadband television transmission utilizing channels with five to 10 times the 6 Mhz bandwidth in use now. With its greatly expanded information capacity, broadband television will provide 1,000-line color television with pictures twice as sharp, twice as detailed as those we have now. Free from the screen size limitations imposed by our 525-line standard, receiver manufacturers will develop television displays with the 5-to-1 aspect ratio now reserved for wide-screen movies. But the most astounding contribution of broadband television will be the addition of a third dimension to the television image. With broadband the transmission of the whorls and swirls of holography will become a possibility, and for the first time you won't be looking at your television set, you'll be looking into it at a three-dimensional image. **R-E**

SONY TC-350 TAPE RECORDER

During playback, one channel of this tape recorder was noticeably lower in level than the other. The VU meters indicated equal levels during record, and tapes made on other machines played back normally. The owner learned by experience to increase the level of the defective channel during record.



LEFT CHANNEL RECORD HEAD DRIVER

The trouble was eventually traced to C113, the emitter bypass capacitor for X104. It had opened, which reduced the gain of the left channel record head driver. It was replaced.

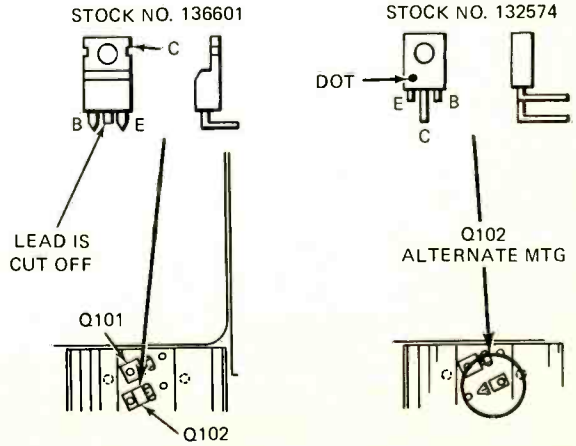
The difference in gain was not apparent on the VU meters or monitor headset during record because these monitor circuits are tapped off ahead of the record head drive amplifier.—*Donald R. Hicke*

SYLVANIA D-14 CHANNEL MOTOR RUNS

If the channel-selector motor runs continuously, unplug the Molex cables from the remote receiver and see if the motor still runs. If so, check for a shorted ceramic capacitor (C514, 0.01 μF) up on the terminal strip next to the motor.—*GTE Sylvania Service Notebook*

RCA CTC46 SERIES

Two different output transistors are used for Q102 in the vertical output stage in this chassis. Their electrical specifications are similar but the transistors are not interchangeable due to physical differences as illustrated in the drawings.—*RCA Service Information*



Digital Readout for SSB Receivers

Read frequency of incoming signal within 100 Hz while eliminating usual errors in reading dial.

by LARRY R. HOUGHTON*, K8ZVF

THE RECENT PROLIFERATION OF LOW-COST FREQUENCY counters has attracted the attention of many amateur radio operators. Hams have always had an interest in knowing their exact operating frequency and for good reason. Regulations require strict adherence to amateur band edges and sub-band allocations. Locating a net or the frequency for a prearranged schedule is much easier when accurate frequency indication is available. It is natural then to see hams attempting to adapt these counters to their home stations.

Direct signal counting

The enterprising amateur radio operator can, however, face a number of application problems in his quest for accurate and reliable indication of receiver frequency. To begin with, he must know *what* his counter is going to count and what it means. A number of hams overlook the fact that a receiver does not always have a single signal at the operating or listening frequency. Let's look at the block diagram of a conventional dual-conversion superhet, single side-band receiver (Fig. 1) to see why.

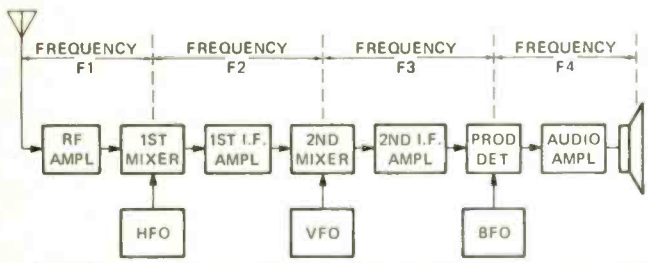


FIG. 1—TYPICAL SSB RECEIVER is a double-conversion superhet with fixed-frequency hfo.

In a typical receiver like this, received signals at frequency F1 coming from the antenna are successively amplified and converted to other frequencies, F2, F3, and F4. The ultimate output is recovered audio at frequency F4. So, in this receiver the only signal at the listening frequency is F1. Can it be counted directly and displayed? Possibly. External amplification would be required to raise incoming signals from the microvolt level to approximately a quarter of a volt, sufficient to trigger most counters. In effect, the counter would be driven directly by received signals which, of course, are not always present. The counter would read out or display a frequency only when signals were tuned in.

*Chief Engineer, Communications, Heath Company

Besides the possible intermittent display, another problem exists in direct counting. Incoming SSB signals are *not* at a single frequency. A number of frequencies are present, represented by an audio bandwidth spaced either above or below the zero-beat or suppressed carrier frequency, depending on whether an upper or lower sideband signal has been received. A typical USB (upper sideband) spectrum might appear as in Fig. 2. The resultant counter readout would show a random

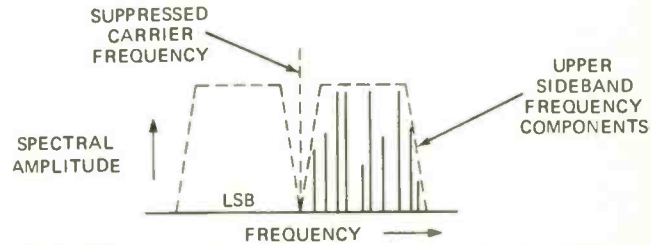


FIG. 2—FREQUENCY SPECTRUM of an incoming upper-sideband signal. When the lower sideband is transmitted, the energy distribution is a mirror-image of the upper sideband.

shift as the spectral components varied with time.

Incoming CW signals are at a single frequency but, of course, are only present during key-down at the transmitting end. The single-frequency carrier of tuned-in AM or FM signals is always present except during fading conditions.

Besides intermittent and random displays, one other direct-counting problem should be considered. When the received signal is amplified to a frequency counter's trigger level undesirable receiver operation might result. The presence of high-level signals at the receiver's frequency would be like having a transmitter operating next door. Front-end overload could occur, resulting in intermodulation distortion. Other distortion or spurious products could also be generated through radiation and ground loop paths; all in all, an undesirable method of frequency indication.

Vfo counting

For a better approach, refer to the other frequencies present within the receiver in Fig. 1. In this SSB receiver, three signals (heterodyne-, variable-, and beat-frequency oscillators) are generated for converting incoming high frequency rf signals to audio frequencies. What is the relationship between these frequencies and the receiver's listening frequency? Keeping in mind how a superheterodyne receiver works, let's examine this relationship.

The hfo (heterodyne-frequency oscillator) is normally crystal controlled and changes frequency when a different

band is switched in. Depending on a receiver mixing scheme, the received signal (frequency) is either added to or subtracted from the hfo frequency. The bfo generates one of two different fixed frequencies depending on USB or LSB operation. The vfo frequency changes as the receiver is tuned. Its frequency has a definite relationship to the listening frequency. Can we count it and know the operating frequency? Yes indeed, but with a couple of limitations.

Suppose the vfo covered a 500-kHz range by tuning from 2.000 MHz to 2.500 MHz. Each band segments of the receiver would then cover 500 kHz. If the vfo frequency varied in the same direction as the receiver was tuned, the vfo frequency could be counted and displayed. For example, if a band segment started at a whole megahertz, say 21 MHz, the vfo frequency would be at 2.000 MHz. The counter display would show "2.000". The "2" would be ignored (or not displayed) and by knowing the position of the receiver's bandswitch, the listening frequency would be interpreted as 21.000 MHz. Tuning the receiver's vfo to 2.250 MHz would change the display to 2.250 MHz and would be interpreted as 21.250 MHz.

Another complication occurs if the vfo tunes "backwards", that is, it changes frequency in the direction opposite to receiver tuning. The vfo counter display would not have an easily interpreted frequency. Frequency inversion can be used either by frequency mixing or digital techniques but still does not offer the ultimate answer.

The greatest drawback to the vfo counting method has to do with accuracy. Accuracy, in this application, infers better frequency indication than obtainable with mechanical dials. The receiver's operating frequency is determined not only by the vfo but by the hfo and bfo frequencies as well. For the vfo frequency to give an accurate indication, each hfo and bfo frequency must be *very close* to their "design" values.

Refer again to Fig. 1. If *subtractive* mixing is used in the 1st and 2nd mixers, the simple equation that shows the relation between the operating frequency F1 (SSB suppressed carrier frequency) and the three oscillator frequencies in the receiver is F1 = hfo–vfo–bfo. For example, if the hfo frequency is 18.000 MHz, the vfo is set at 2.500 MHz, and the bfo frequency is 1.500 MHz, the receiver is tuned to (18.000–2.500–1.500) or 14.000 MHz. Assuming that is the true frequency, then the hfo and bfo oscillator crystals are exactly right. Now suppose the receiver is switched to another band. The vfo and bfo frequencies do not change, only the hfo frequency. Suppose you switched to the 80-meter band where the new frequency should be 3.500 MHz. A hfo frequency of 7.500 MHz would be necessary for the vfo counter to show the "correct frequency": 7.500–2.500–1.500 = 3.500 MHz. If the hfo crystal happened to be low by 1000 hertz (a reasonable assumption in amateur-grade equipment), the true frequency would be 7.499–2.500–1.500 or 3.499 MHz. This error would not be apparent because only the vfo frequency is being counted and displayed.

Hfo and bfo crystals can be "pulled" (trimmed or adjusted) in some oscillator designs so their frequencies can be set exactly to what they should be. However, warmup drift and crystal aging can introduce additional errors, again unapparent when only the vfo is counted.

Frequency mixing

The next step toward greater accuracy and reliability in counting receiver frequency is to generate the operating frequency as indicated by the receiver's mixing scheme. In our previous example of a subtractive mixing scheme, a signal at the operating frequency can be generated and counted as shown in Fig. 3.

The output of Mixer A is tuned to the difference frequency between the hfo and vfo. This signal is then subtractively mixed with the bfo. The resultant is a signal equal in frequency to F1, the operating frequency. Additive mixing can also be used depending on the individual receiver's mixing scheme.

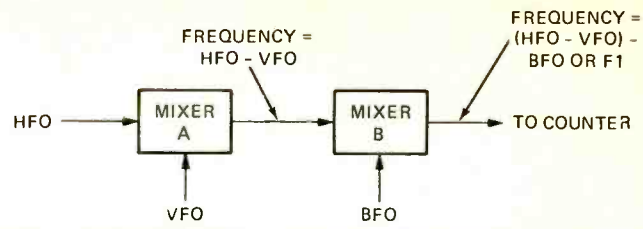


FIG. 3—MIXING SCHEME for generating a signal equal to that to which the receiver is tuned so the counter operates constantly.

Using the mixing method for receiver frequency counting eliminates the errors possible in vfo counting. Hfo and bfo frequencies need not be exact and drift does not become a factor because the generated signal changes by the same amount. Accuracy then is only limited by the counter used. This method has been described previously[1,2] and has been successfully used by hams.

Careful construction techniques are called for when using such a mixer. Receiver overload problems have already been mentioned and can occur using this technique. In addition, the outputs of each mixer (A and B in Fig. 3) require tuned circuits. Thus, the mixer has to be bandswitched along with the receiver.

Calculating receiver frequency

The main advantage of the mixing method just described is that of accuracy. No matter what the individual oscillator signals happen to be, the final displayed frequency, within the counter's accuracy, is the receiver's true operating frequency. When digital techniques replace mixing (an analog process), this accuracy can be retained without the attendant disadvantages.

Such a technique is used in Heath's new SB-650 Digital Frequency Display.[3] By counting each oscillator frequency individually and arithmetically calculating the result, no new frequencies need be generated. The equation $F_{operating}$ = hfo–vfo–bfo is solved digitally rather than by an analog approach. And because no tuned circuits are needed, the SB-650 does not have to be bandswitched.

The SB-650 counts each of the receiver oscillator inputs, Fig. 4, in an up/down counter controlled by an internal clock

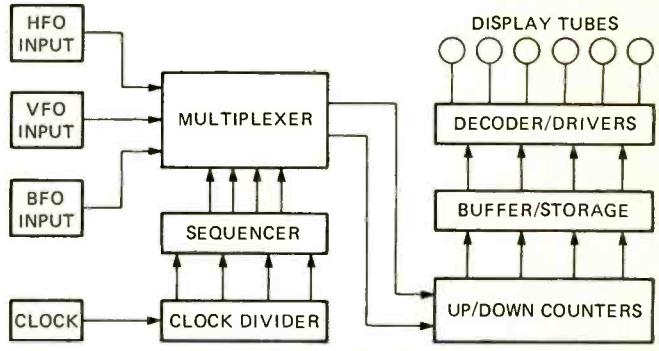


FIG. 4—BLOCK DIAGRAM OF THE SB-650 digital frequency display. Device needs three input frequencies to indicate the frequency to which a typical SSB receiver is tuned.

through a sequencer and multiplexer. Timing signals derived from the clock via the sequencer, select input signals in the proper sequence, direct them to the up/down counter, and tell the counter when to count up and down.

Updated calculations and display occur every 160 milliseconds or approximately six times per second. The sequencer provides four 40 millisecond time periods; three for counting the input signals and one for display updating and counter reset, Fig. 5. During time period T_1, the hfo signal is directed

[1]Macleish "A Frequency Counter for the Amateur Station", *QST*, October 1970.

[2]Macleish, Pattison, Hejhall. "The Rec/Counter", *QST*, May 1971.

[3]Patent applied for.

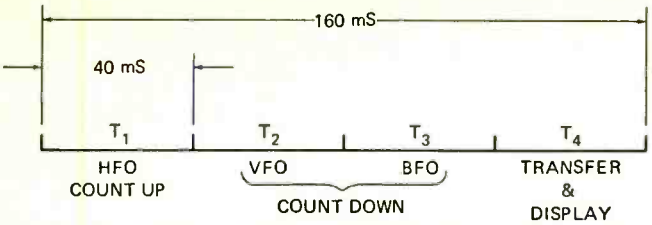


FIG. 5—THE SB-650 COUNTING SEQUENCE. The hfo signal—higher than the incoming signal—is counted; then the vfo and bfo frequencies are subtracted so correct frequency is shown.

by the multiplexer to the count-up input of the up/down counter which is given a count-up command. During T_2 and T_3, the vfo (called LMO in Heath SB-series equipment) and bfo are respectively directed to the count-down input. At the beginning of period T_2, the up/down counter contains the hfo count accumulated during T_1. Now the counter counts "backwards", in effect subtracting from the stored hfo count. The bfo signal is then subtracted during the next period. At the end of T_3, the up/down counter contains in binary form a number equal to hfo–vfo–bfo, the receiver frequency. During period T_4, this number is transferred to storage buffers, decoded to the equivalent decimal number, and displayed on indicator tubes. After the number has transferred, the up/down counter is automatically reset to zero, ready for the next counting sequence.

The SB-650 digital frequency display was designed specifically for operation with Heath's SB-line receivers and transceivers, plus the HW-100 and 101 transceivers. These units are dual conversion using subtractive mixing. The SB-650 construction manual describes minor modifications to provide the display with the three oscillator signals from each receiver or transceiver[4].

The SB-650 displays receiver frequencies on 80 through 10 meter amateur bands to 100 hertz. Its accuracy is specified as within 100 hertz plus or minus one count or another 100 hertz. Calibration is achieved by setting the internal clock for the correct frequency display after zero-beating the receiver with WWV at 15 MHz or CHU at 7.335 MHz. In most cases, this zero-beat will be within 25 hertz. It depends on the operator's ability to hear and detect true zero-beat. The plus or minus one count error is inherent with any asynchronous counter (where the signal source and the counter's timing signals are not synchronized).

When transceiving, both transmit and receive frequencies are the same in the SSB mode. However, in the CW mode the bfo shifts about 1000 hertz during transmit. Since the SB-650 counts the bfo, it will display the CW carrier frequency during transmit.

The SB-650 has been designed for SSB and CW operation; a receiver operating in the AM mode does not require a bfo, hence the frequency displayed would be higher than the operating frequency . This can be better understood by looking at the basics of SSB and AM demodulation.

An SSB signal as shown in Fig. 2 has no carrier. To extract the modulation (as an audio frequency), the receiver essentially reinserts a carrier. This is done by mixing the bfo and intermediate frequency (i.f.) in a product detector. The output is audio. In other words, both bfo and nominal intermediate frequencies are identical and any variations in the i.f. are detected as audio components in the received signal.

In the AM mode, the bfo is not needed because the carrier (converted now to the intermediate frequency) is present. An incoming AM signal is demodulated by detecting the amplitude variations with a diode. After filtering out the i.f. (carrier), only audio frequencies remain.

Recall the simple formula, F = hfo–vfo–bfo. The SB-650 performs this operation even if one of the inputs is missing (equals zero). This, then, is what happens in AM operation. With the bfo shut off, the SB-650 display would only show hfo minus vfo. This is also equal to the operating frequency plus the bfo frequency.

Heath Company does not provide instructions for other makes of equipment, since it has no control over their designs. Operation of the SB-650 with other receivers depends on two criteria. First, the receiver must be subtractive-type single or dual conversion where the received signal is *subtracted* from either the hfo or vfo. Secondly, the loading of the receiver's oscillators by the SB-650 must not degrade its normal performance. Heath units are not degraded due to sufficiently high oscillator signal levels.

Low-cost frequency counters and counting techniques are now within reach of most amateurs. They can be applied to receivers a number of ways depending on the desired accuracy and reliability. Technology is now offering the amateur radio operator the long sought means of accurate frequency indication. **R-E**

[4]The SB-650 is available in kit form for $179.95. Additional information on the SB-650 can be obtained by writing Heath Company, Benton Harbor, Mich. 49022.

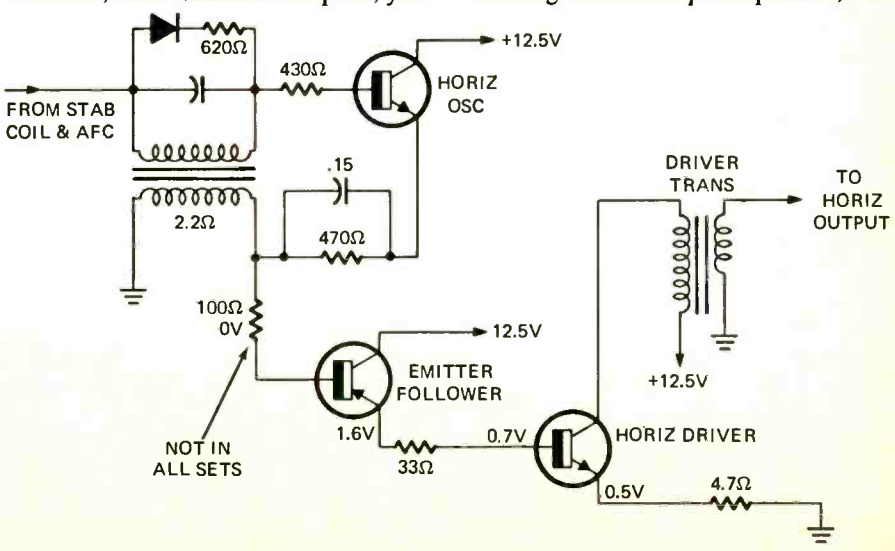
NO RASTER, NO HIGH VOLTAGE

I've got sound, but no raster, in a Sony 5-303W TV. Dc voltages a little high all over. All haywire on the horizontal oscillator, and zero on base and emitter of horizontal emitter-follower and driver. No waveforms on scope on the last two.—L. W. Memphis, TN

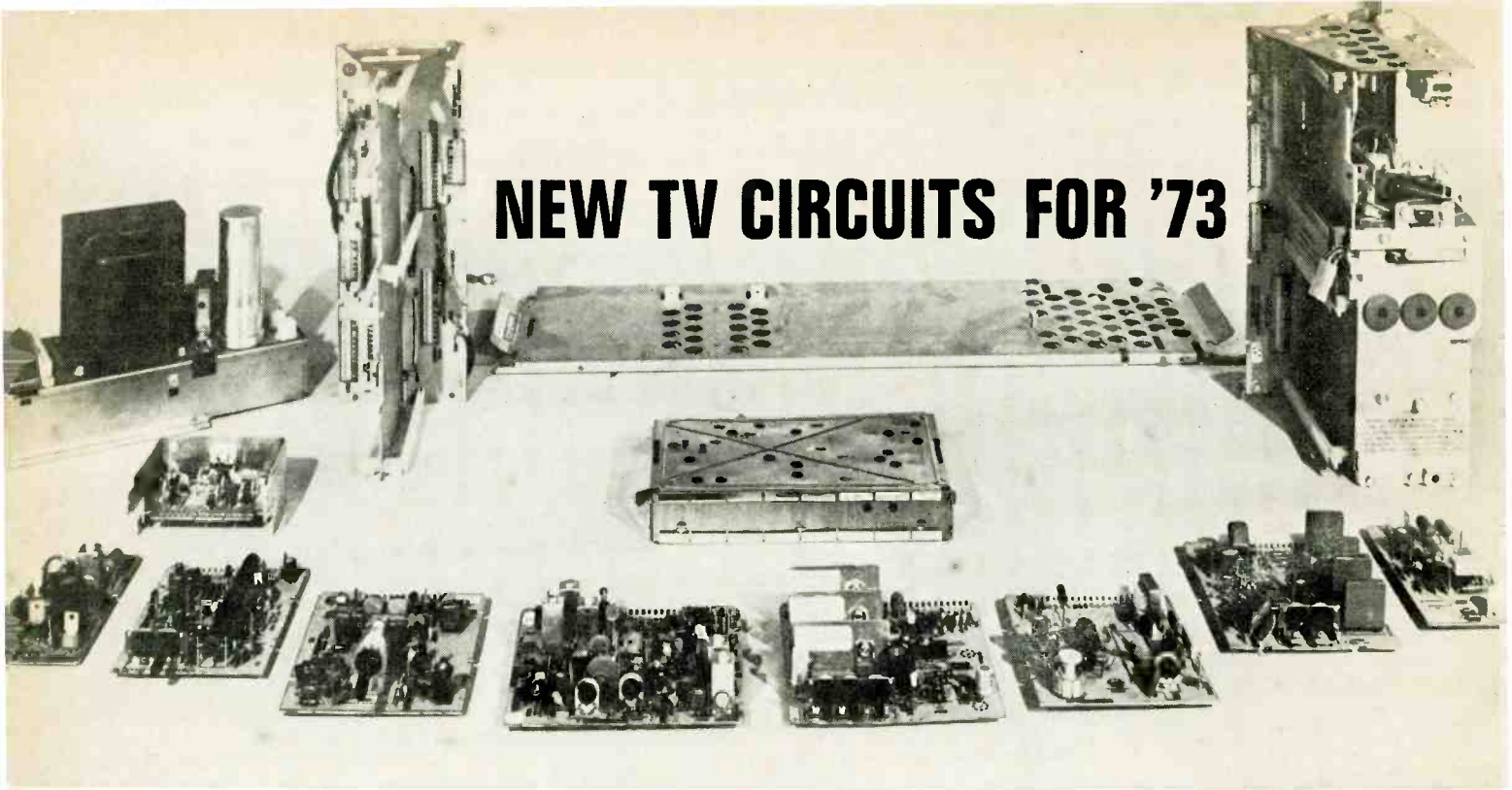
Zero voltage on the emitters of the horizontal emitter-follower and driver indicate no conduction in these transistors. No waveforms here shows why—the horizontal oscillator isn't running.

You say you have about 8 volts on both base and emitter of the oscillator transistor, but read zero on the base of the emitter-follower. This is very odd. The base-emitter junction of the emitter-follower is in the emitter return circuit of the *oscillator*—directly coupled to it! So, you could have a break in the PC board conductor between these points, or an open 100-ohm resistor in sets using that part. Or the emitter-follower transistor could have an open base-emitter junction.

There is a very small winding on the horizontal oscillator coil that goes to ground, too. If this winding is open, or has a bad ground connection, it stops the feedback and kills the oscillator. However, if the circuit *is* complete, you *should* read that 8 volts on the base of the emitter follower. Normal resistance reading from the emitter-follower base to ground should be about 2.2 ohms, through the transformer secondary winding. Check for *open* capacitors, etc.



NEW TV CIRCUITS FOR '73



THERE ARE SOME REALLY INTERESTING circuits in the new sets many of which indicate future trends. The major manufacturers all have modular chassis with 70 to 95% of their components mounted on plug-in modules. The now noticeable impact of consumerism is moving TV instrument design toward increased serviceability and safety. The arrival of IC technology has resulted in a higher degree of sophistication within the same penny-pinching guide lines that have dictated in the past. Let's look at some of the circuit features which show the direction in which we're pointed, avoiding the host of automatic and semi-automatic color controls that have appeared in great profusion, as these will be the subject of a separate article.

Power supplies

Last year Motorola introduced an electronic power supply that is synchronized to run at the horizontal line frequency 15,734 Hz*. From listening around we are led to understand that this is a definite trend, and in the next few years we will see everyone gravitating to this type of supply. Transformer core material can be drastically reduced because of the higher operating frequency, and careful design will increase efficiency since normally wasted power can be conserved. Because the bulky power transformer has disappeared Motorola has been able to put most of the supply on a single module. In its place is a transformer resembling a flyback in construction. The switching type circuit includes voltage regulation and overload protection circuitry. Efficiency is vastly improved in switching regulators because the active devices are encouraged to be either on or off where power dissipation is at an absolute minimum. Regulation is effected by changing duty cycle rather than varying the wasteful dissipation in series power resistors and transistors. Interestingly, the circuit maintains power line isolation, those of us who have ever forgotten to take the proper servicing precautions when working on a hot chassis will well appreciate. Fig. 1 is the block diagram of the supply showing how the oscillator transformer isolates the chassis from the power line by the absence of chassis ground connections in its primary circuit.

Sony's thoughts along these lines are different taking advantage of the already needed horizontal deflection—high voltage system to generate the receiver's 18-, 27.5- and 170-volt supplies. Windings on the flyback feed rectifiers and filters to supply the set's dc power. It's not perpetual motion though and an independent low-drain

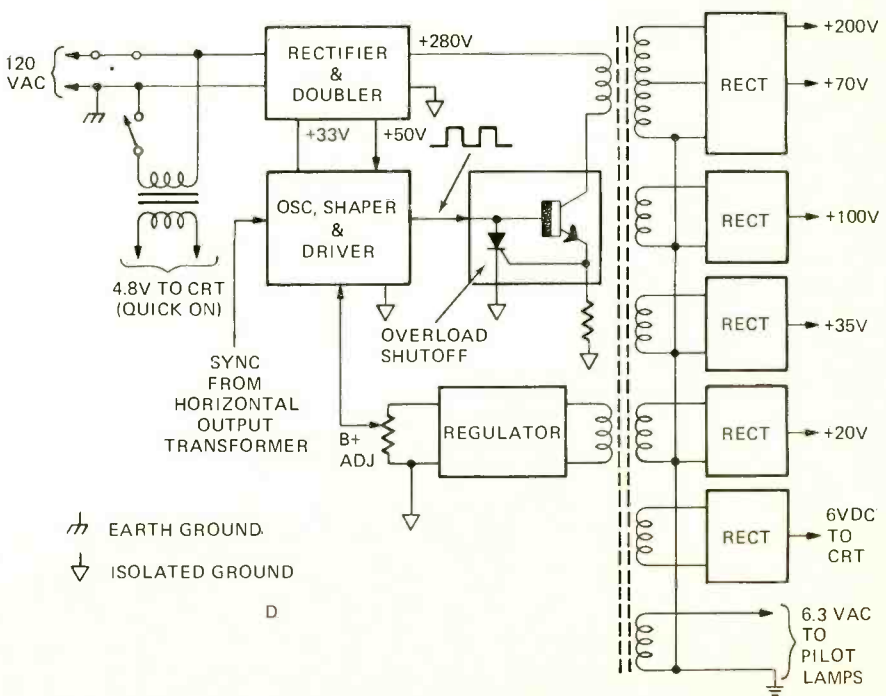
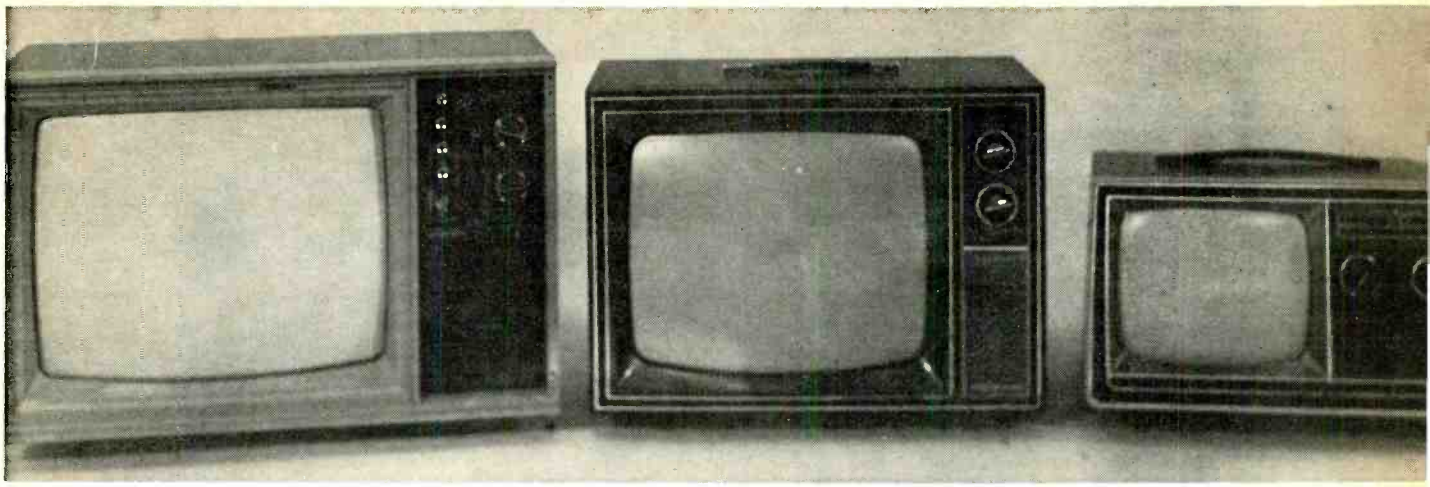


FIG. 1—ELECTRONIC POWER SUPPLY used by Motorola is presented here in block-diagram form. It operates at 15,734 Hz.

*See New Color Circuits for '72. Radio-Electronics, January 1972



Here's a preview of the latest circuits from the '73 color sets. There are nine in all ranging from an electronic power supply to a new kind of horizontal alignment adjustment to a special high-voltage indicator

by STEVE LECKERTS

130 volt supply is needed to get things started. The horizontal oscillator itself is powered from the same 18 volts it helps to generate. The 130-volt supply is used only to start the oscillator and then is automatically disconnected. Fig. 2 shows how it works. At turn-on the charging current through R555 and C531 supplies temporary power to the oscillator to get it going. When C531 is fully charged the 130-volt supply is effectively isolated from the oscillator and power is supplied by the self generated 18 volts through R536 and D510. The diode prevents the 18 volt supply bus from draining current from the 130-volt line used for turn-on. The resistor drops the horizontal oscillator voltage down to 12 volts. For troubleshooting the horizontal oscillator, horizontal deflection or high voltage circuitry the oscillator supply will have to come from some other source like an external supply. One convenient method for troubleshooting is to make the temporary dotted connections bridging a 3900-ohm 5-watt resistor around C531 connecting the 130-volt supply as the main power source for the oscillator. This modification causes a loss of efficiency so should be removed after the repair is completed.

Push-to-adjust horizontal

This is a feature that is not a trend setter because it doesn't save the manufacturer money, is not required by law, nor can be expected to be popular with the buyer, but certainly makes the horizontal alignment adjustments simple to do without the usual assortment of clip leads. It also allows a quick accurate centering of the hold control. The importance of this adjustment is overlooked by many. While the control may have been haphazardly adjusted under strong signal conditions, as the picture gets weaker the nominally ±120-Hz horizontal pull-in range becomes severely narrowed. This is because the reduced signal to noise has the effect of reducing the loop gain of the AFPC loop that reduces pull-in range. The second reason for the importance of this adjustment is that even at high rf signal levels the amplitude of impulse noise that will knock the receiver out of horizontal sync will depend on the control setting. Fig. 3 depicts the optimum and off-centered operating points of the horizontal afpc phase detector characteristic. When the operating point is off-centered a smaller disturbance will cause the detector to move past one end of the positive operating slope of this characteristic where loss of sync occurs. This simply

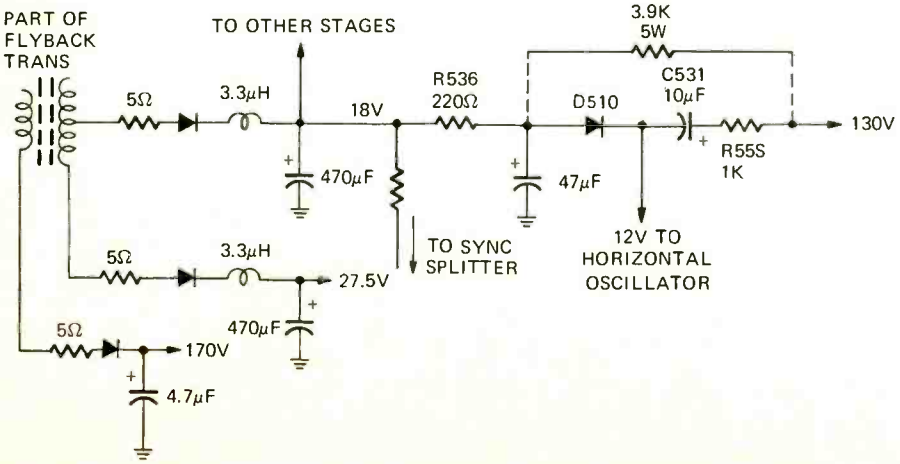


FIG. 2—HORIZONTAL DEFLECTION SYSTEM in Sony receiver is used to generate 18-, 27.5- and 170-volt supplies.

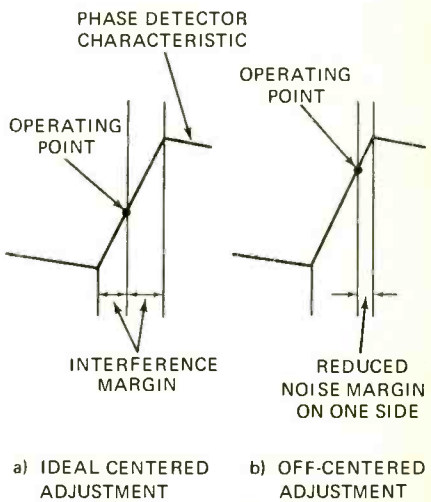


FIG. 3—REDUCED NOISE REJECTION is caused by misadjustment of horizontal circuit.

means that a smaller disturbance will send the mis-adjusted set annoyingly out of sync. Fig. 4 is G-E's approach. On their modular JA chassis used in 10-, 16- and 19-inch receivers they have included a sync shorting switch on the horizontal hold control disabling the sync when the shaft is pushed in. The control can then be adjusted for a floating picture so that its right and left edges are vertical and are slipping by as slowly as possible. This assures that the horizontal oscillator is close to a free running frequency of 15,734 Hz giving the ideal situation of Fig. 3. Magnavox uses the center position on their service switch as shown in Fig. 5 to short the plate of the sync amplifier to ground.

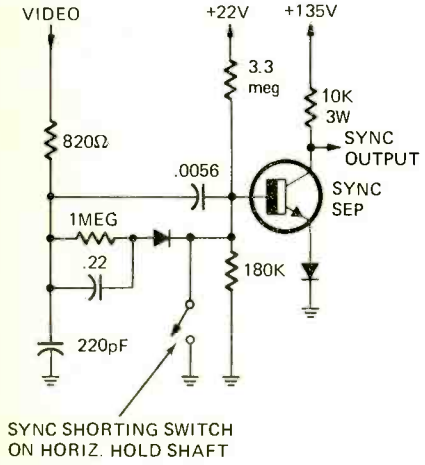


FIG. 4—SYNC DISABLE SWITCH is used by GE in their modular JA chassis.

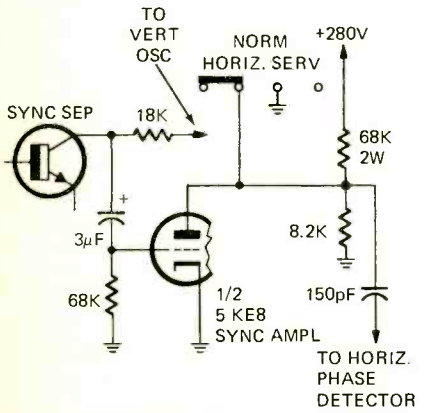


FIG. 5—ANOTHER SYNC DISABLE switch circuit. This one is used by Magnavox.

Hold down circuits

Because of the recent X-ray scare the department of Health, Education and Welfare is issuing requirements for public protection from radiation. One of the requirements is that a non-usable picture be produced if there is a malfunction that causes excessive high-voltage. On some RCA sets when an over-voltage condition is sensed the horizontal oscillator is pulled low in frequency. The design is such that the picture cannot be put back in sync by any adjustment or misadjustment of the customer or factory controls. This circuit must be separate from the high-voltage regulator since one of the important things it must do is protect against a malfunction in the regulator. The circuit can be easily tested by shorting two chassis test points. Another approach in used by RCA in their CTC 63 shown in Fig. 6. The high voltage is sensed by applying the B-Boost to the voltage divider R109, R110, R105, R107. R107 is factory adjusted and sealed. When the voltage is excessive neon lamp DS101 is fired turning on the vertical blanking transistor. The picture is black which is about as unwatchable as you can get. It should be remembered when servicing this chassis that a defect in the protection circuit or high-voltage circuits have to be considered as possible causes of loss of video. The neon lamp will be lit if the protection circuit is blanking the picture. Philco's protection system monitors the typically 26,500-volt kinescope anode supply. If the voltage goes above 30,000 volts the guard circuit disables the horizontal oscillator. The receiver is shut down and remains inoperative until repaired.

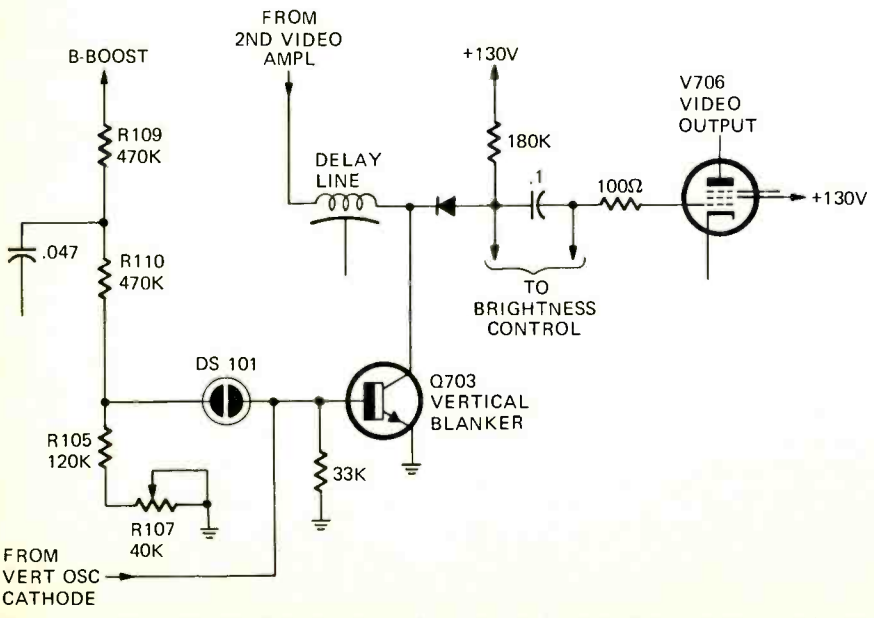
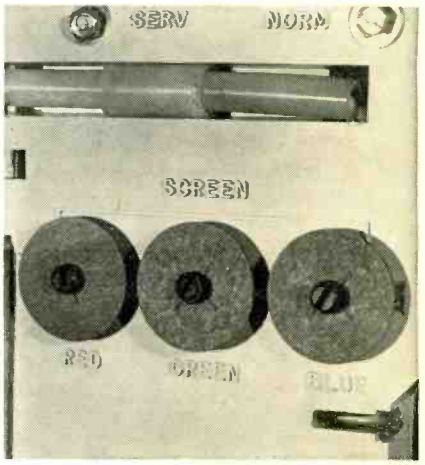


FIG. 6—HIGH-VOLTAGE PROTECTION CIRCUIT is used by RCA in their CTC-63 chassis. If high-voltage becomes excessive, the picture blacks out.

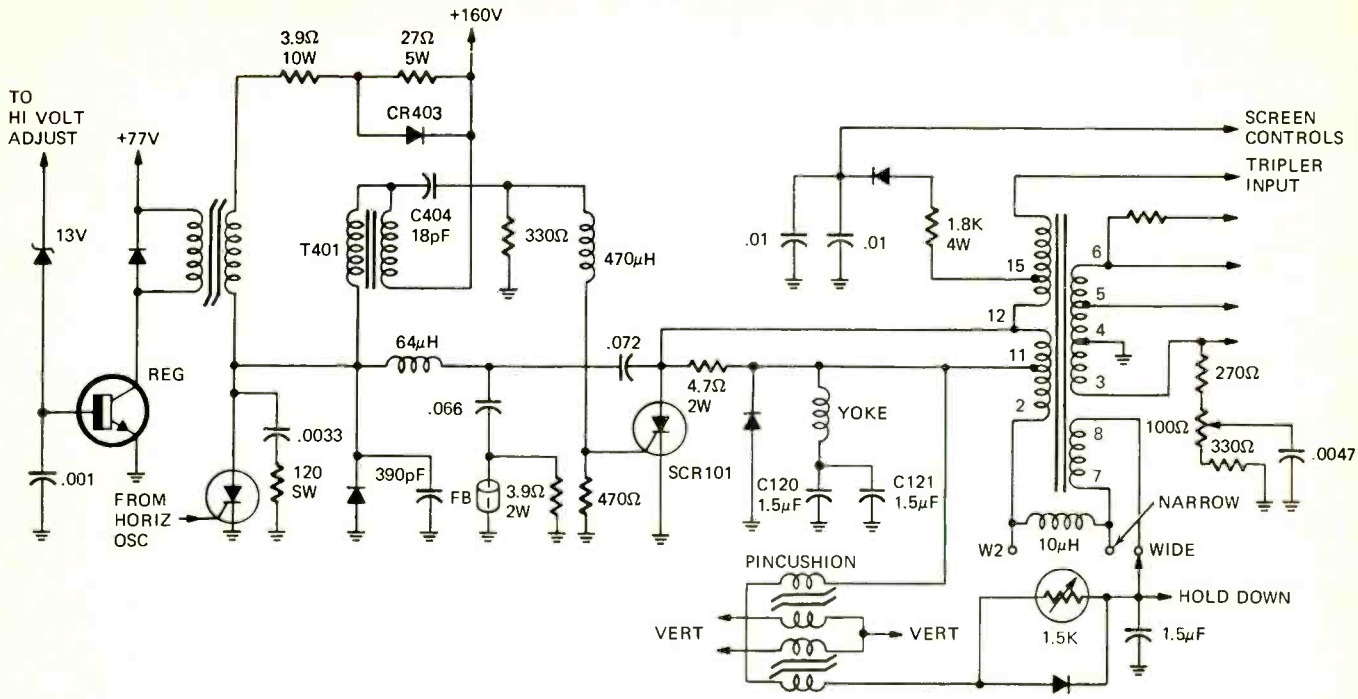
Uhf varactor tuners

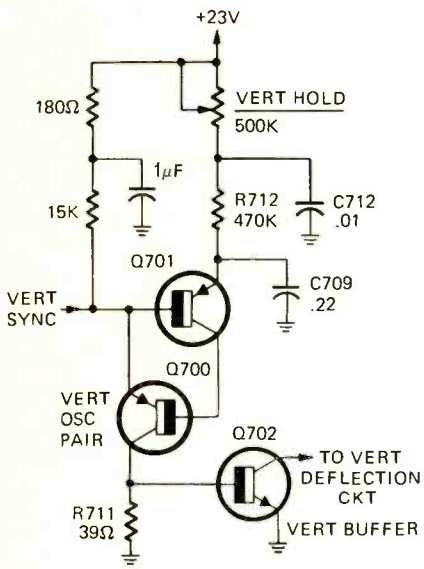
In reaction to the FCC's tuner parity requirements the manufacturers have been busy developing both detented and varactor tuned uhf front ends to make uhf tuning as easy as vhf. The varactor tuners presently



NEON LAMP below blue screen control glows when G-E chassis high voltage operates.

seem to be showing up in remote control equipped sets since they can be preset to a fixed number of channels. The reverse voltage on a series of varactor diodes electronically determines their capacitance controlling the tuning. The mechanically stable diodes take the place of the rotating tuning gang eliminating mechanical wear. Motorola uses a 13-position switch on their uhf wheel allowing remote selection of the same number of channels. Each position contacts a pre-set 30,000-ohm potentiometer by slip rings to tune the varactors to the chosen channel. Four varactor diodes are used in this tuner's resonant lines. RCA has a similar 8-channel system while Dumont, Emerson and Admiral use 6-channel selection. The last three tuners appear to be identical. Varactor tuners open up many possibilities such as automatic search modes now available on some similarly tuned FM receivers. There are such possibilities as digital indicating systems to display channel numbers on the TV screen or digital display, with the selection of the display generated by the same dc voltage or potentiometer that does the varactor tuning. Although frequency dial-in as presently available on 2 or 3





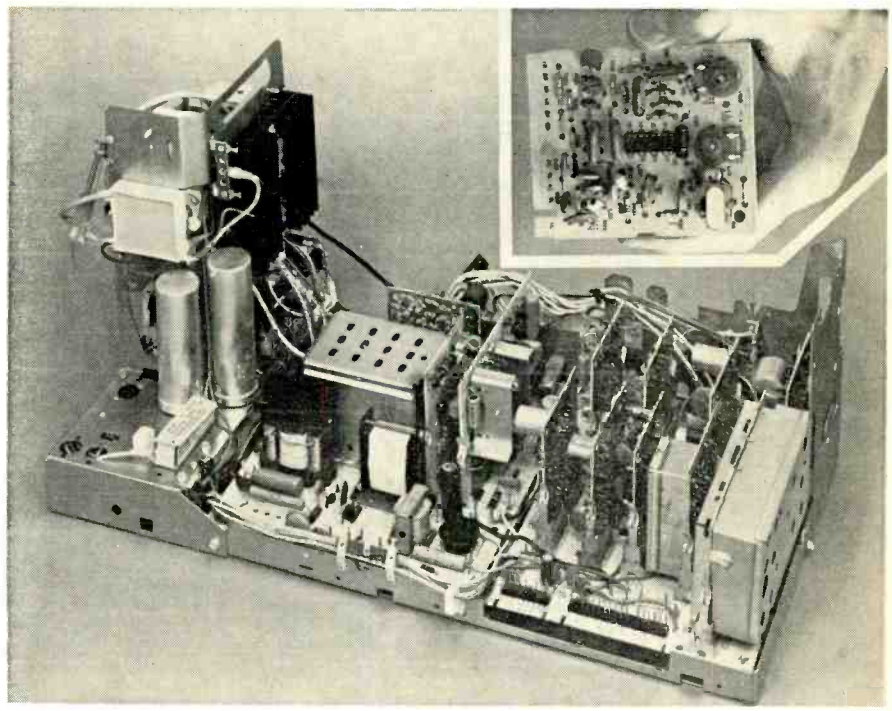


FIG. 7—(top) SCR DEFLECTION circuit is used by RCA.
FIG. 8—(above) PROGRAMMABLE unijunction is used in G-E's vertical oscillator. ALL SOLID STATE PHILCO CHASSIS (right) has 14 plug-in modules.

FM tuners is not practical because nobody wants to remember TV picture carrier frequencies, a channel number dial-in system is probably being worked on now.

SCR deflection

RCA is the sponsor of this unique system first introduced in 1968 which now appears in some Heath and Philco sets. A number of changes have been made this year. The high voltage quadrupler has been replaced with a tripler with the pulse amplitude from the flyback raised from 7.5 to about 9 kilovolts. Along with other set manufacturers using high-voltage multipliers, the use of flame-retardent insulation as well as the elimination of radiation because of the lower voltage, allows the high voltage cage to be eliminated on some models. In Fig. 7, input reactor T401 is now wound as an autotransformer. If C404 becomes leaky; SCR101, the trace SCR will be turned on. Grounding the anode of this SCR is recommended procedure for killing both the high voltage and deflection. Since leakage through C404 turns on the SCR grounding the anode, it will have the same effect. Previously a variable inductor in series with the yoke was used for scan width adjustment. Width is now changed by selecting flyback primary taps. To reduce voltages across the SCR's the yoke impedance in the CTC48 chassis has been lowered to 325 microhenries. This lowered impedance means the yoke must be driven from a correspondingly lower impedance. Paralleled capacitors C120 and C121 are now used to this end.

High-voltage indicator

While we are talking about deflection systems it should be mentioned that arcing the high voltage to test for its presence is a dangerous technique. Although the set makers have taken prudent caution for relia-

bility of their circuitry, it is possible to cause device damage by this practice. To provide a good servicing aid and to discourage this arcing test GE in their transistor deflection MA 25 inch chassis has mounted a neon lamp in the high voltage compartment visible from the rear. The lamp glows when high voltage is present, a good basic and effective idea. On this same chassis protection for the high voltage regulator is provided by using an SCR to open a circuit breaker in the secondary of the power transformer when the regulator is overloaded. The SCR gating circuit is designed so that occasional high voltage arcs will not trigger it. Sustained arcs however will open the breaker.

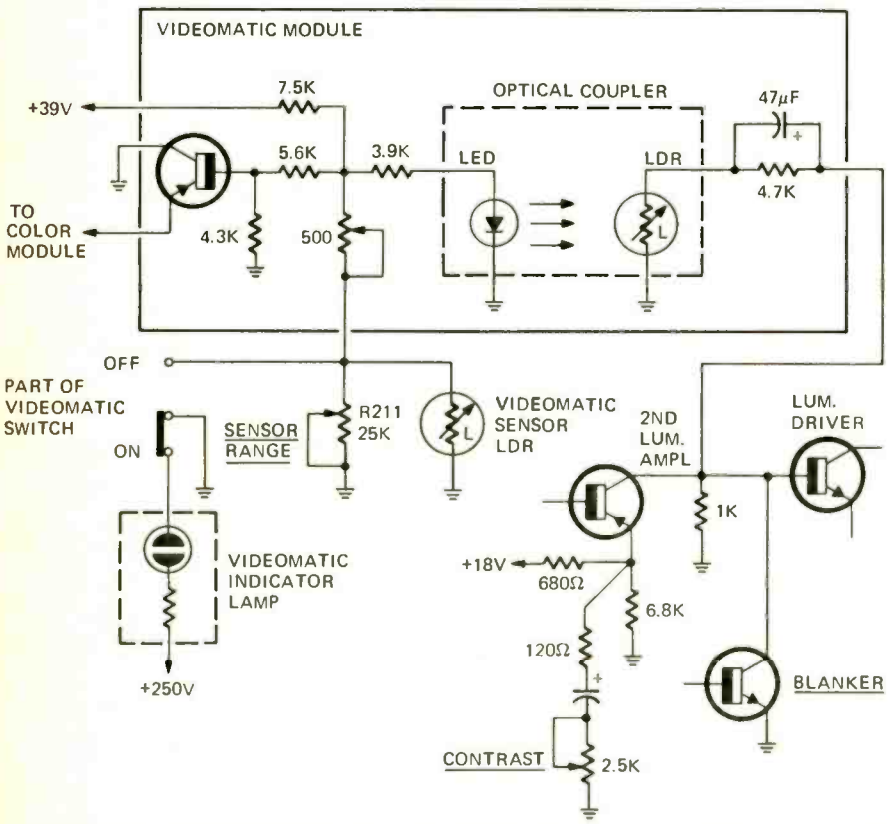
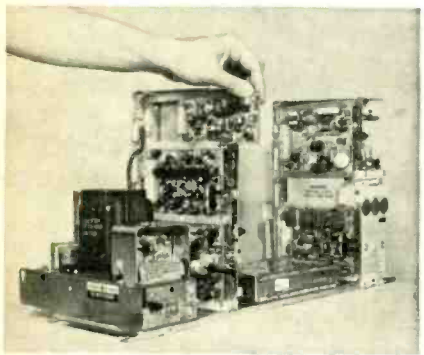


FIG. 9—VIDEOMATIC SYSTEM used by Magnavox controls automatic changes in brightness, contrast, and chroma level.



TEN PLUG-IN MODULES contain 66% of the total electronics components in this new color chassis from General Electric.

Vertical oscillator

An unusual configuration is used in the vertical oscillator of the GE MA modular chassis. The two transistors Q700 and Q701 in Fig. 8 are connected analagously to the internal construction of a PUT or programable unijunction transistor. When the receiver is first turned on C709 is uncharged and both transistors are nonconductive. C709 charges with a time constant determined by its value and the combined resistance of R712 and the vertical hold control. C712 has a negligible effect on the charging time since it is 22 times smaller than C709. When the emitter of Q701 reaches the voltage on its base plus the base-to-emitter junction voltage the device starts to conduct, and because of its regenerative connection to Q700 the transistor pair turns on. The positive feedback of the transistor pair is explained as follows: As the base-to-emitter junction becomes forward biased its collector current increases from zero. Since the collector current of this transistor is also the base current of Q700 it also begins to conduct. The collector current of Q700 is in a direction to pull down the base voltage of the upper transistor turning it on harder, completing the feedback path. This action continues rapidly until the devices latch. When triggered on, all the terminals of the two transistors can be considered shorted together. C709 now discharges through R711 and the base-to-emitter junction of the vertical buffer Q702. As the capacitor discharges the current through the pair falls reducing the regenerative gain until the configuration can no longer maintain its latched condition. The transistors now revert to their non-conductive states and the cycle begins anew. The base of Q701 is an ideal place to insert the vertical sync pulse. A negative pulse here will cause the oscillator pair to turn on early synchronizing its cycle with the vertical sync timing. In the analagous pnpn PUT device the anode corresponds to Q701's emitter, its gate to the base of Q701 and the cathode to the emitter of Q701.

Light activated controls

As television receivers become more automatic and color picture tubes become brighter, the idea of semi-automatically controlling brightness becomes impossible to ignore. After an initial adjustment of the brightness control, lowering ambient room light could lower picture brightness and vica versa. Magnavox is the first to bring this automated refinement into practical fruition. In addition to controlling brightness, contrast and chroma level are also changed to keep the picture properly proportioned. Fig. 9 shows the guts of the system. The videomatic light dependent resistor (LDR) becomes functional when the videomatic switch is turned on, ungrounding the LDR. The LDR in parallel with the SENSOR RANGE adjustment pot R211 are part of a voltage divider. Change in ambient light intensity has two effects in the Videomatic module. Let's assume an increase in room light has lowered the resistance of the LDR sensor. One effect is the lowering of current in the optical coupler's LED lowering the light emitted by the diode and the resistance of its coupled LDR. This LDR in series with the parallel combination of the 47-μF capacitor and 4700-ohm resistor is in parallel with the 1000-ohm collector load of the 2nd luminence amplifier stage. The net effect then is a lowering of the collector load of this amplifier by the increase in ambient light lowering the stage's gain. The reduction in gain lowers both picture brightness and contrast, the proportioning determined by the ratio of unbypassed resistance to the bypassed 4700-ohm resistor. Returning to the Videomatic module the same increase in ambient light reduces the base voltage on the PNP emitter follower. The reduced output of this follower is routed to the color module biasing the acc demodulator in a direction to decrease the color level.

That wraps up nine important new circuits to see service in '73. **R-E**

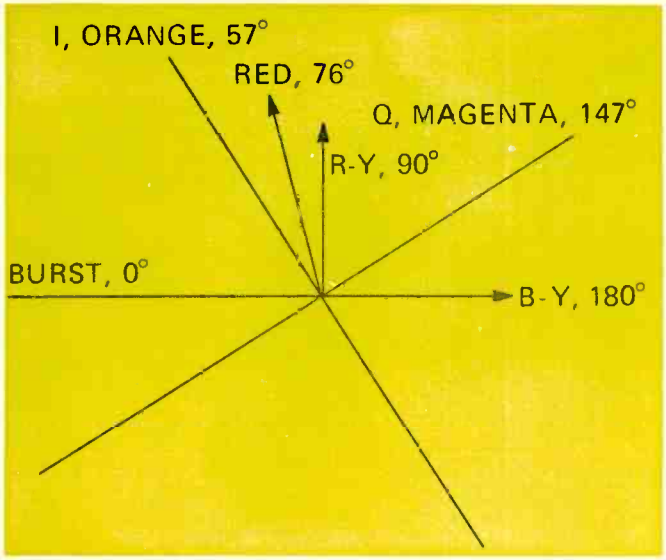


FIG. 1—COLOR phase diagram of a transmitted color signal showing I, Q, red and R – Y vectors

AUTOMATIC COLOR CONTROLS

Almost every color TV maker is using some sort of automatic color control. Here's an introductory look at some of the circuits in the '73 color sets

by HAROLD STEVENS

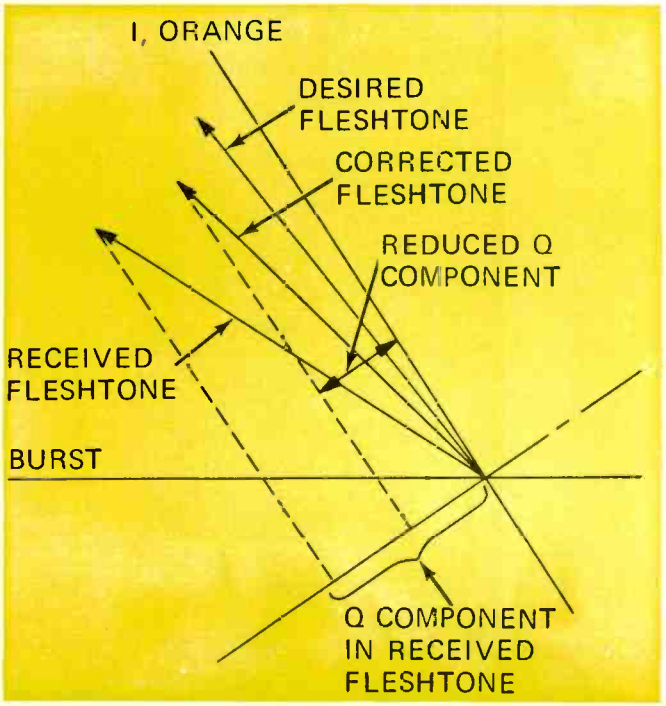
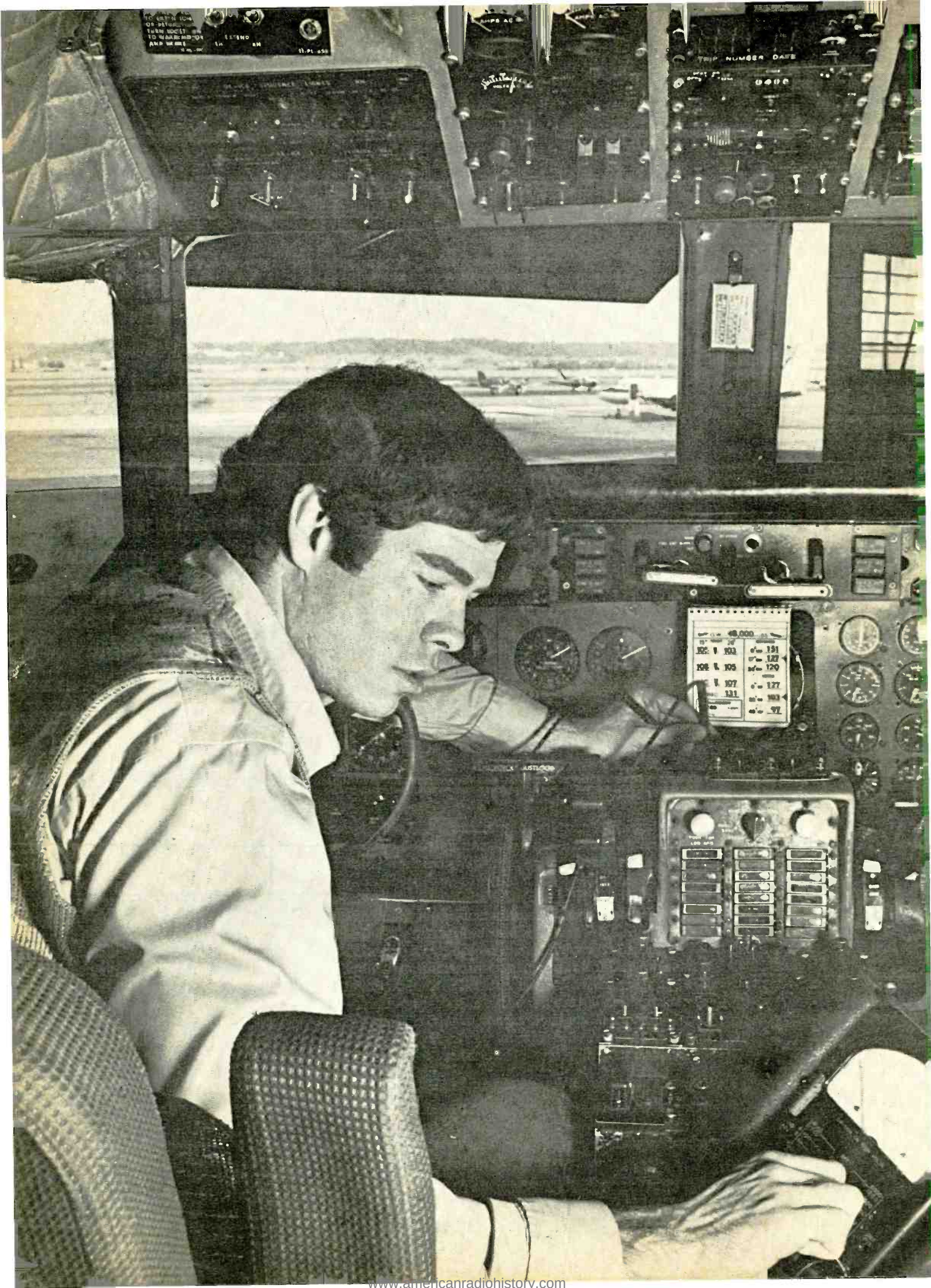


FIG. 2—FLESHTONE errors are related to the immaginary I and Q signals that do not actually exist in the receiver.

INSTAMATIC, ACCUCOLOR, PHILCOMATIC, ATC, One Touch. . . . what's it all about. There is quite a bit of confusion surrounding automatic color and other systems. By listening to salesmen you usually get deeper into limbo. Let's delve into the mysteries of these systems and also try to determine what has created the need for them in the first place. All these systems are basically automatic tint correction schemes in various combinations with automatic frequency control and preset or narrowed range contrast, brightness, color and tint controls.

Stemming from the apparent inability of the TV stations from transmitting flesh tints of equal phase, not only from station to station, but from production to commercial, the automatic tint circuits are the center of some controversy. The problem is partly created by the fact that the signal is reprocessed at the point it is transmitted, which of course may be far from the originating source. When the sync and burst is reinserted errors occur. There have been several experiments with VIR (vertical interval reference) signals placed on the 20th line of the transmitted signal. Some say that the TV receiver should be equipped to operate on such a VIR signal to make error correction nearly perfectly. Others feel, that because of the complexity of the equipment needed to make corrections at the receiver it is logical that the stations use the VIR signal to correct the signals before they get on the air. We agree with the latter since the station should be responsible for doing everything within their power to transmit

(continued on page 50)



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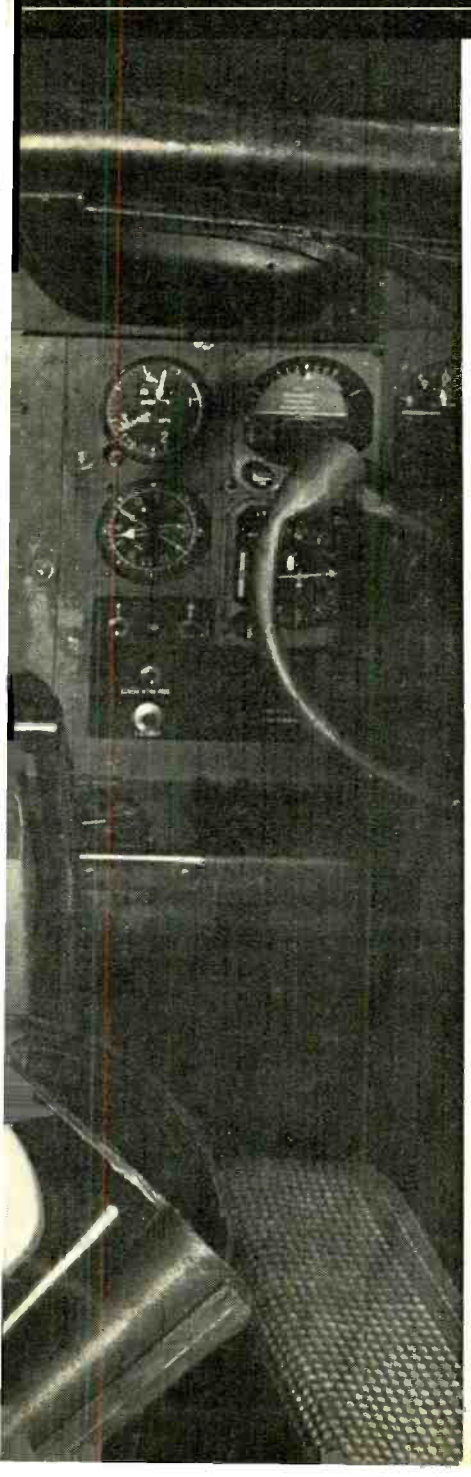

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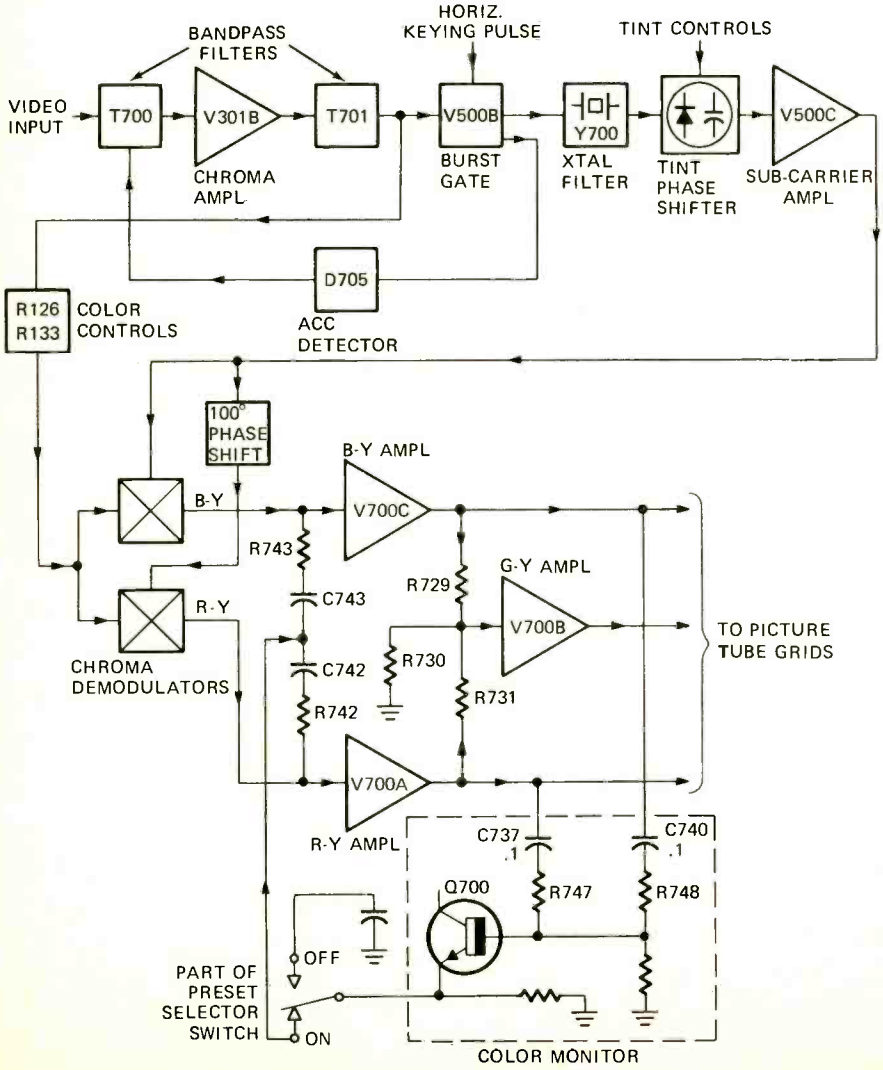
a technically correct signal.

Anyway while the experimentation and discussion goes on we are stuck with second best. Everybody has jumped on the bandwagon with automatic tint correction to automatically bring fleshtones closer to their ideal hues. The system works but we don't get something for nothing. It turns out these automatic correction schemes introduce a form of distortion. However with most average pictures, and without a side by side comparison the overwhelming opinion is that the distortion is small. Because of the profusion in which these circuits have appeared plus the useful function they perform it behooves us to understand the basics of their operation and some of their specific applications.

Once the explanation of the two phase diagrams Fig. 1 and 2 are understood, the rest is easy. Fig. 1 is the phase diagram of a transmitted color signal showing the I, Q, red and R - Y vectors. Color TV uses a quadrature modulation system so called because amplitude and phase information can be encoded and demodulated from the same carrier by using two demodulators with a phase shift of 90 degrees between their carrier inputs. The important point is that we can create a modulated signal that is shifted in both phase and amplitude. In this case the amplitude is chosen to represent the color amplitude or saturation while the phase information represents the hue or color. The reason we always see the I and Q carriers on these diagrams is that these are the two phases of 57° and 147° with respect to the burst that the transmitter uses to generate the chroma signal. On this diagram any particular angle of a drawn vector corresponds to a different hue. The I vector happens to correspond to orange close to the fleshtones we are so interested in, and the Q vector corresponds to magenta. For illustration we have included a red vector that has an angle of 76 degrees clockwise from the reference burst. The receiver, by comparing the instantaneous phase of the chroma signal to the burst sent during the horizontal blanking interval determines the hue at any given moment. In the early days of color television, receivers would actually demodulate along the I and Q directions and then convert these into red, blue and green drive signals by a rather complex matrix. Experience with the animal soon led to the simpler method of detecting along the R - Y and B - Y axis. Located 90° from the burst is R - Y and at 180° B - Y, where Y represents the black and white or luminance signal. If the received color signal is demodulated along these 90 and 180 degrees axes, upon adding back in the luminance signals we have reproduced the red and blue signals. A simple matrixing produces the G - Y from the other two color difference signals and we're set. The I and Q vectors are just used as points of reference and in fact do not actually exist in the receiver unless they are produced by matrixing for some purpose. In Fig. 2 we will relate fleshtone errors to these two imaginary I and Q signals. It turns out these two are indeed convenient for reference since the I vector is very close to the fleshtones that cause trouble. In this diagram we have labeled one vector "desired fleshtone." This is the angle which in our particular imaginary receiver represents fleshtone. This is the angle at which we want a received fleshtone to coincide. Because of some source of error, however, we actually



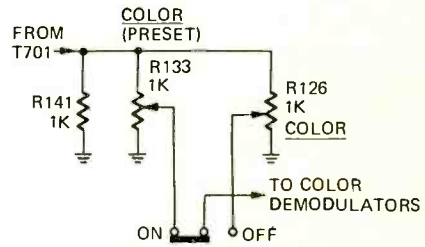
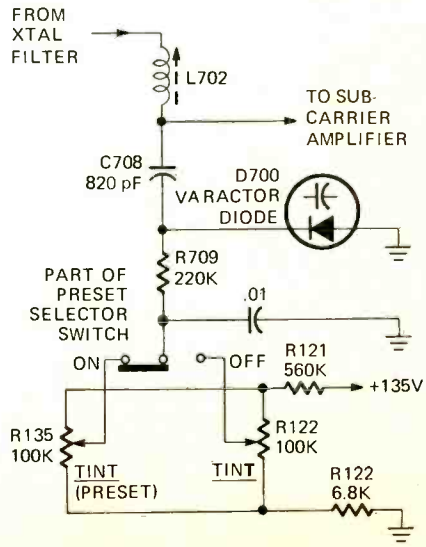


FIG. 3—(left) BLOCK DIAGRAM of the color-processor circuit used by Admiral. It is a ringing-type system.

FIG. 4—(above) COLOR CONTROL scheme in Admiral receivers is a simple attenuator with the color control the variable element.

FIG. 5—(below) THIS AUTOMATIC TINT circuit is used by Admiral. They call it their "Color Monitor."



receive a fleshtone at an angle indicated by the "received fleshtone" vector. Now what we want to do is to rotate this vector as close as possible to the desired fleshtone vector. Any vector can be broken up into components on two other axis. We can take the received fleshtone vector, for example and break it up into two components along the I and Q angles by drawing perpendicular lines to these two from the end of the vector. Note the Q component results in the corrected vector shown in the diagram. This one is much closer to the desired fleshtone and we have reduced the error. It can be shown mathematically that one way to produce this effect is by doing two things. First change the demodulation angle between the R - Y and B - Y vectors. The R - Y axis is rotated counter-clockwise in the vicinity of 70° and the B - Y axis shifted clockwise toward 200° increasing the angle between the two. The second thing that has to be done is to reduce the amplitude of the blue signal. This is the most popular method used to produce automatic tint correction. The other ways to reduce the Q or non-fleshtone components will be discussed when they appear. You can think of the effect by viewing the unmodified phase diagram as a circle with all colors having equal magnitudes. The modified diagram then becomes an ellipse with the minor axis corresponding to the Q vector. The circle has been squashed at its middle to reduce phase angles away from the fleshtones. This is why we say this system creates distortion since the various hues are changed depending on their particular phases.

Who is doing what

Admiral—*Color Master* is the name of this system. When it's switched in four things happen. The automatic frequency control is activated, the front mounted color and tint controls are disconnected with the rear mounted color and tint controls functionally replacing them, a blue light is lit, and of course the color monitor or flesh tone correction scheme turned on. Fig. 3 is the block diagram of Admiral's color processor. It is a ringing type system as the regenerated 3.58-MHz carrier is produced by ringing a crystal filter by passing the burst signal through it. The system does not use a color killer since lack of burst information will produce no sub-carrier. The color difference signals are applied to the picture tube grids. The required red, blue and green signals are produced in the picture tube by inserting the luminance or Y signal at the cathodes. The G - Y signal is formed by a simple voltage divider matrix from the B - Y and R - Y signals as suggested earlier. Fig. 4 shows the color control scheme is simply an attenuator with the color control the variable element. The preset operates by switching between the wiper of the front mounted color control and the rear mounted preset. The tint control circuit of Fig. 5 is the type of system which is going to predominate in the future. It's significance is that it is a dc control. There is no ac signal appearing on the control itself. This gives the manufacturer a great deal of freedom in placing the control since he does not have to worry about the effect of the cable length and its exact positioning. Also there are the cost savings of eliminating coaxial runs and the reduced number of shield connections. The scheme works by the position of the tint control determining the reverse bias of the varactor diode and in turn it's capacitance. Since D700 is part of an LC phase shifter, varying its capacitance changes the shift through the network having the desired effect. Again the *Color Master* switches in the preset control by selecting its wiper. In this system the front-mounted controls are completely disconnected and have no effect when Color Master is activated. Return now to Fig. 3 Admiral's version of automatic tint circuitry. *Color Monitor.* This first system we're looking at works differently than the widened phase angle method we discussed previously. Here we mix the correct proportion of B - Y and R - Y signals to reproduce the Q signal we are trying to reduce. In this instance the Q signal is not imaginary but real since we have reformed it. The matrixed signal at the base of auto tint transistor Q700 is fed back to the inputs of the B - Y and R - Y amplifiers. The Q components of the color signal find themselves in the degenerative feedback path of these amplifiers reducing the Q amplitude and correcting the fleshtones.

In Admiral's M20 modular chassis the *Color Master* system has the same

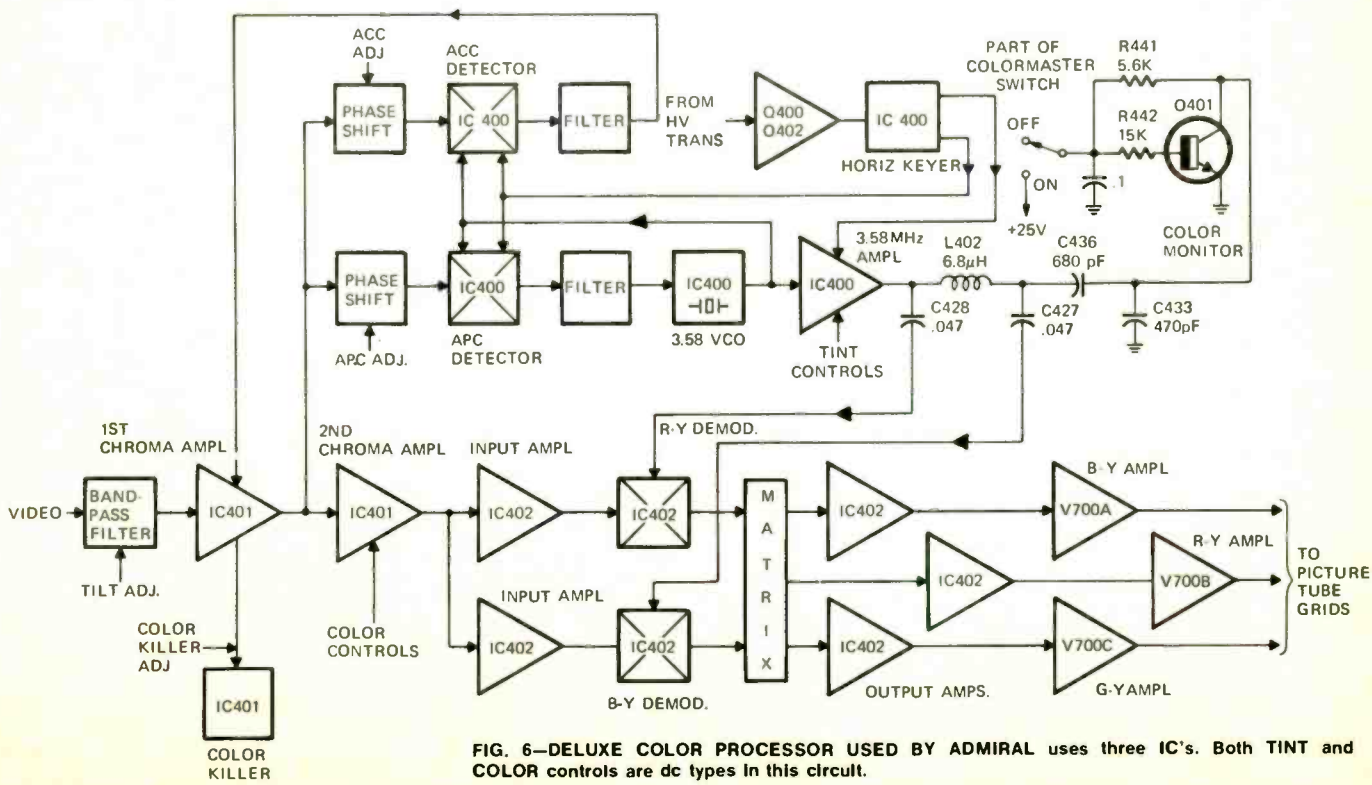


FIG. 6—DELUXE COLOR PROCESSOR USED BY ADMIRAL uses three IC's. Both TINT and COLOR controls are dc types in this circuit.

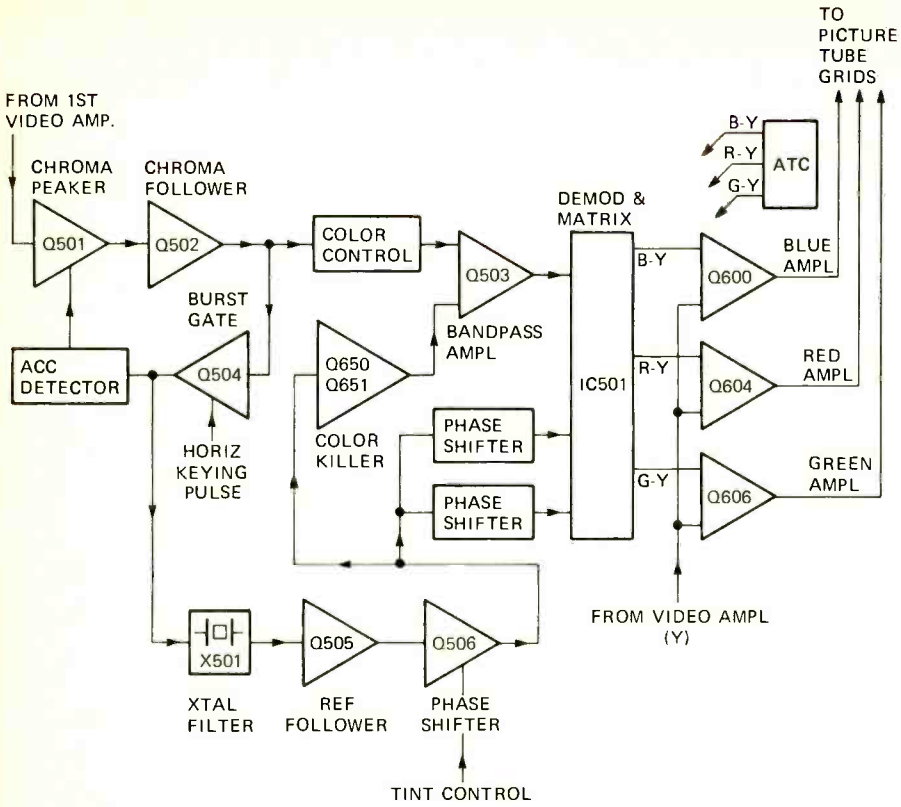


FIG. 7—GE COLOR PROCESSOR is used in many '73 chassis. The "One-Touch" circuit includes TINT, COLOR controls and the TINT LOCK circuit.

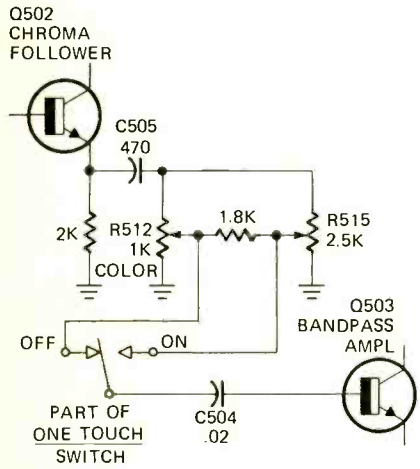


FIG. 8—CLOSE-UP OF COLOR CONTROL used in GE JA chassis. This is a part of the "One-Touch" color system.

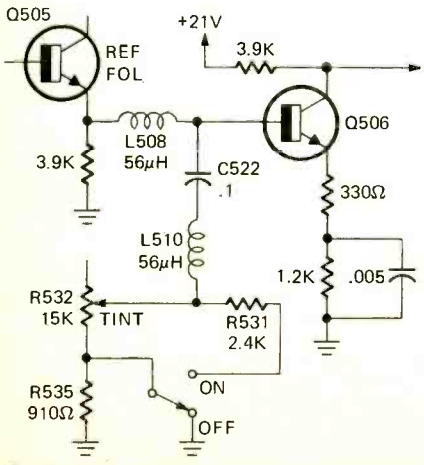


FIG. 9—THIS TINT-CONTROL CIRCUIT is also a part of the GE "One-Touch" color system. It too, is used in the JA chassis.

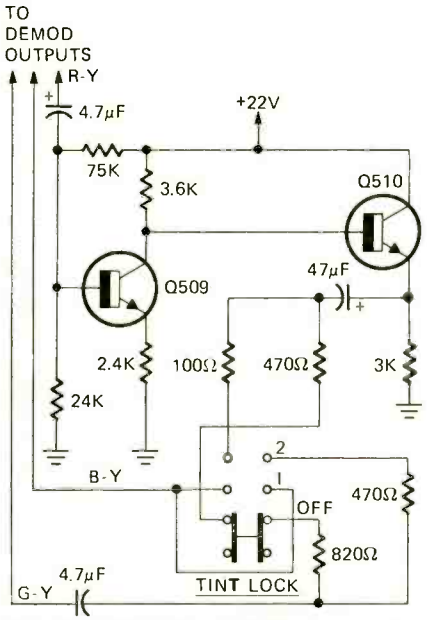


FIG. 10—TINT-LOCK CIRCUIT changes the color difference matrixing in the right ratios to reduce the Q component in GE color sets.

effect but the automatic tint circuits work differently. The presets operate exactly as before. Fig. 6 is the block diagram of the M20 processor. This system uses three IC's. IC400 is the subcarrier regenerator which produces the 3.58 MHz subcarrier by the action of a phase-locked-loop operating on the keyed burst. This is a more theoretically ideal system and is a good illustration of where integrated circuits prove their worth. Both tint and color controls are dc types in this circuit. The *Color Monitor* in this receiver works by switching Q401 on or off. When the transistor is off C436 and C433 are series connected to ground and when the transistor is on C436 is effectively connected directly to ground. This changes the phase shift of the sub-carrier reference to the B - Y demodulator.

DuMont—As far as we could tell the DuMont system is identical to the previous one, except that it is called *Dumatic.*

Emerson—Again this system "*Permacolor*" is similar to Admiral's with two variations. First the aft system is activated separately from *Permacolor* and has its own switch. In addition to the Color and Tint presets there are brightness and contrast presets. All these systems are tested by setting the tint controls to give greenish or purplish faces. When the tint correction circuits are turned on a shift toward the normal fleshtones should be seen.

General Electric—The "*One Touch Color*" system is featured on their JA 10- 16- and 19-inch sets and the MA 25-inch modular chassis. Fig. 7 is the block diagram of the JA one-chip (IC) color processor with Figs. 8, 9 and 10 showing the color control, tint control and Tint Lock circuits. In the GE system when *One Touch* is turned on, a neon lamp is lit, the color and tint ranges are narrowed and apc is enabled. The tint correction scheme called *Tint Lock* is activated by a separate switch with two degrees of correction selectable. The color control is prejudiced by the setting of the 2.5K pot in Fig. 8 when *One Touch* is activated. The color control now has a more limited range and while the control is going to be closer to normal setting if misadjusted, some range of control is left in the user's hands. The tint control works similarly with a reduced range by switching some resistors. Incidently note that this receiver uses a RGB system where the luminance or Y signal is combined with the color difference signals ahead of the picture tube. The *Tint Lock* system works by switching in a two stage matrixing amplifier as shown in Fig. 10. This changes the color difference matrixing in the right ratios to reduce the Q component.

The *One Touch* system in the MA chassis (Fig. 11) gives the same results. Again a three position *Tint Lock* switch is used with Off, 1 and 2 positions. This gives a choice of the normal 104° or widened 135° demodulation angle. The tint control range is reduced to about 40 degrees while maintaining the average tint level. The color gain range is also reduced while maintaining the same average dc level. This chassis uses a two-chip (TC) color processor. IC601 contains the

(continued on page 71)

the state of SOLID STATE

A glimpse into the future at what's on store for semiconductors and at what's new in semiconductors and associated hardware.

by LOU GARNER
SEMICONDUCTOR EDITOR

FOR NEARLY TWO DECADES, NOW, we've enjoyed playing a "guessing game" with the electronics industry. From time to time, we've predicted new developments in technology, guessed at the introduction of unique devices, and projected the manufacture of various solid-state products. Back in the early 1950's, for example, in an elementary book on transistors, we predicted that . . . *within a minimum of five, a maximum of ten, years, more transistors than vacuum tubes would be used in the manufacture of new electronic equipment.* Written at a time when a so-called "low-cost" experimenter's transistor sold for $7.50 each (that's right, *seven dollars* and fifty cents!), and more reliable units hit the fifty dollar, or better, mark, this prediction brought guffaws from tube manufacturers, gales of laughter from vacuum-tube circuit designers, and even skeptical smiles of disbelief from semiconductor producers.

But the prediction came true!!!

Our batting average, over the years, has been a little better than fair-to-middling. Of all the predictions made, *97.3%* have been fulfilled, although not necessarily within the time limits we projected; however, *89.6%* did come true within the predicted time limits.

The crystal ball game

Following established tradition, we're climbing out on the proverbial limb with the following predictions for 1973:

• *Low-cost LED's other than red and infrared.* While the prices of some light-emitting diodes have dropped considerably, the cost of green and yellow devices remains quite high, but we now foresee a significant reduction in the prices of LED's furnishing other than red (or infrared) light. You can expect a 2-color LED too. It changes from red to green as the applied voltage is increased.

• *A new solderless breadboarding system.* Although a number of specialized solderless breadboards have been developed over the years, few have involved complete systems, including components as well as a chassis. We predict, then, the introduction of a new and unique breadboarding *system* ideal for the assembly of equipment designs using IC's and readily adaptable to discrete component circuits as well.

• *Inexpensive programmable solid-state electronic calculators for small business and consumer applications.* The overwhelming success of the pocket electronic calculator using LSI circuitry will lead, we feel, to the introduction of low-cost *programmable* calculators, with special programs for, say, real estate dealers, insurance salesmen, and income tax preparers. Offhand, we project a selling price of under $200.00, retail.

• *A new electronic accessory for automobiles.* Heretofore, the majority of solid-state automotive accessories have been simply semiconductor versions of previously existing products. The transistorized ignition system, IC voltage regulator, or solid-state radio are typical examples. We foresee the introduction of a completely new auto accessory made possible by advanced semiconductor technology and possibly incorporating a special LSI chip as well as digital displays.

• *The development of a new manufacturing technology.* The actual cost of materials in most semiconductor devices, even complex LSI's, is but a few cents. Such factors as yield rate, assembly, and testing contribute to selling prices in the multidollar range. We envision a significant development which may drop the eventual cost of IC's to the price of single transistors.

• *Low-cost solid-state electronic calculators.* The handwriting is clear on this one. Although (as this is written) electronic calculators are now selling in the $60.00 to $150.00 price range, we feel that mass manufacturing economies will drop the price below $50.00 before the end of 1973, virtually driving low-cost electromechanical calculators off the market.

• *A significant breakthrough in electro-optical display arrays.* We find the vision a little blurred on this forecast, but have a feeling it has something to do with TV sets. Could be digital, however.

• *An exciting new solid-state crime fighting product.* With the crime rate increasing in most areas, we'll keep our fingers crossed on this prediction, hoping we're right.

That's it for 1973—next January we'll see how we made out.

FET circuits revisited

Last September, you may recall, we featured a pair of interesting FET circuits abstracted from *FET Design Ideas,* Bulletin CB-145, a valuable 20-page booklet published by Texas Instruments, Inc. (P.O. Box 5812, Dallas, Tex. 75222), promising to review other circuits in the future. In accordance with our promise, and in response to numerous reader requests, we are pleased to feature two more circuits from the TI booklet—a wide-band amplifier and a MOSFET video i.f. amplifier, illustrated in Figs. 1 and 2, respectively.

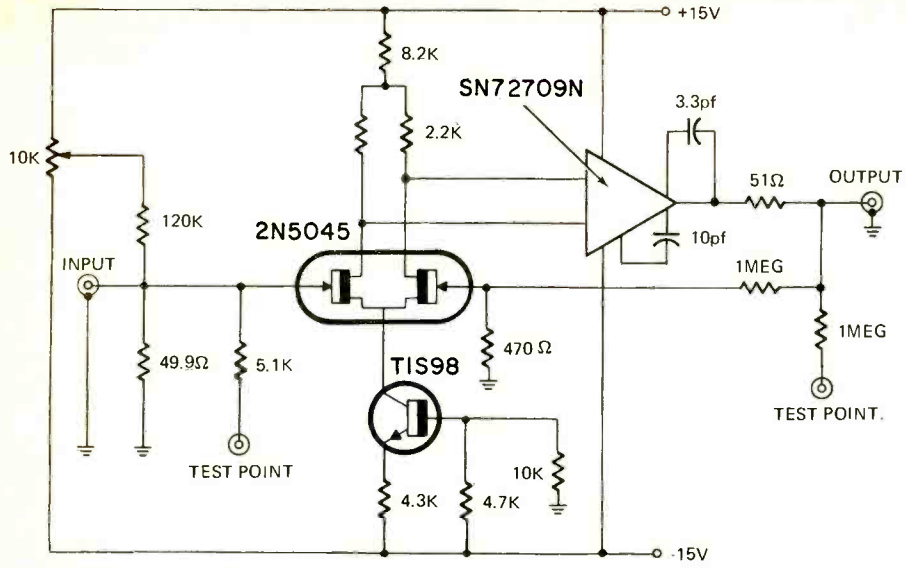


FIG. 1—WIDE-BAND AMPLIFIER CIRCUIT DESIGNED by Texas Instruments.

justable coupling for proper alignment and shaping band response.

When duplicating the i.f. amplifier circuit, observe good rf wiring practice and take the usual precautions to avoid damaging the MOSFET's when installing these devices. Conventional sweep alignment procedures may be used.

Semi-permanent breadboard???

Christiansen Radio (3034 Nestall, Laguna Beach, Calif. 92651) has recently introduced a novel wiring system which combines many of the features of etched wiring with the open layout of a breadboard. Intended specifically for the assembly of solid-state circuits using both discrete devices and IC's, the system can be used for either permanent projects or experimental designs.

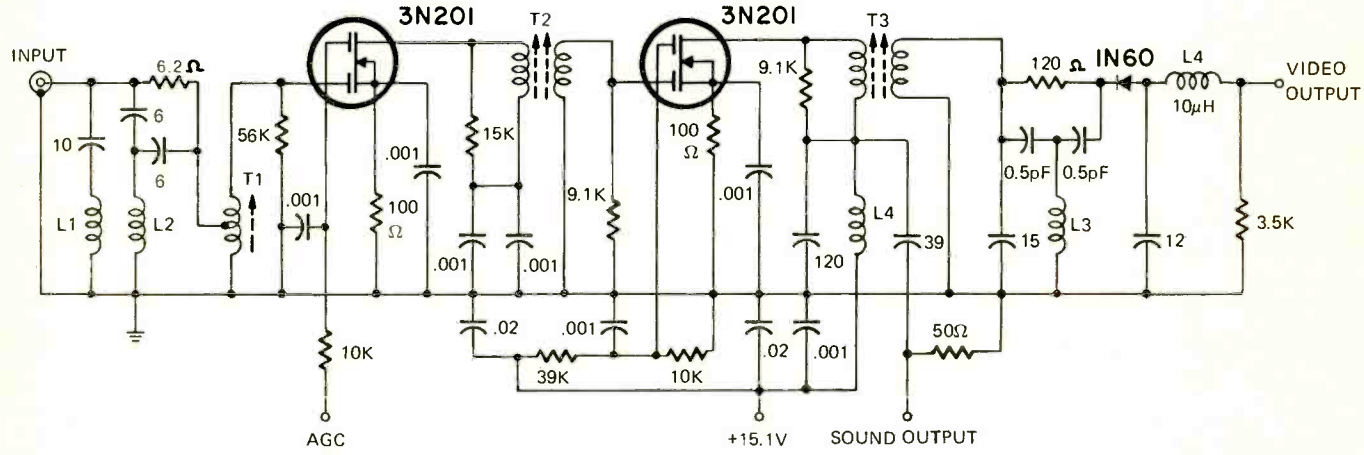


FIG. 2—TI's MOSFET VIDEO I.F. amplifier circuit.

Referring, first, to Fig. 1, this design features a dual *n*-channel junction FET, an *npn* bipolar transistor, and an IC operational amplifier. Except for the input bias adjustment potentiometer, all resistors are one-quarter or one-half watt types, the capacitors small ceramic or mica units. A dual, ± 15 volt dc power source is required.

According to TI, the wide-band amplifier can furnish an overall voltage gain of better than 65 dB and is flat within 3 dB to (approximately) 500 kHz.

Featuring a pair of dual-gate, *n*-channel depletion mode MOSFET's and a single diode detector, the video i.f. amplifier, Fig. 2, is designed to peak at 44 MHz. TI indicates that the circuit's response is down better than 40 dB at 39.75 MHz and 30 dB at 47.25 MHz. The lower -8 dB point is at 42.17 MHz, the upper -6 dB point at 45.75 MHz. Specified sensitivity is 500 μV for 1 volt of video carrier (at 100% modulation), with a sound output of 570 μV of 4.5 MHz signal.

Except for the active devices and the i.f. coils and transformers, standard components are used in the circuit. The resistors may be either quarter- or half-watt types, while the capacitors are good quality mica or ceramic units. Except where noted on the diagram, all capacitor values less than 1.0 are in μF, greater than 1.0 in pF.

TI suggests the use of hand-wound coils and transformers, prepared according to the following table, and using type "J" cores where appropriate:

- L1: 21T, No. 34 enam., double-spaced, on 5/32" form.
- L2: 14T, No. 36 enam., 5/32" form.
- L3: 50T, No. 36 enam., double-spaced, on 7/32" form.
- L4: 50T, No. 34 enam., 5/32" form.
- T1: 27T, No. 30 enam., tapped at 3T, on 5/32" form.
- T2: PRI 29T, No. 30 enam. SEC 21T, No. 30 enam.
- T3: PRI 29T, No. 30 enam. SEC 10T, No. 25 enam.

Both T2 and T3 are wound on 5/32-in. forms and should have ad-

The system's versatility is achieved by the use of small pre-etched, glass epoxy circuit board elements supplied with pressure-sensitive adhesive backs. Dubbed *Mini-Mounts®*, these elements are offered in a variety of patterns suitable for IC's, 3- or 4-pin discrete devices, resistors, coils, capacitors, trimmer potentiometers, and similar components.

In practice, the user first premounts his required components on the appropriate Mini-Mount elements using lap soldering techniques, as illustrated in Fig. 3. Afterwards, complete circuits are assembled simply by peeling off the adhesive backing

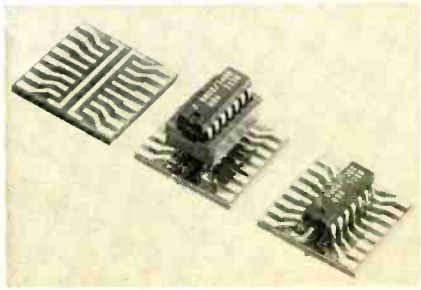


FIG. 3—TYPICAL MINI-MOUNT for a DIP package.

paper and positioning each Mini-Mount on a suitable flat surface, such as a copper-clad ground plane board, as shown in Fig. 4. Component

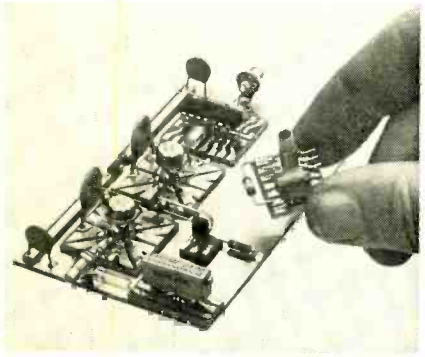


FIG. 4—ASSEMBLING AN EXPERIMENTAL circuit using Mini-Mounts.

interconnections are made using conventional hook-up wire and lap solder joints.

The adhesive-backed elements may be purchased separately in packages of ten or twenty units, depending on type, for $3.80/package, or as part of prepared kit assortments. Currently, the manufacturer is offering three basic kits: the STARTER KIT at $6.50, which includes 15 assorted Mini-Mount elements and a 3" X 4" ground plane, the EXPERIMENTER KIT at $28.50, which includes 75 assorted elements and a 3" X 4" ground plane, and the PROFESSIONAL KIT at $75.00, which includes 250 assorted Mini-Mounts and a 4" X 8" ground-plane board. A fixed charge of $1.50 per order covers postage and handling; in addition, the 5% California sales tax applies to orders from state residents. An illustrated 4-page brochure describing the Mini-Mount system is available on request.

Device/product news

Texas Instruments, Inc. (P.O. Box 5012, Dallas, Tex. 75222) has expanded its TMS0100 family of "calculator-on-a-chip" MOS/LSI integrated circuits to nine standard devices. Designed for use in low-cost calculators, the units are offered in both 8- and 10-digit versions. Each comprises all the basic circuitry needed for a standard calculator, except for power supply, readout, and keyboard; included are a program ROM, RAM storage, an input encoder, control and timing circuits, and output decoders, as illustrated in Fig. 5. Basically similar, the different versions vary in type of roundoff provided, error and overflow fonts, seg blanking, and keyboard-entry systems.

Also from TI . . . a new precision level-detector IC featuring an adjustable threshold level. Designated the SN72560, the new device, Fig. 6, allows designers to adjust the trip point to the most appropriate level for particular circuit needs, thus making it suitable for most level-detection applications requiring Schmitt trigger action. The unit's low input current of only 2 nA and high output current of 100 mA make it ideal in applications for interfacing between low-level systems and TTL, lamps, solenoids, relays, SCR's, or triac systems where precision level detection is required. It may be operated by typical logic supplies or by popular battery voltages ranging from 2.0 to 6.0 volts, but output voltages may be as high as 25 volts if required. Offered in both 8-pin plastic DIP's and 8-lead metal cases, the SN72560 is specified to operate over the 0° to 70° C. industrial temperature range.

RCA's Electronic Components group (415 South Fifth St., Harrison, N.J. 07029) has announced a new line of solid-state microwave diodes. Characterized as CW Transferred-Electron Oscillator (TEO) devices, the sixteen diodes in the line include four types at each power level: 10 mW, 30 mW, 60 mW and 120 mW. All utilize gallium arsenide (GeAs) chips and are intended for the direct conversion of dc power into C-and X-band microwave energy in suitable circuits with 8 to 15 volts input. An Engineering Note, MED-310, *How to Use the Transferred Electron Diode Characterization Data*, as well as a technical bulletin describing the devices, types S3012 through S3027, is available from RCA's Commercial Engineering department at the address given above.

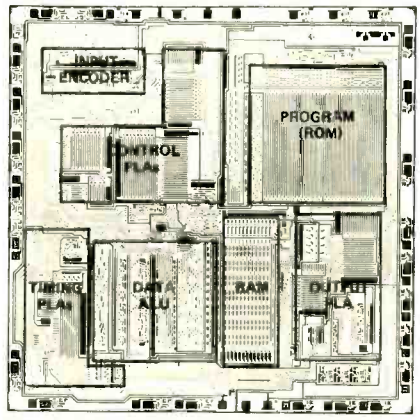


FIG. 5—TI's "CALCULATOR-ON-A-CHIP" element layout—blocks designate the various circuit functions.

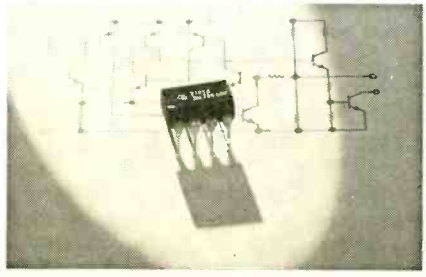


FIG. 6—TYPE SN72560 PRECISION level detector recently introduced by TI.

Twelve new fast-recovery silicon rectifiers are now available from RCA's Solid State Division (Route 202, Somerville, N.J. 08876). Designated developmental types TA8411 through TA8422, the units are offered with prV ratings of 100V, 200V, 400V, and 600V, at current ratings of 6, 12 and 20 ampere. Both forward-polarity (cathode connected to stud) and reverse-polarity (anode connected to stud) types are available, with the latter identified by an "R" suffix added to the type number. Assembled in hermetic DO-4 or DO-5 (stud) packages, all types are intended for use in high-speed inverters, choppers, high-frequency power supplies, "free-wheeling" diode circuits, and other high frequency applications.

A monolithic phase-locked loop IC designed for general purpose tone and frequency decoding has been introduced by Exar Integrated Systems, Inc. (750 Palomar, Sunnyvale, Calif. 94088). Identified as type XR-567, the new device operates over a 0.01 Hz to 500 kHz frequency band and has a logic compatible output which sinks up to 100 mA of load current. Illustrated in Fig. 7, the XR-567 comprises

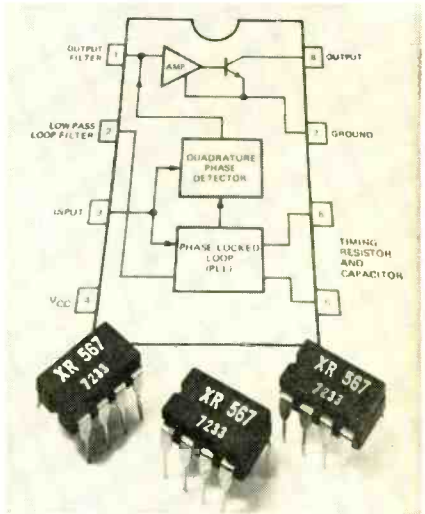


FIG. 7—EXAR NEW XR-567 IC, a monolithic phase-locked loop IC.

a phase-locked loop (PLL), a quadrature AM detector, a voltage comparator, and an output logic driver. Its bandwidth is adjustable from 0 to 14 percent, while its center frequency can be adjusted over a 20:1 range by a single external resistor. The device may be used as a dual-time-constant-tone decoder, as a narrow-band FM demodulator with carrier detection, as a standard dual-tone decoder, and as a FSK decoder. It is offered in both 8-pin TO-99 metal cans and 8-pin dual-in-line packages, and is available in versions with either military or commercial temperature ratings.

That closes out the book for January, but, lest we forget—**HAPPY NEW YEAR!!** **R-E**

Color

A color test jig is a great technicians' helper on Here's what's available

WHAT'S A "COLOR TV TEST JIG?" AN extremely handy thing for servicing color TV sets. For those who haven't seen one yet, a test jig consists of a color picture tube, mounted in a cabinet. The deflection yoke, convergence yoke, and convergence board are mounted on the tube and cabinet. This is connected to the chassis with extension cables. Many jigs have a built-in, permanently-connected voltmeter for monitoring the high voltage. Others have a built-in dc milliammeter for monitoring the all-important cathode current of the horizontal output tube. One even has its own built-in color-bar generator!

The jig sits on the bench in the shop (or above it). When a color TV set must be serviced in the shop, only the chassis need be brought in. The massive cabinet and picture tube are left in the home. With some of the 9-foot long credenza type cabinets used today, this can be very handy! The chassis can be pulled and brought in by one man. So, this can effect a real saving in the operating cost of a service call. The outside technician can work alone, without a helper or an extra technician, which could be another time-saver. If there are two technicians on a call, the chances are they'll spend a good deal of time *arguing* about what the trouble is!

The ultimate in test jigs, for some of the new modular sets, would be a complete unit, with all modules. In difficult cases, this could be used to check out problems by plugging the suspected modules into the "known-good" jig and checking for normal operation. It could also be used for those sets with "reparable" modules, such as Zenith, Motorola, etc. After the defective modules have been brought back to the shop, and the bad parts replaced, they could be tested on the jig. This, of course, would apply mainly to the shops specializing in service for one make.

Practically all major U.S. manufacturers provide test jigs for their own products. RCA was the first to provide them. For a long time, RCA has used the same standard plugs on their yoke and convergence cables, so that any RCA chassis can be operated on the same test jig. Color sets of other makes can also be operated on this jig, by using conversion adapter cables, to fit the Molex and any other specialized plug-socket combination.

RCA has a program called "ICTJ" (Industry Compatible Test Jig). They publish a handbook which lists all of the adapter cables needed to connect color TV sets of other makes to their standard jigs. At this writing, sets of 37 different manufacturers, including several of the bigger import brands, are covered. The ICTJ Handbook is updated at regular intervals.

Luckily for us (and for those who build test jigs) the vast majority of color picture tubes are standardized. The bases of all of the 70° round tubes are the same, and so are the 19-, 23- and 25-inch rectanglar 90° types. Thus jigs with round tubes can be used to test sets built for the rectangular types, and vice versa. A simple extension harness having a "big base" on one end and the smaller socket on the other, (also vice versa) takes care of the differences in base sizes. So, a single jig of either type will be usable on a great many sets.

The question arose concerning the smaller picture tubes, some of which have different basing; the General Electric 11WP22, with all three cathodes internally connected, and a few others. The answer, of course, is that most of these are in *small sets*, and won't need a jig! They can be "carried-in" to the shop for service. In an emergency, for making a substitution test of the picture tube, a simple adapter harness could be used. This is one that hasn't come up in actual operation as yet, but it might.

Let's see how this test instrument can be used. The chassis is brought in, set up in a convenient position on the bench, and connected to the test jig. This requires a minimum of four cables. One for the deflection yoke, one for the picture-tube socket, one for the high-voltage lead and, most important, a good **GROUND!** If you forget the last one, you'll be most rudely reminded of it the first time you touch the jig and the chassis at the same time. The older jigs are in metal cabinets; the new compact jigs are in plastic, but hook up the ground anyhow! (I have attached dual ground leads to mine, using heavy clips. That way, if I knock one off, moving the chassis, I've got a spare.) (The "belt *and* suspenders" method.)

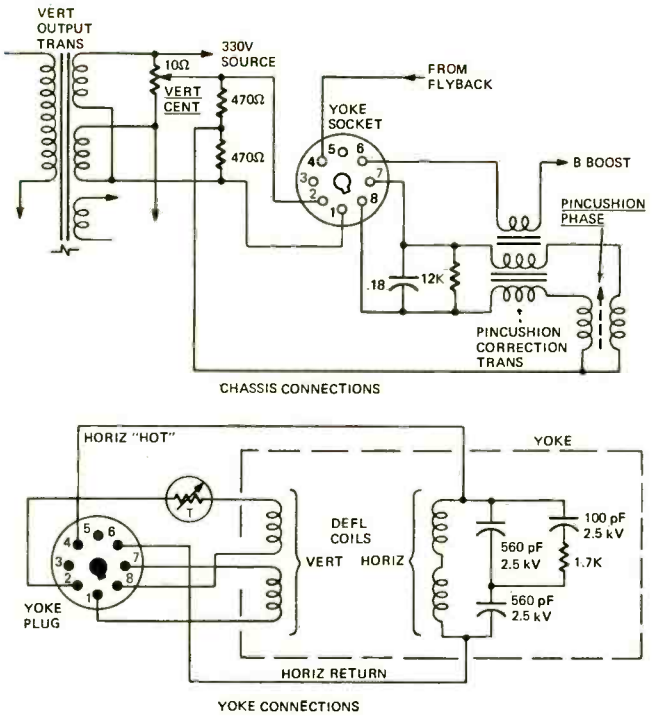


FIG. 1—DEFLECTION-YOKE CONNECTIONS on Sylvania D-12 chassis. Note pin-cushion correction network between vertical deflection coils.

The convergence board

In a lot of sets, the convergence

TV Test Jigs

time-saver that can replace the outside color TV service calls. and how you can use 'em.

by EUGENE CUNNINGHAM

board can be left unhooked. The only ill effect will be a slight misconvergence, mainly dynamic, at the edges. All of the commercial test jigs have static convergence magnets. Manufacturer's jigs, such as RCA, etc. have the complete convergence yoke and control board, of course. Misconvergence can be ignored while servicing. In any case, convergence adjustments should **not** be done on the jig; the excess capacitance of the extension cables will cause misconvergence when the set is put back together.

The worst problem in leaving the convergence board off will be in those sets where the vertical output tube cathode circuit returns to ground through the convergence circuitry. In these, you'll see a loss of height, vertical linearity, etc. In most of these, a dummy load can be used; this plugs into the convergence socket, completing whatever circuits would be left open in this particular chassis.

Actually, true convergence-trouble is uncommon, in the sense of part-failures. Most of it is due to misadjustments. Real trouble can always be identified by a few tests. If any control has no effect on the lines it's supposed to control, that's it. Check for defective controls, coils, wiring, clamp-diodes, **and** for the presence of the convergence pulse waveforms with the proper amplitude **and** polarity! One problem was solved by discovering, with the scope, that the convergence pulses were present, but were inverted! Someone had reversed the wiring to a pulse winding when the flyback was replaced! If this kind of problem comes up, the set's own convergence yoke and board can be taken off, brought to the shop and slipped onto the tube in the test jig, for easier servicing.

Special hookups

The worst problem, of course, is in using the test jig on sets of a different make. This is where the cross-reference Handbooks, such as RCA's ICTJ book and others come in very handy. However, in emergencies, you can hook up practically all sets, by checking the deflection yoke connections.

There are at least four leads which must be properly hooked up. The horizontal deflection coil will have two, the "hot" and the return leads. In some chassis, there will be a center-tap on the horizontal deflection coil. The later jigs have this connection on their yokes; in many cases, it can be left open without trouble. The inductance of the horizontal yoke winding is usually close enough to the original so that it will work.

For the vertical winding in the yoke, most sets use only two leads, hot and return. The main problem here is getting these hooked up so that the picture is right side up. Actually, it doesn't make any real difference, but it looks funny. In a few chassis, you'll find pincushion-correction networks connected between the two vertical windings of the yoke. Fig. 1 shows such a circuit, as used in Sylvania's D-12 chassis. This can be hooked up for test purposes by shorting between pins 7 and 8 on the yoke socket, to complete the circuit. Any pincushion distortion, like misconvergence, can be ignored.

You can always check your jig hookup by remembering what the problem was in the home. For example, if the set was brought in for a sync problem, and now you have no vertical sweep, no high voltage, etc, this is a jig problem, and must be corrected before you can get on with the rat-killin'.

There is one problem, on all jigs, which you will notice, and which should be ignored. This will also show up when using a color set on its own picture tube, with extension cables, for that matter. This is a distinct smearing of fine horizontal detail in the picture. I've christened this "Jig-smear". It's caused by the added shunt capacitance of the picture-tube extension cable, in the video circuits. It is not too bad, but it must be recognized, so that you don't waste time checking video stages, alignment, etc. when it is not necessary! You can check out a couple of chassis which do have good horizontal resolution, and see exactly what I mean.

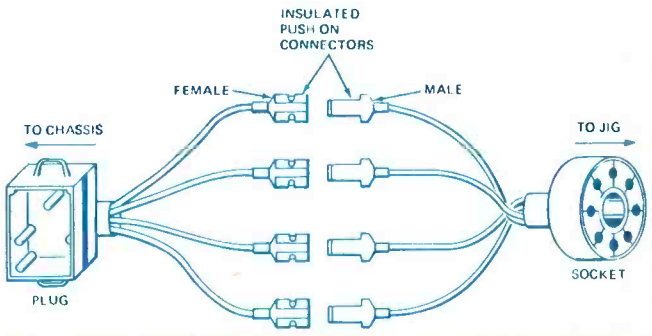


FIG. 2—HOME-MADE ADAPTER CABLES can be used to match almost any color TV set to your test jig. Matching plugs and sockets and insulated push-on connectors do the trick.

Emergency adapter cables

It should be possible to hook up any "standard" U.S.-built chassis to a test jig, if you have the right cables. In an emergency, you can make up this cable. Fig. 2 shows a rough sketch of how this could be done. The socket fits the yoke plug on the cable from the jig's yoke. The socket is of whatever type is used on the TV set. The

leads from the jig-yoke socket should be plainly tagged "H-Hot", "H-Ret" (urn) "H-CT", etc. By putting push-on connectors on these, and mating connectors on the leads from the "set-socket", as shown, you can cross-connect the two together so that each lead goes to the right pin of the set socket. (Insulate them! They bite!)

The schematic diagram will show you how the set is hooked up. By tracing each lead out as to its function, it should be fairly simple to match the connections.

Tube-type jigs vs transistor type

As a general rule, color sets with transistor deflection circuitry cannot be used on the same jig used for testing tube-type color sets. There is some disagreement about this among test-jig manufacturers. The deflection components for the tube-type jigs (and sets) have quite a bit higher impedance than their transistor-type counterparts.

RCA does not recommend trying to use tube jigs on solid-state stuff. They have two versions; in the large-tube type, the 10J102 matches all tube type RCA sets back to the CTC-7, including the 21-inch round, and 19-, 20-, 23- and 25-inch rectangulars. The 10J104 is used for the transistor color sets. It has the same yoke and associated components as solid-state CTC-40 chassis.

Other jig-makers have different ideas. The statements and claims here are those given us by the companies, and most of them have been checked out.

Commercial test jigs

The first test-jigs were simply cabinets and yokes, plus the picture tubes, from old TV sets. Later on, as this became more popular, special cabinets were built for them, as you'll see. Fig. 3 shows the RCA 10J102/-104 test jig, with its built-in high-voltage meter. With the *ICTJ Handbook*, and suitable adapter cables, this will handle any tube-type color set, including several of the more popular imports.

Lately, a new item has been added. This is the portable test-jig, 10J103 (tube) or 10J105 (transistor) seen in Fig. 5. It uses an 18-inch color picture tube, and has the built-in high-voltage meter, and all of the features of the bigger jigs. The cabinet is made of high-impact plastic, and has feet so that it will stand anywhere on the bench. A carrying handle is included, for case in moving this compact jig to any place needed. It can even be carried into the customer's home; this is mainly for the purpose of using the jig's picture tube as a sub, to convince the owner that his picture tube really *is* bad.

RCA does not recommend trying to "convert" tube-type jigs for use with solid-state defection components. However, their engineers tell me that it is **not** necessary to buy two complete test-jigs! You can buy the tube-type jig, and a set of the "neck components" (deflection and convergence yokes, convergence board, etc) of the type used in the transistor sets. If needed, these can be installed on the picture tube already in the jig, in about 10–15 minutes.

As I said before, practically all of the major U.S. setmakers provide test-jigs for use with their own sets. Adapter cables for different models of their line are available. Magnavox, for example, provides a continuously updated cross-reference, and conversion data, for the necessary adapter cables to use the jig with newer models. These can be bought from the Magna-Par parts depots, ready-made, or assembled in the shop, using the right plugs, sockets, etc.

Universal test jigs

There are companies who make test jigs for use with sets of all makes. Some of these make the jigs for the manufacturers.

The Pix-O-Scope jigs. The Pix-O-Scope Company, 3311 Shelby St., Indianapolis, Ind. 46227, makes three test jigs for tube-type sets. The basic version is the P-1 seen in Fig. 6. It comes completely assembled ready to go. All necessary cables are provided; high-voltage and pix-tube socket extensions, a 21–25-inch pix-tube socket adapter, and their patented *Adapto-Scope* yoke hookup lead (Fig. 4). This allows the connection of the P-1 jig to any standard color TV yoke. This is done by plugging the standard color-coded leads into the yoke-socket on the TV chassis; red for "horizontal hot"; blue for "horizontal return"; yellow, "vertical hot", Yellow with tracer, "vertical return".

No convergence board is used. The static magnets are mounted on the tube-neck, including a blue lateral. For initial setup, the yoke is adjusted

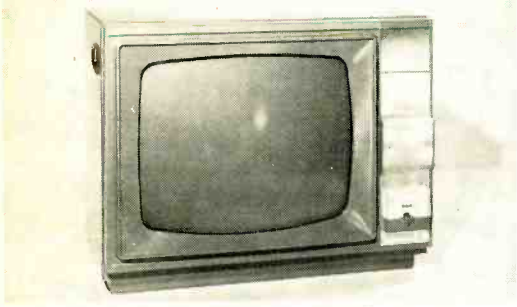


FIG. 3—RCA 10J102/104 TEST JIG has dc voltmeter.

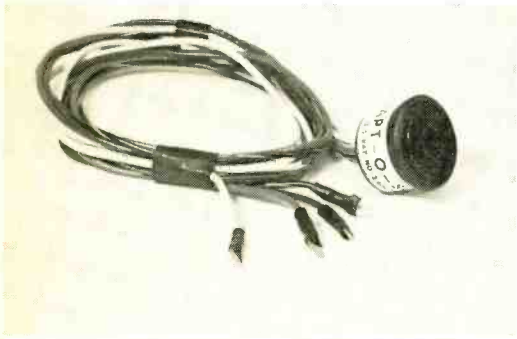


FIG. 4—ADAPTO-SCOPE universal yoke connector.

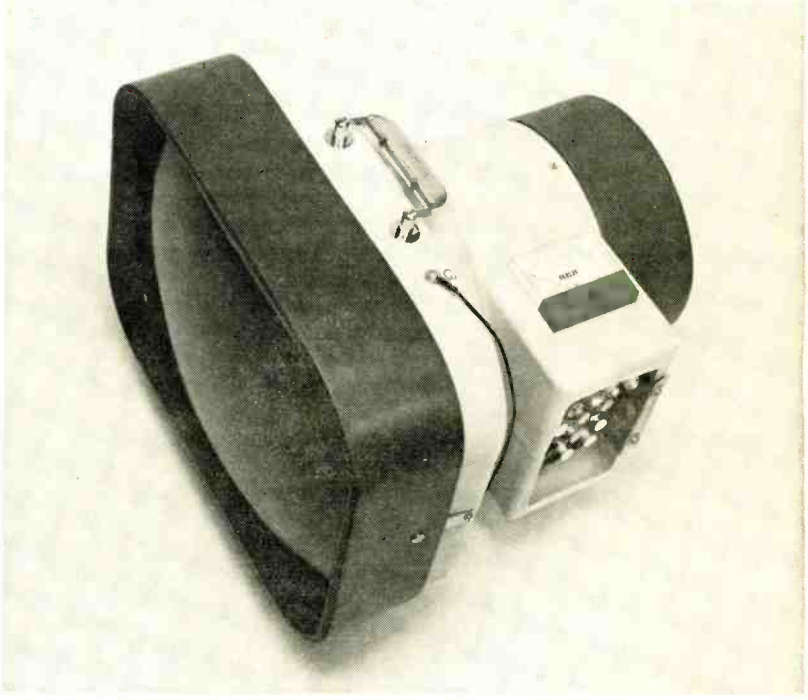


FIG. 5—RCA PORTABLE JIGS. One for tube, the other for solid-state sets.

for best red purity, and the blue lateral magnet set for best center convergence. A special "zero-focus-voltage" color picture tube, Sylvania type TT-15B90 is used. The focus electrode is grounded; a special ground lead is provided in the pix-tube extension cable for this purpose.

The model P-2 Pix-O-Scope jig uses the same cabinet and tube as the P-1, with a high-voltage voltmeter added. This meter can also be used to read direct current. A HV DISCONNECT switch, and jack for the meter leads, is on the meter panel, as seen in Fig. 7.

The model P-3 Pix-O-Scope jig has all of the features of the first two models, plus a built-in volt-ohmmeter, and a color-bar generator. This is shown in Fig. 8. The color-bar generator controls are accessible from the front.

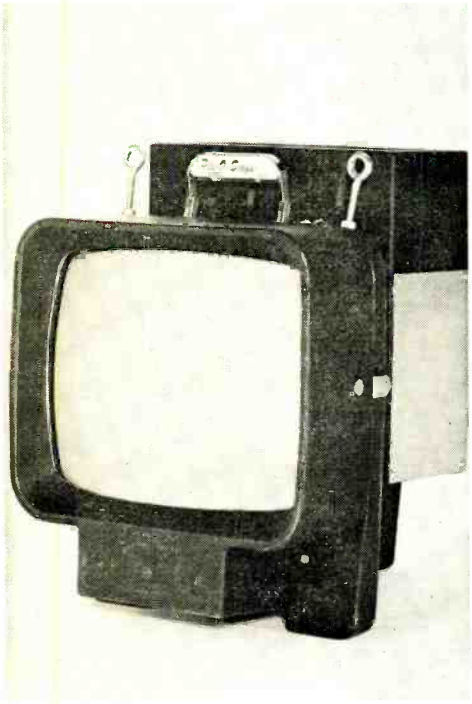


FIG. 6—PIX-O-SCOPE P-1 universal test jig.

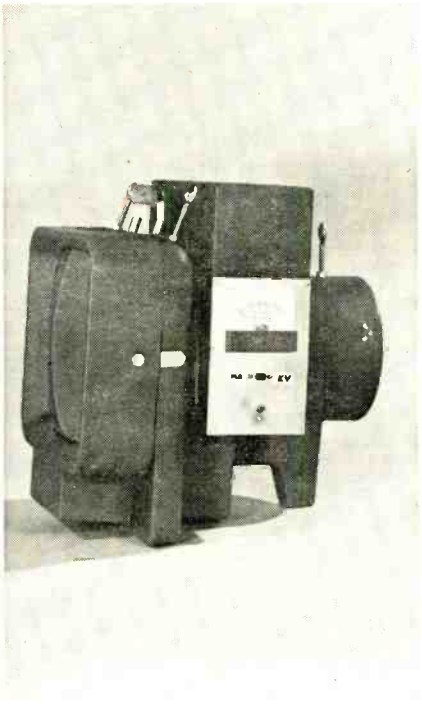


FIG. 7—THE P-2 JIG with built-in meter.

FIG. 8—THE P-3 JIG is the deluxe model.

FIG. 9—TELEMATIC ECONO-JIG is a kit.

All of these jigs are housed in the same type of cabinet made of heavy impact-resistant plastic, with special legs molded on the bottom so that the jig will sit steady on the bench. A carrying handle is mounted on the top. Eyebolts are provided so that they can be hung from the ceiling over the bench, for added convenience. Even the Pix-O-Scope's shipping carton is a dual-duty thing. It is made of extra-heavy cardboard, and instructions are included for cutting this down and bolting it to the floor of the service truck, so that the jig can be carried safely, if you want to take it to the customer's home.

A comprehensive cross-reference listing of all major color set manufacturers is provided with each jig. The company carries a complete line of adapter and conversion cables, so the Pix-O-Scope jig can be used with any set. No convergence board is used, as I said, but convergence-load adapters for any make are also listed. (In fact, the company engineers say that a common 50-μF, 250-volt capacitor will do!) Another comment was about checking of focus voltage, in high-voltage focus chassis. This can be done by disconnecting the jig's high-voltage lead (allowing the high-voltage to drift) and using the test-jig high-voltage lead as a meter-lead, to read the focus voltage on the TV chassis.

For color sets, with solid-state deflection type the Pix-O-Scope company is making a special jig, exactly like the rest, but called PT-1, PT-2, etc. These will work with any transistor color set, such as RCA CTC-40, Motorola Quasars, etc.

Jig in kit form

Fig. 9 shows the components of the Econo-Jig EJ-190; only jig furnished in kit form (as far as I know!) It is made by the Telematic Div., U.X.L. Corp. 2245 Pitkin Ave., Brooklyn, N.Y. 11207 and is furnished without the picture tube. Any standard 19-inch color tube can be used. (Telematic suggests that the technician might have a used one on hand, or could pick up a rebuilt one at a reasonable price.)

The Econo-Jig EJ-190 is built into a metal case, fitted with a carrying handle and eyebolts, so that it can be moved, or hung from the ceiling as desired. A universal 90° yoke is used, and the yoke-lead, pix-tube extension, high-voltage lead, etc. are included. The static magnets, including the blue lateral, are mounted on the tube. (Comment; a standard convergence yoke and control board could be added to this, if it should prove necessary, it seems to me)

Telematic has a complete cross-reference listing of adapter cables to match the Econo-Jig to any tube-type color set. Special convergence load adapters are also listed.

For transistor color sets, the company claims that these can be used on the Econo-Jig with their model TA-2000 Series *Transverters.* These are matching transformers, designed to plug into the tube-type yoke and convert it for servicing transistor sets. A special model of the Econo-Jig, the TA-390, built for use on transistor color TV chassis only, will be brought out very soon, probably by the time you read this.

Conclusion

So, that's about it. I certainly hope I didn't miss anybody! On the whole, from using one for quite a few years, I can vouch for the fact that a test-jig IS a worth-while unit to have.

The portable test-jig is a fairly new development. While its use as a portable, in the home, will probably not be as common as its bench use, it certainly could be a valuable aid to hard diagnoses, both in the home, and in the shop. One in particular that comes to my mind is using the jig's yoke as a substitute for a suspected defective yoke in the set! **R-E**

step-by-step

TV TROUBLE

Color oscillator phase and
The afpc detector must

by ART MARGOLIS

COLOR TV SERVICE TECHNICIANS KNOW that the color carrier is suppressed at the transmitter. Only the color sidebands are sent out over the air. Therefore, the color carrier must be reconstructed inside each and every color TV receiver. An oscillator is installed in all color TV's to produce a CW signal at 3.58 MHz. The oscillator runs free.

To produce colors in the right places on the TV screen the oscillator has to be made to run at the exact frequency and phase of the suppressed subcarrier signal. A color burst of about eight cycles of 3.58-MHz signal is inserted on the back porch of the sync pedestal of the composite video. This burst has the exact frequency and phase as the transmitter's subcarrier oscillator. It is extracted from the composite video signal and processed by the burst amplifier.

A phase-detector consisting of two diodes in series with two resistors across them is the basic circuit. A center tap between the diodes takes the output of the detector. The detector has two inputs; one from the burst amplifier and a second from the 3.58-MHz oscillator. The detector output feeds the compared signals back to the 3.58-MHz oscillator for frequency and phase control.

Typical afpc detector

The amplified burst signal is 180 degrees out-of-phase on the two diodes connected to the ends of the burst transformer secondary. At the same time, a 3.58-MHz reference signal from the CW oscillator is fed in-phase to the cathode of one diode and the anode of the other. Ideally, the 3.58-MHz reference signal leads the burst 90 degrees on one diode and lags the burst 90 degrees on the other. The diodes conduct equally and the voltage at the junction of the two load resistors is zero.

Any change in the reference oscillator frequency or phase causes the diodes to conduct unequally so a dc voltage develops at the junction of the load resistors. This voltage is either negative or positive, depending on which way the oscillator has drifted. It is applied to the control element of a variable reactance device so the oscillator frequency and phase are corrected.

Afpc detector troubleshooting

Detector troubleshooting is needed when the colors won't lock in place. That means either on all channels or perhaps on just the weak ones. A second symptom is noticed through the TINT control. It doesn't work correctly. The colors are wrong or the range of the control is very narrow.

Troubleshooting is easy with discrete components. All a technician needs is a vtvm and a shorting wire with clips on the end. It's a matter of shorting out strategic points, taking a voltage reading, tuning the various transformers around the detector and interpreting the results.

On occasion a component is defective, but most of the time detector problems are simply misalignment of the three adjoining adjustable coils. They are the burst-phase transformer, the 3.58-MHz oscillator transformer and the reactance coil. Either way here is the right way to conduct the job.

The first step is to make sure that the oscillator is actually running at 3.58 MHz. Sometimes an oscillator component can change value slightly throwing the frequency off. The cure

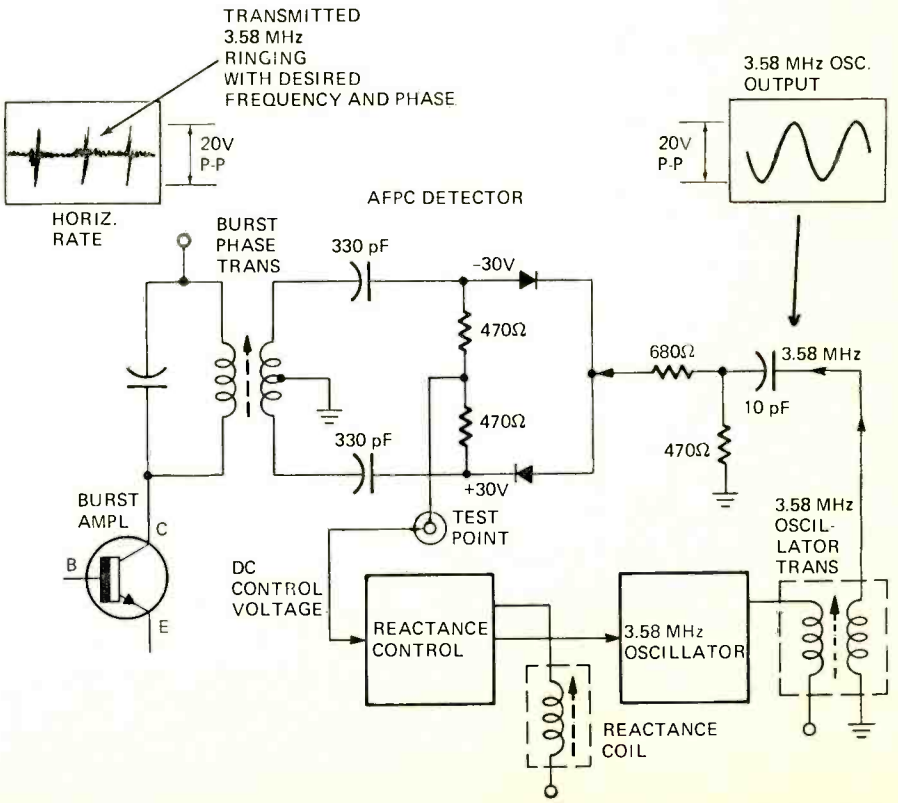


DIAGRAM OF A TYPICAL AFPC DETECTOR. Its purpose is to insure that the 3.58-MHz oscillator's frequency and phase are always in step with the color burst.

SHOOTER'S GUIDE

frequency must be precise for correct color rendition.
be working properly. Here's how to troubleshoot it fast.

is to touch up the 3.58-MHz transformer.

The clip lead is attached across the base and emitter of the burst amplifier. This kills the burst input to the detector. The vtvm is attached to an end of the detector load resistors. About ±20 volts should be read. If it's not, the oscillator is not operating properly. Test it.

When the voltage is present, tune the 3.58-MHz transformer for maximum voltage. The oscillator is good.

Next step is to unhook the clip lead. Your vtvm should show a marked increase in voltage as the burst pulses enter the circuit. If there is no increase, the burst amplifier is defective. Test it. However, should there be an increase while you are there, tune the burst transformer for maximum voltage.

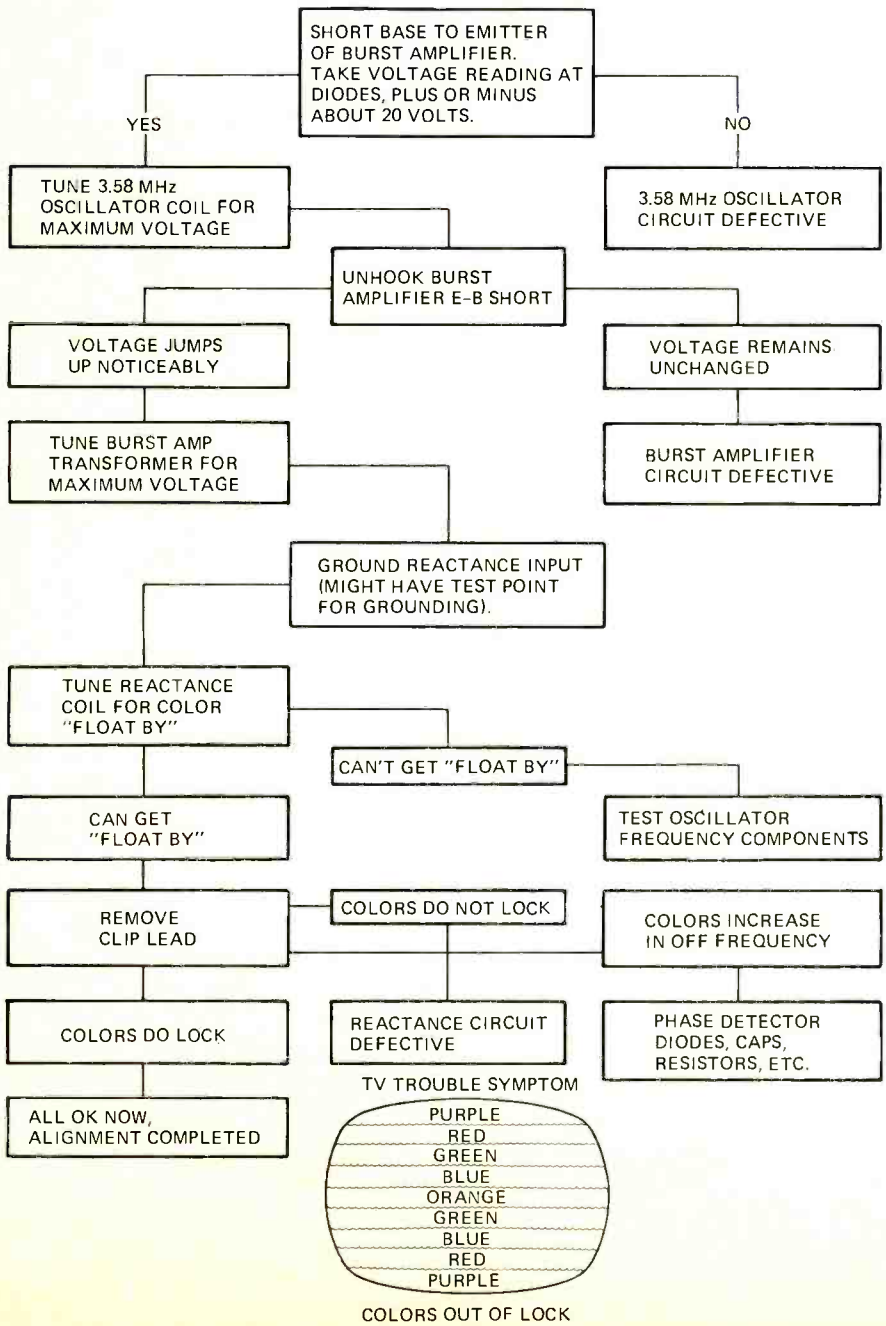
If there is a reactance circuit between the detector and the oscillator, the next step is to ground the reactance input from the detector. There is usually a test point provided for this part of the alignment as it is important and goes out of perfect alignment easily.

When the reactance input is shorted, the oscillator runs free. Watch the TV screen and you'll see the colors roll out of sync. Adjust the reactance output transformer until you attain "float by" of colors. If you can't get it, the oscillator can't run at 3.58 MHz. Test the frequency-controlling components of the oscillator, especially the crystal.

When "float by" is attained, the reactance and oscillator are good. Remove the clip lead. The colors should snap into place. If they do not, the reactance circuit is defective. Test it.

If you should remove the jumper from the output of the detector into the reactance or oscillator and the colors should start moving faster, then there is a malfunction in the detector itself. There is an imbalance and the wrong dc correction voltage is being developed.

Test the diodes first. Even a slight leakage in one could cause the wrong dc voltage to be produced. Make sure the twin load resistors are both the correct value and closely matched. Test the two 330-pF input capacitors and the CW input capacitor. If you don't find anything wrong here, the detector is defective. **R-E**

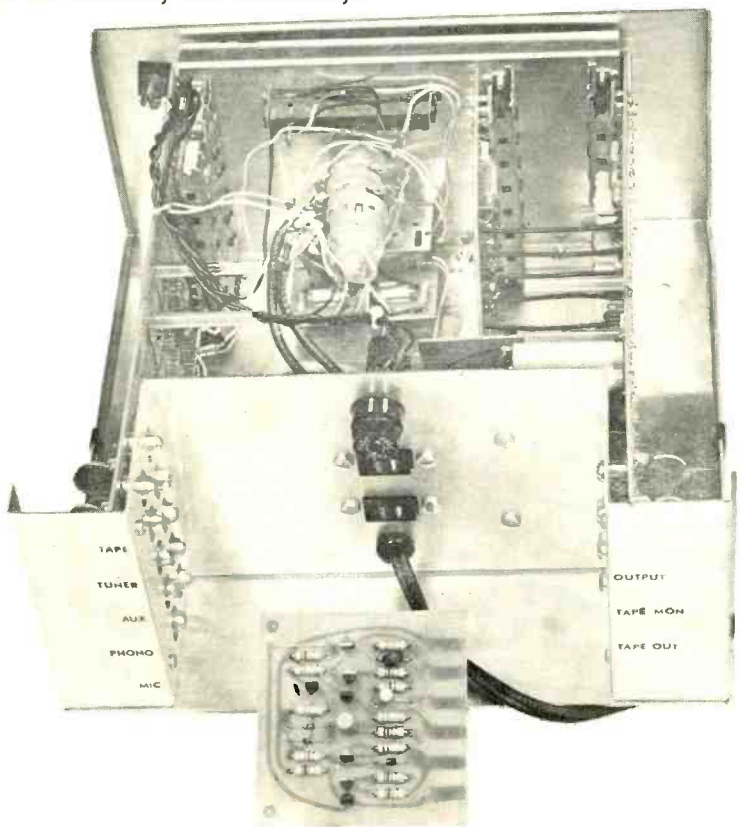


BUILD A "ZERO DISTORTION" STEREO PREAMP

by GARY KAY

Part 2—The wrap-up of construction details on the novel laboratory-grade stereo preamplifier featured in last month's issue.

The photographs and parts placement layouts wrap-up the story on the stereo preamplifier featured on last month's cover. Designed around discrete semiconductors instead of IC's, this lab-quality stereo preamplifier uses a modular concept based on plug-in PC boards for simplicity, ease of construction and troubleshooting; and push-button bass, treble and function controls for versatility and resetability.



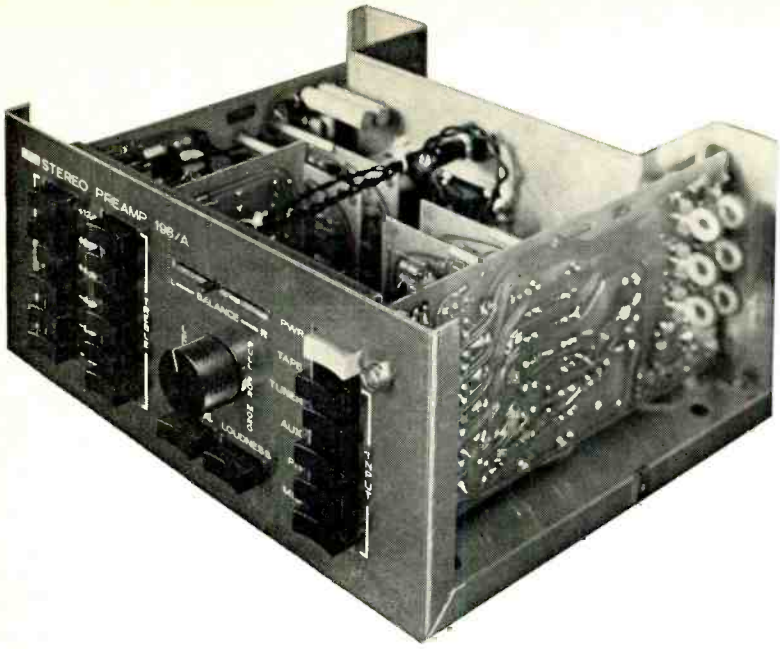
THIS VIEW OF THE PREAMPLIFIER shows how the cable connectors (phono-type jacks) are recessed for protection against mechanical damage. The input connectors are on the left; output on the right.

The following parts for this preamp are available from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio Texas 78216. Complete set of 9 printed-circuits, drilled, with socket clips. No. 198-cb $17.50
Set of 9 circuit boards, socket clips, 3 pushbutton switches, and volume control (dual control with push-pull switch). No. 198-SW $34.50
Complete kit of all parts including cabinet and front panel. No. 198-k $69.50

PARTS LIST

R1 thru R6—1 megohm ¼-W 10%
R7 thru R12—250,000-ohm trimmer
R13, R14—22,000-ohm ½-W 5%
R15, R16—51,000-ohm ½-W 5%
R17, R18—2,200-ohm ½-W 5%
R19, R20, R59, R60—100,000-ohm ½-W 5%
R21, R22—750,000-ohm ½-W 5%
R23, R24, R27, R28, R61, R62—10,000-ohm trimmer
R25, R26—1,000-ohm ½-W 10%
R29, R30—10,000-ohm audio taper pot with 5,000-ohm tap with pull switch
R31, R32—470-ohm, ½-W 10%
R33, R34—300,000-ohm ½-W 5%
R35, R36—150,000-ohm ½-W 5%
R37, R38—82,000-ohm ½-W 5%
R39, R40—8,200-ohm ½-W 5%
R41, R42—15,000-ohm ½-W 5%
R43, R44—30,000-ohm ½-W 5%
R45, R46—10,000-ohm ½-W 5%
R47, R48—3,300-ohm ½-W 5%
R49, R50—6,800-ohm ½-W 5%
R51, R52—18,000-ohm ½-W 5%
R53, R54—180,000-ohm ½-W 5%
R55, R56—68,000-ohm ½-W 5%
R57, R58—33,000-ohm ½-W 5%
R63—10,000-ohm linear taper slide pot
R64, R65—47-ohm ½-W 10%
R66—68,000-ohm ½-W 10%
R*, R*—47,000-ohm ¼-W 10%

C1, C2—.0068-μF polystyrene
C3, C4—.0015-μF polystyrene
C5, C6—4.7-pF disc
C7, C8, C37, C38—20-pF disc
C9, C10—.0047-μF polystyrene
C11, C12—.0082-μF polystyrene
C13, C14—0.012-μF metalized polycarbonate
C15, C16—0.022-μF metalized polycarbonate
C17, C18—0.22-μF metalized polycarbonate
C19, C20—0.12-μF metalized polycarbonate
C21, C22—0.082-μF metalized polycarbonate
C23, C24—220-μF @ 6.3V electrolytic
C25, C26—.0062-μF polystyrene
C27, C28—.0039-μF polystyrene
C29, C30—.0024-μF polystyrene
C31, C32—240-pF polystyrene
C33, C34—390-pF polystyrene
C35, C36—620-pF polystyrene
C39, C40—1-μF 15 volt electrolytic
C41, C42—1000-μF 25 Vdc electrolytic
C43, C44—500-μF 15 Vdc electrolytic
C45, C46—0.1-μF
D1 thru D4—1N5060 silicon diode or equal
D5, D6—15-V 1-W Zener diode, Motorola 1N4744 or equal



*S3—5-station dpdt tandem plus 1 station push-to-lock pushbutton switch
*S1, S2—6-station dpdt pushbutton switch
*S4, S5—dpdt pushbutton switch
S6—spst pull switch mounted on the rear of level control
F1—¼-amp fuse
T1—24-volt 80 mA ct transformer 117 Vac primary
LM1—neon lamp NE-2

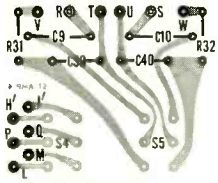
Parts List No. 195 Preamp Module

Q1, Q2, Q6, Q7—2N5210 Motorola
Q3, Q4, Q5—2N5087 Motorola
D1—4.7-V 400mw Zener diode Motorola MZ-70-4.7 or equal
D2, D3—1N914 diode or equal
C1—4.7-μF tantalum electrolytic
C2—5-pF disc
C3—33-μF @ 6-V electrolytic
R1, R3, R9, R10, R11, R13—1000-ohm ½-W 10%
R2—47,000-ohm ½-W 10%
R4, R5—22,000-ohm ½-W 10%
R6—15,000-ohm ½-W 10%
R7—8200-ohm ½-W 10%
R8—10,000-ohm ½-W 10%
R12—4700-ohm ½-W 10%

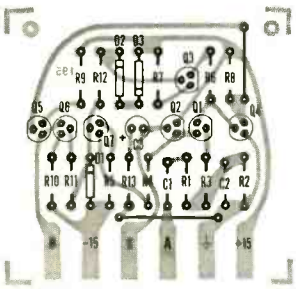
*S1 through S5 are being custom-made for Southwest Technical and no substitutes are available.

The two 47,000-ohm resistors are used only on the two input modules and are connected across capacitor C3 (see Fig. 1) on the foil side of the board. **R-E**

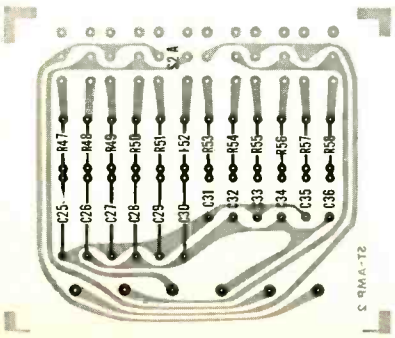
All boards shown one-half actual size.



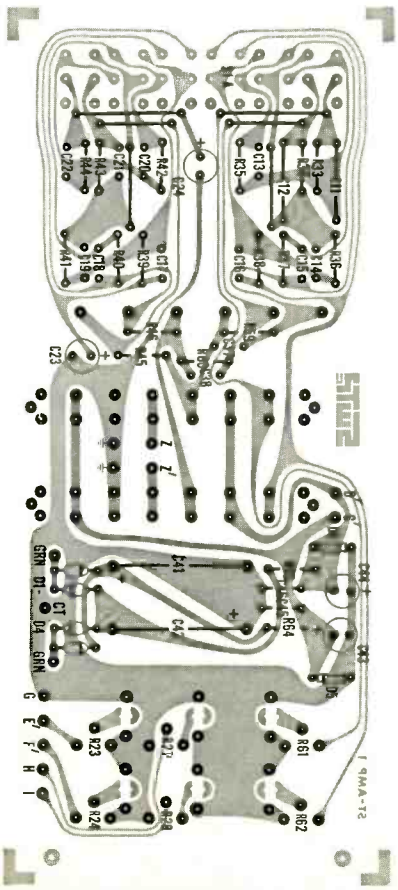
CIRCUIT BOARD D.



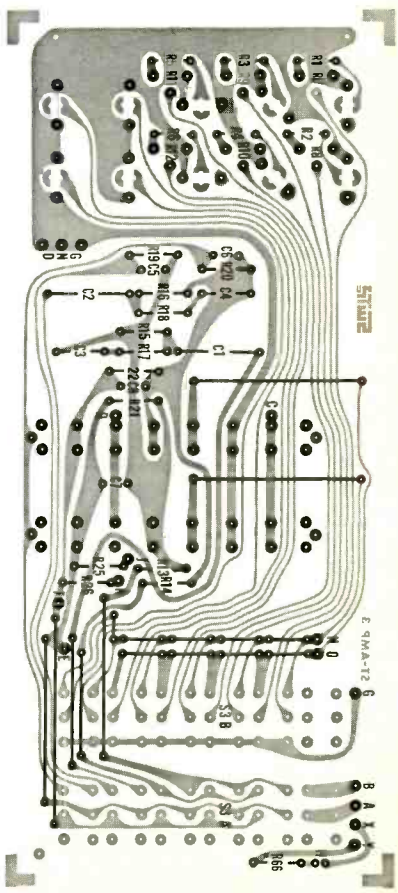
CIRCUIT BOARD B. Four are needed.



CIRCUIT BOARD C. One is required.



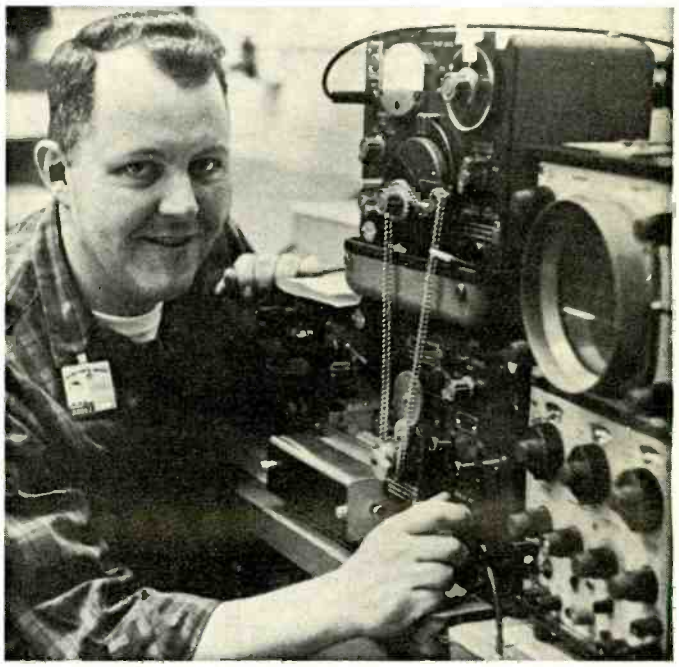
CIRCUIT BOARD A.



CIRCUIT BOARD E.

One of our most successful students wrote this ad!

Harry Remmert decided he needed more electronics training to get ahead. He carefully "shopped around" for the best training he could find. His detailed report on why he chose CIE and how it worked out makes a better "ad" than anything we could tell you. Here's his story, as he wrote it to us in his own words.



Harry Remmert gives his CIE Electronics course much of the credit for starting him on a rewarding career. He tells his own story on these pages.

By Harry Remmert

"AFTER SEVEN YEARS in my present position, I was made painfully aware of the fact that I had gotten just about all the on-the-job training available. When I asked my supervisor for an increase in pay, he said, "In what way are you a more valuable employee now than when you received your last raise?" Fortunately, I did receive the raise that time, but I realized that my pay was approaching the maximum for a person with my limited training.

"Education was the obvious answer, but I had enrolled in three different night school courses over the years and had not completed any of them. I'd be tired, or want to do something else on class night, and would miss so many classes that I'd fall behind, lose interest, and drop out.

The Advantages of Home Study

"Therefore, it was easy to decide that home study was the answer for someone like me, who doesn't want to be tied down. With home study there is no schedule. I am the boss and I set the pace. There is no cramming for exams because I decide when I am ready, and only then do I take the exam. I never miss a point in the lecture because it is right there in print for as many re-readings as I find neccessary. If I feel tired, stay late at work, or just feel lazy, I can skip school for a night or two and never fall behind. The total absence of all pressure helps me to learn more than I'd be able to grasp if I were just cramming it in to meet an exam deadline schedule. For me, these points give home study courses an overwhelming advantage over scheduled classroom instruction.

"Having decided on home study, why did I choose CIE? I had catalogs from six different schools offering home study courses. The CIE catalog arrived in less than one week (four days before I received any of the other catalogs). This indicated (correctly) that from CIE I could expect fast service on grades, questions, etc. I eliminated those schools which were slow in sending catalogs.

FCC License Warranty Important

"The First Class FCC Warranty* was also an attractive point. I had seen "Q" and "A" manuals for the FCC exams, and the material had always seemed just a little beyond my grasp. Score another point for CIE.

*CIE backs its courses with this famous Money-Back Warranty: when you complete a CIE license preparation course, you'll be able to pass your FCC exam or be entitled to a full refund of all tuition paid. Warranty is valid during completion time allowed for your course.

"Another thing is that CIE offered a complete package: FCC License and technical school diploma. Completion time was reasonably short, and I could attain something definite without dragging it out over an interminable number of years. Here I eliminated those schools which gave college credits instead of graduation diplomas. I work in the R and D department of a large company and it's been my observation that technical school graduates generally hold better positions than men with a few college credits. A college degree is one thing, but I'm 32 years old, and 10 or 15 years of part-time college just isn't for me. No, I wanted to *graduate* in a year or two, not just *start*.

"When a school offers both resident and correspondence training, it's my feeling that the correspondence men are sort of on the outside of things. I wanted to be a full-fledged student instead of just a tag-a-long, so CIE's exclusive home-study program naturally attracted me.

"Then, too, it's the men who know their theory who are moving ahead where I work. They can read schematics and understand circuit operation. I want to be a good theory man.

"From the foregoing, you can see I did not select CIE in any haphazard fashion. I knew what I was looking for, and only CIE had all the things I wanted.

Two Pay Raises in Less Than a Year

"Only eleven months after I enrolled with CIE, I passed the FCC exams for First Class Radiotelephone License with Radar Endorsement. I had a pay increase even before I got my license and *another* only ten months later.

"These are the tangible results. But just as important are the things I've learned. I am smarter now than I had ever thought I would be. It feels good to know that I know what I know now. Schematics that used to confuse me completely are now easy for me to read and interpret. Yes, it is nice to be smarter, and that's probably the most satisfying result of my CIE experience.

Praise for Student Service

"In closing, I'd like to get in a compliment for my Correspondent Counselor who has faithfully seen to it that my supervisor knows I'm studying. I think the monthly reports to my supervisor and generally flattering commentary have been in large part responsible for my pay increases. My Counselor has given me much more student service than "the contract calls for," and I certainly owe him a sincere debt of gratitude.

"And finally, there is Mr. Tom Duffy, my instructor. I don't believe I've ever had the individual attention in any classroom that I've received from Mr. Duffy. He is clear, authoritative, and spared no time or effort to answer my every question. In Mr. Duffy, I've received everything I could have expected from a full-time private tutor.

"I'm very, very satisfied with the whole CIE experience. Every penny I spent for my course was returned many times over, both in increased wages and in personal satisfaction."

Perhaps you too, like Harry Remmert, have realized that to get ahead in Electronics today, you need to know much more than the "screwdriver mechanics." They're limited to "thinking with their hands"... learning by taking things apart and putting them back together... soldering connections, testing circuits, and replacing components. Understandably, their pay is limited—and their future, too.

But for men like Harry Remmert, who have gotten the training they need in the fundamentals of Electronics, there are no such limitations. He was recently promoted, with a good increase in income, to the salaried position of Senior Engineering Assistant working in the design of systems to silence submarines. For trained technicians, the future is bright. Thousands of men will be needed in virtually every field of Electronics from two-way mobile radio to computer testing and troubleshooting.

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Circle 14 on reader service card

R-E's Service Clinic

De-modulate the new modular TV receivers

Modular TV and the technician—the technician wins!

by JACK DARR
SERVICE EDITOR

NORMALLY THIS COLUMN IS PRETTY noncontroversial and I like it that way. We are all concerned with various ways of doing the same things. However, once in a while I have to express some opinions—purely personal opinions, of course, but based on quite a lot of experience in doing the things that the opinions are about!

What started all this was a couple of clippings the Editor handed me. They contained some pretty gloomy predictions for the future of electronics servicing.

Being a grouchy old man who has been actively engaged in this business for too close to 50 years, I get a distinct sense of deja vu* every time I hear these things. For one thing, I've *been* hearing them at intervals of about 5 years ever since I started!

Argument: "_____sets will require more highly skilled technicians because they'll break down less often but be harder to fix." The words in the blank this time were "solid-state", but I've heard the same things with color TV; black-and white TV; and, if you go back far enough Ac-powered *radios!* (ca 1927!)

Rebuttal: One: it *will* take more skill on the part of the technician. But the American electronics technician, so far, has taken everything they've thrown at him in his stride! TV, color TV, transistors, integrated circuits—you name it, put it in a set and we'll fix it. Between the manufacturers who give us data, the test equipment people who give us instruments to check 'em with, and the native bull-headedness of the U.S. Service Technician who will not admit that there is anything he can't fix, we make out, and I firmly believe we always will. From experience, solid-state sets run about the same MTBF (mean time between failures) as the others. (From actual tests, including time-and-motion testing of many sets, I *will* say that the overcrowded solid-state PC-board sets run something like 1.6 times the *service-time* per set, compared to terminal-strip construction. The PC-board type, with parts on one side and wiring on the other, **is more difficult to repair,** due to the extra time needed to locate and identify the parts to be tested. The actual (mechanical) job of replacing a part is slower, due to the difficulty of getting parts into crowded chassis, working leads through tiny holes, etc.

So we do have a problem there. But, as usual, we develop the special skills, and the tool-makers give us the special tools we need. Most of us have reduced that average 1.6 time differential to the minimum by now. For technicians reading this, I might say that you're not going to fix these sets with a pair of gas-pliers and a 150-watt soldering iron! The special tools are absolutely necessary, and you might as well get with it. It's the only way.

Argument: Modular TV's will require much less skill to service than the conventional type. Quote: "—they can go down to the corner drug store, buy a module the size of a pack of cigarettes, plug it in, and drive us out of business!" Ho, hum. Remember the Drug-Store Tube-Testers, fellers? They said the same thing about them. I do not know of any competent technician who was driven out of business by these things.

Concession: the actual "plug-in" operation *could* be done by the proverbial 10-year old boy (If he didn't manage to break the module in two trying.) But it will require a skilled *technician* to tell him *which* module to replace.

Rebuttal No. 2: Quote: "You'd have to carry a tremendous stock of modules to service all makes of set." *RIGHT!* This is correct. The stock of modules would be impractical for anyone, with the possible exception of a Government project of some kind.

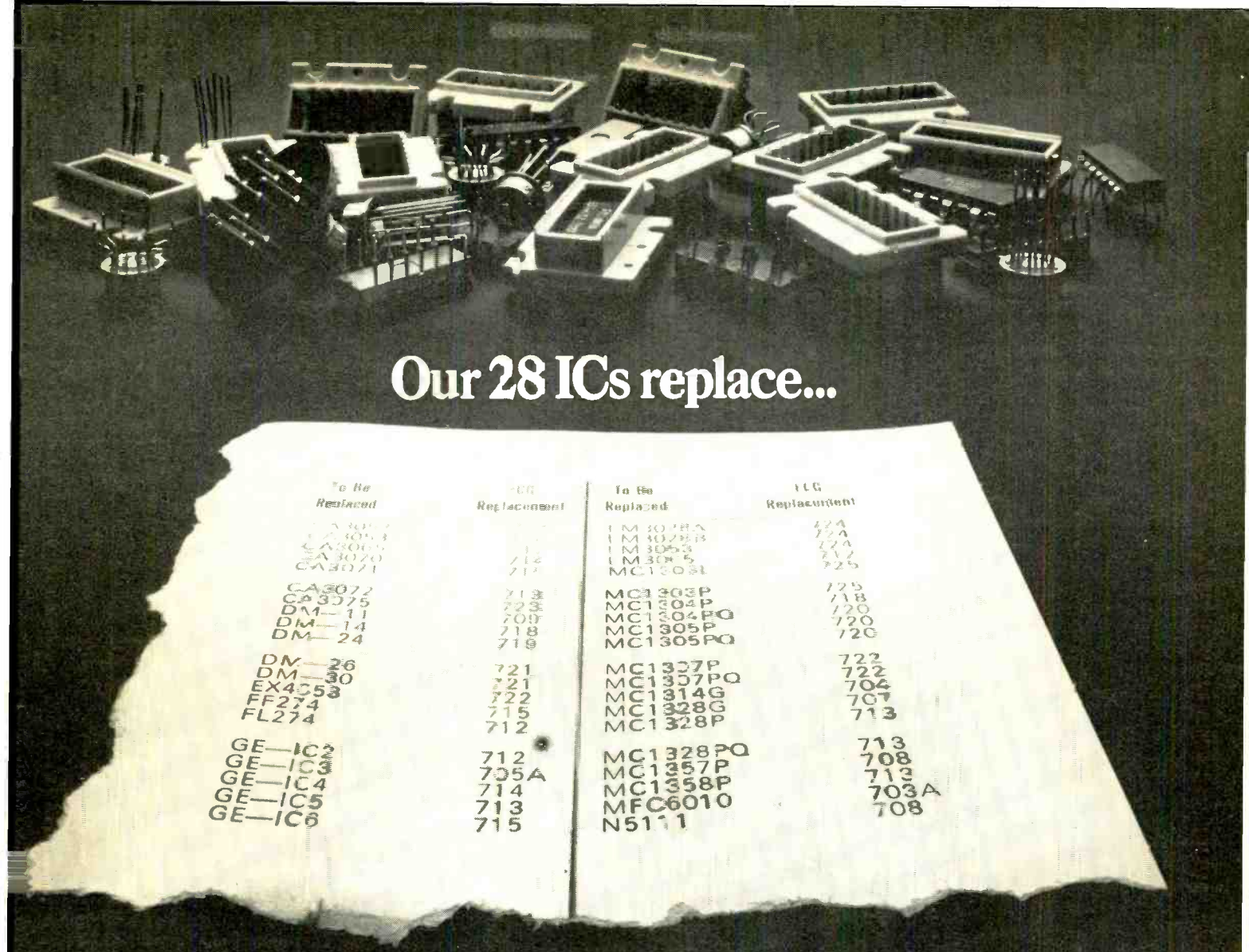
To finish off the argument about the drug-store, pack-of-cigarette modules once and for all, let me say just *one word—STANDARDIZATION.* That did it. For this to have any effect

(continued on page 70)

(*That's French for "You've been here before, Bub!)

This column is for your service problems—TV, radio, audio or general and industrial electronics. We answer all questions individually by mail, free of charge, and the more interesting ones will be printed here.

If you're really stuck, write us. We'll do our best to help you. Don't forget to enclose a stamped, self-addressed envelope. Write: Service Editor, Radio-Electronics, 200 Park Ave. South, New York 10003.



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To Be Replaced	ECG Replacement
CA3072	714
CA3075	714
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DM—14	709
DM—24	718
DM—26	719
DM—30	721
EX4053	721
FF274	722
FL274	715
GE—IC2	712
GE—IC3	705A
GE—IC4	714
GE—IC5	713
GE—IC6	715
MC1303P	725
MC1304P	718
MC1304PQ	720
MC1305P	720
MC1305PQ	720
MC1307P	722
MC1307PQ	722
MC1314G	704
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MC1328PQ	713
MC1357P	708
MC1358P	713
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N5111	708

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GTE SYLVANIA

SERVICE CLINIC

(continued from page 68)

at all, every manufacturer of electronic equipment would have to agree to freeze designs, and use identical modules for given functions.

If you think this is going to happen in the foreseeable future, just pick up two of the reference books that are in every shop. One a Receiving Tube Manual, and two, a Transistor Cross-Reference Guide. I don't know how many tubes there are, now, but the last figure I had on transistors was something like *36,000* "different" types. (It is demonstrably true that about 40 general-purpose replacement transistors will work in place of practically all of these). So if they are going to standardize, I have only one question: *"When are they going to start?"* Note that I didn't even mention standardization of IC's; you can't even find a cross-reference listing on the things. Only factory part numbers. Standardization? It is to laugh!

As a matter of fact, in one of the better-known brands of modular TV, even the maker's own modules are not standardized yet. One function comes in 5 different versions, three of which are not interchangeable. Another unit in the same chassis has been modified 26 times.

We are moving toward a "Service-Oriented Economy." With the growing number of complex devices in daily use, there is no other way we can go. So, the *skilled technician* is going to become more and more important. Without his skill in diagnosing and repairing failures, the economy would come to a screechning halt. To me, this type of work is just as difficult, and just as important, as design.

Don't tell me that the "module-plugger" is going to replace the "Tube-Puller." You know where he went. (By the way, so far there are no Drug-Store Module Testers—at least not yet.) Once more may I be a bit redundant; If we are to have all of this standardization, *when are they going to start?* **R-E**

reader questions

3A3C INTERNAL HOOKUP

An alert reader found that RCA 3A3C tubes will not work properly in Sylvania DO-5 color chassis. The RCA tube uses pins 1, 3, 5 and 8 as internal

(continued on page 72)

(continued from page 52)

chroma bandpass amplifier, the reference oscillator, the acc circuit and the color killer. On IC602 are the chroma demodulators, the color summing matrix and the three output difference amplifiers. Fig. 11 shows the dc tint control and the Tint Lock system used on this chassis. The tint control is a dc type and works similarly to the varactor Admiral circuit we looked at earlier. The reference oscillator output of IC601 first feeds the tint control circuit. The output of phase shift amplifier Q602 is shifted by 52° by C656 and L646 feeding one input to the demodulator chip. A - 52° phase shift is produced by L642 and C657 to drive the other demodulator input. The total demodulation angle is 52 - (- 52) = 104°. Diodes Y631, Y632, Y633 and Y634 are operated by the *Tint Lock* switch to change the angles. In the first switch position Y631 and Y633 are turned on paralleling L643 and L646 increasing the positive shift. C657 and C658 are also paralleled increasing the negative shift. In the second *Tint Lock* position L644 and C659 come into play with the demodulation angle reaching the maximum 160 degrees.

Motorola—Here the name is *Instamatic* controlling a pilot light, AFT, preset contrast, preset color intensity, preset hue, preset brightness and a background and demodulation phase angle shift circuit. Motorola's modular TS-934 chassis uses two IC's with

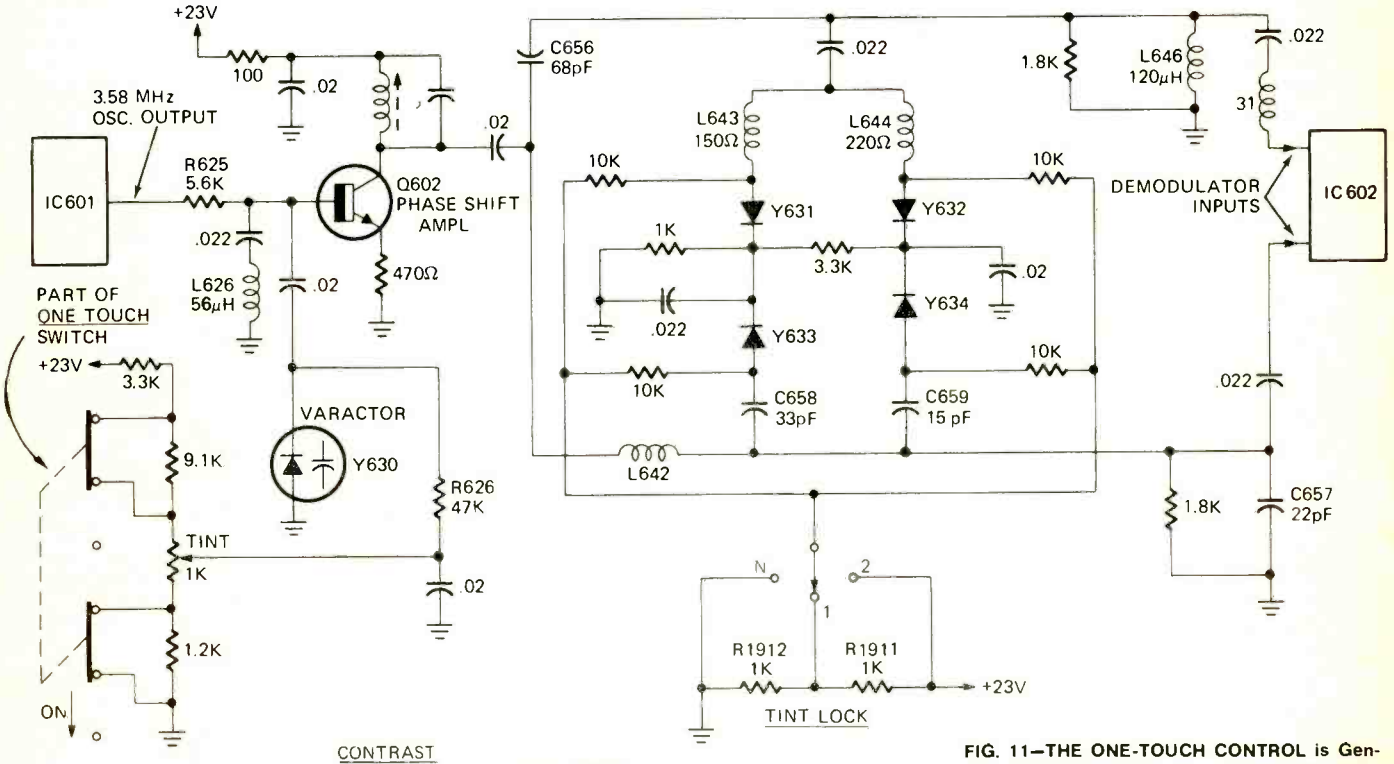

FIG. 11—THE ONE-TOUCH CONTROL is General Electric's latest user control for satisfactory color at flick of a switch.

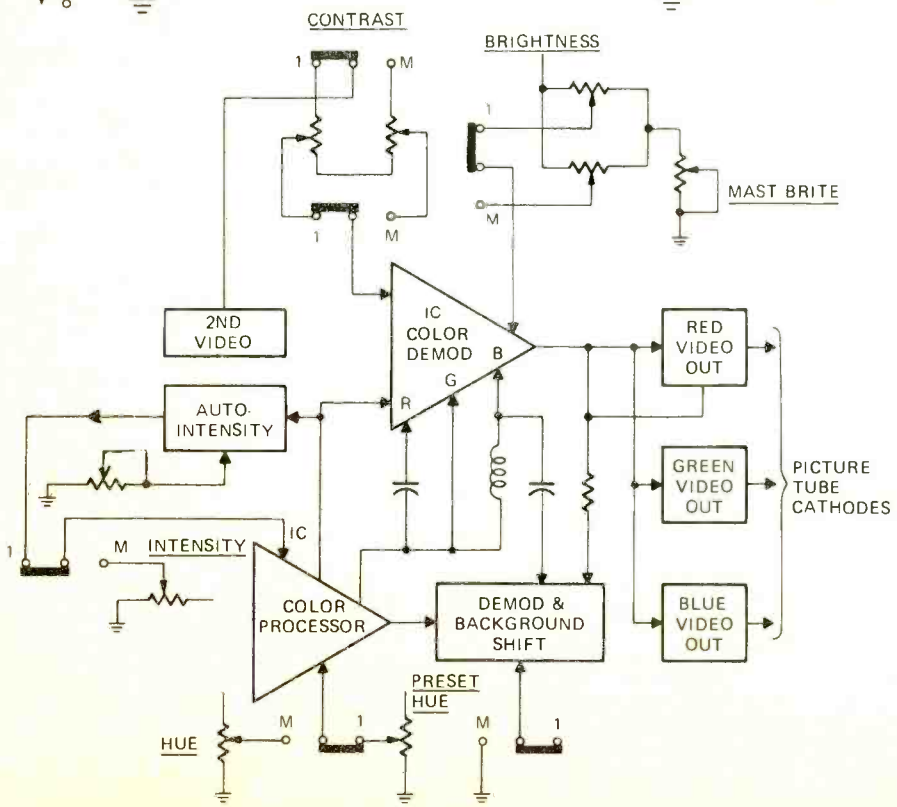

FIG. 12 (left)—INSTAMATIC COLOR in Motorola TS-934 chassis. The circuit uses two IC's and approximately eight transistors.

about eight additional transistors not counting the video color outputs. Fig. 12 is a block diagram of the system. Fig. 13 is the automatic color intensity circuit used in this chassis. In the manual mode the color control directly adjusts color gain. In this mode there is no acc automatic color control action. When switched to Instamatic the acc is connected. This circuit looks at the color signal from the color processor IC amplifier, rectifies it and uses the developed voltage to control the gain of the color amplifier. The preset color intensity control adjusts the color level to which the acc circuit will regulate. In Fig. 14, the tint correction circuit, Q6 is an AND gate which enables the circuit when both the Instamatic switch is on and a color signal is sensed. When both con-

(continued on page 98)

READER QUESTIONS

(continued from page 70)

connections, to support the cathode structure. The original Sylvania 3A3C tube does not use these pins.

When used in the DO-5 chassis, the RCA 3A3C's lasted only about 90 days. The internal connections shunted the heater dropping resistor, resulting in excessive heater voltage. (Incidentally, all of the 3A3A tubes shown in my manuals *do* use internal connections on these pins. Possible cure: move the 4.7-ohm dropping resistor to unused pins; 6, for example)

Thanks to Donald H. Pomeroy, Milestone Laboratories, Manchester, N.H. for this one.

NO HIGH VOLTAGE

I've got a weird condition in an Admiral 1H2 portable. The fuse blew; I replaced it. Now, there's no high voltage, and the screen grid resistor of the 33GY7 gets very hot; smokes. I tried a new 33GY7, and got a raster for a moment, then it went out and the resistor smoked again.—D.Q., Omaha, Neb.

Take a very close look at the *plate* connection of the 33GY7 socket on the circuit board; the plate connection of the pentode output section, that is. I believe you'll find that this will be pretty dark-looking, and probably have a very bad solder-joint. Remelt it and add fresh solder.

Your output tube plate connection is probably opening. So you have no plate, and all of the current flows to the screen grid. There is only a 1-watt 560-ohm resistor here, and this promptly gets very hot. Double-check: read screen voltage at turn-on; if it jumps to normal, then drops to zero, this is it.

INTERMITTENT BRIGHTNESS

I thought this one would be simple but it wasn't. In an RCA CTC-15, the raster would go out. Move the 12BY7 video output tube, and it came back. I replaced the tube; got about a week and the same thing. So, I replaced the tube socket, and I've still ***got the same problem! The 12BY7 goes dim and out goes the raster. N.P.S., Greencastle Pa.***

It is simple (he said hopefully!) I've had the same thing in my own ancient RCA. Try this: run a *jumper wire,* solid No. 20 at least, from the ground terminal of the 12BY7 heater to the nearest ground. Now, for luck, run another from the hot 6.3 volt socket terminal to the nearest lance on the board; toward the front of the video board, brown wire.

I think this will cure it. There is a

(continued on page 78)

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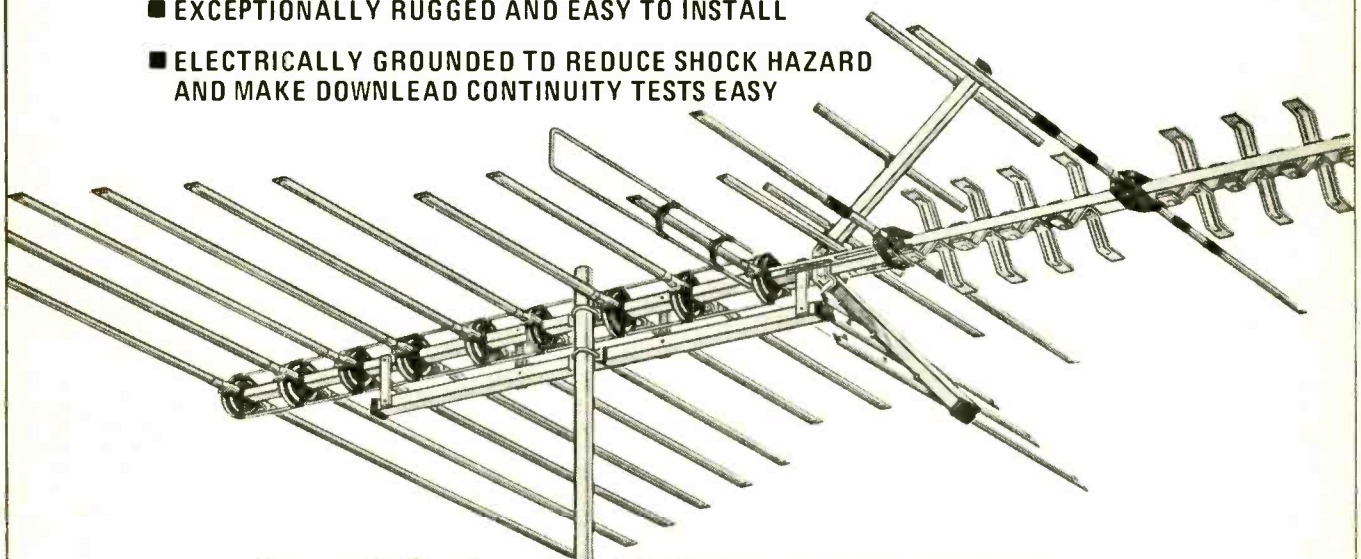

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Just fill out the coupon and mail it to us with the instruction sheet from a Jerrold VU-931S, VU-932S, VU-933S, VU-934S, VU-935S, VU-936S or VU-937 antenna. We will send you two NFL coffee mugs FREE!.

FOR EVALUATING THE NEW JERROLD SUPER VU-FINDER.

JERROLD

JERROLD ELECTRONICS CORPORATION
P.O. Box A, 401 Walnut St., Phila., Pa. 19105/(215) 925-9870

Please send me a free pair of NFL coffee mugs. Enclosed is an instruction sheet from the following Super VU-Finder antenna. (model)_____

1 Before trying the Super VU-Finder, I was using the following antenna: (make)_____ (model)_____

2 In my opinion the Super VU-Finder is: ☐ BETTER ☐ WORSE because: _____

3 Comments: _____

NAME _____
COMPANY NAME _____
ADDRESS _____
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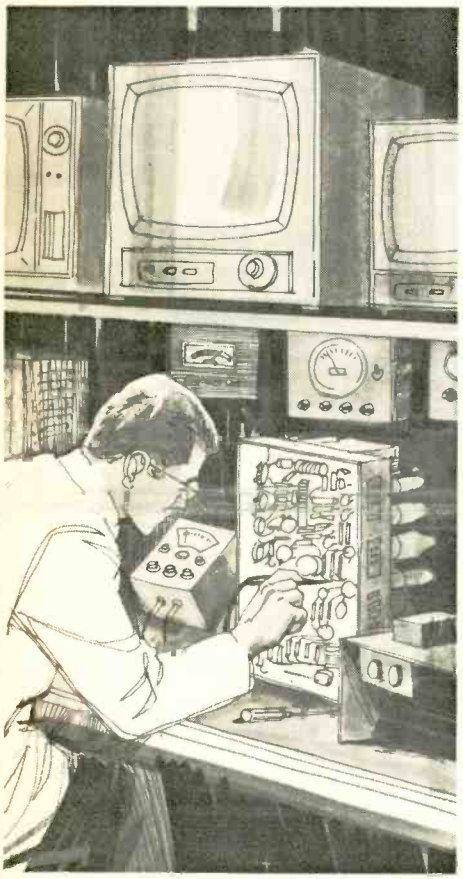
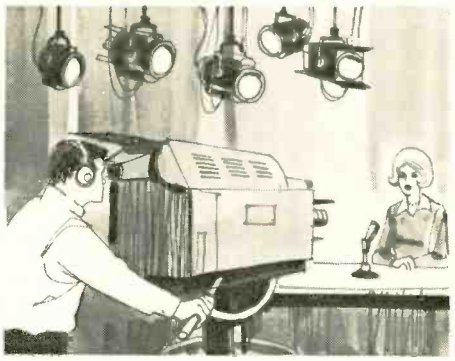
LIMIT ONE SET TO A CUSTOMER

Circle 20 on reader service card

Great careers





Join the high-paid electronics technicians who got their start through NTS Home Training.

Your home can become your own private classroom-workshop. NTS sends you everything you need to learn valuable technical skills in electronics. You get easy-to-grasp lessons, comprehensive kit manuals, large fold-out charts, and more. Plus the finest professional equipment available today. It's all included in your tuition, yours to keep.

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It all begins at home, with NTS Project Method Training. Check card or coupon today for free full-color NTS Catalog and complete details. No obligation. No salesman will call.

NTS COLOR AND B&W TV SERVICING

Build the largest most advanced color TV made! It's a Heath! Over-all solid-state design, 315 sq. in. ultra-rectangular screen, 24 channel detent UHF/VHF power tuning, matrix picture tube, built-in self-servicing features, "Instant On," A.F.T., solid-state VHF tuner, and much more! This is a commercial set, the kind you'll encounter in the field — and not for training purposes only. Also build and keep AM-SW Radio, Solid-State Radio, FET Volt-Ohmmeter, and Electronic Tube Tester. Learn trouble-shooting, stereo multiplex systems, radio, color and B&W TV servicing.

Solid-state B&W TV 74 sq. in. picture (cabinet included)

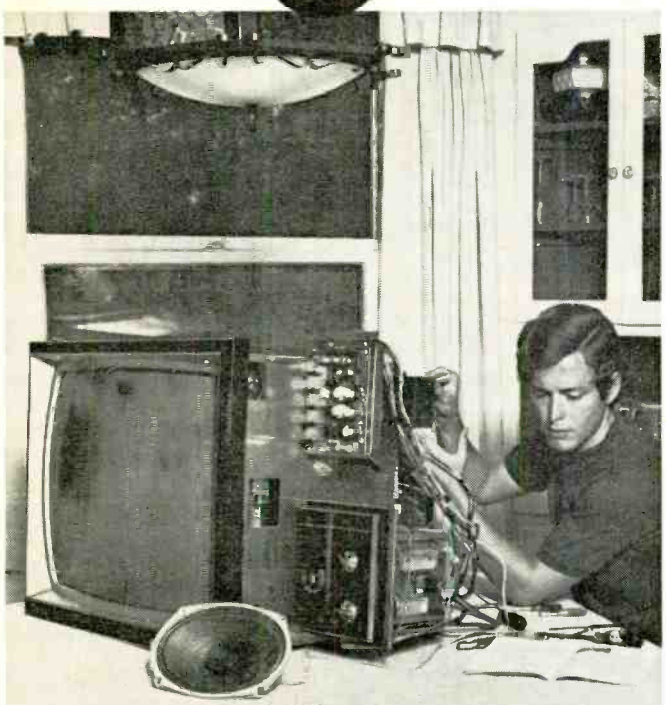
Learn advanced solid-state circuitry as you build this B&W TV receiver. Course covers the full range of home entertainment electronics.

NTS AUDIO ELECTRONICS SERVICING

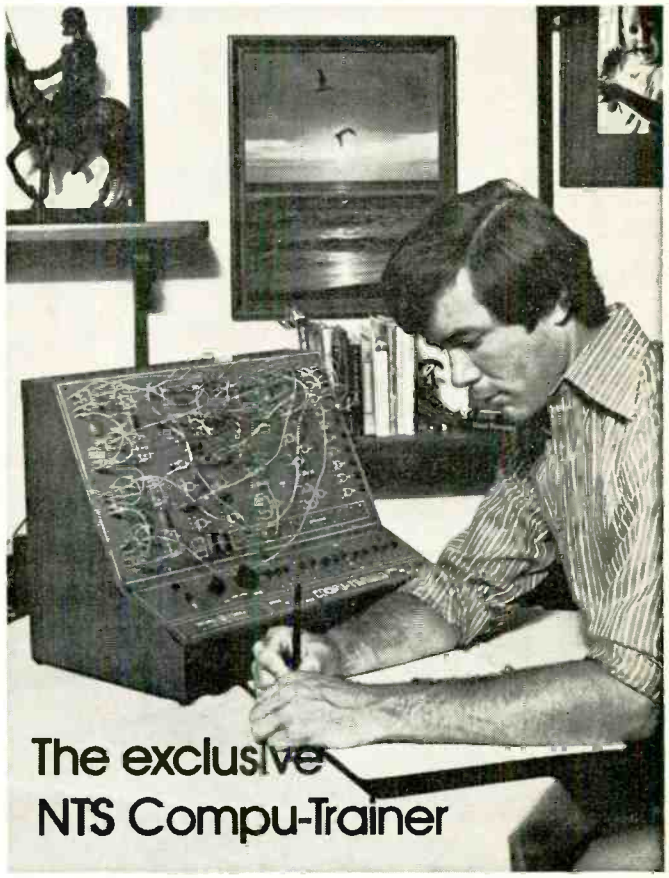
Solid-state Heath Stereo Receiver and Speakers

Learn sound theory — how it works in home radio, 4-channel, and more! Set up a spectacular music system. Learn about sound distortion, amplification and control, loud-speaker baffles, problems of system installation, etc. Included is Volt-Ohmmeter. In-Circuit Transistor Tester and solid-state Radio. Prepare yourself for great opportunities in the Home Entertainment Industry!

begin at home.



New solid-state
315 sq. in. color TV



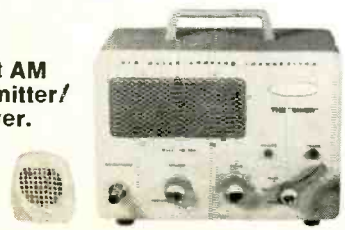
The exclusive
NTS Compu-Trainer

NTS COMPUTER ELECTRONICS

Build and operate the exclusive NTS Compu-Trainer! Loaded with integrated circuits, it teaches you the how, what, and why of computers — faster, more thoroughly. You perform all wiring and patch-cording. No shortcuts! No pre-wired circuit boards. Also receive an FET Volt-Ohmmeter and a 5" wide-band Solid State Oscilloscope.

NTS ELECTRONIC COMMUNICATIONS

Gain the prestige and earning power of owning an FCC First Class Radio Telephone License! Two exciting courses in the fields of transmitting and receiving. Experiment with an amateur phone 6-meter VHF transceiver, NTS exclusive 6-transistor solid-state radio and a fully transistorized volt-ohmmeter.



5-watt AM transmitter/ receiver.

NTS AUTOMATION/ INDUSTRIAL ELECTRONICS

Systems automation is the future of the industry — and you can play an important role! Enter the age of electronic controls by training on the NTS Electro-Lab — a complete workshop. Also receive a Solid State 5" wide-band professionally rated Oscilloscope. Build five industrial controls to regulate motor speed, temperatures, pressure, liquid level and much more.

5" Solid State Oscilloscope

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- ☐ Master Course in B&W TV & Radio Servicing
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- ☐ Practical Radio Servicing
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- ☐ Master Course in Electronics Technology
- ☐ Automation & Industrial Electronics
- ☐ Computer Electronics
- ☐ Basic Electronics
- ☐ Audio Electronics Servicing

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hairline crack *somewhere* in the heater circuit, and this is the fastest way to get it.

FLYBACK REPLACEMENT

If you have to replace the flyback in a Zenith 19DC20 hybrid chassis, you can save a great deal of time. The new flyback will come with the wires already soldered on it. *Don't* use them! Unsolder the original wires at the flyback terminal board. Take the old one out, put the new one in, and then remove the wires one at a time, and resolder the original wires. They'll be of the same colors.

If you do it in this way, you won't even have to pull the chassis. Otherwise, you'll have to pull the chassis, and spend quite a little time threading some of those wires underneath and getting at some tight places.

HOT OUTPUT TRANSISTORS

I've replaced the output transistors in a Zenith stereo, 20AT30Z. Now the new ones get hot and the tone is lousy. Driver transistor is OK. I changed it for the one in the other channel. New transistors match.—B.D., Billings, Mont.

You have bias trouble, I'd say. Check the bias diode, marked CR451 on the board. If it is *open*, you'll lose the proper bias, the output stage will be unbalanced, and get hot. If this is it, you can replace it with a plain silicon diode, such as RCA SK-3030. Your midpoint voltage (at the speaker connection, before going through the capacitor) will settle down somewhere around 14.5 volts. It must be roughly half of the supply voltage, which is about 28 volts.

VIDEO DETECTOR BLOWS

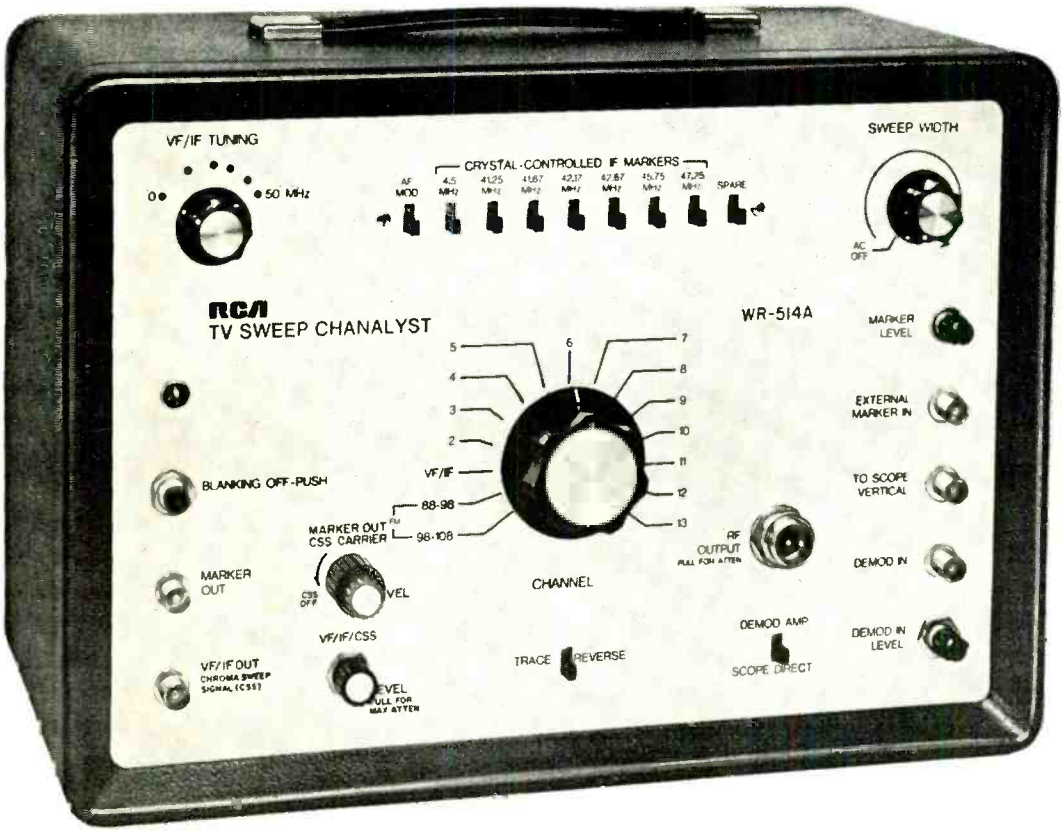
I've got a Truetone MIC3919C portable, which has blown three video detector diodes in about two months. I can't find any trouble in the set; no shorts in the last i.f. transformer, etc.—R.Q., Ariz.

Try replacing the original glass diode with a 1N64. This is how we cured the same trouble a long time ago in an old GE model with the same symptoms. Or use an RCA SK-3091 that has a 40-volt peak rating. Some of the imported diodes seem to have this problem. They short, without apparent reason. So use a higher-rated diode.

This one is in the last i.f. transformer can. The old ceramic 1N64 will be "push-fit" in here, but it can be done. **R-E**

RCA's TV Sweep Chanalyst checks every VHF channel.

And this complete system has other features you need to restore new-set performance.



- Concerned about CATV, CCTV, MATV? WR-514A checks all VHF channels for tuner malfunction
- Precision attenuator permits peak fringe area reception adjustment
- Versatile snap-on probe allows fast, accurate alignment technique
- One-year warranty on parts and labor . . . local replacement parts availability

Unit combines the functions of a sweep/marker generator, marker adder. RF, IF, video and special Chrom-Align sweep signals permit checking of VHF tuners and alignment of IF, video and color bandpass amplifiers. That's why we call the RCA WR-514A a complete system.

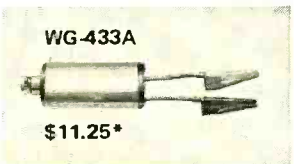
Yours for only $380* including RF output cable, three direct cables, connector adapter, VF/IF 75-ohm input head, and two direct termination units. Ask your distributor if he offers easy payment terms.

Together with the bonus accessories offered below, you will have just what you need for TV alignment procedures.

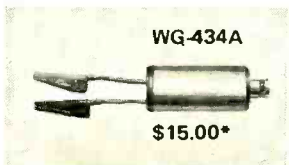
To get the special bonus offer, simply mail the WR-514A warranty card to RCA Test Equipment Headquarters, Harrison, N.J. 07029. Offer subject to withdrawal without notice. See your RCA Distributor for a demonstration of the RCA TV Sweep Chanalyst. Application Notes and other technical data are also available — on request.

*Optional Distributor Resale Price

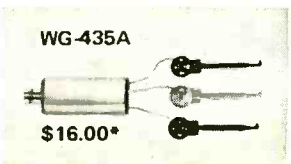
Special bonus offer–3 accessories worth $42.25* free with purchase of an RCA WR-514A



MIXER-INPUT ADAPTER



VIDEO/CHROMA BANDPASS DETECTOR



LINK/IF DETECTOR

RCA Electronic Components

Circle 23 on reader service card

new lit

All booklets, catalogs, charts, data sheets and other literature listed here with a Reader Service number are free. Use the Reader Service Card inside the back cover.

CAPACITOR AND BALL-DRIVE CATALOG SHEET illustrates the Jackson Brothers line of air-dielectric variable tuning and trimmer capacitors and reduction drives available for use with them.—**M. Swedgal,** 258 Broadway, New York, N.Y. 10007.

Circle 31 on reader service card

1973 ANNUAL CATALOG *No. 730,* features 2-channel and 4-channel stereo high-fidelity components, Citizens-band 2-way radio equipment. Lists amplifiers, decoders, decoder/amplifiers, receivers, tuners, modular hi-fi systems, the latest in record changers, speaker systems, tape recorders. Includes cameras and photographic accessories, electronic test equipment, auto supplies, books, microscopes, telescopes. Over 18,000 new major brand electronic parts.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, L.I., N.Y. 11791.

Circle 32 on reader service card

COLOR TV ELECTROLYTIC REPLACEMENT GUIDE, *M-945* lists Sprague Types TVL and PCL aluminum electrolytics intended for color TV servicing and 54 leading color TV manufacturers along with the catalog numbers of the TVL/PCL units which fit their respective chassis. All capacitors are identified by catalog number, capacitance, dc working voltage, dimensions and the number of color TV set makes in which it is used.—**Sprague Products Co.,** Marshall St., N. Adams, Mass. 01247.

Circle 33 on reader service card

ELECTRONICS CATALOG, 180 pages featuring home entertainment products, audio equipment, Citizens-band 2-way radios, test equipment, antennas and hobby kits. Also lists thousands of hard-to-find or specialized electronic items for hobbyists, experimenters, technicians or anyone wanting a wide selection of parts, accessories and maintenance items. New products being introduced for 1973 include stereo and four-channel amplifiers, receivers, adapters and tape decks; speaker systems, CB radios, stereo radios, scanning monitor receivers and a miniature electronic calculator.—**Radio Shack,** Dept. R-26, 2617 W. Seventh St., Fort Worth, Tex. 76107.

Circle 34 on reader service card

ELECTRONIC PARTS CATALOG, for hobbyists, experimenters and do-it-yourselfer's of both beginner and sophisticate level. 16-page catalog, low-price, high-quality components. In addition, a number of electronic kits are described. These include burglar alarms, lamp flashers, rectifier tester and more.—**Cortlandt Electronics, Inc.,** 16 Hudson St., New York, N.Y. 10013. **R-E**

Circle 35 on reader service card

Up-to-the-minute service information* from Sams

*Selected portions of manufacturers' servicing data bound in convenient book format

Transistor Radio Servicing Data

Designed for the service technician, Sams Transistor Radio volumes are published monthly. Each volume in the series contains schematics, parts lists, pictorial presentations, troubleshooting data, plus other information on up to 17 of the latest transistor radio receivers and other youth products. Includes data you need to service virtually any receiver mass-marketed in the U.S.A. The Photofact® Annual Index lists the equipment covered in each volume.

$3.25 each.

Modular Hi-Fi/Stereo Servicing Data

What the transistor radio series does for transistors, this series does for hi-fi and stereo components and compacts. Issued monthly, each volume includes schematics, pictorial presentations, pertinent servicing data and parts lists for up to 13 of the latest modular components — tuners, receivers, amplifiers, etc. Covers virtually all equipment mass-marketed in the U.S.A.

$3.95 each.

Scanner-Monitor Servicing Data

Contains comprehensive servicing data for 30 of the most popular UHF and VHF receivers now in use, including B&K, Browning, Johnson, Midland, Pace, Pearce-Simpson, Penneys, Realistic, Sonar, and Teaberry. As the first guide ever released for scanners and monitors, it is an invaluable aid for service technicians. Its last-minute information includes schematics, voltages, alignment, parts lists, crystal formula data, pictorial presentations, and general troubleshooting information.

No. 06557 **$4.95**

Special Discount Offer

All of the above are available from your Sams Distributor. Ask him how you can save 30¢ a volume on Transistor Radio Series and Modular Hi-Fi/Stereo Series by contracting for each volume as it is issued.

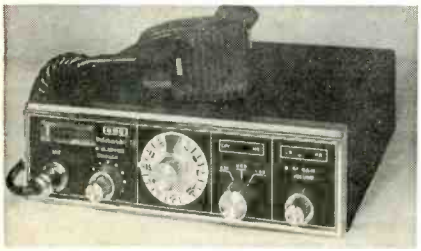
HOWARD W. SAMS & CO., INC.
4300 West 62nd St. • Indianapolis, Ind. 46268

Circle 25 on reader service card

new products

More information on new products is available from the manufacturers of items identified by a Reader Service number. Use the Reader Service Card inside the back cover.

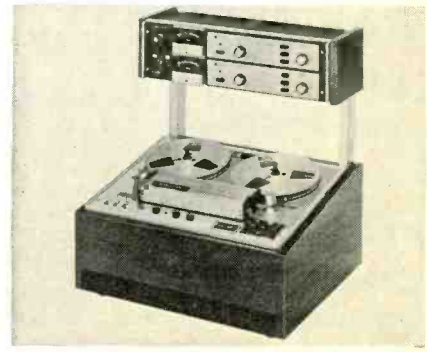
SSB/AM MOBILE CB TRANSCEIVER, *Sidebander II,* is 40% smaller, 20% lighter and 23% lower in price than its earlier version. The new 32-channel



transceiver features a full 15 watts PEP power input to the transmitter final amplifier stage, a four-function back-lighted meter, rf gain control, signal clarifier, public address facility and a plug-in microphone. An accessory 117-volt ac power supply is available.—**Linear Systems, Inc.** 220 Airport Blvd., Watsonville, Calif. 95076.

Circle 36 on reader service card

MINIATURE SOUND STUDIO, *model 9100,* 6-head, 4-track tape deck has digital IC's in the deck's transport system to insure computer-type, feather-touch operation. Professional capabilities include bi-directional recording with automatic reverse and repeat playback; built-in head demagnetizer; photo-electronic shutoff; precision molybdenum heads; three motors; tape-counter memory; three oscillators; tape select switch which increases current by 30% for low-noise, high output tapes; line microphone mixing; echo, S.O.S. and S.W.S. capability with level controls. Signal-to-noise ratio better than 50 dB; wow and flutter less than 0.06%; frequency response 45 Hz to 21kHz ±3db at 7½ ips.



Two-year parts warranty. $699.95.—**Dokorder, Inc.,** Dept. P, 11264 Playa Court, Culver City, Calif. 90230.

Circle 37 on reader service card

FM MULTIPLEX STEREO GENERATOR, *model LSG-231,* has a pilot signal frequency of 19-kHz with ± 2 Hz accuracy.

Leader outduals them all!

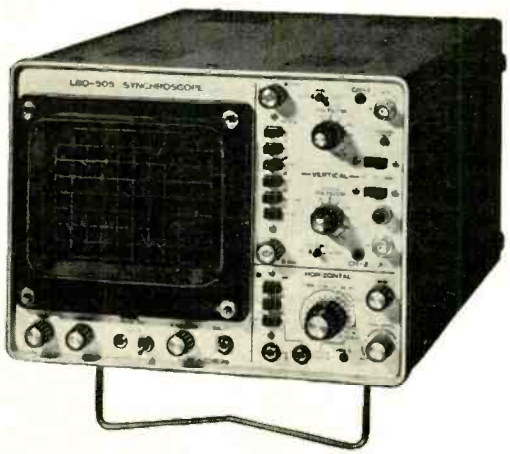
LBO-505 DUAL CHANNEL/ DUAL TRACE SOLID STATE OSCILLOSCOPE

Accuracy! Performance! Exclusive, Leader-developed features! That's what makes the LBO-505 the Number One Dual Channel/Dual Trace Scope. You get triggered and automatic sweep. AC or DC coupling per channel. 15MHz bandwidth. Maximum horizontal speed of 0.1 microseconds/cm (10X magnification). 10MVp-p/cm vertical sensitivity. Separate or simultaneous display in sweep mode of channels 1 and 2, alternating, chopped, added algebraically and vector (X-Y). The triggered sweep range extends from 1μs/cm to 0.5s/cm, calibrated in 17 steps. Scale illumination is continuous with front panel control.

How can you use the LBO-505 most efficiently? You'll find more ways than you can think of ... at first. It makes troubleshooting a breeze! Compare 2 signals simultaneously — input and output, for color, monochrome, audio and much more. Check gain, loss, distortion, phase shift, frequency ... you name it. Do your own thing. The LBO-505 belongs on every bench and in every lab. Feature-for-feature, price-for-price, job-for-job ... it outduals them all!

MODEL LBO-505 $559.95

Price Includes:
2 LPB-8X Direct Lo/Cap Probes
2 Terminal Adapters — BPX
1 Set of Test Leads



Send for new catalog. See your distributor.

The more you see... the more you believe.

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Circle 62 on reader service card

The 1-kHz audio signal is accurate to ±1%. Signal separation is rated at 50 dB with output voltage at 0 to 3 Vrms continuously variable. Useful in the field or on the bench. Easy to operate, compact

and complete with tilt stand; has a dual power supply and measures 8"W x 12"D x 3½"H. Weighs 5.5 lbs. $229.95.—**Leader Instruments Corp.,** 37-27 Twenty-Seventh St., Long Island City, N.Y. 11101.

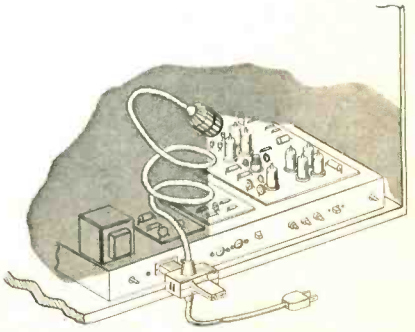
Circle 38 on reader service card

STYLUS CLEANING KIT, *No. R40052,* contains a unique brush designed to assist in removing dirt and foreign matter without harming the delicate stylus point and a special cleaning-fluid formulation

in a convenience container. The product is designed to increase the life of both stylus and records. $2.50.—**Robins Industries Corp.,** 75 Austin Blvd., Commack, L.I., N.Y. 11725.

Circle 39 on reader service card

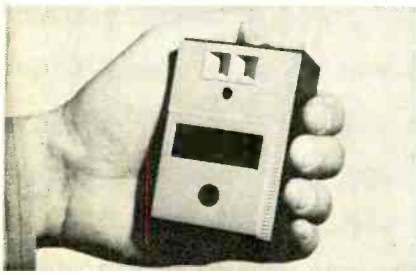
CHEATER CORD AND TROUBLE LAMP, feeds power to the TV, stereo or any unit being tested through a standard or polarized interlock without the need for cheater cords. A flexible, high voltage, insulated goose-neck supports a powerful and compact spot light that can be positioned to illuminate any part of the set. The interlock also affords a convenient auxiliary outlet for any ac feeding or extension and can be used whether plugged into chassis or not. Constructed



of thoroughly insulated and heat resistant materials. $9.95.—**Michelin International,** P. O. Box 6743, Los Angeles, Calif. 90022.

Circle 40 on reader service card

BROWN-OUT PROTECTOR, *model EP-110.* Plug device into wall outlet and appliance into the monitor. When line voltage drops below 100 volts, it automatically disconnects equipment from the line. When power returns to normal, the



device reconnects the equipment. A built-in time delay prevents short duration line drops from disconnecting and restarting equipment. $19.95.—**Logitek, Inc.,** 42 Central Dr., Farmingdale, N.Y. 11735.

Circle 41 on reader service card

ELECTRONIC IGNITION SYSTEM, *Tiger 500* capacitive-discharge solid-state ignition system comes with a dual ignition switch and fits into a 4" x 4" x 3" box. Provides instant starting under all weather conditions, eliminates tune-ups, extends the life of spark plugs and points, improves gasoline mileage, acceleration and performance. Can be added to any 12 V negative-ground generator/alternator system without any rewiring. $49.95.—**Tri-Star Corp.,** Dept. NR, P. O. Box 1946, Grand Junction, Colo. 81501.

Circle 42 on reader service card

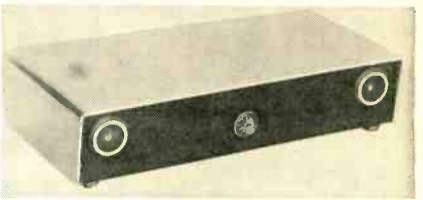
INSTRUMENT REPAIR KIT, *model JTK-90,* more than 60 precision tools with emphasis on watchmakers' tools and electronic assembly tools in the smaller sizes. Kit includes various type screwdrivers; 5-piece spline blade set; precision 10-piece knife set; hand vise; wire stripper-cutter; adjustable wrench; soldering tools; watchmakers' anvil; hand blower; 20-piece miniature drill set; miniature high-intensity lamp and much more. Packaged in a deluxe attache case, hardwood construction, black Mar-

velon covering and brass hardware. Room for spare parts and special tools and a pocket for documents and instruction manuals. With *Triplett #310* vom

$225. Without tester $175.—**Jensen Tools & Alloys,** 4117 N. 44th St., Phoenix, Ariz. 85018.

Circle 43 on reader service card

ULTRASONIC MOTION DETECTOR, has a range of 25 to 30 feet. Has powerful signal and high quality filtering system to

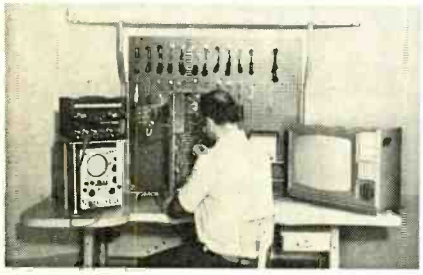


eliminate problems caused by outside interference. Operates from 12Vac. In event of power failure, built-in recharge-

able batteries provide 12 hours of standby operation. All wire terminals and the sensitivity adjustment switch are guarded by a protective cover.—**Alarm Device Mfg. Co.,** 165 Eileen Way, Syosset, L.I., New York 11791.

Circle 44 on reader service card

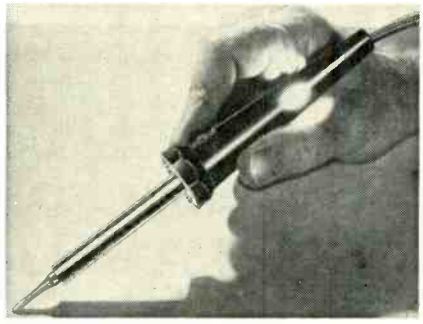
REPAIR SERVICING BENCH, includes a green peg-board that stores test cables, work tools and meters for easy reach and reference. Optional items include locked drawer for reference material, storage area shelf, swivel posture chair, solder iron holster, locking 360° turntable. Nearly shadowless low-wattage lighting is built in. Master indicating 15-



amp fused/switch package is available. For safety, 8 grounded 110V outlets and pre-punched holes for adding standard dc or other receptacles are included. Assembly space: 35 sq. ft., 82" H x 84" L x 82" D. Weight, 175 lbs.—**Alden Systems Co., Inc.,** P. O. Box A, Turnpike Rd., Westboro, Mass. 01581.

Circle 45 on reader service card

SOLDERING IRON, model 540 is a 20–40-watt pencil soldering iron designed for constant use in electronic production, repair and maintenance and for "do-it-yourself" kit building. A built-in



light inside the handle shows operation at either 20 or 40 watts.

Unbreakable handle, burn-resistant cord set, stainless steel element, solid-state control and ironclad tips. 8½ in. long, weighs 2 oz., two- and three-wire cords are offered. Under $8.00 with one tip.—**Endeco,** 5127 East 65th St., Indianapolis, Ind. 46220.

Circle 46 on reader service card

appliance clinic

INTERLOCKS AND MENTAL BLOCKS

by JACK DARR
SERVICE EDITOR

THE DIAGNOSIS OF TROUBLE IN ANY AUTOMATIC appliance looks like a big job, at first. Automatic washers, dryers, and others seem to be pretty complicated. They are, but if you'll take what is often an unusual step—Thinking!—it will be a lot easier. There are always certain key reactions that will help give you a handle on the problem.

The basic principle of this is the same in all types of machinery. First, find out what the thing *is* doing—then, recheck to find out what it *isn't* doing. A lot of these will turn out to be interlocked. That is, if one thing isn't there, this will make something else stop.

All of these units have certain "inputs"; ac power, hot water, cold water, gas, and so on. These *must* be present, and in the right quantities, or the thing isn't going to work, or won't work properly. It's built that way, intentionally. They "interlock". This feature prevents the machine from going through a normal cycle if one or more of the normal inputs is missing.

In automatic washers, the machine will stop if there isn't enough water in the tub, during a certain part of the cycle—rinse, for example. Conversely, it will also stop if there *is* water in the tub when it shouldn't be there—at the point when the machine should go into spin. The excess water in the tub would put a very heavy drag on the cylinder in the high-speed spin cycle; so, this is interlocked with the water-level indicator.

This can happen if the drain hose or pump is clogged. The pump cannot drain the tub; so, the machine will simply stop and sit there waiting for someone to come along and fix it. A similar thing could happen to a dryer. These have two thermostats; one closes when the drum is too cool, to bring the dryer up to proper temperature. The other, normally closed, opens if the drum temperature goes too high, to avoid burning up things. If the vent of the dryer becomes clogged, with a bird's nest or something like that, the air can't get out of the machine. With the circulation blocked, the inside temperature will rise, and the upper-cutoff thermostat will turn the whole thing off.

These are all simple things, but very important. I can vouch for that. Not too long ago, a certain Wife said to her husband, "My washer won't work." "What's the matter?" said Certain Husband, who had only written four books and two correspondence courses on electrical appliances. "How do I know?" replied Wife. "It goes through the wash cycle fine, then stops on rinse."

"OK" said Certain Husband, going down the basement steps with something else on his one-track mind. He ran the timer switch on the washer through the whole cycle, and noticed that all he got in rinse was a buzz. "Call George and ask him to check it," he called back upstairs to his Wife. "After all, it's still in warranty!" and he left for

town to troubleshoot a few Tough Dogs.

When he came home that evening, he was met at the door by a Wife wearing a very wide grin. "Here" she said, handing him a piece of paper. "George left this note for you!" Printed on it, in large block letters, was **"TRY TURNING THE *WATER* ON NEXT TIME, GENIUS!"**

Being blessed with perfect 20-20 hindsight, I (woops—he) immediately knew what had happened. He'd rigged up a Plumber's nightmare on the cold-water cock, so that water could be drawn for various things. Since this leaked, as could be expected, he'd formed a habit of turning it off at the sill-cock. This of course, turned off the cold-water supply to the washer at the same time.

Here's what had happened. The machine had gone through wash cycle since this used only hot water. However, the rinse cycle required warm water; both hot and cold valves open at once. Without the cold water, the machine had not filled to the correct level, by the time it was ready to go into the rinse cycle. So, with this interlock open, it had simply shut itself off and sat there waiting for further instructions.

To avoid this kind of embarrassing contretemps in the future, watch out for that mental block. Don't take anything for granted. Check for the presence of all of the necessary inputs to the machine; ac, hot, cold water, gas, free vent, clear drain, and so on. These are all simple things, and if you make a methodical checkout on them, you'll fix about 75% of the "mysterious troubles" that such machinery is prone to.

Always check the simple things first and save the complicated ones for later on when it becomes apparent that they're necessary. **R-E**

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new books

RADIO AMATEUR OPERATING HANDBOOK, by Marshall Lincoln, W7DQS. Howard W. Sams & Co., Inc., 4300 W. 62nd St., Indianapolis, Ind. 46268. 8½ x 5¼ in. 160 pp. Softcover, $4.95

This book deals primarily with the communications function of amateur radio. It intends to help the reader understand and master the methods developed through years of experience by thousands of other amateur radio operators. Subjects covered include making yourself understood, identification and logging requirements, observing frequency boundries, utilizing propagation effects, DX operating, operating across the border.

NEW IC FET PRINCIPLES & PROJECTS, by Ken Sessions and Don Tuite. TAB Books, Blue Ridge Summit, Pa. 17214. 5¾ x 8¾ in. 160 pp. Hardcover, $6.95; Softcover, $3.95.

This instructional projects book contains a wealth of information to aid in understanding and using the newest FET and IC components. After the introductory groundwork explaining FET's and how they work, the book describes basic circuits that use FET's as amplifiers and then, complete with schematics and parts lists, shows how to construct 12 basic FET circuits.

PRACTICAL DESIGN WITH TRANSISTORS, SECOND EDITION, by Mannie Horowitz. Howard W. Sams & Co., Inc., 4300 West 62nd St., Indianapolis, Ind. 46268. 5½ x 8½ in. 288 pp. Softcover edition $6.95.

This up-dated edition contains most of the information needed by the engineer and technician to plan basic transistor circuits for modern electronic equipment. The book supplies enough factual material to complete independent circuit designs. Math is presented when necessary, but the derivations have been excluded. With the aid of this book, anyone with a working knowledge of algebra and radio electronics should have no difficulty in designing a transistor circuit.

FAX, by Daniel M. Costigan. Chilton Book company, 100 East 42nd Street, New York, N.Y. 10017. 6 x 9¼ in. 270 pp. Hardcover, $10.00.

Facsimile, or "Fax" for short, is the system by which graphics are transmitted by radio waves or by wire from one place to another. Although this system is not new, it is coming closer to its full potential as new scientific developments and more efficient hardware are made available. This book brings it all into focus. The author presupposes some small knowledge of mechanics and electronics on the part of the reader and although the book is not directed to the electrical engineer, even he can find in it portions that are useful.

TRANSISTOR SPECIFICATIONS MANUAL, FIFTH EDITION, by Howard W. Sams Engineering Staff, Howard W. Sams & Co., Inc., 4300 W. 62nd St., Indianapolis, Ind. 46268. 8½ x 11 in. 160 pp. Softcover, $4.50

This is the 5th edition of this book and contains the electrical and physical parameters along with the manufacturers of nearly 10,000 transistor types. The manual is an excellent reference for engineers, technicians, or anyone who enjoys working with transistors. It can alleviate the long and sometimes fruitless search for the source of electrical and physical information dealing with specific transistor types. The manual has specifications, lead-identification and outline sections.

HANDBOOK OF SIMPLIFIED SOLID-STATE CIRCUIT DESIGN, by John D. Lenk. Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632. 6¼ x 9¼ in. 310 pp. Hardcover, $12.00.

Design theory and analytical procedures are kept to the barest minimum sufficient for a working, functional knowledge of the circuit. Coverage includes complete procedures for breadboarding, testing and final circuit completion. The six major chapters treat basic design rules, audio amplifiers, operational amplifiers with IC's, radio frequency circuits, waveforming and waveshaping circuits and power-supply circuits. **R-E**

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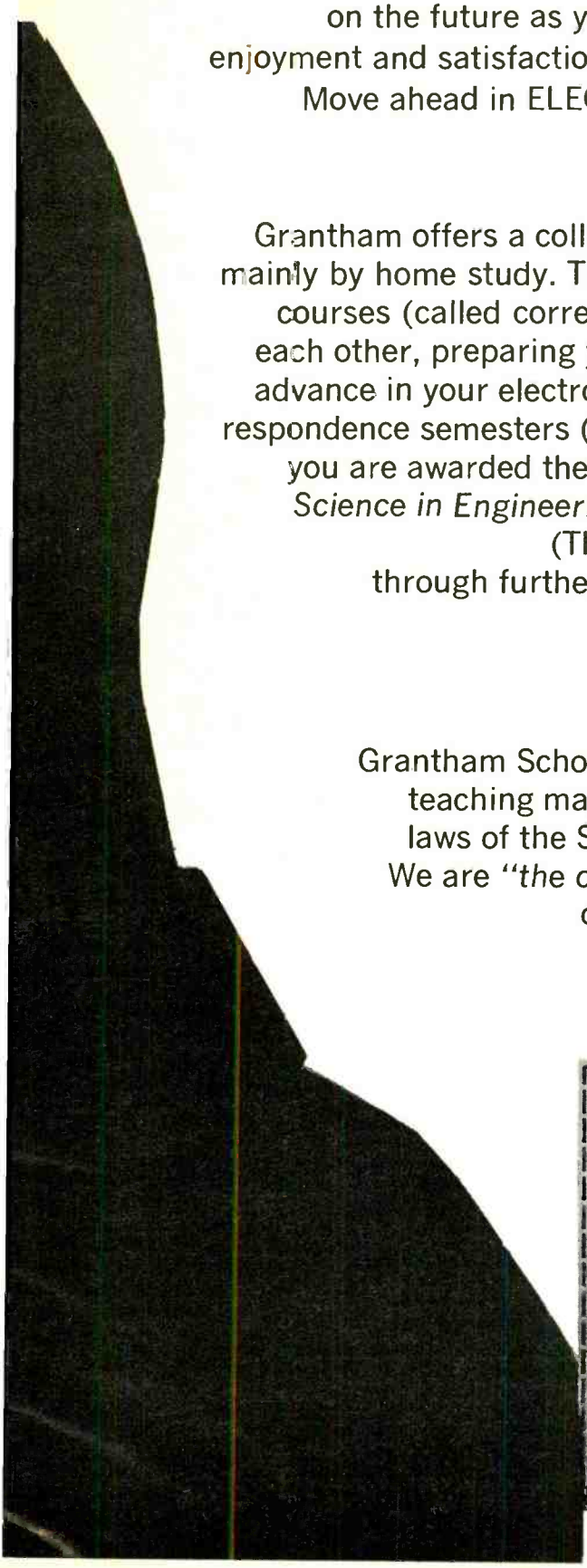

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EQUIPMENT REPORT
(continued from page 22)

do is flip both the socket-selector switch and the polarity switch at the same time. This can be done with one hand.

Another very useful thing the 501A will do is catch those "weirdo" transistors that we run into now and then. In one of my normal unusual coincidences, I ran into a "weirdo" while running the tests on the 501A. I checked a pair of brand-new, high-quality transistors. They didn't work too well (in a comp-symm output on a little stereo amplifier). Pulling them, I checked for balance. I found that one was good, meeting the specs in every way. The other read a very low beta on a conventional transistor checker.

Putting it on the 501A, I could see why. The thing refused to turn on at the point where it should. I had to turn the base-current up to more than five times the normal amount before I could get the thing to conduct. I'm not going to try to explain *why* it did this, but I did *catch it,* and did find out that it was defective in a very short time.

This instrument is going to be a great help to us in using all kinds of solid-state equipment, even industrial-electronics gadgetry. It should be quite essential in solid-state television servicing. You'll find that the in-circuit curves won't look too much like the out-of-circuit curves. However, from what I have seen so far, the main thing is that a transistor which will display a family of curves in-circuit is probably good. Because it is a "cold" check without power applied to the chassis, it should be very useful when we must bring a chassis to the shop for servicing. Another use would be in connection with those reparable modules showing up in increasing numbers. All in all, the 501A is a very worth-while addition to our instrumentation. **R-E**

"I have some bad news for you, Mrs. Benson! You know those lines you thought were crayon marks. . . ."

next month

FEBRUARY 1973

- **Semiconductor Interchangeability Directory**
  Need a replacement for a standard 2N type transistor? Here is the first part of a directory that will list standard 2N types and several brands of direct replacements. This is one directory you will use frequently.

- **All About Dual-Trace Oscilloscopes**
  See how they operate and what you can do with them. A dual-trace scope can speed some service jobs while others may be almost impossible without one of these new instruments.

- **Wonderful World Of Infrared**
  What's new; what's happening; how does it work! A state-of-the-art report on the latest news in the exciting field of infrared.

- **Microprogrammable IC Clock**
  An MOS MSI chip is the entire clock. See how the chip functions; how you can use it in real applications; how it interfaces with readout devices.

PLUS:
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AUTOMATIC COLOR CIRCUITS

(continued from page 71)

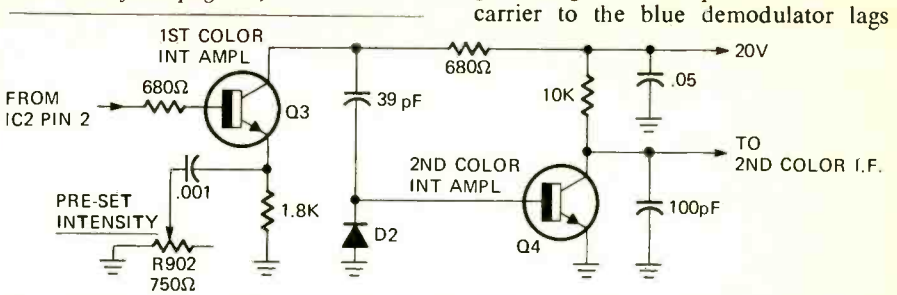


FIG. 13—AUTOMATIC COLOR INTENSITY CIRCUIT by Motorola. The preset INTENSITY control adjusts the acc level. Rectified voltage from the color processor controls color amplifier.

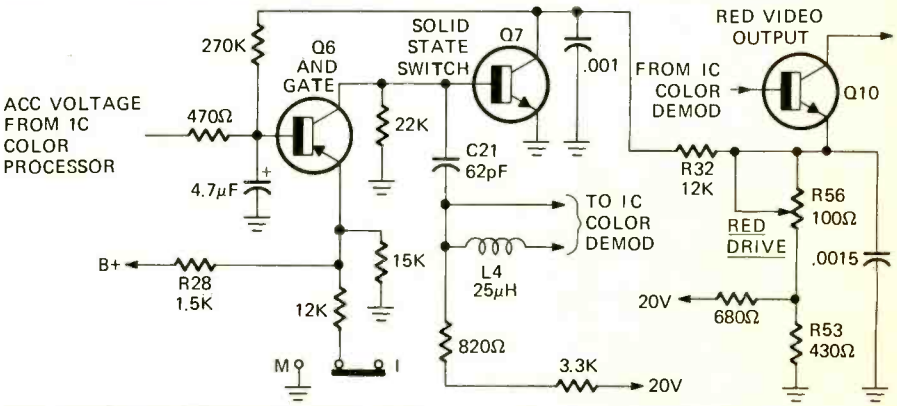


FIG. 14—TINT CORRECTION CIRCUIT alters phase of subcarrier to blue demodulator.

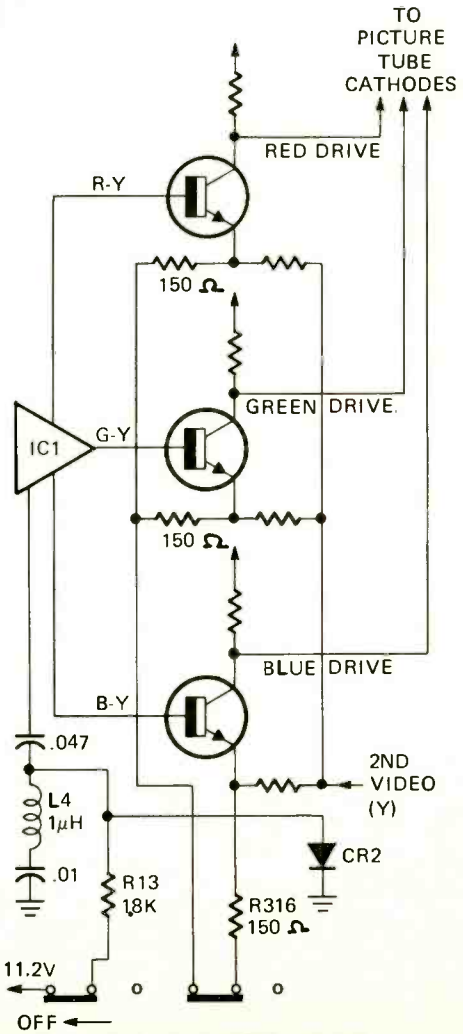


FIG. 15—TINT CORRECTION SCHEME in the RCA CTC48 color television chassis.

ditions coincide Q6 is turned on grounding C21. The phase of the subcarrier to the blue demodulator lags increasing the demodulation angle. When Q6 is on solid-state switch Q7 also conducts grounding the end of R32 connected to its collector. Because of this resistor's connection to the red video output transistor emitter the red drive increases completing the tint correction.

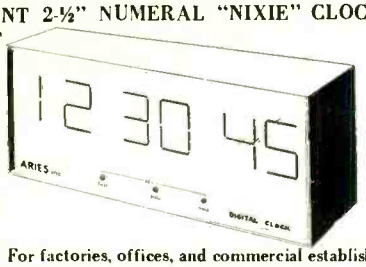
Philco—Although Philco schematics were not available as we write this the literature says that the Philcomatic Master Control activates preference controls to allow variations in color, tint, contrast and brightness. From the description it is not clear whether these are switched in presets or reduced range controls. We'll have to clear this up at a later date.

RCA—RCA uses reduced range controls to retain some feel of operating controls and to allow minor variations in their settings. The tint correction scheme of the CTC48 chassis is shown in Fig. 15. In the on position the forward bias of CR2 is interrupted inserting L4 into the circuit. The connections of this circuit to the demodulator portion of one of the two ICs used produce counterclockwise R - Y and clockwise B - Y rotations as described at the beginning of this article. In addition R316 the 150-ohm resistor in the emitter circuit of the blue drive transistor is opened. Since this reduces the stage gain the second condition for the reduction of the Q components is satisfied.

That's about all we have room for in this issue. The remaining automatic color circuits will be described in a separate article in a future issue. **R-E**

BRAND NEW CATALOG THOUSANDS OF SURPLUS BARGAINS

GIANT 2-½" NUMERAL "NIXIE" CLOCK KIT



New! For factories, offices, and commercial establishments, and those people who like large displays, characters appear as a bright continuous line which can be read from distances as great as 150 feet. All drive circuits are solid state, and unit employs new custom LSI clock chip. Indicates hour, minutes, and seconds. May be wired for 24 hour or 12 hour operation with a simple jumper change. Kit offered complete with or without case for custom installations. Parts include P.C. board, sockets, solid state components, hardware, resistors, caps, viewing filter, etc.

Sh.Wt. 15 lbs.

With Case	GNNC/C	$98.50
Without Case	GNNC	$84.50

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- ☐ SI3120E 12 Volts, 1 Ampere $2.25
- ☐ SI3150E 15 Volts, 1 Ampere $2.25
- ☐ SI3240E 24 Volts, 1 Ampere $2.25
- ☐ SI3050E 5 Volts, 1 Ampere $2.25
- ☐ SI3554M 5 Volts, 3 Amperes $7.00

WIRE-WRAP COMPUTER WIRE

New surplus from a large computer company. Solid silver-plated OFHC copper conductor. Special high-temperature, thin-wall insulation of teflon, and other quality materials. Extremely rugged and flexible wire-wrap wire. In addition to usual applications, can be used for effective breadboarding, and wherever quick stripping of solid wire is desired. Different colors are now available. State first, second, and third choice of colors. Shipping weight per 500' is 1 lb.

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30	WWW30(ft.)	$5.00	$9.00	$75.00
26	WWW26(ft.)	$6.00	$11.00	$95.00
24	WWW24(ft.)	$6.50	$12.00	$100.00

ROTARY THUMBWHEEL SWITCH

Brand new digital switch, available with output in straight decimal form, or BCD. Widely used to set up predetermined counts or intervals, digital values or digital-to-analog values. Prices quoted are per section, or decade.

DECIMAL OUTPUT (10-position)	RTSDCO	$2.35
BINARY-CODED DECIMAL OUTPUT	RTSBCD	$2.35

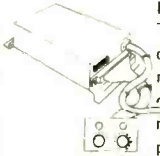
HIGH-TEMP. POWER TRANSISTOR

2N1015D NPN Silicon 200W Power Amplifier 200V 10A $2.00
10 for $17.50 or 100 for $150.00

SANKEN HYBRID AUDIO AMPLIFIER MODULES. We have made a fortunate purchase of Sanken Audio Amplifier Hybrid Modules. With these you can build your own audio amplifiers at less than the price of discrete components. Just add a power supply, and a chassis to act as a heat sink. Brand new units, in original boxes, guaranteed by B and F, Sanken, and the Sanken U.S. distributor. Available in three sizes: 10 watts RMS(20 watts music power), 25 watts RMS (50 watts M.P.), and 50 watts RMS, (100 watts M.P.) per channel. Twenty-page manufacturer's instruction book included. Sanken amplifiers have proved so simple and reliable that they are being used for industrial applications, such as servo amplifiers & wide band laboratory applications.

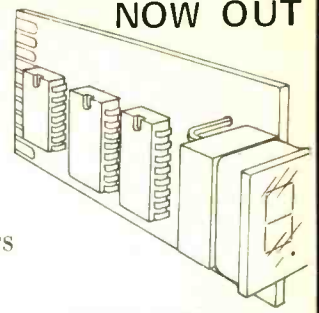
- ☐ SI1010Y 10 watt RMS amplifier, industrial grade $4.75
- ☐ SI1025A 25 watt RMS amplifier, industrial grade $14.75
- ☐ SI1050A 50 watt RMS amplifier, industrial grade $22.50
- ☐ SI1025E 25 watt RMS amplifier, economy grade $14.00
- ☐ SI1050E 50 watt RMS amplifier, economy grade $21.00
- ☐ Transformer for stereo 10-watt amplifiers (2 lbs.) $3.95
- ☐ Transformer for stereo 25 or 50 watt amplifiers (5 lbs.) $5.95
- ☐ Set of (3) 2000 mfd 50V capacitors for 10-watt stereo $4.00
- ☐ Set of (3) 2200 mfd 75V capacitors for 25 or 50 watt amplifiers $5.00
- ☐ 4 Amp Bridge Rectifier, suitable for all amplifiers $2.00
- ☐ Complete kit for 100 watt RMS stereo amplifier (200 watt music) including two 50-watt Sanken hybrids, all parts, instructions, and nice 1/16" thick, black anodized and punched chassis $88.00
- ☐ Same for 50 watt RMS stereo amplifier, includes two 25 watt Sankens, etc $58.00
- ☐ Same for 20 watt RMS stereo, includes two 10-watt Sankens, etc $30.00

ELECTRONIC PRESET COUNTER



This counter is from a copying machine. It uses two Durant electro-mechanical decade counters, and includes a nice power supply, etc. Two rotary switches allow the unit to be preset with any number from 1 to 50. When the number of pulses in reaches this count, a relay opens, shutting off the controlled unit. Should be useful for coil winders, and other applications requiring shut-off at a predetermined count. The parts alone at our low price represent a "steal", as the unit has high quality switches, silicon rectifiers, transformers, etc.

☐ Preset Electronic Counter (6 lbs.) $6.75



NOW OUT

DCU KITS

DECADE COUNTING UNITS WITH READOUTS

Always one of B & F's most popular items, now revised to include drilled boards, I.C. sockets, and right-angle socket for readout. Arranged so that units can be stacked side by side and straight pieces of wire bussed through for power, ground and reset. Several different units are available as follows:

- 7490 Basic 10 MHz counter. Used in frequency counters and events.
- 74196 Same as 7490 except presettable 50 MHz unit. Used where higher speed and/or presettability is required.
- 74192 Bi-Directional Counter, 32 MHz operation. Has two input lines, one that makes the unit count up, the other down. Uses include timers, where the counter is preset to a number and counts down to zero, monitoring a sequence of events, i.e., keeping track of people in a room by counting up for entries and down for departures.
- 7475 Adds latch capability. Used in counter so displays continue displaying frequency while new frequency is being counted for uninterrupted display.
- 7447 Basic decoder module. Drives basic seven segment display which is included for all modules.

NEWEST DCU!

This DCU combines all of the features of our other counting units, that is, high speed counting, up-down operation, storage, and preset. In addition it includes a comparator (7485) and a thumbwheel switch in order to provide comparison and preset capability. With this combination you can do the following:

1) Count up or down at speeds to 33 MegaHertz.
2) Store previous count during new count.
3) Preset to any number, count down (or up) and generate a logic level when count of zero is reached. Stack several units and generate logic level for any count greater than zero.
4) Preset to zero, count up (or down) and generate a logic level for any number greater or equal to the number preset in the thumbwheel switch. Stack several DCU's and generate a logic level showing whether number is greater than, equal to, or less than numbers preset on switches.

7490 - 7447 Counter	$8.25
7490 - 7475 - 7447 Counter	$9.25
74196 - 7475 - 7447 Counter	$10.25
74192 7447 Counter	$9.25
74192 7475 7447 - 7485 Universal DCU	$14.50

FUNCTION GENERATOR KIT

IMPOSSIBLE? A $700.00 function generator for $99.00? But true! The new, low-cost EXAR-205 monolithic waveform generator makes this price possible. Our kit uses two generator circuits – one is a carrier generator, and produces sine, triangle, square, sawtooth, ramp and pulse waveforms. The second is a modulation generator, for amplitude or frequency modulation of the output waveforms. Output frequency range is from 20 Hz to 1.5 megahertz. Modulation is switch-selectable for internal AM, internal FM, or external modulation.

Model AR-620K Function Generator $99.00

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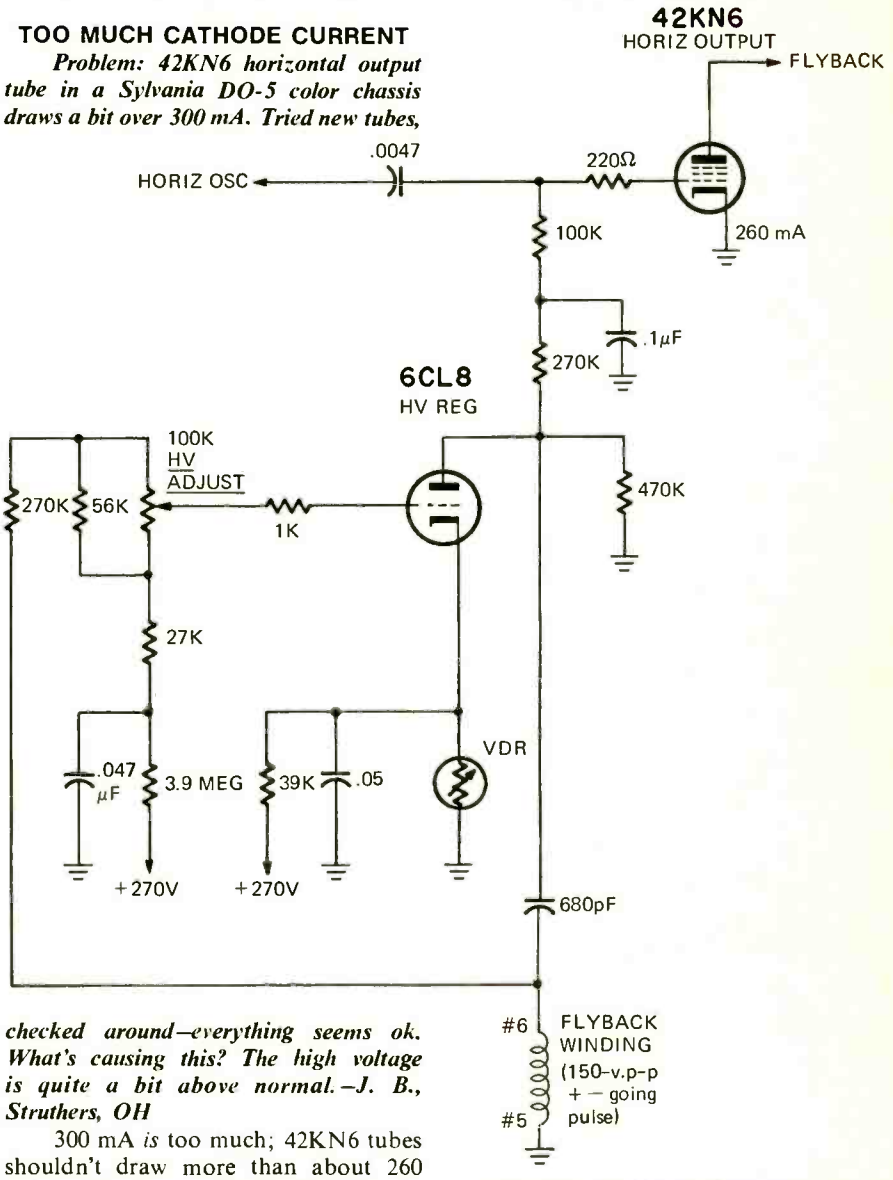
Sylvania service notes

TOO MUCH CATHODE CURRENT

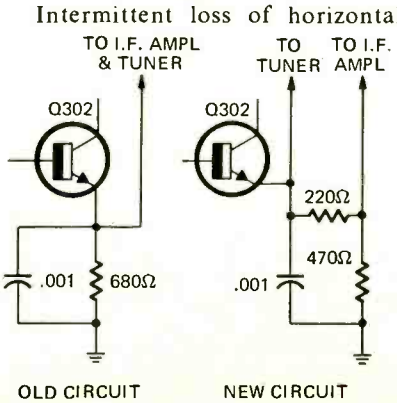
***Problem:** 42KN6 horizontal output tube in a Sylvania DO-5 color chassis draws a bit over 300 mA. Tried new tubes, checked around—everything seems ok. What's causing this? The high voltage is quite a bit above normal.—J. B., Struthers, OH*



300 mA *is* too much; 42KN6 tubes shouldn't draw more than about 260 mA in this chassis. Check all of the resistors in that network around the 6CL8 high voltage regulator tube. This same symptom has been known to be due to a defective voltage-dependent resistor (VDR) in the cathode of the 6CL8 regulator tube.

SYLVANIA D14, D15 AND D16 CHASSIS

Intermittent loss of horizontal sync when changing channels may be a complaint on early chassis without a video buffer stage. All checks on the horizontal and sync circuits show normal operation. Advancing the agc to the point just before overload corrects the horizontal problem but results in vertical jitter. Modifications can be made to eliminate these problems:



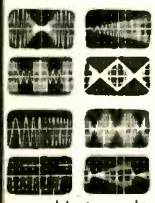
1. Change the emitter resistor in the first i.f. stage (Q200) from 15,000 to 8200 ohms.

2. Modify the agc amplifier circuitry as shown in the diagrams.

3. Change R334 in the base circuit of Q308 from 470,000 to 390,000 ohms. Any lower value than this will affect horizontal phasing and can cause excessive horizontal jitter on weak stations.

4. Change agc filter capacitor C304 to approximately twice its original value. Too much capacitance will cause airplane flutter and increase the affects of co-channel interference. **R-E**

ARE PRICES ON ELECTRONICS COMPONENTS REALLY GOING UP? Of course, no one knows for sure, but we are of the opinion that they are. The recession in the electronics components business is truly over; sales are at a new record. Our, and other "independent distributors" ability to negotiate low prices because of manufacturers' overcapacity is greatly reduced. Many items, such as TTL devices, LED's, and MOS LSI are rationed. Our advice? Place your order now for a good stockpile of components while the hobbyist's paradise still exists.



WAVEFORM GENERATOR, BF-5 Just one of these BF-5 devices produces sine, square, triangle, ramp and sawtooth waveforms without additional active components. By adding a second BF-5, you can create amplitude, frequency or phase modulated varieties of these waveforms. They are able to replace large discrete waveform generators costing from $200.00 to $1300.00. At the same time, they greatly reduce system weight and power consumption. Full technical data, P.C. layout, assembly, and hook-up instructions included.

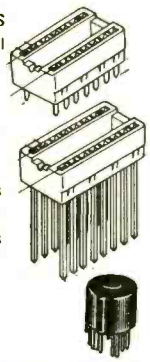
BF-5 WAVEFORM GENERATOR..... $9.75

GENERAL ELECTRIC PA-234, 1.4-WATT POWER AMPLIFIER..... $1.25 This amplifier is housed in a plastic dual in-line package with a tab for heat transfer. Has only four active terminals, and requires only one capacitor for stabilization. Compatible with 8, 16, or 22-ohm loads. Applications include P.A. systems, phonos, movie projectors, TV, AM and FM receivers.

GENERAL ELECTRIC PA-265, 5-WATT VOLTAGE REGULATOR. Housed in plastic dual in-line package with staggered leads and power tab. Usable over wide range of input and output voltages, input voltages to 37 volts and outputs from 3 to 30 volts. Usable in a wide variety of circuits.

PA-234 POWER AMPLIFIER $1.25
PA-256 VOLTAGE REGULATOR $1.25

SUPER QUALITY I.C. SOCKETS
Sockets made by T.I. and Cinch. All are low-profile, compact types.



14 Pin Dip Solder Tale Sockets
3 for $1.25 16 for $5.00
16 Pin Dip Solder Tale Sockets
2 for $1.00 13 for $5.00
14 Pin Dip Gold Wire Wrap Sockets
2 for $1.25 10 for $5.00
16 Pin Dip Gold Wire Wrap Sockets
2 for $1.50 8 for $5.00
10 Pin To-5 Gold Sockets (Cinch)
2 for $1.00 13 for $5.00

SINGLE CHIP 7-SEGMENT DISPLAY COUNTER, AND DECODER. That's right! A single chip TTL decade counter with latches, BCD outputs, a 7-segment decoder driver, AND a 7-segment LED display (with decimal) on top. Only 0.15" thick (not counting pins), the chip mounts in a standard 16-pin DIP socket. Digits are 0.270" high and can be latched in during the next count or blanked.

0.27 DLD $15.00

SPECTRA – STRIP FLAT BONDED We know this is what everyone wants for their home-brew projects, because they always ask for it. We now have over 5 by 10^6 feet, but it won't last long, so order now before it's all gone. We don't want any broken hearts. Specs: 20 conductors, 24 AWG, 7 strands, size is .88" x .044". We could give all its virtues, but most people know them or could easily look it up in any industrial electronics house catalogue.

Sh. Wt. 1 lb./10 feet...,.Order No. SSFBRC (ft.)
Price: $.35/1 ft. $1.00/3 ft. $5.00/18 ft.
$30.00/100 ft. $55.00/200 ft. $100.00/400 ft.
$200.00/900 ft. $500.00/2000 ft.

70 WATT RMS AUDIO AMPLIFIER BASIC PACKAGE. STEREO $5.50 Take advantage of Signetic's NE540 power driver, (class AB amp). Designed for 35 watts RMS per channel. Distortion .5% frequency response, ± .5db 20Hz to 100Hz. NE540 requires two power transistors, a 2N5296 (NPN) and a 2N6109 (PNP), supplied per NE 540. Kit package includes (2) NE540, (2) 2N5296, (2) 2N6109, information on P.C. board layout, parts and circuitry, and a list of miscellaneous small parts required to build the 70 watt amplifier for stereo.

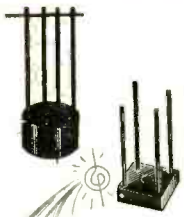
☐ NE540 $2.25/ea.
☐ 2N5296 35 watt NPN .75/ea.
☐ 2N6109 40 watt PNP .75/ea.
☐ 70 watt Stereo Kit $5.50/ea.
☐ 35 watt Mono Kit $2.95/ea.

HARD-TO-GET DIGITAL I.C.'s **SALE**

☐ 7447 BCD To-7 Segment Decoder Driver $1.06
☐ 7490 Decimal Counter..... $ .76
☐ 7485 Comparator..... $1.25
☐ 74192 Up-Down Counter..... $1.45
☐ RCA CD4001 Quad 2-Input Nor Gate (Cosmos)..... $1.25
☐ RCA CD4007 Complementary Pair & Inverter..... $1.50
☐ RCA CD4010 Hex Buffer..... $1.50

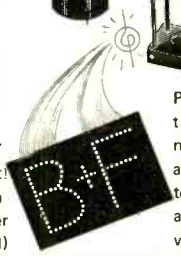
MISCELLANEOUS SEMICONDUCTORS, SALE

☐ MUS 4988 Silicon Uni-lateral Switch. Useful for voltage-sensitive switch, sweep generators, etc. $1.00
☐ MUS A65 PNP High-Current Darlington Transistor. Super high gain in a small package. 2/$1
☐ MPS A14, NPN, SAME AS ABOVE 2/$1.00



COMPACT BRIDGE

2 Amp	200 Volt	$ .60
2 Amp	400 Volt	$1.00
2 Amp	600 Volt	$1.50
2 Amp	800 Volt	$2.00
2 Amp	1000 Volt	$2.50
4 Amp	400 Volt	$1.50
4 Amp	600 Volt	$2.00
4 Amp	800 Volt	$2.50



PLASTIC FIBER OPTICS. Plastic optical monofibers are conveniently card-mounted and available in five different fiber diameters. Excellent supplement for B and F Fiber Optic Kits to provide additional fiber optic material. Fibers available in diameters of .005" (250 ft. card). Offer design versatility to R&D and product engineers. Specifications – maximum cont. oper. temp. - 170 degrees Fahrenheit, acceptance angle - 67 degrees, numerical aperture - 0.55, transmission range - 0.4 to 1.5 microns. YOUR CHOICE – $1.00

TIMER, 0 to 2.75 MINUTES GENERAL TIME. New packaged timers, for 115V, 60 Hz. Timer is set for 2.75 minutes (165 seconds) of operation. At the end of operating cycle, a SPDT switch is closed. May be reworked to provide any time delay between 0 and 2.75 minutes. Makes a useful lab or sequence timer. Latest design with current list price of $15.00

Sh.Wt. 1 lb. TGT $2.75 ea.
2TGT $5.00/2

SGS TAA 621 AUDIO AMPLIFIER
☐ I.C. audio amplifier in 14 pin DIP package, provides up to 4 watts power with proper heat sink, and 28 Volt supply. Can be used at 12 Volts with reduced output power. - $1.95 . . . . . 6 for $10.00

LOGIC AND OPERATIONAL AMP' SUPPLIES

☐ Figure A, potted logic supply, 5 Volts at 1 Ampere, short circuit proof, ultra high regulation, ultra low ripple $16.00
☐ Figure A, potted Op Amp supply, +15 Volts, and -15 Volts at 0.5 Amperes. Mfg. by Analog Devices, similiar to their model 902. Short circuit proof, ultra high performance. $29.00
☐ Figure B, 5 Volt 1Amp supply, regulated by Fairchild 9305, short circuit protected. $9.75
☐ Same as above, in kit form $7.75
☐ Mating connector for above $1.00
☐ 5 Volt 5 Amp regulated supply, by Blulyne, (not shown). $29.00

CALCULATOR CHIP SPECIAL!!! One of the largest manufacturers of MOS Integrated Circuits has discontinued his three-chip set in favor of a single chip. This is the hobbyist's gain, since he can now obtain this fully tested, highly flexible set at a fraction of what even the largest calculator manufacturers pay. Consists of three 24-pin I.C.'s, has debounced input, eight-digit capacity, decoded seven-segment output. Full data included.

8-Digit Floating-Point Calculator Set..... $9.75

FAIRCHILD VOLTAGE REGULATORS This is the UA 7800 Series. Three terminal regulator, with thermal overload protection and internal current limiting, making it essentially blow-out proof. Because simple circuitry is used with this device, designing regulated power supplies is duck soup. Output is rated at 0 to 1 ampere; maximum input voltage is 35 volts. Choice of voltages: 5,6,8,12,15,18, or 24 Volts. Order as 7805, 7806, 7808, etc.

Voltage Regulator (Specify Voltage)..... $2.00

SHRINK TUBING. B and F has a truckload of shrink tubing, but we still expect it to go fast. If you have ever used shrink, you know it is indispensable for electronic construction. Made a wire too short? Just splice and shrink tubing over it and it will look like new. Pins too close? Same solution. Excellent results with hot-air gun, soldering iron, or even a match. This is polyolefin type where outer wall shrinks, inner wall melts to encapsulate wire.

SHRINK TUBING ASSORTMENT, 25 feet each, of 1/8, 3/16, 1/4-inch tubing $5.00

SPECIAL I.C.'S, PHASE LOCKED LOOPS

☐ NE560 Phase Locked Loop $4.65
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☐ NE565 Phase Locked Loop $4.65
☐ NE566 Function Generator/Tone Encoder. . $4.65
☐ NE567 PLL/Tone Decoder $4.65
☐ NE595 Four Quadrant Multiplier. $3.75
☐ NE555 Timer, 2u Sec to 1 hour, Special . . . $1.25

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Circle 86 on reader service card

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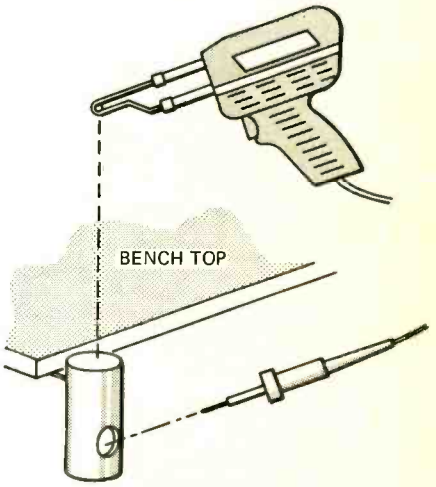
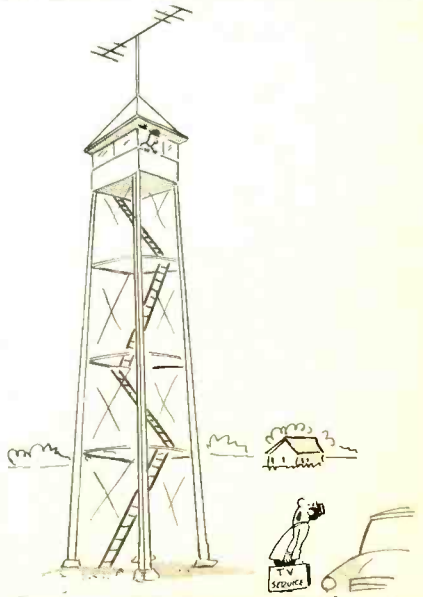
SOLDERING GUN HOLDER

Here is a soldering gun holder that swings out of the way when not in use. It also serves as a soldering-pencil holder and holds both instruments at the same time. It consists of a piece of brass pipe (kitchen sink or face bowl drain) and an angle bracket assembled



as shown in the drawing. Drill a hole near the bottom edge of the pipe for a pencil iron—you need only one hole because the pencil iron goes in the side and comes out the bottom. Mount the holder under the edge of the bench where it can be moved out of the way when not in use.—*J. F. Harris* **R-E**



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ARIES

AIRCRAFT/AUTO/BOAT QUARTZ CRYSTAL CHRONOMETER

Revolutionary!, was the reaction of our customers when they saw our latest kit. Measuring only 2-1/2" x 2-1/2" x 4", and accurate to 10 seconds a month, this chronometer promises to entirely replace mechancial clocks in cars, boats and airplanes.

Fits into a standard 2-1/4" instrument panel cutout. The displays are bright L.E.D. displays that should last a lifetime. Setting controls are recessed and operate from a pointed object such as a pencil point or paper clip, in order to keep non-authorized hands off. The clock should only have to be reset at very great intervals, or in the event of power loss (i.e. replacing battery in car). The clock is wired so that the timing circuits are always running, but the displays are only lit when the ignition is on, resulting in negligable power drain. The low price is only possible because of a new one chip MOS clock circuit, developed for quartz crystal wristwatches.

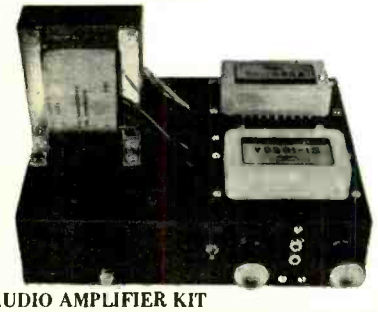
Operates from 10-14 Volts D.C. An accessory unit which mounts on the back adapts the unit to 20-28 volts for twin engine aircraft and larger boats using 24 Volts ignition. Know how disgusted you are with the usual car clock? Order this fine unit now for rallying, sports events, navigation, or just to have a fine chronometer that will give you a lifetime of superbly accurate time.

- ☐ Quartz Chronometer, Kit Form $59.50
- ☐ Quartz Chronometer, Wired $99.50
- ☐ 24 Volt Adapter $10.00

DIGITAL CLOCK KIT WITH NIXIE DISPLAY

Because we have made an extremely good purchase of over 20,000 nixies, we can sell a complete digital clock kit for less than the usual cost of the display tubes alone. We provide a complete etched and thru-plated circuit board, all integrated circuits, complete power supply, display tubes, I.C. sockets and a nice front panel with polaroid visor. We have never seen anyone offer this kit for less than $100.00 before. Includes BCD outputs for use as with timer option. May be wired for 12 or 24 hour display. Indicates hours, minutes and seconds.

- ☐ Clock kit, complete less outside cover . . . $57.50
- ☐ Aluminum blue or black anodized cover . . $4.50



AUDIO AMPLIFIER KIT

This is not our prettiest kit, but it sure does perform. Hybrid Sanken audio modules make wiring easy. Output ratings are maximum continuous at 1000 Hz with a distortion less than 0.5% into a load of 8 ohms. Response is ± 0.5 db 20-20KHz @1 watt. Chassis supplied is heavy guage anodized aluminum. Capacitors are all computer grade. Level controls on both inputs.

- ☐ 100 Watt (RMS) Stereo Kit $88.00
- ☐ 50 Watt (RMS) Stereo Kit $58.00
- ☐ 20 Watt (RMS) Stereo Kit $30.00

50 MHz DIGITAL COUNTER LABORATORY SPECIFICATIONS AT A BUDGET PRICE!

We feel the most important thing about building a kit is saving money. There are a lot of other advantages of course . . maintainability, use of standard parts, complete documentation, and the experience and fun of building it, but the overriding consideration is economy. This kit costs less than half that of the lowest priced competitive unit on the market.

The Aries 50 MHz counter is designed for years of maintainence free service. MSI integrated circuitry, cold cathode display tubes and conservatively rated transformers mean low temperature rise. All displays and I.C.'s are in sockets for easy maintainability. The master oscillator is a 1.0 MHz crystal in a custom designed cosmos oscillator circuit, having a stability of ± 3 PPM. Accuracy is 0.005% worst case, 0.0002% or better when adjusted to WWV with a communications receiver. A front panel selects a timing interval of 1.0 seconds, 0.1 seconds or 10 milliseconds. A variable monostable multivibrator holds the count on the front panel for a period of a fraction of a second to infinity. For use in the period mode, the 1.0 MHz oscillator is connected to the main counting chain and gated by the input signal.

Assembly time for the kit is approx. 10 hours. The semiconductor complement is (1) 7400, (1) 7408, (1) 7442, (10) 7490, (2) 74122, (6) 74141, (1) 74193, (1) 74196, (1) 74S11, (1) CD 4007AE, (1) LM309, (6) Diodes, and (1) Transistor. If you always wanted a laboratory quality counter, but could never justify the price, here is your chance.

☐ 50 MHz Counter Kit, Complete with Crystal Time Base and Case – Postpaid in USA $125.50

POCKET CALCULATOR

We expected a favorable reaction to our calculator, however, we were overwhelmed when we received orders for hundreds at a time. The reaction of our customers was that they felt this was the most advanced pocket calculator on the market, and priced so low, they could assemble and market it at a profit. The features that make this so exciting are:

- So compact it fits in a shirt pocket (3-13/16 x 4-5/8 x 1-1/4).
- Performs every function you would expect in a desk calculator, and them some, multiplies, divides, adds, subtracts and gives true credit balance. Includes constant and chain operation, full floating decimal, suppressed trailing zeroes, and automatic single entry squaring.
- Powered by self contained AA batteries with up to six hours operation (Nicad batteries with charger option, up to five hours per charge).
- Calculations performed by a single 40 pin LSI (large scale integration) chip. Displays are 8 digit LED's (light emitting diodes) and overflow and minus signs are also LED's.

As a student, engineer, salesman, accountant or anyone who would like fast accurate answers, this calculator fills the bill, and at a price that unquestionably makes this the lowest price high quality calculator available.

- ☐ Pocket Calculator Kit $75.00
- ☐ Pocket Calculator Completed $99.00
- ☐ NiCad Batteries & Charger $17.50
- ☐ Batteries & Charger Completed $25.00

16 DIGIT ELECTRONIC DESK TOP CALCULATOR KIT

Just one evening puts it together. Even if you have never assembled a kit before, our comprehensive step-by-step manual makes it easy. This calculator adds, subtracts, multiplies, divides - multiplies & divides by a constant. Has full 16 digit capacity with 8 decades of display and zero suppression. Entries and answers with greater than 8 digits can be displayed in their entirety in two alternate sections: the last eight digits and those digits exceeding eight. Negative results are correctly displayed, and an error symbol indicates an overflow beyond the 16 digit capability. Sequential operations can be performed using the answer to the previous operation as one of the entries for the next. The decimal point can be positioned following any of the eight least significant digits and will be carried automatically during subsequent operations. An additional good feature, concerning the beginner, is that all major components are in sockets, making troubleshooting easy. And if all else fails, (an unlikely occurance) you can send it back to Aries and we will fix it for a maximum of $10.00, no matter what is wrong, baring gross negligence.

☐ Kit - with Power Supply & Case $99.00

NEW FEATURE: CALCULATOR-TO-CLOCK CONVERTER

ARIES is now offering a special feature to convert our desk-top calculator into a clock. An additional chip keeps constant time while calculations are being made. Digital time readouts extinguish and operate silently during operations of calculator. A "must" for the busy executive. Available both with and without the calculator.

- C/C CONVERTER with calculator..... $20.00
- C/C CONVERTER separate order..... $25.00

LOW-PRICED 6-DIGIT CLOCK KIT!

New, low-priced digital clock with General Electric 7-segment numeric display tubes, in a styled walnut wood cabinet. In 1972, the B&F nixie display clock made history by being the first and only clock with electronic hours, minutes, and seconds display under $100. Now we have broken the $50 price barrier for 1973, and we doubt that anyone in the near future will be able to match this super-low price! This economy is made possible by a new large-scale integration chip, custom-designed for a six-digit clock. Clock has BCD output for external devices. May be wired for 24 or 12 hour operation with only a simple jumper change. Complete with all parts, sockets, instruction manual, and real wood case. Only a soldering iron and a screwdriver are required.

Sh.Wt. 5 lbs. LPDCW $47.50

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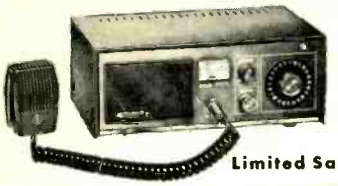
23-Channel, 5-Watt, CB Base Station Transceiver



Limited Sale*

List Price $149.95 — Reg. Catalog $109.90 — **$99.90**

● (ITEM #M13-891-RE) - - Special savings on CB Base Station Transceiver ideal for Contractors, Construction Co's., Road Builders, etc. Full legal power (5-watts) gives you dependable radio contact with all your CB equipped vehicles in the field. Equipped with crystals for all 23 CB channels, none extra to buy! Latest design, solid state circuitry for trouble-free performance, long range, exceptional clarity.

● Operates on 110-VAC, equipped with complete controls; on-off-volume, illuminated channel selector, full variable squelch, transmit/modulate indicator light. Built-in 4" x 2½" dynamic speaker. Dynamic microphone with coil cord furnished. Jacks provided for microphone, external speaker, external antenna. 11" x 7½" x 4½". (10 lbs.)

IBM COMPUTER POWER SUPPLY

● (ITEM #22-934) - - Expensive, regulated unit. Fine for college labs, research co's., service shops, etc. Pure DC over a wide range of voltages. DC output voltages 6, 12, 48, etc. Wide range of AC voltages available.

● Finest transformers, filters, transistor load regulation system. Independent of line voltage fluctuations. Contains five separate rectifier systems. Unit is furnished without small "regulating card" which can be easily made or can be by-passed. Data and circuit diagrams furnished. 30" x 12" x 10". (125 lbs.)

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STANDARD DIAL TELEPHONE

● (ITEM #715) - - Standard, commercial telephone same as used throughout U.S.A. Attractive polished black, like new condition. Use as extension phone to private systems or connect several phones together for local intercom system. Full instructions are furnished. Wt. 9 lbs.

Original Cost $24.50 — **$8.79**

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● (ITEM #738) - - Amazing telephone selector switch. Great experimental item. When used with two-wire telephone dial will select any number from 0 to 100. Make intercom or private system. Use to turn on remote lights, start motors, etc. Complete with contact bank. 13" x 6" x 5". (16 lbs.) Cost Over $90.00 — **$8.95**

● Telephone dial for use with above switch. Order as (Item #700)..... **$1.97**

200 AMP., 50 VOLT, SILICON DIODE

● (ITEM #22-963) - - A Four Star Buy! New, leading make. Heavy duty units excellent for use in 12 or 24-volt fast chargers, high current power supply systems, etc. 2½" x 1½" x 1¾". ⅜"-16 SAE mounting threads. (1 lb.)

List Over $15.00 — **$4.99**

SPECIAL SALE Correspondence Course In ELECTRICAL ENGINEERING

$8.79 Prepaid in U.S.A.
$10.79 Outside U.S.A.

● (ITEM #A180) - - Obtain technical training at low cost! Lincoln Engineering School has suspended its Correspondence Courses because of rising costs. A limited number of Electrical Engineering Courses are available, but without the examination grading service. The course consists of 15 lesson books, each with associated exams and standard answers. Book describing prize winning Home Experimental laboratory Bench furnished at no extra cost.

RUNNING TIME METER

● (ITEM #2188) - - Record number of operating hours of electric lights and electrical devices such as refrigerators, furnaces, etc. Records total hours, tenths and hundredths up to 9,999.99 hours. For 115-volt, 60-cycles. Size 4¾" x 3" x 2½". Shipping weight 2 lbs. **$4.39** Cost Over $29.00

COMPUTER TRANSISTORS ON HEAT SINKS

IBM Computer Quality Units

● (#22-915) - - Unit consists of two 150-watt power transistors, 2 pots., several diodes, capacitors, resistors, etc. on heavy, ribbed aluminum heat sinks. Ideal for use as motor speed control. (4 lbs.)

Cost Gov't Over $35.00 — **$4.91**

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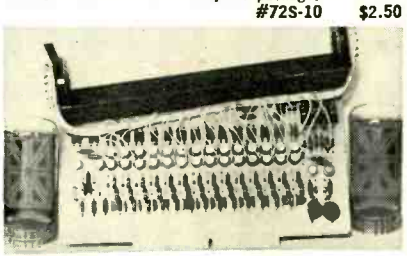
GIANT B-7971 NIXIES (2) with 2 sockets and driver board containing hi voltage transistors. Complete plug-in board as removed from operational equipment. Schematics included. Unbelievable but true . . . just $2.50 for the complete package. **#72S-10** **$2.50**



ALPHA-NUMERIC keyboard removed from unused IBM Selectric machines. Bargain price at only $8.00

15¢ IC BONANZA

Brand new DTL dual inline (DIP) package, factory marked ceramic type. The price is too good to be true. Fully guaranteed and with specs.

930	Dual 4 input NAND gate similar to	7420
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932	Dual 4 input Expand Buff "	7440
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15¢ each. Buy $100 worth and deduct 10%
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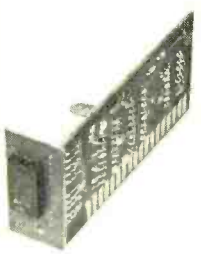

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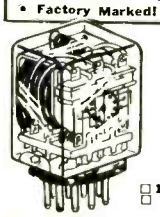

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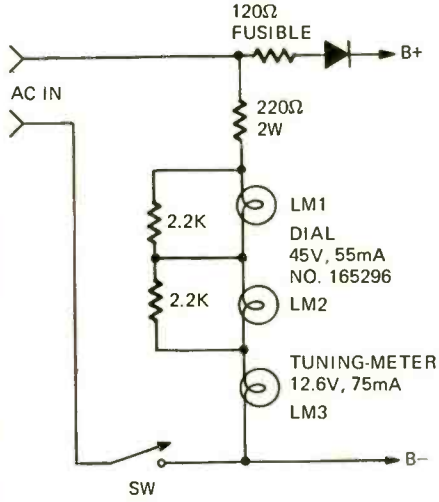
Circle 95 on reader service card

reader questions

PILOT LIGHTS OUT

An RCA RZC-275W radio came in. The only thing wrong with it is the pilot lights. I've checked the circuit, without a schematic, and can't figure it out.—P.L., St. Cloud, Minn.

The schematic for this is in Sams 1075-6 if you need it. The pilot-light circuit *is* a bit unusual (see diagram). This



uses two 45-volt lamps which draw 55-mA apiece. These are shunted by a pair of 2200-ohm resistors and are in series with the tuning-meter lamp, a 12.6 volt 75-mA type. This whole string is across the 117-volt line, with a 220-ohm 2-watt resistor in series.

These are special lamps; the 45-volt types are RCA part No. 165296, and the 12.6-volt one is No. 165295.

CRYSTALS? OSCILLATOR OR FILTER?

This isn't a regular question about a problem, but it's been bugging me for some time. Why isn't a crystal used alone in a color set, instead of being used as an oscillator? I get different opinions from people.—R.R., Dyess AFB, Tex.

A crystal, to simplify things, can be thought of as a very *sharp* resonant circuit. The "Q" (figure of merit) is tremendous. So, we can use one to lock the frequency of an oscillator, by substituting the crystal for the resonant circuit.

We can also use it as a very narrow *filter,* by putting it in series with the incoming signal. In quite a few sets, they pass the actual 3.58-MHz burst itself through the crystal, and then amplify it in the following stage.

With either method, we come out with what we must have: a signal which is locked to the station burst frequency for reference. **R-E**

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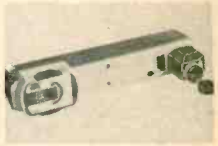

Direct reading up to 2 mi. Has 3 interchangeable pre-computed scales. In seconds, get exact fix, check distance & speed, correct compass. Gives 210' field of view at 500 yds; less than 1% error at 50 & 100 yds. 6 x 18X monocular detaches for sep use. Ideal for hunters, boaters, golfers, engrs., contractors, estimators. Weatherproof. 2-yr warranty.

No. 71,648EH .... (1½ x 11") .....$35.75 Ppd.
No. 71,649EH CASE HOLSTER .....$7.75 Ppd.

GET POLICE, AIRCRAFT CALLS

Your standard AM home or car radio can get exciting 2-way police, fire, local aircraft calls, etc. from UHF bands via Converters. No interconnecting wires needed—just put solid state Converter near set. Easy instrs incl. Ea. Kit req. 9v batt (not included). POLICE & FIRE CONVERTER KIT — LO BAND. Operates in the 30-50 MHz band.

Stock No. 41,828EH ..... $8.25 Ppd.
AIRCRAFT CONVERTER KIT. Operates in the 108-136 MHz band.
Stock No. 41,827EH ..... $8.25 Ppd.

UNDERWATER MICROPHONE BUY

Listen to fish "talk" with this gov't. surplus Hydrophone! Terrific buy! $40 value! Make an accurate fish finder, pool splash-alarm, hear dolphins talk, add sound to underwater movies. Use with both high & low impedance amplifiers, tape recorders. Frequency response: 10-6000Hz. Working depth to 300 ft. Minimum sensitivity 1000 Hz. at depths of 60 or 300 ft. Operating temperature range: 0 to 35°C. Fungus and shock resistant. Includes leads (approx. 8" long) and instrs. Cable not incl. Wt. 2 oz.

Stock No. 41,759EH ..... $5.00 Ppd.

1st LOW-COST VACUUM PUMP!

Nothing like it! Top-quality hand-held pump produces & maintains 25" of vacuum. Has instant release tab, 1¾" diam. stainless gauge (0-30"). 100's of uses—siphon noxious fluids, evacuate bell jars and castings, clean, retrieve, lift sterile objects, demonstrate Magdeburg hemispheres, bleed fuel lines, check leaks, etc. Lifts 40 lbs. with included "T" Lifter (2½" diam. cup)—much more w/larger cup.

Stock No. 71,301EH .....$12.00 Ppd.
No. 71,300EH (without gauge/lifter) ..... 5.50 Ppd.

ASTRONOMICAL TELESCOPE KITS

Grind your own mirror for powerful telescopes. Kit contains fine annealed pyrex mirror blank, tool, abrasives, diagonal mirror, and eyepiece lenses. Instruments you build range in value from $75.00 to hundreds of dollars.

Stock No. 70,003EH ....4¼ diam. ¾" thick $10.75 Ppd.
Stock No. 70,004EH .....6" diam. 1" thick $16.95 Ppd.
Stock No. 70,005EH .....8" diam. 1⅜" thick $24.50 Ppd.
Stock No. 70,006EH 10" diam. 1¾" thick 30 lbs $44.50 FOB
Stock No. 70,007EH 12½" diam 2⅛"thick 46lbs $72.50 FOB

"FISH" WITH A MAGNET

Go treasure hunting on the bottom! Fascinating fun & sometimes profitable! Tie a line to our 5-lb. Magnet—drop it overboard in bay, river, lake or ocean. Troll it along bottom—your "treasured" haul can be outboard motors, anchors, other metal valuables. 5-lb. Magnet is war surplus—Alnico V Type —Gov't. cost $50. Lifts over 150 lbs. on land—much greater weights under water.

Stock No. 70,571EH ..... $14.00 Ppd.
Stock No. 70,570EH 3-½ LBS ..... $8.75 Ppd.
Stock No. 85,152EH 15¾ LBS ..... $33.95 F.O.B.

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And Dolby in all of them.

Now when you buy a Panasonic Hi-Fi cassette deck, the Dolby™ noise reduction system is included in the deal. Plus a lot more.

Our Model RS-276US has Hot Pressed Ferrite heads. That last 10 times longer than the ordinary kind. And provide broader frequency response. A direct-drive DC brushless motor to cut wow and flutter to under 0.1%. And Dolby.

You can also get Dolby in our Model RS-277US. With a 3-pole, 2-coil bi-directional motor. Which is responsible for our continuous automatic reverse. That lets you play an entire cassette. Without flipping it over.

RS-276US	Freq. Resp. 20 Hz—15 kHz with normal tape; 20 Hz—17 kHz with CrO_2 tape. Wow and flutter under 0.1%. S/N better than 60 dB (Dolby).
RS-277US	Freq. Resp. 20 Hz—13 kHz with normal tape; 20 Hz—14 kHz with CrO_2 tape. Wow and flutter under 0.25%. S/N better than 55 dB (Dolby).
RS-263US	Freq. Resp. 30 Hz—13 kHz with normal tape; 30 Hz—14 kHz with CrO_2 tape. Wow and flutter under 0.2%. S/N better than 55 dB (Dolby).

Dolby is also available in our economy deck, Model RS-263US. Which happens to be about the lowest priced Dolby unit made. But Dolby isn't all it has. There's Memory Rewind. It's a switch that lets you return to the exact point on the tape you want to replay. Without sifting through a lot of stuff you don't want. A lockable pause control. Two VU meters. Slide volume controls.

In case you were wondering about chromium dioxide (CrO_2) tape, the answer is yes. These decks have a special switch for normal or CrO_2 tape.

So go and visit your franchised Panasonic Hi-Fi dealer. And take a look at our new cassette decks. You'll find one you like. As long as you like Dolby.

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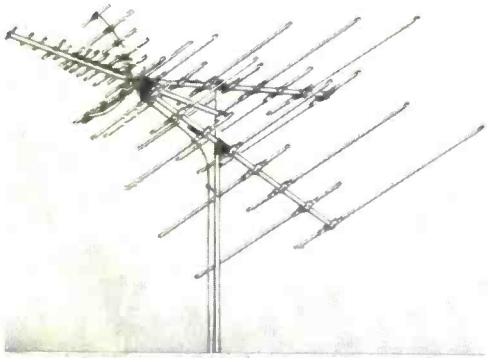
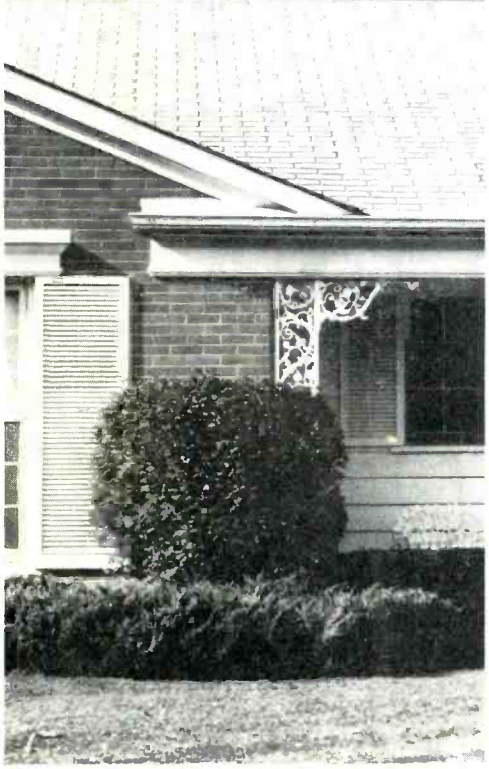
Hi-Fi Cassette Decks

WINEGARD HAS PULL!

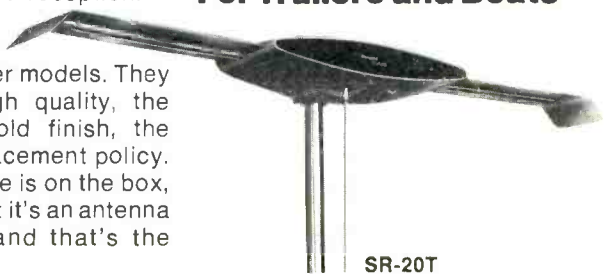
Pull enough to bring in those distant stations—those hard-to-get channels—pull enough to feed more than one set! Try Winegard's CW-980 Color-Wedge VHF-UHF-FM model, with its optional antenna-mounted solid state preamplifier, for the ultimate in TV reception.

Or, for strong-signal areas, try one of Winegard's smaller models. They offer the same high quality, the same protective gold finish, the same two-year replacement policy. If the Winegard name is on the box, you can be confident it's an antenna with real "pull"—and that's the name of the game!





Winegard Antennas For Trailers and Boats

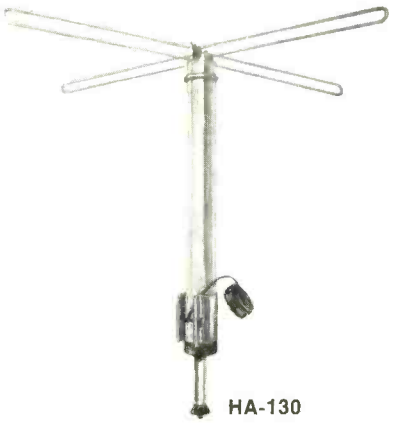


SR-20T

Specially designed SENSAR solid-state antenna for boats & recreational vehicles—extra strong construction.

Winegard Accessories For Complete Systems...

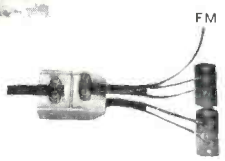
BC-782 BOOSTER-COUPLER
Solid-State Booster-Couplers for all-channel TV and FM signals to 2 to 4 sets.



HA-130

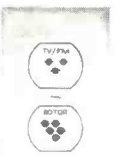
Winegard's new "Hideaway" Travel antenna for trailers, boats, campers, folds like an umbrella for travel!

CC-282 COUPLER
All-Channel non-amplified couplers to connect two sets to one antenna.



CS-380 BAND SEPARATOR
Band separators to connect 75 or 300 ohm downlead to 300 ohm UHF, VHF & FM terminals.

TR-35 TV OUTLET
TV outlets in a variety of models for all-channel TV and FM reception plus rotor.



AC-823B CARTRIDGE PRE-AMPLIFIER
Antenna-mounted pre-amplifiers in 8 models for all-channel, UHF, VHF-FM and FM use, each in its own weather-proof housing.

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