June, 1976 □ 75 cents

Electronic Servicing

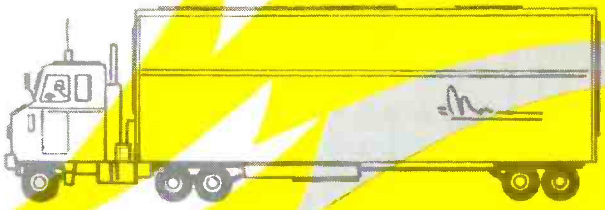
A HOWARD W. SAMS PUBLICATION

SERVICING ELECTRONIC ORGANS

Super Dogs I've Tamed

Calling Dr. Freud!

Buss® Fuses Specialize Too!



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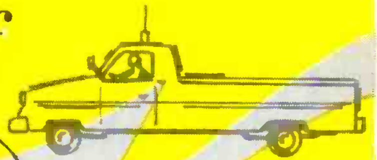
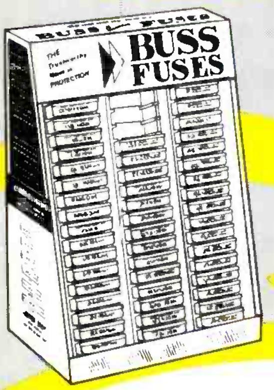


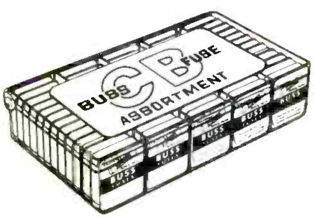
CB

EQUIPMENT

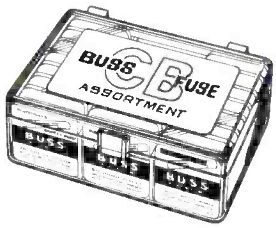


No. 240CB-3
Metal Display Stand

No. 80CB-1
Metal Display Stand



No. 240CB-4
Plastic Display Box



No. 80CB-2
Plastic Display Box

Now . . . four new BUSS fuse assortments exclusively designed with replacement fuses to service most Citizen Band Radios — offering a whole new area of opportunities for increased profits.

Two assortments contain 48 — 5 in metal boxes (240 fuses). BUSS No. 240CB-3 fuse assortment comes in a handy metal display stand. BUSS No. 240CB-4 fuse assortment is packed in a compact plastic display box.

In addition, there are two fuse assortments containing 16 — 5 in metal boxes (80 fuses). BUSS No. 80CB-1 fuse assortment packed in a metal display stand and BUSS No. 80CB-2 fuse assortment in a plastic display box.

Both BUSS fuse assortments contain a careful selection of the most popular fuses used in CB radios.

CB dealers can now have the fuses they need in a neat complete package to service all their customers fuse needs.

For full fuse assortment details, write for BUSS Bulletin CBA.

BUSSMANN MANUFACTURING
a McGraw-Edison Company Division
St. Louis, Missouri 63107

SUPPLIED THE ECONOMICAL WAY THRU DISTRIBUTORS
BUSS FUSES
THE QUALITY LINE

electronicscanner

news of the industry

The E. F. Johnson Company of Waseca, Minnesota, has constructed a new facility in Conyers, Georgia. The division will manufacture business-radio products as well as the more-complex radio equipment required by federal, state, and local governments. Eventually, the facility might have 2,000 employees.

A radio system for messages between a land station and deep-cruising submarines is under development by GTE Sylvania for the U.S. Navy. Conventional frequencies don't penetrate the ocean efficiently, forcing the submarines to rise dangerously-close to the surface. The Sylvania "input message processing terminal" modulates extremely-low-frequency (ELF) radio signals which can be received almost anywhere in the world.

Sony Corporation has developed a dub-proof system for its Betamax video-cassette tapes. When the prints are mass produced, the signal is changed, although the usual playback is normal. However, if the program is dubbed through another video recorder, the quality will be poor. This is intended to prevent the manufacture and sale of illegal copies.

For the first time in Europe, a quadriphonic broadcast used only a single transmitter. This occurred on Radio Picadilly in Manchester, England, one of the commercial stations in the United Kingdom and part of the ILR (Independent Local Radio) network. The broadcast began on Friday, April 2, at 5:00 AM and continued through midnight on Saturday, April 3. Radio Picadilly chose the Sansui QS encoding system for the transmission, playing discrete 4-channel tapes and QS 4-channel records.

Whirlpool Corporation and Sanyo Electric of Osaka, Japan **have agreed that Sanyo will acquire the controlling interest** in the television business of Warwick Electronic Corporation (Whirlpool now owns 57%). Warwick will continue the organ business now operated by its wholly-owned subsidiary, the Thomas Organ Company, according to **Home Furnishings Daily.** A new Warwick subsidiary will be organized, and will operate the present television-manufacturing facility at Forest City, Arkansas.

NASA has contracted with the Aerospace/Optical Division of ITT for a satellite instrument to record the water-surface temperatures of the world's seas and oceans. Such temperature profiles are very useful in long-range weather forecasting. The new equipment will be an upgraded version of the Advanced Very-High-Resolution Radiometer which is already being produced by ITT for the TIROS-N series of meteorological satellites, and it will gather complex data from five spectral bands extending from the visible to the far-infrared.

A new, larger audio-tape cassette system designed to match the sound quality of open-reel machines has been developed by Sony, Matsushita, and TEAC. In the Elcaset system, the cassette shell is larger than the conventional Philips-type cassette. Tape width is 1/4-inch compared with 1/8-inch, and the tape speed is about double the 1.78 IPS of the other cassettes. Also, the tape is pulled **outside** of the cassette shell for transport across the heads, thus allowing multi-head systems, and permitting a stable tape movement, reports the **Home Furnishings Daily.** First models are expected by this fall.

(*Continued on page 6*)

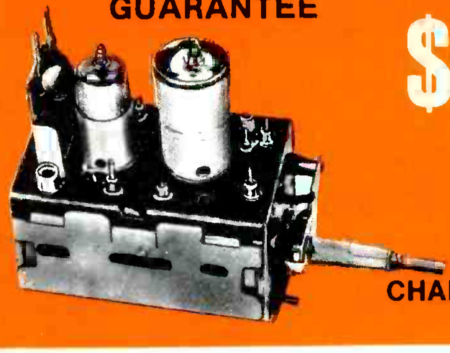
TUNER SERVICE CORPORATION

SUBSTITUNER

JUST **$44.95** U.S.A. ONLY

WITH CABLES

ONE YEAR GUARANTEE



STILL ONLY **$9.95** U.S.A. ONLY

MAJOR PARTS AND SHIPPING CHARGED AT COST

FEATURES

- A UHF Tuner with 70 channels which are detented and indicated just like VHF channels.
- A VHF Hi Gain Solid State Tuner.
- AC Powered
- 90 Day Warranty

Demonstrate the SUBSTITUNER to your customers and show improved reception with their TV sets.

You may place your order through any of the Centers listed below.

NEWS FLASH!

NOW AVAILABLE—TUNER SERVICE PARTS CATALOG OF ALL SARKES TARZIAN VHF AND UHF TUNERS, INCLUDING EXPLODED VIEW DRAWINGS. OVER 200 PAGES. ORDER YOUR COPY TODAY. *SEND $2.50 WITH ORDER TO BLOOMINGTON HEAD OFFICE.*

PROVIDES YOU WITH A COMPLETE SERVICE FOR ALL YOUR TELEVISION TUNER REQUIREMENTS.

REPAIR

VHF OR UHF ANY TYPE	(U.S.A. ONLY)	**$ 9.95**
UHF/VHF COMBINATION	(U.S.A. ONLY)	**$15.00**

MAJOR PARTS AND SHIPPING CHARGED AT COST

- Fast, efficient service at our conveniently located Service Centers.
- All tuners are ultrasonically cleaned, repaired, realigned, and air tested.

REPLACE

UNIVERSAL REPLACEMENT TUNER **$12.95** (U.S.A. only)

- This price buys you a complete new tuner built specifically by Sarkes Tarzian Inc. for this purpose.
- All shafts have a maximum length of 10½" which can be cut to 1½".
- Specify heater type parallel and series 450 mA. or 600 mA.

CUSTOMIZE

- Customized tuners are available at a cost of only $15.95. With trade-in $13.95. (U.S.A. only)
- Send in your original tuner for comparison purposes to any of the Centers listed below.

HEADQUARTERS	BLOOMINGTON, INDIANA 47401	537 South Walnut Street	Tel. 812-334-0411
ARIZONA	TUCSON, ARIZONA 85713	1528 S. 6th Ave.	Tel. 602-791-9243
CALIFORNIA	NORTH HOLLYWOOD, CALIF. 91601	10654 Magnolia Boulevard	Tel. 213-769-2720
	BURLINGAME, CALIF. 94010	1324 Marsten Road	Tel. 415-347-5728
	MODESTO, CALIF. 95351	123 Phoenix Avenue	Tel. 209-521-8051
CONNECTICUT	BRIDGEPORT, CONN. 06606	913 Madison Ave.	Tel. 203-335-0620
FLORIDA	TAMPA, FLORIDA 33606	1505 Cypress Street	Tel. 813-253-0324
	FT. LAUDERDALE, FLORIDA 33315	104 S.W. 23rd St., Bay 16	Tel. 305-524-0914
	MIAMI, FLORIDA 33150	7641 N.W. 7th Ave.	Tel. 305-754-1352
GEORGIA	ATLANTA, GA. 30310	646 Evans St. S.W.	Tel. 404-758-2232
ILLINOIS	CHAMPAIGN, ILLINOIS 61820	405 East University Street	Tel. 217-356-6400
	DALTON, ILL. 60419	1507-09 E. 142nd St.	Tel. 312-841-4444
	SKOKIE, ILLINOIS 60076	5110 West Brown Street	Tel. 312-675-0230
INDIANA	INDIANAPOLIS, INDIANA 46204	112 West St. Clair Street	Tel. 317-632-3493
IOWA	DES MOINES, IOWA 50319	5005 Douglas St. #5E	Tel. 515-278-4217
KENTUCKY	LOUISVILLE, KENTUCKY 40205	2244 Taylorsville Road	Tel. 502-452-1191
LOUISIANA	SHREVEPORT, LOUISIANA 71104	3025 Highland Avenue	Tel. 318-221-3027
MARYLAND	BALTIMORE, MARYLAND 21215	5505 Reisterstown Rd., Box [illegible]	Tel. 301-358-1186
MASSACHUSETTS	SPRINGFIELD, MASS. 01108	405 Dickinson St.	Tel. 413-788-8206
MISSOURI	ST. LOUIS, MISSOURI 63132	9577 Page Avenue	Tel. 314-429-0633
NEVADA	LAS VEGAS, NEVADA 89102	1412 Western Avenue No. 1	Tel. 702-384-4235
NEW JERSEY	TRENTON, NEW JERSEY 08638	1139 Pennsylvania Ave.	Tel. 609-393-0999
	JERSEY CITY, NEW JERSEY 07307	547-49 Tonnele Ave., Hwy. 1 & 9	Tel. 201-792-3730
NEW YORK	ROCHESTER, NEW YORK 14615	37 Pullman Ave.	Tel. 716-647-9180
N. CAROLINA	GREENSBORO, N.C. 27405	2914 E. Market Street	Tel. 919-273-6276
OHIO	CINCINNATI, OHIO 45216	7450 Vine Street	Tel. 513-821-5080
	CLEVELAND, OHIO 44109	4525 Pearl Road	Tel. 216-741-2314
OREGON	PORTLAND, OREGON 97210	1732 N.W. 25th Ave., P.O. Box 10141	Tel. 503-222-9059
PENNSYLVANIA	PITTSBURGH, PA. 15209	515 Grant Avenue	Tel. 412-821-4004
TENNESSEE	MEMPHIS, TENNESSEE 38111	3158 Barron Avenue	Tel. 901-458-2355
TEXAS	DALLAS, TEXAS 75218	11540 Garland Road	Tel. 214-327-8413
VIRGINIA	NORFOLK, VIRGINIA 23513	3295 Santos Street	Tel. 804-855-2518
CANADA	ST. LAURENT, QUEBEC H4N-2L7	305 Decarie Boulevard	Tel. 514-748-8803
	CALGARY, ALBERTA T2H-1Y3	P.O. Box 5823, Stn. "A"	Tel. 403-243-0971

TSC

WATCH US GROW

IF YOU WANT TO BRANCH OUT INTO THE TV TUNER REPAIR BUSINESS, WRITE TO THE BLOOMINGTON HEADQUARTERS ABOUT A FRANCHISE.

For More Details Circle (9) on Reply Card

(Continued from page 4)

For many years California has had a "shop registration" law. Now, the Bureau of Repair Services is looking into "technician licensing". One plan is for all persons who engage in TV repair to register with the Bureau every 5 years and pay a $25-$45 fee. Proof of a training or testing program, such as CET, would reduce this fee by $5. Complaints against a technician would be investigated by a field representative. If complaint seems justified, the accused technician would be tested in his own shop by 4 peers and required to repair 4 rigged TV sets. Failure would result in revocation of his technician's license.

In a Presidential message read to persons attending the recent Personal Communications Two-Way Radio Show in Las Vegas, **President Ford expressed full support** to make two-way radio capability more readily available to consumers. "There are more than ten million CB sets now in use, and that figure is expected to double in this year alone," said the President. Referring to the 500,000 CB license applications the FCC receives each month, President Ford stated, "I expect that steps will be taken shortly to streamline the procedures for granting licenses." The President also indicated confidence that the Federal Communications Commission will find satisfactory solutions to the present scarcity of CB channels. According to news reports, Mrs. Ford has become a CB operator, using the "handle" of "First Momma".

The opening of three new branch offices has been announced by Roland Nobis, president and founder of PTS Electronics, Inc. The new service centers are located in Salt Lake City, Utah, Syracuse, New York, and Davenport, Iowa. Nobis said the three new branches bring the total number of service centers to 38 with several more scheduled for opening in the near future.

The Federal Republic of Germany has selected Kaiser Aerospace and Electronics Corporation to supply a Head-Up Display (HUD) System for the German version of the "Alpha Jet" close-support aircraft. HUD enables the pilot to look out of the cockpit and see electronically-generated symbols superimposed over his view of the outside world.

Timex has purchased the liquid-crystal display operation from RCA. The plant is located in Franklin Township, New Jersey, and its operation will enable Timex to manufacture digital watch displays.

Manufacturers expect color TV sales to reach 7.5-8 million units this year.

RCA Corporation launched its second commercial communications satellite from Cape Canaveral, Florida, March 26th. The second satellite is to go into operation in June and is designed for improved future service to Alaska, as well as serving the rest of the United States.

Andy Winters, and Don Boogar, of Winters Television, Agree:

Chromstar™

SOLVED OUR PROBLEM IN PALMYRA!

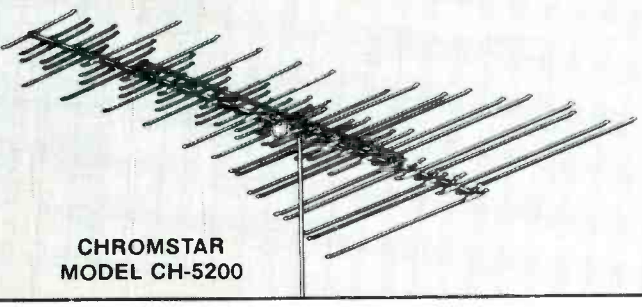
Winegard Chromstar does what no antenna did before!

Anderson "Andy" Winters, owner of Winters Television in Palmyra, New Jersey, and his installer, Don Boogar, solved a problem that had been plaguing tv viewers in Palmyra.

They* stated "The new Winegard Chromstar CH-5200 solved a big problem for us. Formerly, most antennas did an acceptable job of bringing in New York stations, about 120 miles away, except for Channels 9 and 11. Ch. 11 is predominately a sports station. Nobody could get it, or Ch. 9, because of interference from Ch. 10, Philadelphia, just 15 miles away. So we were installing a lot of competitive makes until we tried the Chromstar CH-5200 with Model **AC-2950** preamplifier. It brings in Ch. 9 and 11 perfectly, for the first time. With Ch. 11 a "must" for our area, I think we're going to sell a lot of Chromstars!"

Solve your local reception problems.
Get complete product information and specification charts from your Winegard Distributor.

*A copy of the Winters Television letter will be sent to you upon request.



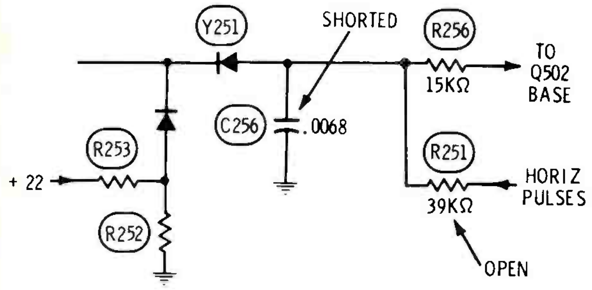
CHROMSTAR
MODEL CH-5200

WINEGARD
C O M P A N Y
3000 Kirkwood • Burlington, Iowa 52601

TV ANTENNAS MORE PEOPLE LOOK UP TO.

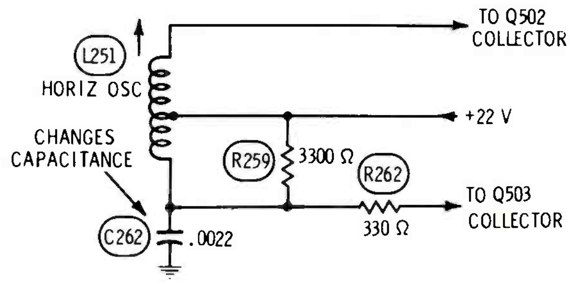
For More Details Circle (10) on Reply Card

Chassis—General Electric C-2
PHOTOFACT—1231-2



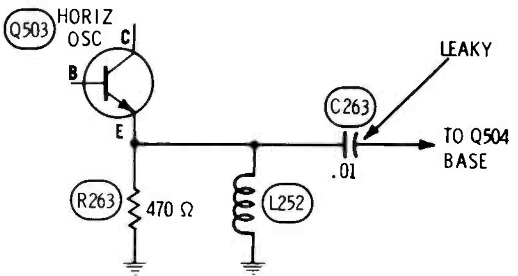
Symptom—No horizontal locking
Cure—Check C256 for a short and R251 for an open; replace if defective.

Chassis—General Electric C-2
PHOTOFACT—1231-2



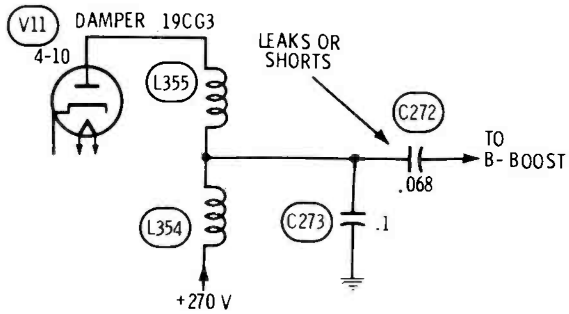
Symptom—Horizontal frequency drifts
Cure—Check C262, or replace on suspicion.

Chassis—General Electric C-2
PHOTOFACT—1231-2



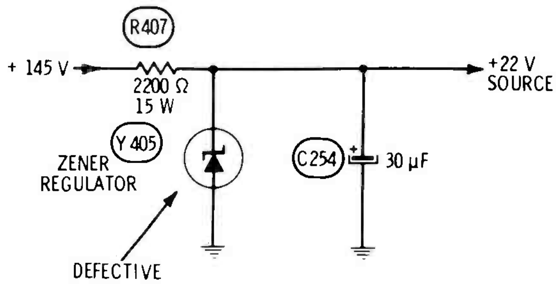
Symptom—Intermittent high voltage
Cure—Check for leakage in C263

Chassis—General Electric C-2
PHOTOFACT—1231-2



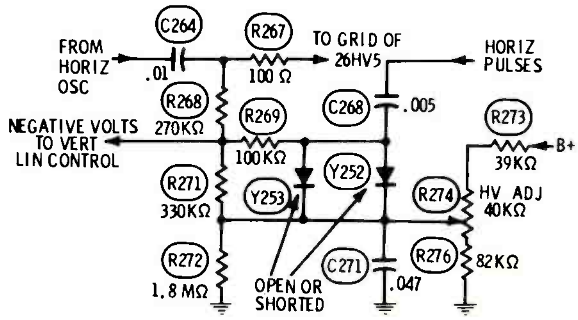
Symptom—No high voltage
Cure—Check for leakage or short in C272

Chassis—General Electric C-2
PHOTOFACT—1231-2



Symptom—Red horiz-output tube, or low contrast
Cure—Check Y405 zener, a short kills drive to output tube; open produces excessive AGC action.

Chassis—General Electric C-2
PHOTOFACT—1231-2



Symptom—Vertical linearity has no effect; and excessive high voltage.
Cure—Check diodes Y253 and Y252 for opens or shorts. □

troubleshooting tips

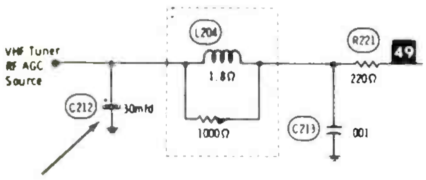
Send in your helpful tips—we pay!

Intermittent hum bar
Philco 3CR40 chassis
(Photofact 1366-1)

The customer reported a black horizontal line that sometimes would move up through the picture. The line appeared the first time I turned on the power. Because there was only one horizontal line, I immediately (and incorrectly) diagnosed the problem as 60-Hz hum produced by a bad filter capacitor in the B+ power supply.

After the chassis was connected to a test jig, the hum bar was gone. Tapping and shaking of connections in the filter section of the power supply started the hum bar. I paralleled each section of each filter capacitor, but without any improvement. Next, I checked for B+ ripple, using a scope; but the waveforms seemed normal.

Where was the hum originating? I used the scope to trace the hum in various circuits. The video coming from the video detector showed hum modulation, and this pointed to the IF's. B+ in the IF stages had little hum, but the AGC sources for both the IF and tuner did have 60-Hz hum.



When I reached the 30-microfarad AGC bypass on the tuner (C212), I noticed that moving the capacitor would start or stop the hum bar. This capacitor is mounted on a terminal strip of the Tuner Mounting Assembly (TMA), and the negative lead connects to the terminal which is riveted to the TMA. Evidently the rivet was not tight enough, because a good solder job of the ground terminal eliminated the hum bar.

Lew Garrett
Oklahoma City, Oklahoma

Bad squelch and distortion
Robyn scanner Model 1000

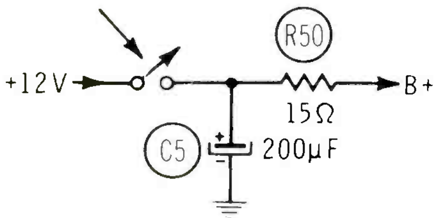
Although the customer complained of improper squelch control with his scanner radio, I also noticed that distorted audio and poor squelch occurred at the same time.

Many things made the radio erratic. Turning it off and on, jarring the chassis, or using coolant sometimes triggered the problem. But no one area seemed particularly sensitive.

The voltage at R50 was about +5 volts, and a normal reading should have been about +11 volts. This seemed to indicate excessive current, and disconnecting the output transistors did increase the voltage. But both checked okay, as did the driver transistors.

To be able to monitor the current drain, I connected my regulated power supply. I was surprised to find that the current **decreased** when the trouble occurred, a rare type of defect.

Next, I made many resistance measurements around the power wiring, and found excessive resistance in the on/off switch. The



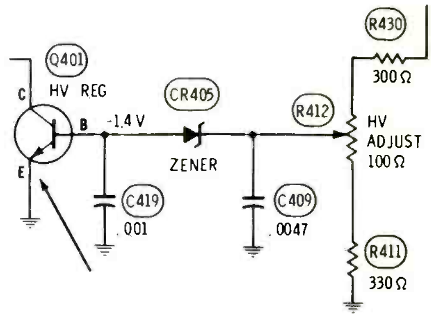
contacts of this particular switch are exposed, so I cleaned them, and that stopped the intermittent.

Gary Steenwyk
Holland, Michigan

Intermittent horiz lock
RCA CTC58 chassis
(Photofact 1428-2)

According to the customer, this XL-100 RCA would operate okay for several days and then lose horizontal locking (many diagonal bars). I remembered that the protective circuit changes the horizontal frequency when the high voltage rises above a safe value. Although the locking was normal at that time, the high voltage was about 1KV too high. I reset the HV, and finished the service call, confident of success.

Unfortunately, the customer called back about a week later with the same complaint. Fortunately, the horizontal frequency now was wrong most of the time. I grounded the testpoint at the base of the pro-



tective transistor. This brought back the locking and excessive HV, but it proved that the basic trouble was the excessive high voltage.

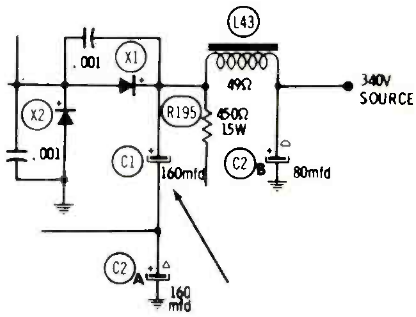
After checking the PW400 board, I located a bad solder joint at the emitter of Q401, the HV-regulator transistor. That cured the intermittent locking. Since that time, I have found several more similar cases.

William Nisbet
Buffalo, New York

Dim picture
Zenith 25NC37 chassis
(Photofact 869-3)

Both the raster and picture were weak, and at first I thought the picture tube was weak. However, it tested okay.

I measured several DC voltages in the power supply, and found that the 340-volt source was only about 190 volts. Several filters were paralleled, and C1 (one of the doubler capacitors) proved to be open.



Wrong supply voltages are one of the defects that might fool a technician into believing the picture tube was weak. I have found this problem in several models.

R. L. Osborn
Wichita, Kansas

reader's exchange

Needed: *Schematic for Model TP-1300L General Electric reel-to-reel tape recorder.*
P. Weissman
1753 Eastern Parkway
Schenectady, New York 12309

Needed: *Schematic and tube location diagram for Motorola FM receiver, Model FM AR (13 V). This is a monitor for police or fire calls. Will buy, or copy and return.*
Leonard L. Waite
30 Malvern Road
Newark, Delaware 19711

For Sale: *Aries Model AR-610 50-MHz frequency counter, good working condition, with manufacturer's data. $100.*
H. Geller
12622 N.E. 3rd St.
Bellevue, Washington 98005

Needed: *Schematic for Motorola hi-fi recorder player, Model SK138.*
Kenneth M. Abramovitz
9673 West Virginia Drive
Lakewood, Colorado 80226

Needed: *Fly-back transformer; part #T-F122 A-M-N (F122-N-150), for Craig color TV, Model 6303.*
Sidney R. Creacey
1358 Turquoise Avenue
Mentone, California 92359

Needed: *Old-type military capacitors, resistors, metal-shell tubes, etc., for radios and transmitters dating back to 1940's-1950's.*
Mark Freywald
713 Blandina St.
Utica, New York 13501

Needed: *Schematic and service information for a Golden Shield TV, Model 30 WP 16. Will copy and return.*
Philip Hite
520 Broadway
Vallejo, California 94590

Needed: *Audio output transformer for a "Knight Kit" Model 83YU774 amplifier; Allied part number 102213, primary impedance 800 ohms, secondary impedance 4-8-16 ohms, power 20 watts.*
Davila Electronics
608 Monge St.
Pekin, Illinois 61554

Needed: *Schematic and operating manual for Raytronics Model CB54A cathode ray tube rejuvenator. Will pay for copying.*
Wilson TV
16519 Parkstone
San Antonio, Texas 78232

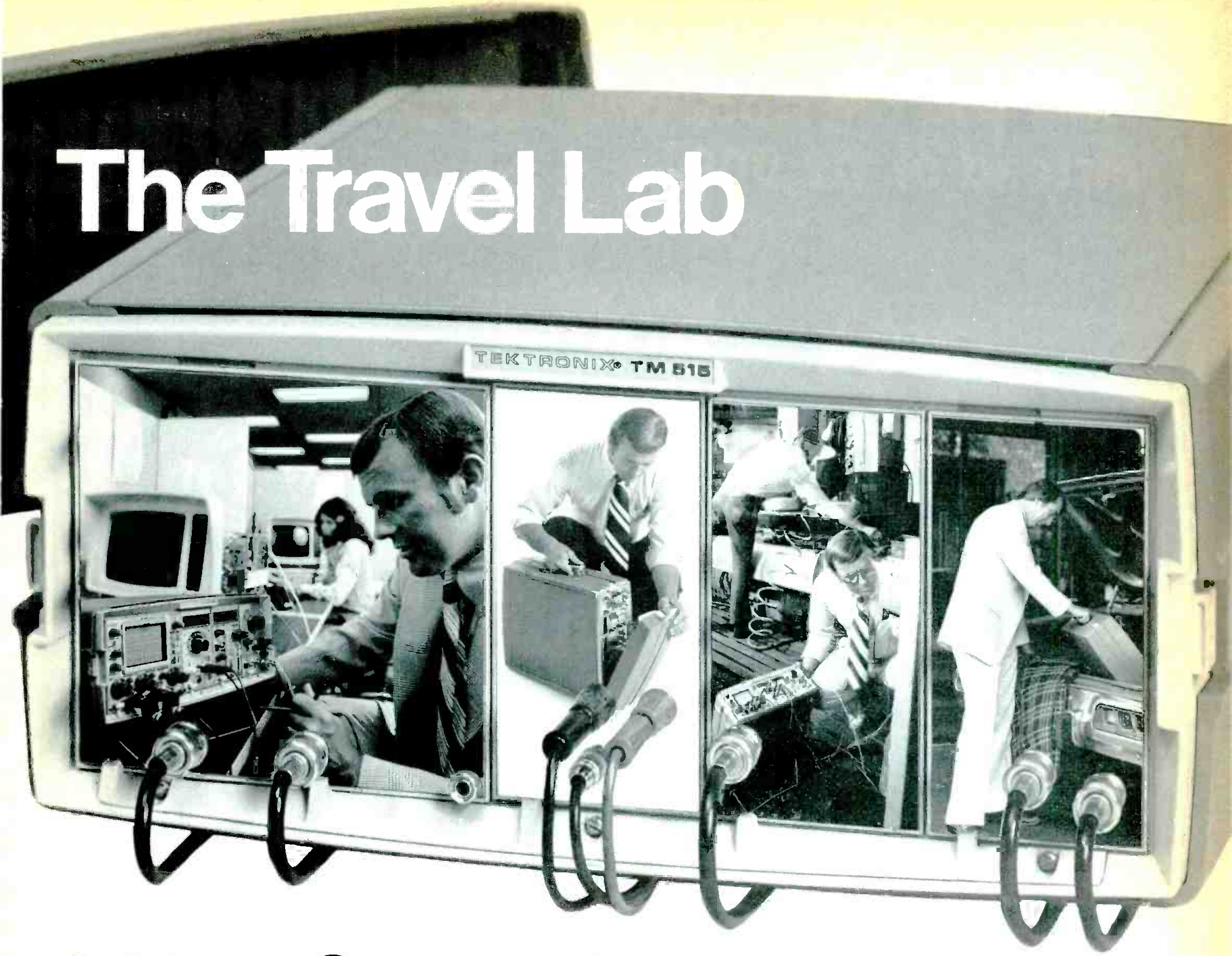
For Sale: *RCA triggered scope Model WO-535A with probes, instruction manual, and manufacturer's 1-year warranty.*
M. Jeffrey
601 W. 115th Street
New York, New York 10025

Needed: *Preamp and record circuit boards with parts for an Aiwa TP1009 stereo tape deck. State condition and price. I also need a cabinet for a Symphonic stereo Model 2233CR, or information about where to obtain one, and a 12LP4 picture tube.*
Patrick Kluge
40 Acorn Circle, Apt. 102
Towson, Maryland 21204

For Sale: *115 new tubes, including some obsolete ones. Examples: 24A, 807, 36, 42, loctals 7A7, 14AF7, etc. All 115 tubes for $250. Write for a complete list.*
Ray Marotteck
5310 N. Knox Avenue
Brooklyn Center, Minnesota 55430

(Continued on page 14)

The Travel Lab



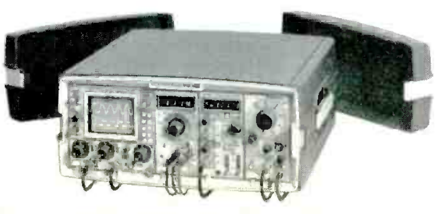
A New Concept In Portable Test Equipment

The TEKTRONIX TM 515 Traveler Mainframe looks like luggage, but it's really a five-compartment mainframe that provides power and interface connections for TM 500 plug-in modular test and measurement instruments. Typically weighing less than 32 pounds (with instruments), it's small enough to fit under an aircraft seat, moisture and dust resistant, and rugged.

With the TM 515, you can take the same instruments with you that you use in the lab . . . and maintain the same standards in the field. The case holds five plug-in instruments, and the covers serve as a storage area for your accessories. Now you can concentrate on making measurements instead of the logistics of getting your instruments to the test site.

You can optimize your system by selecting from over 35 general-purpose and specialized TM 500 plug-ins. Plug-ins include DMMs, counters, generators, power supplies, signal processors, logic analyzer, oscilloscopes, monitors, and even blank plug-ins for your custom circuits. **Intended application areas range from digital field service to medical, from audio/communications to on-site industrial control maintenance.**

For more information, contact your local Tektronix Field Engineer or write or phone: Tektronix, Inc., P.O. Box 500, Beaverton, Oregon 97077, (503) 644-0161 ext. 5542. In Europe: Tektronix Limited, P.O. Box 36, St. Peter Port, Guernsey, Channel Islands.



For More Details Circle (12) on Reply Card

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(Continued from page 12)

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Needed: *Schematic for Knight Safari-I 23-channel tube-type CB radio.*

William Mollenhauer
CB Electronics Associates
Box 3, S. Main St.
Glassboro, New Jersey 08028

Needed: *Heathkit HM-2103 RF load/wattmeter, or equivalent. Also, metered 0-30V power supply, cheap!*

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El Paso, Texas 79924

Needed: *Schematic diagram for a Model TMA 1550 Universal auto radio, 12-volt type.*

Mr. Ken Bryant
C/O Harlem High School
735 Windsor Rd.
Loves Park, Illinois 61111

For Sale: *Heathkit frequency counter Model IB-101 and frequency scaler Model IB-102. Also, a Knight Model KG-688 sine/square wave generator.*

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For Sale: *New factory-boxed tubes for most antique radios.*

Gus Green
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Needed: *New 1st IF coil (AM-FM) for Zenith radio, Model 8H023. Coil # is S-12249.*

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Needed: *Schematic diagram and service data for an Emerson b-w Model 7HP02 TV. Will buy, or copy and return.*

R. L. Yordy
80 West Hill Circle
Stamford, Connecticut 06902

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SERVICING ELECTRONIC ORGANS

Part 1/By Norman H. Crowhurst

It's easy to begin repairing electronic organs, because that business is very compatible with your present one of servicing television or stereo machines. If you have a basic electronic education, the information in this series should help you to repair with confidence almost any brand or model of electronic organ.

Why Service Organs?

Probably you're satisfied to repair television receivers or stereo machines, as you now are doing, and your reaction might be, "Why should **I** want to service electronic organs?" Here are some good reasons:

- Organ circuits and the troubleshooting methods are less complicated than those of TV sets;
- Only the usual tools and test equipment are required (except for a device to make accurate tuning possible). No FCC license is necessary;
- Servicing organs can be fascinating, especially if you have any interest in music or good sound reproduction (although I hasten to add that you do not need to be a musician to work on organs);
- In many areas, there is no competition. Most large cities have retail stores which sell and service a few popular brands, but organs are selling very well now, so more servicers are needed;
- The pay scale is good. Many organs sell in the $3,000 to $6,000 range, and the owners are quite concerned about getting their beloved machines back into playing condition; and
- It can be welcome part-time work to help fill in the valleys of TV servicing. In fact, it's not likely you could operate full time in organ repairs, unless you are located in a large city.

There's only one drawback. Schematics are difficult to obtain for some models. But when you know the basic type of an organ, you can do a lot of troubleshooting without a schematic. Next month, we'll list some of the distinctive differences between brands.

Too Complex?

The first time you see the inside of any electronic organ (Figure 1), you might think that it's more complicated than a computer, and perhaps beyond your ability to work on successfully. That's wrong!

Duplication is the reason the wiring seems so complex. A 61-note keyboard has 61 duplications of parts and circuits. But, when you understand one, you automatically understand all.

Also, the symptoms often indicate the location of the defect, if you know how to interpret them. In that way, it's similar to TV servicing; you don't have to test **everything**, only the circuits under suspicion.

To help you view organs in the proper perspective, we'll describe a minimum type, before explaining actual organs having more features.

A Simple Organ

Provide a separate oscillator for each note you want, add switches to turn the oscillators on and off, amplify this audio to drive a speaker, and you have just built the most-simple electronic organ (Figure 2). Of course an organist would be insulted if asked to play such a machine for very long, but it does illustrate the basic principles.

Additional organ functions (such as vibrato, octave couplers, toneshaping filters, and bass notes from the pedals) provide versatility and richness of tone. That's how modern organs can sound similar to an entire orchestra, and it partially explains why musicians so often derive so much pleasure from playing organs.

By the way, different models usually **do not** sound alike, even when they have "stops" with similar names. Quite often, I can identify the brand (and sometimes the exact model) of organ just by listening to the sound.

Characteristics Of Sounds

Well-trained human ears can identify hundreds, perhaps thousands, of different sounds. That's because all sounds have the following basic characteristics. Good organs will have circuits for varying most of them as desired.

Pitch

Pitch is the frequency of sound. It might be expressed approximately as treble (high frequency) or as bass (low frequency). More exactly, it might be a musical note having a known and precise number of repetitions per second (cycles-per-second, or Hertz).

Human ears are very efficient at detecting pitch changes, if they occur rapidly. Other characteristics of sound can't be identified that accurately.

Timbre

Timbre (or quality) of an audible sound is determined by the harmonics and their amplitudes relative to the fundamental frequency. Actually, this is a simplification, because timbre also includes some kinds of noises, and harmonics that are triggered each cycle, rather than being sounded continuously. Some organ pipes had a starting tone (called "chiff") for each note. Amplitude, attack and decay, and random variations of these properties all contribute to making the sounds distinctive.

Duration

Notes from conventional acoustic musical instruments seldom have the same amplitude for the entire duration. "Attack" refers to the speed with which the note reaches full amplitude, "duration" is the total amount of time the note is sounded, and "decay" indicates the time necessary for the amplitude to decrease to inaudibility. In tests with the attack and decay of notes eliminated by tape editing, ex-

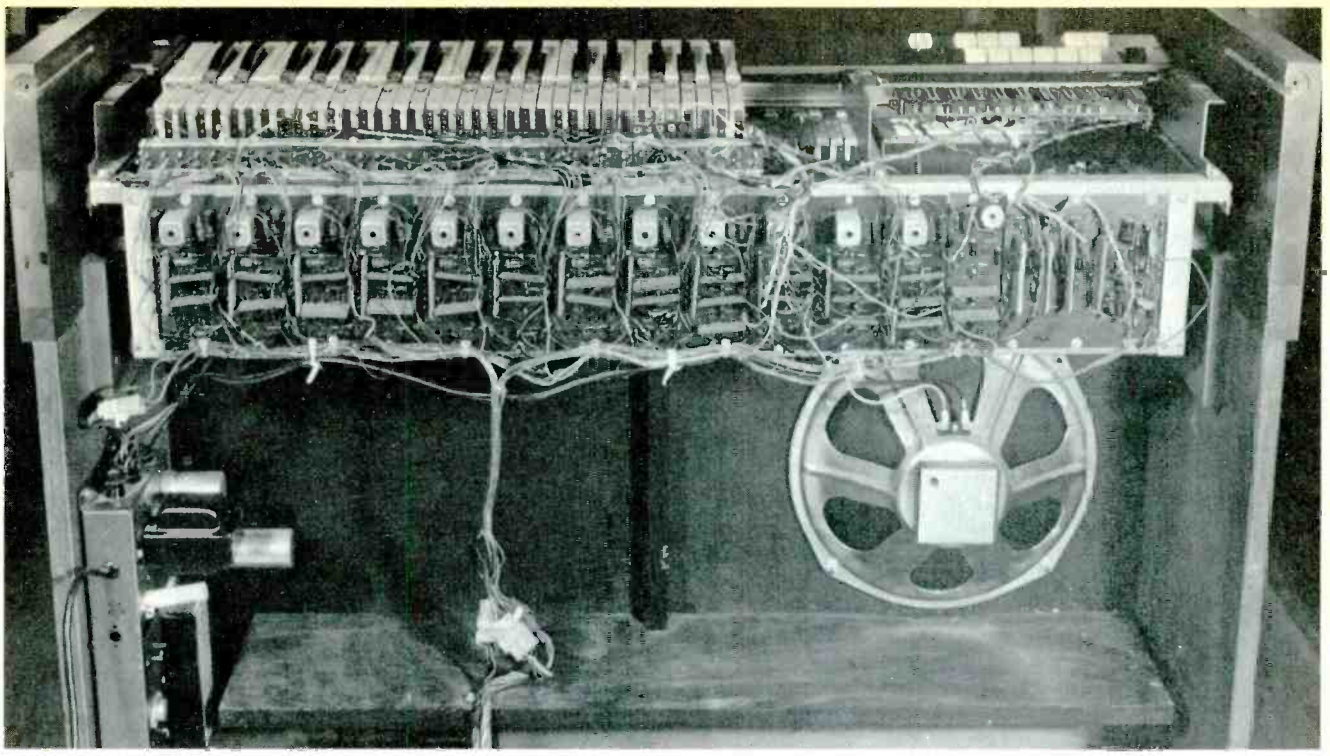


Fig. 1 The rear view of a small solid-state spinet Lowrey Organ shows a large number of components. At the upper left, the "swell" keyboard can be seen, with the "stops" at the right edge. Below them are the 12 boards for the tone generators, one for vibrato, and a larger one at the right for voicing. At the lower left is the amplifier; just below the cable is the loudness pedal; and the speaker is at the right.

perienced musicians were uncertain which instrument was playing.

Loudness

Although there are similarities, loudness is not quite the same as volume (acoustic) and amplitude (electronic). It's different because human ears hear in non-linear ways. Doubling the power of a musical note does **not** double the loudness heard by the ear. Also, the timbre of complex tones apparently changes as the volume is increased or decreased. That's why most organ "expression" controls are wired as loudness controls, giving bass boosting at lower sound levels.

Vibrato

True vibrato is a change of pitch around the correct center frequency, and it is done about 6 times per second (often by a 6-Hz oscillator). In other words, each note is warbled. Most organs have external controls for the amount of vibrato, and to turn it off, when desired.

Tremolo

Tremolo is a volume variation occurring at about 6 Hz. Although tremolo is easier to accomplish than vibrato, it is not as desirable, musically speaking. Used by itself (without vibrato), tremolo rapidly becomes monotonous.

It is interesting to speculate as to why vibrato is preferred by nearly all musicians. A change of frequency breaks up standing-wave patterns in a room. Could this be one reason vibrato sounds better ?

Sometimes, both vibrato and

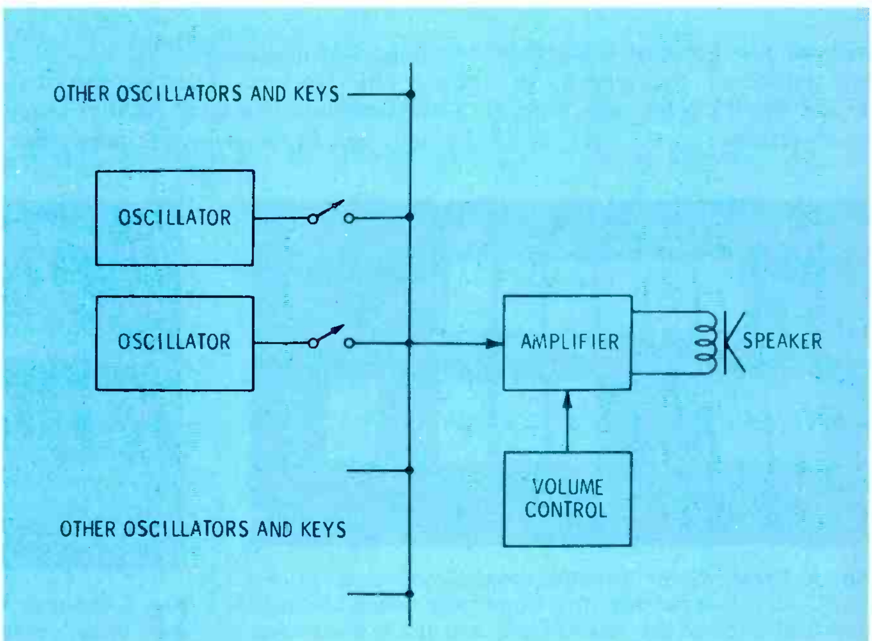


Fig. 2 This is a block diagram of the most-simple organ. No commercial organ has had so few features.

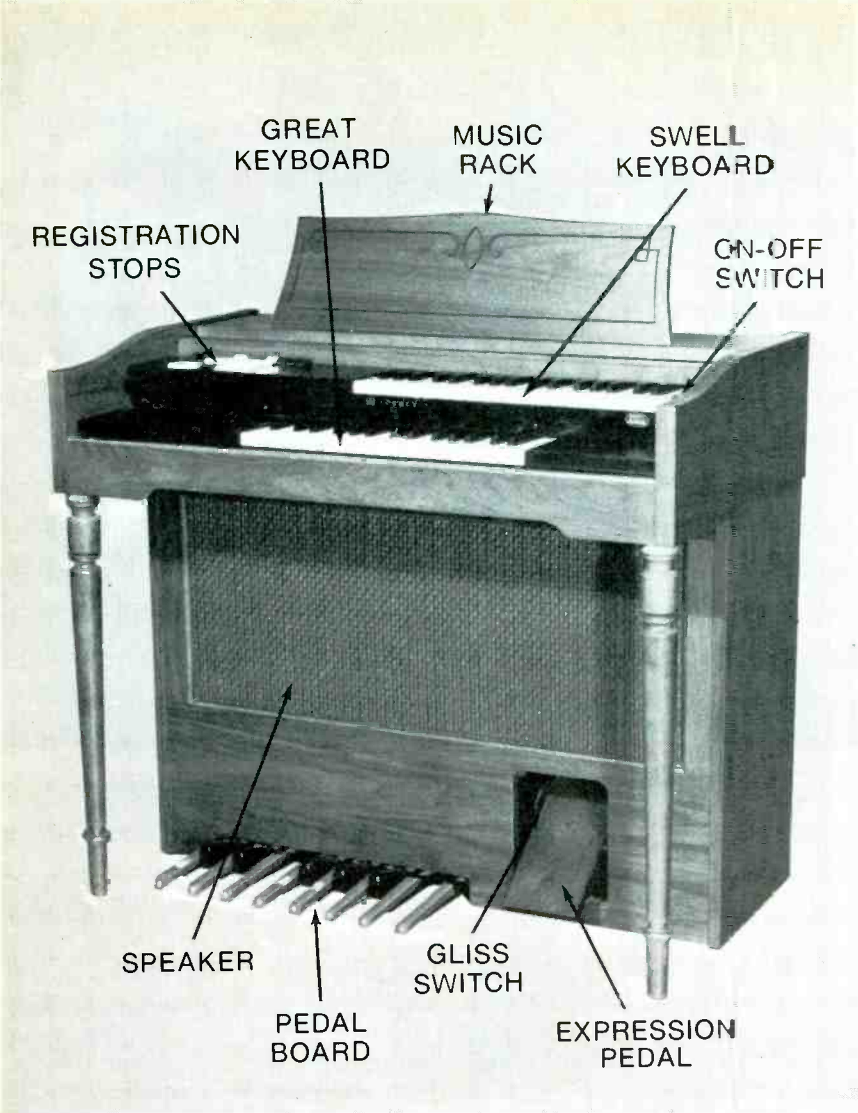


Fig. 3 Arrows point out the major components of a spinet organ.

tremolo are generated together by the nature of the circuit, or the device. We'll explain this more in a later section.

Noise and transients

The timbre of some musical instruments contains sounds that only can be described as noise. For example, the scrape of a rosined bow across the violin strings, and the puffs of air from a trumpet are not related harmonically to the main tone being produced. However, they are required for a genuine sound; and some organs include circuits to imitate them.

Reverberation

After a musical note stops, the sound waves continue to bounce around the enclosed space; from wall to ceiling, to floor, to walls, etc. This is reverberation. The amount and character of reverberation depends on the total volume of space, the shape of it, and the reflectiveness of the enclosure and anything in it. Reverberation usually is not desirable for the best understandability of human speech, but music does not sound "natural" without some.

By their nature, pipe organs were installed in churches or auditoriums, which usually had much reverberation of a long time duration. Probably, that's why it seems natural and "right" for organ music to have reverberation. Many electronic organs provide reverberation, usually by some kind of spring time-delay device.

Random effects

One complaint about the pioneer electronic organs was the unnatural sound produced by the lack of any random variations in the pitch, noise content, timbre, attack time, or speed of vibrato. In other words, the electronic version of music was **too perfect** (in a sense).

If you were to use a mike and a scope to examine the waveforms from acoustic musical instruments,

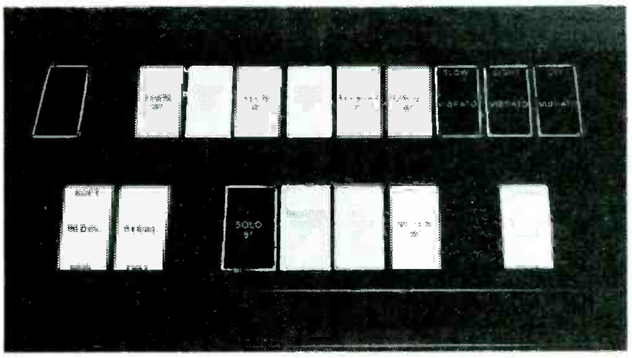


Fig. 4 These rocker switches control the tone of the organ. At the upper left, the white tabs select the tone color and pitch of the swell stops; and the 3 black ones at the right are for the vibrato. Pedal volume is determined by the two white tabs at lower left, and the three on the right select the tone color of the great keyboard. Also, there are solo stops and a treble tab.

Fig. 5 The solo (swell) keyboard usually is played by the right hand, so the lower notes are eliminated to minimize the cost. In the same way, the higher octave of the accompaniment (great) keyboard is not provided. However, the notes of the two keyboards match, C above C, G above G, etc.

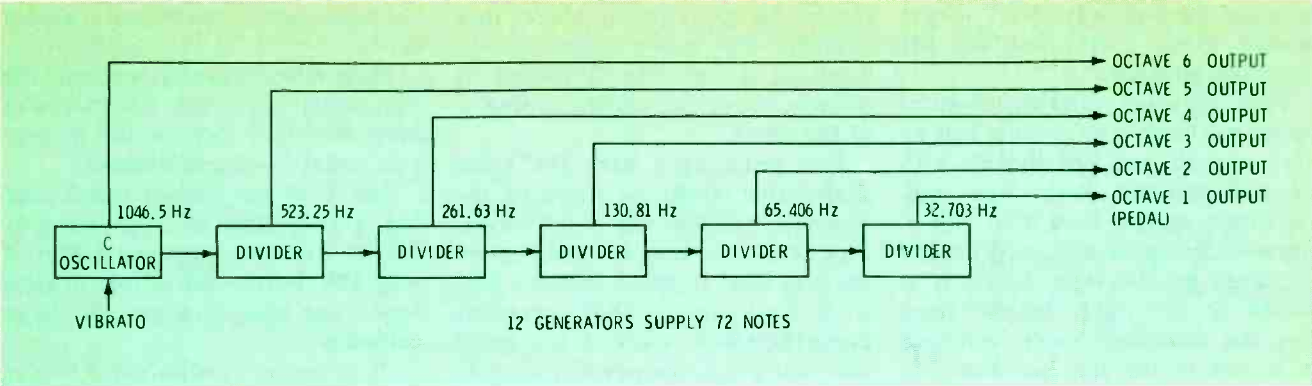


Fig. 6 This block diagram shows how all the C notes are generated. All are locked to the oscillator, so only one tuning adjustment per generator is required (12 for one organ). The dividers might be synchronized blocking oscillators, flip-flops, or locked multivibrators.

it's likely you would be surprised by the amount of movement. Sometimes, it's difficult to keep a scope locked.

Of course, it would be prohibitively expensive to build an electronic organ that could perfectly duplicate the distinctive sounds and random variations of all musical instruments. The makers of the older ones didn't even try, other than supplying artificial reverberation.

Stereo

The directionality of organ music is just as important as with stereo recorded music. Some organs have separate amplifiers and speakers that are arranged to sound different (for example, one might have a rotating tremolo/vibrato), and then certain families of "stops" are channeled to each speaker system, thus giving a stereo effect.

A Typical Small Organ

When various brands and models of organs are compared, usually we find the electronic circuits are vastly different. And yet there are physical similarities, dictated by the ancient pipe-organ consoles, such as the locations of keyboards and pedalboards.

Figure 3 shows the front of a small solid-state spinet organ, with arrows pointing to the various general components.

Organist's Language

Many of the terms used with electronic organs were carried over from pipe organs, and have no direct connection with electronics. For example, 8' pitch identifies notes having the same pitch as those of a piano. This comes from a certain kind of organ pipe that sounded a low C note when the pipe was about 8-feet long. A 4' stop indicates all notes are one octave higher (double the frequency), and a 16' designation is for notes one octave below those of a piano. Separate switching circuits permit any or all of these octaves to sound when one key is pressed.

"Voicing" originated from the first organ pipes which attempted to imitate the human voice, and now it refers to the timbre or quality.

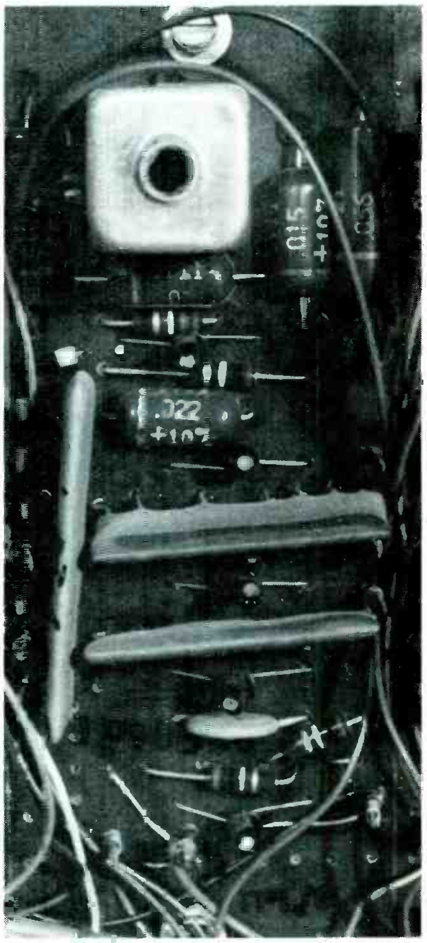
A person's voice speaks, and that extended naturally to a pipe "speaking". Even today, musicians might say that a trumpet or an organ "speaks".

The first "stops" determined whether or not air was allowed to reach a certain rank of pipes. The word now indicates a switch that turns on a specific organ voicing circuit (or an octave), as shown in Figure 4.

"Manuals" are the keyboards, which are played by the musicians hands. Most organs have two keyboards (Figure 5), although a few have only one, and some large ones have three.

You might wonder why there should be more than one. After all, a piano serves very well with only one. There are several reasons. For modern electronic organs, the most important reason is to provide two kinds of tone quality (timbre) with a pleasing balance of volume. Suppose a clarinet stop is selected for the "swell" keyboard, and just one note at a time is to be played. If chords were played in the lower octaves of the same keyboard, the chords would overpower the volume of the melody. So, the lower (great) keyboard is set up for a softer "registration" (that is, combination of stops) of contrasting tone color.

A secondary reason is that few electronic organs are voiced correctly over the entire keyboard, and playing many notes in several



Discrete transistors, resistors, tuning coil, capacitors, and capristors are used in this generator of four octaves.

octaves on one keyboard might involve using some that do not sound so pleasing.

Pipe organists playing classical music use keyboards with a full 61 keys on each, and pedalboards with 32 foot-operated keys. Few new electronic organs have that many. Because the upper keyboard usually is played by the right hand, it is moved to the right. In the same way the shortened lower keyboard is moved to the left (as shown in Figure 5). Of course, where they overlap, the notes must match. That is, C of one keyboard is directly above the corresponding C of the other.

Foot-pedal keys have the same shape and layout as those of the manuals, but they are much larger. Pipe organists, because pedal pipes are very slow to speak, usually play with both feet. That prevents annoying spaces without any pedal note sounding, and permits a legato (smooth and connected) pedal sound.

Most other organists operate the bass pedals with their left foot, and keep the right foot on the expression pedal (loudness control).

Low C of the 16-foot pedal rank has a frequency of approximately 32 Hz. And this gives you a hint of why the better-sounding organs have huge bass speakers and large cabinets.

"Expression" pedals never reduce the volume to inaudibility; that would not be desirable. In fact, some have only about a 15-dB range. Almost all are compensated to give bass boosting at low volume levels.

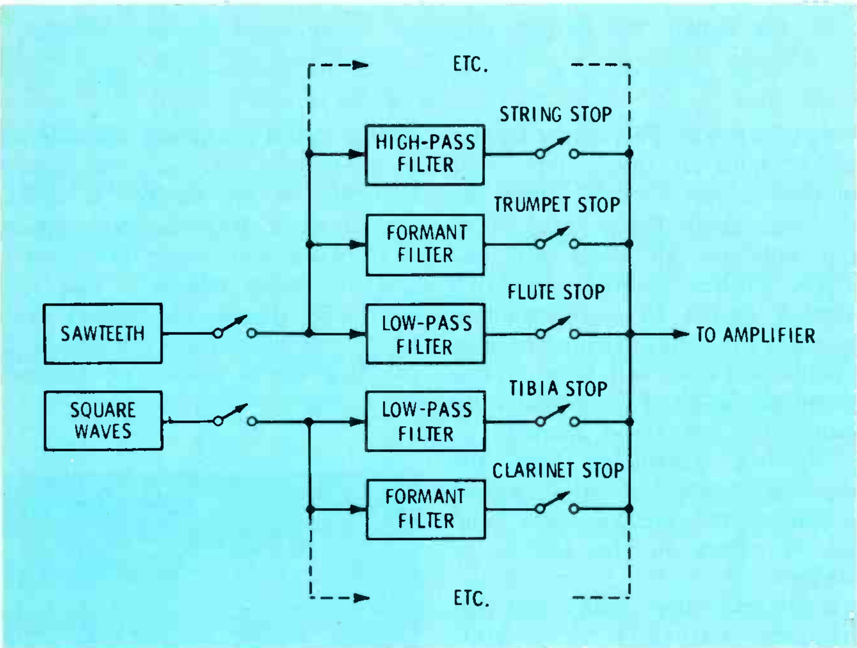


Fig. 7 Musical tones are produced by filtering sawteeth or square waves. Formant filters include a tuned circuit. This is a subtractive system; too many harmonics are there originally, then they are filtered as desired.

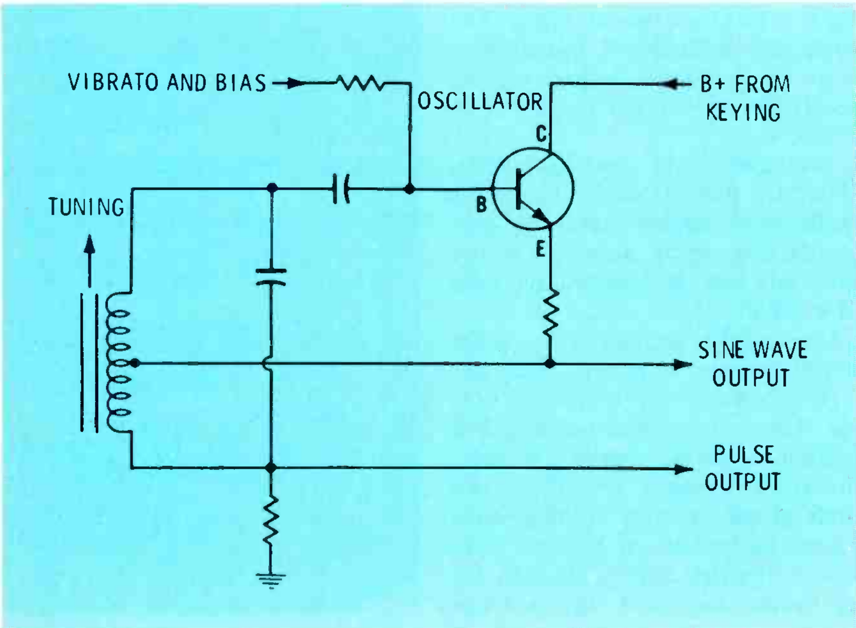


Fig. 8 Organs with separate oscillators for each note have circuits similar to this one.

Many Types

Electronic organs have been built in a bewildering array of types and models. A chord organ, for example, might have a single keyboard, which can sound only one note at a time, plus chord buttons (similar to an accordian), and a choice of two pedal notes obtained from the chord. Or, a deluxe model might have three or three-and-a-fraction full keyboards, 25 pedals, and more controls than are found in a jet plane cockpit.

But, regardless of the simplicity or complexity, you can recognize any organ as being related to the typical spinet we have described.

The basic circuits are variations of only two fundamental kinds: a separate oscillator for each note; or 12 oscillators, with dividers to produce the lower octaves. (For the moment we are ignoring the ones with mechanical production of tones, and those using computers.)

Oscillator Plus Dividers

Figure 6 shows the block diagram of a generator supplying six octaves of C notes; that's all the C's needed for most organs. Eleven additional generators (usually wired on separate boards) supply the other notes of all octaves. These generators are identical, except for the precise frequencies, and one which often has another signal to supply the extra note to complete the last octave. A certain keyboard, for example, might have 6 C's, but only 5 B's, 5 A#'s, etc.

Of course, the oscillators and dividers must operate continuously, so the keying is done either by simple on/off switches under each

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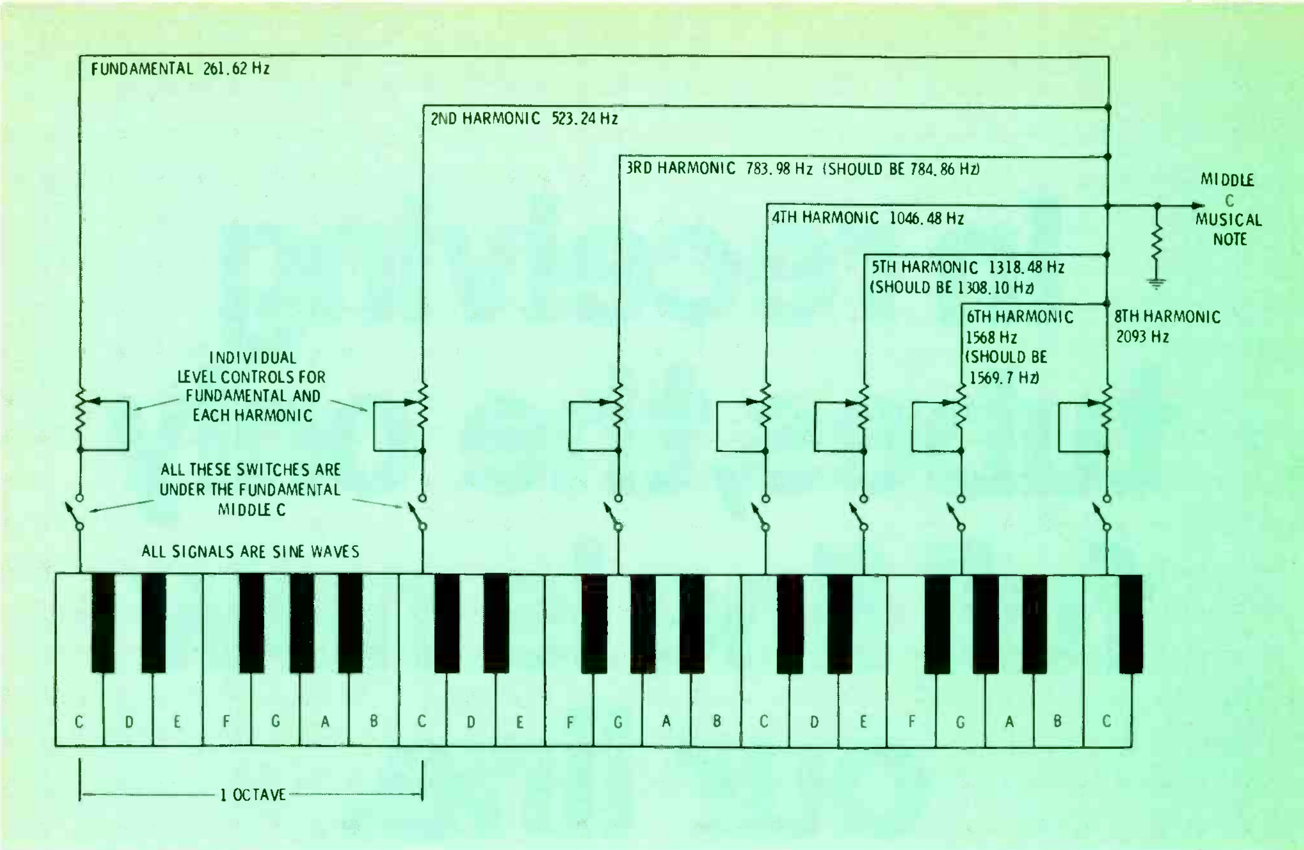

Fig. 9 In the additive system, individual sine waves for fundamental and all desired harmonics are taken from the tempered scale of the master generator. Different tone colors are produced by adjusting the amplitudes of the various harmonics.

key, or by keying transistors, tubes, diodes, or neon bulbs to pass or reject the signal.

Oscillator-output waveforms are near-sinewaves, and the waveform of each divider either is a sawtooth or a square wave, depending on the circuit. Actually, both waveforms are useful for producing pleasing sounds, and often one is changed into the other.

For example, a satisfactory square wave can be made by adding the 8' sawteeth tones of 100% amplitude to 50% amplitude 4' sawteeth tones that have been inverted in phase. On the other hand, a stair-step shape, which is a useable substitute for sawteeth, is produced by adding 100% 8' square waves to 50% 4' square waves. Square waves have no even harmonics, and they are supplied by the 4' square waves.

Voicing of stops

Both sawteeth and square waves are rich in harmonics, and these harmonics are shaped in the stop filters to create musical tones, which might or might not be imitative of acoustic instruments (see Figure 7).

The "formant" stops deserve special mention. According to the dictionary, formant refers to vowel sounds, but in electronic organs it is some variation of a tuned circuit, which rings from the complex waveforms, boosting some frequencies, and softening others.

To sum up, when sawteeth and square waves are generated, there are more harmonics than needed. So, the stop filters remove the ones not wanted, or reinforce others that should be dominant. **It is a subtractive process.**

An Oscillator For Each Note

The other basic kind of organ tone generation provides a separate oscillator for each note. Of course there usually are some compromises, such as using the **same oscillator** as the 8' note of one stop, the 16' for another, and perhaps as the 4' of another stop.

As shown in Figure 8, two or three different waveforms are obtained from each oscillator. The emitter tap is part of the tuned circuit, so the waveform approaches a sine wave. Since the oscillator operates in Class "C", the transistor current is a pulse for each cycle, and this is developed across the resistor from low end of the coil to ground.

Stop filters are used to shape the pulse waveforms. These usually include formant (resonant) filters. Other tone variations come from keying different octaves, and usually the "quint" (a musical fifth above, or about the third harmonic) can be added to simulate a square wave.

These oscillators either operate only when keyed on, or they run continuously, with the outputs keyed by diodes, or other components.

Harmonic Synthesis

The two previous types of tone generation really are electronic equivalents of many acoustic musical instruments. There is a third kind, without a natural or acoustic precedent, which simulates tones by adding individual sine waves. The method is called "Harmonic Synthesis", and has been used (almost) exclusively by Hammond. Figure 9 shows how all the sine waves for both fundamental and harmonics have separate amplitude controls. (In practice, all fundamentals go through the same adjustment device, all second harmonics to a second, etc.)

In the example, middle C is the fundamental, and the harmonics are obtained from fundamental generators of higher notes. These harmonics, therefore, have frequencies from the tempered scale rather than being exact multiples of the fundamental. Notice that the 3rd harmonic is slightly low in frequency (flat), and the 5th harmonic is a bit high in frequency (sharp). This is of no consequence, unless you are a musical genius.

For two reasons, instruments using this additive system seldom go beyond the 8th harmonic (3rd octave). One is the extra costs for more switches and controls. The other is that many of the higher harmonics are discordant, even if taken from the natural scale.

The seventh harmonic is nearly a musical "seventh". But that would be discordant if you wanted a major key, or a minor. In fact, the seventh harmonic is minimized in many acoustic instruments. Pianos have the hammer strike at the nodal point of the 7th harmonic to dampen it.

Discordant harmonics include the 7th, 9th, 11th, 13th, 14th, 15th and many even higher. It's easy to see why these should be omitted if possible. Only the 10th, 12th and 16th are harmonious.

Adjusting the amplitudes of fundamental and harmonics (done with "draw bars" on Hammonds) can produce reasonable facsimiles of many tones. However, the ringing of the formant filters (which serve the same as the mechanical resonant filters of acoustic instruments) is not there, and many musicians regret that missing timbre.

Each key must have as many switches (or control of as many switching devices) as the total of fundamental and harmonics. Also, each tone used as fundamental or harmonic must be a very-pure sine wave. Otherwise, pressing just one key sounds a **chord** rather than a single complex note, which is desired.

Vibrato

All electronic organs have either a vibrato (frequency swing), a tremulant (volume variation), or a combination of both.

At the heart of most such circuits is a low-frequency oscillator (see Figure 10), operating at about 6 Hz. The output signal either modulates the bias of the oscillators, to vary the frequency slightly, or it activates a phase-shift circuit which simulates a frequency shift.

Rotating Speakers

Many variations of rotating speakers have been employed, as shown in Figure 11. Rotating the source of the sound produces two effects. One is a frequency warble from the Doppler Effect, and the other is a tremulant, which is produced because the sound is louder when the speaker points toward you, and it's softer when it points away.

The effect can be duplicated electronically; however, the rotation gives a three-dimensional effect, plus a breakup of standing-wave patterns, that is pleasing to many musicians.

Next Month

Next month, many popular brands of electronic organs are described according to the system of tone generation. Other important information is included to help you get started developing troubleshooting methods. □

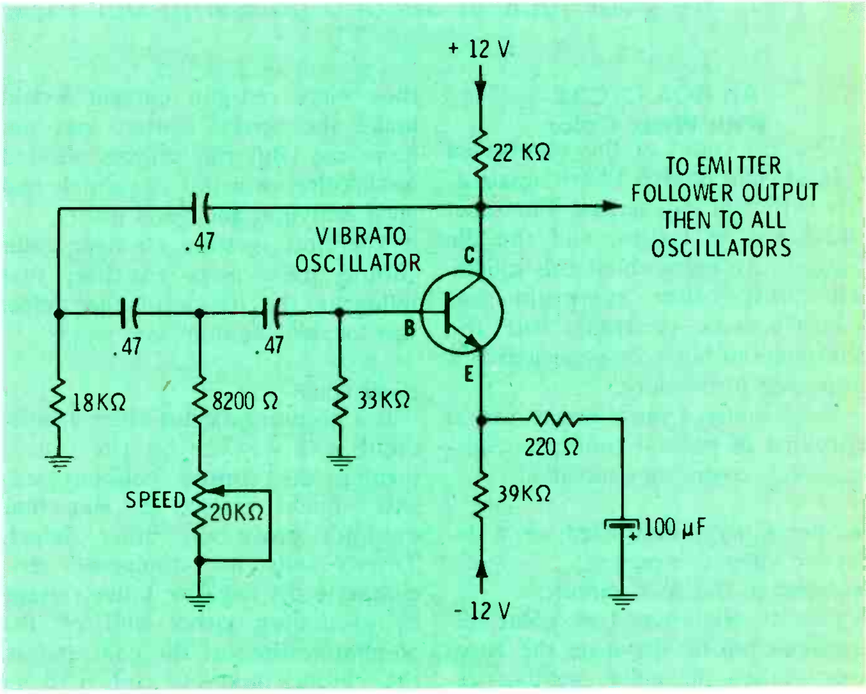

Fig. 10 Oscillators of about 6-Hz frequency are required for electronic vibrato or tremolo. The three .47 capacitors, and their associated resistors shift the phase a total of 180° to produce oscillation.

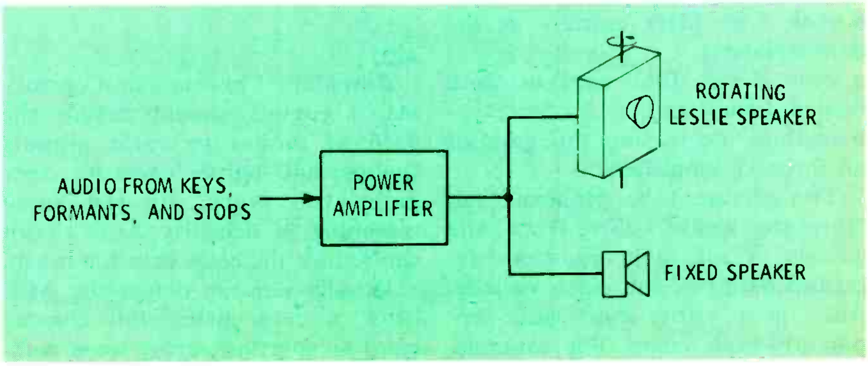

Fig. 11 A pleasing kind of combination vibrato and tremulant can be obtained from a rotating speaker.

SUPER "DOGS" I'VE KNOWN

By Gill Grieshaber, CET

Each repair job is somewhat unique, but a few develop into "dogs", the difficult repairs that demand all the techniques we know. Then there are the worst of the worst, the "super dogs". But perhaps they would have been easy for you; try your luck at second-guessing our expert.

An RCA CTC24 With Weak Color

I've lost count of the number of CTC24 color chassis I have repaired. It's sufficient to say that Photofact 912-3 was in tatters, and the file bulged with notes about this model. The only other symptom was slightly-weak contrast, but the sharpness of both the color and b-w appeared to be okay.

Confidently, I ran down a mental checklist of general problems causing weak color; they included:

- color killer misadjusted, or a defective killer component;
- defect in the ACC circuit;
- poor IF alignment (yes, color frequencies too far down on the curve can weaken the color, without degrading the b-w);
- low gain or misalignment of the chroma bandpass circuits, that weakens the chroma signal at the demodulators;
- weak 3.58 MHz carriers at the demodulators;
- some defect that weakens **both** demodulators; and
- anything decreasing the gain of all three -Y amplifiers.

Two picture tube problems can simulate weak color from the chassis. Weak gun emission decreases both b-w and color, **visually.** Also, poor purity can cause apparently-weak color! For example, if electrons from the red gun illuminate all three colors of dots, then more red-gun current would make the screen whiter, and not more red. But this chassis showed weak color on a test jig, which had good emission and good purity.

Therefore, getting stronger color should have been routine; just following the list until the defect was located. Famous last words!

Color killer

If a borderline color-killer adjustment was weakening the color, turning the control counterclockwise should restore it. But that wouldn't prove any other defect. There's only one foolproof test: eliminate the negative killer voltage by grounding either end of the 56-ohm resistor at the cold end of the chroma take-off coil (L18 in Figure 1). However, it's easier to locate the .047 bypass capacitor (C98). I grounded it, but the color did not brighten, proving that the killer circuit was not at fault.

ACC

Automatic-Chroma-gain-Control (ACC) circuits should reduce the gain of moderate color signals slightly, and reduce excessive color gain even more. By the same reasoning, a **defective** ACC circuit can reduce the color gain too much.

Usually you can defeat the ACC (trick it into giving full chroma gain) by shorting across some component. Or you can substitute the normal control voltage by using a bias supply. Either test is effective for proving an ACC defect.

With the CTC24, the test was easier; this chassis has **no** ACC.

Picture IF alignment

All IF stages of the CTC24 use overcoupled transformers and are difficult to align properly (proved by previous "dog" experiences). But, only about 5 minutes are required to **look** at the IF curve. If enough of you write to the editor asking for it, I'll explain in another article how to analyze it.

Anyway, the curve was within tolerance. But just to be certain, I straightened the color side, moving the markers 10% higher on the curve.

IF alignment was not the cause of weak color here; when the set was tuned to a station, the color remained weak.

Low chroma gain

6GH8 tubes are notorious for their failures, and should be the first suspect. However, these had been checked, and the bad ones replaced before I started.

Blanker shorts often burn up R155 (Figure 1), the cathode resistor that's common with both the blanker and the chroma-bandpass amplifier. In this case, it was normal. (For a fast test, just attach a jumper wire across it; a large increase of color proves it has too much resistance.)

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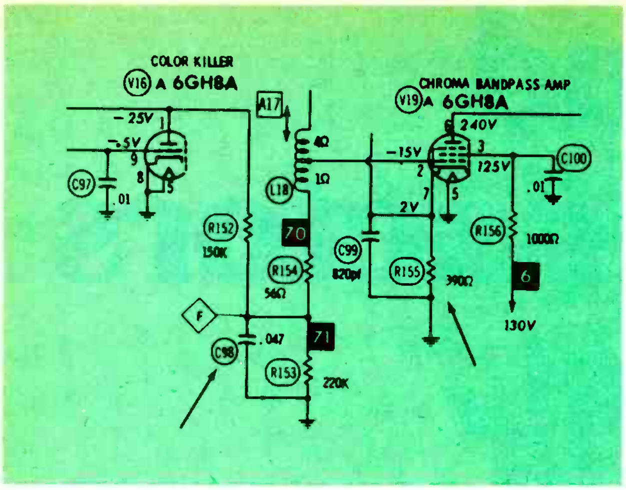
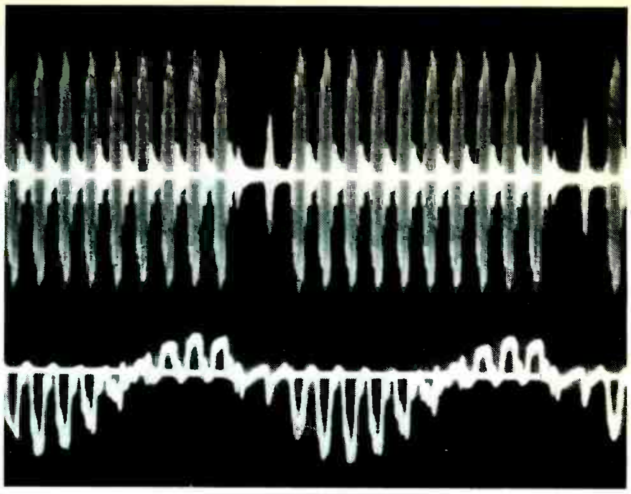


Fig. 1 R155 often becomes burned from blanker or V19A tube shorts. If it opens, the resulting blanker failure will give a dark raster. To test for a killer that's eliminating or weakening the color, ground testpoint "F", or the end of C98. More color proves the killer is out of adjustment or defective. Schematic is taken from Photofact 912-3, of the RCA CTC24.



These dual trace waveforms prove the weak color was caused by the demodulators (a rare defect). Top trace is the normal-amplitude bar pattern at the screen grid, and at the bottom is the weak R-Y output of the demodulator. Much time would have been saved, if I had noticed the **loss** of gain in the demodulators. It pays to check the amplitude accurately.

When I checked with the scope, the chroma signal (at the screen grids of the demodulators) had normal amplitude. All okay so far.

Insufficient 3.58-MHz carriers

Possibly, this is overlooked by many technicians, but **weak color can be caused by insufficient amplitude of the 3.58-MHz carriers** which are applied to the demodulators.

Unfortunately, these signals were adequate.

-Y amplifier gain

A few quick DC voltage and stage gain measurements convinced me the trouble did not originate in the -Y amplifiers, which amplify the demodulated chroma and feed the grids of the picture tube.

Now where?

By now, I had checked **all** general causes of weak color, including weak emission and poor purity of the picture tube, and found nothing wrong. Obviously, I had made a mistake, or overlooked something important. Then I remembered the second symptom: substandard contrast.

Scope waveforms showed good video detector amplitude, but less than normal gain in the sync/AGC/chroma amplifier, and the video-output stage.

I switched to a VTVM and checked the DC voltages of those two stages, finding several incorrect readings. These voltages included the screen grids, which were supplied from the +140-volt supply. After a few measurements, I found that the +140-volt supply checked only about +80-volts.

At last, here was an important clue. Next, what was causing the voltage to be that low? Theory says the source voltage might be too low (that proved to be wrong), the dropping resistor could have too much resistance (no, it was okay), or the load current might be excessive. Well, undoubtedly excessive current was responsible. But many circuits were powered from this one source. Which one had a partial short?

Tracing the short

Tubes are easy to remove, so they should be checked first for too much current. By using a clip lead, I connected the VTVM to the terminal where +140 volts should have been. Then I watched the meter as I unplugged one tube at a time. Some minor increases of voltage were found, but none were sufficient to indicate that tube current was the problem.

Next, I located a couple of lugs used to distribute the voltage to various circuits, and I removed one wire at a time. Success! When one certain wire was disconnected, the supply voltage rose to more than +140.

Visually following the wiring, I found a resistor with a slightly burned look (but not obvious enough to attract my attention before). It measured about 1.8K ohms, out of circuit. With it removed, the contrast was improved, but there was no color. This result was encouraging.

Color bands on the resistor were too burned to be read, but a quick session with the board physical layout proved it was R185 (see Figure 2), which should have been 56K ohms. A new replacement brought back strong color saturation. Also, the low-voltage supply now measured slightly above +140 volts. R176 had been overloaded, so it was replaced to prevent a delayed failure at a later time.

A unique circuit

A technician needs to learn **why** a certain defect changed the set into a "dog", else his time and trouble are wasted. This color demodulator circuit is unique; the RCA CTC24 is the only model (to my knowledge) using it. 6GH8's do not have separate external pins for the pentode suppressor grids, so only the screen grid, control grid, and cathode could be used for demodulation. The designer chose to bring the 3.58-MHz carrier to the control grid of each, and the chroma sidebands to the screen grid.

However, a screen grid must have a positive voltage as well. In this circuit, the demodulation is efficient if the DC voltage is between +1 and +3 volts. But voltages above or below this range decrease the output signal. With the burned resistor, the screens were supplied with about +30 volts, making demodulation inefficient and producing weak color.

Notice in Figure 2 that the DC voltage **must** vary a bit as the color control is adjusted. The DC voltage divider is made up of R185 for the top leg, and the sum of R176 plus the resistance of the color control as the lower section. Of course, C122 provides a path from the color control to screen grid for the chroma signal, without any voltage-divider loss.

No Sound, Good Picture

The Panasonic CT-63PC chassis (Photofact 1025-1) developed into a "super dog" of my own making. To state it plainly, I goofed.

No sound, no hum, and no noise could be heard in the internal speaker. Using a small screwdriver, I shorted across the proper two lugs of the phone jack. (Open contacts of the jack are the cause of many no-sound or intermittent-sound problems.) No improvement was noted.

Signal tracing with scope

Following the advice I have given to other technicians, I started signal tracing the audio signal using the scope. A normal sound signal was found at the high end of the volume control. At the plate of V2A (see Figure 3), the signal was properly amplified. The same amplitude of audio signal was measured at the control grid of the audio-output tube, V2B.

There the signal stopped. No signal could be found at the cathode, and only normal hum was at the screen grid and the plate.

DC voltages

Right on schedule, I switched to my faithful VTVM and checked the DC voltages of the audio output tube. Grid voltage was zero (normal), cathode was +20 (normal), and the screen and plate voltages were on the high end of normal. Nothing to be found there.

Capacitors?

A leaky C20 cathode bypass would reduce the cathode voltage. Or the gain would have been reduced (but not to zero), if it was open; also, an audio waveform could have been found at the cathode. None of those symptoms were true, so the capacitor was not defective.

Approximately the same analysis could be made of C21, the B+ filter. If open, the gain would be low, not zero; and audio would appear there.

Only a few parts remained. C126, which was across the primary of the output transformer, could kill the audio if it shorted. Unfortunately, there was no audio with the capacitor disconnected.

Transformer or speaker?

Perhaps the speaker was open (although it had popped, when the ohmmeter leads were across the terminals). A test speaker clipped direct to the transformer terminals also reproduced no audio and no hum. This test proved the phone jack and the wiring were okay, too.

Substituting the output transformer was left until the last, because of the extra time it would require. The original primary leads of T8 were removed (just in case the old transformer had shorted turns) and a test transformer with speaker was clipped in temporarily. Still no audio! I reinstalled and reconnected all loose parts.

What was overlooked?

Obviously, I had overlooked something or had made a mistake. But what? The output tube was hot, and the heater appeared normal. An open socket seemed unlikely. After all, the normal cathode voltage proved the tube was drawing normal current. Or did it? I couldn't remember measuring the cathode resistor, R113.

As the capacitor accepted a charge from the ohmmeter, and the reading went up above a megohm, **I knew R113 was open.** A replacement was made up of two series resistors, and the audio blasted forth at full volume, after the resistor was soldered in place.

Why the cathode voltage?

Now, the big question was: how had I gotten a normal +20-volt reading from cathode to ground of V2B? If the grid resistor, R110, had returned to cathode rather than to ground, an open R113 would have produced about +200 volts. And even with the grid resistor correctly going to ground, the

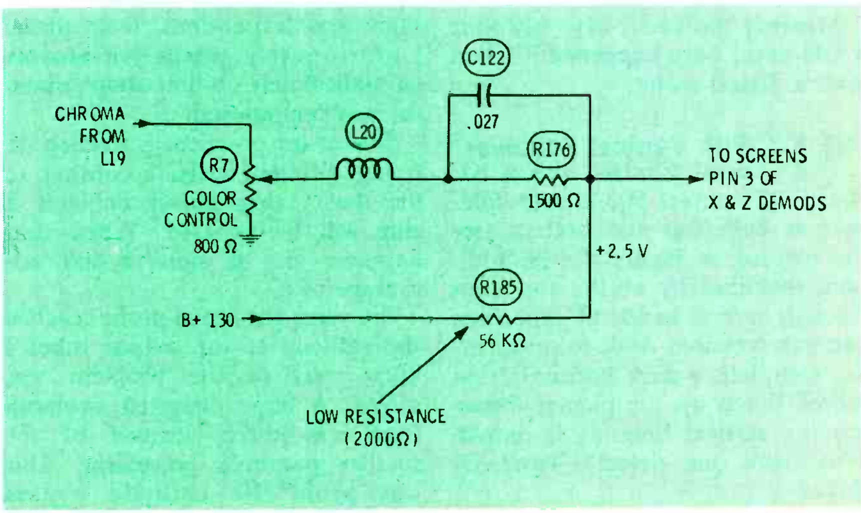


Fig. 2 The CTC24 has demodulators of an uncommon type. Chroma and a very-low positive DC voltage goes to the screen grid of each, and a 3.58-MHz carrier goes to the control grid. Either too little or too much screen voltage gives inefficient demodulation and weak color. In this case the voltage was about +30 volts (which is excessive) because R185 had been burned to a low resistance.

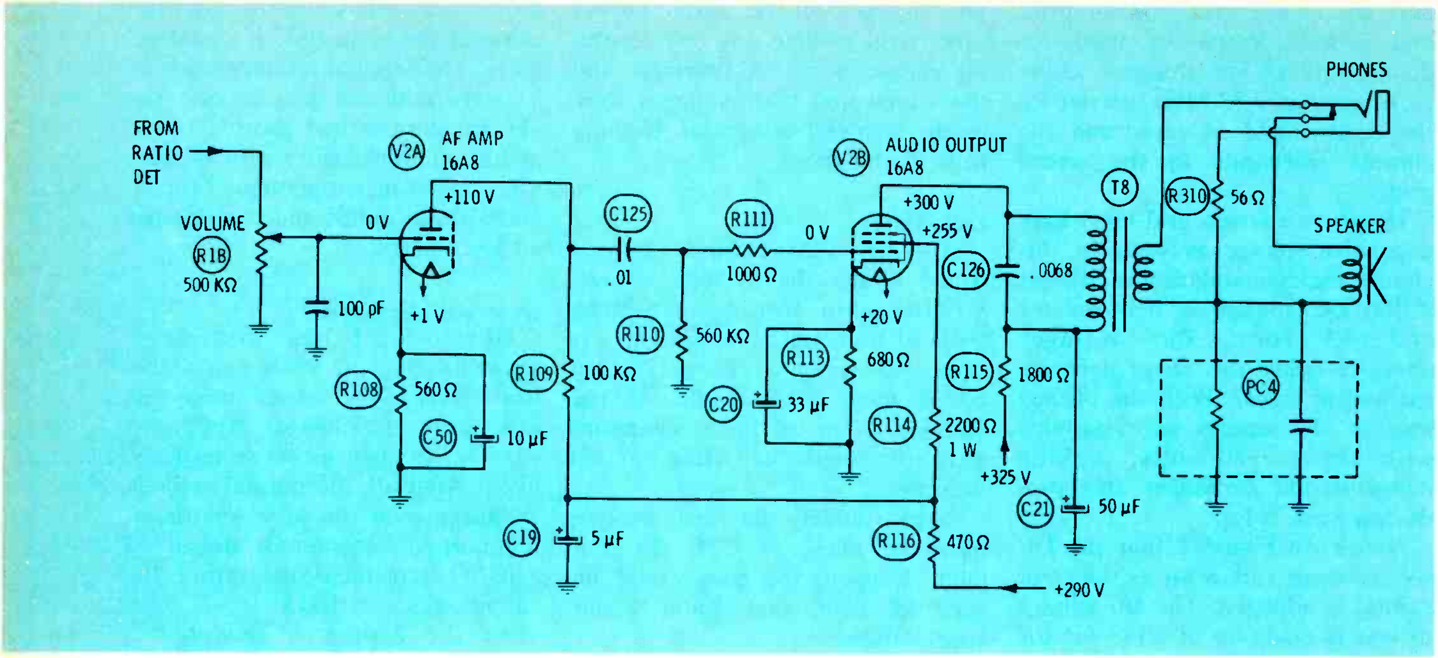


Fig. 3 There's nothing tricky in this Panasonic schematic (Model CT-63PC in Photofact 1025-1). Everything seemed to be okay, so why was the output stage dead?

voltage should have gone up to the cutoff voltage of the tube (the 11-megohm meter resistance was virtually an open circuit). That probably would have been between +60 volts and +80 volts, as a guess. Could I have been reading the wrong meter scale?

Quickly, I unsoldered the replacement R113, and measured the voltage from cathode to ground, after the tubes heated. **It was an even +60 volts!** Then I noticed that +20 on the 50-volt scale was the same calibration mark as +60 would be on the 150-volt scale.

Mystery solved. My blunder would never have happened if I had used a digital meter.

GE KC With Vertical Foldover

The General Electric with a KC chassis (Photofact 903-1) had foldover at **both** top and bottom (see the picture in Figure 4). In addition, the linearity at the top went through several bands of expansion and compression. And, to make my day complete, a dark horizontal bar moved slowly up the picture, bending the vertical lines as it moved. Was there one defect? Two? Or three?

Vertical troubles which **almost** allow a full picture seldom can be found by DC voltage analysis. But just to be safe, I quickly checked the grid and plate of the oscillator, and the grid, cathode, and plate of the output tube. Some were slightly high, and others a little low, but there was no recognizable pattern.

Scope waveforms will solve the puzzle

Waveform analysis is the best method to use in these situations. However, there is one large problem: since any multivibrator oscillator is a closed loop extending over two stages, most of the serious problems change the waveforms **everywhere.** That was the case here. The yoke waveform (and many of the others) clearly showed the ripples where the various compressions and expansions took place. Unfortunately, **these waveforms gave absolutely no hint about where the problem started.**

One of my practices is to keep on trying different tests, according to the theory that sooner or later a clue will be exposed. When that happens, just be alert to take advantage of it.

So, when the scope probe reached the cathode of the output tube, I knew part of the problem was solved. A large distorted sawtooth form was there, instead of the smaller parabolic waveform. This was proof the cathode bypass electrolytic (C8) was open. I had never worked on a KC model before, and had to refer to the Photofact to find the capacitor. The capacitor checked open during a quick ohmmeter test, and a new one gave about 50% more height, especially at the bottom of the screen.

Both the height and linearity controls required adjusting to bring in a picture having full height and good linearity at the bottom. But at the top, several bands of alternate compression and expansion remained.

A butchered chassis

Evidently, the TV had been in other shops before, according to several vertical components which had been tacked in place. One of those parts was C88 (refer to Figure 5), bypassing the plate of the vertical output tube to ground.

I have seen similar conditions at the top of the screen before, and they were caused by ringing in the output-transformer/yoke circuit. In turn, the ringing was produced by excessive capacitance in the output circuit.

With this remembrance to guide me, I examined C88 more closely, and found a previous technician had made up the odd value by paralleling three separate capacitors. Of course, that's okay, just so long as the voltage rating is high enough to withstand the high peak voltages.

Unfortunately, the capacitors totalled about .18 microfarad and not .0018 as it should have been. A new capacitor of the correct value,

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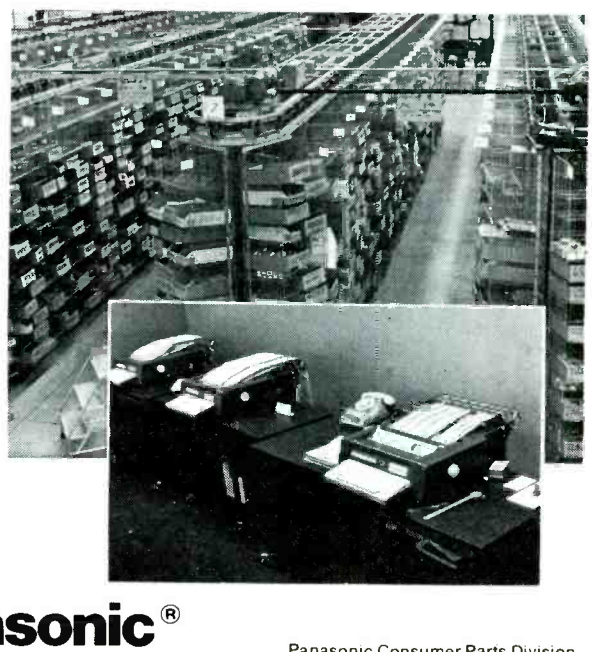

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plus more height and linearity adjustments brought adequate height with good linearity.

Hum in the video

While I was checking the cross-hatch pattern and admiring the good linearity, I noticed a dark horizontal bar moving slowly up the screen. The bar also made a small sideways jog on any vertical lines in the picture.

There was only **one** bar, and it came from the power-line frequency (proved by one complete revolution in about 17 seconds), so the frequency of the hum-bar was 60 Hz. However, the main power supply had a four-diode bridge, and these always double the frequency to 120 Hz. A check of the power-supply ripple, using the triggered scope, showed the ripple actually was 120 Hz, of moderate amplitude. **The hum bar could not be coming from the DC power supply.**

If not the power supply, then what was the source? The video IF's and video stages all were tube-equipped, and it seemed likely heater/cathode leakage was responsible.

Checking for tube hum

There is a faster way of finding tube hum than checking for shorts in a tube tester. Connect the scope in the video where the hum is visible, mixed with the video signal. Then tune to a channel without a signal. If the hum is gone, chances are good that an IF tube is responsible. Otherwise, if the hum remains, it's originating in the video. (The theory behind this test is that hum cannot travel through the tuned IF's without a carrier to modulate.)

Right away, I found that the hum remained when an IF tube was removed, or the tuner was set for a vacant channel. Therefore, the hum was originating in the video. Unfortunately, replacing the video tubes did not reduce the hum.

Tracing video hum

Using the scope as a signal tracer, I started down the video stages, beginning at the video detector. There was no hum at the base of Q1, the 1st video amplifier, but there was at both the emitter and collector. Then I remembered the unique circuit of Q1 in which a low-voltage rectifier circuit, powered from the heater voltage, supplied enough negative voltage to the emitter of the NPN transistor so that the base could operate from the negative video detector.

The circuit is shown in Figure 6. After I found where C6 and C7 were located, it didn't take very long to find that C7 was open. A new tubular electrolytic was installed, and the job was over.

This chassis had **three** separate defective (or wrong size) components. It is one example of the many times it's necessary to actually make the repairs before you can give an estimate.

Small Picture

The picture on the small 120/12-volt portable TV was slightly small. I don't remember the model number, and can't find the ticket to obtain it. But the lesson it gave is universal.

Transistorized horizontal-sweep circuits have far fewer possible defects that can cause a narrow picture. One of the most-probable troubles is reduced B+ supply voltage. In this case, the vertical also was weak. Both symptoms pointed to a power-supply problem (Figure 7).

Check low B+

Many things can cause low B+. They include:

- insufficient input AC voltage (input was fine here);
- wrong AC waveform (virtually impossible with line power);
- shorted or open rectifiers;
- insufficient capacitance of the input (peak-reading) capacitor;
- excessive current drain on the supply; and
- too much series resistance.

For the first test, I paralleled the input filter capacitor with another of the same rating. No significant change of voltage. The old capacitor was not running warm, or showing any signs of excessive leakage, so I concluded the capacitor was okay. However, if all else had checked normal, then I would have disconnected it for a better test.

Current drain was slightly less than the amount specified in the Photofact (that's normal considering the low voltage).

Operation for about 15 minutes did not produce any hot spots on the wiring, the bridge diodes, or any transistors; thus, minimizing the chances of an abnormal series resistance or bad joint.

All probable causes except the diodes had been given preliminary tests, without any success.

I unsoldered one end of each bridge rectifier and measured both forward and reversed resistances. All 4 checked okay! I resoldered them.

Scope to the rescue

Finally, I connected the scope to the input filter capacitor. The ripple waveform was a good sawtooth (proving the input filter was okay), but the frequency was only 60 Hz, when it should have been 120 Hz.

DC and AC tests showed the voltages were actually reaching the leads of the diodes (other dogs had opens before the rectifiers). There seemed to be nothing else to test. Yet something had opened one leg

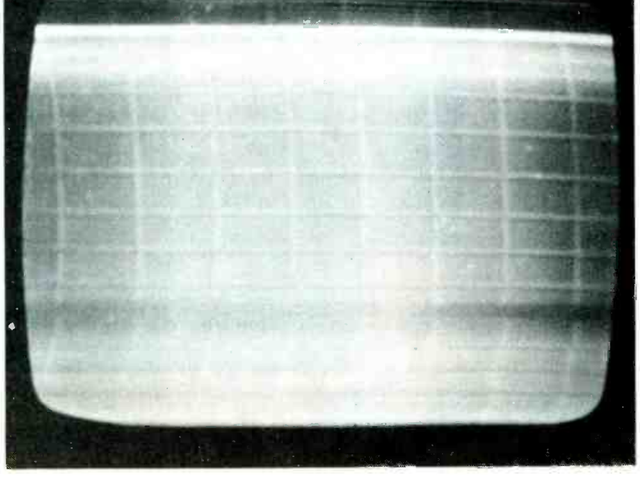
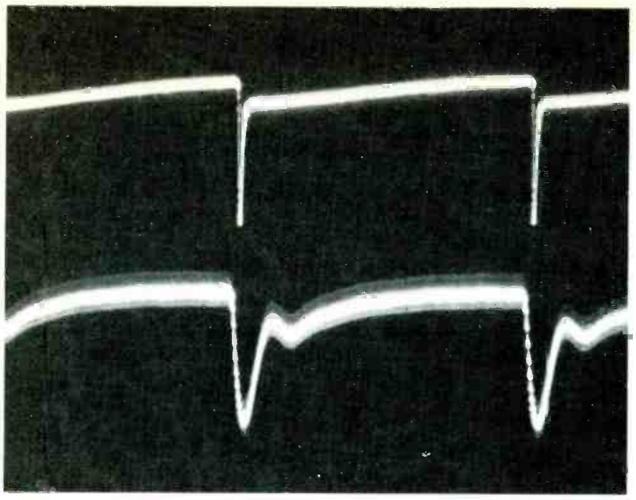


Fig. 4 Insufficient height, poor linearity, and a floating hum bar were visible on the screen of the GE chassis KC. How many defects caused those symptoms?



The lower trace is the yoke waveform of the vertical sweep shown in Figure 4, and the top trace is the normal waveform after two separate repairs were made to the vertical circuit.

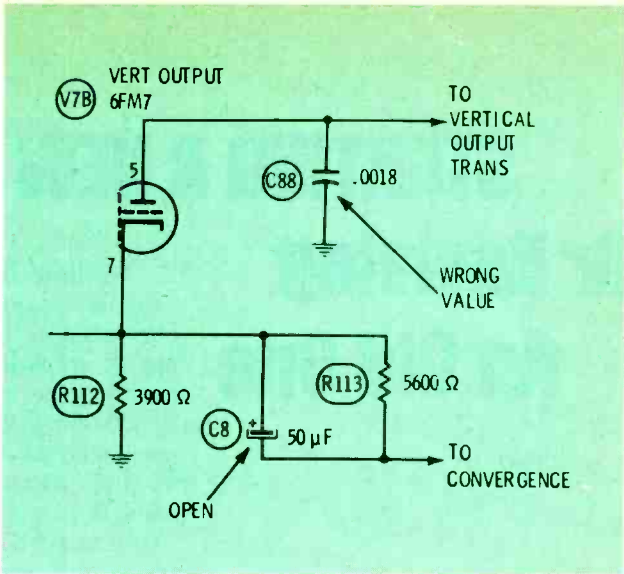


Fig. 5 C8 in the GE chassis KC was open, causing loss of sweep at the bottom of the screen. When the controls were misadjusted in an effort to obtain full height, bottom compression, and expansion at the top appeared. Also, a previous technician had installed a .18 microfarad capacitor for C88, and this caused ringing, which appeared as alternate expanded and compressed spacing of the scanning lines at the top.

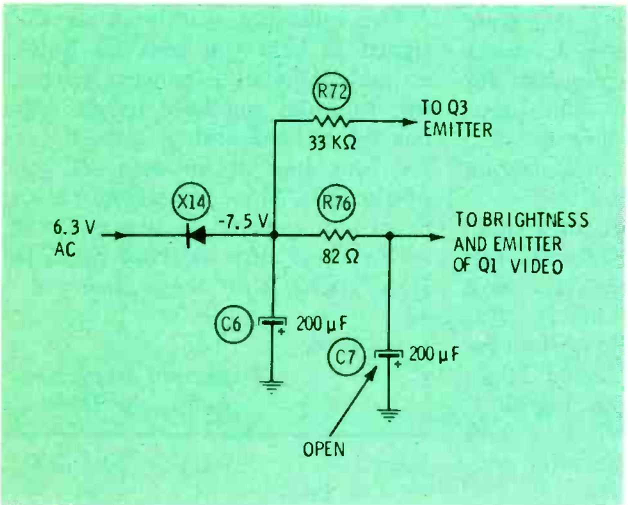


Fig. 6 An open filter in the emitter supply of Q1 caused a single moving hum bar in the picture (General Electric KC, Photofact 903-1).

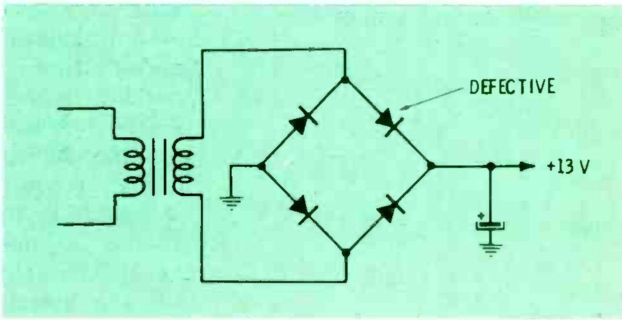


Fig. 7 A "weak" silicon diode acted as though it was open in this power supply of a portable TV. An open diode in a bridge changes the circuit from full-wave to half-wave, thus decreasing the DC output voltage.

of the bridge.

Then I remembered that three of the diodes had measured about 5K ohms forward resistance, but the fourth tested slightly higher, about 6K.

In desperation, I selected four new diodes of the highest current rating in the stock and soldered them in the circuit. Aha, the picture swelled out to full size, and the scope now showed 120-Hz sawteeth ripple.

What defect?

This was one time I didn't return the old parts to the customer (he didn't ask about them anyway). Instead, I waited for a slow day and tried some additional tests on the four rectifier diodes.

When wired into a half-wave test circuit, all four diodes had full voltage at low-to-moderate current. But when the load resistance was decreased to raise the current, this one diode produced less DC voltage than any of the other three.

There was no question about it. Although a curve tracer, several diode checkers, and an ohmmeter **all** indicated that the fourth diode was normal, it would not supply **high** current. I have never before found a "weak" silicon diode. Have you?

Comments

When a "dog" seems unrepairable, consider these suggestions:

- Switch over to whichever item of test equipment is most likely to find the problem (it isn't always the scope, either!);
- Review your rusty theory, to find better tests;
- Consider the unwelcome possibility that you made a mistake; or
- Repeat some of the tests, using a higher level of sophistication.

Of course, when all else fails, push the machine aside, and look at it again the next morning after the third cup of coffee. □

STARTING A NEW SERVICE BUSINESS...

Or Reviving An Old One

Part 2

How to delegate work and responsibility, translate your business plan into dollars, figure the break-even point, and other important suggestions are reprinted from the **Small Business Administration's** publication Number 153.

Getting The Work Done

An important step in setting up your business is to find and hire capable employees. Then you must train them to work together to get the job done. Obviously, organization is needed if your business is to produce what you expect it to produce, namely profits.

Organization is essential because you as the owner-manager cannot do all the work. As your organization grows, you have to *delegate work, responsibility and authority.* A helpful tool in getting this done is the organization chart. It shows at a glance who is responsible for the major activities of a business. Examples are given here to help you in preparing an organization chart for your business.

An organization chart for a small service business will reflect the fact that the owner-manager does most of the managing himself. For example, an organization chart for a small service organization might be similar to the one in Figure 1. Another is included to show how the chart might appear after considerable business growth.

As an additional aid in determining both what needs to be done and who will do it, list each activity that is involved in your business. Next to the activity indicate who will do it. You may do this by name or some other designation such as "worker #1." Remember that a name may appear more than once.

The Plan Versus Money

At this point, take some time to think about what your business plan means in terms of dollars. This section is designed to help you put your plan into dollars.

The first question concerns the source of dollars. After your initial capital investment, the major source of money is the sale of your services. What dollar volume of business do you expect to do in the next 12 months?

Expenses—In connection with your annual dollar volume of business, you need to think about expenses. If, for example, you plan to do $100,000 in business, what will it cost you to do this amount of servicing? And even more important, what will be left over as profit at the end of the year? Never lose sight of the fact that profit is *your* pay. Even if you pay yourself a salary for living expenses, your business must make a profit if it is to continue year after year and pay back the money you invested in it.

The following workblock is designed to help you make a quick estimate of your expenses. To use this formula, you need to get only one figure—the cost of sales figure for your line of business. If you don't have this operating ratio, check with your trade association or with sources such as those listed in *Ratio Analysis for Small Business.*

	Expressed in %	*Expressed in Dollars*
Sales	100	$100,000
Cost of Sales	—61.7	—61,700
Gross Margin	38.3	38,300

Start-up costs—If you are starting a new business, list the following estimated start-up costs:

- fixtures and equipment;
- starting inventory;
- office supplies;
- decorating and remodeling;
- installation of equipment;
- deposits for utilities;
- legal and professional fees;
- licenses and permits;
- advertising for the opening;
- operating cash;
- owner's withdraw during pre-start-up time.

Whether you have the funds (savings) or borrow them, your new business will have to pay back these start-up costs. Keep this fact in mind as you work on the "Expenses" section, and on other financial aspects of your plan.

Itemize your expenses—Your quick estimate of expenses provides a starting point. The next step is to break down your expenses (as shown in Figure 2) so they can be handled over 12 months.

Matching money and expenses—A budget helps you to see the dollar amount of your expenses each month. Then from month to month the question is: Will sales bring in enough money to pay the firm's bills on time? The answer is "maybe not" or "I hope so" unless the owner-manager prepares for the "peaks and valleys" that are in many service operations.

A cash forecast is a management tool which can eliminate much of the anxiety that can plague you if your business goes through lean months. Make up an "Estimated Cash Forecast" as illustrated in Figure 3, and use it to estimate the amounts of cash you expect to flow through your business the next 12 months.

Is additional money needed?—Suppose at this point you have determined that your business plan needs more money than can be generated by sales. What do you do?

What you do depends on the situation. For example, the need may be for bank credit to tide your business over during the lean months. This loan can be repaid during the fat sales months when expenses are far less than sales. Adequate working capital is necessary for success and survival.

Whether an owner-manager seeks to borrow money for only a month or so or on a long-term basis, the lender needs to know whether the store's financial position is strong or weak. He will ask to see a current balance sheet.

A blank current balance sheet is included in Figure 4. Even if you

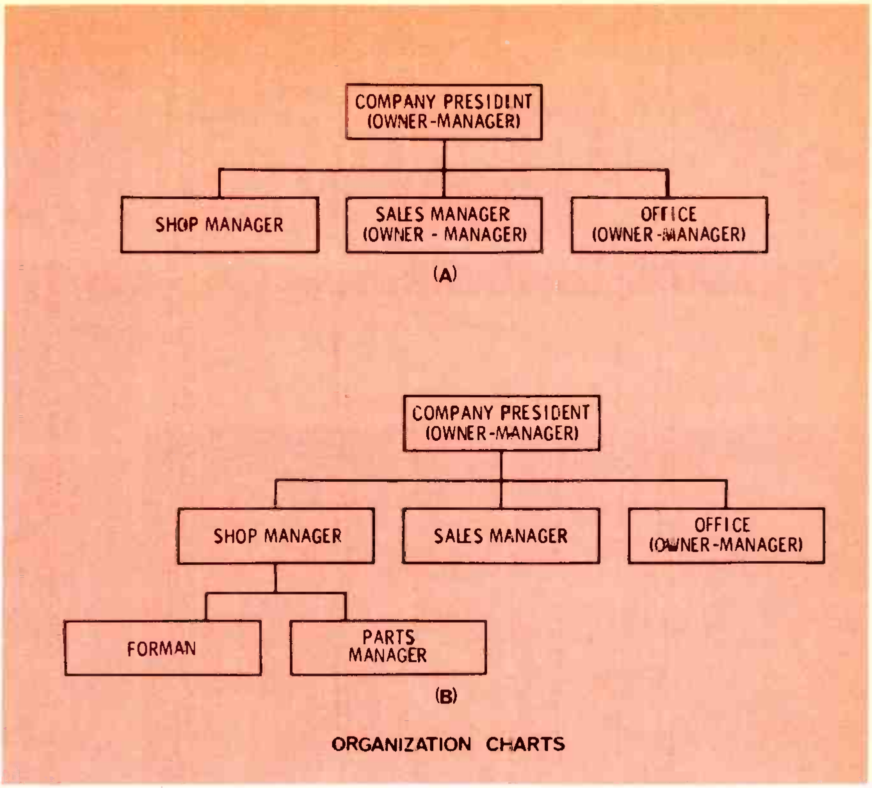


Figure 1. Organization charts

EXPENSES WORKSHEET

	Sample Figures for Repair Services Percent of Sales	% of Your Sales	Your Dollars JAN	Your Dollars FEB
Sales	100%			
Cost of sales	47.51			
Gross profit	52.49			
Controllable expense				
Operating supplies	1.82			
Gross wages	16.98			
Repairs and maintenance	.38			
Advertising	1.45			
Car and delivery	1.52			
Bad debts	.04			
Administrative and legal	.74			
Outside labor	1.21			
Miscellaneous expense	.81			
Total controllable expense	24.95			
Fixed expense				
Rent	3.35			
Utilities	2.05			
Insurance	.95			
Taxes and licenses	.86			
Interest	.12			
Depreciation	1.25			
Total fixed expenses	8.58			
Total expenses	33.53			
Net profit	18.96			

Figure 2.

don't need to borrow, use it, or have your accountant use it, to draw the "picture" of your firm's financial condition. Moreover, if you don't need to borrow money, you may want to show your plan to the bank that handles your store's checking account. It is never too early to build good relations with your banker, to let him know that you are a manager who knows where he wants to go rather than a store owner who *hopes* to make a success.

Control And Feedback

To make your plan work you will need feedback. For example, the yearend profit and loss statement shows whether your business made a profit or loss for the past 12 months.

But you can't wait 12 months for the score. To keep your plan on target you need readings at frequent intervals. A profit and loss statement at the end of each month or at the end of each quarter is one type of frequent feedback. However, the income statement or profit and loss statement (P and L) may be more of a loss than a profit statement if you rely only on it. You must set up management controls which will help you to insure that the right things are being done from day to day and from week to week. *In a new business, the record-keeping system should be set up before your business opens.* After you're in business it is too late. For one thing, you may be too busy to give a record-keeping system the proper attention.

The control system which you set up should give you information about: stock, sales, and disbursements. The simpler the system, the better. Its purpose is to give you current information. You are after facts with emphasis on trouble spots. Outside advisers, such as an accountant, can be helpful.

Stock control—The purpose of controlling parts and materials inventory is to provide maximum service to your customers and to see that parts and materials are not lost through pilferage, shrinkage, errors, or waste. Your aim should be to achieve a high turnover on your inventory. The fewer dollars you tie up in inventory, the better.

In a small business, inventory control helps the owner-manager to offer his customers efficient service. The control system should enable him to determine what needs to be ordered on the basis of: (1) what is on hand, (2) what is on order, and (3) what has been used.

In setting up inventory controls, keep in mind that the cost of the inventory is not your only cost. You will also have costs such as the cost of purchasing, the cost of keeping control records, and the cost of receiving and storing your inventory.

Sales—In a small business, sales slips and cash register tapes give the owner-manager feedback at the end of each day. To keep on top of sales, you will need answers to questions such as: How many sales were made? What was the dollar amount? What credit terms were given to customers?

Disbursements—Your management controls should also give you information about the dollars your company pays out. In checking on your bills, you do not want to be penny-wise and pound-foolish. You need to know that major items, such as paying bills on time to get the supplier's discount, are being handled according to your policies. Your review system should also give you the opportunity to make judgements on the use of funds. In this manner, you can be on top of emergencies as well as routine situations. Your system should also keep you aware that tax monies such as payroll income tax deductions, are set aside and paid out at the proper time.

Break-even point—Break-even analysis is a management control device because the break-even point shows how much you must sell under given conditions in order to just cover your costs with NO profit and NO loss.

Profit depends on sales volume, selling price, and costs. Break-even analysis helps you to estimate what a change in one or more of these factors will do to your profits. To figure a break-even point, fixed costs, such as rent, must be separated from variable costs, such as the cost of sales and the other items listed under "controllable expenses".

The break-even point in sales dollars equals the total fixed costs divided by 1 minus the quantity of total variable costs divided by the corresponding sales volume. This is illustrated in Figure 5.

Is Your Plan Workable?

Stop when you have worked out your break-even point. Whether the break-even point looks realistic or way off base, it is time to make sure that your plan is workable.

Take time to re-examine your plan *before* you back it with money. If the plan is not workable better to learn it now than to realize 6 months down the road that you are pouring money into a losing venture.

In reviewing your plan, look at the cost figures you drew up when you broke down your expenses for one year. If any of your cost items are too high or too low, change them. You can write your changes in the white spaces above or below your original entries on that worksheet. When you finish making your adjustments, you will have a REVISED projected statement of sales and expenses for 12 months.

With your revised figures work out a revised break-even point. Whether the new break-even point looks good or bad, take one or more precautions. Show your plan to someone who has not been involved in working out the details.

Your banker, contact man at SBA, or other advisor outside of your business may see weaknesses that failed to appear as you pored over the details of your plan. And he may put his finger on strong points which your plan should emphasize and convert your strong points in the profit.

Put Your Plan Into Action

When your plan is as near on target as possible, you are ready to put it into action. Keep in mind that action is the difference between a plan and a dream. If a plan is not acted upon, it is of no more value than a pleasant dream that evaporates over the breakfast coffee.

A successful owner-manager does not stop after he has gathered information and drawn up a plan. He begins to use his plan.

At this point, look back over your plan. Look for things that must be done to put your plan into action.

What needs to be done will depend on your situation. For example, if your business plan calls for an increase in sales, one action to be done will be providing funds for this expansion.

Have you more money to put into this business?

Do you borrow from friends and relatives? From your bank? From your suppliers by arranging liberal commercial credit terms?

If you are starting a new business, one action step may be to get a loan for fixtures, employee salaries, and other expenses. Another action step will be to find and hire capable employees.

Keep Your Plan Up To Date

Once you put your plan into action, look out for changes. They can cripple the best made business plan if the owner-manager lets them.

Stay on top of changing conditions and adjust your business plan accordingly.

Sometimes the change is within your company. For example, several of your employees quit their jobs. Sometimes the change is with customers; for example, their desires and tastes shift. Sometimes the change is technological as when new materials are put on the market introducing the need for

ESTIMATED CASH FORECAST

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
(1) Cash in Bank (Start of Month)												
(2) Petty Cash (Start of Month)												
(3) Total Cash (add 1 and 2)												
(4) Expected Cash Sales												
(5) Expected Collections												
(6) Other Money Expected												
(7) Total Receipts (add 4, 5 and 6)												
(8) Total Cash and Receipts (add 3 and 7)												
(9) All Disbursements (for month)												
*(10) Cash Balance at End of Month in Bank Account and Petty Cash (subtract (9) from (8))												

*This balance is your starting cash balance for the next month.

Figure 3.

CURRENT BALANCE SHEET

for

____
(name of your firm)

As of ______________________
(date)

____

Assets

Current assets:	
Cash:	
Cash in bank	$______
Petty cash	$______
Accounts receivable	$______
Less allowance for doubtful accounts	$______
Merchandise inventories	$______
Total current assets	$______
Fixed assets:	
Land	$______
Buildings	$______
Delivery equipment	$______
Furniture and fixtures	$______
Less allowance for depreciation	$______
Leasehold improvements, less amortization	$______
Total fixed assets	$______
Total assets	$______

Liabilities and Capital

Current liabilities:	
Accounts payable	$______
Notes payable, due within 1 year	$______
Payroll taxes and withheld taxes	$______
Sales taxes	$______
Total current liabilities	$______
Long-term liabilities:	
Notes payable, due after 1 year	$______
Total liabilities	$______
Capital:	
Proprietor's capital, beginning of period	$______
Net profit for the period	$______
Less proprietor's drawings	$______
Increase in capital	$______
Capital, end of period	$______
Total liabilities and capital	$______

Figure 4.

BREAK-EVEN POINT

$$\text{Break-even point (in sales dollars)} = \text{Total fixed costs, divided by } 1 - \frac{\text{Total variable costs}}{\text{Corresponding sales volume}}$$

An example of the formula is: Bill Jackson plans to open a laundry. He estimates his fixed expenses at about $9,000, the first year. He estimates his variable expenses at about $700 for every $1,000 of sales.

$$\text{BE Point} = \frac{\$9{,}000}{1 - \frac{700}{1{,}000}} = \frac{\$9{,}000}{1 - .70} = \frac{\$9{,}000}{.30} = \$30{,}000$$

Figure 5.

new processes and procedures.

In order to adjust his plan to account for such changes, an owner-manager must:

(1) Be alert to the changes that come about in his company, his line of business, his market, and his customers;

(2) Check his plan against these changes; and

(3) Determine what revisions, if any, are needed in his plan

The method you use to keep your plan current so that your business can weather the forces of the market place is up to you. Read the trade papers and magazines for your line of business. Another suggestion concerns your time. Set some time—two hours, three hours, whatever is necessary—to review your plan periodically. Once each month or every other month, go over your plan to see whether it needs adjusting. If revisions are needed, make them and put them into action. □

Reports from the test lab

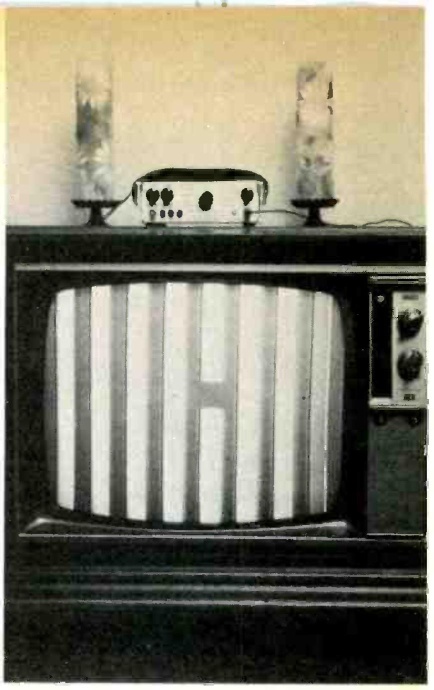


Fig. 1 Here is the Model ATC-10 color/bar pattern generator from American Technology Corporation.

Each report about an item of electronic test equipment is based on examination and operation of the device in the ELECTRONIC SERVICING laboratory. Personal observations about the performance, and details of new and useful features are spotlighted, along with tips about using the equipment for best results.

By Carl Babcoke

The present crop of color/bar generators seemingly had arrived at practical perfection, and could advance no more. Digital countdown circuits provided many different kinds of ultra-stable patterns.

Then the Model ATC-10 was introduced by American Technology Corporation, and I was surprised to find new features I hadn't even thought about.

How would you like to show an all-red screen for purity adjustments, without turning any receiver controls or attaching leads for gun-killing switches? Think of the convenience of setting the free-running frequency of the 3.58-MHz oscillator without grounding test points or pulling tubes.

These unique features, and more, deserve detailed explanations.

American Technology Color/Bar Generator

Model ATC-10 color/bar pattern generator (Figure 1) has 11 positions plus "POWER OFF" around the selector knob. Some of the patterns are conventional, others are not. All were rock-steady, when tested.

Crosshatch and lines

The crosshatch, horizontal lines, and vertical lines patterns were sharp and motionless, but not unusual, as shown in Figure 2.

Dots

The dots were sharp and stable, and the pattern had one useful refinement. One dot above and one dot below the center dot were omitted (Figure 3), so there can never be a question about which dot marks the center.

Hatchdots

If I could choose only one of the many kinds of dots or crosshatch patterns, I would want this one (Figure 4). Crosshatch lines are best for testing the straightness of lines (pincushion, for example), and dots are best for those accurate final adjustments of convergence. The Hatchdots pattern has everything essential. In addition to the center dot, there are two rows of vertical dots and two rows of horizontal dots. All are near the edges, but not too near. Most TV's should permit perfect convergence at each of the dots (it's not efficient to attempt the best convergence any nearer the edges of the picture).

Hatchdot

This pattern is similar to the previous "hatchdots", except there is only **one** dot, located at the center. Personally, I prefer the hatchdots; the extra dots and lines don't confuse me. They can be used or ignored.

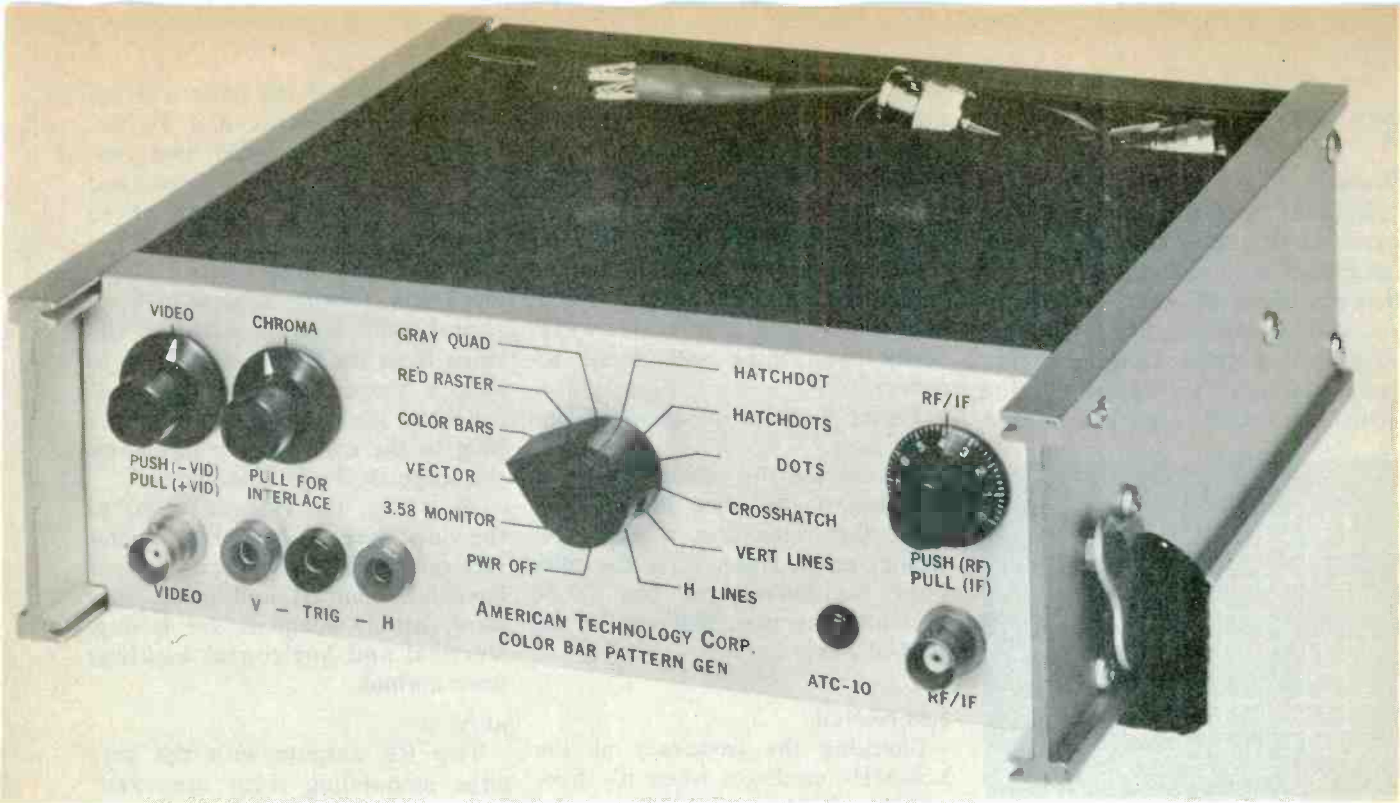
Gray quad

For the "GRAY QUAD" pattern, the screen is divided into four equal parts (Figure 5). Each segment has a different black level. Together they cover from pure white to solid black (although the photo has exaggerated the differences between them).

In addition to giving a pattern that's useful for judging contrast, the quadrants measure the ability of the entire receiver to pass low-frequency video components. Shading from top to bottom of the gray or black quadrants proves a loss of low-frequency response, perhaps an open coupling capacitor, or a wrong RC time constant in the video. Receivers with direct-coupled video stages should not show any shading (similar to the actual TV raster of Figure 5). Also, the pattern is excellent to use while tracing the video with a scope.

Red raster

Instead of biasing off the blue and green guns of the picture tube (in order to obtain a red raster during purity adjustments) the



ATC-10 allows you to obtain the red screen in the same way as is done by the TV station. In other words, the generator provides the proper phase of chroma signal, which will appear as pure red when the set is normal.

Therefore, the color must be turned up enough that the red is fully saturated, and the tint control must be adjusted correctly (all you do is turn the tint until the screen is maximum red). This function also tests the color saturation and tint of the receiver. If full red saturation can't be obtained, then the receiver needs chroma adjustments or repairs. To help diagnosis, the "chroma" level control on the generator operates also for "red raster".

What about green or blue purity? Well, you seldom need to check anything but red. However, if the receiver tint control has a wide range, other colors can be selected. One TV adjusted from magenta to nearly pure green.

According to tests with two receivers, the phase of the red raster is accurate enough to use as a standard for adjusting the tint circuit. If pure red is obtained near the center of the tint control, the colors should be correct on station colorcasts. Of course, that assumes the proper amplitudes of the three primary colors, and those can be determined from the color-bar pattern.

By the way, the manufacturer informs me that all generators leaving the factory after March of 1976 will have a modification of the red-raster function, which will give more red saturation and permit you to evaluate the ACC action of the receiver. This is done by controlling the burst more than the chroma by the "chroma" control on the generator.

Color bars

With two exceptions, the color bars are conventional. Ten bars plus burst are generated (see Figure 6). However, the bars are on video pedestals, so as they are seen on a TV screen, the spaces between the bars are black. I was opposed to the black spaces because I use those areas to check for smear, ringing, etc., when I check the color quality. Then I was relieved to find the "vector" pattern does not have the black spaces.

The sixth bar is marked with a white rectangle (the white is the raster color without color or video) at the vertical midpoint of the bar. This is helpful, because many receivers are too wide and cut off a bar or so from one side or the other.

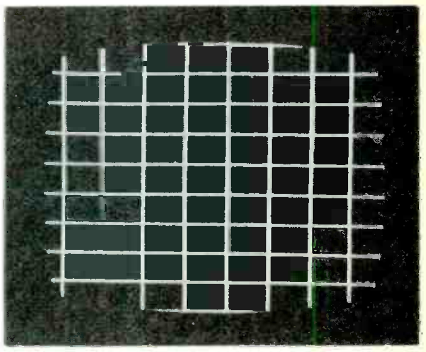


Fig. 2 Sharp, stable crosshatch, vertical lines, and horizontal lines are three standard patterns supplied.

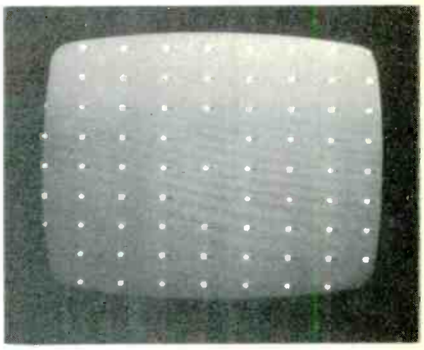


Fig. 3 The center dot is identified by the elimination of one dot above and one below.

Sharpness and stability of the bars were excellent.

Vector

In the "vector" position, the pattern seems to be the same as the color bars without the black spaces between them (Figure 7). Then if you look carefully, you see about 9 very-narrow vertical lines inside each color bar (See Figure 8). The instruction book says you should turn down the color control to make these lines more clear. The lines are individual cycles of 3.56-MHz signal which have been added to the video signal to test the high-frequency response of the receiver.

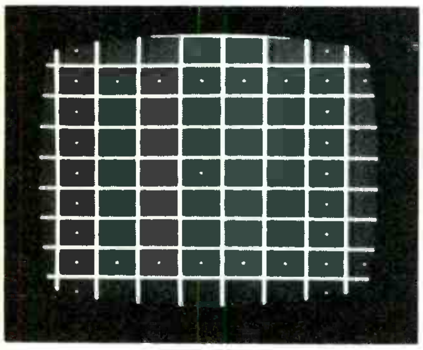


Fig. 4 This is the "hatchdots" pattern, a combination of dots and crosshatch. The hatchdot pattern is similar, except the center dot only is provided.

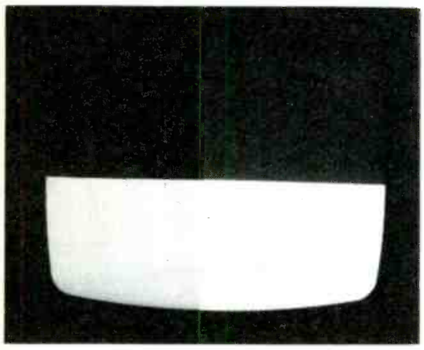


Fig. 5 Four areas with different black levels called "gray quad" are useful for contrast tests and to check for low-frequency attenuation in the bandwidth.

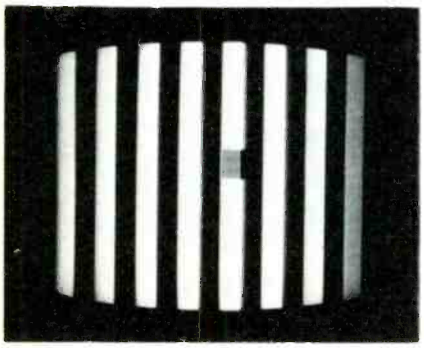


Fig. 6 The "color bars" have black spaces between them, and they are conventional except for the white rectangle removed from the sixth bar, to identify it.

Of course, b-w receivers can be tested this way also. After a bit of experience, you can evaluate receiver bandwidths with some accuracy.

Figure 9 shows the cycles of one color bar.

Do not use the vector pattern as a standard for color locking, because this introduces a small frequency error. Instead use the color bars, or better yet the "3.58 monitor" function, that's to be described next.

3.58 monitor

Checking the frequency of the 3.58-MHz oscillator when it's free-running (locking disabled) can be done the easy way by turning to the "3.58 monitor" position. Figure 10 shows that the blanking is widened so the envelope of 3.58 which is normally used for burst (color sync) is blanked out. In other words, burst is killed in the generator.

The effect is nearly the same as grounding a testpoint in the AFPC circuit (but it's more accurate) as usually is done during the sequence of checking frequency and adjusting for best color locking. Grounding a test point gives an artificial zero voltage, and yet the same phase-detector circuit without burst might not provide exactly zero, because of slight unbalances.

Certainly it's far less trouble with those sets that otherwise require biasing off one section of a double tube to eliminate the burst.

In other ways, the procedure and criteria are the same. The color killer must be defeated, else there will be no color stripes. If the bars float through upright, or with no more than one or two diagonal stripes, the frequency is near enough for proper locking. After the test, switch to the hatchdot pattern and adjust the killer until the color flares disappear.

That's the last position of the pattern switch, but it's not the end of the features.

Video

A knob and an output connector both are marked "video". These are to be used if the pattern is fed into the video circuit of a TV set. Pulling out on the video level control gives positive-going video, and the "in" position changes it to negative-going.

In addition, three banana plugs, just below, provide vertical or horizontal sync signals without the video from the patterns. This is to lock a scope the easy way. Just connect a lead from the appropriate plug to the external-sync input on the scope. It works fine.

As a test, the video was fed to the video-detector output of a color receiver. While the patterns did not have full contrast and color, they were entirely adequate for testing. Vertical and horizontal lockings were normal.

RF/IF

Two RF outputs with the patterns modulating them are available. For the usual output on a channel (channel 2 or 3 according to the crystal supplied), the RF/IF knob is pressed toward the panel, and the knob then becomes an excellent RF-level control.

Let me digress for a moment. I use a color bar generator more often than most technicians do. In addition to the usual patterns during convergence, I use the bars to evaluate alignment and color quality. Then, for AGC problems, I use a bar generator because it supplies a strong signal of the same amplitude each time. And of course, crosshatch patterns will show up many vertical and horizontal sweep problems. And now, the addition of an RF level control extends the value of a generator, when it's used for these extra jobs.

The extreme amount of attenuation possible with the RF-level control was a surprise. As shown in Figure 11, the minimum adjustment reduced the signal deep into the snow. This ability should be of great value in testing for either sensitivity or snow problems.

According to the factory, the unusual attenuation results from a double-shielded design that reduces capacitance feedthrough.

Pulling out on the RF/IF knob changes to a 45.75-MHz modulated signal for use in the IF circuits. I injected the signal into various points of a color IF, and received good results. At the input of the IF channel, the level was more than

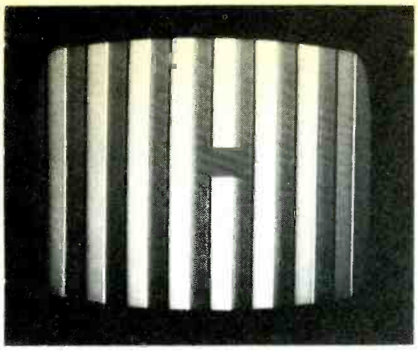


Fig. 7 The "vector" pattern shows color bars, also, but 9 or 10 cycles of the 3.58-MHz color signal are included to be a high-frequency test.

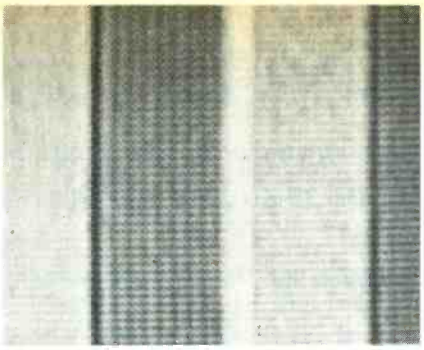


Fig. 8 This close-up shows the "vector" vertical lines formed by the 3.58-MHz signal included in the bars. A color or b-w TV receiver having wide bandwidth will clearly show these lines, when the color is turned down.

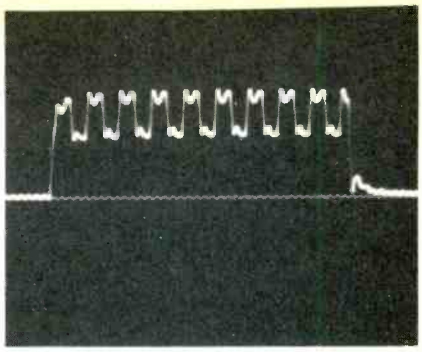


Fig. 9 This is one envelope of 3.58-MHz signal that makes up one color bar. It has been greatly expanded by the triggered-sweep scope.

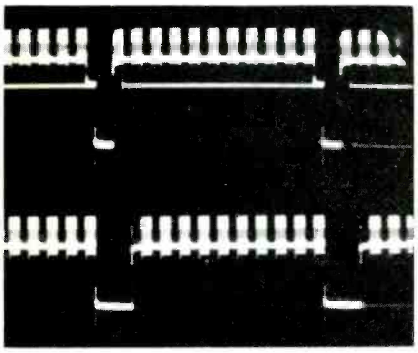


Fig. 10 Frequency of the color oscillator in the receiver is checked by eliminating the color burst in the generator, allowing the oscillator to run without any locking. The top trace shows the normal color bar pattern of the generator (scanned at horizontal rate), and below it is the signal when the "3.58 monitor" pattern is selected. The blanking is wider, so the first envelope (which is used for burst) is eliminated.

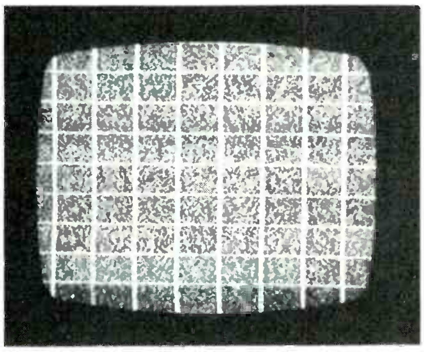


Fig. 11 The carrier-signal attenuator, which is marked "RF/IF," can reduce the signal an unusual amount, because of a special circuit with double shielding. AGC, snow, and other problems can be checked by the ability to select any signal strength that's necessary to trigger the trouble. As shown here, the signal can be attenuated until it is about equal to the snow of a good TV receiver.

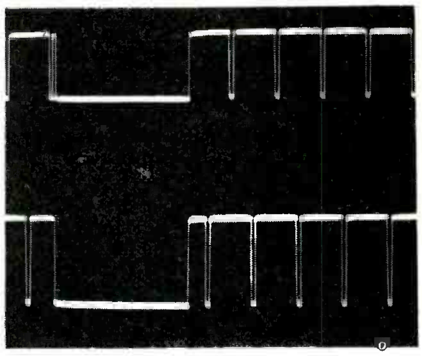


Fig. 12 Interlaced scanning is provided for those TV receivers that have better stability with it. These are the two vertical fields, with the "chroma" knob pulled out to switch in the interlace, and the signal stretched by the scope. The invisible vertical lines have been drawn in.

adequate, and the attenuation-control adjustment helped obtain the best quality of the patterns. When injected at the grid of the last IF tube, the contrast was slightly weak, but still usable.

Interlace

Pulling out on the "chroma" control changes the vertical sync to full interlace (see Figure 12). Most generators do not interlace, and in fact, the crosshatch lines are sharper without interlacing. Why did American Technology add this feature?

The design engineer explained that some sets with the vertical supplied by a count-down circuit are somewhat intolerant of non-interlaced signals, especially when the signal strength is weak.

Use of the interlaced signal with crosshatch patterns results in some flicker. Therefore, you would not normally use interlace unless it's necessary to clear up the other problem.

Physical features

At the rear of the generator is an open cavity for storage of the two cables and the AC cord. There is no lid or door, but the wires have enough stiffness to stay without any restraint.

All four channels which form the corners of the cabinet are extended forward an inch or so, to protect the knobs when the generator is stored with other equipment.

The carrying handle is a woven-cloth strap. This non-rigid strap helps when you carry a tube caddy and the generator with one hand.

Comments

Working with the American Technology generator was a real pleasure. The extra features evidently have been carefully thought out, and they work exactly as intended. Since the circuitry mostly is of the digital count-down kind, the stability of the patterns is perfect.

As I was writing this report, a release came from American Technology saying they are going to refer to it in future advertising as a **General Television Servicer.** □

"Calling Dr. Freud"

These are funny but true (?) experiences in the servicing life of an electronic technician.

By Burchard J. Smith

Nothing in my twenty years as an electronics specialist in the United States Air Force prepared me for some of the extraordinary experiences I have had since starting a second career as a TV technician. Here are some unusual incidents.

Eccentric Professor

On the service-call ticket, the complaint specified "poor picture, and snow." The customer's home was located near a small college, in an area that normally had excellent reception.

I rang the bell, and introduced myself to the customer, whom I'll call Professor Brown. Upon entering the den, I saw a late-model color console that was about two months old, according to the professor.

Yes, the TV screen had snow of blizzard proportions! I moved the set away from the wall to check the antenna connections. Quite often, the delivery people attached the antenna leads to the UHF terminals. That was not the problem here, for there were no leads, or any kind of wire, connected to the terminals. I searched for a coaxial cable, twin lead, or a set of rabbit ears, but found nothing.

"Uh, professor, where is your antenna? I can't find the lead-in wire," I asked.

"My what?" he replied.

"Your antenna," I repeated.

"Everything that came with the device is there, just as you see it, young man," the professor stated.

"Well sir, this TV never will function properly without some sort of antenna system. Have you really been watching it this way for two months?" I asked, disbelievingly.

"Yes, I have. I was hoping it would improve somewhat, but unfortunately, it hasn't. That's the reason you are here. The salesman at the emporium from which I purchased this instrument made no mention of any such antenna", the professor lectured.

Then, I explained the basics of reception and the absolute necessity of an antenna. As I talked, I noticed that Professor Brown's arms were covered with tattoos. A closer look revealed that the tattoos actually were scribblings made with a ball-point pen! This was confirmed when he started taking notes of what I was saying; however, there were no blank spaces on his arms so he unbuttoned his shirt and started writing on his chest: "rabbit-ear antenna—get at drug store". I kept my explanation brief, because the professor was a small man and his chest did not provide a very large writing surface.

I felt uneasy about the entire situation, so I shifted the conversation to a different subject. The floor of the den was covered completely with Sunday editions of the New York Times, arranged in neat rows so they resembled a large checkerboard.

"What are you researching, professor?" I asked, gesturing toward the newspapers.

"Nothing at the moment," he answered.

"Well, I was looking at those copies of the Times, and I just assumed you were doing research," I explained.

"Oh, no," Professor Brown replied with a laugh, "I find these newspapers make an excellent and inexpensive rug. If one portion wears out, I merely replace it with an entire new issue, or just exchange the sports section for the front page. Here, let me show you." And he got down on his knees for a demonstration. The professor became engrossed in arranging the papers, and I was getting a strange compulsion to diagram his "rug" on my arm, so I told him farewell, and got out of there.

The Singing Lady

Another of my customers also arouses a strange compulsion within me. My first contact with Mrs. Green was by telephone. Her voice was very lyrical, and her problem came out in music and rhyme:

Hello, Mr. Smith. I'm having troubles with my TV;
I'm so frustrated that I can hardly see....

As the conversation continued, I found myself caught up in the spirit of the situation, and answered her in song:

Mrs. Green, Mrs. Green,
Tell me what symptoms are on the screen.

So, occasionally I get to star in an operetta, a facet of life I never dreamed of entering. If Mrs. Green's TV breaks down often enough, I just might graduate to an entirely-new profession!

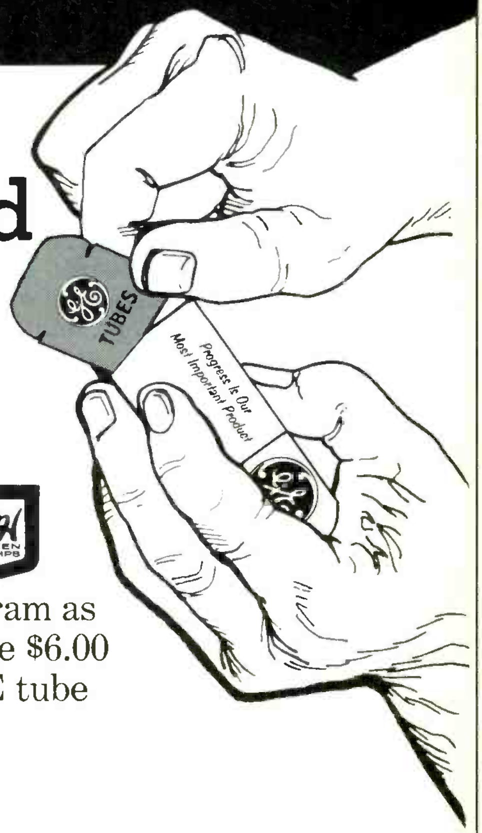
Breaking And Entering

"When you get to the Vista Apartments, don't try to park on the street in front of the building, instead come around to the back," instructed a voice over the telephone. "The apartments are over several small businesses. You'll see doors on the left and right sides of the building, and a couple in the center. Go in the door on the left, and up the stairs." I jotted down "left-center door, around back", grabbed my caddy and departed.

I found the rear parking lot

BOTTOMS UP

DEALERS' CHOICE



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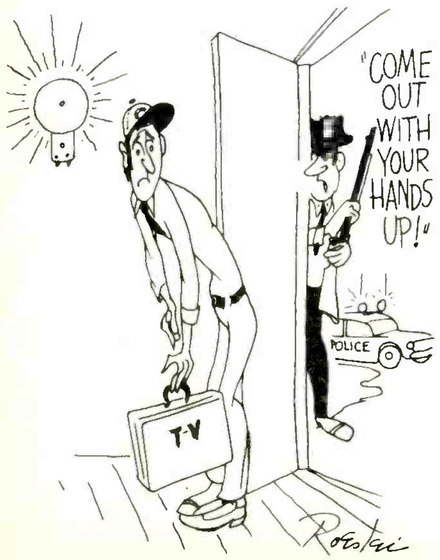
GENERAL ELECTRIC

okay, but there were more doors than the customer had stated. I tried a door that I thought was "left center", but it wouldn't open. Now, we have a swollen door at our shop, and it will open only after some shoulder pressure. I gave it a good lick, and sure enough it opened, just as a burglar alarm sounded. The owner of Vista Drugs came running in to find me standing in his back storeroom. I didn't know what to do, but instinct solved my embarrassment. In the most-professional voice I could muster, I announced, "Hi there, I'm Burt Smith, and I'm here to fix your TV."



Flap...Flap...Flap

"Hey, my main man, like this jive TV we bought down at your place ain't hittin' on nothin'," the now-generation customer informed me. After following the directions, I found myself at a small brick house on a country road, and confronted with an unusual problem. There was no front door, no door bell, and no door frame to knock on. I tried knocking on the bricks, resulting in a dull thud and several skinned knuckles.

Covering the entrance was a window shade. Have you ever tried knocking on a window shade? Forget it. The sound level of "flap—flap—flap" wouldn't disturb a sleeping gnat. Finally, I attracted the customer's attention by old-fashioned yelling.

The long-haired, bearded young man gave me a vigorous greeting, slapping my hands as if I had scored a winning touchdown. At the TV, I found another no-antenna problem causing snow. I found it difficult to believe. Before I left, I couldn't resist asking, "Are you, by any chance, related to a Professor Brown?"

Musical Chairs

The following incident is the most bizarre of all, although it started as a routine call to take the hum out of a new console stereo.

Mr. Black greeted me courteously in the foyer of his palatial home, and explained, "The stereo's in a new play room I'm having built at the rear of the house. Please excuse the mess, the room isn't quite finished yet."

At the new room, the only two items I could see were a small, curved bar, and a large blue-and-white inanimate object sitting near the center of the room. This object resembled the bottom half of an eggshell, with the pointed end fitted into a circular pedestal base. Quilted blue-velvet was stuffed inside the open top portion.

"There it is," Mr. Black said, pointing at the blue-and-white monster.

I was sorry he said that, for I had never seen a stereo like this one. I could see no visible means of turning on the mod-shaped unit, and I searched frantically for a switch or control panel.

"Are you sure this is a Zenith?" I asked. "We do Zenith warranty work; but, frankly, I've never seen one like this before."

"It's a new model, just got it the other day," Mr. Black assured me.

"Well then, why don't you turn it on, and let me hear the hum while I get out my tools?" I said, trying to hide my ignorance.

Mr. Black didn't do any better. On hands and knees, he circled the eggshell, groping for a switch. I joined him, but three laps around it produced no results.

"What are you two doing?" sounded a feminine voice behind us. I glanced around at the lady of the house, and said, as casually as I could, "I'm trying to turn on this thing and listen to it." Mrs. Black gave me an odd look, and said shortly, "That's a chair."

I was speechless, and looked at Mr. Black for help. He uttered an expletive, and said, "I always get this chair mixed up with the stereo."

"Oh boy," I thought to myself, "have I got a screwball here." As I arose from my knees, I noticed Mrs. Black backing away from me, apprehensively. I cleared my throat and asked, "Now then, where is the stereo?"

"How long have you been a repairman?" Mrs. Black asked. I tried to assure her that I could service the stereo correctly, if I could just find it. "It's behind the bar," she said.

Well, I couldn't imagine a console behind such a small bar, but after the chair incident, I was ready to believe anything. I walked behind the bar, and found a **modular** unit, sitting on a shelf.

"This isn't a console," I proclaimed.

"What do you mean?" Mrs. Black asked.

"This is a modular unit," I said, and before I had a chance to explain the in-home versus carry-in service warranty, she interrupted by saying, "Well, we don't know much about technical terms, all we know is that it isn't working right."

After all that, the remainder of the service call was of little importance. Mr. Black's do-it-yourself brother had miswired a connector, causing the hum.

As I was leaving, Mr. Black expressed gratitude that at least one problem was solved. "Now if I can just get my extension phone in the kitchen working, I'll really be in business." I left with a smile on my face, thinking about some unfortunate telephone repairman trying to get a dial tone from a push-button microwave oven, or whatever else Mr. Black might mislead him to.

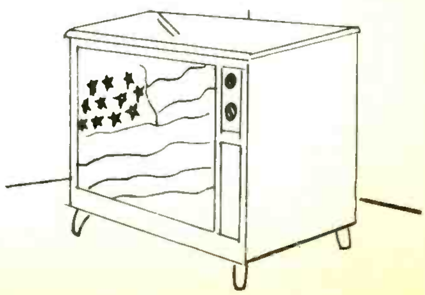
Bicentennial Model

"Service department, may I help you?" I said into the telephone.

"I hope so," a feminine voice answered. "My TV has red, white, and blue stripes all over the screen."

I couldn't resist that opening for a joke. "Oh, it's supposed to be that way. You see, after every 200 hours of playing time, the set automatically will display a red, white, and blue pattern in honor of the Bicentennial," I said, in my most confident manner.

As the conversation continued along those lines, she actually believed the set was designed to have those patriotic stripes. And I laughed inside, thinking how gullible people are. After all, if a person can believe it's possible to get music from a chair, then Bicentennial stripes sound very plausible. □



catalogs literature

Circle appropriate number on Reader Service Card.

100. Jensen Tools and Alloys—offers a free 112-page tool catalog describing over 2,500 individual items. Sections include hand tools, power tools, metalworking tools, soldering equipment, optical equipment, test equipment, and electronic chemicals. Also featured is a solder section.

101. Channel Master—has available a UHF antenna catalog. Nine UHF antenna types designed for color TV are described and illustrated. Sixteen models are shown, plus various special designs and combinations. The brochure covers antennas for every type of reception area, in all price ranges, and includes performance data.

102. Hewlett-Packard—a 32-page brochure—the "Pocket Calculator Buyer's Guide"—describes and gives specifications for the company's full line of preprogrammed and programmable pocket calculators. The free brochure, #5952-6062D, also includes a complete listing of HP pocket-calculator accessories, support literature and prerecorded programs.

103. Audiovox—offers a free speaker application chart. The three-color specially-coded chart unfolds into a 17" X 21" poster for easy interpretation. The chart is designed to show the recommended speakers and available locations for import and domestic cars back to 1970. It lists the speaker type, dimensions, kit number and magnet weight of the mini, in-door, in-deck, surface, convertible and coaxial speaker models.

104. Nortronics Company—has available the 7th edition of its "Nortronics Recorder Care Manual." It shows step-by-step, illustrated methods for maintenance of recording machines and the proper method for splicing tape. A new feature of the current edition is a revised catalog section of consumer recorder-care products. Also included is a bibliography of helpful books for those who wish to learn more about tape recording.

105. Tektronix—the 48-page catalog number A-3183 contains up-to-date data on new TM500 products, such as the SC502 dual-channel oscilloscope and TM515 Traveler Mainframe. It also contains full specifications on the more than 30 TM500 plug-in modular instruments, and features thirteen articles discussing instrumentation technology.

106. Hickok—has a free 16-page catalog describing its full line of portable and bench test instruments. Products covered include single- and dual-trace oscilloscopes, a digital multimeter, a function generator, a curve tracer, FET multimeters, semiconductor testers, color-bar generators, tube testers, a CRT tester/rejuvenator, and a sweep-and-marker alignment generator. Features, operating data, and complete specifications are given for each unit.

107. Cleveland Institute of Electronics—offers a 40-page, four-color catalog covering independent home-study courses, and containing a 24-page section which details each of CIE's 13 electronics-training programs. Each course is outlined with course objective and listing of subjects covered. Other departments include: information about career opportunities in electronics; facts on CIE's background and school/student relationship; and an outline of the school's employment assistance program.

108. Shure Brothers—expanded and updated catalog of Shure professional products for broadcasting, recording, and motion pictures lists Shure microphones, audio components and accessories, and high-fidelity phonograph cartridges. Included in the free catalog are specifications and individual performance profiles, as well as data about installation.

test equipment report

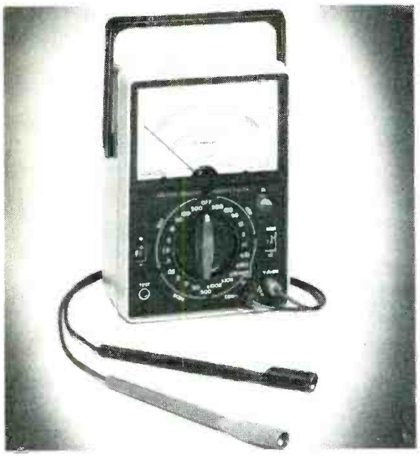
These features supplied by the manufacturers are listed at no-charge to them as a service to our readers. If you want factory bulletins, circle the corresponding number on the Reply Card and mail it to us.

Extended-Range VOM

Triplett Model 60-NA VOM is a new addition to the Series 60 VOM's.

It has a DC accuracy of ±1-1/2%, AC accuracy of ±3%, plus a 2X multimeter switch that permits more readings to be taken at the more-accurate upper portion of the meter scale. It includes a 4-1/2" mirrored-scale meter.

Five resistance ranges from XI to X100K are provided in addition to a -20 dB to 52 dB range. AC current readings from 0-300 amps may be obtained by using a Model 10-C Triplett AC adaptor.



Model 60-NA is drop-proofed for an accidental drop up to five feet. Three fuses provide burnout-proof protection for the meter. It has a suggested price of $130.

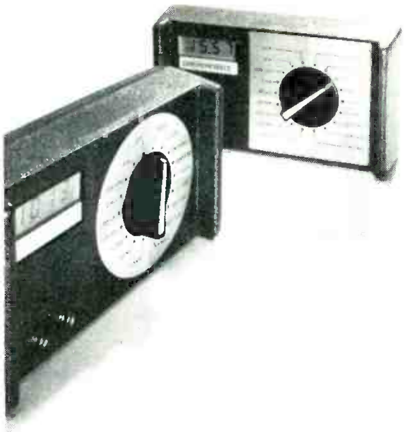
For More Details Circle (20) on Reply Card

Two 3-1/2-digit Multimeters

Dana Laboratories has introduced two new 3-1/2-digit multimeters, the Danameter 2000A and the Danameter II 2100A.

Both units feature all solid-state circuitry, high contrast LCD readout, and one-year battery life. DC voltage measurement capability for both Danameters is from 1mV to 1000V, AC voltage measurements from 1mV to 1000V peak, DC current capability from 10nA to 2A.

The basic DC accuracy of the Danameter 2000A is 0.5% DC for three months; DC accuracy of the 2100A is 0.25% DC for one year. Both have 50dB normal (series) mode noise



rejection and 10M Ω input impedance. They also feature a single control switch for easy operation.

For More Details Circle (21) on Reply Card

HV Test Probe

A new HV test probe with built-in meter for the new higher-voltage color TV receivers has been produced by **ITT Pomona**.

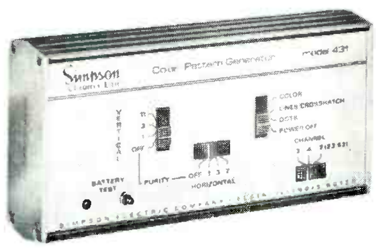
Model 4242 HV probe measures up to 42 KVDC, and weighs slightly over 8 ounces. The sensitivity is 20,000-ohms-per-volt, accuracy of ±2% of full scale, length is 14-3/4 inches, the handle is made of high-impact thermoplastic, and the probe of polycarbonate.

Price of Model 4242 HV probe is $24.95.

For More Details Circle (22) on Reply Card

Color-bar Generator

Simpson Electric has a pocket-size color-generator for television servicing. Powered by a 9-volt battery, the 13-ounce Model 431 uses medium-scale and small-scale integration (MSI and SSI) to miniaturize the circuitry normally found in a much larger bench instrument. It displays 28 patterns, and performs 13 tests for convergence and adjustment. Patterns and tests include blank raster for



purity adjustment, single dot and single crosshatch for static convergence and centering, 11 vertical lines for horizontal linearity, 7 horizontal lines for vertical linearity, 3X3 dots and 3X3 crosshatch, 7X11 dots and 7X11 crosshatch for dynamic convergence. The 431 tests for gray scale tracking, overscan, pincushion, and AGC.

Three front-panel slide switches select all patterns, and another slide switch chooses the output channel. Two thumbwheel controls adjust chroma level and RF output.

Model 431 sells for $89, and comes with an instruction manual.

For More Details Circle (23) on Reply Card

Dual-Trace Scope

A dual-trace 10-MHz scope from **Thornton** features a trace finder and a single control for trigger level and polarity.

Vertical sensitivity is adjustable in 12 calibrated ranges from 10 MV/CM to 50 V/CM. Model 4D-10 provides 16 calibrated sweep times from 1 microsecond/CM to 100 milliseconds/CM, plus an X5 magnifier. The calibrated graticule size is 6X8 centimeters. Display modes include: channel A only; alternate; or chopped. An X10 probe is optional.

Solid-state Model 4D-10 sells for $445.

For More Details Circle (24) on Reply Card

RF Wattmeters

Model 4314 Thruline RF directional peak and CW wattmeters from **Bird Electronic Corporation** have been reduced from $475 to $395. Comparable reductions were announced for the battery Model 4311 (from $450 to $395), the rackmounted Model 4511 (from $475 to $395), and the 75-ohm versions.

All the wattmeters in this series measure peak power of pulsed RF systems, in addition to continuous-wave average-power measurement.

Frequency and power ranges in either the peak or CW mode are 0.45-2300 MHz from 1 watt to 10 kilowatts, depending on the plug-in elements selected ($35 to $75). □

For More Details Circle (25) on Reply Card

productreport

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Radar Motion Detector

RDF Electronics offers a full-coverage motion detector. The solid-state, electronic security device operates at a frequency of 10.525 GHz with an adjustable range of 0 to 150 feet. Connections are made with one 3 conductor 22 ga. cable with a primary power input of 12 VAC; outputs include normally open and normally closed. The entire radar detection head is housed in an unobtrusive 5" X 2" X 2-1/4" "black-box" and weighs only 12 ounces.

The unit may be used as an "add-on" to any perimeter alarm system.

For More Details Circle (30) on Reply Card

CB Converter

Audiovox has introduced a CB receiver, Model CBC-100, that converts any AM car radio to receive all 23 CB channels. It has a variable squelch-control circuit, an illuminated heavy-duty rotary channel selector and a large signal-strength meter.

The receiver has a crystal-controlled frequency-synthesized circuit with dual conversion and noise limitation. It requires no CB antenna or FCC license to operate.

Suggested price of the Model CBC-100 is $69.95.

For More Details Circle (31) on Reply Card

CB Transceiver

First product of **Eico's** re-entry into the CB radio field is the Model 7723 transceiver.

Some features of the compact unit are a full 23-channel synthesized circuit, a dual-conversion superheterodyne receiver, a built-in automatic noise-limiting circuit, and an active automatic gain control. Other features include a full variable-squelch control, a tuned-RF stage, a built-in PA switch, a large, 1-1/4" combination S/RF meter, and the facility for either positive or negative ground. The Model 7723 is priced at $139.95.

Eico has prepared a complete line of accessory equipment to complement this transceiver, including a full line of test equipment, antennas, power supplies and some add-on equipment to make CB operation easier and better.

For More Details Circle (32) on Reply Card

CB Mobile Antenna

The Target CB-5 mobile CB antenna from **S & A Electronics** features an adjustable trunk lip mount. The mount allows the CB-5 to be straight up for maximum radiation even when the antenna is mounted on a sloping surface, such as a hatchback or fastback auto. The base-loaded, quarter-wave antenna has a VSWR of under 2:1 at the band edges and under 1.5:1 at resonance.

Model CB-5 comes complete with 17 feet of coaxial cable and a PL-259 connector.

For More Details Circle (33) on Reply Card

Tool Kit

JTK-14 is an all-weather attache style tool kit by **Jensen Tools and Alloys**. The kit contains more than 60 essential tools, such as: nutdrivers, ignition wrenches, hex-keys, penlight, electrician's knife, mini-hacksaw, 40-watt soldering iron, plus many additional items. Most of the tools are mounted on two fixed pallets of heavy canvas; two pockets with zippered closures hold smaller parts. The bottom of the case provides additional room.

The JTK-14 sells for $150.00; with an optional Triplett 310 VOM meter, the cost is $200.00.

For More Details Circle (34) on Reply Card

For More Details Circle (17) on Reply Card

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audio systems report

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CB Microphones

Three CB microphones from **RMS Electronics** were displayed at NEW/COM '76 in New Orleans, Louisiana.

Model CMB-5006 is an amplified microphone which provides 20 dB more gain than conventional microphones. It has a two-position slide gain control, and operates on a 9-volt battery, which is included. Suggested list price is $29.95.

Model CBM-5009 is a noise cancelling microphone designed for use where high levels of ambient noise interfere with CB and other two-way communications. It has a built-in noise reduction circuit; price is $19.95.

Model CBM-5004 is a basic replacement CB microphone priced at $14.25.

All RMS CB microphones feature a push-to-talk switch, a long-life cartridge, high-impact shock-proof housing, and a 5' coiled cord.

For More Details Circle (35) on Reply Card

"Super Punch" Microphone

The new, transistorized Model 526T "Super Punch" microphone has been designed to improve the intelligibility of CB transmissions. It features a high-articulation dynamic element and a transistorized preamplifier that operates on a standard 9-volt battery.

A volume control allows the user to obtain maximum transmitter modulation.

Other features of the microphone are a two-way normal/voice-operated switch, a push-to-talk switch that locks in, electronic or relay switching, and a high-impact Armo-Dur case.

Model 526T "Super Punch" microphone is available from **Shure Brothers**; suggested net price is $42.

For More Details Circle (36) on Reply Card

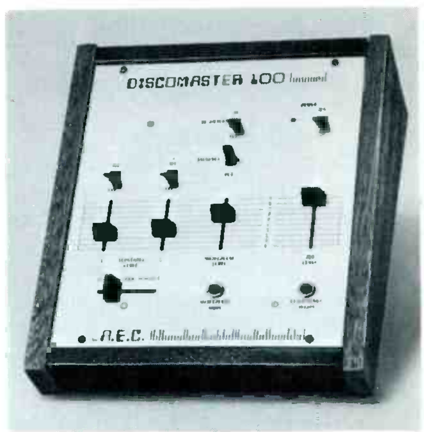
Mobile Sound Systems

"Soundcaster" mobile sound systems from **Paso** are available in four pre-wired, pre-packaged, complete systems. Each system consists of a mobile amplifier, two wide-angle horns premounted on a support base, a dynamic microphone, and cigarette lighter attachment. All models have a tone control and input for a tuner, tape recorder, or turntable. The systems are weatherproof and easy to install. Model MS20C is rated at 20 watts IPM, Model MS35C at 35 watts IPM, Model MS50C at 50 watts IPM, and Model MS75C at 75 watts IPM.

For More Details Circle (37) on Reply Card

Disco Mixer

The AEC Discomaster 100 is a professional-quality sound mixer being produced by **Audio Electronic Components**. The unit has all the essential features of the large rigs and requires no extra mixers or pre-amps. It has two phono inputs as well as a mic input. Two power amplifier output connections are provided, and the rated output is 2 volts RMS into a standard IHF load. Maximum overall gain of the unit is 60 dB and the signal-to-noise ratio is 70 dB. The auxiliary output will drive a pulsating low-level light show or feed an integrated amplifier.



The mixer features a Talkover switch which permits the user to make announcements without interrupting the music or adjusting the volume settings. Cueing switches permit precise pre-cueing of two turntables connected to the system.

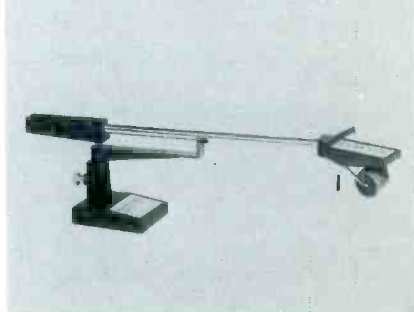
The Discomaster 100 has a frequency response of 26 to 20,000 Hz at ±1 dB, with a total harmonic distortion of less than 0.15% at -2dBm output. The unit carries a one-year warranty on parts and labor; net price is $199.95.

For More Details Circle (38) on Reply Card

Automatic Record Cleaner

A new automatic record cleaner is available from **Robins Industries.** "Groovee" automatically will remove dust and other foreign matter from the surfaces and grooves of phono records while they are being played. Designed for use with single-play turntables, it also can be used effectively with automatic record players in their manual mode.

Groovee consists of a weighted-base tonearm-like design equipped with a trailing vertical-bristle brush and a velvet roller. The brush picks up the dust while the roller catches and holds it, sweeping the record clean. The roller can be revolved periodically to provide a fresh cleaning surface on the record. A special brush is supplied to clean the velvet roller.



The automatic record cleaner is Robins catalog #R41037. Suggested price is $6.49.

For More Details Circle (39) on Reply Card

photofact bulletin

GENERAL ELECTRIC
Chassis 17YA 1578-1

HITACHI
CU-120, CU-130 1581-1

J C PENNEY
685-2012, 855-0154, 2012 1586-1

K MART
SKC2560 1584-1

PANASONIC
Chassis NMX-P3A 1576-2

PHILCO
Chassis E21-4/-5 1585-2

SANYO
61T61 1580-1

SEARS
564.40610500/501 1583-2

SONY
Chassis SCC63B-D/-E 1580-2
Remote Control RM-301 .... 1580-2-A

SYLVANIA
Chassis A12-7/-8/-9, A16-5 1586-2

TEKNIKA
CI-2012 1575-2

TOSHIBA
Chassis TAC500/505/510/515/525 1582-2

ZENITH
Chassis 22GB1 1581-2

bookreview

Sound System Engineering
Author: Don and Carolyn Davis
Publisher: Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, Indiana 46268
Size: 296 pages, book number 21156
Price: $19.95 hardbound

This book is a storehouse of valuable data for technicians and engineers who are serious about learning to be a "professional" sound-system engineer. For example, more than 30 pages are devoted to the equalization of a sound system (such as those in large auditoriums) so it will provide maximum volume without feedback. Systems that formerly required 3 days to equalize now can be done in about two hours. To supplement the text material, the book is filled with drawings, photographs, charts, graphs, and tables.

Contents: Audio Systems; Decibel Notation; Speaker Directivity And Coverage; The Acoustic Environment; Designing For Acoustic Gain; Interfacing Electrical And Acoustical Systems; Installing The Sound System; Equalizing The Sound System; Instrumentation; Sample Design Applications; Writing Specification, and Symbols And Abbreviations.

Mobile Radio Servicing Made Easy
Author: Leo G. Sands
Publisher: Howard W. Sams & Co., Inc. 4300 West 62nd Street, Indianapolis, Indiana 46268
Size: 144 pages, book number 21178
Price: $4.95 softbound (In Canada $5.95)

Many technicians already are experienced in other fields, and the main purpose of this book is to help them become competent in servicing two-way radios. Although radio transceivers are less complicated than are television sets, speed and accuracy are necessary in order to make a profit by servicing them. Typical circuits are discussed, and the use and operation of test equipment (such as signal generators, frequency meters, and distortion analyzers) are covered in detail. Other subjects include business methods with pricing, types of mobile-radio systems, field and shop maintenance, and the streamlining of repair procedures.

Contents: Servicing Requirements; Facilities; Equipment Inspection; Performance Measurements; Alignment And Tune-Up; Troubleshooting; Field Servicing; Glossary; Index.

The MARKETPLACE

This classified section is available to electronic technicians and owners or managers of service shops who have for sale surplus supplies and equipment or who are seeking employment or recruiting employees.

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

Each initial or abbreviation counts a full word.

Minimum classified charge $3.00.

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

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

FOR SALE

ADVERTISING PACKAGE FOR TV service shops. Inexpensive eye catching ads contain personal message from you-build customer confidence. Keeps your name before the public weekly. PROVEN RESULTS. Thirty ads with instructions $19.95. Sample $1.00 refundable. TV TIPS, 430 South Jefferson, Lebanon, Mo. 65536. 11-75-8t

NEW Canadian Magazine "Electronics Workshop". $5.00 yearly. Sample $1.00. Ethko, Box 741, Montreal "A" Canada. 10-75-12t

CONVERT any transistorized T.V. tuner to a tuner substituter. Plans $2.00. New accelerated Radio & T.V. course. RADIO TELEVISION TRAINING, Box 279, ES-66, Syracuse, N.Y. 13206. 8-75-tf

REJUVENATE TV PICTURE TUBES without expensive equipment. Use clip leads, power from set, and tube manual. No boosters required. $5.00. Willie R. Collins, 4 Trans. BDE (PPD) APO NY, 09451. 6-76-1t

STOP...don't junk that television set. ASE manufacturers the world's most complete line of television picture tubes. No other company offers: Over 1700 types of television picture tubes. Most types immediate delivery. Transportation in the Midwest—paid, ½ transportation paid in other states. Tubes for Old or New Models. Complete line of both black & white and color. Full 2 year factory warranty. Lowest prices anywhere. Finest quality. Write today for more information. Allied Sales & Engineering, Inc., Dept. 27, Pimento, Ind. 47866, Telephone - 812-495-6555. 6-76-2t

TV SALES/SERVICE BUSINESS. Southern British Columbia, Canada. Store built 1967 has two levels, 960 square feet each level on ½ acrealand on main road. Three major brands. Close to resort area, hunting, fishing. Gross 1975 $78,000 and growing. $100,000 plus stock. Dept. 509, 1014 Wyandotte, K.C., Mo. 64105. 6-76-3t

REPAIR SHOP—Radio, TV, Motors, etc. Retiring, good business, good location. Million Electronics Co., Inc., Box 618, Fairview Station, Espanola, New Mexico, 87532. 6-76-1t

FOR SALE (CONT.)

TEKTRONIX SCOPES—Hewlett-Packard generators, other test and electronic equipment parts, tubes, "ham" supplies, surplus, and older parts. ELECTRONIC SPECIALTIES, 1659 W. Wetmore, Tucson, Az. 85705. (602) 887-9729. 1-76-12t

TV SERVICE BUSINESS in small mountain community. Operating for 10 yrs. Retiring. Gross $15,000 only part time. Only service in 30 mile radius. Expansion potential unlimited. $15,000 includes 74 van. R. Murray; Box 816; Hayfork, Calif. 96041. 6-76-2t

COMPLETE PICTURE TUBE REBUILDING equipment, used, perfect working condition. Temperature controlled 3 stage oven and glass annealing box. Solid state circuitry. Fast professional glass lathe heavy duty R.F. generator. $10,900. Will train. B. J. LIndon 6410 W. 83rd Place, Arvada, Colo. 80003. 6-76-1t

RIDERS RADIO MANUALS—Volumes 7 thru 14—$10 each. Lappin Radio, 210 N. Goodwin, Urbana, Ill. 61801. 6-76-1t

TELEVISION EQUIPMENT, some new. Cost $2800. $1680 for everything. Self-addressed stamped envelope for list. Edward Kron, Poynor, Missouri 63959. (314) 996-4294. 6-76-1t

SOLID STATE &
HOBBY CIRCUITS MANUAL
$1.95 postpaid to your door. The new manual offers over 400 pages of circuits for the hobbyist, engineer, experimenter and do-it-yourself kit builder. HURRY—Supply limited. Free catalog. Frazer & Associates, Dept. ES, 1888 Century Park East Suite 10, Century City, Calif. 90067.

WANTED

PICTURE TUBE REBUILD PLANT complete. Cost between $1500.00 & $2500.00. Vern Fisher, 388 E. 300 N. #18, Springville, Utah, 84663. 6-76-2t

BUSINESS OPPORTUNITY

CONVERT black/white TV to color: experience not necessary. $3.00 (refundable). Tayo Paul, 980 Greene Ave., Brooklyn, N.Y. 11221. 5-76-3t

TV SHOPS: Repair and update MATV systems with new patented method. $200.00 day possible. Send resume and credit references: Melvin Cohen, Television Broadcast Engineer, May Company Building, 3651 Prospect Avenue, Riviera Beach, Fla. 33404. 5-76-5t

CAPE COD—Established TV Sales & Service business, center of town. Lock, stock & barrel. Reasonable. Write: O. Weatherwood, Box 921, Brewster, Ma. 02631. 5-76-2t

TV SALES & SERVICE in same location 15 years. Nets over $25,000. Retiring. Including truck, equipment & inventory $25,000. A. Bolin, 6361 Balsam Lake, San Diego, Ca. 92119. 6-76-tf

FOR SALE—Established television sales and service business located in Southern Illinois. Includes equipment, inventory and one van. Write: Dept. 508, 1014 Wyandotte St., Kansas City, Mo. 64105. 6-76-1t

FOR SALE—television business established 21 yrs., $100,000 potential, store with 6 room house, 50' basement and attic, second television shop in finished 20' x 20' garage, paneled, heat, electric, property all zoned business 60' x 135' in beautiful suburbia surroundings. Retiring, asking $48,000. Cash needed $16,000. Burke's T.V., 2312 Newbridge Road, Bellmore, 11710 L.I., N.Y., 516-785-9127. 6-76-1t

EDUCATION-INSTRUCTION

REPAIR TV TUNERS—High Earnings; Complete Course Details, 12 Repair Tricks, Many Plans, Two Lessons, all for $2. Refundable. Frank Bocek, Box 3236 Enterprise, Redding, Calif. 96001. 4-76-4t

TV PROBLEMS??? Send symptoms with a copy of schematic and self-addressed stamped envelope and $2.00, to Troubleshooter, Box 4553, Downey, Ca. 90241. Results Guaranteed. 9-75-tf

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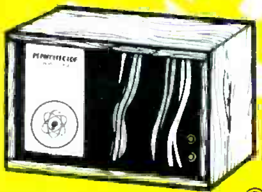
STOP BURGLARS

Before they get inside.



PERIMITECTOR is the world's most versatile and effective solid-state alarm system. It's the fastest selling Modular burglar alarm because it works. Perimitector provides perimiter protection that stops burglars on the outside before they get inside, ECONOMICALLY. Compares with conventional systems costing over $2,000. Perimitector suggested retail—under $500. See your authorized Perimitector Dealer or contact Nationwide Scientific for the location of your local Perimitector, Pyro/Sygnal dealer.

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FEATURES
- Easily installed • Perimeter Protection • MADE IN U.S.A.
- Module concept—When you move, you can take it with you

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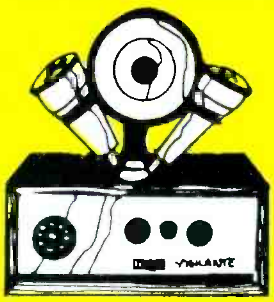
FOR LOW-COST PROFESSIONAL ALARM EQUIPMENT . . .

VIGILANTE™



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FEATURES: A.C. w/Battery stand-by • Remote capabilities • Built-in "Blaster" electronic siren • N/O - N/C Terminals • Residential or commercial models available

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"KEEPS AN EYE ON THINGS . . . WHEN YOU'RE AWAY"

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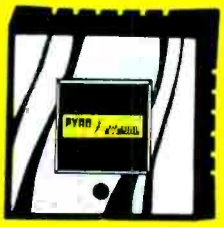
PYRO SYGNAL



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