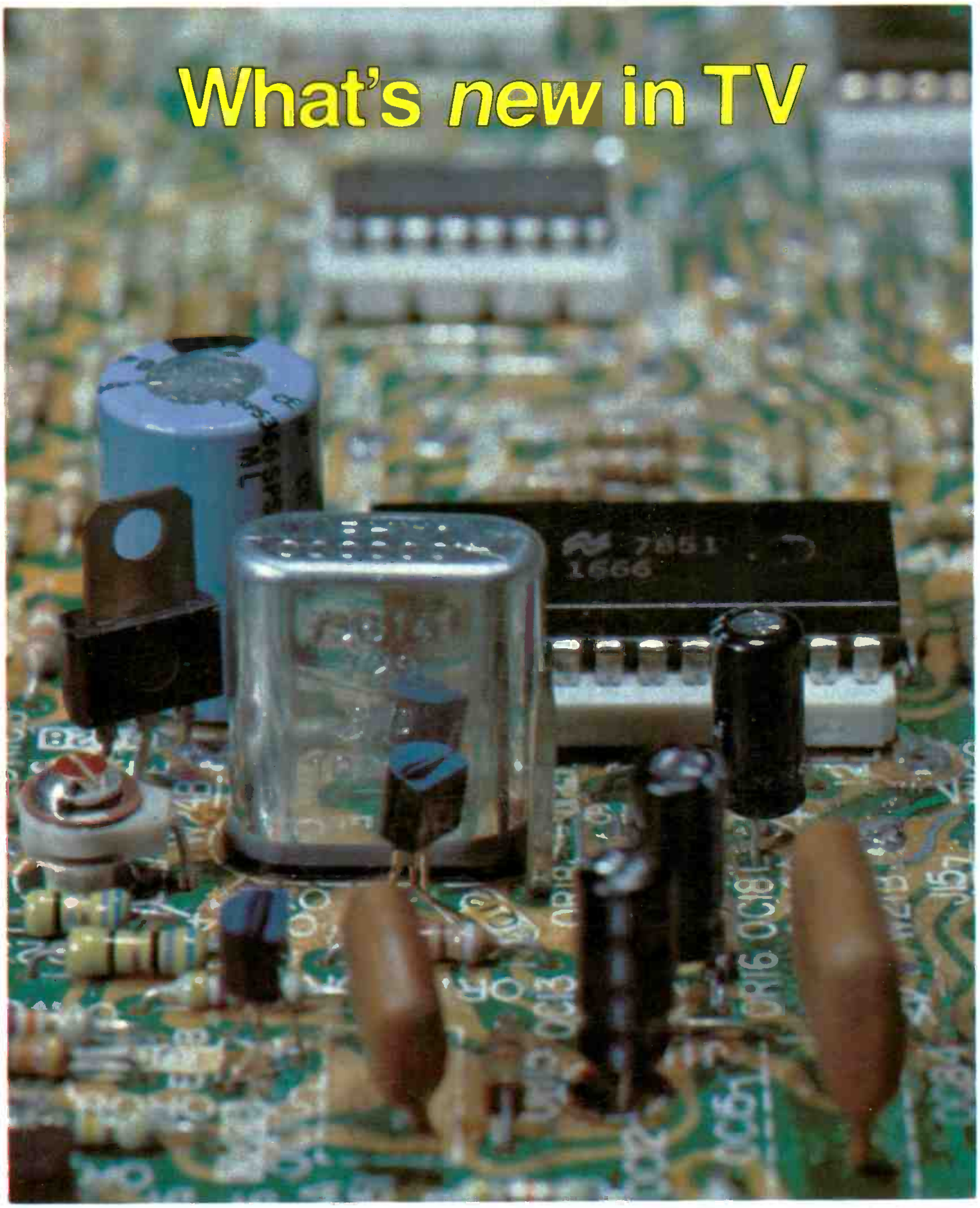
ET/D

SEPTEMBER 1979 • $1.00

ELECTRONIC TECHNICIAN/DEALER

LEADING THE CONSUMER AND INDUSTRIAL SERVICE MARKETS

What's *new* in TV



HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION

Brighten the Profit Picture!

nple to the
d instrument. . .
nly name you
w.

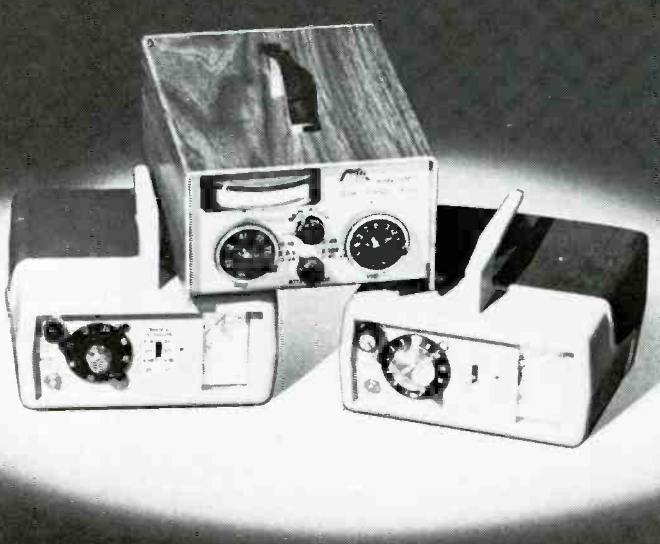
quipment. . .use
on the bench or use
stitute for the
defective tuner dur-
ght different
n the basic Model
Analyst for areas
reception to the
all-channel AC/DC
dles IF or AGC
e Castle line of
signal analyzing
tion also available
F, IF and AGC
e units available in
ully assembled.

th meters. . .end
guessing. Invaluable
on and maintenance
TV systems and
PTS' Model 5001 All-
Channel VHF/UHF Field Strength Analyst and two Castle Mezzer™ models represent the state of the art.

Power supplies. . .PTS has a variety of power supplies available from the DG-1 for most electronic devices to the high current DG-5 Regulated Voltage Control Center/Digital Voltmeter with four independent variable voltages. The MSP-501 Regulated Microprocessor Power Supply meets most microprocessor needs with excellent load, line voltage variation and transient regulations.

Component analyzer. . .for troubleshooting components in or out of the circuit. The Model 8001 tests capacitors, IC's, diodes, transistors and other components in TVs, stereos, computers and many other electronic devices.

PTS ELECTRONICS, INC.
The Only Name You Need To Know



full line of instruments at all PTS tuner/module servicenters and PTS stocking distributors.

SERVICENTER GUIDE

MIDWEST
Home office
BLOOMINGTON, IN 47401
5233 S. Hwy. 37, P.O. 272
812-824-9331
CLEVELAND, OH 44134
5682 State Road
216-845-4480
KANSAS CITY, KS 66106
3119A Merriam Lane, P.O. 6149
913-831-1222
MINNEAPOLIS, MN 55408
815 W. Lake St., P.O. 8458
612-824-2333
ST. LOUIS, MO 63130
8456 Page Blvd., P.O. 24256
314-428-1299
DETROIT, MI 48235
13707 W. 8-Mile Rd.
313-862-1783
GRAND RAPIDS, MI 49501
1134 Walker Northwest
P.O. 1435
616-454-2754
CINCINNATI, OH 45216
8172 Vine St., P.O. 16057
513-821-2298
MILWAUKEE, WI 53218
7211 Fond du Lac
414-464-0789
COLUMBUS, OH 43227
4005A E. Livingston
614-237-3820
INDIANAPOLIS, IN 46202
1406 N. Pennsylvania Ave.
317-631-1551
DAVENPORT, IA 52803
2024 E. River Dr.
319-323-3975
OMAHA, NE 68104
6918 Maple St.
402-571-4800
CHICAGO, IL 60659
5744 N. Western Ave.
312-728-1800

PACIFIC
SACRAMENTO, CA 95841
4351D Auburn Blvd., P.O. 41354
916-482-6220
SAN DIEGO, CA 92105
5111 University Ave., P.O. 5794
714-280-7070
LOS ANGELES
Paramount, CA 90723
7259 E. Alondra Blvd.
213-634-0111
PORTLAND, OR 97213
5220 N.E. Sandy Blvd.
P.O. 13096
503-282-9636
SEATTLE, WA 98188
988 Industry Dr. (Bldg. 28)
P.O. 88831 - Tukwila Branch
206-575-3060

NORTHEAST
SPRINGFIELD
Westfield, MA 01085
300 Union St., P.O. 238
413-562-5205
PHILADELPHIA
Upper Darby, PA 19082
1742-44 State Rd.
215-352-6609
PITTSBURGH, PA 15202
257 Riverview Ave. W., P.O. 4130
412-761-7648
ELMWOOD PARK, NJ 07407
158 Market St., P.O. 421
201-791-6380
BALTIMORE, MD 21215
5505 Reisterstown Rd., P.O. 2561
301-358-1186
BOSTON
Arlington, MA 02174
1167 Massachusetts Ave., P.O. 371
617-648-7110
BUFFALO, NY 14214
299 Parkside Ave.
716-837-1656

SOUTH
CHARLESTON, SC 29407
1736 Savannah Highway 17
P.O. 30511
803-571-7651
JACKSONVILLE, FL 32210
1918 Blanding Blvd., P.O. 7923
904-389-9952
WASHINGTON, DC
Silver Spring, MD 20910
8880 Brookville Rd.
301-565-0025
CHARLOTTE, NC 28225
2542 Lucena St. P.O. 5512
704-332-8007
BIRMINGHAM, AL 35201
210 N. 9th St., P.O. 1801
205-323-2657
MEMPHIS, TN 38118
3614 Lamar Ave., P.O. 18053
901-365-1918
NORFOLK, VA 23504
3118 E. Princess Anne Rd.
804-625-2030
NEW ORLEANS
Metairie, LA 70004
3920A Airline Hwy., P.O. 303
504-837-7569
TAMPA, FL 33690
2703 S. Macdill, P.O. 14301
813-839-5521
NASHVILLE, TN 37214
2426 A Lebanon Rd.
615-885-0688

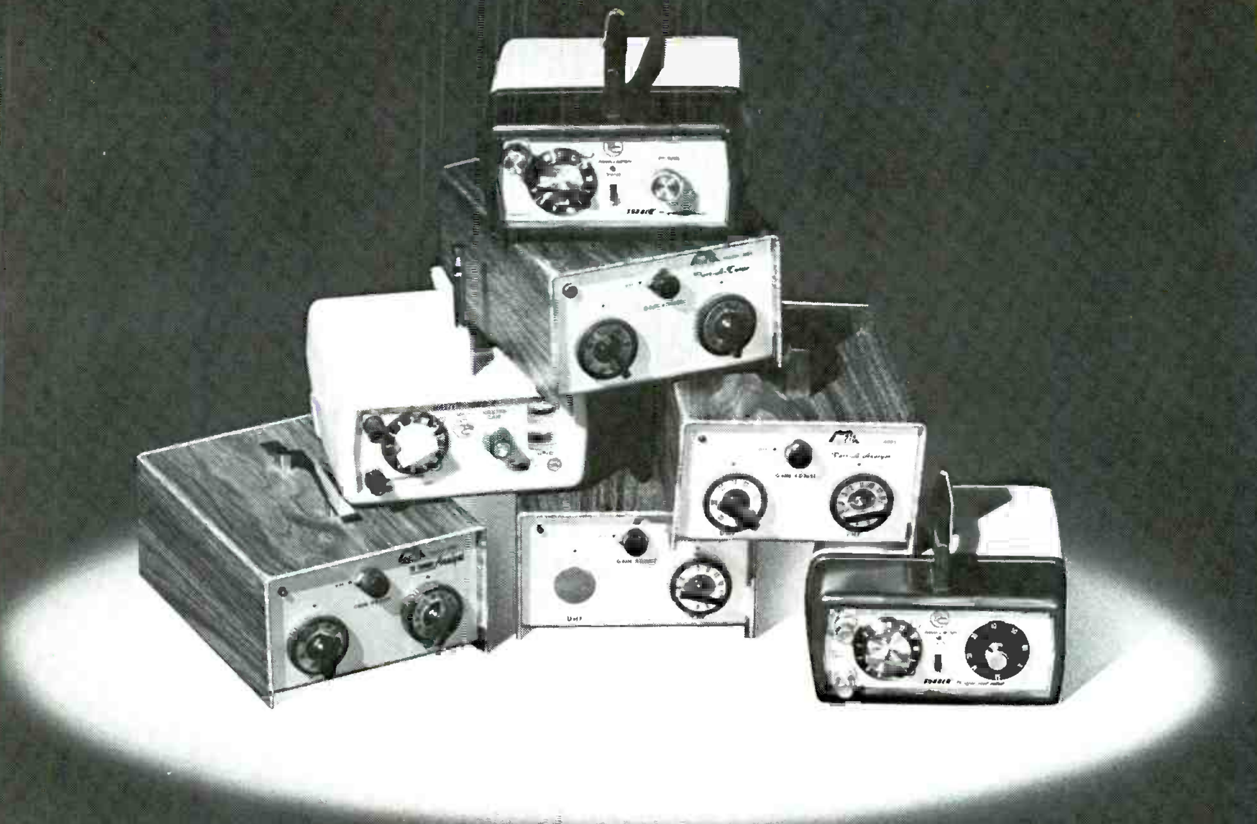
MOUNTAIN
DENVER
Arvada, CO 80001
4958 Allison St., P.O. 672
303-423-7080
SALT LAKE CITY, UT 84106
1233 Wilmington Ave.
P.O. 6218
801-484-1451
PHOENIX, AZ 85009
2916 West McDowell Rd.
602-278-1218

SOUTHWEST
LONGVIEW, TX 75601
110 Mopac Rd., P.O. 7332
214-753-4334
OKLAHOMA CITY, OK 73147
4509 N.W. 10th, P.O. 74917
405-947-2013
HOUSTON, TX 77207
4326 Telephone Rd., P.O. 26616
713-644-6793

THERE'S A PTS BRANCH NEAR YOU!

Circle No. 102 on Reader Inquiry Card

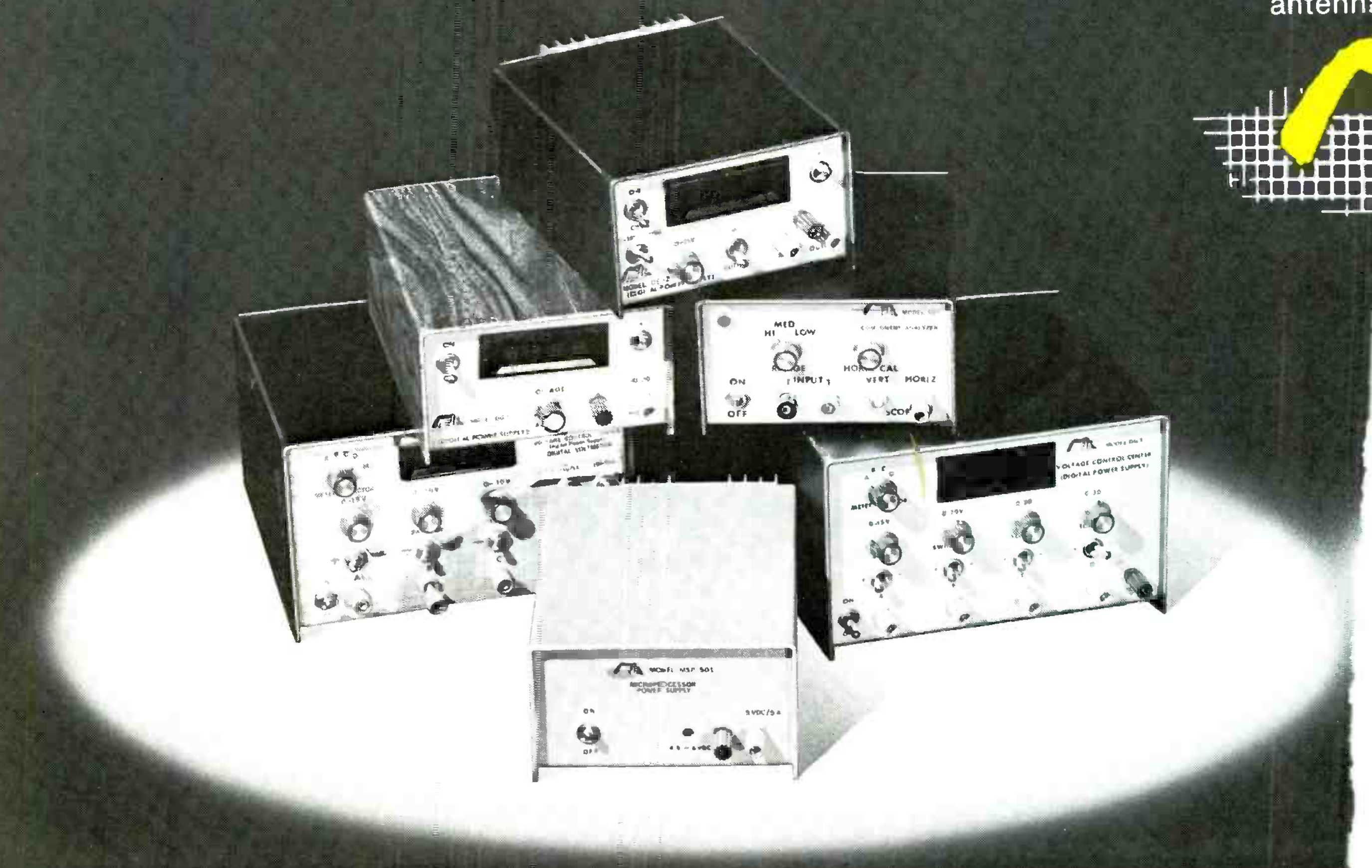
PTS Instruments B
Pr



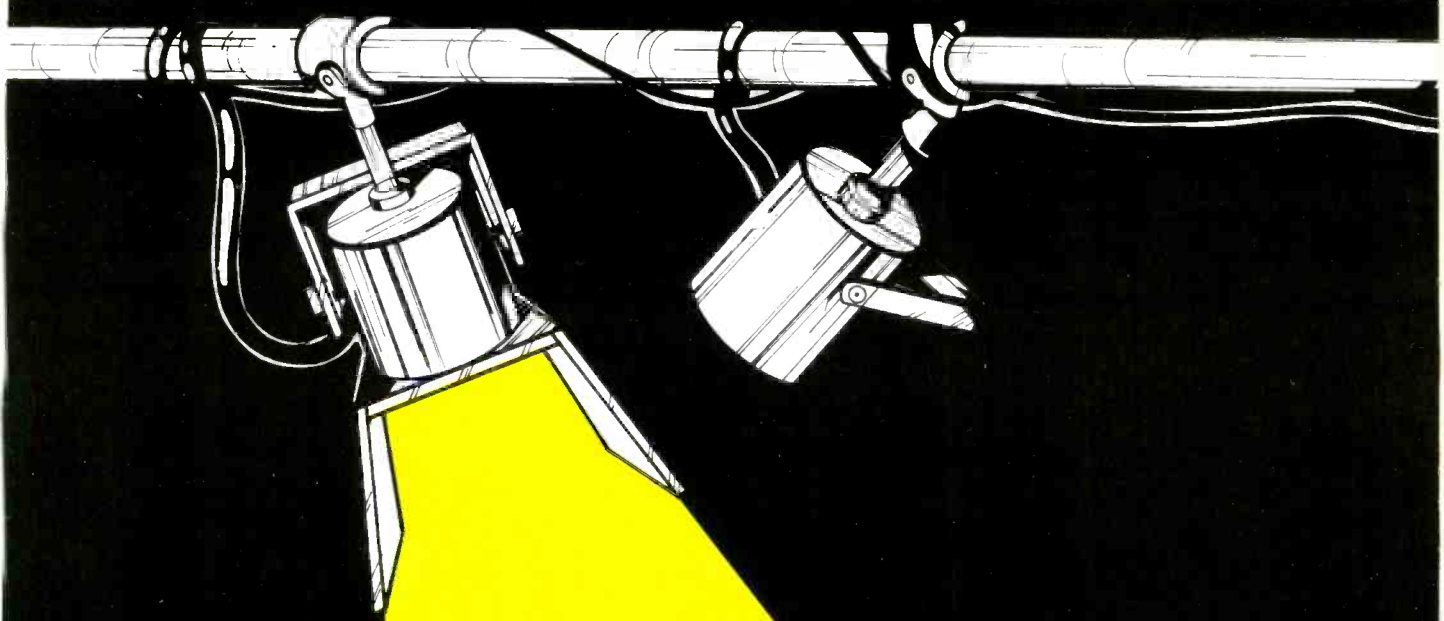
From the sin
sophisticate
PTS is the o
need to knov

Tuner test e
these units c
them to sub
customer's c
ing repair. E
models, from
1010 Port-A-
without UHF
Model 4001
unit that han
systems. The
Subbers® for
and substit
for VHF, U
testing. S
kit form

Field stre
signal le
for insta
of CATV
antennae

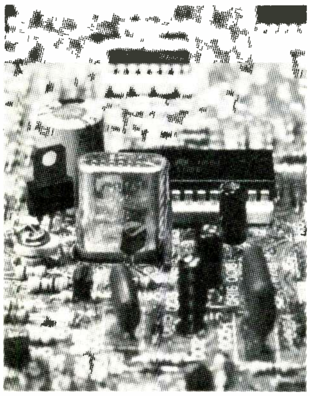


All PTS instruments carry a six month limited warranty.



PTS Sets the Stage for Profit

ET/D
ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND INDUSTRIAL SERVICE MARKETS
SEPTEMBER 1979, VOL. 101, NO. 9



On The Cover: GE's microprocessor, phase-locked-loop, keyboard operated, tuner control. Full, precise control of eighty-two channels with no AFC and no fine tuning is performed by this module.

FEATURES

DEPARTMENTS

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION ABP ABC EIA

ELECTRONIC TECHNICIAN/DEALER [ISSN 0192-7175] is published monthly by Harcourt Brace Jovanovich Publications. Corporate offices: 757 Third Avenue, New York, New York 10017. Advertising offices: 757 Third Avenue, New York, New York 10017 and 111 East Wacker Drive, Chicago, Illinois 60601. Editorial offices: 111 East Wacker Drive, Chicago, Illinois 60601. Accounting, Advertising Production and Circulation offices: 1 East First Street, Duluth, Minnesota 55802. Subscription rates: one year, $10; two years, $16; three years, $20 in the United States and Canada; all other countries: $45. Single copies: $1 in the United States and Canada; all other countries: $3. Controlled Circulation postage paid at Dansville, New York 14437.

POSTMASTER: Send Form 3579 to ELECTRONIC TECHNICIAN/DEALER, P.O. Box 6016, Duluth, MN 55806.

INDUSTRY REPORT

HP Offers First Hand-Held "Computer"

You were warned the hand-held computer was inevitable. It has been on the way ever since the advent of LSI. Now its forerunner, at least, is here in the form of a hand-held calculator from Hewlett Packard with add-on devices that give it very computer-like characteristics.

According to HP, its new 41C (suggested retail $295), is the most advanced and versatile handheld calculator developed by the firm. With 130 preprogrammed scientific and math functions, plus continuous (with power off) memory and LCD display, the 41C is capable of accepting four peripherals to give it printout capabilities, additional memory and magnetic card input/output.

With alphanumeric readout, users are able to label programs in English (as opposed to numbers). The continuous-memory feature is based on CMOS technology and permits retention of user programs and data in the calculator even after the power has been turned off. This feature permits indefinite storage of programs and eliminates the need for re-entry of lengthy programs each time the calculator is used, HP reports.

"Like a small computer," HP said, "the HP-41C has decision-making power. A program can automatically compare data, contents, or results, and then alter execution based on the outcome of the comparison. It can also test two alphabetic strings for equality."

Additionally, HP said the new unit—which is now available—has 56 flags to enhance its usefullness. Memory modules, priced at $45 apiece, contain 64 data storage registers, or 400 lines of program instructions.

Zenith to Buy Heathkit

Zenith Radio Corp. of Chicago and Schlumberger Limited, owner of Heath Company which markets electronic test instruments, computer products and consumer items in kit form, have reached a tentative agreement.

According to a statement released by Zenith headquarters, Zenith would pay $64.5 million in cash for Schlumberger's Heath division. The deal hinges on the signing of a definitive purchase agreement and compliance with government regulations, Zenith said.

Zenith, which has laid off about 25 percent of its U.S. workforce since late 1977 and moved many of its manufacturing and assembly functions to foreign shores, last year had net sales of $980 million and earnings of $23.3 million.

Heath Company, the statement said," in the past three years ... has been profitable and sales have exceeded $80 million annually." Heath has long been a leading producer and marketer of "build-it-yourself" electronic kits sold through "Heathkit" electronic centers. Recently Heath began marketing assembled small computer systems, video display terminals, and printers for use in small businesses and in the home.

Zenith for years has contended with RCA for the position of the nation's number one marketer of television receivers. Zenith also manufactures audio products and color and black and white television tubes in addition to marketing replacement parts and components.

TV Programming: On the Upswing?

Television reception as we have known it may soon be a thing of the past if any of a number of experimental and theoretical projects now in progress are successful.

If you, like many Americans, have thought network television programming to be tuned to idiots only, just look around you at the possibilities that new and evolving technologies are spawning. Such developments, of course, hold significant meaning for the television repair and antenna installation industries.

—The British Ceefax system of broadcasting "printed data" on the television screen, such as horse racing tips, recipies, television schedules, grocery prices, etc. Newspapers are watching this development carefully with more than passing interest.

—Atiope, the French system, is being watched carefully during trials in that country and in Canada. This system, in addition to broadcasting "printed" data, also provides "teletext" hard copy at the TV terminal.

—In Coral Gables, Fla., next year, Knight Ridder Newspapers plans to offer news, activities schedules, and advertising.

—Southern Satellite Systems Inc. and Micro-TV plan to feed cable television companies the news from United Press International, Reuters and the Associated Press for broadcast use.

Perhaps the most exciting development thus far is the burgeoning interest being shown in "Personal" reception of satellite transmissions. A recently held seminar in Oklahoma drew some 300 interested persons to a series of lectures and seminars on the technologies and methods of installing "home" earthstations for the reception of satellite television transmissions.

With developments like these progressing within our midst it is hard to believe that television programming quality won't rebound from the inarticulate grub being fed to the American public by the three "major" networks. ET/D

ET/D

Richard W. Lay, *Editor (Chicago)*

Walter H. Schwartz, *Managing Editor (Duluth)*

David Hagelin, *Publisher (Chicago)*

Tom Greney, *Group Vice President (Chicago)*

John Paszak, *Graphic Design*

Kathy Tarnowski, *Production Manager*

Debi Harmer, *Production Supervisor*

Lillie Pearson, *Circulation Supervisor*

Gene Bailey, *Reader Service*

Julie Laitin, *Promotion Director*

Dawn Anderson, *Classified Ad Mgr.*

Please submit editorial manuscripts to:
Editor, ET/D, 111 East Wacker Drive
Chicago, Ill., 60601

ADVERTISING SALES

Please send all advertising material to:
ET/D,
Production Mgr.
1 East First Street
Duluth, Minn. 55802
(218) 727-8511

East Region
Thomas Palmisano
757 Third Avenue
New York, N.Y. 10017
(212) 888-4382

Midwest Region
David J. Hagelin or Larry Eaton
111 East Wacker Drive
Chicago, Ill. 60601
(312) 938-2344

Southern & Western Region
Chuck Cummings
613 N. O'Connor
Irving, TX 75061
(214) 253-8678

HBJ

HARCOURT BRACE JOVANOVICH PUBLICATIONS

Robert L. Edgell, *Chairman*
Richard Moeller, *President*
Lars Fladmark, *Senior Vice President*
Arland Hirman, *Treasurer*
Joe Bilderbach, *Vice President*
James T. Gherna, *Vice President*
George A. Glenn, *Vice President*
Thomas Greney, *Vice President*
Ezra Pincus, *Vice President*
Harry D. Ramaley, *Vice President*
Lois Sanders, *Vice President*

150,000 REASONS WHY YOU SHOULD SWITCH NOW TO THE BIGGEST, BROADEST-EVER LINE OF ZENITH UNIVERSAL SEMICONDUCTORS covering Zenith exact replacements plus the most popular types in the industry—all in a new catalog!

It's all under one numbering system that saves you time and adds value to any Zenith semiconductor you may already have in stock!

Switch now to Zenith Universal Semiconductor replacements and see how well your shop shapes up...your bottom line, too.

Shown here are just a few of the more than 150,000 cross-references in the July, 1979 edition of the Zenith Universal Semiconductor cross-reference guide.

Check with your Zenith distributor for your copy of Zenith's Universal Semiconductor cross-reference guide...and ask how you can enjoy the convenience of our special Tube Caddy/Benchtop Organizer.

ECG is a registered trademark of GTE SYLVANIA

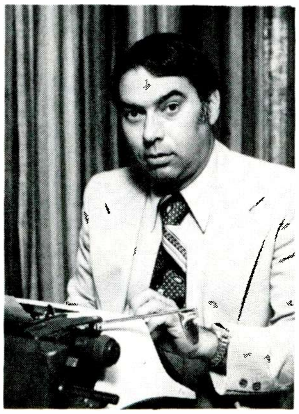
ZENITH®

The quality goes in before the name goes on®

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

Circle No. 122 on Reader Inquiry Card

FROM THE EDITOR'S DESK



As has been our custom at ET/D for a number of years now, each September we begin our review of the new television chassis.

This year our roundup article simply confirms that the trend toward more and more digital circuitry in consumer products is advancing at an accelerating pace. In television, for example, we see this phenomenon in the form of digital tuning systems. There are more on the market this year than ever before.

Also, as manufacturers look around them for "add on" enhancements to chassis previously introduced, we find more of them taking advantage of the new broadcast sound standards. Several now provide FM sound systems capable of frequency response in the 10KHz and over category.

Some of the changes in the new chassis are so new in fact that we know about them, but have not yet received full details from the manufacturer. RCA's new comb filter system in the video channel is a case in point. We'll be passing that information along to you just as soon as we receive the technical information from RCA.

Looking ahead to the coming months, it certainly seems as if the nature of consumer electronics servicing is about to make a drastic transformation. In addition to television and stereo, the impact of a growing microwave oven market is beginning to exert itself. VCR servicing is another growth area that is making inroads in professionals electronics serviceshops. Just over the horizon we can see the vidio disk, with its digital/laser technology, evolving into a potentially profitable service market once these already popular units proliferate. It appears the only thing holding them back at this point is a supply problem. Beyond vidio disks is the home and small business "minicomputer" service market that seems to hold virtually unlimited potential insofar as opportunity is concerned in the "consumer" electronics service market.

I don't think there is any doubt that these are times of tremendous opportunity for the professional technician and the professional serviceshop that stays current with the new technologies as they evolve.

Along more personal lines, I would like to inform you that the Chicago editorial office of Electronic Technician/Dealer is now in a new location ... 111 East Wacker Drive, Chicago, Ill., 60601. Please make that notation in your address book, it will certainly expedite your letters and comments to us, and we do want to encourage you to express your views and to share information with us.

Our telephone number incidentally is 938-2338 (area code 312) in case you need to call the "editorial side" of ET/D in Chicago. Our Duluth address remains the same.

Sincerely

Richard M. Lay

SIMPSON 260® VOM

Choice of Professionals for Over 40 Years!

- Fast accurate measurements on 27 popular ranges
- Rugged taut-band varistor-protected movement
- Optional 5 KV probe
- External access battery and fuse compartment
- Multi-purpose color-coded test leads with combination and screw-on alligator clips

Audio, TV and Communications Service

Electrical Maintenance

Production and Quality Control

COMPLETE LINE OF PROBES, LEADS, CARRYING CASES AND OTHER ACCESSORIES AVAILABLE

SEE THEM AT YOUR LOCAL SIMPSON DISTRIBUTOR

260-6 VOM — $95.00
260-6M with mirror scale — **$98.00**
260-6P overload protected — **$141.00**
260-6PM overload protected with mirror scale — **$145.00**
260-6RT in roll top case — **$106.00**
260-6PRT overload protected in roll top case — **$153.00**
260-6MRT with mirror scale in roll top case — **$110.00**
260-6XL with extra ranges and features - **$111.00**
260-6XLM with mirror scale — **$115.00**
260-6XLP overload protected — **$152.00**
260-6XLPM overload protected with mirror scale — **$156.00**

Simpson®
INSTRUMENTS THAT STAY ACCURATE

SIMPSON ELECTRIC COMPANY
853 Dundee Avenue, Elgin, Illinois 60120
(312) 697-2260 • CABLE SIMELCO • Telex 72-2416
IN CANADA: Bach-Simpson, Ltd., London Ontario
IN ENGLAND: Bach-Simpson (U.K.) Ltd., Wadebridge, Cornwall
IN INDIA: Ruttonsha-Simpson Private, Ltd., Vikhroli, Bombay

KATY INDUSTRIES
INDUSTRIAL EQUIPMENT GROUP

Circle No. 119 on Reader Inquiry Card

NEWSLINE

EDS CHANGES FORMAT. Following this year's dismal fourth day turnout, the Electronic Distribution Show (EDS) is going back to a three-day format--but on different days. The 1980 edition of EDS will be Thursday through Saturday--May 1 through 3--in the Las Vegas Hilton Hotel. Previously the show was held Tuesday through Friday and incorporated space in Las Vegas' spacious convention center.

SATELLITE "MOVIE" NETWORK ANNOUNCED. An independent videotape distributor--Video Communications--has contracted with Satellite Program Network to provide feature length motion pictures for broadcast to some 800,000 cable TV subscribers in 39 states. The service is scheduled to be in operation Saturday and Sunday evenings. Under the arrangement, VCI will produce videotapes at its Tulsa studio and send them to SPN's satellite earth station near Atlanta for transmission to RCA's Satcom One satellite. VCI also says it will make 14 minutes of commercial time available to sponsors of the movies for broadcast on cable systems.

SATELLITES ARE BIG NEWS THESE DAYS. There seems little doubt that satellite antenna technology has taken the spotlight insofar as broadcast electronics is concerned. Within a three months period at least three nationwide, major seminars have been held on the subject. Last August private home earth stations--and how to build them--was the subject of a seminar in Oklahoma City. Last month the prestigious WESCON show--sponsored by the western division of IEEE--held a major seminar on satellite technologies, applications and future systems. This November the University of Southern California's continuing education engineering section is sponsoring a seminar on a state-of-the-art techniques for upcoming generations of satellites.

RED CHINA TO IMPORT TVS. Red China will be forced to import television sets to meet demands in that country, according to a news statement from the New China News Agency. According to the source, Red China hopes to produce a million of its own sets this year, but that won't be enough to meet demand. Last year, the news agency said, some 490,000 televisions were produced in Red China, and the year before that about 289,000.

DISC AND VCR MARKET GROWING. There will be over 17-million videodisc players and more than 13-million VCR's in American homes by 1988. That's according to market surveys conducted by NBC. However, in defending the strength of commercial television, NBC says that compares with the 89-million television sets in homes by that time and the commercial TV viewing time will average over 47 hours per week.

ON THE FINANCIAL TRAIL...Matsushita Electric reports record second quarter results for both sales and earnings, including its consumer electronics and components group. Results were obtained largely in Japan while U.S. operations (profitwise) lagged...Zenith Radio Corporation meanwhile said its second quarter earnings were down substantially from the comparable period a year earlier. Earnings were 12 cents per share this quarter compared with 30 cents per share a year ago.

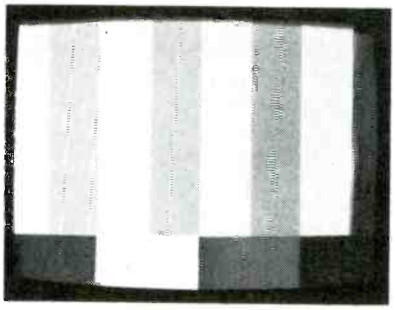
Master the art of color with the High-Performance NTSC Generator

The best foundation for accurate color reproduction is an accurate and stable test signal source. B&K-PRECISION's new NTSC color pattern generator is all that and more.

The B&K-PRECISION "1250" is a state-of-the-art generator intended for color broadcast, CATV and industrial applications. Its simple operation also makes it a time-saving tool for aligning and trouble-shooting video tape recorders.

The primary pattern generated by the 1250 is NTSC color bars with or without an -IWQ signal (occupying the lower quarter of the pattern). Other features are a five-step staircase pattern with selectable chroma levels; convergence dot, cross-hatch, dothatch and center-cross patterns; and a choice of eight color rasters (including black burst). The 1250 doesn't stop at video patterns though, it also generates a stable 4.5 MHz sound carrier, modulated by 1 kHz or 3 kHz signals or any external audio signal. RF outputs can be generated on channels 3 or 4, or the standard TV i-f frequency. Each output is crystal controlled for stability.

For trouble-shooting applications, in-



circuit analysis of custom ICs can be done by using the NTSC bar signal and an oscilloscope to examine the inputs and outputs at each IC pin. These results can then be compared to that of a known good unit or reference diagram. The presence of NTSC sync, color bars, luminance components and sound carrier make possible a thorough evaluation of all video circuits. The internal RF modulator can be fed by an internal test signal or any external composite video source. In addition, an RF output can be selected independently of the composite video output, so that a waveform monitor and a television receiver can be fed simultaneously.

The B&K-PRECISION 1250 will give you the master's touch for color. For immediate delivery or additional information, contact your local B&K-PRECISION distributor.

B&K PRECISION DYNASCAN CORPORATION

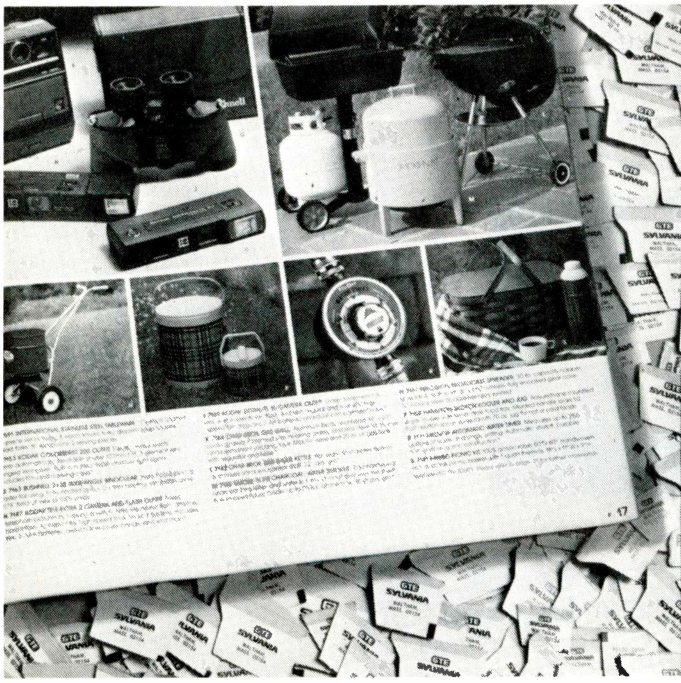
6460 W. Cortland Street • Chicago, IL 60635 • 312/889-9087

In Canada: Atlas Electronics Ontario   International Sales: Empire Exporters, Inc. 270 Newtown Road, Plainview, L.I., N.Y. 11803

B&K-PRECISION Model 1250 $795

Circle No. 106 on Reader Inquiry Card

ENTER THE SYLVANIA TABS 'N' TRAVEL SWEEPSTAKES



WIN YOUR SHARE OF OVER ONE HALF MILLION TABS

WIN ONE OF FIFTY WEEKENDS FOR TWO TO OPRYLAND USA

TNT—"Tabs 'n' Travel"...it's Sylvania's dynamite sweepstakes that will deliver well over one half million extra tabs, good for the goodies in our Supertab '79 Awards Catalogue*—or a bang-up weekend trip for two to Opryland USA in Nashville, Tennessee.

HOW YOU CAN WIN

Easy! Pull off the Inventory Control Tab from a five-pack of Sylvania receiving tubes or prepare a reasonable facsimile. On the back, clearly print your name, your address and the name of both your Sylvania distributor and his salesman. Mail to Sylvania Award Headquarters, P.O. BOX 1000, Fenton, MO 63026.

WHAT YOU CAN WIN:

- 1 Grand Prize of 25,000 Tabs
- 4 Second Prizes of 10,000 Tabs
- 8 Third Prizes of 5,000 Tabs
- 250 Fourth Prizes of 500 Tabs
- 1260 Fifth Prizes of 250 Tabs

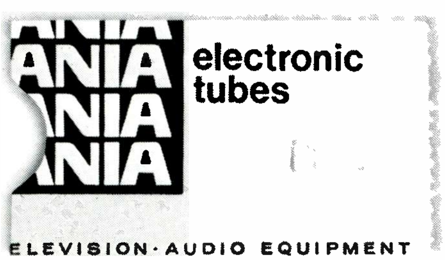
PLUS

- 50 trips for two to Opryland USA

ENTER EARLY—AND OFTEN

There's no limit to the number of Sweepstakes entries you can submit, so keep those Inventory Control Tabs rolling in to increase your chance of winning extra tabs, or a great trip.

* If you haven't started saving Sylvania receiving tube tabs, what better time? Ask your Sylvania distributor salesman for full details and your Supertab '79 Awards Catalogue.



Sweepstakes open September 1, close midnight October 31, 1979.

The Sylvania Supertab '79 program is available only to dealers and service technicians. Employees of General Telephone & Electronics, GTE Sylvania, their subsidiaries, affiliates, authorized distributors, or their advertising agencies are not eligible to participate. No purchase required. Void in Missouri, Utah and where prohibited by law.

SYLVANIA | **GTE**

ET2066

STRICTLY BUSINESS

How much productivity can you expect from technicians? The computer operated by NARDA gives us some insight into that subject.

On the average, technicians complete 4.4 jobs per eight hour day. Since that's an average, about half the techs don't do that well ... but half do better. If you are going to have an objective, you would probably want to set your standard at about six calls a day for an outside man, about three jobs a day for a bench man who is being fed by outside men, and perhaps four to five jobs a day for bench men who do a lot of carry in service.

The average tech completes about 84.5 per cent of the calls with only one visit, the rest requiring two visits (or more) because the part wasn't on the truck, or because he had to go back on a call back, or because the customer wasn't home to receive the technician. Again, the standard should be a little better, with something close to 90 per cent completed on the first visit, maybe one per cent not homes, about five per cent lack parts, and three to four per cent for call backs.

About 45 per cent of the time, the averages say the technician is working productively, performing work that can be charged to the customer. That should be more like 55 to 60 per cent.

On average, technicians spend 49.5 minutes per job. At that rate, and figuring 15 minutes travel between jobs, they should easily get in seven calls per day. But the objective should be more like 40 minutes per call. Then he could get in eight calls in a day. What would that be worth to you in a year's time? Well, that would come to 222 calls in a year. The computer says that the average income per call is $21.53. That comes to $4,779.66. And that's for just one man. If you had five men, that additional income would come to $23,898.30. And that's a lot of money.

That's why we at NARDA stress productivity so much, why we spend four hours at each one of our one-day Service Symposiums showing you how to get more productivity, why we spend so much time on this subject at our Annual Schools of Service Management.

You can put your parts in inventory and use them at a later date. But you can't put the man's time in inventory. You have 480 minutes of each man's time available to you each day. Use it wisely ... or it is lost forever!

Mgr., NARDA's Service Division

LETTERS

HELP NEEDED:
Schematic/service literature for a BEL-AIR 8 track/FM sterio, Model CRH-401. Will purchase or copy and return.
Tom Houlihan
2 Willow Rd.
Saugerties, NY 12477

I need a schematic of a Dumont oscilloscope Model 208.
Mitch Ross
Wiscasset Hardware, Inc.
Water St.
Wiscasset, ME 04578

I need a schematic and/or manual and parts information on a Bell Hospital Systems Inc. " Sterivision" video camera Model QIT-101A.

I would appreciate hearing from anyone who has any such information or can direct me to another source. I will gladly pay copy and mailing costs.
Vincent J. Berardinelli
Jim's Radio & TV Service
110 Oak St.
Yonkers, NY 10701

We require service information for Standard transistor radio Model SR-RV600F; also, Crown TV/radio Model CTV-15, and 5 iron dust cores for video and sound IF trans for this model, and address of anyone handling Eldorado calculators.
S. G. Electronics
Middle Road, Southhampton West
PO Box 242, Mangrove Bay
Somerset 9, Bermuda

HELP RECEIVED.
Thank you for publishing my request for TEKFAX 113. I've received numerous offers and have acquired a #113 thanks to a Mr. Jones from New York. Perhaps you could put a letter of thanks in an upcoming issue of ET/D. Because of the large number of replies, I am afraid I won't be able to personally reply to all who have written me.

My special thanks to you and your fine publication for your assistance!
Jan D. Gorandor
Jan's Solid State Service
1 Sha-Lane
Cherry Valley, IL 61016

ET/D welcomes letters from readers and tries to answer all requests in this column or individually.

NOW PRODUCED IN NEW, LARGE **Xcelite®** FACILITY

every electronic hand tool you'll ever need

The new, ultra-modern Xcelite manufacturing plant . . . the most advanced in the world for producing top quality forged tools . . . is now turning them out in record numbers to meet the ever-growing demand for the world's finest family of electronic hand tools. And at no-nonsense, competitive prices.

Employing the latest in manufacturing technology and quality controls, with every step in the production process under one roof, this new, large facility is continuing evidence that Xcelite . . . the pioneer that brought you so many innovations in electronic hand tool design . . . is also the front-runner in production innovations.

Whatever your needs for electronic product assembly, service, or maintenance, the Xcelite line, finest and most diverse available anywhere, offers your best answers . . . perfectly aligned, hand-honed pliers and cutters, precision-machined screwdrivers and nutdrivers, exclusive thin-pattern adjustable wrenches, plus dozens of related tools and kits you might require.

It was no accident that Xcelite long ago earned . . . and still holds . . . "Preferred Status" among electronics professionals. So keep expecting leadership from Xcelite . . . and see your distributor for today's most wanted hand tools made by tomorrow's production methods.

Circle No. 109 on Reader Inquiry Card

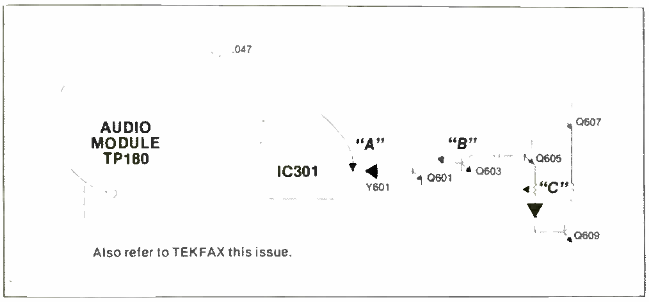
COOPER INDUSTRIES

The Cooper Group
Electronics Division
WELLER®• WISS®• XCELITE®
P.O. BOX 728, APEX, NORTH CAROLINA 27502. 919/362-7511

SERVICE SEMINAR

GE

Color TV Chassis EC—Vertical problem, test procedure.
Note:
For picture on top half of screen only, check C619 (shorted).



Also refer to TEKFAX this issue.

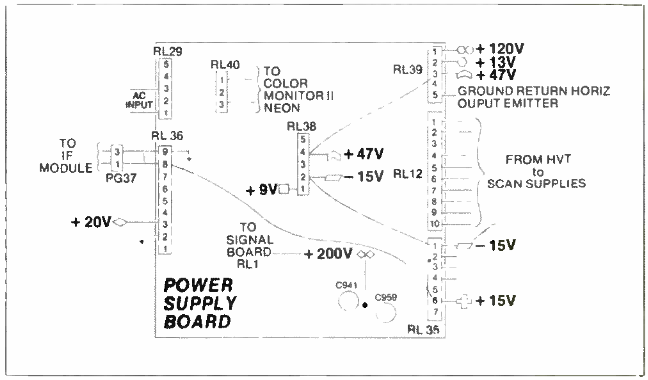
STEP 1: Check the following voltages at the sweep module.
PG10 connector: +15, +115V, −15V
PG11 connector: −15V
If all voltages check okay, go to step 2.

STEP 2: Test stages by coupling signal from vertical circuit to audio module TP180 as follows: If signal is present, a sync buzz will be heard out of speaker. If vertical buzz can be heard at "A," this means IC501 is okay. At "B" this means Q601 is okay. At "C" this means Q603 and Q605 are okay.

STEP 3: Check R603 and R610 for overheating. If one or both resistors exhibits evidence of overheating, replace Q607. If both resistors are okay, replace Q609.

Color TV Chassis EC—No raster, No high voltage, test procedure.
Caution:
If raster is pulsating, do not permit set to play longer than a few seconds. Check R957 and Y957.

STEP 1: Turn set on. Does the high voltage build up and then collapse? (Models with channel digital readout will flash on, then off.) If this is not the problem, go to step 2.
If voltage reads 135V, check Q2903.
normal and that the high voltage shutdown module has shut the system down.
Check: Disconnect PG39 on power supply and check 120V.
If voltage reads 135V, check Q2903.
STEP 2: Check the following voltages on PG39 on the power supply: +120V, +13 volts −47V



See Fig. 1. If +120V is okay, go to step 3.
No +120 volts
A Disconnect PG39 and check for +120V at Pin 1 of RL39.
B. If +120V is restored, check for shorts in horizontal output circuit. Also disconnect PG9 to check yoke for vertical to horizontal winding short.

If +120V is not restored, check PG29, Pins 1 and 3 for 120V ac. No 120V ac check F3901 and R3903, then check bridge rectifiers Y903, Y901, Y906. If okay, check regulators Q2901 and Q2903 for open circuit.
No +13 or +47 volts
A. Check R957, Y957 and SCR901 start-up circuit
B. No +12V. Check R913 and HVAD module (high voltages shutdown circuit).

STEP 3: If +120V is okay, check voltage at collector of Q1550 (horizontal driver). Collector voltage should be +45 volts. A lower voltage like +40V can indicate loss of drive to base of Q1550. Check Q1550, if it's okay, then replace IC501 (countdown IC located on sweep module).

ZENITH

'H' line and later chassis, 9-87 Sync-AGC module if a 9-87 replacement module is used on an 'H' line or later receiver the picture will not have color. The reason is, module terminal U1 . is connected to the ground foil of the 9-87.

On an 'H' line or later chassis the receptacle terminal U10 for the 9-87C module is used as a tie point in the Chroma circuitry. Therefore, the pictures will not have color if a 9-87 (no suffix) is used because the U10 receptacle (tie point) would be grounded. Modules 9-87A, 9-87B, 9-87C and 9-87D have no contact terminal at point U10, so any of these may be used as replacements on the 'H' line or later receivers.

9-87 (no suffix) module, which was originally used in 'E' and 'F' lines, has been superseded by more updated versions. Therefore, at no time recently, would you have recieved any 9-87 (no suffix) modules, either new or reconditioned, from your Zenith Distributor. However, any 9-87 (no suffix) modules remaining in your inventory may still be used as replacements on 'E', 'F' and 'G' line receivers where a 9-87 (no suffix) module is removed. ET/D

The newest television circuits

TV for the Eighties

ET/D's survey of leading TV manufacturers reveals that most of the circuit upgrading has occurred in the sound and tuning channels.

By Richard W. Lay

Nineteen-eighty may be known as the year of modification. Having successfully made the transition from transistor to integrated circuit signal processing, manufacturers this year seem to be concentrating more on the "extras" rather than any full blown application of new technology to television receiver development.

Digital television signal processing for the home still remains ahead of us.

Most of the changes in the 1980 model television lines (of the manufacturers who responded to ET/D's annual survey to determine what's going on in the way of chassis innovation) involved upgrading rather than wholesale revision of older chassis.

There were, of course, the usual changes associated with field trials, but most of the innovation dealt with localized improvement in sound systems and electronic tuning.

Taking advantage of the "improved" sound being broadcast by some TV stations, i.e., anything over 5Khz, were Sylvania, Magnavox, Zenith and RCA. Quasar, incidentally, began this trend toward better sound three years ago with the introduction of Dynasound. Also, new electronic tuning systems, or at least later generation versions of earlier models, were added by Magnavox (Touch Tune), Quasar (Compumatic II), G.E. (Quartz Electronic), and Zenith (Touch Command). All, of course, are microprocessor based programmables.

RCA and General Electric provide us with the major chassis changes this year.

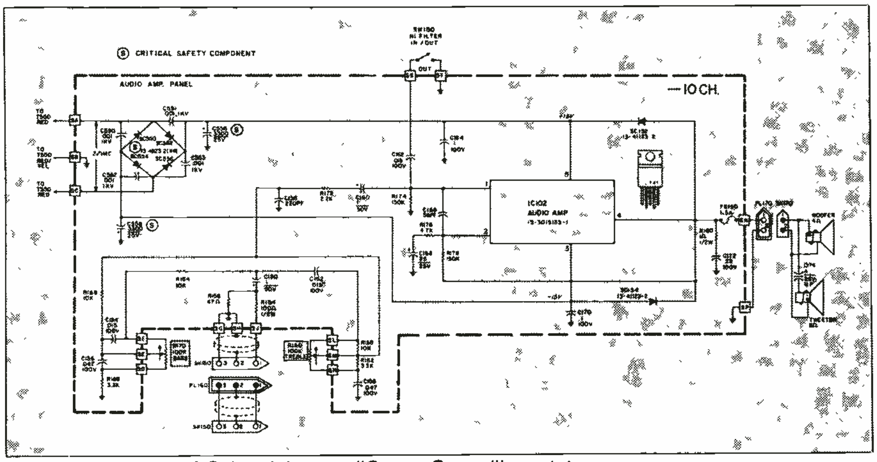


Fig. 1 Schematic of Sylvania's new "Super Sound" module.

RCA is out with a completely new color chassis, the CTC 100. With this unit, available in 25-and 19-inch models, RCA becomes the second in the industry to offer the high resolution picture detail capabilities available through use of the comb filter. (Magnavox introduced its comb filter system last year, see ET/D, Sept., 1978.)

General Electric, covered in more detail elsewhere in this issue, is out with a new "Energy Conscious" chassis for its 19-inch models. This unit features a new quartz crystal tuning system.

While we don't have specific circuitry information yet on the RCA CTC 100, preliminary reports from RCA say it continues RCA's emphasis of the "single board, repair in the home" philosophy reintroduced last year. The CTC 100, in addition to the comb (Dynamic Detail System) filter, also features a fully programmable tuning system (programmable up to seven days hence), and "Dual Dimension Sound."

Among the other major design changes are:

—The addition of Zenith's System-3, Triple Plus, chassis to 13-and-17-inch models.

—The addition of a SAW filter system for its IF strip (eliminating tuning coils) by Sanyo.

—And, a new "Velocity Modulated" picture tube for use in the new 26-inch set by Sony.

Sylvania

Sylvania reports its newest innovation, "Super Sound," consists of a 6-inch woofer and 3-inch tweeter to compliment the normal 6-inch speaker in its E48-10 chassis. Circuitry for Super Sound is located on a new module utilizing one IC chip. The chip, IC102 (see figure 1), is soldered into the board and is powered by an on-board bridge rectifier.

A crossover capacitor, C174, is a 4Mfd capacitor which assures that only high frequencies reach the tweeter. Sylvania warns, however, that all of the audio circuitry is still located on the IF board, 02-4502-2, which replaces, and is interchangeable with, the previous IF board. The older IF board, 02-45021-1, can be modified to serve the new Super Sound module simply by connecting a jumper between pin 12 of the sound IC and TA-8 on the IF module.

Also new to Sylvania is its portable,

Increase your viewing pleasure!

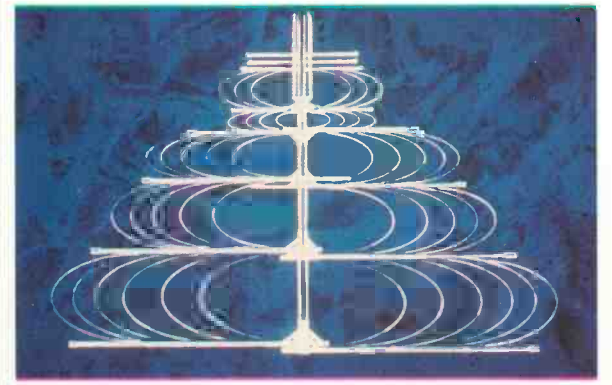
RCA Outdoor Antennas

RCA's Advanced Outdoor TV Antennas for Color and Black & White Reception

PERMACOLOR

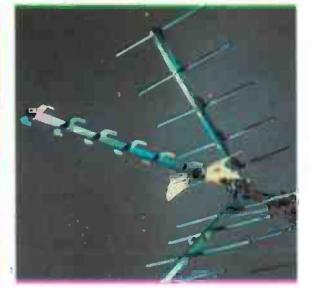
RCA presents Permacolor . . . the first antenna with solid, permanent connections from elements to feed line . . . the first antenna with pivoting, polypropylene insulators . . . the first antenna with a weather-proof blue and gold vinyl finish. There's a full line of antennas, including Permacolor UHF-VHF/FM combinations featuring an exclusive corner reflector-bow tie UHF section . . each one an easy to install, top quality performer in its class, for permanent "high fidelity" color reception.

And remember . . . Permacolor features tuned circuits which provide better performance with fewer elements.



Perma-tuned circuits . . . an original RCA development. Arrangement of elements forming tuned circuits results in full-range, all-channel reception which is maintained throughout the life of the antenna by means of solidly riveted connections of flexible aluminum between elements and feed lines.

Polypropylene insulators . . . an extremely low loss material that resists weathering for peak performance and long life. Entire insulator pivots and snaps into place. Holds its element over a span of almost 6 inches, for great strength.



Combination bow tie and corner reflector on UHF-VHF/FM models results in full range, no compromise, all channel reception.

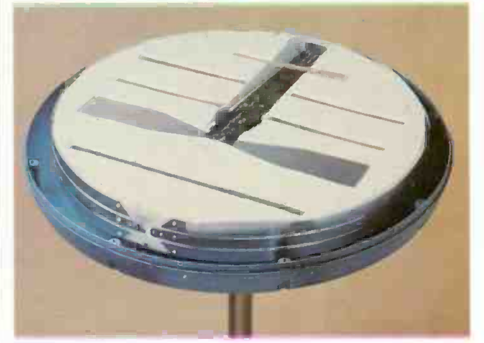
MINI-STATE

An exciting innovation in outdoor TV antenna technology has been created by RCA's antenna engineers so that now apartment dwellers and home owners alike can have an antenna system that will deliver the best possible TV reception.

The RCA Mini-State TV antenna system is the first true miniaturized rotating antenna system for UHF/VHF, color and black and white. It has been engineered to bring in sharp, clear TV reception in both metropolitan and suburban areas, up to 35 miles from transmitter. This compact outdoor antenna is small enough for use indoors if desired, just 21″ diameter, 7″ height and weight only 6 lbs.

AC-DC model 5MS550 also available for 12V DC and 120V AC operation on boats, RV's, vans, and homes.

Model 5MS440

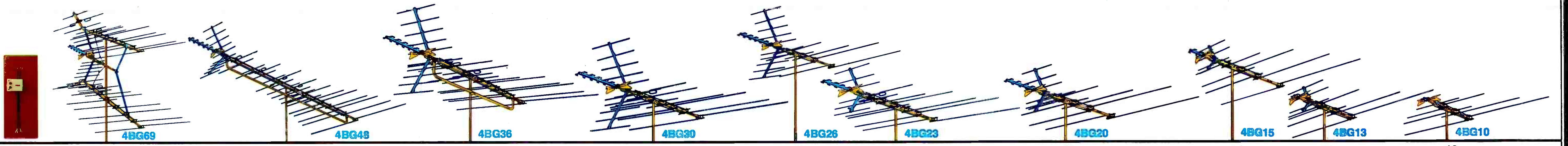


The heart of the RCA Mini-State TV antenna system is the unidirectional antenna, integrated solid state amplifier with interference filters, and motor driven antenna rotator unit completely enclosed in a space-age shaped plastic radome.

Hand-held remote control unit precisely aims the antenna, for top reception on any channel. Exclusive direction indicator light on unit shows the direction antenna is aimed.

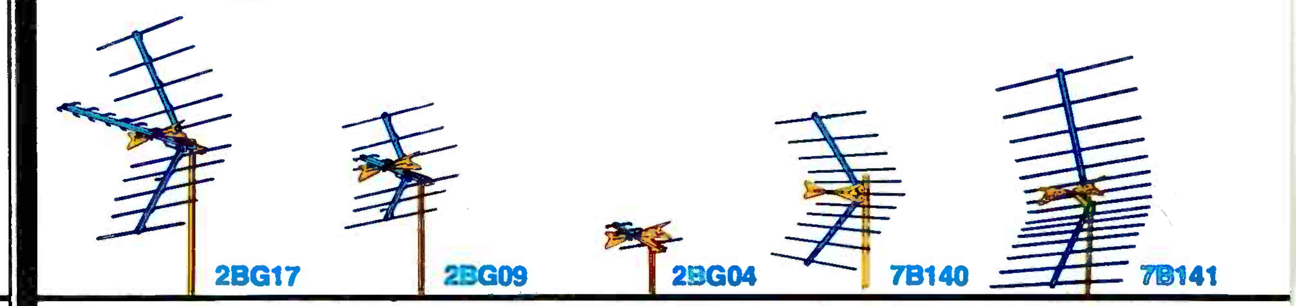
UHF-VHF/FM Outdoor Antennas

(Back of Set VHF/UHF 300 ohm Band Separator Included)



	4BG69	4BG48	4BG36	4BG30	4BG26	4BG23	4BG20	4BG15	4BG13	4BG10
Perma-tuned Circuits (Total)	69	48	36	30	26	23	20	15	13	10
Lo VHF (Ch. 2-6 + FM)	16	11	8	6	4	6	4	4	3	3
Hi VHF (Ch. 7-13)	20	20	11	7	5	6	5	4	4	4
UHF (Ch. 14-83)	33*	17*	17*	17*	17*	11*	11*	7*	6*	3*
Corner Reflector Size Height and Width	59″ x 24″	38″ x 23″	38″ x 23″	38″ x 23″	38″ x 23″	20″ x 23″	20″ x 23″	12″ x 23″	12″ x 26″	—
Overall Length	132″	198″	146″	104″	88″	94″	78″	67″	43″	39″
Maximum Width	108″	108″	108″	108″	108″	108″	108″	108″	97″	97″
Turning Radius For Rotating	86″	114″	92″	75″	68″	68″	68″	68″	54″	54″
Boom Type	Triple	Double	Double	Single	Single	Single	Single	Single	Single	Single
FM Reception Control Elements‡	Yes (8)	Yes (8)	Yes (4)	Yes (2)	No	Yes (2)	No	No	No	No
Available with Mounting Kit	No**	No**	No**	No**	Yes (4BG26 K or F)	No**	Yes (4BG20 K or F)	Yes (4BG15 K or F)	Yes(4BG13 K or F)	Yes (4BG10 K or F)

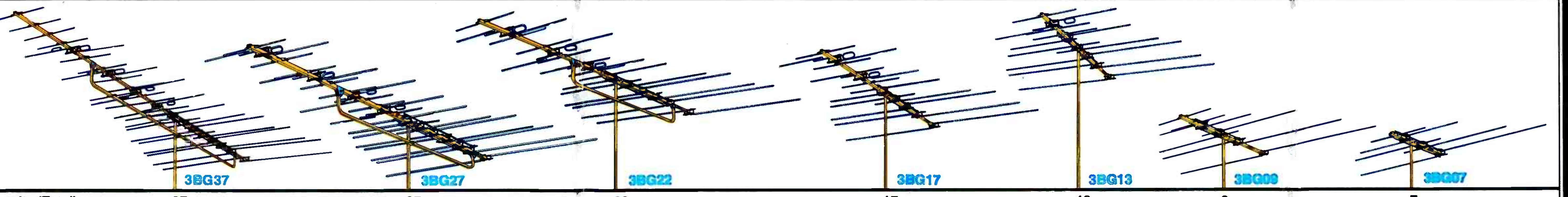
UHF Only



	2BG17	2BG09	2BG04	7B140	7B141
Perma-tuned Circuits (Total)	17†	9†	4	12†	16†
Lo VHF (Ch. 2-6 + FM)	VHF Antenna	VHF Antenna	—	—	—
Hi VHF (Ch. 7-13)	Coupler Built-in	Coupler Built-in	—	—	—
UHF (Ch. 14-83)	17*	9*	4*	12	16
Corner Reflector Size Height and Width	38″ x 23″	20″ x 23″	—	30″ x 22″	38″ x 28″
Overall Length	38″	22″	19″	—	—
Maximum Width	23″	23″	15″	22″	28″
Turning Radius For Rotating	36″	20″	17″		

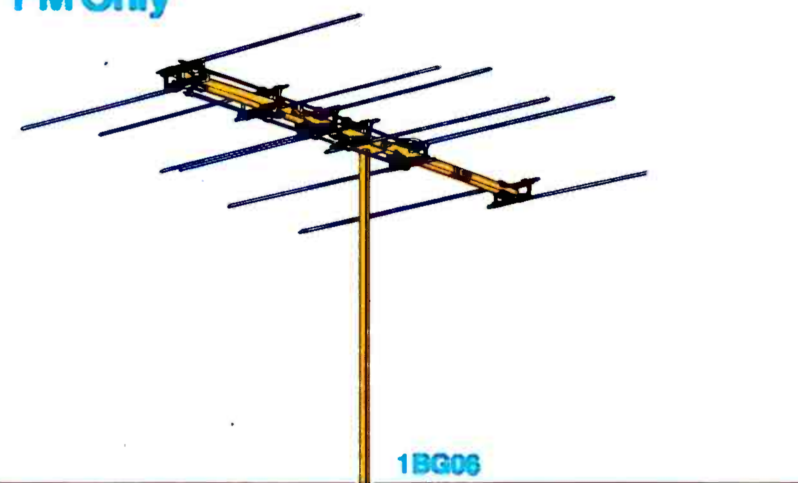
†These are aperture reflector type antennas in which the performance cannot be judged by the number of Perma-tuned circuits. Performance is more proportional to overall capture area as indicated by height and width.

VHF/FM Outdoor Antennas



	3BG37	3BG27	3BG22	3BG17	3BG13	3BG09	3BG07
Perma-tuned Circuits (Total)	37	27	22	17	13	9	7
Lo VHF (Ch. 2-6 + FM)	12	11	9	7	6	4	3
Hi VHF (Ch. 7-13)	25	16	13	10	7	5	4
Overall Length	203″	164″	134″	97″	77″	56″	33″
Maximum Width	108″	108″	108″	108″	108″	108″	97″
Turning Radius For Rotating	117″	92″	81″	75″	68″	62″	53″
Boom Type	Double	Double	Double	Single	Single	Single	Single
FM Reception Control Elements‡	Yes (8)	Yes (8)	Yes (6)	Yes (4)	Yes (2)	No	No
Available with Mounting Kit	No**	No**	No**	No**	Yes(3BG13 K or C)	Yes (3BG09 K or C)	Yes (3BG07 K or C)

FM Only



	1BG06
Perma-tuned Circuits (Total)	6
Overall Length	58″
Maximum Width	65″
Turning Radius For Rotating	43″

Prepackaged RCA Antennas With Mounting Kit

For single package convenience certain Permacolor Antennas (4BG10, –13, –15, –20 and 3BG07, –09, –13) include a kit of mounting hardware right in the antenna carton. These kits include everything needed for an average installation — a boon for do-it-yourselfers.

Each Kit contains:
1 — antenna
1 — 4 ft. universal tripod mounting base with one standoff installed
2 — Wood-screw standoffs
4 — 3″ drive screws
4 — neoprene washers

50 ft. transmission line:
"K" Kits include 300 ohm flat wire
"F" Kits include low-loss 300 ohm foam wire

"C" Kits include 75 ohm coaxial cable with "F" connectors at each end, plus 2 matching transformers and weather boot at antenna terminal end.

*Break-off elements provided to extend response from channels 70 to 83.

**Separate mounting kits are available without antennas as well as a complete line of RCA antenna installation hardware, masting and antenna system accessories.

‡Designed to reduce interference from strong FM stations. Break-offs provided if maximum FM reception is desired.

RCA | Distributor and Special Products Division | Deptford, New Jersey 08096

1W5499
Rev. 8/79

5-inch AC/DC chassis, MQ9014GY. A black and white unit, see block diagram Figure 2, the chassis power source for DC operation is nine, 1.5V batteries, or a car 12-volt "lighter."

The output of the regulator circuit is designed to operate at 11.5VDC. A B+ adjust is located at the base of Q901. The output should be measured at the CRT filament where it is necessary to maintain the 11.5VDC. An -11.5VDC is developed from the flyback system for use in bandswitching in the tuning system. This chassis also develops a 350VDC B+ for the focus anode, off of the flyback.

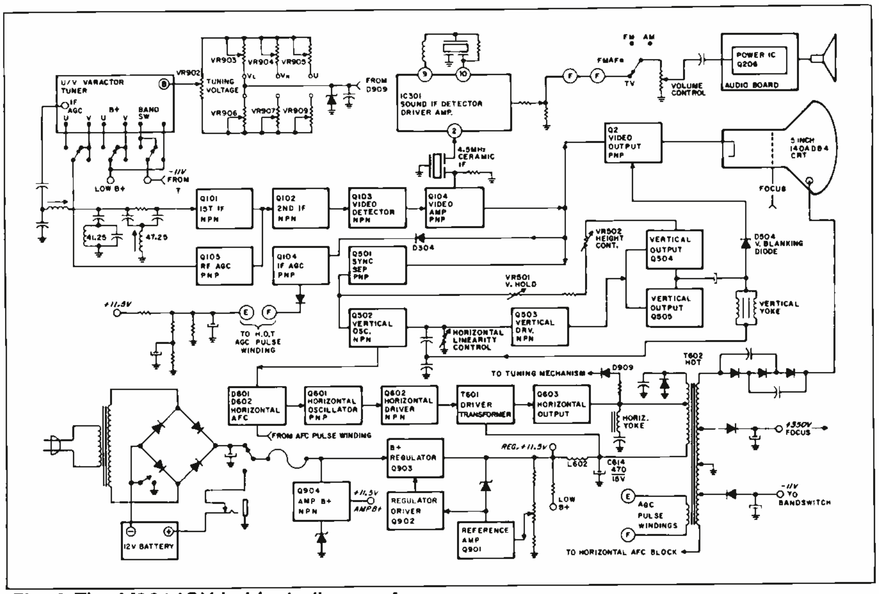


Fig. 2 The M9014GY in block diagram form.

Zenith

Zenith has introduced "Touch Command," its new microprocessor based tuning system, added Royalty Sound, and continued the proliferation of its Triple Plus chassis to its 13-and-17-inch sets in the color TV line.

Also recently introduced were a series of similar chassis in its 9, 12, 19, and 22-inch black and white line. These chassis, basically straightforward transistorized units, are the 9JB2X the 9JB4X, the 12JB2X and the 12KB1X the 19GB1X and 19LB1X and the 22LB1X. One difference in the 19GB1X is the voltage regulating transformer in the power supply. The secondary of this transformer is tuned to the 60HZ line frequency.

When the secondary resonates, the voltage increases and saturates the core material, preventing any further increase in secondary voltage.

In its color line, Zenith's Touch Command, the company reports, is "the first fully cable-ready television receiver" with random or direct access to VHF, UHF, and all 23 mid and superband cable channels. It is available in 25-inch consoles and 19-inch table models.

The improved sound in the 1980 line involves a special amplifier capable of 10 watts into 4 ohms over a bandwidth of 100-10,000Hz. Enhanced sound is produced with two oval woofers and two round tweeters and harmonic distortion, Zenith says, is less than 2 per cent.

These new Triple Plus chassis (13 and 17-inch) consist basically of four modules, M1, M2, M5, and M10. M10 is brand new and replaces the M3 and M4 modules in earlier Triple Plus chassis.

M1 is available in two versions, full or partial depending on whether the chassis contains a SWIF or not. The full version contains the IF and tuner circuits, sync, AGC, audio, and the master scan oscillator. The partial version does not have a tuner section. This version carries a video IF section with the SWIF, a new IF gain block IC, and a synchronous detector.

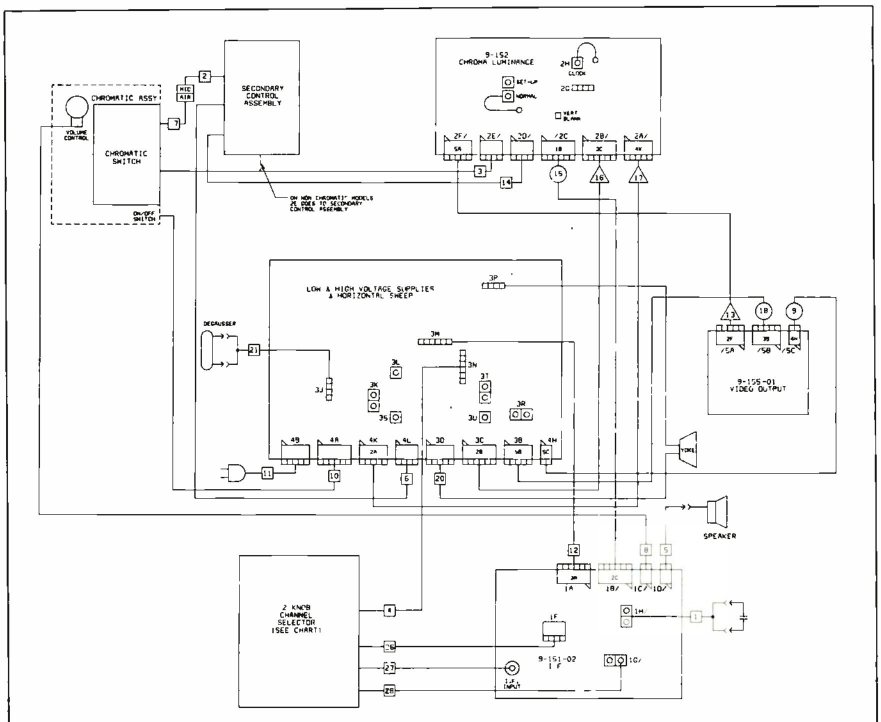


Fig. 3 The modular interconnect diagram for Zenith's L131C and 331 Triple Plus chassis.

M2 is the luminance and chroma circuit and M5 mounts on the CRT neck. This contains video output circuits and the CRT socket and a new mounting bracket.

M10 combines the functions of the previous M3 and 4 modules, including power supply and voltage regulation (Electronic Power Sentry).

Quasar

Quasar has three newly modified chassis out for 1980, known as its R-line. These are the TS970 and TS972, both using 25-inch, tri-potential, 100 degree deflection, in-line CRTs, and the TS973, with a 19-inch bi-potential, in-line. The 970 differs from the 972 in that the latter carries a ferroresonant transformer while the former is voltage regulated. All three new chassis contain Quasar's newly modified Dyna Module—the main circuit board.

All 972 models feature Compu-matic tuning and Dynacolor, Quasar's automatic flesh tone color corrector. The DTS972 features manual direct access tuning from a keyboard and LED channel display; the EDTS972 carries direct access channel selection, LED display, channel up/down, and a channel seek function—plus "audio spectrum" enhanced sound.

AEDTS972 carries infra-red remote control direct access channel selection, up/down, seek, and remote volume control and on-off—plus audio spectrum sound and on-screen channel display.

Both the 970 and 973 chassis are also available with numerous feature variations.

The new R-line is similar to Quasar's 1979 Q-line except that all new chassis feature full range customer controls with the Dynacolor on or off. Additionally an emitter follower transistor, Q302, has been added for improved isolation between the video line and IC501, the sync and noise inverter stage.

Quasar says that all versions of the 973 chassis contain a new audio IC201. This chip has been changed from an AN5210 to HA1364. Eventually this change will cover all chassis versions.

A second generation electronic tuning system, Comput-Matic II, in manual or remote form, has been added in some models by Quasar. Compu-Matic is Quasar's two-digit channel selection system (02 for channel 2 and 36 for channel 36). The difference between Compu-Matic II and the earlier version is that the latter contains the channel seek function and a manual/automatic switch.

When the appropriate buttons are pressed on the keyboard the seek function causes the tuning system to search for a station that is on the air. The system also contains an adjustment for skipping weak and snowy stations if desired. During this operation the audio is muted and the picture blanked out.

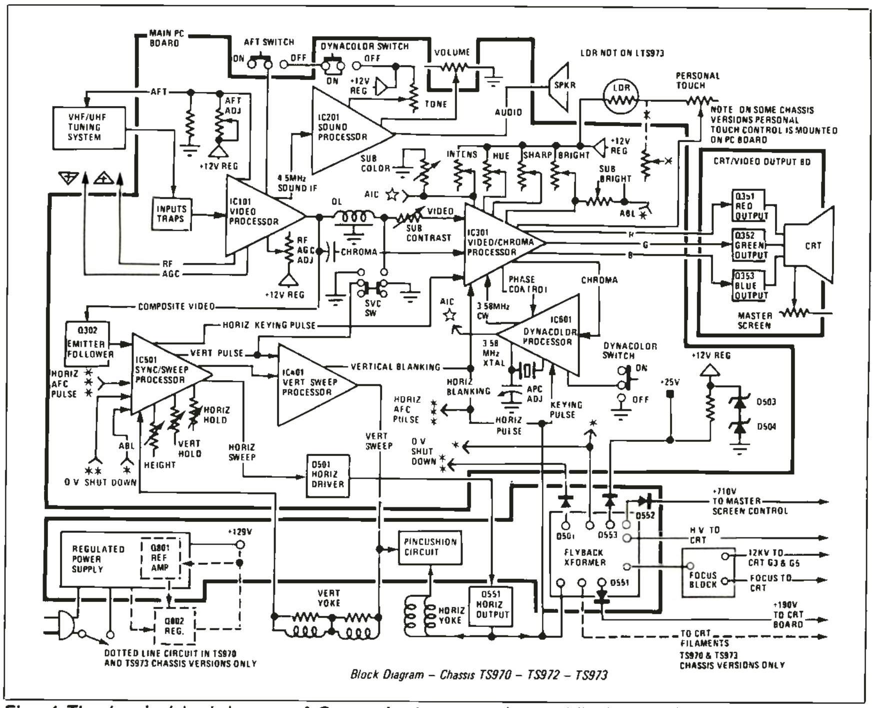


Fig. 4 The basic block layout of Quasar's three newly modified chassis, the TS970,972, and 973.

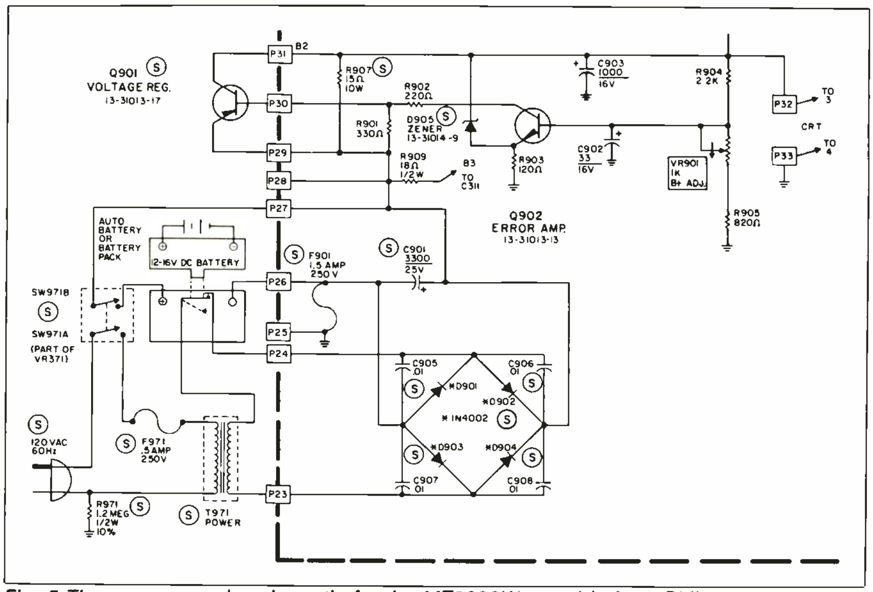


Fig. 5 The power supply schematic for the MT9022W portable from Philco.

Philco

Philco enters the 1980 model year with a slightly modified E25 color chassis and two new black and white chassis, the B384LWA nine inch model and the 12-inch B451WA. Both are AC/DC models. The 9-inch set is also common to Sylvania where it is identified as the MT9022W chassis.

Both models use similar chassis. One difference from previous black and white models is that there are now two AGC adjustments, RF and IF.

These models are impossible to operate in the AC mode with the battery plugged into its socket since a switch leading to the power transformer is open until the battery is unplugged. This prevents grounding the bridge rectifier diodes through the transformer and thus discharging the battery. (See figure 5.)

These black and white units use a 12 to 16 volt battery. When running off the AC line, a bridge rectifier feeds regulator transistor Q901. A special B+ adjustment in the circuit should be set to provide 11.5VDC at the filamets of the CRT.

Another change from previous black and white models is a new flyback

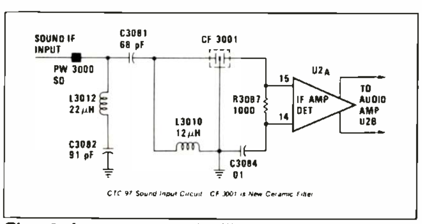


Fig. 6 A new ceramic filter, CF3001, replaces the transformer/capacitor tuned circuit in the CTC97's audio channel.

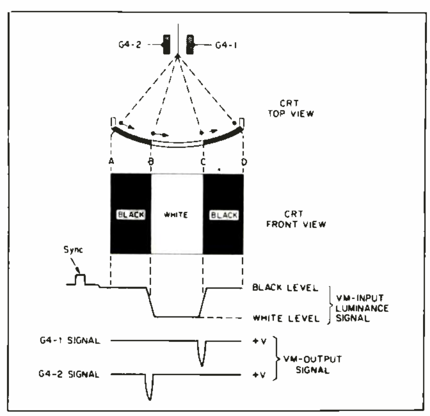


Fig. 7 Sony's newest, Velocity Modulation, controls electron beam scan speed in the new 26-inch CRT for sharper edge enhancement in black to white, and white to black switching.

system. It is now a tapped autotransformer with the second anode voltage taken directly off the top. This provides about 300 VDC more than the previous method of using a secondary winding.

In its color line, Philco has made changes in the video chroma and sync circuits in the E25 chassis, improved selectivity in the IF strip, and added a new split-diode flyback transformer.

The former changes involve the elimination or addition of certain components and component value changes. For instance the elimination of two components in the chroma section, plus the addition of new values of capacitance, inductance, and resistance have added to improve chroma bandpass, better color reproduction and fewer beat patterns.

The addition of the new flyback assembly in the E25 results, Philco says, in better high voltage regulation, better tracking, more brightness and picture drive, and greater reliability.

Essentially the circuit consists of four multiplier diodes in series, capable of producing 30KV, depending on individual model requirements.

General Electric

GE has produced a new color chassis, the EC, which will be used in all 19-inch 1980 models. It brings power consumption down from 143-to-100 watts in this CRT size chassis, GE reports.

Also new to GE is its all channel quartz crystal referenced electronic tuning system, and a new VIR arrangement using fewer components.

The quartz crystal tuning system eliminates the need for fine tuning, GE says, since oscillator is phase locked to a reference crystal. GE's second generation VIR system uses a new integrated circuit to reduce the number of components and GE has added a light sensor in all VIR II models to adjust automatically for room brightness.

This new EC chassis uses five modules which are replaceable and two reparable boards.

RCA

RCA is continuing on with its frequency synthizesed "ChanneLock" tuning system introduced last year (see ET/D, Sept. 1978), and in addition, has added the AD162 black and white chassis in the 16 inch screen size. Other new monochromes from RCA include 9-inch AD091 and the 16-inch D191.

RCA's most recent introductions, previous to the new CTC100 chassis, were their CTC96 and 97 chassis—part of the 1979 line. Both chassis are very similar to the CTC87 introduced early last year as part of the 1979 line.

The CTC96 uses a KRK252A VHF "stick" type tuner. The UHF tuner is 70 position dentent. The CTC97, meanwhile, comes in a variety of tuner arrangements, including frequency synthesis. According to RCA, the CTC97 may be serviced using the same techniques as employed on the CTC87 because of chassis similarities.

The 97 is currently used in nine 1979 models, including 13, 17 and 19 inch screen sizes.

Here are some of the differences in the 97 chassis. The audio channel has been modified to include a permanently pre-tuned, ceramic filter (see figure 6). This replaces the previously used transformer and capacitor tuning circuit. Additionally, the focus voltage has been raised from 3-to-6KV to 6-to-8KV. This has required use of a separate connector assembly and changing most of the values of components in the focus/screen divider string.

Sony

Sony several months back came out with its new 26-inch CRT, which is used on its Alpha chassis. This CRT uses a new circuit which Sony says is designed to increase picture sharpness at lower video frequencies. It is called the Velocity Modulation (VM) circuit.

This CRT contains a new electron gun assembly with a double section focus electrode, G4-1 and G4-2 (see figure 7). According to Sony, the VM circuit develops output signals based on the luminance amplitude and its maximum effect is when the luminance signal switches between black and white. During the "switching" period, the VM circuits develop a negative pulse as its output.

Referring to figure 8, circuit operation is as follows: when the electron beam is at point A, voltage at both G4-1 and G4-2 is equal and the beam velocity is controlled by the magnetic field developed by the deflection yoke. However, at point B, where the signal switches from black to white, the voltage at G4-1 is more positive with respect to G4-2 because of the pulse developed by the VM circuit. The resultant effect on the electron beam is to speed it up. Sony reports that as the luminance signal

continued on page 55

Servicing early Betamax VCR's

An overview

Here is a review of some of the major electronic circuitry in early Betamax units, including a look at servo timing circuits and key test points.

By Robert L. Goodman, CET

The purpose of this article is to introduce you to VCR circuits and ways to utilize the dual-trace triggered-sweep scope to locate problems in this relatively complicated video recorder system. Some selected circuits and scope techniques will be covered in detail to help start you on your way to VCR servicing.

Sony's Betamax One VCR format was introduced in the U.S. in late 1975. This is a half inch wide tape cassette system, capable of one hour playing time. Two video heads are used with full frame recording. The tape is threaded by pulling the tape out of the cassette and around the head drum. The Betamax One recorded track pattern is shown in Figure 1.

The recorded, slanted tracks of this Helical scan system are 60 microns wide, with no spacing between tracks, thus no guard bands. This is accomplished by two arrangements that reudce the cross talk effects. Luminance signal cross talk from track to track is avoided by the slanting of the two head gaps relative to the tracks. This is called the Azimuth technique. Color cross talk cancellation occurs because of a more involved signal phasing system involving a comb filter. Refer to drawing in Figure 2 for the recorded signal spectrum of the Betamax One format.

**Block diagrams courtesy of Zenith Radio Corp.*

The Sony two hour Betamax has the same cassette and tape length, but the Capstan speed has been cut in half. The slant track pitch is now 30 microns instead of 60. The head track has been reduced from 60 to 40 microns. This results in a negative guard band and produces overlapping tracks. The Azimuth and comb filter techniques, however, provide adequate crosstalk rejection. This system results in very low tape consumption.

The Sony made machine—Note photo of drum head closeup in Figure 3—has a very easy tape threading arrangement. The tape guides are fixed and the guides are at 90 degrees to the tape motion and can be rotated for lower tape friction. The video tape is wrapped around the drum. A long piece of tape is pulled from the cassette, thus isolating the tape from cartridge feed irregularities which results in fewer time base errors. The tape cassettes are good for about 200 passes (plays) before the video quality will be degraded significantly.

This VCR is designed to provide good serviceability. The printed circuit boards are very neatly arranged and hinge out so they can be serviced from both sides. Greater use of IC's specifically designed for this purpose produces good reliability. Note the photo in Figure 4, of the case removed from the VCR in order to clean the head, troubleshoot and repair the system.

Technical operation

The video signals in helical recording systems process the luminance information separately from the color information. The audio signal is not recorded in the helical format but is recorded longitudinally along one edge of the tape. A third signal track referred to as a "control track" is also recorded

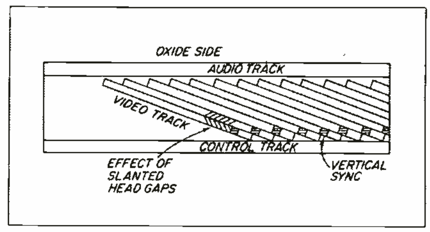


Fig. 1 The VCR track pattern

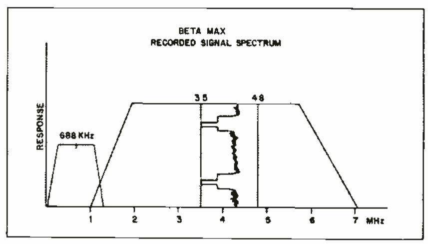


Fig. 2 The Betamax signal spectrum

longitudinally. The control track provides reference pulses used to resynchronize the spinning head to the slanted video tracks during playback.

The spinning video heads are part of a mechanical phase-locked-loop system. The synchronous motor that drives the head assembly is designed to operate at a speed slightly faster than required for proper playback. A fixed head picks up the control track which tells the deck exactly where the slanted video tracks are recorded. A second circuit (magnetic sensor) determines the position of the spinning video head assembly which has permanent magnets as reference points. A phase detector then determines the phase relationship of the heads to the control track pulses. The output of the phase detector controls a magnetic brake which varies the spinning head speed the proper amount to line up the playback head with the slanted video recorded tracks.

Electronics inside a VCR is divided into 5 main systems.

1-Luminance video circuits,

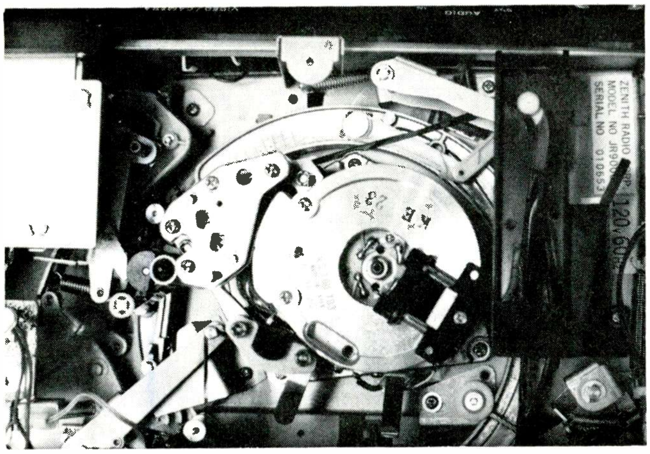


Fig. 3 View of the recording drum and tape heads

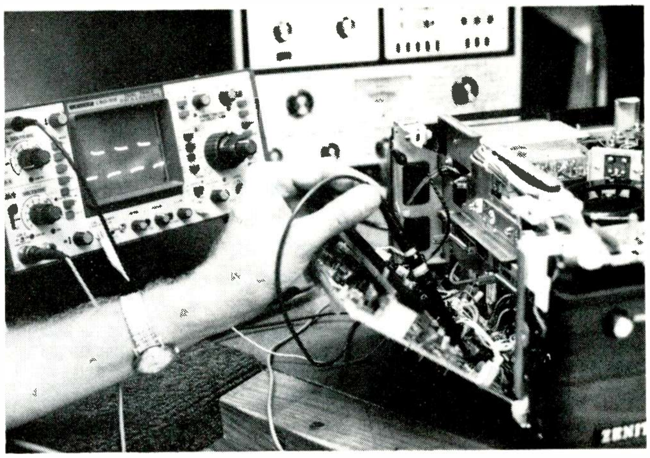


Fig. 4 Slant down boards aid circuit accessability

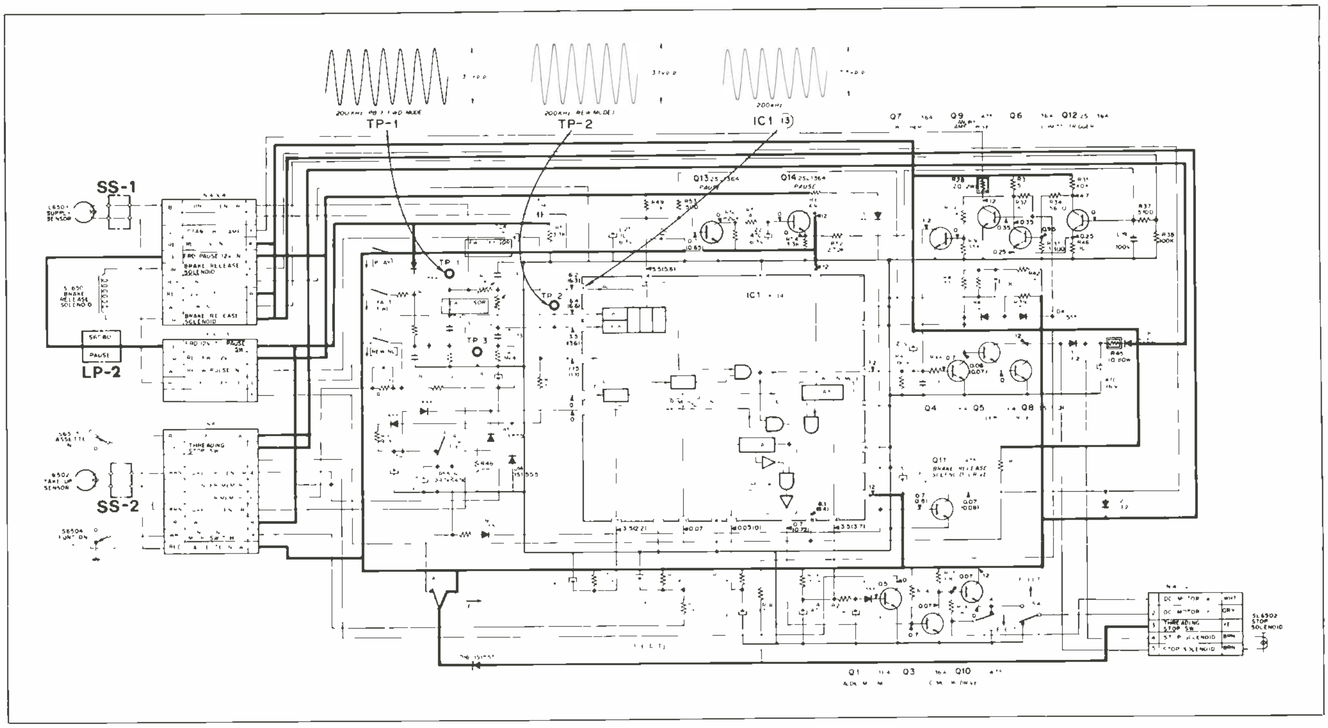


Fig. 5 The SY-2 system circuit diagram

record and playback.
2 - The chroma circuits, record and playback.
3 - The servo circuits that control the spinning record/playback heads.
4 - Sound circuits.
5 - The input/output circuits. This includes the RF tuner, IF amplifier-video and RF modulator unit.

SY-2 system control

This circuit controls all the tape functions in the VCR machine. Some of the functions are as follows: Auto stop, brake release, tape threading, drum rotation detection circuit and motor threading. IC1 (CX-141) is the heart of this total system and is shown in the Figure 5 circuit diagram. Some of the key scope check points are TP-1, TP-2 and pin 13 of IC1 as noted on the circuit diagram. A 200 KHz signal as shown in the top trace of Figure 6 should be found at pin 13 of IC1 during all tape operation modes. The 200 KHz signal shown on bottom trace of Figure 6, TP2, should occur only in the tape rewind mode of operation. And the 200 KHz signal at TP1 should be present only in the play-back and fast forward tape modes.

Chroma record signal

The chroma record signal is processed with IC2 (CX-133A) which is located on the YC-L board which is located on the bottom of the machine (Figure 7). Some of the functions that take place in this circuit are briefly described as follows:

The chroma record system operates as a record ACC (automatic chroma level control), as a color killer, and performs the frequency down conversion to 688 KHZ.

Referring to the block diagram in Figure 7, you will see that the video signal is fed to a 3.58 MHz bandpass filter at which point the chroma signal is separated.

The filter output is then fed to the ACC gain-controlled amplifier. This circuit is similar to the ACC control range in some TV chassis. This amplifier controls the gain to keep the burst signal at a constant level.

The ACC output goes to a frequency converter and burst gate circuit. Also going to this circuit is a delayed horizontal sync input pulse. This opens the burst gate at the proper time to allow only the burst through. This burst signal is then coupled to the burst transformer and then to a crystal ringing filter circuit which converts the burst signal to a CW signal. The amplitude of this CW signal is proportional to the amplitude of the burst signal and is fed into pin 6 of IC2. The filtered CW signal is then amplified to a level high enough to drive the ACC detector citcuit. The ACC peak detector detects the CW signal and compares it with the reference voltage to obtain an error voltage. The ACC output level can be adjusted by changing the reference voltage.

In essence, the converted chroma signal recorded on the tape retains the same level relationship as did the

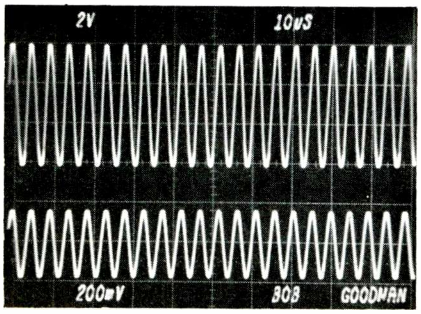


Fig. 6 Top: 200Khz signal at pin 13 of IC1
Bottom: 200Khz signal at TP-2

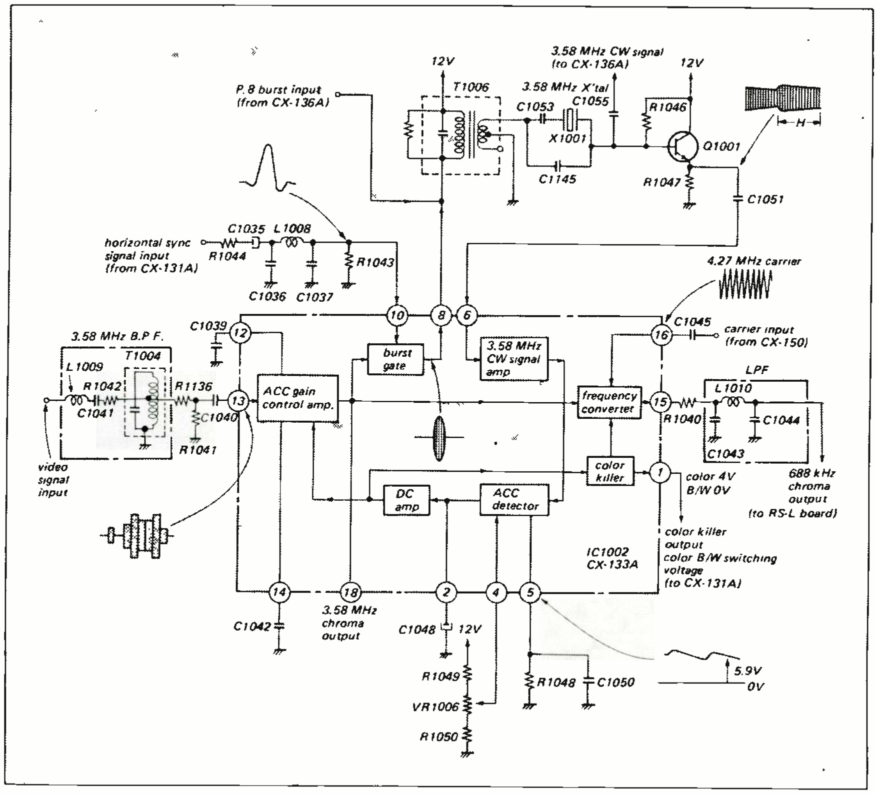


Fig. 7 Block diagram of the chroma playback circuitry

original chroma signal. Thus, if the recorded video tape chroma level is different from the original TV program (color too strong or too weak) then this circuit may be defective.

The scope can be used to check for the waveforms shown on the block diagram in Figure 7. A chroma signal should be found at pin 13 of IC2, a delayed horizontal sync pulse at pin 10, the 3.58 MHz CW signal at pin 6, and a 4.27 MHz input signal at pin 16. There should also be a 3.58 MHz chroma output at pin 18 and a 688 KHz chroma output at pin 15 of IC2. If all input signals check correct on the scope then IC2 may be defective. Of course, make sure all DC power voltages are correct.

Chroma playback (IC4)

In playback mode the RF signal is received from the RF playback amplifier. This signal contains both the chroma and Y-FM signal. This signal is routed through a low pass filter which rejects the Y-FM signal, extracting only the 688 KHz chroma signal. This point is at pin 15 of IC4 as shown in the Figure 8 circuit.

The 688 KHz signal is fed to an ACC gain control amplifier. The DC voltage, obtained by detecting the playback burst signal, is also fed to this stage. The feedback loop thus formed adjusts the gain of the ACC amplifier so that the burst signal level remains constant. Sinc෴ separate capacity stage circuits for the ACC detection output are provided for each channel, the ACC loops are independent for each of the two heads, thus no chroma output level is noted even if a large level difference exists between the two head outputs.

The signal now passes through the 3.58 MHz filter and then to an emitter follower circuit-pin 4 of ICR—and is coupled to the comb filter, where the cross talk component is removed. The scope signal at pin 4 is shown on the top trace of Figure 9. The comb filter output is fed to an output amplifier and then to the Y/C mixer.

Count-down circuits

The sync separator, horizontal pulse generator, and divide by 44 countdown circuit form a part of the AFC loop. The; circuit—note block diagram and scope waveforms in Figure 10—is located on the YC-L board. The scope is used to check on operation of the monostable multivibrator (MMV) and the divide by 44 countdown circuit. The correct trapezoid horizontal pulse is shown on the top scope trace in Figure 11 that should be found at pin 5 of IC5 (CX-145). The bottom scope trace was taken at the emitter of Q6, also located on the YC-1 board. This was scoped during the playback of a NTSC test tape.

Phase inverter and burst ID

IC1007, shown in the Figure 12 block diagram, contains a carrier signal phase inverter circuit and the burst ID circuit.

The carrier phase inverter consists of a flip-flop and switching circuit. A 4.27 MHz Carrier signal is phase-split by the phase-splitter transformer T15. The output from the secondary of T15 is fed to the switching circuit via pins 8 and 9. The normal phase 4.27 MHz carrier is fed to pin 8 and the out of phase carrier to pin 9. The dual-trace scope probes can be connected to pins 9 and 8 of IC1007 to check on the 4.27 MHz signal and for the phase shift from T15. The dual-trace waveforms in Figure 13 show the normal signals found at pins 9 and 8. Note the phase shift. The switching circuit is driven by the flip-flop output and the RF switching pulse, both of which are fed to the switcher through an OR gate. As you will note in Figure 12, the flip-flop is triggered by a horizontal pulse and toggles at the horizontal rate. The output of this flip-flop and the 30 Hz RF switching pulse are applied to the OR gate. The output of the gate is waveform (7) in Figure 14. The 4.27 MHz carrier output from pin 5 is fed to the chroma frequency converter circuits of the record and playback systems. Check with the scope at pin 5 for the 4.27 MHz signal to see if the IC switch is working properly.

The 688 KHz recorded chroma signal is phase inverted line-by-line on every track recorded by the "A" head. When this signal is recovered, it is necessary that the switching phase of the 4.27 MHz

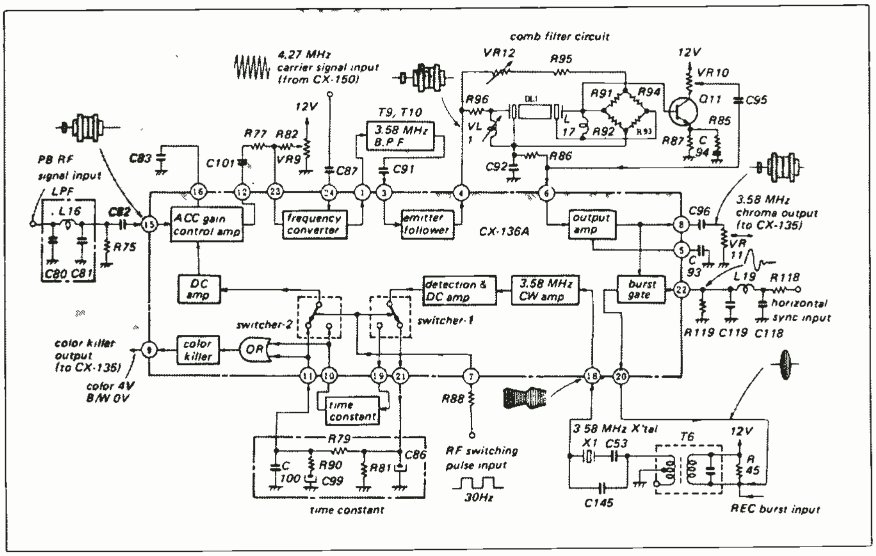


Fig. 8 Block diagram of the chroma playback circuitry

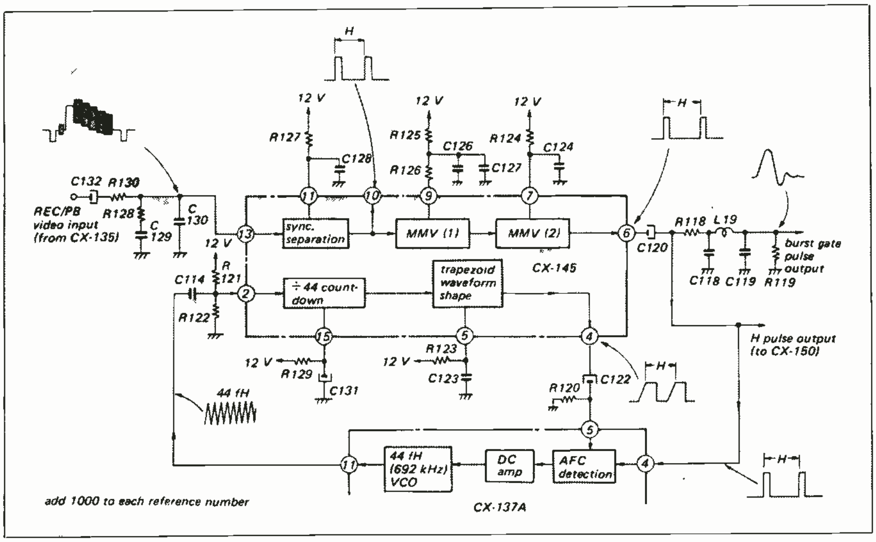


Fig. 10 Block diagram of the sync separator and countdown circuits

carrier be phase inverted line-by-line. Since the switching is done by a flip-flop toggled by a horizontal sync pulse, a signa loss due to drop-out would mean there is a good probability that the flip-flop will be in the wrong state at any given line of playback. To prevent this, a circuit is provided which determines the state of the flip-flop relative to the playback signal on a line-by-line basis and resets it as required. The circuit is a burst phase ID circuit that compares the phase of the playback burst signal against the 3.58 MHz stable crystal reference oscillator. Another scope check point would then be pin 11 of IC1007 for the 3.58 MHz oscillator signal. This 3.58 MHz signal is a burst phase reference in the playback mode. When the APC loop is locked, there is a 90 degree phase difference between the playback burst signal and the crystal reference oscillator. The output signal from the reference oscillator is fed through a 90 degree phase shift network before it goes to the phase comparator. This places both the oscillator signal and the playback burst signal at the same phase.

Whenever a phase inversion occurs between the two signals, due to misorientation of the flip-flop, a large output error signal is produced at the phase detector. This error signal pulse is fed to the flip-flop, through the second input of the OR gate than that through which the flip-flop is normally toggled by the horizontal sync pulse, and forces the flip-flop into the correct state.

Servo and pulse systems

The head servo system is operating while all of the video signal processing is taking place. The composite video input signal is fed to a sync separator which has the vertical sync pulses at its output. A second signal is fed to the servo circuits from the spinning disk of the video heads. This signal (called the "PG" or "pulse generator" pulse) is generated by a permanent magnet located on the video head disc assembly which passes over a pickup coil as the heads rotate. The phase between the PG pulse and the vertical sync pulse is compared and the speed of the head disk is varied until the two signals are in phase with each other.

The vertical sync signal is also fed to a stage that divides the frequency in half. This 30 Hz signal is fed to a recording head along the tape travel path. This head records the 30 Hz "control track" which will be used as a reference to

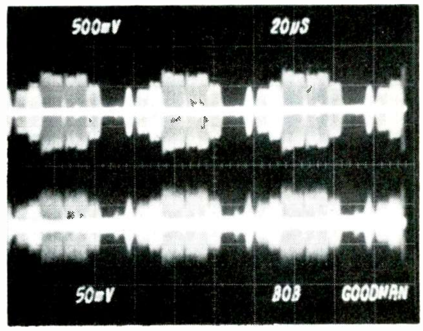


Fig. 9 Chroma dual trace signals

control the servo circuits during playback.

The head drum is belt driven by an AC synchronous motor. The drum's free running speed is set slightly higher than the desired speed, and speed regulation is achieved by applying braking action. This brake is controlled by the Servo System.

The Servo System controls the speed of the head drum only. The pulse system produces switching signals used in switching between heads A and B and in switching the 4.27 MHz carrier.

The two video heads are mounted 180 degrees apart on the periphery of the head disc. Two magnetic pole pieces and PG coils, are also mounted on the disc. The 30 PG (A) signal is used in the drum servo system. While the 30 PG (A and B) signals are used to produce the RF switching pulse. Use the scope to check for these pulses. Refer to servo timing pulse charts in Figures 15 and 16.

The pulse generated by the 30 PG (A) coil is amplified by the 30 PG (A) amplifier, see Figure 17, and from there to both the lock PG delay multivibrator and delay MMV2. Both delay multivibrators are one shots, toggled by the 30 PG (A) pulse and both produce rectangular shaped output pulses. The output from (monostable multivibrator) MMV1 toggles a second one shot, MMV4, which squares the signal into a 50% duty cycle waveform. The output from MMV4 is passed through an

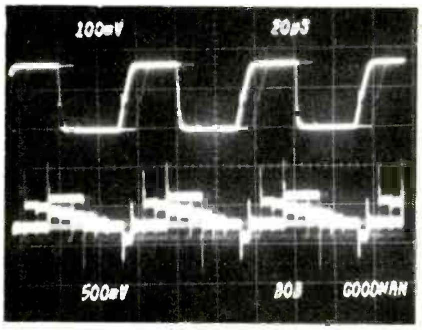


Fig. 11 Top: pin 5 of IC5 (.2 volts pp)
Bottom: Emitter of Q6(1.5 volts pp)

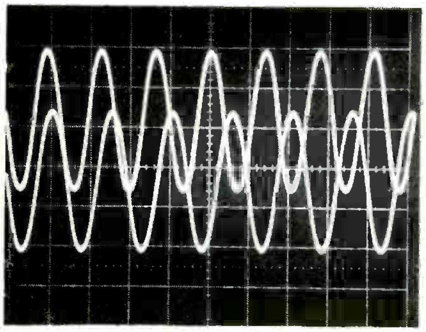


Fig. 13 Correct phase relationships at pins 8 and 9 of IC1007

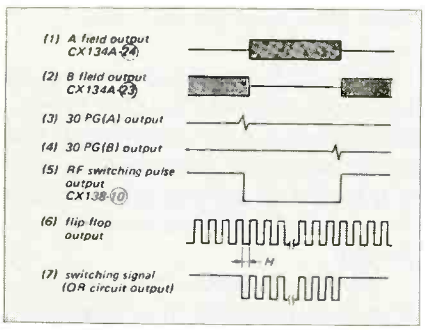


Fig. 14 The OR gate waveforms

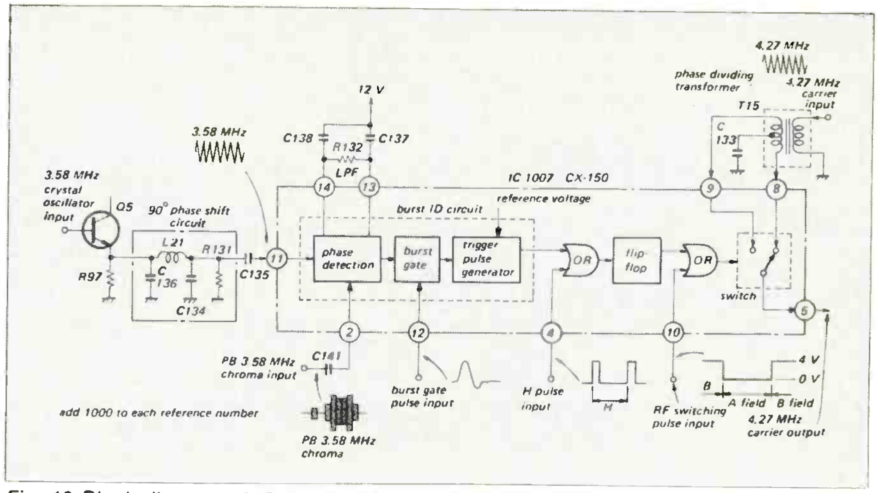


Fig. 12 Block diagram of IC1007

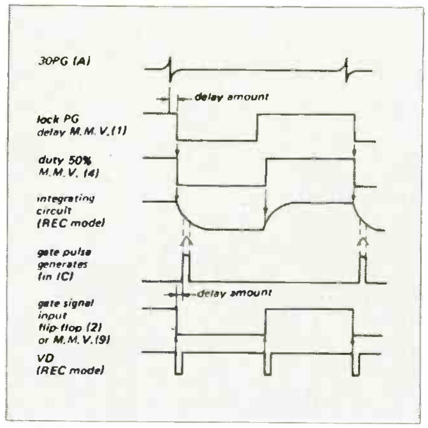


Fig. 15 Timing chart for Servo signals

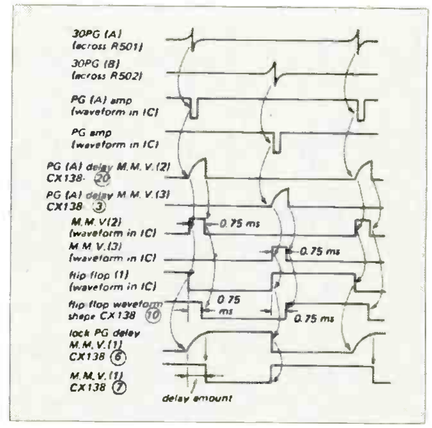


Fig. 16 Timing chart for the 30Hz pulse generator circuit

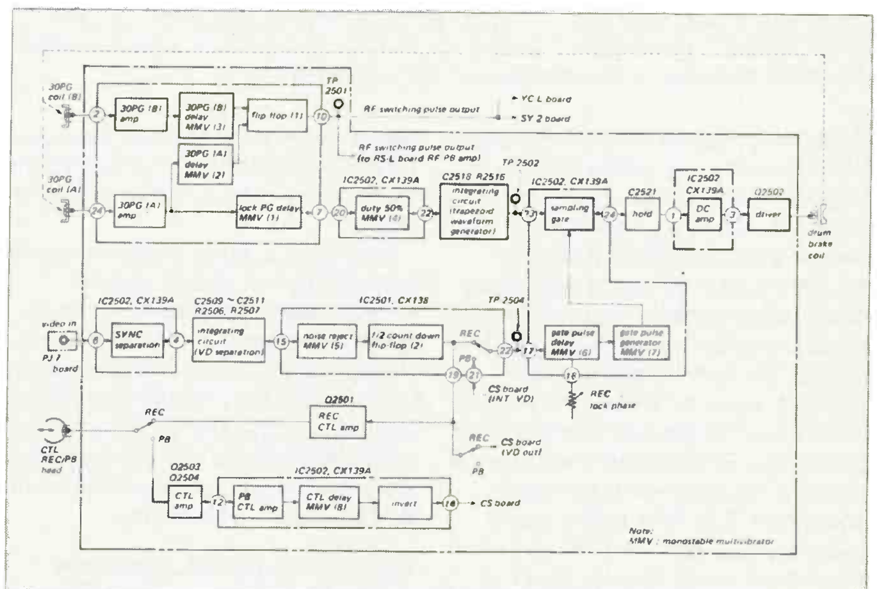


Fig. 17 The servo circuit block diagram

integrator network which converts the squarewave into a trapezoidal waveform. Use the scope to see if the pulses are being processed properly in the flip-flop and count down "chips" found in the servo system.

The sync-separator

The composite video is fed to the sync-separator and then passed through an integrator network that removes only the vertical sync pulse. This is fed to a one shot in the MMV5 which eliminates noise. The output from MMV5 toggles a flip-flop which divides and shapes the signal into a 30 Hz square-wave. This signal is used in the record mode as the control (CTL) signal. It is also applied to a gate pulse to delay the one shot MMV6 which in turn toggles MMV7, the Gate pulse generator. The gate pulse is fed to the sample gate along with the trapezoidal 30 PG (A) signal. In the sample gate the two signals are phase-compared and the sample voltage stored in a hold circuit. This stored voltage is amplified by DC amplifiers and controls the drum brake coil driver transistor.

To lock-up the Servo on playback, a 300 Hz oscillator is phase-locked to the line frequency and counted down by a 1/10th count down circuit which will form a 30 Hz square wave at test point 4604. This is a good scope test point to go to if you encounter Servo problems. This pulse is transferred to the tracking control circuit where it becomes the servo reference voltage during playback.

The servo control circuits of a video recorder simply compare two signals to indicate that the video heads are in the correct position during both recording and playback. During recording, the two signals are the vertical sync pulses and the head position signal PG pulse). The two signals should arrive at the servo comparison circuits at the same time. The dual-trace scope is a must for evaluating this action. If they are not properly timed, the servo circuits adjust to rotational speed of the video heads until the two signals correspond.

During playback, the same head reference pulse (PG pulse) is compared with the output of the control track head. Again, the two signals are compared and the speed of the rotating head disk is adjusted until the two pulses are properly timed. Signal pulse injection may also be used to analyze some sections of the servo circuits that are difficult to analyze using the scope or other troubleshooting techniques.

Signal injection works very well when combined with the scope for signal tracing. Just inject the substitute signal at the input to a stage and monitor the resulting signal at the output of the same stage or one that is supposed to be controlled by the injected signal. Many circuits in the VCR require that both the amplitude and the waveshape of the signals be correct. In these cases, the use of an oscilloscope is essential. The combination of both signal tracing and signal injection in many cases provides the best analyzing techniques.

Servo timing circuits

The vertical sync signal, separated from the video input signal, becomes the servo reference signal in the record mode. Note block diagram in Figure 18. The filter rejects chroma burst signal and high frequency noise. The video output is connected as an input to the RS-L board. If you have servo and timing trouble, check with the scope and see if you are getting the proper video signal input at this point.

The video signal is sync-separated in the circuit between pins 6 and 4 of 1C502. The sync separation circuit consists of a feedback clamp circuit for sag correction and a switching amplifier. An RC integrator circuit separates the vertical sync from the sync separator output and triggers the noise elimination one-shot, MMV(5), via SW(1) of 1C501. SW(1) switches to the pin 15 side for a zero volt input at pine 16 and to the pin 14

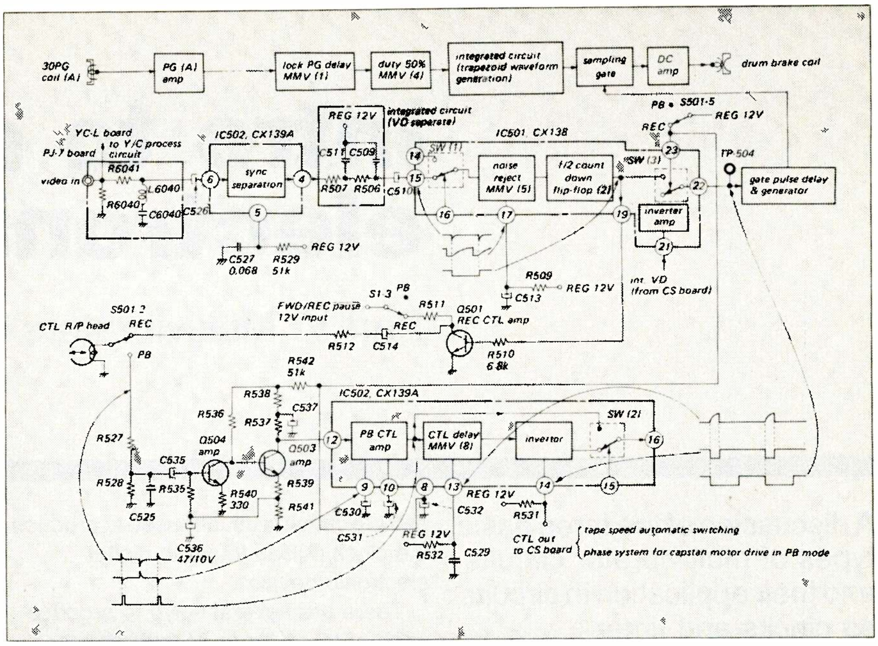


Fig. 18 The vertical sync and CTL (control) signal circuits

side for 12 volts. The noise elimination one shot, MMV(5), eliminates noise by the fact that a one-shot, once toggled, cannot be toggled again until after it has reset itself. The external circuit at pin 17 is the time constant network for MMV(5). The 60 Hz vertical sync signal is divided into a 30 Hz square wave in the divide by 2 flip-flop. The 30 Hz square wave passes through SW(3), and appears as the gate signal output at pin 22.

The negative-going transition of the flip-flop output becomes the servo reference phase that is used on the video tape control track. Thus, the internal vertical reference signal becomes the gate signal for control of the drum servo.

Phase comparison gate

In the phase comparison circuit a trapezoidal waveform is produced from the 30 PG pulse versus that is sampled using a gate pulse produced from either the vertical sync signal or the internal vertical sync signal. The gate output is amplified in a DC amplifier to drive the head drum brake coil. In some cases the CTL (control) signal may drop out due to clogging or dust on the head. In the CTL/INT vertical sync system, the hold voltage is fed to the DC amplifier until the CTI signal returns to its normal state. In this way, the influence of the CTL drop-out on the reproduced picture is minimized.

An NTSC color video test tape or generator is a must for servicing this unit, to monitor tape machine performance.

It should be stressed that because of the complex nature of the circuitry of these machines, we have only touched on a limited amount of service information in this article. Indeed, thick manuals are available to cover all of the electronic service adjustments. ET/D

Intro to digital electronics

Part V: Multivibrators and timers

A discussion of the three basic types of multivibrator circuits and their application in circuits as clocks and timer-controllers.

By Joseph J. Carr, CET

Thus far in this series, we have covered the IC logic families, the various different types of gate, and assorted types of flip-flops. In this installment, we are going to discuss multivibrator and timer circuits.

A multivibrator is basically a pulse producing circuit. There are three basic types of multivibrator: *monostable, bistable,* and *astable*.

As you might guess, these labels refer to the stable states of the output possible in each circuit. The monostable multivibrator has but one stable state (usually Q is LOW). Triggering the monostable causes Q to go HIGH for a time, but since this is not a stable state, Q will drop LOW again when a predetermined time period has elapsed. Monostables are also known as one-shot circuits, and sometimes (though erroneously) as "pulse stretcher" circuits.

The bistable multivibrator has two stable states. It can remain in either state (i.e. Q HIGH or Q LOW) indefinitely. The RS flip-flop discussed in Part III (ET/D, July p. 30) of this series is a bistable multivibrator.

The astable multivibrator has no stable states. It is not happy in either Q HIGH or Q LOW states. The Q output of the astable MV will flip back and forth between HIGH and LOW conditions, producing a squarewave pulse train output signal. For this reason, the astable circuit is usually used to produce the clock pulses found in digital electronic devices.

There are several ways to produce each of these types of multivibrator. Space prevents us from considering all of them. We will examine a few circuits built from discrete gates and the IC types. Some IC devices, like the 55 timer chip, will operate in either monostable or astable modes. We will not consider the circuits in which discrete transistors and resistors form the MV.

When we speak of bistable multivibrators we are actually talking about our old friend, the RS flip-flop. Recall from Part II of this series that RS FFs can remain in either state, e.g., Q HIGH or Q LOW, indefinitely. Only commands applied to the R and S inputs can change the output conditions. These circuits will change state only when commanded to do so. If the RS FF is in one state, or the other, then it can remain in that state forever (at least until the power is turned off!).

The monostable multivibrator, or one-shot as it is sometimes called, has but one stable state. In most circuits, the stable state exists when Q is LOW. When the input of the monostable is triggered, then the output will snap HIGH for a predetermined length of time, and then drops LOW again. The monostable, then, produces one pulse at the output for each pulse received at the input. This is why they are called "one-shot" circuits.

There are a number of reasons why you might want a "one-out-for-one-in" circuit. One of the most common is to stretch pulses. A very rapid input pulse, even down into the nanosecond range, can trigger a one-shot with periods from nanoseconds to days. The duration of the pulse, then, is much longer than the trigger pulse. In so-called pulse stretcher applications, the output of the

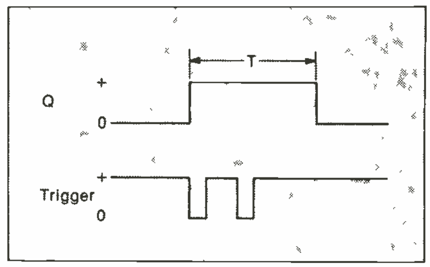


Fig. 1A Normal one-shot operation.

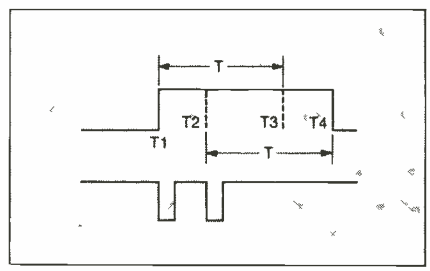


Fig. 1B Retriggerable one-shot operation.

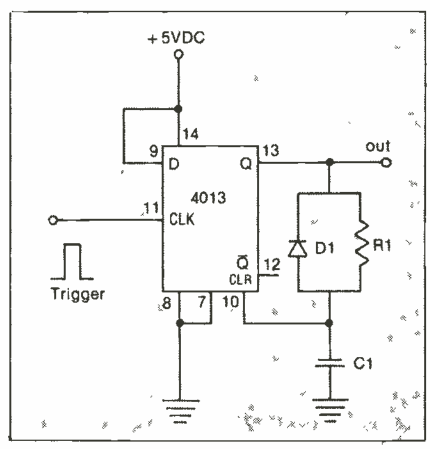


Fig. 2A 4013 Type-D FF used as a one-shot.

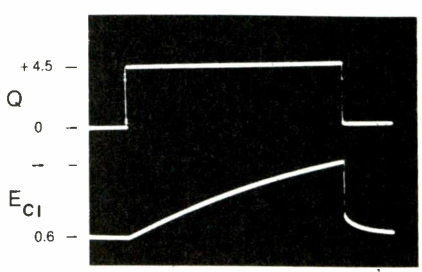


Fig. 2B Output and capacitor waveforms.

one-shot is used to substitute for the shorter trigger pulse.

Most monostable MVs will not respond to further input trigger pulses until the period of the output pulse has timed out, i.e. the output has dropped LOW again and the MV is once again in the stable state. Monostables that will not respond to further trigger commands until the output duration has expired are called *nonretriggerable* monostables.

Retriggerable monos

But some one-shot circuits are retriggerable, meaning that they *will* respond to further input trigger commands while the one-shot is in the unstable state, i.e. before it has timed out. Consider Figure 1 to see how this might work. Figure 1A shows the operation of a regular nontriggerable, one-shot MV. The first trigger pulse causes the output to go HIGH, and it remains HIGH for period *T*. A second trigger pulse has no affect on the one-shot because it occurs before *T* expires.

Now consider Figure 1B. This is a timing diagram for a retriggerable one-shot. The output goes HIGH when the first pulse arrives. But before *T* exqires, a second trigger pulse is received. This second pulse causes the one-shot to retrigger, so the output will remain HIGH for an additional period *T*. Note that the total duration of the HIGH state is not 2*T*, but *T* plus the portion of the first period that expired prior to the second trigger pulse, i.e. T + (T2-T1).

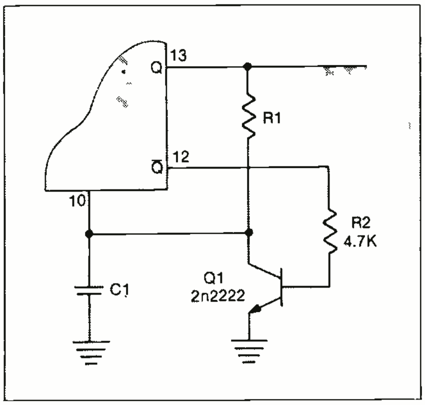


Fig. 3 One-shot (Per figure 2A) modified to allow Q to drop all of the way to zero on low.

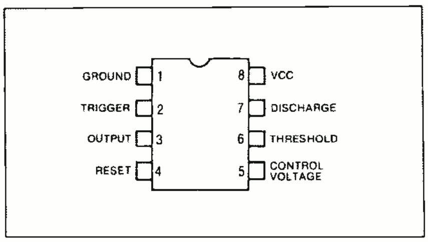


Fig. 4A 555 pinouts and package.

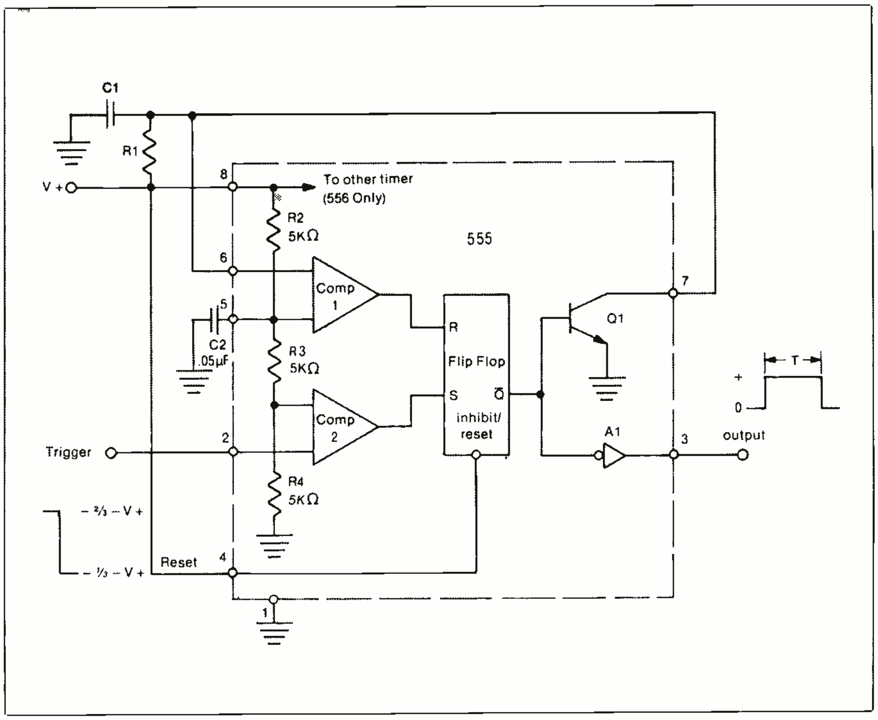


Fig. 4B 555 Connected as a one-shot (internal block diagram).

An example of a monostable built from a CMOS type-D FF is shown in Figure 2A. Recall the rules for this FF: 1) since D is HIGH, a HIGH will be transferred to *Q* when the *clk* line goes HIGH, and 2) when *clear* goes HIGH the *Q* is forced LOW. The operation of the circuit is as follows:

1) When the circuit is at rest, *Q* is LOW and any charge on C1 is drained off through diode *D*1.
2) When a trigger pulse is received by the *clk* input, *Q* goes HIGH. When *Q* is HIGH, capacitor *C*1 will charge through resistor *R*1.
3) When *C*1 has charged to a potential of approximately 2 volts, the *clear* input thinks it is HIGH, so the FF will force *Q* LOW.
4) The period that *Q* was HIGH, i.e. the period of the one-shot, is determined by the time constant of R1C1, and the potentials of the Q output and the point at which the *clear* input sees a HIGH instead of a LOW.

The circuit in Figure 2A uses a diode (*D*1) across resistor *R*1 to discharge *C*1 during the period when *Q* is LOW. This diode is not strictly necessary, but serves to speed the circuit up considerably. Without *D*1, the charge on capacitor *C*1 would bleed off through *R*1. But this would require another *R*1*C*1 time constant (or so) before the voltage across *C*1 would discharge enough to allow retriggering of the one-shot. The purpose of *D*1 is to rapidly discharge *C*1, so that retriggering can occur almost immediately after *Q* drops LOW (see Figure 2B).

But the use of *D*1 creates a little problem. The charge potential across *C*1 cannot drop lower than the function potential of the diode (200 - 300 mV in Germanium types, 600 - 700 mV in silicon types). Figure 3 shows a modified version of the circuit that uses a switching transistor (*Q*1) to discharge *C*1. The base of *Q*1 is driven by the *not-Q* output of the flip-flop. When the one-shot is at rest, *not-Q* is HIGH, so *Q*1 will be forward biased. When a trigger pulse is received, however, *Q*goes HIGH and *not-Q* becomes LOW. This condition turns off *Q*1, allowing *C*1 to charge. When the voltage on *C*1 reaches the threshold point, the FF sees a *clear* command (i.e. *clear* input HIGH), and this forces *Q* LOW and *not-Q* HIGH. Transistor *Q*1 then discharges *C*1.

The 555

One of the most popular IC devices used for one-shots is the 555 timer chip, originated by Signetics. The 555 is offered in an 8-pin miniDIP package (Figure 4A). A typical one-shot circuit based on the 555 is shown in Figure 4B.

The 555 IC contains a control RS flip-flop (FF1), two voltage comparators (COMP1 and COMP2), a switching transistor (Q1), and an inverter (A1).

During the rest period, when the one-shot is not active, the output is LOW. Since the output is an inverter, the not-Q terminal of the FF is used. During the reset period, the not-Q will be HIGH.

The *reset* input of the 555 is active when LOW, so to disable it, we must tie it to V+ (i.e. a HIGH).

The trigger input (pin No. 2) is normally kept HIGH, which in this case is defined as a potential greater than 2/3 V+. When triggering of the one-shot is desired, we must bring this trigger terminal down (i.e. a negative-going transistion) to 1/3 V+ or lower. This is the threshold of COMP2.

When the trigger terminal is brought below the COMP2 threshold, the output of COMP2 goes HIGH, forcing the FF into the *set* condition. The not-Q terminal, then, goes LOW, forcing the output (pin No. 3) of A1 HIGH.

With the not-Q terminal of FF1 LOW, transistor Q1 is no longer turned on, so C1 begins to charge from potential V+ applied to R1. When the voltage across C1 reaches 2/3 V+, then the output of COMP1 goes HIGH, resetting FF1. The output of A1 then drops LOW again, and Q1 is turned back on forcing C1 to discharge to zero rapidly. The HIGH period of the output is given by the express T_{sec}+ 1.1(R1C1), where (as usual) R1 is given in ohms and C1 in farads.

Astable MVs

An astable multivibrator has no stable state. It will bounce back and forth, output HIGH/LOW, producing a squarewave signal. The astable, then, may be used to produce clock signals, or as a basic oscillator in signal generators.

One view of the astable, and a method used to produce some astable circuits, is that it is a one-shot that retriggers itself after the output pulse times out. Figure 5A shows a 555 connected as an astable multivibrator. The trigger control pin (#2) is connected across the capacitor, so the 555 will retrigger 1) when power is initially applied and 2) every time the device times out and the capacitor charge is dumped through the internal transistor.

In this circuit, C1 is charged through R1 and R2, but is discharged through R2 only. This makes the LOW time of the output signal shorter than the HIGH time. These time periods, and the frequency of oscillation, are given by the expressions shown in the figure.

When capacitor C1 charges to 2/3 V+, the output goes LOW, and the discharge transistor (Q1) is turned on. This will cause C1 to discharge through R2. When the voltage across C1 drops to 1/3 V+, the 555 will retrigger and the cycle is repeated.

But we do not necessarily need a 555, or similar device, to form an astable multivibrator. We may, for instance, use either TT1 or CMOS gates or inverter circuits as the active elements. In the former case, incidentally, it is common practice to use NAND gates (i.e. 7400) connected with both inputs shorted together, effectively forming an inverter. Figures 5B and 5C show typical TTL astable multivibrators capable of oscillating to frequencies up to 20 - 25 Mhz (although top end frequencies of 5 Mhz are more realistic). Both of these circuits are RC oscillators, so their stability at high frequency is marginal. In many cases, however, we find that the capacitor is replaced with a piezoelectric crystal, so the circuit will oscillate on the crystal frequency.

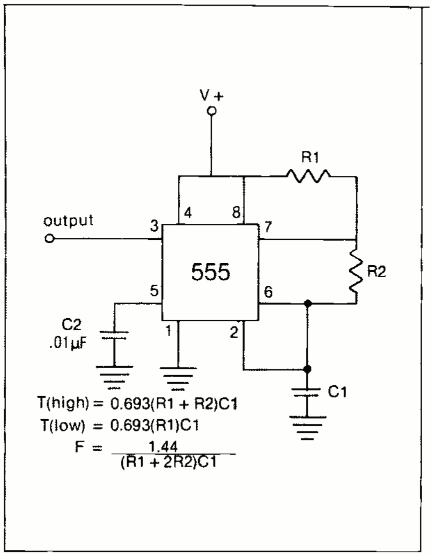


Fig. 5A The 555 used as an astable MV.

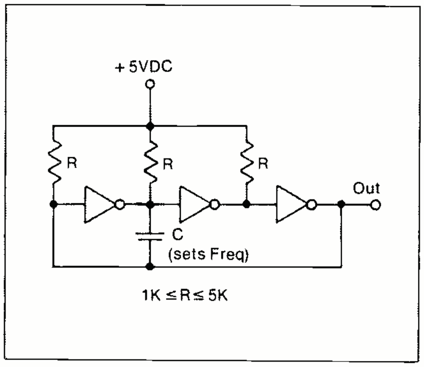


Fig. 5B TTL inverters connected as an astable.

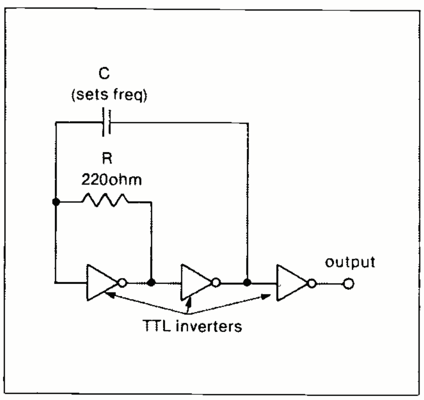


Fig. 5C Another configuration for TTL astables.

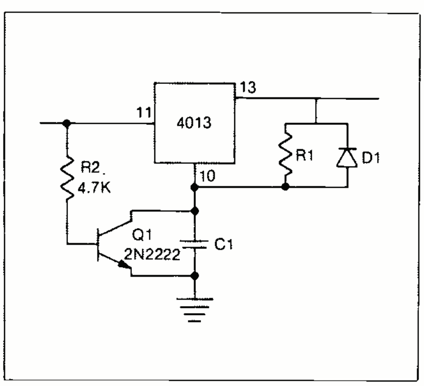


Fig. 6 Figure 2A modified to allow retriggerable operations.

IC examples

There are several IC devices capable of operating as a clock, timer, or astable multivibrator. We have already discussed the 555.

Exar and Intersil make a timer circuit called the 2240, in which a circuit similar to the 555 circuit drives a binary counter. The outputs of the counter drive transistors that are open-collector. By connecting appropriate outputs together to a single pull-up resistor in a wired-OR configuration, we can generate periods that are very much longer, yet still have the oscillator section operating at frequencies that are easy to control. Since there are eight binary outputs, maximum times of 255T (where T is the period of the 555-like section) are possible. Cascading two 2240 devices, allows periods up to 65536T (256^2).

The Motorola MC4024P is a TTL-compatible bipolar device (it is not CMOS, don't let the 4000 series type number throw you) that will function as a voltage controlled oscillator, or fixed frequency oscillator, at frequencies from 2 Hz to 25 MHZ. A capacitor is used as the frequency control element. If a piezoelectric crystal is used, instead, the frequencies from 2 MHZ to 25 MHZ are possible. It is also possible to extend the crystal range down to 1 MHz if an external capacitor is used also.

Experiments

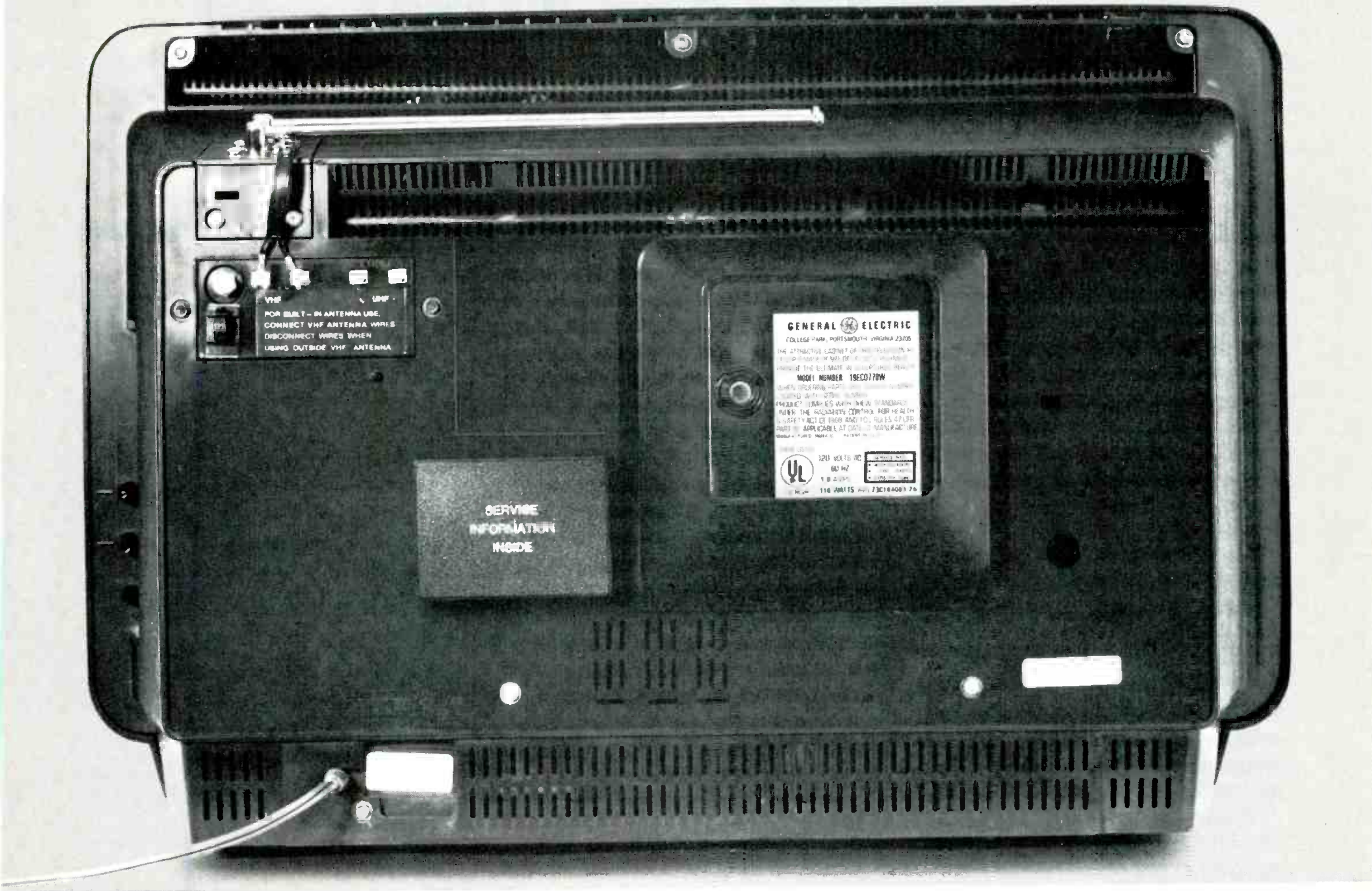
The experiments in this section are designed to be performed on the AP Products *Powerace 102* digital breadboard. Also needed are a wideband oscilloscope, and (optionally) a frequency/period counter.

Experiment No. 1 CMOS One-shot

Connect the circuit of Figure 2A, using the pinouts shown and a CMOS 4013 IC. Let R1 be some value between 500 k

Continued on page 55

CAN YOU FIND THE SERVICE MANUAL IN THIS PICTURE?



It's there. Inside a unique compartment right on the back of the set. Something special from General Electric.

Every one of our retail color models built since June, 1977 has included its very own Mini Service Manual.

And it's specially-designed, just for you.

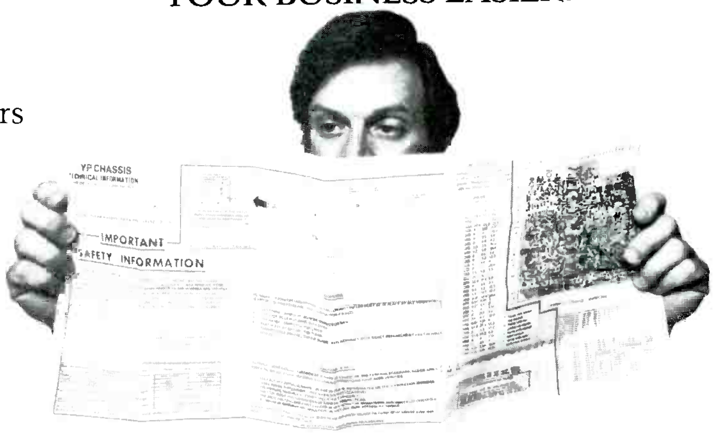
The MINI-MANUAL is accessible from the inside, where only you can reach it. And it's got all the things you need to make repairs fast and easy. You get a schematic diagram, parts list, symptom repair information and adjustment instructions.

We've even included a directory of our Replacement Part Centers with their telephone numbers. Just tell us what you need and charge it to your VISA, Master Charge or GE Open Credit Account. Our computer-linked network will get you the parts fast.

Look for our MINI-MANUAL. Because when it comes to repairing one of our TV's, GE wants to be there when you need us.

And where you need us.

IT'S OUR BUSINESS TO MAKE YOUR BUSINESS EASIER.



GENERAL ELECTRIC

GE for 1980

A new chassis and a new tuning system*

A thoroughly revised chassis and a quartz crystal reference, phase-locked-loop tuning system without any fine tuning or AFT are features of the GE line for 1980.

By Walter H. Schwartz

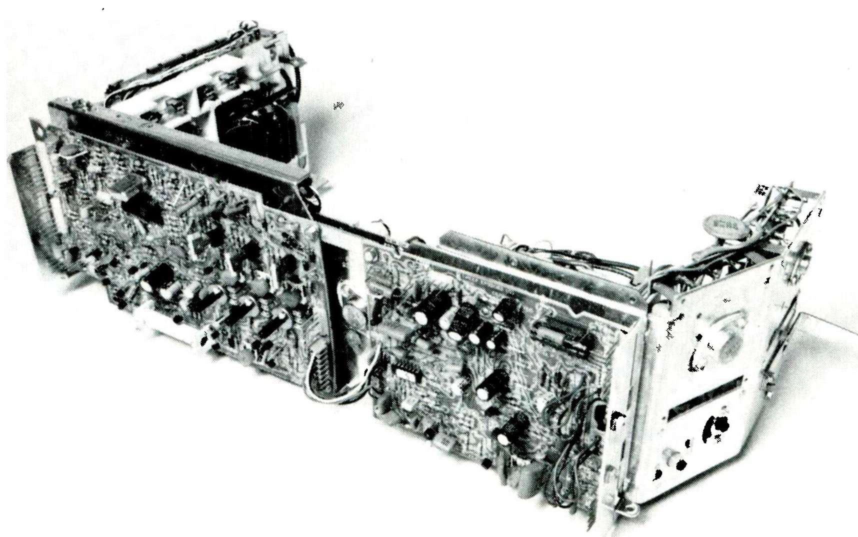


Fig. 1 The new EC chassis.

New developments from General Electric for the 1980 model year include a new "Energy-Conscious" 19-inch chassis, EC, an all channel quartz crystal referenced electronic tuning system, a refined more versatile VIR color control system and a programmable, "dual mode" microprocessor remote control system.

The new EC chassis will appear in all 19-inch GE sets for 1980. It consists primarily of five circuit boards mounted vertically on a chassis frame. With 28kv on the picture tube, it consumes an average of 100 watts compared with 143 watts for its predecessors. GE feels that the lower power dissipation and vertical mounting of components for improved air flow contribute significantly to component life and reliability.

All of GE's 25-inch consoles and most of their 19-inch line use the new quartz electronic tuning system. Three different channel selection methods are available: an all-channel one knob system, a random-access keyboard, and a microprocessor "dual-mode" remote control. All local oscillator frequencies are locked to a reference quartz crystal by phase-locked-loop circuitry; there is no fine tuning.

VIR II uses a new integrated circuit to reduce significantly the number of components in the system. All the sets with VIR II also have a light sensor to automatically adjust brightness and contrast levels with changes in room light.

Now for some specifics: first, the EC chassis and then the quartz tuning system.

With some manufacturers returning to the more difficult to service single board concept, primarily because of connector problems, GE has stated that they have attempted to strike optimum balance between reliability and serviceability in the EC chassis. It utilizes five replaceable modules, two repairable boards and a number of chassis mounted components. All components, modules and boards are mounted on a vertical heat sink/chassis for good cooling air flow.

The IF module

The IF Module contains two transistors and one IC. A MOSFET with a gain of about 12dB is used as a preamplifier and is followed by two stages of amplification in the IC with about 40dB more gain. Other functions in the IC are a synchronous video detector, RF and IF AGC, AFC, sound detector and a video preamplifier.

Audio module

The audio system of the EC chassis is even more straightforward than the IF. The module contains one IC which functions as limiter, quadrature detector, DC volume control, a power amplifier, and a voltage regulator. Most of the external components on the module are for audio feedback and stabilization.

Power supply

The power supply is a repairable, not replaceable, circuit board. It contains the basic bridge rectifier, a startup SCR, a +135V pre-regulator, a +120V regulator, six scan rectifiers, and a +15V regulator. Power supply outputs include: +120V dc for the horizontal and vertical deflection, +46V and +13V for startup, +15V regulated for the signal and sweep modules, scan derived −15V for tuners, +47V for buffer, sweep and tuner, +20V for audio and +8V for tuners, a flyback +200V dc

* *For schematics of the EC chassis and the ET-82 and MP-82 tuning systems see this month's TEKFAX.*

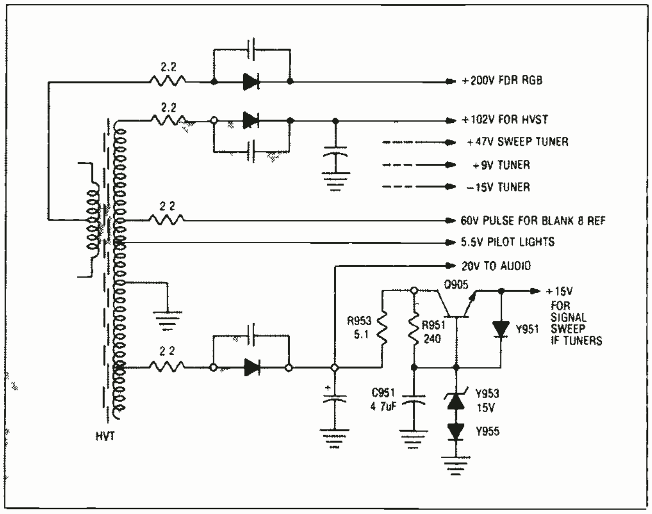


Fig. 2 The EC chassis scan derived supplies.

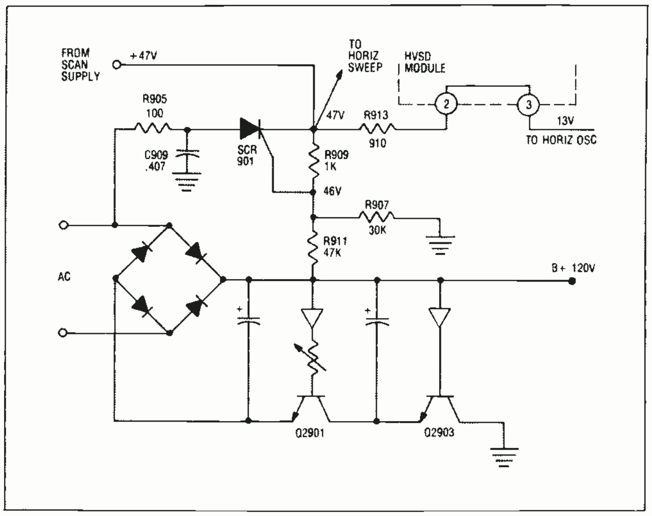


Fig. 3 Power supply start-up circuit.

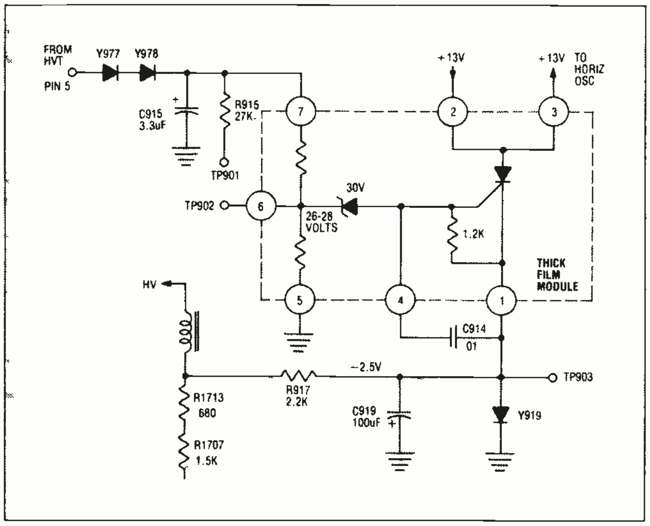


Fig. 4 High voltage shutdown circuit.

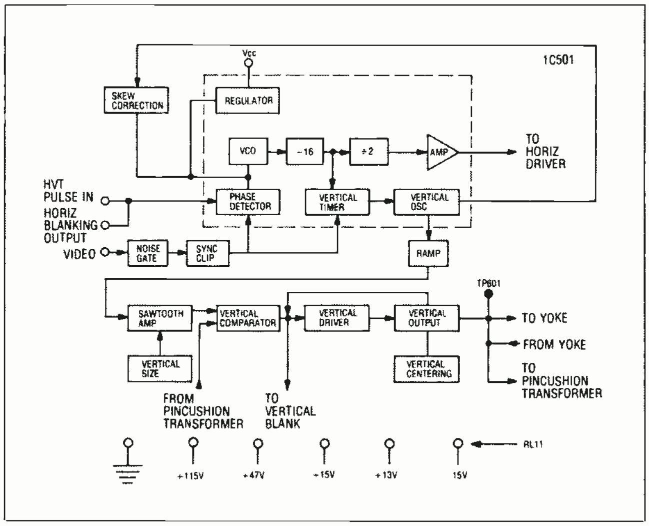


Fig. 5 Sweep module block diagram.

supply for RBG outputs, 5.5V pulse for pilot lamps and +105V dc for the shutdown system (see Fig. 2 and TEKFAX).

Both the +120V dc and +15V dc supplies are conventional series regulators with zener references. The control for Q2903 (see schematic in TEKFAX) is a thick film unit, preadjusted and sealed to produce a constant 120V across its divider.

Disregarding the degaussing action, the start-up action is as follows (Fig. 3); the 120V regulator system begins to operate and turns on start-up SCR901 producing +46V on the +47V line to the horizontal driver and a +13V for the sweep board to start the horizontal and vertical oscillators. Now, since the horizontal sweep system is operating, it produces + 47V from the scan supply which takes over the driver and + 13V loads after shutting off SCR-901.

HV shutdown

A combination of too much beam current, sensed in the return of the flyback HV winding, and too much +15V dc, flyback derived, will trigger the SCR on the thick film shutdown circuit and ground the +13V source stopping the sweep oscillators and shutting down the scan derived supplies. The +120V supply and the SCR-901 startup begin to function, but the + 13V supply stays inoperative until the +12V supply is shutoff and completely drained (Fig. 4).

Service notes

Both the +15V and the + 120V regulated supplies have overload current protection. No external current limiting is necessary when servicing the horizontal output stage; removal of a short will restore supply operation. The scan derived supply diodes have series 2.2 ohm resistors which act as fuses to protect the horizontal output transformer in case of diode failure. Disconnects can be used to localize defects; RL12 connects HVT sweep energy to 6 scan diode circuits; RL29 connects ac line voltage to power supply board; RL35 provides −15V and + 15V to sweep module; RL 36 provides +20 volts to audio module and +20 volts to audio module and −15V to IF module; RL38 provides −9V, −47V and −15V to tuner. RL 39 provides +120V to horizontal output transistor, +47 volts to horizontal driver and +13V to oscillators.

These can isolate both power supply components and other circuitry.

Sweep circuitry

Most of the sweep circuitry is on the sweep module (Fig. 5). The horizontal driver and output transistors are mounted on a chassis heatsink.

Sync is fed via the noise gate and sync separator to a phase detector, part of IC501 which also receives a flyback pulse for comparison. IC501 contains a voltage controlled oscillator which has its nominal frequency of 503.5kHz determined by a ceramic resonator. The 503.5kHz is divided by 16 to produce 31.469kHz, and then by 2 to produce the horizontal frequency of 15.735kHz which is fed to the horizontal driver. The 31.469kHz is divided down to 60Hz by the vertical timer which in turn drives a ramp former, the output of which goes to vertical amplifiers, followed by driver and output stages.

The high voltage assembly on the right (viewed from the rear) side of the chassis contains the horizontal output transformer, driver transformer, output and driver (buffer) transistors, the pincushion transformer, focus pot centering pot, and the screens pot. Driver collector supply is +47V and output collector supply is + 120V.

Outputs are 28kV dc high voltage, focus voltage of about 6kV dc, boost 800V dc and pulses to scan and flyback supplies. The CRT heater supply is flyback pulse and a similar supply lights the pilot lamps. (For basic horizontal and vertical trouble-shooting procedures, see Service Seminar this issue.)

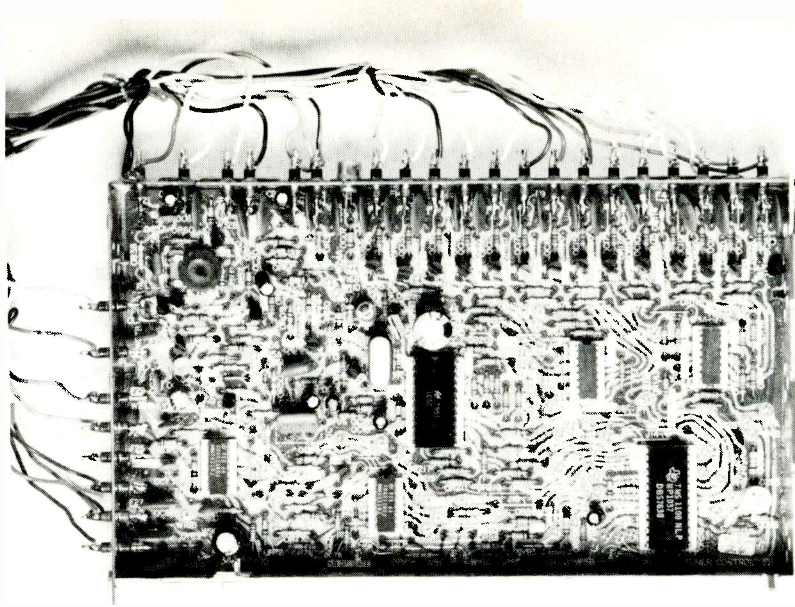


Fig. 6 MP-82 control module.

Signal module

The signal module is a repairable board; it is not intended to be replaced. Composite video is processed by a handful of transistors and an IC that performs the color processing functions. (See TEKFAX)

Composite video is fed to RL5 through C200 and to Q220, which amplifiers the negative sync video, inverts it and drives the differential amplifier Q201, Q203. Q200 is biased by the same network which biases Q220 and is fed partly integrated composite video. This is amplified, inverted and fed to the sweep (for sync) and to the VIR board. Q201 and Q203 are a gain stage, controlled by dc inputs from the pix control (R4291), the LDR (R1920) and the brightness limiter (Q210 and Q212). Pix control voltage is fed to Q203 base, and to chroma sub gain, pin 18 of IC300, to provide chroma tracking.

The video output at R213 is ac coupled to Q205 which splits the video into a high frequency component (from the collector coupled through C254 and R258 to R257), and a low frequency component (coupled from the emitter through L253 and R257). When the sharpness control is at minimum resistance, the current gain is at maximum and the high frequency gain at the collector of Q207 is maximum. At maximum sharpness control resistance, the high frequency gain is at a minimum, while low frequency gain at the emitter remains relatively constant. Hi and Lo are added at R257. Preshoot and overshoot are controlled together to give an increased apparent peaking control range as viewed on the picture.

The signal from R257 is ac coupled to Q207 which amplifies, inverts and feeds delay line L2261. The delay line is

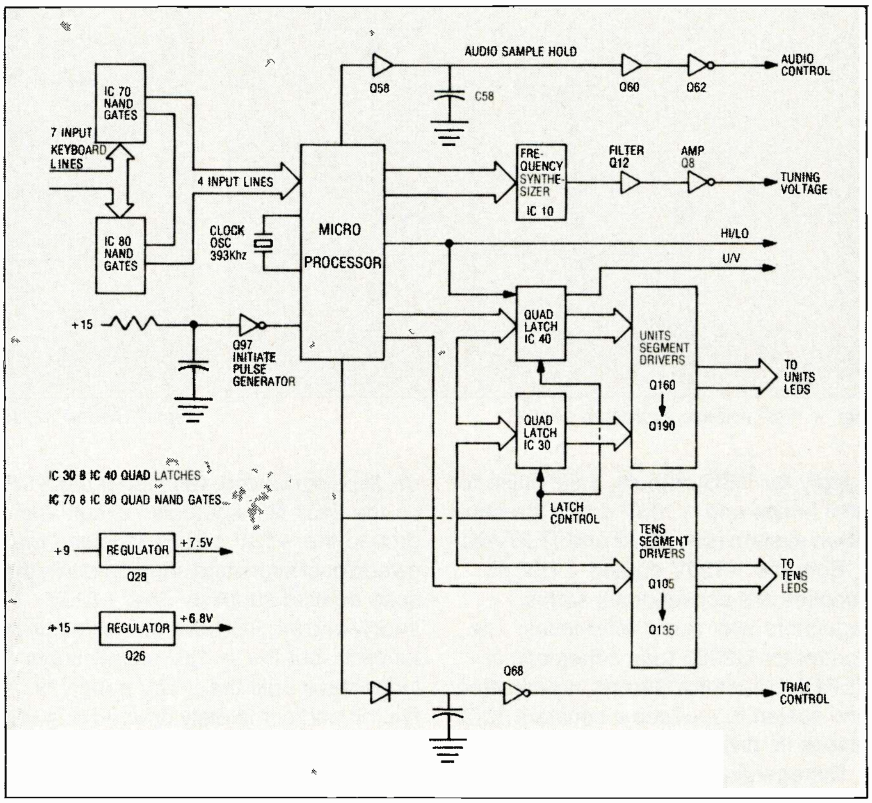


Fig. 7 MP-82 block diagram.

terminated at both ends to prevent ringing and feeds Q209, another amplifier, which has a 3.58MHz trap and some peaking in its emitter. Q209 feeds positive sync video (without 3.58MHz) to emitter follower Q211 which is ac coupled to EF Q213.

From the base of Q213 to the CRT cathodes, the signal is dc coupled. The black level of the video signal from which burst has been removed is clamped during burst only at the base of emitter follower Q213 (by clamping transistor Q262) to a dc level determined by brightness control R296 and brightness centering R271. Q262 is turned on by the burst interval pulse from R373 and emitter follower Q26, and adjusts (clamps) the voltage on Q213 base to the voltage on C263 during each back porch period. R241 constantly tends to draw the base of Q213 more positive, but the clamping action holds it down.

Video from Q213 emitter is mixed with horizontal blanking from Q280 and associated networks and the resultant

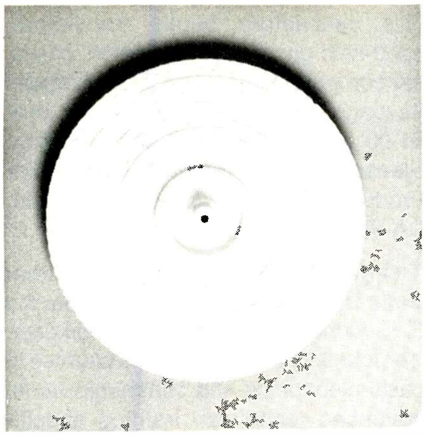


Fig. 8 The MP-82 is controlled by this "memory disc."

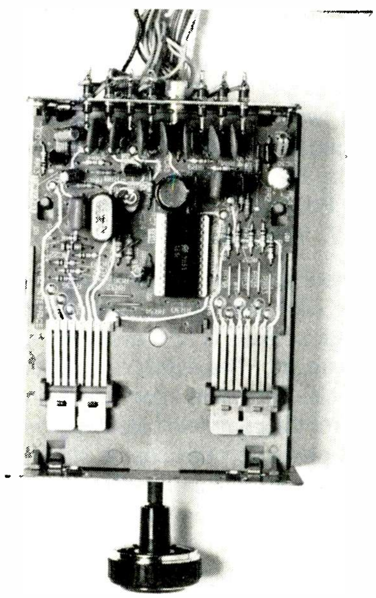


Fig. 9 The switch fingers are operated by the raised sections on the disc.

signal is fed to Q407 emitter follower. Q407 drives the emitters of the R, G and B output transistors Q401, Q403, and Q405.

The R, G, and B output emitters have dc biasing networks for CRT cutoff since the CRT has internally connected G 2's (as well as G 1's, which are near ground, all for maximum arc protection).

The chroma processor IC300 is the same as used in AA chassis. It features adjustable APC, fixed ACC, fixed killer, fixed chroma bandpass, and fixed individual (differential) inputs to the demodulator. Tint, color and color tracking are dc controlled. The tint control system has been moved to the chroma circuit because the APC system does not respond rapidly enough for VIR circuitry (preference). The chroma from IC300 pin 19 is fed to Q350 through a phase shifting network C341, C358, etc. Y350 acts as a variable resistor to change the phase of the chroma in the network. The dc tint control voltage from R350 with VIR information added is fed to the base of Q350. The change in emitter dc voltage causes Y350 resistance to vary. The chroma sees Q350 as a common base amplifier. The collector of Q350 then has chroma with variable phase. This signal is fed through emitter follower Q340 to the individual demodulator input phase shift networks. These networks shift 0 degrees, 12 degrees and 20 degrees for B-Y, R-Y and G-Y respectively, because the 3.58mHz oscillator produces approximately 90 degree vectors to the demodulators.

Electronic tuning

GE's new "Quartz" electronic tuning system offers three different electronic tuning systems: The ET82—all channel, one knob, the MP82—microprocessor, all channel, programmable with remote control, and the MMP82—manual microprocessor with random access keyboard. These systems are modular; repairs may be made either by replacement or repair of boards.

The modules used with the EC chassis, as necessary to assemble the various systems, include an on-off module, a standby module, a wideband amplifier module, a tuner control module, the ET82 control board, a receiver module, and a remote control transmitter.

The on-off module uses a triac to switch the set on and off. It is the same as used in previous models.

The standby module (standby power and interconnect module) has several functions. The Hi-Lo switch (PQ22-PQ24, see TEKFAX) takes the Hi-Lo control signal and switches its output from +15V, 20μa high level to −15V 1μa low level for the tuner Hi-Lo switch.

The U-V switch (PQ33, 37, 39) switches +15V to either the VHF or UHF tuner.

The +30V tuning supply is derived by PR12 and PY12 from the +47V supply.

Audio control is developed by RR64 and PY66. Initially, forward biased to —0.6V, increases in control current greater than 5.5mA will begin to reverse bias PY66 and the audio control voltage can rise with control current.

Standby control power is rectified by PY1 and PY2, and regulated by PQ5. The +9V, tuner +15V, microprocessor +15V, AGC, On-Off control, audio control, and tuner control voltages and currents are distributed by the control module. In the MMP82 system, +15V for the microprocessor is jumped from the tuner supply.

The wideband amplifier and prescaler module amplifies the UHF-VHF tuner oscillator outputs and divides its input by 256. The amplifier consists of three highly fedback stages and an ECL prescaler IC capable of operation to over 1000MHz. The prescaler is followed by an output buffer.

The MP82/MMP82 tuner control module sets up the tuner and the channel number display with information entered by the keyboard. The microprocessor OIC90 accepts keyboard information and outputs channel selection information to 1C10.

The frequency synthesizer, OIC10, gets a signal from the 256 prescaler. The synthesizer divides this input by an integer equal to the channel oscillator frequency in MHz giving a constant 3906.25Hz output if the tuner is on frequency. The divider output is compared with a reference which is 4.0MHz divided by 1024 (also 3906.25Hz) and the comparator output on Pin 10 goes HIGH if the divided input is higher than the divided reference, or LOW if the divided input is lower than the divided reference.

The amplifier built into the synthesizer (input on OIC10 Pin 8, output Pin 9) along with feedback circuit OR18, OC18, and OC16 and input impedance, OR19, integrates the comparator output. The integrator output is filtered by OQ12 and its associated components to remove the 3.9kHz comparison frequency. OQ08 is then used as a voltage amplifier with a range of 9.5 to 30V to drive the tuning voltage for the electronic tuner.

The synthesizer divider integer, which is equal to the oscillator frequency in MHz, enters OIC10 in binary code on ten pins, P0 through P9. Because the oscillator frequency is always an odd number, the input P0, pin 23, is always HIGH. Input P9, pin 12, is logically the same as the U3V switch. The P9 level comes from the section of OIC40 which latches the microprocessor output 0-. The remaining programming inputs P1 through P8 (OIC10 pins 22-20, and 17-13) are driven by microprocessor outputs R1, through R8 (OIC90 pins 1, and 28-22) through pull-down voltage dropping resistors OR193-OR219.

The ET82 tuner control 82 position switch manually performs functions similar to those of the microprocessor and the keyboard for the ET82 control board. Information given here on the operation of SIC10 also applies OIC10 above.

The frequency synthesizer SIC10 is a

continued on page 55

BULLETIN BOARD

"Practical Design with Solid State Devices" by Mannie Horowitz can be of considerable value to the troubleshooter. You don't want to redesign your problems, but the design information presented here is a basic and complete treatment of circuit operation, which can be of great assistance when troubleshooting. It covers oscillators, amplifiers, power supplies and filters, feedback circuits, coupling methods and other design problems from a "workbench," practical, standpoint. Hardbound, 528 pages, $18.95 from Reston Publishing Company, Inc., A Prentice-Hall Company, Reston, VA.

A catalog of new electronics titles is now available to interested technicians, engineers and hobbyists from the *Parker Publishing Company.*

Requests for this free Book News Catalog should be sent to Mr. Joseph Schaumburger, Assistant Vice President, Parker Publishing Company, Inc., West Nyack, NY 10994. Ask for Book News Catalog #9, and enclose a stamped, self-addressed envelope.

Filled with a wide range of titles of interest to the electronics professional or enthusiast, this catalog features books on digital test equipment, reading schematic diagrams, troubleshooting color TV servicing, home electrical repairs, digital integrated circuits, solar energy, microelectronics, and tape recorder serving. Included are books of repair shortcuts and troubleshooting timesavers, reference works listing component values and symbols, identification characteristics, wiring codes and more, guides to setting-up an electronics servicing business, books on solid-state electronics, as well as books on many aspects of computer technology. All titles listed in this catalog are fully described in capsule summaries.

The 1979 edition of Advanced Computer Products Catalog is now available. The catalog is a reference guide for both large and small users of computers and peripherals. Also featured is a new section of "intelligent computer Products and Gadgets." The catalog offers a complete range of products including personal computers, business computers, software, floppy disks, media, IC's, calculators, books, translators, hand-held games, backgammon, chess, car computers and more. The complete 92 page catalog is available for only $1.00 to cover postage and handling. Please send to: Advanced Computer Products, 1310 E. Edinger, Santa Ana, CA 92705.

Technical Training in Communications is the subject of a catalog from the *E. F. Johnson Technical Education Center.* Johnson offers residence courses in basic electronics and communications, advanced technician training specifically on the Johnson land mobile product line and "JETPAC's" a self-taught, audio-visual package on several specific products. Courses remaining to be offered in '79 are a six week Basic Electronics and Communications course and the two week course for more experienced technicians. For more information write: E.F. Johnson Company, Technical Education Center, 299 Tenth Ave., S.W., Waseca, MN 56093.

A new short form catalog on fuses, fuse clips and blocks, fuseholders and circuit beakers is now available from *Littelfuse, Inc.* The eight-page catalog lists concise technical information and pricing for the complete Littelfuse line of circuit protection devices. A literature request form included within the catalog describes additional literature available and provides a convenient way to order it. A free copy of the catalog may be obtained from your distributor or by writing Littelfuse, Inc., 800 E. Northwest Highway, Des Plaines, IL 60016.

A catalog of "factory-direct" parts/utility bins for storage and transport is available from *Kole Enterprises.* Seventy-two sizes of bins for the plant, office, warehouse, and repair or service shop are described plus storage files and steel shelving for the office. For a free copy write: Kole Enterprises, Inc., PO Box 520152, Miami, FL 33152.

A new catalog which contains information, technical specifications and illustrations of all current products marketed by *Phillips Test and Measuring Instruments, Inc.,* in the United States and Canada has been announced. The listing groups products by category for convenience. These include: oscilloscopes, counters and counter/timers, recorders, signal generators, and radio and TV service equipment. A list of PTMI sales offices is included. To receive a free copy of the catalog write to: Philips Test & Measuring Instrument, Inc., 85 McKee Drive, Mahwah, NJ 07430. ET/D

HITACHI OSCILLOSCOPES

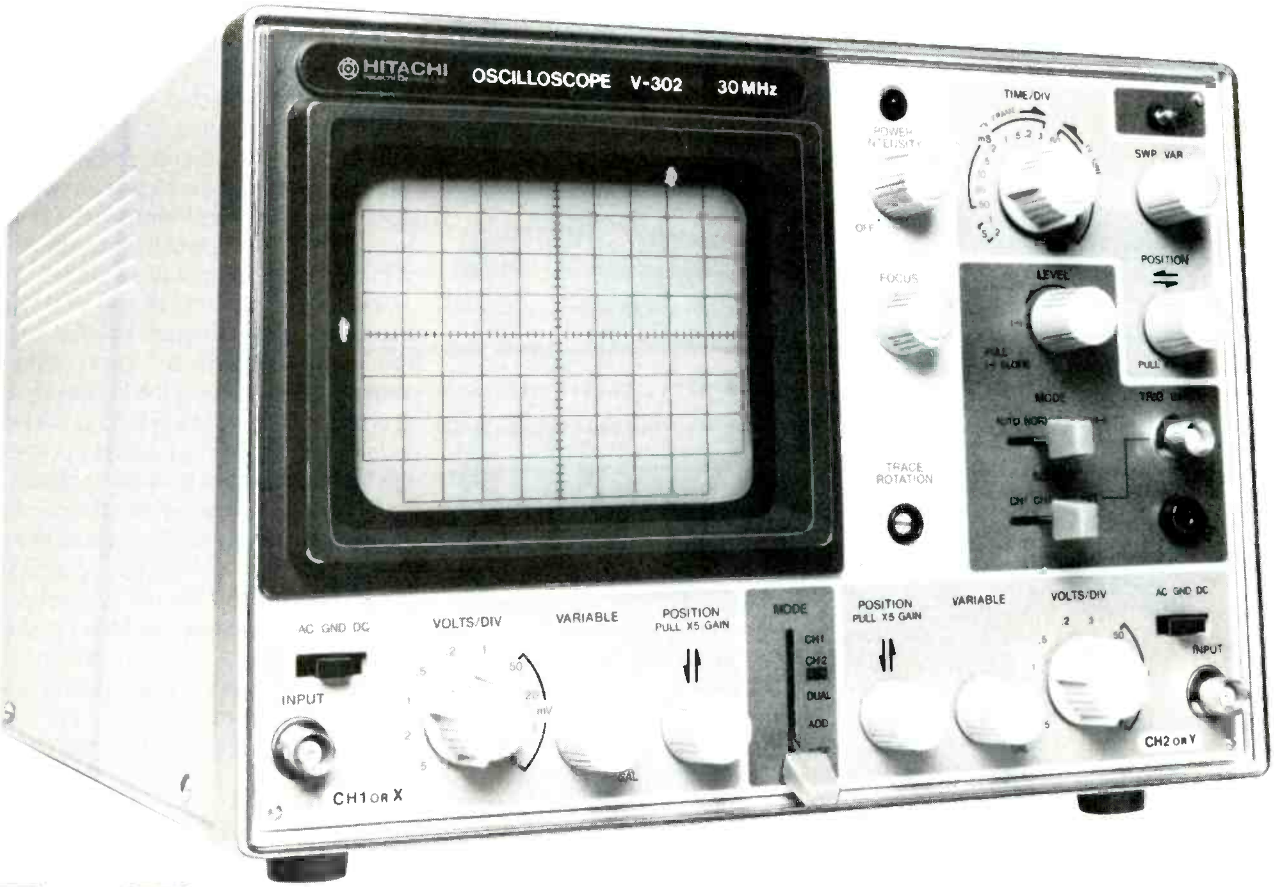
Single and dual trace, 15 and 30 MHz. All four high sensitivity Hitachi oscilloscopes are built to demanding Hitachi quality standards and are backed by a 2-year warranty. They're able to measure signals as low as 1mV/division (with X5 vertical magnifier). It's a specification you won't find on any other 15 or 30 MHz scopes. Plus: Z-axis modulation, trace rotation, front panel X-Y operation for the dual trace models, and X10 sweep magnification. And, both 30 MHz oscilloscopes offer internal signal delay lines. For ease of operation, functionally-related controls are grouped into three blocks on the color coded front panel. Now here's the clincher: For what you'd expect to pay more, you actually pay less. Suggested list price of our top line V-302 dual trace 30 MHz is only $945.00. The other models comparably less. Check our scopes before you decide.

Hitachi...The measure of quality.

- V-302 30 MHz Dual Trace $945.00
- V-301 30 MHz Single Trace $745.00
- V-152 15 MHz Dual Trace $695.00
- V-151 15 MHz Single Trace $545.00

HITACHI
Hitachi Denshi America, Ltd.

For more information, contact
Hitachi Denshi America, Ltd.,
175 Crossways Park West, Woodbury, N.Y. 11797
(516) 921-7200.



More sensitive to your input.

Circle No. 112 on Reader Inquiry Card

TEST INSTRUMENT REPORT

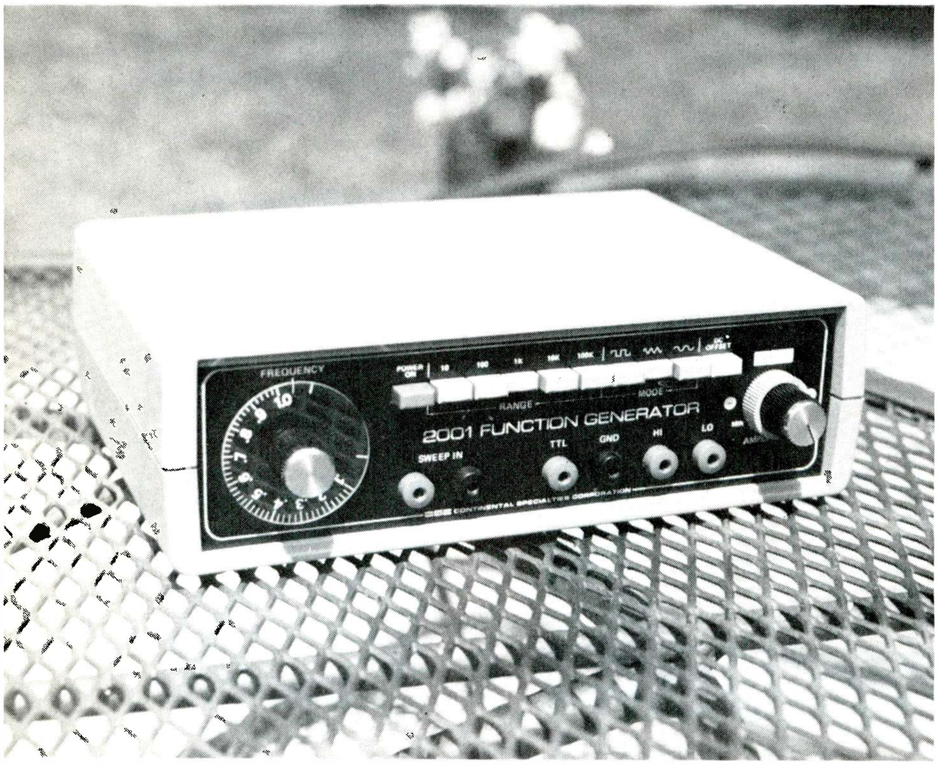
CSC's Model 2001 Functional Generator

With sweep

By Richard W. Lay

A function generator can be one of the best friends you'll find when working in audio circuitry, substituting clock signals in digital circuits, or even in checking performance specifications and parameters of your own test equipment.

And to be sure, the impact of microelectronics has brought a new influx of these units into the consumer elec-



For More information about this instrument, circle 150 on The Reader Service Card in this issue.

tronics marketplace at low price levels. One of the lowest priced units we've been able to locate is Continental Specialties' 2001 "sweepable" function generator.

For $150 this unit carries a "sweep" function with a sweep ratio of 10:1 over its linear range. The 2001 is variable from 1Hz to 100KHz continuously through front panel push buttons and frequency vernier dial.

Attractively packaged in a bench portable, light weight, plastic case and cover, the 2001 is built around four ICs, including the 12-volt regulator chip and an 8038 chip which serves as the sine, triangle and square wave generator. This square wave output then feeds a 7400 buffer stage which drives a TTL output jack.

The 2001 is controlled via ten front panel pushbuttons, the frequency vernier, a dc offset vernier, and an amplitude control. It is ac operated. It has three output jacks, TTL, Hi and Lo, a sweep input jack and two ground jacks for use with the output and sweep input. When driving a 600-ohm load, the unit will produce a variable + 5Vdc maximum at the Hi jack and 50mVdc maximum at the Lo output jack. The TTL output is a non-variable square wave locked in phase and frequency with the square wave found at the Hi and Lo output.

Frequency is controlled with five range pushbuttons generating 10Hz, 100Hz, 1KHz, 10KHz and 100KHz. Continuous downward frequency adjustments from these fundamentals may be obtained through use of the frequency vernier. The vernier is marked in .1 increments from .1 times and range switch setting all the way up to the full setting.

Another of the front panel pushbuttons is the dc offset. When pressed in the waveform selected via the mode switches can be varied up to ±2.5 volts from ground. With the dc offset switch "off," the signals at the Hi and Lo output jacks are symetrical with respect to ground. The TTL output is independent of the dc offset control at all times.

The sweep feature of the 2001 is employed by applying an external voltage to the "Sweep In" jack. When employing this function, the frequency at all output jacks, including TTL, is varied depending on the amplitude of the voltage input. A positive voltage applied to the jack causes an increase in frequency while a negative voltage has the reverse effect. A zero to 10 volt sweep signal can effect a 100 to 1 frequency change.

The overall average distortion of the 2001 is less than 2 per cent. The unit is fuse protected and the fuse is easily accessible simply by removing the top cover. Power consumption is rated at 6 watts. ET/D

Specifications

Frequency: 1Hz to 100KHz in five decade ranges; 10:1 dial calibrated ±5% of setting at 10Hz, 100Hz, 1KHz, 10KHz

THD: Sine, less 2%; Triangle linearity better than 2%; Square ± 2%; TTL square wave rise and fall times under 25Nsec.

Sweep: 100:1 maximum; 10:1 linear range; 0 to 10V Sweep input.

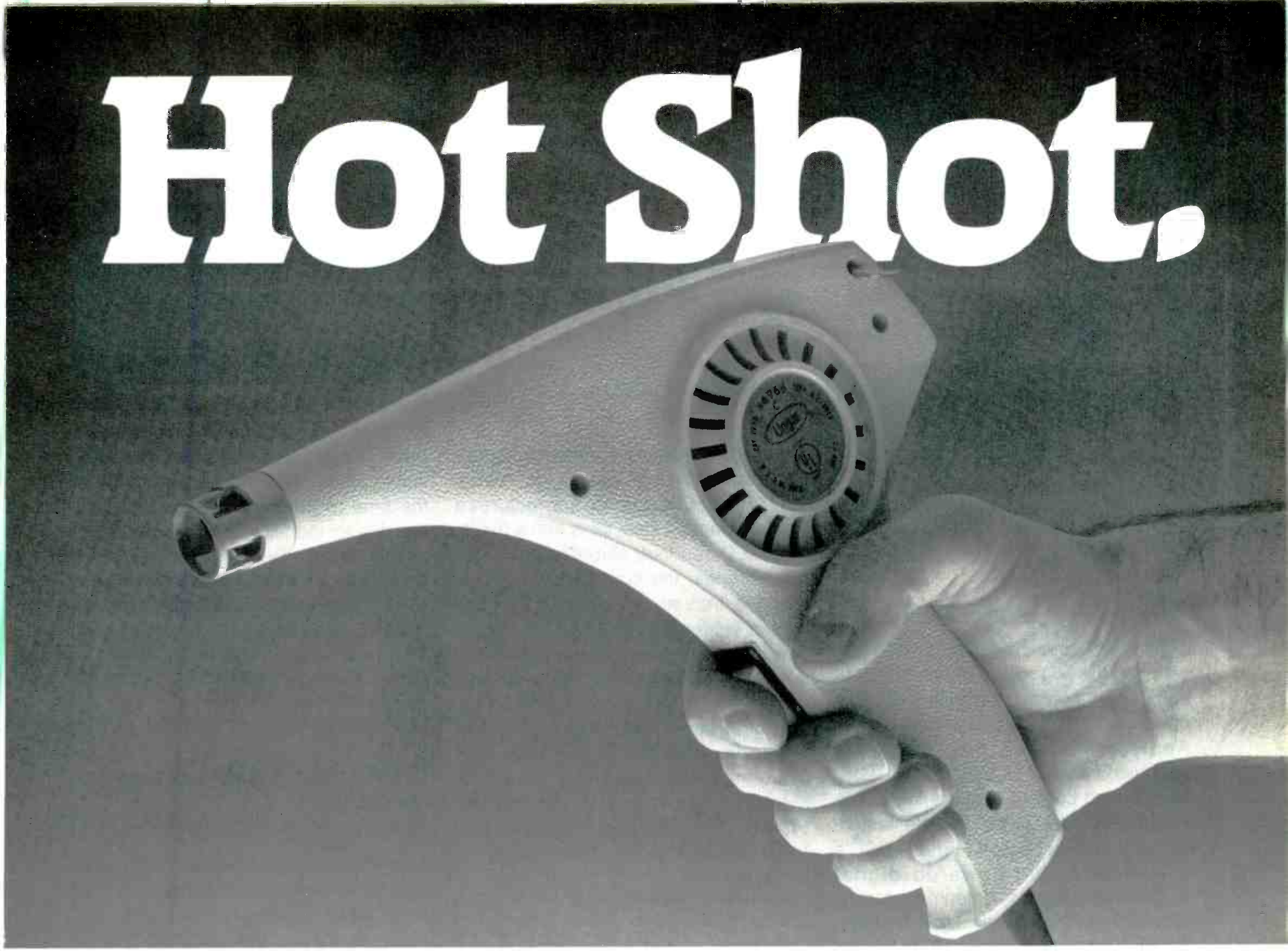
Outputs: Hi, 0.1-10pp open circuit; 0.5-5pp, 600 ohms. Lo, 100mV open circuit; 5-50 mV, 600 ohms. TTL drives 10 TTL loads

Offset: Switch selectable; ±5V into an open circuit; Maximum offset (AC+DC before clipping) ±10V Hi or ± 1V Lo setting into open circuit, or ±5V into 600 ohms.

Power: 6 watts

Size: 10 by 3 by 7 inches.

Weight: 2.2 pounds.



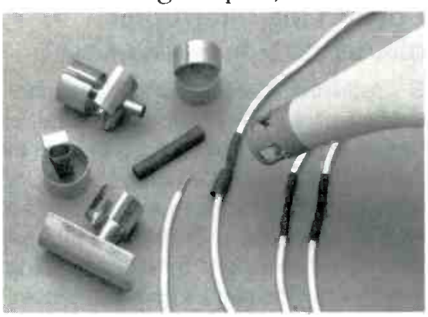
Our heat gun is light, tough and very easy to control. You get easier handling with precise hot air direction and built-in durability.

Weighing only 13 ounces, including its 3-wire cord, the heat gun sits comfortably in your hand. Its handle stays cool even during long hours on the job.

You can put the hot air stream exactly where you want it because the nozzle is smaller. And the four baffles that are included with the gun adapt it for a wide variety of uses.

There's a 3-way trigger switch with hot and cool positions. The nozzle temperature reaches 750° 800°F in seconds. And you can get our optional stand to hold the heat gun securely in several work positions.

In its high impact, heat resistant molded case, the heat gun can withstand the rigors of industrial, service shop or laboratory use.



Try our versatile, economical heat gun for everything from shrink tubing, to reflow soldering, to repairing plastics. You'll see why half of our heat guns are bought by or on the recommendation of a satisfied user.

For our new catalog, write to Ungar, Division of Eldon Industries, Inc., P.O. Box 6005, Compton, CA 90220.

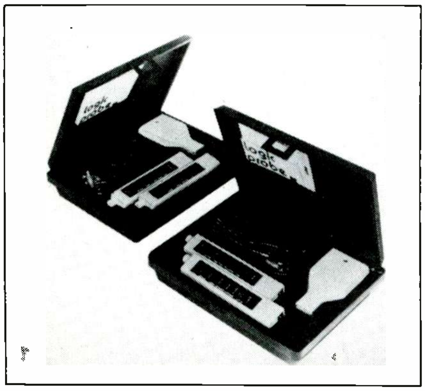
Ungar.

The Heat Gun. For Precise Control Of Hot Air.

Circle No. 121 on Reader Inquiry Card

Asbestos-Free!

NEW PRODUCTS



Digital Tool Kits

Circle No. 130 on Reader Inquiry Card

Continental Specialties Corporation has adjusted the suggested resale prices of both of its Logical Analysis Test Kits downward. LTC-1, the Standard Logical Analysis Test Kit now carries a suggested resale of $205; the LTC-2 High Speed Logical Analysis Test Kit is now $235. The LTCs feature instruments from The Logical Force™, CSC's series of circuit-powered digital trouble-shooting instruments, compatible with most available logic families. Each LTC includes a DP-1 Digital Pulser, which is a probe-size pulse generator and is used as a digital signal injector; and LM-1 Logic Monitor, which clips onto DIP ICs and simultaneously displays the logic state at each of up to 16 pins on built-in LEDs; either an LP-1 (in LTC-1, good to 50nsec and 10MHz) or LP-3 (in LTC-2, captures pulses as narrow as 6nsec, typical, pulse rep rates to 60MHz) Logic Probe; a full complement of accessory tips and cables; complete instruction and application manuals; and a custom-molded carrying case. Each kit weighs 23 ounces. These price adjustments were effective April 2, 1979.

DMM

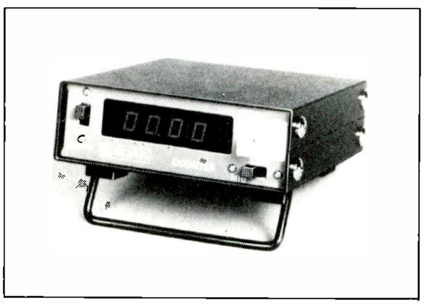
Circle No. 131 on Reader Inquiry Card

A new digital multimeter, the Model 164, has been announced by *Keithley Instruments*. It offers five functions, 0.6 in. display, color coded push button switching, input protection to 1400 V on all voltage ranges, and up to 300 VRMS on resistance ranges, a one-year calibration cycle , up to 1000 hours battery life on "C" carbon-zinc batteries and a calculated MTBF of 20,000 hours. The price is $149.00.

Frequency Counter

Circle No. 132 on Reader Inquiry Card

The *Soar* FC-841 is a seven-digit multifunction frequency counter that covers the 10Hz to 50MHz range and features a tilt-view stand, a steel case and a 0.3-in. high LED readout. Supplied with four AA batteries, the counter also can be plugged into an ac outlet or a car's cigaret lighter. The FC-841 has a gate time of 100 msec or 1 second and a sensitivity of 30 mv rms up to 30MHz, decreasing to 60 mv rms at 60MHz. The time base stability of the counter is 3 ppm from 68° F to 86° F. The instrument also features a switch for selecting the kHz or MHz ranges. The FC-841 is supplied complete with batteries, antenna, and test lead. The price is $90.00.



Power Line Interrupter

Circle No. 133 on Reader Inquiry Card

G T Industries has announced the introduction of a new protective device. L Series Line Interrupters are intended to prevent damage to a wide variety of electrical and electronic equipment, including computers, CRTs, and laboratory instrumentation, by disconnecting power when the source goes out of spec in voltage or frequency. A varistor transient suppressor also filters the output to further protect equipment. The unit is connected between the power source and the protected equipment. A response delay avoids false triggers, and once tripped, the power remains interrupted until a button is pressed. Trip points are internally adjustable with nominal ranges of +20%-30% for voltage (based on 120/140vac) and ±20% for frequency. Normal factory settings are one half these limits but other settings can be requested at no charge at the time of purchase. All versions are suitable for indoor or outdoor use. Each unit is reportedly computer analyzed, power aged, and shake tested to ensure reliable operation. The L series includes the L15 rated at 15 amps resistive or 1.5hp at 240vac. Pricing for 1 to 9 units is, L15 (120vac), @$174.95. Dealer inquiries are invited.

DMM with 20 AMP current range

Circle No. 134 on Reader Inquiry Card

Data Precision has introduced a new 3½ digit benchtop digital multimeter, Model 1351, which can measure ac or dc currents up to 20A. The Model 1351 is an accurate (0.1% basic accuracy), full-function DMM which sells for $199. It has 34 ranges and can measure dc volts from ± 100μV to 1200V, ac volts from 100μV to 1000V RMS and resistance from 100mΩ to 20MΩ with either high

(2.8V) or low (300mV) excitation. In addition, both ac and dc current can be measured from 0.1 μA up to a full 20A full scale. Measurements are displayed on a 0.43" LED display. Pushbutton controls are provided for all ranges and functions. The Model 1351 offers electrical protection from up to 6KV spikes or voltages up to 500V on resistance ranges. It is supplied complete with test leads, instructional manual, certificate of conformance to NBS Standards, spare fuse and 1-year warranty.

Anti-Static Spray

Circle No. 135 on Reader Inquiry Card

Chemtronics has announced the availability of Stat-Free, an anti-static spray that has been in the R & D stage for some time. Reportedly, tests have proven that Stat-Free, which neutralizes static electricity generated by friction

and low humidity, has no adverse effect on any substance whatsoever. It may be used to eliminate static and its accompanying dust and dirt, on devices such as data entry terminals, visual display terminals, magnetic tape and disc drives, computer printers and decollators, CRT screens, disc surfaces and anywhere else static build-up is a problem. Useful on panel meters and oscilloscope faces, it prevents inaccurate readings which may be caused by static charges. Spraying the workbenches and tools used with static-sensitive IC's eliminates the stray static discharges which can ruin these components. For shop and field use, Stat-Free is available in economical 16 oz. (454 gram) cans from authorized Chemtronics distributors.

Oscilloscope Calibrator

Circle No. 136 on Reader Inquiry Card

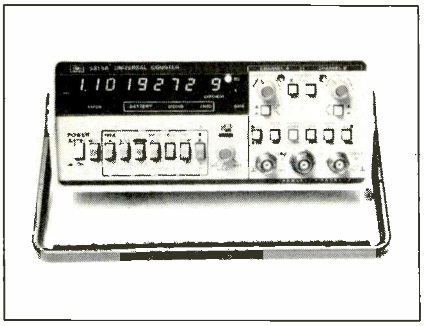
For maintenance and calibration shops, the new TE303 Oscilloscope Calibrator by *Zu-Tech* provides a convenient means to check oscilloscope performance. It is a source of calibrated amplitude signals, precision timing marks and fast-rise pulses for response bandwidth determination. Two waveforms are provided for calibration of the oscilloscope's Y inputs. The trapezoidal waveform has sloping edges suitable for checking trigger level performance, and the square

waveform enables the overshoot/undershoot characteristics of both the internal and external amplifiers/attenuators to be set up. The frequency of these waveforms is 1kHz, and the amplitude is adjustable in calibrated steps to match the conventional switched input range (1-2-5) sequence from 0.1mV per division to 50V per division. A front panel control selects one of three most commonly used graticule heights (6, 8 or 10 divs.). For time base calibrations, the frequency is crystal controlled to better than 0.01%. the timing marks are positive going 1V pulses and the period can be adjusted from 100nS to 0.5S in a 1-2-5 sequence. Risetime and bandwidth performance can be checked using the fast-rise square wave output. This output has a risetime of less than 2nS and is capable of driving a 50 ohm termination. The price of the TE303 is $935.00.

1GHz Frequency Counter

Circle No. 137 on Reader Inquiry Card

Hewlett-Packard's Model 531A Universal Counter extends its 100 MHz frequency measurement range to 1GHz with a new Option 003. This expanded measurement range opens up uses for



the 531A in new areas of design, production and maintenance of equipment for communications, navigation and FM and TV broadcasting. The 531A also measures low frequency pilot tones to a high resolution in communications systems. Because it measures input waveform period and inverts the measurement to display frequency directly, the 531A achieves a resolution of at least seven digits (0.0001%) in measurement time of only one second, from 1Hz up to 1GHz. The 531A, without extra cost options has measurement functions of frequency, frequency ratio, period, period average, time interval, time interval with delay, time interval average and will totalize events. U. S. price of the Model 531A is $800. Option 003, 1 GHz frequency extension, $250. Option 001, high stability time base, $100. Option 002, battery and charger, $225. Model 531B is the 531A in a metal, rack-mountable package: $950 (battery not available in 531B).

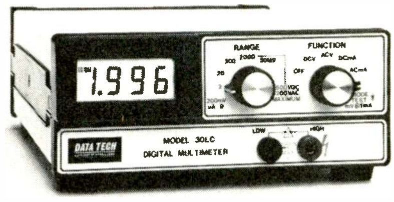
Microprocessor Power Supply

Circle No. 138 on Reader Inquiry Card

PTS Electronics, Inc., has announced a new piece of equipment designed to meet the power supply needs of most microprocessors and other similar electronic devices. The MSP-501 reportedly offers excellent load and line voltage variation regulation, and transient protection. The unit is a fully regulated 5VDC power supply with an output current capability of up to 5 amps. Features include a new hybrid regulator and output circuitry for high reliability, noise and ripple of less than 10 mv., shortcircuit current limiting, and a front panel 4.5 to 6.0 VDC calibration adjustment. The price of the MSP-501 is $99.95 with a one-year limited warranty.

Digital Multimeter

Circle No. 139 on Reader Inquiry Card

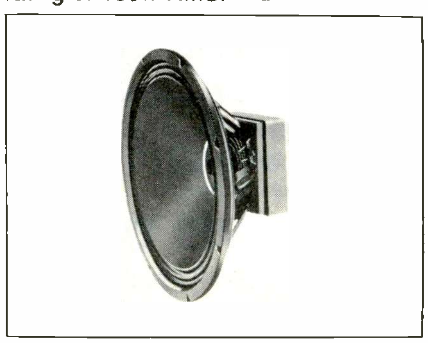


Model 30LC by *Data Tech* is a new 3½ digit, six function DMM with a basic accuracy of 0.1%. It offers, reportedly, over 1300 hours of battery life with average use of all functions (on alkaline batteries). Features include ac and dc voltage and current ranges, resistance to 0.1 ohm resolution, a diode test feature, automatic zero and polarity, and overrange display blinking. Options include a 10 amp current range, RF probe, high voltage probe, and a demodulator probe. Price of the basic instrument is $159.00.

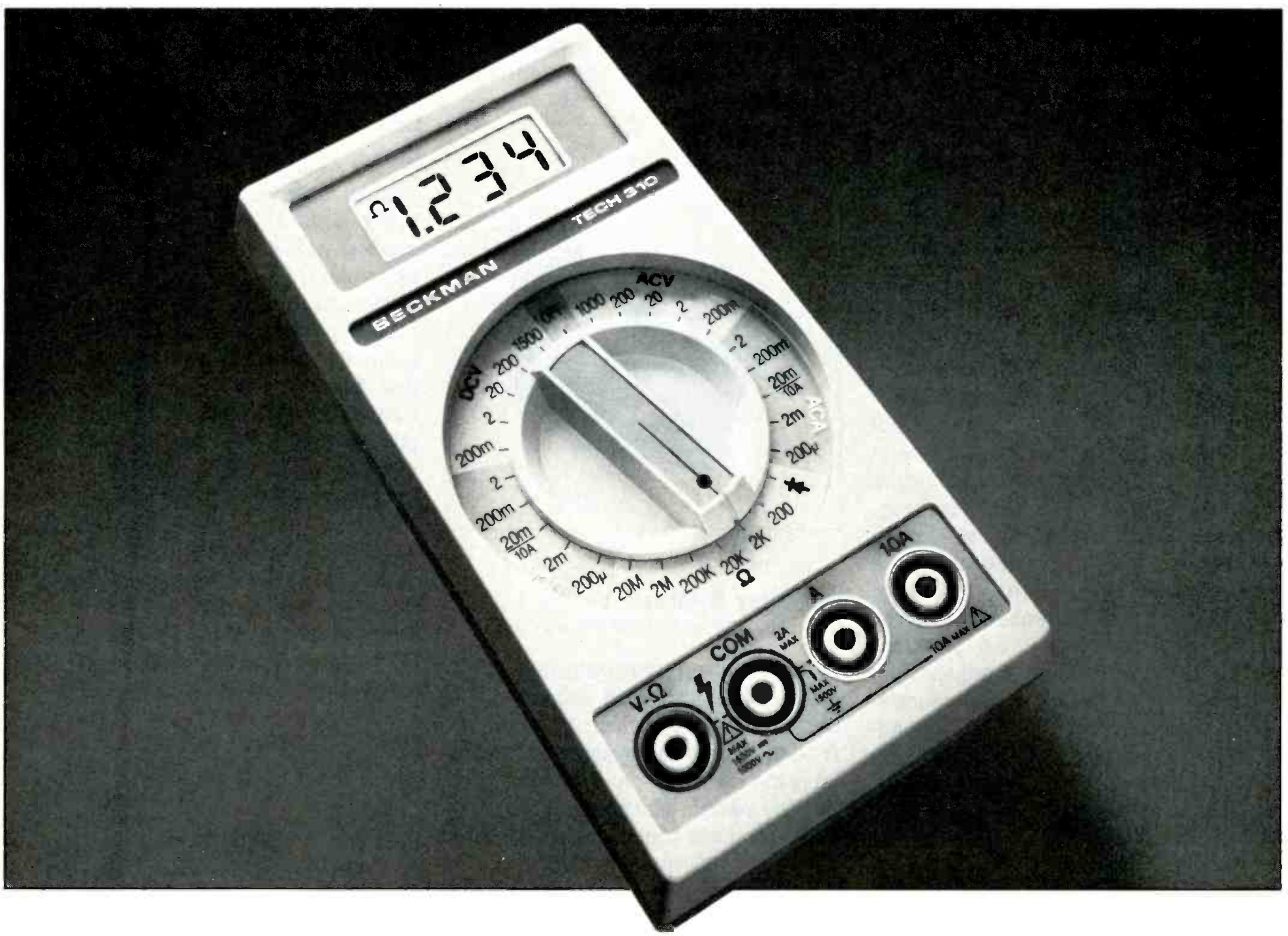
High Power Speaker

Circle No. 140 on Reader Inquiry Card

A musical instrument speaker capable of handling up to 300w peak power has been introduced by *Oaktron Industries, Inc.* The model M15Y2, is reportedly designed for bands, electronic organs, and musical instruments requiring extreme ranges of amplification, with a heavy-duty magnet and matched voice coil on a heat resistant aluminum form. The model M15Y2 is available with normal 8 ohm voice coil, but can be ordered with any desired impedance. The M15Y2 is a nominal 15 in. round speaker, with standard EIA mounting centers, for all new or replacement requirements. A 2½ in. voice coil diameter and a 108 oz ferrite magnet provide a continuous power-rating of 150w RMS. **ET/D**



WHEN THE GOING GETS TOUGH, BECKMAN'S NEW DIGITAL MULTIMETERS KEEP GOING.



Featuring new continuity function.

If you've ever been troubled by a faulty multimeter—or had to use one that wasn't quite up to the tougher jobs—your troubles are over. Now there's the Beckman line of digital multimeters. A new generation of 3½-digit models that combine superior reliability with highly versatile features.

Features like a unique continuity test function. With Beckman's new Insta-Ohms™ quick continuity indicator, you no longer need an analog VOM for fast, convenient continuity checks.

There's also 10-amp current ranges, in-circuit resistance measurement capability in all six-ohm ranges, a dedicated diode test function, and up to two years normal operation from a common 9V battery.

The Model TECH 310 with all these features, 7 functions, 29 ranges, and 0.25% Vdc accuracy is only $130.

The Model TECH 300 with 0.5% Vdc accuracy, but without the continuity function or the 10-amp current ranges, is just $100.

Whichever model you choose, you get a multimeter that won't let you down. There's exceptional overload and 6kV transient protection, plus ruggedness to take a 6-foot fall and to come up working.

So get the Beckman digital multimeter that performs and keeps on performing. No matter how tough the going gets. For information on the complete line and accessories, write or call your local distributor or the Advanced Electro-Products Division, Beckman Instruments, Inc., 2500 Harbor Boulevard, Fullerton, CA 92634, (714) 871-4848, ext. 3651.

BECKMAN

Circle No. 107 on Reader Inquiry Card

DEALER'S SHOWCASE

800 MHz Mobile Radio

Circle No. 152 on Reader Inquiry Card

E. F. Johnson Company, Waseca, Minnesota, has announced the addition of the Fleetcom II 880 FM two-way mobile radio to its 800 MHz product line for Business and Industrial applications. The Fleetcom II 880 provides 10 watts of talk power in a completely transistorized, one piece die cast aluminum chassis. Critical circuits are voltage regulated to ensure frequency stability. No "warm-up" time is required and there are no tubes to fail. The transmitter features ± 2.5 PPM frequency stability. Only one high stability ± .00025% TCXO channel element is required per channel for on frequency communications under all operating conditions. Adding a channel is as simple as plugging in an additional TCXO. Optional accessories available with the Fleetcom II 880 include two external speakers, a number of versatile mounting configurations, a Call Guard tone squelch, various microphones, a two channel capability and a 117/234 VAC power supply. Use of this power supply permits the transfer of the Fleetcom II 880 between mobile and control station without modification.

Cordless Telephone

Circle No. 153 on Reader Inquiry Card

Mura Corporation has introduced the Muraphone, a cordless telephone system with a suggested retail price of $89.95. The Muraphone is an answer only, cordless telephone allowing freedom of movement in, around and outside the home. The system consists of an ac powered base station and a rechargeable battery powered mobile unit that is compact, lightweight and can be easily clipped to a belt or put in a pocket. A beep signal at the remote unit lets you know when the phone is ringing. To answer, simply extend the antenna, press the talk button located on the side of the unit and begin your normal phone conversation. The Muraphone can also be used as an intercom from the standard telephone instrument at the base station to the remote unit or to screen incoming calls (the incoming call is automatically placed on "hold" while using the intercom to the remote unit).

The Muraphone operates in a range of up to 700 feet. The communications system employs a unique simplex technique which is covered in pending patent applications.

Speaker System

Circle No. 154 on Reader Inquiry Card

Jensen Sound Laboratories Home Audio Products Group recently introduced its newest product, the Model 30. A 10-in., three-way system, the Model 30 is the big brother to Jensen's Model 20. The newest addition to the Jensen home products lineup, the Model 30 is priced at $169.95 each. The Model 30 features a 10-in. high-compliance woofer, a 3-½ in. high-compliance, direct radiating midrange driver and a 2-in. direct radiating tweeter. Reportedly designed to handle up to 50 watts of power, the Model 30 has a stated frequency response of 32Hz to 20kHz. Crossover points are at 1kHz and 4kHz. Rated at 8 ohms impedance, the Model 30 boasts dispersion of 160 degrees. The cabinet, which measures 24-½ in. high × 15 in. wide × 10 in. deep, features walnut grain finish. The baffle is also finished in vinyl walnut wood grain. In addition, the Home Audio Products Group has updated the Model 20 with new vinyl walnut grain finish on both the cabinet and baffle board. The Model 20 carries a suggested retail price of $89.95.

Weather Alert Radio

Circle No. 155 on Reader Inquiry Card

A new weather alert radio designed to monitor both warning tones broadcast by the National Weather Service broadcasting network is being offered by *Motorola Communications and Electronics, Inc.* The Motorola Weather Alert Radio meets the institutional specifications set forth by the National Weather Service. The unit is crystal controlled for reliable rf reception and utilizes integrated circuitry for increased reliability. Even in areas where rf interference is present, the FET (Field Effect Transistor) front end reportedly provides superior intermodulation protection. A switch on the radio allows it to be operated in either a "monitor" or "alert" mode. In the "alert" mode, the radio operates silently until a severe warning is in effect. The "monitor" mode permits con-

tinuous reception of weather forecasts. As an extra safety feature the monitor is available with an emergency power supply that allows it to keep playing for hours should the power go out. A flashing, red light on the front of the radio lets the user know if the battery inside is weak.

Record Cleaning System

Circle No. 156 on Reader Inquiry Card

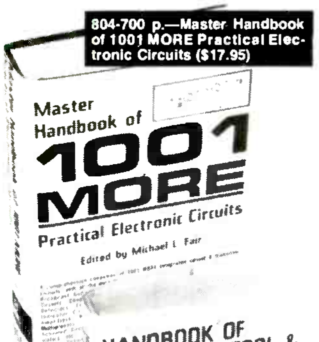
A new low priced record cleaning system packaged in self-contained impulse counter display has been introduced by *Robins*. This system called "Record Sweep" incorporates a "quick-fill" cov-

An Extraordinary Offer to introduce you to the benefits of Membership in

ELECTRONICS BOOK CLUB

take any 6 of these 24 unique electronics books (values to $102.70) for only $1.99 for ALL SIX

with a Trial Membership in the Book Club that guarantees to save you 25% to 75% on a wide selection of electronics books



804-700 p.—Master Handbook of 1001 MORE Practical Electronic Circuits ($17.95)

1077-294 p.—Handbook of Remote Control & Automation Techniques ($12.95)

1062-308 p.—The A To Z Book of Computer Games ($12.95)

1038-350 p.—Electronic Designer's Handbook—3rd Edition ($14.95)

1128-252 p.—How To Make Home Electricity From Wind, Water and Sunshine ($9.95)

925-406 p.—Practical Electrical Installation, Repair & Rewiring ($12.95)

1118-144 p.—Making And Using Electricity From The Sun ($7.95)

1141-238 p.—How To Build Your Own Working Robot Pet ($10.95)

1097-192 p.—All About Telephones ($7.95)

931-252 p.—Direct Current Motors ($14.95)

1216-190 p. (7"x10")—Towers' International OpAmp Linear-IC Selector

1123-210 p.—The Laser Experimenter's Handbook ($9.95)

962-420 p.—Microwave Oven Service & Repair ($12.95)

1034-238 p.—How To Select & Install Your Own Speakers ($9.95)

802-462 p.—The Giant Book of Amateur Radio Antennas ($12.95)

1093-420 p.—Radio Control Handbook: 4th Edition ($14.95)

1035-434 p.—Instrument & Control Systems Engineering Handbook ($19.95)

1132-280 p.—Handbook of Electrical Noise: Measurement & Technology ($10.95)

1111-308 p.—How To Design, Build & Program Your Own Working Computer System ($12.95)

1076-252 p.—Artificial Intelligence ($12.95)

1053-266 p.—Microprocessor Cookbook ($9.95)

101-416 p. (8½x11")—Electronic Circuit Design Handbook—4th Edition ($19.95)

1101-546 p.—How To Design & Build Your Own Custom TV Games ($14.95)

1133-280 p.—The Active Filter Handbook ($9.95)

Facts About Club Membership

- The 6 introductory books of your choice carry publisher's retail prices of up to $102.70. They are yours for only $1.99 for all 6 (plus postage/handling) with your Trial Membership.
- You will receive the Club News, describing the current Selection, Alternates, and other books, every 4 weeks (13× a year).
- If you want the Selection, do nothing; it will be sent to you automatically. If you do not wish to receive the Selection, or if you want to order one of the many Alternates offered, you simply give instructions on the reply form (and in the envelope) provided, and return it to us by the date specified. This date allows you at least 10 days in which to return the form. If, because of late mail delivery, you do not have 10 days to make a decision and so receive an unwanted Selection, you may return it at Club expense.
- To complete your Trial Membership, you need buy only four additional monthly Selections or Alternates during the next 12 months. You may cancel your Membership any time after you purchase these four books.
- All books—including the Introductory Offer—are fully returnable after 10 days if you're not completely satisfied.
- All books are offered at low Member prices, plus a small postage and handling charge.
- **Continuing Bonus:** If you continue after this Trial Membership, you will earn a Dividend Certificate for every book you purchase. Three Certificates plus payment of the nominal sum of $1.99 will entitle you to a valuable Book Dividend of your choice which you may choose from a list provided Members.

May we send you your choice of 6 of these practical time-and-money-saving books as part of an unusual offer of a Trial Membership in Electronics Book Club?

Here are quality hardbound volumes, each especially designed to help you increase your know-how, earning power, and enjoyment of electronics. Whatever your interest in electronics, you'll find Electronics Book Club offers practical, quality books that you can put to immediate use and benefit.

This extraordinary offer is intended to prove to you through your own experience, that these very real advantages can be yours...that it *is* possible to keep up with the literature published in your areas of interest, and to save substantially while so doing. As part of your Trial Membership, you need purchase as few as four books during the coming 12 months. You would probably buy at least this many anyway, without the substantial savings offered through Club Membership.

To start your Membership on these attractive terms, simply fill out and mail the coupon today. You will receive the 6 books of your choice for 10-day inspection. YOU NEED SEND NO MONEY. If you're not delighted, return the books within 10 days and your Trial Membership will be cancelled without cost or obligation.

ELECTRONICS BOOK CLUB, Blue Ridge Summit, Pa. 17214

ELECTRONICS BOOK CLUB

Blue Ridge Summit, Pa. 17214

Please open my Trial Membership in ELECTRONICS BOOK CLUB and send me the 6 books circled below. I understand the cost of the books I have selected is only $1.99 for all 6, plus a small shipping charge. If not delighted, I may return the books within 10 days and owe nothing, and have my Trial Membership cancelled. I agree to purchase at least four additional books during the next 12 months after which I may cancel my membership at any time.

101 802 804 925 931 962 1034 1035
1038 1053 1062 1076 1077 1093 1097 1101
1111 1118 1123 1128 1132 1133 1141 1216

Name ____________ Phone ____________

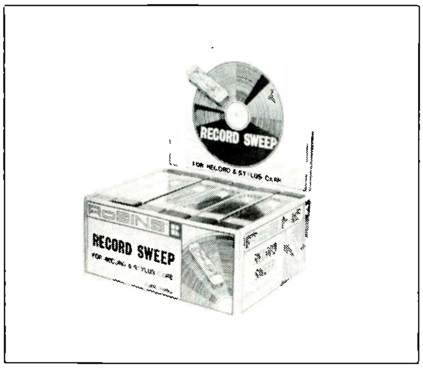
Address ____________

City ____________

State ____________ Zip ____________

(Valid for new Members only. Foreign and Canada add 15%.) T-99

Circle No. 110 on Reader Inquiry Card



ered reservoir which feeds metered amounts of moisture to a plush velvet cleaning surface. Individual fibers reach down into the grooves to loosen and pick up accumulated dust particles. The "Record Sweep" record and stylus care system catalog #41-049, which comes packaged in a high-impulse P.O.P. counter display of 12 units to generate high volume sales carries a suggested list price of $3.35.

Projection TV

Circle No. 157 on Reader Inquiry Card

Video Concepts, Inc. has developed a line of home projection TV systems with projectors and screens housed in bars, bookcases and tables. The Concept 5050 projection is housed in a coffee table of hand rubbed real wood finish and features full fidelity speaker systems and optional AM/FM stereo and 8-track player. The screens are available in four, five and six foot diagonal sizes. The Concept 5050 retails for $2995.

XK Police Radar Detector

Circle No. 158 on Reader Inquiry Card

Rigel Systems has announced that a new generation of their Sidewinder-SK Radar Detector is now available. It has a new front-end design that reportedly reduces false alarms to a minimum, plus advanced circuitry to provide protection against the new K Band Coded-pulse guns now being used by the police. It offers "Fore & Aft" monitoring, with a single unit (patents pending), and monitors both the X and K Bands. The compact unit (2 in. × 2.25 in. × 3.75 in.) has an extruded, solid aluminum case with black matte finish that houses the solid-state integrated electronics, high gain antenna, sensitivity control, on/off lamp, and the dual advance-warning media (light/sound). Actual range of the Sidewinder XK varies with ambient conditions, but the average is stated to be roughly six times the "reach" of the best police radar, whether stationary, moving-car, or handgun. The complete Sidewinder package includes the detector and the universal 4-way mount options (visor, dash, windshield or trimstrip). A special adaptor is now available that permits permanent wire-in to the vehicle's electrical system. All Sidewinders are stated to be thoroughly burned-in prior to shipment. Each unit carries a one-year warranty. Price: $149.50.

Telephone Patch

Circle No. 159 on Reader Inquiry Card

Vox-A-Phone is a new Vox switching telephone patch by *Vox Systems Inc.* Developed to allow telephone usage thru a two-way radio system it's stated features are: AC powered, output switching; 5 wire universal switching, Mic output; same as preamp Mic-universal, speaker input; 8 ohms, Internal speaker; 8 ohms, phone line input; 600 ohms, power supply 115Vac or 12 Vdc, will work with either a relay or electronic switching base, three minute timer, phone cradle, reset button for extra time, automatic shut-off. **ET/D**

GE

continued from page 43

24 pin CMOS integrated circuit with built-in oscillator, frequency divider, and phase comparator circuits. The crystal reference frequency is set with an adjustable trimmer capacitor SC24 to 4,000,000 ±15Hz.

The inputs to the board are the three power supply voltages, the oscillator signal from tuner through the wideband amp and prescaler, and the information for channel selection.

The outputs from the board are the bandswitching voltages and the tuning; voltage (Vt).

The MM55110 synthesizer, SIC10, receives a local oscillator signal from the prescaler (which divides by 256). The channel select information enters SIC10 on nine pins. This binary channel select information corresponds to the local oscillator frequency in MHz. (Example: Channel 2, local oscillator 101MHz, binary code 0001100101.) This binary code is generated, except for the 2° bit, by the ET82 mechanical switch. The channel select code will allow the synthesizer to select a divider chain which will, in turn, provide an input to the phase comparator that is always 3906.25Hz when correctly tuned. The other input to the phase comparator is the 4MHz divided by constant 1024 (i.e., 3906.25Hz). The output of the phase comparator then controls the tuning voltage via an amp in SIC10 and two external transistors (SQ12 and SQ8).

The remote transmitter output is infrared, modulated by an eight bit pulse train at a pulse frequency of 35.3kHz. The remote receiver detects infrared radiation. The light detecting pin diode is followed by one stage tuned to 35.3kHz, two untuned stages and a Schmidt trigger output to the tuner control module.

Tuning system troubleshooting

The remote transmitter may fail completely or suffer reduced range. The most likely causes are a weak battery or defective infrared diodes. The remote receiver can cause a total loss of remote control. Standby module defects can result in a loss of tuning and/or bandswitching voltages to the tuner. The on-off module can prevent the set from turning on or prevent it from turning off, once on. The likely component failures here are the triac and relay.

Failures in the tuner control module can cause loss of tuning and bandswitching voltages, loss of channel number display segments, loss of on/off or volume control function. Failure of IC10 affects tuning voltage; failure of IC90 affects bandswitching, tuner B+,channel display. Wideband amplifier failure results in loss of tuning voltage.

The IC's and the microprocessor plug into sockets for easy substitution.

Odd service hints

Remove seven screws to remove the cabinet back. The chassis positions for service by releasing two screws, engaging the service support arm and tilting back; all modules and boards can be released for inspection by the removal of one to three screws.

Remember the "Mini Manual." Each GE color TV has in its cabinet a Mini Manual containing schematics, parts list and ordering info, adjustment and convergence information, service and troubleshooting information, power supply data, a block diagram, a B+distribution chart, safety information and component location information. Don't forget to replace it when you are through—you might want it again. ET/D

DIGITAL V

continued from page 38

and 1 megohm, and C1 5 - 35 µF. Note that the time constant of the circuit is dependent upon these values. If you are using only the *Powerace* 102, then you will have to measure time durations with a sweep second hand (or stop watch). In that case, opt for higher values for R1/C1 so that the duration(s) will be longer.

1. Connect the trigger input (pin no. 11 on the 4013) to the P1-Q output on the Powerace 102.
2. Connect the Q output (4013 pin no. 13) to the L2 lamp on the Powerace 102.
3. Turn on the Powerace 102. L2 will probably turn on at this time, but will go out in a few second.
4. Press P1 and note L2. L2 should come on for a period of several seconds (up to 60 seconds if maximum values for R1/C1 are used), and then go out.
5. Repeat step no. 4, but time the output pulse (i.e. period when Q is HIGH-L3 on -) using a sweep second hand or oscilloscope time base. This is normal one-shot operation.

Experiment No. 2 Is the circuit of Figure 2A retriggerable?

Perform the steps in Experiment no. 1. But add the step below.

6. Press P1 and release, while timing the output period. When approximately ½ of the time is measured in step no. 5 has elapsed, press P1 again.
7. If the circuit is retriggerable, then the time measured in step 6 will be longer than in step 5.

Experiment no. 3 Retriggerable one-shot.

If you performed the previous experiment correctly, you will have noticed that the circuit of Figure 2A is nonretriggerable. The output pulse duration is the same no matter how many trigger pulses arrive before the time-out period is expired. We can modify the circuit of Figure 2A according to the changes shown in Figure 6, however, to add retrigerability. In this case, Q1 and R2 are added, so that the trigger pulse can cause Q1 to discharge C1.

Without oscilloscope.

1. Turn off Powerace 102 and wait for L2 to go out.
2. Press P1 and observe L2. Use a sweep second hand or stop watch to measure the period of the one-shot (time L2 is on).
3. Repeat steps 6 and 7 in Experiment no. 2. ET/D

TV CIRCUITS

continued from page 29

reaches 50 per cent of its white level, the beam decelerates back to its normal trace speed, "thus minimizing the gray scale between switching levels." A similar action occurs at point C, in switching from white to black where beam speed this time is decreased due to the controlling VM pulse.

The overall trace time of a horizontal cycle remains unchanged with this system.

SAW filters

The past 12 months has witnessed a larger migration of manufacturers to the surface acoustic wave (SAW) filter (ET/D, August 1979) method for maintaining proper intermediate frequency passband requirements. Zenith was first to employ these devices on a large scale several years ago.

Also employing SAW filter IF strips are Toshiba, with SAWs in its complete 1980 color line and Sanyo.

These devices have been included in Sanyo's newest 19 and 13 inch screen size models and both models also feature one chip video signal processing and a new in-line, slotted mask, black matrix picture tube. ET/D

CLASSIFIED

RATES: 45 cents per word (minimum charge, $15). Bold face words or words in all capital letters charged at 60 cents per word. Boxed or display ads charged at $55 per column inch (one inch minimum). For ads using blind box number, add $5 to total cost of ad. Send ad copy with payment to Dawn Anderson, ELECTRONIC TECHNICIAN/DEALER, 1 East First Street, Duluth, MN 55802.

BOX NUMBER REPLIES: Mail box number replies to: ELECTRONIC TECHNICIAN/DEALER, Classified Ad Department, One East First Street, Duluth, MN 55802. Please include box number in address.

FOR SALE

send a message...
...write here.

____

____

____

____

1. Number of insertions: (circle) 1 2 3 6 12
2. Start with (month) ____________issue (Copy must be in by 1st of month preceding)
3. Amount enclosed: $____________.

PAYMENT MUST ACCOMPANY ORDER. WE'LL BILL RATED FIRMS

NAME____________________COMPANY________________

STREET____________________________________

CITY____________________STATE____________ZIP________

MAIL AD COPY TO: DAWN ANDERSON, ELECTRONIC TECHNICIAN/DEALER, 1 EAST FIRST STREET, DULUTH, MN. 55802.

RATES: 45 cents per word (minimum charge, $15). Bold face words or words in all capital letters charged at 60 cents per word. Boxed or display ads charged at $55 per column inch (one inch minimum). For ads using blind box number, add $5 to total cost of ad.

ELECTRONIC STUDENTS SERVICE TECHNICIANS-Service/Repair TV receivers the easy way with the **WAVEFORM ANALYSIS CHART** and test procedure-$9.95 postpaid-**TELEVISION SERVICE AIDS** 548 Cooke St., Honolulu, HI 96813. 10/79

COLOR PICTURE TUBE REBUILDING EQUIPMENT. SEMIAUTOMATIC ELECTRONICALLY CONTROLLED PROCESS. COMPLETE TRAINING. Call or write Atoll Television, 6425 W. Irving Park, Chicago, IL 60634. Phone 312-545-6667. 11/79

LINEAR AMPLIFIER, 2-30 MHz, 100 or 200 watt solid state. 300 MHz COUNTER. Modulation BOOSTER. Omnidirectional BASE ANTENNA. Plans $3.00 each. $10.00/all. Catalog of others. **Panaxis** Box 130-ET9 Paradise, CA 95969

ELECTRONIC BARGAINS, CLOSEOUTS, SURPLUS! Parts, equipment, stereo, industrial, educational. Amazing values! Fascinating items unavailable in stores or catalogs anywhere. Unusual FREE catalog. ETCO-013, box 762, Plattsburgh, NY 12901. TF

VIDEO MOVIES G/PG/R/X: Beta or Vhs, bought, sold, rented. Blank tapes, Video recorders, supplies: Cat $1.00, refundable. Astro Electronics, 160 Woodbridge Ave., Highland Park, NJ 08904. 11/79

For Sale: All new picture tube Rebuilding Equipment. First class professional Grade. 2 ovens, Litton sealing machine, etc. $5800 or offer. Call or write: T&C Services, Inc., 37 W. Quincy, Westmont, IL. 60559. 312-963-4020. 12/79

MATV-CATV INSTALLERS Get lowest prices on antenna accessories, fastest service from **ANTSCO CORPORATION.** Call collect, ask for catalog & prices. All orders shipped same day. Sierra Madre, CA. 91024. 213-355-2510. 1/80

Video Tape—4 hr. VHS $15.99, 2 hr. Sony $12.25, 3 hr. Sony $16.95, Video Recorders, cameras. Entertainment Electronics, 8-B Centre Ave., East Rockaway, NY 11518. 516-887-2550. 9/79

SATELLITE TELEVISION-MOVIES, SPORTS, ETC. BUILD OR BUY YOUR OWN EARTH STATION. Send $3.00 for information Satellite Television, Box 140, Oxford, NY 13830. 10/79

AM RADIO reception systems for interiors of buildings, ships, tunnels, etc. Receiver connection not required. Catalog A, Extronix, Inc. 64 Gough Ave., Ivyland, PA. 18974. 12/79

TV REPAIR SHOP INVENTORY. Stock of tubes, panels, parts and service literature. Full line of test equipment, all in excellent condition. Write to P. O. Box 538, Big Timber, MT 59011, 406-932-3344.

TUBES—Receiving, Industrial and Semiconductors, factory boxed. Free price list. Low, low prices. **TRANSLETERONIC INC.** 1365-39th Street, Brooklyn, N.Y. 11218E 800-221-5802, 212-633-2800.

Sams CB Photofacts. 1-100 $2.00 each; 100-213 $2.50 each. Rise Communications, 1206 Green St., Warner Robins, GA 31093. 912-923-7006. 10/79

HELP WANTED

ELECTRONICS/AVIONICS EMPLOYMENT OPPORTUNITIES. Report on jobs now open. Details FREE. Aviation Employment Information Service, Box 240Y, Northport, New York 11768 8/79

TUNER TECHNICIAN 18 months experience or more. Unique opportunity. 40% commission on labor, 5% on parts, and 40% on additional shipping charges. Send resume to P.O. Box 6456, Oakland Park, FL 33309. 10/79

WANTED

WANTED: Used color TV's unrepaired in Southeastern U.S. Must be in fair condition, no junk, no round tubes. Also B & K model 415 for sale $300. Call 704-375-4199.

TUNER SERVICE serving over 300 dealers in the Chicago area wants additional lines. Write or call: Economy Tuner Service. 4901 N. Elston, Chicago, IL 60630. Phone 312-282-3939.

WANTED: Vertical rotary burner type necking and sealing machine for picture tubes. R.E.W. Electronics, Rt. 2 Barrington, N.H. 03825. 603-742-0717. 10/79

BUSINESS OPPORTUNITIES

TV Sales and Service for sale. Well established dealership. Excellent location on 5 acres of prime commercial property in Alpena, Mich. Good gross sales. Business showroom and shop attached to a 4 bedroom house. (Now has many commercial accounts). McGirr Reality, 1020 W. Chisholm, Alpena, MI (517) 354-3482. 11/79

MECHANICALLY INCLINED INDIVIDUALS: Assemble electronic devices in your home. Investment, knowledge, or experience not necessary. Get started in spare time. Above average profits. $300-$600/wk. possible. Sales handled by others. Write for free details. Electronic Development Lab, Drawer 1560B, Pinellas Park, FL 33656.

T.V. Service in affluent Greenwich CT-Established 5 yrs. new equipment & parts-inventory included-low overhead. Asking $15,000. Contact Jake Sharet 203-531-7949 or write 16 North Water St., Greenwich CT 06830.

Business Opportunity. TV sales and service business doing $50,000/yr, Zenith and RCA sales and warranty. Everything goes, owner retiring from 15 years service. No. California Mountain community of 5000 at 2400 ft. elevation. Only shop within 35 miles. Write to "Dick"; P. O. Box 816; Hayfork, CA 96041. 9/79

Radio & TV service business-Same location 17 years. 3 bedroom home plus mobile home hookup-2 storage sheds-on lot 153 x 203-zoned C1. If interested write Tom R. Ludgate, P. O. Box 448, Show Low, Ariz. 85901.

Growing T.V. Sales and Service business for sale in Northern New Jersey; complete, with van and inventory. Excellent opportunity; contact Mr. Richard Trueman, after 7 p.m. at 201-838-6912, or write ET/D box 127.

BROADCAST STATION. Start your own, any type! Unique Cable FM station operation-investments/experience unnecessary! Receive free tapes, records. Get your FCC license! Much more. Free details. "Broadcasting:" Box 130 ET9, Paradise, CA 95969

TV Servicing Business, $25,000 takes all. Low overhead. Contact Stan Listzwan, 9909 E. Creek St., Tucson AZ 85730. 602-889-4910 or 885-3137. 11/79

AD INDEX

This index is furnished for the readers' convenience. However, the publisher can not guarantee its accuracy due to circumstances beyond our control.

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

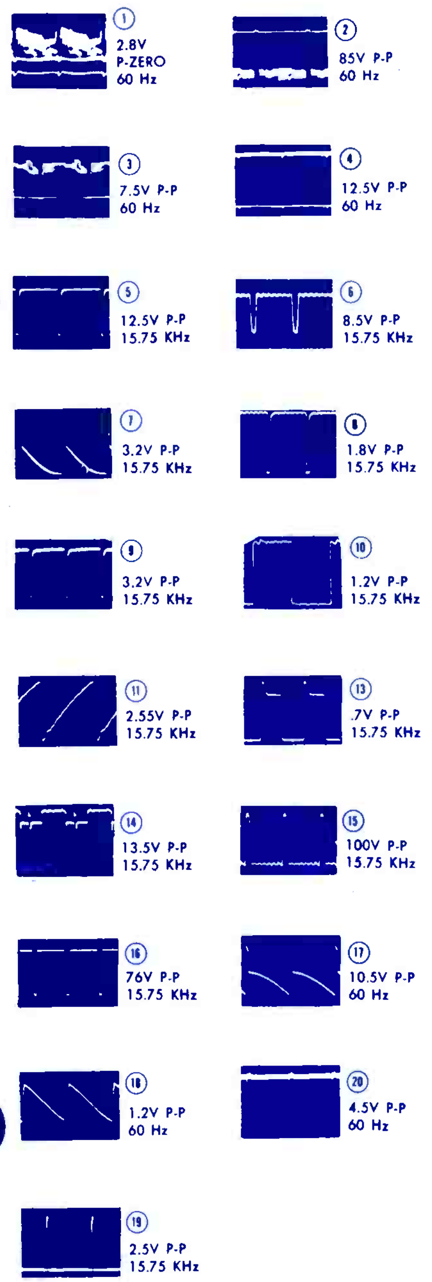
SCHEMATIC NO.		SCHEMATIC NO.	
ZENITH B&W Chassis 9JB2X, 9JB4X, 125B2X, 125B3X	1806	HITACHI Color TV Chassis NP4SX	1809
GENERAL ELECTRIC Color TV Chassis EC-A	1807	PANASONIC B&W TV Chassis T126A	1810
GENERAL ELECTRIC Electronic Tuning System ET-82, MP-82	1808		

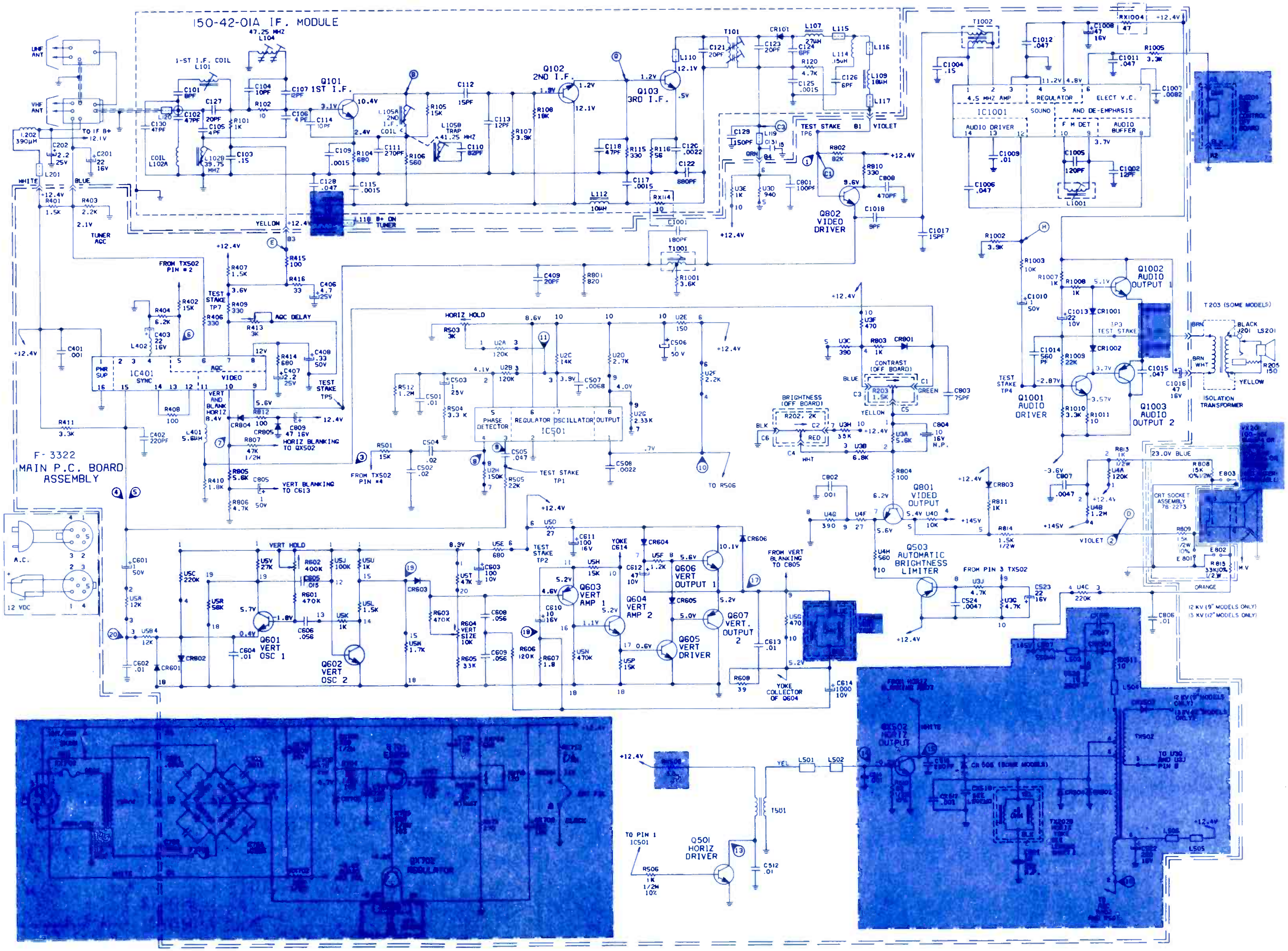
1806

ZENITH
B&W TV Chassis
9JB2X

SEPTEMBER • 1979

COMPONENT	9" SETS	9JB2X, 9JB4X 12" SETS	12JB2X
CX518	22-7612-02	22-7612	22-7612
RX204	.033 MF-200V 63-10638	.027 MF-200V	.027 MF-200V 63-1051A or 63-10570-02 (not interchangeable!)
SX201	Volume Cont: Rotary Part of RX204 ON/OFF Switch		Volume Control-Slide 85-1478 ON/OFF Switch



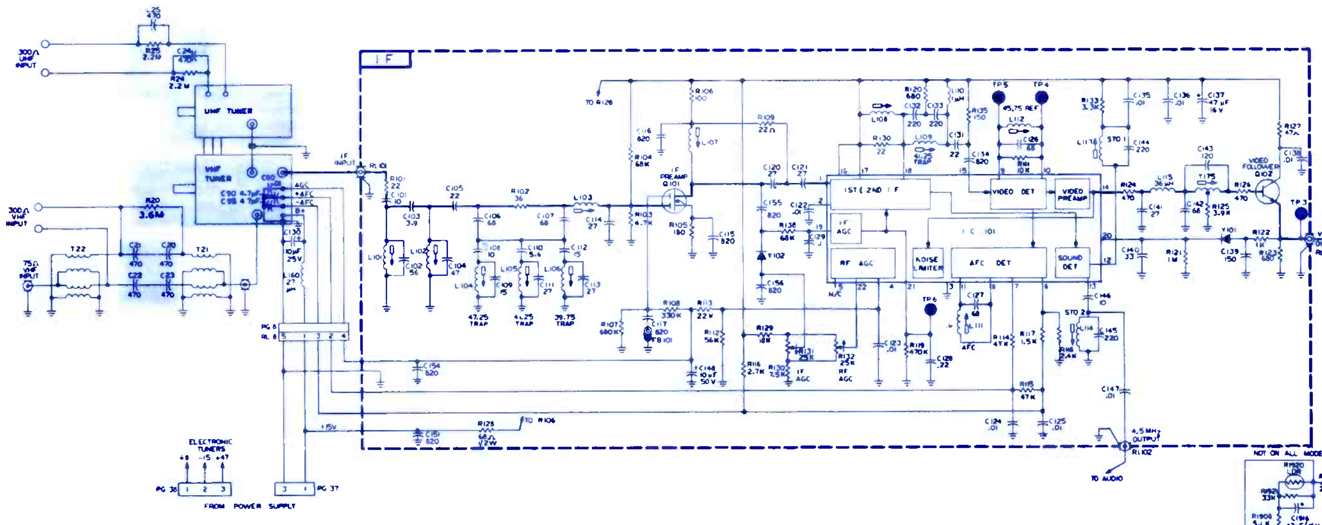


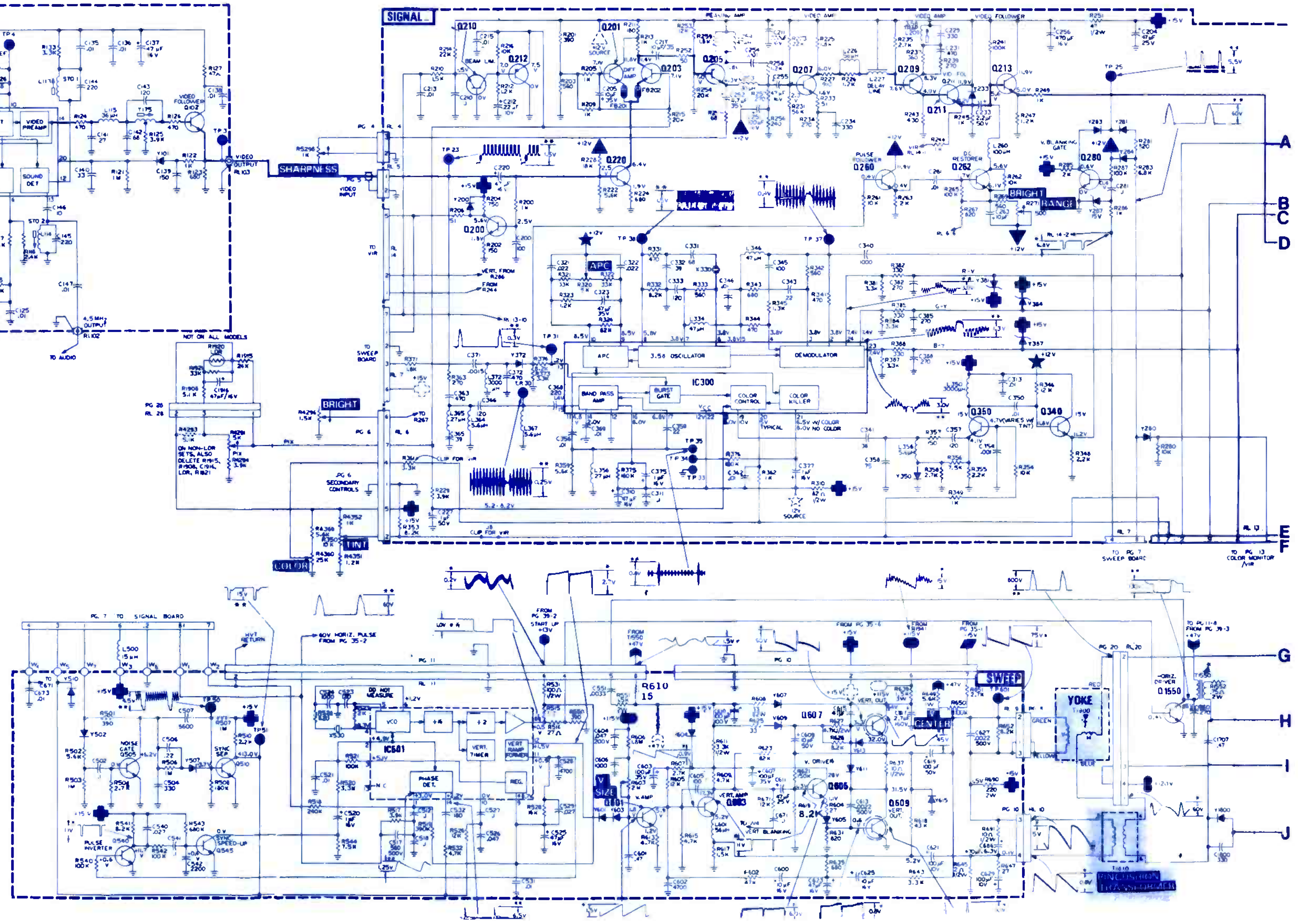
G.E. Color TV Chassis EC-A

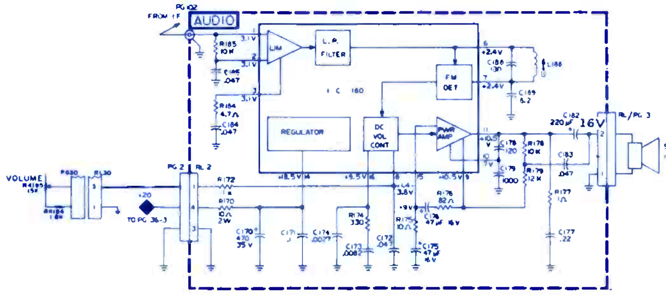
SEPTEMBER • 1979

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS







SCHEMATIC - EC 19"
SERVICE #A01

UNLESS OTHERWISE NOTED:
K=1,000 M=1,000,000
CAPACITORS MORE THAN 1 = µµF = pF
CAPACITORS LESS THAN 1 = µF
RESISTORS ARE 1/4W OR 1/8W
INDUCTORS MORE THAN 1 = µH

VOLTAGE MEASUREMENTS MADE WITH A VTVM WITH RESPECT TO CHASSIS.
RECEIVER SET FOR NORMAL OPERATION WITH STRONG SIGNAL.
MEASUREMENTS MAY VARY ±10% AT 120VAC LINE VOLTAGE.
SIGNAL WAVEFORMS TAKEN WITH KEYED RAINBOW GENERATOR SIGNAL.

# # INDICATES WAVEFORMS TAKEN AT 1/2 HORIZONTAL SWEEP RATE.
# INDICATES WAVEFORMS TAKEN AT 1/2 VERTICAL SWEEP RATE.
RL = RECEPTICAL
PG = PLUG

† YOKE
Vert. 60 OHMS
Horiz. 1.73 OHMS

*BUFFER T1550
Pri. 15 OHMS
Sec. .18 OHMS

PRODUCT SAFETY SHOULD BE CONSIDERED WHEN COMPONENT REPLACEMENT IS MADE IN ANY AREA OF A RECEIVER. THE SHADED AREAS OF THE PARTS LIST AND SCHEMATIC DIAGRAM DESIGNATE COMPONENTS IN WHICH SAFETY CAN BE OF SPECIAL SIGNIFICANCE. IT IS PARTICULARLY RECOMMENDED THAT GENERAL ELECTRIC CATALOGED PARTS BE USED FOR REPLACEMENT OF COMPONENTS WHICH ARE IN THE SHADED AREAS OF THE PARTS LIST AND SCHEMATIC DIAGRAM.

USE OF SUBSTITUTE REPLACEMENT PARTS WHICH DO NOT HAVE THE SAME SAFETY CHARACTERISTICS AS RECOMMENDED IN FACTORY SERVICE INFORMATION MAY CREATE SHOCK, FIRE OR OTHER HAZARDS, OR EXCESSIVE X-RADIATION.

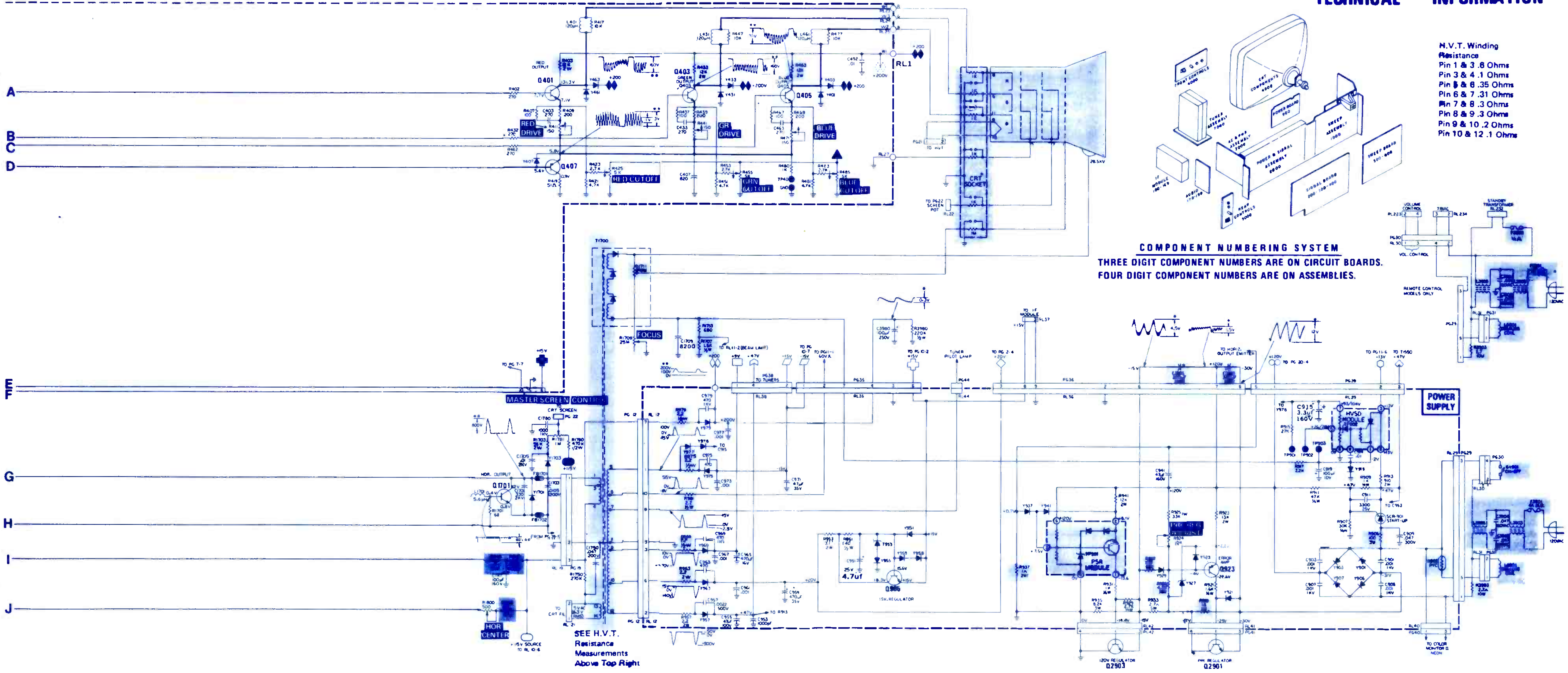
GENERAL ELECTRIC
Color TV Chassis
EC-A

TECHNICAL INFORMATION

H.V.T. Winding
Resistance
Pin 1 & 3 .6 Ohms
Pin 3 & 4 .1 Ohms
Pin 5 & 6 .35 Ohms
Pin 6 & 7 .31 Ohms
Pin 7 & 8 .3 Ohms
Pin 8 & 9 .3 Ohms
Pin 9 & 10 .2 Ohms
Pin 10 & 12 .1 Ohms

COMPONENT NUMBERING SYSTEM

THREE DIGIT COMPONENT NUMBERS ARE ON CIRCUIT BOARDS.
FOUR DIGIT COMPONENT NUMBERS ARE ON ASSEMBLIES.



1808

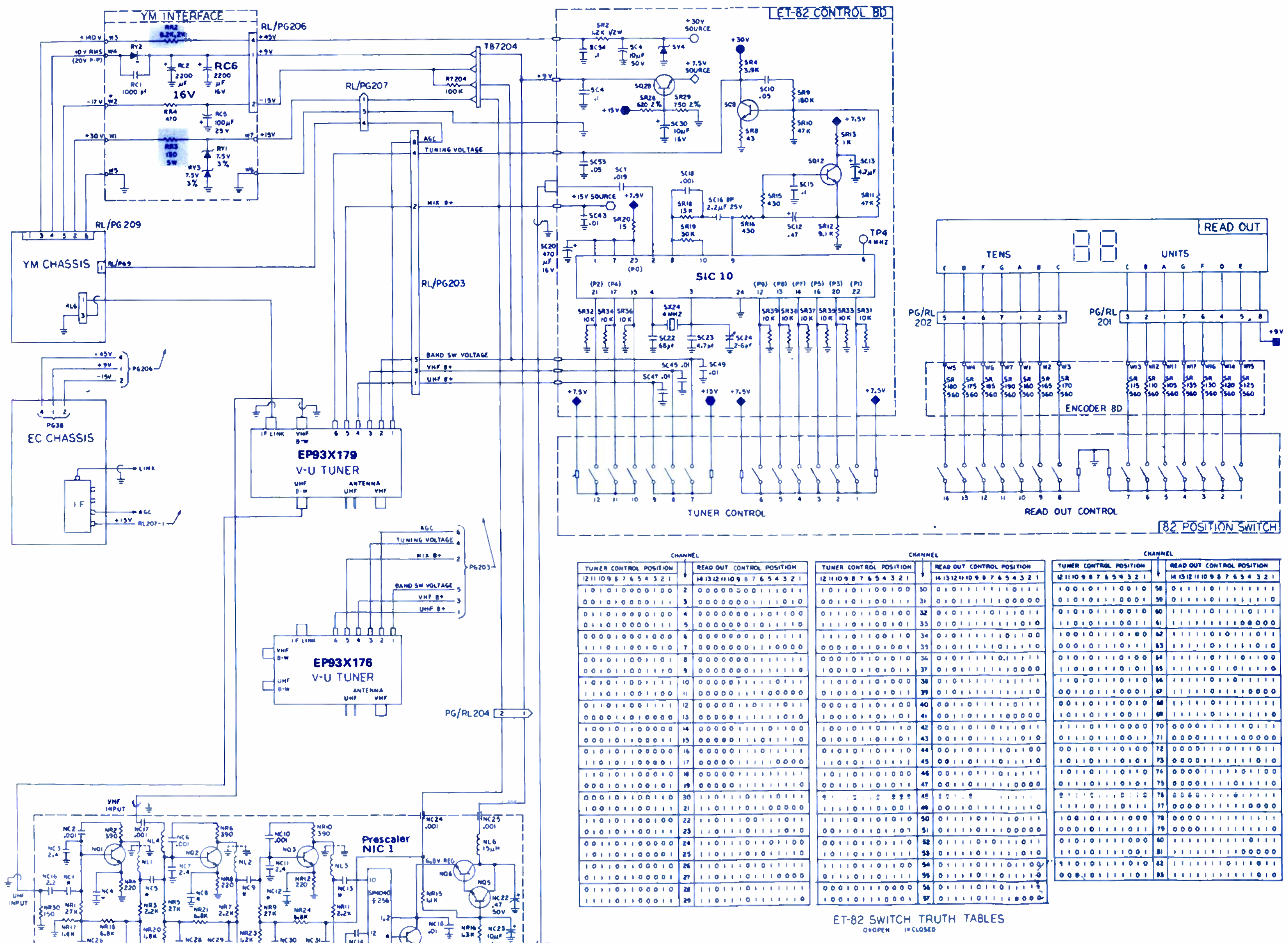
G.E.
Tuning System
ET-82, MP-82

SEPTEMBER • 1979

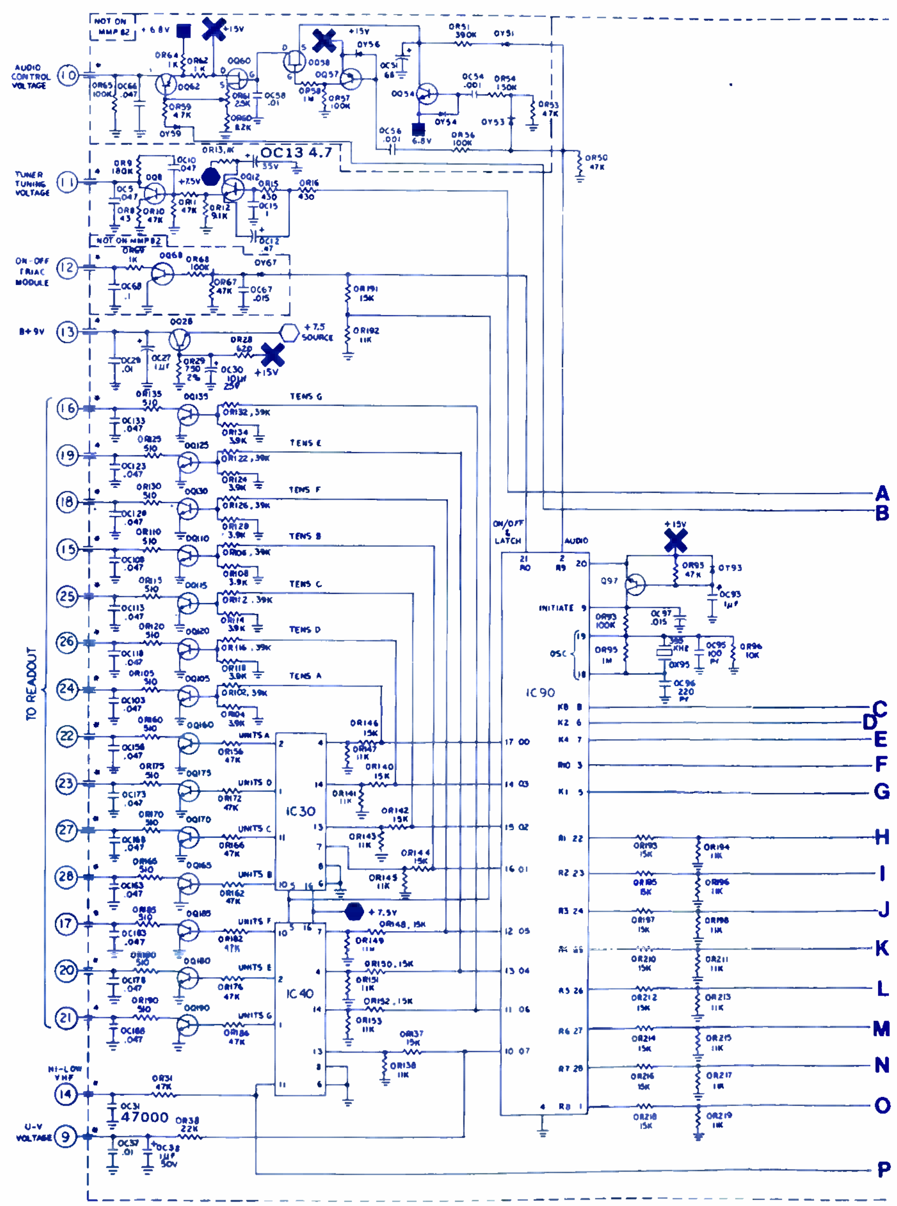
ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

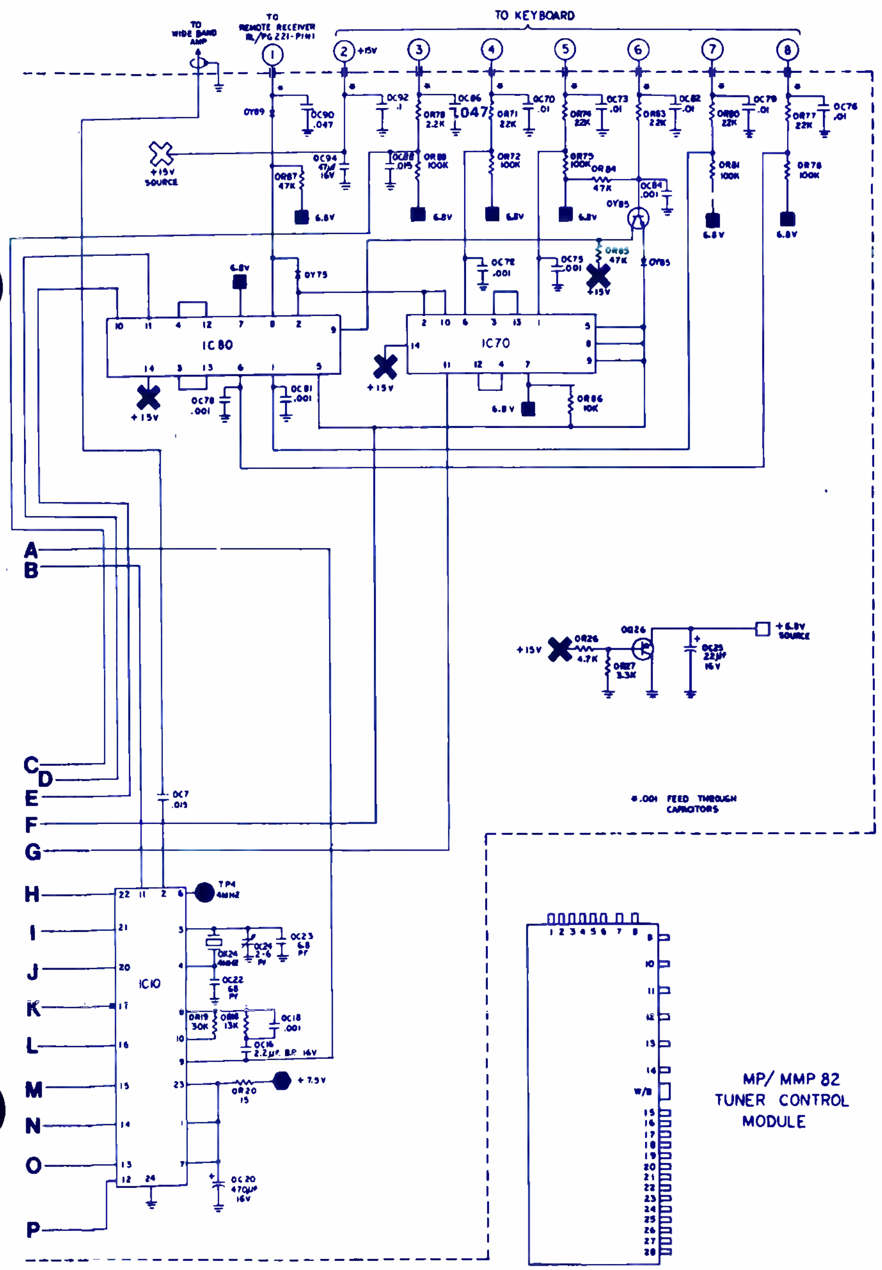
SCHEMATIC DIAGRAM ET82 TUNING SYSTEM



SCHEMATIC DIAGRAM TUNER CONTROL MODULE

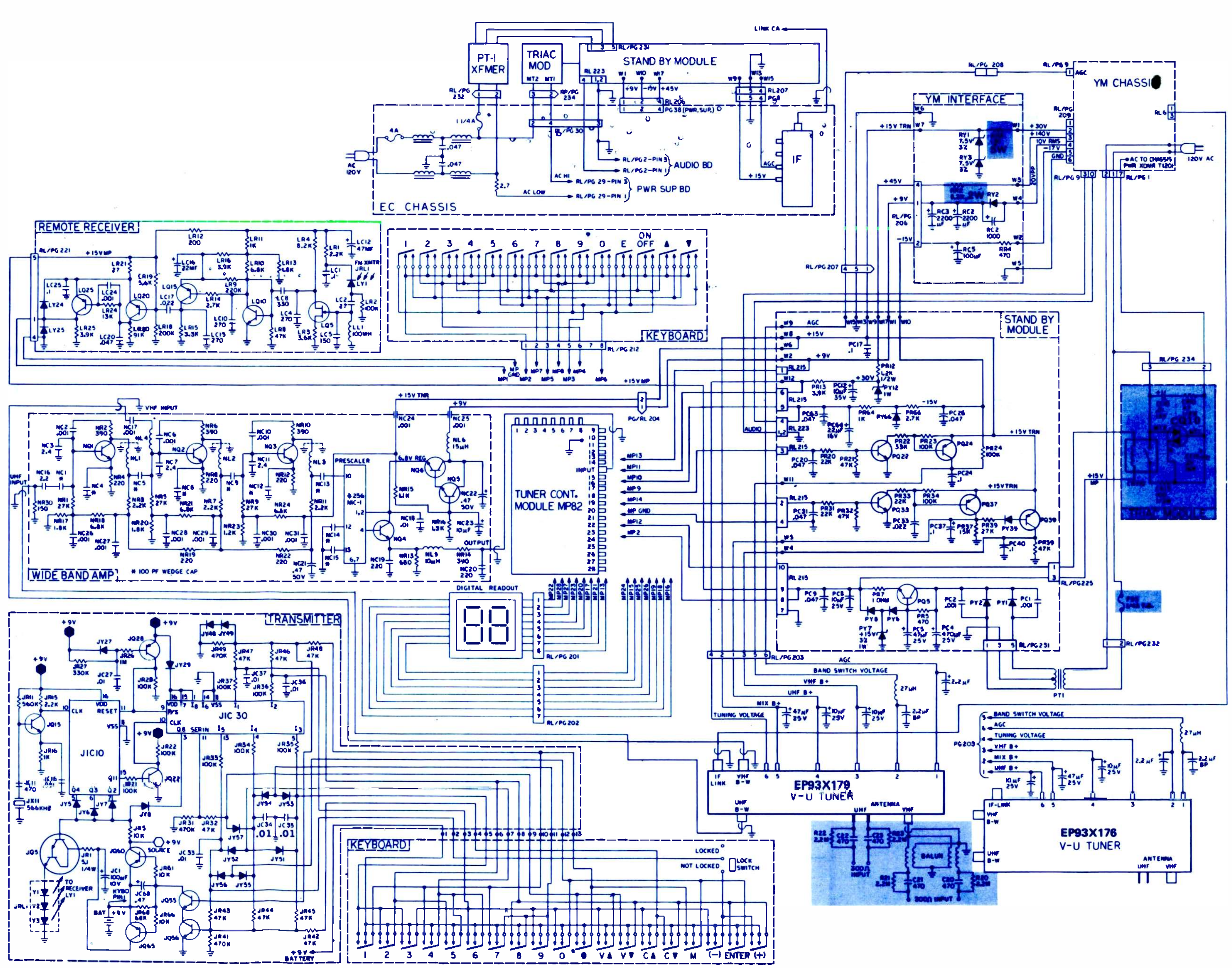


GENERAL ELECTRIC
Tuning System
ET-82, MP-82



MP/ MMP 82
TUNER CONTROL
MODULE

SCHEMATIC DIAGRAM MP82 TUNING SYSTEM



1809

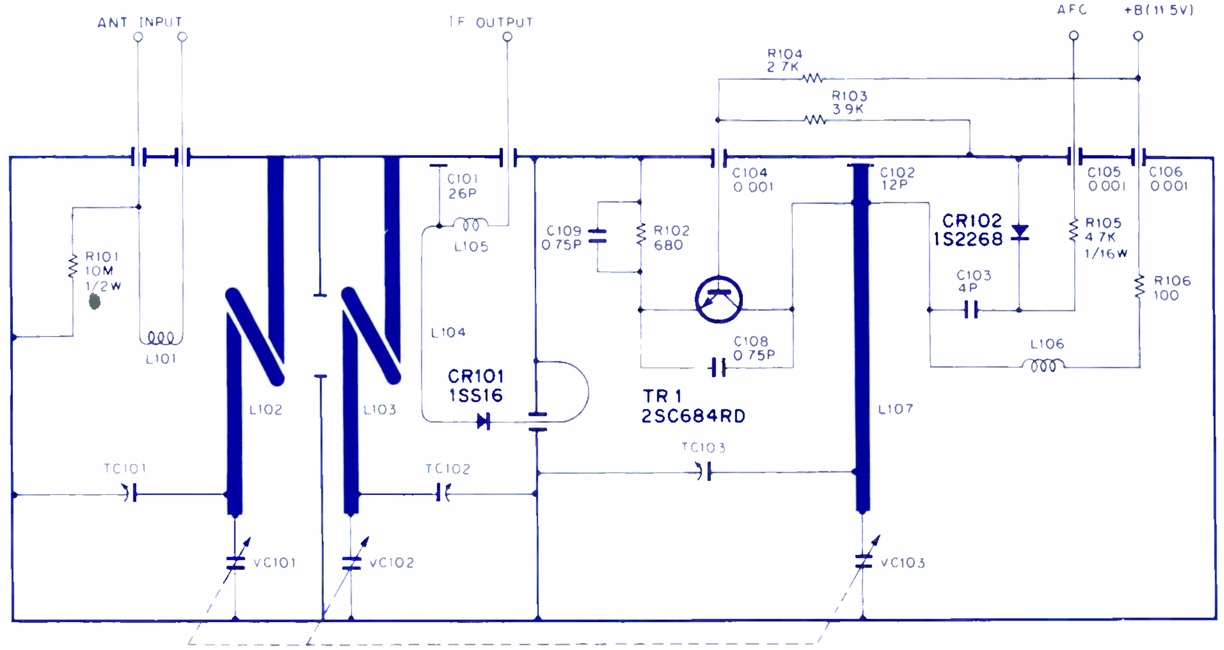
HITACHI
Color TV Chassis
NP4SX

SEPTEMBER • 1979

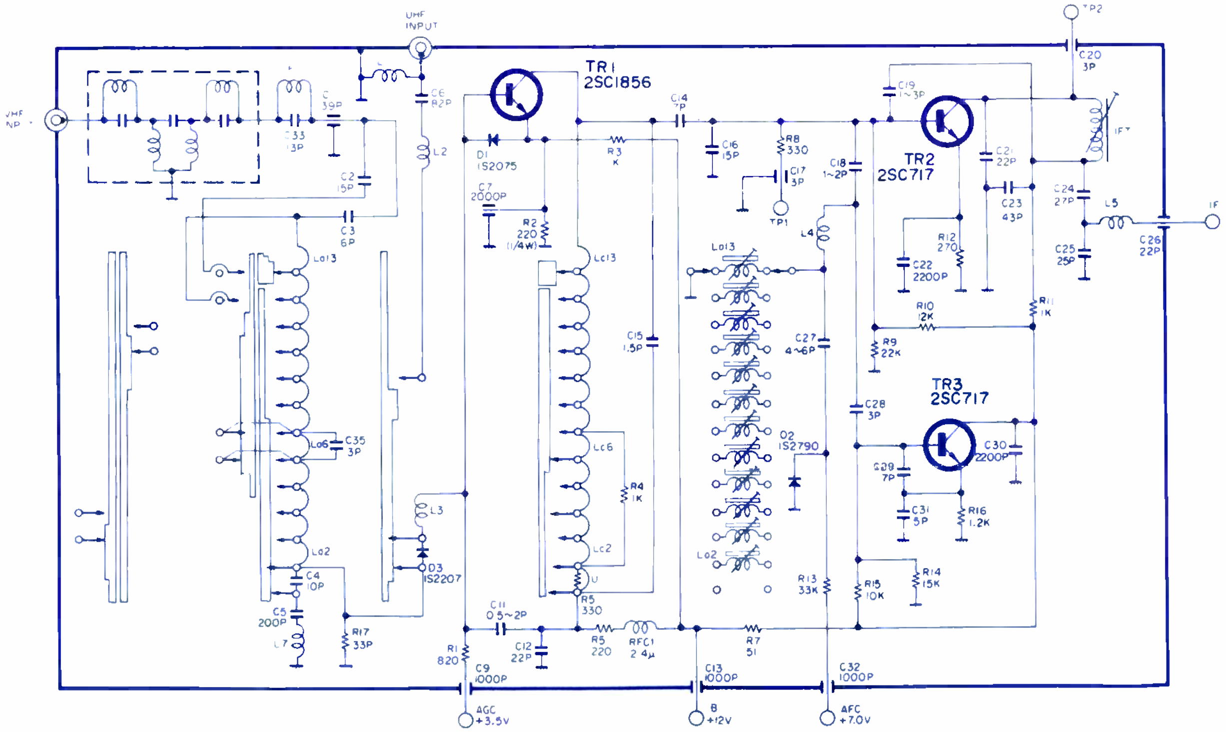
ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

UHF TUNER (HU-354D)

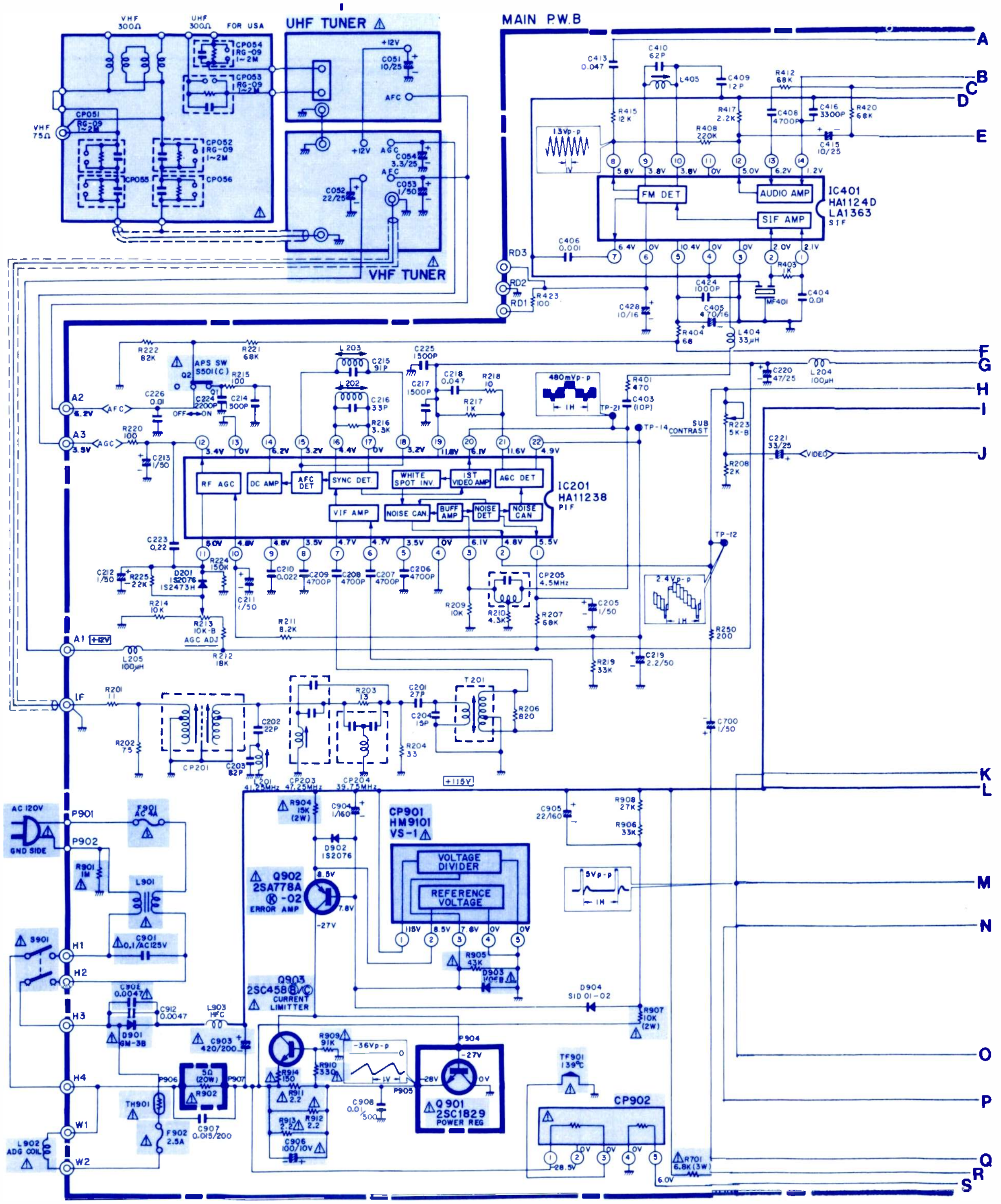


VHF TUNER (HT-455A)

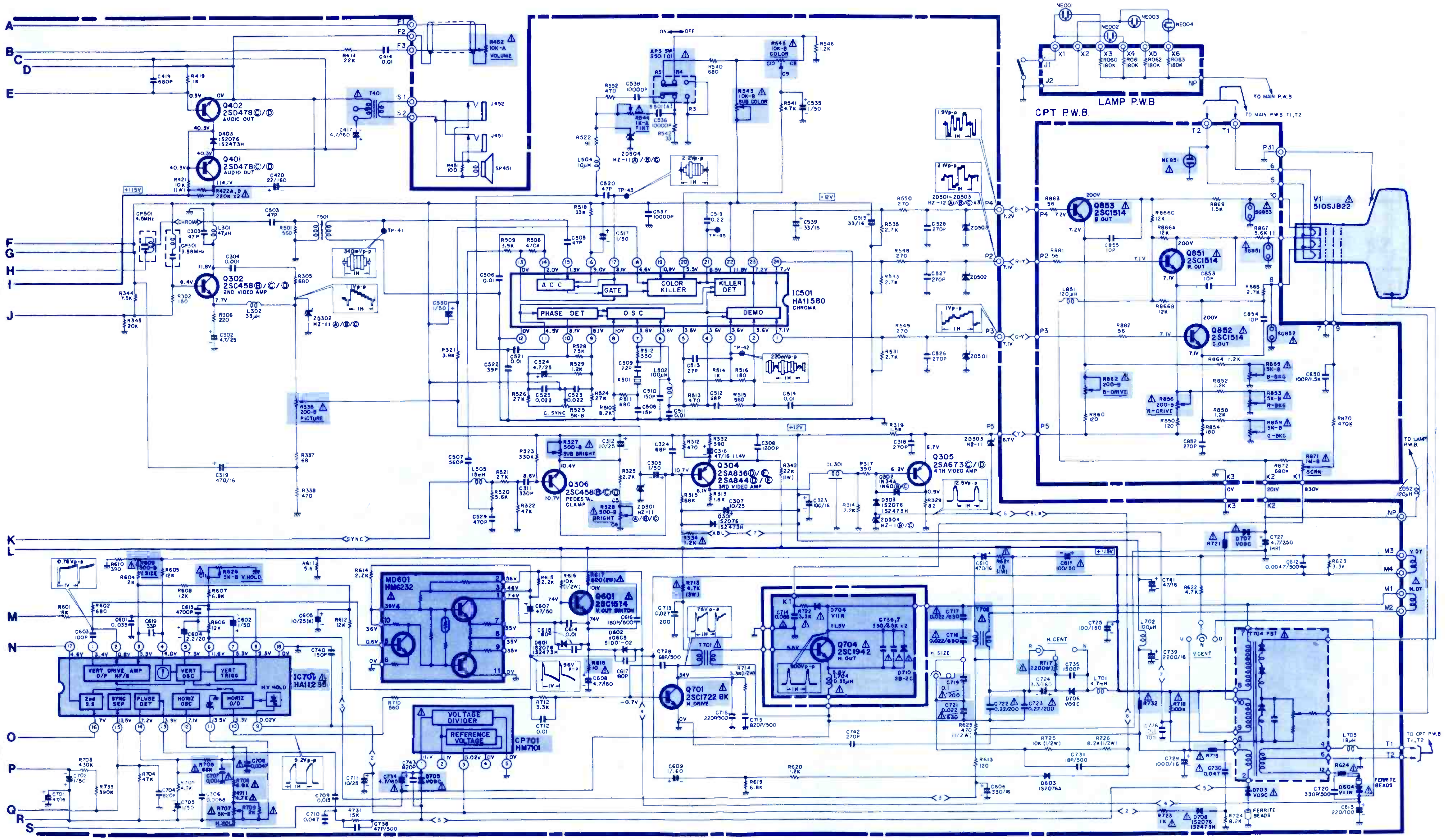


PRODUCT SAFETY NOTE

Components marked with a ⚠ and shaded have special characteristics important to safety. Before replacing any of these components read carefully the product safety notice of this service manual. Don't degrade the safety of the receiver through improper servicing.



HITACHI
Color TV Chassis
NP4SX



1810

PANASONIC
B&W TV Chassis
T126A

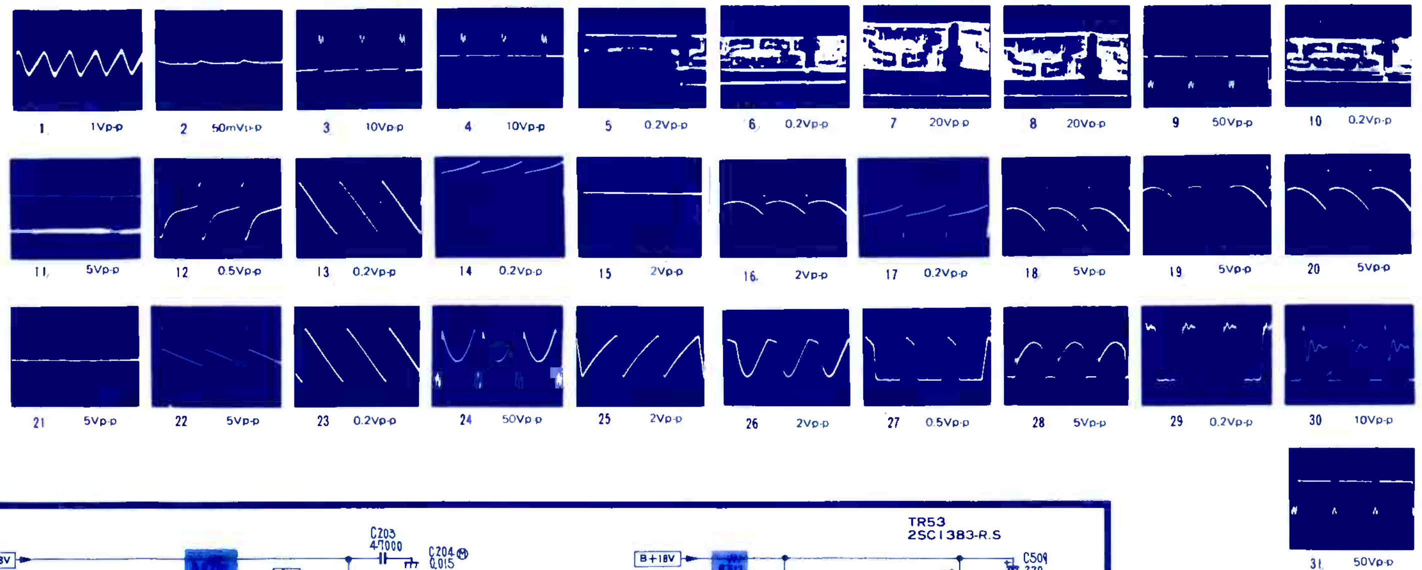
SEPTEMBER • 1979

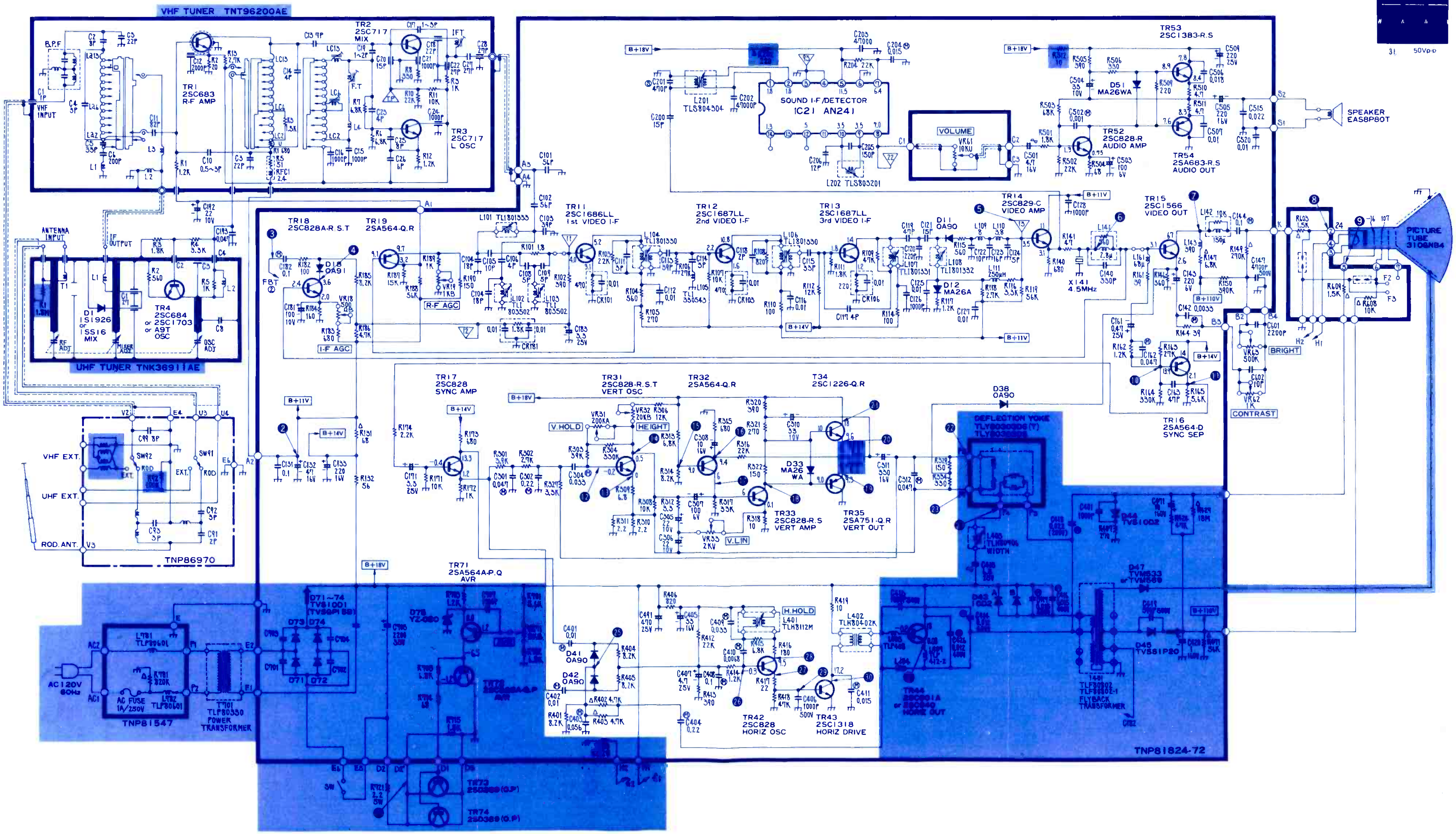
ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

IMPORTANT SAFETY NOTICE

THE SHADED AREA ON THIS SCHEMATIC DIAGRAM INCORPORATES SPECIAL FEATURES IMPORTANT FOR PROTECTION FROM X-RADIATION, FIRE AND ELECTRICAL SHOCK HAZARDS. WHEN SERVICING IT IS ESSENTIAL THAT ONLY MANUFACTURER'S SPECIFIED PARTS BE USED FOR THE CRITICAL COMPONENTS IN THE SHADED AREAS OF THE SCHEMATIC.





TYPE	25-UP	10-24	1-9
2SA 473	.45	.55	.60
2SA 483	2.00	2.20	2.50
2SA 484	1.50	1.75	1.95
2SA 485	1.40	1.60	1.80
2SA 489	1.10	1.25	1.40
2SA 490	.70	.80	.90
2SA 493	.45	.53	.59
2SA 495	.30	.35	.40
2SA 496	.50	.64	.70
2SA 497	1.00	1.20	1.30
2SA 505	.50	.64	.70
2SA 509	.30	.35	.40
2SA 525	.50	.64	.70
2SA 530	1.50	1.70	1.90
2SA 537A	1.50	1.70	1.90
2SA 539	.40	.45	.50
2SA 545	.45	.53	.59
2SA 561	.30	.35	.40
2SA 562	.30	.35	.40
2SA 564A	.20	.27	.30
2SA 565	.70	.80	.90
2SA 566	2.50	2.70	3.00
2SA 606	1.00	1.20	1.30
2SA 607	1.10	1.25	1.40
2SA 624	.70	.80	.90
2SA 627	3.10	3.30	3.60
2SA 628	.30	.35	.40
2SA 634	.40	.45	.50
2SA 640	.30	.35	.40
2SA 642	.30	.35	.40
2SA 643	.30	.40	.45
2SA 653	1.90	2.10	2.40
2SA 659	.35	.40	.45
2SA 661	.50	.64	.70
2SA 663	3.65	3.80	4.20
2SA 666	.35	.40	.45
2SA 671	.80	.90	1.00
2SA 672	.30	.35	.40
2SA 673	.35	.40	.45
2SA 678	.35	.40	.45
2SA 679	4.20	4.40	4.90
2SA 680	4.20	4.40	4.90
2SA 682	.80	.90	1.00
2SA 683	.30	.35	.40
2SA 684	.35	.40	.45
2SA 695	.40	.53	.59
2SA 697	.40	.53	.59
2SA 699A	.50	.64	.70
2SA 705	.40	.53	.59
2SA 706	.85	1.00	1.10
2SA 715	.60	.70	.80
2SA 719	.30	.35	.40
2SA 720	.30	.35	.40
2SA 721	.30	.35	.40
2SA 725	.30	.35	.40
2SA 726	.30	.35	.40
2SA 733	.20	.27	.30
2SA 738	.40	.53	.59
2SA 740	1.50	1.70	1.90
2SA 743A	.85	1.00	1.10
2SA 744	4.20	4.40	4.90
2SA 745R	3.80	4.00	4.40
2SA 747	4.20	4.40	4.90
2SA 748	.70	.80	.90
2SA 750	.35	.40	.45
2SA 755	.80	.90	1.00
2SA 756	2.30	2.40	2.65
2SA 758	3.40	3.55	3.90
2SA 764	3.80	4.00	4.40
2SA 765	3.10	3.30	3.60
2SA 774	.40	.45	.50
2SA 777	.50	.64	.70
2SA 794A	.60	.70	.80
2SA 798	.50	.55	.60
2SA 814	.70	.80	.90
2SA 815	.60	.70	.80
2SA 816	.50	.64	.70
2SA 818	.70	.80	.90
2SA 837R	2.50	2.70	2.90
2SA 839T	1.30	1.45	1.60
2SA 908	8.60	8.80	9.80
2SA 913	.70	.80	.90
2SB 22	.30	.35	.40
2SB 54	.20	.27	.30
2SB 55	.40	.53	.59
2SB 75	.35	.40	.45
2SB 77	.35	.40	.45
2SB 173	.30	.35	.40
2SB 175	.20	.27	.30
2SB 176	.30	.35	.40
2SB 178	.35	.40	.45
2SB 186	.20	.27	.30
2SB 187	.20	.27	.30
2SB 202	1.10	1.20	1.30
2SB 220	.90	1.10	1.20
2SB 303	.30	.35	.40
2SB 324	.30	.35	.40
2SB 337	.70	.80	.90

TYPE	25-UP	10-24	1-9
2SB 346	.30	.35	.40
2SB 367	1.10	1.25	1.40
2SB 368B	1.80	2.00	2.25
2SB 379	.70	.80	.90
2SB 381	.30	.35	.40
2SB 400	.30	.35	.40
2SB 405	.30	.35	.40
2SB 407	.80	.90	1.00
2SB 415	.30	.35	.40
2SB 434	.80	.90	1.00
2SB 435	.90	1.10	1.20
2SB 440	.40	.53	.59
2SB 449	1.30	1.45	1.60
2SB 461	.90	1.10	1.20
2SB 463	.90	1.10	1.20
2SB 471	1.10	1.25	1.40
2SB 472	2.10	2.50	2.80
2SB 473	.80	.90	1.00
2SB 474	.70	.80	.90
2SB 481	.90	1.10	1.20
2SB 492	.60	.70	.80
2SB 507	.80	.90	1.00
2SB 509	1.10	1.20	1.30
2SB 511	.70	.80	.90
2SB 514	.70	.80	.90
2SB 523	.70	.80	.90
2SB 526C	.70	.80	.90
2SB 527	.90	1.10	1.20
2SB 528D	.70	.80	.90
2SB 529	.70	.80	.90
2SB 530	3.20	3.40	3.70
2SB 531	1.80	2.00	2.25
2SB 536	1.00	1.20	1.30
2SB 537	1.00	1.20	1.30
2SB 539	3.20	3.40	3.70
2SB 541	3.20	3.40	3.70
2SB 554	5.00	6.00	6.60
2SB 556	3.20	3.40	3.70
2SB 557	2.10	2.50	2.80
2SB 561B	.35	.40	.45
2SB 564	.40	.53	.59
2SB 595	1.10	1.40	1.50
2SB 596	1.10	1.40	1.50
2SB 600	5.00	6.00	6.60
2SC 183	.40	.53	.59
2SC 184	.40	.53	.59
2SC 281	.30	.35	.40
2SC 283	.40	.53	.59
2SC 284	.80	.90	1.00
2SC 317	.40	.53	.59
2SC 352A	2.00	2.20	2.50
2SC 353A	1.40	1.60	1.80
2SC 367	.60	.70	.80
2SC 369	.30	.35	.40
2SC 370	.20	.27	.30
2SC 371	.30	.35	.40
2SC 372	.20	.27	.30
2SC 373	.20	.27	.30
2SC 374	.30	.35	.40
2SC 375	.30	.35	.40
2SC 377	.30	.35	.40
2SC 380	.20	.27	.30
2SC 381	.35	.40	.45
2SC 382	.35	.40	.45
2SC 383	.35	.40	.45
2SC 387A	.35	.40	.45
2SC 388A	.40	.53	.59
2SC 394	.20	.27	.30
2SC 403	.30	.35	.40
2SC 430	.50	.64	.70
2SC 454	.30	.35	.40
2SC 458	.20	.27	.30
2SC 460	.35	.40	.45
2SC 461	.35	.40	.45
2SC 478	.60	.70	.80
2SC 481	1.30	1.40	1.50
2SC 482	1.10	1.25	1.40
2SC 484	1.30	1.40	1.50
2SC 485	1.30	1.40	1.50
2SC 486	1.30	1.40	1.50
2SC 493	3.00	3.20	3.40
2SC 495	.45	.55	.60
2SC 496	.45	.55	.60
2SC 497	1.10	1.25	1.40
2SC 509	.35	.40	.45
2SC 510	1.30	1.40	1.50
2SC 515A	.80	.90	1.00
2SC 517	2.50	2.70	3.00
2SC 535	.30	.35	.40
2SC 536	.30	.35	.40
2SC 537	.30	.35	.40
2SC 627	1.30	1.45	1.60
2SC 631	.35	.40	.45
2SC 632A	.35	.40	.45
2SC 634A	.35	.40	.45
2SC 680	1.90	2.10	2.40
2SC 681A	3.00	3.25	3.50
2SC 684	.80	.90	1.00

TYPE	25-UP	10-24	1-9
2SC 693F	.20	.27	.30
2SC 696	1.00	1.20	1.30
2SC 708	1.30	1.45	1.60
2SC 710	.20	.27	.30
2SC 711	.20	.27	.30
2SC 712	.20	.27	.30
2SC 715	.30	.35	.40
2SC 717	.35	.40	.45
2SC 727	1.00	1.20	1.30
2SC 730	3.00	3.20	3.40
2SC 731	2.50	2.70	2.90
2SC 732	.20	.27	.30
2SC 733	.20	.27	.30
2SC 734	.20	.27	.30
2SC 735	.20	.27	.30
2SC 738	.20	.27	.30
2SC 756	1.50	1.80	2.00
2SC 756A	1.50	1.80	2.00
2SC 763	.35	.40	.45
2SC 772	.30	.35	.40
2SC 773	.35	.40	.45
2SC 774	1.00	1.20	1.30
2SC 775	1.40	1.60	1.80
2SC 776	2.00	2.20	2.50
2SC 777	3.00	3.25	3.50
2SC 778	2.90	3.20	3.40
2SC 781	1.90	2.10	2.40
2SC 783	2.10	2.50	2.80
2SC 784	.30	.35	.40
2SC 785	.35	.40	.45
2SC 789	.80	.90	1.00
2SC 790	.80	.90	1.00
2SC 793	2.00	2.20	2.50
2SC 799	2.00	2.20	2.50
2SC 828	.20	.27	.30
2SC 829	.20	.27	.30
2SC 830H	2.50	2.70	3.00
2SC 838	.35	.40	.45
2SC 839	.30	.35	.40
2SC 853	.70	.80	.90
2SC 867	3.20	3.40	3.70
2SC 867A	3.20	3.40	3.70
2SC 870	.35	.40	.45
2SC 871	.35	.40	.45
2SC 895	4.20	4.40	4.90
2SC 897	2.00	2.20	2.50
2SC 898	2.50	2.70	3.00
2SC 900	.20	.27	.30
2SC 923	.20	.27	.30
2SC 929	.20	.27	.30
2SC 930	.20	.27	.30
2SC 941	.20	.27	.30
2SC 943	.35	.40	.45
2SC 945	.20	.27	.30
2SC 959	1.00	1.20	1.30
2SC 971	.70	.80	.90
2SC 982	.70	.80	.90
2SC 983	.50	.64	.70
2SC 1000	.35	.40	.45
2SC 1012	1.20	1.40	1.50
2SC 1013	.50	.64	.70
2SC 1014	.50	.64	.70
2SC 1017	.80	.90	1.00
2SC 1018	.60	.70	.80
2SC 1030	1.80	2.10	2.40
2SC 1047	.35	.40	.45
2SC 1051	3.40	3.55	3.90
2SC 1060	.70	.80	.90
2SC 1061	.70	.80	.90
2SC 1076	30.00	35.00	39.00
2SC 1079	3.40	3.55	3.90
2SC 1080	3.40	3.55	3.90
2SC 1096	.45	.55	.60
2SC 1098	.50	.64	.70
2SC 1111	2.10	2.50	2.80
2SC 1114	4.20	4.40	4.90
2SC 1115	2.50	2.70	3.00
2SC 1116	3.20	3.40	3.70
2SC 1116A	3.40	3.55	3.90
2SC 1124	.80	.90	1.00
2SC 1127	.80	.90	1.00
2SC 1161	1.30	1.45	1.60
2SC 1162	.70	.80	.90
2SC 1166	.20	.27	.30
2SC 1167	3.80	4.00	4.40
2SC 1170B	3.80	4.00	4.40
2SC 1172B	3.20	3.60	3.95
2SC 1173	.50	.55	.60
2SC 1175	.35	.40	.45
2SC 1177	11.00	12.60	14.00
2SC 1189	1.00	1.10	1.20
2SC 1209	.30	.35	.40
2SC 1211D	.30	.35	.40
2SC 1212A	.80	.90	1.00
2SC 1213	.30	.35	.40
2SC 1215	.35	.40	.45
2SC 1222	.20	.27	.30
2SC 1226	.50	.55	.60

TYPE	25-UP	10-24	1-9
2SC 1226A	.50	.55	.60
2SC 1237	1.80	2.00	2.25
2SC 1239	2.20	2.70	2.90
2SC 1279	.50	.55	.60
2SC 1306	1.30	1.45	1.60
2SC 1307	1.90	2.10	2.40
2SC 1310	.20	.27	.30
2SC 1312	.20	.27	.30
2SC 1313G	.20	.27	.30
2SC 1316	4.20	4.40	4.90
2SC 1317	.20	.27	.30
2SC 1318	.35	.40	.45
2SC 1325A	6.50	6.90	7.60
2SC 1327	.20	.27	.30
2SC 1330	.50	.55	.60
2SC 1335	.50	.55	.60
2SC 1342	.45	.53	.59
2SC 1344	.45	.53	.59
2SC 1358	4.20	4.40	4.90
2SC 1359	.30	.35	.40
2SC 1360	.50	.55	.60
2SC 1362	.35	.40	.45
2SC 1364	.35	.40	.45
2SC 1377	3.20	3.40	3.70
2SC 1383	.30	.35	.40
2SC 1384	.35	.40	.45
2SC 1396	.45	.53	.59
2SC 1398	.70	.80	.90
2SC 1400	.35	.40	.45
2SC 1402	3.00	3.20	3.40
2SC 1403	3.20	3.40	3.70
2SC 1407	.50	.55	.60
2SC 1419	.60	.70	.80
2SC 1444	1.60	1.80	2.00
2SC 1445	2.50	2.70	2.90
2SC 1447	.60	.70	.80
2SC 1448	.70	.80	.90
2SC 1449	.60	.70	.80
2SC 1451	1.00	1.10	1.20
2SC 1454	3.20	3.40	3.70
2SC 1475	.80	.90	1.00
2SC 1478	.50	.55	.60
2SC 1509	.50	.55	.60
2SC 1567	.60	.70	.80
2SC 1567A	.60	.70	.80
2SC 1584	6.00	6.30	7.00
2SC 1586	6.50	6.90	7.60
2SC 1624	.60	.70	.80
2SC 1626	.60	.70	.80
2SC 1628	.60	.70	.80
2SC 1647	.70	.80	.90
2SC 1667	3.00	3.20	3.40
2SC 1669	.90	1.00	1.10
2SC 1674	.30	.35	.40
2SC 1675	.20	.27	.30
2SC 1678	1.10	1.25	1.40
2SC 1679	3.00	3.20	3.40
2SC 1681	.30	.35	.40
2SC 1682	.30	.35	.40
2SC 1684	.30	.35	.40
2SC 1687	.40	.45	.50
2SC 1688	.35	.40	.45
2SC 1708	.30	.35	.40
2SC 1728	.70	.80	.90
2SC 1730	.45	.53	.59
2SC 1756	.50	.55	.60
2SC 1760	.70	.80	.90
2SC 1816	1.50	1.75	1.95
2SC 1856	.45	.53	.59
2SC 1885	.45	.53	.59
2SC 1908	.30	.35	.40
2SC 1909	1.80	2.00	2.25
2SC 1945	4.50	5.00	5.60
2SC 1957	.60	.70	.80
2SC 1969	3.60	4.00	4.40
2SC 1973	.70	.80	.90
2SC 1975	1.30	1.70	1.90
2SC 1978	5.40	6.00	6.60
2SC 2028	.50	.64	.70
2SC 2029	1.50	1.80	2.00
2SC 2074	.80	.90	1.00
2SC 2076	.50	.64	.70
2SC 2091	.90	1.10	1.20
2SC 2092	1.80	2.00	2.25
2SC 2098	3.20	3.40	3.70
2SC 2166	1.40	1.60	1.80
2SD 72	.50	.64	.70
2SD 77	.35	.40	.45
2SD 90	1.30	1.45	1.60
2SD 91	1.30	1.45	1.60
2SD 92	1.30	1.45	1.60
2SD 93	1.60	1.80	2.00
2SD 118	2.90	3.20	3.40
2SD 130	1.10	1.25	1.40
2SD 187	.35	.40	.45
2SD 201	2.30	2.40	2.65
2SD 202	3.40	3.55	3.90
2SD 218	2.50	2.70	3.00

TYPE	25-UP	10-24	1-9
2SD 234	.60	.70	.80
2SD 235	.60	.70	.80
2SD 261	.35	.40	.45
2SD 287	2.50	2.70	2.90
2SD 300	4.50	5.00	5.60
2SD 313	.60	.70	.80
2SD 315	.60	.70	.80
2SD 325	.60	.70	.80
2SD 330	.60	.70	.80
2SD 350	3.80	4.00	4.40
2SD 380	5.20	5.40	5.95
2SD 381	.85	1.00	1.10
2SD 424	3.80	4.00	4.40
2SD 425	2.90	3.20	3.40
2SD 426	3.10	3.30	3.60
2SD 427	1.80	2.00	2.25
2SD 525	.90	1.10	1.20
2SD 526	.60	.70	.80
2SK 19BL	.50	.55	.60
3SK 22Y	1.40	1.60	1.80
3SK 39	.90	1.10	1.20
3SK 40	.90	1.10	1.20
3SK 41	1.30	1.45	1.60
3SK 45	1.30	1.45	1.60
AN 203	1.40	1.60	1.80
AN 214Q	1.50	1.70	1.90
AN 239	4.20	4.40	4.90
AN 247	2.50	2.70	3.00
AN 274	1.50	1.75	1.95
AN 313	3.00	3.20	3.40
AN 315	1.80	2.00	2.25
BA 511A	1.80	2.00	2.25
BA 521	1.90	2.10	2.40
HA 1151	1.50	1.75	1.95
HA 1156W	1.60	1.80	2.00
HA 1306W	2.00	2.20	2.50
HA 1339	2.50	2.70	3.00
HA 1339A	2.50	2.70	3.00
HA 1342A	2.50	2.70	3.00
HA 1366W	2.50	2.70	3.00
HA 1366WR	2.50	2.70	3.00
LA 4031P	1.80	2.00	2.25
LA 4032P	1.80	2.00	2.25
LA 4051P	1.80	2.00	2.25
LA 4400	1.90	2.10	2.40
LA 4400Y	2.00	2.20	2.50
LA 4420	2.00	2.20	2.50
LD 3001	2.00	2.20	2.50
M5 1513L	2.00	2.20	2.50
STK 011	3.80	4.00	4.40
STK 013	7.60	8.00	8.80
STK 015	4.20	4.40	4.90
STK 435	4.50	5.00	5.60
STK 439	7.90	8.00	8.80
TA 7045M	2.00	2.20	2.50
TA 7055P	2.00	2.20	2.50
TA 7061AP	.90	1.10	1.20
TA 7062P	1.10	1.25	1.40
TA 7203P	2.50	2.70	2.90
TA 7204P	2.00	2.20	2.50
TA 7205P	1.60	1.80	2.00
TA 7222P	3.40	3.55	3.90
TA 7310P	1.30	1.45	1.60
TBA 810SH	1.90	2.10	2.40
TC 5080P	5.00	5.20	5.80
TC 5081P	3.00	3.20	3.40
TC 5082P	3.40	3.55	3.90
UHIC 001	4.20	4.40	4.90
UHIC 002	4.20	4.40	4.90
UHIC 003	4.20	4.40	4.90
UHIC 004	4.20	4.40	4.90
UHIC 005	4.20	4.40	4.90
uPC 20C	2.10	2.50	2.80
uPC 563	1.90	2.10	2.40
uPC 575C2	1.30	1.45	1.60
uPC 576	1.90	2.10	2.40
uPC 592H	.70	.80	.90
uPC 1001H	1.90	2.10	2.40
uPC 1008C	4.20	4.40	4.90
uPC 1020H	1.90	2.10	2.40
uPC 1025	1.90	2.10	2.40
uPC 1154	2.00	2.20	2.50
uPC 1155	2.00	2.20	2.50
uPC 1156	1.90	2.10	2.40
uPD 861	8.00	8.40	9.50
uPD 857	8.00	8.40	9.50
uPD 858	6.00	6.30	7.00
PLL 0IA	3.00	4.20	4.60
PLL 02A	5.00	5.20	5.90
PLL 03A	7.60	8.00	8.80
C-3001	1.30	1.45	1.60
2SC F8	2.20	2.70	2.90
4004	1.90	2.10	2.40
4005	2.00	2.20	2.50
SG 613	5.20	5.40	5.95
78L05	.90	1.00	1.10
MPS U31	1.50	1.70	1.90
SN 7400	.15	.17	.19

THE

performers.

Models 310 and 310-C... hand-size testers with ADD-ON versatility.

LOW AS **$64**

Hand-size, but big on performance, the drop-resistant Model 310 VOM with high impact thermoplastic case is a boon to field servicemen, as well as circuit designers, technicians, electrical maintenance engineers, and the price is right on for vocational and hobby use.

MODEL 310 (with 18 ranges) . . . Only $64.

1. Drop-resistant, hand-size VOM with high impact thermoplastic case.
2. 20,000 Ohms per volt DC and 5,000 Ohms per volt AC; diode overload protection with fused R x 1 Ohms range.
3. Single range switch; direct reading AC Amp range to facilitate clamp-on AC Ammeter usage.

MODEL 310-C (with 18 ranges) . . . Only $82.

MODEL 310-C offers the same features, compactness and size as the Model 310 plus a self-shielded, diode overload-protected suspension movement, a DC polarity reversing switch, a single enclosed range switch, and 15K Ohms per volt AC sensitivity.

Versatility of the Model 310 and 310-C increases with the use of optional accessories like the Model 10/10-C clamp-on ammeter and the Model 101 line separator. They both come complete with 42" leads, insulated screw-on alligator clips, batteries and instruction manual.

For a demonstration, contact your Triplett distributor, Mod Center or representative.

Triplett Corporation, Bluffton, Ohio 45817.
(419) 358-5015, TWX (810) 490-2400.

THE MARK OF QUALITY
75TH ANNIVERSARY

Triplett performance... a tough act to follow

...Circle No. 104 for information
...Circle No. 105 for free demonstration

TRIPLETT®