

ET/D

MAY 1979 • \$1.00

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS

Intel's
8080
Sperry
Tech
System
Projection
TV

```
0746 LD
0747 LD
0748 LD
0749 LD
0750 LD
0751 CALL
0752 JP NC,
0753 LD E,2
0754 LD A,(HNUSNS
0755 CALL NOOMOO
0756 SRIPH1: LD HL,(TPOINT)
LD (HL),D
INC HL
LD (TPOINT),HL
LD A,L
LD HL,PADBUF
LD B,A,32
LD ;if
Z,TBFCLR
LD A,D ;Barrin
LD B,ZSSSDL ;on the
DISOUT
WIPOUT ;then, go
LD HL,PADBUF ;Arrive here
LD (TPOINT),HL ;Reset buffer
LD ZCLRL ;and clear the
0772 CALL
0773 JP
0774 SENDIT: LD
0775 CALL
0776 JP ALLOFF
NUMOFF: XOR A
OUT OUTDAT,A
LD A,ZLNULT ....physical
CALL ALLOOP
XOR A
LD (ONMAP),A ; ....and in
0782
0783
0784
0785 COMSET
LD
0789
0790
0791
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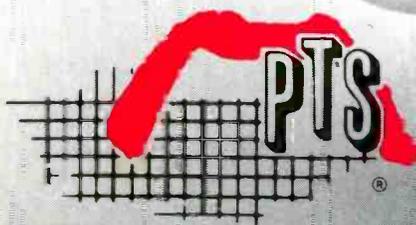
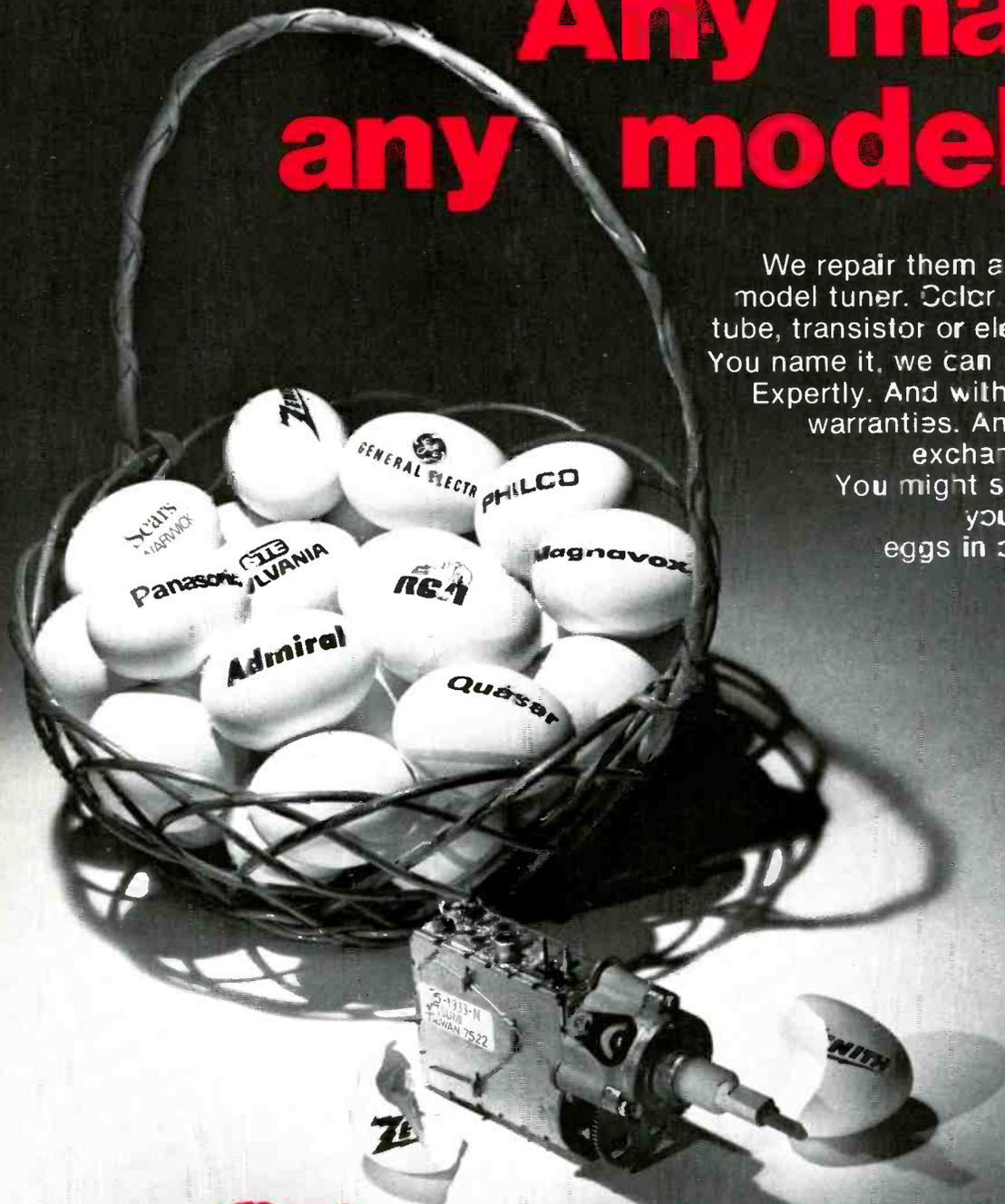
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IRON RIVER

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No yoke! Any make, any model.

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For the location nearest you, see Servicenter Guide on next page.

PTS SERVICENTER GUIDE

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 8119A Merriam Lane, P.O. 6149
 913-831-1222
MINNEAPOLIS, MN 55408
 815 W. Lake St., P.O. 8458
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 8456 Page Blvd., P.O. 24256
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 313-862-1783
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 4005A E. Livingston
 614-237-3820
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OMAHA, NE 68104
 6918 Maple St.
 402-571-4800
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 5744 N. Western Ave.
 312-728-1800

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 8880 Brookville Rd.
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 726 Seigle Ave., P.O. 5512
 704-332-8007
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 210 N. 9th St., P.O. 1801
 205-323-2657
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 3118 E. Princess Anne Rd.
 804-625-2030
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 3920A Airline Hwy., P.O. 303
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 813-839-5521
NASHVILLE, TN 37214
 2426 A Lebanon Rd.
 615-885-0688

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SAN DIEGO, CA 92105
 5111 University Ave., P.O. 5794
 714-280-7070
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 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

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 300 Union St., P.O. 238
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 1742-44 State Rd.
 215-352-6609
PITTSBURGH, PA 15202
 257 Riverview Ave. W., P.O. 4130
 412-761-7648
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 158 Market St., P.O. 421
 201-791-6380
BALTIMORE, MD 21215
 5505 Reisterstown Rd., P.O. 2581
 301-359-1186
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 1167 Massachusetts Ave., P.O. 37
 617-648-7110
BUFFALO, NY 14214
 299 Parkside Ave.
 716-837-1656

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 303-423-7080
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 P.O. 6218
 801-484-1451
PHOENIX, AZ 85009
 2916 West McDowell Rd.
 602-278-1218

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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

INDUSTRY REPORT

RCA Demonstrates Satellite Distribution

RCA's American Communications division has officially unveiled its proposed new satellite distribution system for supplying movies, sports, feature and syndicated programs to the nation's commercial TV stations.

At demonstrations held during the recent National Association of Broadcasters convention in Dallas, RCA Americom said receive only earth stations would be erected—at RCA expense—at all participating television stations. These stations would be aimed at one of the RCA satellites and would receive material broadcast from the RCA transmitter at Vernon Valley, N.J.

Under the concept, stations would have the option of broadcasting the material—supplied by Viacom International—live or taping it for later rebroadcast.

Zenith Marks 1978 Gains

Zenith Radio Corporation, Chicago, has announced improved financial results for 1978.

Although sales were up only one per cent, earnings rose almost 400 per cent to \$23.3 million, or \$1.24 per share compared with a per share loss of 25 cents a year earlier.

Zenith Chairman John Nevin reports 1978 earnings benefited from higher color TV sales, from the effects of "substantial" cost reduction programs begun in 1977, and from land sales that added 17 cents per share to 1978 earnings.

In commenting on it's loss in the courts regarding the television "dumping" charges it brought against Japanese manufacturers, Nevin said Zenith continues to believe the layoffs, plant shutdowns, low profits "that have characterized the American television industry for the past decade have been a direct result of economic pressures imposed on the domestic television industry by predatory pricing associated with dumping."

ETA Announces NEW MET Designation

The newly formed Electronics Technicians Association (ETA) has announced what it calls major revisions of its new testing program, including the addition of a new category known as Master Electronics Technician (MET).

According to ETA's Certification Director Ron Crow, the association's new testing program is completely revised to reflect present state of the art electronics. "In addition to designating suc-

cessful examinees as a Associate CETs or Certified Electronics Technicians', ETA has established a higher level of attainment for some qualified technicians ... MET."

Crow said the MET will be required to have at least 10 years electronics technology training and experience instead of the four now required for the CET rating.

The qualification test, Crow said, involves 200 written questions with a minimum correct score of 180. "In addition the MET must score at least 75 per cent in each of the six specific career areas of the exam," Crow added. These options are communications, audio, consumer electronics, medical, computers, and industrial electronics.

Exam fees are: Associate, \$10; CET, \$25; and MET, \$65.

Further information may be obtained from Ron Crow, ETA Certification Director, P.O. Box 1258—ISU Station, Ames, Ia. 50010.

NARDA REPORTS Tech Wage Figures

The "average" technicians' wage—on a national basis—is \$6.62 per hour, according to figures released by NARDA's School of Service Management.

Breaking that down by region, NARDA reported that the average wage paid in the east was \$6.38, with ranges of \$4.50 to \$9; the midwest average was \$6.54, with range of \$3.50 to \$11.41, and the average western wage was \$6.95, with a range between \$4 per hour and \$10.

Additionally, NARDA reported that the average service call charge was near \$20 and this figure did not include in home service charges for diagnosis and labor.

March TV Sales Soar

According to *TV Digest*, color sales topped 1 million for the best March ever. First quarter color sales also set a record at an annual rate of about 10.2 million.

Summer CES is Sellout

The Summer Consumer Electronics Show (CES), which last year drew a record 55,000 to Chicago, is reporting a sellout for its 1979 show.

The four day event, June 3-6, already has over 850 exhibitors lined up and is looking for space for more. If ever there was evidence of the strength of the consumer electronics marketplace, this show is definitely it.

This year is the 13th annual for the show and in addition to visitors from every state in the union, show officials report registrants and exhibitors from at least 50 foreign countries will be on hand.

Among this year's special events will be special marketing seminars on selling, technology, video cassettes, home computers and video games. **ET/D**



Circle No. 102 on Reader Inquiry Card

ET/D

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS

MAY 1979, VOL. 101, NO. 5

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FEATURES

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Inside the 8080

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Digital Electronics Part I

The basic families 25

How to price labor and parts

ET/D examines the Sperry Tech System 32



On the cover: Intel's powerful 8080A microprocessor, the backbone of a new and burgeoning computing industry is highlighted against the "software" which controls it. In this issue we discuss the building blocks of the 8080.

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ELECTRONIC TECHNICIAN/DEALER [ISSN 0363-5821] 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 43 East Ohio Street, Chicago, Illinois 60611. Editorial offices: 43 East Ohio Street, Chicago, Illinois 60611. 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. Copyright © 1979 by Harcourt Brace Jovanovich, Inc. All rights reserved. No part of this publication may be transmitted or reproduced in any form or by any means, electronic or mechanical, including photocopy, recording or any information storage and retrieval system, without permission in writing from the publisher. ELECTRONIC TECHNICIAN/DEALER is a registered trademark of Harcourt Brace Jovanovich, Inc.

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Introducing the Troubleshooter.

Six functions and 24 ranges for \$129* make the jump from Analog to Digital more affordable than ever.

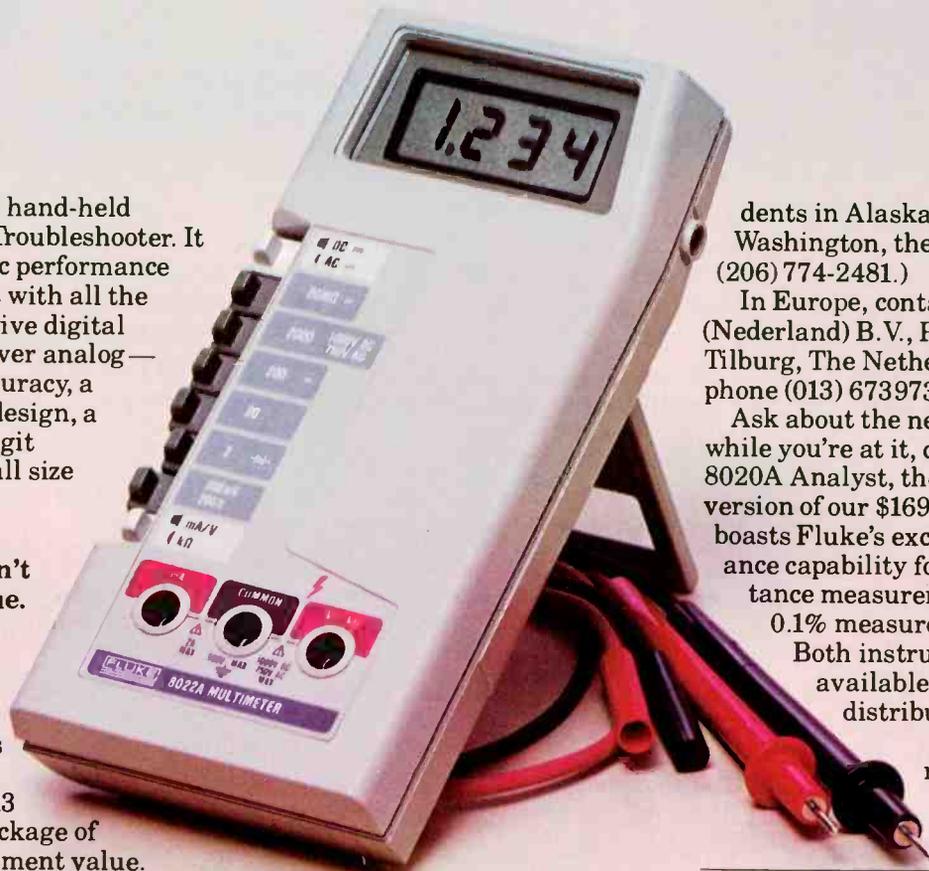
We call our new hand-held 8022A DMM the Troubleshooter. It combines the basic performance features you want with all the advantages that give digital DMM's the edge over analog—0.25% basic dc accuracy, a rugged, reliable design, a razor sharp 3½-digit LCD readout, small size and light weight.

Measure for measure you won't find a better value. Six functions—high and low ohms, ac and dc voltage and current (24 ranges in all) make the Troubleshooter a 13 ounce (0.37 kg) package of excellent measurement value. This kind of value wasn't possible until our custom CMOS LSI single chip design made hand-held DMM's an affordable reality and Fluke the industry leader.

Here's something new that won't shock you. Fluke's exclusive probe design features finger guards on the probe and shrouded connections to discourage accidental contact with circuit voltages.

You won't find a more rugged or reliable hand-held DMM. There's a lot more to building a high-quality hand-held DMM than you might suspect. The case has to survive bumps, scrapes, and scuffs. The LCD readout must withstand the extremes of humid-

*U.S. Price Only



ity, temperature, and vibration. Function switches need to perform reliably through thousands of cycles. And electrical circuitry must survive both physical shock and electrical overloads.

We built the 8022A to withstand all these tortures—with a rugged impact resistant plastic case, a custom LCD display, reliable push-buttons instead of rotary switches and over 20% of the components devoted to overload protection.

Take the next step. Contact the Fluke office, representative or authorized distributor in your area. In the U.S., CALL TOLL FREE (800) 426-0361. (For resi-

dents in Alaska, Hawaii, and Washington, the number is (206) 774-2481.)

In Europe, contact: Fluke (Nederland) B.V., P.O. Box 5053, Tilburg, The Netherlands. Telephone (013) 673973. Telex 52237.

Ask about the new 8022A. And while you're at it, check into the 8020A Analyst, the improved version of our \$169* DMM. It boasts Fluke's exclusive conductance capability for high resistance measurements and 0.1% measurement accuracy.

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P.O. Box 43210
Mountlake Terrace, WA 98043

- Please send 8022A Troubleshooter data.
- Please send the 8020A Analyst specs.
- Please have a salesman call.

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Address _____

City _____ State _____ Zip _____

Telephone () _____ Ext. _____

ETD 5/79

For Technical Data Circle No. 113 on Reader Service Card
For Demonstration Circle No. 114 on Reader Service Card

NEWSLINE

NEW LINES INTRODUCED. Nine television manufacturers have opted to introduce their 1980 model television lines to distributors this month. They are G.E., Zenith, Sylvania, RCA, Philco, MGA, Panasonic, Quasar and Toshiba. Two others, Hitachi and JVC, have said they plan new model introductions to coincide with the Summer Consumer Electronics Show (CES) in Chicago June 3.

GE INTRODUCES THE "EC" CHASSIS. GE is now out with a new 28KV chassis for all of its 19-inch models--the E.C. chassis. Built to run at 100-watts, the EC is comprised of five basic, snap out modules and relies more heavily on integrated circuits for energy conservation. Horizontal and vertical stabilizer controls are eliminated in this chassis through the use of digital countdown controllers.

AM STEREO UNDERGOES TESTS. Five radio stations in the United States have been authorized by the FCC to carryout 30 day broadcast experiments with AM stereo. All four systems still in the running will be tried. They are the technologies developed by Motorola, Belar, Harris and Kahn/Hazeltine. Stations authorized to participate in the experiments are WJR, Detroit; WABC, NYC; WFIL, Philadelphia; WGN, Chicago; and WTAQ, LaGrange, Ill.

SHARP SCHEDULES MICROWAVE SEMINARS. Sharp Electronics Corporation has announced it is currently holding microwave servicing seminars across the United States. Seminars run either a half day or full day. According to Gene Jadwin, general manager for service, the sessions cover the entire range of service operations for a microwave, from circuit operation to troubleshooting and cleaning.

NESDA SEEKS NEW CHIEF EXEC. The National Electronic Service Dealers Association (NESDA) has just announced it is beginning an immediate search for a chief executive. The position has been vacant since the February 1 resignation of Executive Vice President Charles Porter. NESDA President Bob Villont says interested applicants should have association management qualifications. A full job description is available from Mr. Villont at 8444 East F Street, Tacoma, Wa., 98445.

IHF SEEKS EXEMPTION. The Institute of High Fidelity has told the Federal Trade Commission its proposed regulation on Standards and Certification would have a retarding effect on the Institute's measurement standard activities. The IHF recommends a modification to the FTC proposal which would exempt IHF-type technical measurement standards by ensuring that they are distinguished from product standards.

ABOUT PEOPLE. Richard W. King, national sales manager for PTS Electronics since 1976, has been named Vice President of Marketing, according to President Roland Nobis. King formerly was with RCA Consumer Electronics...Jack Wayman, Senior Vice President of the International Consumer Electronics Shows, has been named "Man of the Year" by the National Association of Retail Dealers of America. The award was given for making "available to the retailers of the country both product information and management know-how."

TUNER SERVICE



CORPORATION

SAME DAY SERVICE



ONE YEAR GUARANTEE

The Company of Independent Professionals

Better Quality



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Faster Service

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

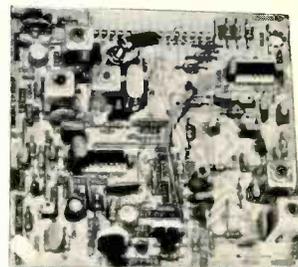


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ARKANSAS	LITTLE ROCK, ARKANSAS 72204	4200-C Asher Avenue	Tel. 501 / 661-0393
CALIFORNIA	MODESTO, CALIF. 95351	123 Phoenix Avenue	Tel. 209 / 521-8051
	NATIONAL CITY, CALIF. 92050	117 East 8th Street	Tel. 714 / 477-8746
	NORTH HOLLYWOOD, CALIF. 91601	10654 Magnolia Boulevard	Tel. 213 / 769-2720
	SAN MATEO, CALIF. 94402	600 South Amphlett Boulevard	Tel. 415 / 348-3292
FLORIDA	TAMPA, FLORIDA 33606	3841 N.W. 9th Avenue	Tel. 813 / 253-0324
	FT. LAUDERDALE, FLORIDA 33309	3516 N.W. 10th Avenue	Tel. 305 / 566-4882
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	SKOKIE, ILLINOIS 60076	5110 West Brown Street	Tel. 312 / 675-0230
INDIANA	INDIANAPOLIS, INDIANA 46204	112 West St. Clair Street	Tel. 317 / 632-3493
	SOUTH BEND, INDIANA 46619	2010 Western Avenue	Tel. 219 / 288-8918
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LOUISIANA	SHREVEPORT, LOUISIANA 71104	2423 Southern Avenue	Tel. 318 / 221-3027
MASSACHUSETTS	SPRINGFIELD, MASS. 01109	144 Boston Road	Tel. 413 / 788-8206
MISSOURI	ST. LOUIS, MISSOURI 63132	9577 Page Avenue	Tel. 314 / 429-0633
NEVADA	LAS VEGAS, NEVADA 89102	1114 South Casino Center Blvd.	Tel. 702 / 821-4004
NEW JERSEY	TRENTON, NEW JERSEY 08638	1139 Pennsylvania Avenue	Tel. 609 / 393-0999
	JERSEY CITY, NEW JERSEY 07307	454 Central Avenue	Tel. 201 / 792-3730
NEW YORK	ROCHESTER, NEW YORK 14606	25 Howard Road	Tel. 716 / 647-9180
NORTH CAROLINA	GREENSBORO, N. CAROLINA 27405	2914 East Market Street	Tel. 919 / 273-6276
OHIO	CLEVELAND, OHIO 44109	4525 Pearl Road	Tel. 216 / 741-2314
OREGON	PORTLAND, OREGON 97210	1732 N.W. 25th Ave., P.O. Box 10141	Tel. 503 / 222-9059
PENNSYLVANIA	PITTSBURGH, PENNSYLVANIA 15209	515 Grant Avenue	Tel. 412 / 821-4004
TEXAS	DALLAS, TEXAS 75218	11540 Garland Road	Tel. 214 / 327-8413
CANADA	ST. LAURENT, QUEBEC H4N-2L7	305 Decarie Boulevard	Tel. 514 / 748-8803
	CALGARY, ALBERTA T2H-1Y3	P.O. Box 5823, Station "A"	Tel. 403 / 243-0971

If you want to branch out into the TV Tuner Repair Business write to the Bloomington Headquarters about a franchise.

Circle No. 128 on Reader Inquiry Card

ETID - May 1979 / 5

FROM THE EDITOR'S DESK



It is being said: "The whole world is going digital!" True or not, it certainly seems like that sometimes. While digital signals have not yet reached into the home television receiver on a large scale basis, it seems safe to say that eventually the demodulation of the composite TV signal will be digitally controlled. (Already, for instance, some satellite transmissions of TV signals are via digital means).

But, this aside, just look at the other areas to see the inroads that "digital" has made in ancillary applications in the home electronics field.

We have digitally controlled electronic tuners in the TV, digitally controlled programmable controllers (microprocessors) to schedule our television and VCR recording and viewing times; we have digitally processed stereo signal handling (pulse code modulation); we have microprocessor controlled home appliances.

The point is, to ignore "digital" at this point in time is to invite certain extinction in the electronics service business.

So, for the second time in two years ET/D is presenting a refresher course in digital basics. We begin this month with the first of six articles by Joe Carr which are designed to bring you up to date and give you "hands on" experience in working with digital circuits.

Another of our articles this month deals with one of the most serious problems facing the independent electronic service shop—the number which are dropping out simply because they don't know how to manage their business affairs.

Last October in ET/D we offered an article, Pricing for Profit, on one currently used method of business management. In this issue we are presenting another *tested* system.

On page 00 you'll find a description of one of the most complete labor and parts pricing systems ever developed for the home electronics service industry—the Sperry Tech System. Developed by John Sperry of Lincoln, Neb., owner and president of Sperry TV, this system is the result of seven years of field testing.

We at ET/D know that many of the marginal electronics service businesses in the United States are now at the point of no return. They will have to learn efficient business management practices or succumb.

We also know this can be avoided by taking the proper steps NOW.

Thus I especially recommend both of these articles and bring them to your attention. We at ET/D can't educate you. But we can let you know what is going on and where to get the information you need to stay in business.

The rest is up to you!

Sincerely,

Mallory Fasteners fit right in anywhere.

Because Mallory's got just about every kind your customers will ever need—clamps, clips, wire

saddles, ties, cable hangers, circuit board supports, guides and dozens of others.

Add to this complete line, the right prices, and packaging the way your customers prefer, and you have a profitable line that sells.

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MALLORY

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New SIMPSON 5" Dual-Trace 15-MHz Scope

with triggered sweep. Reliable, versatile and easy to use. It's your best scope buy.



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- Differential vertical amplifier stages provide wide DC to 15 MHz bandwidth with smooth rolloff useable thru 27 MHz.
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- 24 nanosecond rise time
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- Displays CH A, B, A&B, A + B, A-B
- 0.5V peak-to-peak 1kHz square wave calibrator
- Voltage-calibrated vertical and horizontal inputs (eleven steps in 1-2-5 sequence)
- X5 magnification
- Human-engineered front panel controls

See Your Local Electronics Distributor or Write for Bulletin T-837.



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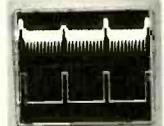
KATY INDUSTRIES



INDUSTRIAL
EQUIPMENT
GROUP



Check logic including countdowns and PLL



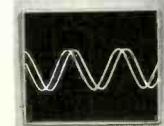
Display composite video and AGC pulse



Display op-amp input/output, A/D converter



27 MHz "CB" envelope and modulating signal



Check phase shift and distortion in amplifiers

LETTERS

I have not been ignoring your (subscription) offer. I have decided to close up shop after 50 years of servicing—1929-1978. I have been reading ET/D from its beginning, or so it seems to me. Many an article has cleared up a tough dog, making it easier on my time, and adding to my knowledge. I wish you the best of everything in your continuing effort to aid the servicemen.

F. Earl Oliver
17925 Toepfer
East Detroit, MI 48021

TEKFAXS WANTED:

A letter which appeared in the January, 1979 issue from a T.R. Brown, seeking out-of-print TEKFAX issues, prompts me to make a similar appeal; I am interested in obtaining TEKFAX books prior to Vol. 110. If anyone "out there" has any to sell, I am definitely in the market for them. I, too, find them very useful.

(If there exists a high level of demand for these, and enough of us servicers write the editor, perhaps ET/D would find it feasible to manufacture reprints. How about it, Editor?)

Max McKahan, Owner
MM Television and Radio
300 E. Jefferson St.
Westville, IN 46391

EDITOR: We have no plans for reprinting TEKFAX. You never know though, it might be a good idea. How much demand would there be?

I would like to obtain TEKFAX 113. I missed it by resubscribing at the wrong time and now it's out of print.

Jerry Ledford
1810 Sandyhollow Rd.
Rockford, IL 61109

I need a TEKFAX No. 113. Does anyone have a duplicate?

Jan D. Goranson
1 Sha Lane
Cherry Valley, IL 61016

I have been a subscriber to ET/D for four years and I have found the Tekfax Schematics useful on many occasions in my service business. However, I only have Tekfax 112, 114 and those accompanying ET/D since April 1975. Although I requested 113 on a previous renewal, I was sent a copy of The Electronic Troubleshooting Guidebook. A

more complete set of Tekfax Schematics would greatly enhance their value to me. I wonder if 113 and earlier editions are available from the publisher, and if so, what the cost of these publications would be to a subscriber.

Ernest D. Niper
NECO
3309 Reina Drive N.E.
Albuquerque, NM 87111

HELP WANTED!

Will you please publish the following in you Letters column in a future issue of ET/D.

I need a schematic and/or manual

and parts information for an Amphenol Model 860 Color Commander Color Bar Generator. Originally manufactured by Amphenol and later distributed by Aztec Electric, Mount Prospect, IL. Will pay for copy cost. Thanks.

William F. Clark
7401 Jewel Lane
Indianapolis, IN 46250

I will appreciate hearing from any reader who can provide service literature for the JBL preamplifier (Graphic Controller) SG520, and the JBL power amplifier (Energizer) SE4005. These models were discontinued some years ago

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2SA 484	2.30	2SC 634A	.45	2SC 1448A	1.15	2SO 525	1.10	TA 7045M	2.40
2SA 495	.30	2SC 710	.25	2SC 1475	.90	2SO 526	.75	TA 7055P	2.40
2SA 497	1.20	2SC 711	.25	2SC 1509	.60	2SK 19	.50	TA 7060P	1.10
2SA 509	.35	2SC 712	.25	2SC 1567A	.70	2SK 23	1.00	TA 7061P	1.10
2SA 562	.30	2SC 717	.40	2SC 1675	.30	2SK 30	.45	TA 7062P	1.30
2SA 564A	.34	2SC 730	3.30	2SC 1678	1.50	2SK 33	.70	TA 7063P	1.45
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2SA 643	.35	2SC 733	.25	2SC 1728	.95	2SK 41	.55	TA 7089P	2.40
2SA 673	.40	2SC 734	.25	2SC 1760	1.05	2SK 55	.70	TA 7120P	1.80
2SA 678	.50	2SC 735	.25	2SC 1775	.35	3SK 22Y	1.75	TA 7203P	2.80
2SA 683	.50	2SC 756	1.90	2SC 1816	1.90	3SK 35	1.45	TA 7204P	2.40
2SA 684	.50	2SC 756A	2.15	2SC 1908	.35	3SK 37	2.25	TA 7205P	1.90
2SA 695	.50	2SC 778	3.25	2SC 1909	2.70	3SK 40	1.50	TA 7310P	1.50
2SA 699A	.60	2SC 781	2.40	2SC 1945	5.45	3SK 41	1.50	T8A 810SH	2.30
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2SA 720	.35	2SC 789	.90						
2SA 733	.25	2SC 793	2.40						
2SA 747	4.80	2SC 799	2.40						
2SB 22	.50	2SC 828	.25						
2SB 54	.35	2SC 829	.25						
2SB 77	.40	2SC 839	.35						
2SB 175	.40	2SC 867A	4.45						
2SB 186	.25	2SC 900	.25						
2SB 187	.25	2SC 930	.25	2SC 1969	4.25	3SK 48	3.65	TC 5081P	3.25
2SB 324	.35	2SC 945	.25	2SC 1973	.65	3SK 49	1.50	TC 5082P	3.75
2SB 367	1.30	2SC 1000BL	.40	2SC 1974	1.80	AM 2140	1.80	UHC 001	5.55
2SB 405	.30	2SC 1013	.60	2SC 1975	1.80	AM 239	4.75	UHC 002	5.55
2SB 407	.90	2SC 1014	.60	2SC 2028	.60	AM 247P	2.85	UHC 003	5.55
2SB 463	1.10	2SC 1018	.80	2SC 2029	1.90	AM 274	1.85	UHC 004	5.55
2SB 474	.85	2SC 1030	2.30	2SC 2076	.60	AM 313	4.55	UHC 005	5.55
2SB 507	.85	2SC 1060	.80	2SC 2091	1.10	AM 315	2.15	UPC 20C	2.65
2SB 511	.80	2SC 1061	.85	2SC 2092	2.15	BA 511A	2.10	UPC 554C	1.75
2SB 557	2.70	2SC 1096	.50	2SC 2098	3.40	BA 521	2.30	UPC 555H	1.75
2SC 183	.50	2SC 1114	3.75	2SO 72	.60	HA 1151	1.80	UPC 575C2	1.50
2SC 184	.50	2SC 1116A	3.75	2SO 91	1.50	HA 1156W	1.90	UPC 576	2.30
2SC 372	.25	2SC 1124	.90	2SO 92	1.70	HA 1306W	2.35	UPC 592HZ	.90
2SC 373	.25	2SC 1127	.90	2SO 180	1.90	HA 1322	2.85	UPC 1001HZ	2.30
2SC 380	.25	2SC 1162	.80	2SO 187	.40	HA 1339	2.90	UPC 1008C	5.70
2SC 382	.40	2SC 1166	.35	2SO 218	3.40	HA 1339A	2.90	UPC 1020H	2.30
2SC 387A	.40	2SC 11728	3.80	2SO 234	.75	LA 4031P	2.15	UPC 1025H	2.30
2SC 394	.30	2SC 1173	.65	2SO 235	.75	LA 4032P	2.15	UPC 1156H	2.30
2SC 458	.25	2SC 1209	.35	2SO 261	.35	LA 4400	2.30	UPD 857C	9.35
2SC 460	.50	2SC 1226	.65	2SO 287	2.80	M 51513L	2.40	UPD 858C	7.15
2SC 481	1.40	2SC 1226A	.65	2SO 291	2.70	PLL 01A	4.50	UPD 861C	9.05
2SC 482	1.40	2SC 1237	2.10	2SO 313	.65	PLL 02A	5.75	C-3001	1.60
2SC 485	1.40	2SC 1239	2.80	2SO 315	.75	PLL 03A	8.65	ZSC F8	2.90
2SC 495	.55	2SC 1306	1.80	2SO 325	.70	SG 613	5.80	4004	2.40
2SC 509	.40	2SC 1307	2.80	2SO 330	.84	STK 011	4.30	4005	2.50
2SC 517	3.20	2SC 1318	.40	2SO 356	.75	STK 013	8.75	78L05	1.10
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2SC 2098	3.40	BA 521	2.30	UPC 555H	1.75
2SO 72	.60	HA 1151	1.80	UPC 575C2	1.50
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and JBL cannot provide service manuals. I have schematics, but they do not indicate voltages. Thank you.

Jacob Landy
11 Gardenia Lane
Hicksville, Ny 11801

I need a schematic diagram for a Minshall-Estey Organ, Model L, Serial No. 1199. This organ was manufactured at Battleboro, VT, but my inquiry there has not been answered.
Kenneth L. Rude
Columbus, ND 58727

I need schematics and any other information on Auto Electronic Radioclast Models 0-20-1P and HO made by Electronic Equipment Co., Tiffin, OH.
Aaron P. Holt
RR1
Lyndor, IL 61261

I am in need of a schematic or any other info for an ANACONIC Digital Multimeter Model 390, manufactured by Rowe Electronics of Summit, NJ.

Because they are apparently out of business, I would appreciate hearing from anyone who could supply me with a copy or direct me to another source for the information.

Of course, I would be happy to pay all costs involved.
R.J. Blacka
Chroma TV & Electronics of Wyndmoor
1000 E. Willow Grove Ave.
Wyndmoor, PA 19118

I am looking for technical data and a schematic of a penetrator Model 12PT30 made by Fyr Fyter Co.
Joe Duval
Duval Electronics
11345 Waterville St.
Whitehouse, OH 43571

I need help with an amplifier, Voice of America, Model 1544. The transistors in the right side output are shorted. The numbers on them do not match any in the parts books. A schematic and any other information or a source of either is needed.

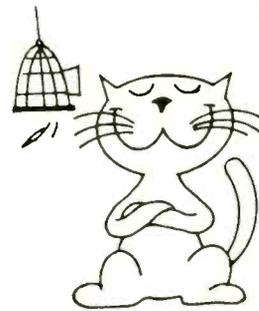
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199 Western Ave.
Cambridge, MA 02139

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Ted Wojciehowski
507 Oak St.
Huntley, WI 54534 ET/D

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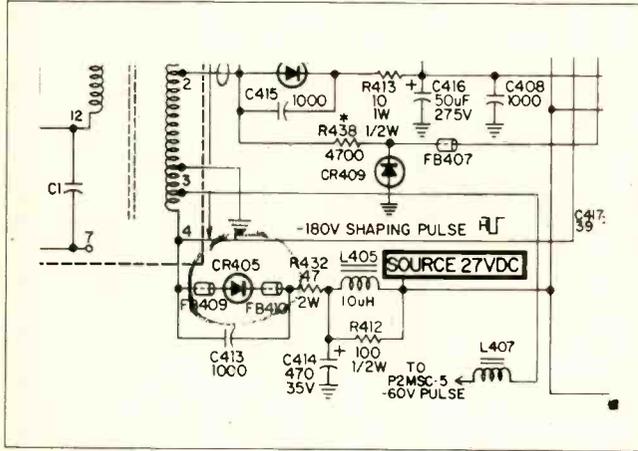
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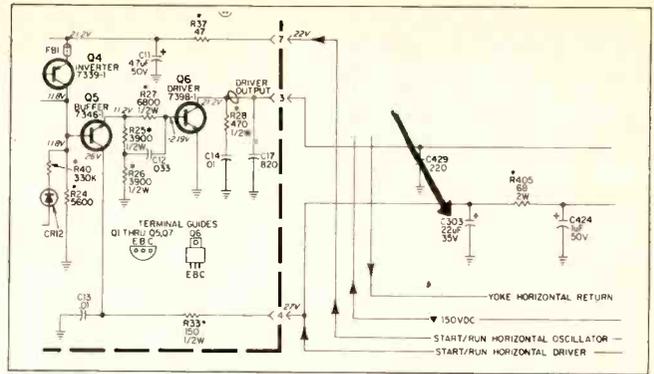
SERVICE SEMINAR

RCA

Color TV Chassis CTC86—RF401 (screen fuse resistor) and Q401 (horizontal output) fail after about one minute of operation. Likely cause—defective CR405, 27 volt source rectifier.

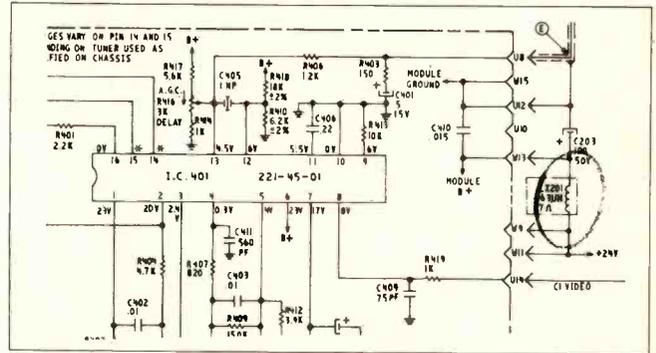


Color TV Chassis CTC-85, 86, 89, 90, 91, 92—Repetitive failure of MDH001 module (horizontal oscillator). Replacement module lasts from a few minutes to a few days. Q5 or Q6 usually becomes defective. Probable cause—open C303 or broken ground lead to C303.

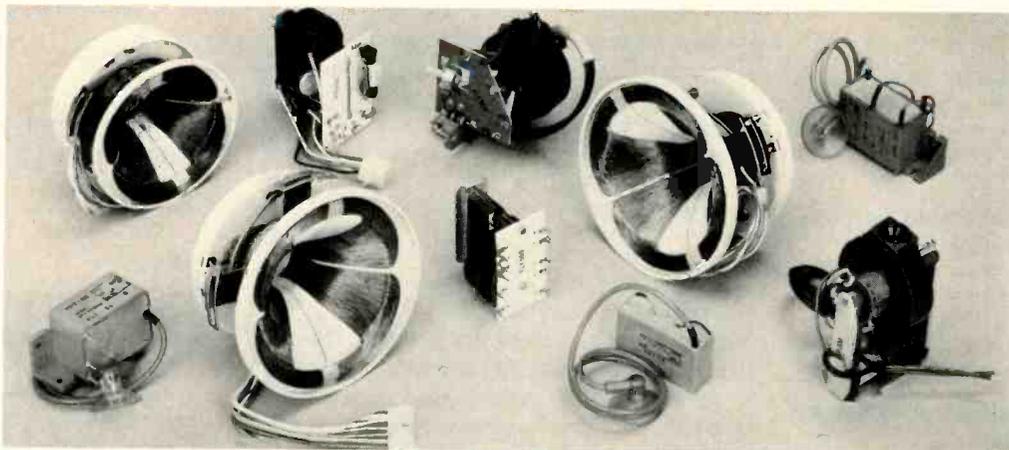


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2SA 484	1.50	1.75	1.95	2SB 368B	1.80	2.00	2.25	2SC 708	1.30	1.45	1.60	2SD 261	.35	.40	.45
2SA 485	1.40	1.60	1.80	2SB 379	.70	.80	.90	2SC 710	2.00	2.27	2.50	2SD 287	2.50	2.70	2.90
2SA 489	1.10	1.25	1.40	2SB 381	.30	.35	.40	2SC 711	.20	.27	.30	2SD 300	4.50	5.00	5.60
2SA 490	.70	.80	.90	2SB 400	.30	.35	.40	2SC 712	.20	.27	.30	2SD 313	.60	.70	.80
2SA 493	.45	.53	.59	2SB 405	.30	.35	.40	2SC 715	.30	.35	.40	2SD 315	.60	.70	.80
2SA 495	.30	.35	.40	2SB 407	.80	.90	1.00	2SC 717	.35	.40	.45	2SD 325	2.90	3.20	3.40
2SA 496	.50	.64	.70	2SB 415	.30	.35	.40	2SC 727	1.00	1.20	1.30	2SD 330	.60	.70	.80
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2SA 505	.50	.64	.70	2SB 435	.90	1.10	1.20	2SC 733	2.50	2.70	2.90	2SD 380	5.20	5.40	5.95
2SA 509	.30	.35	.40	2SB 440	.40	.53	.59	2SC 738	.20	.27	.30	2SD 381	.85	1.00	1.10
2SA 525	.50	.64	.70	2SB 449	1.30	1.45	1.60	2SC 739	.20	.27	.30	2SD 424	3.80	4.00	4.40
2SA 530	1.50	1.70	1.90	2SB 461	.90	1.10	1.20	2SC 734	.20	.27	.30	2SD 425	2.90	3.10	3.30
2SA 537A	1.50	1.70	1.90	2SB 463	.90	1.10	1.20	2SC 735	.20	.27	.30	2SD 426	3.10	3.30	3.60
2SA 539	.40	.45	.50	2SB 471	2.10	2.50	2.80	2SC 736	1.50	1.80	2.00	2SD 427	1.80	2.00	2.25
2SA 545	.45	.53	.59	2SB 472	2.10	2.50	2.80	2SC 738	1.50	1.80	2.00	2SD 525	.90	1.10	1.20
2SA 561	.30	.35	.40	2SB 473	.80	.88	1.00	2SC 756A	1.50	1.80	2.00	2SD 526	.60	.70	.80
2SA 562	.30	.35	.40	2SB 474	.70	.80	.90	2SC 763	.35	.40	.45	2SK 198L	.50	.55	.60
2SA 564A	.20	.27	.30	2SB 481	.90	1.10	1.20	2SC 772	.30	.35	.40	3SK 22Y	1.40	1.60	1.80
2SA 565	.70	.80	.90	2SB 492	.66	.70	.80	2SC 773	.35	.40	.45	3SK 40	.90	1.10	1.20
2SA 566	2.50	2.70	3.00	2SB 507	.90	1.00	1.00	2SC 774	1.00	1.20	1.30	3SK 41	1.30	1.45	1.60
2SA 600	1.00	1.20	1.30	2SB 509	1.30	1.20	1.30	2SC 775	1.40	1.60	1.80	3SK 45	1.30	1.45	1.60
2SA 607	1.10	1.25	1.40	2SB 511	.70	.80	.90	2SC 776	2.00	2.20	2.50	AN 203	1.40	1.60	1.80
2SA 624	.70	.80	.90	2SB 513	.70	.80	.90	2SC 777	3.00	3.25	3.50	AN 214Q	1.50	1.70	1.90
2SA 627	3.10	3.30	3.60	2SB 514	.70	.80	.90	2SC 778	2.90	3.20	3.40	AN 247	2.50	2.70	3.00
2SA 628	.30	.35	.40	2SB 526	.70	.80	.90	2SC 781	1.90	2.10	2.40	AN 274	1.50	1.75	1.95
2SA 634	.40	.45	.50	2SB 527	.90	1.10	1.20	2SC 783	2.10	2.20	2.80	AN 313	3.00	3.20	3.40
2SA 640	.30	.35	.40	2SB 528D	.70	.80	.90	2SC 784	.30	.35	.40	AN 315	1.80	2.00	2.25
2SA 642	.30	.35	.40	2SB 529	.70	.80	.90	2SC 785	.35	.40	.45	BA 511A	1.80	2.00	2.40
2SA 643	.30	.40	.45	2SB 530	1.20	3.40	3.70	2SC 789	.80	.90	1.00	BA 521	1.90	2.10	2.40
2SA 653	1.90	2.10	2.40	2SB 531	1.80	2.00	2.25	2SC 790	.80	.90	1.00	HA 1151	1.50	1.75	1.95
2SA 659	.35	.40	.45	2SB 536	1.00	1.20	1.30	2SC 793	2.00	2.20	2.50	HA 1156W	1.60	1.80	2.00
2SA 661	.50	.64	.70	2SB 537	1.00	1.20	1.30	2SC 798	2.00	2.20	2.50	HA 1306W	2.50	2.70	3.00
2SA 663	3.65	3.80	4.25	2SB 539	3.20	3.40	3.70	2SC 799	2.00	2.20	2.50	HA 1307W	2.50	2.70	3.00
2SA 666	.30	.35	.40	2SB 541	3.20	3.40	3.70	2SC 828	.20	.27	.30	HA 1324A	2.50	2.70	3.00
2SA 671	.80	.90	1.00	2SB 544	5.00	6.00	6.80	2SC 829	.20	.27	.30	HA 1366W	2.50	2.70	3.00
2SA 672	.30	.35	.40	2SB 556	3.20	3.40	3.70	2SC 830H	2.50	2.70	3.00	HA 1366WR	2.50	2.70	3.00
2SA 673	.35	.40	.45	2SB 557	2.10	2.50	2.80	2SC 834	.35	.40	.45	LA 4031P	1.80	2.00	2.25
2SA 678	.35	.40	.45	2SB 561B	.35	.40	.45	2SC 839	.30	.35	.40	LA 4032P	1.80	2.00	2.25
2SA 679	4.20	4.40	4.90	2SB 568	1.40	.53	.59	2SC 853	7.00	8.00	9.00	LA 4051P	1.80	2.00	2.25
2SA 680	4.20	4.40	4.90	2SB 595	1.10	1.40	1.50	2SC 867	1.20	3.40	3.70	LA 4400	1.90	2.10	2.40
2SA 682	.80	.90	1.00	2SB 596	1.10	1.40	1.50	2SC 872	.20	.27	.30	LA 4400Y	2.00	2.20	2.50
2SA 683	.30	.35	.40	2SB 600	5.00	6.00	6.60	2SC 874	3.20	3.40	3.70	LA 4420	2.00	2.20	2.50
2SA 684	.35	.40	.45	2SC 183	.40	.53	.59	2SC 877	.35	.40	.45	LD 3001	2.00	2.20	2.50
2SA 695	.40	.53	.59	2SC 184	.40	.53	.59	2SC 893	.30	.35	.40	M5 1513L	2.00	2.20	2.50
2SA 697	.40	.53	.59	2SC 281	.30	.35	.40	2SC 897	2.00	2.20	2.50	STK 011	3.60	4.00	4.40
2SA 699A	.50	.64	.70	2SC 283	.40	.53	.59	2SC 900	2.00	2.20	2.50	STK 013	2.60	8.00	8.80
2SA 705	.40	.53	.59	2SC 284	.80	.90	1.00	2SC 923	.20	.27	.30	STK 015	4.20	4.40	4.90
2SA 706	.85	1.00	1.10	2SC 317	.50	.53	.59	2SC 929	.20	.27	.30	STK 435	4.50	5.00	5.60
2SA 715	.60	.70	.80	2SC 352A	2.00	2.20	2.50	2SC 930	.20	.27	.30	STK 439	7.90	8.00	8.80
2SA 719	.30	.35	.40	2SC 353A	1.40	1.60	1.80	2SC 941	.20	.27	.30	TA 7045M	2.00	2.20	2.50
2SA 720	.30	.35	.40	2SC 367	.50	.53	.59	2SC 943	.35	.40	.45	TA 7061AP	2.00	2.20	2.50
2SA 721	.30	.35	.40	2SC 369	.30	.35	.40	2SC 945	.20	.27	.30	TA 7062P	1.10	1.25	1.40
2SA 725	.30	.35	.40	2SC 370	.20	.27	.30	2SC 959	1.00	1.20	1.30	TA 7203P	2.50	2.70	2.90
2SA 726	.30	.35	.40	2SC 371	.30	.35	.40	2SC 971	.70	.80	.90	TA 7204P	2.00	2.20	2.50
2SA 733	.20	.27	.30	2SC 372	.20	.27	.30	2SC 982	.70	.80	.90	TA 7205P	1.60	1.80	2.00
2SA 738	.40	.53	.59	2SC 373	.30	.35	.40	2SC 983	.50	.64	.70	TA 7222P	3.40	3.55	3.90
2SA 740	1.50	1.70	1.90	2SC 374	.30	.35	.40	2SC 984	.20	.27	.30	TA 7310P	1.30	1.45	1.60
2SA 743A	.85	1.00	1.10	2SC 375	.30	.35	.40	2SC 1012	1.20	1.40	1.50	TBA 810SH	1.90	2.10	2.40
2SA 744	4.20	4.40	4.90	2SC 377	.30	.35	.40	2SC 1013	.50	.64	.70	TC 5080P	5.00	5.20	5.80
2SA 745R	3.80	4.00	4.40	2SC 380	.20	.27	.30	2SC 1014	.50	.64	.70	TC 5081P	3.00	3.20	3.40
2SA 747	4.20	4.40	4.90	2SC 381	.35	.40	.45	2SC 1017	.80	.90	1.00	TC 5082P	3.40	3.55	3.90
2SA 748	.70	.80	.90	2SC 382	.35	.40	.45	2SC 1018	.60	.70	.80	UHC 001	4.20	4.40	4.90
2SA 750	.35	.40	.45	2SC 383	.35	.40	.45	2SC 1020	.80	2.10	2.40	UHC 002	4.20	4.40	4.90
2SA 755	.80	.90	1.00	2SC 387A	.35	.40	.45	2SC 1030	.80	2.10	2.40	UHC 003	4.20	4.40	4.90
2SA 756	2.30	2.40	2.65	2SC 388A	.40	.53	.59	2SC 1047	.35	.40	.45	UHC 004	4.20	4.40	4.90
2SA 758	3.40	3.55	3.90	2SC 394	.20	.27	.30	2SC 1051	.30	3.55	3.90	UHC 005	4.20	4.40	4.90
2SA 764	3.80	4.00	4.40	2SC 403	.10	.15	.20	2SC 1061	.70	.80	.90	UHC 006	4.20	4.40	4.90
2SA 765	3.10	3.30	3.60	2SC 430	.50	.64	.70	2SC 1076	30.00	39.50	45.00	UHC 007	4.20	4.40	4.90
2SA 774	.45	.53	.59	2SC 454	.30	.35	.40	2SC 1079	3.40	3.55	3.90	UHC 008	4.20	4.40	4.90
2SA 777	.50	.64													

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- Most technicians start their working day around 8:00 to 9:00 in the morning ... still during the rush hour. Keep the length of that first drive as short as possible, to avoid losing time driving in heavy traffic.

- Where possible, schedule the first call from the technician's home. It is kind of fruitless to have the technician make the tortuous drive through heavy traffic to the store, only to turn around and make the tough drive to the customer's home. If he is going to come in to the store, it is just as effective to come in at 10:00 or 11:00 as at 8:00.

- Avoid having all technicians come in at the same time. As the boss, you can only deal with one man at a time, so why crowd them all in at once. Besides, when they are all there together, they are quite likely to spend their time talking about ball games and bowling scores.

- Avoid having them come in to the store at all, and certainly more than once a day. If they were in this morning and will be in again tomorrow morning, do you really need to see them again at 4:30 this afternoon ... or could they be getting in one more call?

- If the truck is stocked properly, and dispatching is done by radio or telephone, maybe they only have to come in two or three days a week.

- One call at a time dispatching, whether done by radio or telephone, can be very effective. When the man finishes his first call, he contacts you to get his next one. He is given the call that is nearest to his present location. Since he is always being dispatched to his closest call, he makes maximum use of his time, as well as holding down vehicle expense. One story is told of the customer who called in for service, hung up the phone, walked into the living room and saw the truck pull into her driveway. She was flabbergasted ... and obviously pleased with the promptness of service.

Attention to a few simple details could conceivably result in one extra call per day per man which might translate into an addition \$5,000 per man per year in PURE PROFIT.

John Gooley
Mgr., NARDA's Service Division

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Projection television

Getting the big picture

While projection color TV is expensive and bulky and therefore not in too widespread home use, it is enjoying an increasing popularity. Here's what the major manufacturers are doing in systems suitable for the home.

by **Walter H. Schwartz**

Recently projected television has begun to enjoy an upsurge in popularity as a means of producing a picture larger than that offered by cathode-ray tube sets. This new popularity is actually something of a revival. In the early and middle fifties black and white projection television enjoyed a momentary popularity and even earlier than this some of the first large screen, i.e., 20 in. sets used a projection system. Large black and white CRT's apparently put an end to such systems however, and except for theater or auditorium use black and white projection TV came to an end. While a few companies such as Kalart Victor manufacture auditorium systems capable of high quality, high brightness black and white pictures, color projection systems have just recently come to the notice of the major television manufactures and a number of small manufacturers alike.

Projection color television for home use or small commercial installations probably obtained its initial impetus from Advent, who in 1967 began development work and in 1973 test marketed their first model with a seven ft diagonal screen. Apparently about this time Sony entered the market with a 50. in. model using a single tube and later introduced a three tube unit.

Since then a number of small manufacturers have offered single tube systems, generally projecting an enlargement from a small screen, Sony or Quasar or other 13-15 in. portable, and within about the last year General Electric, Panasonic, Quasar and MGA have begun production of projection color television.

Projection designs

Projection television is available in three basic designs (Fig. 1) and numerous variations on them. The first, and perhaps most obvious, is the two piece system: a projection unit and a separate screen. The second is a self contained system where the image is reflected onto the screen by a mirror. And the third is a self contained system which uses one or more mirrors to project the picture onto the screen from the rear. All of these are in use currently. The lower cost systems project the picture from a small screen set onto a separate screen. There is no limitation on screen size with this system, but there is a practical limitation of brightness. The largest color systems use a separate screen with three ultra-bright tubes projected and converged on the screen to obtain an adequately bright picture. Several of the intermediate screen size sets are self contained front projection units. These appear generally to use 40 to 60 in. screens. General Electric and Century Projection Systems use rear projection one piece units.

Screens and viewing angles

The screens used for projection TV have a gain when compared to a standard perfect reflection surface—a chalk like or matte, flat surface which reflects equally in all directions. The degree of directivity determines the



gain. The specifications of the several manufacturers indicate screen gains of 6 to 10 are common (Fig. 2). The screens are also curved to ensure even illumination and are inclined slightly to reflect extraneous light downward, instead of into the viewers eyes (Fig. 3). These factors restrict the optimum viewing angle to within certain limits to maintain adequate brightness and uniform color (Fig. 4). Typical viewing range is up to 30 degrees on each side of a center line horizontally and about 10 degrees from the center line vertically (Fig. 5).

Lens systems

On the premise that the technician will normally have to perform little repair or maintenance on the optical systems, they will be surveyed quickly here.

The simplest is the straight refracted projection from a single tube (Fig. 6). This system positions a lens in front of a normal CRT. The light output is limited by the characteristics of the shadow mask CRT and by the size of the lens. The systems that are

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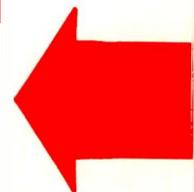
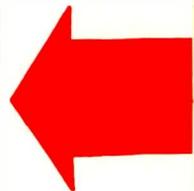
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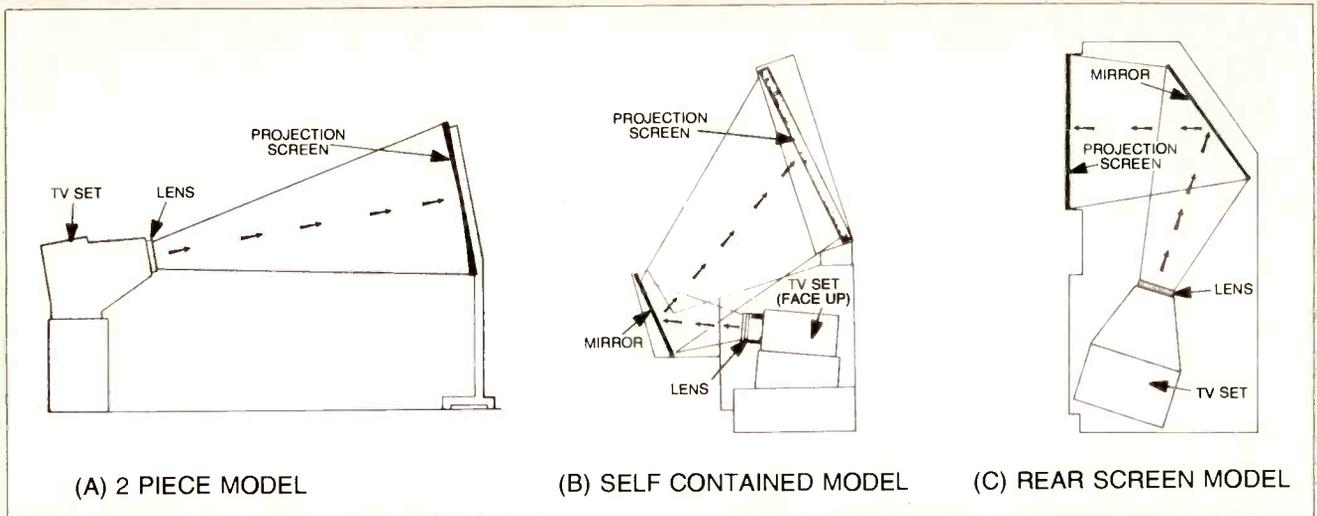


Fig. 1—Projection TV's three basic designs.

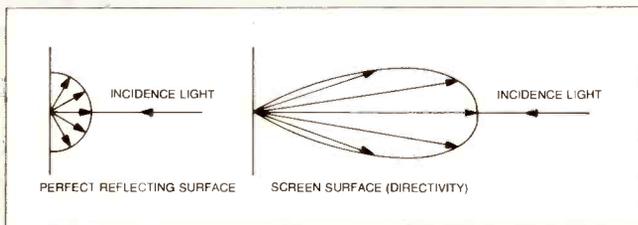


Fig. 2—Projection screen gain.

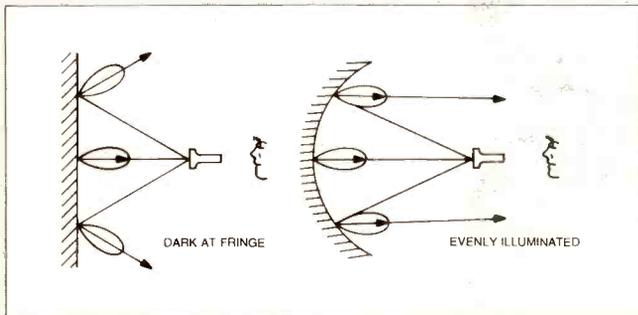


Fig. 3—Screen illumination.

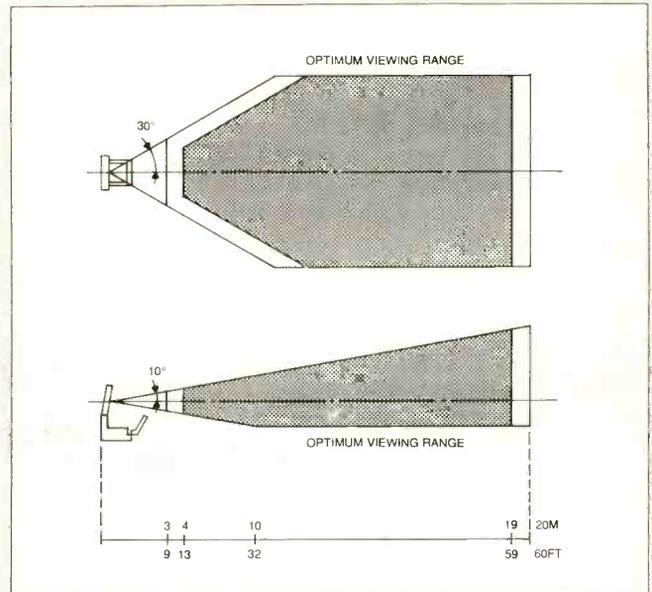


Fig. 5—Typical optimum viewing area.

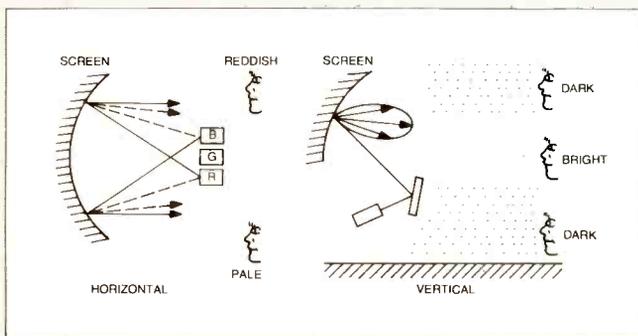


Fig. 4—Effects of screen viewing angle.

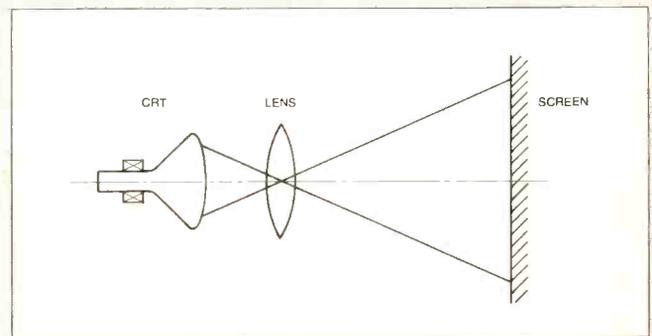


Fig. 6—The simplest projection system—a single lens.

accessory to a standard TV receiver all use this method. These must be viewed in a rather dark room. A modification of this system is used in certain rear screen and single unit models (See Fig. 1). Here a special, bright, CRT is operated at rather high anode voltage and produces an image bright enough for good light output after a considerable degree of magnification. General

Electric and Sony use variations of this system. Most of the really large screen systems use three small monochrome (red, blue and green) CRTs, eliminating the shadow mask for higher efficiency and permitting a very bright image when operated at high anode voltages. Advent and Sony use this system with monochrome tubes and separate lenses. Mitsubishi,

Quasar, and Panasonic use monochrome tubes which contain all or part of the optics (Fig. 7). **The electronics** The chassis used in the major manufacturer's projection color television systems are all top of the line. Since the pictures are so large, the quality, resolution and absence of snow, is very important. The chassis'

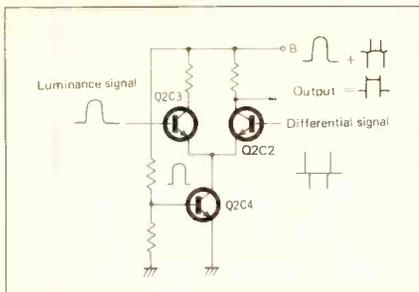


Fig 10—Luminance peaking circuit of the VS-700U

drivers and output stage and regulated +24 volts to the rest of the chassis. There is also a -29 V source for certain functions in the Omega control system. The power requirements are 250 watts maximum.

Mitsubishi®

Mitsubishi/MGA offer two models. The VS-500U, a self contained model (Fig. 1a) with 50 inch screen and the VS-700U, a two piece system with a 72 inch screen. Mitsubishi has developed its own meniscus lens tube with completely self contained optics (Fig. 7). Three tubes are used, red, blue and green providing a screen brightness of up to 40 foot Lamberts.

The VS-700U chassis contains different and additional circuitry when compared to a standard TV receiver. Several of these will be covered in some detail here.

To insure a high resolution signal video frequency response is flat to approximately 4MHz, which allows a horizontal resolution of more than 400 lines (center screen). Since the luminance bandwidth overlaps the chroma in the 3 to 4MHz region, a 3.58MHz dot pattern can be produced. The chroma and luminance signals are interlaced, luminance on odd and chroma on even harmonics of the horizontal sweep frequency.

Therefore, a comb filter can be used to eliminate this effect (Fig. 9). Video signal, containing chroma, is applied to the base of Q2A0, and thereby to Q2A1. Signal delayed by 1H is applied to the base of Q2A3 and thus appears at the emitters of Q2A1 and Q2A2. The sum signal appears at the collector of Q2A1 and is taken as the chroma out. Difference signal is taken from the collector of Q2A2. This is luminance with chroma cancelled. Exact cancellation balance can be made by adjusting Q2A3 gain by means of VR2A0.

Another attempt to maintain high picture quality under varying

continued on page 47

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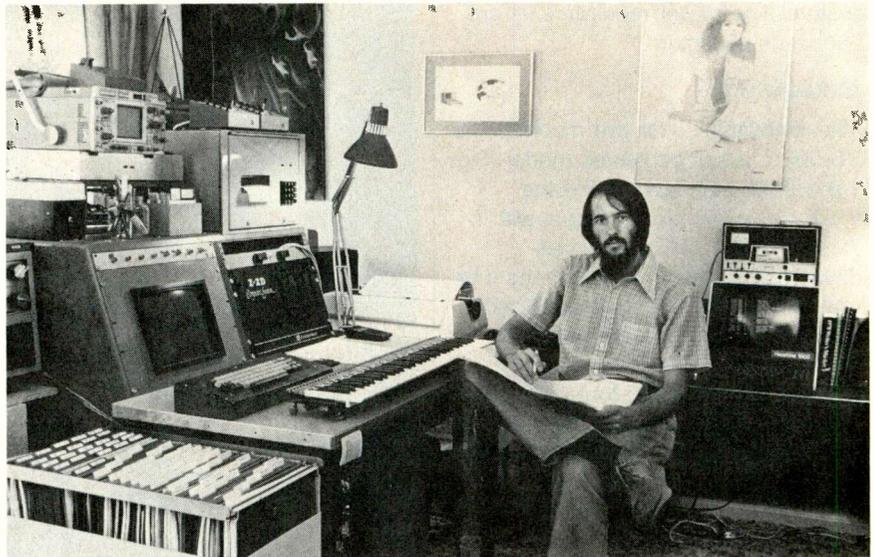
Think of it as black magic if you will, but the fact is if you ever handle modern logic circuits—and you will—then this step-by-step description is just the thing you'll value for future reference.

By Steven K. Roberts

It's time to pull the 8080 microprocessor chip out of its socket in the single-board computer we looked at in January, pry off the lid, and find out once and for all what wizardry has been tucked inside. The CPU cannot remain a mysterious black box if we are to intelligently discuss further applications, programming, and service (yes, eventually we'll get to that). Once we whisk away the shroud of mystery that surrounds the Central Processing Unit, we should really be able to see microprocessors for what they are: the simplest way to build control systems that has ever been devised by man.

Before we dive into the guts of the Intel 8080 and become confronted with new concepts left and right, let's first review what it takes to make a simple computer.

First, there's the obvious: memory. We have already discussed this somewhat, but in case you missed it, memory for a computer can be thought of as a large number of addresses (Locations) which can be selected by the Central Processor, each of which defines a *byte*, or 8-bit unit of information. (There are computers in existence which use 4, 12, 16, 24, 32, and even 64 bit memory elements, but they all follow the same general principles, and 8 bits is most common.) Each location can be used to store a program instruction or a piece of data, and can be read by the processor or updated with a new byte. There is, of



The author at this computer. Mr. Roberts, the president of Cybertronics, Inc., a microprocessor engineering firm in Louisville, Ky., has designed numerous small systems for business.

course, a type of memory called *Read Only Memory* (ROM) which cannot be changed by the processor - this is used for permanent program storage.

Second, there is interconnection with the outside world, generally referred to as "I/O," or Input/Output. Like memory, the I/O of a system consists of a number of addresses, but each corresponds to some *device*, such as keyboard, printer, motor, light bulb, numeric display, temperature sensor, or diagnostic socket.

And third, of course, is the Central Processing Unit (CPU), interconnected with the others as shown in Figure 1, via the three buses we discussed in January (Address, Data, and Control).

Functions of the CPU

Now, what is a Central Processing Unit?

We know that it has to be able to fetch instructions from memory, either in sequence or as the result of a JUMP, CALL, or RETURN instruction. We know that it must be capable of taking the

instruction apart to determine the type of operation to be performed, and perhaps fetch additional information from memory to allow its completion. It must be able to make logical decisions based upon relationships between various pieces of data, and act upon those decisions by altering the flow of instruction execution.

So, what do we need in a CPU?

We need an *instruction decoder*, to determine which of the 72 basic instruction types is being presented and to use this information to generate internal commands which accomplish the operation. We need an *Arithmetic Logic Unit* to perform logical operations, and we need some testable *flags* to allow decisions to be made. We could use some internal *registers* to simplify manipulation of the data without having to do everything in memory, and we'll make one of the registers more important than any of the others and call it the *Accumulator*. Naturally, we have to have a way of communicating with the

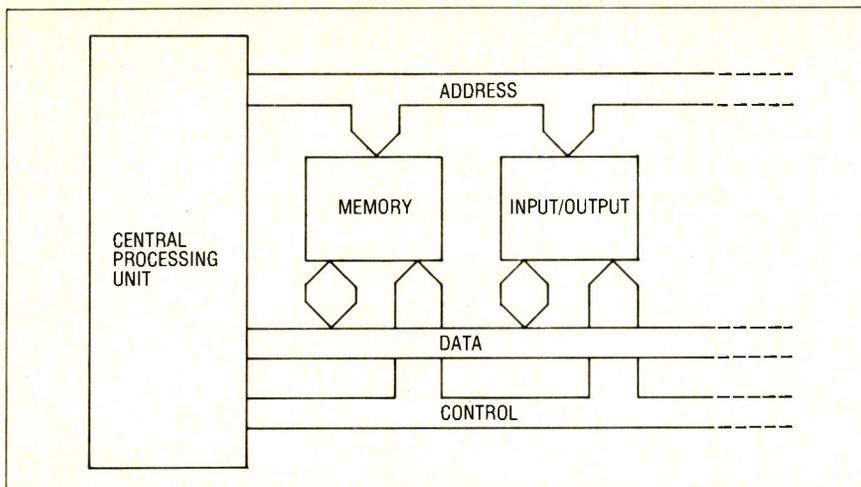


Fig. 1—The general structure of a microprocessor system.

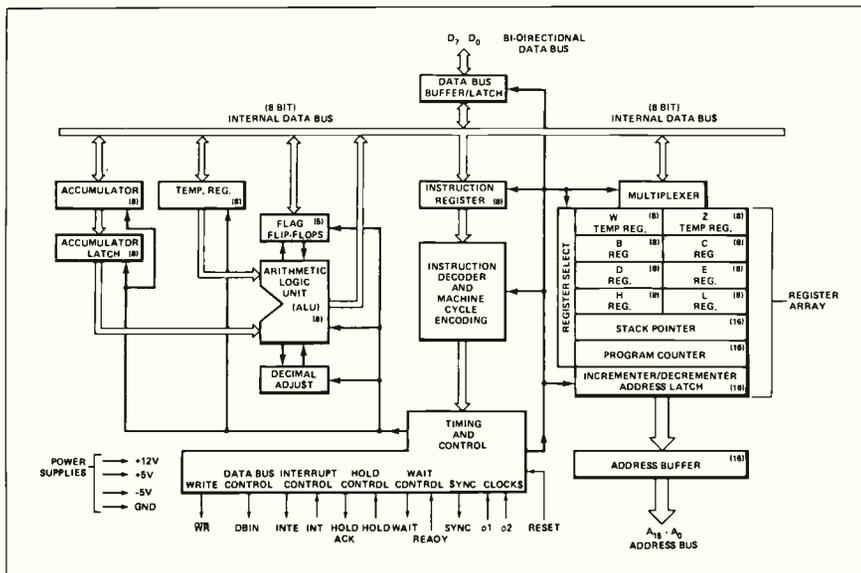


Fig. 2—A functional block diagram of the Intel 8080 CPU. (Courtesy Intel Corporation).

memory and the I/O: we'll create address and data latches to take care of information to and from the outside world, and we'll buffer them so that they can handle the loading imposed by external devices. So far, so good: the only other major item we need is logic to take care of timing and control, effectively tying all the rest together and telling each part of the system when to move, and how.

Intel puts all that together as shown in Figure 2, the Functional Block Diagram of the 8080 CPU. Don't panic.

Turning it on

When an instruction is fetched from memory (from a location addressed by the Program Counter), it passes, under the direction of the Timing and Control logic, through the Data Bus Buffer/Latch onto the Internal Data Bus. This bus is identical in principle to the System Data Bus we talked about before, accepting data from various tri-state logic devices to act as the central avenue of internal

communication. The only difference is that it is not directly visible to the outside world, which, for the purposes of this discussion, consists of everything that is not contained within the 8080 chip itself. (Sometimes, we speak of the outside world as everything not contained within a complete computer system.) Anyway, the instruction that the CPU is supposed to perform (execute) is gated onto the internal data bus, and then the Instruction Register is commanded to latch it. We have an instruction in the Instruction Register. Wonderful.

An instruction can take many forms. Sometimes a single byte will suffice - the command to increment the contents of the accumulator, for example, is always a 3C. (This is a hexadecimal number - the easiest way to express a binary value. The '3' means that the left four bits are '0011' and the 'C' means that the right four bits are '1100'. Converting 00111100 to decimal is a little clumsy, but results in 60 in case you're curious. Now, the instruction decoder doesn't

just say, "Aha, a 3C! I think I'll increment the accumulator!" First of all, the increment instruction contains three bits of variable information *which* register to increment. The instruction actually looks like this:

0/ 0/ D/ D/ D/ 1/ 0/ 0

The three bits called "D" make up the *destination operand*, which affects the subsequent activities only in choice of register (of course, that's a rather significant effect, from a system standpoint). Had those three bits been '010' instead of '111', the instruction would be '14' in Hex (get it? 0011, 0100?) and would cause the 8080 to increment the D register, not the accumulator (usually just called 'A'). The point of all this is that the actual command to increment is expressed by the specific combination of the first two and the last three bits, and then the remaining three bits are examined to see which register is the lucky one. Other types of instructions have different codes, but are the same in principle.

Sometimes, where the choice of operand is not one of the seven registers but is instead one of the 65,536 possible memory locations (like in a JUMP instruction), the single 8 bit code is not sufficient. The CPU must fetch two more bytes to make up the full 16 bit address. Remember - the numeric value of the instruction itself is of little interest (after all, a 3C and a 14 are both increments); the decoder simply responds to bit patterns in order to determine what action must be taken.

Instruction commands

Armed with the decoded instruction, the instruction decoder is in a position to create a sequence of internal commands which cause the operation to be carried out (with the help of the control logic). Some of these commands, such as those resulting from a LOAD instruction, merely cause the contents of the *source* register to appear on the internal data bus (leaving the original unchanged) and then cause that data to be loaded by the *destination* register, obliterating whatever was there before. Nothing fancy, data just gets copied from one internal location to another, a few thousandths of an inch away. Others do the same thing, but the source or destination may be one of the locations in memory or possibly even a device on an input or output port.

Other instructions may affect execution. If the processor is plodding along, incrementing the Program Counter (PC) to follow instructions in sequence (which is what it always does,

unless directed otherwise) and suddenly encounters a JUMP command, it inhales the next two bytes and loads them into the PC to find out where to continue. No data moves, all registers and flags are unchanged, but the processor is now executing instructions somewhere else. As we discussed in December, there are many variations on this theme, which represent not only the ability to do subroutines, but also provide the processor with the ability to make logical decisions, without which it would be quite useless.

And then there are the instructions which affect the data somehow, beyond

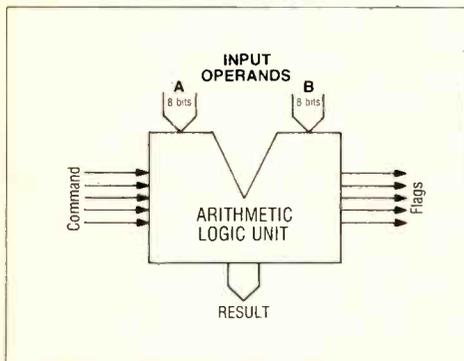


Fig. 3—Block diagram of an arithmetic Logic Unit (ALU). Here operands A and B are used to produce the Result—under the control of command lines. Status flags are set after each operation to provide decision criteria for the processor logic.

just moving it about. The increment is of this type, serving to add 1 to whatever piece of data is specified. What if you want to add 37? Do you do 37 successive increments?

2 + A = Add A,2

If you ever do, we'll cancel your subscription! No, fortunately there is an ADD instruction among the 72 or so available in the 8080. You have three choices if you want to add 37 to the accumulator (by the way, the accumulator is special because it is *always* where the result of a logical operation involving two pieces of data ends up). First, if another register already contains the 37, you can simply say "ADD r," where 'r' is the register in question (A, B, C, D, E, H, or L . . . yes, you can add A to itself). Second, if the 37 is out there in memory somewhere, you can stuff its address into H and L, then say, "ADD A,(HL)." Wait - I'm confusing you. At the gut level, an ADD instruction looks like this:

1 / 0 / 0 / 0 / 0 / S / S / S

Like the increment instruction that we tore apart a few minutes ago, the add instruction is recognized by a specific bit pattern - in this case the first five bits

must be '10000'. The bits called 'S' make up the *source operand* (since A is the destination) and, if you think about it, offer eight possibilities (2)³. There are seven registers.

The eighth one is memory. Anywhere in memory. The location currently addressed by H and L, taken as a pair (call 'em High and Low) is treated exactly like one of the seven registers. If SSS (or DDD in the increment instruction) is '110' then the register in question is a memory location. Neat, eh?

So, you can see that the addition of a 37 in a memory location to the accumulator is just a special case of the ADD that came before, when the 37 was in another register. The only difference is that H and L must be set up properly ahead of time.

But what if the 37 doesn't exist anywhere else in the system at the moment, and the program still wants it added to A? You could be inefficient and stick it somewhere, then do the add, but a better way is to use a variation of the instruction called ADD IMMEDIATE. Use a slightly different opcode and a second byte in the instruction (the 37), and the processor decodes the command (C6), promptly pulls the next byte from memory, and adds it to A. In assembler lingo, it looks like this: ADD A,37.

(This inevitably turns into a software discussion. Describing a central processing unit without going into some of the programming aspects is like writing a biography of Beethoven without mentioning music.)

Now that we have discussed some of the types of operations that go on in the system, we can see what an Arithmetic Logic Unit is good for.

There is an ALU in Figure 3. If you have spent much time with TTL, you may recognize this as a 74181. Here's what it does: Two operands, A and B, are combined in a fashion determined by the command code to produce the Result, along with a few flags to indicate some important things about what just happened.

The ALU takes care of adding (with or without a carry), comparing, subtracting, ANDing, ORing, and various other logical operations. These operations affect the flags in predictable ways - the ZERO flag is set if the result is zero, for example - so that the conditional JUMPs, CALLs, and RETURNs can have conditions to work with. The ALU occasionally looks at the flags as well, such as when adding two numbers with carry. The carry represents an overflow

from a previous addition, and allows the processing of numbers too large or too precise to be expressed in eight bits [which can only be arranged in 256 possible combinations (2)⁸]. CARRY is one of the flags.

And so, hopefully, it all ties together. There are some little boxes in Figure 2 that we have not discussed, but they either perform an invisible internal function or they will be easier to deal with in our next installment, which will be heavily oriented toward software. The stack pointer, for example, is a wonderful device which cannot possibly make any sense without a detailed description of what happens when a subroutine is called.

Why the 8080?

The 8080, as I mentioned in the past, is presently the world's most popular microprocessor, especially if you count its more intelligent descendant, the Z80. There are many, many others, however, with widely varying architectures. There are dozens of relatively new devices that are oriented toward dedicated control tasks (appliances and the like), one new family even incorporating analog I/O on the chip. It is this class of devices, more than the 8080 and Z80, that you are most likely to encounter on your bench.

Why, then, do we treat the 8080 in such detail? This type of design represents one of the major families of microprocessors, and most others are closely related. Further, even completely different chips must follow the same basic design criteria: fetch instructions, decode them into moves or logical operations or transfers of execution, and then execute. The differences, while significant, are only visible in the programming and in the device wiring - not in the fundamental design of a system. Since the 8080 and the Z80 are the processors you are most likely to deal with if you acquire a system of your own or pursue further literature, we have chosen them for this discussion. And, just to make sure you are confused, we use the Z80 mnemonics (like INC A for 3C) when talking about the 8080, which has its own set of mnemonics (INR A). The instructions are exactly the same, but the Z80 mnemonics offer an easier way of thinking about them when you start to program.

You may wonder, further, why we bother to go into detail about the inside of the microprocessor, something you are guaranteed to never see no matter how many systems you ultimately

continued on page 47

Introduction to digital electronics

The IC logic families

In this first of six articles you are invited to brush up on your digital theory. Subsequent articles will take you on a step-by-step learning experience complete with built-in experiments to test your knowledge.

By Joseph J. Carr, CET

Digital electronics is no longer an exotic field that can be safely ignored by the electronic service technician. Servicers in areas once far removed from "digital" are now finding many devices that depend heavily on these circuits in today's modern television and stereo receivers.

While many technicians in these areas voice dismay at recent digital incursions into their world, others see it as an opportunity. If you have been apprehensive about the world of digital electronics consider this: Digital circuits only recognize "on" and "off" states like switches and relays! Such circuits are, for the most part, merely electronic versions of simple switch and relay logic combinations.

The fact is that, in most cases, anyone who can understand switch and relay logic can understand digital circuits, and—digital circuit servicing is generally easier than color television servicing. Personal experience in both areas leads me to the latter conclusion.

Logic states

We have mentioned that digital circuits respond to only two different input states. These are called "1" and "0" (after the two permissible digits of the

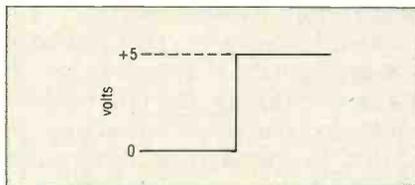


Fig. 1A. The digital logic level for a TTL device

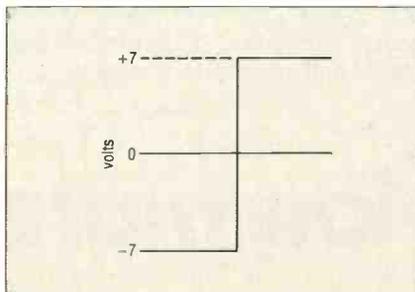


Fig. 1B. One possible CMOS bipolar logic level

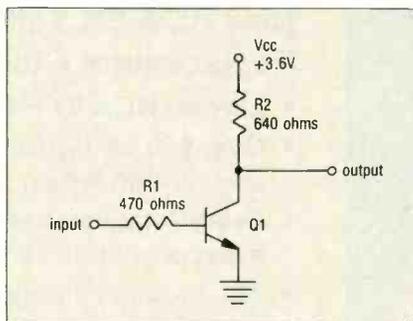


Fig. 2. A typical RTL inverter circuit

binary, or base-2, number system), "HIGH" and "LOW", or (in older texts) "true" and "false." These merely designate the two different voltage levels. In this series we will use mostly the HIGH/LOW designations because they more graphically describe what is going on in the circuit.

Transistor-transistor-logic (TTL) responds only to 0 and +5 volts. If any other voltages are applied, then the

device will either 1) fail to work at all, 2) work unpredictably, or 3) burn out. The standard TTL voltage levels are shown in Figure 1A.

Complementary metal oxide semiconductor IC devices may use the same 0 and +5 volt levels as TTL, but may also use any level between ± 4 volts and ± 15 volts. In figure 1B we see ± 7 volt levels being used. The two voltage levels need not be equal. In some devices, it is found that proper operation will occur only if the voltage levels are over 7 volts. Some oscillators and counters, for example, must use selected devices to find those able to operate at 0 and +5 volts.

You will hear terms such as *positive logic* and *negative logic*. These terms tend to confuse the newcomer, and mean nothing more than how the voltage levels are designated. In positive logic the HIGH voltage (i.e. +5 volts in TTL) is designated logical-1, while the LOW voltage (i.e. 0 volts in TTL) is designated as the logical-0 level. In negative logic these designations are reversed (i.e. HIGH-0 and LOW-1). In the vast majority of cases positive logic is used. In fact, the descriptive names given by the manufacturers to their IC devices reflect positive logic terminology in most cases. This potential confusion is why we prefer to use HIGH and LOW. The "1/0" designations will be reserved for the illustrations and truth tables used ... but recall that positive logic is implied.

Logic families

A logic family is a series of IC devices that may be interconnected without concern for interfacing, and which use similar technology in their construction. All of the devices within a given family will have the same input and output

circuits, so that direct interconnection is possible.

The only major consideration is whether an output can supply sufficient current to drive all of the inputs that are connected to it. But in any given family output voltage and current levels and input voltage and current requirements are fixed by agreement, and are defined in terms of *fan-in* and *fan-out* ratings. The *unit* used to describe these terms in most cases is the current requirement of one standard input (the voltage is fixed). Such an input has a fan-in of 1 unit. If an IC is said to have a fan-out of, say, 10, then this means that it is capable of supplying adequate current to drive 10 standard inputs. The total fan-in of all devices connected to an output must be equal to, or less than, the rated fan-out of the output.

The logic families which we will consider are: RTL, DTL, TTL, HTL, ECL, and CMOS. Of these, CMOS and TTL are the most popular; RTL and DTL are considered obsolete and are not used in new designs. They are, however, frequently encountered in older equipment.

Speed-vs-power

The principle factors governing the

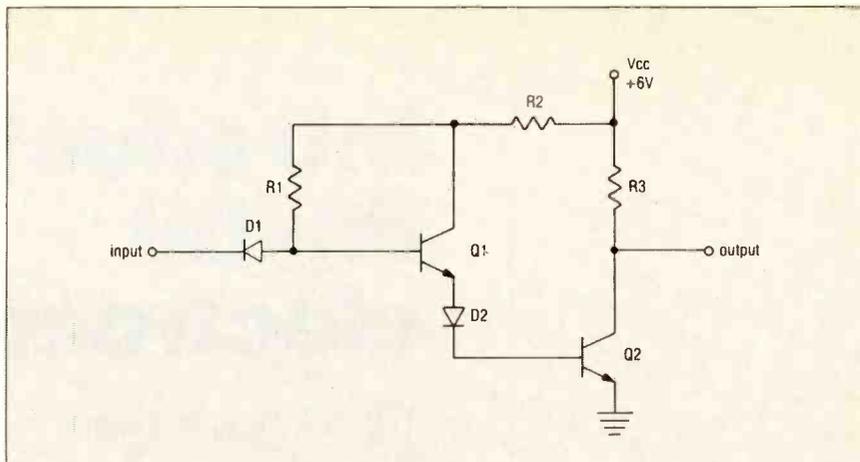


Fig. 3. Schematic of a DTL inverter circuit

speed, i.e. maximum operating frequency, are internal resistances and capacitances. If resistances are increased, so that power consumption is reduced, then the RC time constant of the device is longer. Long RC time constants mean slower operating speeds. As a *general rule*, higher speed logic families require greater current consumption. CMOS devices, which require very little current, operate well only to 4 or 5 MHz, with some devices going to 10 MHz. TTL devices, on the other hand, usually work to 18 to 20

MHz, with some going to well over 80 MHz.

RTL devices

Resistor-transistor-logic (RTL) is an obsolete type used in the mid-60's. Figure 2 shows a typical RTL inverter circuit; i.e. a circuit that produces an output the opposite of the input level. An inverter produces a HIGH output when the input is LOW, and a LOW output when the input is HIGH.

RTL logic ICs use 0 and +3.6 volts for the LOW and HIGH levels, respectively.

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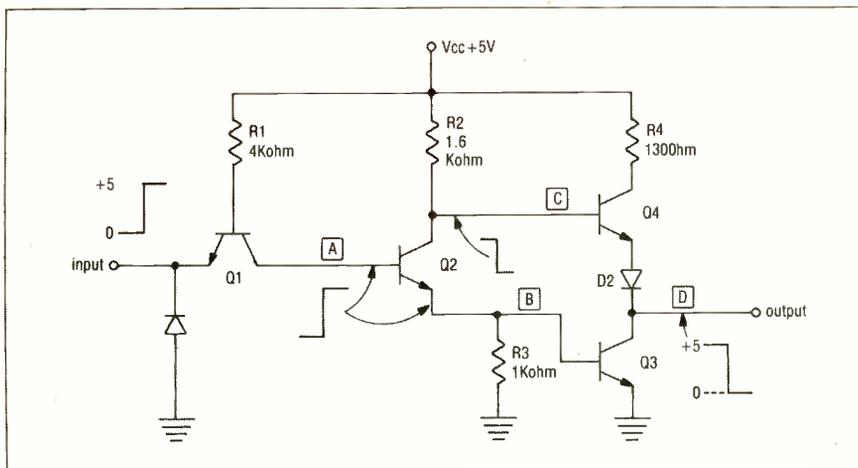


Fig. 4A. A typical TTL inverter circuit

If the input is grounded (i.e. at 0 volts), then the output will be at +3.6 volts dc. But if the input is at +3.6 volts, then the output will be at 0 volts.

RTL devices usually carry type numbers in the μ L900 range (mostly 9 and 10-pin metal cans) and MC700 series (mostly 14-pin DIPs).

DTL devices

The next popular generation of digital IC logic devices was called *diode-transistor-logic* (DTL). These devices operated at speeds greater than

most RTL devices. Figure 3 shows a typical DTL inverter circuit.

When the DTL input is HIGH, diode D1 is reverse biased. In that condition R1 will forward bias transistor Q1, which in turn forward biases D2 and Q2. Voltage levels in most digital circuits are selected to *saturate* the transistors, so when Q2 is turned on it is turned on to saturation. This means that the output of the inverter, which is the collector of Q2, goes nearly to ground, but is actually $V_{ce(sat)}$ of the transistor, on the order of a few tenths of a volt.

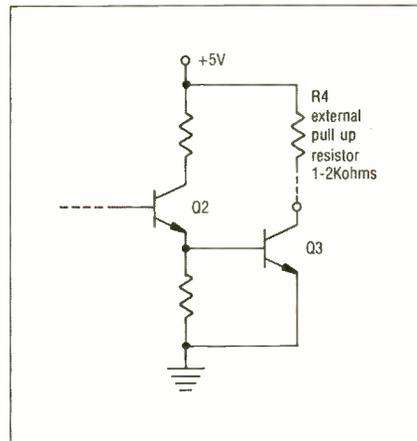


Fig. 4B. The modified open collector TTL output circuit

When the input is LOW, the cathode of D1 is grounded. Since D1 is now forward biased, the base of Q1 is essentially grounded. Under this condition Q1, D1, and Q2 are reverse biased. With Q2 cut-off, then, the output voltage rises to that of $V_{cc}+$. Most DTL devices carried part numbers in the MC900 and MC800 ranges.

TTL devices

Probably the most widely used digital logic family is *transistor-transistor-logic* (TTL). When most people speak of

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digital ICs, it is the TTL family of devices to which they refer. Most TTL devices carry type numbers in the 7400 range. Those in the 5400 range are military versions of the 7400 equivalents (i.e. a 5490 is a military temperature range version of the 7490 counter).

Figure 4A shows the circuit for a typical TTL inverter IC. Like DTL, the TTL input acts like a *current source*,

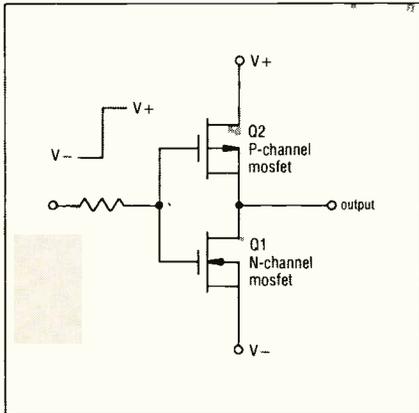


Fig. 5A. The CMOS inverter circuit

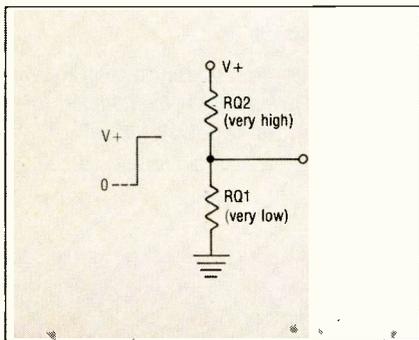


Fig. 5C. CMOS equivalent output circuit with a high input

while the output acts like a *current sink*. The typical TTL input sources 1.8 mA, and will be LOW if 0 to 0.8 volts are applied, and HIGH if 2.4 to 5 volts are applied. Performance at values of input voltage between 0.8 and 2.4 volts are not defined.

When the input is HIGH, Q1 is cut off, so point A goes HIGH. This condition turns on Q2 forcing B HIGH and C LOW. We find, then, Q3 is turned on and Q4 is off. This forces the output LOW. Again, the transistors are operated either totally cut off or totally saturated.

If the input is LOW, then exactly the opposite occurs: Q1 is on (forcing point A LOW), Q3 is off, and Q4 is on (connecting the output to Vcc +).

TTL devices must have a regulated dc power supply of +4.75 volts to +5.25 volts. In fact, there are some circuits or combinations of devices that require a more limited range of voltages, nearer to +5.0 volts dc. Voltages greater than

+5.25 volts often results in a high failure rate of TTL devices.

Some TTL devices are described as being "open collector" types. These devices are essentially the same as regular TTL devices, except that the output circuit is modified; i.e. Q4 and D2 are missing. An example is shown in Figure 4B. These devices require an external 1 to 2 Kohm pull-up resistor

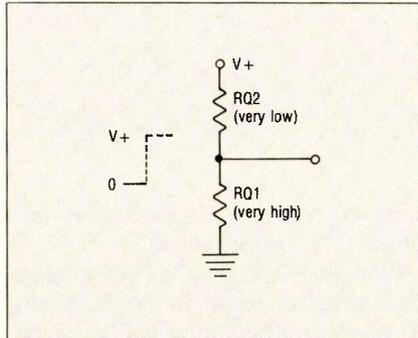


Fig. 5B. CMOS equivalent output circuit with a low input

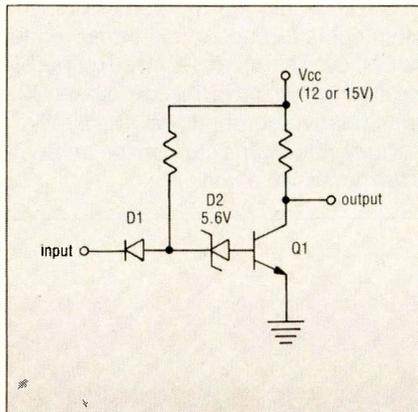


Fig. 6. The HTL inverter circuit

between the output terminal and the +5 volt dc supply.

CMOS devices

Complementary metal oxide semiconductors use MOSFET transistors instead of the bipolar (NPN and PNP) transistors used in the other logic families. CMOS inputs, therefore, are very high impedance. Figure 5A shows a typical CMOS inverter circuit. Note that this family is called *complementary* because the output circuit consists of a complementary pair of MOSFET transistors; i.e. an n-channel and a p-channel in series.

CMOS devices can use a monopolar power supply, like TTL and DTL, or may use a bipolar power supply after the manner of operational amplifiers. In the bipolar supplies the V+ can be any potential between +4 and +15 volts, while the V- may be -4 to -15 volts. In monopolar cases the V+ can also be

+4 to +15 volts, although +5 volts, is very common.

CMOS outputs are not directly TTL compatible, although some specific ICs have TTL outputs to make them compatible at the expense of higher current requirements. Such devices are easier to interface to TTL circuitry.

Figures 5B and 5C show the equivalent circuits for a CMOS inverter in both possible input conditions; i.e., HIGH and LOW. Recall that a p-channel MOSFET turns on when the gate is LOW, while the n-channel device turns on when the gate is HIGH.

Figure 5B shows the situation where the input is LOW. Q1 will have a very high channel resistance, and Q2 will have a very low (i.e. 200 ohms) channel resistance. In this case the output is equivalent to a 200 ohm resistor to the V+ supply, and appears HIGH.

In Figure 5C we see the situation where the input is HIGH. Q2 now has a very high channel resistance, and Q1 has a very low channel resistance (again, about 200 ohms). The output in this case looks like a 200 ohm resistor to ground, so is LOW. The HIGH/LOW or LOW/HIGH output transition in a CMOS device occurs at the point where the input voltage is midway between V+ and V-. If V- and V+ are not equal, then the transition occurs at a potential of $[(V+) - (V-)]/2$. If, on the other hand, V+ and V- are equal, then the transition occurs at 0 volts. If the V- is zero, then the transition occurs at $(V+)/2$.

The CMOS output stage always looks like a high and a low resistance in series across the power supplies (compare Figures 5B and 5C), so negligible current is drawn from the power supply. The only time the power supply sees a low resistance load will be when the input is at the transition point. The overall current drain, however, looks very small.

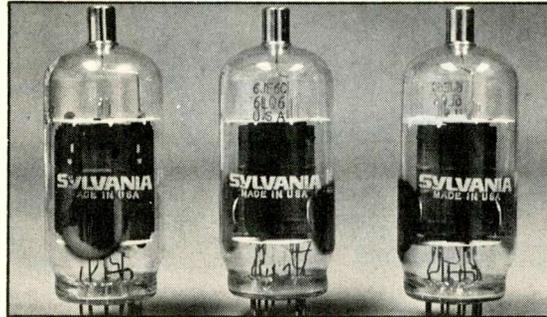
But CMOS devices have a problem; like MOSFETS they are sensitive to damage from static electricity (see "Caution: CMOS ICs" ET/D, April, 1977). All A-series devices (i.e. CD4011A) have this problem, but the B-series (i.e. CD4011B) has diode gate protection built into the chip. Nonetheless, they should be handled with care.

HTL devices

Noise pulses are often seen by logic circuits as valid input pulses. This problem is especially bothersome in high speed TTL devices that are normally able to pass high frequency,

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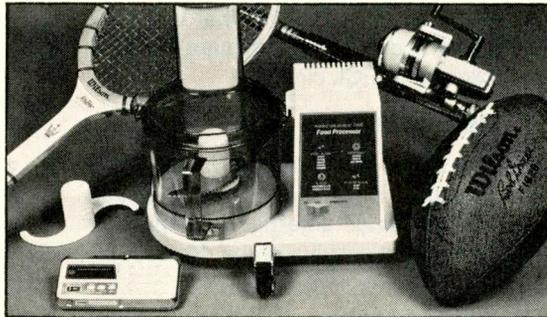
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short duration pulses. The solution in noisy environments is to use a digital IC logic family that requires a high input voltage to trigger. CMOS operated at high V+ and V- values meets this requirement, but an older bipolar "high threshold logic" may also be used.

HTL (also called *high noise immunity logic*) uses Vcc+ values of 12 or 15 volts, depending upon the series. As a result, the logic levels are also high, so it requires a bigger noise spike to cause trouble.

Figure 6 shows an HTL inverter. Note that it is similar to a DTL input circuit, except for diode D2: a 5.6 volt Zener diode. It is diode D2 that prevents lower amplitude noise spikes from affecting the device.

ECL devices

Up until now we have been talking about saturated logic families, i.e. the transistors in the ICs are either on or off (cut off or saturated). Emitter coupled logic is called an "ac" logic family because the transistors are operated in a non-saturated mode. As a consequence, ECL devices are capable of very fast operation. Most common-place devices will operate to 80 or 100 MHz, while some special (and



Fig. 7 The AP Products, Inc., Powerace-102

costly) devices operate to 300 - 1200 MHz. The usual "prescaler" that divides 500 MHz signals down to 50 MHz for your lower priced counter to count, uses an ECL counter as the prescaler element. Note that VHF/UHF layout and design techniques must be followed in ECL circuits.

Upcoming

This series of articles is a multi-part tutorial on digital electronics. This first article is the last time that we will present the internal circuitry of the devices. In

future issues each device will be treated as a circuit building block.

We prefer a hand-on approach to learning new areas of electronics. So, while not discounting the value of theoretical concepts, we will design the coming articles with both theory and practice. There will be experiments on each class of digital IC device. It is recommended that you also go back and reread the article on binary arithmetic, "Digital Electronics - Part I" in the November, 1977 issue of ET/D. Also note the correction to this article in the January, 1978 issue of ET/D page 4.

The experiments are performed on any IC socket "breadboard," although I have selected the AP Products, Inc. (P. O. Box 110-Q Painesville, OH, 44077) Powerace-102 (Figure 7). This model contains a 5 volts @1 ampere dc power supply (regulated), a pulse detector circuit, logic level switches, a one-shot pulse generator, and an astable clock generator that produces 50 percent duty cycle squarewaves at frequencies of 1 Hz, 10 Hz, 100 Hz, 1000 Hz, 10 KHz, or 100 KHz. The same experiments can be performed on other models (i.e. the Heathkit), but the instructions given will reflect the layout and features of the AP Powerace-102. **ET/D**

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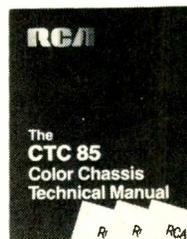
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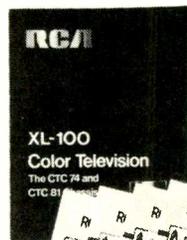
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ETD-579

Managing the successful serveshop

Pricing parts and labor

A logical, systematic approach to business management is essential for survival in today's highly competitive electronics service industry. In this article, ET/D presents a look at the Sperry Tech system, one of the most comprehensive ever developed specifically for our industry.

By Richard W. Lay

"The next 18 months is going to separate the men from the boys," John Sperry said, "it's really going to get brutal out there."

If anyone should know, I guess John Sperry should. It was 1949 when Sperry opened his first television repair shop in Lincoln, Neb., in association with a partner whom he later bought out. But, three years later, Sperry now on his own, found that he owed just about everybody in town. "I was so far in debt that had I known what I know now I don't think I ever would have stuck it out.

"I realized at that time that while I knew electronics I didn't know anything about running a business so I just sat down and studied what made it tick—then I raised my prices."

Perhaps Sperry's story, incidentally he is now president of Sperry TV with 22 technicians, a fleet of 11 trucks and annual service sales of close to a million dollars, is not all that unfamiliar to you.

Actually, what he did those 30 years ago or so when he sat down to find out "what made it tick," was to set in motion

the forerunner of what has now become known in the home electronics service industry as the Sperry Tech System of pricing parts and labor.

With seven years of design, field testing and adjustment, readjustment and redesign behind it, Sperry now believes the system is ready for dissemination throughout the industry.

Whether it is his particular system or another one, Sperry is convinced that now is the last opportunity that many of the nation's marginal shops will have to implement a sound, practical and workable business management system. There is no question that those shops lacking the proper management tools will not long survive.

The reason for this is simple. Your service business is comprised of two primary elements—time and products.

Since time is a costly element, it contributes heavily toward the profit stance of your business. Any service shop without a rational system for efficiently managing and charging for time cannot effectively compete with those shops which do—if indeed they manage to keep their heads above water at all.

Similarly, parts handling and pricing, being the second element in the cost-price-profit mix, is vitally important.

The role of inventory

Proper inventory control is one of the most important factors in determining your profitability. Financial people have various ways of determining a firm's overall profitability, one of them is directly related to your net worth.

Let's put it this way. Say your annual sales are \$100,000, your net worth (which includes your parts inventory, building, equipment, and owner's equity) is \$40,000 and your before tax



Fig. 1—The records and communications center of Sperry TV service, Lincoln, Neb. A complete record of all service data is kept in the console at center while traffic controllers kept track of service personnel in the field.

profit is \$10,000. You've netted 10 per cent profit on sales and 25 per cent on your net worth. However, let's assume your inventory stock is "loaded" with outdated and seldom used replacement parts and has pushed your overall net worth to say—\$60,000. Using this figure, your net profit on sales remains 10 per cent, but look what happens to your return on net worth. It has fallen from 25 per cent to 16.7 per cent. The main reason has been the slow or non-moving spare parts lying around on your valuable shelf space.

This is the classic example of why you should not clutter your shelves with "dead beat" items. They are literally taking money out of your pocket as surely as any thief. Sperry estimates that perhaps 50 per cent of parts inventories in serveshops fall into the "dead beat" category.

Consider the alternative if you had stocked faster moving merchandise on your shelves. It sells, adds to annual

MARK-UP TABLES											
TABLE NO. 5			TABLE NO. 6			TABLE NO. 7			TABLE NO. 8		
Dealer Price	X = (Times)	Gross Margin	Dealer Price	X = (Times)	Gross Margin	Dealer Price	X = (Times)	Gross Margin	Dealer Price	X = (Times)	Gross Margin
00 15	14.30	93.0%	00 15	16.70	94.0%	00 15	20.00	95.0%	00 15	25.00	96.0%
16 18	12.55	92.0%	16 18	14.30	93.0%	16 18	16.70	94.0%	16 18	20.00	95.0%
19 22	10.00	90.0%	19 22	12.50	92.0%	19 22	14.30	93.0%	19 22	16.70	94.0%
23 27	8.33	88.0%	23 27	10.00	90.0%	23 27	12.50	92.0%	23 27	14.30	93.0%
28 33	7.14	86.0%	28 33	8.33	88.0%	28 33	10.00	90.0%	28 33	12.50	92.0%
34 40	6.25	84.0%	34 40	7.14	86.0%	34 40	8.33	88.0%	34 40	10.00	90.0%
41 48	5.60	82.0%	41 48	6.25	84.0%	41 48	7.14	86.0%	41 48	8.33	88.0%
49 57	5.00	80.0%	49 57	5.60	82.0%	49 57	6.25	84.0%	49 57	7.14	86.0%
58 67	4.44	77.5%	58 67	5.00	80.0%	58 67	5.60	82.0%	58 67	6.25	84.0%
68 78	4.00	75.0%	68 78	4.44	77.5%	68 78	5.00	80.0%	68 78	5.60	82.0%
79 125	3.60	72.5%	79 125	4.00	75.0%	79 125	4.44	77.5%	79 125	5.00	80.0%
126 200	3.33	70.0%	126 200	3.60	72.5%	126 200	4.00	75.0%	126 200	4.44	77.5%
201 350	3.08	67.5%	201 350	3.33	70.0%	201 350	3.60	72.5%	201 350	4.00	75.0%
351 500	2.86	65.0%	351 500	3.08	67.5%	351 500	3.33	70.0%	351 500	3.60	72.5%
501 750	2.67	62.5%	501 750	2.86	65.0%	501 750	3.08	67.5%	501 750	3.33	70.0%
751 1050	2.50	60.0%	751 1050	2.67	62.5%	751 1050	2.86	65.0%	751 1050	3.08	67.5%
1051 1400	2.35	57.5%	1051 1400	2.50	60.0%	1051 1400	2.67	62.5%	1051 1400	2.86	65.0%
1401 1800	2.22	55.0%	1401 1800	2.35	57.5%	1401 1800	2.50	60.0%	1401 1800	2.67	62.5%
1801 2250	2.11	52.5%	1801 2250	2.22	55.0%	1801 2250	2.35	57.5%	1801 2250	2.50	60.0%
2251 2750	2.00	50.0%	2251 2750	2.11	52.5%	2251 2750	2.22	55.0%	2251 2750	2.35	57.5%
2751 3300	1.90	47.5%	2751 3300	2.00	50.0%	2751 3300	2.11	52.5%	2751 3300	2.22	55.0%
3301 4000	1.82	45.0%	3301 4000	1.90	47.5%	3301 4000	2.00	50.0%	3301 4000	2.11	52.5%
Over 4000	1.74	42.5%	Over 4000	1.82	45.0%	Over 4000	1.90	47.5%	Over 4000	2.00	50.0%

Fig. 2-Sperry Tech Mark Up Tables 5 through 8. Eight tables supplied with the system allow each service shop owner/manager to select the overall average markup desired.

GENERAL ELECTRIC			
Part	Rank	Description	Price
EP93X46	A	MODULE	33.65
EP93X66	B	MODULE	35.80
EP93X72	B	MODULE	39.00
EP93X74	A	MODULE	37.00
EP93X79	A	MODULE	39.90
EP93X80	A	MODULE	23.75
EP93X86	A	MODULE	35.80
EP93X88	A	MODULE	38.60
EP93X89	A	MODULE	39.90
EP93X91	B	MODULE	31.00
EP93X92	B	MODULE	26.50
EP93X101		EP93X131	
EP93X103	A	MODULE	31.90
EP93X113		EP93X130	
EP93X122	B	MODULE	28.75
EP93X127	B	MODULE	31.55
EP93X128	C	MODULE	6.45
EP93X130	B	MODULE	43.60
EP93X131	B	MODULE	52.70
ES15X90	C	TRANSISTOR	6.00
ES15X91	B	TRANSISTOR	7.15
ES15X92	B	TRANSISTOR	6.00
ES15X125	C	TRANSISTOR	7.15
ES15X126	C	TRANSISTOR	18.70
ES16X27	C	DIODE	2.65
ES31X230	D	CAPACITOR	18.75
ES36X88	C	COIL	6.00
ES39X10	D	SWITCH	7.70
ES43X37		ES43X81	
ES43X79	C	KNOB	2.60
ES43X81	C	KNOB	2.75
ES43X103	C	KNOB	2.75
ES43X115	C	KNOB	2.15
ES43X168	D	KNOB	2.25
ES43X195	D	KNOB	2.10
ES43X228		ES43X255	
ES43X255	D	KNOB	2.15
ES43X300	C	KNOB	2.60
ES43X612	D	KNOB	2.65
ES43X663	C	KNOB	2.60
ES43X738	C	KNOB	2.60
ES49X2	C	CONTROL	12.15
ES49X105	D	CONTROL	11.35
ES66X5	D	CORD	10.15
ES66X7	D	CORD	5.23
ES66X8		EU66X12	
ES66X24	D	CORD	13.35
ES69X10	C	SHAFT	2.20
ES83X3	E	ANTENNA	7.85
ES83X5	E	ANTENNA	11.35
ET43X270	E	KNOB	1.58
ET43X688	E	KNOB	3.15
ET43X828	C	KNOB	2.65
ET76X56	C	YOKE	28.75
EU2X330	D	BUTTON	1.85

Fig. 3-A page from the "Manufacturers Replacement Parts" section of the book showing part number, description and price of G.E. parts. The letter designation next to part EP93X86 identifies that module as being one of the 25 best selling GE replacement parts.

hotel work; outdoor antennas and MATV, commercial and industrial installation and repair, and miscellaneous.

The system also includes specific pricing categories for portable and clock AM and FM, portable phonographs, "show and tell," monitors and multibands, communications, car radio, portable cassettes, deck cassettes, cartridge tape players, and reel tape monaural, stereo and quad.

Parts pricing

The parts pricing segment of the Sperry Tech system includes automatic and periodic updating with information on manufacturers price changes as well as a special inventory control feature that allows you, the shop owner/manager, to identify the fastest moving parts for four major manufacturers: RCA, Zenith, Magnavox, and GE. Others will be added as they become available, Sperry reports.

The parts pricing guide provides manufacturers' price data—including price changes as they are announced by manufacturers—on five categories of parts. These are "Manufacturer's Replacement Parts," a listing of 17 home entertainment companies; "Semiconductors," which lists ECG, GE, SK, and HEP prices; "Universal Parts;" "Picture Tubes," a listing for Channel Master, RCA, Zenith, and Sylvania; and a picture tube "interchangeability Guide."

In addition this manual contains a directory of manufacturers with addresses and telephone numbers and sales tax tables computed at for your individual area requirements.

The method of establishing parts prices differs from the traditional "suggested retail" where the manufacturer sets the gross margin of profit.

Eight tables

There are eight parts pricing markup tables, see Figure 2, providing various owner-selected mixes of gross margin. Each higher table progressively increases the selling price, while the gross margin tapers down gradually within each table. "This," Sperry said, "keeps the price of major parts from becoming overpriced."

For example, let's say the dealer cost of a circuit breaker is 88 cents. This falls in the 79 cents to \$1.25 price range. Now select one of the eight charts. If chart five is selected, they you multiply the price by the "multiplier" 3.6, to determine your selling price of \$3.17, which provides

sales and reduces your inventory at the same time. The result is higher gross profits and higher return on net worth.

Now you understand why overstocking is as bad—maybe even a little worse—than understocking, though both should be avoided as both contribute to profit deterioration.

The Sperry Tech System

Like any successful system of management control, it is these two critical elements toward which the Sperry Tech system of business management directs its attention. It is a complete, fully integrated labor and parts pricing system for use by both management and technicians on the job.

And one advantage of the Sperry System, if you consider it an advantage, is that it keeps you away from the traditional "flat rate" method of pricing which has caused so many customer problems in the past wherein the customer with a small repair job must help foot the bill for a customer with a "catastrophic" repair job.

Essentially the system catalogues each repair step according to the average time required to complete this step as computed through actual "real time" studies conducted during the seven years the system has been in use. It can adjust hourly rates to inflationary trends in a matter of seconds. It can provide a shop owner or technician in the field with information to compute the exact gross margin (price-cost/price) of any inventory repair part which management has decided to charge simple via a glance at a set of computational tables.

The labor pricing section of the system contains an extensive labor pricing system for over 19 major repair categories. These are black and white and color TV, radio and phonograph consoles, radio and phonograph compacts, intercom system, motel and

you with a gross margin of 72.5 per cent.

Notice, however, how gross margin is reduced for higher priced items. For a horizontal output transformer, let's say the dealer cost is \$45. Your multiplier in this price range becomes 1.74, which gives you a selling price of \$78.30 while reducing gross margin to 42.5 per cent.

This "lowered" selling price contributes to good customer PR. However, you are not losing anything in this deal through the simple fact that each of the eight tables has been statistically developed to yield a specific overall *average gross margin* taking into account the product mix of the repair industry.

For example, table 1 is designed to provide a service business with an overall average mark up of 45 per cent while table number eight provides mark up of 65 per cent average. Table five, the one we worked through the example with, was designed for an overall 56 per cent average markup, and notice how our markup fluctuated from 72.5 to 42.5 per cent.

Sperry's system also permits identification of the fastest moving replacement parts—as mentioned before—for four major television manufacturers. They are RCA, Zenith, Magnavox, and General Electric.

The letter designation in the "rank" column of the replacement parts list determines how popular a replacement item a part is (see figure 3). The Sperry system identifies the fastest moving 200 parts from each of the four manufacturers according to the following designation:

A—top 25; B—26-50; C—51-100; D—101-150; E—151-200; F—over 200.

Sperry recommends that for television brands which you service regularly to stock groups A, B, C, and D. For brands you seldom service stock only groups A and B, with a possibility of C.

Labor pricing

Now let's move on to look at the labor pricing section of this system and see how it works (refer to Figure 4).

You will note a heading in the upper center of the illustration marked "Tech's Guide Time." This is a table listing the number of minutes that should be "charged" according to the service performed and difficulty involved. The "charge times" have been accrued through the averaging out of thousands of actual case histories under actual working conditions using experienced, professional electronics technicians.

There is also a category, you will note, for including travel time to and from

locations on field service calls.

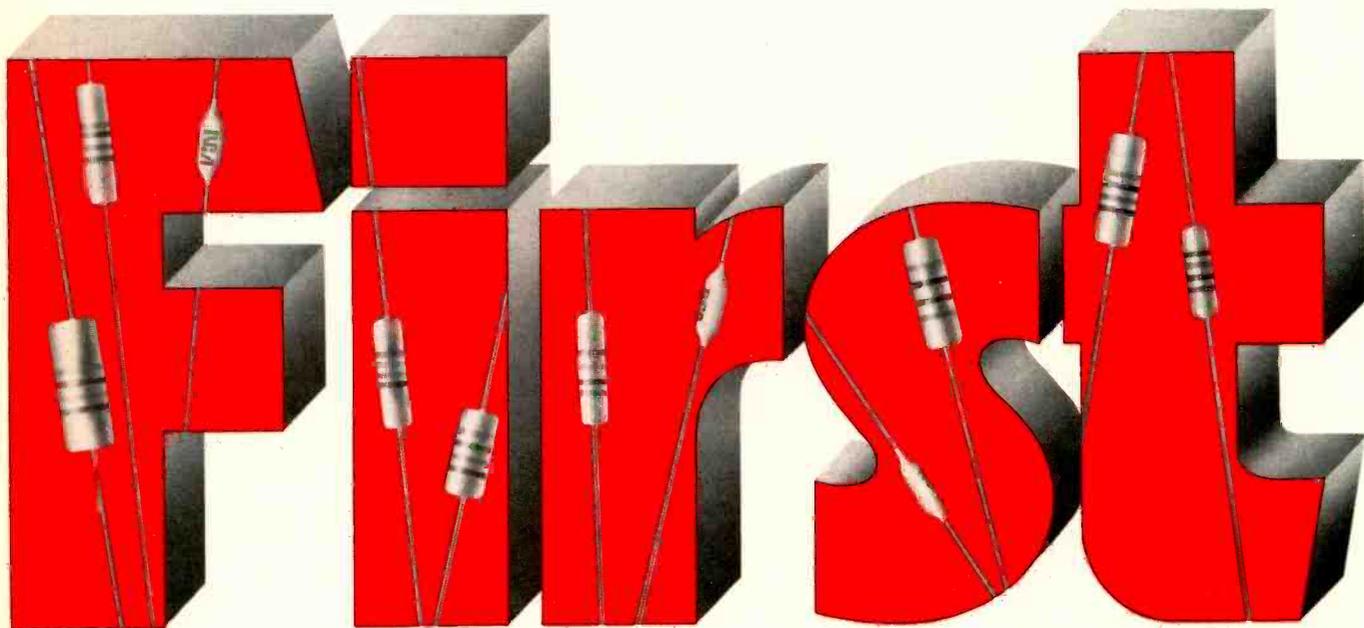
Take a moment to study this chart on color TV and then we'll take you—hand-in-hand—through a hypothetical case to show you how to apply the labor pricing guide to actual work.

Before we start, however, you should be aware that the computation of your labor price rate is intimately tied to your hourly rate—that is the rate you determine which is required to cover all of your expenses plus to provide you with the profit margin you desire. It is beyond the scope of this article to explain this. However, a method is explained in the books supplied with the Sperry Tech System and for another explanation see ET/D, October, 1978, page 26.

Suffice it to say it is comprised of four elements—your labor cost, your expenses, your productivity ratio and the profit margin you desire. For simplicity, let's just say the hourly rate we have determined as practical is \$19.80.

A case history

Now let's assume we are called out on a home service call to service a color console. Our call is within the main service area of our shop and is considered a normal distance. The



RCA's broad line of flameproof resistors.

color tv

	Tech's Guide Time
1 / Outside Service Requirements	
a / trip	20
b / return trip	15
c / delivery & reinstallation (including return trip)	35
d / mileage (area map or mileage each way)	Per Mile
2 / Preliminary Diagnosis & Routine Adjustments*	1st 2nd
a / portable	35 20
b / table/console	35 20
c / combination TV & Radio	45 20
d / audio component of TV combination	Refer to Combination Radio
2A / Outside Antenna or MATV	
a / minor repairs	**
b / major repairs completed on this call	Time Price
c / major repairs unable to complete on this call	Refer to Antenna Section
3 / Removal & Reinstallation	
a / complete unit in table or portable cabinet to shop	**
b / complete unit in console cabinet to shop	10
c / back off set	**
d / main chassis	**
e / tuner or sub-chassis (each)	10
4 / Adjustments (precision)	
a / A F C	5
b / A F P C	10
c / A F T	5
d / convergence (touch up)	**
e / convergence (complete set up)	15
f / low voltage regulator	10
g / R F neutralization	10
5 / Cleaning	
a / chassis & cabinet (major)	10
b / controls (each)	5
c / function switches (each)	5
d / tuner (clean & lube)	10
e / battery terminals & holder	5
6 / Modification	
a / additions or alterations	Time Price
7 / Repair of Auxiliary Wiring/Accessories	
a / controls, jacks, speakers & switches	Time Price
8 / Interference	
a / identification	**
b / remedy (when applicable)	Time Price

*The 1st preliminary diagnosis is performed on each set serviced which will complete minor repairs or prepare the unit for major service. The 2nd preliminary diagnosis is used in addition to the 1st preliminary only when outside repairs are taken to the shop for bench service. See page 11 for detailed instructions.

**Time is included in preliminary diagnosis.

9 / Bench Diagnosis

a / first circuit or mechanical defect	40 45 50 55 60 70
b / 2nd & subsequent circuit or mechanical defect (ea.)	20 20 25 25 30 30
c / re-work or damaged areas	Time Price

		Tech's Guide Time	
Tuner			
UHF	9		
VHF	9		
Elec. Tuning	9		
Mech. Tuning	8		
AFT	9		
DIALS	5		
GEARS	6		
Signal			
AGC	9		
I F	8		
Sync	9		
Video	7		
Chroma			
Amplifiers	7		
Acc & Killer	9		
OSC & Burst	8		
Demodulators	7		
Pix. Tube			
Grid Drives	7		
Input Circuitry	7		
Blanking	8		
Control			
Electronic Tuning	7		
Motor Controls	9		
Tun. Volt Cont.	9		
Motors	7		
Remote	7		
Receiver	8		
Transmitter	7		
Audio			
Amplifiers	7		
Detection	8		
Output	6		
Sound I F	7		
Speaker	5		
Miscellaneous			
Cables	6		
Connectors	7		
Deflection			
Convergence	8		
Deflection Yoke	8		
High Voltage	8		
Horiz. OSC/AFC	9		
Horiz. Output	8		
Pin Cushion	9		
Vert. OSC	8		
Vert. Output	8		
Focus	7		
Power			
Degaussing	6		
Filament	6		
Low Voltage	6		
Regulated	8		
Non-Regulated	6		
AC-Power	5		
Battery Circuits	5		
Clocks / Timers			
Standard	6		
Digital	6		
Electronic	6		
Mechanical	7		

10 / Alignment

a / A F C	10
b / A F T	30
c / A F P C	20
d / A T C	15
e / sound I F	20
f / chroma	30
g / video I F	30
h / remote control receiver functions (each)	10
i / tuner UHF	Exchange
j / tuner VHF	Exchange

11 / Component Removal & Replacement Time

Item Replaced	Plug in Parts & Assemblies				Soldered Connections				Rivets		Screws, Bolts, Retainer Rings, Etc.					
	1	2	5 up	10 up	1	2	5 up	10 up	Each	1	2	5 up	10 up	20 up		
Individual Part or Assembly	5	10	15	15	5	10	15	20	25	30	5	5	10	15	20	25
Cabinet Parts	Time Price															
Dial Cords - Drives	Time Price															
Outside Ant. - MATV	Time Price															
Picture Tube	Regular Installation - 20				Irregular Installation - 40											

12 / Warranty Parts Tags

	5 Each
--	--------

Fig. 4-One of 19 separate labor price guides, the Color TV guide, supplied with the Sperry Tech System. The guide lists 12 separately defined job functions with their associated "average" times for service.

And still your best source for replacement use.

Since RCA's flameproof resistor line was first announced in 1974, the line has included the values and ratings most needed in modern electronics circuitry. Available in 1/4, 1/2, 1 watt and 2 watt ratings from 0.1 ohm to 1.5 megohms, these high-quality metal-film resistors can be used in nearly all applications calling for 2, 5, or 10 percent tolerances.

RCA flameproof resistors are attractively packaged in easy-to-spot blister packages, color coded by wattage ratings.

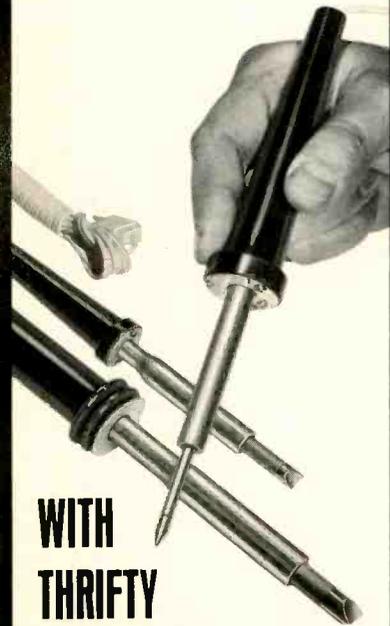
RCA now offers more values where you need them most.

RCA has added a total of 120 new flameproof resistors — all in the low values: from 0.1 to 9.1 ohms in 1/2, 1 and 2 watt ratings.

RCA's line is still first in its field and is still your best choice for the flameproof resistors you need most. For full information, contact your RCA distributor. Or write to RCA Distributor and Special Products Division, 2000 Clements Bridge Road, Deptford, N.J. 08096.

RCA Flameproof Film Resistors

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MARKSMAN IRONS**
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Circle No. 108 on Reader Inquiry Card

in-home diagnosis we do shows a bad picture tube and four bad receiving tubes. We've removed the main chassis to remove the CRT, and in so doing have had to remove the tuner also. Also, because we do not carry color picture tubes in our truck, we will have to make a return trip.

So, after finishing the job, let's tabulate just what the proper labor charge should be—according to our predetermined \$19.80 hourly rate.

First we need to list our services and total our minutes as listed on the Color TV chart of Figure 4.

This is how it would look:

Trip20 (Item 1)
Return trip15 (Item 1)
Preliminary Diagnosis (1st)35 (Item 2)
Remove and Reinstall Main Chassis10 (Item 3)

R & R Tuner10 (Item 3)
Convergence15 (Item 4)
Adjust High Voltage, Height and Linearity	* (Item 2)
Replace four receiving tubes10 (Item 11)
Replace picture tube20 (Item 11)
TOTAL	135

*Time included in preliminary diagnosis.

Now all that needs to be done is to convert our labor minutes into dollar charges. We can do this, of course, simply by dividing our hourly rate by 60 and multiplying by minutes worked (i.e., $19.80/60 \times 135 = \$44.55$. This then become our labor charge for this particular service call.

However, there is an easier way. A whole set of pricing calculator charts, 30 in fact, are supplied with the Sperry Tech system. Choose the card with your hourly rate on it (see Figure 5) and find

pricing calculator Chart No. 20

Your own hourly rates...	TECH'S GUIDE TIME	RATES PER HOUR FOR TWO MEN										TECH'S GUIDE TIME	ONE-MAN HOURLY RATE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
		20.40	21.60	22.20	22.80	23.40	24.00	25.20	26.40	27.60	28.80																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
5	1.70	1.75	1.80	1.85	1.90	1.95	2.00	2.10	2.15	2.20	2.30	2.35	2.40	2.50	2.55	2.60	2.70	2.75	2.80	2.90	2.95	3.00	3.10	3.15	3.20	3.30	3.35	3.40	3.50	3.55	3.60	3.70	3.75	3.80	3.90	3.95	4.00	4.10	4.15	4.20	4.30	4.35	4.40	4.50	4.55	4.60	4.70	4.75	4.80	4.90	4.95	5.00	5.10	5.15	5.20	5.30	5.35	5.40	5.50	5.55	5.60	5.70	5.75	5.80	5.90	5.95	6.00	6.10	6.15	6.20	6.30	6.35	6.40	6.50	6.55	6.60	6.70	6.75	6.80	6.90	6.95	7.00	7.10	7.15	7.20	7.30	7.35	7.40	7.50	7.55	7.60	7.70	7.75	7.80	7.90	7.95	8.00	8.10	8.15	8.20	8.30	8.35	8.40	8.50	8.55	8.60	8.70	8.75	8.80	8.90	8.95	9.00	9.10	9.15	9.20	9.30	9.35	9.40	9.50	9.55	9.60	9.70	9.75	9.80	9.90	9.95	10.00	10.10	10.15	10.20	10.30	10.35	10.40	10.50	10.55	10.60	10.70	10.75	10.80	10.90	10.95	11.00	11.10	11.15	11.20	11.30	11.35	11.40	11.50	11.55	11.60	11.70	11.75	11.80	11.90	11.95	12.00	12.10	12.15	12.20	12.30	12.35	12.40	12.50	12.55	12.60	12.70	12.75	12.80	12.90	12.95	13.00	13.10	13.15	13.20	13.30	13.35	13.40	13.50	13.55	13.60	13.70	13.75	13.80	13.90	13.95	14.00	14.10	14.15	14.20	14.30	14.35	14.40	14.50	14.55	14.60	14.70	14.75	14.80	14.90	14.95	15.00	15.10	15.15	15.20	15.30	15.35	15.40	15.50	15.55	15.60	15.70	15.75	15.80	15.90	15.95	16.00	16.10	16.15	16.20	16.30	16.35	16.40	16.50	16.55	16.60	16.70	16.75	16.80	16.90	16.95	17.00	17.10	17.15	17.20	17.30	17.35	17.40	17.50	17.55	17.60	17.70	17.75	17.80	17.90	17.95	18.00	18.10	18.15	18.20	18.30	18.35	18.40	18.50	18.55	18.60	18.70	18.75	18.80	18.90	18.95	19.00	19.10	19.15	19.20	19.30	19.35	19.40	19.50	19.55	19.60	19.70	19.75	19.80	19.90	19.95	20.00	20.10	20.15	20.20	20.30	20.35	20.40	20.50	20.55	20.60	20.70	20.75	20.80	20.90	20.95	21.00	21.10	21.15	21.20	21.30	21.35	21.40	21.50	21.55	21.60	21.70	21.75	21.80	21.90	21.95	22.00	22.10	22.15	22.20	22.30	22.35	22.40	22.50	22.55	22.60	22.70	22.75	22.80	22.90	22.95	23.00	23.10	23.15	23.20	23.30	23.35	23.40	23.50	23.55	23.60	23.70	23.75	23.80	23.90	23.95	24.00	24.10	24.15	24.20	24.30	24.35	24.40	24.50	24.55	24.60	24.70	24.75	24.80	24.90	24.95	25.00	25.10	25.15	25.20	25.30	25.35	25.40	25.50	25.55	25.60	25.70	25.75	25.80	25.90	25.95	26.00	26.10	26.15	26.20	26.30	26.35	26.40	26.50	26.55	26.60	26.70	26.75	26.80	26.90	26.95	27.00	27.10	27.15	27.20	27.30	27.35	27.40	27.50	27.55	27.60	27.70	27.75	27.80	27.90	27.95	28.00	28.10	28.15	28.20	28.30	28.35	28.40	28.50	28.55	28.60	28.70	28.75	28.80	28.90	28.95	29.00	29.10	29.15	29.20	29.30	29.35	29.40	29.50	29.55	29.60	29.70	29.75	29.80	29.90	29.95	30.00	30.10	30.15	30.20	30.30	30.35	30.40	30.50	30.55	30.60	30.70	30.75	30.80	30.90	30.95	31.00	31.10	31.15	31.20	31.30	31.35	31.40	31.50	31.55	31.60	31.70	31.75	31.80	31.90	31.95	32.00	32.10	32.15	32.20	32.30	32.35	32.40	32.50	32.55	32.60	32.70	32.75	32.80	32.90	32.95	33.00	33.10	33.15	33.20	33.30	33.35	33.40	33.50	33.55	33.60	33.70	33.75	33.80	33.90	33.95	34.00	34.10	34.15	34.20	34.30	34.35	34.40	34.50	34.55	34.60	34.70	34.75	34.80	34.90	34.95	35.00	35.10	35.15	35.20	35.30	35.35	35.40	35.50	35.55	35.60	35.70	35.75	35.80	35.90	35.95	36.00	36.10	36.15	36.20	36.30	36.35	36.40	36.50	36.55	36.60	36.70	36.75	36.80	36.90	36.95	37.00	37.10	37.15	37.20	37.30	37.35	37.40	37.50	37.55	37.60	37.70	37.75	37.80	37.90	37.95	38.00	38.10	38.15	38.20	38.30	38.35	38.40	38.50	38.55	38.60	38.70	38.75	38.80	38.90	38.95	39.00	39.10	39.15	39.20	39.30	39.35	39.40	39.50	39.55	39.60	39.70	39.75	39.80	39.90	39.95	40.00	40.10	40.15	40.20	40.30	40.35	40.40	40.50	40.55	40.60	40.70	40.75	40.80	40.90	40.95	41.00	41.10	41.15	41.20	41.30	41.35	41.40	41.50	41.55	41.60	41.70	41.75	41.80	41.90	41.95	42.00	42.10	42.15	42.20	42.30	42.35	42.40	42.50	42.55	42.60	42.70	42.75	42.80	42.90	42.95	43.00	43.10	43.15	43.20	43.30	43.35	43.40	43.50	43.55	43.60	43.70	43.75	43.80	43.90	43.95	44.00	44.10	44.15	44.20	44.30	44.35	44.40	44.50	44.55	44.60	44.70	44.75	44.80	44.90	44.95	45.00	45.10	45.15	45.20	45.30	45.35	45.40	45.50	45.55	45.60	45.70	45.75	45.80	45.90	45.95	46.00	46.10	46.15	46.20	46.30	46.35	46.40	46.50	46.55	46.60	46.70	46.75	46.80	46.90	46.95	47.00	47.10	47.15	47.20	47.30	47.35	47.40	47.50	47.55	47.60	47.70	47.75	47.80	47.90	47.95	48.00	48.10	48.15	48.20	48.30	48.35	48.40	48.50	48.55	48.60	48.70	48.75	48.80	48.90	48.95	49.00	49.10	49.15	49.20	49.30	49.35	49.40	49.50	49.55	49.60	49.70	49.75	49.80	49.90	49.95	50.00	50.10	50.15	50.20	50.30	50.35	50.40	50.50	50.55	50.60	50.70	50.75	50.80	50.90	50.95	51.00	51.10	51.15	51.20	51.30	51.35	51.40	51.50	51.55	51.60	51.70	51.75	51.80	51.90	51.95	52.00	52.10	52.15	52.20	52.30	52.35	52.40	52.50	52.55	52.60	52.70	52.75	52.80	52.90	52.95	53.00	53.10	53.15	53.20	53.30	53.35	53.40	53.50	53.55	53.60	53.70	53.75	53.80	53.90	53.95	54.00	54.10	54.15	54.20	54.30	54.35	54.40	54.50	54.55	54.60	54.70	54.75	54.80	54.90	54.95	55.00	55.10	55.15	55.20	55.30	55.35	55.40	55.50	55.55	55.60	55.70	55.75	55.80	55.90	55.95	56.00	56.10	56.15	56.20	56.30	56.35	56.40	56.50	56.55	56.60	56.70	56.75	56.80	56.90	56.95	57.00	57.10	57.15	57.20	57.30	57.35	57.40	57.50	57.55	57.60	57.70	57.75	57.80	57.90	57.95	58.00	58.10	58.15	58.20	58.30	58.35	58.40	58.50	58.55	58.60	58.70	58.75	58.80	58.90	58.95	59.00	59.10	59.15	59.20	59.30	59.35	59.40	59.50	59.55	59.60	59.70	59.75	59.80	59.90	59.95	60.00	60.10	60.15	60.20	60.30	60.35	60.40	60.50	60.55	60.60	60.70	60.75	60.80	60.90	60.95	61.00	61.10	61.15	61.20	61.30	61.35	61.40	61.50	61.55	61.60	61.70	61.75	61.80	61.90	61.95	62.00	62.10	62.15	62.20	62.30	62.35	62.40	62.50	62.55	62.60	62.70	62.75	62.80	62.90	62.95	63.00	63.10	63.15	63.20	63.30	63.35	63.40	63.50	63.55	63.60	63.70	63.75	63.80	63.90	63.95	64.00	64.10	64.15	64.20	64.30	64.35	64.40	64.50	64.55	64.60	64.70	64.75	64.80	64.90	64.95	65.00	65.10	65.15	65.20	65.30	65.35	65.40	65.50	65.55	65.60	65.70	65.75	65.80	65.90	65.95	66.00	66.10	66.15	66.20	66.30	66.35	66.40	66.50	66.55	66.60	66.70	66.75	66.80	66.90	66.95	67.00	67.10	67.15	67.20	67.30	67.35	67.40	67.50	67.55	67.60	67.70	67.75	67.80	67.90	67.95	68.00	68.10	68.15	68.20	68.30	68.35	68.40	68.50	68.55	68.60	68.70	68.75	68.80	68.90	68.95	69.00	69.10	69.15	69.20	69.30	69.35	69.40	69.50	69.55	69.60	69.70	69.75	69.80	69.90	69.95	70.00	70.10	70.15	70.20	70.30	70.35	70.40	70.50	70.55	70.60	70.70	70.75	70.80	70.90	70.95	71.00	71.10	71.15	71.20	71.30	71.35	71.40	71.50	71.55	71.60	71.70	71.75	71.80	71.90	71.95	72.00	72.10	72.15	72.20	72.30	72.35	72.40	72.50</

the number of total minutes you spent on the job. Then follow across the page to the "One man hourly rate" to determine that your charge for this call is indeed \$44.55. (Note the charts also contain Rate per Hour for Two Men.)

That's really all there is to it. Thus your total charge will be: Labor \$44.55 + Parts Charges = Total.

You already know how to compute the parts charges for this "call" since this is what we discussed in the first half of this article. So actually we've now come full circle with a demonstration of the Sperry Tech System.

There's one other thing that should be mentioned in connection with the pricing Guide (Figure 4). Note under Section 9—"Bench Diagnosis." The circled numbers over the minutes to be charged refer to specific repair functions.

Here's how this works. If during bench diagnosis, a "first circuit or mechanical defect" was found to be in the VHF tuner, the time charged for this diagnosis would be 55 minutes.

Simply refer to the box marked "Tuner" under Section 9, and notice the "8" associated with this function.

Now proceed up to the Tech's Guide Time Box again at the top righthand of the illustration and find the time to be charged for this "first circuit" diagnosis under the "8" column. It is 55 minutes.

While this may have been a brief description of a very comprehensive business system, it nevertheless comprises all of the basic elements you will find included in it. The labor pricing edition comes in two sizes. The hardbound cover sells for \$19.95. The pocket size is \$16.95. The parts pricing service ranges from \$24.50 for one book to \$16 per book for purchases of 25 books and up.

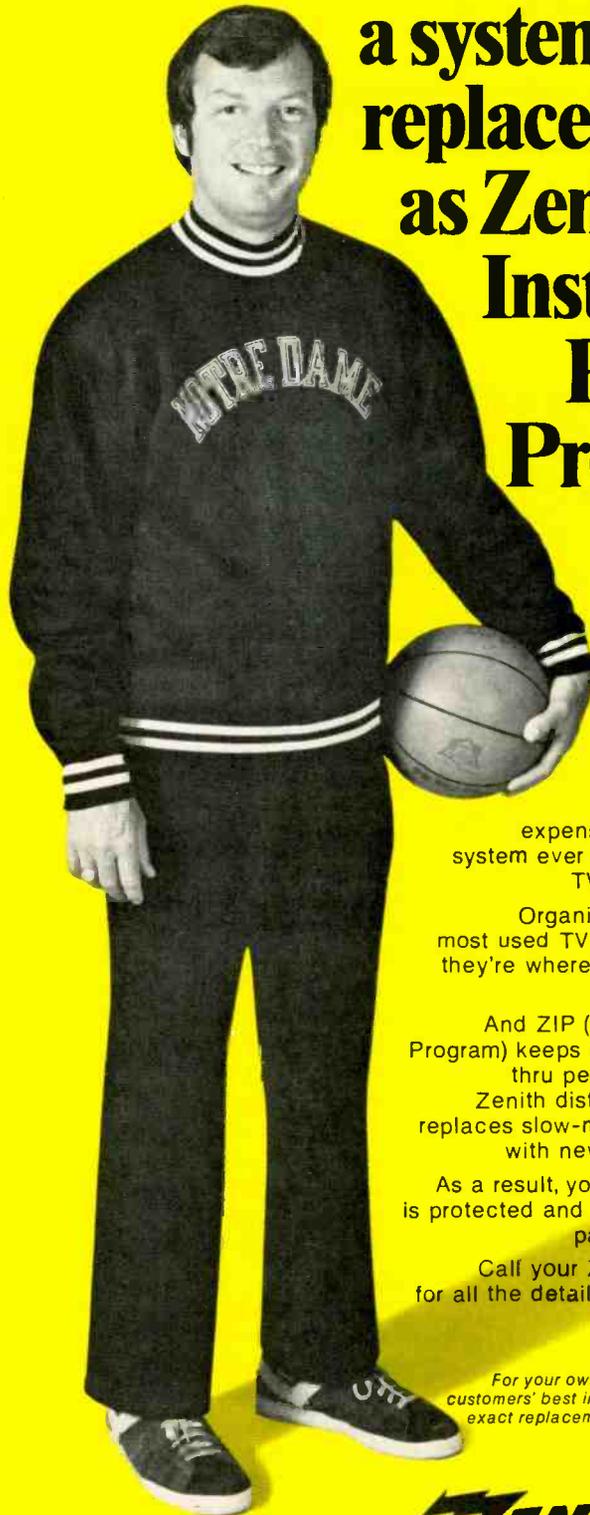
The monthly subscription fee (updating price service) for one book would be \$9.40 per month and up to \$53.75 for the 25 book updating service. Details are, of course, available from Sperry TV, Lincoln, Neb. Simply call their toll free number 800-228-4338 between 8:00 AM and 5:00 PM CST.

If you are not already using an effective system of business management, the consensus is you won't be around in 18 to 24 months from now. So this is one of the possible alternatives for you to investigate.

Regardless of what system you might choose, John Sperry seems certain:

"New products and multiple set use in the home are rapidly bringing about new business procedures. Either we accept the change or we move over and make room for someone who will." **ET/D**

"We'd never lose a game if I had as sure-fire a system for replacements as Zenith's Instant Parts Program!"



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It's the easiest, least expensive Inventory control system ever devised by Zenith for TV service technicians.

Organizes the most needed, most used TV replacement parts so they're where you want them when you want them.

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Circle No. 129 on Reader Inquiry Card

ET/D - May 1979 / 37

TEST INSTRUMENT REPORT

Here's another in-circuit capacitor tester. In the last twenty years or so, I've tried several different types and models and have found that while some of them were helpful, they required in-circuit balance adjustments or were not consistently reliable or were limited in range, and so they tended to get put back on the shelf and forgotten and I went back to

12A12C52, produced no misleading results. Capacitors which checked high ESR, did, when disconnected from their circuits, check reduced in capacitance and/or high power factor. With off the shelf capacitors, new units checked good—no surprises there. A number of unused electrolytics of considerable age were tested and checked marginal. Double checking these on a capacitance bridge showed them to be leaky and often reduced in capacitance. Allowing them to reform until the leakage was within normal limits, also reduced the ESR enough to bring them within recommendations.

The ESR meter is essentially an ac ohmmeter with a scale calibrated from zero to effectively 100 ohms—anything much over this looks like infinity. It will measure resistors in the range of 1 to 100 ohms with reasonable accuracy. It applies 25mV of 100KHz ac to the circuit under test. This voltage is low enough to avoid trouble with semiconductors: the 100KHz is high enough so that a 1mfd capacitor, the lowest value recommended for test, has less than 2 ohms reactance. Shunting resistances over about 200 ohms are not perceptible. Lower shunting resistances have predictable effect if the resistance is known. Shunting a good capacitor with lower resistances will not be noticed. Shunting a capacitor with an ESR of 50 ohms with 50 ohms of external resistance will produce a meter reading of 25 ohms. The capacitor is apparently bad anyway.

It usually isn't even necessary to know the value of the capacitor. It either checks quite obviously bad or good. The exception to this might be a few low capacity electrolytics which have a high ESR. To help in these instances the lower scale of the meter indicates ESR limits for various value capacitors.

Creative Electronics offers several tips for use of the ESR meter. If the ESR changes when wiggling the leads, the capacitor is unreliable. Replace it. (Be sure your test connections are good.) If a capacitor measures over 50 ohms it will probably fail soon, even though it functions now. Replace it. Capacitors that measure between 20 and 50 ohms are okay in medium or high impedance circuits, coupling or timing. A general formula for maximum ESR is $C(\text{mfd}) \times R(\text{ohms}) = 1000$ (maximum). For example; 1000 mfd: 1 ohm max.

Quality of construction of the ESR meter is excellent. It uses quality conservatively rated, components, glass-epoxy circuit board, is housed in a $6\frac{1}{4} \times 3\frac{3}{4} \times 2$ in. case, is heavy for its size and sells for \$79.50 and it works! **ET/D**



The Creative Electronics ESR Meter. For more information circle number 150 this issue.

Creative Electronics' ESR Meter

It works!

by Walter H. Schwartz

bridging or clipping the capacitor free for an out of circuit test.

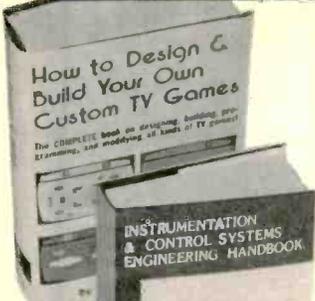
Finally, here is an electrolytic capacitor in-circuit tester that does seem to work. It measures equivalent series resistance which is effectively resistance between the terminal lug or lead and the actual capacitor plates. Creative Electronics states that their research on field failures of electrolytics indicates that almost all of them fail because of high ESR which reduces the capacitor's rate of charge and discharge, effectively making it an open capacitor. The electrolyte deteriorates—drys out—because of external heat, old age or heating due to high ripple current, the cause of failure of voltage doubler series capacitors and input filters.

Another cause of failure can be broken welds, loose crimps or rivets and internal corrosion. These also can be intermittent and obviously can show up as high ESR.

Tests made in the ET/D lab on an assortment of capacitors, both in and out of circuit, were completely consistent. In circuit, knowing roughly the shunting impedance, which could lower the apparent ESR, insures against confusing indications.

Checking the electrolytics in a RCA CTC 38, a CTC 24, and a Zenith

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



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



1082-308 p.—T.V. Field & Bench Servicer's Handbook (\$8.95)



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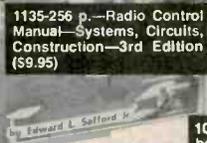
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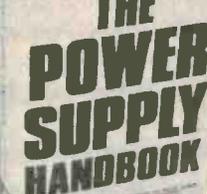
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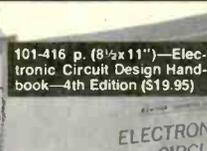
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101-416 p. (8 1/2 x 11")—Electronic Circuit Design Handbook—4th Edition (\$19.95)



1095-140 p.—Programs in Basic for Electronic Engineers, Technicians & Experimenters (\$7.95)



1073-336 p.—Modern Amateur Radio License Study Guide for Novice, Technician & General Class (\$12.95)



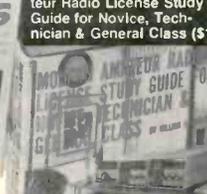
1015-308 p.—A Beginner's Guide to Computers & Microprocessors—with projects (\$9.95)



1113-182 p.—Understanding Electronics (\$8.95)



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1088-322 p.—Illustrated Dictionary of Microcomputer Terminology (\$12.95)



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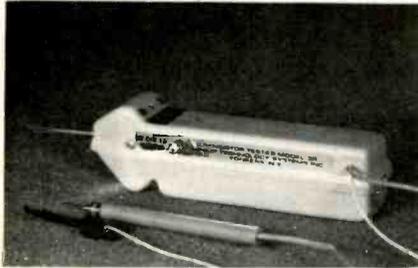
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NEW PRODUCTS



Hand-Held Transistor Tester

Circle No. 135 on Reader Inquiry Card

Group Technology Systems Model 3R, transistor tester is a handheld battery operated instrument designed for rapid in and out of circuit solid-state device testing. It will reportedly test bipolar transistors, FET's, SCR's, LED's, diodes and circuit continuity and identify the emitter, base and collector of a transistor, as well as determine whether it is PNP or NPN, silicon or germanium. It can indicate shorted, leaky, open, or low gain transistors. In

circuit tests can be made with shunting resistances as low as 70 ohms. It is powered by four "AA" cells. The price is \$49.95.

Digital Multimeters

Circle No. 136 on Reader Inquiry Card

The Weston Instruments Model 6000 is an auto ranging, auto zero, 3½ digit LCD display instrument with an unusual variety of available accessories. A function switch is its only control, range



changing is automatic. Measurement ranges are dc and ac volts from .1mV to 1000V, dc and ac current from .001mA to 10A and resistance from .1 ohm to 19.99 megohms. The accessories include a hold probe which will hold a reading if the operator's eyes have to remain on the test point during measurement, a light meter attachment, HF and VHF RF probes, a 50KV high voltage probe, an ac clamp on amp-meter and a carrying case.

Color TV Test Generator

Circle No. 137 on Reader Inquiry Card



The new VIZ SignalystSM color bar generator can reportedly supply signals to perform 34 significant tests for color TV service. Patterns available include: super pulse; color bars; color bars with luminance; color bars less burst; red,

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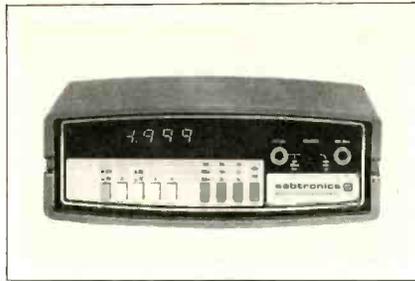
Circle No. 109 on Reader Inquiry Card

blue or green raster; color trio; grey quad; hatch dots and dots—all with progressive or interlaced scanning and 4.5MHz sound carrier. Outputs include video—0-1.7V into 75 ohms, RF and IF from 20 to 200,000 microvolts and 3.7V p-p scope trigger.

Touch-Hold DMM

Circle No. 138 on Reader Inquiry Card

Sabtronics International of Dallas, TX, has introduced a new, low cost bench/portable 3½ digit DMM that features touch-and-hold capability with an optional test probe. This permits retaining the display's reading even when the probe is removed from the circuit. The Model 2010A DMM provides standard ac, dc, and high/low power resistance measurements in 31 ranges. The Model 2010A DMM is designed for current measurements up to 10 amps (ac or dc), with an ac frequency response from 40Hz to 40kHz, with an input overload protection to 1200V, dc or RMS on voltage ranges. Single chip LSI circuitry is the basis of this compact unit. The display is made up of large LED's that read to ±1999 with automatic decimal point. The manufacturer has incorporated a stable band gap reference for long term



accuracy, and states that typical DCV accuracy is 0.1d% ± digit. Other features of the unit are automatic zeroing, fuse protection on ohm and current ranges, automatic polarity, and over range indication. Optional accessories for the Model 2010A include a touch-and-hold probe for measurements in hard to reach places, a high voltage probe, rechargeable nickel cadmium batteries, and an ac adaptor/charger. The price is \$89.50

Portable Oscilloscope

Circle No. 139 on Reader Inquiry Card

A low cost portable 15MHz dual trace oscilloscope, offering several display modes and automatic triggering, has been introduced by Philips. A+B and A-B modes are provided with possible B channel inversion. X-Y display is also



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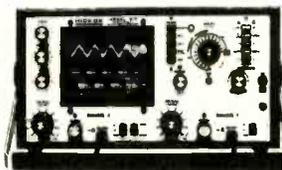
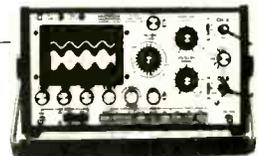
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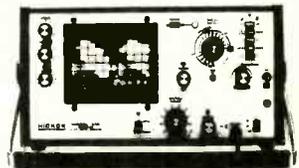


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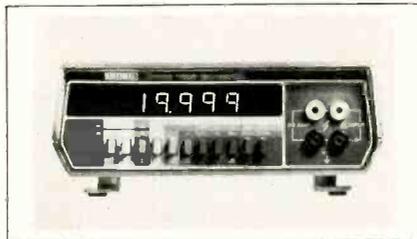
available. Automatic, manual and automatic TV triggering are available from both internal and external sources. Maximum input is 400 volts peak. The price of the PM3207 is \$795. Optional accessories include probes, viewing hoods, a camera and adapter and a current probe.

Digital Multimeter

Circle No. 140 on Reader Inquiry Card

A 4½ digit, full five-function multimeter of moderate cost and excellent accuracy has recently been announced by *Keithley Instruments*. The Model 179-2D/A measure voltage from 10µV to 1200V dc, 10V to 1000V ac (true root mean square) current from 10nA to 20 amps dc and TRMS ac, and resistance

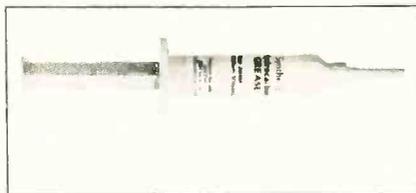
from .1 ohm to 20 megohms with Hi-Low ohms power available. The basic accuracy on dc is .04%. Overload protection extends to 1000V dc, ohms and current ranges are fused. An optional rechargeable battery pack is available. The price is \$349.



Lubrication Kit

Circle No. 141 on Reader Inquiry Card

Projector Recorder Belt Corp. has developed an all inclusive technician's lubricant kit. Each kit contains 3 commonly used greases; tuner grease, silicone grease, and hydrocarbon grease. The

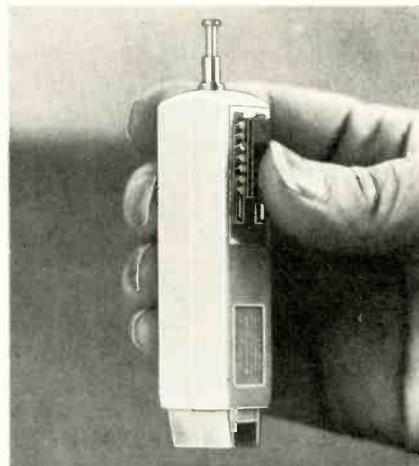


kit also contains light machine oil. Each of these lubricants comes in a precision applicator for dispensing minute quantities in hard to reach places.

IC Pin Straightener-Inserter

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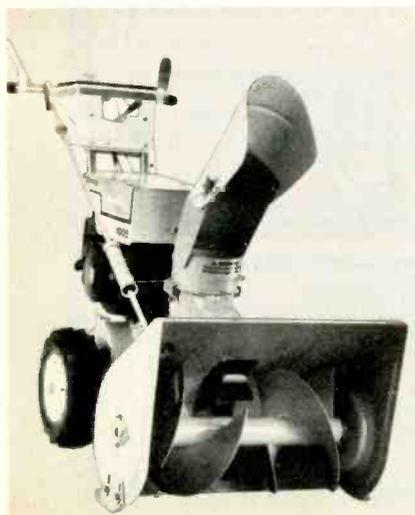
OK Machine and Tool Corp. offers the new Model MOS-1416 IC insertion tool for both 14 and 16 pin in-line IC pack-



ages. It is totally conductive and can easily be attached to a ground strap for static electricity protection. Its price is \$7.95.

REDI-CHECK Awards '79

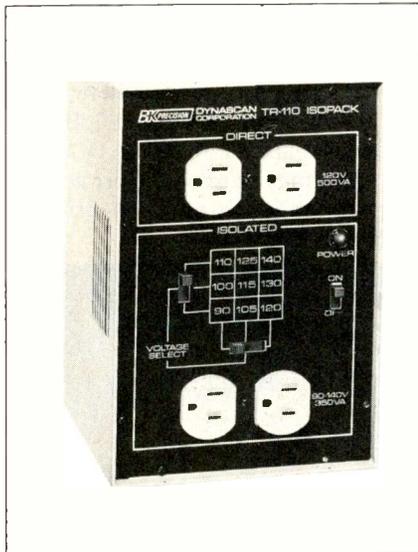
RCA Electron Tube SK Series



Isolation Transformer

Circle No. 143 on Reader Inquiry Card

B&K Precision now offers the TR-110 Isopack isolation transformer to eliminate the hazard of testing transformerless equipment. It offers isolated ac output from 90 to 140V in nine steps with a power rating of 350Va continuous and 500Va intermittent and provides direct outlets rated at 500Va. It includes a pilot lamp and off-on switch for the isolated output. The price is \$75.00.



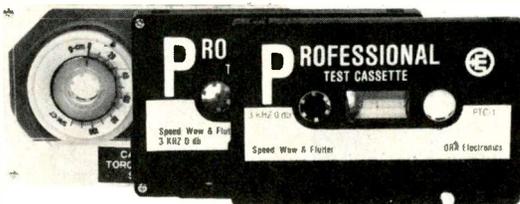
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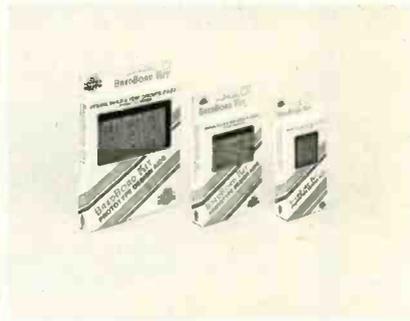
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44 / ET/D - May 1979

BredBord Kits

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Suitable for prototype development, design or for setting up a few TTL circuits to learn something about digital electronics are the H.H. Smith "BredBord" kits. Eight different kit models are available,



assembled on heavy duty glass epoxy board with color coded binding posts, rubber mounting feet, and capacity for multi pin DIP IC's.

RF Load Resistor

Circle No. 145 on Reader Inquiry Card

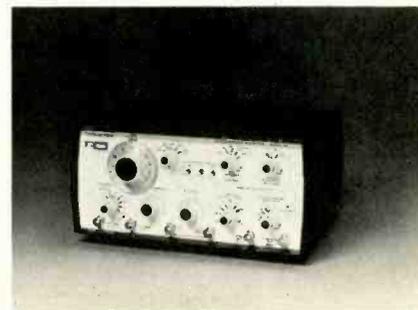
The new Bird Model 8173 Termline dry highpower coaxial load is designed for 50 ohm RF line and system termination during design, test and alignment. At 300w continuous duty it complements

the present Bird dry loads group ranging from 2w through 600w. The group, with air dielectric (no liquid coolants), now include 2, 5 and 10w loads with fixed input connectors, and 25, 50, 100, 150, 300 and 500/600w loads with quick change connectors.

AM/FM/PM/Generator

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Wavtek's Model 148 generator is a source of modulated waveforms, as well as sine, triangle and square waves at frequencies from 200 μ Hz to 20MHz with 30v p-p maximum output. Attenuation is 20dB per step and 20dB continuous for maximum of 80dB. DC offset is ± 15 v. It may be externally or internally triggered and gated. The price is \$945.00. **ETD**



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DEALER'S SHOWCASE



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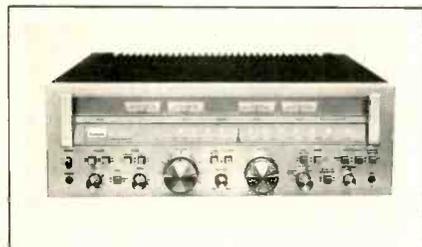
Circle No. 152 on Reader Inquiry Card

Communications Power, Inc., offers the new CP-2500 mobile CB radio system, a trunk mounted AM-SSB transceiver with a dash mounted control unit. The control unit has digital channel readout and a full complement of other controls as well as a signal/power/modulation meter. An 18 foot cable with lock-on cable connectors connects the transceiver and control unit.

High Performance Receiver

Circle No. 153 on Reader Inquiry Card

A new receiver of reduced cost and increased power output has recently been introduced by Sansui. The Pure Power DC G-7500 receiver is stated to have a genuine DC power amplifier section with a frequency response down to 0Hz and an upper limit which has been extended



to 200kHz (+0-3dB). The G-7500 is rated at 90 watts RMS per channel, both channels driven into 8 ohms from 20-20,000Hz with no more than 0.025% total harmonic distortion. The slew rate is 60V/ μ sec and the rise time is 1.4 μ sec. The suggested retail price is \$620.

CB/VHF Marine Antenna

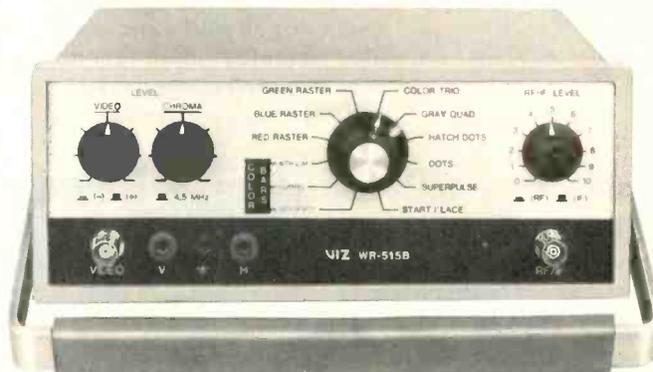
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Antenna Specialists' new ASM-107 is a 17-foot fiberglass whip capable of high performance on VHF (156-163MHz) and CB (all forty channels), according to

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The VoltOhmyst company

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Noise Canceling Microphone

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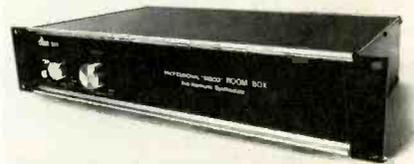


JMR Systems Corporation has produced a new acoustically designed, high fidelity, noise canceling, handheld mobile microphone. Designated the Model 45 Silencer, it is stated to be insensitive to noise originating within a few inches of the microphone, enabling the user to talk through the noise of most noisy environments. It is said to be a result of the firm's experience in developing and manufacturing aerospace-communications equipment.

"Boom Box"

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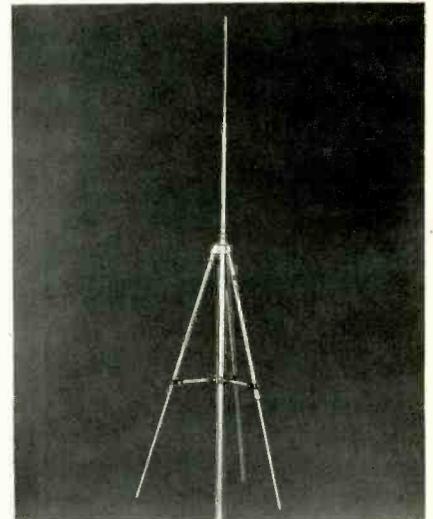


back with the music, is being marketed by dbx Inc. as part of a disco line which includes in addition to the "Boom Box," the 503, three-band dynamic range ex-

pander and the 162, stereo compressor/limiter.

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The Channel Master Econo-Hawk is a half wave CB base antenna that reportedly performs as well as half wave antennas costing much more. It is a 16 foot, partially pre-assembled omni directional antenna finished with a solid EPC coating. Suggested retail price is \$29.95. **ETD**

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MICROPROCESSOR

continued from page 24

service. Simple answer: if you want to understand it, feel comfortable around it, and confidently hang probes onto it, you have to know what goes on inside, if only conceptually (yeah, who cares how the instruction decoder is wired? We know what it does, and where it fits in the system). If transistors, for example, were completely mysterious devices whose function was only dimly suspected, service of a transistorized unit would be a bit awkward, eh? Multiply that by a few thousand for a microcomputerized unit.

Coming attractions

The next installment will treat programming in some detail, including a presentation of the complete instruction set of the 8080 and some basic routines.

Somewhere along the way, we should spend some time with numbers: the differences between BINARY, HEX, OCTAL, DECIMAL, and ASCII (which are all ways of looking at exactly the same thing, depending on what you happen to be looking for). Also, a few notes on binary arithmetic, including logical operations such as AND and OR, might be useful.

Then, we'll be in a position to look at a real-life application, probably picking a system produced by Cybertronics (me) and tearing it apart to see how, and why, it works.

Then: some notes on service - finding problems when everything is connected to the same buses, using diagnostics, types of test equipment, etc. How fixing micros is similar to, and different from, traditional kinds of debugging.

By then, we will probably have some genuine consumer microprocessor service problems to look at, as well as ongoing refinement of our conceptual basis, introduction of different CPU chips, detailed looks at hardware, and more in using your own computer.

If you didn't just skip to this paragraph

CORRECTION

Figure 4 of *Microprocessor Hardware*, page 18, January 1979 *ET/D*, contains a potentially misleading typographical error. The I/O READ line which extends from the control bus and turns upward to enable the tri-state buffer on Port 2 should not also go to the 8 bit latch of Port 4. The correct control line for the latching command of the output port is I/O WRITE.

from the title to catch the punchline, you'll be pleased to know that the worst is about over. You should now possess an "internal model" of a microprocessor system, with enough of a feel for its activities that new information should fit right in, enhancing the model *Relaxen und watch das blinkenlights!* **ET/D**

PROJECTION TELEVISION

continued from page 21

conditions involves a double differentiation peaking, circuit (Fig. 12). Luminance signal is applied to the base of Q2C3 and a differentiated signal to Q2C2. Q2C4 is a constant current source. A composite signal is present at the output. A feedback circuit adjusts the amount of differential signal fed to Q2C2 for automatic correction.

Since this is a three tube system, three yokes are also used. The vertical yoke coils are in series; the horizontal yoke coils are in parallel with individual horizontal amplitude and linearity controls available (similar to Advent Fig. 8). For keystone correction, fairly complex circuitry drives secondary deflection yokes (see Fig. 7) with compensating signals. Six, green horizontal, green vertical, red horizontal, red vertical, blue horizontal, blue vertical, output stages and drivers supply compensating waveforms to these yoke coils.

Magnetic focus is used with the Mitsubishi projection tubes. Each of the three tubes has an individual regulator system to maintain a constant current (in the 200-300ma range) to the focus coil.

Because of the high voltage, 25KV, and the large beam current, a vertical deflection failure, resulting in a horizontal line across the screen, would soon burn the phosphor and destroy the tube. To prevent this, a protection circuit can turn off the CRTs via the video amplifier circuit.

The Mitsubishi VS-700U is a complex television receiver. The touch channel selection and remote control contain about 35 transistors and three integrated circuits. The tuner and the stages up to and including the video detector, use four ICs and eight transistors. The sweep, video, chroma and audio use nearly 150 transistors and several ICs on about a dozen circuit boards.

More to come

In a future issue, we will examine the projection TV offerings of Sony, GE, Panasonic and Quasar. **ET/D**

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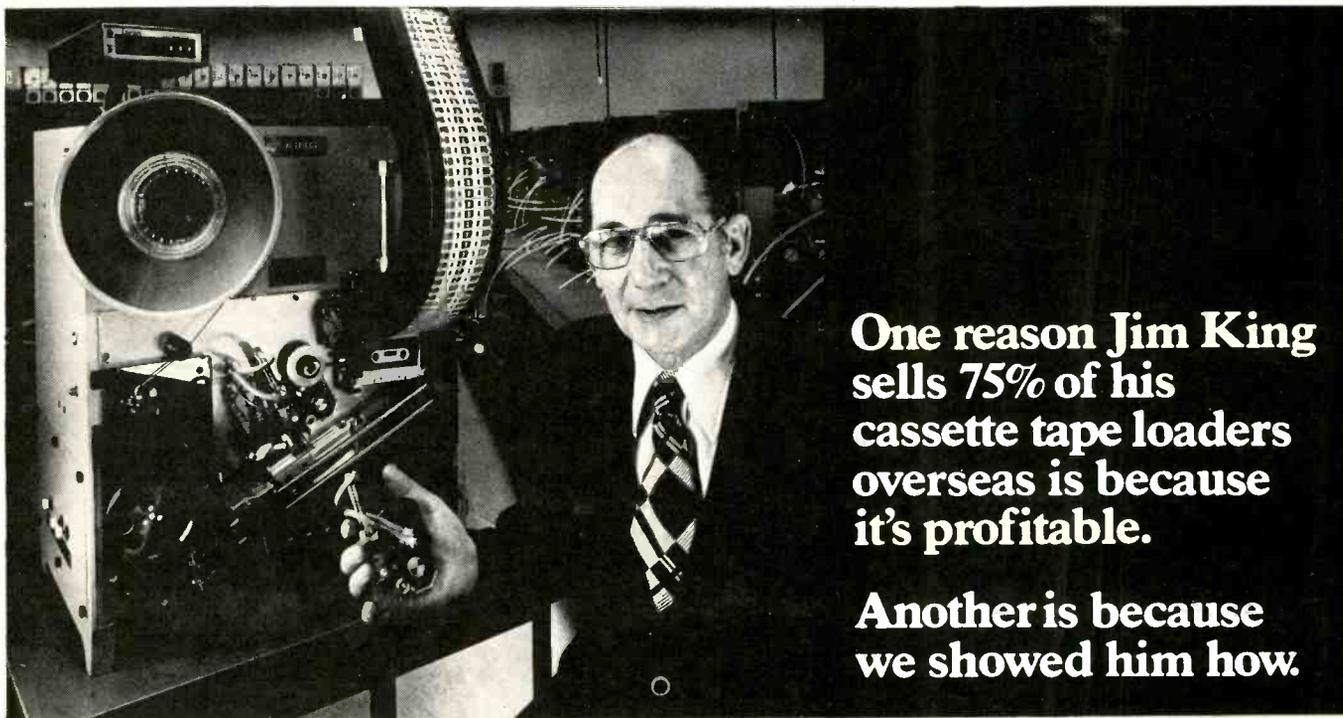
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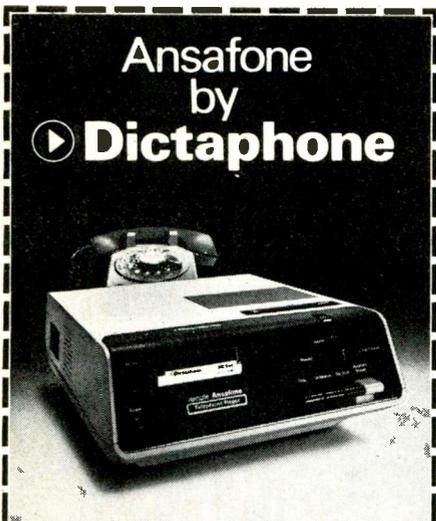
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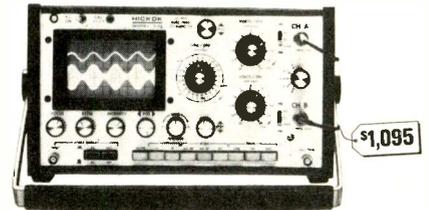
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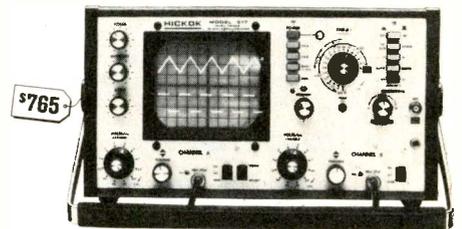
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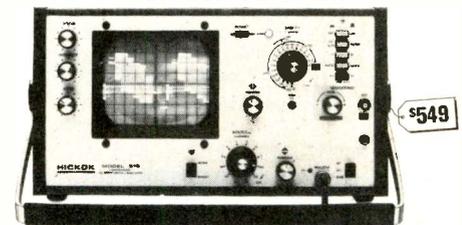
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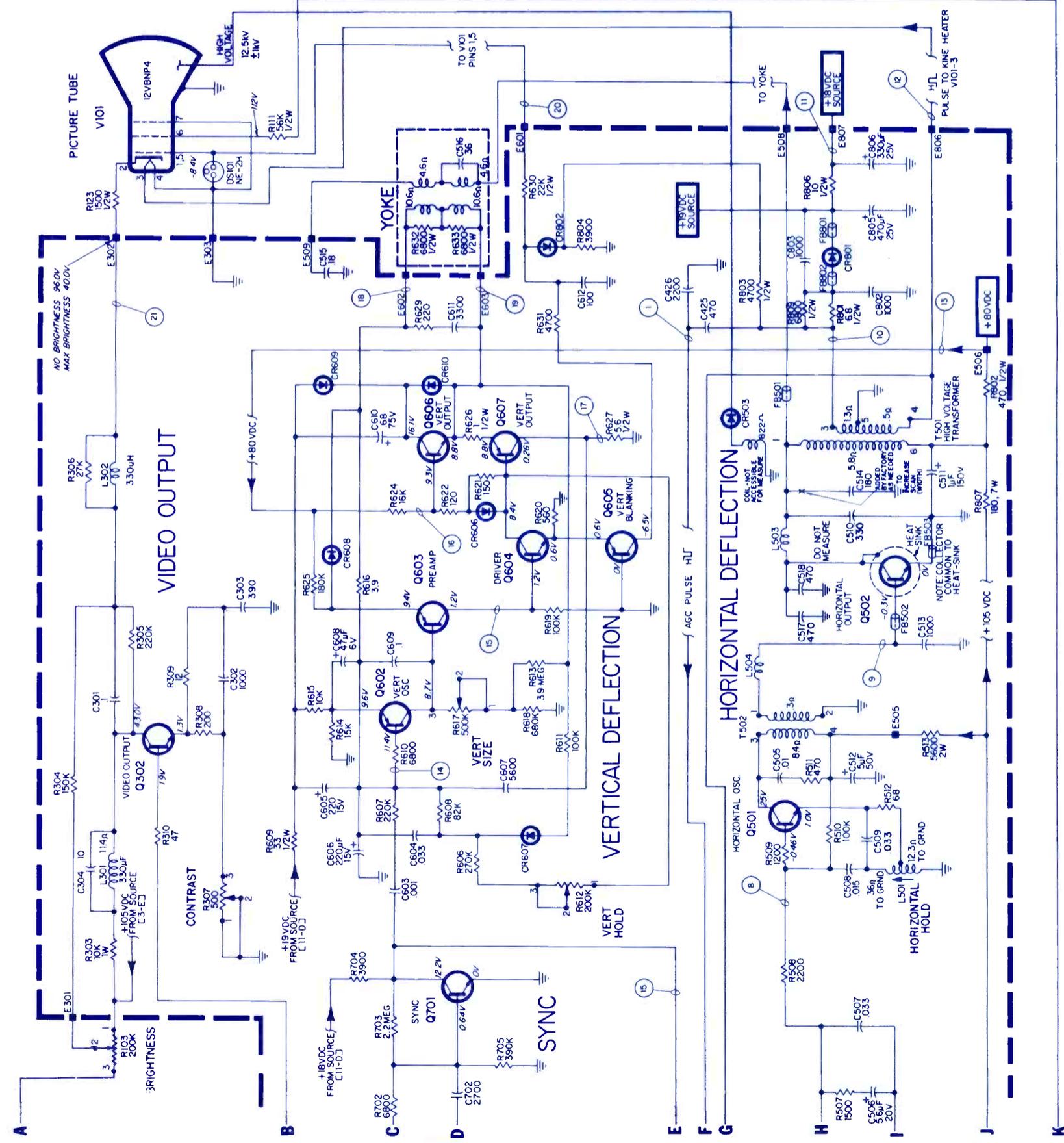
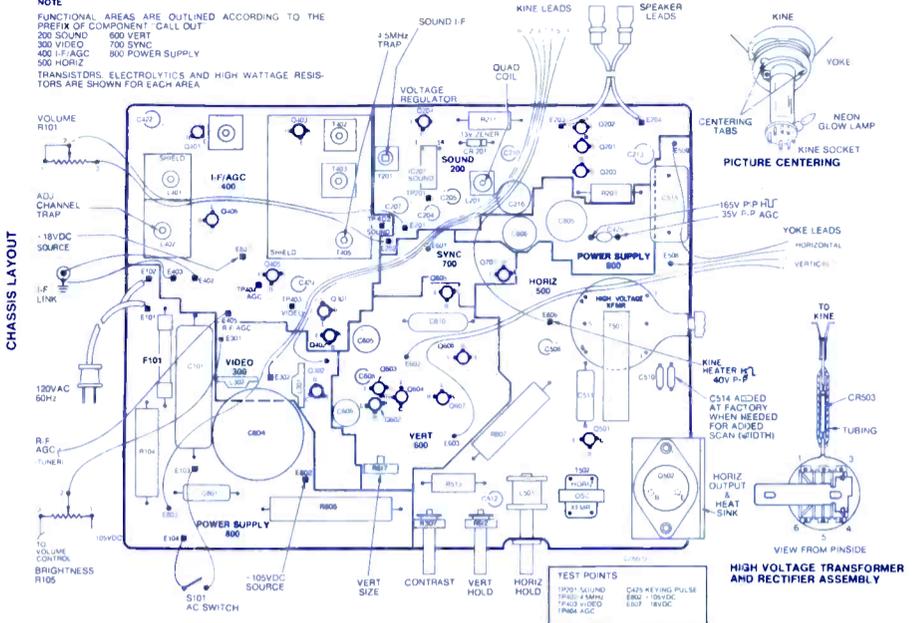
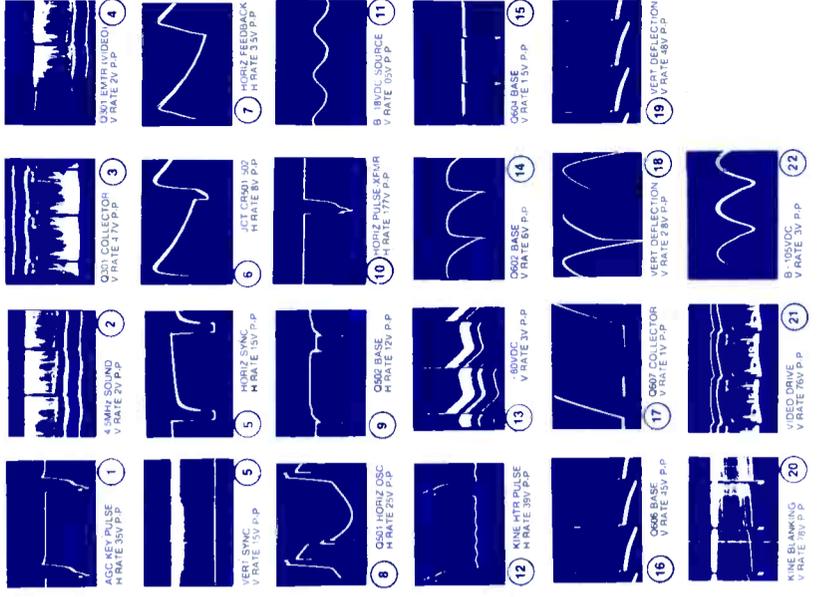
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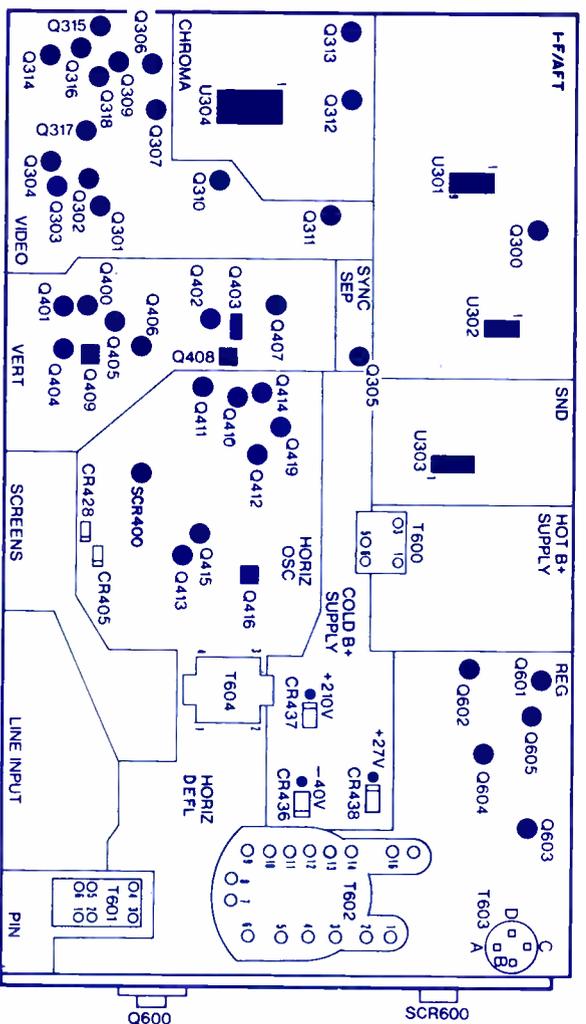
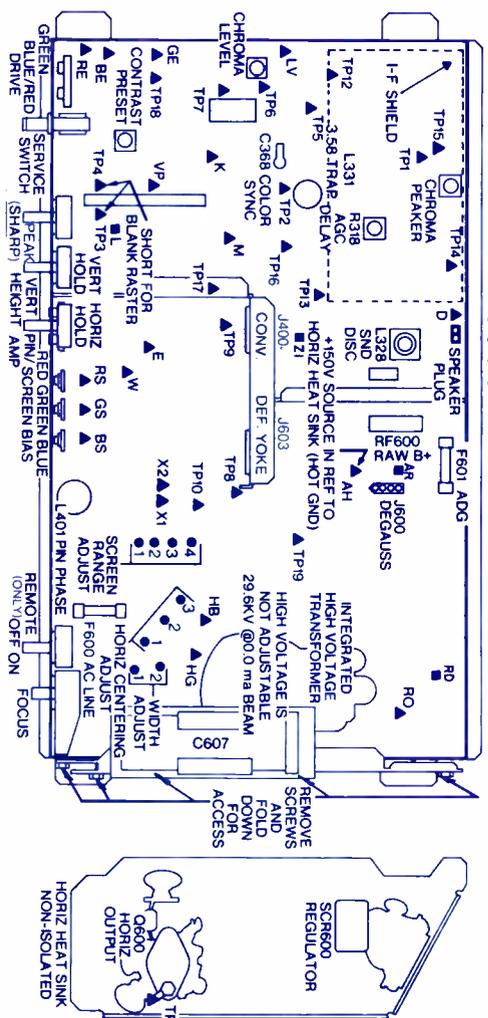
INSTRUMENTATION & CONTROLS DIVISION
THE HICKOK ELECTRICAL INSTRUMENT CO.
10514 Dupont Avenue • Cleveland, Ohio 44108
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Circle No. 116 on Reader Inquiry Card

**RCA
B&W TV Chassis
KCS 204**

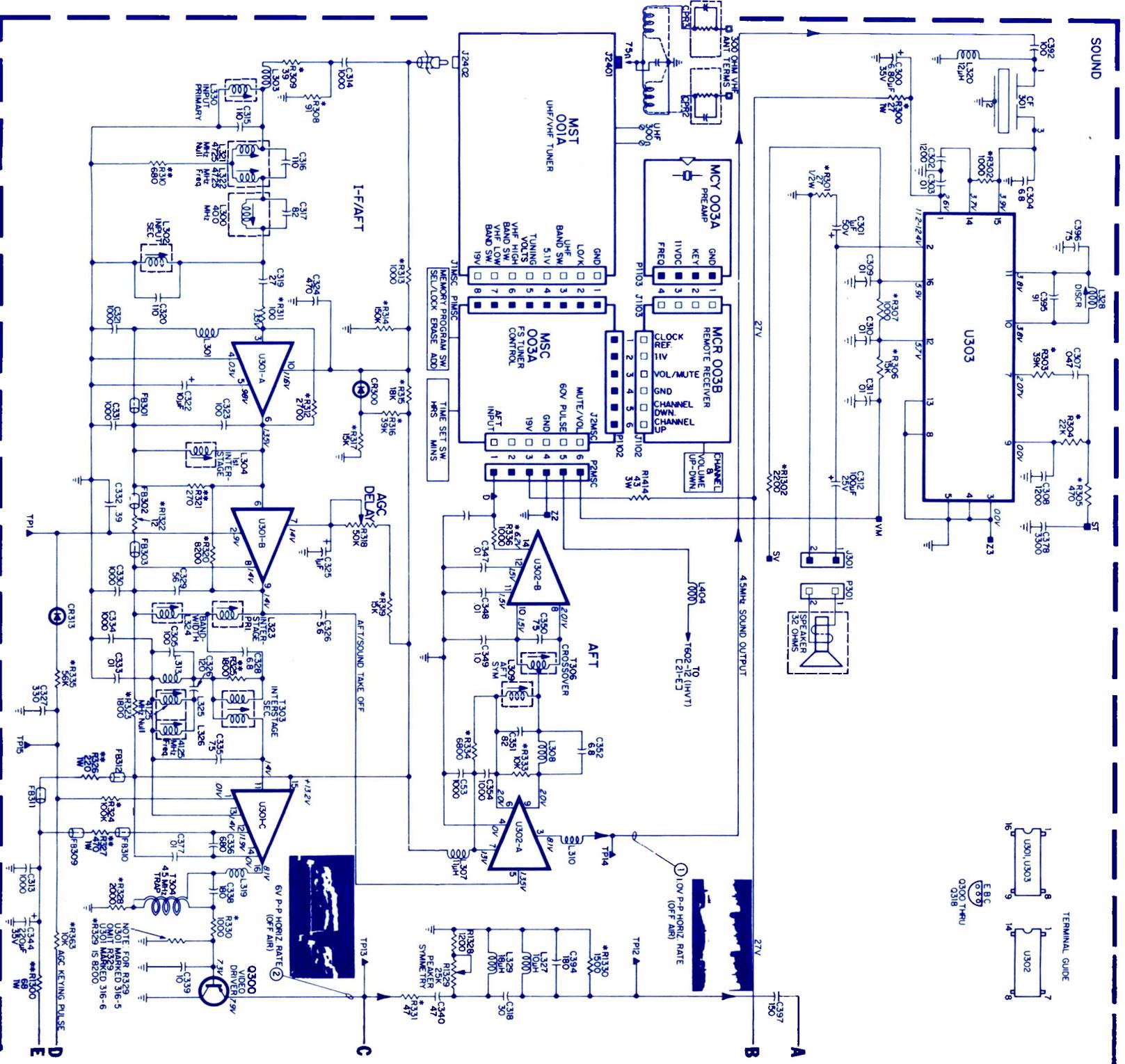


— CHASSIS LAYOUT —
PICTURE TUBE 19WHP22

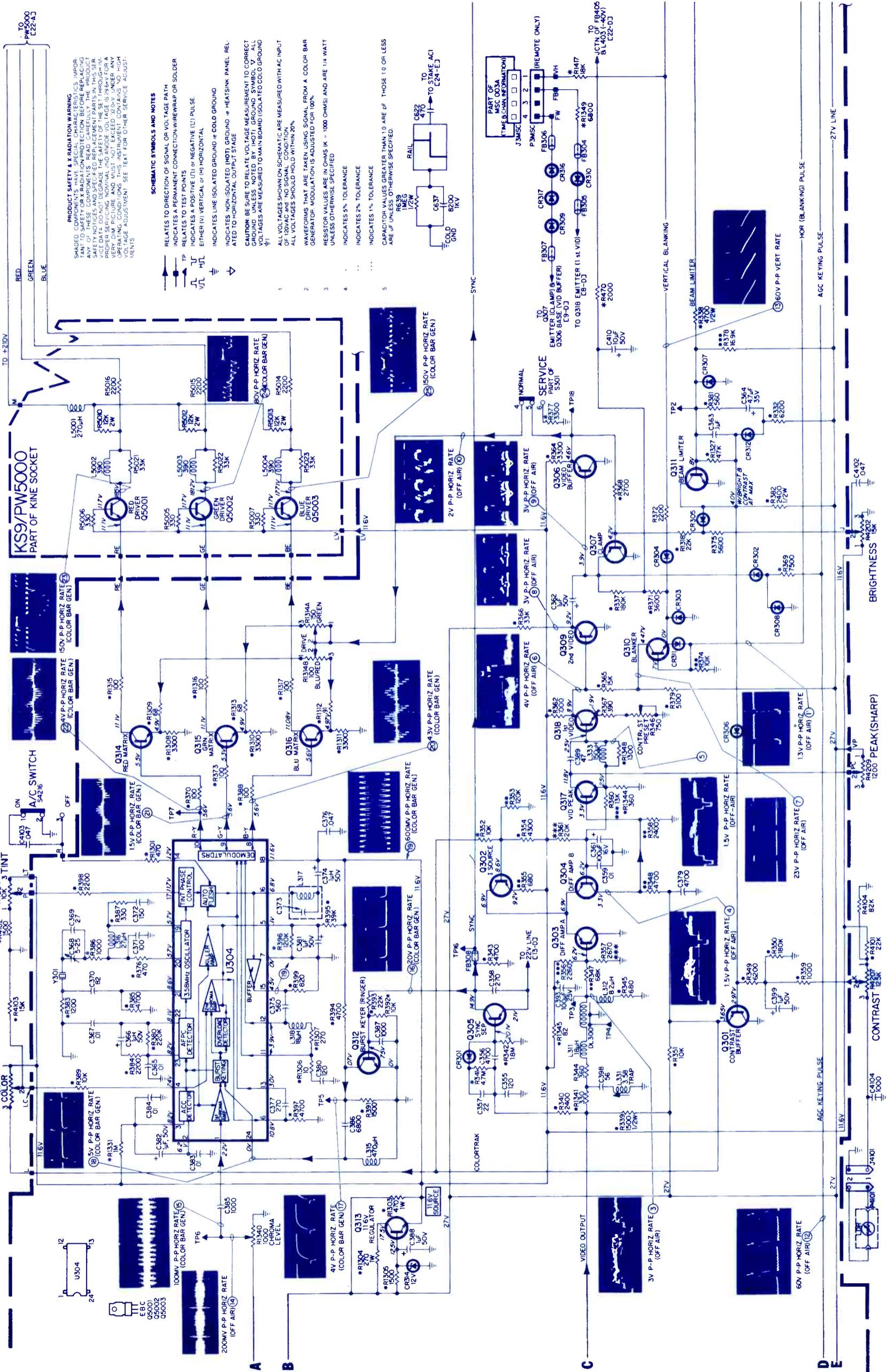


FREQUENCY
SYNTHESIS
TUNER
VOLTAGE
CHART

CHANNEL	TUNING VOLTAGE (TYPICAL)	PRESCALER FREQ (MHZ)
V	2	1.58
U	3	1.67
H	3.3	1.87
F	4	2.07
L	5.4	2.27
O	6.5	2.48
W	7.6	2.68
6	8.7	2.88
5	9.8	3.08
4	10.9	3.28
3	12.0	3.48
2	13.1	3.68
1	14.2	3.88
0	15.3	4.08
9	16.4	4.28
8	17.5	4.48
7	18.6	4.68
6	19.7	4.88
5	20.8	5.08
4	21.9	5.28
3	23.0	5.48
2	24.1	5.68
1	25.2	5.88
0	26.3	6.08
9	27.4	6.28
8	28.5	6.48
7	29.6	6.68
6	30.7	6.88
5	31.8	7.08
4	32.9	7.28
3	34.0	7.48
2	35.1	7.68
1	36.2	7.88
0	37.3	8.08
9	38.4	8.28
8	39.5	8.48
7	40.6	8.68
6	41.7	8.88
5	42.8	9.08
4	43.9	9.28
3	45.0	9.48
2	46.1	9.68
1	47.2	9.88
0	48.3	10.08
9	49.4	10.28
8	50.5	10.48
7	51.6	10.68
6	52.7	10.88
5	53.8	11.08
4	54.9	11.28
3	56.0	11.48
2	57.1	11.68
1	58.2	11.88
0	59.3	12.08
9	60.4	12.28
8	61.5	12.48
7	62.6	12.68
6	63.7	12.88
5	64.8	13.08
4	65.9	13.28
3	67.0	13.48
2	68.1	13.68
1	69.2	13.88
0	70.3	14.08
9	71.4	14.28
8	72.5	14.48
7	73.6	14.68
6	74.7	14.88
5	75.8	15.08
4	76.9	15.28
3	78.0	15.48
2	79.1	15.68
1	80.2	15.88
0	81.3	16.08



ADDITIONAL INFORMATION NEXT PAGE



PRODUCT SAFETY & X-RADIATION WARNING: SHADDED COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY OR X-RADIATION PROTECTION. BEFORE REPLACING THESE COMPONENTS, CONSULT THE SERVICE MANUAL FOR SAFETY INFORMATION. THESE AND SPECIFIC REPLACEMENT PARTS IN THIS SERVICE DATA DO NOT DEGRADE THE SAFETY OF THE SET THROUGHOUT PROPER SERVICE. NOMINAL AND MODE VOLTAGE IS 286KV FOR A PROPER OPERATING CONDITION. THIS INSTRUMENT CONTAINS NO HIGH VOLTAGE ADJUSTMENT. SEE TEXT FOR OTHER SERVICE ADJUSTMENTS.

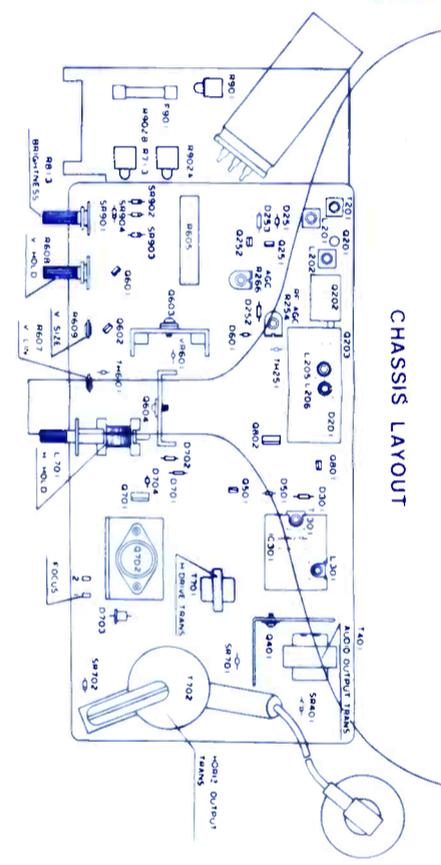
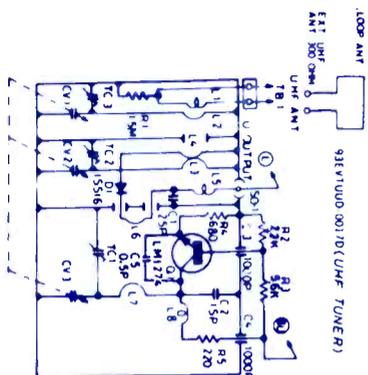
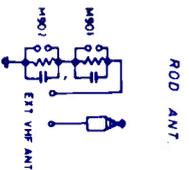
SCHEMATIC SYMBOLS AND NOTES:

- RELATES TO DIRECTION OF SIGNAL OR VOLTAGE PATH
- INDICATES A PERMANENT CONNECTION WIREWRAP OR SOLDER
- INDICATES A POSITIVE (+) OR NEGATIVE (-) PULSE
- EITHER (V) VERTICAL, OR (H) HORIZONTAL
- INDICATES NON-ISOLATED GROUND (COLD GROUND)
- INDICATES ISOLATED GROUND (HOT) GROUND (HEATSINK PANEL RELATED TO HORIZONTAL OUTPUT STAGE)
- CAUTION: BE SURE TO RELATE VOLTAGE MEASUREMENT TO CORRECT GROUND, UNLESS NOTED BY (HOT) GROUND SYMBOL (V). ALL VOLTAGES ARE MEASURED TO MAIN BOARD ISOLATED COLD GROUND (F).
- ALL VOLTAGES SHOWN ON SCHEMATIC ARE MEASURED WITH AC INPUT OF 120VAC AND NO SIGNAL CONDITION.
- ALL VOLTAGES SHOULD HOLD WITHIN 20%.
- WAVEFORMS THAT ARE TAKEN USING SIGNAL FROM A COLOR BAR GENERATOR. MODULATION IS ADJUSTED FOR 100%.
- RESISTOR VALUES ARE IN OHMS (K = 1000 OHMS) AND ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
- INDICATES 5% TOLERANCE
- INDICATES 1% TOLERANCE
- CAPACITOR VALUES GREATER THAN 1.0 ARE OF THOSE 1.0 OR LESS ARE OF UNLESS OTHERWISE SPECIFIED.



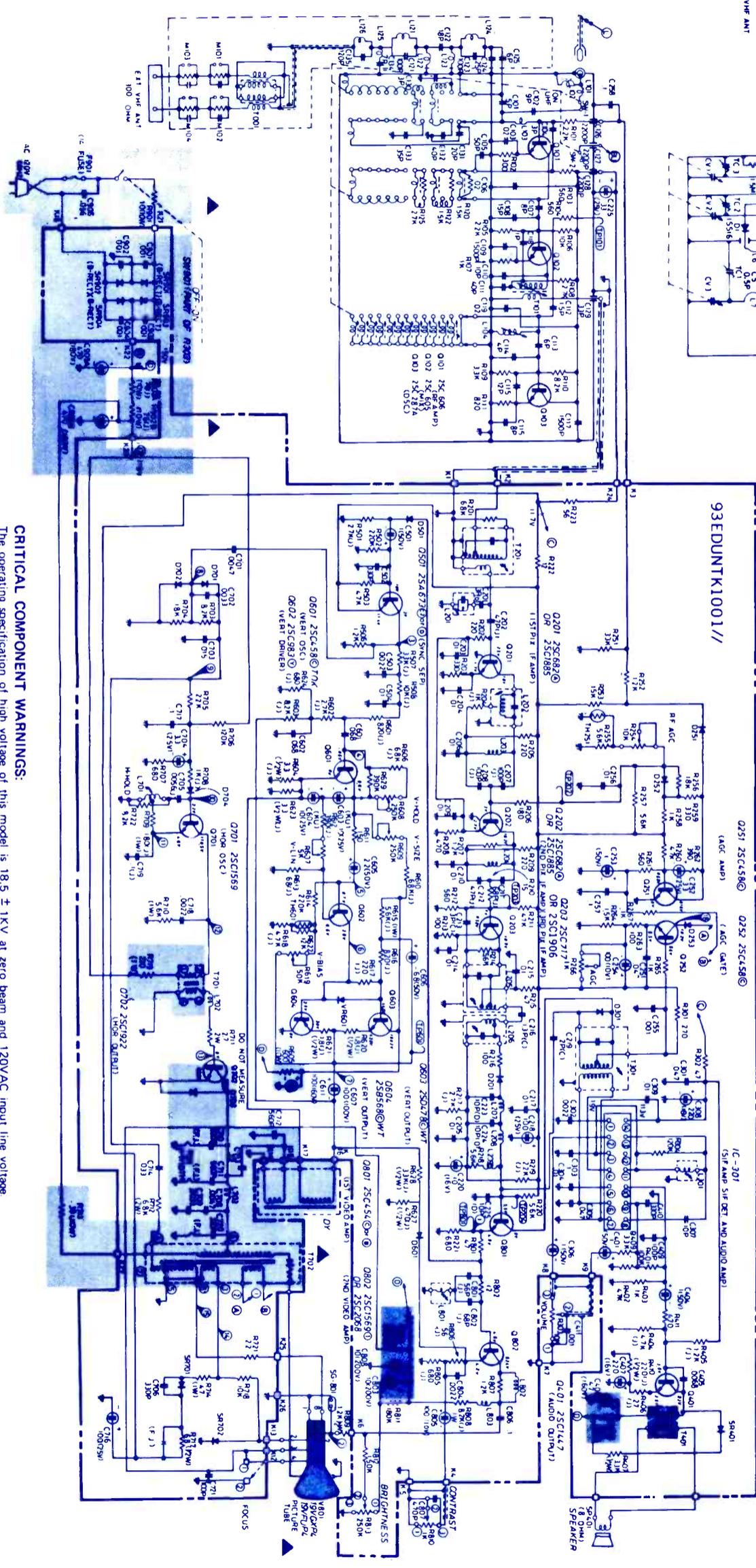
ET/D TEKTRAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS



IMPORTANT SAFETY NOTICE: COMPONENTS HAVE SPECIAL SHADED AND MARKED ▲ CHARACTERISTICS IMPORTANT TO SAFETY. FOR CONTINUED PROTECTION, REPLACEMENT PARTS MUST BE IDENTICAL TO THOSE USED IN THE ORIGINAL CIRCUIT. SEE THIS PART LIST FOR SPECIFIED REPLACEMENT PARTS.

SHADED COMPONENTS: SAFETY RELATED PARTS MARKED ▲ COMPONENTS: X-RAY RELATED PARTS

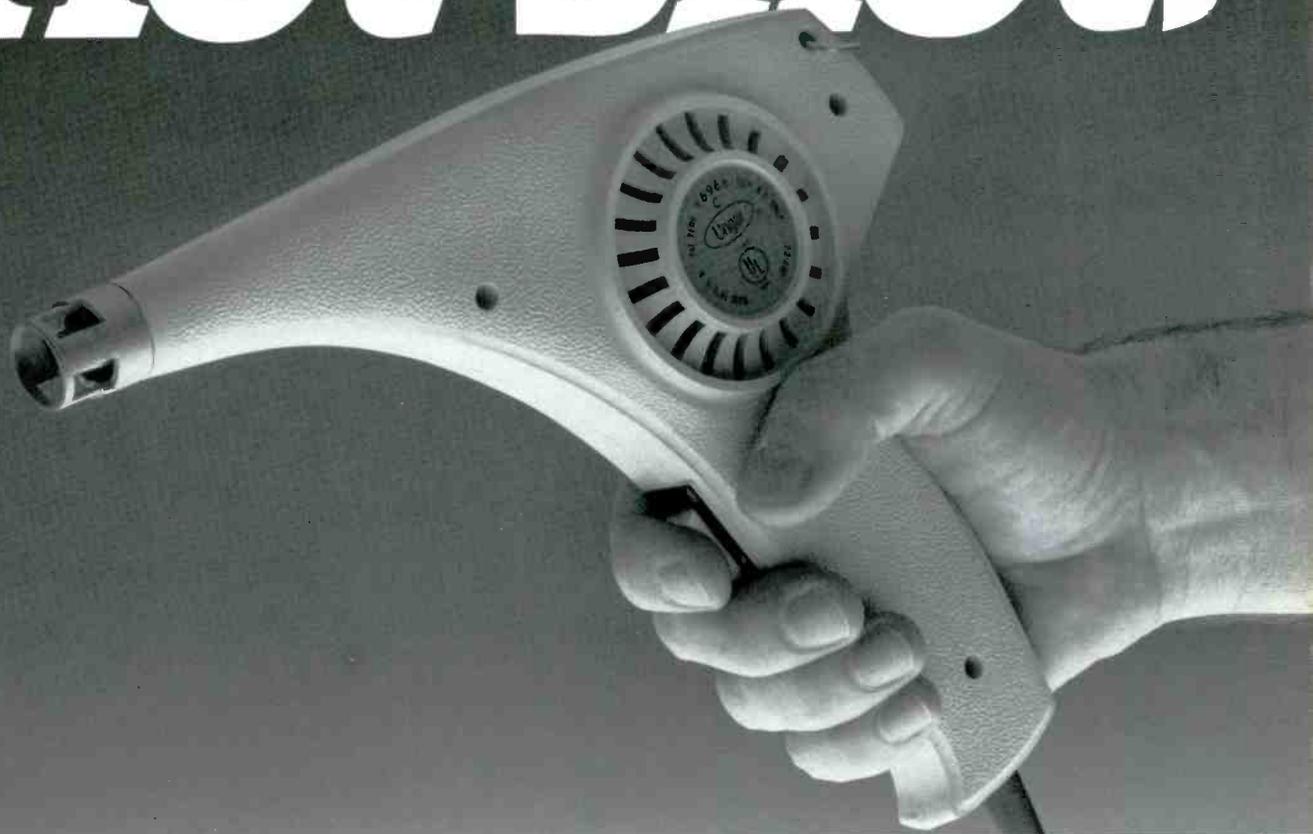


LINE CORD IS POLARIZED
SMALLER PIN IS CONNECTED
TO HOT SIDE OF AC LINE

CRITICAL COMPONENT WARNINGS:
The operating specification of high voltage of this model is 185 ± 1KV at zero beam and 120VAC input line voltage. Serviceman should adjust the high voltage to the specified value as follows:
(1) Determine H-Width by adjusting the Factory Jumpers near C710, C711 and C720 to make sure the power supply voltage at K23 110V ± 6V at 120VAC input voltage.
(2) Adjust Horizontal Drive Oscillation L701 to get a usable picture.
(3) Examine all the critical components to see whether there are the same type as those in the schematic diagram and parts list.
CAUTION: This circuit diagram is original one. Therefore there may be a slight difference from your set.
Do not remove back of television. No user serviceable parts inside.
Refer servicing to qualified service personnel.



Hot Shot.



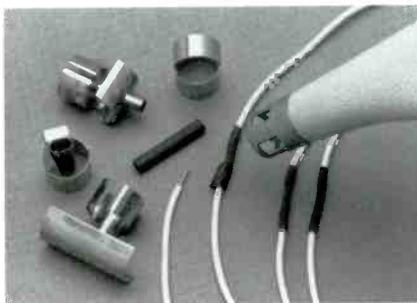
Our heat gun is light, tough and very easy to control. You get easier handling with precise hot air direction and built-in durability.

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 resis-



tant 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.

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The Heat Gun. For Precise Control Of Hot Air.

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THE

performers.

Triplett FET-VOMs have a super- sensitive delivery.



In your hand, or on the bench, these Triplett FET-VOMs have the sensitivity you'll need for a safe transistor or IC testing.

MODEL 310 FET-VOM only \$101.
Model 310 FET is little, light, loaded with features like:

1. Hand-size FET V-O-M with 10 megohm input resistance and diode overload-protected suspension movement.
2. 300 mVDC; low voltage range, X 1 megohm range.
3. Single range switch; DC polarity-reversing switch

MODEL 603 FET-VOM only \$204.
The portable Model 603 FET VOM with swive carrying handle has such features as:

1. Exclusive Triplett MICRO POWER-TMP™ provides battery life in excess of a year for carbon batteries with unit left ON continuously.
2. LOW POWER OHMS-LPΩ™—6 ranges with 70 mV power source for in-circuit measurements without component damage.
3. FET V-O-M WITH AUTO-POLARITY—convenient and time saving, always reads up scale.

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

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



Triplett performance... a tough act to follow

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

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