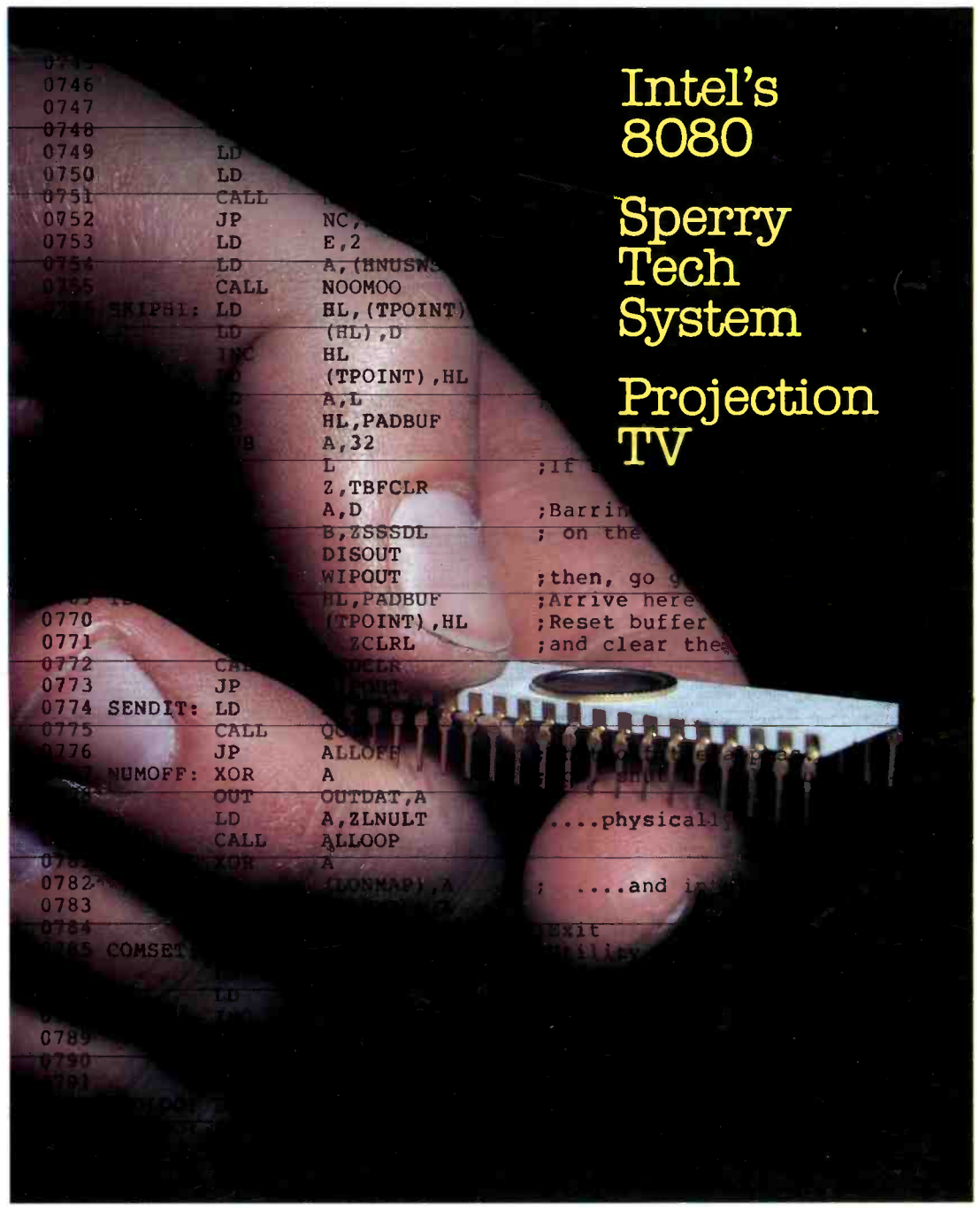
ET/D

MAY 1979 • $1.00

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS



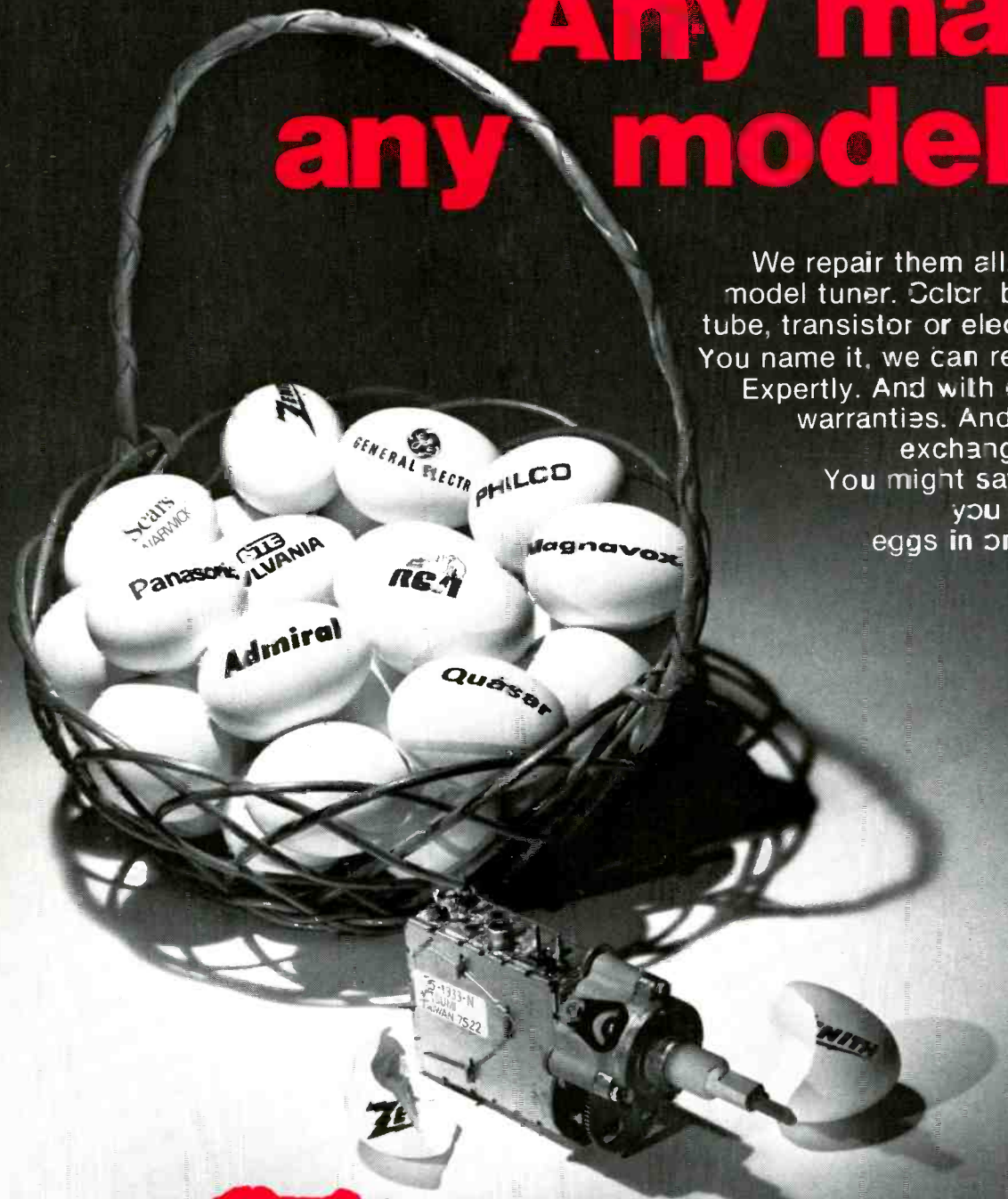
Intel's 8080

Sperry Tech System

Projection TV

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION

No yoke! Any make, any model.



We repair them all. Any make, any model tuner. Color, black and white, tube, transistor or electronic/varactor. You name it, we can repair it. Quickly. Expertly. And with one-year limited warranties. And we rebuild and exchange modules too! You might say that with PTS, you **can** put all your eggs in one basket. Ours.

PTS®

PTS ELECTRONICS, INC.

THE ONLY NAME YOU NEED TO KNOW

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

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 successful 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 NARD'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**

ET/D

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS

MAY 1979, VOL. 101, NO. 5

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.

FEATURES

DEPARTMENTS

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION ABP ABC EIA

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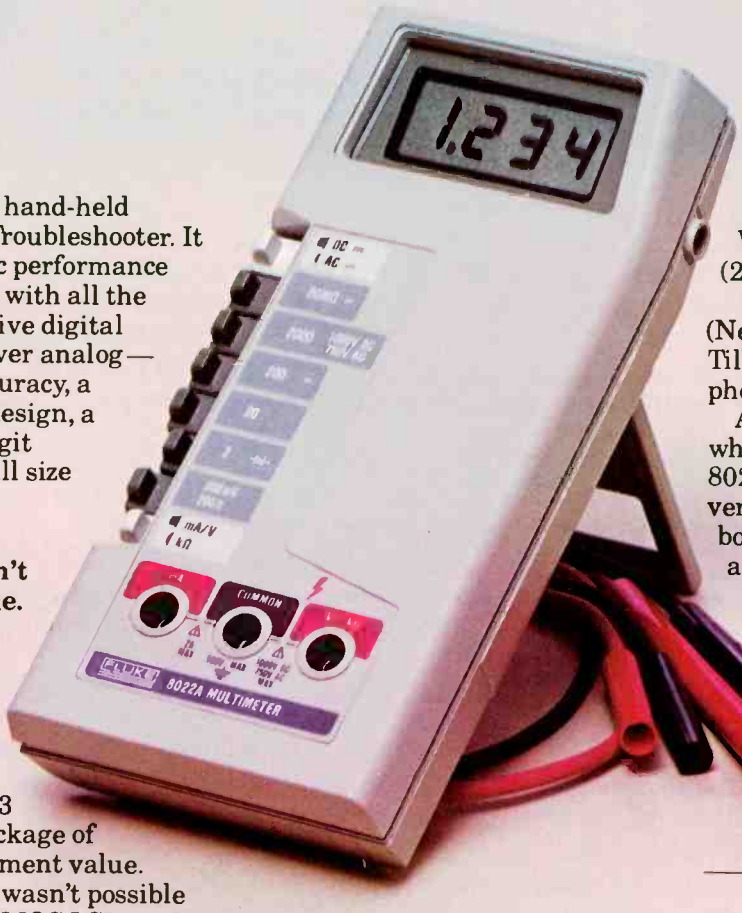
Introducing the Troubleshooter.

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 humidity, 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 residents 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. Both instruments are available at your distributor from stock. For immediate response, fill out the attached coupon.

*U.S. Price Only

FLUKE®

John Fluke Mfg. Co., Inc.
P.O. Box 43210
Mountlake Terrace, WA 98043

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

Name

Title Mail Stop

Company

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."

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,

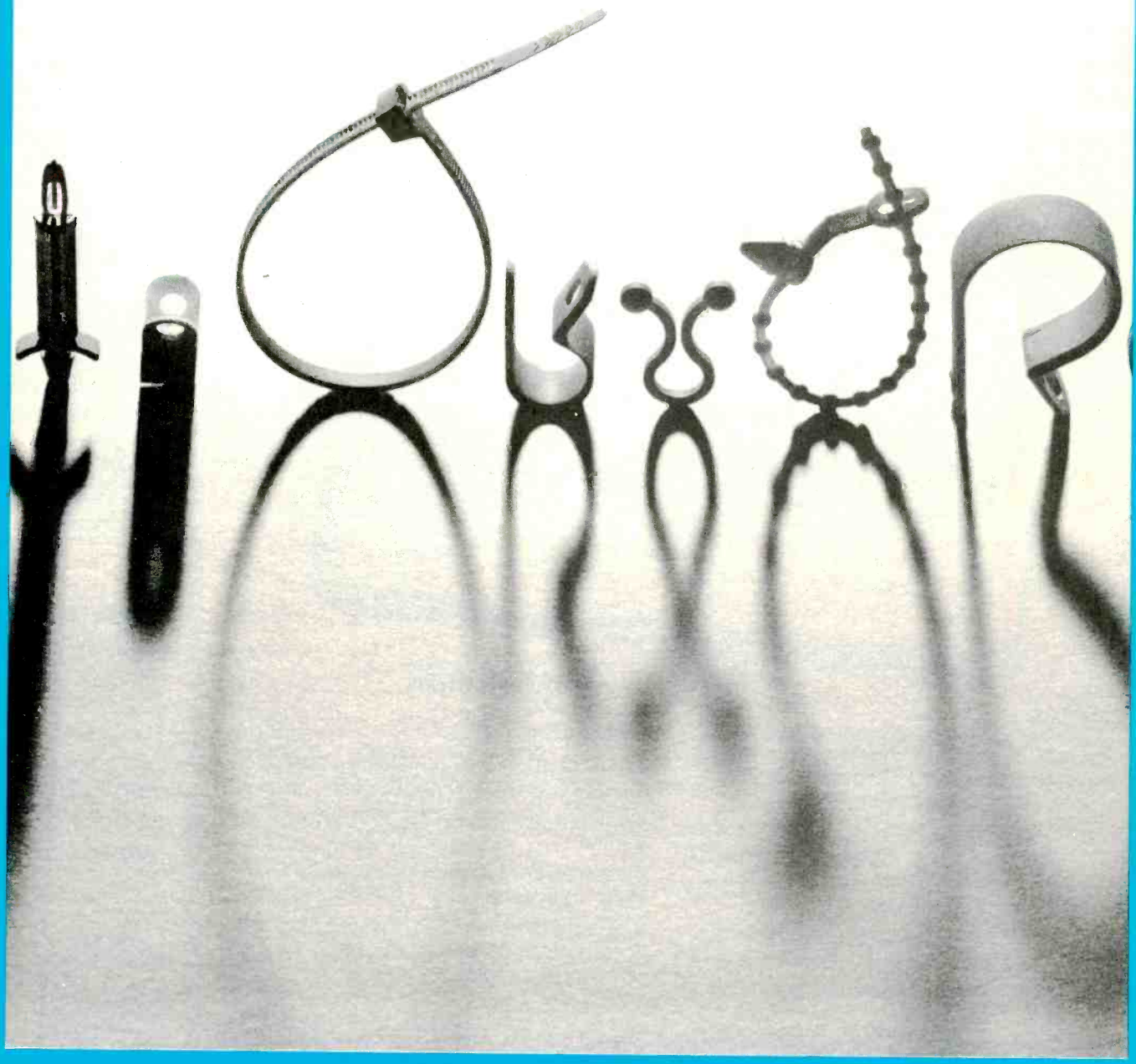
Richard M. Lay

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.

See your Mallory representative. Or contact Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., Box 1284, Indianapolis, Indiana 46206. (317) 856-3731.



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.

MODEL 452 $795

- For design, development and service of digital circuitry, communications, audio, TV equipment . . . in lab, shop or field.
- Differential vertical amplifier stages provide wide DC to 15 MHz bandwidth with smooth rolloff useable thru 27 MHz.
- Reliable integrated circuitry, all-solid-state (except CRT)
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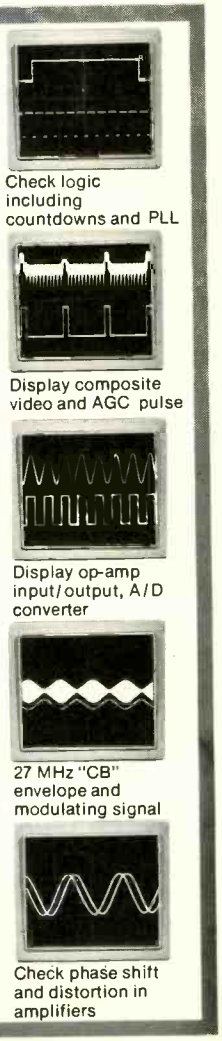
- 24 nanosecond rise time
- Front-panel X-Y operation, dual matched vertical amplifiers.
- Displays CH A, B, A&B, A + B, A-B
- 0.5V peak-to-peak 1kHz square wave calibrator
- Voltage-calibrated vertical and horizontal inputs (eleven steps in 1-2-5 sequence)
- X5 magnification
- Human-engineered front panel controls



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

Simpson
INSTRUMENTS THAT STAY ACCURATE

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KATY INDUSTRIES
INDUSTRIAL EQUIPMENT GROUP

Circle No. 123 on Reader Inquiry Card

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

SYLVANIA PUTS EMERSON AND ADMIRAL BACK IN BUSINESS.

In the 55 years Sylvania has been making receiving tubes a lot of companies have gone out of business. But thanks to Sylvania their products haven't gone out of service. Because Sylvania makes receiving tubes to replace those of every make of radio and television. Even those whose manufacturers haven't been seen in years.

When it comes to replacement parts the right place to come is Sylvania. Your Sylvania distributor carries a complete line of receiving tubes, picture tubes, test equipment and ECG® semiconductors designed to make any brand work like it's brand new.

Sylvania. The easy way to get even the hardest part.

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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

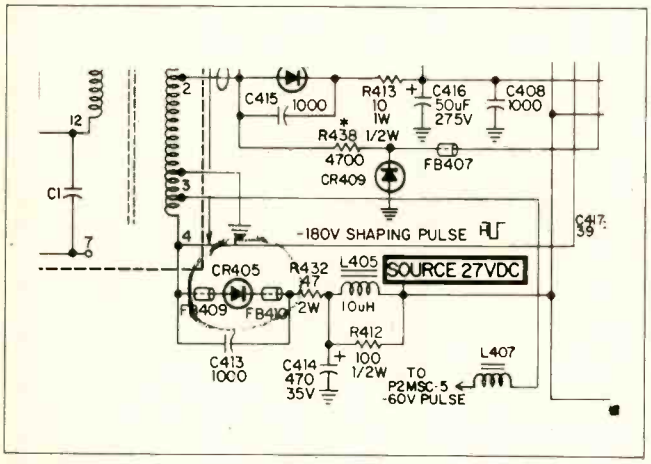
I need help with an amplifier, Voice of America, Model 1544. The transistors in the right side output are shorted. The numbers on them do not match any in the parts books. A schematic and any other information or a source of either is needed.
Albert J. Barnes
199 Western Ave.
Cambridge, MA 02139

BACK ISSUES!
I have my magazines stacked up in the storage closet. Anyone need any back issues?
Ted Wojciehowski
507 Oak St.
Huntley, WI 54534 ET/D

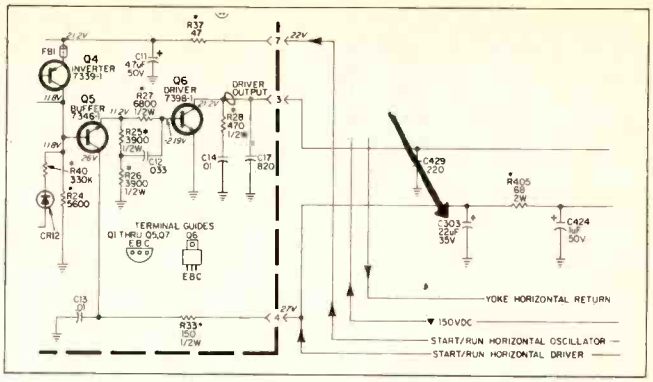
SERVICE SEMINAR

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.

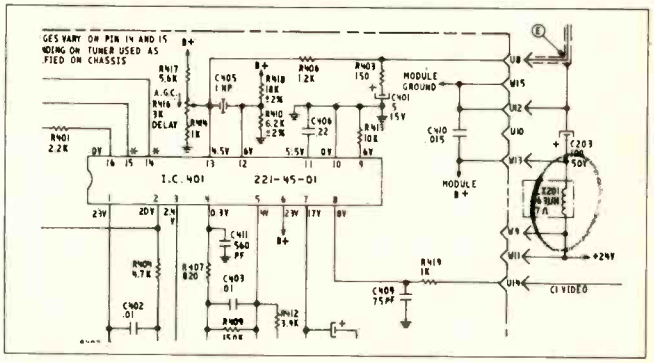


Color TV Chassis CTC-85, 86, 89, 90, 91, 92—Repetitive failure of MDH001 module (horizontal oscillator). Replacement module lasts from a few minutes to a few days. Q5 or Q6 usually becomes defective. Probable cause—open C303 or broken ground lead to C303.



ZENITH

Raster only when brightness is advanced—no video or sound. Possible cause: Open LX201, terminals W9 to W13 of socket for sync AGC module. ET/D



STRICTLY BUSINESS

The name of the game in service is getting each technician to work as productively as is humanly possible. For our purposes, working productively means having the technician spend the great majority of his available time repairing the equipment and creating income.

Continuing awareness of productivity extends into every facet of service operations—including routing and dispatching. Here are a few thoughts on scheduling calls.

- 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 Dooley

Mgr., NARDA's Service Division

Six ways to be as smart and make as much money servicing Zenith products as any technician in town!

If you are really serious about being the best Zenith service technician in town, sign up now for Zenith's 1979/80 Service Literature Subscription Program.

For a full year beginning June 1, you will receive the latest information on how to service Zenith products.

And we will keep on sending you fresh information thru May 31, 1980 as new Zenith products are introduced...and new techniques for servicing Zenith products are developed.

1 

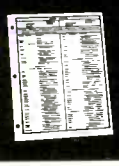
First of all, you will receive individual service manuals with step-by-step instructions, diagrams, charts, exploded views and photographs covering everything you need to know to service Zenith's newest product lines.

2 

Periodically thru the year, you will receive up-dated information, tips on servicing short cuts, and other important data as they develop.

3 

New product announcements will be sent to you, too...plus news of any new components kits and accessory items that could help improve your efficiency and your profit picture.

4 

Chassis parts lists will be simplified and your inventory requirements reduced, because we will group into a much smaller list of chassis families all parts that are identical in one or more chassis.

5 

The same for parts lists covering all cabinet models. They will be organized for you by model family to reduce the size of your cabinet parts lists as much as 90%...and greatly simplify your stocking procedures.

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6 

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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 diagnonal 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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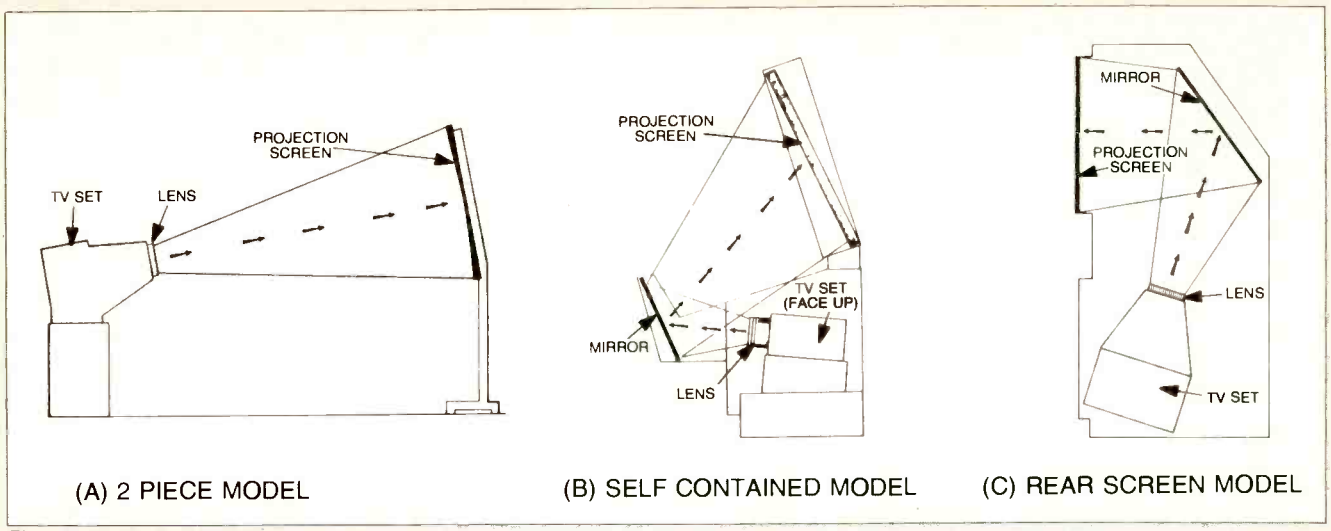


Fig. 1—Projection TV's three basic designs.

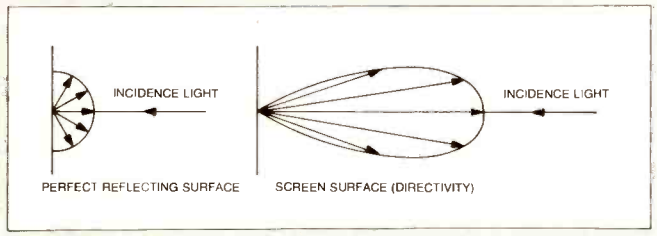


Fig. 2—Projection screen gain.

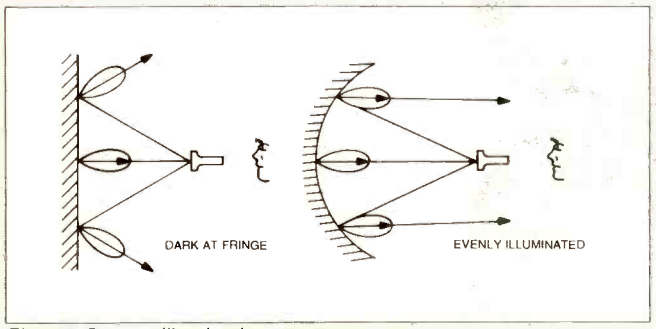


Fig. 3—Screen illumination.

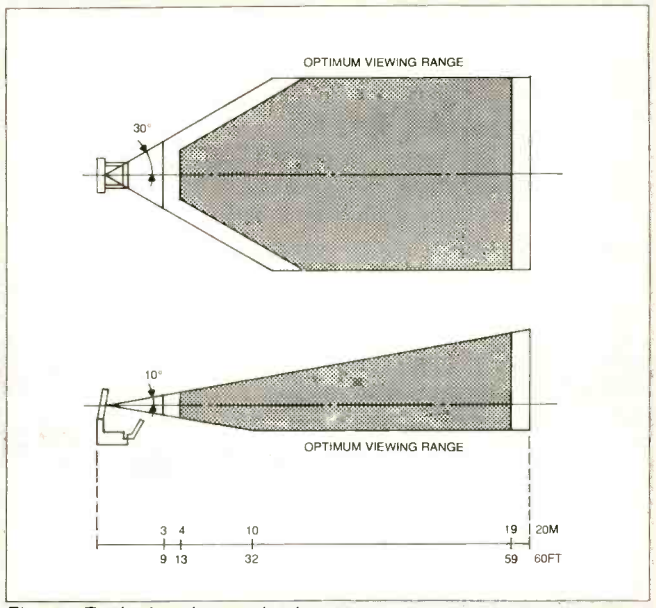


Fig. 5—Typical optimum viewing area.

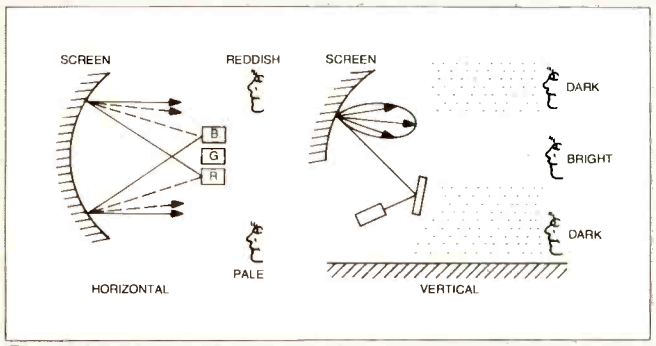


Fig. 4—Effects of screen viewing angle.

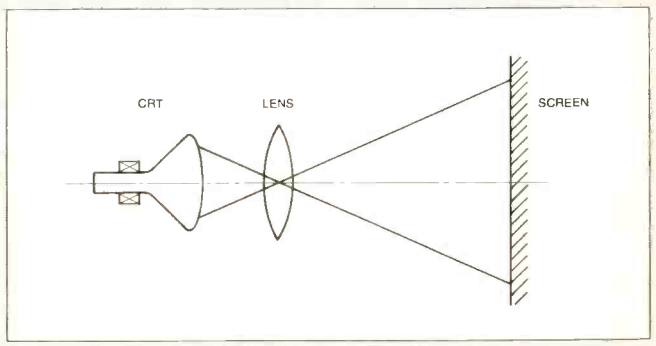


Fig. 6—The simplest projection system—a single lens.

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'

often have extra video amplification, some have had comb filters to insure better resolution, (See ETD Sept. 1978, Page 19), better than average audio, heavy duty power supplies, and the three tube systems must have extra heavy duty HV supplies to supply the extra beam current.

Advent

The Advent 700 Series consists of three units: The 710 5 foot screen priced at $2395, the 710-6 foot screen at $2595 and the 760 with a 6 foot screen priced at $3295. The 760 uses three tubes, each with a four element f 1.3 lens system and produces a screen brightness of approximately 32 ft. Lamberts, twice the recommended standard for movie theaters.

The 760 uses the Omega random access keyboard tuning system with remote control. (For details on the Omega tuning system, see ET/D August '68, Page 16). The video IF and video detector are contained in a single module—nothing unusual to this point, but now some unique features begin to appear. Video from the IF module is fed to a signal processing IC which develops AGC and acts as a sync amplifier and separator. This video also feeds an emitter follower for video output to external equipment. At this point, an external/normal switch permits switching between output of the video detector, or the output of an external video amplifier and sync separator which accepts local video camera signals, or the direct video output of a video tape system, or other video, not RF signals. Also, at the input to the video amplifiers, a built-in cross hatch generator is available for convergence touch-up.

The video amplifier and the chroma amplifiers and demodulator are conventional, and ultimately feed R, B and G outputs which are different only in that they drive individual CRT's instead of a tri-color tube.

The sweep circuits also have some unusual features. Some extra pains have been taken to insure vertical linearity and the vertical output stage drives the three vertical yokes in series. The horizontal sweep system schematic appears conventional, except for the output side of the horizontal output transformer. Here the three horizontal yoke windings are in parallel, each in series with its own linearity controls (Fig. 8). Three focus controls are in parallel; a tripler supplies 28.5 KV to the CRTs through a high voltage splitter. The focus tap on the tripler also supplies a signal to a crowbar circuit in the main power supply to shut it down in case of excessive high voltage. There are no scan derived supplies, except the CRT screen supply which is rectified pulse from the primary of the horizontal output transformer.

The main power is only unusual in that it uses a straight forward power transformer, rectifier, filter setup to supply +200 volts to the R, G, and B outputs, +116 volts to the horizontal output stage, +59 volts to the vertical

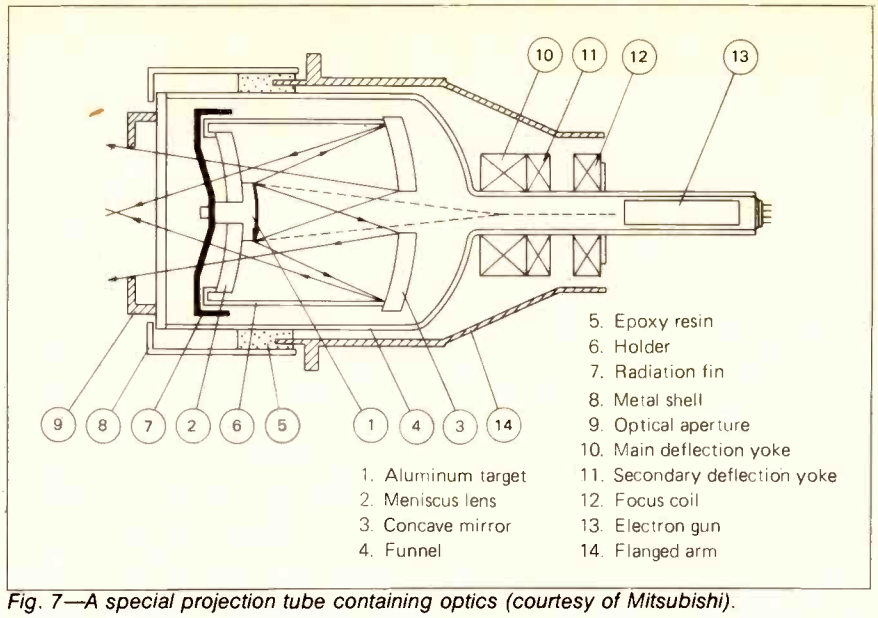


Fig. 7—A special projection tube containing optics (courtesy of Mitsubishi).

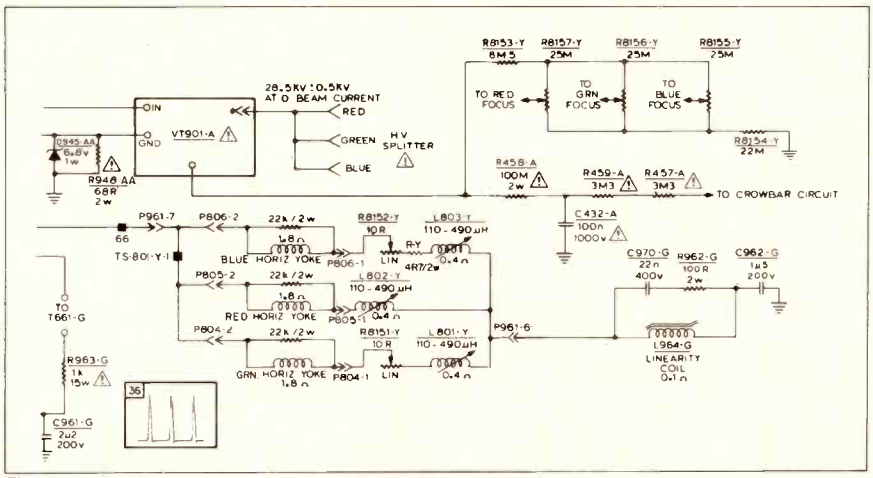


Fig. 8—Advent 760 horizontal yoke/HV/2nd focus circuit.

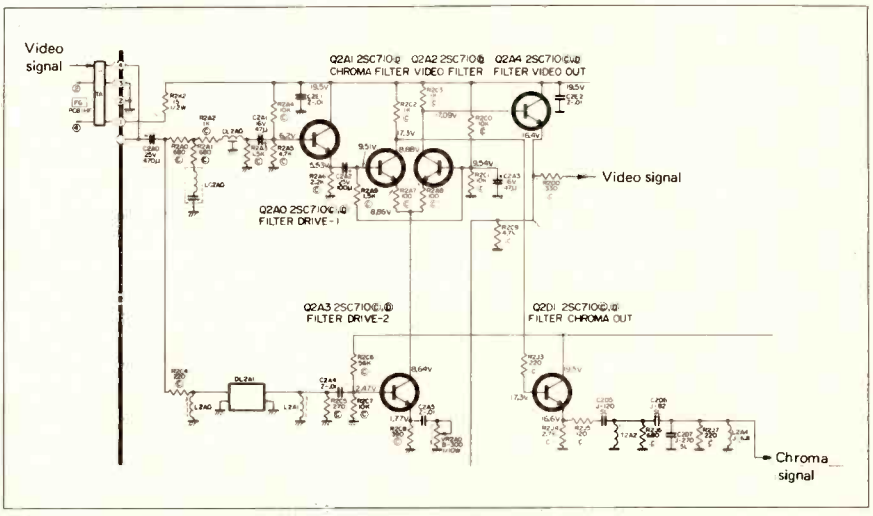


Fig. 9–The VS-700U comb filter. (Courtesy Mitsubishi.)

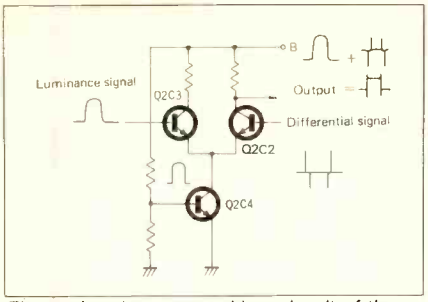


Fig 10–Luminance peaking circuit of the VS-700U

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

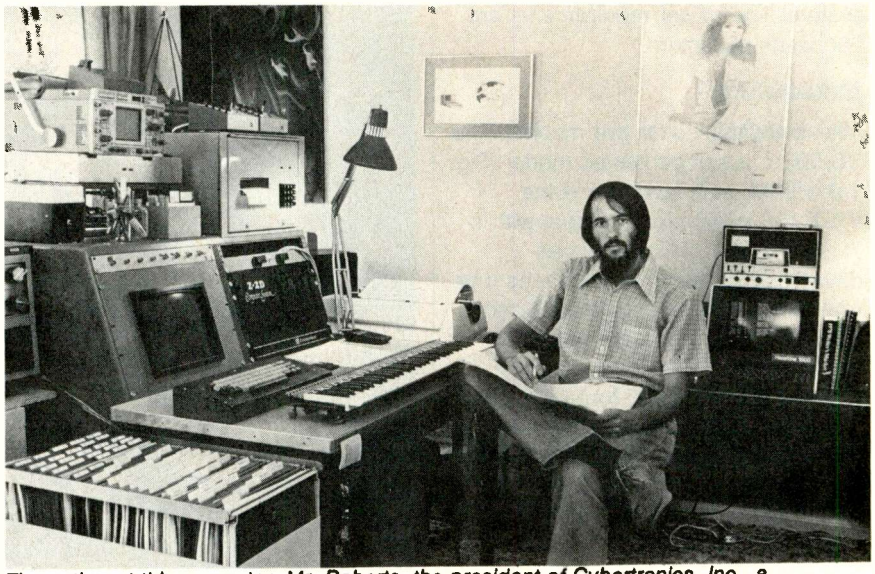
continued on page 47

Inside a real, live, microprocessor

And, it really works

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



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.

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 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 *Arthmetic 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

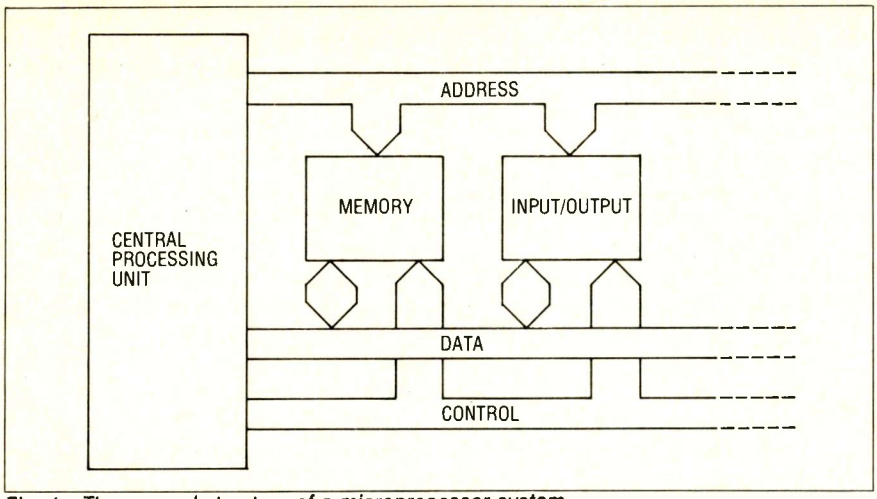


Fig. 1—The general structure of a microprocessor system.

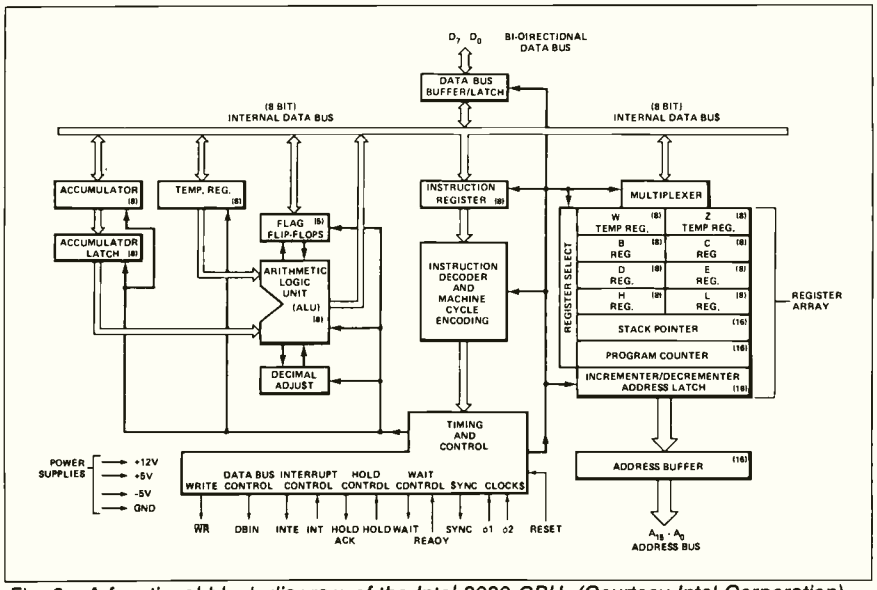


Fig. 2—A functional block diagram of the Intel 8080 CPU. (Courtesy Intel Corporation).

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 decorder 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

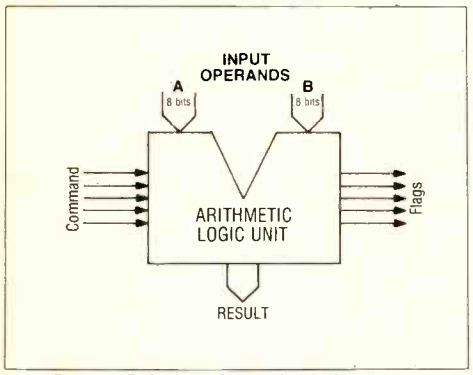


Fig. 3—Block diagram of an arithmetic Logic Unit (ALU). Here operands A and B are used to produce the Result—under the control of command lines. Status flags are set after each operation to provide decision criteria for the processor logic.

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 permissable digits of the 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.

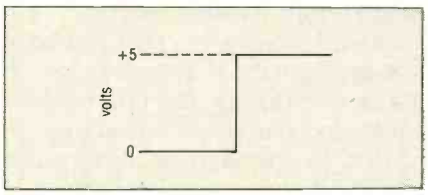


Fig. 1A. The digital logic level for a TTL device

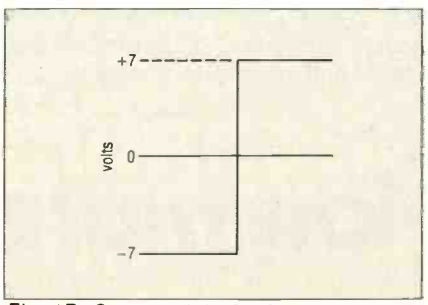


Fig. 1B. One possible CMOS bipolar logic level

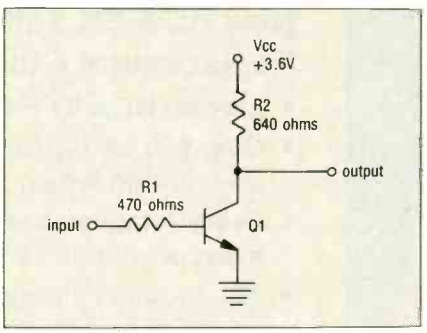


Fig. 2. A typical RTL inverter circuit

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.

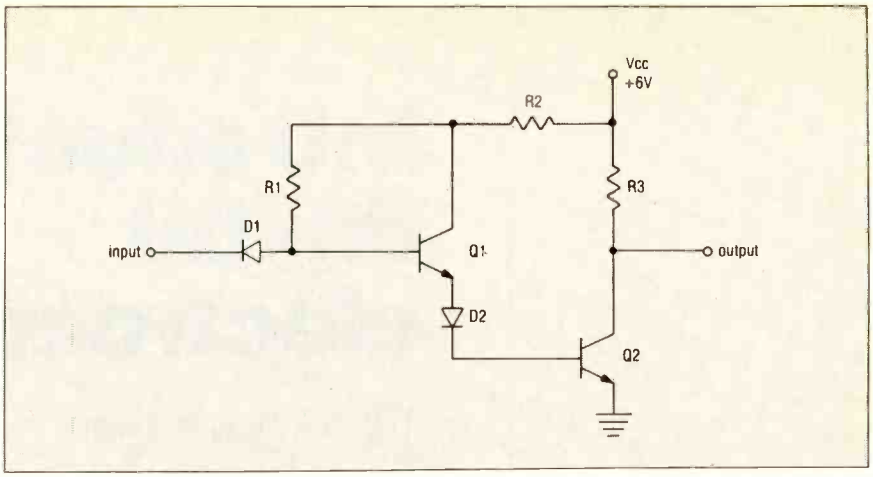


Fig. 3. Schematic of a DTL inverter circuit

Speed-vs-power

The principle factors governing the 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.

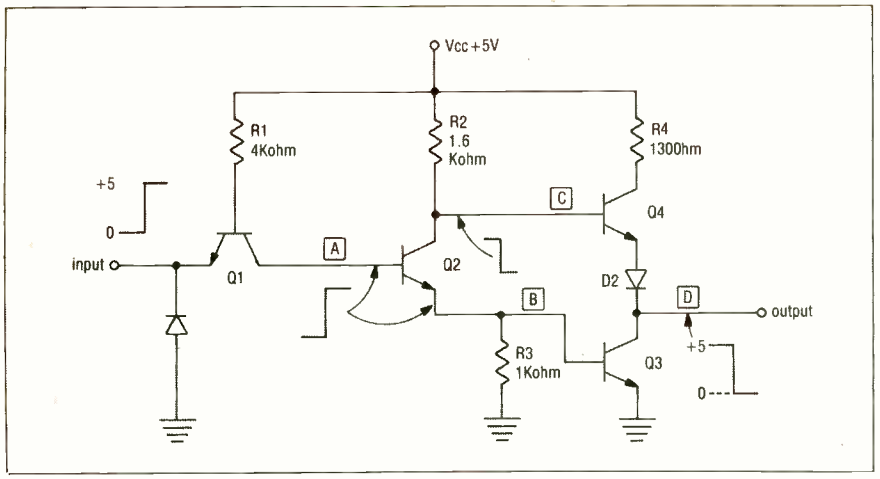


Fig. 4A. A typical TTL inverter circuit

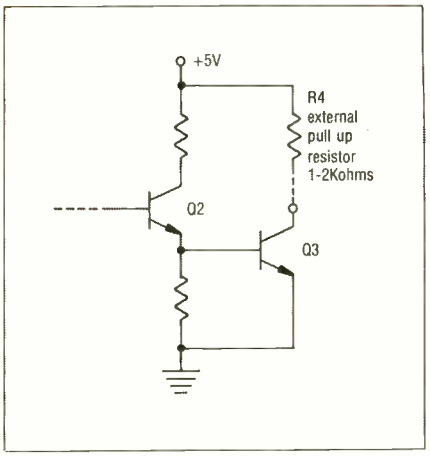


Fig. 4B. The modified open collector TTL output circuit

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 µL900 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 *D*1 is reverse biased. In that condition *R*1 will forward bias transistor *Q*1, which in turn forward biases *D*2 and *Q*2. Voltage levels in most digital circuits are selected to *saturate* the transistors, so when *Q*2 is turned on it is turned on to saturation. This means that the output of the inverter, which is the collector of *Q*2, goes nearly to ground, but is actually V_{ce}(sat) of the transistor, on the order of a few tenths of a volt.

When the input is LOW, the cathode of *D*1 is grounded. Since *D*1 is now forward biased, the base of *Q*1 is essentially grounded. Under this condition *Q*1, *D*1, and *Q*2 are reversed biased. With *Q*2 cut-off, then, the output voltage rises to that of Vcc+. 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

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,*

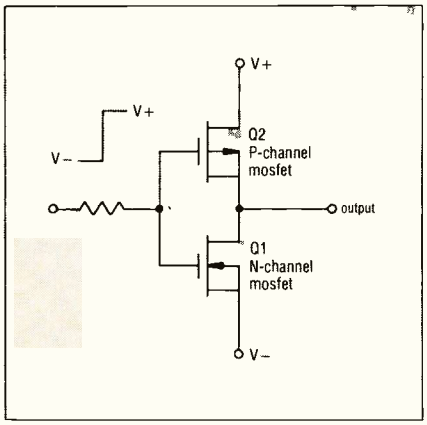


Fig. 5A. The CMOS inverter circuit

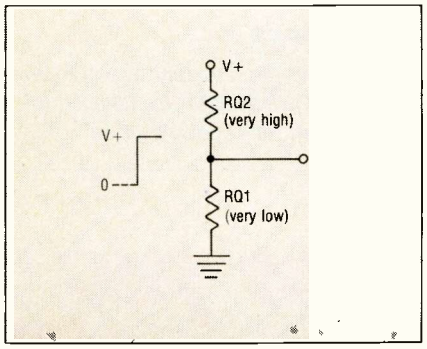


Fig. 5C. CMOS equivalent output circuit with a high input

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, *Q*1 is cut off, so point A goes HIGH. This condition turns on *Q*2 forcing B HIGH and C LOW. We find, then, *Q*3 is turned on and *Q*4 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: *Q*1 is on (forcing point A LOW), *Q*3 is off, and *Q*4 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. *Q*4 and *D*2 are missing. An example is shown in Figure 4B. These devices require an external 1 to 2 Kohm pull-up resistor

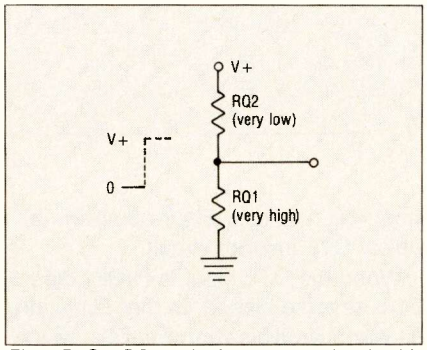


Fig. 5B. CMOS equivalent output circuit with a low input

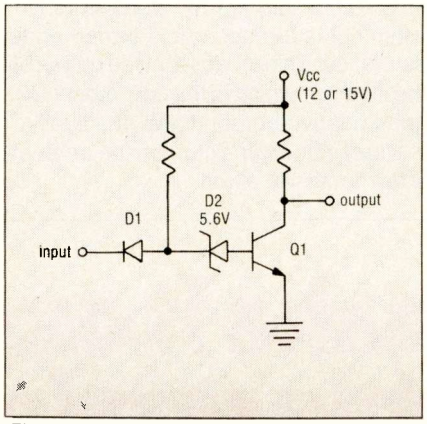


Fig. 6. The HTL inverter circuit

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 monpolar 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. *Q*1 will have a very high channel resistance, and *Q*2 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. *Q*2 now has a very high channel resistance, and *Q*1 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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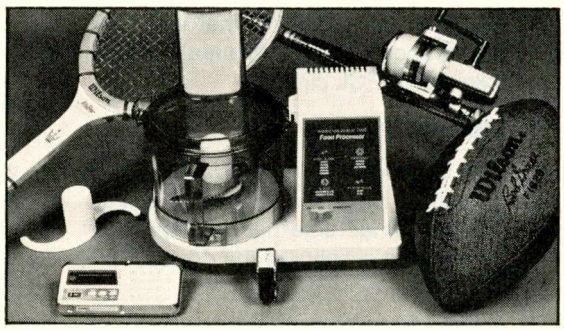

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short duration pulses. The solution in noisy environments is to use a digital IC logic family that requires a high input voltage to trigger. CMOS operated at high V+ and V- values meets this requirement, but an older bipolar "high threshold logic"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

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

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*. ETD

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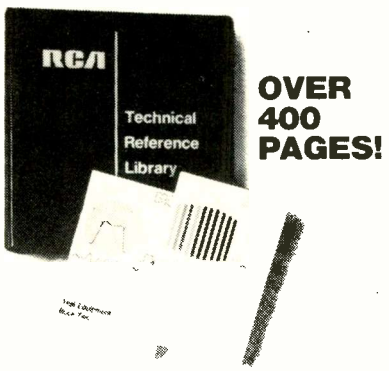

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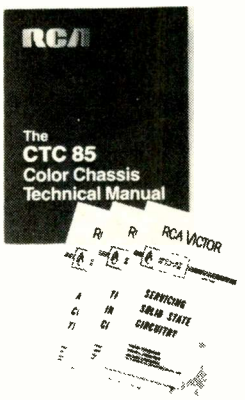

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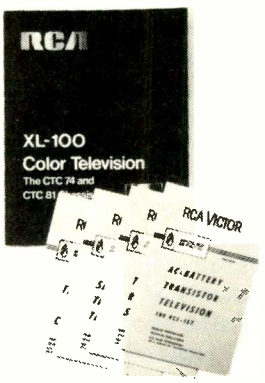

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A logical, systematic approach to business management is essential for survival in today's highly competitive electronics service industry. In this article, ET/D presents a look at the Sperry Tech system, one of the most comprehensive ever developed 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 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 fugure, 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 ot 16.7 per cent. The main reason has been the slow or non-moving spare parts lying around on your valuable shelf space.

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.

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 serviceshops fall into the "dead beat" category.

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

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19 22	10 00	90 0%
23 - 27	8 33	88 0%
28 33	7 14	86 0%
34 40	6 25	84 0%
41 - 48	5 60	82 0%
49 57	5 00	80 0%
58 - 67	4 44	77 5%
68 - 78	4 00	75 0%
79 - 1 25	3 60	72 5%
1 26 - 2 00	3 33	70 0%
2 01 - 3 50	3 08	67 5%
3 51 - 5 00	2 86	65 0%
5 01 - 7 50	2 67	62 5%
7 51 - 10 50	2 50	60 0%
10 51 - 14 00	2 35	57 5%
14 01 - 18 00	2 22	55 0%
18 01 - 22 50	2 11	52 5%
22 51 - 27 50	2 00	50 0%
27 51 - 33 00	1 90	47 5%
33 01 - 40 00	1 82	45 0%
Over 40 00	1 74	42 5%

TABLE NO. 6

Dealer Price	X = (Times)	Gross Margin
00 15	16 70	94 0%
16 18	14 30	93 0%
19 22	12 50	92 0%
23 27	10 00	90 9%
28 33	8 33	88 0%
34 40	7 14	86 0%
41 48	6 25	84 0%
49 57	5 60	82 0%
58 - 67	5 00	80 0%
68 - 78	4 44	77 5%
79 1 25	4 00	75 0%
1 26 2 00	3 60	72 5%
2 01 3 50	3 33	70 0%
3 51 - 5 00	3 08	67 5%
5 01 - 7 50	2 86	65 0%
7 51 - 10 50	2 67	62 5%
10 51 14 00	2 50	60 0%
14 01 - 18 00	2 35	57 5%
18 01 22 50	2 22	55 0%
22 51 - 27 50	2 11	52 5%
27 51 33 00	2 00	50 0%
33 01 40 00	1 90	47 5%
Over 40 00	1 82	45 0%

TABLE NO. 7

Dealer Price	X = (Times)	Gross Margin
00 15	20 00	95 0%
16 18	16 70	94 0%
19 22	14 30	93 0%
23 27	12 50	92 0%
28 - 33	10 00	90 0%
34 40	8 33	88 0%
41 48	7 14	86 0%
49 57	6 25	84 0%
58 67	5 60	82 0%
68 78	5 00	80 0%
79 - 1 25	4 44	77 5%
1 26 2 00	4 00	75 0%
2 01 3 50	3 60	72 5%
3 51 5 00	3 33	70 0%
5 01 7 50	3 08	67 5%
7 51 - 10 50	2 86	65 0%
10 51 14 00	2 67	62 5%
14 01 18 00	2 50	60 0%
18 01 - 22 50	2 35	57 5%
22 51 27 50	2 22	55 0%
27 51 33 00	2 11	52 5%
33 01 40 00	2 00	50 0%
Over 40 00	1 90	47 5%

TABLE NO. 8

Dealer Price	X = (Times)	Gross Margin
00 15	25 00	96 0%
16 18	20 00	95 0%
19 22	16 70	94 0%
23 27	14 30	93 0%
28 33	12 50	92 0%
34 40	10 00	90 0%
41 48	8 33	88 0%
49 57	7 14	86 0%
58 67	6 25	84 0%
68 78	5 60	82 0%
79 1 25	5 00	80 0%
1 26 2 00	4 44	77 5%
2 01 - 3 50	4 00	75 0%
3 51 5 00	3 60	72 5%
5 01 7 50	3 33	70 0%
7 51 10 50	3 08	67 5%
10 51 - 14 00	2 86	65 0%
14 01 18 00	2 67	62 5%
18 01 22 50	2 50	60 0%
22 51 27 50	2 35	57 5%
27 51 - 33 00	2 22	55 0%
33 01 - 40 00	2 11	52 5%
Over 40 00	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.

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 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

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

color tv

1 / Outside Service Requirements — Tech's Guide Time

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	10
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 — Tech's Guide Time ⑤⑥⑦⑧⑨⑩

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

Tuner		**Signal**		**Chroma**		**Pix. Tube**	
UHF	⑨	AGC	⑩	Amplifiers	⑦	Grid Drives	⑦
VHF		I.F.	⑧	Acc & Killer	⑨	Input Circuitry	⑦
Elec. Tuning	⑨	Sync.	⑨	OSC & Burst	⑧	Blanking	⑧
Mech. Tuning	⑧	Video	⑦	Demodulators	⑦		
AFT	⑨						
DIALS	⑤						
GEARS	⑥						
Control		**Audio**		**Miscellaneous**		**Deflection**	
Electronic Tuning		Amplifiers	⑦	Cables	⑥	Convergence	⑧
Motor Controls	⑮	Detection	⑧	Connectors	⑦	Deflection Yoke	⑧
Tun. Volt Cont.	⑩	Output	⑥			High Voltage	⑧
Motors	⑦	Sound I.F.	⑦			Horiz. OSC/AFC	⑨
Remote		Speaker	⑤			Horiz. Output	⑧
Receiver	⑧					Pin Cushion	⑨
Transmitter	⑦					Vert. OSC	⑧
						Vert. Output	⑧
						Focus	⑦
Power		**Clocks / Timers**					
Degausing	⑥	Standard	⑥				
Filament	⑥	Digital					
Low Voltage		Electronic	⑩				
Regulated	⑧	Mechanical	⑦				
Non-Regulated	⑥						
AC-Power	⑤						
Battery Circuits	⑤						

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 IF	20
f / chroma	30
g / video IF	30
h / remote control receiver functions (each)	10
i / tuner UHF	Exchange
j / tuner VHF	Exchange

11 / Component Removal & Replacement Time

Item Replaced (NOTE: Accumulate time from left to right per part)	Plug-in Parts & Assemblies			Soldered Connections					Rivets	Screws, Bolts, Retainer Rings, Etc.				
	1	2-5	6 UP	1-3	4-6	7-9	10-12	13-15	16 UP	Each	1-5	6-10	11-15	16-20	21 UP
Individual Part or Assembly	5	10	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.

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:

Trip .....20 *(Item 1)*
Return trip .....15 *(Item 1)*
Preliminary Diagnosis (1st) .....35 *(Item 2)*
Remove and Reinstall Main Chassis .....10 *(Item 3)*
R & R Tuner .....10 *(Item 3)*
Convergence .....15 *(Item 4)*
Adjust High Voltage, Height and Linearity ....* *(Item 2)*
Replace four receiving tubes .....10 *(Item 11)*
Replace picture tube ...20 *(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 × 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	21.00	21.60	22.20	22.80	23.40	24.00	25.20		19.80
	5	1.70	1.75	1.80	1.85	1.90	1.95	2.00	2.10	5	1.65
	10	3.40	3.50	3.60	3.70	3.80	3.90	4.00	4.20	10	3.30
	15	5.10	5.25	5.40	5.55	5.70	5.85	6.00	6.30	15	4.95
	20	6.80	7.00	7.20	7.40	7.60	7.80	8.00	8.40	20	6.60
Tech's Guide Time indicates total minutes. Convert minutes to charge in your own hourly charge column.	25	8.50	8.75	9.00	9.25	9.50	9.75	10.00	10.50	25	8.25
	30	10.20	10.50	10.80	11.10	11.40	11.70	12.00	12.60	30	9.90
	35	11.90	12.25	12.60	12.95	13.30	13.65	14.00	14.70	35	11.55
	40	13.60	14.00	14.40	14.80	15.20	15.60	16.00	16.80	40	13.20
	45	15.30	15.75	16.20	16.65	17.10	17.55	18.00	18.90	45	14.85
	50	17.00	17.50	18.00	18.50	19.00	19.50	20.00	21.00	50	16.50
	55	18.70	19.25	19.80	20.35	20.90	21.45	22.00	23.10	55	18.15
	60	20.40	21.00	21.60	22.20	22.80	23.40	24.00	25.20	60	19.80
	65	22.10	22.75	23.40	24.05	24.70	25.35	26.00	27.30	65	21.45
	70	23.80	24.50	25.20	25.90	26.60	27.30	28.00	29.40	70	23.10
	75	25.50	26.25	27.00	27.75	28.50	29.25	30.00	31.50	75	24.75
	80	27.20	28.00	28.80	29.60	30.40	31.20	32.00	33.60	80	26.40
	85	28.90	29.75	30.60	31.45	32.30	33.15	34.00	35.70	85	28.05
	90	30.60	31.50	32.40	33.30	34.20	35.10	36.00	37.80	90	29.70
	95	32.30	33.25	34.20	35.15	36.10	37.05	38.00	39.90	95	31.35
	100	34.00	35.00	36.00	37.00	38.00	39.00	40.00	42.00	100	33.00
	105	35.70	36.75	37.80	38.85	39.90	40.95	42.00	44.10	105	34.65
	110	37.40	38.50	39.60	40.70	41.80	42.90	44.00	46.20	110	36.30
	115	39.10	40.25	41.40	42.55	43.70	44.85	46.00	48.30	115	37.95
	120	40.80	42.00	43.20	44.40	45.60	46.80	48.00	50.40	120	39.60
	125	42.50	43.75	45.00	46.25	47.50	48.75	50.00	52.50	125	41.25
	130	44.20	45.50	46.80	48.10	49.40	50.70	52.00	54.60	130	42.90
	135	45.90	47.25	48.60	49.95	51.30	52.65	54.00	56.70	135	44.55
	140	47.60	49.00	50.40	51.80	53.20	54.60	56.00	58.80	140	46.20
	145	49.30	50.75	52.20	53.65	55.10	56.55	58.00	60.90	145	47.85
	150	51.00	52.50	54.00	55.50	57.00	58.50	60.00	63.00	150	49.50
	155	52.70	54.25	55.80	57.35	58.90	60.45	62.00	65.10	155	51.15
	160	54.40	56.00	57.60	59.20	60.80	62.40	64.00	67.20	160	52.80
	165	56.10	57.75	59.40	61.05	62.70	64.35	66.00	69.30	165	54.45
	170	57.80	59.50	61.20	62.90	64.60	66.30	68.00	71.40	170	56.10
	175	59.50	61.25	63.00	64.75	66.50	68.25	70.00	73.50	175	57.75
	180	61.20	63.00	64.80	66.60	68.40	70.20	72.00	75.60	180	59.40
	185	62.90	64.75	66.60	68.45	70.30	72.15	74.00	77.70	185	61.05
	190	64.60	66.50	68.40	70.30	72.20	74.10	76.00	79.80	190	62.70
	195	66.30	68.25	70.20	72.15	74.10	76.05	78.00	81.90	195	64.35
	200	68.00	70.00	72.00	74.00	76.00	78.00	80.00	84.00	200	66.00
	205	69.70	71.75	73.80	75.85	77.90	79.95	82.00	86.10	205	67.65
	210	71.40	73.50	75.60	77.70	79.80	81.90	84.00	88.20	210	69.30
	215	73.10	75.25	77.40	79.55	81.70	83.85	86.00	90.30	215	70.95
	220	74.80	77.00	79.20	81.40	83.60	85.80	88.00	92.40	220	72.60
	225	76.50	78.75	81.00	83.25	85.50	87.75	90.00	94.50	225	74.25
	230	78.20	80.50	82.80	85.10	87.40	89.70	92.00	96.60	230	75.90
	235	79.90	82.25	84.60	86.95	89.30	91.65	94.00	98.70	235	77.55
	240	81.60	84.00	86.40	88.80	91.20	93.60	96.00	100.80	240	79.20
	245	83.30	85.75	88.20	90.65	93.10	95.55	98.00	102.90	245	80.85
	250	85.00	87.50	90.00	92.50	95.00	97.50	100.00	105.00	250	82.50
	255	86.70	89.25	91.80	94.35	96.90	99.45	102.00	107.10	255	84.15
	260	88.40	91.00	93.60	96.20	98.80	101.40	104.00	109.20	260	85.80
	265	90.10	92.75	95.40	98.05	100.70	103.35	106.00	111.30	265	87.45
	270	91.80	94.50	97.20	99.90	102.60	105.30	108.00	113.40	270	89.10
	275	93.50	96.25	99.00	101.75	104.50	107.25	110.00	115.50	275	90.75
	280	95.20	98.00	100.80	103.60	106.40	109.20	112.00	117.60	280	92.40
	285	96.90	99.75	102.60	105.45	108.30	111.15	114.00	119.70	285	94.05
	290	98.60	101.50	104.40	107.30	110.20	113.10	116.00	121.80	290	95.70
	295	100.30	103.25	106.20	109.15	112.10	115.05	118.00	123.90	295	97.35
	300	102.00	105.00	108.00	111.00	114.00	117.00	120.00	126.00	300	99.00
	305	103.70	106.75	109.80	112.85	115.90	118.95	122.00	128.10	305	100.65
	310	105.40	108.50	111.60	114.70	117.80	120.90	124.00	130.20	310	102.30
	315	107.10	110.25	113.40	116.55	119.70	122.85	126.00	132.30	315	103.95
	320	108.80	112.00	115.20	118.40	121.60	124.80	128.00	134.40	320	105.60
	325	110.50	113.75	117.00	120.25	123.50	126.75	130.00	136.50	325	107.25
	330	112.20	115.50	118.80	122.10	125.40	128.70	132.00	138.60	330	108.90
	335	113.90	117.25	120.60	123.95	127.30	130.65	134.00	140.70	335	110.55
	340	115.60	119.00	122.40	125.80	129.20	132.60	136.00	142.80	340	112.20

Fig. 5-The pricing calculator chart. Thirty such charts are included with various "one man hourly rates." To find your hourly charge, simply match up the "Tech's guide time" with the proper calculator chart.

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.

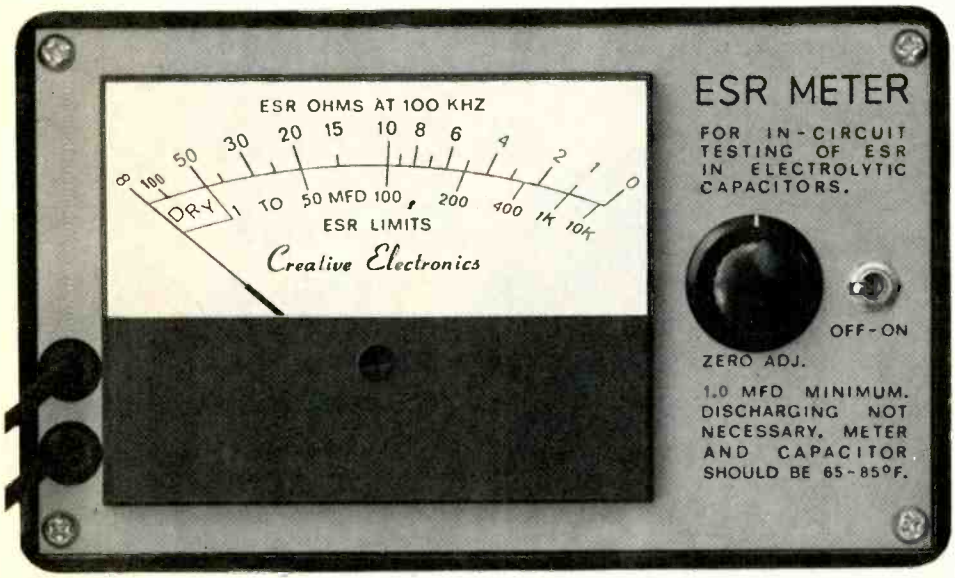
The monthly subscription fee (updating price service) for one book would be $9.40 per month and up to $53.75 for the 25 book updating service. Details are, of course, available from Sperry TV, Lincoln, Neb. Simply call their toll free number 800-228-4338 between 8:00 AM and 5:00 PM CST.

If you are not already using an effective system of business management, the concensus 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

TEST INSTRUMENT REPORT



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

Creative Electronics' ESR Meter

It works!

by Walter H. Schwartz

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 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 hign 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 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 perceptable. 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(mfd) × R (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 6¼ × 3¾ × 2 in. case, is heavy for its size and sells for $79.50 and it works! ET/D

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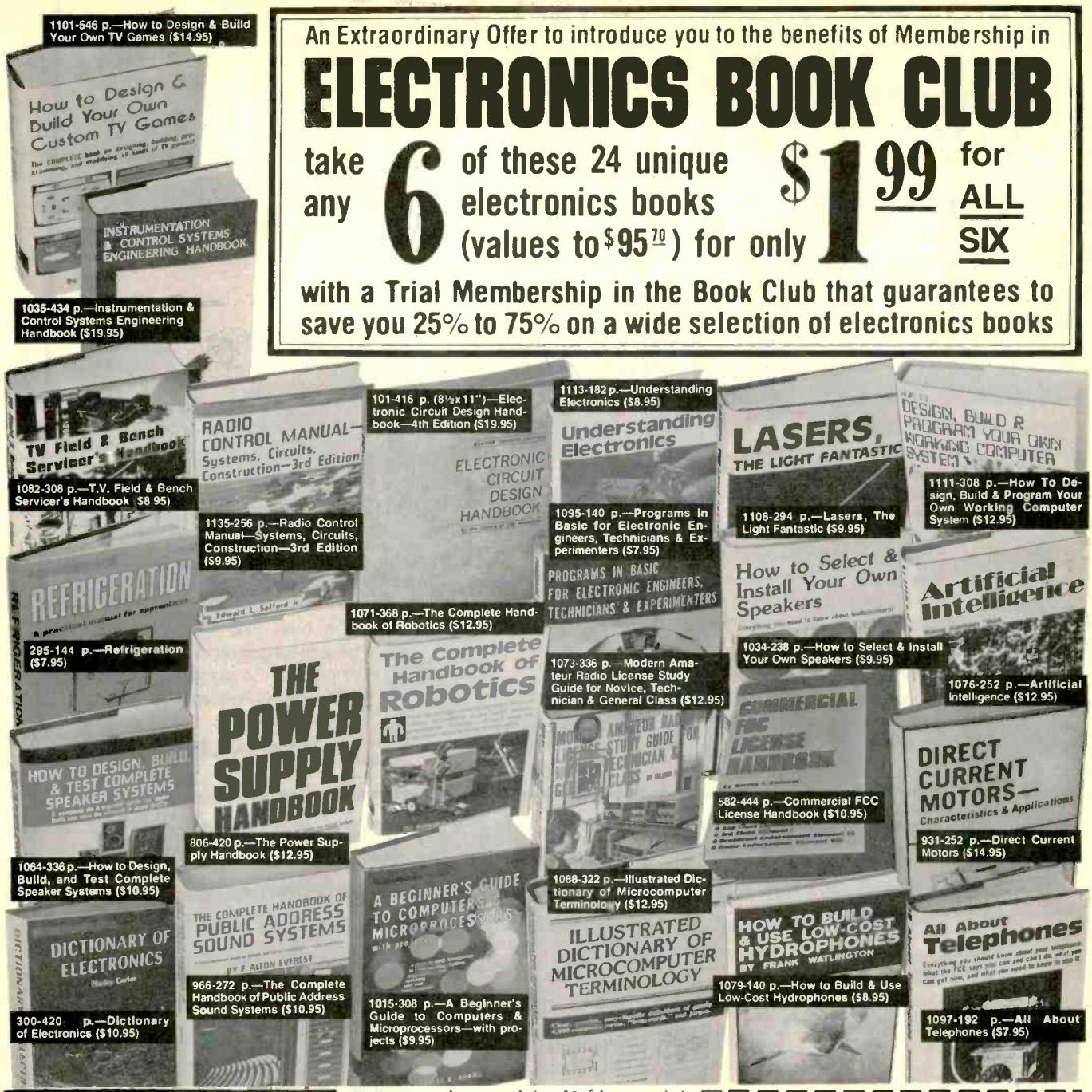

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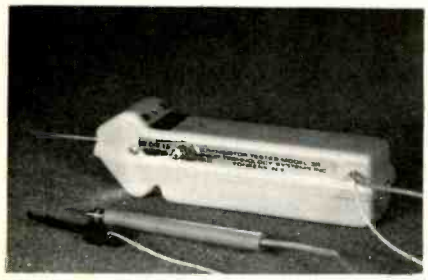


Hand-Held Transistor Tester

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

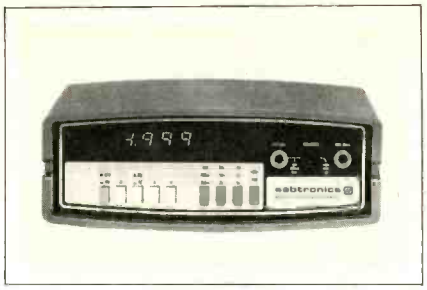
The new VIZ Signalyst™ color bar generator can reportedly supply signals to perform 34 significant tests for color TV service. Patterns available include: super pulse; color bars; color bars with luminance; color bars less burst; red,

blue or green raster; color trio; grey quad; hatch dots and dots—all with progressive or interlaced scannning 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

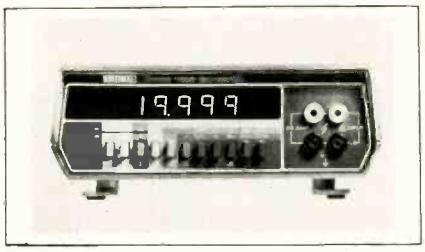
A low cost portable 15MHz dual trace oscilloscope, offering several display modes and automatic triggering, has been introduced by *Philips*. A+B and A−B modes are provided with possible B channel inversion. X-Y display is also

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

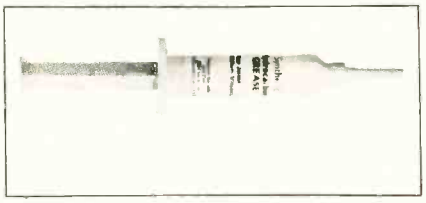
A 4½ digit, full five-function multimeter of moderate cost and excellent accuracy has recently been announced by *Keithley Instruments*. The Model 179-2D/A measure voltage from 10µV to 1200V dc, 10V to 1000V ac (true root mean square) current from 10nA to 20 amps dc and TRMS ac, and resistance from .1 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

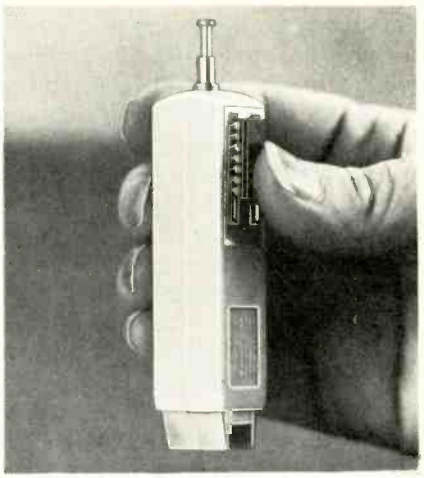
Projector Recorder Belt Corp. has developed an all inclusive technician's lubricant kit. Each kit contains 3 commonly used greases; tuner grease, silicone grease, and hydrocarbon grease. The kit also contains light machine oil. Each of these lubricants comes in a precision applicator for dispensing minute quantities in hard to reach places.



IC Pin Straightener-Inserter

Circle No. 142 on Reader Inquiry Card

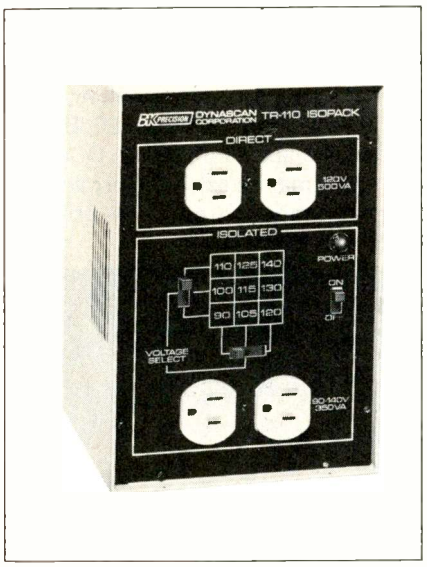
OK Machine and Tool Corp. offers the new Model MOS-1416 IC insertion tool for both 14 and 16 pin in-line IC packages. It is totally conductive and can easily be attached to a ground strap for static electricity protection. Its price is $7.95.



Isolation Transformer

Circle No. 143 on Reader Inquiry Card

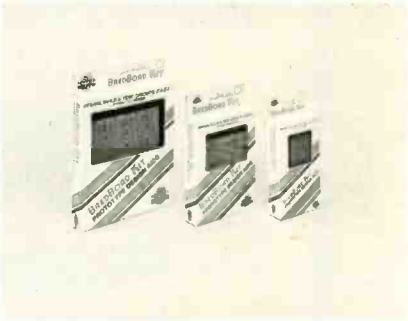
B&K Precision now offers the TR-110 Isopack isolation transformer to eliminate the hazard of testing transformerless equipment. It offers isolated ac output from 90 to 140V in nine steps with a power rating of 350Va continuous and 500Va intermittent and provides direct outlets rated at 500Va. It includes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



BredBord Kits

Circle No. 144 on Reader Inquiry Card

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

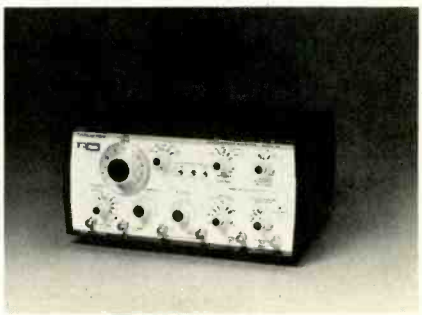
Circle No. 145 on Reader Inquiry Card

The new *Bird* Model 8173 Termaline 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

Circle No. 146 on Reader Inquiry Card

Wavtek's Model 148 generator is a source of modulated waveforms, as well as sine, triangle and square waves at frequencies from 200 μH_2 to 20MHz with 30v p-p maximum output. Attenuation is 20dB per step and 20dB continuous for maximum of 80dB. DC offset is ± 15v. It may be externally or internally triggered and gated. The price is $945.00. **ET/D**



DEALER'S SHOWCASE

Remote Control CB

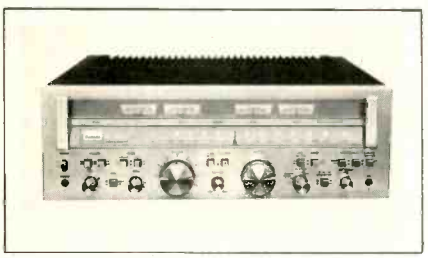
Circle No. 152 on Reader Inquiry Card

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/μsec and the rise time is 1.4μsec. The suggested retail price is $620.

CB/VHF Marine Antenna

Circle No. 154 on Reader Inquiry Card

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

the manufacturer. An isolation coupler separates the signal and feeds two separate transceivers.

Noise Canceling Microphone

Circle No. 155 on Reader Inquiry Card

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"

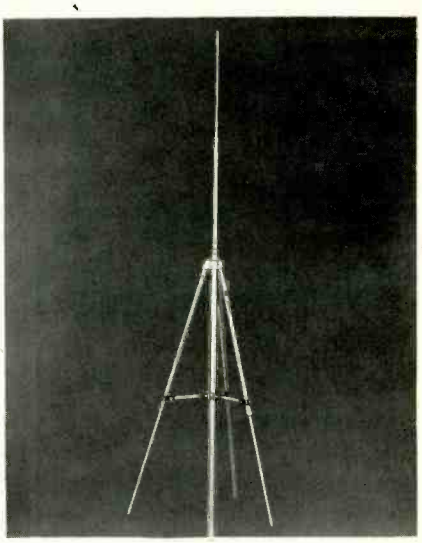
Circle No. 156 on Reader Inquiry Card

A sub-harmonic synthesizer which creates low frequencies an octave below the music signal and mixes them

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 expander and the 162, stereo compressor/limiter.

Low Price CB Base Antenna

Circle No. 157 on Reader Inquiry Card



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

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 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

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.

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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TV TECHNICIAN AND DEALERS, "INCREASE YOUR INCOME THOUSANDS OF DOLLARS YEARLY," "Rent-Lease-Sell TV's with a guaranteed system," Send stamp or call (1-805) 937-4905 for free details, basic plan $15.00, deluxe version $25.00, master plan $40.00...Perry's Rental System, Box 1407, Santa Maria, CA 93456. TF

MECHANICALLY INCLINED INDIVIDUALS—BUILD ELECTRONIC DEVICES IN YOUR HOME. GET STARTED IN YOUR SPARE TIME. $300 TO $600/WK POSSIBLE. EXPERIENCE NOT NECESSARY. WRITE FOR FREE LITERATURE. ELECTRONIC DEVELOPMENT LAB., BOX 1535 (B), PINELLAS PARK, FLA., 33565. TF

GENUINE SONY SEMICONDUCTORS—CHECK THESE PRICES!!
EG. 1-9/ 10-24—SG613—8.50/7.30—SID 30-15 2.60/2.30, -2SC867A 5.10/4.90—2SC1114 5.50/4.80—2SC1358 6.50/5.70, -2SC1124 1.50/1.30—2SC634A 0.45/0.41. Contact us for complete list of Japanese semiconductors and pricing information. Bescor, 547 S. Broadway, Hickville,NY 11801 (516) 822-3988

REPAIR TV TUNERS-High earnings, Complete Course Details, 12 Repair Tricks, Many Plans, Two lessons, all for $2. Refundable. Frank Bocek, Box 3236, Ent., Redding, CA 96001. T/F

REPLACEMENT COLOR YOKES-DEALERS ONLY. Zenith 95-2501-2532-2638-2667-S89633 etc. $19.95. Magnavox 361380-1 $21.95 etc. Sylvania, G.E. etc. $17.95 to $22.95. Request for price list on your letterhead. David Sims Enterprises, Inc., 665 Jerricho Turnpike, Huntington Station, N.Y. 11746, 516-549-3925

Sencore CB-42. CB Analyzer. Cost $1095, sell for $690 including shipping. Complete, like new. Used about six times. Had planned going into CB servicing after retiring from FAA, but am too busy. Call Roy 406-586-5049, 512 S. 15th. Bozeman, Mt. 59715

SUPREME Radio Diagram manuals between 1969 and 1951, total 12 large volumes, regular $48, only $29.85, prepaid. Sample group of five Television volumes, $20 value, only $10. Supreme Publications, Box 46, Highland Park, IL 60035.

SONY-PANASONIC-RCA-ZENITH-EXACT REPLACEMENT PARTS—LARGE INVENTORIES—SEND PART OR MODEL NUMBERS—WILL UPS COD—GREEN TELE RADIO DISTRIBUTORS, 172 SUNRISE HIGHWAY, ROCKVILLE CENTRE, N.Y. 11570

CB'S & Accessories, Communication Power Inc. BC 2000-$214.95, CP 2000-$499.95, CP 400-$389.95, FC 70-$124.95, FT 76-$114.95, WM 1000-$74.95, FL1-$34.85, TP1-$47.95, **Shakespeare Model** 740 List-$399.95 Sale $179.95. Sheriff's Radio, 50 Erie St., Lockport, NY 14094.

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2. Start with (month) _____ issue (Copy must be in by 1st of month preceding)
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TV AND RADIO TUBES 36¢ EA!! Send for free color parts catalog. Your order free if not shipped in 24 hours. Cornell Electronics 4215-17 University San Diego California 92105 TF

CAPACITOR TESTER. 1 pf. to 1 mf.. Not Electrolitic. Kit $14.95. Wired $19.95. $1.00 Shipping or send 25%, balance COD. WS Electronics Lab, 120 W. 97 St., 12E, New York, NY 10025.

COLOR PICTURE TUBE REBUILDING EQUIPMENT. SEMIAUTOMATIC ELECTRONICALLY CONTROLLED PROCESS. COMPLETE TRAINING. Call or write Atoll Television, 6425 W. Irving Park, Chicago, IL 60634. Phone 312-545-6667. 5/79

Sam's Photofacts, Series 300 thru 1689. Have two sets must sell one. First $1000.00 gets it. Rick's TV Service, 2121 N. Hobart, Pampa, Texas 79065, 806-669-3536. 5/79

Build flyback and **transformer tester** for under 5 dollars. Send two dollars for plans to: Ross Electronics, 6206 N. Francisco, Chicago, IL 60659.

BUSINESS OPPORTUNITIES

Alpena MICHIGAN: TV Show room, repair shop and office, all attached to 4 bedroom home. All like new condition. Thriving business. Choice location. McGirr Realty, 1020 W. Chisholm, Alpena, Mich. (517) 354-3042.

BROADCAST STATION. Start your own, any type! Unique Cable FM station operation-investments/experience unnecessary! Receive free tapes, records. Get your FCC license! Much more. Free details. "Broadcasting:", Box 130-ET5, Paradise, CA 95969

MOVING TO FLORIDA? TV SERVICE AND RENTAL BUSINESS FOR SALE ON FLORIDA'S WEST COAST. DOING $40,000 - $50,000 PER YEAR. ALL REASONABLE OFFERS CONSIDERED, ALSO BUILDING AVAILABLE. CONTACT: MR. SOTHERN, 1-813-535-2026 AFTER 7 PM OR WRITE: 1834 SUNRISE BLVD., CLEARWATER, FLORIDA 33520 TF

T.V. Sales and Service Business for sale—25 years in same location—1970 Ford van and entire stock; asking $20,000.00. Write: R. N. Stellmach, 1571 So. Missouri Avenue, Clearwater, Florida 33516.

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

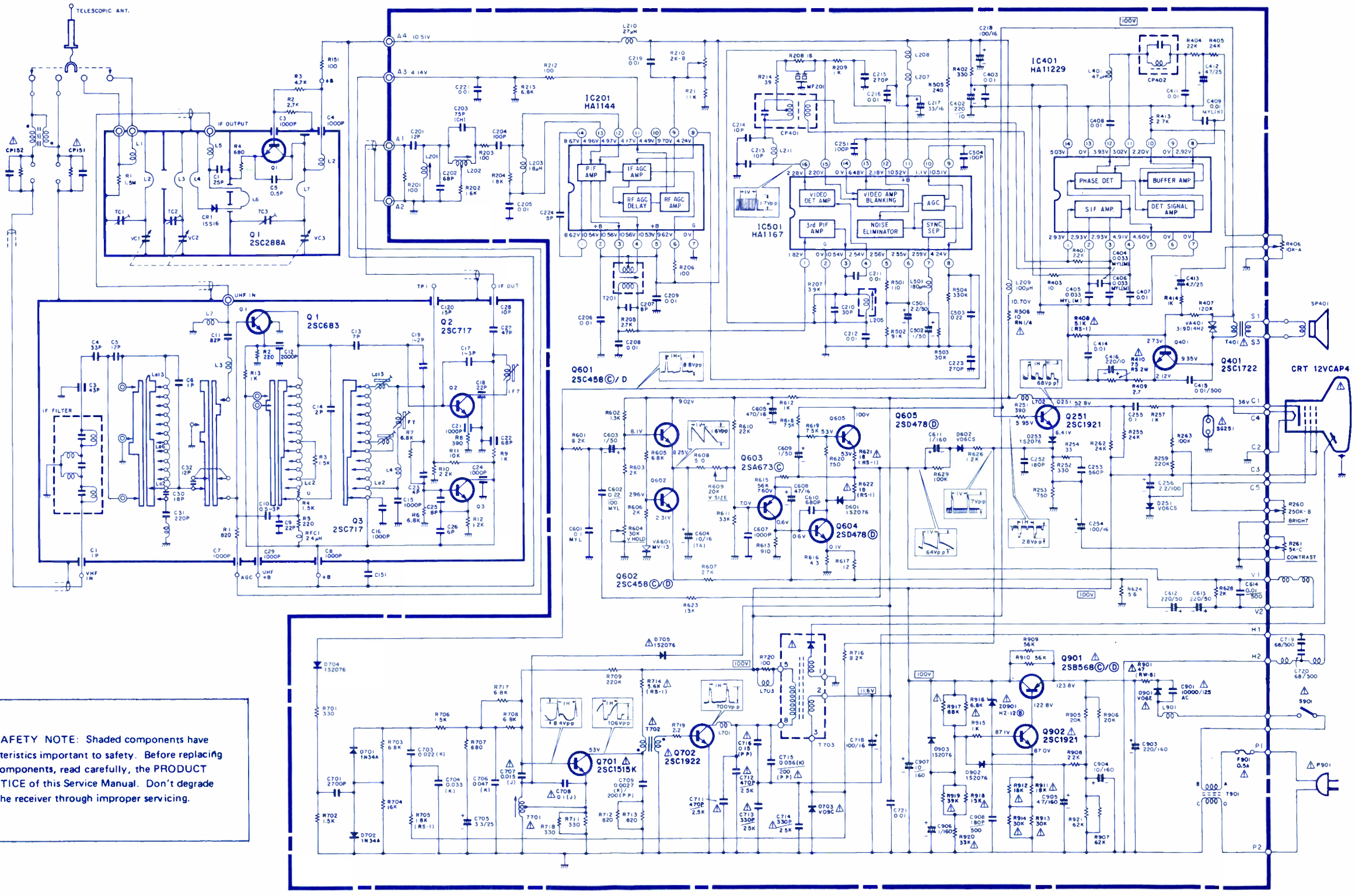
Move to progressive front-range Colorado community. Established, growing TV sales and service. 1978 gross $120,000. All equipment new within last 18 months. Asking $35,000. Write ET/D Box 126. 6/79

AD INDEX

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

ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

1788
HITACHI
B&W TV Chassis
SV
MAY • 1979



PRODUCT SAFETY NOTE: Shaded components have special characteristics important to safety. Before replacing any of these components, read carefully, the PRODUCT SAFETY NOTICE of this Service Manual. Don't degrade the safety of the receiver through improper servicing.

1789
RCA
B&W TV Chassis
KCS 204

ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

MAY • 1979

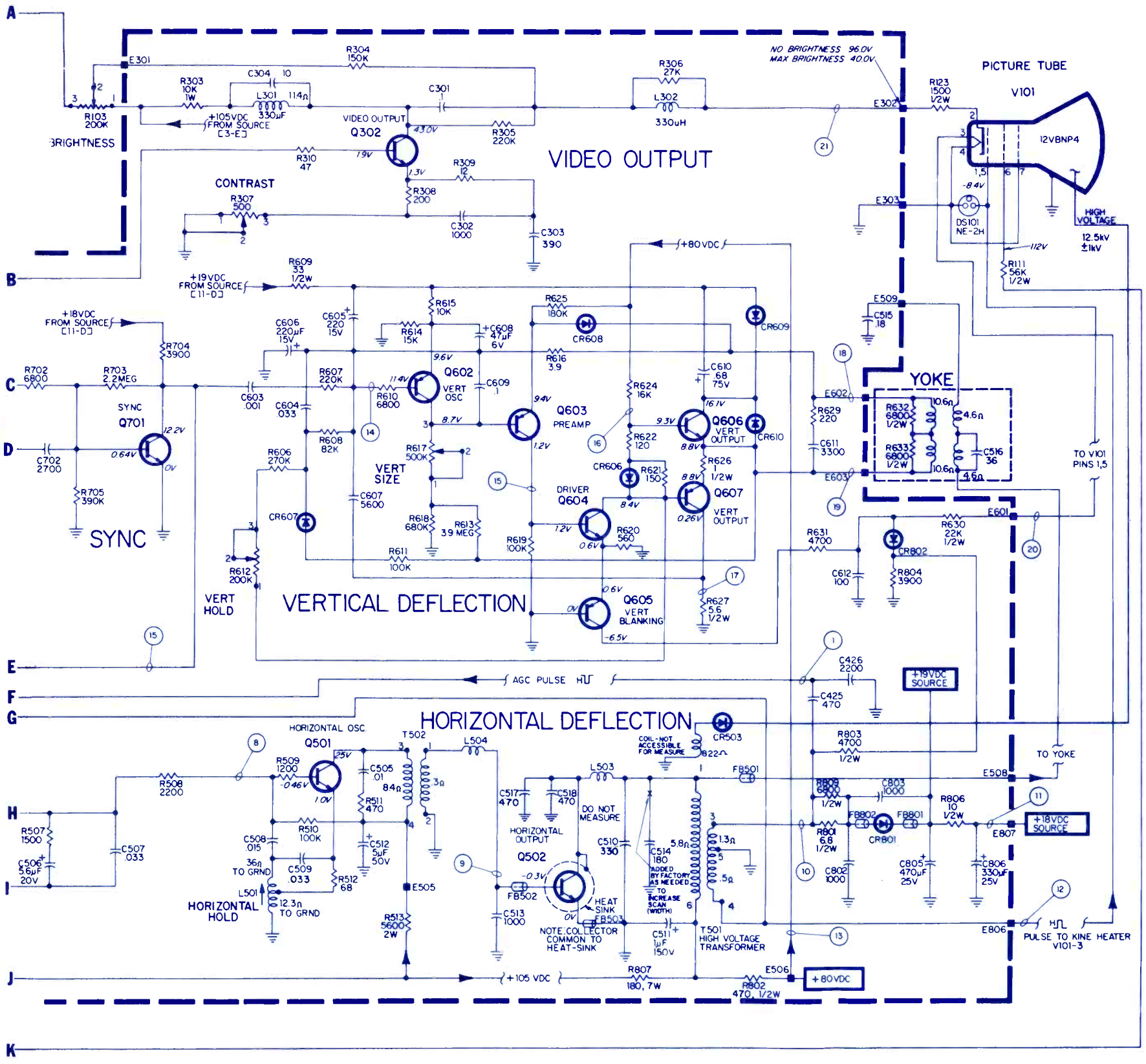
PRODUCT SAFETY NOTE

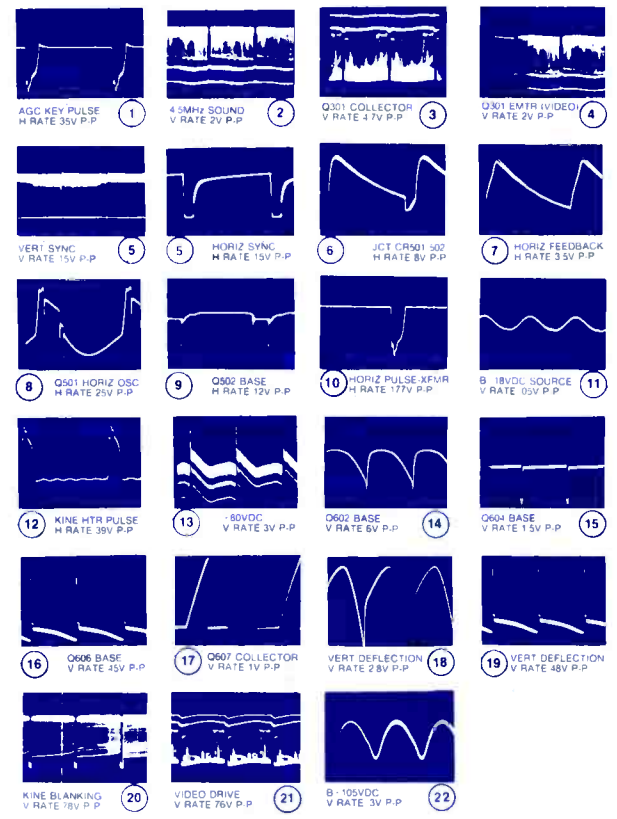
SHADED COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY. BEFORE REPLACING ANY OF THESE COMPONENTS READ CAREFULLY THE PRODUCT SAFETY NOTICE ON PAGE 2 OF THIS SERVICE DATA. DON'T DEGRADE THE SAFETY OF THE SET THROUGH IMPROPER SERVICING.

NOTES
1. RESISTOR VALUES ARE IN OHMS, K=1000
2. CAPACITOR VALUES GREATER THAN 1.0 ARE IN PF. THOSE 1.0 AND LESS ARE IN MFD, UNLESS OTHERWISE DESIGNATED.
3. VOLTAGES MEASURED WITH RESPECT TO ⏚ USING A "VOLTOHMYST", NO SIGNAL CONDITION, AND SHOULD HOLD WITHIN ±20%.
4. ALL RESISTORS ARE 1/4WATT AND 5% TOLERANCE, EXCEPT WHERE OTHERWISE INDICATED.
   ⏚ INDICATES GROUND
   * INDICATES 5% TOLERANCE
   ** INDICATES 2% TOLERANCE
   *** INDICATES 1% TOLERANCE
   [ ] RELATES TO ZONING ON PERIMETER OF DRAWING
   ( ) VOLTAGES MEASURED WITH SIGNAL

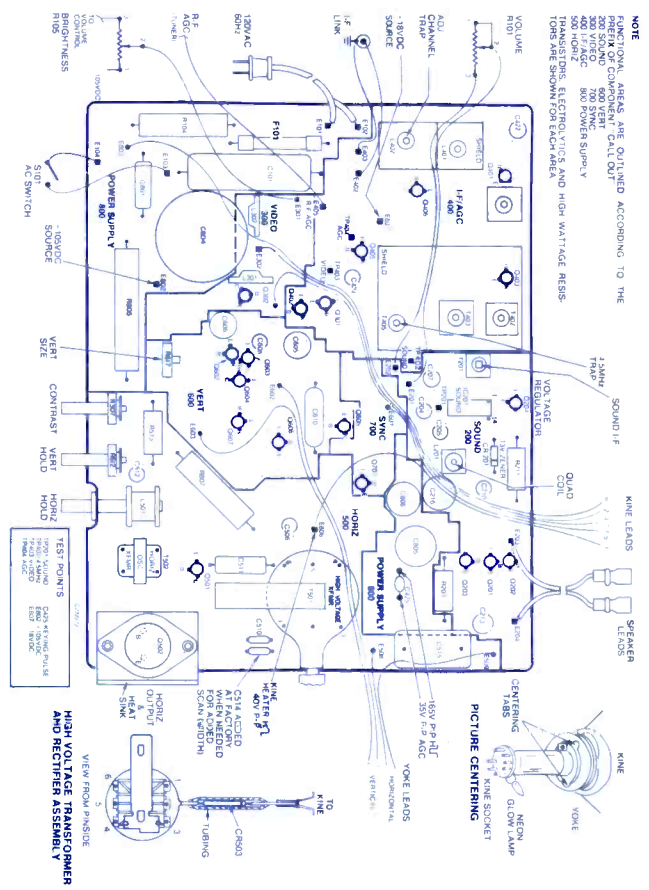
MONOPOLE ANTENNA
ANT TERMINALS
ANTENNA ISOLATION ASSEMBLY
1200
1200
3.3 MEG
L
GROUND TO TMA
300 OHM
VHF/UHF SPLITTER
R-F (UHF) 300 OHM
UHF TUNER
C7
B+
W102 I-F (UHF) 75 OHM
C37
VHF TUNER
W101
C28
I-F LINK
C17
C18
E402
E403
E405
E404
+18VDC FROM SOURCE [11-D]
SHIELDED AREA
**R402 22
L401
C404 3.9
C405 3.9
C403 4.7
L402
C402 680
C407 6.8
C408 39
C410 .001
2ND PIC I-F Q401
FB402
R405 100
R404 2700
C409 2200
R430 1000
C422 1uF
R428 1000
AGC AMP Q405
R406 1000
C424 2uF
R425 6800
R426 560
(R-F) AGC NO SIGNAL 1.2V STRONG SIGNAL 3.5V
CR402
TP404
1.2V NO SIGNAL
3.8V STRONG SIGNAL
R423 15K
R429 220
R427 1500
AGC
R422 3900
C423 .047
R408 270
I-F AGC Q406
R418 27
R419 22K
R421 1800 1/2W
AGC GATE Q402
R420 33
CR404
CR403
+18VDC FROM SOURCE [11-D]
VOLTAGE READINGS - SOUND I-F/AUDIO
NO SIGNAL
MAX AUDIO
VOLUME
R101 40K
E201
E202
+19VDC FROM SOURCE [6-D]
R202 270 1/2W
R203 47 2W
SOUND I-F AUDIO
R201 3300
C204 1uF 50V
C205 1uF
C201 1uF 50V
C215 .01
T201
C202 82
.4Ω
C201 3.9
C203 .022
REFER TO SERVICE DATA FOR INTERNAL DETAIL
IC 201
TP201
C209 .01
*C211 12
*C208 68
L201 1.1Ω
R205 6800
R204 3300
CR202
CR203
R212 22K
C212 2200
R210 1
R209 1
C213 56uF 15V
AUDIO OUTPUT Q202
AUDIO OUTPUT Q203
Q201 AUDIO DRIVER
R208 3000
R207 56
C210 1uF
C214 1000
CR201 13V ZENER
R211 75 2W
Q204 REGULATOR
C216 330uF 25V
E203
E204
SPEAKER 23.7Ω
EARPHONE JACK
R115 180
T102
J102
SPEAKER 25 OHMS
EARPHONE CIRCUIT NOT ON ALL MODELS
4.5 MHz SOUND
TP402
PICTURE I-F
T401
TP401
TP406
R403 10K
+18VDC FROM SOURCE [11-D]
R409 220 1/2W
C421 6.8
*C406 270
R411 2200
*C451 39
C420 .001
C416 .001
R407 47
*C411 22
L405
R401 270 1/2W
C415 390
C412 .001
C401 .001
R410 4700
C452 2.2
*R415 2200 1/2W
R416 270K
T402
VIDEO DETECTOR
CR401
FB403
3RD I-F Q403
C455 2.2
*C456 56
T403
C414 6.8
C415 4.7
C454 10
FB405
L403 36uH 6.2Ω
L404 2.7uH 1.1Ω
*C418 180
T405 4.5MHz TRAP
R414 3900
**R413 470
C419 .01
C413 2200
R412 390
SHIELDED AREA
R424 150
VIDEO DRIVER Q301
TP403
VIDEO
R302 470
R301 1200 1/2W
*R701 2700
C701 .056
C703 220
R501 1K
C501 2700
C503 .1
R502 3300
R506 10K
CR501
CR502
C502 .001
R503 12K
R504 15K
C504 .018
VIDEO
AGC PULSE
+105VDC
POWER SUPPLY
+105VDC SOURCE
S101 ON/OFF
GROUND TERMINAL OF POLARIZED PLUG
120VAC 60Hz
E101
E102
E103
E104
F101 1.0A
R104 22 7W
C101 .1
CR101
R805 180 7W
E802
R808 1.5 MEG 1/2W
C103 680
C801 1uF 150V
C804A 200uF 175V
C804B 250uF 175V
E803
WARNING
-SHOCK HAZARD-
USE ISOLATION TRANSFORMER WHEN SERVICING
TECHNICIAN X-RADIATION WARNING -KCS204
THIS TV CONTAINS CRITICAL PARTS TO PROTECT AGAINST X-RADIATION. NOMINAL 2ND ANODE VOLTAGE IS 13.0KV AT 120VAC AND MUST NOT EXCEED 20.0KV UNDER ANY VIEWABLE CONDITION. TO MEASURE SET BRIGHTNESS FOR VERY DIM PICTURE-USE A HIGH IMPEDANCE METER, CONNECT (-) TO CHASSIS GROUND AND (+) TO 2ND ANODE. THIS INSTRUMENT CONTAINS NO HIGH VOLTAGE ADJUSTMENT. SEE SERVICE DATA FOR REPLACEMENT PARTS AND INFORMATION.
CAUTION: RESETTING WIDTH MAY AFFECT HIGH VOLTAGE.

RCA
B&W TV Chassis
KCS 204





CHASSIS LAYOUT



1790

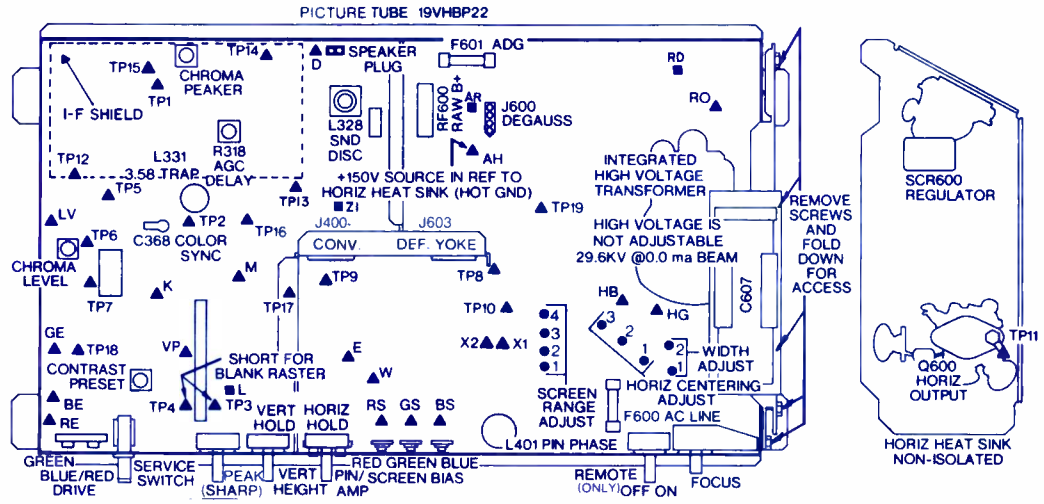
RCA
Color TV Chassis
CTC 93

MAY • 1979

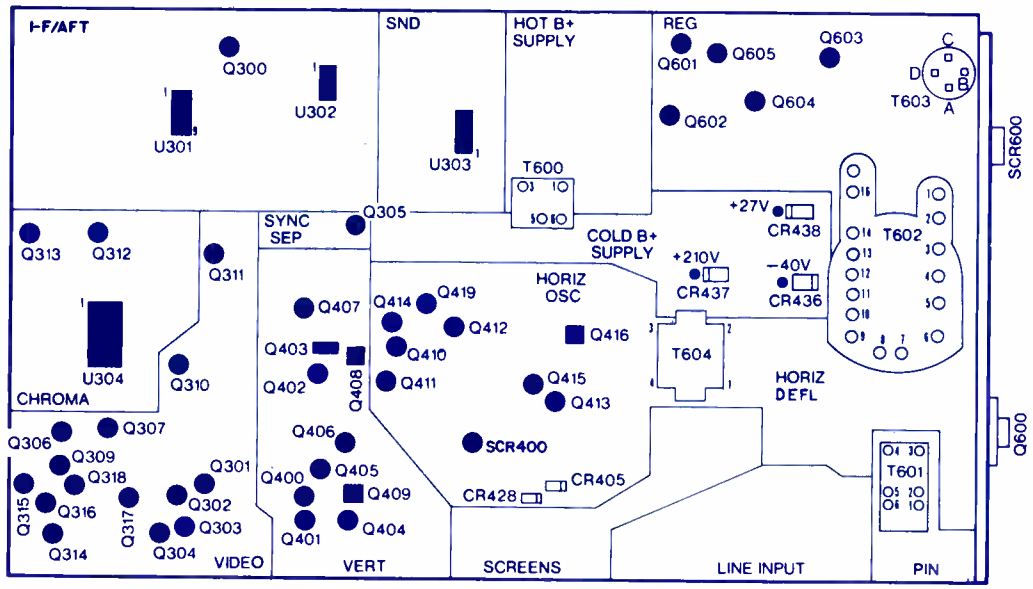
ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

— CHASSIS LAYOUT —

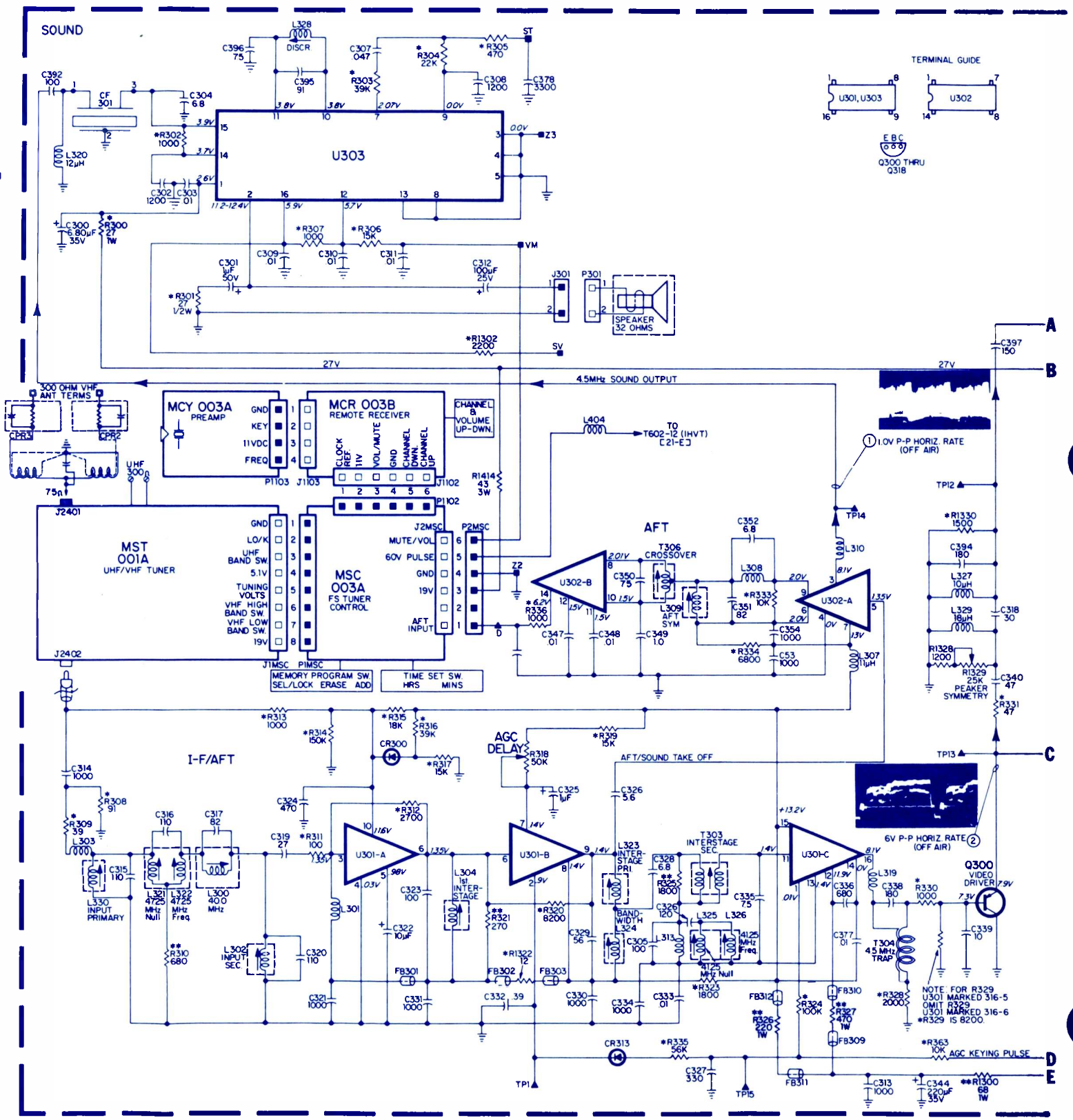


— DEVICE —



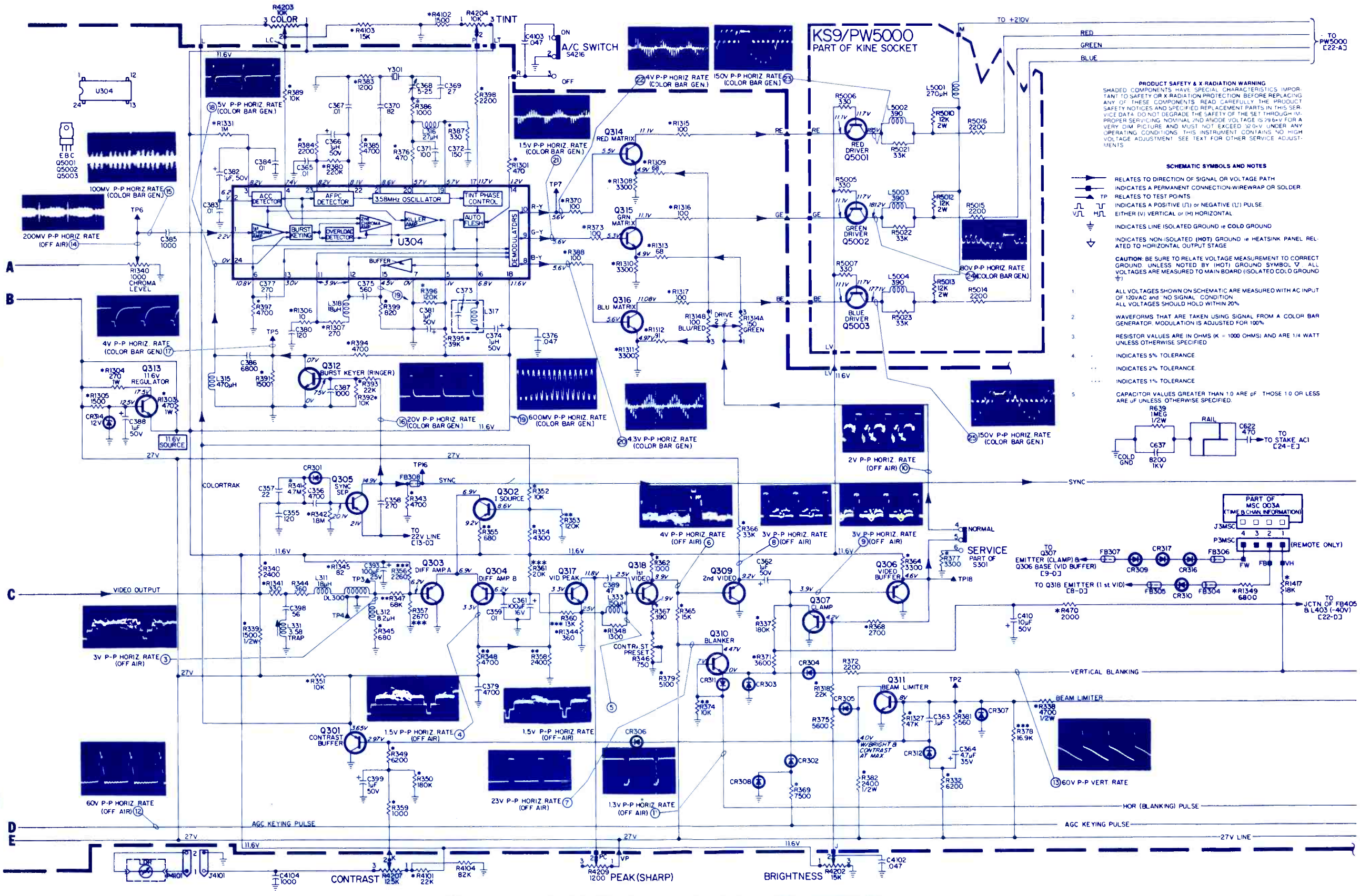
FREQUENCY SYNTHESIS TUNER VOLTAGE CHART

	CHANNEL	TUNING VOLTAGE (TYPICAL)	PRESCALER FREQ (MHZ)
V	2	1.8	1.58
H	3	3.3	1.67
F	4	5.4	1.76
L	5	11.4	1.92
O	6	16.0	2.01
**	**********	**********	**********
V	7	8.5	3.45
H	8	9.6	3.54
F	9	11.0	3.65
H	10	12.6	3.73
I	11	14.6	3.84
G	12	17.5	3.92
H	13	22.0	4.01
**	**********	**********	**********
	14	1.8	2.02
	24	3.8	2.25
	34	6.3	2.48
U	43	8.4	2.69
H	53	10.5	2.93
F	63	13.4	3.16
	73	17.0	3.40
	83	24.0	3.63

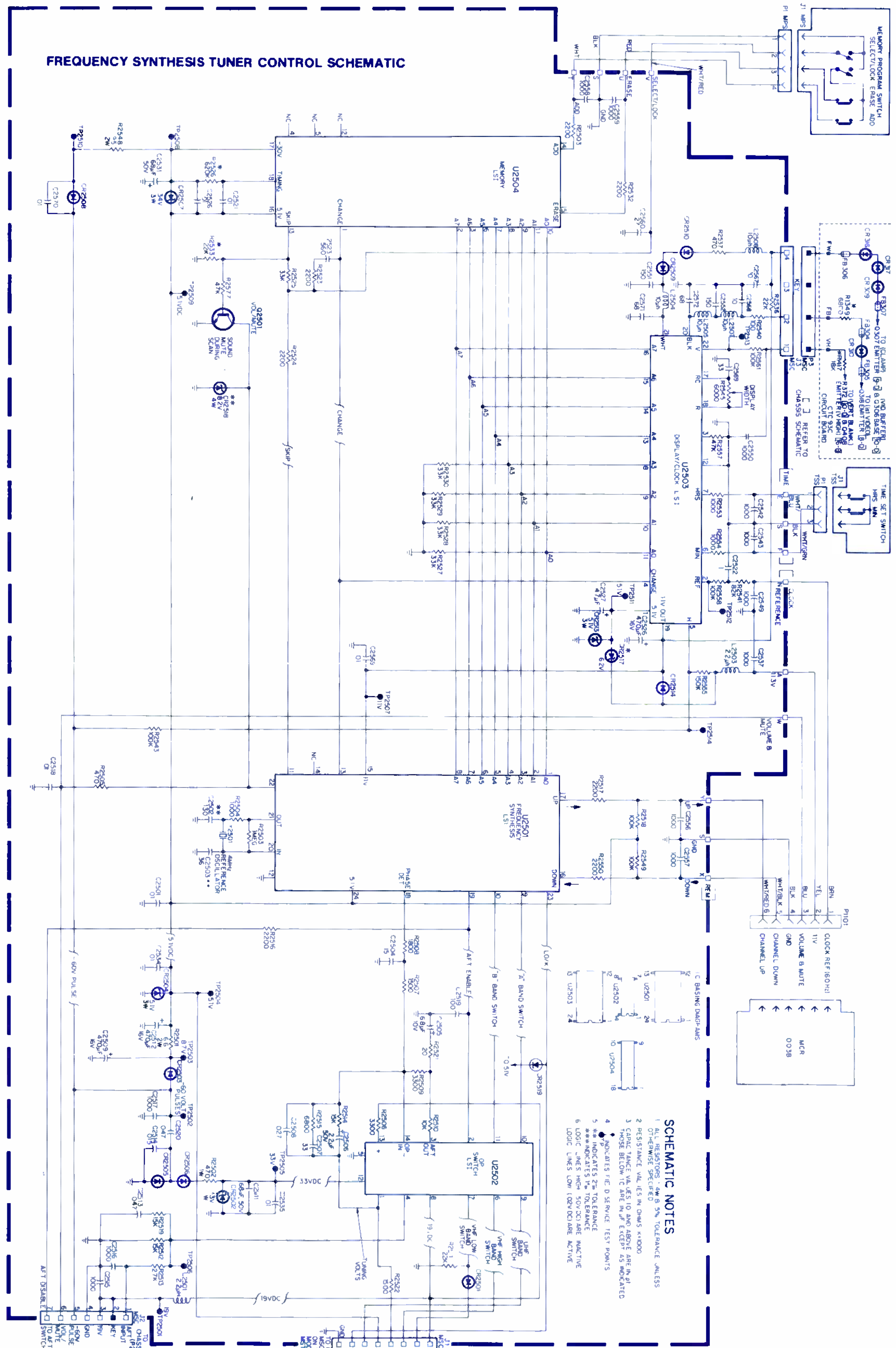


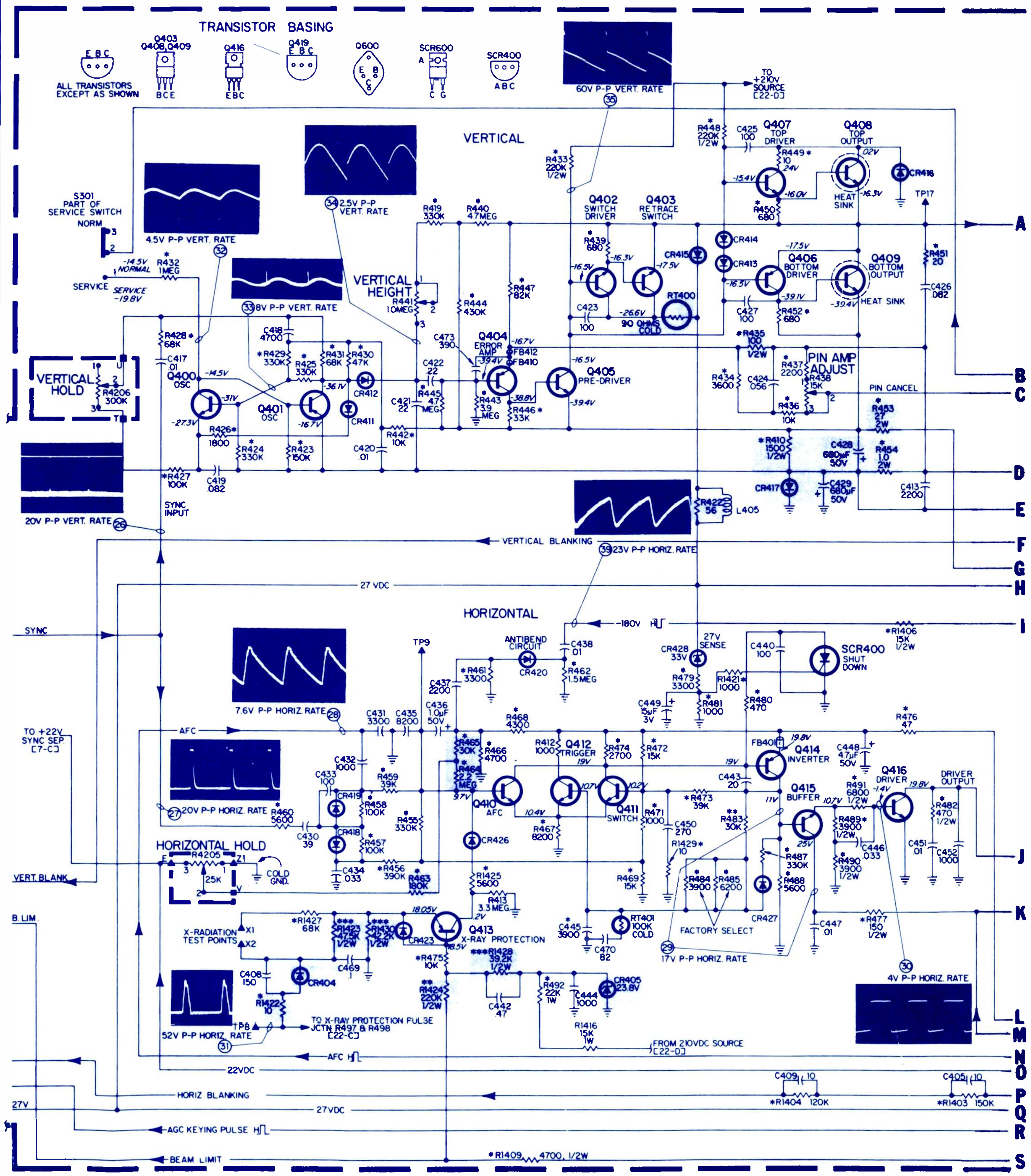
RCA
Color TV Chassis
CTC 93

ADDITIONAL INFORMATION NEXT PAGE

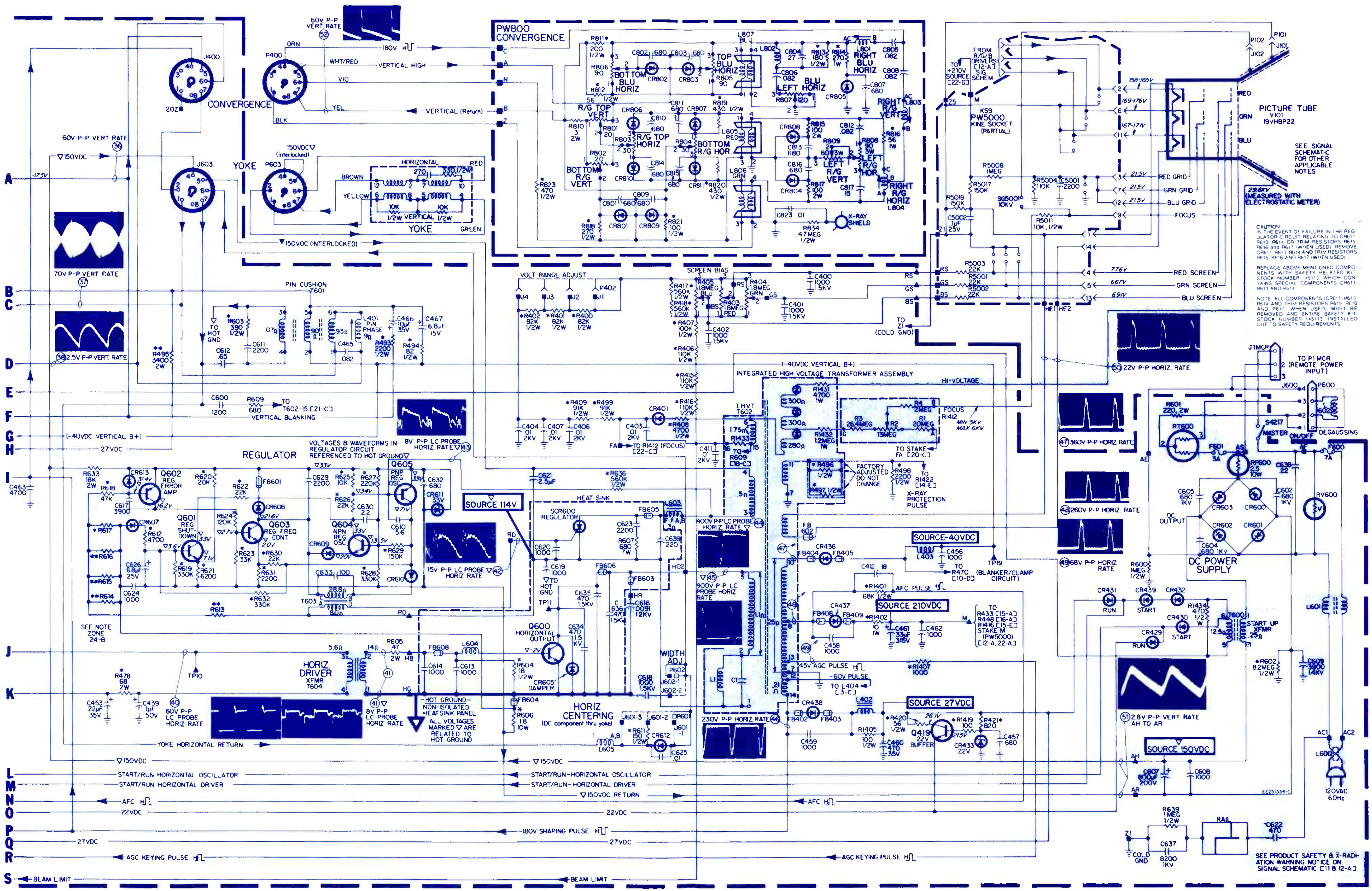


RCA
Color TV Chassis
CTC 93





RCA
Color TV Chassis
CTC 93



1791

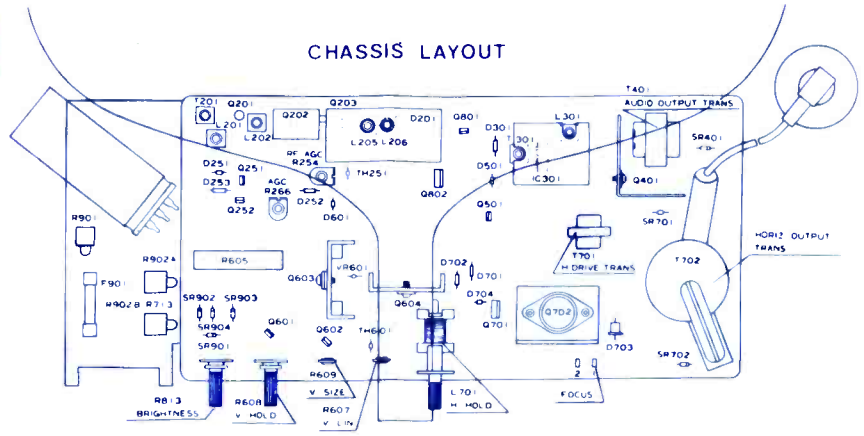
SHARP
B&W TV Model
3W99

MAY • 1979

ET/D TEKFAX

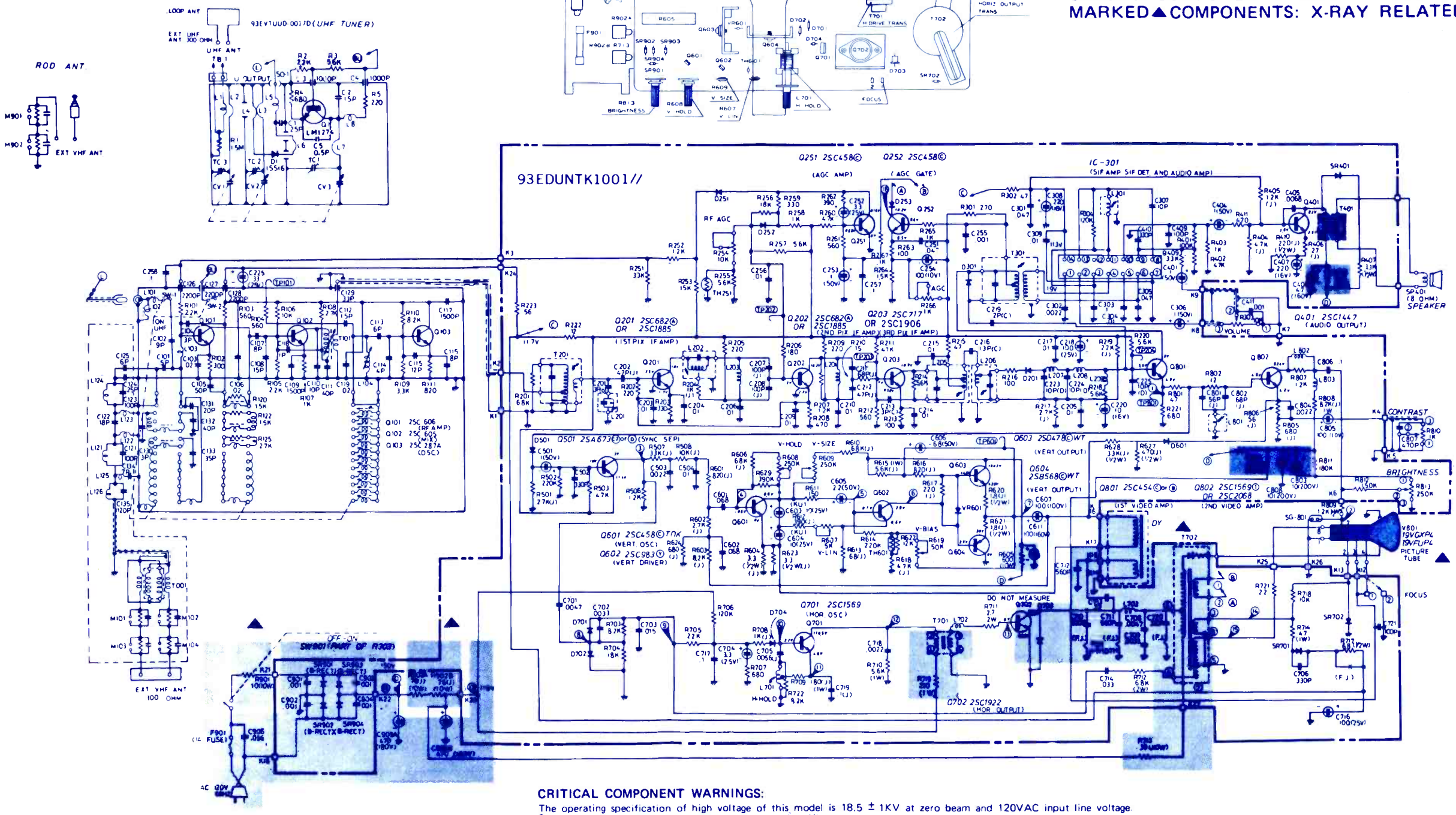
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

CHASSIS LAYOUT



IMPORTANT SAFETY NOTICE:
SHADED AND MARKED ▲ COMPONENTS HAVE SPECIAL 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



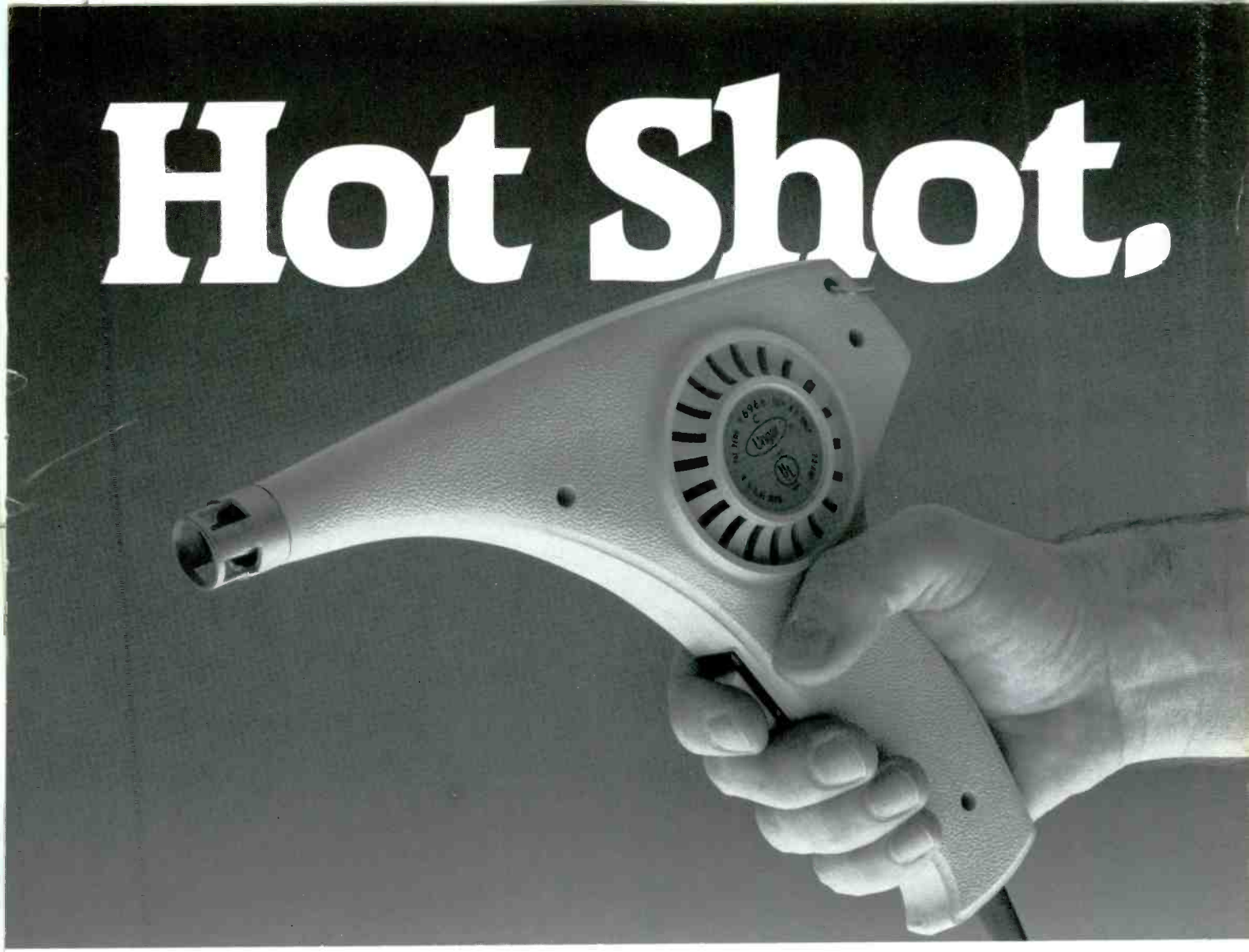
LINE CORD IS POLARIZED
SMALLER PIN IS CONNECTED
TO HOT SIDE OF AC LINE

CRITICAL COMPONENT WARNINGS:

The operating specification of high voltage of this model is 18.5 ± 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 these 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.



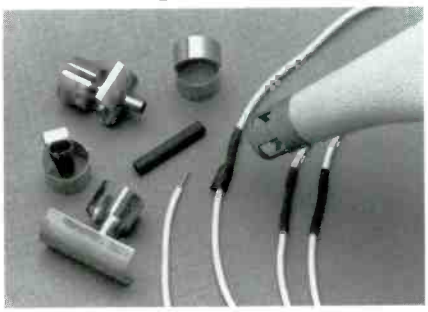
Our heat gun is light, tough and very easy to control. You get easier handling with precise hot air direction and built-in durability.

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



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

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

Ungar.

The Heat Gun. For Precise Control Of Hot Air.

Circle No. 103 on Reader Inquiry Card

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.

THE MARK OF QUALITY 75TH ANNIVERSARY

Triplett performance... a tough act to follow

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

TRIPLETT®