ET/D

SEPTEMBER 1980 • $1.50

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS

Heat and semiconductors

What's new in television

Field service costs

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION

QUICK RELIEF FOR THE COMMON CALLBACK

Too many callbacks got you down? Get quick relief with PTS' module and tuner rebuilding programs. Our 8-hour express service enables you to buy, rebuild or exchange most any module or tuner made. They're rebuilt with quality parts that are as good or better than those available from the original manufacturer. Unlike most OEM's rebuilding programs, we purchase duds. Eliminate the headaches in your life. One stop PTS. . .quick relief for the common callback.

PTS ELECTRONICS, INC.

The Only Name You Need To Know

For the location nearest you, see servicenter guide on next page.

INDUSTRY REPORT

Home Alarm Market put at $240 million by 1984

The market for home burglar alarms and detection systems will reach $240 million annually, it is predicted by the market research firm of Frost and Sullivan. That same market this year is expected to be about $142 million.

The market consists of installed systems and components, appliance type systems, with the former being sold through retailers.

According to the study an increase of 32 per cent in installed systems volume—from $87 million to $115 million by 1984—is forecast. A 136 per cent advance in appliance systems demand during the 1980-84 period is forecast. These are radio frequency systems which include control console and transmitters for attachment to doors and windows, and self contained trap zone systems, etc. This market should total $125 million by 1984, Frost and Sullivan said.

The "hard wired" perimeter system because of its relatively high price of $1,500 to $2,000, will remain a limited market aimed primarily at affluent homeowners.

AT&T and Knight-Ridder Begin two way Video Tests

AT&T and Knight-Ridder Newspapers have announced an experimental trial of their Viewdata system involving 160 homes in the Coral Gables, Fla., area.

Viewdata, a subsidiary of Knight-Ridder is supplying computer programs for the six months trial and will maintain the central computer. AT&T is supplying equipment and installation services for the project.

The trial involves modification of RCA color TVs to interface with a microprocessor and keyboard.

Magnavox Completes Headquarters Move

The Magnavox Consumer Electronics Company has completed its move from Fort Wayne, Ind. to Knoxville, Tenn. The new address is Straw Plains Pike, P.O. Box 6950.

The move, Magnavox said, was made to consolidate manufacturing and engineering operations with its sales, marketing and design groups.

ETA-I Annual Meeting

Continuing its policy of regional meetings, the Electronics Technician's Association-International held a technician workshop at Iowa State University July 11 and 12 in conjunction with its annual meeting at the Gateway Center, Ames, Iowa.

Simultaneous technical and non-technical programs were presented interspersed with microcomputer and other educational demonstrations. Technical sessions covered microprocessors, solar and wind energy, phase-locked-loops, op-amps and other subjects. The non-technical sessions covered microcomputer applications, using the microcomputer in training, resume writing and other business and training subjects.

ETA's annual business meeting was convened at approximately 5:00 PM July 12. Various committee reports indicated moderate and constant progress in all areas of membership, certification, educational activities and development of the Canadian division. After the report of the election committee, the gavel was passed from outgoing Chairman Jesse Leach to Vice-Chairman D.C. Larson who under the by-laws succeeds him as chairman.

The scheduled events ended the same evening with a special President's Dinner and Awards Banquet at which Ron Lettieri was presented the Norris R. Brown Technician of the Year Award.

Zenith Earnings Up

Zenith Radio Corporation has announced first half results were up for the period ended June 30. Sales advanced from $476 million to $530 million and earnings rose to 57 cents per share, compared with 32 cents for the same period a year earlier.

Second quarter results also showed strong gains with earnings up to 22 cents per share, compared with second quarter earnings of 12 cents per share for 1979.

TV Stereo Tests Underway

The Electronic Industry Association's subcommittee on multichannel television sound is currently evaluating and testing three proposed designs for dual channel sound in the United States.

Systems being considered, at tests being run at Quasar's Franklin Park, Ill., plant, are those designed by EIA-J, Zenith and Telesonics.

The effort is an all industry cooperative effort to come up with a standard for the U.S. market.

New Trade Association Announced

A new trade association, designed for sound contractors, and known as the National Sound and Communications Association, has been formed.

According to a statement from the public relations group for the body, the purpose is "to provide a vehicle for evaluation, analysis, communication, and exchange of ideas on matters of common interest to sound and electronics systems contractors; to conduct

ET/D

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS

SEPTEMBER 1980, VOL. 102, NO. 9

On the cover: Heat, the perpetual enemy of the electronic circuit, is the subject of a special report this month by Bernard Daien. Specifically, the impact of heat on semiconductors and what can be done to minimize its destructive effects.

FEATURES

DEPARTMENTS

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION ABP ABC EIA

ELECTRONIC TECHNICIAN/DEALER [ISSN 0192-7175] is published monthly by Harcourt Brace Jovanovich Publications. Corporate offices: 757 Third Avenue, New York, New York 10017. Advertising offices: 757 Third Avenue, New York, New York 10017 and 111 East Wacker Drive, Chicago, Illinois 60601. Editorial offices: 111 East Wacker Drive, Chicago, Illinois 60601. Accounting, Advertising Production and Circulation offices: 1 East First Street, Duluth, Minnesota 55802. Subscription rates: one year, $11; two years, $18; three years, $24 in the United States and Canada; all other countries: $30. Single copies: $1.50 in the United States and Canada; all other countries: $3.50. Controlled Circulation postage paid at Dansville, New York 14437.

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

marketing conferences for such contractors; and to engage in other activities to foster better business practices for sound and electronics systems contractors."

According to the statement, eligible companies for membership are those which sell and install sound and communications equipment and electronics systems. The association also hopes to attract installers of telephone interconnect equipment, burglar and fire alarm systems, and CCTV and security systems.

A national meeting has been tentatively set for next May in Atlanta, GA to coincide with EDS.

GTE Sylvania to Make Piezo Electric Components

GTE Sylvania has announced it will soon be making piezo electric components at its Tienen, Belgium plant for sale to the U.S. color television industry.

Products to be manufactured will include ultrasonic chroma delay lines for CTV decoders, used in PAL and SECAM products. They are also used in TV comb filters, cameras, and VTR/VCR/VDR applications. Sylvania will also make quartz crystals and surface wave, saw filters, which are becoming increasingly more popular as bandpass filters in television receiver IF stages. ET/D

ET/D

Richard W. Lay, *Editor (Chicago)*

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

Dave Neiman, *Associate Publisher (Chicago)*

Tom Greney, *Group Vice President (Chicago)*

John Paszak, *Graphic Design*

Missy Jersett, *Production Manager*

Debi Harmer, *Production Supervisor*

Lillie Pearson, *Circulation Supervisor*

Gene Bailey, *Reader Service*

Julie Laitin, *Promotion Director*

Dawn Anderson, *Classified Ad Mgr.*

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

ADVERTISING SALES

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

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

Midwest Region
Dave Neiman
111 East Wacker Drive
Chicago, Ill. 60601
(312) 938-2325

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

Sheila Connolly
10741 Moorpark St.,Suite #21
North Hollywood, CA 91602
(213) 980-7750 or (213) 760-1684

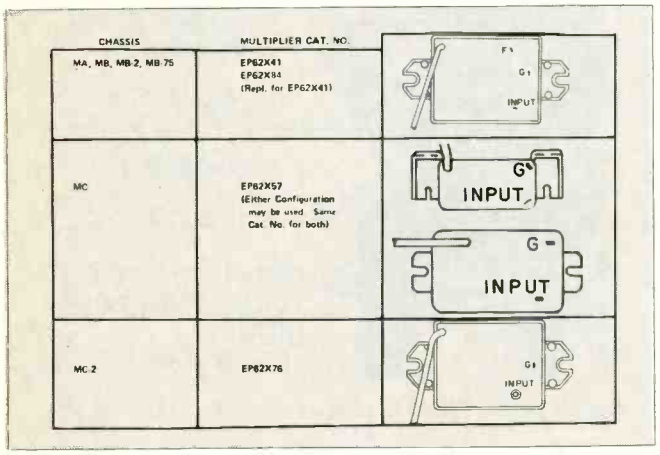
HBJ
HARCOURT BRACE JOVANOVICH PUBLICATIONS

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

SERVICE SEMINAR

GENERAL ELECTRIC

M Series High voltage multipliers. The various high voltage multipliers used in the M series are not interchangeable except as noted. A small number of MC-2 chassis used MC high voltage assemblies and EP62X57 multipliers. Use the part number on the original part for ordering when possible.

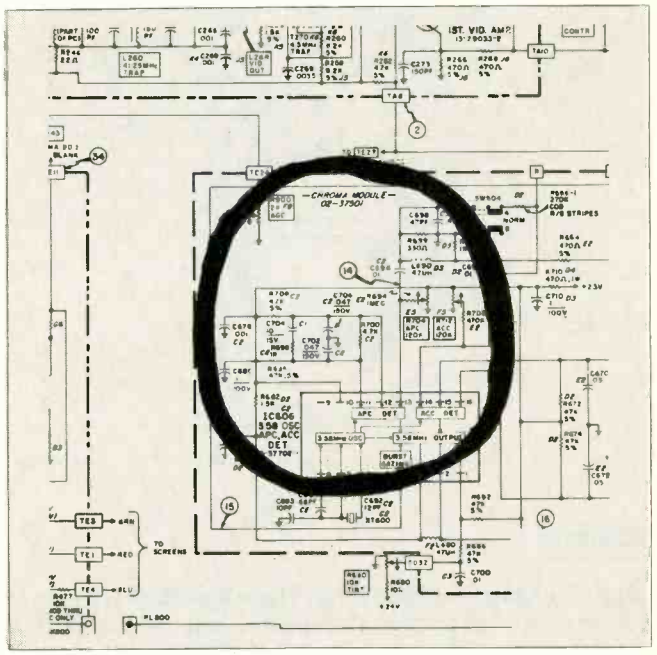


RCA

CTC, 85, 86, 89, 90, 91, 92—Xtended life Modular Chassis.

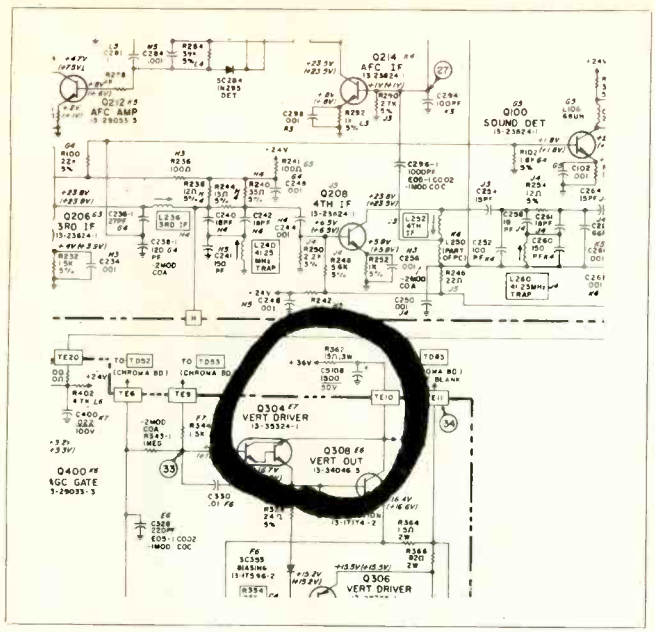
Horizontal driver transformer resistance readings are reversed in some schematics. The Primary's resistance is 7.6 ohms—the secondary's resistance is 0.15 ohms in all the above chassis.

SYLVANIA

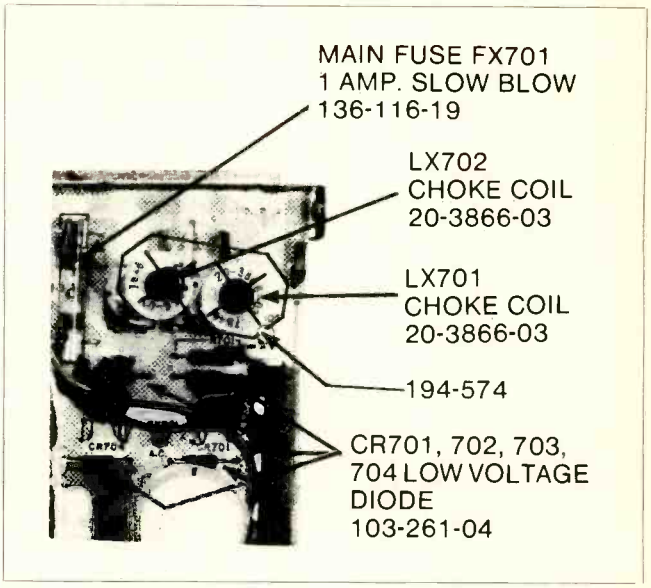


E 03/04/05—Takes one or two minutes to come into color sync. Possible cause, shorted C706.

No vertical—new module does not help. No voltage at test point TE10. Likely cause, open R362.



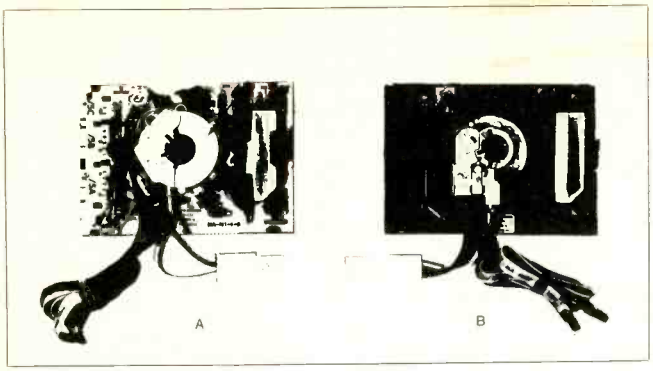
these coils. This oscillation may be the core vibrating within the coil or it may be the coil form vibrating against the circuit board. This oscillation may be damped by pressing a duroid captivating strip (194-574) down over the cores of the two coils or by applying a small amount of silicone rubber sealant, (205-229) about the coils.



ZENITH

19LB1X chassis—120Hz buzz. There have been reports of 120Hz buzz in 19 in. b&w TV receivers that use the 19LB1X chassis. This is the line connected chassis that uses a pair of choke coils (LX701 & LX702) at the point where the line cord enters the chassis. An oscillation may be set up by either of

9-155-01A Modules—Arcing at high altitudes—There were a number of 9-155-01A modules used in "L" line Color TV receivers that employ a CRT socket that has been found to arc at higher altitudes. This socket may be identified by its shape. Illustration A. Should you be called upon to service one of



these receivers for arcing at the CRT socket, be certain that the replacement socket is shaped the same as the socket in illustration B.

COMING NEXT MONTH IN ET/D

RCA's CTC 108

Residential Security Systems

Getting More Business

Digital Memories

NEWSLINE

TECHNICOLOR ENTERS VCR RACE. Technicolor--the color movie film people -- have jumped into the video cassette recorder marketing race with a super small portable which uses one quarter inch tape. The seven pound unit uses 30 minute cassettes. Firm president Jack Minor says the Model 212 is a "micro helical systems which represents an evolutionary development" in portability without loss of picture or sound fidelity. The unit is manufactured in Japan by the Funai Electric Trading Company--a manufacturer of electronics equipment for major American companies. NiCad batteries permit 80 minutes of use and the unit is equipped with a plug for 12-volt operation. It'll sell for $995.

AM STEREO SNAFU. The AM stereo SNAFU has brought predictable reactions from all parties concerned including Magnavox, developer of the system originally sanctioned by the FCC. Magnavox also issued a statement saying they have developed a "simple" conversion which permits broadcasters who have purchased Kahn stereo exciters to convert to the Magnavox format. Magnavox says this entails 13 component changes and insertion of a voltage controlled crystal oscillator in place of the rf crystal oscillator in the Kahn system.

EDS PLANS MOVE AHEAD. Plans for the 1981 Electronic Distribution Show, May 5-7, are moving ahead. The event is scheduled to be headquartered in the Atlanta Hilton. It will be the first time since 1971, when held in Bal Harbour, Florida, that the event is on the east coast.

SEARS ADOPTS RCA DISK SYSTEM. Sears has announced it will sell RCA manufactured video disk players this Christmas season. Meanwhile, Sanyo, a partner with Sears in the Sanyo Manufacturing Company, also has announced it would make RCA video disk systems for sale in the U.S. market. As it stands now four marketing organizations--RCA, Zenith, Sears and Sanyo, have announced for the RCA developed disk systems.

SALARIES UP. The "average" salary of a national service manager rose 12.8 per cent to $32,357 during the past 12 months. This figure, from the research firm of Abbott, Langer and Associates, included data from non-independent service facilities--such as manufacturing, merchandising, and test equipment firms.

AT&T BARRED FROM SELLING ALARMS SERVICES. In what the National Burglar and Fire Alarm Association calls a major victory, the House Commerce Committee has amended the Communications bill (HR6121) to restrict AT&T from selling alarm services. If the bill becomes law, it would restrict AT&T from providing to the public any instrusion or fire alarm service.

Facts from Fluke on low-cost DMM's

Conductance: What it is, and what it can do for you.

We've often referred to conductance as the "missing function" in DMM's – the capability so many of you have wanted in a DMM but couldn't find until we introduced the 8020A Analyst.

Since its introduction, the Fluke 8020A has become the world's best-selling DMM. And four more low-cost models with conductance ranges have been added to our line. But you'll still find this function only on Fluke DMM's.

Simply stated, conductance lets you make resistance measurements far beyond the capacity of ordinary multimeters. Until the 8020A, there was no way to make fast, accurate readings from 20 MΩ to 10,000 MΩ – ranges typically plagued by noise pickup. Yet, measurements at these levels are vital in verifying resistance values in high-voltage dividers, cables and insulators.

With conductance, the inverse of ohms, which is expressed in Siemens – Fluke DMM's can measure extreme resistances. Simple conversion of direct-reading conductance values, then, yields resistance measurements to 10,000 MΩ (and 100,000 MΩ with the 8050A), without special shielding and using standard test leads.

Here the 8020A is being used to check leakage in a teflon pcb. With a basic dc accuracy of 0.1% and an exclusive two-year warranty, this seven-function handheld DMM has made hundreds of new troubleshooting techniques such as this possible, and more are being discovered every day.

For more details, call toll free **800-426-0361**; use the coupon below; or contact your Fluke stocking distributor, sales office or representative.

FLUKE®

8020A Multimeter

IN THE U.S. AND NON-EUROPEAN COUNTRIES:

John Fluke Mfg. Co., Inc.
P.O. Box 43210 MS#2B
Mountlake Terrace, WA 98043
(206) 774-2481
Telex: 152662

IN EUROPE:

Fluke (Holland) B.V.
P.O. Box 5053, 5004 EB
Tilburg, The Netherlands
(013) 673 973
Telex: 52237

☐ Please send 8020A specifications.
☐ Please send all the facts on Fluke low-cost DMM's, including the conductance application note.
☐ Please have a salesman call.

Name

Title Mail Stop

Company

Address

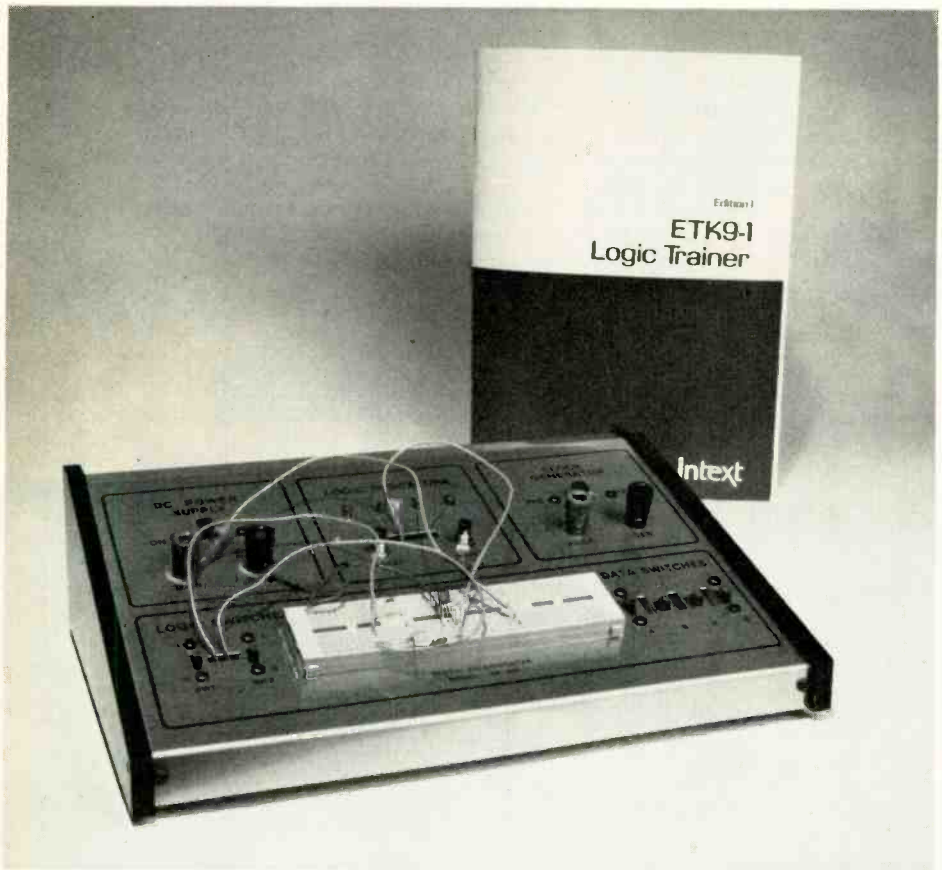
City State Zip

Telephone ( ) Ext.

For literature circle no. 111 ETD 9/80

CONTINUING EDUCATION REPORT

ICS recently announced a program of training in logic and digital techniques which can be pursued several different ways. This digital study program is part of ICS' career program in electronics and also part of ICS' associate degree program, as well as being available by itself. In fact, ICS will work out a program to suit apparently almost any need.



ICS (Intext) Logic Trainer and manual. For more information circle 151 on the reader service card in this issue.

Logic and digital techniques

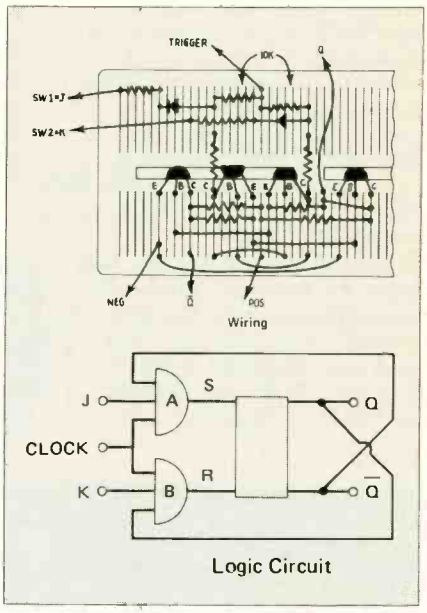
ICS' Program

By Walter H. Schwartz

The material of most interest to us here is a series of six texts and a digital logic trainer. These six texts by title are; *Number Systems and Logic, Part 1,* and *Part 2, Digital Methods and Components, Part 1,* and, *Part 2, Organization of Digital Computers* and *Logic Trainer.* For most of us the logic trainer with its manual and the thirty-five experiments performed with it are of the greatest importance. The preceding five texts however are valuable preparation for the understanding of digital logic.

The experiments begin in the most simple manner possible, with switches; gates are, after all, switches. Experiment 1.2, for example, is an two input AND gate, two switches in series—both must be closed for output. Experiment 1.3 is a two input OR gate, two switches in parallel—either closed produces an output. And this is really all the corresponding gate circuit does, be it diode, transistor, or integrated circuit. Other experiments with switches include the exclusive OR gate and the proofs of several of the basic Boolean theorems.

The second group of experiments uses discrete components to construct basic logic circuits—like those used in early computers. Among the circuits in this unit are diode AND and OR gates, a



transistor inverter, diode/transistor NOR and NAND gates, discrete component flip-flops (RS, JK, D and T). Unlike experiments performed solely with IC's I *think* I get a better feel for what is going on with such basic experiments.

The third group of experiments uses the ubiquitous 7400 series TTL. Most of the experiments use 7474 dual D type flip-flops to build a shift register, a ring counter, a BCD counter, a down counter and with a 7400 quad NAND gate also, a divide-by-ten counter. Other experiments involve a seven segment display and its decoder (a 7446), and assembling all the necessary components for a binary counter with BCD and decimal readout.

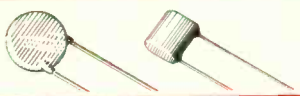
Each section has questions and answers, and an overall examination to be sent to ICS for correction consists of a tabulation of the results of the experiments.

The cost depends upon how many preliminary lessons one needs. The six lesson texts previously mentioned and the Logic Trainer would cost a bit less than $200. This includes response to written requests for help and a toll-free telephone service for instant help, 8 AM to 8 PM EST, Monday through Friday, from an instructor. At other hours phone requests will be recorded and answered within 24 hours by mail or phone. ET/D

You'll find MORE of what you want in Sprague Q-LINE™ capacitors

MORE Types • MORE Ratings
MORE Quality • MORE Value

Sprague Q-LINE Capacitors are on display for self-service purchasing at leading electronic distributors. The buying is easy because you can see what's available . . . without waiting, without asking, without searching . . . all pertinent information is clearly spelled out on attractive, color-keyed Blister-Pak packaging, which keeps capacitors visible while protecting them from moisture and dirt. Q-LINE Capacitors give you a broad choice of popular, frequently-needed types and ratings:

Capacitor Type		Number of Ratings	Capacitance Values	Working Voltage Range
	Axial-Lead Electrolytic	62	.47 to 15000 μF	0-6.3 to 0-450 V
	Vertical-Mounting Electrolytic	33	.47 to 4700 μF	0-16 to 0-630 V
	Vertical-Mounting Film	63	.0010 to .47 μF	0-100 to 0-1600 V
	Resin-Coated Solid Tantalum	31	.1 to 680 μF	0-3 to 0-50 V
	General-Application Ceramic	65	5 pF to 3.3 μF	0-25 to 0-1000 V
	Epoxy-Dipped Mica	17	10 to 1000 pF	0-500 V

For detailed definition of types and ratings available, write for a copy of Q-LINE Capacitor Listings to Sprague Products Co., *Distributors' Division of the Sprague Electric Co.,* **65 Marshall St., North Adams, Mass. 01247.**

Where MORE is more than a promise.

SPRAGUE®
THE MARK OF RELIABILITY
a subsidiary of GK Technologies Incorporated

6S-0105

Circle No. 127 on Reader Inquiry Card

FROM THE EDITOR'S DESK

I received a recent inquiry about a statement I made in an editorial (July, 1980) concerning the necessity for adequate skills in digital electronics in order for a professional technician to compete amid today's array of high technology consumer products. Today's modern technician exists in an environment filled with digital/microprocessor controlled devices.

How, the writer asked, would I suggest that technicians go about acquiring these skills at the same time they must keep up with the normal, and always demanding, workload—and remain productive at that too.

Admittedly, it is not easy. Yet there is only one answer to this question as far as I know. And, that is for the individual to make a strong and firm commitment to *continuing education.*

Fortunately, once this commitment is made there are many sources from which a professional technician may draw.

Perhaps the oldest and certainly one of the best sources in continuing electronics education would be the system of technical and vocational schools that exist on a nationwide basis. Many independent vocational/technical schools exist—some with classroom facilities such as DeVry Institute, while others offer home study courses, for instance the Cleveland Institute of Electronics.

The technician interested in learning more about the educational opportunities about him will have to survey the junior colleges and vocational schools in his area to learn of them.

Other sources of continuing education in electronics are the manufacturers themselves. For instance, Sylvania has just offered, through its authorized distributors, a fine basic course in Basic Digital Electronics. I know in the past Sony has offered instructional material in both classroom and video cassette form; and when I attended a class on Magnavox's microprocessor controlled Touch Tune system, much of the instructional material offered in that course dealt with basic digital principals. Certainly manufacturers are a prime source of educational material—how else could they offer service support for digitally controlled products without teaching the basics?

Also there are independent companies in the continuing educational field. Heath/Zenith Educational Systems has recently been formed (ET/D June, 1980) which offers a wide variety of home study course material in many areas, including digital electronics and microprocessors, operational amplifiers, active filters, and many, many more. ICS in Scranton, PA., is another source of continuing education in electronics.

The industry associations usually hold technical sessions at their annual meetings each year.

There is ET/D also. The very reason for the existence of ET/D is for continuing educational purposes. ET/D, for instance, recently completed its third series on digital electronics, the first series having been printed about 10 years ago; the second a three part series beginning in the November, 1977 issue; and the last a seven part series, complete with lab experiments, which began in the May, 1978 issue. The latter two were by Joe Carr, a regular contributer.

Running hand-in-hand with this series was Bernard Daien's eight part series on basic microprocessor technology, a description of microprocessor technology that is a complete basic introduction to these devices. (This series, incidentally, will soon be offered in reprinted booklet form.)

Together with these series, ET/D regularly offers "Continuing Education Reports," articles reviewing various educational courses being offered.

This is certainly not a complete listing of the opportunities available today for continuing education. But the opportunities are there. It is up to you to seek them out and take advantage of them.

Sincerely

The Tools.

Boker, Crescent, Lufkin, Nicholson, Weller, Wiss, Xcelite.

The right tool makes the job easier.
And Cooper makes the right tool for the job.
Whether you're making or mending, cutting or joining, measuring or stripping, there's a Cooper tool that's just right. Don't take chances on tools. Specify Cooper and get 'em right the first time!

from Cooper The Toolmaker.

COOPER INDUSTRIES

The Cooper Group

BOKER® CRESCENT® LUFKIN® NICHOLSON® WELLER® WISS® XCELITE®

P.O. Box 728, Apex, North Carolina 27502. Tel: (919) 362-7511. Telex: 579497.

Circle No. 108 on Reader Inquiry Card

LETTERS

ANTIQUE RADIO INFO:

I have a treasury of old radio and TV servicing data dating from 1927. Included are:

(1) "Most Often Needed Radio Diagrams and Servicing Information" 1926 1949 Vol. 1 thru 9 Supreme Publications, compiled by M. N. Beitman

(2) Radio Encyclopedia, Gernsback 1927

(3) Radio Service Manual, Gernsback Publications 1930

(4) Radiola 66 RCA Service Notes 1929

(5) ARRL Handbook 6th Edition 1930

(6) Modern Radio Servicing, Radio and Technical Publishing Co. 1935

Collection also includes service bulletins for Hallicrafters S-55 and S-56 Receivers, old tube manuals, magazines, etc.

G. Zvolanek
RFD 1
Wakeeney, KS 67672

HELP NEEDED:

I need help in locating a transformer for a Symphonette radio model LCR511. I wrote to a company in Larchmont, N.Y. but letter came back "Out of Business." Does anyone know who took over parts for these radios? The part number on transformer is 11590-02B.

Charles Hess
201 S. Oak St.
Buchanan, MI 49107

I need schematic and operating manual for a PACO OSCILLOSCOPE MODEL S-55. Any information will be appreciated.

Richard Gagnon
42 Elbow St.
Woon, RI 02895

I need your help. I need information and/or schematic/tube placement chart for a Korting Constellation 66, reel-to-reel stereo tape player recorder. It has two unknown tubes.

Daniel Martinez
Radio Clinic
239 E. 115 Street
New York, NY 10029

You keep sending me subscription offers. I have told you several times I have retired. Fourty-one years in business is enough. I have been a subscriber since 1938 when your magazine was known

as "Radio Retailing." I still have all copies since Feb. 1938. Is there a market for these? They are collector's items.
Paul G. Wunsch
Clifton Radio Service
421 Clifton Ave.
Clifton, NJ 07011

I would appreciate it very much if you could kindly run the following in your letters column. Wanted: Picture tube for 3'' Symphonic, model TPS-30 (part # C6407); on-off/volume control for Zenith radio Royal 275, chassis 7CT40Z2, part #63-4602 or 6303693; Emerson B&W yoke #708452 (Y-105).
Mike Danish
Mike's Repair Service
P.O. Box 217
Aberdeen Proving Ground, MD 21005

I would be grateful if you could publish my request in the letters section of your monthly magazine that I have subscribed to for 15 years and found extremely informative and very helpful.

"Help Needed: I need a schematic and operating manual for a Precision White Dot/Bar Generator Model E 420 and Precision Color Bar Generator Model E 440. Would be glad to pay the cost of copies of these manuals which I have not been able to purchase so far."
P. S. Raju
493 Wickham Avenue
St. Lambert, J4R 2B6
Quebec, Canada

TEKFAX:
As a new subscriber I would like to know if there is a cross reference available for determining if a certain TV Schematic has ever been published in the magazine?
Eugene E. Hess
40 Tinker Way
Santa Barbara, CA 93101

Editor: We've never done a cross reference from one brand of TV set to another for TEKFAX. We could use a good model cross reference as a feature article if any one has compiled one or perhaps we could collect information and compile one. Does any have any contributions?

So far I have been depending upon the Schematics manuals you have been supplying by the subscription that I made long time ago. Your service has been wonderful and I have been proud of it as a subscriber. Now, I need to get the following manuals: 110, 113. Please, let me know if you have any of them or if you could pass this information to "Letters" for public information.
Gabriel Y. Martinez
Magnificent TV Service
6809 N. Manhattan Ave.
Tampa, FL 33614

Editor: The only TEKFAX in print are 112, $3.50, 114, $3.50 and the new 115 at $5.00. All others are long out of print.

BOUQUETS:
I just want to thank you very much for the very necessary technical information I have received over the many years I have been receiving your magazine. There is no doubt that it is necessary for the proper operation of a TV Repair Station.

Now that I have retired (2 years ago), I have plenty of copies to review in my retirement.

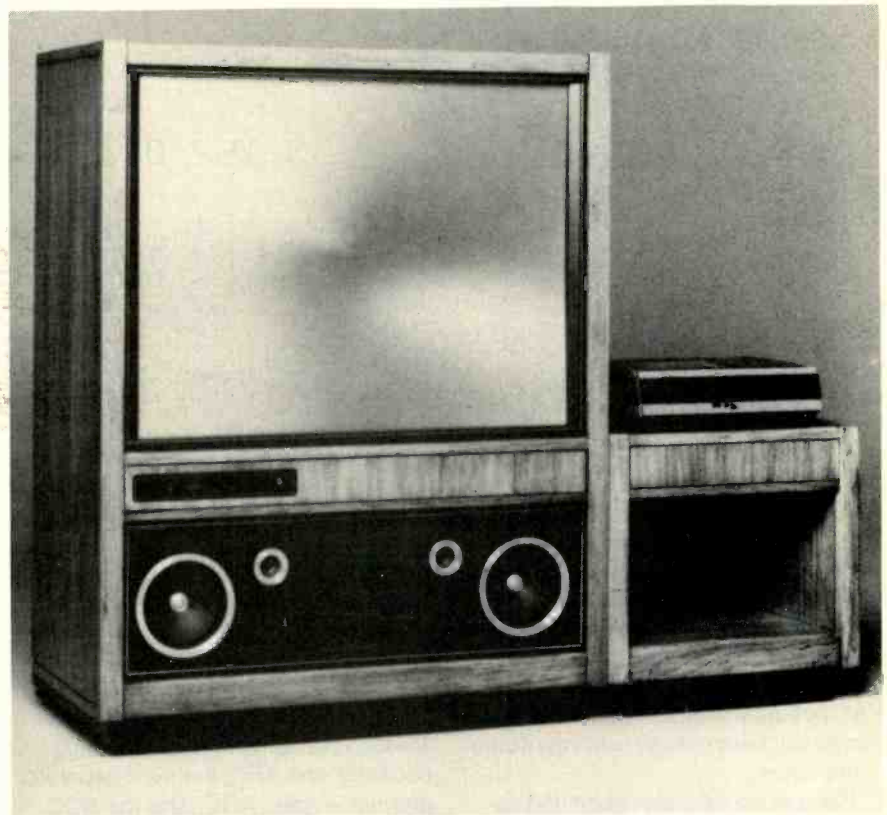
I have sent the subscription blank to another service shop that I feel will take up where I left off. Suggestion: Add a small section for beginners.
Marvin Levin
(Levin Television Service)
Brooklyn, NY 11204 ET/D

The latest TV chassis

What's new for 1981

There's more microprocessor controlled tuning, higher circuit integration and fewer components on board, and the industry is gearing up for CATV. Here's a survey of the latest chassis for the 1981 marketing year.

By Richard W. Lay



General Electric's new Widescreen 3000 television center.

If there is any doubt of the impact CATV is having on the consumer television industry, a look at this year's 1981 model TV receivers should clean this up quickly. Many major manufacturers, RCA, Zenith, GE, Quasar, Panasonic, are offering midband capable channels as part of their standard tuning systems.

The other major change, outside of the continuing spread of "computerized" tuning systems, is the comb filter which has finally just about spread throughout the industry. With more sensitive IC circuitry, better picture tubes, and higher quality broadcast transmission, this was a natural. The other noteworthy trend is the incorporation of low level video detectors — also called synchronous — into more products and the increasing use of SAW filters in IF strips to help eliminate the costly coils which, as you know, from time to time can cause hefty realignment problems.

The fact that the 1981 chassis are small is not new, the size of chassis having dropped steadily — and rapidly — in the last five years. But it just dawned on me that if they continue getting smaller and smaller, as long as the 25-inch console remains, some innovative manufacturer might just decide to make that inner compartment a storage area. That's just about how much space you have back there now days.

Well, enough "humor." Let's take a look at what's going on in TV design and circuitry for 1981. New chassis have been introduced by GE, RCA, Sylvania, Quasar.

Sylvania

Sylvania has introduced two new large screen television chassis for 1981 as the first of its E50 series, plus a 12-inch portable, AC/DC black and white set.

Also new to the color TV year is a brand new digitally operated frequency synthesized tuning system which includes an infra red remote control unit. For the first time, too, Sylvania is using its own 100 degree, in line, tripotential CRT and a precision wound hybrid deflection yoke (which can't be removed). This combo is in all 25-inch models.

The two new color chassis are the E51 (25-inch) and the E53 (19-inch). Both are readily field serviceable with easy to

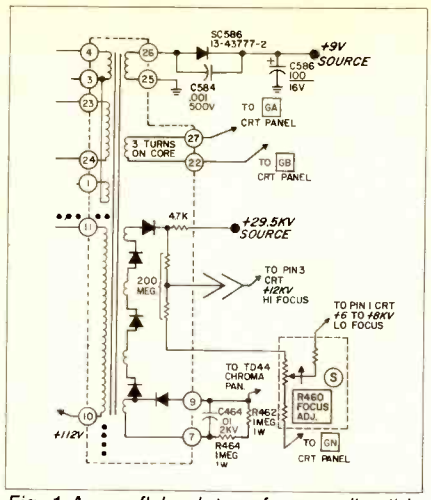


Fig. 1 A new flyback transformer, all solid state, is part of the new E51 and 53 chassis. A special high voltage sensing circuit causes automatic shutdown when the latter exceeds specified limits.

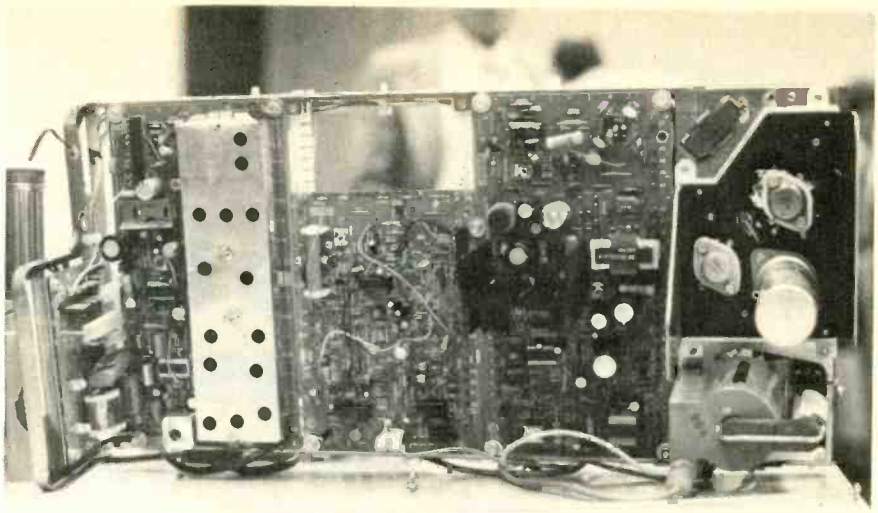


Fig. 2 Sylvania's new E53 (19-inch) chassis.

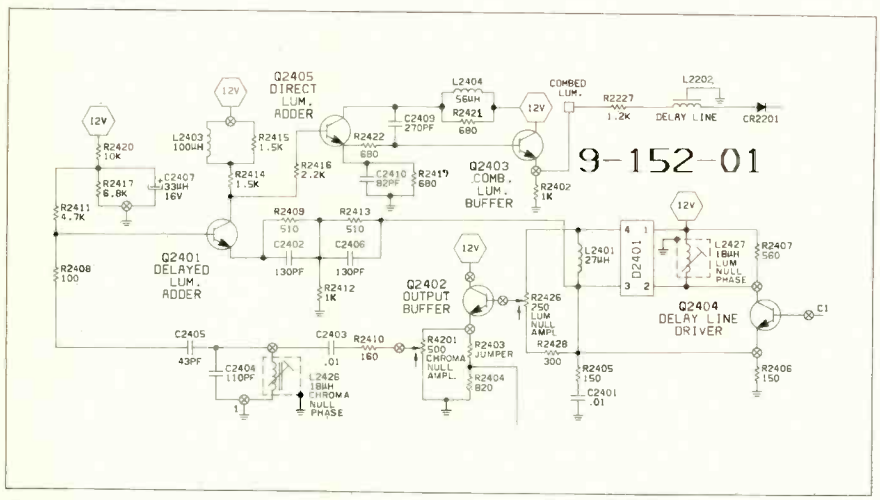


Fig. 3 The schematic diagram for Zenith's comb filter circuitry.

get at slide out chassis. Before going any further though, it should be noted there are two grounds, the chassis ground — which is connected to the AC line — and the isolated ground. A 60 VAC potential exists between each and can render false voltage readings if care is not taken.

There is an AC input panel in this chassis and all points on it are tied to the AC line. AC then passes to the deflection module where a mixture of ground systems exist. All power supply components, including the 112VDC, must be tied to the isolated ground. Three transformers on this board isolate the two systems.

The E50 series carries third generation GT-Matic, which incorporates automatic sharpness, color and black and white level controls, and a new vertical countdown IC.

Customer horizontal and vertical hold controls have been eliminated and a new high frequency, switching type voltage regulator has replaced the ferro resonant self-regulating power transformer used in the E45/E48 chassis.

Countdown IC

The new countdown IC, part number 15-43312-2, controls the horizontal oscillator and AFC, the sync separator and noise gate, AGC, and the AGC noise gate.

The vertical countdown is achieved by dividing a PLL locked 31.5KHz oscillator in the chip. Logic circuitry compares the signal thus generated with the incoming vertical sync and automatically adjusts for the proper frequency. Additional logic circuitry searches for incoming equalization pulses and if none are found, the system switches from the countdown to a directly synchronized mode.

Sylvania's new Dark Lite picture tube, tri-potential, in the 25-inch models, has allowed designers to reduce the cabinet depth by three inches (2.5 inches for high end 19-inch models). Incidentally, the Dark Lite 100 degree, 19-inch tubes are bipotential focus.

New tuning

A new digital logic tuning system of the frequency synthesis type is part of the new look for Sylvania this year. This is a random access system — available with a new infra red remote system — that requires two buttons to be depressed for channel selection.

The heart of this unit is an 4MHz crystal controlled oscillator which generates the digital pulses required for tuning.

One output drives display driver and decoder circuits for the two digit LED channel display; another biases bandswitch transistors on and off, and a third output is sent to the phase detector integrator (IC404) which produces voltages from 0 to 30VDC for tuning varactor circuits.

Zenith

Major changes in Zenith's Triple Plus chassis for 1981 include the addition of a comb filter in the luminance channel; modification in the video output module, an improved vertical countdown IC, plus the addition of the innovative "Space Phone" which permits, with the flick of a switch, the television viewer to turn his set into a two-way telephone device.

With so many sets now encompassing the comb filter — first introduced two years ago by Magnavox — it might be good to review the basic function of the circuit. (For a more detailed review, see ET/D, September, 1978.) The reason, incidentally, for the sudden rush to comb filters is — as Zenith points out in its training manual — reduced production costs for the filter itself.

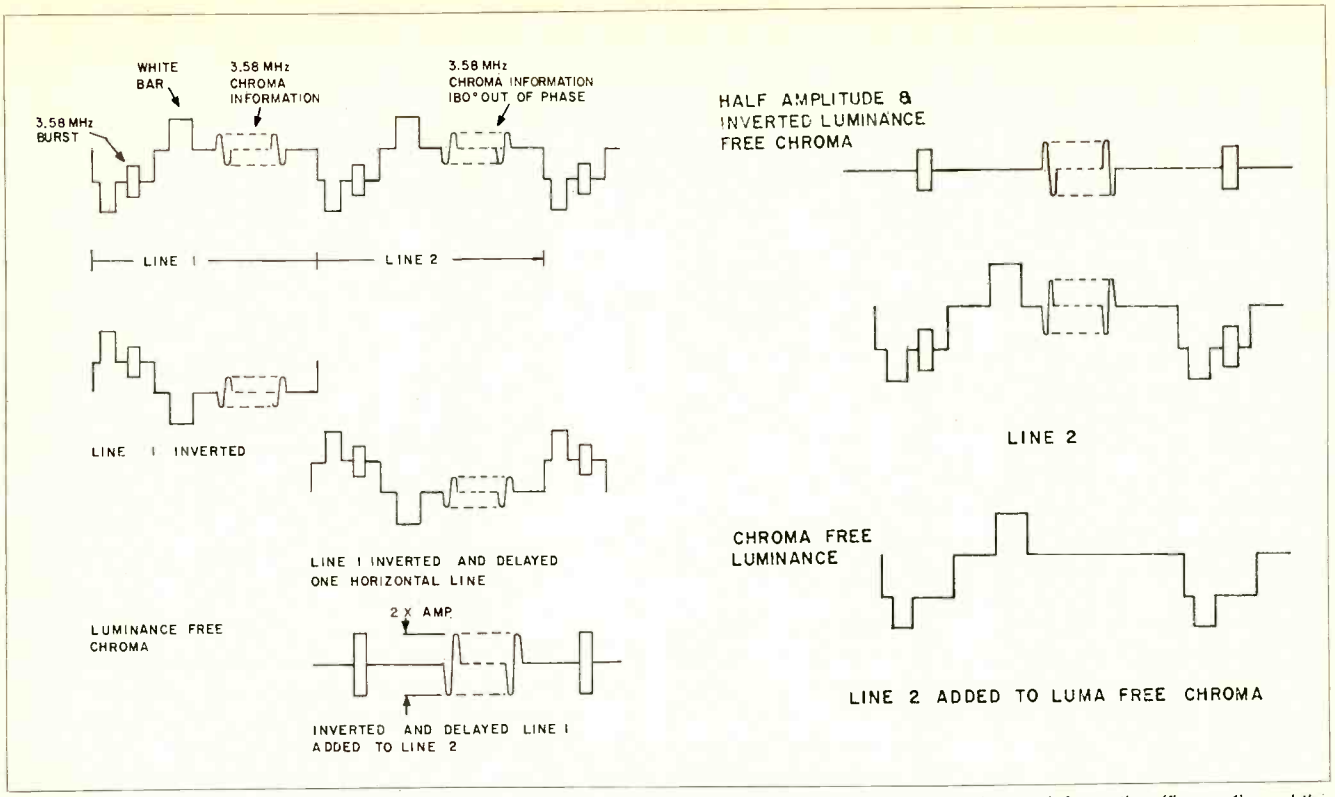


Fig. 4 & 5 How the comb filter works. Two separate functions, the separation of luminance from the chroma information (figure 4), and the separation of chroma from the luminance channel, are performed by the comb filter and delay line circuitry.

The comb filter, of course, basically increases horizontal resolution (frequency response) of the set from about 270 lines to 330 lines while eliminating chroma crosstalk which shows up as color confetti in a high frequency black and white signal.

Until the use of comb filters, which are becoming more economically feasible with their widespread use in home video cassette recorders, acceptable luminance bandwidth was generally limited to about 3.58MHz because of the 3.58MHz trap in the luminance channel for the purpose, of course, of eliminating chroma crosstalk.

Zenith's filter is basically signal canceller and adder circuits that takes advantage of the fact that line by line luminance information is in phase while line by line chrominance is 180 degrees out of phase. By taking one line of video information, delaying it by one horizontal trace period, inverting it and adding it to the next incoming line (line 2), the result is cancelled luminance and pure chroma at twice its normal amplitude. Dividing this signal by two and adding it back to line 2, a pure luminance signal, minus chroma, is achieved.

Adjustments

There are four adjustments for the filter, two for nulling luminance out of chroma and two for nulling chroma out of luminance. Only the latter, Zenith says, should be adjusted in the field. These are R2401 and L2426. The comb filter, and its associated circuitry, is located on the 9-152-01 module.

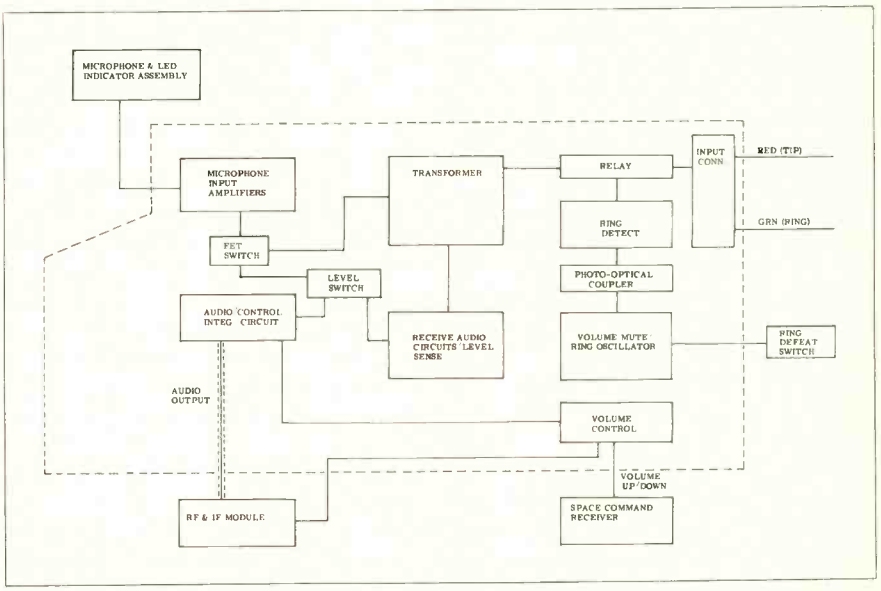


Fig. 6 The block diagram of Zenith's new "Space Phone" telephone answering and transmitting system.

The new vertical countdown circuit is designed to offer improved performance whenever the receiver is used with a video tape recorder's speed search function; with TV games, or CATV signals. Essentially, circuitry has been added to detect if 525 lines per frame exist. If so, the standard mode of operation is selected by the system logic; if not, the non standard mode is cut in. Also, a noise detector has been added so that the system begins looking for equalizing pulses if noise is detected. If they are not found, the non standard mode of operation is selected.

Some enhancement of "M" line tuning systems has also been achieved for the 1981 product line. This includes a more powerful microprocessor than in previous models; a black background for the on screen channel number and time display, automatic channel retention memory, and 105 channel tuning to accommodate CATV channels.

Space phone

Also unique to Zenith this year is its "Space Phone" concept, through which

the television receiver may be used to anwer incoming telephone calls. A microphone on the set's front panel permits the user to speak directly through his phone system and the caller's voice is heard through the receiver's speaker system. Separate switches permit the system to be defeated while connected to a phone system or to mute the "ring" while still preserving system operation.

The system operates as follows: When an incoming call is applied to the input circuitry, a yellow LED indicates this condition. When the answering button is depressed, the microphone amplifier circuitry is activated. Added features include a privacy button which allows muting of the outgoing signal and retention of the incoming signal. A feedback prevention circuit is also included. This utilizes a differential amplifier circuit to cancel out a feedback signal arising from possible variations in send/receive signal levels.

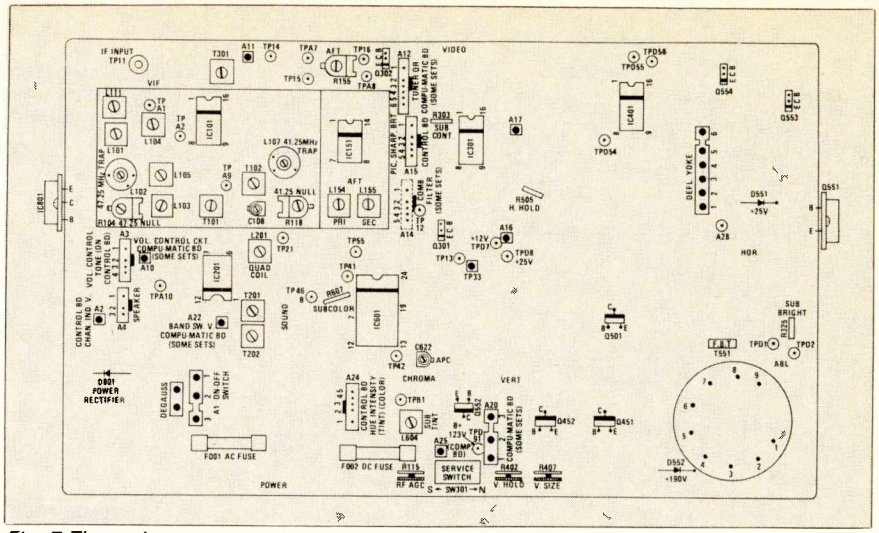


Fig. 7 The main component location chart for Quasar's newest 19-inch chassis.

Quasar

Quasar has introduced several new chassis models, the 25-inch 976, the 19-inch 979, two new 15-inch screen sizes using the 981 chassis, and a new 10-inch color model with the 983 chassis. Additionally, some new Quasar models carry 105 channel capability, including 23 cable channels.

The GTS 981 chassis is a manual 18-detent varactor tuned model with signal knob tuning and Dynacolor (automatic flesh tone correction). The ADTS 981 features remote digitally synthesized electronic tuning (Compu-Matic) with direct access keyboard and a 16-function infrared remote transmitter.

The only differences between the 19-inch DTS 976 and the ADTS 976 is the latter is a remote control version.

Quasar this year has also followed the industry trend in introducing a high resolution comb filter into its top of the line 976 chassis. The DTS 976 has manual direct access channel selection from a keyboard on set and infrared remote.

Quasar calls its comb filter a "Dynafilter." It is mounted on a separate board at the rear of the chassis and performs the usual function of eliminating high frequency chroma information from entering the luminance channel which is seen as a "barber pole" effect in high frequency video.

While other features have been around for some time, it might be a good idea just to review. Quasar's *Audio Spectrum* Sound is a special three speaker sound system with low, high and mid range response. A potentiomenter controls the volume of the low and high frequencies from zero to a level equal to the mid range speaker. Thus, the audio range expands as the control is turned up.

Dynacolor is Quasar's name for its automatic flesh tone and color intensity control systems. This includes a light sensor which compensates for room lighting variations. This circuit operates in conjunction with the picture control, a dual control affecting both contrast and color intensity.

The new 10 inch TS 983 chassis features a single picture level control, mechanical switch type VHF tuner and 70-position detent UHF. The signal processing circuitry is contained in four ICs, the video processor, sound processor, color processor and the vertical and horizontal sweep generators, sync separators and noise canceller. Horizontal output and B-plus regulator transistors are mounted on a vertical bracket.

Power is from a bridge rectifier which furnishes 130 volts. A 24 VDC supply is derived via scan rectification.

RCA

RCA is out with a new basic chassis, the CTC 107, 13-inch; CTC 108, 19-inch; and the CTC 109, 25-inch version that for the first time carries a SAW (Surface Acoustic Wave) filter in the IF strip, thereby eliminating the need for alignment. (See ET/D, August, 1979.) This new basic chassis, RCA says, carries 75 fewer components than the CTC 97, much of the reduction in the number of components, of course, is through the introduction of the SAW filter. The latter device replaces the usual three of four tuned IF circuits and associated circuitry.

Other features include RCA's frequency synthesis tuning system which is capable of tuning cable channels A-2 through I. A user accessible "cable normal" switch is all that need be adjusted.

New, higher density integrated circuits perform most of the signal processing in these chassis. The IF integrated circuit contains the circuitry for synchronous video detection (see ET/D, January, 1980), three stages of IF amplification, AGC and AFT. Adding to the compact size of this new chassis is another IC which performs most of the chrominance and luminance signal processing. Use of this IC has allowed RCA to add another circuit heretofore not found in RCA chassis — an automatic color/contrast control. This feature adjusts the color level automatically as the contrast level is changed.

General Electric

Highlights of General Electric's 1981 product line include TV receivers ranging in size from its 10-inch "Porta Color" unit to the recently announced Widescreen 3000 projection system based on the recently introduced EM chassis.

The new line includes higher performance sound, a new programmable infrared sequential remote system for 13, 17, 19, and 25-inch screen sizes; and the addition of the midband CATV channels.

GE is out with two basic chassis, the AB/AC chassis in the 10, 13 and 17-inch sizes and the EC/EM used in the 19 and 25-inch models, plus the widescreen projection system where it is called the EP chassis.

The "E" series, GE reports, denotes those systems which are modular in design for easier in home repair and the A chassis, designed for shop service

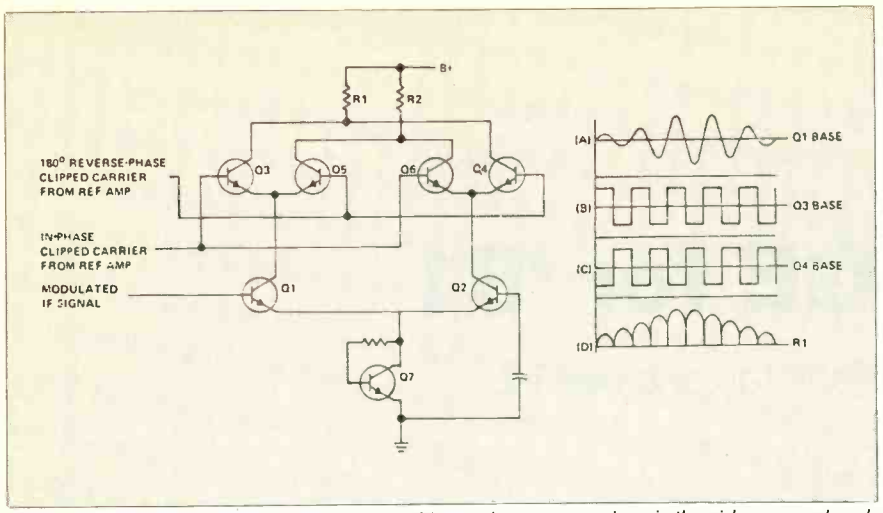


Fig. 8 GE has replaced all diode detectors with synchronous versions in the video, sound and AFT circuits.

with a single main printed circuit board.

The *Performance Sound* system which GE is showing for 1981 is designed for the use in 19 and 25-inch sets. It contains two 9-inch woofers and two 3-inch tweeters powered by a 10 watt amplifier which handles 50Hz to 15KHz. There are separate bass and treble controls and GE has also included a special audio output jack for routing sound through a home audio system.

Also new is a programmable infrared scan remote system. It features a small remote unit that scans pre-programmed channels, including nine midband cable channels.

All detectors in this chassis are synchronous, GE reports, to minimize the likelihood of intermodulation beats.

The video detector uses the IF carrier (45.75MHz) as the synchronizing signal. This reference is applied to the synchronous detector (see illustration). Transistor Q7 inside the IC is a constant current source, Q1 and Q2 form a differential amp. Q3 and Q6 are switches driven by the 45.75MHz referencve amp.

When positive half cycles of the IF carrier appears at Q1, the latter increases conduction, and the in-phase reference amp simultaneously turns on Q3. Q4, being reversed biased is off at this time. However, negative half cycles of the IF signal decrease Q1's output; this in turn, causes Q2 to conduct more, and this turns switch Q4 on. The result is increasing current flow through R1 which provides us with the amplitude modulation envelope. Pin 14 of this IC drives an emitter follower (Q102) and is connected to the signal module from there.

VHD

Another noteworthy announcement by GE is that it has adopted the "third" JVC video disc format previously developed by JVC, a division of Matshushita Electric Company. While it probably won't be marketed this year, the system, which denotes Video High Density, produces full color video and two channel stereo sound. The basic operation consists of a stylus which picks up capacitance variations in a laser beam pitted "record." GE says the fact that the contact area of the stylus and disc are about ten times the area when compared to the "grooved" audio record system, the life of the stylus and disc is increased. More details appeared in the January, 1979 ET/D.

Briefly, Other 1981 products:

—Sharp's new Signa 4000 chassis being used in 19 and 13-inch screen models. The top of the line includes quartz synthesized PLL tuning with 12 pre sent VHF channel and 8 UHF channels of one's choice, direct access infra red remote, rapid-on picture and sound, and a CATV jack.

—Sony has introduced its SL5800 Betamax VCR which features a double azimuth video head and a new Betascan feature which allows the user to search backward or forward at any speed from five to 20 times normal, slow motion and freeze frame, and 14 day programing.

—Sony also is out with its improved KV chassis for less power consumption and fewer components parts. It includes Matrix sound four simulated stereo.

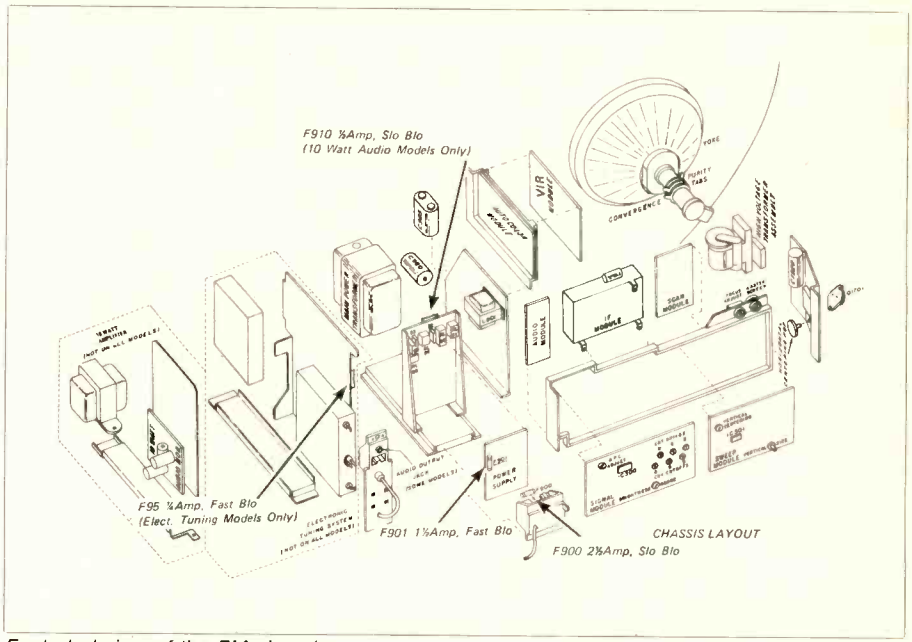
—Toshiba is offering its 1981 customers a comb filter, CATV jack, digital electronic tuning, and *Tele Tune*. Admittedly, this has been a quick and certainly not complete, rundown of the newest in circuitry for the 1981 model year. ET/D will be running separate articles on individual manufacturers in more detail. As more information is received by ET/D, more information will be passed on to you. **ET/D**

GE for '81

Features and service

Evolution of the '81 GE color television line from the previous year's models has resulted in improved performance, reliability, and serviceability*

By Walter H. Schwartz



Exploded view of the EM chassis.

What's new with General Electric Television for 1981? Well, first they are happy with the last year's sales picture. GE moved up to a tie for third place in sales with about 7.5% of the market (tied with Sears), under its own name. A substantial private label business probably brings GE's production to about 10% of the U.S. market.

This reportedly is an 83% increase in the last four years and brings GE to its highest sales in its 32 years of television production. And everyone at GE seems to be confident of a good '81 season in spite of the recession, with industry wide sales projected to be about 9 million color sets and 6 million black and white *and* about 65,000 projection sets.

GE also recently announced a cooperative effort with Matshushita, Japan Victor and Thorn EMI of Great Britain to develop a video disc system for the U.S. market (ET/D Newsline, July '80).

GE's '81 color line consists of two basic chassis types, the AB/AC used in 10, 13 and 17 in. sets and the EC/EM/EP used in 19, 25 and 45 in. sets.

19EC chassis

The EC(A) chassis used in the 19 in. sets in the 1980 line has been modified several times and is continued in the '81 line. The EC-B chassis has had the 15 volt preregulator adjustment potentiometer removed from the power supply board. Retrofitability was maintained. The horizontal driver transistor was moved from the heat sink to the sweep module and appropriately relabeled.

The EC-C has had further revisions to the power supply board.

The EC-N used a ferroresonant power transformer and an IF and audio module similar to that used in the YM chassis. The Horizontal sweep circuitry was also modified.

For '81 two variations on the EC chassis are used, developed from the EC-C and the EC-N (see Fig. 1). The EC-D is used in the electronic tuning models. The EC-P is used with standard switch type tuners; later the EC-Q will have a new power supply for use with the single knob electronic tuning system.

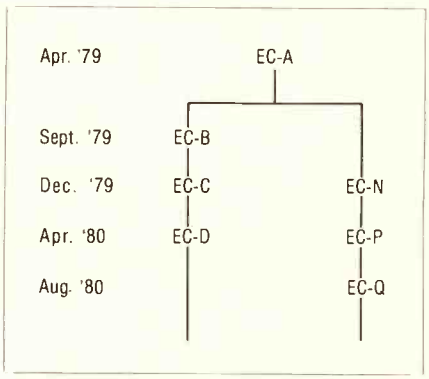


Fig. 1. Development of the 19EC chassis.

25EM chassis

The EM chassis is used in all 25 in. color consoles. It powers a black matrix 100° picture tube. Most EM modules are interchangeable with those used in the EC chassis. The EM chassis uses a

*Illustrations courtesy General Electric

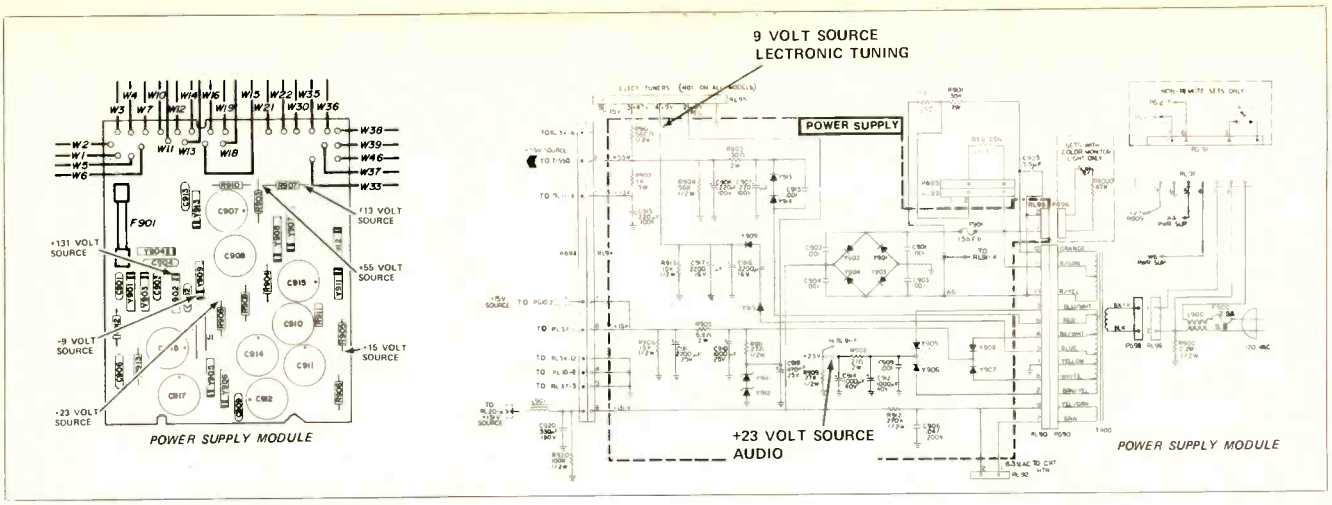


Fig. 2. Power supply module and layout.

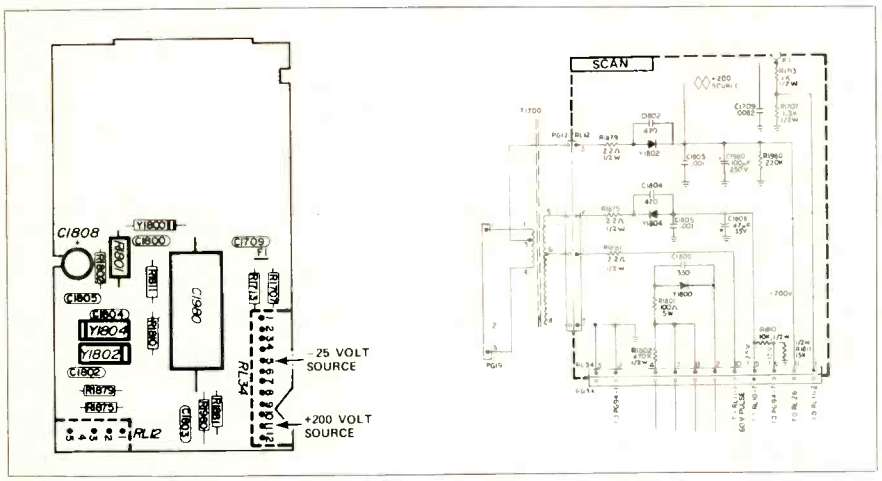


Fig. 3. Scan module.

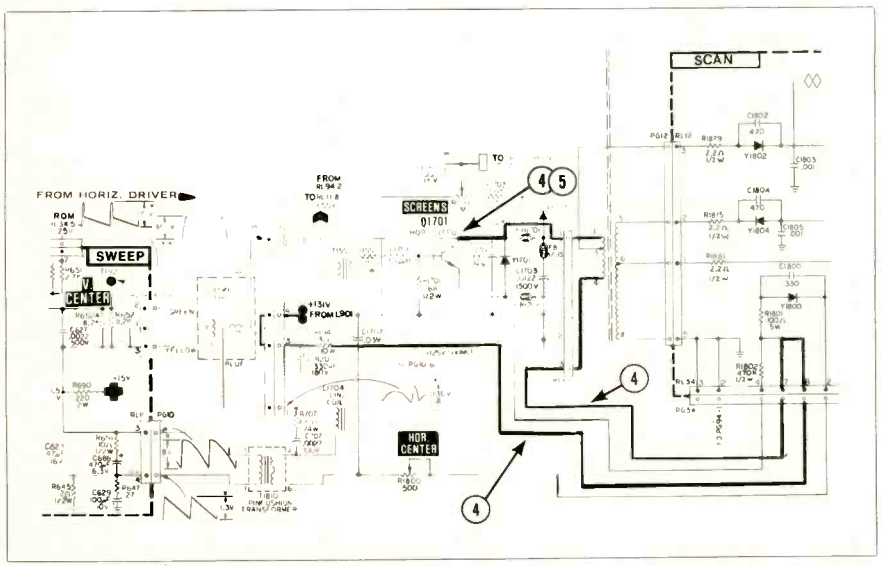


Fig. 4. Horizontal output circuit.

conventional power transformer type power supply.

Electronic tuning

GE uses four electronic tuning systems in the '81 line. All use phase-locked-loop frequency synthesis. The ET-82, 82 channel, system is a carry over from last year. The new MMP-91, LMP-91 and MP-91 cover the 82 broadcast channels and 9 cable mid-band channels.

The MMP-91 is a random access non-remote system. The LMP-91 and the MP-91 are remote control systems. The MP-91 is a consecutively programmable system; the LMP-91 is a random access control system. Many of the tuning system modules are used in more than one of the various systems.

Serviceability

GE has been quite serviceability conscious recently and has designed the EC and EM chassis for easy service access, included Mini-Manuals with all sets and has published symptom/repair manuals (the current edition is the 6th). The *Technical Training Manuals* published each year cover circuit details and descriptions for all chassis and for the tuning control systems. GE also offers parts kits for the new models and now has toll free numbers for ordering parts from new, relocated, and reportedly better stocked, parts warehouses. GE service data is $18.50 per year currently; '77 thru '80 data costs $38.45. Previous year's data is available for $7.00 or less per year.

GE also has developed a set of *Troubleshooting Charts* for each of the current or recent chassis. These troubleshooting procedures, which can be used to pinpoint many if not most of the likely problems, have been simplified to use set generated signals and a minimum of equipment, making them especially valuable for service calls. We will go over here, a number of the procedures for the EM chassis.

The equipment required is a multimeter, an eighteen inch jumper with a series 0.047 mfd capacitor, two six inch jumpers, a twelve inch jumper with a series 18 pfd capacitor and a soldering iron, solder wick, and other standard hand tools.

Power supply checkout

Loss of each of the various supply voltages will produce its own special symptoms. Most of the voltages come from the power line operated power supply; a couple of them come from the scan module (see Figures 2 and 3).

The +131 volt source is supplied by

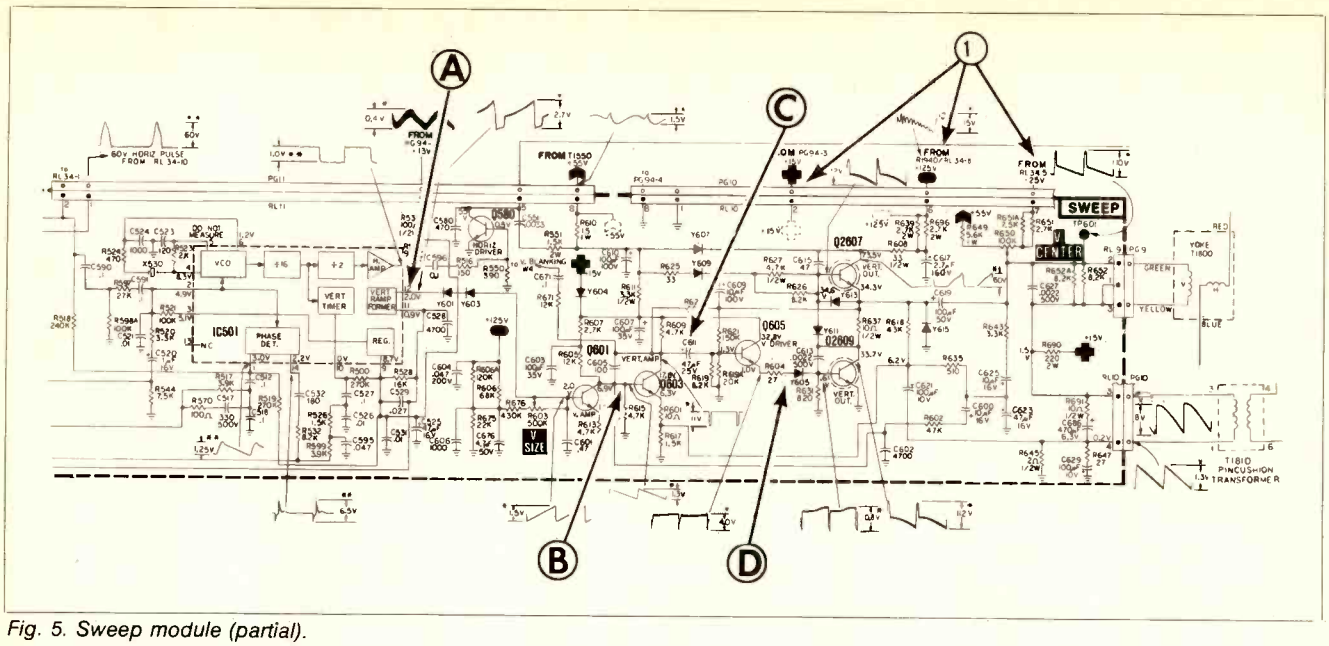


Fig. 5. Sweep module (partial).

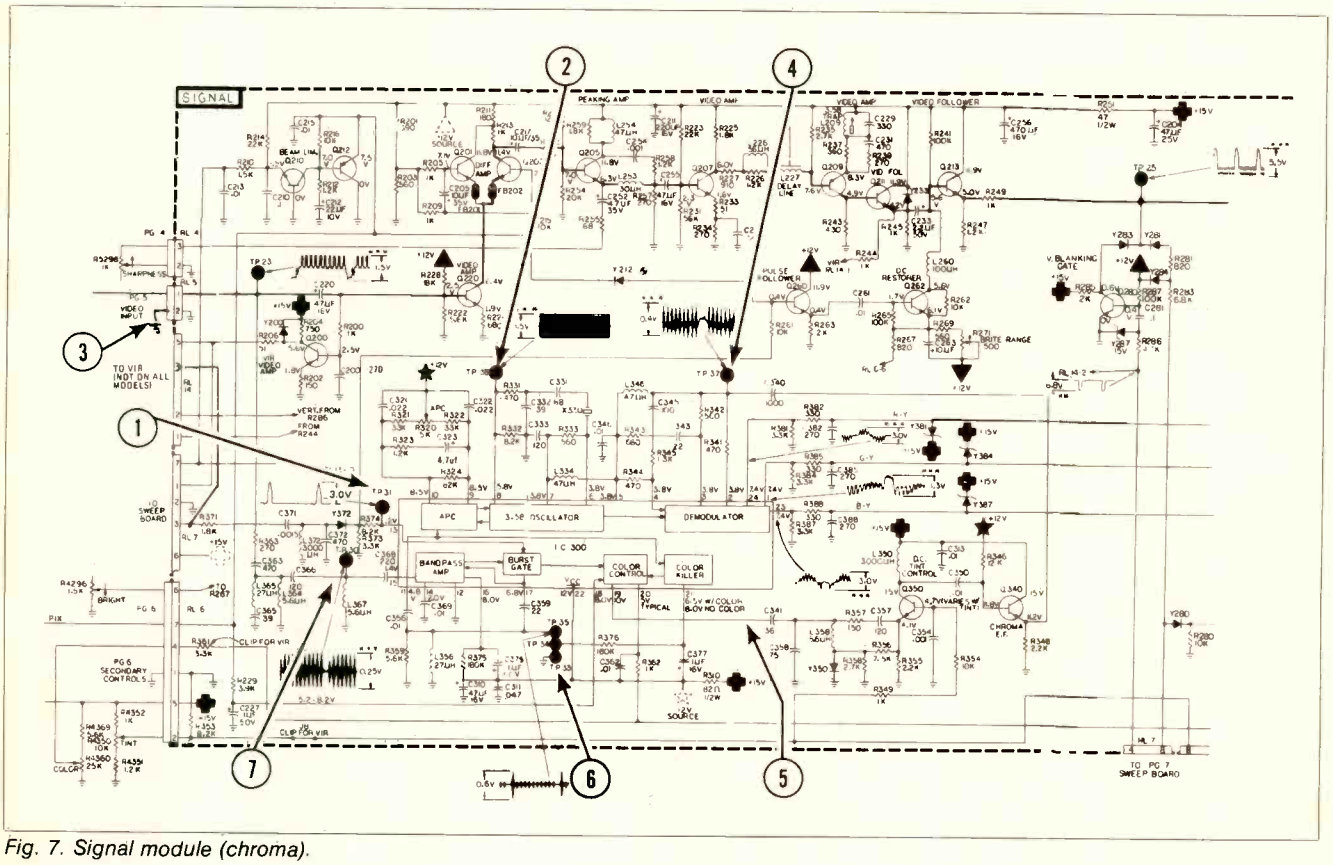


Fig. 7. Signal module (chroma).

the bridge rectifier (Y901, 902, 903, 904) and supplies the horizontal output transistor. Its loss means no sound or picture.

The +15 volt source is supplied by Y905 and Y906. It supplies the signal module, the sweep module, the IF module and the electronic tuning system. Its loss results in a dim narrow raster, no sound but static is heard.

The +55 volt supply comes from Y913, Y914 and supplies the sweep module. Its loss results in no raster and no audio except static is heard.

The +13 volt source is derived by means of a dropping resistor from the +55 volt source and operates the horizontal oscillator. Its loss results in no raster, sound OK.

The +9 volt source from Y909, Y915 supplies the electronic tuning system. Its loss results in a good raster, static in audio but no channel selection is possible.

The +23 volt source from Y905 and Y906 supplies the audio module. Its loss causes no sound, picture remains good.

The -25 volt source is developed by scan rectification and supplies vertical centering. Its loss results in an off center vertical sweep.

The +200 volt source is developed by pulse rectification. It supplies the sweep module and its loss results in a very bright raster and no sound.

Horizontal sweep

Here is GE's recommended procedure for basic horizontal sweep

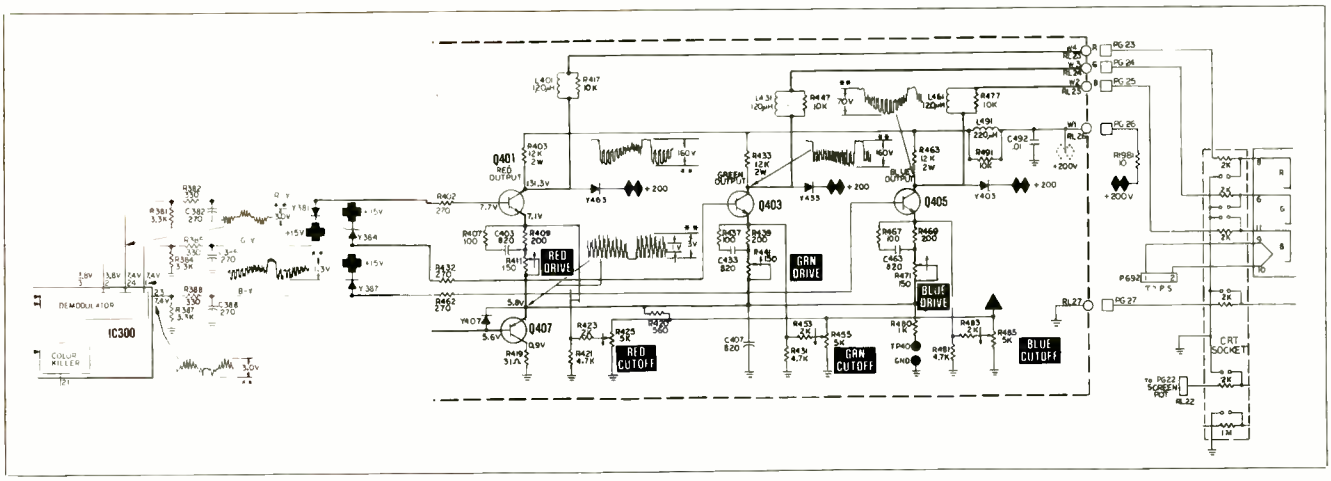


Fig. 8. Chroma output stages.

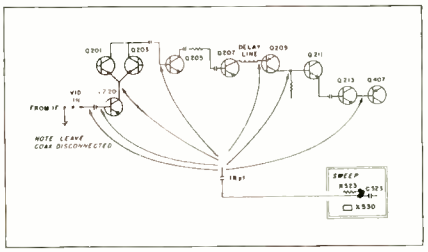


Fig. 6. Signal module (video).

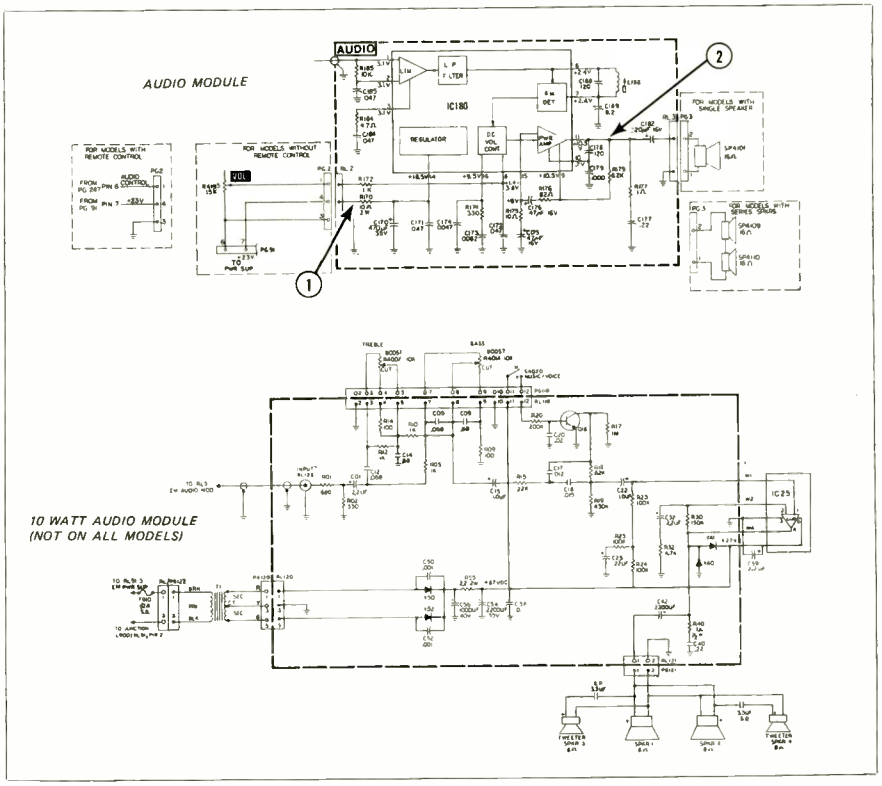


Fig. 9. Audio.

trouble-shooting (Fig. 4 and 5).

Check to make sure supply voltages are present. Check Q580, the horizontal driver; base to emitter resistance should be between 100 and 390 ohms. If the resistance checks OK the base voltage should be –0.5 volts dc. If not, IC501 or associated circuitry is the trouble.

The horizontal output collector voltage should be +110 Vdc. If not present, trace from the supply as in Fig. 5.

Check the horizontal output transistor out of circuit. While it is removed, check the damper, Y1701, and C1703.

Vertical sweep checkout

Check the supply voltages (1) (Fig. 5.); the +125 volts is derived from the +131 volt source.

If the power supplies are OK, the eighteen inch jumper and the .047 mfd capacitors can be used to inject vertical 60 Hz into the receiver's audio output stage (pin 11 of IC180). Referring to Fig. 5, a buzz heard at point A indicates that IC 501 is functioning, if heard at B, Q601 is OK, at C, Q603 is OK, and if heard at D, Q605 is functioning.

Video tests

First, of course, verify supply voltages; +15 volts should be present at pin 6 of RL7 and +200 volts at RL26 (W1).

If voltages are OK use the jumper lead and the 18pfd capacitor for signal injection from the junction of R523 and C523 on the sweep board (also pin 5 or IC501). A bar pattern should result. Follow the test points as in Fig. 6.

Chroma problems

To isolate color problems to either the signal module or the VIR/Color Monitor circuitry; remove PG13 from the signal module, jumper RL13 pin 8 to RL6 pin 2 and RL13 pin 7 to RL6 pin 4. If the color is now OK the fault lies in the VIR or Color Monitor circuitry; if not it lies in the signal module.

Now, to check the color circuitry on the signal module (refer to Fig. 7) first short the base of Q260 to chassis. A slight darkening of the screen indicates the keying pulse at the burst gate is OK. If not check from RL7 to TP31.

Using the test lead with the 18 pfd capacitor, with one end attached to TP38 (2), unplug PG5, the video input plug and touch the test lead to pin 1 of RL5. A slight change in raster color indicates the 3.58 MHz oscillator is OK.

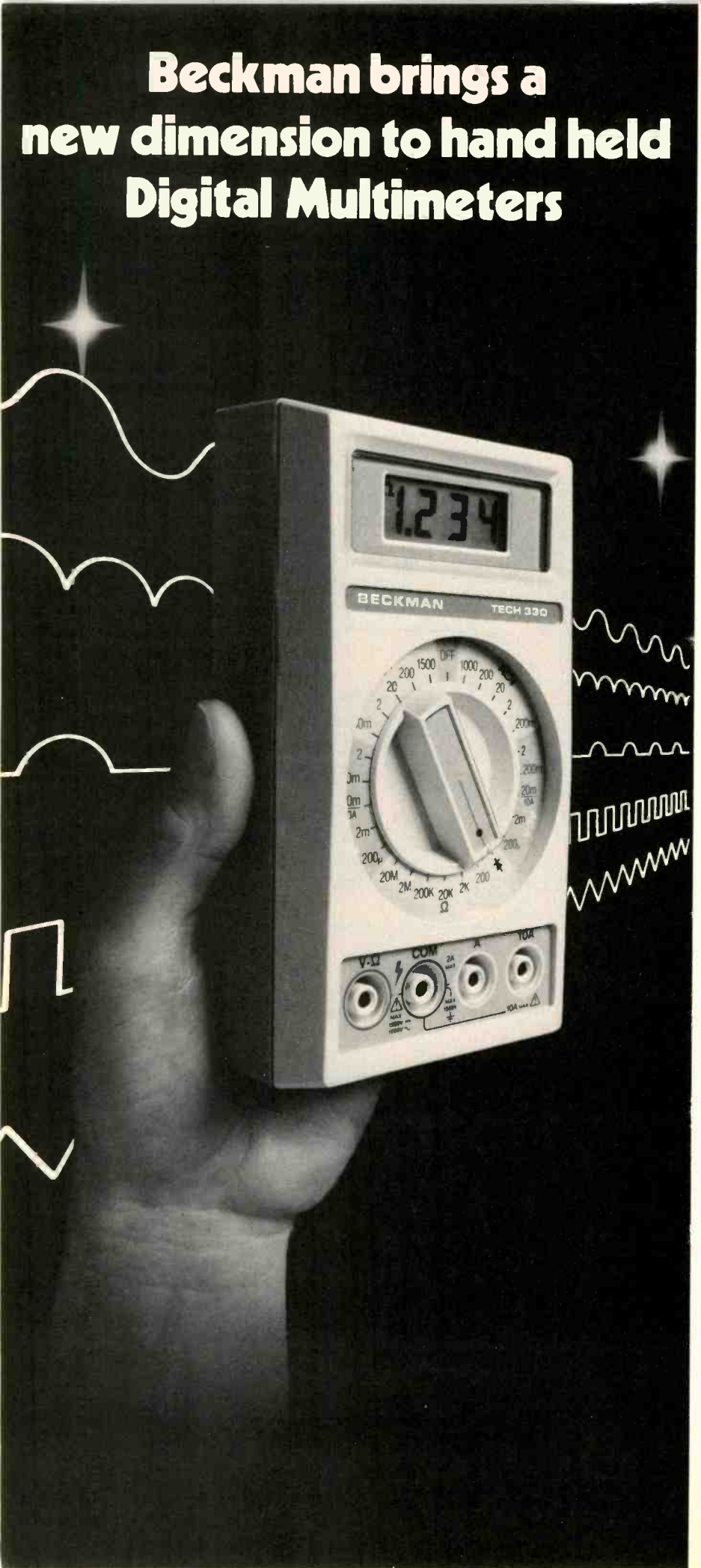
Touch the test lead to TP37 (4); a slight raster color change indicates the demodulator is OK. Touch the test lead to C341 (5). Here a slight raster color change indicates that the tint circuit is OK. A similar result when touching TP35 (6) indicates the color control circuitry is functional. Again a similar effect at TP30 (7) means the band pass amplifier is working.

Raster color problems

Overall raster color problems will usually be confined to the color output stages, the picture tube, or its socket, according

continued on page 45

Beckman brings a new dimension to hand held Digital Multimeters



True RMS capability at an affordable price

Now you can measure the exact power content of *any signal* – regardless of waveform. Beckman delivers the new TECH™ 330 multimeter with true RMS capability and many more fine performance features for just $200.

Unlike the common average responding multimeters calibrated to measure only sine waves, the TECH 330 with true RMS capability gives you accurate readings of both sine and non-sine waveforms.

True RMS makes a significant difference in accuracy when measuring switching power supplies, flyback power circuits, SCR or TRIAC controlled power supplies or any other circuit generating a non-sine signal.

The TECH 330 also accurately measures the entire audio band up to 20 kHz. But that's not all you can expect from Beckman's top-of-the-line multimeter.

Measurement Comparison Chart

Waveforms (Peak = 1 Volt)	Average Responding Meter	Beckman TECH 330	Correct Reading
Sine Wave	0.707V	0.707V	0.707V
Full Wave Rectified Sine Wave	0.298V	0.707V	0.707V
Half Wave Rectified Sine Wave	0.382V	0.500V	0.500V
Square Wave	1.110V	1.000V	1.000V
Triangular Sawtooth Wave	0.545V	0.577V	0.577V

You also get 0.1% basic dcV accuracy, instant continuity checks, 10 amp current ranges, a separate diode test function, 22 megohm dcV input impedance, and an easy-to-use rotary switch.

With so much capability in hand, you'll be able to depend on the TECH 330 for a long time. That's why Beckman designed it tough enough to go the distance.

Enclosed in a rugged water-resistant case, the TECH 330 can take a 6-foot fall onto concrete and still perform up to spec. And to further ensure reliable, trouble-free operation, the TECH 330 gives you 1500 Vdc overload protection, RF shielding, 2000-hour battery life, gold switch contacts, and fewer electronic components to worry about.

Add another dimension to your world of electronics. Visit your Beckman distributor today for more information on the TECH 330 and Beckman's complete line of digital multimeters, starting at $110.

To find out which of our 500 distributors is nearest you, call: (714) 993-8803 or write Beckman Instruments, Inc., Electro-Products Group, 2500 Harbor Boulevard, Fullerton, CA 92634.

BECKMAN

Circle No. 104 on Reader Inquiry Card

Controlling field service costs

Some energy conscious tips

Gasoline prices are up, trained technicians are scarce, technology has taken a flying leap into outer space; all of these factors have added to skyrocketing costs for field service. Here are a few practical tips on ways to bring some control to this troublesome area.

By William Joseph

If you're keeping a sharp eye on the various elements that go into the cost of home service calls, you already know that one of those costs is rising a lot faster than the others. While inflation is doing a good job of seeing to it that every item in your expense ledger grows faster than a hungry teenager, truck and travel costs are racing ahead at an even scarier pace.

Way out front, of course, is the cost of gasoline. And if we can believe the "experts," the doubling of that cost during the past couple of years is only the beginning. When you add the initial cost of service vans, repairs and maintenance, and the travel time between calls, it becomes obvious that the ability of any service dealer to continue to provide home service calls on a profitable basis will become much more difficult in the months and years ahead.

Since competition limits your ability to pass along rising costs to your customers, skillful management of your expenses will become even more important as the battle with inflation heats up. And travel expenses are a timely target for the best of your personal skills.

Some techniques for controlling the cost of home service are very much dependent on the size of your service fleet. The wholesale purchase of gasoline, for example, probably isn't practical for a fleet of fifty. Here are a few that may be of help to you.

Routing and dispatching

Once upon a time, an extra mile or two on the odometer between service calls wasn't a big deal. Not so today. With the average cost-per-mile for operating a service van rapidly approaching thirty cents (plus payroll costs for driving time), the distance between service calls may someday dictate the amount of your profit, or the lack thereof.

For that reason, the assembling of routes for your road technicians is one of the most important of your daily operating procedures. Clean, tight routes carefully planned to minimize the distance between stops is an absolute requisite in a modern service organization.

In this connection, more and more service dealers are recognizing that daily service to *all* of the communities on the outer edges of their service areas is no longer a practical policy. Service two or three days per week will keep you out of trouble with the customers on the outer fringes of your service area, and will go a long way toward reducing your average miles-per-call to an acceptable minimum.

How do you know if your efforts to tighten up your routes are paying off? That's easy. Just take a look at one of the most important operating statistics that you can compile: average miles-per-call. Your objective, of course, is to arrange the travel of your road technicians so that this figure is kept as low as possible.

While the actual numbers will vary among dealers of different sizes in different kinds of geographic situations, your target is improvement over your own current performance. To compute miles-per-call for individual technicians, simply add up the total miles driven during the month, and divide that figure by the number of stops made during the same period. Total performance for your entire fleet is computed in the same way.

Gasoline costs

While you may not be able to do very much about those OPEC rascals, there are a few tricks that may keep you a step

or two ahead of the competition.

Many service dealers who never before thought of putting in their own storage tanks to enable them to buy gasoline from wholesale distributors are taking another look. Saving a few cents per gallon can add up to big numbers at the end of a year. More important to some dealers, though, is the comfort of an official allocation during the recurring gas crunches. You weren't alone if you sweated out a lot of hours in the spring of 1979 while your service techs stood in endless lines waiting to buy gas.

However, as we all know, there's just no such thing as a free lunch. If you don't have tanks now, you missed your best opportunity. As hard as it may be to believe today, back in the halcyon days before the '73 - '74 gas crunch, many wholesalers would happily install storage tanks and pumps at their own expense, *just to get you to buy gasoline from them* (sob). If you think those days are gone forever, you're right. If you want your own gas supply today, you'll have to pick up the whole tab. And for a small dealer, the cost is anything but small.

The smallest practical storage tank to install would be the 1,000 gallon size. That may sound like a lot of gas to you, but it's just a drop in the proverbial bucket to a wholesale supplier. In fact, in quantities as small as a thousand gallons, there will be little if any savings over normal retail pump prices in many locations.

Marvin Yeager, service manager for Gerhard's Inc., of Glenside, Pa. says, "Our thousand gallon tank doesn't really save us any money on gasoline costs for our fleet of eleven trucks, but it does provide time-saving convenience."

That's because 1,000 gallons comes under the heading of less-than-truckload; and receiving so-called tank wagon prices usually depends on your being able to accept full tanker loads at each delivery. Since a full load averages around 8,000 gallons, you'll need a 10,000 gallon tank to join that league.

If you feel that wholesale gasoline may be a possibility for you, you may want to have a couple of suppliers quote you some prices and then have your accountant advise you on the economic practicalities for your business. If you do, don't forget to remind old Scrooge of the comfort of having your own gasoline supply if more shortages come along.

Practical steps

Alas, the fact is that most dealers will have to continue to look to regular retail stations for their gasoline. If that's your situation, have heart. There are some very practical steps that you can take to help the situation.

Joe D'Agostino of Warminster TV in Warminster, Pa. says that recent gas crunches didn't cause him any real problems. He has an arrangement with a local service station to give them all the repair and maintenance work for his fleet of three service vans. In return, the station operator has always seen to it that Joe's trucks get all the gas they need, even when things were at their darkest.

Dick Senato of Gerardi Brothers in Denton, Md. says, "Keeping a very close eye on the miles-per-gallon for each service truck is a fact of life for the modern service manager." Dick keeps a wall chart showing gas mileage and maintenance schedules for each truck. Any drop in mileage performance is carefully checked.

As the cost of gasoline continues to rise, the payback on tuneups becomes less a matter of debate and more an obvious benefit. An engine seriously out of tune can waste as much as 20% of the gasoline it consumes. At that rate, a tuneup turns into a profitable investment very quickly.

Another cheap and easy method to improve gas mileage is to make sure that all tires are properly inflated. In addition to wasting your precious gasoline, an under-inflation of only 5 p.s.i. will reduce a tire's tread life by 10%.

Pilferage?

While most service dealers prefer to invest full trust in their service techs, the harsh fact of life is that gasoline has become a valuable commodity and must be handled as such. Poor gasoline mileage can be an indicaton that some of your gasoline is finding its way into someone else's vehicles.

For these reasons, a continuing analysis of gas mileage is an essential requirement today, and this means that precise records of gas purchases must be maintained for each truck and computed against miles driven.

For the most part, the experts say that you can forget additives as a way to improve gasoline mileage. Most of them are worthless at best, and some are actually harmful. One exception that may be a bright spot, however, is the new family of super oils that are being developed. Exxon, for example, recently announced its new XD-3 engine oil which, Exxon says, will improve gas mileage by at least 3% over its best competitors. A super slippery consistency that reduces internal engine friction seems to be what makes such performance possible.

By the way, locking gas caps may be a mixed blessing according to some service dealers. While they may discourage some siphoning thefts, one New York area dealer wishes he had never seen them. Unable to remove the locked caps from his fleet of five service vans, thieves simply pierced the bottom of each tank with a steel rod and drained all five. The result: stolen gasoline and the cost of five new gas tanks.

Your truck policy

Should a service dealer require that his trucks be returned to the shop in the evening, or should he allow the technicians to take them home at the end of the day?

You may as well ask whether chocolate is better than vanilla than ask that question. For every service dealer who can wax eloquently on why it makes sense to allow the techs to take the trucks home, there's another who wouldn't think of it. We can't solve that dilemma here, but there is little doubt that many of the advocates of the take-em-home theory are now taking a second look. The whole idea, which first saw the light of day when the cost of gasoline was negligible, may now be a much more expensive policy than some managers realize.

One large midwestern dealer was dismayed to learn that *one-third* of the total miles put on his service fleet was travel between the tech's homes and the shops — a huge and easy to overlook expense.

Then, too, many dealers share the feelings of Joe D'Agostino of Warminster TV who says that vehicles garaged away from the business premises offer an unfair temptation to employees, especially during periods when gasoline may become extremely scarce as well as expensive.

Whatever your feelings on the matter, consideration for the gasoline problem should be a part of your future decisions.

Some economists have predicted that home service calls as we know them today are destined to become a rare and expensive luxury available only to the affluent minority. Whether or not things will ever reach that point remains to be seen. One thing, though, seems quite likely: the service dealers who take the trouble to sharpen up their up their expense control techniques may be the only ones around to provide tomorrow's service calls. ET/D

Good news for you and your customers. NESDA/ISCET rates RCA serviceability:

'Excellent'

"The RCA CTC 108 and CTC 109 chassis have earned the highest possible serviceability rating category... Excellent... by incorporating serviceability features required in the ISCET Serviceability Rating Form.

"RCA's many years of cooperation with ISCET's Serviceability Committee has helped produce excellent results."

—Dean R. Mock, Chairman, NESDA/ ISCET Serviceability Committee

ISCET's 92% (CTC 108) and 93% (CTC 109) ratings were good news to us. Because they mean that some of the most demanding critics in the industry agree that we've succeeded in designing chassis that not only give your customers a first rate picture, but are easy to repair too. Here are some reasons why they think so:

All subassemblies plug into chassis. No tools are needed to remove chassis (main circuit board). Just remove the cabinet back, unplug subassemblies and the chassis is ready for removal.

Roadmapping on both sides of the board. Although the XL-100 chassis use single-sided circuit boards, double road-mapping means you can easily trace circuits from either side.

Circuits and voltages directly identified. Major circuit areas as well as power supply source and key pulse voltages are labeled by name on the board. So you can find them fast.

That all means that when you do have to repair our new XL-100 chassis, in most cases you can fix them quickly and easily.

And you won't have to waste your valuable time trying to find out where to go to fix what you already know is wrong.

Because to us that's what really counts. Making your job easier and your customers happier.

RCA

RCA IS MAKING TELEVISION BETTER AND BETTER.

For your free subscription to RCA COMMUNICATOR, our magazine of news and advice for service technicians, write: RCA, Dept. 1-455, 600 North Sherman Drive, Indianapolis, IN 46201.

The effects of heat on semiconductors

What you can do about it

Heat can have some drastic effects on semiconductors. For a look at what's happening, why it happens, and how you can make your own thermal calculations for corrective action, read on.

By Bernard B. Daien

Experienced technicians know that heat reduces the life, and reliability, of electronic components. Nowhere is this truer than with semiconductors...and the situation has been worsened by the sales pitches which were given with the introduction of the " . . . all new, solid state sets, which will never wear out!" Purchasers of these solid state sets were led to believe that they would never need servicing. But, like automobile windshields which may not wear out, they certainly do "fail catastrophically." Look in the pages of your Yellow Phone Directory, and notice all the shops that replace automobile windshields which have chipped, cracked, scratched, etc., *in normal usage.*

So it is with semiconductors . . . they may have an indefinite life, but they often do fail prematurely under *so-called normal usage.* The factors which lead to these failures are usually overvoltage, overcurrent, overpower, or overtemperature. In *all* of these, junction overheating is a factor. The fact that you have a commercial piece of equipment is not insurance that the thermal design is adequate. I have had a top brand oscilloscope which required the addition of heat sinks on most of the transistors before failures could be stopped.

Those of you who struggled with the automobile radios using germanium power transistors are well aware of the problem. The problem was repeated ten years later with the advent of high fidelity stereo sets for home use. And today we are being deluged with high power audio amplifiers for auto use which are even worse! Thermal design has been a very neglected area of solid state equipment design and the technician has been left with the problem in many cases. Some manufacturers have provided "add-on" heat sink kits, for service modification use, but, for the most part, the problem has been treated as if it might go away by itself, by some miracle.

So let's start at the beginning with how the transistor is made. Of course we all know that germanium transistors cannot withstand much more than 100° Centigrade. (We will use the abbreviation "C" for Centigrade hereafter. In the "C" system, water boils at 100° C, or 212° Fahrenheit, and ice melts at 0° C, or 32° F.) I am not an advocate of the metric system changeover, but since the existing literature has been in Centigrade for many years, it is just simpler for us to use it in this case.

Since germanium devices cannot withstand temperatures much over the boiling point of water, they have largely been abandoned for uses involving any appreciable heat rise. We will therefore discuss the generally used silicon devices . . . although the same factors can be applied to germanium devices if the maximum junction temperature of 100° C is observed, along with some other precautions which are mentioned later.

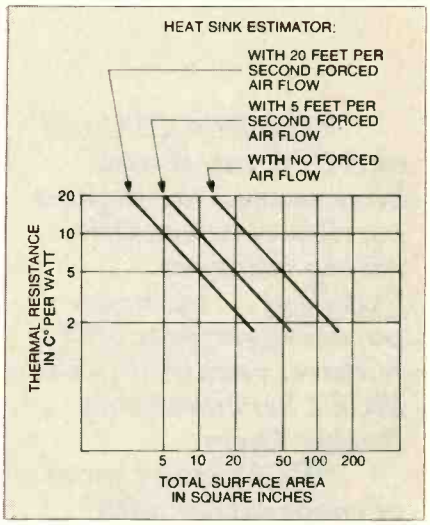


Fig. 1 Heat Sink Estimator: a useful graph for estimating a heat sinks ability. This chart is applicable to a single flat aluminum plate at least 1/16inch thick. A black finish would improve the heat sink's performance by about 10 per cent.

Junction temperatures

Some devices intended for power use operate at 200° C *junction* max temperature. (Note the use of the word "junction." The junction is the actual PNP, or NPN, semiconductor chip . . . the heart of the transistor.) These are generally the metal cased devices. The *same family of transistors* in a modern plastic package, such as a TO-202, or a TO-220, plastic power transistor with a metal pad incorporated for heat sinking, *is usually rated for only 150° C* max junction temperature. And, a small signal transistor in a TO-92 package, all

plastic, is rated in some cases at only 125° C maximum junction temperature.

So it is apparent that different transistors can withstand different temperatures, depending upon what material they are made of, how they are made, how they are packaged . . . and even which company makes them. For example, a 2N2712 made by General Electric is rated at 125°C max, while the equivalent Motorola MPS 2712 is rated at 150°C max. This is not true across the board on G.E. vs. Motorola products, but merely illustrates that there are differences between manufacturers' products which cannot be neglected in some instances. At this point you are probably asking, "How do I find out about these characteristics? I don't see them mentioned in cross-reference books." Each manufacturer publishes "Data Books," available at very nominal cost. RCA, G.E., Motorola, National Semiconductor, Fairchild, and others, put out such books. If you buy in any quantity, you can probably get one free from your local distributor, If a semiconductor device has a 1N, 2N, 3N, or 4N number, the specifications will be the same *regardless who makes the device!* This series of numbers is assigned only to devices which have been very completely characterized.

Other numbers, such as Motorola's "M . . . " series, G.E.'s "A . . . ", "C . . . ", or "D . . . " series, Fairchild's "F . . . " series, and National Semiconductors "LM . . . " series are what are known as, "Non-Registered" numbers. They can, and do, vary, depending on which manufacturer makes them. You must consult each manufacturer's data sheet on these products. The same thing applies to all "house" or "special numbers" . . . which is why the cross-reference books don't always work. To sum up, only "registered" 1N, 2N, etc., numbers are fully interchangeable from various manufacturers' product lines. And this applies to thermal characteristics as well as electrical characteristics!

Influencing factors

Assuming that you have obtained the data sheet, or a data book, covering the devices you are interested in, we can proceed with the discussion on the thermal aspects of some common transistors. A very common, and useful silicon NPN power transistor, which is used as a general purpose power transistor, is the 2N3055. As shown in the data sheets, it has a maximum junction temperature of 200°C . . . which means that the *inside* of the transistor cannot be higher than that temperature

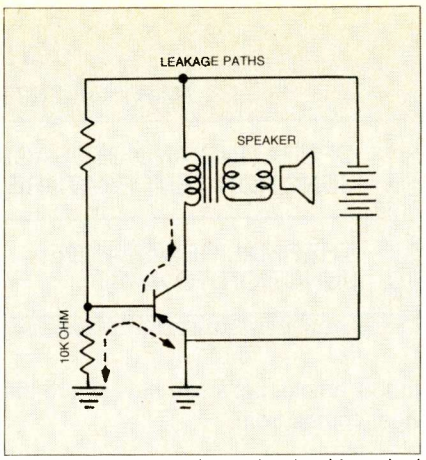


Fig. 2 A basic transistor circuit with typical leakage paths indicated by the dotted lines.

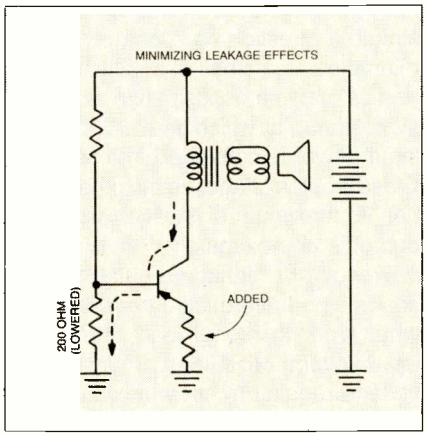


Fig. 3 A modified circuit to reduce leakage currents. Here a low ohmage shunt across the base-emitter junction draws off the transistor's junction leakage. Notice the added emitter resistor.

under any circumstances. What then determines how hot the junction will be? Obviously the outside surrounding environment has an influence. This outside temperature is called, "the ambient" temperature, abbreviated "TA" (T for temperature, and letter A for ambient). Room temperature is about 25°C, while the inside of a TV set might rise to 60°C. We have to begin with the ambient temperature, since any heat dissipated inside the transistor will *raise it* above the surrounding ambient. We will return to the 2N3055 later.

If we are dealing with the simple case of a transistor *without a heat sink*, the next factor to consider is how much opposition there is to the flow of heat from the junction (where it is generated) to the ambient air (where it is "dissipated," or lost). This too is given in the data sheet. Looking at the data sheet in Chart 1, for a 2N4409 small plastic TO-92 packaged NPN silicon transistor, we see, under the heading, "thermal Characteristics" the term, "θJA." θ is a Greek letter, "Theta" and is also used for other things, such as symbolizing phase angles. In this case it means "thermal resistance." The letters JA mean "junction to ambient." Put together, they mean, "the opposition to the flow of heat from the junction to the ambient" . . . which means of course, the flow of heat *through the package material* from the interior, to the exterior. Figure 1 shows this. It is given as 200° C per watt. Thus one watt would cause a rise of 200° C between the ambient temperature, and junction inside the case.

Let's use this data to calculate the maximum permissable power we could dissipate. Assume an environment of 50° C inside a small radio, which might get that hot in the summer sun on the beach. If we are not to exceed the maximum *junction temperature of 150° C,* we cannot permit a rise of θJA of more than 100°C above the ambient, for a *total of 150°C.* At *200°C per watt* rise we could safely handle one half watt of dissipation. Note that dissipation is the difference between input and output power. In the case of a Class A audio stage, *with no signal input,* the full DC input power is dissipated, since there is no useful output.

There is also another symbol given, "θJC," which is the thermal opposition between the junction and outside of the transistor *case*. At this point you may ask, "What's the difference between θJA and θJC?" This gets us to a point that often confuses the reader in thermal texts. Let's see if we can avoid confusing what is a relatively simple fact.

θJA vs. θJC

When we apply power to a transistor junction, it heats up. This heat flows out of the junction, into the only place it can go, the surrounding case. In turn, the case transfers the heat which flows through it, into the surrounding ambient, where it ends up heating the air flowing through the equipment. You can tell when the transistor is dissipating heat *because it feels warmer than the ambient* when you touch it. Thus the case must be warmer than the ambient in order to lose heat into the ambient. (If the case were cooler than the ambient, it would *absorb* heat from the ambient!) So we are really dealing with two separate thermal resistances . . . one is the θJC . . . resistance from junction to case . . . the other is the θCA . . . thermal resistance from the case exterior to the ambient. For convenience, the data sheet lumps them together (adds them up in series), and gives us the result of θJA, *which is used when the transistor stands alone without a heat sink.*

OK, let's use a little common sense, if θJC = 83°C per watt (from Figure 1), and θJA = 200°C per watt . . . what must

θCA be? Since θJA = θJC + θCA, then it is obvious by simple subtraction that θCA must be 117°C per watt. This tells us that the transistor case is a very poor heat dissipator . . . which is logical since it is plastic, not metal and has very little dissipating surface exposed to the ambient. This is precisely why we usually clamp transistors to external heat sinks. The heat is *conducted* out of the transistor case by *physical contact*, into the heat sink, which dissipates the heat into the air by radiation and convection. Conduction is a very efficient means of getting rid of heat, as you have experienced first hand by touching a hot tube or transistor! Radiation is less efficient, and convection (air flow cooling) is also relatively inefficient until forced air flow (fan) is introduced. In order to make up for the inefficiency of radiation and convection, large surfaces are used (heat sinks).

As we said, the heat is transferred via efficient conduction from the case to the heat sink, which is a much better dissipator of heat into the ambient than the tiny transistor. In this case, the transistor had a θCA of 117°C per watt, and a θJC of 80°C per watt, for a total of 200°C per watt. Notice that the θCA was larger than the θJC. By using a clip on heat sink, with a little silicone grease, to insure no air voids between the case and the heat sink, (good conduction), we can get the total θJA down to about 130°C per watt. Thus instead of the device failing with a half watt of input, in an ambient of 50° C, as noted before, the junction temperature would only be 115° C, well under the limit of 150° C max. (We arrive at this figure by saying that a half watt of input would cause a rise of 65°C with a θJA of 130°C PER WATT. Since the ambient is 50°C, and we rise 65° above that, the total rise would give us a junction temperature of 115° C.) Now that's not very complicated . . . only one symbol to learn, plus a little arithmetic, common sense, and a data sheet.

As a matter of fact, practical thermal calculations (reasonable estimations) are simpler than Ohm's law. All the thermal drops are given in the data sheets. If you use a commercial heat sink, the drop is also given. The only thing that needs to be estimated is the thermal drop across the insulating washer and its two interfaces (when a washer is used), and even that is usually closely estimated by the washer manufacturer, and the heat sink manufacturer. This will be covered in the section on heat sinks, which follows later in this article. Let's see now where the heat comes from.

CHART 1

PART OF 2N3055 DATA SHEET

OPERATING AND STORAGE JUNCTION TEMPERATURE	→	− 65 TO +200 C°
THERMAL RESISTANCE, JUNCTION TO CASE	→	θJC = 1.5C° PER WATT

Heat generation

Perhaps we should ask, "how does the heat get generated?" This is not as simple a question as it looks. For example . . . a class A amplifier stage has its maximum dissipation at zero signal input, at which time *all* of the DC input power is converted into heat. A Class B output stage, on the other hand, has its maximum dissipation when the output is approximately *40% of full power output*. Voltage regulators of the series type have maximum dissipation when working into full load, during high input voltage conditions. Shunt type voltage regulators have maximum dissipation when running into the *lightest* load, under high input voltage conditions. Thus it is apparent that in order to calculate the wattage to be dissipated you must know two factors . . . what the input power is to the device, and what the efficiency of the circuit is. The more efficient the circuit, the less the power dissipated. Recently I had the misfortune to examine in some detail one of the new high powered automobile stereo amplifiers, which had an overall efficiency so low, that at the rated 100 watts power output, there was 184 watts of heat to be dissipated. Due to the poor thermal design, the amplifier went into thermal runaway at 20 watts output per channel, at room temperature. The measured transistor junction temperature was 153° C . . . three degrees over the limit, *in a 20° C ambient*. You can imagine what happens to such a product when exposed to a hot auto interior in a southwestern summer!

Unfortunately, some manufacturers use their customers as "guinea pigs" to determine the reliability, and customer acceptability, of poorly designed products, and it is up to the service technician to somehow make the product work until it gets out of warranty! In this case, the simplest fix would be to add fan cooling, using a small 12 volt automotive fan, and charge back the manufacturer for costs, giving him the alternative of refunding the customers money.

It's obvious that this article cannot cover the efficiency of all the basic circuits, therefore for the standard Class A, B, AB, and C amplifiers, I must regretfully refer you to the many texts available in your local library, or perhaps among your own school books gathering dust on the shelf.

Effect of leakage

As you know, current through a transistor produces heating. Therefore leakage current produces heating. Unfortunately, heating produces more leakage, and leakage in turn produces still more heating, and so it goes round and round, until the device overheats and is destroyed. So we must consider where leakage comes from, how to minimize its effects, etc. When you consider that a power transistor junction may be operating at close to 200° C, (twice the temperature of steam), you quickly realize that we have a real problem in controlling this tendency to runaway. Now let's take a closer look at what goes on in a semiconductor circuit. Notice I said, "circuit."

Since we cannot get inside a transistor to control leakage, we must control the effects of leakage by means of the external circuitry. And that is where we separate the "cut and try" types from the professional technicians. The test of the professional is the making, or repairing of a circuit which will operate under varying ambient and electrical conditions, despite parts tolerances. When you have to "select" components to make a circuit work, or it fails under varying conditions within the normal operating range, the design, or repair, is defective.

Leakage is often mentioned as if it were a single factor. Actually leakage is made of several components, which are lumped together, although they behave differently. One component is the "surface leakage" which is related to the *quality* and design factors of the particular device. It acts like a leakage

CHART 2
2N4409 THERMAL CHARACTERISTICS (FROM DATA SHEET)

CHARACTERISTIC	SYMBOL	MAXIMUM
THERMAL RESISTANCE, JUNCTION TO AMBIENT	ΘJA	200C° PER WATT
THERMAL RESISTANCE, JUNCTION TO CASE	ΘJC	83C° PER WATT

path *across the CB junction* (resistive), and like a resistor is voltage dependent. An increase in the reverse voltage between collector and base causes an increase in the CB leakage current. This leakage also increases as the temperature increases, so you can see that at a combined high voltage and high temperature, this current may be significant.

Another leakage is the "charge generation current" which is due to impurity ions *in* the depletion zone. This current is also dependent upon the applied reverse CB voltage, and tends to double about every ten degrees C rise in junction temperature, so it is very temperature dependent. There are other leakages, but these two are the dominant ones in silicon devices. At some high voltage, there is a sudden increase in the leakage, just before the device is about to fail.

Notice that leakages are both temperature and voltage sensitive. They tend to increase with increase in temperature and voltage.

Other factors

Before we consider the *effects* of these leakages, we must look at some other factors which act to "magnify" the leakages to much greater proportions. First we must consider the temperature of the *emitter-base junction.* As you know, it is common to assume that the voltage required to "turn on" a transistor is 0.6 volts applied between the base and emitter (forward basis). Actually this is a very temperature sensitive voltage, varying several millivolts per degree C, depending upon the current level. The important point to remember is that this is a *negative temperature coefficient* . . . as the temperature goes up, the amount of voltage required to turn on (or increase) current flow, actually decreases. Thus a transistor actually becomes more "sensitive" as the temperature rises, requiring very little drive.

As an example, a transistor that requires approximately 0.9 volts between base and emitter to produce a collector current of 2 milliamperes, at minus 50 degrees C, will require only about 0.5 volts to produce the same collector current at plus 100 degrees C. We are talking about junction temperatures . . . so from a cold start, it is quite possible for a junction to vary over a hundred degrees, as discussed earlier.

To sum up . . . an increase in temperature not only increases the leakage currents, but also results in more collector current for a given input voltage. As you will see shortly, these effects not only add up, they tend to aid each other as well.

Another factor is the way the current amplification B, (beta) changes with temperature. Again, the same problem, current gain tends to increase as the temperature increases, and can easily vary by a two to one ratio . . . i.e., the current gain can more than double, over the normal operating range of the device.

Leakage paths

Now if we put these facts alongside each other we see that the leakages increase, the collector current increases with the same input voltage, and the amplification goes up, with increasing temperature. At this point you might be thinking things couldn't get much worse as far as current runaway is concerned . . . but wait! Look at Figure 2 which shows a very basic transistor circuit, which includes only a transistor, a load, and a bias network to set the operating current at some relatively small current close to zero ("turn on" point). Let's see what happens as the temperature goes up. (This might well be one half of a Class B output stage, with a small quiescent current to prevent cross-over distortion.)

As the temperature rises at the junction, the leakage between the collector and base increases. This leakage follows the dotted lines in returning to the battery supplying the collector.

Notice that some of the current flows through the emitter base junction on the way back to the battery . . . to the transistor this looks just like an input signal current, and tends to turn the transistor on more fully. While this is going on, the Beta of the transistor is also increasing, further increasing the collector current, and simultaneously, the input voltage requirement is decreasing (sensitivity increasing), still further increasing the collector current. This increase in current generates more heat, which in turn generates more current . . .

Altering circuits

Now there are some factors which can be changed in the circuit to reduce the *effects* of leakage. In figure 3 we have reduced the resistance of the bias resistors. Collector base leakage current now tends to flow through the low ohmage resistor shunting the emitter-base junction, instead of flowing through the junction. This helps. It also explains why we must never use a transistor without a resistor between emitter and base . . . even the smallest leakage would be forced to flow through the base-emitter junction *as the only return path* back to the source. (In the previously mentioned auto high powered stereo amplifier there were no less than five such base-emitter junctions without shunting resistors!)

An emitter resistor was added, to minimize the effects of changing base voltage, since the drop across the emitter resistor is in series with the input voltage, and tends to increase as the leakage current increases. Further, this resistor provides degenerative current feedback, which tends to hold the DC current level despite changes in Beta in the transistor.

But other changes should have been made, which do *not* show on the schematic because they are mechanical in nature . . . heat sinking! If you think about it, thermal runaway can only occur if the transistor temperature continues to rise, and this in turn is dependent upon the cooling action provided. If the heat sinking is adequate, the transistor temperature will not rise to the point where the other temperature dependent effects, described previously, can become a serious problem.

To review to this point: Transistor thermal runaway can occur if there is sufficient temperature rise, in a circuit which is not adequately designed electrically, and not adequately heat sinked. Under electrical design we must consider the current and voltage level applied, the circuit efficiency, and the features of the circuit which minimize the effects of leakage currents.

Most manufacturers provide derating information which indicates that both *current and voltage must be reduced* if the device is to be operated at high temperatures . . . which is another way of implying that *the power level* must also be reduced when the transistor is operated at high junction temperatures. It is therefore advisable to provide adequate heat sinking in order to insure the capability of high power output. No matter how you look at it, good heat sinking is essential. Nevertheless, since heat sinking increases size, weight, and cost, it is the area most frequently ignored in design and manufacture. And this is despite the fact that no one area contributes more to reliability than heat sinking.

Heat sinking

Earlier in this article we mentioned the 2N3055 power transistor, and Chart 2 is part of the data sheet for a 2N3055. This metal cased TO-3 package is rated for 200° C junction temperature, as compared to the 150° C rating for the same transistor in a plastic package. This should tell you that where it is possible to do so, replacing plastic transistors with metal cased ones immediately improves the heat handling ability. Further, the θJC is 1.5°C per watt, a silicone greased mica washer is about 1°C per watt, and a practical heat sink of a surface totaling 50 square inches (total of *both* sides), would have a thermal resistance of about 5° C per watt. Adding up all the drops comes to 1.5 + 1.0 + 5 = 7.5° C per watt. If we assume a 50°C ambient, there is 150°C rise permissible before we hit the 200°C maximum junction temperature. That leaves us no safety factor, so for good design we'll limit the rise to 125° C. At 7.5° per watt we can dissipate about 17 watts in this transistor, quite conservatively.

A *pair* of such transistors, each with its own heat sink, can dissipate 34 watts. Operated Class B, the worst dissipation would occur at 40% of the power output capability, and at that point the power dissipated would also be *40% of the maximum output.* Thus we could easily handle about 85 watts R.M.S. sine wave. As a point of fact, many amplifiers now being sold at *100 watts* per channel, use this identical design, except, they use less expensive plastic 150° C junction transistors! As you can see, figures don't lie, but liars can figure. The argument advanced is that "speech and music are not continuous waveforms, and produce less heating than a sine wave" . . . but 100 watts R.M.S. means 100 watts of *power* (that's exactly what R.M.S. means. R.M.S. is *not* affected by waveform!)

It is an interesting fact that the Federal Trade Commission has imposed some "truth in advertising" regulations on the makers of "Home Entertainment Amplifiers" . . . but the new auto amplifier industry maintains that these regulations do not apply to them because although they are in the "entertainment" business, they make a product for automobile use, not "home" use! Mainly the problems in advertising specifications come from the limitations imposed by thermal considerations . . . so you technicians who face this problem in the auto amplifier field, be warned . . . you cannot "repair" an amplifier that fails due to poor thermal design. It will only fail again the first warm day! But, you can successfully cool it with a fan. To illustrate the point, the same 50 square inch (total surface) heat sink which rises by 5° C per watt (thermal resistance) in free air, drops to 2° C per watt with only a 5 foot per second air flow from a small fan! To do this with a heat sink in *free air* would require a sink with almost 150 square inches of surface.

Physical characteristics

Incidentally, since heat sinks lose heat by radiation and convection, painting the sink black with a *thin flat black* paint helps the radiation. Increasing the surface area helps both radiation and convection . . . so instead of buying one of those expensive shiny black anodized heat sinks, just get a cheap bright aluminum heat sink, and wire brush it, or run some coarse emery paper across it to groove it, and thus increase the surface area. Then spray it with one or two *light* coats of *flat* black lacquer If the sink has fins, the fins should stand vertically to insure the flow of air, if in free air. (Heated air rises, remember?) Dark green paint does just about as well as black, but reds are a no-no.

Aluminum is a fairly good heat conductor, and being light, will do a good job, although copper is very good if the weight can be tolerated. Remember, *anodized* aluminum heat sinks have a layer of insulation on the surface, and often do not make contact when an electrical connection is desired. It is necessary to clean the anodizing off areas where an electrical connection is to be made. Anodized finishes, when scratched, are not easily touched up. It is generally preferable to use wire brushed, and flat black painted, heat sinks, both from the performance, and the convenience standpoint. Commercial *finned* heat sinks are more efficient.

There are many types of "add-on" heat sinks now available, at very low cost. These devices can be clipped onto a transistor, to make a sort of stand-alone assembly. They are very handy. I use them generously. Buying them in large quantities reduces the price to the 20 cent range, and the cost can be added to the repair bill. The only precaution is to make sure that vibration of the extra mass won't break the leads on the supporting transistor. A plastic tie-down usually solves the problem. A good rule is . . . "whenever a transistor is too hot to hold your finger on, even momentarily, it needs extra heat sinking." (Of course you don't put your finger on a transistor without turning the power off . . . some transistors are rated for over 1500 volts!) And, if the transistor is a high frequency amplifier or oscillator, the extra capacitance of a heat sink may detune things, or cause feedback via radiation from the large surface. So you must use a little of your technical skill in heat sinking too.

Silicone grease

The use of silicone grease is required wherever thermal heat transfer is essential . . . on both sides of the mica washer, for example. I prefer plain old silicone grease, colorless . . . and have used silicone stop-cock grease (thick, for chemical lab use), and general purpose silicone grease. I do not use the oxide filled white grease...it's too messy, gets onto clothes, and some of it is very toxic. CAUTION! ALL SILICONE GREASE IS VERY DANGEROUS WHEN GOTTEN INTO THE EYES. It's hard to remove, sets up a severe irritation, and requires immediate medical treatment. Most containers state this...but who reads labels? I prefer to spread the stuff on with a little wooden coffee stirrer stick...plastic ones are just as good. They're cheap. The main thing is to keep the grease in original squeeze tube packages until used. Jars are no good, eventually grit gets into them, the grit punctures the mica washer, and there goes the job. Cleanliness is essential when coating the insulating washer, for the above mentioned reason. Finally, sometimes there are insulating washers *under the mounting screws.* When used, the screws must be firm, but not so tight as to crush the little nylon washer under the screw head. If the transistor is not clamped firmly, there will be excessive heat loss across the large mica washer.

If too tight, the nylon washer will eventually fail. So watch the washer for signs of head flattening, and stop!

There are many substitutes for the old mica washer, some are rubber-like, some are anodized aluminum, some are ceramic. The ceramics can withstand very high temperatures (but the transistor itself can't!). The rubbery ones puncture easily, tear easily, and are expensive. The aluminum ones work fine until scratched. On balance, the mica is cheap, durable enough, and works as well as anything else. Just be aware that the mica comes in various thickness; a half a thousandth, one thousandth, two thousandths, and four thousandths of an inch. The two thousandths is rugged and works well, thinner is fragile, thicker starts losing heat conductivity . . . so be sure you know what you are buying!

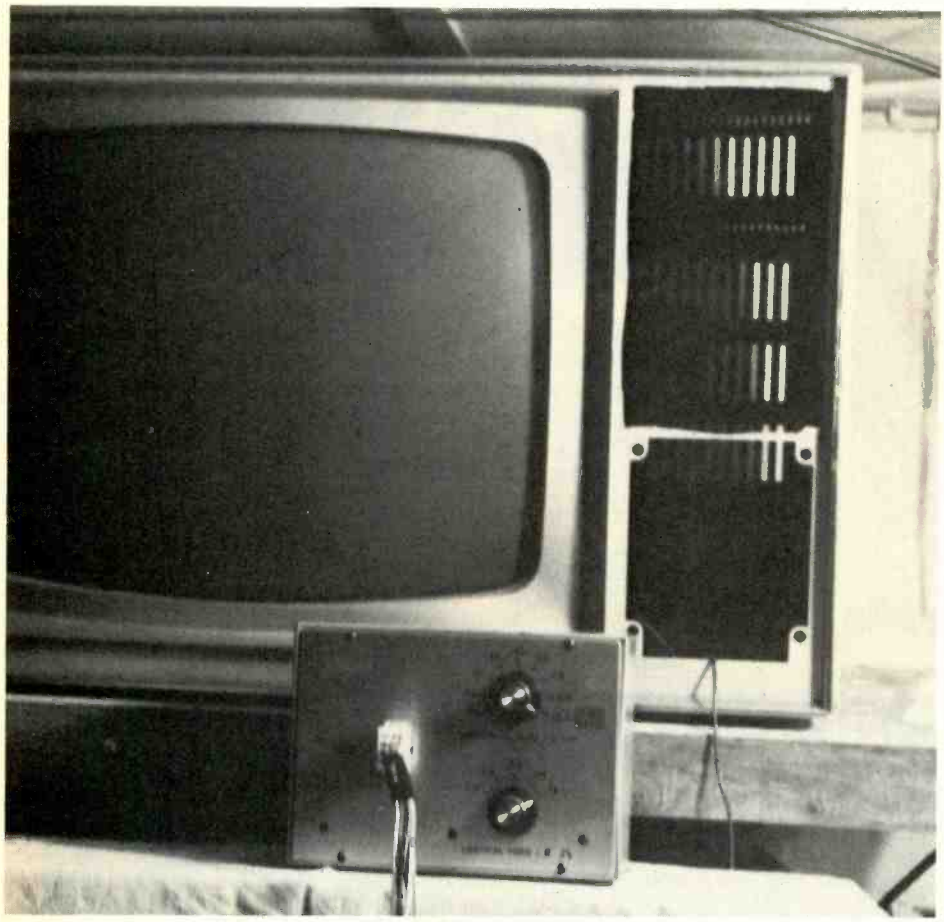
The term heat sink is a misnomer. The proper name is "heat dissipator," and it dissipates heat into the ambient. There are many different configurations of commercially available dissipators, at lower cost than you can make them and they come with full specifications.

Let's review what we've been talking about. If the problem is one of improving the heat dissipating ability of an existing piece of equipment, the best approach is: 1. Replace plastic transistors with metal ones where physically compatible. 2. Add heat sinks to transistors which are running hot, but are not heat sinked. 3. If existing heat sinks are polished bright, wire brush them, and paint flat black,. 4. Add a small fan. There are some flat "pancake" type fans which can be bolted onto the back of an existing unit, or on the bottom, if the height of the legs are increased. Of course, the ventilating openings may have to be blocked in some areas, and enlarged in others, to assure a proper flow path for the forced air, but this is a relatively simple problem.

It is a fact that transistor failures are directly affected by the operating temperature of the junction . . . the higher the temperature, the shorter the time between failures. Proper heat sinking is the answer to longer life. Some amplifiers have thermal switches which shut down whenever the temperature is too high. Some electronic circuits do the same thing. While these are steps toward preventing short circuits, they are poor substitutes for preventing premature transistor failures by adequate heat sinking. Figure 1 is a useful graph for estimating heat sink ability, and helps acquire a "feel" for heat sink size requirements. ET/D

TEST INSTRUMENT REPORT

Do you have a test jig suitable for use with solid state chassis? Or are you struggling along with only your old tube chassis jig as too many shops are, needlessly transporting complete solid state sets? Or did you buy a new test jig and put the old one in the back room to collect dust while occasionally wishing it could be used to cook a chassis while the new jig is in use? Or could you use another jig and do you have a junk 18 or 19 inch set with a useable picture tube?



The 10J107 Test Jig Adapter and the defunct TV set that was converted. For information Circle No. 150 on the Reader Service Card.

Test jig adaptor

RCA's 10J107

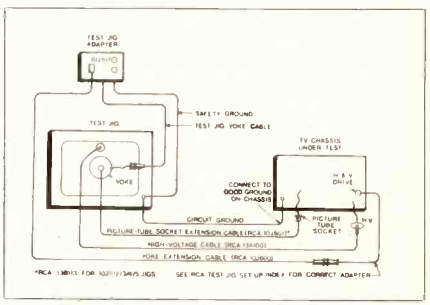
By Walter H. Schwartz

The RCA 10J107, which has been available for a couple of years, allows you to make a test jig out of almost any, preferably high voltage focus, 18 or 19 inch color picture tube. The complete package consists of the adapter transformer unit, a low impedance yoke, an extension cable, and set-up information (all adapters from RCA's 10J106 series test jigs are compatable).

The 10J107 adapter contains a vertical yoke circuit auto transformer and switching, allowing selection of vertical yoke resistances of from 2.0 to 3.4 ohms in five steps and a horizontal yoke matching transformer with switchable taps to match yoke impedances of from 0.16 to 13.7 mH in nine steps.

To convert an existing tube type chassis test jig or a junked TV set simply remove the original yoke and replace it with the yoke supplied with the 10J107. Reinstall the original convergence assembly and blue lateral assembly and use them for static convergence of the jig. Without a dynamic convergence capability, some edge misconvergence is normal with all test jigs.

We converted an elderly Motorola 19 inch table model TV set with the 10J107. This cabinet formerly contained a TS921 chassis and a 19EYP22 equivalent CRT. We simply stripped everything out of the cabinet except the CRT, installed the new yoke, reinstalled the convergence assembly and had a useful test jig. It Would be necessary to use some sort of CRT socket adapters for some of the newer picture tubes, but the 19EYP22 matches most of the older chassis you are likely to repair. The junk set jig worked fine; if you convert an older jig or junked set however, you must keep the CRT high voltage within the specifications of the tube you use (25-26 KV for our old 19EYP22) or install, in the old 18 inch test jigs a 18VAHP22 or an RCA 1895P22 and in the 19 inch jigs a 19VEDP22 or an RCA 1906P22. These tubes are rated X-ray safe to 33KV. (RCA also offers a 10J110 High-Voltage Meter kit which will measure HV to 35KV. This can be installed in any test jig needing a meter.)



Test Jig hookup

Make sure you have a proper ground lead, and use it to avoid unpleasant surprises.

Adapter information updating service covering three, approximately yearly, issues is $3.00. So, if you need a new test jig or another test jig and especially if you already have an RCA jig and assorted adapters, here's a way to get it for about one half the price of an entirely new jig.

Also, it is a particularly economical (cheap) way to end the nuisance and inefficiencies of working without a test jig. A usable test jig should pay for itself in weeks, in time saved and uncertainties settled and chiropractor bills avoided. ET/D

BULLETIN BOARD

A new 16-page bulletin describing the complete line of Gould **portable oscilloscopes** is available from *Gould Inc., Instruments Division*. The line includes instruments for a broad range of applications from educational and service use to laboratory and digital circuit measurements. Among the instruments detailed in Catalog 449-16 are 15MHz dual trace and true dual beam oscilloscopes, a 25MHz scope with signal delay, a 30MHz unit with variable trigger delay, and 60MHz and 100MHz scopes with third channel trigger view and holdoff. An optional 3½-digit DMM add-on for the latter two scopes accurately displays signal amplitudes, times and frequencies. In digital storage scopes, Gould offers the OS4000 with conventional 10MHz oscilloscope performance combined with digital storage to 450kHz, roll-mode viewing, and up to 100% capture of pretrigger information, and the second-generation OS4100 which offers both T-Y and X-Y display, trigger-window control, and a 1k × 8-bit memory. Catalog 449-16 is available from Marketing Communications, Gould Inc., Instruments Division, 3631 Perkins Avenue, Cleveland, OH 44114.

A new 12-page **sound products catalog** describing a complete line of Perma Power portable, packaged sound units is now available from *Perma Power Electronics, Inc.* Described as powerful, portable, versatile and easy-to-use, all of the Perma Power sound units included operate on ordinary "D" cell or transistor batteries, for quick, easy set-up and operation anywhere. Product illustrations and full color in-use photos show the many applications for this type of sound products. Designed for use in schools, churches, hotels, motels, offices, and similiar applications, several Perma Power units incorporate the reading lectern as well as the amplifier, microphone and speaker in a single case. Two systems, the Roving Rostrum and Sound Column Lectern, are designed to reach audiences ranging from 50 to 1000 persons. A highly portable unit, the briefcase-size Announcer, covers audiences up to 150 persons. The Half-Mile Hailer covers very large audiences outdoors and is ideal for athletic events and crowd control. Specialty products include the Sound Cruiser

mobile sound system and a Paging System with background music capability. In addition to the packaged sound systems, Perma Power sound systems components are completely compatible and interchangeable for "custom" system design. The catalog includes a complete list of accessories, including amplifiers, microphones, mixers, microphone stands, speakers and power supplies for easy reference. For further information on Perma Power Portable Sound Systems, and a free catalog, contact Norman Ackerman, Perma Power Electronics, Inc., 5615 West Howard Street, Chicago, IL 60648.

The National Bureau of Standards (NBS) has issued two publications offering information on its **time and frequency measurement services.** NBS generates, maintains, and distributes standards of time and frequency to users throughout the country. *NBS Time & Frequency Dissemination Services,* edited by Sandra Howe, provides a detailed description of the time and frequency dissemination services of NBS. The 16-page publication provides a brief history of the Bureau's services and discusses the broadcasts available from radio stations WWV and WWVB in Fort Collins, Colorado, and from WWVH in Kauai, Hawaii. In addition, the use of network television and satellites for time and frequency dissemination is also summarized.

Time & Frequency Users' Manual, edited by George Kamas and Sandra Howe, is intended as a guidebook for engineers and technicians making time and frequency measurements, as well as for anyone needing general information on time and frequency. The 256-page manual outlines the history of time and frequency measurement and the roles that are played by NBS, the U.S. Naval Observatory, and the International Time Bureau. In addition, it explains the laboratory use of time and frequency measurements, as well as the use of radio, television, and satellites for time and frequency calibration and dissemination. The *Users Manual* includes for example information on how to build the equipment necessary to use network color burst as a primary frequency standard against which to very accurately check secondary standards to a degree of precision which would otherwise be very time consuming. An essential book for anyone interested in precision time/frequency standards. Both publications are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. *NBS Time & Frequency Dissemination Services* (Special Publication 432) can be ordered for $1.50 by Stock No. 003-003-02105-9. *Time & Frequency Users' Manual* (Special Publication 559) is $6.00 by Stock No. 003-003-02137-1.

Blonder-Tongue Laboratories, Inc., Old Bridge, NJ has announced the availability of a new brochure describing and illustrating its complete **BTVision™ Addressable Subscription Television System.** The brochure highlights a functional description of the system's operation, illustrated details of encoding and monitoring equipment, and STV accessories. Features, options and controls of the new BTVision Addressable Decoder are also detailed. Blonder-Tongue's Addressable Subscription Television System is fully integrated with a variety of programming options and is designed for centralized control of individual subscriber decoders by means of a computer. The company's engineers can design a station's total STV computer software package. For a copy of the brochure write: Blonder-Tongue Laboratories, Inc., One Jake Brown Road, Old Bridge, NJ 08857. ETD

CUT YOUR AD BUDGET LATELY?

Honesty compels us to admit that you're not alone.

Whenever the cost/price squeeze gets really tough, it's a temptation to regard advertising as a cost...and to cut.

Not at every company, however.

In recent years, a significant change has taken place in the thinking of many management men about advertising budgets. No longer are appropriations cut automatically when the pressure is on.

Why?

For a number of reasons. Among them are:

1. *With the growth of the marketing concept,* advertising is no longer looked upon merely as an expense, but as an integral part of the company's marketing mix.

2. *Firms that maintain advertising during recession years do better in sales—and profits—in those and later years.* That was proved conclusively in studies of five separate recessions made by ABP and Meldrum and Fewsmith.

3. *The cost of a salesman's call today makes it imperative to make maximum use of advertising.* The average cost of an industrial sales call soared to a record $96.79 according to the latest report by McGraw-Hill's Research Laboratory of Advertising Performance. Yet studies show that a *completed* advertising sales call—that is, one ad read thoroughly by one buying influence—literally costs only pennies. Why deny yourself such efficiency?

4. *In some cases, there is no way to reach customers except by advertising.* The "Paper Mill Study" shows (1) the number of buying influences in the average plant is far greater than marketers are aware of, (2) the vast majority of these influences are unknown to salesmen, (3) no salesman has the time to contact all influences even if he knows them.

5. *Selling costs are lower in companies that assign advertising a larger role in marketing products.* So advertising is an investment in profit, just like a machine that cuts production costs.

6. *Memories are short.* There is an estimated 30% turnover every year among buyers. It isn't surprising, then, that lack of advertising contact can quickly result in loss of share of market.

7. *Most down periods turn out to be shorter than expected.* The history of every postwar recession is that it didn't last as long as predicted. Why gamble your market position for short-term gain?

8. *Consider lead time.* Very few products sold to business and industry are bought on impulse. The advertising you are doing—or missing—right now will have its effect years from now.

9. *Advertising works cumulatively.* It would be nice to think that every reader reads all of your ad. We know it doesn't work that way. To be most effective, advertising must have continuity.

10. *Did your competitor cancel his budget, too?* If not, you may be taking a big risk.

11. *Will you lose salesmen?* They know that their chance of getting an order is better if they are backed up by advertising. Can you be sure of keeping them when they learn that that support has gone?

12. *You know better.* Survey after survey of executives shows that they expect a *drop* in sales if advertising stops.

But there is need for efficiency...

whenever advertising budgets are being assembled—never more than in these inflationary times. Significantly, a recent survey shows that nearly 40% of the average budget for advertising to business and industry is invested in business publication space and preparation. That's *more than double* the next largest item.

Why? Because specialized business publications remain the most effective and efficient method of reaching target audiences in business, industry and the professions.

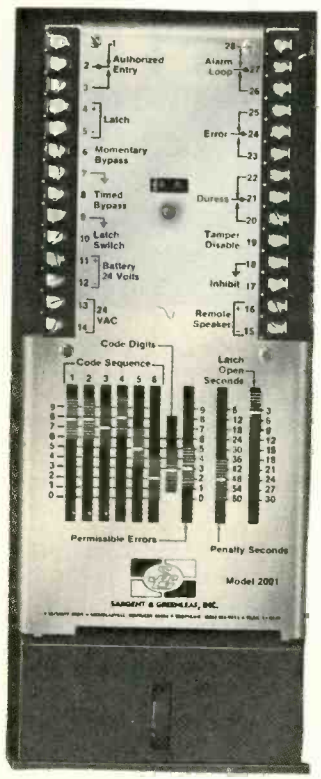
And we can prove it.

Write for your copy of "The ABP Library of Publishing, Advertising & Marketing" to American Business Press.

ABP

American Business Press, Inc.
205 East 42nd Street
New York, N.Y. 10017
212 661-6360

SECURITY PRODUCTS



Digital Access Control System

Circle No. 132 on Reader Inquiry Card

Sargent & Greenleaf, Inc. has announced the introduction of its third generation of the Code/Tronic III-2001. Reportedly designed around U.S. government specifications (MIL-C-52913), the 2001 includes a variety of special features which offer a new dimension in secure, flexible and economical door-to-door access control. Central to the 2001 is a microprocessor which controls and monitors such functions as a tamper alarm, a duress alarm and a latch/bolt monitor. With a capacity for up to one million possible code combinations, it enables the user to easily change the combinations whenever needed through a series of simple slide switches. Other functions that can be controlled include: the amount of time the lock will remain open on an authorized entry; the number of permissible code entry errors permitted before penalty time is incurred and the duration of any penalty time incurred. A cumulative penalty function is also provided which may be programmed to automatically multiply penalty time up to 180 seconds with each successive code entry error. In addition, the 2001 is stated to offer several more useful security features. Timed and momentary bypass features enable the lock to be controlled by a remote switch. A standby power hookup that will accept any 24 volt rechargeable power source is also available. An inhibit feature can turn the 2001 into a virtual time lock by denying all entries for a predetermined period of time.

Packaged in a wood grain vinyl finish, the Code/Tronic III is also available in a modified version, the 1999. It provides the same degree of flexibility and security, but with more limited functions.

With its variety of features and options, the Code/Tronic III can be applied to many situations in private industry, as well as the medical, governmental and law enforcement areas. It is considered reliable enough to provide high security and convenient flexibility without hampering daily operations. The manufacturers feels it is one of the most advanced access control systems available today.

Ultrasonic Alarm

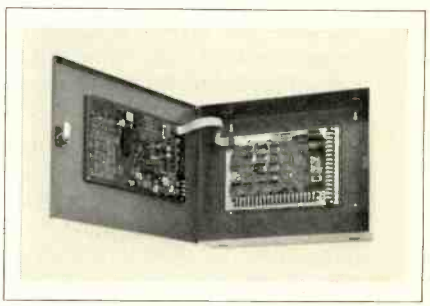
Circle No. 133 on Reader Inquiry Card

A burglar alarm from *Master Lock*—ULTRASON-II (No. 2606)—reportedly provides low-cost protection for homes, businesses and institutions, with an intruder-sensing beam of "silent sound" that instantly detects unauthorized entry. This system automatically adjusts to room differences for stable operation without attention from the owner. Simply plug-in, aim and turn it on. No installation work is required. "Smart circuits" distinguish between random room disturbances and actual intrusion. A built-in alarm horn sounds loud warning to drive off thieves and vandals. ULTRASON-II can also alert people in rooms remote from the detector. The system will automatically send a signal over existing house wiring to trigger small, hand-size optional Satellite repeaters (No. 2608) that simply plug into any wall outlet. Satellites respond only to the *special FM-coded signal* from ULTRASON-II. A switch permits by-passing Ultrason-II's internal horn for "silent alarming" using a satellite to alert guards without warning intruder. Automatic delay allows entering and leaving the protected area without triggering the alarm, and gives the owner 15 seconds to disarm the unit upon entry. Two outlets are included for controlling lights, triggering sirens, actuating flashers or other auxiliary burglar-stopping devices. ULTRASON-II alarm automatically silences and resets to detect any further instrusion after 5 minutes.

Outdoor Security System

Circle No. 134 on Reader Inquiry Card

Intrusion Detection Systems, Inc. is marketing a new version of its outdoor buried seismic security system which includes an audio listen-in capability. The concealed, all-weather, all-terrain detection system utilizes seismic sensors and discriminators (permanent or temporary) of a type which are buried out of sight in earth, asphalt/concrete, or installed on roofs. A feature of the system is a signal processor (portable or permanent) said to differentiate between intruder and unavoidable disturbances caused by animals, trains, trucks, freeways, air compressors, or sonic booms, thereby preventing false alarms. After eight years of installations in most countries of the world the company claims to have never had a sensor fail in the field. The listen-in capability now permits security personnel to identify the cause of alarm signals in any number of zones. Applications include major plants, nuclear center, utility companies, auto and truck dealers, trucking lines, schools, prisons, estates, etc. It is said the system drastically reduces false alarms while providing an exceptionally high degree of protection. IDS distributes its products nationally. ET/D



WE REACH THE PEOPLE YOU NEED TO REACH!

Place a recruitment ad in any of these HARCOURT BRACE JOVANOVICH PUBLICATIONS - and you know your ad dollar is wisely spent.

HBJ PUBLICATIONS does a better job of reaching those who count *(your potential employees)* than any other business publisher.

Magazine	Circulation
Body Fashions/Intimate Apparel	10,226
Dental Industry News	6,000
Dental Laboratory Review	11,800
Dental Management	103,000
Drug & Cosmetic Industry	9,200
Electronic Technician/Dealer	50,000
Fast Service	53,026
Flooring	20,223
Food Management	53,078
Hearing Instruments	16,119
Home & Auto	22,353
Hotel & Motel Management	38,200

Magazine	Circulation
Housewares	14,500
LP Gas	14,112
Neurology	13,100
Paper Sales	11,600
Professional Remodeling	32,478
Quick Frozen Foods	24,000
Rent All	11,150
Roofing/Siding/Insulation	18,343
Snack Food	10,113
Tobacco Reporter	5,000
Toys, Hobbies & Crafts	14,262

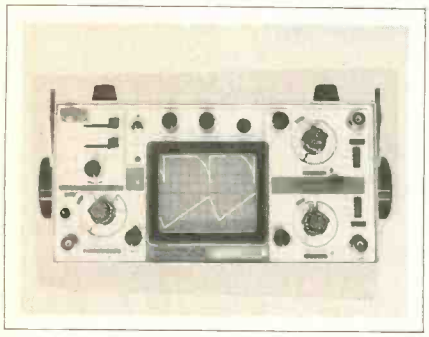
Don't forget that classified advertising works just as effectively in locating employees as it does if you are looking for a position, have a line, machinery or a business to sell, are seeking representatives or wish to buy a specific item. Let it go to work for you!

HBJ PUBLICATIONS - COUNT ON US TO REACH THOSE WHO COUNT!

HBJ **Harcourt Brace Jovanovich Publications**
One East First Street
Duluth, Minnesota 55802

Call Dawn Anderson at 218-727-8511

NEW PRODUCTS



Portable Oscilloscope

Circle No. 136 on Reader Inquiry Card

The new BS310S oscilloscope from *Universal Enterprises* is a three inch, dual trace 15MHz (–3dB) instrument capable of operation from an optional internal battery pack or an external 11 to 30 volt dc source as well as from 120/220 Vac line. It also features 2mV/div maximum sensitivity, sweep speeds from 0.5 µsec to 0.5 sec/division (and a X5 magnifier), X-Y operation and TV sync. The price is $855 with the battery pack and 2, 10:1/1:1 probes. An optional carrying case is $38.00.

Intermodulation Distortion Analyzer

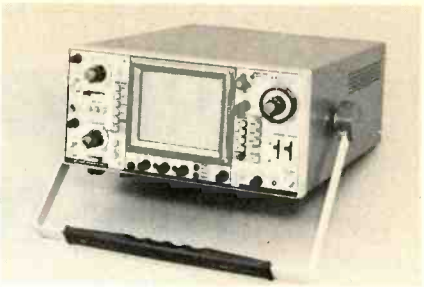
Circle No. 137 on Reader Inquiry Card

The new model 6000A Analyzer from *BPI* features digital readout and pushbutton operation. It has isolated internal signal sources, 60Hz/7kHz at 4:1 for SMPTE standard measurements, and 9kHz/10kHz, 14kHz/15kHz, and 19kHz/20kHz all mixed 1:1 for measurements to C&IF standards. The 6000A has differential input switch selectable for two channels, a true RMS voltmeter and less than .0005% residual distortion in CCIF mode; 0008% in the SMPTE mode. The 6000A is priced at $2550. The 3000C, a harmonic distortion analyzer of similar appearance is $1995.

Alternate Time Base 50MHz Scope

Circle No. 138 on Reader Inquiry Card

A new 50MHz, dual channel, portable KIK-Scope reportedly capable of passing signals to 100MHz with only a slight reduction in vertical gain has been introduced by *Kikusui International Corporation*. The KIK-5650 features an alternate time base for viewing four waveforms simultaneously, an auto-dynamic focus circuit and a metal case that minimizes RFI interference. Rated at 50MHz, the 5650 will reportedly maintain a 3dB bandwidth at 65MHz and better than 9dB at 100MHz. Normal sensitivity (deflection factor) is 5mV/div to 5V/div in 10 steps. A 5X magnification capability can increase this sensitivity to 1mV/div to 1V/div. Operational modes are Channel 1, Channel 2, Alternate, ADD, X-Y and Chop. The chop frequency of 500kHz is stated to provide a more accurate "sampling, of each of the two waveforms and presents a clearer trace. The horizontal



axis (sweep time) for Channel A (main sweep) and Channel B (delayed sweep) is 0.1 usec/div to 0.5 sec/div in 21 steps. A 10X magnification can accelerate the sweep time to 10nsec/div to 50msec/div. There are four trigger modes for Source A signals (internal, external, external ÷ 10 and line) plus two trigger modes for signal Source B (internal and external). Trigger coupling includes ac, Hf rejection and dc. For video waveforms , a synchronization circuit linked to the time/div switch lets the user view signals associated with TV servicing. In the X-Y mode, the Model 5650 bandwidth is dc to 2MHz (–3dB) with a deflection factor of 5mV/div to 5V/div in 10 steps. Z-axis bandwidth is dc to 5MHz with a sensitivity of ±3V peak to peak. The Model 5650 measures 370mm × 165mm × 480mm and weighs approximately 10kg. The six inch rectangular, internal graticule CRT has 8 × 10 divisions, each measuring 10mm. A trace rotation control is located on the front panel. The Model 5650 is completely modular. All internal construction is on plug-in boards, and, in the event of trouble, a board swap-out program can assure fast maintenance turn-around and minimum down-time. The Model 5650 comes with a 2-year warranty (CRT 1 year) and the price is $1,895.

DMM's

Circle No. 139 on Reader Inquiry Card

Keithley Instruments has recently announced two new versatile, low cost digital multimeters. Model 130 is a five function handheld featuring 0.5% basic dc accuracy, auto-zero, auto-polarity and 0.6 inch LCD readout. The control

Circle No. 105 on Reader Inquiry Card

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

ELECTRONICS BOOK CLUB

take any **6** of these 24 unique electronics books (values to $107.70) for only **$2.95** for ALL SIX

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

Facts About Club Membership

- The 6 introductory books of your choice carry publisher's retail prices of up to $107.70. They are yours for only $2.95 for all 6 (plus postage/handling) with your Trial Membership.
- You will receive the **Club News**, describing the current Selections, Alternates, and other books, every 4 weeks (13x a year).
- If you want the Selection, do nothing, it will be sent to you automatically. If you do not wish to receive the Selection, or if you want to order one of the many Alternates offered, you simply give instructions on the reply form (and in the envelope) provided, and return it to us by the date specified. This date allows you at least 10 days in which to return the form. If, because of late mail delivery, you do not have 10 days to make a decision and so receive an unwanted Selection, you may return it at Club expense.
- To complete your Trial Membership, you need buy only four additional monthly Selections or Alternates during the next 12 months. You may cancel your Membership any time after you purchase these four books.
- All books — including the Introductory Offer — are fully returnable after 10 days if you're not completely satisfied.
- All books are offered at low Member prices, plus a small postage and handling charge.
- **Continuing Bonus.** If you continue after this Trial Membership, you will earn a Dividend Certificate for every book you purchase. Three Certificates plus payment of the nominal sum of $1.99 will entitle you to a valuable Book Dividend of your choice which you may choose from a list provided Members.

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

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

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

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

ELECTRONICS BOOK CLUB, Blue Ridge Summit, Pa. 17214

Circle No. 103 on Reader Inquiry Card

ELECTRONICS BOOK CLUB

Blue Ridge Summit, Pa. 17214

Please open my Trial Membership in ELECTRONICS BOOK CLUB and send me the 6 books circled below. I understand the cost of the books I have selected is only $2.95 for all 6, plus a small shipping charge. If not delighted, I may return the books within 10 days and owe nothing, and have my Trial Membership cancelled. I agree to purchase at least four additional books during the next 12 months after which I may cancel my membership at any time.

800 870 905 1059 1060 1064 1066 1077 1088 1101 1119 1123 1132 1133 1136 1138 1183 1184 1199 1203 1205 1222 1225 8224

Name _____ Phone _____

Address _____

City _____

State _____ Zip _____

(Valid for new Members only. Foreign and Canada add 15%.) T-980

designations, reportedly printed on the back of the transparent overlay for maximum protection, are color coded for easy use and the 130 is specified to be fully overload protected to 1000V dc or peak ac nonswitched (750V peak switched) (except 200mv ac range, 15 sec max above 300V). Current ranges are fused and the ohms ranges are protected to 300V dc or ac RMS.

The bench/portable Model 169 offers again five functions, 0.25% basic dc accuracy, 0.6 inch LCD readout, color coded push button controls, and an estimated battery life (on alkaline C cells) of 2,000 hours.

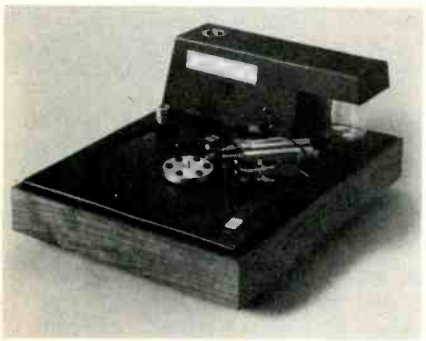
Both models have available accessories such as carrying cases, extra test leads, spare parts kits, (only advised where a number of instruments are to be maintained), high voltage probes, high current shunts, RF probes and clamp on ac probes.

The price of the 130 is $109 and the price of the 169 is $159, both with test leads and batteries.

Disc Cleaning Machine

Circle No. 140 on Reader Inquiry Card

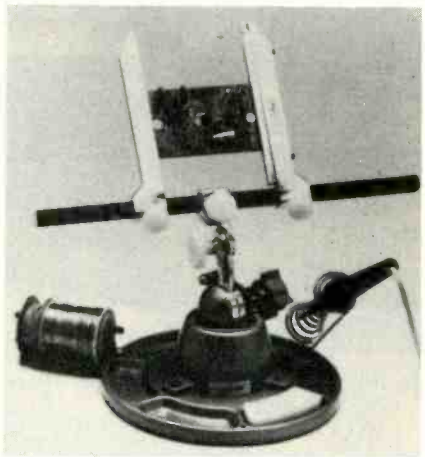
TMA Enterprises announces the availability of a new unit which cleans both side of a record at the same time. The unit accomplishes this by applying a cleaning solution, brushing the wet record surface and then vacuuming the top layer of fluid off. Dirt is removed with the fluid that is vacuumed off. The unit then blows clean air deep into the grooves to dry the record. This process is reportedly more effective for removing static than merely vacuuming the record dry. The total cleaning process takes about 3½ minutes. Suggested retail price is $695.00. A coin-operated version is also available.



PC Board Work Center

Circle No. 141 on Reader Inquiry Card

The Model 324 *PanaVise* Work Center consists of popular models Number 300 Standard Base, 312 Tray Base Mount. 315 Circuit Board Holder and the 371 Solder Station. This combination is reportedly the result of demand, and it carries a price advantage if purchased as a unit.



The 324 PanaVise Work Center will have a suggested user net price of $49.95. If the above four items were purchased separately, they would have a price of $52.80. Soldering iron and solder shown only for illustration purposes.

Aluminum Truck Bodies

Circle No. 142 on Reader Inquiry Card

Reading Body Works, Inc., has expanded its line of aluminum service bodies for standard and compact trucks to include Spacemaker models with top opening compartments, panel bodies, and models with sliding tops.

Built of heavy duty aluminum, the Reading bodies are reportedly comparable in durability to equivalent steel bodies but are approximately 45 per cent lighter in weight. The aluminum bodies are furnished for use in bare metal or finished in color in automotive enamel.

The lighter weight aluminum bodies permit contractors to realize fuel economy with a normal load or to carry a heavier load without exceeding vehicle weight limitations.

The multiple weathertight compartments of all bodies have removable shelves and adjustable bin dividers to handle organized storage of a large assortment of parts and tools. Reading's patented concealed pin hinges permit doors to operate freely on stainless steel bushings. The slam-action zinc coated door locks have cylinders guaranteed for the life of the body to the original owner.

All members are electrically welded into an integral unit based on an understructure of aluminum extrusions, reportedly braced and reinforced at critical stress points.

Sweep/Function Generator

Circle No. 143 on Reader Inquiry Card

Exact Electronics' 501 is a sine, square, triangle generator with variable symmetry, DC offset, internal ramp, gate and trigger, start/stop frequency controls, and 30V P-P output amplifier as standard features. Included as waveform

functions are positive and negative square, and positive and negative ramp. Attenuation of the output signal is provided by 10dB additive steps plus 20dB variable. A full-time ramp output, a start level control for adjusting the gate/trigger mode lockout level, external VCF input, main generator sync output and ramp generator sync output are also standard features. The frequency multiplier/start frequency and stop frequency controls are reportedly precision Kelvin-Varley dividers. This is stated to provide 10 times better resolution of the frequency vernier potentiometer within the decade range selected. An S (search) position switches the multiplier to 3 decade (1000:1) linear VCF range. Housed in a lightweight package with aluminum covers for RFI shielding, the Model 501 weighs 10 lbs. It measures 5 inches high, 12.5 inches wide and 11 inches deep. An optional tilt stand/carrying handle is available. The price is 595.00 F.O.B. Tillamook, Oregon.

Touch Selection DMM

Circle No. 144 on Reader Inquiry Card

Touch Test 20 by *Non-Linear Systems*, has no conventional switches, reportedly making it the first digital test instrument with touch selection of functions, ranges and on-off power control. The results are said to be a clean, attractive, well-organized front panel providing easy comprehension and fast error-free operation.

The 3 ½-digit Touch Test 20 measures 10 parameters, 20 functions and includes 44 ranges, making it, the manufacturer states, the first digital multimeter to include numerous useful functions in a truly low cost, small package with extreme ease of operation.

Test parameters include ac & dc volts, ac & dc current, resistance, capacitance, temperature, continuity, conductance and diode test. Package size is 2.9 inches high by 6.4 inches wide by 8 inches deep. Weight is less than 3 pounds. Touch Test 20 may be purchased as a line powered unit or optionally comes equipped with rechargeable batteries for battery or line operation.

Accessories included with the instrument are OSHA style test leads, a temperature probe and a component test adapter for radial lead components.

An optional leather carrying case allows the Touch Test 20 to be operated while worn around the neck or on the belt, providing hands-free operation.

The single unit price for Touch Test 20 is $399.50 for line operation. Touch Test 20B is $425.00, including rechargeable batteries and charger.

Variable Control Freeze Spray

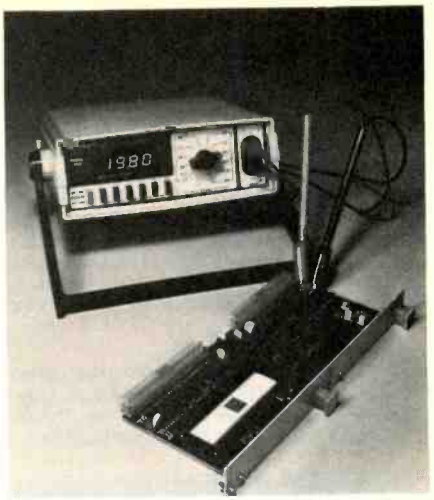
Circle No. 145 on Reader Inquiry Card

Chemtronics Freez-It® now is available with a variable control valve which allows pin-point or variable wide area application. The light setting produces a spray approximately one centimeter in diameter, medium spray is 1.7 cm and wide angle is about 2.5 cm in diameter. Freez-It® is available in fifteen and thirty ounce cans.

3-½ Digit Multimeter

Circle No. 146 on Reader Inquiry Card

Intended for bench top use, circuit design, production and maintenance testing, educational training, commercial electronic equipment test and measurement use, the new Model 4000, 3-½ digit multimeter from *Triplett Corporation,* offers a wide angle LED digital display for easy viewing and pushbutton function selectors. Single range selector switch and two input jacks serve all functions and ranges and there is auto-zero and auto-polarity in the voltage and current modes. Thirty-one ranges are available. Ranges included are: 200mV to 1000Vdc/Vac; 200µA to 2000mA ac/dc current; 200 ohms to 20 Megohm low power and high power resistance. Input Impedance is 10 Megohms on all ranges and Accuracy is ±0.2 to ±0.5% depending upon the range selected. Multiple fusing to 1000V on all ranges is provided. Fuses included are a 1/8 Amp



power line, 2 Amp input and a 3 Amp high energy type. Forty-eight-inch long insulated safety test leads with screw-on insulated alligator clips, combination carrying handle/bench stand, plus a 3-wire detachable long line cord are also furnished. Power requirements are 50/60Hz, 120 or 240 Vac with internal change. Optional accessories include miniature clip leads for high density circuits and a 30 amp dc current shunt. The price is $235.

GE for 1981

continued from page 25

to GE (Fig. 8). A blue, green, or red raster with retrace lines would likely be caused by a defective Q405, Q403, or Q401 respectively. No blue, no green or no red, again with retrace lines would probably be caused by the combination of Q405 and Y403, Q403 and Y433 or Q401 and Y463 respectively.

IF module problems

A signal from TP38 on the signal module, (see Fig. 7) can be injected into the IF input with the 18 pfd test lead to produce an interference pattern on the CRT if the module is functional. Also, of course, check for the presence of + 15 volts.

Audio

For '81 GE offers an improved audio system in certain top of the line sets. The 10 watt audio module contains its own power supply and obtains its drive from the output of the standard module (Fig. 9).

Pin 4, RL2 of the standard module should have +23 volts present. Injecting vertical sync pulses from the cathode of Y601 (Fig. 5) to 11 of IC180 will check the speaker and the 10 watt module. Since all active devices in the audio system are in IC180 it is the most likely cause of audio failure. ET/D

CLASSIFIED

RATES: 50 cents per word (minimum charge, $15). Bold face word or words in all capital letters charged at 65 cents per word. Boxed or display ads charged at $60 per column inch (one inch minimum). Agency commissions will be given only when camera-ready art is provided by agency. For ads using blind box number, add $5 to total cost of ad. Send ad copy with payment to Dawn Anderson, ELECTRONIC TECHNICIAN/DEALER, 1 East First Street, Duluth, MN 55802.

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

FOR SALE

BUGS. Build professional miniature FM transmitters. Complete plans. Send $4.95. Money-Back Guarantee. PCEP Enterprises, Box 837-C, New York, N.Y. 10274 8/80

Replacement Phono Belts- *BIC, *PIONEER, *KENWOOD, *SANSUI. $1.65 to $3.25. Minimum 10 pc each. Toll-Free 1-800-543-3568 Consolidated Elect., Inc.

Speaker Reconing-Complete rebuilding of all major brands 8" to 18". 48 hour return and 6 month guarantee on JBL, EV, Altec Professional Series including Cerwin Vega 18" models. The Speaker Shop. 1-800-543-3568 Toll-Free. 9/80

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

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, 800-645-5030.

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

SCRAMBLED-TV WHAT IT IS-HOW IT WORKS. New publication explains how the two encoding/decoding systems used today work. Theory, circuits, etc. Send $9.95 to: Workshop, Box 393ETB, Bethpage NY 11714. TF

ELECTRONIC REPAIR SERVICE
Let us be your complete electronic repair specialist. We will repair your tape recorders, receivers and telephone answering machines for $20.00 plus parts. Free estimates. Warranty station for many companies also. 412-561-6114
ON-CUE ELECTRONICS
1761 West Liberty Avenue, Pittsburgh, PA. 15226

Horizontal Output-Replaces ECG 238-$2.39 minimum 10 pieces. Also complete line Japanese semi's. Catalog sent free upon request, Toll-Free 1-800-543-3568. Consolidated Elect., Inc. 9/80

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

Build your own speaker system. Write for free catalogue. **MCGEE RADIO,** 1901 McGee St., Kansas City, MO 64108.

TV AND RADIO TUBES 49¢ 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

Satellite Television-Movies, Sports, etc. Build or buy your own Earth Station. Article gives alot of hard-to-find, necessary information. Send $3.00 for article to: Satellite Television, R.D.3, Box 140, Oxford, NY 13830. TF

SPECIAL-TV PIX TUBES-2 YR. WARRANTY. 25XP22 color @ $45.00. Free price list on request. CRT Sales. 1314 Hamilton Ave. Telephone 1-216-431-4608 Cleveland, Ohio 44114. 9/80

FOR SALE: B & K 1077B ANALYZER. LIKE NEW WITH SLIDES & INSTRUCTIONS. AFTER 5 P.M. 212-449-7510 9/80

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

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

PAYMENT MUST ACCOMPANY ORDER. WE'LL BILL RATED FIRMS

NAME_____ COMPANY_____

STREET_____

CITY_____ STATE_____ ZIP_____

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

RATES: 50 cents per word (minimum charge, $15). Bold face words or words in all capital letters charged at 65 cents per word. Boxed or display ads charged at $60 per column inch (one inch minimum). For ads using blind box number, add $5 to total cost of ad.

PICTURE TUBE REBUILDING EQUIPMENT capable of producing four high quality tubes per day **(WILL TRAIN TO OPERATE)** $4200. Call or write Atoll Television, 6425 Irving Park, Chicago, Illinois 60634, ph. 312-545-6667. 11/80

Automobile radio and tape replacement parts: Delco, Chrysler, Philco-Ford, Motorola, Panasonic and many others. Large inventory. **Laran Electronics Inc.** 3768 Boston Road, Bronx, NY 10469 (212) 881-9600 out of New York state (800) 223-8314. TF

MATV-CATV INSTALLERS Get lowest prices on antenna accessories, fastest service from **ANTSCO CORPORATION.** Call collect, ask for catalog & prices. All orders shipped same day. Sierra Madre, CA 91024. 213-355-2510. 11/80

THE BOOTLEGGERS BIBLE, modify CB's above CH-40, below CH-1, $12.95 **CB RADIO REPAIR**, circuit descriptions Professional Repair techniques, $8.95 **LINEAR AMPLIFIER PLAN BOOK II,** 13 plans from 2 to 400 MHZ, 15 to 1000 watts, $11.95 A.P. SYSTEMS, Box 263 E, Newport, Rhode Island 02840. TF

HITACHI AND SANYO EXACT REPLACEMENT PARTS. Largest inventory. **HITACHI OSCILLOSCOPES** at lowest prices. UPS, COD available. **TEDCO**, 1509 E. Del Amo Blvd., Carson, CA 90746. 213-639-4120. 10/80

TUBE CADDY complete with tubes. Approx. $800 worth for $600. Route 1, Box 529, Waynesboro, VA 22980. 703-942-1594.

ANALOG MM SWAP DIGITAL MM Send me your old, beat up, used Analog Multimeter and a check for $180.00 and I will send you a new 3 ½ Digital DMM 3020 Digital Multimeter the same day. Kontron Electronic, Inc., 700 So. Claremont St., San Mateo CA 94402, Jack Frye, (415) 348-7291 11/80

WANTED

Wanted for Cash: 7N7, 7F7, 6L6, metal, 6AF6, 6HU8, 304TL, 4CX1000A, all transmitting, special purpose and Eimac tubes, etc. DCO Inc., 10 Schuyler Avenue, North Arlington, N.J. 07032, Toll Free (800) 526-1270. 1/81

WANTED: PICTURE TUBE REBUILDING EQUIPMENT working or not. Write or call Atoll Television, 6425 Irving Park, Chicago, Illinois 60634. Phone 312-545-6667. 11/80

CASH for used tech data SAMS: TV, MFH, CB, AR - $1 each. Manufacturers' tech data—will make offer. Write: SR 70830, Fairbanks, AK 99701.

BUSINESS OPPORTUNITIES

MECHANICALLY INCLINED INDIVIDUALS Assemble electronic devices in your home. Knowledge or experience not necessary. Get started in spare time. Above average profits. $300-$600/wk. possible. Sales handled by others. No investment-Write for free details. ELECTRONIC DEVELOPMENT LAB, Box 1560B, Pinellas Park, FL 33565. TF

TELEVISION SALES & SERVICE established 22 yrs., in sunny San Diego area. Gross $140,000, excellent net. Owner becoming Colorado gentleman rancher. Excellent location & lease, fastest growing area in Calif. John Koopman's TV, 2203 East Valley Parkway, Escondido, CA 92027. Phone 714-745-8803 or 303-858-9513.

TV TUNER REBUILDING COMPANY: ESTABLISHED 20 YEARS. HELP RUN-CAN EXPAND-OTHER INTERESTS-SELL FOR STOCK, FIXTURES AND EQUIPMENT VALUE, MILES, 4611 W. JEFFERSON BLVD., LOS ANGELES, CALIF. 90016 10/80

Growing T.V. Sales and Service business for sale in Northern New Jersey; complete, with van and inventory. Excellent opportunity; Contact Mr. Richard Trueman, after 7 p.m. at 201-838-6912.

AD INDEX

SECURITY PROD.

NEW PRODUCTS

TEST INSTR. RPT.

CONT. ED. RPT.

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

1861

SHARP
B&W TV Model
3T-50

SEPTEMBER • 1980

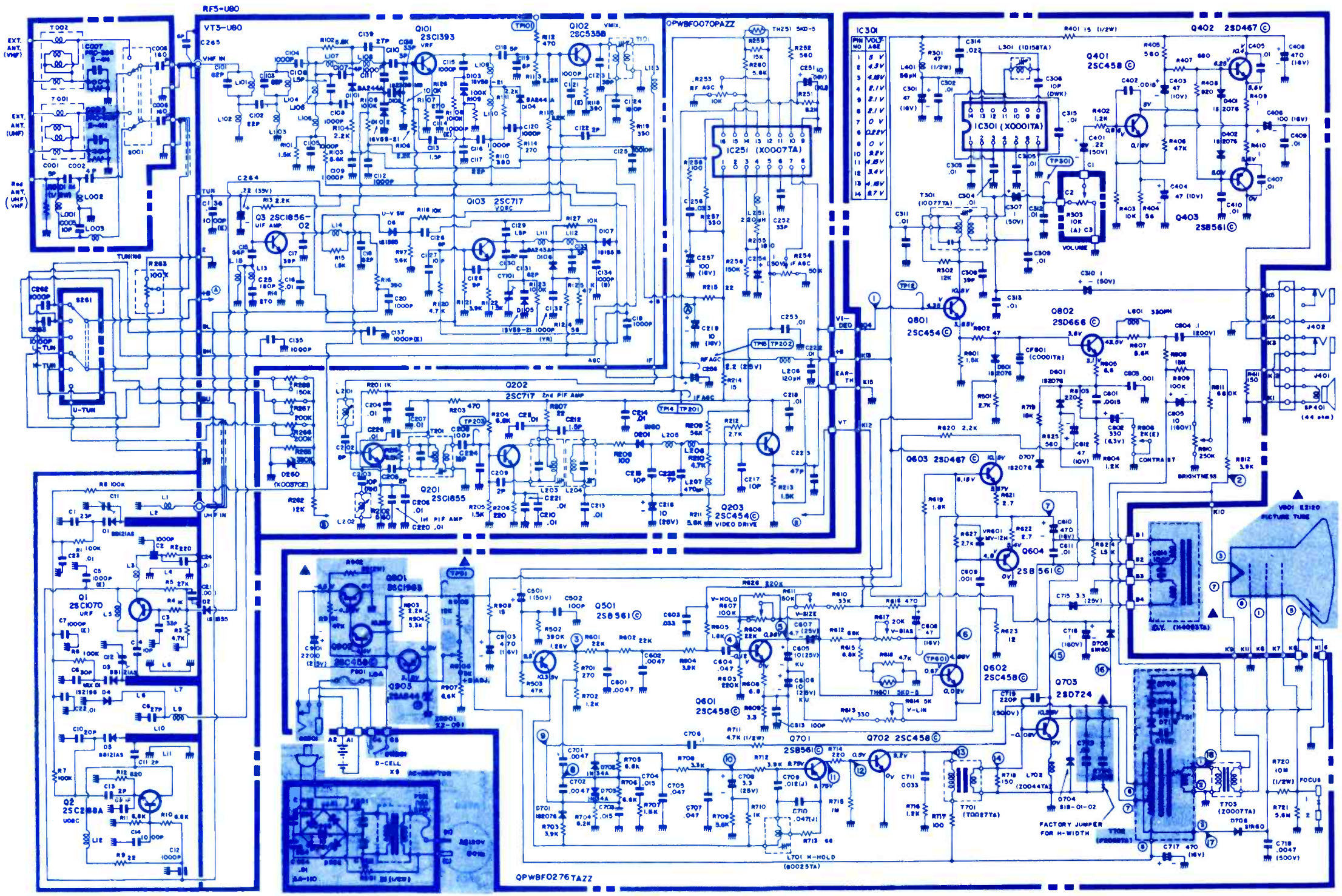
SCHEMATIC NO.		SCHEMATIC NO.	
SHARP B&W TV Model 3T-50	1861	RCA B&W TV Chassis KCS 206 Series	1863
QUASAR Color TV Chassis TV-965	1862	SONY B&W TV Model TV-411	1864

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.

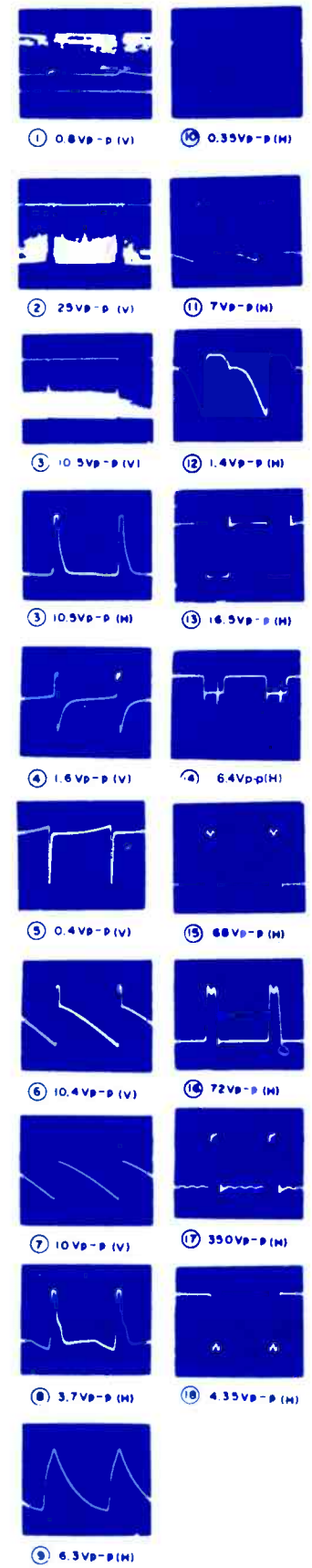
SHADED COMPONENTS: SAFETY RELATED PARTS
MARKED ▲ COMPONENTS: X-RAY RELATED PARTS

NOTE:

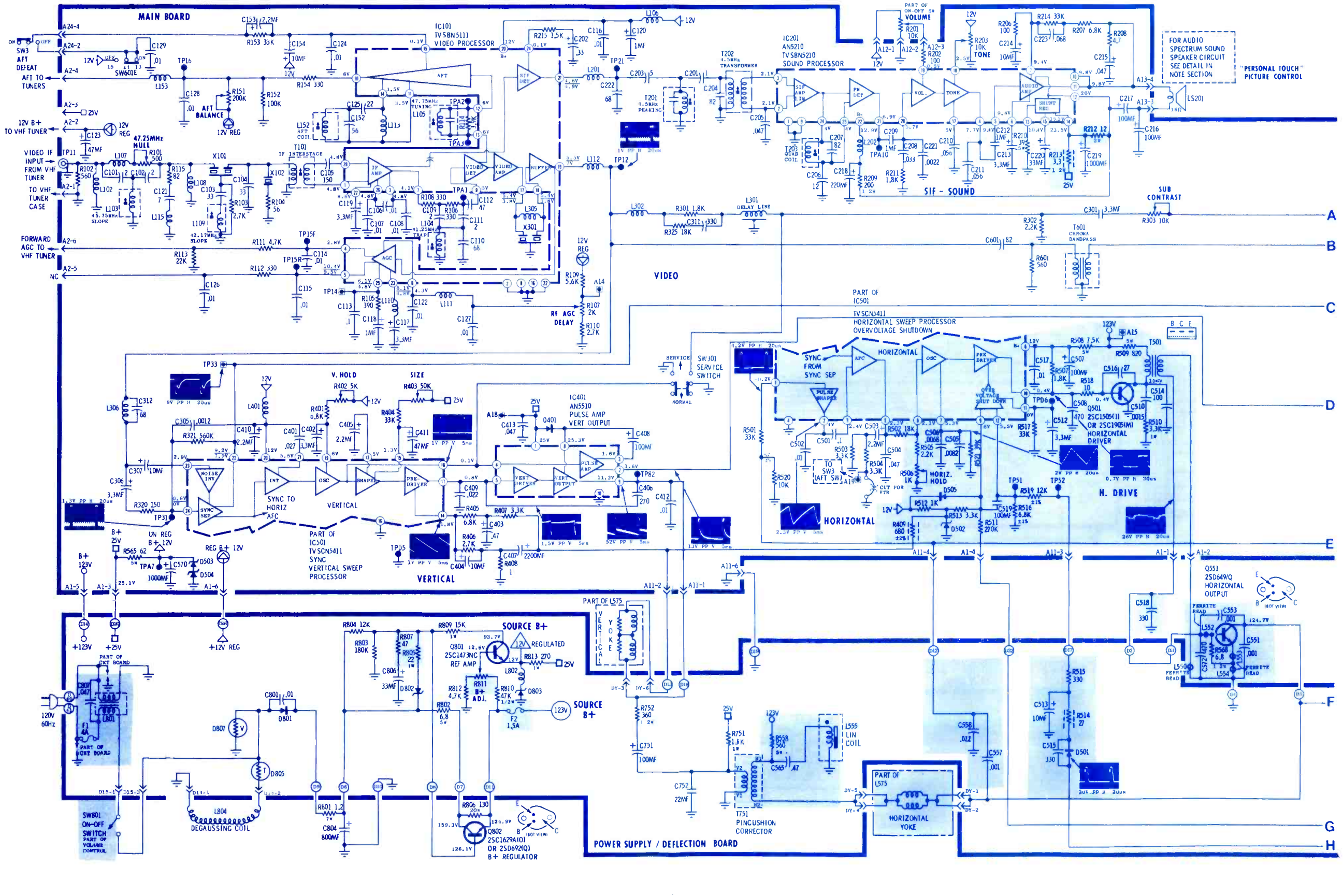
(1) This circuit diagram is original one. Therefore there may be a slight difference from yours.
(2) All the voltages in each point are measured with vacuum tube voltage meter (No input signal).
(3) All the voltage waveform values are measured with synchroscope.



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

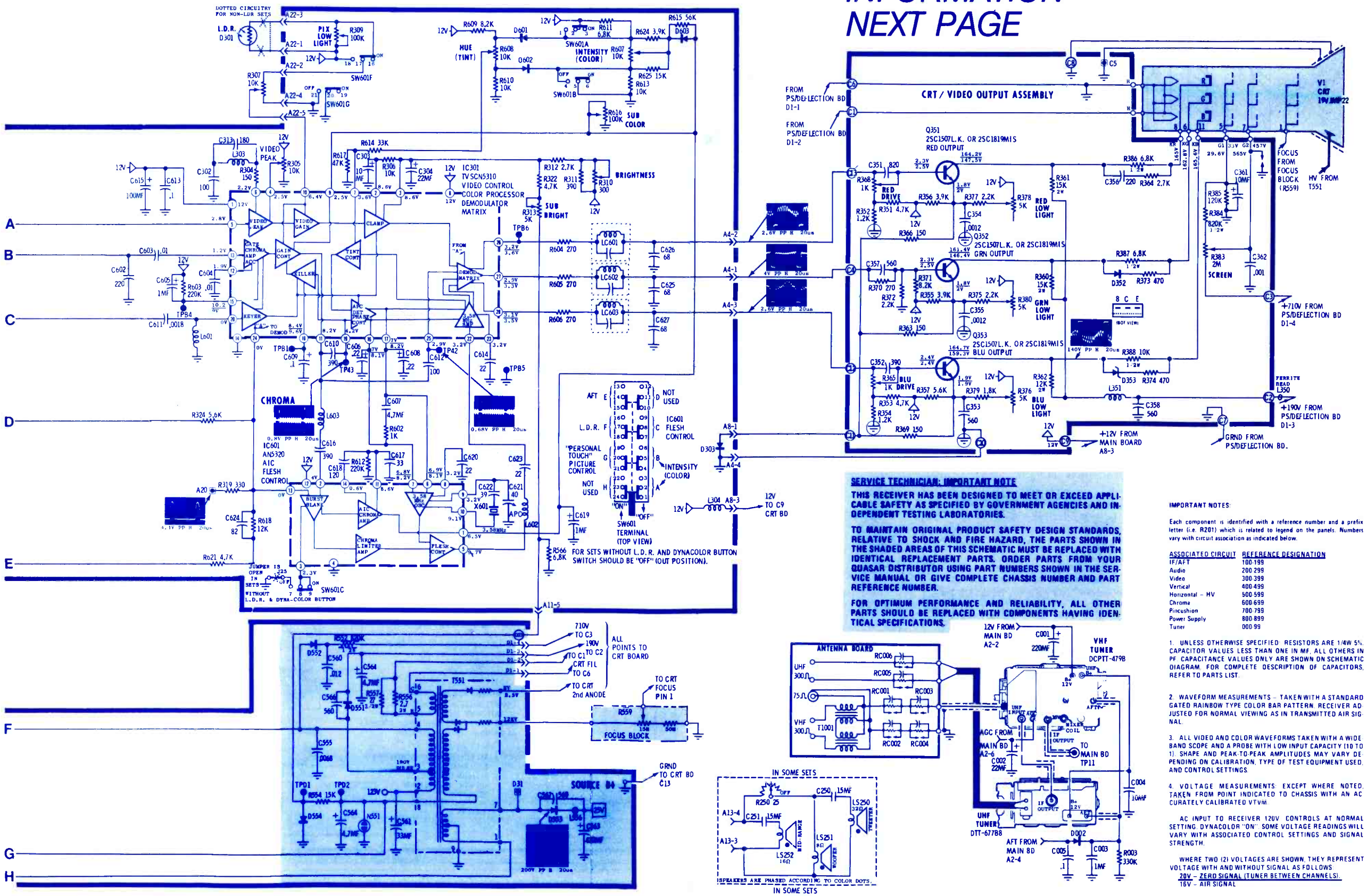


1862
QUASAR
Color TV Chassis
TV-965
ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS
SEPTEMBER • 1980



QUASAR
Color TV Chassis
TV-965

ADDITIONAL INFORMATION NEXT PAGE



SERVICE TECHNICIAN: IMPORTANT NOTE

THIS RECEIVER HAS BEEN DESIGNED TO MEET OR EXCEED APPLICABLE SAFETY AS SPECIFIED BY GOVERNMENT AGENCIES AND INDEPENDENT TESTING LABORATORIES.

TO MAINTAIN ORIGINAL PRODUCT SAFETY DESIGN STANDARDS, RELATIVE TO SHOCK AND FIRE HAZARD, THE PARTS SHOWN IN THE SHADED AREAS OF THIS SCHEMATIC MUST BE REPLACED WITH IDENTICAL REPLACEMENT PARTS. ORDER PARTS FROM YOUR QUASAR DISTRIBUTOR USING PART NUMBERS SHOWN IN THE SERVICE MANUAL OR GIVE COMPLETE CHASSIS NUMBER AND PART REFERENCE NUMBER.

FOR OPTIMUM PERFORMANCE AND RELIABILITY, ALL OTHER PARTS SHOULD BE REPLACED WITH COMPONENTS HAVING IDENTICAL SPECIFICATIONS.

IMPORTANT NOTES:

Each component is identified with a reference number and a prefix letter (i.e. R201) which is related to legend on the panels. Numbers vary with circuit association as indicated below.

ASSOCIATED CIRCUIT	REFERENCE DESIGNATION
IF/AFT	100-199
Audio	200-299
Video	300-399
Vertical	400-499
Horizontal – HV	500-599
Chroma	600-699
Pincushion	700-799
Power Supply	800-899
Tuner	000-99

1. UNLESS OTHERWISE SPECIFIED: RESISTORS ARE 1/4W 5%, CAPACITOR VALUES LESS THAN ONE IN MF, ALL OTHERS IN PF. CAPACITANCE VALUES ONLY ARE SHOWN ON SCHEMATIC DIAGRAM. FOR COMPLETE DESCRIPTION OF CAPACITORS, REFER TO PARTS LIST.

2. WAVEFORM MEASUREMENTS – TAKEN WITH A STANDARD GATED RAINBOW TYPE COLOR BAR PATTERN. RECEIVER ADJUSTED FOR NORMAL VIEWING AS IN TRANSMITTED AIR SIGNAL.

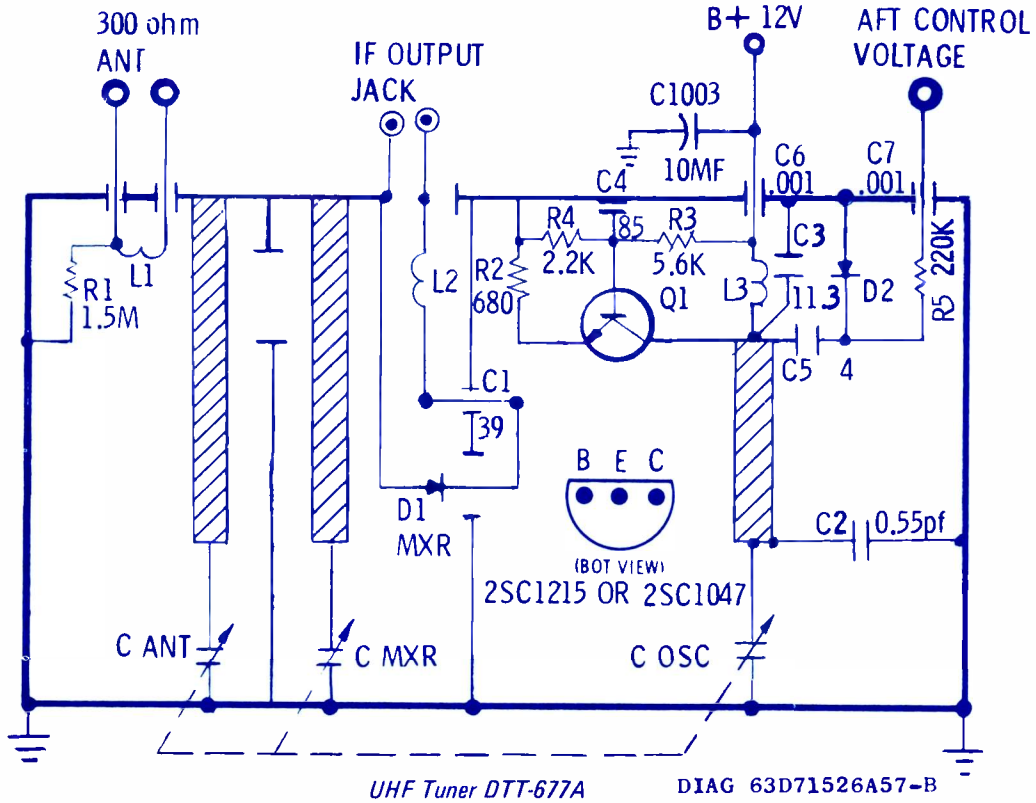
3. ALL VIDEO AND COLOR WAVEFORMS TAKEN WITH A WIDE BAND SCOPE AND A PROBE WITH LOW INPUT CAPACITY (10 TO 1). SHAPE AND PEAK-TO-PEAK AMPLITUDES MAY VARY DEPENDING ON CALIBRATION, TYPE OF TEST EQUIPMENT USED, AND CONTROL SETTINGS.

4. VOLTAGE MEASUREMENTS: EXCEPT WHERE NOTED, TAKEN FROM POINT INDICATED TO CHASSIS WITH AN AC CURATELY CALIBRATED VTVM.

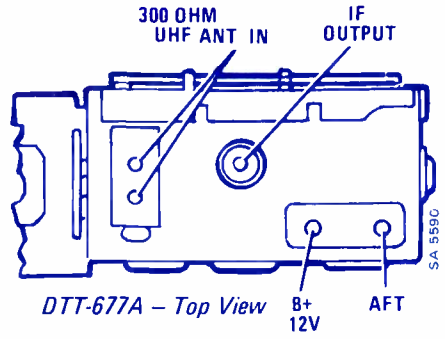
AC INPUT TO RECEIVER 120V. CONTROLS AT NORMAL SETTING. DYNACOLOR "ON". SOME VOLTAGE READINGS WILL VARY WITH ASSOCIATED CONTROL SETTINGS AND SIGNAL STRENGTH.

WHERE TWO (2) VOLTAGES ARE SHOWN, THEY REPRESENT VOLTAGE WITH AND WITHOUT SIGNAL AS FOLLOWS:
20V – ZERO SIGNAL (TUNER BETWEEN CHANNELS).
16V – AIR SIGNAL

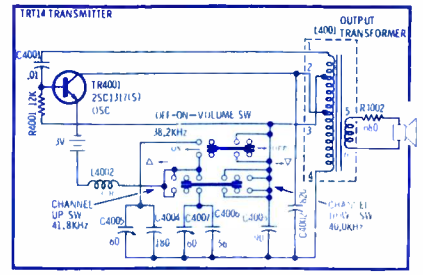
QUASAR
Color TV Chassis
TV-965



UHF Tuner DTT-677A DIAG 63D71526A57-B

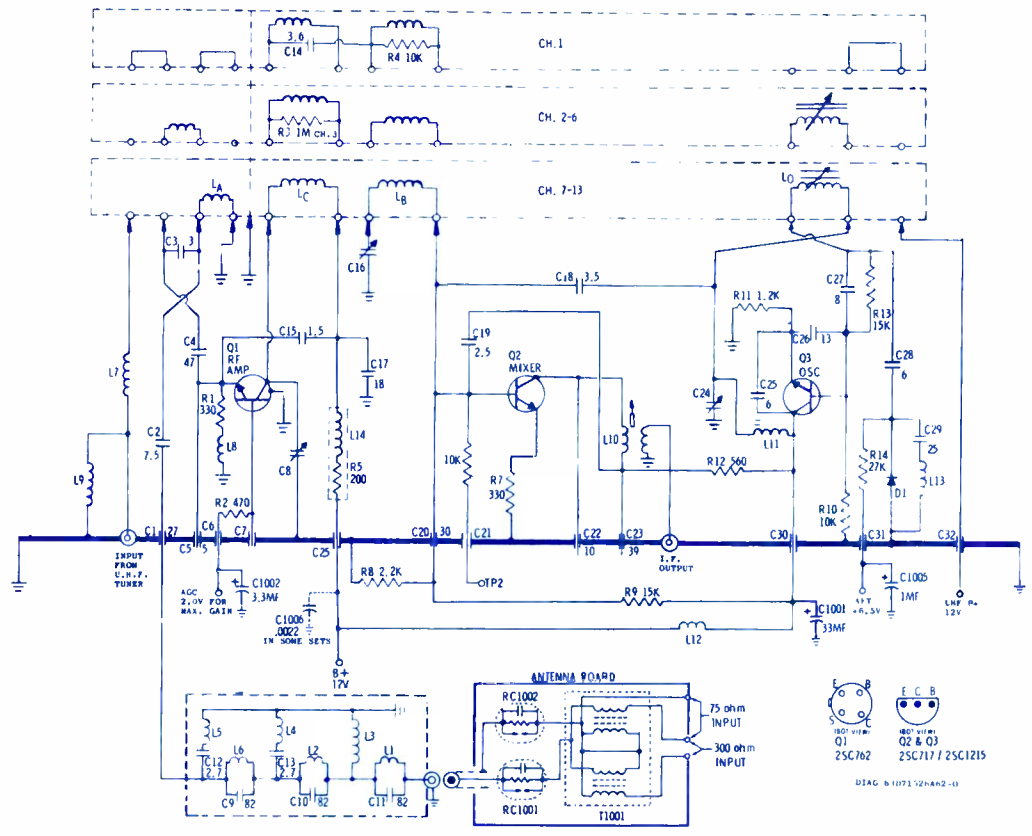


DTT-677A – Top View

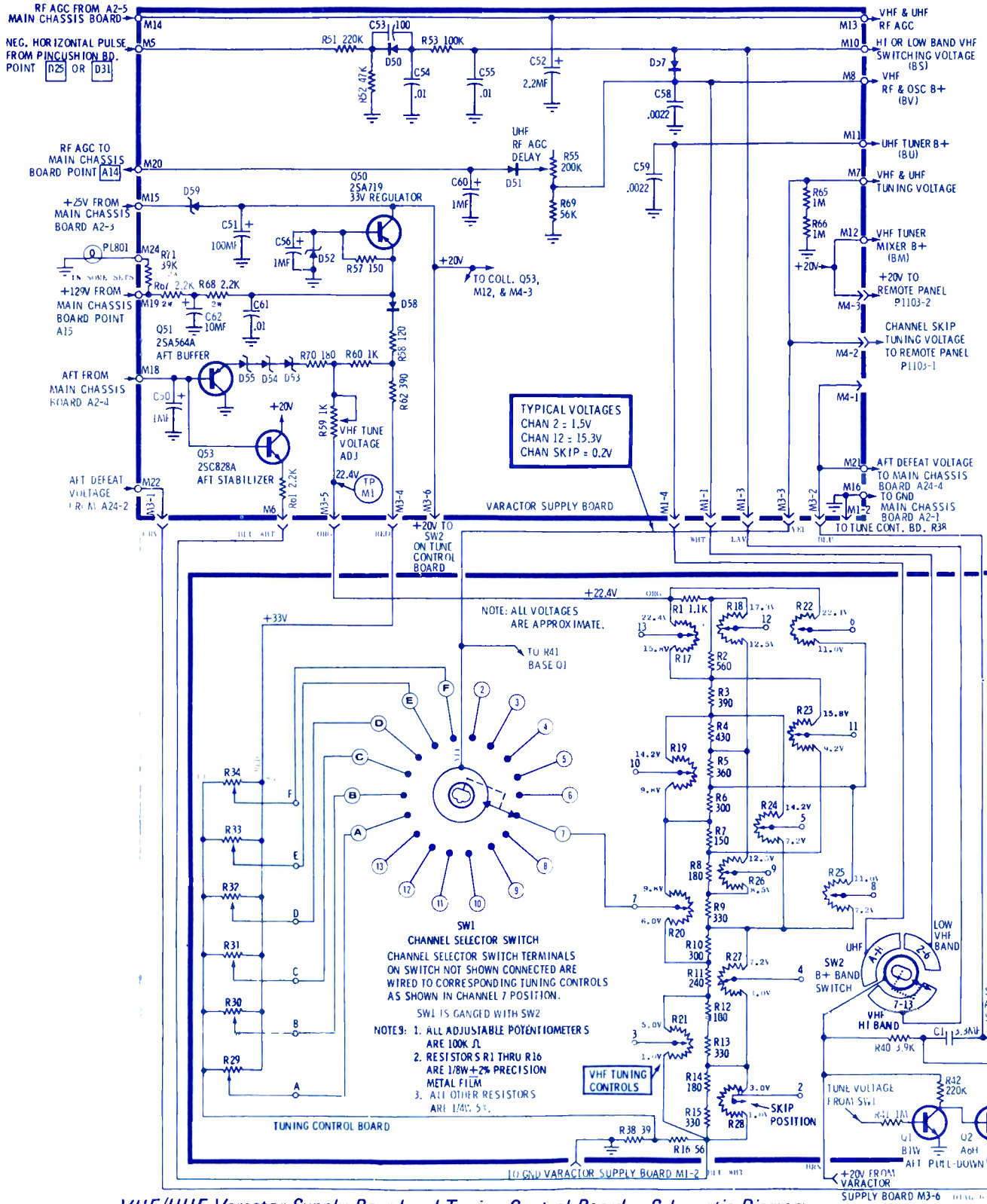


Remote Transmitter TRT-14 – Schematic Diagram

TUNER SERVICE INFORMATION



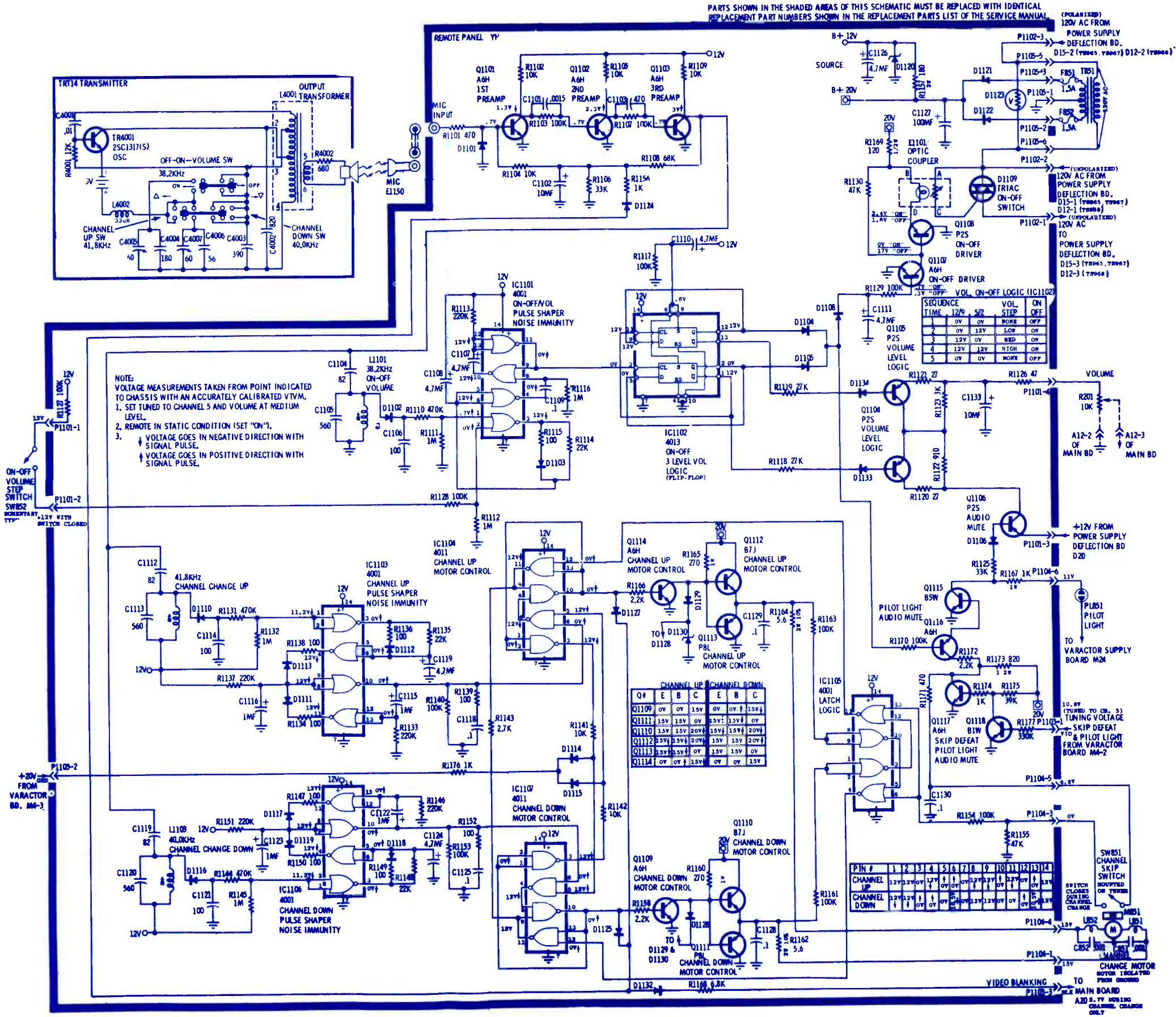
VHF Tuner DCPTT 479 – Schematic Diagram



VHF/UHF Varactor Supply Board and Tuning Control Board – Schematic Diagram

QUASAR
Color TV Chassis
TV-965

PARTS SHOWN IN THE SHADED AREAS OF THIS SCHEMATIC MUST BE REPLACED WITH IDENTICAL REPLACEMENT PART NUMBERS SHOWN IN THE REPLACEMENT PARTS LIST OF THE SERVICE MANUAL.



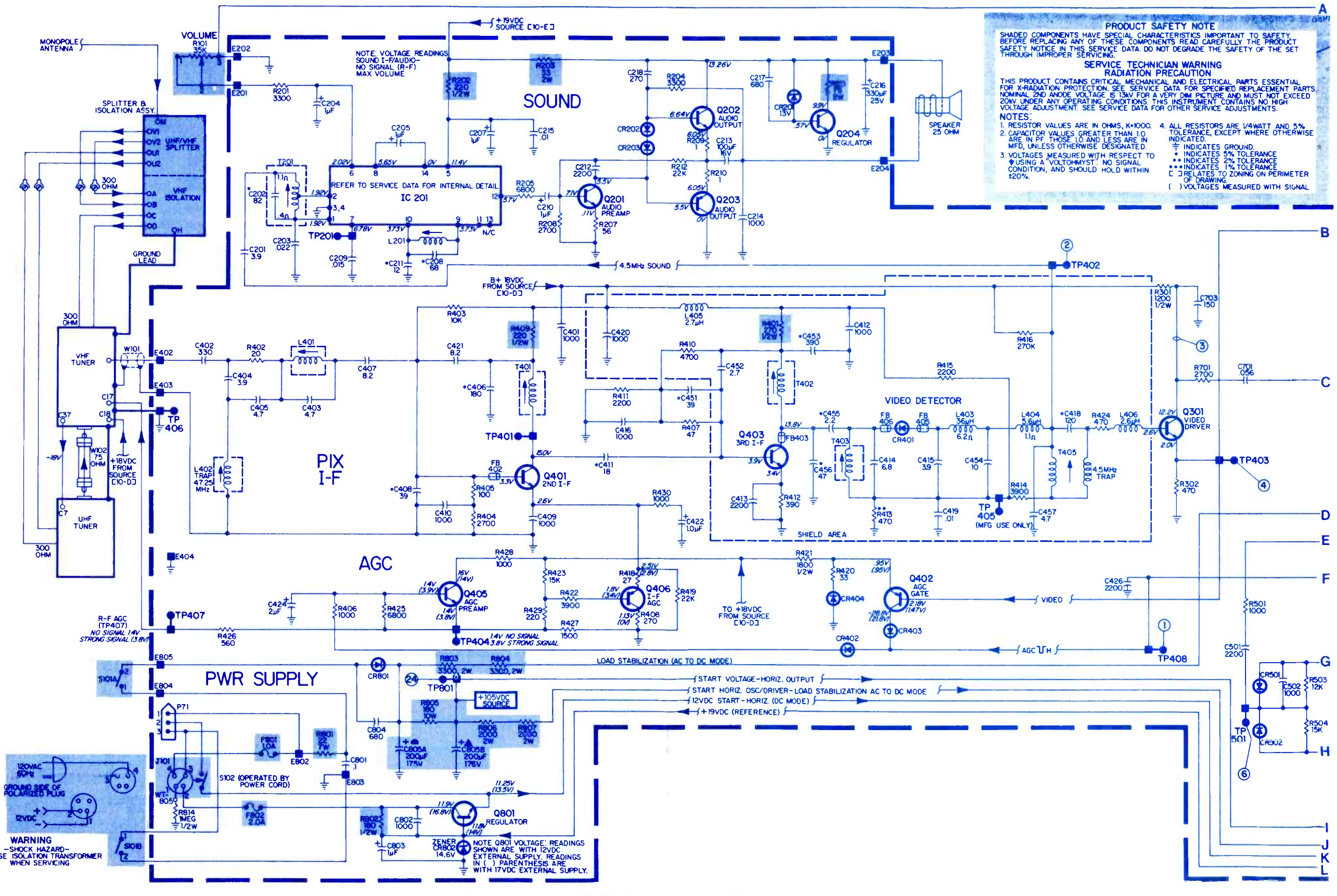
1863

RCA
B&W TV Chassis
KCS 206 Series

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

SEPTEMBER • 1980



RCA
B&W TV Chassis
KCS 206 Series

VIDEO OUTPUT

BRIGHTNESS

PICTURE TUBE
V101

96.0V NO BRIGHTNESS
40.0V MAX BRIGHTNESS

HIGH VOLTAGE
12.5kV
±1.0kV

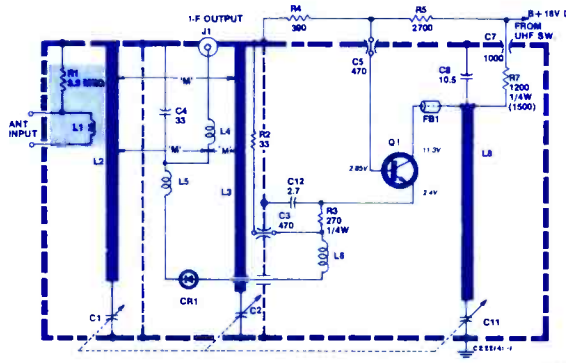
YOKE

SYNC

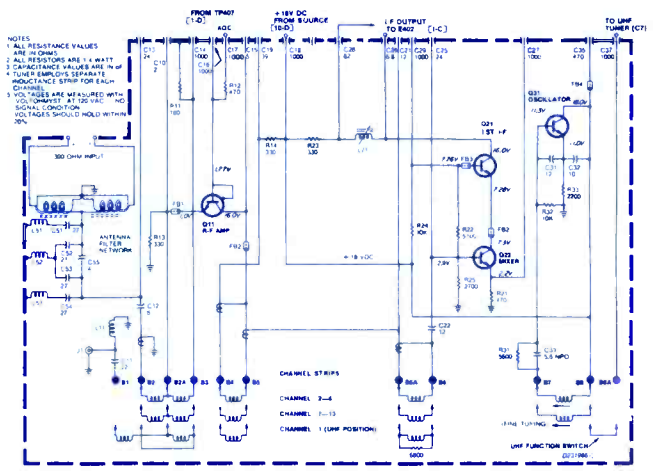
VERT

HORIZ

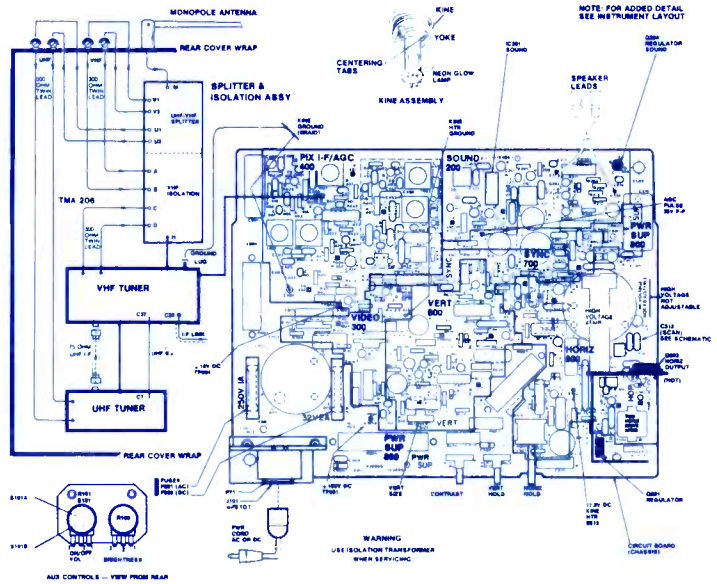
UHF/VHF TUNER SCHEMATICS



STAR or SHADING (* ■■■) See PRODUCT SAFETY NOTICE on page 2 of this Service Data.



CHASSIS LAYOUT



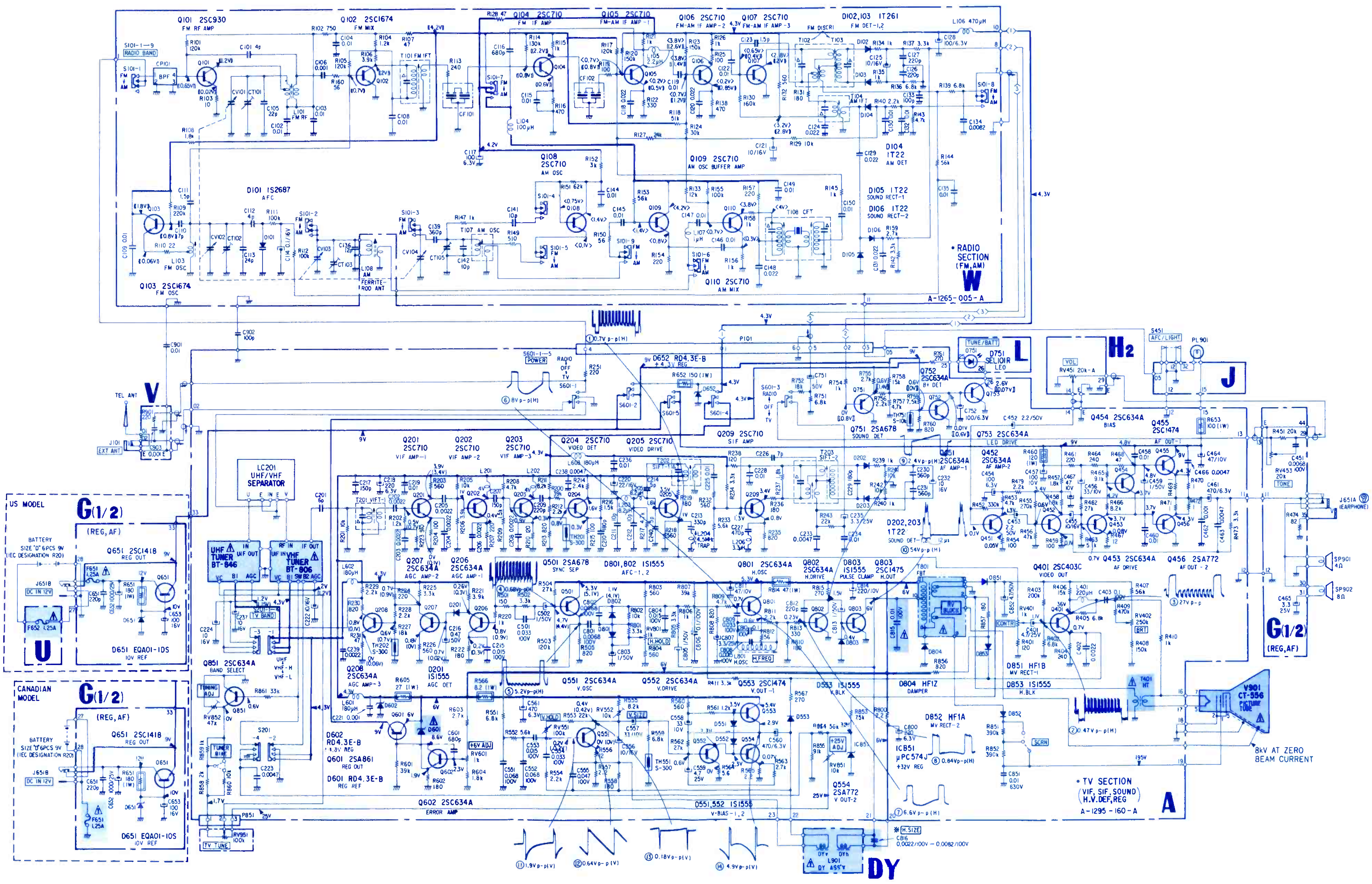
1864

SONY
B&W TV Model
TV-411

SEPTEMBER • 1980

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS



Hand-held computer power is here!

An autoranging DMM breakthrough from B&K-PRECISION.

B&K-PRECISION's new microcomputer controlled Model 2845 is a major advance in digital multimeter technology. At a price comparable to ordinary manually operated units the 2845 brings microcomputer intelligence to a handheld portable DMM. When applied to a circuit, its computer selects the range providing maximum resolution without the slow "hunting" action characteristic of many bench-type autoranging DMM's.

The 2845 is certainly the most user oriented hand-held DMM available. No other DMM can match its speed and simplicity of operation. With tilt stand, large display and optional AC power adapter, it becomes a remarkable inexpensive bench DMM.

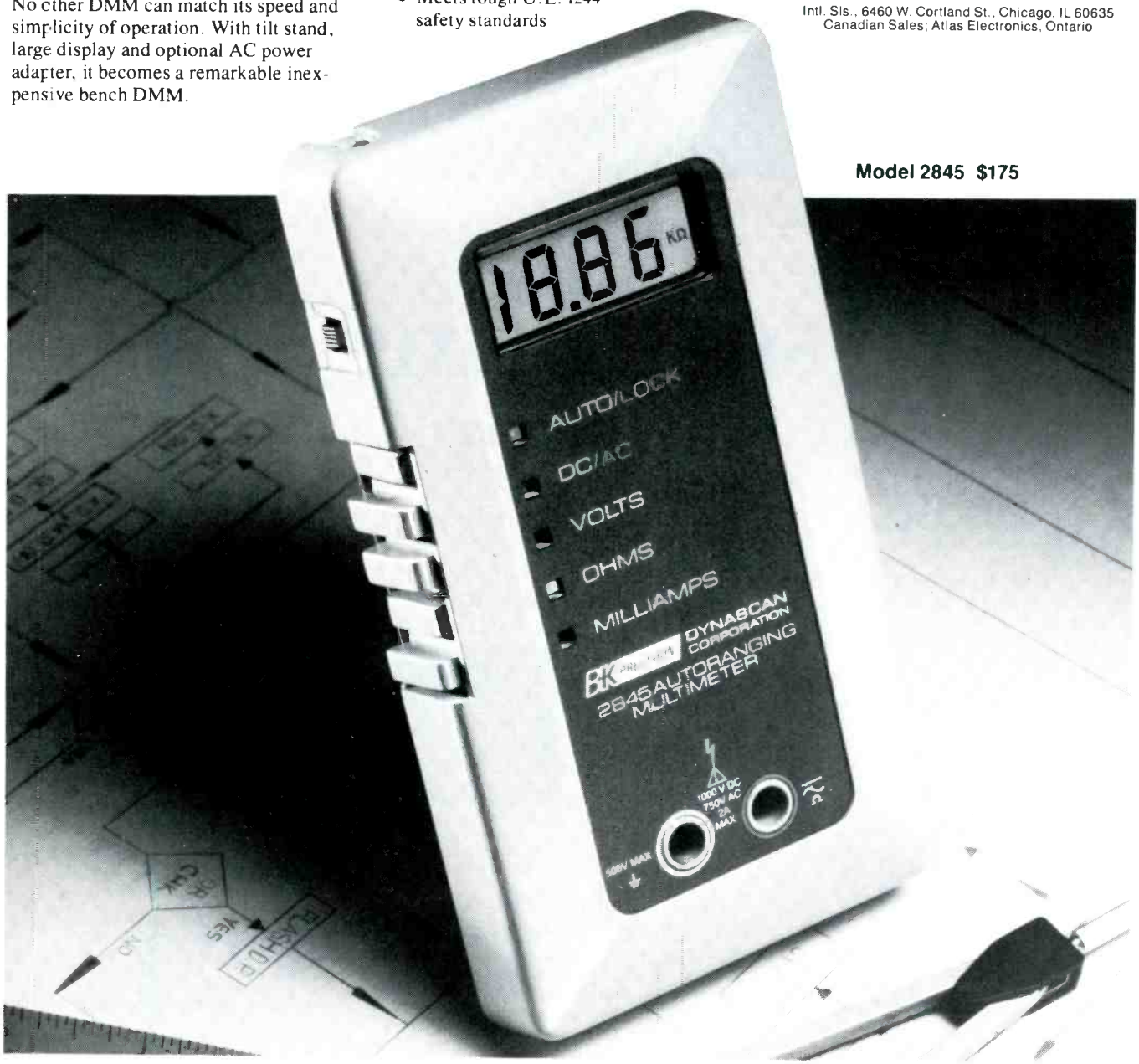
- Microcomputer autoranging speeds operation and stabilizes readings
- Auto-skip program for best resolution in least time
- Easiest, fastest-to-use DMM available
- 0.1% basic DC accuracy
- 3½ digit, 0.5" LCD display
- Continuity test "beeper"
- Range-lock, holds selected range
- Measures AC/DC voltage; AC/DC current; resistance
- Meets tough U.L. 1244 safety standards

Available for immediate delivery from your local distributor. Call toll-free 800-621-4627 for additional information and the name of your local distributor.

B&K PRECISION
DYNASCAN CORPORATION
6460 West Cortland Street
Chicago, Illinois 60635 • 312/889-9087

Intl. Sls., 6460 W. Cortland St., Chicago, IL 60635
Canadian Sales; Atlas Electronics, Ontario

Model 2845 $175



Circle No. 107 on Reader Inquiry Card

10 to 30 MHz oscilloscopes with more performance and reliability than you ever thought possible.

It's easy to see why LEADER oscilloscopes are now specified more than ever. More performance and quality for less cost... with immediate deliveries from over 100 stocking distributors. They also come with the best two-year warranty in the industry... backed by efficient factory service depots on the East and West Coasts.

The surprising leader.

A full-range of reliable, medium bandwidth oscilloscopes.

LEADER's oscilloscope line includes 11 models, single and dual trace versions, for bench or field use. All models offer comprehensive triggering controls, TTL compatible Z-axis modulation, front panel trace alignment control and convenient, color-keyed front panel layout. Probes are furnished with every oscilloscope and options include probe pouches, carrying cases, front panel covers and rack mounting adapters.

30 MHz delayed sweep – $1,530.

LBO-515B is a compact, precision oscilloscope at a moderate price. Using a PDA 4-inch CRT with parallax-free internal graticule, it features 5 mV sensitivity and delayed sweep for viewing and measuring complex waveforms. Also has 120 ns signal delay, trigger hold-off and x-y operation at full sensitivity.

30 MHz with signal delay – $1,100.

LBO-520 combines a 11.7 ns rise time with 5 mV sensitivity and 120 ns signal delay lines. Has single shot triggering, X10 sweep magnifier and bright, sharp PDA CRT. Triggers to 50 MHz.

20 MHz dual and single trace – $835., $610.

LBO-508A and LBO-507A give you versatility at low cost. Rise time is 17.5 ns with 1 MΩ (35 pFd) input impedance. Automatic or external triggering, X5 sweep magnifier, 10 mV/cm sensitivity and add/subtract modes.

Oscilloscopes, frequency counters, function generators, video and audio instruments... a LEADER instrument for almost every need.

10 MHz with 1 mV sensitivity – $645.

LBO-514 has both vertical and horizontal X5 magnifiers. Sensitivity is from 1 mV/cm to 10 V/cm. Sweep speeds from 0.2 s/cm to 0.1 µs/cm. Auto or normal triggering. Z-axis modulation. (Single trace version, LBO-513, $495.)

20 MHz battery/ac portable – $950.

LBO-308S provides lab performance and high reliability in field service applications. Sensitivity is 2 mV with a complete set of triggering controls and 18 sweep ranges to 0.1 µs/div. with X5 magnifier. Compact, lightweight with 3-inch rectangular, internal graticule CRT. (Optional 2 hour internal battery pack is recharged during ac operation, $75.00.)

Two-year warranty. Evaluation units.

A history of high reliability permits LEADER to provide a generous 2-year warranty... backed by factory service depots on the East and West Coasts. A free, trial use of LEADER instruments is available to all qualified companies.

Call toll-free (800) 645-5104 to request:

- an evaluation unit
- our 40-page catalog
- the name of your nearest "Select" distributor
- additional information

When Quality Counts

LEADER Instruments Corporation

380 Oser Avenue
Hauppauge, N.Y. 11787 (516) 231-6900
Regional Offices:
Chicago, Los Angeles, Dallas.

Circle No. 112 for literature—Circle No. 113 for demonstration