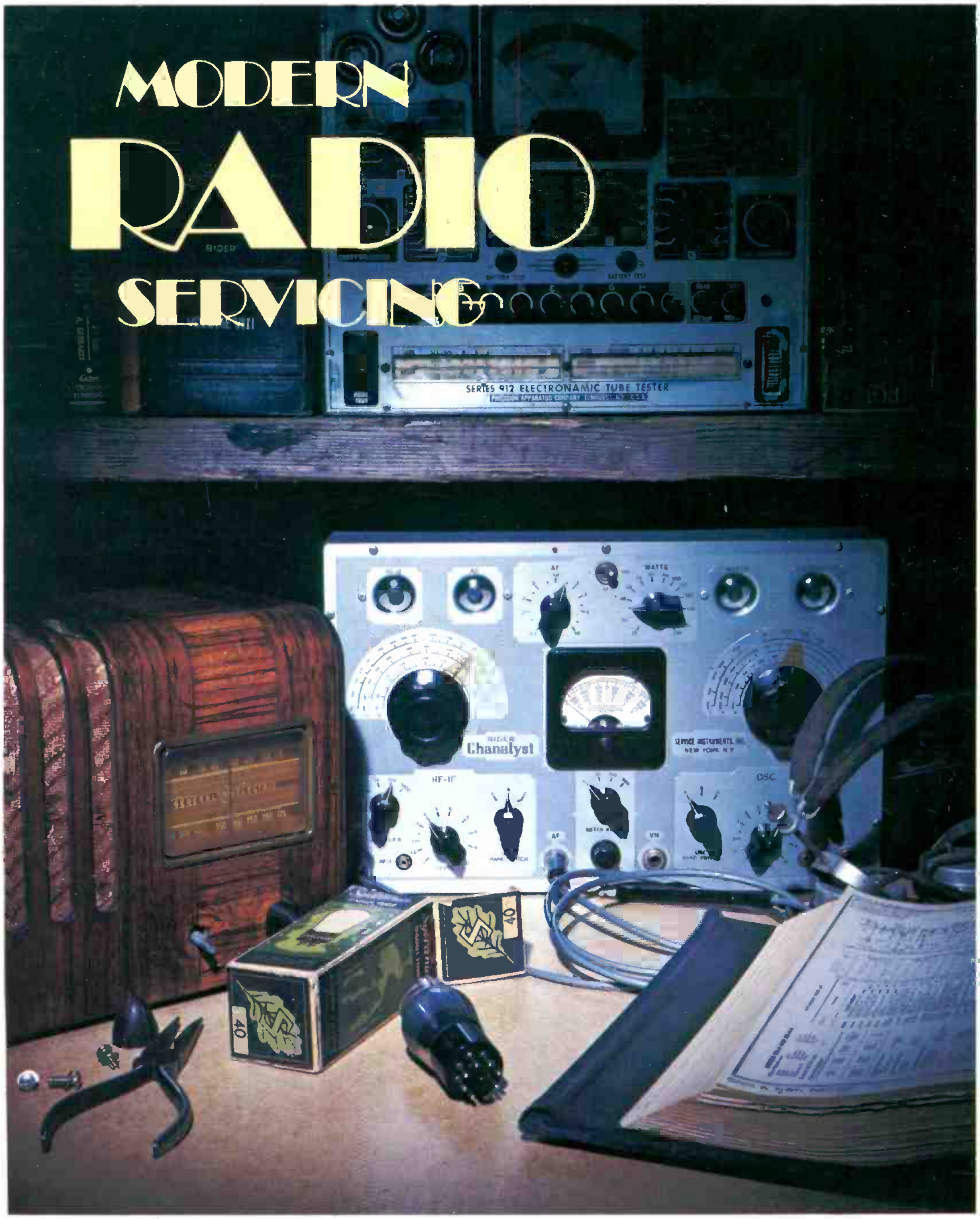
ET/D

JANUARY 1979 • $1.00

ELECTRONIC TECHNICIAN/DEALER

LEADING THE CONSUMER AND INDUSTRIAL SERVICE MARKETS



HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION

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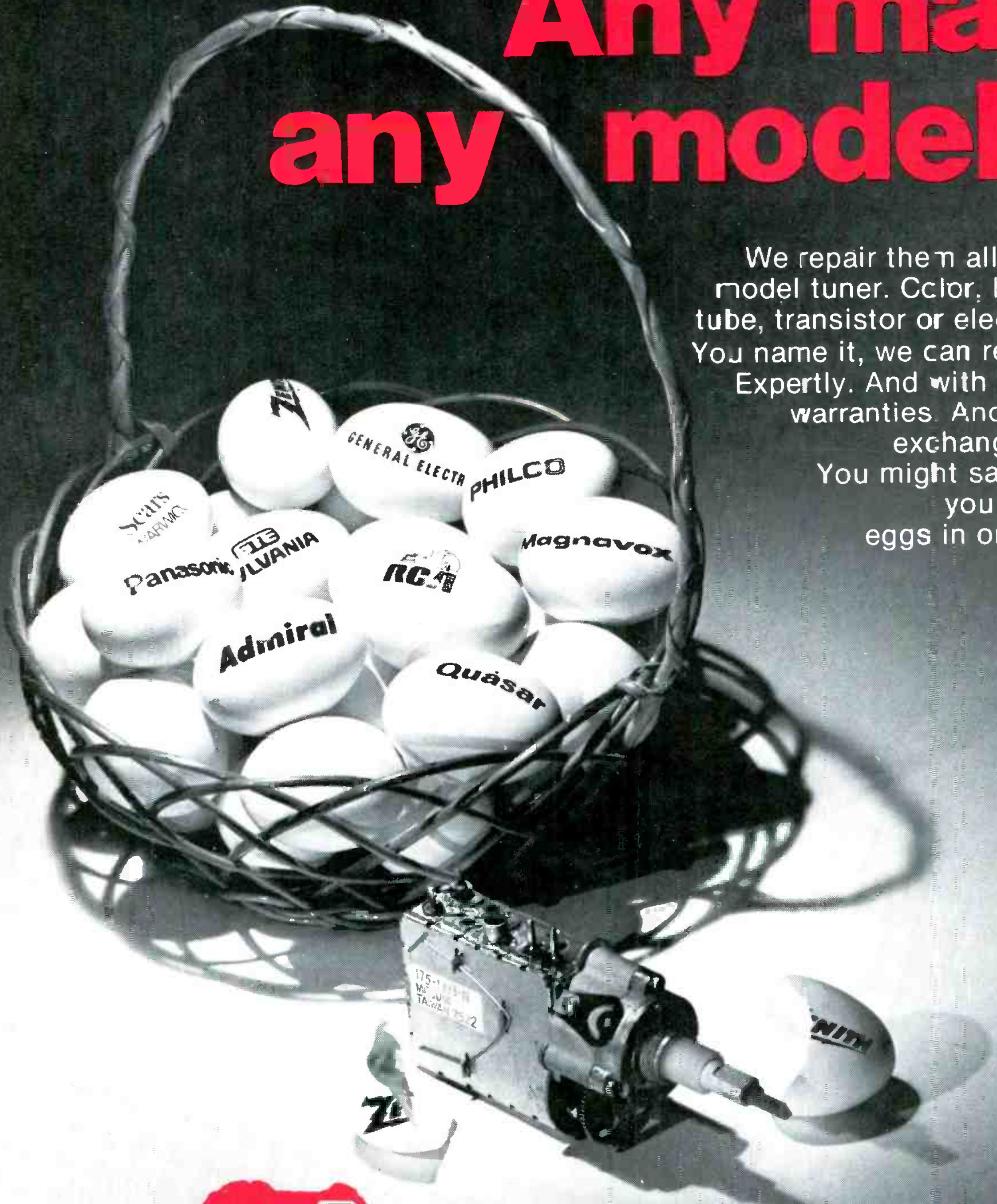
We repair them all. Any make, any model tuner. Color, black and white, tube, transistor or electronic/varactor. You name it, we can repair it. Quickly. Expertly. And with one-year limited warranties. And we rebuild and exchange modules too! You might say that with PTS, you **can** put all your eggs in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



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INDUSTRY REPORT

Hagelin Named ET/D Publisher

David J. Hagelin, Associate Publisher and General Manager of ET/D Magazine, has been named Publisher, effective Jan.1, it has been announced by Tom Greney, Vice President and Group Publisher of HBJ Publications. Al Menegus, Publisher since 1971, becomes Senior Publisher.

Hagelin, a former Managing Editor of another HBJ Publication, joined ET/D in 1973 as a District Manager. A graduate of the University of Minnesota, Duluth, he has been associated with the broadcast and newspaper business and is a former Executive Director of the Taxpayers Research Association, Duluth. He was named ET/D's Midwest Sales Manager in 1975 and became General Manager and Associate Publisher in 1977.

Menegus, who will complete 10 years with ET/D next month, is a veteran of over 25 years in the electronics industry.

Glass to Head New Association; Program will rival NESDA's ISCET

The storm driven waters of the national association movement swelled to hurricane proportions with the formation of a new—and third—electronic technicians' association.

ET/D has learned that Dick Glass, leader of a faction that split from the then National Alliance of Television and Electronic Service Organizations (NATESA) to form the forerunner of the National Electronic Service Dealers Association (NESDA) in the 1960s will head the new group as president.

Reaction from the two other national associations was swift, to the point, and critical. Two officers of the new association, Jesse B. Leach and Leon Howland, who are also officers of ISCET, have been fired by NESDA President Bob Villont.

"There was no alternative under the circumstances, "Villont told ET/D.

In a telephone conversation with Glass, ET/D learned the new organization—the Electronics Technicians Association (ETA)—was formed officially November 10 at a meeting in a Rammada Inn at Indianapolis. As we go to press the headquarters of the new group was listed as Glass' residence in Indianapolis, Ind.

A statement released by ETA said the group's officers are Leach, Lintheum, Md., chairman; D.C. Larson, Houston, Tex., vice chairman; Howland, Indianapolis, Ind., secretary; Walter Cooke, Hampton, Va., treasurer; and Ron Crow, Ames, Ia., who will head ETA's newly formed educational division.

Crow just quit as executive director of ISCET. Working with Crow, according to the statement, will be Edward T. Carroll, an instructor of electronics technology at the Indiana Vocational Technical Institute, Indianapolis. He will be secretary, treasurer of the educational division.

In statements highly critical of NESDA, both Leach and Glass said the move to set up the new association was triggered by the continuing division of opinion on whether the educational and certification programs for the industry should be separated entirely from a national association and run independently and of the desire to form an organization devoted primarily to individual technicians and secondly to service business establishments.

Glass made it clear ETA intended to set up a separate and competing certification organization to ISCET. "It's time the strain and tension between ISCET and NESDA is ended. It's understandable they want to retain control of ISCET programs because they are glamorous, active, and income producing. They (NESDA) would have been a lot better off in relinquishing control instad of fighting this action," Glass charged.

Glass said ETA would be aimed primarily at the nation's 300,000 individual electronics technicians in all fields. "There never has been a technical association devoted entirely to the needs of the individual technicians. They've always been combinations of service dealers and individuals."

According to Glass ETA will cross all industry boundaries. "We'll seek membership through every channel, industrial, computer, military, medical, as well as home entertainment."

Membership drives will begin immediately, Glass said. "We now have people in state associations contacting fellow members who are turned off with the activities of the other groups."

Leach said the "continuing and deepening rift within NESDA has forced technicians to seek other opportunities for a representative association. The ETA we expect to carry on programs

ET/D

ELECTRONIC TECHNICIAN/DEALER
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JANUARY 1979, VOL. 101, NO. 1

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JVC's Video disc system
The "grooveless" record ____ 32

On the cover: A nostalgic look into the past, the radio repair industry as it existed 40 years ago. It's still a potential profit area if handled properly as our feature on page 20 points out. However, the technology has changed and new cost effective service procedures are called for.

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such as certification, serviceability and educational seminars similar to those presently administered by ISCET.

"Hopefully, by establishing the governing body as an elected board of directors rather than regional allied groups we will have eliminated the seeds of dissention which have dampened past service association efforts."

The bitterness undermining the plight of the national associations showed clearly when one association spokesman, who asked not to be identified, told ET/D "You would think by now they would have run out of organizations they want to bust, yet it seems they are out to bust another."

Charles Porter, NESDA executive director, called the move disruptive at best. "These efforts are duplicative, triplicative, if you will, we've already heard from many of our state affiliates who are dead set against it."

Frank Moch, NATESA head, commented "we have no choice but to let nature take its course.

"All in all, though, its a regrettable situation. Rather than unity we continue to divide ourselves and rather than unity it appears we are going to divide ourselves completely out of existence."

In the statement announcing its formation, ETA listed its goals as: expansion and improvement of present industry certification programs for technicians; to provide a professional trade association for all electronic technicians; to establish continuing technical educational opportunities; to set training and competency standards; to provide an opportunity for discussion and informational exchanges; and "to collect, preserve, and distribute valuable technical information and to promote the interests of all electronics technicians."

Nipper's Back with RCA

The world famous trademark of the fox terrier listening to "His Master's Voice" is being rejuvenated by RCA for use in its consumer electronics advertising campaigns.

The trademark is patterned after the painting by British artist Francis Barraud. Painted in 1890, RCA acquired the Victor Talking Machine Company in 1929 and the American rights to the dog and phonograph trademark.

It's all part of a new $8 million corporate advertising program by RCA. ET/D

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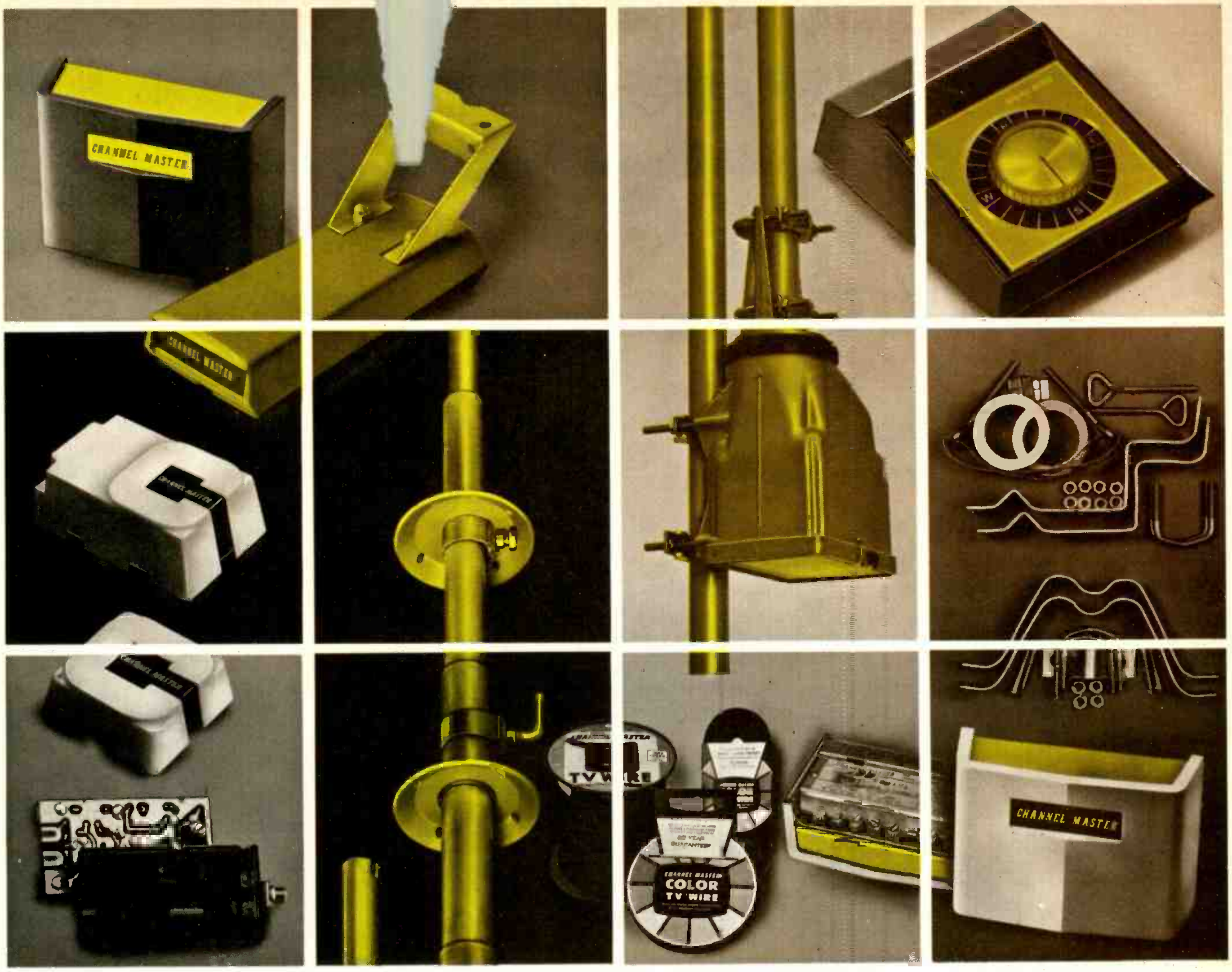

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Circle No. 108 on Reader Inquiry Card

FROM THE EDITOR'S DESK

Once again we mark the beginning of a new year.
And to keep you, our readers, updated on just what is going on at ET/D, I thought this would be the best time to provide some idea of our plans for 1979 and how they related to you.

The most important service ET/D can render is to keep you on top of the new developments "coming down the pipe" insofar as technological developments in consumer products are concerned.

If we can help you identify the rapid changes having impact upon the very fluid consumer electronics industry we feel that you will be in a better position to prepare yourself, and your staff, to handle the deluge of new and electronically intricate consumer products. I am speaking, of course, about the whole range of products from the vastly changed television circuitry, relying as it does on today's integrated circuit technology, as well as the maze of microprocessor controlled devices, ranging from programmable tuner systems and video recorders, and who knows, perhaps even home computers.

That is why throughout 1979 you will see increased emphasis on the theory, uses, and general understanding of the microprocessor. In fact, in this issue we carry the third installment of our series by Steven K. Roberts on consumer applications of the microprocessor.

However, we all know that technological competence is not enough if you are the owner of manager of a serviceshop. On the business side, you need to be kept abreast of the the newest and latest methods as they apply to managing a modern, profitable, serviceshop.

ET/D is pleased to announce that, starting with this issue, we will be bringing to you on a monthly basis the invaluable business management expertise of Mr. John Gooley, who for the past 14 years has conducted NARDA's well known school of service management. It is the only school devoted entirely to the efficient operation of an electronics service business. Mr. Gooley, who is manager of NARDA's Service Division, as ET/D's Contributing Business Editor, will be discussing monthly with you such topics as inventory control, pricing policies, measuring technician productivity, and many, many more subjects concerning running and managing a service business.

Of course, we will be continuing with our practice of covering developments throughout the consumer electronics industry, in stereo, CB, communications, marine, and digital electronics.

New and vastly superior test equipment is a mark of our industry, and ET/D will continue to feature monthly reports on selected pieces of test gear. We know there are some really sophisticated scopes, counters, and DMMs now on the drawing boards of the manufacturers as the industry moves to meet the challenge of the microprocessor revolution.

All in all, we at ET/D think 1979 will be one of the most remarkable, fast-paced, and intersting years in consumer electronics history. And ET/D wants to be there with you as you meet the challenge.

Sincerely,

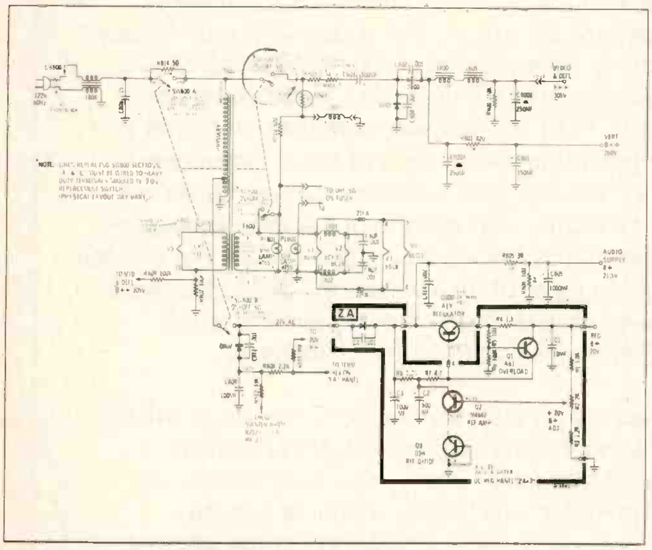
Richard M. Lay

SERVICE SEMINAR

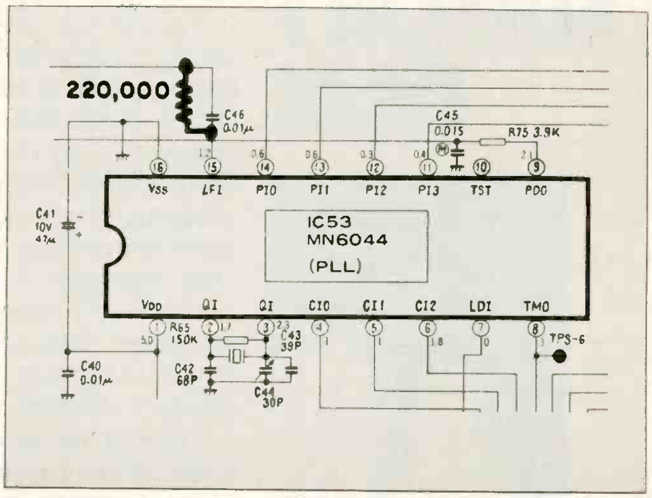
MAGNAVOX

Color Chassis T982—Top half of picture blanked out at an angle like a defective yoke. The cause is a defective C243 100mfd 25v or, in early production, a 22mfd 25v capacitor from pin 16 of vertical IC to ground.

MOTOROLA



Color Chassis TS-929—All chassis not equipped with an off-on relay. Set dead when turned on, circuit breaker kicks out, apparently when turned off. Horizontal output tube life short. Check off-on switch linkage—rear sections may not be turning off, leaving reduced B+ on horizontal output tube, but no drive since 20v supply is off.

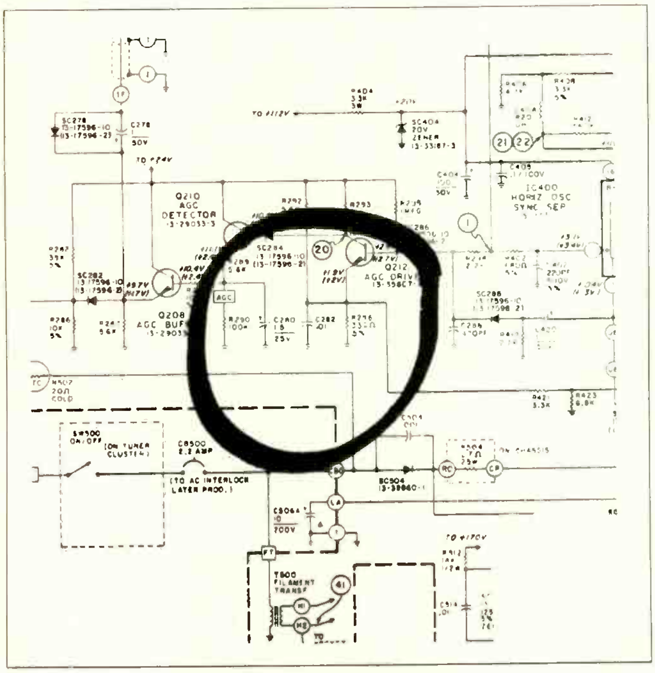


PANASONIC

Color Model CT978 sets with serial number below MB8550001—Interference in nearby TV sets most noticeable on channel 2 as a 3/4-inch wide disturbance in the center of the picture when CT978 primary switch is on and power switch is off—problem disappears when power switch is turned on. Pulse circuits in the synthesizer tuner are on when the primary power switch is on and may radiate enough to cause this interference. To remedy, add a 220k ohm resistor across C46 on the tuner board.

SYLVANIA

Color Chassis E21—Severe horizontal tearing. C282 shorted—reads 22 ohms from emitter of AGC Drive, Q212 to ground.

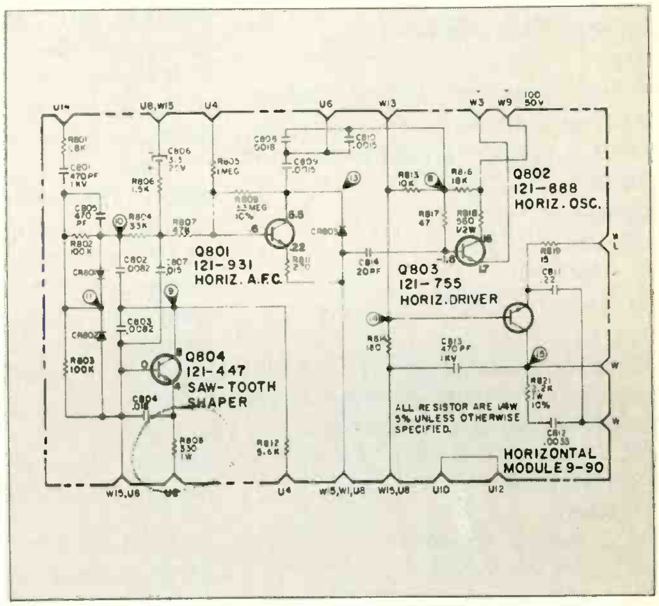


Color Chassis E20—Horizontal tearing—Open C280 1.4mfd 25v. (Refer to circuit of similar E21 above.)

ZENITH

Color Chassis 19EC45—Weak or no color—fine tuning won't adjust chroma. Horizontal hold is good. Check resistor R808 on horizontal module 9-90, may have increased in value from a nominal 330 ohms to 1400 ohms.

This resistor can also at times cause loss of color sync in this chassis and others of this general series. **ET/D**



LETTERS

I'm looking for surplus filter capacitors as used in computers up to 140,000 mfd at 30vdc. Can anyone furnish me with the address of a surplus outlet that may have some of these at reasonable prices?
Robert R. Blevins
Box 113A RD 1
Lexington Park, MD 20653

Would you please run this in your magazine? I need a schematic for a B&K 360 VOM. It is no longer available from B&K. Help from any of your readers would be appreciated.
K. E. Lee
RT. 1 Box 44
Big Rock, VA 24602

I am a recent subscriber to ET/D and find TEKFAX very useful. I would like to buy out of print TEKFAX numbers 105, 106, 107, 108, 109 and 111 if anyone has them to sell.
TR Brown
832 Greenfield Dr. #97
Lynchburg, VA 24501

Help Needed:
I need an operators and service manual for an old Precision Model 612 tube tester.
John D. Miller
3704 Bold Bidder Drive
Lexington, KY 40502

We need information and output tubes (ECLL800's) for an imported radio marked on the front glass, IMPERIAL, and on the back, stereo-korgerttruhe Granada, M. T. Imperial Vollstereo Grobstuger 864.
C. R. Biles
433 W. Kirwin
Salina, Kansas 67401

ABOUT TEKFAX
The diagrams of TEKFAX are very helpful. What would be a big help is printing the layout of all transistors and IC's. In many cases you have the TEKFAX, open up the set and are lost, not knowing one circuit from another. In many cases there is no layout in the set.
C. Nellum
1358 8th Ave.
Terre Haute, IN 47804

EDITOR: We print as much as we can within the limitations of space and available material. We do try to print waveforms and chassis layouts whenever possible and are constantly trying to include as much information as possible in those pages we have set aside for TEKFAX.

We are in need of any information on Sears TV. Also troubleshooting and common failure items of Sears series string color and B/W sets. Can you or any of your readers help us?
Lloyd K. Simonson
Fox TV Service Company
507 E. Main
Waterford, WI 53185

STRICTLY BUSINESS

I forget now who first asked me, "Who said life had to be fair?" It seems that servicers shoulder more than their fair share of problems. Two of the most serious are the twin problems of "too much business" and "too little business" and we are being grievously hurt by both at the same time.

On one hand, incidence of failure is falling off—drastically. Where once we might have expected perhaps two service calls in the course of a year, the new solid state equipment is experiencing a half-a-call a year. With less demand, there is a sharp decline in income. Worse, there is no corresponding decrease in expense. Costs for rent, light, heat go on, as do costs of vehicles and overhead personnel and even technician wages. It is unquestionably true that firms are going out of business for just this reason. Apparently, there is too little business.

On the other hand, we are continuing to face the problem of a shortage of technicians. Almost invariably, owners and managers report they would hire a good technician today, if only they could find one. They yearn to expand or diversify, if they had the people for it. Apparently, there is too much business ... or at least, servicers are hard pressed to get the work completed.

It is unfair that servicers should be hurt by both extremes ... but who said life has to be fair?

There are solutions, but investigating them takes far more space than we have here. As incidence of failure goes down, the dealer must look toward servicing more brands, or more products, or move into new fields. Garage door openers, perhaps? Home communications equipment? Marine equipment? Hospital equipment?

As the technician shortage pinches, the dealer must consider training, or cooperative ventures in training, and most certainly, making the best possible use of every technician's every available hour.

For those who would like to meet together and explore these subjects in depth, an opportunity is available through the NARDA College of Service Management* On the Sunday night of each of the meetings, there will be a two-hour session on the problems of declining business. On the Monday nights, there will be a two-hour session on the problem of the technician shortage.

Experience has shown that servicers can solve their problems if they will come together ... think together ... work together.

* *The College of Service Management is a four-day meeting for the express purpose of considering solutions to service problems. Three "colleges" will be offered–in College Park, Maryland February 25-28–in South Bend, Indiana February 18-21–in Albuquerque, New Mexico February 4-7. For details write NARDA, 2 N. Riverside Plaza, Chicago, Illinois, or call (312) 454-0944.*

John Dooley

Mgr., NARDA's Service Division

NEWSLINE

"THE FED" BLOCKS GE/HITACHI TV VENTURE. With logic, that on the face of it seems hard to follow, the U.S. Dept. of Justice has opposed the planned GE/Hitachi venture to form a new television set production company in this country. If the parties go through with the deal, the Justice Dept. said, its "present intention" is to sue. The reasoning behind the decision, according to the government, is that is was not persuaded of the necessity of the combo to "maintain the viability of either party." It would eliminate competition between GE and Hitachi, the government added.

WOULD HAVE FORMED GTA. Consummation of the deal would have resulted in creation of a third company, General Television of America (GTA). The plan had been to jointly manufacture color television receivers in this country at present GE facilities with a pooling of technological resources. The Justice Dept. said the merger would have created the third or fourth largest set manufacturer in the United States. With the ruling, Hitachi remains the only Japanese television set maker without a plant in the U.S.

SHARP ANNOUNCES PLANS FOR U.S. TV PLANT. The Sharp Electronics Corporation of Japan will build its first manufacturing facility in the United States at Memphis, Tenn. In a year-end announcement, Sharp said the plant, tentatively set for completion in the fall, will initially produce 10,000 TVs and 30,000 microwave ovens per month. Eventually, Sharp added, "this will be a multi-product manufacturing facility and we will expand production capabilities" to audio and business equipment products. The new, ultra modern facility will be located on 88 acres of land outside Memphis and will employ some 700 persons, Sharp contends.

CABLE TV BOOM? With cable TV reportedly reaching 20 per cent of American homes and the industry itself winning just about every regulatory bout with the federal government to date, the last impediment to virtually unrestricted growth remains state legislatures. Here is where the industry will launch its main attack in an effort to keep states out of their business. The latest count shows some 300 small earth stations in operations to receive satellite transmitted programming and some 4,400 cable systems in operation.

ATARI ENTERS HOME COMPUTER MARKET. Atari, up to now the TV game people, will enter the home computer market with two entries--the Atari-400 (retailing about $450) and the Atari-800 (retailing at $900). Backed by a library of softwave including personal financial management, education, auto mechanics, etc., the systems are user programmable in BASIC with other programming languages to be made available on preprogrammed solid state cartridges.

CONSUMER ELECTRONICS TO REMAIN STRONG. The sale of consumer electronics products in 1979, coupled with comparatively depressed price levels, an extensive array of new products, and "hard hitting" sales promotions--will remain strong in 1979, according to the Electronics Industry Association. Consumer products sales are expected to account for more than $1-billion in sales in 1979, compared with some $700-million last year and $300-million in 1977.

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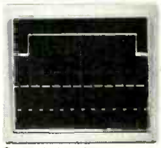
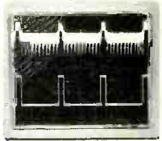
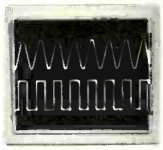


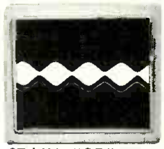
Check logic including countdowns and PLL



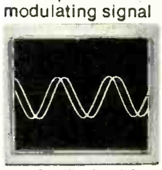
Display composite video and AGC pulse



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



27 MHz "CB" envelope and modulating signal



Check phase shift and distortion in amplifiers

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

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SYLVANIA Electronic Components GTE

Microprocessor hardware

A first look

We continue our series on microprocessors with a look at the functional limits of the memory, central processor and the input/output port.

By Steven K. Roberts

There is an elegance to the structure of a computer which can be quite beguiling, especially after years of fighting transistor circuits and random logic. The general purpose design and the utter simplicity of the hardware might leave you wondering why everything isn't done that way. Don't worry: it will be.

This is the third article in our series on microprocessors. In the first, we spoke of the philosophical basis for their existence and use in consumer electronic equipment. In the second, we created a computer-controlled stereo cassette deck in our imaginations, and tore into the program that runs it to demonstrate some of the concepts behind software. In this one, our task is to sketch the fundamentals of hardware architecture—the gross logic of the processor itself and the communications techniques that allow its interconnection with memory and the outside world.

In the early days of computers—even of microprocessors ('way back in the early 70's)—the hardware was anything but simple. The concepts behind it were similar to those used today, but the level of circuit integration had not advanced to the point where one could treat a block diagram as a schematic. Now that entire subsystems and controllers are available as inexpensive IC's, it is possible to concentrate more on the application of a system than on its design. It is this, more than anything else, that is causing the revolution in digital electronics.

Riding the bus

We will start by looking at Figure 1. This is a block diagram of a typical computer system, representing just about every microprocessor in use today. The "brain", of course, is the Central Processing Unit (CPU), which actually performs the instructions and tells data where to go. The instructions are stored in the memory, in a logical sequence that allows the CPU to begin executing somewhere and proceed in an orderly fashion. Communication with the outside world (terminal, printer, hardware being controlled, etc.) is all lumped together in the block labeled "input/output" (I/O).

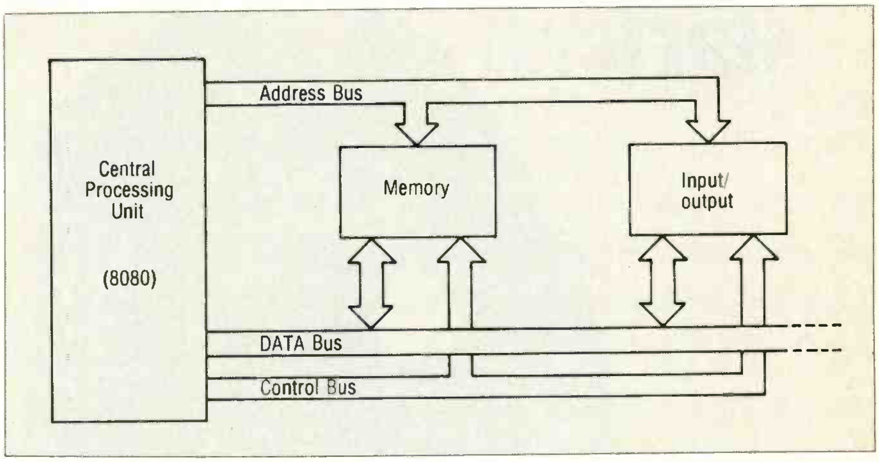


Fig. 1–General structure of computer system. The processor chip sends out addresses and commands, setting up two-way communication on the data bus. Buses can be extended, as shown on the data bus, to accommodate additions to a system.

Communications between these three blocks can be accomplished in a number of ways, most of which are represented by the different chip families on the market. Because of the personal preferences of the author, the structure of the Intel 8080 (and all of its cousins) will be used in this discussion.

One concept that is common to all the microprocessors in existence is that of the "bus," basically a group of signals considered together as a family: there is an Address Bus, comprised of all the signals which are needed to define any of the possible memory or I/O locations in the system, a Data Bus which handles all communication of instructions and data, and a Control Bus which is used by the CPU to direct the actions of the other elements in the system. In the 8080-style system, the data bus consists of 8 lines (it's an 8 bit system), the address bus of 16 lines (allowing 65,536 possible combinations, or addresses), and the control bus of 5 lines.

There are two ways a bus can be used. The address bus, for example, is without exception used to send an address from the CPU to the rest of the system. If it is time to fetch a new instruction from memory, the CPU places the proper address on the bus, issues a command on a control line, and receives the instruction on the data bus. Hence, the address bus is unidirectional, as the information flow is always away from the CPU. On the other hand, the data bus can be used for either the input or the output of data, and is thus spoken of as a bidirectional bus. This raises the need for a new idea in logic: Tri-State.

Normally, one thinks of logic circuits as having one of two possible states—on or off; high or low; 1 or 0. The TTL IC's that are most familiar recognize and output only these two states. The output is often accomplished by the "totem pole" circuit shown in simplified form in Figure 2.

The internal logic of the IC, whatever it may be, informs other circuits of its activities by turning on one transistor or the other, issuing either a 'high' or a 'low' to the output line. Since only two states are used, one transistor is always conducting.

Tri-State logic is identical, but with one exception: in certain modes, neither transistor is on. As far as other devices in the circuit are concerned, the Tri-State chip has disappeared, since it is pulling the output line neither high nor low. The remarkably useful offshoot of this is that a number of devices can be connected to drive the same line without conflicting with each other. Only one is ever 'enabled' at a time.

(Incidentally, we could speak of a fourth state which the output structure in Figure 2 could assume: both transistors ON. This would have the immediate effect of melting the transistors, and would be useful as a self-destruct feature.)

It is this, then, that makes the key concept of a bidirectional data bus a possibility. Dozens of memory IC's and I/O devices may be connected to the same set of lines, and only the one that is actually addressed by the CPU will be allowed to become active.

With this information, we may now observe the system's general operation:

FIRST, the CPU issues a command on the Control Bus which defines to the other elements of the system what type of activity is about to occur.

SECOND, the CPU issues a binary code on the Address Bus which specifies the memory location or the I/O device which will be involved in the activity.

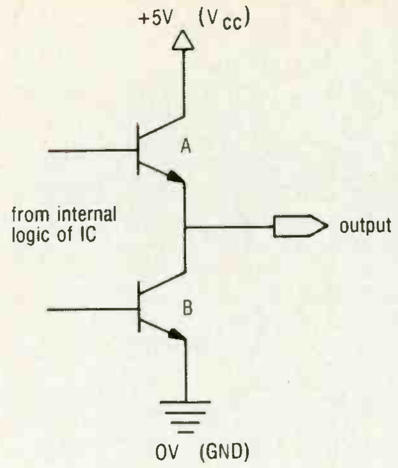
THIRD, data transfer occurs between the CPU and the selected memory or I/O location, followed by an internal process if required (such as an ADD).

FOURTH, the CPU completes the operation and starts the sequence over with the next instruction or data transfer.

Memories are made of this ...

Now that we have avenues of communication among the elements of the system, we can begin to define some of the hardware that will be used, beginning with the memory.

A microprocessor's use of memory depends heavily upon the type of job being performed, but every system, without exception, has one fundamental need: a program. Programs are



A	B	FUNCTION
off	off	Inactive
off	on	Logic "0"
on	off	Logic "1"
on	on	Self-destruct

Fig. 2–Tri-state logic devices. Normal TTL IC's, to produce two-state output, always have transistor A or B of the totem-pole output ON. Tri-state devices allow Party-line use of data bus by allowing both transistors to be off, making the device logically disappear.

step-by-step sequences of instructions which completely define the computer's task. They are seen by the system as binary codes in memory, available in eight-bit chunks.

If a program is to be the heart of a product which will end up in a customer's home (such as the ET/D COMPUSETTE 80 we conjured into existence in our December issue), it is well to provide for its permanent residence in the system. This need has led to a distinction between two major classes of memory devices: ROM and RAM.

ROM, or Read-Only Memory, is a family of parts that do just what their name implies. Once a program is stored in the chip, it can be used in a system, stashed on a shelf, tossed about—all without affecting the data within. The microprocessor cannot change the contents; it can only look at them. These are universally used as permanent program and data storage for a variety of computer products.

RAM, or Random-Access Memory, differs from ROM in that the microprocessor can both read from it and write to it, allowing data storage while the program is running. Most systems use some mixture of ROM and RAM.

The use of most memory devices is simplicity itself. In the case of the ROM, the CPU merely gives it an address and tells it that it has been selected to speak to the data bus. Within a few hundred nanoseconds, the eight bit piece of data that is stored at the specified location appears on the output pins. A typical ROM, the popular 2716, is diagrammed in Figure 3. From a user's standpoint, that's all there is to it: address in, data out.

The 2716, incidentally, is one of a handy group of ROMs known as EPROMs (for Erasable Programmable Read Only Memory). Whereas the "classic" ROM's have to be programmed at the factory of their origin, EPROMs can be programmed cheaply and easily by the user. Then, when the data stored has outlived its usefulness, it can be erased by a dose of ultraviolet light, allowing the part to be used again and again.

The use of RAM in a system is not vastly different from the use of ROM; in fact, the process of reading data from it is identical. When the CPU wishes to write data into it at some location, it simply gives it the address, the data to be written, and a WRITE command. Any

Glossary of Terms

DMA Req—Direct Memory Access Request. Allows the other parts of system to suspend CPU activity and use memory directly.
1,2—Phase 1 and 2 of two phase clock
WR—Write command to memory or I/O
DBIN—Data Bus In. Controls direction of data flow on Bus
HLDA—Hold Acknowledge. Rarely used. Suspends system operation, releasing the buses. Used with multiple processors.
BUSEN—Bus Enable
INTA—Interrupt Acknowledge. Indicates CPU acceptance of an interrupt condition from the outside world.
I/O R—Input/Output Read
I/O W—Input/Output Write
MEM R—Memory Read
MEM W—Memory Write
RDYIN—Ready Input
RESIN—Reset Input

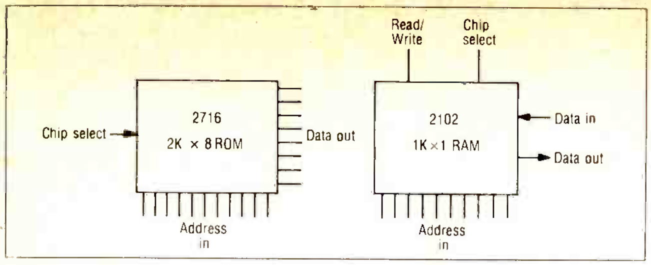


Fig. 3–Simplicity of ROM and Ram chips is suggested by pinouts of these popular devices.

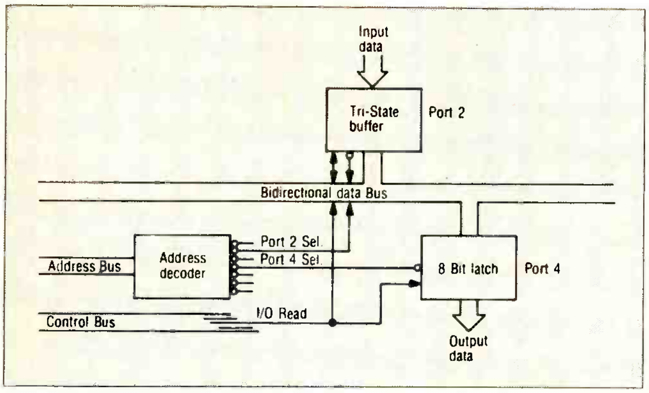


Fig. 4–Typical input/output logic of a system, showing one buffered input port and one latched output port. Address decoder and command line from the Control Bus govern the data flow, injecting or extracting data into or out of the data bus at the proper time.

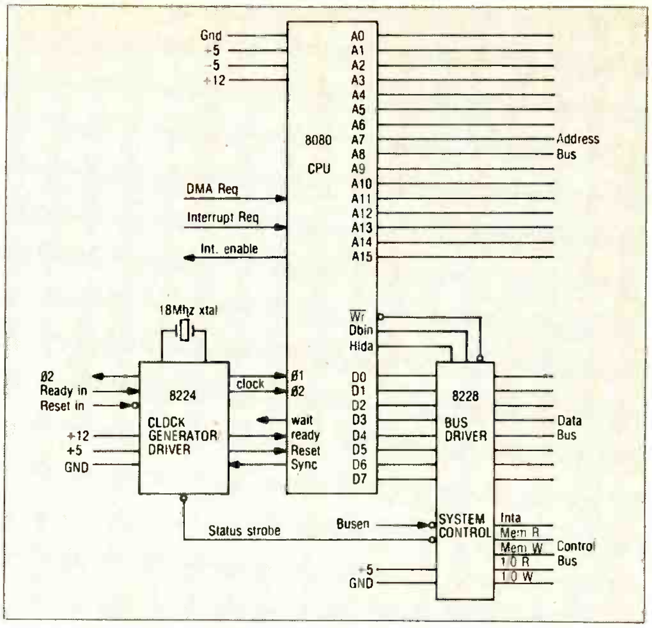


Fig. 5–8080 CPU chip is shown with its support logic. This circuit with added memory and I/O is a complete computer. Parts cost can be as little as $40.

future read operation from that location (until another write or a power failure) will reveal the data written.

Mail Call

If you have trouble visualizing the action of a memory, try thinking of it as a wall of numbered post office boxes. Each of them contains a slip of paper which may or may not have something written on it.

Assuming you are the central processing unit, you go to box #1 and open it. Removing the slip of paper, you read, "Get the data in box #1538 and write it down." You do this, then proceed to box #2. The note therein says, "Compare that number to 100. Note whether it is less than, equal to, or greater than." When you do that, you are performing a logical operation on the data. Then, in box #3, you read, "If it was equal, JUMP to box #62." This is a conditional test—if the number you got from box #1538 was 100, then the next instruction you perform will be in box #62. Otherwise, you would simply ignore it and go on to box #4.

That's hardly an elegant way of looking at it, but it really is that simple in concept. The microprocessor is only taking instructions one at a time from memory, in a sequence that is strictly numeric except when the program directs it to do otherwise.

The computer is a servant to its program.

Inputs and outputs

In a somewhat similar fashion, the processor talks with the outside world. There is no limit to the types of devices that can be interfaced with a computer, and in the field of "control," some rather unusual ones may be found. Apart from the obvious, such as switches and displays, one may discover temperature sensors, valves, stepping motors, optical devices, sound-effects generators and communication lines. They all have one thing in common: by the time they are connected with the microprocessor they are merely digital inputs or outputs with defined addresses. The temperature sensor, for example, originally produces a voltage variation as a function of its thermal environment. This signal is connected to the input of an analog-to-digital (A to D) converter, which produces a binary value that represents the voltage input to it. This binary data is passed to the microprocessor on an input port with a certain address, allowing the value to be read by the program as easily as data from a location in memory.

Take a look at Figure 4. This is a diagram of the I/O structure for a typical system, showing one input port and one output port. The "threshold" which incoming data crosses upon entry to the system is a Tri-State buffer, which performs exactly the function talked about above: unless it has been actively selected by the CPU, it is completely invisible to the data bus. The process of selection involves two actions: the address of the port appears on the address bus, which, when decoded, presents an enabling signal to the Tristate buffer, and the execution of an I/O READ function results in that status signal on the control bus, strobing the interface chip. The tri-state device becomes enabled and remains so as long as both the I/O READ command and the decoded address are present.

A similar phenomenon occurs in the Output section of the system. In this case, the interface chip is a latch (though it does not have to be in every system), and when it is strobed with data present on its inputs, it holds the data on its outputs until another strobe with different data occurs. The decoding and strobing are performed identically with the input operation described above, the only difference being the direction of data flow.

In the case of the 8080-style microprocessors, up to 256 each of input and output ports are allowed on the system. It is a rare computer that uses more than 10% of that.

Plugging in the "brain"

Having discussed two of the three mysterious boxes in the diagram of Figure 1, the Memory and the Input/Output, we can at last turn our attention to the Central Processing Unit itself. This article is concerned primarily with the hardware of a system, so we'll save the details of the microprocessor chip's internal architecture for the next installment, concentrating instead upon the actual interface with the other components.

Figure 5 is a complete schematic of the "processor" part of a system—all the hardware that is responsible for the existence of the three buses we talked about before (Address, Data, and Control). Three IC's accomplish the task in an 8080 system, but newer CPU chips do it alone. By way of comparison, the Intel 8008, the first 8 bit microprocessor, required a few dozen IC's to do its job (and it took over 10 times as long as the 8080).

The prime mover of a computer system is its clock, and it is here provided by the 8224. Connection of an external crystal (usually 18 MHz) allows the Clock Generator/Driver chip to produce the 2 MHz two-phase clock required by the CPU, and while it is doing that, it handles the READY and RESET signals, synchronizing them for the 8080. READY is simply a means of suspending the processor's activity by means of an external condition—when the line goes low, CPU activity freezes. This is rarely used except as a means of synchronizing the system with slow memory or for allowing a "single step" mode wherein only one instruction is performed at a time (very useful for debugging, when instructions normally zip by in a couple of microseconds!). RESET is used to start the processor at location 0 of memory, and is the universal method of telling a system to GO.

Looking at the CPU chip itself, we note four supply voltages; GROUND, +5, −5, and +12. The need for anything other than +5 and GROUND is a pain from the system design standpoint, and again, newer processors operate on just that. (We are discussing the 8080 because it is the most universally used CPU chip, and many newer units, including some of the single supply parts, are based on its design.)

The largest single group of pins on the 8080 is the Address bus, which we have already covered. In small systems, these pins may be connected directly to memory and I/O devices, but in larger configurations, they would be seriously overloaded if used in that fashion. For this reason, devices known as "Bus Drivers" exist which serve the dual purpose of isolating the CPU from the rest of the system and increasing the number of loads that the address bus can handle.

The directional data bus, consisting of lines D0-D7, is connected directly to the 8228. This chip buffers the data bus, and also acts as the "system controller," extracting timing information which the CPU places on its data bus at certain points in the clock cycle and using it to create the five signals we have termed the Control Bus. This approach prevents the 8080 from needing more than 40 pins.

This standard configuration shown in Figure 5, coupled with the memory and I/O structures which we talked about before, comprises a complete computer system. Machines that once consisted of thousands of parts are totally overshadowed and outperformed by single printed circuit boards with a few dozen IC's, most of which are memory. An early IBM system used "core stacks" of 64K bytes which were about five feet tall and two feet square; today's state-of-the-art microprocessor may be equipped with eight 16-pin chips with identical storage capacity and about 20 times the speed. Small wonder that microprocessors are so often called a revolution.

Your own computer?

This might be a good time in this series to toss up some thoughts about the best of all possible ways to learn this technology. We have just covered the hardware that comprises a microprocessor system: the most intriguing insight that you should have gleaned from this is that there's really not much to it. Designing the chips would be a different story entirely, but we don't have to worry about that.

There are a multitude of courses, seminars, textbooks, training aids, and magazine articles that in various ways purport to teach the intricacies of computers. You can make a major commitment and go back to school, you can take a week in any major city where manufacturers regularly hold seminars on their products, or you can buy all the books you see advertised and do a lot of studying. You can get frustrated and confused very efficiently.

The materials mentioned are important, providing as they do the essential information about the subject. However, most leave out one or two major ingredients: hands-on experience and motivation.

Microprocessors, now that they are cheap and accessible, are the basis of a rapidly growing "personal computer" market. A surprising number of people, from accountants and investors with business interests, to musicians wishing to simplify composition, to hard-core hobbyists scratch-building systems and using them for countless applications,

continued on page 44

Table model radio repair

In 10 easy steps

Generally not thought of as a profitable area in this day and age, small radio repair can be with a systematic approach to troubleshooting.

By Homer L. Davidson

Although the table and portable radio have been with the radio-TV technician for many, many years, a lot of the independent TV shops will not service them. Yet there are millions of these radios in use today, thousands manufactured each year, and many are coming in each week for repairs (Fig. 1), including into my own shop.

We must admit servicing radios is a small ticket item compared to TV repairs, but you can still make money on them. Perhaps with less TV servicing revenue each year now's the time to get back into the radio repair business. Not only will it help pay some of those monthly bills, but it will keep you in contact with a new or old TV customer.

Servicing the radio chassis can be made simple, quick and quite profitable. You don't have to spend a lot of time servicing the table or portable radio—in fact, a half hour, many times, will do. Simply follow the 10 Steps to Table Model Radio Repair and see how easily they are restored.

Step 1/On-off switch

If the defective radio comes in in a dead condition, go directly to the on-off switch (Fig. 2). In case the dial light is on, you may assume the on-off switch is normal. If not, with power disconnected, check for continuity across the switch terminals. When turned to the "on" position and the switch contacts are open, you may assume the switch is defective.

In many of the small transistorized radios a standard on-off switch is found behind the volume control. If a separate switch is not handy, pick up a universal volume control with switch, and install the new control. You may find a different type switch in the clock AM-FM radio. Generally, the switch is mounted with the on-off clock and alarm function assembly. These special switches must be replaced with the original part number.

Before leaving the switch assembly, check the ac cord for continuity. Many times a dead radio is caused by a broken ac cord. Check both sides of the ac cord with the VOM. You may find the cord breaks right at the back of the ac male plug or where the cord enters the radio chassis. For possible intermittent operation, simply flex the cord with the ohmmeter connected and watch the meter movement.

Step 2/Dropping resistor

You may find either a power transformer or ac powered circuit in the radio chassis. The quickest method to locate a dead power supply is to measure the dc voltage at the positive terminal of the silicon rectifier and common ground. Another method is to check for dc voltage across the large filter capacitor. If no voltage, suspect problems in the power supply. When the dc voltages are real low, either the outside circuits are pulling excessive current or a problem lies in the power supply itself.

A few of the larger table model radios operate directly from the ac power line. You will find a large voltage dropping resistor on one side of the ac line (Fig. 3). (Also a high voltage type sound output transistor is found in these same models.) This resistor drops the ac voltage to the required operating voltage and it can vary in size from 150 to 450 ohms (Fig. 4). Most of these resistors are of the 5 and 7 watt variety, but should be replaced with a 10 watt component.

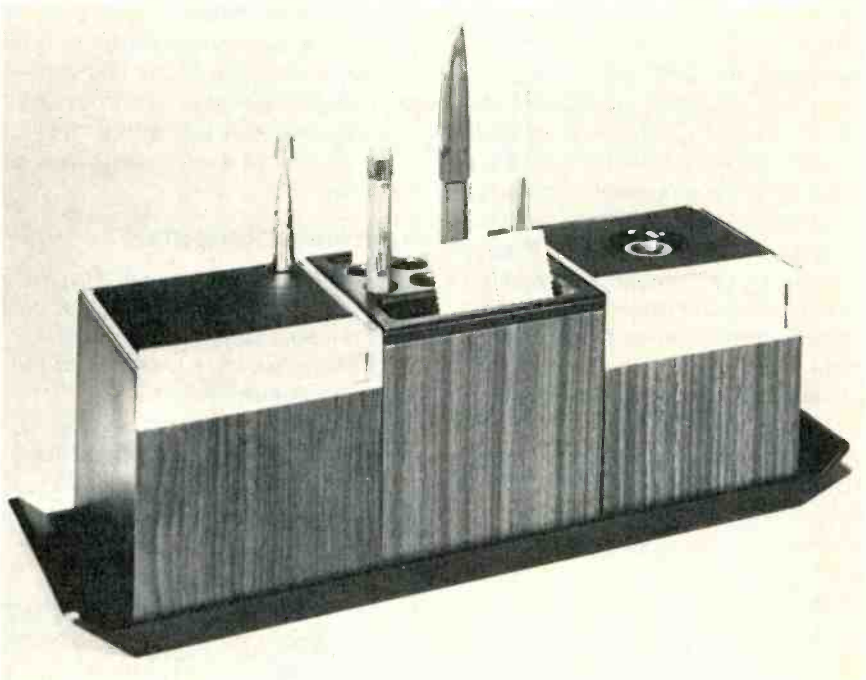


Fig. 1-A Realistic AM Deskube table model radio (courtesy Radio-Shack).

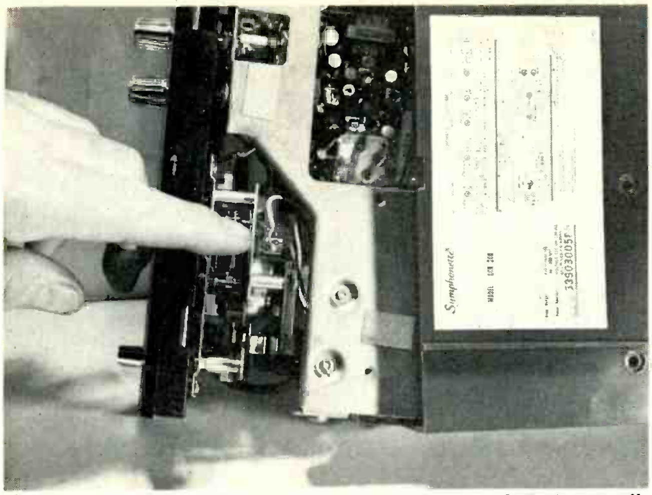


Fig. 2-Check the on-off switch continuity with the VOM, the on-off switch is located on the clock assembly in this Symphonette model LCR200.

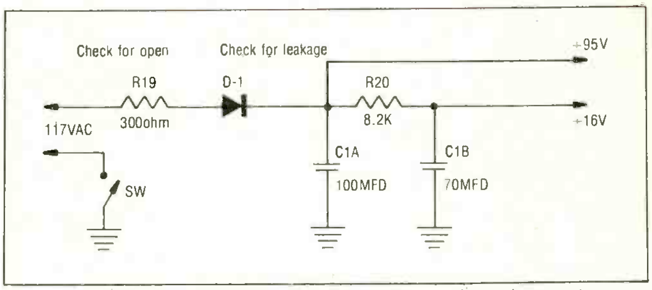


Fig. 4-A schematic diagram of the ac voltage dropping resistor (the resistance may vary between 150 and 450 ohms).

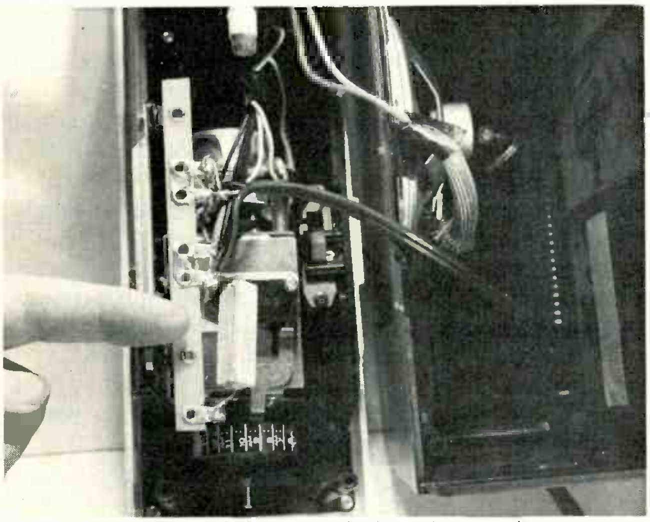


Fig 3-A photo showing the size and where the ac voltage dropping resistor is located in many table model radios.

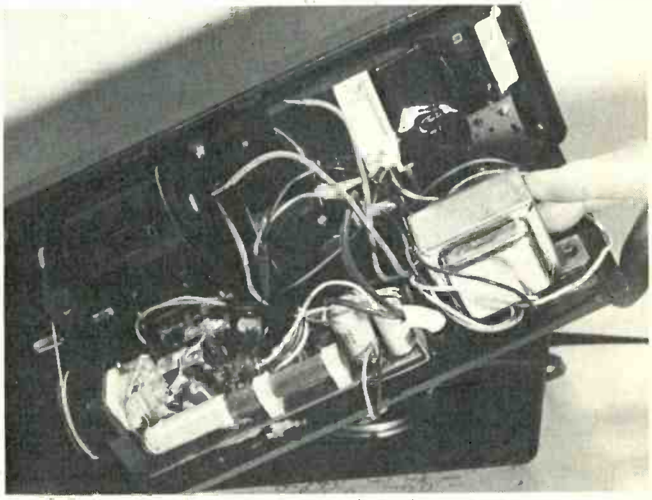


Fig. 5-Some table and portable receivers have a power transformer to operate the radio and digital clock circuits (Dyn model DS4555).

They normally run fairly hot and tend to open up. They are also sometimes destroyed if a silicon diode or high voltage output transistor becomes leaky.

Check the condition of the resistor by measuring the resistance across it. If in doubt of the reading, clip one end from the circuit. Many times you can spot a defective resistor from burn marks. Before replacing, check the silicon rectifier with your ohmeter for a leaky or shorted condition.

If a schematic is not available and the resistance of the ac voltage dropping resistor is not known, try a 400 ohm 10 watt type. Now, check the voltage on the collector terminal of the high voltage output transistor. This voltage should be somewhere around 75 to 112 volts. If the voltage is too low you will notice distortion in the audio circuits and if too high, in time it may ruin the output transistor. Sub and reduce the resistance of the voltage dropping resistor until the collector voltage is around 90 volts. This is about normal in most table models.

Step 3/The transformer

Some table and portable models carry a small power transformer in the power supply (Fig. 5). Most of these radios use full-wave rectification with two small silicon diodes. In some clock radios the power transformer also supplies ac voltage to the digital clock mechanism. If a transformer is found defective in a digital system, the original part number should be ordered. These transformers may have odd voltage taps supplying both units and a universal type usually won't do.

Since the primary winding of the small transformer opens under excessive loading conditions, it should be checked with a VOM. Connect the meter test leads to the ac plug and switch on the radio. If no continuity, either the winding is open or it's the on-off switch. Next check for continuity across the transformer winding. In case of a low ohm reading, the winding is normal and the switch may be defective. Check for a loaded condition in the secondary of the transformer when the primary winding is open. Generally, leaky sound output transistors or silicon rectifiers are the most likely culprits.

To check each silicon diode apply the VOM leads across its terminals. A good diode may read under 10 ohms and infinity with reverse test leads. A defective diode will have a meter reading in both directions. Tolerances of these small rectifiers are not critical and you can use a diode rated at one amp/200 volts or more.

Step 4/Capacitors

When excessive 60 cycle hum is heard, suspect a defective filter capacitor. In

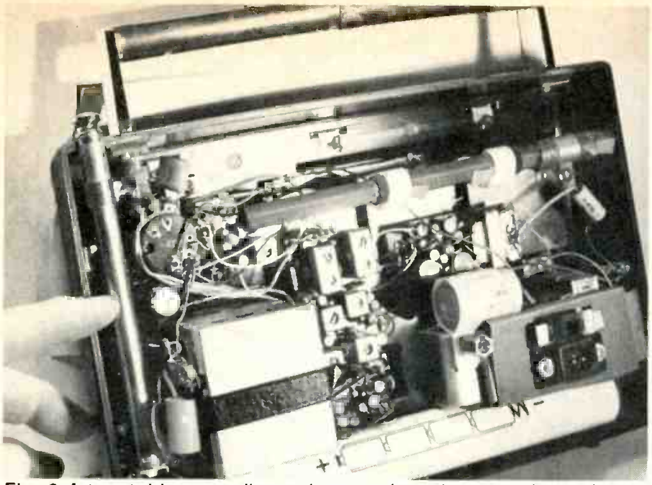


Fig. 6-A tunetable squealing noise was heard across the entire band in a Magnavox IR-1201 3-band radio. The finger points at the defective decoupling capacitor.

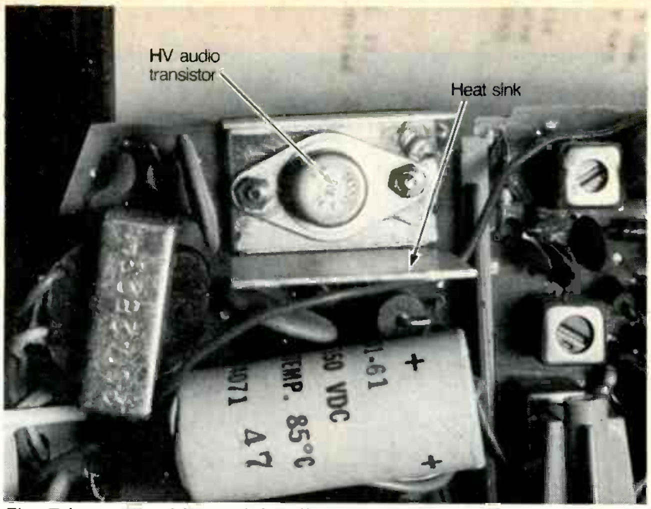


Fig. 7-In some table model radios a large single power output transistor is found bolted to a small heat sink.

the newer table radios, several single filter capacitors may be used while in the older models one filter unit may contain up to three separate capacitors. When one large filter capacitor is found, the value may range from 470 to 2200 mfd.

To determine if a filter capacitor is causing the hum condition, simply shunt another equivalent one across it. It's best to turn off the radio and clip the good capacitor in place; then turn the power back on. Sometimes a transistor can be ruined while shunting a charged capacitor across another one when the unit is turned on. Shunt each filter capacitor until the hum disappears and then remove the old capacitor and install the new one.

Filter or de-coupling capacitors may produce weak and squealing reception. When a squeal is heard along side the station signal, suspect a defective de-coupling capacitor (Fig. 6). These small electrolytic capacitors filter the lower B+ voltage to the RF, IF and audio pre-amp sections. Again, shunt a known capacitor across the suspected one to eliminate the squealing noise.

These de-coupling capacitors may vary from 50 to 470 mfd's and they operate no higher than 15 volts dc. If it's not your day, you may have to dismantle the chassis to get at the capacitor terminals. A defective de-coupling capacitor in the RF and IF section may also reduce the sensitivity of the receiver.

Step 5/Dead and no sound

After the power supply voltages have been checked, go directly to the audio output stages. If a large power output transistor is found in the audio section, you may assume it's of the high voltage operating type (Fig. 7). Simply touching the center terminal of the volume control may tell you if the audio section is dead. The audio section is normal if a loud click or hum is heard in the speaker.

The high-voltage transistor can be dead or intermittent. To locate a defective sound output transistor measure the collector voltage. Voltage abnormally high or equal to the supply voltage indicates the transistor is open or has an open emitter resistor. When the voltage is fairly low on the collector terminal and very high on the emitter and base terminals you have a leaky transistor. Since most of these power output transistors are riveted to the heat sink, you will have to remove the emitter and base connections for an in-circuit leakage test. Next check the resistance of the emitter resistor.

When the output transistor is found defective, use a small drill bit to remove the rivets. You may find the transistor is bolted directly to the heat sink without insulation between heat sink and transistor. If this is the case, the heat sink is insulated away from the pc board. Be sure to replace the piece of insulation with silicone grease, applied on each side. The transistor now may be bolted back into the circuit or pop-riveted into place.

Step 6/Push-pull sound

Many table and portable radios have push-pull transistors in the sound stages. Sometimes, these stages are transformerless while others carry a small output transformer (Fig. 8). Problems found in the audio stages are dead, intermittent, weak and distorted sound. When weak reception is noted, coupled with excessive distortion, it is generally because one of the output transistor is leaky.

First check the voltages on both transistor terminals. It's best to have a schematic handy with operating voltages. When an output transformer is used, all terminal voltages should be the same on each transistor. With transformerless output circuitry you may find one transistor collector terminal higher than the other. In fact, the transistor with the zero collector voltage Q704 will have equal emitter voltage of the higher collector terminal transistor Q703 (Fig. 9). Of course, these voltages are normal when the receiver is operating perfectly.

When transistor Q703 appears open the collector voltage may equal the supply voltage. If transistor Q703 becomes leaky the emitter and base voltage may be close to the lower emitter voltage. Also, you will find the emitter voltage of transistor Q704 to be somewhat higher. If transistor Q704 opens the collector voltage of Q703 will be higher than normal, but lower than the emitter voltage of transistor Q703. No audio can be the result of a shorted Q703 or an open transistor Q704. Weak and distorted conditions can be caused by either or both output transistors.

Step 7/Intermittent sound

Intermittent sound problems can occur in the front end or sound section of any radio. Try to isolate the different sections or stages with an outside signal tracing amplifier. Go from stage to stage and remember that most intermittent conditions are caused by transistors, poor board connections and cracked pc boards.

The intermittent transistor may be located with the signal tracing amplifier, coolant or hot air spray. If the intermittent lies ahead of the volume control, use coolant and hot air spray on the suspected transistor.

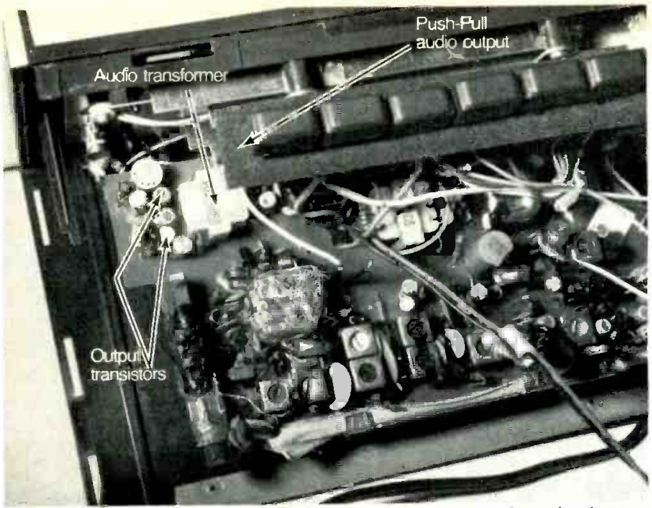


Fig. 8-Notice the two small audio output transistors bunched near the audio output transformer in this Lloyds J-627G model.

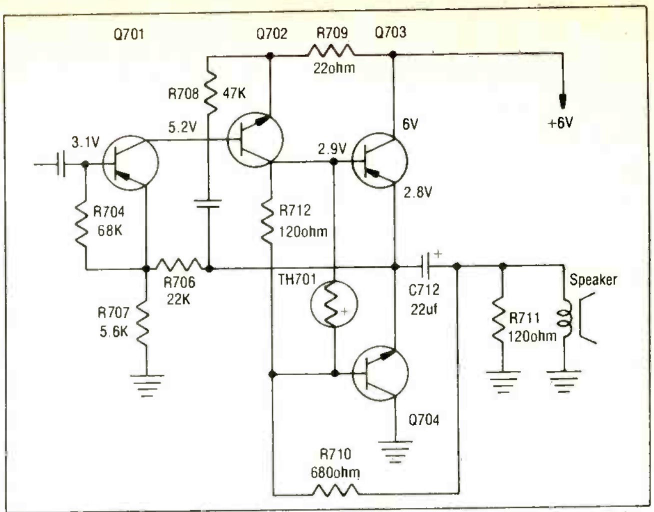


Fig. 9-A schematic of a transformerless sound output stage with normal transistor voltages.

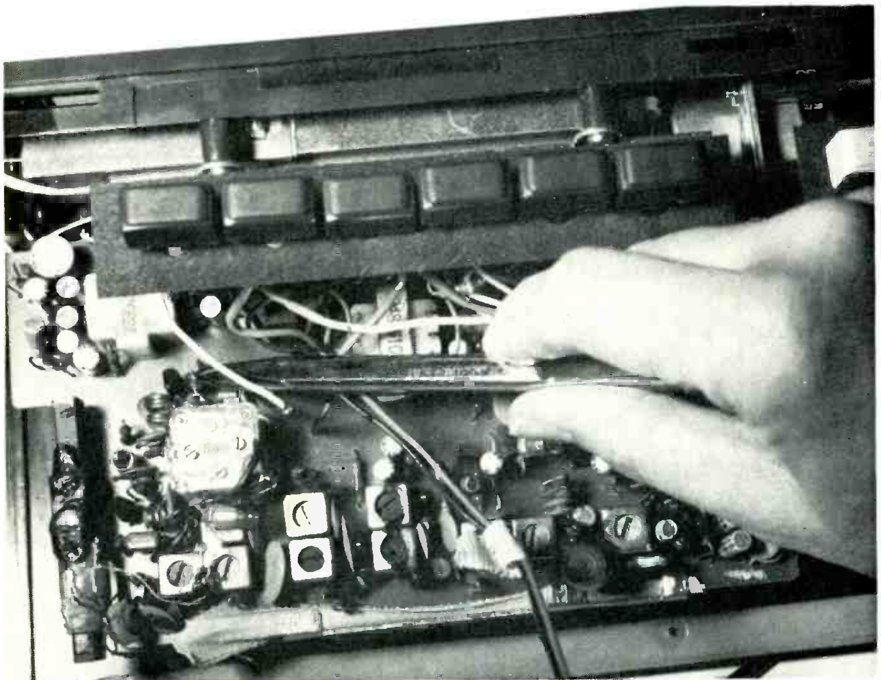


Fig. 10-The FM oscillator transistor may be located next to a couple of air-wound self-supporting coils and close to the variable tuning capacitor.

Sometimes by probing the pc board with an insulated tool or flexing the pc board you can get a poor board connection to act up. A poor capacitor or resistor connection can be located by simply pushing and moving the component upon the board. Press the larger components on the pc board to see if bad solder connections exist underneath.

A broken pc wiring connection is a little more difficult to locate. Twisting the board, or a component, might make the radio intermittent, but the broken foil connection can be in an entirely different section. Check all ground screw and mounting terminals with extreme care. A magnifying glass is a great help in locating possible broken foil connections. In difficult intermittent situations the entire board should be gone over with a light pencil type soldering iron.

Step 8/No AM

Most of the radio receivers coming in today for service are of the AM-FM, FM MPX or multiband types. Sometimes two transistors are found in the separate AM and FM sections, although some later receivers have one IC chip serving as the AM and IF section (Fig. 10). In this particular type, when the audio section is normal and there is no front end signal, replace the entire IC circuit. Otherwise the AM and FM transistors must be located before isolating the defective AM component. Isolate to see if the AM section is dead and the FM sections are normal.

After locating the suspected AM transistor make an in-circuit transistor test. You may have to remove the transistor for a correct leakage test. Simply clip the transistor terminals ¼-inch above the pc board. Then, when a new transistor is installed, make a loop over each terminal lead and solder over the stub end. Not only can this be done quickly, but in many cases it saves removing the tuning and dial coard mechanism to get at the transistor terminals under the pc board.

In addition to the AM transistor check, don't overlook the tuning capacitor for broken leads or poor ground connections. Also, a broken or cracked AM antenna ferrite core will produce very weak reception. Double check the fragile antenna wires for broken connections. Unsolder the RF and oscillator coil connections to the variable capacitor and check for leakage between rotor and stator plates. It's best not to attempt to repair the radio when a defective tuning capacitor is located, due to expense and difficulty in obtaining the correct replacement.

Step 9/No FM

If the AM section is okay and the FM section is dead, locate the FM transistors. You will find them near a couple of open air wound coils. In the small table model radio you will find at least two FM transistors and in larger deluxe receivers up to three transistors. Separate RF, oscillator and mixer transistors are used in these models.

Go directly to the oscillator transistor when the FM stages are dead (Fig. 11). When only a weak local station can be heard suspect a defective RF FM transistor stage. If a loud rushing noise is heard check the mixer stage. Generally,

continued on page 45

A new chassis for Sony for '79

No more GCS

The 1979 Sony line features improvements in serviceability, simplified horizontal sweep circuitry and lowered power consumption

By Walter H. Schwartz

For several years Sony's larger screen color television receivers have had a unique horizontal deflection system reportedly due to the sweep requirements of the wide deflection angle Triniton picture tubes and the limitations Sony engineers felt were imposed by SCR's and bipolar transistors. This sweep system used a GCS (gate controlled switch) and a separate horizontal output transformer which drove the yoke and supplied, typically, an 18 volt source for most of the low level stages of the chassis, a 200 volt source for the video output stages and the CRT G2, the picture tube heaters, and other pulses and voltages, and a high voltage transformer which had no other function than the development of the 25 Kv high voltage for the anode and the slightly lower voltage for the convergence plates of the Triniton. These transformers are both driven by the GCS. The GCS has a reputation for excellent reliability, but requires a definite, carefully observed procedure for circuit troubleshooting and checkout (see April '78 ETD).

The "I" chassis using the GCS was introduced in the 1976 line. This was a 6 circuit board set with many of the interconnections plugin for convenience in production and service. The smaller sets contemporary with the "I" chassis used the "R" chassis also with GCS

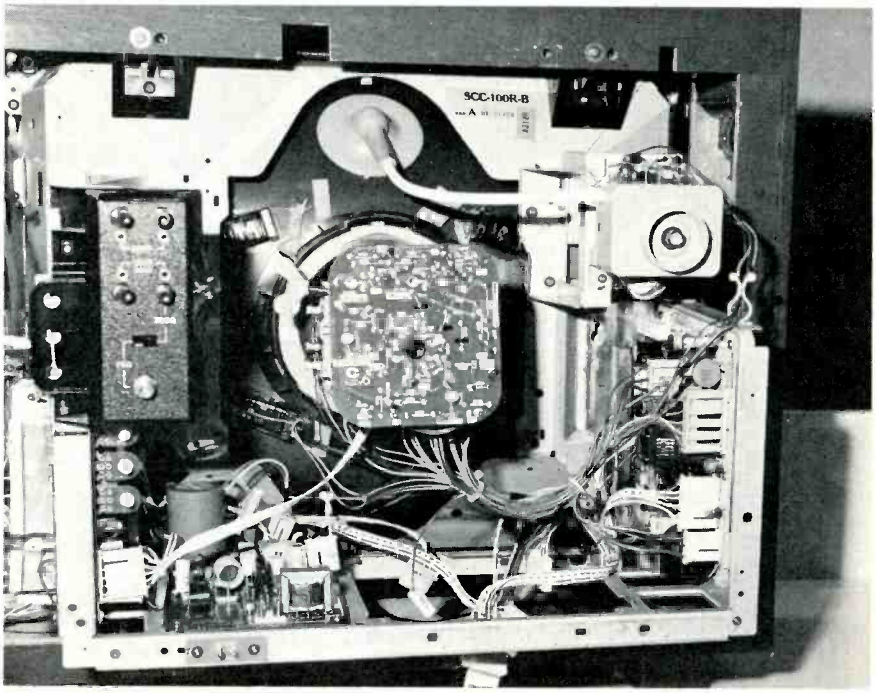


Fig. 1 The Sony "I2" chassis with one board removed. (Courtesy Sony Corporation of America)

sweep, while the smallest sets used bi-polar transistor horizontal sweep.

The "I 2" chassis

A short time ago Sony introduced the "I2" chassis similar in circuitry but with an improved mechanical layout as part of a program to upgrade serviceability of Sony television receivers. This is a modular chassis designed for accessibility: the removal of two screws, once the back is off, allows the chassis to slide out backwards into its service position. All circuit boards unplug and can be removed after the removal of two screws. This chassis is used in the remote control and the 21 in (diagonal) sets at present. Service procedures are similar to previous chassis.

The X2 and Y2 chassis

Sony's all new chassis used in the current line are designated the X2 and Y2. The X2 chassis replaces the R chassis and is used in the smaller sets with 12 and 15 inch (diagonal) Trinitrons except for the 15 inch remote control model which continues to use the R chassis. The Y2 is used in the larger sets with 17 and 19 inch Trinitrons. The actual chassis number series are SCC-171, etc., for the X2 series and SCC-174, etc., for the Y2 series. The smaller Trinitrons, apparently since length is not as much of a problem, are

90°, deflection tubes, while the larger Trinitrons are 114° tubes.

The two chassis are similar in many areas. Sony has returned to single board construction for both. The new design has reportedly resulted in a 20% reduction in components and a significant reduction in power consumption.

Electronic tuning system

The tuning system is similar for both the X2 and Y2 chassis. Both use an electronic tuning system which Sony calls express tuning. This uses a twelve pushbutton mechanically latching switch, any section of which can select any VHF or UHF channel depending upon the setting of its band select switch (Fig. 2). Each tuning network consists of the three position band select switch, a channel indicator lamp and a preset potentiometer.

VHF low-channel operation is accomplished by switching the band-select switch to L (low). The channel preset voltage from the preset control is supplied to the varactor diodes in the tuner through R111 and R112 to VHF tuner terminal VC. The AFC correction voltage is also applied to VC through R110 (Fig. 3). Current flow through R114, the neon lamp, and R101 turns on Q101 and applies 18Vdc to terminal L to power the tuner. Under these conditions Q102 is off and -12Vdc is applied to terminal H of the tuner to reverse bias switching diodes D151-D154.

VHF high-channel operation is accomplished by switching the band select to H (high). This turns on Q102, supplying voltage through D101 to terminal L to power the tuner and supply voltage to terminal H to turn on switching diodes D151-154 to switch inductances in the tuner for high channel operation.

UHF operation requires switching to U (UHF) with the band select switch. This turns on Q103 and supplies power to the UHF tuner and forward biases D155 to allow UHF tuner output to pass through the VHF tuner.

To avoid channel lockout and noise the AFT is defeated and the sound muted at turn on and during channel select (Fig. 4). When power is turned on 33vdc is applied to C120 which charges, producing a pulse at the junction of D105 and D106. The positive portion of this pulse turns on Q105 and Q106 through D106 and associated resistors. The AFT voltage which is across Q105 is thus defeated. The audio signal is connected to Q106 and is similarly muted. During channel selection the discharge of C114 produces a negative pulse which turns on Q104 to produce a positive pulse which is coupled through R121 and R125 to mute the sound and defeat the AFT as previously explained.

The video IF

The video IF circuitry of both chassis uses a new IC which contains two video IF stages, a syncronous detector, noise immunity circuitry, and AGC amplifiers.

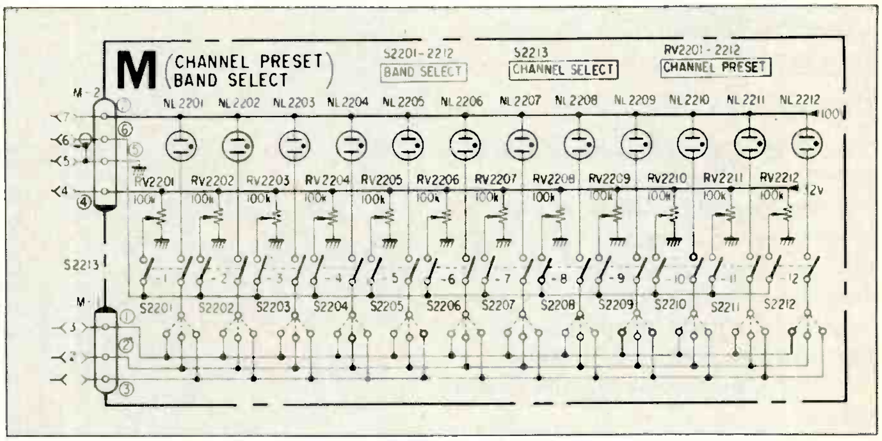


Fig. 2 Channel select panel

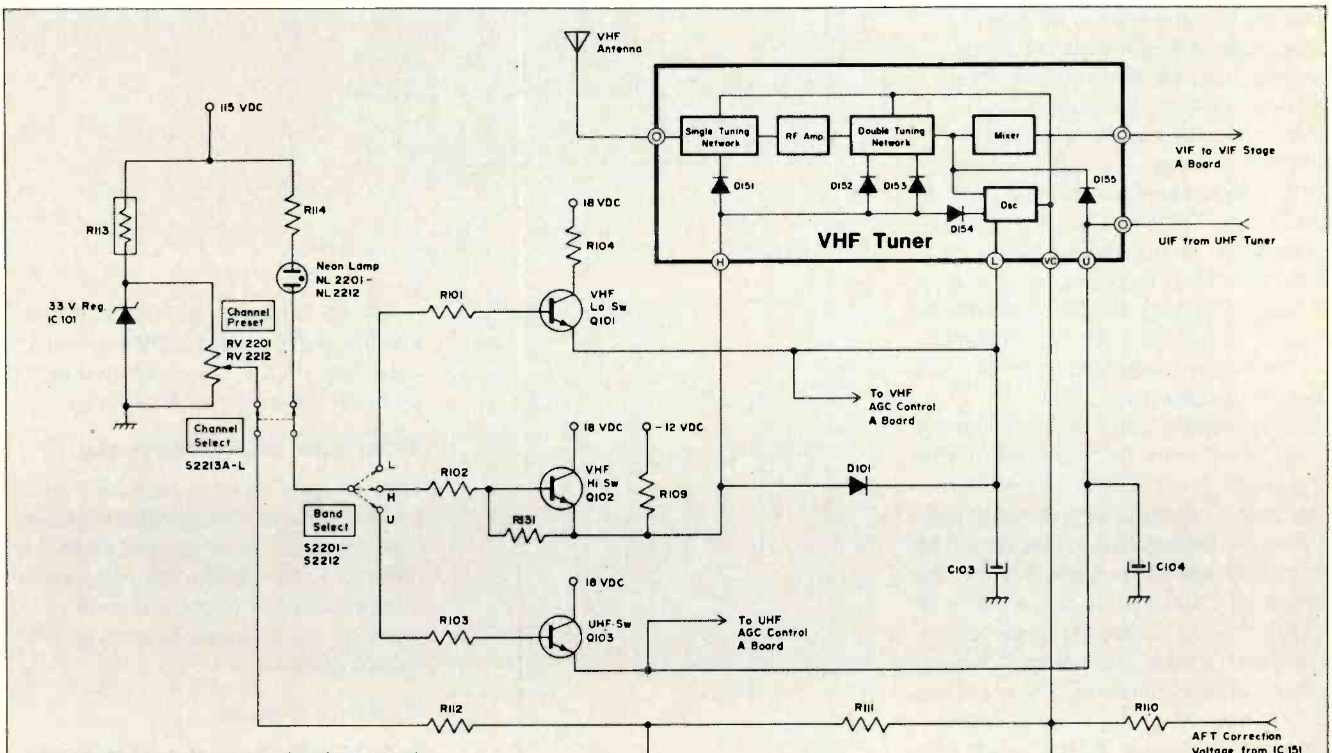


Fig. 3 Simplified schematic of electronic tuner control circuitry

The input circuitry has been redesigned and uses an encapsulated helical bandpass filter which requires no tuning.

The sync separator circuit uses two transistors connected in parallel. Sync separator 1 amplifies and separates both horizontal and vertical sync pulses. Sync separator 2 amplifies only vertical pulses to produce a more stable vertical sync particularly at low signal levels.

AFT and sound

The sound and AFT circuitry of the X2 and Y2 are nearly identical. The AFT uses an integrated circuit which contains, as is becoming common with IC's, a voltage regulator, and an IF amplifier, a discriminator, and a dc amplifier. The sound circuitry consists of an IC containing the low level stages and detector and a three transistor AF driver and output stage. There are only detail differences between the X2 and Y2 chassis audio.

Chroma

The X2 and Y2 chroma circuitry differ considerably. The X2 uses an integrated/circuit containing chroma processing and a discrete transistor video amplifier. These, in turn, drive the three output transistors. The Y2 uses two IC's for chroma and video processing to drive an CRT socket mounted output module much like that of the X2.

Sweep systems

In spite of the adoption by many manufacturers of integrated circuit, master scan oscillator, count down sweep systems, the Sony sweep systems consist of fairly standard oscillator, driver, and output ciruitry, which does seem to work very well for them. The Trinitron requires special pincushion compensation which is introduced into the yoke circuitry through a transformer in the X2 and by means of a GCS in the Y2 chassis.

The high voltage hold down circuit in the X2 chassis uses a PUT (programmable unijunction transistor), (Fig. 5). When the high voltage is normal the Q509 (the PUT), is off and the horizontal oscillator operates normally. When the flyback pulse rises sufficiently to supply approximately 8.5 vdc at the anode of Q509 it turns on and turns off Q501, the horizontal oscillator, and oscillation stops. The set must be shut off to restore operation. The shutdown circuit may be disabled for service by opening the anode of D517. The Y2 chassis uses a transistor in a similar circuit.

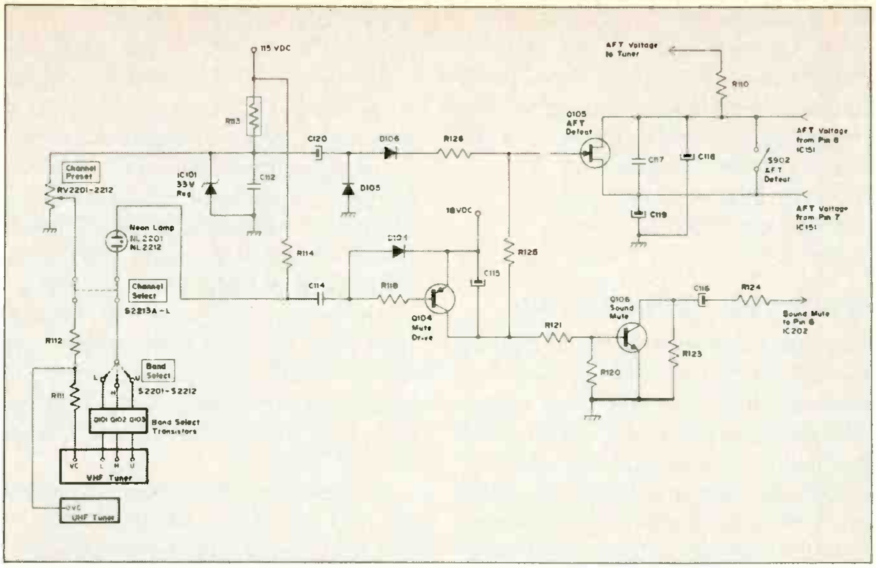


Fig. 4 Simplified schematic of AFC defeat mute circuitry.

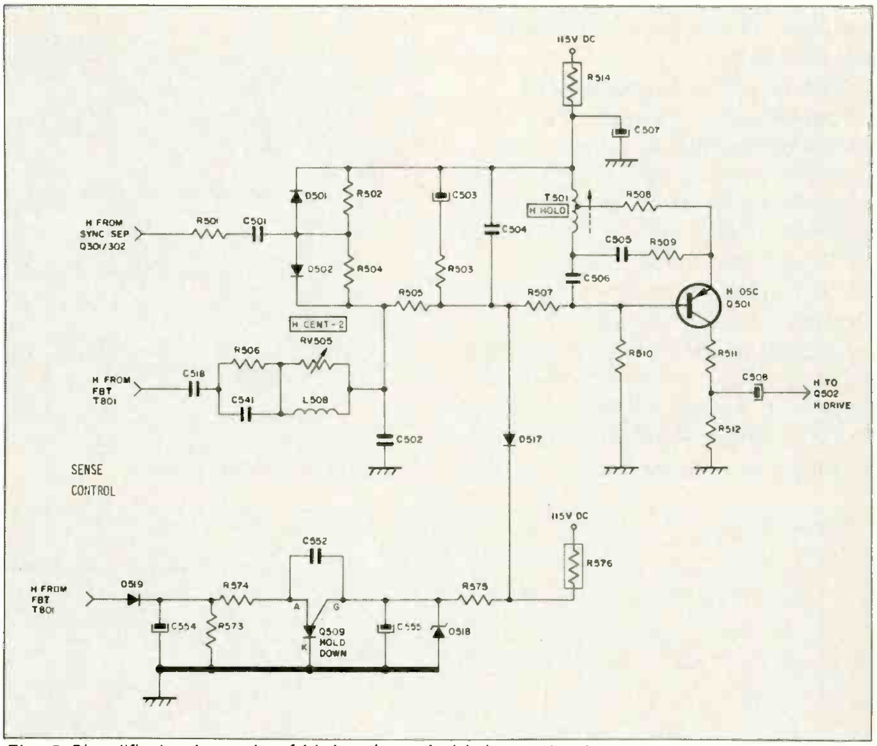


Fig. 5 Simplified schematic of high voltage hold down circuit.

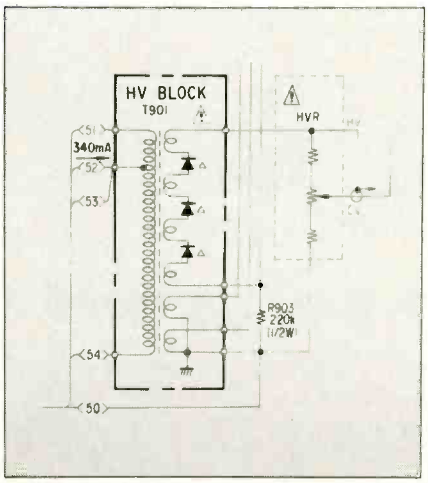


Fig. 6 Flyback transformer from Y-2 chassis.

The horizontal output transformers and the high voltage rectifiers are in one assembly (Fig. 6), as recently adopted by several other manufacturers.

Trinitron improvements

The "L" type Trinitron plus CRT has been improved. The phosphor grains have been made larger and more uniform. Sony reports this results in a 30% increase in brightness over previous Trinitrons and improves picture contrast.

Service notes

Sony reports that many of the Sony products returned to them for repair

continued on page 45

Another look at modulation

How it all happens

Some basic theory followed by practical troubleshooting hints and why the FCC is dead set against those CB linear amps.

By Bernard B. Daien

The modulation process is used for many different purposes ... in transmitters, test equipment, video tape machines, and instrumentation. Most technicians know *what* happens in the modulation process, but *why* it happens is sometimes unclear.

In servicing, when there is no modulation, the fault is easy to correct, but when modulation is not quite right, the problem becomes more difficult. This article discusses modulation in a practical way, with applications for troubleshooting.

There are many ways to modulate a signal. Amplitude modulation, using vacuum tubes, can employ plate modulation, screen modulation, grid modulation or cathode modulation. Of course there is also frequency and phase modulation, single sideband, double sideband and reduced carrier. And then there is outphasing modulation, controlled carrier, efficiency and absorption modulation. Since we cannot cover all of these, we will cover the basic collector (plate) modulation system of A.M. as a vehicle for our discussion, but there will be useful fallout for the other systems.

Some basics

The starting point is the simple sine wave, which is the only wave shape consisting of a single frequency. All other wave shapes consist of a fundamental repetitive frequency with one or more harmonics. If we put a perfect sine wave into a linear amplifier, we get a perfect sine wave in the output. If the amplifier is nonlinear, the output wave form will be distorted and contain harmonics. This is called "harmonic distortion." Furthermore, a nonlinear amplifier or device also produces a "mixing" action, so that if several different frequencies are applied to the input simultaneously, they will all mix together to produce additional sum and difference frequencies in the output.

In high fidelity and other amplifiers we term this "intermodulation distortion." We use this nonlinearity to deliberately provide mixing action ... for example, TV UHF tuners frequently employ diode mixers, since the diode accepts an input of a sine wave and converts it into half wave output ... and that is real nonlinearity!

The amplifier

This immediately makes it clear that we *cannot* use a linear amplifier as a modulated amplifier, since the modulation process consists of applying an audio (or video) frequency, and a carrier frequency, to the modulated amplifier, and getting output of the two original frequencies, plus their sum and difference due to mixing action. We want the carrier (F1), the carrier plus the modulating frequency (F1 + F2), and the carrier minus the modulating frequency (F1 − F2). F1 + F2 is the upper sideband, and F1 − F2 is the lower sideband. *Since the carrier and the sidebands are quite close together in frequency, they pass through the output tuned circuits, while the modulating frequency F2 cannot.* Oh, but I forgot ... we can't do this because we are using a linear amplifier! What kind of amplifier would be nonlinear? Class C amplifiers are not only nonlinear ... they are also very efficient. Thus we will use an amplifier biased Class C.

Where does this biasing come from? It can be a fixed bias, or it can be gridleak bias derived from the RF input signal ... or a combination of both. Suppose the bias shifts? The modulation would certainly be affected ... and since the bias is often a combination of fixed and gridleak, both the biasing network and the RF drive level can severely affect the modulation.

Since the Class C modulator operates over less than half the input RF cycle (definition of Class C operation), the output RF waveshape is also distorted, and therefore full of harmonics of the carrier frequency. These harmonics are reduced by the tuned circuit(s) in the output of the modulated amplifier, along with traps and low pass filters. Unfortunately we cannot use very sharply tuned (High Q) filters, since the tuned circuits must be broad enough to pass the upper and lower sidebands as well as the carrier ... and in the case of video modulating frequencies the circuits must be quite broad. This problem of harmonic radiation accounts for some of the government requirements for filtering of CB transceivers.

Transistors

If a transistor is used as a modulated amplifier, it becomes impossible to achieve a high percentage of modulation. This is due to the characteristics of the bipolar transistor, shown in Figure 1, which is the usual curve of collector current versus collector voltage and base current. You will note that the collector current increases when the base current increases, but for a given base current the collector current does not increase as the collector voltage increases. Since power is voltage times current, changing the voltage only, does not increase the power nearly as much as does increasing BOTH current and voltage. When we modulate a transistor amplifier by changing the collector voltage, we do

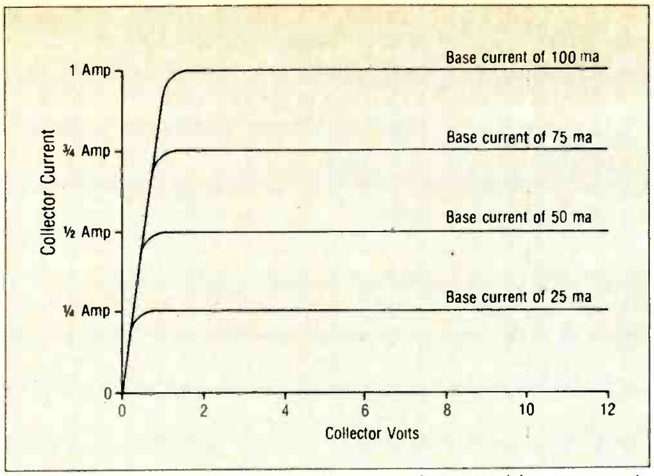


Fig. 1 Collector current versus collector voltage and base current of a silicon transistor

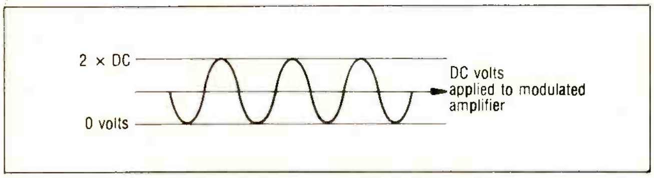


Fig. 2 AC "swing" require from modulator is twice the applied DC (peak to peak).

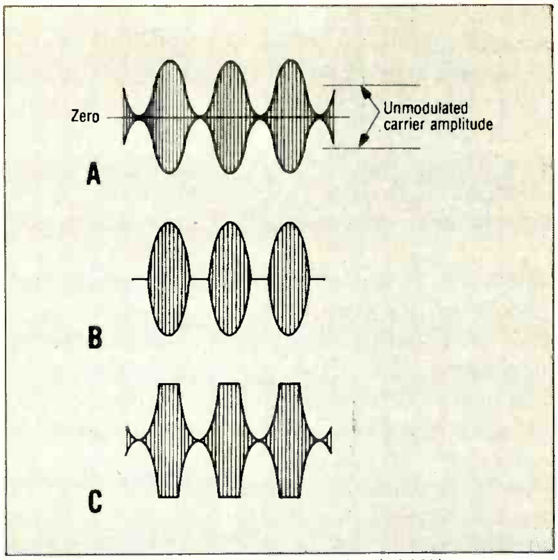


Fig. 3A Sine wave modulated carrier (100%). 3B Overmodulated carrier 3C Peak flattening due to inability of modulated amplifier to provide peak output power.

not affect the output of the modulated stage nearly so much as if we were able to swing the collector current too. This problem is solved by applying some modulation to the RF driver, which thus varies the input base current drive, and causes the collector current of the modulated stage to vary.

Those of you who have used pentode or tetrode tubes remember that this same problem existed with them. Tetrode plate current is dependent upon the grid voltage, and the screen voltage, and not markedly upon the plate voltage. Thus, when using tetrodes as modulated amplifiers it was necessary to modulate the screen voltage along with the plate in order to achieve a high percentage of modulation.

If what we have stated is true, then a diode should be capable of use as a modulator. As a matter of fact, a diode biased so that it operates class C (less than a half cycle), and fed with the output of a signal generator and video from a TV receiver, has been used to provide signals on UHF, for checking UHF tuners when the UHF stations are off the air. Of course, diodes do not provide power gain, so it is preferable to use a class C tube or transistor for most purposes.

Types of modulation

When we modulate the last stage in a transmitter, so that the modulated amplifier is the highest power stage (feeding the antenna or other load), we term it "high level modulation." Using lower power transmitters, such as CB transceivers, the system is practical because the power required from the modulator is quite small. To achieve 100% modulation, the modulator must swing the voltage input to the modulated stage down to zero, and up to twice the supply voltage. Figure 2 illustrates this. Thus the *peak* voltage required from the modulator must be equal to the supply voltage applied to the Class C modulated amplifier. Assuming sine wave modulation, the RMS value is therefore 0.7 times (70%) the supply voltage. Since power is proportional to voltage squared we get 0.7×0.7 or 0.49 (approximately 49%) of the input power to the modulated state as the required power output from the modulator. Suppose we wanted to build a 50 kilowatt broadcast transmitter ... we would need a 25 kw audio modulator, and since audio amplifiers cannot operate class C, the modulator would be less efficient than the modulated amplifier. It would require tremendous input power, the iron cored components would be very large and heavy, *not* very practical.

In such circumstances we use "low level modulation," modulating a stage operating at a low power level, and then using one or more RF amplifiers to build up the power to the desired level. Remember ... we would have to use *linear* amplifiers following the Class C modulated stage, otherwise all the frequencies would beat together, and harmonics would be generated. The result would be a useless hodgepodge of frequencies. It is very difficult to design a high power RF amplifier that is almost perfectly linear, which is why the FCC is trying to eliminate the linear amplifiers being used by many CB operators, and which cause severe interference with other services, including aircraft and navigational aid frequencies.

To sum up, the modulated amplifier must be nonlinear, while any amplifiers following the modulated amplifier must be very linear.

Direct feed

Most of the low to moderate power amplitude modulated transmitters employ high level modulation, since the modulator power requirement is modest, and linear RF amplifiers are critical. This means that the modulated amplifier directly feeds the antenna, or other load. Frequently problems in the loading cause poor modulation. Fortunately such problems are easily located with the use of a SWR (Standing Wave Ratio) device. These inexpensive instruments usually incorporate a power output meter as well. Connecting the SWR meter between the antenna output terminal of the transmitter, and the transmission line, will quickly reveal whether or not the *external* antenna system is operating properly, but it cannot tell you if the *internal* adjustments are correct or not. The power meter will tell you if the output level is adequate ... but not if the output is comprised of less fundamental and more harmonics than it should be, or if the modulation is splattering due to spurious frequencies. The only way to check if someone has "tweaked" the internal adjustments is to do an alignment in accordance with the service manual ... and unfortunately we are plagued with home brew mechanics who have inadequate training, insufficient equipment, and excessive zeal!

Misalignment and "redesign" are two problems peculiar to CB and must never be overlooked as a possible cause of modulation problems. It should be noted here that attempts to increase power output, in an effort to achieve greater range are almost entirely futile, for the following reasons. Let us assume that by some miracle the "tweaker" was able to double his power output. This would result in a 3 decibel increase in power, which translated into "R" units (Readability Units) as used by amateurs, would only raise his signal one R unit ... from very weak, to weak.

On the other hand, an effective antenna system ... say going from a short trunk mounted antenna to a larger pair of antennae, would raise his signal from weak to moderate (2 R units), at less cost ... and would provide the extra bonus of also boosting his receive range. In actuality, all such efforts to raise power output beyond the design level are generally worse than useless, and raising modulation beyond the 85% level is equally foolish, since any apparent increase in power is due to spurious frequencies generated by overmodulation. The most effective way to increase intelligibility is by means of speech compression, or limiting, and automatic volume leveling, and some form of these is usually incorporated into well designed communication systems anyway. The best and easiest way to achieve improvement is by means of better antenna systems.

Modulation problems

Modulation problems generally fall into three categories, undermodulation, overmodulation, and distorted modulation. Of course, no modulation at all is a relatively simple matter and will not be included here.

Undermodulation may be the result of insufficient audio output from the modulator. If the transmitter has a Public Address mode of operation, a quick check on the power amplifier (modulator) can be made by using it as a PA system. A better way is to disconnect the modulated amplifier(s), and substitute a resistor of the same impedance. The value of this resistor is simple, $R = \frac{E}{I}$ where E is the supply voltage to the modulated amplifier, and I is the collector current of the modulated amp. If the undistorted output of the modulator achieves 85% or more of the supply voltage, we can assume the trouble is not in the modulator. If some form of limiting is used in the audio amplifier preceding the modulator, distortion may occur on peaks, but this can be avoided by injecting the test signal into the input to the modulator itself. Of course, we are talking about the modulator output taken from the modulation transformer output.

Use your scope

Troubles in the speech amplifier and limiter are not properly modulation problems, and should pose no trouble for the technician. Assuming the modulator is capable of sufficient output, and also that all supply voltages have been checked, it is still advisable to look at the supply voltages on a scope during modulation.

The reason is that all power sources have series impedance in the filter chokes, dropping resistors, and leakage reactance in power transformers. Even battery operated systems have problems with ground resistance, wiring drops, etc. During modulation relatively high current peaks are drawn. Assuming peaks of four amperes, one ohm of effective resistance will cause a four volt drop on a 12 volt supply line! To prevent this, many transmitters employ large filter capacitors in the unit itself, which establishes a low impedance for voice frequencies. These capacitors are subject to hard use in the environmental conditions imposed by mobile service, and tend to deteriorate. Reduced filter capacitance means that the supply voltage will fluctuate, dropping on current peaks, even though the average DC read on a multimeter may look good. The result is poor modulation.

Another cause of undermodulation is improper antenna loading on a high level modulated amplifier. While the SWR meter will show if the EXTERNAL antenna system is tuned right, it cannot show if the internal antenna tuning and loading adjustments are right. Realignment in accordance with the service manual should correct this.

Check the drivers

The drive from the RF driver must be of the correct level in order to achieve proper Class C operation as previously discussed. Thus defects in the driver, or in the driver tuneup adjustments can drastically affect modulation, while not noticeably causing other symptoms.

If there is some point available for monitoring the current drawn by the modulated Class C amplifier, it can be used in troubleshooting. One point possible is the voltage drop across an emitter resistor, another the drop across a decoupling resistor ... or you may just have to open the circuit at the modulation transformer. During normal modulation, there should be no change in the current drawn by the modulated amplifier (assuming a 1000 Hz sine wave). This occurs because the carrier increase on modulation peaks is exactly equal to the carrier decrease on modulation valleys.

At 100% modulation, you will recall, the carrier just goes to zero, and upwards to twice the unmodulated amplitude. If operating conditions are not correct, the carrier may try to go below zero, and be cut off for some period of time. During this interval the modulated amplifier is cut off, so there is a noticeable drop in current drawn. This condition is called "Negative carrier shift" and is positive proof of modulation problems. On the other hand, if the modulated amplifier is unable to deliver full peak power, the peaks will flatten, and again there will be a change in current drawn. These conditions are shown in Figure 3. Remember, a properly operating modulated amplifier shows no change in current drawn during modulation, as compared to the current drawn with no modulation ... because with sine wave modulation the modulation is symmetrical ... i.e., the upwards and downwards changes are equal and opposite, and cancel each other.

Dummy load

A useful device is a good dummy load. If the transmitter modulates OK with the dummy load, but not with the antenna system, you can be sure something is wrong with that particular antenna hookup ... perhaps grounding. The dummy load also provides a good indication of true output if it has an output power meter built in.

Defective components can always cause problems, and we are aware of this, but substitute parts sometimes just don't operate properly, and this is very true in the case of the modulated amplifier. It is advisable to use manufacturers' recommended replacements. Lead dress is also critical, and often the lead lengths are part of the tuned circuits. If leads are changed in length or position, instability may result, and tuneup may be impossible. Always suspect the possibility of "home brew" repairs, with lack of skill and instrumentation! This is more prevalent in working with transmitters than it was when working with TV sets.

If the transmitter frequency runs out of tolerance, the signal will be distorted due to improper tuning when received on a fixed tuned receiver. Changes in the transistors, or crystals, in crystal oscillators shift the frequency, but it is a less known fact that such a simple thing as replacing a defective biasing resistor can do the same thing. Resistor tolerances can cause a shift in collector current, which changes the internal capacitance of the oscillator transistor, shifting the frequency. And different resistors have different capacitances too.

Other applications

Although we usually think of modulation as used in transmitters, the process has widespread use in industry, and in test gear. For example, it is very difficult to amplify very small DC voltages. We would have to use a chain of direct coupled amplifiers. Now suppose the supply voltage to these DC amplifiers varied ... the changing dc supply could easily be larger than the signal, and completely mask it. And then we have DC drift due to time and temperature, etc., all masking out the signal.

Finally, DC amplifiers have design problems in that the collector of one stage has to be coupled to the base of the next, and these voltages are not compatible ... so we have to add voltage level shifters between stages, or inverters, and the whole design gets sticky. We solve this by "chopping" the DC into a square wave, which can then be amplified with great precision by operational amplifiers. If we choose to chop, at say 1000 Hz, we can even use tuned filters to remove all other frequencies (including most noise), thus we have arrived at a 1000 Hz amplifier, which is capable of handling microvolt signals! Of course this was made possible by "modulating" the DC. Yes, chopping is a form of modulation, with the chopping frequency the carrier, and the DC level the modulation. ET/D

Bernard B. Daien is a B.S.E.E., C.E.T., and holds an FCC 1st Class Radio Telephone License.

JVC's high density audio video disc system

A new technology

ET/D takes a look at a new consumer electronics technology that is sitting just over the horizon.

The Victor Company of Japan (JVC) recently unveiled its new video/audio high density disc system based on a laser beam recording technique which is not yet generally available commercially. It is a groveless, capacitive pick-up technique developed by JVC which—when connected to an ordinary color television receiver is capable of playing a 12-inch groveless plastic disc.

According to JVC, the disc is capable of storing one hour of information on each side and may be used, as mentioned previously, to feed an ordinary color TV receiver or it can be used to play "super hi-fi" digitally recorded pulse code modulated discs (PCM).

The system is capable of reproducing luminance and chrominance bandwidths of 3.1MHz and .5Mhz respectively with greater than 230 lines of horizontal resolution, according to the company. In the audio mode the bandwidth extends from 1Hz to 20Khz.

Here, as a first look at this new technology, is the description furnished by JVC of its new disc system.

Disc

The disc is designed to record multiple pits on its smooth, flat surface. Although the information pits are recorded spirally, the tracking pits between them permit a linear playback signal. The information pits produce either video and audio signals or only audio signals, and the tracking pits precisely control the stylus tracing along the information pits.

Stylus control

The most important feature of the VHD/AHD, according to JVC, is the control of the stylus along the disc surface to cause the stylus to trace a single track and to perform variable or random access playback, it must slide along a smooth, flat disc surface.

Figure 2 shows the method of controlling the stylus. It is mounted on the end of a cantilever pick-up arm opposite to the end on which the magnet is mounted. Fixed coils are mounted near the magnet; a single coil is wound around but not in contact with the magnet, and a pair of vertical coils are mounted, one on either side of the single coil. They are in phase opposition to each other.

Thus, the stylus can move transversely and longitudinally in response to the particular current flowing in these coils. The current is varied by the tracking error signal, by the time base error signal, or by a command to move the stylus to a desired track, permitting various functions during playback, including stop action and search.

Recording

Recording is performed using a master disc made of glass by means of a special recording device installed in a clean room. The smooth, flat glass disc is coated with ordinary photosensitive material. While rotating

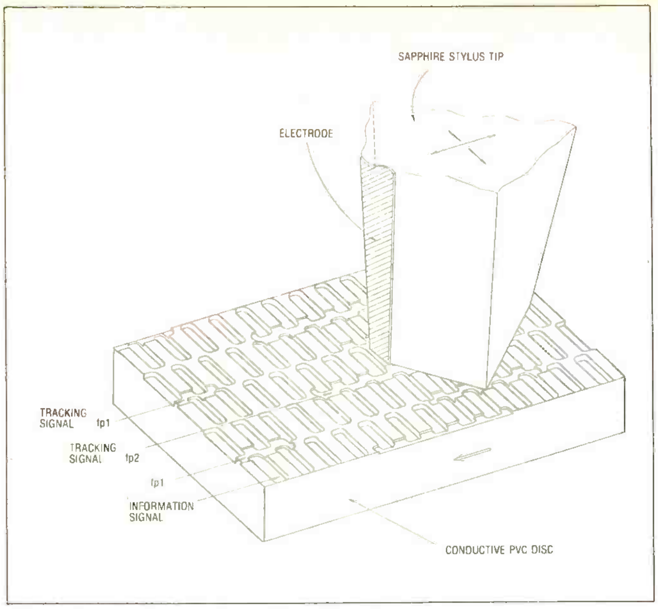


Fig. 1 Information and tracking signals are recorded on the disc surface as fine pits.

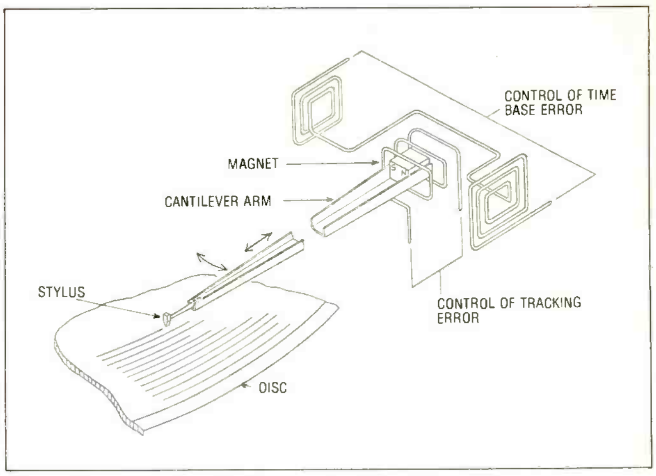


Fig. 2 Diagram showing the electro tracking system.

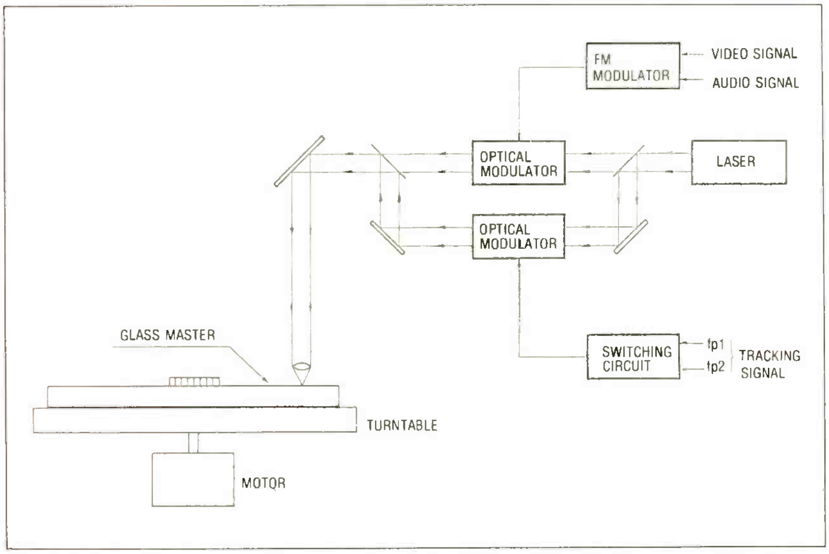


Fig. 3 Information and tracking signals are recorded optically and are carried to their destination via split beam laser.

Specification

VIDEO	
Signal modulation	Single Carrier FM Format
Luminance bandwidth	3.1 MHz
Chroma Bandwidth	0.5 MHz
Horizontal Resolution	> 230 lines
Video S/N Ratio	> 40 dB
Audio Signal	2 Channels
Audio Bandwidth	20 KHz
Audio S/N Ratio	> 60 dB
AUDIO (PCM)	
Number of channels	2
Audio Bandwidth	1 HZ 20KHz (± 0.5 dB)
Harmonic Distortion	less 0.05%
Dynamic Range	> 90 dB
Wow-flutter	range of crystal
Sampling Frequency	44 056 KHz
Quantization (Recording)	14 bits
Error Correction	V-Format
Recording Method	FM Format

at a speed of 900 rpm, minute laser beams are irradiated onto the disc, the source of the beams being moved radially at a constant speed.

As a result, as shown in figure 1, fine pits are recorded spirally on the glass disc.

The laser beam is actually split in two, one half for the information signals, the other for the tracking signals. The information and tracking pits are recorded simultaneously by these beams. A metallic master disc is then produced from the glass master by the conventional process.

Playback

Several combinations of the player and auxiliary units provide different video and audio functions. In the case of video operation (VHD), Normal (back and forth), Special Effects (still, slow, quick motion: back and forth) and Fast Search (back and forth) modes are performed by the player itself. The system is capable of locating a preselected single track so that recorded materials can be played back automatically in preprogrammed order by the user, including special effect modes as mentioned.

In the case of audio operation (AHD), digitally recorded stereo music can be enjoyed by connecting the PCM decoder to the player. In conjunction with a random access unit, the system plays music recorded on the disc, automatically searching programs preselected by a user. Wireless control of the random access unit by a remote controller is also available for use with the system.

Signal pickup

Information and tracking signals are simultaneously picked up electronically as capacitance variations between the disc surface and an electrode on the tracking stylus.

The cantilever arm which holds the stylus is servo-controlled to track the imaginary grooves on the disc and to correct for the time base error of the disc by an electro-tracking system.

There are no actual mechanical grooves on the disc's surface. Instead, the stylus slides along the surface and is guided electronically to pick up the recorded signals. This feature enables the pick-up arm to move freely over the entire surface of the disc, and permits the special effects such as random access, still, slow and quick motion to be achieved. ETI/D

BULLETIN BOARD

"How to Repair Video Games" is the title of a new TAB book authored by Goodman. It covers basic digital troubleshooting techniques and home pinball machines, as well as video games. Games covered are those by Radio Shack, Magnavox, RCA and Atari and the families of games which use the game microporcessors made by General Instrument and Texas Instruments, and the video game system developed by National Semiconductor. The book is very well illustrated with schematics, layouts, service adjustment locations, and timing diagrams and voltage charts. "How to Repair Video Games," by Goodman, paper $7.95. from TAB BOOKS, Blue Ridge Summit, PA 17214.

A brochure describing communications accessories and filters is now available from *J. W. Miller.* The four page pamphlet describes the CN-720 direct, simultaneous reading SWR, forward power, reflected power meter, the Moden RF-440 speech processor, models CS-201 and CS-401 coaxial switches and a line of high-pass, low-pass and audio and ac line filters. For a free copy or more information contact Jerry Hall, Operations Manager, J.W. Miller Division, Bell Industries, 19070 Reyes Ave., Compton, CA 90224.

A new CATV Coaxial Cable Guide has just been published by *Belden*. This 20-page catalogue lists over 60 styles of 59/U-type and 6/U type drop cables, converter and accessory cables. Physical specifications include various shielding methods and suggestions for matching them to the cable environment. Electrical ratings including complete attenuation ratings are given. An excellent explanation of the methods used to analyze shielding effectiveness is given. For a copy of the guide, Publication EL 10-78 write Manager, Marketing Communications, Belden Corp., 2000 Batavia Ave., Geneva, IL 60134.

A new full color CB Antenna product catalog has recently been announced by *Pal Antenna Corp.* It features a series of fiberglass rod top loaded CB Antennas for marine, RV, automobile, truck, van, or motorcycle and a wide variety of mounting hardware, brackets, quick disconnects, cables and springs. It includes information on CB base and commercial/ham VHF antennas. Copies are available free of charge from Pal Antenna Corp., 2614 E. Adams, Phoenix, AZ 85034.

The new fifth edition of "FM Atlas and Station Directory" contains a comprehensive listing of the FM stations of North America. The book's maps show cities with FM Stations, their call letters and frequencies. Station directories are arranged by geographical area and frequency and give station format, network, coverage, whether the stations are stereo, Dolby, have vertical polarization or have SCA subcarrier. Geographic primary and secondary coverage in miles is also listed. This 112-page atlas is available from *FM Atlas Publishing Co.*, Adolph, MN 55701. The cost is $3.95 post paid.

A new catalog, 4800, of panel meters, and test equipment has recently been published by *Simpson Electric Company*. It covers an exceptionally wide range of panel meters; voltmeters, millammeters, elapsed time meters, frequency meters, pyrometers, controllers and meter relays; digital and analog test equipment from the latest version of the old-faithful Model 260 to insulation testers, noise level meters and digital voltmeters and counters; and oscilloscopes, color television pattern generators and chart recorders. It also offers accessories such as probes, leads, and cases. Copies are available free from Simpson distributors, or: Simpson Electric Company, 853 Dundee Ave., Elgin, IL 60120.

A wire and cable products catalog has recently been released by *Remee Products Corp.* The catalog covers a broad line of coaxial cables, rotor cables, twin lead, speaker cables, multi-conductor cables, and alarm system cables. Their pricing structure is reportedly advantageous to OEM's, installers and security distributors. The catalog can be obtained by contacting Remee Products/ Wire and Cable Division, 41 Bridge St., Florida, NY 10921. ET/D

in the Public Schools.

Now it's readin', 'ritin'... and training through television.

Educators in Montgomery County, Maryland, believe strongly in the effectiveness of television as a classroom teaching tool. Each of the County's 186 schools is equipped with a TV distribution system for both off-the-air and closed-circuit programming.

Though the school system does not have over-the-air broadcasting facilities, it does have a complete studio with commercial quality color cameras, lighting and props. General and custom-tailored classroom programs are produced there on 1-inch video tape, then reproduced on ½-inch reel-to-reel and video cassettes for distribution to the schools.

There are several schools that have TV studio facilities, too, for producing their own black and white closed circuit programs. Interested students are trained in various phases of television production, and many go on to careers in the TV industry.

A few years ago, the Maryland public broadcasting network began transmitting on UHF channel 22. Few of the Montgomery County schools were equipped for adequate reception of this important educational channel, so the decision was made to begin modernizing the antenna systems. MATV contractor, Don Morar, of Woodbine, Maryland, was awarded the bid. To assure meeting reception specifications, Morar selected various combinations of Winegard antennas and preamplifiers to fit each reception location. A favorite combination Morar uses for difficult UHF reception areas is Winegard's CH-9095 antenna with an AC-4990 preamp. *"I have found this setup does an excellent job,"* Morar said, *"and as we all know, nobody makes a more reliable antenna preamplifier than Winegard."*

It is interesting to note that more and more educators are using TV as a positive influence and valuable aid at all levels of education within our nation's school systems. And Winegard reception products are at work to help them achieve better education from coast to coast.

Don Morar, MATV Contractor

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Circle No. 129 on Reader Inquiry Card

TEST INSTRUMENT REPORT

The Gould OS255 is an excellent example of what has perhaps become the standard general purpose oscilloscope; a 15Mhz dual trace instrument. However, even while using a full 8 × 10cm display CRT, it is small enough, 5¼ × 12 × 16½ in., and light enough, 15 lbs., to be very conveniently portable.

The display modes include single

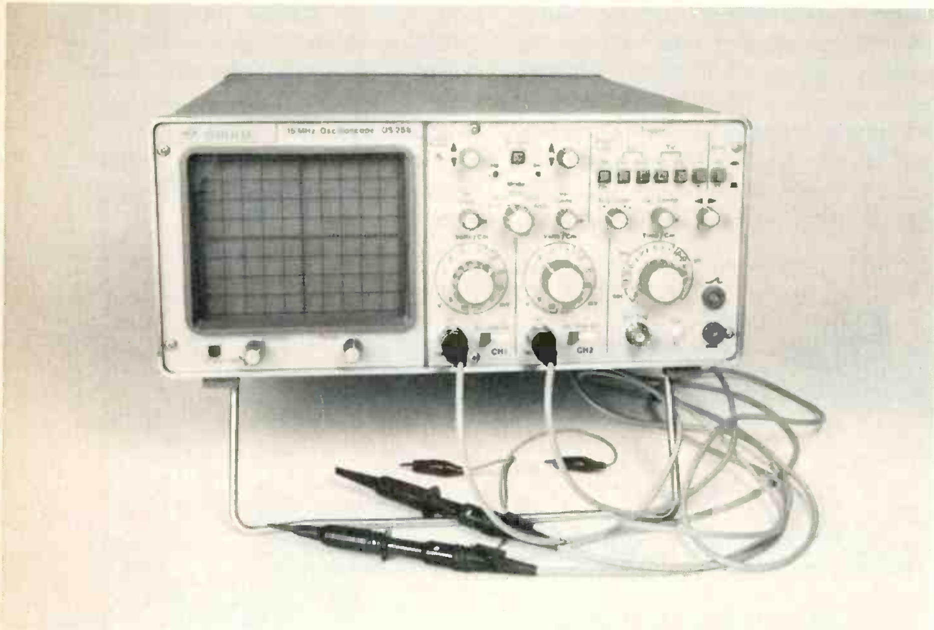


Fig. 1 The Gould OS255 Oscilloscope Circle number 150 Reader Service Card for more information.

The Gould OS255 dual trace oscilloscope

Full featured yet portable

By Walter H. Schwartz

trace from either channel 1 or channel 2, dual trace, either chopped or alternate, the mode switches by means of the time base switch between .5 and 2ms/cm, and X-Y which permits the use of the OS255 as a vectorscope for color demodulator, amplifier servicing. Additionally, channels 1 and 2 can be added algebraically and with channel 2 inverted algebraically subtracted. The inverted channel 2 also simplifies comparison of 180° out of phase waveforms.

Sweep speed is switchable in 18 ranges from .2sec/cm to .5µsec/cm with ×5 expansion available. The variable control can slow each range by 2.5 to 1, allowing a slowest sweep speed of .5sec/cm. The trigger system includes an active sync separator for TV work, plus or minus slope selection, and a bright line feature which allows the sweep to free run, in the absence of sufficient trigger signal, for ease in locating the trace.

Opening the case shows how the OS255 can be as light in weight as it is. (See Fig. 2.) Since the entire instrument draws a rated 40VA, the power transformer is small and light. The only other large component in the instrument is the CRT. The major portion of the OS255's circuitry is contained on one large circuit board with the input attenuators and time base switch on another, smaller board. Integrated circuits appear to perform most of the functions in the trigger and sweep circuits, notably, these plug into sockets. Good circuit board component identification and a very complete manual should make maintainence and any necessary service straight forward.

The OS255 is easy to use, as any good test instrument should be. Control layout is convenient; triggering is satisfactory; input protection limits the user to 400Vdc, ac peak, or sum, so care is necessary. A viewing hood, an available accessory, is very useful, indeed really necessary in brightly lighted rooms. The probes are easy to handle but the hook tips are too large to get between a half-watt resistor lead and a circuit board.

The price of the Gould OS255 is $795, including probes and a 2-year warranty.

Specifications

DISPLAY
8 × 10cm rectangular mono-acceleration CRT at 2kv, trace rotation by front panel reset.

VERTICAL DEFLECTION
Two identical input channels.
Bandwith (-3dB); dc to 15Mhz (2hz to 15Mhz on ac).
Sensitivity: 2mV/cm to /10Vcm in 1-2-5 squence.
Accuracy: ±5%
Variable Sensitivity: 2.5:1 range allows continous adjustment of sensitivity from 2mV/cm to 25V/cm.

DISPLAY MODES
Single Trace: CH1 or CH2
Dual Trace: Chopped or alternate modes automatically selected by the TB switch between 0.5 and 0.2 µsec/cm. Chop frequency 500Khz.
Add: CH1 and CH2 added to give the algebraic sum of the two channels.
Invert CH2: CH2 may be inverted. When used in conjunction with add mode, it giues the algebraic difference of the two channels.
X-Y: CH1 input gives Y deflection and CH2 input gives X deflection. Bandwidth (-3dB) dc to 1Mhz with less than 3° phase shift at 50Khz.

HORIZONTAL DEFLECTION
Timebase: 0.5µsec/cm to 0.2sec/cm, 18 ranges in 1-2-5 sequence.
Accuracy: ±%
X Expansion: X5 pushbutton gives fastest speed of 100ns/cm, with no loss of accuracy.
Variable Sweep: 2.5:1 allows continuous coverage from 0.5µsec/cm to 0.5sec/cm.

TRIGGER
Variable level control with bright line off/on facility, with bright line on, the time base free
continued on page 45

DEALER'S SHOWCASE

Wireless Extension Telephone

Circle No. 140 on Reader Inquiry Card

A remote extension telephone has just been announced by *Pathcom*, Inc. The Pace "Ez phone" is a wireless extension telephone resembling the hand set of a Trimline telephone. The base unit also functions as a charger for the remote. The Ez phone operates unlicensed, in two ranges—1.6 to 1.8Mhz and 49.8 to 49.9 Mhz, because of its low transmitter power. The base unit can be used with either dial or touchtone systems while separate remote handsets are made for the two different systems; the touch tone pad on the dial unit sends rotary dial pulses to the base unit.

Operating range is about 300 feet and the remote will ring even with the antenna collapsed.

The suggested list price is $169.96 per unit: model 8502 dial system remote; model 8503 touchtone remote; 8510 base unit.

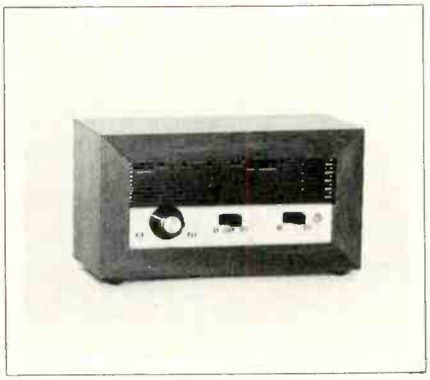
Business Band Radio

Circle No. 141 on Reader Inquiry Card

A unique, frequency synthesized, business band transceiver, capable of operation on two simplex channels or one semi-duplex channel in the VHF high band without crystals has recently been announced by *GENAVE* (General Aviation Electronics Inc.). Called the Syn Com, it can be set up on one frequency and then changed to another frequency and retuned without changing crystals, making it ideal for short term lease or loan. The power output is rated at 25 watts. The transceiver has a panel size of 3 3/8 x 4 3/4 in. x 12 in. deep and weighs 6 lbs. The special introductory price is $495.00.

Sound Detection Alarm System

Circle No. 142 on Reader Inquiry Card

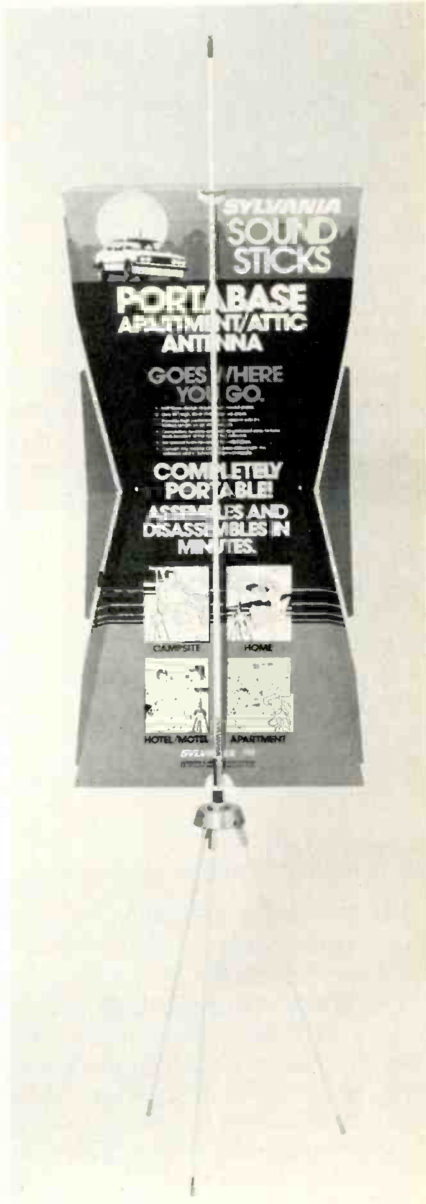


Micro-Mag by *Magnum Products* is a new crime deterent system which detects sounds associated with breaking and entering and sounds a horn and turns on a light in the trouble area. The system simply plugs into a 120V outlet (12V models are available) and is then adjusted to proper sensitivity for the area and acoustics. The cost is less than $250.00.

U.S. Made CB Radio

Circle No. 143 on Reader Inquiry Card

Pace has announced the early fall availability of a new domestically manufactured CB transceiver, the Model 8016. The manufacturer states that this radio uses the very latest state-of-the-art large-scale integration (LSI) semiconductor technology for high efficiency in a small space. Reportedly it far exceeds Federal Communications Commission minimum specifications and has far greater interference rejection than comparable transceivers. Features include a built-in power microphone, automatic noise limiter and LED channel readout. It measures 7¼ in. wide by 2⅜ in. high by 5¼ long. The manufacturers suggested retail price is $99.95.



CB Antenna Display

Circle No. 144 on Reader Inquiry Card

A new Sylvania CB Antenna and a display which uses the assembled antenna as a stand have been recently announced by *General Telephone and Electronics*. The Model SYL-AA antenna, a top loading 64 in. fiberglass portable unit can be set up in an attic or an apartment, and reportedly assembled and disassembled in minutes. The display is a 16 by 33 in. full color display card for floor or counter. ET/D

NEW PRODUCTS

Communications Service Monitor

Circle No. 151 on Reader Inquiry Card

The new BR-1000 Communications Monitor is now available from *Com-Ser Laboratories*. According to specifications the BR-1000 measures frequency from 10kHz to 1000 MHz with 1ppm accuracy, supplies a CW or AM or FM signal at levels from 1 µV to 10mV and sweep up to plus or minus 1MHz from center frequency. Frequency setting is quickly accomplished with telephone type push buttons, except for the last two digits which then allow the operation to move the frequency up or down in 100Hz steps. The price is $3500.00.

Digital Multimeters

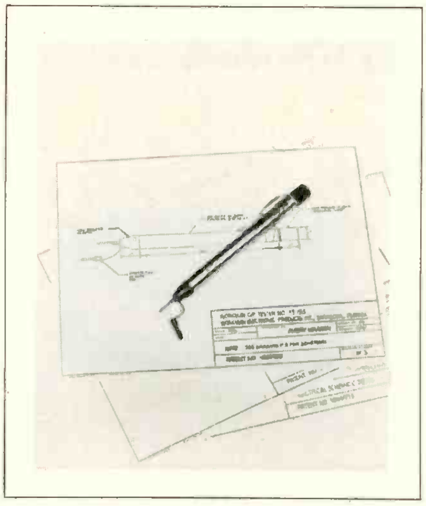
Circle No. 152 on Reader Inquiry Card

Two new digital bench/portable multimeters have recently been introduced by *Fluke*. Models 8010A and 8012A are 3½ digit instruments with LCD readouts and a Fluke-manufactured thick-film hybrid True RMS converter with 50 kHz response for ac measurements. Both can effectively measure resistance to 10,000 megohms; The 8012A substitutes 2 and 20 ohm ranges for the standard high current ranges giving it the capability of measuring resistance down

to 1 miliohm. The accuracy is reportedly .1% on dc and the instruments will hold this accuracy for at least one year. Both the 8010A and the 8012A are protected against transients to 6000V and against voltages up to 600V (400vRMS) applied to the current terminals. The prices are $239 for the 8010A and $299 for the 8012A.

Probe Multitester

Circle No. 153 on Reader Inquiry Card



A probe multitester has been developed and patented by *Workman Electronic Products*. The New CVP Multitester (Model 33-133), reportedly can be used for continuity, voltage and polarity testing, to check for floating grounds, capacity leakage, and can check fuses, ac line voltage and determine ac neutral. It was stated that it can be used for logic checking and checking circuit boards.

Portable DMM

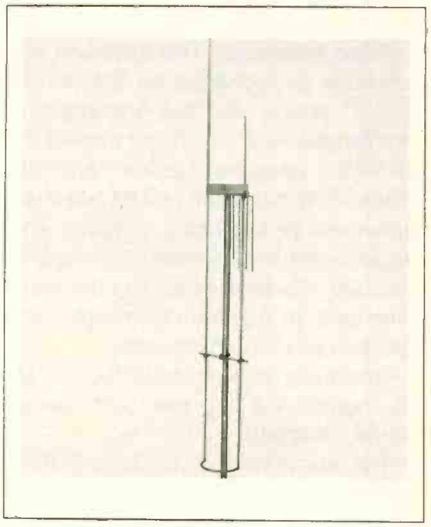
Circle No. 154 on Reader Inquiry Card

Simpson Electric Company has recently introduced a compact, portable, digital multimeter, the Model 463, a 3½ digit LCD instrument with 26 ranges. The low current LCD readout and all LSI circuitry permit up to 200 hours of continuous operation on a 9V alkaline "transistor" battery. The Model 463 has 5 dc volt ranges to 1kV, 5 ac volt ranges to 750V, 6 resistance ranges to 20 megohms and 5 each ac and dc current ranges to 2000 mA. Dc accuracy is reportedly 0.2% and ac response extends to 20kHz. All ranges have transient and overload protection. It weighs 1 lb. and comes complete with battery, test leads and manual for $170. Optional accessories are RF and 40KV probes, ac clamp on adapter and carrying case.

Monitor Antenna

Circle No. 155 on Reader Inquiry Card

Avanti Research & Development, Inc. has announced a new tri-band base monitor antenna using the patented Astro Plane design. This design features exceptional gain across the entire tri-band spectrum; 4.4 dBi on HF, 2.1 dBi on VHF and 3.3 dBi on UHF according to Avanti engineers who state also that it is light weight, easy to install, durable, and has low wind resistance.



Pastic Parts Bin

Circle No. 156 on Reader Inquiry Card

Kole Enterprises has applied manufacturing processes similar to those used to produce fiberboard bins to corrugated polypropylene plastic. This reportedly produces an exceptionally strong bin, washable, and resistant to mold, bac-

B&K PRECISION OSCILLOSCOPES

Model 1432-P
New 15MHz portable 3" dual-trace scope
• 15MHz bandwidth with smooth roll-off, usable response extends beyond 30MHz • 2mV/div vertical sensitivity • Operates on 117VAC, 234 VAC, 12VDC or optional internal battery pack • Fully regulated high and low-voltage supplies

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• 24nSEC rise time permits display of high-speed square wave pulses • Dual trace display • Individual vertical sensitivity and positioning controls • Large 8 x 10cm viewing area

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• Usable deflection to 15MHz • 35nSEC rise time permits accurate display of high-speed square wave pulses • Large 8 x 10cm rectangular viewing area • Front panel Vectorscope operation with matched sensitivity inputs • TTL compatible intensity modulation (Z-axis) input

1403A-P
3" -5MHz Solid State Oscilloscope
• High sensitivity • CB modulation monitor • Ultra compact and lightweight (weighs only 8½ lbs) goes anywhere • Vertical sensitivity 10mV division • New high brightness CRT and smoked glass graticule

1474-P
Dual-Trace 5" -30MHz Triggered Scope
• 11.7 nS rise time • 30 MHz dual trace operation • Internal signal delay line • 21 position sweep switch

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• Cuts troubleshooting time in half • Provides signal substitution for the entire range of signals present in any TV set, black-and-white or color • Horizontal and vertical drive for solid state and tube type circuits • Audio output • Built-in scanner for test-pattern slides (supplied) or any 3 x 4" positive transparency • High-voltage indication • 8 VHF channels... all UHF channels 14-83

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Model 1248
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Circle No. 115 on Reader Inquiry Card

For cost effective capacitance measurement

One C-meter stands out of the darkness— the $130 B&K-PRECISION 820

For about one-third the cost of the most popular digital capacitance meter, you can own five times more measurement capability. The new B&K-PRECISION 820 reads from 0.1pF all the way to 1 Farad, in ten ranges. With 0.5% accuracy, the 820 resolves to 0.1pF for a maximum count of 9999.

The 820 retains its high accuracy in freezing cold to blistering 100 degree heat, making it ideal for field use. The bright LED display is easily readable under all lighting conditions. It has the versatility needed for any application and the durability to stay on the job. The 820 can be powered by disposable batteries or optional rechargeable batteries.

Unlike many specialized instruments, the 820 has almost unlimited applications in engineering, production line work, QC, education and field service. First time users are quickly discovering that the number of time-saving applications exceed their original expectations. For example, you can measure unmarked capacitors...Verify capacitor tolerance ...Measure cable capacitance...Select and match capacitors for critical circuit applications...Sample production components for quality assurance...Measure capacitance of complex series-parallel capacitor networks...Set trimmer capacitors to specific amounts of capacity...Check capacitance in switches and other components.

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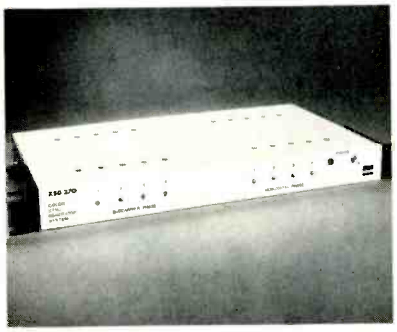
Circle No. 107 on Reader Inquiry Card

teria, harsh chemicals, solvents and moisture. Kole states they are available in ten sizes to fit standard shelving. Free samples and a catalog are available.

Sync Generator

Circle No. 157 on Reader Inquiry Card

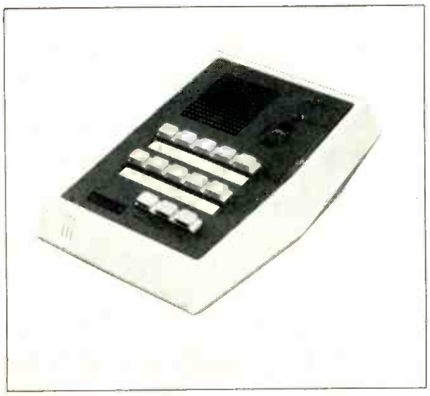
Sharp Electronics Corporation, Professional Products Department has introduced a sync generator system, Model XSG-370, which is capable of driving five independent cameras, according to the manufacturer. The XSG-370 has four subcarrier and four horizontal outputs, all independently phase adjustable. The horizontal outputs can be either sync or horizontal drive to allow the system to drive all kinds of cameras with external drive capability.

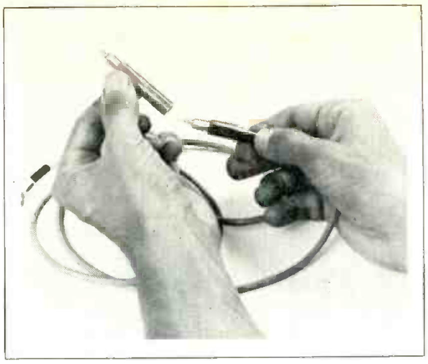


Intercom System

Circle No. 158 on Reader Inquiry Card

A new *Bogen* intercom, the IP series offers several convenience and privacy features. Bogen describes the IP master stations as having the capability of locking out eavesdroppers and interruptions, hands free answering, and a separate dedicated remote station. The IP master has a locked-station warning which sounds after 60 seconds, if not released at the end of a conversation and LED indicators, to indicate when the system is busy. The IP-11 allows up to 11 masters in a system, and the IP-6 allows up to six.





Universal Scope Probe

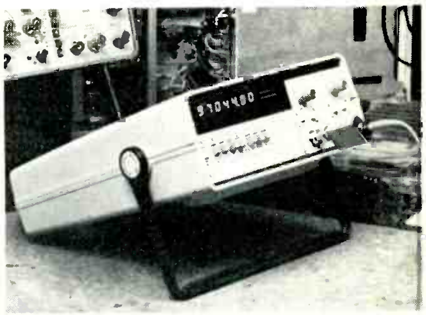
Circle No. 159 on Reader Inquiry Card

VIZ has introduced a new flexible, modular, probe system, rated to 100MHz, for oscilloscopes and frequency counters. The W6-478 probe system includes a direct probe with a BNC connector, a ×10 low capacity adapter tip, a compensation module, male and female BNC connectors, a hook or probe element, ground clip assembly and isolation boots. To change to low capacity from direct, the low capacitance X10 module is screwed to the probe tip and the compensation module is inserted between the scope and the probe cable. The cost is $39.00, a demodulator tip is $9.00, and an optional BNC probe is $6.00.

Universal Counter

Circle No. 160 on Reader Inquiry Card

The New Model 5314A Universal Counter from *Hewlett-Packard* has a range of features the manufacturer states are generally not found on counters costing twice as much. It measures frequencies to 100 MHz, period to 400 nanoseconds with 100 picosecond resolution, and time interval. Pulse width, time between events and logic timing can be measured to a resolution of 100 nanoseconds. The 5314A has a seven digit display, and trigger levels and slope controls for both channels. The 5314 A's U.S. price is $375. Option 001 is a high stability temperature compensated crystal oscillator, $100, and option 002 is batteries for fully portable operation up to eight hours, $95.



Turntable Dual Level

Circle No. 161 on Reader Inquiry Card

Robins Industries Corp. has introduced a "Dual Plane Sprit-Bubble Level" intended for leveling precision automatic and manual turntables. This level consists of two levels mounted at 90 degrees to each other in a "T" shaped housing allowing turntables to be easily leveled. The Robins Dual Spirit Turntable level has a suggested list price of $4.25.

Digital Multitester

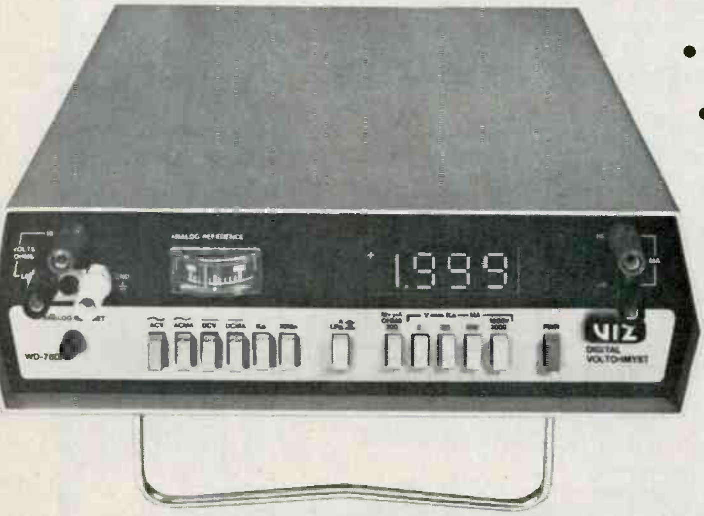
Circle No. 162 on Reader Inquiry Card

Universal Enterprises' DM100 digital multimeter offers, according to the manufacturer's specifications, excellent accuracy at a modest cost. The stated accuracies range from .1% on the lowest range of dc voltage and resistance functions to 1% on the highest ac range. It features ranges to 200ma ac and dc, 1000v ac and dc and 2000K ohms. Accessories available are tilt stand carrying case, ac adapter/charger, nickel cadmium batteries, test leads, probes, adapters and connectors. The price is $99.95.

4½ Digit Multimeter

Circle No. 163 on Reader Inquiry Card

The *Ballantine* model 3036A is a 4½ digit, five-function multimeter from Ballatine Laboratories priced at $345. The unit features a crest factor of 5 at full scale (19,999 counts) and 10 at half scale. Resolution is 10 uV on the 200 mV AC and DC ranges and 10 nanoamperes and 10 milliohms on the lowest current and resistance ranges. The 3036A provides full EMI shielding and features basic accuracy of ±0.05% for one year without recalibration. It may be powered by external 9-14 VDC sources.



Protected Substitution Box

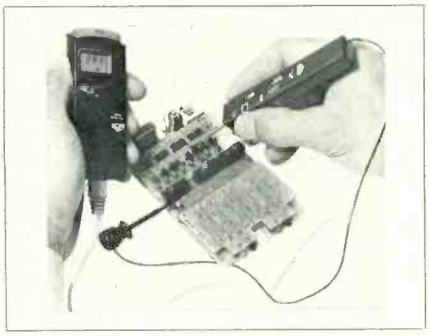
Circle No. 164 on Reader Inquiry Card

A surge protector circuit is a feature of *B&K Precision's* new substitution box, Model 2910. Problems eliminated are shock hazards, accidental discharges, and the temporary healing of defective electrolytic capacitors (during substitution testing). A resistor is automatically put in series with the substitute capacitor. A lockable switch is moved to the substitute position when the capacitor is fully charged. After substitiution the switch is moved to the discharge position for safe discharge. The 2910 features 24 substitution resistors from 10 ohms to 6.8 megohms and 12 capacitors from .0001 mfd to 1000 mfd. and it is priced at $50.00.

Miniature DMM

Circle No. 165 on Reader Inquiry Card

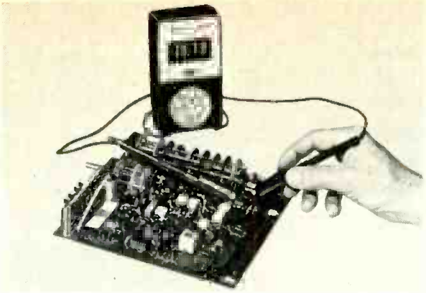
Heuer has introduced, reportedly, the world's smallest digital multimeter. The Model 2000 features modern micro-miniaturisation techniques, remote control on the probe, LCD display, and four ranges each of voltage and current (ac/dc), and resistance. It weighs less than 3 ounces including probes and batteries and sells for $450.00.



Super-compact DMM

Circle No. 166 on Reader Inquiry Card

Triplett Corporation has just introduced a new super-compact digital VOM with auto-zeroing, auto-polarity, auto-low battery and auto-overrange indicator features. The 3½ digit, ½ in., LCD display provides three readings per second; overrange blanks the display ex-

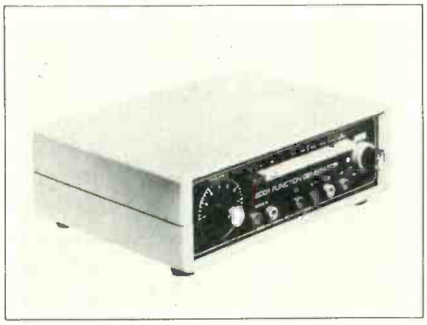


cept for the ½ digit. Ranges of the Model 3400 are 200 mv to 500 v ac and dc in 5 ranges, 2 to 2000 ma ac and dc current in 4 ranges and 200 ohms to 20 Megohms in 6 ranges. The ohmmeter features high and low power ohms ranges for semi-conductor circuit resistance measurements. The Model 3400's price is $140 with test probes, battery, instruction book and 1 year warranty.

Sweepable Function Generator

Circle No. 167 on Reader Inquiry Card

Continental Specialties Corporation has added a sweepable function generator to its line of inexpensive trouble-shooting and design instruments. The Model 2001, according to the manufacturer, offers sine, triangle, square and TTL square waves from 1Hz to 100kHz in 5 ranges, tuned with a vernier dial with ±5% of setting, accuracy. High level output is .1 to 10Vp-p into an open circuit .05 to 5vp-p into 600 ohms. Low level output is .5 to 50mV into a 600 ohm load. Amplitude is reportedly constant ±0.5 dB over the entire range. The sinusoidal waveforms offer less than 2% distortion; the triangular waveform has less than 1% linearity error and the square wave form has rise and fall times of less than 100 nanoseconds according to specifications. The price of the 2001 is $124.95. **ET/D**



RADIO
continued from page 22

these transistors can be checked directly in the circuit for open conditions. Remove the collector lead when making in-circuit leakage tests.

Before removing any FM transistor, check to see how long the terminal leads are and how the transistor is laying in the circuit. Exact installation of the new transistor is very critical in FM circuits. Test the new transistor before soldering into the circuit. It's much easier to do it before than after. Double check for small metal beads on the transistor terminals to help eliminate microphonic tuning conditions. You may have to touch up the FM alignment after replacing an FM transistor.

Step 10/The dial cord

A broken dial cord can be a real dog at times. Generally, the dial cord will either break at the selector knob shaft or at either end. Sometimes, the dial cord will remain intact, but slip off one of the small pulleys. Dial cord slippage will occur at the selector pulley shaft. A worn or ragged dial cord should be replaced before it breaks in two.

If the cord is broken find a dial cord

layout or a dial stringing schematic. When a diagram is not readily available, draw a simple dial cord layout the way the cord is found laying. Choose a dial cord of the same diameter as the original one. Most dial cords come in either heavy, medium, or light weight.

Step 11/No repair

Because of the value of the average small radio, and the price the customer will pay for a repair, and the fact that often they are taken in on speculation—no repair, no charge—the secret of making a profit repairing them is to set a rate that will pay even if it means turning some away, and then severely limiting the time spent on any radio to that necessary go through a procedure such as that previously outlined. Examine the unit carefully; the mechanical work involved in repair may be more time consuming than warranted by the radio's value. If at any point the particular radio you are working on promises to require an unusual amount of time, discard it. Like money, do not throw good time after bad; you are not likely to be paid for it. Speed and knowing when not to repair are the ingredients of successful small radio repair. ET/D

COMPUTER

continued from page 19

are acquiring systems at prices ranging from $100 to $10,000 and playing (read: learning) with them at home. If, as we pointed out in the August issue, computers are to become a key element in your future work, it might be good to dig in and get a true intuitive feel for them. No course in the world, no series of articles (no matter how comprehensive) can hope to equal the depth of understanding you can obtain by staying up all night obsessed with getting your computerized burglar alarm or checkers game to work. Really!

Step one: Visit your local computer store, buy and subscribe to some magazines like *Kilobaud* and *Byte*, seek out a nearby computer club, and start thinking about what you might do with a computer at home. If you do, by the time microprocessors start showing up on your bench, they'll be welcome.

SONY

continued from page 26

have had original semiconductor devices replaced with those of other manufacturers and that invariably this caused the problem, masked the original problem or degraded performance. They state that many of their semiconductors were designed for specific circuits making it very difficult to substitute adequately. Use Sony authorized transistors to avoid trouble. Sony has prepared a semiconductor replacement guide, now in its fifth edition, to help the technician select replacements.

The X2 and Y2 chassis are quite accessible once the back is off the set. The circuit board is mounted on slides and can be released by pressing two plastic tabs. It can be withdrawn and turned 90° for access for even easier service. The board is marked with component designations and test points on both sides and circuit areas are blocked off and labeled.

Shields on the IF and chroma sections snap off instead of soldering, eliminating a three minute nuisance job. ET/D

TEST INSTRUMENT

continued from page 36

runs when insufficient signal (40hz-2Mhz) is present or when the selected level is outside the range of the input signal.
Source: Internal CH1 or CH2 or external
Slope: + or −
Coupling: dc, ac on TV (active sync separator with line, frame selected by TB switch between 50 and 100µsec/cm).
Sensitivity: Internal, 2mm to 2Mhz, 1cm at 15Mhz External, ..5V to 2Mhz, 2.5V at 15Mhz. External input impedance 10kohm/10pfd, approx.

SUPPLY
100v, 120v, 220v and 240v I 10% 45 to 440hz, approx. 40VA. Operating Temperature 0 to +50C (+15 to 35°C for full accuracy).

DIMENSIONS
140 × 305 × 460mm.

WEIGHT
6Kg approx. ET/D

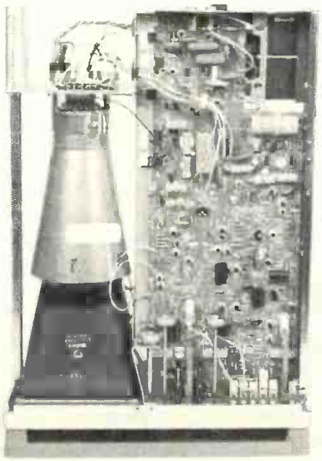


Fig. 2 The main circuit board presents a clean uncluttered appearance.

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103	.99	1.84	165	7.25	13.50	230	3.40	5.11
103A	1.09	1.90	166	.95	1.68	231	4.00	5.85
104	.97	1.60	167	1.10	2.05	232	.59	.98
104MP	1.94	3.20	168	1.26	2.25	233	.62	1.02
105	2.45	4.22	169	1.84	3.05	234	.57	1.00
106	.52	.95	170	2.75	4.95	235	3.50	6.30
107	.68	1.35	171	1.25	2.15	236	6.25	10.40
108	.85	1.53	172A	.50	.90	237	4.60	8.10
109	.24	.33	173BP	4.30	6.54	238	12.25	15.75
110MP	.32	.54	175	1.25	2.25	239	2.75	3.63
112	.55	.87	176	2.21	3.94	241	1.35	2.29
113	.35	.60	177	.50	.90	242	1.55	2.52
114	.35	.60	178MP	.54	.95	243	1.85	2.69
116	.38	.66	179	5.01	8.88	244	2.60	3.63
117	.35	.60	180	4.98	8.84	245	3.10	4.40
118	1.35	2.95	181	4.15	7.50	246	3.95	4.77
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121	1.70	3.18	183	3.25	5.00	248	4.50	6.42
121MP	3.40	6.36	184	1.10	1.99	249	5.65	8.38
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131	1.75	2.84	196	1.65	2.70	281	5.40	8.20
131MP	3.50	5.68	197	1.60	2.52	282	4.50	6.45
132	.88	1.60	198	1.58	2.65	283	6.75	9.40
133	1.00	1.80	199	.46	.81	284	6.70	10.10
152	1.20	2.20	210	1.15	1.99	285	7.30	10.95
153	1.30	2.50	211	1.35	2.29	286	6.70	8.20
154	1.85	3.30	218	3.10	5.25	287	.60	.86
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CORONADO
B&W TV Chassis
EMC 12126

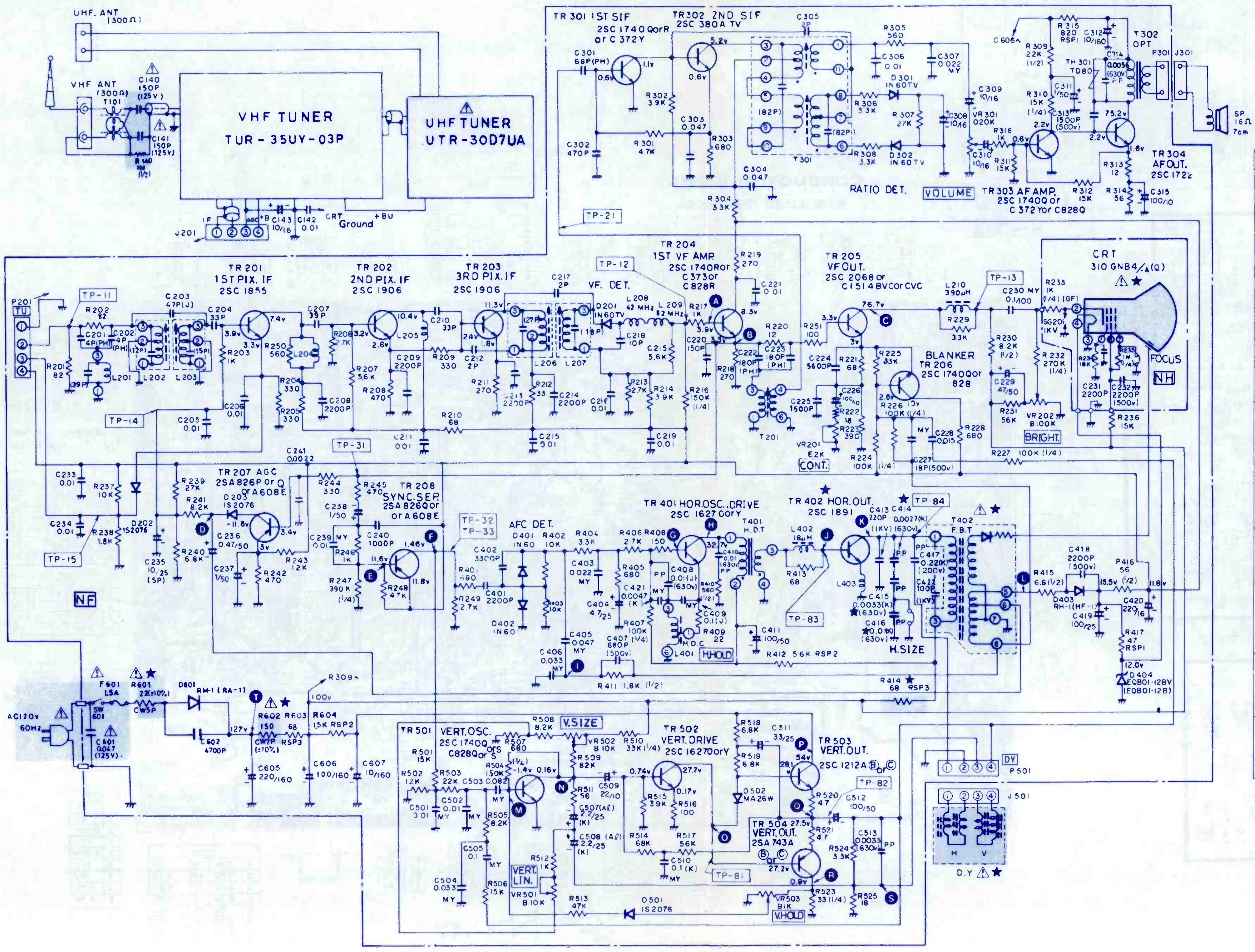
JANUARY • 1979

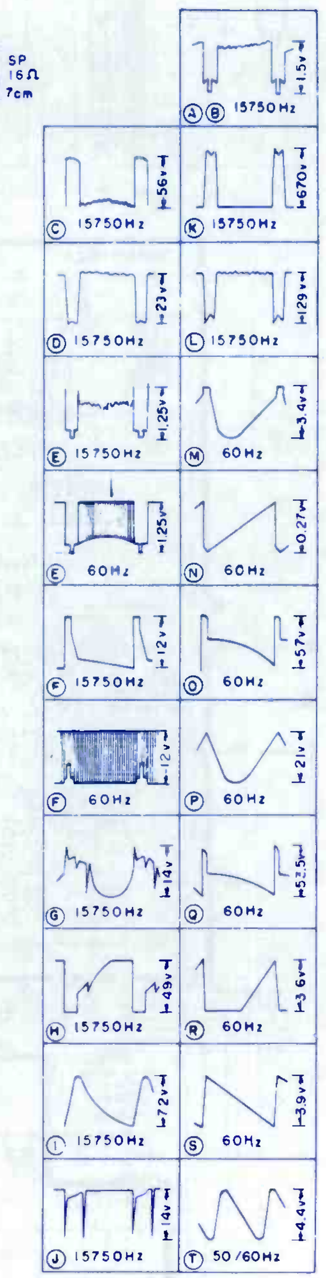
ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

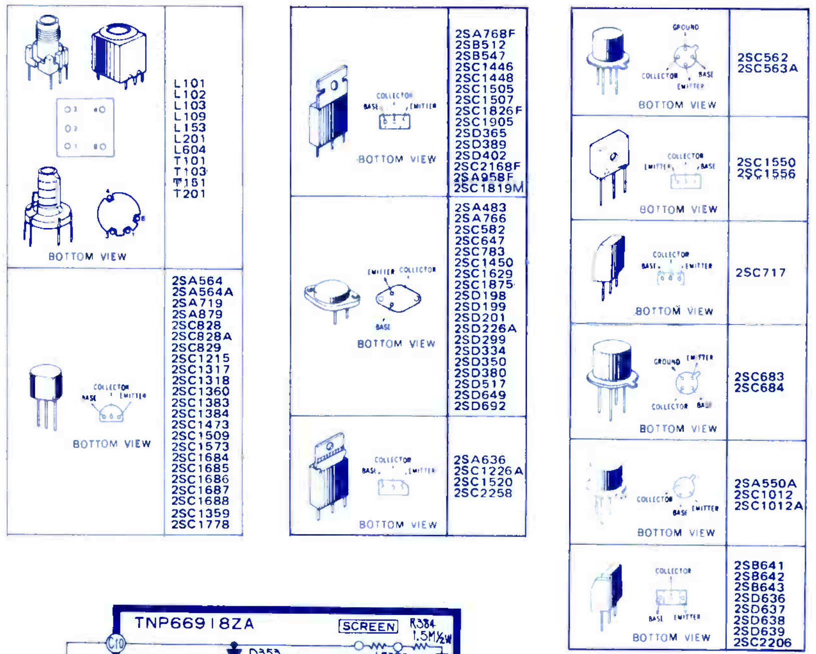
NOTE:

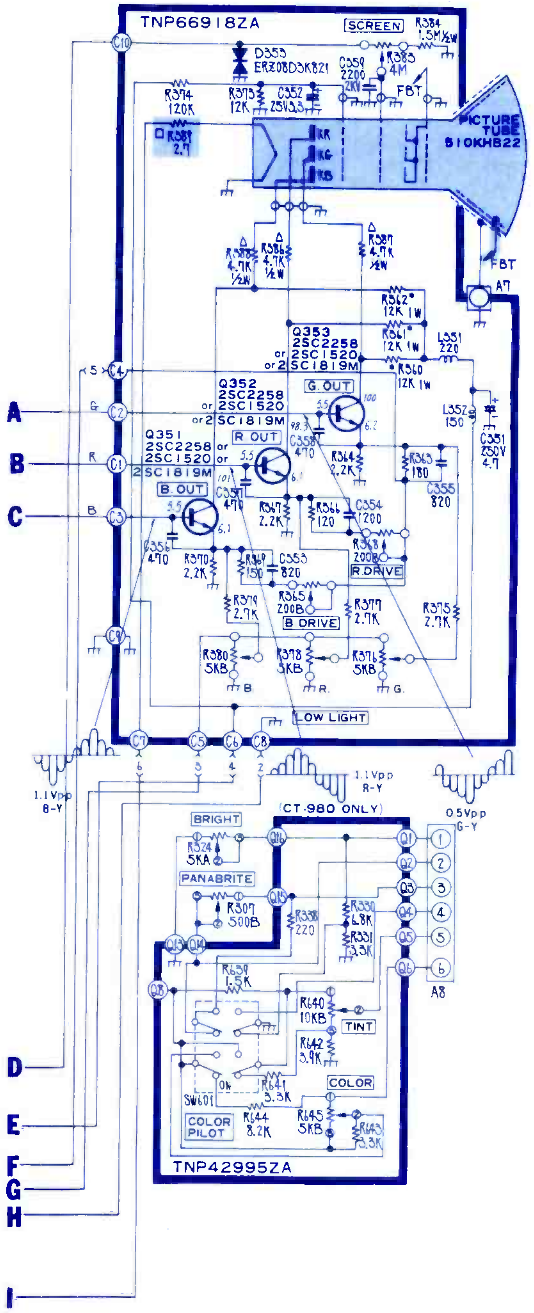
1. All capacitance values are in μF ±20% 50V unless otherwise indicated.
2. Tolerance of all capacitance values indicated in (K) is ±10% and indicated in (J) is ±5%.
3. Mylar film capacitors are marked MY, Polypropylene film capacitors are marked P.P and Tantalum solid electrolyte capacitors are marked (Al).
4. All resistance values are in ohm ±5% 1/6W unless otherwise indicated.
5. Composition resistors are marked (GF), Cemented resistors are marked (CW), and Oxide metal film resistors are marked (RSP).
6. The number inside ( ) of resistors is indicating wattage.
7. Wave forms are taken with controls set for a normal Picture.
8. DC voltages are measured from point indicated to ground with Digital Volt Meter under line voltage 120V no signal condition.
9. This curcuit diagram is subject to change without notice.
10. ⚠ Safety Related Parts ★: X Ray Radiation Related Parts For replacement Purposes, these Parts use only the types shown in the Parts List.





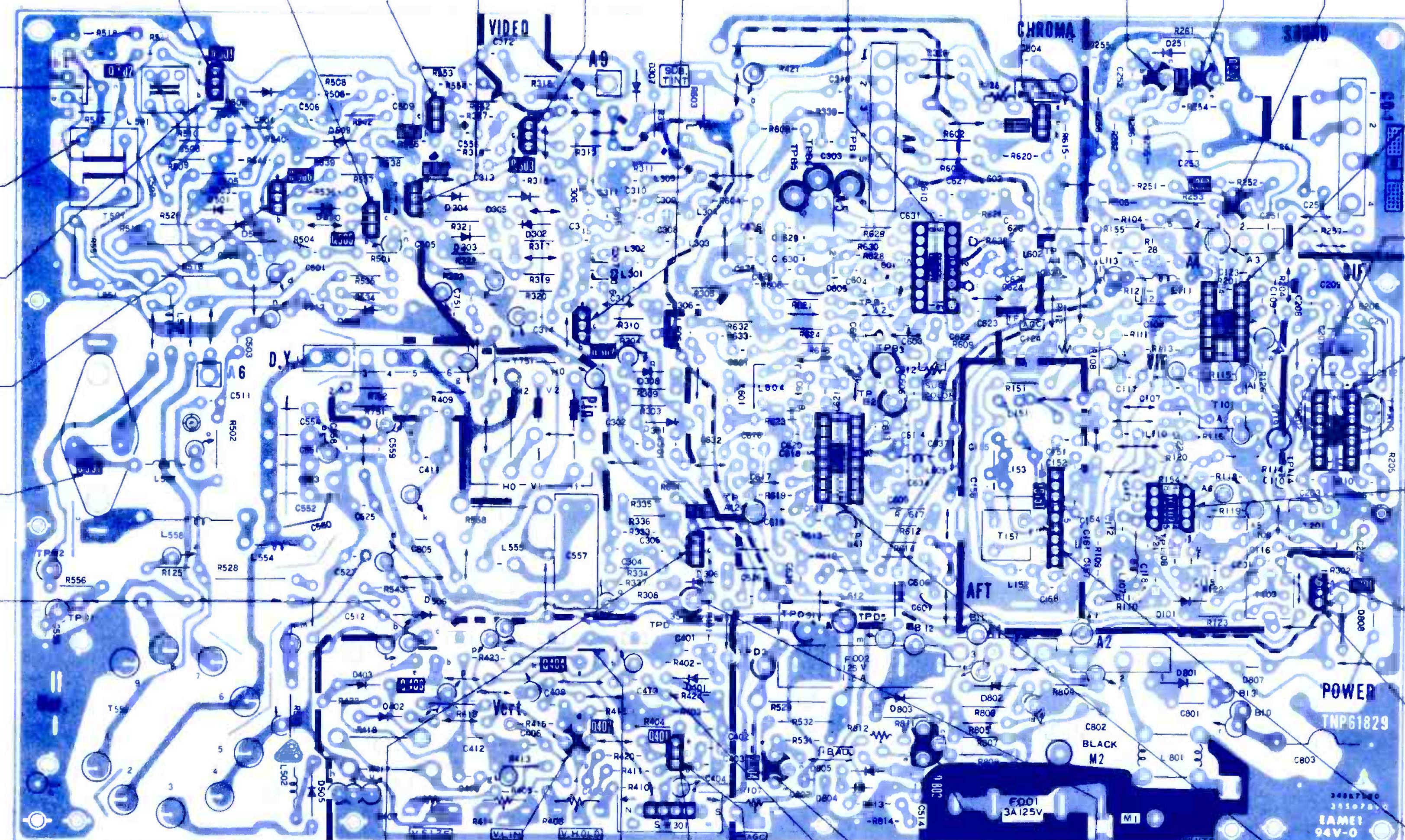
PANASONIC
Color TV Chassis
NMX-L1A





CONDUCTOR VIEWS

MAIN BOARD TNP61829ZA



Q501	
E	15.5V
B	15.5V
C	2.6V

Q505	
E	6.5V
B	6.2V
C	17.2V

Q552	
E	9.6V
B	10.1V
C	4.2V

Q304	
E	5.7V
B	5.3V
C	0V

Q303	
E	3.8V
B	4.2V
C	10.6V

Q302	
E	2.6V
B	3.3V
C	6.2V

IC602			
1	3.5V	9	4.0V
2	10V	10	0V
3	1.1V	11	6.0V
4	1.9V	12	11.9V
5	0V	13	11.9V
6	5.5V	14	5.4V
7	5.5V	15	0V
8	5.5V	16	8.6V

Q601	
E	1.0V
B	1.7V
C	10.1V

Q253	
E	18.5V
B	18.5V
C	0V

Q252	
E	18.5V
B	18.5V
C	18.5V

Q251	
E	1.6V
B	2.2V
C	18.5V

Q502	
E	0V
B	0.3V
C	10.6V

Q506	
E	15.7V
B	17.2V
C	0V

Q551	
E	0V
B	0V
C	118V

Q403	
E	19.7V
B	20.1V
C	44.0V

IC101			
1	3.8V	8	11.1V
2	3.8V	9	7.3V
3	0V	10	2.0V
4	0V	11	11.1V
5	0.8V	12	5.1V
6	2.6V	13	5.2V
7	11.1V	14	5.6V

IC201			
1	2.0V	8	7.3V
2	2.0V	9	3.7V
3	0V	10	3.7V
4	0V	11	0V
5	11.3V	12	5.0V
6	4.9V	12	5.7V
7	8.0V	14	1.7V

IC102			
1	4.0V	5	11.1V
2	5.3V	6	11.1V
3	5.3V	7	3.2V
4	2.6V	8	0V

Q301	
E	2.1V
B	2.7V
C	11.9V

IC151	
1	6V
2	6V
3	0.75V
4	11V
5	0.75V
6	11V
7	0V
8	0.7V
9	0.7V

Q305	
E	11.9V
B	11.7V
C	1.5V

Q402	
E	1.2V
B	1.8V
C	18.8V

Q404	
E	19.2V
B	18.8V
C	0V

Q401	
E	0V
B	−1.4V
C	1.8V

Q504	
E	12.6V
B	12.6V
C	18.5V

Q802	
E	12.6V
B	13.1V
C	127.2V

IC601			
1	2.0V	9	0V
2	8.5V	10	8.7V
3	8.5V	11	8.8V
4	8.7V	12	11.9V
5	0V	13	0.5V
6	8.7V	14	1.7V
7	2.1V	15	9.3V
8	8.8V	16	4.5V

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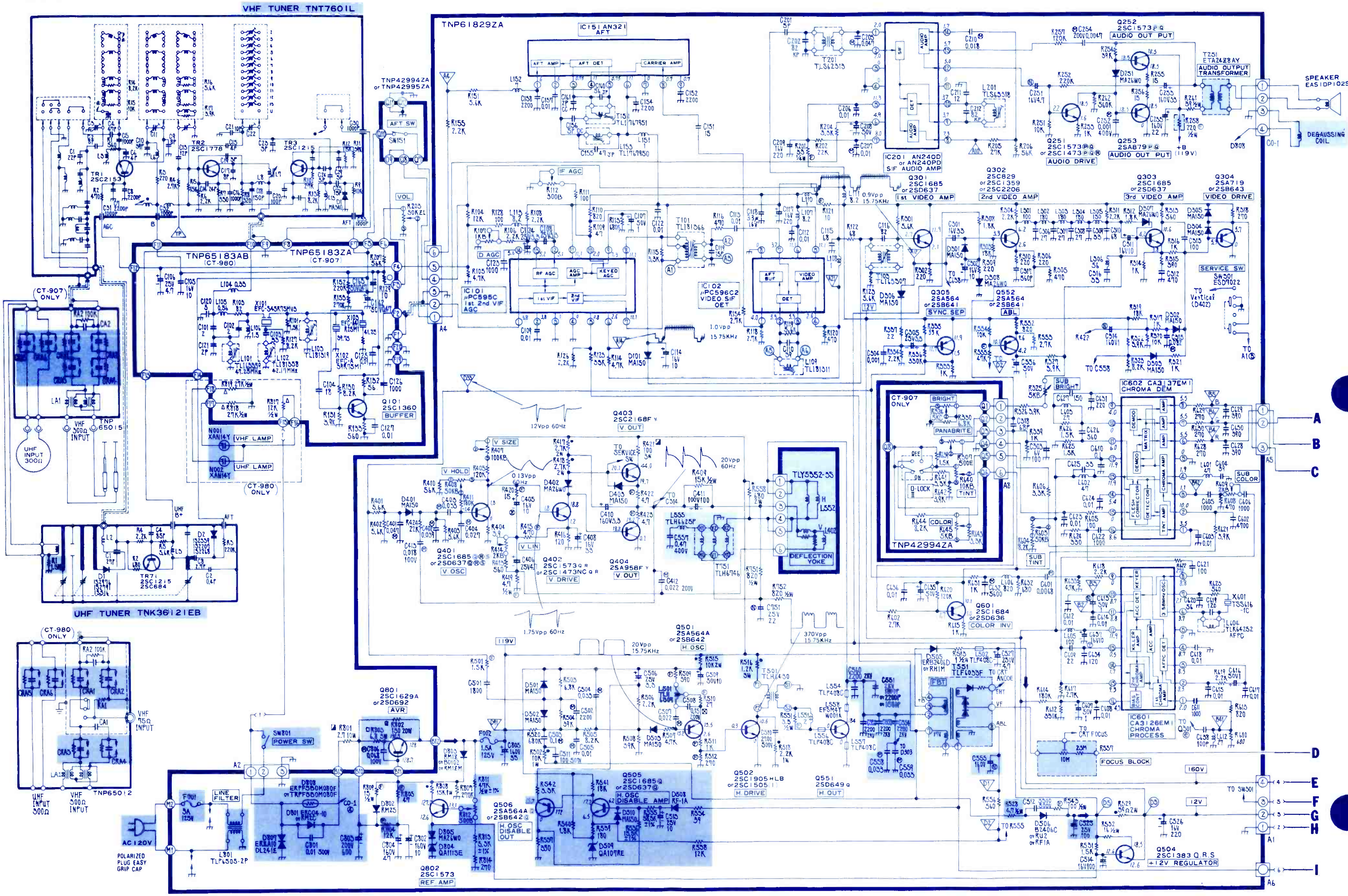
PANASONIC
Color TV Chassis
NMX-L1A

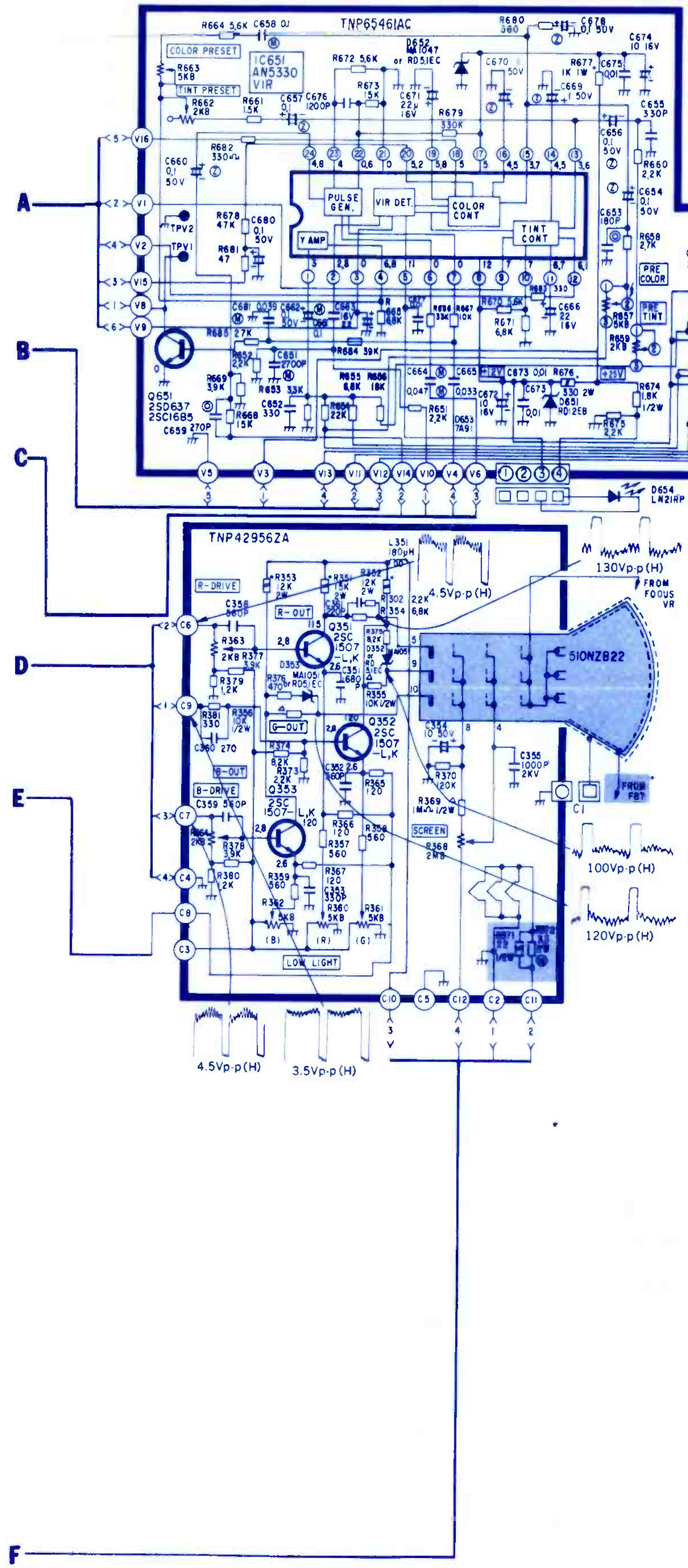
JANUARY • 1979

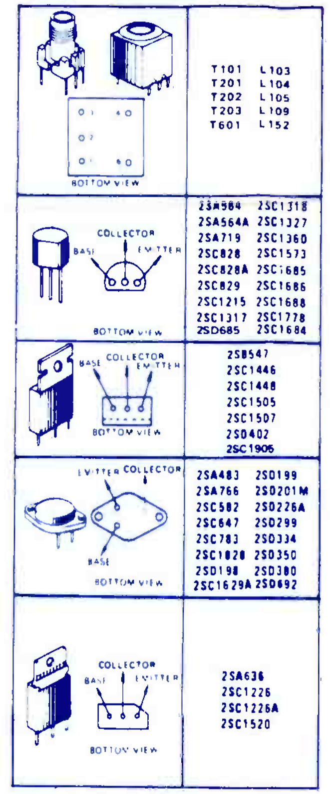
ET/D TEKFAX

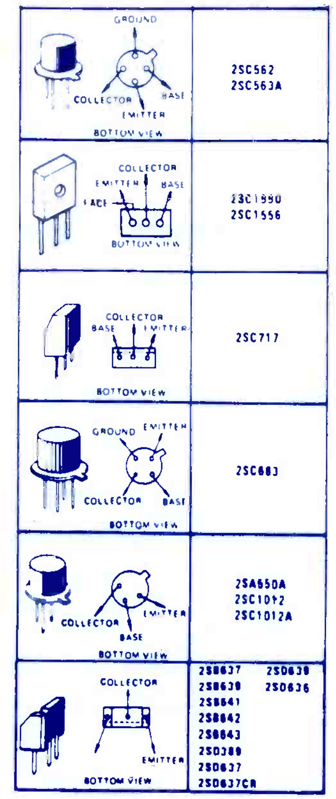
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS



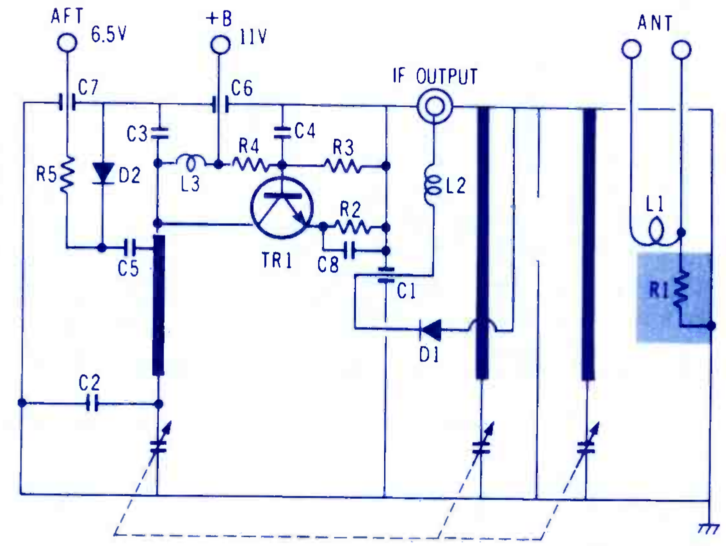
PANASONIC
Color TV Chassis
NMX-G12

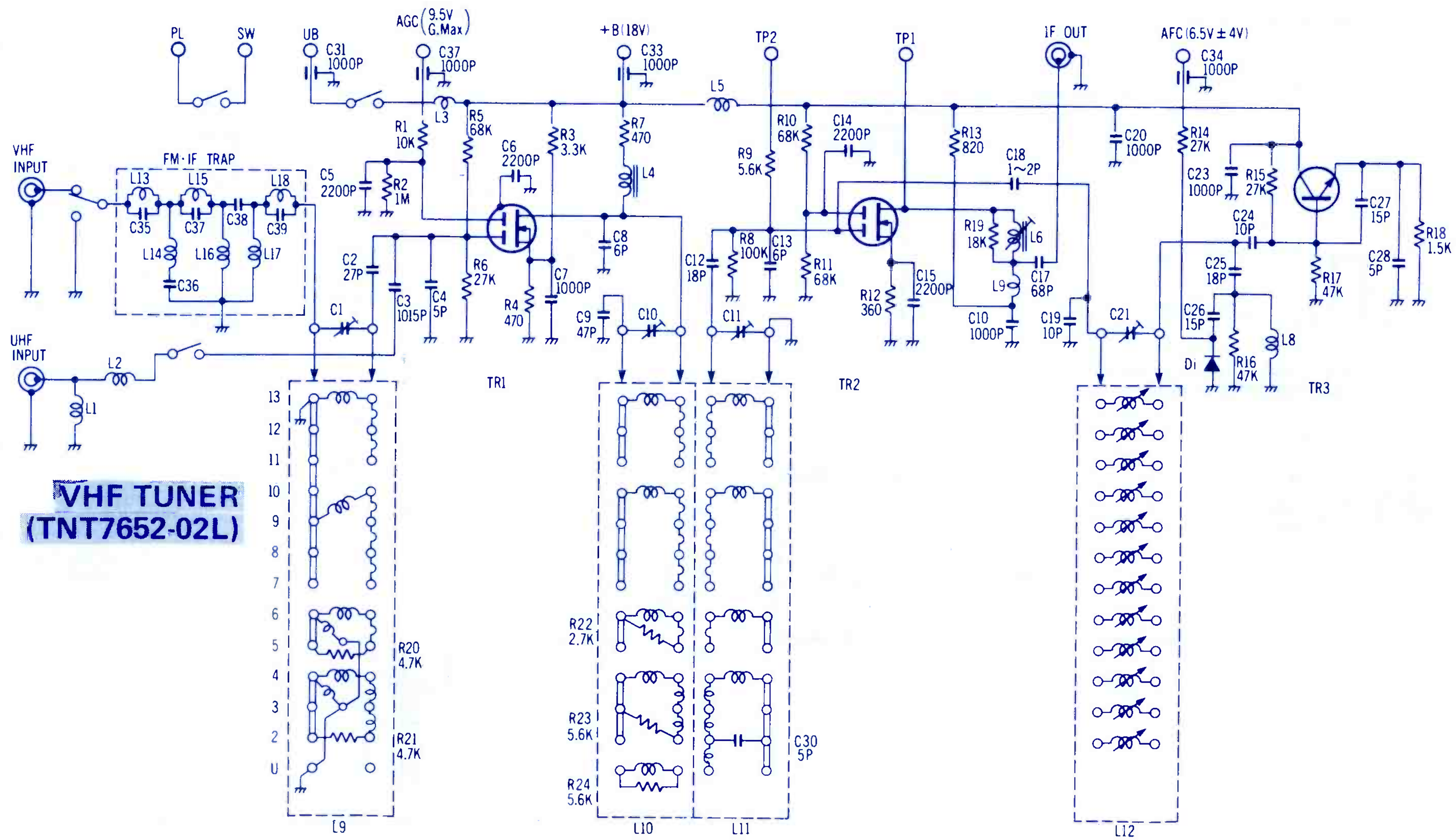






UHF TUNER (TNK36153E)





VHF TUNER (TNT7652-02L)

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PANASONIC
Color TV Chassis
NMX-G12

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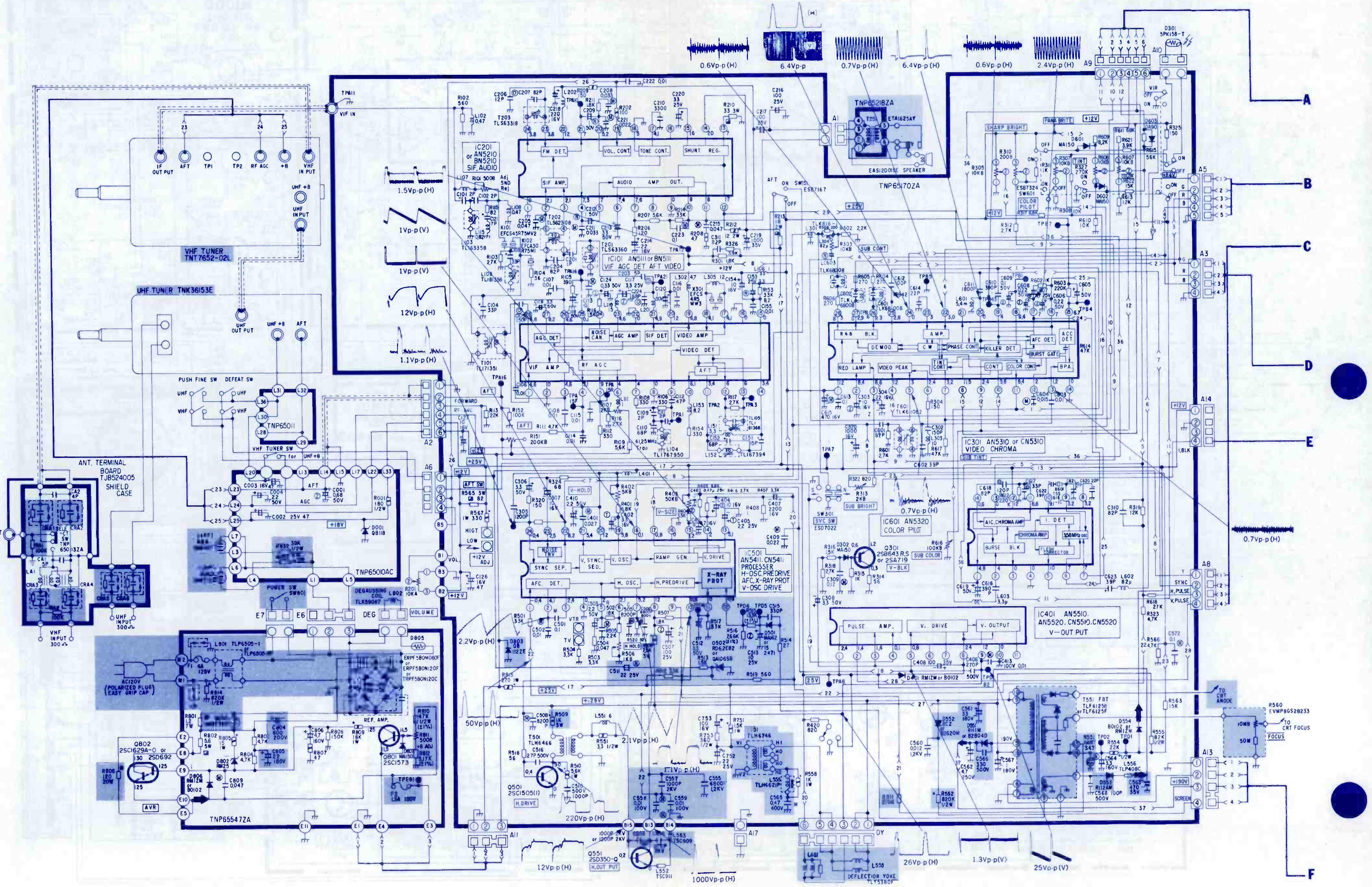
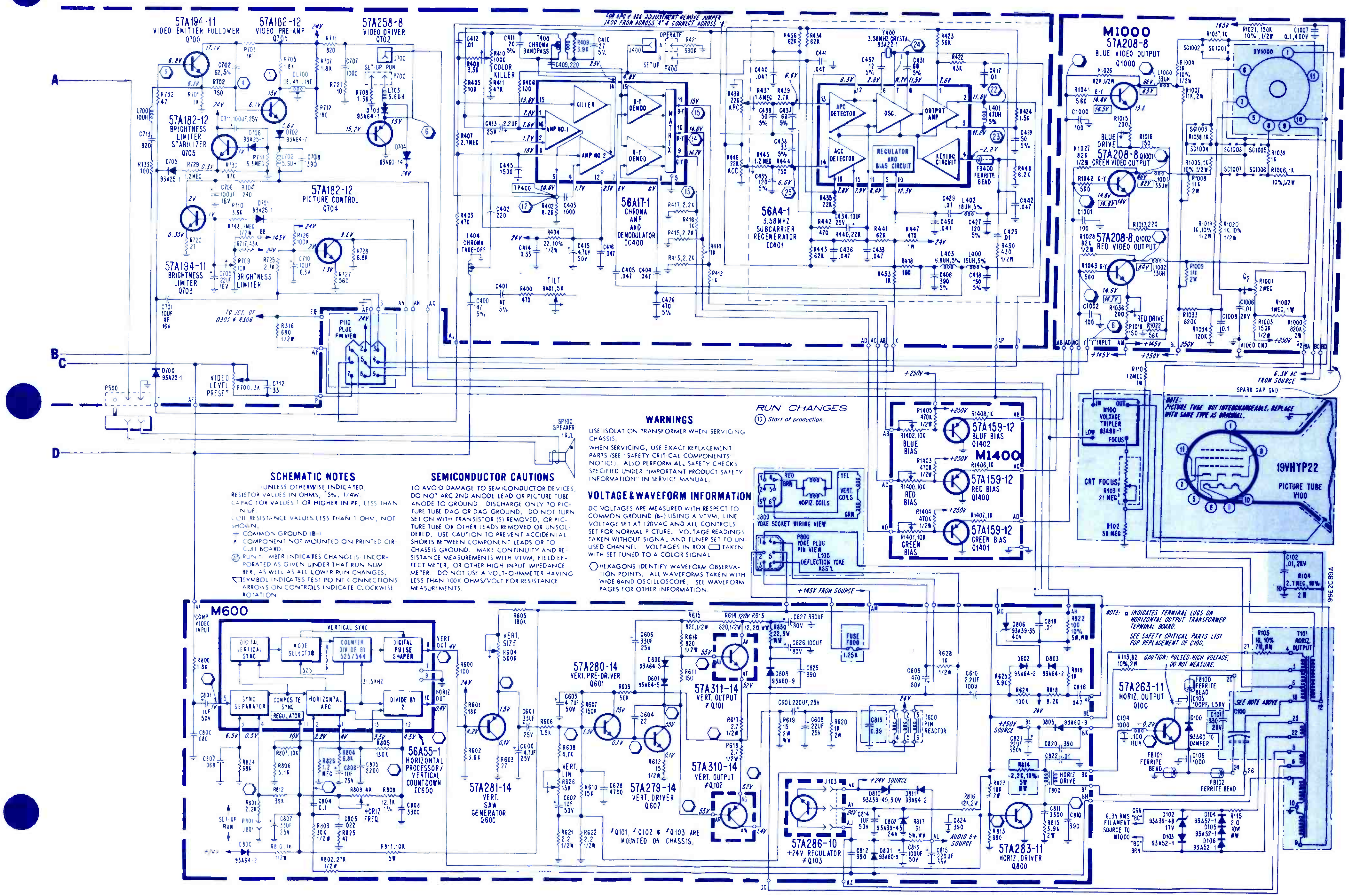
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS



ADMIRAL
Color TV Chassis
10M55



SCHEMATIC NOTES

(UNLESS OTHERWISE INDICATED)

RESISTOR VALUES IN OHMS, ±5%, 1/4W.

CAPACITOR VALUES 1 OR HIGHER IN PF, LESS THAN 1 IN UF.

COIL RESISTANCE VALUES LESS THAN 1 OHM, NOT SHOWN.

- COMMON GROUND (B-)
- * COMPONENT NOT MOUNTED ON PRINTED CIRCUIT BOARD.
- RUN NUMBER INDICATES CHANGE(S) INCORPORATED AS GIVEN UNDER THAT RUN NUMBER, AS WELL AS ALL LOWER RUN CHANGES.
- SYMBOL INDICATES TEST POINT CONNECTIONS

ARROWS ON CONTROLS INDICATE CLOCKWISE ROTATION

SEMICONDUCTOR CAUTIONS

TO AVOID DAMAGE TO SEMICONDUCTOR DEVICES, DO NOT ARC 2ND ANODE LEAD OR PICTURE TUBE ANODE TO GROUND. DISCHARGE ONLY TO PICTURE TUBE DAG OR DAG GROUND. DO NOT TURN SET ON WITH TRANSISTOR (S) REMOVED, OR PICTURE TUBE OR OTHER LEADS REMOVED OR UNSOLDERED. USE CAUTION TO PREVENT ACCIDENTAL SHORTS BETWEEN COMPONENT LEADS OR TO CHASSIS GROUND. MAKE CONTINUITY AND RESISTANCE MEASUREMENTS WITH VTVM, FIELD EFFECT METER, OR OTHER HIGH INPUT IMPEDANCE METER. DO NOT USE A VOLT-OHMMETER HAVING LESS THAN 100K OHMS/VOLT FOR RESISTANCE MEASUREMENTS.

WARNINGS

USE ISOLATION TRANSFORMER WHEN SERVICING CHASSIS.

WHEN SERVICING, USE EXACT REPLACEMENT PARTS (SEE "SAFETY CRITICAL COMPONENTS" NOTICE). ALSO PERFORM ALL SAFETY CHECKS SPECIFIED UNDER "IMPORTANT PRODUCT SAFETY INFORMATION" IN SERVICE MANUAL.

VOLTAGE & WAVEFORM INFORMATION

DC VOLTAGES ARE MEASURED WITH RESPECT TO COMMON GROUND (B-) USING A VTVM, LINE VOLTAGE SET AT 120VAC AND ALL CONTROLS SET FOR NORMAL PICTURE. VOLTAGE READINGS TAKEN WITHOUT SIGNAL AND TUNER SET TO UNUSED CHANNEL. VOLTAGES IN BOX ▭ TAKEN WITH SET TUNED TO A COLOR SIGNAL.

⬡ HEXAGONS IDENTIFY WAVEFORM OBSERVATION POINTS. ALL WAVEFORMS TAKEN WITH WIDE BAND OSCILLOSCOPE. SEE WAVEFORM PAGES FOR OTHER INFORMATION.

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ADMIRAL
Color TV Chassis
10M55

ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

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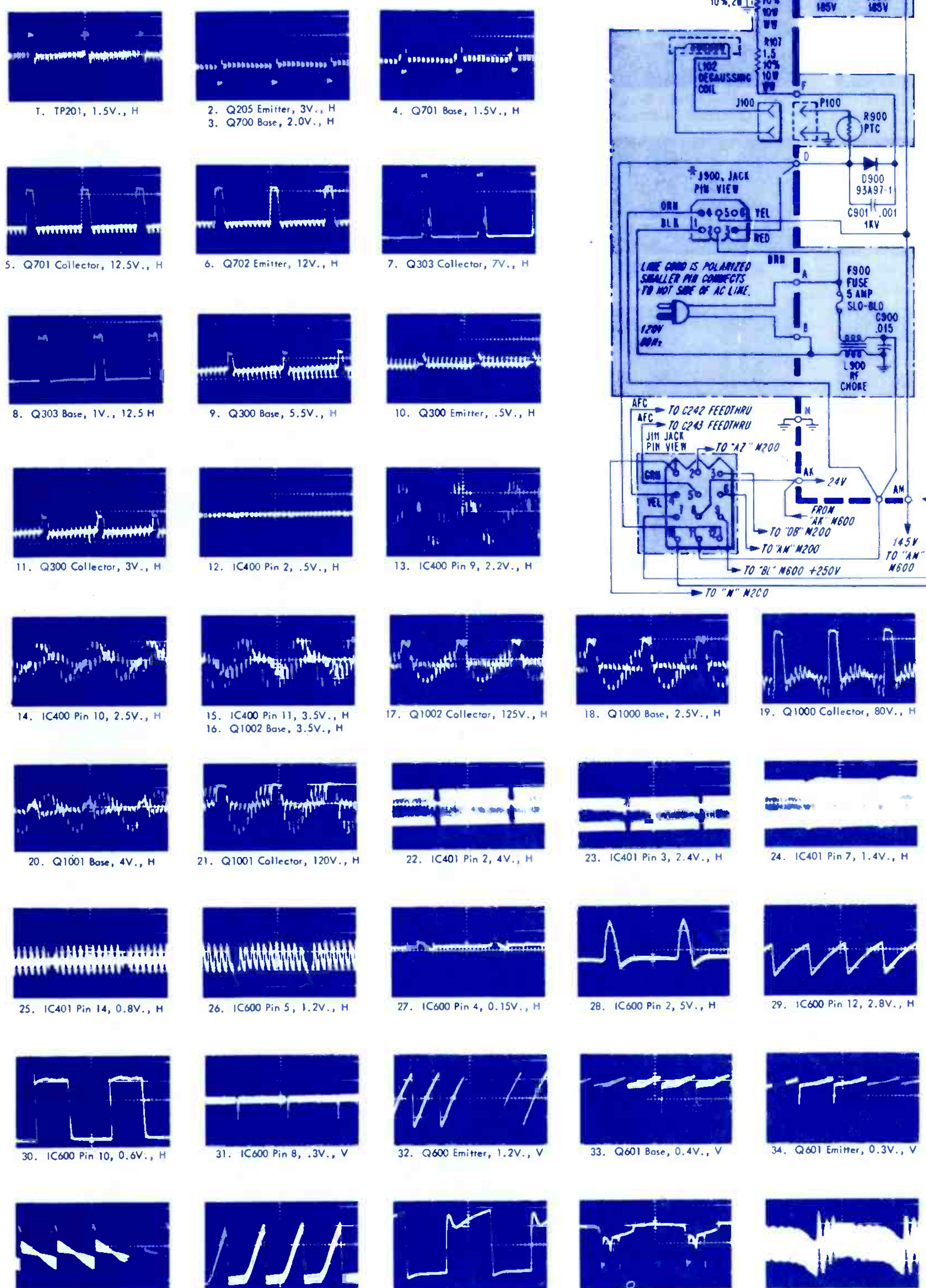
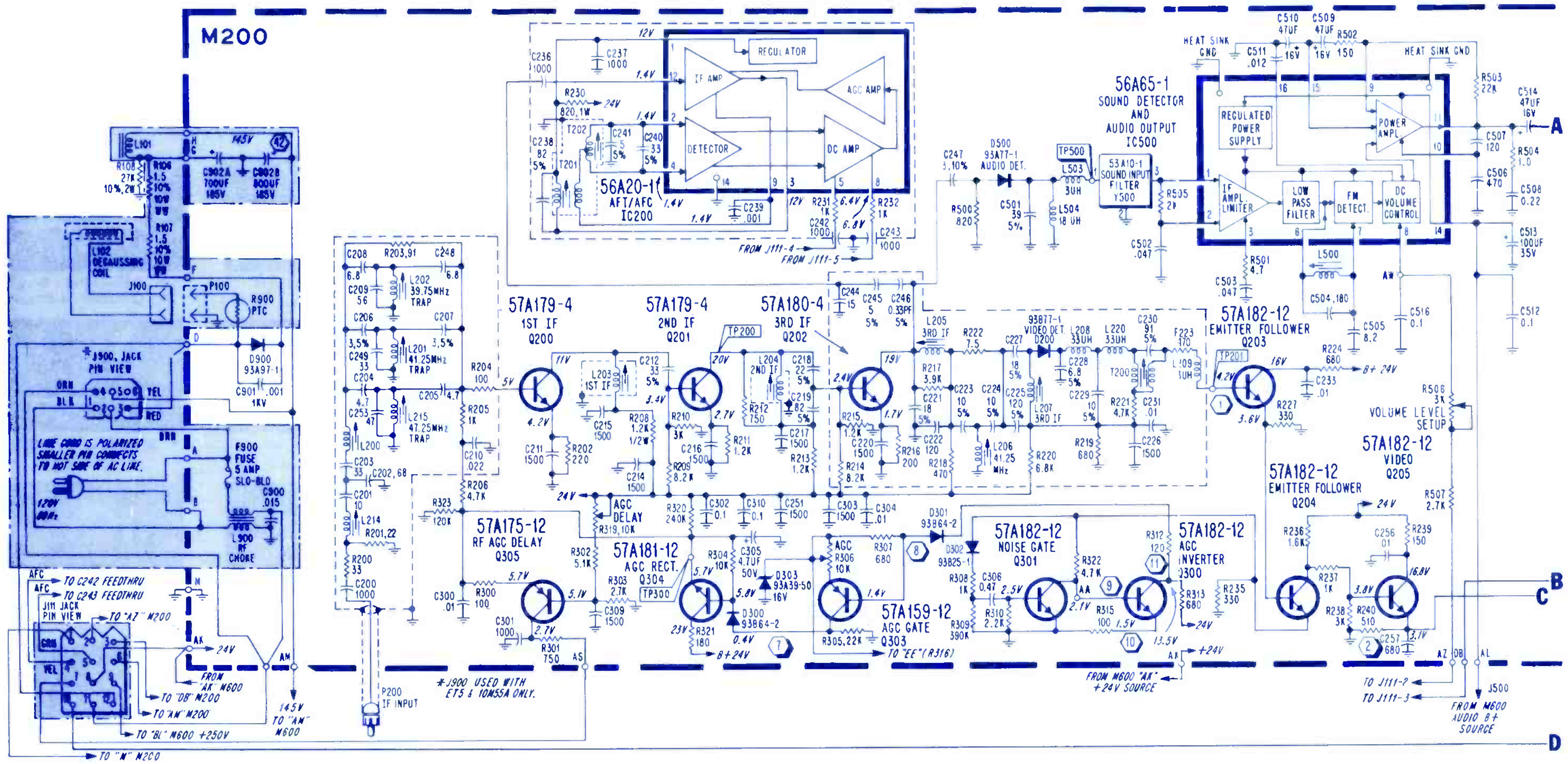
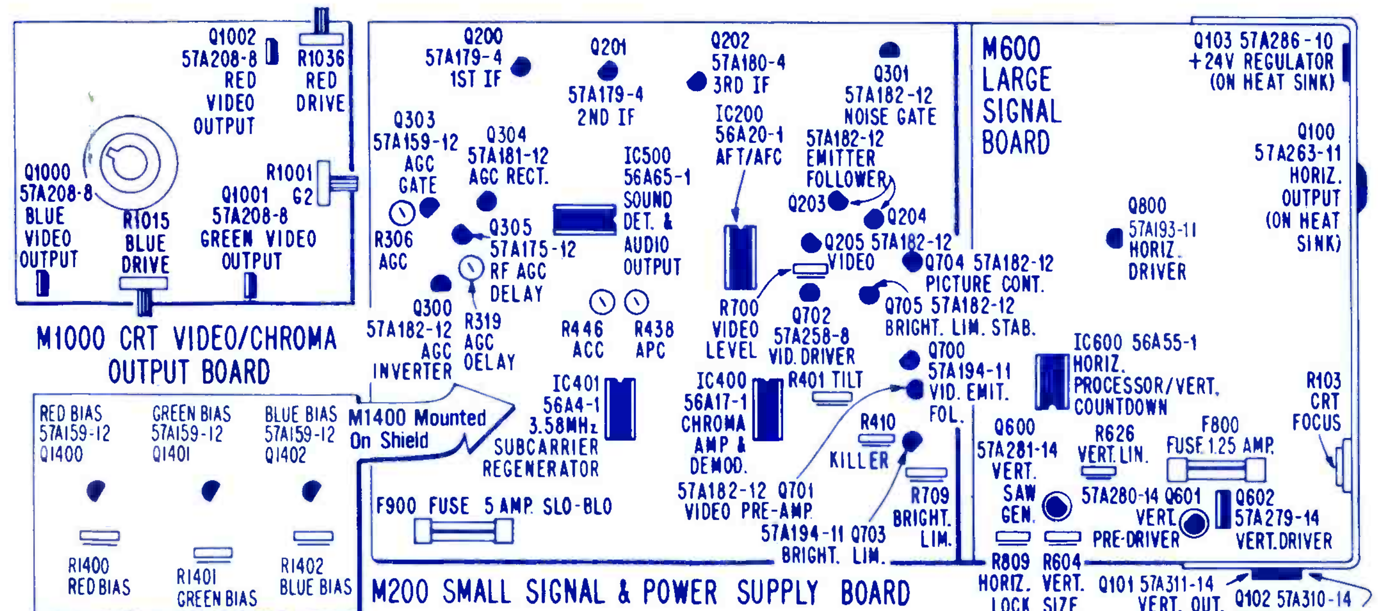


1. TP201, 1.5V., H
2. Q205 Emitter, 3V., H
3. Q700 Base, 2.0V., H
4. Q701 Base, 1.5V., H
5. Q701 Collector, 12.5V., H
6. Q702 Emitter, 12V., H
7. Q303 Collector, 7V., H
8. Q303 Base, 1V., 12.5 H
9. Q300 Base, 5.5V., H
10. Q300 Emitter, .5V., H
11. Q300 Collector, 3V., H
12. IC400 Pin 2, .5V., H
13. IC400 Pin 9, 2.2V., H
14. IC400 Pin 10, 2.5V., H
15. IC400 Pin 11, 3.5V., H
16. Q1002 Base, 3.5V., H
17. Q1002 Collector, 125V., H
18. Q1000 Base, 2.5V., H
19. Q1000 Collector, 80V., H
20. Q1001 Base, 4V., H
21. Q1001 Collector, 120V., H
22. IC401 Pin 2, 4V., H
23. IC401 Pin 3, 2.4V., H
24. IC401 Pin 7, 1.4V., H
25. IC401 Pin 14, 0.8V., H
26. IC600 Pin 5, 1.2V., H
27. IC600 Pin 4, 0.15V., H
28. IC600 Pin 2, 5V., H
29. IC600 Pin 12, 2.8V., H
30. IC600 Pin 10, 0.6V., H
31. IC600 Pin 8, .3V., V
32. Q600 Emitter, 1.2V., V
33. Q601 Base, 0.4V., V
34. Q601 Emitter, 0.3V., V
35. Q602 Collector, 100V., V
36. Q101 Base, 100V., V
37. Q102 Base, 100V., V
38. Q101, 102 Emitter, 100V., V
39. Q102 Collector, 6V., V
40. Q800 Collector, 175V., H
41. Q100 Base, 12V., H
42. B+, 145V Ripple, 0.7V., V





10M55 CHASSIS LAYOUT

Locations of Transistors, Integrated Circuits, and Service Controls.

ET/D TEKFAX

SCHEMATIC NUMBER		SCHEMATIC NUMBER	
ZENITH B&W TV Chassis 9JB1X-12JB1X	1771	PANASONIC Color TV Chassis NMX-L/1A	1774
ADMIRAL Color TV Chassis 10M55	1772	CORONADO B&W TV Chassis EMC12126	1775
PANASONIC Color TV Chassis NMX-G12	1773		

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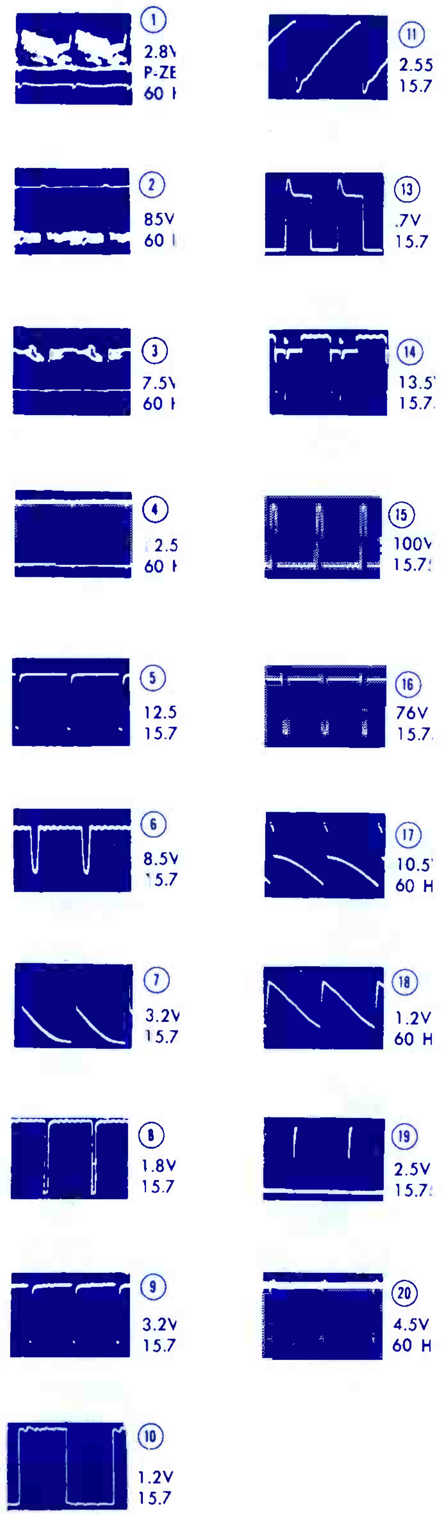
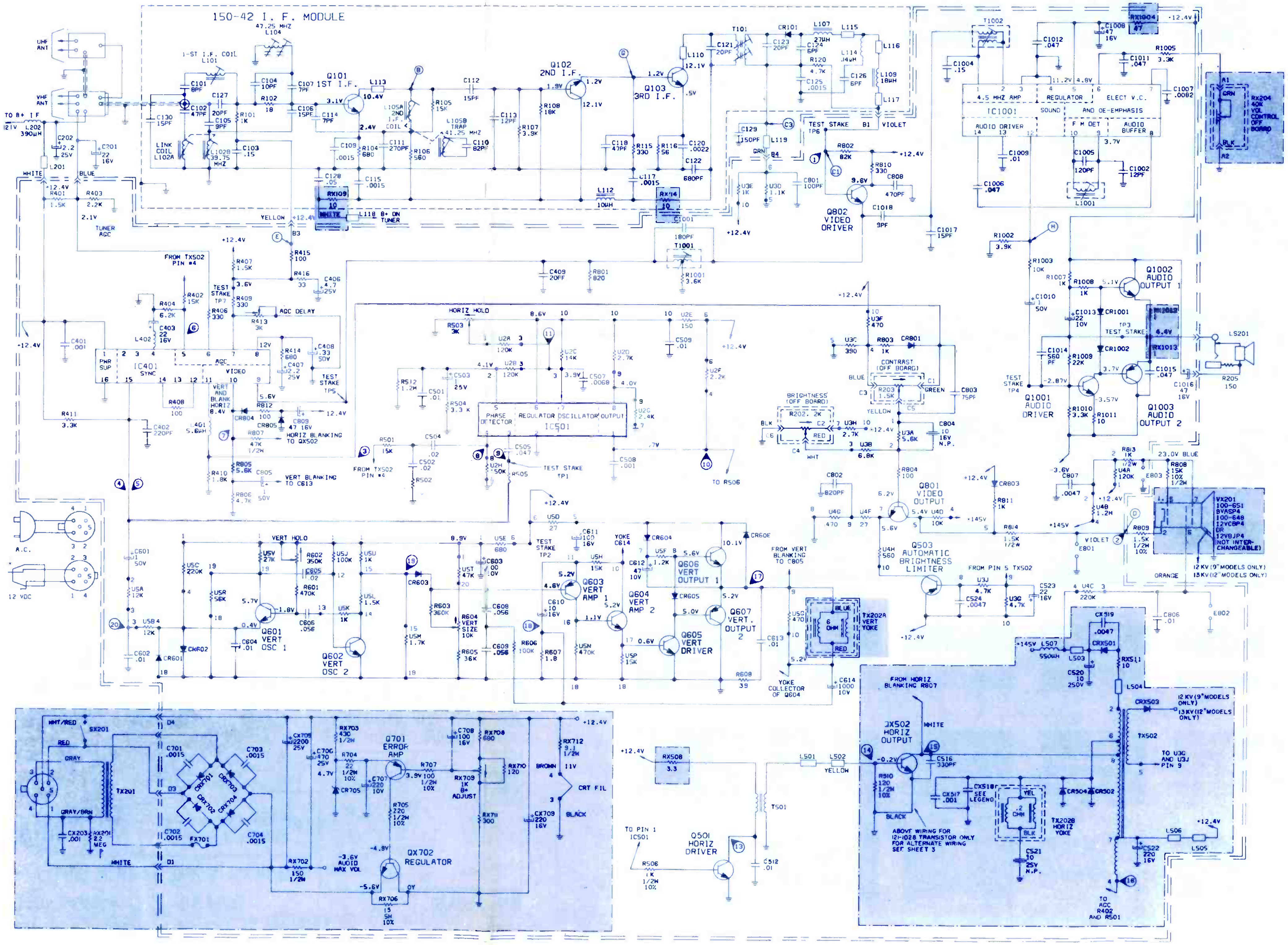
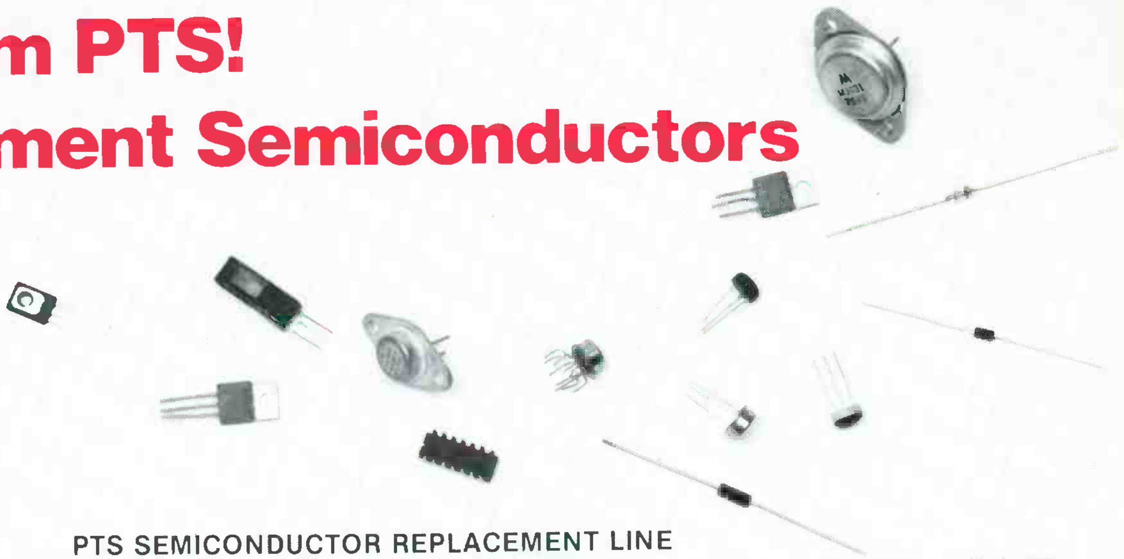
ZENITH
B&W TV Chassis
9JB1X-12JB1X

JANUARY • 1979





New from PTS! Replacement Semiconductors



ORDER FROM YOUR PTS SERVICENTER TODAY!

PTS SEMICONDUCTOR REPLACEMENT LINE

PTS P/N	MFG. CROSS REFERENCE #'S	DESCRIPTION	TYPE CASE	BASING	DLR. COST	SUGG. RETAIL
PTS8108	SK3452 ECG 108 GE-11	NPN, Si-RF/IF Vld Amp, Osc, Mxr, UHF/VHF	TO-92	EBC	1.42	2.37
PTS8123A	SK3444 ECG 123A GE-20	NPN, Si-AF/RF Amp	TO-92	EBC	.84	1.40
PTS8124	SK3021 ECG 124 GE-12	NPN, Si-HiV AF, PO	TO-66		2.22	3.70
PTS8128E	ECG 128	NPN, Si-AF Pre-amp, Dr, Vid, Amp		EBC	1.42	2.37
PTS8128M	SK3024 ECG 128 GE-18	NPN, Si-AF Pre-amp, Dr, Vid, Amp	TO-5	EBC	1.42	2.37
PTS8129E	ECG 129 GE-67	PNP, Si-AF Pre-amp, Dr, Vid, Amp		EBC	1.21	2.02
PTS8129M	SK3025 ECG 129	PNP, Si-AF Pre-amp, Dr, Vid, Amp	TO-5	EBC	1.21	2.02
PTS8130	SK3027 ECG 130 GE-14	NPN, Si-AF, PO	TO-3		3.55	5.92
PTS8152	SK3054 ECG 152 GE-28	NPN, Si-AF, PO	TO-220	BCE	1.71	2.85
PTS8153	SK3083 ECG 153 GE-29	PNP, Si-AF, PO	TO-220	BCE	1.71	2.85
PTS8154	SK3044 ECG 154 GE-40	NPN, Si-Vid Output	TO-39	EBC	3.21	5.35
PTS8157	ECG 157 GE-27	NPN, Si-HiV, AF, PO	X-58	ECB	2.09	3.49
PTS8159	SK3466 ECG 159 GE-22	PNP, Si-AF Pre-amp, Dr	TO-92	EBC	1.09	1.82
PTS8163	SK3439 ECG 163 GE-36	NPN, Si-Horiz. Defl.	TO-3		9.38	15.64
PTS8165	SK3115 ECG 165 GE-38	NPN, Si-Horiz. Defl.	TO-3		11.13	18.55
PTS8171	SK3201 ECG 171 GE-27	NPN, Si-AF/Vid Amp		EBC	2.22	3.70
PTS8182	SK3188 ECG 182 GE-55	NPN, Si-AF, PO	X-58A	BCE	5.00	8.33
PTS8186	SK3192 ECG 186 GE-28	NPN, Si-AF, PO	X-51	BCE	2.05	3.42
PTS8187	SK3193 ECG 187 GE-29	PNP, Si-AF, PO	X-51	BCE	2.05	3.42
PTS8190	SK3232 ECG 190 GE-32	NPN, Si-AF, PO Horiz. Dr.	X-81	EBC	2.30	3.84
PTS8192	SK3137 ECG 192 GE-63	NPN, Si-AF, PO	R-205	CBE	1.75	2.92

PTS P/N	MFG. CROSS REFERENCE #'S	DESCRIPTION	TYPE CASE	BASING	DLR. COST	SUGG. RETAIL
PTS8193	SK3138 ECG 193 GE-67	PNP, Si-AF, PO	R-205	CBE	1.46	2.44
PTS8194	SK3275 ECG 194 GE-18	NPN, Si-HiV, Gen Purp. Amp.	TO-92	EBC	.92	1.54
PTS8196	SK3054 ECG 196 GE-66	NPN, Si-AF, PO	TO-220	BCE	1.71	2.85
PTS8197	SK3083 ECG 197 GE-69	NPN, Si-AF, PO	TO-220	BCE	1.71	2.85
PTS8230	SK3042 ECG 230	SCR-Horiz Defl.	TO-66		4.63	7.72
PTS8231	SK3042 ECG 231	SCR-Horiz Defl.	TO-66		4.63	7.72
PTS8708	SK3135 ECG 708 GEIC-10	IC-TV/FM Sound IF, Amp, Det, Lim			3.70	6.16
PTS8713	SK3077 ECG 713 GEIC-5	IC-Chroma Demod.			4.17	6.95
PTS8731	SK3170 ECG 731 GEIC-13	IC-TV Vid Sig Processor			5.15	8.58
PTS8738	SK3167 ECG 738	IC-Chroma IF Amp.			5.63	9.39
PTS8739	SK3235 ECG 739	IC-Chroma Demod, Dr.			4.17	6.95
PTS8749	SK3168 ECG 749	IC-TV Vid. IF Amp			4.38	7.30
PTS8779	SK3240 ECG 779	IC-TV Sig. Processor			7.71	12.85
PTS8780	SK3141 ECG 780 GEIC-20	IC-TV AFC			3.34	5.57
PTS8783	SK3215 ECG 783 GEIC-21	IC-TV AFC			3.34	5.57
PTS8796	ECG 796	IC-Class "B" Audio Driver			2.09	2.49
PTS81112	ECG 1112	IC-2.2 W. Audio Amp			4.17	6.95
PTS8147	SK3095 ECG 147 GEZD-33	ZD-33.0 V, 1 W			.71	1.19
PTS8177	SK3175 ECG 177 GE-300	D-Si-Gen Purp Det, 200PRV			.63	1.05
PTS85072	SK3136 ECG 5072	ZD-8.2 V 1 W			.81	1.35
PTS8125	SK3081 ECG 125 GE-509	R-Si-1000PRV, 2.5 A			.81	1.35
PTS85404	SK3627 ECG 5404	SCR-20 VRM, 0.8 A			1.19	1.98

PTS ELECTRONICS, INC.

The Only Name You Need To Know

Available at your local PTS Tuner and Module Servicenter.
See Page 1 for complete listing.

Circle No. 103 on Reader Inquiry Card

THE

performers.

3 SMASH HITS... the 60 Series family

Ruggedness ▪ Safety ▪ Overload Protection

These VOM's have X-TRA™ rugged construction that can take a 5 ft. drop onto a concrete floor! They're safety engineered throughout with an unusual diode and multiple fuse arrangement providing overload protection for all ranges. Single selector switch reduces errors, in fact, the 60's eliminate over 90% of costly repairs from VOM misuse.

MODEL 60 VOM - 28 ranges, approved by Mining Enforcement and Safety Administration (2G-2880), only $112.00. Model 60-A has 1½% DC accuracy plus mirrored scale, only $121.00.

MODEL 60-NA VOM - 50 ranges, 1½% DC accuracy, mirrored scale, multiplier switch, only $154.00.

MODEL 64 FET-VO - FET design (high input impedance), Low-Power Ohms-LPΩ™— for in circuit testing, junction test circuit, exclusive MICRO POWER-TMP™ for long battery life under continuous operation, only $154.00.

Prices include test leads, new screw-on insulated alligator clips for probes, batteries, spare fuses, instruction manual and 1 year warranty.

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

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

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