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Here's how an exciting new micro-electronic breakthrough will make your children heros and improve your tennis game.

In Roger started pitching for his little league team, he was just another player. And then there was no better than anybody else. Months later a small miracle took place. The unit accepted two commercially available 6-volt lantern batteries which you can purchase locally or from JS&A for only $2 each. The batteries will last for weeks with normal use.

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The unit comes in a sports blue color and weighs 38.4 ounces, exclusive of batteries. It's rugged, well built and designed to endure the typical use and abuse it would normally receive.

We urge you to test this exciting new product during our 30-day free trial. Order the Sports Radar gun. When you receive it, measure your child's pitching speed. Test it on your own tennis serve. See how knowing your speed will actually improve it as you try to cut perform your previous record last pitch or serve. Then decide if the Sports Radar gun doesn't make a very exciting addition to your sports equipment.

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If you are not convinced that the Sports Radar gun is something that you'll use constantly to help improve your game, return it for a prompt and courteous refund, including your $3.50 postage and handling. You can't lose--and chances are your son will at least have the most popular new product in the neighborhood.

To order one for your test, simply send your check for $149.95 plus $3.50 for postage and handling to JS&A Group, Inc., at the address shown below. (Illinois residents please add 5% sales tax.) Credit card buyers may call our toll-free number below. If you wish to buy a set of two six-volt batteries, simply add $4.00 to your order.

We'll then send you the unit, the batteries (if you order them from us), a 90-day limited warranty and complete easy-to-understand instructions.

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Sabtronics gives you DMM and Frequency Counter kits with more features, better performance and incredibly lower prices

Model 2010A Bench/Portable DMM: $69.95 kit
Features: 3½ digit LED display • 31 measurement ranges 6-Functions • 0.1% Basic DCV accuracy • Touch-and-hold capability • Hi-Low Ohms • 40 Hz to 40 kHz frequency response • Auto Zero, Auto Polarity • Overload protected • Overrange indication • Single chip LSI logic • Laser-trimmer resistor network and ultra-stable band-gap reference for better long term accuracy • Built-in NiCd battery charging circuit.

Brief Specifications: DC Volts 100µV to 1000V in 5 ranges; AC Volts 100µV to 1000V in 5 ranges; DC Current 0.1µA to 10A in 6 ranges; AC Current 0.1µA to 10A in 6 ranges; Resistance 0.1Ω to 20MΩ in 6 ranges; Diode Test Current 0.1µA to 1mA in 3 ranges; Input impedance, 10MΩ on AC and DC volts; Power requirement, 4.5 to 6.5 VDC (4 "C" cells) or optional AC adapter/charger.

Model 2015A Bench/Portable DMM: $89.95 kit
Same features and specifications as Model 2010A except with large, 0.5" LCD 3½ digit display.

Optional Accessories:
#AC-115, AC adapter/charger $7.95
#THP-20, Touch and Hold Probe $19.95
#NB-120 NiCd Battery Set $18.75

Model 8610A Frequency Counter: $89.95 kit
Features: 8-digit LED display • 10 Hz to 600 MHz guaranteed frequency range (5 Hz to 750 MHz typical) • 3 Gate times • 10 MHz TCXO Time base • Auto decimal point • Overflow indicator • Leading zero blanking • Resolution to 0.1 Hz • Built-in charging circuit for NiCd batteries.

Brief Specifications: Frequency Range, switch selectable, 10 MHz, 100MHz, 600 MHz Sensitivity, ±10nV RMS to 100 MHz, ±50nV RMS, 100 MHz to 450 MHz, 90nV RMS 450 MHz to 600 MHz; Impedance, 1 MΩ, 10 MHz and 100 MHz ranges; 50Ω, 600 MHz range; Gate time (switch selectable) 0.1 sec, 1 sec, 10 sec; Temperature stability, 0.1 ppm/°C; Ageing rate <±5 ppm/yr; Accuracy, 1 ppm or 0.0001%; Input protection, 150V RMS to 10 kHz (declining with frequency); Power Requirement, 4.5 to 6.5V DC @ 300mA (4 "C" cells) or optional AC adapter/charger (7.5 to 9V DC @ 300mA).

Also available Model 8110A, same as 8610A except maximum frequency is 100MHz and without battery charging circuit: $59.95 kit

Ordering Information
USA - Add $5.00 per kit for shipping & handling. Personal checks have to clear before goods are shipped (allow 2-3 weeks). For faster delivery send cashier's check or money order. 10% deposit for C.O.D. orders. Florida residents and sales tax. CANADA - Add $6.00 per kit for shipping & handling. No C.O.D. payment in U.S. funds. OVERSEAS - Add $21.00 per kit for airmail delivery. Payment by bank draft in U.S. funds.

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For other information call (813) 623-2631.

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BUILD

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ON THE COVER

Even though it costs less than $125 to build, the triggered oscilloscope contains some rather nifty features. For example, a reference display of the zero volt DC level. To find out more and to get started building your own, turn to page 39.

MULTI-LINGUAL VOICE SYSTEM from Votrax can talk to you in seven languages. To find out what other speech synthesizer equipment is available, turn to page 44.

IF BANDPASS FILTER provides satellite TV receiver with the required selectivity. To find out the other missing components of the receiver, turn to page 47.


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The only thing that beats their performance is their price.

Accurate performance you can rely on, time after time. That's what you expect from a quality DMM. But don't expect to pay as much for it any more. Because now Sabtronics brings you top quality DMMs with more features and better accuracy than other comparable units on the market today. And they cost surprisingly less!

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What you get is a precision crafted unit that features single-chip LSI logic, laser trimmed resistor network and a stable band-gap reference element for better long term accuracy. Basic DCV accuracy is 0.1%. The Model 2035A gives you 32 measurement ranges over 6 functions and the Model 2037A an additional two temperature ranges.

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Both models feature touch-and-hold capability with the optional probe - its so convenient, you'll wonder why the expensive models haven't got it yet! And two-terminal input for all measurement functions - this eliminates lead switching and makes your job easier. The Model 2037A even has a built-in temperature measuring circuit with a -50°C to +150°C range (-58°F to +302°F) and is supplied complete with the sensor probe. Of course, auto zero, auto polarity and overload protection are standard. And you get 200 hour operation from a single 9V transistor battery. A low battery indicator warns you of the last 20% of battery life. The large, crisp LCD readouts allow easy viewing even in bright sunlight.

Assembling either kit is simple with our easy-to-follow, step-by-step instructions. And the built-in calibration references allow you to calibrate the unit any time, any place.

We've even eliminated difficult inter-connect wires. All parts mount on the PC board. The only wires you solder are the two battery-snap leads.

Biggest value in small DMMs

We are so sure that the Model 2035A and 2037A are the best values available that we offer a money-back guarantee. Examine either unit in your own home for 10 days, and if you are not convinced that it is the best value for your money, return it in its original condition for a prompt and courteous refund of the purchase price (less shipping and handling). Order yours today! Use the convenient order form or call us with your Master Charge or Visa number.

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<table>
<thead>
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<td>Shipping and Handling @ $5.00 per instrument*</td>
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Videodiscs heat up: A traditional rivalry has been buried in the interest of videodisc standardization. CBS and RCA, traditional rivals in the battles over color-TV systems, postpone record speeds, and bitter competitors in broad- 
ding and records, have finally gotten together on some- 
g. CBS has taken over a license to press discs for the 
A SelectaVision grooved capacitance disc system, 
which is scheduled to go into nationwide marketing early in 
operation is scheduled to be on stream in 1982. In the 
meantime, RCA will custom-press videodiscs for CBS.

A second from Japan: Mighty Matsushita Electric finally got 
involved on videodiscs, too, after more than a year of indeci-
d. Matsushita scrapped its own mechanical Visc-O-Pac 
system to officially embrace the grooveless capacitance 
(video high density) system developed by its subsid-
ary-Japan Victor Corporation. Matsushita said both com-
panies would produce players and seek to have VHD estab-
lished as the Japanese and world standard. Although both 
A SelectaVision and SelectaVision operate by reading variations in 
capactance, they are incompatible. Not only is one groove-
less and the other grooved, they use different modulation 
stands and RCA's revolves at 450 rpm while JVC's spins 
30 rpm.

Following the Philips-MCA optical system, now on the 
market, and RCA's announcement, VHD becomes the third 
standard to be announced for the consumer market. All 
the companies are wooing other TV receiver and record-
player manufacturers as licensees for their respective systems. In 
J.S., Zenith—the largest TV manufacturer—is getting 
most attention. There's a feeling that if it opt for the 
system, the battle is over. If it chooses either of the 
other systems, consumer market will be saddled with mul-
tidivers.

another VCR: If you think that videodisc standards 
are muddy, how about those for videocassette record-
ing in addition to fast-, medium- and slow-speed Beta and 
formats, BASF is about to introduce its LVR (Linear 
Recording), using 8-mm tape. Toshiba says it will mar-
ket its own LVR (Longitudinal Video Recorder) using 1/2-inch 
ass-loop tape. Time along comes another—a neat- 
ing little seven-pound attache-case portable VCR that 
quadrants-inch cassettes resembling audio cassettes. 
ning time per cassette currently is 30 minutes, but is 
duled to be stepped up to a full hour. The unit is made 
by Funai Electric, and is expected to be imported the U.S. by Technicolor as both a consumer and edu-
an-institutional product. Price in the U.S. is targeted 
under $1,000,” double the prospective price of Toshi-
LVR.

Color: Nearly 20 years of lobbying effort by the 
Commerce Department and the American television 
industry have finally paid off in South America, as the NTSC 
system makes a clean sweep of the six Andean coun-
tries. Colombia was the last country in the group to opt for 
American-developed system, following Venezuela's 
choice of the system. Just before Venezuela's commitment, 
the other countries are Bolivia, Chile, and Peru. Some of them won't be color-
casting for quite a while. But South America's two biggest 
countries are lost to NTSC. Brazil colorcasts in the German-developed PAL color on a 525-line television system. 
Argentina, which has not officially chosen a color system, 
probably will add PAL to its 625-line system, largely as a 
result of its extensive imports of German color equipment 
for last year's World Cup soccer matches. Argentina's 
nighbors Paraguay and Uruguay are still uncommitted.

Subscription TV: First it was pay cable. Now over-th-air 
subscription TV is beginning to make the kind of impact 
its proponents have forecast for 35 years. Although there are 
only six stations broadcasting the special no-commercial 
service, and they had a total of 400,000 subscribers at the 
start of this year (as compared with nearly 6,000,000 pay-
cable subscribers), rapid growth is seen, as network 
executives are hurrying to set up systems. Some familiar names are getting into the act. Magnavox and 
Zenith are preparing to make the units, along with Ca-
da's Electrohome, and CTS Knight, Oak, and Blonder-
Tongue, the latter three already in production, as well as 
Consumer Technology. Up to a million decoders are 
expected to be installed this year, at $125 and up. The 
simplest decoders merely unscramble the pay picture and 
are rented for a fixed monthly fee.

Dishes and captions: The old-line catalog and retail 
chain, Sears Roebuck, is gradually coming into the fore-
front of consumer-electronics technology. This month, 
Sears is scheduled to begin marketing captioning decoders 
for TV viewers with impaired hearing; they're manufactured 
by Sears affiliate Sanyo Manufacturing Co. ABC and NBC 
each is scheduled to offer five hours of programming with 
captions encoded in the vertical interval; PBS will provide 
10 hours. Captioning will be handled by the new National 
Captioning Institute, which will get a royalty on each de-
coder and special TV decoding receiver sold. Decoders initially 
will be priced at $250. The IC's for the decoders are being 
made by Texas Instruments. Sears, meanwhile, is holding 
talks with Comsat about possibly handling subscriptions 
and providing receiving installations for its proposed 
direct-to-home pay-TV system, which Comsat hopes to 
propose formally to the FCC this month.

Talking IC's: What's the hottest thing on the drawing 
boards in the semiconductor industry? Probably voice-
synthesis and voice-recognition IC's. Everybody's working 
on special IC's to recognize and answer commands. One of 
the most interesting—and probably one of the first in the 
consumer field—is expected to be the talking automobile 
dashboard, considered a potential safety device. An imagi-
nary conversation between driver and dashboard: "How's 
the gasolette?" "You've got over two gallons, enough 
to get 40 miles." "What about the oil pressure?" "It's OK." 
"Tune the radio to 96.2 and mute the commercials." "Yes, 
sir—and, by the way, you're exceeding the speed limit by 
five miles per hour."

DAVID LACHENBRUCH
CONTRIBUTING EDITOR
APRIL NEWS AROUND THE WORLD

FIBER SONICS

Warsaw——— Polish scientists, following research designed to produce an inexpensive equivalent to fiber optics for use in the audio ranges, have announced the discovery of fiber sonics. They have discovered that certain tubular materials, consisting of interiors transparent to sound and skins opaque to sound, can actually transfer sound from one end to another over lengths of several dozen meters through a series of internal reflections. Research group head Tomski Edissinski completed his successful first trial using a garden hose and two funnels, following over 800 unsuccessful trials using such lavish materials as sausage casings stuffed with cheese, prune-whip filled soda straws, and 10-meter-long filter cigarettes.

FIBER PHONICS

Moscow——— Russian scientists, claiming they had discovered "fiber sonics" years ago, but abandoned it due to a shortage of garden hose, today responded to the Polish announcement of fiber sonics with their own announcement of fiber phonics. Fiber phonics, instead of relying on the internal reflections of a carrier medium, takes advantage of the transmission capabilities of a suitably stressed elastic fiber. Initial tests involving two tin cans and a string were expanded to four tin cans and two strings for stereo; work on six tin cans and three strings has been delayed pending advances by Soviet medical technologists in grafting together the heads of one-and-a-half dogs.

NOPE SCOPE

Eugene——— Oregon oscilloscope manufacturer Whobet-Packers today announced a major breakthrough in low-price oscilloscopes. Their surprising new no-trace oscilloscope offers response and bandwidth specifications reaching into the several Gigahertz region. Offering a 5-inch undergraduate display with illuminated ridicule, this new scope is slated to sell in the "under-$100" area (just outside Enid, Oklahoma). Compared to single-trace, dual trace and multiple-trace scope, a company spokesman described this new no-trace scope as the ultimate in simplicity. "There's not a trace of confusion" sez he.

SOLDERLESS CAKE

No Haven——— Solderless breadboard manufacturer Condimental Special Tease has again denied rumors of the development of solderless raisin, rye, and whole-wheat breadboards, while announcing plans to create an international breadboard shortage, resulting in a breadboard crisis, mandatory rationing, and wholesale price increases to an unaffordable level. Warned that price increases might dampen sales because of inflationary influences on available discretionary dollars, a company spokeswoman said "The peasants have no bread? Let them eat cake!" This announcement was quickly followed by the firing of the spokeswoman, abandonment of the planned price increases, new contracts for workers at the company's Bastille plant, and the announcement of a new line of inexpensive solderless cake boards.

PICO COMPUTERS

Austin——— Taxless Instruments has announced a new level of miniaturization resulting in an under-three-hundred-dollar home computer, complete with keyboard and voice synthesis capabilities, small enough to fit on the head of a pin. Company miniaturization director V. Pyrrs, wearing a cloth over his head, explained to newsmen that only two problems remain before the new computer can be introduced to the public. First, keyboard entry seems to be a problem with the tiny, quarter-pinhead size keyboard. Second, they can't remember which pinhead they left it on. Meanwhile, several newsmen in the garden reported hearing a small voice crying "Help me! Help me!"

BUS STRUCTURES

Rainyvale——— The California District Federal Court has ruled on the level of integration in integrated circuits, found it inadequate, and will enforce mandatory bussing beginning immediately. The judge in the case denied taking payoffs from wealthy IEEE Bus Company executive Carmen Gettiss, claiming they were campaign contributions only.

ONE-CHANNEL STEREO

Parma——— Ohio inventor Emma R. T. Sullivania has announced stereo for one ear. The new advance is said to require only one amplifier, one speaker, and is compatible with everything from current television audio to old 78-RPM records. Called Emma Natural after its inventor, the new advance is not expected to be commercially available in Parma until sometime in the next millennium.

CALCULATOR POCKET

Salerno——— Fashion-designer Coochy has attacked what he finds as a major disadvantage to the pocket calculator. "Putta the dumma thing inna yor pocketta anna you no see what she says," complains Coochy. The answer is in his new line of shirts with transparent calculator pockets, including cutouts for keyboard access. The fashion world has acknowledged this as another Coochy coup.

MARTIN BRADLEY WEINSTEIN

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Facts from Fluke on low-cost DMM’s

Is this any way to treat a $139 multimeter?

Through world of industrial even a precision test can get treated like dirt. All the ruggedness and utility you can get in a DMM.

Find these qualities and a Fluke line of low-cost DMM’s have been from towers, stepped on, and construction equipment. We survived because we never on quality, even on our rugged, six-function Model subleshooter at $139 U.S. a close look at a low-cost Fluke and you’ll notice lightweight construction that to the hard knocks of life.

Sturdy internal design and high-impact, flame-retardant shells make these units practically indestructible. Right off the shelf, they meet or exceed severe military shock/vibration tests.

Even our LCD’s are protected by cast-tempered plastic shields. We use rugged CMOS LSI circuitry for integrity and endurance, and devote a large number of components to protection against overloading, accidental inputs and operator errors.

We go to these lengths with all our low-cost DMM’s to make sure they are genuine price/performance values. You can count on that. Because, that’s what leadership is all about.

For more facts on DMM reliability and where to find it, call toll free 800-426-0361; use the coupon below; or contact your Fluke stocking distributor, sales office or representative.
Everybody's making money selling microcomputers. Somebody's going to make money servicing them.

New NRI Home Study Course Shows You How to Make Money Servicing, Repairing, and Programming Personal and Small Business Computers
seems like every time you turn around, somebody comes along with a new computer for home or business use. And what’s made it all possible is the miniaturized microprocessor, the tiny little chip that’s a computer in itself.

Using this new technology, the industry is offering compact, affordable computers that will handle things like payrolls, billing, inventory, and other tasks for businesses of every size... perform household functions including budgeting, environmental systems control, indexing recipes, and more. And thousands of hobbyists are already experimenting and developing their own programs.

**Growing Demand for Computer Technicians**

This is only one of the growth factors influencing the increasing opportunities for qualified computer technicians. The U.S. Department of Labor projects over a 100% increase in job openings for the decade through 1985. Most of them new jobs created by the expanding world of the computer.

**Learn at Home in Your Spare Time**

NRI can train you for this exciting, rewarding field. Train at home to service not only microcomputers, but their larger brothers, too. Train at your convenience, with clearly written “bite-size” lessons that you do evenings or weekends, without going to classes or quitting your present job.

**Assemble Your Own Microcomputer**

NRI training goes far beyond theory. It includes practical experience, too. As you progress, you perform meaningful experiments building and studying electronic circuits on the NRI Discovery Lab. You assemble test instruments that include a transistorized volt-ohm meter and a CMOS digital frequency counter... instruments you learn on, use later in your work.

And you build your own microcomputer. Each step of construction advances your knowledge, gives you deeper insights into this amazing world that’s upon us.

This is the only microcomputer designed for learning. It looks, operates, and performs just like the finest of its kind... actually does more than many commercial units. But NRI engineers have designed components and planned the assembly procedure so it demonstrates important principles, gives you working experience in detecting and correcting problems.

And that’s what NRI training is all about.

**Other Opportunities in Electronics**

Since 1914, before commercial radio was even on the air, NRI has been the way to learn new electronics skills. Today’s modern offerings include, in addition to three different computer courses, TV/Audio/Video Systems Servicing, with training on the only designed-for-learning 25" diagonal color TV, with state-of-the-art computer programming. Or, check out our Complete Communications Course, preparing you to enter this booming field servicing, installing, and repairing equipment like microwave, broadcast, CB, shortwave radio, paging, radar, and more.

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International bird watching

A high percentage of the mail generated by the current series of articles on satellite TV in Radio-Electronics asks about receiving direct satellite-relayed reception from Europe, South America, and so on. It is possible. It is no more difficult than receiving the U.S. or Canadian domestic satellites, provided that you make a few minor adjustments to your equipment, and are ready to accept slightly inferior pictures.

One of the most interesting targets is the Russian Stasiional-4 satellite positioned over the Atlantic at 14° west (longitude). Stasiional-4 has at least six operating transponders: 3,695 MHz, 3,745 MHz, 3,795 MHz, 3,845 MHz, 3,895 MHz, and 3,945 MHz. The polarization is horizontal and audio is carried on a 7.5 MHz subcarrier. The apparent footprint-signal level is in the 19 dBw region on a global beam, which means that this satellite is receivable throughout all of Europe and Africa and west to an imaginary line drawn north by south from Chicago to New Orleans. All of South America is included in that coverage.

Within that coverage region a ten-foot dish, 150° Kelvin LNA and a tunable receiver with a 11-13 dB noise figure should insure high-quality reception. It won't be in color however, because Russia employs the SECAM color system. That satellite is but one of approximately ten the Russians expect to have operational before this year is out, so that they can relay television worldwide by the start of 1981 using their own network of geostationary satellites.

Can American (or Canadian) DOMSAT's (domestic satellites) be received outside of North America? Yes, in some cases. Canadian ANIK satellites have scupltured antenna patterns favoring Canada: but reception south of the Mason-Dixon line without big antennas (20 feet in diameter or bigger) is poor. U.S. DOMSAT's have a bigger area to cover (Alaska to Puerto Rico, Maine to Hawaii) so there is more spillover than with ANIK birds. Bermuda, the central and western Caribbean, virtually all of Central America, and the shoreline regions of South America bordering on the Caribbean are all capable of receiving U.S. DOMSAT's. But along with those coverage edges big antennas (20 to 30 feet in size) are required and with bigger antennas comes added expense.

The same people who refuse to grant private terminals permission to view their signals are quick to point out that, under international law, the U.S. (and Canadian) DOMSAT's are only licensed to serve their respective countries and that legally you are not supposed to set up a terminal in Caracas or Bogota in order to pirate U.S. satellite signals outside U.S. borders.

ROBERT B. COOPER, JR.

Cable TV companies selling homesat

Scientific-Atlanta has shifted its marketing strategy for the Homesat subsidiary it created last year. Now cable-TV companies will be selling the small TVRO earth stations to individual families within certain geographical regions. Originally, Homesat sold directly out of Scientific-Atlanta's home office. The first major cable-TV firm to hook into the deal is Tele-Communications Inc., which will sell Homesat equipment in the western states area, where that company operates many cable-TV systems. Meanwhile the increasing number of competing firms that sell earth-station equipment to families (such as Gardner Communications' StarScan, Avcomm, Channel One) continue to work out their own distribution means.

Satellite news notes

KRON-TV, an NBC-TV affiliate in San Francisco, is the first Bay Area TV station to set up its own Washington D.C. news bureau. The staff there beams news reports affecting Californians back home each evening via satellite, thus giving the newscast a Washington report with a local touch. WOR-TV New York Channel 9—with its hefty line-up of sporting events and movies—is now a round-the-clock superstation via Eastern Microwave which sends the signal around the country aboard RCA Satcom on Transponder 17.

C-SPAN (Cable-Satellite Public Affairs Network), which carries live coverage of debates from the House of Representatives, is adding other Capitol Hill and political features. C-SPAN recently transmitted highlights of a Republican political caucus in Texas; and starting this year, there's an arrangement with Close-Up Foundation that will involve the presentation of high-schoolers interviewing Washington figures during the traditional school excursions to the Nation's Capitol. Those interviews will be beamed to schools around the country to be used as supplements in social studies, government, and civics classes.

Sony, which makes equipment for the Japanese direct-to-home-satellite experiment, is looking at the U.S. and could introduce components or entire systems when direct-broadcasting satellites arrive here. Currently the 12-GHz experiment in Japan involves earth terminals costing about $350 each.

Political commercials via satellite! It's a possibility for this fall's campaign if a plan by John Blair & Co. materializes. Blair, a leading media company, has been experimenting with sending commercials directly to local TV stations via satellite links and hopes to have a system in place nationwide by this Autumn so that quickly up-dated commercials could be sent out. One obvious kind of commercials are the paid political announcements that are now usually air-freighted to TV stations; the satellite process could speed up their timeliness by a day or more.

GARY H. ARLEN
Just Another Limited Area Motion Detector!

Guardex

Protects Every Square Inch Of Your Building

Turns On Lights Automatically

Powerful Electronic Siren

Low Cost Computerized Burglar Alarm System

Home - Office - Business

NO INSTALLATION

tap the Guardex 8000 alarm system in, make several control adjustments to suit your particular building and home! There are no other wires to run. This totally self-contained burglar alarm can completely seal off every square inch of the surface of your building. It protects doors, windows, and most alarms miss... your roof, walls and floors.

HOW CAN ONE SMALL COMPUTER PROTECT MY WHOLE BUILDING?

The Guardex 8000 Alarm System works on the principle of audio imimation. This, put simply, is the process of electronically separating normal everyday sounds, such as voices, telephones, etc., from break-in type noises such as breaking glass, metal, or forcing a door open. The Guardex 8000 monitors story homes and offices up to 2000 square feet and commercial buildings up to 10,000 square feet. The Guardex 9000 with wireless remote sensor capability is available for multi-story homes and offices or single story with more than 2000 square feet. Call the factory for more detailed information.

TURNS ON LIGHTS AUTOMATICALLY

If the first break-in type sound is detected, the system will instantly turn on lights, radio, or other electronic equipment you have plugged into the back of the alarm. These lights will remain on for a period of five minutes, automatically turning off.

POWERFUL ELECTRONIC SIREN

Guardex 8000 alarm is equipped with a loud built-in siren. When the five minute period the lights or other electronic equipment has been activated, a second break-in sound is detected (it can be only a second or two after the first break-in). The built-in siren will start blasting for 90 seconds. At the end of approximately 90 seconds the siren will shut off and the system listens again. If another break-in sound is heard, the system will come on for another 90 seconds. If no other break-in is detected, the siren will stay off and at the end of the minute period the lights will shut off and the alarm automatically resets.

EXIT AND ENTRY DELAY

The Guardex 8000 alarm has a built-in exit delay allowing you approximately one minute to lock up and leave the building before the alarm is armed. When you enter your building, you may find that just your normal entering sounds activate the siren. You may delay it from starting for up to 30 seconds by turning up the siren entry delay control.

BATTERY BACK-UP

Burglars rarely cut power. However, to give you total protection from a burglar and possible power failure, our alarm has provisions for a battery back-up. (Batteries not included.) 12 volt lantern batteries are available at most hardware stores.

THE BURGLARY PROBLEM

The F.B.I. statistics show that at the present rate, one out of every four Americans are going to be burglarized. That is not a very pleasant fact, but it is true. You have greater chance of being burglarized than being a victim of a fire or automobile accident. The time is now to help protect yourself and your valuables with a Guardex 8000 alarm system.

OUTSIDE SIREN

The Guardex 8000 alarm is equipped with a loud, built-in siren, but if you desire an additional siren to mount outside or in an area away from the main alarm, they are available with 50 feet of wire for $24.95. (Connecting terminals are provided on the back of the alarm.)

30 DAY NO RISK TRIAL

This is your opportunity to purchase an alarm system directly from the factory for only $199.95. Try it in your home or business for thirty days without risking one cent. Put our Guardex 8000 alarm to your own test. See for yourself! It will protect every window and door from break-in. If you are not completely satisfied, return the alarm within 30 days for a complete refund. To order your Guardex 8000 alarm, CALL TOLL FREE to charge your credit card or send your check to Guardian Electronics, Inc. in the amount of $199.95. If you want the optional outside siren, add $24.94. (California residents add 6% sales tax.)

(Circle 48 on FREE INFORMATION CARD)

Call during California business hours, Monday - Friday)

California residents:
(213) 889-1414 collect

Guardian Electronics, Inc.
31133 Via Colinas, Dept. B
Westlake Village, Calif. 91361

13 APRIL 1980

Graphical and tabular content is included as described in the text.
It was electronics time in Las Vegas. The 1980 Winter Consumer Electronics show had arrived and more than 65,000 retailers and distributors jammed the convention center to capacity, while previewing the products that will soon be available to us. Much of what was shown was conventional—those everyday products that are the staples of the consumer electronics industry. But here and there, the spotlight shone on the exceptional.

I'd like to take just a few moments of your time for a look at these exciting products.

A flat-screen TV prototype from Sinclair. It will not be available this year, but the unit demonstrated was a working model. It forfells a whole new world of television. I believe the prototype unit I saw may finally introduce those large-screen, hang-on-the-wall color sets that have been so consistently predicted over the years and have, to date, not appeared.

"The Source" is the name of a time-shared computer service. Connect your home computer to your phone via a modem and with a local phone call you can now dial up all kinds of advanced programs, daily news, and wire-service features that you can select with key words of your choice. It makes your terminal a part of a nationwide communications network that will permit you to talk or send mail to any other terminal for as little as $2.75 per hour. It provides a buying service that lets you order merchandise, charge it to your credit card, and have it delivered to your door. It's an information service with endless possibilities. And there's much, much more; but that will be the subject of a complete article in a future issue.

Quasar presented a talking microwave oven. Again it's a prototype, but obviously represents the start of a whole wave of talking appliances, from wrist-watches and calculators to you name it.

And then there are the TV's you talk to—actually command. "Tell" it to switch on and it will. Tell it to change channel and it will. And it's custom-tailored to your voice—no one else can operate the remote. Panasonic and Toshiba showed these.

How about a Sharp TV that lets you watch nine channels at the same time on a single 25-inch color screen. Oh, you can switch frames too. And Toshiba showed a four-channel-on-one-screen set too. Of course, it will probably be less expensive to buy multiple individual sets, but what a beautiful example of technology.

Satellite TV? Out in the parking lot, and not officially a part of the show, was a $7500 earth station for satellite TV reception. In a truck with the antenna on the tailgate it was available for sale. The owner got his idea from the satellite-TV series currently running in Radio-Electronics.

Last, but not least, was Kenwood's FM stereo receiver. It has a CRT display that shows you every station on the air in your area; displays call signs and frequencies; measures signal strength, multipath distortion, and just about everything else you could possibly want. It is several years away from production, but if there had been one piece of equipment that I would have been allowed to cart out of the show, that FM tuner would have been my choice.

The next CES show is in Chicago in June and I just can't wait to get a look at that one.
The most automatic DMM you can buy

- Automatically selects correct range for faster, more accurate measurements of voltage, current and resistance.
- Automatically places decimal point for correct readings.
- Automatically indicates polarity.

Heathkit IM-2212 Digital Multimeter is loaded with automatic features that save you time and make it so much easier to get accurate measurements.

The Heathkit IM-2212 Digital Multimeter automatically puts you in the correct range for the measurements you're making. And it gives you accuracy you can count on: ±0.2% on DC and ±0.4% on AC. That's precision.

The IM-2212 is super-fast, too. Response time on DC is less than 3 seconds, so you're not standing around waiting for a reading. You get a large, clear digital readout of your measurement with decimal point automatically placed at the correct digit.

Ranges include:
- AC & DC voltage from 200mV to 1000V.
- Resistance from 200 ohms to 20 megohm.
- AC & DC current from 200 μA to 2.000 A.

A special hold switch lets you lock into the range you're using for added convenience.

The quality design of the IM-2212 includes complete input protection on all functions to prevent damaging overloads. An optional battery is even available for work in the field.

FREE CATALOG
Complete details and price on the Heathkit IM-2212 Digital Multimeter are in the new Heathkit Catalog, which describes more than 400 electronic kits for your home, work or pleasure. Send for your free Heathkit Catalog today or pick one up at your nearest Heathkit Electronic Center.

Heath Company, Dept. 020-644, Benton Harbor, MI 49022

Heathkit Products are also sold and serviced at Heathkit Electronic Centers (Units of Veritech Electronics Corporation) in major cities throughout the U.S. See your white pages.

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www.americanradiohistory.com
AC OUTLET CHECKER

The AC outlet checker described by William D. Kraengel, Jr., in the August 1979 issue has a serious shortcoming which may null its users into a false sense of security. All neon-lamp outlet testers of that type will indicate whether the neutral and grounding conductors are at the same potential, but none of them will measure the actual quality of the ground.

It is imperative that the grounding (green or bare wire) conductor be able to carry the full fault current, which would be 15 or 20 amperes in a residential receptacle. To do that, the resistance to ground must be less than 8 ohms on a 15-ampere circuit, or 6 ohms on a 20-ampere circuit. Mr. Kraengel's tester will indicate a satisfactory ground connection even if the ground resistance is up on the kilohm range.

I recommend that all users of the simple neon-lamp receptacle testers perform a simple added check: De-energize the circuit, and measure the resistance between the grounded (wider slot) terminal and the grounded (round hole) terminal on a receptacle that has passed the neon-lamp test. That resistance should be less than 10 ohms. It would be a good idea to measure the resistance between the grounding terminal on the receptacle and a known good ground, such as a water pipe or a ground rod, that resistance should be a few ohms at most.

One last word about ground quality: Some ground clamps that are sold in handymen and department stores are of inferior quality, being made of aluminum with a copper or brass plating. Don't use them! The safest, most durable grounding system uses copper ground rods (or a buried copper water-pipe network) with copper ground clamps and copper wire. I have discovered many faulty grounding systems where the clamp used to connect the load center's ground wire to the ground rod was made of aluminum, and had been eaten away completely by galvanic corrosion.

ERIC LEMMON
Lompoc, CA

VIDEODISC SYSTEMS

I have been reading your articles on the two major videodisc systems, as well as updates and letters from other readers. I myself have managed to order a Magnavision optical system machine through the aid of a friend.

My concern is that a potentially beneficial invention, such as this, may be totally lost in the shuffle, or be greatly delayed in production, because of the useless haggling over different and entirely incompatible systems.

Many articles have stated: "Let the public decide." I would certainly agree with that. The problem is that the various companies are stacking the decks so that the public's decision will not be based upon the merits of a particular system but on the software available. Magnavision/MCA has Paramount, Universal, and Warner Brothers films, for example, while RCA has MGM and 20th Century Fox. Isn't that familiar—or have we forgotten about the quad situation when Columbia and RCA were incompatible? Everyone lost, including the consumer—perhaps especially the consumer!

Perhaps we could learn a better lesson from the videocassette "war" now going on.

continued on page 22
If you don’t see your kind of electronic pliers here, ook again,

Xcelite® makes them all.

Xcelite, long acknowledged as the world’s first family of electronic hand tools, now includes a greatly expanded line of solid joint pliers and cutters. All the pliers you’ll ever need, and more. Because new designs are continually added as new electronic products are born.

The present range extends through 36 patterns and sizes including 13 new models for miniature electronics. Made in U.S.A. by the latest technology and quality controls, in one of the world’s most modern electronic hand tools plants, Xcelite pliers set the standards for the industry. Yet the same advanced production techniques make them competitively priced.

Typical of the features that single out Xcelite quality are coil spring openers, polished heads, cleanly milled and perfectly aligned jaws, hand-honed and mated cutting edges, exceptional strength and performance provided by forged alloy steel construction, precision machining and scientific proportioning. Handles are designed for maximum leverage and convenience, with plastic coated "Cushion-Grip" for added comfort.

Styles? What else could you possibly need: standard, midget, and taper nose diagonals; standard, very fine and extra thin needle nose; long and short nose; long, short and midget chain nose, with and without side cutters; side cutting; short flat nose, round nose; tip cutter wiring; cutting and looping; short nose tip cutting; thin bent nose; midget semi and full flush cutting; diagonal full flush cutting; and stainless diagonal cutting.

You don’t know what you can do with pliers until you know what Xcelite pliers can do for you. See your distributor and let him update you.
Learning electronics is no picnic.

At any level it takes work and a few sacrifices. But with CIE, it's worth it.
said, "The best things in life were not just a bowl of cherries, learn electronics..."

3. **Programmed learning.**

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**MAIL TODAY!**
on. True—there are different systems, but when software is made available it's produced in both formats: Beta and VHS. That way, the buyer can select a recorder for its recording abilities rather than being penalized because of which pre-recorded material he wants.

Along those lines, I see no reason why the two videodisc systems can't exist side by side. Those who want only movies, and a less expensive machine, can buy an RCA system. Those who want (or need) the extra features that Magnavision/Philips provides the recording abilities rather for information ket, and bers for some

WILLIAM STAR

Star systems.

(a to one

to

WILLIAM RADFORD-BENNETT

Washington, D.C.

TEXTRONIC TEST EQUIPMENT

Off and on in your magazine, I have noticed requests for technical data for Textronic and related test equipment. I have located the Air Force technical order numbers for some of the more common oscilloscopes and preamps on the surplus market, and have listed them below. To obtain those, individuals should write to the Government Printing Office, Washington, D.C. for information on price and availability.

Oscilloscopes:

Tex. RM35 ... T. O. No. 33A1-13-76
Tex. RM35A, T. O. No. 33A1-13-177
Tex. 535...... T. O. No. 33A1-13-76
Tex. 536A ..... T. O. No. 33A1-13-241
Tex. 545 T. O. No. 33A1-13-73
Tex. 545A T. O. No. 33A1-13-247
Tex. 585...... T. O. No. 33A1-13-173
Hickock 1805,

1805A .......... No. 33A1-13-66

Preamps:

Tex. type B ... T. O. No. 33A1-13-115
Tex. type C A......... No. 33A1-13-116
Tex. type K ....T. O. No. 33A1-13-113
Tex. type 53/54A.. No. 33A1-13-114
Tex. type 53/54B.. No. 33A1-13-115
Tex. type 53/54C.. No. 33A1-13-409
Tex. type 53/54CA No. 33A1-13-116
Tex. type 53/54G. No. 33A1-13-118
Tex. type 53/54K... No. 33A1-13-113

CHARLES BROWN

EINSTEINIAN IMPOSSIBILITIES

Having made a list of extensive impossibilities in Einstein's special theory of relativity, I notice that Dr. Howard Mark's letter (October 1979 issue) mentioned an Einsteinian notion that is one of my evidences: relativity of simultaneity.

Mark states that events simultaneous to one observer cannot be simultaneous to (a moving) observer. By "events" he means, for instance, flash-emissions of light at two spots (A' and B') in the moving reference system and equidistant from the "moving" and "rest" observers (M' and M respectively).

Resulting flash-beams are received simultaneously by M' but not simultaneously by M' because M' moves closer to one (from B') and farther from the other (from A'). Einstein could not explain how the beams could be received simultaneously by M' in his reference system (say a train) because that would mean the beams had unequal or variable velocities coming from each direction along the train. So he assumed that the emissions occurred "nonsimultaneously in the train. Purporting that one flash (at A') occurred later than the other (at B') he could insist that the beams had equal or constant velocities. Inspect Einstein's logic closely: As M' and M coincide, M judges that the flash at A' occurs (with the flash at B'). It did not yet occur according to M' but occurs later, after M' moves farther to the right of M. Meanwhile, according to M, the beam has already passed A', having traveled along the train to some spot to the right of A'; observers in the same train with M', stationioned between A' and that spot cannot have helped notice! Einstein's logic proves to be a physically impossible self-contradiction. Relativity of simultaneity is physically impossible.

ANTHONY HANS KLOTZ

Long Island, NY

OUTBOARD CONVERTERS

Can you tell me something about the availability of "outboard converters" as mentioned in the review of the Electra BC-220 scanner on page 35 of the September 1979 Radio Electronics? Any information about the purchase or construction of such converters would be greatly appreciated. Also, any information about improving reception on the Aircraft Band (118-136 MHz) would also be very helpful.

Your magazine is the finest in its field. Keep up the good work!

J. P. MAGUIRE

Wappingers Falls, NY

Converters are available both as kits and factory-wired units from several domestic manufacturers:

Hamtronics, Inc., 65 Mou Rd., Hilton, NY 14468;

Vanguard Electronic Labs, 196-23 Jamaica Ave., Hollis, NY 11423;

VHF Engineering, 320 Water St., Binghamton, NY 13901;

Hermes Research and Development Co., 3997 Eckam Blvd SE., St. Petersburg, FL 33705;

Janel Laboratories, 33900 Eastgate Cir., Coralvirs, OR 97030;

Advanced Receiver Research, Box 1212, Burlington, CT 06013.

We have been advised by the Electra Company (Cumberland, IN 46229) that they have tested the BC-220 aircraft performance has been improved since our evaluation sample was tested. They assure us that customers should find no trouble receiving stations in the 118-136 MHz frequency range. In any case, sensitivity on weak signal reception may be improved with the addition of a preamplifier available from virtually all of the converter manufacturers above.—Robert B. Grove

R-E

DMMs from Keithley. Call your nearest distributor.

ALABAMA

Huntville PIONEER 205/837-9300

ARIZONA

Phoenix METERMASTER 602/243-4111

Tampa JENSEN TOOLS, INC. 602/968-6231

CALIFORNIA

Los Angeles METERMASTER 213/695-4340

San Diego METERMASTER 317/395-0313

CONNECTICUT

Middletown EIL/MANClB DIVISION 203/346-6446

FLORIDA

Orlando PIONEER 305/859-3600

Palm Bay EIL, INSTRUMENTS, INC. 305/775-8300

ILLINOIS

Chicago METERMASTER 312/593-8650

PIONEER 312/437-0690

INDIANA

Indianapolis PIONEER 317/949-7030

MAINE

Burlington EIL/MANClB DIVISION 207/272-9450

MARYLAND

Baltimore PIONEER 301/782-7500

Gaithersburg PIONEER 301/948-0710

Timonium EIL, INSTRUMENTS, INC. 301/532-1260

MICHIGAN

Ann Arbor PIONEER 313/465-9090

Livonia PIONEER 313/525-1800

MINNESOTA

Minnex Ltd. PIONEER 612/855-5444

NEW JERSEY

Fairfield AMPower 201/327-7720

NEW YORK

Great Neck INSTRUMENT MAST 516/487-7430

Long Island EIL, INSTRUMENTS, INC. 516/233-6333.

New York ADVANCE 212/687-2224

Rochester AMPower 716/377-1030

NORTH CAROLINA

Greensboro PIONEER 919/273-4441

OHIO

Cleveland PIONEER 216/887-3600

Dayton PIONEER 513/898-7116

OREGON

Portland PIONEER 503/283-0132

PENNSYLVANIA

Philadelphia PIONEER 215/691-4800

EIL, INSTRUMENTS INC. 215/357-7733

Pittsburgh AMPower 412/782-2390

TEXAS

Dallas PIONEER 214/386-7390

Garland METERMASTER 214/271-5671

Houston METERMASTER 713/388-5555

QUALITY InSTRUMENT LABS, INC. 713/324-0528

VIRGINIA

Alexandria EIL, INSTRUMENTS, INC. 703/354-8030

Virginia Beach EIL, INSTRUMENTS, INC. 804/469-3746

USA.

ADVANCE ELECTRONICS 800/223-0474

(except New York)

AMPower 800/526-2514

(except New Jersey)
Your 130 DMM gives you 0.5% DCV accuracy, a 10A range, a bigger display, easier controls, and lighter weight.

With all the hand-held DMMs around these days, it can be tough to pick the one that's best for you. Some are just too basic; others have a lot of high-priced frills that you may not want. Our Model 130 Digital Multimeter makes that choice a lot easier because it was designed with your needs in mind.

**Accurate.** The 130 is five times more accurate than many comparably priced analog VOMs, and it also compares favorably with other, more expensive hand-held DMMs. Its basic 0.5% DCV accuracy is probably as much as you'll need outside of lab situations, so you don't have to pay for more than you want. That's long term accuracy—only one calibration adjustment is required, once a year.

**Rugged.** We built the 130 to be tough enough to take it in real-world situations. The case is 2.5mm (.100") thick and made of high strength, impact resistant plastic. The LCD window is tough, scratch-resistant polycarbonate. The handsome faceplate is designed for maximum legibility and ease of use—all ranges and functions are color-coded and clearly marked.

Components are on a single PC board that's mounted to the faceplate, permitting the vital electronics to be free of the backing and protecting them from jolts. Yet the whole unit weighs a mere 283g (10 oz.) of the lightest units around.

**Easy to use.** Our 15mm (0.6") LCD display is 60% larger than that of many other pocket DMMs. Both range and function are easily selected with one hand—no complicated pushbuttons. And a rear panel mount lets you use the 130 while it's mounted to a stand or special holder, even without taking it out of its carrying case.

And that's no fluke.

**Keithley quality.** Like all Keithley products, precision components and user-oriented design are built right in to the 130. Full overload protection, a 10A current range, auto zero and auto polarity round out the list of standard features. And a full set of accessories expands its capabilities to 40kV, 200A and 700MHz. But the real measure of Keithley value is what we give you all this performance at a sensible price.

Keithley Instruments, Inc.
28775 Aurora Road
Cleveland, Ohio 44139
(216) 248-0400

Available through local distributor.

$99 (CASE EXTRA)

Prices and specifications change without notice.
Beckman Instruments
Models Tech 300 and 310
Digital Multimeters

CIRCLE 101 ON FREE INFORMATION CARD

BECKMAN INSTRUMENTS, INC. (2500 HARBOR Blvd, Fullerton CA 92634) has been making test instruments and precision components of many kinds for a long time. They're now making a complete line of digital multimeters. One pair of almost twin meters are designed and priced especially for electronic technicians and hobbyists in all fields. These are the models Tech-300 and Tech-310. A 10-ampere current range and a built-in continuity function are provided on the 310, but otherwise they're almost identical. The readout is a highly legible 3½ digit liquid crystal display.

The Tech-300 has a total of 27 ranges for seven functions, while the Tech-310 has 27 ranges, plus an additional 10-ampere current range. The functions and ranges are selected using the function/range switch. (You can't say "controls" because there is only one.)

Each function and range is very plainly marked, and the knob is recessed to avoid accidental damage. So are the special banana jacks along the bottom. Those are of the protected type, so that no bare metal is exposed when the test-leads are plugged in. The test leads, by the way, are very rugged-looking and the probes have protective collars on the end to keep fingers out of things.

Both meters measure DC volts on 5 ranges from 200 mV up to 1500 V with an accuracy of 0.25% for the Tech-310 and 0.5% for the Tech-300. AC volts are measured on the same ranges except for the top one which is 1,000 volts RMS. The accuracy of the AC voltage measurements is 0.75% for the Tech-310 and 1.5% for the Tech-300. Alternating and direct current are measured in 5 ranges (6 ranges on the Tech-310) from 200 microamps to 2 amps with the Tech-300 and 10 amps with the Tech-310. There are 5 resistance ranges, from 200 ohms to 20 megohms. All are low-power ohms with a maximum in-range voltage of 250 mV.

For diode/transistor testing, a special range is used, marked with a diode symbol. That applies up to 2.0 volts across the junction. If the junction is reverse-biased, ohm appears on the display indicating circuit condition. Reverse the test leads and if the junction is good, you'll read the actual voltage drop across the junction on the 2-volt scale with a resolution of 0.1 mV. The current flowing is limited to 5 mA by a constant-current source. That protects transistors from damage. Junctions may be tested in-circuit with as little as 200 ohms shunt resistance.

A special continuity test that Beckman calls Insta-Ohms is used in the Tech-310 on all ohms ranges. Continuity tests have been difficult on conventional DMM's. With this new feature, if you touch the test leads to a circuit and the resistance is anything less than twice the range chosen, an ohms (omega) symbol will appear instantly in the upper left corner of the display. It tells you that the circuit does have continuity. A fraction of a second later (1/2, second to be exact) the circuit resistance will appear. (If you're on the 200-ohm scale, you'll see the reading if there's anything below 400 ohms.) If it's more than range, ohm appears and you switch to a higher range. The ohm is also overrange readout for all other ranges and functions.

Another feature that should also be popular is the battery life. The meters use only a single 9-volt rectangular battery and an average life of 1600 hours or 2 years is claimed for a common zinc-carbon battery (with an alkaline battery, up to 2,000 hours). The low battery indication is a blinking decimal point. When that appears, there's approximately 200 hours of battery life left.

Practically all of the circuitry is contained on a custom-CMOS LSI IC. The CMOS technology accounts for the long battery life. By using the LSI IC, the total count of electronic parts is reduced to less than 40. Each instrument is given a 100-hour burn-in test and complete calibration tests. A one-year warranty is given, which includes calibration.

The high accuracy of those two meters is obtained by the use of special thin-film IC-type voltage divider networks. They are used on all functions. None of the inputs are protected against overload including the resistance ranges, which can withstand up to 300 VDC or RMS AC. The current inputs are protected against overload by a 2-ampere fuse, except for the 10-ampere range on the Tech-310. That input will withstand up to 20 amps for 30 seconds (which should give you plenty of time to "get out of there!")

Accessory probes are available for reading up to 50 kV DC. 200 MHz AC currents up to 1000 amps, with a current-clamp-type probe. Also available are a set of deluxe test leads and two carrying cases. The meter case itself is a tough plastic case claimed to withstand a drop of 6 feet to a hard surface. It has a retractable bail that is used for a bench-rest, or can be flipped around to make a carrying handle.

The price is quite reasonable for instruments of this quality: $110.00 for the Tech-300 and $140.00 for the Tech-310. The Beckman company has a wide reputation for making quality instruments and precision components and their technology has been put to good use in designing and building these two meters.

We checked our meters out on TV sets and assorted semiconductors, and found them very easy to use and to read in dark places with no problems. Quite a pair of instruments! R-E

JVC HR-6700U Video Cassette Recorder

CIRCLE 102 ON FREE INFORMATION CARD

The first blow to the motion picture industry was the widespread proliferation of home television. Box-office receipts plummeted. Then Hollywood discovered that, rather than a threat, TV was a logical medium to exploit with the made-for-television movies. Now, a new threat appears to have emerged: the home video recorder.

The home video machines are available in two hotly-contested formats: Beta and VHS. At the present time, there seems to be an indication that VHS is winning. We decided to have a look at one of the better VHS machines, the 6700U video cassette recorder from JVC. In addition, JVC offers a matching Vistavision film camera that can turn the video cassette recorder into an instant home movie camera. But more about that later.

The HR-6700U VCR weighs in at 31 pounds, and is a videophile's delight! Handsome in appearance and flexible in performance, the recorder touts a variety of features, many controlled by six microprocessor memories.

Selectable tape speeds provide up to six hours of recording from a standard two-hour T-120 video cassette. Slow motion at 1/5 to 1/5 normal speed shows no degradation or noise on the signal; and even still playback is available for "freeze-frame" fans.

The secret behind the quality of slow-speed video recording is the recording-head complement. Most competitive recorders use the same heads for recording a variety of speeds. Because of that tradeoff, non-standard speeds suffer distortion. The HR-6700U features six separate recording heads, providing a much higher density of information. Both picture and sound are enhanced using that technique at both slow and normal speeds.

Crosstalk distortion is also minimized by an advanced H-aligned format that allows noiseless double-speed playback in the normal (two-continued on page 32
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EQUIPMENT REPORTS
continued from page 24

hour) mode as well as triple-speed playback in the six-hour mode.

Picture stability has always been a problem in video recording as speed fluctuates, so does the synchronization signal. The new JVC recorder incorporates a microcomputer-controlled timer that works in conjunction with a fast-response capstan servomechanism to lock on to those synchronizing signals that prevents the annoying flipover so frequently associated with home recorders.

For recording off the air, a built-in VHF/UHF solid-state tuner is operated manually or by microprocessor memories. Unattended, the machine will record six programs on different channels up to a week in advance, or at the same time every day—or at different times on different days! Now that's flexibility!

A dual-mode auto-search counter allows the user to program the recorder to stop at "0000" in rewind, or to stop where the recording began—whether in fast forward or rewind.

A remote-control accessory allows the operator to shift speeds from the comfort of his viewing position. But to use the convenience of the many automatic features, he may allow the machine to do his speed thinking for him. The HR-6700U senses the speed format of the tape that has been loaded and automatically switches to the correct speed.

When the owner desires to watch TV, he merely switches off his recorder, the antenna will be automatically connected to the television receiver. The tuner portion of the recorder is a presettable 12-channel VHF/UHF tuner with channel-lock provision. Input impedance is nominally 75 ohms on VHF, and 200 ohms on UHF.

Video signal-to-noise ratio is better than 45 dB, and horizontal resolution is at least 240 lines; the audio-frequency response is 50-10,000 Hz.

The optional matching color camera is compact and lightweight, slightly over three pounds, depending upon zoom lens.

The original engineering philosophy was to provide a camera that is as small and lightweight as a standard 8 mm home movie camera—and as easy to operate. A tall order, but JVC seems to have done it! In our test, the video camera came through with flying colors. Focus was sharp; persistence was fast (very little smear from rapid movement), and the camera was not fatiguing to hold and operate.

The operation of the camera couldn't have been simpler: Point and shoot! Zoom and focus are no more awkward than on a quality photographic camera. For the home-movie addict who wants to move up into the electronic age, this is the way to go.

The camera is built around a 0.66-inch vidicon with either a 3 X or 6 X zoom lens available. It features automatic iris control and through-the-lens viewer. Color correction (temperature or white balance) is accomplished electronically without the need of optical filters. Exposure indicators in the viewfinder alert the user whenever there are improper lighting conditions.

A built-in high-sensitivity condenser microphone features a wind screen. While a ten-foot cable is provided, extensions up to 60 feet from the recorder are allowable. A pistol-trigger switch activates the camera and recorder. A tripod and spotlight accessory may be purchased separately if desired, to be used with the camera.
specifications for the camera show it to
MHz single-carrier frequency multi-
cum with 525 lines, 2:1 interlaced. Col-
atures are switch selectable among
800, or 6000° K. Video output is 1 volt
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The suggested retail list price for the GX-
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shunted by 30 pF. A switch selects AC or DC input, as well as acting as a grounding switch for the input circuitry.

Other features are located in the brown-shaded area at the upper right hand corner and the extreme bottom center. The latter is the MODE switch that determines which input signals will be displayed. Aside from the normal Channel-1 or Channel-2 signals being displayed alone or simultaneously, the switch will also algebraically add or subtract the input signals. That feature is particularly useful when comparing phase and voltage relationships of the two input signals, among other important tests.

The center right-hand portion of the front panel is related to the triggering of the time-base. In that section will be found the LEVEL control; the MODE switch, which selects whether the scope will be triggered automatically, in the normal manner, or if it is to be used with composite signals such as a TV signal. In fact, like most better scopes today, the MODE switch has positions for TV(+), TV(-) and TV(2) signals. There is also a SOURCE switch that obtains the trigger pulse from the Channel-1 or Channel-2 inputs, the 60 Hz line, or the external TRIG INPUT jack. The latter is a BNC type.

For calibration purposes there is a 0.5V P-P squarewave signal available on the front panel. It is located at the upper right-hand side of the unit. The amplitude is accurate to within 3% and the frequency is 1 kHz ± 10%.

Another control that is often not found on many scopes is a TRACE ROTATION control. It is useful in eliminating the effects of external magnetic fields and could be called a tilt control as that is the effect of misalignment.

The rear panel contains an external blanking input jack, a 2-amp fuse (for 90-132V operation) and the AC line cord.

All input connectors with the exception of a common ground jack on the front panel are of the BNC type that allows for quick connection and disconnection of cables and probes. The ground jack is the banana-plug type.

Using this Hitachi scope on the bench is enjoyable. After the short period of time that is needed to become familiar with the location and function of the various controls, the ease of operation was quite noticeable. The patterns displayed were steady, sharp, and showed no signs of blooming. A composite video waveform was used to test the usefulness of the scope. The V-302 came through with flying colors. If your use for an oscilloscope is in the TV and video industry, then you are sure to appreciate the V-302’s ability to display a composite waveform.

The operating manual supplied with the scope tested was complete and contained all the material necessary to help you become adept at the operation of the V-302. All controls, input jacks, and adjustments are outlined within the three dozen pages in the manual. In addition, there is a wealth of information and theories that outline the manner in which the shape of the trace can be used to its fullest extent— including the measurement of frequency and time, amplitude, and quality. Other uses include phase measurements and delays. Some internal operator-adjusted adjustments are also outlined in the manual.

Although many owners of such exotic equipment may be in the habit of making most of their own repairs, one thing lacking from the manual is almost anything relating to service. There is no schematic or any internal layout charts to assist in even minor servicing. While we do not doubt that such information is available, we feel that such equipment should be shipped with a simple service manual at the very least. There is, however, a list of Hitachi Denshi Ltd. offices throughout the world and continued on page 36

**SPECIFICATIONS**

- **Bandwidth**
  - DC to 30 MHz
  - DC to 5 MHz (using X 5 gain)
- **Rise time**
  - 12 nanoseconds
- **Max input**
  - 600 volts P-P
  - 300V (DC + AC peak)
- **Timebase**
  - 0.2 µs to 0.2 s
  - 19 steps, 1-2-5 sequence
- **Magnification**
  - X 10 (max speed, 100 ns-per-div.)
- **Sensitivity**
  - Y Axis: 5 mV to 5 V-per-div.
  - X Axis: same as above
- **Bandwith**
  - X Axis: DC to 500 kHz
- **X-Y phase**
  - Less than 3-degrees at 10kHz
- **Trigger sensitivity**
  - 20 Hz to 5 MHz
  - 0.5 div internal, 200 mV external
  - 5 MHz to 30 MHz
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Level "C" includes a 4k RAM and EPROM to use the popular S-1027 or the TI 2516. It includes all sockets, power supply, regulator, heat sink, and decoding and decomposing components. Sockets may also be used as RAM (4k) allowing for up to 128k of RAM.

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Level "E" Specifications
Level "E" adds a 4k EPROM to use the popular S-1027 or the TI 2516. It includes all sockets, power supply, regulator, heat sink, and decoding and decomposing components. Sockets may also be used as RAM (4k) allowing for up to 128k of RAM.

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deluxe steel cabinet, with probes and power supplies.
The design adds the Toolkit commands to PET's own BASIC-command list. Once the system is initialized, you can't tell where the Toolkit takes over, that the added commands cannot be

AUTO command automatically prints line numbers, starting at any legal and increasing by any increment.

ERB spreads your line numbers apart you have inserted too many lines to allow additional. RENUMBER updates all jump

APPEND command combines two pro-

DUMP command lists all the variables arrays, following program execution.

STEP is a variation of trace that enclose statement at a time. OFF disables the line and STEP functions.

FIND command searches all program's a group of lines for a specified character. It is very useful when you want to particular line that has been moved.

HELP command makes short of careful program errors. When the display an error message, typing HELP use the computer to display the line in the error occurred and, in addition, dis-

RENUMBER is a feature of renumbering. It also helps deter familiar variable name has already used.

FIND displays all lines that include a text reference.

The Toolkit is available in several versions with the various PET configurations. All the connection of a ROM into the "B" 1096 block of memory. Early PET's PET's have the extra sockets, so the tape kits consists only of a ROM—no serial memory decoding is required. There are versions for Expandamem and Skylesry boards, so the Toolkit can be added at a point where the memory connector y used to interface with the memory board.

BASIC Programmer's Toolkit is a pro-

PET's of Palo Alto IC's and is available only at PET dealers. Chip-only versions sell for 5, and the completely-assembled versions & Pets, Skyles or Expandamem boards 9.5. The Toolkit is an exceptional, pro-

Pet is serious about BASIC program would do well to put it at the top of his

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**INDIVIDUAL COMPONENTS**

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOS-1416</td>
<td>14-16 PIN MOS CMOS SAFE INserter</td>
<td>$ 7.95</td>
</tr>
<tr>
<td>MOS-2428</td>
<td>24-28 PIN MOS CMOS SAFE INserter</td>
<td>$ 7.95</td>
</tr>
<tr>
<td>MOS-40</td>
<td>36-40 PIN MOS CMOS SAFE INserter</td>
<td>$ 7.95</td>
</tr>
<tr>
<td>EX-1</td>
<td>14-16 PIN EXTRACTOR TOOL</td>
<td>$ 1.49</td>
</tr>
<tr>
<td>EX-2</td>
<td>24-40 PIN CMOS SAFE EXTRACTOR TOOL</td>
<td>$ 7.95</td>
</tr>
</tbody>
</table>

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TRIGGERED OSCILLOSCOPE

This easy-to-follow design lets you keep cost low by using a CRT of your choice. Its operational feature is a continuous zero baseline.

DANIEL METZGER and DENNIS PERRY

A technician has experienced shoot out with a calibrated DC scope, he’ll probably want to keep scope probe close at hand most of the time he’s at the service bench. Transistor-emitter voltages, collector base voltages, and IC logic levels checked as easily as power-supply while the operating signals are on. No other instrument provides simultaneous readout of bias and conditions.

Two factors have conspired to keep scope probe out of the hands of experimenters. The first is cost. Approaches $200—even for a kit. The problem is easily solved by simple design. The scope described here is built from standard parts for and considerably less if the junk box is well stocked. Yet it boasts a 20,000-bandwidth and 10 mV-per-division sensitivity.

The second factor is the annoyingly intermittent need to lay down the probe. When you switch over to the scope, throw the input from DC to ground, check the operation of the zero-volt baseline, and switch back to DC. That problem is handled by incorporating a circuit that provides a continuous display of the ground level at a brightness level that is much lower than that of the signal display.

It works

Operation of the scope as a whole can be understood from the block diagram. Fig. 1. The vertical attenuator and filter provide a replica of the input both AC and DC, at the approximate voltage level needed at the deflection plates of the CRT. The electronic baseline switch interrupts the signal grounds the amplifier input for approximately 3 ms each 15 ms, thus providing a 1/3 duty-cycle baseline display at a rate of about 60 Hz—too fast for the eye to perceive the flicker.

A separate trigger amplifier is fed from a point ahead of the electronic baseline switch to preserve continuity of sweep triggering. A Schmitt trigger produces squarewaves in sync with the input signal, and a differentiator produces sharp spikes from the edges of the squarewaves. The negative spikes initiate a linear ramp that always starts at the same selected point on the input AC waveforms.

![Diagagram of the zero-baseline scope](link)
form. That ramp is applied to the horizontal amplifier to produce the calibrated time sweep. A source-follower provides a low output impedance for the ramp, and an op-amp comparator holds off further triggering signals until the ramp voltage returns to zero.

An auto-trigger circuit senses when the Schmitt trigger is not switching and immediately applies a voltage to the ramp generator commanding continuous ramps, thus providing sweeps for the display of DC voltages.

A UJT baseline oscillator running at approximately 60 Hz is synchronized to the sweep generator to insure that the switching from signal to baseline will always occur during a retrace of the sweep. The baseline flip-flop drives the baseline-switching FET's at the input of the vertical amplifier.

The CRT cathode is operated at -900 volts to accelerate the electron beam toward the CRT face. Deflection sensitivity and hence calibration depend upon that voltage, so it is regulated by a string of 180-volt Zener diodes. Vertical and horizontal position and sweep time depend upon the 9-volt supplies, so they are transistor-regulated. The +150-volt supply serves only differential amplifiers, and their inherent common-mode rejection makes regulation of that supply unnecessary. We shall now proceed to a detailed description of each functional block.

Vertical attenuator: Voltage dividers RA and Rb (Fig. 2) reduce the input signal to a maximum of 0.32 volt (8 divisions at 0.04 volt-per-division) or a minimum of 0.01 volt (1 division at 0.01 volt-per-division). Capacitors Ca and Cb of the diagram of the optional multiplier probe.

Vertical amplifier: The overall gain of the vertical amplifier (Fig. 3) is about 2000 in the full-gain (+4) position, and about 500 in the calibrated (×1) position of the vertical variable control. Resistor R201 and D201 provide input protection in the event of accidental overload. Source-follower Q201 and common-base amplifier Q202 form a trigger amplifier with a non-inverting AC gain of about 40 and a high input impedance.

Transistors Q203 and Q204 are switched alternately by the zero-baseline flip-flop (Q207 and Q208, Fig. 4), connecting the base of source-follower Q205 alternately to the signal input and to ground. The stray capacitance of these FET's amounts to about 10 pF, and produces switching transients of about 10 μS duration on the 1-megohm input line.

### PARTS LIST (Attenuators, Fig. 2)

**Resistors 1% tolerance or better, 1/2 watt**

- R401—806,000 ohms
- R402—162,000 ohms
- R403, R412—40,200 ohms
- R404, R406, R409—1 megohm
- R405—604,000 ohms
- R406—909,000 ohms
- R407—953,000 ohms
- R410—402,000 ohms
- R411—100,000 ohms
- R413—10,000 ohms
- R414—4,020 ohms
- R415—9 megohms

**Capacitors**

- C401—0.05 μF, 600 volts, ceramic
- C402—100 pF, Mylar
- C403, C405—C414, C416*—6.60 pF ceramic trimmer
- C404, C415*—10 pF, ceramic
- C410—62 pF, mica
- C411—250 pF, mica
- C412—620 pF, mica
- C413—0.022 μF, Mylar
- C414—0.0062 μF, Mylar
- S401—miniature double-pole 3-position toggle switch (Alco MST205)
- S402—3-pole, 6-position rotary wafer switch
- R403—2-pole, 6-position rotary wafer switch

**Miscellaneous:** printed circuit board

*Note: Components required for optional 10X probe

![Diagram of the optional XIO probe](https://www.americanradiohistory.com/diagram.png)

FIG. 2.—THE ATTENUATORS. Components for the vertical attenuator are mounted on a special circuit board. Also shown in the diagram of the optional multiplier probe.

The switching frequency must therefore be held below a few hundred hertz to prevent those transients from being frequent enough to be seen on the CRT display.

Transistors Q206 and Q207 are wired as a variable-gain differential amplifier. Potentiometer R213 is the 10-mV calibrator and sets the gain to four times the indicated vertical sensitivity with R214...
maximum resistance. Pot R216 is the calibrator. It adjusts the in- 
sensitivity with R214 at maximum bias. Pot R218 is the DC balance pot; it sets zero voltage between the miller trimmers zero input in order that the control will not shift the vertical center. Trimmers Q208 and Q209 provide a second stage of amplification, producing a maximum differential output of about 180 volts P-P. Capacitor C203 lowers the impedance between the emitters to track the decrease in impedance between the collectors caused by CRT plate capacitance at high frequencies. Since gain is essentially the ratio of those impedances, C203 tends to preserve a constant gain as frequency increases. Because an 820-pF trimmer would be large and unstable, we adjust the associated resistor (R202) to suit the capacitor, instead of vice-versa. Capacitor C203 thus determines the stage gain, and should be altered if necessary to produce a stage gain of about 50.

Horizontal amplifier: This amplifier (Fig. 3) is similar to the vertical amplifier except that the low-voltage differential stage is omitted and the entire gain (about 70) is achieved in the high-voltage stage. The differential output voltage required is about 250 volts P-P because the second (less sensitive) set of CRT deflection plates is used. Bandwidth is about 500 kHz.

PARTS LIST (Amplifiers, Fig. 3)

<table>
<thead>
<tr>
<th>Value</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>R229—3600 ohms</td>
<td>R231—2200 ohms</td>
</tr>
<tr>
<td>R232—5000 ohms, potentiometer</td>
<td>R233—4700 ohms</td>
</tr>
<tr>
<td>R234—700 ohms</td>
<td>R235—1200 pF, Milar</td>
</tr>
<tr>
<td>R236—100 pF, 15 volts, radial-lead electrolytic</td>
<td>R237—820 pF, mica</td>
</tr>
<tr>
<td>C203—330 pF, mica</td>
<td>C204—330 pF, mica</td>
</tr>
<tr>
<td>C205, C206, C208—0.1 pF, ceramic disc</td>
<td>C207, 1800 pF, Milar</td>
</tr>
<tr>
<td>Semiconductors:</td>
<td></td>
</tr>
<tr>
<td>D201, D202—1N914 or similar silicon diode</td>
<td>Q201, Q203, Q204, Q205, Q210—MPF4393 or similar N-channel FET (Motorola)</td>
</tr>
<tr>
<td>2N3440 or similar</td>
<td>Q202—2N4402 or similar</td>
</tr>
<tr>
<td>2N4400 or similar</td>
<td>Q206, Q207—2N4400 or similar</td>
</tr>
<tr>
<td>Q208, Q209, Q211—2N3440 or similar</td>
<td>Miscellaneous: PC or perforated circuit board, hookup wire, mounting hardware, transistor sockets, etc.</td>
</tr>
</tbody>
</table>

ZERO-BASELINE DISPLAY permits reading the DC component of this waveform. Scale factor is 1 V/div and the sinewave is 3 volts peak-to-peak riding on a 4-volt DC level.
**Parts List (Sweep and zero-baseline generators, Fig. 4)**

Resistors 1/2 watt, 10% unless otherwise noted

- R301—220,000 ohms
- R302—1 megohm
- R303, R304, R306—4700 ohms
- R305, R311—1800 ohms
- R307, R317—20,000 ohms, potentiometer
- R308, R312, R313, R315, R333—1000 ohms
- R309—22 ohms
- R310, R318, R331—10,000 ohms
- R314—15,000 ohms
- R316, R335, R336—27,000 ohms
- R319—10,000 ohms, trimmer, vertical mount
- R320—100,000 ohms, 1%
- R321—25,000 ohms, 1%
- R322—10,000 ohms, 1%
- R323, R327—3300 ohms
- R324—100,000 ohms
- R325—5000 ohms, trimmer, vertical mount
- R326—18,000 ohms
- R328—56,000 ohms

- R329, R330—220 ohms
- R332—270 ohms
- R334, R337—2000 ohms

**Capacitors**

- C301—0.05 μF, 600 volts, ceramic disc
- C302, C304—47 μF, ceramic disc
- C303, C307—100 μF, ceramic disc
- C305, C306—10 μF, 25 volts, axial-lead electrolytic
- C308—4.7 μF, 25 volts, axial-lead electrolytic
- C309—0.1 μF, ceramic disc
- C310—0.1 μF, Mylar
- C311—0.1 μF, Mylar
- C312—0.1 μF, Mylar
- C313—0.01 μF, Mylar
- C314*—100 μF, ceramic disc
- C315—680 μF, ceramic disc
- C316—2 μF, 25 volts, axial-lead electrolytic
- C317, C318—0.1 μF, ceramic disc
- C319—5 μF, 25 volts, axial-lead electrolytic

**Miscellaneous**

- PC or perforated circuit board, shielded cable, transistor and IC sockets, mounting hardware, knobs, etc.

*Note: select to keep ratios within ±1%*

**Note:** In prototype, C314 was made by connecting a 47-pF disc in parallel with a 6–60-pF ceramic trimmer.
The power supply is simple and inexpensive to build. The voltage-tripler replaces the live and dangerous high-voltage power transformer used in many scopes. The string of Zeners replaces a high-resistance voltage-divider string.

The trigger circuits: Source-follower Q301-4 provides the high input impedance required during external triggering and the low driving impedance necessary for good sensitivity of the Schmitt trigger Q302 and Q303. The trigger will operate with 0.1 volt P-P input, and trigger at 5 MHz with 0.3-volt P-P input. The edges of the Schmitt-trigger output (inverted or non-inverted) are coupled through switch S302-a capacitor and C307 to the trigger input of the NE555, IC 301; that is where the negative edges are used to initiate the sweep ramps.

In the driven mode, the trigger input is held high by the +9 volt supply through R314 and triggering occurs only by negative pulses from C307. In the auto mode, AC detectors D302, D303, and C306 furnish the positive supply as long as the Schmitt trigger is switching. However, if the trigger remains inoperative for longer than about 150 ms, C306 discharges and R316 pulls the trigger input low, resulting in automatic triggering with no input signal.

Sweep circuit: Transistor Q304 is a variable-current source that charges the selected timing capacitor (C310 through C314) at a linear rate depending on the sweep variable control and the selected timing resistor (R320 through R322). Pin 7 of the NE555 automatically discharges the capacitor whenever pin 6 rises to +6 volts. A source-follower Q305 buffers the ramp voltage since any current drawn from it would destroy its linearity. Pot R325 reduces the ramp to 4.4 volts, thus providing 11 divisions of sweep to the 0.4 volt-per-division horizontal amplifier.

continued on page 80
MACHINES THAT CAN TALK

Here's a look at some of the hardware available; what it does, what it costs, and how it's used. You may be surprised how much of it there is, and where.

MARTIN BRADLEY WEINSTEIN

LAST TIME WE LOOKED AT THE PROBLEM of how a human voice might be synthesized, from the simplest digitized recording media to the sleeker new equipment (Radio-Electronics, March 1980).

The block diagram (Fig. 1) boils it all down into the most common areas of circuitry (by function) found in the more sophisticated general vocabulary synthesizers. How each function is handled varies widely from manufacturer to manufacturer, and often from product to product. But in some form or another, those elements almost always occur.

Somehow, having actual equipment to look at and talk about (eventually, to listen to) tends to make things easier to understand. So here's a brief review of the equipment available today, plus a peek at early tomorrow.

Telesensory Systems, Inc.

Speech + ™ is a talking calculator designed for the blind and vision-impaired. In addition to operating as any normal calculator might, it offers the option of having its calculations announced by a built-in, 24-word-vocabulary speech synthesizer.

Telesensory Systems, Inc. (TSI, 3408 Hillview Avenue, P.O. Box 10099, Palo Alto, CA 94304), the manufacturer of Speech +, offers the board—in English—for $150. The same vocabulary is available in a small printed-circuit board module (less filters, amplifier, speaker) in English, French or German—for $95. And for $179, two 64-word modules are available: one designed for announcing key hits on typewriter-style keyboards, the other for announcing electronic instrumentation readings.

Those modules contain little more than a custom MOS microprocessor
for TSI by General Instruments, a ROM or two. Custom vocab.
are available to OEM's interested in volume purchases, and to those
willing to invest $200 per word for
m coding.
It has also announced a two-chip
custom LSI IC's that can be
to speech synthesis, as well as
tasks, but details are still a few
away.

In fact, TSI is a special
ich LSI IC's that can be
ed to speech synthesis, as well as
tasks, but details are still a few
away.

Votrax Division
Votrax Division of Federal Screw
es, (500 Stephenson Highway,
MI 48084) manufactures what
be the broadest line of voice syn-
zers available today.

Starting at the top of the pile, the
Business Communicator is a
vocabulary computer peripheral
ed to tie into 4 to 64 tele-
e lines. It offers up to 128 seconds
of speech, translatable into as many as
individually-addressable variable-
length messages. Voice quality is excel-
ent. That is the kind of voice/speech
synthesizer often used with banks, tele-
phone services, and "talking" computer
services. Prices vary from under $10,000
to over $50,000, depending upon capa-
bilities.

Working our way down the price
stream, we find a generalized-vocabulary phonetic (phoneme-based) speech
synthesizer capable of speaking English,
German, Spanish, Italian, Japanese,
French, and Farsi.

The key to that flex-
ibility is an un-minimized phoneme set,
including 122 selectable phonemes; in
addition, each 12-bit command word
permits 8 levels of inflection, or pitch,
and 4 phoneme rates, or duration... yes,
you can program it to speak with a
drawl. The ML-1 Multi-Lingual Voice
System doesn't come cheap (except,
perhaps, comparatively, in terms of
value received), with prices between
roughly $6000 and $8000, depending on
configuration, plus $1500 for the com-
panion keyboard and more for every
language after English (standard). It's
well worth it, though, where multilingual
capabilities are needed in conjunction
with a computer, as evidenced by the
success of the ML-1 in schools.

In the $3500 to $5000 range, the
Votrax VS-6 Electronic Voice System
uses 8-bit command words to select 61
phonemes and four levels of inflection;
one VS-6 user has reportedly developed
a vocabulary of over 300,000 words for
it. While priced well beyond most hobby
budgets, the VS-6 performs admirably
in a number of fascinating applications,
including military flight simulators.
AS MANY AS 300,000 WORDS have been developed by one user of the Votrax VS-6 Electronic Voice System.

talking instrumentation, handicapped aids, and talking OCR (optical character recognition) printed copy readers.

Votrax also manufactures the Radio Shack TRS-80 Voice Synthesizer, and includes with it software for a talking blackjack game. The user hears cards shuffling and the banter of a "wise guy" dealer.

RADIO-SHACK SPEECH SYNTHESIZER is a part of their TRS-80 personal computer system and is available as an option.

HC Electronics, Inc.

That division of American Hospital Supply Corporation (HC Electronics, Inc., 250 Camino Alto, Mill Valley, CA 94941) manufactures and distributes products for language and speech therapy. Their two speech syntheses, Phonie Mirrorex® HandiVoice® models HC110 and HC120, are actually manufactured for them by Votrax.

The HC110 is a lap-size, flat device designed for young children, the handicapped, or developmentally disabled persons with speech impairments or disabilities. Most of its surface is covered by its 128-key keyboard, itself covered with one of three overlays — words, graphics, or symbols. It is pre-programmed with 373 words, 45 phonemes, 26 letters (the English alphabet), 13 morphemes (standard word prefixes and suffixes), and 16 short phrases like "My name is...", "How are you?", "Would you come here?".

The HC120, by comparison, is a physically smaller unit that offers all the capabilities of the HC110, plus an additional 520 words, accessed by a 4x4 keyboard and a 3-digit control code.

Computalker Consultants

One of the least expensive, though highly capable, speech synthesizers available that is based on phonemes, yet capable of direct parameter control, is the CT-1 Speech Synthesizer by Computalker Consultants (P.O. Box 1951, Santa Monica, CA 90406).

The CT-1 is in the $425 to $550 range, depending on software options, and plugs into the S-100 bus. Pre-packaged AC-powered versions for Apple II (CT-1A) and the TRS-80 (CT-1T) are available for $595.

In the Direct Parameter Control Mode, signals modeled after previously-decoded words are used to recreate them. That is obviously a limited-vocabulary approach, but the naturalness of speech is especially high; even the mannerisms of the original speaker are preserved.

The Phonetic Mode, by comparison, is phoneme-based, but with a twist. Target values for each phoneme parameter are first located, then a smoothingcalculation performed to calculate parabolic trajectories between them. The result is less mechanical-sounding speech.

The computer hobbyist interested in experimenting with speech synthesis is strongly urged to investigate Computalker.

Also, about a year from now, expect news from Computalker about a totally digital system, replacing their current analog approach. Much of the cost of their current hardware is attributable to precision tuning and calibration of the many analog-circuit sections, a cost that the all-digital approach promises to all but eliminate.

Texas Instruments

While the TI approach to speech synthesis leads inevitably to fixed vocabulary products (for the time being, at least), their expertise with high-density memories and the economies of high-volume production has yielded a group of products affordable and useful at a general-consumer level.

Speak & Spell® (mine cost about $55), was introduced a couple of years ago. It conducts spelling bees and plays word games, primarily for children. (My wife and I both get a kick out of ours, though we have no children.)

New ROM modules to expand the vocabulary of Speak & Spell have now been introduced. Vowel Power® (recommended resale $15) adds 140 words to help children master vowel sounds in four categories. Two new Super Stumpers modules (also $15 each) for grades 4–6 and 7–8 add word lists to cover such problems as silent letters, irregular spellings, double consonants, and homonymous spellings.

The heart of the Texas Instruments approach to speech synthesis is multiple-stage digital filtering and Linear Predictive Coding—a mathematical approach to modeling, analyzing, and synthesizing the human voice. While TI is producing 40,000 to 60,000 synthesizers on-a-chip each month, their entire production output is currently going into TI products.

Two of those products are their talking Language Translator (about $300, with $60 modules to translate English, French, Spanish, German, Chinese, and Japanese) and their new Home Computer. The Solid State Speech TM peripheral (suggested resale $150) synthesizes a 200-word vocabulary.

Who else?

Lexicon, Craig, Matsushita, and others have all admitted to "looking at" talking products. National Semiconductor has announced a one-chip synthesizer, about which little has reached us. Ohio Scientific offers a speech synthesizer of some description for their Challenger computers, but repeated calls to the company have resulted in no information to date.

Stay tuned. There's no telling who will speak up next.
CONCLUSION OF BOB COOPER'S SERIES ON OPERATIONAL SATELLITES THAT ARE RELAYING TELEVISION PROGRAMS AND HOW WE CAN RECEIVE THEIR SIGNALS. THIS STORY DESCRIBES RECEIVER-SYSTEM HARDWARE AND HOW IT GOES TOGETHER.

ROBERT B. COOPER, JR.

In previous six parts of this article series, appearing in the August through March 1980 issues, and January and February issues, we described the background for the operational domestic and foreign satellite systems that are transmitting television programs. We looked closely here to tell you how to get it. Here are several suggestions

1. You need 50 dB of gain here. The amplified signal from the LNA should then drive a similar GAAs-FET active mixer converting our 4-GHz signal down to a more manageable and comfortable 70-MHz IF. The balance of the gain should then be provided by the 70-MHz circuitry.

2. Getting gain at 70 MHz is so simple that it almost becomes a waste of space. Here is a final gain strip. You couple into and out of the device through a .01 disc capacitor. Just pop four in a row on a piece of G-10 double sided board and you are in business. The AWT-120 costs around $5 per device; for $30 or so you have the full 50+ dB gain IF strip.

Note however that our gain is spread from near DC to 300 MHz. And all we really want is the 30-MHz-wide spectrum between 55 MHz and 85 MHz, centered on 70 MHz. Obviously we need some bandpass filtering in here someplace.

There are sound arguments for placing the 70-MHz bandpass filter ahead of the IF strip, and for placing it after the IF gain stage. Some builders compromise and place it in the center of the IF stage, or between the first and second AWT-120 devices. Briefly, if you place the bandpass filter ahead of the IF gain stage, you run the risk of permitting a mistuned (or improperly built) 70-MHz bandpass filter to degrade the noise figure of the system. The bandpass filter will have some loss and that loss be-
comes part of the total system signal-to-noise equation. We'll describe a nearly foolproof 70-MHz bandpass filter for you shortly.

If you place the bandpass filter after the IF gain string, you run the risk of amplifying in the IF string undesirable heterodyne-produced products that may sum the desired signals coming out of the 4-GHz-to-70-MHz IF port on the mixer and causing the AWT-120 (or whatever) IF string to go into saturation. One solution is to run the AWT-120 first stage immediately after the 70-MHz IF output from the mixer, then stick in your bandpass filter, and proceed thereafter to amplify the 70-MHz signal in another three stages. We'll leave the final decision to you, noting only that we have placed the 70-MHz bandpass filter at the end of the IF string in the block diagram shown in Fig. 1.

Bandpass filter construction

There is no way we can suggest in good conscience that you will be able to construct and tune up this bandpass filter by eye or meter. You will need to run down a good CATV-type sweep generator and marker system to show you where in the spectrum you are tuning, and a detector and display. The sweep system should span the 50-to-100-MHz region as a minimum to align the bandpass filter properly.

Building the bandpass filter, shown in Figs. 2-a and 2-b, is not complicated, and if you follow the layout shown and mount the device in the Bud box recommended you won't have any problems. The coil forms, wire size, and capacitors (all are 5% dipped micas; don't substitute!) are important. If you change anything in the parts called for, you have just entered the R and D business and you'll have to recompensate other part values accordingly. Properly constructed, and aligned, the passband of the IF filter will be from 55 to 85 MHz, ± 3 dB at the very edges, with less than 1.5-dB insertion loss and a passband ripple of less than ± 0.5 dB from 60 through 80 MHz.

70 MHz to baseband

The utter simplicity of recovering good quality satellite TV video and audio becomes apparent as you study Fig. 3 (for the video) and Fig. 4 (for the audio). The secret is that you are coming into the field "late," all of the dozen-transistor circuits worked out initially, some three or more years ago, have fallen by the wayside since clever design people such as Taylor Howard of Stanford tackled the project with an eye to reducing every section of the system to its basic required parts.

The 70-MHz IF input, following the 70-MHz IF gain-string, plugs into the input side (left hand side) of Fig. 3. The NE564 phase-locked loop makes a dandy video demodulator for this application, although note that there is this 5% warning:

The 564 is operating at the upper end

---

**FIG. 2—70-MHZ BANDPASS FILTER is relatively easy to build and is housed in a standard Bud enclosure.**

**PARTS LIST (70 MHz to baseband, video/audio)**

- **Resistors** 1/4 watt, 10% unless otherwise specified:
  - R1—2200 ohms
  - R2—27,000 ohms
  - R3, R7—27—1000 ohms
  - R4—200 ohms
  - R5, R17, R23, R28, R29—10,000 ohms
  - R6—3900 ohms
  - R8—R10, R12—147 ohms
  - R11—41 ohms
  - R13, R19—22,000 ohms
  - R14—470 ohms
  - R15, R16—R18—560 ohms
  - R20, R21—10,000 ohms, potentiometer
  - R22—270 ohms
  - R24—R26—100,000 ohms
  - R30—510 ohms

- **Capacitors**
  - C1, C4, C6, C15, C19—0.01 μF ceramic disc
  - C2—1 μF, 15 volts, electrolytic
  - C3—100 μF, 20 volts, electrolytic
  - C5—0.01 μF ceramic disc
  - C7—1.5 to 8 pF trimmer
  - C8, C9—3 pF, dipped silver mica
  - C10—330 pF
  - C11—4400 pF
  - C12—91 pF
  - C13—300 pF
  - C14—100 μF, 10 volts, electrolytic
  - C16—1 μF, 20 volts, electrolytic
  - C17—15 μF, 15 volts, electrolytic
  - C18—300 μF, 16 volts, electrolytic
  - C20—22 μF, 6 volts, electrolytic
  - IC1—7812 voltage regulator, ±12 volts
  - IC2—NE564 phase-locked loop
  - IC3—NE592 video amplifier
  - Q1—Q3—2N2222
  - D1—HP5082/2800 Schottky diode (Hewlett-Packard)
  - D2—1N5248 Zener diode, 12 volts
  - RFC1—100 μF
  - RFC2—2.7 μF
  - RFC3—4.7 μF
frequency range in this application you may find that some small stage of the 564's around will not quite properly the video from the carrier. On the other hand (the good news), some 564's do to nearly 100 MHz. They are cheap; several of the newer com-
receivers use the same device for and thousands of home-
receivers have been built using

The audio subcarrier does not get on into the balance of the video circuits. Frequencies above 4.2 MHz in the baseband region do not contribute to the video quality and in fact, if left in, will create high-frequency video noise on your baseband video signal.

Between the second 2N2222 (following the NE592) and the third such stage is a harmless-looking Schottky diode, the HP 5082/2800. That is a clamp diode. You may recall from previous sections that the uplink signals transmitted to the satellites are "frequency dithered" at a 30-Hz rate as a means of dispersing the energy waveform over a relatively wide band (36 MHz if you follow out to the 1% energy levels). That dispersal action was motivated by designers of early INTELSAT systems, who feared they might cause interference to terrestrial microwave circuits operating in the same 3.7-to-4.2-GHz region. Spreading the waveform energy out with the 30-Hz waveform reduces the probability that any appreciable amount of satellite TV downlink energy will get into any terrestrial system. To get rid of the 30-Hz waveform we shove the video into a hard clamp. The Schottky diode is fast and it clamps the 30-Hz waveform to ground by as much as 40 dB or more. That either eliminates the 30-Hz flicker in the picture or reduces it to the point where it cannot be seen.

There are these caveats and cautions about this portion of the system:

1. Use only double-sided board; good quality G-10 board will do.
2. Mount the finished board in a container, grounding all the way around on both sides of the board. Place the 15 VDC regulated line on the backside of the board along with power supply bypasses and the 7812 regulator.
3. The 70-MHz VCO output test jack is for setting the operating frequency of the PLL to 70 MHz. Adjust the 1.5-to-8 pF trimmer (C7) for 70 MHz (a counter is handy but you could do it with the TV monitor tuning for best picture).
4. Adjust pot R20 off pin 1 of the NE592 for the same voltage on pin 1 as you have on pin 14 of the same device.
5. The AFC output shown is not totally applicable to the system you are presently building. As you get more sophisticated in using your home terminal you may wish to add an AFC system later on (as many have) and that brings it out so it is available when you wish to add the feature.
6. The output of the NES92 (pins 7 or 8) is selectable for good reason. As long as your local oscillator is driving the 4-GHz-to-70-MHz mixer on the low side (i.e. 4-GHz input frequency minus the VTO-8360 local-oscillator source equals 70 MHz) you will find the video in the proper polarity on pin 8. If you mistune and end up with the local oscillator on the high-frequency side you will have to swap the video output lead to pin 7 to re-establish the proper video polarity. A simple switch here will make changing simple.

There is absolutely nothing else to adjust or fiddle with! You have just gone from 70 MHz to relatively complicated FM video to baseband with a minimum of hassle.

Recovering Audio

The RCA SATCOM and Western Union WESTAR birds carry their FM audio on either 6.2 MHz or the more common 6.8 MHz subcarriers. When you demodulate the 70-MHz IF signal, the NES64 PLL recovers that higher-frequency baseband component right along with the video. We take it off after the first 2N2222 baseband amplifier and send it on to the CD 4 second demodulator which is L-C tuned to the 6.2- or 6.8MHz subcarrier frequency.

Two methods of recovering the audio are presented here. In Fig. 4 we have the basic (Taylor Howard developed) audio demodulator that uses a 2N3565 amplifier, a tuned network designed for either 6.2- or 6.8-MHz, a second 2N3565 amplifier, a (Motorola) HEP603P demodulator (or RCA CA3065), and finally an audio amplifier. That system has seen thousands of duplications by home builders and it works just fine.

Simply tune L1 and L2 for the desired frequency (6.8- or 6.2-MHz) and then tune L3 for recovery of the audio on that frequency by simply listening on some suitable audio-display system. There is a 50K volume-control pot and those are the only adjustments that are in the system.

Figure 5 shows how to do the same thing for about $12 for each audio subcarrier desired and perhaps 15 minutes of your time. Several satellite TV enthusiasts in the Indianapolis area, where RCA has a production facility, discovered that the RCA XL-100 audio demodulator (model PM-200) can be field-modified with a pair of capacitors to tune not the usual 4.5-MHz subcarrier channel found in the NTSC system but rather the 6.2- or 6.8-MHz subcarrier found in the satellite system. The PM-200 is a stock replacement item for XL-100 chassiss; it is a complete module ready to hook up and operate (RCA’s stock number is 130-753). You go into the module and add capacitors C1 and C2 (both 33 pF to hit 6.8-MHz) as shown. Input is through pin 3. As noted, the cost of this module (new, through an RCA parts house) is in the $12 range.

Once again recovering the satellite audio is not much of a trick.

Modulating to NTSC

Now that you have the baseband video and audio displayed on a color-video monitor and audio system, it would be nice to watch your favorite programming from satellite programs on your TV receiver. In fact, if you are like most of us, you don’t own a video monitor in the first place. So let’s get the baseband signal back to NTSC format RF.

![RF Modulator Circuit](image)

**PARTS LIST**

(Audio demodulator, Fig. 4)

<table>
<thead>
<tr>
<th>Resistor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>3300 ohms</td>
</tr>
<tr>
<td>R2</td>
<td>2200 ohms</td>
</tr>
<tr>
<td>R3</td>
<td>1000 ohms</td>
</tr>
<tr>
<td>R4</td>
<td>150.000 ohms</td>
</tr>
<tr>
<td>R5</td>
<td>270.000 ohms</td>
</tr>
<tr>
<td>R6</td>
<td>6200 ohms</td>
</tr>
<tr>
<td>R7</td>
<td>50.000 ohms</td>
</tr>
<tr>
<td>C1 - C12</td>
<td>±20VDC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capacitor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 - C12</td>
<td>±20VDC</td>
</tr>
</tbody>
</table>

- **Note:** The RCA CA3134GM can replace the CA3065/LM380 combination
If you don't have a VCR, you'll need to build, or buy, your own video RF modulator. The most common RF modulator used by satellite TV enthusiasts is shown in Fig. 6. This system uses the LM1889 IC that is really a miniature TV transmitter disguised as an IC. The LM1889 device (or something very similar) is found in dozens of TV games, VCR modulators, computer modulators, and so on. The 1889 is available from firms such as Poly-Pak, usually for under $5.00. A complete modulator kit, using the LM1889 is available (model PXP-4500) for around $25 (ATV Research, 13-B Boardway, Dakota City, NB 68731).

The schematic in Fig. 6 shows what is involved. Coil L2 establishes the 4.5-MHz sub-carrier for the audio in a tuned network and a 1K pot connected to pin two of the 1889 establishes the saturated white level for the video. Although the schematic establishes tuning procedures (off pins 8 and 9 of the 1889) for Channel 3 or 4, many people have also found that the system will work on VHF TV Channel 5 as well, by adjusting the tank circuit accordingly.

A modulator such as this is capable of putting out around 10,000 microvolts of maximum signal (3,000 is more typical). That is more than enough RF voltage to drive through several hundred feet of RG-59/U coaxial cable into, perhaps, as many as a half dozen TV receivers connected.

**PARTS LIST (RF-modulator, Fig. 6)**

Resistors 1/4-watt, 10% unless otherwise specified.

- R1, R6—15,000 ohms
- R2, R4—4.7,000 ohms
- R3, R9—2,700 ohms
- R5—3,300 ohms
- R7, R12—75 ohms
- R8—2,000 ohms potentiometer
- R9—100 ohms
- R10, R11—270 ohms
- R13—3000 ohms

Capacitors

- C1—120 pF dipped mica
- C2—.1 μF ceramic disc
- C3—33 μF ceramic disc
- C4—37 μF dipped mica
- C5—2.2 μF, 10 volts, electrolytic
- C6—43 pF dipped mica
- C7—C9—.01 μF ceramic disc
- C10—75 pF dipped mica
- C11—15 μF, 10 volts, electrolytic
- C12—1 μF, 10 volts, electrolytic
- C13—20 μF, 20 volts, electrolytic
- C14—7808 voltage regulator, +8 volts
- C15—LM1889 TV video modulator
- C16—7908 voltage regulator, -8 volts
- C17—HEP2504 varactor diode (Motorola)
- C18—1N4005 diode
- D2—2N7005 diode
- D3—2N7005 diode
- L1—tank coil .08 μH (3 turns No. 16 wire on air-wound 1/8" ID, 1/4" long)
- L2—adjustable 12-ohm pot.

**NTSC RF MODULATOR for Channel 3, 4, or 5.**
SATELLITE TV REPRINTS
A booklet containing reprints of all seven articles in the series on Backyard Satellite TV Receivers by Robert B. Cooper, Jr. is available by sending $5.50, including first-class postage, to:
Satellite TV Reprints
Radio-Electronics
45 East 17th St.
New York, NY 10003
New York State residents must include $0.50 State Sales Tax.

Satellite television has been called the new frontier of electronics. There is little doubt that a proliferation of communication satellites in the geostationary orbit will change the way we perceive ourselves and our world neighbors in the decade ahead. Heretofore we have been able to keep control of our individual nationalistic goals through a flood of programming created largely by our own countrymen. What we have seen of Brazil, for example, or Zambia, have been the views of our own program producers, writers, and actors.

Satellite television is changing all of that: a trickle now, a flood within the next ten years. International satellites (INTELSAT) already in operation are beaming programs from Brazil, Zambia, and dozens of other nations not only to their own citizens but to 40% of the whole globe at a time. Regional satellites with shaped antenna patterns are spilling the programs from India, for example, throughout Africa and the Middle East. A Russian geostationary satellite system called Stassionar is nearing completion so that by 1981 you may sit in your home—virtually any place in North America—and tune in Moscow directly. Those Stassionar satellites can be expected, like Radio Moscow of shortwave fame, to become instruments of their operators, beaming video propaganda over the entire globe.

Satellite receiving hardware is a new, business still struggling between the first $50,000 INTELSAT receivers and what will become ultimately (perhaps soon) $1,000 receivers sold through electronic emporiums. By 1990, satellite television will be a household word and satellite receiving systems will proliferate into every book corner of the world.

Just as our U.S. television system has shaped and re-shaped the America of the 1940's into the present-day America, so, too, will satellite television shape and re-shape the world of the early 1980's into an entirely different world by the year 2,000; some say perhaps ten years sooner than that.

Until October of 1979, for private individuals to own satellite television receivers here in the United States was something of a misdemeanor. It wasn't clearly illegal, but wasn't approved by law either. Since the FCC decided last October that private satellite terminals did not require a federal license, a marked change has begun in the attitude of electronic hardware suppliers throughout the world. Suddenly there is a marketplace for satellite TV gear—a very large, national and even worldwide marketplace. That FCC decision alone will result in dozens of receiving-system packages entering the marketplace in the year ahead.

As an electronics enthusiast you have a leg up on the rest of your countrymen. You have a head start on this new technology and, for a few years at least, your expertise in that area will make you a special person with special knowledge—and the opportunity either to enjoy it to the fullest, or cash in on a very attractive business opportunity.

Never before in electronics has the sky been the limit. Never before have we had satellite television available. R-E

LEARNING MORE ABOUT SATELLITE TV
If you are fascinated by the rapid development of satellite television as a worldwide video communications system, some of the following reference materials may be of interest to you:

Satellite Study Package—A thorough study of how the satellite system works, what the individual elements of a successful satellite TV receiving system are, how they work, and what they do. Includes a 72-page book written by Bob Cooper, that explains in lay terms just what the satellite TV revolution is all about. Includes reference section with dozens of other study materials sourced. Also includes 22 × 35-inch four-color, two-sided wall chart depicting the presently operating international network of geostationary communication satellites, where they are, and what their operational parameters are. Price is $15 for first class mail; cash, U.S. and Canada (in U.S. funds) elsewhere from Satellite Television Technology, P.O. Box 2476, Napa, CA 94558.

Satellite Seminar—The third in a series of Satellite Private Terminal Seminars; scheduled for mid-June in the San Francisco Bay Area of California. Three days of lectures, classroom instruction taught by leading designers of low-cost satellite TV systems. A combination of "how to do it yourself" featuring the latest state-of-the-art technology and "entering the satellite TV business" sessions. Two early seminars (Oklahoma in August, 1979, Miami, Florida this February) were total sell outs, so advance registration is a must. For complete details contact: SPTS, 80/California, P.O. Box G, Arcadia, Oklahoma 73007.

Construction Manuals—A series of three manuals describing the construction of (1) the Swan spheri-cal TVRO multi-satellite antenna, (2) Coleman TD-2 conversion Satellite TV Terminal, and (3) Howard Terminal Receiver. Swan's manual takes you into the satellite TV antenna world for less than $300-cost for a very effective 10 × 10 foot antenna that features the unique ability to receive up to 9 separate satellites with one antenna in a fixed position. The Coleman TD-2 manual covers conversion of surplus (inexpensive) microwave equipment to satellite TV reception, plus illustrates new low-cost microwave technology for home builders. The Howard Terminal Receiver manual describes 24-channel frequency-agile, double conversion receiver, LNA and feed antenna system that can be duplicated for under $800. Price per manual is $30, all three for $80 (U.S. funds) from Satellite Television Technology, P.O. Box G, Arcadia, Ok. 73007.

Monthly Publication—Monthly publication aimed squarely at explaining the construction of low-cost terminals, satellite operations, and the business of selling and installing private satellite TV terminals. Price for Coop's Satellite Digest is $50 per year in U.S. and Canada, $75 (in U.S. funds) elsewhere via first class mail from Coop's Satellite Digest, P.O. Box G, Arcadia, Ok., 73007.

Circuit Boards—A series of circuit boards and drawings virtually all portions of the satellite TV receiver described in this series. Circuit board IF-70A provides the circuit necessary to create your own 70-MHz IF strip as described here, using the Motorola ART-120 device. Circuit board, OMO-70VRO provides the layout for the 70-MHz-to-baseboard demodulator circuits described in this issue. For price and delivery contact: Robert M. Coleman, RFD 3, Box 58-A, Travelers Rest, SC 29690.
PORTABLE ELECTRONIC ORGAN

If you don’t play a keyboard instrument but would like to learn, you might consider starting out on one of the two simple easy-to-build organs described here. One plays melody; the other also plays chords.

I. QUEEN

One with seven white keys, the other with five black keys forming a pair and a trio (See Fig. 1). A letter of the alphabet, from A to G, is assigned to each of the seven white keys. The word “sharp” (written as ♯) may be applied to a black key to indicate one step higher. For example, F♯ is one step above F. Sometimes it is more convenient to use the word “flat” (shown as ♭) to indicate a black key that is one step lower. For example, B♭ is one step below B. Obviously, A♯ and B♭ refer to the same black key.

The human ear is a sensitive detector of frequency ratios. For example, it easily distinguishes a ratio of 2:1. The higher frequency is said to be one octave above the other. Since piano and organ keys cover an extensive range of frequencies, let’s use an octave as a convenient interval of sound. Each octave is divided into 12 equal geometric steps, a step representing a change of 6%. A piano keyboard is arranged so that a pianist can distinguish and identify a regular key out of the 12 in each octave. The keys are arranged in 2 rows: C, C♯, D, D♯, E, F, F♯, G, G♯, A, and B.

An inexpensive keyboard can be constructed with individual calculator keys, approximately 1/2-inch square, that you can take from an old calculator, or purchase from a surplus parts dealer. Poly Paks for instance has carried switches that are easy to operate, and have low resistance. They come in sets of 4 switches, one of which is a dummy switch without leads. You can remove the inoperative switch and substitute a good one from another set. A set of 4 switches can also be sawed apart to make a group of 2 or 3, which are needed for the black keys. Key caps are sold that mate with the key switches.

Radio Shack has sold individual calculator keys, and some stores may still stock them. They are fairly good and can be cemented down on any flat surface. (Neither of the switches we used are currently available from Poly-Paks or Radio Shack but you are sure to find suitable substitutes if you keep an eye on ads and catalogs from surplus parts dealers. Any SPST pushbutton switch can be used provided it is large enough to be comfortably used in a keyboard. Simply modify the switch mountings and organ housing to match the switches you use.—Editor)

BUILDING THE ORGAN

The top and bottom of the organ are made of three-ply wood, held in place by aluminum supports at the front and rear, as shown in Fig. 2. Two L-shaped lengths of aluminum that are held together with machine screws form each U-shaped support. The aluminum comes in 6-foot lengths and measures 1 inch on each side. It is readily available in hardware stores.
For a 3-octave range, the length of the organ should be about 18 inches.

Note that the top of the organ is narrower than the bottom. This allows you to use a convenient metal base to mount the white keys right in front. The black keys should be slightly behind and somewhat higher than the white ones. Some types of keys have a flat bottom and are made to be cemented onto any flat surface. The Poly Paks key sets came with No. 2-56 screws extending from the bottom. With No. 2-56 hex nuts, I mounted the sets on a metal strip, since the screws are not long enough to pass through the plywood. Then, the metal strip is mounted on the plywood, with the aid of machine screws. Use a strip about three inches long to hold 3 black keys, and another strip about 2 1/2 inches long for 2 black keys.

Below each key, drill holes for the leads to pass through to the terminals.

Mount the power and the output jacks, as well as the volume control, on the rear metal panel.

To build either organ model, you must have a frequency meter that can measure to about 100 Hz. It is suggested that you construct the simpler organ first to get the feel of playing music. If you are still enthusiastic about playing, then go for the more difficult organ.

**Melody organ**

In Fig. 3, IC1 is a VCO (Voltage-Controlled Oscillator) whose output frequency varies with the voltage applied to pin 8. The frequency is minimum when the pin is connected directly to the positive (+) terminal of the power supply. As R2 increases, so does the frequency. With a 9-volt supply, the minimum frequency is about 130 Hz.

Oscillator IC1 generates three output waveforms: a sine wave (pin 2), a square wave (pin 9) and a triangular wave (pin 3). (The latter waveform is not used.) The squarewave output is sufficient to drive a 45-ohm speaker directly at J1. The sine wave has a pleasing tone, and can drive a high-impedance earphone at J2 or drive an external amplifier. An internal amplifier, IC2, is provided however. The output at J3 is greatly attenuated for a tape-recorder.

**TABLE 1**

<table>
<thead>
<tr>
<th></th>
<th>G</th>
<th>Gs</th>
<th>Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>139</td>
<td>139</td>
<td>Hz</td>
</tr>
<tr>
<td>Ds</td>
<td>147</td>
<td></td>
<td>Hz</td>
</tr>
<tr>
<td>Ds</td>
<td>156</td>
<td></td>
<td>Hz</td>
</tr>
<tr>
<td>E</td>
<td>165</td>
<td></td>
<td>Hz</td>
</tr>
<tr>
<td>E</td>
<td>175</td>
<td></td>
<td>Hz</td>
</tr>
<tr>
<td>F</td>
<td>185</td>
<td></td>
<td>Hz</td>
</tr>
</tbody>
</table>

See Fig. 6 for higher tones. Frequencies in Hz.

**FIG. 4—HOW KEYS ARE WIRED to switch in different resistors to tune the VCO.**

**PARTS LIST FOR MELODY ORGAN**

- Resistors are 1/4 watt, 5%
- R1—500 ohms, potentiometer
- R2—calibrating resistors (see text and Fig. 4)
- R3—82,000 ohms
- R4—6—4700 ohms
- R7—10,000 ohms
- R8—390 ohms
- R9—100,000 ohms
- R10—10,000-ohm potentiometer
- C1—0.022 µF, Mylar or low-temperature
- C2—4.7 µF, 10 volts, electrolytic
- C3—0.1 µF, disc
- C4—500 µF, 10 volts, electrolytic
- IC1—8038, voltage-controlled oscillator
- IC2—LM380 audio amplifier
- J1—J4—miniature jacks
- Misc.—sockets for audio amplifier, keys (12 per octave), plywood, aluminum supports, hardware (see Fig. 2).
**Table 2**

(Frequency mHz)

<table>
<thead>
<tr>
<th>Oscillator</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Octave B</td>
<td>247</td>
<td>C6</td>
<td>D5</td>
<td>E4</td>
<td>F3</td>
<td>G2</td>
</tr>
<tr>
<td>Octave C</td>
<td>287</td>
<td>D6</td>
<td>E5</td>
<td>F4</td>
<td>G3</td>
<td>H2</td>
</tr>
<tr>
<td>Octave D</td>
<td>301</td>
<td>F6</td>
<td>G5</td>
<td>H4</td>
<td>I3</td>
<td>J2</td>
</tr>
<tr>
<td>Octave E</td>
<td>306</td>
<td>G6</td>
<td>H5</td>
<td>I4</td>
<td>J3</td>
<td>K2</td>
</tr>
<tr>
<td>Octave F</td>
<td>307</td>
<td>H6</td>
<td>I5</td>
<td>J4</td>
<td>K3</td>
<td>L2</td>
</tr>
</tbody>
</table>

*Rb is shown in more detail in Fig. 6 as a series of 6 fixed resistors.

**ONE OF SIX OSCILLATORS** based on a pair of CMOS inverters. The instantaneous frequency is determined by the value of resistor Rb.

**Parts List for Melody and Chord Organ**

1. PC board (6 resistors, 1 for each oscillator)
2. MEG (6 resistors, 1 for each oscillator)
3. Pair of 74C04 CMOS hex inverters (building 6 oscillators as in Fig. 5)
4. Resistors for inverters: terminal strips for leads; and plywood, aluminum, frame, keys, as for organ 1.

Shack 276-024). I used a small pocket of PC board to hold the socket of the board.

**1 and Melody Organ**

An organ is superior in several ways: it only plays the melody but also plays and contains 3 octaves. It is more responsive with respect to frequency and voltage than the IC's. Less expensive and less expensive. A disadvantage is that the ubiquitous resistors vary over a wide range of values, and so are more difficult to select. You may need two or three resistors in series to achieve a desired value. An accurate calibration is desirable. Errors are more noticeable than in a chord organ where chords are played three times, it is at first glance that we need 46 oscillators, but this thought quickly recedes! However, we can simplify the design. The oscillator is responsible for two musical tones (called half-steps), for example A and A#. Half-steps are 10,600 ohms, 5%. C5, C6 - 1 µF, 10 volts, electrolytic C7 - 0.1 µF, 10 volts, disc C6 - 250 µF, 10 volts, electrolytic

**Parts List for Amplifier**

- R11 - 10,000 ohms, potentiometer, 1/4 watt, 5%
- C5, C6 - 1 µF, 10 volts, electrolytic
- C7 - 0.1 µF, 10 volts, disc
- C6 - 250 µF, 10 volts, electrolytic
- J5 - miniature jack
- IC4 - LM386

Table 2 shows how six oscillators cover three octaves. A typical oscillator is shown in Fig. 5. This oscillator is very stable with respect to voltage and temperature. It uses a pair of CMOS inverters operating at 5 volts. One hex inverter such as the 74C04 can be used to make three oscillators. With R4 and C fixed, the frequency depends on R5 only. A larger R5 means a lower frequency. Of course, the voltage applied to the inverter must remain constant. This oscillator can generate only one frequency at a time. For six different frequencies, you must provide six different values of Rb, each with its own switch (See Fig. 6).

**WHAT IS A CHORD?**

It is a combination of 3 or more simultaneous tones that harmonize and enhance the playing of a melody. The ear is a sensitive frequency ratio detector. The octave (2:1) was mentioned earlier. If you call any note of an organ, 1, and count half-steps upwards, you can show that the pair, 1 and 3, bear the ratio 3:2. Other pairs (and ratios) are: 1 and 4 (3:2), 1 and 5 (5:4), 1 and 6 (4:3), 1 and 8 (3:2). If the 4 notes; 1, 4, 6, 10, are played, it is called a "seventh chord" and combines the following pairs: 1 and 4, 1 and 6, 1 and 3, and 1 and 5. The pair, 4 and 6, plays the same frequency ratio as 1 and 3, since both have the same interval of 2 half-steps. A "major chord" is played, 1, 6, 10. Many other chords, and variations of them, are played in organ and piano music.
CAR STEREO STANDARDS

Until now, makers of car stereo equipment have not had a set of standards and specifications that were meaningful to the consumer. Recently twenty-two manufacturers agreed on these new standards. Others are expected to follow.

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

IF YOU ARE A HIGH-FIDELITY ENTHUSIAST who has considered duplicating the good sound you enjoy at home in your car, truck, or van, you already know that until now there has been virtual chaos in the car stereo marketplace. Twenty watts of power in a car stereo amplifier or complete receiver is, in most instances, not even remotely related to 20 watts of audio power in a home hi-fi system. And a tuner sensitivity of 2.0 µV in a car radio (if quoted at all by the manufacturer) has usually meant sensitivity that is only one fourth as good as that of a home tuner boasting the same 2.0 µV sensitivity. As for tape-playing equipment in automobiles, frequency response, if quoted at all, has provided the prospective purchaser with little or no information as to the fidelity of the product being considered for installation in his or her vehicle.

We can now hope that the situation is about to change. As of this writing, 22 leading car stereo equipment manufacturers have agreed to publish specifications and measurements about their products that will be meaningful and helpful to consumers who want good sound on the road. What follows is some of the background that led to the creation of those new standards and a summary of the standard measurements themselves. Particular thanks are due to Marshall Mack Brown of Craig Corporation, who was in charge of the standards meetings that led to the creation of the new standards, along with Jim Twerdahl of Jensen Sound Laboratories and Don Coleman of Clarion Corporation.

It took more than 30 years for the home audio component industry to reach its present level. But in less than five years annual sales of car stereo equipment have actually equaled or surpassed those of home audio equipment. Unfortunately, the rapid growth of car stereo has resulted in many practices that are contrary to high-fidelity philosophy and concepts. Perhaps the most flagrant abuse has been the artificially inflated "power ratings" of car stereo products. (We all remember that battle in home equipment.)

Back in 1974 the Federal Trade Commission formulated a rule that requires all manufacturers of home audio equipment to state the power output of audio amplifiers on the basis of continuous power, with extremes of frequencies at which the rated power can be delivered for a given level of harmonic distortion and into a specified load impedance. Note, however, that the FTC rule applies only to "home" audio equipment. In 1974, car-stereo equipment sales were not significant, and the FTC did not include that category in its rule. Given that loophole, many car-stereo manufacturers began to exaggerate power ratings, omit references to distortion levels, and so forth. Serious and conscientious audio-equipment makers were caught up in the specification race as well, and were often forced to publish unrealistic figures for their own products. If only to survive in a highly competitive marketplace.

Discouraged, but by no means defeated, those manufacturers (including many in the U.S., and several importers of equipment from abroad) did not give up. More than a year ago, they formed an Ad Hoc Committee of Car Stereo Manufacturers and set about to write and publish their own measurement standards. Seventeen well-known manufacturers and importers participated in the deliberations. Their work has now been completed and, in a letter to all car-stereo manufacturers, they have invited all to endorse and use the specifications as presented. By endorsing the new standards, participating companies agreed that by June 1, 1980, all of their printed catalogs, specifications sheets, advertisements, and other literature will present product specifications in accordance with the new standards.

Amplifier measurements standards

The new car-stereo standards are divided into three sections. Section I deals with audio power amplifiers (whether supplied as separate components or as part of a car radio) and parallels many of the standards developed for home audio amplifiers by the IHF (Institute of High Fidelity). Six specifications must be presented by a manufacturer in standard format. The format for specifying power output must read: "Power Output: ___ watts per channel minimum continuous average power into ___ ohms, both channels driven, from ___ Hz to ___ Hz with no more than ___% total harmonic distortion." While that method of presentation corresponds almost exactly to that required for home-audio equipment, the committee had to address itself to one important additional matter. The nominal 12-volt supply in most cars may vary from 11 to 16 volts under driving conditions. Figure 1 shows what happens to the power output of a nominally-rated 10-watt-per-channel amplifier over those
mes of supply voltage. With only
lts of supply voltage, clipping dis-
n is reached with only 8 watts de-
d, while with 16 volts of battery,
power output increases to more
12 watts per channel. The new
rds call for a standard DC voltage
4 volts to be used when measuring
put of a car amplifier.

**FIG. 2—TONE-CONTROL CURVES** can be shown in specs. These curves are typical of those for a five-section equalizer.

Input Sensitivity must be referenced
to 1-watt of power output and should
be expressed in volts. Here, an option
is provided, wherein an additional sen-
sitivity specification may be given for
the input voltage required to produce
rated output.

A minimum input-impedance specification
is called for in the new standards,
but that spec is applicable to separate
component amplifiers only and is in-
tended to establish compatibility of in-
terfacing between models and brands.
It would be stated, simply, in ohms.

The last required amplifier specification
is Tone Control Action and the
format will be: Tone (Equalizer) Action:
\[ \pm \, \text{dB} \] at \[ \pm \, \text{Hz} \] and \[ \pm \, \text{Hz} \].
In the case of bass and treble controls, the
recommended test frequencies are 100
Hz and 10,000 Hz. For multiband
equalizers, the appropriate center fre-
quencies should be used in making the
measurements. Curves, such as those
shown in Fig. 2, may also be presented
as an option, but those will most likely
be used only for multiband equalizers.

**Standards for FM tuners**

The second section of the new stan-
rds is concerned with FM-tuner
specifications, or the tuner section of a
complete radio receiver. Nine separate
disclosures are called for. The first of
those is Monophonic Usable Sensitivity.
It is to be stated in dBf. There has been
wide variation in practice in measuring
and stating the sensitivity of an FM re-
ciever or tuner. Although it has been
common practice to state sensitivity
either in dB re: 1 \( \mu \text{V} \), or directly in
volts (or microvolts), the modern practice
of stating the sensitivity in terms of rela-
tive power level (expressed in dBf) eli-
minates ambiguity and enables the con-
sumer to make direct comparisons
between products. The ambiguities have
been particularly prevalent when it
comes to car stereo FM receivers, large-
ly because their antenna input impe-
dance is usually 75-ohms as opposed to
the more common 300-ohm input im-
pedance found on home FM equipment.

Figure 3 shows how 2 \( \mu \text{V} \), applied to
a 75-ohm antenna input impedance, is
actually four times as much power delivered to the first stage of the receiver as the same 2 nV would be if connected to a 300-ohm impedance. Looking at it another way, a tuner that boasts a 2-µV sensitivity (and fails to mention the fact that this figure applies to 75-ohm inputs) is really only one fourth as sensitive as one which has a 2-µV sensitivity but has a 300-ohm input.

Another indicator of tuner sensitivity that must be stated by manufacturers adhering to the new Car Stereo Standard is 50-dB Quieting Sensitivity, in mono. A signal-to-noise capability of 50 dB is generally considered to be the least amount of noise (with respect to signal peaks) that can be tolerated in high-fidelity equipment, whereas the 30-dB S/N figure, often used by car-stereo equipment manufacturers, really amounts to "barely usable" performance. The signal strength required for producing 50 dB of S/N is also to be quoted in terms of power, or dBf.

Frequency response of the tuner section is to be quoted over the range from 30 Hz to 15,000 Hz (the frequency limits of FM broadcasting) with a "plus and minus" dB tolerance required in the reporting format.

Such less familiar tuner characteristics as Capture Ratio (the ability of a tuner to zero in on the stronger of two stations broadcasting at the same frequency), Alternate Channel Selectivity (the ability of the tuner to reject signals that are removed in frequency from the desired station frequency by 400 kHz), Image Response Ratio (the ability of the tuner to reject incoming signals that are above 10.7 MHz the local oscillator frequency), and IF Response Ratio (ability of the tuner to reject incoming radio signals that are broadcast at the tuner's 10.7-MHz IF) are all called for in the new standard and are generally to be measured and reported in a manner consistent with the universally used IHF/IEEE Tuner Measurement Standard which has been formalized since 1975 (IHF-T-200, 1975).

One additional tuner measurement standard called for in the new Car Stereo standards is actually borrowed from the IHF Amplifier Standard, and is called Maximum Output Voltage. It is to be reported in Volts, from 30 Hz to 15,000 Hz, with 1000-ohms load. That specification is applicable to tuners, decks, and integrated units provided with line output terminals and is intended to establish compatibility of interfacing between models and brands. The minimum recommended load impedance must also be stated.

The third and final section of the new Car Stereo Standards deals with tape players. Since IHF standards for tape decks have not as yet been established, here the committee had to develop its own interim standards. Six required measurements and specifications are called for.

The first of these is playback frequency response. Tape playback frequency response has probably been one of the most flagrantly exaggerated specifications relating to car stereo tape equipment. As illustrated in Fig. 4, the frequency response shown in curve "A" for one typical tape deck and that shown in curve "B" for an inferior product could both be reported as extending from "30 Hz to 15,000 Hz"—providing that no tolerance in dB accompanies the published statement.

Clearly, the tape deck represented by the response curve of "B" is able to deliver some output at 30 Hz and some output at 15,000 Hz. That output, however, is some 15 dB lower than the reference level measured at 1 kHz and is therefore all but useless. For that reason, the format for stating tape playback frequency response must be: Frequency Response: Hz to Hz.

To measure stereo separation of car tape equipment, a reference level of 250 nWb/meter tone at 1 kHz is used, recorded on one channel. The opposite channel is played back through a narrow-band filter that includes 1 kHz, and the residual signal is measured. The purpose of the filter is to minimize the masking effect of tape noise, since interchannel leakage (crosstalk) may actually be lower in level than the noise and still be more objectionable. "A"-weighted signal-to-noise ratio is also to be specified for tape playback devices intended for car use and is to be measured with respect to a 1-kHz recorded signal at a level of 250 nWb/meter, using a 20 Hz to 20,000 Hz band-pass filter.

Finally, the maximum output voltage of the tape deck is to be specified in volts, over the relevant frequency band and with a minimum recommended load also stated. That specification is intended to establish compatibility of interfacing between models and brands, particularly where separate car stereo components (as opposed to all-in-one car stereo units) are used.

While there are certainly many more specifications which might be measured and published for mobile audio products in those three categories of amplifiers, tuner/receivers, and tape players (or combinations of them), it is significant that a group of audio-equipment manufacturers were able to get together, without any government prompting or pressure, to produce meaningful measurement standards. The result of their efforts can only benefit the audio consumer who wishes to have good high-fidelity sound while traveling in a vehicle.

The proposed standards have been printed, and readers wanting to learn more about them may write to Marshall Mack Brown, Chairman of the Ad Hoc Standards Committee of Car Stereo Manufacturers, at Craig Corporation, 921 West Artesia Blvd., Compton, California 90220.
UC EQUALIZERS HAVE BECOME ONE OF MOST POPULAR ADD-ON PRODUCTS IN A HIGH-PSX STEREO SYSTEM. BY DIVIDING THE AUDIO SPECTRUM INTO SEVERAL SEGMENTS, AN EQUALIZER PERMITS THE USER TO TAILOR THE RESPONSE OF THE ENTIRE SYSTEM MORE PRECISELY THAN WOULD BE POSSIBLE USING ORDINARY TREBLE CONTROLS OR EVEN BASS, MIDRANGE, AND DYNAMIC CONTROLS. UNTIL NOW, MOST OF THE MODELS WE HAVE SEEN FEATURED EITHER FIVE OR TEN BANDS PER CHANNEL, WITH A FEW EVEN MORE FREQUENCY SEGMENTATIONS.

NOW, NIKKO HAS COME UP WITH A GRAPHIC EQUALIZER, MODEL EQ-II SHOWN IN FIG. 1, THAT OFFERS SIX BANDS OF FREQUENCY-PER-CHANNEL, THEREBY PROVIDING A BIT MORE FLEXIBILITY THAN THAT OFFERED BY FIVE-BAND UNITS WITHOUT INCREASING THE RETAIL PRICE TO THAT OF MOST TEN-BAND UNITS.

The all-black front panel of the EQ-II features a power on/off switch at the left-hand side, above which is a small, red indicator light that turns on when power is applied to the unit. Near the power switch, along the lower edge of the panel, are two pair of pushbutton switches. One of these is used to bypass the equalizer when its functions are not required, or for making instant audible comparisons between equalized and unequalized sound. The other switch introduces a tape monitor circuit that can be used to connect a tape deck, since the tape out/tape in jacks on any associated receiver or amplifier will have been used up by installation of the equalizer.

The wiring of the tape-monitor circuit is such that only preequalized signals can be fed to the line inputs of the connected tape deck. In other words, you cannot use the EQ-II to equalize signals being recorded; only to equalize signals being played back via the tape deck or your other program sources. Above the equalization in/out switch is a small green light that turns on when the EQ-II is "in circuit".

NIKKO AUDIO EQ-II
GRAPHIC EQUALIZER

FACTURER'S PUBLISHED SPECIFICATIONS:

Control Frequencies: 40 Hz, 125 Hz, 400 Hz, 1.25 kHz, 4 kHz, 12.5 kHz. Control Range: ±12 dB at center frequencies. Rated Output Level: 1.0 volt. Maximum Output Level: 4.0 volts. Total Harmonic Distortion: 0.01%. Signal-to-Noise Ratio: IHF "A"-weighted; 100 dB. Frequency Response: 10 Hz to 30 kHz, ±1.0 dB. Input Impedance: 10 kohms. Power Requirement: 120 volts 60Hz, 14 Watts. Dimensions: 16½ W X 3¾ H X 3-inches D. Net Weight: 10.8 lbs. Suggested Retail Price: $200.00

RADIO-ELECTRONICS AUDIO LAB
EXCELLENT

Nikko Audio EQ-11
Graphic Equalizer

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

DUE TO THE VERSATILITY OF THE GRAPHIC EQUALIZER, THE INSTALLER WILL FIND THE RESISTANCE TO INSTALLATION OF THE EQ-II A GREAT MAJOR.

www.americanradiohistory.com
frequencies in adjacent pairs. Each approach, of course, has its advantages and disadvantages. With all the controls of one channel grouped together, if the user finds that both channels require the same degree of equalization, the arrangement on the EQ-II requires that each channel be adjusted separately. When similar center frequencies are paired together, (as on some other equalizers we have tested), the user can adjust left and right sliders with a single finger motion. On the other hand, in most practical situations, with speaker systems placed at different positions in the listening room, in non-identical environments, the likelihood is that the left-channel equalization requirements will differ from those of the right channel, and individual adjustment would be required in any case.

The center frequencies chosen by Nikko for this six-band equalizer are 40 Hz, 125 Hz, 400 Hz, 1.25 kHz, 4 kHz and 12.5 kHz. Spacing is therefore something more than one octave and less than two octaves. The slider controls used to adjust response at each of these center frequencies have well defined detents with approximately a 2-dB step per detent. Sliders are calibrated from 0 (center position) to 10 in both the boost and cut directions of the slider. Those calibration points have no direct correlation to dB of boost or cut, however, since maximum boost or cut is 12 dB.

The rear panel of the EQ-II, shown in Fig. 2, is equipped with a pair of input jacks at the left, a pair of output jacks at the center and the previously mentioned TAPE-OUT and TAPE-IN jacks in between. An unswitched AC convenience outlet, rated at 200 volts, is located at the extreme right of the rear panel above the power cord. There are no externally-replaceable fuses on the rear panel.

Figure 3 shows the inside of the chassis of the unit. Note that the single circuit board at the right rear contains no inductors, as such. Instead, gyrator circuits using op-amps with feedback networks are used to create the necessary individual filter circuits required. The entire circuit is well shielded from any induced hum via the front panel and from the small power transformer mounted at the extreme left of the chassis. That careful layout accounts in part for the excellent signal-to-noise ratio that we found. Figure 4 shows how to connect the EQ-II into a hi-fi system.

**Lab measurements**

Table 1 summarizes the laboratory measurements made on our sample unit. The exceedingly low distortion levels, measured at mid-frequencies as well as at the audio frequency extremes, were measured with an input signal level of 1.0 volt, which corresponds to the rated output level of the unit (the EQ-II has 0 dB or unity gain, as an equalizer should). Even as one approaches maximum output level, however, distortion remains almost as low until output exceeds 4.0 volts.

![Figure 5](image1)

Figure 5 shows the response of the EQ-II with each of its frequency levers alternately moved to the maximum boost and cut positions. Vertical sensitivity for the presentation was 10 dB-per-division while frequency, plotted from left to right, extended from 20 Hz to 20 kHz, logarithmically. Thus, spacings between center frequencies of the various bands are almost precisely equal, between one and two octaves apart.

Figure 6 presents a sequential plot of one of the slider controls (the one having a center frequency of 400 Hz) for each of its eleven detented steps and while the boost and cut for each step, they are very nearly equal.

**Summary**

At its price, the Nikko EQ-II offers a good deal of tonal control flexibility. In listening tests, the unit introduced no noticeable coloration when the controls were set to their mid-positions and the EQ light was on. Neither was there any noticeable increase in distortion or noise level when the equalizer was switched into the rest of our test stereo component system. More detailed summary comments, together with our overall product evaluation, will be found in Table II.
BUILD THIS

3½ Digit DMM

Want to design and build your own DMM? If so, this developmental prototype is a good place to start. You can add features and select an enclosure and layout to meet your needs.

CARSON CHEN*

S HOW AN ACCURATE, INEXPENSIVE 3½ digit DMM can be built. The DMM designed around a single 3½ digit IC that performs the analog-to-digital conversion function. The specifications of the DMM are shown in Table 1.

Referring to the schematic in Fig. 1, the basic building block of the DMM is the ADD3501 analog-digital converter using a pulse-modulation technique. A 2-volt reference voltage is applied to the LM336 2.5-volt precision reference diode. For a 1-mV resolution, additional ADD3501 support circuitry consists of an NSB5388 LED display, a DS75492 digit driver, a RA08 array, and an LM340 to regulate dc supply voltage.

Voltage measurement: Depending on the range selected, the positive or negative DC voltage to be measured is applied to the + and − meter probes where applicable, attenuated so that maximum voltage per range is 31h digit full-scale and applied across the ADD3501 $V_{IN}+ V_{IN}-$ pins (pins 13 and 15 respectively). The ADD3501 then forms a pulse modulation analog-to-digital conversion and digitally displays the numerical equivalent of the analog voltage.

Current measurement: In the DC current mode, the meter probes are connected in series with the current to be measured. On any range, the DMM is a known resistance in series with the current to develop a 2-volt full-scale voltage drop. (This voltage drop may be reduced to 200 mV; refer to the last section of this article). The equivalent drop across the current measuring resistor is then converted and displayed by the ADD3501.

Resistance measurement: As in all multimeters, a current source develops a voltage drop across the unknown resistor being measured. In this case the resistor to be measured is placed across the + and − meter probes and, depending upon the range selected, a constant current is forced through the resistor developing a voltage drop. This voltage is applied to the $V_{IN}+ V_{IN}-$ pins of the ADD3501 and converted to its proper digital equivalent displayed as ohms. The current source is designed around two of the op-amps in the LM346 (IC2-a and IC2-b) and transistors Q1 and Q2.

Isolating the current source and analyzing the circuit in Fig. 2, we see that resistor $R_X$ sets the desired current for a chosen resistance measurement range. It is essential to note that varying resistor values placed at $R_X$ must not alter the constant current through $R_X$. If this occurs, erroneous resistance readings will be displayed. To eliminate any non-constant current conditions, op-amp IC2-b and transistor Q2 function as follows:

To establish a constant-current source, a constant voltage drop must be maintained across load resistor $R_L$. The closed-loop operation of IC2-b tries to maintain a zero differential input voltage. With $V_A$ applied to the non-inverting input, point A is forced to $V_A+ V_{BE}$ so that the voltage of point B would equal $V_A$. Thus a constant voltage potential is maintained across $R_L$. With $V_A$ constant at point A, the current source remains constant, and varying $R_X$ has no effect on the current source, provided that $R_X \times I_{SOURCE}$ is not greater than $V_A - V_{BE}$, so that transistor Q2 is saturated. This non-linear condition however will not be noticed since $R_X \times I_{SOURCE} = 2 \Omega$ will force the ADD3501 to display +OL (see Fig. 3.)

A change in the $V_{CC}$ supply voltage is

<table>
<thead>
<tr>
<th>TABLE 1—SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Volts: Accuracy better than ±1%</td>
</tr>
<tr>
<td>Ranges: 2 volts, 20 volts, 200 volts, 2 kV</td>
</tr>
<tr>
<td>Input impedance: greater than 10 megohms on 2-volt range; 10 megohms on 20-volt to 2-kV ranges.</td>
</tr>
<tr>
<td>AC RMS Volts: Accuracy better than ±1%</td>
</tr>
<tr>
<td>Ranges: 2 volts, 20 volts, 200 volts, 2 kV (40 Hz to 8 kHz, sinewave)</td>
</tr>
<tr>
<td>DC Amps: Accuracy better than ±1%</td>
</tr>
<tr>
<td>Ranges: 200 μA, 2 mA, 20 mA, 200 mA, 2 amps</td>
</tr>
<tr>
<td>AC RMS Amps: Accuracy better than ±1%</td>
</tr>
<tr>
<td>Ranges: 200 μA, 2 mA, 20 mA, 200 mA, 2 amps</td>
</tr>
<tr>
<td>Ohms: Accuracy better than ±1%</td>
</tr>
<tr>
<td>Ranges: 200, 2000, 20,000, 200,000 ohms, 2 megohms</td>
</tr>
</tbody>
</table>

*Applications Engineer, National Semiconductor Corporation
drive shaft. On its upper end, the shaft has another gear that engages the large-diameter threading ring.

The threading ring revolves counterclockwise (as you look down at it). The lead guidepost encounters the tape as the rotation brings the post outward and then begins pulling the tape out of the cassette.

The tape coming out of the cassette travels around the video-head drum. At first, the tape being pulled out by the lead post is doubled. But, at intervals, three additional guideposts on the circumference of the threading ring enter the tape loop. These posts hold the outer side of the tape loop away from the video-head drum. The inner side of the loop, however, wraps very closely around the face of the video-head drum. Behind the drum, two fixed guideposts also shape the outside dimensions of the tape loop.

Meanwhile, on the left-hand side of the cassette, a lever—with a guidepost that is also inside the cassette similar to the lead guidepost—has filled out a tape-tension arm. That post has also drawn some tape from the supply reel of the cassette.

Near the end of the threading-ring travel, a cam-follower lever moves the tape-tension arm solidly outward. That completes the tape-wrapping procedure around the video-head drum. As shown in the photo, this action also positions the tape so that it can pass the audio-control head properly.

A stopper tab ends the threading-ring travel. Microswitches open the circuit to the DC threading motor. Toggle levers hold the ring firmly against the stopper. The tape is in the proper position for any of the RUN modes: PLAY, RECORD, FAST FORWARD, or REWIND.

Unthreading or unloading

When the EJECT button is down, the voltage at the DC motor reverses and starts the threading ring, or circling clockwise. A few degrees of rotation triggers the cam-follower lever and loosens the tape-tension arm.

Tape could suddenly go slack and create a "spill," but a lever lifts the brake from the takeup-reel turntable.

The direction of the reel rotation winds up any slack in the tape as it occurs.

Continuing clockwise, the threading ring unwraps the tape from the video-head drum—exactly the reverse of how it operates in threading the machine.

Finally, at the end of the unthreading operation, the cassette-lift mechanism raises the compartment. The cover at the front of the cassette closes, and the cassette can be removed.

Tape-loading electronics

Unless you know what happens electronically during the threading sequence, you cannot always determine for certain whether a defect is mechanical or an electronic fault. Once you are familiar with both sides, troubleshooting can proceed directly.

Several electronic functions must be taken into account during tape loading.

Many are safety interlocks that prevent damage to the machine. The basic threading circuits are shown in Fig. 1.

A CASSSETTE-IN microswitch operates from a plunger that is activated when the cassette is in the lift compartment and the assembly has been pushed down to latch it. The switch applies 12 volts of regulated DC to the loading-circuit board.

A LOADING-STOP microswitch connects as an interlock between pin 2 of connector CN4001 and pin 3 of CN4002. This switch is located beside the threading ring. It stays closed at all times except when the threading ring reaches its limit (when the tape is loaded).

Thus, at the start of tape loading, the switch carries 12 volts from the CASSSETTE-IN switch to the threading-control circuits.

With both microswitches closed, 12 volts goes to a standby-lamp stage (the circuits are not shown in Fig. 1). An illuminated standby lamp warns the operator to wait until loading is finished before pressing one of the RUN-mode buttons. Some Beta-format machines omit this warning light.

Forward-biased diode D4016 carries 12 volts DC to a charge-up circuit that consists of R4011, R4055 and C4009. This capacitor holds a 12-volt charge even after the voltage is removed; which is what happens when the threading-stop switch opens. The purpose is to keep the threading motor turning an extra moment or so until the threading ring reaches its mechanical-stop pin. That assures complete loading.

Diode D4015, which is also forward-biased, places 12 volts on pin 19 of the threading-logic IC. (In digital logic, that constitutes a logic high on pin 19.) As long as the other input of gate AND-2 sees a logic high, the output is a logic high. Two logic-high inputs to gate AND-3 gives another logic-high output, which inverts in the gate immediately following it.

The logic low from IC pin 21 cuts off transistor Q4003, placing a logic high on the base of Q4010. Because it is an emitter-follower (noninverting), Q4010 delivers a logic low through switch segment S4004-1 to one side of the DC threading motor. Switch segment S4004-2 grounds the other side of the motor. The threading motor runs.

Now, let's review some of the ramifications of various circuit elements you have encountered along the way. Some of them can, for one reason or another, inhibit the operation of the threading motor.

First, let's start with gate AND-2. To deliver a logic-high output, both gate inputs must be high. However, if certain things malfunction elsewhere in the machine, an automatic-stop system switches a logic-low signal onto this line. A logic-low signal would inhibit gate AND-2, and this would force a logic high at IC pin 21, and, ultimately, a logic high at IC pin 21, and, ultimately,
a logic low at the emitter of Q4010. Thus, the threading motor would stop.

Let’s look at the delay-logic circuit block shown in Fig. 1. The delay circuit acts as a switch that keeps IC pin 20 normally grounded. This in turn sends a logic low to the delay gate and a normal logic high to gate AND-3.

However, when gate AND-2 applies a logic high to the delay input, it effectively lifts the ground from IC pin 20. Capacitor C4013 begins charging through R4017. If the threading finishes in the usual two or three seconds, the threading-stop switch opens, the output of gate AND-2 goes low and IC pin 20 reverts to ground or zero.

But if something goes wrong and threading has not been completed in ten seconds, capacitor C4013 attains nearly full charge. The delay gate inverts the developed logic-high output from the delay amplifier, sending a logic-low input signal to gate AND-3. A logic-high output thus appears on IC pin 21, which shuts off the threading motor, thus averting excessive tape stress or breakage.

Eject or unload

Eject mode is another term for unthreading the tape, returning it to the cassette and raising the cassette-lift mechanism to remove the cassette.

Basically, unthreading can proceed whenever the EJECT button is depressed. Figure 1 shows that Main Eject switch S4004 has four segments. Switch segments S4004-1 and S4004-2 reverse the DC voltage that is applied to the threading motor from Q4010. The motor runs in the opposite direction, and the gearing system now drives the threading ring back clockwise toward the tape-unloaded position.

One type of VCR uses circuits inside the threading-logic IC to verify the video-head drum rotation. See Fig. 2. Capacitor C4007 couples a sample of the 30-Hz pulse-generator signal to a sample-and-hold stage in the IC. Capacitor C4012 is the charge-holding capacitor. As long as the signal is present, the logic output of the sample-and-hold stage stays high. When this logic-high output is fed to inhibit gate AND-1, it keeps the gate operative and feeding a logic high to gate AND-2 (Fig. 1) through threading IC pin 19.

When the signal ceases, indicating that the AC motor has stopped, C4012 discharges—leaving a logic low at pin 23. The sample-and-hold output goes low. Gate AND-1 inhibits gate AND-2, stopping any threading action. The same logic-low indication appears on the auto-stop signal line, and also triggers a STOP solenoid into action.

Figure 2 shows that other safety shutoffs work through IC4001 and duplicate those shown in Fig. 1.

In Fig. 1, the delay system works for the unthreading operation just as for threading. If the unthreading is not finished in less than 10 seconds, the delay system shuts off the threading motor.

Brake-release electronics

During the loading or threading operations, the brakes on both the takeup and supply-reel turnstables must be freed. In some VCR’s a solenoid controls the brakes; in others, a mechanical link-up provides control. (In the rewind and unthreading modes, individual links manipulate the turntable brakes one at a time.)

Figure 3 shows the brake-release solenoid electronics. When the solenoid is at rest, the brakes are spring-applied to both takeup and supply-reel turnstables. When activated, the solenoid releases both brakes. Inserting the cassette and dropping the lift compartment to its latched position turns on the cassette-in switch. This action applies 12-volts DC directly to the solenoid.

The bottom of the solenoid goes to ground through Q4011, but only when the transistor turns on. Figure 3 shows that there are two paths to the base of Q4011. One is via PLAY switch S4001, PAUSE switch S6080, R4006, and D4013. This path turns Q4011 on only when the PLAY pushbutton is down.

The other signal path goes through LOADING-STOP switch S6506, D4016, EJECT switch S4004-3, R4014 and D4009. Inserting a cassette applies DC to this enable path to Q4011. Therefore the transistor turns on and the brakes are released.

At the end of threading, switch S6506 opens and the brakes are set again. The same procedure occurs if the EJECT mode is selected; the mechanical linkages control the takeup brake.

---

**Fig. 3—Brake Release Electronics**

Brakes are released when solenoid is energized.
Once the tape has been threaded, both brakes can be released simultaneously by pressing either the RECORD or PLAY buttons (they’re labelled FORWARD on some machines).

The braking system is simple, but you must remain aware of it. If a malfunction leaves the brakes set during the threading operation, the machine will shut down when the ten-second safety delay expires. That’s because turntable brakes prevent the tape from being pulled out of the cassette.

**Automatic stop signals**

As you already know, due to the load-inhibit operation of gate AND-2 an automatic-stop signal from any stage in the machine can prevent loading or bring it to a halt. Hence, when you set out to troubleshoot a loading problem, you may track the fault to some far-away stage or section.

Now, refer again to Fig. 1. If you’re familiar with digital-logic diagnosis and tracing, you know there are two ways to check out inhibit operation of the AND-2 gate.

You can check the top input with a logic probe (or voltmeter). If the input measures logic low, the warning must be coming from elsewhere in the machine, and you troubleshoot there for the fault.

If the inhibit input measures a logic high, the auto-stop signal line is OK, and the fault must lie inside the threading-logic system.

A less-desirable approach can be used: Disconnect the auto-stop line and feed a logic-high input to the inhibit side of gate AND-2. If all is well in the threading system, loading or unloading will start again. (Warning: Do not let the loading continue. The fault located “elsewhere” might cause damage, which is the reason for including the inhibit gate. Track down the trouble that is causing the auto-stop signal (a logic low).

Automatic-stop signals comprise part of the system control network. The threading/unthreading system you just studied is part of the system control, as are the brake release system and all mode pushbuttons. Here are other stages you must investigate when you detect a logic-low signal on the automatic-stop line.

**Tape-end detector**—Metallic leaders at both ends of the video tape in the cassette indicate end-of-tape. Two coils do the supply sensing. A supply-end sensing arm holds one coil beside the left-side tape path, next to the tape-tension arm. In the PLAY, RECORD, or FAST-FORWARD modes, this supply-sensing coil triggers automatic shutoff just before tape runs out. A fixed bracket holds the takeup-sensing coil next to the tape path on the right side beside the threading ring. It works the same way, but only during REWIND.

Figure 4 shows the switching that connects the sensing coils. DC from one of the forward-mode switches couples supply-sensing coil L6501 into the feedback loop of an oscillator. The signal from the oscillator is rectified and filtered in the detector, and then continued on page 91.
A precision color-bar generator is desirable when servicing the color circuits of TV receivers and all types of video recorders. This new instrument brings TV-station accuracy to the shop at service-bench prices.

JACK DARR
SERVICE EDITOR

Up to now, there have been two kinds of TV test equipment: One kind is expensive, accurate and designed for use in TV stations and studios. The other kind is inexpensive, less accurate and made for TV service work. Now, the B&K-Precision Product Group of Dynascan Corp., 6460 W. Cortland St., Chicago, Ill. 60635 has come out with an instrument that is accurate enough for use in TV stations and studios and, at the same time, versatile and inexpensive enough to be valuable in the better TV service shops. In fact, the price is a real breakthrough at $795.

Their new model 1250 NTSC (National Television Systems Committee) Color-Bar Generator will generate the same color-bar patterns used in TV stations with the same accuracy. It will also make four stock convergence patterns and all three color rasters (or any mix of the three). The RF output is on Channel 3 or Channel 4 and is crystal controlled. There is an IF output at 45.75 MHz, also crystal controlled. The sound subcarrier is at 4.5 MHz and may be frequency modulated with either a 1 kHz or 3 kHz audio signal that is generated internally. The audio signal is also available at a jack labelled AUDIO OUT for testing audio equipment, and there is a jack for an external audio input signal.

There is a composite video output that can be calibrated to the standard 1.0 volt P-P negative modulation, or can be varied up to 1.5 volts P-P. This is another standard signal for making many tests on video tape recorders, whether the big studio types or the home units. The video can be modulated by any of the standard patterns. A very accurate 3.579545-MHz color subcarrier signal is available. All RF and video output impedances are 75 ohms and are equipped with BNC connectors. Audio inputs and outputs are phono jacks.

**NTSC**

Now, just what is an "NTSC color Signal?" Back in the early 1950's there was quite a hassle over two different color-TV systems. One was approved by the FCC and tried out. That was the CBS system which used a color wheel. The other, developed by RCA, was the all-electronic color system, with all of the matrixing done inside the picture tube. Eventually, that was the system chosen.

A national committee was appointed to study the RCA and other systems, and came up with a set of standards for transmitters and receivers. (That committee was the National Television Systems Committee.) In 1953, after some years of testing, deliberation and probably quite a bit of arguing, they selected what are now the NTSC Standards. The color TV systems now in use in Europe—PAL, and the French SEACAM—were considered, tested and not chosen.

The NTSC system has worked very well so far; there have been no major alterations since its adoption. One of the headaches was coming up with a system that was fully compatible with black-and-white TV.

The NTSC Standards cover everything—the TV signal transmitted from the station, color modulation, and you name it. Thus, TV station engineers now had a set of standards to go by in setting up their equipment; and receiver designers used those standards for making color TV receivers.

Now we come to the nitty-gritty: They also specified an NTSC Standard color-bar pattern that could be used in setting up TV cameras, monitors, and color TV receivers as well. There are several of these patterns, intended for use in checking the ability of TV equipment to reproduce the transmitted signal exactly.

At first, only TV stations had generators capable of producing the NTSC pattern. They were big and expensive, so only very few (if any) TV shops had them. Now, we have an NTSC generator that is not only accurate enough for a TV station but also can be afforded by a service shop. Somewhat simpler and less accurate types had been developed for the service shop, but they had some disadvantages, especially if you wanted precision.

**The NTSC color bars**

Let's go into the NTSC color-bar pattern a little more; there's more to it than meets the eye. Figure 1 shows the waveform of one line of the NTSC color-bar pattern. On the screen it looks like an ordinary color-bar pattern, with colors in a different place than we're used to. The first bar is pure white; next, in a logical progression comes yellow, which is nearest to white. Then comes cyan (blue-green), green, magenta (blue-red), red, blue, and finally a black bar. It progresses from the brightest color, nearest to white, to the darkest, blue, which is nearest to black. The color signals are carefully controlled both in phase and in amplitude. Each of the colors is fully saturated; that is the difference between the NTSC sig-
nal and that of lower-priced generators. With lower-priced generators, the color bars are all at the same amplitude, and some are over-saturated.

The NTSC composite video signal is exactly 1.0 volt peak-to-peak. It is divided into 140 equal units, called “IEEE units.” At first they were “IRE units” from Institute of Radio Engineers, but when this was changed to IEEE (Institute of Electrical and Electronic Engineers), the name of the units was also changed. Note, in Fig. 1, that the zero-reference for the composite video signal is the blanking level—the porches of the horizontal sync pedestal. The tips of the horizontal sync pulses are at -40 IEEE units; the sync pulse is approximately 0.3 volt. Note that the black level is at +7.5 units. That is called the setup level and is the black reference for the picture. Levels of luminance between 7.5 and 100 units produce various shades of gray. The brightest white is 100 units, or 100% and it is equivalent to zero modulation of the composite RF signal. The sync tips are at -40 units, which corresponds to maximum modulation of the RF carrier—hence the strongest signal. The advantage is that the weakest signal—where interference can cause snow—is in the white parts of the picture where snow isn’t easy to see.

Now, we come to the really different part: Note that each color is at a different luminance level. Note also that there is a difference between some colors. That was done so that each color will have precisely the right amplitude (of the chroma carrier) to give it full saturation—no more and no less. Note that the luminance has a “staircase” effect. That is a very important part of it. The staircase is another standard NTSC signal.

As previously mentioned, on the screen it looks like a color-bar signal. On the scope it doesn’t! Therein lies a major advantage. For example, when you feed the NTSC signal into the antenna you should see an exact duplicate at the video detector output. (Set the scope to display it at exactly 1.0 volt P-P.) Feed in a video signal from the model 1250 to the upper channel of a dual-trace scope. (All RF, IF and video outputs may be used at the same time.) If there is any difference between the two waveforms, you have problems in the IF or 1F circuits of the receiver. In fact, you can superimpose the two waveforms to make comparison easier. The model 1250 also provides scope trigger signals at vertical and horizontal frequencies, so that the patterns will be steady. Any distortion or poor frequency response, etc., will make the waveforms look different.

The -IWO signal.

If you’ve ever seen a network color-bar signal (usually switched in by accident!) you’ve probably seen black and white bars across the bottom. That is another NTSC standard signal, called the “-IWO.” It’s composed of equal parts of the signal called -1 (which is chroma at a phase angle of 303° from burst), a fully saturated 100 units white bar and the Q signal (which is chroma at 33° from burst). Both the I and Q signals are at a level of 40 units. The last bar you see at the right is a black signal at the 7.5 unit reference level.

The IWO signal is used mainly in studio phase measurements, in video processors, amplifiers, and similar items. For an eyeball test, the first quarter of the pattern should be black, then you see pure white, then black again for the rest. Transitions between black and white should be sharp.

The NTSC-color bar pattern can also be used for vectorscope analysis. That is the method used in TV stations. The pattern is basically similar to the familiar “flower” pattern, but it has no petals; each color makes a single dot on a vectorscope. Fig. 2 shows a vectorscope ratio graticule for use with the NTSC-color bar pattern. Note the small boxes for each color or combination of colors; each color must fall within its box. If it isn’t in the box, there’s an incorrect phase.

One novel test is possible with this graticule and the model 1250. The model 1250 will make a pix raster of each primary color—red, blue, or green. You can also use two colors at once to make combinations such as cyan. On the vectorscope only the dots for the color in use will be seen. Very small phase shifts can be detected by this method. Note that the colors, burst, I, Q, etc., are all marked on the graticule.

The Staircase

Another NTSC standard pattern that is available with the model 1250 is the “staircase.” The reason for the name should be obvious from the waveform. There are theoretically three different staircase patterns available, each with a different purpose. They are shown in Fig. 3. The pattern in Fig. 3-a is just 5 steps of video luminance without modulation. The screen will show a pattern of vertical bars, starting at left with black and going to white. The steps are 20 IEEE units each. These bars can be used to check for luminance response and linearity. It’s the same procedure as with the color bars: Use a comparison pattern on one channel of the scope. All steps in the signal at the video detector must be exactly the same amplitude as the signal from the model 1250. Turn the CHROMA switch on the front panel of the model 1250 off to get this signal.

Figure 3-b shows one of the two modulated staircase patterns. Each step is modulated 20 IEEE units with chroma at burst phase. To get this signal, push the LOW STAIRCASE button. Figure 3-c shows the high staircase—identical but modulated at 40 IEEE units.

What can you do with these two unmodulated staircase signals? You can make
The front panel of the unit is laid out so that switching can be very easy. There are 15 pushbutton switches that are functionally divided into three groups. The NTSC patterns are all selected by the right-hand group, along with the full burst, top burst (that one turns off the burst for only the top fourth of the screen on the color bars and raster patterns: it's used to check the sync), chroma. — 1WQ. Low staircase and high staircase pushbutton switches.

The next group, from right to left, are the four convergence pattern switches: dots, crosshatch, dot/hatch, and center cross. Those are mechanically interlocked with the NTSC switches; if any of those is turned on the other patterns are turned off. Because of interlaced scanning, you may see a small vertical jitter in the convergence patterns. That is normal and won't affect convergence adjustments. It does not indicate any problems in vertical sync.

Last, but definitely not least, are the raster switches: one for each primary color and a raster on-off switch. The raster on-off switch is interlocked so that it turns off the NTSC or convergence switches that are on. There are three color raster buttons; you can make eight different color rasters with them. All switches off produces black at the 7.5 unit reference level. This is used for adjusting the receiver brightness control.

Pure red, green, or blue rasters are for purity adjustments. Red was used in many older sets and some new ones. In some sets with In-line pix tubes, the green raster is for purity. By pushing any two at once you can get the combination of the two colors. Red and green give yellow, and so on. The three pure colors could be handy for checking the guns of a picture tube for equal emission. Pushing all three primaries at once gives you a pure white raster at a 7.5-unit level.

The IF output can be used for tuning substitution. It has a level of 10 mV with no signal, which is ample.

If you use all possible combinations of switching, you can get a total of 28 different patterns! The manual lists them.

For TV and VTR testing, the composite video signal is available through a jack on the front panel. It has a gain control that will vary the level from 0 to 1.5 volts P-P. Turning the control fully counter clockwise until a click is heard sets the output at the standard level of 1.0 volt P-P with the sync negative going. That is the standard video input used for many VTR tests. Any of the patterns can be used to modulate the video signal. You can feed the NTSC color bar signal into a VTR, record it, then play it back to make sure it comes out the same as it went in. If you have sound problems in the VTR, you can feed an RF signal into its tuner, with either of the two audio frequencies as modulation.

continued on page 93
An inexpensive wide bandwidth preamplifier in kit form that has many applications on your workbench.

EARL "DOC" SAVAGE, K45DS, HOBBY EDITOR

A WHILE BACK I WAS WORKING WITH SOME low-level RF circuits and discovered that my frequency counter would not pick up those feeble signals. Needing that information, I had two choices. One was to rebuild the counter-input stage to provide more gain. That seemed to be too much trouble so I chose to add a preamplifier.

International Crystal (10 North Lee St., Oklahoma City, OK 73102) has a little two-stage, broadband-amplifier kit that looked good for this application. The BAX-1 has 30 dB to 6 dB gain over a range of 20 Hz to 150 MHz—that was just what my counter needed. I put it together in about ten minutes and temporarily inserted it between the RF circuit and the counter.

The setup worked so well that I started taking the counter cabinet apart to stick the amplifier inside. Fortunately, I decided to try a few more things before wiring it in. Here is what happened.

With the BAX-1 in the input line, my AC voltmeter was much more sensitive. Of course, all measurements were relative instead of absolute but those really weak ones were in there.

The BAX on the output of a little crystal oscillator made an excellent low-power transmitter. Placed between the antenna and a shortwave receiver, it amplified the incoming signals and thus enabled the receiver to pick up weaker signals.

That's just for starters. There is no reason why the BAX can't be used to increase the sensitivity of a microphone. I want to try it on my TV antenna and on the FM in the car. The BAX is quite versatile and, in some applications, should be even better with a tuned circuit or filter before and/or after it. Needless to say, mine hasn't gotten into the counter cabinet yet and probably won't, at least for a good long while.

The BAX-1 ($6.67 including postage in U.S.A.) contains a circuit board, all parts, and mounting hardware. You can get the kit or build your own from scratch. With International's permission, the circuit is shown in Fig. 1. There is nothing critical about its construction.

In a couple of applications I found that some method was needed to vary the gain (there was too much). Of course, that can be done in several ways; for example: a pot used as a voltage divider at the input, or by varying the bias on a transistor. The easiest way for me was to vary the applied voltage. The BAX-1 specifies 9 to 15 volts but it works fine at much lower voltages, too.

By the way, International has several other interesting little kits that I really want to investigate. If you have used any of them in unusual applications, how about sharing your experiences with me and other readers?

Technical training

In past columns I have mentioned from time to time the need for the serious hobbyist to learn more than just tinkering will provide. The real pleasure of electronics is found beyond the stage of following “cookbook” building plans (though that is a good place to begin). The satisfaction that comes from experimenting, modifying and, ultimately, designing is hard to beat.

Going beyond the simple matter of just following instructions requires a basic knowledge. Several suggestions have been made for acquiring that base. Among the suggestions was independent study—a method probably most suited to a majority of the hobbyists.

One of the problems with independent study has been finding the right materials. I have told you about study materials from the Heath Company and the American Radio Relay League, among others. Recently, I have discovered some excellent materials from the McGraw-Hill Book Company.

McGraw-Hill publishes textbooks on a wide range of technical subjects. In the electricity and electronics area, the list goes on and on from servicing to applied mathematics. Of particular interest at this point are a couple of texts that I have had an opportunity to examine quite thoroughly. They are: Electronics: Principles and Applications by C. A. Schuler, with its Activities Manual ($16.00 and $7.50, respectively) and Digital Electronics by R. L. Tokheim, with its Activities Manual ($8.50 and $5.75).

As a professional educator, I have examined many textbooks over the years. Those two are near if not at the top in instructional quality. Both are unusually well-written and well-presented. Organization of content, clarity of circuit diagrams, and explanatory text are outstanding. Best of all, from our standpoint, is that those textbooks are as well suited to independent study as they are to classroom use.

I recommend either or both of those books, depending upon your interests and needs, for building that base of knowledge which will enable you to get the most from your hobby. If you choose to go that route, I also recommend that you get the corresponding Activities Manual(s). They are not necessary to an understanding of the texts but they will be an additional help.

The Manuals contain specific lab-type activities to illustrate and “nail down” the concepts in the texts. Components that may be needed to carry out the activities are readily available and inexpensive. (You probably have most of them in your junk box.)

It is unlikely that you can find those books and manuals locally. Exact prices and ordering information can be secured from Gordon Rockmaker, Editor in Chief, Electricity/Electronics, Gregg Division, McGraw-Hill Book Company, 1221 Avenue of the Americas, New York, NY 10020.

Again, I urge those of you who have not done so to do some studying and enjoy your “work” more!

Photo timer

J. D. Miner of Lima, OH has written about adapting a clock module for photographic use. Color processing, as you know, requires several sequential timed steps. Of course you can do that, J.D. It will start at zero and read elapsed minutes and seconds.

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Here’s a look at the various ways you can interface a microprocessor to a 7 segment LED display.

J. TITUS, P. RONY, D. LARSEN and C. TITUS

REGARDLESS OF THEIR APPLICATION, MOST microcomputers need peripheral I/O devices for the input and output of data. The more common output devices include 7-segment displays, 5 × 7 dot-matrix displays, printers and CRT displays.

This month, we’ll look at several methods that can be used to interface 7-segment displays, as well as different programs to “drive” such displays that are widely used in electronic games, calculators, point-of-sale (POS) terminals, gasoline pumps, children’s toys and taxicab meters.

One of the simplest methods for interfacing a 7-segment display to a microcomputer consists of latching the appropriate data values from the data bus under software control (see Fig. 1). The latch’s inputs (7475) are wired to the computer’s bidirectional data bus, and the latch’s outputs are wired to a 7-segment decoder/driver (7447). The decoder’s outputs (current-sinking) are wired to the 7-segment display with 220-ohm current-limiting resistors. When an OUT125 instruction is executed, the content of the 8080’s A register is latched by the display interface, and the two BCD numbers represented by D7–D4 and D3–D0 are illuminated on the two displays. The instructions listed in Table 1 cause a “39” to be displayed.

To display a 10-digit number using this method, 10 latches, 10 decoder/drivers, 70 resistors and 10 seven-segment displays will be required. One method of reducing the “parts count” for this interface is to use a device such as the 8255 Programmable Peripheral Interface (PPI) integrated circuit. This device can be used as three independent 8-bit output ports, so it is the equivalent of six 7475 latches. Therefore, two 8255 PPI IC’s, along with 10 decoder/drivers, 70 resistors and 10 seven-segment displays would be required in the interface. An obvious disadvantage of this method is the large number of IC’s required. However, one advantage is that the software needed to drive this interface is relatively simple. Also, the microcomputer only has to output this information once to the interface for the information to be continuously

---

**TABLE 1—DISPLAYING A 39 on the two-digit display**

/this section of a program outputs the /bit pattern 00110001 (octal 071, hex 39) /to an output port equipped with two /seven-segment displays.

- MVI A
- 071 /load a with the following immediate
- OUT /data byte (hex 39, binary 00110001)
- 125 /output it to the two seven-segment
- CONTINUE WITH THE REMAINDER OF THE /program
displayed. This, of course, is due to the latches or the 8255 IC's in the interface. Thus, the microcomputer can output numeric information once and then go on to perform any other required operations.

Another interfacing method is digit multiplexing. Multiplexing reduces the display-interface electronics (number of parts) to a minimum; however, at the expense of longer and more complex display-driver software. Multiplexing a display consists of enabling or turning on one particular digit with a digit-enable code and providing the BCD numeric information for that digit to a multidigit display interface. In this way each digit is turned on, one at a time, as the actual BCD data for each digit is provided. Multiplexing is usually only used with multidigit displays.

As an example, let's suppose the number "237" is to be displayed on a 3-digit multiplexed display. To display this number the BCD value for the digit "2" would be output to the interface along with the digit-enable code for the right-hand display. After a short period (1 µs to 10 µs) the BCD value for number "3" would be output along with the digit-enable code for the middle digit. Again, after a short delay, the BCD value for the number "7" and the digit-enable code for the left-hand display would be output to the interface. By performing this sequence 50 or more times every second, each digit in the display appears to be on all the time. This display method is used in hand-held calculators. Even though the digits are being turned on and off, it happens too fast for the eye to see. The interface for a 10-digit multiplexed display is shown in Fig. 2.

When an OUT125 instruction is executed, bits D3-D0 of register A determines which one of the 10 digits in the display will be enabled (turned on). Therefore, these 4 bits constitute the digit-enable code. Bits D3-D0 are latched (7475) and are decoded with a one-of-10 decoder (7442). The decoded outputs of the 7442 are wired to the common cathodes of the individual digits in the display. Bits D7-D4 provide the BCD code of the value to be displayed (0-9). These bits are also latched (7475) and are decoded by a 7-segment decoder/driver (DS8857, manufactured by National Semiconductor, Santa Clara, CA).

An additional display method involves the use of an external display controller IC to control the multiplexed display. The Intel Corporation manufactures some of these IC's that are compatible with the 4004/4040, 8080 and 8085; these IC's are the 4269, 8279 and 8279-5. National Semiconductor Corporation also has developed two display controller IC's that can be used with 6-digit displays. One of the devices (the MM74C912) can be used to display 0-9 and the other (the MM74C917) can be used to display hexadecimal numbers R-E.
The Clock of the 80's!

computer products

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PARALLEL INTERFACE, model VPI-1, is an SS-50 bus-compatible board providing four I/O ports to interface keyboard, printers, etc., with CPU's. Two MC6820 peripheral interface adapters, two MC6522 versatile interface adapters or a combination of both give a total of 40 I/O lines (36 of them for input/output, 4 for input only) to hookup to IC power drivers and buffers. The MC6522 has 48-line expansion interface. Also available are an assembler/editor, extended machine-code monitor and complete software library. System is powered by +5-VDC 3-amp supply (not included) and is also available as Challenge TP complete with case and on-board power supply. Suggested retail prices: Superboard II, $279. Challenger TP, $349—Ohio Scientific, Inc., 1333 S. Chillicothe Rd., Aurora, OH 44202.

16K EPROM BOARD uses 2708 16k memories compatible with Digital Group 2708 systems. Features 8K or 16K selectability with each 8K memory block jumper to any 8K boundary and

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two programmable timers that provide for real-time interrupts and waveform generation. Address selection and port selection are DIP-switch or jumper-selectable. Prices: model VPI-1 board, $32.50, plus $2.50 per order shipping and handling; documentation, $5 ppd. Ohio residents add state and local taxes where applicable. —F & D Associates, 1210 Todd Rd., New Plymouth, OH 45654.

SINGLE-BOARD COMPUTER SYSTEM, Superboard II, is a complete personal computing system on one board. It provides 8K BASIC in ROM; 6K RAM; 6502 microprocessor; user-programmable 53-key keyboard; video display interface, audio cassette interface; machine-code monitor; and I/O ports. Video display provides upper/lower case, graphics and game characters for up to 156 X 256-point resolution. Available options include expander board with 24K RAM, dual mini-floppy disc; port adapter for printer or modem; and lower case ASCII character set, plus a TMS 2716 socket for optional 128-character set; plus 2K RAM. User can create own graphics for storage on PROM, disc or tape. The board can be used to display up to 256 characters simultaneously, either in inverse or normal mode, at half or full intensity. The board is addressable to any 2K boundary, addressing allows multiple boards at the same address. Available software includes GMXBUG video-based 3K ROM monitor, separate driver routines and a program that lets you create your own characters. Price: $458.76.—Gimix, Inc., 1337 W. 37th Pl., Chicago, IL 60609.

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fully buffered address and data lines. The board comes assembled and ready for EPROM insertion. Price per board, $99.50, 2708 EPROM's, $12.50 each. —PEC, 21720 Alcazar Ave., Cupertino, CA 95014.

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RELAY MULTIVIBRATOR

Among the earlier multivibrators, one of the simpler models was a device using two relays and one or more capacitors and resistors to control the timing cycle and operating frequency. When it comes to small size and speed, all is in favor of the solid-state electronic multivibrator.

![Diagram of relay multivibrator](image)

However, from time to time we may need the simplicity of the relay multivibrator. Most circuits shown in literature use the charging of a capacitor to control the timing and one or more resistors to limit the discharge current so it won’t damage the relay contacts. The circuit in Fig. 1 was developed around two relays and a single capacitor to perform the same tasks as the more elaborate circuits.

Circuit operation is as follows: When switch S1 is first closed, the C1 charging current activates relay RY1 and causes its normally closed contacts (RY1-1) to open. When the C1 charging current falls below the hold-in rating of RY1, the relay releases and closes contact RY1-1.

At that moment, the coil of RY2 is connected across C1. The capacitor starts to discharge and the discharge current energizes RY2 and causes contact RY2-1 to open. When the discharge current drops below RY2’s hold-in current rating, RY2-1 closes to start the cycle anew. The multivibrator will switch back and forth between the relays at a frequency governed by the capacitance of C1, the resistance of the relay coils, the applied voltage, and the hold-in current of the relays. As the relays cycle, switching operations can be carried out as needed by auxiliary contacts on either or both relays.

A potentiometer can be inserted between the relays as in Fig. 2 so you can vary the cycling. — J. Ofer

NEW IDEAS

This column is devoted to new ideas, circuits, device applications, construction techniques, helpful hints, etc.

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Oscilloscope
continued from page 43

The LM318 op-amp (IC302) is used as a voltage comparator, holding the trigger input of the 555 positive until the timing capacitor has completely discharged. Premature triggering during retrace is thus prevented. The 555 provides a squarewave output at pin 3 that goes to +9 volts while the ramp is rising and drops to ground during retrace and hold-off. That line is capacitively coupled to the CRT grid to suppress the beam except during the sweep.

Baseline generator: The retrace-suppression line is used via R330 to synchronize the zero-baseline oscillator Q306, insuring that the switch from baseline to signal display will always occur at the start of a retrace when the beam is suppressed. For the lower sweep speeds, synchronization requires a slower oscillator, and for that C319 is switched in.

Each time unijunction transistor Q306 fires, C316 discharges through R332, setting flip-flop Q307–Q308 through D308 and initiating a baseline sweep. After the baseline sweep (or several sweeps if C316 is not discharged after the first one) pin 3 of the 555 goes low, bringing the base of Q307 low through C315 and D307, thus resetting the flip-flop for a series of signal displays.

Power supplies: The power supplies (Fig. 5) are entirely conventional except for the 900-volt tripler. Diodes D105 and D106 charge C102 to the peak negative voltage of the transformer secondary on the negative half cycle. On the positive half-cycle, C102 and the secondary appear in series to charge C101 to twice the peak secondary voltage (negative on top), through D103 and D104. On the next negative half-cycle, C101 and the secondary appear in series to charge C103 to three times the peak secondary voltage through D101 and D102. The drain on that supply is about 200 μA, so the 0.1 μF Mylar filters are quite adequate. Some of those capacitors are used at 20% or so above their rated voltage, but many have been tested at four times rated voltage with no breakdowns. Any string of five to ten Zener diodes adding up to about 900 volts will do for D109 through D113 if 180-volt Zener diodes are hard to find. Capacitor C105 filters out the 60-Hz noise picked up from the power transformer by the CRT heater winding.

We must break off our discussion of the oscilloscope's power supplies now and will conclude it next month when we will also go into construction, checkout and calibration.  

R-E

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AMPLIFIED MICROPHONE, model T²M has integral touch-pad encoder, 12-key keyboard and LED display. Other features include preamplified electret element, digital integrated tone generator and has 3.5795 crystal, and a mixer amplifier with up to 15-dB gain. Power is supplied by 6-0.16-volt DC sources. Mike is housed in rugged shielded plastic, and an 8-foot, 3-conductor cable is included. Suggested retail price: $105—The Astatic Corp. Conneaut, OH 44030.

THREE-BAND ANTENNA, System Three, is a lightweight antenna designed for 10-15-20 meters, and features low SWR across the entire bandwidth, and a 14-foot X 4-inch boom length.

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The antenna can survive up 100-mph winds. Direct feed with 52-ohm coax cable or a balun and has a power-handling capability of 2000 watts. Suggested retail price: $179.95.—Wilson Electronics, P.O. Box 19000, Las Vegas, NV 89119.

CORDLESS REMOTE TELEPHONES, models CP-100S and CP-200S, contain full duplex circuitry and have an effective range of 300 feet. Features include pushbutton number entry, automatic redialing of the last number called, and rechargeable nickel cadmium batteries. Model CP-100S is portable style and CP-200S is phone handset style. Suggested retail price $269.95.—Cobra Communications, Dynascorp Corp., 6460 W. Cortland St., Chicago, IL 60635.

MORSE CODE READER, Morse-A-Word, assembled or kit, is designed for SWL’s and amateur radio operators. Accepts audio signals from communications receivers and displays 8 digital characters sequentially. Other features are a 5- to 35-word-per-minute code speed, a built-in oscillator and monitor speaker for code practice. The unit measures 7.735 W x 5.75 D x 3.75 inches H, and weighs 4 lb. Suggested retail prices: kit, $169.95; assembled, $249.95.—Microcraft Corp., Box 513, Theinsville, WI 53902.

CB RADIO, model PC-100, has a wide range of control functions including volume/squelch, RF microphone gain, clarifier, tone control and ANL. A panel switch provides instant shift to Channel 9.

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Performance is monitored by a meter reading signal strength and power output, a TX modulation indicator and an RX lamp. Operation is from 13.8 VDC, positive or negative ground. Suggested retail price $119.95.—NDI, 22125’S S. Vermont, Torrance, CA 90502.

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How to locate faults in the all-electronic tuners

JACK DARR, SERVICE EDITOR

Understanding that gives us our first handle on the problem. Look at the TV set. What is it doing? If the answer is "nothing", providing just a plain or snowy white screen, then we may have a tuner problem. To make sure, use the old test: Feed the output of a tuner subber into the IF input and see if the rest of the set works. If so, the problem is definitely in the tuner and we've eliminated a whole lot of things.

The tuner will have the standard stages: an RF amplifier, usually a dual-gate FET, a mixer, another mixer, and the oscillator. All tuning will be done with varactor diodes that are controlled by the tuning voltage from the control unit. If the TV set tunes to a wrong channel, or refuses to change channels, the first thing you need to check is that tuning voltage.

Sams, and others, provide us with the other necessity: very complete service data and pinouts on the various circuits. Among that service data is a table of the tuning voltages you should get for the various channels. For example, let's look at the tuner in an RCA CTC-92A chassis. You should read +1.8 volts for Channel 2, +19 volts for Channel 6, +8.5 volts for Channel 7, and +14.6 volts for Channel 11. Punch in the various channels on the keyboard and make sure these voltages are correct; there is a small tolerance. If the tuning voltage is OK but the tuner still doesn't work, then the fault should be in the tuner itself and not in the control unit.

Bandswitching is also done by voltages and switching-diodes. Those voltages are also given in table form in the service data. If they prove not to be correct, you have a control-unit problem. Same principle goes for the tuning voltages. If the voltages are correct, the trouble lies in the tuner circuitry.

Since these are tuners, we can use signal-tracing tests to find out which stage is bad, just as we did with the mechanical tuners. Inject a signal into the mixer input. If that produces some kind of picture or at least a reaction, move to the RF input. Easy way: you do not have to make contact with the circuit. For safety's sake, connect a short piece of insulated wire to either lead of an antenna, or to the RF output of a bar-dot generator. Just holding the insulated end of the wire near the input of a stage should radiate enough signal into it to get some reaction.

Many of those units are modular. At first, you would probably be better off simply to replace the suspected module. However, when you're more familiar with them, you could try to locate and replace bad parts since the modules are pretty good-sized with "room to work" and make tests.

A lot of set-makers have come out with very detailed descriptions on how those circuits work, along with servicing hints and check-points—Magnavox, RCA, Sylvania and others among them. Get hold of those descriptions and read up on them. They provide a very valuable source of reference and familiarization material. Service data is absolutely necessary so that you'll know where the test points are for the voltages, etc.

So, I don't see why the new tuners should be any more difficult to service than some of the impossibly-crowded old ones. In many cases, they should be a lot easier! (For our sake let's hope so.) If you use a calm "functional approach." Look at it and see what it's doing, then look at the service data and see what could make it do that, the new tuners should be much simpler than you'd think at first glance.

New service center

I've just gotten a notice that PTS Electronics, Inc., has opened a new service center at 1289 Madison Ave., P.O. Box 41043, Memphis, TN 38104. They rebuild tuners, modules, and quite a few other things. That should improve service for people in the Mid-America area. John Postlewaite, General Manager, invites all technicians to visit the new facility and get a first-hand look at the many things they can provide to help us out.

service questions

VERTICAL RASTER LINES

I'm having a problem with a Zenith model 20X1C38. The set has bright vertical lines in the raster. So far nothing that I've checked or changed has had any effect! Any help would be appreciated—O.B.G., Albuquerque, NM.

continued on page 84
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SPECIFICATIONS

FREQUENCY Direct - 10 Hz to 60 Hz
RANGES: Prescaled - 1G MHz to 600 MHz
SENSITIVITY: .15 mw at 30 MHz typical
25 mw at 150 MHz typical
50 mw at 450 MHz typical
TEMP. STABILITY: ±.2 ppm/°C (+1 ppm)
GATE TIMES: Selectable - 1.0 second
3.1 second
RESOLUTION: 1 Hz - 10 Hz to 5 MHz
10 Hz - 10 MHz to 50 MHz
100 Hz - 10 MHz to 600 MHz
(1 Hz (Prescribed))
INPUT IMPEDANCE: 60 MHz - 1 Meg shunted by 20 pf
600 MHz - 50 ohm
INPUT PROTECTION: Direct input -
100 MΩ up to 13 MHz
50 MΩ up to 60 MHz
Prescaled input -
2 V max.
DECIMAL POINT: Automatic placement
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SERVICE QUESTIONS
continued from page 82

This one has a vaguely familiar look. Quite a while back, I had a similar problem, also in a Zenith of about this vintage. After "checking and changing everything we could think of," I noted that with a probe held near the high-voltage cage the stray pickup waveform showed something odd. If you turn the gain up until you can only see the horizontal part of the waveform (the spike is up and off-screen), note there is a vertical spike on it. This is the sawtooth part of the waveform. After some nail-biting, we tried changing the flyback and that fixed it. I've still got the original flyback in a box and to this day I have no idea at all what the defect is! My only guess is that it could be some kind of oddball ringing in one of the windings.

ARcing PROBLEM

When I turn the brightness up on this Admiral model 4H12 chassis, light and dark horizontal streaks show up in the picture. I've checked quite a few things with no luck. Any ideas?—S.L., Massapequa Park, NY.

(I suggested that he do a few things, and check the high-voltage rectifier tube, etc.) Later he wrote:

"I checked all the things you mentioned. While I was working, I happened to touch the degaussing coil socket and it bit me! I disconnected it, and the arcing disappeared. A new degaussing coil fixed it. Thanks!"

Glad to hear he found the trouble. Degaussing coils can do some fantastical funny things.

MYSTERY STEREO IDENTIFIED

I can't identify this AM/FM stereo that's labeled "252," and is made in Taiwan. One source tells me it's an Admiral model ST-400, but Admiral says no. Both the output transistors are shorted, and a diode in one transistor base has exploded. The PC board schematic shows a diode as being a "KB-162," and something else is shown as a 15-ohm resistor. The KB-162 in the working channel tests as a diode, but the 15-ohm resistor looks more like a glass diode. It checks out as a glass diode too, but if it is leaky! It has a low front-to-back ratio. Any help will be much appreciated.—J.P., Lewistown, MT.

Without much hope, I looked in my Admiral file and found a 252 listed that certainly looks like the microcircuit you sent! (Sams Photofact Folder No. 1443-2 shows it.) The output transistors are a complementary-symmetry pair. An RCA SK-3083 replaces the 2SA699A(Q),PNP, and an SK-3054 replaces the 2SC1266A(Q). The bias diode is an SK-3087.

Both the Sams and Admiral schematics show two diodes in series in this stage. If the "something" you have checks as a diode, I'd say that it is one. (Just to double-check on the leakage, lift one end of the transistor and repeat your tests.) Since it has 0.7 volt across it, it is probably a silicon diode. Perhaps an Si and a Ge diode were used in series to obtain the required bias voltage. I once had an amplifier that had one Si and one Ge transistor in the output stages. I replaced them with two Si's; this resulted in quite a lot of distortion. I finally checked and found out what was going on.

TRANSiSToR SUBs WANTED

I need replacement transistors for a Dynaco model 120 power amplifier. I can't seem to locate them anywhere. I understand Dynaco is out of business. Can you help?—H.K., Akron, OH.

Yes, apparently Dynaco has gone out of business. Sams lists the name but not the address and no photocopies schematics! However, the RCA SPS-202X Transistor Guide shows the 2N3053 as an SK-3024, NPN silicon, TO-39 case; the 2N4037 is an SK-3262, NPN silicon, TO-39 case. The voltage for each is about 90. That should do it.

TEXTBOOK ON PICTURE TUBES?

I'm looking for a textbook on picture tubes that tells how to test and handle them, what instruments to use, etc. Can you give me the name of such a book?—J.O., Richmond, IN.

I'm afraid not. This information is all available from set manufacturers (in their service data), and from picture tube manufacturers such as RCA, GE, Sylvania, etc. The "picture tube characteristics" books show a great deal of data on biasing, voltage ratings, specs, etc. You should be able to obtain these books from your local radio-TV supplier.

In order to test picture tubes, you need a picture tube tester! These are manufactured by several companies. The instruction manuals give all the necessary data on how to use them. Suggestion: Try to obtain a Heathkit manual that describes one of this company's better picture tube testers. This manual will usually have a full circuit description and a very well-written explanation.

WORKS ON JIG, NOT IN SET

This RCA CTC-46 works on a test jig. Put it back in the cabinet and the vertical output transistors blew out! However, the yoke resistance checks out OK.—J.S., Lakewood, CO.

Well, the vertical output used here is a complementary-symmetry circuit, as used in audio amplifiers. It will withstand an open but a short will damage it. So, you have a short somewhere in the vertical yoke or in the pincushion circuitry. If the yoke resistance seems to be OK, check the pincushion corrector circuitry, looking for possible shorts to ground or to boost. It's bound to be in there somewhere!
VOLTAGE METER, the Volt Sentry, is designed to identify faulty outlets and circuits. It can be plugged into the common outlet to indicate the voltage level. The scale is divided into Normal, Brown-Out and Surge. The meter also shows the actual voltage being fed to an appliance plugged into the same outlet. Measures \( 2\frac{1}{4} \times 2\frac{1}{4} \times 1\frac{1}{8} \) inches. Price is $14.95.—Whitesavers Co., 71 E. 13th St., Huntington Station, NY 11746.

SOLAR POWERED RADIO, 3 solar cells operate this 8 oz., 1.5 volt AM radio during daylight hours. By means of a selector switch, the radio can also run during darkness from a battery contained in the case. Suggested retail price $39.95.—Solec International, Inc., 12523 Chadron Ave., Hawthorne, CA 90250.

HEX KEYS AND WRENCHES, offers 4 new sizes of short-series standard right-angle hex keys, sizes \( \frac{1}{2}'' \), \( \frac{3}{4}'' \), \( \frac{5}{8}'' \) and \( \frac{3}{8}'' \), and two new long-series, sizes 8mm and 10mm. Featured are pouched sets No. LM12 with 12 metric-sized keys and No. SLK17 with 17 short-series keys. The wrench line is available in short, long, extra and foot-long series, and includes a wrench that can drive at angles up to 40° with full torque. These products are made of steel, are corrosion resistant and are heat treated for added strength.—Vaco Products Co., 1510 Skokie Blvd., Northbrook, IL 60062.

LED SAMPLER KIT, model EK-2, contains samples of LED indicator lights that can be used in breadboarding or building working prototypes. The kit consists of 28 different LED’s and assem-
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NEW PRODUCTS
continued from page 85

600 volts in three ranges. Insulated test leads are
disconnected when model 30 is set for AC current
ranges. Optional accessories include a 0–1000
ohms plug-in adapter that is required for measur-
ing resistance. The model can withstand moment-
ary overloads and has an accuracy of 3% in all
ranges. Frequency response of voltmeter is flat ±
1% of full scale from 20 to 5000 Hz. Price is $65.—Tripplett Corp., Dept. PR, 286 Harmon Rd.,
Bluffton, Ohi 45817.

TOOL KIT, model JTK-24, is a miniature and sub-
minature tool kit designed for servicing, repair
and assembly of precision electronic equipment.
It contains more than 120 tools including screw-
drivers, nutdrivers, pliers, wrenches, drills, hex
keys and many more. These tools are useful for
repair of many types of equipment such optical,
photographic, sound, broadcast and test equip-
ment. Tools come in a 10 1/4 x 12 1/4-inch zippered
case. Price is $315.—Jensen Tools, Inc., 1230
South Priest Dr., Tempe, Az 85281.

COLOR PATTERN GENERATOR, model 1250, is
designed as a test signal source for station CATV
as well as for maintenance and trouble-shooting of
video equipment. It generates the NTSC bar pat-
tern with a -1WQ signal plus a full-screen color
bar pattern. Other patterns include a staircase
with selectable chroma levels, plus dot, cross-
hatch, center cross and color raster.

CIRCLE 156 ON FREE INFORMATION CARD

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Model 1250 also produces a 4.5 MHz sound
carrier or an external audio signal, and generates
RF outputs on either Channel 3, 4, or the stand-
tard TV IF frequency. Operating manual is
included. Price is $795.—B & K—Precision, 6460
W. Cortland St., Chicago, Il 60635.

PICTURE TUBE MACHINE, the latest in research
and development, enables anyone to rebuild any
CRT—color, black and white, 20 mm, foreign or
domestic picture tube, in approximately two
hours. Complete information and literature availa-
able.—Lakeside Industries, 4071 N. Elston Ave.,
Chicago, Il 60618.

DIGITAL PANEL METER, model B500, is a 3 1/2-
digit meter containing 13 parts—one IC, 7 pas-
sive components and a display. The unit is bipo-
lar, differential and features auto-zero. The input
range is from 50mV to 1000V. Requires either a
5VDC source or a 115/230 VAC, 47-400 Hz
source. It consumes 200-800 mW and its accura-
cy is ±0.05% ± 1 digit. The red LED display is 5
inches high. Price is $49.00.—International Mi-
crotronics Corp., 4016 E. Tennessse St., Tucson,
Az 85714.

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SPECIFICATIONS
■ Frequency coverage: 50 kHz to 28.7 MHz, continuous. Digital synthesis in 5 kHz steps, fine tune for 5 kHz.
■ Reception modes: AM, upper sideband, lower sideband, CW.
■ Sensitivity for 10 dB S + N/N: CW, SSB
AM 100 kHz 1 kHz 15/10/15 uV 1 kHz 15/10/15 uV
■ Selectivity: 60dB @ ± 2 kHz or ±4 kHz and -60dB @ ±5 kHz or ± 4 kHz
■ AM Harmonic distortion: 5% modulation at T.H.D. 90% modulation at 1.5% T.H.D. (1kHz modulation)
■ Frequency stability: Within ±40 Hz in any 8 hour period at a constant ambient of 25C, after 30 minute warm up
■ Circuitry: 43 integrated circuits, 18 transistors, 16 FETs and 54 diodes.
■ Dimensions & Wt.: (W x D x H) 17.5 x 14.5 x 5.1 inches. Shpg. Wt. 19 lbs. (8.7 Kg)

CIRCLE 76 ON FREE INFORMATION CARD
fed as a DC logic high to gate AND-1. (The other input of gate AND-1 is fed by the drum-rotation detector stage shown in Fig. 2.) A logic-high output goes to IC pin 15 when both detectors are working.

Near the end of the tape, the metallic strip severely loads down the Q of the supply-sensing coil. Oscillation stops, and the detector no longer sends a logic-high signal to the input of gate AND-1. A logic low goes to the auto-stop signal line and to gate AND-2 shown in Fig. 1.

Besides inhibiting any threading motion, the auto-stop signal triggers a driver stage that activates a STOP solenoid. The result is the same as you get from pressing the STOP pushbutton—tape transport ceases.

Rewind switching connects takeup-sensing coil L6502 into the oscillator-feedback loop. Again, as long as regular tape moves past the coil, the oscillator supplies a signal to the detector and (thus) a DC logic signal to gate AND-1. But when the metallic leader moves alongside the coil, the oscillation is loaded down and stops. A logic low at the input of gate AND-1 places a logic low on the auto-stop signal line.

You have already seen how the drum-rotation detector works. If the videohead drum stops spinning, the pulse generator that is a part of the drum immediately stops generating a signal. The sensing stages no longer produce logic high for gate AND-1. Again, a logic low on the auto-stop signal line triggers the STOP solenoid and also (through gate AND-2) inhibits any threading (or unthreading) activity.

Dew sensor—Not all Beta machines include this protective system. It keeps the mechanism from operating if moisture has condensed in the works (that could damage tape seriously). Figure 5 is the diagram of the dew-sensing stage used in one Toshiba model.

The sensor itself is a resistance that decreases in value (generally to below 500,000 ohms) when moisture forms on its probes. The sensor is part of the feedback circuit in a dew-oscillator stage. No oscillation takes place as long as the sensor resistance is high. As the resistance lowers, the feedback becomes sufficient to start the oscillator.

Network R832-C820 feeds the oscillator-output signal to rectifiers D802-D803. Filter capacitor C819 charges to a negative DC value (note the orientation of the diodes). This negative voltage “bucks” to zero the normal logic high that is fed to the base of Q803 through R830.

A logic low at the base of Q803 creates a logic high at the collector, and then again a logic low at the collector of Q804. We know that a logic low on the auto-stop line to the STOP-solenoid driver causes the solenoid to activate. The same logic low from Q804 goes to gate AND-2 and inhibits the threading system.

In the Toshiba model, the reed switch on the tape-slack detector arm is also connected at the base of Q803. Any slack in the tape closes the switch and plunges the Q803 base to a logic low. Transistor Q803 generates a logic high and transistor Q804 generates a logic low. The STOP solenoid is activated, and threading is inhibited too.
More information on stereo products is available. Use the Free Information Card inside the back cover.

PHONO CARTRIDGE, model M95HE, is a top-of-the-line phono cartridge incorporating a hyperelliptical nude diamond-tip stylus (model N95HE) that provides up to 25% reduction in distortion, and is also used with the model V15 Type.

CIRCLE 131 ON FREE INFORMATION CARD

CIRCLE 132 ON FREE INFORMATION CARD

detented linear controls, three tape-deck switches for record equalization, playback equalization and tape monitor, and a separate power supply for low noise. Model GEM-1 also uses a system in which the user contours cards for a specific equalization setting. When a card is moved up the faceplate of the unit, all the frequency controls are automatically positioned. Another feature is narrow-bandwidth circuitry for minimum adjacent band interaction. All components are mounted on a single glass epoxy PC board. Frequency response is 10 Hz to 150 KHz ± 0.5 dB. Suggested retail price is $89.95.—Superex Electronics Corp., 151 Ludlow St., Yonkers, NY 10705.

PERCUSSION SYNTHESIZER, the Drum 5700, is a versatile instrument that uses continuously variable controls for pitch modulation—up or down, oscillator waveform mix, noise filter frequency, and oscillator/noise mix. It features modular construction which allows it to configure any size drum set, and numerous rear panel patching and control points which allow multiple cards to be cascaded for a wide range of effects. Other features include an encapsulated sensor that can be mounted permanently or temporarily to a drum set, and an optional cancel switch that disables the synthesizer when not in use. Price is $59.95 for a kit; assembled units are also available.—PAIA Electronics, Inc., 1020 Wilshire Blvd., Oklahoma City, OK 73116.

DIRECT-DRIVE TURNTABLE, model 650 RC is an automatic single-play turntable that can be operated in automatic, semiautomatic and manual modes, and has remote-control capability (optional). The turntable features a high-torque DC motor, an ultra-low-mass (ULM) tonearm (with optional ULM cartridge), gimbal suspension, pitch control, cue control, antiskating control and

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- AND
- Process choices—make circuit on copper and etch for 1 card. Make circuit on film, expose, develop and etch for 1 or many cards.

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disables the synthesizer when not in use. Price is $59.95 for a kit; assembled units are also available.—PAIA Electronics, Inc., 1020 Wilshire Blvd., Oklahoma City, OK 73116.

DIRECT-DRIVE TURNTABLE, model 650 RC is an automatic single-play turntable that can be operated in automatic, semiautomatic and manual modes, and has remote-control capability (optional). The turntable features a high-torque DC motor, an ultra-low-mass (ULM) tonearm (with optional ULM cartridge), gimbal suspension, pitch control, cue control, antiskating control and
an aluminum platter. The turntable comes complete with cover and base, and sells for a suggested retail price of under $400. Optional cartridge, model 55E, $110; and infra-red remote control, model RC 152, $79.95.—United Audio Products, 120 So. Columbus Ave., Mt. Vernon, NY 10553.

SPEAKER SYSTEMS, a line of four speakers feature a unique total motor system that results in a higher than normal efficiency for acoustic suspension speakers. The 8-inch 2-way system, model 94-1200, is a lightweight compact speaker rated at 25 watts RMS with a frequency response of 45 to 20,000 Hz. The 10-inch 2-way system, model 94-1350, features a 10-inch woofer and a 4¾-inch midrange, is rated at 45 watts RMS and has a frequency response of 35 to 20,000 Hz. Prices range from $59.95 to $79.95.—United Audio Products.

The model 1250 is only a bit more than 4 inches tall and 17.5 inches wide. The jacks that you will use most often are on the front panel. All of the controls are conveniently arranged, which makes the model 1250 a very easy instrument to operate quickly.

All of the RF and IF signals are crystal controlled for greater accuracy. Each one has its own crystal oscillator for maximum stability. The sync-generator circuitry uses the latest LSI circuit design. A single integrated circuit generates all of the sync signals, again to strict NTSC standards. Even the newer TV receivers, which use a count-down IC to develop the sync signals will work here. Every one of the outputs of the model 1250 may be used at the same time. You could drive a video monitor with the video output and at the same time feed RF signals to a color TV set!

There’s one other thing you can do with it, too. If you run into the hypercritical customer who insists that a problem is in his TV set (and you are almost sure that it is either a network goof or a local TV station goof!), you can show him that his set will indeed make the standard patterns and tell him that this is the kind of equipment that the TV station ought to be using!

CIRCLE 135 ON FREE INFORMATION CARD

wide dispersion and is rated at 35 watts RMS. The 10-inch 3-way system, model 94-1350 (shown), handles a power of 40 watts RMS; the 12-inch 3-way system, model 94-1400, has a 12-inch woofer, 4¾-inch midrange, is rated at 45 watts RMS and has a frequency response of 35 to 20,000 Hz. Prices range from $59.95 to $99.95.—GC Electronics, 400 So. Wyman St., Rockford, IL 61101.

COLOR-BAR GENERATOR continued from page 71

Even video cameras may be tested with the model 1250. You can switch to an external video input signal by just pulling out the center knob of the RF switch. Feed the camera output signal into the EXT VIDEO IN on the rear panel and you can see the results on a video monitor or color TV set.

Also on the rear panel is a BNC output jack for the 3.579545 subcarrier. A frequency counter can be connected there to check the frequency, or the signal can be used for synchronizing other circuits. The signal is at the 1.0 volt level with no load and is matched for a 75 ohm input impedance.

The model 1250 is an accurate and very versatile piece of electronic equipment for any serious video engineer, technician, or anyone else in the field. It can be used for many tests in CATV and MATV systems, and also for closed-circuit TV systems. Up to now, equipment of such accuracy has been far too expensive for the average TV shop, and also too big to fit comfortably on the service bench.

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Lab accuracy WD-758 with LED readout $149.95

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School in San Francisco, and has spent over 17 years as a printed circuit draftsman, designer, and PC supervisor in the commercial and military electronics field.

The book includes chapters on schematics, PC board layout ground rules, discrete components layout, mounting components, IC grouping, digital layout, multi-layer PC boards, production considerations, artmaster tape-up, ground planes, familiarity with fabrication and assembly drawings, silk-screen drawings and artmasters, the manufacturing process of PC boards, and logic as it relates to PC design reference materials. There are over a hundred clear "how to" diagrams and charts.


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The subjects covered are: Technical math review, DC circuit analysis, AC circuit analysis, Selecting R, L, and C components. Selecting semiconductor devices, audio amplifiers, tuned amplifiers, feedback, oscillators, power supplies, batteries and special skills, op amp applications, digital logic, computer-aided circuit design, analog-to-digital conversion, video amplifiers, microprocessors, transmission lines, filters, antennas, microwaves, communications systems, measurements, and thick-film technology. There are also 23 pages of appendices, and an index. The publishers state that the present volume is the first fully comprehensive electronics handbook that can help you solve the day-to-day problems of electronics engineers and technicians in a practical way.

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Universal SCR C160D .34 400V 5A, TO-220

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<td>$9.95</td>
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<tr>
<td>TMS2716</td>
<td>$24.95</td>
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<tr>
<td>C716/TMS2516</td>
<td>$29.95</td>
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</table>

Special of the Month

Eeprom C2706-65/4706-6 $6.90

1K (1K x 8) 650 ns

1980 IC MASTER

JUST RELEASED over 2700 pages

Special Edition featuring the latest I.C.'s including microprocessors and consumer circuits, 45,000 device types. Wide selection of products as small as pin diode packages. Complete new section on MPU boards and systems.

Free Quarterly Updates

Special $59.95

MICROCOMPUTER BOARDS

NEC

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Price</th>
</tr>
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<tbody>
<tr>
<td>TK055A</td>
<td>$299.00</td>
</tr>
</tbody>
</table>

Based on the 8008A microcomputer board by Zilog and 8K memory, available in ROM and EPROM expandable to 64K 8 and 32K 8 in board.

Texas Instruments TM960/199 $333.00

UNIVERSITY MODULE

A complete kit. An add-on circuit with the Texas Instruments tutorial. It allows hands-on experience with microprocessors, I/O, memory and assembly language programming. The kit features a built-in keypunch, keyboard, a powerful instruction set, multiple device sections, one single-bit I/O manipulation parallel I/O and 7 addressing modes.

Synertek SYM-1 $239.00

Fully assembled, tested, documented and expandable. Powerful 6502 bit microcomputer, 6-digit LCD display, 1.6 M-byte, unbuffered. Single plus 5V power requirements.

L.E.D. LAMPS

<table>
<thead>
<tr>
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ISOLATORS

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<td>Dual Opto-isolator</td>
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<tr>
<td>LED27</td>
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</tr>
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<td>LED28</td>
<td>Dual Opto-isolator</td>
</tr>
<tr>
<td>LED29</td>
<td>Dual Opto-isolator</td>
</tr>
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</table>

Additional interface monitor program provides enhanced control and program development functions, 1K RAM.

Rockwell International $375.00

Aims System Aims gives you all assembled, tested and warranted RS/200 based microcomputer system with a full-sized keyboard, an alphanumeric display, four extension interfaces, an interface monitor program, an Advanced interfaces monitor program provides enhanced control and program development functions, 1K RAM.

P.O. BOX 35 FRAMINGHAM, MASSACHUSETTS 01760

Zilog

<table>
<thead>
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<td>Z8020</td>
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<td>Z8040</td>
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MOBILE MEMORIES

MOS Static RAM's

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MOS Dynamic RAM's

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U.A.R.T.

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<td>0 to 20K baud</td>
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SHIFT REGISTERS

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<td>3341APC</td>
<td>1 MHz</td>
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<td>3341NPC</td>
<td>60 Hz, Shift Register</td>
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<tr>
<td>3341PF</td>
<td>80 Hz, Shift Register</td>
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ECL RAM

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<tbody>
<tr>
<td>1610-16C</td>
<td>40ns, $99.00</td>
</tr>
</tbody>
</table>

www.americanradiohistory.com
Low cost, high performance, that's the DM-700. Unlike some of the hobby grade DMMs available, the DM-700 offers professional quality performance and appearance at a hobbyist price. It features 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3½ digit, ½ inch high LED display, with automatic decimal placement, automatic polarity, and overrange indication. You can depend upon the DM-700, state-of-the-art components such as a precision laser trimmed resistor array, semiconductor bandgap reference, and reliable LSI circuitry ensure lab quality performance for years to come. Basic DC volts and ohms accuracy is 0.1%, and you can measure voltage all the way from 100 µV to 1000 volts, current from 0.1 µA to 2.0 amps and resistance from 0.1 ohms to 20 megohms. Overload protection is inherent in the design. The DM-700 has 1250 volts AC or DC on all ranges, making it virtually foolproof. Power is supplied by four "C" size cells, making the DM-700 portable, and, as options, a nicad battery pack and AC adapter are available. The DM-700 features a handsome, jet black, rugged ABS case with convenient retractable tilt bail. All factory wired units are covered by a one year limited warranty and kits have a 90 day parts warranty. Order a DM-700, examine it for 10 days, and if you're not satisfied in every way, return it in original form for a prompt refund.

Specifications

DC and AC inputs: 100 µV to 1000 Volts, 5 ranges
DC and AC current: 0.1 µA to 2.0 Amps, 5 ranges
Resistance: 0.12 to 20 megohms, 5 ranges
Input protection: 1250 ± 20 Volts AC/DC all ranges fuse protected
Input impedance: 10 megohms, DC/AC volts
Display: 3½ digits, 0.5 inch LED
Accuracy: 0.1% basic DC volts
Power: 4 "C" cells, optional nicad pack, or AC adapter
Size: 6"W x 3½"H x 6"D
Weight: 2 lbs with batteries

Prices
DM-700 wired + tested ...........................................$99.95
DM-700 kit form ..................................................79.95
AC adapter/charger ............................................4.95
Nicad battery pack .............................................16.95
Probe kit ..................................................3.95

The CT-70 breaks the price barrier on lab quality frequency counters. No longer do you have to settle for a kit, half-kit or poor performance, the CT-70 is completely wired and tested, features professional quality construction and specifications, plus is covered by a one year warranty. Power for the CT-70 is supplied by four "AA" size batteries or 12 volts, AC or DC, available as options are a nicad battery pack, and AC adapter. Three selectable frequency ranges, each with its own pre-amp, enable you to make accurate measurements from less than 10 Hz to greater than 600 mHz. All switches are conveniently located on the front panel for ease of operation, and a single input jack eliminates the need to change cables as different ranges are selected. Accurate readings are insured by the use of a large 0.4 inch seven digit LED display, a 0.1 ppm TCXO time base and a handy LED gate light indicator. The CT-70 is the answer to all your measurement needs, in the field, in the lab, or in the shack. Order yours today, examine it for 10 days, if you're not completely satisfied, return the unit for a prompt and courteous refund.

Specifications

Frequency range: 10 Hz to 600 mHz
Sensitivity: less than 25 mV to 150 mHz
Stability: 1.0 ppm, 20-40°C; 0.5 ppm/°C TCXO crystal
Display: 7 digits, LED, 0.4 inch height
Input protection: 50 VAC to 60 Hz, 10 VAC to 600 mHz
Input impedance: 1 megohm, 6 and 60 mHz ranges 50 ohms,
600 mHz range
Power: 4 "AA" cells, 12 V AC/DC
Gate: 0.1 sec and 0.1 sec LED gate light
Decomposed point: Automatic, all ranges
Size: 5½"W x 1½"H x 5½"D
Weight: 1 lb with batteries

Prices
CT-70 wired + tested ...........................................$99.95
AC adapter ..................................................4.95
Nicad pack with AC adapter/charger ..................9.95
Telescopic whip antenna, BNC plug .....................7.95
Tilt ball assembly .............................................3.95
CT-70 Kit Form ...........................................75.95
CONDENSER speaker output! peak panel!!! This Mark Stereo level non-linearities to be Graphic equalizer Specifications:

- Output power: 100W RMS into 8-ohm
- Frequency response: 10Hz - 100KHz
- THD: less than 0.005%
- S/N ratio: better than 80dB
- Input sensitivity: 1V max.
- Power supply: +40V @ 5 amp

MARK IV 15 STEPS LED POWER LEVEL INDICATOR KIT

This new stereo level indicator kit consists of 36 4-color LED (15 per channel) to indicate the sound level output of your amplifier from -36dB +36dB. Comes with a well-designed silk screen printed plastic panel and has a selector switch to allow floating or gradual output indicating. Power supply is 6-12V D.C. with THD on board input sensitivity controls. This unit can be used with any amplifier from 1W to 200W!

MARK IV KIT $31.50
30W + 30W STERO HYBRID AMPLIFIER KIT

It works in 12V DC as well! Kit includes 1 P C SANYO STK-043 stereo power amp. (IC LM 1458) as pre amp. all other electronic parts, PC Board, all control pots and special heat sink for hybrid. Power transformer not included. It produces ultra hi-fi output up to 60 watts (30 watts per channel) yet gives out less than 0.1% total harmonic distortion between 100Hz and 10KHz.

BATTERY POWERED FLUORESCENT LANTERN

MODEL 188 R

- Circuitry: designed for operation by high efficient, high power silicon transistor which enables illumination maintain in a standard level even the battery supply drops a certain amount of low voltage.
- 9" 6W cool/daylight miniaturized fluores-
cent tube.
- 8 x 1.5V UM-1 (size D) dry cell battery.
- Easy sliding door for changing batteries.
- Stainless, reflector with wide angle in-
creasing illumination of the lantern.

$32.50 PER KIT

STEREO AMPLIFIER

60W + 60W

COMPLETED UNIT - NOT A KIT!

OCL pre amp. Power stereo amp. with bass, mid-
dle, treble 3-way tone control. Fully assembled and tested ready to work. Total harmonic distortion less than 0.5% at full power. Output maximum is 60 watts per channel at 8Ω. Power supply is 24 - 36V AC or DC. Complete unit: Assembled $49.50 ea. Power transformer: $ 8.50 ea.

5W AUDIO AMP KIT

2 LM 380 with Volume Control

Power Supply 6 - 18V DC

ONLY $6.00 EACH

MARK II SOUND ACTIVATED SWITCH KIT

A new designed circuit employed 2 I.C., a DPDT relay with a led indicator. A condenser microphone comes with the kit. The relay can handle up to 200 watts contact to allow to control most things. Just click the finger, the relay will close, the second switch will release. Sensitivity can be adjusted by on board trim pot. Operating voltage 5V D.C. 12V TV $8.50 PER KIT

MARK IV KIT $31.50

PROFESSIONAL 10 OCTAVE STEREO GRAPHIC EQUALIZER!!

Graphical equalizer have been used for years in sound studios and concert arenas but were too expensive to be considered for home use. Now we offer you the facility at an affordable price. This unit can extend your control of your Hi-Fi system by minimizing the non-linearities of the combined speaker/room sys-
tem. Fantastic features as follows:
- 10 double slide controls for two channels.
- Cut out shadowing and hiss.
- Minimizes speaker/room non-linearties.
- Frequency response from 30KHz to 16KHz.
- 10 tone controls plus defeat, monitor and tape selector.
- Control range: 12dB in 10 octaves (30Hz, 60Hz, 120Hz, 240Hz, 500Hz, 1KHz, 2KHz, 4KHz, 8KHz, 16KHz).
- Operating voltage 115V 60Hz.

FACTORY ASSEMBLED UNIT. NOT A KIT

SPECIAL PRICE $117.00 ea

SUB MINI SIZE FET CONDENSER MICROPHONE

Specifcation:
Sensitivity: -66dB = 3dB
Fees Response: 50K Hz - 8 KHz
Output Impedance: 1K ohm max.
Polar Pattern: Omni-directional
Power Supply: 1.5V 9V D.C.
Sound Pressure Level: Max. 120dB EIAEMI 4.25 ea. $2.50 ea.

NEW MARK III

9 Steps 4 Colors LED LV

Stereo level indicator kit with arc-shape display panel!! This Mark III LED level indicator is a new design PC board with an arc-shape 4 colors LED display (change color from red, yellow, green and the peak output indicated by blue). The power range is very large, from -30dB +5dB. The Mark III indicator is applicable to 1 watt 200 watts amplifier operating voltage is 3V - 9V DC at max 400 MA. The circuit uses 10 LEDs per channel. It is very easy to connect to the amplifier. Just hook up with the speaker output.

IN KIT FORM $18.50

MARK II SOUND ACTIVATED SWITCH KIT

A new designed circuit em-
ployed 2 I.C., a DPDT relay with a led indicator. A con-
denser microphone comes with the kit. The relay can handle up to 200 watts con-
tact to allow to control most things. Just click the finger, the relay will close, the sec-
ond switch will release. Sensitivity can be ad-
justed by on board trim pot. Operating voltage 5V D.C. 12V TV $8.50 PER KIT

CIRCLE 24 ON FREE INFORMATION CARD
FLUORESCENT LIGHT DRIVER KIT
12V DC POWERED
Lights up 8-15Watt Fluorescent Light Tubes. Ideal for camper, outdoor auto or boat. Kit includes high voltage coil, power transistor, heat sink, all other electronic parts and PC Board, light tube not included!
With Case Only $5.50 Per Kit
SUPER FM WIRELESS MIC KIT – MARK III
This new 2-stage circuit uses high FET. FET transistors with 2 stages of pre-ampl. Transmits FM Range (66-105 MHz) up to 2 blocks away and with the ultra sensitive condenser microphone that comes with the kit, allows you to pick up any sound within 15 ft. away! Kit includes all electronic parts, O2C coils, and PC Board.
$11.50 PER KIT Board. Power supply 9V D.C.
PRESS -A MICRO KIT
..,Y."
TRANSFORMER, 
ELECTRONIC DUAL SPEAKER PROTECTOR
Cut off when circuit is shorted or over load to protect your amplifier as well as your speakers. A must for OCL circuits.
KIT FORM $8.75 EA.
"FISHER" 30 WATT STEREO AMP
MAIN AMP (15W x 2)
Super Buy Only $18.00
Uses STK-015 Hybrid Power Amp
Kit includes: STK-015 Hybrid IC, power supply with power transformer, front Amp and tone control, all electronic parts as well as PC Board. Less than 0.5% harmonic distortion at full power with response from 20-200,000 Hz. This amplifier has QUASI -Complementary B out, output max is 2 to 30W at 4Ω. ONLY $23.50 each.
HIGH KIX 3X303
DIGITAL LCD MULTIMETER
• 3/4 digits display - 200 hours 9V battery life
- Auto zero: polarity overrange indication - 1000V DC
- F.S. sensitivity - 19 ranges and 1% of reading - 0.1% to 1000V
- A.C. volt: 0.1 V to 600 V
- Resistance: 0.1Ω to 20 MΩ + 0.01Ω current on 0-1A to 100 MA
OUR PRICE $71.45
RUSH-BUTTON SWITCH
N/Open Contact
Color: Red, White, Green, Black
3/$1.00
1/Close also Available 50¢ each
LARGE QTY. AVAILABLE
HEAVY DUTY CLIP LEADS
10 pairs — 5 colors Alligator clips on a 22" long lead. Ideal for any testing. $2.50/pack.
MANY SOUND DECISIONS!
Solid state sound indicator operating voltage 6V DC 30V. Small size approximately 1" x 1" x 1".
Model ER216 (Continuous)...
Model ER216 (Slow Pulse)...
Model ER216 (Fast Pulse)...
$3.60 EACH
"C" SIZE BATTERY PACK
10 C size hi-cap battery in chg pack, gives off 12.6V D.C. 1.8 amp per hour. All fresh code, pull-out from metal canister. Can be disconected to use as single c cells. Hard to find $15.00 per pack of 10 batteries.
ELECTRONIC ALARM SIREN
COMPLETE UNIT
Ideal for use as an Alarm Unit or hook up to your car back-up to make a reverse indicator. Light Output up to 1300 feet. Voltage supply 6 D.C.
AU-999 $7.50
SUB MINIATURE TOGGLE SWITCH
SPST 2 FOR 2.5B SPST 2 FOR 3.20
6 AMP D.C. AC CONTACT
TRANSFORMERS
ALL 117 VOLT INPUT
4V 4 AMP $0.50 EA.
36V CT 3 AMP $10.50 EA.
48V CT 3 AMP $12.50 EA.
24V CT 3 AMP $15.00 EA.
24V CT 0.5 AMP $2.50 EA.
12V CT 0.5 AMP $2.75 EA.
20 MA $1.80 EA.
AC POWER SUPPLY
Wall Type Transformer
12V A.C. Output 200 MA $2.75 EA.
12V A.C. Output 20 MA $2.10 EA.
6V DC Output 120 MA $1.90 EA.
12V DC Output 100 MA $1.10 EA.
ULTRASONIC SWITCH KIT
Kit includes the Ultra Sonic Transducers, 2 PC Boards for transmitter and receiver. All electronic parts and instructions. Easy to build and a lot of uses such as remote control for TV, garage door alarm system or counter. Unit operates 9-12 V D.C.
$15.50
COMPLETE TIME MODULE
0.3" digital LCD Clock Module with month, date, hours, minute and seconds. As well as stop watch function! Battery and back up light is with the module. Size of the module is 1 1/4 dia. Ideal for use in auto control, computer, instrument and many others!
$5.95 EACH
SOUND ATTENUATED SWITCH
All parts completed on a PC Board S/N will turn on relay, buzzer or trigger other circuit for 2 to 10 sec. (adjustable). Ideal for use as door alarm, sound controlled toys and many other projects. Supply voltage 4.5V-9V D.C. 2 for $3.00
FM WIRELESS MIC KIT
It is not a pack of cigarettes. It is a new FM wireless mic kit. New design PC board fits into a plastic cigarette box (case included). Uses a condenser microphone to allow you to have a better response in sound pickup. Transmits up to 350 ft. With an LED indicator to signal the unit is on and has none! Easy to use. Ideal for camping, auto, outdoor, etc.
$7.50 EA.
FORMULA INTERNATIONAL INC.
4/80
SEND $1.00 ORDER PROTECTOR MASKS & CATALOGUE
4124 CRENSHAW BLVD, HANFORD, CA 93230
PHONE (213) 795-1762 / FAX (213) 836-7818

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30
12

10 -POWER
1-12 CDC SOLENOID, 40 -PLASTIC TRANSISTORS, 2
40
10-1000V
50
15 -NE
1
10 -SLIDE SWITCHES, SPST, SPDT,
12
12
10

40pc-SEMI-CON
4
30

-THermal
-ROCKER SWITCHES, DPDT,
12
12

-ICs
-TRAnSISTOR SOCKETS, for np0 and pap types, (#3845) 1.29

-HEAT SENSITIVE SWITCH
-2 LAMPS, neon red,

-2 LAMPS, neon green,

-2 LAMPS, neon blue,

-2 LAMPS, neon yellow,

-15 -NE

-10 -SLIDE SWITCHES, SPST, SPDT,

-MERCURY TILT SWITCH, N.C. rated 24VDC

-WATCH
-MAGNETIC
-PL
-2 LAMPS, neon red,

-2 LAMPS, neon green,

-2 LAMPS, neon blue,

-2 LAMPS, neon yellow,

-15 -NE

-10 -SLIDE SWITCHES, SPST, SPDT,

-MERCURY TILT SWITCH, N.C. rated 24VDC

-WATCH
-MAGNETIC
-PL
-2 LAMPS, neon red,

-MERCURY TILT SWITCH, N.C. rated 24VDC

-WATCH
-MAGNETIC
-PL
-2 LAMPS, neon red,

-MERCURY TILT SWITCH, N.C. rated 24VDC

-WATCH
-MAGNETIC
-PL
-2 LAMPS, neon red,

-MERCURY TILT SWITCH, N.C. rated 24VDC

-WATCH
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-PL
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-MERCURY TILT SWITCH, N.C. rated 24VDC

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-MAGNETIC
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-MERCURY TILT SWITCH, N.C. rated 24VDC

-WATCH
-MAGNETIC
-PL
-2 LAMPS, neon red,
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