ET/D

FEBRUARY 1980 • $1.50

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HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION

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INDUSTRY REPORT

Neiman Named ET/D Associate Publisher

David P. Neiman, 38, a veteran of 11 years in the publishing industry, has been appointed Associate Publisher of ET/D magazine, by Publishing Director Tom Greney.

Neiman, a graduate of Ohio University, will be responsible for advertising sales in his new position. Married and the father of two children, he began his career as a teacher in junior and senior high school.

In 1969 he joined Prentice-Hall in Ohio and later became Midwest Division manager for that firm. Neiman joined another Harcourt Brace Jovanovich publication, *Pipeline & Gas Journal*, as District Manager, in 1978.

France and Germany Announce TV Satellite Venture

Two French and two West German companies have announced a joint venture to produce television satellites which they hope will attract one-third of the international market during the next 20 years.

The firms are Messerschmitt-Boelkow-Blohm and AEG-Telefunken and France's state-owned Societe Nationale Aerospatiale and Thomson-CSF. According to spokesmen for the project, Messerschmitt and Aerospatiale will produce hardware for the statellites while Thomson and AEG will provide the electronics.

NESDA Announces Management Seminars

The National Electronic Service Dealers Association (NESDA) has announced that seminars on managing the service shop business are now available through its Management Development Committee.

Headed by committee chairman C.J. Rucker, a 38-year veteran of the service/dealer business, the seminars will feature methods of pricing, calculating costs and profits, sales training, and customer and employee relations. The first seminars, NESDA said, will be held in April as part of the Tennessee Electronic Service Dealers Association meeting, and at Richfield, Ohio, where the Ohio group will hold its annual meeting.

Additional information is available through NESDA's national office located at 2708 West Berry St., Fort Worth, Tex., 76109.

Electro/80 Sold Out; New Show Added

Five months before its opening May 13 in Boston, sponsors of Electro/80 reported all available booth space has been sold out. In addition, the sponsoring Electronic Conventions, Inc., said a new show is being added to the circuit—Southcon, which is slated for Atlanta, Ga., next January 13.

With the latest addition, the circuit now includes Wescon, Midcon, Southcon, and Electro. The shows are major gathering points for manufacturers, reps, and design engineers and technicians involved in all phases of high technology electronics.

Motorola Announces High Efficiency Solar Cells

Using advanced technology which includes square, instead of round, cells, Motorola Solar Systems has developed solar panels for the direct conversion of sunlight to electricity.

According to Motorola, the square cell

modules provide "ample" battery charging voltage in all climates. The solar cells supply 12-volt charging current in three separate systems rated at 10, 20, and 40 watts. Applications, Motorola reports, would be in village power systems, remote communications equipment, electrical power on boats, and microwave relays.

Leader Moves Headquarters

Leader Instruments Corp. has moved into a newly constructed, 10,000 square foot headquarters building at Haup-

ET/D

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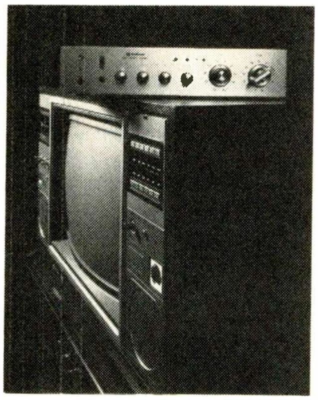
FEBRUARY 1980, VOL. 102, NO. 2



On the cover: The multiplex TV sound adaptor from Matsushita pictured on our cover enables a conventional TV to receive bilingual broadcasts or stereo sound when equipped with double speakers. *(Photo courtesy of Matsushita Electric Co., Japan)*

FEATURES

DEPARTMENTS

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2SC1308K Sanyo Horizontal Output Transistor Equivalent to ECG 238

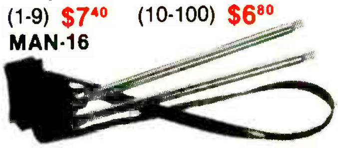
(ECG is a registered trade mark of the Sylvania Corp.)

2.45

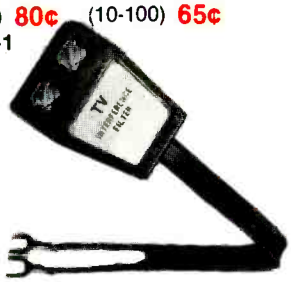
Minimum order of 10

Stock up on these popular TV parts while prices are low!

Sony Trinitron Dual Antenna
Sony AN16
(1-9) $7.40 (10-100) $6.80
MAN-16



TV Interference Filter
(1-9) 80¢ (10-100) 65¢
TVI-1



Universal Globar Resistor Kit
2 Universal Globars for color TV automatic degauss circuit. Contains a thermistor and a varistor. Fits many famous make color TV's
(1-9) $1.96 (10-100) $1.85
KT-2

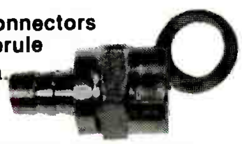
UHF/VHF/FM Splitters
300 OHM
(1-9) $1.39 (10-100) $1.19
SPL-701

75 Ohm to 300 Ohm Converter
(1-9) 65¢ (10-20) 55¢
TVT-1

High Voltage Tripler
Equivalent to ECG-500A
(1-9) $12.40 (10-100) $11.80
HVT-500A

75 Ohm
(1-9) $1.45 (10-100) $1.30
SPL-702

F-59 Connectors with Ferule
14¢ ea.
(on minimum order of 100)



There just isn't enough room . . .

Limited space prevents the listing of the many hundreds of TV & Stereo parts we stock. This page contains just a few of the low, low priced replacement parts we keep in our huge inventory, **at the lowest prices you'll ever find!** For our complete parts listing, call our toll-free number listed below, or write for our free 24-page catalog.

Tube Number	10-up	1-9	Tube Number	10-up	1-9	Tube Number	10-up	1-9
1V2	.95	1.10	6EL4	2.75	3.15	8AW8	2.45	2.65
2AV2	1.15	1.35	6FQ5	2.15	2.35	8FQ7	1.10	1.25
3A3	1.50	1.70	6FQ7/ECG7	1.15	1.30	8CG7	1.10	1.25
3AW3	1.50	1.70	6GF7A	1.95	2.25	12AU7A/ECC82	1.15	1.30
3CY3	1.60	1.85	6GH8A	1.15	1.35	12AV6	1.10	1.25
3DB3	1.60	1.85	6GM6	1.55	1.80	12AX7/ECC83	1.15	1.30
3HA5	1.40	1.60	6GU7	1.55	1.80	12GN7	2.10	2.35
3HM5	1.40	1.60	6HA5	1.45	1.60	12HG7	2.10	2.35
5GH8A	1.75	1.95	6HB7	1.45	1.60	13GF7A	1.95	2.20
5U4	1.20	1.40	6HM5	1.45	1.60	17BF11	2.85	3.10
6AQ5	1.20	1.40	6JI0	2.30	2.60	17JZ8	1.60	1.85
6AU6	1.20	1.40	6JE6	3.10	3.50	24JE6	3.05	3.95
6AW8A	1.60	1.90	6JS6	2.80	3.10	24LQ6	3.05	3.45
6BA11	1.85	2.05	6KD6	3.20	3.60	31JS6	2.75	3.10
6BK4	2.75	3.15	6L6GC	2.30	2.60	33GY7	2.45	2.80
6BL8/ECF80	1.05	1.20	6LB6	3.00	3.45	38HE7	2.80	3.15
6CJ3	1.40	1.60	6LQ6	3.10	3.50	38HK7	2.75	3.10
6DW4	1.40	1.60	6MD8	2.20	2.50	40KD6/36KD6	3.15	3.55
6EJ7/EF184	1.40	1.60	6ZI0	2.30	2.60	50C5	1.15	1.30

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pauge, N.Y. The test instrument manufacturer had been housed in temporary quarters following a 1978 tornado which destroyed its Plainview, N.Y. headquarters building.

During ceremonies at the dedication, Vice President William L. Brydia said it will be possible to expand "up to three times our present size . . . so that we can implement plans for design and production facilities here in the U.S."

ETA-I Holds Technician Seminar

The Electronics Technicians Association-International held, November 9 and 10, 1979, the first of what it is expected will be a series of seminars and workshops to help the technician prepare for the future in electronics technology. This meeting, at Central Technical Community College, Hastings, Nebraska, is to be the forerunner of seminars to be held in other areas.

Attended by approximately 100 technicians from the surrounding states, as well as the central Nebraska area, the seminar covered wave propagation, microprocessors, technician productivity, video analyzers, op-amps and other subjects and also included an electronics educators panel discussion.

Exhibits included test equipment, microcomputers and technical publications. ET/D

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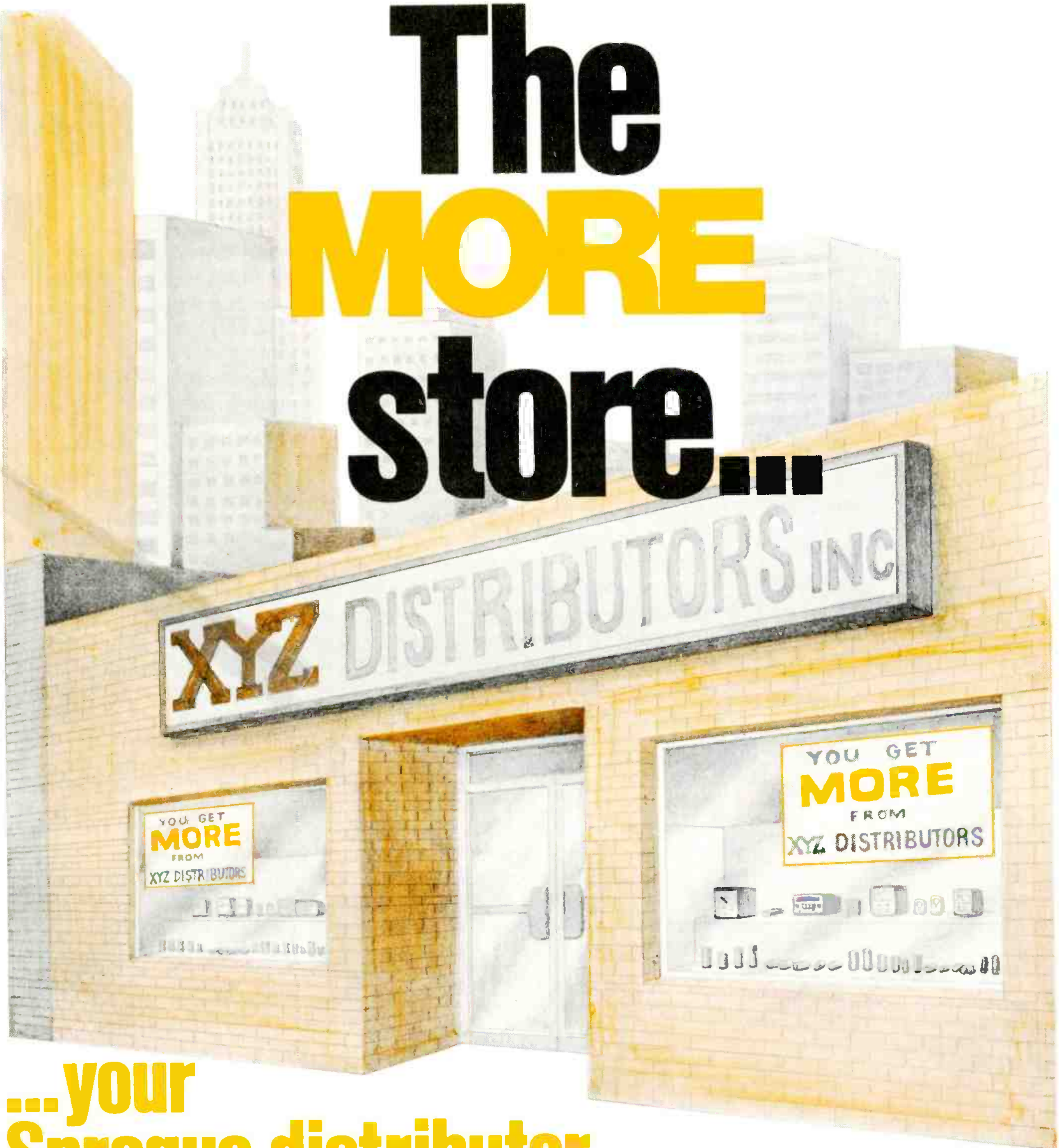

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FROM THE EDITOR'S DESK

Probably the most important new consumer product to make it onto your service bench in any significant numbers in the past year has been the video cassette recorder. These units have grown immeasurably in popularity with the public as later generation devices hit the marketplace offering more and more extras such as programmability, multi-speed and variable time units, plus battery operated portables.

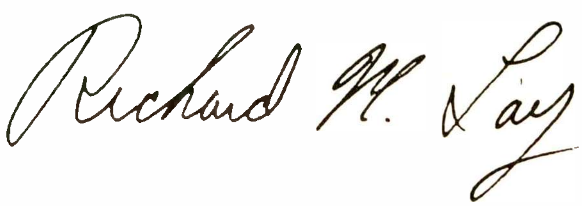
Despite the shifting electronics inside of these VCR units, it is no secret that some of the most troublesome problems—regardless of format—is the failure of the electro mechanical systems. Thus it seems appropriate at this time to present an article devoted to a discussion of the operation and likely trouble spots you might hit when servicing the servo sections of either the VHS or Betamax machines now on the market. You'll find an excellent overview on this subject in the article by Martin Middlewood beginning on page 16 of this issue.

A *new sound* is here. The past decade in television has seen a most dramatic improvement in the actual quality of the color television picture in America. Largely due to the development of the black matrix, in-line color picture tube, improved phosphors, and more lately the addition of higher response video sections (comb filter) by Magnavox and RCA, this trend will hopefully continue.

Long neglected, however, has been the relatively low grade sound generated by the broadcasters, despite the irony that video is AM and TV sound FM. Well, things are about to change as our look at the future of sound broadcasting tells us. It's part of a new revolution in sound now sweeping the United States. Stereo sound already is a part of television—at least experimentally—in several foreign countries. Therefore ET/D's "Sound Update", by Bernard Daien, should be interesting reading for you as you gear up to meet the 80's.

Rounding out our "look at the future" is Managing Editor Walter Schwartz's report on the most recent IEEE Fall conference on consumer electronics. Consumer electronics design engineers from around the world gathered in Chicago late last year to bring together their ideas on the latest theories and techniques for use in the consumer arena. For a report on the newest in television control ICs, satellite frequency converters, and a look at the future of projection TV, I recommend this report on things to come.

Sincerely,



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Here are the truly inexpensive, no nonsense, high performance DVOM's you've been looking for! Compact. Lightweight. Easy to read, indoors or out. Accurate. Precise. Reliable. Rugged. Safe. Self-contained. Easy to hold and operate with the same hand.

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- Automatic polarity, zero and overrange indication
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- ½ year battery life in typical use
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- Withstands 4 ft. drop without loss of accuracy
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LX304 – $89.95

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LETTERS

HELP NEEDED:
Needed: A wiring diagram for an Atwater Kent "B" Power Unit. Will cheerfully pay for same.
Paul Capito
Capital Radio Service
637 W. 21 St.
Erie, PA 16502

I need TEKFAX 111.
Harry Young
34 Appleton Dr.
Bricktown, NJ 08723

I have a Concord video tape recorder being used for instructional purposes and need to find the address of Concord Electronics Corp., formerly of 1935 Armacost Ave., Los Angeles, CA 90025, to obtain a schematic or service manual of their Model VTR 600-1.
Daniel Bartko
Rt. 2, Box 377
Greensboro, NC 27405

I am trying to locate a source for a schematic on a Telefunken Concertino 105, solid state stereo receiver. Any help will be appreciated.
William Hartley
HI-FI Workshop
1201 Paul Ave.
Schenectady, NY 12306

I have a Mercury vacuum tube voltmeter Model 1700C, made by Mercury Electronics Corp., Mineola, NY. I need repair parts or a place to have it repaired; I cannot find the company. HELP!
Herbert Lawson
8515 W. Throop St.
Chicago, IL 60620

CET EXAMINATIONS
After reading often in ET/D about the Certified Electronics Technician program I asked at my local electronics supply houses about it, but none knew anything about it or about material I could get to prepare myself for the tests.

I wrote to ISCET in Ames, IA but got my letter back. Can you tell my where I can get more information?
Ronald Dandurand
936 Meadow Ln.
Lexington, KY 40505

Editor: Two organizations now offer CET programs; ISCET, International Society of Certified Electronics Technicians and ETA-I, Electronics Technicians Association-International. ISCET is at 2708 W. Berry St., Fort Worth, TX 76109 and ETA-I is at 7046 Doris Drive, Indianapolis, IN 46224. Both certiy in several specialty areas of electronics; ETA-I now offers a Master Technician certification; both, I believe, have study materials. ETA-I's Electronics Educators Association, an electronics teachers and instructors division, publishes training programs on various aspects of electronics. Each organiztion has a network of test monitors to give the tests.

CORRECTION:
Concerning the article "Basic Microprocessor Operations" in the December '79 issue: Eight binary ones do not equal 256. There are, however, 256 valid states because 0 is considered valid. The maximum decimal number attainable with eight binary bits would be 255. 256 would be 100000000.
Walton R. Ussery
Wilshire Television Co.
336 Hillside Village
Dallas, TX 75214

EDITOR: No one noticed this mistake in all the times it was read and reread. Thank you for the correction. ET/D

NEWSLINE

RECORD WINTER CES TURNOUT. Well over 50,000 consumer electronics industry faithful turned out last month in Las Vegas for what has grown into one of the largest trade shows in the world--the Winter Consumer Electronics Show. This year's version leaves little doubt of the ascendency of the consumer himself as king. Virtually every major product displayed was geared toward freeing the consumer from the shackles of network television and permitting him to create his own entertainment environment in the home.

OUTLOOK IS GOOD FOR CONSUMER MARKET. Barring any unforeseen economic or political catastrophe, the outlook for consumer spending during the coming year is basically good. Consumers will be able to choose from video tape recorders offering programmability, six hours of operating time, or portability; television with enhanced sound; Magnavox's video disc player--soon to be joined by consumer entries from Pioneer and RCA; and a list of audio accessories that includes pulse code modulated sound and voice activated TVs and music systems. For a complete rundown of the 1980 CES see next month's ET/D.

SHARP PREDICTS GROWTH IN MID-FI. Sharp Electronics' national audio sales manager--Harvey Schneider--predicts 1980 will be a strong year for the "mid-fi" portion of the audio business. Schneider says the mid-fi business has not felt the effects of the economic downturn as severely as the high end of the audio market. He says audio dealers who remain aggressive in advertising and promotion should show good sales and increased profits. Schneider says the fastest growing category during 1980 will be portable stereo radio/cassette combinations and sales should be up from one million units in 1979 to 1.5 million.

ELECTRONIC TUNERS AND REMOTES KEYNOTE TV YEAR. Microprocessor controlled electronic tuners and remote operation--even for small screen TVs--will be the dominant features of color TV receivers introduced this year. At least that is the consensus of industry "experts" gathered at the Winter CES. They forecast 85 per cent of all color chassis will be loaded with electronic tuners and up to 30 per cent will be sold with remote controls.

ISCET TECH LIBRARY OPERATING. The ISCET Technical Library--formerly operated out of Kansas City by founder Harry Golden--is again open for business. Persons wishing copies of technical data may now obtain it by writing George Sopocko, CET, at 5631 Irving Park Rd., Chicago, 60634. A basic $2 search fee should be included for the first two pages plus 50 cents for each additional page.

CABLE TV SYSTEMS EXPAND. There are now 10.6-million cable television subscribers served by the nation's 50 largest cable operators, according to figures published by an industry weekly--Television Digest.

Facts from Fluke on low-cost DMM's

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

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

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

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

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

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

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

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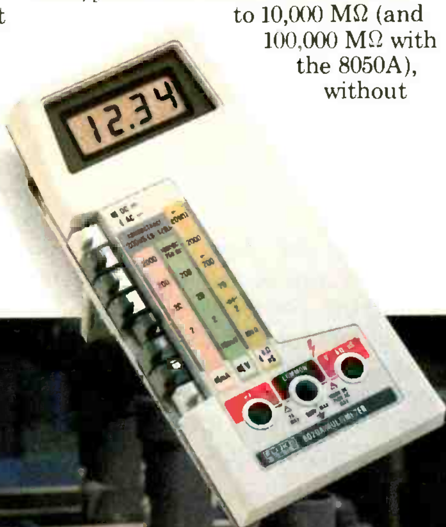

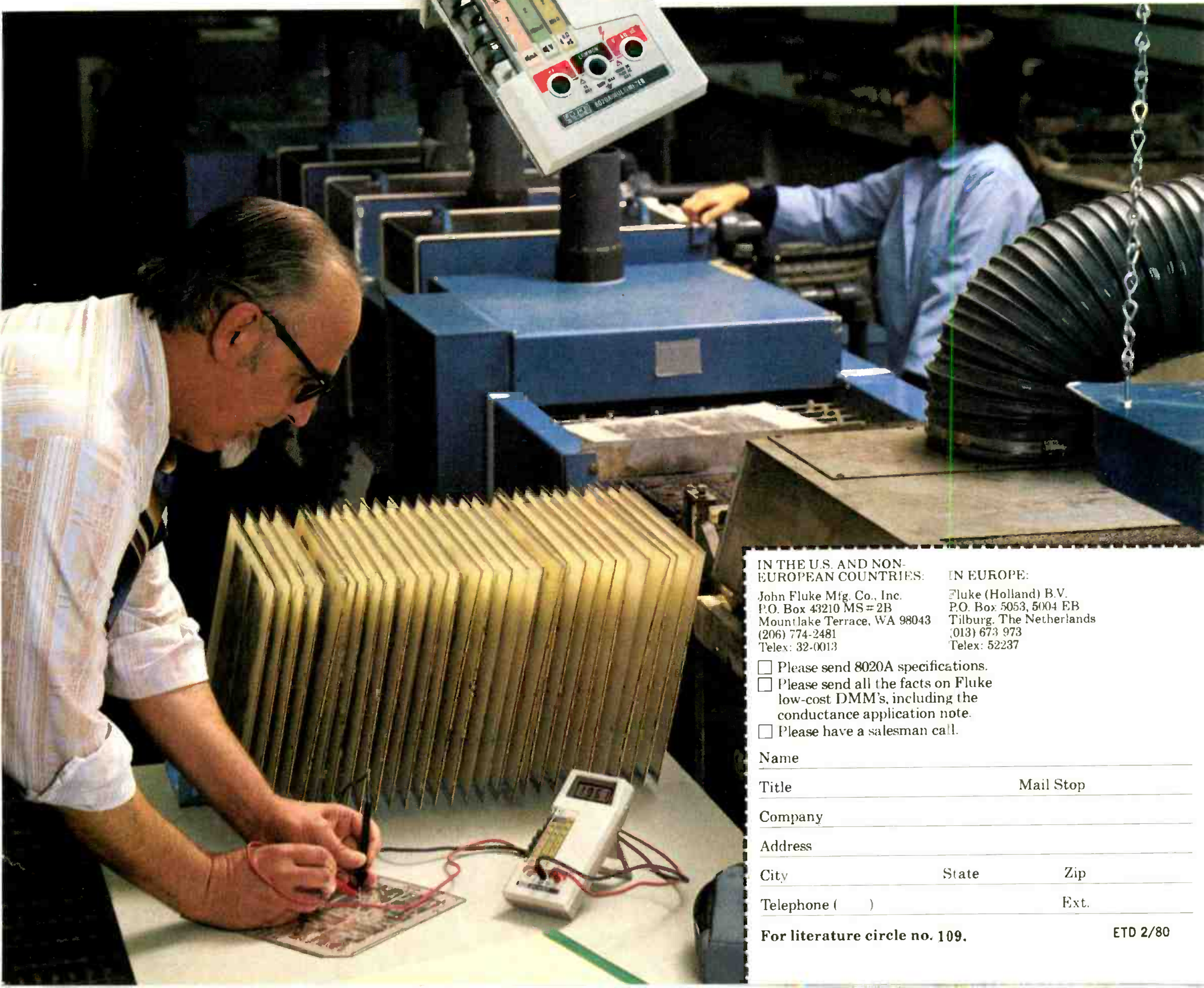

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☐ Please send 8020A specifications.
☐ Please send all the facts on Fluke low-cost DMM's, including the conductance application note.
☐ Please have a salesman call.

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Company

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Telephone ( ) Ext.

For literature circle no. 109. ETD 2/80

BULLETIN BOARD

A new test instrument catalog is now available from *Dynascan Corporation.* Catalog BK-180 features more than fourty instruments for engineering, production and troubleshooting, with detailed descriptions of each. Included are eight new oscilloscopes including a 35MHz model, a new pulse generator, a variable output isolation transformer, a NTSC color pattern generator and frequency counters, analog multimeters, signal generators, power supplies, probes, cables, cases, and accessories. B&K-Precision test equipment has wide distribution throughout North America and some products are available worldwide. Catalog BK-180 is free from B&K-Precision, Dynascan Corp., 6460 West Cortland St., Chicago, IL 60635.

A new **catalog of security system equipment** is available from *Mountain West.* This 70 page catalog covers burglar and fire alarm components of all types, surveillance systems, microwave, infrared, and ultra sonic motion detectors, automatic telephone dialers, locks, controls and tools. Bug detectors for detecting telephone taps and radio transmitters are also featured. Mountain West, 4215 North 16th St., P.O. Box 10780, Phoenix, AZ 85064.

A New Work-Holding Vise is described in a new brochure produced by Dremel Manufacturing. The product is called the "O-Vise"TM, and utilizes a full-tilt, full swivel-locking arrangement. Application photos in the brochure show how the D-Vise can be used in electronic circuit assembly and repair, camera repairing, sculpturing, and scientific and musical instrument repair. Diagrams describe the ball swivel mount that permits a 180⊗tilt and 360⊗rotation. The brochure is free from *Dremel Manufacturing,* 4915 21st Street, Racine, Wisconsin 53406.

DATA-TECH has announced a new 8 page short form catalog describing their entire product line. This includes a broad line of digital panel meters, 3½ and 4½ digit DMM's, data conversion modules and a logic card series. The catalog is free from DATA-TECH, 2700 South Fairview St., Santa Ana, CA 92704.

A new **Audio Accessories Catalog** has just been issued by *Switchcraft.* The catalog describes Switchcraft jacks, plugs, switches, audio and phono connectors, adapters, and cable assemblies as well as microphone mixers and audio amplifiers. All are available in blister packs or plastic bags, which include part number, function, name, size, etc., and price. Write Switchcraft, Inc., 5555 N. Elston Ave., Chicago, IL 60630.

Semiconductors, IC's and components with quantity prices are featured in the latest catalog from *Digi-Key*. The catalog offers a wide vriety of TTL, CMOS, Linear IC's and descrete semiconductors as well as resistors, capacitors, hardware, pc board supplies, tools and books. Write for a free copy: Digi-Key Corp., P.O. Box 677, Thief River Falls, MN 56701.

An opto-electronic replacement products catalog has recently been announced by *General Telephone and Electronics.* About one thousand industry part numbers are reportedly cross references to 117 Sylvania ECG devices, such as optoisolators, display drivers, LED indicators, LED displays phototransistors, and infrared emitting diodes. Electrical and mechanical specifications are given. Copies of this catalog and other ECG literature may be obtained by writing on company letterhead to: Marketing Dept., Sylvania Electronics Components Group, 1025 Westminister Drive. Williamsport, PA 17701.

A new catalog of capacitors, resistors, interference filters, switches, optoelectronic devices, pulse transformers, miniature lamps, and wiring components, is available from *Sprague Products Co.* Intended for entertainment and MRO service, as well as schools and laboratories, Catalog C-622 is available from Sprague Technical Literature Service, Marshall St., North Adams, MA 01247.

Reconditioned test equipment is the subject of a new 104-page catalog from *Tucker Electronics Company.* Categories of instruments include: amplifiers, analyzers, bridges, frequency measuring equipment, signal generators, standards, meters, oscilloscopes, power supplies and other instruments and microwave components. All equipment is reconditioned and recalibrated to manufacturers specifications. The catalog is free from Tucker Electronics Co., 1717 S Jupiter Rd., Garland, TX 75042.

A catalog of computer and computer-related books has recently been released by *Howard W. Sams & Co., Inc.* The catalog is divided into five areas: Basics, Programming, Computer Technology, Reference, and Computer-Related, with a variety of books in each area. Free copies are available from Robert W. Soel, Advertising Coordinator, Howard W. Sams & Co., Inc., 4300 W. 62nd St., P.O. Box 558, Indianapolis, IN 46206.

A **new Knob Directory** has just been published by *RCA.* This sixteen page directory covers replacement knobs for all functions, for model years 1977, '78 and '79, by model numbers. Available from your authorized RCA parts distributor.

An Audio-Visual Source Directory" of AV materials, equipment and services has recently been published by *Motion Picture Enterprises*. This directory lists suppliers of all types of equipment tape recorders, video recorders and cameras, movie equipment, film strip equipment, and services, such as movie and slide film libraries, film producers, and motion picture laboratories. Cost of the guide is $3.50 from Motion Picture Enterprises Publications, Inc., Tarrytown, NY 10591.

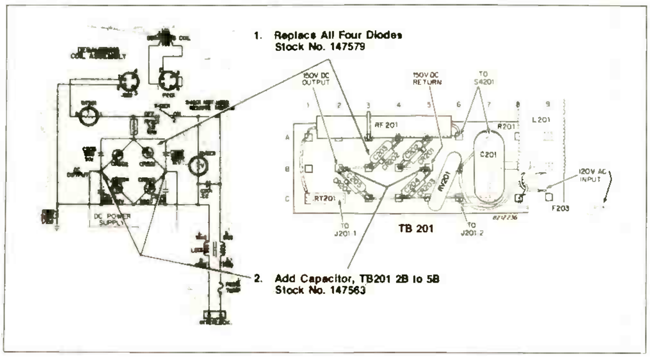
Micro Processors, Principles and Applications by M. J. Debenham is a easy to read, understandable intruduction to the micro processor, how it is used, why it is used, how systems are designed around it and the software associated with its use. Future uses and their economic, engineering, personnel and manufacturing implications are examined. An excellent inclusive glossary of terms is included. Cost $7.50 from *Pergamon Press, Inc.,* Maxwell House, Fariview Park, Elmsford, NY 10523.

Calibration and measurement equipment are the subject of a new catalog by *Zi-Tech.* This new short form catalog describes dc voltage and current calibrators, null detectors, scope calibrators and decade boxes. High voltage meters capable of measurements to 40kv at 1% accuracy are also featured. For a copy of the TE products line catalog write: Jeff Ziman, 2151 Park Blvd., P.O. Box 26, Palo Alto, CA 93202. ET/D

SERVICE SEMINAR

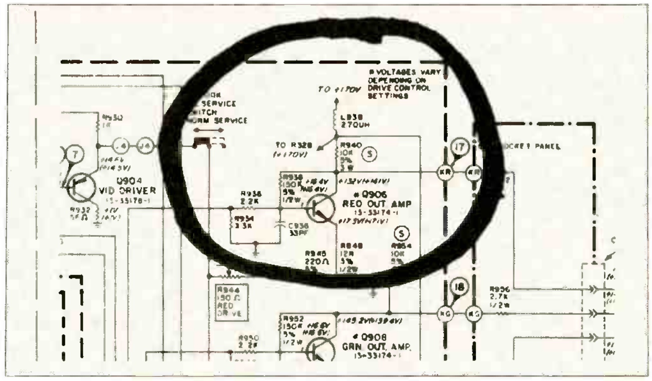
RCA

Chassis CTC 85, 86, 89, 90, 91, 92—150 volt bridge rectifier failure. In the case of failure of CR201, 202, 203, 204; replace all four diodes using RCA stock number 147579. Avoid stressing the body of the diodes when forming leads. Add capacitor RCA stock number 147563, special for this application, as in schematic and illustration. Perform standard leakage test.

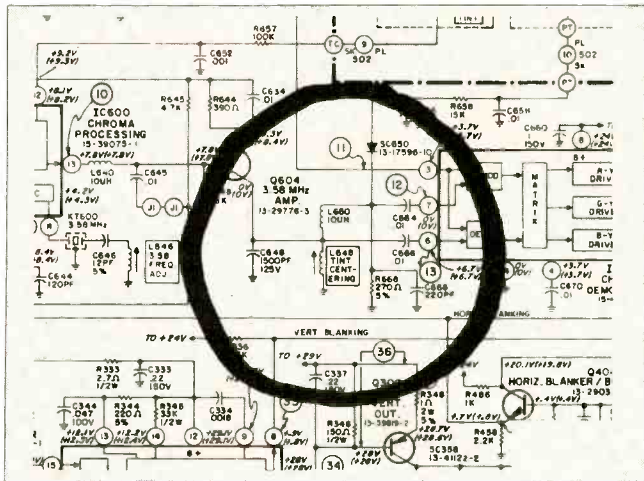


SYLVANIA

Chassis E21—Excessive brightness, B+ on collectors of R-6-B drivers measure approximately +70 volt. Possible cause: open L938 (high resistance).



Chassis E21—Intermittent loss of flesh tones Possible cause: L650 opens under load (substitute). ET/D



VCR servo systems

Looking at Beta and VHS

Video cassette recorders have been with us for several years now and their popularity is growing daily by leaps and bounds. This article concentrates primarily on the operation of the servo mechanisms found in both the VHS and Beta formats, traditionally among the most troublesome of all VCR operating systems.

By Martin Middlewood*

The VCR, like the audio recorder, is a magnetic recording system. There are several differences in the two systems, however. VCR's record a wider and higher frequency spectrum (30 Hz to 4 MHz). To do this, they use a narrower head gap and a 2-headed helical scan method of recording. Audio recorders record material longitudinally along the length of the tape; VCR's record material obliquely across the tape. Each head has a different azimuth to eliminate luminance crosstalk between adjacent tracks. Because each head must play back only the tracks it has recorded, a control system is necessary. The control head writes a control pulse on the control track each time one of the heads records its track. This pulse references the servo system to that track, and if the heads aren't reading the proper tracks, the servo system adjusts the speed of the head drum until they are. Chrominance interference between the recorded tracks is eliminated by formating signals on the tape to cancel out chrominance crosstalk. The two most popular systems for doing this are the VHS system, which rotates the chroma phase 90° from line to line, and the Beta system, which inverts chroma phase every other horizontal line that the A-head records.

There are two ways of looking at a VCR. Disregard the difference in format between VHS and Beta machines, and you'll find the same information on the tape: audio signals, control pulses, luminance (black and white) and chroma (color) signals. Except for the control pulses, these are the same signals that you find in any color television. From the serviceman's point of view, both ways of looking at a VCR are equally valid. In order to service VCR's, you need to know this information is recorded on the video tape, and how it's processed for recording on the video tape, and how it's processed for reproduction, or playback, on the television monitor. To understand these things, let's break the VCR down into its essential blocks and look at the operation of each block. The first two blocks, the power supply and audio blocks, should be fairly familiar to you. Therefore, this article's discussion of them is limited and more time is spent on one of the less familiar blocks—the servo section. The other two essential blocks are the luminance and chroma sections. They will be covered in another article.

In reality, the VCR has more blocks than this, as any VCR service manual indicates. In the manual, you're likely to find timing, memory, loading-unloading, and tape transport blocks. The five basic blocks covered here should, however, put you well on your way to understanding VCR's.

Whenever you're looking at a VCR, remember that you're looking at integrated circuits. This means that some of the portions of the blocks discussed here may be inside an IC. But with a little help from the service manuals of the VCR's you're dealing with, you should overcome this.

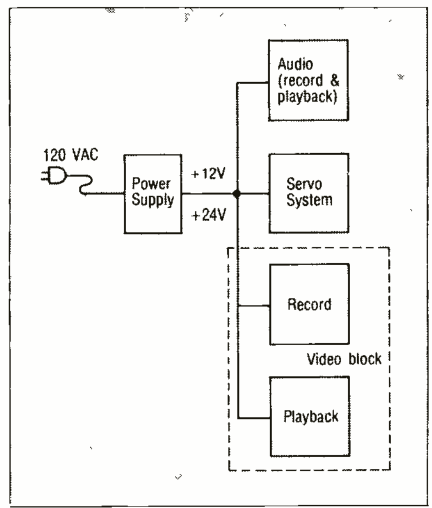


Fig 1 The VCR Power supply transformer steps down the incoming voltage. Secondary windings feed regulated DC power supply circuits

VCR audio

VCR audio recording differs slightly from that of an audio cassette deck. Audio recording is done on a slower moving tape making "wow and flutter" a more serious problem. VCR audio levels aren't monitored as exactly, although a monitoring of sorts is possible in the electronics-to-electronics (E-to-E) mode. The response curves, audio frequency response, signal-to-noise ratio, and total harmonic distortion (thd) are close enough to that of a good audio cassette deck to satisfy all but the most critical audiophile.

The audio block of a VCR has two

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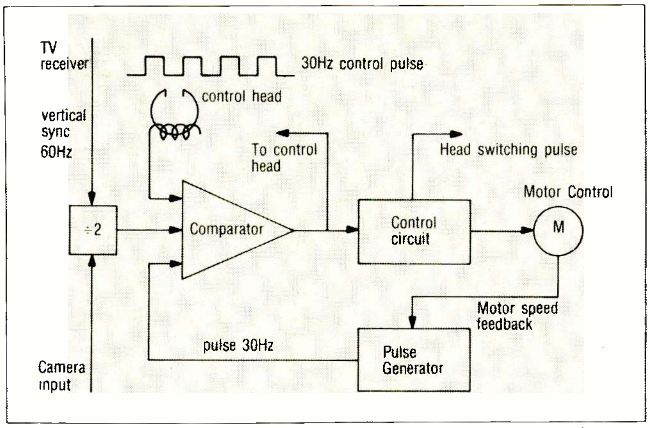

Fig 2 The VCR has three external recording inputs. Depending on the input, one of the incoming signals is compared to the pulse generator (PG) pulse. Differences between the input signals and pulse generator pulse results in a change in voltage at the output of the comparator which adjusts the motor speed.

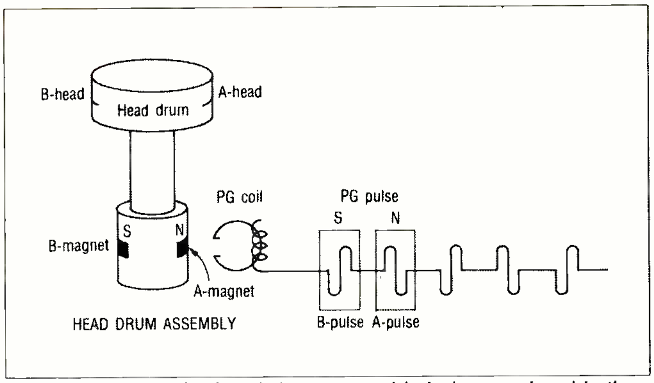

Fig 3 Magnets in the head drum assembly induce a signal in the pulse generator coil as they pass. The A-magnet passes the PG coil just as the A-head begins to cross the tape. The output is used to control head switching and the speed of the head drum motor.

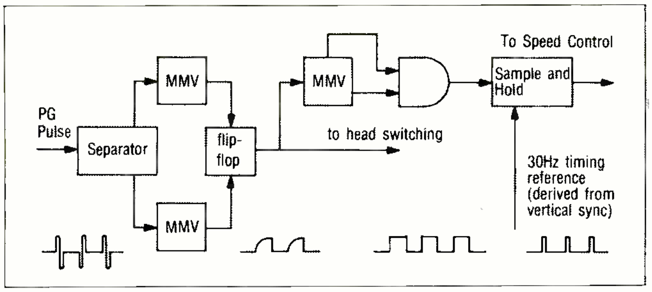

Fig 4 The PG pulse is used to control the speed of the head motor and head switching.

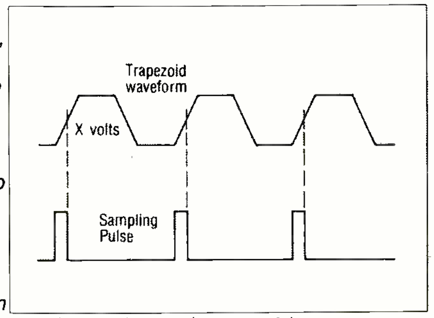

Fig 5 When the speed and phase are correct, the trapezoid and sampling pulse line up as illustrated, on some systems. If the motor speed increases, the sampling pulse lines up lower on the trapezoid ramp; if the motor speed decreases, it lines up higher. When the relationship between the falling edge of the sampling pulse and trapezoid ramp changes, the voltage determining the motor speed also changes until normal speed is resumed.

signal paths. Both are accessed through input jacks at the rear of the VCR. One input jack is for audio dubbing and is grounded whenever you use the TV tuner. The other comes from the TV tuner and is used for recording signals directly off the TV tuner. During recording, the VCR audio section uses a bias signal just as any audio recorder would.

Record operation

During recording, the audio block processes either of the two inputs. (The microphone takes precedence over other inputs whenever it's used, to allow for audio dubbing). The microphone/TV input couples to an equalizer and pre-amplification stage. Then the signal goes to the AGC (Automatic Gain Control) stage, whose output controls the gain of the equalization and pre-amplification stage. Then it goes on to the main amplification stage, which provides additional amplification of the signal. The output of the main amplifier also splits. One portion of it goes on to the line amplifier and out the audio jack; the other portion of it goes on to the record amplifier, whose output drives the audio head. A small portion of the line amplifier feeds back to the AGC to maintain a relatively constant output level. Before the output of the record amplifier goes to the head, it's mixed with the bias frequency from the bias oscillator, which provides the bias signal necessary to record the audio signal. The bias frequency, when applied to the full erase head, deletes all pre-recorded audio, video and control information.

Playback

In playback, the equalization amplifier boosts the low frequencies and attenuates the high frequencies of the audio signal. (A frequency selective network that has the inverse shape of the playback head response curve determines the characterization of the equalization network. Combining the record and playback response curves gives the nearly flat response output needed to reproduce audio signals without distortion.) From the equalization amplifier, the playback audio signal goes through the playback gain control and to the main amplifier, which boosts the signal before it goes on to the line amp and either out the audio jack or to the television monitor.

Power supplies

The second major block of a VCR that you're already familiar with is the power supply block. The VCR power supply steps down the incoming 117 volts AC by means of a transformer, whose secondary winding is protected by a fuse, to the DC levels necessary to operate the recorder. Usually two secondary windings feed a separate regulated DC supply which produces the voltages operating the VCR circuits. The exact voltages used and their method of distribution depend upon the VCR model and manufacturer.

Like all power supplies, VCR supplies have voltage adjustments that involve metering at specified points and adjusting the indicated control. The output of the power supply's test points varies as conditions vary (i.e. room temperature, operating time, input line voltages, etc.), so you may not find the exact voltages noted in the service manual. But they should be within 10% of the indicated voltage.

The servo system

A servo system is simply an electro-mechanical device that permits automatic control over the speed and position (phase) of moveable mechanical parts. A servo system needs two kinds of information in order to accurately control these moveable mechanical parts: It must know what these parts should be doing, and it must know whether these parts stray from a predefined state. To do this it needs two signals: a reference signal (to tell it what

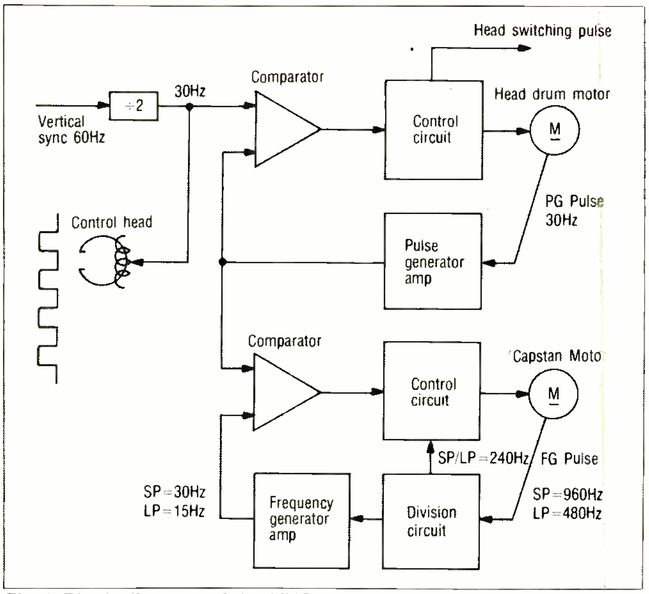

Fig 6 Block diagram of the VHS servo system in record.

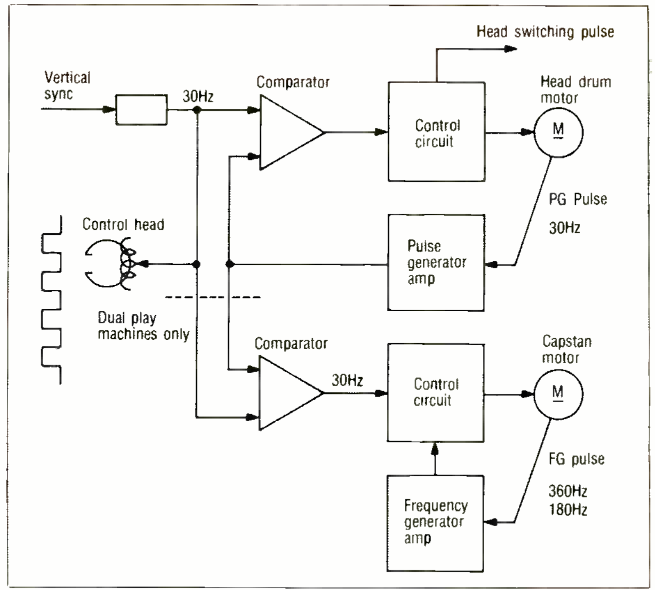

Fig 7 Block diagram of a Beta servo system in record.

the parts should be doing) and a feedback signal (to tell it what the parts are doing).

Modern VCR's, especially those used for editing, put servo systems to one of their most exacting uses. The VCR servo places the video heads on the correct paths and in the correct position to play back a video tape. This function is called tracking. In playback, the servo must switch on the head coming into contact with the video tape and switch off the head leaving the tape. This is head switching. In both tracking and head switching, the servo has to have precise control over the video heads.

In video tape recorders, you'll find a variety of servo control systems, but in VCR's you'll usually find a head servo system, a capstan servo system, or a combination of the two. To operate at all, a VCR must have a head servo, because a television signal cannot be recorded or played back without controlling the head speed and position during these operations. In both VHS and Beta machines the head servo can be either an AC or a DC motor. Single speed, or standard play (SP), VCR's often use a head drum motor that belt drives the capstan, but some VCR's, such as the JVC machines, use separate capstan motors. In dual speed machines (SP and LP) a motor drives the capstan. In both cases, the purpose of the capstan is to transport the video tape at a constant speed during standard play and long play operations. In some VCR's the capstan servo must also maintain alignment of the recorded tracks and the video heads during playback. An alternate system uses a capstan system that simply keeps the capstan moving at the correct speed and leaves tracking to the drum servo. (This means the head drum must speed up and slow down to make the heads hit the right place on the tape at the right time.) Tracking is necessary to ensure that the signal played back produces an acceptable picture. In all VCR's, slight tracking problems can be overcome by adjusting the front panel tracking control.

A VCR can have three different inputs: a video camera, a television broadcast signal, or another VCR. When recording from a camera, the head servo allows the head drum to produce a stable signal and allows the tape to run at a constant speed. The signals from the frequency generator and the pulse generator coils provide reference signals for the camera so that it synchronizes itself with the video heads. Another method to do the same thing is to have a camera with an independent sync generator that allows the VCR to lock to the camera. A vertical sync pulse always appears when the video head is in the correct position to record it. This vertical sync pulse becomes the control track pulse that controls the servo system during playback.

The other two inputs use the vertical sync pulse for reference signal and for creating the control track pulses necessary for servo control during playback. To write a control pulse on the tape during recording, the servo system takes the incoming 60 HZ vertical sync pulse from the television broadcast signal or another VCR and divides it in half. This 30 hertz frequency is the reference signal that is compared to the pulse generator signal (the feedback signal) coming from the head drum assembly. If the two pulses aren't in phase, the output of the comparator network speeds up or slows down the head-drum motor until the two signals are in phase. A 30 hertz signal (derived from the vertical sync) becomes the control pulse when routed to the control head.

During playback a similar process occurs, except the control pulse is taken off the tape and compared to the signal from the pulse generator. When they're different, the servo motor makes the necessary motor speed adjustments.

Head drum operation

In recording, the servo control system has three functions: 1) It controls the speed and phase of the head drum motor; 2) it controls the position (or phase) of the video heads; and 3) it writes the control pulses on the control track that later becomes the playback reference signal.

To accomplish the first two functions the servo system uses a pulse generator (PG) pulse created by the pulse generator coil as one or more permanent magnets imbedded in the head drum assembly pass it. In a VCR the head drum motor drives the video heads at 1800 rpm. (Note: 1800 rpm is 30 Hz.) In the head drum assembly of some VCR's (Matsushita's VHS for example), the two magnets are arranged so that one north pole and one south pole are exposed. Then as the head drum spins at 1800 rpm's, the PG coil senses the coming and going of each magnetic field and creates a PG pulse. (See Figures 3 and 4.) Whenever the magnet passes the head coil, video head-A begins its scan of the video tape. In other VCR's (Sony for example), the polarity of the magnets is unimportant. A

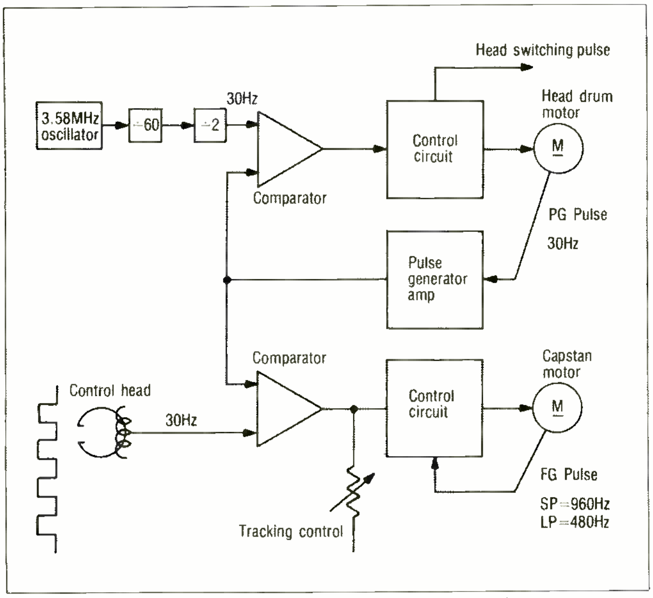

Fig 8 Block diagram of a VHS servo system in playback.

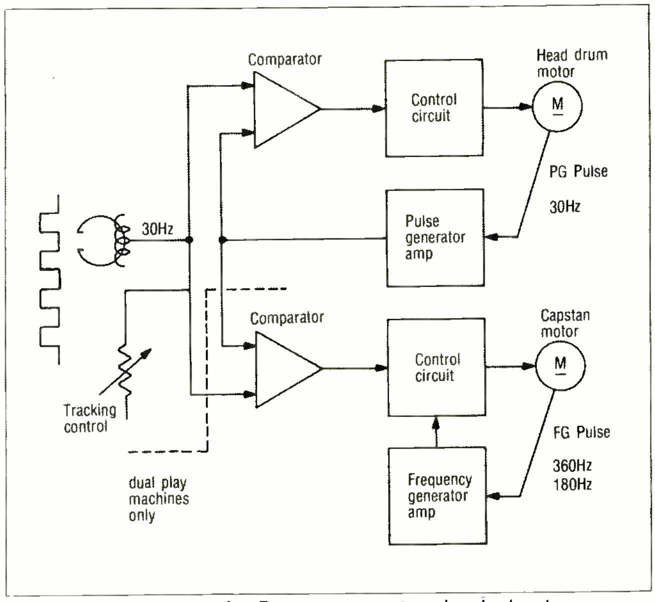

Fig 9 Block diagram of a Beta servo system in playback.

magnet sweeps a pickup coil as the A-head crosses the place on the track where vertical sync should lie.

Each PG pulse swings negative and positive. The pulse for the A-head is the mirror image of that for the B-head. These pulses feed into two monostable multivibrators. One multivibrator triggers on the positive sweep of the signal and the other on the negative. These negative and positive swings set and reset a flip-flop whose output is a square wave used for head switching during playback. As the input to the trapezoidal waveform generator, they eventually control the speed of the head drum motor. The trapezoidal waveform generator shapes the pulses into trapezoidal waveforms that control the head position.

Head position

To control the position of the heads, the PG pulse triggers a voltage ramp (a sampling pulse) that is later compared to a trapezoidal waveform. (A trapezoidal waveform has rise and fall times somewhat slower than a square wave.)

In some VCR systems, when the head drum speeds up, the sampling pulse will shift down the trapezoidal ramp. This lowers the voltage output of the sampling gate. If the head drum slows down, the opposite happens. (Fig. 5.)

In either case, the speed of the motor adjusts to compensate for the change in head drum speed. When the sampling pulse is compared to the trapezoidal waveform the result is a voltage that varies according to the relative position of the sampling pulse in relation to the slope of the trapezoidal waveform. As this relationship changes, so does the voltage that determines the head drum speed, and therefore the position of the heads.

Frequency pulse

In addition to the PG pulse, the dual speed machines use a frequency generator pulse as a feedback signal. This signal is picked off the head drum motor and is proportional to the speed of the head drum. Its frequency, however, depends upon which mode (SP or LP) the machine is in.

In most VHS systems, the head motor produces a frequency generator (FG) pulse. In the Beta systems, only the dual play machines have an FG pulse. In either system, when it comes off the head drum motor, the FG pulse aids the trapezoid waveform derived from the PG pulse in controlling the head drum motor speed. When it comes off the capstan motor, it helps control the capstan motor speed. When either motor runs too fast, the FG pulses increase. Then, after they're fed back to the motor brake, the amount of inductive reactance drops and the motor speeds back up until it reaches its normal operating speed.

Control track pulses

In record, the incoming vertical sync pulse is processed so that when it's applied to the control head, the control head writes a 30 Hz control pulse (a square wave) with 50% duty cycle on the lower edge of the video tape. (Although it's convenient to think of the control track pulses as square waves, they're really amplitude modulated sine waves.)

Capstan servo

The head motor is the main motor in a VCR servo system. It locks to the capstan either mechanically by a drive belt, such as in the single play Beta systems, or electronically by a trapezoidal pulse as in Beta and VHS dual speed systems.

The capstan, regardless of how it's driven, maintains a constant linear tape speed and a constant tape position. It aids in aligning the tape with the incoming video or camera signal for editing. To accomplish this the tape speed must be varied until the vertical sync pulses on the tape and those of the incoming video signal align. The capstan also controls the longitudinal motion of the tape so that the rotating heads follow the center of the pre-recorded tracks during playback. A detailed description of the Beta and VHS servo system, which follows, will tell you more about the capstan.

Recording with VHS

The RCA VHS servo system assures that there is always a 20 micron guard band in standard play, a 10 micron track overlap during long play, and that the vertical sync pulse occurs at the ninth horizontal line from the beginning of each track. (See Fig. 6.) In order to lock to the vertical sync pulse, the head drum motor rotates at 1798.2 rpm, a speed derived from the 59.94 Hz vertical sync rate of the color video (59.94Hz ÷ 2 video heads × 60 seconds = 1798.2 rpm.

A divide by 2 circuit steps down the vertical sync signal to 30 Hz and applies this signal to the control head to establish the 30 Hz control track reference signal. The pulse generator signal coming off the permanent magnets in the head drum assembly contains both positive and negative going pulses. The amplitude of these pulses is too low to be directly used. The PG amplifier brings them up to a useable amplitude. Then after a short delay, the PG pulses set and reset a flip-flop whose output is a square wave that controls head switching. A second output from this flip-flop goes to the head sampling gate and to the capstan sampling gate after being shaped by a trapezoidal waveform generator.

The head sampling gate compares the trapezoid waveform to a sampling pulse derived from the vertical sync input. The output of this block supplies a voltage to the speed control and the head motor drive block, and finally to the head motor, which drives the head drum. The voltage output of the head sampling gate depends upon the relationship between the trapezoid and sample waveforms, in the manner already discussed.

Recording with Beta

Two basic types of older model Beta servos exist, those designed to operate at only one speed either SP (1 hour) or LP (2 hours) and those designed to operate at both these speeds.

Two types of Beta recorders have servos from the first group. Those recorders, based on the Sony 6200, 7200, and 7200A design, operate in the SP mode only; and those designs based on the Sony 8600 operate in the LP mode only. Beta dual speed machines base their design on the Sony 8200. Because a discussion of this machine covers all of the Beta servos, we'll use it as an example.

The major difference between the dual speed and single speed Beta recorders is that the dual speed Beta VCR's drive their capstans with a DC capstan motor, while the single speed VCR's belt-drive their capstans, which eliminates some of the servo electronics.

A divide-by-2 circuit (Fig. 7) steps down the 60 Hz incoming vertical sync to the 30 Hz signal, which, after some amplification, becomes the control track signal used during playback. This stepped down vertical sync signal becomes the sampling pulse, controlling the position and speed of the head drum and capstan.

Permanent magnets in the rotating head drum generate signals in the A and B pulse generator pickups that other blocks amplify and delay. The outputs of the A-PG amplifier and the B-PG delay, set and reset a flip-flop which produces a square wave used for head switching. A trapezoidal waveform generator shapes the output of the A pulse generator delay and feeds it to the head sampling gate. Here the 30 Hz pulse samples the trapezoidal ramp and produces a voltage output that's determined by the relationship between the two waveforms. This output then adjusts the phase and speed of the head drum motor so that it always runs at about 1800 rpm.

The 30 Hz signal also acts as the sampling pulse for the capstan servo electronics. The frequency generator pickup signal is formed into a square wave and amplified. It becomes the capstan speed feedback reference and the trapezoidal waveform determining the capstan motor speed. The capstan sampling gate determines its output voltage according to the relationship between the sampling and trapezoidal waveform just as the head drum sampling gate did.

Four functions

The servo system has four functions in playback: 1) It keeps the head drum and capstan at a constant speed; 2) it controls the occurrence of head switching; 3) it keeps the video heads on the pre-recorded tracks; and 4) it picks the control pulses off the control track.

The first two functions are handled just as they are during video recording. However, during record the VCR uses the incoming vertical sync pulse as a reference signal. During playback, this signal is gone. So, in order to maintain the same control, another signal must be substituted.

In VHS (Fig. 8) recorders a 3.58 MHz oscillator provides the reference signal for the head drum motor during playback. This 3.58 MHz signal is counted down to a 60 Hz signal which is used during playback in the same way as the vertical sync pulse is during recording.

When it's recording, the VCR uses the vertical sync pulse to create control pulses on the lower edge of the video tape. When a VCR plays back a tape, the control head takes these pulses off the tape. They become the reference signal which controls the phase and speed of the video heads and capstan. (In the case of a tracking capstan servo, the control pulses don't control the phase of the video heads, which run free, but only the capstan. The capstan makes the tape get into the right place at the right time.) In Beta (Fig. 9) recorders, they are the main reference signal for both the head and capstan motors, while in the VHS recorders, they're only the capstan reference signal.

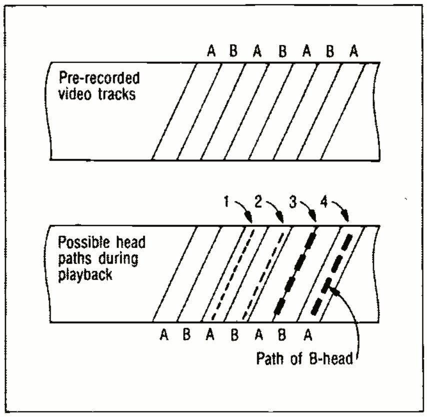

Fig 10 Of these possible video head paths, only path one will give optimum output. Path two will give a reduced output; path three will give noise and a partial output. Path four (B-head reading on A-track) will give only noise. Mistracking is caused by the control signals being played back too early or too late.

TABLE 1

Common Servo System Problems:

Head drum motor runs erratically or hunts
Servo speed increased after machine is run for a while
Monitor picture is noisy, bent, and flagging
Intermittent video in playback
Increased capstan and tape speed
Monitor picture tearing
Donald Duck voices and rapidly moving figures
Playback exceptionally noisy
Noise bar through picture
Pre-recorded tapes won't playback
Head switching at wrong point
Servo drive belts stretched

In both cases, this reference signal is compared to the PG pulse. When the reference signal and the PG pulse are synchronized, both the rotational speed and the phase (position) of the heads are identical and playback operation is stablized. If one of the two pulses being compared should be lost, you'll be able to hear the servo motor speed up to try and find it.

Head switching

To have continuous playback, the two video heads are alternately switched on and off. This is accomplished by switching the first stage of each pre-amplifier on and off according to which head is scanning the tape. Usually, a switching transistor controlled by the head switching pulse turns the pre-amplifiers on and off. This prevents excess noise from appearing in the video display.

The point at which head switching occurs is critical. If it occurs prior to the vertical interval, head switching is barely discernable in the video display. The only evidence of its occurrence is a slight misalignment of the first few horizontal lines of video with the previously displayed video lines. If head switching occurs in the back porch of the vertical interval, it causes noise in the black bar of the vertical blanking which you can see by adjusting the television vertical control. Of course, this hurts nothing.

To avoid video dropouts during head switching, most two headed video recorders wrap the tape around the video head drum more than 180°.This allows both heads to come in contact with the tape for a short time. Such simultaneous contact prevents video signal drop outs.

Tracking

Obviously, the video heads must follow the recorded paths identically during playback. In addition, because of the different azimuths of the two heads, a head can only reproduce those tracks recorded at the same azimuth. If it doesn't, there's no video output.

The guard bands used in standard play (SP) recording can allow some degree of mistracking without a severe loss in output. But when the tracks are adjacent in either the VHS or Beta format, tracking must be exact. Crossing over two or more track edges creates noise bands on the monitor screen.

The control track pulses identify one of the heads as a reference head. Whenever the VCR picks up a control pulse, it knows that it's reading the A-track, for example. If the wrong head is reading a track the head speed increases until the reference head locks to the control track. The occurrence of the control track pulse indicates that the vertical interval on the tape is in the correct position for playback.

The tracking adjustment on the front panel compensates for most minor tracking problems. But if the tracking adjustment should need major adjustment, follow the directions listed in the service manual for that model.

In VHS playback, most of the process is the same as that during record. One exception to this is that the reference signal is not the vertical sync, which isn't present during playback, but the stepped down output of a 3.58 MHz oscillator. Except for the difference in reference signals, the control of the head drum position and speed is virtually the same as it is during the record operation.

Control of the capstan speed and position is, however, somewhat changed. The control head picks up the control track pulses referencing the head position. A control pulse amplifier brings the control track pulses up to a useable amplitude. The front panel tracking control adjusts the output of the control pulse amplifier to compensate for any tracking problems.

The trapezoid waveform derived from the PG pulse is applied to the capstan sample gate and controls the position and speed of the capstan motor.

Troubleshooting

Taking the time to know the VCR you're working on can save you hours of troubleshooting time. For instance, when you discover an audio problem, don't limit your thinking to just the audio block. Sometimes audio problems are caused elsewhere. This is especially true when an audio problem is accompanied by other symptoms. "Donald Duck" voices and rapidly moving figures on the monitor screen probably indicate a capstan servo problem rather than an audio problem. So, if your troubleshooting of a suspected audio problem reveals an operational audio block, don't be alarmed. The problem is probably somewhere else.

Check some other places. The loss of a few control pulses could cause your audio problem. The buzz in the audio might be due to a bad antenna connection, or a misadjusted VHF modulator. With an audio problem, be sure that you examine the video symptoms. Oftentimes they will lead you to the real problem.

Of course, the audio block can have problems. A consistently low audio output might mean that the audio head needs alignment. An audio head that has a height misalignment can reduce the audio output by as much as 50%, but misalignment of the azimuth would reduce the high frequency response. Fluctuating audio tends to be a "wow and flutter" problem caused by poor tape flow past the audio head.

Servo problems

Servo problems show up in both playback and record. For this reason, VCR technicians like to have the playback section operating before worrying about the record section. The symptoms of servo problems are often

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A sound future in audio

Digital is on the way

Digital sound, laser beam or capacitance pickup, "wearless discs," stereo television sound, AM stereo! Yep, it's all happening now, For a look at what's going on in audio then delve into this industry update.

By Bernard B. Daien

Soon the public will be listening to sound amazingly better than anything we have now. Imagine sound recordings free of noise, flutter, and distortion! Records that never wear out! and there is more...

Television sound will be broadcast with an audio bandwidth of 50 Hz to 15KHz, and stereo sound is already available. (Japanese TV viewers have been listening to stereo sound for a year.) AM broadcast stations in the United States expect to be broadcasting stereo in less than a year, and many stations have already bought the equipment necessary for stereo sound.

Some of the technology used to accomplish all this is "old," and technicians familiar with present stereo FM, will find that most of their training will be useful with the new sound, BUT...... a great deal of the new technology is some form of digital, and it is clear that this will have significant implications for both technicians and store owners.

Technicians will be required to use both linear and digital theory, and new instruments will have to be mastered, Store owners will have to dispose of present inventories, and phase in new products. New test equipment will be needed for the shop.

This is a repeat of an old story, for those who went through the changes of monaural to stereo FM, or the transition from black and white to color TV, or the advent of the video tape recorder. Each of these changes brought problems to those caught unprepared by swift technological change. For those who were ready, change meant golden opportunities for advancement and profits.

This article is a reportorial "overview," to assist technicians and shop owners to understand how these new developments affect them, and to better perceive where we are, and where we are heading with the "New Sound."

The "Sound Industry"

Those familiar with the sound industry know that it encompasses the manufacture of technical equipment, its use in broadcasting and recording, as well as the consumer at the end of the line. These elements are complexly interrelated, which is often not understood or appreciated by consumer electronics personnel. One good example. For years color TV was ready, but did not "catch on." The reason? Sponsors did not wish to pay the extra cost of color TV broadcasts when there were so few viewers with color sets.

On the other hand, viewers did not wish to pay for an expensive color TV set when there were so few color programs on the air. This "chicken and egg" standoff delayed the widespread use of color TV for a considerable period, with a consequent impact on color TV sales and service. So you see it is necessary to look at what *all* of the elements in the sound chain are doing, and thus understand their mutual impact on each other. Which is what we are going to do now.

Fig. 1 Magnavox's "Magnavision" optical videodisc player. A laser beam "reads" digitally encoded grooves which contain both video and stereo sound information.

In order to appreciate the fact that the new sound is not just an advertising gimmick, I am going to drop a few names of companies now involved in the development of this new sound. I am sure you will recognize most of them. Sony, Three M Company, Mitsubishi Corporation, Matsushita Electric Corporation, Teac, JVC, Phillips Corporation, American Telephone and Telegraph, Public Broadcasting System, N.H.K. (the Japanese public system). The RKO AM radio chain, MCI, EMI. And recording companies like Warner Brothers, A and M Records Orinda Recording, Telarc Records, Chalfont Records, and Sound 80. Most of these firms use Soundstream's digital recording process.

Together these companies represent an immense investment in time, talent, and money. They should impress you with their likelihood of successfully penetrating the audio field . . . soon.

What's going on

You already know that video tape recorders (VTR) are capable of recording frequencies up into the megahertz, with a precision that far exceeds that of audio tape recorders. Sony is marketing an adapter that takes audio waveforms, encodes them into digital form, which is then recorded on the VTR in the same manner as TV waveforms are now recorded. On playback the adapter reverses the procedure, translating the digital information on the tape back into linear (analog) audio. Two models are made, the PCM-1 which can be used with home VTRs like Betamax, and the PCM-1600 which is a professional machine using a 16 bit digital format with a dynamic range over 90 db, distortion less than 0.05%, and no measurable flutter!

Teac, Sony, Mitsubishi, JVC, and Phillips have developed laser disc machines using a flat disc, similar to present day phono records. The discs are stamped out like present day records, but use a laser beam for "reading" the information which is digitally encoded on the record. One side of a small laser disc is capable of holding *several hours* of playback material, with *no record wear*, virtually no noise, and no measurable fluttter or distortion! These systems have all been demonstrated with prototypes, and all that is holding them up now is lack of standardization.

Those among you who recall the great fight over which long playing (LP) system would become the standard, remember that the original records were 78 rpm, but RCA introduced the small 45 RPM records with the large center hole, while CBS pushed the 33 1/3 rpm large discs with the small center hole, and the fight held things up for years. Hopefully, we have learned from that situation and that the digital sound people will either get together, or use some "compatible" intermediate system, as we did when color TV superceded black and white, and we needed a system that would handle both . . . and we got it!

Other developments

In addition to the aforementioned firms, several others are developing similar systems which they are expected to introduce soon.

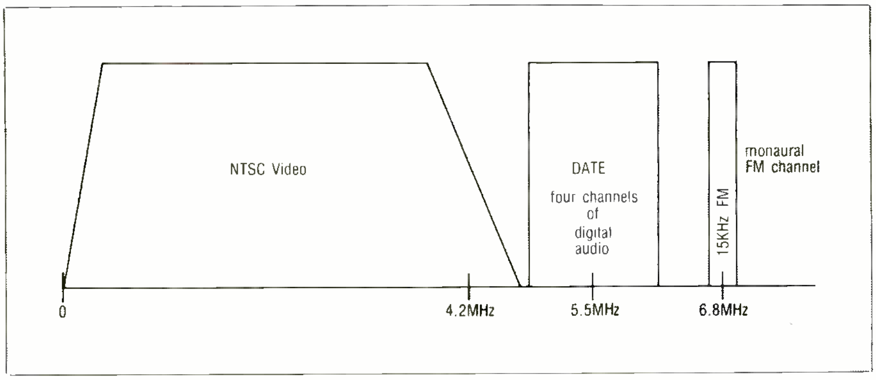

Fig. 2 The modulation spectrum for the DATE System, which carries provisions for broadcasting both digital stereo or enhanced FM sound.

There are many local TV stations now starting to use the "DATE" system, The DATE system was developed by the Public Broadcasting System and Digital Communications Corporation, for use in Public Broadcasting's satellite distribution network.

The commercial TV network stations are using American Telephone and Telegraph Company's diplex system to distribute the new sound to their affiliates. (Some technical details of Date and AT&T's diplex system are covered later in this article.)

Many of the top name TV receiver manufacturers are already selling sets with improved audio fidelity, as a step towards the "new sound" in TV. Sylvania has "Supersound," RCA "Dual Dimension Sound" and Quasar "Dynasound." The improvements consist of audio amplifiers with higher output and lower distortion levels, larger and heavier speakers in acoustic enclosures. They have been selling well.

It may come as a surprise to note that over seventy stations in the PBS system of TV have been broadcasting stereo audio, utilizing the DATE system! And over half a million Japanese TV fans have been listening to stereo audio on the NHK system.

Some pointers

As you can see, the broadcasters, equipment manufacturers, and consumer electronics people are all moving simultaneously to implement the new sound. Which brings us to the last link in the chain . . . YOU. At this point you may be asking "what will I need to know, to do my part in getting ready for the new sound?" Here are some pointers.

It is almost a certainty that TV sets using the new sound will be using synchronous detection. (See ET/D, January, page 22). There will also have to be better fidelity in the TV audio amplifier, probably using Output Transformerless circuitry to save cost and weight. (See ET/D, December, 1979, page 30). Old timers may find that TV set design reverts to an old friend, is a separate intermediate frequency amplifier for the sound, instead of the present "intercarrier" system. In the old days critical tuning was a problem, and the intercarrier system solved that . . . but today's sets use A.F.T., so correct tuning should be no problem now.

The moral is, "stick your nose into literature about the synchronous detector, the older split sound TV system, (and Hi-Fi systems if you have been primarily in TV)." Further, since the new record players use many of the refinements in speed controllers, and positioning, that are now in use in video tape recorders, it behooves the Hi-Fi tech to get into the theory and operation of VTRs now. And, of course, if you haven't gotten started on digital theory and practice, it's getting *very* late. Till now you could get by in Hi-Fi and TV consumer repair without digital, but that is no longer probable. The tech who does not understand digital will be as handicapped as the tech who failed to make the transition from vacuum tubes to semiconductors in the last decade.

The DATE system

Referring to Figure 2, the signals transmitted by the PBS satellite are illustrated in spectrum form. A standard NTSC video vestigial sideband spectrum is transmitted, as in current practice . . . but in addition, there is a sub carrier at 5.5 MHz center frequency, for sound, which contains *four channels* of digital audio. The sampling rate for each audio signal is 34.43 KHz, with a 14 bit coding. After processing for transmission, the coding is 13 bits. The four channels are then combined to provide a bit stream of 1.79 megabits per second. This provides, after decoding, audio signals with band-widths of 50 Hertz to 15 KHz at less than 1% total harmonic distortion, single tone. In addition, there is another subcarrier at 6.8 MHz for a 15 kiloHertz FM modulated signal, for use as a high grade monaural sound channel for stations that do not use the stereo signal. Thus the DATE system provides for both monaural, and four channels of digital audio.

The AT&T diplex system differs from the DATE system in that the audio subcarrier is at 5.8 MHz, FM modulated 15 KHz, plus another subcarrier at 6.4 MHz for stereo use.

Standards needed

Other systems are in use in Japan, and under test in the U.S., using either multiplex techniques, or the familiar stereo technique of matrixing into a L+R, and L-R signal as currently used in stereo FM sets in the U.S. Again the problem is only one of standardization, and on the air tests are being run to help resolve the situation. These matters are being studied by The Subcommittee on Multichannel Sound of The Broadcast Systems Committee of The Electronic Industries Association. And, of course, the Federal Communication Commission is carefully supervising all testing, and monitoring the effects and results.

The situation is much the same in AM stereo, with five systems in contention. It is expected that by the time you read this the FCC will have made a decision on which system will be standard, but the broadcasters have not been standing idly by. Most have already purchased the needed stereo equipment, and it is in place. Once the go ahead is given, stereo AM, sounding almost as good as stereo FM, will be here overnight! That will trigger off a boom in stereo AM receivers matching the boom that took place when stereo FM wiped out monaural FM in the recent past. Here, however, any tech competent in stereo FM will have no troubles with stereo AM receivers. Of course new test equipment will be needed for the shop bench, but it should not be very expensive, nor will more than one or two pieces be required per typical shop. The main problem will be moving out obsolete monaural AM, and replacing it with new stock, once the boom starts. As usual, those with shrewd business foresight will do well in the matter of timing. The others will take a loss.

Disc and tape machines

In the matter of disc and tape players and recorders, the new sound offers some interesting implications. Since one can use a VTR for stereo new sound, it is obvious that the owner of a VTR can now make it do double duty, which should spur the sales of VTRs, and also provide for the sale of digital sound adapters to those who already own VTRs. The fact that laser discs never wear out makes discs more attractive when compared with tapes, and the fact that the discs will play for hours, provides for even more competition between disc and tape. Remember, the disc has always been less expensive than tape! This should provide a big shot in the arm for discs.

There is one flaw in the picture. For stereo AM to sound like the Hi-Fi that it can be, the AM receiver will have to be a good one. The sort of junk that is being put into AM today will have to be eliminated, and this is the major worry of

continued on page 44

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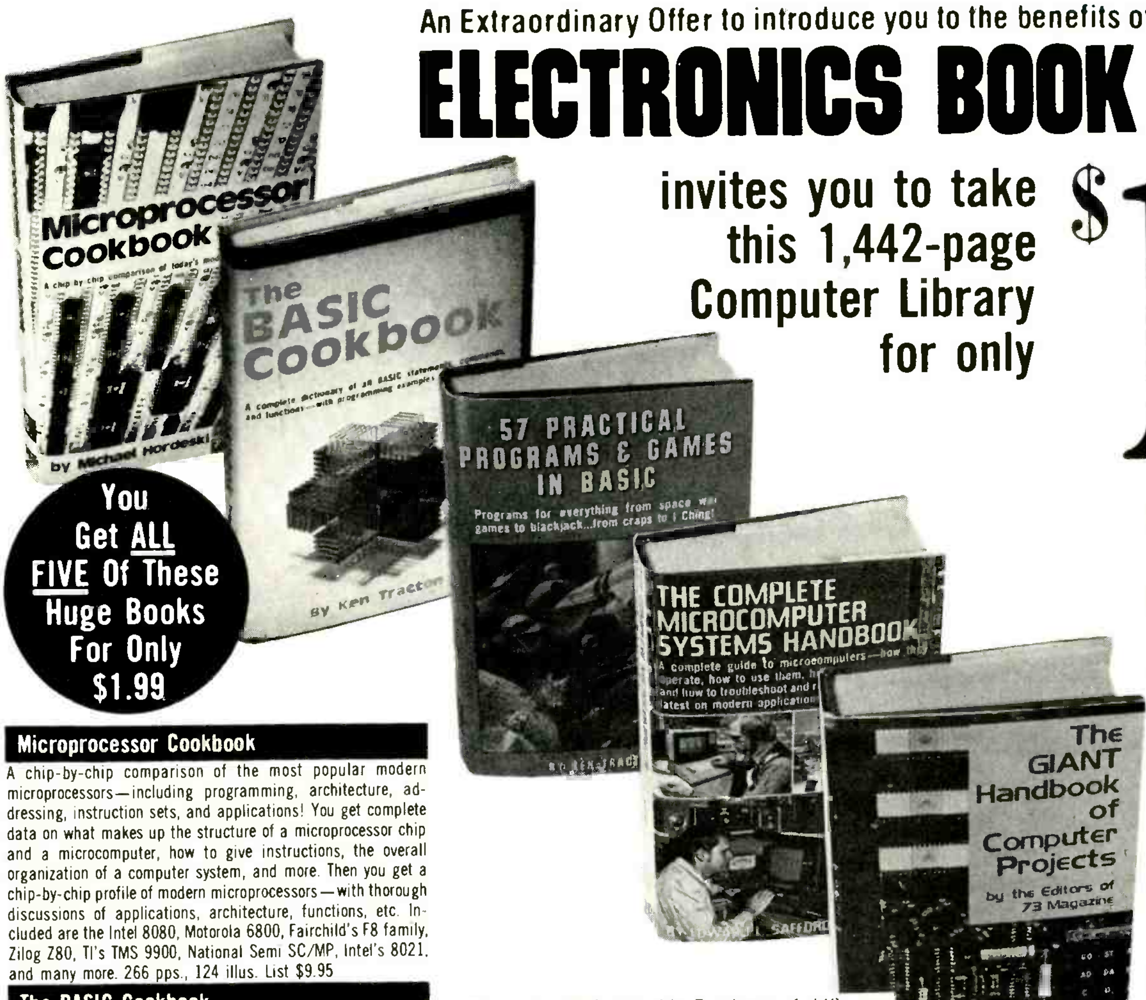

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The IEEE fall conference on consumer electronics

A preview of things to come?

Many of the features, and much of the circuitry of future consumer electronics products is described at these IEEE conferences. Here is some speculation on what we may see in a year or two.

By Walter H. Schwartz

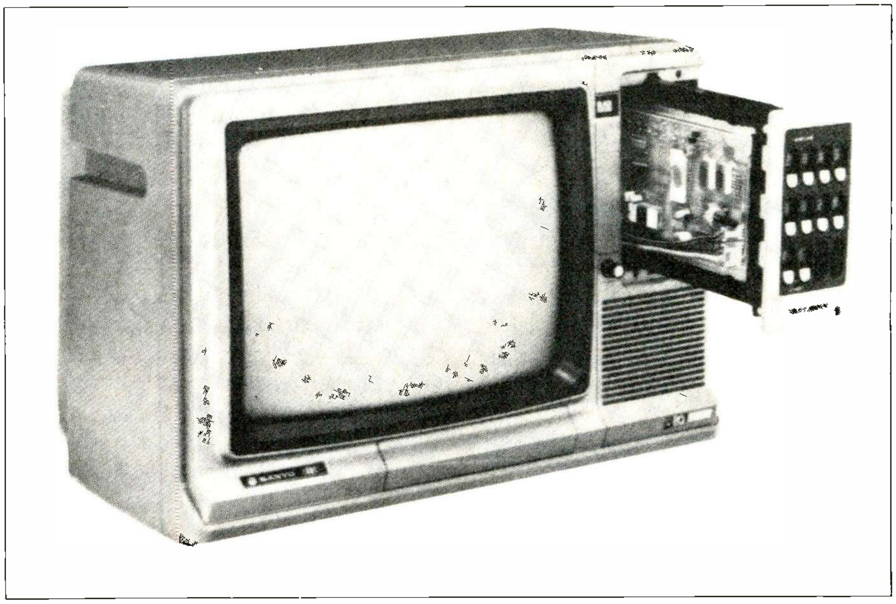


Fig. 1 Sanyo's television receiver using the MNMOS memory. (Courtesy Sanyo).

The ninth annual Chicago Fall Conference on Consumer Electronics, of The Institute of Electrical and Electronics Engineers, was held November 12 and 13. Papers on state of the art consumer electronics were presented by engineers and scientists from RCA, Sanyo, Plessey, Hitachi, GTE, Motorola and other companies involved in consumer electronics or as suppliers of components to such companies. The subjects ranged from microwave television converters to high power IC audio amplifiers for automotive applications.

Television control

RCA described a new microprocessor tuning control system with features beyond any in use at this time. A phase-locked-loop local oscillator is controlled by either a local keyboard or a 35 key remote unit, which transmits pulse position modulated infra-red pulses. The design is all CMOS and has auxiliary Ni-Cad power in event of power failure.

The clock continues to run, after power failure, for a week, at which time the system shuts down, except for the RAM which reportedly will operate for three months before the Ni-Cads run down.

The design approach presented by RCA allows options such as Teletext, Viewdata and TV games to be added later.

Sanyo engineers presented details on an electronic tuning system using an analog memory, part of a combined digital/analog LSI IC. The analog memory remembers the correct fine tuning voltage. The approximate tuning voltage is held in a 5-bit digital memory to which the analog voltage is added, thereby reducing the complexity of the digital memory and the analog to digital conversion process from the usually required 13-bit capacity of both the memory and DAC. Analog isn't dead yet!

Analog information is stored in the floating gates of an MNMOS IC (Fig. 2) capable of storing information for 16 TV channels.

Sanyo also announced the development of a phase-locked-loop IC which can directly divide, without an external prescaler, 130MHz FM receiver local oscillator frequencies. This n-channel molybdenum gate MOS IC, in combination with a programming microprocessor and appropriate

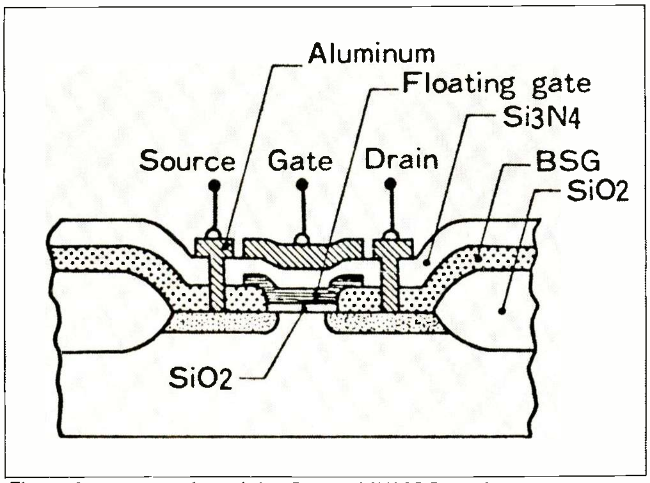


Fig. 2 A cross section of the Sanyo MNMOS analog memory. (Courtesy Sanyo).

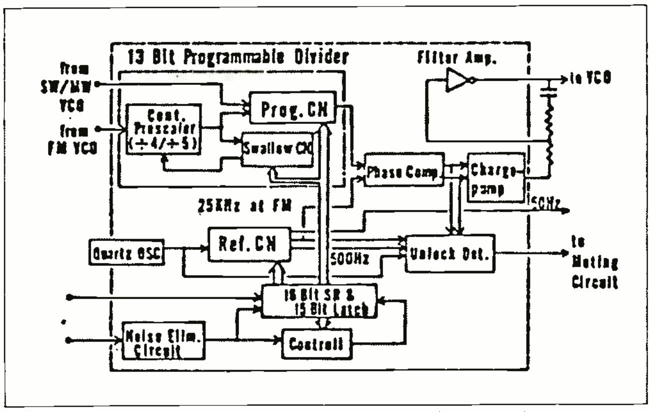


Fig. 3 Sanyo's AM-FM-SW receiver PPL IC in block form. (Courtesy Sanyo).

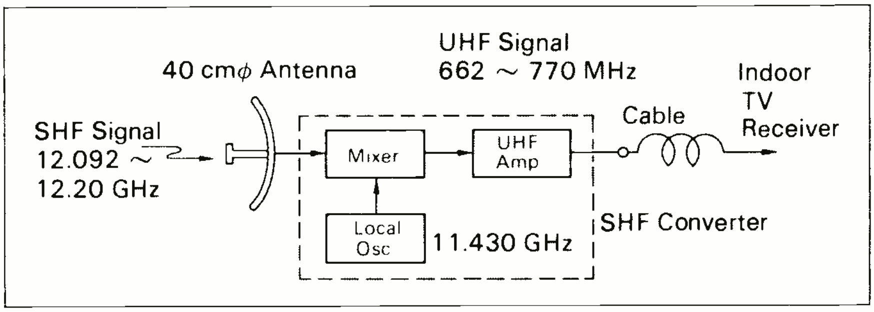


Fig. 4 12GHZdown converter block diagram. (Courtesy Hitachi).

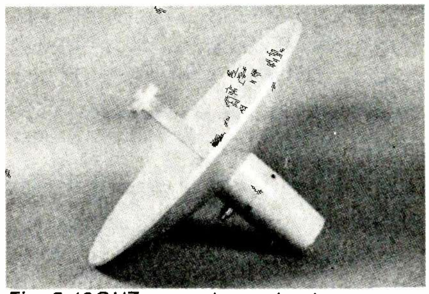


Fig. 5 12GHZ converter and antenna. (Courtesy Hitachi).

auxiliary circuitry can generate local oscillator frequencies in 25kHz steps for FM and in 1, 5, 9, and 10kHz steps for shortwave and medium wave (AM broadcast) use (Fig. 3).

Plessey Semiconductors announced a frequency synthesis system adaptable to the various TV standards used around the world. This system has fine tuning steps of 50kHz and can store information for up to 32 programs (channels). A standard synthesizer and a custom programmed microprocessor comprise this versatile system.

Projection TV

The future of projection television was contemplated by U.S. Precision Lens Inc. Sales of projection television receivers were about 20,000 in 1977. In 1979, such sales should total between 50,000 and 60,000. And projection sales in 1983, it is speculated, could be between 350,000 and 500,000 or about 5% of the present market, with a price range from slightly below $2000 to over $3000. To meet the needs of this sales expansion, U.S. Precision Lens is developing low cost high performance plastic lenses; for example, its new Delta IV is a 114mm, f/1.0 lens designed for use with 5 inch flat faceplate CRTs and screens of 45 to 55 inches (diagonal). Reportedly, it is felt that this is where most systems will be designed, since smaller tubes offer much less available light and larger tubes require much more expensive lenses.

SHF TV

Another preview of something we may be contending with in a few years is Hitachi's 12GHz converter. This frequency range will probably be used for both satellite and terrestrial television transmission. A system is presently operating in Japan (Tokyo) which provides TV reception to about 2000 homes shadowed by large buildings from standard transmissions (Figs. 4 and 5). The significant feature of this converter is its construction, tuned circuits and filters, oscillator and mixer, on a single substrate of teflon-fiberglass circuit board material. Components other than the etched circuitry appear to be only a mixer diode, a local oscillator FET, a dielctric resonator for oscillator frequency control, and a couple of chip capacitors and a couple of resistors. As authors stated in conclusion: "The technical results obtained. . .are obviously applicable to the direct reception of satellite broadcasting.

Other TV applications

Other subjects of discussion were a microprocessor control system for variable playback speed of video tape recorders, automatic deghosting circuitry for TV receivers, additional uses for the 3.579545 oscillator signal in color TV receivers, i.e., for generating a dot matrix for video display systems, among others. RCA explained its comb filter, which appears in some models of its 1980 line of TV receivers.

Plessey also described an integrated circuit and a SAW filter for use in a parallel, shades of 1950!, split sound system for TV receivers. The benefits obtained are elimination of inter-carrier buzz and sound beats in the video and reportedly over all better quality sound.

Microprocessors

American Microsystems presented two papers on low cost microprocessors for control applications in appliances, toys and games, and automotive use. By including specialized I/O functions on the microprocessor chip, external discrete components can be eliminated, and the microprocessor can directly drive displays, SCRs and handle keyboard or other control inputs.

Related to this, Plessey has developed a pulse code modulated infrared remote control system for toys and games.

Awards

As a sidelight, at the awards luncheon, one award of particular interest to TV

continued on page 46

Sony for '80

The new "Alpha" chassis* **

Sony has made significant changes for two consecutive years. A new Trinitron, including a 26 inch version and a more serviceable "Alpha" chassis highlight this year's offerings.

By Walter H. Schwartz

Fig. 1 One of Sony's new 26 inch (diagonal) Trinitron television receivers, Model KV2643.

After introducing a new simplified chassis about a year and a half ago (the "I2" chassis, ETD/Jan. '79), Sony, for the 1980 model year, offers the yet more simplified—both mechanically and electronically—"Alpha" chassis. The "Alpha" chassis is available in 12, 15, 17 and 19 inch sets, as well as in the new 26 inch receivers.

The bulk of the circuitry of the Alpha chassis is on two circuit boards, the tuning or "MA", and the main "A" boards. The receivers also have various auxiliary boards in the tuning and control systems and a R-G-B output board on the CRT socket. The tuner is also a separate unit.

Much of the Alpha chassis circuitry is similar to that of the earlier "I2" and "Y2" series. New features will be covered here.

Tuning system

The tuning system, mostly on the "MA" board, uses digital techniques to perform the tuning functions. It will tune in up to 14 different channels, generate and store the digital tuning data in memory, and retain it in event of power cutoff, recall the last channel when power returns, recall the stored data to tune in the pre-programmed channels, and auto search up or down.

The tuning data processing circuits use three IC's (Fig. 2). IC034 is a tuning memory. It has 14 memory locations to store data during programming and to later supply this data to tune in a channel.

IC033 is a neon channel indicator lamp driver and also senses whether the AFT is tuning up or down. IC032 is the control IC. It synchronizes all the tuning logic operations. Its various pin functions include the following: Pin 1: The voltage level applied here determines IC032's operational mode, i.e., 12 Vdc turns on the AFT, 6V dc turns the AFT off and with zero volts, the mode is program; Pin 2: The 1MHz clock

ADDRESS LINES		A	B	C	D
14 CHANNEL LOCATIONS	A	L	L	L	L
	B	H	L	L	L
	C	L	H	L	L
	D	H	H	L	L
	E	L	L	H	L
	F	H	L	H	L
	G	L	H	H	L
	H	H	H	H	L
	I	L	L	L	H
	J	H	L	L	H
	K	L	H	L	H
	L	H	H	L	H
	M	L	L	H	H
	N	H	L	H	H

Fig. 3 Channel locate logic.

**For a complete schematic of the "Alpha" chassis in its 26 inch version, see TEKFAX in this issue of ET/D.*
***Illustrations courtesy Sony Corporation of America*

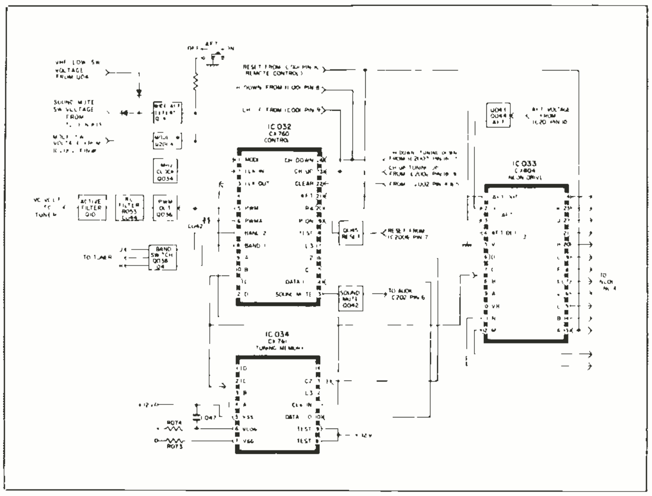


Fig. 2 Tuning data processing circuits.

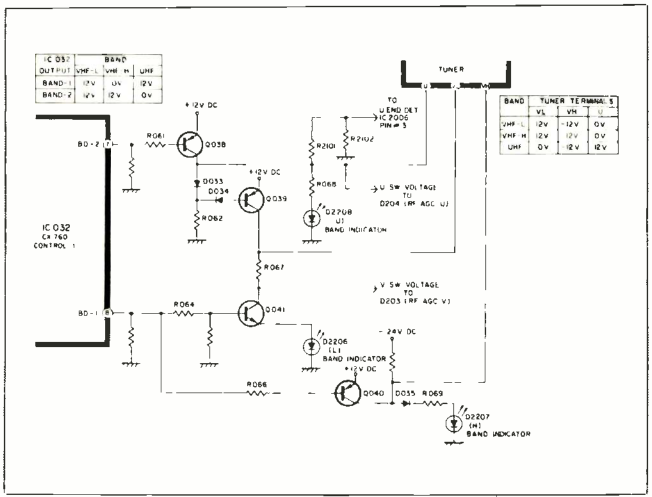


Fig. 4 Tuner band select.

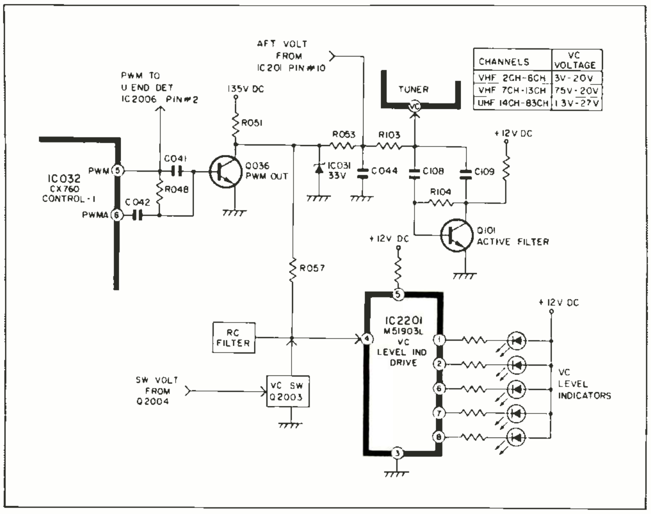


Fig. 5 Tuning voltage processing.

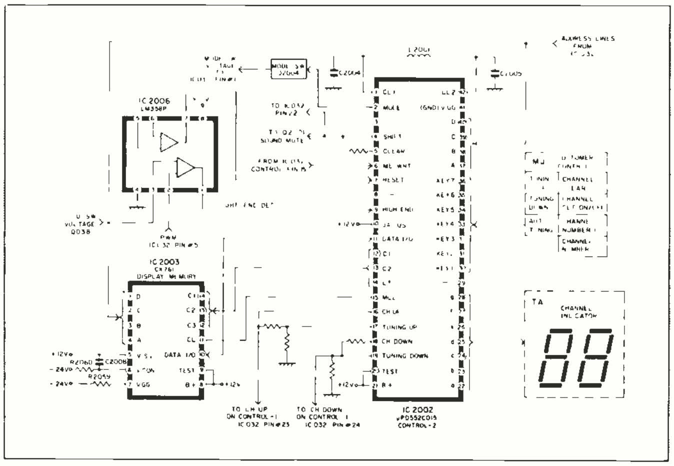


Fig. 6 Programming control circuit.

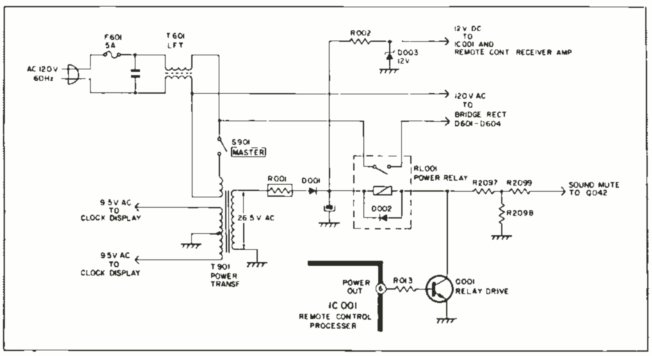


Fig. 7 Remote control chassis power turn on.

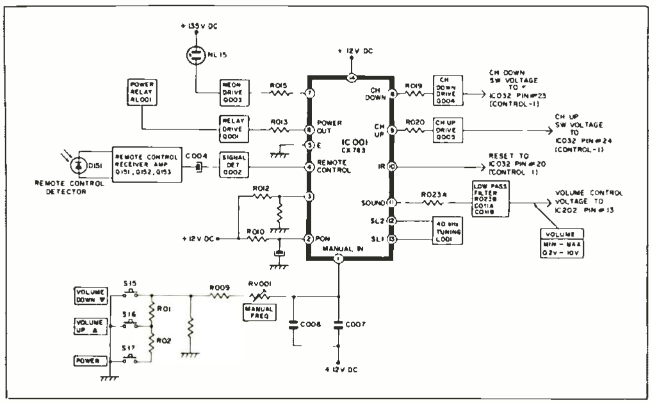


Fig. 8 Remote control IC

input; Pin 3: the 15,625Hz clock output; Pins 5 and 6: The pulse width modulation (PWM) signal output; the pulse width here determines the control voltage for the tuner; Pins 7 and 8: The voltage level here selects the tuning range of the tuner (VHF low, VHF high or UHF, Fig. 4); Pins 9 through 12: These are the four address lines which identify each of the pre-programmed 14 channels selected; Low is 0 volts, high is 12 volts as in Fig. 3; Pin 13: A high pulse here produces sound muting during channel change and turn on; Pin 14: The data I/O line; digital information corresponding to each channel location is written into the memory or readout here; Pins 15 through 17: The logic level on these pins controls the tuning memory, IC034, write, read, standby, last channel, and change I/O line to input or output; Pin 19: A high when power is turned on reads the last channel memory of IC034 and tunes this channel in; Pin 20: A high pulse is applied here each time a channel is randomly selected for reset; Pin 21: Twelve volts here tunes the AFT up, zero volts tunes it down, to correct the PWM signal; Pin 22: A low here clears the memory corresponding to the tuned channel location; Pin 23: A low tunes the system to the next higher active channel; Pin 24: A low here tunes to the next lower active channel.

Channel tuning

The tuning band is selected by the logic at pins 7 and 8 of IC032 (Fig. 4). The individual channels are selected by filtering the PWM signal from pins 5 and 6 (Fig. 5). The PWM signal is a series of

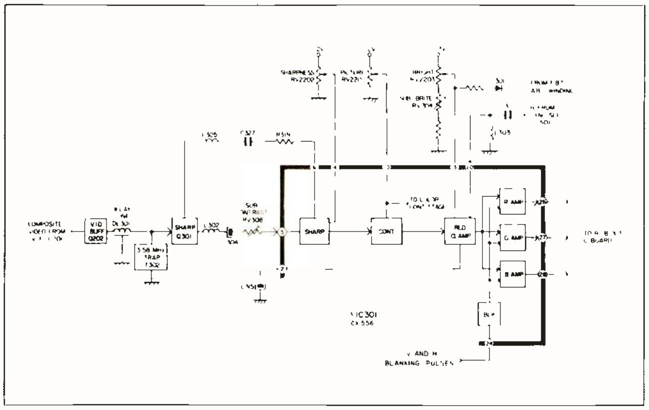


Fig. 9 Luminance amplifier circuitry.

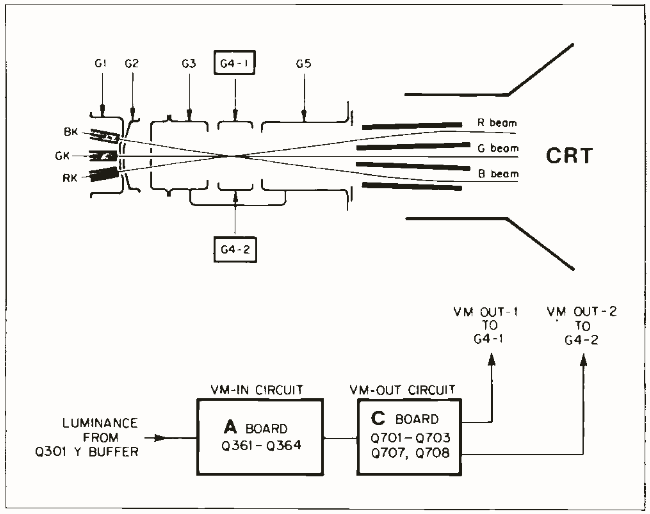


Fig. 10 Sony's 26 inch CRT electron gun and a block diagram of the velocity modulation circuit.

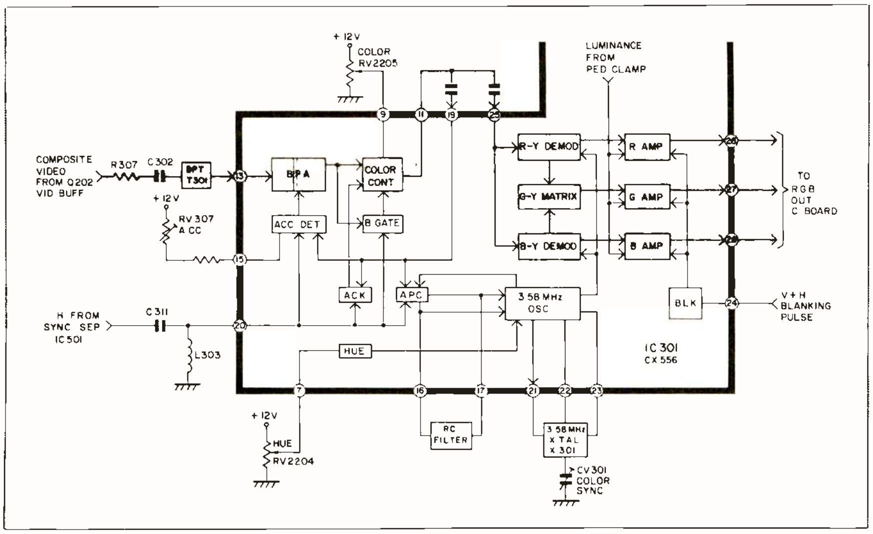


Fig. 11 Chroma, IC301.

pulses the width of which is determined by the channel selected; the wider the pulse, the greater the voltage after filtering.

The PWM signal is filtered by R053 and C044 and the active filter consisting of Q101 and associated components.

IC2201 and the associated LED's are a five-step voltmeter, which indicates the approximate tuning voltage level within each band. As the voltage to pin 4 increases, more LED's light (during programming). In the 26 inch sets transistor switch Q2003 disables this function during normal operation; in other models a manual switch does so.

AFT voltage is applied to the control line also. To prevent false tuning voltages from being produced, an AFT stop detector is used (See TEKFAX). The AFT stop detector must sense the presence of composite video before it will turn on the AFT. Q2007 is a video buffer, Q2008 is a sync separator, and IC2004 is a phase-locked loop. When the leading edge of sync pulses at pin 14 are in phase with the leading edge of the VCO pulses applied to pin 3, output pin 1 will go high, turn off Q2009 and turn on the AFT.

Programming control

The functions of the programming control circuit are to respond to commands from the user controls on the "MJ" board, (see TEKFAX schematic) place the tuning processing circuit in the programming mode and supply the proper information to the channel indicator (Fig. 6).

"MJ" commands include: *Channel set OFF/ON,* which turns on the programming functions by causing pin 2 to go high; *Tuning Up/Tuning Down* controls, respectively, cause pin 17 to go low (and, thereby, pin 23 of IC032) initiating search for the next higher channel and pin 19 to go low (and pin 24 of IC032) to initiate search for the next lower channel; when *Auto Tuning* is activated, the system will tune and store logic for all available channels to a maximum of 14; Channel Clear produces a low at pin 5 during programming. The programming control and the tuning processing are synchronized by the address lines (A, B, C and D). A two-phase 400kHz clock signal is present on pins 1 and 42.

Remote control

In all of the remote control Alpha chassis receivers a master switch can turn the set completely off (Fig. 7). When the master switch is on, power is supplied only to the remote control detector ("N" board, see TEKFAX), and IC001 (Fig. 8).

The remote control is by means of an infrared beam. After detection by D151, the signal is ampified by the remote control amplifier and applied to pin 4 of IC001. Commands supplied to IC001 result in various responses: *Power on* produces a high at pin 6 and turns Q001 on, closing power relay RL001; the volume level controls generate pulses at pin 11; at initial turn on the frequency of these pulses is such that the output of the low pass filter to pin 13 of IC202 is about 1.5Vdc for a fixed, moderate volume level; to *increase volume,* the pulse frequency increases resulting in a higher voltage to IC202; *Volume Down* produces the opposite result; as long as the *Channel Down* is operated, Q004 is switched off and on by pin 8's pulse output, commanding IC032 to switch channels down; similar action occurs when the *Channel Up* signal from pin 9 operates Q005 and then IC032; *Random Access Channel Select* produces a single pulse at pin 10 to reset IC032, and a number of pulses, depending upon channel selected, at pin 9 (always drives IC032 channel up).

All commands are synchronized by a 40kHz clock signal developed at pins 12 and 13.

Luminance processing

Video from pin 19 of IC201 (the video IF

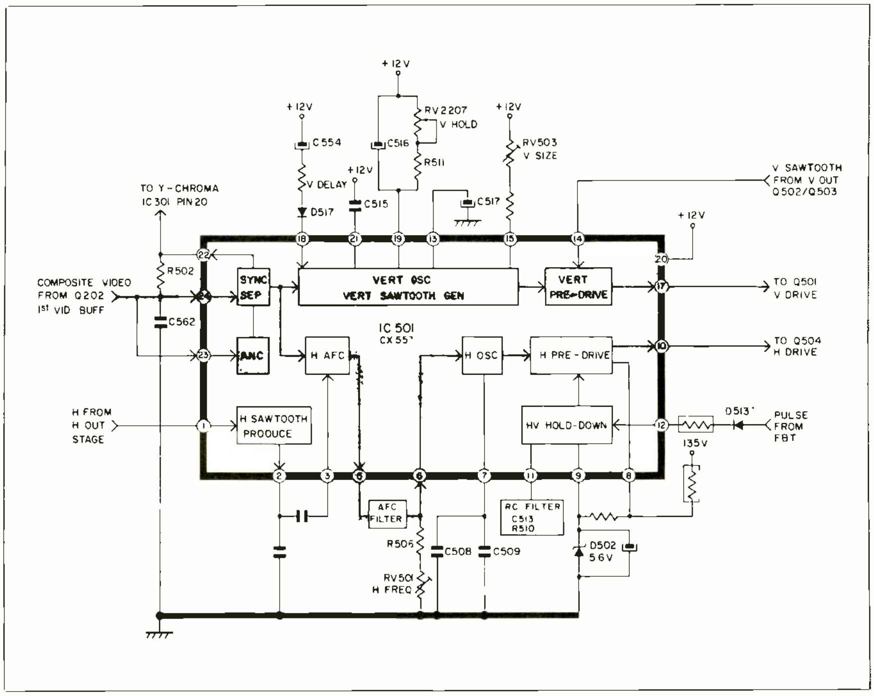


Fig. 12 Sweep/Sync IC501.

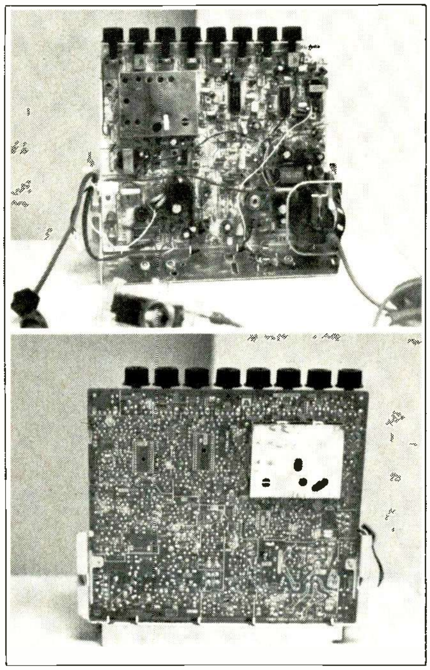


Fig. 14 The "A" board, top and bottom views.

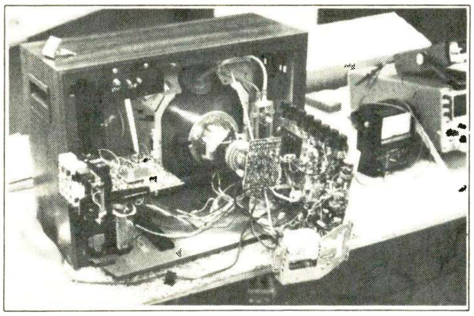


Fig. 13 An "Alpha" chassis Sony table model in service position.

IC, see TEKFAX) is fed via a buffer and the delay line to Q301, a sharpness amplifier, (Fig. 9). Peaking is accomplished by L305, C327 and R319. Sharpness is varied by control of the dc voltage applied to IC301, pin 4. IC301 also contains a contrast stage, the gain of which is controlled by dc applied to pin 10. A pedestal-clamp stage follows; the automatic brightness limiting signal reduces the conduction of the pedestal clamp stage if beam current exceeds normal. Separate R, G and B video drivers, which also are retrace blankers supply drive the R, G and B outputs on the "C" board.

Sony's velocity modulation circuit (see page 28, September ET/D) is used with the new 26 inch CRT's to increase picture sharpness. Very simply, pulses are applied to G4-1 and G4-2 (Fig. 10) of the CRT gun to speed up the beam horizontally during video transitions from white to black and black to white, reducing grey edges. Total horizontal sweep time must, of course, remain unchanged.

Chroma processing

All chroma processing takes place in IC301, which is also the luminance processor (Fig. 11). It contains a bandpass amplifier, ACC circuitry to vary the bandpass amplifier gain, a color level control stage, the gain of which is varied by changing the dc level at pin 9, a burst gate, color killer, the 3.5MHz oscillator and AFPC and a dc operated hue control circuit. It also contains R-Y and B-Y demodulators and a G-Y matrix and the R, G and B amplifiers which supply color difference signals to the ampifiers on the "C" board. The luminance and chroma are matrixed in these last amplifiers in IC301.

Deflection

Sweep oscillators and sync processing are all functions of IC501 (Fig. 12). An RC network consisting of C516, RV2207 and R511 sets the free running vertical frequency. C517 and internal circuitry shape the vertical sawtooth waveform which is amplified by a pre-driver. Feedback from the vertical output to pin 14 of IC501 helps maintain linearity.

The free running horizontal frequency is set by C508, C509, R506, and the horizontal frequency control RV501. IC501 also contains the horizontalAFC and a pre-driver stage.

A high voltage hold down circuit in IC501 receives a rectified pulse from the flyback (via D513), and compares it with a 5.6V reference from D502. If the dc voltage at pin 12 of IC501 exceeds 5.6V, the pre-driver is turned off, and the HV is shut down. As is usual, the HV remains shut down until the set power is interrupted momentarily.

Service

Last year's I2 chassis offered a significant improvement in serviceability, when compared to earlier Sony television receivers; the Alpha chassis appears to be about as easy to service as a single board soldered in component arrangement can be.

Remove two screws and take the back off the cabinet; remove a couple more and the main "A" board can be pulled out of the cabinet, rotated 90 degrees and stood upright on its heatsink. The screws that hold the tuning assembly are captive; loosen them and remove the tuning board and mount it in the service mounting provided on the left, from the rear, side of the cabinet and it is fully accessible (Fig. 13).

The board layout—thanks to some rather comprehensive ICs—is fairly uncluttered (Fig. 14). Both sides of the boards are sectioned by function and well roadmapped, and components are identified on both sides as well. Shield covers pop off—no unsoldering, and interconnecting cables un-plug. Since Sony now has large console TV receivers, it may be desirable to pull a chassis for shop service: a kit is available for compatibility to RCA, Sylvania and Zenith test jigs. The cost is reportedly about $15. Also, incidentally, for the first time, rebuilt Trinitrons in 17 and 19 inch sizes are available at some savings in cost. ET/D

Coping with line transients

The "Glitch Witch" at bay

In the world of digital memory devices, line transients can cause catastrophic failure. Often past remedies used for analog circuits will no longer suffice. For a look at some newer approaches to "coping," read on.

By Joseph J. Carr

A glitch is an unwanted pulse, or other disturbance, that raises hob with digital circuits. When one of these glitches gets into a system it can increment counters, erase memory, or reset everything back to square zero (or some other unlikely spot that is equally unuseful).

Now that digital devices are found in almost all walks of private and professional or business life, we hear more and more complaints about glitch witches having a field day. In the "old days," there was often the possibility of designing the location of the equipment so that glitches from external environment were all but eliminated. Equipment, too, was designed to have fewer problems.

But today, digital equipment is found in almost all types of "unprepared" sites, and competition has caused many manufacturers to leave out some of the design features that helped alleviate previous problems.

We can easily identify two types of external glitch: static electricity from our bodies and power line transients. Let us deal with these one at a time.

Static electricity builds up on our bodies, clothes and tools without any help at all! Just by ordinary rubbing, we can create many thousands of volts of electrical potential. This is viewed rather dramatically when you walk across certain types of rug, or other floor covering, and then touch a grounded object: ZAP! A spark will jump from your hand to the object, often rather painfully. While most static discharges are not harmful to people, they can be devastating to digital electronics circuits.

Leaving aside the fact that sparks can blow out CMOS and certain low power TTL I.C. devices, there is the possibility of the spark getting into the circuit as a transient, and resetting some of the circuits. A small desk-top microcomputer used where I work (when not writing for ET/D, I actually work for a living) used to "go bananas" when someone would walk across the carpeted floor and then touch the keyboard, or the mainframe of the computer. The guy who had just typed in a 1000 step program usually takes a dim view of losing all of that work because a static discharge sent the computer into *reset*.

There are only a few things that could be done for this type of problem. One of them, of course, is to remove the rug and replace it with insulated tiles! No rug, no static. It's simple. Or is it? In some cases, the building management will not permit you to remove the rug. Another possible cure is to place a rubber, or plastic, covering over the rug. But be sure that the covering is anti-static, or you will just change one problem for another.

If the building manager does not want the rug removed, and the covering option is, for some reason, not reasonable, then you might want to try having a carpet cleaning firm, or the building custodial staff, apply an anti-static treatment to the rug. If there are no firms that do this, try it yourself. Contact the suppliers of carpet cleaning materials. Note that this treatment must be repeated 3-4 times per year, despite manufacturers' claims.

The static problem will be worse in areas of low humidity, and will vary with the season over most of the country. Short of grounding everybody, which is tantamount to suicide in a service shop environment, there is little that can be done.

Power line transients

In technical school we all learned that the electricity that we get from the power company is real nice, clean, sinewave, right? Wrong! The electrical power mains *often* contain *transients* that average several hundred volts and may easily reach levels in the 1600-2000 volt range. Most transients last only milliseconds, but in that time they can shut down a major computer, foul up a transaction made on a point of sale terminal, or wipe out a letter stored in a digital word processor. An oscilloscope waveform used by G.E. in their MOV advertisements (a kind of transient suppressor) showed literally dozens of over-kilovolt transients recorded on a 110 volt a.c. power line in a 24 hour period.

There are many sources for these transients. Lightning, of course, is well known. But what is not well known is that it does not take a direct hit to induce kilovolt transients in the power line! Ever heard of induction? A bolt of lightning, anywhere near a power line (up to about ¼ mile!), to ground or overhead, can induce mighty transients. This transient could be propagated along the line for

Fig. 1A There are numerous types of AC line conditioners on the market. Among them these power line conditioners/isolation transformers. Figures A and B are designed especially for microcomputer applications by Topaz Electronics. C, D, and E are from Sola Electric.

many miles, but is usually most severe in the area on the same side of the transformer where the induction occurred. Transformers tend to attenuate (but not eliminate!) the transient, and cause it to spread out . . . even more drastic for a digital device!

Sometimes the source of power line transients is inside the same building with the digital equipment. My own experience is in medical equipment, and consequently, my "war stories" revolve around hospitals and medical school facilities. In one case, sensitive scientific research instruments would give intermittently bad results. At other times, an optical scanning machine that was used to grade the *mark-sense* answer sheets turned in by medical students taking examinations would flunk out the whole class.

The trouble was traced to severe transients arriving on the a.c. power line. The origin of the transient pulses was some power system switching equipment located in the basement of the building. We could get a premium rate from the power company if we used special equipment that would sense the lightest loaded phase (buildings this size use three-phase a.c. power), and then switch the load of the building around to balance the drain from the three phases. While this was nice and efficient, it also tended to raise hell with all of the digital equipment (*seven* computers!) and many of the analog instruments used in the building. Since this equipment was inherent in the design of the building, there was little that we could do to solve the problem at the source.

The final cure

The final cure was grounding of the equipment chassis through a redundant ground wire (not the power cord ground). Sometimes, a power line ground is not too good for a computer's needs, although it works fine for a.c. power. The redundant wire ground went to a *cold* water pipe made of metal, not plastic.

In another case, the glitch was due to X-ray equipment in a room a few yards away. A secretary at this suburban hospital was using a "word processor" device that digitally stores patient records. This particular model would allow the user to type in 256 words (averaging five characters each), until the cathode ray tube screen was full. This data was held in temporary, semiconductor, memory. When the screen was full, or the job completed, then the user typed an *enter* command, and the material was stored more permanently on discs or magnetic tape. But every now and again, usually after the secretary had typed in 255 of the allowed 256 words, a power line glitch would erase most of the data (*sigh*). The problem was traced to nearby X-ray equipment. An X-ray generator is a high powered device. It might require 125 Kv at 60 mA, which is 7500 watts, for a brief instant. This could throw a transient out onto the a.c. power line. It is this transient that will cause problems.

In this case, the problem was solved by using a special type of isolation transformer. These transformers (see Fig. 1) attenuate the pulse much more than ordinary transformers and help keep glitches from the equipment. These transformers are actually a.c. line voltage regulators, and are used for protection against brownouts, transients and other forms of a.c. power line problem.

Start up transients

One of the most difficult to suppress problems is the so-called *start-up transient*. When a heavy duty motor, or other mechanical device, is started up, it momentarily requires a large surge of electrical power in order to overcome the resting inertia of the equipment. But when the device is running at full speed the power requirements drop to a much lower level. This phenomenon is seen most easily, perhaps, by watching the lamps in the room when a window air condition turns on. They will dim almost completely for an instant. In fact, it is *likely* that the average residential a.c. power line will experience 25 percent voltage drops lasting less than one (fatal to digital) second three times per day! It is also probable that a 75 percent, split-second, drop will occur at least once a month. Overvoltage transients, in which the line voltage goes up by 2000 percent for 10 milliseconds, occur more than two dozen times per day in the average installation. Commercial and factory installations, where additional heavy machinery or transient-generating electrical devices exist, can be expected to be worse.

Of course, the best cure is to tackle the transient at the source. Bypass capacitors, in the same manner as used to reduce noise in mobile radio installations, and series inductive filters can often reduce the level of noise to a livable level. But be sure to contact the manufacturer of the specific equipment before applying any "corrections." They might have some objections, related to design problems, or might be able to offer some suggestions of their own. A good review of mobile noise suppression might be in order for any technician who contemplates this type of service.

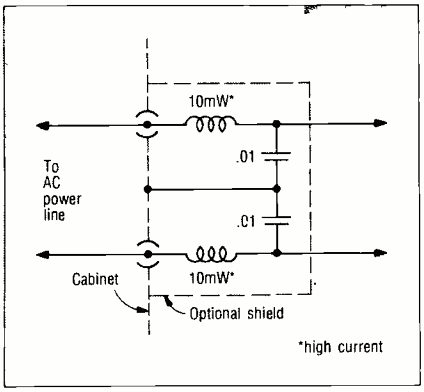


Fig. 2 The schematic diagram of an LC line filter. These can sometimes do the trick but be wary of voiding manufacturer's warranty with their use.

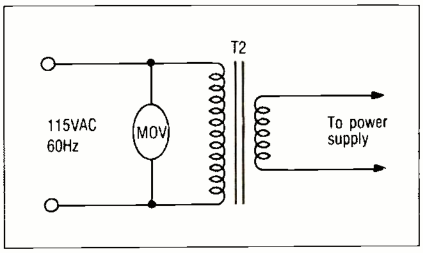


Fig. 3 The use of a specially built line transient device is another method to be considered.

If it is not possible to suppress the noise at the source (often the case), or if the noise trouble-shooting problem turns into a sticky mess much akin to trying to nail Jell-O to the wall, then consider using one of those transformers. There might be a little customer resistance because of the initial cost, but they will provide many benefits. Not the least of these is the fact that they can now use their expensive digital instrument, where before they were being reset to square-zero every time some clown down the hall turned on the air conditioner, or took an X-ray.

Equipment modifications

Sometimes, modification of the equipment being interfered with is necessary. Either the modification alone, or in conjunction with a line isolation/regulator transformer, is often the real key to eliminating the problem.

But before jumping into some modification scheme, it might be best for you to contact the manufacturer about the problem. It might be that they have already seen this problem and know the cure. But be sure to contact the in-house service technicians *first*, the engineers second, and the salesmen last. Keep in mind, that corporate pressure is heavy on sales people (most salesmen are liars, and sales managers are first kin to Satan) so they will not want to tell you the defects of their equipment (it is also likely that no one will tell them!).

The engineers have pride of design and the same corporate pressure as the salesman. But that kid technician in the repair shop, whom nobody pays any attention to, will have some good smoke about the product's defects. There is something about being nailed to the wall that gives one a special insight. Note that the service guys have much to say, so much in fact, that many general managers refuse to permit the customers to talk to any one in the service shop. I recommend that my "customers" refuse to buy anything from companies who, in the past, have followed this policy.

Also, be sure that the problem is not in the peripherals connected to the digital device. My own personal microcomputer would *reset* every time I turned on the Teletype machine, or switched the function from *local* to *loop*. The problem turned out to be the interface between the computer and the teletypewriter. The +5 volts d.c. and the −12 volts d.c. used in the type of circuit that this manufacturer designed to supply the 20 mA current loop for the teletypewriter would throw a glitch into the d.c. supplies of the computers. The solution was to connect the teletypewriter to the computer through optoisolators and use separate d.c. power supplies for the 20 mA loop.

LC filters

One of the most common forms of equipment modification involves installation of an LC filter (Fig. 2) in the 115 volt a.c. power circuit. This is best done right at the cord entrance to the equipment so that reradiation will not occur. Several manufacturers offer balanced LC filters built right into a 115 volt a.c. chassis receptacle. These could be installed in place of the power receptacle already on the equipment. Alternatively, the filter should be installed in a location very close to the receptacle that already exists. It is my own opinion that the filter should be fused, in the event that the capacitors become shorted, you do not want an

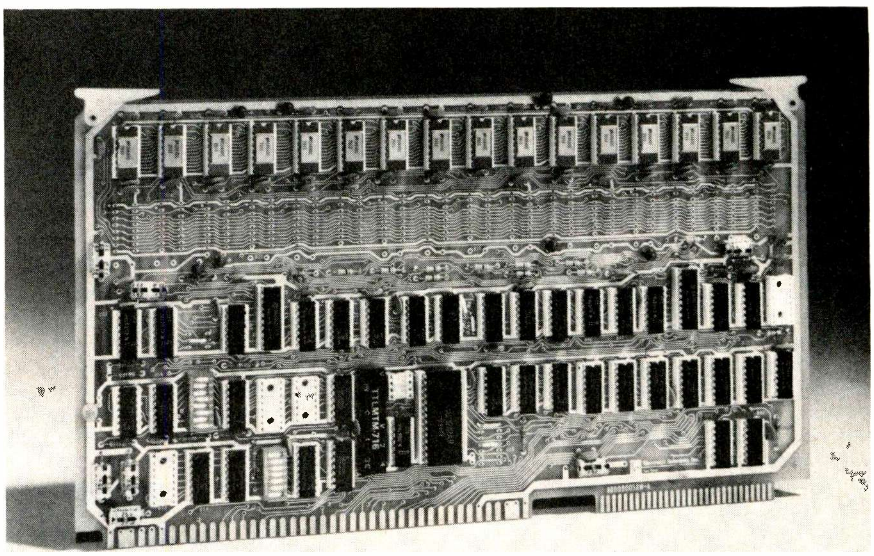
continued on page 46

Microprocessors part IV

The Architecture of the MPU

ET/D continues its series on the operating principals of the MPU. In this fourth installment the author discusses MPU interconnections, the arithmetic and logic unit, the control unit, and some of the registers

By Bernard B. Daien



Add on memory. Typical of the multitude of new hardware being developed in conjunction with today's MPU based home and small business computer systems is this board. It contains 32K of RAM for expanding a system's memory and computing capability. This board, from Electronic Solutions, is compatible with Intel's ISBC-80 Multibus and sells for about $1,000.

In the previous three parts of this MPU series we discussed the role of the MPU, how we can talk to it, and how the MPU receives the information we desire to impart to it. Now we will go on to the next step... how the MPU is able to respond to the instructions we give it. In order to do this, we must look a little closer at the "insides" of the MPU . . . the different sections that comprise the MPU and how they are interconnected. Two words are commonly used to describe these internals of the MPU, "architecture," or, "organization." They mean the same thing. Now we will proceed to look at some architecture (organization).

The bidirectional bus

Information is constantly being put into, taken out of, or transferred between the different sections of the MPU. This is accomplished by means of interconnections called "buses." As pointed out in the preceding article, data is moved around by means of the data bus, which consists of eight parallel lines which can handle an eight bit word in parallel format. Another bus handles memory addresses, and may be a 16 line, 16 bit bus. Commonly there is still another bus, usually less than 8 lines, which handles control signals only, and therefore does not need the capacity of even a one word byte.

Since the MPU is a large integrated circuit, all of the interconnections between the various internal sections are handled via internal buses. (Some of the bus connections are also brought out to terminal pins, so that we have external access to them.) In order to minimize the amount of the IC chip that must be used for the buses, MPUs employ what is known as a "bidirectional bus" system. This means that signals can move in either direction on a bus . . . sort of like using a single track to route trains back and forth in both directions, between the various stations.

As you will quickly perceive, only one train can use the track at a time, in order to avoid collisions. So it is with the bidirectional bus system . . . *only one device is permitted to send information at any given instant.* Several devices can "listen," i.e., *receive information,* from the bus at any instant, since they are not putting signals on the line which can interfere with each other. You should understand this point clearly.

The bidirectional bus is made possible by means of "three state logic" design. In the usual binary logic, there are only two possible states, a "one" or a "zero," as previously mentioned. A three state

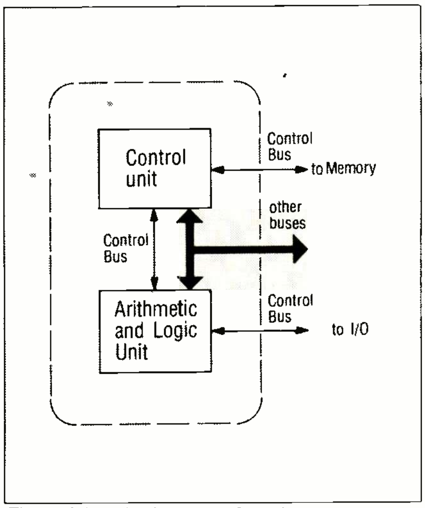


Fig. 1 A block diagram of a microprocessor, also called the Central Processing Unit, or CPU. The latter terms derives from the earlier days of computing when the CPU unit was made up of a series of descrete circuits.

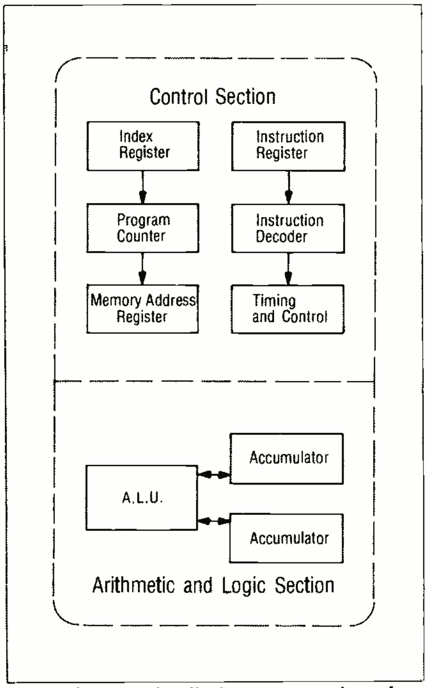


Fig. 2 A more detailed representation of an MPU's interior functions.

device has an extra input terminal, labeled "enable." Using this input terminal, we can apply a "control" signal which for all practical purposes, produces the effect of connecting, or disconnecting the logic device from the bidirectional bus.

Using the railroad as an analogy again, this is similar to shunting a train off the track onto a siding. Actually the train is still in the system, but it is non-existent as far as the main track is concerned. So it is with three state logic circuits. They appear to be out of the bus system when the control signal is in the "disable" mode, and are active in the bus system when the control signal is in the "enable" mode. Physically, the device is still connected, but electrically it has become a complete open circuit and therefore has no more effect on the bus than an open switch would.

Now, can you guess where the control signal comes from, that enables, or disables, the three state logic devices on the bus system? You guessed it . . . it comes from the control bus!

Let's review the last few paragraphs: The bus used in MPUs is a bidirectional bus, with signals flashing back and forth on the bus in both directions; and, only one signal can be on the bus at any time in order to prevent interference. This is accomplished by permitting only one device at a time to "send" (transmit) information, although several devices can be receiving information at any moment.

There are actually three separate bus systems in use in the MPU. The data bus handles data, an address bus handles addresses for the many different memory locations (and also the addresses of the various devices on the bus); and the control bus handles the enable signals for the three state logic used and for certain other uses.

Clocking

At this time you will better understand some of the functions of the "clock" mentioned in an earlier part of this series. If you think about it, the enable signals on the control line have to be timed, in a sequence. The clock pulses accomplish this timing (synchronizing) function. Each three state device is timed, in proper sequence, for a predetermined length of time, by . . . of course . . . the clock! This prevents overlapping of signals, and allocates a definite period of time to perform the required task. Without the clock, the MPU would be just as disordered as you would be, in performing your daily tasks, if you had no clock available.

Let's go further: if you think about it a bit more, you realize the desired logic circuit has to be enabled at the precise moment that the information it receives, sends, or stores, is present. There is no point in enabling a circuit if information isn't available at that instant. Since the clock controls the timing of all information movements, *it insures the proper coincidence in time,* of all three state circuits on the various buses.

Memories and registers

Now that we know how signals flow, via the buses, we can go on. You will recall that the source program is converted to an object program in binary. This binary program is then stored in some form of *external* (add-on) memory. Usually, with an MPU, a solid state IC is used as the memory, and information is stored in the form of 8 bit words. Each word in the memory has its own numbered location (addressing). Thus the program stored in the external memory can be quickly retrieved.

The amount of add-on memory that can be addressed is limited by the addressing capability of the MPU. (In the case of an MPU with a 16 bit addressing capability, the maximum number of addresses would be over 64,000 since 16 binary bits is a maximum of 65,536 different combinations.)

As the programmer feeds his instructions to the MPU, he assigns memory locations to each *in a sequence set forth by the program.* Later, when the program is executed, a register, the "program counter," comes into use. This is an *internal register* which stores the address *of the next instruction* to be read out of the external memory. As each instruction in the program is read out, in turn, this register indicates where to look for the next instruction in the sequence. For convenience, this register is abbreviated to "PC." Think of the program counter (PC) as a pointer, used much like the way you use your finger, moving down the lines of a printed page, in *sequence, keeping track of the next line you intend to read.*

It takes a small, but finite, time interval for the MPU to execute an instruction after it is retrieved from memory. During this time *the instruction must be held available until the execution is completed.* This is accomplished by storing the instruction, for the required interval of time, in an internal "instruction register." Remember, we previously noted that several registers are used, and that they are named for the use to which they are put. (Some registers are used for several different purposes, depending upon the architecture of the MPU.) The instruction register will be discussed again, later in this article.

So far we have been talking about instructions . . . but what about "data"? Obviously data must also be stored somewhere, until needed. Since data changes, as a result of computations . . . this ever changing data must also be stored. For example, if the numbers 5 (data), and 7 (data), are added (instruction), the result is 12 (data). *Data is stored in another register* . . . and this includes input data, intermediate data resulting from an instruction execution, and output data. *This register is called "the accumulator."*

Remembering that the MPU has

several registers, the usual use of the accumulator is that numbers in other registers are added to, or subtracted from, the number held in the accumulator . . . and the resulting number is then held in the accumulator during computations. This is true when relatively simple operations are performed, but in executing more complicated operations considerable amounts of intermediate data may be generated, and some of it may have to be stored externally in a "read/write memory." Such a memory is one that we can enter information into . . . read the information out of . . . erase stored information when desired . . . or write new information in when desired. Such memories are also called "random access memories," or "RAM" for short.

As noted above, external memory is often needed to supplement the accumulator when large amounts of data are generated. To minimize this, many MPUs contain several accumulators, enabling faster execution times, and reducing the need for external memory. MPUs often incorporate several registers labeled "general purpose," and these are frequently used as accumulators, as well as for other purposes. They greatly increase the flexibility of the MPU. Some literature refers to such general purpose registers as "scratch pad registers" . . . an apt name. Unfortunately this often leads to confusion in the minds of the student trying to comprehend the architecture of the MPU!

Remember, registers are named for the use to which they are put. If the use changes, the name of the register will change, too! Thus, one register may have different titles, depending upon the manufacturer, or the author of the article being read.

Time for review again. We can now perceive that information is put into some form of memory, and held there, until the moment it is needed. The program itself, which is often a long series of steps, must be held in memory, as it is entered step by step. In order to execute the operations called for in the program, we need many memory devices, called registers, which hold information for short periods of time, to enable the completion of each step in the program. We have looked at a few typical internal registers commonly used in MPUs, and we will look at the rest later. Perhaps this is the time to make a block diagram of the architecture of a typical MPU, showing the main parts. Figure 1 is such a diagram.

MPU versus CPU

Please take note of the fact that the Microprocessor Unit (MPU) is sometimes titled "Central Processing Unit" (CPU). This stems from the fact that in the days before integrated circuits, the functions now performed by the MPU in a computer, were then performed by several separate discrete circuits. Together these circuits were the Central Processing Unit. The CPU, reduced to a single integrated circuit, is today's MPU. This has led to a great deal of confusion for persons attempting self study of the MPU. Simply restated, the functions of the CPU and the MPU are the same. Only the method of construction differs.

As shown in Fig. 1, the MPU, or CPU if you wish, is composed of two main sections, a "Control Unit," and an "Arithmetic and Logic Unit." As shown by the signal flow arrows, signals flow back and forth between the Arithmetic and Logic Unit (ALU), and the Control Unit. In addition, signals flow into and out of the Control Unit and the ALU on the other lines shown, which represent the various buses. If we add some memory, and I/O device(s), we have a basic microcomputer. But, for the moment, let's examine the Control and ALU sections.

The control section

The control section fetches the *instructions* from memory, interprets them, and is instrumental in carrying out the instructions by sending the proper commands over the control bus, to the other circuitry of the computer. The instructions are executed *in the sequence in which they are numbered.* (A number is assigned to each instruction as it is entered by the programmer. The number assigned has nothing to do with the order in which instructions are entered . . . i.e., instruction 4 might be entered before instruction 2, but the instructions will be executed in accordance with *the numbers assigned to them.)*

The ALU section

The ALU, as its name implies, performs arithmetic operations (adding and subtracting), and digital logic operations. (For readers who have had previous digital exposure, we are referring to OR and AND gates, etc.) For readers with no digital knowledge, the words "digital logic" mean the electronic manipulation of binary signals necessary to achieve the desired result from the available input signals. The ALU section contains the various registers used for short term storage of *data* while operations are being executed. For all practical purposes, it can be stated that *data handling* is performed in the ALU section.

Back to the MPU (CPU)

Together, the Control and ALU sections comprise the MPU . . . and they work in a precisely coordinated way. Again, we need a word of explanation. The MPU is a one chip device. The ALU and control sections are convenient concepts, named for the functions they perform. Literature refers to them in this manner because of a hold-over from bygone days when the MPU was the CPU in computers made of circuit boards with discrete components.

Old ways die hard, often taking many years . . . but since so much of the current literature is influenced by terminology in older texts, and since so many people in the business had their education years ago, it is necessary to deal with the old terms and concepts. This is a major cause of confusion to the student attempting self-learning, and is one of the reasons for this series.

As a matter of fact, many common terms in electronics had new terms substituted for them when the "digital computer" people succeeded in establishing their own field of electronics. This is part of the ever present effort, in every field, to cloak the new with a "mystique," and thus discourage competition.

Early digital logic gates, for example, were nothing more than simple discrete transistors, used as switches, and could have been mastered by any technician working in electronics . , . but they were presented in such a fashion in the text books on the subject, that most techs were unable to comprehend the material, and were frightened off. As an example, the complexity, and variety of circuits in a color TV far exceeds the complexity and variety encountered in an MPU. MPUs do not deal with microvolt signal levels, or high voltage levels, etc., ad infinitum.

The fact is that this attempt to frighten off techs has been remarkably successful, with experienced techs afraid to get into MPUs, while, peculiarly, young students entering the field find no difficulty in comprehending them in school!

With the above in mind, we will go to Figure 2, which is a more detailed illustration of Figure 1, showing how some of the registers, etc., fit into the picture. Some of the labels are strange, but they will be explained as we go along, a bit later, in logical sequence. Of course, it must be understood that the architecture of the various makes of MPUs varies, but the same functions are accomplished by each, just as the various makes of color TV sets varied in the tube complement, type of sound detector, type of AGC, number of I.F. stages, etc. Yet all color TV sets accomplished the same functions, and an experienced technician was able to "follow through" the various circuits because of this. Figure 2 is a composite ...a non-existent "typical" MPU, drawn for model purposes only.

A few more details

It was mentioned earlier that the bidirectional bus was important to the operation of the MPU. A major reason for this is that the larger an integrated circuit is, the greater the probability of a defect occurring in the larger area encompassed. If unidirectional buses were used, there would have to be twice as many of them. Since interconnections have to be made to every section of the MPU, the buses would take up a great deal of chip area. Bidirectional buses take half as much space.

When we speak of memory addressing, we are talking about finding the location of a memory word (usually 8 bits), stored somewhere inside the memory. Visualize the Post Office box array in your local Post Office. Each box is numbered, in a logical order. So it is with RAM and ROM memories. A coded number is assigned to the location of each memory word, and that word can be located (addressed, accessed) by means of the location number assigned (in binary, of course!). The entering of information into a memory is termed "writing." Retrieving information is termed "reading."

Having picked up these details, we can go on to some of the strange boxes on the MPU in Figure 2. Since there are quite a few of these circuits, the ones not covered in this article will be discussed as we progress through this series, therefore it is advisable that you save these issues of ET/D so that you can later refer back to the earlier articles in the series.

At this point, however, the previous comment, that the amount of add on memory is limited by the addressing capability of the MPU, should have significance to you. If the address is a 16 bit address, we can address something over 65,000 locations . . . (usually a bit less, since some addresses are used for other things than memory). And, this is a good example of why you will want to refer back in the text at times.

More registers

We have already mentioned the program counter and the accumulator, so let's look at the "index register" now. The index register is used to modify the action of the program counter.

You will recall that the program counter points to the location of the next *instruction* to be executed, as the previous one is executed. Sometimes we may want to change the order in which instructions are executed, instead of progressing in a step-by-step sequence. The contents of the index register can be used to either add to, or subtract from (go forwards, or backwards) the address in the program counter. This gives us needed flexibility, so that we are not locked rigidly into sequence in our programming capability.

The "memory address register" is often not shown on MPU diagrams. It is abbreviated MAR, and usually crops up in that form, without a word of explanation! The MAR stores the

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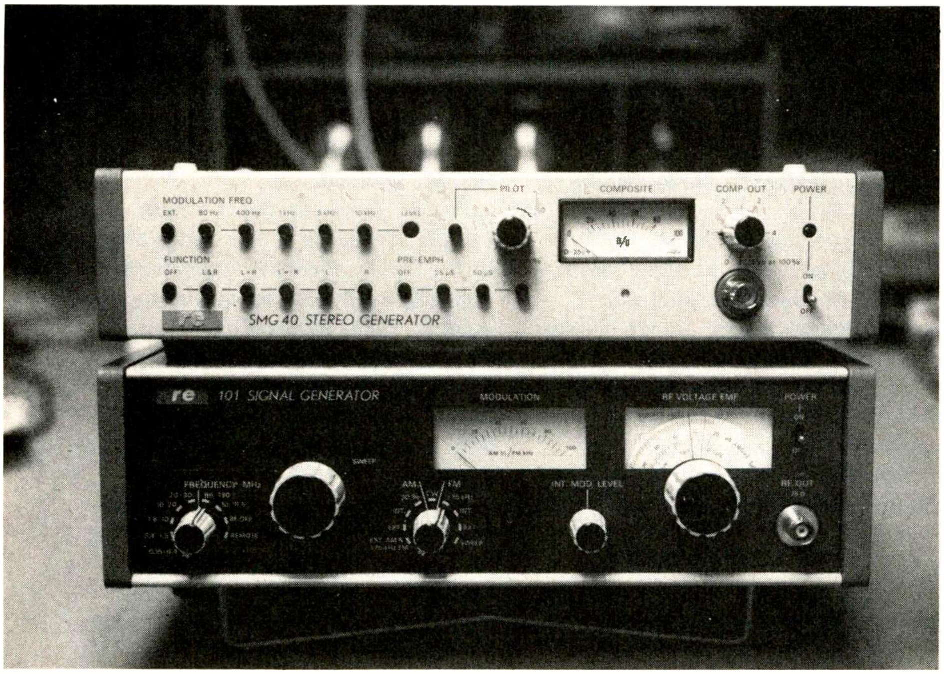
TEST INSTRUMENT REPORT

This month we review a complementary pair of expensive but superbly high quality instruments, Radiometer's RE101 signal generator and SMG40 stereo generator. Each can be used separately but they also stack together and interconnect to provide a complete radio frequency signal source for testing quality AM-FM stereo receivers.



For more information about this instrument, circle 150 on The Reader Service Card in this issue.

The Radiometer Signal Generator and SMG40 Stereo Generator

Quality, versatility

By Walter H. Schwartz

The RE101 generates its signals rather uniquely, at least compared to the usual service shop's lower priced instrument. The basic oscillator is voltage controlled and covers a frequency range of 86 to 130MHz tuned by a ten-turn potentiometer, connected through the range setting divider to a highly stabilized voltage supply.

This basic tuning range, of course, covers somewhat more than the FM broadcast band. The other tuning ranges are covered by hetrodyning this range against a 100MHz crystal oscillator signal, which after filtering produces a signal in the 0.15 to 30MHz range. This range is divided, by restricting the voltage range of the tuning potentiometer, into the six overlapping bands selected by the band switch. A five-digit frequency counter, through a prescaler, indicates the output frequency to 10kHz in the 86-130MHz range and to 1kHz in the 0.15-30MHz ranges.

Frequency accuracy is rated at ± 20 PPM ± 1 count and stability is stated to be better than ± 5kHz/15 min., ± 10kHz/3 hours and temperature stability is better than ± 5kHz/°C.

Amplitude modulation is available at a fixed 30% or a variable 0 to 90% at 400 or 1000Hz. Distortion, incidental FM and stability are all very good. FM from 0 to ± 100kHz and fixed at ± 75kHz at 400 or 1000Hz is also available. Again modulation characteristics are very good. Sweep of ± 10kHz at a 5Hz rate, in the range 0.15 to 30MHz, and ± 0.5MHz at a 50Hz rate in the 86 to 130MHz and 10 to 11.5MHz ranges is also available (with 5 or 50Hz output for an oscilloscope).

The output attenuator is a constant impedance (75 ohms) resistive type with a range of from one volt to one tenth micro volt. The attenuator is calibrated in both voltage and dB. Spurious outputs are very low but it is too involved to explain them all, along with the methods of measurement, here.

Physical construction of the RE101 is in keeping with its electronic characteristics. The RF circuitry is housed in compartments milled in a massive block of aluminum. Leads come and go via feed-thru capacitors and coaxial cables; individual sections are very well shielded.

The SMG40 Stereo Generator produces a high quality composite stereo signal (or variations thereon) for use in testing stereo demodulators or modulating signal generators such as the RE101. Composite output signals include: L=R (mono) L=−R (stereo), L (left channel), and R (right channel). The 19kHz pilot can be varied between 0 and 15%. Modulation frequencies available are 80, 400, 1000, 5000 and 10,000Hz at low distortion (0.07% at 80Hz, 0.025% at other frequencies.

The instruments are small; the two stacked measure 12 inches wide by 9 inches deep by about 7 inches high and are quite heavy, weighing a total of about 20 pounds. The cost of the two would be over $6300, definitely putting them out of the impulse buying class.

How do such sophisticated instruments work? Very well indeed! They met every specification we could verify. The frequency stability is good; it seems to be two or three times better than specified, for our tested unit. The attenuator will drop the output below audibility in the receivers we checked; we cannot, unfortunately, measure the actual output down this far, nor can we measure the various modulation distortion products properly since they are of such a low level. As far as we can check them we have no reason to doubt the manufacturer's specifications.

Therefore—if you do performance verification work on quality FM stereo receivers the RE101/SMG40 pair will not only meet your requirements but will add a 0.15 to 30MHz capability. ET/D

NEW PRODUCTS

Accurate DMM

Circle No. 130 on Reader Inquiry Card

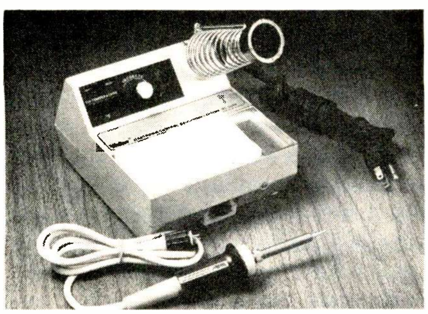
Kontron's new DMM3020 and DMM4021 feature built in calibrators with specified long term accuracy and stability sufficient to permit user recalibration of the instrument. The calibrators only need to be checked against external standards at five and ten-year intervals for the 4021 and 3020 respectively, as the anticipated reference change is 0.0008% per month,maximum, on the basis of five hours operation per day.

The DMM3020 is a 3½ digit instrument of 0.1% basic accuracy; the 4021 is a 4½ digit unit of 0.05% basic accuracy. The prices are $225 and $325 respectively.

Soldering Station

Circle No. 131 on Reader Inquiry Card

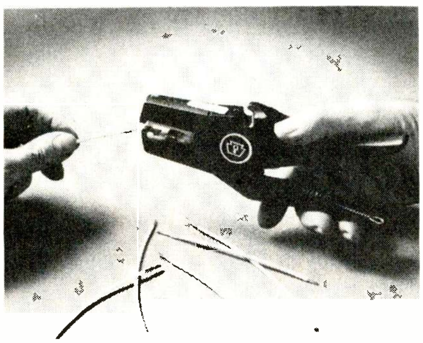
Weller has a new electronically controlled soldering station reportedly capable of maintaining a constant pre-set tip temperature, with settings and readings shown on an LED digital display. The EC2000 unit, with variable temperature settings from 350 degrees to 850 degrees F, features a platinum sensor inside the iron's tip providing immediate reaction to change of temperature. The interference-free design further eliminates variations due to line voltage, voltage spikes, line noise, and is stated to create no line noise. Nine different tip styles are available, interchangeable without recalibration. A dial controlled ECI000 is identical to the EC2000 in all specifications except the LED readout.



One Step Wire Stripper

Circle No. 132 on Reader Inquiry Card

A new, pocket size hand tool that reportedly provides one-step stripping of nearly any type of wire from 30 to 12 AGW has been introduced by *Hollingsworth Solderless Terminal Co.* The H-70 Wire Stripper has a built-in sensor which automatically adjusts to accommodate solid or standard wire and multiple cable. Its stainless steel blades, reportedly good for 100,000 or more strips, will handle as many as six conductors simultaneously in bonded or molded cables. Since the H-70 stripper feeds from the front, it is suited for reaching wire or cable in tight places. Another feature is the built-in cutter which eliminates the need for a separate wire cutting tool. A switch on top of the tool's upper jaw is used to adjust the stripper for thick, normal or thin insulations. This adjustment can remain in the "normal" position for about 90% of wires to be stripped. Stripping length also is adjustable. Both the wire stop and stripping blades are replaceable.



Topical Antistatic

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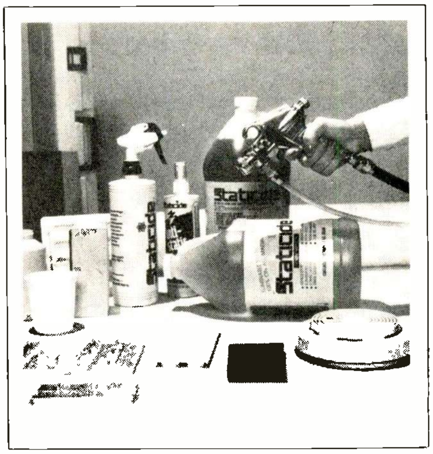
A new safe and long-lasting antistatic that eliminates static effectively from any material and can be easily applied to industrial production environments, computer rooms, conveyor belts, floors, and electronic components and instruments, lenses, PC boards and packaging by wiping, dipping, spraying or roller coating, is being marketed by the Industrial Staticide Products Division, *Analytical Chemical Laboratories.*

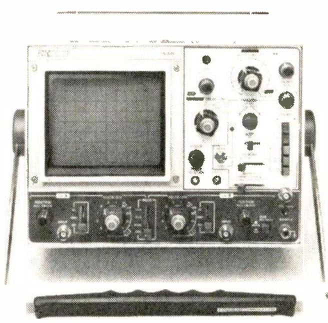
This formulation eliminates shocks and involuntary manufacturing operator reactions that cause accidents. It can prevent the ignition of combustible materials, dust, vapor or solvents due to static sparks. It also prevents assembly or manufacturing operations from shutdown that can be caused by static pre-triggered electronics or jamming caused by static holding of materials.



The ACL topical antistatic reportedly is effective without the need for costly hardware, grounded assembly tables, assembler's wrist bracelets, metallic storage bags and other devices that attempt to eliminate the static charges present but not the cause.

The ACL "Staticide" is stated to be totally non-toxic, non-flammable, and biodegradable and effective on materials found and used in electronics and industrial environments such as plastics, films, metals, textiles, wood, fiberglas, rubber, paper, clothing, carpeting, glass and composition materials.

Typically, a trial gallon of ACL's "Staticide" is priced at $5.95.



30MHz Oscilloscope

Circle No. 134 on Reader Inquiry Card

B&K-Precision has recently introduced a new 30MHz oscilloscope with delayed sweep, which reportedly allows waveforms with repetition rates of up to 25kHz to be expanded as much as 1000 times; expansion at 30MHz is a minimum of five times. Using both channels A and B, the signal to be expanded can be viewed on A and the delayed portion can be viewed on B. The Model 1530 also offers variable sweep hold-off, all the usual features of a dual trace instrument and a variety of trigger source capabilities. The price of the 1530 is $1340. ET/D

VCR'S

continued from page 23

simple—a good tape just won't play back correctly, if at all. Something as simple as a loose drive belt can prevent the servo from locking onto the control track pulse. Even something as remote as static on the drive belts can hamper perfect video reproduction. In some ways, the servo system is probably the most complex block of the VCR. At first glance it appears to be a mad designer's nightmare. But with a thorough understanding of the basic operational principles given here, the experience of finding servo problems, and several trips through the servo information of the service manuals, you'll awaken from the nightmare.

Power problems

Power supply problems frequently appear as no control lights, dim or flickering control lights, lack of tape movement, failure to load a cassette, no video or audio, and lack of head drum rotation. Checking for power supply faults isn't hard. Besides doing the usual checks (i.e. visually checking for blown fuses, burnt wiring, etc.) a general purpose oscilloscope is an excellent tool for troubleshooting power supplies. The general purpose oscilloscope can be used to do such things as meter the incoming line voltage or to locate power supply transformer problems.

In this article we have concentrated primarily on servo mechanism operation, traditionally one of the least understood, yet most troublesome, of all the sections of any VCR. In our next article we will dig into the function and operation of the luminance and chroma blocks. ET/D

DIGITAL SOUND

continued from page 26

the AM stereo broadcasters. AM stereo could be killed before it ever really gets started, if the dealers are foolish enough to stock, and sell, junk. It is up to the shop owners to educate the public to the fact that stereo AM will cost the same price as a good stereo FM receiver, if the results are to be comparable. Fortunately, the owner of a good

component stereo system can save a lot of bucks by buying a stereo AM tuner and feeding it into one of the auxiliary input jacks on his system. That will serve as a good interim fix, until the integrated systems appear, and are purchased, by new buyers.

Summary

This article presented a view of what is happening now, and what is about to happen in the near future, in the "new sound." The various technical, business, and human implications have been spelled out for the technician, and shop owner. Hopefully, this will aid you in determining where you fit into the picture, what you will need to do to fit into the new sound market, and in planning a personal strategy for what you want to accomplish in this new field. **ET/D**

IEEE

continued from page 29

technicians was made. Sarkes Tarzian was given the 1979 Consumer Electronics Award for his broad contributions to the industry. Sarkes Tarzian, after being chief engineer for Atwater Kent and chief engineer, RCA Argentina, and chief engineer, RCA Proximity Fuse operations during World War II, organized his own company in 1946. Since then he has designed and manufactured, among other products, vast quantities of selenium rectifiers and television tuners which have been used in over 50 million TV receivers worldwide. **ET/D**

GLITCH WITCH

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unprotected short across the a.c. power line.

The other way to eliminate the problem is place a transient suppression device, such as the General Electric MOV, across the power line. The MOV is a varistor-like device that remains inert in the presence of ordinary 115 volt a.c., but will develop a very low resistance to a high voltage transient. This causes it to shunt the transient between the lines, but a.c. flows in the ordinary manner. The G.E. MOV is actually one of a family of devices, and it is wise to read the applications literature in order to select one for any given application.

There are also a number of similar-acting devices that operate on different principles. Some, for example, are high power Zener diodes that have a V_Z value of greater than 200 volts. The a.c. power line potential will not cause them to break over, but transients will. Others are selenium stacks.

A method that is not used quite as often is the use of RC "snubber" networks. These act to reduce the a.c. potential, however, so their use is limited to other types of lines entering the cabinet (that could also admit transient signals picked up by capacitive or inductive coupling).

Of these methods, I tend to prefer the use of a line conditioner isolation transformer (ala Topaz and Sola), as the least effort with the greatest likelihood of success. The use of transient suppressors, LC filters, or snubbers could, conceivably, void your customer's warranty. So it is advisable that you contact the maker of the equipment prior to modification if the equipment is still in warranty. **ET/D**

MICRO-PROCESSORS

continued from page 41

which can be *either data, or an instruction*. If an instruction location is involved the MAR gets its input from the program counter, but if a data location is addressed, the MAR gets input from the memory.

The "instruction register" is used to store instruction words, the way an accumulator stores data words. When an instruction word is retrieved from memory, it is temporarily stored in the instruction register, until it is decoded and the operation indicated is performed. The instruction word held in the instruction register is decoded by the circuitry labeled "instruction decoder." The word decode as used here means the conversion of the binary data in the instruction word, to a series of operations, in accordance with the intended instruction that was coded (in binary) into that instruction word.

Summary

This article in the series introduced MPU architecture, including the use of tristate devices and the bidirectional bus system. The need for clocking was covered. The program counter, instruction register, accumulator, CPU, ALU, control section, index register, memory address register, and instruction register were defined. The words "addressing" and "decoding", as used in MPU terminology, were explained. Additional background material relating to the MPU was provided. **ET/D**

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For Sale. 19" Admiral B/W television sets. Model 19B890K. Purchased 1978; unboxed; never been used. $115 each. 47 sets available. Hurry while supply lasts. Sun Country Rental, 1473 Lee Trevino, El Paso, TX 79935.

CATALOG OF ELECTRONIC PLANS. Preamps, speakers, crossovers, transmitters, linears, and more. Send $1.00 to: Peter-Schmitt Enterprises, Dept. ED, P.O. Box 07071, Milwaukee, WI 53207 3/80

Save Hundreds: American Made quality Head-Ends, V/V, U/V Converters, Camera Modulators. Factory Prices. Send $5.00 (or letterhead). Dept R, Box 809, Boynton Beach, FL 33435. 12/80

TV AND RADIO TUBES 49¢ EA!! Send for free color parts catalog. Your order free if not shipped in 24 hours. Cornell Electronics 4215-17 University San Diego California 92105 TF

WANTED

CASH for used Sams, 900 and later series. We'll pay $1.00 and shipping, for complete TV folders, CB and MHF manuals, in good condition. Contact Stellar Industries, SR70830, Fairbanks, Alaska 99701.

Wanted for Cash: 53, 7N7, 7F7, 6L6 metal, 6AF6, 6HU8, 304TL, all transmitting and special purpose tubes. DCO Inc., 10 Schuyler Avenue, North Arlington, N.J. 07032, Toll Free (800) 526-1270. 3/80

TUNER SERVICE serving over 400 dealers in the Chicago area wants additional lines. Write or call: Economy Tuner Service., 4901 N. Elston, Chicago, IL 60630. Phone 312-282-3939. 4/80

WANTED: 16 VATP22 Pix tubes-new, rebuilt or duds. Contact Greg Small, SwedishAmerican Hospital, 1400 Charles Street, Rockford, IL 61101 2-80

HELP WANTED

Help Wanted: TV Technician/Service Manager. Experienced-Good Salary-Paid Vacations. Fringe Benefits-Excellent Opportunity for secure future-Start March 1980. Delman TV, 651 E. Park Ave., Long Beach, NY 11561, 516-432-7373. 2/80

T.V. Technician-sharp, management capable. Relocate to suburb of San Francisco in sunny California. Excellent opportunity for ambitious, self confident person. Send resume to American T.V., 3309 Vincent Dr. Pleasant Hill, CA 94523.

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

We need both tuner and module technicians for our expanding operation. Top pay for first class technicians. Call toll free 1-800-433-7124 or 1-800-772-7411.

BUSINESS OPPORTUNITIES

ORLANDO Complete inventory including Van of well established 17 year old T.V. sales and service business. Gross $51,000, Net approx. $28.000. Owner retiring. Real opportunity. Price $32,000. Contact Fireside Realty Inc., 172 Oxford Road, Fern Park, Florida 32730 Phone 305-834-5600. 2/80

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

Sunny Arizona-Sell business and property, zoned C-3. Apt. in rear. Same location 15 years. Zenith, Sylvania sales and service. Fast growing E. Mesa. Phone 986-0126—E. Ray Curl, 959 N. Ellsworth, Mesa AZ 85207 2-80

ST. PETERSBURG, FLA: T.V. Sales and Service attached to modern 2 bedroom home. Separate rental house. Includes inventory, equipment, truck and furniture. Newly remodeled. Excellent area for home and business. $140,000. Phone owner 1-813-541-2039. TF

BROADCAST STATION. Start your own any type! Unique Cable FM station operation-investments/experience unnecessary! Receive free tapes, records. Get your FCC license! Much more. Free details. "Broadcasting:", Box 180 ET2, Paradise, CA 95969

ALARM SYSTEMS

POLICE DIALER $29.95. **FREE** burglar alarm equipment **CATALOG. SASCO,** 5619 E. St. John, Kansas City, MO 64123. (816)483-4612.

FOR RENT

TV RENTAL SYSTEMS! COMPLETE & GUARANTEED. MANUAL OR COMPUTERIZED, SEND $2.00 FOR COMPLETE DETAILS. PERRY'S RENTAL SYSTEMS, BOX 1407, SANTA MARIA, CA 93456 TF

AD INDEX

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

This is an offer you shouldn't resist. To introduce you to the new family of oscilloscopes from B&K-PRECISION, we'll let you "live with" one for up to 10 days, free! We're confident that after trying any one of our new scopes, you'll want to keep it for a lot longer. Of course, there's no obligation.

Leading off our 1400 series scopes is the new 1479, 30MHz dual-trace triggered scope. It's ready to challenge your testing needs with 5 mV/cm vertical sensitivity, 11.7 nS rise time, 50MHz triggering and built in high- and low-pass filters. A signal-delay line is built in to permit view of the leading edge of high frequency pulses. The 1479 also provides differential input capability and algebraic addition and subtraction of input signals.

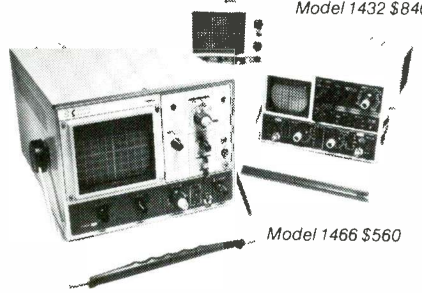
For those requiring only a 15MHz dual-trace scope, the 1477 is an outstanding solution. Having many of the features of the 1479, the 1477 also offers a standard video sync separator for use with video systems or computer terminals. If battery portability is essential, the B&K-PRECISION 15MHz 1432 is a field-proven workhorse. It's a full-featured 3", dual-trace scope with an optional battery pack. For a 10MHz response, choose either the dual-trace 1476 or the single-trace 1466. With video sync separators and vectorscope capability, both are standouts. For basic monitoring applications, the low cost 3" 1405 is the best answer.

Common features of all 5" 1400 series scopes include Z-axis inputs, plug-in PC board construction, scope camera-compatible CRT bezels, triggered sweep, excellent high- and low-voltage power supply regulation, built in calibration signals and cool, energy-efficient operation. The 1466 draws 20 watts; the 1479 draws only 25 watts.

For immediate delivery on the scope of your choice or for additional information, contact your local B&K-PRECISION distributor.

Model 1405 $280

Model 1432 $840



Model 1466 $560

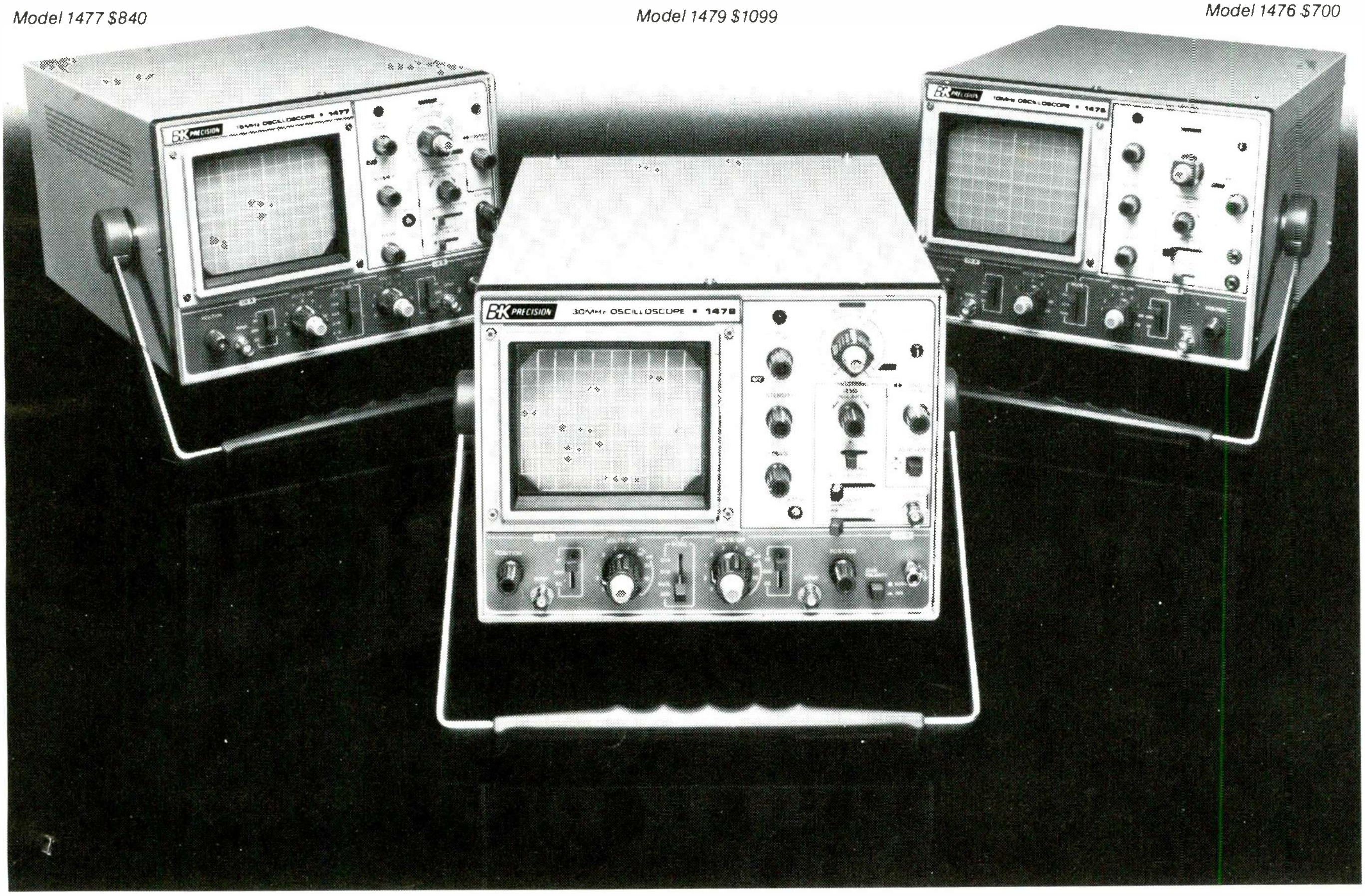
B+K PRECISION **DYNASCAN CORPORATION**

6460 W. Cortland Street • Chicago, IL 60635 • 312/889-9087

In Canada Atlas Electronics Ontario International Sales Empire Exporters Inc. 270 Newtown Road, Plainview, L.I., N.Y. 11803

Before you look at another scope, try one of these free for 10 days!

Model 1477 $840 *Model 1479 $1099* *Model 1476 $700*



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The portable Model 603 FET VOM with swivel carrying handle has such features as:

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3. FET V-O-M WITH AUTO-POLARITY—convenient and time saving, always reads up scale.

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

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