ET/D

APRIL 1980 • $1.50

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS

Microprocessors part VI
Yamaha's T-2 tuner
Teletext, it's on the way
ATC circuits

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION

DON'T MISS THE BOAT

PTS 1980 SWEEPSTAKES

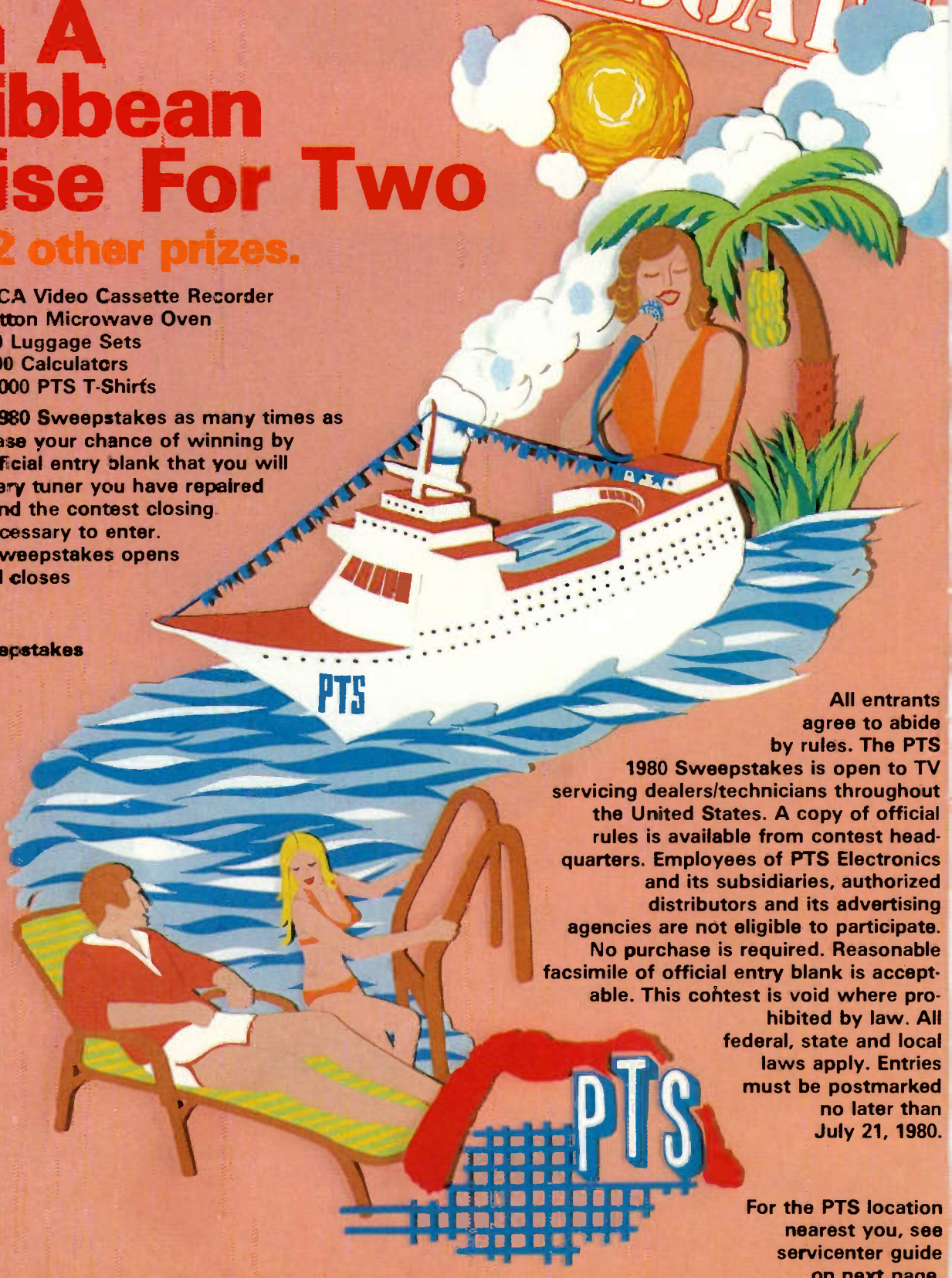
Win A Caribbean Cruise For Two

or 1,152 other prizes.

Second Prize: RCA Video Cassette Recorder
Third Prize: Litton Microwave Oven
Fourth Prize: 50 Luggage Sets
Fifth Prize: 100 Calculators
Sixth Prize: 1,000 PTS T-Shirts

Enter the PTS 1980 Sweepstakes as many times as you wish. Increase your chance of winning by returning the official entry blank that you will receive with every tuner you have repaired between now and the contest closing.
No purchase necessary to enter.
The PTS 1980 Sweepstakes opens May 1, 1980 and closes July 21, 1980.
Mail entries to:

PTS Tuner Sweepstakes
P.O. Box 489
Brazil, IN 47834



All entrants agree to abide by rules. The PTS 1980 Sweepstakes is open to TV servicing dealers/technicians throughout the United States. A copy of official rules is available from contest headquarters. Employees of PTS Electronics and its subsidiaries, authorized distributors and its advertising agencies are not eligible to participate. No purchase is required. Reasonable facsimile of official entry blank is acceptable. This contest is void where prohibited by law. All federal, state and local laws apply. Entries must be postmarked no later than July 21, 1980.

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

INDUSTRY REPORT

ARRL National Convention

The 26th national convention of the American Radio Relay League will be held in Seattle, July 25-27, 1980. The theme of the convention is "World Friendship Through Amateur Radio" and will feature speakers, seminars and manufacturers exhibits.

Information is available from: 1980 ARRL National Convention Committee, P.O. Box 68534, Seattle, WA 98168.

Magnavision Available in Five More Cities

Magnavision, the home video disc player system introduced by Magnavox, has announced its laser scan, no wear, disc system is now being sold in five new metropolitan areas in the United States.

In addition to Dallas, Atlanta, and Seattle where it has been available, the units are now being sold in Pittsburgh, Minneapolis, Buffalo, Cleveland and Phoenix.

Magnavision, first introduced in December of 1978, will be available in every major marketing area in the U.S. by the end of the year, according to a company spokesman. These marketing areas are said to cover 65 per cent of the nation's television households.

Future Office Workers: Will They Work at Home?

Employees in some fields may be doing their office jobs at computer terminals in their own homes by as early as 1985 and busy executives—who now spend half their time in airports—could be holding international conferences via satellite without leaving their desks.

At least those are some of the predictions that have come out of a survey undertaken by the International Information Technology Institute (IITI). The survey, gathered from information supplied by 400 designers and manufacturers of computer and office equipment says that as early as 1983 there will be major changes in office systems. These changes, it was stated, will significantly impact both worker productivity and energy usage. "Medium and large corporations would have electronic information networks, using space satellites, to interconnect computer and word processing systems at local plants and offices...the end result would be that the majority of business communications would be sent by electronic means rather than by mail," according to the survey.

Additionally, the "new" technology will have major impact on banking. Most transactions will take place by electronic—rather than human/teller—means. "Business banking transactions will be effected through electronic funds transfer systems rather than using paper documents such as checks and letters of credit," the survey results said.

Perhaps the least surprising survey result is the one which contends that sometime between 1990 and 2015, the computer industry will become the world's largest in terms of revenue.

"Every year the number of businesses making use of computer technology is snowballing and as early as 1985," the survey reports, "businesses would be able to provide, as normal procedure, terminals for access to data and word processing systems serving those employees who want to work at home or a neighborhood center rather than a centralized office building."

This augurs well for energy efficiency perhaps, but what about the good old reliable secretary? "The personal secretary, so indispensable today, will be on the way to being replaced by a desk top computer," That's according to the survey too!

Edwin Armstrong Elected to Hall of Fame

The late Edwin Howard Armstrong, considered to be the inventor of FM radio, has been elected to the National Inventors Hall of Fame. Armstrong, who died in 1954, was a Columbia University professor for 20 years.

Since his death, Armstrong has been ranked as "the U.S.'s greatest inventor since Edison and one of the last of the free-lance attic tinkerers." At induction ceremonies last February in Arlington, Va., he was cited by Charles F. Schroeder, president of the Hall of Fame, for his invention during World War I of the superheterodyne receiver. This accomplishment paved the way for the breakthrough of FM radio.

According to W. Stevenson Bacon, an officer of the Armstrong Memorial Research Foundation, the superheterodyne circuit is "by the most important and classic of Armstrong's inventions. Today it is still the basis of all electronics communication, from radio and television to long-range radar and satellite telecommunication," he said.

RCA to Lease AT&T Satellite

RCA, which lost its $77 million SatCom III satellite in space last December, plans to lease AT&T facilities in order to expand satellite broadcast services to some 10 cable TV companies.

According to an RCA statement, the corporation plans to use as many as 11 transponders on Comstar D2 at a cost of $770,000 per year with extensions possible through 1981. Although the plan will allow RCA to make up much of the lost business it expected from SatCom III, it will not be a complete solution since

ET/D

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS

APRIL 1980, VOL. 102 NO. 4

On **the cover:** The screen of this TV receiver shows a short index of the sort of information available through Info-Text℠ (Teletext). A conventional television receiver and a special decoder comprise the system. (courtesy Micro TV, Inc.)

FEATURES

DEPARTMENTS

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION ABP ABC EIA

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

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

Here's Proof! SAVE UP TO 40% ON 10 OR MORE OF THE SAME ITEM!

ECG is a registered trademark of GTE Sylvania.

EQUIV.		EQUIV.		EQUIV.		EQUIV.		EQUIV.		EQUIV.		EQUIV.		EQUIV.		EQUIV.		EQUIV.	
102A	.40	135A	.40	171	2.25	231	4.90	298	1.10	381	3.10	720	1.50	791	2.80	975	1.60	1036	3.20
103A	.80	136A	.40	176	1.30	233	.80	299	.75	382	1.00	721	3.80	793	3.20	978	1.60	1037	3.00
104	2.00	137A	.40	176	1.10	234	.40	300	.70	383	1.10	722	1.50	801	2.00	987	1.40	1040	1.40
105	3.90	138A	.40	177	.25	235	1.60	302	1.30	390	1.10	723	1.50	802	8.80	990	4.80	1041	1.20
106	.40	139A	.40	180	4.60	236	1.80	306	1.30	391	1.10	724	2.80	803	8.80	992	1.80	1042	2.40
107	.80	140A	.40	181	3.40	237	2.40	307	.50	500A	12.40	725	1.50	804	2.90	1002	1.20	1043	3.90
108	1.20	142A	.40	182	3.20	238	3.35	308	7.40	506	1.50	726	3.50	805	3.20	1003	1.20	1045	2.60
109	.20	143A	.40	183	3.75	276	7.90	310	7.40	523	18.80	728	3.80	806	3.80	1004	2.40	1046	3.20
110	.40	144A	.40	184	1.30	277	7.80	312	.60	525	1.35	729	4.20	807	3.20	1006	2.20	1049	3.90
113	.55	145A	.40	185	.90	279	7.40	313	.80	526A	18.80	731	1.50	814	4.00	1009	2.20	1050	2.00
116	.20	152	1.30	186A	.60	280	3.40	315	1.00	551	2.00	737	3.80	815	3.80	1010	2.20	1051	5.90
117	.20	153	.90	187A	.80	281	4.60	320	10.60	601	.30	738	4.80	818	3.80	1011	2.25	1052	1.00
118	.90	155	2.90	190	1.80	282	2.00	321	3.60	605	1.65	739	3.20	823	1.20	1014	1.90	1053	2.70
121	2.75	156	.60	192	.45	283	4.60	323	2.20	612	.35	740A	2.60	824	2.50	1016	2.20	1054	1.70
123A	.35	157	1.50	193	.55	284	4.30	324	2.50	613	.40	742	4.20	904	6.90	1019	1.20	1055	2.70
124	2.00	158	.40	195A	2.00	285	6.20	325	29.20	703A	1.50	743	3.80	905	4.50	1020	2.20	1056	2.80
125	.20	159	1.10	196	1.30	287	.70	333	19.00	708	1.50	744	5.20	912	2.40	1021	2.20	1057	3.10
126	.80	160	1.80	197	1.50	289	.60	334	19.00	709	1.50	746	3.80	917	3.20	1024	4.20	1058	1.95
127	2.95	161	1.20	198	1.50	290	.60	335	26.00	710	3.00	748	2.80	923	1.30	1025	5.90		
128	1.40	162	4.60	199	.60	291	1.30	336	26.00	712	2.25	749	2.90	925	7.80	1027	4.90	Many more items to choose from but space does not permit listing them all.	
129	1.20	163A	4.60	220	1.60	292	1.50	373	2.50	713	1.50	778A	1.80	941M	.90	1028	10.40		
130	1.30	165	3.35	221	1.40	293	1.00	374	2.60	714	2.80	780	3.20	955M	1.40	1029	2.60		
131	1.00	166	1.45	222	1.60	294	1.10	375	1.50	715	3.20	783	2.60	966	1.30	1030	3.60		
132	.60	167	1.45	229	.80	295	.60	376	2.25	718	1.50	788	1.50	973	1.80	1032	2.90		
133	.60	168	1.45	230	4.60	297	1.00	380	3.00	719	1.50	790	2.80	973D	2.00	1035	4.60		

Special

Equivalent to ECG 163A

$3.90 Horizontal Deflection TO-3 CASE

Equivalent to ECG 165

$2.40 Horizontal Deflection TO-3 CASE

Equivalent to ECG 238

$2.45 Horizontal Output TO-3 CASE

mcm audio, inc.

Parts for the TV, Stereo & Communications World

639 Watervliet Avenue, Dayton, Ohio 45420

Call This Toll-Free 24 Hour Hot Line

1-800-543-3528

Ohio Watts 1-800-762-3418

ALL ORDERS SENT U.P.S. WITHIN 24 HOURS.

Circle No. 114 on Reader Inquiry Card

use of AT&T's satellite will necessitate a realignment of earth stations because of its different location in the sky.

Eventually, RCA plans — apparently next year—to launch another SatCom III satellite. This launching scheduled tentatively for June will come only four months before the scheduled launch of SatCom IV.

Chicago to Get Pay TV Soon

The nation's three largest population centers—New York, Los Angeles, and Chicago — will be covered by at least one pay TV outlet each if plans to begin service in Chicago sometime this summer materialize.

According to a spokesman for Chicago's Channel 44, which currently ties up much of its evening schedule with religious programming, the plans call for initiation of a nighttime pay operation between the hours of 7 p.m. and 1 a.m. The move, which just gained FCC approval, means Chicagoans will have available for the first time on pay TV uninterrupted viewing of new movies, nightclub performances, concerts, and some sports.

A spokesman for Channel 44 said it is estimated about 200,000 Chicago area homes would be signed up for the pay operation within a year. Currently similar stations have proved to be extremely popular in New York and Los Angeles. The Los Angeles operation boosts a subscriber list of 300,000 homes.

Two-way Technicians Needed

The growth of two-way radio in the United States has created an annual need for 4,000 new electronic technicians, according to a General Electric Company spokesman.

Speaking to the Texas Junior College Teachers Association in Austin, Tex., GE's manager of technical training for mobile Communications—A. K. Guthrie —said the radio communications industry currently has 40,000 technicians. Twenth-thousand of these, he said, sell two-way radio service nationally and another 20,000 work for government agencies, utilities, railroads and telephone companies.

Matsushita Formally Picks Video Disc System

Matsushita Electric, the Japanese electronic giant and father of Panasonic, Quasar and National, has officially jumped into the emerging video disc market with the surprise announcement it is backing JVC's capacitance pickup videodisc system.

The announcement—a surprise because it had been working on developing its own video disc system—leaves the infant market in an even more confused state than ever. Matsushita, obviously a tremendous political force in the electronics world by nature of its very size alone, said it would seek to have its approach made the standard for Japan.

Matshushita's announcement means three contenders are in the ring for the consumer's video disc dollars. Philips-MCA—the first—has its grooveless laser/capacitance pickup systems; RCA will be marketing its stylus pickup system (with grooved record) in 1981; and now Matsushita, with a system that is said to feature a grooveless disc similar to Philips-MCA.

One major source into the U.S. marketplace for Matshushita could be Zenith which up to now has shown little interest. However, that stance is apparently about to change. That would leave Zenith with the choice between the Philips laser beam system, Matshushita, or the system developed by arch rival RCA.

Sylvania Announces Lifetime Tube Warranty

GTE Sylvania has announced a new lifetime warranty policy for replacement color television picture tubes. The policy, which became effective at the first of the year, covers all Sylvania Color Bright and all new tubes.

According to Sylvania, the tubes offered with the lifelong warranty are fifteen types which can be used to replace more than 440 of the most popular types. The policy warrants the tube for as long as the buyer owns the television set in which it was installed and only labor and other costs associated with tube installation are not included.

Electronics Exec Warns of Microprocessor Backlash

An electronics industry executive has warned that unless support instrumentation in the service field keeps pace with advances in technology, the introduction of the microprocessor could cause as many problems as it solves.

Jerry Casilli, president of Millennium Systems, told a recent meeting of the American Electronics Association that introducing micros into such booming areas as automotive controls would, unless properly supported, result in "aftershock" that will slow the growth of these "wonder chips."

The industry, he said, must be willing and able to deal with the resulting development, test, and service problems that will result and this will take new and innovative test equipment. ET/D

CORRECTION

A line of copy was accidentally dropped from the article, Microprocessors—Part IV, February 1980 ET/D—in the "jump" from page 41 to page 46. It should read:

"The MAR stores the *address word* of a memory location, which can be *either data, or an instruction.*"

The Editor

ET/D

Richard W. Lay, *Editor (Chicago)*

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

Dave Neiman, *Associate Publisher (Chicago)*

Tom Greney, *Group Vice President (Chicago)*

John Paszak, *Graphic Design*

Kathy Tarnowski, *Production Manager*

Debi Harmer, *Production Supervisor*

Lillie Pearson, *Circulation Supervisor*

Gene Bailey, *Reader Service*

Julie Laitin, *Promotion Director*

Dawn Anderson, *Classified Ad Mgr.*

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

ADVERTISING SALES

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

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

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

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

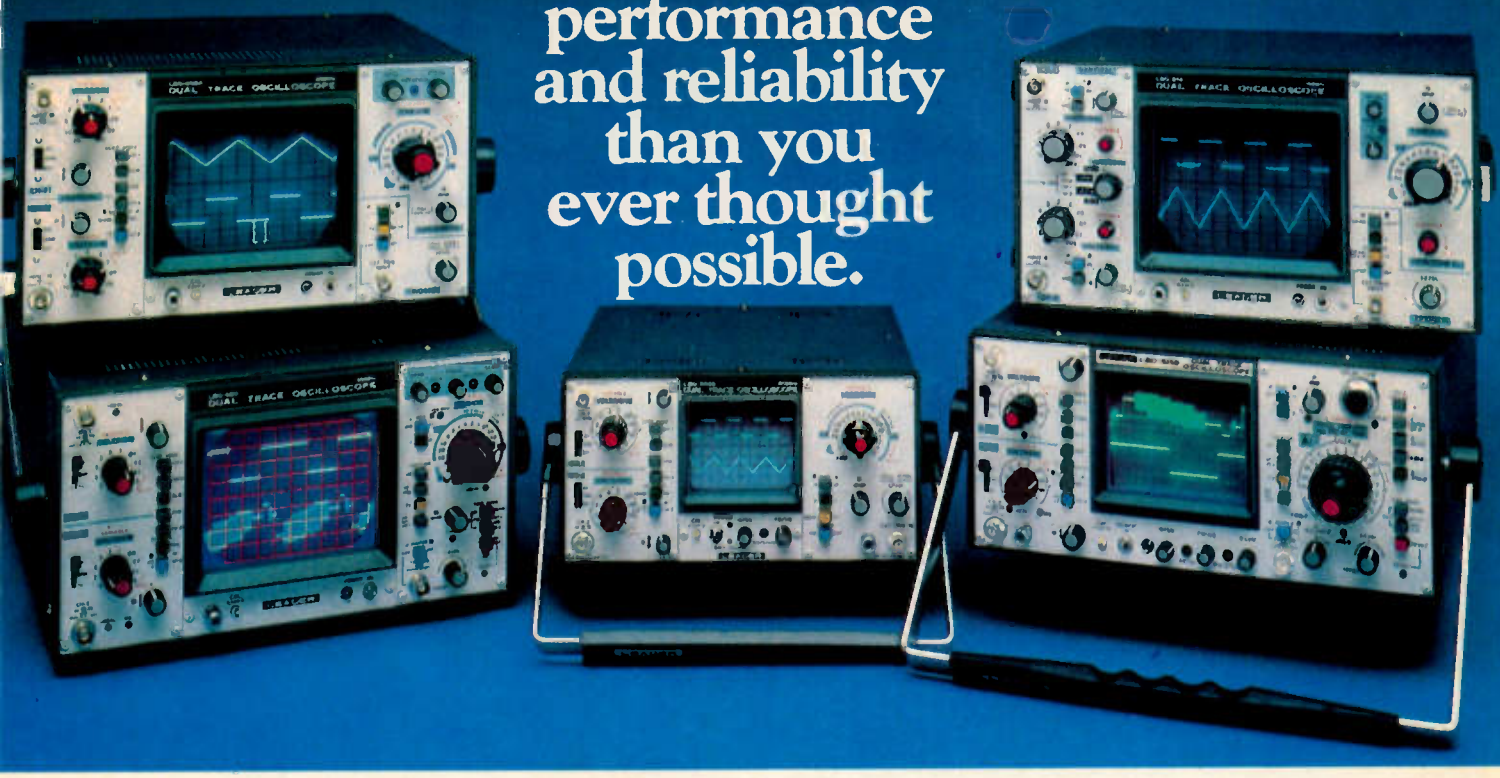
Sheila Connolly
10741 Moorpark St.,Suite #21
North Hollywood, CA 91602
(213) 980-7750 or (213) 760-1684

HBJ

HARCOURT BRACE JOVANOVICH PUBLICATIONS

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

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



The surprising leader.

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

A full-range of reliable, medium bandwidth oscilloscopes.

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

30 MHz delayed sweep – $1,530.

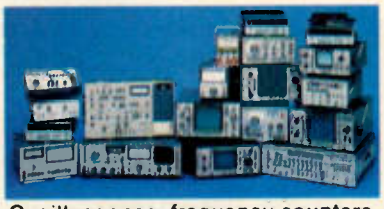
LBO-515B is a compact, precision oscilloscope at a moderate price. Using a PDA 4-inch CRT with parallax-free internal graticule, it features 5 mV sensitivity and delayed sweep for viewing and measuring complex waveforms. Also has 120 ns signal delay, trigger hold-off and x-y operation at full sensitivity.

30 MHz with signal delay – $1,100.

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

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

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



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

10 MHz with 1 mV sensitivity – $645.

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

20 MHz battery/ac portable – $950.

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

Two-year warranty. Evaluation units.

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

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

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

When Quality Counts

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

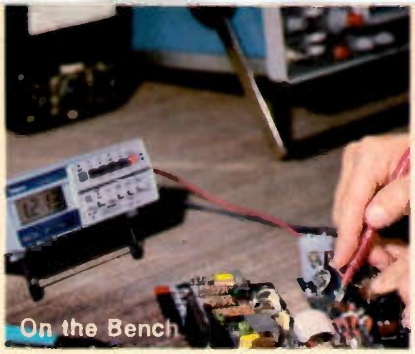
Circle No. 112 for literature—Circle No. 113 for demonstration

Let's Cut Through the Haze of Specmanship and Gimmicks . . .

Simpson Hand Portable DMMs Have The Features You Really Need!

Model 463
Actual Size!
$184

Model 461
$173



The Best All-Around Design for hands-free measurements in all situations . . . in the production line, on the service bench, on the test-lab shelf, in the field.

Designed For Years Of Trouble-Free, Reliable Service by the maker of the world famous 260®.

These Simpson hand portable DMMs meet the new UL 1244 standard for safety of electrical and electronic measuring and testing equipment.

. . . and also meet ANSI C39.5.

Built To Last, Inside And Out — on the inside, with quality-selected active and passive components Plus a *high-energy, double fusing protection system;* on the outside, with a rugged high-impact ABS molded case.

Positive, Simple, One-Finger Push-button Selection of Functions and Ranges.

10 Megohm Input Impedance on both DC and AC voltage ranges . . . as most often referenced in factory service manuals.

100%

Double Burn-In!

Every Simpson DMM gets double burn-in and final factory test of every range and function.

One-Year Warranty. Every Simpson DMM is backed by a *one-year factory warranty.* (Fully stated in operator's manual and warranty registration card. Copy available at factory or authorized Simpson distributors.)

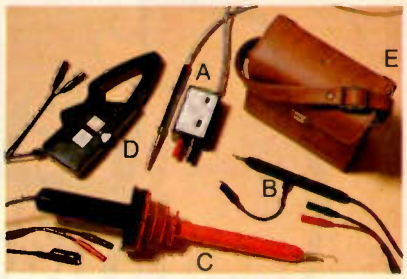
UL Approved Safety-Engineered Test Leads are included with each instrument.

Circle No. 126 on Reader Inquiry Card

The Cordless Model 463 has easy-to-read .5" liquid crystal display, 26 most needed measurement ranges. Rated accuracy is 0.1% on DC V ranges. You can get up to a year of service on a 9-volt alkaline battery, included **$184**

The Popular Model 461 has large, bright .3" LED display, 26 most needed ranges, 0.25% DC V accuracy. Gives 8 hours of continuous battery operation on a single charge. *Price includes nickel-cadmium batteries and AC charger/adapter* **$173**

The Autoranging Model 462 automatically selects the range and the decimal point position on voltage and resistance measurements. Has bright .3" LED display, 0.25% DC V accuracy. Gives 8 hours of operation on a single charge. *Price includes nickel-cadmium batteries and AC charger/adapter* **$215**



A Broad Line Of Accessories expands the measurement capabilities of the 461, 462, 463 and other popular Simpson DMMs. (A) universal temperature probe, (B) rf probe, (C) high-voltage probe, (D) AC Amp-Clamp adapter, (E) deluxe case.

Available from Simpson Distributors Worldwide. Ask or Write for Free Catalog.

Model 462
$215

Simpson
INSTRUMENTS THAT STAY ACCURATE

SIMPSON ELECTRIC COMPANY
853 Dundee Avenue, Elgin, IL 60120
Telex 72-2416 • Cable SIMELCO
(312) 697-2260

KATY INDUSTRIES, INC
ELECTRICAL EQUIPMENT AND PRODUCTS GROUP

SERVICE SEMINAR

GE

Too much brightness, washed out picture, poor resolution at maximum brightness and contrast or insufficient brightness or too much contrast. Possible repair—Adjust R319 (Y channel adjust pot) on Low Level Video Module (early modules EP93X38 did not have this pot). Use the following procedure:

1. Adjust gray scale correctly.
2. Obtain lowest room lighting possible.
3. Set brightness control to minimum (CCW).
4. Set contrast (picture) control to maximum (CW).
5. Set R319 to full CW position.
6. Turn R319 CCW slowly until picture just extinguishes.
7. Readjust brightness and contrast (picture) controls for best picture.

ZENITH

L-Line Triple Plus chassis using M10 module—test procedures. Zenith recently alerted technicians to the possibility of a shock hazard in the event of a breakdown of the H.V. transformer. To prevent this, they were instructed to place a protective gap device across RX3377 in any receiver using a 9-160 or a 9-160-02 module.

Although this device protects against the possibility of serious shock hazard in these sets, should a H.V. transformer breakdown occur, the transients are such that safety components on this module and elsewhere in the set could be affected if these test procedures are not carefully followed.

The H.V. shutdown circuit operates when the H.V. transformer breaks down because the cathode of CR3356 goes negative with respect to the base of QX3351 transistor as a result of the arc transient, which energizes QX3351 shutdown transistor.

A functional test of the H.V. shutdown circuit must be performed to check for proper operation if any attempt is made to service the H.V. supply or shutdown circuitry.

Measure the dc voltage across the Zener diode (CRX3355) cathode to ground. It should be approximately 10Vdc. Temporarily connect a 1K 5%, ½w resistor across the Zener diode (CRX3355). The H.V. should shutdown. This confirms the circuit operation.

The following more detailed test can be made to determine the precise level at which H.V. shutdown will occur. It will normally not be necessary to perform this test, unless components in the H.V. shutdown circuit are replaced or if the operational test described in the previous paragraph was unsuccessful.

CAUTION: Significantly elevated H.V. will be produced during this test and adequate care should be taken to avoid picture tube damage.

Adjust the picture and black level controls to zero. Connect a 40kv H.V. meter to the H.V. supply in the set. Temporarily, connect (with clip leads) a 1.8 Mω ½ w 5% resistor between pins 1 and 2 connector 3R (located near the H.V. transformer). Observe any increase in the H.V. reading. Using a variable resistor, reduce this resistance in small increments, (Caution: To prevent circuit damage do not allow this resistance to fall

below 470 Kω), while observing the increase in H.V. until H.V. shutdown occurs.

The H.V. shutdown must be accomplished before the H.V. reaches 32 kv for 9-160-03 and 36 kv for 9-160-04. Most sets will shut down well below these values; however if no H.V. shutdown occurs even up to these values, the circuit must be repaired.

CAUTION: In a receiver where the H.V. voltage shutdown circuit is being activated for any reason, DO NOT, under any circumstance, disconnect the protective gap device which is used across RX3377. To do so, may create a potential shock hazard and may result in serious damage, not only to the M10 board but to other parts of the receiver.

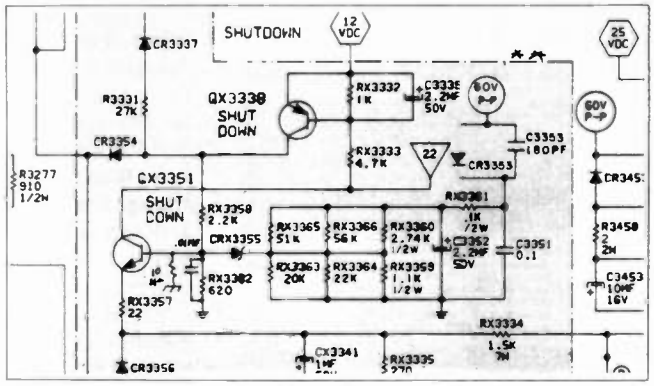
In order to determine if there is a breakdown in the H.V. transformer that is causing the protective gap device to activate the shutdown circuit, the following test can be conducted:

CAUTION: Use a line isolation transformer and disconnect all test equipment, including the antenna connections, from the TV set prior to this test, as it involves tying together the hot and cold grounds.

Temporarily, connect a jumper wire across RX3377. If the high voltage remains on, most likely the H.V.transformer is breaking down and the board must be replaced.

If the shutdown circuit is still activating even with the jumper wire from hot to cold grounds, the problem is due to either a malfunction in the shutdown circuit or in the H.V. supply circuit, in which case the H.V. is excessively high and is in turn causing the shutdown circuit to activate.

To determine where the fault lies, do not disconnect the shutdown circuit, (that may cause the high voltage to rise excessively) without first plugging the receiver into a variable ac supply such as a Variac.



Adjust the ac supply voltage to zero and, after temporarily disconnecting the Zener diode (CRX3355), slowly raise the ac Variac output voltage while monitoring the high voltage with a meter capable of reading at least up to 40 KVdc. If H.V. does not exceed 28 KV for 9-160-03 or 32 KV for 9-160-04 modules even when the ac supply is at 120 vac, the fault is probably in the H.V. shutdown circuit and the circuit should be repaired.

If the high voltage exceeds the preceding valued by more than 2 KV, the H.V. shutdown circuit is functioning as intended and the condition which is making the high voltage excessive should be identified and repaired.

Once repairs are made, the H.V. shutdown circuit must be reconnected and tested per the above outlined functional tests and the following leakage test.

NOTE: Any M10 module that cannot pass the preceding functional or leakage tests should be returned to Zenith for repair.

Perform a standard ac leakage safety test before releasing the set. **ETD**

FROM THE EDITOR'S DESK

Consumer electronics is generally considered to be a $16-to-$18-million-a-year industry at the retail sales level—and still growing. Unlike just a few years ago, five or six to be more precise, it is no longer restricted to just the old standbys of television, stereo and tape recorders, and radios.

New products have, in effect, opened up whole new industries in the consumer electronics field. The video tape recorder—once only a broadcast station phenonenon—is today growing ever more common in the form of the home VCR unit. It's introduction has spawned the introduction of "home" video color cameras. The VCR is also responsible for a whole new multimillion dollar industry—prerecorded tapes of movie classics and a blank tape industry for recording off the air.

Also, the advent of satellite transmission of television signals is about to initiate another phenomenon into the ever changing "consumer" electronics market—the home earth station. As I noted in a recent news column here in ET/D, at least one supplier of satellite television entertainment is toying with the idea of offering private "home" earth stations to America's television set owners—right on their own rooftops or in their back yards.

You can go down the list of "consumer" electronic items and document the continuing growth in retail sales for virtually every category. That includes video discs, electronic games, personal computers, traditional radio, microwaves, phonographs, audio components and audio tape equipment, and on and on. The list never seems to end.

My only reason in mentioning these facts is to ask the question: Are you prepared to handle the influx of new products into your service marketplace at some point in time? Obviously these units are going to need service of some sort; a new antenna system that needs to be installed, another video camera in need of repair, a TV, a video recorder, a microwave!

The point is that today's serviceshop owner is at a crossroads. He can consciously make the decision to aggressively seek these new servicing opportunities, to aggressively market his services, and to actively seek the expansion of his service business by hiring more technicians as his business expands, or—he can watch his business whither and die away.

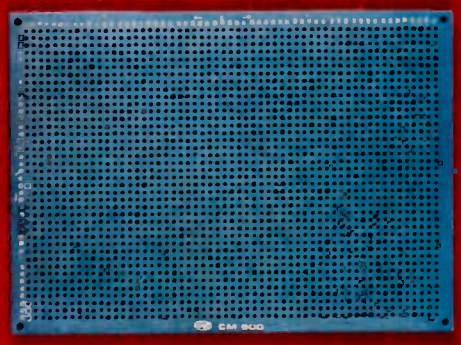
Many service businesses have, in fact, gone out of business simply through their inability to grasp and implement traditional business and marketing concepts. With the revolution now occurring in home and consumer electronics, now is the time for the forward looking and aggressive serviceshop to meet the exciting challenge of the future through expansion.

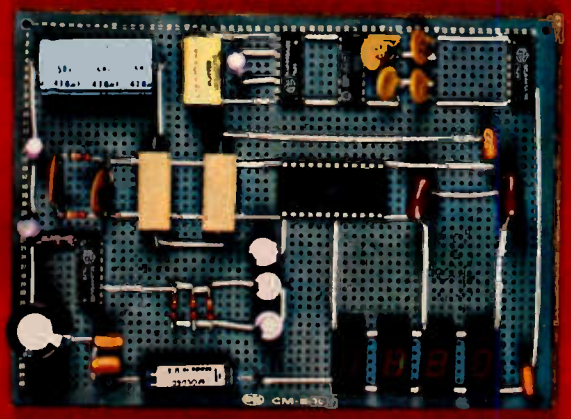
If you aren't anticipating the future—you should be!

Sincerely

Richard W. Day

CM-600 Circuit Mount





CM-600 $6.95*
RW-50 $2.98*

NEW CM-600 SOLDERLESS PROTOTYPE BOARD

CM-600 is a unique system for solderless construction of circuit prototypes, useful to both engineers and hobbyists. The CM-600 is a neoprene board 4½" (114mm) x 6" (152mm) with 2280 holes on .100" (2.54mm) centers. Standard components including DIP's are mounted by simply inserting leads into the holes in the long life neoprene material. Interconnections are easily made using 20 or 22 AWG (0,8 or 0,65mm) wire jumpers. Positive contact is assured by the elasticity of the hole, which compresses the leads together. To remove components or leads, simply pull out. This facilitates easy circuit changes making it ideal for breadboarding experimental circuits. CM-600 also features numbered rows and columns for easy reference.
Accessory Kit RW-50 contains 50 pcs of AWG 20 (0,8mm) insulated jumper wires of assorted lengths from ½" (13mm) to 4' (100mm). Both ends are stripped and bent 90° for easy insertion. In stock directly from

OK Machine & Tool Corporation
3455 Conner St., Bronx, N.Y. 10475 U.S.A.
Tel. (212) 994-6600 Telex 125091

*Minimum billings $25.00, add shipping charge $2.00
New York State residents add applicable tax

Circle No. 116 on Reader Inquiry Card

LETTERS

TEKFAX:

May I introduce our school and myself to you and your company. The Southwestern Indian Polytechnic Institute, was dedicated on the 21st of August, 1971, to serve the Indian youth. The school provides the Native American the opportunity to advance in three areas: Business Education, Occupational Education and Dental Technology. Our Electronics Department is under the Occupational Education Program. The Electronic Department has five specialized areas, one of them being Consumer Electronics (Radio/TV Repair). My name is Joe Bacca and I am the coordinator of the Electronics Department.

We are presently receiving a subscription of your magazine, ELECTRONIC TECHNICIAN/DEALER and it has been very useful. Our request is that if you would send us information of your volume of schematics, we would like to purchase them. The schematics we are interested in would be from Volume I, or your earliest, to your latest volume, if it is possible. Any additional information will be greatly appreciated.

Thank you for taking the time to consider our request.

Joe Bacca
Coordinator, Electronics Dept.
United States Department of the Interior
Bureau of Indian Affairs
Southwestern Indian Polytechnic Institute
PO Box 10146-9169 Coors Rd., N.W.
Albuquerque, NM 87184

Editor: All except the current volume are out of print. If anyone has earlier volumes for sale, please contact Mr. Bacca.

I would like to obtain TEKFAX 108-114 and the monthly schematics from 1960 to date. I will pay a fair price as necessary. Help me complete my sets. Thanks.

Stanley Chalker
1176 Smithsonian Ave.
Youngstown, OH 44505

HELP NEEDED:

This letter is two fold.

FIRST: I would like to congratulate every one connected with ET/D.

The magazine is informative, easy to read, has excellent topic coverage; and overall just unique!

SECOND: If some one can pull this out of a hat I would really appreciate it. I have a DeVry 16 mm model Q movie projector. I need any information, schematic or parts list on this. I especially need the number only of the photo sound tube (Film O Sound Photocell). It is a 4 prong, 2 large, 2 small pins; approximately 2 inches long, not including pins.

Will remit for any any expenses.

Sig. E. Olsen
3226 Riverside
Bristol, PA 19007

I am attempting to repair an antique GE 9 inch B&W, for a customer; Model 9T001. I am in need of a flyback transformer, which is no longer available from G.E. Thordarson is the only transformer manufacturer that I have catalogs for who lists a replacement. It also is not available in the San Diego or Los Angeles area. My letter to Thordarson Co. went unanswered. May I enlist your help either directly or through the "letters" column in ET/D?

**GE original # is RTO 196*

**Thordarson list their part # FLY 144 as a suitable replacement.*

**Also listed as using FLY 144 are the*

following other GE part numbers, but I have no way of knowing if they are exactly the same: ET77 –37, #R3587

I am willing to pay any reasonable price to your other readers who may have one, including shipping.

Chester V. "Chet" Cox
Chet's Repair Service
2260 Central Ave.
SP Valley, CA 92077

I am in need of any information on where to get a service diagram for a Project/One Model Mark IV-A receiver. It has defective output transistors with "no name city" type numbers, so I can't do anything with it.

Howard Sams has never heard of them, so if you could lend some assistance, both I and the owner will love it!

Steve Oberman
O.K. Electronics, Inc.
422 N. Broad St.,
Carlinville, IL 62626

I would like to know if any of your readers could help me with this.

I have a T.G. and Y. color set Model R4646, Ch. Z100A, May 1977. Howard Sams does not show a diagram for this set and I checked through my files and have not found another set to match this one. There may be another brand set like it that I can compare or if someone had a good diagram to this set, would they contact me by mail. The set was made by Nippon Electric Co., Tokyo, Japan. (also called N.E.C.)

Please send information to:
Landry's T.V. Service
3765 5th St.
Berwick, LA 70342

Also I have ET/D books dating back 10 or 12 years. Anybody that is interested drop me a line.

I need a cartridge shell for a Garrard Laboratory Model Record Changer Type A. The shelf if square with a round four pin plug that plugs into the changer arm.

Roy J. Beeman
Roy's Radio and TV Repair
509 Harriet
Burkburnett, TX 76354

Does anyone have service data for Sears Roebuck 23 Channel C.B. (with PLL) Model 934.3676 0600 Roadtalker. I have the Sams for 40 Channel Roadtalker (CB 225) but these animals ain't nowhere close!

Donald G. Seibel
Seibel Electronics
321 Artesian Forest
Conroe, TX 77304 ETD

NEWSLINE

VCR SALES TAKE OFF. The entire video industry seems poised for what could be a takeoff if some of the indicators hold true. Industry statistics show VCR sales for the first two months of the year were 69 per cent ahead of a year ago and tape sales--both blank and recorded--are soaring. One of the big boosts came through Sony's introduction of its popular high speed scan models permitting freeze frame, fast forward and reverse--while viewing the screen. Some experts optimistically predict VCR sales of near one million for 1980.

NASA PREDICTS HUGE TELECOMMUNICATIONS GROWTH. The demand for telecommunications services in this country is expected to grow fivefold by the turn of the century. That's what a recent study conducted for the NASA Lewis Research Center predicts. The studies indicated that demand for conventional voice services--message-toll service and private line traffic -- will continue to predominate.

ZENITH INTRODUCES 100 DEGREE, 23-INCH IN LINES. Zenith has introduced a family of five 23-inch color receivers featuring for the first time a 100-degree tri-focus color CRT. According to Zenith the new sets use an average of 34 per cent less electricity than previous 23-inch models. Simultaneously introduced were seven black and white models--a 16-inch, three 19-inch, and three 22-inch models. Zenith also announced some financial results for 1979. Earnings were off $4.3 million from 1978's $23.3 million figure--or from $1.24 per share to $1.01.

ELECTRO MEETING SET. Strategic planning and VLSI will be two of the topics explored during a special tutorial seminar sponsored just prior to the opening of Electro/80 next month in Boston. The sponsoring IEEE says the seminars will explore the role VLSI will play in the 1980s and the impact on both industrial and consumer electronics.

ZENITH AND RCA SIGN VIDEO DISC AGREEMENT. Zenith President R. W. Kluckman and RCA Chairman Edgar H. Griffiths jointly announced March 3, the signing of an agreement by which each has access to the other patented video disc player developments, indicating Zenith's choice is RCA's capacitance format video disc. RCA has already announced first-quarter 1981 introduction of its video disc player. Mr. Kluckman stated Zenith expects to have an under $500 disc player available for sale by mid '81 and that Zenith dealers would also have a wide variety of recorded discs to offer.

GHOSTLY TV? John Prigg of Scottsdale, Arizona, couldn't figure out why night after night he'd wake up to the sound of voices drifting into his bedroom from his TV. It seems his dog was accustomed to sleeping in the living room with the TV and when he purchased his new remote control it was later learned that the dog's snores would trigger the set on. He got rid of his remote--not the dog.

Facts from Fluke on low-cost DMM's

Is this any way to treat a $139 multimeter?

In the rough world of industrial electronics, even a precision test instrument can get treated like dirt. You need all the ruggedness and dependability you can get in a DMM for field use.

You'll find these qualities and more in the Fluke line of low-cost DMM's. Our DMM's have been dropped from towers, stepped on, and run over by construction equipment. And they've survived because we never cut corners on quality, even on our lowest-priced, six-function Model 8022A Troubleshooter at $139 U.S.

Take a close look at a low-cost DMM from Fluke and you'll notice tough, lightweight construction that stands up to the hard knocks of life. Sturdy internal design and high-impact, flame-retardant shells make these units practically indestructible. Right off the shelf, they meet or exceed severe military shock/vibration tests.

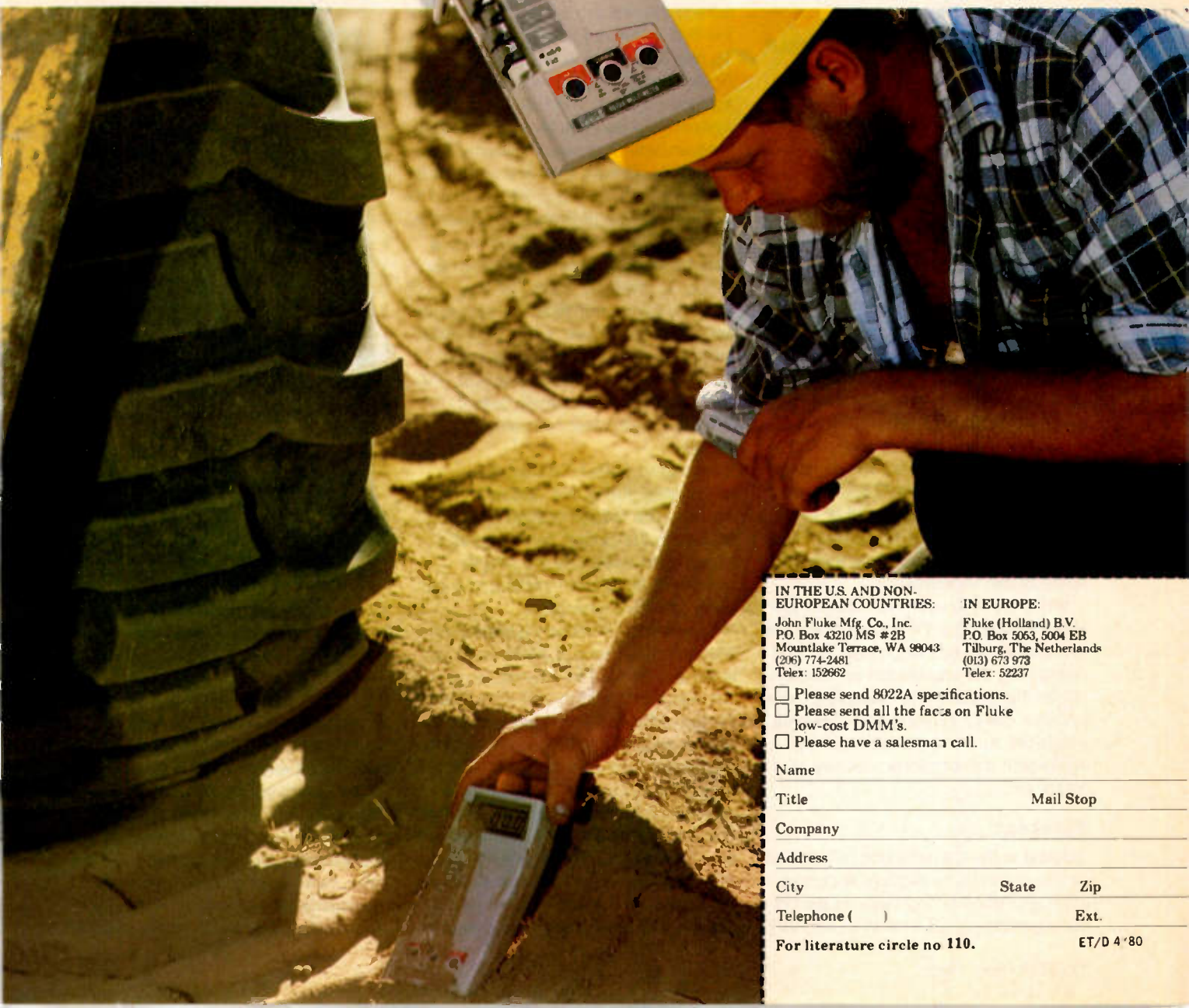
Even our LCD's are protected by cast-tempered plastic shields. We use rugged CMOS LSI circuitry for integrity and endurance, and devote a large number of components to protection against overloading, accidental inputs and operator errors.

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

For more facts on DMM reliability and where to find it, call toll free **800-426-0361**; use the coupon below; or contact your Fluke stocking distributor, sales office or representative.

FLUKE®

8022A Multimeter



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

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

IN EUROPE:

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

☐ Please send 8022A specifications.
☐ Please send all the facts on Fluke low-cost DMM's.
☐ Please have a salesman call.

Name

Title Mail Stop

Company

Address

City State Zip

Telephone ( ) Ext.

For literature circle no 110. ET/D 4/80

Teletext, viewdata and digicast

Video magazines

The newspaper of the future may be a video display, updated regularly throughout the day, giving you up-to-the-minute weather, news, shopping and entertainment information and it may even let you talk back to it.

By Walter H. Schwartz

Sit down before your television receiver, pick up the remote control transmitter, touch keys 101 and call up the news headlines, then go on to pages 102 to 116 for details. Or touch 134 to check the stock exhange or 177 to see what live theater offers tonight. All of this information and much, much more may soon be available to you (it already is to some British viewers).

While the end result is similar, a color video display on a TV screen, there are two major methods of processing and distributing the information for display. Under the general title "Videotext" are systems called Teletext and Viewdata which can further be subdivided by equipment manufacturer, country of origin, etc.

Teletext

Teletext is the transmission of text and simple graphics by digitally encoding them and transmitting them as part of the television signal. Like VITS and VIR it is transmitted during the vertical retrace interval (on lines 17 and 18, in the British system, proposedly on lines 15 and 16 with an NTSC signal. Several systems differing by name or by application exist. The BBC calls its system Cee-fax (see facts); the British Independent Broadcast Authority has named its, Oracle; they are technically identical. In France, a system tailored to the peculiarities of French television, is called Antiope and broadcast over a data broadcasting network known as Didon. In the U.S., Micro TV has adapted the system to NTSC standards and calls it Info-Text, while Bonneville International Corporation has been running test transmissions at KSL-TV, Salt Lake City, and simply calls it Teletext. Japan also is evaluating Teletext.

As stated earlier Teletext is transmitted during the vertical retrace interval. The following description applies to the British Teletext and Orcale; just substitute the proper number of lines and frames and it can apply to NTSC standards.

The British TV picture is formed by interlacing two sets of 312½ lines 25 times a second. The information is inserted into the 17th and 18th lines. If the top of the picture is lowered with the hold or linearity (or height) controls this information appears as lines of bright dots (Fig. 4) Each line contains the information for one line of standard text. The rows for a page are transmitted one after another until the page is complete. Then the next page is transmitted and so on until all the pages have been transmitted. Then the process repeats.

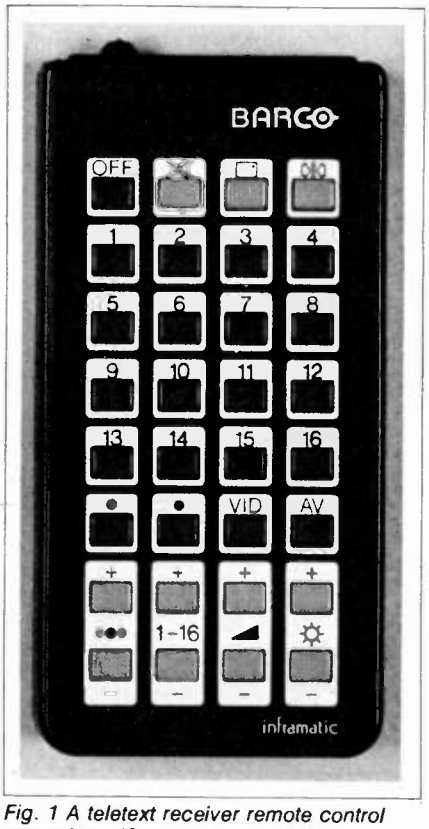
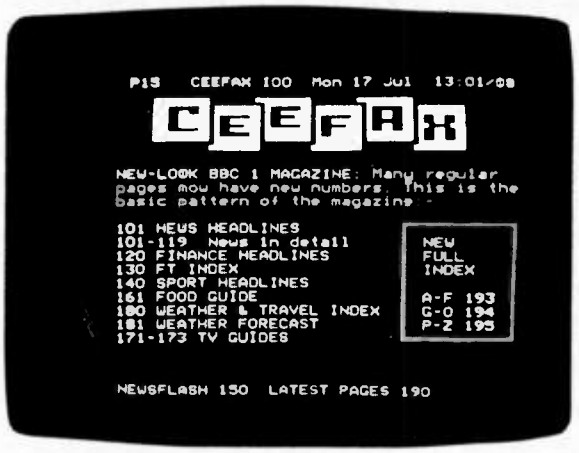


Fig. 1 A teletext receiver remote control transmitter. (Courtesy Barco-Cobar Electronic n.v.).

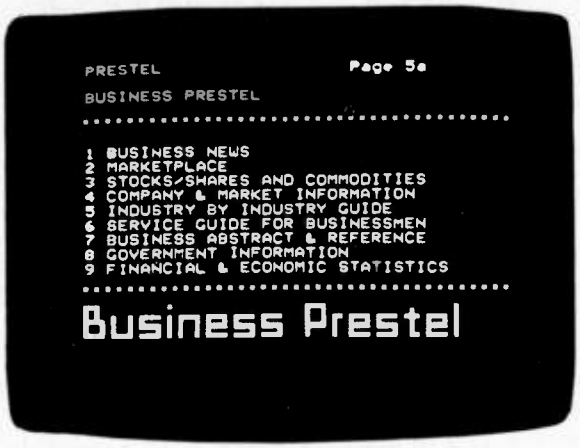
Each page can consist of 24 rows of 40 characters. At two lines per field and 50 fields per second 250 pages can be transmitted each minute.

The binary pulses on each line are divided by function. The first pulses identify the row of text on the page. The second group defines the text etc. Each letter, number or graphic symbol is represented by an eight-digit binary number. The first row of a page identifies

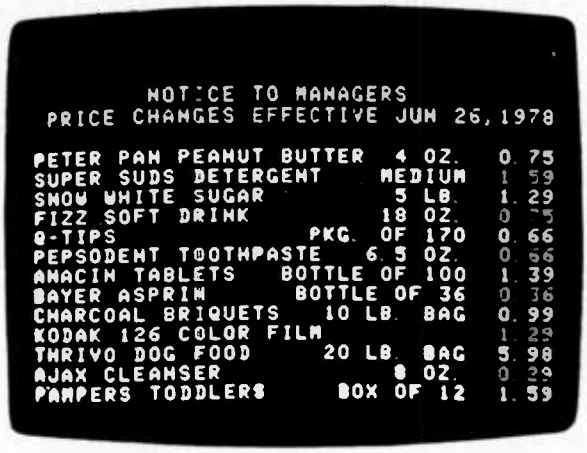
Weather (Ceefax)



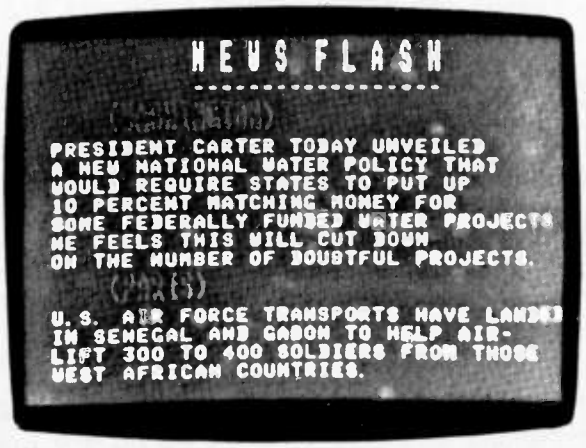
Quick index (Ceefax)



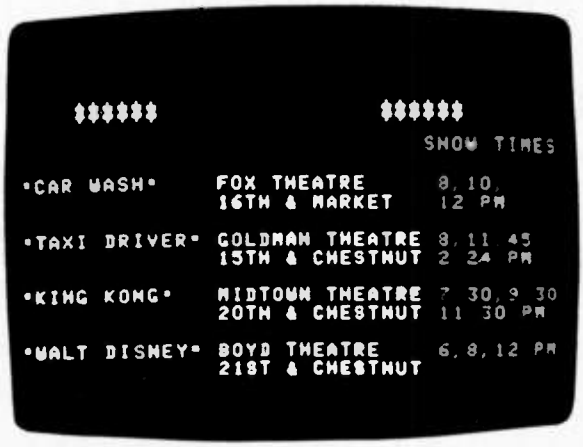
Business index (Prestel)



Supermarket (Infotext)



News flash (Infotext)



Entertainment (Infotext)

Fig. 2 Videotext displays

the page and its "time code."

Twenty-four rows of forty standard characters can be displayed; larger letters and simple drawings are possible. Six colors, red, green, blue, yellow, cyan and magenta (and white) can be used. The basic characters are based upon a 5 × 7 dot matrix. Double height characters are also available. Larger characters and drawings are assembled by the use of small rectangles (Fig. 5).

The top row is the page header. It shows the page number, the date and the time. The remaining 23 rows are the text or the graphics.

The system can handle up to 800 pages, however this could mean a waiting time between pages; therefore few than 800 are presently used. The number of pages can be expanded by self-changing pages. Here pages change regularly after allowing sufficient time for reading. Different material can be transmitted on a given page at different times of the day and held for viewing at leisure. Pages that do not need frequent updating could be transmitted perhaps only once a day. At the rate of once per minute, a page can be updated more than 1000 times each day. A large auxiliary memory could store many infrequently changing

pages.

The television receiver needs decoding circuitry to process teletext. Data extraction and recognition circuits identify and process those pages selected. This data is stored in a RAM so the picture can be displayed normally. The binary data stored in the RAM is translated by a ROM into the proper characters or graphics. As the final step a raster representation is displayed on the screen (See Fig. 2).

Viewdata

Viewdata is a system which produces its video display by the decoding of digital data which has been modulated on an audio frequency which is usually transmitted over the telephone lines. It can be interactive (two way). Present systems are Prestel offered by the British Post Office, Telidon being evaluated in Canada and the wired version of the French Antiope, called Titan.

The Prestel System requires a television receiver with proper auxilliary circuitry to receive and display the information, a computer to store the information and a telephone line to link the two. Information is transmitted at a rate of 1200 bits/sec from the computer and since the system is interactive the return channel can presently transmit back to the computer at a 75 bit/sec rate. It is decoded and displayed in much the same way as teletext.

Digicast

A somewhat similar concept using the FM SCA subcarrier ("storecast"

continued on page 55

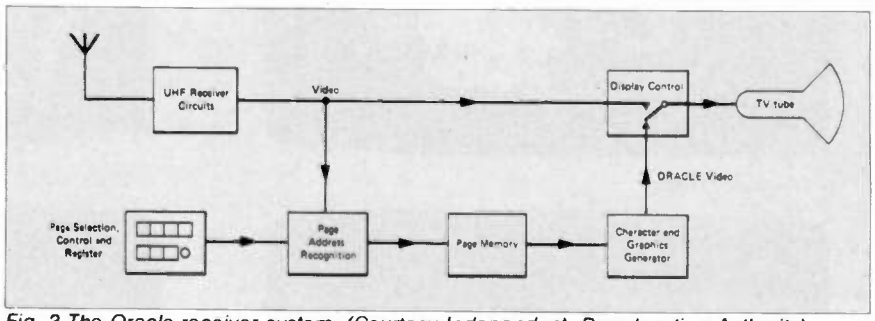


Fig. 3 The Oracle receiver system. (Courtesy Independent Broadcasting Authority).

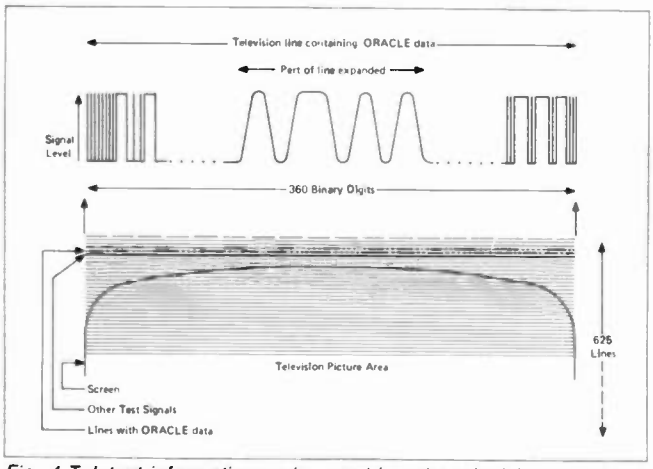


Fig. 4 Teletext information as inserted into the television signal. (Courtesy Independent Broadcasting Authority)

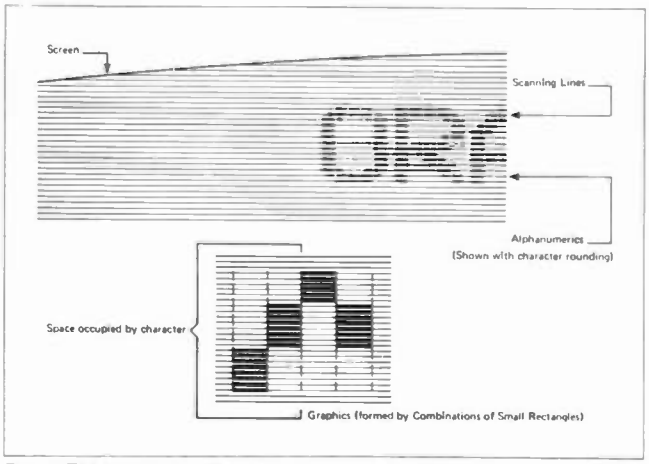


Fig. 5 The character display. (Courtesy Independent Broadcasting Authority).

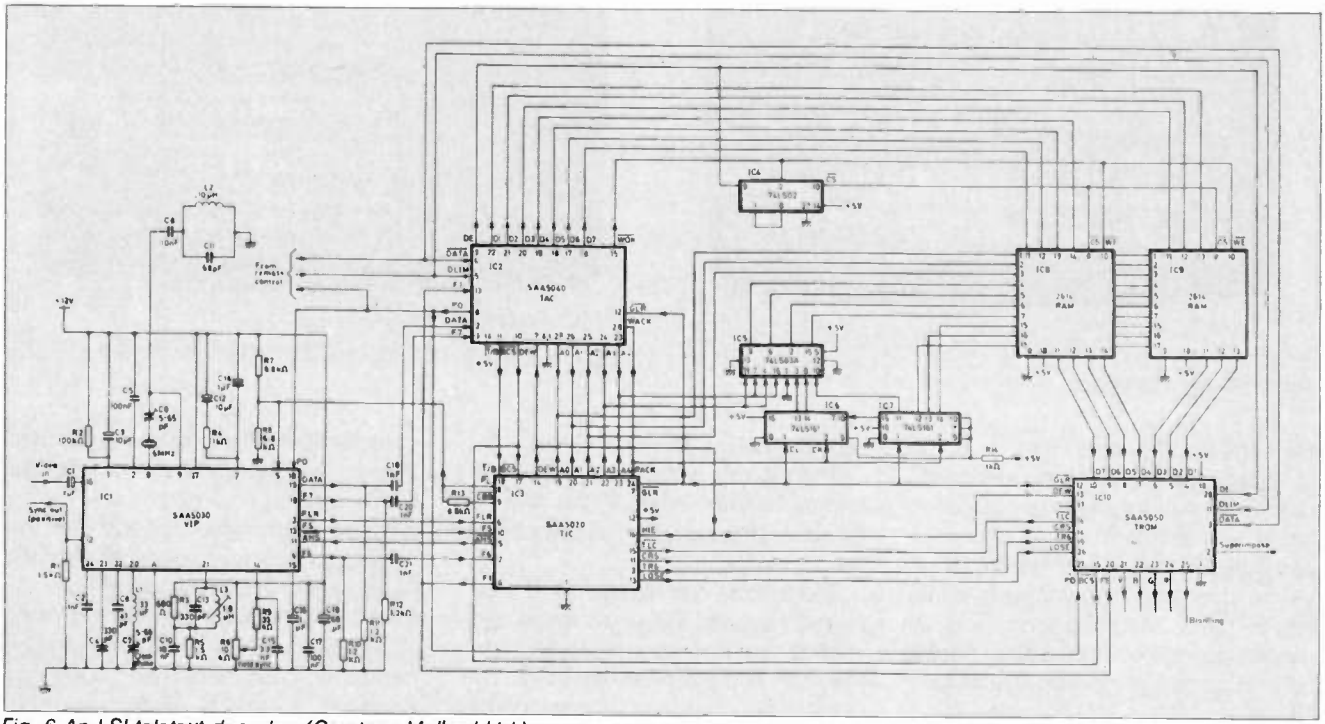


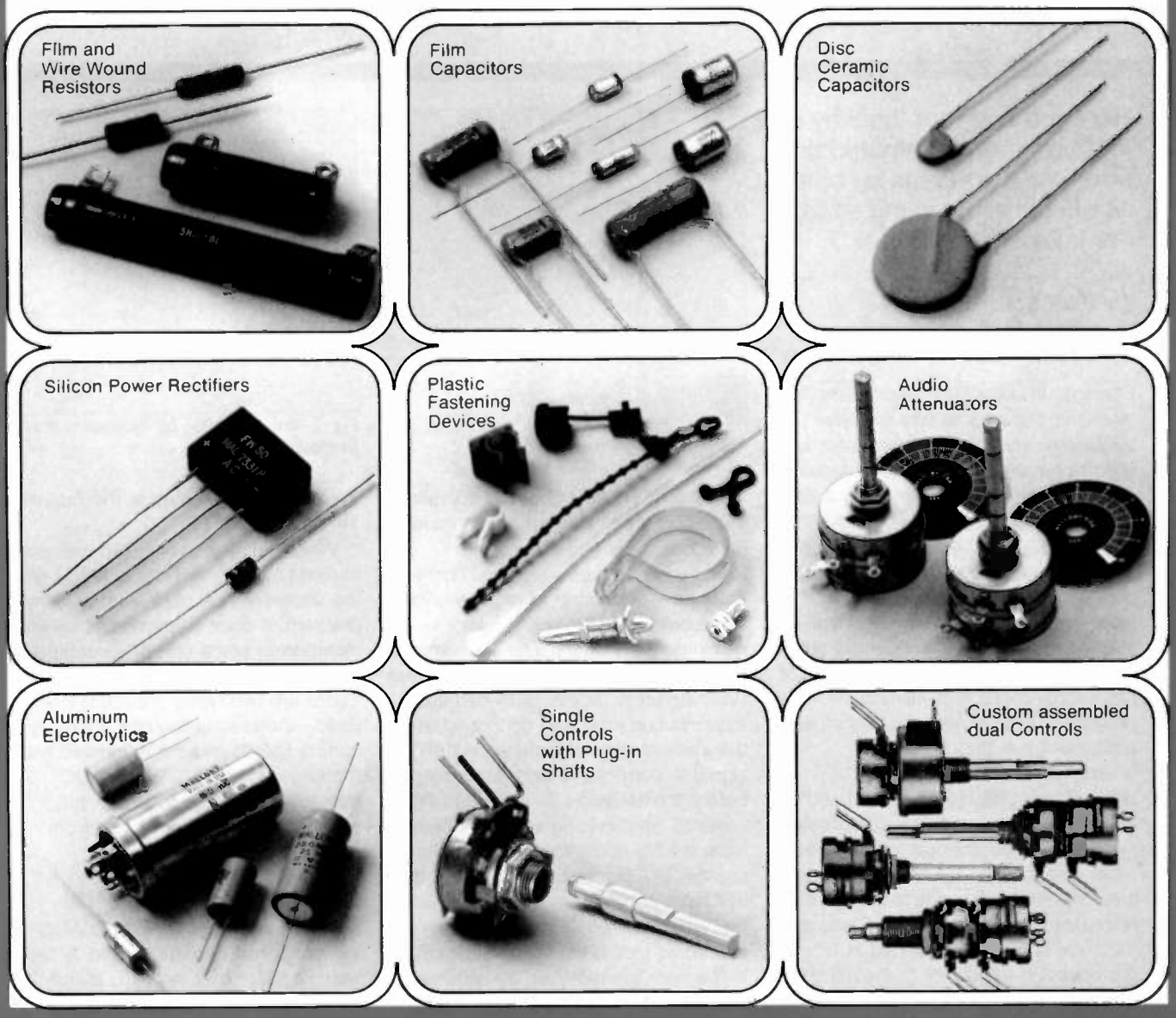
Fig. 6 An LSI teletext decoder. (Courtesy Mullard Ltd.)

One call.
Your Mallory distributor's got them all.
More than ever!

Take the search and wait out of finding electronic parts. Go straight to your Mallory distributor, by phone or in person.

Get to know the convenience and economy of simplified single-source buying. To deliver exactly what you want in parts, quality, and quantity. Immediately from stock on hand, or in most cases within 24 hours from the factory. Your Mallory distributor goes all out for his Number 1 VIP...you. Get in touch with him soon. Mallory Distributor Products Division, Mallory Components Group, Box 1284, Indianapolis, Indiana 46206. (317) 636-5353.

MALLORY
ELECTRICAL/ELECTRONIC GROUP
EMHART



MALLORY

Circle No. 115 on Reader Inquiry Card
See us at the EDS Show May 1, 2, 3, Booths H-11 to H-17 and J-12 to J-18

Automatic tint control

Flesh-tone correction

Here are some of the why's and how's of transmitted tint error and the means by which its effects are minimized at the television receiver.

By Paul Shih

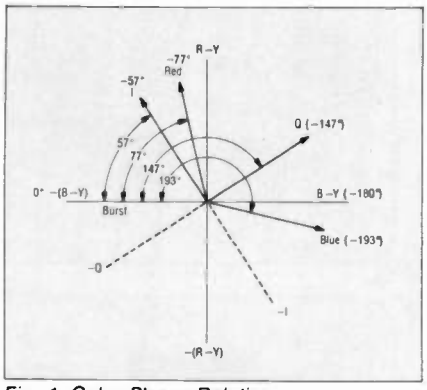


Fig. 1–Color-Phase Relation

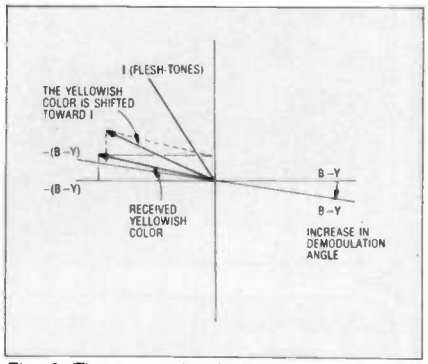


Fig. 2–Tint correction by Increasing the Demodulation Angle

Changes in color from time to time in television pictures as one switches stations or when the program materials change have been well-known since color television came into being a little more than 20 years ago The color change comes in two forms, change in intensity and change in tint or hue. The problem arises partly from the fact that most television stations have difficulties in transmitting technically correct color signals at all times. When one thinks of the number of cameras, film chains, tape recorders, microwave links and other equipment that may be used in broadcasting, disturbances to the precise color phase relations caused by a minor malfunction in the complicated system must be anticipated. An even more disturbing effect on the precise color transmission is due to the fact that errors are introduced when the sync and the color burst are reinserted in reprocessing the signal at the point of transmission. The phase and amplitude relationships of the reproduced signal may be different from the originating source, making precise transmission of color signals difficult.

One inconvenient way to compensate for the station transmission errors in order to obtain correct color pictures would be for the receiver user to adjust the color and tint controls on the set frequently. Actually there is nothing wrong with the set under this condition; therefore, the broadcasting industries have been trying to reduce the transmission errors for years. There have been a number of experiments conducted to find a solution for eliminating the errors. The experiments started first with the Vertical Interval Test (VIT) signal to reduce the video chain transmission error and continued with the Vertical Interval Reference (VIR) signal to correct the processed signal before transmission. In 1971, the FCC required all television stations which have remote operation to originate and use the VIT signal. Later, in 1975, the FCC also adopted the specifications for the VIR signal as recommended by Electronic Industries Association (EIA). In the near future, when all television stations use the VIR signal for more precise control over the color signals they broadcast, a television receiver equipped with a VIR-controlled color system will require no color or tint adjustments during normal viewing. General Electric Co. began to incorporate the "VIR broadcast controlled" color system into some of their 1977 and subsequent line color chassis. A detailed description of the system was presented in the August, 1976 issue of ET/D.

While not all the television broadcast stations use the VIR signal at this time, the usual method of dealing with the problem of color changes has been to incorporate some sort of automatic chroma control circuits into the receiver. There are two types of circuits being used—the automatic color (intensity) control (ACC) and the automatic tint (phase) control (ATC). The ACC maintains constant color intensity, whereas the ATC keeps hue from changing from time to time.

Automatic color control

The ACC is actually another "AGC" function for the chroma section. At first, it would appear that the ACC is not needed because the AGC system in the RF and IF sections should maintain the chroma signal along with the Y-signal at a constant level. However, the chroma signal sidebands may vary in magnitude independently of variations in the video signal due to slightly different propagation effects on the two signals which are separated by a distance of 3.58MHz in frequency. It is, therefore, desirable to incorporate an ACC system

SYLVANIA ECG® SEMICONDUCTOR GUIDE HELPS SOLVE GE AND RCA'S PROBLEMS.

No one knows better than Sylvania that the show must go on. So when a faulty semiconductor in any brand of home entertainment product turns into a showstopper, it's Sylvania to the rescue. Our ECG® semiconductor guide is the most used, and useful, guide in the industry. It makes it easy to replace any ailing performer with an ECG semiconductor that will get the show back on the road.

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

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

SYLVANIA | GTE

ECG is a registered trademark of GTE Sylvania.

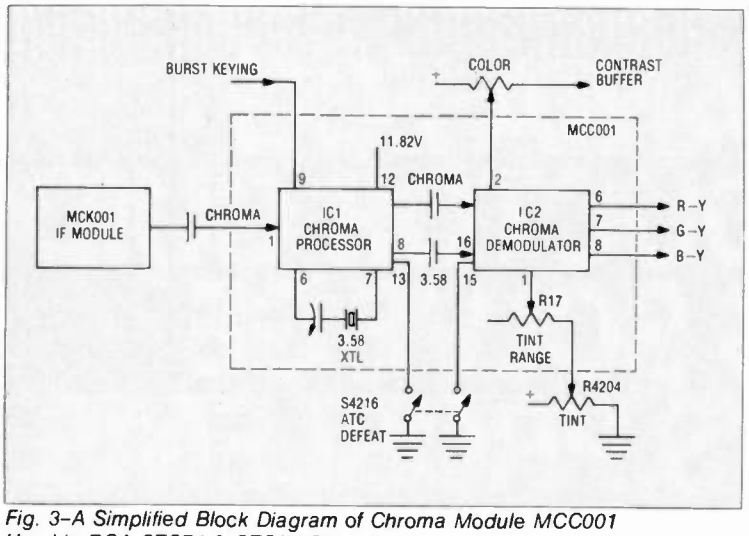


Fig. 3–A Simplified Block Diagram of Chroma Module MCC001 Used in RCA CTC74 & CTC81 Chassis

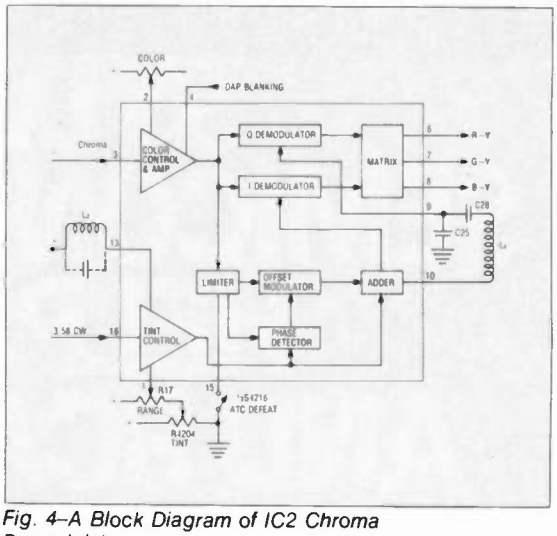


Fig. 4–A Block Diagram of IC2 Chroma Demodulator

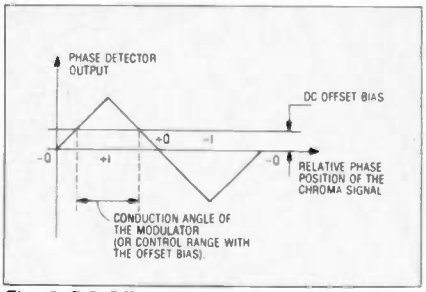


Fig. 5–DC Offset Bias Limits Tint Correction to Colors Near Flesh-tones

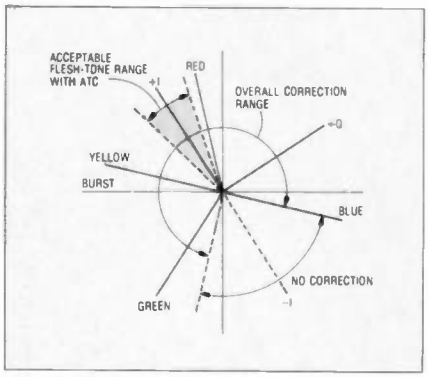


Fig. 6–Tint Correction Range

to make sure that the chroma signal is maintained at a constant level at all times. The basic principle of ACC is similar to that of AGC; thus its operation is not detailed here; this article is devoted to the description of the more intricate automatic tint (phase) control systems.

Color-phase relationship

In color transmission, different color or hue is transmitted by means of phase, whereas saturation of the color is transmitted in terms of magnitude. Any color may be represented by a vector having a certain length and a certain angle with respect to the reference burst (Fig. 1). For example, red is represented by a radial line drawn from the center having an angle of 77 degrees from the burst, while blue has an angle of 193 degrees.

The vector representing a color may be broken into two subcomponents along any two axes. In the standard color transmission, I and Q are the two axes being used. The "I" axis, having an angle of 57 degrees, corresponds to a vector of human flesh-tone color, and the "Q", at (57 + 90) = 147 degrees, coincides with a vector having a color of magenta.

Modulation and demodulation

The transmitted color signal is generated by means of a quadrature modulation process in which I and Q components of the color signal are used to modulate the "I", in phase subcarrier, and the "Q", quadrature phase subcarrier, in two separate modulators. The color signal is recovered in the receiver by two demodulators with a phase shift of 90 degrees or more between their reinserted subcarrier inputs. Demodulation may be performed along the "I" and "Q", R-Y and B-Y, or any other two axes; it means that the reinserted subcarrier may be at any fixed angle with respect to the transmitted burst as long as the original signal can be reconstructed from the two subcomponents.

Phase shift

When a color signal is transmitted at the television station, its two I and Q subcomponents along with a sample of subcarrier burst will be received. If there is an unintended phase shift between the transmitted reference burst and the transmitted color subcomponents, the reconstructed signal vector in the receiver will have a different phase angle with respect to the burst than the original. The result is that the original color will not be reproduced correctly; the intended hue will be changed.

The change in tint or hue often goes unnoticed in the blue-green color region but becomes very objectionable in the flesh-tone color region. Due to this different reaction toward change in the color of a human face and that of a tree, most ATC circuits are designed to correct tint change in the flesh-tone color region only.

Most ATC circuits introduce some form of over-all color distortion because they limit the color range for red and yellow and also shift the phase for colors not in the yellow-orange-red region. Nevertheless, the ATC does bring flesh-tone closer to the ideal hue; few people are actually concerned about or aware of this distortion.

How ATC works

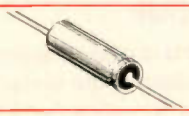
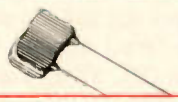
Magnavox in 1970 introduced the first automatic tint control circuit which corrected color errors in the yellow-orange-red region. The circuit consisted basically of a yellow gate, a red gate and a solid state switch which amplified and phase shifted the off flesh-tone color signal. The phase-shifted chroma signal was then added back to its original to cancel the phase error for the desired flesh-tone color.

Another common method used to automatically correct tint errors involves reducing the "Q", B-Y or blue component or increasing gain for red or the "I" component in the demodulator or subsequent driver stages. In a R-Y/B-Y demodulation system, an equivalent Q component is reduced by matrixing the R-Y and B-Y components in the right ratios. When the gain or attenuation for the signal components mentioned above is correct, green-yellowish or reddish colors are shifted toward the flesh-tone color and

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

MORE Types • MORE Ratings
MORE Quality • MORE Value

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

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

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

Where MORE is more than a promise.

SPRAGUE®
THE MARK OF RELIABILITY

a subsidiary of GK Technologies incorporated

65-0105

Circle No. 127 on Reader Inquiry Card

magenta or purplish colors are shifted toward the red.

Increasing the demodulation angle between the two demodulation axes, is one more way to bring about color correction in the flesh-tone region. For example, widening the demodulation angle by increasing the phase lag for B-Y with respect to R-Y has the same effect as decreasing the angle between R-Y and -(B-Y) axes. With this phase angle arrangement, any color near the yellow region will be shifted toward the "I" or flesh-tone color region (Fig. 2). However, for an off flesh-tone color falling in the reddish color region, widening the demodulation angle by decreasing the phase lag for R-Y with respect to the burst tends to shift the color toward orange or the flesh-tone color.

Most automatic tint control systems used today employ basic principles similar to those mentioned above, in their control actions, but they make use of customized integrated circuits as major active components. Each system works a little differently from the others, but all attempt to achieve the same goal of bringing the variable tint under control automatically. The operation of one well-known color system, RCA's ColorTrak automatic tint control system, will be described.

RCA ColorTrak

The most important operating feature of RCA's ATC system is the controlled deviation of the "I" subcarrier phase from its nominal value by an offset modulator for minimizing flesh-tone errors but without an accompanying disturbance to "Q" demodulation fidelity. The system, used in chassis CTC 74, CTC 81 and CTC 81AD, consists basically of IC2, Chroma Demodulator, working in conjunction with IC1, Chroma Processor, on Chroma Module MCC001 or MCC001A and a number of passive components, including a tint range control R17 and a customer tint control R4204 (Fig. 3). The customer tint control and a customer color control are not used in chassis equipped with Direct Address Package (DAP), such as CTC 81AD. Instead, the color and tint control functions are carried out by solid state circuits in the remote Command Module and activated by push-buttons "C" and "T", "Up" and "Down" on the Control Center.

The chroma signal from MCK001 IF module enters the Chroma Processor IC1. With an input also of horizontal keying pulses, IC1 performs chroma

continued on page 55

Get the best selling line in the business! Channel Master

SPARTAN AMPLIFIERS and the broadest selection of home ANTENNA SYSTEMS EQUIPMENT in the industry!

Channel Master's Spartan Amplifiers are a complete line of outdoor signal boosters, designed to meet the entire spectrum of TV and FM reception needs. They cover everything from 300 ohm Deep Fringe VHF/FM to 75 ohm High Input UHF, and they all display the same superior engineering and technology that has made Channel Master famous. Backed by Channel Master's Antenna Systems Equipment, Spartan amplifiers represent the ultimate in performance and dependability.

Different areas, different stations and different sets all add up to customers with different reception needs. That's why Channel Master has developed ASE, Antenna Systems Equipment, a versatile group of reception components that will let you match your customer's needs exactly. The ASE system gives you all the pieces, both actives and passives, every piece quality-engineered and feature-oriented for superior performance and trouble-free installation.

Channel Master Spartan and ASE—get the competitive edge!

NEW! Couplers, Joiners, Separators and Rejection Filters with newly designed housings and packaging. Ask your Channel Master distributor for them today.

Channel Master

Division of Avnet, Inc., ETD1279, Ellenville, New York 12428

Circle No. 107 on Reader Inquiry Card

Microprocessors part VI

Peripherals

Article six of the author's continuing series discusses in some detail the concept of peripherals—those input/output devices "connected" to the MPU, how they work, and without which the MPU would be nothing more than a deaf-mute.

By Bernard B. Daien

The word "peripherals" as used in computer technology has its roots in the common English word "peripheral," meaning on the edge, or boundary or something. If you visualize the MPU as the core of a computer (or controller), then the various things which we add on, such as interface devices, terminals, and displays, are between the MPU and the outside world . . . therefore they are on the boundary of the MPU, and are peripheral to it. The word "peripheral" is a very general word, covering a wide variety of devices, and is a label that can be applied to almost anything that ties onto the MPU . . . a fact that lends itself to some confusion!

The MPU often communicates with an assortment of peripheral equipment, including teletype machines and keyboards. The MPU has to be able to accept information from them and output information to them.

In order to communicate with differing signal sources, "interface devices" are often necessary. These interface devices will be discussed shortly, but first we are going to look at the actions which take place *inside the MPU,* in order to communicate with peripherals.

In order to transfer a *data* word *from an "input,"* (including interface devices), to the MPU, it is first moved into an accumulator (or a general purpose register). The data word can then be transferred into memory, or another register, depending upon what is to be done with it, in accordance with the "INPUT" instruction.

In order to transfer a *data* word *from the MPU* to an external device, the word is first transferred to an accumulator (or a general purpose register functioning as an accumulator). When the "OUTPUT" instruction is executed, the word is transferred from the accumulator to the appropriate external device.

As you can readily appreciate, this intermediate step of transferring information into, then out of, an accumulator, takes extra time to execute, and therefore slows the operation of the MPU. In certain cases, where speed is essential (and it frequently is), there is a means provided for going directly into the memory banks of the microcomputer. This will be covered later on.

Control and interrupts

By now you know that the programmer enters his instructions in two parts, or "fields." One is the "op code" which is the "instruction" word, indicating what is to be done. The other is the "operand," usually data. Thus we have one 8 bit data word, and one 8 bit instruction word stating what you want to do with the data. Notice that the term "instruction" is used in two ways. The program is a series of statements, or "instructions," entered by the programmer. Each "instruction" entered, has two parts, one of which is labeled the "op code" and is also an "instruction," but in a different sense. So we are dealing with two different uses of the word "instruction," and you can only tell which one we are talking about by the context . . . (back to the old confusing "buzz words" of the business again.)

When an instruction is completed (executed), we term it an "operation." Where do "input" and *"output"* instructions originate? They fall into three general categories, "programmed I/O," "I/O interrupts," and "direct memory access (DMA)."

Programmed I/O operations are performed in accordance with the steps in the program, *as entered by the programmer.* The peripheral devices (there may be several), *are controlled by control* signals from the MPU. The MPU selects the desired peripheral out of the several different peripheral devices in the system, ascertains whether or not it is ready to handle information, and then proceeds to use it. If the peripheral desired is not able to handle information at that time, a signal is generated, which tells this to the MPU. The MPU may have to wait until the desired peripheral can handle information, and does this by storing the information in memory until the correct conditions exist for information transfer in accordance with the programmed instructions.

Interrupts

An "I/O interrupt" on the other hand is initiated *by a signal generated by a peripheral.* When the MPU receives this signal, *it finishes the operation in process* at that instant, then turns its attention to the peripheral requesting attention, before proceeding further. The status of the various registers at the instant of interruption, is "popped" into the stack (as described in an earlier article in this series). Thus, in an "I/O

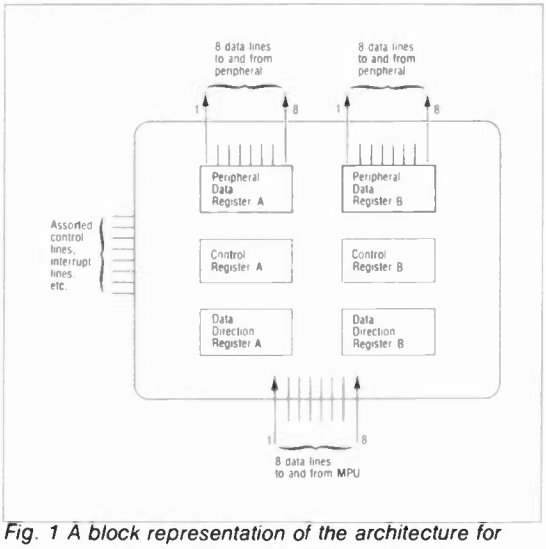


Fig. 1 A block representation of the architecture for Motorola's MC6821 Parallel Interface Adaptor.

Comparison Chart for Some Popular MPU's

Make and Model MPU	Clock	Number of Instructions in Set	Number and Types of Internal Registers
8080 T.I., NSC., NEC, AMD, Intel	500KHz 2 phase	78	Accumulator, instruction register, 6 general purpose 8-bit, 16-bit program counter, 16-bit stack pointer, condition code.
6800 Motorola, AMI, Fairchild, Itachi	1MHz 2 phase	72	2, 8-bit accumulators, instruction register, 16-bit stack pointer, 16-bit program counter, 16-bit index register, condition code register.
Z80 Zilog, Mostek	4MHz 1 phase	158	2 accumulators, 12 general purpose, 2 index registers, interrupt address register, program counter, stack pointer, 2 status registers, memory refresh register.

Fig. 2 A comparison chart for some of the more popular types of MPUs on today's market.

interrupt" *the peripheral exercises some control over the MPU.* This "interrupt" procedure makes it possible for the MPU to handle several I/Os, keeping busy, instead of handling only one I/O, and sitting idle a great deal of the time.

"Direct memory access" (DMA) is a totally different kind of I/O operation, since data bypasses the intermediate steps of going through an accumulator (part of the CPU). Data is *directly transferred between the memory, and the peripheral,* which makes the name self explanatory. Although DMA is very useful for high speed data transfer, it has certain disadvantages. Even though DMA *bypasses the CPU,* the CPU *is not available* for other program executions, since the memory is in use. What we are saying is that DMA avoids using the MPU accumulators, thus eliminating steps which consume time.

While we are talking about "interrupts," an interesting point arises. Many MPUs make provisions for at least two types of interrupts . . . one is a "request for interrupt" (IRQ), *which may either be acted upon, or ignored, by the MPU.* The other class of interrupt is the "non-maskable interrupt" *which cannot be ignored.* When a non-maskable interrupt (NMI) is received by the MPU, it clears its registers by popping them onto the stack. After finishing the operation in process it then proceeds to handle the information from the peripheral generating the NMI.

There is a very good reason for doing all of this. You must keep in mind the fact that the MPU moves information in millions of operations per second. It is capable of handling a variety of inputs, and outputs, apparently simultaneously. Actually, it handles each in turn, sharing its time between them. If you think of a teletypewriter generating several pieces of information per second, you can see that many peripherals are very slow by comparison with the MPU. What the MPU designers have done is to set up a system so that a peripheral that needs immediate attention can get it, while other peripherals wait. Each gets a share of the MPUs attention, on a priority basis. When things are slow, the low priority peripherals get their share of attention. Of course waiting may mean only a few milliseconds, and often memory holds information, so that none is lost. By this means the utility of the MPU is greatly increased.

Terminology

It should be noted that the above abbreviations, such as IRQ and NMI are quite common, but some literature uses other abbreviations for the same functions, (depending upon the make and model of the MPU). The reader will have to adjust to these variations . . . but the important thing is to understand what happens, and why. Since each MPU has somewhat different mnemonics in its instruction set for use in programming, MPU technicians understand, and have become accustomed to, this lack of uniformity.

One of the most frequently encountered I/O devices is the "terminal." A terminal consists of a keyboard with alphabetic letters, decimal numbers, punctuation, and special symbols. The terminal also has some sort of display for readout, such as a cathode ray tube, or some form of printer. A teletypewriter is one kind of terminal, but has the disadvantages of being quite slow and mechanically complex, and is expensive.

It should be noted that many MPU basic kits come with a "keyboard," which is not to be confused with a terminal. Such keyboards usually have decimal numbers, and capital letters A through F, to permit *programming in hexadecimal.* In addition there may be one or two other letters or symbols as required for programming the particular make and model of MPU . . . but they do not have a complete keyboard with all decimal numbers, 26 letter alphabet, punctuation, and symbols, as in a true terminal. The "readout" on such rudimentary keyboards is usually a small LED (light emitting diode) display, using seven segment numerals also capable of forming the letters A through F and certain special symbols . . . again, not a full readout. Since such keyboards are limited to hexadecimal programming, *they cannot be used for anything other than machine language* (a severe handicap).

More I/O instructions

Up to this point the only I/O instructions considered were those that said "Accept this input," or, "Deliver this output." These are the most basic of the I/O instructions, but others are also necessary to control, or test, the operations and status of peripheral devices. Let's look at some of them now.

Remember, several peripherals are often used with a MPU, thus *it is necessary to select the desired peripheral before executing an input or output operation.* A method of doing this is by assigning an address to each peripheral, just as is done with memory addressing. By programming the proper address, we can select a peripheral, just as we select a desired word stored in a specific memory location (address).

But there is more. What if the peripheral selected is not ready to accept, or output, information at the

moment? In order to ascertain this, the MPU can generate a test signal, in accordance with instructions. The test will indicate to the MPU whether the peripheral addressed is ready for inputting, or outputting, in which case the MPU may be programmed to wait until the peripheral indicates a "ready" status. Some MPUs interrogate, or "poll" peripherals, in sequence, and therefore continually monitor the status of *all* the peripherals!

When a slow peripheral, like a teletype machine, is employed, the MPU can actually take inputs from the teletype, and in the spaces between signals, handle another peripheral, so that both seem to be inputting at the same time. Actually they are time sharing the MPU. The same procedure can be used in outputting. To get a better "feel" for this, remember that a high speed mechanical peripheral may take milliseconds per operation, while the MPU takes only microseconds . . . which indicates that the MPU is a thousand times faster!

I/O addressing

As noted earlier in this article, a peripheral is selected by addressing it. The I/O device address is also known as the "port address," and may be an 8 bit or 16 bit address, as is the case with most modern MPUs. One common method of port addressing treats I/O devices as if they were memory locations. A memory address word is used to identify each I/O tied into the data bus. This method is known as "memory mapped I/O." Another method uses special input and output instructions which contain the port address . . . the first byte is the op code, and *the second byte is the address.*

At this time we can make an observation about addressing. You already know that most MPUs use an 8 bit word, and that the memory has a sequence of storage locations for those 8 bit words (which can be either data words, or instruction words). If a data word is limited to 8 bits, the largest number that can be stored is 255, because an eight bit word has only 256 possible combinations, starting with zero. In order to store *numbers* larger than 255, additional memory storage is used. Thus two 8 bit locations can store a total of 16 bits. (It is customary to assign two sequential memory locations.)

When the MPU handles this data, it will process it 8 bits at a time. We were talking about data, but PROGRAM "instructions" are handled the same way, with up to three 8 bit words being used. (*Remember,* the word instruction means an entry in the program, and also can be used to denote the op-code kind of instruction!). Thus three words can be used in a program instruction, the first being the op-code, and the second and third 8 bit words forming a 16 bit address. More commonly a program instruction consists of two 8 bit words, the first being the op-code, and the second an 8 bit address. (This gets you started on your first step towards programming.)

Other models

Obviously you realize now that there are several kinds of addressing modes . . . some have been discussed here. A variety of addressing "modes" (which is what we are talking about), makes a microcomputer more useful, and faster, which is another way of saying "more powerful." Although the description makes the MPU sound more complex, the end result is actually a simplification of the internal processing, since the programmer can specify more efficient operations.

Earlier we discussed serial and

parallel format, and the Asynchronous Communications Interface Adapter (ACIA), one of many interface devices used with MPUs. Now, another such device . . .

The Peripheral Interface Adapter (PIA) connects to the 8 bit bidirectional data bus, along with the ROMs and RAMs, and uses the bus to accept outputs from, and deliver inputs to, the MPU, in the parallel 8 bit word format which the MPU uses internally.

The PIA also connects to two, independent, 8 bit buses, going to peripherals. This means that the PIA can handle 16 bits from the outside world, and deliver them in two 8 bit words, sequentially, to the MPU. Or, since the PIA is bidirectional, it can take two consecutive 8 bit words from the MPU, and deliver them to two independent 8 bit lines connecting to peripherals. Or any combination of the above! As with all such devices, the PIA uses internal registers to accomplish this. Referring to Figure 1, the PIA (a Motorola MC6821), has two independent, identical sections, commonly labeled "A" and "B." Each section has a control register, a data direction register, and a peripheral data register.

The peripheral data register does what its name implies, stores *data* moving between the peripherals and the MPU, and vice versa.

The data direction register stores the information which tells the PIA whether the peripheral lines are going to be used for inputting, or outputting, and which ones are to be so used.

The control register is tied into four lines on a control bus system, which permits the MPU to control the PIA. Since this is an 8 bit register, the remaining bits are also able to handle the interrupt signal functions.

The ACIA

As you can see, the PIA interfaces between peripherals using an 8 bit parallel format (or 16 bits by using two 8 bit words), and the MPU (which also uses an 8 bit parallel format). The ACIA, in contrast, interfaces between a serial format single line, and the MPU. Both can be controlled by signals from the MPU, and both have interrupt capability, and of course, both accomplish their tasks by means of internal registers. Each offers an advantage for certain uses . . . for example, if we wish to transfer data over long distances, the ACIA permits us to use the telephone lines. Without the ACIA we would need eight wires to accommodate an 8 bit bus for parallel format! (The PIA handles information faster than the ACIA by using 8 bit parallel format.)

Frequently in this series you have been cautioned that there is a lack of standardization in MPU architecture . . . that the same register, for example, may have a different name, depending upon the use to which it is put, or upon the make and model of MPU. Figure 2 shows a comparison between some established MPUs, and is self-explanatory. It is used to demonstrate why we are stressing concepts, instead of details. Each MPU is significantly different from the others in architecture, yet all are sufficiently alike, in function and concept, that a technician conversant with MPU theory can quickly master them.

Summary

This article discussed peripherals, including some common interface devices. Input and output operations were covered, along with interrupts, and I/O addressing and control. A brief comparison was made, of some of the features of popular MPUs, in order to emphasize the "concept" approach used in this series. ETD

Yamaha's newest high end tuner

A look at the T-2

You'll find some unique circuits inside this compact state of the art unit, including an automatic eignal quality sensor and one for electronically emphasizing sensitivity or selectivity as noise conditions require. For a detailed review, read on.

By Geoffrey L. Power*

Fig 1 The T-2

From the cat's whisker to the cat's eye, the vernier dial to the slide rule, tuning in a broadcast station was often times a difficult and unpredictable procedure.

With today's electronic tuning it is now almost totally automatic and nearly perfect in preciseness. Although some of us may feel a certain amount of nostalgia for the mystery and mystique almost totally automatic and nearly perfect in preciseness. Although some of us may feel a certain amount of nostalgia for the mystery and mystique of the old methods, the actual performance of most tuners on the market today far outweighs any lost there you have it. Tuned in, locked on, and digitally displayed.

Digital displays seem to be an ever increasing part of our life. Nowhere is this more obvious than in the consumer electronics field.

Audio products in particular in the past year have shown an increased tendency to adopt this type of display, particularly for showing tuner frequency. Although once reserved for the "top" end of most manufacturers' lines, digital displays are now being incorporated in receiver lines and lower priced tuners. At the recent Winter Consumer Electronics Show in Las Vegas almost all of the major manufacturers of stereo components offered new models incorporating digital displays.

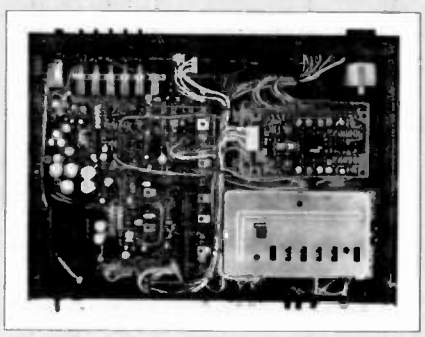


Fig. 2 Serviceability of the T-2 is excellent. Removal of bottom panel exposes main test point and adjustment slugs.

Digital technology is also branching into not only displays but preset logic controlled tuning and automatic station selection. However, displays are still the most active area of development to date.

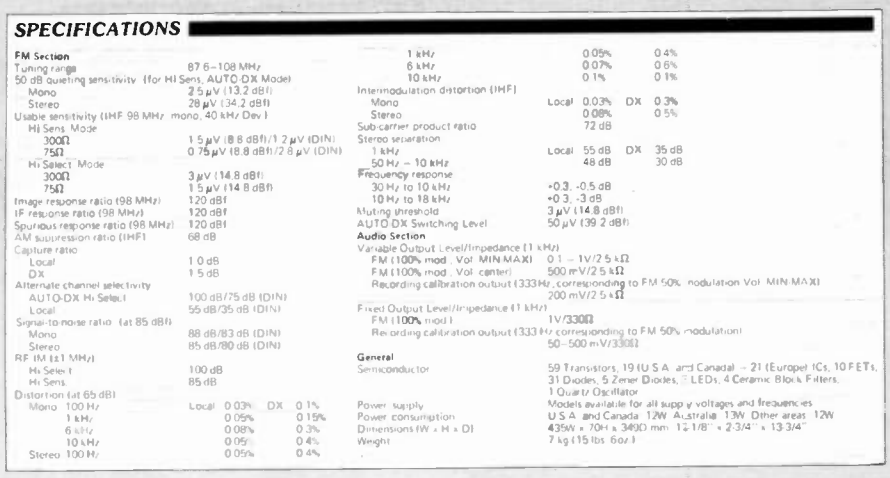
The Yamaha T-2 Tuner, at a suggested retail of $750.00, is an excellent example of a high end professional quality product incorporating digital display with the more traditional slide rule dial scale. The styling approach is a slim, classic, design modeled to match Yamaha's other professional top of the line components. The front panel is elegantly simple with a minimum of controls.

Power is provided by the elongated push-button on the lower left corner. The *Rec-Cal* button activates a built in 333Hz tone generator set at a level equal to 50% modulation for precise setting when recording from FM. The

*National Service Manager, Yamaha Audio Division

Blend button allows the user to override the automatic blend feature which reduces hiss or noise under poor reception conditions. A *Mode* switch allows the user to override the normal stereo function when mono reception would improve listenability. The *MUT/OTS* switch offers the listener a choice of defeating the optimum tuning circuits that limits the reception of stations to only those with adequate signal conditions. Placing this switch in the Off/Multipath position allows the listener to hear any station regardless of quality. The *I.F. Mode* switch provides automatic DX (distance) reception when signal condition deteriorates or a local mode for stronger signal areas. The *R.F. Mode* switch offers the user a choice of either *High Sensitivity* for maximum signal pulling power or *High Selectivity* when crosstalk or adjacent signal distortion is a problem.

The two tuning meters indicate signal quality and center tuning respectively. The *station* window is the digital display indicator. This display is normally dark until the station is locked in by the optimum tuning circuits, then the station frequency will appear in the window. When the *MUT/OTS* switch is in the off position the display window will remain on continuously. Tuning is accomplished via the large tuning knob at right. A heavy fly-wheel inside the chassis lends a positive feel to the tuning action. Three LEDS at the right end of the dial scale indicate reception status.



SPECIFICATIONS

FM Section			
Tuning range	87.6–108 MHz		
50 dB quieting sensitivity (for Hi Sens, AUTO-DX Mode)			
Mono	2.5 μV (13.2 dBf)		
Stereo	28 μV (34.2 dBf)		
Usable sensitivity (IHF, 98 MHz, mono, 40 kHz Dev.)			
Hi Sens. Mode			
300Ω	1.5 μV (8.8 dBf)/1.2 μV (DIN)		
75Ω	0.75 μV (8.8 dBf)/2.8 μV (DIN)		
Hi Select. Mode			
300Ω	3 μV (14.8 dBf)		
75Ω	1.5 μV (14.8 dBf)		
Image response ratio (98 MHz)	120 dBf		
IF response ratio (98 MHz)	120 dBf		
Spurious response ratio (98 MHz)	120 dBf		
AM suppression ratio (IHF)	68 dB		
Capture ratio			
Local	1.0 dB		
DX	1.5 dB		
Alternate channel selectivity			
AUTO-DX Hi Select	100 dB/75 dB (DIN)		
Local	55 dB/35 dB (DIN)		
Signal-to-noise ratio (at 85 dBf)			
Mono	88 dB/83 dB (DIN)		
Stereo	85 dB/80 dB (DIN)		
RF IM (±1 MHz)			
Hi Select	100 dB		
Hi Sens.	85 dB		
Distortion (at 65 dBf)			
Mono 100 Hz	Local 0.03%	DX 0.1%	
1 kHz	0.05%	0.15%	
6 kHz	0.08%	0.3%	
10 kHz	0.09%	0.4%	
Stereo 100 Hz	0.05%	0.4%	
1 kHz	0.05%	0.4%	
6 kHz	0.07%	0.6%	
10 kHz	0.1%	0.1%	
Intermodulation distortion (IMF)			
Mono	Local 0.03%	DX 0.3%	
Stereo	0.08%	0.5%	
Sub-carrier product ratio	72 dB		
Stereo separation			
1 kHz	Local 55 dB	DX 35 dB	
50 Hz – 10 kHz	48 dB	30 dB	
Frequency response			
30 Hz to 10 kHz	+0.3, -0.5 dB		
10 Hz to 18 kHz	+0.3, -3 dB		
Muting threshold	3 μV (14.8 dBf)		
AUTO-DX Switching Level	50 μV (39.2 dBf)		
Audio Section			
Variable Output Level/Impedance (1 kHz)			
FM (100% mod., Vol. MIN-MAX)	0.1 – 1V/2.5 kΩ		
FM (100% mod., Vol. center)	500 mV/2.5 kΩ		
Recording calibration output (333 Hz, corresponding to FM 50% modulation Vol. MIN-MAX)	200 mV/2.5 kΩ		
Fixed Output Level/Impedance (1 kHz)			
FM (100% mod.)	1V/330Ω		
Recording calibration output (333 Hz corresponding to FM 50% modulation)	50–500 mV/330Ω		
General			
Semiconductor	59 Transistors, 19 (U.S.A. and Canada) – 21 (Europe) ICs, 10 FETs, 31 Diodes, 5 Zener Diodes, 3 LEDs, 4 Ceramic Block Filters, 1 Quartz Oscillator		
Power supply	Models available for all supply voltages and frequencies		
Power consumption	U.S.A. and Canada: 12W, Australia: 13W, Other areas: 12W		
Dimensions (W x H x D)	435W x 70H x 340D mm: 17-1/8" x 2-3/4" x 13-3/4"		
Weight	7 kg (15 lbs. 6oz.)		

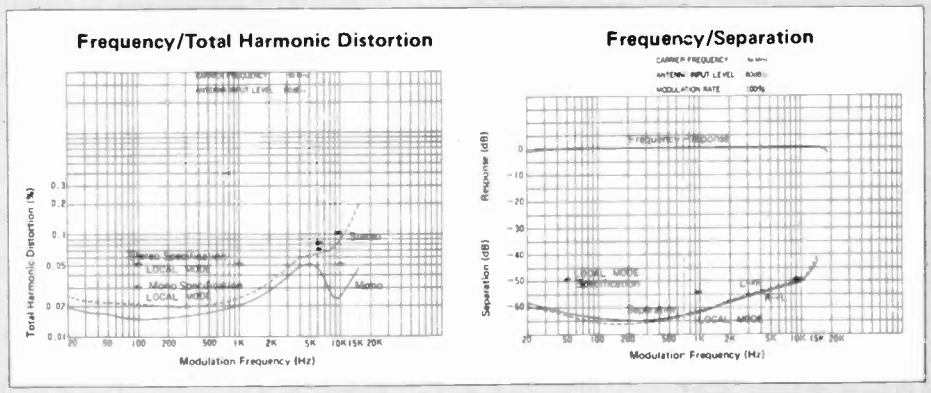


Fig. 3 T-2 Specification sheet

Basic construction

The layout and construction of the T-2 are unique. The faceplate and top of the T-2 is actually one single section of thick aluminum extrusion with a smooth black anodized finish giving the product the look and feel of substance and quality although adding to its weight (15 lbs.). Serviceability is extremely good since removal of the metal bottom cover (6 screws) allows full access to all circuitry. (See Fig. 2.) The main circuit board is in full view with reference designations and adjustments clearly identified. The front end RF pack is enclosed in a separate shielded enclosure and sits next to the post amp and digital counter module which can be removed by unplugging (4) connectors. The power supply, fusing, and dial stringing are all open and within reach.

One caution that should be noted is that since the servicing technician will be working from the bottom of the unit and the top is not removeable, care must be taken to make sure that the unit rests on a soft, protected surface that is free of debris. Although anodized aluminum is a tough durable finish, scratches are permanent and cannot be removed or easily disguised. In addition, the owner of a $750 tuner tends to be perhaps a little more sensitive about the appearance of his purchase so extra care is advised.

Circuitry

The Yamaha T-2 is an ultra precise no compromise approach to FM reception. As can be seen from a brief look at some of the more significant specs. (See Fig. 3), the T-2's obvious purpose is to receive and process stereo FM broadcast signals with maximum clarity and fidelity. It should be kept in mind that the digital display of tuned frequency is incidental to that objective. Although a precise readout of the station frequency is an excellent user convenience and has strong appeal, it has no significant relationship to the quality of the signal received or reproduced and,therefore, for troubleshooting purposes the digital circuit can be considered separate and apart from the FM circuitry. This is not always the case, since a few recent product introductions do involve synthesized digital tuning circuits and some logic control circuits. The T-2 has four major circuits (Fig. 4) not including the power supply which although fairly elaborate, should not present any difficulty in understanding.

The RF unit

The RF unit tunes the desired frequency, then amplifies and converts the signal to the I.F. frequency (Fig. 5). It features a selectable reception mode controlled by a front panel switch and also supplies the signal to the display circuit.

In the front end D1 is used to switch the selectivity of a single tuning capacitor, while D2 is used to switch the gain of the first RF amplifier stage. When the RF MODE switch is in the HI SENSITIVITY position, +B bias is applied to both D1 and D2, resulting in D1 being turned off while D2 is turned on. The single tuning capacitor trimmer TCA2 is thus floated from ground, resulting in a smaller resonance circuit gradient. And with D2 turned on, the TR1 negative feedback is by-passed, thereby increasing the gain for higher sensitivity.

If a -B bias is then applied, the D1 and D2 switching positions are reversed, D1 turning on the D2 turning off. TCA2 is thus connected to ground to give the resonance circuit a steep gradient to improve the rejection of interference signals. And with D2 switched off, the amount of negative feedback is increased, thereby reducing the gain.

An Exciting New Parts Concept For In-Home TV Service.

RCA has a better and more flexible system to help TV service people tailor their parts inventory to the types of chassis being serviced. The heart of the new system is a carrying case that we think is ideal. We call it the RCA Sidekick.

Whether you're servicing in-warranty or out-of-warranty chassis, you'll find that the RCA Sidekick is your best friend when it comes to stocking and carrying the right RCA parts.

Now it's no longer necessary to carry a separate kit for each new chassis. When a new RCA chassis comes out, you buy only those parts you don't already have. A handy RCA chart helps you cross reference parts by chassis usage.

The RCA Sidekick holds 164 standard RCA part boxes — enough room for all the parts you'll need with plenty of room to spare. The large drawer has room for tools, handbook, drop cloth, etc. Everything you need is at your fingertips.

The Sidekick can take a lot of abuse. It's made of strong, lightweight ABS plastic. The drawers can't fall out because of a no-spill lock-in feature.

No one else has anything like it. We're excited and we think you'll be too. For full information see your RCA Distributor or write to: RCA Distributor and Special Products Division, Deptford, New Jersey 08096.

RCA Distributor and Special Products Division

The total RF stage gain is 30dB in the HI SENSITIVITY position, and 27dB in the HI SELECTIVITY position.

Buffer amplifier

TR4 is employed to prevent the local oscillator from oscillating as a result of the signal applied by the mixer when a strong input is received, and also to amplify the local oscillator signal to a level sufficient for the mixer to operate normally. By keeping the mixer level low, and placing TR4 right next to the mixer, the effects of unwanted emissions from the local oscillator are eliminated. When using an RF stage which is not completely shielded as in the T-2 tuner, keeping the local oscillator output level as low as possible, and increasing the level right next to the mixer, is an effective way of protecting the mixer from the local oscillator emissions. TR6 has also been positioned so as to protect the local oscillator from the effects of the clock pulse generator for the digital circuit board. TR4 has a similar gain.

AFC

Output signals from the discriminator are returned to the AFC terminals via a DC amplifier stage. If the discriminator potential varies in either direction (positive or negative) from zero, the voltage is applied to D3, resulting in a change in the capacitance of the D3 varactor diode. The extent of the change

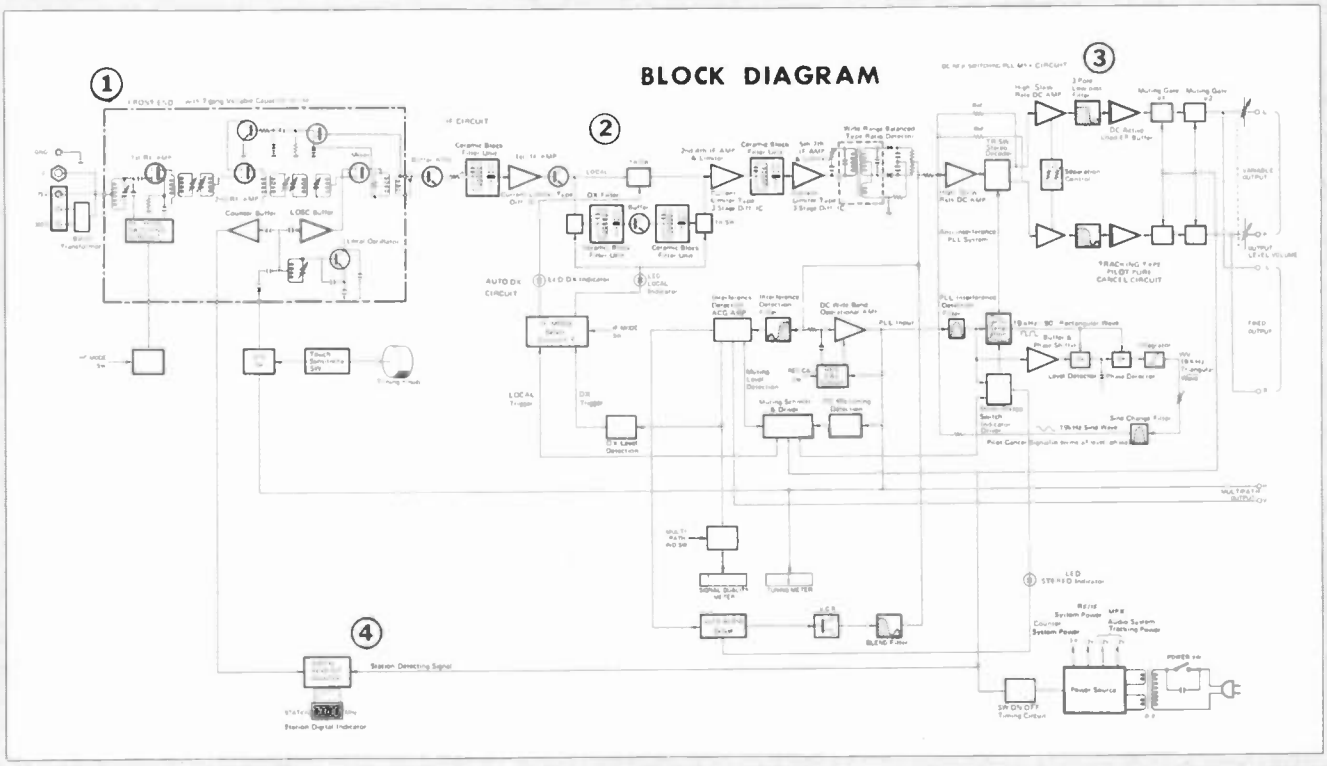


Fig. 4 The overall block diagram

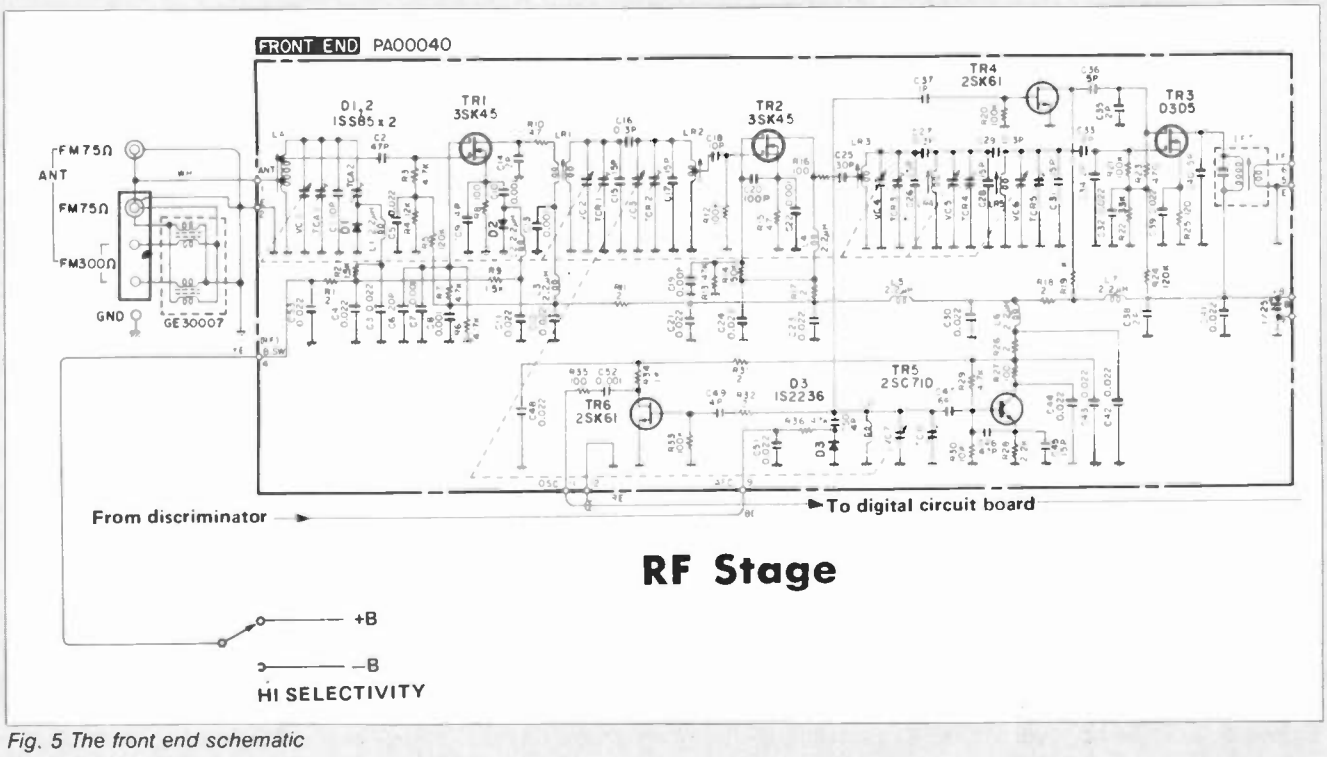


Fig. 5 The front end schematic

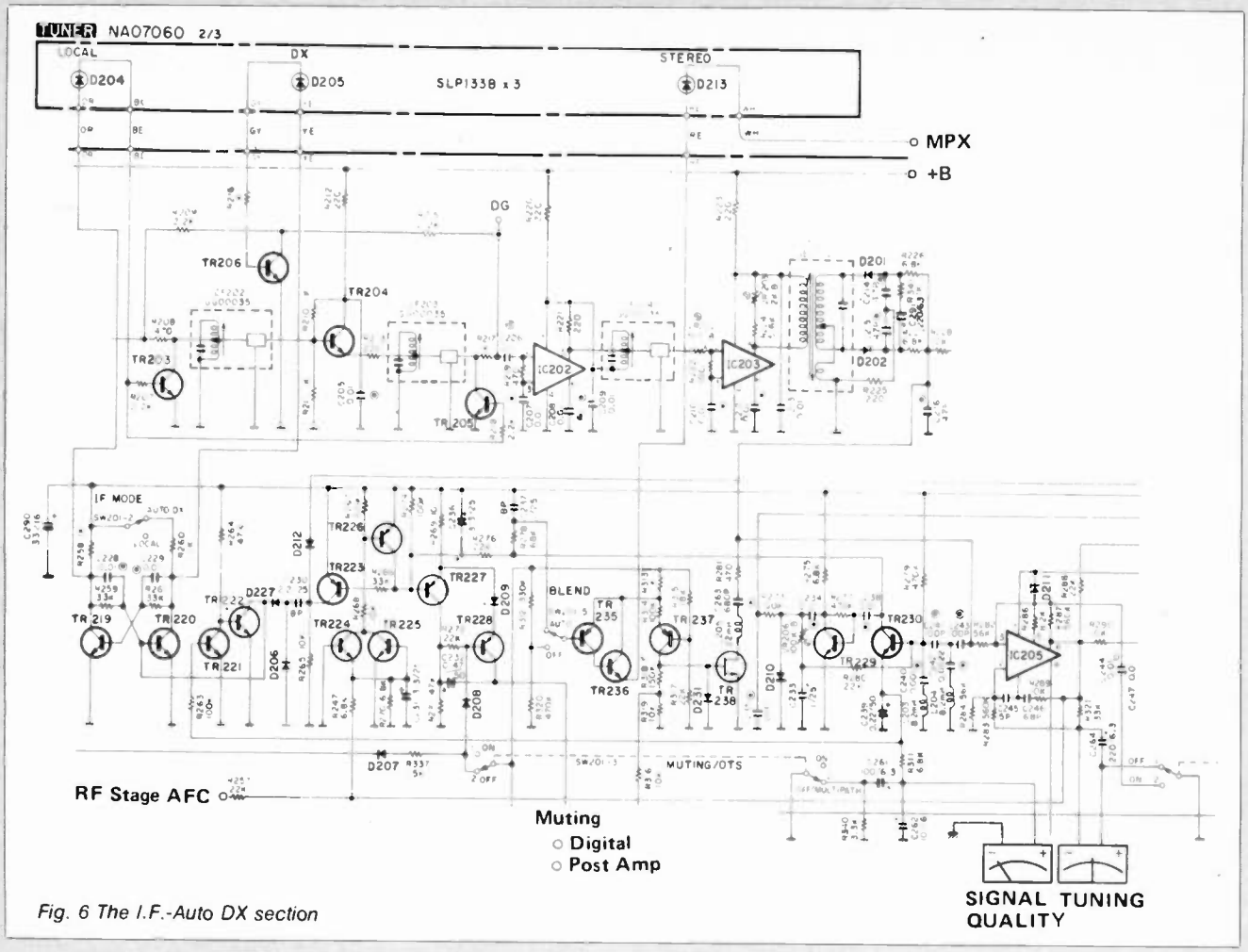


Fig. 6 The I.F.-Auto DX section

is determined by the voltage level, and subsequently alters the local oscillator frequency by a corresponding amount.

Auto DX-Muting

The IF auto DX-muting stage further amplifies the signal while at the same time removing unwanted interference. The mode switching feature automatically adds two additional filter stages for added interference suppression.

In order to correct for any variation between different filters, impedance matching circuits of capacitors, resistors, and coils have been connected to the input and output sides of each ceramic filter. Consequently, the differential gain deviation within the passbands has been reduced to no more than 0.2dB. Also note that these filters have been readjusted by the differential gain direct-reading method when mounted in the tuner.

LOCAL-DX switching

The IF amplifier may be switched to LOCAL mode where emphasis is on audio quality with relatively little interference, or to DX where greater emphasis is placed on reduction of interference (when the interference level is higher).

When the IF MODE selector is switched to the LOCAL position, CF202 and CF203 are by-passed, resulting in a selectivity of 55dB and an S/N ratio of 85dB with 0.05% distortion and 55dB separation. When switched to the DX position, these 2 ceramic filters are included in the signal path, resulting in a very high selectivity of 100dB, 0.15% distortion, and separation of 30dB.

When detuned, the LOCAL-DX switching circuit is held in the DX position, and the digital circuit and POST AMP circuit are muted. (See the "S" curve in Fig. 7.) The signal component from the discriminator consists of noise only, and the (-) AGC voltage returned to the base of the meter amplifier TR23 is set to maximum level.

There will consequently be no current flowing between collector and emitter of this transistor, and the signal quality meter will read zero. And since there will be no bias applied to the base of TR221, this transistor will turn off, and TR222 turn on, thereby connecting the base of TR220 to ground to hold the switching circuit in the DX position. The collector potential of TR230 will be high at this time, so TR227 will turn off, and TR228 will turn on, thereby applying a bias signal to TR502 in the digital circuit and TR411, 412, 413, and 414 in the POST AMP circuit. The digital display will therefore turn off, and the POST AMP output will be shorted. Hence, there will be no sound.

With TR220 turning off and the collector potential increasing, the DX indicator LED D205 will light up, and TR206 will be turned on to connect the LOCAL route to ground. The IF signal will therefore pass through the CF204, and CF203 narrow band filter.

Since there will also be a high voltage on the base of TR223 (the LOCAL switching pulse generator transistor) this transistor will turn off. If the MUTING switch is turned off, the +B voltage will be applied to the base of TR228 via D208, thereby forcing the transistor to turn off. This will cut the muting voltage applied to the digital circuit and the POST AMP circuit, resulting in the digital display coming on and the audio output becoming audible again.

Tuning to a station

Upon entering the S-curve region, the level of noise components from the

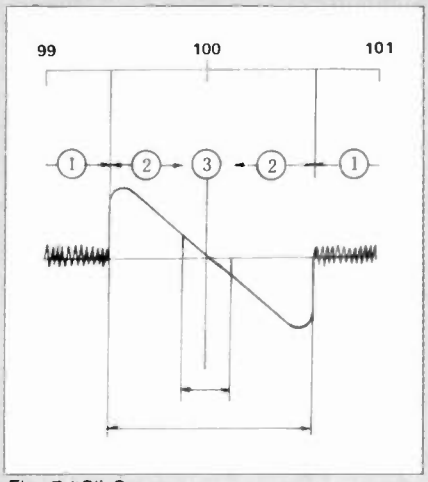


Fig. 7 "S" Curve

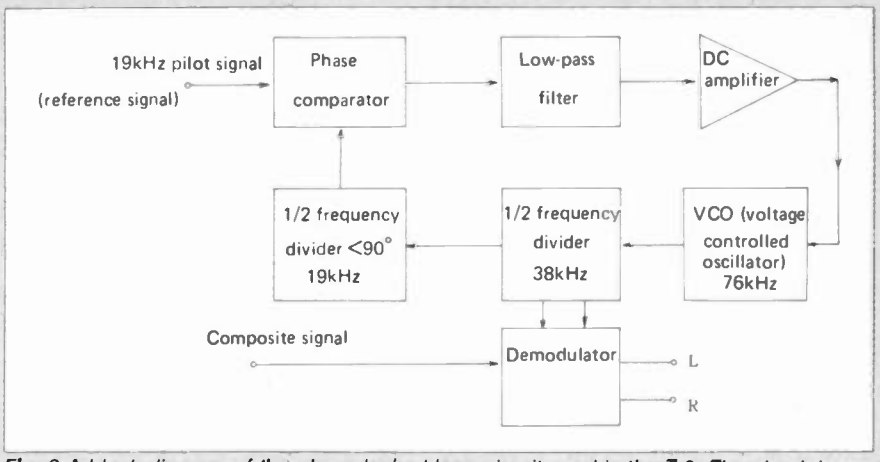


Fig. 8 A block diagram of the phase locked loop circuit used in the T-2. The circuit is completely contained in one single IC chip.

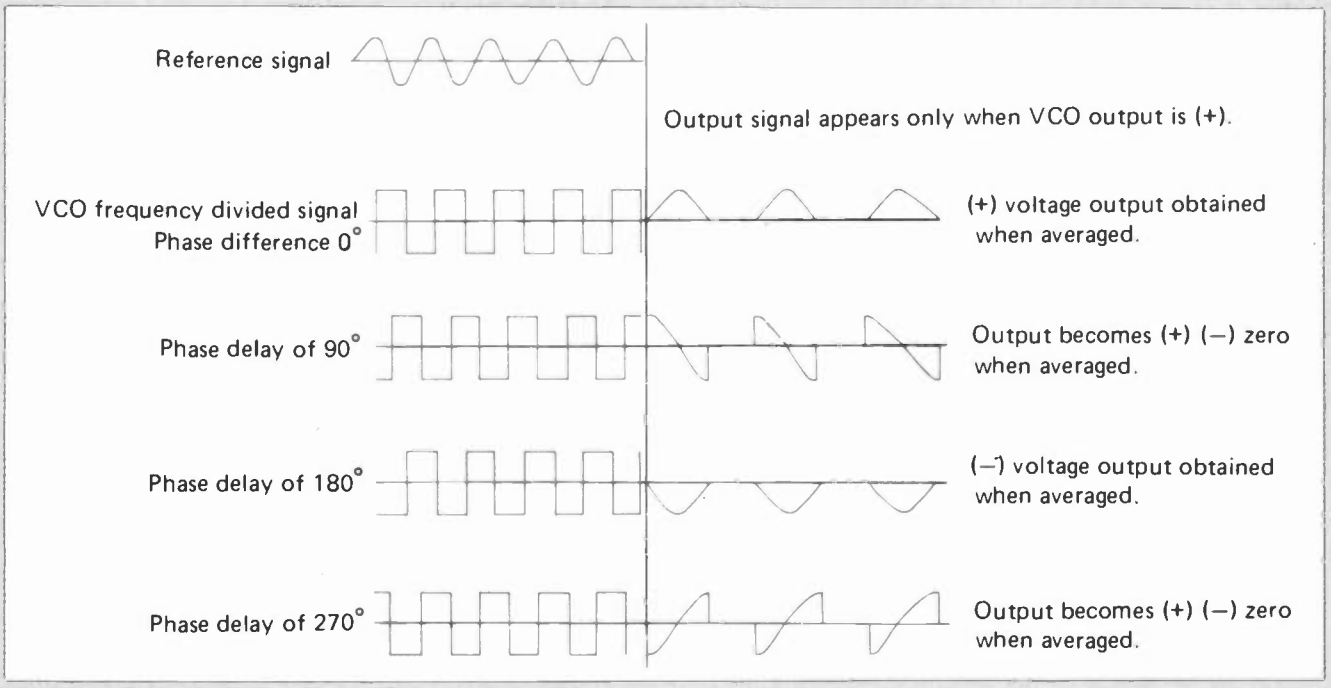


Fig. 9 Signal reference charge for the PLL circuit

discriminator is considerably decreased, resulting in the emitter potential of the meter amplifier transistor TR230 being increased. The signal quality meter will commence to deflect, and the DX level detector circuit TR221 which had been held in DX mode will be turned on, and TR222 turned off. This, however, will not release the DX hold status.

Although the DC level was zero when tuned away from the station (region 1), a DC potential appears at the discriminator output once the S-curve region has been reached.

This DC potential is amplified by the wide band inversion DC amplifier IC205, and is then subsequently applied to the AFC for the tuning meter and RF stage, and also to TR224 and TR225 (the circuit which detects the tuning away from a station).

Because of the decrease in noise level once the S-curve region is reached, the base of TR227 becomes biased in the negative direction, resulting in its being turned on, and TR228 being turned off, thereby terminating the muting status. At this stage, however, the desired broadcast will still be several 100KHz away, and the sound will still be considerably distorted.

For example, when approaching a desired station at 99MHz from the 100MHz direction, the DC amplifier output will become positive the moment that TR227 base potential becomes negative (due to the sudden decrease in noise level). This positive voltage will then be applied to the emitter and base of TR224 and TR225 (the DC de-tuning point detector circuit). TR224 will consequently turn off, and TR225 turn on. And since the TR226 base bias will remain high, the muting will be terminated.

The tuning meter will then swing back to center from the minus side as a result of the DC voltage comparison.

When station is tuned

When the desired station is tuned more accurately and region 3 is entered, the emitter voltage of TR230 will reach a maximum (as long as there are no interference signals) and the signal quality meter deflection will also indicate maximum level.

The collector voltage will consequently be at a minimum level, and the LOCAL switching pulse generator transistor TR223 will turn on to commence generating positive pulse signals by C230, D227, and D206. Since TR221 had already been turned on and TR222 turned off when in region 2, these pulse signals will be applied to the base of the DX switching transistor

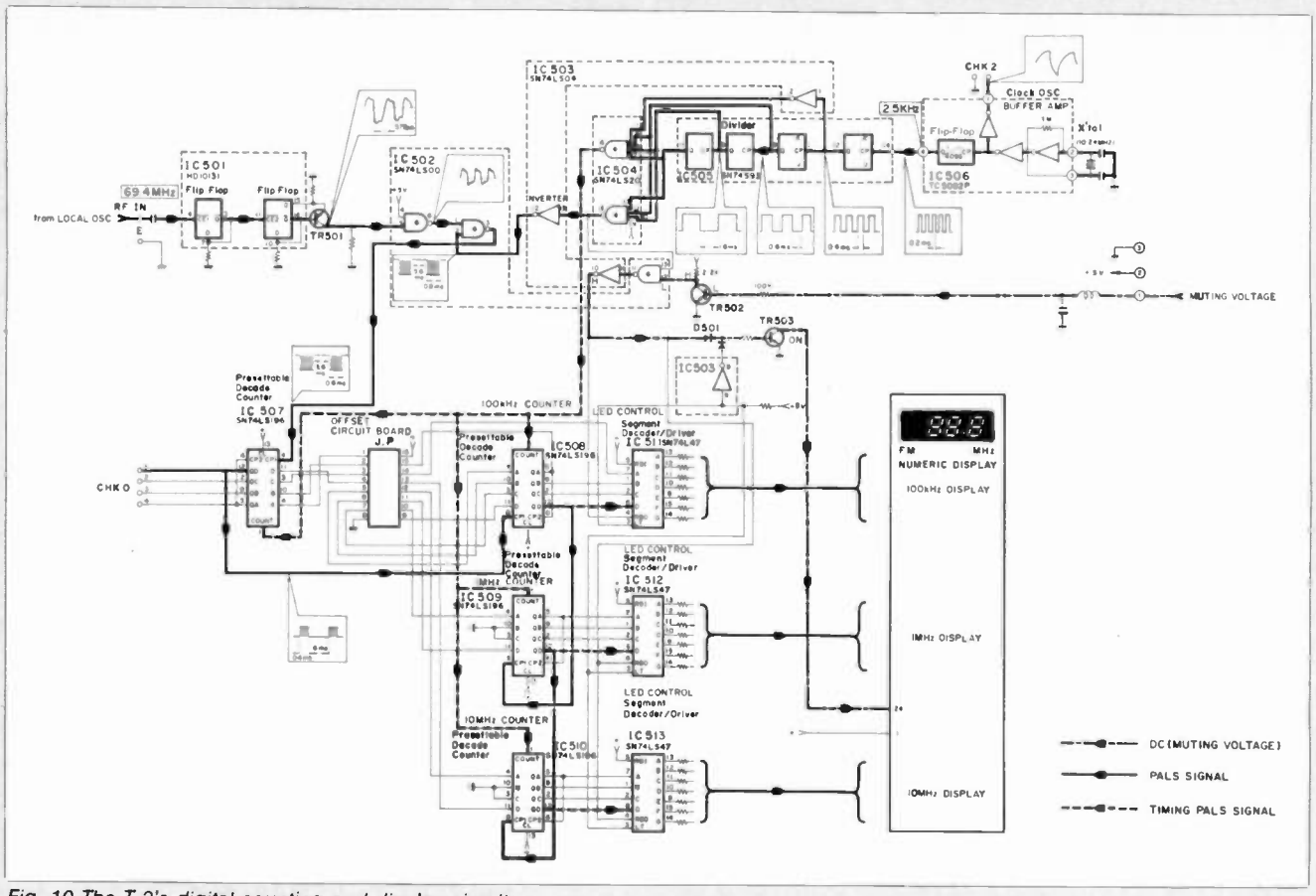


Fig. 10 The T-2's digital counting and display circuit

TR220, resulting in it being turned on and TR219 being turned off. The TR219 collector potential will consequently increase, thereby lighting up the LOCAL indicator, and connecting the DX route to ground by turning TR203 and TR205 on.

At the same time, TR227 will be turned on, and TR228 consequently turned off, thereby terminating the muting of the digital circuit and the POST AMP circuit.

If there is interference even at the central tuning point, there will be considerable noise from the discriminator. And since the TR230 emitter potential will be low, TR221 will be turned off, but leaving TR222 turned on. With the TR222 base connected to ground, the pulse signals generated by TR223 will also be shorted to ground, thereby maintaining the hold on the DX mode.

If the interference signal is rather strong, or the antenna input signal extremely high, the high noise level will maintain a high potential on the collector of TR230, resulting in TR227 being turned off, and TR228 being turned on, which means the output will remain muted.

If a signal of rather poor quality, or containing considerable pulsating noise, is received when tuning in LOCAL mode, the reduced TR230 emitter potential will connect the TR220 base to ground, thereby switching over to DX mode. Note that if the noise level should disappear after this, TR223 will not turn off and on again unless the muting circuit is reactivated. This means that there will be no LOCAL switching pulse signals generated, so there will be no automatic switch back to LOCAL mode from DX mode.

Furthermore, D212 connected to the collector of TR223 is also connected to pin no. 10 of IC204 which has been designed to force the MPX into mono operation when tuning to and tuning away from broadcasting stations. Once the station is tuned, +B will be applied via TR223, resulting in a reverse bias being applied to pin no. 10. This pin will thus be raised to ground potential to switch back to stereo mode.

PLL multiplex stage

This stage basically decodes the processed IF signal from the detector to obtain the (L) (R) stereo signal (see Fig. 8).

Many FM tuners today employ a switching system in the MPX circuit, and these require synchronous switching with the broadcasting station in order to separate the left and right channel signals. To obtain this switching signal, most tuners use a PLL (phase locked loop) circuit which compares and then "locks" the phase of an oscillator signal with that of a reference signal in order to obtain an accurate frequency. The basic operation is as follows:

—When the power supply is turned on, or when a monaural signal is received, the VCO oscillates freely at a frequency around 76kHz. When a stereo signal is received the 19kHz pilot signal contained in the composite broadcast signal is applied to the phase comparator where it serves as the reference signal.

—The 76kHz signal generated by the VCO is divided by 2 frequency dividing stages into a 19kHz signal which is also applied to the phase comparator.

—The phase comparator then compares these two 19kHz signals and detects the presence of any phase difference between them. An output voltage signal is generated in proportion to the degree of difference in phase. (See Fig. 9.) This signal is then converted by a low-pass filter into a DC voltage signal which corresponds in level to the phase comparator output voltage.

—A DC amplifier than amplifies the

DC voltage applied by the low-pass filter and uses it to drive the VCO.
—The VCO consequently varies the oscillator frequency (phase) in accordance to the level of the DC amplifier output. Steps (4) to (7) above are repeated until the phase comparator output is reduced to zero. The output is then locked. (Generally, the phase difference between the reference signal and the VCO divided signal is set to 90° or 270°.)

Once the phase has been locked, the 38kHz signal obtained by dividing the signal generated by the VCO will conform precisely to the timing of the broadcasting station, and is thus used for switching purposes. The final audio signal thus obtained has very good stereo separation with little distortion.

The stereo lamp

The stereo lamp drive circuit also contains a phase comparator and a frequency divider stage. Once the phase-locked status has been attained, a (+) output will be obtained due to phase conformity with the reference signal (the 19kHz pilot signal). This output is passed via a low-pass filter and DC amplifier to activate the stereo lamp drive circuit. The lamp is lit once the circuit containing Vcc, lamp, lamp drive circuit, and ground is completed. An output signal is also applied to the demodulator by the lamp drive circuit at this time, resulting in output signals separated into left and right channels being obtained from the demodulator. Consequently, the output signal will become monaural whenever the lamp turns off. When a stereo broadcast is received, the stereo lamp will light up as soon as the phase lock is applied, and the output signals separated into left and right channels. The PLL circuit utilized in the T-2 is contained in one single IC 204.

Digital display

Although counting numbers is a relatively simple task (adding, remembering results, shifting), measuring high frequency signals at low levels accurately and displaying the results involves complex circuitry. (See Fig. 10).

As indicated in the digital printed circuit board's block diagram, the IC's are actuated by the DC muting voltage for LED control and by the clock oscillation and frequency display pulse signals, the frequency of the local oscillator output from the OSC terminal of the RF front end is divided and

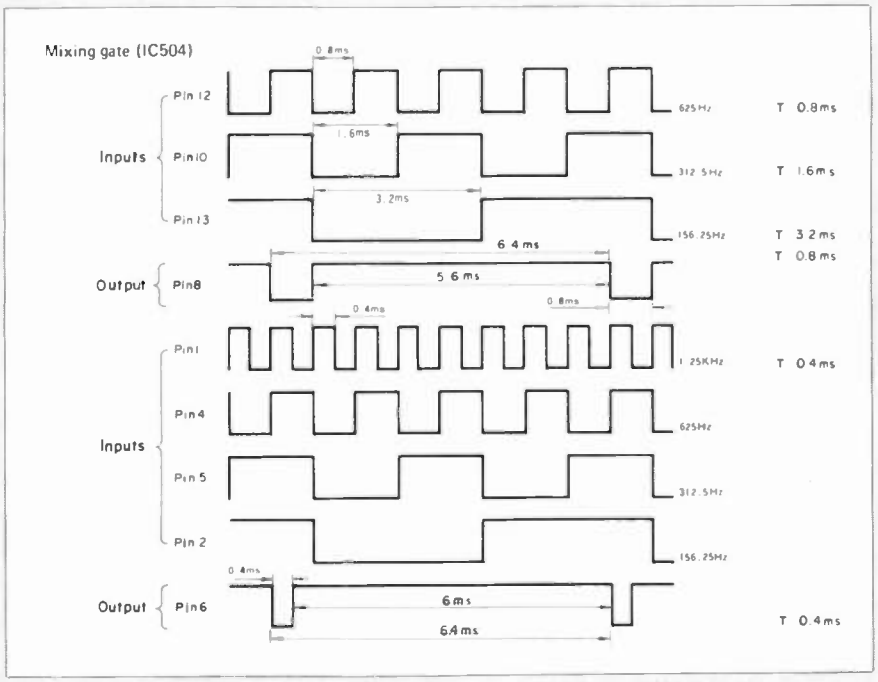


Fig. 11 The timing chart for IC504 which serves as a dual input NAND mixing gate

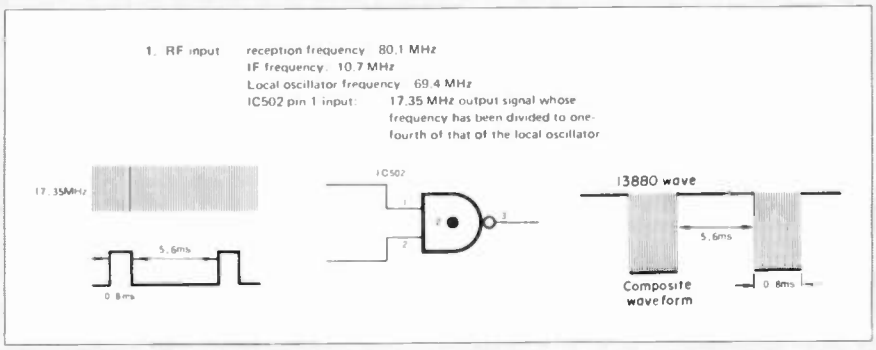


Fig. 12 Signal flow chart

detected, and the LED indicators light up.

Clock oscillator

The clock oscillator is composed of IC506 and a 10.24MHz crystal oscillator. IC506 is an IC which integrates a flip-flop for frequency division at a ratio of 1/4096 with the oscillator section. The output which passes through the 12-stage flip-flop, is divided by 4096 and the output appears as a 2.5 KHz pulse signal at pin 4.

This 2.5 KHz output signal from the clock oscillator is sent to pin 14 of IC505 for the divider. IC505 is a high-speed counter composed of four master-slave flip-flops and it is made up for a 1/16 frequency divider.

IC504 is a dual input NAND gate circuit using multi-emitter transistors. It receives the output of IC505, mixes it and feeds out timing pulses such as those in Fig. 11 from pins 8 and 6. The output signal from pin 8 becomes the pulse that determines the RF input through-time, and the output signal from pin 6 of IC504 becomes the IC507-508-509-510 reset timing pulse.

RF input circuit

The RF input signal of the local oscillator which is taken from the RF front end OSC terminal enters the RF IN terminal on the digital printed circuit board, and then enters pin 6 of IC501. The signal passes through the two pairs of high-speed flip-flops inside IC501 and its frequency is divided by 4. It is then level-converted by TR501 and sent to pin 5 of IC502. Its output from pin 6 of IC502 is then sent to pin 1 of IC502 again. The 0.8 mS pulse output signal from pin 8 of IC504 is inverted and it enters pin 2 of IC502. This means that composite waveforms such as that illustrated in Fig. 12 are available at pin 3 of IC502.

Pins 1 of IC507 to IC510 are triggered by the trailing edge of the composite waveform, and then the decade counting operation begins. If the FM reception frequency is taken to be 80.1 MHz, then the frequency of the local oscillator will be 69.4 MHz, and a

17.35MHz signal (frequency which is one-fourth of that of the local oscillator) will enter pin 1 of IC502, it will be mixed with the 0.8 ms pulse and a composite output will be obtained as in Fig. 12.

The counter

The output signals appearing from pin 3 of IC502 are sent to each of the presettable counter IC's: 507, 508, 509, and 510. Since the IF center frequency (fi) tends to fluctuate, the oscillation frequency of the local oscillator also tends to fluctuate, and these counters serve to compensate for these fluctuations.

The preset values of IC507 to IC510 are determined by the offset printed circuit board.

The output of IC502 enters pin 8 (CPI) of IC507, its frequency is divided, and becomes the pin 12 (QD) output. It is counted to pin CP1 of IC508, and then IC509 and IC510 and fed until the digits reach the 10MHz level. When the output of pin 6 of IC504 goes to LOW, the input data for IC507 to IC510 are preset.

LED drive circuit

IC511 is a decoder/driver IC for driving the 7-segment LED indicator from the 4-bit BCD input. It is configured as an output open collector and a maximum current of 80mA may be allowed to flow to each of the LED indicator segments when it is in the active low mode. It is responsible for counting at a reception frequency level of 100kHz. There are seven outputs (A to G), and the LED array through which the outputs of pins A to G are displayed.

Servicing the T-2

As stated earlier the T-2, although a very sophisticated product, can be relatively easy to work on. What tends to make servicing a product of this type difficult is its preciseness of performance and the subsequent high expectations of the consumer. It is not sufficient to merely receive a good quality signal in a functional manner, but it is necessary to receive a virtually perfect signal with maximum separation and essentially no distortion. To service this type of product only the best in test equipment will do the job.

Although servicing high quality audio products can be very satisfying, it can also be discouraging unless the servicer is adequately prepared and properly informed. A bench with high quality equipment is essential and, of course, the technician must be familiar with its use in addition to being thoroughly familiar with FM circuitry.

Yamaha does have a list of recommended test equipment—nine pieces of equipment which carry a retail price tag of $7,416.55. While it is not necessary to carry this specific equipment, it is necessary for authorized service centers to meet the basic requirements found in Fig. 13.

Audio products account for a rapidly growing share of all consumer electronic goods sold yearly. Component audio servicing provides an interesting and profitable opportunity for the service professional. ETD

YAMAHA AUDIO
SUGGESTED TEST EQUIPMENT LIST
FOR AUTHORIZED WARRANTY SERVICE CENTERS

INSTRUMENT TYPE	PREFERRED SPECS.	MINIMUM SPECS.	USEFUL OPTIONS
R. F. Stereo Generator	.05% THD Stereo 60dB Sep.	.2% THD 50dB Sep. and level calibrated RF Attenuator	400 Hz, 1000 Hz Oscillators
Total Harmonic Distortion Analyzer and Audio Oscillator	.001% Residual THD	.005% Residual THD	Square wave output
Oscilloscope	DC-200 MHZ 1mV. Sen.	DC-10MHz 10mV Sen.	Dual Trace or Dual Beam
Non-Inductive Load Resistor	8 Ohms ± 1% 250W	8 Ohms ± 1% 250W	Switching for 4 and 16 Ohms
Wow-Flutter Meter	.01% f.s. flutter Nab. w/rms .03% f.s. wow	.1% f.s. flutter Nab. w/rms	Din., JIS, Standard 3kHz/3.15kHz
Frequency Counter	5Hz - 200 MHz 10mV. Sens.	50Hz – 10MHz 25 mV. Sens.	Period Averaging
Digital Multi-Meter	4 (or more) digits/ 100mV to 1000v ac-dc/ 1 - 1000mA ac-dc/ 100 Ohm to 10M Ohm (full scale ranges)	3 digits/ IV-500V ac-dc/ 100-1000 mA ac-dc/ 1K – 1M Ohm (full scale ranges)	Auto-Ranging Overload & Protector circuits and 3½ (or more) digits
Variable AC Supply	0-140 V. a.c. 20A	0-140 V.a.c. 7½A	A.C. Voltmeter A.C. Watt Meter

Fig. 13 Yamaha's suggested test equipment list for authorized warranty service centers

General Electric has just published your favorite book. Again.

We have added over 90 pages of MRO types and related information. And we have presented ICs in easier-to-use fashion than ever before. The latter are now shown in chart form and are grouped under various application headings—such as Preamps—in descending order of power dissipation.

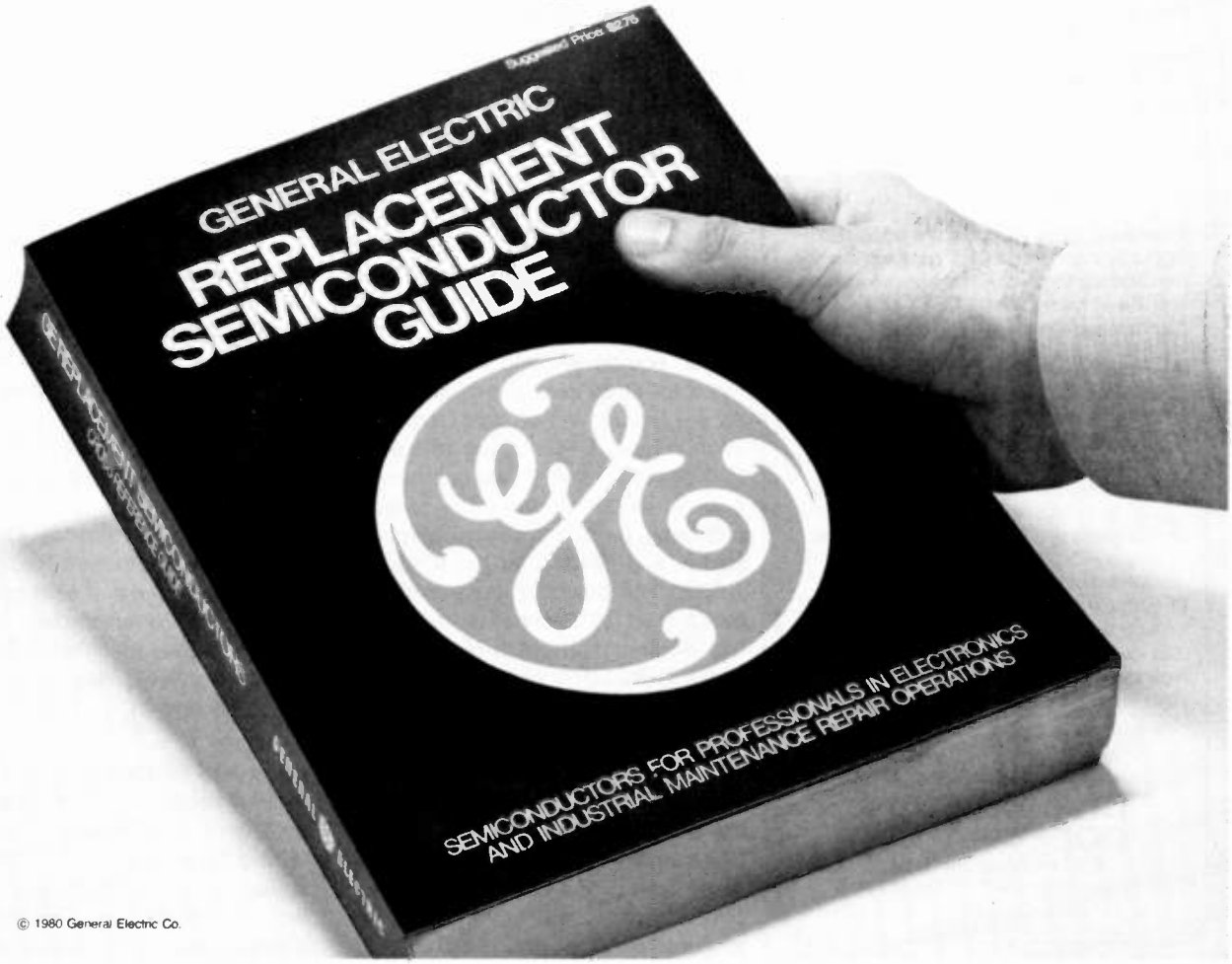
As before, our unique parts ID numbering system tells you at a glance almost all you need to know when making a replacement. Thus, GE5ZD3.3 stands for a 5-watt, 3.3-volt zener diode by General Electric.

Keeping up with the industry is how General Electric helps you stay in touch. With technical literature like this updated Semiconductor Guide...and with the replacement parts you need for the equipment you service.

For your copy of the book you asked us to publish again, see your authorized GE distributor today.

Tube Products Department—Owensboro, Kentucky 42301

GENERAL ELECTRIC



BULLETIN BOARD

A new 1980 catalog of Tele-Communications tools has just been published by *P. K. Neuses, Inc.* The catalog has 16 pages of cable and wire tools, including cable slitters and strippers, tension gauges, dynamometers and thickness gauges, and screwdrivers, wrenches, and other tools for work on electronic equipment. Write: P. K. Neuses, Inc., PO Box 100, Arlington Heights, IL 60006.

The K line supplement to Volume II of the *Zenith* color TV chassis schematic manual has just been issued. this supplement contains all chassis schematics for 1979 models and an updated index. The set (Volumes I and II) cover all Zenith color TV chassis thru 1979, with supplements and are available from Zenith distributors.

Disc capacitors, ceramic resonators and resistive/capacitance networks are described in a catalog recently published by *RMC-Radio Materials Corporation*. Complete specifications on many types of monolithic, low voltage subminiature, temperature compensating and high voltage capacitors are included. Also described are ceramic resonators, solder-in capacitors (without leads) and multiple capacitor, resistor capacitor networks. From RMC-Radio Materials Corp., 4242 W. Bryn Mawr Ave., Chicago, IL 60646.

Tools, equipment and supplies of all types for electronics repair and assembly are featured in the latest catalog from *Techni-Tool*. This catalog offers over 200 pages of tools, test instruments, chemicals, work benches, storage cabinets, parts handling equipment, solder, and clothing for the electronics industry. All products are stated to be guaranteed by Techni-Tool as well as the original manufacturer. Minimum order is $25.00. Write: Techni-Tool, Apollo Rd., Plymouth Meeting, PA 19462.

Instruments for Testing and Design is the title of the new 1980 catalog from *Continental Specialties Corporation*. Along with a line of solderless breadboard assemblies, CSC offers logic analyzer kits, logic probes, IC test clips, instrument cases and hardware, and test instruments, including a digital capacitance meter, a tri-mode comparitor, logic monitors, a function generator, frequency counters, a counter/timer, and pulse generators and accessories. Write: Continental Specialties Corp., 70 Fulton Terrace, New Haven, CT 06509.

A supplement to the 1979 Sylvania ECG Semiconductor Master Replacement Guide has recently been announced by *General Telephone and Electronics*. ECG212J-1 is a twelve page supplement containing data on 30 new ECG devices and reportedly 3200 additional part numbers in the cross reference. Available from Sylvania distributors.

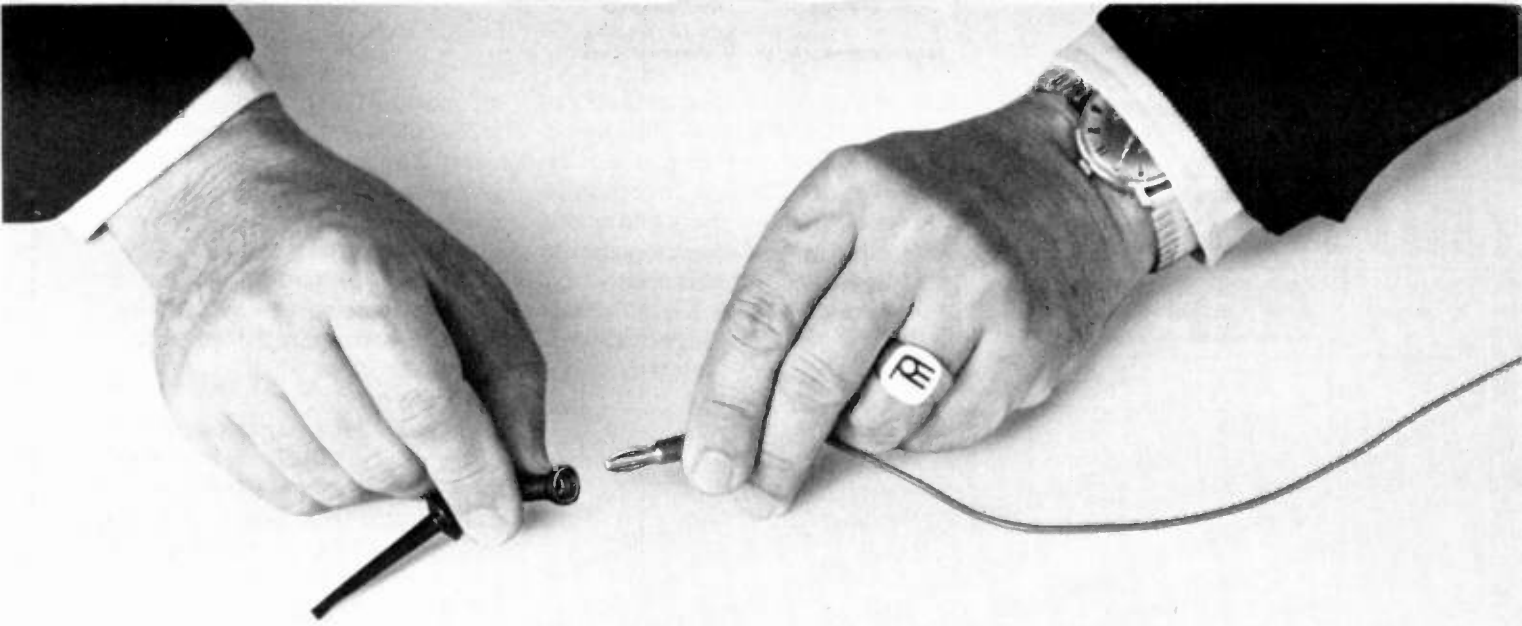
Kits for amateur and two-way radio are featured in the new 1980 catalog from *Hamtronics*. Products include transmitting converters, a UHF FM receiver, an AM aircraft receiver, a weather tone alert receiver module, VHF converters and linear power amplifiers. Write: Hamtronics, Inc., 65F Moul Rd., Hilton, NY 14468.

A new **General Line/MRO Components Catalog** is available from *Cornell-Dubilier*. Its 60 pages feature electrolytic capacitors, ac capacitors, metallized-film capacitors, Mica capacitors, disc ceramic capacitors, EMI filters, relays and decade boxes with full information on each. Cross-referenced. Write: Cornell-Dubilier, 150 Ave. L, Newark, NJ 07101.

A very extensive line of multiple outlet strips is featured in a new 24 page catalog from *SGL WABER Electric*. Detailed descriptions and illustrations of 119 stock models and examples of custom design are included. The catalog is free from SGL WABER Electric, 300 Harvard Ave., Westville, NJ 08093.

Antique Radio Service Data is now available from *Antique Radio Services* which also buys and sells antique radio equipment. For a complete list of materials and sets available write: Antique Radio Services, 646 Kenilworth Terrace, Kenilworth, IL 60043.

Complete replacement packages for flyback replacement are now offered by Thordarson Meissner. Each kit contains a flyback, a damper diode, a horizontal output transistor and installation instructions. At your Thordarson distributor. ET/D



Keep your test instruments honest.

Introducing the non-skid banana.

It's what you get when you cross a tenacious Minigrabber with a standard banana plug in our new Model nos. 4723 and 4724.

To ensure a good connection that won't slip, skid or pop off, the Grabber features a gold plated beryllium copper contact held secure by a strong, stainless steel spring.

ITT Pomona Electronics makes a full line of Maxi, Mini, and Micro Grabber patch cords plus do-it-yourself models with simplified threaded or solder assembly procedures.

See your distributor for genuine ITT Pomona Electronics Grabbers. And be sure to write for our giant 100-page catalog of quality electronic test accessories.

ITT Pomona Electronics, 1500 E. Ninth St., P.O. Box 2767, Pomona, CA 91766. Phone (714) 623-3463.

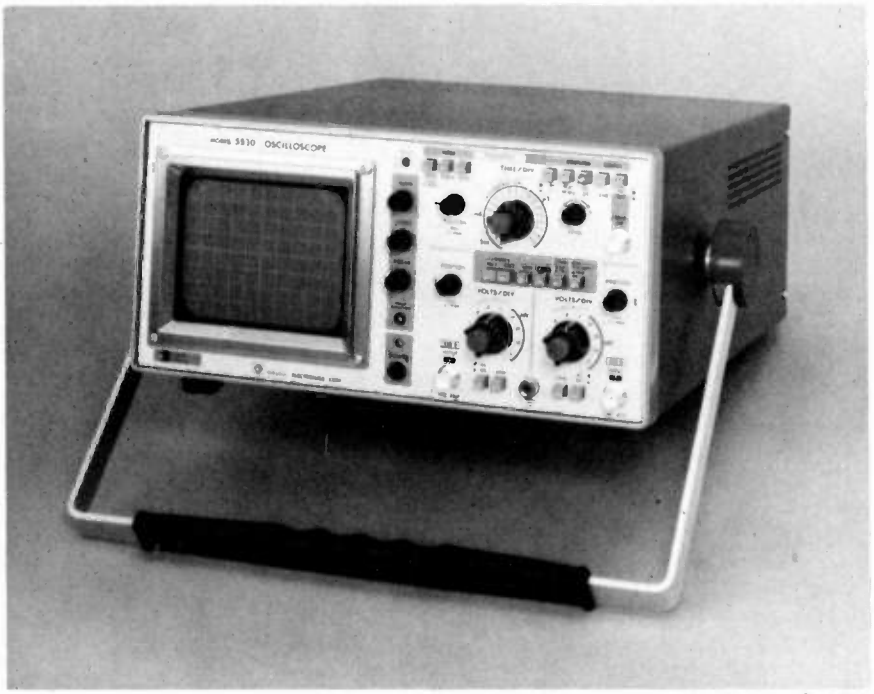
AVAILABLE THROUGH YOUR FAVORITE ELECTRONIC PARTS DISTRIBUTOR

FREE 1980 YEARBOOK CATALOG
Contains 100 pages of adapters, cable assemblies, jacks, plugs, boxes, sockets, connectors, jumpers, clips, probes, patch cords, wire, and much more. Yours free upon request. See our pages in EEM.

Pomona Electronics ITT

Circle No. 122 on Reader Inquiry Card

TEST INSTRUMENT REPORT



For more information circle number 150, Reader Service card this issue.

The 5530 oscilloscope

Kikusui's re-entry into the U.S. market

By Richard W. Lay

Kikusui Electronics Corporation of Japan, with a U.S. office in Carson, Calif., has begun marketing test instruments in this country again after a lapse of about eight or nine years, and among the family of oscilloscopes they offer are two dual channel, 35-MHz units.

Other instruments by Kikusui include voltmeters, digital multimeters and frequency counters, wow and flutter meters, DC power supplies and RC oscillators.

Getting back to the scopes, we find the units ranging from the Model 5509 10MHz single trace with "TV" triggering built in ($475) all the way up to the 35 MHz, dual trace model 5630 with delayed sweep and retailing about $1,595.

The unit ET/D looked at was the lower end "sister" to the aforementioned. It was the 5530, with a suggested retail of $1,095. The basic differences between the two as listed by the manufacturer are the 5630's delayed sweep capability, the built in "TV" trigger mode of the 5630, and its greater Z-axis bandwidth of 5MHz, compared to the stated 1MHz Z-axis of the 5530.

Talking about bandwidth, both are rated at 35MHz but practical use found that the 5530 far exceeded that claim.

Notwithstanding the performance of the unit itself, one of the first things I noticed about the 5530 when I opened the box was its almost complete pushbutton operation. In my opinion, this feature, rather than switches, makes an oscilloscope much more compatible and even less prone to user error.

The 5530's relatively wide bandwidth makes it an ideal instrument in today's service environment. It's readily available for use in either digital or analog settings. As far as its dual trace capabilities, it's hard to imagine such scopes once were considered a luxury. With phase comparison and timing so important in digital work, a dual trace is now essential.

Eighteen front panel pushbuttons supply most of the control functions for the 5530. Eight front panel dials and three time/division selectors for horizontal and vertical controls round out the unit's front panel controls. On the rear you will find the Z-axis input and a special plug connector which cuts in various transformer taps to modify the line voltage to a level appropriate for the unit. It may be operated at voltages within 10 per cent of 100, 115, 215, and 230VAC, the manufacturer states.

A 5¼ inch P31 (blue) CRT with illuminated graticles is used in the unit. A hefty 5.6KV of acceleration voltage aids viewing even magnified signals. (The 5530 is capable of 5-times magnification on horizontal and vertical channels.

Also located on the front panel are the vertical inputs, the ground connector, an external trigger input, and a 1V p-p (1KHz) square wave signal output.

Four of the unit's front panel dials control horizontal and vertical positioning and double (when pulled out) as the signal magnifiers. The fourth is the trigger (positive or negative) level adjustment.

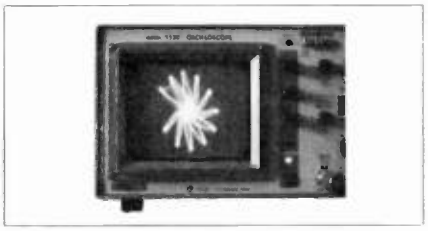
Ease of operation of the 5530 is what I found to be one of the real pluses for this Kikusui scope. Pushbuttons allow the user to select channel one, two, dual, add, or X-Y display of the signals. Another permits triggering of channel one off channel two, or vice versa, and differential readings (for instance for use in stereo channel alignment) are available through a channel two polarity inversion pushbutton when the scope is used in the "add" mode.

Located along the top of the unit's front panel just above the horizontal positioning control are three triggering control pushbuttons and a red LED. The buttons are labeled AUTO, NORM, and SINGLE. In conjunction with the LED indicator, these controls can be used, among other things, to confirm the presence of an unwanted spike on a power supply. By setting the scope to the NORM mode, "arming" the LED with SINGLE pushbutton, and properly adjusting the scope's trigger level, an unwanted spike can be used to trigger a

sweep, thereby extinguishing the LED and alerting the operator of the presence of the spike.

When used in the AUTO mode, the input signal is automatically grounded but the time axis is swept and a trace is displayed to permit a check of the zero level of the signal in question.

To the right of this set of pushbuttons



are five more. They control positive/negative triggering; the Flat/HF Rej mode; the AC/DC coupling state for the trigger signal; the LINE trigger button; and the Int/Ext trigger mode.

The Flat/HF Rej mode permits accurate triggering on comparatively noisy signals which are being displayed, by stripping the high frequency noise component through insertion of a filter with a cutoff frequency of about 50KHz, according to Kikusui.

Although there is no separate Alt/Chop mode selection switch, the 5530 does switch between the two states, depending on the setting of the 20 section horizontal sweep time/division selector. All settings under .5mS are displayed in the Chop mode while those from .5mS to .2uS are displayed alternately.

The scope's X-Y mode setting permits those of you interested in Lissajou patterns to display them on the screen. The Z-axis modulator will accept a signal which modulates the intensity of the displayed signal.

The suggested retail on the 5530 is $1,095. ETD

Specifications

VERTICAL:	5mV/div to 5V/div in 10 steps, X5 Mag, 1mV/div to 1V/div
Delay Time	About 150nS
Input Impedance	1Megohm, 25pf
HORIZONTAL:	
Time Base	.2uS/div to .5S/div in 20 steps, X5Mag, 40nS/div. to .1S/div
Amplifier Bandwidth	Dc to 2 MHz
TRIGGER	Auto, Normal, Single
Source	Internal (ch1, ch2), Ext, Line
Coupling	DC, AC, HF Reject
Z AXIS	Intensity modulation
Sensitivity	3V p-p (brighter with negative input)
Bandwidth	DC to 1MHz

NEW PRODUCTS

Computer Terminal CRT Tester

Circle No. 130 on Reader Inquiry Card

Information is now supplied with *B&K-Precision* CRT restorer/analyzers to permit the field testing of computer terminal cathode ray tubes—both monochrome and color. A built-in restoring capability also permits the field engineer to restore extended life to faulty tubes. Reportedly, user's have found that more than 95% of CRT's will function as well as new tubes after restoration. B&K-Precision's 467 is designed for fast operation and will reportedly remove shorts and leakage from faulty tubes. Automatic restoration timing it is stated will prevent possibly costly timing errors that could cause cathode stripping. Perpetual set-up chart updates and new adapters are available. The Model 467 offers an exclusive multiplex testing technique, called Tri-Dynamic™ testing. The system tests all three guns of a color CRT simultaneously, under actual operating conditions. Another 467 exclusive is its capability to test focus electrode lead continuity. The B&K Precision Model 467 CRT restorer/analyzer is housed in a convenient carrying case with internal storage compartments for CRT adapters and set-up charts. The unit is priced at $360.

Low Cost High Performance DMM

Circle No. 131 on Reader Inquiry Card

A new true RMS, LCD digital multimeter that provides a high Vdc accuracy of 0.1% and four measuring ranges has been introduced by *DSI Instruments*.

Stated to offer features normally found only in DMM's selling for 50%-100% more, the Model LC5000 is priced at $169.95. The LC5000 affords pushbutton control of all measuring functions; five true RMS AC and five DC voltage ranges—200mV, 2.0V, 20V, 200V and 1000V; five DC current ranges—200μA, 2.0mA, 20mA, 200mA and 2 Amps; and six resistance ranges—200 ohms, 2.0 kohms, 20 kohms, 200 kohms, 2.0 Megohms and 20 Megohms. It also provides automatic polarity (plus/minus) indication. The use of precision Laser-Trimmed Resistor Networks and advanced LSI integrated circuit chips reportedly result in long-term accurate and reliable performance, as well as minimizing the need for recalibration. The LC5000 also incorporates fused input circuitry to help prevent possible damage to the instrument due to over-

ITEM NO.
WK-7

CMOS SAFE

IC INSERTION/EXTRACTION KIT

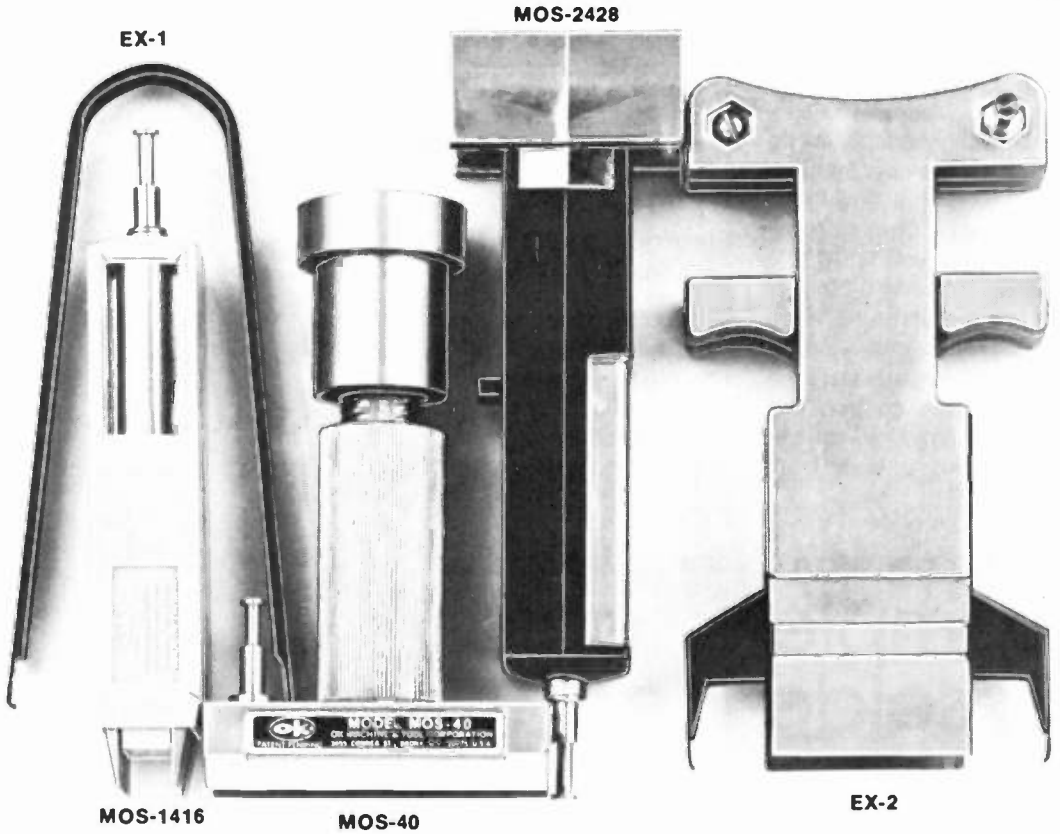
KIT INCLUDES

- MOS-1416 14-16 CMOS SAFE INSERTER
- MOS-2428 24-28 CMOS SAFE INSERTER
- MOS-40 36-40 CMOS SAFE INSERTER
- EX-1 14-16 EXTRACTOR
- EX-2 24-40 CMOS SAFE EXTRACTOR

OK MACHINE & TOOL CORPORATION
3455 CONNER ST., BRONX, N.Y. 10475 U.S.A.
PHONE (212) 994-6600 TELEX NO 125091

PRINTED IN U.S.A.

PATENT PENDING



WK-7	COMPLETE IC INSERTER/EXTRACTOR KIT	$29.95

INDIVIDUAL COMPONENTS

MOS-1416	14-16 PIN MOS CMOS SAFE INSERTER	$ 7.95
MOS-2428	24-28 PIN MOS CMOS SAFE INSERTER	$ 7.95
MOS-40	36-40 PIN MOS CMOS SAFE INSERTER	$ 7.95
EX-1	14-16 PIN EXTRACTOR TOOL	$ 1.49
EX-2	24-40 PIN CMOS SAFE EXTRACTOR TOOL	$ 7.95

MINIMUM BILLING $25.00. ADD SHIPPING CHARGE $2.00. NEW YORK RESIDENTS ADD APPLICABLE TAX.

OK MACHINE & TOOL CORPORATION 3455 CONNER ST., BRONX, N.Y. 10475 (212) 994-6600/TELEX 125091

Circle No. 119 on Reader Inquiry Card

loads. Front panel connections are three low-loss "banana type" plug receptacles. The first is for current inputs to 2.0 Amps. The second is for inputing up to 1000V, and resistances to 20 Megohms. The third is for common (gnd.) input. The instrument weighs just over two pounds, including the 9-Volt battery, and measures only three inches high, 8 inches wide (without the handle) and 9 inches deep. Typical current requirements are stated to be 2mA for DC voltage, current and resistance measurements, while 5mA are needed for AC measurements.

30MHz AM/FM/Phaselock Generator

Circle No. 132 on Reader Inquiry Card

The new *Krohn-Hite* Model 2400 consists of two complete generators in one package, stated to provide features never available before in a single unit. Each generator may be used independently, or combined to provide 0-100% AM or suppressed carrier AM, 0-20% FM trigger (Pulse), Gate (Burst) and 100:1 sweep up or down, or two, phase-locked outputs with 100:1 locking capture range and 90° variable phase control. The main generator provides sine, square, triangle, ramps and pulses from

.003Hz-30MHz and, features 30V p-p output, pushbutton dB attenuator and vernier, fixed and/or variable dc offset, symmetry control and more. The auxiliary generator provides sine, square, triangle, ramps and pulses from 0.3Hz-300kHz, and features 20V p-p output and more. The 2400 is intended for high frequency design or testing of AM, FM or phase lock circuits and systems, or communications equipment. It is priced at $1,495.00

Electrical System Fault Finder

Circle No. 133 on Reader Inquiry Card

The Fault Finder, by *Trinity Electronics*, is a solid-state electronic device which, when used in conjunction with a standard clamp-on ammeter, is stated to aid in locating shorts or opens in automotive, marine and aircraft electrical systems or any other type of electrical system which operates in the range of 5 to 30 volts DC.

In an automotive electrical system, the Fault Finder is clipped into the circuit at the fuse block or at the battery and the clamp-on ammeter gives a direct indication of a short. Any ammeter deflection means a short exists in the circuit. No deflection, no short. Location of the short is accomplished by taking readings with the ammeter at various points in the circuit away from the battery or fuseholder. When no current is indicated the short is between that point and the last point at which current was indicated.

Location of open circuits is accomplished without the use of the ammeter. A puncture clip is provided for this purpose and a red LED indicator lamp on the Fault Finder gives indication of voltage.

The Fault Finder requires no internal battery and comes with a one-year limited warranty at a suggested retail price of $79.95.

Variable Isolation Transformer

Circle No. 134 on Reader Inquiry Card

The "Powerite" from *Sencore* is a 400 watt isolation transformer with output voltage variable from 0 to 140 volts. The "Powerite" provides an automatic safety check by simply pushing in two pushbuttons while using the included safety probe to touch suspected "hot" parts of the equipment, such as control shafts, tuner shafts, exposed screw heads, etc. One button checks leakage to the high side of the AC line and the other to the low side. Leakage is read on the meter directly in microamps and compared to manufactgurer's recommendations of to 500 microamps maximum as established by Underwriter Laboratories. Medical equipment may be checked for a standard 100 micro-

HICKOK LX SERIES MULTIMETERS OBSOLETE YOUR TRUSTY OLD VOM!

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.

A complete line of inexpensive accessories is available to extend other capabilities far beyond those of a comparably priced VOM.

All the super-durable, high quality professional meter you need for service and maintenance work at an analog price. So why pay *as much* for analog inaccuracy.. or *more* for digital frills?

Write today for complete details or contact your local Hickok distributor. Better yet, call us toll free, outside Ohio, at 800-321-4664

- Automatic polarity, zero and overrange indication
- Easy-to-read ½" high LCD display
- ½ year battery life in typical use
- 12 oz. including 9V battery
- Withstands 4 ft. drop without loss of accuracy
- Automatic decimal point, built in low battery indicator, diode and transistor testing capability (LX304 only)

Carry it in your pocket, brief case or tool box and enjoy on-the-spot accuracy whenever and wherever you need it.

No need to worry about damage. It's built to take it...so you can take it with you wherever you go.

LX303 – $74.95

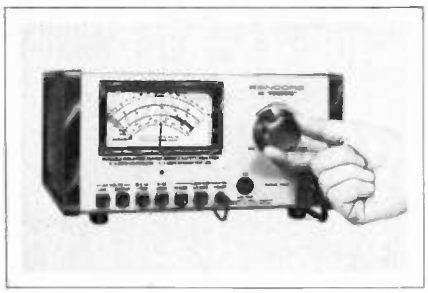
LX304 – $89.95

HICKOK
the value innovator

Circle No. 129 on Reader Inquiry Card

See us at EDS '80 Show Booth G-27

THE HICKOK ELECTRICAL INSTRUMENT CO.
10514 Dupont Avenue • Cleveland, Ohio 44108
(216) 541-8030 • TWX: 810-421-8286

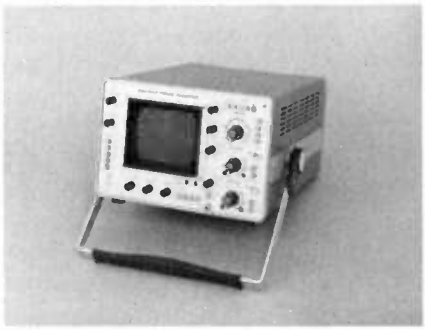


amps. The meter is protected against overload should the safety probe be touched to the AC line. The probe also contains a resistor that doubles as a safety device and enables a full scale field calibration check at 800 microamps. The resistor is switched out of the circuit for accurate current measurements, once a leaky component is found, by a push switch on the probe. A 2% recessed 6-inch meter is used to monitor AC volts, current, and watts. All measurements are read separately with pushbutton operation. AC line and "Powerite" AC voltage output is read from 0 to 150 volts. AC current is measured from 0 to 4 amps. Wattage is read in volt amps to 470 watts. The "Powerite" is protected by a magnetic circuit breaker which is backed by a 4 amp slo blo fuse on the rear. Weight is 18 pounds; the price is $375.

Storage Oscilloscope

Circle No. 135 on Reader Inquiry Card

A new high sensitivity, dual channel, 10MHz storage oscilloscope has recently been introduced by *Kikusui*. Intended for use in low frequency medical, mechanical and physical measurement applications, the Model 5516ST can be used as a conventional oscilloscope or can be used in a bi-stable storage mode where it will reportedly display stored events for up to one hour. Vertical sensitivity is from 5mV/div to 10V/div with a X5 amplification available. Sweep time is from 0.5usec/div to 1 sec/div. X-Y mode is available. Stored display can be held up to one hour on the trace and can automatically be erased after a selected viewing time. The price of the 5516ST is $1,795 with a 2-year warranty.



Super Champ Tool

Circle No. 136 on Reader Inquiry Card

A new tool with the capacity to crimp insulated and uninsulated terminals and splices is available from *AMP Special Industries*. The Super Champ IV crimps both the wire barrel and insulation barrel on insulated terminals in the same crimping notch. There is another set of crimping notches for uninsulated terminals. This tool features an in-nose wire cutter; a "0" crimp for universal ignition terminals; color coded insulation crimp notches; a bolt cutter; a stud gauge; a wire stripper gauge and cushioned handles.

Benchtop DMM

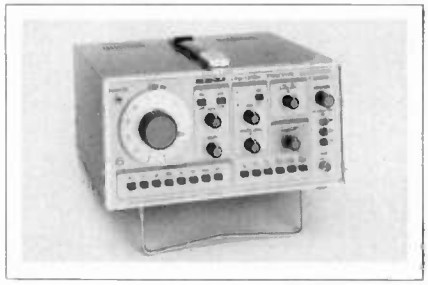
Circle No. 137 on Reader Inquiry Card

Data Precision has recently introduced a new low-cost 3-l/2digit benchtop digital multimeter, Model 1351, which can measure AC or DC currents up to 20A. The Model 1351 has 34 ranges. It can measure DC volts from 100μV to 1200V, AC volts from 100μV to 1000V RMS and resistance from 100mΩ to 20MΩ with either high (2.8V) or low (300mV) excitation. In addition, both AC and DC current can be measured from 0.1uA up to a full 20A full scale. The basic accuracy is rated at 0.1%. Measurements are displayed on a 0.43" LED display. Pushbutton controls are provided for all ranges and functions. The Model 1351 reportedly offers excellent electrical protection—even from 6KV spikes or inadvertent voltages up to 500V on resistance ranges. The Model 1351 is packaged in a modern styled molded case with a built in tilt stand and carrying handle. It is supplied complete with test leads, instruction manual, certificate of conformance to NBS Standards, spare fuse and 1-year warranty. The unit is priced at $199.

2MHz Function/Sweep Generator

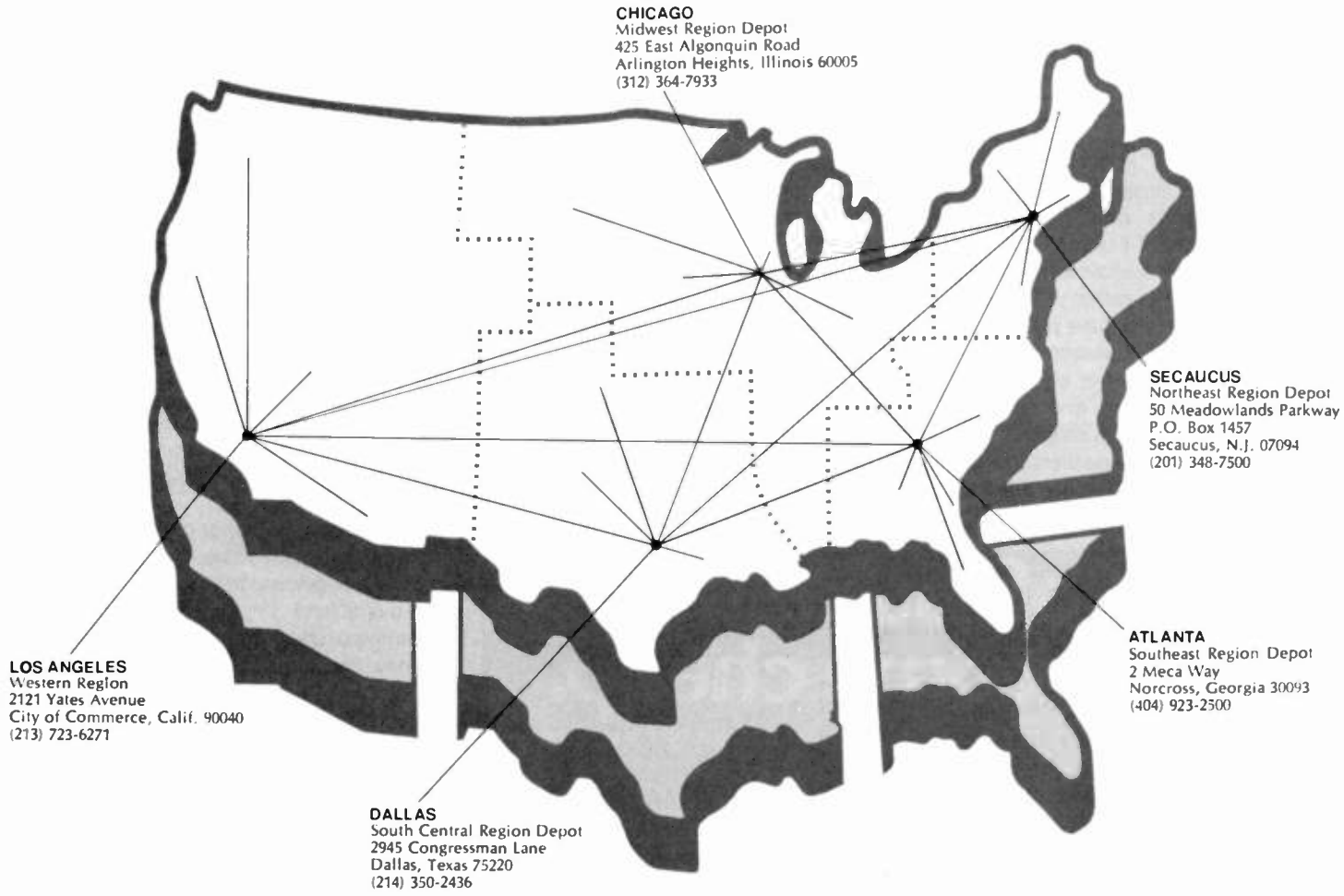
Circle No. 138 on Reader Inquiry Card

Leader Instruments new function generator, the Model LFG-1300S provides an extremely wide range of signal generator capabilities suitable for use in design, testing and service applications. The LFG-1300S reportedly covers frequencies of 0.002 to 2MHz in 8 ranges



and includes linear and logrithmic sweep modes with sweep widths up to 1000:1 and sweep rates of 0.5 to 50Hz. The generator output frequency may also be varied by an external 0-10 V signal. Waveform outputs include sine, triangle, sawtooth and pulses. The symmetry of the pulse output is variable from 9:1 to 1:9. In the pulse mode, adjustment of pulse width does not change the pulse repetition rate. Output level is continuously variable from 0 to 20 V p-p (50-ohm load) and a push button attenuator provides up to 70dB steps. An auxiliary connector provides TTL level signals for driving logic circuits. DC offsets of 0 ±10V are provided and front panel controls adjust the percent modulation and carrier level when an external amplified modulation signal is applied. The manufacturer's suggested selling price for the LFG-1300S Function Sweep Generator is $495.00. ETD

Nine years ago we split the country today we've got it all together and we made it smaller



Last year Panasonic Company made the following improvements in its computerized distribution network:

- **Automatic drop shipment from any one of our five regional depots regardless of where the order originates from**
- **Automatic substitutions**
- **Automatic replenishment of regional stocks**
- **On line status information**
- **Panafax facsimile network linking the regional depots together**

The overall result was a binding together of our resources in order to service you better. In addition we have:

- **A central parts depot with 120,000 individual parts on file and in addition four regional parts depots with 20,000 part numbers in stock**
- **Toll free calls connect Panasonic distributors and authorized servicenters to automatic facsimile machines located at regional parts depots, thus orders can be received 24 hours a day, 7 days a week**
- **One hundred independent part distributors conveniently located to bring needed parts and accessories closer to the customer**
- **Plus a toll free number (800-447-4700) for the location of the nearest authorized Panasonic parts distributor**

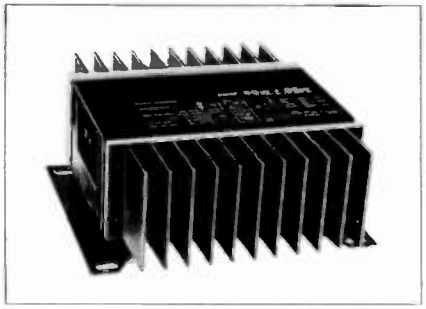
Our system is designed to get parts to a customer more quickly and easily than ever before. First we got the country together, then we made it smaller. For more information, write:

Panasonic
just slightly ahead of our time

Attn: SUPPORT SERVICE DEPT.
Panasonic Consumer Parts Division
50 Meadowlands Parkway
Secaucus, N.J. 07094

Circle No. 121 on Reader Inquiry Card

DEALER'S SHOWCASE



Auto-Sound Line

Circle No. 140 on Reader Inquiry Card

Audiovox Corporation has recently introduced its new Hi-Comp line—including the Hi-Comp $1,000 "ultimate" system. The Audiovox Hi-Comp line includes AM/FM radios with in-dash cassette and 8-track tape players, modular receivers with cassette decks, stereo radios for imported cars, equalizers, amplifier-boosters and speakers. Hi-Comp components range in price from $36 for a pair of speakers to a high-end receiver at $650. The "ultimate" Hi-Comp auto-sound system incorporates a receiver with auto-reverse cassette deck, a 120-watt 4-channel power amplifier, a semi-parametric graphic equalizer and four high-end speakers. The entire package, including installation, costs approximately $1,000.

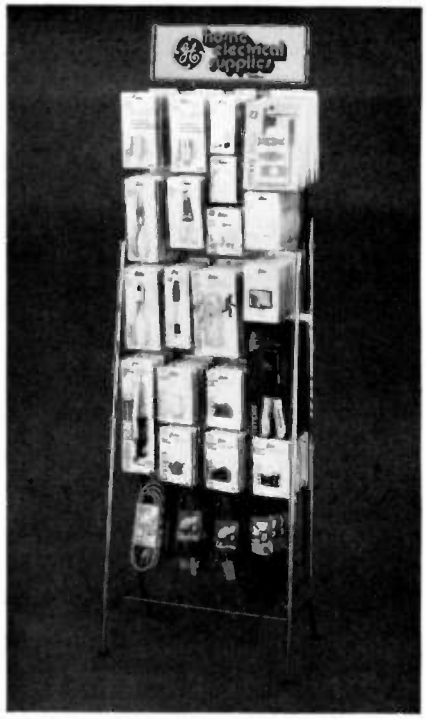
Wiring Aids Displays

Circle No. 141 on Reader Inquiry Card

General Electric Co., Tube Products Dept., introduces two new wiring aids profit displays aimed at increasing sales in the electronics renewal/repair markets.

"Our new displays feature electrical items most needed by consumers who purchase TV sets or other home entertainment products," said Chuck Liddic, manager of semiconductor and special product sales for the GE Tube Products Dept. in Owensboro. "Our extensive line of GE wiring aids includes voltage spike protectors, TV extension cords and numerous wiring terminals and tools," Liddic added.

The new 4-panel rotating display unit contains over two dozen GE home electrical products including soldering iron kits, solderless terminals, wire cutters, crimpers, electrical plugs and taps, and silicone sealants and adhesives.



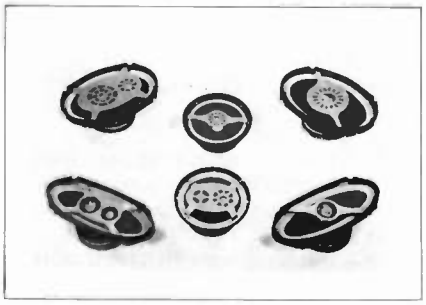
The stationary display style accommodates up to 24 different GE wiring aids products.

Stereo-Speakers

Circle No. 142 on Reader Inquiry Card

A wide variety of super-performance speakers for autos has been announced by *RCA* to supplement its present line of stereo speakers

Marketed under the name Hi-Tech, this new line includes two 6-inch round models, two 6 inch x 9 inch models and two 4 inch x 10 inch models--with a 2-way and 3-way design in each size. All feature 30-watt power rating, 20 oz ceramic magnets, acoustically transparent wire mesh grills, and high compliance rim suspension.



The 12R410 (2-way) and 23R411 (3-way) 6 inch round models include snap-on grills and require 2-¼ inch mounting depth, making them suitable for installation in vans and hatchbacks. The 12R411 features a 1-½ inch tweeter in addition to the 6 inch woofer and 2 inch mid-range that both models provide. The 6 inch x 9 inch models 12R412 (2-way) and 12R413 (3-way) and the 4

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

ELECTRONICS BOOK CLUB

invites you to take this 826-p. Computer Library for only

49¢

You Get BOTH of these HUGE Books for only 49¢

- ✓ Only 49¢ for BOTH HUGE volumes!
- ✓ Regular List Price $27.90
- ✓ Top-Quality Hardbinding
- ✓ Over 250 illustrations
- ✓ Contains over 250,000 words
- ✓ 826 data-packed pages

How to Design, Build & Program Your Own Working Computer System

Here's the complete computer build-it book, including design, construction, programming, testing, and de-bugging! It's a 2-in-1 volume that combines both hardware *and* software—that provides ALL the details you need to build your own computer . . . and program it! It's a concise and very readable guide to homebrewing your own computer system complete from power supply to terminals. Much data is also included to allow you to modify or add to an existing computer system. Here you'll find just the information you need to make intelligent design decisions, to incorporate the hardware you need, to test each component as you build, and to rig your creation for expanded capabilities. This new manual explores the applications and interface possibilities of a wide variety of computer hardware and software, and examines them in terms of specifications, in terms of actual computer-building problems and solutions. Not only does it fully illustrate the know-how that goes into building a computer with easy step-by-step methods, it also shows you as each segment is built how to program and test the operation of each of the self-built plug-in module boards. This is perhaps close to the ultimate in owner-built computer construction techniques—you see how to assemble the hardware, how to test it in the operating system, and then how to program it. You first learn how to select and customize a central processor, and from there you just keep on building, step by step, until you've concocted the computer system you're after. Each Chapter gives you more goodies to pour in; each section will help you create greater design sophistication. 308 pps., 138 illus. list $14.95

Computer Programming Handbook

A complete guide to computer programming and data processing, with scores of worked-out examples. It's an extremely comprehensive, informative, and interesting work on computer programming (and data processing in general), including number systems, languages, and application of languages to the kinds of real-world problems computers are programmed to solve. This GIANT text (25 Chapters plus Appendices—518 pages) covers all three types of computer languages—machine, symbolic, and problem-oriented; each language type is covered in detail—complete with worked-out examples which include computer printouts and actual results. Throughout, the author emphasizes the importance of techniques to get answers from a computer, rather than focusing on the complexities of the languages themselves. This approach simplifies the learning process and makes it easier to relate the problems involved in programming to the capabilites of the equipment. The problem-oriented language portion focuses on FORTRAN IV, and all illustrative programs have been computer-tested where necessary to make sure they are operationally sound and workable and contain no errors. If ever there was a one-book, first-class course on computer programming and data processing, this is it! 518 pps., 114 illus. List $12.95

Let us send you this 2-volume, 826-page Computer Library as part of an unusual offer of a Trial Membership in Electronics Book Club.

Here are quality hardbound volumes, each especially designed to help you increase your know-how and enjoyment of electronics and computers. Whatever your interest, you'll find Electronics Book Club offers practical, quality books that you can put to immediate use and benefit. Among selections offered, for example, are *Artificial Intelligence; The Complete Microcomputer Systems Handbook; The GIANT Book of Computer Projects; Illustrated Dictionary of Microcomputer Terminology; The A to Z Book of Computer Games; 57 Practical Programs & Games in BASIC, Microprocessor Cookbook, etc.*

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

To start your Membership on these attractive terms, simply fill out and mail the coupon today. You will receive the 2-volume Computer Library for 10-day inspection. YOU NEED SEND NO MONEY. If you're not delighted, return the books within 10 days and your Trial Membership will be cancelled without cost or obligation.

ELECTRONICS BOOK CLUB, Blue Ridge Summit, Pa. 17214

Facts About Club Membership

- The 2 introductory books carry a publisher's retail price of $27.90. They are yours for only 49¢ for both (plus postage/handling) with your Trial Membership.
- You will receive the Club **News**, describing the current Selection, Alternates, and other books, every 4 weeks (13x a year).
- If you want the Selection, do nothing; it will be sent to you automatically. If you do not wish to receive the Selection, or if you want to order one of the many Alternates offered, you simply give instructions on the reply form (and in the envelope) provided, and return it to us by the date specified. This date allows you at least 10 days in which to return the form. If, because of late mail delivery, you do not have 10 days to make a decision and so receive an unwanted Selection, you may return it at Club expense.
- To complete your Trial Membership you need buy only four additional monthly Selections or Alternates during the next 12 months. You may cancel your Membership any time after you purchase these four books.
- All books—including the Introductory Offer—are fully returnable after 10 days if you're not completely satisfied.
- All books are offered at low Member prices, plus a small postage and handling charge.
- **Continuing Bonus:** If you continue after this Trial Membership, you will earn a Dividend Certificate for every book you purchase. Three Certificates plus payment of the nominal sum of $1.99 will entitle you to a valuable Book Dividend of your choice which you may choose from a list provided Members.

ELECTRONICS BOOK CLUB

Blue Ridge Summit, Pa. 17214

Please open my Trial Membership in ELECTRONICS BOOK CLUB and send my 2-volume Computer Library, invoicing me for only 49¢ plus shipping. If not delighted, I may return the books within 10 days and owe nothing, and have my Trial Membership cancelled. I agree to purchase at least four additional books during the next 12 months after which I may cancel my membership at any time.

Name _____ Phone _____

Address _____

City _____

State _____ Zip _____

(Valid for new Members only. Foreign and Canada add 15%.) T-480

inch x 10 inch models 12R414 (2-way and 12R415 (3-way) are furnished with raised grills that permit installation of the speaker above or below surfaces. The 6 inch x 9 inch woofers are accompanied by 3 inch midrange speakers (plus 2 inch tweeter in the 3-way model), while the 4 inch x 10 inch woofers are matched with 2 inch midrange speakers, along with a 1-½ inch tweeter in the 3-way version.

Suggested list prices for the Hi-Tech speakers are $39.75 per pair for the 12R410; $53.95 per pair, 12R411; $47.75 per pair, 12R412; $64.50 per pair, 12R412; $64.50 per pair, 12R413; $47.75 per pair 12R414, and $64.50 per pair, 12R 415.

Wind Turbine

Circle No. 143 on Reader Inquiry Card

A new wind turbine, which may be sold to farms, factories and small businesses, has been installed at a *Grumman* facility in Bethpage, Long Island.

The Windstream 33 was developed under a Dept. of Energy contract as part of its program for developing small turbine generators. After initial testing at the Bethpage site, this windmill will be sent to DOE's test site facility at Rocky Flats, Colorado, for further evaluation.

The Windstream 33 is a second generation wind turbine and the successor to Grumman's Windstream 25. It has three blades with a total diameter of 33 feet, and can generate 15 kilowatts of electricity at 24 mph. At an annual average speed of 12 mph, it can produce 30,000 kilowatt hours per year.

According to GESI engineers, the new turbine has several advantages over its predecessor. It provides greater performance, is more durable, requires less maintenance, and its output power can be easily interfaced with that of an electric utility.

Tape Noise Reduction System

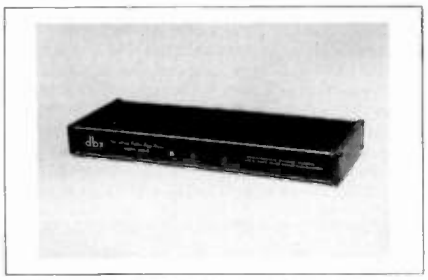
Circle No. 144 on Reader Inquiry Card

A new simultaneous encode/decode-tape noise reduction system, introduced by *dbx, Incorporated*, is said to provide up to a 40 dB increase in usable dynamic range.

The Model 224 is suitable for use with 2-head recorders and provides full monitoring capability with 3-head recorders. It features a special decoding function which enables the user to decode commercially available dbx Encoded Discs. Compatible with standard record playing equipment, these dbx Discs reportedly provide full dynamic range music reproduction against a background of silence.

The new dbx Tape Noise Reduction System allows simultaneous monitoring of the noise reduced signal off tape while recording. The system can be used for recording live, tape-to-tape and record-to-tape, in addition to taping off radio.

Complex level matching and alignment procedures are stated to be unnecessary since the dbx Tape Noise Reduction System operates as a linear decibel compander. The key is dbx's rms detector, an ingenious device which precisely and instantly measures the dynamic content of the music. dbx's patented voltage controlled amplifier answers the rms detector's commands to precisely increase or decrease level during recording and playback.



The new dbx Model 224 and other dbx models, are said by the manufacturer to be the only tape noise reduction systems which provide the consumer with the ability to make tape copies that sound exactly the same as the original, with no audible tape noise added during the tape recording process.

Automatic Turntables

Circle No. 145 on Reader Inquiry Card

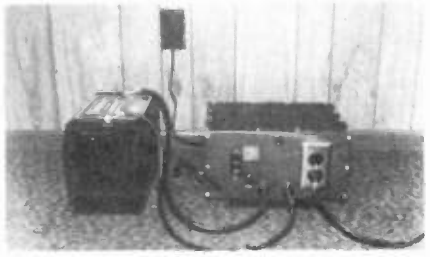
Two new fully automatic, multiple-single play turntables have recently been in-

troduced by *Garrard*. Both belt driven, the turntable of the GT350 is driven by a dc servo controlled motor, while the GT250 uses an advanced version of Garrard's Synchro- Lab motor. The platters are cast from aluminum alloy. The tone arm pivots on jeweled bearings and features a low-mass carbon fibre headshell. The combined tone arm and headshell weight is reportedly 12 grams. Both turntables carry 3-year limited warranties.

Stand-by Power Systems

Circle No. 146 on Reader Inquiry Card

Two new power systems have recently been introduced by *Best Energy Systems for Tomorrow, Inc.* to provide automatic stand-by power for requirements in the 100-2500 watt range. A system of storage batteries and an inverter of reportedly 90% efficiency transfers from the commercial power lines in less than 1/25th of a second. The systems are equipped with cords and receptacles for quick installation and are available in 1000 and 2500 watt models.



TELETEXT

continued from page 20

subcarrier) has been tested at KXOA-FM, Sacramento, California, Digitally encoded audio information was transmitted as FM on the 67KHz SCA subcarrier. At the receiver it was demodulated and fed to a computer for decoding and display.

Hardware

A remote control unit for controlling a teletext receiver is shown in Figure 1. A variety of functions are available to command functions and pages.

A teletext decoder system (Multitext by Mullard Limited) is shown in Figure 6. Extensive use of LSI simplifies the schematic greatly. The SAA5030 is a video input processor. It sets a threshold at half the data level to improve noise performance, regenerates the clock signal and provides a sync signal and clocks data into the SAA5040 which further processes the teletext data so it can be written into the (two) 2614 RAMS.

The SAA 5020 subdivides the 6MHz clock signal from the SAA5030 to 25Hz (remember this is British TV), the frame rate and generates the timing signals for the display. It also can drive the timebases of the receiver in the absence of transmitted sync ("after-hours" operation).

The memory consists of two 1Kx4 RAMS (2614's) arranged as four 32 × 32 matrices. Auxiliary IC's translate this to the 40 × 24 matrix for display.

The SAA 5050 ROM converts the 7-bit character data from the memory into a dot matrix pattern for display. It has outputs to drive R, G and B output circuitry.

The Future

All of these systems, except Digicast, have been in use on a trial basis since as early as 1975 in the United Kingdom. Various systems have been successfully tested in the United States. We'll be seeing them in use in a few years.

ATC

continued from page 26

amplification, automatic chroma control, subcarrier regeneration, and subcarrier frequency and phase control.

The amplified chroma signal and 3.58MHz subcarrier (CW) enter IC2 at pins 3 and 16 respectively. With additional amplification by a gain-controlled color amplifier in IC2, the chroma sidebands are then applied to "Q" and "I" demodulators (Fig. 4).

The 3.58MHz subcarrier with a nominal "I" phase is coupled to the "I" demodulator via a tint control circuit and an adder stage. A network consisting of L1, C25 and C28 produces a 90-degree phase shift in the subcarrier for application to the "Q" demodulator.

With the Auto Tint Correction Defeat switch S4216 on, the subcarrier phase may be altered by adjusting either one of the DC controls, tint range control R17 or tint control R4204. Since the tint control circuit may distort the subcarrier waveform, a coil, L2, resonating with its distributed capacitance at 3.58MHz is used to restore a sinewave shape to the subcarrier. With no tint correction, demodulation is performed on the "I" and "Q" axes at angles of 57 degrees and 147 degrees respectively.

When the Auto Tint Correction Defeat switch is off, the ATC is in operation. It starts with a sample of the chroma sidebands from the gain-controlled color amplifier being limited by a limiter stage. The phase of the limited sidebands is then compared with the nominal "I" phase of the 3.58MHz CW subcarrier in a phase detector. By continuous phase comparison, the phase detector produces output voltages which are inversely proportional to the phase deviation of the sidebands from the nominal "I" phase. These variable output voltages are used to control the conduction of an offset modulator.

Acting as a voltage-controlled gate, the offset modulator allows proportional amounts of the limited sidebands to be added to the subcarrier in the adder stage. The addition of these sidebands causes the subcarrier phase to deviate from its nominal "I" value to minimize flesh-tone errors. The operation is similar to manual adjustments of the customer tint control to correct flesh-tone errors except that it is done automatically and continuously.

A DC offset bias applied to the modulator limits its conduction angle to restrict correction to colors closest to the + "I" vector near the flesh tones (Fig. 5). Due to insensitivity to the − "I" phase, the phase detector does not produce enough voltage to turn on the offset modulator. As a result, there is no phase correction in the cyan-blue or − "I" region. All other colors are subject to some extent to phase shift toward the flesh-tones. Figure 6 shows the overall color correction range with emphasis in the flesh-tone region.

Conclusion

Occasional chroma phase shift found in standard color transmission results in undesirable tint changes in television pictures. Most automatic tint control systems in use compensate for this phase shift by either altering the reinserted subcarrier phase or changing the gain ratio for "I" and "Q" or other equivalent components.

There are a number of different ATC circuits found in a variety of color chassis, and most of the circuits utilize part of one or more ICs in their control operation. This article briefly described the operation of RCA's ColorTrak ATC system. ET/D

CLASSIFIED

RATES: 45 cents per word (minimum charge, $15). Bold face words or words in all capital letters charged at 60 cents per word. Boxed or display ads charged at $55 per column inch (one inch minimum). Agency commissions will be given only when camera-ready art is provided by agency. For ads using blind box number, ad $5 to total cost of ad. Send ad copy with payment to Dawn Anderson, ELECTRONIC TECHNICIAN/DEALER, 1 East First Street, Duluth, MN 55802.

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

FOR SALE

OSCILLOSCOPES
Discount priced from $212.00.
BECKMAN METERS in stock.
Call (213) 786-6890
TESTEK, 6910 Hayvenhurst Ave.
Van Nuys, CA 91406

PICTURE TUBE REBUILDING EQUIPMENT capable of producing four high quality tubes per day **(WILL TRAIN TO OPERATE)** $3600. Call or write Atoll Television, 6425 Irving Park, Chicago, Illinois 60634, ph. 312-545-6667. 5/80

Sams Photofacts. 145 photofact sets. Numbers scattered from #98 to 1459. All for $65.00 plus freight. Ray's TV, 4841 East View Dr., New Orleans, LA 70126.

PASS FCC EXAMS
The Original FCC Tests Answers exam manual that prepares you at home for FCC First and Second class Radiotelephone licenses. Newly revised multiple-choice exams cover all areas tested on the actual FCC exam. Plus "Self-Study Ability Test." Proven! $9.95 postpaid. Moneyback Guarantee.
TESTS ANSWERS FOR FCC FIRST AND SECOND CLASS COMMERCIAL LICENSE
COMMAND PRODUCTIONS
Radio Engineering Division
P.O. Box 26348 w w
San Francisco, CA 94126

CLOSED CIRCUIT TV SYSTEM. Whether you're a one man operation or a large shop, you can increase your business sharply by selling, installing, & renting CCTV systems for schools, hotels, business, etc. For information on the many uses and a free catalog, for the best prices anywhere on these ALL AMERICAN made units, call or write Columbia Video Systems, Box 676, Beltsville, MD 20705. (301) 587-3355.

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

HAMs, CBers, SWLs—eight character **MORSE-A-WORD** morse code reader with built-in code practice oscillator; **RTTY READER.** Decodes signals off the air. Send for details. **MICROCRAFT CORPORATION,** Box 513E, Thiensville, WI 53092, 1-414-241-8144. 4/80

ELECTRONIC organ kits. The ultimate design. Sounds like a pipe organ. Build it to sell or build it to keep. Models for churches, homes, clubs, pizza parlors. Send $2 for demo record and catalog. **DEVTRONIX,** Dept. 75, 6101 Warehouse Way, Sacramento, CA 95826.

REPLACEMENT COLOR YOKES-DEALERS ONLY. Zenith 95-2501-2532-2638-2667-S89633 etc. $19.95. Magnavox 361380-1 $21.95 etc. Sylvania, G.E. etc. $17.95 to $22.95. Request for price list on your letterhead. David Sims Enterprises, Inc., 665 Jerricho Turnpike, Huntington Station, N.Y. 11746. 516-549-3925 800-645-5030 TF

TV DEALERS! Computerize! Now available for the Apple II, a computerized TV management package, includes Master File-inventory, depreciation and profit analizer plus electronic checkbook. Send $2.00 for complete details and computer printout samples. Perry's Computer System, 133 Brenda Street, Milton, FL 32570.

PICTURE TUBE MACHINE
We buy and sell NEW AND USED CRT rebuilding machinery. COMPLETE TRAINING. Buy with CONFIDENCE from the ORIGINAL MFGR. For complete details, send name, address and zip code to:
LAKESIDE INDUSTRIES
4069-71 N. Elstone Ave., Chicago, IL 60618
Phone: 312-583-6565

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

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

Reconditioned test equipment. $1.00 for catalog. **JAMES WALTER TEST EQUIPMENT,** 2697 Nickel, San Pablo, CA 94806.

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

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

PAYMENT MUST ACCOMPANY ORDER. WE'LL BILL RATED FIRMS

NAME_____ COMPANY_____

STREET_____

CITY_____ STATE_____ ZIP_____

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

RATES: 45 cents per word (minimum charge, $15). Bold face words or words in all capital letters charged at 60 cents per word. Boxed or display ads charged at $55 per column inch (one inch minimum). For ads using blind box number, add $5 to total cost of ad.

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

TV TECHNICIAN AND DEALERS, "INCREASE YOUR INCOME THOUSANDS OF DOLLARS YEARLY," "RENT-LEASE-SELL TV'S WITH A GUARANTEED SYSTEM," SEND STAMP FOR FREE DETAILS, BASIC PLAN, DELUXE VERSION $25.00, MASTER PLAN $40.00....PERRYS' RENTAL SYSTEM, 133 BRENDA STREET, MILTON, FLORIDA 32570. 904-994-8251

While they last For Hitachi Parts Super Specials Sharp Video Board Current all new ($9.99) (Dist. Cost 27.00). 10 pc wire-wound Resistor kit 3 watt-25 watt only ($2.25). Sylvania tubes 70% dist. Full warranty original Sony 2SC867A only $5.00 (Wow). Redcoat Electronics, 66-15 Thornton Pl., Forest Hills, NY 11374. 212-261-9479

CB Modification Manual **The Bootleggers Bible** Now with 77 different PLL chips explained $12.95, **CB Radio Repair Manual** $10.95, 20, 60, 140 and 300 watt **Linear Amplifier Plans** all for $8.00. A.P. Systems, Dept. ETD, Box 488, Milford PA 18337. MC/VISA 717-686-5900

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

CARBIDE CIRCUIT BOARD DRILLS- Stock sizes shipped immediately. **NEW.** Numbers **68** (.031"), **65** (.035"), **62** (.038"), **60** (.040"), and **58** (.042"). All ⅛ inch shank. One for $4.25-each additional drill, $3.25. **CM CIRCUITS,** 22 Maple Avenue, Lackawanna, NY 14218. 4/80

LINEAR AMPLIFIER, 2-30 MHz, 100 or 200 watt solid state. 300 MHz COUNTER. Modulation BOOSTER. Omnidirectional BASE ANTENNA. Plans $3.00 each. $10.00/all. Catalog of others. **Panaxis** Box 130 ET4 Paradise, CA 95969

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

KEYBOARDS for synthesizers and organs. Available in 37 and 61 notes, completely assembled with single/or dual contacts. Send for information: **DEVTRONIX** Organs Dept. 75, 6101 Warehouse Way, Sacramento, CA 95826. 4/80

LEARN DIGITAL ELECTRONICS & COMPUTER PROGRAMMING THE EASY WAY using video tapes or audio cassettes with summary sheets included. Available from International Video Technology, P. O. Box 7172, Shreveport, Louisiana 71107. 5/80

Picture Tube Rebuilding Equipment. Produce 48 Quality Color, B/W Tubes Per Week. Sell To Distributors, TV Shops And Retail. Everything Needed For A Profitable Business. $7500.00. John Culver, 30E Dory Drive, Mystic Islands, N.J. 08087. 6/80

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

HEWLETT-PACKARD 'SCOPES 22 mhz Dual Trace $350. 50 mhz Dual Trace $650. Calibrated & Guaranteed, Free Catalog. 1445 N.W. 9th St., Homestead, FL 33030. (305)247-6349 4/80

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

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

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

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

BUGS. Build professional miniature FM transmitters. Complete plans. Send $5.00. Money-Back Guarantee. **PCEP ENTERPRISES,** Box 837-C, New York, NY 10004.

BUSINESS OPPORTUNITIES

Established TV-Stereo business. RCA-Pioneer-Kenwood. Excellent return. Farming community, good area to raise family. 1700 square ft. building with two apartments available. Southeast Nebraska (402) 645-8122 between 9 and 5. 4/80

THE EASY LIFE: W. Mass. house and attached TV sales and service business. House has 4 bedrooms, 1½ baths, family room with bar and pool table. Located near schools and center of town. Business established 5 yrs. excellent rep. Magnavox sales, service all brands, plus good MATV accounts. Business includes all test equipment, parts, office furniture and 1978 chevy van. Move in and start making money. Business grosses 100K plus per yr. Nets 28K. Priced for quick sale. Tel. 413-243-2450.

Television Sales and Service Business established since 1942. Good lease on 1,000 sq. ft. shop on busy street with good parking. Price includes all new and used inventory and service van. First time listed for sale in Boomtown, U.S.A. beautiful Seattle, WA. $30,000 firm & cash only. Call anytime 206-784-3840 or write Ballard Radio and T.V., 6018 24th N.W., Seattle, WA 98107.

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

Beautiful Albuquerque. Eight year old TV Sales & Service Business. Grossing $68,000.00. Net approximately $30,000. Corner location in shopping center with no competition in expanding area. Price $23,500.00. Westside TV Service, 5509-A Central Ave. N.W., Albuquerque NM 87105. 505-836-0500.

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 ET4, Paradise, CA 95969

NEW JERSEY. T.V. Sales and Service. Business and Building. Located in prime commercial location. Established 7 years. Terms available. Pete Hayes, 280 Kingston Road, Parsippany New Jersey. 201-386-9794 5/80

TV and major appliance business in northern Iowa community, currently grossing in excess of $100,000. Includes inventory, equipment and service vehicles. Building with business and living quarters negotiable. Terry Hermeier, Tripoli TV & Appliance, 232 So. Main, Tripoli IA 50676.

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

HELP WANTED

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

WANTED

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 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

WANTED: PICTURE TUBE REBUILDING EQUIPMENT working or not. Write or call Atoll Television, 6425 Irving Park, Chicago, Illinois 60634. Phone 312-545-6667. 5/80

Wanted: Hotel-Motel TV's Any quantity. Call or write C.C.T.V. (714) 891-1776, 12081 Beach Blvd., Stanton Calif. 92680. 4/80

AD INDEX

TEST INSTR. RPT.

NEW PRODUCTS

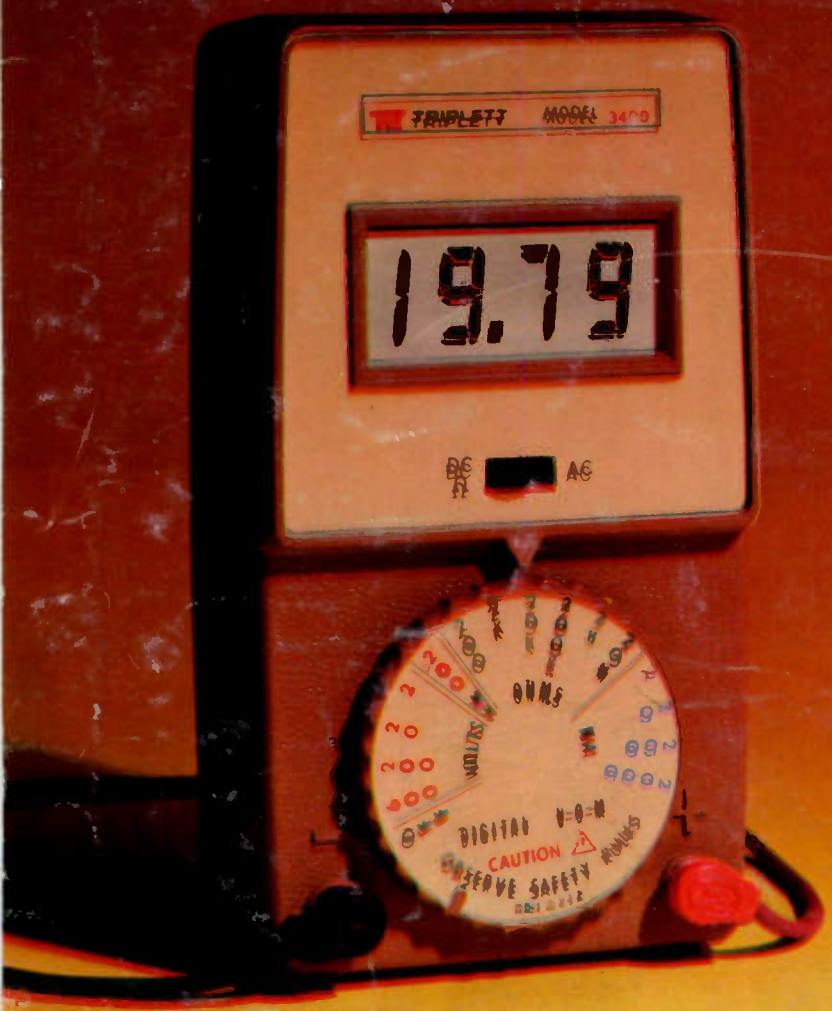
DEALER'S SHOWCASE

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

Circle No. 103 on Reader Inquiry Card

THE NEW performer.

Model 3400 has features that upstage other compact DVOMs.



Built to fit your hand and budget, the new Model 3400 (shown actual size) is loaded with features. Like a color coded single range switch for one-hand selection of all functions . . . overload protection for all ranges and 200 hour minimum battery life . . . time-saving automatics including auto-zeroing, auto-polarity, auto low-battery and auto-overrange indication . . . easy to read .5" LCD readout.

Six functions and 24 ranges, typical DC accuracy .5% Rdg, including High and Low Power Ohms for sensitive IC testing, makes the Model 3400 ideal for design, production and maintenance testing, vocational tech training schools, commercial electronic equipment test and measurement use.

1. HAND SIZE, 3½ digit, single range switch —6 function, 24 ranges with Hi and Low Power Ohms, Auto-zero and Auto-polarity.
2. OVERLOAD PROTECTION—Protected up to 600 volts on all ranges with special 2 fuse arrangement.
3. BATTERY LIFE—200 hour minimum with 9V battery, display includes low battery indication.

ONLY $140

Includes test leads, new screw-on insulated alligator clips for the probe, 9V alkaline battery, plus instruction book and 1 year warranty.

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

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

THE MARK OF QUALITY OVER 75 YEARS

Triplett performance... a tough act to follow

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

TRIPLETT®

See us at EDS '80 Conference Room CR-1