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SEPTEMBER 1982 VOLUME 20, NUMBER 9

Popular Electronics

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE

The Electronic World

Feature Articles

Construction Articles

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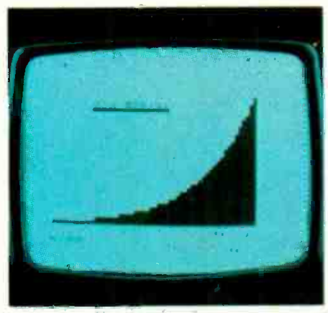

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EDITORIAL

"You Ain't Seen Nothing Yet"

The Al Jolson quote can be sounded by the video industry with supreme confidence. The full impact of video has not yet reached our households, even though there are some 160-million TV sets in use in about 78-million U.S. homes. According to the EIA, the typical household is reported to view more than 7⅓ hours of TV programming each day. And this does not include video-game playing or using a video monitor or TV set for home computer applications.

Given the impending changes that will take place in the near future, the viewing figure cited is certain to increase substantially, while the number of TV sets and the number of households having TV will also increase. On the horizon are satellite programming and high-definition TV transmissions that will be captured by small rooftop antennas, thanks to a recent go-ahead by the FCC for DBS broadcasting. Teletext and stereo TV sound are moving along, too.

At a recent trade show, it was apparent that there will be plenty of upgraded TV equipment introduced in a month or so. In particular, many companies have hopped on component TV systems, initiated by Sony with its Profeel ("professional feel") line, which is reviewed in this issue. These are high-ticket color monitors that feature superb horizontal resolution (370 lines, for example), heftier audio output (7 watts per channel in the 25" NEC monitor), matching speaker systems, smoked-glass screen filters, BNC-type or 8-pin video connectors, and superb interference shielding. A VCR or separate TV tuner is needed to bring in broadcast TV channels.

Home video equipment has adopted more features ordinarily reserved for professional equipment. For example, there are home video cameras with built-in titlers, fade-in/fade-out controls, C-rings for substituting lenses, and so on.

Video games continue to proliferate, with Coleco joining the programmable games pack, and others introducing new models, some with synthesized speech and accompanying plug-in cartridges.

Our work with the author of the "Electronic World" video article appearing in this issue also underlined the creative possibilities that exist with video recording equipment. It proved that video need not be a passive encounter. To fully appreciate the results achieved through preparing this article, however, one must view (and hear) the video tape itself. The end result was a truly professional video *story*, rather than a series of haphazard scenes, that would favorably impress any video recordist.

As you can see, there is a lot for video enthusiasts to look forward to in the near future.

Art Salsberg

Editorial and Executive Offices
One Park Avenue
New York, New York 10016
212 725-3500

Publisher
Joe E. Mesics
212 725-3568

New York Office
Advertising Director:
Richard Govatski 212 725-7460

Sales:
Tom Ballou 212 725-3578
Ken Lipka 212 725-3580

Midwestern Office
Suite 1400, 180 N. Michigan Ave.,
Chicago, IL 60601 312 346-2600
Ted Welch

Western Representative
3460 Wilshire Blvd.
Los Angeles, CA 90010 213 387-2100
Sales: Ted Welch

Representation in Japan
J.S. Yagi
Iwai Trading Co., Ltd.
603 Ginza Sky Heights Bldg.
18-13, Ginza 7-Chome
Tokyo, Japan 104

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LETTERS

Down with QWERTY

Yes! Down with QWERTY and up with *asonetuhid*! (See Editorial, July 1982.) This is the first exercise in the Dvorak learner's manual, the "Simplified Keyboard Supplement." With the fingers numbered starting with the little ones, it consists of left one, right one, 12, r2, 13, r3, left fore, right fore, and left and right fore again. Three of the most obvious of the Dvorak advantages are home-row concentration, left-right, left-right rhythm, and the frequency of the fastest and easiest strokes of all, the teaming up of corresponding fingers of opposite hands. The Dvorak variant that is in widest vocational use does not change the positions or shape or size of the keys, nor does it rearrange the digit row or violate the conventional pairings of characters on keys. Hence the retrainee, with the key-finding skill down pat, adds the Dvorak to his repertoire rapidly and easily.—*Philip Davis, Publisher, Quick Strokes, West Sacramento, CA.*

AM Stereo

Regarding your Editorial ("Copping Out," June 1982) bemoaning the FCC's decision not to select an AM stereo transmission method, all is not lost because Delco is doing the FCC's job. It is testing all five systems and in due course will decide which is the best. Having done this, it will then start putting that system into its car radios; whereupon—as night follows day—AM broadcasters around the country will adopt the system.—*Gerald Shirley, Mt. Vernon, NY.*

I strongly disagree with your Editorial denouncing the FCC's decision. As an AM broadcaster, I feel the marketplace decision is the best way to resolve the situation. Once AM stereo goes on the air at many stations, the technical advantages and faults of the various systems will become apparent. Not many broadcasters will sacrifice existing coverage or quality for the sake of stereo. Within 6 months after stereo broadcasting begins, a clear leader will probably emerge.—*G. Wachter, KTSA, San Antonio, TX.*

Up-to-Date Shortwave

I would like to express my continuing pleasure in finding information relating to shortwave radio in your magazine. It is of particular interest to see the guide to English-Language Broadcasts, since this is probably the most up-to-date information available.—*William P. Kramer, E. Falmouth, MA.*


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Audio Product of the Month

CHOSEN BY THE EDITORS OF POPULAR ELECTRONICS

B&O Beocord 9000 Cassette Deck

THE Bang & Olufsen Beocord 9000 microprocessor-controlled cassette deck offers exceptional operating flexibility and electrical performance. It features the HX Professional recording system, developed by B&O in cooperation with Dolby Laboratories, for reduced distortion and increased headroom at high frequencies. In addition, it has both Dolby B and C noise-reduction systems.

The Beocord 9000 is a top-loading machine, measuring 21″W × 12″D × 5″H and weighing 17 lb. The slightly sloping top surface is divided into brushed aluminum and black sections, with the cassette and some controls hidden behind a hinged panel during normal operation. The edge is trimmed in wood. The deck comes with a blank cassette of Maxell XL-IIS tape (C-90), a precision azimuth calibration tape using TDK MA (metal) tape, a head-cleaning kit, and DIN cables. Suggested retail price is $1800.

General Description. Most of the regular operating controls of the Beocord 9000 are momentary-contact pushbuttons grouped on the right front top panel. Nine oblong silver-colored buttons control the usual tape transport functions and the basic operating mode (record or playback). Twelve square black buttons set timed functions, including programming features.

The indicator group is behind a tinted glass panel. It includes twin level "meters" (fluorescent light segments) and a four-digit index counter. Its bright red 1″-high numerals can display arbitrary units of tape movement or actual playing time in minutes and seconds (or even the time remaining on the cassette). The internal clock of the Beocord 9000 is always operating when it is plugged into a "live" outlet, and the time of day can be displayed by pressing the TIME SET button. Pressing STANDBY turns off the recorder, and it is turned on again by pressing any of its operating control buttons. Identifying words for the special operating modes and functions appear in red behind the window when activated.

Pressing either end of a long black bar marked EJECT at one end and PROGRAMMING at the other causes a panel to swing up, revealing the cassette well (whose hinged holder also swings up when EJECT is pressed). Also behind this panel are slider controls for recording level and headphone volume and a group of eight buttons that control various timing and calibration functions. Just behind them are lights, visible through holes in the hinged cover when it is closed, that identify the type of tape used and whether the recording mode is enabled. Inside the cover are printed instructions for using the several timing, calibration, and recording functions.

Operationally, the Beocord 9000 is a

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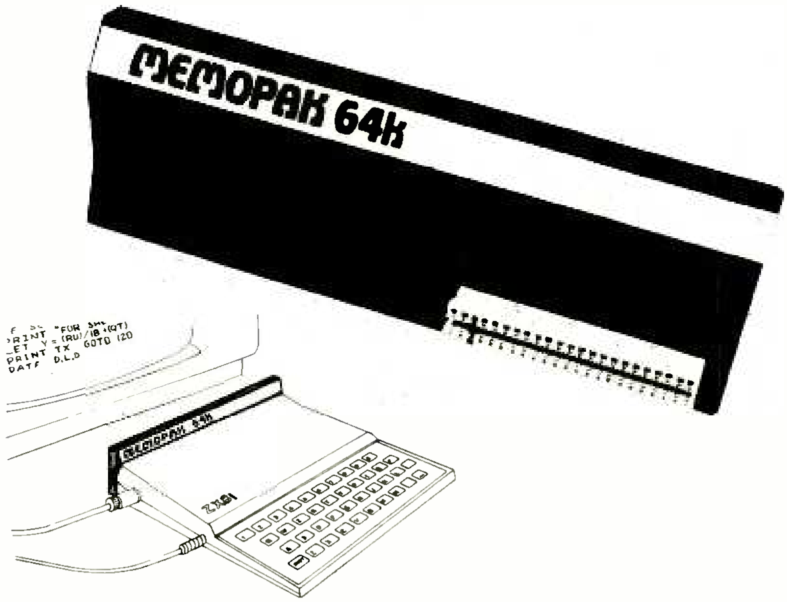

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"2 head" machine, which does not permit monitoring from the tape while recording (in fact, there is no line output while recording). The manual describes the head as a "double, sendust and ferrite" type, and examination of its gap area (plus the measured performance) indicates that it actually consists of separate recording and playback heads in a common housing.

Bang & Olufsen set out to create a modified HX (headroom extension) system that would represent an improvement over the original Dolby design; that is, it would affect each recording channel separately, depending on the spectral difference between their programs. The result, incorporated in their two top cassette decks (Beocord 8002 and 9000) is known as "HX Professional."

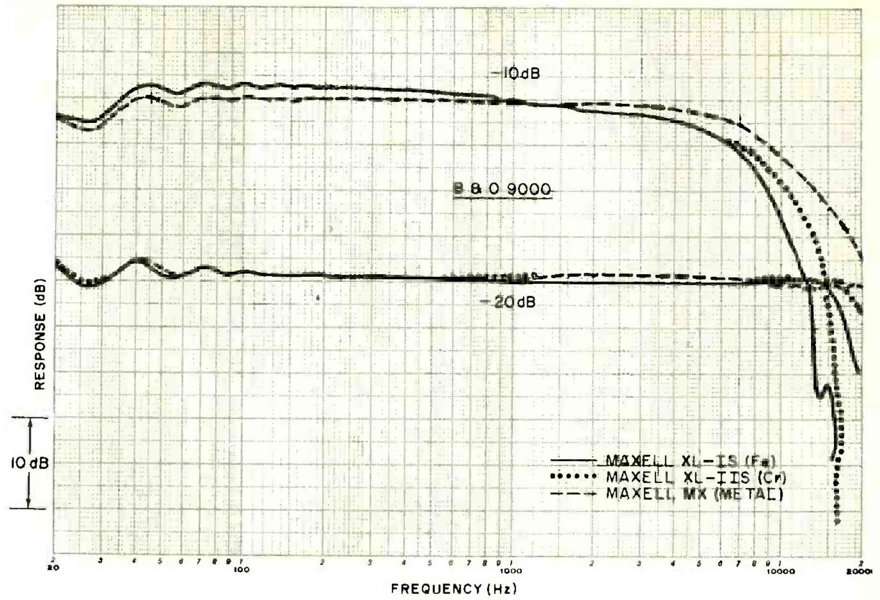
None of the operation of the HX Professional system is connected to the Dolby system. (In fact, it can be used without Dolby noise reduction.) The control signals are taken from the recording head inputs (separately for each channel). Thus, they include the effect of recording equalization at high frequency levels. Each signal, combined with the bias signal, operates a voltage-controlled amplifier to hold the total effective bias constant for all audio frequencies. Unlike Dolby HX, HX Professional does not vary the recording equalization.

The performance improvement claimed for HX Professional is an increase in high-frequency headroom with ferric tapes of 5 to 7 dB above 10 kHz. This gives a good ferric tape approximately the same headroom as metal tape—at a considerably lower price. Metal tapes are also improved by the system, but to a lesser degree.

The Beocord 9000 has an automatic calibration system that optimizes bias, equalization, and sensitivity for the particular tape being used. When a cassette is loaded and the hinged carrier is pushed down into its operating position, the playback equalization is set automatically by the keying holes on the back of the cassette housing. If the holes are not present, the TAPE TYPE button can be used to select the correct playback equalization, as indicated by red lights marked FE, CR, and METAL. For ferrichrome tapes, there is a setting of the button that lights both FE and CR.

Pressing REC CAL initiates the automatic Computer Controlled Calibration (CCC) sequence, advancing the tape to clear the leader portion and recording a series of test tones with different bias levels. The tape rewinds and plays to verify the optimum bias, and a similar sequence is followed for setting equalization and level. After about 12 to 15 seconds, the tape has rewound to the starting point, ready for use. Pressing STORE places the optimum settings in a nonvolatile (battery-maintained) memory, from which they are recalled automatically whenever that tape type is selected.

The level meters of the recorder operate from the same point in the signal path as the HX system. They monitor the equalized recording, and their virtually



Frequency responses for three different types of tape.

instantaneous response gives a valid reading of the true peak program level. As part of the CCC calibration, the meter sensitivity is also set to match the tape characteristics, so that a "0 dB" recording will result in playback distortion of 2 to 3%, regardless of the tape used. As a result, the peak program levels during recording should not exceed 0 or +1 dB.

The timing functions of the Beocord 9000 are quite complex. Not only can its internal clock turn the machine on and off, in either recording or playback, the tape motion can also be timed in minutes and seconds in either direction of tape motion, at normal or fast speeds. A TIME CAL mode even allows the actual running time of a cassette to be measured in advance of making a recording. When a cassette is loaded, pressing the GO button causes the mechanism to check the thickness of the tape at fast speed, after which the TIME CAL indication appears behind the tinted window. Following that, it is only necessary to key in a time in minutes and seconds (from the start of the cassette) and press GO to move the tape at high speed to that point on the tape and begin playing from there.

Pressing MEMO SET at any time enters that tape location in a computer memory; and when MEMO GO is pressed, the tape returns to that point at high speed and resumes playing. The RETURN key brings the tape back to the point from which the tape was started. In fast forward or rewind, the tape slows down a few seconds before the end is reached to lessen the shock of stopping.

In normal operation, the key marked ">" starts playing the tape and STOP halts it. To record, only a single button is used (after the REC OPEN button has been pressed to enable recording). The first operation of RECORD activates the recording system so that levels can be set (the word RECORD behind the tinted glass blinks on and off at this time) and a second operation places the tape in motion and leaves the word on steadily. When STOP is pressed once, the recording stops immediately but the tape continues moving for four seconds to leave a silent interval on the tape. Pressing it twice in rapid succession stops the tape immediately.

Along the front bottom edge of the recorder there is an input jack for a mono microphone, a DIN socket for either microphone or AUX inputs, a switch to select the DIN input, and a stereo headphone jack.

Laboratory Measurements. The playback equalization of the Beocord 9000 was measured with BASF standard test tapes. The 120-μs response was flat within ±0.5 dB from 31.5 to 18,000 Hz, which is the best playback response we have yet measured from a cassette deck. The 70-μs response was nearly as good: ±1 dB over the same range.

The CCC calibration system should give the equipment nearly the same frequency response with almost any tape. Because of the difficulty of making measurements by first recording a sweeping signal and then rewinding and playing it, we limited our measurement of record/playback frequency response to three tapes: Maxell XL-IS (Fe), Maxell XL-IIS (Cr) and Maxell MX (metal)—all C-90. After calibrating for each tape with the CCC system, we measured the record/playback response at levels of 0 and −20 dB.

The response of the XL-IS tape at −20 dB was ±1 dB from 20 to 15,000 Hz (after averaging the low-frequency "head bumps," which were relatively minor). At 0 dB the high-frequency response rolled off gradually above 1000 Hz due to tape saturation, intersecting the −20-dB curve at 12,000 Hz (a fairly typical result for ferric tapes). The XL-IIS gave a slightly more extended high-frequency response at 0 dB, with a ±0.5-dB variation from 20 to 16,000 Hz. Even without averaging the low-frequency irregularities, the response was an impressive

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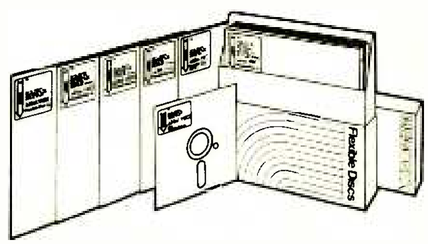

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±2.5 dB from 20 to 20,000 Hz. The 0-dB saturation was not very different from what we measured on the Fe tape, with the intersection of the curves being at 14,000 Hz.

As expected, the metal tape gave the best frequency response. At −20 dB, it was within ±1.25 dB from 20 to 20,000 Hz; and when the low-frequency bumps were averaged, it was ±1 dB over that range. The response at 0 dB was flat to about 4000 Hz, and it did not intersect the −20-dB curve all the way up to our measurement limit of 20,000 Hz.

The "tracking" of the Dolby circuits was measured by plotting the record/playback frequency response (using XL-IIS tape) at levels of −20 and −30 dB, with and without Dolby B and C. In such a measurement, it is usual for the two curves (Dolby on and off) to diverge by at least 1 or 2 dB over some part of the high-frequency range. The Beocord 9000 was essentially perfect in this test, with no significant change in response from either of the Dolby systems at any of the test levels, up to about 15,000 Hz.

The effect of the MPX filter was also measured. Up to 14,000 Hz it had no effect, but the response was down 10 dB at 17,000 Hz and considerably more than 30 dB down at 19,000 Hz.

After the deck had been calibrated for each of the tapes, its sensitivity for a 0-dB meter indication (at 1000 Hz) was 28 to 30 mV (line input) and about 0.25 mV for the microphone input. The playback level was 1.3 V for the Cr and metal tapes and 1.6 V for Fe tape. The playback distortion at 1000 Hz was 3% from a 0-dB recording level (from −2 dB in the case of metal tape).

The S/N in playback from a 0-dB recording was nearly the same with all tapes. The unweighted readings were 53 to 54 dB. The CCIR/ARM weighted readings were 66 to 67.5 dB with Dolby B and 75 to 77 dB with Dolby C. In each case, the best result (though only by a small amount) was obtained with the XL-IIS (Cr) tape.

The "meters" responded virtually instantaneously, reading 100% of the steady-state value on 0.3-s tone bursts. The weighted peak (CCIR) flutter was ±0.05% and the weighted rms (JIS) flutter was 0.03%, using a TDK AC-342 test tape. The tape speed was 0.5% fast. A C-90 cassette was moved through its entire length in 104 seconds in fast forward and 98 seconds in rewind. The crosstalk between channels, measured at 1000 Hz with a TDK AC-352 tape, was a low −62 dB.

User Comment. Our measurements (which in every significant respect confirmed or surpassed the B&O ratings) show that the Beocord 9000 is an outstanding cassette deck. This was further confirmed when we recorded FM interstation hiss from a tuner and compared the playback with the original. With the MX and XL-IIS tapes, the accuracy of the playback signal, even at a 0-dB level, was virtually perfect. When we used the XL-IS (Fe) tape, the reproduction was practically perfect at −20 dB, and there was only a slight dulling of the highest frequencies at 0 dB.

To the maximum extent possible, we used and verified the performance of the recorder's special operating features. Most seemed to work as expected, but we had some difficulty with the REC CAL automatic tape calibration. It did not always function predictably. Sometimes the RECORD indicator would go into a blinking condition that prevented the test recordings from being made. (The measured performance of the machine would seem to confirm that it was operating correctly for our tests, however.)

We did experience some confusion when trying to learn how to operate the deck (the instruction manual being of little help in this regard); but this is a subjective reaction to a startlingly different, new product. It is unarguable that the Beocord 9000 is a state-of-the-art cassette deck, capable of making and playing recordings of the highest quality. Its operating versatility (once mastered) is as outstanding as its performance. If the price of this machine is within one's budget, it is well worth considering for a deluxe music system. —*Julian Hirsch*

CIRCLE NO. 101 ON FREE INFORMATION CARD

CONTROLS AND INDICATORS

Transport Control Buttons
STANDBY: Shuts off recorder.
RECORD: Begins recording (if REC OPEN is activated)
STOP: Stops tape. From RECORD, one touch stops recording at once, tape stops in 4 seconds. Two rapid operations stop tape immediately.
MEMO SET: Sets tape location for return by MEMO GO.
MEMO GO: Returns tape at high speed to point where play started and goes into PLAY.
RETURN: Returns tape at high speed to point where play started and goes into PLAY.
< <: Rewind.
> >: Fast forward.
>: Play.

Timing Buttons
0-9: Used to key in time for clock or reference playing time for tape indexing.
CE: Clears entry.
GO: Initiates playing with automatic TIME CAL of tape length.

Programming Controls (under panel)
TIMER START: For programming timed tape start.
TIMER STOP: For programming timed tape stop.
TIME SET: For presetting clock (or displaying time on readout).
TAPE END: Gives countdown of remaining tape time in last 5 minutes of operation.
REC OPEN: Must be pressed to enable recording function.
TAPE TYPE: Manually sets tape type.
REC CAL: Initiates automatic computer tape calibration.
STORE: Stores result of calibration in memory.
DOLBY:
NR OFF—No noise reduction.
NR B—Dolby B noise reduction.
NR C—Dolby C noise reduction.

Slider Controls
PHONES: Controls headphone volume.
REC(L,R): Sets recording levels.

Buttons
PROGRAMMING: Opens door.
EJECT: Opens door and raises cassette carrier.

Status Lights
REC OPEN: Red light shows recording status is enabled.
FE, CR, METAL: Green lights indicate tape type. FE and CR are both lit for FeCr tape.
NO STORE: Red light shows tape calibration has not been stored, being too far from allowable range for selected tape.

Recessed Under Front Edge
MIC: Jack for mono microphone.
AUX/MIC: DIN socket.
Switch: Selects input via DIN.
PHONES: Jack for stereo headphones.

Indicators
REC CAL: Shows that tape has been calibrated. (Blinks during calibration.)
RECORD: Indicates recording mode (blinks during "ready").
TAPE END: Shows end of tape has been reached.
TIME CAL: Shows tape has been calibrated in real time. Blinks during calibration.
Index Display: Four 1" red fluorescent digits. Displays tape indexing in arbitrary units or in real time (minutes and seconds), or alternating between the two. Shows actual time when TIME SET is pressed. Has symbols to show tape direction and speed, and whenever an illegal command has been entered.
Level Meters: Two 8-segment fluorescent line displays from −20 to +5 dB (green up to 0 dB, red above 0).

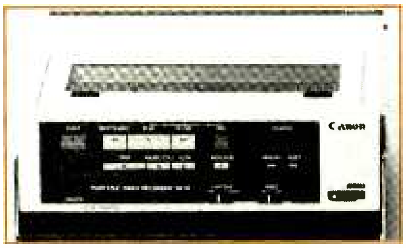
Rear of Recorder
AMPLIFIER: DIN socket for line input and outputs.

Underneath Recorder
MPX FILTER: Two-position toggle switch.
LEVEL (LINE/DIN): Two-position toggle switch to set input sensitivity for line or DIN signals.
OUPUT LEVEL: Screwdriver adjustments of playback level, separate for L and R channels.

NEW PRODUCTS

Additional information on new products covered in this section is available from the manufacturers. Either circle the item's code number on the Free Information Card or write to the manufacturer at the address given.

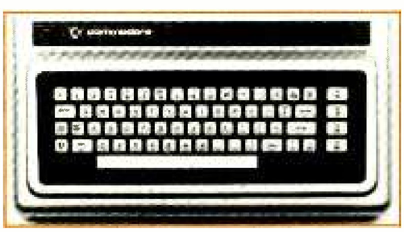
Canon Portable VCR



Canon, Inc. has introduced its first video cassette recorder, the VR-10A. The unit, in the VHS format, is designed to be used in conjunction with the 105-channel Canon VT-10A tuner timer (as well as with a video camera). Power for the recorder is supplied from a 12-V lead-acid rechargeable battery pack that fits into the base of the chassis. There is also a choice of accessory charger/ac converters. (Power for the tuner/timer is ac only.) The recorder can play for eight hours in the EP mode, and features soft-touch controls that permit ten times normal speed in forward and reverse, still-frame viewing, noiseless slow motion, frame-by-frame advance, and a dew warning light. The machine can also be operated by remote control from as far as four meters away. Another recorder feature allows the user to insert a new image while retaining existing sound or change sound while keeping the original image. It has an LCD tape counter and a battery condition check. Dimensions are 9.4" x 3.7" x 9.6"; weight is 8.4 lb. $860.

CIRCLE NO. 89 ON FREE INFORMATION CARD

Commodore MAX



The Commodore MAX Machine is a three-in-one home computer/game console/music synthesizer that is reported to produce color graphics previously available only with a sophisticated character generator. Its 40 column x 25 line screen and 16-color capability are interfaced to the new 6510 microprocessor (programmed in BASIC) to permit users to create their own games and store them on cassette tape, as well as to play prerecorded game software. The MAX can also handle word strings and math functions. Sound effects are produced by three independent "voices," each with a nine-octave range, containing a programmable ADSR (attack, decay, sustain, release) generator and a programmable filter with variable resonance. $180.

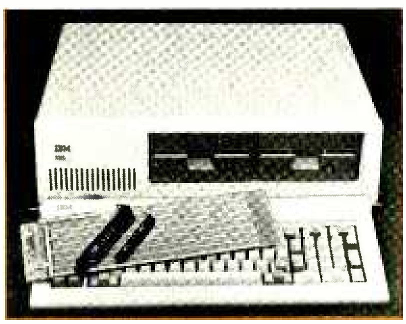
CIRCLE NO. 91 ON FREE INFORMATION CARD

Auto-Reverse Cassette Deck

Technic's Model RS-M258R features an infrared sensor auto-reverse mechanism that functions in both playback and record modes. To eliminate gaps in the recorded material, the tape is reversed as soon as the sensor detects the leader tape. The RS-M258R has soft-touch operation and a two-color fluorescent meter with 18 segments and peak hold. The deck also provides music select ; automatic tape selection for normal, CrO_2, and metal types; Dolby NR; and output and input level controls. Using a servo motor, wow and flutter is rated at 0.05%. $400.

CIRCLE NO. 92 ON FREE INFORMATION CARD

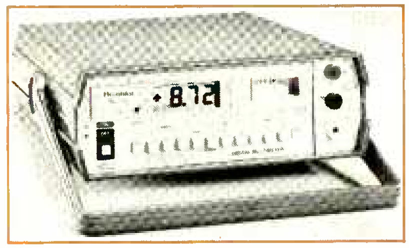
Computer Wiring Board



Vector Electronic's Model 4613 prototyping and expansion board for the IBM Personal Computer has an overall pattern of drilled, plated-through holes on an 0.1" grid. Three-hole solder pads are interspersed between heavy power and ground buses for solder-wire interconnections. It is said to hold up to 48 14-pin DIPs, 41 16-pin DIPs or a mixture of devices with various pin spacing. In addition to the DIP-mounting surface, the boards include a 3.5" square with individual padded, plated-through holes for mounting discrete components or hardware. Devices may also be mounted by tack-soldering. Fabricated of 0.062" FR4 green epoxy-glass material, the component-mounting circuits have two-ounce copper with reflowed solder plating. The 31/62-terminal IBM-bus card-edge connectors have gold-flashed nickel plating said to give low resistance and durability. The board measures 4.2" × 13.3" and comes with layout planning sheets, instructions, a card guide, and a universal I/O connector mounting bracket. $59.

CIRCLE NO. 93 ON FREE INFORMATION CARD

Heathkit DMM



The top-of-the-line IM-2264 multimeter from Heath measures voltage from 200 mV to 1000 V dc or 750 V ac; current from 200 μA to 10 A; resistance from 200 ohms to 20 megohms; and both forward and reverse diode conduction. Features include a flashing LED to alert the operator of excessive ac input, a switch-enabled alarm for quick testing of voltage and continuity without having to view the display, and an auxiliary auto-polarity analog meter adjustable from zero to full-scale. Current ranges are protected by diode and fuse circuit, and a resettable rear-panel circuit breaker provides protection on current measurements from 200 μA to 2000 mA, eliminating fuse replacements for moderate overloads. Resistance ranges are electronically protected to 300 V (peak), and isolated circuitry is said to permit floating measurements up to 500 V (peak) from earth grounds. The IM-2264 operates on six carbon-zinc, alkaline, or NiCd batteries (not included) or on an ac line with the optional Heathkit PS-2404 Battery Eliminator. The unit has a battery test circuit, a LO-BAT indicator, and a recharge circuit for the NiCd batteries. $240.

CIRCLE NO. 94 ON FREE INFORMATION CARD

Video Projection Monitor

The Kloss Novabeam Model II is a portable video projector that is reported to produce a TV picture on a flat white wall—eliminating the need for a projection screen. According to Kloss, the user needs only to position the unit four feet from a wall and turn off most of the room lights (or draw the shades for daytime viewing) to see a bright (200 lumens over 12 sq ft) five-foot diagonal color picture. Portability is said to have been achieved by enclosing the three Novatron projection tubes in a pop-up cabinet and omitting a TV tuner. A wired remote control permits the adjustment of contrast, brightness, color, tint, sharpness, and video source switching, as well as channel selection (from a VCR or component TV tuner), on/off, and volume. All audio/video feeds are connected via the remote control panel. Dimensions are $21^1/_2$" H x $24^1/_2$" W x 12" D; weight is 60 lb. $2200.

CIRCLE NO. 95 ON FREE INFORMATION CARD

Phone Call Interceptor

The Fox-Fone, from Fox, Inc., is said to permit one to choose what incoming phone calls will be accepted. The owner selects his own three-digit code and communicates that number to important callers. When a call is received, the Fox-Fone automatically answers. The caller hears a computer-generated voice asking him to enter the code by touchtone dialing (it will not work with a rotary dial). The Fox-Fone then produces a distinctive ring to indicate that a call has been received and cleared. A wrong code (or no code) will cause a call to be disconnected. To install the unit, two modular plugs (supplied) are required: one for the telephone wall socket, the other for the telephone. $130.

CIRCLE NO. 88 ON FREE INFORMATION CARD

Foreign Voltage Adapters

Ac line voltages and plug configurations vary from country to country. The Parks Products' Foreign Voltage Converter travel kit is designed to help one cope with these variations. It consists of five different adapter plugs that are reported to permit entry into every type of wall outlet used worldwide, including the new British 3-blade and the Australia/China slanted 2-blade. The converters will operate low-wattage appliances such as shavers, and high-wattage items such as hair dryers. Power range is from 1 to 1600 W. An automatic reset circuit breaker protects against overload. $35. **Address:** Parks Products, 3611 Cahuenga, Hollywood, CA 90068.

Wireless Stereo Headphones

Cybernet has announced availability of its new TM-301 Freedom stereo wireless headphones. The heart of the system is a compact stereo transmitter that connects to an audio amplifier or receiver. The headphones receive the signals via a closed-loop antenna reported to be able to transmit through walls and even from one floor to another. A talk button and built-in microphone on the transmitter permits someone to reach you while you have the headphones on; and a modulation control is said to optimize sound performance. $160.

CIRCLE NO. 96 ON FREE INFORMATION CARD

Video Interface

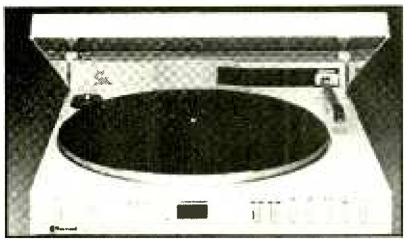
The Hewlett-Packard HP 82163A Video Interface adds video capability to HP-IL (In-

terface Loop) systems by displaying any combination of 96 characters and symbols in a 32-column by 16-line format. The unit, which plugs into a television or monitor, is

designed to operate in conjunction with the HP-41 hand-held computer. According to Hewlett-Packard, developing and debugging HP-41 programs is thus made easier, and program review sessions can be virtually paper-free. With the HP-41 computer set in "trace-with-stack-option," the interface will display all four operational-stack registers simultaneously, allowing review of the stack after execution of each program step. Other features include full cursor control and inverse-video display. The unit also permits a group of people in a classroom setting to more easily observe the video simulation of the HP-41 display. $295.

CIRCLE NO. 97 ON FREE INFORMATION CARD

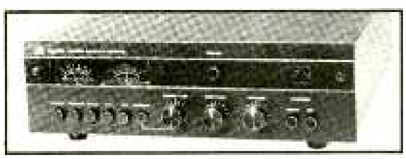
Linear-tracking Turntable



Sherwood has announced availability of its ST-905 phono turntable. It incorporates a tangential tracking tonearm and quartz-locked direct drive. Operation is automatic, with all controls on the front panel: pitch control, automatic replay, and a window for viewing the lighted strobe. The tonearm accepts plug-in LT-style cartridges. Wow and flutter are rated at 0.04%; S/N at 80 dB; and tracking error is 0.05%. $280.

CIRCLE NO. 98 ON FREE INFORMATION CARD

Earth Station Receiver



The Channel Master Model 6128 is a 24-channel synthesized earth station receiver. Channels are selected using Up/Down pushbuttons, and the selection is shown on a front-panel LED display. Fine tuning is accomplished with a center-tune meter. Audio channels (6.8 and 6.2 MHz) are selected with two Priority Audio Buttons, and additional audio channels can be tuned in manually. A Signal Strength meter shows the relative strength of the received signals. Depressing the Channel Scan allows the receiver to go through the complete horizontal channel range in about one second, ensuring, it is claimed, accurate aiming of the antenna. Additional features include Automatic Polarity Switching, permitting one-button selection of a given channel without further polarity adjustments. A remote control, with channel Up/Down and fine tuning, is available as an option. $1195.

CIRCLE NO. 99 ON FREE INFORMATION CARD

Ten-Band Equalizer

The Model DC2214 from Soundcraftsmen is a ten-band graphic equalizer that uses a "Differential/Comparator" circuit to provide "True Unity Gain" adjustments. According to the manufacturer, input-to-ouput matching is within 0.1 dB of the optimum signal voltage for any EQ curve desired. Distortion from the DC2214 is claimed to be virtually unmeasurable. The unit comes with a 19" rack-mount front panel and Soundcraftsmen's Frequency Spectrum Analyzer Test Record. $299.

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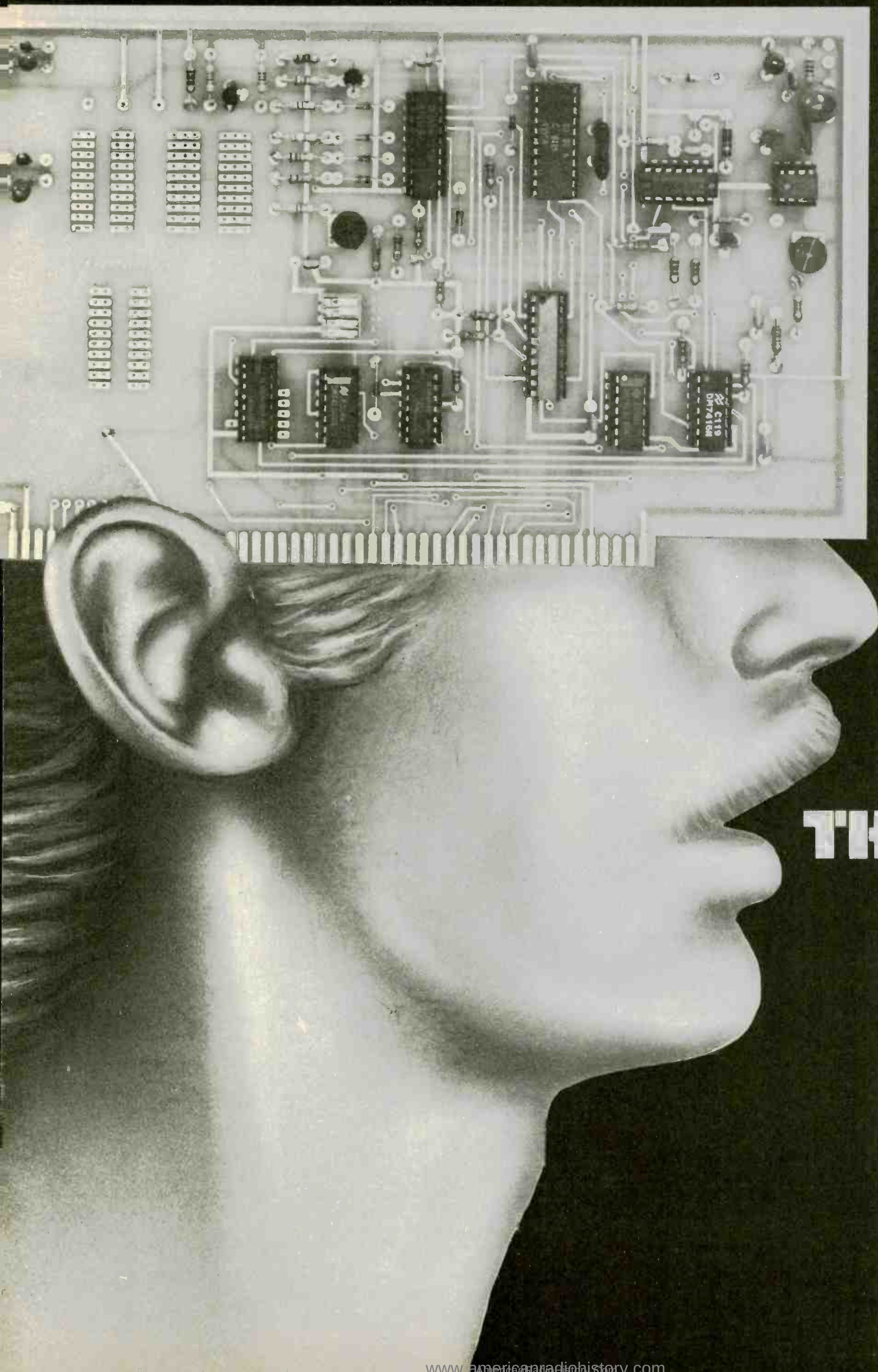


THIS IS

PART I

BY RANDY CARLSTROM

Talk is now cheap— Here's a speech synthesizer you can build for use with an S-100 bus computer

YOUR COMPUTER SPEAKING

"GOOD morning. It is 10:15, Friday, September fifteenth. You have a doctor's appointment at 2:30 this afternoon."

No, this needn't be your secretary reminding you of your day's schedule. It could be coming from a disembodied voice! Moreover, the physical make-up of this voice might consist of only a very small piece of silicon and some fine wires. As such, it is part of a rapidly growing family of devices that are revolutionizing computer output techniques called speech (or voice) synthesizers.

Electronic Analog. To successfully design a voice synthesizer, the techniques by which the human vocal system produces the basic unit sounds of speech (called *phonemes*) must be considered. For instance, how is the production of the sound *er* different than the production of the sound *oo*? An analysis of this kind would require a comprehensive knowledge of such speech characteristics as *format frequencies, diphthongs*, and so on, which is beyond the scope of this article and better left for the speech scientists.

For our purposes it is sufficient to know that a phoneme is composed of many different frequencies (as determined by the dynamic frequency response of the vocal tract), and it is the relationship of these frequencies to each other and their relative amplitudes that determine the type of sound that will be heard.

An important instrument used in the analysis of speech is the voiceprint machine (or "Sonagraph"). This is a special type of spectrum analyzer that displays both frequency and the relative amplitude of each frequency of the input signal as a function of time. With this instrument, measurements can be made of the various parameters of any speech utterance. Utilizing data obtained from such measurements, electronic filter networks can be designed to model the human vocal tract. An algorithm for controlling the filters in such a way as to produce artificial speech can also be developed using these measurements.

An electronic analog of the human vocal system is shown in Fig. 1. The dashed lines represent parameter control lines, which allow the various parameters of the model (voicing amplitude and frequency, filter network frequency response, etc.) to be externally controlled. These may be control bits from a digital computer, corresponding to signals from the brain. Through proper sequencing of the filter parameters and excitation sources, an electronic model can generate quite intelligible synthetic speech. The overwhelming, and almost formidable, task of controlling these parameters, however, is where the similarities of speech synthesizers end.

Phoneme Synthesizer. One approach to electronic speech synthesis is the *phoneme synthesizer.* This type of synthesizer is capable of generating a number of different phonemes which, when combined in the appropriate sequences, can synthesize any word. The phoneme-generation control circuits incorporated into such a synthesizer make it possible to generate continuous speech without the complex methods associated with synthesizers commonly used before. The phoneme synthesizer is ideally suited for the experimenter, because it allows a virtually *unlimited* vocabulary for a minimum in support hardware and software.

Until very recently, the cost of phoneme synthesizers has been prohibitive. However, a recent development in speech synthesis technology has brought the price and amount of required support hardware down substantially. This significant achievement was made by the Votrax company with the introduction of the first *single-chip* phoneme synthesizer. Called the *SC-01*, this device is capable of generating 64 different phonemes, accessed by a 6-bit code.

An on-chip parametric control generator enables the device to *automatically* generate each phoneme necessary for any given word; its internal parameters never need to be updated by the user. This translates into an input data rate of only 70 bits (less than 9 bytes) per second for continuous speech output. A dynamic articulation controller (also on chip) provides smooth transitions from one phoneme to the next as speech is synthesized from each of the 64 possible phonemes, which is essential to the production of intelligible speech. The speech synthesizer described here uses this SC-01 chip.

Circuit Operation. In the synthesizer interface circuit shown in Fig. 2, *IC1, IC2,* and *IC3* decode selected S-100 bus address and control lines to generate four input and four output port control signals. In this application, only ports *n*1 and *n*2 are used, with the remaining I/O ports for future use.

The value of *n*, a hexadecimal number representing the upper four bits of the decoded port address, is selected via switches *S1* through *S4*. When all four switches are closed (associated pins grounded), $n=0$; with *S4* open and *S1* through *S3* closed, $n=1$; etc. The vocabulary software to be described later requires that $n=3$ (*S1* and *S2* closed, *S3* and *S4* open).

Also shown in Fig. 2 are the two power supplies required. *IC4* delivers +5 volts regulated to the board, while *IC5* delivers +12 volts regulated.

The phoneme synthesizer is *IC7* of Fig. 3. The data bus is buffered by elements of *IC6*, while pull-up resistors *R2* through *R7* insure that the minimum input-high requirement of *IC7* is met. The inflection (pitch) data from the CPU is latched by *IC8*, with elements of *IC9*, in conjunction with *R10* and *R11*, providing the level-shift buffering required by the MOS inputs of *IC7*. The timing signal to *IC7* and *IC8* is provided by *IC9F* reacting to an OUT *n*0 instruction from *IC3* pin 15 (Fig. 2). The rising edge of this signal latches the contents of the data bus (which contains the phoneme access code and inflection information) into *IC7* and *IC8*.

Each time *IC7* (the phoneme synthesizer) completes the production of a phoneme, and is ready to accept new data, it requests an interrupt of the CPU via *IC11A* which gates the interrupt request only when the synthesizer is enabled (*IC10*, pin 19 of Fig. 4 is high). The output of *IC11A* (pin 3) can be connected to the desired vector-interrupt (VI0 through VI7) of the system. If your particular system does not have vector-interrupt capability, the output of *IC11A* can be connected to the system $\overline{\text{PINT}}$ line of the S-100 bus. Interrupt requests from this line will be acknowledged by a restart at memory location 0038H (RST7), in the same manner as a VI0 vectored interrupt. This is because the data bus is floating high during the Interrupt Acknowledge period.

When the synthesizer is not being used, the synthesizer enable bit at *IC10*, pin 19 (Fig. 4) should be cleared to prevent *IC7* from interrupting the CPU, should the interrupt system be enabled. This can be done by outputting 0*xxxxxxx* (*x* means don't care) to port *n*1. The synthesizer's interrupt circuit is automatically disabled at power-up via the $\overline{\text{POC}}$ signal.

Parameter control latch *IC10* is updated via pin 11 whenever the CPU executes an OUT *n*1 instruction. This signal is decoded at *IC3* pin 14, and passed through *IC9E* to *IC10*. The eight outputs of *IC10* (Q1 through Q8) form the "control" word for the synthesizer output volume via Q6 and Q7, the master clock frequency via Q1 to Q5, the mode via Q5, and the interrupt control circuit

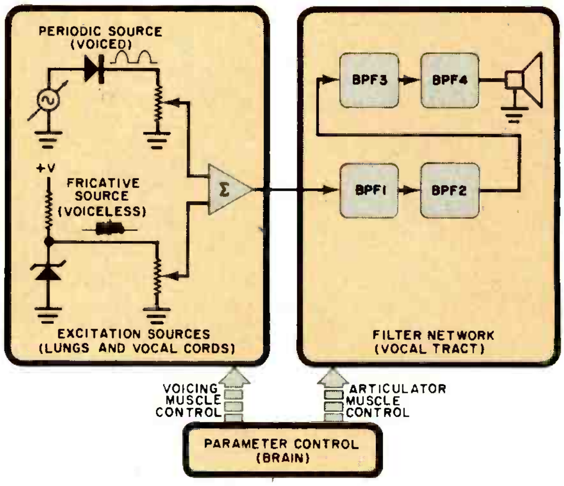


Fig. 1. Block diagram representing the electronic analog of the human speech mechanism with analogous parts marked.

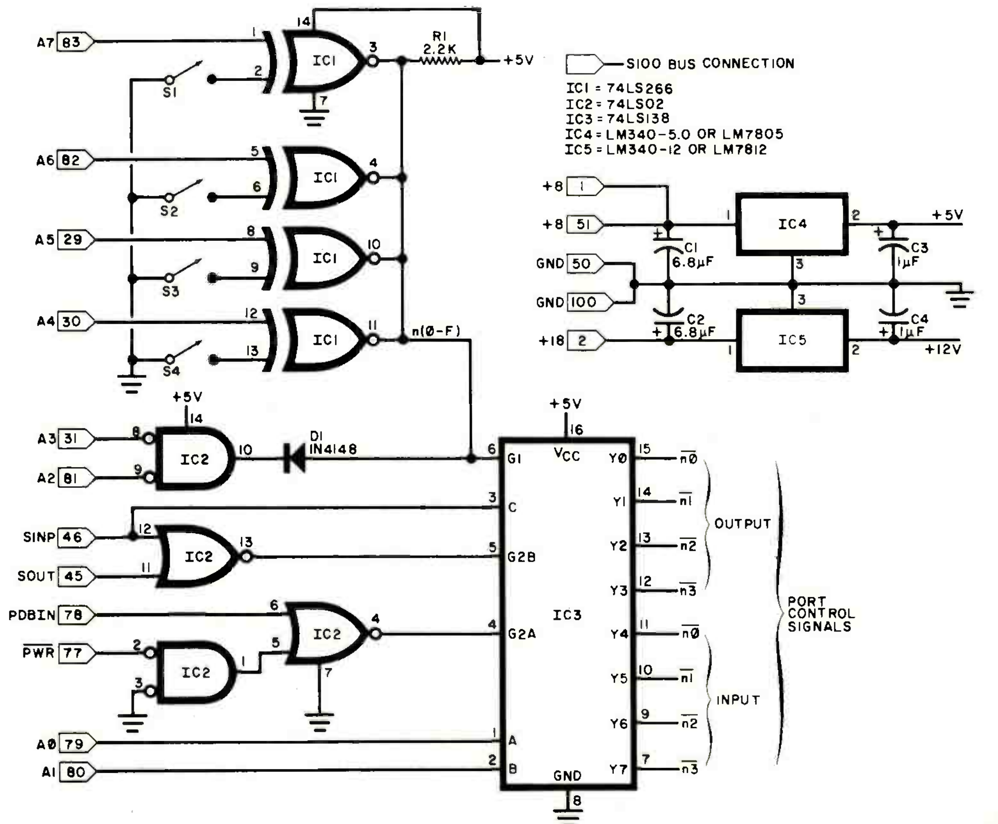


Fig. 2. This circuit decodes the selected S-100 bus lines.

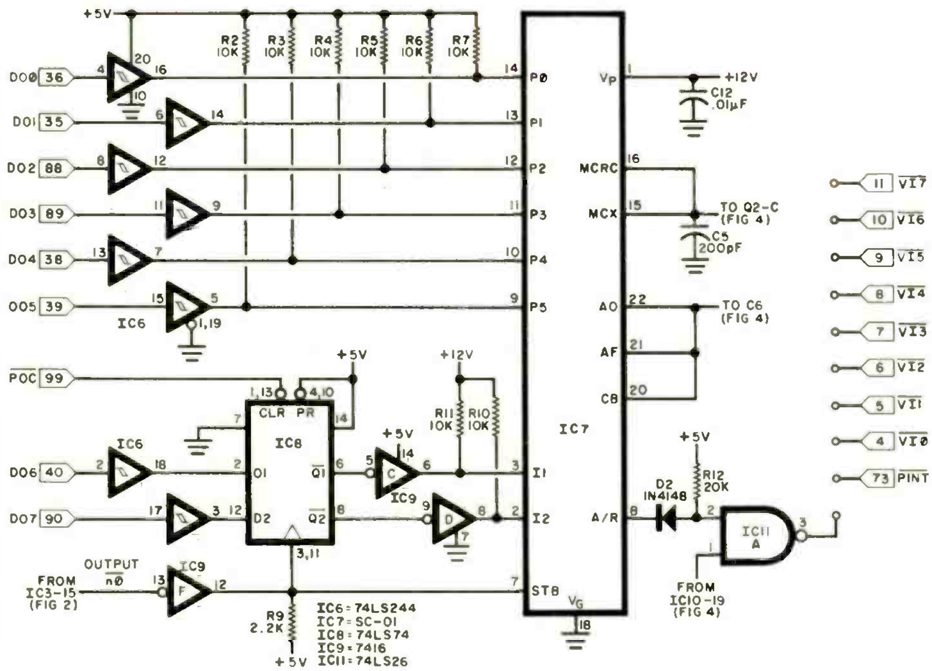


Fig. 3. The phoneme synthesizer is IC7. Pitch data from the CPU is latched by IC8.

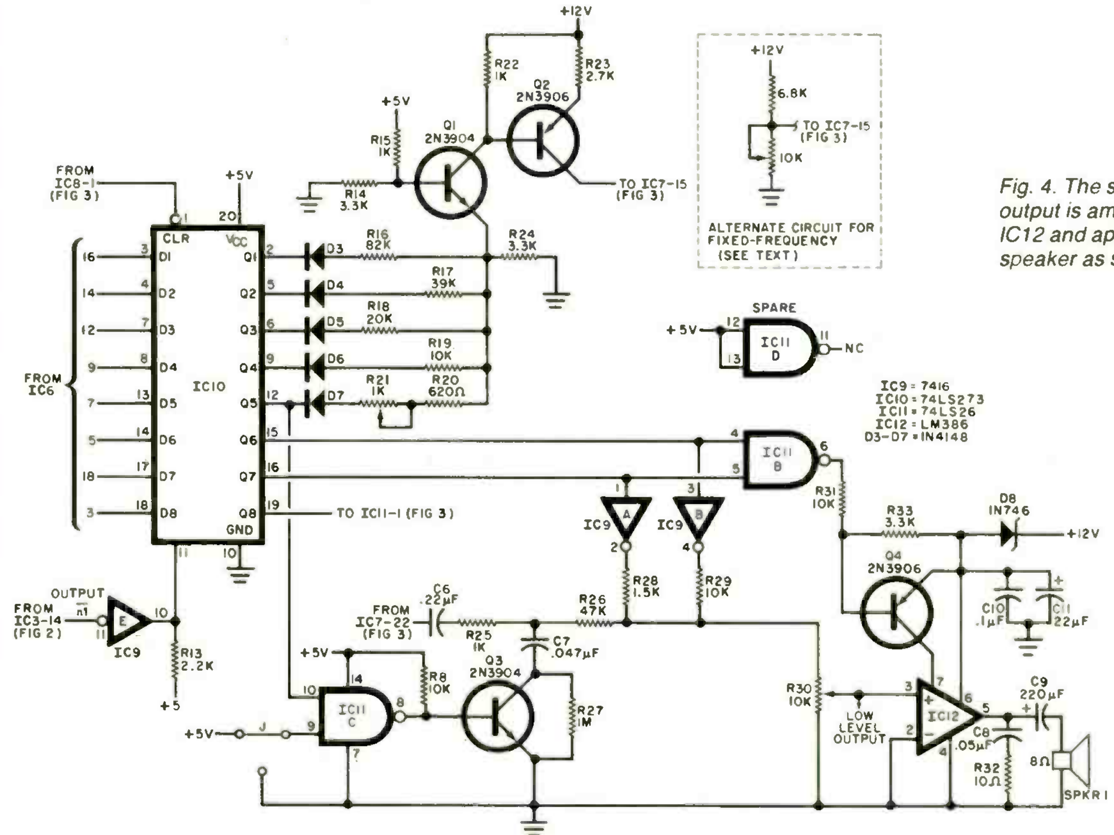


Fig. 4. The synthesizer output is amplified in IC12 and applied to the speaker as shown here.

b7	b6 b5	b4	b3 b2 b1 b0
ENABLE	VOLUME	MODE	MASTER CLOCK FREQUENCY

CONTROL WORD

Fig. 5. The control word, is made up of the following bits:

Bit 7: Enables/disables interrupt request from synthesizer. 0=disable; 1=enable.

Bit 6,5: Set synthesizer output power (XAn). 00=full power; 01=medium power; 10=low power; 11=no power.

Bit 4: Determines mode of synthesizer (XE, XS). 0=speech; 1=sound effects.

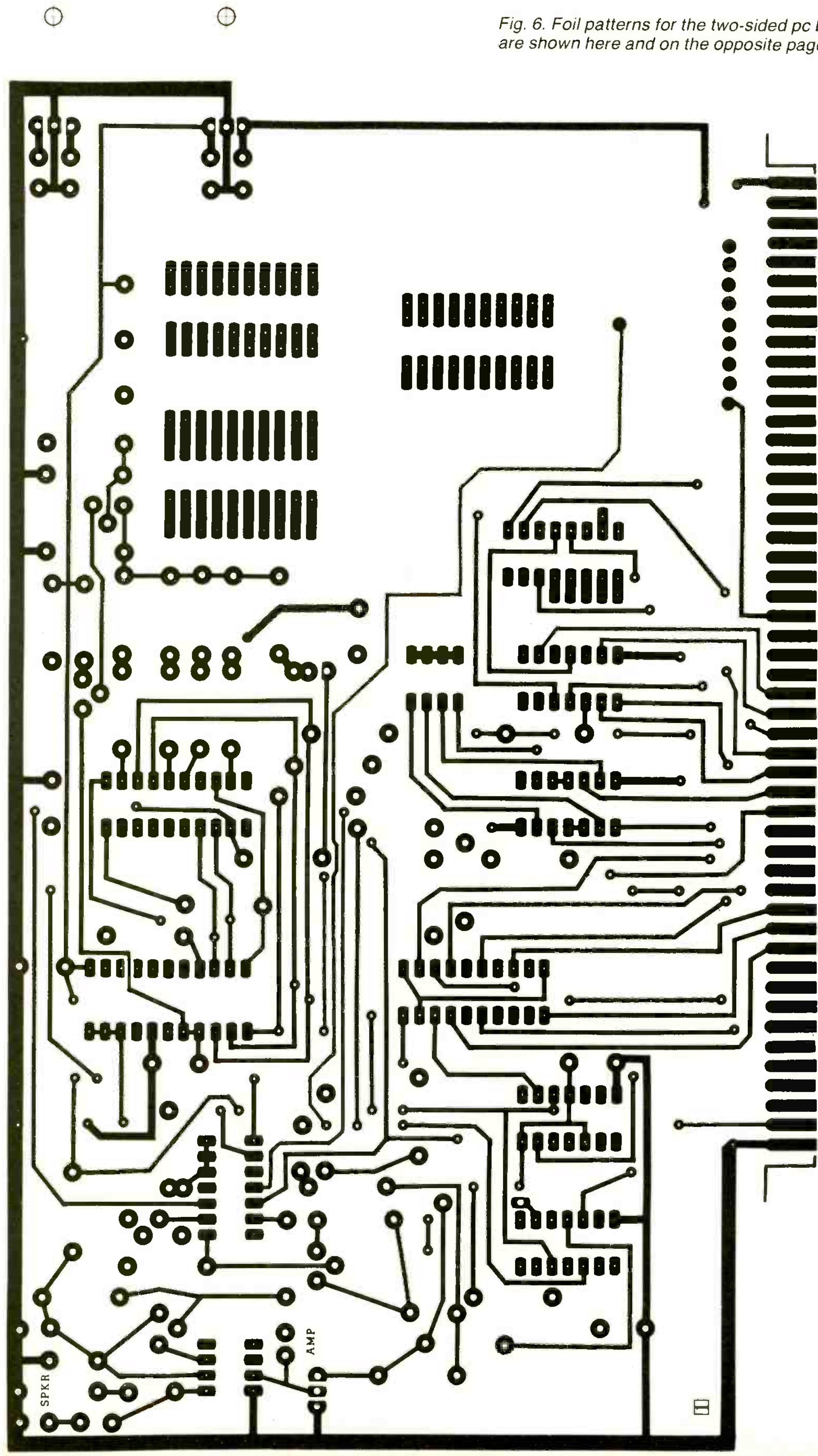
Bits 3-0: Set synthesizer master clock frequency (XFn). 0000=highest frequency setting . . . 1111=lowest frequency setting.

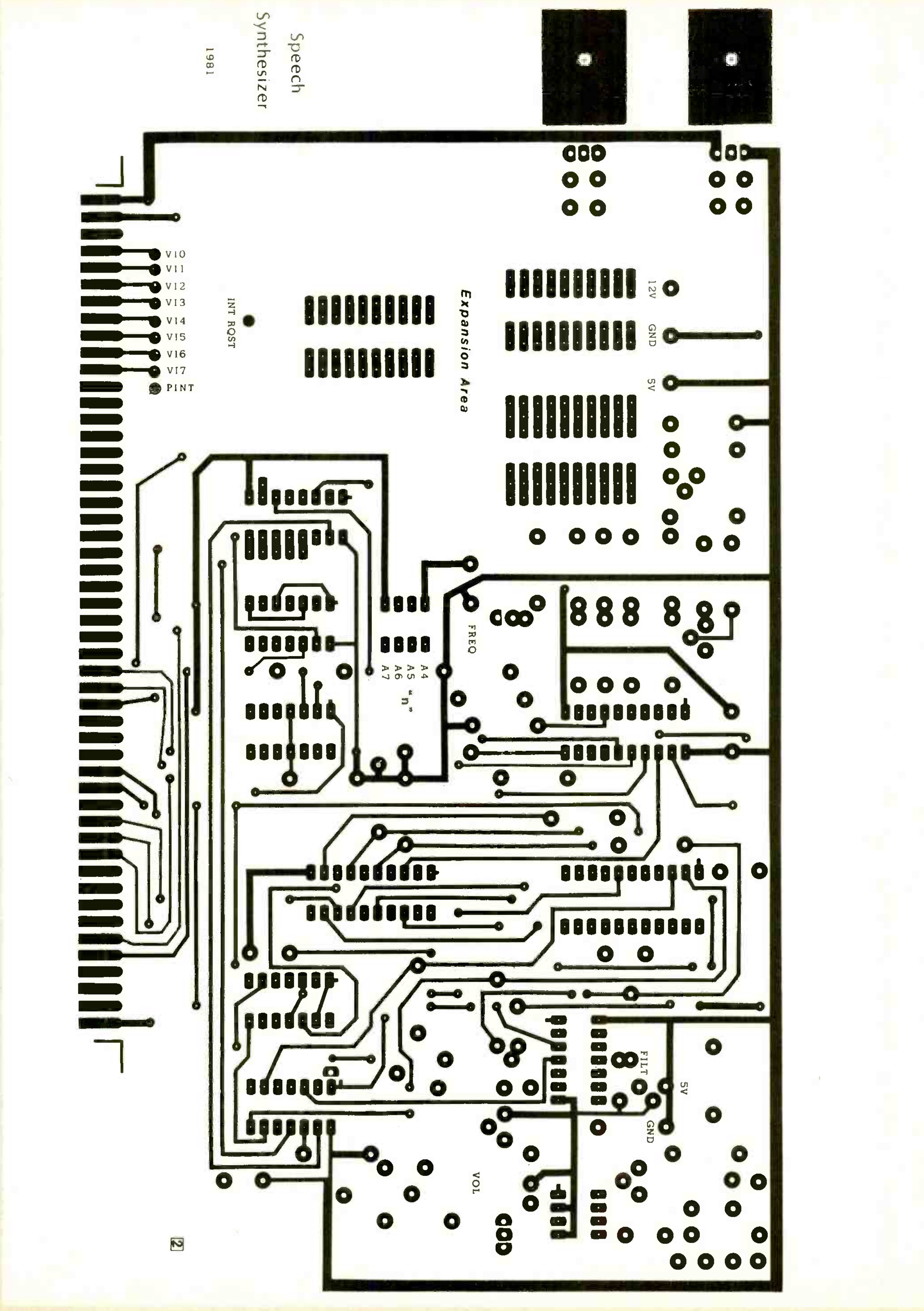
via Q8. The control word is fully described in Fig. 5.

As shown in Fig. 4, *Q1, Q2, R14* through *R24*, and *D3* through *D7* form a programmable current source whose output is coupled to timing capacitor *C5* (Fig. 4). In conjunction with *IC7* pin 16, this determines the clock frequency at pin 15. Varying the amount of current varies the frequency which, in

(Text continues on page 26)

Fig. 6. Foil patterns for the two-sided pc board are shown here and on the opposite page.




Speech
Synthesizer
1981
Expansion Area
INT RQST
VI0
VI1
VI2
VI3
VI4
VI5
VI6
VI7
PINT
12V
GND
5V
FREQ
A4
A5
A6
A7
"n"
FILT
5V
GND
VOL
2

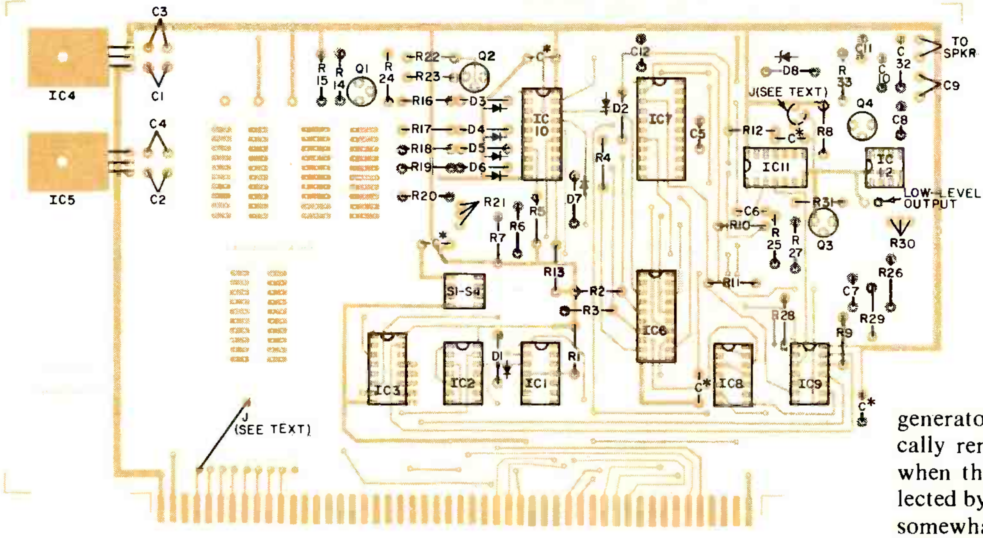


Fig. 7. Use this layout to install the components on the top of the board.

turn, varies the voice and sound effects quality of the synthesizer. If this feature is not required, as in a stand-alone speech synthesizer, the circuit shown in the dashed box in Fig. 4 can be substituted for the programmable current source.

The audio amplifier is formed by *IC12* and its associated components. Transistor *Q4* shuts down the amplifier when *IC11B* decodes that command from *IC10*. Elements *IC9A* and *IC9B*, in conjunction with *R26, R28*, and *R29* form a programmable audio attenuator, controlled by signals from *IC10*.

A programmable single-pole, 3.4-kHz low-pass filter formed by *R25, C7, Q3* is controlled by *IC11C* and can be switched on during normal speech operation to reduce any high-frequency switching components that may be present in the signal from phoneme generator *IC7*. This filter is automatically removed from the circuit by *Q3* when the "sound effects" mode is selected by the user program. This action somewhat improves the sound effects quality. If it is desired to leave this filter permanently turned on, *IC11C* pin 9 should be tied to ground instead of +5 volts via the jumper.

Construction. The circuit can be constructed on a conventional S-100 prototyping board, or a double-sided pc board can be fabricated using the foil patterns shown in Fig. 6. The component installation is shown in Fig. 7, which may also be used with a prototyping board. Keep in mind that *IC7* is a static-sensitive device and should be handled accordingly. Sockets should be used for all ICs and DIP packages can be used for switches *S1* through *S4*. Install decoupling capacitors as denoted by C* on Fig. 7 and listed under miscellaneous in the Parts List.

Prior to installing the ICs, and with the two voltage regulators wired in, install the board in an S-100 bus and check for the presence of +5 and +12 volts at the proper pins of each IC and the transistors. Once the board has been checked for correct voltages and all passive components are correctly installed, install the ICs within their sockets.

To test the board, output xxx01000 to port *n*1 (selected by *S1-S4*) and connect a frequency counter to *IC7* pin 15. Then adjust *R21* for a clock frequency of 720 kHz. If the boxed circuit of Fig. 4 is used, adjust the 10-kilohm potentiometer for 720 kHz at pin 15 of *IC7*. There is no hard and fast rule that the clock frequency must be 720 kHz—the user is encouraged to experiment with different frequency settings to find the one he likes best. Audio volume control *R30* is used to adjust the output volume of the synthesizer.

Next month, in Part 2, we will describe software for the speech synthesizer and some typical applications. ◇

PARTS LIST

C1,C2—6.8-µF, 25-V tantalum capacitor
C3,C4—1-µF, 20-V tantalum capacitor
C5—200-pF, 10% silver mica or ceramic capacitor
C6—0.22-µF ceramic capacitor
C7—0.047-µF, 10% metal film or ceramic capacitor
C8—0.05-µF ceramic capacitor
C9—220-µF, 10-V tantalum capacitor
C10—0.1-µF ceramic capacitor
C11—22-µF, 15-V tantalum capacitor
C12—0.01-µF ceramic capacitor
C*—See Miscellaneous
D1 through D7—1N914,1N4148 or similar silicon switching diode
D8—1N746A 3.3-V zener diode
IC1—74LS266 quad 2-input Exclusive NOR
IC2—74LS02 quad 2-input NOR
IC3—74LS138 3-to-8 line decoder
IC4—LM340-5.0 or LM7805 5-V voltage regulator
IC5—LM340-12 or LM7812 12-V voltage regulator
IC6—74LS244 octal noninverting tri-state buffer
IC7—SC-01 phoneme synthesizer
IC8—74LS74A dual D flip-flop
IC9—7416 hex inverting buffer
IC10—74LS273 octal D flip-flop
IC11—74LS26 quad 2-input NAND
IC12—LM386 audio power amplifier
Q1,Q3—2N3904 npn transistor
Q2,Q4—2N3906 pnp transistor
Unless otherwise specified, the following are ¼-W, 5% resistors:
R1,R9,R13—2.2 kilohms
R2 through R8, R10, R11, R19, R29, R31—10 kilohms
R12,R18—20 kilohms
R14,R24,R33—3.3 kilohms
R15,R22,R25—1 kilohm
R16—82 kilohms
R17—39 kilohms
R20—620 ohms
R21—1-kilohm, pc-mount potentiometer
R23—2.7 kilohms
R26—47 kilohms
R27—1 megohm
R28—1.5 kilohms
R30—10-kilohm, pc-mount potentiometer
R32—10 ohms
S1 through S4—Spst 4-position DIP switch
SPKR1—200-mW, 8-ohm speaker
Misc.—Etched and drilled pc board or perf board; solder; 0.05-µF or 0.1-µF, 5-V bypass capacitors distributed near IC power pins; IC sockets; etc.

Note: The following is available from PAIA Electronics Inc., Box 14359, Oklahoma City, OK 73116: complete kit of all parts including double-sided pc board and SC-01 chip at $179.95 + $3 postage and handling. Also available separately from the same source: double-sided pc board (#SS100PC) at $34.95 + $2 postage and handling; SC-01 speech synthesizer chip at $59.95 + $2 postage and handling; software listing at $3.00.

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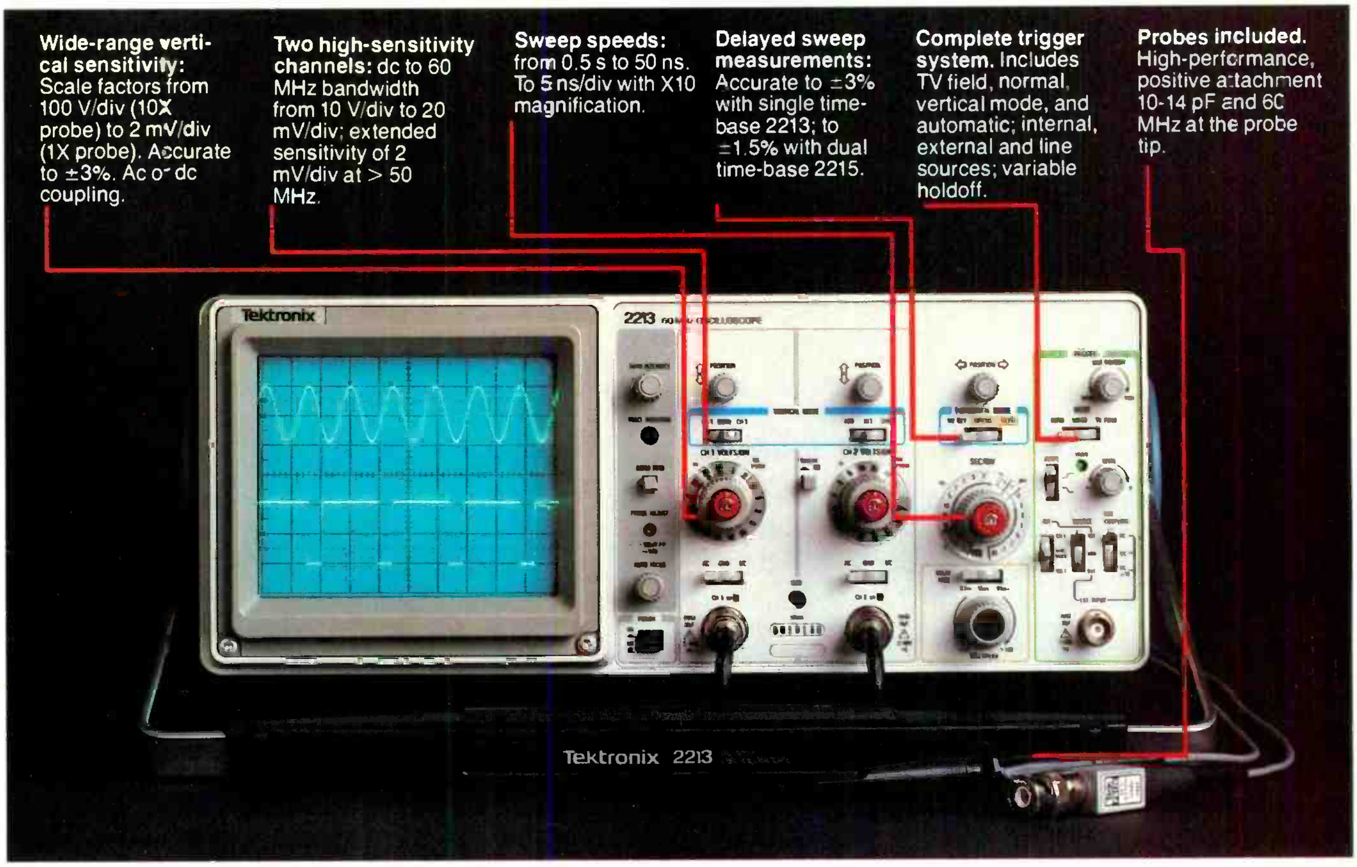

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Sony Profeel Component TV System

THE new Sony Profeel Component TV System is a video version of a good-quality audio stereo system. Individual components and the resulting versatility make it particularly appealing to serious video enthusiasts and to anyone who wants more than a standard TV set.

The Profeel product line includes a color monitor (either 19 or 25 inches) with a built-in stereo amplifier for the audio section, a TV tuner with remote control that covers all CATV channels, and a video cassette recorder with a separate tuner-timer. In our tests, we have focused on the features and performance of the TV tuner (VTX-1000R) and the 19-inch monitor (KX-1901).

Tuner Section. The VTX-1000R is designed to be operated with the Remote Commander IR control unit—the latter featuring volume and picture control through two "up or down" pushbuttons, power on-off and a TV channel selection by two methods. The viewer can either scan the channels by means of two "up or down" pushbuttons or access the desired channel directly with the 10-pushbutton matrix. The same controls are repeated on the tuner front panel, together with presetting controls that permit scanning only through the channels available in a particular location. The selected channel is indicated by green 7-segment numerals; red and green LEDs indicate whether the antenna or auxiliary inputs have been selected. A stereo phone jack is provided at the front of the tuner together with bass/treble, balance, and headphone volume controls. Dimensions are 3"H × 11" D × 17" W; weight is 11 lb.

The tuner has full ac line isolation through a power transformer and operates from well-regulated +12 V. It contains two 4-bit microcomputers: a remote signalling decoder and a phase-locked-loop (PLL) controller. The electronic vhf and uhf tuners are varactor-tuned, crystal-controlled units with frequency synthesizer and PLL channel selection. The control signals from the tuner are encoded by one of the microcomputers and are transmitted in serial, digital form to a matching decoder at the monitor.

One of the unique features of the VTX-1000R is the availability of either the usual intercarrier sound or a split sound channel that offers hum-free audio suitable for eventual stereo reception. Figure 1 shows the system used by Sony to achieve this capability. The video i-f signal normally goes through the *SAW1* filter and is amplified, detected, and separated into video and 4.5-MHz intercarrier sound. AGC (automatic gain control) and video amplifiers are included in a single IC, together with the intercarrier limiter, FM detector, and volume control. The resulting audio goes to the a-f switch on the special split-sound IC. A portion of the i-f signal from the tuner goes to *SAW2*, after passing through an amplifier. Filter *SAW2* is tuned sharply to 41.25 MHz, the sound i-f. A voltage-controlled oscillator (vco) provides the mixing signal for heterodyning to 10.7 MHz, the standard for FM receivers. The signal is then amplified and detected like any FM signal. Depending on the setting of the "carrier" switch on the tuner's rear panel, either the intercarrier or the split sound will go to the audio amplifier.

Note that the "mute" control can shut off either sound source. The FM stereo sound available during FM-TV simulcasts can be substituted for the TV audio and supplied to the stereo amplifiers located in the monitor.

Monitor Section. The KX-1901 uses a special glass front panel which can be removed for cleaning. All controls are located behind a slim, hinged panel at the right bottom of the set. Two feather-touch pushbuttons increase or decrease volume and picture intensity, one by controlling power and the other by determining whether the monitor operates on normal video or on the digital RGB inputs. Tiny lamps indicate the selected mode, and a separate "master" pushbutton determines whether power is controlled at the monitor or at the VTX-1000 tuner. Vertical hold, sharpness, hue, color and brightness controls are located under the same hinged panel, but are recessed since they are not often used. These controls override the automatic control circuits. Monitor dimensions are 22" H × 19" D × 26" W. Weight is a heavy 72 lb due to the use of iron in the transformer and filter. This is intended to isolate the chassis from the ground, stabilizing the picture.

The circuitry of the KX-1901 and its 25" version resembles that of a high-quality studio color monitor rather than a usual color TV set. There are chains of

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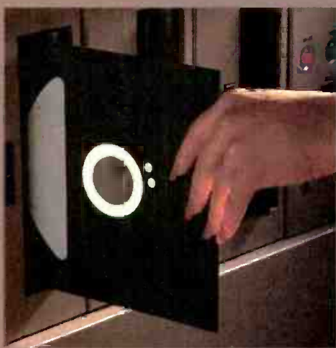

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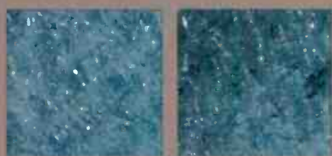

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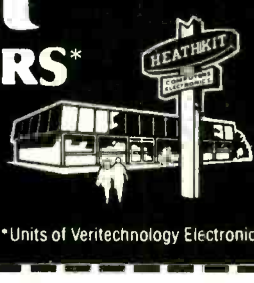

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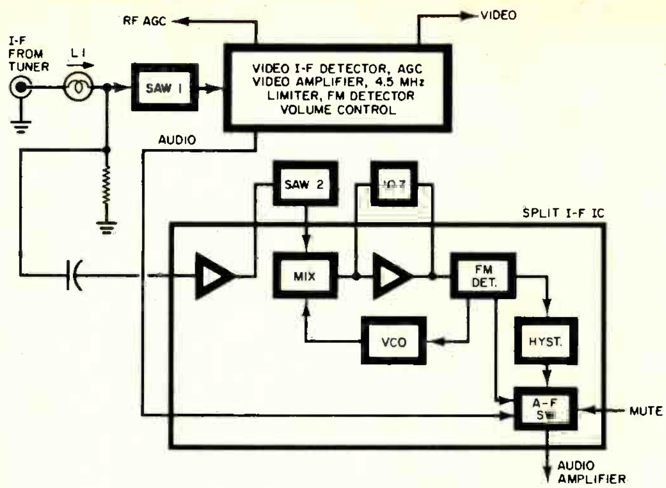

Fig. 1. Simplified schematic of the audio detector system.

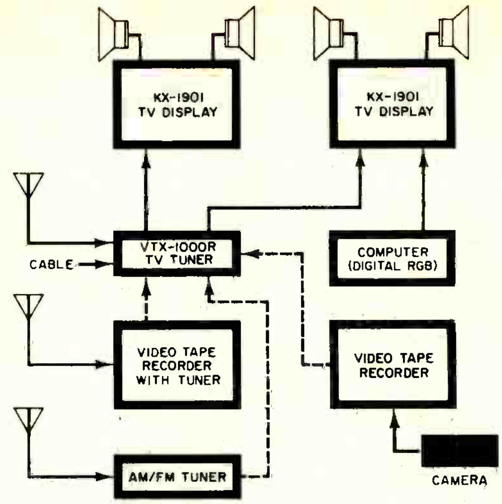

Fig. 2. Configurations possible with Sony's Profeel.

video amplifiers, dc clamps, linearization networks, buffer amplifiers, and phase correction networks. The Y (or brightness signal), the 3.58-MHz color subcarrier, and the vertical and horizontal sync signals are all carefully processed, with correct impedance-matching amplifiers at each input and output terminal. Automatic color correction, phase correction, fleshtone correction, blanking and color-killer circuits are incorporated in a few ICs, but additional, external transistor circuits provide the kind of video processing normally associated with studio equipment.

A stereo audio amplifier section in the chassis uses two ICs, in combination with discrete transistors, to drive the two speakers that are part of the Profeel. The SS-X1A speaker system consists of two cabinets, approximately 8" × 4.5" × 3.3", each containing a 3.3" woofer and a 2" tweeter. These two cabinets can be mounted at the left and right rear of the monitor on hinged brackets. They have a nominal 7-W (max 15-W) output power capability and a rated frequency response of 60 to 20,000 Hz. Sony also offers a set of larger speakers for standalone, component-style operation.

Two separate power supplies operate from the single power transformer, which is preceded by a special, inductive line-filter assembly. All of the video circuitry uses the well-regulated 115-V dc supply, while the audio section obtains its power from the other transformer secondary and runs at ±12 V dc. A separate, small, power transformer is used to provide +12 V through a one-transistor regulator to the decoder and control section. The degaussing coil circuit is conventional and uses a series, voltage-dependent resistor. Separate fuses are provided for the main ac input, and for each branch. The high voltage is adjustable through a special HV potentiometer and is current-regulated.

Five major printed wiring boards contain all of the circuitry, and five minor ones contain such assemblies as the front panel controls, indicator lights, connectors, and line filters. Sony supplies detailed schematics, together with board layouts and pin connections.

A unique aspect of both the TV tuner and the monitor is the "jack-pack," the large number of the connectors supplied with each unit. For example, three separate coax connectors are available at the rear of the VTX-1000R TV tuner just for vhf antenna inputs. One is for the vhf converter (cable) and one for auxiliary inputs, such as the vhf output from a TV game, video disc player, or VCR. (Of course, there are also separate 300-ohm uhf antenna terminals.) In addition, three identical sets of jacks, color-coded for video and left and right stereo inputs, are located at the rear of the tuner, as well as various jacks for control and multiplexed input and output, audio attachments, and a multipin connector that joins the tuner directly to the monitor. All video jacks are for 1-V, NTSC, negative video at 75 ohms, while the audio is for either 47 or 5 kilohms. Two separate ac outlets, one switched and the other unswitched, complete the total of 28 separate connectors.

Similarly, at the rear of the monitor, ten connectors are provided, including those for the stereo speaker, and a special 34-pin connector for digital RGB (red, green, blue) and control signals coming from a computer. This array makes it possible to set up virtually any arrangement of video components.

Figure 2 illustrates the versatility of the system. Note that a single VTX-1000R can control and drive two monitors, either 19" or 25". Of course, a TV game or video disc player can be used instead of the tuner-equipped VCR. The TV camera, for example, does not have to be routed through the VCR, but can be connected directly either to the monitor or to the VTX-1000R. Sony supplies a special interconnection manual that describes nine specific configurations, though many more are possible.

Laboratory Measurements. The VTX-1000R tuner shows excellent sensitivity on both vhf and uhf, i.e., the 57-dBm figure (vhf) is equivalent to an input signal of 6 microvolts, and the 54-dBm figure (uhf) means that a 12-microvolt signal will result in a noise-free picture.

SONY KX-1901 and VTX-1000R PROFEEL TV SYSTEM

Parameter	Measurement
Sensitivity, vhf (Ch. 3):	−57 dBm
Sensitivity, uhf (Ch. 20):	−54 dBm
Noise figure, vhf (Ch. 3):	6 dB
Noise figure, uhf (Ch. 20):	10 dB
Video bandwidth to CRT (−6 dB):	4.05 MHz
R-f oscillator frequency stability: (105 to 130 V ac, 2 hr)	
Ch. 3:	0.05 MHz
Ch. 20:	0.05 MHz
Agc dynamic range:	68 dB
Dc restoration:	95%
Horizontal linearity:	100% left, 100% right
Vertical linearity:	100% top, 100% bottom
Convergence:	90% at worst area
Dc voltage regulation, B+: (105 to 130 V ac)	98%, KX-1901; 95%, TX-1000R
High-voltage regulation: (105 to 130 V ac)	95%, KX-1901
Power rating:	93 W, KX-1901; 18 W, TX-1000R

Both measurements indicate that the tuner will be usable in fringe areas.

We measured a video bandwidth of 4.05 MHz right up to the CRT input, a better video response than we've encountered on any commercial TV set. This, coupled with a fairly large agc dynamic range and practically perfect dc restoration, accounts for the excellent broadcast pictures seen on the screen.

A frequency synthesizer which is phase locked to a low-frequency crystal accounts for the excellent r-f oscillator stability; we were unable to measure more than 50-kHz variation under any condition.

Linearity on both axes was essentially perfect, but the set we tested had some misconvergence at the extreme right of the screen, resulting in the notation of 90%, at the worst area. Using a staircase pattern we found the gray scale to be excellent, just as the color bar pattern appeared practically perfect on the screen.

The audio-frequency response was the same on both channels of the stereo amplifier. We used test tones through the SS-X1A speaker system as a rough indication of audio quality, and were able to hear from about 80 to 16,000 Hz. A full audio test procedure was not performed, however.

User Comments. The picture quality of the KX-1901 was really superb, both on the commercial TV broadcasts and as a studio monitor. Not only were the colors well-balanced and natural, but resolution, linearity and convergence (except for the anomalous area at the extreme right) were excellent.

After appreciating the technical features and excellent performance of the Sony Profeel System, we asked the crucial question: How much does it cost? Current suggested retail price for the 19-inch monitor is $850 while the 25-inch monitor lists for $1500. The VTX-1000R tuner price is $520, including the remote control unit, which costs $65 when purchased separately. The stereo speakers described here, Model SS-X1A, are priced at $80 a pair.

For $1450, the Sony Profeel line offers the equivalent of a high-quality, 19-inch color set, with a set of stereo speakers, and a tuner that contains the latest features and picks up all possible channels, together with a handy IR remote control. This is obviously more money than a comparable single TV receiver, but many of the Profeel features are just not available in a standard set. If you're using a personal computer, for example, the monitor can provide an 80-character display, which is twice as big as is possible with a regular TV. If you plan a multi-input video system, the jack-pack and control features of both the tuner and monitor, as well as the modularity of the system, are very significant advantages.

To sum up, if price is not a key consideration, the KX-1901 and VTX-1000R tuner make up a super deluxe 19-inch color television, with a host of features you can't get on a standard receiver. At least not yet. —*Walter H. Buchsbaum*

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Popular Electronics Tests

Osborne 1 Portable Computer

THERE have been other portable computers, but the Osborne 1 was the first portable computer to include a video screen, two 5¼" floppy disk drives, a detachable keyboard, Z80 CPU, 64K of memory, and both serial and parallel interfaces. A large application software package and the CP/M-80 operating system has been included too, all at a very modest price. As such, the Osborne 1 is a pioneer in much the same manner as, say, the Sinclair ZX80 or the Sharp (Radio Shack) PC1200 handheld computer were front runners.

Description. The computer is mounted in a lightweight case with the keyboard folding in so that the entire package can be carried (by a handle on the "bottom" of the case) and stowed under an airline seat. There is a cavity in the rear of the case that contains the power switch, a circuit breaker, and the power cord. The latter can be wound on a bracket on the cavity cover when not in use. The cover is secured to the case by two Velcro strips.

The complete computer weighs 24 lbs and is 20½" W × 8½" H × 17" D. The suggested price of $1795 includes a software package that would list for $1200 if sold separately. The software package consists of WordStar (word processor); SuperCalc (electronic spread sheet); MailMerge, CBASIC, CP/M-80, and utilities. This package is supplied on five diskettes. The complete CP/M version 2.2 is supplied, including DDT (Dynamic Debugging Technique), ED (the CP/M line editor), and ASM (the CP/M assembler).

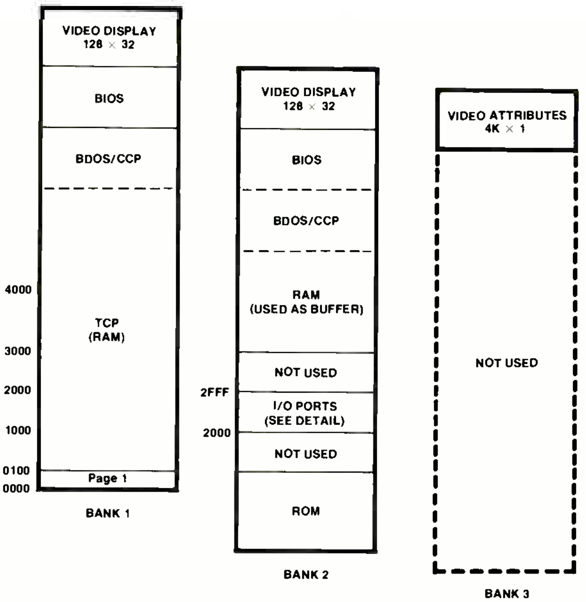
The Osborne 1 is opened by unlatching a plastic toggle on either side of the case, with the keyboard folded into an operating position below the front panel. The keyboard is connected to the front panel by a 10" replaceable cable. (A 24" cable is available from a separate source.)

The keyboard has a QWERTY-typewriter format with the addition of four arrow keys used to position the cursor and to scroll the video "window" (more about this later). There is also a 12-key numeric keypad for rapid input of numerical data. All keys have good "feel" to them and no noticeable bounce. Some of the keys we have become used to on a computer keyboard are missing on the Osborne 1. One of these is DEL, which is used for deletion in many applications. Other missing characters are the braces and the tilde. When using WordStar, the program substitutes other keys for these functions. In all, the keyboard is better than those supplied on more expensive terminals and computers.

The first thing that you really notice about the Osborne 1 is the small (5") video screen located in the middle of the front panel between the disk drives. There are two rotary knobs below the screen to control the brightness (BTR) and contrast (CONTR).

The display takes some getting used to, more because of its unusual format than its size. The computer actually writes information into a display that is 32 lines of 128 characters, but the video screen is only a window showing 24 rows of 52 characters each. This window can be scrolled in either a horizontal or vertical direction by using the arrow keys with the SHIFT key depressed.

Reading the characters on the small screen is no more difficult than reading characters in a book since they are about the same size. However, for nonportable operation, better reading comfort can be obtained with a video monitor connected to the Osborne 1 front panel. The connector is a card edge designed to mate only with a cable supplied by Osborne for its monitor. However, the EXMON Adapter by Esoteric Engineering, which sells for $39.95, converts the EXT VIDEO connector into a standard video port. There is also an EXMON-II, which includes an r-f modulator capable of producing a video display on a conventional TV receiver. Using the larger video mon-



The Osborne 1 memory is allocated in three banks.

itor does not increase the area of the video window; you still only see 24 rows of 52 characters each, but you see them in a larger format.

One of the less desirable features of this computer is the use of minifloppies having only single-density format. This results in 92K bytes of data storage which is not quite enough for extensive word-processing applications, or for accounting programs. However, as of this writing, dealers all over the US will soon be installing dual (double) density drives. This modification extends the data storage capacity to 184K per diskette. In addition, the update doubles the data transfer rate, which results in faster access to information stored on the diskette. The existing disk drives require no physical modifications for conversion to dual density, by the way. The modifications affect only the support circuits, cables, firmware, and software.

The term "dual" density means that the disk system can be operated as either single or double density. The system automatically recognizes the different densities when a diskette is booted. The double density modification will add about $185 to the cost of the computer, and it can be done in about a half hour at the dealer's service department.

Memory Usage. The memory map of the Osborne 1 is different from other computers because of the unusual use of memory banks. The 64K of dynamic RAM memory is assigned to Bank 1, a normal organization of memory within a CP/M system using memory-mapped video. (See the memory usage chart). The area referred to as Bank 2 is a combination of the system monitor ROM that controls the system before the CP/M operating system is booted, and memory-mapped I/O ports. The remainder of the 64K address space in Bank 2 is a "phantom" of Bank 1. Bank 3 is unused except for the top 4K block, which is used for a video attribute to control the underlining of characters.

People who are familiar with the normal organization of a Z80 computer will find the use of memory-mapped I/O ports strange. In most cases, CP/M computers use I/O support chips that require programming through a port with IN or OUT instructions. The Osborne 1 uses Motorola support chips (an M6850 and an M6821) which provide I/O by addressing an area of memory. (See the memory map chart.) There are advantages to this arrangement when it comes to providing a variety of I/O. The Osborne 1 User Guide explains this and illustrates the I/O memory map.

I/O. One of the most important measures of computer utility is the ability of a system to communicate with the outside world. The Osborne 1 is equipped with both a serial and a parallel I/O port.

One of the "user friendly" things that Osborne has done in its version of CP/M is the implementation of the CP/M I/O BYTE. This enables the user to send data to and from either the serial or the parallel port by assigning them to be the list device (LST:) used with the STAT command in CP/M.

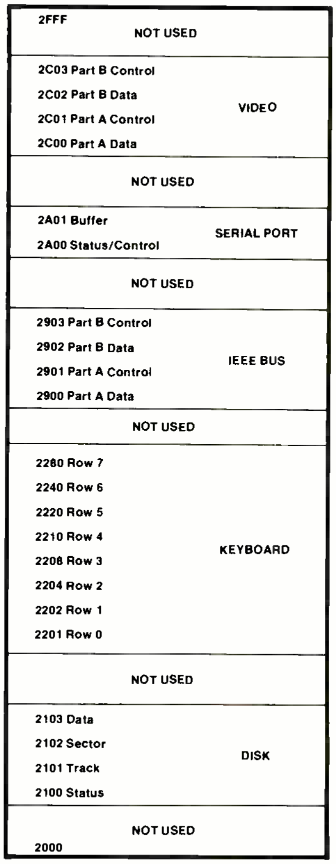
The RS232C serial port has a standard DB25S connector with enough pins connected to implement most printer protocol.

The modem port is an extension of the RS232 port connected to a 9-pin D connector plug. It includes the RCV (Receiver Enable, pin 4) and DSR (Transmitter Enable, pin 5). These are open-collector terminations that may be damaged if improperly terminated.

If the modem port is used without an external adapter, be sure that nothing is connected to pin 4 at the computer end of the cable. In view of this, probably the best way to use a modem is to employ the RS232 port. The Osborne Company advises it will be supplying a modem with the correct terminations for its machine.

Any IEEE 448 device can be connected to the Osborne 1 by using the proper adapter and cable. Osborne uses the IEEE 488 port for both IEEE 488 devices and the Centronics parallel printer interface. Therefore, they use a card edge connector instead of a standard IEEE cable connector for this port. The Osborne 1 technical manual describes details for constructing both an IEEE 488 card-edge/cable adapter or IEEE 488 card-edge/Centronics 36-pin connector cable adapter. Both of these cables can be obtained commercially. In fact, several manufacturers sell Osborne-to-Epson, Osborne-to-IDS, and Osborne-to-Centronics cables.

The EXT VIDEO connector is also a card edge type rather than a familiar video connector used in other computers or



Detail of Osborne 1 memory-mapped input/output.

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Actual size.
(1" x 5⅛" x 2¾")

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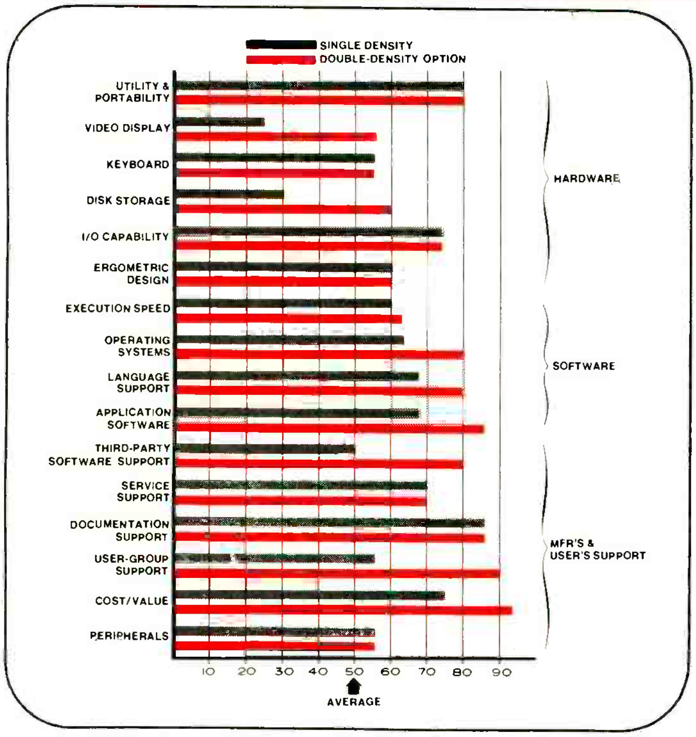


Comparative analysis of Osborne 1 characteristics.

OPERATIONAL CHARACTERISTICS

Operating System: CP/M-80
Languages: Microsoft BASIC-80, CBASIC2
Assembly Language: CP/M Assembler with DDT
Internal Memory Capacity: 64K in 3 switched banks; uses 60K CP/M
Disk Storage: 2 drives; single-density standard with 102K bytes; 92K bytes formatted for CP/M; double-density optional with 184K bytes.
Benchmark: Generates primes to 1000 in 24 seconds.
CP/M Characteristics:
Format Time: 34.6 s
Sysgen Time: 33.6 s
PIP & Verify System Disk: 2 min, 40 s
CBASIC2 Compile Time (Benchmark): 36.5 s
Telecommunications Operation:
Baud Rate: RS-232C 300 baud or 1200 baud software selectable. 600 baud or 2400 baud jumper selectable.
Escape Codes: Same as Televideo.

video monitors. The card edge is covered with a video shunt that has two uses. First, it transfers the video signals from the bottom of the card to the top where they are connected to the built-in 5" CRT. Second, since the 12-volt dc is brought out to the card edge, it provides short-circuit protection.

External Power. The BATT connector provides input for the external power system of the Osborne. The battery- pack option consists of a 12-volt battery with a charger, shoulder carrying case, and adapter cable. The computer has a new power panel installed with an AC/DC switch, 12-volt power plug, and a power inverter module with a plug-in harness. This modification can be made by an Osborne dealer.

The external battery power system can serve as battery backup when required, providing full power for as long as 60 minutes. The primary application is to permit operation from the 12-volt dc system at remote locations, or mobile installations in cars, boats and planes.

RFI Test. A sample unit was tested for radio-frequency interference with television and broadcast radio reception. Interference was noticed on vhf television channels when the Osborne 1 was operated in the same room. No interference was noticed on uhf television channels. There was interference on the AM broadcast band during disk access, but no interference with FM unless the stations were tuned off-channel.

PHYSICAL CHARACTERISTICS

Housing: Single fiberglass case with keyboard in removable cover.
Components: 5" CRT, two 5¼" disk drives, keyboard, controls and connectors.
Controls:
BRT: Monitors brightness.
CONTR: Monitors contrast.
RESET: Starts computer operation from scratch.
Connectors:
MODEM: Type D.
RS232C: Standard DP-25p.
IEEE 488: Card-edge 26-pin, can be adapted for standard IEEE or Centronics parallel printer can be adapted for IEEE connector.
KEYBOARD: Detachable cable.
EXT. VIDEO: Covered with shunt for internal monitor operation. Requires adapter for use with ordinary video monitor.
BATT: Use with battery pack and requires modification of panel to add ac/dc switch.
Keyboard: Standard QWERTY type with cursor arrow control keys, CTRL key, ESC key, RETURN key, and numerical keypad.
Monitor: 5" diagonal B&W CRT display 24 lines of 52 characters. The CRT is "window" on the actual display, which is 32 rows of 128 columns stored in the video memory. The window can be moved by pressing CTRL and one of the directional arrow keys. (Using a larger monitor does not increase the number of rows and columns in the window. It only makes them larger.)
Disk Drives: Two 5¼" minifloppies (single-sided, single-density).
Rear Compartment: Contains power cord, on/off switch, circuit breaker reset button.
Options:
Double Density Modification: Increases data storage capacity from 92K to 184K bytes (after formatting). $185.
Portable Power Modification: For portable use, offers power from a battery pack or a plug-in dc source. Consists of installation of ac/dc switch on computer rear panel and use of battery pack and recharger/inverter unit.
Centronics Parallel Printer: Cables can be constructed according to diagrams in technical manual or purchased elsewhere to connect the Centronics type of parallel interface to the Osborne.
External Video Monitor: The Osborne 12" External Monitor can be connected by removing the EXT VIDEO shunt and plugging in the video cable. For any other video monitor, an adapter must be used. This can be made according to the video circuit diagrams in the technical manual or purchase from another source.
Telecommunications: The Osborne Modem is the only such unit that should be connected into the MODEM port. A standard modem can be connected to the RS-232C port.
Size: 8½" H × 20½" W × 17" D.
Weight: 24 lb.
Price: $1795 for single-density model includes CP/M and application software package.

User Comments. All of the software delivered with the Osborne 1 appears to work as well as the same programs work on other computers. However, due to the small amount of data storage permitted by the single density format, there is not enough room left on the disk for extensive user application data. To achieve maximum data storage space, data diskettes were formatted with no CP/M system. These data diskettes were placed in drive B and used to store data files for WordStar and Supercalc. This appears to be the only practical method of using the single-density version of the Osborne 1 for practical applications. This situation will be helped by installing the double-density option.

Osborne never advertised this machine as a general-purpose computer for accounting applications. The distributors of software, such as Lifeboat Associates, now support the Osborne format, but they do have to qualify this support because the larger packages will simply not fit on the single-density format. There are now software houses writing specifically for the Osborne and their products may offer greater variety than users have had previously.

With any start-up operation there is a lag between the time the machines are delivered and the time spare parts are available to dealers' repair departments. This period is over as far as the Osborne 1 is concerned. Through the efforts of the Osborne Company and its dealers, service departments now have technical information and spare parts to repair, modify and service Osborne 1 computers.

The dealers rate the company as one of the better supporting manufacturers. The users are now much happier and they have formed user groups within existing computer clubs and as independent organizations. They intend to establish a software library for Osborne format software.

The Osborne 1 is a mature, serious computer for any stand-alone application or for portable use; and it is one of the best bargains offered in the computer industry.

The documentation and service seem to have caught up to the marketing effort and the company is making every effort to support its dealers and users. Osborne has announced that the Computerland stores and at least 50 additional dealers will be added to the network in 1982. This will make the product easier to buy and the increased sales will probably lead to more software development. It would seem that the double-density modification is necessary for all but the most limited applications.—*Stan Veit*

CIRCLE NO. 102 ON FREE INFORMATION CARD

CIRCLE NO. 3 ON FREE INFORMATION CARD

COMPUTER BITS

By Les Solomon

A First Look at Zenith's Z-100

IF you've been waiting for the new Zenith microcomputer, it's here, and we have had a chance to see it and even put in some "hands-on" time. The Z-100 is a powerful new desktop microcomputer employing an 8085/8088 single-board computer operating at 5 MHz. It has 128K of RAM (expandable to 192K) on the main board, an integrated 5-slot S-100 motherboard, two synchronous/asynchronous serial I/O ports, an 8-bit parallel port, RGB color interface, light-pen interface, and an 8035 μP controlled keyboard.

Unlike the CompuPro system, the Z-100 is an integrated desktop unit available in two configurations: the ZF-110-21 low-profile model includes an RGB color-display controller that generates 225 raster lines and a 640 by 500 dot resolution with 8 colors; the Model ZF-120-21 is an all-in-one computer with integrated 12" green phosphor display and built-in support for an outboard color display by adding memory, for red and blue color generation, to the display controller.

A notable design technique used is evident in the method of character generation. Rather than employing character set ROMs, the Z-100 treats the screen in the graphics mode. Therefore, even alphanumeric characters are addressed dot-by-dot, with look-up tables in the system ROM. This, asserts product-line manager Barry Watzman, provides an additional level of flexibility to the OEM who wants to create specialized characters either by providing ROMs or using downloadable character definitions.

The basic systems, including the single-board dual processor with 128K of RAM, 5 expansion slots, CRT controller (an integrated display for the Model ZF-120-21), dual 48-tpi Tandon disk drives, full-size keyboard, light-pen connector, disk controller capable of supporting a total of 8 drives (four 5¼" and four 8") are expected to be priced well under $5000. Full production is due by 1983.

Super Software. The Z-100 series comes with CP/M-85 and MS-DOS, the same operating system used on the IBM PC. The 8-bit CP/M-85 is an optimized version that takes advantage of the unique attributes of the system. For example, the throughput of the system is several times greater than standard CP/M and takes advantage of the "goodness" of the hardware design.

Moreover, the 8-bit O/S allows the use of any number of CP/M packages currently available. Zenith is planning to offer Supercalc and Wordstar and, possibly later, some graphics software for the 16-bit processor.

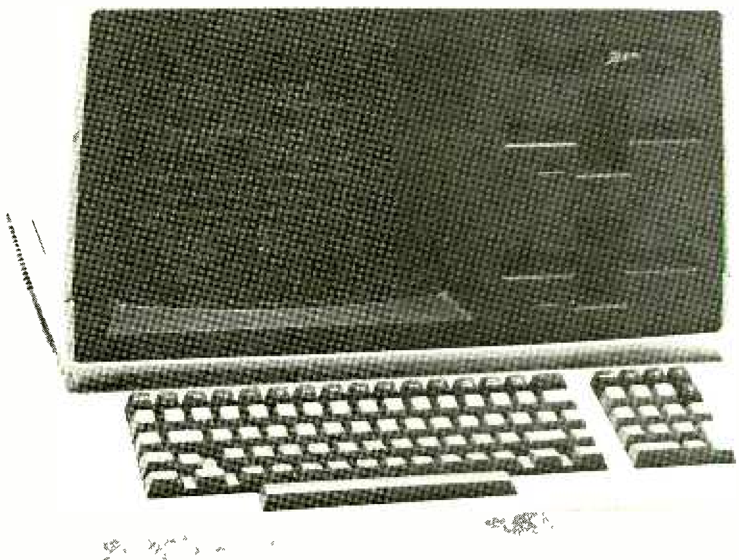
We specifically like the implementation of Microsoft BASIC. This version of BASIC uses MS-DOS and has built-in graphics primatives to take advantage of the powerful bit-mapped screen. You can, for example, perform area fills, paint objects, and even perform rotations. Zenith has allowed 64K for the screen, which means that you can create foreground and background planes. Although we didn't perform the function, it appears from the unique screen handling capabilities that you can move objects over and through existing objects in a manner similar to that on much more expensive dedicated graphics terminals.

What surprised us about the software systems introduced was the absence of a multiuser/multitasking operating system such as MP/M either for the 8- or 16-bit environment. Currently, Zenith has no plans to make such an offering; but it fully expects dealers and OEMs to add this feature.

Even though we could understand Zenith's strategy in offering a one-machine/one-user system, we felt that ignoring the aspect of multiple use was a bit short-sighted. We would have liked to have seen, as a possibility, the use of concurrent CP/M and MP/M-86, along with networking capabilities. It appears that the system would be almost an ideal node in a Corus Omninet environment. When asked about this, Zenith elected to defer it to a later time, when they may have an answer.

Already, though, speculation is running high that Zenith's solution may be an implementation of Microsoft's Xenix, a UNIX look-alike. Sources close to Microsoft indicated that discussions between the two companies have been taking place. What appears to be in the near future, though, is an implementation of MP/M by independent dealers who will probably offer an Omninet or similar network interface.

Interestingly, the drives chosen for the Z-100 are 48-tpi Tandon 5¼" floppies rather than 96 tpi. We questioned Mr. Watzman about this and he contended that they felt a conservative approach was required at this time simply because 96-tpi drives haven't really proven themselves. Moreover, there appears to be



Zenith's Z-100 desktop microcomputer system.

some question of data interchange on the devices with higher track densities.

One aspect of the system that we like was the inclusion of the disk controller. It supports up to four 5¼" and four 8" floppies. The drives can be single-sided single-density, double-sided double-density, or any combination that suits your requirements.

In addition, you can add a Winchester drive and controller without disturbing the operation of the system. Zenith plans to offer a Winchester drive shortly.

About the Light Pen. A part of the basic architecture of the Z-100 system is a light-pen port. Although the capability exists, Zenith elected not to provide software support for it at this time. The reasoning was partly based on the unavailability of a reliable low-cost light pen. However, this situation may be solved as early as January, according to Zenith officials.

In general, we found the Z-100 desktop systems to be high-performance units with a great deal of expansion capability. We liked the attention paid to detail in the layout of the units and the solid switching power supply. To our knowledge, this is the only system that provides a supply that delivers 2 A to each S-100 bus slot and has full margining for brownout protection.

Those of you who enjoy kit building will be glad to know that the Heathkit side of Zenith will be offering the computers in kit form later this year. But don't plan on building the CPU board! It's a four-layer board and is extremely complicated. What you will get to build is the disk controller, video board, and parts of the enclosure. In general, the kit will be very similar to the popular WH-89.

To further enhance the system, a great deal of care has been taken in the preparation of the support manuals. Unlike the 89 manuals that had many shortcomings and mistakes, the Z-100 manuals are designed with the novice user in mind, but they contain enough technical details for the experienced user also.

Zenith has taken a similar approach to the software manuals. They have carefully documented all the important functions of a package and lead you into the operation in a carefully controlled manner in order that you can become familiar with the machine quickly.

The Z-100 series isn't going to be limited to the models discussed here but will grow to meet specific data processing requirements. Even though Zenith officials were not willing to discuss future plans, they did hint that we could probably look forward to the use of the ZT-1 communications terminals (with some unique enhancements) as part of the Z-100 series. ◊

WILL SOMEONE PLEASE TELL

ACCOUNTING

Account Keeper
Accounting Plus II
Accounting Plus II Biz Package
Accounts Receivable
Accounts Receivable Balance Forward
Accounts Receivable/ Sales Analysis
ACS Basic Accounting System
AMI Client Write-Up
Asset Record System
B/F Accounts Receivable System
Billings Management
Bookkeeper II General Ledger
Bookkeeper II-Depreciation
BPI General Ledger
Business Accounting
Business Check Register and Budget
Business Control System
CPA
Client Accounting System
Construction Accounting
CPA Client Write-Up
Datawrite Client Write-Up System
Delivery Service Automation
Depreciation Calculations and Reports
Executive Accounting System
Financial and Management Accounting
Financial Partner
Fixed Asset Accounting
Fixed Asset Depreciation
Fixed Assets/ Depreciation Schedules
Fund Accounting System
General Accounting
General Accounting Package
General Ledger
Glector
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Integrated Accounting System
IRAP
Ledger System Business Module
Management – Financial Reporting
MAXILEDGER
Microaccountant Accounting System
MICROLEDGER
MJA Multi-Journal Accounting
Nominal Ledger
One-Type Accounting System I
One-Type Payroll and Accounting
Paysystem Accountant
Peachtree General Ledger
SBCS General Ledger
SNIP – Integrated Accounting
TCS Accounting
TCS Client Ledger
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APPLICATION PROGRAM DEVELOPMENT AIDS

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CBASIC Program Maintenance Utilities
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CRTFORM Programmer Productivity
Diagnostics II
DISTEL-Disk Based Disassembler
Executive Planning System
Floating Point Dictionary
Forms 2
Key Perfect-Checksum Table Generator
Linkdisk-Disk Utility for Apple Pascal
Linkvideo-Screen Utility
Lower Case Character Generator
MULISP/MUSTAR-80
OGI-Forth-Implementation of FIG-Forth
Pascal Programmer
Pascal Level 1
Pearl III-Rapid Logic Generator
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Senior Analyst
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Smarterm-CP/M Terminal Program
Term II-Computer Intercommunications
Term Intercommunications Package
TTY-Communications With Other Computers
U-Net-Shared Resources Network
Ultimate Transfer
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VT-100 Emulator
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DATA MANAGEMENT

ANALYST
CBS-Configurable Business System
CCA Data Mgt System
CM 2020 Configurable Manager
Condor Series 20
Data Management Program
Data Manager
Data Master
Data-View Electronic Filing Cabinet
Database II
Database Management
Datafax
Dataflow-Info Processing
Datastar
Datastore
Datatree
Disk-Edit-Screen Oriented Disk Editor
DMS-Data Mgmt System
FABS II-Rapid Keyed Access
Fast Entry for Tabs Business Modules
FINDAFYL-Reference Retrieval System
FMS 80-Data Base Management System
GBS Database
General Database
HDBS-Hierarchial Data Base
IFO Database Manager
Information File Organizer
Information Master-Data Mgmt System
KTDS-Key to Disk, Data Entry
Linkindex-Pascal Utility
MAG/Base-Data Base Management
Manager-Relational Data Base
MDBS DRS-Micro Database Mgt System
MUMPS-Language for CP/M Database
Optimum Data Mgmt Program
PRISM/IMS-Information Mgt System
RADAR-Random Access Data Acquisition
Reprogrammable Data Base
Scientist-Data Base & Statistical Pkg
Selector III-Data Base Processor
Selector IV-Data Base Mgt
Selector IV-Key Access Info
Selector V-Data Base Mgmt
STATPRD-Integrated Database System
Stoneware Utility Package
Super Kram II – Multi-Keyed Random Access
The Reprogrammable Data Base Program
VisiDex-Data Base Mgt System
VisiFile-Data Base Mgt Package
Whatsit?-Conversational Query/Retrieval

DATA SECURITY SYSTEMS

Absolute Security
Encode/Decode Security System

DISTRIBUTION

ABT Retail Manager
Beer Distributor Management
Inventory, Order Entry, Invoicing
Oil Jobber Management System
Order Entry and Inventory Control
The Store Manager
Wholesale/Retail Distribution System

EDUCATION – BUSINESS

Accounting Tutor
Comparative Buying
Income Meets Expenses
Interactive Typing Tutor
Job Readiness-Assessment & Development
Mastertype-Typing Instruction
Money Mgmt Assessment
Typing
Typing Tutor
You Can Bank On It-Bank Concepts

EDUCATION – CHEM/PHYSICS

Acid-Based Chemistry
Atomic Structure
Chem Lab Simulation
Chemical Equilibrium
Chemistry With A Computer
Fundamental Skills for General Chemistry
High School Chemistry
High School/Jr College CAI Biology
High School/Jr. College CAI Physics
Organic Nomenclature
Physics

EDUCATION – ENGLISH

A Batch of Endings
Agreement of Pronoun/Antecedent
Alphabetize
Capitalization
Catalog Cards
Commas
Compu-Read
Compu-Spell
Coordination
End Marks
Excess Words
Faulty Coordination
Hearing the Homonyms
Irregular Verbs
Is It "ie or ei?"
Language Drill
Locate Books on the Shelf
Magic Spells
Misplaced Modifiers
Parallel Structure
Possessing the Possessives
Prefixes & Suffixes
Quotations
Reading Level
Readings In Literature
Run On Sentences
Scramble
Sentence Diagramming
Sentence Fragments
Speedreader
Spell-N-Time
Spelling Bee with Reading Primer
Spelling Those Plurals
Still More Nasty Demons
Subject/Verb Agreement
Subordination
The End of the Endings
Those Nasty Demons
Understand the Card Catalog
Understand the Title Page
Use an Index
Use the Table of Contents
Using Adjectives/Adverbs Correctly
Word Scrambler & Super Speller

EDUCATION – MATH

Addition & Subtraction
Algebra I
Basic Math Skills
Compu Math Arithmetic Skills
Compu-Math Decimals
Compu-Math Fractions
Counting Bee
Decimal Estimation
Division Drill
Drill II
Elementary Math
Fractions
Geometry
Geometry and Measurement Drill
Lessons in Algebra
Matching and Using Numbers
Matching Geometric Figures
Math-Addition & Subtraction
Matrix Mathematics Package
Measurements
Multiplication & Division
Mumath-PO Symbolic Math
New Subtraction
Numerical Analysis Mathematics
Problem Solving
Problem Solving in Everyday Math
Sets
Sign Drill/Typing
Statistical Analysis I Mathematics
Statistics 3.0
Typing Fractions

EDUCATION – MISC

2ES Courseware
American History Through Biographies
American Indians
Antonyms
Apple Sack 2 Home Education
Approximate Measure
Astronomy I & II
Concentration-Taxing
Counting Calories
Early Civilization
Educational Package
Educator's Disk
Family Fun
Farm and Farm Products
HI-Res Life
History
Home Safe Home
Insects
Light Pen Quiz
Literature
Living Things
Math, Sports, Etc
Middle Ages
Money
Moptown
Mother Goose Rhymes
Music/Art
Our Bodies
Poison Proof Your Home
Questions & Answers in Biology
Questions & Answers in History
Quizstat
Reverse/Sampling
School Days
Sentence Beginning
Shore Features
Sound
Supermap
Synonyms
Systems of the Body
Teacher Create Series
Teacher Plus
Telling Time
The Basic Teacher Pac
The Earth and It's Composition
The Professional-Teaching Program
The Solar System
Transportation History
Typing
United States
Visual Perception Tests
Weather Fronts
Work Relationships
World Desert Region
World Polar Regions

FINANCE-INVESTMENT & PORTFOLIO ANALYSIS

Analysis I-Stock Trend Data Analysis
Commoapx System
Computicker
Computrac File Reader
Dow Jones News & Quotes Reporter
Dow Jones Portfolio Evaluator
Dowlog-MC
Electronic Stock Package
Engineer's System For Trading
Forecast I
Forecast II
Fotofolio-Visual Display w/Statistics
Gann's Square of Nine Analysis
Intelligent Investor
Investment Analysis
Market Charter-Technical Analysis
Moneybee-Investment Analyst
Options 80-Stock Options Analyzer
Portfolio Master
Quotecharter
Quoteprocessor
Ratortn-Investment Analysis
Stock and Options Analysis
Stock Forecasting
Stock Market Management
Stock Market Utility
Stock Option Analysis
Stock Tracker
Stock Valuation Program
Stocksheets
Strategy M-Monitor Price Change Dynamics
The Clover Method Trading System
The Stock Portfolio Program
Tickertec-Tickertape Program
Wilers 6 Systems Analysis

FOREIGN LANGUAGES

Chinese Lessons
Foreign Words and Phrases
Greek Roots and Prefixes
Japanese Lessons
Latin Roots and Prefixes
The French Hangman
The Russian Disk
The Spanish Hangman

GAMES

Adventures
Alien Rain
Alien Typhoon
Almanac – The Time Machine
Amaze
Analiza
Animal
Anti-Ballistic Missile
Apple Adventure
Apple Bowl
Apple Fun
Apple Panic
Apple Sack 3 – Adventure Pak
Apple Sack 7 – Space Sack
Apple Sack 8 – Game Sack
Apple Sack 9 – Base Star
Apple Stellar Invaders
Apple-oids
Asteron
Astro-Scope
Astrology
Autobahn
Backgammon 20
Battle of Midway
Beer Run
Best of Muse
Biorythms
Blackjack
Both Barrels
Brands
Bridge 2.0
Bridge Tutor
Bubbles, Planetoids and Burnout
Cartels and Cutthroats
Castle Wolfenstein
Chambers of Xenobia
Chebychev 1
Chebychev 2
Chronicles of Osgroth
Civil War
Compu-Math Arithmetic
Compu-Math Decimals
Compu-Math Fractions
Computer Air Combat
Computer Baseball
Computer Bismark
Computer Conflict
Computer Napoleonics
Computer Quarterback
Cops and Robbers
Cosmo Mission
County Carnival
Cyber Strike
Disk Talker
Dr. Chips
Dragon Fire
Dungeon
Executive Fitness
Falcons
Fantasyland 2041
Fastgammon
Flight Simulator
Galactic Attack
Galactic Wars
Galaxy Wars
Games People Play
Gamma Goblins
Gobbler
Golf/Cross-Out
Gorgon
Hammurabi
Head On Game
Hellfire Warrior
Hi-Res Football
Hi-Res Soccer
In The Army Now
Into Ships
Jet Fighter Pilot
Klondike 2000
Lost By Ship
Mastermind
Meteoroids in Space
Micro Othello
Mimic
Mind Games Package
Mission Asteroids
Mystery House
Need an Analyst
Nominoes Jigsaw
Oil Tycoon
Olympic Decathlon
Operation Apocalypse
Orbitron
Outpost
Paddle Fun
Pegasus II
Perception 3.0
Phantoms Five
Planetoids
Plot 3D
Pokeno
Poker Slot Machine
Pool 1.5
Pot 'O Gold I
Pot 'O Gold II
President Elect
Pro Football
Pro Picks
Project Omega
Pulsar II
Race For Midnight
Raster Blaster
Red Baron
Rendezvous
Robot Wars
Sahara Warriors
Sargon II (Chess)
Satellite Trak
Shell Games
Shuffleboard
Skybombers
Skybombers II
Sneakers
Snoggle
Soft Porn
Softside Publications
Space Eggs
Space Warrior
Spellguard
Spelling Bee
Star Cruiser
Star Dance
Star Thief
Startraders
Startrek
Stock
Sub Attack
Tawala's Last Redoubt
Teacher's Pet
Temple of Apshai
Terrorist
Tetrad
The Strip
The Asteroid Field
The Great Escape
The Horse Selector I
The Prisoner
The Scorekeeper
The Shattered Alliance
The Warp Factor
Three Mile Island
Torpedo Fire
Ultima
Voyage of the Valkyrie
War and Games
War Games
Warp Factor
Watch Your Moves
Win at the Races
World's Greatest Blackjack
Wumpus
Xplode

ME WHAT AN APPLE CAN DO?

GRAPHICS/
COMPUTER-AIDED DESIGN

3-D Surface Plotter Package
A2-3D1 Graphics Family
ABT Barward Software
Action Sounds & Hi-Res Scrolling
Apple Plot
AppleGraphics II
Artist Designer
Bar Chart (Histogram) Graphics
Business Graphics III
Circuit Designer Graphics
Circuit Simulator
Creativity Tool Box
CURVFIT
Data Plot
E-Z DRAW
FLGDZINE
Graforth – Development Tool
Graph-Fit
Graph-Pak
GRAPHPOWER
Hi-Res Secrets
Line Graphics
MC Painting
ORIFICE
Pascal Animation Tools
Pascal Graphics Editor
Perspective Plot – 3-D Graphics
PGE – Graphics Editing Package
PILOT Animation Toolkit
Polar Coordinate Plot
RGL Real Time Graphic System
Screen Director
Shape Table Generator
Stats-graph
Super Shape Draw & Animate
Tablet Graphics
The Coloring Board Program
The Designer
Topographic Mapping
Ultra Plot
Utopia Graphics Tablet System
VACVESL – Vacuum Vessel Design
VESDZINE – Design of Vessels
VISITREND/VISIPLOT
X-Y Vector Plot Package

HOME MANAGEMENT

Address File
Auto Records
Checkbook Balancing
Checking Account Management
Chequemate
Diet Analysis
Financial Analyzer
Five Minute Financial Check-Up
Grocery List
Home Finance
Home Inventory File
Home Money Minder
Home Purchase Analysis
Magazine File
Mortgage Analysis
Personal Accounting System I
Personal Expense Record
Personal Finance Manager
Personal Financial Planning
Programmed Exercise
The Personal Check Manager

INCOME TAX

Dow Jones Portfolio Evaluator
Individual Tax Planner
Micro-Tax Individual Tax Package
Micro-Tax Integrated State Income Tax
Micro-Tax Partnership Package
SHORTAX – Tax Planning Package
Tax Planner
Tax Preparer
TRPS – Tax Return Preparation System

INVENTORY CONTROL

ARM-1000 – Rental Business
Basic Business Inventory
Bill of Materials
BPI Inventory Control
Introtory Inventory System
Inventory Accounting
Inventory Control
Inventory Management
Inventory Management for Stock Control
Inventory Pac
Inventory System Business Module
Manufacturing Inventory Control
MATSTAT-Materials Tracking
Order Entry/Inventory Control
Peachtree Inventory System
Point-Of-Sale Retail System
Property Manager for Moveable Equipment
Retail Inventory
Rogis Stock Control for Components
Stock Control
Stock Recording
Stockfile Inventory System
Stockroom Inventory and Purchasing
Structured Systems Inventory Control
TCS Inventory Management
The Order Scheduler

JOB & CONTRACT
COST ACCOUNTING

Billflow
Bookkeeper II-Job Costing
BPI Job Costing
Contract Billing
Contractor Job Cost
Cost Accountant
Job Accounting System
Job Control System
Job Cost Accounting
Project Cost Accounting for Architects
Project Cost Accounting for Engineers
The Software Fitness Job Cost Analyst
Time Recording-Job Cost Analyst
Timerec-Transaction Carry Forward

MAILING LIST &
LABEL PROCESSING

Address Book Mailing List
Apple III Mail List Manager
Apple Mail Sack
Apple Post
Benchmark Mail List
Commercial Mailer
Mail List
Mail80 Mailing List Software
MAILER-Name & Address Management System
Mailing Address
Mailing List Package
Mailing System
MAILMERGE
MAILPRO
Mailroom-Mailing List Management
Master Mailing List
NAD-Name & Address Selection System
Name And Address
Postmaster-Mail Management
Professional Mailout
School Mailer
Small Business Mailing & Filing
Super-M-List Mailing List Program
Ultra Plot/Mailing & Filing System I

MARKETING/SALES ANALYSIS

EASYTRAK-Salesmen Monitoring Package
Marketing Systems – Proposal Developer
Office and Agent Productivity Package
Sales Analysis
Sales Pro Prospect Mgt Package
Sales Tracker
SALESLOG – Sales Mgt Program
SNAP – Questionnaire Design and Printing
TCD Life Insurance Computer System

MISCELLANEOUS

BILL – Building Energy Use
Circuit Analysis
Hand Holding BASIC
Insulate
Mini-Warehouse System
Stepwise Multiple Regression

MUSIC

Alpha Syntauri Music Synthesizer
Apple Music Theory
Apple Sack Music & Graphics
Appleodion Music Synthesis System
Music System
Musicomp
The Electric Duet

ORDER ENTRY/
ACCOUNTS RECEIVABLE

BPI Accounts Receivable Program
Cash Receipts System
Company Sales
Invoice Compiler
Invoicing
Membership Billing
MICROREC
Multi-Property Accounts Receivable
Open Item Accounts Receivable
Order Entry
Order Entry and Billing
Order Entry and Invoicing
Order Tracking System
Peachtree Accounts Receivable
Peachtree Sales Invoicing
Progressive Billing
Purchase Order System
Receivables System Business Module
Receiver
Sales Invoicing
Sales Ledger
Sales Order Processing
Software Fitness Program – A/R System
Structured Systems Accounts Receivable
T-SOP Sales Order Processing
TCS Accounts Receivable Package
TCS Total Receivables
The Biller

PAYROLL PROCESSING

Advanced Payroll Package
After-The-Fact-Payroll – updates records
Apple Payroll System
Bookkeeper II-Payroll
BPI Payroll
Business Basic Payroll System
Contractor Payroll
Jobcost Payroll
Micropayroll
Passive Payroll
Paymaster
Paymaster-Payroll System
Payrecord I
Payroll
Payroll Accounting Package
Payroll Assistant
Payroll I
PeachPay
Piece Rate Payroll System
Post Facto Payroll
Print/Paycheck Accounting System
Run Time Payroll Program
Sheltered Workshop Reporting
Structured Systems Group Payroll
TCS Payroll Package
TCS Total Payroll
Variable Worker's Compensation
WH-347-Accessory program for Jobcost

PERSONNEL MANAGEMENT

AMI Post-Facto Payroll
MICROPERS – Payroll & Personnel Mgmt
Personnel Data Recorder
Personnel Office – Federal Compliance
Personnel Record
Personnel Record/Employee Records System

PROFESSIONAL OFFICE SYSTEMS

AMI Omegabyte Time & Billing
BETA – Stand Alone Time & Billing System
Billkeeper – Professional Billing
Client Billing System
Client Record/Bill Preparation
Datalaw System 3-Law Office Mgmt
DataTime
Dental 80A-Dental Accting & Billing
Dental Billing Package
Dental Office Management
DentalEase
Dentistaid – Dentist Office Management
Insyst (Insurance System)
Legal Billing & Timekeeping System
Legal Clerk – Office Management System
Legal Time Accounting System
Medicaid Day Treatment
Medical Accounting and Billing
Medical Clinic
Medical II – Office Mgmt System
Medical Office Management
Medical Secretary
Medical/Dental Management System
Medical/Manager
MedicalEase
MedPak
Medtips – Billing & Insurance Forms
PAS – 3-Patient Billing & Accts Receivable
Patient Accounting System
PIP-Payroll/Invoicing Program
Professional Office Management
Professional Time & Billing
PTA – Professional Time Accounting Pkg
Series 8000 Dental Mgmt
Series 8000 Medical Mgmt
Series 9000 Family Dental Management
The Patient Scheduler
Timeclok
Timemaster – Time Accounting
Timesaver Client Billing System

PROGRAMMING LANGUAGES

Ada Compiler
APL/V80 Language
Apple III Business Basic
Apple III Pascal
Apple FORTRAN
Apple Logo
Apple PILOT
ASM 65-Assembler
BASIC A+ – Extended Business Basic
BASIC Compiler
BASIC-80
BASIC/Z – Native Code Compiler
BD Software "C" Compiler
C Compiler
CBASIC 2 Compiler
CIS COBOL
COBOL 80
Cos Assembler
Cos COBOL
Focal 65-High Level Programming
Forth 86
Forth-Language Compiler
FORTRAN 80
FORTRAN IV
Hand Holding BASIC
KBASIC – Microsoft Disk Extended BASIC
Language System with Apple Pascal
LISP-80 Compiler
MAC 8080 Macro Assembler
MULISP Compiler
MULISP/MUSTAR 80
muMath/muSimp 80-High Level Programming
Nevada COBOL Compiler
Pascal Compiler
Pascal/M86
Pascal/MY+With SPP-ISO Standard
PL/1-80-Programming Language
RATFOR – FORTRAN Language
S-BASIC
SSS FORTRAN Compiler
Softronics
Stiff Upper Lisp
TCL Disk BASIC Interpreter
TCL-Pascal
TEC 65-Editing Language
Tiny BASIC High-Level Language
Tiny C
Tiny Pascal
Tiny-C-Two Compiler
Transform II
UCSD Pascal
Whitesmith's Compiler
XPLO-Structured Language
XY BASIC Interactive Process Control

PROGRAMMING UTILITIES

Apple Sak 4 – Utility Package
Basic Utility Disk
Disk Utilities 3
Disk Utility Package
Disk-o-Tape-Pascal
DOS Tool Kit
File Maintenance Package
MAG/Sam Keyed File Mgmt System
MAG/Sort-Record Sort
Masterdisk-disk Sector Editor
MSORT – for COBOL 80
Pascal Utility Library
Pascal – Sort Program
PSORT – Pascal File Sorting
QSORT – Sort/Merge Program
SORT/B – Hybrid Sort
Supersort
Ultrasort

PURCHASING/ACCOUNTS PAYABLE

Accounting Payable
Accounts Payable Business Module
Accounts Payable/Purchase Order
Bookkeeper II – Accounts Payable
Cash Disbursements Posting System
Check Writer
Company Purchases
Contractor Accounts Payable
Disk-O-Check
Micropay-Accounts Payable
Print Check Accounting System
Purchase Ledger
Structured Systems Group Accts Payable
T-POP – Purchase Order Processing

REAL ESTATE

American Software Property Management
Apartment Building Investment Analysis
Apartment Manager
Commercial Property System
Construction Cost/Profit Analysis
Cornwall Apartment Management
Income Property Analysis
Listings
Multi-Property Accounting System
Office/Apartment Real Estate Management
Property Analysis System
Property Management
Property Management System
Property Mgmt – G/L Tenant and Expenses
Real Estate Analysis Program
Real Estate Analyzer
Realty Package
Rent vs Buy
Rental Manager
Residential Property Management
Tax Deferred Exchange Model
Tenant Processing Package
The Landlord-Property Mgmt System
VisiCalc Real Estate Templates

TIME MANAGEMENT
& SCHEDULING

Agenda Files
APM – Project Scheduling
Appointment Calendar
Color Calendar Package
Datebook Appointment Calendar
Datebook Time Management System
GUARDIAN – Computerized Scheduling
Office Manager – Staff Appointments
Personal Datebook
Professional Secretary
PROSCHED – Project Schedule
Time Manager

WORD PROCESSING

Apple World Oriented Text Editor
Apple Writer II
Apple Writer III
Benchmark – Word Processing System
Docuwriter Text Processor
Easywriter Word Processing
EDITRIX 1.0 – Word Processing
Form Letter Module
Formulex – Business Form Design
Goodspell
Letter Master – Basic Word Processor
Letteright Correspondence Processing
Letterite Word Processing System
Magic Spell – 20,000 Word Dictionary
Magic Wand – Phrase Insertion
Magic Wand – Word Processor
Magic Wand Word Processing System
Magic Window Word Processor
MAIL-MERGE-Wordstar Enhancement
Manuscripter – Word Processor
Master Text Processor
Memorite III Word Processing
Microspell Spelling Corrector
PALANTIR – Word Processing and Accounting
Personal Text Processing
Report Writer – Word Processing
Script III
Secretary – Word Processing
Spellbinder Word Processing
Spellguard
Super-Text Word Processing
Supertext II
TEXTWRITER III – Text Formatting Program
The Word Spelling Checker
VTS-80 CP/M Word Processing
WordIndex
WordMaster – Comprehensive Editor
WordMaster Text Editor
WordStar – Word Processing

With these and thousands of other ready-to-use programs to choose from, including the vast array of CP/M® software, you can do more things with an Apple® than any other computer you can buy. So over 1200 authorized Apple dealers have a question for you:
What do you want to do?

apple® The personal computer.

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CIRCLE NO. 5 ON FREE INFORMATION CARD


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Wiss
Nicholson
Boker
Lufkin
Crescent
Plumb
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CooperTools
CIRCLE NO. 14 ON FREE INFORMATION CARD

By Larry Marks

How to Get a Professional Look From Your Video Tape Recordings

Follow the example of professionals who record special events in people's lives. Use professional equipment on your shoot and dupe the results to home ½-inch video cassettes. It's easier than you might think.

YOUR first step into the world of home video tape was probably to buy a Beta or VHS recorder. You taped your favorite programs—the Super Bowl, *Star Trek* reruns, motion pictures, and all the rest. And it was great fun to play them all back in sparkling color on your TV receiver!

Then you were ready to move on to bigger, more exciting projects. What about the possibility of taking your own video pictures? So you went out and got a modestly priced video camera. Again, it was fun to take the video tapes of your family and friends and play them back for everyone's enjoyment—with the picture and sound automatically synchronized. If you owned a portable recorder, you probably strapped it to your shoulder and moved out into the real world where marvelous things are happening all the time. What things? A sports event; your son playing baseball; Jones Beach or Malibu, with snarling waves crashing against the rocks; or a picnic or other outdoor activity with friends. Capturing these video-with-sound moments on tape was rewarding, and rather easy to accomplish.

After a time, though, you became aware of the shortcomings in your video productions. As proud as you were, you knew they were rather amateurish. This fact generally didn't hit home until after a few showings when the novelty of seeing people you knew on the screen wore off. What about a more brilliant picture? What about editing? What about clean cuts without rolls and glitches? What about the repositioning of scenes or the elimination of erratic pans? What about wipes and dissolves and titles? What about a professional project?

You say, no, you've gone as far as you can; a person must realize his limitations. I say nay! You *can* execute an assignment with a professional look. If you feel adventurous and find the challenge irresistable, then the thrill of producing a broadcast-quality video story can be yours for as little as $1000, though it could be more, depending on what you want to do. But $1000 can include rental of all professional equipment for one day, including insurance and reasonably sophisticated editing—through to a ¾" edit master and reduction to a ½" Beta or VHS dub for playback on your home video machine. It is also possible to shave a few hundred dollars by substituting an industrial camera for a broadcast camera. Both are professional; but, of course, the broadcast-type is superior.

Obviously, the expenditure of this amount of money should be reserved for recording only special occasions: a small wedding, golden anniversary, etc. The first step up to "pro" is the move from the ½" cassette format to the ¾" cassette (called U-Matic). Not only is the video quality of ¾" far superior, the editing technology is more sophisticated; in fact, creative possibilities are almost unlimited.

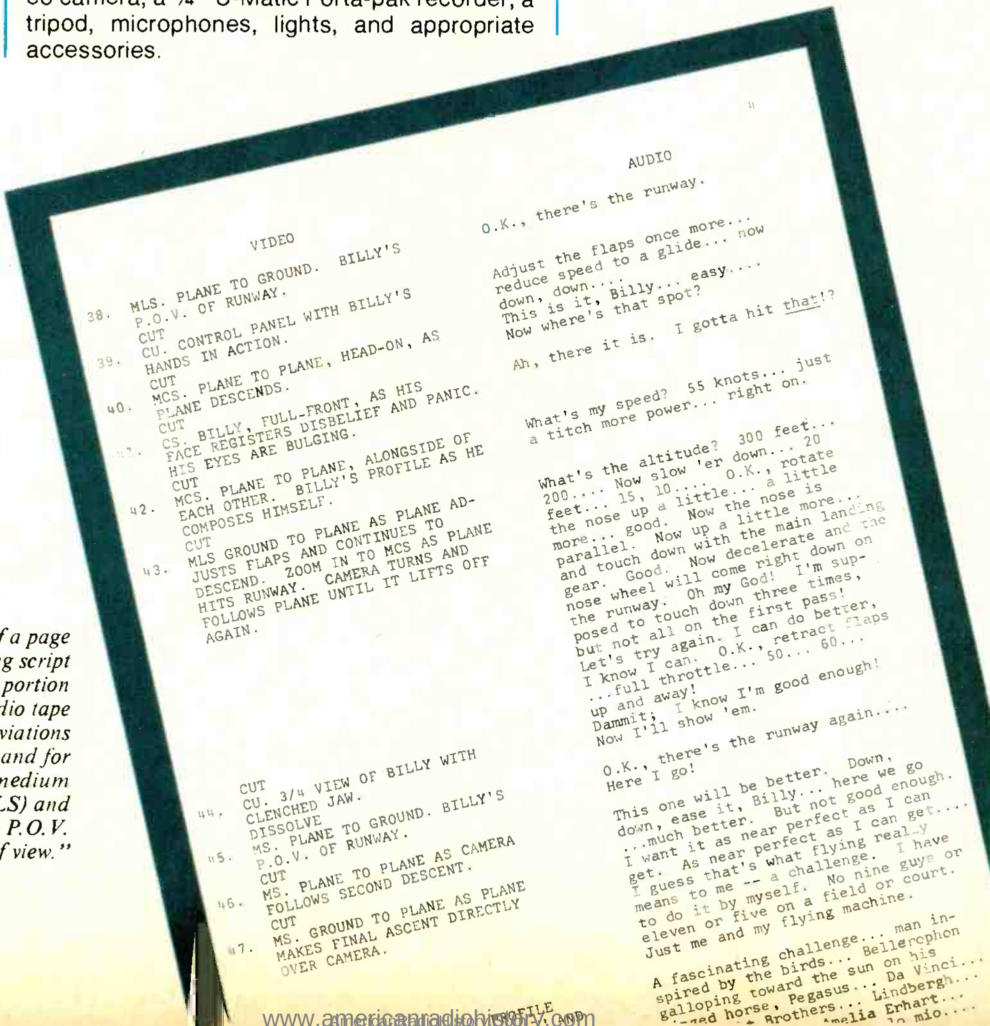
The equipment that I would suggest you get is generally referred to as the ENG (Electronic News Gathering) or the EFP (Electronic Field Production) package. Most TV news stores are recorded with this equipment. It consists of a portable broadcast-quality three-tube color video camera, a ¾" U-Matic Porta-pak recorder, a tripod, microphones, lights, and appropriate accessories.

To find such equipment, it is necessary to ferret out a professional equipment rental house. They're not everywhere, but chances are there is at least one nearby. To find out, call a professional film or video tape production company, or perhaps your local television station. Once you have located a rental house, call and set up an appointment. This will give you an opportunity to see, price, and learn how to handle the equipment. Almost always there is someone on the staff of the rental house who is qualified and eager to explain in detail the function and operation of every item in the video package.

Be sure to check the condition of the equipment and the rental company's adherence to a high standard of maintenance. This is most vital to the project. After all, what good is recourse once you've arrived on location and all is ready for the shoot—except the equipment? The old adage, "A carpenter is only as good as his tools," applies here. Our rental price for the ENG package, which included a $35,000 + video camera, was $650. Most important, the equipment was kept in top condition by the rental house, G&R Video, New York City.

The Project

ONCE you've got your equipment, what are you going to do with it? Being surrounded by


VIDEO

38. MLS. PLANE TO GROUND. BILLY'S P.O.V. OF RUNWAY.
CUT
39. CU. CONTROL PANEL WITH BILLY'S HANDS IN ACTION.
CUT
40. MCS. PLANE TO PLANE, HEAD-ON, AS PLANE DESCENDS.
CUT
41. CS. BILLY, FULL-FRONT, AS HIS FACE REGISTERS DISBELIEF AND PANIC. HIS EYES ARE BULGING.
CUT
42. MCS. PLANE TO PLANE, ALONGSIDE OF EACH OTHER. BILLY'S PROFILE AS HE COMPOSES HIMSELF.
CUT
43. MLS GROUND TO PLANE AS PLANE ADJUSTS FLAPS AND CONTINUES TO DESCEND. ZOOM IN TO MCS AS PLANE HITS RUNWAY. CAMERA TURNS AND FOLLOWS PLANE UNTIL IT LIFTS OFF AGAIN.
CUT
44. CU. 3/4 VIEW OF BILLY WITH CLENCHED JAW.
DISSOLVE
45. MS. PLANE TO GROUND. BILLY'S P.O.V. OF RUNWAY.
CUT
46. MS. PLANE TO PLANE AS CAMERA FOLLOWS SECOND DESCENT.
CUT
47. MS. GROUND TO PLANE AS PLANE MAKES FINAL ASCENT DIRECTLY OVER CAMERA.

AUDIO

O.K., there's the runway.

Adjust the flaps once more... reduce speed to a glide... now down, down.... This is it, Billy... easy.... Now where's that spot?

Ah, there it is. I gotta hit that!?

What's my speed? 55 knots... just a titch more power... right on.

What's the altitude? 300 feet... 200.... Now slow 'er down... 20 feet... 15, 10.... O.K., rotate the nose up a little... a little more... good. Now the nose is parallel. Now up a little more... and touch down with the main landing gear. Good. Now decelerate and the nose wheel will come right down on the runway. Oh my God! I'm supposed to touch down three times, but not all on the first pass! Let's try again. I can do better, I know I can. O.K., retract flaps ...full throttle... 50... 60... up and away!
Dammit, I know I'm good enough! Now I'll show 'em.

O.K., there's the runway again.... Here I go!

This one will be better. Down, down, ease it, Billy... here we go ...much better. But not good enough. I want it as near perfect as I can get. As near perfect as I can get.... I guess that's what flying really means to me -- a challenge. I have to do it by myself. No nine guys or eleven or five on a field or court. Just me and my flying machine.

A fascinating challenge... man inspired by the birds... Bellerophon galloping toward the sun on his

At right is part of a page from the shooting script for "Solo." The audio portion was recorded on audio tape before the shoot. Abbreviations in the video column stand for such information as "medium long shot" (MLS) and "close up" (CU), while P.O.V. means "point of view."

great technology is no better than sitting behind the wheel of a Ferrari . . . without gas. You need something to make the technology go. What you need is a video project. Doubtlessly, you've already reached down deep and tapped your own private well of creativity for this. I made my choice for this article and I will follow it through for you as an example of what can be done on a modest budget compared to what you'd have to pay for the services of a professional video crew.

Although I am not a pilot, I have logged close to a half-million miles as a sky traveller, island hopping the Caribbean in small single-engine props and spanning continents in 747s. Assignments have sent me north to the ice flows of the Arctic and southeast to the parched sands of the Sahara. Capturing images on film or tape . . . I love it . . . it's my flirtation with part of the sprawling universe.

I had a book of poetry published years ago. It was titled *With My Head in the Clouds.* All the poems were written while I was in flight. Not surprising, then, that the title of my video story is: *Solo*—a man's first flight alone. That, to me, is one true measure of a man. How he performs, how he reacts when all he has to rely on when facing fate is himself. Now that I've related the genesis of my project, you may be inspired to begin searching for one of your own.

All film and video tape projects are divided into three phases: preproduction, production, and postproduction.

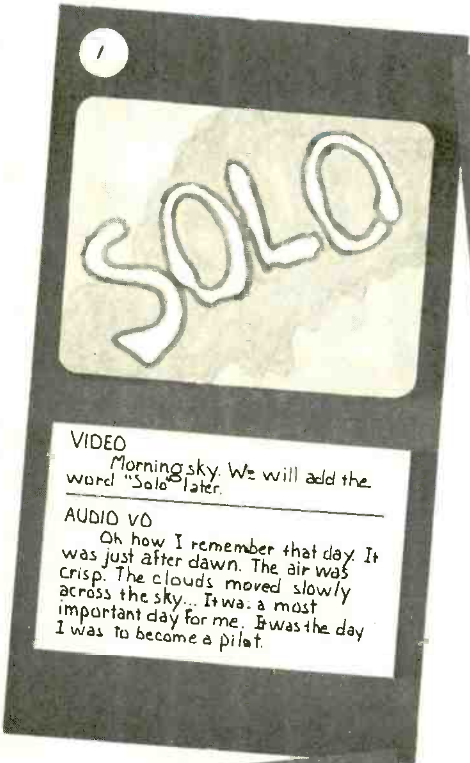
- **Pre-production.** This includes idea, research, script, storyboards, location, securing of crew, talent, and equipment.
- **Production.** The actual shoot.
- **Post-production.** Taking all the materials to an editing facility and arranging it into a coherent piece of art, ready for viewing.

First, I needed a flying school. A phone call and a few minutes with Norbert Koenig, chief instructor at Nassau Flyers, and I knew I had the right man. A few days later, loaded with enthusiasm, I dropped in on Norbert at the Republic Airfield in Farmingdale, Long Island. We met in his office and he cooperated fully. He would provide the pilot and two planes, one for the solo flight and one for the air-to-air photography. He briefed me as if I were the pilot ready for the test

The photographs below were taken from a TV screen while the "Solo" recording was being run. They show the general excellence of the taping—with close-ups and plane-to-plane shots.

with the wild wind of adventure at the scruff of my neck. He even took me up in a Cessna 172 to demonstrate the precise procedures and maneuvers his pupil would have to execute on that special day when he would be alone in the cockpit for the first time. I was now ready to begin.

Obviously, it is unwise to grab your rig, race out to the location, and shoot. A guide or guides are necessary. One guide may take the form of a shooting script (the story in sequence matching the audio and video components). Another is the story board, a graphic illustration of the story with the audio typed in beneath each frame. Probably the most important guide to have on hand the day of the shoot is a "shot sheet." This is a scene-by-scene breakdown of all the shots necessary to complete the project and the order in which these scenes are to be accomplished. Scripts are rarely shot in sequence. Most often, the script is divided into in-



At left and above are five story boards, describing briefly what the scene is to show (including a sketch of the general idea you want in the shot) and the audio that is to accompany it. The actual scenes from the tape of these five shots are on the facing page. (The word "Solo" will, of course, be added in special effects.)

teriors and exteriors. For example, if multiple segments of a script take place in one exterior location, it is, without question, more feasible to cover those scenes at one session.

Also, if daylight is a factor, and we know that days always run out of light sooner or later, it becomes apparent that on a one-day schedule, exteriors should be dealt with first and interiors last—even if the interior scenes appear first in the script. A well-planned shot sheet reduces "run-around time," "set-up time," and almost ensures that no scene or shot will be omitted. For the technical approach to each shot, the director can refer to the shooting script, which will undoubtedly reflect his own artistic predilections.

Remember, time spent on preparation is never wasted. On the other hand, time wasted during production could affect completion of the project, especially when you realize you are strapped to a one-day rental schedule or that weather may not be favorable the next day.

Now the first preliminary was completed. The juices were flowing. To execute the project I needed a little help, so I enlisted Mike Cohen, my Production Co-ordinator, to work the camera. Mike was a good selection. He is not a professional cameraman. (We wanted no special advantage.) We also limited ourselves to the basic equipment package. No rigs, no dollies, no Tyler mounts for in-flight photography. What we could get for free by charming or pleading, we accepted with wide-eyed appreciation. This was not a pro project for us, merely a step up to pro—the same adventure we are suggesting for you. I would direct, as well as handle the microphone and Porta-pak.

Nothing could stop us. We decided to shoot on a Saturday. That's something to remember. If you shoot on a Saturday you can generally rent and pick up the equipment on Friday afternoon, keep it all weekend, and return it Monday morning. And be billed for only one day's rental! But now let's devote a little space to the professional equipment that was used for the shoot with the intention of duping the results for playback on home ½" VCRs.

The Equipment

THE intrinsic differences between cameras for home, industrial, and broadcast use are given in Table I.

The average home video camera has some obvious attributes. It is light and compact. Since the electronics are less complicated, less maintenance is required. In addition, it will capture a fine image under ideal lighting conditions: the results are acceptable, of course, on a nonprofessional level. But there's the rub.

It is true that the broadcast camera is heavier to carry about, though it does incorporate a comfortable shoulder brace to lessen the burden. More important, since we're discussing stepping up to pro, the additional weight is the direct result of the increased electronics and

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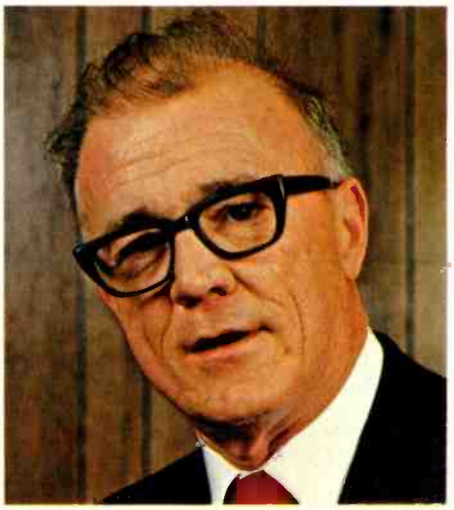

My father always told me that there were certain advantages to putting all your eggs in one basket. "John," he said, "learn to do one important thing better than anyone else, and you'll always be in demand."

I believe he was right. Today is the age of specialization. And I think that's a very good thing.

Consider doctors. You wouldn't expect your family doctor to perform open heart surgery or your dentist to set a broken bone, either. Would you?

For these things, you'd want a specialist. And you'd trust him. Because you'd know if he weren't any good, he'd be out of business.

Why trust your education and career future to anything less than a specialist?

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FACT: CIE is the largest independent home study school in the world that specializes exclusively in electronics.

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Specialists aren't for everyone.

I'll tell it to you straight. If you think electronics would make a nice hobby, check with other schools.

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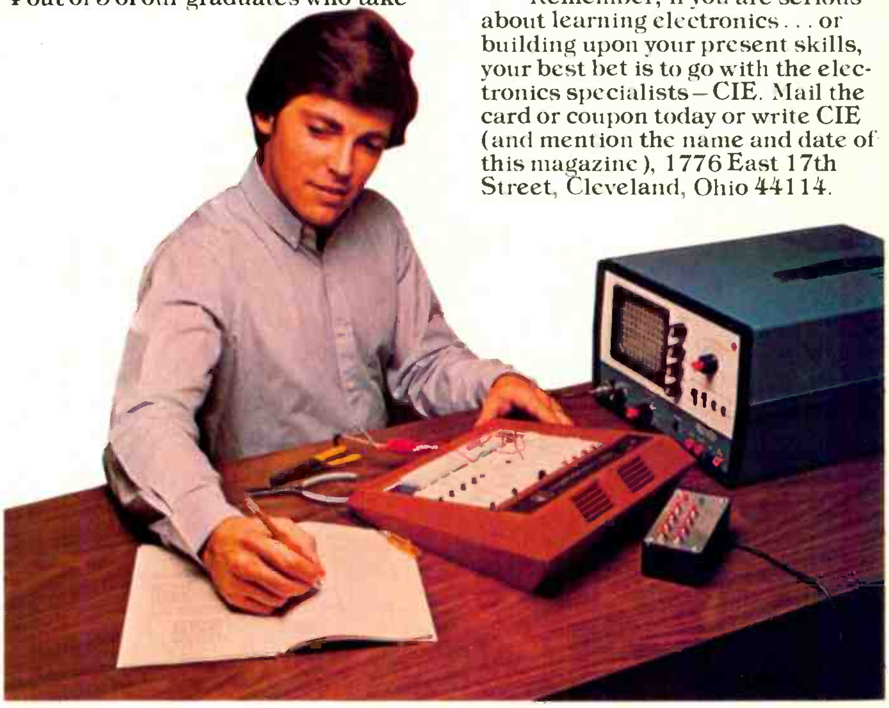

Pattern shown on oscilloscope screen is simulated.

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optics required to produce a superior image. The home video camera's single, color-sensitive tube cannot produce especially sharp, definitive color images when compared to professional cameras. The broadcast camera, in contrast, incorporates three individual ⅔" tubes—each one sensitive to one of the primary colors: red, blue, and green. This individual sensitivity guarantees that the color you see is the color you get.

And what about lenses? Both the home and the broadcast cameras incorporate zoom lenses. The home camera features a one or two-speed, 6-to-1 or 8-to-1 electric zoom. The broadcast camera in contrast, has a variable multi-speed 12-to-1 electric zoom, with far superior optics. That 12-to-1 zoom makes it possible to home in on subjects that would otherwise be far out of range.

Now let's take a look at resolution. A broadcast camera produces 500 to 600 lines of resolution (the theoretical number of lines produced by a TV receiver with our NTSC system is 525). This produces a picture that maximizes sharpness and detail, assuming you use a good video monitor or superior TV set. The home camera produces an average of about 250 lines of resolution providing approximately one-half the resolving power. Hence, sharpness and detail are severely compromised.

Another important basis for performance comparison is signal-to-noise ratio. The broadcast camera has much higher S/N, usually in the vicinity of 55 to 57 dB, as opposed to 42 to 49 dB for a home video camera. The higher the number, the purer the signal and the less intrusive the noise and interference. As a result, the video picture is decidedly less grainy. Also, the broadcast camera will produce an overall superior picture, especially in situations with minimal light.

Lens speed aside, the broadcast camera has a built-in gain control switch. This feature provides unusual shooting flexibility under low light conditions. By adjusting the gain switch you can add the equivalent of three f-stops—an advantage any professional will welcome with open lens.

Other positive attributes of a professional video camera include an automatic beam control (ABC) circuit that minimizes "comet tails" from moving objects and blooming that could occur with reflections or strong backlighting, plus a built-in genlock circuit and color-bar generator.

The professional ¾" video tape deck itself provides better resolution than the home recorder. This results in far greater detail perception. The superior signal-to-noise ratio of the professional deck ensures a sharper image and more brilliant chroma.

Equally important is what can be done with professional equipment relating to the final video tape, the one you will play. For example if you want to do an "in-camera edit" using a Beta or VHS deck, you will probably wind up with disturbing glitches and rolls between edited segments. The professional deck, in contrast, will likely enable you to get clean, frame-accurate "in-camera edits," the kind you are used to observing in TV commercials and programming. Another important benefit is that ¾" video-tape quality far exceeds the ½" format. The reasoning is simple. The ¾" width provides each frame with 0.0039" for the recording of video information, as compared to 0.0023" in the ½" format. Simply stated, ¾" tape allows almost double the recording area. An analogy that suggests itself is a comparison between 8-mm and 16-mm film. The 16-mm quality is obviously superior to 8-mm because it, too, having twice the area, captures almost twice the detail. Also, ¾" tape incorporates two audio tracks instead of the one inherent in ½". This allows for greater sound recording and mixing capability.

One of the most significant reasons for using ¾" rather than ½" is that the poorer quality of a ½" original can't produce an acceptable third-generation copy. The ¾", alternatively, can indeed give a commendable third-generation copy. Since editing-room work results in producing the finished product, the one that will be shown is generally a second-generation copy. Hence you can appreciate the advantage of working in the ¾" format.

If you've recorded with a Beta or VHS deck, you've probably wished you were allowed a little more sound flexibility, too. Having a microphone attached to the camera, which is commonplace with home video cameras, limits your creative potential significantly. You can only operate at a relatively near distance from your subjects. Professional equipment includes microphones that are unattached to the camera, and can accom-

TABLE I—PORTABLE VIDEO EQUIPMENT

CAMERAS

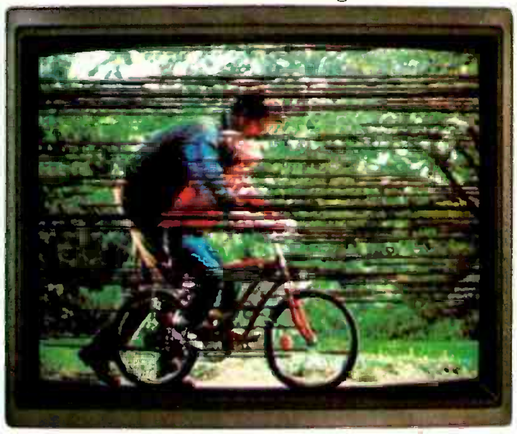
	Home	Industrial	Broadcast
Weight (lb)	5	8 to 12	15
Cost ($)	500 to 1000	10,000 to 20,000	35,000
Lenses	6:1 to 8:1 single-speed power zoom	12:1 multispeed servo zoom	14:1 with built-in 2X extender multispeed servo zoom
Resolution (lines)	230 to 250	300 to 500	500 to 600
S/N (dB)	42 to 49	52	55 to 65
Gain (dB)	0 to 6	6 + 12	6, 12 + 18
White Balance	Manual, auto	Auto	Auto
Built-in Filters	Indoor/outdoor	Indoor/outdoor/ fluorescent	Indoor/outdoor/ fluorescent/ neutral density

RECORDERS

	Home	Industrial	Broadcast
Weight (lb)	8 to 12	20 to 25	25 to 27
Cost ($)	800 to 1200	2000	4500
Tape	½" VHS or Beta	¾" (20 min)	¾" (20 min)
Tape Cost ($)	10 to 15	15 to 20	15 to 20

Drop-Outs

Particle Shedding



Color Distortion

Noise

BE PREPARED TO GIVE UP A LOT WHEN YOU SWITCH TO MAXELL HGX VIDEO TAPE.

If you're using ordinary video tape, you're probably getting a lot of extras you won't get with Maxell HGX. Like drop-outs, particle shedding, color distortion and noise—problems that can easily develop in tape that's imperfectly manufactured.

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In fact, our binder system has given HGX a drop-out rate that's significantly lower than that of any ordinary video tape. It has also virtually eliminated particle shedding—that's when oxide particles come off your tape and clog the heads of your machine. And because our oxide particles are so densely packed, Maxell HGX has superior high frequency response and a higher signal-to-noise ratio. Which means you don't have to live with color distortion or watch your picture through a screen full of snow caused by video noise.

So next time you buy video tape, try Maxell HGX. And give up a lot of things that never should have been part of your picture in the first place.

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modate mikes for almost all occasions. There are basically three types of microphones to choose from: omnidirectional to pick up sound from all directions; cardioid, which is a more directional microphone to minimize surrounding sound; and a highly directional microphone called a "shotgun" that's designed to pick up pinpointed-sound areas. Further, all professional cameras accommodate low-impedance microphones, usually 600 ohms, which permits using long cables without sacrificing high freqencies. Not all home cameras incorporate this feature.

A typical minimal professional contingent of lights would include some self-contained units. A Lowel kit is quite popular. One such kit holds three spots, and they accept bulbs of 750 or 1000 watts. When using lights it is important to exercise extreme care. A 1000-watt bulb uses approximately 9 amperes.

Mounting your camera on a good pan/tilt head, with a light but sturdy tripod, will assure you smooth pans and tilts and a pleasant, flowing image. Heavier pro cameras require stronger tripods, naturally, to achieve optimum stability. You should avoid using the simple friction-head types. A heavy-duty cradle-type or cam-link head is desirable. Best would be a professional fluid head. Add cables, extra batteries, connectors, and a slate, and you're ready to go.

Be sure to take along extra tape cassettes, masking tape, a felt pen, and an extra copy of the script. Make certain, too, that the battery is fully charged. Check your cables before you leave the rental place to be sure they all mate properly. Pro equipment uses pro connectors such as XLR, not RCA pin jacks.

The Shoot

ON a cold Saturday morning, Mike and I in our station wagon with the equipment, roared into Republic to turn the story of *Solo* into a videotape reality.

The story is about a student pilot's first attempt at a solo flight. It is the final test. If he passes it, he graduates. He will no longer be a student pilot, but a pilot with bonafide credentials to challenge the very sky itself. We follow his every step. We record his fears, his doubts, his impressions, and finally his pride and near-ecstacy as he brings his single-engine Cessna in for the final successful landing. He will have demonstrated the ability to conquer . . . to prevail . . . to overcome.

Our first set-up was listed on our carefully prepared shot sheet as being in Norbert's office at Nassau Flyers, where a flight instructor was giving final briefing to his student. We placed our Lowel lights to illuminate the desk area, then Mike white-balanced the camera.

To white-balance, a white card is held in front of the camera in the illuminated shooting area. The balance button is pressed. When a light indicator flashes, the button is released and the camera is automatically white-balanced for indoor video taping. When the camera is balanced for white, not only will white be pure, but all colors will be vibrant and true. Indoor lighting is generally considered to be about 3200 Kelvin. But nothing is perfect. The broadcast camera will adjust automatically to the actual existing

The shoot began one cold Saturday morning when the author and his colleague (serving as cameraman) Mike Cohen, arrived at the airport to set up their equipment. In the shot at left, Joe Bumbalo, the student pilot, approaches the plane to start his solo flight.

light temperature, however. Most home cameras are preset at the factory for exactly 3200 Kelvin. Consequently if color temperature is slightly less, the image will be slightly pink; if the light temperature is slightly higher, the image may be tinged with blue.

The second scene was the student outside the office, on his way to the training aircraft. Since this was an exterior shot and tubes are maufactured for indoor lighting conditions, it was necessary for Mike to make an in-camera switch to an 85 filter. This filter balances the tubes for daylight conditions, 5200 Kelvin. After the filter wa flipped into place, Mike white-balanced once again and we were ready to go.

The rest of the day was filled with work, and the fun and feeling of accomplishment. There was a shot list to be followed and sound effects to be recorded: the roar of take-offs and landings, the underscore of voices, and the whistle of the wind. For our ambiance and SFX (sound effects) we chose a directional shotgun mike with a protective windscreen.

When selecting your project, be aware that there are always limitations and opportunities. Remember, you have one day to record your story. My most fervent suggestion is to keep the project simple. For example, avoid on-camera dialogue as much as possible. In this case, remember your own limitations and those of nonprofessional talent. A good concept can be ruined by a touch of amateurism. Also, dialogue takes time to direct—many takes are required before satisfactory results are achieved. On a one-day shoot you forfeit the luxury of time. Stick to narratives. Shoot MOS. (MOS was a marvelous addition to the film lexicon often attributed to Eric Von Stroheim. The great German director was said to have informed his crew that he wanted a sequence shot in complete silence. When questioned, he was reported to have blurted out, "I vant the scene shot MIT OUT SOUND!" Thus, MOS.)

Plan your project for voice-over (a narration that moves the story along on one of the tape sound tracks). Since there are two sound tracks on ¾" video tape, the second track can be used for music, sound effects, or to carry a prepared audio mix. In our case, the voice-over had been recorded on audio cassette so that the student could react to playback throughout the shoot.

Here are some hints for the new director. The more complicated the project, the longer it takes. The longer it takes, the more pressure you'll feel as you battle against the daylight and the clock.

Now that we have confronted some limitations, what about opportunities? They are many. What can be more rewarding than creating a piece of art, flawed though it must be? To conceive an idea, and to help it develop into a finished work that bears the recognizable imprint of your talent has to be one of life's greater rewards. You are the writer . . . you are the producer . . . you are therefore The Creator.

Keep it as simple and uncluttered as possible. The camera is the observer. Let the action pass before it. A few appropriate zooms and some deliberate pans should suffice. Be creative by shooting alternate angles of the same action. What are alternatives? There are long shots, medium shots, close shots, extreme close shots, high-angle shots, and low-angle shots. There are other possibilities. For example, tracking shots, crane and boom shots, and helicopters, to name a few. However, these are

During the shoot it was necessary, in order to show the student pilot actually in the air, to have a second plane for the director and cameraman. The wing of the second plane can be seen in the photo at right above. At near right, the tape crew cheers the student pilot as he completes his solo flight.

hardly feasible considering limited experience and the time and money at your disposal.

If you intend to use different angles during one sustained action or scene, you must shoot the scene several times. The talent must repeat the actions almost identically so that, when the shots are taken to the editing room, the cuts will match.

The second scene of *Solo*, where the student goes to his aircraft, can be used to illustrate a complete directorial procedure.

The student has emerged from the school building. He is about to head for the plane and get ready for his solo. He is worried. He will hesitate, then walk to the plane, and hesitate again before boarding. He will then open the door, enter the plane, close the door, and glance at the operating panel. Then he begins to throw the switches. Here was my shot sequence.

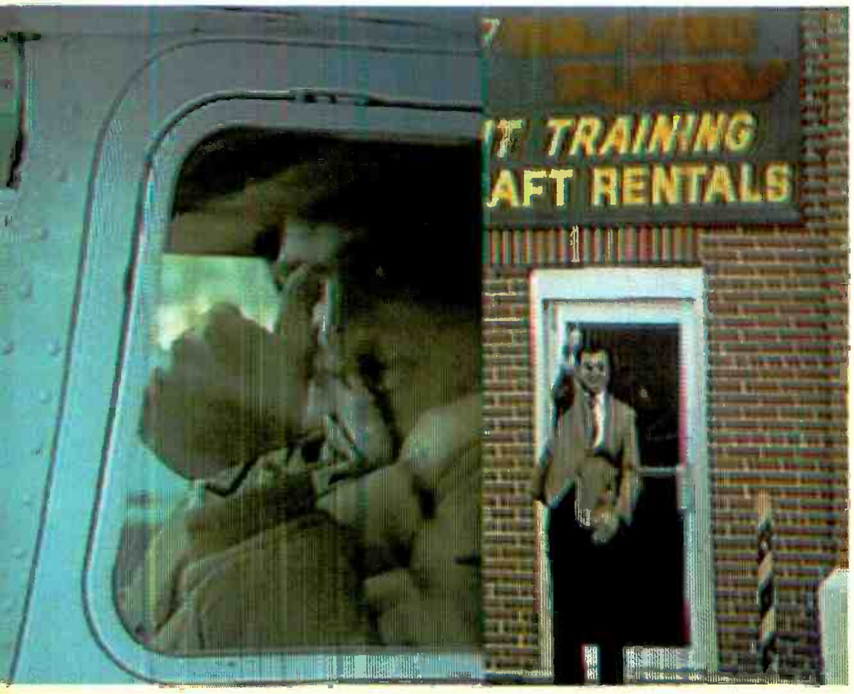
I had the student hesitate as he took a long look at the plane. Since the camera is trained on the talent, we are not photographing the plane. We will shoot that for the "point-of-view" shot, the shot that reveals what the talent was looking at the end of the scene. The student now begins walking toward the side of the camera.

The opening shot was a medium-long shot of his full figure. He starts toward the side of the camera. The camera is locked down as he approaches. As he approaches, the apprehension on his face is more apparent. As he moves past the camera and out of frame, we cut. We now turn the camera on the tripod and ready a rear shot of the student. His head will reflect the same field sizes as the end of segment one. On the word "action," the talent starts toward the plane, which is now in view. He approaches the plane and halts. He shakes his head and proceeds to board. He opens the door and enters. At this point we cut. The camera is now placed on the other side of the plane. We will shoot a medium close shot of the pilot entering the aircraft. The pilot deboards and repeats the boarding action. He opens the plane door, steps up and in, seats himself in the cockpit, and closes the door. He takes a hard look at the panel—as we execute a slight zoom. His hand then moves out and begins to throw switches in preparation to starting the engine. He throws all the switches. We cut.

We now move the camera man into the back seat for an over-the-shoulder close insert shot. We use a "Sun Gun" to illuminate the panel. We then shoot the panel alone, then cue the talent, who reaches for the switches and throws them. End of sequence.

Shooting in sequences and changing angles will help add visual excitement to your story.

All went well with our shooting because we were all prepared. At the end of the day we thanked Norbert and the pilot. We removed the red plugs from our video cassette so the images could not be erased, bagged our video cassettes, and headed for home. It was Saturday night and the editing rooms wouldn't be open until Monday morning. However, Sunday was not to be wasted. We screened all the original camera material. Since we had slated scenes and takes by originally setting our VTR counter to zero and logging by numbers the takes of



The illustrations at left show some of the excellent special effects that can be obtained. At top, the title, drawn by hand, is superimposed on an opening shot of clouds. Below, Norbert Koenig, of the Nassau Flyers School, gives the thumbs-up salute to the student pilot at takeoff. The two are combined in a vertical split-screen effect.

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each scene we felt were best, we had the luxury of making preliminary selections.

Before leaving the shoot, however, let's consider some other thing you should do on a shoot that can make or break you. For example, check your video and audio levels beforehand and make a short test recording. Should you have wheels on your tripod, which we do not recommend for inexperienced video recordists, make sure they are locked except when moving. And when moving, orient the wheels in the direction you plan to go. Be sure, too, that you move aside cables that might obstruct your path.

To avoid tripping, tie cables around the tripod and the mike stand if you're using one. If using extension cables, tie the plug ends into a knot so that any pulling pressure will not disengage connections.

Always keep in mind that TV pictures have a 4-to-3 aspect ratio. Therefore, maintain a safe tilting area, all your important work inside a 10% border area, for instance.

For easy editing, use a 10-second leader before and after each scene. Simply continue to record the scene ends while counting to ten, then stop. This will make it easy to find each scene in the editing room.

Don't smoke around equipment; it can get into the heads and tape area and ruin a shoot. And label everything. Rushes, title, date, cassette number, master, copy, and whatever. This will avoid possible sorrow later, especially when you're paying for time in an editing room.

If your subject moves a distance closer or farther away from you, you must refocus the camera by zooming in all the way to the subject, and setting your focus anew.

Plan your shot sheets carefully, keeping in mind what various types of camera zooms, angles, and so on, mean to a viewer. For instance, if you zoom in for a close shot, the viewer will have a sense of participation in the scene; zooming out will make the viewer an observer. Keep a subject who is speaking to a side off center so that he appears to be speaking into some area or to someone. An eye-level shot gives one a feeling that he or she is talking to you personally.

To show a creative video change of scene or time, you could plan to fade out and fade in (in the editing room, generally) where the picture gradually dissolves and then becomes another picture.

Be wary of objects behind the subject that could undermine clear shots of it, whether they are simply clutter, objects with the same coloring, or objects seemingly growing out of the subject's head. If there's excess light behind the subject, zoom in on him so that the automatic iris will not be misled and leave you with a video subject who's in the dark.

Audio effects can be creative, too. One might plan to add music to start a scene, fading the sound as speech begins (MUSIC UNDER).

You can even be creative with titles, shooting them on your own. For instance, you might lead with a title and credits for your video "motion picture" by putting them on a long strip of paper and recording it close up as you "pedestal" the tripod as smoothly as you can from top to bot-

More special effects. The pilot, superimposed on a shot of the planes lined up on the apron, has a slight look of anguish on his face as he approaches his plane for the takeoff. At left, a diagonal split screen shows the pilot looking out of the cockpit just before descent; and below is the airfield, looking pretty small and maybe a little hard to hit.

tom of the listing. Or you could secure the titles and credits to a drum and roll it while recording.

Here are some key words to use (and write on your shot sheets):

- Tilt: camera up or down on vertical plane.
- Pan: camera left or right on horizontal plane.
- Pedestal: camera elevation up or down.
- Dolly: camera moved back or forward. Then there are: Zoom (in or out), Long Shot (LS), Medium Shot (MS), Close-up (CU), Tight Close-up (TCU), One Shot (full person alone), Two Shot (two full figures), Full Shot (everyone full figure), and so on.

The Edit

NOW we go on the editing room. You've probably heard the expression, "We'll fix it in the editing room." It's equally accurate to state that a good video project can be "made" in the editing room . . . . especially in a ¾", 1", and 2" facility.

Beta and VHS offer very limited editing possibilities. For special effects, your ½" master would likely have to be bumped up to ¾", then edited and reduced back down to ' " again. The quality would be acceptable only to the most indiscriminating eye. Remember, each generation experiences a ten percent loss in image quality.

There are several editing options you should be aware of. There's a basic system that consists of an electronic editor, one tape deck, video monitors for search and preview, and one deck and one monitor for record purposes. The system is adequate for many projects. Of course, it limits your editing possibilities to clean professional cuts, though pre-shot titles can be inserted. Let's call this our "no-frills" editing package. Cost in New York City would be about $40 to $60 an hour with a video editor.

A more advanced system would include a Special Effects Generator (SEG), a title camera, and some pre-prepared graphics to be added during the session. Now you have the same possibilities as before, plus effects that add that magic touch of creativity. With the SEG, you can add to butt cuts by recording a variety of wipes with soft-edge or border-edge effects: vertical, horizontal, diagonal, and center to out-of-frame. You can wipe to black or color fields, pop on or fade in a graphic, colorize it, and then cut cleanly to the next selected scene. Cost? About $75 to $100 an hour with an editor.

A really sophisticated system could include equipment as elaborate as a $250,000 computerized machine with a joy stick to easily produce insets of one picture placed anywhere in another picture.

After analyzing the script, we decided that for *Solo*, a basic two-machine edit would accomplish our two main objectives. First, it would help keep our budget under control; and, second, it would provide us with a finished product capable of satisfying our artistic appetites.

The New York facility that we used was Supermedia. It has everything we needed: two video decks, two monitors, and electronic editor, a ¼" reel-to-reel audio tape deck, a graphics camera, and an editor, Sheldon Richmond, whose reputation for fast, creative editing was well-known to our colleague.

Briefly, here's the procedure. We had recorded the narration for *Solo* on a reel of ¼" audio tape. The editor transferred the narration to one audio track on the ¾" tape. Then, using our camera original, we cut picture to narration. With the use of the graphics camera and preset type, we also laid in the titles and credits. We played back our accomplishment and were well satisfied.

Unfortunately, creative effort never completely fulfills expectations. Playing the edited tape at home, we felt the need for some special effects to truly impress our intended viewers. So we took our edited ¾" cassette to Devlin Studios, a highly respected creative New York video shop that's open 24 hours a day. Here we added special video effects, some of which are shown in this article. A special-effects generator was used, of course. Also our ¾" tape was bumped up to 1" tape on an open-reel system, which is where the actual special-effect inserts were made before being inserted on our original.

The editing brought us to the end of our *Solo*. We emerged with a ¾" master and a ½" dub to play for (and impress) all our friends. We had invested our energies and talents in this project and saw it finally emerge as a home video tape we're proud of. Picture quality of the edited version was equivalent to a first-generation tape shot with a good home video camera/VCR system, which is very satisfactory. What we gained was a professional-appearing film with appropriate scenes in proper order, seguing from one to another just like in the movies, an absence of editing glitches and wild camera movements, and titling and sound effects beyond the reach of home equipment. It's a video tape we can show again and again without apologies. For recording a special event, it was worth the time and money. One final piece of advice, though: If you have never used a video camera to create a flowing home story, it would pay to rent a ½" color camera (about $50-75) or borrow one to get some dry-run experience before attempting that rare, more expensive shoot you'd like to create and own. ◇

The End

__Credits:__ Production—Ganymede Productions, NYC (Larry B. Marks, Michael Cohen); Flight School—Nassau Flyers, Farmingdale, NY (Norbert Koenig, Joe Bumbalo); Editing—Supermedia, NYC (Sheldon Richmond); Special Effects—Devlin Studios, NYC (Bob Deuber, Peter Gold); Video Equipment—G&RVideo, NYC (Stu Ruby, James Gleason).

TURN YOUR TV SCREEN INTO AN OSCILLOSCOPE

Low-cost device operates without modification on connections to your television receiver

BY LARRY REAGAN

THE TV-Scope is a television-to-oscilloscope converter that transforms an ordinary television receiver into a sensitive, large-screen oscilloscope for audio frequencies. The TV-Scope doesn't require any modifications or connections to the TV and can be constructed with power supply and probe for around $25.

What can the TV-Scope do? It can show pure tones (sine waves), distortion (undesired responses), ac riding on top of dc (ripple), and peak-to-peak amplitudes. You can also measure frequency (cycles per second), relative phases (time delays at different points in a circuit), and attenuation (gain versus frequency).

The TV-Scope features audio-frequency operation with a bandwidth in excess of 20 kHz. Input impedance is 20,000 ohms per volt and voltage ranges are from ±1 V full scale to ±500 V full scale. An unusual characteristic of the TV-Scope is a displayed trace that is vertical rather than the normal horizontal.

How it Works. The TV-Scope makes use of two normally annoying properties of television—transmission and reception of electromagnetic interference (EMI). Examples of these phenomena occur when a TV interferes with an AM radio (EMI transmission) or when a vacuum cleaner motor interferes with a TV (EMI reception).

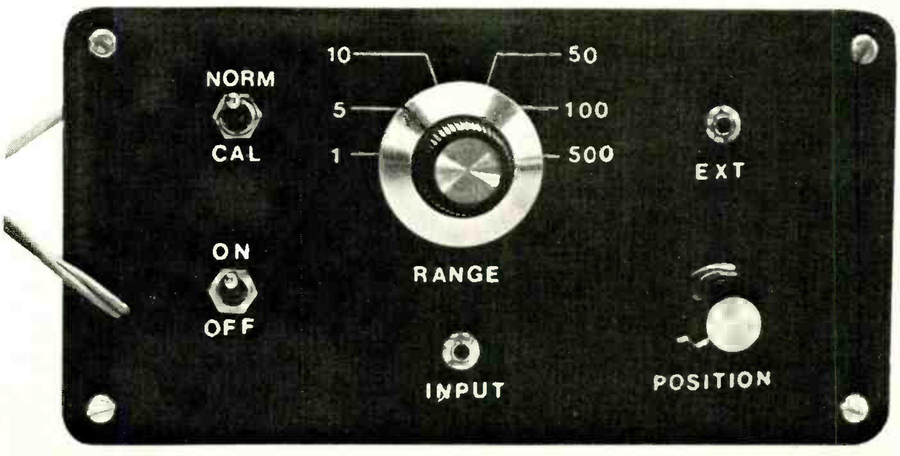
EMI is generated when the field around the high-voltage transformer inside the TV collapses. The pulses emitted occur at a precise time in the scan of each line of the raster. The TV-Scope detects the flyback pulses and synchronizes its operation to them. It then generates a controlled noise pulse. This noise rides right through the TV tuner without using an r-f carrier (just like the EMI from the vacuum cleaner).

If one noise blip is generated for each scan line and if the blips occur at the same time in each line, your eye integrates the blips into a continuous pattern from the top to the bottom of the screen. This is the oscilloscope trace. The timebase of the scope is the vertical oscillator of the TV. Varying the vertical hold changes the sweep rate.

Circuit Operation. A 555 timer chip configured as a pulse-width modulator is the heart of the TV-Scope. This chip generates a stream of pulses at a frequency exactly equal to the horizontal scan frequency of the TV. The rising edge of each pulse occurs each time the TV starts a new scan line. The falling edge of each pulse occurs at a time directly proportional to the magnitude of the signal being measured.

Referring to the schematic (Fig. 1), we see that *Q2* detects the pulses emitted by the TV. Each time a pulse is detected, a flip-flop inside of timer chip *IC3* is set. This causes pin 3 of *IC3* to go to +6 V. Transistor *Q1* and resistor *R3* form a current source that charges *C4*. When the voltage on pin 6 of *IC3* is equal to the voltage on pin 5 of *IC3*, the internal flip-flop resets, and pin 3 immediately goes to −6 V. This rapid fall is transmitted on a small antenna and is treated by the TV like a spark of noise. Simultaneously, pin 7 goes to −6 V, which causes *C4* to discharge to −4.2 V. On the next scan line the cycle repeats (Fig. 2).

Operational amplifier *IC2* is used to condition the input signal being measured. The amplifier is programmed to a gain of about 20 by *R4* and *R6*. Positioning of the trace is provided by offsetting the input by a voltage produced by *R5* and *R17*. The input signal is presented to the noninverting input of *IC2* through a voltage divider determined by *R14* and a resistor selected by switch *S3*. Switch *S2* selects either the probe



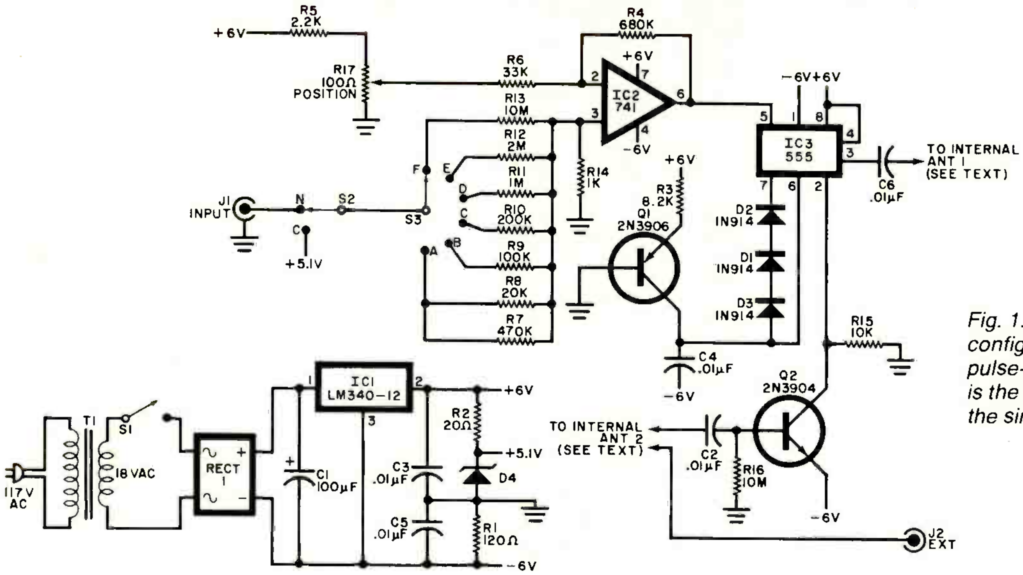


Fig. 1. A 555 timer configured as a pulse-width modulator is the heart of the simple circuit.

PARTS LIST

C1—100-µF, 50-V electrolytic
C2,C3,C4,C5,C6—0.01-µF disc capacitor
D1,D2,D3—1N914 diode
D4—5.1-V, ¼-W zener diode
IC1—LM340-12, +12-V regulator
IC2—741 op amp
IC3—555 timer
J1,J2—Subminiature earphone jack
Q1—2N3906 transistor
Q2—2N3904 transistor
The following are ¼-W, 10% resistors unless otherwise specified:
R1—120 ohms
R2—20 ohms
R3—8.2 kilohms
R4—680 kilohms
R5—2.2 kilohms
R6—33 kilohms
R7—470 kilohms
R8—20 kilohms, 1%
R9—100 kilohms, 1%
R10—200 kilohms, 1%
R11—1 megohm, 5%
R12—2 megohms, 5%
R13—10 megohms, 5%
R14—1 kilohm, 1%
R15—10 kilohms
R16—10 megohms
R17—100-ohm, linear-taper potentiometer
RECT1—1-A (or more) 50-PIV (in-line package) diode bridge
S1—Spst switch
S2—Spdt switch
S3—6-position rotary switch
T1—117-V/18-V, 85-mA transformer
Misc.—Pc board, nonmetallic enclosure, subminiature phone plug (2), alligator clip (2), 8-pin socket (2), knobs, wire, solder, etc.

Note: The following is available from Microgrid, Box 613, Ithaca, NY 14850: a partial kit including pc board and all components that mount on board (less enclosure and externally mounted components) at $17.50 plus $1.50 postage and handling. Also available separately is the pc board for $7.50. New York residents, add 7% sales tax.

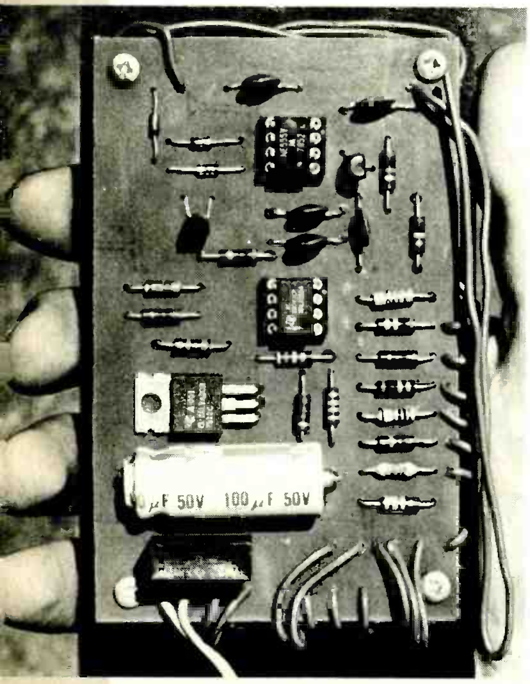


Photo of author's prototype pc board.

input or an internally generated 5-V signal for calibration.

Switch *S1* applies power to the circuit. Full-wave diode bridge *RECT1* converts the 18 V ac to dc that is filtered by capacitor *C1*. Voltage regulator *IC1* creates a stable 12-V source. Resistors *R1* and *R2* and zener diode *D4* provide the +6, +5, −6 and ground references.

Construction. A pc-board layout and its corresponding component placement guide are shown in Figs. 3 and 4. Solder all components to the board, taking care to note component polarities. The enclosure must be nonmetallic so that the required EMI can get in and out. The external output and input antennas are pieces of 22-gauge wire about 8 and 24 inches long respectively.

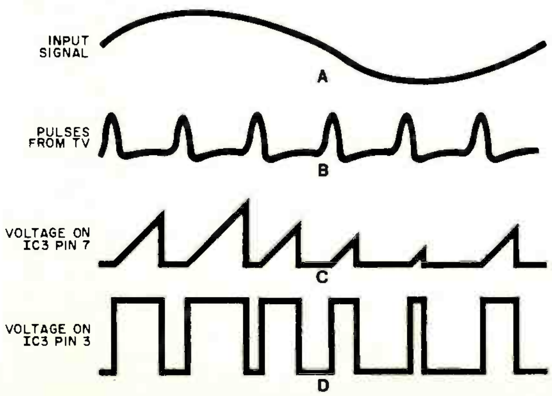


Fig. 2. Waveshapes at various points in the circuit.

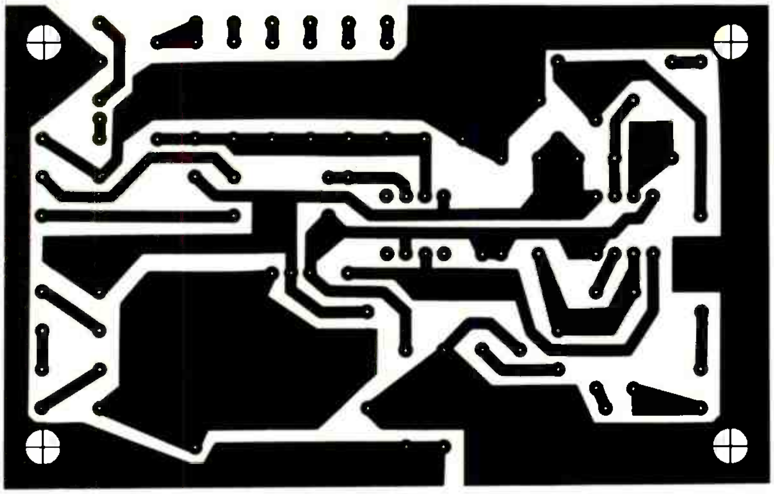


Fig. 3. Foil pattern for the printed circuit board.

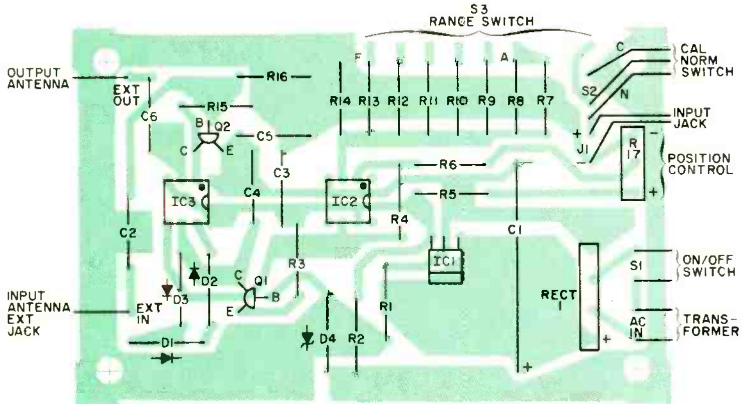


Fig. 4. Component layout diagram for the pc board.

It is helpful to terminate the input antenna to a jack labelled "EXT" on the front panel in case more wire is needed. Remember the TV radiates strongest near the high-voltage section and directly in front of the screen.

A low-cost probe can be constructed by mounting two pieces of wire to a subminiature earphone plug. Red and black alligator clips or probe tips can be used to indicate signal input and ground.

Set-Up and Calibration. Turn on the TV-Scope and set the position control midway through its range. Set the NORM/CAL switch to NORM. Set the range switch to the 5-V range. Disconnect the TV from any remote antennas or cables. If the TV has a built-in antenna, it should be connected. If the TV does not have a built-in antenna, construct one by attaching two pieces of wire approximately three feet long to the antenna terminals. Turn on the TV and set it to a channel that is not normally used (channels 2-6 on the vhf dial work best). Hold the TV-Scope six inches from the TV and move it around until you get a black line down the center of the screen. (If you find that you can't get a line or if you can get one only by holding the TV-Scope in an awkward position, try adding three feet of wire to the EXT input of the TV-Scope.) The best trace is a wide black bar with a thin white line down the middle on a gray background.

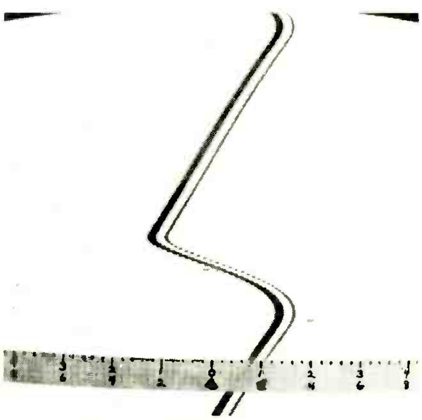


Fig. 5. Calibrated strip of paper taped to front of TV screen.

Tape a strip of paper horizontally across the face of the TV screen in order to construct the voltage scales. Move the position control so that the trace is centered on the screen. Mark this point on the strip "0" for zero volt. Turn the NORM/CAL switch to CAL and note that the trace moves to the right. Mark this point "+5." Move the position control until the trace is back to zero volt. Now set the NORM/CAL switch to NORM and note that the trace moves to the left. Mark this point on the strip "−5." Now you can divide the distance between −5 and +5 into 10 equally spaced large divisions representing one volt per division (Fig. 5). The other ranges are automatically calibrated by this procedure. The +5 mark on the 5-V range corresponds to +1 of the 1-V range, etc.

Applications. You can experiment with the TV-Scope by hooking the input probe across one of the speakers of a phonograph amplifier. The trace will follow the music, varying in shape with the different sounds received. The light show produced is also a practical indicator for detecting clipping and other types of distortion in the amplifier.

Consistent waveforms can be seen by playing a test record, such as the Shure TTR103 Phono Cartridge Traceability Test Record. Different frequencies can be produced by changing the turntable speed. Although the TV-Scope has no trigger, you can stabilize the display by adjusting the vertical-hold control on the TV.

If you can't get your hands on a sine-wave generator, an electric guitar can be used to synthesize sine waves. You can also investigate the waveforms of electronic organs and other music synthesizers.

Many home computers use audio-cassette recorders for program storage and loading. The TV-Scope connected to the cassette output allows you to adjust the peak-to-peak output to the recommended optimum value (usually 4 V) for reliable program loading.

You can measure frequency and relative phase with two TV-Scopes. A known reference signal is displayed on one channel and the input signal on the other channel is compared against it. Dual-trace also enables measurement of stereo separation and phasing between speakers by displaying both speaker outputs at the same time. These are just a few of the ways to use the TV-Scope. After working with the scope for a while you'll find many more applications. ◇

BY ROBERT COLWELL

TIMING DIAGRAMS: HOW TO READ AND USE THEM

Ability to interpret timing diagrams from device manufacturers is essential in designing and troubleshooting digital circuits

IN A digital system, whether it is a simple countdown circuit or a complex computer, timing is everything. Except for the simple inverter (one input, one output), logic elements such as gates, flip-flops, and counters require that two or more signals be applied to their respective inputs at the right time in order to produce the desired output. If there is a timing error and one signal is delayed for some reason, the logic element will not function properly—if at all. Thus, timing diagrams are important tools in the work of digital circuit designers.

The waveforms of digital signals are invariably shown in ideal shapes such as that in Fig. 1A. Note the infinitely fast rising and falling edges of the ideal pulse. However, we live in a world where capacitance, inductance, and time are realities, so it takes a finite amount of time (usually measured in nanoseconds) for a digital signal to change states. This is shown in Fig. 1B, where rise and fall times are measured between the 10% and 90% points of the waveform.

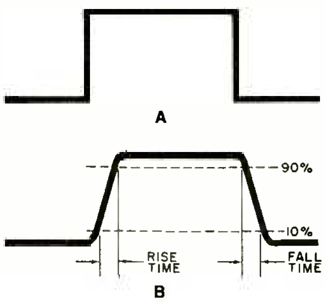


Fig. 1. An ideal digital signal (A) and a more realistic waveshape (B).

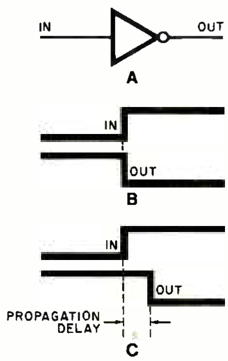


Fig. 2. Input and output waveforms for an inverter. Propagation delay shown at (C).

In the waveforms shown in this article, idealized shapes are used to simplify the drawings. In reality, they would look more like the waveshape in Fig. 1B.

The Timing Diagram. A timing diagram illustrates how logic signals change with time in relation to other signals. The format is: logic level (or voltage) on the vertical axis, and time on the horizontal axis. The diagram is "read" from left to right.

Consider the inverter shown in Fig. 2A. (The small circle at the output indicates signal inversion.) The timing diagram for this device (Fig. 2B) shows how the output is the inverse of the input signal. However, in the real world, it takes time for the semiconductor elements within the device to respond to the input signal. This is known as the "propagation delay" between the two signals (Fig. 2C). This delay is present in all logic elements

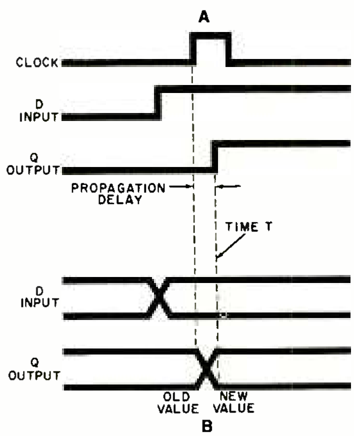
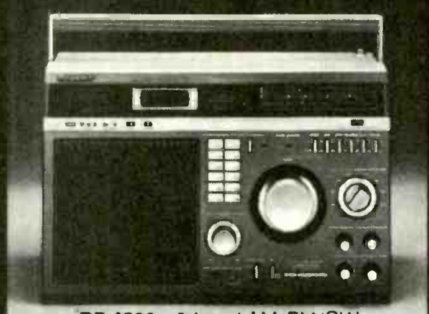


Fig. 3. Timing diagram for a D flip-flop (A); modified at (B) to show delay.

Introducing incredible tuning accuracy at an incredibly affordable price: The Command Series RF-3100 31-band AM/FM/SW receiver.* No other shortwave receiver brings in PLL quartz synthesized tuning and all-band digital readout for as low a price.† The tuner tracks and "locks" onto your signal, and the 5-digit display shows exactly what frequency you're on.


RF-6300 8-band AM/FM/SW

There are other ways the RF-3100 commands the airways: It can travel the full length of the shortwave band (that's 1.6 to 30 MHz). It eliminates interference when stations overlap by narrowing the broadcast band. It improves reception in strong signal areas with RF Gain Control. And the RF-3100 catches Morse communications accurately with BFO Pitch Control.

Want to bring in your favorite programs without lifting a finger? Then consider the Panasonic RF-6300 8-band AM/FM/SW receiver (1.6 to 30 MHz) has microcomputerized preset pushbutton tuning, for programming 12 different broadcasts, or the same broadcast 12 days in a row. Automatically. It even has a quartz alarm clock that turns the radio on and off to play your favorite broadcasts.

The Command Series RF-3100 and RF-6300. Two more ways to roam the globe at the speed of sound. Only from Panasonic.

*Shortwave reception will vary with antenna, weather conditions, operator's geographic location and other factors. An outside antenna may be required for maximum shortwave reception.

†Based on a comparison of suggested retail prices.

This Panasonic Command Series™ shortwave receiver brings the state of the art closer to the state of your pocketbook.

With PLL Quartz Synthesized Tuning and Digital Frequency Readout.

Panasonic
just slightly ahead of our time.

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and has to be accounted for in timing diagrams.

The timing diagram for a D flip-flop is shown in Fig. 3A. Operation of this device is such that, when the clock input is a signal with a rising edge, the data (logic 0 or logic 1) at the D input is transferred to the Q output and held there until the next clock pulse. The diagram in Fig. 3A is for the case where the D input was at logic 1 when the clock pulse appeared. The Q output shows the D-input transfer along with the propagation delay. If the D input were at logic 0 when the clock pulse was received, the Q output would not have changed. There would still be a propagation delay but it would not show on the timing diagram because both sides would be at logic 0. In either case, the Q output would be valid at time T.

In the modified partial timing diagram shown in Fig. 3B, the D input and the Q output are shown at logic 0 and logic 1 at the same time—clearly an impossible situation. This technique is used to illustrate both logic conditions (old value and new value) that can exist before the clock pulse and after the clock pulse propagation delay time. After time T, the signals assume their proper states.

In computer circuits, there are sets of signals called "busses." In an 8-bit processor, there will be eight signals in the data bus, 16 in the address bus, and some undetermined number in the control bus. As shown in Fig. 4A, instead of drawing all eight input and output signals separately, we show them as a group. Here the inputs settle in before the arrival of the clock pulse, and the outputs assume the required state after the propagation delay of the data pulse. In the logic diagram of Fig. 4B, the large arrows with the numbers inside them are used to indicate the eight inputs and outputs.

Another symbol that is often used is shown in Fig. 5. In this case, the falling edge of signal 1 causes the falling edge of signal 2 or the rising or falling edges of whatever other signals are being triggered.

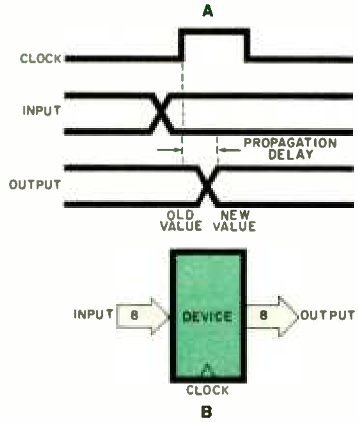


Fig. 4. How sets of signals are indicated as busses in an 8-bit processor.

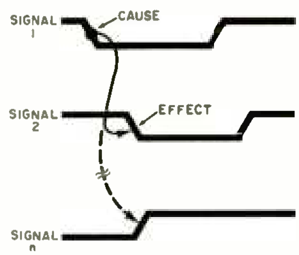


Fig. 5. Arrows are used to indicate cause and resultant effects.

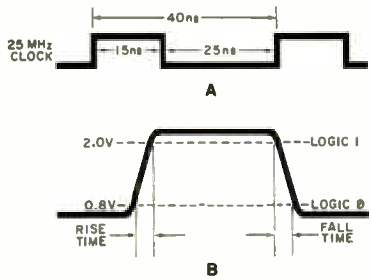


Fig. 6. The clock period has a lowtime and a hightime.

A Real Chip. Let us examine the specifications for a real TTL device—in this case a 74LS163 4-bit counter. As indicated by the letters "LS" in the number, this is a low-power Schottky device.

Other than gates, most digital logic (regardless of family) is timed from a system "clock"—a pulse train with steep rising and falling edges. Since the 74LS163 is a TTL device, the clock must be "TTL compatible." This means that a clock level less than 0.8 volt is considered a logic 0 and a level greater than 2 volts is considered a logic 1. Input voltages between these two levels are disallowed.

To determine the maximum clock frequency that can be used, one must examine the specification sheet for the 74LS163. When the chip is operated at 5 V at 25°C, the specs say the maximum clock frequency (f_{clock}) is 25 MHz. Some individual chips may operate above this frequency, but there is no guarantee.

At 25 MHz, a single clock period is 40 ns and 25 million of these occur in every second. On the spec sheet it also states that the minimum period allowed (clock hightime plus clock lowtime) is 40 ns and that the width of the clock pulse (T_{wclock}) is 25 ns min. The manufacturer defines T_{wclock} as the low interval, leaving 15 ns for the high interval. This is shown in Fig. 6A. Note that ideal waveforms are used in this illustration. The more realistic waveforms are shown in Fig. 6B. Here, the rise time is the length of time the clock voltage spends in the region between a valid logic 0 and a logic 1.

The fall time is the analogous length of time when the clock voltage is falling from a logic 1 to logic 0. The rise and fall periods are known as the clock's "edges." Maximum rise and fall times are usually not specified, but they should be kept as fast as possible in a clock circuit.

In Fig. 7A, the 74LS163 is counting the clock pulses to produce an output sequence of 0000, 0001, 0010 0011, etc., which converts to 0, 1, 2, 3, etc., in decimal. This is clearly shown in the timing diagram of Fig. 7B, where the outputs for each clock pulse are shown. In a diagram like this, it is customary to put the input (cause) on the top and the outputs (effects) below.

If clocking of the circuit in Fig. 7A continues, it will eventually arrive at its maximum count of 1111 (decimal 15), with the next clock pulse producing an 0000 output. The cycling between decimal 0 and decimal 15 continues as long as clock pulses are provided.

To make this circuit count to some number less than decimal 15, say 12, some means of detecting the occurrence of decimal 12 (1100 binary) must be used. This is shown in Fig. 8A, where a two-input NAND gate has been added. The bi-

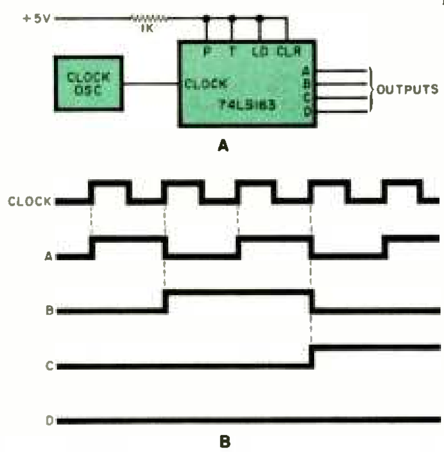


Fig. 7. The circuit at (A) is counting the clock pulses to produce the proper output sequence as illustrated by the waveforms in (B).

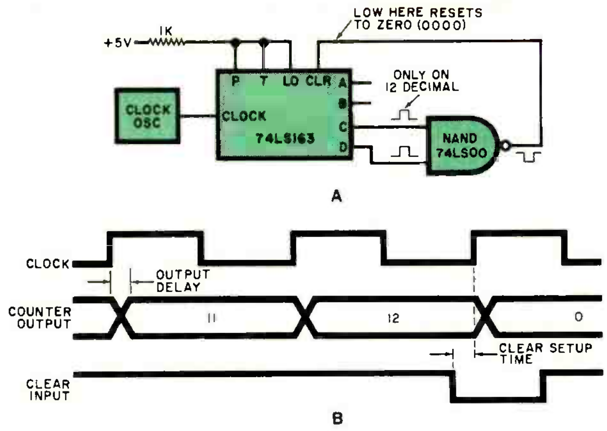


Fig. 8. The circuit of Fig. 7 modified to detect the occurrence of decimal 12.

nary sequence from 0000 to 1111 for the output terminals of the 74LS163 is as follows:

Binary D	C	B	A	Decimal
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

There are two important facts about this circuit: (1) when both inputs of a NAND gate are high, the output is low—otherwise it is high; (2) when the CLR (clear) input of the 74LS163 is low, the counter resets to 0000 and when the CLR is high, the device counts.

In this example, the two NAND gate inputs are connected to outputs C and D, with the normally high output connected to the clear input of the counter. It counts normally from 0000 until it reaches 1100. Then the output of the NAND gate goes low, resetting the counter to 0000. Thus, the counter/gate arrangement can be forced to count up from 0000 to 1100 in cyclic fashion. The timing diagram for this is shown in Fig. 8B. The circuit and the timing diagram appear to be satisfactory, but it is important to determine whether the 74LS163 will produce the new output and whether the NAND gate will produce an output in time to provide the clear signal before the next clock pulse.

The time period labelled "output delay" is a measure of how fast the counter changes states with the clock pulse. If we refer to the specification sheet for the 74LS163, we find that two different switching parameters are listed: one when switching from a 0 to 1 and another for the 1-to-0 transition. Since the major concern is to produce a 1100 signal for the NAND gate, the maximum specification of 24 ns will be used. Thus, at most, 24 ns after the twelfth clock pulse's rising edge, both of the inputs to the NAND gate will be at logic 1. According to the specification sheet for the 74LS00, the output goes to logic 0 within 15 ns max. This becomes the clear signal for the 74LS163 and will get clocked into the counter at the next clock edge.

The timing diagram is now as shown in Fig. 9. When the time delays through the counter and NAND gate are added, the result is 39 ns—just barely in time for the next clock edge. Will this work? Although it looks as if it would, one more specification has to be accounted for.

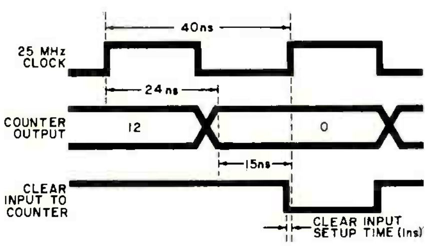


Fig. 9. Timing diagram for the circuit in Fig. 8 using parts specified.

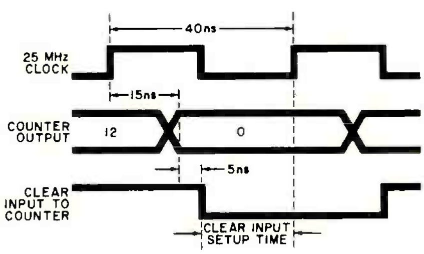
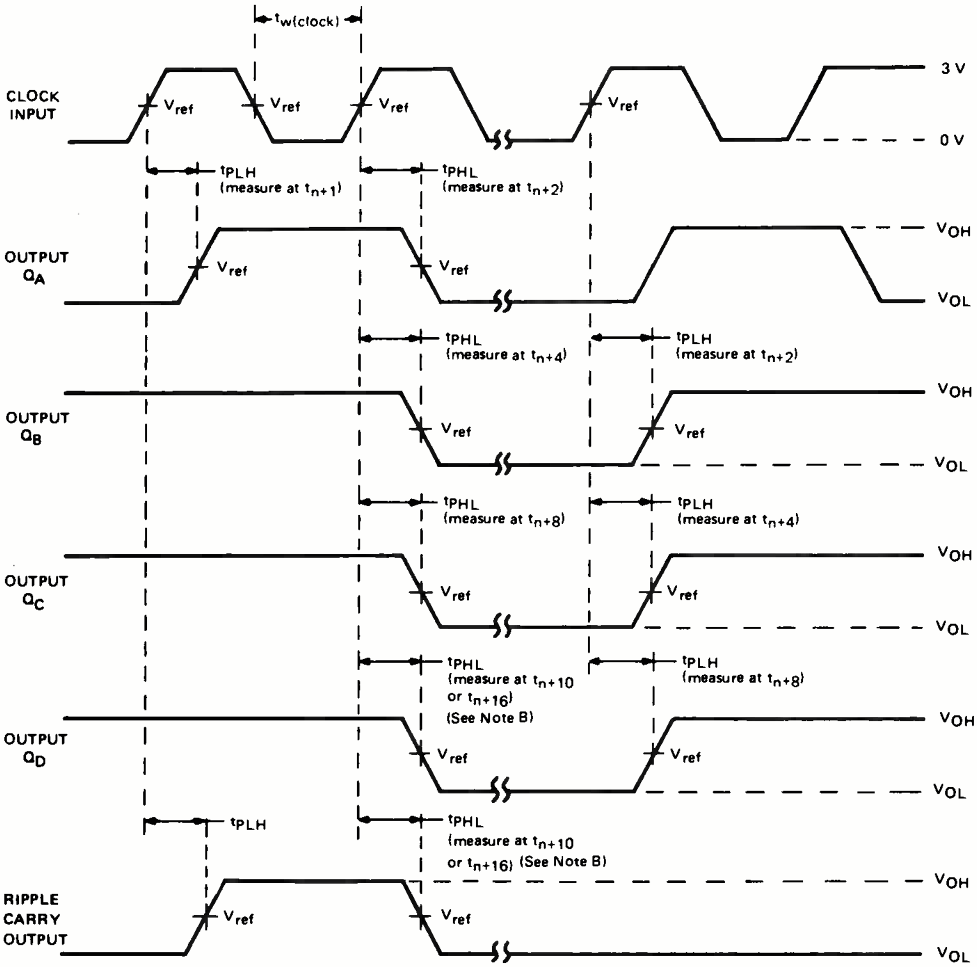


Fig. 10. Timing diagram for the clock circuit using a faster counter unit.

TYPES SN54160 THRU SN54163, SN54LS160A,THRU SN54LS163A, SN54S162, SN54S163, SN74160 THRU SN74163, SN74LS160A THRU SN74LS163A, SN74S162, SN74S163 SYNCHRONOUS 4-BIT COUNTERS

PARAMETER MEASUREMENT INFORMATION



VOLTAGE WAVEFORMS

NOTES: A. The input pulses are supplied by a generator having the following characteristics: PRR ≤ 1 MHz, duty cycle ≤ 50%, $Z_{out} \approx 50\ \Omega$; for '160 thru '163, $t_r \le 10$ ns, $t_f \le 10$ ns; for 'LS160A thru 'LS163A, $t_r \le 15$ ns, $t_f \le 6$ ns; and for 'S162, 'S163, $t_r \le 2.5$ ns, $t_f \le 2.5$ ns. Vary PRR to measure f_{max}.

B. Outputs Q_D and carry are tested at t_{n+10} for '160, '162, 'LS160A, 'LS162A, and 'S162, and at t_{n+16} for '161, '163, 'LS161A, 'LS163A, and 'S163, where t_n is the bit time when all outputs are low.

C. For '160 thru '163, 'S162, and 'S163, $V_{ref} = 1.5$ V; for 'LS160A thru 'LS163A, $V_{ref} = 1.3$ V.

FIGURE 1—SWITCHING TIMES

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Timing diagrams for the 74LS163 from "The TTL Data Book."

This is setup time, the minimum amount of time the IC requires a signal to be valid before the next clock edge appears.

The 74LS163 specifies a "Clear Input Setup Time" of at least 25 ns. Unfortunately, according to the timing diagram, our circuit provides only 1 ns. If we used a faster Schottky NAND gate instead of low-power Schottky, the gate delay would be 5 ns instead of 15 ns. Since we are off by 24 ns, substituting a faster Schottky makes the circuit off by 14 ns. So it still will not work properly.

Now if the counter were a faster Schottky, the "Clock to Output Valid" time is reduced to 15 ns (instead of the 24 ns for the low-power Schottky). The setup time on the clear input is reduced to 14 ns. This is shown in Fig. 10. Thus the new Schottky version will indeed work.

There is one circuit "trick" that can be

recommended operating conditions

		SN54LS'			SN74LS'			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}		4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}				−400			−400	μA
Low-level output current, I_{OL}				4			8	mA
Clock frequency, f_{clock}		0		25	0		25	MHz
Width of clock pulse, $t_{w(clock)}$		25			25			ns
Width of clear pulse, $t_{w(clear)}$		20			20			ns
Setup time, t_{su} (see Figures 1 and 2)	Data inputs A, B, C, D	20			20			ns
	Enable P or T	20			20			ns
	Load	20			20			ns
	Clear◊	20			20			ns
Hold time at any input, t_h		0			0			ns
Operating free-air temperature, T_A		−55		125	0		70	°C

◊ This applies only for 'LS162 and 'LS163, which have synchronous clear inputs.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER¶	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}			C_L = 15 pF, R_L = 2 kΩ, See Figures 1 and 2 and Notes 8 and 9	25	32		MHz
t_{PLH}	Clock	Ripple carry			20	35	ns
t_{PHL}					18	35	
t_{PLH}	Clock (load input high)	Any Q			13	24	ns
t_{PHL}					18	27	
t_{PLH}	Clock (load input low)	Any Q			13	24	ns
t_{PHL}					18	27	
t_{PLH}	Enable T	Ripple carry			9	14	ns
t_{PHL}					9	14	
t_{PHL}	Clear	Any Q			20	28	ns

¶f_{max} ≡ Maximum clock frequency
t_{PLH} ≡ propagation delay time, low-to-high-level output.
t_{PHL} ≡ propagation delay time, high-to-low-level output.
NOTES: 8. Load circuit is shown on page 3-11.
9. Propagation delay for clearing is measured from the clear input for the 'LS160A and 'LS161A or from the clock transition for the 'LS162A and 'LS163A.

Characteristics for the 74LS163 from the "The TTL Data Book."

used with the low-power Schottky devices. That is to detect the decimal-11 state as shown in Fig. 11. The circuit uses a three-input NAND gate and a flip-flop to detect the decimal-11 state and delay the result by one clock pulse so that clock-pulse 12 catches up before clearing the counter. The gate has a 7-ns propagation delay and the flip-flop requires 5 ns to setup. The flip-flop propagates the D input to the Q output in 9 ns max. Thus the 25-ns setup required is met. Note that the counter has 31 ns to setup on the clear input.

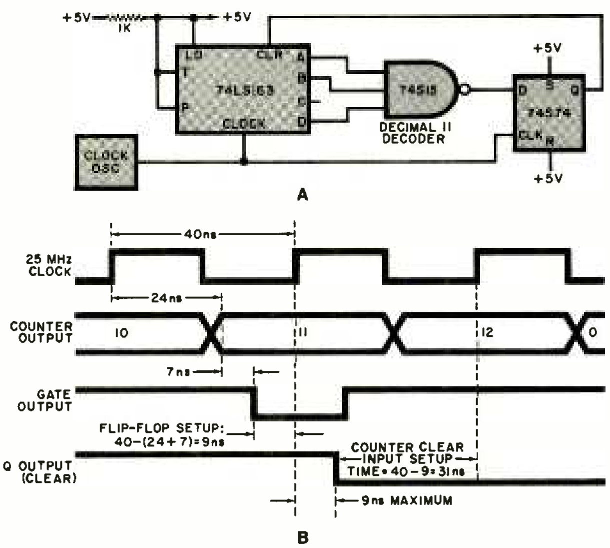


Fig. 11. Circuit and timing diagrams to detect the decimal-11 state.

Conclusion. There are two areas to watch. Timing specifications are usually given for devices operating at 5 V and 25°C. Since chips tend to get warm when operating, their timing specifications degrade at higher temperatures. This is why cooling fans are used in most equipment. Since winter temperatures may go below specifications, low-temperature specifications must also be considered when selecting chips for outdoor or automotive use.

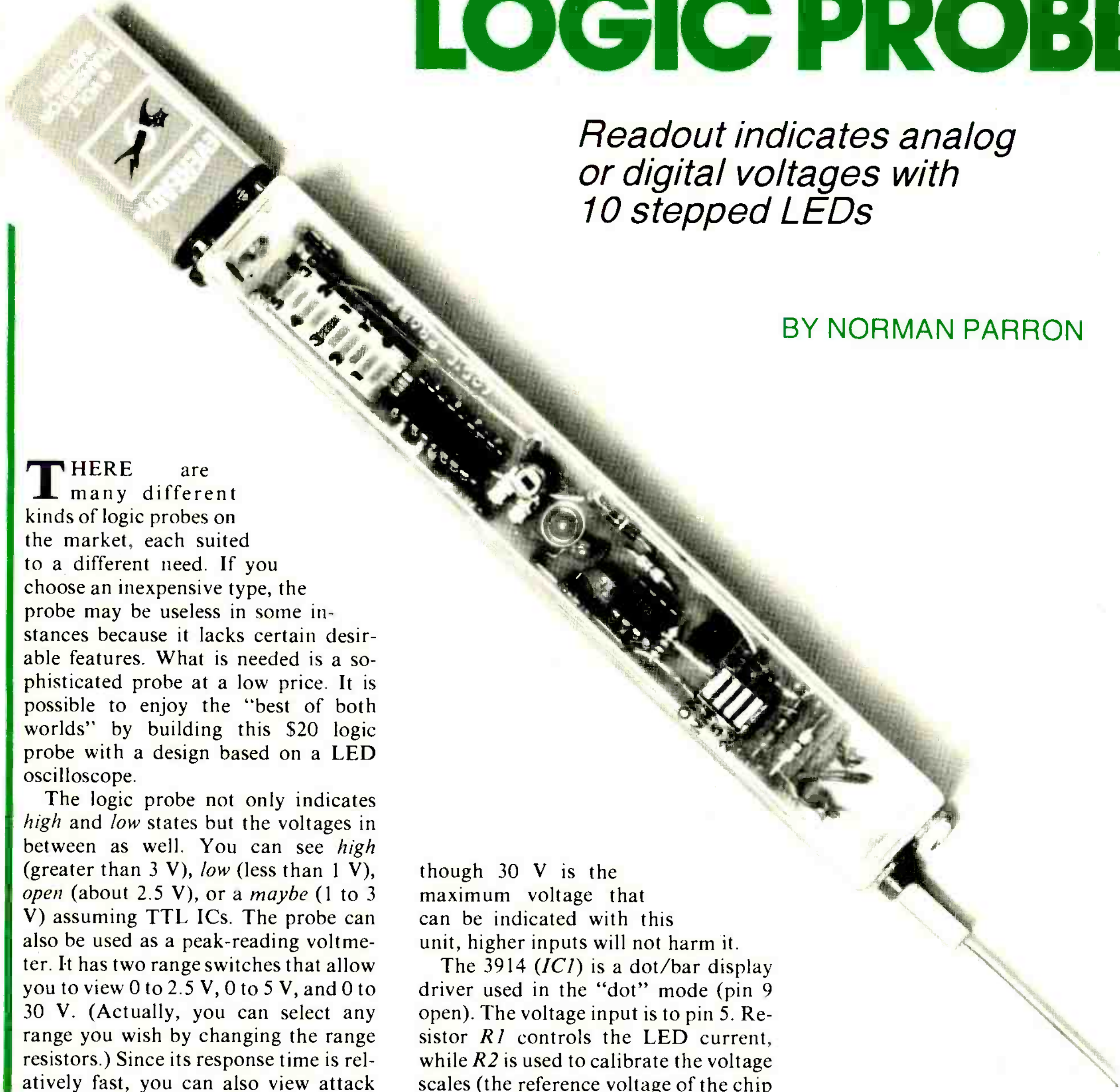
The second problem may arise because specifications are published only for dc loads. If the dc load (fanout) of the circuit exceeds that of the specifications, other values will be downgraded. Increasing the surface area of a printed circuit trace or attempting to drive a length of cable could cause the IC to "see" a higher capacitance than specified. In each of these cases, the chip will exhibit slightly degraded performance. Most manufacturers provide a "derating" graph to take care of such contingencies.

Now you can see how even a circuit as simple as a counter can be assembled in correct logical order yet not work properly. What is important is that the timing diagram of the circuit is a valuable design tool which can save a lot of time later. ◇

10-LED LOGIC PROBE

Readout indicates analog or digital voltages with 10 stepped LEDs

BY NORMAN PARRON



THERE are many different kinds of logic probes on the market, each suited to a different need. If you choose an inexpensive type, the probe may be useless in some instances because it lacks certain desirable features. What is needed is a sophisticated probe at a low price. It is possible to enjoy the "best of both worlds" by building this \$20 logic probe with a design based on a LED oscilloscope.

The logic probe not only indicates *high* and *low* states but the voltages in between as well. You can see *high* (greater than 3 V), *low* (less than 1 V), *open* (about 2.5 V), or a *maybe* (1 to 3 V) assuming TTL ICs. The probe can also be used as a peak-reading voltmeter. It has two range switches that allow you to view 0 to 2.5 V, 0 to 5 V, and 0 to 30 V. (Actually, you can select any range you wish by changing the range resistors.) Since its response time is relatively fast, you can also view attack and decay times (leading and trailing edges) of a pulse.

The probe is good for digital and analog signals and positive or negative voltages. It uses battery or other external power, and has a frequency range up to 1 MHz. It can be used to troubleshoot computers and peripherals, electronic organs, stereo equipment, etc.

Circuit Operation. Referring to the schematic of Fig. 1, switches *S1* and *S3* select voltage ranges of 0 to 2.5 V and 0 to 5 V respectively. When both switches are off, the 30-V range is selected. Although 30 V is the maximum voltage that can be indicated with this unit, higher inputs will not harm it.

The 3914 (*IC1*) is a dot/bar display driver used in the "dot" mode (pin 9 open). The voltage input is to pin 5. Resistor *R1* controls the LED current, while *R2* is used to calibrate the voltage scales (the reference voltage of the chip is between pins 7 and 8). The 3914 drives a LED bar-graph array, which is made up of 10 LEDs housed in a 20-pin dual-in-line package. For the 5-V range, each LED lights in 0.5-V steps.

Transistors *Q1* and *Q2* are connected in a Darlington configuration and serve as a high-impedance buffer. Connecting the 555 (*IC2*) as a monostable stretches the input pulse to 50 ms (or any length desired). Switch *S2*, between pins 6 and 7, allows the 555 to stretch (switch closed) or store (switch open) a transient pulse. When *S2* is open, pin 6 is left floating. This disables the reset portion of the 555 monostable. It will stay on until it is reset by closing the switch. This enables the probe to catch pulses as narrow as 0.1 μs. Indicator *LED1* is a rectangular, yellow light-emitting diode that signals the presence of a pulse. The time constant of the 555 is set by *R3* and *C1*.

Construction. Construction of the probe poses one small problem—finding a case of the appropriate size and shape. The one used here was ob-

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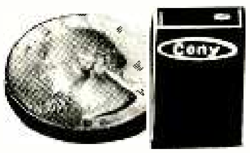

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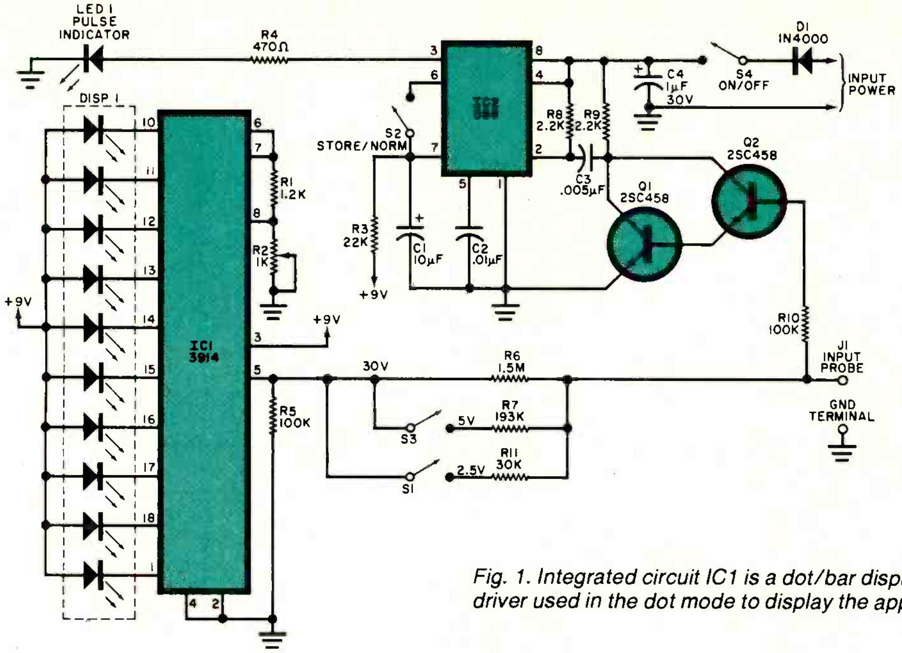

Fig. 1. Integrated circuit IC1 is a dot/bar display driver used in the dot mode to display the appropriate LED.

PARTSLIST

C1—10-μF, 35-V tantalum capacitor
C2—0.01-μF capacitor
C3—0.005-μF capacitor
C4—10-to-22-μF, 35-V tantalum capacitor
D1—1N4000 diode (or any diode with a 50-V or greater PIV)
DISP1—Light-emitting diode bar-graph array (Radio Shack 276-072 or similar)
IC1—3914 dot/bar display driver
IC2—555 timer
J1—Red nylon-insulated tip jack (Allied Electronics 828-1513 or similar)
J2—Black nylon-insulated tip jack (Allied Electronics 828-1512 or similar)
LED1—Rectangular, yellow light-emitting diode (Radio Shack 276-081 or similar)
Q1,Q2—2SC458 transistor (see note)
Unless otherwise noted, the following are ¼- or ⅛-W, 5% resistors:
R1—1.2 kilohms
R2—1-kilohm miniature trim pot
R3—22 kilohms
R4—470 ohms
R5,R10—100 kilohms
R6—1.5 megohms (see text)
R7—193 kilohms (see text)
R8,R9—2.2 kilohms
R11—30 kilohms (see text)
S1 through S4—4-position, miniature spst DIP switch
Misc.—Pc board, case, probe tip, 9-V battery clip, etc.
Note: Q1 and Q2 are npn signal transistors chosen for their square shape. The pin configuration is base-collector-emitter. (A single Darlington can be used in their place.) The transistor is available at stereo repair shops or from Fugi-Svea, Inc. (Torrance, CA). A noninsulated tip plug is available from Allied Electronics (part no. 920-0108).

tained with one dollar and a trip to the supermarket for a Pepsodent toothbrush holder. It is transparent, small, plastic, and reasonably rugged. The holder has a hook attached to one end that has to be cut off with a fine saw and filed smooth.

Remove the battery clip from a dead 9-V battery and lay it against the end of the case where the hook was removed. Mark where the two holes are and drill the case. Solder two 3″ insulated wires to the battery clip and slide the wires through their respective holes.

Coat the edges and ends of the case top with petroleum jelly.Then put the case together and hold it closed with a rubber band. With this done, coat the white section under the battery clip with clear epoxy and tape the clip in place. Put it aside to harden.

The pc board is long and narrow, as can be seen from the foil pattern (Fig. 2). Since the board is double-sided, you will have to use solder-through holes, molex socket pins, or spring pins.

For those who don't use photo etching, make the pc board using the bottom pattern only. Install both top and bottom components as shown in the parts-layout diagram (Fig. 3). Using fine wire-wrap wire, connect all the points that should have been connected by the top pc runs. Although this is not economical for mass production, it is easy and inexpensive for the one-time project—especially a tightly packed one.

Once the epoxy has hardened, remove the tape and rubber bands and carefully separate the top and bottom of the case. If the petroleum jelly was put on properly, they should not be stuck together. At the opposite end, carefully cut, drill, or melt two holes large enough to insert red and black tip jacks. File two small notches in the top cover so that it will fit properly. Tip jacks are used for two reasons. First, it is simple to make a probe tip with the help of a tip plug. The second reason is that since this probe uses battery power, negative voltages can be measured by reversing the probe tips.

Remove the tip jacks and solder one 3″ wire to each jack. Insert the jacks in their holes and glue them in place with clear epoxy. Hold the jacks in place by putting the top on and a piece of tape across the jacks.

Cut a piece of soft foam ½″ thick and as long and wide as the pc board. Once the epoxy has hardened, remove the top and tape, and clean with alcohol to remove the petroleum jelly. Place the pc board bottom side up next to the bottom of the case and attach the four wires to the bottom of the pc board.

Place the piece of foam in the bottom of the case and put the pc board on the foam. Push the top down and mark a square over the DIP switch and a dot over the calibration pot. Then using a small drill and file, cut out the holes. Once the holes are completed, position the top and hold with rubber bands. Label the DIP switch with press-on lettering.

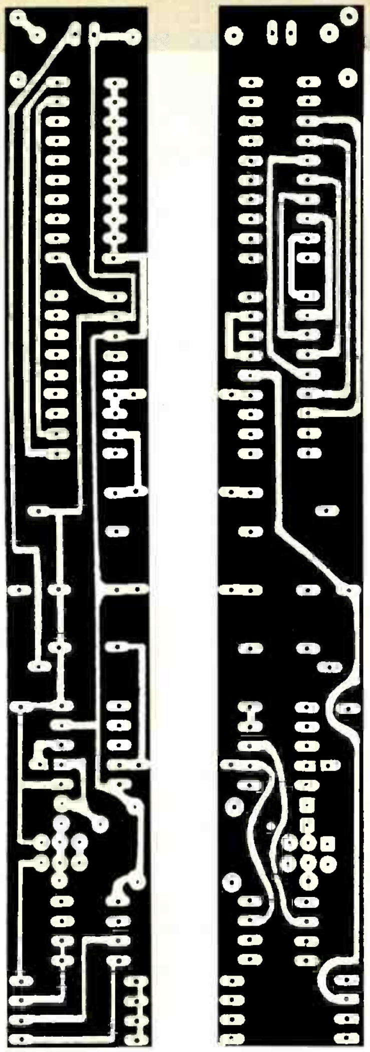

Fig. 2. Foil patterns for making a double-sided board.

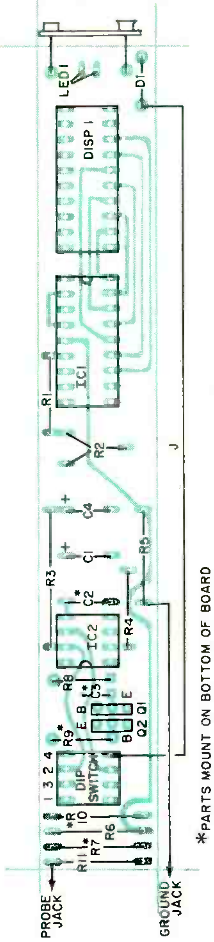

Fig. 3. Component layout on pc board.

To make a probe tip, solder the blunt or eye end of a heavy needle (or multipurpose T-pin) into the back of an insulated tip plug. Then cover the plug and part of the needle with heat-shrink tubing. The tip plug can then be inserted into the tip jack.

Calibration. Select a resistor just under 193 kilohms (e.g. 180, 150, or 120 kilohms) and connect it to a DVM. Use a Dremel-type grinder or small file and carefully remove enough carbon to obtain 193 kilohms or as close to it as possible. Do the same for the 1.5-megohm and 30-kilohm resistors. Seal the cut with epoxy or fingernail polish (nonmetallic type). Install the resistors, select the most important range, use a power supply to apply the full-scale voltage to the input, and adjust the calibration pot until the top LED just lights. No further adjustment is necessary.

Lower the input voltage to zero volts and then slowly increase it, noting the voltage that triggers each LED. For the 5-V range, each LED lights in 0.5-V steps. Do this for all voltage ranges. Using press-on lettering, label the LEDs. Down the left (narrow) side, label every other LED starting at the top with 5. On the right (wide) side, mark alternate LEDs starting at the top with 30. The 2.5-V scale need not be labeled because there isn't enough room and each LED is ½ of the 5-V scale.

Connect signal ground to the ground terminal of the probe. Touch the probe tip to +5 V with the range switch in the 5-V position. The yellow pulse LED should light for a time set by the RC constant of the 555 (about 20 ms for the components shown). Change the range switch to 30 V; and when the probe tip is applied to +5 V, the LED should still light.

If the calibration is good, seal the case with clear plastic glue. Put the glue in only four to six places so that it can be taken apart if required. You may find it useful to cover the lettering with clear fingernail polish to prevent it from rubbing off. But this must be done quickly and carefully.

The logic probe should be a useful piece of test equipment. It can function as a probe or a multirange voltmeter, all in a package to fit in a shirt pocket. ◇

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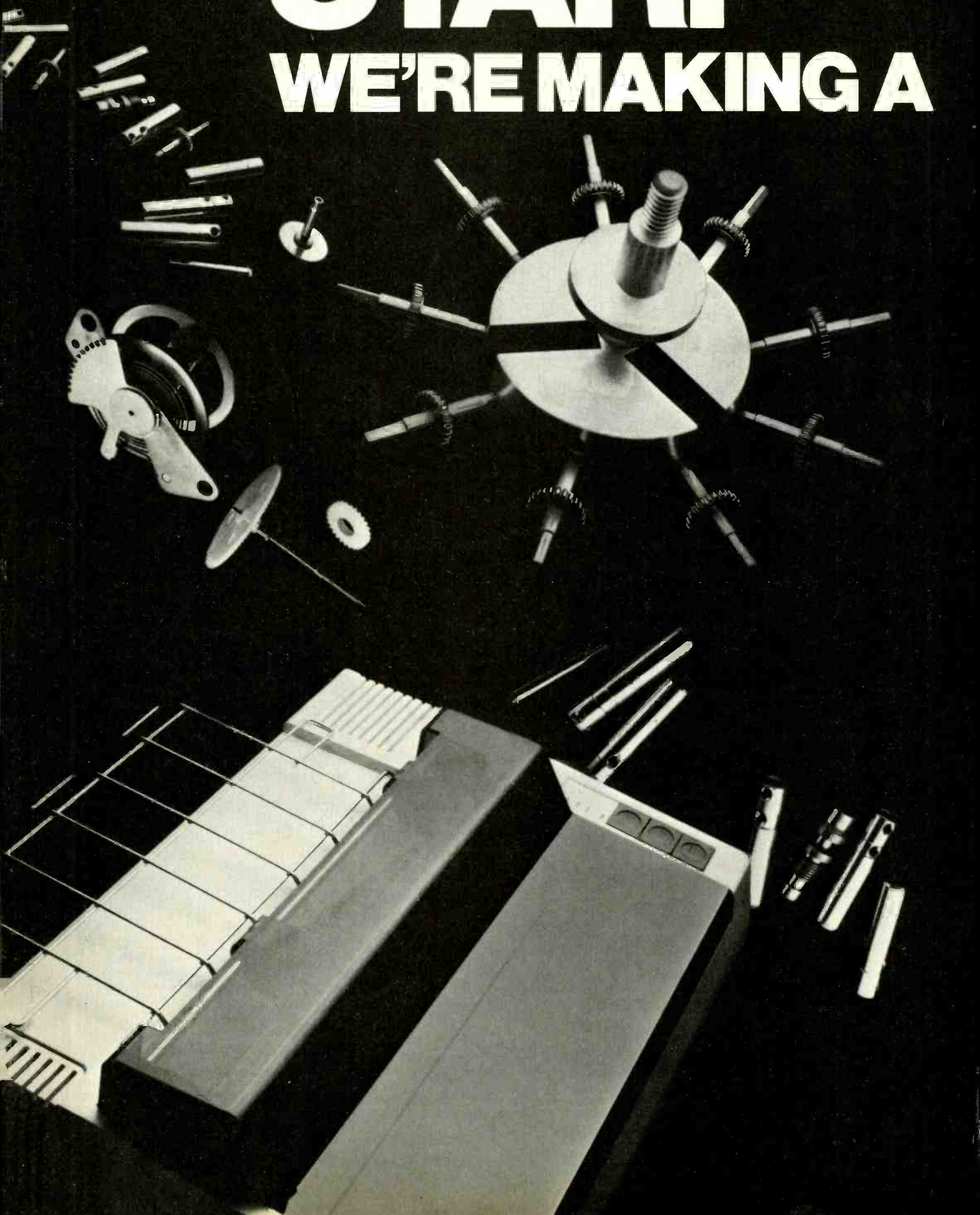

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CIRCLE NO. 48 ON FREE INFORMATION CARD

ENTERTAINMENT ELECTRONICS

By Len Feldman

Professional-Quality ½″ Video Tape

THE first video tape recorders, developed for broadcasting in the late 1950s, used tape that was 2″ wide. Most of today's VCRs use ½″ tape and provide reasonably good picture quality. However, even the best ½″ VCR (Beta and VHS) begins to roll off frequencies at 2.0 MHz above the video baseband—well below the 4.0-MHz limit of the NTSC standard. This means loss of picture "sharpness" or resolution of detail. For that reason TV studios continue to use 1″ or even 2″ video recorders and playback equipment.

New ½″ Video Tape Format. Last April, the Commercial Communications Commission of RCA proposed a new industry standard for *broadcast quality* ½″ video tape to the Society of Motion Picture and Television Engineers (SMPTE). The new format uses a baseband recording technique, which RCA calls Chroma Trak, for recording on the ½″ video tape housed in standard 250-meter (2/4/6 hour) VHS cassettes. Chroma Trak is already being used in RCA's "Hawkeye" system which consists of all the components necessary for field and studio production, and post production. For example, the Model HCR-1 (Fig. 1) is a combined camera/video tape recorder. Separate cameras and portable video recorders, as well as studio model recorders and an edit controller, have also been developed for the Chroma Trak format and are already in use in some professional ENG (Electronic News Gathering) applications.

Compared with the now-standard U-matic format, for example, the color performance of Chroma Trak is said to be strikingly better. Freedom from color noise, streaky colors and even misplaced colors is reported to be apparent to even the most casual viewer. Perhaps most important of all is the fact that Chroma Trak is designed to be recorded on the familiar VHS home-recording cassette. Also, because the color subcarrier itself is totally eliminated from the recorded tape, problems of color framing in editing, which are prevalent in other systems, disappear entirely.

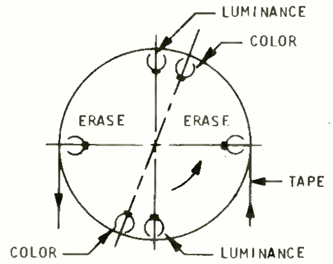


Fig. 3. Drum and color heads rotate in same direction as tape.

The greater "packing density" of the system (twice that of the U-Matic) translates into greatly improved picture quality; chrominance (color) resolution is claimed to be more than three times as sharp as in ¾″ systems. In addition, chrominance signal-to-noise ratio is reportedly improved by about 10 dB, and chrominance-to-luminance (brightness) registration is improved by a factor of more than 3 to 1. Finally, luminance small-image detail is preserved, giving a sharpness previously not obtainable except in wide-tape studio VTRs.

How It Works. As illustrated in Fig. 2, Chroma Trak is basically a dual-track, helical-scan system which records the luminance or brightness signal in a track 7 mils wide, and records the color signal in an accompanying track 2.5 mils wide. These two tracks are slanted across the tape at a 4.7 degree angle. The two side-by-side luminance and chrominance tracks are "laid down" by a pair of heads mounted very close to each other on the drum, as shown in Fig. 3. Each of the two tracks is 4.1″ long, and the two tracks, taken together, contain the information for a complete video field. The tape is wrapped 180 degrees around the drum and the drum rotates at exactly 29.97 revolutions per second. (Contrary to popular belief, the NTSC color is *not* synchronized to our 60-Hz power-line frequency any longer. The slight deviation to 59.94 fields per second, or 29.97 frames per second, was instituted when the standard NTSC color system was adopted.) One TV frame is recorded for each revolution and one TV field is recorded on the tape for each 180 degrees of drum rotation. The drum's diameter is 2.44″.

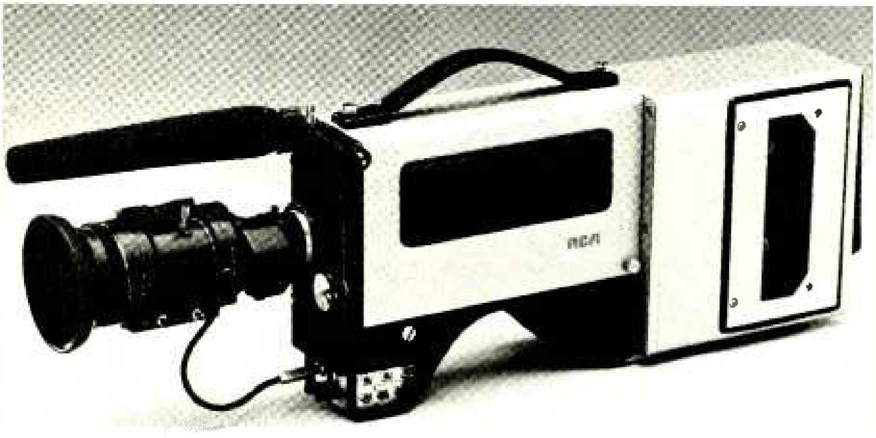


Fig. 1. RCA's Hawkeye Model HCR-1 video camera and tape recorder.

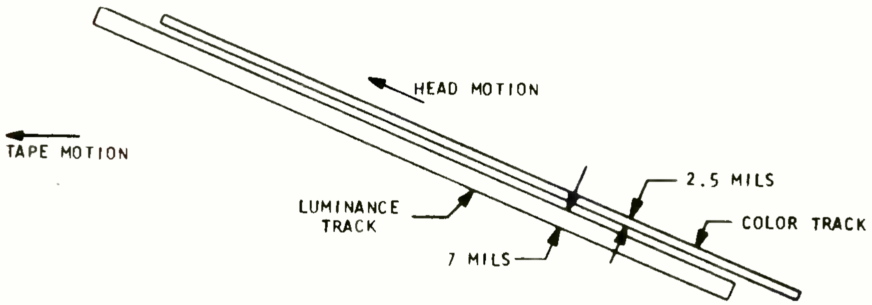


Fig. 2. Separate tracks are used for brightness and chroma.

Figure 4 shows the complete tape format for the Chroma Trak system. There are four longitudinal tracks in addition to the angled video signal tracks. (The video tracks in Fig. 4 are now represented as a single track of 11-mil width, but remember that they really consist of side-by-side luminance and color tracks, as shown in Fig. 2.) Two of the longitudinal tracks are used for audio (future stereo audio broadcasting for TV is taken into account), one for a control track, and one for time code for use in professional video work for subsequent post-production editing, dubbing, and audio synchronization. Longitudinal speed is 8 inches per second—much faster than the longitudinal tape speed used in home VCRs such as Beta or VHS format machines.

A bit of simple arithmetic tells us that a standard T-120 VHS cassette, which contains approximately 800 feet of tape, will provide only about 20 minutes of recording time. If the new T-160 VHS tapes work properly in the Chroma Trak system, recording time will increase to something better than 26 minutes per cassette. Though this may not seem adequate to many home video recordists, remember that the primary purpose of the system is for use with cameras (and not for off-the-air recording) and virtually *no* news or special event stories run anywhere near that length of time.

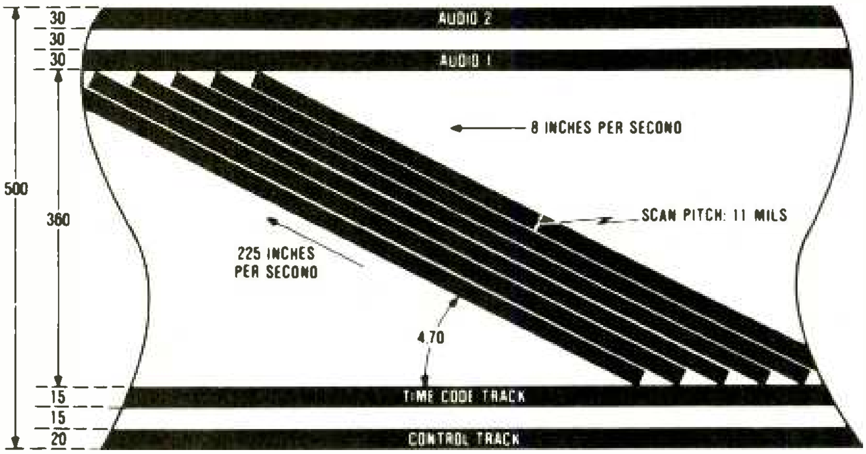


Fig. 4. Format of the Chroma Trak tape.

The drum diameter, its rotational rate, and the speed of the tape moving longitudinally result in a head-to-tape effective speed of 225 inches per second. Since the Chroma Trak system claims a recording capability of 27 kHz per inch, the bandwidth capability of the system is greater than 6.0 MHz!

Signals On The Tape. When Chroma Trak is used in conjunction with the Hawkeye camera/recorder system, a pure luminance or "Y" signal as well as separate chroma "I" and "Q" signals are derived directly from the camera encoding matrix. In cases where such a camera is not used and the recorder is fed from another external NTSC signal source, a comb-filter type of decoder derives the Y, I and Q signals. In either case, the three separate signals are converted to frequency modulation prior to being recorded on the tape. As shown in Fig. 5, the Y signal FM-deviates from 4.3 MHz (sync tip) to 5.9 MHz (peak white signal), and occupies a band which extends up to about 10 MHz. The signal is purely monochrome; strong color subcarrier systems that have caused moire-pattern interference in past systems are completely absent. Pre-emphasis is applied to the Y video signal before modulation. In addition, incremental pre-emphasis is applied to small transitions in signal amplitude to provide added edge definition

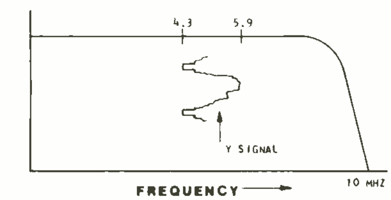


Fig. 5. Baseband distribution of FM Y (luminance) signal.

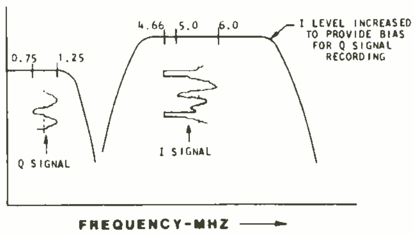


Fig. 6. Baseband distribution of FM I and Q (color) signals.

in the final picture and freedom from noise on fine detail.

The I and Q color signals are also converted to FM signals independently. The I signal deviation is from 5.0 to 6.0 MHz, while Q signal FM deviation is from 0.75 MHz to 1.25 MHz, as shown in Fig. 6. Both of these signals are also pre-emphasized before modulation. These two FM signals are then combined by simple addition and fed to the color track of the tape. The I FM signal is recorded at a level high enough to serve as the record bias for lower-level Q FM signal, which is recorded as a linear signal.

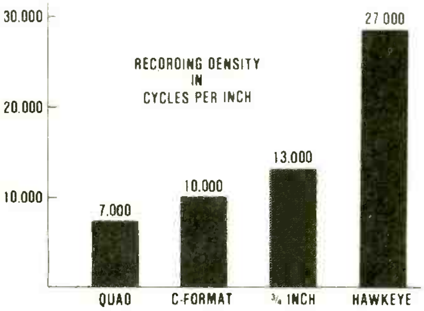


Fig. 7. Comparison of recording densities.

Those familiar with the technical problems associated with high-quality video recording will appreciate how some of these problems are eliminated with this system. Since the luminance signal is alone in its own channel, the moire-pattern from the subcarrier is simply not there. Also, there is no sub-carrier on the color track to be time-modulated by jitter, so there is complete freedom from visible noise streaks. Moreover, since differential phase and gain are a result of intermodulation between luminance and chrominance, the complete separation of these signals eliminates the problem.

The chart in Fig. 7 gives some idea of how video recording densities have improved over the years. Recording density is shown in cycles per inch of tape-to-head speed, and the new RCA Hawkeye system is compared with the popular U-Matic ¾" tape system, as well as with earlier systems such as Type C and the even older Quadruplex or Quad system.

The table in Fig. 8 is a comparison of picture quality between the new Hawkeye (Chroma Trak) system and the U-matic system in terms of color resolution, color signal-to-noise ratio, and color-to-luminance registration

Home Use. So far the Chroma Trak system components are intended strictly for broadcasting professionals. That's not to say that you couldn't order a Hawkeye camera or video tape recorder from RCA if you were willing to pay the price. However, many manufacturers of home video equipment are busily attempting to come up with standards for 8-mm or ¼" video tape formats—some of which may deliver as good a picture as the current home-type machines. If such narrower tape replaces the ½" variety for noncritical home applications, an improved ½" system such as the Chroma Trak might become the alternate choice for amateur video recordists who want professional quality. If the demand is strong enough, prices will probably come down. ◇

	HAWKEYE	¾ INCH
CHROMINANCE RESOLUTION	1.0 MHZ	0.3 MHZ
CHROMINANCE NOISE-SNR	48 dB	38 dB
CHROMINANCE REGISTRATION 3RD GENERATION	90 NS	300 NS

Fig. 8. Comparing picture quality.

NEW LITERATURE

Microcomputer Products
A new 40-page catalog (821) from Electric Specialists presents their line of microcomputer interference control products. Protective devices such as line voltage regulators and ac power interrupters are also included. Descriptive sections outline particular problems and suggested solutions. **Address:** Electronic Specialists, Inc., 171 Main St. Box 389,Natick, MA 01760.

Semiconductor Guide
The Tube Products Dept. of GE has announced the availability of a new Replacement Semiconductor Guide that features over 195,000 cross references for quickly locating replacement semiconductors. The guide is 592 pages long and lists more than 4500 old and new parts, both foreign and domestic. **Address:** General Electric, 101 Merritt 7, PO Box 5900, Norwalk, CT 06856.

Digital Computer Distributors
Digital Equipment Corporation's Commercial OEM Group has published a new Directory that profiles over 50 independent firms nationwide that have become Authorized Digital Computer Distributors. **Address:** Computer Director, Digital Equipment Corp., Continental Blvd., Merrimack, NH 03054.

TV/Video Sync Primer
The fundamentals of video and associated waveforms are explained in a new primer (Product Note 5953-3900) from Hewlett-Packard. Sixteen pages long, with 13 drawings and three photographs, the booklet includes a discussion of broadcast standards and nomenclature, as well as a comparison of the three systems of color transmission used around the world. Other sections cover theory of operation, typical setup, specifications, and possible applications when a TV/video sync option is added to an HP 1700-series oscilloscope. A glossary of TV and video terms is included at the back. **Address:** Inquiries Manager, Hewlett-Packard Co., 1820 Embarcadero Rd., Palo Alto, CA 94303.

Avionics Build-It-Yourself Kits
Radio Systems Technology is offering a 16-page catalog containing over 20 kits for the do-it-yourself avionics enthusiast. Among them: aircraft intercoms, marker beacon receivers, unicom stations, headsets, and more. Miscellaneous equipment and supplies are also featured. **Address:** Radio Systems Technology, Inc., Airport Industrial Park, Grass Valley, CA 95945.

SOLID-STATE DEVELOPMENTS

By Forrest M. Mims

New Power MOSFETs

IF YOU have purchased power MOSFETs, you know that they generally cost more than conventional bipolar power transistors. Recently, however, Siliconix, Inc. announced a series of new, low-priced MOSFETs. Designed specifically to interface logic circuits with power devices, the transistors can be driven directly by CMOS, TTL or MOS logic. Typically, they are used to drive high-speed lines, transformers, LED digit strobes, relays, or solenoids.

All these new power MOSFETs are priced between 32 cents and 85 cents each when purchased in quantities of 100. One unit, the VN0300M (80 cents) has a maximum on-resistance of only 1.2 ohms. Supplied in a TO-237 package, it's rated at 700 mA (I_D) and has a breakdown voltage (BV_{DSS}) of 30 V.

The VN0808M provides a BV_{DSS} of 80 V, an I_D of 350 mA and an on-resistance of 5 ohms. It's also supplied in a T0-237 package, and it sells for 85 cents.

At 32 cents, the VN2222L is the lowest-priced transistor of this new line. Supplied in a T0-92 package, it has an I_D of 150 mA, a BV_{DSS} of 60 V, and an on-resistance of 7.5 ohms.

For more information about all nine of the power MOSFETs in this series, write Siliconix Marketing Services (P.O. Box 4777, Santa Clara, CA 95054). You may also wish to request a list of authorized Siliconix distributors.

Incidentally, if you want to begin experimenting with power MOSFETs immediately, you can buy the Siliconix VN10KM and VN67AF at Radio Shack stores. Radio Shack was apparently among the first major sources of electronic components for hobbyists and experimenters to recognize the importance of power MOSFETs. Let's hope other suppliers join the trend to this important new technology.

A Panel-Mounted Thermal Printer. The miniature solid-state thermal printer originally developed for use with compact calculators is finding many other uses. One is the Datel Model DPP-Q7 Digital Panel Printer. Measuring only 5.25″ wide by 2.82″ high, the printer incorporates an inkless thermal printer capable of printing up to seven columns of BCD input data at four lines per second.

The DPP-Q7 is designed specifically as a hard-copy panel meter. For printing of the full ASCII character set of upper- and lower-case letters, digits, punctuation marks, etc., Datel makes the Model APP-20 20-column alphanumeric thermal printer. Similar in external appearance to the DPP-Q7, the APP-20 measures 4.44″ wide by 2.70″ high.

For more information about these thermal printers, write Datel/Intersil (11 Cabot Blvd., Mansfield, MA 02048). Both are expensive, but they're ideal for specialized applications requiring a hard-copy output.

A Fast Breaking Development. A group of scientists at Bell Laboratories has managed to create the shortest known pulse of light—an event lasting only 30 *femtoseconds*. Since a femtosecond is a millionth of a billionth of a second, 30 femtoseconds is 0.00000000000003 second (3×10^{-14}).

According to Charles V. Shank, one of the Bell Labs' scientists who worked to achieve this new accomplishment: "Words like 'split-second' and 'instantaneous' just don't mean too much in the microelectronics field. Relatively speaking, a second is an eternity. For example, in one second, a pulse of light can travel to the moon and back, but in 30 femtoseconds, light would travel no farther than one-third the thickness of a human hair."

Of course, light actually requires a little more than two and one-half seconds to make a round trip between the earth and the moon, but I'll not let that lapse take away from the importance of Shank's accomplishment. He and his team have provided physical, chemical, and biological researchers with a valuable new tool for examining exceptionally brief transient events. As Shank explains: "By using a series of these very short bursts of light, each timed precisely to follow the other, we can measure very subtle changes in a reaction far more precisely than we can using other techniques. He presented the results of his work with the laser at the April 1982 joint Conference on Lasers and Electro-Optics and Optical Fiber Communications in Phoenix. ◇

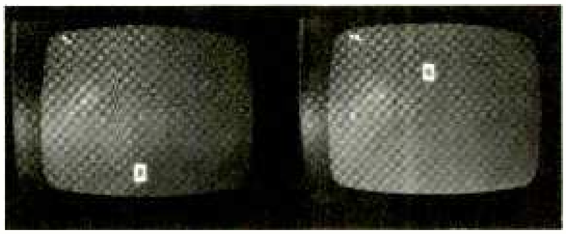
PROGRAMMER'S NOTEBOOK

By Jim Keogh

Moving And Firing A Gun At Will

DEVELOPING your own personal computer games can be fun and a challenge. Although many of the commercial computer games are written in assembly or machine language, you can incorporate some of the same features found in "store bought" games in your own Basic programs.

In the "Programmer's Notebook" column in the June 1982 issue, we discussed a program module that displayed a computer "gun" and permitted the operator to fire the gun in almost any direction. Since that column appeared, we have heard from some of our readers who wanted to see more flexibility built into that module. They wanted to be able to move the gun anywhere on the screen and fire it.



This month, we will give you some modules that will enable you to direct the movement of the gun from the keyboard. After the program is loaded into your mi-

TRS-80

```
5 REM CLEAR THE SCREEN
10 CLS
15 REM STARTING COORDINATES FOR GUN
20 A = 55
30 B = 20
35 REM DRAW GUN
40 FOR D = A TO (A + 6)
50 E = B
60 SET (D,E)
70 NEXT D
80 FOR E = B TO (B + 4)
90 D = A
100 SET (D,E)
110 NEXT E
120 FOR D = A TO (A + 6)
130 E = (B + 4)
140 SET (D,E)
150 NEXT D
160 FOR E = B TO (B + 4)
170 D = (A + 6)
180 SET (D,E)
190 NEXT E
195 REM OPERATOR INSTRUCTS COMPUTER
200 INPUT T
205 REM CLEAR SCREEN
210 CLS
215 REM THE COMPUTER DECIDES WHICH LINE TO EXECUTE
220 IF T = 1 THEN GOTO 270
230 IF T = 2 THEN GOTO 290
240 IF T = 3 THEN GOTO 310
250 IF T = 4 THEN GOTO 330
260 IF T = 5 THEN GOTO 350
265 REM MOVES THE GUN TO THE LEFT
270 A = A - 10
275 REM LOOPS THE PROGRAM AND DRAWS GUN IN NEW POSITION
280 GOTO 40
285 REM MOVES THE GUN TO THE RIGHT
290 A = A + 10
295 REM LOOPS THE PROGRAM AND DRAWS GUN IN NEW POSITION
300 GOTO 40
305 REM MOVES THE GUN TOWARDS THE TOP OF THE SCREEN
310 B = B - 5
315 REM LOOPS THE PROGRAM AND DRAWS GUN IN NEW POSITION
320 GOTO 40
325 REM MOVES THE GUN TOWARDS THE BOTTOM OF THE SCREEN
330 B = B + 5
335 REM LOOPS THE PROGRAM AND DRAWS GUN IN NEW POSITION
340 GOTO 40
345 REM FIRES THE GUN
350 FOR X = (((B + 6)/2) + 1) TO 2 STEP -5
360 EE = A
370 SET (EE,X)
380 FOR Z = 1 TO 15
390 NEXT Z
400 RESET (EE,X)
410 NEXT X
415 REM LOOPS PROGRAM TO LINE 40
420 GOTO 40
```

APPLE II

```
5 REM CLEARS SCREEN
10 CALL -936
15 REM STARTING COORDINATES
20 A = 15
30 B = 20
35 REM DRAW GUN
40 HLIN A, (A + 6) AT B
50 VLIN B, (B + 4) AT A
60 HLIN A, (A + 6) AT (B + 4)
70 VLIN B, (B + 4) AT (A + 4)
195 REM OPERATOR INSTRUCTS COMPUTER
200 INPUT T
205 REM CLEAR SCREEN
210 CALL -936
215 REM THE COMPUTER DECIDES WHICH LINE TO EXECUTE
220 IF T = 1 THEN GOTO 270
230 IF T = 2 THEN GOTO 290
240 IF T = 3 THEN GOTO 310
250 IF T = 4 THEN GOTO 330
260 IF T = 5 THEN GOTO 350
265 REM MOVES THE GUN TO THE LEFT
270 A = A - 10
275 REM LOOPS THE PROGRAM AND DRAWS GUN IN NEW POSITIONS
280 GOTO 40
285 REM MOVES THE GUN TO THE RIGHT
290 A = A + 10
295 REM LOOPS THE PROGRAM AND DRAWS GUN IN NEW POSITION
300 GOTO 40
305 REM MOVES THE GUN TOWARDS THE TOP OF THE SCREEN
310 B = B - 5
315 REM LOOPS THE PROGRAM AND DRAWS GUN IN NEW POSITION
320 GOTO 40
325 REM MOVES THE GUN TOWARDS THE BOTTOM OF THE SCREEN
330 B = B - 5
335 REM LOOPS THE PROGRAM AND DRAWS GUN IN NEW POSITION
340 GOTO 40
345 REM FIRES THE GUN
350 FOR X = (((B + 6)/2) + 1) TO 10 STEP -5
360 E = A
370 PLOT X,E
380 NEXT X
415 REM LOOPS PROGRAM TO LINE 40
420 GOTO 40
```

crocomputer and run, you will notice that the gun is drawn in the center of the display terminal. Not much of a gun, we agree, but with your artistic talent you can enhance its appearance.

In the upper left corner of the screen a question mark appears along with the cursor. You can move and fire the gun by typing one of the following codes:

Code	Function
1	Moves gun to left
2	Moves gun to right
3	Moves gun to top
4	Moves gun to bottom
5	Fires gun

After you input the code and press enter, you will notice that the gun moves in the direction you requested or, in the case of code 5, it fires a shot. The question mark and the cursor again appear in the upper left corner of the screen and wait for your next instruction.

If you study the program closely, you will find that the computer receives only two coordinates for drawing the gun (lines 20 and 30). To complete the outline of the gun, the program instructs the computer to add or subtract certain numbers from the starting coordinates until the complete image of the gun is drawn on the screen (lines 40 through 190).

The program then asks the operator for instructions (line 200). When the operator responds with a code, the computer will branch to the appropriate line of the program. It will then add or subtract certain numbers, which are used as the starting coordinates to draw the gun on the screen. The gun is then drawn at a new location on the display.

Something else happens each time an instruction is received by the computer. The values of the original coordinates (lines 20 and 30) change to become the coordinates of the new gun location. The program automatically establishes new starting coordinates each time a new instruction is received (except when the instruction is to fire the gun). By having the program reset the starting coordinates of the gun, the computer is actually executing an endless loop, enabling the operator to move the gun all over the screen.

When code 5 is received to fire the gun, the program executes lines 350 through 420. Line 350 finds the center of the gun while lines 360 through 410 fire the shot towards the top of the screen.

If you study this program module, you will realize that to move a gun around the screen is as easy as adding and subtracting numbers. You should be able to modify this module to include some of the features contained in previous columns or combine this subroutine with some of your own ideas and develop your own game programs.

Although programs contained in this column are designed for the TRS-80 and the Apple II, you should be able to compare command statements contained in these programs to similar command statements used by other versions of Basic. Then you should be able to modify the programs to operate on other computers besides TRS-80 and Apple II. ◇

COMPUTER SOURCES

By Leslie Solomon, Technical Director and Stan Veit, Computer Editor

Hardware

TRS-80 Printer Options. The TRS-80 Bidirectional Tractor Feed attachment (26-1447) permits use of fanfold continuous form paper with the Daisy Wheel II printer including multi-part forms, pressure-sensitive labels, and special data-processing forms. It provides complete roll-ahead/roll-back capabilities under software control. $289.95. The Automatic Sheet Feeder (26-1448) feeds and stacks up to 200 sheets for the Daisy Wheel II printer. Initial installation is required. $1495. The Acoustic Cover (26-1455) reduces noise produced by the Daisy Wheel II printer, even with the tractor feed attachment in place. The cover is hinged for easy access to printer and paper, there is a top window, and a built-in cooling fan. $399. Available at Radio Shack Computer Centers and stores.

Hard Disk Kit. Marketed in kit form, this 5¼", 5-megabyte Winchester disk drive uses a Xebec S-1410 Intelligent

Disk Controller. It requires only "a few simple connections that can be performed in less than 10 minutes and requires no technical expertise at all." $1299. **Address:** Xebec, 432 Lakeside Drive, Sunnyvale, CA 94086 (Tel: 408-735-1340).

Apple III Interface. The protocard III uses a parallel interface chip (6522) to allow the user to put custom circuits right on the board. No knowledge of the Apple III bus is required. Room is provided for either a 26-pin ribbon connector (supplied) or a 25-pin D-type connector (also supplied) for external connections. A software driver links the card to the language that uses the SOS Drivers. $195. **Address:** Elcom Systems Peripherals, 439 Harrison St., Suite A, Corona, CA 91720 (Tel: 714-734-8220).

IBM Card. The DSI-ASYNC card is a dual asynchronous serial card for the IBM Personal Computer that allows dumb terminal emulation, serial printer interface, and printing with expanded tabs. It includes two I/O channels (one current loop or RS-232 selectable), one RS-232-C (DTE or DCE selectable), switch-selectable serial port addressing, and four software programs that the user can copy. Software includes a set-up program serial printer installation, full duplex terminal emulation, and a print program. Serial port addresses are switch selectable to avoid conflict with other equipment. $199. **Address:** Davong Systems Inc., 1061 Terra Bella Ave., Mountain View, CA 94043 (Tel: 415-965-7130).

Speech Synthesizer. The Sweet Talker adds speech to a computer and features the Votrax SC-01A phonetic speech synthesizer chip. It speaks 64 phonemes with four levels of inflection and includes an on-board audio amplifier. An optional ($35) software package contains a 6502 text-to-speech algorithm with patches to BASIC or machine-language programs. Model ST-01 ($139) interfaces to any parallel port and Model ST-02 ($149) is designed for the Apple II. **Address:** Micromint Inc., 917 Midway, Woodmere, NY 11598 (Tel: 516-374-6793).

Video Kit. The VDM-1 features optoisolation between a computer or video game and a TV receiver. It enables up to 80 character lines because of its direct connection to the video circuitry, bypassing the tuner and IF circuits. This removes the effects of moire, ghosting, color shifting, etc. $64.95. **Address:** VAMP Inc., POB 411, Los Angeles, CA 90028 (Tel: 213-466-5533).

ZX81 Memory Expansion. The Memopak 64K is a RAM package that plugs into the rear of the Sinclair ZX81 and expands the memory by a further 56K. The unit is user-transparent and accepts such commands as DIM A(9000). The ZX81 has 8K of ROM from 0 to 8K, and 1K of RAM from 16 to 17K. This 1K is disabled and covered by 48K between 16 and 64K. At one limit the user has 15K below the 32K line, and 32K for arrays, etc. Or the user can have 45K to work in. $179.95. **Address:** Memotech Corp., 7550 W. Yale Ave., Suite 220, Denver, CO 80227 (Tel: 303-986-0016).

Apple Scope. The Model 85 dc to 50 MHz digital memory oscilloscope module fits with an Apple II and uses the monitor screen and keyboard as the scope screen and control panel. Using BASIC or machine language, the Model 85 can be used for waveform processing such interesting functions as Fast Fourier Transforms, auto- and cross-correlation, power density spectra, integration, differentiation, etc. Fast sweep speed is 10 ns/div and at 1 ms/div or slower, the scope operates as a real-time A/D converter. Once acquired, waveforms are displayed on the software generated 8 × 10 division graticule. A cursor provides DVM readout for any specified point on the displayed waveform. Hard copy output is also provided. Requires Apple II, Disk II, 48K, and DOS 3.3. $995. **Address:** Northwest Instrument Systems Inc., POB 1309, Beaverton, OR 97075 (Tel: 503-297-1434).

Software

TRS-80 Word Processor. SCRIPSIT 2.0 (26-4531), the latest version of SCRIPSIT, stores approximately 100 single-spaced pages on a single diskette, and permits printing while another text is being typed or edited. It includes automatic block moving and duplication, global search and replace, easy page numbering, 20 user-defined keys, 11 stored user-definable formats, and full headers and footers. $399. Requiring a second drive, SCRIPSIT Spelling and Hyphenation Dictionary (26-4534) can be added for automatic proofreading. It contains a 100,000-word reference with room for 2000 user defined words. It checks and displays SCRIPSIT-prepared text, highlights misspelled words and allows correction. Automatic hyphenation is also available, and it provides total word count, and a count of words not found. $199. Both are available at Radio Shack Computer Centers and stores.

Apple III COBOL. The release of COBOL for the Apple III has been certified by the U.S. General Services Administration's Federal Compiler Testing Center. It was rated as High Intermediate Level, a higher rating than many of the COBOL versions used in minicomputers. The addition of COBOL to the Apple III makes this computer a serious tool for business applications using the huge amount of software packages written in COBOL. Apple III COBOL features "Animator" a powerful debugging system that provides an actual view of program execution. The system also contains FORMS-2 which permits the creation of data entry screens for application programs. The COBOL requires the use of a Apple III with a minimum of 128K of RAM, and at least two disk drives. Full use of the Animator requires 256K of memory. The COBOL system will be fully released in the fall of 1982 and will carry a suggested list price of under $500.

ZX81. Sinclair Research Ltd. has released a new group of cassette-based software for the ZX81 computer, covering business applications, educational programs, general interest programs and games. The business applications include VU-CALC, an electronic spreadsheet, VU-FILE for general-purpose filing, Collectors Pack for collection records and Club Record Controller for personal records of up to 100 people. The business application cassettes sell for between $14.95 and $17.95. The Fun To Learn series include English Literature, Geography, History, Mathematics, Inventions and Music. $12.95 ea. The general interest programs are called "The Super Programs" series. They include eight cassettes with games, quiz, conversion and household programs. Game programs include backgammon and a six-level chess program. Flight Simulation offers instant response between the aircraft controls, the instruments and the user controls. The arcade type games are represented by Space Raiders and fantasy games. The Sinclair Biorhythms cassette offers an explanation of the technique to create a special personal program for a person which identifies their physical, emotional and intellectual peaks on a chart. $13.95. All of the software cassettes except the "Super Programs" require the use of the add-on 16K RAM pack. **Address:** Sinclair Research Ltd., 3 Sinclair Plaza, Nashua, NH 03061.

Pascal-80. Pascal-80 by Phelps Gates fills the need for a version of the Pascal language that can run on the 48K TRS-80 Models I and III. The Model II can use UCSD Pascal but the memory capacity of the Models I and III simply do not have enough room to operate the UCSD-P System. Previously, the only Pascal that could be used on Models I and III was the very abbreviated verson, Tiny Pascal. Pascal-80 is an effective implementation of "Standard" Pascal as described in "Pascal User Manual And Report" by Jensen and Wirth (published by Springer-Verlag). It does have some restrictions and extensions to permit it to use the TRS-80 disk file systems, but these will not affect the average pascal user and student. Pascal-80 uses the TRS-80 ROM routines to enable it to have a monitor, editor and compiler in memory at the same time and still leave enough memory to create programs up to 23K bytes with an additional 9K left over while the program is running for variables and work space. $1000. **Address:** New Clasics Software, 239 Fox Hill Road, Denville, NJ 07834.

Dental Office Management. The Dental Office Management I for the Apple II and TRS-80 models I, II and III features appointment scheduling and patient checkup recall, and prepares billing for private patients and for dental claim form preparation. The software focuses on such management techniques as fee productivity and recall effectiveness. It prepares daily billing, appointment logs, ADA claim forms, and accounts receivable. The Apple II version requires Applesoft with at least 48K of memory

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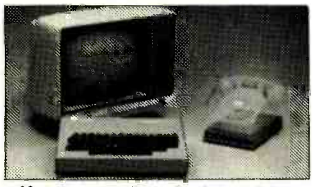

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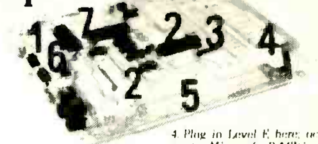

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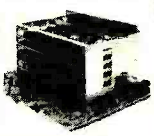

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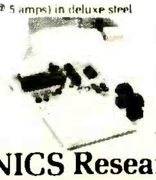

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and from two to four disk drives. The TRS-80 Models I and III version requires 48K memory and from two to four disk drives. The TRS-80 Model II version requires 64K memory and two disk drives. All versions require a 132-column printer. **Address**: Charles Mann & Associates, 55722 Santa Fe Trail, Yucca Valley, CA 92284. (Tel: 714-365-9718).

ZX81 Business Programs. The LOAN/MORTGAGE program features single-payment data broken down by interest and principal, single-year data, profile by month, profile by year, and interest/principal plot graph. New data allows changing informatin and Save allows storage on cassette. $14.95. VU-CALC constructs, generates and calculates large tables for financial analysis, budget sheets, and projections. The main menu allows picking the number and sizes of the displayed boxes. Any box can be accessed. Hard copy is allowed. $19.95. CHECK BOOK stores 250 transactions allowing up to 3600 transactions on a 90-mintue cassette. Each transaction includes number, date, etc. Listing is by date or alphabetically. Checks and deposits can be listed alphabetically or by date. $14.95. **Address**: Softsync Inc., POB 480, Murray Hill Stn., New York, NY 10156 (Tel: 212-685-2080).

Osborne 1 Software. Among the 11 programs for the Osborne 1 computer are SPELL, a 50,000-word proofreader that works with wordstar files and occupies one half of the Osborne diskette, MYCHESS that features a full graphics display board, Adventure, Eliza, and arcade-style video games. Programming languages include C, RATFOR, LISP, and macro assembler for Z80/8080 codes. A catalog is available. **Address**: The Software Toolworks, 14478 Glorietta Dr., Sherman Oaks, CA 91423 (Tel: 213-986-4885).

Fast CP/M. Super CP/M claims to increase CP/M speed by 400% and have an extensive error management scheme and interactive user-oriented utility programs. After booting from any drive, including hard disk and tape, once brought up, it no longer needs a system disk even for warm boots. A loader determines memory size and builds the largest system allowed, thus only one version is required for all memory sizes. This new implementation uses 1024-byte sectors which also allows for 1.26 megabytes of formatted data on a double-sided diskette. When an error occurs, the logical CP/M device number (A-P) is supplied along with track, head, and sector number. There is also an error code for any one of the 13 unrecoverable error types. $190. **Address:** Systems Group, 1601 Orangewood Ave., Orange, CA 92668 (Tel: 714-633-4460).

Pie Writer. Hayden Book Co. offers an improved version of Apple Pie for both the standard 40-column Apple and one with an 80-column board. The improvements include a buffer which allows text to be entered as the machine is scrolling. Multiple tab stops allows the cursor to stop at the beginning of each word, not only at set stops. A single command allows placement, or correction of characters, words, sentences or paragraphs. The program now includes automatic paragraph indenting and global search and replacement of words throughout the document. The new version also includes an improved formatter which allows fractions of a character space to be inserted for justification. **Address**: Hayden Book Co., 50 Essex St., Rochelle Park, NJ 07662. (Tel: 201-843-0550).

File Access Program. Designed for the Apple III, Record Processing Services (RPS) is for Pascal programmers and is used to save development time in writing software systems in Apple III Pascal. RPS for Apple III supports the Apple ProFile hard disk and any other SOS block device. It permits a maximum file size of 16 megabytes and up to 8 keys per file with no primary key required. RPS supports both variable length and fixed - length records and permits multiple simultaneous file scans. This software system is designed to become a major software development tool for the Apple III. $150.

Inventory for IBM. INV-X is an inventory control system that features a sort/merge package, a new hashing algorithm with an average of 1.2 I/O's on a 28,000-record file, a report writer in addition to standard reports, and a capacity of 2,200 records on a 5¼" diskette, or 28,000 for unlimited storage. Requires dual disk, 64K memory, IBM DOS, monochrome display, BASIC, and 132-column printer. $298. **Address**: Micro Architect Inc., 96 Dothan St., Arlington, MA 02174 (Tel: 617-643-4713).

Ethnic And Religious. The Institute for Computers In Jewish Life has announced a series of programs designed to teach children Jewish history, and customs and Hebrew Language. The programs run on Apple II and TRS-80 computers and require at least one disk drive. The Institute also announced it's new computer assisted Bar/Mitzvah training program. This software system is custom designed for the student. It gives complete Hebrew text and English translation. Since the service is sung, the program provides music with the "bouncing ball" technique to teach the words and music. The customizing features provide for Orthodox, Conservative, Reform, and Reconstructionist versions of the service. $100.00 with computer gererated music. A version with accompaning sound tape is $175.00. **Address**: ICJL, Suite 843 845 North Michigan Ave. Chicago, Il 60611. (Tel: 312-787-7856).

Color Computer Utility. The Super Color Terminal allows the user to communicate with almost any host system that uses an RS-232 port. Features include lower and upper case, control A-Z, and 27-31 with Escape and Line Break: change RS-232 parameters to allow nonstandard format; print all data from the host; receive and send BASIC, machine-language, or ASCII files; save and load BASIC, machine-language, or ASCII files; and create tapes that are compatible with the Super Color Writer word processing system. Tape is $39.95; Rompack is $49.95; Disk is $69.95. **Address:** Nelson Software Systems, POB 19096, Minneapolis, MN 55419 (Tel: 612-827-4703).

Recovering ERA Files. The UNE2 program recovers CP/M files that have been ERAsed or it can be directed to look at all ERA files on a disk and allow the user to UNERAse them. The companion CON2 program provides the user with status of ERA files that are using the same disk space as active files. The programs will handle all CP/M 2.2 systems using single-and double-density floppy and hard disks that have standard directories. The programs also work on single-density CP/M 1.4 systems using the IBM 8" disk format. Available on 8" single density diskettes as well as 5¼" single/double density for North Star users. $75 plus $1.50 shipping and handling. **Address:** Elliam Associates, 24000 Bessemer St., Woodland Hills, CA 91367 (Tel: 213-348-4278).

Statistics Package. NWA STATPAK V2.0 is a multi-function statistical package with both data file handling and computational functions. It includes sections on contingency tables, non-parametic analysis, time series, and regression analysis. It can interface with other packages such as spreadsheets and databases. Forecasting and modeling capabilities have been enhanced by the addition of forward stepwise regression, deseasonalization, and time-series analysis. Added or enhanced functions include three-way ANOVA with test options and non-parametric analysis such as Pearson R and Kolmogorov-Smirov tests. Requires CP/M with 48K and Microsoft BASIC 5.xx. **Address:** Northwest Analytical Inc., 1532 SW Morrison St., Portland, OR 97205 (Tel: 503-224-7727).

Circuit Analysis. The TRS-80/Apple II circuit analysis package contains ac analysis, dc analysis, and a line editor, used to create/edit a circuit description disk file for either analysis program. Accepted components include resistors, inductors, capacitors, diodes, transistors, FET's, op-amps, voltage, and current sources. Output is node voltage (magnitude, phase, and dB from reference frequency for ac). The editor may also create files for other applications. Programs are in BASIC and require 48K of RAM and at least one disk drive. $79. **Address:** FB Circuit Products Inc., 4984 Teton Lane, Ventura, CA 93003 (Tel: 805-644-8502). ◇

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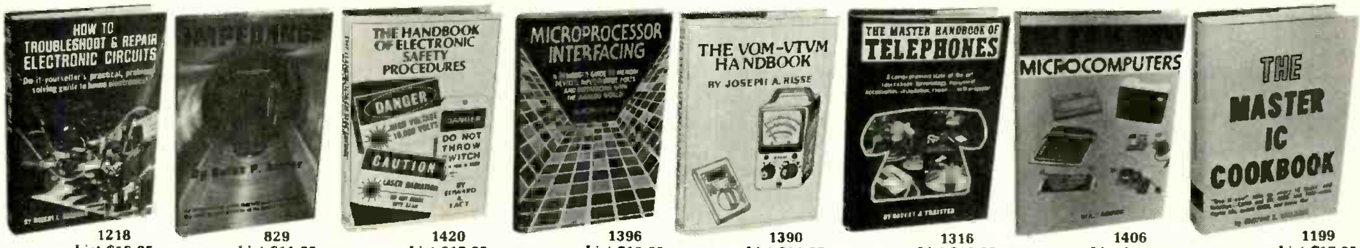

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DX LISTENING

By Glenn Hauser

Monitoring the Falklands Crisis

THE crisis in the Falkland Islands proved once again that shortwave listeners enjoy a front-row seat to history in the making. Unlike previous, more remote conflicts, this time the language barrier was less of a problem, since English and Spanish are the two languages understood by most Americans.

Argentina has long realized the importance of broadcasting in furthering its national goals. Not very subtle points about Argentina's claim to part of Antarctica were made as soon as radio station *LRA36* had been established at Esperanza Base.

A top priority following the April 2 invasion of the Islands was taking over the existing radio outlet, *Falkland Islands Broadcasting Station*, which had remained on the air far beyond its usual schedule, warning islanders about what was happening. *FIBS*, on 2370 and 536 kHz, was immediately renamed *Radio Nacional Islas Malvinas* and given the call sign *LRA60*. DX listeners as far away as northern Argentina were delighted to hear the station on its first day under control of Argentina—despite this loss of a "radio country." Some of its programming was relayed via another captured transmitter, Cable & Wireless on 24147 kHz, which in turn was picked up by the Argentine government network in Buenos Aires and broadcast throughout the country. Strangely, the C&W station continued to identify as such. It was also reported to use 19950 kHz, and was heard after 0100 GMT by Ernie Behr in Ontario, on 11565 kHz, calling Buenos Aires without success.

Most of the programming on *LRA60* continued to be in English, including transcriptions on hand from the BBC, and relays of BBC sports programs (but not BBC news any longer!), although the new ID was also given in Spanish. The "Malvinas March" became the number-one hit, both on this station and throughout Argentina. Within a few days, English-speaking Argentines were brought in to operate the station.

Nor did the invaders lose any time in setting up a small color television transmitter on channel 7 (reportedly this was accomplished in less than a day). There had been no local television in the Falklands, and consequently few receivers, though some islanders had been picking up TV-DX from as far away as Brazil. The new station carried the main news program from the ATC network, "60 Minutos." There quickly followed applications from private broadcasters in Argentina to set up another television station and a radio station on 710 kHz.

Press reports claimed the Argentine occupiers were confiscating shortwave receivers owned by the islanders. It seems more likely that they were transceivers since there were a relatively large number of ham radio operators in VP8-land and the shortwave war over the Falklands was just beginning. Nevertheless, some hams managed to get messages to the outside world, with more of them reappearing as British forces began to regain control of the islands.

Soon after the invasion, one pseudo-amateur station was set up for the Argie soldiers to maintain personal contact with home—*LU4ERM* reportedly on 7075, 14150 and 21225 kHz. But operations by the many thousands of hams in Argentina were prohibited due to the state of war. Those who did try to transmit were quickly shouted off the air by others observing the ban.

In mid-April, *Radio Nacional Islas Malvinas* was reported to be relaying for several hours daily the *Radio Nacional* station in Comodoro Rivadavia. At this point, such a relay may have been the only way for the Malvinas station to hook into the national network. Later, as a security measure, the Comodoro Rivadavia station and others on the mainland cut power and ceased to identify.

Our monitor in Paraguay, Tony Jones, noted that *LRA60* had a new Argentine director named Norman Powells, and that it was adhering to its old schedule, closing at 0130 GMT except Sundays to 0030 GMT Mondays. These are the hours North Americans keep in mind when trying for the station. Toward the end of April, as hostilities increased, *Radio Nacional Islas Malvinas* was ordered off the air when it was discovered that a British reporter had been monitoring it in southern Chile, possibly gaining useful intelligence.

This may have referred to the shortwave outlet only, with mediumwave remaining on the air. There was also an unconfirmed report from an Argentine DX listener that *LRA60* planned to put a 10-kW transmitter on 4784 kHz.

On only one occasion, one of our reporters, Frank Gilmore in Springfield, MO, heard a "Radio Freedom for the Falklands" on 9996.23 kHz, as he tuned across *WWV* at 0711-0724 GMT April 14. This might have been a phony operation by a U.S. amateur, as many transceivers have 10-MHz capability, which can be varied slightly.

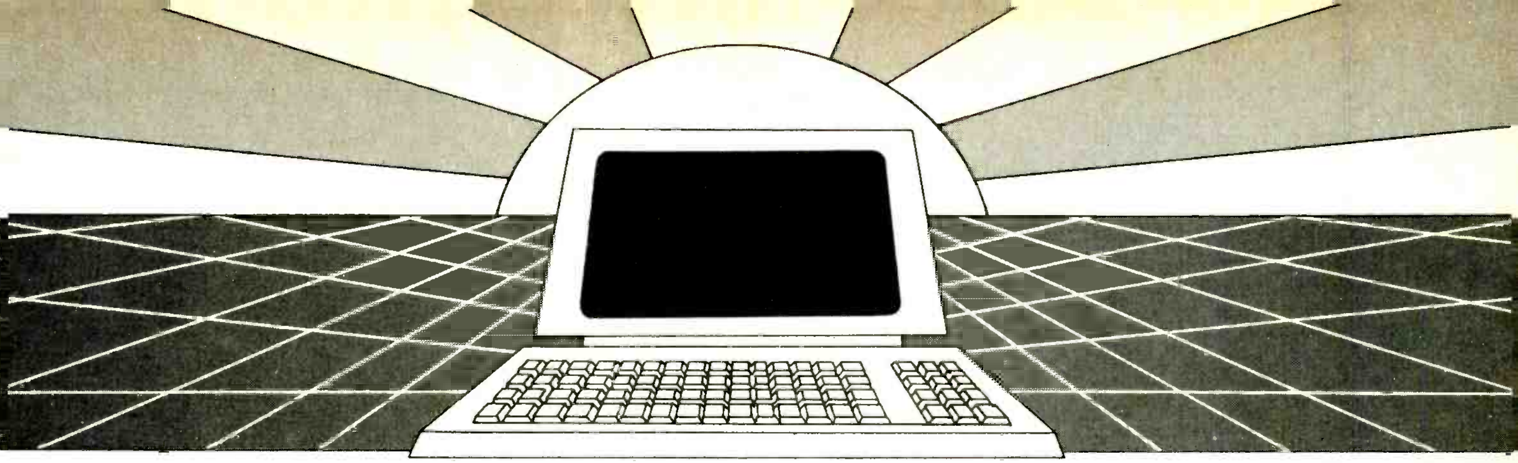
On April 22, a strange new radio operation began on 17740 kHz. The station did not give any specific ID or location, but featured a sultry-voiced lady calling herself "Liberty." Purportedly she was speaking from Argentine islands to the British troops in the South Atlantic, playing on their homesickness with musical nostalgia, but she was heard better in Britain and North America. It was a throwback to World War II, reminiscent of "Tokyo Rose" and "Axis Sally," and about as convincing. Programs lasting about 45 minutes at 1800, 2000, 2200 and 2400 GMT opened and closed with "Yesterday." The final airing was heard best in North America. She would play tapes of Big Ben (as if the British forces could not hear that direct from the BBC), music of big bands of the '30s, "Yellow Submarine," and punk rock. And every night in closing she would proudly proclaim, "The world listens when Argentina speaks."

Two other unconfirmed frequencies were 25680 and 15110 kHz. The fact that two of these three frequencies had been used by Algeria led to speculation that the transmissions were actually coming from there, and one Argentine DX club also claimed that this was coming from the African continent. However, there was no reason to make such assumptions, as propagational evidence indeed pointed to southern South America. And a resourceful DX listener, David Crawford, called the FCC, asking them to get a fix on it. The FCC did so, then refused to divulge the data until the Freedom of Information Act came into play. A bearing taken at the FCC monitoring station near Kingsville, TX, showed maximum signal from the direction of 147°, while FCC Fort Lauderdale put it at 160° or 162°. In a report published in DX-South Florida, Crawford concluded that these bearings cross in the Córdoba-Junín area of Argentina. The station lasted a few days after the British victory, but shifted its frequency to 17738, and switched to Spanish for its farewell June 23.

"Liberty" was always difficult to understand, due to poor transmitter modulation. A likely reason for this is that the transmitter was not originally intended for AM broadcasting. Argentina has a considerably larger number of point-to-point transmitters designed for SSB, than it has broadcast transmitters.

Indeed, the official external service from Buenos Aires, though broadcasting in several languages including English, has long had a justified reputation for extreme inefficiency. For many years, only one or two frequencies were used, 11710 and 9690 kHz, regardless of interference problems (such as *Radio Moscow* on 11710), or basic propagation, which would call for much higher frequencies to reach North America and Europe effectively.

Radiodifusión Argentina al Exterior (RAE) had reserved Sundays for Spanish-only broadcasts; but within a week of the invasion, it extended English and other languages to seven days a week. At



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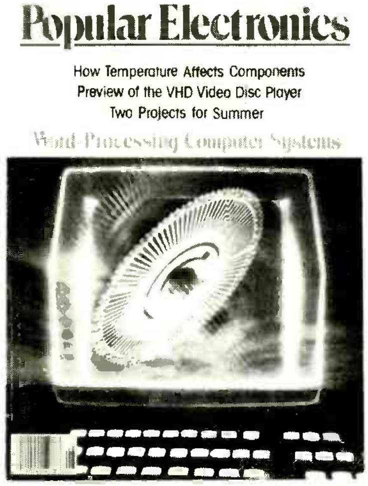

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times it was possible to pick up English at 2200 or 0100, and later extended to 0230 and 0430 with the first broadcast retimed to 2230. These two frequencies, as well as 6060 and 15345 kHz, which had been used mainly for *Radio Nacional*'s domestic news and cultural services respectively, were kept on the air much longer hours, with a large block of programming time temporarily turned over to such domestic stations as *Radio Rivadavia* and *Radio Del Plata*. *RAE* added a fifth high power transmitter on 6180.

The British Move. Meanwhile, the British side was also making rapid changes in its shortwave broadcasting. At the end of March, Portuguese broadcasts to Brazil from *BBC* had been cut by one hour, as ordered by the government months before. This left a gap in transmission between 2315 and 0015 GMT, when a four-hour Spanish broadcast started. It has been planned to move "English By Radio" from 2145 into the 2315 slot. Under the circumstances, however, only a few days after the invasion, Spanish was expanded to start at 2315.

On May 3, Argentina started jamming the *BBC* Latin American Service in Spanish, disturbing listeners as far away as New Zealand. The *BBC* promptly countered by putting four more frequencies on the transmission. Another way to counter jamming is to increase the length of broadcasts. Besides the earlier one-hour extension of the evening service in Spanish, *BBC* also began in early May a morning edition at 1100-1130 via the Ascension relay on 17780 and 21735.

For many years, *BBC* has been "Calling the Falklands" once a week on Sundays at 2209-2245 GMT on 12040 and 9915 kHz, using transmitters in Britain. This service suddenly having acquired a much higher priority, a new transmission at 2115-2200 GMT three days a week (Sunday, Tuesday and Thursday) replaced the old one, fed to the Ascension relay station on 19455 kHz, and then broadcast with a much stronger signal than before to the Falklands on 15400 and 11820 kHz. (The 15400 signal could be heard quite well in North America, too.) The new time slot for "Calling the Falklands" was chosen because it filled in an already existing gap in transmissions from Ascension, after the closing of the Portuguese service to Africa at 2115 and before the beginning of the Portuguese service to Brazil at 2200.

From April 26 this was expanded to seven days a week, and a few weeks later the old frequencies of 12040 and 9915 were reintroduced, to combat jamming, which by then Argentina had extended from *BBC* Spanish broadcasts to English as well.

"Calling the Falkland Islands" provided a daily summary of news concerning the situation, messages from British government officials, etc. But its main purpose continued to be for Falklanders and their relatives in Britain to keep in touch through brief personal messages—some of them by tape, some read in the studio. But now there was a difference: this was the only means of such contact during the conflict.

Naturally, the *BBC* World Service itself was the prime source of news about the crisis, typically devoting half of each newscast to this one subject.

BFBS. The *British Forces Broadcasting Service* has long operated at the remaining British bastions in Gilbraltar, Berlin, and until recently, Singapore, on FM. But suddenly there was a need for long-distance coverage, and shortwave was required. A similar scheduling situation to "Calling the Falklands" led to the *BFBS* program being inserted at 1100 GMT via *BBC* facilities three days a week. Initially the frequencies were reported to be 21490 and 17830 kHz, which although via Ascension, had been used for relays of the *Voice of America* morning programs in Portuguese until 1100, and Spanish after 1130. But by May, the BFBS program could be heard instead between 1130 and 1155 GMT on another Ascension frequency, 15105, and again, this was subject to jamming. BFBS programs were mainly musical requests and dedications.

The Argies got the jump on the British in psychological warfare broadcasting,

dx listening

with "Liberty," but on May 19, the British Defence Ministry opened up its own propaganda station, called *Radio Atlántico del Sur.* Against protests from the *BBC* and trade unions representing *BBC* workers, the British government invoked a little-known provision of *BBC*'s license allowing it to commandeer *BBC* transmitting facilities in an emergency.

One of the four Ascension transmitters was removed from the *BBC* World Service between 2300 and 0200 GMT, and again at 0815-0945. Both broadcasts began on 9710 kHz, a frequency not formerly used by the *BBC* and, thus, disassociated from a *BBC* connection. The 9710 frequency also happens to be the channel of a not-very-active Argentine station. Jamming accompanied "9-71, Radio Atlántico del Sur" from its very first moments on the air. The frequency was shifted to 9700 for the morning broadcast, putting it even closer to a very active Argentine frequency, 9690. Reception of the evening broadcast was quite good in North America until two U.S. stations coincidentally signed on at 0100 GMT, 5 kHz above and below 9710.

Strangely, by June, some jamming could be heard against "Liberty" on 17740 kHz, of a type quite similar to that plaguing *Radio Atlántico del Sur* on 9710. Could it have been from a third party? More likely it was caused by a technical problem in Argentina.

Radio Atlántico del Sur was a considerably more sophisticated operation than "Liberty," with a snappy electronic interval signal, several announcers, and a "magazine" format, mixing music with short talk pieces. This contrasts with the *BBC* Latin American Service, which maintains the block programming format. Still, on its very first night on the air, it broadcast obviously phony musical dedications for Argentine soldiers on the Falklands, from their mothers back on the mainland. One could only wonder how and why any Argentine mothers could have sent in these dedications even before the enemy station went on the air. But it apparently hoped for such input by announcing an address of GPO Box 408, London. The station was hardly taken seriously in Argentina, as the announcers were criticized in the press for speaking with a combination Chilean and Cambridge accent, rather than authentically Argentine. Unlike "Liberty," whose origin was not publicized, world press agencies had revealed exactly who was behind *Radio Atlántico del Sur* even before it went on the air. This station was promptly closed down once the British had recaptured the Falklands.

This developing story was covered in detail, including tapes of the stations concerned, from week to week on our DX program, "World of Radio," which all DX Listening readers are invited to monitor via *WRNO*, New Orleans, Sundays at 2330-2400 GMT on 11855 and Tuesdays at 1900-1930 on 15420 kHz. (Times and frequencies subject to change from September, if not earlier; listen for announcements). ◇

EXPERIMENTER'S CORNER

A Single-Chip Analog Building Block

By Forrest M. Mims

A NEW kind of multi-function analog integrated circuit has been introduced by Precision Monolithics, Inc. (1500 Space Park Dr., Santa Clara, CA 95050). The chip is designated the GAP-01, after *G*eneral-purpose *A*nalog *P*rocessor. It combines on a single chip two differential transconductance amplifiers, two low-glitch current-mode analog switches, an output-voltage buffer amplifier, and a precision comparator.

The factor that distinguishes this unique chip from other multi-circuit analog IC's, such as quad op amps, is that the outputs from the two differential amplifiers can be internally switched to the noninverting input of the output buffer. This is shown clearly in Fig. 1, a functional block diagram of the GAP-01. The external capacitor required for loop compensation serves also as a holding capacitor when the GAP-01 is used in sample-and-hold applications.

The status of the two analog switches between the differential amplifiers and the output buffer is controlled digitally by means of logic signals applied to their respective control inputs (pins 18 and 1). This provides two programmable signal paths through the integrated circuit. The gain of each channel can be controlled by connecting a feedback resistor between the buffer's output (pin 3) and the appropriate amplifier input.

Unity-Gain Analog Multiplexer. Figure 2 shows how the GAP-01 can be connected as a two-channel analog multiplexer having unity gain. A low at the channel select input selects channel A while a high selects channel B. Typical applications for this circuit include selecting between two analog transducers (e.g. temperature and air speed) in a remote telemetry system or selecting between two microphones in an audio system.

Incidentally, note that Fig. 2 employs a simplified diagram of the GAP-01 that shows each analog switch merged with its respective amplifier. This diagram, which is used by PMI in a 12-page GAP-01 specification and application brochure, will be used in the circuits that follow.

Analog Multiplexers with Gain. Adding gain to the circuit in Fig. 2 is easily accomplished by inserting input and feedback resistors in one or both channels. For example, Fig. 3 shows how both channels are given feedback so they might function as adjustable-gain, inverting amplifiers. The gain of each channel equals the feedback resistance divided by the input resistance.

PMI's GAP-01 specification and application brochure shows two other ways to design an analog multiplexer with gain. The circuit in Fig. 4, for example, shows how to achieve both positive and negative gains.

If it's necessary for both channels to have the same positive voltage gain, the circuit in Fig. 5 can be used. Here a single voltage divider simultaneously sets the gain for both channels.

A Continuously Switched Analog Multiplexer. In the previous three circuits, the GAP-01 can be considered a 2-line to 1-line analog encoder or multiplexer with individually controlled gain stages for each channel. In each case, the control signals that determine which channel is selected are CMOS- and TTL-compatible logic levels derived from external logic.

To more fully exploit the many possible applications for the GAP-01 operated as a 2-channel multiplexer (or encoder), a fully adjustable switcher is required. This role is admirably filled by half of a 558 quad timer connected as a pulse generator having independently controlled pulse rate and duration.

The circuit in Fig. 6 uses a 558 in this free-running switcher mode. In operation, *R5* controls the duration of pulses applied simultaneously to the two GAP-01 channel-control inputs. Resistor *R6* controls the pulse-repetition rate. The addition of a 10-kilohm voltage divider as shown in Fig. 6 results in a constant duty cycle irrespective of the pulse rate.

For preliminary test, set the gain of both amplifiers at 10 (e.g. *R1* and *R3* = 1 kilohm; *R2* and *R4* = 10 kilohms.) Connect any desired signal to the inputs and monitor the output with an oscilloscope while adjusting *R5* and *R6* to vary the switching conditions.

A Dual-Output Pulse Generator. The unused half of the 558 in Fig. 6 can be used to provide a dual-output pulse generator having independently controlled pulse rates. This permits the

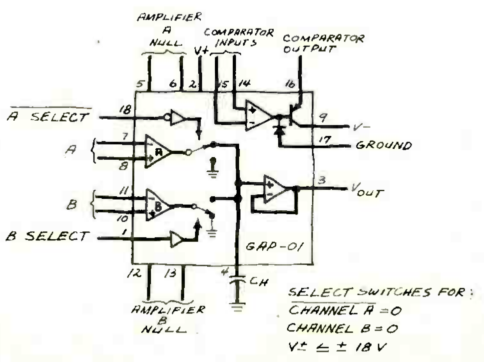


Fig. 1. Block diagram of the GAP-01.

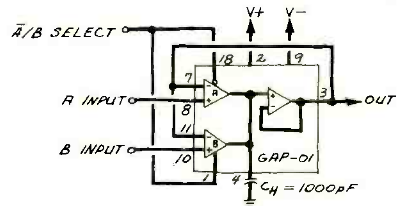


Fig. 2. Unity-gain two-channel analog multiplexer.

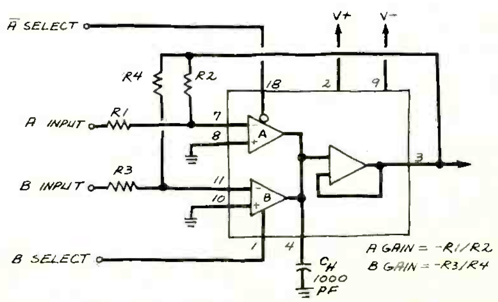


Fig. 3. Two-channel inverting analog multiplexer.

construction of FSK (frequency-shift keyed) generators, tweedell sirens, function generators, and tone-burst sources using only two chips.

Figure 7 shows the circuit I used to implement these ideas. Resistors *R9* and *R12* control the pulse rates of the two pulse generators. Incidentally, the 558 circuits in Figs. 6 and 7 may occasionally cease operating if an attempt is made to operate them beyond their maximum frequency limits. Should this occur, disconnect the power momentarily or ground pin 13 momentarily.

Learning More About the GAP-01. The most unique feature of the various analog multiplexer circuits with which we've experimented is their generic relationship to so-called "active" devices. For example, if a filter with an op-amp gain block is an *active filter*, then the circuits in this column can be considered as *active multiplexers.*

Of course, there are many other applications for the GAP-01, and you can find out more about them by referring to the chip's specification and application note. It describes an absolute value circuit with polarity-programmable output, a two channel sample/hold amplifier, and a synchronous demodulation circuit. Also covered are recommendations for the external compensation capacitor, tips for minimizing gain errors, and information regarding the logic levels applied to the channel select inputs among other things.

Additional applications for the GAP-01 are covered in an article by David Gillooly and Paul Henneuse, both PMI engineers. The article, which appeared in the April 7, 1981 issue of *Electronics* (pp. 121-129), describes a GAP-01 two-channel digital-to-analog converter, a four-quadrant multiplying digital-to-analog converter, a synchronous demodulator for strain gages, and a photoelectric control circuit that's immune to the effects of ambient light.

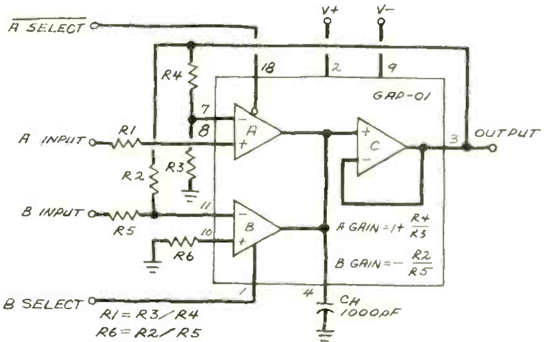


Fig. 4. Multiplexer with positive and negative gain.

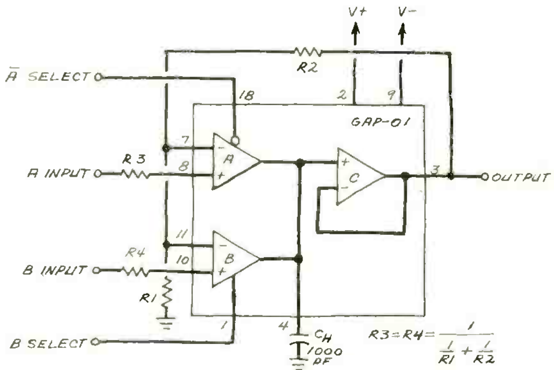


Fig. 5. Multiplexer with identical gain per channel.

Finally, five additional GAP-01 applications were published in the April 20, 1982 issue of *Electronic Products* (pp. 61-66). Finalists in a GAP-01 contest sponsored jointly by PMI and *Electronic Products* magazine, the circuits include a digital capacitance meter, a high-performance digital audio system, and a signal conditioner for a linear-position transducer.

Clearly the GAP-01 is a highly versatile analog building block. Yet it is still primitive when one contemplates what might be achieved by adding more amplifiers and digital switches. Many kinds of active filters, multiplexers, demodulators, sample/hold, and computational circuits could be implemented, all under digital control. Let's hope that analog designers will be able to extend the GAP series in the future.

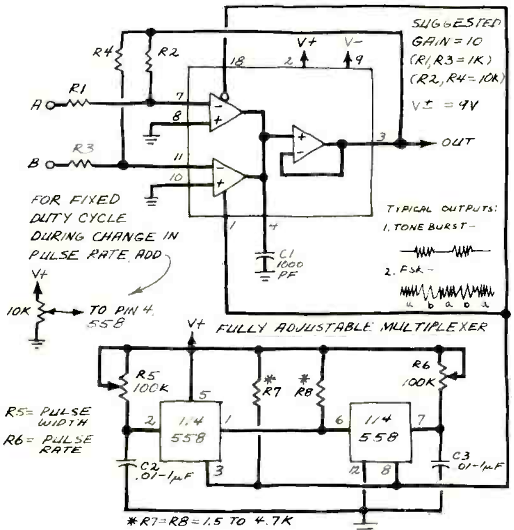


Fig. 6. Continuously switched analog multiplexer.

Where to Find It. Much of the mail to this column concerns problems readers have experienced in locating components for various projects. For that reason alone, I've not written about several of my favorite circuits since they use hard-to-find parts.

The GAP-01 is a good example of a relatively new chip that's not readily available from the mail order electronics parts dealers that cater to hobbyists and experimenters. Until it is, how do you purchase one if you want to try some of the experiments in this column?

PMI has more than two dozen sales offices scattered around the United States and Canada. Check your telephone directory to see if one is in your city. If not, PMI components are sold by authorized distributors such as Bell Industries, Hall Mark Electronics, Pioneer Electronics, and others. Again, check your phone book to see if one of these distributors is near you.

If you cannot find a sales office or authorized distributor yourself, write PMI and request a list of them. You might also want to request a copy of the GAP-01 specification and application brochure. (Hint: A neatly typed letter written in a courteous, professional manner will go a long way toward expediting a reply. Unfortunately, some hobbyists and experimenters request far too much information, personal consulting advice, free samples, and "anything else you can provide." This is the primary reason some electronics manufacturers do not even answer mail from individuals. Include your address.)

You can use this same procedure to find components made by virtually any company. This column always provides the address of the manufacturer of any unusual component to provide a starting point. Sometimes a price is given. I did not give a price for the GAP-01 since by the time this column appears in print the price may have dropped somewhat. Furthermore, the price provided by PMI was for the chip when purchased in quantities of 100. This means the single chip price will be somewhat higher than the $7.50 posted by PMI.

Most components used in this column are available from retail electronics parts stores and mail order suppliers like those that advertise in this magazine. It's wise to get on as many mailing lists of these companies as you can.

Mims vs. Bell Labs. The two-part series in "Experimenter's Corner" about submitting an idea to a manufacturer (March and April, 1982) elicited some thought provoking mail from readers interested in my unfortunate misadventure with Bell Laboratories. Several readers described incidents in which they believe a company may have improperly used their invention. One writer who is a Ph.D. candidate at a major university and a regular reader of this magazine forwarded a copy of a letter he sent Mr. W.L. Keefauver, Vice President and General Counsel of Bell Labs, asking for an explanation of their side of the story.

Since Bell Labs has declined my repeated offers of space in this column to explain their position, here instead is Mr. Keefauver's reply to the reader: "The controversy with Mr. Mims ended with settlement of the lawsuit. To give you or anyone else our side of the story at this time would merely renew the controversy. That is something we do not wish to do."

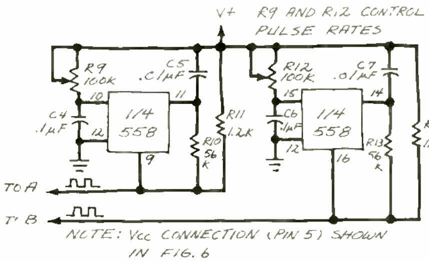


Fig. 7. Dual-output pulse generator for circuit in Fig. 6.

Medical Electronic Projects. Among the most popular subjects covered in this column are medical electronic projects. This came to mind while I was preparing this month's column. The inside front cover of the PMI 1982 product catalog of *Linear Integrated Circuits* contains what PMI terms its "Life Support Application Policy." Similar to a policy followed by National Semiconductor and other electronics manufacturers, the PMI policy reads, in part:

"As a general policy, Precision Monolithics, Inc. does not recommend the use of its components of any type in 'Life Support Applications' wherein failure or malfunction of the PMI component threatens life or makes injury probable. Any manufacturer incorporating PMI's components in a life support system must obtain PMI's prior consent based upon assurance to PMI that a malfunction of PMI's component does not pose direct or indirect threat of injury or death, and (even if such consent is given) shall indemnify PMI from any claim, loss, liability, and related expenses arising from any injury or death resulting from use of PMI components in a life support application."

While policies such as this may seem overly restrictive, firms such as PMI and National are simply taking a necessary step to protect themselves from liability in the event one of their components used without their knowledge in a life support system fails on the job. The policy seems entirely reasonable since equipment manufacturers cannot possibly know as much about the failure mechanism of a component as the manufacturer. Furthermore, the component manufacturer has no control over how its components are used by the equipment manufacturer.

The lesson for readers of this column is clear: *Never* use in a life support application a circuit you have built. Furthermore, any life support systems should only be used under appropriate medical attention and supervision. ◇

HOBBY SCENE

By Joe Desposito
Technical Editor

Apple Users Clubs

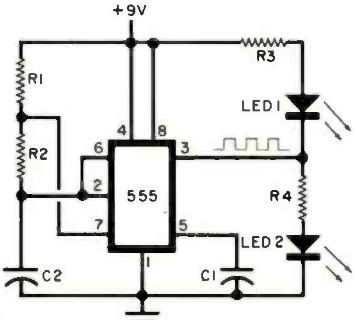
Q. ***As a regular reader of your monthly magazine in Europe, I am writing to your office asking for help. Can you give me, or tell me how and where to get information about addresses of Apple Users Clubs in the United States? Since such information is not available here in Austria, your help would be greatly appreciated. —Mike Dauer, Graz, Austria.***

A. There are Apple Users Clubs all over the world. If you contact the Apple Users Club in Austria (contact M. Weissenboeck, P.O. Box 51, A-1181 Wien, Austria0; Tel.: 01143-222-476216). I'm sure that you can get all the information you need. If not, write to International Apple Core, P.O. Box 976, Daly City, CA 94017, USA.

LED Flip-Flop

Q. ***I have tried many ways to utilize National's LM3909 in a simple design to operate two LEDs as a flip-flop oscillator. I cannot do any more than flash a single LED and change its timing by changing the capacitor I use with this IC. Is there possibly a better IC to use for a flip-flop?—John G. Burke, Sr., Indianapolis, IN.***

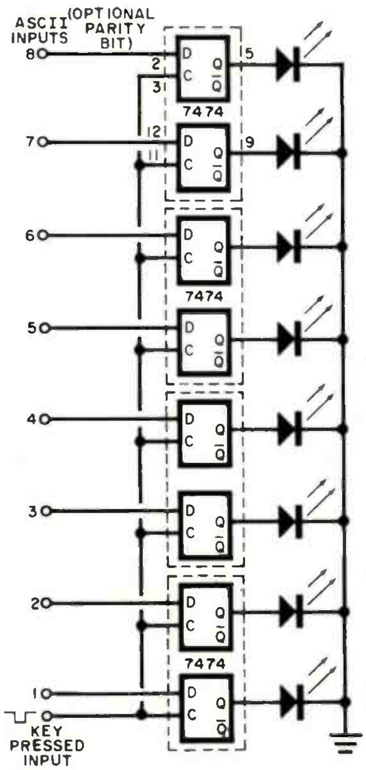
A. The LM3909 is designed primarily to flash a single LED. If you want flip-flop LED action, try using a 555-timer IC operating in the astable mode. The timing components are *R1, R2,* and *C2,* while *C1* acts as a bypass capacitor (see figure). The 555 outputs a square wave at pin 3 with frequency determined by $f = 1.44/(R1 + 2R2)C2$. The duty factor (ratio of output high time to total time of one cycle) approaches 50 percent when *R2* is made much larger than *R1*. To design for different values of duty factor, the formula to use is $DF = (R1 + R2)/(R1 + 2R2)$. If the 555 draws too much current for your purposes, you could try using a 7555, which is the CMOS version of the chip. Typical values for the circuit are: $R1$ = 1 kΩ, $R2$ = 220 kΩ, $R3 = R4$ = 470Ω, $C1$ = .01=μF, $C2$ = 4.7=μF.



ASCII Keyboard Check

Q. ***I have several ASCII keyboards that have some malfunction in them. Is there any simple circuit that can hold the 8-bit ASCII code on LEDs long enough to check each key?—Ed Glover, Riverhead, N.Y.***

A. One of the ways to store digital information is with flip-flops. Since the ASCII code has eight inputs, you'll need that number of flip-flops. Shown below is a circuit that uses four 7474 dual D flip-flops (D for data). When you press a key, the circuit accepts the ASCII input, lights the corresponding LEDs, and holds the information until the next key is pressed.



PROJECT OF THE MONTH

By Forrest M. Mims

Two 60-Hz Hum Filters

THE MOST prevalent noise in electronic equipment is probably 60-Hz hum from the ac power line. The hum can be transmitted directly through the power supply, or it can be inductively coupled into a circuit from nearby power lines. The latter makes even battery-powered equipment susceptible to 60-Hz hum.

Since audio-frequency amplifiers are particularly vulnerable to 60-Hz hum, a well-designed unit often includes an on-chip power supply decoupler-regulator circuit. This provides rejection of power supply ripple that might give rise to 60-Hz hum. For example, the LM381 provides 120-dB supply rejection, while the LM387 low-noise preamplifier provides 110-dB supply rejection.

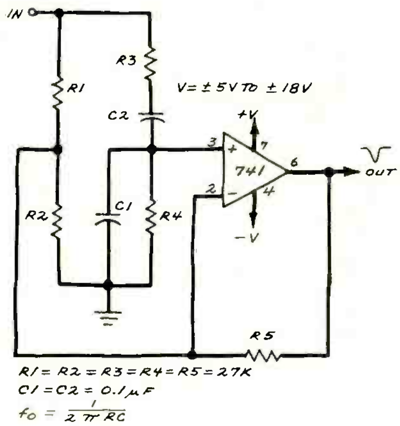


Fig. 1. Schematic of a Wien-bridge 60-Hz notch filter.

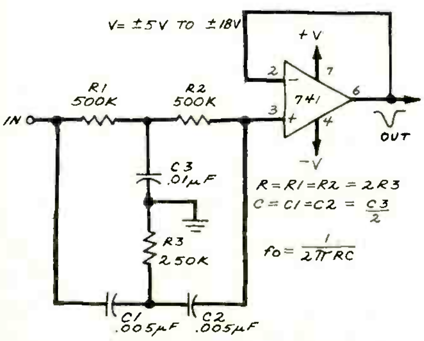


Fig. 2. Design for a twin-tee 60-Hz notch filter.

Typically, op amps provide less supply rejection. The 741 and 308, for example, have about 80-to 96-dB supply-voltage rejection.

A common place for 60-Hz hum to get into a properly designed and shielded audio preamplifier is the input jack. Using an improperly or poorly shielded input cable or simply touching the input with a finger may couple more 60-Hz hum than signal into the preamplifier. In both cases, the cable and the human body serve as antennas that pick up 60 Hz radiated by nearby power lines.

Several kinds of passive and active notch filters can be used to trap 60-Hz hum. Since passive filters are disadvantaged by insertion loss, let's examine a couple of representative active notch filters.

Wien-Bridge 60-Hz Notch Filter. Figure 1 shows an active Wien-bridge 60-Hz hum filter. This filter directs the input signal along two routes leading to the inputs of an op amp. The components are selected so that at a given frequency the gains of both the inverting and noninverting inputs match and thus cancel one another. An advantage of the circuit is that the two capacitors, as well as the five resistors, have equal values.

The notch frequency of the circuit in Fig. 1 is the reciprocal of $2\pi RC$. The component values in Fig. 1 give a predicted notch minimum of 58.95 Hz. A breadboard version of the circuit I built gave a notch minimum of 61 Hz, certainly very close to the predicted result considering the large tolerance of the components I used. At the notch frequency, 93 percent of the signal was rejected. This corresponds to a rejection of −12.5 dB.

Twin-Tee 60-Hz Notch Filter. Figure 2 is an active twin-tee 60-Hz notch filter with better rejection than the Wien-bridge version. This circuit requires one less component than the Wien-bridge version, but takes two resistor and two capacitor values.

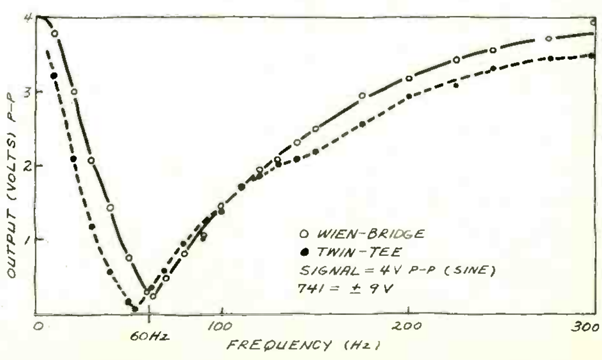
The notch frequency of this circuit is, like the circuit in Fig. 1, the reciprocal of $2\pi RC$ where $R = R1 = R2 = 2R3$ and $C = C1 = C2 = C3/2$. The component values in Fig. 2 give a predicted notch minimum of 63.66 Hz. However, the breadboard version of the circuit I built gave a notch minimum of 53 Hz. The attenuation at this frequency was −32.47 dB.

The difference between predicted and measured notch frequencies is probably due to the large tolerance of the components I used. Nevertheless, the filter provides an attenuation at 60 Hz of −23.2 dB.

Comparing the Two Filters. The actual frequency response of both 60-Hz notch filters described above is compared in Fig. 3. Note that while the twin-tee filter has a somewhat wider and deeper notch, the overall shape of both curves is very similar. Note also that the vertical axis in this plot is linear, not logarithmic.

Incidentally, some texts present an idealized, symmetrical notch to illustrate the performance of various filter circuits. However the notches shown in Fig. 3 are certainly not symmetrical. This is because they are not derived from equations but from actual measurements made with breadboard versions of the circuits in Figs. 1 and 2. This illustrates the importance of plotting results from real test measurements rather than depending solely upon theoretical predictions. ◇

Fig. 3. Actual frequency response of Wien-bridge and twin-tee 60-Hz notch filters.



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74S570*	16	2.95
74S571*	16	2.95
74S572*	18	4.95
74S573*	18	4.95
74S940	20	2.49
74S941	20	2.49

CA—LINEAR

Part No.	**Pins	Price
CA3010H		.99
CA3013H		2.15
CA3023H		3.25
CA3035H		5.95
CA3039H		1.35
CA3046N	14	.89
CA3059N	14	3.25
CA3060N	16	3.25
CA3080H		1.25
CA3081N	16	1.49
CA3082N	16	1.49
CA3083N	16	1.49
CA3086N	14	.69
CA3089N	16	1.69
CA3096N	16	1.19
CA3130H		1.95
CA3140H		1.49
CA3160H		1.95
CA3401N	14	.59
CA3600N	14	3.95

CD—CMOS

Part No.	**Pins	Price
CD4000	14	.29
CD4001	14	.29
CD4002	14	.29
CD4006	14	.89
CD4007	14	.29
CD4009	16	.39
CD4010	16	.39
CD4011	14	.29
CD4012	14	.15
CD4013	14	.39
CD4014	16	.79
CD4015	16	.39
CD4016	14	.39
CD4017	16	.75
CD4018	16	.79
CD4019	16	.39
CD4020	16	.75
CD4021	16	.79
CD4022	16	.79
CD4023	14	.29
CD4024	14	.69
CD4025	14	.23
CD4026	16	2.49
CD4027	16	.45
CD4028	16	.69
CD4029	16	.79
CD4030	14	.39
CD4034	24	1.95
CD4035	16	.89
CD4040	16	.79
CD4041	14	.79
CD4042	16	.69
CD4043	16	.79
CD4044	16	.79
CD4046	16	.89
CD4047	14	.89
CD4048	16	.39
CD4049	16	.39
CD4050	16	.39
CD4051	16	.79
CD4052	16	.79
CD4053	16	.79
CD4056	16	2.95
CD4059	24	7.95
CD4060	16	.89
CD4066	14	.39
CD4068	14	.39
CD4069	14	.29
CD4070	14	.39
CD4071	14	.29
CD4072	14	.29
CD4073	14	.29
CD4075	14	.29
CD4076	16	.79
CD4078	14	.49
CD4081	14	.29
CD4082	14	.29
CD4093	14	.49
CD4098	16	1.95
CD4506	16	1.19
CD4507	14	.39
CD4508	24	3.95
CD4510	16	.89
CD4511	16	.89
CD4512	16	.89
CD4514	24	1.79
CD4515	24	1.79
CD4516	16	.99
CD4518	16	.99
CD4519	16	.39
CD4520	16	.79
CD4526	16	1.19
CD4528	16	1.19
CD4529	16	1.19
CD4543	16	1.19
CD4562	14	6.95
CD4566	16	1.39
CD4583	16	2.49
CD4584	14	.75
CD4723	16	1.19
CD4724	16	1.19
MC14409	16	13.95
MC14410	16	13.95
MC14411	24	11.95
MC14412	16	13.95
MC14419	16	7.95
MC14433	24	13.95
MC14538	16	1.19
MC14541	14	1.19

MICROPROCESSOR COMPONENTS

STATIC RAMS

Part No.	**Pins		Price
1101	16	256x1 (650ns)	1.49
2101	22	256x4 (450ns) 8101	2.49
2102	16	1024x1 (350ns)	.89
21L02	16	1024x1 (450ns) L.P.	1.49
2111	18	256x4 (450ns) 8111	2.95
2112	16	256x4 (450ns) MOS	2.95
2114	18	1024x4 (450ns)	2.25 — 8/14.95
2114L	18	1024x4 (450ns) L.P.	2.49 — 8/16.95
2114-2	18	1024x4 (200ns)	2.49 — 8/16.95
2114L-2	18	1024x4 (200ns) L.P.	2.95 — 8/19.95
2141-3	18	4096x1 (150ns)	3.95
2147	18	4096x1 (70ns)	4.95
2148	18	1024x4 (70ns)	8.95
TMS4044	18	4096x1 (450ns)	3.95
TMS4045	18	1024x4 (450ns)	3.95
5101	22	256x4 (450ns) CMOS	4.95
MK5257	18	4096x1 (450ns) 4044	4.95
HM6116-4	24	2048x8 (200ns) CMOS	7.95
HM6116LP-4	24	2048x8 (200ns) L.P. CMOS	8.95
7489	16	16x4 (50ns) 3101	2.25
74C920	22	256x4 (250ns) CMOS (6551)	3.95
74C921	18	256x4 (250ns) CMOS	3.95
74C929	16	1024x1 (250ns) CMOS (6501)	3.95
74C930	18	1024x1 (250ns) CMOS (6518)	3.95
74S189	16	16x4 (35ns) 93405	1.95
74S200	16	256x1 (80ns) 93410	3.95
74S206	16	256x1 (60ns) 93411	3.95
74S289	16	16x4 (35ns) 3101	2.25
82S10	16	1024x1 (50ns) O.C. (93415)	3.95
82S25	16	16x4 (50ns) O.C. (74S289)	2.25

EPROMS

Part No.	**Pins		Price
1702A	24	256x8 (1us)	4.95
2708	24	1024x8 (450ns)	3.95
2708-5	24	1024x8 (550ns) SM00246	2.95
TMS2516	24	2048x8 (450ns) 2716	6.95
TMS2532	24	4096x8 (450ns) NMC2532	9.95
TMS2564	28	8192x8 (450ns)	29.95
TMS2716	24	2048x8 (450ns) 3 voltage	7.95
2716	24	2048x8 (450ns)	5.95
2732	24	4096x8 (450ns)	8.95
27580	24	1024x8 (450ns) single +5V	2.95
MM2764	28	8192x8 (450ns)	29.95

MICROPROCESSOR CHIPS

Part No.	**Pins		Price
Z80 (780C)	40	CPU (MK3880N) (2MHz)	5.95
Z80A (780-1)	40	CPU (MK3880N-4) (4MHz)	6.95
CDP1802	40	CPU	9.95
2650	40	MPU	14.95
IDM2901ADC	40	CPU—4-bit slice (Com. Temp. Gr.)	19.95
MC6502	40	MPU w/Clock (65K bytes mem.)	9.95
INS8035N-6	40	MPU—8-bit (6MHz)	5.95
INS8039N-6	40	CPU-Sgl. chip 8-bit (128 bts. Ram)	6.95
INS8040N-6	40	CPU (256 bytes RAM)	14.95
INS8070N	40	CPU (64 bytes RAM)	19.95
INS8073N	40	CPU w/Basic Micro Interpreter	24.95
P8085	40	CPU	5.95
TMS9900JL	64	MPU — 16-bit	39.95

MICROPROCESSOR MANUALS

Part No.		Price
M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

6800/6800 SUPPORT DEVICES

Part No.	**Pins		Price
MC6800	40	MPU	4.95
MC6802CP	40	MPU with clock and RAM	7.95
MC6810API	24	128x8 Static RAM	3.95
MC6821	40	Peripheral Inter. Adapt (MC6820)	4.95
MC6828	24	Priority Interrupt Controller	15.95
MC6830L8	24	1024x8-bit ROM (MC68A30-8)	10.95
MC6850	24	Asynchronous Comm. Adapter	4.95
MC6852	24	Synchronous Serial Data Adapter	5.75
MC6860	24	0-600bps Digital MODEM	9.95
MC6862	24	2400bps Modulator	12.95
MC6880A	16	Quad 3-state bus. trans. (MC8T26)	2.25

8080/8080A SUPPORT DEVICES

Part No.	**Pins		Price
INS8080A	40	CPU	3.95
DP8212	24	8-bit Input/Output	2.25
DP8214	24	Priority Interrupt Control	3.95
DP8216	16	Bi-Directional Bus Driver	2.25
DP8224	16	Clock Generator/Driver	2.25
DP8226	16	Bus Driver	2.25
DP8228	28	System Controller/Bus Driver	3.49
DP8238	28	System Controller	4.49
INS8243	24	I/O Expander for 48 Series	5.95
INS8250	40	Asynchronous Comm. Element	10.95
DP8251	28	Prog. Comm. I/O (USART)	4.49
DP8253	24	Prog. Interval Timer	6.95
DP8255	40	Prog. Peripheral I/O (PPI)	4.49
DP8257	40	Prog. DMA Control	7.95
DP8259	28	Prog. Interrupt Control	6.95
DP8275	40	Prog. CRT Controller	29.95
DP8279	40	Prog. Keyboard/Display Interface	8.95
DP8303	20	System Timing Element	3.95
DP8304	20	8-bit Bi-Directional Receiver	2.49
DP8307	20	8-bit Bi-Directional Receiver	2.49
DP8308	20	8-bit Bi-Directional Receiver	2.49
DP8310	20	Octal Latched Peripheral Driver	4.95
DP8311	20	Octal Latched Peripheral Driver	4.95

DYNAMIC RAMS

Part No.	**Pins		Price
1103	18	1024x1 (300ns)	.99
4027	16	4096x1 (250ns)	2.49
4116N-2	16	16,384x1 (150ns)	2.25 — 8/16.95
4116N-3	16	16,384x1 (200ns)	1.95 — 8/14.95
4116N-4	16	16,384x1 (250ns)	1.49 — 8/10.95
4164N-2	16	65,536x1 (200ns)	9.95
MM5261	18	1024x1 (300ns)	.49 — 8/1.95
MM5262	22	2048x1 (365ns)	.49 — 8/1.95
MM5270	18	4096x1 (250ns) MK4096	2.95
MM5280	22	4096x1 (200ns) 2107	3.95
MM5290-2	16	16,384x1 (150ns)	2.25 — 8/16.95
MM5290-3	16	16,384x1 (200ns)	1.95 — 8/14.95
MM5290-4	16	16,384x1 (250ns)	1.49 — 8/10.95
MM5298-3	16	8192x1 (200ns)	1.69

PROMS

Part No.	**Pins		Price
*74S188	16	32x8 PROM O.C. (6330-1)	1.49
74S287	16	256x4 PROM T.S. (6301-1)	1.95
74S288	16	32x8 PROM T.S. (6331-1)	1.95
74S387	16	256x4 PROM O.C. (6300-1)	1.95
74S471	20	256x8 PROM T.S. (6309-1)	5.95
74S472	20	512x8 PROM T.S. (6349-1)	4.95
74S473	20	512x8 PROM O.C. (6348)	4.95
74S474	24	512x8 PROM T.S. (DM87S296N)	4.95
74S475	24	512x8 PROM O.C. (6340)	4.95
74S478	24	1024x8 PROM T.S. (TBP28S86)	8.95
74S570	16	512x4 PROM O.C. (6305)	2.95
74S571	16	512x4 PROM T.S. (6306)	2.95
74S572	18	1024x4 PROM O.C. (6352)	4.95
74S573	18	1024x4 PROM T.S. (82S137)	4.95
82S23	16	32x8 PROM O.C. (27S18)	2.95
82S115	24	512x8 PROM T.S. (27S15)	9.95
82S123	16	32x8 PROM T.S. (27S19)	2.95
82S126	16	256x4 PROM O.C. (27S20)	3.95
82S129	16	256x4 PROM T.S. (27S21)	3.95
82S130	16	512x4 PROM O.C. (27S12)	5.95
82S185	18	2048x4 PROM T.S. (TBP24S81)	9.95
DM87S180N	24	1024x8 PROM O.C. (82S180)	9.95
DM87S181N	24	1024x8 PROM T.S. (82S181)	9.95
DM87S184N	18	2048x4 PROM O.C. (82S184)	9.95
DM87S185N	18	2048x4 PROM T.S. (82S185)	9.95
DM87S190N	24	2048x8 PROM O.C. (82S190)	19.95
DM87S191N	24	2048x8 PROM T.S. (82S191)	19.95

ROM'S

Part No.	**Pins		Price
2513 (2140)	24	Character Generator (Upper Case)	9.95
2513 (3021)	24	Character Generator (Lower Case)	9.95

NMOS READ ONLY MEMORIES

Part No.	**Pins		Price
MCM66710P	24	128x9x7 ASCII Shifted w/Greek	13.50
MCM66740P	24	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	24	128x9x7 Alpha. Control Char. Gen.	13.50

DATA ACQUISITION

Part No.	**Pins		Price
DC10		Mostek DC/DC Convert. +5V to -9V	2.95
MC3470P	18	Floppy Disk Read AMP System	4.95
MC1408L7	16	7-bit D/A Converter (DAC0807LCN)	2.49
MC1408L8	16	8-bit D/A Converter (DAC0808LCN)	2.95
AF100-1CN	16	Universal Active Filter 2.5%	5.95
AF121-1CJ	24	Touch Tone Low Band Filter	19.95
AF122-1CJ	24	Touch Tone High Band Filter	19.95
LM308CH		Super Gain Op Amp	1.15
LM334Z		Constant Current Source	1.30
LM335Z		Temperature Transducer	1.40
LF356N	8	JFET Input Op Amp	1.10
LF398N	8	Sample & Hold Amplifiers	3.95
LM399H		Temp Comp. Prec. Ref. (5ppm/C°)	5.00
ADC0804	20	8-bit A/D Converter (1 LSB)	3.49
DAC0806	16	8-bit D/A Converter (0.78% Lin.)	1.95
ADC0808	28	8-bit A/D Converter (8-Ch. Multi.)	4.49
ADC0817	40	8-bit A/D Converter (16-Ch. Multi.)	9.95
DAC1000	24	10-bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1008	20	10-bit D/A Conv. Micro. Comp. (0.20%)	7.95
DAC1020	16	10-bit D/A Converter (0.05% Lin.)	8.49
DAC1022	16	10-bit D/A Converter (0.20% Lin.)	5.95
DAC1222	18	12-bit D/A Converter (0.20% Lin.)	6.95
CD4051N	16	8-Channel Multiplexer	.79
AY-5-1013	40	30K BAUD UART	3.95

SPECIAL FUNCTION

Part No.	**Pins		Price
DS0025CN	8	Dual MOS Clock Driver (5MZ)	2.49
DS0026CN	8	Dual MOS Clock Driver (5MZ)	1.95
INS1771N-1	40	Floppy Disk Controller	16.95
INS2651N	28	Communication Chip	8.95
MM58167N	24	Microprocessor Real Time Clock	8.95
MM58174N	16	Micro. Compatible Time Clock	7.95
COP402N	40	Microcontroller w/64-digit RAM and Direct LED Drive	5.95
COP402MN	40	Microprocessor w/64-digit RAM & Direct LED Drive w/N Buss Int.	5.95
COP470N	20	32-seg VAC Fluor. Drvr (20-pin pkg.)	3.25

TELEPHONE/KEYBOARD CHIPS

Part No.	**Pins		Price
AY-5-9100	18	Push Button Telephone Dialer	14.95
AY-5-9200	16	Repertory Dialer	14.95
AY-5-9500	14	CMOS Clock Generator	4.95
AY-5-2376	40	Keyboard Encoder (88 keys)	9.95
HD0165-5	24	Keyboard Encoder (16 keys)	9.95
74C922	18	Keyboard Encoder (16 keys)	4.49
74C923	20	Keyboard Encoder (20 keys)	4.95
MM53130N	18	Touch Tone Dialer	5.95
MM53190N	20	Push Button Pulse Dialer	4.49

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CONNECTORS

25 Pin — D Subminiature (meets RS232)

Part No.	Description	Price
DB25P	PLUG (RS232)	2.95
DB25S	SOCKET (RS232)	3.50
DB25PF-179	PLUG (RS232) Wire Wrap style	4.95
DB51226-1	CABLE COVER for DB25P or DB25S	1.75
DB25P-831	PLUG — Right Angle — PC Mount	4.95
DB25S-831	SOCKET — Right Angle — PC Mount	5.25
D20418-2	Screw Lock for DB25 Series Connectors (Locks connector to panel)	2/.99

Solder Eyelet/Wire Wrap Edge Card

Part No.	Contacts	Sp.	Description	Price
15/30SE	15/30	.156	Solder Eyelet	1.95
18/36SE	18/36	.156	Solder Eyelet	2.49
22/44SE	22/44	.156	Solder Eyelet	2.95
22/44PC	22/44	.156	PC type (no mtg. ears)	1.49
50/100SE	50/100	.125	Solder Eyelet	9.95
22/44WW	22/44	.156	Wire Wrap - Level 3	7.95
67031-5	22/44	.156	WW (Pns .0625x.03x.75)	3.95
R681-1	50/100	.125	Wire Wrap - Level 3	12.95
R681-2	50/100	.125	Wire Wrap - Level 3	12.95

IC SOCKETS

For Socket Required, See Column After The IC Part No.

LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

— Soldertail Standard Tin & Gold Also Available —

WIRE WRAP (GOLD) SOCKETS LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

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INTERSIL

*Evaluation Kits

Part No.	**Pins	Function	Price
7045IPI	28	C,OS Precision Timer	14.95
7045EV/Kit*	28	Stopwatch Chip, XTL	19.95
7106CPL	40	3½ Digit A/D (LCD Drive)	9.95
7106EV/Kit*	40	IC, Circuit Board, Display	34.95
7107CPL	40	3½ Digit A/D (LED Drive)	11.95
7107EV/Kit*	40	IC, Circuit Board, Display	29.95
7116CPL	40	3½ Digit A/D LCD Dis. HLD	16.95
7117CPL	40	3½ Digit A/D LED Dis. HLD	15.95
7201IUS		Low Battery Volt Indicator	2.25
7205IPG	24	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	24	Stopwatch Chip, XTL	14.95
7206CJPE	16	Tone Generator	4.95
7206CEV/Kit*	16	Tone Generator Chip, XTL	7.95
7207AIPD	14	Oscillator Controller	5.95
7207AEV/Kit*	14	Freq. Counter Chip, XTL	7.95
7208IPI	28	Seven Decade Counter	15.95
7209IPA	8	Clock Generator	3.95
7215IPG	24	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	24	4 Func. Stopwatch Chip, XTL	14.95
7216AIJI	28	8 Digit Univ. Counter C.A	29.95
7216CIJI	28	8 Digit Freq. Counter C.A	24.95
7216DIPI	28	8 Digit Freq. Counter C.C	19.95
7217IJI	28	4 Digit LED Up/Down Counter C.A.	10.95
7217AIPI	28	4 Digit LED Up/Down Counter C.C.	14.95
7224IPL	40	LCD 4½ Digit Up Counter DRI	10.95
7226AIJL	40	8 Digit Univ. Counter	29.95
7226AEV/Kit*	40	5 Function Counter Chip, XTL	74.95
7240IJE	16	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	8	CMOS Divide-by-256 RC Timer	2.25
7250IJE	16	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	16	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	8	CMOS 555 Timer	1.45
7556IPD	14	CMOS 556 Timer	2.20
7611BCPA	8	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	8	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	8	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	16	CMOS Tri Op Amp Comp. 10MV	6.35
7641CCPD	14	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	14	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	8	Voltage Converter	2.95
8038CCPD	14	Waveform Generator	3.95
8048CCPE	16	Monolithic Logarithmic Amp	19.95
8069CCQ		50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	8	Volt Ref/Indicator	2.95
8212CPA	24	Volt Ref/Indicator	2.95

74C—C/MOS

Part No.	**Pins	Price
74C00	14	.35
74C02	14	.35
74C04	14	.29
74C08	14	.35
74C10	14	.35
74C14	14	.59
74C20	14	.35
74C30	14	.35
74C32	14	.39
74C42	16	1.39
74C48	16	1.95
74C73	14	.79
74C74	14	.69
74C85	16	1.95
74C86	14	.39
74C89	16	5.95
74C90	14	1.19
74C93	14	1.19
74C95	14	1.39
74C107	14	.89
74C151	16	2.49
74C154	24	3.49
74C157	16	2.25
74C160	16	1.19
74C161	16	1.19
74C162	16	1.19
74C163	16	1.19
74C164	14	1.49
74C173	16	.79
74C174	16	1.19
74C175	16	1.19
74C192	16	1.49
74C193	16	1.69
74C195	16	1.39
74C221	16	1.95
74C240	20	1.95
74C244	20	1.95
74C373	20	2.49
74C374	20	2.49
74C901	14	.39
74C903	14	.39
74C906	14	.39
74C911	28	8.95
74C912	28	8.95
74C915	18	1.19
74C917	28	8.95
74C922	18	4.49
74C923	20	4.95
74C925	16	5.95
74C926	18	5.95
80C95	16	.39
80C97	16	.39

LINEAR

Part No.	**Pins	Price
LH0002CN	10	5.95
LM10CLH		3.95
LM11CLH		3.95
LH0070OH		4.95
TL071CP	8	.49
TL072CP	8	.59
TL074CN	14	1.49
LH0082CD		29.95
TL082CP	8	.59
TL084CN	14	.59
LH0094CD		24.95
LM300H		.99
LM301CN	8	.35
LM302H		1.95
LM304H		1.95
LM305H		.99
LM307CN	8	.45
LM308CN	8	.69
LM309H		1.95
LM309K		1.25
LM310CN	8	1.75
LM311CN	8	.69
LM312H		2.49
LM317MP		1.15
LM317T		1.19
LM317K		3.95
LM318CN	8	1.95
LM319N	14	1.95
LM320K-5		1.35
LM320K-12		1.35
LM320K-15		1.35
LM320T-5		.89
LM320T-12		.89
LM320T-15		.89
LM323K		5.95
LM324N	14	.59
LM329DZ		.65
LM331N	8	3.95
LM334Z		1.19
LM335Z		1.40
LM336Z		1.19
LM337T		1.95
LM337MP		1.15
LM338K		6.95
LM339N	14	.69
LM340K-5		1.35
LM340K-12		1.35
LM340K-15		1.35
LM340T-5		.79
LM340T-12		.79
LM340T-15		.79
LM341P-5		.75
LM341P-12		.75
LM341P-15		.75
LM342P-5		.69
LM342P-12		.69
LM342P-15		.69
LM348N	14	.99
LM350K		4.95
LF351N	8	.60
LF353N	8	1.00
LF355N	8	1.10
LF356N	8	1.10
LM358N	8	.69
LM359N	14	1.79
LM370N	14	4.49
LM373N	14	3.95
LM377	14	1.95
LM380N	14	.89
LM381N	14	1.79
LM382N	14	1.39
LM384N	14	1.79
LM386N-3	8	.89
LM387N	8	.89
LM389N	18	1.19
LM392N	8	.69
LF398N	8	3.95
LM399H		5.00
TL494CN	16	2.95
TL496CP	8	1.19
NE510A	14	4.95
NE529A	14	2.95
NE531V	8	2.95
NE536H		6.00
NE540H		4.95
NE544N	14	2.95
NE550A	14	1.95
NE555V	8	.35
LM556N	14	.69
NE564N	16	2.95
LM565N	14	1.19
LM566CN	8	1.49
LM567V	8	.89
NE570N	16	3.95
NE571N	16	2.95
LM703CN	8	1.19
LM709N	14	.49
LM710N	14	.69
LM711N	14	.79
LM723N	14	.55
LM733N	14	1.00
LM739N	14	1.95
LM741CN	8	.35
MC1741SCG		2.95
LM747N	14	.69
LM748N	8	.59
LM1014N	10	1.19
LM1310	14	1.49
LM1458CN	8	.59
LM1488N	14	.69
LM1489N	14	.69
LM1496N	14	1.95
LM1556V	8	1.75
LM1800N	16	1.49
LM1871N	18	1.95
LM1872N	18	2.49
LM1877N-9	14	1.95
LM1889N	18	1.95
LM1896N	14	2.95
LM2002T		1.49
LM2877P		1.95
LM2878P		2.25
LM2896P-1		1.59
LM3189N	16	1.59
LM3900N	14	.59
LM3905CN	8	1.19
LM3909N	8	.99
LM3914N	18	3.49
LM3915N	18	3.49
LM3916N	18	3.49
RC4136N	14	1.25
RC4151NB	8	1.95
RC4194TK		3.95
RC4195TK		3.95
LM4500A	16	1.95
ICL8038B	14	3.95
LM13080N	8	1.19
LM13600N	16	1.19
75138N	16	1.95
75450N	14	.59
75451CN	8	.39
75492	14	.69

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
10 pf	.08	.06	.05	.001µF	.08	.06	.05
22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.09	.07	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
470 pf	.08	.06	.05	.1µF	.15	.12	.10

100 VOLT MYLAR FILM CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
.1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

MINI. ALUMINUM ELECTROLYTIC CAPACITORS

Axial	1-99	100-499	500+	Radial	1-99	100-499	500+
.47/50V	.16	.14	.10	.47/25V	.15	.13	.12
1.0/50V	.19	.16	.12	.47/50V	.16	.14	.13
3.3/50V	.17	.15	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27

4116 16K DYNAMIC 250NS 8/$11.95 SET

2114 1KX4 STATIC LOW POWER 200NS 8/$15.95 SET

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STATIC RAMS

			Each	100 pcs
2101	256 x 4	(450ns)	1.95	1.85
5101	256 x 4	(cmos) (450ns)	4.95	3.95
2102-1	1024 x 1	(450ns)	.89	.85
2102L-2	1024 x 1	(LP) (250ns)	1.69	1.55
2102L-4	1024 x 1	(LP) (450ns)	1.29	1.15
2111	256 x 4	(450ns)	2.99	2.49
2112	256 x 4	(450ns)	2.99	2.79
2114	1024 x 4	(450ns)	8/16.95	1.95
2114L-2	1024 x 4	(LP) (200ns)	8/15.95	1.90
2114L-3	1024 x 4	(LP) (300ns)	8/18.95	2.25
2114L-4	1024 x 4	(LP) (450ns)	8/17.95	2.10
2147	4096 x 1	(55ns)	9.95	call
TMS4044-4	4096 x 1	(450ns)	3.49	3.25
TMS4044-3	4096 x 1	(300ns)	3.99	3.75
TMS4044-2	4096 x 1	(200ns)	4.49	4.25
MK4118	1024 x 8	(250ns)	9.95	call
TMM2016	2048 x 8	(150ns)	call	call
HM6116-4	2048 x 8	(cmos) (200ns)	call	call
HM6116-3	2048 x 8	(cmos) (150ns)	call	call
HM6116-2	2048 x 8	(cmos) (120ns)	call	call
HM6116LP-4	2048 x 8	(LP) (cmos) (200ns)	call	call
HM6116LP-3	2048 x 8	(LP) (cmos) (150ns)	call	call
HM6116LP-2	2048 x 8	(LP) (cmos) (120ns)	call	call
Z-6132	4096 x 8	(Qstat) (300ns)	34.95	call

LP = Low Power Qstat = Quasi-Static

DYNAMIC RAMS

			Each	100 pcs
TMS4027	4096 x 1	(250ns)	2.50	2.00
MK4108	8192 x 1	(200ns)	1.95	call
MM5298	8192 x 1	(250ns)	1.85	call
4116-120	16384 x 1	(120ns)	8/29.95	call
4116-150	16384 x 1	(150ns)	8/18.95	1.95
4116-200	16384 x 1	(200ns)	8/13.95	call
4116-250	16384 x 1	(250ns)	8/11.95	call
4116-300	16384 x 1	(300ns)	8/13.80	call
2118	16384 x 1	(5v) (150ns)	4.95	call
MK4816	2048 x 8	(5v) (300ns)	24.95	call
4164-200	65536 x 1	(5v) (200ns)	call	call
4164-150	65536 x 1	(5v) (150ns)	call	call

EPROMS

			Each	8 pcs
1702	256 x 8	(1us)	4.95	4.50
2708	1024 x 8	(450ns)	3.75	3.50
2758	1024 x 8	(5v) (450ns)	9.95	8.95
TMS2516	2048 x 8	(5v) (450ns)	6.95	5.95
2716	2048 x 8	(5v) (450ns)	4.95	3.95
2716-1	2048 x 8	(5v) (350ns)	9.00	8.50
TMS2716	2048 x 8	(450ns)	9.95	8.95
TMS2532	4096 x 8	(5v) (450ns)	9.95	7.95
2732	4096 x 8	(5v) (450ns)	9.95	7.95
2732A-2	4096 x 8	(5v) (200ns)	call	call
2764	8192 x 8	(5v) (450ns)	call	call
TMS2564	8192 x 8	(5v) (450ns)	call	call

5v = Single 5 Volt Supply

EPROM ERASERS

	Timer	Capacity Chip	Intensity (uW/V,²)	
PE-14		6	5,200	83.00
PE-14T	X	6	5,200	119.00
PE-24T	X	9	6,700	175.00
PL-265T	X	20	6,700	255.00
PR-125T	X	16	15,000	349.00
PR-320T	X	32	15,000	595.00

Z-80

2.5 Mhz	
Z80-CPU	6.00
Z80-CTC	5.95
Z80-DART	15.25
Z80-DMA	17.50
Z80-PIO	6.00
Z80-SIO/0	18.50
Z80-SIO/1	18.50
Z80-SIO/2	18.50
Z80-SIO/9	16.95
4.0 Mhz	
Z80A-CPU	6.00
Z80A-CTC	8.65
Z80A-DART	18.75
Z80A-DMA	27.50
Z80A-PIO	6.00
Z80A-SIO/0	22.50
Z80A-SIO/1	22.50
Z80A-SIO/2	22.50
Z80A-SIO/9	19.95
6.0 Mhz	
Z80B-CPU	17.95
Z80B-CTC	15.50
Z80B-PIO	15.50
ZILOG	
Z6132	34.95
Z8671	39.95

8200

8202	34.95
8205	3.50
8212	1.85
8214	3.85
8216	1.80
8224	2.50
8226	1.80
8228	4.90
8237	19.95
8238	4.95
8243	4.45
8250	14.95
8251	4.75
8253	9.25
8253-5	9.85
8255	4.75
8255-5	5.25
8257	8.50
8257-5	8.95
8259	6.90
8259-5	7.50
8272	39.95
8275	29.95
8279	9.50
8279-5	10.00
8282	6.65
8283	6.65
8284	5.70
8286	6.65
8287	6.50
8288	25.00
8289	49.95

8000

8035	7.25
8039	7.95
INS-8060	17.95
INS-8073	29.95
8080	3.95
8085	7.95
8085A-2	11.95
8086	59.95
8088	39.95
8089	89.95
8155	7.95
8156	8.95
8185	29.95
8185-2	39.95
8741	39.95
8748	29.95
8755	32.00

DISC CONTROLLERS

1771	21.95
1791	29.95
1793	38.95
1795	54.95
1797	54.95
6843	34.95
8272	39.95
UPD765	39.95
1691	18.95
2143	18.95
INTERFACE	
8T26	1.69
8T28	2.49
8T95	.99
8T96	.99
8T97	.99
8T98	.99
DM8131	2.95
DP8304	2.29
MISC	
3341	4.95
76477	3.95
AY3-8910	12.95
MC3340	1.49
95H90	7.99
11C90	13.95
8202A	34.95
3242	7.95
MC3480	9.00
MC4024	3.95
MC4044	4.50
3205	3.50
BIT-RATE GENERATORS	
14411	11.95
BR1941	11.95
4702	12.95
COM5016	16.95
MM5307	10.95
UARTS	
AY3-1014	6.95
AY5-1013	3.95
PT1472	9.95
TR1602	3.95
2350	9.95
TMS6011	5.95
IM6402	7.95
IM6403	8.95
INS8250	14.95
KEYBOARD CHIPS	
AY5-2376	11.95
AY5-3600	11.95
74C922	5.25
74C923	5.50
CLOCK CIRCUITS	
MM5314	4.95
MM5369	3.95
MM5375	4.95
MM58167	8.95
MM58174	11.95
MSM5832	6.95

6800

68000	call
6800	4.95
6802	10.95
6808	13.90
6809E	19.95
6809	19.95
6810	2.95
6820	4.95
6821	4.95
6828	14.95
6840	12.95
6843	34.95
6844	25.95
6845	16.95
6847	12.25
6850	3.45
6852	5.75
6860	10.95
6862	11.95
6875	6.95
6880	2.95
6883	24.95
68047	24.95
68488	19.95
6800 = 1MHZ	
68B00	10.95
68B02	22.25
68B09E	29.95
68B09	29.95
68B10	7.95
68B21	12.95
68B45	35.95
68B50	12.95
68B00 = 2 MHZ	

6500

1 MHZ	
6502	6.95
6504	6.95
6505	8.95
6507	9.95
6520	4.35
6522	8.75
6532	11.25
6545	22.50
6551	11.85
2 MHZ	
6502A	9.95
6522A	11.70
6532A	12.40
6545A	28.50
6551A	12.95
3 MHZ	
6502B	14.95

CRYSTALS

32.768 khz	1.95
1.0 mhz	4.95
1.8432	4.95
2.0	3.95
2.097152	3.95
2.4576	3.95
3.2768	3.95
3.579535	3.95
4.0	3.95
5.0	3.95
5.0688	3.95
5.185	3.95
5.7143	3.95
6.0	3.95
6.144	3.95
6.5536	3.95
8.0	3.95
10.0	3.95
14.31818	3.95
15.0	3.95
16.0	3.95
18.0	3.95
18.432	3.95
20.0	3.95
22.1184	3.95
32.0	3.95

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8086	$29.95
68000 8MHZ	$99.95

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2732 32K EPROMS 8/$7.95 EACH

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74LS00

74LS00	.25	74LS85	1.15	74LS168	1.75	74LS295	1.05
74LS01	.25	74LS86	.40	74LS169	1.75	74LS298	1.20
74LS02	.25	74LS90	.65	74LS170	1.75	74LS324	1.75
74LS03	.25	74LS91	.89	74LS173	.80	74LS352	1.55
74LS04	.25	74LS92	.70	74LS174	.95	74LS353	1.55
74LS05	.25	74LS93	.65	74LS175	.95	74LS363	1.35
74LS08	.35	74LS95	.85	74LS181	2.15	74LS364	1.95
74LS09	.35	74LS96	.95	74LS189	9.95	74LS365	.95
74LS10	.25	74LS107	.40	74LS190	1.00	74LS366	.95
74LS11	.35	74LS109	.40	74LS191	1.00	74LS367	.70
74LS12	.35	74LS112	.45	74LS192	.85	74LS368	.70
74LS13	.45	74LS113	.45	74LS193	.95	74LS373	1.75
74LS14	1.00	74LS114	.50	74LS194	1.00	74LS374	1.75
74LS15	.35	74LS122	.45	74LS195	.95	74LS377	1.45
74LS20	.25	74LS123	.95	74LS196	.85	74LS378	1.18
74LS21	.35	74LS124	2.99	74LS197	.85	74LS379	1.35
74LS22	.25	74LS125	.95	74LS221	1.20	74LS385	1.90
74LS26	.35	74LS126	.85	74LS240	1.29	74LS386	.65
74LS27	.35	74LS132	.75	74LS241	1.29	74LS390	1.90
74LS28	.35	74LS136	.55	74LS242	1.85	74LS393	1.90
74LS30	.25	74LS137	.99	74LS243	1.85	74LS395	1.65
74LS32	.35	74LS138	.75	74LS244	1.29	74LS399	1.70
74LS33	.55	74LS139	.75	74LS245	1.90	74LS424	2.95
74LS37	.55	74LS145	1.20	74LS247	.75	74LS447	.37
74LS38	.35	74LS147	2.49	74LS248	1.25	74LS490	1.95
74LS40	.35	74LS148	1.35	74LS249	.99	74LS624	3.99
74LS42	.55	74LS151	.75	74LS251	1.30	74LS668	1.69
74LS47	.75	74LS153	.75	74LS253	.85	74LS669	1.89
74LS48	.75	74LS154	2.35	74LS257	.85	74LS670	2.20
74LS49	.75	74LS155	1.15	74LS258	.85	74LS674	9.65
74LS51	.25	74LS156	.95	74LS259	2.85	74LS682	3.20
74LS54	.35	74LS157	.75	74LS260	.65	74LS683	2.30
74LS55	.35	74LS158	.75	74LS266	.55	74LS684	2.40
74LS63	1.25	74LS160	.90	74LS273	1.65	74LS685	2.40
74LS73	.40	74LS161	.95	74LS275	3.35	74LS688	2.40
74LS74	.45	74LS162	.95	74LS279	.55	74LS689	2.40
74LS75	.50	74LS163	.95	74LS280	1.98	74LS783	24.95
74LS76	.40	74LS164	.95	74LS283	1.00	81LS95	1.69
74LS78	.50	74LS165	.95	74LS290	1.25	81LS96	1.69
74LS83	.75	74LS166	2.40	74LS293	1.85	81LS97	1.69
						81LS98	1.69

LINEAR

LM301V	.34	LM1800	2.99
LM308V	.98	LM1889	2.49
LM309K	1.49	LM3900	.59
LM311	.64	LM3909V	.98
LM317T	1.95	LM3914	3.95
LM317K	3.95	LM3915	3.95
LM318	1.49	LM3916	3.95
LM323K	4.95	75451V	.39
LM324	.59	75452V	.39
LM337K	3.95	75453V	.39
LM339	.99		
LM377	2.29	**BI FET**	
LM380	1.29	TL071	.79
LM386V	1.50	TL072	1.19
LM555V	.39	TL074	2.19
LM556	.69	TL081	.79
LM565	.99	TL082	1.19
LM566V	1.49	TL083	1.19
LM567V	1.29	TL084	2.19
LM723	.49	LF347	2.19
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ST = SOLDERTAIL

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4013	.45	4093	.95
4014	.95	4098	2.49
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4023	.35	4508	1.95
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4025	.35	4511	.95
4026	1.65	4512	.95
4027	.65	4514	1.25
4028	.80	4515	2.25
4029	.95	4516	1.55
4030	.45	4518	1.25
4034	2.95	4519	1.25
4035	.85	4520	1.25
4040	.95	4522	1.25
4041	1.25	4526	1.25
4042	.75	4527	1.95
4043	.85	4528	1.25
4044	.85	4531	.95
4046	.95	4532	1.95
4047	.95	4538	1.95
4049	.55	4539	1.95
4050	.55	4543	2.70
4051	.95	4555	.95
4053	.95	4556	.95
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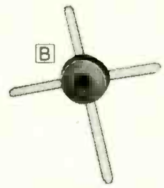
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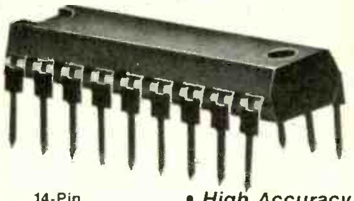
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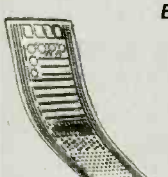

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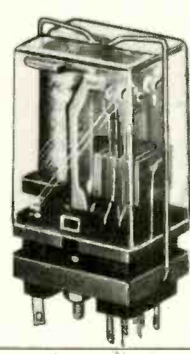

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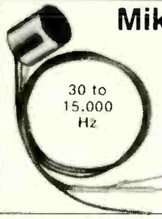

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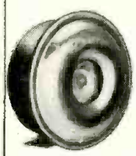

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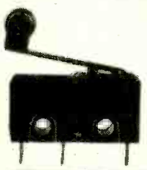

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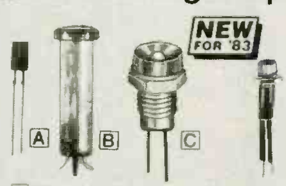
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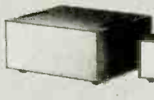
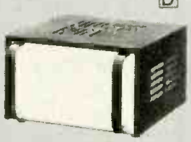

B


C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Voice of Music Model 1404 amplifier. Need schematic. Warren Chamberlin, 4166 Almond St., Riverside, CA 92501.

Hammarlund Model HZ-110 receiver. Need schematic and operating manual. Rod Herrada, 17913 Florwood Ave., Torrance, CA 90504.

Texas Instruments Speak and Spell. Need schematic diagram or any information available. M.I. Saleem, Consultants Department, Ministry of Planning, Box 15, Kuwait.

Gonset Model G-76 transceiver, **Paco** Model G-34 square-wave generator and **RCA** Model WV77E voltommeter. Need manuals and schematics. Larry Forster, 420 Herndon Dr., Evansville, IN 47711.

Elco Model 368 sweep generator. Need operation manual and schematic. C.R. Wilson K1GVA, 61 Warwick St., Portland, MN 04102.

Knight Model 400 tube checker. Need operating manual and tube chart. Norman Reiss, 633 Hoff St., Random Lake, WI 53075.

I.D. Electronics Model CF-501 FM/AM clock radio. Need service manual, schematic and parts list. Richard Urciolo, Keyes Ferry Acres, Box 353, Harpers Ferry, WV 25425.

Radio City Products Inc., Model 664 voltohmmeter. Need schematic and alignment data. J. Welden Dupre, #7 HMS Court, Houma, LA 70360.

H.H. Scott LK72/2996 amplifier. Need power transformer part #TR 13-3. Ed Wheeler, 1135 La Rosa Ct., Turlock, CA 95380.

Hammarlund Model 212 CB. Need schematic and operating manual. Theodore Nadeje, 2108 Imperial Palm Dr., Largo, FL 33541.

Elco Model 460 wide-band oscilloscope. Need schematic. Arthur Searles, Star Route, Box 53, Mineral Wells, TX 76067.

Hammarlund Model Sp-500-SX receiver. Need schematic and any additional information. Glenn Durant, 1320 7 Ave., Greeley, CO 80631.

Boes Dayton Model 416 signal generator and Model 214 electron beam tube tester. Need operating service manuals, and schematics. David P. Urban, 36 Spring St., Port Henry, NY 12974.

Superior Instruments Co. Model TW-11 tube tester. Need schematic and roll chart. Vic Tomalonis, Box 136, Painter, VA 23420.

Fairchild Model 701 oscilloscope. Need operating manual, schematics and service manual. Paul Tindall, Rm. 213, Spedding Hall ISU, Ames, IA 50011.

Hallicrafters Model S-38D multi-band receiver. Need schematic and service manual. Clarence E. Morgan, 2332 S. Grove, Wichita, KS 67211.

Telequipment Model S32AR oscilloscope, **BWD Electronics** Model 141 sine and square wave generator, and **Hammond** "The Sounder" rhythm box. Need any information available. Errol May, Box 74, Delhi, Ontario, Canada N4B 2W8.

Hammarlund Model SP 600 radio receiver. Need any information available. L. Waters, Jr., P.O. Box 24283, Chicago, IL 60624.

RCA Model 155 oscilloscope, **Hickok** Model 530 tube tester, **Hallicrafters** Models S20R and S40, and **Devry Tech. Instruments** Model 1609 oscilloscopes. Need schematics and operating instructions. J.T. Lohman, 3221 S. Granby St., Aurora, CO 80014.

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Hickok Model 533A tube tester and Model CA-5 tester adaptor. Need schematics and manuals. H. Lookabill, 504 W. 86th Terr., Kansas City, MO 64114.

Boonton Model 202B signal generator. Need operation manual and schematic. Edward E. Leibert, Rt. 4, Box 70, Walla Walla, WA 99362.

Knight Model KG-600B tube tester. Need schematic and operation manual. Ed Barlow, PO Box 29, Tweed, Ontario, Canada K0K 3J0.

Hickok Model 195 oscilloscope. Need owner's manual. Steve Louas, 103 South Hall, Menomonie, WI 54751.

Atwater Kent Model 33 radio. Need schematic. J. Loubriel, 524 James St., New Milford, NJ 07646.

JFD Model 600 B&W TV camera. Need schematic and manual, Tom Workman, Rt. 9, Box 688, Tuscon, AZ 85743.

Lafayette Model SQ-L 4 channel decoder. Need schematic and service manual. Kenneth A. Eberle, Rt. 3, Box 627, Hollywood, MD 20636.

Altec Lansing Model 729A Acousta-Voicette stereo equalizer. Need schematic, service manual, and wiring diagram. Anthony Taylor, 8419 Rambler Dr., Adelphi, MD 20783. *(Continued on page 119)*

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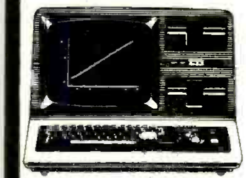

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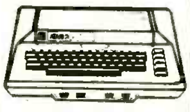

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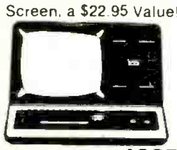


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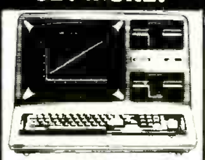


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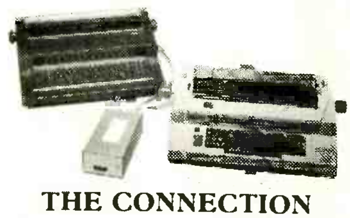

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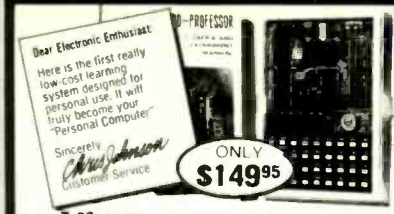

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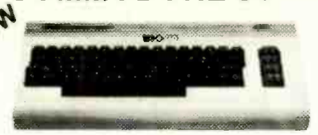

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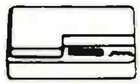

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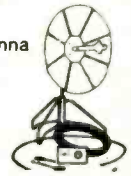

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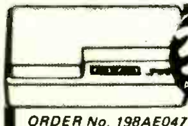

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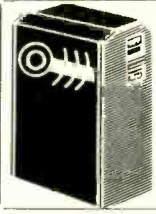

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A NEW TV CRT DESIGNATION STANDARD has been developed by Electronics Industries Association (EIA) of Japan and Pro Electron of Europe. In the new scheme, each designation consists of alphanumeric symbols coded into five or six symbol groupings. The first symbol indicates whether the tube is for a receiver (A) or a monitor (M); the second symbol gives the diagonal screen measurement in centimeters; a three-letter code defines a general family of tubes; the fourth symbol distinguishes color (a two-digit number) from monochrome (one digit); the fifth is the phosphor designation (single letter for color, two letters for monochrome); and a sixth symbol is added for tubes having integral yokes.

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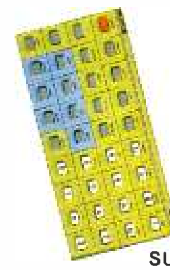

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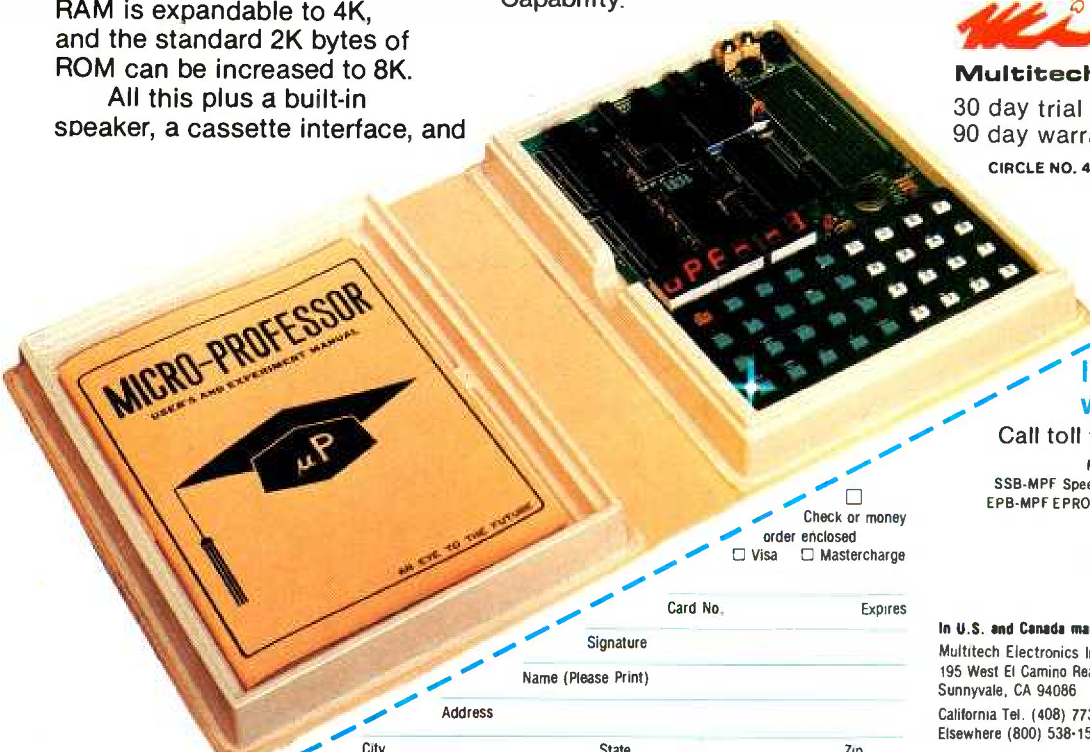

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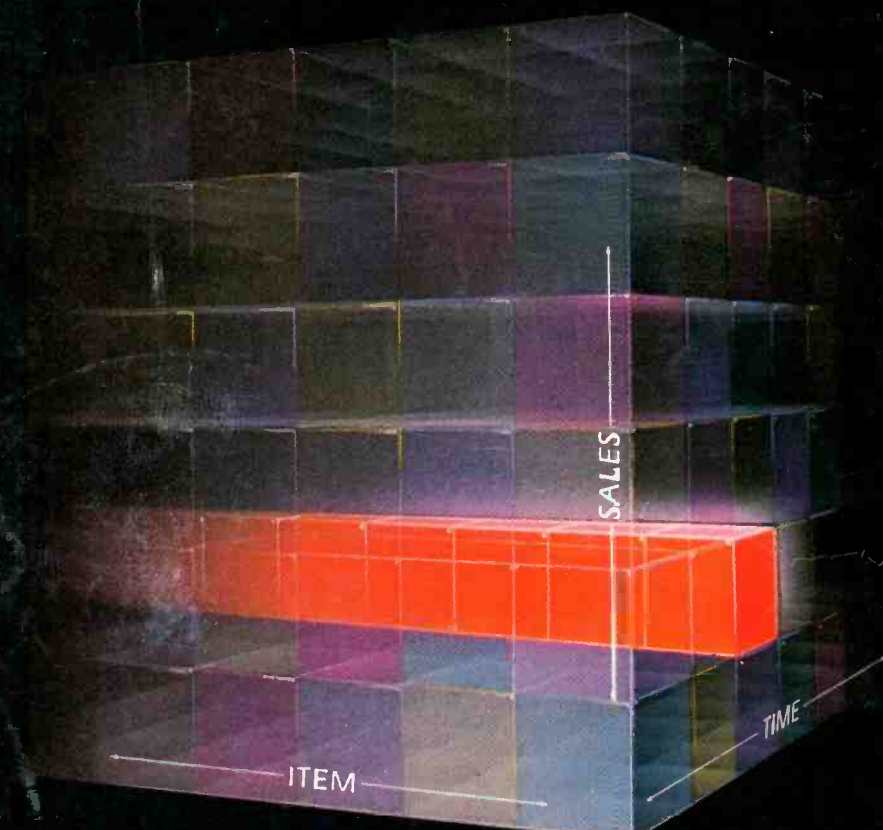

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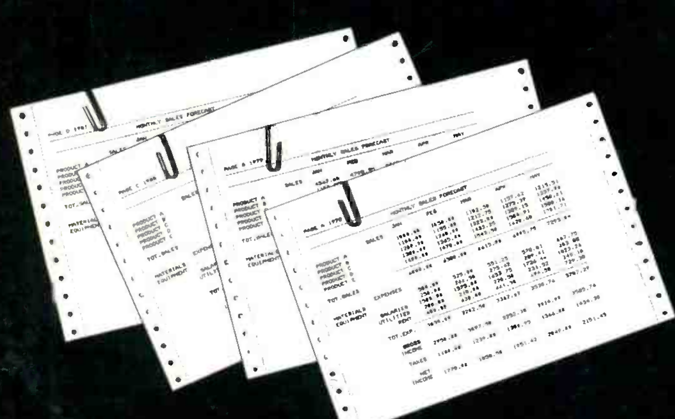

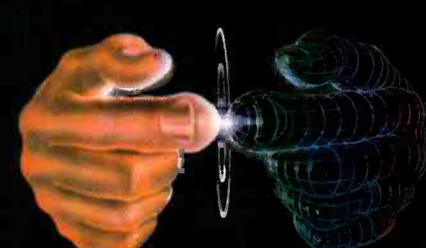

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