THE COMPUTER HOBBYIST

VOLUME 1 NUMBER 2 DECEMBER 1974

With this issue, THE COMPUTER HOBBYIST begins regular publication. It will be published once a month in Raleigh, North Carolina. Plans are to send out a new issue during the first week of each month. We appologize for not being on time this time, but after all it is only our second printing.

Since THE COMPUTER HOBBYIST has decided to publish regularly, we have secured a post office box for newsletter mail. Our new address is:

The Computer Hobbyist
Box 295
Cary, North Carolina 27511

Those who have written us letters of intent to subscribe will find a bill for one year's subscription at $6.00 for 12 issues printed on the inner side of the protective mailer. For those who are receiving a sample issue there is a subscription blank printed on the inner side of the mailer.

Because the name THE COMPUTER HOBBYIST is used many times in our text, it will be abbreviated as TCH in this issue and future issues. Also since there will be many schematic diagrams printed in TCH, we have included in this issue an article which we hope will standardize the notation used.

This issue contains part 2 of the graphics series which was started in issue 1, an article on logic notation, an article on interfacing teleprinters, and a write-up on a new 8080 microcomputer kit. Also included are most of the columns which will be standard in TCH. Your comments on the content of the newsletter are welcomed.

LETTERS

TCH will publish a few of our more interesting letters each month along with comments by the staff. This month we have a couple just to get started.

Gentlemen:

Having built a TV Typewriter, I would like to provide a few comments that may save future builders some time.

If on line one, to the left of each character displayed, several undesired bits of video appear, the output line register on the memory A board is probably being loaded during the previous 9-12 blank sequence. To correct this, take the output load command (pin 1, IC9, timing board) and OR it with the 9-12 blank clock (pin 11, IC7, timing board). Substitute this signal for the present output load command by breaking the connection leading to pin 45 on the timing board and jumpering wires to a spare OR gate in IC8.

If one is having difficulty stabilizing the display on an old AC-DC TV set, the problem may be due to AC ripple in the TV set. This can be verified by running the set on a 120VDC power supply.

One jumper connection on the timing board is easy to miss. If timing difficulties appear, check that pin 11, IC10 goes to test point Q (not point R as shown in the derived timing schematic).

Timing board problems can be easily traced with a TTL logic breadboard by replacing the 4.56 MHz oscillator with a variable audio oscillator and checking timing points with state indicators.

I recommend that one use reliable IC's in the project, especially on the cursor board where timing pulses are critical.

James T. Parker

Thanks. I'm sure that there are readers who will benefit from your advice. TCH hopes to be able to assist our readers with their problems, either hardware or software. If you have advice or a problem please send us a letter.

The Computer Hobbyist:

Consider this my letter of intent to subscribe.

You may wish to consider these suggestions:

Conduct a survey to determine content of future articles in larger editions by asking the subscriber's

1. Knowledge of computers, uses, operation, etc.
2. Specific areas of interest (software, storage, displays, input/output interfacing, etc.)
3. Uses of computer techniques (telemetry, signal processing, statistical operations, video games similar to "Odyssey", etc.)
4. Specialized equipment in possession or readily available (keyboards, displays, teleprinter gear, card hardware, mag. tape equipment, etc.)

This survey could easily be performed through a returnable form in a future issue.

Publish a list of material available for self-instruction in various phases of computer technology.

Include a want-ad section. Fees charged could help defray costs and maintain support of the publication even with a reduced number of subscribers.

Start a "Trivia" column for reader contribution of tips and shortcuts that individual subscribers have discovered, developed, concocted, or just want to pass on to the gang.

W. Smyth

TCH will conduct a survey in the January issue to determine the background and desires of readers. In the meantime, feel free to write us about any type of articles you would like to see. As for want ads, this issue begins a column which is free to subscribers. A trivia column is a good suggestion and will be started if sufficient material is submitted, so start sending in trivia!

THE 8080 IS HERE

It is getting to the point that every week when a new Electronic News, Computerworld, or Electronic Design magazine is received a new case of "future shock" leaves us reeling for some time. The January 1975 issue of Popular Electronics is no exception. In that issue another computer kit was announced using not the common, cheap (we thought) 8008 or 8008-1 chip but the new, super-performance 8080.

The company is MITS and the computer is dubbed the ALTAIR 8800. The price for a basic kit (less case, switches, power supply) of $298 left us here at TCH very skeptical as to the inclusion of the 8080 chip. The singles list price of $360 for the 8080 and the ambiguous language of the Popular Electronics article led us to a long and very informative conversation with H. Edward Roberts, president of MITS.

Yes, Virginia, there really is an 8080 in the basic, $298 kit. Not only that but the system is properly organized around a comprehensive, single bus, somewhat like DEC's UNIBUS but synchronous. 256 words of RAM are also included in the basic kit to get the buyer started. The lack of a power supply in the basic kit is a minor problem since MITS's philosophy is local regulators on each board. Other versions of the ALTAIR 8800 currently offered are a complete system kit with cabinet, console, and power supply for $397 and an assembled, checked out, 90 day warranted system for $498. First deliveries are slated for mid-January, 1975.

Large memory users have not been forgotten by MITS. Although the memory board supplied with the system uses 1K static RAM's and has a maximum capacity of 1024 words, larger boards with 4096 words each will be available. These will use the new 4K dynamic RAM chips which until now have been enthusiastically ignored even though the price per bit in 25 quantity from industrial distributors is actually less than surplus 1103's. The 4K RAM's being used are the TI style with 22 lead packages, the most common type. Price for the 4K board will be about $230.

Besides the computer, MITS has on their drawing boards or in the lab a complete line of peripheral gear for their systems. There will be four different types of general I/O interface boards, one 8 bit parallel and the other three serial using UART's. An audio recorder modem usable with one of the serial interfaces will be available. A 16 line by 64 character alphanumeric CRT display is planned using a high-quality monitor, which is required for such a long line. Both hard and floppy disk controllers are planned using, you guessed it, an 8080 chip for the control intelligence. These disk controllers will use the inherent direct memory access capability of the ALTAIR bus. Other more esoteric devices mentioned in our conversation include a 32 by 32 element image sensor, PROM programmer interface, and 8 bit analog-to-digital and digital-to-analog converters.

MITS has not forgotten software either. Naturally an assembler has been written. This one is unusual however in that it is a one-pass assembler. It will be free to customers who purchase more than 8K of memory with their ALTAIR 8800. Of course I/O handlers are being written for each peripheral device. In addition an operating system is being written. High-level languages are being considered with BASIC at the top of the list. Software will probably be for sale to anybody.

The natural question is how can MITS offer so much for so little and stay in business. The answer is both supprising and indicitive of near future trends. It is well known that Intel and others can be induced into giving deep discounts on complex IC's when quantities get into the range of 10K to 100K, particularly with the current slump in the economy. Deep discounts here mean a factor of five or so. Mr. Roberts said flatly in response to our question that his company believes the potential computer hobbyist market is larger than the amateur radio market. The latter has over 300,000 liscense holding members, supports several high quality publications and manufacturers, has several active nationwide and worldwide organizations, and even has a yearbook. The prospect of a "computernik" on every block is truly mind-boggling. In the words of Mr. Roberts, the whole concept is truly "super!"

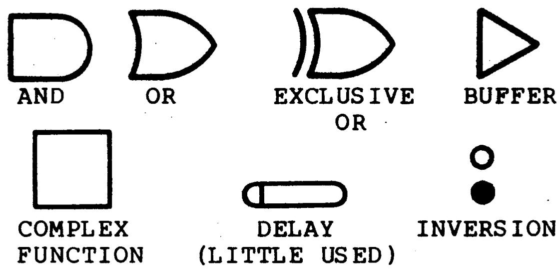
LOGIC SYMBOL CONVENTIONS
or
HOW TO READ TCH LOGIC DIAGRAMS

It is a historical fact that an intellectual discipline does not expand and mature until a suitable, human-engineered notation is developed for that discipline. The notation must lend itself to convenient, meaningful manipulations which aid the thought processes of the user. In this way new properties of the discipline are discovered, understood, and propogated.

The most obvious example of this principle is the development of mathematics. Roman numerals adequately represented numbers but could not be conveniently manipulated and combined. Arabic numerals and the base-radix method of notation helped unlock all of the "secrets" of mathematics since discovered. Music also was static in its development until the present notation was devised and adopted. In short, a good method of notation aids the thinking of the user and helps guide him to the desired conclusion.

Logic design is also an intellectual discipline which requires a good notation method. In the early days of computers only a few highly talented people practiced logic design. Symbologies such as IBM's square boxes for everything or DEC's schematicized diode-transistor symbols were developed for the purpose of documentation. These and other logic notations were of little value in the design or understanding of digital logic systems. Several years ago the Military realized that in the future it would become necessary for a great number of people of average intelligence to design, understand, and troubleshoot logic systems. With this in mind MIL-STD-806C was formulated. Logic diagrams in TCH will conform to the spirit of this standard.

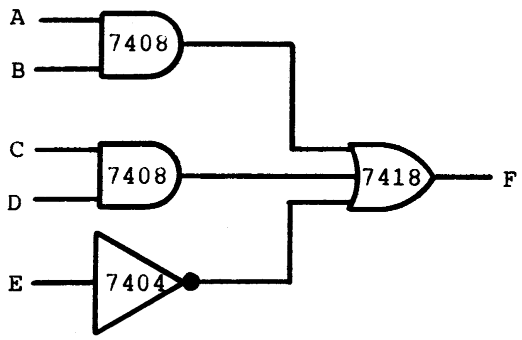
The 806C standard consists of two fundamental parts, the mnemonic logic shapes and the "dot convention." In addition, TCH will adopt some additional standards designed to reduce ambiguity and confusion. The basic logic shapes are shown below:



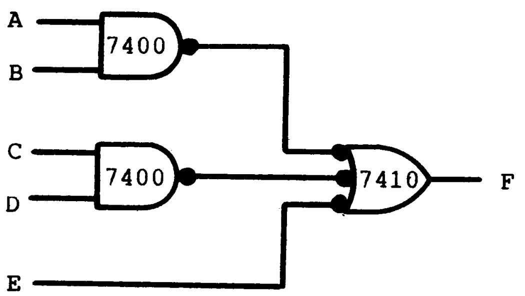
Note that the triangle by itself is a non-inverting buffer or amplifier. The solid dot and open circle are interchangable, with the former being easier to draw. Whenever a signal passes through a dot it is logically inverted, i.e., a one becomes a zero and vice-versa. Thus an inverter such as a 7404 may be drawn with a dot on the output or on the input. The same holds for the other logic symbols, dots are allowed on both the inputs and the outputs.

Figure 1 shows the truth table of the possibilities of AND and OR gates and dots. A little observation should reveal that the truth tables for the NAND and the OR-NOT gates are identical as are the NOR and AND-NOT gates. Likewise an AND gate and an NOR-NOT gate are the same and the OR and NAND-NOT gates are the same. From this the following rule can be formulated: The truth table or a gate is unchanged when the DOT/NO-DOT status of all lines is flipped and the AND and OR symbols are interchanged. This also holds for any number of inputs. This is actually just an expression of DeMorgan's theorem in this logic symbol notation. The rule also applies to groups of interconnected gates. Figure 2 shows the two representations of the common 7451 AND-OR-INVERT gate.

At this point the question arises as to why play around with dots and truth tables at all, why not just draw 7400's as NAND's and 7402's as NOR's, etc. Although doing so would certainly document the circuit, it would in most cases hide the logical functioning of the circuit and thus be bad notation. An example should serve to prove the point. Assume that for some reason the logic function $F=(A \cdot B)+(C \cdot D)+\overline{E}$ is needed (. means AND and + means OR) and that A, B, C, D, and E are available in their true forms only. TTL gates are now available to realize this function directly as shown below:



However the following will also work with some important advantages:



In order to understand how the above works consider the line at the output of the topmost 7400. A and B are ANDED together by the AND symbol and then the result is inverted by the dot at the output. The inverted result then travels along the wire and is inverted again at the 7410 input. Since the two inversions cancel, the OR symbol "sees" A.B at this input. The same holds for the other 7400. E is inverted as it enters the OR also giving $\overline{E}$ at that input as desired. Think of how difficult it would be to understand the circuit operation if all of the gates were drawn as NAND's.

Advantages of the second circuit include the elimination of an inverter, use of more common less costly IC's, 50% greater speed, and 40% less power consumption. In addition, if the F output needed to drive a heavy load, the 7410 could be replaced with a 7440 with little penalty.

Synthesis of the second circuit can be as straightforward as the first. One would first draw the circuit with AND and OR symbols directly from the equation. Then by either consulting figure 1 or applying the dot movement rule to available gates, the design of the second circuit will almost automatically emerge. In order to test your understanding of this principle, try the following example using no more than two full packages of gates.

$$\overline{F1}=(\overline{A}+\overline{B}).\overline{C}.\overline{D}$$
$$\overline{F2}=(\overline{I}.J)+(J.\overline{K})$$
$$F3=F1+F2$$

A	B	AND	OR	NAND	NOR	AND-NOT	OR-NOT	NAND-NOT	NOR-NOT
0	0	0	0	1	1	1	1	0	0
0	1	0	1	1	0	0	1	1	0
1	0	0	1	1	0	0	1	1	0
1	1	1	1	0	0	0	0	1	1

Fig. 1 Variations Of Two Input Gates

Fig. 2 Two Representations of 7451

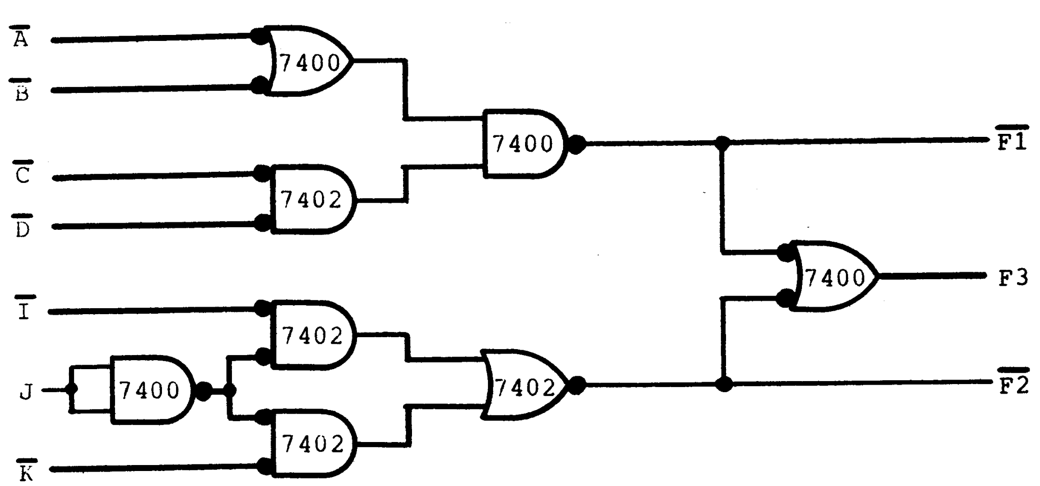
A line with dots on both ends is called a false or active-low line. The RESET or CLEAR inputs of many flip-flops and counters function when a zero is applied and have no effect when a one is applied, hence the term "active-low." Such inputs are always drawn with a dot. If a name is to be given to the line for some reason, a horizontal bar would be drawn above the name indicating that it is active-low.

When an inverter such as a 7404 is in a line, the dot may be either at the input or the output. The choice is usually made such that the inverter's dot is placed on the line that already has a dot on the other end. Non inverting buffers such as 7407's or 7417's would have no dots if placed in an active-high line and dots on both input and output when placed in an active low line. The general rule is that the dot status of both ends of a line is the same unless a negation is specifically required. A notable exception to this is the $\overline{Q}$ output on flip-flops and single-shots. The dot is customarily omitted on such outputs and the bar above the Q is substituted for it.

Some flip-flops and counters have what is called a "dynamic" clock or "edge-triggered" clock. An honest edge-triggered clock responds only to the transition from one logic state to another. There are no restrictions on what other inputs can do when the clock is stationary or making the opposite non-triggering transition. Such dynamic inputs are denoted on TCH drawings by a small triangle adjoining the inside edge of the logic symbol at the input. A positive edge-triggered input responds to a zero-to-one transition and has no dot. A negative edge-triggered input responds to one-to-zero transitions and is drawn with a dot as well as the triangle. On flip-flops and counters that are not truly edge-triggered such as 74107's and 74161's, the dot is assigned to the clock according to the transition direction that causes the outputs to change. Thus the 74107 would have a dot on the clock input whereas the 74161 would not. Neither would have the triangle since there are restrictions on what the synchronous inputs (J, K, LE, CEP) can do when the clock is stationary in one of its two possible states (low for 74161, high for 74107) for predictable operation.

There are additional standards for data busses, bit numbering, MSI pin/function labelling and drawing organization that will be dealt with in future articles as the need arises.

ANSWER TO LOGIC DESIGN PROBLEM

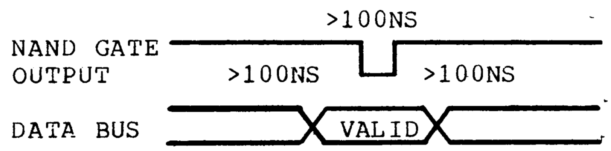


A GRAPHICS DISPLAY FOR THE 8008 Part 2 by Hal Chamberlin

This month the digital and analog circuitry necessary to generate X, Y, and Z deflection voltages for the display scope will be described. The major and minor deflection subsystems are described separately so that they may be built separately or the minor system omitted in purely graphic applications. The speed of the display circuitry has been chosen to match the speed of the 8008 or 8008-1. The vector draw time is 100 microseconds plus 20 us for settling and the stroke draw time is 40 us. This translates into a rather modest scope bandwidth requirement of 100kHz for X and Y and 2 mHz for Z. DC coupling is required however on all three axes. The included circuits have been thoroughly tested and have been operating on The Computer Hobbyist's demonstration 8008 system for two months.

All of the parts used in the display interface are standard and readily available with the possible exception of the two 8 bit digital-to-analog converters. The Motorola MC1408L8 is specified on the drawings because it is the least expensive 8 bit converter known to the author. For more precision or in the case of difficulty in getting the Motorola part, a DAC 371-8 from Hybrid Systems can be used. The price for two is $25.00 and throw in another dollar for handling and shipping. Type 748 op-amps with external compensation were used instead of 741's for two reasons. The first is that the bandwidth and slew rate of the 741 varies considerably from unit to unit, particularly with surplus parts. This is due to the on chip 30 pF MOS capacitor which suffers greatly from manufacturing tolerances. The second is that reduced compensation is possible in circuits with gain thereby increasing bandwidth.

The address decoding and data registers for the main deflection system is shown in Figure 1. The four NAND gates at the left decode the four OUT instructions; XMOV, YMOV, XSTOR, and YDRAW as described in the last issue. The inputs are connected as required by the host system such that the outputs pulse low cleanly when the output data bus contains valid data as shown below:



The following OR-NOT gates invert and transfer the output strobes to the three pairs of latches. For XMOV both the X storage latches and the X latches are enabled and the bus data ripples through the X storage latches into the X latches. For XSTOR only the X storage latches are enabled. For YMOV, the Y latches are enabled which loads them with bus data and the X latches are enabled which loads them with the contents of the X storage latches. A DRAW signal is also generated which triggers the vector generator. YMOV simply enables the Y latches to be loaded with the bus data. 7437's are used for the OR-NOT gates instead of 7400's since the clock inputs on the 2 7475's present 16 loads total. The 7404's connected to the data bus isolate the loading presented by the 7475 D inputs from the data bus. The logic is drawn for a false data bus. A true data bus can be used if Q and $\overline{Q}$ outputs are interchanged on the X and Y latches but not the X storage latches. This applies also to the minor system if used.

The signals leaving from the right of Figure 1 enter at the left of Figure 2 which shows the X and Y D-to-A converters. The MC1408 output acts like a programmable current source. When the binary input is all zeroes, the output is essentially an open circuit. When the input is all ones, the output sources a negative current equal to 255/256 of the reference current into pin 14. Intermediate binary inputs provide the equivalent fraction of the reference current to the output. This reference current is set to approximately 2 MA by the 2.7K resistor connected to the zener regulated +5.1 volt supply. The 0 to -2 MA analog output is summed with a +1MA fixed current in an op-amp which converts the resulting -1MA to +1MA current into a -2.5 to + 2.5 volt voltage. The 1K trimpot adjusts the output offset so that a zero word from the 8008 (10000000 to the MC1408) results in 0 volts at the op-amp output. The 500 ohm trimpot adjusts the output scale factor so that a -128 from the 8008 (00000000 to the MC1408) results in -2.5 volts output.

Figure 3 shows an alternate circuit used with the Hybrid Systems DAC 371-8. Basic operation is similar except that a positive current is sourced from the output and an internal 2MA reference is provided. The 5.1 volt reference has been made negative because of the positive output current. The op-amp is reconfigured for non-inverting operation. This setup is about twice as fast as the previous one, even though the DAC itself is slower, because the reduced compensation allowed by the 2.5 gain of the op-amp gives a faster slew rate. The speed difference is of no consequence in this display generator however.

The raw X and Y voltages from either DAC go to Figure 4 which is the vector generator and timing logic. The vector generator is based on CD4016 quad analog switches. Each switch has two signal terminals and a control terminal. When the voltage applied to the control terminal is equal to the VSS supply voltage, (-7.5 volts here) the switch is off and the two signal terminals are isolated. When the control terminal is at VDD (+7.5 volts) the switch is on and the signal terminals are connected together through about 300 ohms. The switch will behave properly however only when the signal voltage is confined into the range from VSS to VDD or +7.5 to -7.5 volts in this case. The VSS and VDD voltages are obtained from zener regulators powered from the +15 and -15 volt supplies used by the op-amps. The 2N3906 transistors form two level shifters to convert TTL 0 and +3 volt logic levels to +7.5 and -7.5 volt logic levels required by the switch control. Transistors slower than the 2N3906 should not be substituted in the level shifters.

In the quiescent state switches 1 and 3 are on and 2 is off. This allows the raw X voltage into the two storage capacitors which are charged to that voltage. The voltage accross C2 is buffered by the output amplifier and becomes the main X deflection voltage. This results in an output voltage range of -2.5 volts to +2.5 volts for full screen deflection, more than adequate for most scopes.

When a YDRAW is executed, the first single-shot is fired for a 20 microsecond settle delay. This single-shot through the OR-NOT gate turns switches 1 and 3 off. The voltage on C1 and C2 thus remains at the old value while RAWX and RAWY move toward and settle at their new values. Op-amp A2 is connected such that its output settles to twice the new value minus the old value. It can be shown that the output of A2 will always lie in the range of -7.5 to +7.5 volts, keeping the analog switch happy. The worst case occurrs when the old voltage is -2.5 volts and the new voltage is +2.5 volts (or vice-versa). 2*NEW-OLD = 2*2.5-(-2.5) = 5+2.5 = 7.5 volts.

When the first single-shot times out it fires the second single-shot which turns the beam on and turns switch 2 on. Switches 1 and 3 remain off because of the OR-NOT gate. An R-C delay has been added to delay gate response to the turnoff of the first single-shot until the second single-shot triggers, thus avoiding a glitch in the gate output. The integrating capacitor, C2, now starts charging toward the 2*NEW-OLD voltage through switch 2 and its series resistance along an exponential curve. The circuit is adjusted so that the second single-shot times out just as the voltage on C2 crosses the desired new endpoint voltage. At this time the beam is blanked, switch 2 turns off, and switches 1 and 3 turn back on. The C2 voltage adjusts itself to exactly the new voltage through switch 3 thus preventing any endpoint error from accumulating. The fact that the output voltage changes along a portion of an exponential curve has no bearing on the straightness of the displayed line provided both axes are identical. The beam velocity does change by a factor of two from beginning to end however. The only effect of this is a very slight difference in brightness between the beginning and the end of the line.

When an XMOV (YMOV for the identical Y circuitry) is executed, the raw X voltage changes to the new value but the timing single-shots are not fired. The switches remain in their quiescent state and the storage capacitors gradually charge to the new voltage. The beam also remains off and the net result is a rapid (about 25 microseconds) move to the new position.

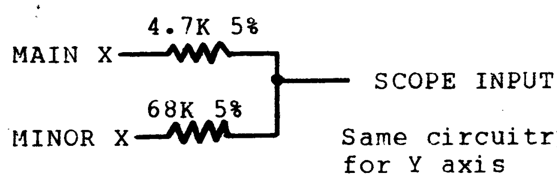
Adjustment of the vector generator is fairly simple. First adjust the two single-shots to 20 and 100 microseconds respectively. Finally adjust X and Y SLOPE so that there is no correction in output voltage at the end of a draw cycle. The visual effect of the slope controls is either an overshoot or a shortfall of the vector endpoint with respect to their desired position. A good test pattern is a simple square, preferably one with full scale coordinates.

Figure 5 shows the minor deflection system used for conveniently drawing characters or small, simple objects. Two more OUT instructions, MINSZ and MINXY are decoded by the NAND gates. The data inputs to the latches are taken from the buffering inverters used in the main deflection system. Seven bits are active in the MINXY latches with the eighth left for software use in marking the end of a minor coordinate list. Bits 0 through 5 are the minor X and Y coordinate bits. The latch outputs are fed through open collector inverters into a resistor array that is actually a pair of 3 bit multiplying digital-to-analog converters. The open collector outputs swing between approximately .15 volts for logic zero and the reference voltage supplied by the op-amps in the size register circuitry for logic one. The reference voltage can vary between .15 volt and 5 volts depending on the size register content. If a size register is not desired, the reference voltages can be obtained from op-amp buffered potentiometers tied between +5 and ground for manual variation or simply from +5 if size variation is not needed at all. The voltages at the open collector outputs are then summed in a binary weighted resistor network and sent to the minor deflection vector generator.

A four-pole lowpass filter is used for the minor deflection vector generator. The components of the filter have been chosen such that the step response assumes an "S" shape and is essentially complete in 50 microseconds. This scheme, although simple, gives good results only for the relatively short vectors drawn with the minor system. Besides filtering, the circuit has a high input impedance and low output impedance under steady state conditions which isolates the weighted resistor DAC output from the load. When a new word is sent to MINXY, a beam control single-shot is fired. At the same time the step change in minor X and/or Y voltage is smoothed into an S-shaped ramp by the lowpass filter. The single-shot times out in 40 to 50 microseconds when the transition is complete. The beam control single-shot output is NANDed with bit 6 of the MINXY latches and sent to the Z axis circuitry. Adjustment of the single shot duration should be such that the character stroke endpoints barely meet without bright dots at their juncture.

The size register and associated resistor network comprise two 4 bit digital-to-analog converters. The 1K pullup resistors at the latch outputs standardize the logic one level at +5 volts independent of individual latch characteristics. The op-amps buffer the size DAC output voltage against the varying load presented by the minor X and Y DAC's.

The main and minor X and Y coordinates are combined at the input terminals of the monitor scope with a resistive mixer as shown below:



If the leads between the display generator and the scope are much longer than a foot, they should be run through individual shielded cable. The outputs of the display generator should then be isolated from the cable capacitance with 470 ohm resistors at the display generator end of the line. Also the 4.7K resistor in the mixing network should be reduced the 4.3K.

Construction of the display generator should be done as compactly as is reasonable and preferably over a ground plane in order to minimize crosstalk coupling and ground loops. The lowpass filters in the minor system are particularly prone to VHF oscillation if not built compactly over a ground plane with power supply bypassing right at the transistors. A good material to use is phenolic microvectorboard copperclad on both sides. The copper can be removed from the edges of holes that receive components by hand-twisting a new, sharp 1/8 inch drill bit in the hole a couple of turns.

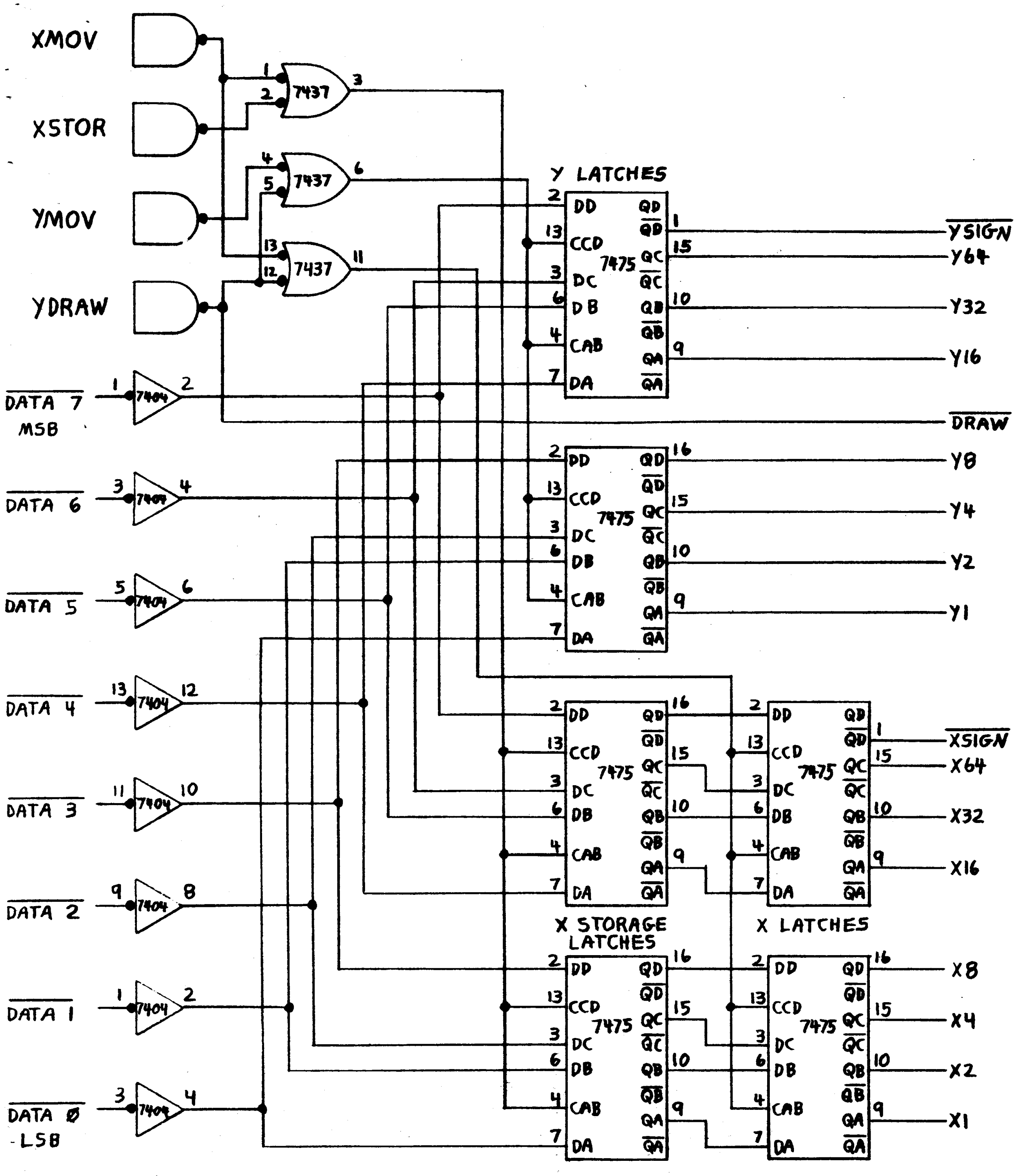


Figure 1. Address Decode and Main X Y Latches

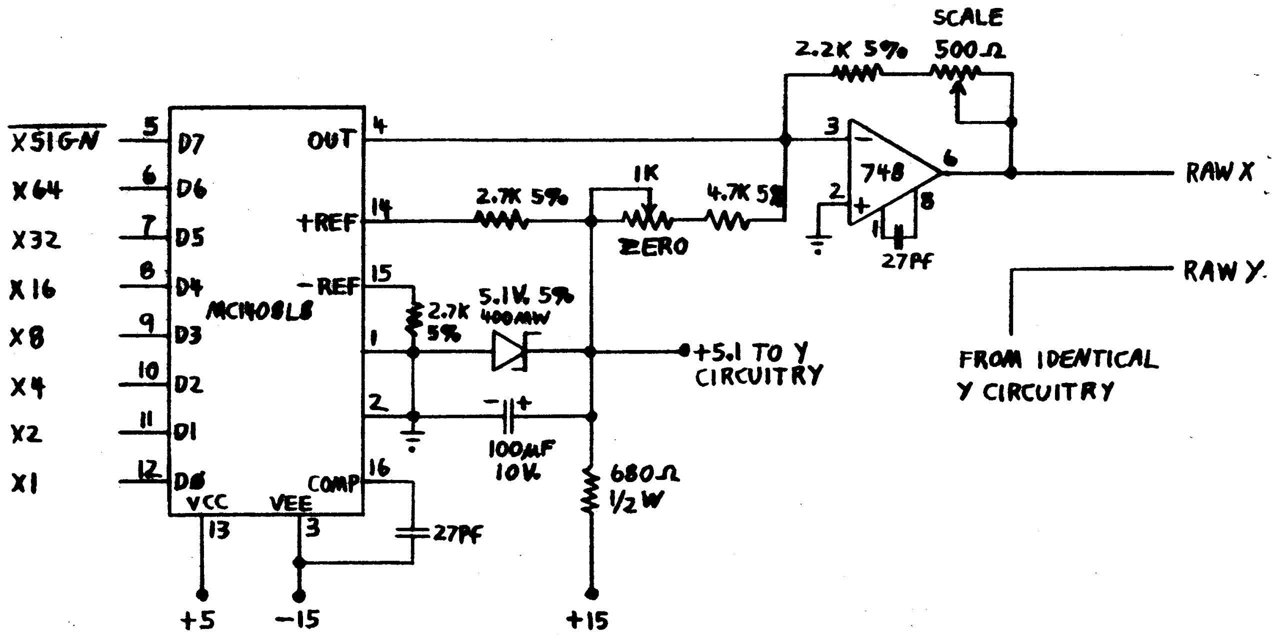


Figure 2. Main X and Y Digital-to-Analog Converters

With Motorola DAC

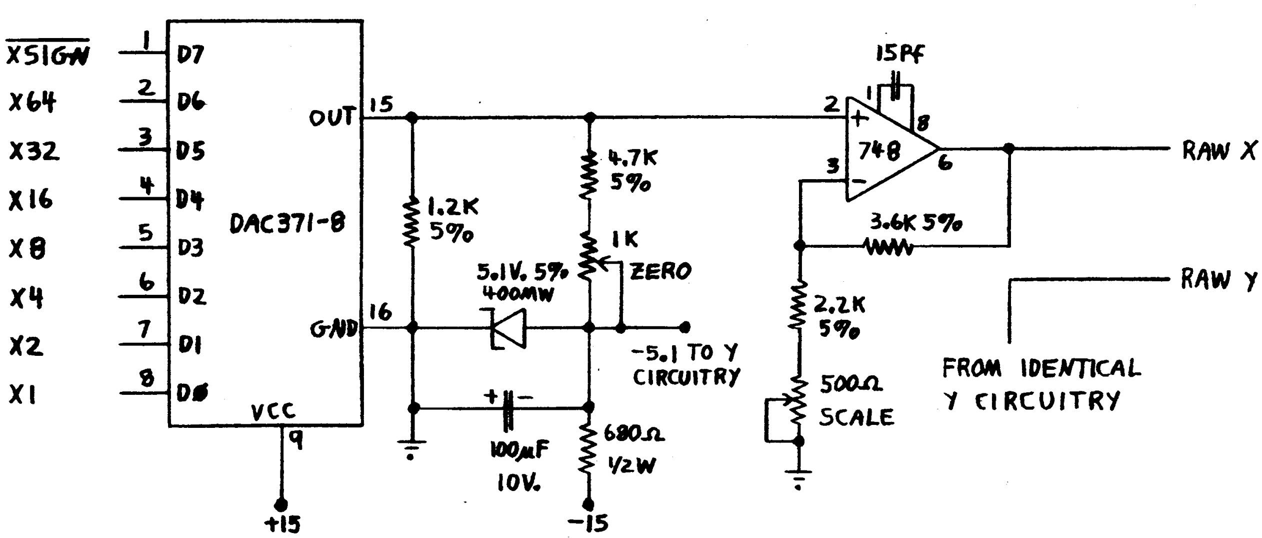


Figure 3. Main X and Y Digital-to-Analog Converters

With Hybrid Systems DAC

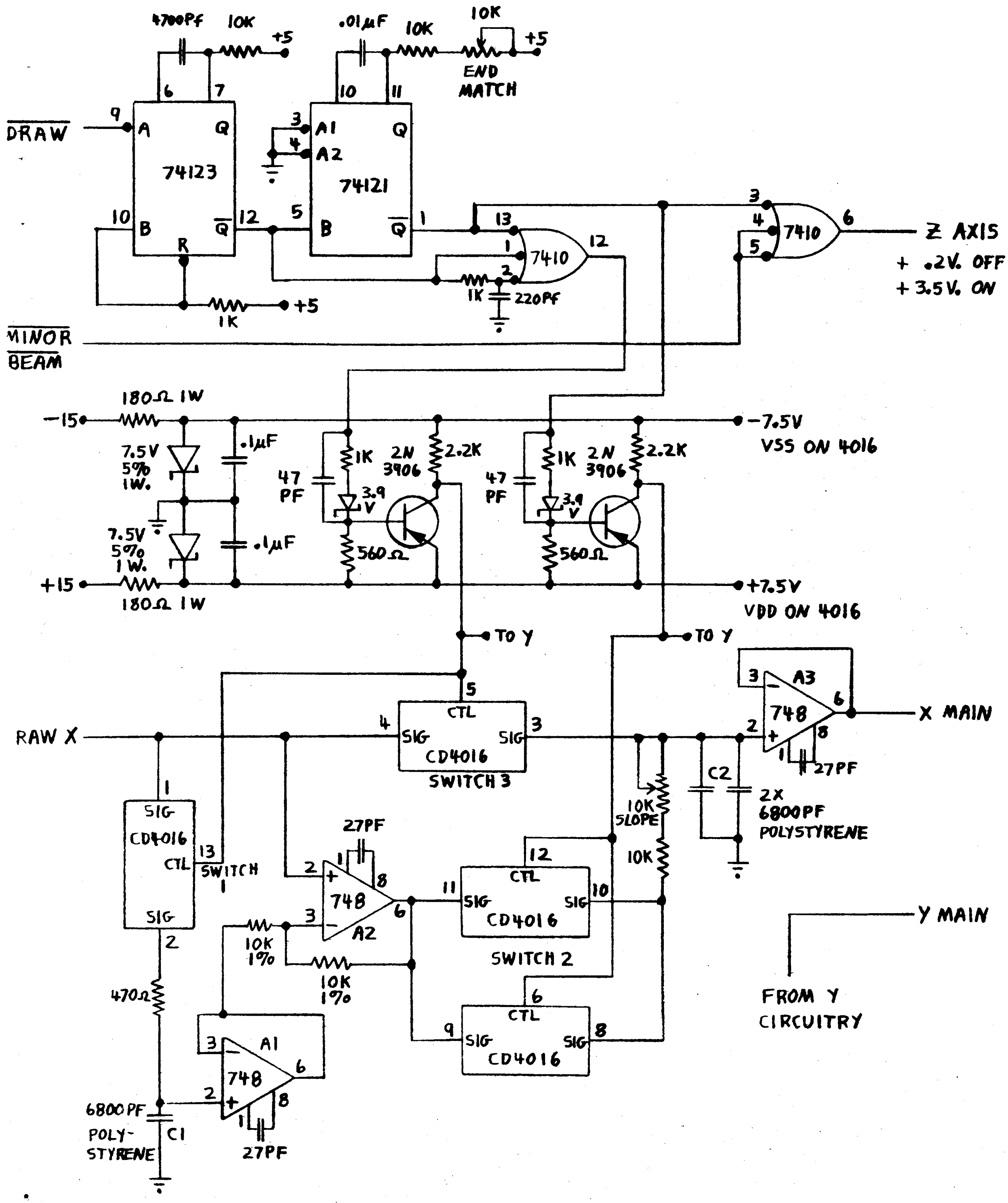


Figure 4. Main X and Y Vector Generator

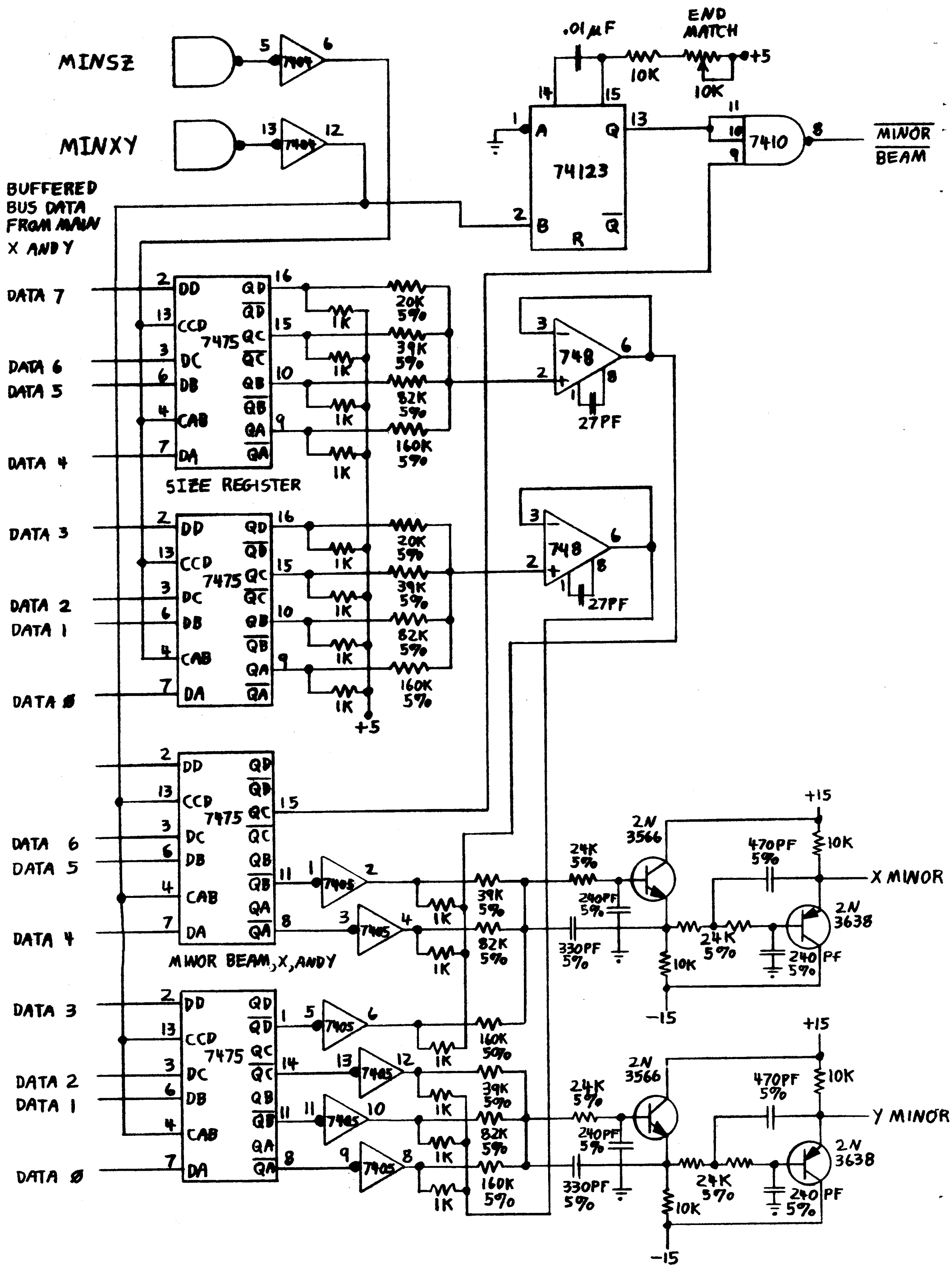


Figure 5. Minor Deflection System

Microvectorboard can be purchased from K A Electronic sales.

Take heed of the 1% and 5% tolerance specified on some components. Those not marked may be 10% tolerance. Unmarked resistors may be 1/4 watt if desired. Use only carbon or film resistors; wirewounds have too much inductance which may cause oscillation or poor performance. The +5, +15, and -15 power supplies should be semiconductor regulated so that ripple is less than 20Mv. peak-to-peak. The power drain will be less than 1 amp on +5 and .2 amp on +15 and -15.

Although excellent results can be obtained with an ordinary 5 inch oscilloscope, the full glory of graphics display can only be achieved with a larger screen. Part 3 in the January TCH will discuss a large screen magnetic CRT X Y Z monitor that has the necessary bandwidth and can be built with but one exception from readily available parts.

APPENDIX

Hybird Systems Inc.
87 Second Ave.
Burlington, Mass. 01803

INTERFACING A 5 LEVEL TELEPRINTER

This article will describe one possible way to interface a 5-level teleprinter to an 8008 system. As we mentioned in our last issue there are many 5-level machines which can be obtained cheaply. Some machines which qualify are Teletype models 12, 15, 19, 26, and 28, and Kleinschmidt models TT100 and TT117.

The interface consists of a power supply and a circuit to turn the current to the teleprinter magnet coil on and off. All intelligence and timing is contained in the program in the 8008. This allows for maximum flexibility with respect to machine type and speed. The circuit used is illustrated in Figure 1.

The NAND gate output represents the decode of the output instruction to the teleprinter. The 7474 latches bit 0 of the data bus. Timing should conform to Figure 2. If your data bus is true rather than inverted the 470 ohm resistor from the base of Q1 should connect to the true Q output of the 7474 rather than the inverted one. K1 can be any fast, light duty relay. Reed relays are ideal. The contacts are normally open. The value of R2 is determined by the coil current of K1 and Vcc. If the coil current is represented as I, then (I*R2)+Vcc=40 volts or less. The network formed by R2 and D1 clamps the voltage spikes generated when K1 turns off to less than 40 volts which is the breakdown voltage of the 2N2222. If Vcc is 12 volts and I is 50 ma, then R2 equals 560 ohms. Vcc should not exceed 24 volts and of course must not exceed the rated coil voltage of K1.

R3 and C1 form another spike suppression network, this one to protect the contacts of K1. In addition both networks help keep noise out of the logic system. R4 is used to limit the current in the teleprinter's selector magnet coils to 60 mA. This requires 390 ohms for the Kleinschmidt machines and 330 ohms for the Teletype models 15 and 19. It also makes the power supply look somewhat like a current source, which is desirable when driving the selector magnets. While the teleprinter is sitting idle this resistor will be carrying 60 mA. and will dissipate 1.4 watts. Two watts is the smallest recommended size for this resistor. While working on this circuit be careful as R4 will be quite warm and the voltage spikes generated when K1 opens can be supprisingly tingly.

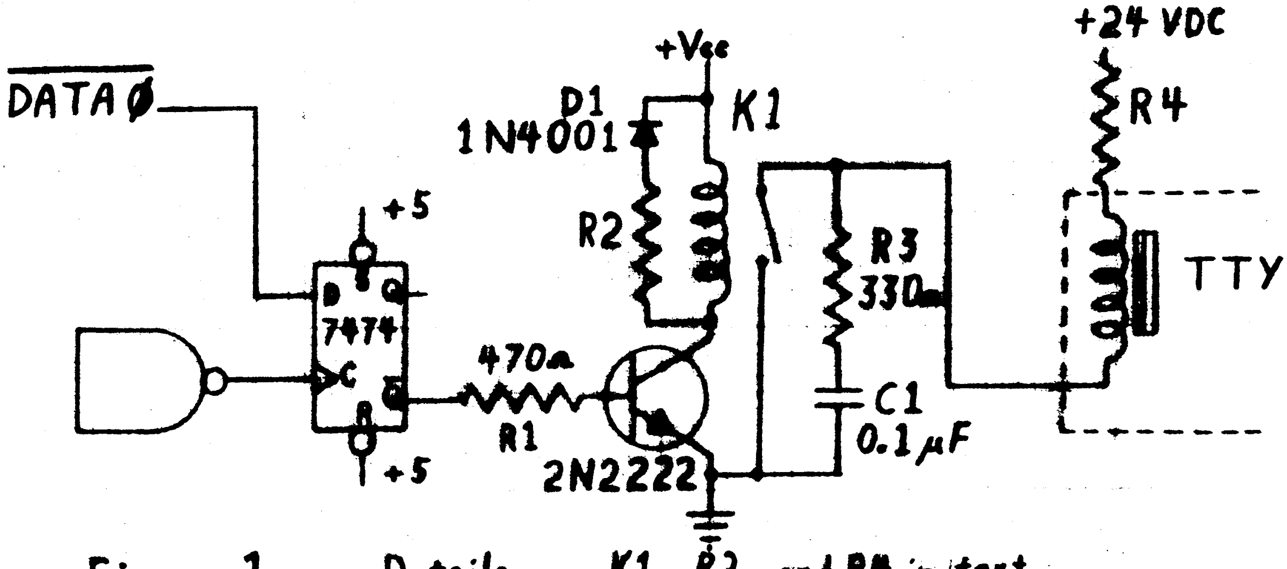


Figure 1. Details on K1, R2, and R4 in text.

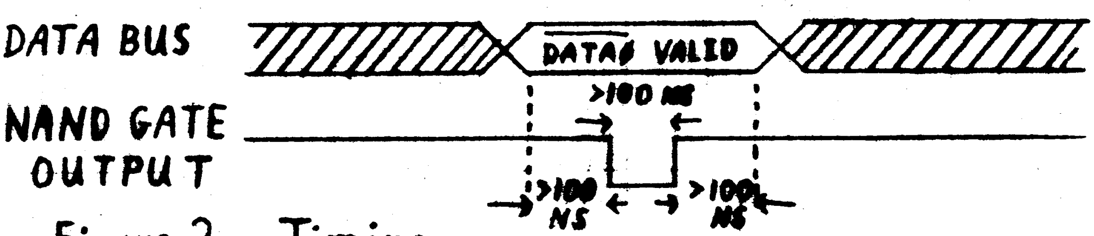


Figure 2. Timing

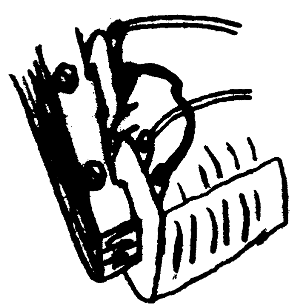


Figure 3. Teletype Corp.

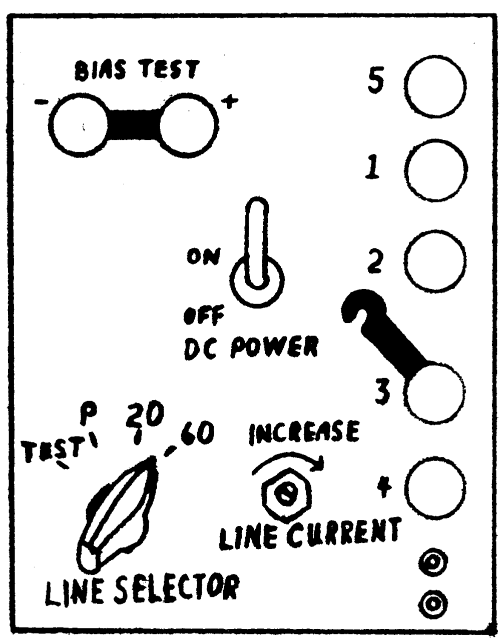


Figure 4. Kleinschmidt

So far all is fine, but we have not even told you how to locate the connections to the selector magnets on your teleprinter. Naturally this depends on the type of machine you have. Illustrations below will show connections to the more common Teletype model 15 and 19 and the Kleinschmidt model TT100 and TT117. If your machine is not one of the above we suggest that you contact a local ham for advice. In all cases the selector magnet coils need to be connected for a 60 mA circuit. This is mentioned because a few of the newer Teletype Corp. machines and all Kleinschmidt's can operate at 20 mA also. A Teletype Corp. machine properly wired for 60 mA will measure about 180 ohms accross the selector magnets and a Kleinschmidt set for 60 mA will measure about 60 ohms.

If your machine is a Teletype Corp. model 15 or 19 machine, the selector magnets are located on the left hand side of the machine. However, before you dig in, check to see if there is a cord with a 1/4 inch phone plug attached coming out of the machine. If so it should be connected to the selector coils. Measure the resistance accross it and/or connect 24 volts in series with 330 ohms to it and check to see if the armature pulls in on the selector magnet. If there is no cord on your machine, look for two coils mounted side-by-side horizontally, about one third the way up the left side of the machine. Looking at the coils from behind you should see their terminals as shown in Figure 3. The coils should be connected in series as shown, then check as above.

If your machine is a Kleinschmidt you will find a hookup box in the left rear corner of the machine. See Figure 4. The terminals labelled BIAS TEST should be connected together. The line selector switch should be set to 60. The D.C. power switch should be on in order to supply bias current needed by the coils. Connection to the coils is made on terminals 3 and 4. The positive connection from R4 must be connected to terminal 3. Again, to check out the circuit, an ohmmeter should read about 60 ohms when connected to terminals 3 and 4, and 24 volts in series with 390 ohms should actuate the armature of the selector magnet.

There are many adjustments on teleprinters, however most of them will be OK just the way they were when the machine was removed from service. The only adjustment the inexperienced should attempt is the range adjustment. If you decide to make this adjustment, start with a trial setting of 50. This adjustment will be found near the selector magnets on both machines, and is a lever on the Teletypes and a thumbwheel on the Kleinschmidts. While sending a steady signal of RYRYRYRY... find the minimum and maximum values at which the printer will copy correctly, then set the control halfway between the trial values. If you have problems with adjustments or connections try to find a knowledgeable, friendly ham radio man.

We hate to say it but there is not enough time or room to present the software for running a teleprinter in this issue. The necessary software has been written and tested though, and will be included in the next issue. For the pioneers, we will give you a few hints. Everything is done with timed program loops. Specifications for timing and bit patterns can be found in <u>The Radio Amateurs' Handbook</u> put out by the ARRL. As a general rule, Teletype Corp. machines will be 60 words per minute and Kleinschmidts will be 100 words per minute.

<u>THE POWER OF AN 8008</u>

This issue of TCH was generated on an 8008 driven system. All text was entered, edited, justified, and printed under the control of a stand-alone 8008. The system has 8K of 1103 memory and a floppy disk. The program is divided into 12 overlays and consists of over 10,000 8008 assembly language statements. The CRT display used for editing and formatting is probably the biggest ever with 69 lines of 102 characters capacity. The actual printing was done with offset masters which were photographically reduced from the printout from a Diablo Hytype I printer. Isn't it wonderful, the things you can do with a microprocessor.

SUBSCRIBER LIST

Each month TCH will publish the names and addresses of new subscribers who so desire. We hope this service will aid people in finding assistance and friends with a common interest. So far the following people have given us permission to publish their names:

Hal Chamberlin
P. O. Box 5985
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Ph. 919/851-7225

C. N. Lee
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Elizabeth City, NC 27909

Jim Parker
Box 15388
North Carolina State University
Raleigh, NC 27607

Richard Smith
Box 5882
Raleigh, NC 27607
Ph. 919/467-3145 or 919/851-7223

Steve Stallings
520 Sorrell St.
Cary, NC 27511
Ph. 919/467-3145 or 919/851-7223

Joe Tolbert
Box 307
Ninety-Six, SC 29666

CLASSIFIED ADS

With this issue TCH begins publishing "want ads" submitted by our subscribers. There is no charge for ads but they must pertain to the general area of computers or electronics, and must be submitted by a non-commercial subscriber. At the present, commercial advertising is not accepted by TCH, however the matter is under consideration. Feel free to use them to buy, sell, trade, seek information, announce meetings, or for any other worthwhile purpose. Please keep length down to 10 lines or less. Now this month's ads, all 3 of them!

NEEDED: Information, hardware and software on the BIT 483 minicomputer. This machine was manufactured in Mass. but company no longer exists. R. E. Smallwood, 20-12 St., N.W., Calgary, Alberta, Canada T2N 1Y3

FOR SALE: Keypunch cards $15 per case (10,000 cards) plus shipping. These are standard data cards with columns ruled off in groups of 4 and a colored stripe accross top of card. Will send samples. Steve Stallings, 520 Sorrell St., Cary, NC 27511

INFORMATION: Will act as clearing house for people who own Computer Entry Systems surplus tape drives and need help getting them running. Gary Coleman, 530 Glaser Bldg., 11900 Carlton Rd., Cleveland, Ohio 44106

SURPLUS SUMMARY

This month we have in addition to surplus listings a special listing of places to get 8008's, and micro-computer kits.

K. A. Electronic Sales
1220 Majesty Drive
Dallas, Texas 75247

K. A. is selling microvectorboard for breadboarding with IC's. All types of clad and unclad board with holes on standard .1 inch centers is available. This allows wirewrap sockets to be simply dropped in and wired. Write for prices.

MNH Applied Electronics
P.O. Box 1208
Landover, Maryland 20785

MNH-AE has wire for your wire-wrapped projects. The price is $10 per 1000 feet of wire, and this is wire that was intended for wire-wrapping, not just wire that happened to be #30 AWG.

Les Veenstra
Action Technical Services
919 Crystal Springs Ave.
Pensacola, Florida 32505

We are told that Les has some overhauled model 33RO (receive only) Teletype machines which he will sell for $280.

Herbach & Rademan, Inc.
401 East Erie Avenue
Philadelphia, PA 19134

H&R has a number of keyboards available at prices ranging from $35 to $56. Two of the units available use Hall-effect keyswitches. Nice! Write for catalog Volume 40 No. 4.

Andy Electronics, Inc.
6319 Long Drive
Houston, Texas 77017
Ph. 713/641-0576

For those of you who cannot find a teletypewriter locally, you can buy a Kleinschmidt from Andy by mail order. They sell rebuilt model TT100's for $119. Or if you are brave, "as is" machines go for $59.

Next, here are the addresses of companies which offer microprocessor chips or micro-computer kits along with their pricing when available.

Scelbi Computer Consulting, Inc.
1322 Rear-Boston Post Road
Milford, CT 06460
Ph. 203/874-1573

8008 micro-computer blank board set $135
8008 micro-computer assembled & tested board set $440
8008 Micro-computer kit all parts including assembled boards $580

RGS Electronics
3650 Charles St., Suite K
Santa Clara, CA 95050

8008 Micro-computer kit, all parts except fuses $375
8008 chip, will sell if sufficient supply $50

Bill Godbout Electronics
P. O. Box 2673
Oakland airport, CA 94614
Ph. 415/357-7007

8008 chip $50

K. A. Electronic Sales
1220 Majesty Drive
Dallas, Texas 75247
Ph. 214/634-7870

8008 chip $66

International Electronics Unlimited
P. O. Box 1708
Monterey, CA 93940
Ph. 408/659-4773

IMP 16 Micro-computer kit $349.50

MITS, Inc.
6328 Linn N.E.
Albuquerque, NM 87108
Ph. 505/265-7553

8080 board set kit, includes 8080 $298
8080 micro-computer kit, complete $397
8080 Micro-computer, assembled & tested $498

FOR YOUR INFORMATION

The field of hobby computing is served by at least two publications other than TCH. The two best known are the publications of People's Computer Company, and Mark-8 User's Group, both of which contain great material.

People's Computer Company, P.O. Box 310, Menlo Park, CA 94025 issues a newsletter 5 or 6 times a year. A typical issue is 28 pages tabloid (11" X 17") and contains user oriented articles and lots of computer games. Regular subscription is $5 per year but PCC will let TCH readers subscribe for $3 until January 1, 1974.

Mark-8 User's Group, Cabrillo Comp. Center, 4350 Constellation, Lompoc, CA 93436 publishes a newsletter about twice a month. The newsletter was set up for owners of the Radio-Electronics Mark-8 micro-computer, but applies to the 8008 in general. It includes lots of tips and techniques for owners of the Mark-8. For information send them a self-addressed stamped envelope.