the digital group
po box 6528 denver, colorado 80206 (303) 777-7133

# TV & CASSETTE INTERFACE CARD/64 CHARACTER

298-040-A-51+3

TVC-64 DOCUMENTATION UPDATE

1. C4 and C5 -- 220mfd micas are changed to 100mfd micas.
2. R3 and R4 -- 6.8K resistors are changed to 15k resistors.

   NOTE: These changes increase the noise immunity of the circuit.

# DIGITAL GROUP 1024 CHARACTER TV READOUT/CASSETTE INTERFACE CARD

## General Design

This PC Board combines two functions needed by microprocessors, the ability to output data and messages on a low-cost TV set, and the ability to reliably store, retrieve, and exchange programs or data at low cost. The TV Readout will display 1024 characters, 16 lines of 64 characters per line, with upper and lower case alpha characters, Greek alphabet, math symbols, and special characters. The characters are formed from a 7 x 13 matrix of dots, producing easy to read characters with a normal height to width aspect ratio.

The cassette section provided circuits for recording data as well as receiving data previously recorded. Frequency Shift Keying is utilized, 2125 Hz being the Mark of "1" frequency, and 2975 Hz used as the Space or "0" frequency. The frequency shift keying system gives a better signal/noise ratio and the wide spacing of the harmonically unrelated frequencies permit the use of low cost home cassette recorders in spite of their generally poor "wow" and "flutter".

Software parallel to serial conversion systems are used for record, and software serial to parallel conversion systems for data playback. These software conversion systems permit complete flexibility in Data rate (from near Ø to 1000 bits per second), Codes utilized (ASCII, Baudot, etc.), and Error checking (Parity, CRC, etc.) inclusion.

## TV Readout Description

The TV Readout consists of five interacting sections. They are Memory, Character Generation, Composite Video Output, Read Clock, and Write Clock. The memory section consists of seven 2102A or faster 1K memories, giving a possible storage of 1024 seven bit ASCII characters. The microprocessor, keyboard, or some attached circuit writes the characters one by one into the 2102's, and then the TV Readout continuously displays these characters until either more characters are entered, or the circuit is turned off.

The character generation circuit consists of two IC's, the MCM6571L character generator, and 74165 parallel to serial converting shift register. the 6571 takes the seven bit ASCII character coming from the memories and outputs 7 dots making up a character row for each of 13 potential rows making up each character. The 74165 loads these 7 dots coming out at a time into its internal memory, and then outputs these one at a time for serial transmission to a TV set. For more information on TV character generators, I would suggest reading an excellent article by Don Lancaster in June, 1974 Radio-Electronics (p. 48-52).

The video output section uses a 74151 data selector, a 7401 open collector NAND gate and a driver transistor to produce a low impedence composite video signal. The 74151 permits selecting either white characters on a black background, or black characters on a white background. In addition extermal binary level video (such as TV graphics) may be selected/inverted. The TV output is around 2 volts peak to peak with about a ½volt horizontal and vertical sync and blanking pedestal.

the digital group
po box 6528 denver, colorado 80206 (303) 777-7133

The Read Clock is the master control of the various sections. Starting from an initial frequency of 11.980 MHz, a countdown chain of three 74193's (IC's 26, 25, and 37 ) produce and 8µs horizontal sync when gated by 1/6 IC2, 1/2 IC27, 2/3 IC29, and 1/4 IC28. A 20 µs horizontal blanking circuit prevents loss of characters at the edges of the screen and is produced by the gating action of 3/4 IC17, 1/6 IC2, and 1/3 IC29. The resultant horizontal frequency is 15,598 Hz, somewhat lower than the standard 15,750 Hz, but usually only requires trimming horizontal hold slightly if at all.

The vertical countdown chain uses three more 74193's (IC's 1,15, and 5) to obtain a final vertical frequency of 60 Hz, syncronous with the AC line to avoid hum roll and wobble problems on low cost TV's. 3/6 IC7 and IC8 produce an 820µs Vertical sync pulse, 2/3 IC6 gives a ÷ 22 gating to IC's 15 and 5, and the 1/6 IC7 produces a 3.5ms Vertical blanking pulse.

A special feature of this TV Readout board is its ability to be externally syncronized to an external video timed base. This permits syncronizing the microprocessor's video countdown chain to an external video source such as a TV camera or a commercial TV program for titling, "Frame Grab", etc. operations. The horizontal countdown chain is syncronized by a short negative going pulse applied to connector pin U which will reset the horizontal counters and the horizontal sync pulse. The Vertical chain is reset by applying a short negative pulse to connector pin V.

The various Read Clock timings are brought out to the connector so that external video based systems (such as graphics) may be easily coupled with this TV system. As if these operations weren't enough, various timings from the Read Clock also tell which of the 13 rows, which make up each character, is being currently accessed, and loads the 74165 when the row of 7 dots is available from the 6571. The 11.980 MHz signal then shifts out 8 dot peroids (the 8th one is a horizontal space between characters) before the next dot load command occurs. All of these timings are very critical during the design phase, but the builder should have no problems, since no adjustments are needed. The Read Clock also controls which of 1024 characters is currently being inputed to the 6571 for dot encoding, except during Write Clock times.

I thought you'd never ask about the Write Clock. Well, it controls the entry of the characters from whatever external source into the 2102 memory bank. Several alternatives in character entry are possible. However, this design tries to be as simple as possible, yet give the user a very capable unit, particularly when using a microprocessor, or even mini, midi, or maxi processors.

A sequential entry system is utilized. A Home Reset control signal is developed by IC22 when it detects the 7 character defining input lines high ("1"). IC's 23, 13, and 3 are then preset so that the next character to be entered will result in its being displayed as the top leftmost character on the screen. The 2nd character will be viewed to the right of the first,....until on the 65th character a new line appears, displaying the 65th character. Up to 1024 characters are thus sequentially entered and displayed. If a 1025th and following characters are entered, an overwrite condition results, with the new page load displayed from the top

leftmost, the former character overwritten "gone forever". The display may be reset at any time. Screen erase consists of either 1024 or more ASCII "spaces" (Octal 240) and an ASCII ▮ (all bits on (either a 177 or a 377)), or an ASCII ▮ and exactly 512 ASCII spaces, the latter being preferable.

Memory writing occurs when the MSB goes high. The 74157's then allow the 74193's IC23, 13 and 3 in the Write Clock to control the memory address lines on a priority interrupt basis. 600 ns later, a 600 ns strobe pulse writes the new character into memory.

There is a parallel logic path to step the Write Clock address forward or backward without writing a character. This produces a "Pseudo Cursor" effect without the usual expense of a number of comparators, etc. A software "blink" may be easily implemented with a final result indistinguishable from a hardware cursor. The "Pseudo Cursor" logic consists of 1/4 IC16 and IC38 which detect the presence of an LSB, toggling the Write Clock 74193's up in count without firing the 74L123 (IC20) Write Strobe if not simultaneously brought high (indicating character entry then, of course). LSB + 1 high without the MSB toggles the Write Clock 74193's down in count, which backs up the cursor.

A 74122 (IC39) produces a short pulse each time the MSB is brought high, thereby blanking the screen while the memory updating process is taking place. This reduces the glitches appearing on the screen when high rate updating occurs. The only way to completely eliminate the glitches would be to only update during the Vertical blanking pulse, but this would seriously downgrade performance in some critical operations.

## Cassette Interface Circuit Description

The previous 512 character Digital Group TVC used a tunable oscillator which required careful alignment. This requirement has been eliminated by using a digital frequency synthesizer countdown chain. The TV master oscillator is divided by either 5650 or 4030 to get the 2125 or 2975 cassette frequencies. The actual frequencies are a few Hertz low, but well within tolerances. The main cassette countdown chain consists of IC's 45, 46, and 43. IC49 is used to gate an early reset to achieve the 2125 tone, and IC48 gates an early reset for 2975. The actual output of this chain is 10 times too high, and the 7490 (IC42) provides a ÷ 10 smoothing and squaring function. A logic level input at pin 18 on the connector controls the resultant audio frequency at output pin 10. A high input ("1") produces a 2125 Hz output, and a low output ("Ø") results in 2975 Hz. The output wave shape is a symetrical square wave. The 47K (R13) resistor in series with the output is a typical value to be used when coupling to the low level, low impedence external microphone inputs of most cassette recorders.

The cassette receive circuitry detects the prerecorded frequency shift keying and produces a "1" or a "Ø" output as a result of a detected 2125 Hz or 2975 Hz tone at the input. IC40 is a clamped limiter which prevents variations in amplitude from affecting the resultant detection process. The output of IC40 should be about 1.2 volts p-p, roughly a square wave of the incoming frequency, constant in amplitude regardless of tape volume setting or minor tape "dropout" problems.

Two bandpass active filters then amplify a tone 5 times when actually tuned to their respective frequencies of 2975 Hz for the top filter and 2125 Hz for the lower filter. The further off the tuned frequency the tone is, the less amplification the filter will produce. The actual resonance points of the filters may be easily adjusted by merely trimming the multiturn potentiometers in each filter.

Full wave active detectors produce rectified full wave pulses at the summing junction, pin 5 of IC47. The 2975 Hz tones are rectified +, and the 2125 Hz tones are rectified -. As tones depart from either exact frequency, a value less + or - is produced until approximately midway a summed voltage of Ø results.

A 3-pole lowpass active filter then removes the remaining traces of pulsating DC from the summed signal with almost no effect on the data pulses up to a speed of 1000 bits per second. If lower data rates were to be utilized, an improved signal to noise ration could be obtained by multiplying the values of C35, C37, and C38 by the reciprocal of the data rate difference. I doubt you would notice any operational difference, however.

The final section is a slicer connected 741 (IC51). This op amp detects whether the voltage at its pin 2 is + or - with respect to the constant voltage at its pin 3. The output voltage will then swing either to nearly +5 or to nearly -12. A forward biased germanium diode prevents the actual output voltage from going less than ≃ -.2 volts, so that valid TTL levels are not exceeded. An offset adjusting pot allows the output to be placed in a "Mark Hold" condition when no tone input is being detected. 2/4 7400 (IC50) provides output TTL level buffering, and allows data inversion by tapping the output to the pin 11 section if a customized circuit required this modification.

## Construction

Tools: Fine tipped, low wattage soldering iron, "wire solder" (around 20 gauge resin solder), small diagonal cutters.

Test Equipment: Ohmeter
Audio Generator helpful
10 MHz or better triggered sweep oscilloscope
Frequency Counter
Microprocessor, Mini, etc.

Estimated Construction Time: 3-6 hours

1. Insert the 24-pin socket, 5 8-pin sockets, 28 16-pin sockets, and 17 14-pin sockets into the PC board. If the sockets have a keyway indication, orient this away from the connector. Note: the top side of the board is indicated by The Digital Group label.

2. Invert the board and carefully solder in the sockets. A special plating process is used by The Digital Group to minimize solder joint troubles. We would suggest a "warmup area" by starting with the cassette interface sections of the card.

3. Insert and solder the 17 resistors in the TV Readout section enclosed by the +12 bus line. Insert and solder the 22 resistors in the cassette section.

4. Insert and solder the zener diode, the germanium diode, and the 8 silicon diodes. Note: all of the diodes are oriented with their cathode or "bar" end oriented towards the right.

5. Insert and solder the output transistor in the TV Readout section.

6. Insert and solder the two 220 pfd and the 330 pfd and the 100 pfd condensers in the TV Readout section.

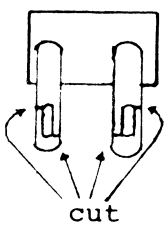
7. Insert and solder the fourteen condensers in the Cassette Interface section.

8. Insert and solder the three potentiometers in the Cassette section. Note that the potentiometer is a 50K, the other two are long multi-turn 500 ohm units.

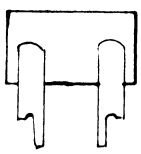
9. Insert and solder the various bypass condensers in the TV Readout section. Note: the positive (+) end of the dipped tantalum condensers is indicated by the vertical marking (paint strip) along one side. Additional holes have been provided between IC's 9 and 30 for additional input bypassing with 50-200 pfd condensers if your installation so requires.

10. Trim the crystal socket's pins as shown to fit into the crystal holes.

Pin view:




Result:



Press the rear tab into the board hole provided for it. Solder the pins and the rear tab.

The socket provides a space-saving flat mount as well as avoids soldering to the heat-sensitive crystal.

11. At this point, measure the resistance between ground (pin 20) and the other voltage supply pins (19, 21, & 22). A very low resistance indicates a bad bypass or a solder bridge short somewhere.

12. Insert the IC's in the TV Readout section except for the memories (2102's) and the MCM6571L character generator. The notch or pin 1 end of each IC should be oriented away from the connector end of the board. Measure the resistance between pins 19 & 20, noting the value. Reverse the ohmeter leads and remeasure. A shorted reading indicates a bad IC, and near equal readings indicates a reversed IC.

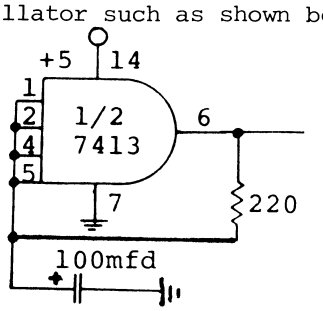
13. Temporarily groung pin 1 of the TV readout and connect a TV set modified for direct video, or a commercial TV monitor, between pins 16 (video) and 20 (ground).

14. Putting a +5 voltage between pins 19 (+) and 20 (Ground) should result in 64 vertical white columns on the screen. Refer to "Troubles" section if this does not happen.

15. Connect the other ±12 supplies, and turn on power again. Measure the voltages on pins 1, 2, and 3 of the MCM6571L socket. They should measure -5, +5, and +12 respectively.

16. Plug in the 2102's and the 6571. The temporary grounding jumper to pin 1 should still be connected as well as the TV monitor. Turning on power this time should result in a random display of 1024 characters on the screen. The actual character at each location is determined by the chance bit structure at the memory locations. Remove the temporary grounding jumper from pin 1 when done with this test.

17. Complete testing of the TV Readout is best performed under microprocessor control, and sample diagnostic programs are included with The Digital Group Systems. "Breadboard diagnostic testing" may be accomplished by temporarily tieing each of pins 2 - 8 to +5 through a 1K resistor. Tie pin 1 to the output of a simple oscillator such as shown below:




Grounding pins 2 - 8 to ground should produce:

| pin to ground | Character |
|---|---|
| 8 | ∿ |
| 7 | } |
| 6 | { |
| 5 | w |
| 4 | o |
| 3 | |
| 2 | ? |

18. Plug in the twelve IC's in the Cassette section.

19. Connect a calibrated frequency counter between pin 10 and ground.

20. Apply +5 and ±12 voltages to the board. With the Cassette Write input pin 18 open or tied to +5, the frequency counter should read approximately 2120 Hz.

21. With voltages still applied, ground input pin 18. The frequency counter should now read approximately 2970 Hz. This completes cassette write turn up. Easy, isn't it.

22. Jumper pins 10 and 9 together. This permits using the Write Cassette section as a master oscillator to align the Read Cassette section.

23. Measure the output at pin 6 of the 741 limiter (IC40) with an oscilloscope. The waveshape should be an approximate square wave of about .6 volts p-p.

24. Keeping the jumper from ground to connector pin 18, (the frequency counter should read about 2970 yet) measure the output at pin 7 of the 5558 active bandpass filter (IC41). Turn the 2975 trimmer pot (R30-the pot in the right corner) until the signal exactly peaks, and leave at this point.

25. Move the jumper on connector pin 18 from gorund over to +5. The frequency counter should now read about 2120. Measure the output at pin 1 of IC41. Turn the 2125 pot (R29-the middle pot) until the signal exactly peaks, and leave at this point.

26. Measure the detected voltages at pin 5 of IC47. When the input frequency approaches 2125, the output should go -. When approaching 2975, the output should go +. Trouble in this area would most likely be caused by reversed or defective diodes, or adjacent line shorts.

27. Measure the voltage at the cathode (bar) end of the output clamping germanium diode (G1). If desired, remove the jumpers and attach an audio oscillator. Sweeping the frequency between 2125 and 2975 Hz should result in a clean voltage jump somewhere between 2125 and 2975. Be sure that the negativemost voltage at this point is about -.2 volts.

28. Remove the jumper between pins 9 and 10 and short input pin 9 temporarily to ground. Measure the output at pin 6 of IC40 again. A stable condition (no oscillation) should be seen. Connect the oscilloscope to the cathode of G1 again. Adjust the balance potentiometer (R18 - the small leftmost pot) clockwise so that the voltage is at a - level. Slowly turn the potentiometer counterclockwise until the voltage jumps + and leave setting at this point.

29. Disconnect the temporary jumper from conncector pin 9 and reconnect the audio oscillator. Perform step 24 again. If all proceeds well at this point, the cassette interface is ready to receive data.

Troubles - General

1. One of the more difficult troubles to find is an IC pin which was bent under the IC when it was inserted. Any unusual pressure when inserting an IC should be investigated.

2. Every pin should be soldered. The most frequent cause of trouble is an unsoldered pin, generally an end IC pin. Carefully sighting down parallel rows of pins usually finds any that are not soldered.

3. When troubleshooting with a 'scope probe, measure from the top side of the IC, not the bottom, to eliminate a bent under pin problem or defective socket from misleading.

4. Before ever plugging in any IC's, always measure the voltages at the PC board and at the pins of the more expensive IC's, like the 6571.

5. When handling IC's, avoid static charges. Run your house humidity high, and ground yourself ty touching a grounded chassis before touching IC's.

6. Beware of solder splashes and drilling errors. Please inform The Digital Group of board manufacturing errors that you detect. A flashover or splash on the topside would be very difficult to find after soldering the sockets. The black socket body of the sockets used in The Digital Group kits may be pried off after removing the IC should a hidden splash be suspected.

7. Beware of shorts in the cassette area between component leads and underlying circuitry.

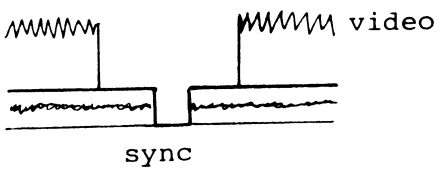
Specific Troubles

No white colums on the screen at step 14.

1. Bad connection between connector pin 16 and TV.
2. Temporary jumper from connector pin 1 to ground not connected.
3. Crystal not oscillating. Check for pulses at pin 1 of IC16.
4. Horizontal Countdown chain defective. Successively measure output at pin 3 of IC's 26, 25, and 37. Each should be progressively lower in frequency.
5. Vertical Countdown chain defective. As above #4, but measure IC's 1, 15, and 5.
6. Defective video mixer. Look for pulses at pins 1 and 13 of IC19.

Poor or lacking syncronization at step 14.

1. TV is overloaded by the ≃ 3 volts of video. Swamp the video with a 10 ohm resistor to see of sync & video stabilizes.
2. Check for Horizontal and Vertical sync and blanking pulses at connector pin 16. A 75 ohm load should be attached. The pattern should look like:




   a. If Horizontal Sync is defective, check IC's 2, 27, 28, and 29.
   b. If Vertical Sync is defective, check IC's 7 and 8.
   c. If Horizontal Blank, check IC's 2, 17, and 29.
   d. If Vertical Blank, IC7.

No characters at Step 16.

1. Missing voltages at the MCM6571 (IC11).
2. Defective Character generator.
3. Defective 74165 (IC10) or 74157 (IC18).
4. Defective logic signals to and from IC11 and IC10. All inputs and outputs should be pulsing at valid TTL levels (Ø to .8 volts = low/ 2 to 5 volts = high).
5. Pins 11 and 10 of 74151 (IC18) not at +5.

Wrong character(s) in display

1. Miswired or misjumpered input.
2. Defective Memory IC. Note: the bit difference between the intended character. IC30 is the memory for the Least Significant Bit (LSB) of the character... and IC36 is the Most Significant Bit's (MSB) memory.
3. Defective 74157(s) - IC's 24, 14, and 4.
4. Shorted lines in the memory and write clock area.

"Twinkling" character on TV

1. Slow memories. 500 nanoseconds or faster 2102's must be used.
2. Overheated memories. Access times increase with heat.
3. Slow 6571L - none seen so far, but possible.

Uneven lighting of leading and trailing edges of characters, esp. "H".

1. Monitor bandwidth too low produces a dim left side of H, bright on the horizontal bar part.
2. Incorrectly high peaked monitors give an excessively bright left edge to characters such as "H".
3. Dim right side of "H" and other characters may be monitor or may require increasing the clock lag condenser (IC43) in value. Too high of a value will reduce the left side of characters such as "H".

Won't write characters

1. Missing Storbe pulse, or continuous level on MSB input (connector pin 1).
2. No Write pulse from 74L123 (IC20). Measure at pin 12 of IC20, looking for an ≃ 600 ns negative going pulse. Connecting the MSB (connector pin 1) to a ≃50KHz TTL clock will permit viewing on lower cost oscilloscopes.
3. Write Clock not toggling. With above temporary oscillator inputting to MSB, look for pulses at pin 3 of IC's 23, 13, and 3.
4. Defective Read/Write Multiplexers (IC's 24, 14, and 4.

Extraneous Characters

1. Noise on the input lines to the memory, particularly on the MSB (connector pin 1). Pads for C1, C2, and C3 - small pfd condensers used on the input line to suppress most noise sources. This trouble generally shows up as an α appearing on the screen when another port is addressed.
2. Data sent to the TV character generator faster than it can handle. Data must be valid for 1.5 microseconds following the rise of MSB strobe. Faster data rates can be handled by reducing the value of the condensers in the 74L123 (IC20) Write strobe singleshot. Alternatively, a data hold loop consisting of NOP's can slow the data output to the readout.
3. Defective or slow memories. Look at the bit pattern of the extraneous character to determine if a single memory is bad.
4. More bypassing required. A number of unused voltage bypassing pads at the top of the TV Readout section have been included should your particular system require them.

Defective level output from Cassette Input Limiter

1. None at all: Check for ±12 to IC40.
2. Too high output level. Diodes (S3 and S4) open or one is reversed.

Bandpass Active Filter Problems

1. Check by sweeping with audio oscillator for proper range.
2. Swap 5558 (IC41) with IC's 44 and 47.
3. Check for shorts or out of tolerance (5%) condensers C30, C31, C32, or C33. Disc ceramics are a no-no in tuned circuits!

Full Wave Detector

1. Diodes open, reversed or shorted.
2. Defective 5558 (IC44).

Low Pass Active Filter

1. Shorted or out of tolerance condensers.
2. Defective IC47.

Output Slicer (IC38)

1. Reversed, open, or not Germanium diode at G1.
2. Defective or missoldered resistors in pin 3 circuitry of 741 (IC51).
3. Defective 741 (IC51).

# 1024 CHARACTER READOUT & CASSETTE INTERFACE - PARTS LIST

| IC's | |
|---|---|
| IC30,36 | 7 - 2102-1 or better |
| IC11 | 1 - MCM6571L |
| IC9, 17, 28, 50 | 4 - 7400 |
| IC19 | 1 - 7401 |
| IC16 | 1 - 7402 |
| IC2, 7 | 2 - 7404 |
| IC6, 29 | 2 - 7410 |
| IC27 | 1 - 7420 |
| IC8, 22, 48, 49 | 4 - 7430 |
| IC42 | 1 - 7490 |

| IC's | |
|---|---|
| IC39 | 1 - 74122 |
| IC20, 38 | 2 - 74L123 |
| IC18 | 1 - 74151 |
| IC4, 14, 24 | 3 - 74157 |
| IC10 | 1 - 74165 |
| IC1, 3, 5, 12, 13, 15, 21, 23, 25, 26, 37, 43, 45 46 | 14 - 74193 |
| IC40, 51 | 2 - 741 |
| IC41, 44, 47 | 3 - 5558 or LM1458 |

| Capacitors | |
|---|---|
| C2 | 1 - 100 pfd mica |
| C4, 5 | 2 - 220 pfd mica |
| C43 | 1 - 330 pfd mica |
| C24 | 1 - 1000 pfd mica |
| C35 | 1 - .0047 mylar |
| C30 - C33 | 4 - .01 polystyrene (may be marked 10000) |
| C37 | 1 - .01 mylar |
| C38 | 1 - .015 mylar |

| Diodes | |
|---|---|
| S1 - S8 | 8 - 1N914 or 1N4148 |
| G1 | 1 - 1N48 or eq. Germanium |
| Z1 | 1 - 5V 1 watt zener (1N4733 or eq.) |
| T1 | 1 - 2N5129/2N2369 |

| Bypass Capacitors |
|---|
| 24 - .01 mfd disc |
| 4 - 1 mfd tantalums |

| Crystal |
|---|
| 1 - 11.980 MHz |

| Misc |
|---|
| 5 - 8 pin sockets |
| 17 - 14 pin sockets |
| 28 - 16 pin sockets |
| 1 - 24 pin sockets |
| 1 - crystal holder |
| 1 - documentation |

| Resistors - all ¼ watt 5% unless noted | |
|---|---|
| R11 | 1 - 22 ohm |
| R12 | 1 - 220 ohm |
| R31 | 1 - 390 ohm |
| R1, 2, 10 | 3 - 470 ohm |
| R28 | 1 - 470 ohm ½ watt |
| R32 | 1 - 620 ohm |
| R5, 42 | 2 - 1K |
| R6, 7, 8, 9, 14 | 5 - 2.2K |
| R22 | 1 - 4.7K |
| R3, 4, 22 | 3 - 6.8K |

| Resistors | |
|---|---|
| R16, 17, 19, 20, 21, 26, 27, 35, 36, 37, 38 | 11 - 10K |
| R15 | 1 - 33K |
| R13, 24, 25, 33 | 4 - 47K |
| R34 | 1 - 68K |
| R39, 40, 41 | 3 - 100K |
| R29, 30 | 2 - 500Ω trimpot |
| R18 | 1 - 50K pot |

the digital group
po box 6528 denver, colorado 80206 (303) 777-7133

# 1024 Character TVC

## Front of Board

| Pin | Function | |
|---|---|---|
| 1 | MSB | Strobe |
| 2 | MSB | |
| 3 | MSB | |
| 4 | MSB | Data to TV |
| 5 | MSB | |
| 6 | MSB | |
| 7 | MSB | |
| 8 | LSB | |
| 9 | Data from Cassette | |
| 10 | Data to Cassette | |
| 11 | Clock | |
| 12 | H sync | |
| 13 | V sync | |
| 14 | H Blank | |
| 15 | V Blank | |
| 16 | Video | |
| 17 | Data to CPU | |
| 18 | Data from CPU | |
| 19 | +5 | |
| 20 | Ground | |
| 21 | +12 | |
| 22 | -12 | |

## Pin Side of Board

| Pin | Function | |
|---|---|---|
| A | P | |
| B | A | |
| C | B | |
| D | C | Horz |
| E | D | |
| F | E | |
| H | N | |
| J | F | |
| K | G | |
| L | H | |
| M | I | Vert |
| N | J | |
| P | K | |
| R | L | |
| S | M | |
| T | Data Inv | |
| U | H Preset | |
| V | V Preset | |
| W | Graphic Input | |
| X | Graphic Select | |
| Y | not used | |
| Z | | |

the digital group
po box 6528 denver, colorado 80206 (303) 777-7133

# 512 TO 1024 UPGRADE SPECIAL DIRECTIONS

This 512 to 1024 character upgrade kit permits using most of the 512 character IC's in addition to a new board, sockets, resistors, condensers and miscellaneous parts to achieve a 1024 character TV readout.

Steps:

1. Remove all IC's from your 512 board except IC27 (74L00), IC23 (74123), and IC33 (566).

2. Add the 34 IC's just removed to the IC's supplied with the 1024 character upgrade kit.

3. Continue with regular 1024 character readout directions.

the digital group
po box 6528 denver, colorado 80206 (303) 777-7133

## 1024 CHARACTER READOUT & CASSETTE INTERFACE UPGRADE - PARTS LIST

| IC's | |
|---|---|
| (IC30, 36) | 7 - 2102-1 or better |
| (IC11) | 1 - MCM6571L |
| IC9, 17 (28, 50) | 4 - 7400 |
| (IC19) | 1 - 7401 |
| IC16 | 1 - 7402 |
| (IC2, 7) | 2 - 7404 |
| IC6, (29) | 2 - 7410 |
| (IC27) | 1 - 7420 |
| IC8, 22, (48, 49) | 4 - 7430 |
| IC42 | 1 - 7490 |

| IC's | |
|---|---|
| IC39 | 1 - 74122 |
| IC20, 38 | 2 - 74L123 |
| IC18 | 1 - 74151 |
| (IC4, 14, 24) | 3 - 74157 |
| (IC10) | 1 - 74165 |
| IC1, 3, 5, 12, 13, 15, 21, 23, 25 (26, 37, 43, 45, 46) | 14 - 74193 |
| (IC40, 51) | 2 - 741 |
| (IC41, 44, 47) | 3 - 5558 or LM1458 |

| Capacitors | |
|---|---|
| C2 | 1 - 100 pfd mica |
| C4, 5 | 2 - 220 pfd mica |
| C43 | 1 - 330 pfd mica |
| C24 | 1 - 1000 pfd mica |
| C35 | 1 - .0047 mylar |
| C30 - C33 | 4 - .01 polystyrene (may be marked 10000) |
| C37 | 1 - .01 mylar |
| C38 | 1 - .015 mylar |

| Diodes | |
|---|---|
| S1 - S8 | 8 - 1N914 or 1N4148 |
| G1 | 1 - 1N48 or eq. Germanium |
| Z1 | 1 - 5V 1 watt zener (1N4733 or eq.) |
| T1 | 1 - 2N5129/2N2369 |

| Bypass Capacitors | Misc |
|---|---|
| 24 - .01 mfd disc | 5 - 8 pin sockets |
| 4 - 1 mfd tantalums | 17 - 14 pin sockets |
| | 28 - 16 pin sockets |
| Crystal | 1 - 24 pin sockets |
| 1 - 11.980 MHz | 1 - crystal holder |
| | 1 - documentation |

Resistors - all ¼ watt 5% unless noted

| | |
|---|---|
| R11 | 1 - 22 ohm |
| R12 | 1 - 220 ohm |
| R31 | 1 - 390 ohm |
| R1, 2, 10 | 3 - 470 ohm |
| R28 | 1 - 470 ohm ½ watt |
| R32 | 1 - 620 ohm |
| R5, 42 | 2 - 1K |
| R6, 7, 8, 9, 14 | 5 - 2.2K |
| R22 | 1 - 4.7K |
| R3, 4, 22 | 3 - 6.8K |

| Resistors | |
|---|---|
| R16, 17, 19, 20, 21, 26, 27, 35, 36, 37, 38 | 11 - 10K |
| R15 | 1 - 33K |
| R13, 24, 25, 33 | 4 - 47K |
| R34 | 1 - 68K |
| R39, 40, 41 | 3 - 100K |
| R29, 30 | 2 - 500Ω trimpot |
| R18 | 1 - 50K pot |

( ) indicates IC's removed from 512 Character Readout and Cassette Interface

the digital group
po box 6528 denver, colorado 80206 (303) 777-7133

NOTE TO OWNERS OF THE PREVIOUS 512 CHARACTER TVC-F.

The 1024 character TV readout board produces 64 characters on each horizontal line now, instead of the previous 32 per line. This will generally result in a need for reprogramming the screen formatting somewhat. Most D.G.S.S. Z-80 tapes using 512 character TV output have been modified to reflect this additional character count requirement. However, user designed programs may have to be modified to support the additional characters. A "quick and dirty" implementation can be performed by outputting an additional space "after each character or space."

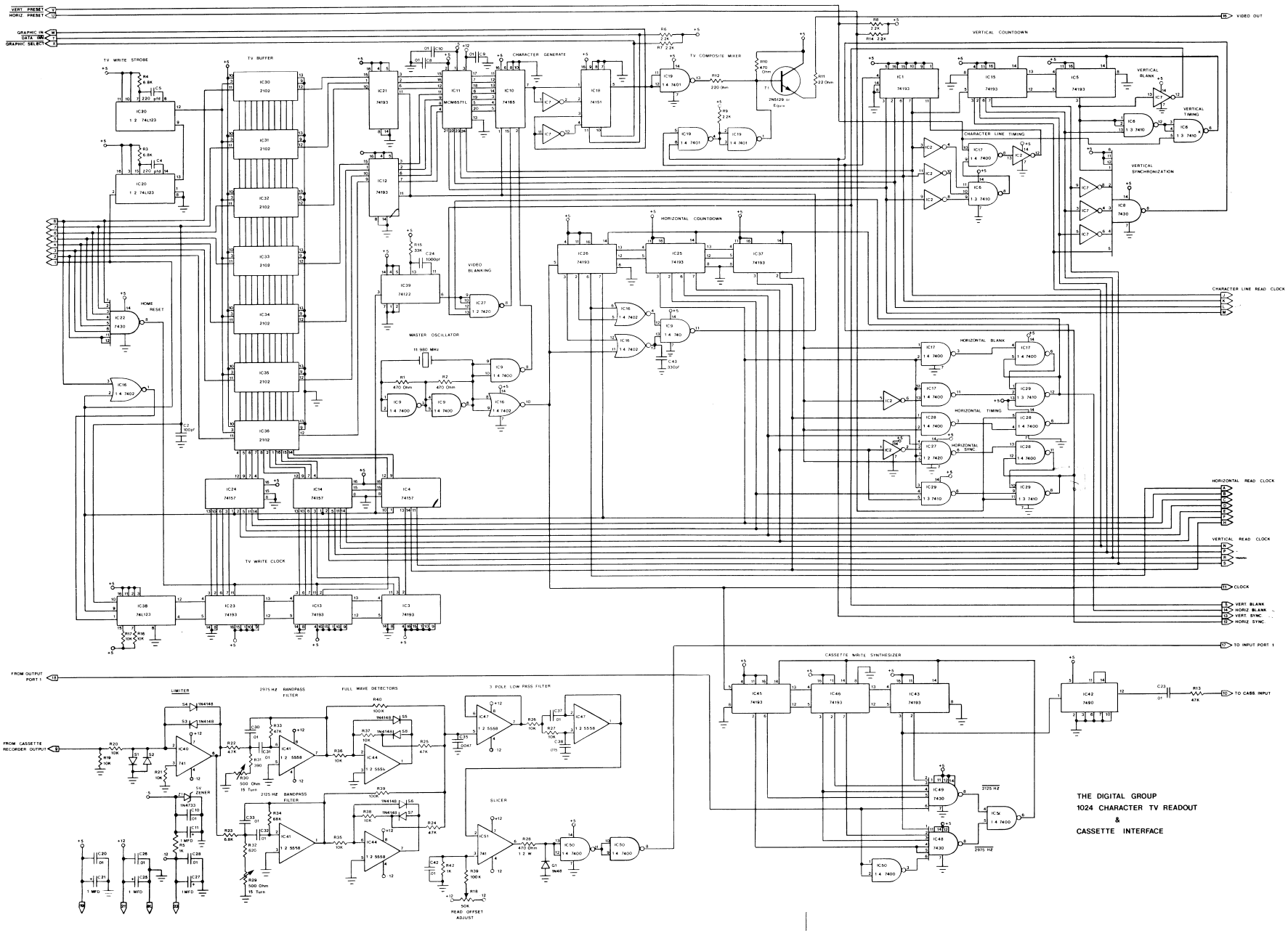
The screen erase subroutine must output 1024 spaces. This subroutine is part of the EROM op system of the various Digital Group CPU boards. The Z-80 has had several versions of EROM supplied, marked ZA, ZB, ZC, ZD, and ZE. ZE is the latest and most common. All but the ZA version already perform a correct "Erase" for both the 1024 and the 512 character TVC's.

The 8080, 6800or 6502, (or 6501) must have 80B, 68B or 6502, respectively, EROM's to satisfactorily perform a 1024 character Erase.

Should you have an older 512 character erasing EROM (a very small number of customers are in this category) please return your EROM and the Digital Group will reprogram/exchange it with the latest version for $5.00 postpaid.



the digital group
po box 6528 denver, colorado 80206 (303) 777-7133


VERT. PRESET
HORIZ PRESET
GRAPHIC IN
DATA IN
GRAPHIC SELECT
VIDEO OUT
TV WRITE STROBE
TV BUFFER
CHARACTER GENERATE
TV COMPOSITE MIXER
VERTICAL COUNTDOWN
VERTICAL BLANK
VERTICAL TIMING
CHARACTER LINE TIMING
VERTICAL SYNCHRONIZATION
HORIZONTAL COUNTDOWN
VIDEO BLANKING
HOME RESET
MASTER OSCILLATOR
11.980 MHz
HORIZONTAL BLANK
HORIZONTAL TIMING
HORIZONTAL SYNC.
CHARACTER LINE READ CLOCK
HORIZONTAL READ CLOCK
VERTICAL READ CLOCK
TV WRITE CLOCK
CLOCK
VERT. BLANK
HORIZ BLANK
VERT. SYNC.
HORIZ SYNC.
TO INPUT PORT 1
FROM OUTPUT PORT 1
CASSETTE WRITE SYNTHESIZER
TO CASS INPUT
FROM CASSETTE RECORDER OUTPUT
LIMITER
2975 Hz BANDPASS FILTER
FULL WAVE DETECTORS
3 POLE LOW PASS FILTER
2125 Hz BANDPASS FILTER
SLICER
READ OFFSET ADJUST
THE DIGITAL GROUP
1024 CHARACTER TV READOUT
&
CASSETTE INTERFACE

# 1024 CHARACTER TV READOUT & CASSETTE INTERFACE