THE DIGITAL GROUP
IMPACT PRINTER

298-056-B-25+13

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

CUSTOMER UNPACKING INSTRUCTIONS FOR THE DIGITAL GROUP PRINTER

Please read the documentation materials before assembling the printer as it contains all pertinent information and changes. A fuse modification has been detailed in the documentation to prevent damage to the print head in the event of excess current from the solenoid drive circuitry. Parts for this modification are also included.

Inspect the printer mechanism for any damage that might have occurred in shipping. Before operating the printer, remove the foam block or tape used to secure the print head. Inspect the print head to see that it moves freely. The margin detecting circuitry (photo cell) referred to in the documentation and in the P.A. Manual is located on the right as you face the front of the printer. Check to see if it is still in place and that a flat metal bar mounted on the print head breaks the path of the photo cell with the print head moved to the far right. This is used for starting the left printing margin (note convention for left). The bar may be adjusted by carefully pushing it through the head.

Inspect the ribbon inking spools and ribbon posts and install the ribbon as detailed in Figure 7 of the P.A. Manual.

The print head makes connections to the interface card via a 16-pin DIP plug. This DIP plug has been mounted on the printer mechanism PC card to prevent shipping damage and should be removed before making any connections to the printer PC card. This DIP plug will be installed as detailed in later assembly instructions and is shown in a photo in the documentation.

The 40-conductor cable connects to the printer mechanism PC card with the lower numbers on top. These numbers are labeled on the face of the cable plug with odd numbered cables on the right (facing the front of the printer) and even numbers on the left side of the PC card.

Testing as detailed in the documentation packet uses Maxi-BASIC, Option 7. Maxi-BASIC commands OUT and INP may be used to directly test the printer; read and follow the troubleshooting section in the documentation.

The audio cassette tape supplied with your printer contains 32 and 64 character printer routines that may be interfaced with Maxi-BASIC and ASSEMBLER software. To run either Maxi-BASIC or ASSEMBLER software with your printer, first load Maxi-BASIC or ASSEMBLER from an already existing software tape into your computer. After the program tape has been successfully loaded, load the cassette tape supplied with your printer into the computer. Two separate tone bursts are on the tape. The first tone burst is the driver routines for Maxi-BASIC and the second tone burst is the driver routines for interfacing with the ASSEMBLER. By using the READ option, Option 1, to load in the printer routines, the original operating system with the "menu" of options is updated and the printer routines are loaded. This modified operating system and program may be copied onto a blank tape by using the WRITE option, Option 2. Option 9, "Digital Group Printer", may be selected to use the printer. Power to the printer should be on just prior to selecting Option 9. An 8080 listing and tape is available upon request from the Digital Group.

A listing of printer driver routines for a Z80, 64 character TV-based Digital Group system, is included in the documentation. This should provide useful information on understanding or modifying the driver routines on audio tape. The address locations described in the documentation refer to the supplied listing and vary from those of both the 32 and 64 character driver routines supplied on tape. Important parameter constants and addresses, however, have been included for the tape versions.

THE DIGITAL GROUP IMPACT PRINTER

Introduction

The Digital Group presents its full size impact printer to complement the Digital Group microcomputer system. Available as a kit or assembled, The Digital Group Printer consists of an impact printer mechanism from Practical Automation, an interface card, and a power supply, all available in a handsome cabinet to match the Digital Group system.

The printer interfaces with the microcomputer via one parallel 8-bit input port and one parallel 8-bit output port. It is completely software driven, i.e., motor control signals, ribbon advance and line feed signals, and character font signals are generated in software. The character fonts control the signals to each of the seven impact pins forming a vertical column. Characters are printed as a 5 × 7 matrix. Lower case ASCII characters are converted to upper case characters under software control. Other character sets may be implemented by modifying the existing font table to include user-defined characters.

Initial Z-80 microprocessor support for The Digital Group Printer is provided on audio tape with Maxi-BASIC and ASSEMBLER driver routines with both 32 and 64 character TV displays. An 8080 printer driver routines listing and tape are available upon request.

The driver software addresses input port 3 and output port 3. Double width characters, variable character spacing, and print intensity changes may be implemented easily with one-byte changes in the software. These are detailed later in the documentation.

The interface card requires no power from a host system other than 110V AC from a switched outlet on the CPU cabinet backplane. +35V DC and 5V DC are developed on the interface card and are filtered by two off-board capacitors connected to the interface card power supply, connector 8. A center-tapped transformer that is part of the printer power supply provides the 28V AC needed by the P.A. printer mechanism and the interface card power supply.

An 18 yard inked ribbon with a life of roughly 10 million characters is provided. The printer utilizes a motor driven ribbon advance mechanism and re-inking rollers.

The printer will make up to four copies simultaneously. Paper can be either 8½" paper roll, fanfold, or cut page. A paper cutting edge is mounted on the front edge panel to facilitate removing copy. If you have purchased a Digital Group cabinet the front dress panel serves as the paper cutting edge.

System Description

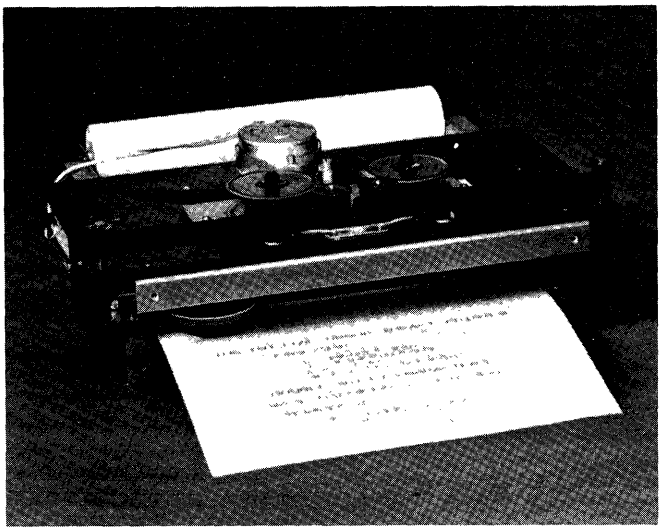
The printer interface card controls the operation of the printer mechanism circuitry and the printer head impact pins. It requires one parallel 8-bit input port and one parallel 8-bit output port. The interface card documentation includes a complete technical description of the interface card operation, assembly instructions, software description and printer driver routines (Z-80 printer routine listing provided; 8080 available upon request), Maxi-BASIC and ASSEMBLER 32-character and 64-character driver routines on audio cassette (1100 Baud), and an operational testing procedure of the printer and interface card.

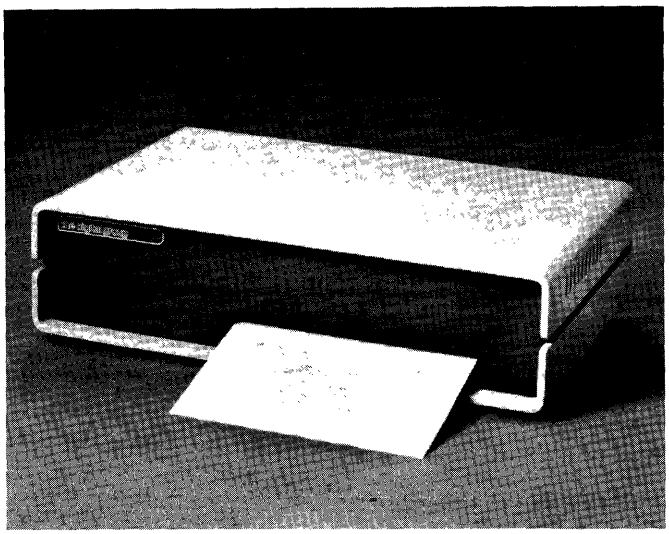
To complete The Digital Group Printer several additional items are needed. These items are all included when ordering a complete printer, or may be purchased separately from The Digital Group.

1. **Power Supply.** The interface card requires a 28V AC center-tapped transformer for printer motor operations and DC power supply operation. The card generates +5V DC and +35V DC. Two off-board filter capacitors are required for each respective power supply. The AC line connections to the 28V AC transformer primary should be properly fused. Complete documentation including cabinet wiring is provided.

2. **Cabling.** Cables for connecting the interface card to the printer mechanism and for connecting the interface card to the Digital Group motherboard are included in this package. Complete documentation is provided for connecting the interface card to the printer backplane, the printer backplane to the CPU cabinet backplane (4' cable), and the CPU backplane to the motherboard.

3. **Cabinets** that match the rest of your Digital Group system are available and house the printer interface card, power supply, and printer mechanism. Cabinets include an AC line cord, fan, fuse, power switch, and assembly documentation.





Specifications

Printing technique: impact, dot matrix

Printing speed: up to 120 characters/second

Line length: 80 to 96 characters depending on horizontal character spacing

Horizontal character/inch: variable — up to 12 characters/inch

Vertical character/inch: 6 lines/inch (with standard ratchet advance sprocket)

Paper width: 8½" maximum, 3½" maximum roll diameter

Paper feed: roll on internal holder, fanfold fed through back opening in cabinet, automatic line feed after CR character entry

Paper type: standard 8½" roll, fanfold, or cut sheet — up to four copies possible simultaneously without adjustment (3 mil to 16 mil thickness)

Character set: upper case ASCII, numbers, and special symbols; character fonts may be user-defined

Character size: .110" height × .100" width typical

Ribbon: standard ½" nylon ribbon on 2" spools, 10 million character ribbon life with automatic re-inking mechanism

Head traverse speed: 9.6"/second @ 60 Hz line

Power Requirements

Head: 35V DC ±5%, 7A peak current (all solenoids operating)

Needle solenoid pulsing: .6 amp average/needle

Paper feed solenoid: 35V DC (±3V), 20 milliseconds

Head motor: 28V AC at 400 mA

Photo electric head position sensor: +5V

Ribbon advance motor: 28V AC @ 125 mA

Dimensions

Printer cabinet: 11.250" × 18.050" × 4.620"

Interface Requirements

The printer interface card requires one parallel 8-bit input port and one parallel 8-bit output port; the interface is independent of any bus structure. An interface card cabling kit provides complete cabling and documentation, including a cable between the interface card and the printer cabinet backplane edge connector, dual edge connectors for the CPU cabinet and the printer cabinet backplanes, a cable running between the CPU and printer cabinets, and a set of Molex interconnect cables for connections between the CPU backplane and the standard motherboard - I/O 36-pin connector.

Power Supply

A transformer and two filter capacitors mount exterior to the card and connect to the printer interface card, connector 8. Cables and accessories to connect between these components and the interface card are included with documentation when ordered separately or when ordered as part of a complete printer.

Software Support

The printer is software driven. Lower case ASCII is converted to upper case ASCII under software control. A software description as well as a listing of the printer driver routines is included within the interface card documentation. Also included is an audio cassette recorded at 1100 Baud with Maxi-BASIC and ASSEMBLER driver routines with both 32-character and 64-character TV drivers. The listing provided is a 64-character version of the Maxi-BASIC driver routines.

All mechanical operations are under software control. The character set may be user-defined. Margin controls and the number of characters printed per inch are under software control. An entire line is loaded into the computer's line buffer before the print head starts in motion. The line is then printed after striking a C/R on the keyboard.

Head Drive Motor—Bi-synchronous Motor

Normal motor speed is 300 RPM (approximately 10"/second)

Print Head

The Digital Group Printer utilizes the P.A. DM101 needle print head. The print head contains seven vertically mounted needles and their associated solenoids. As the head moves across the ribbon and paper, the needles strike the platen located under the paper. It strikes up to five times for each character, creating the successive horizontal dots of a 5 × 7 dot matrix.

Print Head Electrical Specifications

Solenoid coil resistance: 16 ohms per coil

Inductance: 10 mh

Operating current: current limit at 1 amp per solenoid, maximum 1 millisec on-time

Operating voltage: 25 - 50V DC (35V DC typical @ 625 microseconds on-time)

Paper Advance

The paper advance (line feed) is provided by a +35V DC solenoid driven ratchet under software control.

Ribbon Advance Mechanism

The printer incorporates its own ribbon advance motor and re-inker. The ribbon is advanced during the entire print head travel time (both forward and reverse). The ribbon is inked by porous re-inking rollers while the ribbon advance mechanism is in motion. The ribbon travels on a diagonal skew to distribute the wear. As the ribbon supply is exhausted on one spool, the ribbon direction is automatically reversed.

Inking

A twin spool 18 yard inked ribbon is provided with each printer. Each ribbon will last for approximately 10 million characters. Refer to Figure 7 in the P.A. Manual for installation procedures.

Periodic Maintenance

Similar to any mechanical peripheral, periodic maintenance will improve the quality and longevity of your printer. See the P.A. manual for maintenance information.

Technical Description—Printer Interface Card

The printer interface card essentially converts TTL level inputs from an output port (port 3) to appropriate signals that control the print head motor, ribbon advance motor, line feed solenoid operation, and the actual printing of characters by selecting the appropriate impact pins striking the platen.

Status or condition signals from the printer mechanism are likewise converted to TTL levels and received by the driving computer through one input port, as labeled on the schematic.

To print a character, it is necessary to select the number of pins in a vertical column that make up a character. Since the printer uses a 5 × 7 matrix for each character, the interface card must have access to five columns of data at the appropriate times to tell it which pins must strike the paper. In software the computer must provide a look-up table for the complete set of printable characters that are desired. The data for each character is stored in five sequential locations, so each byte has the information for one vertical column of a character — seven vertical bits for a character and one bit (the MSB) to provide a strobe.

Font data input to the card is gated through seven 7409's (quad-2 input and gates) by a font strobe from pin 13, IC1. Q1, Q2, Q4 - Q8 (Darlington transistors) are solenoid circuit driver transistors which activate the individual print needle solenoids. Motor control signals enter via the same output port but a different strobing sequence is used.

Since the interface card must interpret both motor commands and actual font data, and must also screen out improper inputs, the interface card uses IC1 (74123) to make sure proper software sequences are followed. IC1, which contains two "one-shot" triggers, is controlled (or strobed) by the MSB bit from output port 3. One of the triggers of IC1 (pin 12) latches motor commands into a 74174. The outputs of the 74174 are used to run the print head motor, forward or reverse, advancing the ribbon, and activating a line feed solenoid.

The other trigger of IC1 is used to gate font data into IC4 and IC5, which turn on the appropriate impact pin solenoid drivers. The "one-shot" font pulse from IC1 also prevents the print solenoids from being overdriven. The length of the pulse (determined by RC time constant) being gated into IC4 and IC5 provides a maximum time that fonts may be printed. IC13 is used to synchronize motor commands with the AC line crossing Ø via a status signal sent to input port 3. IC2 (3302, quad comparator package) is used as a protection device for both power-on or power-down conditions. On initial power-on it clears out motor commands, disables input to the impact pin solenoids with Q3, and also provides a status signal back to the CPU through input port 3. At other times one of the comparators is used to detect the left printing margin (HOME) and send this status signal back to the computer via the input port. Q3, as previously mentioned, disables input to the impact pin solenoids on initial power-on conditions or power failure conditions of the +35 volt supply.

A summary of status signal to an input port is listed below. IC8, IC10 and IC11 and Q11 - Q13 control full wave 28V AC to the AC driven devices of the printer and provide isolation from TTL circuitry in the interface card.

LSB .....PRINT FWD
LSB + 1.....PAPER OUT (not used)
LSB + 2.....READY (power on status)
LSB + 3.....POWER (AC line sync condition)
MSB - 3 .....PRINT FIELD (not HOME)
MSB - 2 .....LINE FEED (status signal)
MSB - 1 .....FONT (indicates font-entered condition)
MSB.....STROBE (MSB condition or status)

Motor command signals are strobed into IC6 by a high-to-low transition input to pin 9 of IC1. Fonts are strobed or gated into IC4 and IC5 by a low-to-high transition input to pin 2 of IC1.

To send a motor command to the printer the following sequence must be followed:

1. Send the strobe bit (MSB) high with all other bits zero, thus setting up the trigger. 80 h.

2. Send out the appropriate command with the MSB low.
   a. MOTOR FWD—octal Ø06, motor FWD and ribbon advance 06 h
   b. MOTOR REV—octal Ø05, REV and ribbon advance 05 h
   c. LINE FEED—octal Ø20 10 h
   d. ALL STOP—octal ØØØ 00 h

Note: If you use Maxi-BASIC to test motor commands, all parameters must be converted from octal to decimal values.
Example: Ø20 octal is 16 decimal.

Assembly Instructions

The recommended procedure for installing and operating the printer with the Digital Group system is detailed briefly below, with more explanation and figures provided in later documentation.

Steps

1. Assembly of printer interface card
   a. Component assembly
   b. Fuse modification — fuse modification (current limit protection) parts are included

2. Cabling procedure
   a. AC line wiring (parts and cabinet wiring documentation provided with cabinet). Be sure that AC line is fused properly (2A) and that a switch controls power to the fan and interface card.
   b. Installation of DC power supply to printer interface—connector 8
      1) Hook-up
      2) Testing — +5V DC , +35V DC
   c. Installation—40-conductor flat cable between 40-conductor plug and printer interface card, connector 6
      1) Hook-up
      2) Testing
   d. Installation — I/O connections between CPU cabinet motherboard and printer interface card
      1) Connections between printer interface card, connector 3, and printer backplane edge connector
      2) Connection of printer cabinet to CPU cabinet via cable
      3) Connections of CPU cabinet backplane to I/O port (Molex connections made between backplane edge connector and motherboard — I/O port 36-pin edge connector
      4) Testing

3. Diagnostic testing procedure: including software description, operational testing of circuitry with printer driver routines
   a. AC and DC power testing
   b. Printer command testing — motor commands, ribbon advance, line feed operation
   c. Software testing — print head circuitry
   d. Driver routines operation

It should be noted that testing should be carried out carefully as damage to the printer head may result from improper hook-up or operation of the interface card. The solenoid driver circuitry is first tested without the printer head DIP plug connected. Finally, when all circuitry has been tested and paper has been installed, the tape provided can be used to test printing characters with the printer DIP plug cable (16-pin) connected to connector 2 on the interface card.

To send a font to the appropriate solenoid drivers follow this sequence:

1. Send out MSB low, i.e., ALL STOP command **000**.

2. Send out appropriate font with MSB high.
   Note that this sequence must be repeated five times for an individual character. Motor command 006 is also sent out between each font column printed. After the last font of a line has been printed a line feed command is entered in IC6. If the font gate pulse is still present when the line feed command is given, the command will also be interpreted as a font.

The interface card also generates two on-board voltages: +35V DC for line feed operation and solenoid drivers for impact pins, and +5V DC for the on board TTL operations. Two off-board capacitors (wired into connector 8) filter both voltages. The capacitor with the largest voltage rating, i.e., greater than 35V DC, should be used to filter +35V DC.

Interface Card Assembly

To build The Digital Group Printer Interface Card you will need the following tools and equipment:

Fine tipped low wattage soldering iron (approximately 25 watt)
Solder—60/40 resin wire solder, 20 - 30 gauge (approximately)
Do not use acid core solder!
Diagonal cutters—small micro shear type preferred
Long-nosed pliers
Flux remover or alcohol
Small brush
Volt-ohm meter
X-acto knife

Refer to the parts placement diagram during construction.

Before beginning to mount and solder components, inspect the Printer Interface Card. **The side from which the components are mounted has The Digital Group label on the far right area of the card.** Compare the areas where IC sockets will be inserted with the layout to see that there are no shorts occurring between either the traces leaving the IC or the IC pads or holes in which the IC's are mounted. While plating errors like this are a rare occurrence and The Digital Group tries to inspect and maintain the quality of its printed circuit board, once the IC sockets are inserted it is very difficult to find such a problem.

The voltage ratings listed are the minimum rating allowed for capacitors included in the kit. Individual capacitors may be substituted with higher voltage ratings.

The sockets should be mounted as close to the board as possible. Do not bend the leads of the IC sockets excessively before soldering, as they may break off at the base of the socket.

Three-pin socket strips are used for IC8, IC10, IC11, and IC13. Solder them carefully to make sure the spacing matches that of the IC's.

1. ☐ Install and solder the three 16-pin IC sockets for connector 2, IC1 and IC6.
2. ☐ Insert the five 14-pin IC sockets for IC2 - IC5 and IC7 and solder.
3. ☐ Insert six MR501 power diodes, D36 - D41, and solder with the banded end oriented as shown on the layout.
4. ☐ Insert the 18—1N4001 diodes, D1, D12, D21 - D32, D35, D42 - D44, and solder. Note the polarity markings shown on the layout.
5. ☐ Insert the two 1N4372 3V zeners, D3 and D4, and solder.
6. ☐ Install and solder the seven 1N4004 diodes, D5 - D11, in position indicated on the layout.
7. ☐ Insert and solder diode 1N5010A 3.9 volt 1 watt zener, D2. Note the polarity.
8. ☐ Install and solder capacitor C2, a 10 pfd silver mica. Mica capacitors can be recognized by their rectangular shape.
9. ☐ Insert and solder the seven .1 mfd capacitors, C6 - C12.
10. ☐ Insert and solder C3, a 10 mfd 15 volt tantalum capacitor ("tear drop" shape). Note the polarity marking indicated by the labeling on the body of the capacitor and on the layout diagram.
11. ☐ Insert and solder capacitor C1, a .33 mfd mylar capacitor, a smaller square package than C2.
12. ☐ Insert and solder the six .01 mfd 50 volt ceramic capacitors, C4, C5, C13, C15 - C17.
13. ☐ Insert and solder the two .1 mfd 25 volt ceramic capacitors, C24 and C25.
14. ☐ Insert and solder the 22 mfd tantalum capacitor, C26, with the polarity shown on the layout.

15. ☐ Insert and solder the seven 470 ohm 1 watt resistors, R23 - R25 and R28 - R31.

16. ☐ Insert and solder the eleven 470 ohm ¼ watt resistors, R10, R11, R20 - R22, R26, R27, R33 - R35, and R54.

17. ☐ Insert and solder the three 220 ohm ¼ watt resistors, R36, R39, and R40.

18. ☐ Insert and solder the 47 ohm ½ watt resistor, R32.

19. ☐ Insert and solder the 15 - 1K ohm ¼ watt resistors, R1 - R6, R12 - R16, R47, R48, R51, and R53.

20. ☐ Insert and solder the five 100K ohm ¼ watt resistors, R7, R19, R46, R49, and R50.

21. ☐ Insert and solder two 10K ohm ¼ watt resistors, R8 and R9.

22. ☐ Insert and solder the 100 ohm ¼ watt resistor, R41.

23. ☐ Insert and solder three 4.7K ohm ¼ watt resistors R17, R18 and R52.

24. ☐ Insert and solder transistor Q3 (2N2222). Note the collector emitter and base lead labeling on the layout.

25. ☐ Install and solder eight TIP-120 Darlington transistors, Q1, Q2, Q4 - Q9. The flat metal portion of each TIP-120 will be facing away from connectors 3 and 6 on the layout. Note that this may require tapering the leads to fit the circuit board. The flat metal portion of each TIP-120 will be facing away from connectors 3 and 6 when correctly installed. See the layout diagram.

26. ☐ Install and solder three transistors Q11 - Q13 (2N1598 SCRS), adding the nylon spacers provided to separate the transistor body from the circuit board.

27. ☐ Install the heat sink for IC14 on the PC board by installing only the top screw and tightening. Bend the leads of IC14 (LM340-5 5volt regulator) at a right angle at the point where the lead diameters decrease. Make sure the leads are bent downward. Before soldering in place, install IC14 and fasten with bottom mounting screw.

28. ☐ Install the four 6-pin sockets for IC8, IC10, IC11 and IC13. Install strips of socket pins and solder.

29. ☐ Install IC8, IC10 and IC11 (MCS-2 SCR's) and IC13 (TIL-113 optical isolator).

30. ☐ Install IC1 - IC7 according to the parts placement diagram.

31. ☐ Install and solder jumpers J1 and J2 as shown. Use wire of approximately 30 gauge; resistor leads may be used.

32. ☐ Check the circuit board layout for correct parts and IC placement.

33. ☐ Check the circuit board connections for shorts, unsoldered pins, or other problems.

Fuse Modification
(Print solenoid—overload current protection circuitry)

The following detailed modification should be made to the interface card before hook-up of the cables and electrical power. In the event a solenoid is overdriven or a solenoid driver fails, the fuse will blow to protect the print head. The fuse provided is a .5 amp slow-blow. **Do not exceed a .6 amp slow-blow fuse.** If the fuse blows frequently, check the solenoid driver voltage supply and the components in the seven driver circuits on the interface card.

Figure 2 shows the physical location of the two traces that need to be cut, and Figure 3 shows the circuitry being modified.

Fuse Modification

The fuse is being installed in the circuit between diode D41 and connector 2. Two traces must be cut and the two fuse clips provided should be mounted and soldered in the existing holes on the board. Two jumper wires are then added to connect the fuse clips in the circuit. See Figures 2 and 3.

NOTE: This modification deleted and 7 fuses (.5A SLOW BLOW) installed in each driver line to solenoid. Reason: when drive time was increased to point needed for good density printing and double print was selected (see software) under some conditions fuse would blow. Seven fuses are mounted on the printer itself. 7/19/84

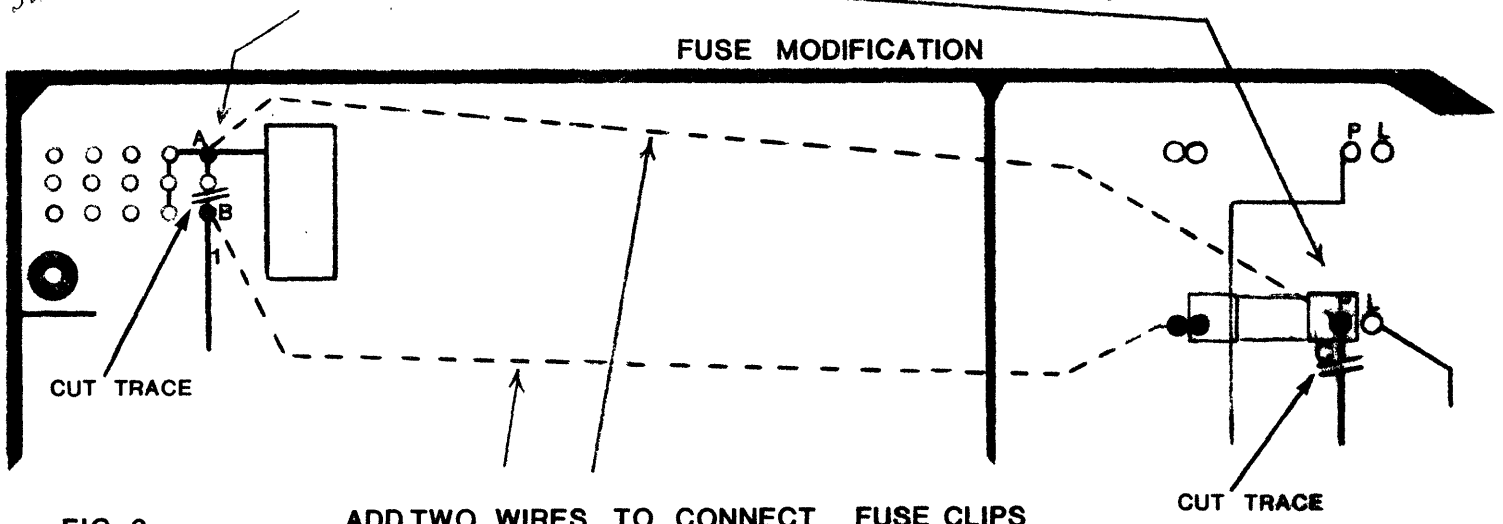


FIG. 2 ADD TWO WIRES TO CONNECT FUSE CLIPS ON BACKSIDE OF BOARD

Procedure

1. Locate and cut the traces within the connector at points A and B, and below the fuse clip at point C. An X-acto knife is recommended for this procedure.
2. Mount the fuse clips and solder. To mount, cut one lug off each clip and mount as shown in the figure. Be sure the fuse clip openings are facing each other when soldering the clips in place.
3. Check to see that the fuse clips do not connect to anything at this point. Install two jumper leads between the fuse clip ends on the circuit side of the board and the circuit side points A and B.
4. Mount the fuse provided. The recommended fuse is a .5 amp slow-blow fuse. Do not exceed a .6 amp slow-blow fuse.

FIG. 3 SOLENOID DRIVER CIRCUITRY

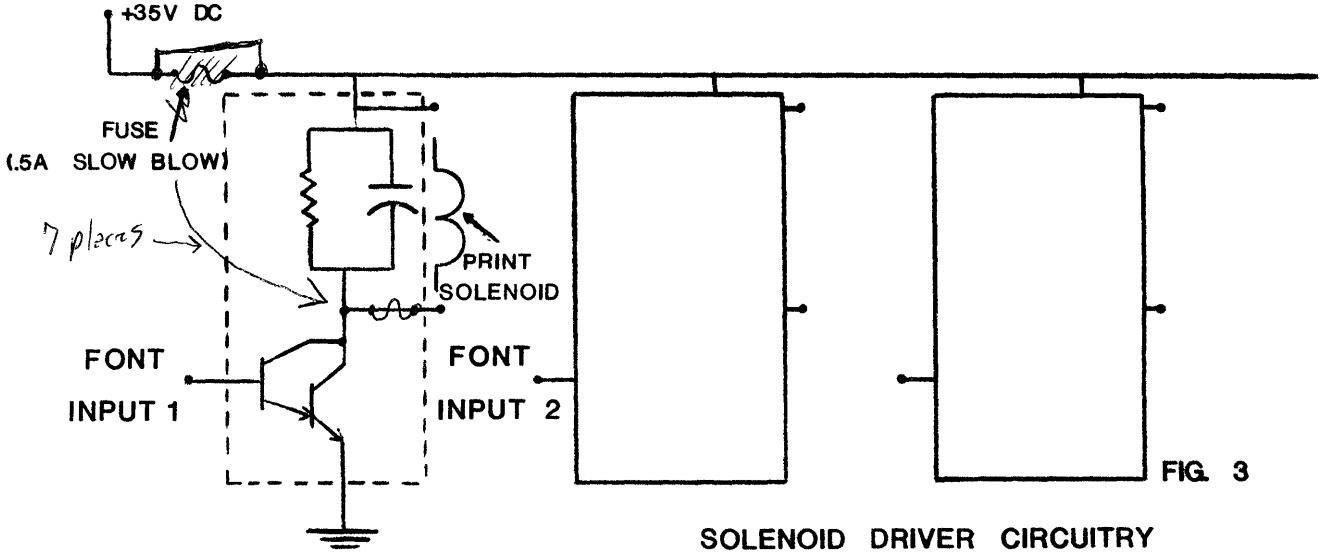


FIG. 3 SOLENOID DRIVER CIRCUITRY

POWER SUPPLY HOOK-UP

The printer power supply consists of a 28V AC center-tapped transformer, two filter capacitors for the +5V DC and +35V DC supply, and associated cable to connect the power supply to the interface card. These parts are supplied when ordering a printer power supply or with a complete printer.

The AC line to the 28V AC transformer must be properly fused (2 amp) and the printer chassis grounded when installing the power supply and hooking up the printer. AC supply parts are supplied with the Digital Group printer cabinet. DC supply parts, including wire lengths, Molex blocks and pins, are supplied when ordering a Digital Group Printer Power Supply or a complete Digital Group Printer.

Figure 6 shows the general configuration and parts of the printer interface power supply. Figure 5 shows the physical location of the power supply components within the Digital Group cabinet. Figure 6 also shows the physical lengths of wire used in the cable and their connection points. Follow the instructions for connecting the lengths and attaching Molex pins to each length of wire. An 8-position male Molex block is soldered directly to connector 8 of the interface card on the component side of the card. This block mates with an 8-position Molex block with Molex pins inserted.

To build The Digital Group Printer Power Supply you will need the following tools and equipment:

Molex pin crimping tool
Fine tipped low wattage soldering iron (approximately 25 watt)
Solder—60/40 resin wire solder, 20 - 30 gauge (approximately)
Do not use acid core solder!
Diagonal cutters—small micro shear type preferred
Long-nosed pliers
Volt-ohm meter

Note: The power supply hookup detailed below refers to installing components which are provided in the power supply package. If you have not purchased the Digital Group Printer Power Supply, use components referenced in the parts list and Figures 5 and 6 as a guide.

Steps

1. Identify all lengths of wire included with the power supply. All connecting wire is 18 gauge wire.
2. Crimp Molex pins on one end of each supplied wire with the exception of a 10" wire length used to connect the grounded terminals of C27 and C28.
3. Install and solder the three 15" lengths of wire to the lugs on the 28V transformer. Install the Molex pins in the corresponding position of the Molex block using Figure 5 and Figure 6 as a guide. Be sure that the centertap lead goes to connector 4 on the interface card.
4. Next, crimp a lug connector on a 12" and 15" length of wire. These lengths are used to connect the positive terminal of each capacitor to pins 1 and 2 of the Molex block. Be sure that the Molex pins on one end and the crimp-on solderless connectors on the other end are solidly attached. The Molex pins should be inserted in positions 1 and 2 of the Molex block (+5V and +35V DC terminals).
5. Prepare the other lead running to each capacitor (the grounded terminal) by crimping solderless connectors onto the wire leads used to connect the terminals of C27 and C28 to ground (position 6 of the Molex block). Two wires are crimped into the lug connector on C27 as shown in Figure 6.
6. Connect the wire leads to the filter capacitors with the 10-32 x ¼" screws provided with each capacitor. Metal washers may be used to firm the terminal connections.
7. Install the 8-position Molex block, with all pins inserted in the block. **Be sure that your wiring matches that shown in Figure 6 before applying power to the AC transformer. Do not connect any other wiring to the printer mechanism or to your computer without testing the power supplies on the interface card.**
8. Check the resistance with an ohmmeter between pin 1 and pin 6 and between pin 2 and pin 6. Pin 1 on the interface card is the connection for +35V DC. Pin 2 on the interface card is +5V DC. Be sure that a short does not exist between either of these supplies and GND (pins 6, 16, and 18).
9. With all fuses installed, switch power-on (110V AC). Check the voltages at pin 6 on connector 6 for +35V DC using a voltmeter. Be careful not to short the pins with a voltmeter probe or touch the exposed AC wiring within your cabinet. Also check the +5V supply. A large trace running along the top of the card is labeled +5.

Measure all voltages with respect to GND, located on pins 6, 18, and 16 on connector 8.

PRINTER CABINET (POWER SUPPLY) COMPONENT PLACEMENT

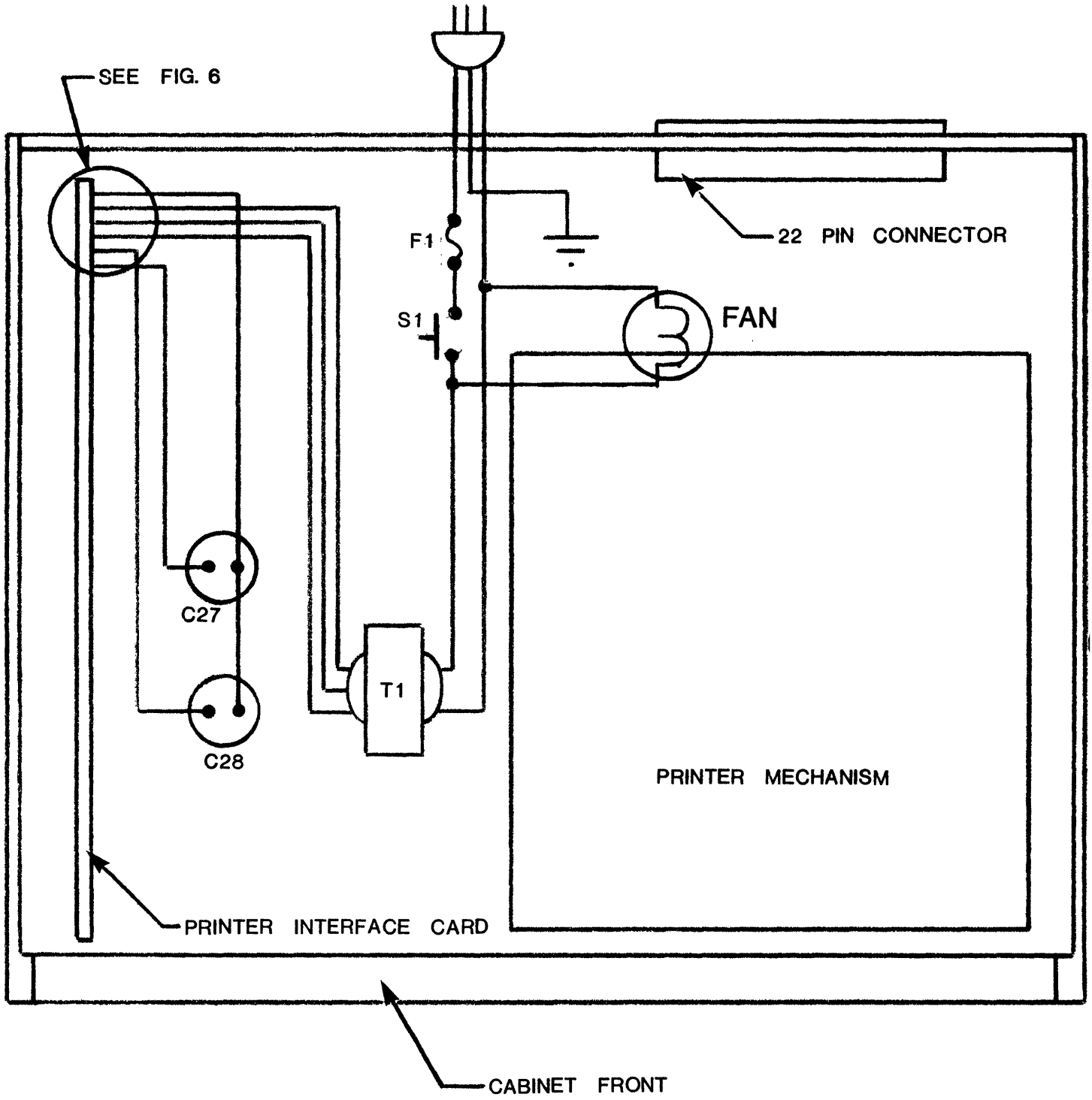


FIG.5

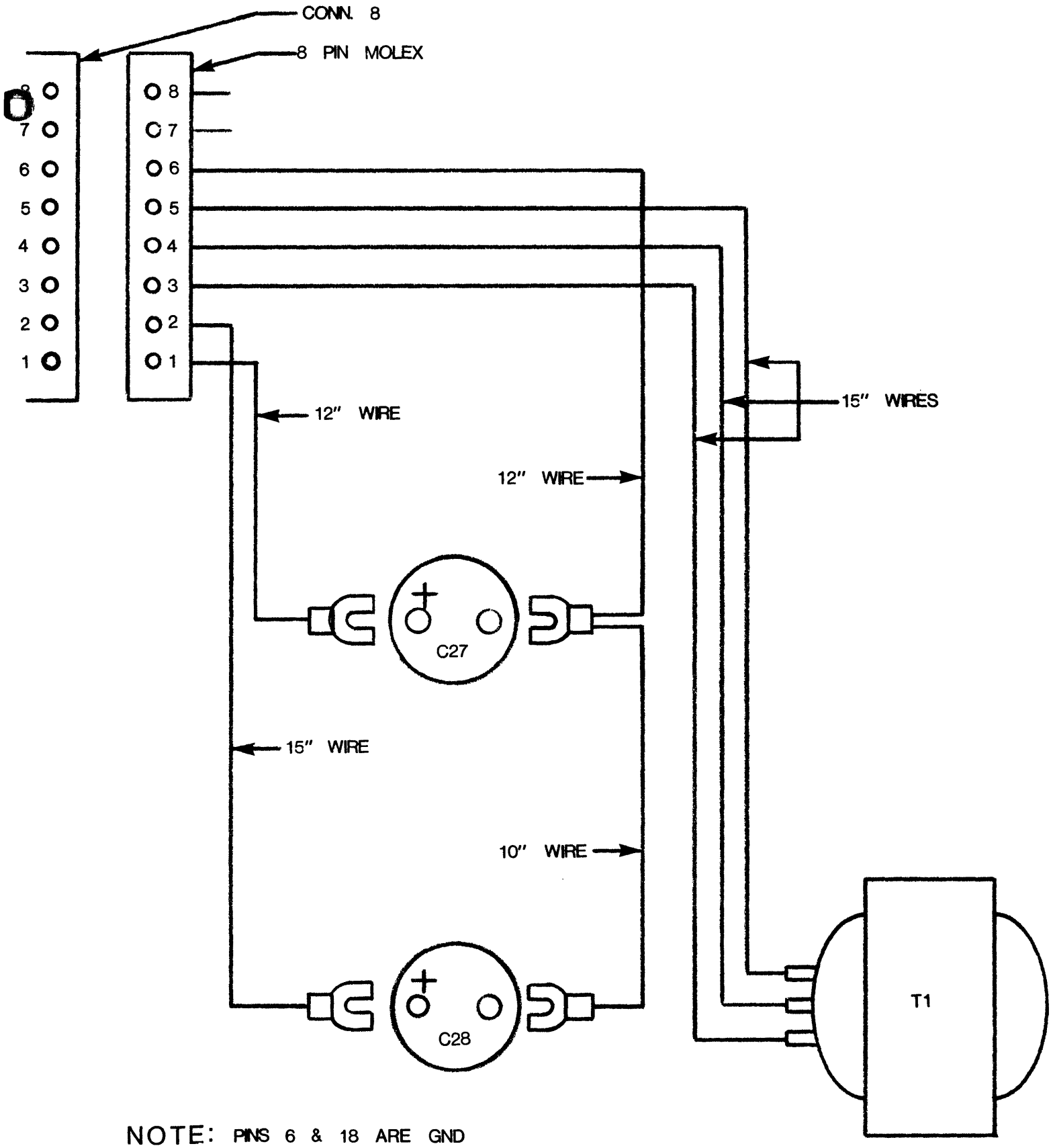

CONN. 8
8 PIN MOLEX
8
7
6
5
4
3
2
1
12" WIRE
15" WIRES
12" WIRE
C27
15" WIRE
10" WIRE
C28
T1
NOTE: PINS 6 & 18 ARE GND

FIG. 6

CABLING PROCEDURE

The cables and cable parts you have received provide all connections for signals between the interface card and the computer (Digital Group cabinet), and between the interface card and the printer mechanism. An illustration of the connections made onto the interface card is shown below. Signals to the interface card are either status signals from the printer, or motor commands and font data to the printer. Figure 7 illustrates the connections made between the interface card and the printer via a 40-conductor flat cable and plug (numbering on face of plug).

STEPS

1. Using Figure 7 as a guide connect the 40-conductor cable to the printer interface card. These connections should be soldered making sure that adjacent pins on the card are not shorted.

2. To prepare the 40-conductor flat cable, locate the leads to be used and separate them from the cable for approximately 2". The cables used are #'s 1, 2, 4, 6, 9, 10, 11, 21, 32, and 35.

3. Be sure that cable numbering matches the cable numbering on the face of the plug.

4. Beginning at pin 1 of connector 6 on the interface card, install and solder each cable according to the connection table below Figure 7. Power should not be on while soldering or installing the plug on the printer.

Check the cable wiring with Figure 7. Tape back the unused cables or cut them back approximately 1½" from the connected cables.

TESTING

1. Test the printer and the interface card with the 40-conductor plug installed on the printer. The plug mounts on the printer with the cable leaving the plug on the left side as you face the front of the printer. The lowest numbers on the plug should be up, with odd cable numbers on the right and even cable numbers on the left as you face the front of the printer.

2. Without connections made to I/O ports, no motor control signals are sent to the printer. Thus if any motor action occurs when the plug is installed, unplug the printer and inspect the circuitry controlling motor control functions, i.e., IC6, IC7, IC8, IC10, IC11 and Q9, and the wiring connections on connector 6. Be careful not to touch AC voltages present on the power switch, transformer, or the interface card.

With power on to the printer the outputs of IC6 (74174, "D" latch) can be checked with a voltmeter. IC6 along with the associated circuitry of IC8, IC10, and IC11 and Q11, Q12, and Q13 provide switching for the AC devices on the printer, the print motor and ribbon advance motor. IC5 and Q9 provide current for line feed operations.

I/O CONNECTIONS

I/O connections are made between the interface card and the computer. These steps are detailed in three steps for the Digital Group system; connections from the interface card connector 3 and the printer backplane, connections between the printer backplane and the CPU cabinet backplane, and connections between the CPU backplane and the I/O card, port 3. Photos 1 and 2 show the configuration of the interface card to printer backplane connector, and Photo 3 shows the configuration of the printer to CPU cabinet cable. Photo 4 shows the printer cabinet with all components, i.e., the interface card, power supply and printer mechanism, installed.

Connections between the interface card, connector 3, and the printer backplane edge connector (supplied with cable pack) are made via two 8-position Molex cables by soldering one end into the connector positions 2 through 17 and attaching each lead on the other end to a Molex pin inserted in a Molex block. INPUT port connections are made via one 8-position block and 8-position cable. OUTPUT connections are made with one block and an 8-position cable.

A printer to CPU cabinet cable is detailed using two 22-pin paddlecards and two 4' lengths of 10-position shielded cable. One wire per cable is connected to ground on pins A and Z. Connections to both cabinets are on the lower row of wirewrap pins (of each backplane connector). A wire should be soldered between pin 1 on connector 3 and one of the grounded backplane pins (A or Z). This will help prevent erratic operation of the printer.

Connections between the CPU backplane and the I/O connector are made with two 14" lengths of eight wire cable with Molex pins on each end. The pin-for-pin connections are illustrated in Figure 8.

Detail 1 — Interface Card to Printer Backplane

Connector 3 Pin # (interface card)		Backplane Connector Pin #
1 GND	connect to	A or Z
2 MSB-3	to input port #3	S
3 MSB-2	"	R
4 LSB+3	"	T
5 MSB	"	N
6 MSB-1	"	P
7 LSB+2	"	U
8 LSB+1	"	V
9 LSB	"	W
10 MSB-1	from output port #3	L
11 MSB-2	"	K
12 MSB-3	"	J
13 LSB	"	D
14 LSB+2	"	F
15 LSB+1	"	E
16 LSB+3	"	H
17 MSB	"	M

Note: Wiring the printer backplane by this convention will maintain the same "bit" significance as adopted for the CPU backplane as viewed from inside the cabinet. Numbering is from left to right on the top row of pins on the dual edge connector. The lower row of pins is labeled from left to right A through Z.

Detail 2 — Printer Backplane to CPU Backplane

Make a cable according to the connection chart of Figure 8. See Photo 3. Solder the wires of each cable into the paddlecards, making sure that the "bit" significance is maintained for both the printer and CPU cabinet backplanes. Wires will be soldered to pins D through M for output "bits" and pins N through W for input port "bits".

Detail 3 — CPU Backplane (dual edge connector) to Digital Group I/O Card (port 3).

The connections are made via two 8-position Molex cables terminated on both ends by Molex pins inserted in nylon Molex blocks. One cable is used for input port connections between the CPU backplane and the input pins on the I/O 36-pin connector, and another between the CPU backplane and the output pins on the I/O 36-pin connector. The connections of these cables is also detailed in Figure 8.

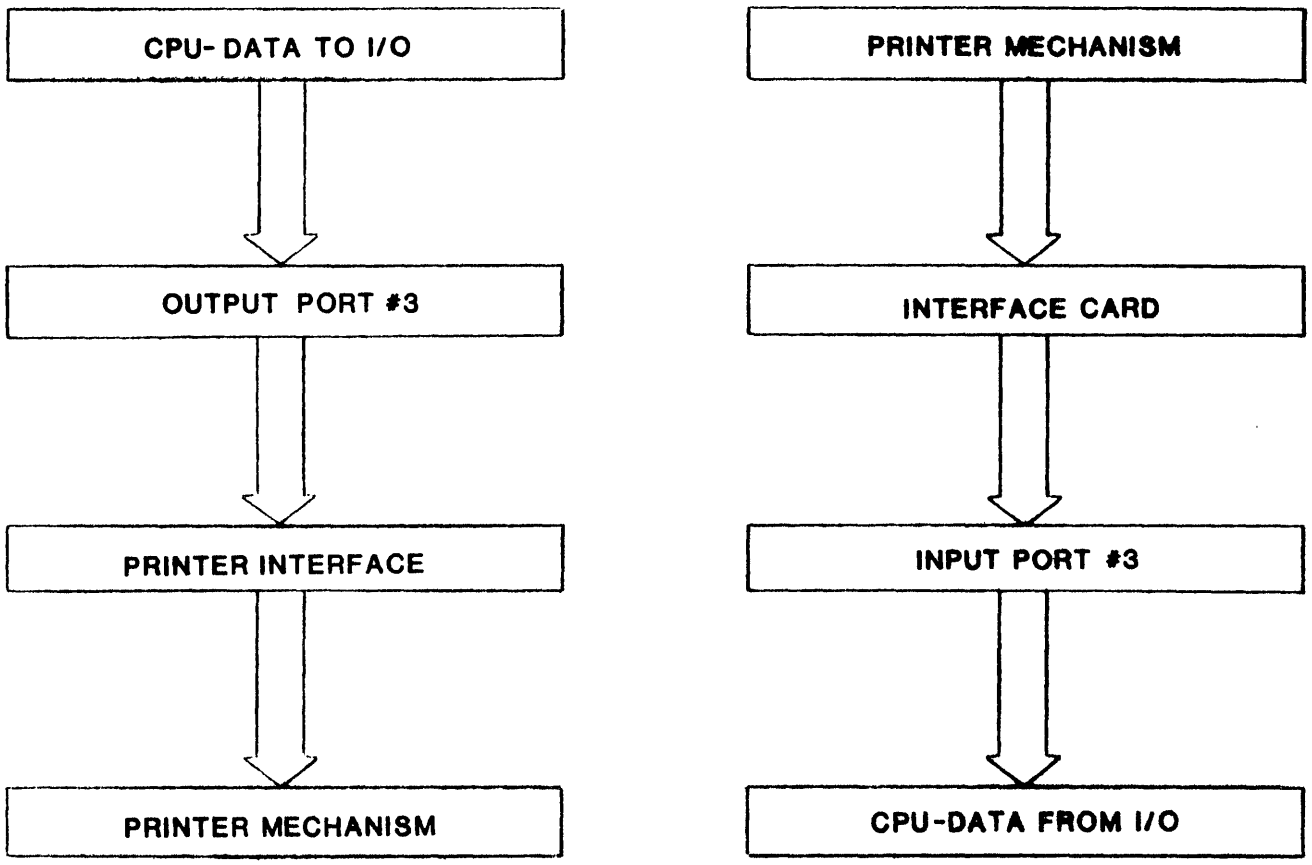
This completes the I/O connections to the printer from the microcomputer. Check over all connections, between the I/O card and the printer interface card with all cables connected but power off to the microcomputer and printer.

Grounds should be run to the printer cabinet through the cable. Pins A and Z are designated grounds on the CPU backplane and should be designated grounds on the printer backplane connector also.

FIGURE 8

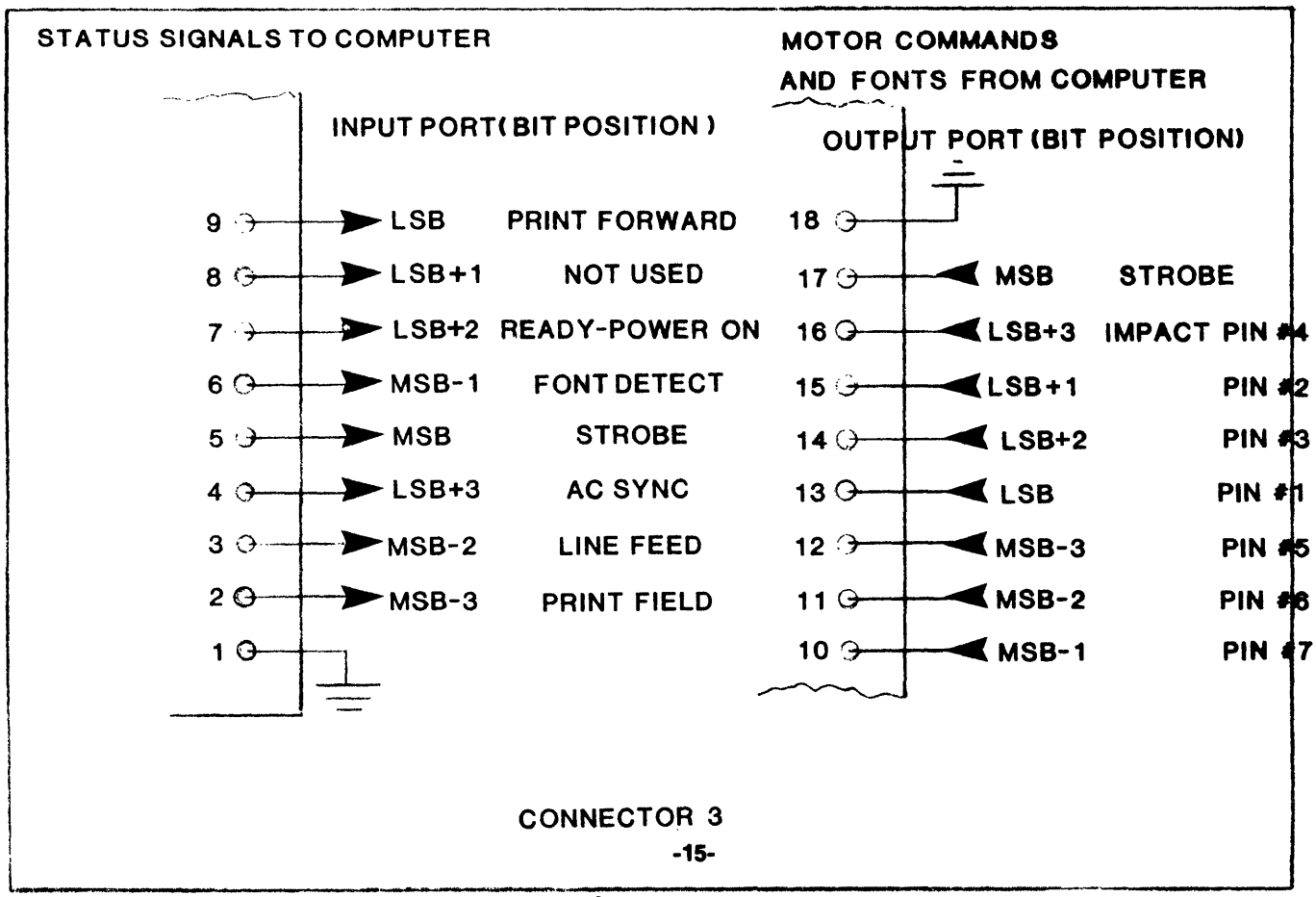
Interface Connector 3	Printer Backplane	CPU Backplane	Port 3 I/O 36-pin Connector	
1	A or Z	A or Z	N/C	
13	D	D	$\overline{F}$	LSB
15	E	E	$\overline{H}$	LSB + 1
14	F	F	$\overline{J}$	LSB + 2
16	H	H	$\overline{K}$	LSB + 3
12	J	J	$\overline{L}$	MSB - 3
11	K	K	$\overline{M}$	MSB - 2
10	L	L	$\overline{N}$	MSB - 1
17	M	M	$\overline{P}$	MSB
5	N	N	35	MSB
6	P	P	34	MSB - 1
3	R	R	33	MSB - 2
2	S	S	32	MSB - 3
4	T	T	31	LSB + 3
7	U	U	30	LSB + 2
8	V	V	29	LSB + 1
9	W	W	28	LSB

Pins $\overline{F}$ through $\overline{P}$ are opposite pins 28 through 35 on the I/O card, 36-pin wirewrap connector.



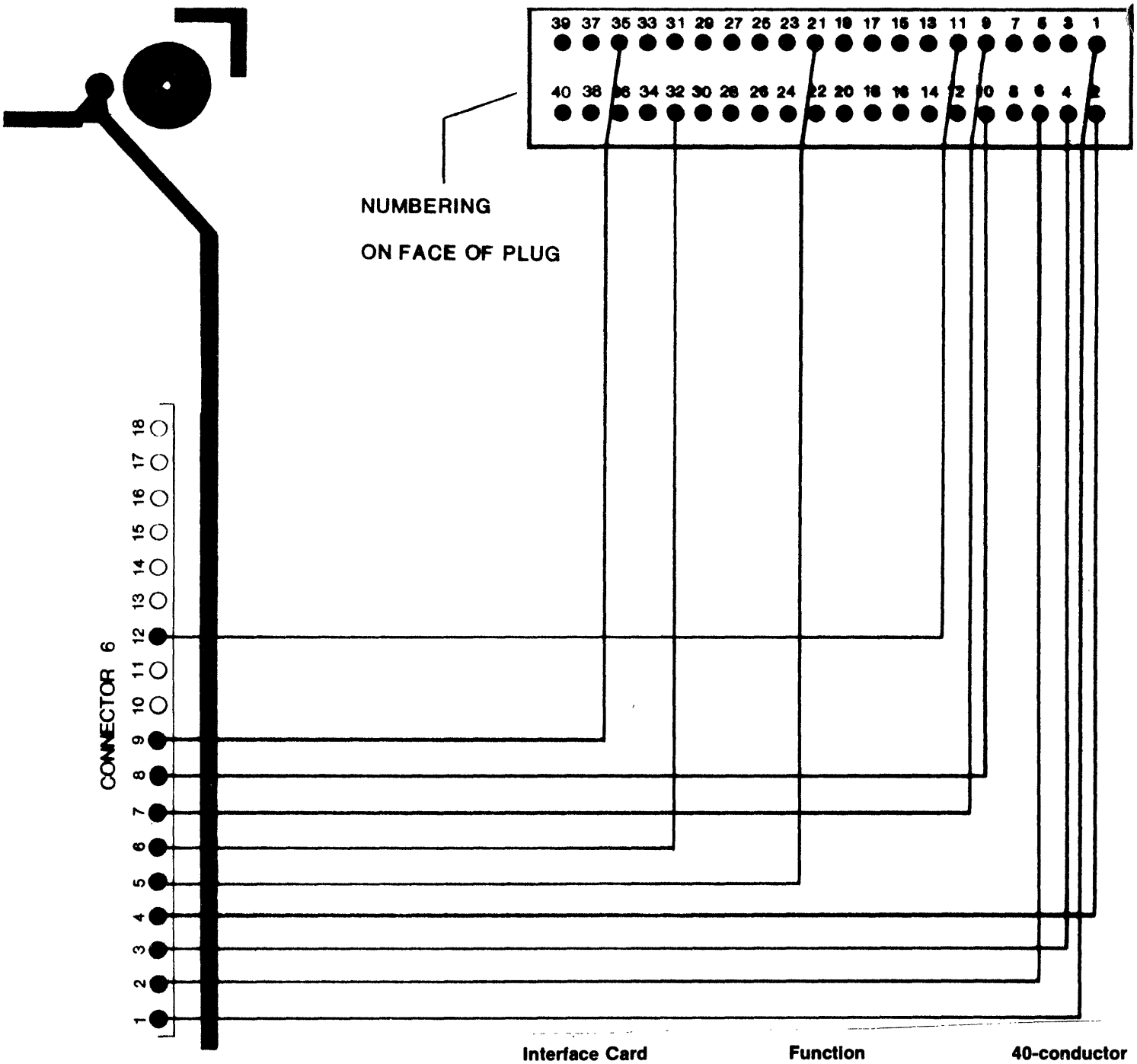
MOTOR COMMANDS AND FONTS SENT TO PRINTER

STATUS SIGNALS SENT TO COMPUTER



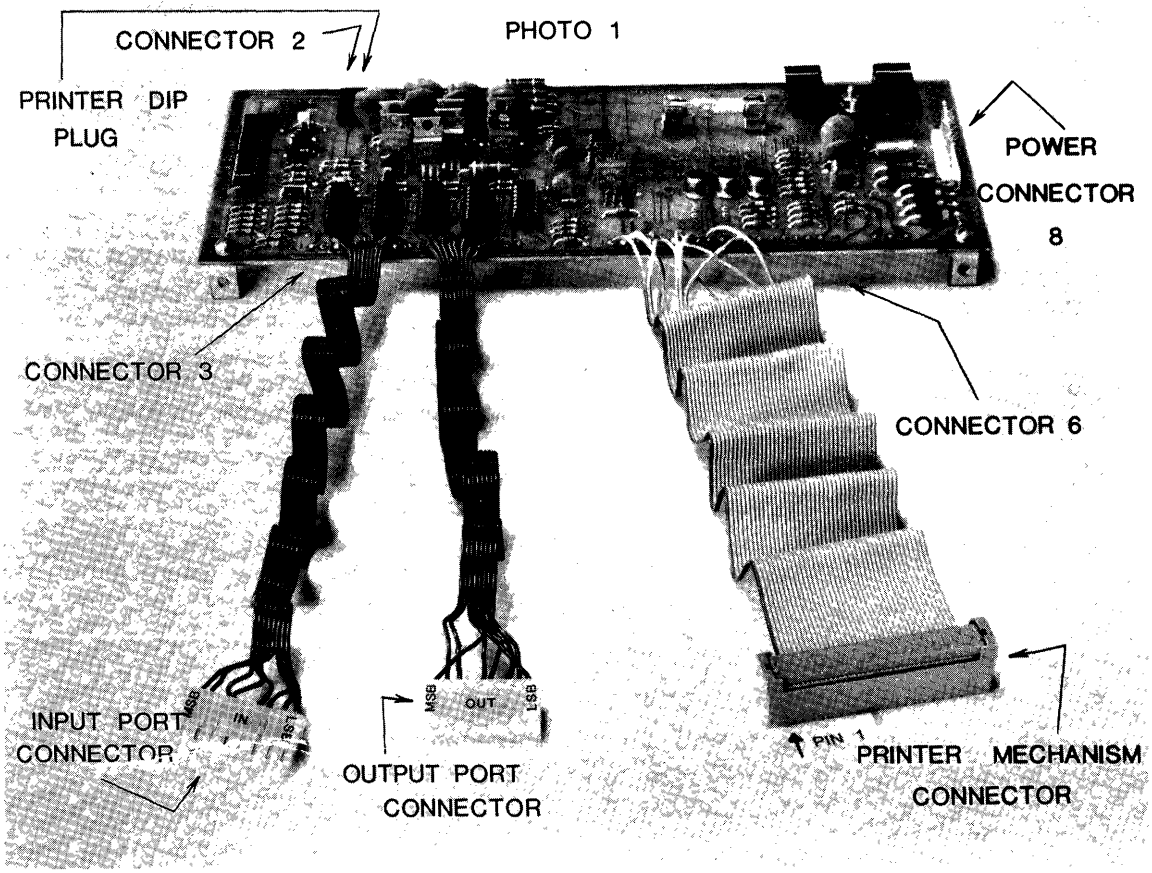
CONNECTOR 3

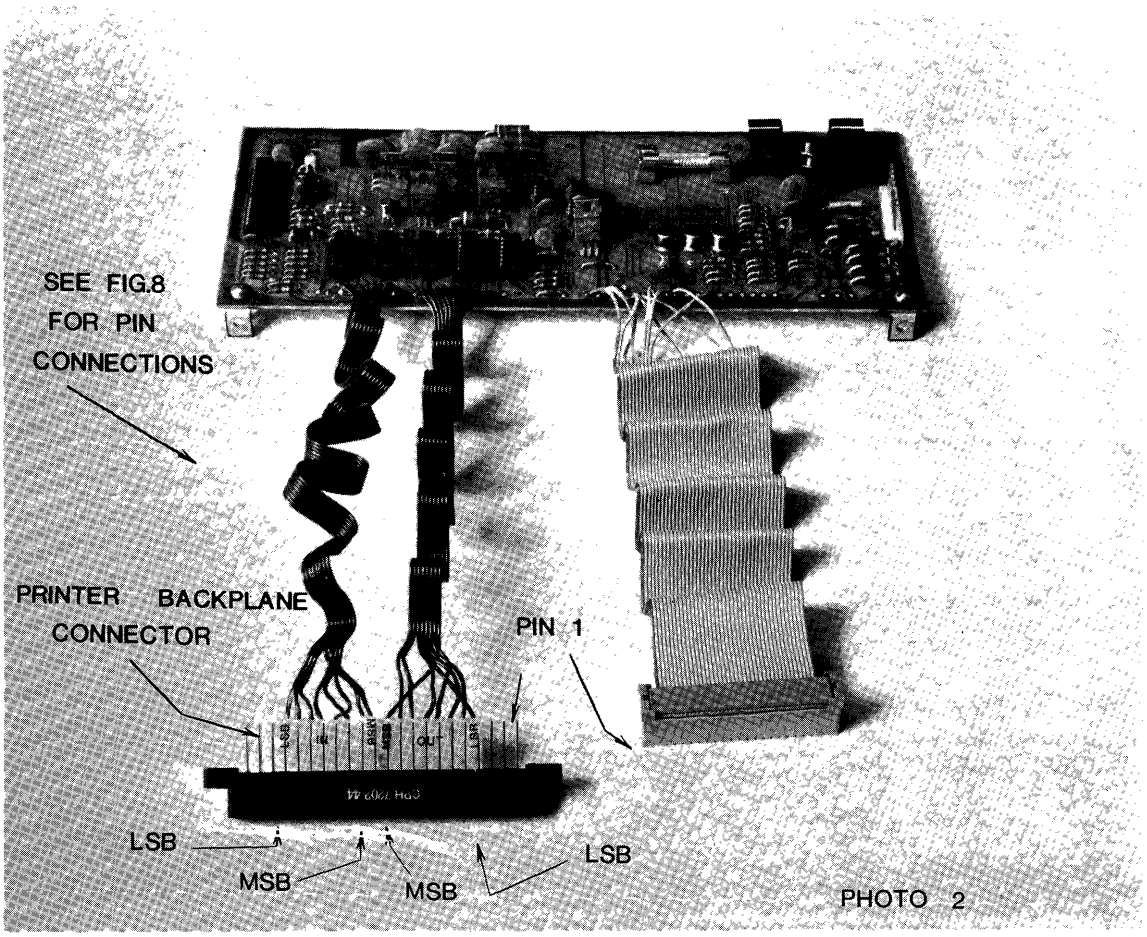
FIG. 7--PRINTER INTERFACE TO PRINTER MECHANISM



Connections for the printer to the interface card connector 6 are detailed below, pin to pin with the function provided.

Interface Card Pin #	Function	40-conductor Flat Cable #
Pin #1	to LED (emitting)	#1
Pin #2	GND	#6
Pin #3	from detector transistor (collector)	#4
Pin #4	GND	#2
Pin #5	Line feed (+35V control line)	#21
Pin #6	+35V DC source	#32
Pin #7	Motor REV control line	#9
Pin #8	Motor FWD control line	#10
Pin #9	28V AC source	#35
Pin #12	Ribbon advance control line	#11


CONNECTOR 2
PHOTO 1
PRINTER DIP PLUG
POWER CONNECTOR 8
CONNECTOR 3
CONNECTOR 6
MSB
IN
LSB
MSB
OUT
LSB
PIN 1
INPUT PORT CONNECTOR
OUTPUT PORT CONNECTOR
PRINTER MECHANISM CONNECTOR


SEE FIG.8 FOR PIN CONNECTIONS
PRINTER BACKPLANE CONNECTOR
PIN 1
LSB
MSB
MSB
LSB
PHOTO 2

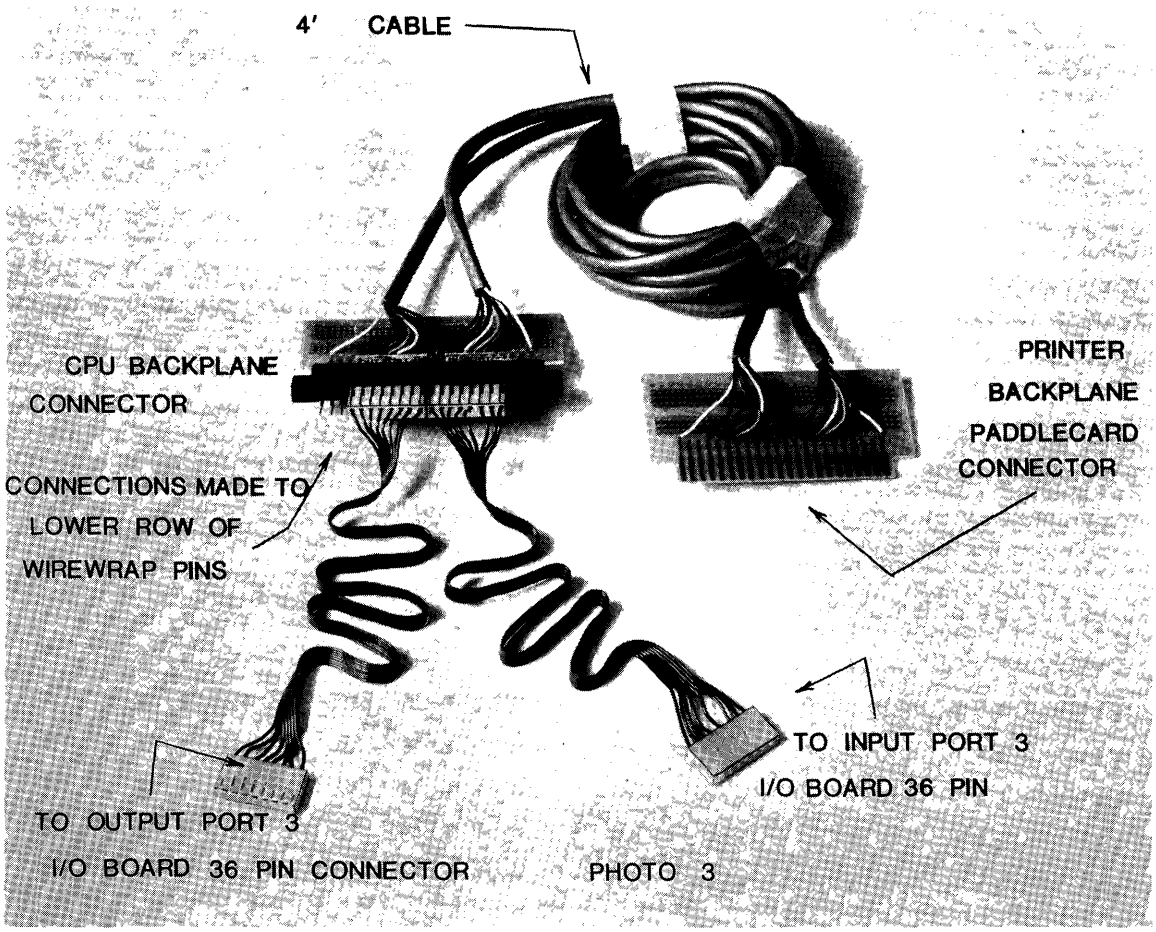


PHOTO 3

DIGITAL GROUP PRINTER CABINET

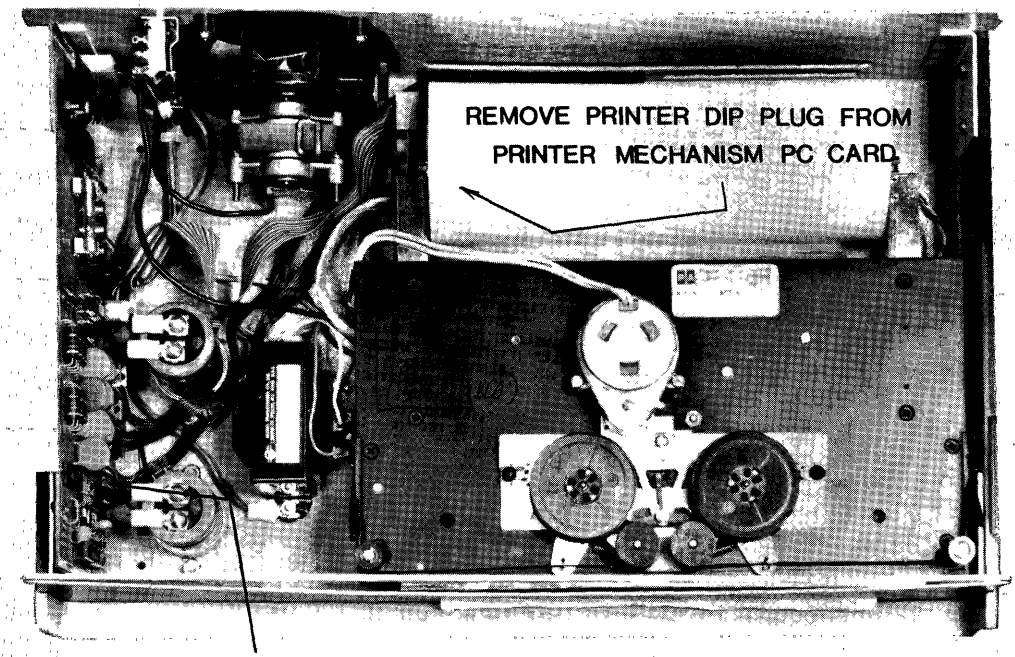


PHOTO 4

FOR EQUAL COL. WIDTHS

GIVEN: NO. CHAR.
AND DOTIME (SINGLE)

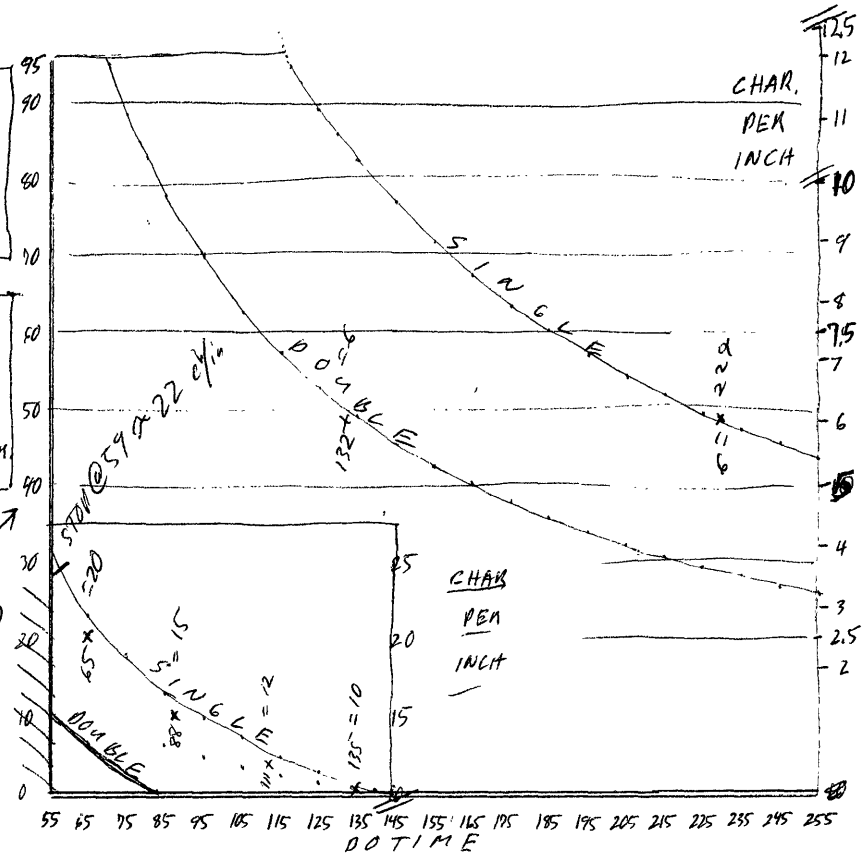
$$DOTIME(DBL) = .5967 \times DOTIME(SGL) - \frac{25.164}{NO.\ CHAR.}$$

GIVEN: NO. CHAR.
AND DOTIME (DOUBLE)

$$DOTIME(SGL) = 1.676 * DOTIME(DBL) + \frac{40.17}{NO.\ CHAR.}$$

MIN DOTIME: = 59 SGL 55 DBL

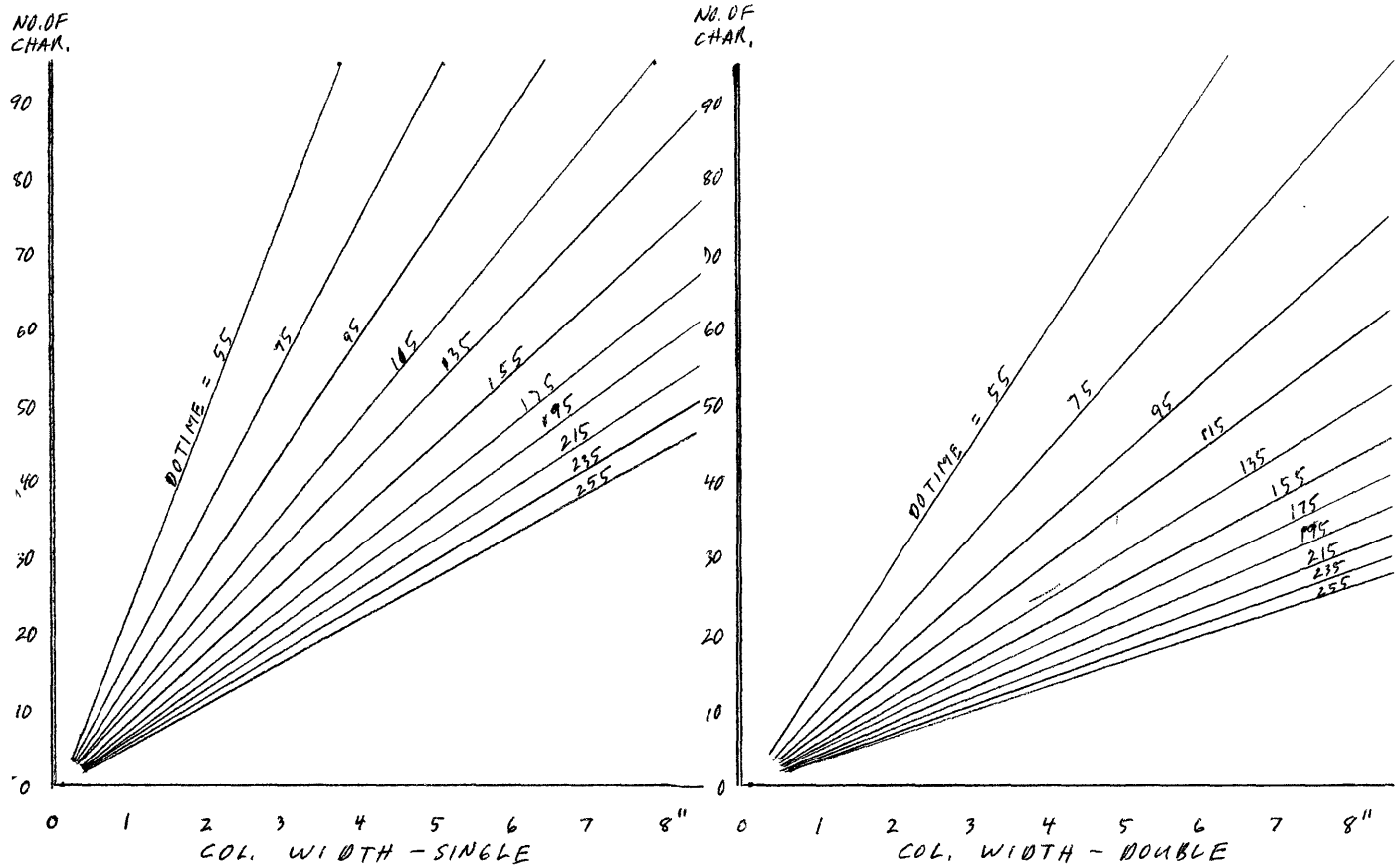
CHAR PER IN	DOTIME SNGL	DBL
4		200
5	(5½ @ 255)	159
6	229 =	132
8	170	97½
10	135 =	77
12	111 =	63
15	88	(13⅓ @ 55)
20	(22 @ 59)	



$$COL.WIDTH = A + B \times \frac{NO.OF\ CHAR}{DOTIME}$$

A = .08567 B = .0007083

A = .01554 B = .0012187



SOFTWARE

Software Description

The printer driver routines provide all the software to communicate with the printer; input and output port 3 are used, the input port receives status signals from the interface card and output port 3 sends motor control and fonts to the printer.

The driver is called as a subroutine and stores ASCII characters from the calling program in a line buffer. Characters stored in the line buffer are stored sequentially with a maximum of 96 character/line. The printer routines may be relocated or reassembled at any location in memory. It is important, however, that all calls to this routine be changed appropriately. ASCII characters as stored in the line buffer are converted to offset values, referring to the font table which runs from address 007141 to 010235 in Maxi-BASIC. For example, the letter A 7-bit ASCII code is 101. It is stored as an offset character of 042 meaning that the five sequential font bytes for A are (42) * 5 octal bytes away from the beginning of the font table.

A line is terminated by a C/R. Typing "return" on the keyboard begins the printing of one line as stored in the line buffer. Before the characters are printed, the software must set up properly to run the motor forward and advance the ribbon, and make sure the printer is starting away from the left margin at a constant speed.

Note: The left printing margin is on the right as you face the front of the printer, and the HOME position (left margin) photo cell detect circuitry should be mounted on the right.

In sequence the software must determine the head to be starting at the left margin; if it is not, it must first reverse the head motor until it is HOME. To begin the printing operation, the software starts the motor forward. The motor is advanced forward for the entire line to insure equal spacing between characters. When the software detects leaving the left margin it begins printing characters, calling them one at a time from the line buffer and looking up data from the font table. Between each font printed a motor forward command is given which maintains the forward motor motion and character spacing. Also, because the driving computer is much faster that a mechanical printing device, the software inserts timing loops between every vertical row of dots which keep the impact pin solenoids at a duty cycle of about 10%. Hence, the printer head is given time to cool between characters. At the end of a line the printer stops the firing of the impact pin solenoids, activates a line feed solenoid to advance the paper for the next line, and returns to the HOME position.

Some additional software constants of interest to the user are listed below.

Parameter	Location	Decimal	Description
DOUBLE	007131	1881	Filling this location with 200 (bit 7 high) will cause a double hit on each column of a character.
DOTIME	007137 007140	Low order byte 1887 High order byte 1888	Presently filled with 000147, this constant affects spacing between columns of an individual character and between characters and, as a result, the maximum number of characters per inch printed.
STDLN	007134	1884	The constant stored at this address is presently 076. This affects the intensity of characters printed with the hardware limits set by IC1.

Note: The locations of the parameters are the same for the Maxi-BASIC and ASSEMBLER I driver routines.

Printer Routines Audio Tape Instructions

The Printer Routines tape provides driver routines to interface with Maxi-BASIC and ASSEMBLER programs, with both 32 and 64 character TV displays. The driver routines are supplied on audio tape in two blocks or tone bursts. The first tone burst interfaces with Maxi-BASIC, while the second routine interfaces to ASSEMBLER programs.

To operate the tape, load a copy of an existing tape containing either Maxi-BASIC or ASSEMBLER into your computer. An audio tape may be used on audio-based systems while a PHIMON version tape may be used on a digital cassette storage system.

After the Maxi-BASIC or ASSEMBLER has loaded correctly, load the driver routines (selecting the first or second tone burst on the tape) into your computer, using the READ option (Option 1). By using the READ option to load in the printer routines, the original operating system with the "menu" of options is updated as well as the printer routines being loaded. A copy of this modified operating system and program may be copied onto a blank tape by using the WRITE option (Option 2). If you have any questions or problems concerning the tape, please contact The Digital Group.

The complete character set printed with the Digital Group Printer and the Digital Group Z-80 Printer Driver Routines.

```
LIST

 5    FOR C = TO 10
10    FOR X = 128 TO 254
20    #CHR$(X);
30    NEXT
40    NEXT
READY
RUN
```

```
!"#$%&'( )*+,- /0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←
!"#$%&'( )*+,- /0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←
 "#$%&'( )*+,- /0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←
!"#$%&'( )*+,- /0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←
```

Double width characters are implemented by changing the byte **DOUBLE** from **000** to **200** octal.

```
!"#$%&'( )*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←
!"#$%&'( )*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←
!"#$%&'( )*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←
!"#$%&'( )*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←
```

Print intensity illustrated using the intensity constant octal values for STDLN of 20, 40, 60, 80, 100, 120, 140, and 160.

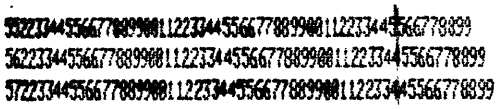
```
10 A=20
20 FILL 1881,128
30 FILL 1884,A
40 #"INTENSITY=";A;" THIS IS A SAMPLE
50 A=A+20
60 IF A<180 THEN 30
70 END
```

```
STDLN= 20THIS IS A SAMPLE OF THE ILLUSTRIOUS D.G. PRINTER.
STDLN= 40THIS IS A SAMPLE OF THE ILLUSTRIOUS D.G. PRINTER.
STDLN= 60THIS IS A SAMPLE OF THE ILLUSTRIOUS D.G. PRINTER.
STDLN= 80THIS IS A SAMPLE OF THE ILLUSTRIOUS D.G. PRINTER.
STDLN= 100THIS IS A SAMPLE OF THE ILLUSTRIOUS D.G. PRINTER.
STDLN= 120THIS IS A SAMPLE OF THE ILLUSTRIOUS D.G. PRINTER.
STDLN= 140THIS IS A SAMPLE OF THE ILLUSTRIOUS D.G. PRINTER.
STDLN= 160THIS IS A SAMPLE OF THE ILLUSTRIOUS D.G. PRINTER.
READY
```

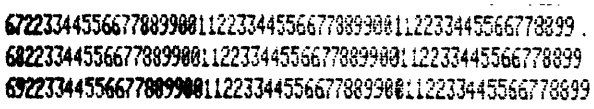
Horizontal character spacing is affected by the parameter constant DOTIME. With the values listed the printout below indicates the spacing results.
DOTIME: 60, 70, 80, . . .

```
DOTIME= 60 THIS IS A TEST
DOTIME= 70 THIS IS A TEST
DOTIME= 80 THIS IS A TEST
DOTIME= 90 THIS IS A TEST
DOTIME= 100 THIS IS A TEST
DOTIME= 110 THIS IS A TEST
DOTIME= 120 THIS IS A TEST
DOTIME= 130 THIS IS A TEST
DOTIME= 140 THIS IS A TEST
DOTIME= 150 THIS IS A TEST
DOTIME= 160 THIS IS A TEST
DOTIME= 170 THIS IS A TEST
DOTIME= 180 THIS IS A TEST
DOTIME= 190 THIS IS A TEST
DOTIME= 200 THIS IS A TEST
DOTIME= 210 THIS IS A TEST
DOTIME= 220 THIS IS A TEST
DOTIME= 230 THIS IS A TEST
DOTIME= 240 THIS IS A TE
DOTIME= 250 THIS IS A T
```

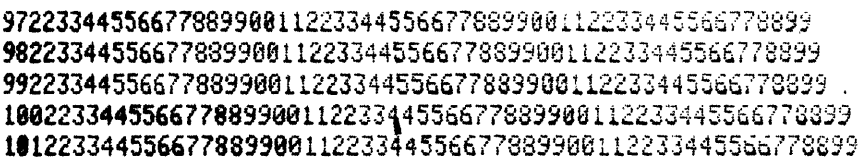
25 characters/inch



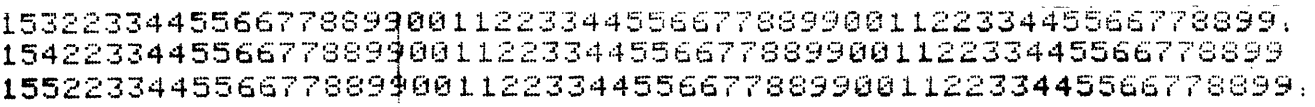
20 characters/inch



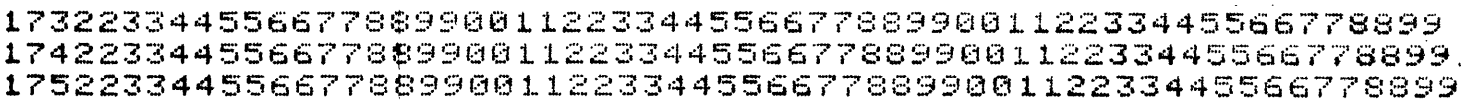
13.3 characters/inch



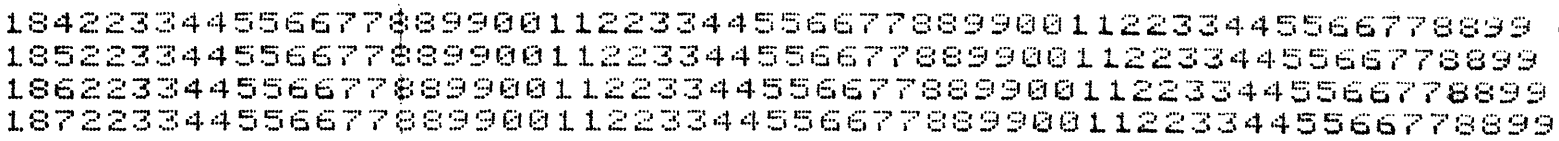
9 characters/inch



8 characters/inch



7.5 characters/inch



Horizontal Characters/Inch Spacing

Diagnostic Operation and Testing of the Printer

- ☐ Test all voltages on the interface card: +35V on pin 1 and +5V DC at pin 2 on connector 8.
- ☐ Connect the printer mechanism via the 40-conductor cable plug noting the orientation of the face of the plug.
- ☐ Connect all cables from the computer to the interface card making sure paddlecards are installed correctly.

The 16-pin connector plug from the printer mechanism is not connected until the printer solenoid circuitry has been tested. The fuse modification which was made earlier prevents any damage occurring in the event that the driver circuitry is not working properly. If a Darlington transistor fails or draws excess current the fuse installed will blow before any damage can occur to the print head.

The following procedure should allow you to test and debug your printer in the shortest amount of time. Use a voltmeter and an oscilloscope if available.

With all electrical connections made to the printer with the exception of connector 2 (print head connections), enter the following program using Maxi-BASIC (option 7).

```
10   FOR I = 1 TO 200
20   OUT 3, 0
30   OUT 3, 255 (377 octal)
40   NEXT
50   FOR I = 1 TO 200
60   OUT 3, 0
70   OUT 3, 128 (200 octal)
80   NEXT
90   GOTO 10
```

Voltmeter: Run this program. Place a 1K resistor from pin 8 connector 2 to pins 9, 10, 11, 12, 13, 14 and 15, successively, and, using a portable voltmeter, measure the voltage across the resistor. The voltage should slowly pulse from 0 volts to 5 - 7 volts. (The + side of the voltmeter is connected to pin 8). A constant +35 volt reading indicates a shorted TIP-120 associated with that pin or a 7409 that has a constantly high output. A zero voltage reading indicates an open TIP-120 or a 7409 with low output.

Scope: If a scope is available, make sure the pulses are travelling from connector 3 through the 7409 to TIP-120's. Check that IC1 outputs are pulsing correctly.

If everything checks, your print drivers are probably operating correctly.

Now change lines 20, 30, 60 and 70 of the Maxi-BASIC program.

```
20   OUT 3, 128 (200 octal)
30   OUT 3, 127 (177 octal)
60   OUT 3, 128 (200 octal)
70   OUT 3, 0
```

Voltmeter: Voltage (measured with reference to ground) at pins 2, 6, 4 and 8 of IC7 and at pin 6 of IC5 should be slowly pulsing between 0 volts and +5 volts. Failure of one of these outputs to do so indicates a localized problem at that point. If they all fail to pulse, the problem is associated with IC6.

Scope: Pin 9 might not be clocking correctly or pin 1 might be going low and clearing IC6. A problem at pin 9 indicates IC1 might be at fault. A problem at pin 1 indicates IC2 (3302) and the power-up circuitry might be at fault. After power-up, pin 14 IC2 should be between +3 and +5 volts.

If everything checks, connect the printer DIP plug to the interface card connector 2.

Use Option 9 on Maxi-BASIC and type return several times. The printer should respond by printing "SYNTAX ERROR". If a fuse blows, replace it with a .6 amp slow-blow fuse. **Never use a larger fuse or jumper.** If the head fails to move you might try sliding it to the left.

This completes assembly and testing of the Digital Group Printer. If you have any problems or questions please contact the Digital Group or a Digital Group dealer.

Digital Group Printer Parts List

	Label	Description	Qty.	Digital Group Part #
☐	IC1	74123 monostable multivibrator	1	075-029
☐	IC2	3302 quad comparator	1	078-006
☐	IC3	7407 hex buffer	1	075-006
☐	IC4, IC5	7409 hex driver, non-inverting	2	075-008
☐	IC6	74174 hex "D" latch memory	1	075-039
☐	IC7	7406 hex driver, inverting	1	075-005
☐	IC8, IC10, IC11	MCS-2 optically coupled SCR	3	190-001
☐	IC13	TIL-113 optical isolator	1	190-002
☐	IC14	LM-340-5 5V regulator	1	070-003
☐	Q1, Q2, Q4 - Q9	TIP-120, Darlington transistor	8	026-001
☐	Q3	2N2222	1	020-001
☐	Q11, Q12, Q13	2N1598 SCR	3	020-000
☐	C1	.33 mfd, mylar capacitor	1	016-007
☐	C2	10 pfd, silver mica capacitor	1	018-001
☐	C3	10 mfd, 15V tantalum capacitor	1	010-003
☐	C24, C25	.1 mfd, 25V ceramic disk capacitor	2	014-003
☐	C6 - C12	.1 mfd, 50V ceramic disk capacitor	7	014-005
☐	C4, C5, C13, C15 - C17	.01 mfd, 50V ceramic disk capacitor	6	014-002
☐	C26	22 mfd, 15V tantalum capacitor	1	010-004
☐		Printer PC board (DG 0014-A)	1	90-009
☐	D1, D12, D21-D32 D35, D42-D44	1N4001 diode	18	040-003
☐	D2	1N5010A, 3.9V zener diode	1	040-013
☐	D3, D4	1N4372, 3V zener diode	2	040-007
☐	D5-D11	1N4004	7	040-005
☐	D36-D41	MR501 power diodes	6	040-014
☐	R1-R6, R12-R16, R47, R48, R51 R53	1K ohm, ¼ watt carbon film resistor	15	001-025
☐	R17, R18, R52	4.7K ohm, ¼ watt carbon film resistor	3	001-032
☐	R7, R19, R46, R49, R50	100K ohm, ¼ watt carbon film resistor	5	001-045
☐	R8, R9	10K ohm, ¼ watt carbon film resistor	2	001-037
☐	R10, R11, R20-R22, R26, R27, R33-R35, R54	470 ohm, ¼ watt carbon film resistor	11	001-018
☐	R41	100 ohm, ¼ watt carbon film resistor	1	001-010
☐	R32	47 ohm, ½ watt carbon film resistor	1	003-002
☐	R23-R25, R28-R31	470 ohm, 1 watt carbon film resistor	7	003-004
☐	R36, R39, R40	220 ohm, ¼ watt carbon film resistor	3	001-013

☐	S2-S5, S7	14-pin, IC socket	5	060-001
☐	S1, S6, connector 2	16-pin, IC socket	3	060-002
☐	S8, S10, S11	Molex socket pin, (30 pins supplied)	30	082-011
☐		40 conductor ribbon cable	1	110-019
☐		I.D. 40-pin connector	1	083-005
☐	IC14	Heat sink, regulator	1	130-001
☐	Q11-Q13	Case insulator	3	131-002
☐		4-40 x ⅜" screw	2	228-009
☐		4-40 kep nut	2	228-252
☐		Fuse clips	2	190-010
☐		Fuse insulation wire,14" length	1	110-002
☐		Fuse, .5A slow blow	1	123-004

Power Supply Parts List

☐	C27	2900 mfd, 50V electrolytic capacitor	1	012-007
☐	C28	2700 mfd, 25V electrolytic capacitor	1	012-005
☐		Wiring harness, hook-up wire, 18 gauge, 8' length	1	110-020
☐		Crimp lugs, 14 gauge	3	221-003
☐		Crimp lugs 10-12 gauge	1	221-009
☐		8-position nylon Molex strip	1	082-008
☐		8-position nylon Molex block	1	082-004
☐		Crimp-on Molex pins	6	082-007
☐		10-32 x ¼" screw, capacitor terminal	4	228-010
☐	T1	Transformer, 28V AC centertap	1	850-509

Cabling Kit Parts List

Detail 1 — Printer Interface to Printer Backplane

☐		22-pin dual-edge connector	1	540-011
☐		8-position Molex wire, 14"	2	110-000
☐		8-position nylon Molex blocks	2	082-004
☐		Crimp-on Molex pins	16	082-007

Detail 2 — Printer Backplane to CPU Backplane

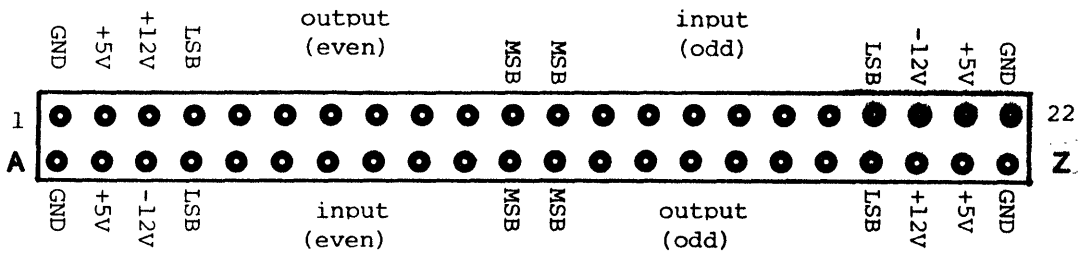
☐		10-wire shielded cable, 4'	2	110-002
☐		22-pin single sided paddlecard	2	090-038

Detail 3 — CPU Backplane to I/O Card, Port 3

☐		22-pin dual-edge connector	1	540-001
☐		8-position Molex cable, 14" length	2	110-000
☐		8-position nylon Molex blocks	4	082-004
☐		Crimp-on Molex pins	32	082-007

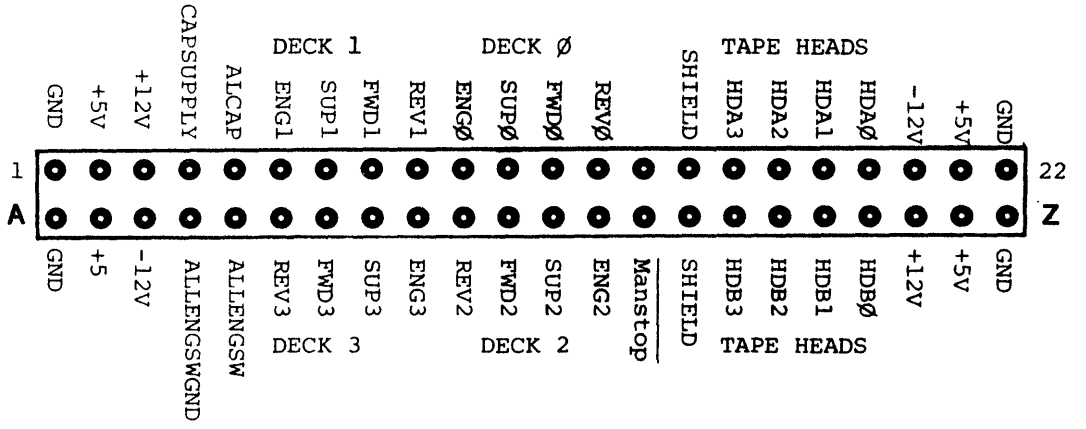
PADDLE CARD CONNECTOR BLOCK
PINOUT (BACKPLANE)

GENERAL

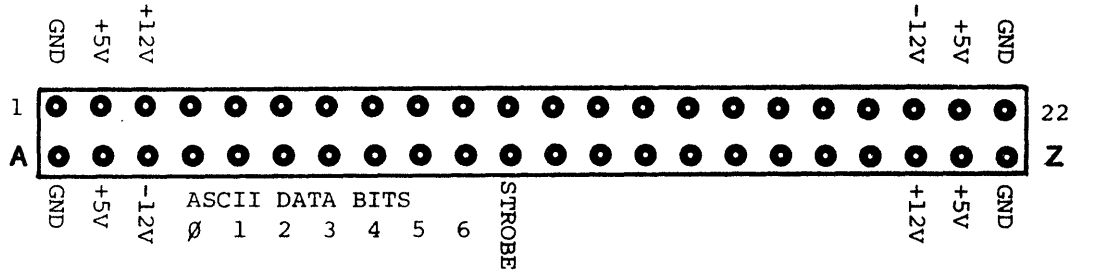


ALL VIEWS FROM PINSIDE OF CONNECTOR

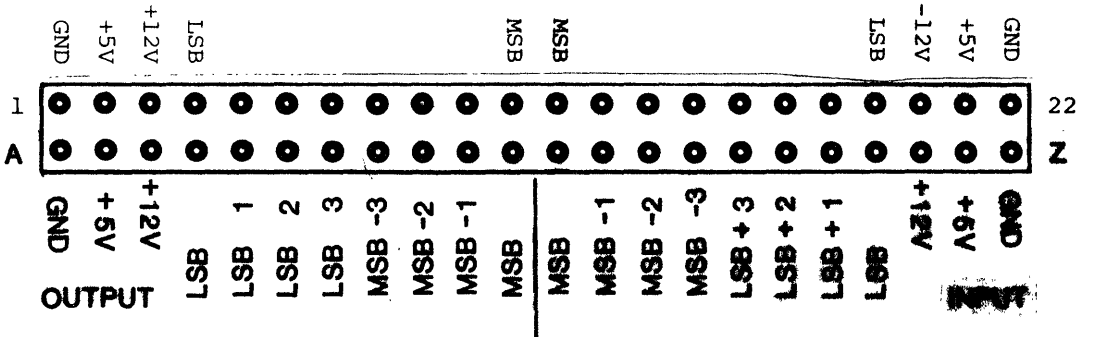
PHI-DECK



KEYBOARD



PRINTER



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

THE DIGITAL GROUP

PRINTER INTERFACE CARD

PARTS INSIDE DOTTED LINES NOT SUPPLIED
USE FOR FUTURE EXPANSION

D17 Thru D32
IN4001 OR IN4004

FROM OUTPUT PORT

CON 3

LSB
LSB+1
LSB+2
LSB+3
MSB-3
MSB-2
MSB-1
MSB

STROBE

CON 1

CON 2

TO PRINT HEAD

+35V

Q1 TIP 120
Q2 TIP 120
Q3 2N2222
Q4 TIP120
Q5 TIP120
Q6 TIP120
Q7 TIP 120
Q8 TIP120

IC 4 7409
IC 5 7409
IC 1 74123
IC 2 LM3302
IC6 74174
IC7 7406
IC 8 MCS2400 OR MCS 2
IC 9 MCS 2400 OR MCS 2
IC 10 MCS 2400 OR MCS 2
IC11 MCS 2400 OR MCS 2
IC13 TIL 113
IC 14 LM340-5 5V REG.

Q10 2N1598
Q11 2N1598
Q12 2N1598
Q13 2N1598

MOTOR FWD
MOTOR REV
RIBBON ADVANCE
NOT USED
LINE FEED
PAPER ADVANCE

CON 4
CON 5
CON 7
FUSEABLE LANDS

C21 15uf (ON PRINTER)

CON 6
28VAC
HEAD MOTOR—REVERSE
28VAC
HEAD MOTOR—FORWARD
28VAC
RIBBON ADVANCE
+35 VDC
LINE FEED SOLENOID
+5
HEAD POS DET (XMIT)
GND
GND
HEAD POS DET (RCV)

CON 8
GND
GND
GND
+35V. TO FILTER CAP
TO +5V FILTER CAP
28VAC.
28VAC.
GND

TO INPUT PORT
CON.3

LSB PRINT FWD
LSB+1 PAPER OUT
LSB+2 READY
LSB+3 POWER
MSB-3 PRINT FIELD
MSB-2 LINE FEED
MSB-1 FONT
MSB STROBE

OUTBOARD COMPONENTS
TO CON 8

ON-OFF SWITCH
117VAC
F1 2A
T1
28VAC
FAN MOTOR
PWR IND
RED LED
100 Ω

555 TIMER
820K
140K
.01
10K

5A SLO BLO
BK
R
O
Y
Gn
Bu
V
GRY
WHT
SHIELD
W/R
W/Br

PRINTER INTERFACE CARD