

DIGITAL GROUP PRINTER

General Description

The Digital Group presents it's full size impact printer. Fast? You bet! At 120 characters per second it nearly flies. That is 96 characters per line, less than a second per line. The time per line is directly proportional to the number of characters per line because the head travels only the distance required to print desired characters. The printer consists of five major parts: The head drive motor, print head, paper advance, ribbon advance mechanism, and the interface electronics.

Head Drive Motor

The head drive is a bi-directional synchronous motor. Its purpose is to move the print head in the forward and reverse direction during the print and head return cycles, respectively. Normal motor speed is 300 rpm (10 inches/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 5x7 dot matrix. The contact with the platen makes it possible to use pressure sensitive paper and utilize carbon paper.

Upon return to the head-home position, the print head de-activates a photo-detector. The photo-detector then sends the print head status to the computer.

Paper Advance

The paper advance (line feed), makes it possible to use standard 8½" roll, fanfold, or cut paper. The paper is advanced using a solenoid driven ratchet.

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.

Interface Electronics

The printer has on-board power supplies. The voltages produced are 36 VDC for the print head and paper advance solenoid, 28 VAC for the head motor and ribbon mechanism motor, and +5 VDC for the photo-detector and interface logic and control board.

One 8-bit output port and one 8-bit input port handles all data, control transfers, and handshake requirements.

Software Support

A unique feature of The Digital Group Printer is that all mechanical operations are under software control. These operations include print head movement (forward and reverse), paper advance, and ribbon advance. Other software controllable features include:

- a) Character set (complete ASCII less underline, for example)
- b) Pitch (number of characters per given area)
- c) Margin controls

Unlike conventional typewriters, an entire line is loaded into the computer's line buffer before the print head starts in motion. The line is then printed in about the time of a normal carriage return, somewhat less than one second.

Circuit Description

The data from the CPU comes in on Connector 3. IC's 4 and 5 and half of IC1 decode the data words as a character to be printed or a command word. If it is a command word, it is latched into IC6 and determines the conditions of the head motor, ribbon advance, and the line feed. Q1, Q2, and Q4 - Q8 are the solenoid drivers which activate the desired print needle solenoid.

IC2 and Q3 are used for power on reset. The power on reset prevents the printer from interpreting any random noise as data or instructions and prevents any instruction from being carried out until the power supplies are up to normal. This is done by disabling the input to the solenoid drivers and clearing the command control latch. This also occurs when powering down.

Periodic Maintenance

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

Inking

An inked ribbon is provided for each printer. This is typically a twin spool, black, 18 yard ribbon. Each ribbon will last for approximately 10 million characters. Refer to Figure #7 for installation procedures.

Assembly

The following list attempts to breakdown the complete assembly and testing of The Digital Group Printer into logical steps. It is intended to make the assembly flexible enough for a wide range of assembler expertise.

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.

Recommended Procedure (steps detailed in later documentation)

- 1) Assemble the printer interface card per instruction steps 1-31.
- 2) Inspect the interface card.
- 3) Wire power supply and install printer mechanism.
- 4) Test power supply connections.
- 5) Complete wiring between the interface card and the printer (Connector 6), normally to a 40 conductor printed circuit board mounted on the side of the printer mechanism.
- 6) Power on testing of interface card and printer mechanism connections.
(NOTE: Connector 2 is not connected until the final interface card testing has been completed.)
- 7) Complete connections between the interface card and the computer.
 - a) Wire Connector 3 input and output on interface card to computer I/O board (see schematic and parts placement).
- 8) Final test - Power on without printer head connected (Connector 2).
- 9) Install paper for printer test.
- 10) Connect 18-pin DIP connector to interface card (Connector 2).
- 11) Power-on printer test - final test.

PRINT YOUR HEART OUT!!

Construction

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

Test Equipment: Volt ohmeter.

Estimated Construction Time: 5 to 12 hours.

NOTE: The top side (component side) of the board is indicated by The Digital Group label. All parts must be placed on this side of the board. Parts are inserted into the parts placement page, diagram, and parts list.

- (✓) 1. Insert the 3 16-pin IC sockets and solder (Connector 2, IC1, IC6).
- (✓) 2. Insert the 5 14-pin IC sockets and solder (IC2 - IC5, IC7).
- (✓) 3. Insert 6 MR501 power diodes and solder (36 - 41). NOTE: Cathode band.
- (✓) 4. Insert the 11 1N4001 diodes and solder (^{DL}~~D5 - D12, D35, D43, D44~~). NOTE: Polarity marking.
- (✓) 5. Insert the 2 1N4372 3 volt zeners and solder (D3 and D4).
- (✓) 6. Insert the 13 1N4001 power diodes and solder (D21 - D32, ~~D42~~). NOTE: Polarity.
- (✓) 7. Insert and solder diode 1N5010A 3.0 volt 1 watt zener (D2). NOTE: Polarity.
- (✓) 8. Install and solder capacitor C2 (10 pfd silver mica).
- (✓) 9. Insert and solder 7 .1 mfd capacitors (C6 - C12).
- (✓) 10. Insert and solder C3 (10 mfd 15 volt capacitor). NOTE: Polarity marking, tantalum capacitors may be used.
- (✓) 11. Insert and solder capacitor C1 (.33 mf mylar).
- (✓) 12. Insert and solder C4, C5, C13, ^{C15}~~C17~~ (.01 mfd 50 volt ceramic capacitors).
- (✓) 13. Insert and solder C24 and C25 (.1 mfd 25 volt ceramic capacitors).
- (✓) 14. Insert and solder C26 (22 mfd capacitor). NOTE: Polarity (+ side direction).
- (✓) 15. Insert and solder R23 - R25, R28 - R31 (470 ohm 1 watt resistors).
- (✓) 16. Insert and solder resistors R10, R11, R20, ³R22, R26, R27, R33, ⁴R36, R39, R40, R54 (470 ohm ¼ watt resistors).

- (✓) 17. Insert and solder R32 (47 ohm 1 watt resistor).
 - (✓) 18. Insert and solder resistors R1 - R6, R12 - R16, R47, R48, R51, R53 (1K ohm $\frac{1}{4}$ watt resistors).
 - (✓) 19. Insert and solder resistors R7, R19, R46, R49, R50 (100K ohm $\frac{1}{4}$ watt resistors).
 - (✓) 20. Insert and solder resistors R8 and R9 (10K ohm $\frac{1}{4}$ watt resistors).
 - (✓) 21. Insert and solder resistor R41 (100 ohm $\frac{1}{4}$ watt).
 - (✓) 22. Insert and solder resistors R17, R18, R52 (4.7K ohm $\frac{1}{4}$ watt).
 - (✓) 23. Insert and solder transistor Q3 (2N2222).
 - (✓) 24. Install and solder Q1, Q2, Q4 - Q9 (TIP-120 Darlington transistors).
NOTE: This may require tapering the leads to fit the circuit board.
 - (✓) 25. Install and solder Q11 - Q13 (2N1598 SCRS), adding plastic spacers to separate the transistor body from the circuit board.
 - (✓) 26. Install the heat sink for IC14 on the PC board by installing only the top screw and tighten. Bend the leads of IC14 (LM340-5 5 volt regulator) at a right angle at the point where the lead diameters decrease. Make sure the leads are bent downward. This allows the part to lie flat when the second screw is installed connecting IC14 and the heat sink to the PC board.
 - (✓) 27. Install the 6-pin sockets for IC's 8, 10 and 11 (metal molex pins are used).
 - (✓) 28. Install IC8, IC10, and IC11 (MCS-2 SCRS).
 - (✓) 29. Install IC1 - IC7 into the appropriate sockets.
 - (✓) 30. Install and solder IC13 (TIL-113 optical isolator).
 - (✓) 31. Install and solder jumpers J1 and J2 as shown. (Use wire of approximately 30 gauge; resistor leads may be used.)
 - () 32. Check circuit board layout diagram for correct parts and IC placement.
 - () 33. Check circuit board connections for shorts, unsoldered pins, or other problems.
- PRINTER CABINET POWER SUPPLY HOOK-UP (Connector 8) (*No previous interface connections made)
- (✓) 34. Make connections to line cord, fan, fan switch, fuse, and 28VAC transformer. See Figure #1.

() 35. Make sure 117VAC is properly connected to primary side of T1.
NOTE: Do not connect cables to printer at this point.

() 36. Measure with reference to GND (pin 18, connector 8).

1) Pin 1 of Connector 8 = +35 - 40V with printer disconnected

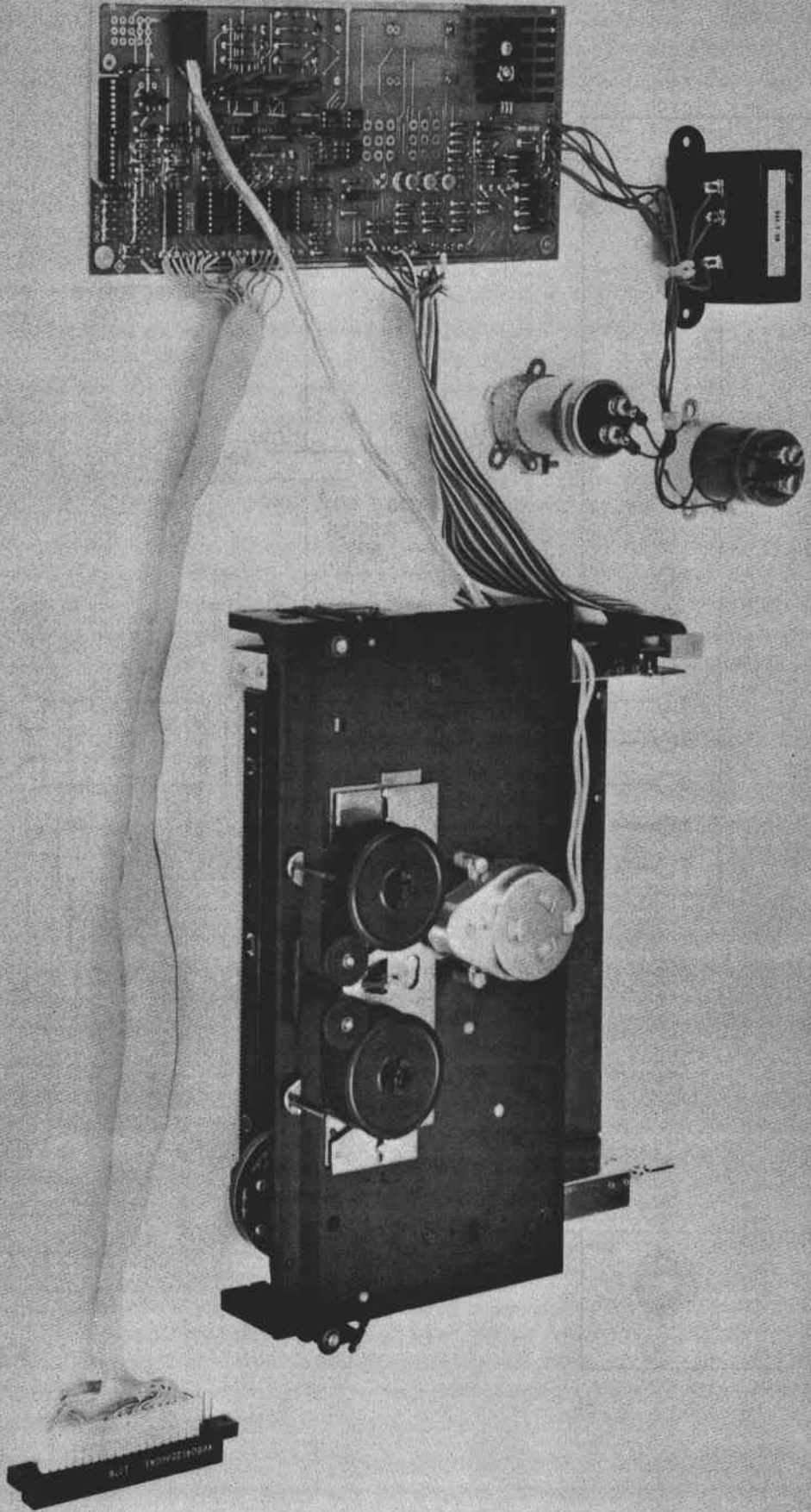
2) Pin 18 of Connector 6 = +5V

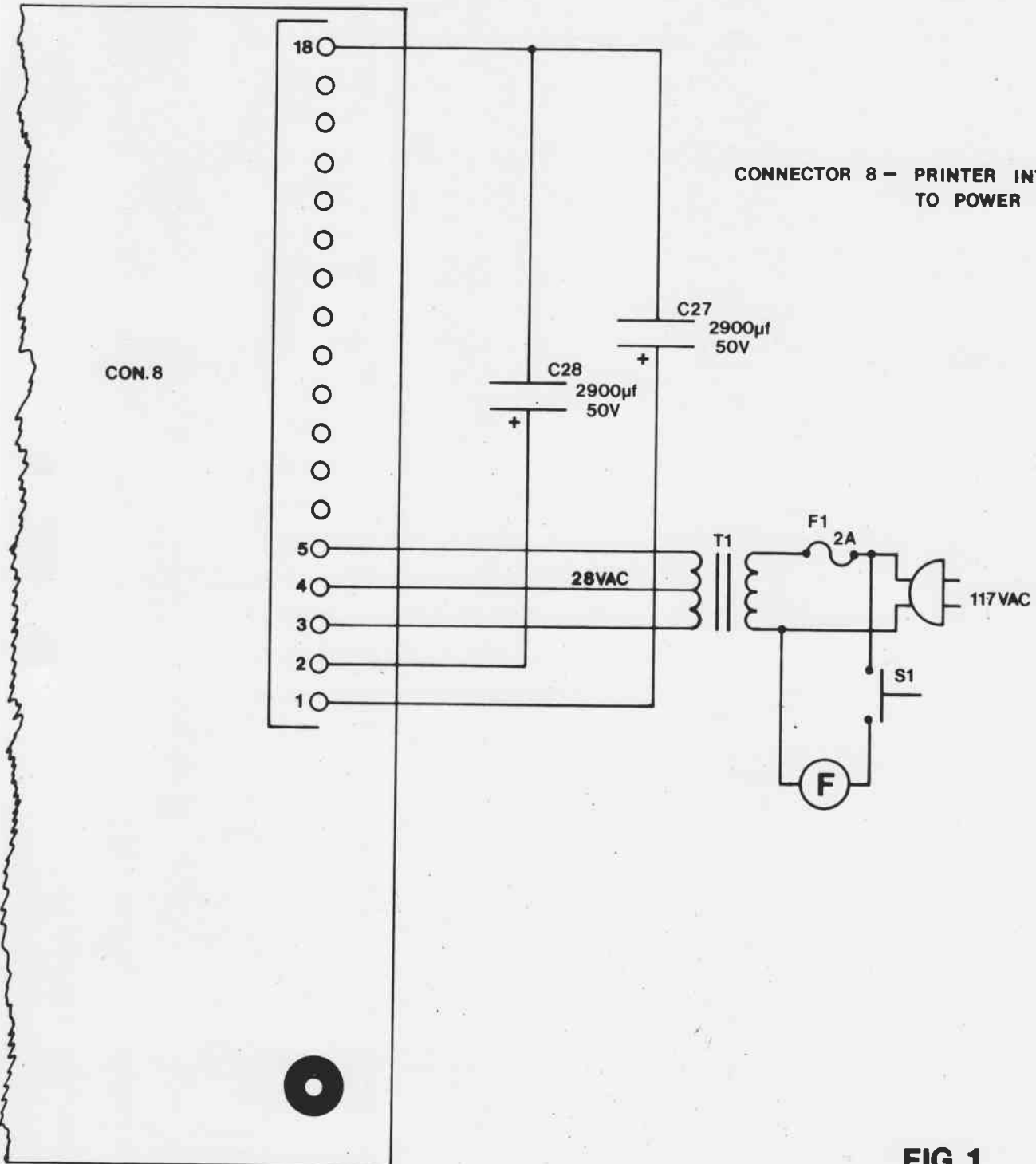
NOTE: Use caution when working with 117VAC and interface power supply connections.

() 37. Correctly position the 40 conductor cable (connector 6) and determine cable numbering orientation. Lead #1 is brown, 2 is red, 3 orange, etc. (Figure #2).

() 38. Connect 40 conductor cable to printer interface card. The 40 conductor cable runs from Connector 6 on the interface card to the circuit board mounted on the rear of the printer.

NOTE: As an option, Molex connectors may be used to mate cables to the connectors 3 and 6 on the interface card. Whether or not the connections are hardwired or mated by Molex connectors is left to the assembler. It is not recommended that Molex connectors be used for Connector 8 on the interface card as problems may arise from printer power requirements.





CONNECTOR 8 - PRINTER INTERFACE CARD
TO POWER SUPPLY.

FIG.1

CONNECTOR 6 - PRINTER INTERFACE CARD TO
PRINTER MECHANISM CONNECTOR.

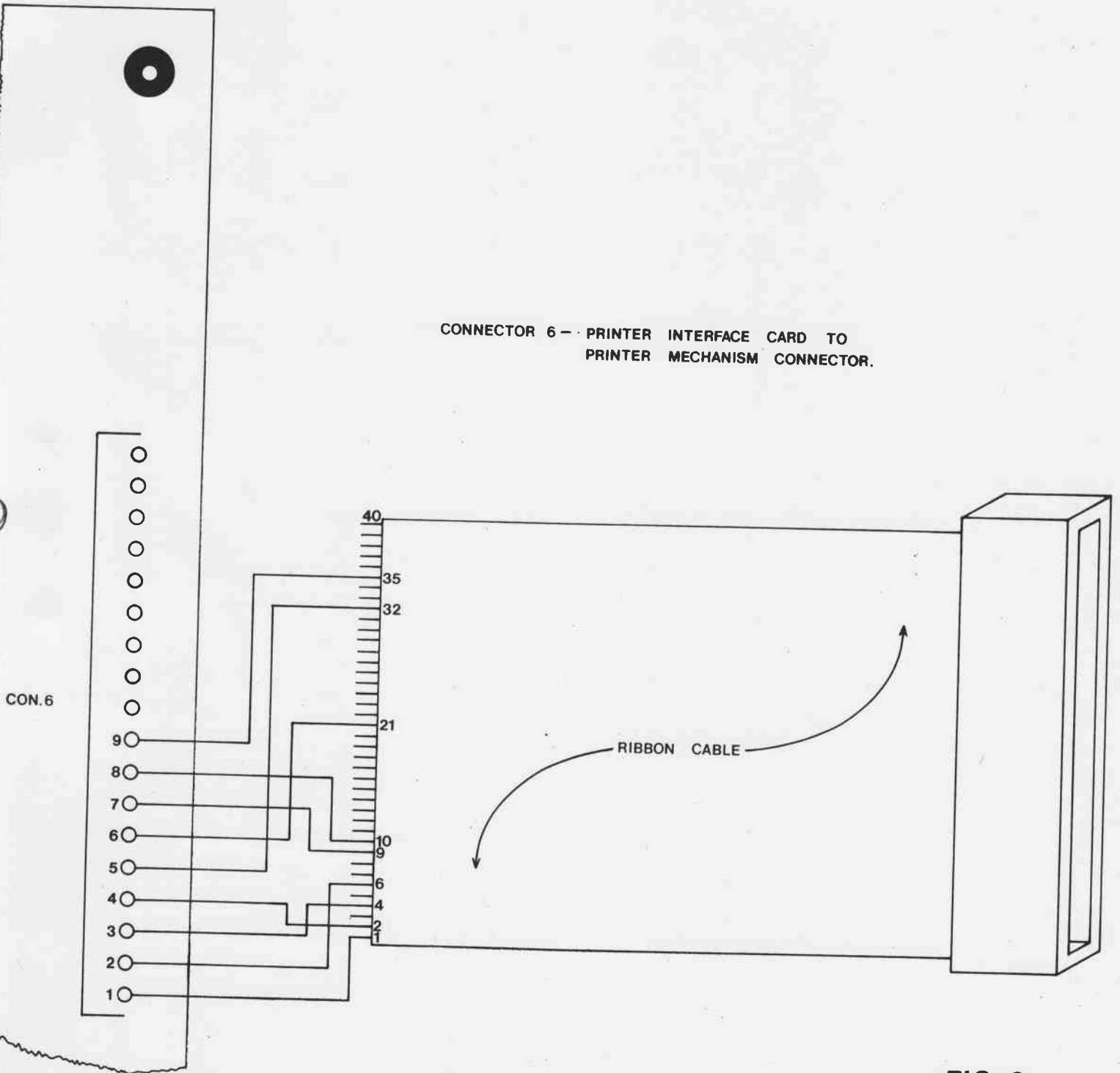


FIG. 2

DIGITAL GROUP PRINTER PARTS LIST

IC's

IC1	1-74123 Monostable Multivibrator
IC2	1-3302 Quad Comparator
IC3	1-7407 Hex Buffer
IC4,5	2-7409 Quad and gate, open collector
IC6	1-74174 Hex Latch
IC7	1-7406 Hex Buffer
IC8,10,11	3-MS-C-2 Optically Coupled SCR, sockets
IC13	1-TIL-113 Optical Isolator
IC14	1-LM-340-5 5 Volt Regulator, TO-220

Transistors

Q1,2,4,5,6,7,8,9	8-TIP-120 Power Darlington Transistor
Q3	1-2N2222 Transistor
Q11,12,13	3-2N1598 SCR

Capacitors

C1	1-.33mfd Mylar
C2	1-10 pfd Silver Mica
C3	1-10 mfd 15 Volt Tantalum
C24,25	2-.1 mfd at 25 Volt Ceramic
C6,7,8,9,10,11,12	7-.1 mfd at 50 Volt Ceramic
C4,5,13,14,15,16,17	7-.01 Ceramic (50V typical)
C26	1-22 mfd at 15 Volt Electrolytic

Diodes

D2	1-1N5010A 3.9 Volt 1 Watt Zener Diode
D3,4	2-1N4372 3 Volt 1 Watt Zener Diode
D1 D5-12	24-1N4001 Power Diode
D36-41	6-MR501 Power Diode

Resistors

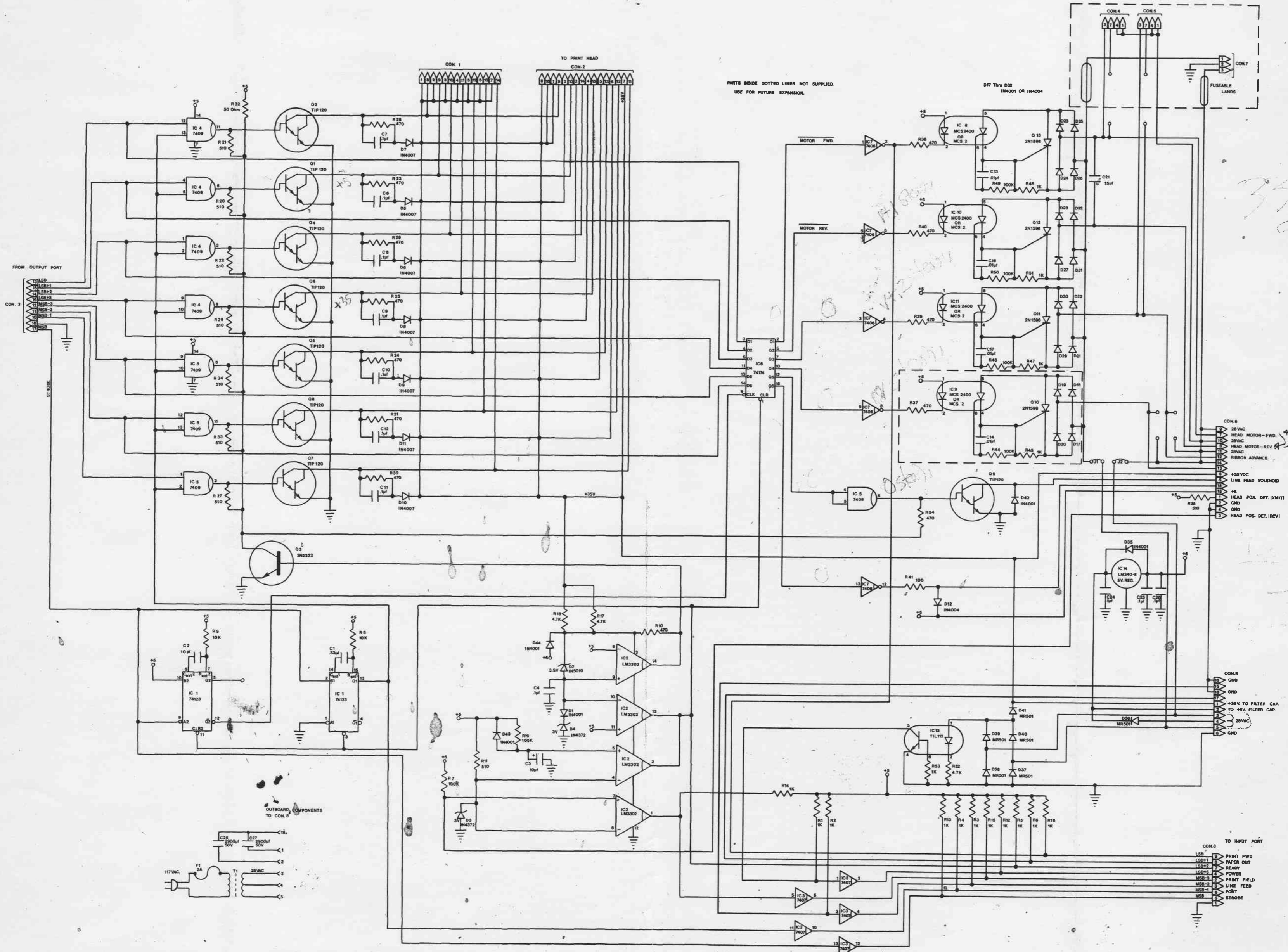
R1-6,12-16,47,48,51,53	15-1K ohm ½ watt
R7,19,46,49,50	5-100K ohm ½ watt
R8,9	2-10K ohm ½ watt
R10,11,20-22,26,27,33-36,40,54	14-470 ohm ½ watt
R17,18,53	3-4.7K ohm ½ watt
R32	1-47 ohm 1 watt
R23-25,28-31	7 470 ohm 1 watt
R41	1-100 ohm ½ watt

Sockets

S2-5,7	5-14 pin IC socket
S1,6	2-16 pin IC socket
S8,10,11	4-6 pin IC Molex

Connector

Conn. 2	1-16 pin IC socket
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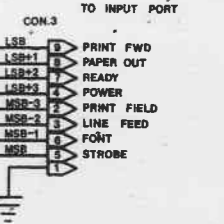
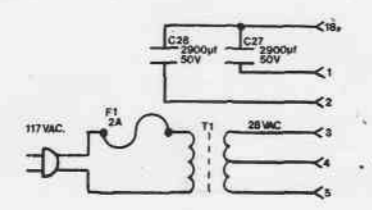


PARTS INSIDE DOTTED LINES NOT SUPPLIED.
USE FOR FUTURE EXPANSION.

D17 Thru D32
1N4001 OR 1N4004

33800
9680

OUTBOARD COMPONENTS
TO CON. 6

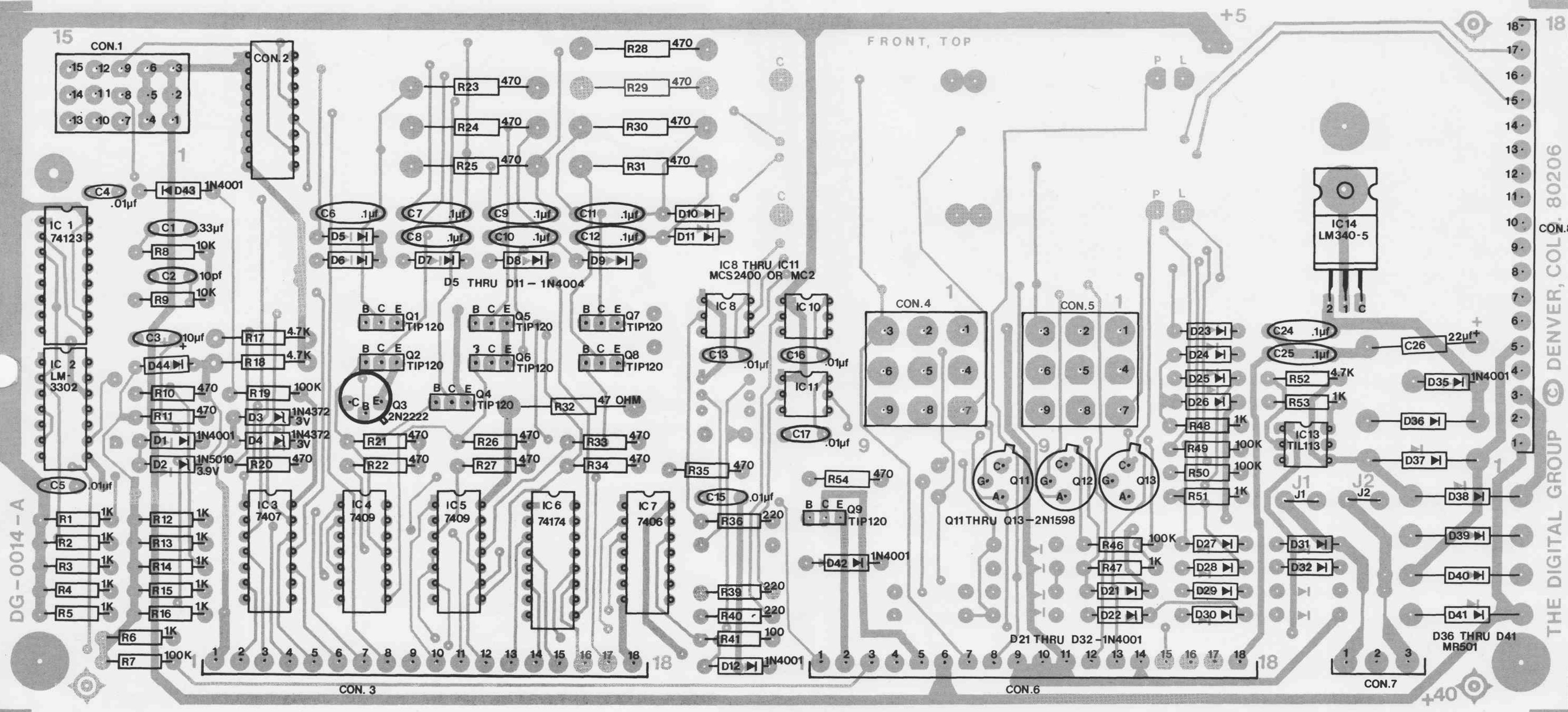


CON. 6
28VAC
HEAD MOTOR - FWD.
28VAC
HEAD MOTOR - REV.
28VAC
RIBBON ADVANCE

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

CON. 3
L3B
PRINT FWD
L3B+1
PAPER OUT
L3B+2
READY
L3B+3
POWER
L3B+4
PRINT FIELD
L3B+5
LINE FEED
L3B+6
FONT
L3B+7
STROKE

PRINTER INTERFACE CARD



DG-0014-A

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