MAINTENANCE MANUAL

PC02
PERFORATED TAPE READER

DIGITAL EQUIPMENT CORPORATION • MAYNARD, MASSACHUSETTS

DEC-08-I2BA-D

PC02

PERFORATED TAPE READER MAINTENANCE MANUAL

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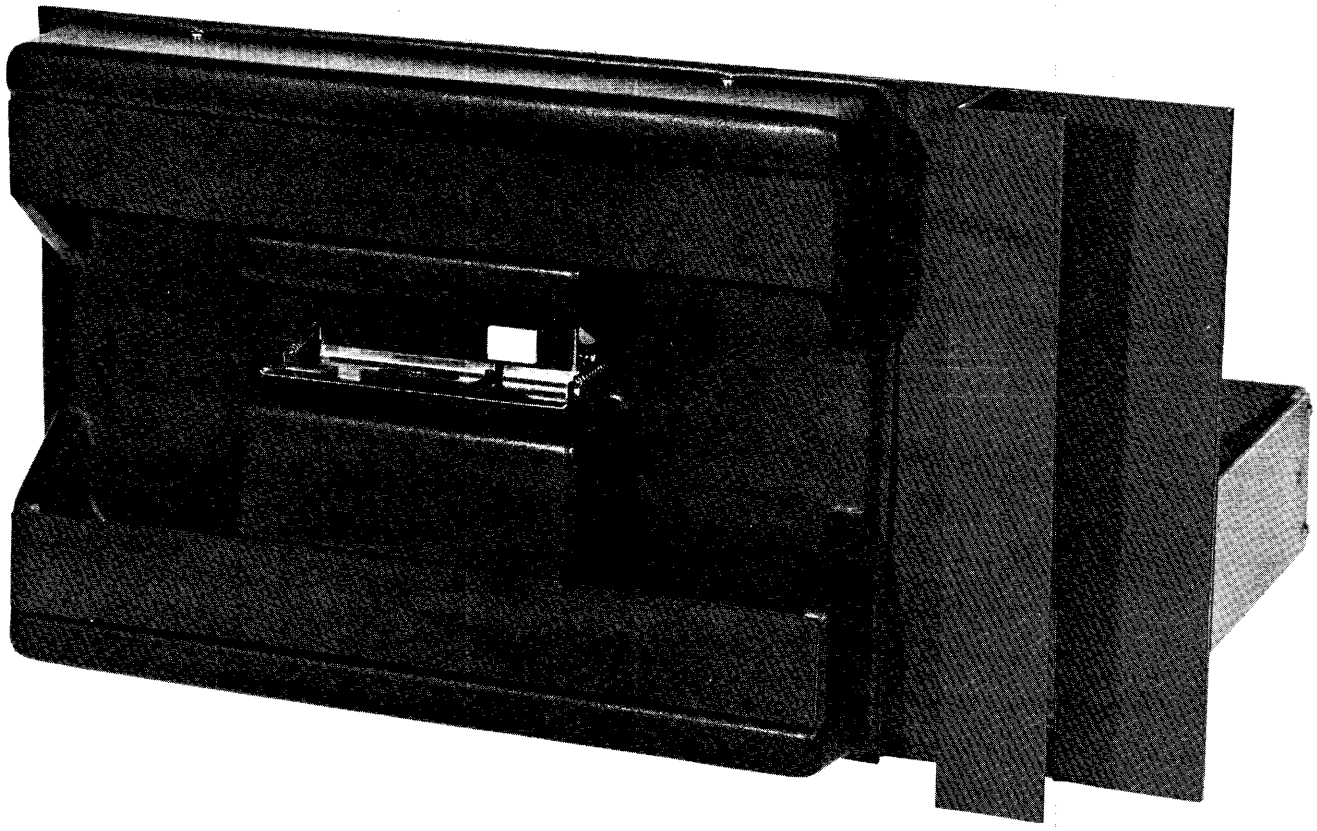
CONTENTS

TABLES

ILLUSTRATIONS

PC02 Perforated-Tape Reader



PC02 Perforated-Tape Reader

PC02 PERFORATED TAPE READER
MAINTENANCE MANUAL

Digital Equipment Corporation of Maynard, Massachusetts offers as part of its product line a high-speed, perforated-tape reader, designated PC02.

The basic tape reader consists of an electromechanical tape-feed system, with associated current drivers, and a 9-channel photoelectric tape-read head, including photocell amplifiers. The PC02 reads 8-level, 1-inch-wide perforated tape, under external control, at a rate of 300 characters per second. The resulting data may be transmitted to an external device for processing.

This manual covers complete maintenance data for the basic PC02 Tape Reader (see Figure 1) with details of construction, operation, theory, maintenance, repair, replacement of parts, and interface spelled out in appropriate sections.

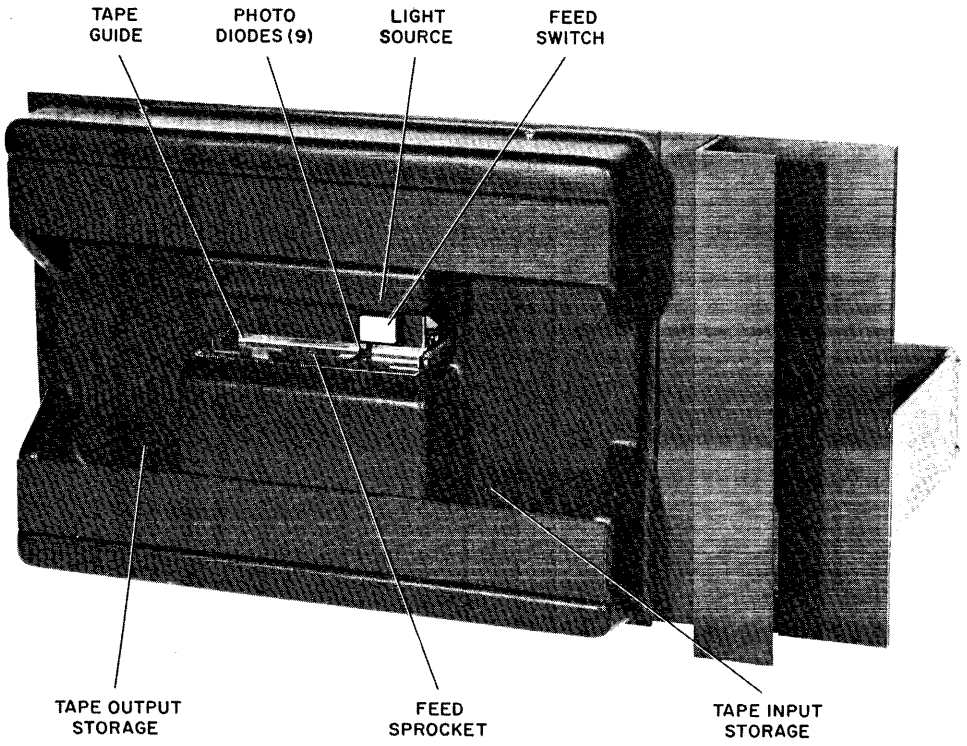


Figure 1 PC02 Perforated-Tape Reader, Front View

1. PHYSICAL DESCRIPTION

The PC02 consists of two basic elements, the tape reader and the tape transport system, mounted in a cabinet which is 10-1/2 in. (26.7 cm) high, 19 in. (48.3 cm) wide, and 15 in. (38.1 cm) deep. The unit can also be set in a standard 19-in. (48.3 cm) radio rack or integrated into a system console.

Nine photo-sensitive semiconductors, or photovoltaic cells, and their light source comprise the read station (see Figure 1). Eight of the photocells read perforations in the data tracks; the ninth senses the presence of the sprocket feed hole in the tape.

A feed-hole sprocket-drive system, actuated by a stepping motor (see Figure 2) transports tape through the read station. A snap-action tape retainer guides the tape over the read head and feed mechanism. A FEED pushbutton permits manual control of tape feeding, without reading, by the operator.

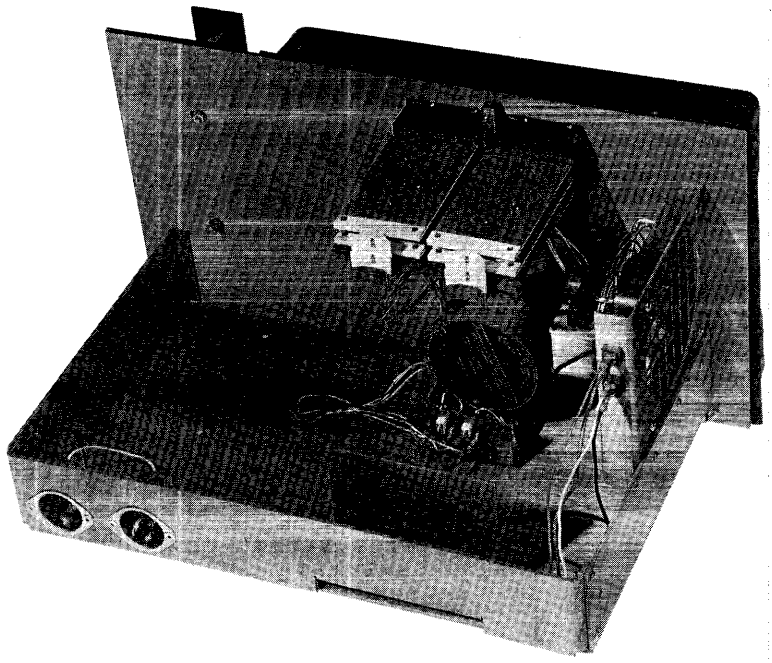


Figure 2 PC02 Perforated-Tape Reader, Rear View

Five FLIP CHIP circuit modules, mounted on a double connector block, contain the drivers and amplifiers used by the reader. The connector block, located above the stepping motor, likewise serves as an interface point for the signal cables attached to the unit. A fan, mounted on the left side of the chassis, as viewed from the front, provides a flow of cooling air for the circuit modules and the motor.

Two 3-terminal 110V ac power connectors, located at the rear of the chassis, provide both an input and an output point for primary power. The connectors, one male and one female, permit the inclusion of the reader in a power chain with other devices in the system.

2. FUNCTIONAL DESCRIPTION

The following paragraphs, which describe the general operating characteristics of the PC02, provide a basic understanding of its various functions.

2.1 Photoelectric Tape Reader

The photoelectric tape reader consists of a light source, a photovoltaic read head, and amplifier circuits for the photo-cell outputs. The read head, located below the tape, contains nine photovoltaic cells physically arranged to sense or read perforations in the light data tracks or channels of the tape in the tape feed-hole track. The light source is directly above the photocells.

Light passing through a hole in the tape activates an appropriate photocell. A photoamplifier produces a −3V output for transmission to an external processor. Circuits outside the PC02 reader control the transmission of data read from the tape.

The amplified output of the feed-hole diode may be used by the control circuits, if sampled between character locations, as a TAPE OUT indication.

2.2 Tape Transport System

A Type HS50 SLO-SYN Precision Stepping Motor is the primary element in the tape transport system. Electromagnetic stepping of the motor, under electronic control, frees the system of the maintenance problems normally associated with ratchets, detents, and clutch/brake mechanisms. The resultant reduction in moving parts greatly enhances the reliability of the unit.

The motor contains four bifilar (counter-wound) windings. Driving current, applied to pairs of windings in the proper sequence, produces motor movement. The continuous application of drive current to a single pair of windings generates a holding force which does not develop rotational torque.

Solenoid drivers provide drive current to the four motor windings. External switching of the activating inputs to these drivers rotates the motor to feed the perforated tape past the read station.

Eight solenoid drivers, two for each winding, are provided. The stepped activation of both solenoids in each of two pairs (see Figure 3) causes rotation of the motor. When a holding force is required, the stepping action is stopped, and only one driver in each selected pair is activated. The single drivers produce sufficient force to hold the motor static, with a lower power drain and subsequent reduced heating effect in the motor and the drive circuits.

Switching the activation of the solenoid pairs at 1.667-ms intervals results in tape reading at the rate of 300 characters per second. The system may also be operated in a single-character stop-start mode at the rate of 25 characters per second. To achieve the 300 character-per-second feed rate in minimum time, an acceleration and deceleration circuit must be used in conjunction with the motor drive clock.

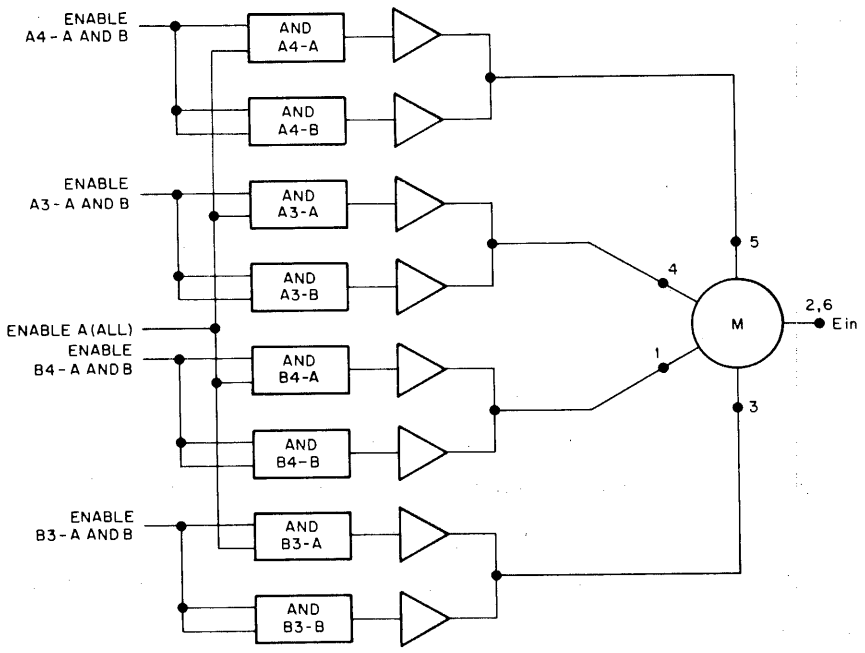


Figure 3 Motor Drive Circuit, Simplified Block Diagram

3. THEORY OF OPERATION

The PC02 Perforated Tape Reader feeds and reads 8-channel 1-inch-wide perforated tape at the rate of 300 characters per second. External circuits control all functions of the unit.

Nine photosensitive diodes are arranged below the tape track perpendicular to the direction of tape movement. A light source, located directly above the diodes, provides the light necessary for sensing the apertures in the tape. Eight of the diodes sense the coded apertures in the tape; the ninth senses the presence of a feed hole. The photocell output, when shuttered from the light, sits at a -2.8V to -3.2V level, depending upon the setting of the threshold sensitivity potentiometer. When exposed to the light, the output of the photocell increases (in a positive direction) above its preset shuttered value. Nine photoamplifiers continuously monitor the outputs of the diodes to provide a -3V output when a hole is sensed, and a 0V output when no hole is sensed.

By synchronizing its sampling of the outputs of the photoamplifiers with its inputs to the motor drive circuits, the external controller selects the output levels of the photoamplifiers which represent valid punched data.

The external controller provides pair-sequential inputs to motor-controlling solenoid drivers. The drivers generate the current needed to activate the windings of the synchronous tape-feed motor. Each switching of the paired inputs to the solenoid drivers causes the motor to rotate 1.8°. Switching the driver inputs 200 times, therefore, results in one complete revolution of the motor (1.8° x 200 = 360°).

A sprocket wheel, containing 100 feed-hole-engaging pins about its periphery, performs the actual feeding of the tape. This sprocket wheel mounts on, and rotates with, the shaft of the synchronous tape-feed motor. This results in tape movement equivalent to 100 character positions for each full revolution of the motor.

3.1 Tape Reading

The tape reader, as noted, senses coded perforations in 1-inch-wide 8-channel paper tape. The nine photodiodes located on the tape track are oriented perpendicular to the direction of tape travel (see Figure 1). An OSRAM 6475 Lamp, located directly above the photocells, provides a light source.

The following discussion describes the operation of the channel 1 photocell amplifying circuit. All other channels operate in an identical manner. The referenced amplifying circuit is on the left center of engineering drawing CS-C-G904-0-1 in Section 8 of this manual.

Photoamplifier G904 accepts the output of the photocell for channel 1, at terminal BN, through terminal N of the W023 Connector. When the photocell does not sense light (no hole) a bias level, determined by the setting of the threshold sensitivity potentiometer, is applied to terminal BN and the base of the left side of differential amplifier Q1. In this state, the left side of Q1 is cut off, permitting the right side of Q1 to conduct. The current flow through the right side of Q1 produces a voltage drop across R5 of approximately 10.7V. Current flows into the base of Q2, causing it to conduct. With Q2 conducting, the ground potential at its emitter is felt at the collector producing a 0V output at AD.

When the photocell senses light, a small positive voltage change occurs at terminal BN. This voltage drives the left side of Q1 to conduction, disturbing the balance of current flow and cutting off the right side of the transistor. With the right side of Q1 cut off, diode D1 clamps the right collector of Q1 and the base of Q2 to a point slightly more positive than ground. This cuts off the conduction of Q2. With Q2 cut off, diode D2 clamps both the collector and output terminal AD to a -3V level.

In summary: the sensing of a hole in any channel of the tape produces an output of -3V from the photoamplifier terminal corresponding to that channel. The lack of a hole in any channel results in a photoamplifier output of 0V (ground).

3.2 Tape Feeding

A Type HS50 SLO-SYN Synchronous Motor drives the tape past the read station. This motor contains six input terminals connected as shown in Figure 3. Terminals 1, 3, 4, and 5 connect to Type W040 Solenoid Drivers, which supply drive current to the windings. Terminals 2 and 6 connect to the motor input voltage supply (-30V dc). Correct operation of the system at the rate of 300 characters per second requires proper sequence and timing of the inputs to the solenoid drivers.

Drawing BS-D-PC02-0-1, located in Section 8 of this manual, shows the connection of the solenoid drivers to the motor. Note that each driver symbol contains an identifying letter/number code (A3, A4, B3, B4). This code refers to the physical location of the circuit module in the FLIP CHIP connector block (see Figure 6 in Section 4).

The W040 Solenoid Driver module contains two discrete driver circuits with independent inputs and outputs. Each driver output circuit in this application feeds into a series-connected current-limiting resistor. The jumpered ends of the resistors from each module connect to one input winding of the motor. Each section of a driver module provides 600 mA to its winding for a total drive current of 1.2 A per winding. The solenoid driver pairs produce the torque required for operation at a rate of 300 characters per second.

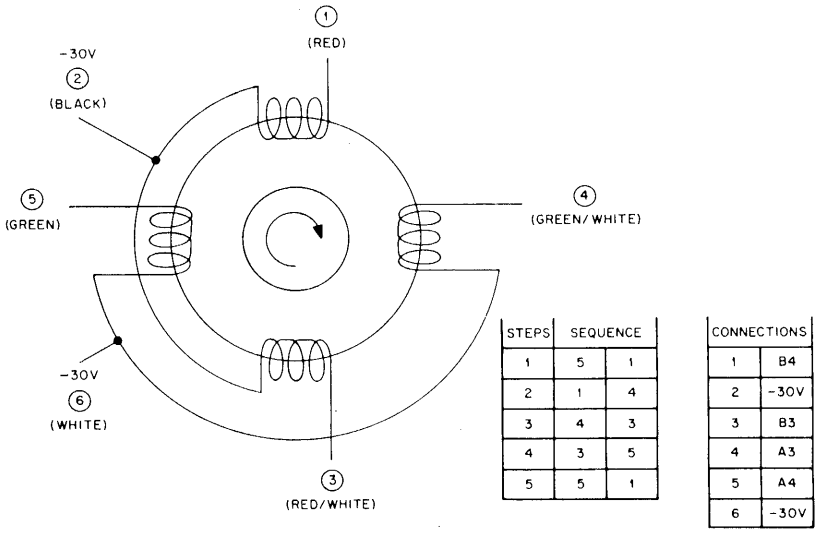
For the purpose of the discussion which follows, section 'A' consists of that section of the drive module served by inputs D and E. Conversely, section 'B' consists of that section of the module served by inputs K and J.

Each driver section contains a 2-input NAND gate. As shown in BS-D-PC02-0-1, terminal P of W023 at A1 provides one -3V level to each of the input gates (D,K) of driver A4. Terminal U of W023 at A1 furnishes the second input to this and all other 'A' sections of the drivers at E. Terminal J of driver A4 is left unconnected, permitting terminal K to assume full control of the 'B' section of the driver.

For instance, a -3V level, applied to terminals P and S of W023 at A1, supplies two of the four required inputs to modules A4 and B4. The application of a -3V level to pin E of all modules through pin U of the W023 Connector at A1 provides the third required input to these drivers. (Terminals R and T of the W023 Connector are at 0V, disabling drivers A3 and B3.)

Upon receipt of these three inputs, both sections of drivers A4 and B4 conduct providing drive current to windings 5 (green lead on motor) and 1 (red lead on motor). The applied drive current rotates the motor 1.8° and moves the tape a distance equal to one-half a character position (see Figure 4).

The application of a -3V level, 1.667 ms in duration, to pairs of input terminals in the sequence indicated below produces continuous tape feeding at the rate of 300 characters per second. A -3V level must be applied to terminal U of W023 for the entire period during which tape feeding is desired. A 0V (ground) level must be applied to the inactive terminals (see Figure 5).



STEPS	SEQUENCE	
1	5	1
2	1	4
3	4	3
4	3	5
5	5	1

CONNECTIONS	
1	B4
2	-30V
3	B3
4	A3
5	A4
6	-30V

Figure 4 Tape-Feed Motor, Simplified Schematic Diagram

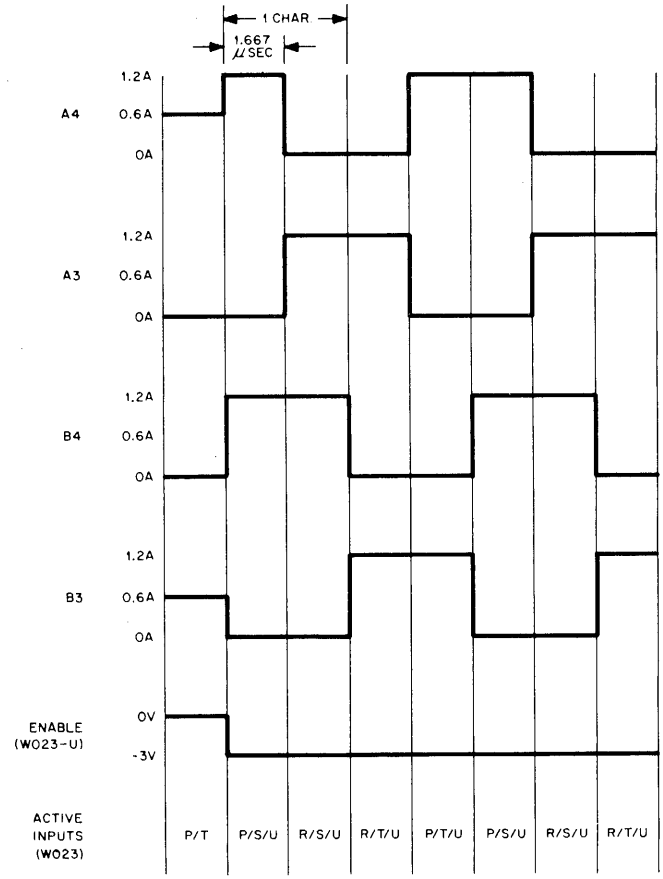


Figure 5 Sequence and Timing of Inputs to Solenoid Drivers

Assume that a step 1 (see below) P and T are active (-3V), and terminal U is inactive (0V). In this state, one section of driver A4 and one section of driver B3 are activated. The current produced is not sufficient to move the motor, but is sufficient to hold the motor at rest.

Step	Active Terminals (W023)
1	P, T
2	P, S, U
3	R, S, U
4	R, T, U
5	P, T, U

At step 2, P, S, and U are active, triggering both drivers in A4 and both drivers in B4. The motor rotates 1.8°, moving the tape a distance equal to one-half a character.

At step 3, R, S, and U are active, triggering A3 and B4. The motor rotates an additional 1.8° providing a total tape movement to this point of one full character.

Accordingly, performing steps 1 through 5 above moves the tape over a distance of two full characters. Continuous stepping of the inputs in this sequence at the rate of 1.667 ms per step produces a tape-feed rate of 300 characters per second.

If the external controller cannot provide inputs at this rate, it is necessary to reduce the feed rate to approximately 25 characters per second. This requirement reflects the acceleration and deceleration characteristics of the motor. The inertial characteristics of the system require that operation not be started at the full 300 character-per-second rate. Means must be provided to accelerate the system from a start to the full-speed rate in approximately three steps. The first input occurs when ENABLE goes to a 1 (-3V), the second 3.7 ms later, the third 2.5 ms after the second (6.2 ms from start) and all others at intervals of 1.667 ms. When ENABLE returns to a 0 (0V), one additional pulse occurs 4 ms later. This causes the motor to move one more position (one-half of a character distance) thus stopping the tape with data aligned with the photocells.

4. INTERFACE

The PC02 Perforated-Tape Reader interfaces with its external controller through a single connector. The equipment accepts a DEC W023 Connector in one position of the FLIP CHIP module connector block located on the rear of the front panel. Figure 6 shows the module side of the connector block, with its location code designation and module assignment.

The W023 Connector, with its required input and supplied output signals, is shown in Figure 7. With the exception of the -30V dc motor supply voltage input, this connector is the sole interfacing point between the PC02 and its controller.

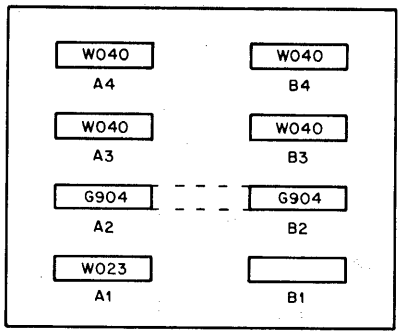


Figure 6 FLIP CHIP Module Connector Block

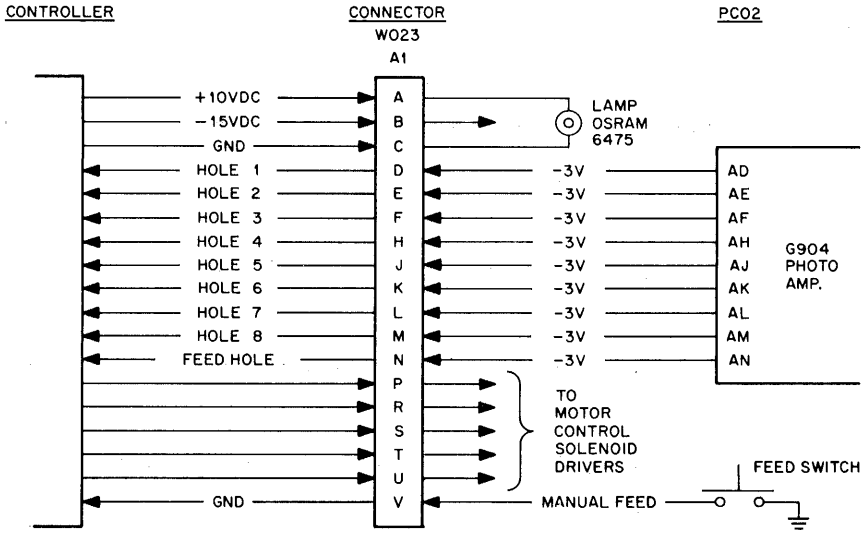


Figure 7 Tape Reader Input/Output Signals

5. MAINTENANCE

The information and procedures presented on the following pages apply to the DEC PC02 Paper-Tape Reader. Maintenance data for the logic control portion of the equipment is provided as part of the documentation of the processor with which the tape reader interfaces.

5.1 Preventive Maintenance

Preventive maintenance consists of tasks performed at periodic intervals to ensure proper equipment operation and minimum unscheduled downtime. These tasks consist of visual inspection, operational checks, cleaning, lubrication, adjustment, and replacement of borderline, or partially defective parts.

5.1.1 Scheduling - Preventive maintenance scheduling depends upon the existing environmental and operating conditions at the installation site. Under normal environmental and work-load conditions,

a schedule of preventive maintenance consisting of inspection, cleaning, and lubrication every 600 hours of operation, or every 4 months, whichever occurs first, is recommended. Relatively extreme conditions, however, of temperature, humidity, or dust, and/or abnormally heavy work loads demand more frequent maintenance.

5.1.2 Inspection - Inspect the PC02 Tape Reader as follows:

a. Visually inspect the tape reader for completeness and general condition.

b. Clean the interior and exterior of the tape reader using a vacuum cleaner or clean cloth moistened in nonflammable solvent.

c. Lubricate the slide mechanisms with a light machine oil. Wipe off excess oil.

d. Inspect all wiring and cables for cuts, breaks, fraying wear, deterioration, kinks, strain, and mechanical security. Tape, solder, or replace any defective wiring or cable covering.

e. Inspect the following for mechanical security: FEED switch, lamp assembly, diode assembly, all connectors and circuit modules, fan mounting bracket and fan, tape-feed motor, front cover, and resistor bracket.

5.2 Corrective Maintenance

Before commencing troubleshooting procedures in the PC02 Tape Reader, ensure that the processor portion of the system including the reader control logic and power supplies, is operating properly. Refer to the appropriate processor maintenance manual for operational checks to determine the system status.

When the processor has been eliminated as a source of trouble perform the troubleshooting procedures outlined below.

5.2.1 Preliminary Investigation - Examine the system maintenance log to determine if this fault has occurred before, noting what steps have been taken to correct it. Especially note if there appears to be any cyclic occurrence to the fault.

5.2.1.1 Visual Inspection - Visually inspect the tape reader to determine the physical and electrical security of all cables, connectors, modules, and wiring. Check the lamp for operation and the glass plate over the photodiodes for cleanliness. Pay special attention to ground connections between the tape reader and the processor as poor ground connections may produce a variety of faults.

5.2.2 System Troubleshooting - DEC provides special test programs (MAINDEC) with all processors to exercise and check the operation of input/output equipment. The program determines whether the peripheral is at fault and helps localize the problem area.

After localizing the fault within a functional logical element, program the computer to repeat some operation that uses all functions of that element. Trace signal flow through the suspected element with an oscilloscope. Synchronize the oscilloscope sweep with control signals or clock pulses

generated within the processor or in the reader control logic. Carefully examine all tape reader input and output signals for proper level, duration, rise and fall characteristics, and timing.

Use a combination of signal tracing and aggravation techniques to localize intermittent failures. If the system is equipped for them, marginal power checks may localize intermittent failures by causing borderline components to fail consistently. Refer to the processor maintenance manual for marginal test techniques.

Intermittent failures may also be caused by poor wiring connections. Run a repetitive test program and introduce physical vibration into the unit by gently tapping or moving the module connector block, circuit modules, and signal and power connectors. After isolating the malfunction in this manner, check the seating of the modules and the connectors; check the module connector block for wear or misalignment of terminals; and check the module wiring for cold solder joint and loose or broken wires or copper.

Since only two module types (four W040 Solenoid Drivers, and one G904 Photodiode Amplifier) are used in the tape reader, system troubleshooting is relatively simple. Output checks of both card types should quickly determine the location of the fault.

5.2.3 Solenoid Drivers - The four solenoid driver modules DEC Type W040 (Figure 2), are tested in the following manner

a. Connect the oscilloscope to pins R and S of the module under test.

b. Depress the manual feed button on the face of the reader.

c. Observe on the oscilloscope, while the reader motor is turning, that the output of the W040 changes from 0 to -30V.

5.2.4 Circuit Troubleshooting - When the faulty module has been isolated, circuit troubleshooting may be performed either with the module in the reader or on the bench. Replacing the faulty module with one from spares will hold system downtime to a minimum. It will also permit the module to be subjected to bench static or dynamic checks to isolate the faulty component or will permit its return to DEC for repair or replacement. If on-site repair of the faulty module is desired however, circuit troubleshooting with the module in the reader is the most economical of personnel time. This approach permits program exercising of the module for rapid fault isolation.

Formal engineering diagrams of each module are supplied with the tape reader. Copies of these schematics are provided in Section 8 of this manual. Basic function descriptions and specifications for these modules are presented in the Digital FLIP CHIP Modules Catalog, C-105.

5.2.5 Repair - Limit FLIP CHIP module repairs to the replacement of semiconductors. In all soldering and unsoldering operations, avoid placing solder or flux on adjacent parts or service lines. When soldering semiconductors (transistors, crystal diodes, metallic rectifiers, or integrated circuits) take the following special precautions to avoid heat damage:

a. Use a heat sink, such as a pair of pliers, to grip the lead between the device and the joint being soldered.

b. Use a 6V soldering iron with an isolation transformer. Use the smallest soldering iron adequate for the work.

c. Perform the soldering operation in the shortest possible time, to prevent damage to the component and delamination of the module etched wiring.

When removing any part of the equipment for repair and/or replacement, make sure that all leads or wires which are unsoldered, or otherwise disconnected, are legibly tagged or marked for identification with their respective terminals. Replace defective components only with parts of equal or better quality and equal or narrower tolerance.

5.3 Adjustment Procedures

5.3.1 Test Equipment Required -

Oscilloscope Tektronix, Type 453 or equivalent.

Tape loop of all 1s

Tape loop of alternate 1s and 0s

Basic hand tools

All prints from MDL-PC02

5.3.2 Tape Path Alignment - PC02 Paper-Tape Readers may contain either one-piece or two-piece tape guides. Before performing this alignment, determine which type of guide has been provided and use the appropriate procedure as detailed in a. and b. below.

> NOTE: The tape-path alignment procedure is not part of the normal preventative maintenance routine and should be performed only when parts have been removed or replaced.

a. Alignment of Two-Piece Tape Guide

(1) Remove the external reader cover and the tape face plate against which the tape hold-down bar rests.

(2) Set the tape hold-down bar (Figure 15, part number 25) in its upright position. The tape face plate should have a slot cut out in the lower right corner, which allows face plate adjustment without interference from the bottom screw on the diode assembly. (In some early models of the PC02 the slot was not made available, in which case the plate must be modified or replaced.)

(3) Loosen the two Phillip screws that hold the left paper-tape guide and photo-cell block.

(4) Punch approximately five fan folds of paper tape from the punch. Using the fan fold, tear the tape so that the result is two pieces of paper with double thickness and one long piece of paper tape.

(5) Insert one piece of the double thickness tape over the left paper-tape guide and one piece over the photocell block. Ensure that these pieces of tape do not touch the sprocket wheel.

(6) Place the long piece of paper tape over the sprocket wheel covering both of the previously inserted pieces of paper tape. The end result should be a triple thickness of tape over both the left paper-tape guide and photocell block and one piece over the sprocket wheel.

(7) Place the tape hold-down bar in its down position so that it attempts to compress the tape between the photocell block and the left paper-tape guide. Then move the photocell block and left paper-tape guide up so they compress the tape between them and the hold-down bar. Check that the hold-down bar has not been raised from its original down position and ensure that the tape path is straight and parallel.

(8) Tighten the two Phillip screws that secure the photocell block and the left paper-tape guide. Using a 6-in. steel ruler, recheck the parallelism and straightness of these parts.

(9) Replace the tape face plate but do not secure it or move the tape hold-down bar up. Proceed to move the tape face plate up until it touches the tape hold-down bar equally along its whole top edge. Check that the tape face plate is parallel with the hold-down bar.

(10) Tighten the screws for the tape face plate and move the double thickness of paper tape back and forth while the hold-down bar is in its down position. Observe that there is a slight amount of drag on the paper tape. Ensure that the paper tape is not compressed so tightly that it cannot be moved.

b. Alignment of One-Piece Tape Guide

(1) Remove external reader cover.

(2) Raise tape hold-down bar and insert three pieces of fan-fold paper tape as described in steps 4, 5, and 6 above.

(3) Lower the tape hold-down bar so that the tape is compressed between the hold-down bar and the tape guide. Be very certain that the tape is firmly back against the reader face and that no tape is being pinched at the front edge of the tape guide.

(4) Carefully raise the tape guide until there is a slight drag on the double-thickness tape. This drag should be equal at each end of the guide. At this time, the hold-down bar should be straight across and parallel to the tape guide.

(5) Tighten the two 6-32 screws on each end of the tape guide and recheck for tape drag and straightness.

5.3.3 Sprocket-Wheel Alignment - Required only if motor or sprocket wheel have been removed.

> NOTE: Sprocket-wheel alignment is not a part of the normal preventative maintenance procedure. This alignment procedure should only be performed when required; i.e., when the motor or sprocket wheel have been removed.

(1) Ensure that the machine is shut off and the ac power cord has been removed.

(2) Loosen the four Phillip screws that hold the stepping motor to the base plate.

(3) Place the motor in the center of its rotational play and secure the four screws three-fourths tight.

(4) Loosen the two Allen screws which secure the sprocket wheel to the motor shaft.

(5) Place the tape with all 1s through the tape path and over the sprocket wheel. Center the feed sprocket pin in the feed hole while holding light pressure against the sprocket wheel. This ensures that the back edge of the tape is against the reader plate.

(6) Rotate the sprocket wheel (Figure 15, part number 35) so that the punched holes are in alignment with the photodiodes. Check that the tape is not skewed which would cause some parts of the holes to be covered.

(7) Tighten the Allen screws that secure the sprocket wheel to the motor shaft. Recheck the tape for proper alignment of sprocket and feed hole.

(8) Place a tape of alternate 1s and 0s in the reader.

(9) Attach an oscilloscope probe from trace A to the output of the clock accelerator circuit in the reader control logic, and from trace B to any one of the photocell amplifier data output pins (AD, AE, AF, AH, AJ, AK, AL, or AM). Synchronize the oscilloscope at pin E of any one of the solenoid driver modules.

(10) Load the processor with the reader-test program appropriate for the particular system with which the PC02 is interfaced. These programs are as follows:

PDP-8, 8/I, 8/S	- MAINDEC-08-D2FC
PDP-9	- MAINDEC-9A-D2CC
PDP-10	- MAINDEC-10-D2BA

Following the instructions provided in the program writeup, select the portion of the appropriate program which permits continuous cycling through the acceleration phase of reader operation. Use a block length of six characters and a delay (stall) of approximately 150 ms.

(11) Start the program. Trace A will appear as a sawtooth waveform in which the first, and subsequently every other sawtooth peak, occurs simultaneously with strobe. This is shown in Figure 8. If necessary, loosen the four machine screws securing the motor to the reader plate and rotate the motor slightly to obtain the operating charateristics shown in Figure 8.

> NOTE: If the rotational adjustment range of the motor is found to be insufficient to complete the procedure, the sprocket wheel must be adjusted to meet the operation requirements. Place the motor in the approximate center of its rotational play and secure the four motor-mounting machine screws. Complete the adjustment by loosening the two sprocket-wheel mounting screws and rotating the sprocket wheel slightly. Since the machine must be stopped for this adjustment, it will be necessary to determine the desired direction of movement of the sprocket wheel (or motor), make a tentative adjustment, and restart the program to check the results. If the sprocket-wheel adjustment becomes necessary, recheck the adjustment parameters of steps 5 and 6 of this procedure.

It is important that the sawtooth peaks representing the strobe pulse be as nearly centered as possible on the first five to six data outputs. It may be necessary to compromise strobe centering on data outputs beyond this point, but the operating characteristics of the system are much less critical when the feed motor has reached full speed. It is far more important that the strobe be centered on the data output during the critical acceleration period of the motor.

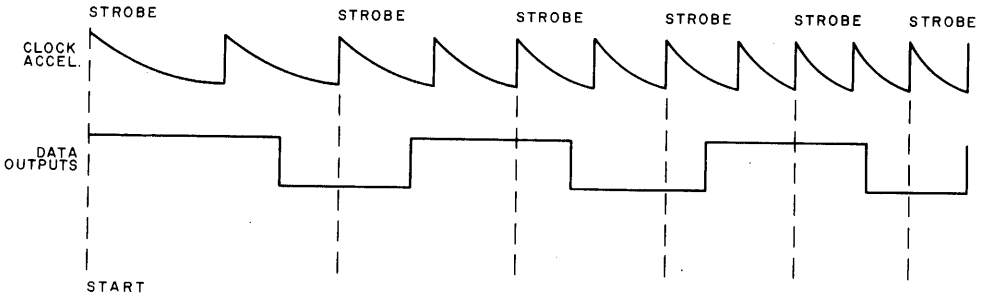


Figure 8 Waveforms for Sprocket-Wheel Alignment Procedure

Rotate the motor to its final strobe position if necessary. Tighten the Phillip screws that fasten the motor to the base plate.

5.3.4 Photodiode Amplifier Adjustments -

(1) Place a tape of alternate 1s and 0s in the PC02 reader and set the processor for continuous operation. Set the oscilloscope so that one cycle is equal to 10 cm. With trace A sync the oscilloscope and observe that any one of the information channels is as shown in Figure 9. There will be a ±10% difference between channels due to skew and component tolerances.

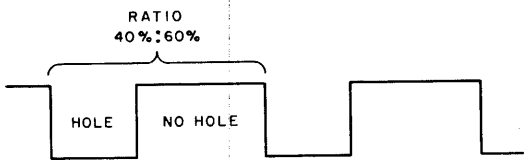


Figure 9 Typical Output from 1-0 Tape

5.3.5 Reader Tests - Exercise the PC02 using a reader diagnostic program. There should be no failures while running this test program.

6. PARTS LIST

The illustrations on the following pages furnish a breakdown of all replaceable parts of the PC02 tape reader. The key numbers on the illustrations refer to the parts list that follows the illustrations.

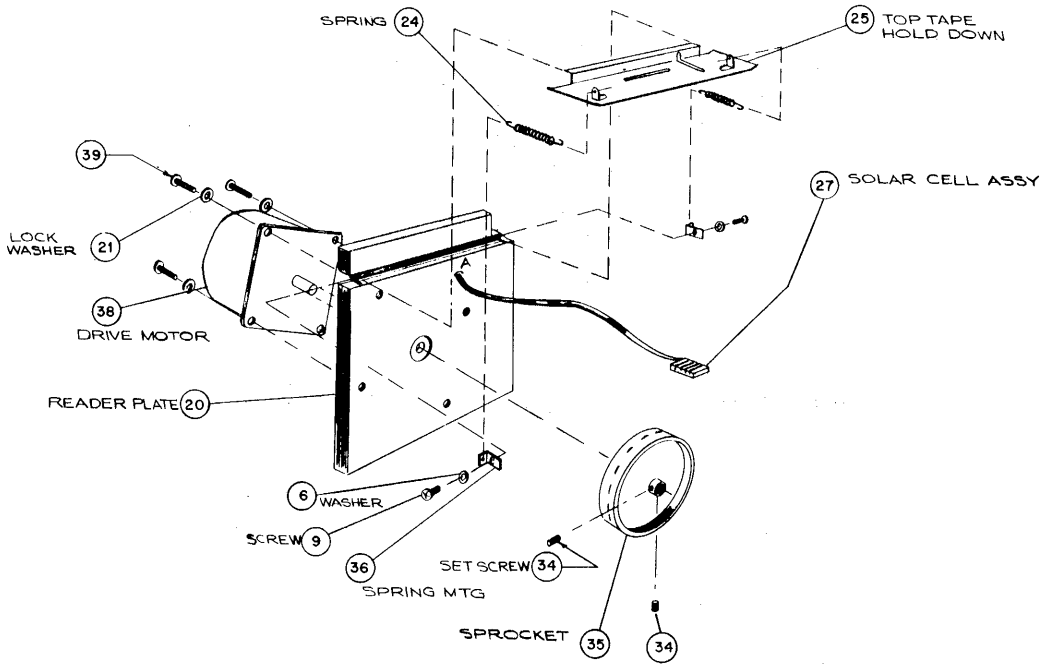


Figure 10 Front Cover Assembly

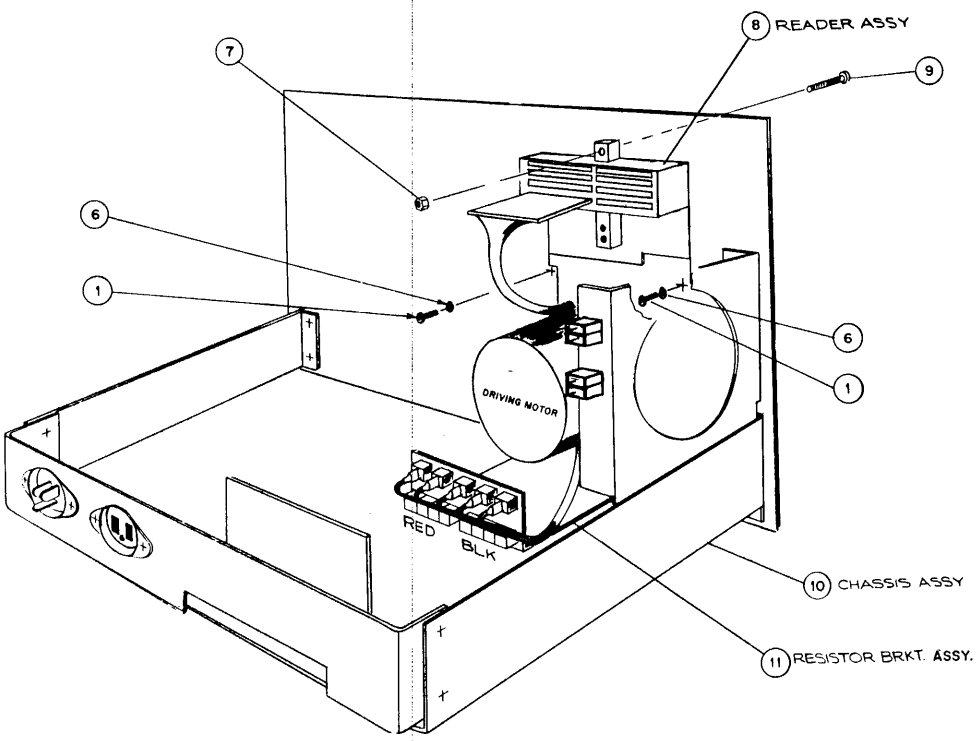


Figure 11 Rear View Showing Reader Assembly Mounting

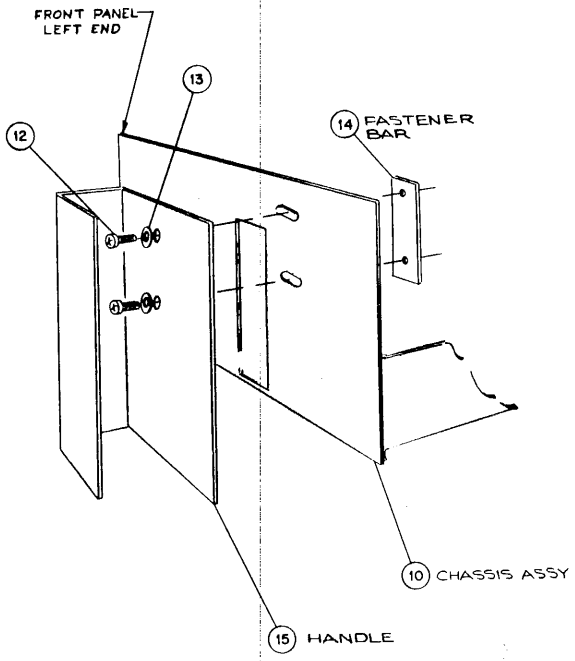


Figure 12 Handle Assembly

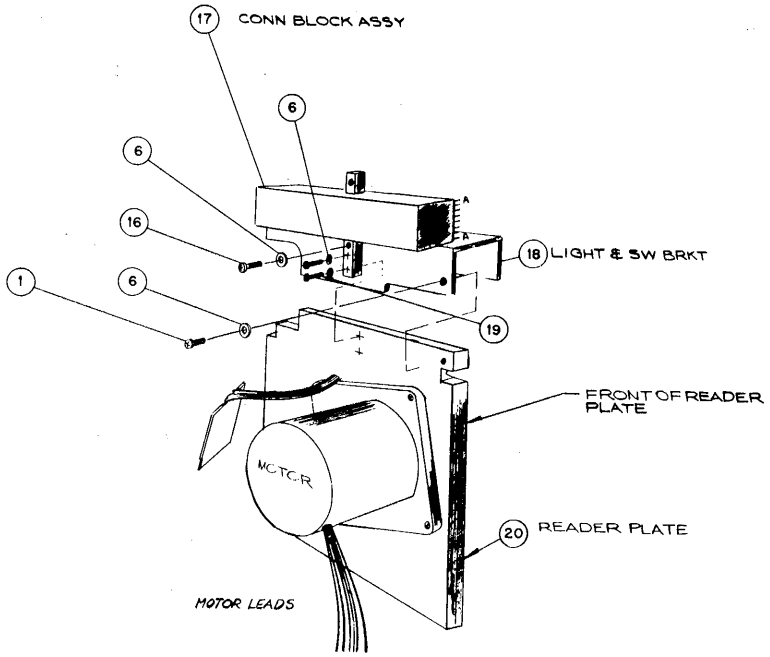
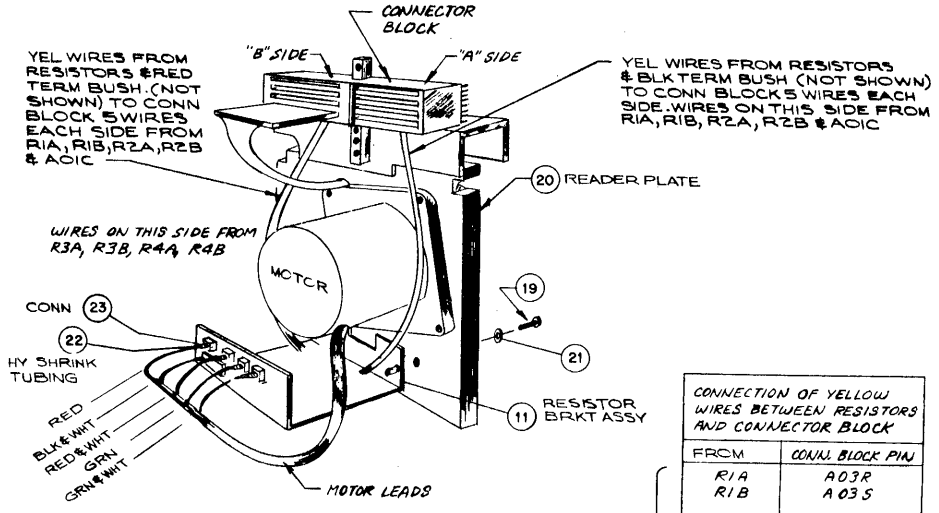


Figure 13 Connector Block Assembly Mounting



CONNECTION OF YELLOW WIRES BETWEEN RESISTORS AND CONNECTOR BLOCK	
FROM	CONN. BLOCK PIN
RESISTOR R1A	A03R
R1B	A03S
R2A	A04R
R2B	A04S
R3A	B03R
R3B	B03S
R4A	B04R
R4B	B04S
BULB TERMINAL	B01A
TERM BUSH (RED)	B03V
TERM BUSH (BLACK)	A01C

Figure 14 Reader Assembly, Wiring

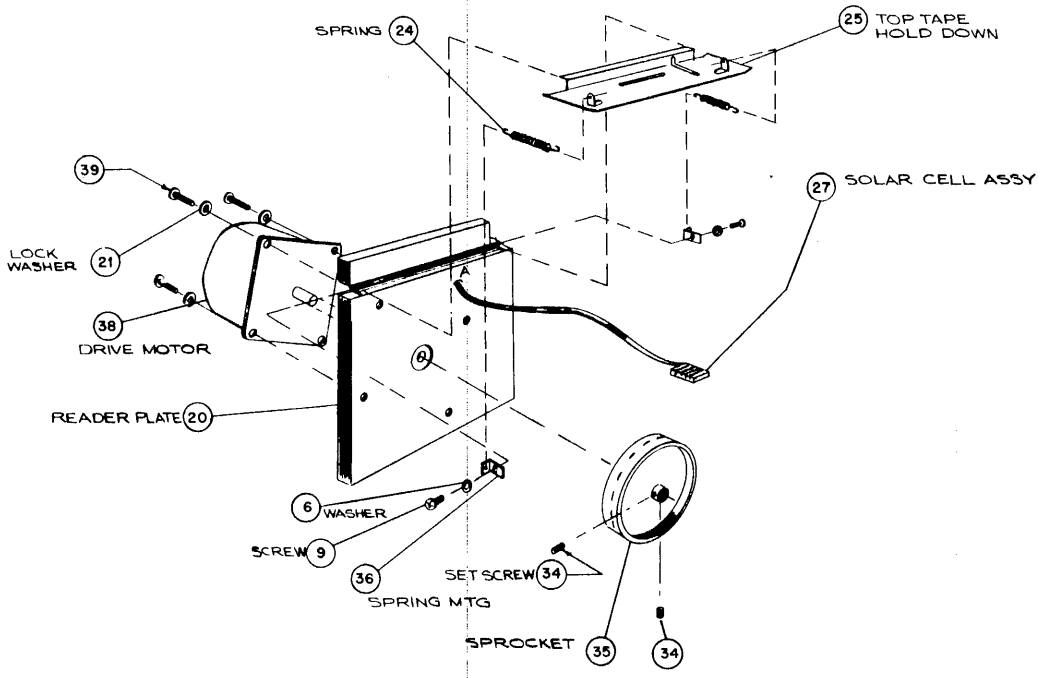


Figure 15 Reader Assembly, Front, Exploded View

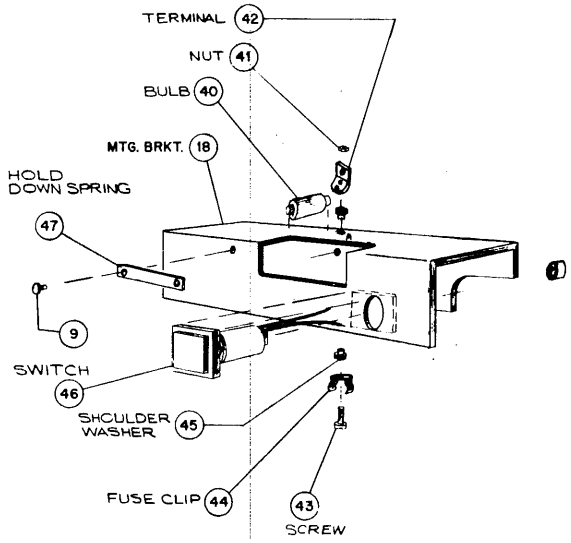


Figure 16 Switch Assembly, Front, Exploded View

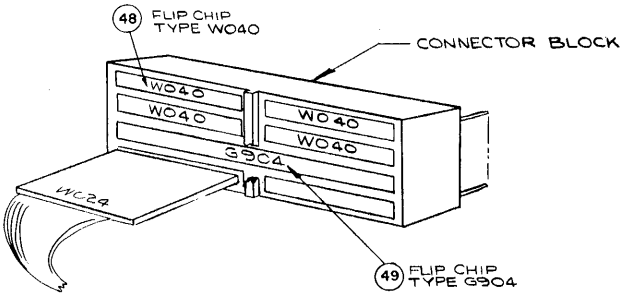


Figure 17 Connector Block Assembly

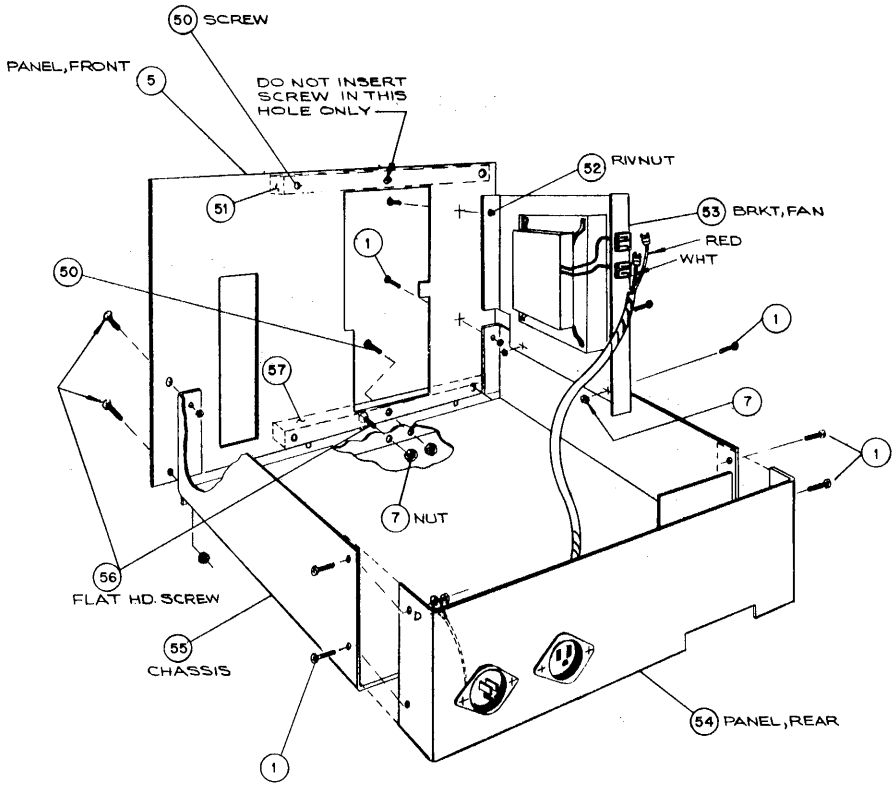


Figure 18 Chassis Assembly, Rear View

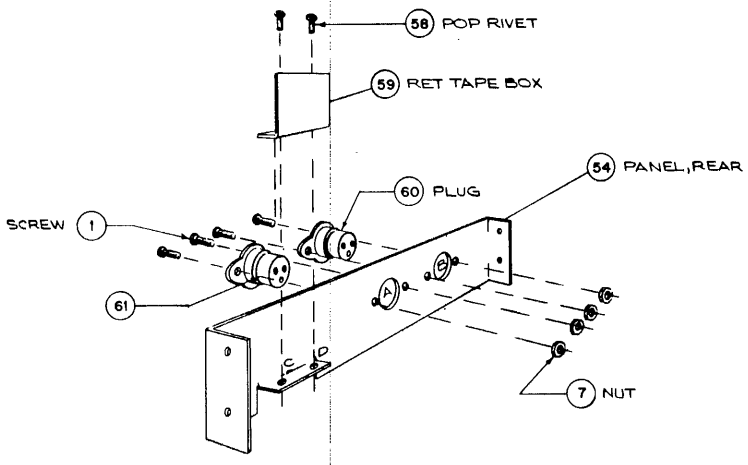


Figure 19 Rear Panel Assembly, Exploded View

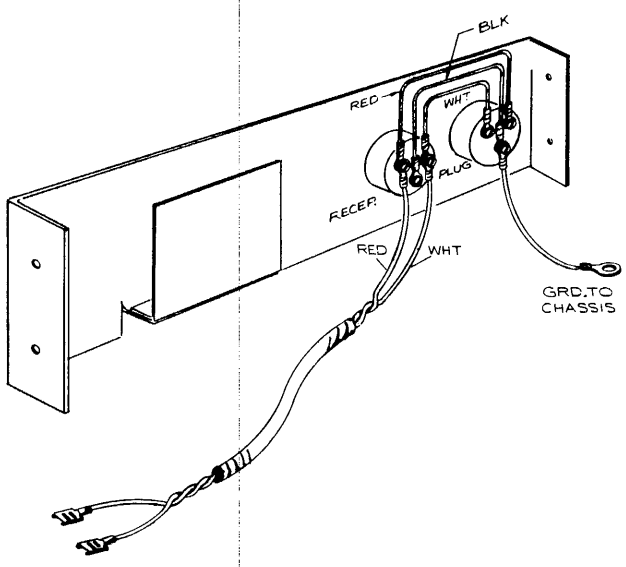


Figure 20 Rear Panel Assembly, Wiring

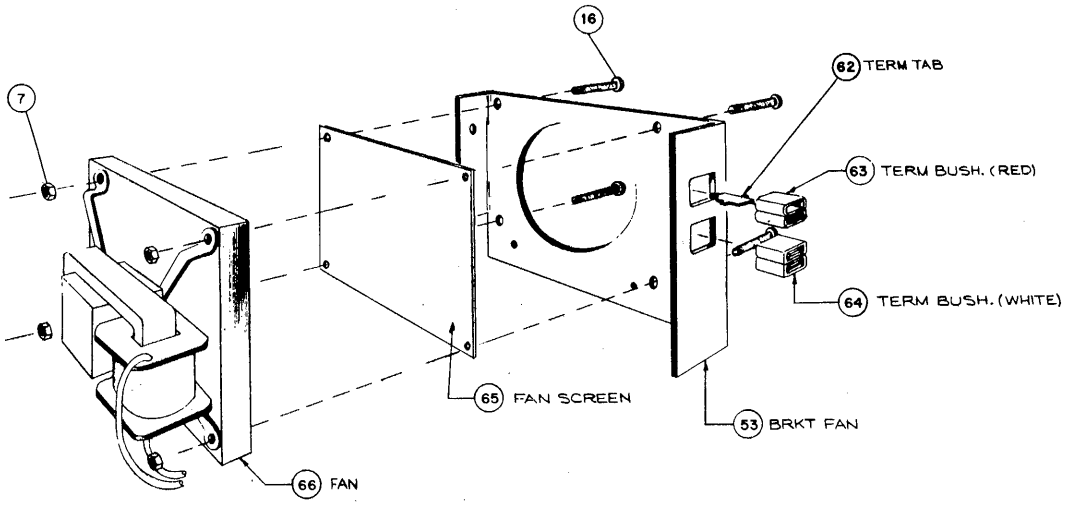


Figure 21 Fan Assembly, Exploded View

Table 1
Parts List

Key No.	Description	Qty.	DEC Dwg.No.	DEC Part No.
1	Screw; machine, Phillips pan-head. #6-32x3/8 lg. SST	11		
2	Cover (front) with cutout (19-in. panel).	1	D-MD-7405427-3-0	74-5427
3	Cover (front) with cutout (19-1/2 in. panel)	1	D-SC-3404738-1-0	34-4738
4	Roll pin ; 1/8x1/2 lg. SST	2		
5	Panel; front (chassis)	1	D-MD-7405119-0-0	74-5119
6	Washer; lock, internal tooth, #6 cl. hole, SST	10		
7	Nut; hex, Keps, #6-32, SST	25		
8	Reader assembly	1	D-AD-7005120-0-0	70-5120
9	Screw; machine, Phillips pan-head. #6-32x1/4 lg. SST	7		
10	Chassis assembly	1	D-AD-7005121-0-0	70-5121
11	Bracket assembly; resistor	1	D-AD-7005155-0-0	70-5155
12	Screw; machine, Phillips pan-head. #6-32x1/2. SST	2		
13	Washer; #8 cl. hole, nylon	2		
14	Bar; fastener (handle)	1	A-MD-7405292-0-0	74-5292
15	Handle (PC02)	1	D-MD-7405255-0-0	74-5255
16	Screw; machine, Phillips pan-head. #6-32x7/8 SST	5		
17	Connector block assembly	1	B-AD-7005159-0-0	70-5159
18	Mtg. bracket; light & sw.	1	D-MD-7405132-0-0	74-5132
19	Screw; machine, Phillips pan-head. #6-32x 1 lg. SST	2		

Table 1
Parts List (Cont.)

Key No.	Description	Qty.	DEC Dwg.No.	DEC Part No.
20	Reader plate (reader)	1	D-MD-7405133-0-0	74-5133
21	Washer; lock, external tooth, #6 cl. hole. SST	6		
22	Tubing, Hyshrink, (red) #14x1/2 lg.	5		
23	Connector; solderless, #42025-0-1 Amp, Inc.	4		
24	Spring; SST., Lee Spring Company	2	Lee P/N LE-031B-2	
25	Tape hold-down; top (reader)	1	D-MD-7405257-0-0	74-5257
26	N/A			
27	Solar cell assembly (reader)	1	D-AD-7005152-0-0	70-5152
28*	Head Assembly (reader)	1	A-PL-7005169-0-0	70-5169
29	N/A			
30	Screw; machine, Phillips pan-head, 6-32x3/16 lg. SST	2		
31	Screw; machine, Phillips pan-head, 6-32x1-1/2 lg. SST	3		
32*	Guide; front (reader)	1	B-MD-7405126-0-0	74-5126
33	Spacer; front guide	1	A-MD-7405129-0-0	74-5129
34	Screw; set, pointed, 6-32x1/8 lg. SST	2		
35	Sprocket; tape (reader)	1	C-MD-3404748-0-0	34-4748
36	Mounting; spring (reader)	2	A-MD-7405274-0-0	74-5274
37*	Guide; tape (reader)	1	B-MD-7405125-0-0	74-5125
38	Motor; stepping, precision Superior Elec. Co.	1	Superior Elec. Co. No. 34-HS-50	34-4735
39	Screw; machine, truss head 6-32x1/2 lg. SST	4		

* Replaced with Parts #67 and 68 at Serial #200.

Table 1
Parts List (Cont.)

Key No.	Description	Qty.	DEC Dwg.No.	DEC Part No.
40	Bulb; #6475 OSRAM	1		34-4734
41	Nut; hex, Keps, 4-40, SST	1		
42	Terminal; shakeproof, #2104-06-0-0	1		
43	Screw; machine, Phillips pan-head, 4-40x1/2 lg. SST	1		
44	Clip; fuse, Busman	1	Busman No. 4592	
45	Washer; shoulder, fiber	2	H.H.Smith P/N 2153	
46	Switch; snap-action, mini, SPDT, momentary, #01-121	1	34-01-121	34-4877
47	Spring; hold-down	1	A-MD-7405128-0-0	74-5128
48	Module; FLIP CHIP, Type W040	4	B-CS-W040	
49	Module; FLIP CHIP, Type G904	1	C-CS-G904-0-1	
50	Screw; machine, Phillips, pan-head 6-32x3/4 lg. SST	5		
51	Bar; mtg, top (cover)	1	B-MD-7405228-0-0	74-5228
52	Rivnut; #6-32 Thd.B.F.Goodrich	1	B.F. Goodrich P/N SS6-120	
53	Bracket; fan (chassis)	1	D-MD-7405138-0-0	74-5138
54	Panel; rear (chassis)	1	D-MD-7405118-0-0	74-5118
55	Chassis	1	D-IA-7405206-0-0	74-5206
56	Screw; cap, slotted flat head. 6-32x3/4 lg. SST	5		
57	Bar; mtg, bottom (chassis)	1	B-MD-7405268-0-0	74-5268
58	Rivet; pop, 5/32 dia. x 3/8 lg. United Shoe Machinery Corp.	2	United Shoe Mach. P/N AD54ABS	
59	Retainer; tape box (chassis)	1	C-MD-7405208-0-0	74-5208

Table 1
Parts List (Cont.)

Key No.	Description	Qty.	DEC Dwg.No.	DEC Part No.
60	Recept; motor, flush, 2-pole. Amphenol	1	Amphenol P/N 160-5	12-1252
61	Recept; motor, flush, 2-pole Amphenol	1	Amphenol P/N 160-4	12-1251
62	Tab; term., Heyman Mfg. Co.	4	Heyman P/N T-202-5-1/4	
63	Bushing; terminal junct. (red) Heyman Mfg. Co.	1	Heyman P/N DC-202-2	
64	Bushing; terminal junct. (wht) Heyman Mfg. Co.	1	Heyman P/N DC-202-2	
65	Screen; fan	1	C-MD-7404881-0-0	74-4881
66	Fan	1	Std: 34-8015 w/reverse; 34-B-218302	34-3502
67	Tape Path Guide	1	D-MD-7405944-0-0	74-5944
68	Solar Cell Mtg.	1	B-MD-7405944-0-0	74-5945

7. INSTALLATION

7.1 Mounting Considerations

The PC02 Perforated-Tape Reader is rack mountable in either a 19- or a 19-1/2 in. wide radio rack. Drawer slides are provided for ease of maintenance. Figure 20 shows the overall physical dimensions of the tape reader.

7.2 Environmental Considerations

No special environmental conditions need be met for proper operation of the PC02 Tape Reader. Ambient temperature at the installation site can vary between 60 and 95°F (15 to 35°C) with no adverse effect on its operation.

During shipping or storing of the system, the ambient temperature may vary between 32 and 130°F (0 and 55°C). Although DEC treats exposed surfaces of all cabinets and hardware against corrosion, avoid exposure of the unit to extreme humidity for long periods of time.

7.3 Power Requirements

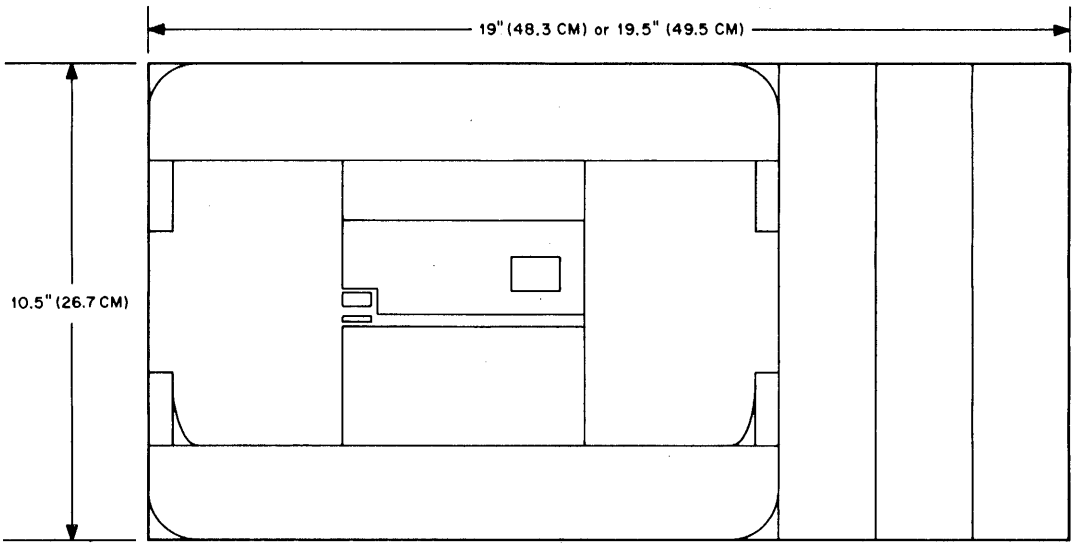
The power supply used must provide the PC02 tape reader with the following input voltages:

-15V dc (-14.5 to -16.5)

+10V dc (9.5 to 11.5)

-30V dc

These voltages may be supplied by a DEC Type 779 Multiple Power Supply or its equivalent. The Type 779 Power Supply accepts 115 ± 10V ac, 60 Hz. For 50-Hz operation, a DEC Type 779A Power Supply, or its equivalent, should be used. Digital System Modules Catalog, C-100, contains additional information on these power supplies.



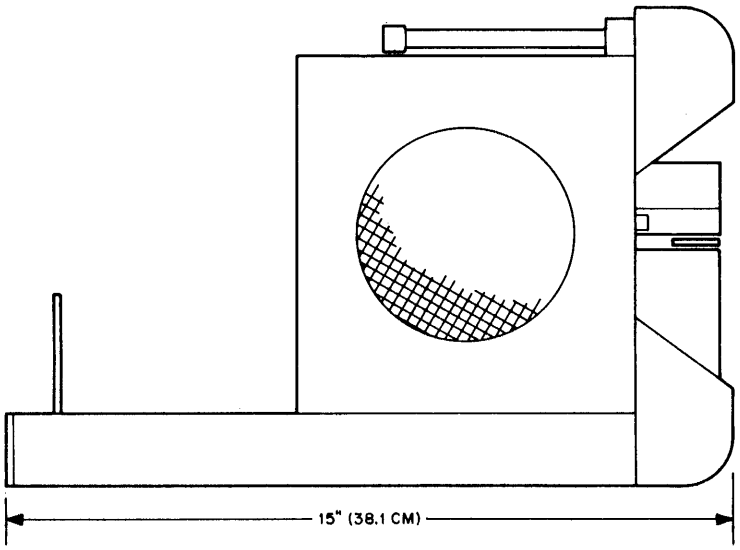


Figure 22 PC02 External Dimensions

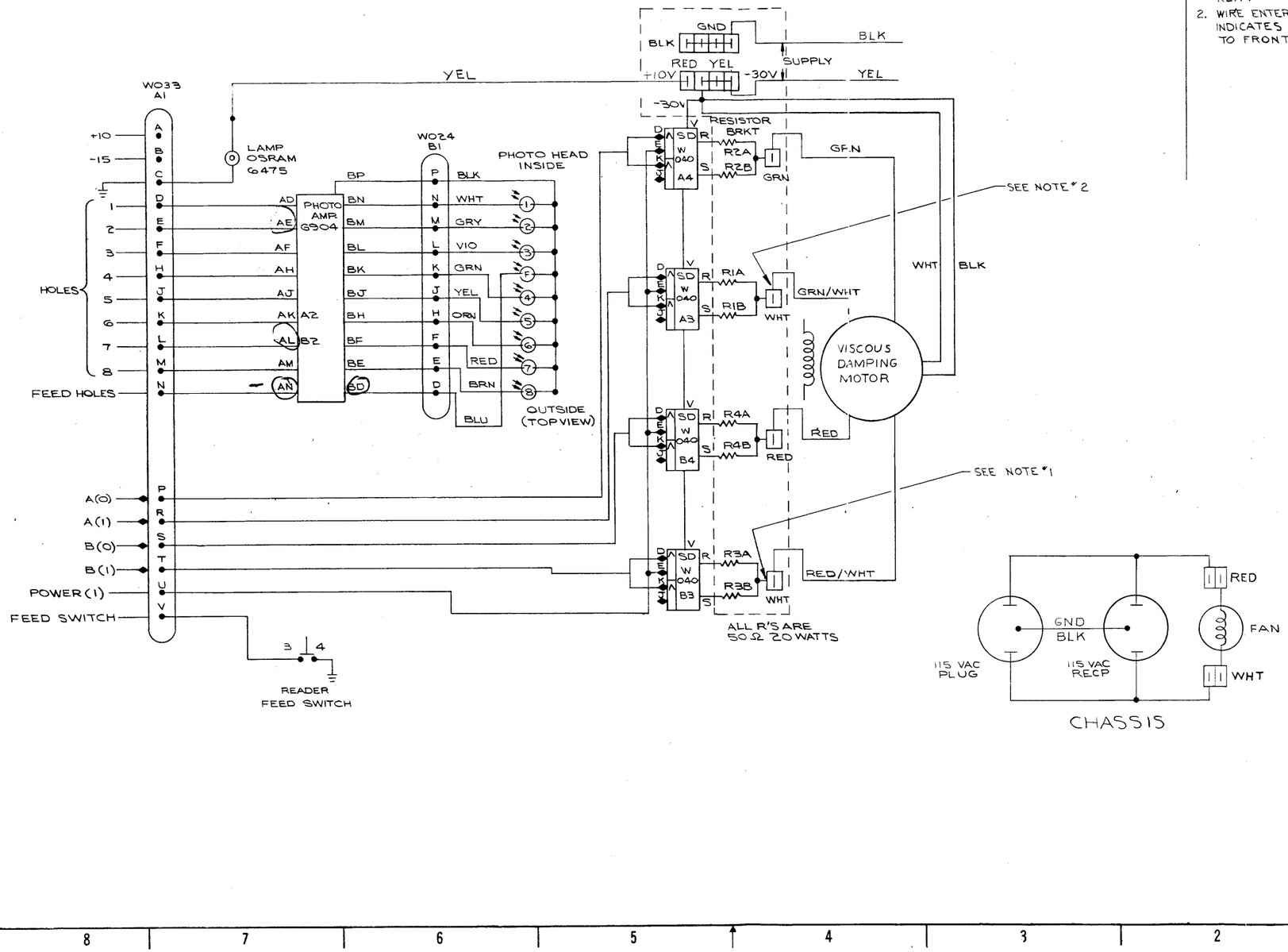
8. ENGINEERING DRAWINGS

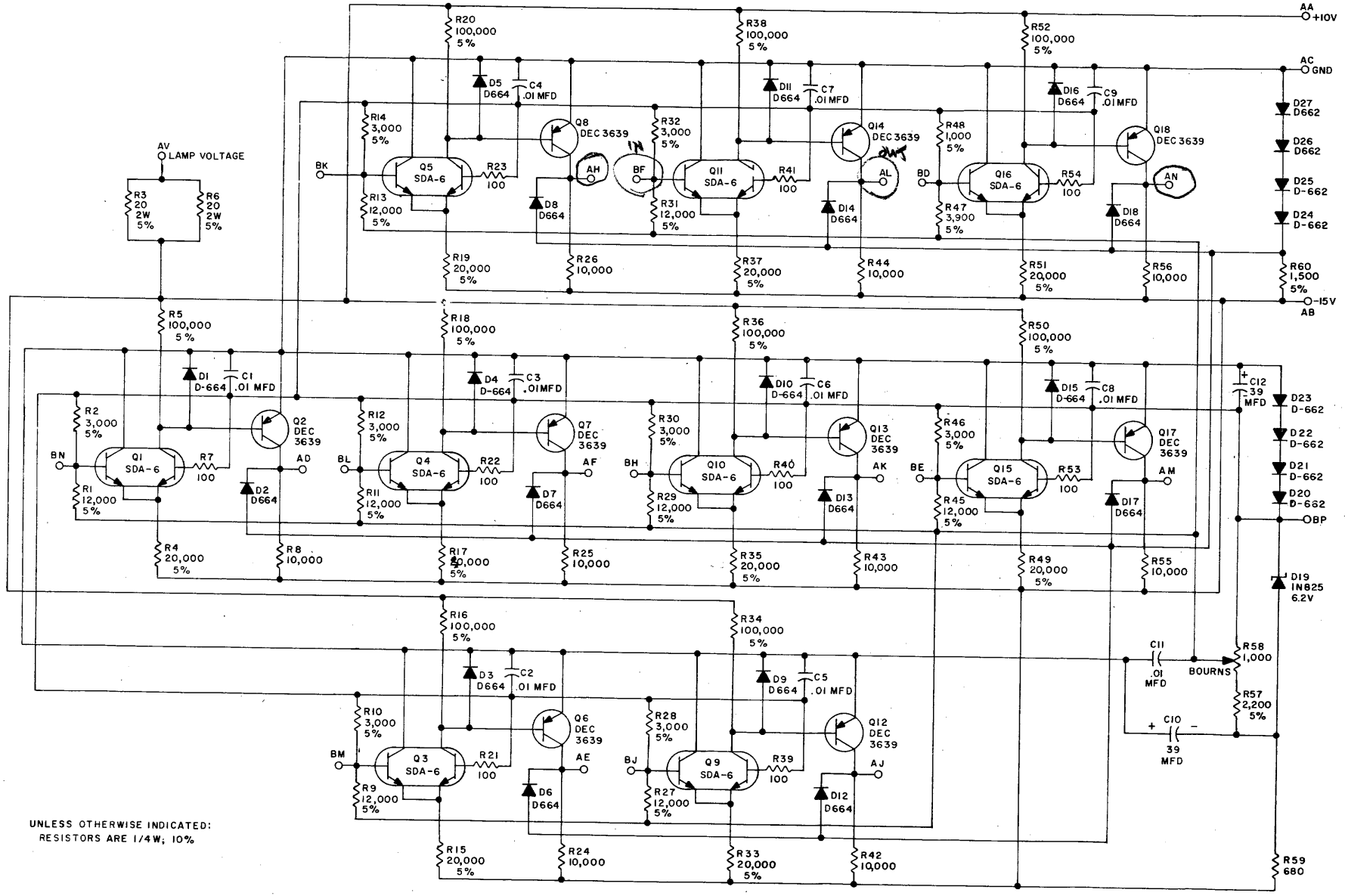
Table 2 lists the engineering drawings included in this manual with revision letter and page number.

Table 2
Engineering Drawings

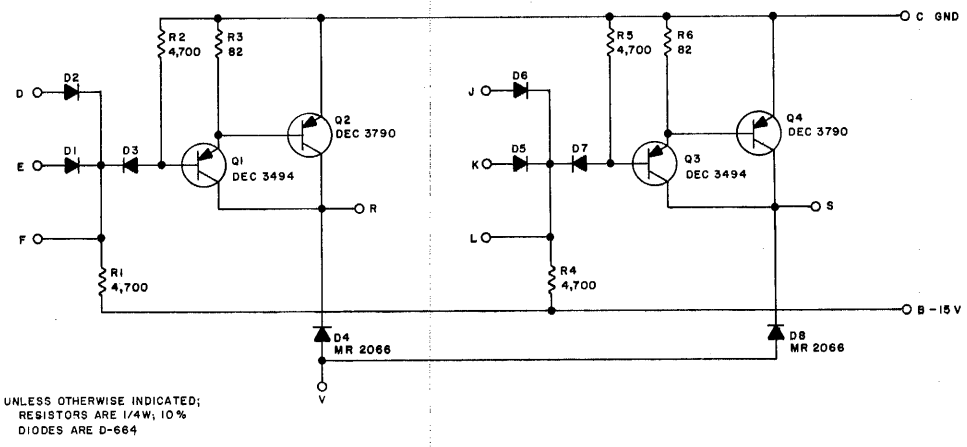
Drawing Number	Title	Revision	Page
BS-D-PC02-0-1	PC02 Reader	B	31
CS-C-G904-0-1	Photo Amplifier Module G904	A	33
CS-B-W040-0-1	Solenoid Driver W040	2	34

NOTES:
1. WIRE ENTERING HEYCO TAB HORIZONTALLY INDICATES A SOLDER CONNECTION ON REAR
2. WIRE ENTERING HEYCO TAB VERTICALLY INDICATES A QUICK DISCONNECT TAB TO FRONT





CS-C-G904-0-1 Photo Amplifier Module G904



CS-B-W040-0-1 Solenoid Driver W040