Installation and Operation Manual

KENNEDY
A Division of Shugart Corporation

Embedded Formatter

Model 9220

FCC CERTIFIED COMPUTER EQUIPMENT

This equipment, freestanding with shielded Data and Control Cables, complies with Part 15, Subpart J of FCC Rules Governing Class A Computing Devices Operated In A Commercial Environment. However, the equipment generates radio frequency energy and, when operated in a residential area, the user must take adequate precautions against interference to radio communications.

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SECTION I

GENERAL DESCRIPTION AND SPECIFICATION

1.0 GENERAL DESCRIPTION

Section I contains KENNEDY 9220 Formatter product definition, features, a functional description, electrical and machanical specifications, inputs/outputs, interface connections, speed selection, and read/write/search operations.

1.1 PRODUCT DEFINITION

The 9220 Formatter performs tape formatting in Nonreturn-to-Zero version one (NRZI) or Phase Encoded (PE) with formatting control electronics that meet the requirements to read and write ANSI compatible 800 characters per inch (cpi) NRZI and 1600 cpi PE formats. The 9220 Formatter can be mounted/embedded in a KENNEDY Tape Drive model 9000, 9100, 9300, 9700 or 9800, and can control a maximum of any four of these Tape Drive models in a daisy chain arrangement.

1.1.1 FEATURES

1. Industry compatible formatter interface: NRZI/PE ANSI compatible format.
2. Data Density: Single Density (800 cpi; or 1600 cpi) or Dual Density (800/1600 cpi).
3. Maintenance free.
4. Based on switch selectable addressing of Tape Drives in a Daisy Chain.
5. Switch selectable data transfer rate.
6. Signature Analysis diagnostics.
7. Crystal controlled timing.

1.1.2 FUNCTIONAL DESCRIPTION

The 9220 Embedded Formatter consists of three major sections:
1. Phase Encoded data recovery circuits.
2. Microprogrammed control unit.
3. Host interface.

The above three sections are on one PCBA which uses, for compactness, a bipolar microprocessor and MSI logic for: motion control, internal synchronization, reading and writing of NRZI and PE data, transfering of commands/data to/from the Controller and Tape Transports.

The 9220 Formatter reads/writes magnetic tape by conforming to ANSI X3.22 and ANSI X3.39 which allow tape interchange. These standards include generation and detection of gaps, file marks, preambles and postambles, error detection and recovery, and buffering.

The 9220 Formatter can handle read/write or read after write in NRZI (800 cpi) or PE (1600 cpi) formats at twelve tape speeds in the range of 12.5 inches per second (ips) to 125 ips. It also has fixed and variable commands, tape editing, and generation and detection of PE mode ID burst. Two special features are also available: Space Forward/Reverse (FWD/REV) One Block, and Space Forward/Reverse (FWD/REV) One File.

One KENNEDY 9220 Formatter can format/control four KENNEDY Tape Drives in any combination of models 9000, 9100, 9300, 9700, and 9800 in a daisy chain. The daisy chain requires two ribbon cables: one cable to daisy chain the Control function, and another cable for the Data function, each a maximum of 20 ft. long.

1.2 SPECIFICATIONS

1.2.1 ELECTRICAL AND MECHANICAL SPECIFICATIONS

Table 1-1 provides mechanical and electrical information and summarizes the operational specifications for KENNEDY 9220 Formatter.

TABLE 1-1 9220 EMBEDDED FORMATTER OPERATIONAL SPECIFICATION

Compatible transport models	KENNEDY models: 9000, 9100, 9300, 9700, 9800
Formats/Recording Modes	PE and NRZI ANSI Compatible
Data Density	800 cpi (NRZI), 1600 cpi (PE)
Number of channels	9 track read-after-write
Tape Speed (set via dip switch)	12.5, 18.75, 25, 37.5, 45, 75, and 125 inches/second
Data rate variation	+/-10%
Parity	Odd
Controller interface	Two 50-pin ribbon cables
Electrical interface	TTL low = true, industry compatible
Power requirements	5VDC at 10 amps (nominal draw 5 amps) +/-12VDC at 100 mA
Dimensions	Length: 15.5 inches (39.37 cm.) Width: 8.5 inches (21.59 cm.)
Operating temperature	+35.6 to +122 Fahrenheit (+2° to +50° Centigrade)
Non-operating temperature	-31 to +149 Fahrenheit (-35° to +65° Centigrade)
Operating altitude	20,000 feet (6,096 meters)
Non-operating altitude	50,000 feet (15,240 meters)
Humidity	15% to 95% non-condensing

1.2.2 RELATED DOCUMENTS

1. ANSI X3.22 Recorded Magnetic Tape for information interchange (800 cpi, NRZI).
2. ANSI X3.39 Recorded Magnetic Tape for information interchange (1600 cpi, PE).
3. ANSI X3.40 Unrecorded Magnetic Tape for information interchange (800 cpi, NRZI and 1600 cpi, PE).

4. Model 9000 Installation and Operation Manual P/N 93-09000-601.
5. Model 9100 Installation and Operation Manual P/N 93-09100-101.
6. Model 9300 Installation and Operation Manual P/N 93-09300-101.
7. Model 9700 Operation and Maintenance Manual P/N 93-09700-001.
8. Model 9800 Operation and Maintenance Manual P/N 93-09800-001.

9. The complete 9220 Formatter field mounting/installation instructions, including the power connections, for newer series 9000 Tape Drives are in Section II of this Manual.

10. "Installation/Adjustment Field Instructions for the Embedded 9220 Formatter AC Power Hook-up to Model 9100 or 9300 Tape Drive" P/N 93-00922-100 are included in the "9220 to 91/9300 VAC Power Hook-up Kit" P/N 98-00922-001 which comes with the 9220 Formatter P/N 92-09220-904 (9 track, dual 75 ips, for 115 VAC Drives) or the 9220 Formatter P/N 92-09220-905 (9 track, dual 125 ips, 115 VAC).

11. "Field Mounting Instructions of the Kennedy Embedded Formatter Type 9220 on to the Kennedy Tape Drives Type 9700 and 9800" P/N 03-00356-001 are included in the "9220 to 97/9800 115VAC Kit" P/N 98-00189-001 which comes with the 9220 Formatter.

12. "Field Mounting Instructions of the Kennedy Embedded Formatter Type 9220 on to the Kennedy Tape Drives Type 9700 and 9800" P/N 03-00356-002 are included in the "9220 to 97/9800 40VDC Kit P/N 98-00189-002 which comes with the 9220 Formatter.

1.3 INTERFACE DESCRIPTION

The KENNEDY 9220 Formatter board features the same data and control interface hardware from KENNEDY Tape Drive models 9000, 9100, 9300, 9700, and 9800 to the Host/Controller.

All inputs and outputs require twisted pair or ribbon cables with alternate ground wires. The maximum length of the Host Controller to Formatter cables is 20 feet.

Line driver and receiver circuits are in Figure 1-1. Table 1-2 lists Formatter input/output signals; Table 1-3 shows the combination of Host/Controller Command Lines activated to produce a command for the 9220 Formatter. Connector pin assignments and cross reference to a 100 pin edge connector are provided in Tables 1-4 and 1-5.

Two DIP switches on the 9220 Formatter board set the data transfer speed. Any two of seven speeds may be selected in a single multidrive phase encoded (PE) formatter daisy chain system; any four of seven speeds are available in NRZI. Switch settings to select the data transfer speed are given in Table 1-6 and Figure 1-2. VCO filters (PLO components) for single speed PE Tape Drives are given in Table 1-7. Write and read interface timing diagrams are shown in Figures 1-4 and 1-5.

1.3.1 INTERFACE SIGNAL CHARACTERISTICS

Signals from the Host controller/coupler to the 9220 Formatter must conform to the following specification:

Levels: Low = True = OV
High = False = +3V (approx.)

Pulses: Low = True = OV
High = False = +3V (approx.)
Minimum Pulse Width: 1.0 microsecond

Timing: Maximum signal propagation delay is 200 nanoseconds. This limits ribbon cable length from the Formatter to the last Drive on a daisy chain to 20 feet (6 m.) for any Host interface.

Drivers: All output signals from the Model 9220 Formatter are driven by open collector type line drivers capable of sinking up to 36 mA (25 standard unit loads) in the low true state (Figure 1-1).

Open Circuit: An open line will result in false signal levels.

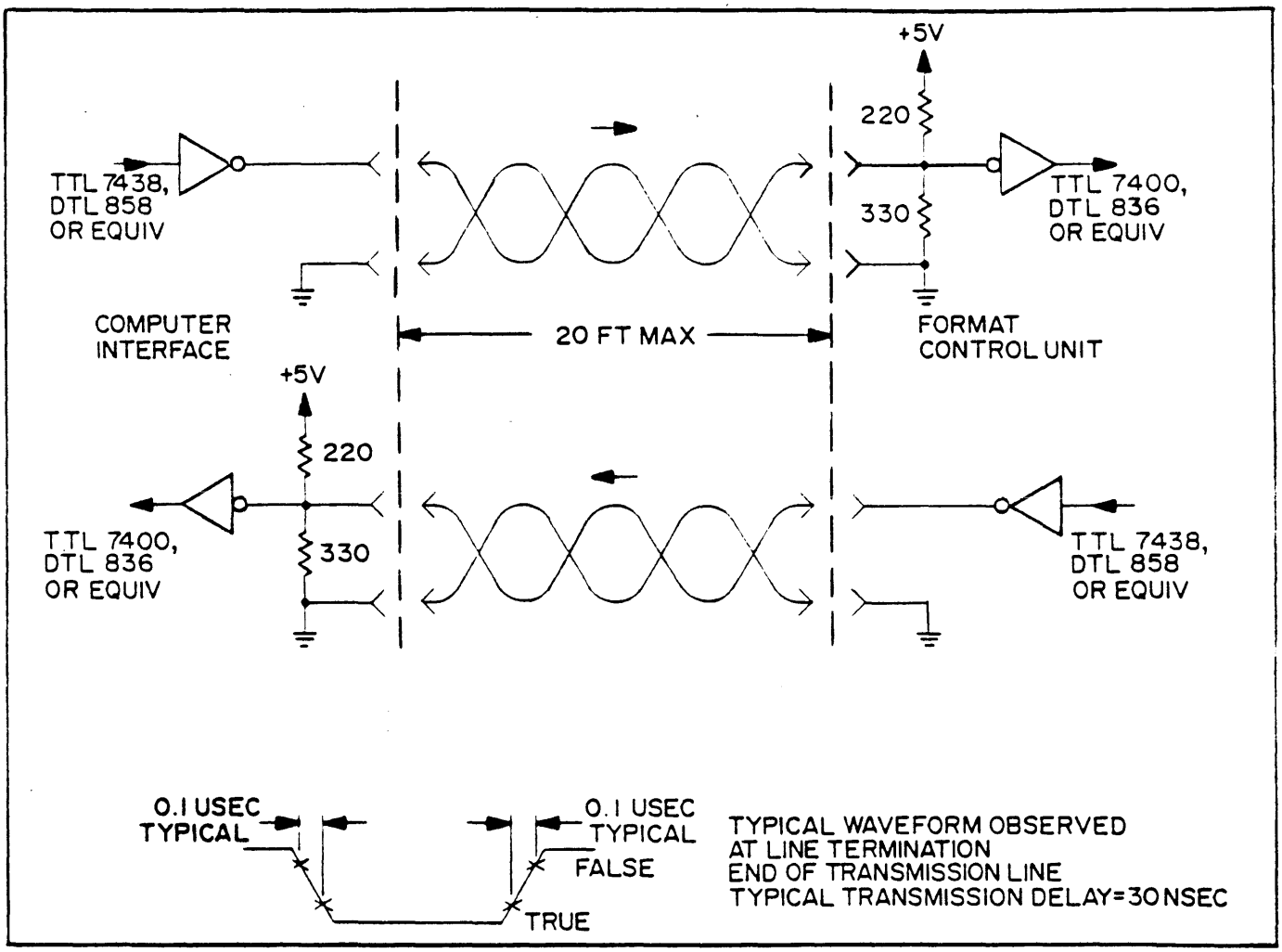


Figure 1-1
Typical Line Driver and Receiver Circuit Interface

TABLE 1-2 FORMATTER INPUT/OUTPUT SIGNALS

Signal	Mnemonic	Level or Pulse
Interface Inputs		
(Controller to Formatter)		
Formatter Address	FAD	L
Transport Address	TAD0,TAD1	L
Initiate Command	GO	P
Reverse/Forward	REV	L
Write/Read	WRT	L
Write File Mark	WFM	L
Edit	EDIT	L
Erase	ERASE	L
Rewind	REW	P
Density Select	DEN	L
Offline Command	OFL	P
Last Word	LWD	L
Formatter Enable	FEN	L
Write Data Lines	WP, W0-W7	L
Interface Outputs		
(Formatter to Controller)		
Formatter Busy	FBY	L
Data Busy	DBY	L
Hard Error	HER	P
Check Character Gate	CCG	L
Identification	IDENT	L
Corrected Error	CER	P
File Mark	FMK	P
Write Strobe	WSTR	P
Read Strobe	RSTR	P
Read Data Lines	RP, R0-R7	L
Ready	RDY	L
Rewinding	RWD	L
Load Point	LDP	L
Online	ONL	L
File Protect	FPT	L
End of Tape	EOT	L
NRZI/PE	NRZI/PE	L

1.3.2 INTERFACE INPUT SIGNALS (CONTROLLER TO FORMATTER)

An I/O signal list is provided in Table 1-2. The following paragraphs describe each 9220 Formatter interface input signal required from the Host Controller by first introducing:

1. The signal name.
2. The mnemonic designation.
3. The active pin designation for the input signal line.
4. The connector.

1.3.2.1 FORMATTER ADDRESS FAD Level B48

FAD selects one of two Formatters: FAD false selects formatter address 0; FAD true selects formatter address 1. The Formatter performs operations only when it is selected. FAD is not latched on GO pulse. An address switch on the Formatter PCBA determines the Formatter Address.

1.3.2.2 TAPE DRIVE ADDRESS

TAD0, TAD1 Levels J5-46; J1-46

The Formatter selects one Transport from a maximum of four Drives via the Transport Address (Select Transport: SLT) command lines. Drive addresses are latched by the Formatter on GO pulse.

TAD0	TAD1	ADDRESS
0	0	SLT0
0	1	SLT1
1	0	SLT2
1	1	SLT3

1.3.2.3 INITIATE COMMAND

GO Pulse J5-8

This pulse initiates the Command Lines of Table 1-3. The Host/Controller sends the Command Line signals to the Formatter on the trailing edge of the GO pulse. The Formatter Busy (FBY) output is set true when the GO pulse is given at the time that both the Formatter and the selected Drive are ready to receive the Command Line signals.

1.3.2.4 COMMAND LINES

The Command Lines of Table 1-3 produce the Commands described in paragraphs 1.3.2.4.1 to 1.3.2.4.6. Information on the Command Lines is issued to the Formatter on the trailing edge of the GO pulse (1.3.2.3 Intiate Command). The Reverse (REV), Write (WRT), Write File Mark (WFM), EDIT, ERASE and Density Select (DEN) levels must be held steady from 0.5 microsecond before the trailing edge of the GO pulse to 0.5 microsecond after.

1.3.2.4.1 REVERSE

REV Level J5-18

REV true initiates reverse tape motion; when false, it specifies forward motion.

1.3.2.4.2 WRITE

WRT Level J5-34

This level is true to specify Write mode, and false for Read mode.

1.3.2.4.3 WRITE FILE MARK

WFM Level J5-42

When WFM and WRT are true, the Formatter will write a file mark on the tape.

TABLE 1-3 COMMAND LINES

NOTE: Command lines must be stable 0.5 msec. before and after GO trailing edge.

COMMAND (X = Asserted)	COMMAND LINES Rev/Fwd	WRT/Red	WFM	Edit	Erase
Read Forward					
Read Reverse	X				
Read Reverse (Edit)	X			X	
Write		X			
Write (Edit)	X		X		
Write File Mark		X	X		
Erase (Variable)		X			X
Erase (Fixed)		X	X		X
Space Fwd Block					X
Space Rev Block	X				X
Space Fwd File			X		X
Space Fwd File (with Strobe: w/STB)				X	
Space Rev File	X		X		X
Space Rev File (w/STB)	X		X		

1.3.2.4.4 EDIT

EDIT Level J5-38

EDIT true and REV true modify the read reverse stop delay to optimize head positioning for a subsequent edit operation. When EDIT is true and WRT is true, the Overwrite (OVW) line is activated and the selected Drive operates in the edit mode.

1.3.2.4.5 ERASE

ERASE Level J5-40

ERASE true and WRT true cause the Formatter to execute a dummy write command. The Formatter issues a normal write command which records no data, but erases a length of tape (Last Word, LWD, defines the length of tape to be erased). When ERASE, WRT/READ and the WFM command lines are true, approximately 3.75 inches (9.52 cm) of tape will be erased.

1.3.2.4.6 DENSITY SELECT

DEN Level J1-50

This optional level selects the lower of two possible data transfer storage densitites when true, and the higher density when false. This line is not latched by the Formatter on GO pulse. DEN is to be used only with the Tape Drive in remote density select. Formatter density will be slaved off Drive status.

1.3.2.5 REWIND

REW Pulse J5-20

The REW pulse causes the Drive to rewind the tape to load point. This pulse is directly routed to the Drive, which avoids the Formatter from going busy.

1.3.2.6 OFFLINE COMMAND

OFL Pulse J1-24

This pulse causes the Tape Transport to go offline without causing the Formatter to go busy.

1.3.2.7 LAST WORD

LWD Level J5-4

During a Write or Erase command, LWD true indicates that the next character to be strobed into the Formatter is the last data character of the record and that this character is on the interface lines.

1.3.2.8 FORMATTER ENABLE

FEN Level J1-18

Formatters revert to the quiescent state for FEN false. FEN disables the Formatters if the Controller looses power or it clears Formatter logic if illegal commands or unusual conditions occur.

1.3.2.9 WRITE DATA PARITY & WRITE DATA LINES

WP,W0-W7 Level (see pin list)

The following paragraphs define these command lines for both NRZI and PE Formatters:

1. THE NRZI FORMATTER

These 9 lines transmit write data from the Controller to the Formatter. Lines WP, W0-W7 are for 9-channel operation. The 8 data bits on W0-W7 are written onto the tape channels 0-7, respectively. W7 corresponds to the least significant bit of the character. The line Write Parity (WP) has an option to write the parity bit specified by the customer, else the Formatter generates odd parity internally on the basis of data on W0-W7.

The first character of a record is available on these lines within one character period after Data Busy (DBY, 1.3.3.2) goes true and remains true until the trailing edge of the first Write Strobe (WSTR, 1.3.3.9.1) is issued by the Formatter. The next character of information must then be placed on these lines within one-half of a character period.

Subsequent characters of a record are processed in this manner until Last Word (LWD; see above) is set true by the Controller when the last character is transmitted.

2. THE PE FORMATTER

The 8 write data lines (9 in the case of external parity option) transmit write data from the Controller to the Formatter. W0 corresponds to the most significant bit of each character, and W7 to the least significant bit.

The first character of a record is available on these lines less than 40 character periods after Data Busy (DBY, 1.3.3.2) goes true and remains until the trailing edge of the first Write Strobe (WSTR, 1.3.3.9.1) is issued by the Formatter. The next character of information is placed on these lines within one-half of a character period.

Subsequent characters of a record are processed in this manner until Last Word (LWD; see above) is set true by the Controller after the last character is transmitted.

1.3.3 INTERFACE OUTPUTS SIGNALS (FORMATTER TO CONTROLLER)

Pin J1-16 (together with ground pin J1-15) outputs the Check Character Gate (CCG) for NRZI mode and Identification (IDENT) for PE mode. The Controller must allow for this signal when combination NRZI/PE formatting is used. All pulse widths are 1 microsecond wide (minimum).

1.3.3.1 FORMATTER BUSY

FBY Level J5-2

FBY goes true on the trailing edge of GO when a command is issued by the Host/Controller; FBY will remain true until tape motion ceases.

1.3.3.2 DATA BUSY

DBY Level J1-38

This level goes true when the tape is up to speed and has traversed the Inter-Block Gap (IBG) and the Formatter is about to write data or look for a read signal on the tape. DBY remains true until both data transfer and the appropriate post record delay are completed. DBY goes false when the capstan starts to decelerate the tape. New commands may be issued 0.5 microsecond after DBY goes false.

1.3.3.3 HARD ERROR (NRZI Mode)

HER Pulse J1-12

When true, this pulse indicates one or more of the following read errors:

1. Longitudinal parity error
2. Improper record format
3. Cyclic Redundancy Check Character (CRCC) parity error
4. Vertical Redundancy Check (VRC) parity error on a data character

In all cases above, except for the vertical parity error on a data character, HER is pulsed after the record has been completely read. For a vertical parity error, the HER line is pulsed when a Read Strobe (RSTR) pulse is issued for the character in error. DBY goes false after all error information has been transferred to the Controller.

1.3.3.4 CORRECTED ERROR (PE Mode only)

CER Pulse J1-42

A single track dropout sets CER true; consequently, Formatter performs error correction.

1.3.3.5 HARD ERROR (PE Mode)

HER Pulse J1-12

When the HER pulse is true, an uncorrectable read error has occurred and the record should either be reread or rewritten. Here is a table illustrating the possible HER/CER signal combinations with their meaning:

HER	CER	(HER/CER are valid during RDS)
0	0	= No Error Detected
0	1	= Single Channel Error
1	0	= Postamble Vertical Redundancy Check (VRC) Error or Multiple Channel Errors
1	1	= Excessive Skew or: Single Channel Failure with Postamble VRC Error

1.3.3.6 CHECK CHARACTER GATE (NRZI)

CCG Level J1-16

This level is set true by the NRZI Formatter when the read information to the Controller is a Cyclic Redundancy Check Character (CRCC) or a Longitudinal Redundancy Check Character (LRCC). When these data characters are transmitted, CCG goes false. Data and check information can be distinguished by gating Read Strobe (RSTR) or its inverse with CCG false. After leaving load point, J1-16 functions only when the NRZ/PE status indicates NRZI mode.

1.3.3.7 IDENTIFICATION (PE Mode)

IDENT Level J1-16

When IDENT true identifies PE tapes, switch to PE mode since the Drive is in NRZI. PE tapes are detectable in the read forward mode from load point by the presence of an idenfitication burst on the parity channel.

1.3.3.8 FILE MARK

FMK Pulse J1-14

File mark line is pulsed after a complete file mark record has been read during a read operation, or during a write File Mark operation in a read-after-write Drive. Error conditions should be ignored when a File Mark is detected.

1.3.3.9 TRANSPORT STATUS AND CONFIGURATION LINES

The status and configuration lines, after they are gated with the Formatter Address signal (FAD), send information on the selected Transport to the Controller.

The low true Transport Status Lines are:
READY (RDY), ONLINE (ONL), REWINDING (RWD), FILE PROTECT (FPT), LOAD POINT (LP) AND END OF TAPE (EOT).

Refer to the pin list for location of the transport configuration lines (Table 1-5):
NRZI false/PE true (NRZI/PE), 7TRACK false/9TRACK true (7TK/9TK) and LOW/HI (SPEED).

1.3.3.9.1 WRITE STROBE

WSTR Pulse J1-36

Each time a data character is written onto tape, this line pulses. WSTR samples the write data lines WP, W0-W7 from the Controller and copies the write data character-by-character into the Formatter. The first character is available prior to the first Write Strobe pulse and the succeeding characters are set up within half of a character period after the trailing edge of each Write Strobe pulse. The Write Strobe is active during variable length erase commands and copies data into the Formatter, but this data has no meaning.

1.3.3.9.2 READ STROBE

RSTR Pulse J1-34

This line pulses once for each character of read information sent to the Controller. These signals sample the read data lines RDP, RD0-RD7.

In NRZI Formatters, the transmission of CRC and LRC data characters will be flagged by the Check Character Gate (CCG) signal as described under 1.3.3.3 HARD ERROR (HER).

1.3.3.9.3 READ DATA LINES

RP, R0-R7 Levels (see pin list)

In the NRZI Formatter, RP and R0-R7 are utilized for 9-channel operation; in PE Formatters the 9 PE channels are assigned to RP, R0-R7.

Each character is read from tape by parallel sampling the read lines with Read Strobe. The data remains on the read data lines for a full character period. The corresponding RSTR pulse is timed to occur after approximately the center of the character period.

TABLE 1-4
FORMATTER INTERFACE PIN LIST/CROSS REFERENCE TO 100 PIN CONNECTOR (J101)

J5 (A Connector) Sig	Gnd	Signal Name	Mnemonic	In/Out	9220 J101 Sig Gnd
2	1	Formatter Busy	FBY	Out	B22/B23
4	3	Last Word	LWD	In	B13/B14
6	5	Write Data 4	W4	In	B19/B20
8	7	Initiate Command	GO	In	A3/A2
10	9	Write Data 0	W0	In	B16/B17
12	11	Write Data 1	W1	In	A16/A17
14	13	Single	SGL	Out	A33/A32
16	15	+5v	+5V	Out	A48, 49, 50
18	17	Reverse/Forward	REV	In	B4/B5
20	19	Rewind	REW	In	B12/B11
22	21	Write Data Parity	WP	In	A15/A14
24	23	Write Data 7	W7	In	A21/A20
26	25	Write Data 3	W3	In	A18/A17
28	27	Write Data 6	W6	In	B21/B20
30	29	Write Data 2	W2	In	B18/B17
32	31	Write Data 5	W5	In	A19/A20
34	33	Write/Read	WRT	In	A4/A5
36	35	Read Threshold Level 2 (not used)	THR2	In	B9/B8
38	37	Edit	EDIT	In	A6/A5
40	39	Erase	ERASE	In	B7/B8
42	41	Write File Mark	WFM	In	B6/B5
44	43	Read Threshold Level 1 (not used)	THR1	In	A7/A8
46	45	Transport Address 0	TAD0	In	A1/A2
48	47	Read Data 2	R2	Out	B39/B38
50	49	Read Data 3	R3	Out	A39/A38

J1 (B Connector) Sig	Gnd	Signal Name	Mnemonic	In/Out	9220 J101 Sig Gnd
1	5	Read Data Parity	RP	Out	A36/A35
2	5	Read Data 0	R0	Out	B37/B38
3	5	Read Data 1	R1	Out	A37/A38
4	5	Load Point	LDP	Out	B30/B29
6	5	Read Data 4	R4	Out	B40/B41
8	7	Read Data 7	R7	Out	A42/A41
10	9	Read Data 6	R6	Out	B42/B41
12	11	Hard Error	HER	Out	A24/A23
14	13	File Mark	FMK	Out	A25/A26
16	15	Check Character Gate/Identification	CCG/IDENT	Out	B24/B23
18	17	Formatter Enable	FEN	In	A13/A14
20	19	Read Data 5	R5	Out	A40/A41
22	21	End of Tape	EOT	Out	A30/A29
24	23	Off Line Command	OFL	In	A12/A11
26	25	NRZI	NRZ	Out	A31/A32
28	27	Ready	RDY	Out	B27/B26
30	29	Rewinding	RWD	Out	B28/B29
32	31	File Protect	FPT	Out	A28/A29
34	33	Read Strobe	RSTR	Out	B36/B35
36	35	Write Strobe	WSTR	Out	A34/A35
38	37	Data Busy	DBY	Out	A22/A23
40	39	Speed	SPEED	Out	B34/B35
42	41	Corrected Error	CER	Out	B25/B26
44	43	Online	ONL	Out	A27/A26
46	45	Transport Address 1	TAD1	In	B3/B2
48	47	Formatter Address	FAD	In	B1/B2
50	49	Density Select	DEN	In	A9/A8

TABLE 1-5
I/O CORRELATION CHART OF 100 PIN EDGE CONNECTOR TO FORMATTER

9220 J101 Sig Gnd	Signal Name	Mnemonic	In Out	Embedded Formatter Sig Gnd
A1/A2	Transport Address 0	TAD0	In	A46/A45
A3/A2	Initiate Command	GO	In	A8/A7
A4/A5	Write/Read	WRT	In	A34/A33
A6/A5	Edit	EDIT	In	A38/A37
A7/A8	Read Threshold Level 1 (not used)			A44/A43
A9/A8	Density Selection (see notes)	DEN	In	B50/B49
A10	No Connection			
A12/A11	Offline Command	OFL	In	B24/B23
A13/A14	Formatter Enable	FEN	In	B18/B17
A15/A14	Write Data Parity	WP	In	A22/A21
A16/A17	Write Data 1	W1	In	A12/A11
A18/A17	Write Data 3	W3	In	A26/A25
A19/A20	Write Data 5	W5	In	A32/A31
A21/A20	Write Data 7	W7	In	A24/A23
A22/A23	Data Busy	DBY	Out	B38/B37
A24/A23	Hard Error	HER	Out	B12/B11
A25/A26	File Mark	FMK	Out	B14/B13
A27/A26	Online	ONL	Out	B44/B43
A28/A29	File Protect	FPT	Out	B32/B31
A30/A29	End of Tape	EOT	Out	B22/B21
A31/A32	$\overline{\text{NRZI}}$/PE	$\overline{\text{NRZI}}$/PE	Out	B26/B25
A33/A32	Single (not used)	SGL	Out	A14/A13
A34/A35	Write Strobe	WRST	Out	B36/B35
A36/A35	Read Data Channel P	RP	Out	B1/B5
A37/A38	Read Data Channel 1	R1	Out	B3/B5
A39/A38	Read Data Channel 3	R3	Out	A50/A49
A40/A41	Read Data Channel 5	R5	Out	B20/B19
A42/A41	Read Data Channel 7	R7	Out	B8/B7
A43/A47	No Connection			
A48, 49, 50	+5 vdc	+5	Out	A16
B1/B2	Formatter Address	FAD	In	B48/B47
B3/B2	Transport Address 1	TAD1	In	B46/B45
B4/B5	Reverse/Forward	REV	In	A18/A17
B6/B5	Write File Mark	WFM	In	A42/A41
B7/B8	Erase	ERASE	In	A40/A39
B9/B8	Read Threshold Level 2 (not used)	THR2	In	A36/A35
B10/B11	Parity Select (see notes)	PAR	In	(not used)
B12/B11	Rewind	REW	In	A20/A19
B13/B14	Last Word	LWD	In	A4/A3
B16/B17	Write Data 0	W0	In	A10/A9
B18/B17	Write Data 2	W2	In	A30/A29
B19/B20	Write Data 4	W4	In	A6/A5
B21/B20	Write Data 6	W6	In	A28/A27
B22/B23	Formatter Busy	FBY	Out	A2/A1
B24/B23	Check Character Gate (see notes)	CCG	Out	B16/B15
B24/B23	Identification (see notes)	IDENT	Out	B16/B15
B25/B26	Corrected Error	CER	Out	B42/B41
B27/B26	Ready	RDY	Out	B28/B27
B28/B29	Rewinding	RWD	Out	B30/B29
B30/B29	Load Point	LDP	Out	B4/B5
B33/B32	$\overline{\text{7 Track}}$/9 Track	$\overline{\text{7TRK}}$/9TRK	Out	(not used)
B34/B35	Low/Hi Tape Speed (not used)	SPEED	Out	B40/B39
B36/B35	Read Strobe	RSTR	Out	B34/B33
B37/B38	Read Data 0	R0	Out	B2/B5
B39/B38	Read Data 2	R2	Out	A48/A47
B40/B41	Read Data 4	R4	Out	B6/B5
B42/B41	Read Data 6	R6	Out	B10/B9
B43/B47	No Connection			
B48, 49, 50	Ground			

Notes: Density Selection (DEN) and Parity Selection (PAR) Check for 9220 Formatter NRZI mode only. Check Character Gate (CCG) for 9220 Formatter NRZI mode; Identification (IDENT) is used in PE mode.

1.3.4 SPEED SELECTION

1.3.4.1 INTRODUCTION

A single Formatter can control a maximum of four tape drives, each drive operating at any one of seven speeds from 12.5 to 125 ips in NRZI Mode. In PE mode, this group of four drives may only operate in any two speeds.

Two DIP switches, U35 and U74 (Figure 1-2), set the formatter write clock frequency to match the speed (which establishes the read/write transfer rate of bytes) for each of the four Drives. In addition, during PE operation, the DIP switch settings allow the Formatter to distinguish between the faster and slower drives.

1.3.4.2 DIP SWITCH SETTINGS FOR PE AND NRZI MODES

Refer to Figure 1-2 for the layout of DIP switches U35 and U74. DIP switch section U74-4 controls Dual Speed PE for Drive #0; set U74-4 ON if Drive #0 is one of the higher speed Drives (with respect to other Drives using the same 9220 Formatter), and OFF if it is a slower Drive. DIP switch sections U74-8, U35-4, and U35-8 for Drive #1, Drive #2 and Drive #3, respectively, function identically to U74-4.

In NRZI Mode or with Single Speed PE the setting of U35-4, U35-8, U74-4 and U78-8 are not used.

The remaining sections of U35 and U74 are set to the drive speed (the switches actually match the formatter clock to the speed of the Drive) for both Single Speed PE and Dual Speed tape drives. DIP switch sections U74-1, U74-2, and U74-3 must match the speed of Drive #0 per Table 1-6. Sections U74-5 though U74-7 work similarly to U74-1 through U74-3 for Drive #1; sections U35-1 though U35-4 for Drive #2; sections U35-5 through U35-8 for Drive #3.

1.3.4.3 PE MODE HEADER CONFIGURATIONS

A Formatter built for Single Speed PE Mode (in addition to using the settings of U74 and U35) has two headers: header U96 contains steering jumpers and header U97 has soldered on PLO components for different speeds per Table 1-7: Single Speed Versions. A Formatter for two PE speeds has CD4053 analog switch U96 for steering and PLO components on header U97 per Table 1-7: Dual Speed Versions.

The component values of the PE speed selection header U97 must accommodate the speed of the respective Drive. The factory initially installs header U97 for the customer with the appropriate speed version. A customer may upgrade the Drive that uses a single speed Formatter to one that uses dual speed by changing the speed DIP switch setting on the Drive, and installing analog switch U96 and the correct version of header U97 on the Formatter. To order U97 from KENNEDY CO., use the part number 190-5445-XXX for U97 and the 3 digit dash number (-XXX) corresponding to two speed settings per Table 1-7.

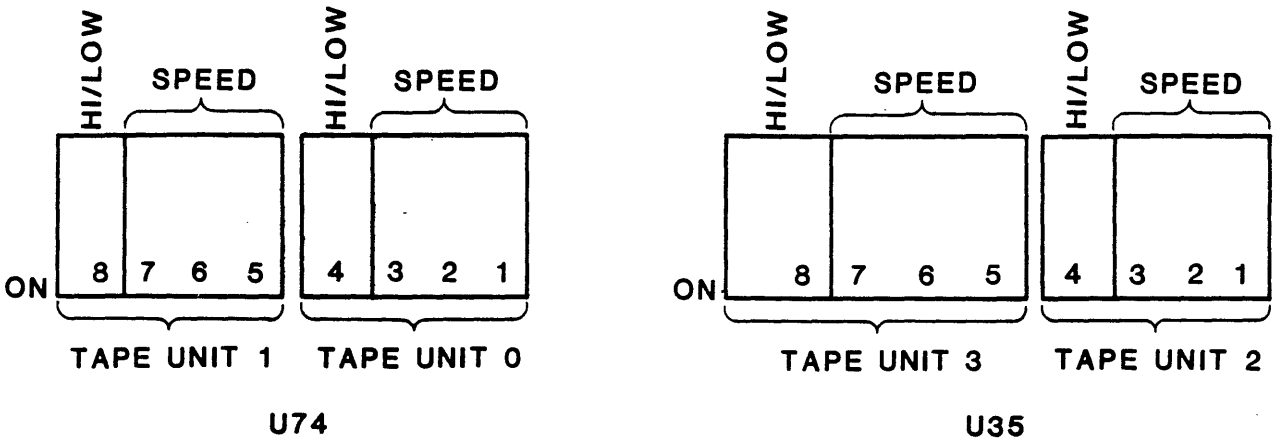


Figure 1-2, Dip Switch Layout (used in Single and Dual Speed PE)

TABLE 1-6 SPEED SELECTION SWITCHES

SPEED ips	U35/U74 SWITCH SETTINGS					
	SW3 (4)*	SW2 (2)	SW1 (1)	SW5 (4)	SW6 (2)	SW7 (1)
12.5	OFF	OFF	ON	OFF	OFF	ON
18.75	OFF	ON	OFF	OFF	ON	OFF
25	OFF	ON	ON	OFF	ON	ON
37.5	ON	OFF	OFF	ON	OFF	OFF
45	ON	OFF	ON	ON	OFF	ON
75	ON	ON	OFF	ON	ON	OFF
125	ON	ON	ON	ON	ON	ON

*Numbers in parenthesis represent the binary weight of the switch position.

TABLE 1-7 PE MODE HEADER CONFIGURATIONS

A. Single Speed Versions (Low Speed Only: C3, C5 and R9 Not Used)

Dash No.	-011	-033	-044	-055	-066	-077	-088
Speed (ips)	12.5	18.75	25	37.5	45	75	125
C4 (uF)	.47	.33	.33	.33	.15	.068	.047
C6 (pF)	1500	820	680	430	390	220	150
R10 (Ohms)	270	150	150	150	270	560	820

B. Dual Speed Versions

		HIGH SPEEDS					
Speed (ips) **C3/C4 (uF)** **C5/C6 (pF)** **R9/R10 (Ohms)**		18.75 C3=.33 C5-820 R9-150	25 C3=.33 C5-680 R9-150	37.5 C3=.33 C5-430 R9-150	45 C3=.15 C5-390 R9-270	75 C3=.068 C5-220 R9-560	125 C3=.047 C5-150 R9-820
LOW SPEEDS	12.5 C4=.47 C6=* R10=270	*680 **-031**	*820 **-041**	*1000 **-051**	*1000 **-061**	*1200 **-071**	*1200 **-081**
	18.75 C4=.33 C6=* R10=150	see **-033** single speed	*150 **-043**	*390 **-053**	*430 **-063**	*620 **-073**	*680 **-083**
	25 C4=.33 C6=* R10=150	not used	see **-044** single speed	*240 **-054**	*270 **-064**	*470 **-074**	*560 **-084**
	37.5 C4=.33 C6=* R10=270	not used	not used	see **-055** single	*39 **-065**	*220 **-075**	*270 **-085**
	45 C4=.15 C6=* R10=270	not used	not used	not used	see **-066** single speed	*180 **-076**	*150 **-086**
	75 C4=.068 C6=* R10=560	not used	not used	not used	not used	see **-077** single speed	*68 **-087**

U97 =Header P/N 90-05445-xxx (fully assembled); Dash No. (-xxx) is underlined above.
U96 =Analog Switch CD4053 P/N 49-00179-001 for PE only.

P/N 21-00153-001
14-pin dip component
Header Unassembled

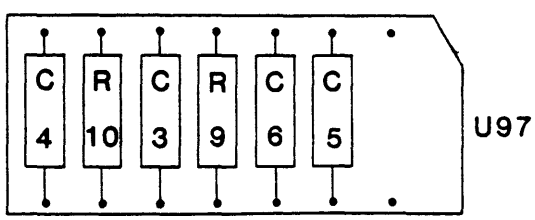


Figure 1-3 Speed Selection Header

1.3.5 MODES OF OPERATIONS

The timing for an operational Drive is described in succeeding paragraphs. Commands during Tape Drive operations are issued at the drop of DBY. For full start/stop mode operation, the Host/Controller waits for FBY to drop before issuing a new command. Reverse motion commands are accepted while the Drive is busy and executed at the drop of FBY.

1.3.5.1 READ OPERATIONS (refer to Figure 1-4 for Read timing)

1.3.5.1.1 READ ONE BLOCK

Select a Formatter and a Transport by setting appropriate FAD, TAD0, TAD1 with FEN true. During read operations, monitor HER, as well as the status lines. Monitor CCG/IDENT from load point during the read mode. If IDENT is true from load point, the tape was recorded in PE mode. Compare IDENT with NRZ to ensure that the Tape Drive is set at the appropriate density. If the Drive is in NRZI mode, CCG true indicates that check characters, not data, are being transferred with RDS.

Refer to the timing diagrams in Figure 1-4 for the following sequence of commands to (from the Host/Controller) and responses from the Formatter during a read operation.

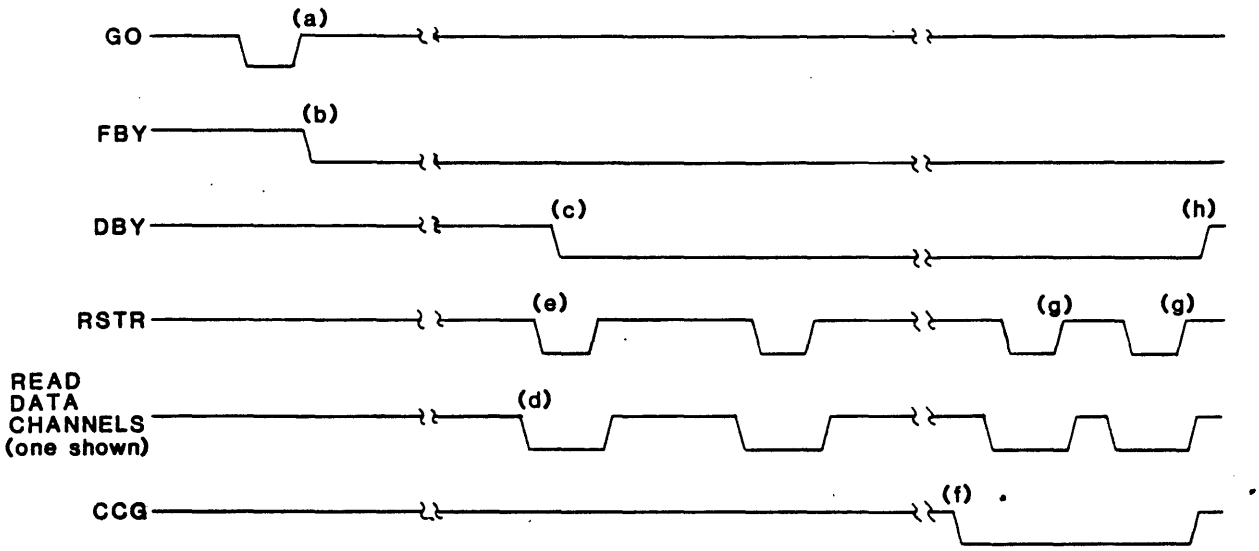
a. With the Tape Drive selected and online at Load Point (LP), Host/Controller sets all command lines false (read one block) and
b. Issues initiate command (GO pulse).
c. The Formatter responds with FBY true and,
d. After the prerecord delay, with DBY true.
e. The Formatter checks status and configuration (Online, ONL; Ready, RDY; NRZ and IDENT).
f. If the status is OK, then the Drive reads the data with RDS.
g. At the end of the record, DBY goes false.
h. The Controller **may** issue a new command at DBY false. If no new command is received, the Drive stops and
i. FBY goes false.

1.3.5.1.2 READ ERROR RECOVERY

If a HER occurs during read operation, then error recovery is attempted at the drop of DBY or FBY. The following sequence of commands from the Host/Controller and responses from the Formatter rereads a record in error. The Controller:

a. Sets Rev/Fwd True;
b. Issues initiate command (GO pulse).
c. FBY goes true.
d. DBY goes true after a delay.
e. The Controller may reissue the Read One Block command (see this sequence above) when DBY goes false, but it is not executed until FBY drops.

NOTE: After three retrys, all available automatic clipping levels have been tried. More attempts may be made or the record may be flagged as a non-recoverable error.



a. Read One Block command is accepted.
b. FBY is set true.
c. DBY is set true after the prerecorded delay.
d. Read data true.
e. Read data is clocked on RSTR pulse.
f. At end of data, CCG is true.
g. CRCC and LRCC bytes are read with RSTR pulse.
h. DBY goes false.

NOTE: For PE operation omit (g) and (h) as there is no CRCC or LRCC in PE format.

Figure 1-4 Read Sequence Timing

1.3.5.1.3 READ FILE MARK

File marks which are detected in read one block operations are flagged by FMK. If FMK is true at end of record, error status is ignored.

1.3.5.1.4 FILE SEARCH OPERATION

There are two Forward and two Reverse file search modes (Table 1-3). The following sequence is for file search operations:

a. The Controller sets desired search command and

b. Issues GO pulse.

c. FBY goes true.

d. DBY moves to true after a delay.

e. The Formatter detects a File Mark; File Mark flag (FMK) is set true and is sent to the Controller.

f. Errors for FMK record are ignored if any occur.

g. DBY returns to false.

h. The Controller may issue a new command at the drop of DBY, but

i. FBY goes false if it does not issue a command.

NOTE: If file search with strobe is used, RSTR is active for all records read.

1.3.5.1.5 PE READ REVERSE

This command is executed in PE to allow reverse read of a record. It is executed in the same manner as a read command, but with Reverse set true.

1.3.5.2 WRITE OPERATIONS (Refer to Figure 1-5 for Write T ming)

1.3.5.2.1 WRITE ONE BLOCK OPERATION

The sequence listed below is for NRZI only and assumes proper FAD, FEN, TAD0, TAD1, ONLINE and READY status. If initiated from load point, the Host/Controller performs BOT and GAP, and the IDENT burst (for PE only) which must be written first and performed automatically. The following sequence is for NRZI (Figure 1-5); for PE operation, see note after this sequence. The Host/Controller:

a. Sets WRT true;

b. Initiates command by issuing GO pulse.

c. FBY goes true.

d. After prerecorded delay, DBY goes true.

e. The Formatter issues WSTR at one character period after DBY goes true (the first byte must be on data lines within one half character time of DBY true).

f. The Controller may change the Data on the trailing edge of WSTR (Data must be changed at least one half character time before WSTR).

g. Last word (LWD) is set true coincident with last byte to be written.

h. The Formatter automatically writes the proper CRCC and LRCC.

j. Raw Error checking is completed.

k. Record is terminated; DBY returns to false.

l. The Controller may issue a new command at the drop of DBY.

m. If no new command is issued, the Transport stops; FBY goes false.

NOTE: In PE operation, WSTR is delayed 40 character times after DBY. IDENT goes true on start from LP. HER and CER should be monitored throughout the record. Refer to 1.3.3.4 CER and 1.3.3.5 HER in the PE mode for CER/HER meanings.

1.3.5.2.2 WRITE FILE MARK OPERATION

Follow the same sequence as in 1.3.5.2.1, with the addition of WFM and WRT true. A file mark will automatically be written. No WSTR will be issued. File Mark flag will go true on read-after-write of File Mark.

1.3.5.2.3 WRITE ERROR RECOVERY

When a write error occurs, it is recommended either to rewrite or to erase the record. Since write errors may be caused by dust on the head, attempt to rewrite the record. If a write error is repeated, the tape may be causing the error; erase and write the record again on an area "down tape."

To handle write errors, follow the the recommended commands listed below:

a. On detection of a write error and at the drop of FBY, set Space Reverse Block command.

b. The Controller issues GO pulse. Space Reverse Block command is executed; FBY goes true.

c. At the drop of FBY, set WRT command.

d. Continue as in sequence for Write One Block in paragraph 1.3.5.2.1.

If the error recurs, then assume the tape is defective and erase the tape area where write attempts had been made, and write the record again by the following procedure:

a. On detection of a write error and at drop of FBY, set Space Reverse Block command.

b. The Controller issues GO to initiate command.

c. FBY goes true.

d. At drop of FBY, set Erase Variable command.

e. The Controller issues GO.

f. Set Last Word (LWD) at a number of bytes in excess of the length of the record to be erased. The sequence for setting LWD is the same as for Write One Block in 1.3.5.2.1.

Alternatively, if the record length is less than 4 Kbytes, an erase fixed length command may be issued. In this case, approximately 3.75 inches of tape will be erased and it is not necessary to use LWD in the sequence above. A new command may be issued with GO pulse at drop of DBY.

1.3.5.2.4 WRITE EDIT OPERATION

To update a record on an existing tape, follow the Write Edit operation:

a. Read the tape until the desired record is found.

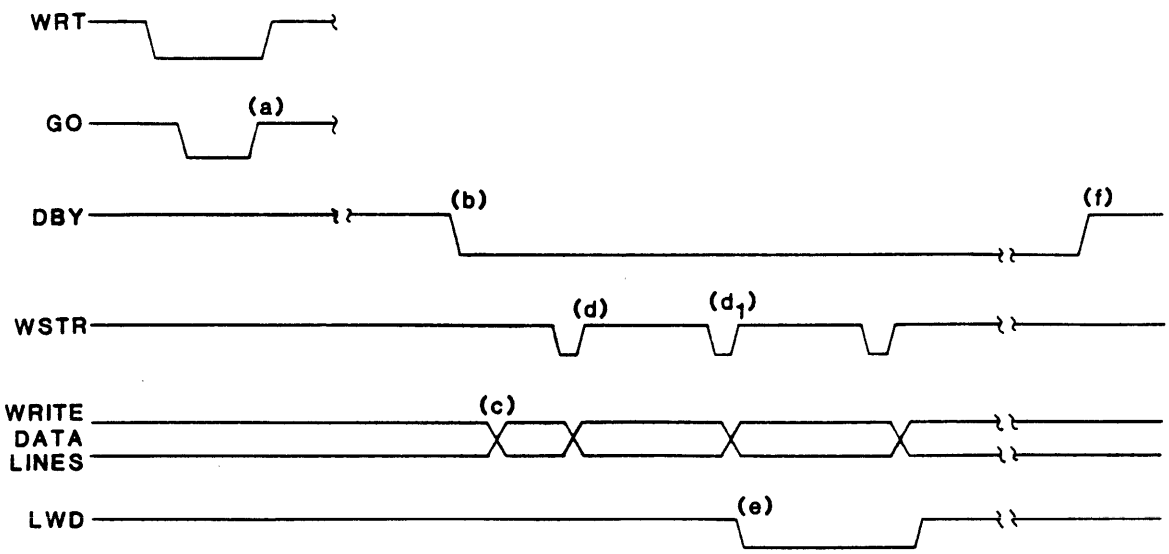
b. Read forward one additional record.

c. Read reverse.

d. Read reverse edit.

e. Write edit.

The updated record must be the same length as the original record; avoid editing the same record more than three times.



a. Command is executed on the trailing edge of GO.
b. After the prerecorded delay, DBY is set true.
c. Write data is true at least one half character time before WSTR (b to d = d to d_1).
d. Write Strobe (WSTR) writes data.
e. Last Word (LWD) is set true coincident with the last byte to terminate the record.
f. After post record delay, DBY goes false.

Figure 1-5 Write Sequence Timing

SECTION II

INSTALLATION INSTRUCTIONS

2.0 INTRODUCTION

Section II provides instructions for installing the 9220 Formatter into the Models 9000, 9100, 9300, 9700 and 9800 Tape Drives as single drive systems and as daisy chained systems. Installation instructions include control and data interface cabling; and Power Supply cabling for the latest 9000, 9700 and 9800 only. Instructions for connecting the Formatter Power Supply to Models 9100 and 9300 Drives are included in Formatter package. Consult KENNEDY Customer Service for assembly and cabling instructions not covered in this manual.

With a Formatter installed, the overall dimensions of the Drive is larger than without the Formatter. Drives Dimensions with an embedded 9220 Formatter are illustrated in Figures 2-25 to 2-28.

2.1 INTERFACE CABLES

2.1.1 FORMATTER TO HOST

Interface connections from the 9220 Formatter (Ports J1 and J5) to the Host require two 50-conductor ribbon cables. An adapter board, P/N 98-06304-004, is available to convert a dual 50-pin ribbon cable required for the Formatter Ports to a 100-pin male or female edge connector for a Host Port if required.

2.1.2 FORMATTER TO TAPE DRIVE

The 9220 Formatter requires a Cable Adapter Assembly (kit) consisting of a Cable Adapter, and two 50-conductor ribbon cables. The Cable Adapter adapts the two ribbon cables (Control Cable and Data Cable) to the Tape Drive Control and Data Interfaces. Neither Cable should exceed 20 feet (6.1 m) in length.

2.1.3 TAPE DRIVE INTERFACE HARDWARE AND DAISY CHAIN CABLES

One 9220 Formatter can control a maximum daisy chain of four Tape Drives, but with a maximum daisy-chain cable length of 20 feet.

2.2 MODEL 9000 TAPE DRIVE FORMATTER INSTALLATION

Installing the 9220 Formatter into the Model 9000 Tape Drive for both single Drives and daisy-chained Drives requires the use of Cable Adapter Assembly (Kit) 4900. This Assembly comes in various configurations depending on the number of Drives in the system. Table 2-1 lists the assortment of Cable Adapter Assemblies with their applicable parameters.

TABLE 2-1. FORMATTER CABLE ADAPTER ASSEMBLIES FOR MODEL 9000 DRIVES

Part Number		Parameters**		
Cable Adapt Assy* 90-04900-NKK	Ribbon Cable 90-04999-NLL	Drives N	Length KK	Length LL
90-04900-102	90-04999-102	1	2	2
-103 ***	-103	1	3	3
-104	-104	1	4	4
-107	-107	1	7	7
-110	-110	1	10	10

NOTE:

* One Cable Adapter Assembly is needed for each 9000 Drive as a single Drive or on a daisy chain. Each Cable Assembly (Figure 2-1) includes:

1. Two Ribbon Cables (Control Cable, Data Cable).
2. Two Cable Adapters: 4679 (Control) 4779 (Data).

** Parameters: N = Quantity of Drives: always = 1 for 9000 Drives
KK = Cable Length between Connectors
LL = Total Cable Length in Feet
KK = LL for Kit and cables for one 9000 Drive

*** Standard Kit supplied with Formatter when not otherwise specified.

2.2.1 FORMATTER FIELD INSTALLATION INSTRUCTIONS

Note: For convenience in running and connecting cables, mounting of the Formatter Assembly is delayed in this procedure until most of the cables are connected.

A. Turn off the AC Power Switch, then disconnect the power cord from the electrical power source.

B. Connect the Ribbon Cables (from Kit P/N 90-04900-1KK) as follows (Ref. Figure 2-1):

1. **Control Cable:** Aligning cable connector pin 1 (designated by the red stripe or similar trace on the cable) with pin 2 (adjacent to "Z"), connect the cable to the Connector labeled "FROM FORMATTER" on the **Control** PCB Connector Board

2. **Data Cable:** Aligning the other 50-conductor cable connector pin 1 (designated by the red stripe or similar trace on the cable) with pin 2 (adjacent to "A"), connect the cable to the Connector labeled "FROM FORMATTER" on the **Data** PCB Connector Board.

CAUTION

The raised triangle on the front of the Cable Adapters have no meaning for this application. Ignore this designator.

C. Find Control Master Board A10/J1 and Data Master Board A11/J1 on the rear side of the 9000 Tape Drive (Figure 2-2).

1. Align pin A of edge connector **receptacle** of the Control PCB Connector Board (4679) to pin A of the Control Master Board A10/J1 edge **connector**, and connect receptacle to connector.

2. Align pin A of edge connector **receptacle** of the Data PCB Connector Board (4779) with pin A of the Data Master Board A11/J1 edge **connector**, and connect receptacle to connector.

3. Route both the Control and the Data Ribbon Cables out the back of the Tape Drive.

D. Remove Formatter Mounting Screws (Figure 2-3) from the Drive side panels.

1. Position the Formatter Assembly (Mounting Bracket, Formatter Board, Formatter Cover) into the Drive so that the mounting holes in the Formatter Mounting Bracket align with the Mounting Holes in the Chassis, and the Formatter Cover labels J5 and J3 face toward the rear of the Drive.
2. Insert the Formatter Formatter Mounting Screws through the Formatter Bracket into the Tape Deck Chassis, but do not tighten any until all screws have been inserted.
3. Route the power cord down the inside and out the lower rear of the Tape Drive.

E. Align pin 1 (red stripe/marker trace) on the Control Ribbon Cable with the triangle/arrow on the Formatter Cover at port J3 and connect the Control Ribbon Cable to J3.

F. Align pin 1 (red stripe/marker trace) on the Data Ribbon Cable with the triangle at J2 on the Formatter Cover, and connect the Ribbon Cable to J2.

G. Plug the Formatter power cord into the outlet on the rear as illustrated.

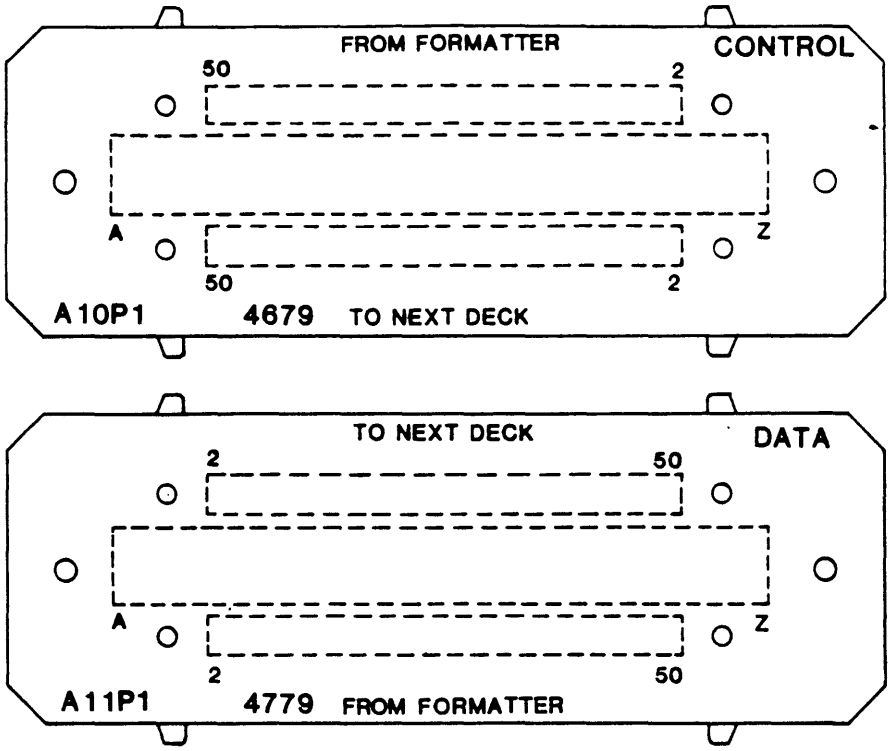
H. The Formatter is now ready to receive electrical power from the Tape Drive.

2.2.2 CONNECTING INTERFACE CABLES TO A FACTORY-INSTALLED FORMATTER

The Model 9000 Tape Drive with Embedded Formatter connected as a single-system Drive requires Cable Adapter Assembly Kit P/N 90-04900-1KK, which is included with the Formatter. This Kit interfaces the Formatter to the Drive. For daisy-chain systems, additional Kits must be ordered per required cable lengths from KENNEDY per Table 2-1. Order one Kit for each additional Drive in the daisy chain.

Connect the Embedded Formatter as follows:

A. Turn the Tape Drive Power Switch OFF; then disconnect the power cord from the electrical power source.



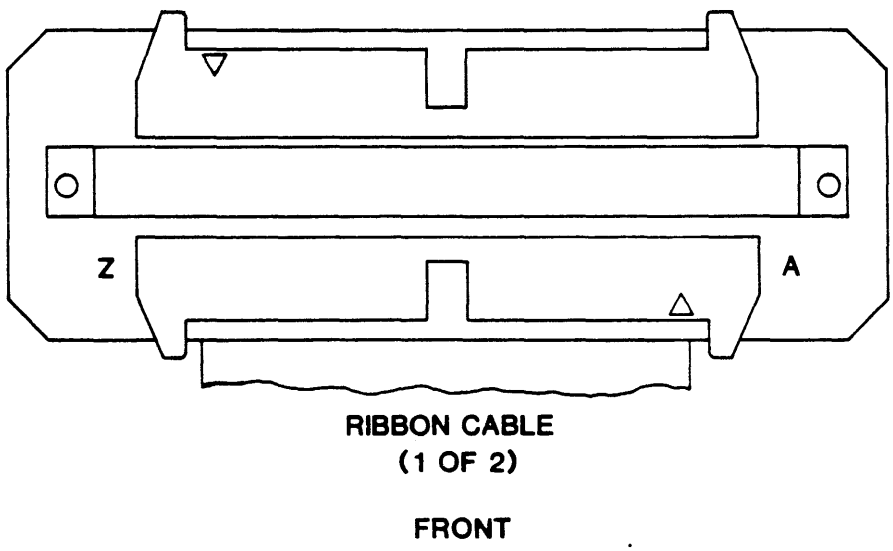


Figure 2-1. Cable Adapter Assembly (Kit) P/N 90-04900-1KK

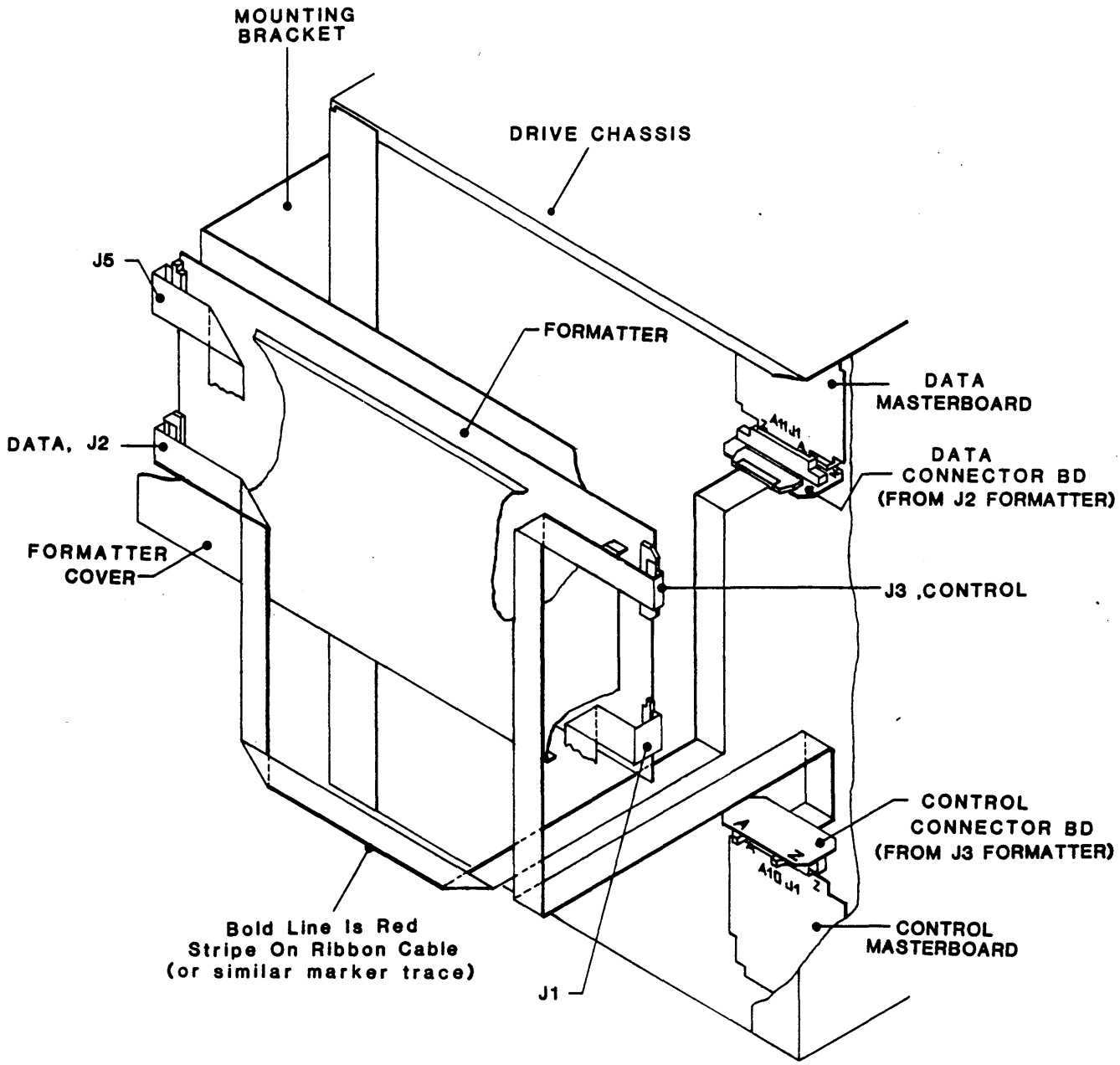
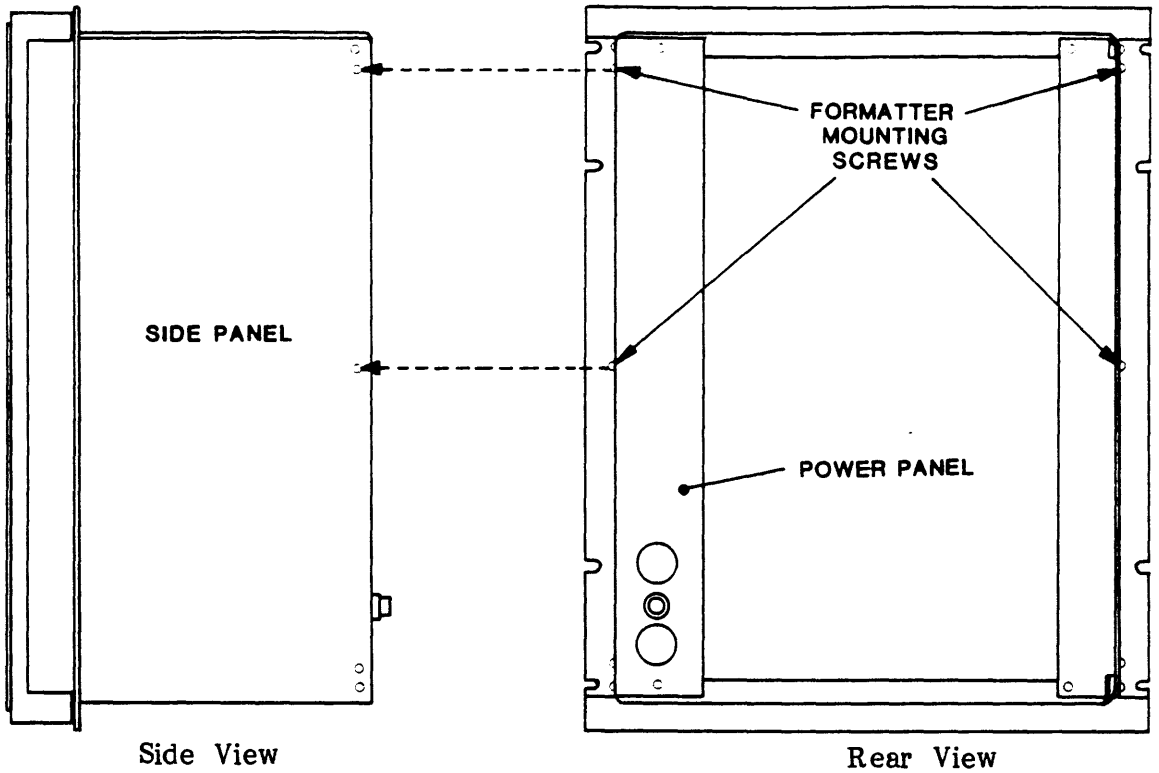


Figure 2-2. Model 9000 Tape Drive (rear view)



Formatter Mounting Area

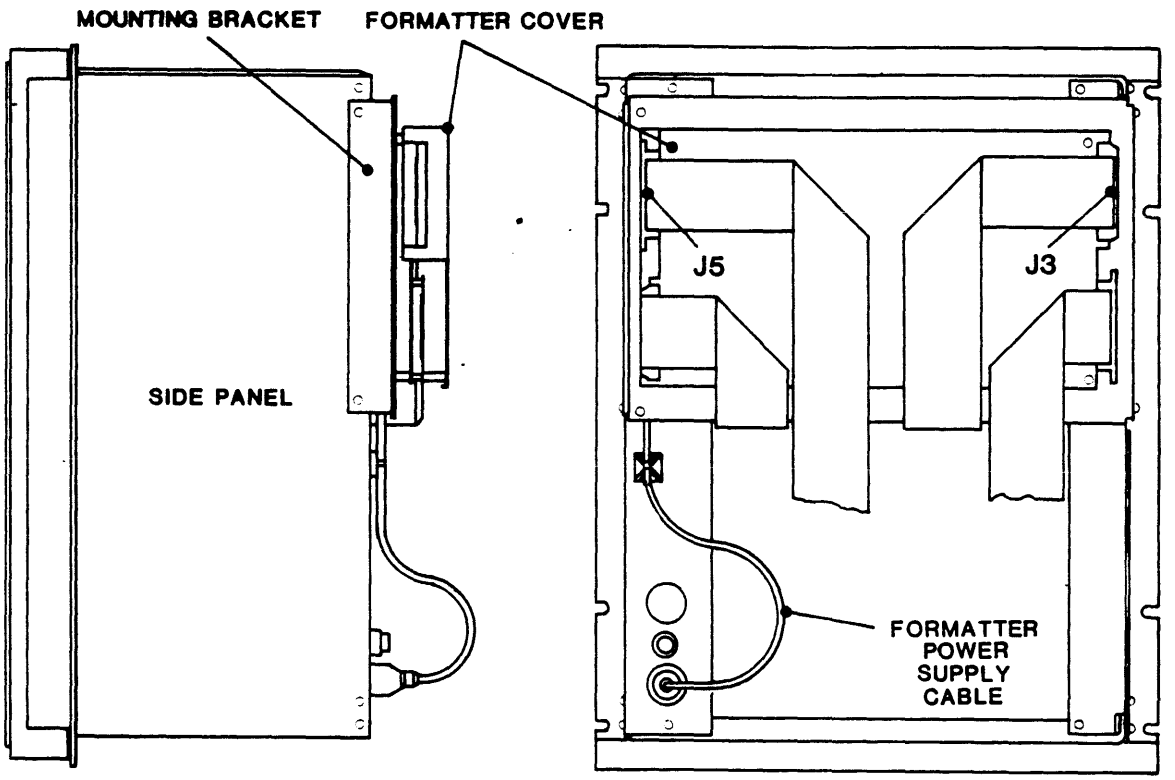


Figure 2-3. Model 9000 Tape Drive Formatter Installation

B. Follow instructions per paragraph 2.2.1, step B.1 and B.2.

C. Align pin 1 (designated by a red stripe or similar trace) on the **Control** Ribbon Cable with the triangle on the Formatter Cover at port J3, and connect the Control (ribbon) Cable to J3.

D. Align pin 1 (red stripe) on the **Data** Ribbon Cable with the triangle at J2 on the Formatter Cover, and connect the Data (ribbon) Cable to J2.

E. Find Control Master Board A10/J1 on the rear of the Drive (Figure 2-2). Route the Control Cable into the Drive through the rear. Match pin A of the edge **receptacle** of the Control Cable Adapter (4679) to pin A of the Control Master Board A10/J1 edge **connector**, and connect receptacle to connector.

F. Open the front door of the Drive and find Data Master Board A11/J1 (Figure 2-2). Route the Data Cable into the Drive through the rear. Through the open front door of the Drive, align pin A of the edge **receptacle** of the Data Cable Adapter (4779) with pin A of the Data Master Board A11/J1 edge **connector**, and connect receptacle to connector.

G. Plug the Formatter Power Cord into the outlet as illustrated (Figure 2-3).

H. The Formatter is now ready to receive electrical power from the Tape Drive.

2.2.3 DAISY CHAINING FOUR MODEL 9000 TAPE DRIVES

A daisy chain of Model 9000 Tape Drives requires, for each Drive in the chain, one Cable Adapter Assembly P/N 90-04900-NKK, consisting of two Cable Adapters and two Ribbon Cable Assemblies. A standard Formatter includes a Cable Adapter Assembly Kit with 3 ft Ribbon Cables. Order one Kit for each Drive in the daisy chain; the Kit may be ordered for custom length cables per Table 2-1.

One Formatter can control up to four Drives. The following steps describe connecting a daisy chain of four Drives to a single Formatter.

> **Note:** Daisy chaining **Formatters** is not considered to be standard practice for 9000 Drives. Contact KENNEDY Customer Service for further information.

A. Turn Tape Drive power OFF, and disconnect the power cord from the electrical power source.

B. Connect the Control PCB Connector Board and the Data PCB Connector Board (hereafter called Cable Adapters) of the first Drive directly to its embedded Formatter by following the instructions in paragraph 2.2.1 (for Non-Embedded Formatters) or 2.2.2 (for Embedded Formatters).

C. Route both the Control and the Data ribbon cables in and out the back of each Tape Drive, and connect as follows:

1. Orient each Cable Adapter so that the Connectors marked "TO NEXT DECK" and "FROM FORMATTER" will attach to the cables coming from the correspondingly marked connectors in the next Drive (See Notes (1) and (2) in Figure 2-4).

2. Orient the red stripe (or similar trace) on each Ribbon Cable with the "2" designation on each Cable Adapter Assembly Connector.

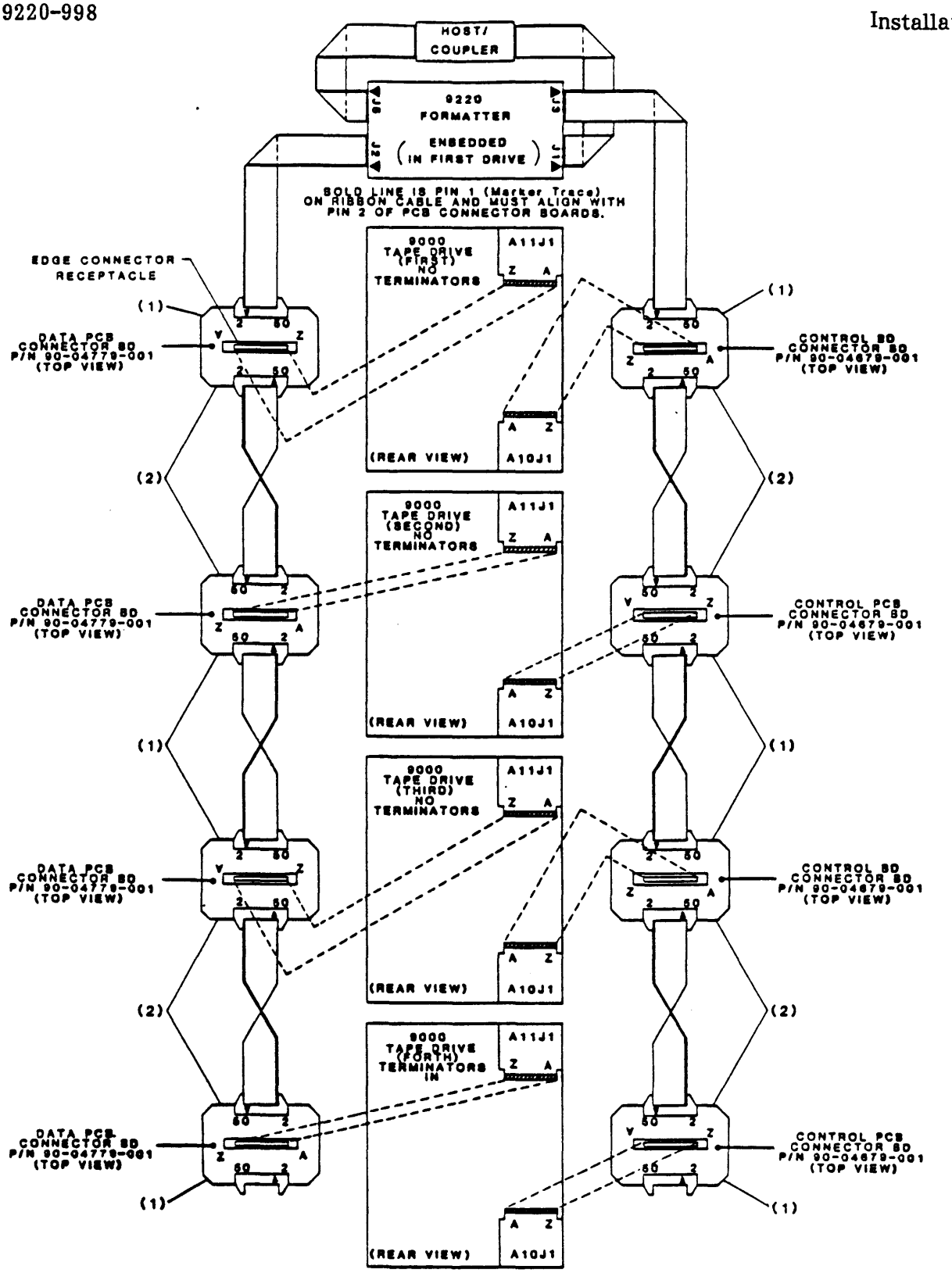
3. Plug each oriented Ribbon Cable Connector into the aligned Cable Adapter Connector.
4. Orient the Control Cable Adapter so that the end of the Receptacle marked "A" aligns with "A" designation on Control Master Board Connector A10P1. Plug the Receptacle into A10P1.
5. Orient the Data Cable Adapter so that the end of the Receptacle marked "A" aligns with "A" designation on Data Master Board Connector A11P1. Plug the Receptacle into A11P1.

D. All output lines on Tape Drives are terminated at the factory with a 220-ohm 5% resistor to plus five volts and a 330-ohm 5% resistor to ground. Earlier versions have terminator resistor boards (Figure 2-5), and the later ones have Single In-line Terminator resistor Packages (Figure 2-6).

E. For all Drives **except** the last Drive in the daisy chain, open the Front Panel of the Drive and, depending on the Drive version:
   1. Early Versions: Remove (through the front, Figure 2-5) Control Terminator Board 3841 and Data Terminator Board 3860.
   2. Later Versions: Remove some of the Circuit Boards from the Card Cage to allow access to the Master Boards, and using an IC Remover, as necessary, remove Control and Data Terminator Packages (SIPs) from the Data Master Board and the Control Master Board (Figure 2-6).

F. Some Drives have a thumbwheel type Address Select Switch. For these Drives, set the Drive Address by using the thumbwheel Switch as required. Other Drives have a jumper type address select feature. They normally include an Address Select Jumper on the Control Master Board (Figure 2-6). The Jumper is normally set for Address 0. For these Drives set the Drive Address as required by replacing the Address Select Jumper with one of the appropriately configured Jumpers listed below:

Drive Address	Part Number	Note
0	90-04356-001	Addresses can be any single-digit number sequence in ascending order.
1	90-04356-002	
2	90-04356-003	
3	90-04356-004	



Notes:

(1) FROM FORMATTER label (hidden).
(2) TO NEXT DECK label (hidden).

Figure 2-4. The 9220 Formatter and a Daisy Chain of 9000 Tape Drives

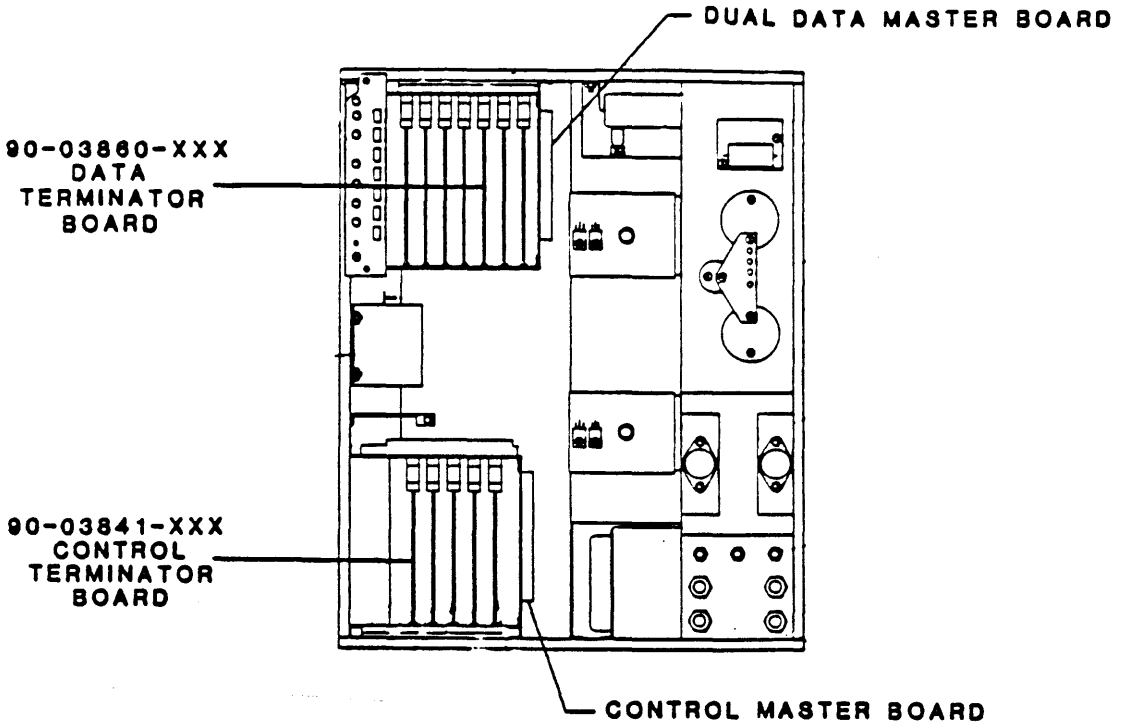


Figure 2-5. Model 9000 Drive Terminator Boards

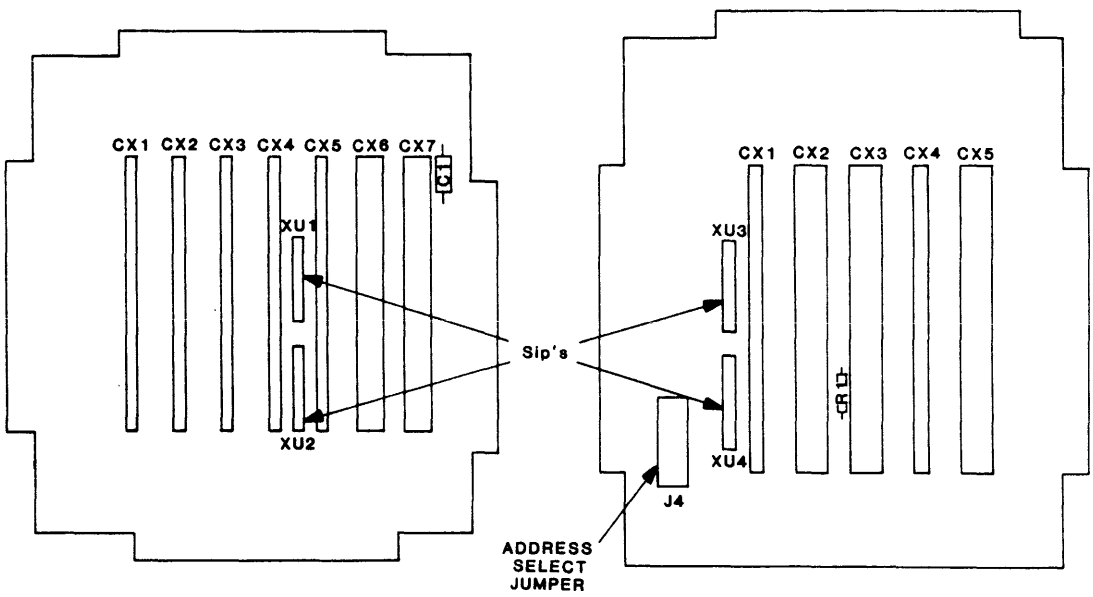


Figure 2-6. Model 9000 Drive Data and Control Master Boards

2.3 MODEL 9100, 9300, 9700 AND 9800 TAPE DRIVES

Installing a Formatter into the Models 9100, 9300, 9700, and 9800 Drives for either single Drives and daisy-chained Drives requires the use of Cable Adapter Assembly P/N 90-04970-NKK. A daisy chain can consist of any combination of up to four of the above listed Models. The Cable Adapter Assembly, consists of one Control Cable, one Data Cable, and a Cable Adapter. Table 2-2 lists Cable Adapter Assembly Options; and Figure 2-7 illustrates a Cable Adapter Assembly. Figure 2-8 illustrates a typical Cable Assembly.

TABLE 2-2. FORMATTER CABLE ADAPTER ASSEMBLIES FOR MODELS 9100, 9300, 9700, AND 9800

Part numbers		Parameters		
Cable Adapt Assy 90-04970-NKK	Cable 90-04999-NLL	Drives N	Segment (Ft) KK	Total (Ft) LL
90-04970-102 *	90-04999-102	1	2	2
-103 ^	-103	1	3	3
-104	-104	1	4	4
-106	-106	1	6	6
-110	-110	1	10	10
-120	-120	1	20	20
-202	-204	2	2	4
-204	-208	2	4	8
-207	-214	2	7	14
-210	-220	2	10	20
-304	-312	3	4	12
-307	-321	3	7	21
-404	-416	4	4	16
-405	-420	4	5	20

NOTE:
* Standard Cable Assembly Kit for 9700/9800 Models.
^ Standard Cable Assembly Kit for 9100/9300 Models.

2.3.1 9100/9300/9700/9800 TO 9220 FORMATTER INTERFACE CABLES

Connect Data and Control Cables to the 9220 Formatter as follows:

A. Turn Drive AC power OFF, and disconnect the Power Cord from the AC power source.

B. On Models 9100 and 9300, install Cable Adapter Assembly 4740 (Figure 2-7) on the underside of the card cage (Figures 2-9 and 2-10). On Models 9700 and 9800, install Cable Adapter Assembly on the back/rear (Figures 2-13).

C. Silk screen labels on the sheet metal above the two Connectors of the Cable Adapter identify the ports as CONTROL and DATA.

   1. Align Cable Connector Pin 1 (designated by a red stripe or similar trace on the Ribbon Cable) with the engraved triangle (Pin 1) on the Control Port Connector of the Cable Adapter, and plug the Cable Connector into the Port Connector. Similarly connect the other Ribbon Cable to the Data port. These Cables are hereafter referred to as Control and Data Cables.

   2. Route both the Control and the Data Cables out the back of the Tape Drive.

D. For 9100 and 9300 Drives do procedure per paragraph 2.3.2. For 9700 and 9800 Drives do procedure per paragraph 3.3.3.

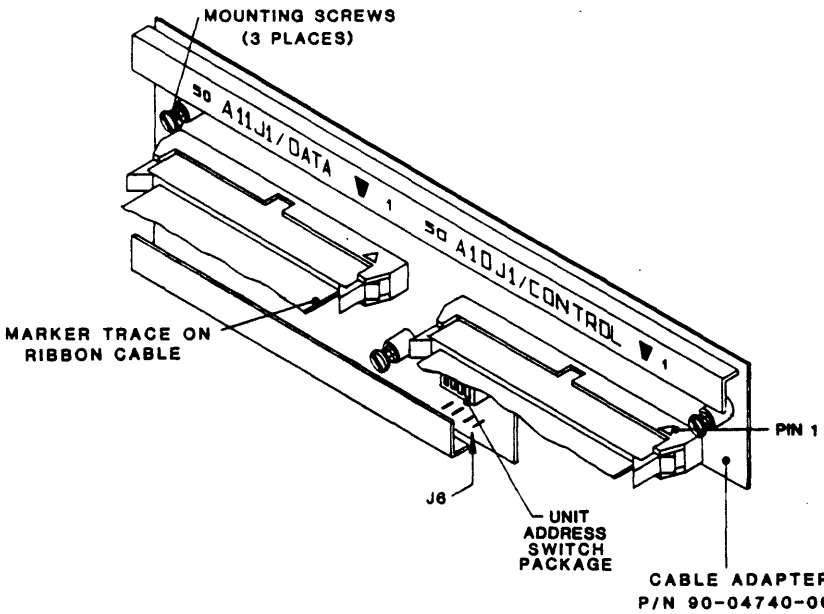


Figure 2-7. Cable Adapter Assembly (Kit) P/N 90-04970-NKK

Note:
This cable is one of two for N Drives (in this figure, N = 3 Drives), which can be any combination of 9100s, 9300s, 9700, and 9800s. This cable includes:
N + 1 Connectors, with
KK feet between
Connectors
LL feet total cable length

See Table 2-2 for Part Numbers.

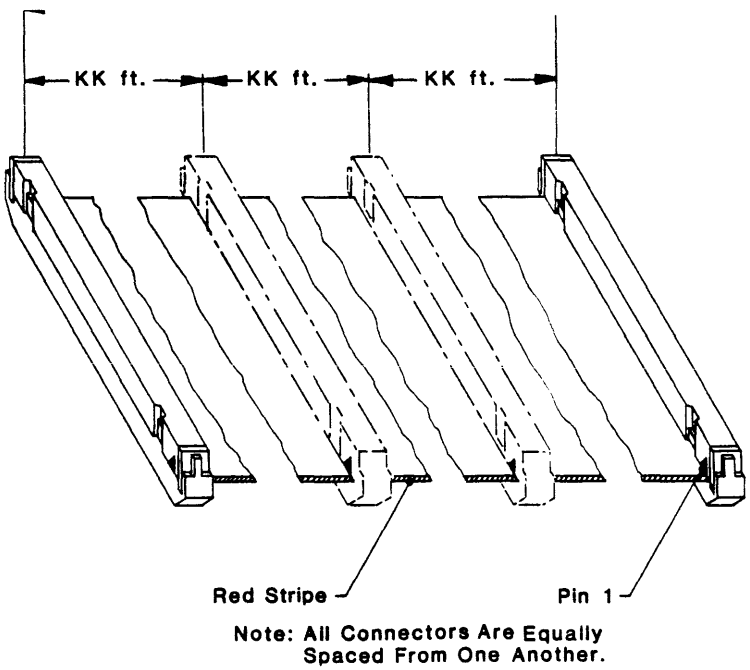


Figure 2-8. Cable Assembly P/N 90-04999-NLL For Daisy Chain, Typical For Models 9100, 9300, 9700 and/or 9800

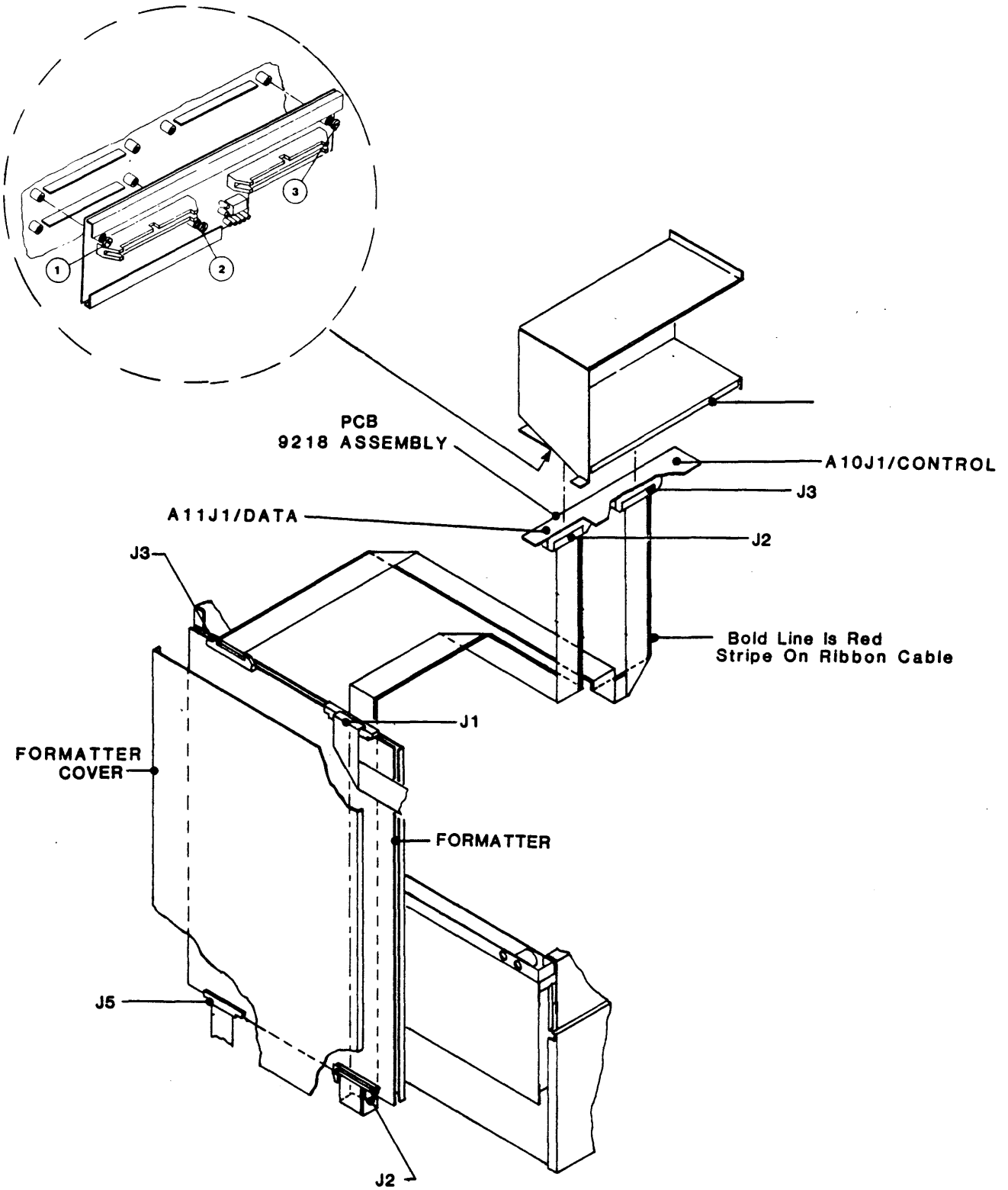


Figure 2-9. Model 9100 Drive to Formatter Interface (Rear View)

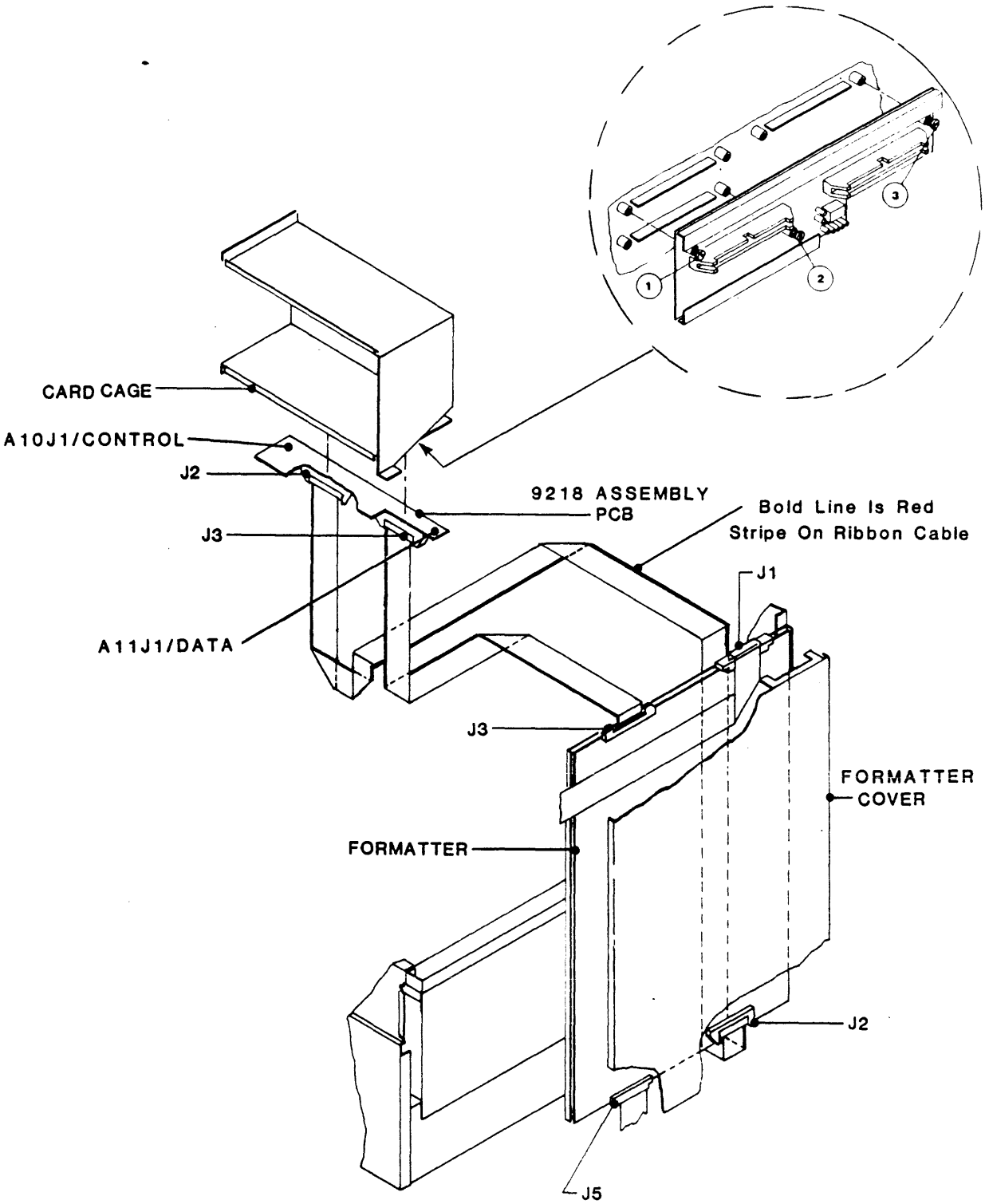


Figure 2-10. Model 9300 Drive to Formatter Interface (Rear View)

2.3.2 FORMATTER FIELD MOUNTING INSTRUCTIONS FOR 9100 & 9300 DRIVES

With the Tape Drive turned OFF and the Drive Power Cord disconnected, perform the following:

A. Refer to Figure 2-11 for model 9100 or Figure 2-12 for model 9300: remove three screws, items 1, 2, and 4; and remove the Cover.

B. Mount the Formatter as shown by the shaded area of Figure 2-11 or Figure 2-12. Install a screw in location 4 through the Formatter Brace and into the Tape Drive, but do not tighten.

C. Reach inside the Drive and lift the Blower Assembly to align the screw holes, and install two screws, items 1 and 2. Then tighten screws 1, 2, and 4.

D. Route the power cable, which is connected to the Formatter, down and across the inside back of the drive and through the hole in the Power Panel.

E. Connect Power Supply per Installation Instruction Document 93-0922-100A supplied with the Formatter.

F. Align pin 1 (red stripe or similar trace) on the Control Cable with the triangle on the Formatter Cover at port J3, and connect the Control Cable to the Formatter Board (Figure 2-9 or 2-10).

G. Align pin 1 (red stripe) of the Data Cable with the triangle on the Formatter Cover at J2, and connect the Data Cable to the Formatter Board (Figure 2-9 or 2-10).

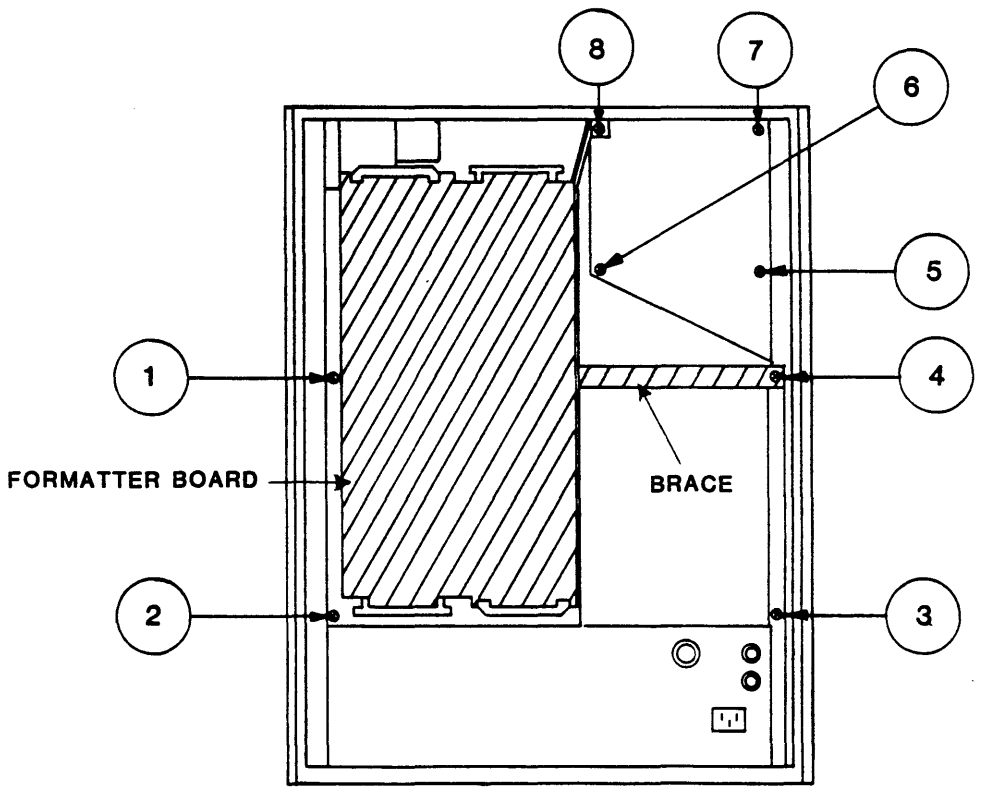


Figure 2-11. Model 9100 Drive and 9220 Formatter (Rear View, Cover Removed)

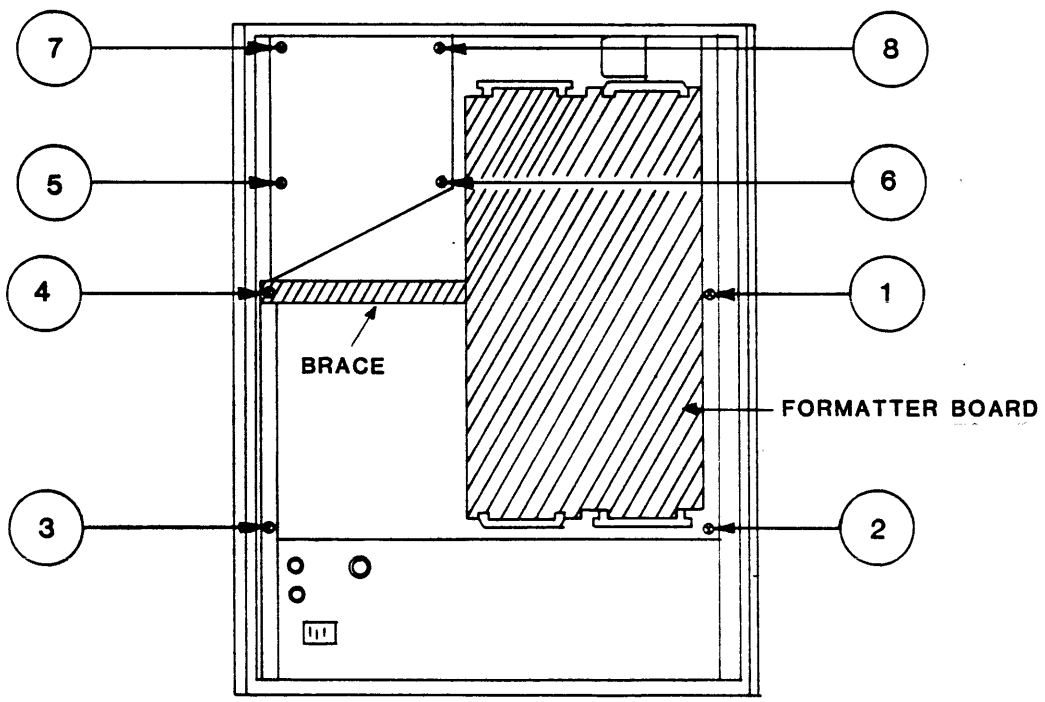


Figure 2-12. Model 9300 Drive and 9220 Formatter (Rear View, Cover Removed)

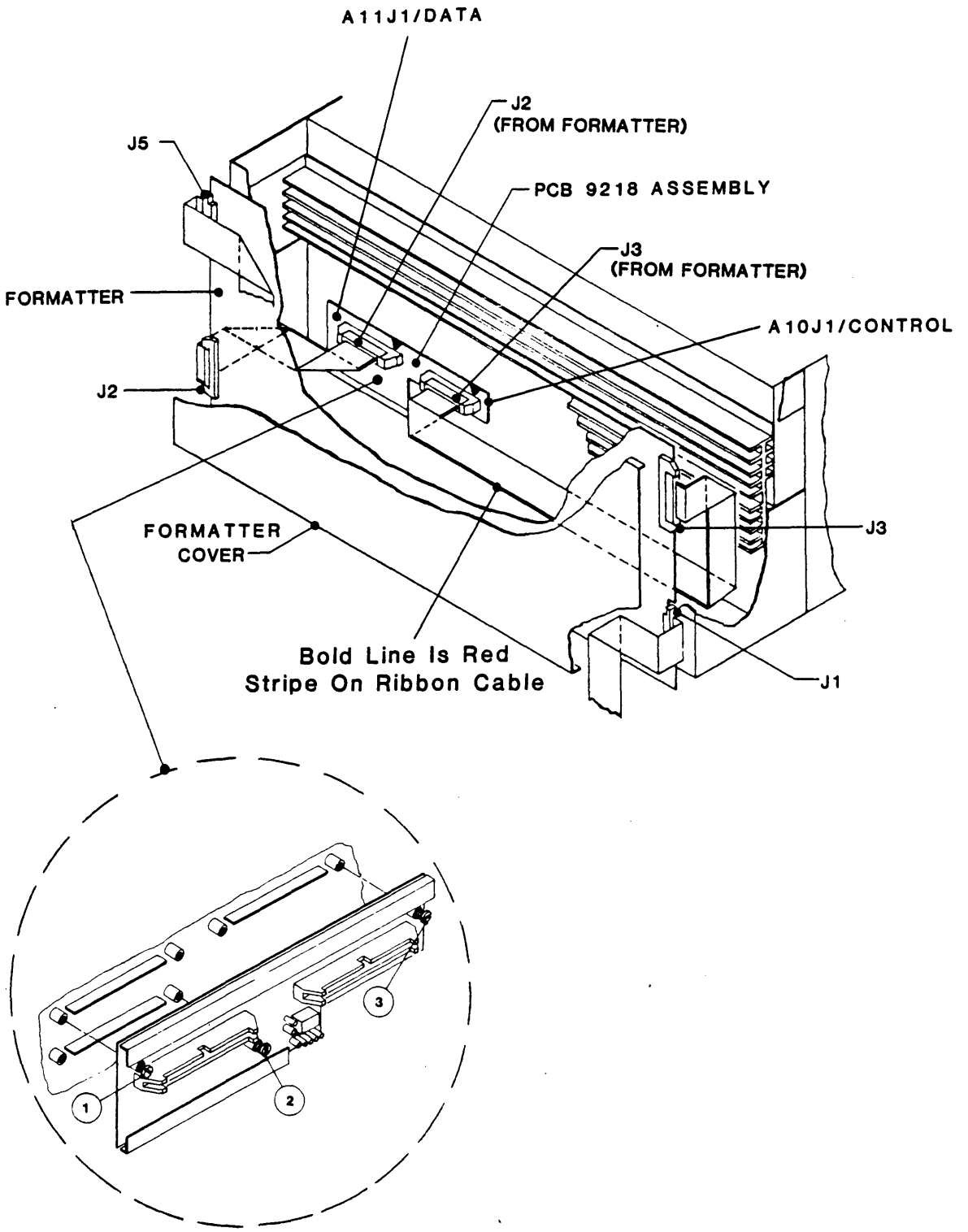


Figure 2-13. Models 9700/9800 Drives to Formatter Interface (Rear View)

2.3.3 FORMATTER FIELD MOUNTING INSTRUCTIONS FOR 97/9800 DRIVE

With the Tape Drive turned OFF and the Power Cord disconnected, and referring to Figure 2-14, proceed as follows:

A. Remove the six sheet metal screws, items 1 through 6.

B. Align the Formatter Mounting Bracket with the three holes on one side, and install three 3/8th-inch screws from the Field Mounting Kit through the aligned holes. Mount the other side of the Bracket in the same way.

C. Repeat Step B for the other side of the Bracket.

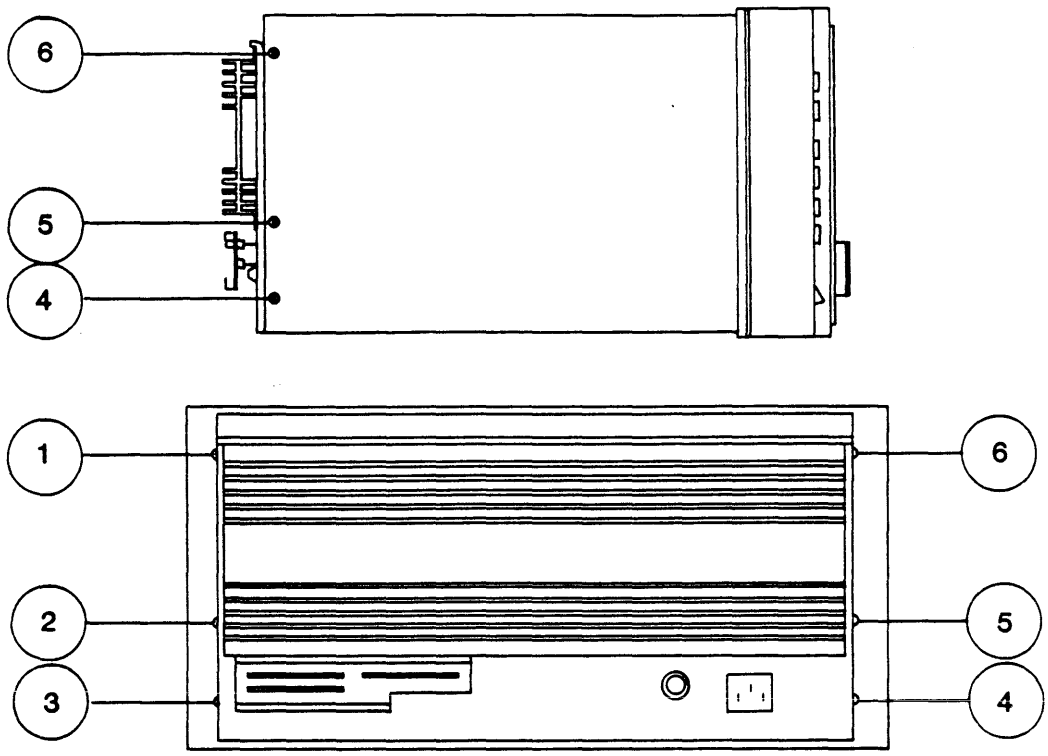


Figure 2-14. Model 9700/9800 Drive and Formatter Mounting Screws

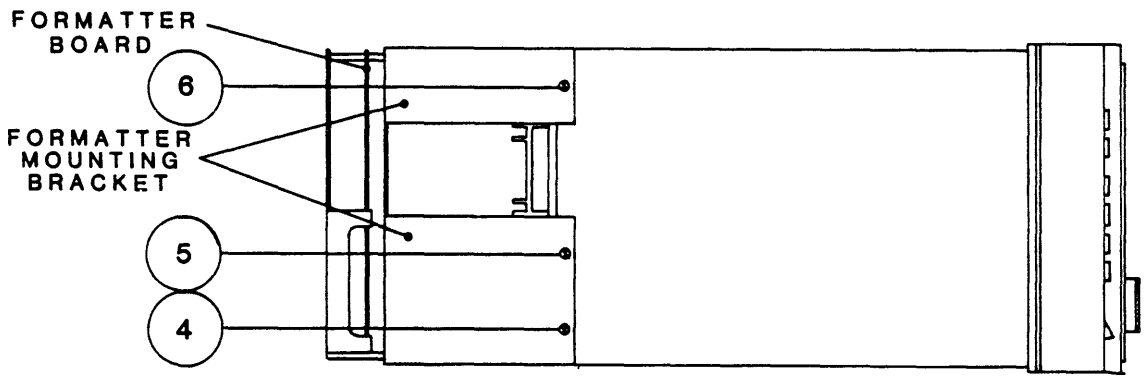


Figure 2-15. Model 9700/9800 Tape Drive and Formatter

D. Locate the MOLEX Connection underneath the 97/9800 Tape Drive (Figure 2-16). A cable tie normally holds this connection in place on the Master Board. One end of the connection, P4, connects to the transformer (inside the card cage) and the other end, J4, attaches to the Input Voltage Select Switch.

E. Disconnect P4/J4 and connect the Power Cable Assembly P/N 90-07006-004 to both P4 and J4 per Figure 2-16.

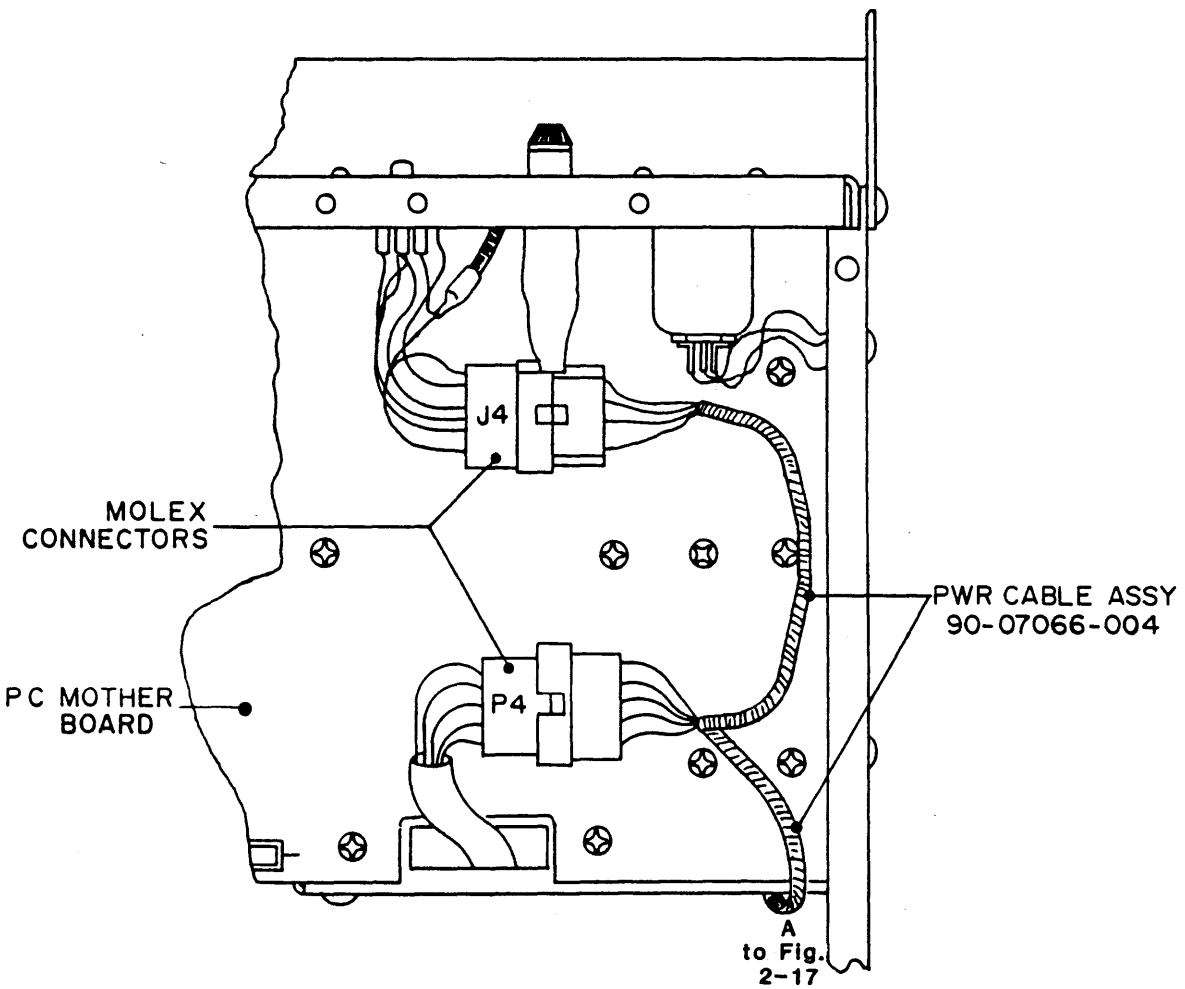


Figure 2-16. 9700/9800 (Bottom View), Formatter Power Cable Installation

F. Route the wires toward Formatter Power Supply Connector P5 (Figure 2-17). Hold the wires LOOSELY in place with the plastic tie wraps form the Kit and mount the cable ties.

G. Connect P5 to J5. Tighten and trim the end of the plastic tie wraps.

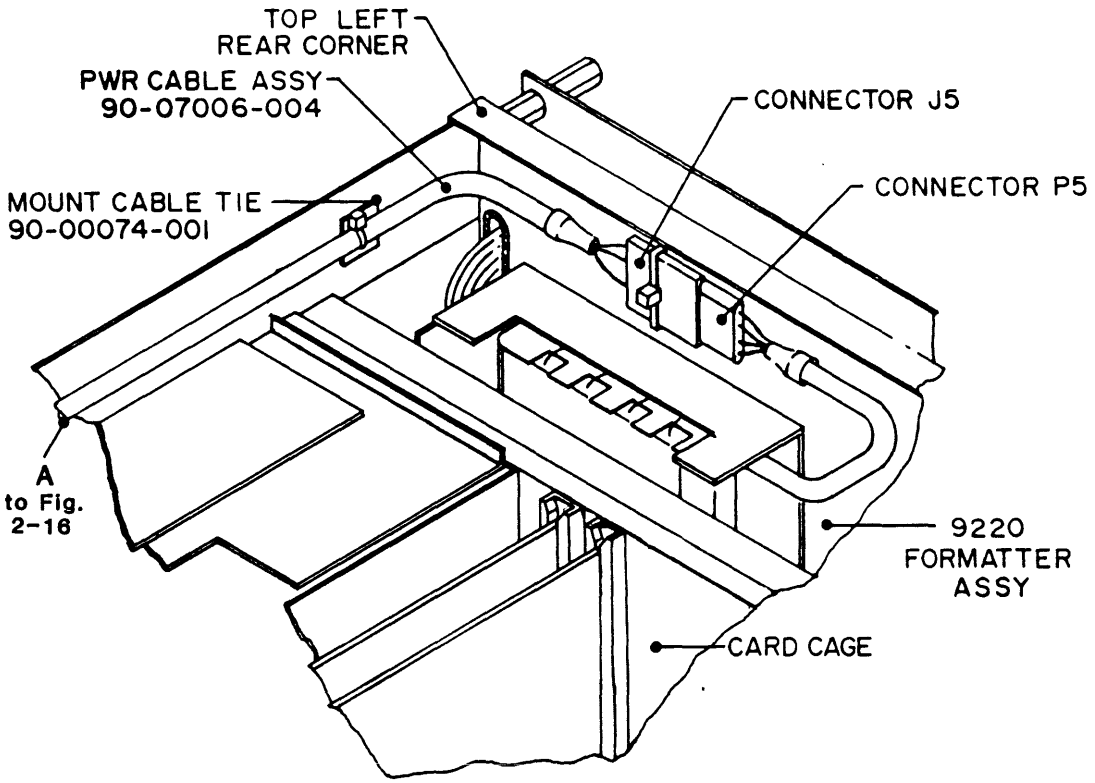


Figure 2-17. Model 9700/9800 (Top Left Rear Corner View), Formatter Power Cable Installation

H. Align pin 1 (red stripe or similar trace) on the Control Cable with the triangle on the Formatter Cover at port J3, and connect the Control Cable to the J3 (Figure 2-13).

I. Align pin 1 (red stripe) of the Data Cable to the triangle on the Formatter Cover at J2, and connect the cable to J2 (Figure 2-13).

J. Reconnect the Drive to the power source.

2.3.4 DAISY CHAINING THE 9100, 9300, 9700 AND 9800 TAPE DRIVES

To daisy chain up to four 9100, 9300, 9700, and 9800 Tape Drives in any combination:

A. Choose an appropriated Cable Assembly (Kit) from Table 2-2.

B. Turn off the Tape Drive AC Power Switch, then disconnect the Power Cord from the power source.

C. On Models 9100 and 9300, Install Cable Adapter Assembly 4740 (Figure 2-7) on the underside of the card cage (Figures 2-9 and 2-10). On Models 9700 and 9800, install Cable Adapter Assembly on the back/rear (Figures 2-13).

D. All Tape Drive interface lines are terminated with a 220-ohm 5% resistor to plus five volts and a 330-ohm 5% resistor to ground. Termination is implemented on earlier versions of the 9100 and 9300 Drives by Terminator Resistor Boards (Figures 2-18, 2-19, 2-20 and 2-21). On later versions termination is by Single In-line (resistor) Packs (SIPs - Figure 2-24). All 9700 and 9800 Drives use Terminator Resistor Boards only.

As applicable, remove the 3841 Control and 3860 Data Terminator Boards (Fig 2-18 thru 2-21) or Single In-line Packs (SIP's) on the Master Board (Figure 2-22) **from all but the last Drive** (the furthest Drive from the Formatter) as described below:

1. Tape Drives with Control and Data Terminator PC Boards have them located in the card cage which can be reached from the side of models 9100 and 9300, and from the top of models 9700 and 9800 (Fig.2-18 thru 2-21). To remove the Data and Control Terminator Boards, pull the white release levers above the boards.

2. Drives with SIP Terminators have two in the Control Section of the Master Board, and two in the Data Section. The Master Board is located in the card cage which can be reached from the side of models 9100 and 9300 (Figure 2-22). To remove the four SIP's (U1, U2, U3, and U4) on later version Drives: pull the white release levers above the boards and remove some of the PC Boards from the Master Board near the SIP's to make space for your hand or an IC remover. Remove the four SIP's from their IC sockets on the Master Board, and return the PC Boards to their original locations on the Master Board.

E. Set The address of each Tape Drive, as applicable, by setting the Unit Address Switch on Cable Adapter 4740 (Figure 2-7) as indicated below:

Switch	Transport Address	
1	TAD0	**Note:**
2	TAD1	All switches must be OFF
3	TAD2	except the one selected.
4	TAD3	

F. **9100 and 9300 Drives:** If the Drive includes a thumbwheel Address Switch on the Front Panel, set all sections of the Unit Address Switch on the Cable Adapter to OFF, and connect* J6 on the Cable Adapter to Connector J4 on the rear of the Card Cage. The appropriate Drive address may now be selected with the thumbwheel.

* Optional Cable Assembly P/N 90-04910-001: if not included in the original sales order, it must be special ordered from Kennedy Company.

9700 and 9800 Drives: Thumbwheel Switch is not a standard option with the 9700 and 9800 Drives. Contact Kennedy Company Customer Service for information.

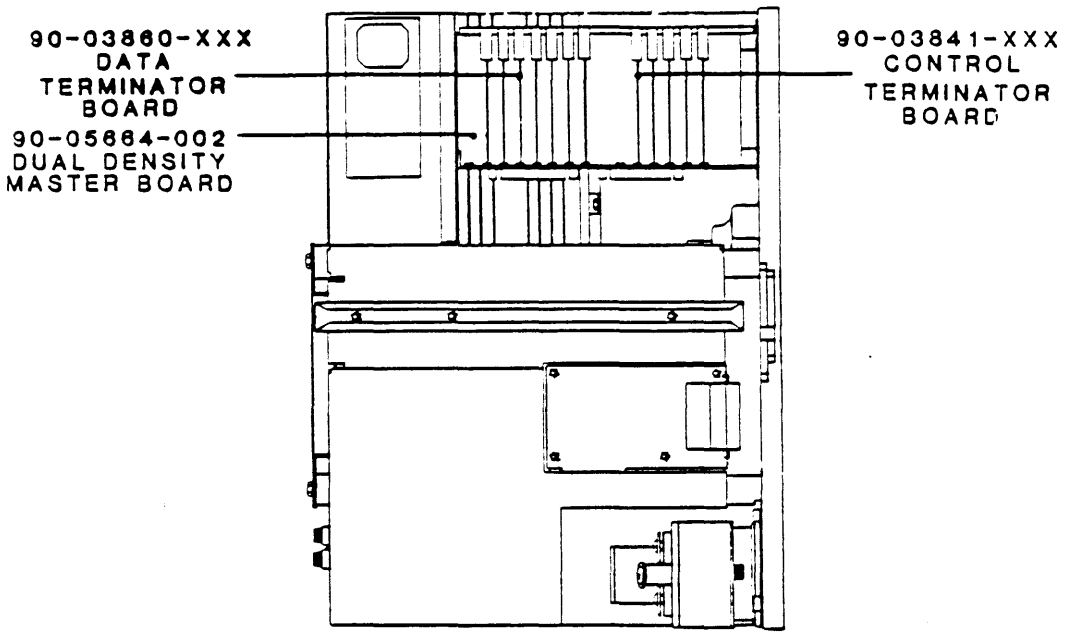


Figure 2-18. Model 9100 (Left Side View), Data and Control Terminator Boards

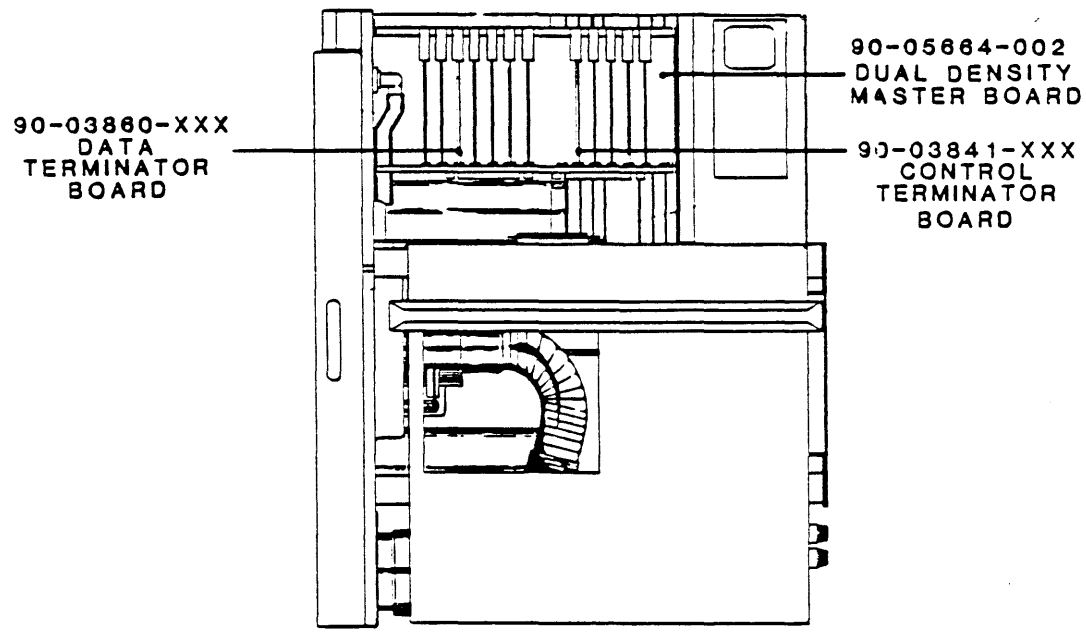


Figure 2-19. 9300 Drive (Right Side View), Data and Control Terminator Boards

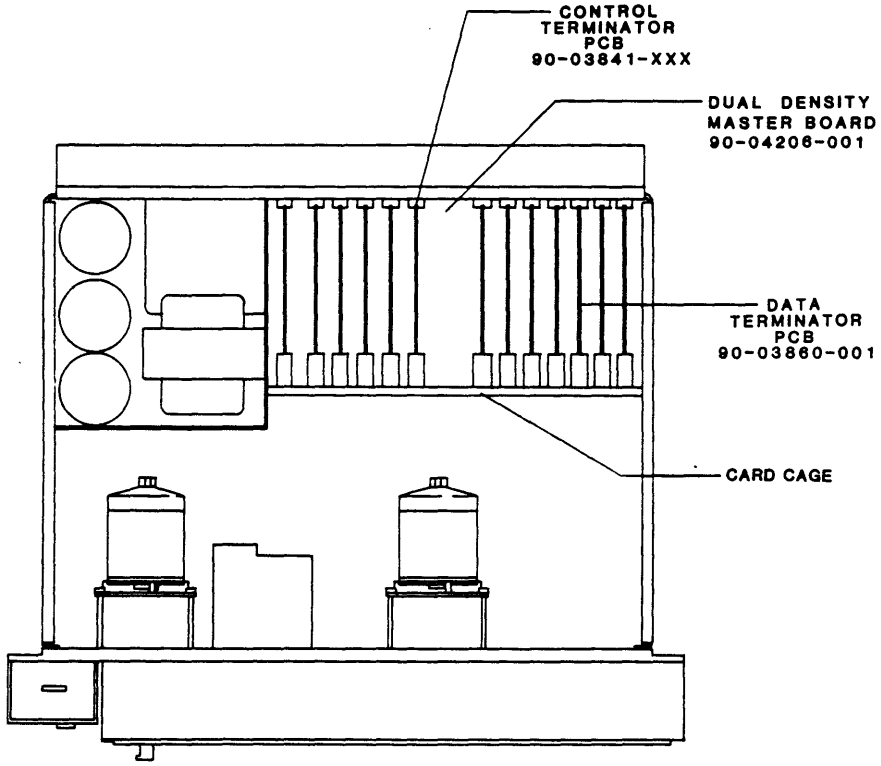


Figure 2-20. 9700 Drive (Top View), Data and Control Terminator Boards

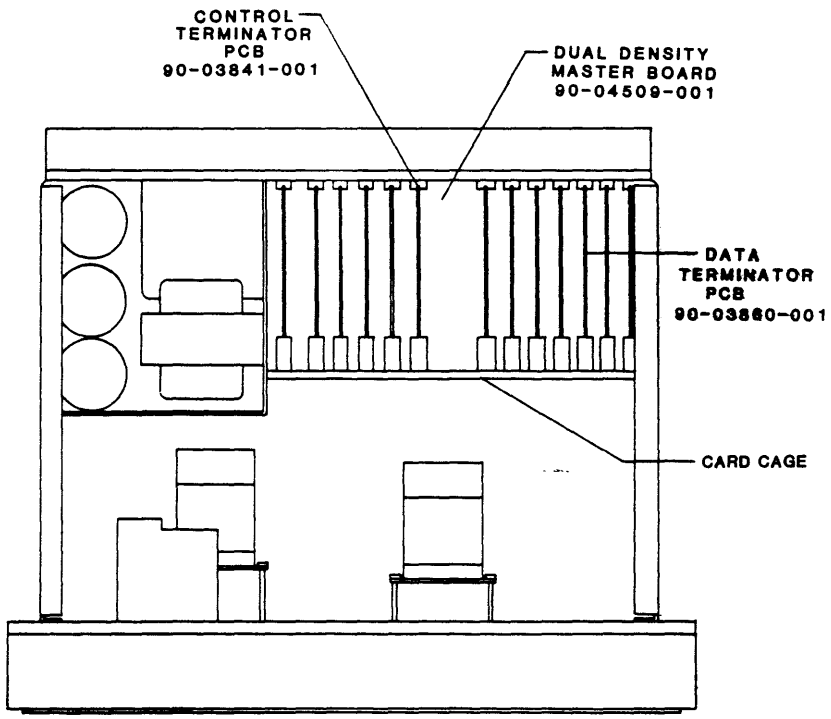


Figure 2-21. 9800 Drive (Top View), Data and Control Terminator Boards

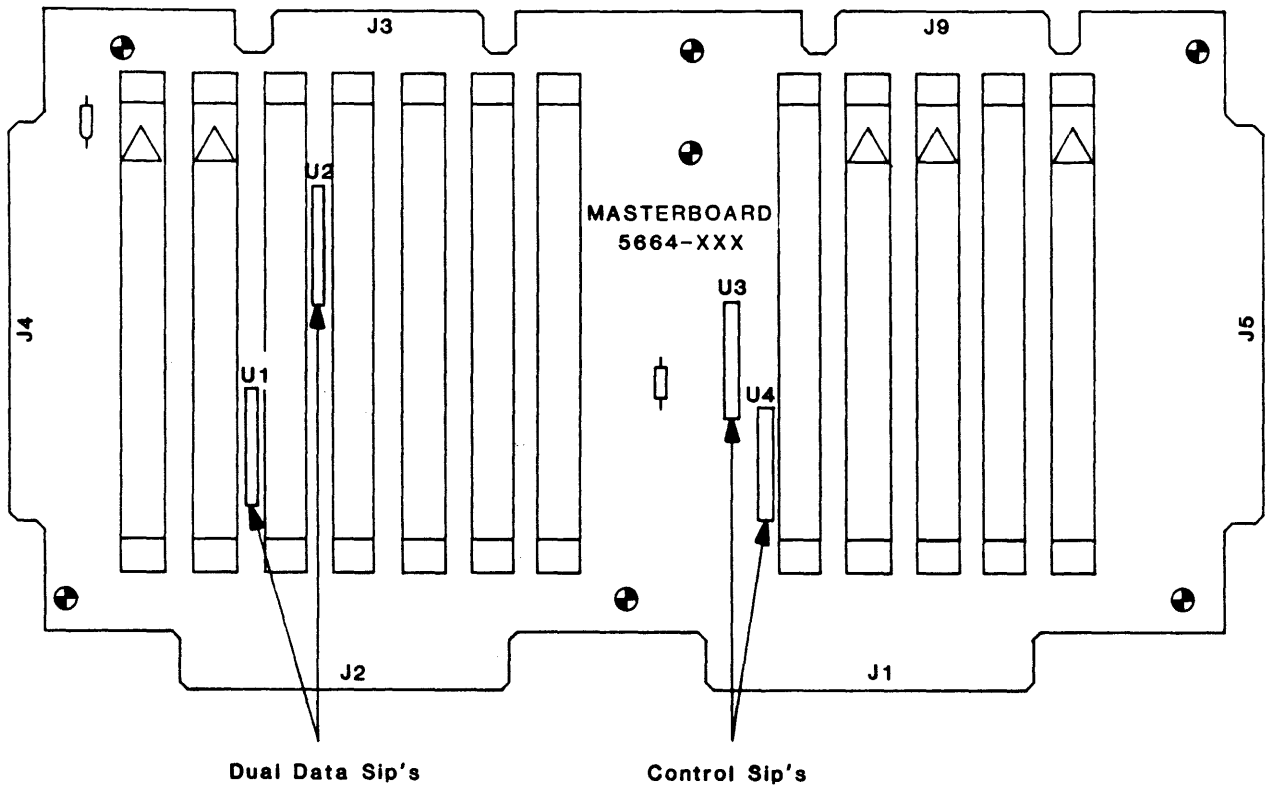


Figure 2-22. 9100/9300 Drive Master Board, Terminator Single In-line Packages (SIP's)

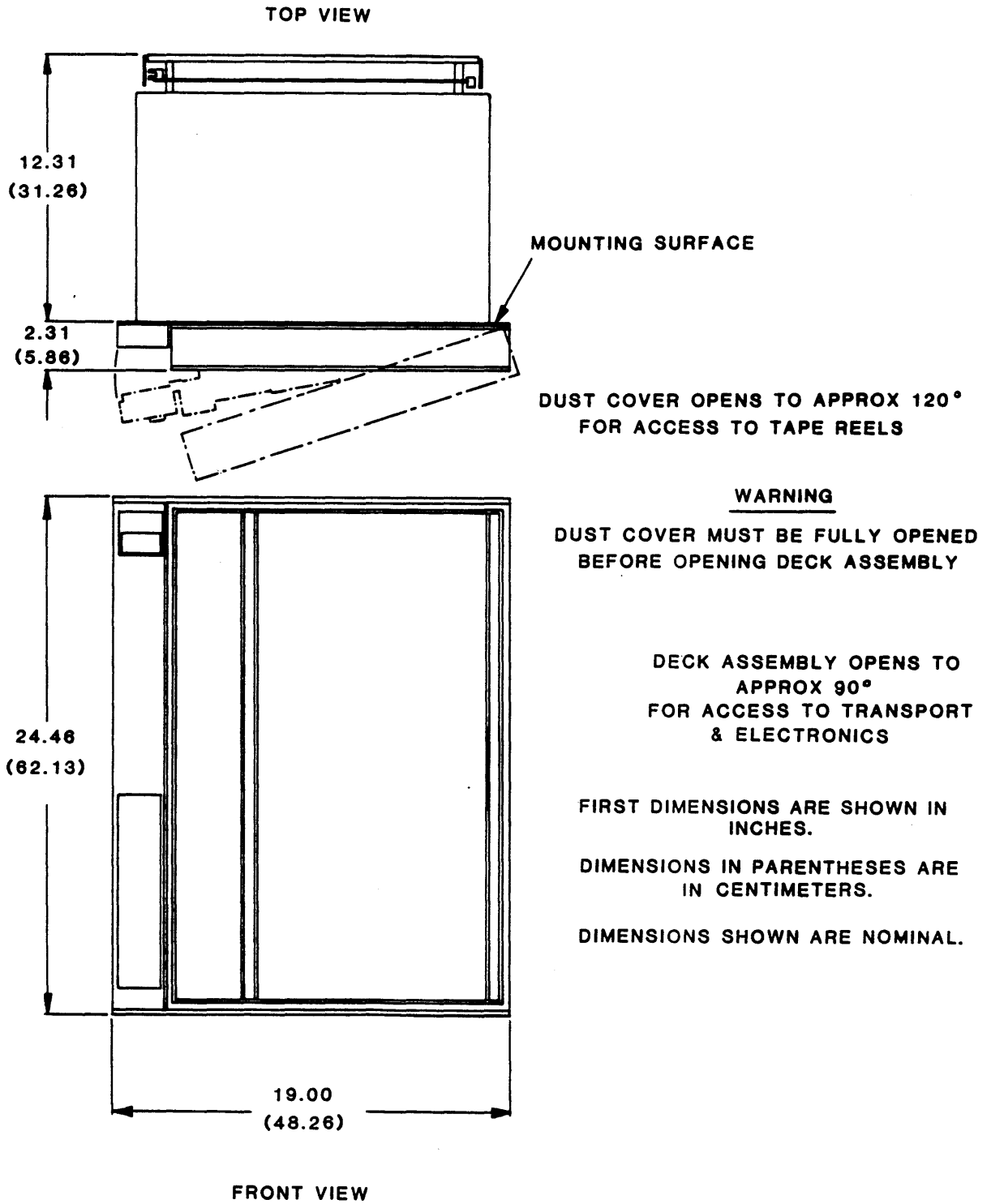


Figure 2-23. Dimensions, Model 9000 with Embedded Formatter

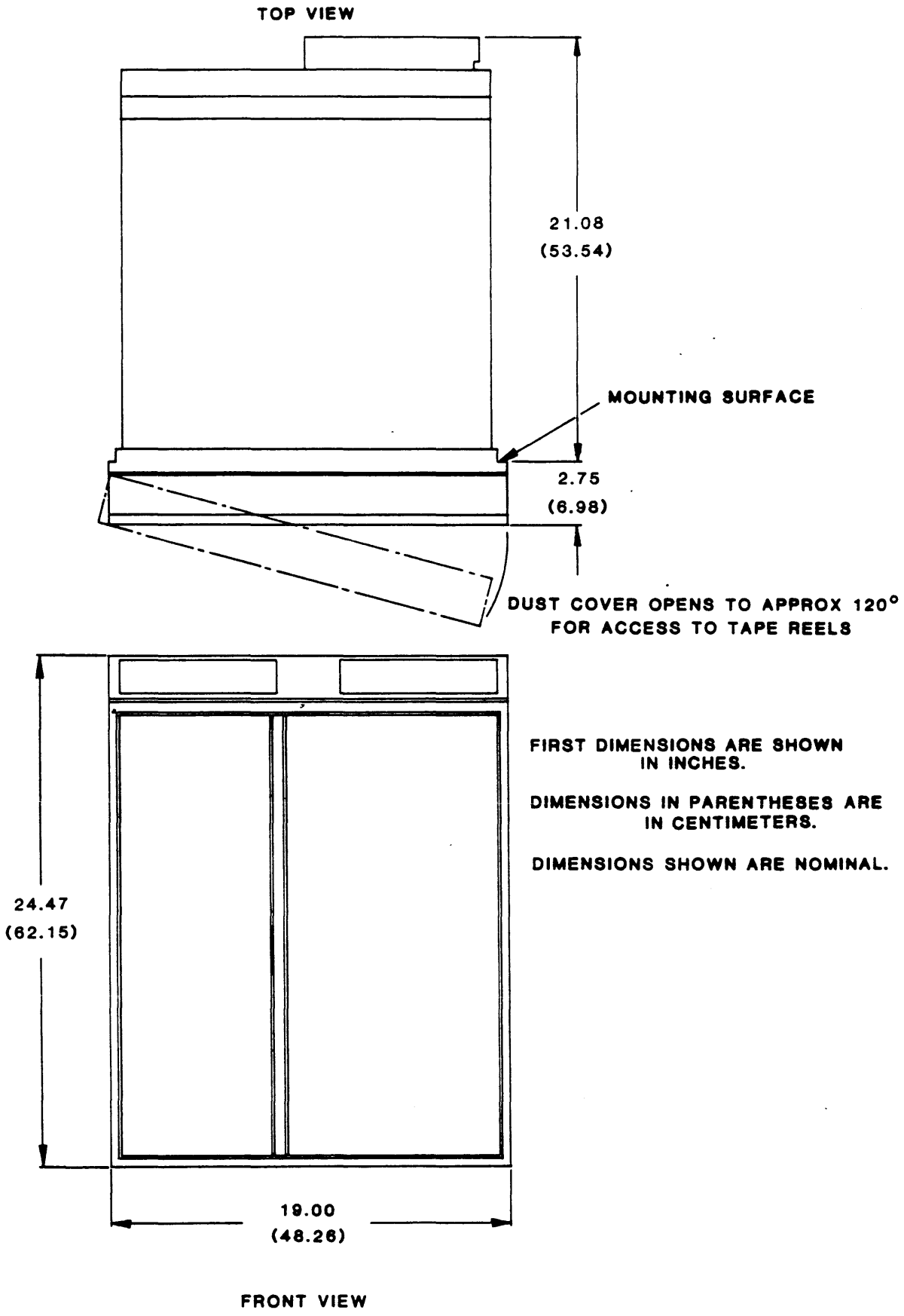


Figure 2-24. Dimensions, Model 9100 with Embedded Formatter

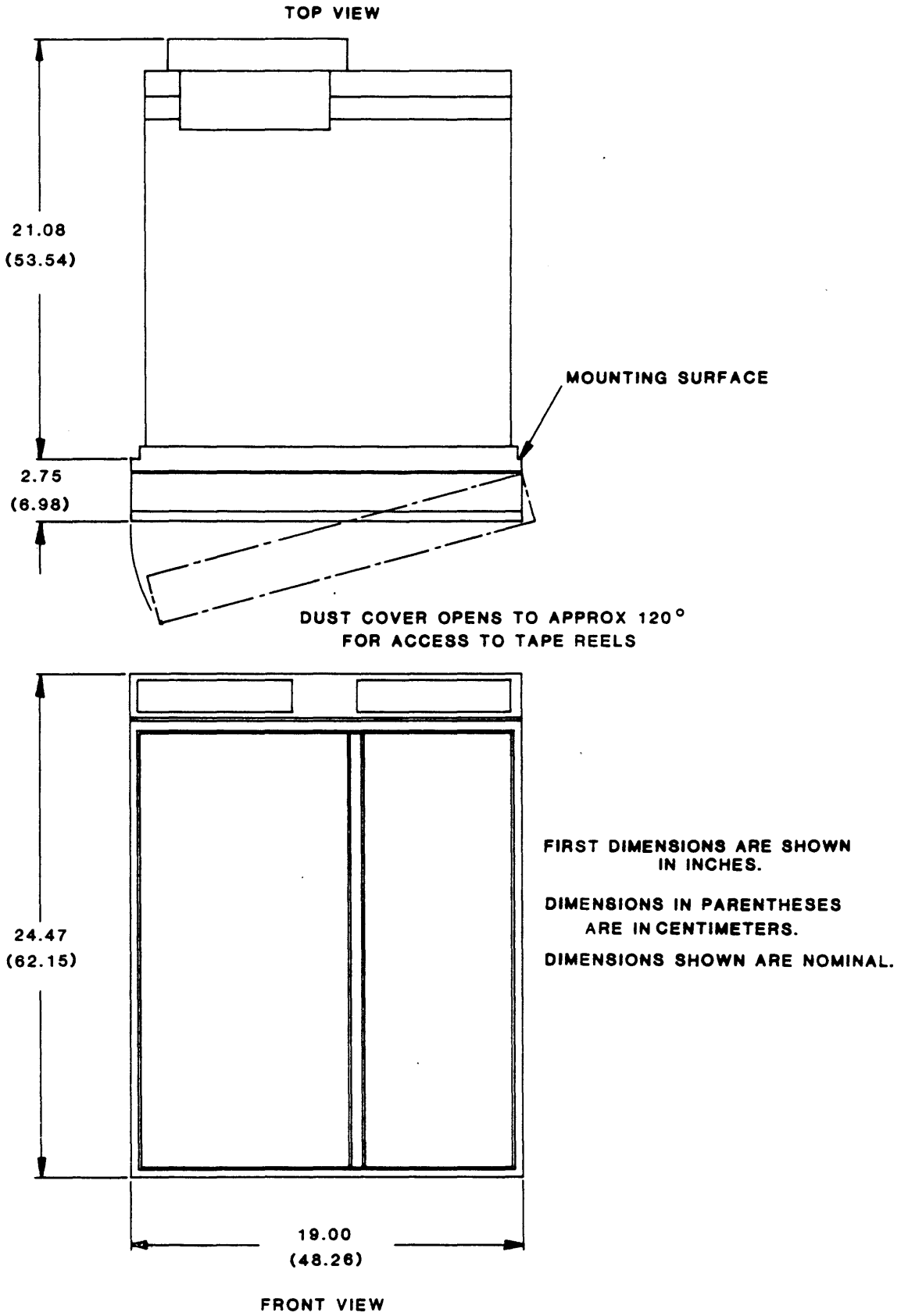


Figure 2-25. Dimensions, Model 9300 with Embedded Formatter

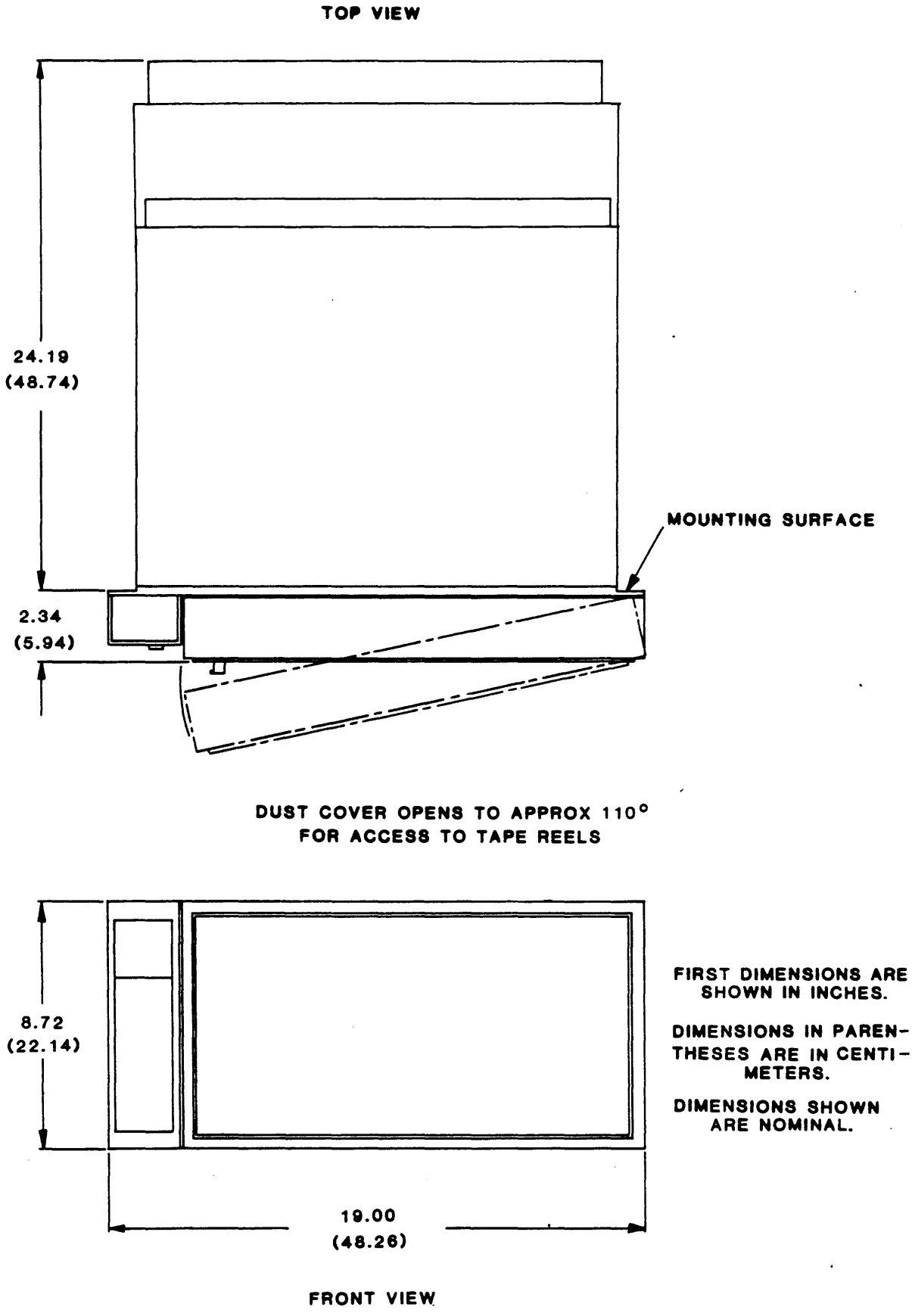


Figure 2-26. Dimensions, Model 9700 with Embedded Formatter

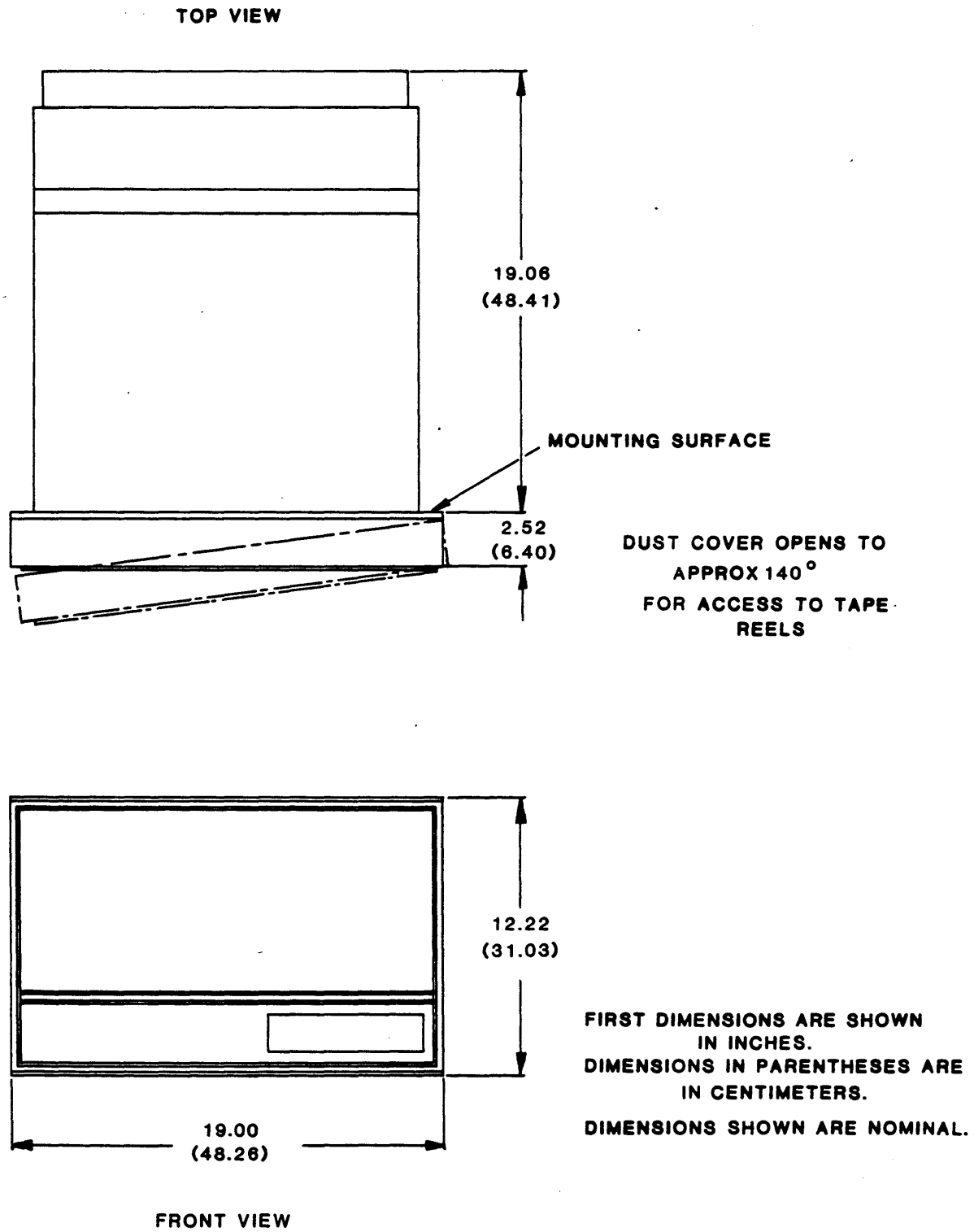


Figure 2-27. Dimensions, Model 9800 with Embedded Formatter

Warranty

The Company warrants its devices against faulty workmanship or the use of defective materials (except in those cases where the materials are supplied by OEM) for a period of one year from the date of shipment to OEM, with the exception of $\frac{1}{4}$" cartridge products which are warranted for a period of ninety (90) days.

The liability of the Company under this warranty is limited to replacing, repairing, or issuing credit (at the Company's discretion) for any devices which are returned by OEM during such period provided that (a) the Company is promptly notified in writing upon discovery of such defects by OEM; (b) the defective unit is returned to the Company, transportation charges prepaid by OEM; and (c) the Company's examination of such unit shall disclose to its satisfaction that such defects have not been caused by misuse, neglect, improper installation, repair alteration or accident.

Kennedy Company is continually striving to provide improved performance, value and reliability in its products and reserves the right to make these changes without being obligated to retrofit delivered equipment.

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