141
Shop

3155-4-420-11-1

TEXAS INSTRUMENTS

Improving Man's Effectiveness Through Electronics

Model 980 Computer
Terminal User's Guide
Model 733 ASR/KSR Data Terminal

MANUAL NO. 943009-9701
ORIGINAL ISSUE 15 AUGUST 1974
INCLUDES
CHANGE 1 ..... 1 SEPTEMBER 1975

BASIC AND ALL CHANGES HAVE BEEN MERGED TO
MAKE THIS A COMPLETE PUBLICATION.

15 AUG. 74
CHANGE 1 15 SEPT 75

AFLC RAFB, GA REPRINT

Digital Systems Division

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES DESTROY SUPERSEDED PAGES

Note: The portion of the text affected by the changes is indicated by a vertical bar in the outer margins of the page.

Model 980 Computer Terminal User's Guide
Model 733 ASR/KSR Data Terminal (943009-9701)

Original Issue . . . . . 15 August 1974
Change 1 . . . . . 1 September 1975 (ECN 393175)

Total number of pages in this publication is 70 consisting of the following:

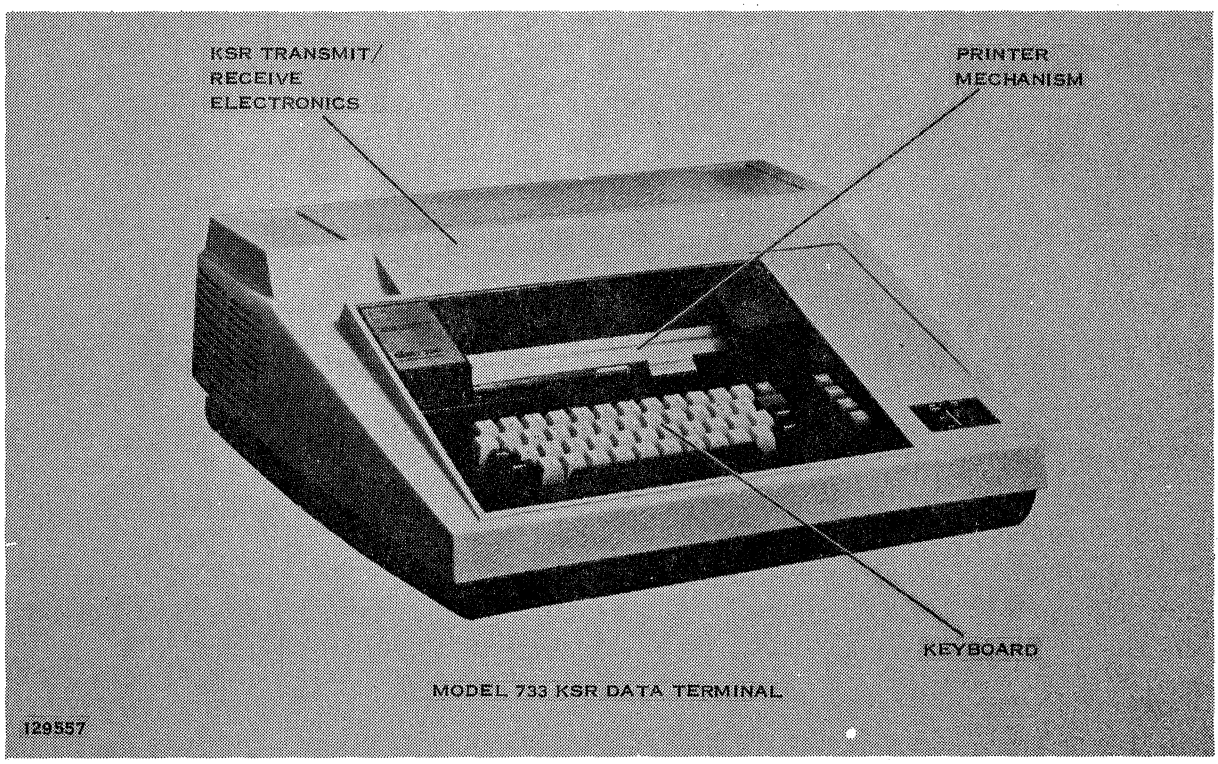
PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.	PAGE NO.	CHANGE NO.
Cover	1				
Eff. Pages	1				
iii - v	0				
1-0 - 1-6	0				
2-1 - 2-6	0				
2-7/2-8	1				
2-9 - 2-18	0				
3-1 - 3-8	0				
4-1 - 4-20	0				
5-1 - 5-2	0				
Alphabetical Index Div.	1				
Index-1 - Index-6	1				
User's Resp	1				
Bus. Reply	0				
Cover Blank	0				
Cover	1				

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

LIST OF TABLES



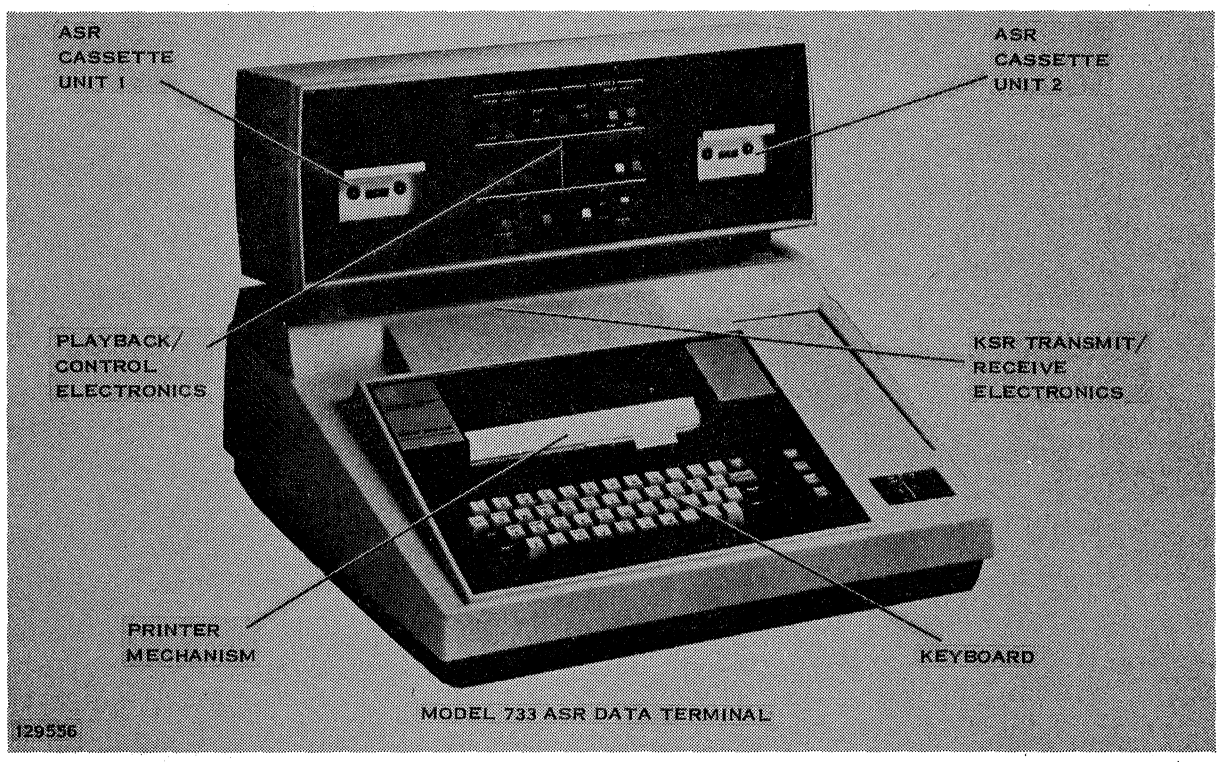


Figure 1-1. Model 733 ASR/KSR Data Terminals

SECTION I

GENERAL DESCRIPTION

1.1 DESCRIPTION

The Model 733 Terminals serve a wide variety of telecommunications applications requiring the USASCII code. The Model 733 KSR is a keyboard send-receive unit with selectable transmission speeds of 110, 150, and 300 baud (10, 15, or 30 characters per second). The Model 733 ASR is an automatic send-receive terminal that uses the keyboard and printer of the KSR plus two magnetic tape cassette units for automatic data transmission. The Model 733 ASR uses a transmission speed of 1200 baud (120 characters per second). However, the printer is only capable of printing at 300 baud (30 characters per second).

The Terminals consist of several modular units: the keyboard, the printer mechanism, transmit and receive electronics of the KSR lower unit, and record and playback cassette units including associated controls of the ASR upper unit as illustrated in figure 1-1. The modular units provide the following capabilities:

- The keyboard permits manual typing operations and transmission of printable characters and operational codes in seven-level USASCII code.
- The printer mechanism contains a paper handling mechanism, printhead movement devices and a solid-state, 5 by 7 matrix, heating element printhead.
- The transmit/receive electronics within the Terminals permit telecommunications with remote terminals and computers or with local (no transmit/receive) units.
- The RECORD section in the ASR upper unit controls recording of local (from the keyboard) or remote (from the telecommunication lines) messages on magnetic tape cassettes.
- The PLAYBACK section in the ASR upper unit controls playback of messages recorded on the magnetic tape cassettes for local use (printed out by the printer unit) or transmission to remote terminals or other devices.

The basic features of the Terminals and their optional equipment make them ideally suited for timesharing, point-to-point telecommunication, remote access, remote data entry, computer console, and similar applications. A unique serial data bus provides switch-selectable simultaneous operation in local or on-line modes and the capability to accept optional features without changing the basic unit. A self-contained power supply provides all power necessary to operate the terminal. The supply can be wired for either 115V or 230V operation, 50 or 60 Hz.

The ASR Terminal includes a magnetic tape cassette system consisting of two cassette transports, a record controller, and a playback controller. Either of the two transports may be used with the record controller or the playback controller but must operate alone or in opposite modes; i.e., one in the record mode and the other in the playback mode.

The tape recording format is serial-by-bit and serial-by-character, 86 characters to a physical block. The recording system permits the operator to edit or correct any line of data being recorded. It also allows correction of previously recorded lines, and blocks may be added to or deleted from a tape using a local mode tape duplicating process. In continuous tape format maximum storage capacity of a cassette using both sides of 310,000 characters. Data read from the tape is stored (one block at a time) in a buffer (memory) before being transmitted to a line or local device. The playback system allows data to be read from the tape, either continuously, a block at a time, or a character at a time. A block can also be reread any number of times to aid in recovering data in which a read error is detected. If the playback operation stops because of a read error, the erroneous block just read can be either skipped, transmitted, or reread.

1.2 SPECIFICATIONS

1.2.1 DATA FORMAT AND TRANSMISSION

A single data bus routes data within the Terminal. Data transmitted from the Terminal is in a serial 8-bit-per-character format. The eight bits include a 7-bit USASCII character code plus an eighth bit which is used as an end-of-block indicator in the ASR unit.

Transmission speed of the Model 733 KSR is switch selectable by the operator to 110 baud (10 characters per second), 150 baud (15 characters per second), or 300 baud (30 characters per second). The Model 733 ASR transmission speed is set at the factory to 1200 baud (120 characters per second).

An ON-LINE switch located on the switch panel controls the status of the entire Terminal. Refer to Section III of this manual for a description of the Terminal controls and indicators.

1.2.2 PRINTER

Refer to table 1-1 for the printer specifications.

1.2.3 COMMUNICATION LINE INTERFACE

The standard line interface conforms to EIA Standard RS232C. The Terminal can receive, without error, signals with mark and space distortion of up to 45 percent. The minimum stop bit time for error-free reception at any speed is 0.6 of a normal bit time.

Table 1-1. Printer Specifications

Specification	Value
Printing Method	5 x 7 dot matrix, electronically heated, on heat-sensitive paper
Line Length	7.9 inches, 80 characters
Character Spacing	0.1 inch, character center to center
Line Spacing	Six or three lines per inch (single or double spaced)
Paper (TI Part Number 213714-0001 or 953167-0001	Roll, 8.5 inches wide by 3.625 inches maximum diameter (300 feet), heat-sensitive
Platen	Friction feed
Carriage Return Time	195 milliseconds maximum. Note: Terminal is inhibited for 200 milliseconds during the carriage return.
Line Feed Time	33 milliseconds maximum (single space), 66 milliseconds maximum (double space)
Audible Alarm Time	250 (±50) milliseconds on receipt of the BEL character
Printable Characters	95
Carriage Return and Line Feed (CR/LF)	Automatic at column 81, no code is transmitted
Visibility of Printed Lines	At least 50 previous lines of print (including line and character being printed) are visible and unobstructed
Print Contrast	Operator adjustable

1.2.4 PHYSICAL

1. Dimensions — ASR, figure 2-1; KSR, figure 2-4
2. Weight — 38 pounds KSR, 56 pounds ASR, exclusive of all options

1.2.5 POWER REQUIREMENTS

1. Frequency — Normal operation with primary input power frequencies in the range of 48 to 62 Hz.
2. Voltage — 115 (+10% - 15%) volts RMS. It is possible to field-modify the terminal to operate on 230 (+10% - 15%) volts RMS. Refer to Electronic Data Terminals Manual, part number 959227-9701.
3. Power — Required primary input power at maximum rated voltage is 200 VA maximum

1.2.6 TAPE TRANSPORT

Refer to table 1-2 for the tape transport specifications.

Table 1-2. Tape Transport Specifications

Specification	Value
Recording Speed	8 inches per second
Rewind Time	60 seconds maximum
Tape Drive	Capstan drive for recording or playing back
Error Rate	One in 10^6 maximum, using certified cassette tapes and proper head-cleaning procedures; one in 10^7 typical
Interchangeability	Any tape recorded on any 733 ASR transport operating within specifications may be read on any other 733 ASR transport of the same model operating within specifications
Sensors	EOT, BOT, cassette-in-place, write tab, transport-door-closed

1.2.6.1 RECORD. Data can be recorded on the designated record transport from the keyboard, line interface, or the playback transport. Recording from the line interface is done at 1200 baud (120 characters per second). The recording method is phase encoding at 800 bits per inch (1600 flux reversals per inch) single track (a second track in the cassette is also available for recording by turning the cassette over.)

1.2.6.2 PLAYBACK. Data can be retrieved from the playback transport and transmitted to the printer, line interface, or record transport. Playback to the communication line is performed at 1200 baud (120 characters per

second). When transferring data from a playback transport to the line interface or page printer, playback is inhibited for 200 milliseconds following the carriage return character in the line tape format (carriage return character time is included in the 200 milliseconds) or at the end of each block in either format. Local high speed duplication is performed at a 2500 baud rate (250 characters per second). If a printout is desired during duplicating, then the maximum speed is limited to 300 baud (30 characters per second) due to the printer.

SECTION II

INSTALLATION

2.1 GENERAL

This section provides the instructions to install the Terminal and prepare it for use. Obtain a copy of Electronic Data Terminals Manual, part number 959227-9701 for reference during installation.

2.2 MODEL 733 ASR

Refer to figure 2-1 for the Terminal outline dimensions and weight. To unpack and install the Terminal, select an appropriate location and proceed as follows:

1. Remove the KSR (lower) unit from its shipping container and place it on the accessory terminal stand or other flat surface. (Leave the keyboard cover closed.)
2. Remove the ASR (upper) keyboard unit from its shipping carton and carefully place it, display panel down, on a flat surface.
3. Facing the bottom of the upper unit, loosen the four 10-32 screws about 4-1/2 turns (these are the screws with the largest heads). The four screws should protrude 1/8 to 3/16 inch.
4. Note the two keyhole slots in both pedestals at the top rear of the KSR (lower) unit. Pick up the ASR upper unit and place it on the two pedestals so that the heads of the four screws loosened in step 3 enter the large portion of the slots. Ensure that the upper unit controls face the keyboard.
5. Check that the base of the upper unit is resting squarely on the pedestals. Now slide the upper unit to the rear so the screws locate at the narrow part of the keyhole slots.

CAUTION

Before proceeding, check that the upper unit is in proper position by trying to lift it from the KSR unit. It will not lift from the lower unit if properly located.

6. Slowly raise the keyboard cover to its uppermost position. The four upper unit mounting screws are now accessible through the four rectangular shaped holes in the metal support plate.

   Tighten the four mounting screws securely. Lower the keyboard cover.

7. Locate ASR/KSR interconnecting cable 959371-1 and the terminal maintenance kit. (This kit contains alcohol and cotten swabs for cleaning the terminal components.) Within this kit find a plastic bag containing four screws (two 4-40 x 3/8 and two 4-40 x 5/8). These screws are used to fasten the ASR/KSR interconnecting cable to the respective assemblies.

8. Plug the connector marked P1 onto the cassette connector (figure 2-1) of the ASR unit. The key slot must be positioned up to mate with the tab on the cover. Ensure that the connector is inserted as far as the cover will allow. Secure the connector with the two shorter screws (4-40 x 3/8) through the holes in the connector ears.

9. Dress the cable to the left (viewed from the rear) in a "C" shaped configuration close to the unit and plug the connector marked P3 onto the cassette connector (figure 2-1) of the KSR unit. The key slot must be positioned up to mate with the key in the connector housing. Insert as far as possible. Secure this connector with the two longer screws (4-40 x 5/8) through the holes in the connector ears.

10. Plug the small white connector (P13) on the cable extending from the fan into the connector next to the fuse and power cord outlet on the KSR unit. It is keyed and may be inserted only one way. A protective clip may have to be removed.

11. Ensure that the POWER switch is OFF and connect the AC power cord to an AC power source.

12. Carefully lift the keyboard cover and verify the following switch positions:

    SPEED - HI

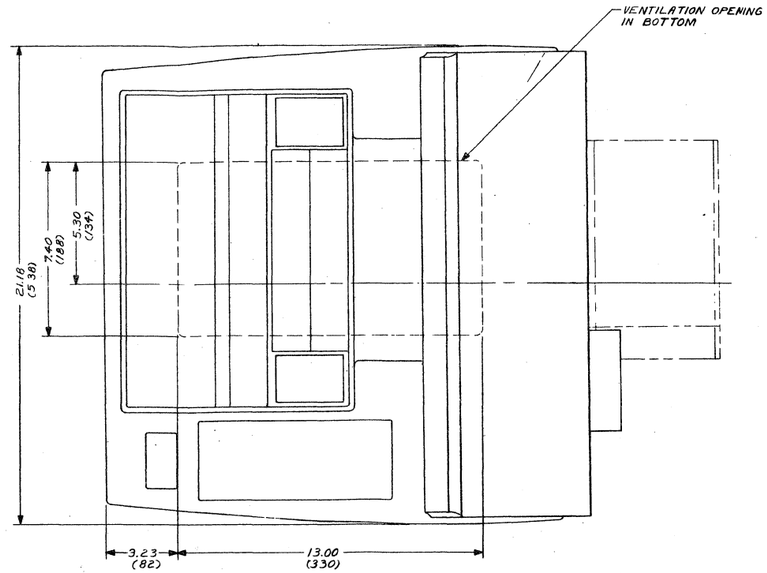
    DUPLEX - FULL

    ADC - ON

    LINE FEED - 1

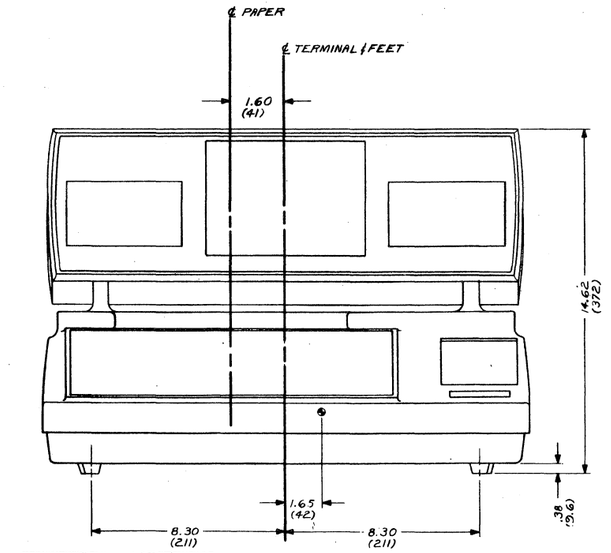
    PARITY - ODD

13. Close the keyboard cover. In the RECORD CONTROL section of the ASR unit, set TAPE FORMAT switch to CONT.



NOTES:

1. DIMENSIONS IN PARENTHESIS ARE IN MILLIMETERS.
2. WEIGHT IS APPROXIMATELY 56 LBS.



(B)129558 (960132)

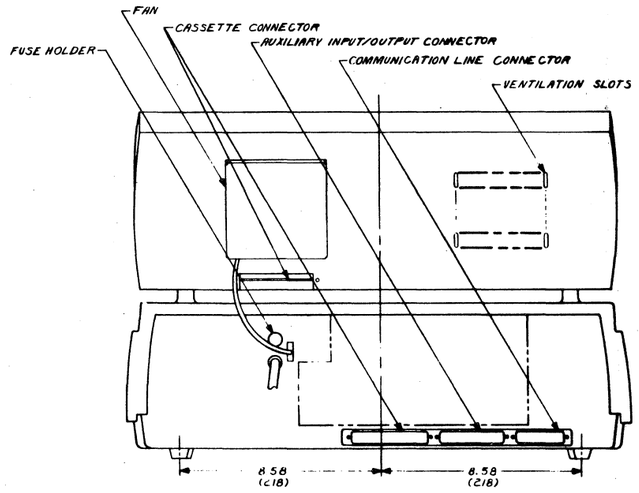


Figure 2-1. Model 733 ASR Data Terminal Outline Dimensions and Weight

2.2.1 PAPER LOADING

The Terminal must be loaded with paper before turning it on. Refer to figure 2-2 and proceed as follows:

1. Open the terminal cover and lift the pinch roller. Do not turn the drive roller (platen) unless the pinch roller is lifted.
2. Place the roll of paper on the holders. Ensure that the roll can turn freely.
3. Feed the paper down the paper chute, then between the paper chute and drive roller (platen). Ensure that the paper is centered in the paper chute.
4. Lower the pinch roller, making sure that the paper is between the pinch roller and the drive roller (platen).
5. Turn the POWER switch on and press the PAPER ADV key. Ensure that paperfeed is smooth and straight.
6. Close the terminal cover. Feed the paper through the slot in the cover.

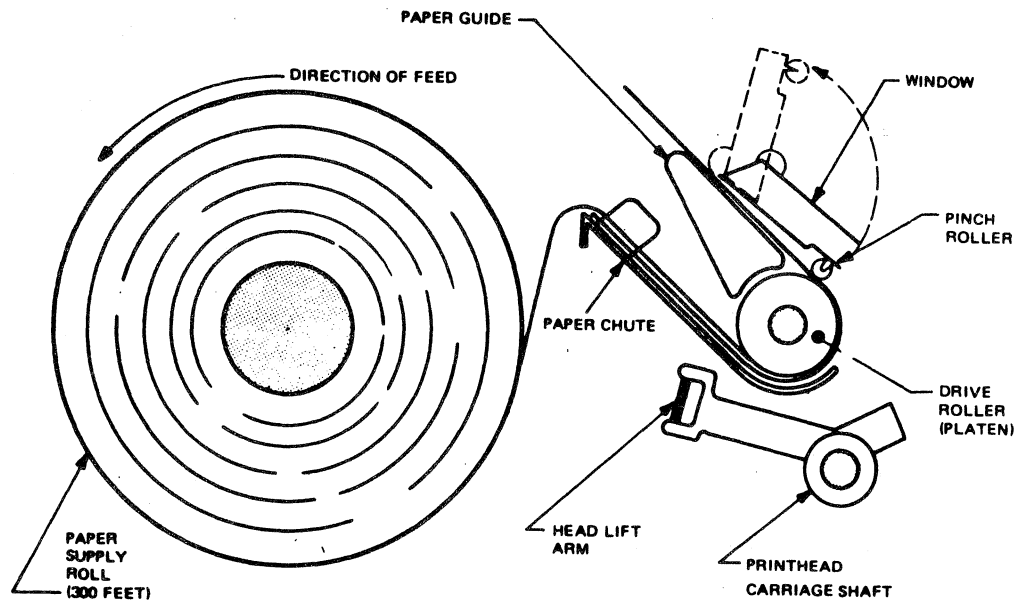


Figure 2-2. Paper Loading

2.2.2 CASSETTE INSTALLATION

To install or remove a magnetic tape cassette refer to figure 2-3 and proceed as follows:

1. Open the transport door.

NOTE

Letter designating the side of the cassette called out must be facing operator when the cassette is properly installed.

2. Insert the cassette with the tape side up (figure 2-3A).
3. Press the cassette down and in (figure 2-3B). Be sure that the capstan and reel rotors fit into the proper holes.
4. Close the transport door.
5. To remove a cassette from the transport, open the door to the first stop. A quick downward motion from that point will eject the cassette from the transport.

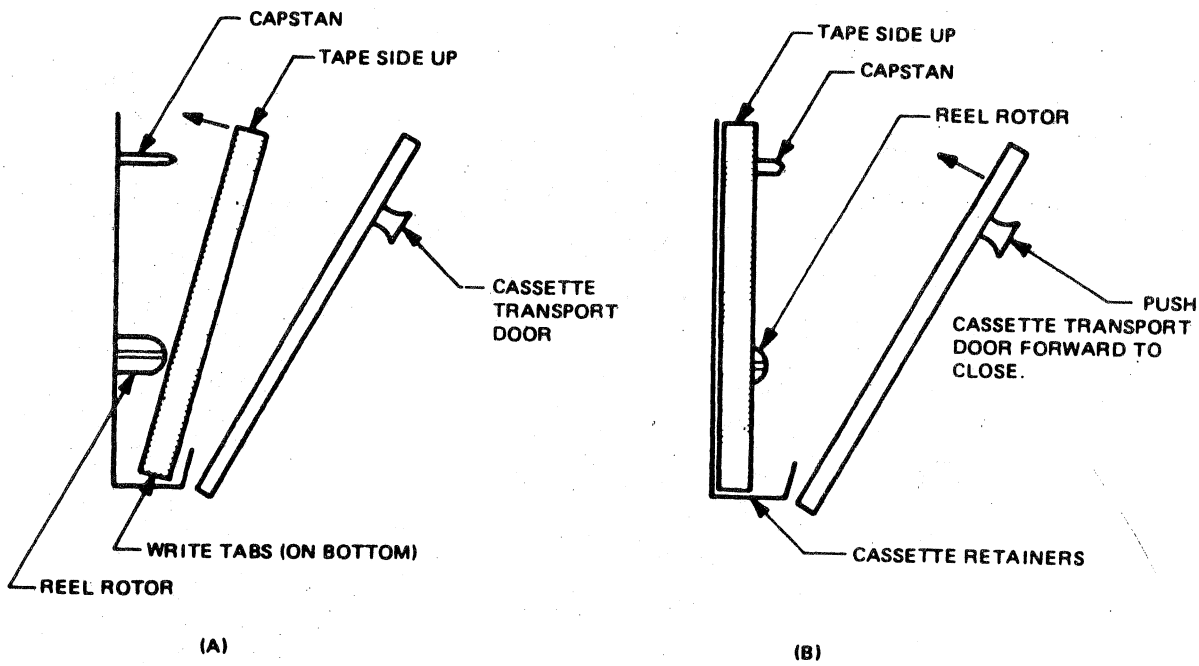


Figure 2-3. Cassette Installation

2.3 MODEL 733 KSR

Refer to figure 2-4 for the Terminal outline dimensions and weight. Select an appropriate location and proceed as follows:

1. Remove the KSR unit from its shipping container and place it on the accessory terminal stand or other flat surface. (Leave the keyboard cover closed.)
2. Ensure that the POWER is OFF and connect the AC power cord to an AC power source.
3. Carefully lift the keyboard cover and verify the following switch positions:

   SPEED - HI

   DUPLEX - FULL

   LINE FEED - 1

   PARITY - ODD

4. Close the keyboard cover.

2.3.1 PAPER LOADING

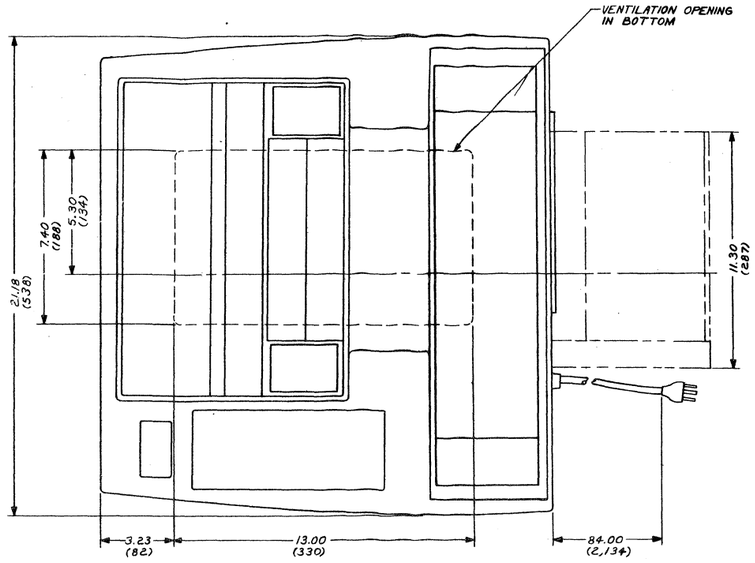
The Terminal must be loaded with paper before turning it on. Refer to paragraph 2.2.1 for loading instructions.

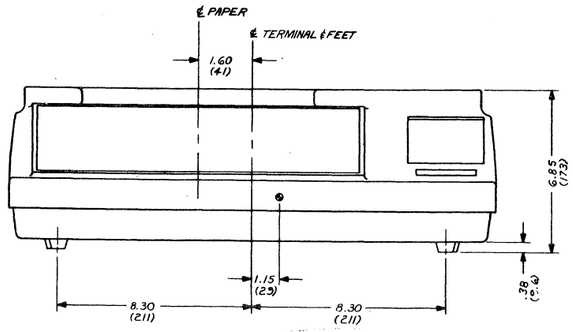
2.4 INTERFACE CIRCUIT CARD

The CPU interface card used for the Terminal is the Communications Module, TI part number 966637-0002. This circuit card has a number of options which must be set, using the two Dual-Inline Package (DIP) switches S1 and S2, before the circuit card is installed. In the following tables the ON position of a switch pole equals a logic zero. The OFF position equals a logic one. Review the following options and set the switch poles accordingly.

2.4.1 MODULE ADDRESS SELECTION

The 64 addresses available for use by the communications module are: 00_{16} to $0F_{16}$, 10_{16} to $1F_{16}$, 40_{16} to $4F_{16}$, and 50_{16} to $5F_{16}$. Table 2-1 illustrates how to set a desired address (in binary format) into the module. The module address is contained in word 1 of the WDS or RDS instruction. Bits 9 and 11 through 15 are used for the address. Bit 10 is used to designate the WDS or RDS instruction. Poles 2 through 7 of switch S1 are used to set in the address. To correlate between the address bits and the switch poles of S1 the nomenclatures A09 and A11 through A15 are printed on the circuit card next to the appropriate poles. The standard address used by TI supplied software is 05_{16}. The most significant digit of the address is set with poles 2 and 3 of switch S1. The least significant digit is set with poles 4, 5, 6, and 7.





(B)129559 (960131)

NOTES.

1. DIMENSIONS IN PARENTHESIS ARE IN MILLIMETERS.
2. WEIGHT IS APPROXIMATELY 38 LBS.

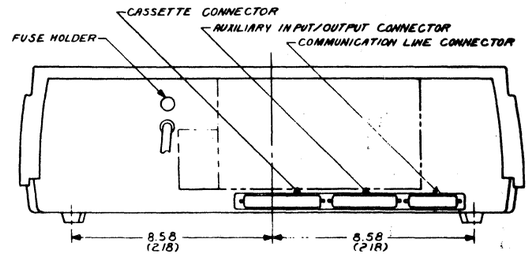


Figure 2-4. Model 733 KSR Data Terminal Outline Dimensions and Weight

Table 2-1. Module Address Selection

Switch S1			Switch S1				
MSD	Pole 2 (A09)	Pole 3 (A11)	LSD	Pole 4 (A12)	Pole 5 (A13)	Pole 6 (A14)	Pole 7 (A15)
0	ON	ON	0	ON	ON	ON	ON
1	ON	OFF	1	ON	ON	ON	OFF
4	OFF	ON	2	ON	ON	OFF	ON
5	OFF	OFF	3	ON	ON	OFF	OFF
			4	ON	OFF	ON	ON
			5	ON	OFF	ON	OFF
			6	ON	OFF	OFF	ON
			7	ON	OFF	OFF	OFF
			8	OFF	ON	ON	ON
			9	OFF	ON	ON	OFF
			A	OFF	ON	OFF	ON
			B	OFF	ON	OFF	OFF
			C	OFF	OFF	ON	ON
			D	OFF	OFF	ON	OFF
			E	OFF	OFF	OFF	ON
			F	OFF	OFF	OFF	OFF

NOTE: The standard address for TI supplied software is underscored with a dashed line.

2.4.2 BAUD RATE SELECTION

The transmit and receive baud rate is determined by switch S2 poles 1, 2, and 3. To aid in identifying these poles the letters R/A, R/B, and R/C are printed on the circuit card next to the appropriate pole. Table 2-2 lists the switch positions required for the various baud rates.

Table 2-2. Baud Rate Selection

Baud Rate	Switch S2		
	Pole 1 (R/A)	Pole 2 (R/B)	Pole 3 (R/C)
75	ON	ON	ON
110	OFF		
150	ON	OFF	
300*	OFF		
1200**	ON	ON	OFF
2400	OFF		
9600	ON	OFF	
4800***	OFF		

*Normal rate for 733 KSR
**Normal rate for 733 ASR
***Jumper wire between E16 and E15 (standard manufacture), or 600 baud with jumper wire between E16 and E17

2.4.3 PARITY ENABLE AND SELECTION

The parity generation and checking option is selected by switch S2 poles 4 and 5. To aid in identifying these poles PI (parity inhibit) is printed on the circuit card near pole 4 and PS (parity select) is printed near pole 5. When parity is enabled, switch S2 pole 5 selects either even or odd parity as shown in table 2-3.

Table 2-3. Module Parity Selection

Parity Selection	Switch S2	
	Pole 4 (PI)	Pole 5 (PS)
Parity Inhibited	OFF	No effect
Odd Parity*	ON	ON
Even Parity		OFF

*Normal position for 733 ASR and KSR

2.4.4 WORD LENGTH SELECTION

The number of data bits in the word to be transmitted and to be checked in the word received may be set to 5, 6, 7, or 8 bits (in addition to parity). The number of data bits is selected by switch S2 poles 6 and 7. To aid in identifying these poles WL2 (word length 2) is printed on the circuit card next to pole 6 and WL1 (word length 1) is printed near pole 5. Table 2-4 lists the switch positions for selecting the number of data bits.

Table 2-4. Word Length Selection

Number of Data Bits	Switch S2	
	Pole 6 (WL2)	Pole 7 (WL1)
5	ON	ON
6		OFF
7*	OFF	ON
8		OFF

*Normal position for 733 ASR and KSR

2.4.5 STOP BIT SELECTION

The number of stop bits is normally switch selectable although it can be programmable. For programmable stop bit selection connect a jumper wire between E2 and E3. For switch selectable stop bits, E1 is jumpered to E3 (standard manufacture) and switch S1 pole 1 determines the number of stop bits as listed in table 2-5. To aid in identifying this pole STB (stop bit) is printed on the circuit card next to the pole.

Table 2-5. Stop Bit Selection

Stop Bit Selection	Switch S1 Pole 1 (STB)
1 Stop Bit*	ON
2 Stop Bits	OFF

*Normal position for 733 ASR and KSR

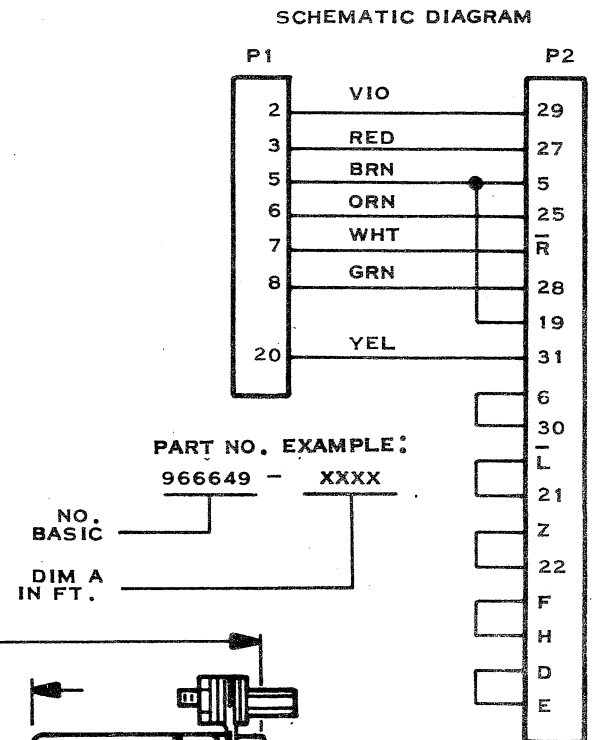
2.5 INTERFACE CABLES

The interface cables used to connect the Terminal to the interface circuit card are TI part numbers 966649 and 959372. Data on these cables are given in figures 2-5 and 2-6.

2.6 INTERFACE CONNECTIONS

Ensure that the interface circuit card is installed in the CPU I/O chassis with the colored ejector tab toward the chassis slot designator strip. The P2 connector of interface cable 966649 is attached to the top of the interface card so that the cable is dressed to the left (over the power supply) and out the rear of the CPU. The P1 connector connects to P13 of adapter cable 959372. The P1 connector of adapter cable 959372 connects to the communication line connector on the rear of the Terminal. See figure 2-7.

WIRE NO.	DESCRIPTION	TOTAL LENGTH	SIGNATURE	COMPONENT CONNECTION FOR START STATION	COMPONENT CONNECTION FOR FINISH STATION
1	RED	31 FT	XMTDE→RCVDE	P2 – 27	P1 – 3
2	GRN		RTSE→DCDE	P2 – 28	P1 – 8
3	ORN		DTRE→DSRE	P2 – 25	P1 – 6
4	BRN		PCTSE→CTSE	P2 – 5	P1 – 5
5	YEL		DSRE←DTRE	P2 – 31	P1 – 20
6	VIO		RCVDE←XMTDE	P2 – 29	P1 – 2
7	BLK		SPARE	———	———
8	WHT		(GND)←→SGRD	P2 – $\overline{R}$	P1 – 7
9	BLU		SPARE	———	———
10	GRY	31 FT	SPARE	———	———
11	#22 IPVC,WHT	AR	PCTSE→CTSE	P2 – 5	P2 – 19
12			PDCDE→DCDE	P2 – 6	P2 – 30
13			RCVD/EIA→RCVD/EIA	P2 – $\overline{L}$	P2 – 21
14			$\overline{\text{RCVD/IN}}$→(GND)	P2 – 22	P2 – Z
15			$\overline{\text{XMTD/A}}$→$\overline{\text{XMTD}}$	P2 – H	P2 – F
16	#22 IPVC,WHT	AR	XMTD/A→XMTD	P2 – E	P2 – D



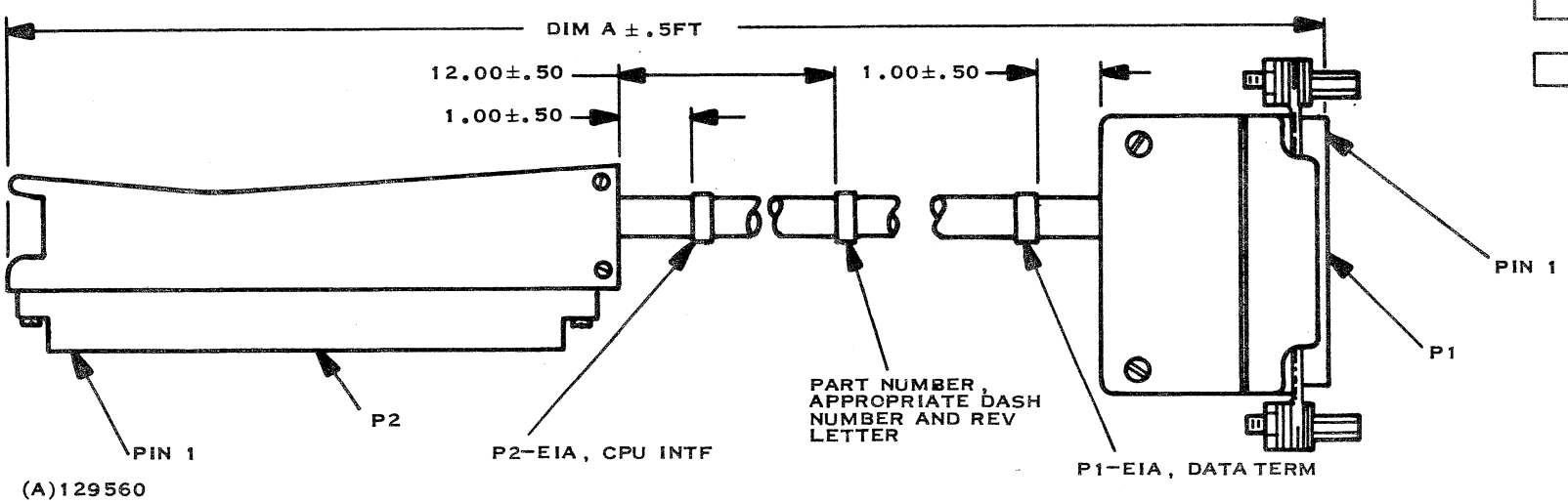
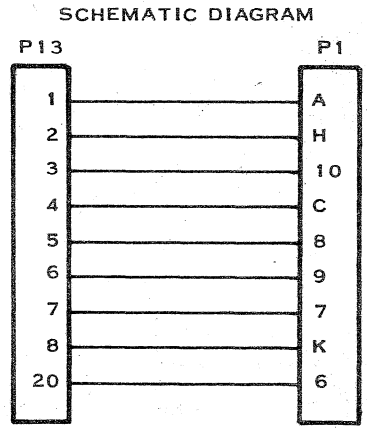


Figure 2-5. Interface Cable Data

WIRE NO.	DESCRIPTION	TOTAL LENGTH	START STATION	FINISH STATION
1	#22 IPVC WHT		P1 – A	P13 – 1
2			H	2
3			10	3
4			C	4
5			8	5
6			9	6
7			7	7
8			K	8
9	#22 IPVC WHT		P1 – 6	P13 – 20



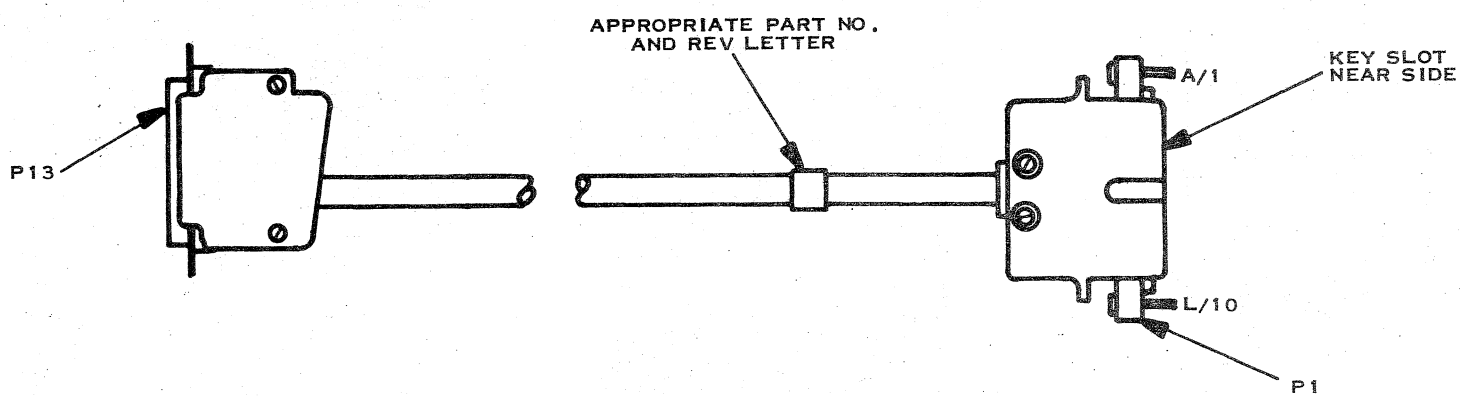


Figure 2-6. Adapter Cable Data

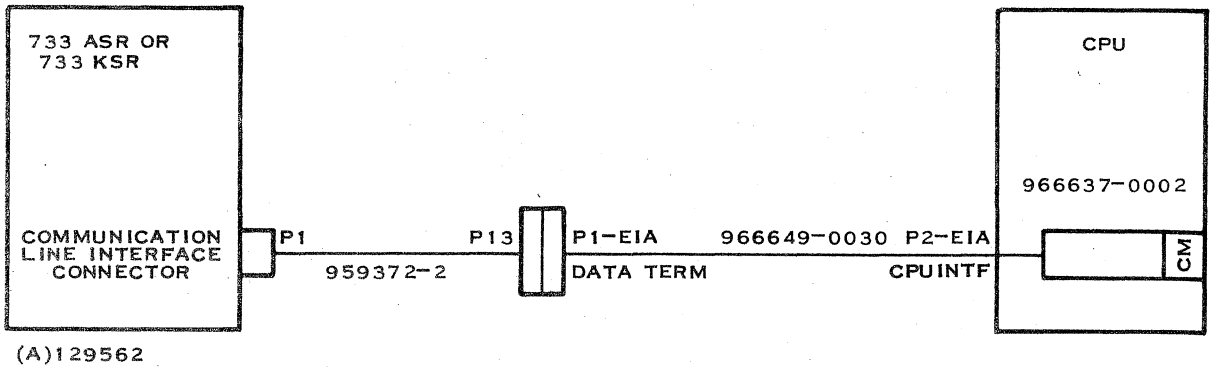


Figure 2-7. Interface Connectors

SECTION III
OPERATION

3.1 GENERAL

This section contains a brief description of the controls and indicators of the Terminals. More detailed information is contained in Electronic Data Terminals Manual, part number 959227-9701. Preliminary operation information is also given in this section.

3.2 TERMINAL CONTROLS AND INDICATORS

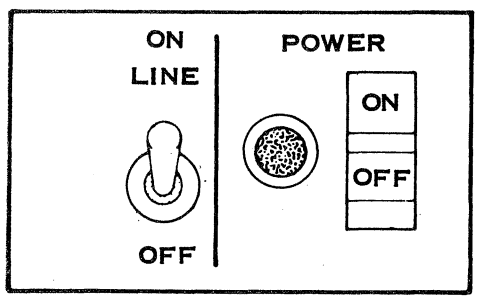
The Terminal's primary control areas are:

1. The ON-LINE/OFF and master POWER switch
2. The keyboard controls
3. The upper switch panel (ASR only).

3.2.1 ON-LINE/OFF SWITCH (FIGURE 3-1)

In ON-LINE, the terminal is set up to communicate with external devices through the line interface. The terminal transmits to the outside line from the keyboard or playback tape and receives data on the printer or recorder tape.

3.2.1.1 ASR LOCAL OPERATION. Local operation for the ASR is normally controlled from the upper switch panel LINE/OFF/LOCAL switches (figure 3-2) while the terminal ON-LINE/OFF switch remains set to ON-LINE. The ON-LINE/OFF switch is set to OFF if it is desired to disconnect the entire terminal from the communications line. When set to OFF, the printer and keyboard are automatically set to the local mode if the upper



(A)128600

Figure 3-1. Terminal ON-LINE/OFF Switch and Power Switch

switch panel PRINTER and KEYBOARD switches are set to either LINE or LOCAL. The playback and recorder, however, are held in the off state unless the bottom row LINE/OFF/LOCAL switches are set to LOCAL.

3.2.2 KEYBOARD CONTROLS

The standard USASCII keyboard special function keys are the following:

TAPE, TAPE	These two keys are used in the local mode to allow editing of data in the record buffer. After placing characters in the record buffer, tape reverse (TAPE) backspaces a character at a time to the selected character, then the character can be changed from the keyboard. To return to the point where the tape was started, actuate tape forward (TAPE) as many times as necessary. If the PRINTER switch is in LOCAL, the printhead will move with actuation of these switches to help locate the character. No code is transmitted.
HERE IS	Depressing this key activates the optional Answer-Back memory. However, this option is not standard for Terminals supplied with 980 Computers.

3.2.3 UPPER SWITCH PANEL (ASR ONLY)

The upper switch panel (figure 3-2) controls the major devices (keyboard, playback cassette, record cassette, and printer) of the terminal. The switch panel is divided into three rows, each corresponding to a major function:

- Top row: tape mode and tape motion control
- Middle row: record and playback control and editing
- Bottom row: device functions (keyboard, record, playback, and printer) and their connections with an outside line or local loop.

3.2.3.1 TOP ROW, TAPE CASSETTE CONTROL. The cassette controls perform the following:

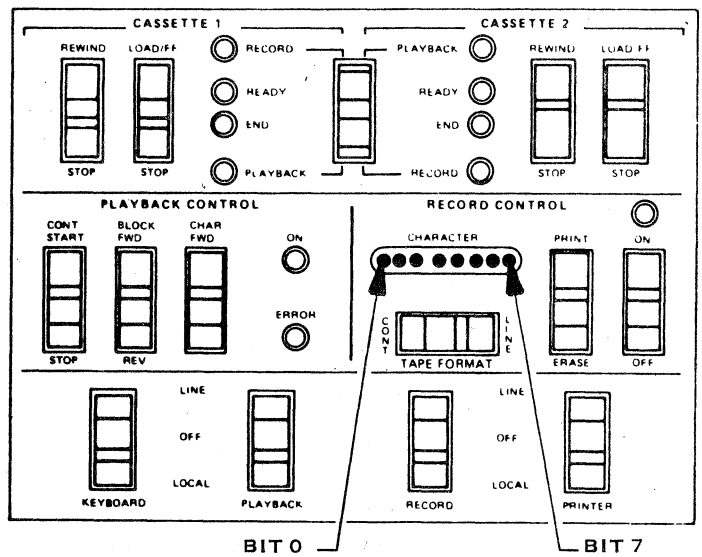
- Select which tape cassette will be played back or recorded on;
- Rewind, fast forward, and load (ready) the cassettes;
- Describe tape position and readiness using indicators.

Table 3-1 lists the functions of each top row switch.

Always rewind tape:

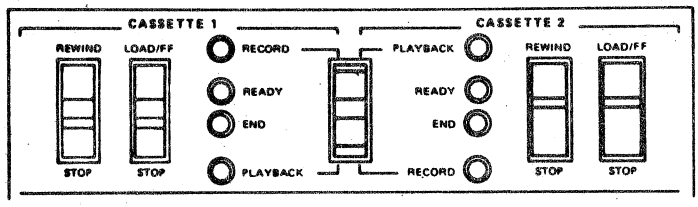
1. After a tape is inserted in a transport
2. After every initialization of power
3. Before removing a tape from a transport
4. Before switching off power to the terminal

To rewind a tape which is on clear leader with the takeup reel (reel on the left) full and the END indicator lighted, the REWIND switch must be depressed until the END indicator extinguishes. The tape is then past the clear leader.



(A)128601

Figure 3-2. Upper Switch Panel



(A)128602

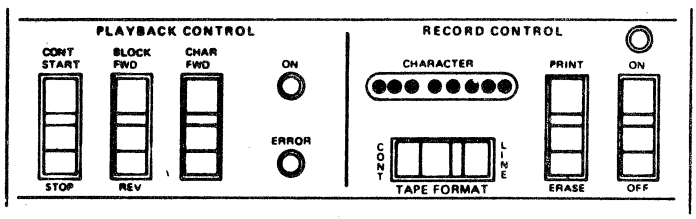
Table 3-1. Tape Control Switches (Switch Panel Top Row)

Switch/Indicator	Function
REWIND/STOP	REWIND causes the tape to wind toward the beginning-of-tape; continues until clear leader is sensed or STOP is pressed
LOAD/FF/STOP	After rewinding to tape beginning, the cassette is "loaded" by pressing LOAD/FF. Tape moves forward to the beginning of tape marker, then stops. Pressing LOAD/FF again causes the tape to wind forward at high speed to the end of tape or until STOP is depressed. The fast forward is useful in advancing the tape to the opposite end or for performing a local tape search for editing purposes.
NOTE REWIND and LOAD/FF are inoperative when RECORD CONTROL or PLAYBACK CONTROL (second row of switches) are ON.	
PLAYBACK/RECORD Switch	Selects which cassette is in playback mode or record mode (cassette 1 or 2); cassettes automatically switch to opposite modes.
PLAYBACK/RECORD INDICATOR Lamps	Indicate cassette is in playback or record mode.
END Indicator Lamps	Lights when clear leader is sensed at either end of tape
READY Indicator Lamps	Lights when cassette is ready for applicable record or playback operation.

3.2.3.2 MIDDLE ROW, PLAYBACK AND RECORD CONTROLS. Some of the functions performed by the PLAYBACK and RECORD controls are the following:

- Allow print or erasure of blocks while recording;
- Start and stop tapes during recording or playback;
- Select whether recording will be either line or continuous tape format;
- Perform the edit functions. Editing is conducted in the LOCAL mode only (off-line).

Table 3-2 lists functions of each middle row switch.



(A)128603

Table 3-2. PLAYBACK/RECORD Control Switches (Switch Panel Middle Row)

Switch/Indicator	Mode	Function
		PLAYBACK CONTROL
CONT START/ STOP		Momentarily pressing CONT START begins continuous playback of the cassette designated by the illuminated PLAYBACK light. Tape will stop when clear leader is sensed or STOP is momentarily pressed.
BLOCK FWD/ REV	PLAYBACK	Momentarily pressing BLOCK FWD causes the next block on tape to be read and played back, or the remainder of a block should the playback of that block have been stopped in the middle. Momentarily pressing REV causes the tape to back up one block and stop (used in block locating).

Table 3-2. PLAYBACK/RECORD Control Switches (Switch Panel Middle Row) (Continued)

Switch/Indicator	Mode	Function
CHAR FWD		Momentarily pressing CHAR FWD allows reading out the playback buffer one character at a time. If the buffer is empty, the next block will be entered in the buffer from the tape, and the first character will be read. A character can be read on the CHARACTER display (if duplicating a tape) or on the printer.
ON Indicator Lamp		Lights when PLAYBACK CONTROL is in use.
ERROR Indicator Lamp		Lights when a parity error (missing flux reversal) on the tape is found during playback.
		RECORD CONTROL
CHARACTER Incator Lamps		Shows 7-bit USASCII code of the character being addressed in the Record Buffer. Bits 0 to 7 read from left to right. Bit 7 is used internally by the terminal.
LINE/CONT (TAPE FORMAT switch)	R E C O R D	This two-position switch controls the recording tape format. When the switch is in the LINE position, recording of data on tape is initiated by the USASCII carriage return character or the 86th character of each block. Therefore, each block of data normally corresponds to one line of printout on the printer. This format is especially helpful when preparing and/or editing a tape on the recorder. With TAPE FORMAT switch in the continuous (CONT) position, recording of data on tape is initiated only by the 86th character of each block. Therefore, each block of data on tape may contain several lines of printout on the printer. This format is especially useful when maximum tape storage is desired. Tapes recorded in one format may be easily converted to the other format through the tape duplicating process.

Table 3-2. PLAYBACK/RECORD Control Switches (Switch Panel Middle Row) (Continued)

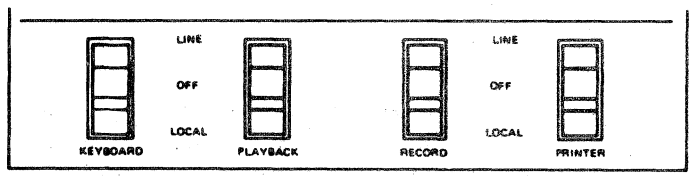
Switch/Indicator	Mode	Function
PRINT/ERASE		This switch is used to check record buffer contents during editing. The PRINTER and RECORD switches must be set to LOCAL. Contents of the record buffer will be printed out (but not recorded on tape) when PRINT is pressed and the buffer contents will not be affected. Pressing ERASE will erase the record buffer contents but will not affect data recorded on the tape. To erase an entire tape cassette, refer to Electronic Data Terminals Manual, part number 959227-9701.
ON/OFF		This switch turns on the recorder and RECORD CONTROL allowing receipt of data into the record buffer and transferring the contents of the record buffer (if any) to tape. If ERASE is pressed before or during actuation of OFF and OFF is released first, tape erasure will be initiated and continue until OFF is pressed again.
ON Indicator Lamp		Lights when RECORD CONTROL is in use.

3.2.3.3 BOTTOM ROW, DEVICE CONTROLS. The functions of the major 733 ASR devices are controlled by the bottom row of switches, as follows:

Select whether to connect the devices to the local loop or to the outside communication line (LINE, LOCAL);

Disconnect the devices from both the local loop and outside communication line (OFF).

Table 3-3 lists the function of each bottom row device mode switch.



(A)128604

Table 3-3. Device Function Switches (Switch Panel Bottom Row)

Setting	Function
LINE/OFF/LOCAL	The LINE/OFF/LOCAL switches are used to connect the keyboard, recorder, and printer to the local loop or to the line loop. Devices set to LOCAL are interconnected but not connected to the line loop. When the terminal ON-LINE/OFF switch adjacent to the keyboard is set to ON-LINE, devices set to LINE will be interconnected and also connected to the line loop if in half duplex. In full duplex the keyboard and playback can be connected to the transmit line; the recorder and printer can be connected to the receive line. Devices set to OFF are disconnected from both the line and local loops.

3.3 OPERATION

During normal program execution, the ON-LINE/OFF switch shall be kept in the ON-LINE position. The four lower switches on the upper switch panel of an ASR unit (KEYBOARD, PLAYBACK, RECORD, PRINTER) shall be in the LINE position. Ensure that the TAPE FORMAT switch is in the CONT position.

SECTION IV

INTERFACE DESCRIPTION

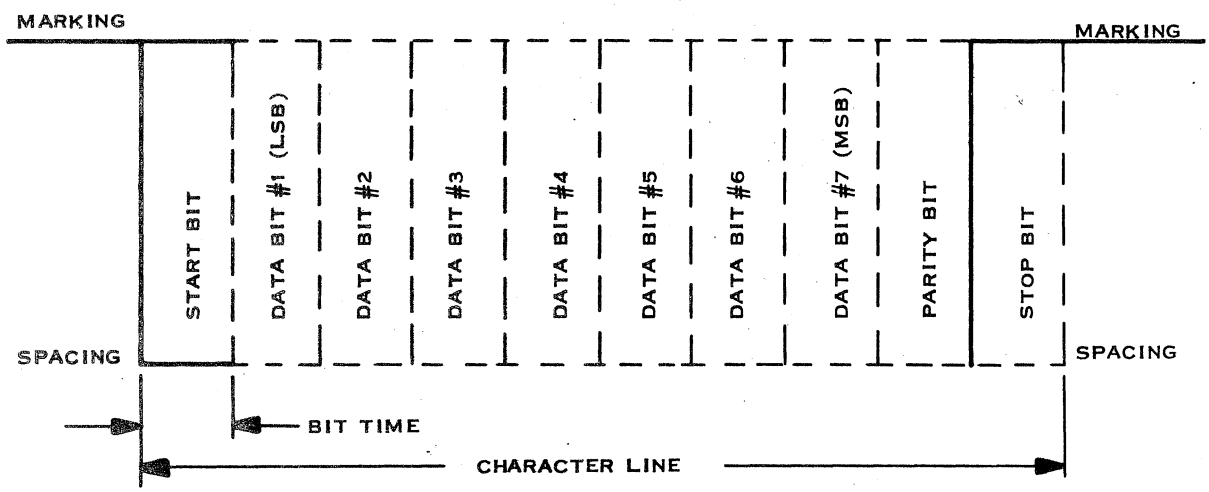
4.1 GENERAL

The Model 733 Terminals interface with the Model 980 computer using a standard 30 foot cable. The Model 733 ASR normally operates at a 1200 baud rate to allow rapid data transfer both to and from the cassette tape units.

NOTE

Although the Model 733 ASR can receive data at a 1200 baud rate, the printer section of the Terminal can only print at a 300 baud rate.

The Model 733 KSR normally operates at a 300 baud rate since it cannot print more than 30 characters per second. With the exception of the 110 baud rate, the USASCII character will be represented throughout the interface as the 10-bit data pattern shown in figure 4-1 and will be serially transmitted between



TIME VERSUS BAUD RATE	300-BAUD	1200-BAUD
BIT TIME	3.33ms	.833ms
CHARACTER TIME	33.3ms	8.33ms

(A)129563

Figure 4-1. Bit and Character Time Definitions

all interface components as a start bit, seven data bits with the least significant bit first, a parity bit, and a stop bit. The seven bits of data in conjunction with the parity bit comprise the standard 8-bit USASCII character code which is either presented to or expected from the computer. The start and stop bits are meaningful only with respect to timing considerations on the interface itself.

4.1.1 COMMUNICATIONS MODULE

The communications module is a general purpose circuit card used to interface data terminals and communications lines. The logic circuitry on the card performs all of the functions required to serially transmit and receive data while supplying a variety of status indicators and control functions to the computer. The formats of the computer write commands are defined in paragraph 4.2.1. The formats of the computer read commands are defined in paragraph 4.2.2.

The transmit and receive circuits on the communication module operate independently of one another (full-duplex mode of operation). Each circuit contains the devices to convert TTL logic levels into EIA voltage levels and the converse. All outgoing circuits on the communications module present two levels to the interface cabling and the associated data terminal. The positive level is defined as +8 ±3 volts in reference to the common signal ground and the negative level is defined as -8 ±3 volts. All incoming circuits recognize any voltage on the interface lines between +3 and +25 volts as the positive level and any voltage between -3 to -25 volts as the negative level.

4.1.2 INTERFACE CABLE

The interface cable is comprised of two independent serial data transmission lines, several control and status lines, and a common signal ground. Data on the interface signal lines between the communications module and the Terminal is given in figure 4-2. Each of these lines may exist in one of the two different states; however, each of these states has a different nomenclature depending on the specific type of signal and/or condition which is under discussion. Table 4-1 cross-references the various nomenclatures with their equivalent interface states.

4.1.3 BAUD RATE

The Model 733 ASR is interfaced at a baud rate of 1200 in order to provide a maximum efficiency in handling cassette tapes. The teleprinter portion of the Model 733 ASR is only capable of printing 30 characters per second when data is received in the on-line mode of operation. Therefore, in order to maintain a synchronous operation it is necessary to create an effective 300-baud transmission rate consisting of an 8.33 millisecond character time followed by a 25.0 millisecond minimum delay time. On the communications module this is accomplished by setting the WRITE REQUEST DELAY (WRD) bit of the module control register prior to initiating transmission of an USASCII character data string.

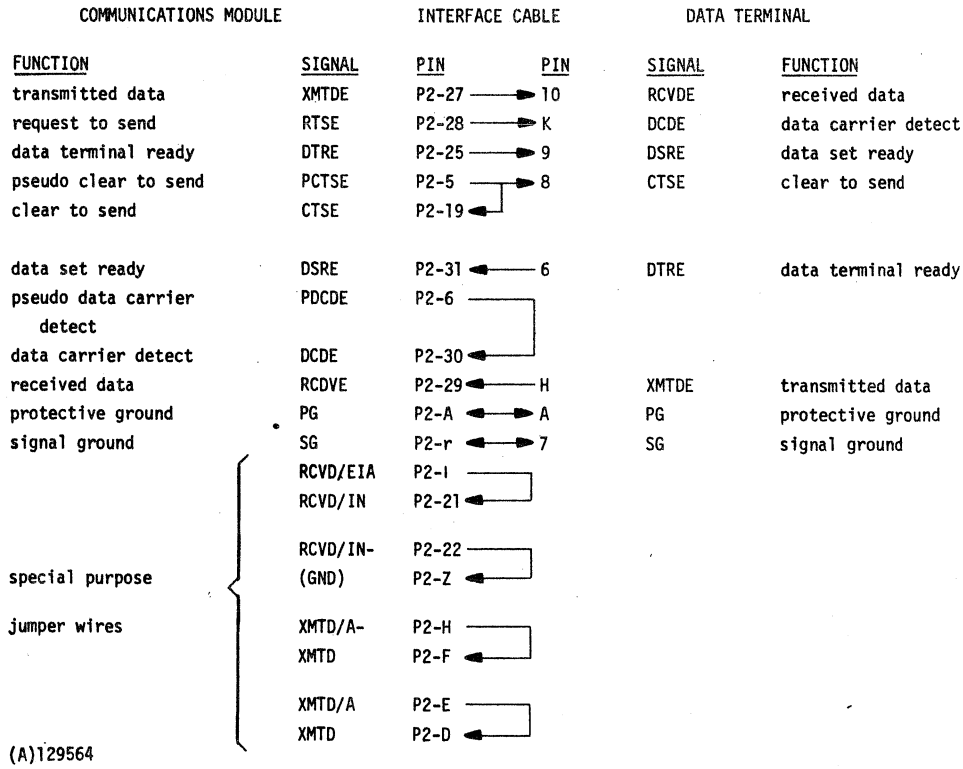


Figure 4-2. Interface Data

Table 4-1. Signal to Nomenclature Cross Reference

Applicable Signals	Conditions or Interface States	
EIA voltage levels	Negative (-8±3 volts)	Positive (+8±3 volts)
Binary logic states	Logic one	Logic zero
Control and status functions	Off	On
Data transfer signals	Marking	Spacing

4.2 SIGNAL DEFINITIONS

4.2.1 COMPUTER TO INTERFACE (FIGURE 4-3)

- CLEAR READ REQUEST (CRR)

  A logic one in bit 0 will clear the module READ REQUEST (RREQ) flag and its associated interrupt if one should exist. A logic zero causes no action.

- WRITE DATA READY (WDR)

  A logic one in bit 1 will cause the communication module transmit buffer register to be loaded with the USASCII character in bits 8-15 of the WDS data word. At the appropriate time the communications module will transfer the character to the transmit (shift) register and initiate serial transmission to the data terminal. A logic zero causes no action.

- CLEAR NEW DATA SET STATUS (CNS)

  A logic one in bit 2 will clear the communications module DATA SET STATUS (DSS) flag and its associated interrupt if one should exist. A logic zero causes no action.

- CLEAR WRITE REQUEST (CWR)

  A logic one in bit 3 will clear the communications module WRITE REQUEST (WREQ) flag and its associated interrupt if one should exist. A logic zero causes no action.

- Bits 4, 5, and 6 are not used.

- LOAD MODULE CONTROL (CON)

  A logic one in bit 7 will cause the communication module control register to be loaded with bits 8 through 12 of the WDS data word.

  (Bits 13, 14, and 15 are not used).

  The functions served by bits 8 through 12 are explained in the following paragraphs. A logic zero causes no action.

  Interrupt Enable (INT)

  A logic one in bit 8 will enable the communications module to issue an I/O bus interrupt upon the occurrence of a READ REQUEST (RREQ), a WRITE REQUEST (WREQ), and/or a NEW DATA SET STATUS (change in state of Data Set Ready). A logic zero inhibits the interrupt. The interrupt is reset by clearing (CRR, CWR, and/or CNS) all the conditions (RREQ, WREQ, and/or DSS) which are causing the interrupt.

  Write Request Delay (WRD)

  A logic one in bit 9 will enable the communications module to delay approximately 33 milliseconds after starting serial transmission of an USASCII character before issuing the WRITE REQUEST (WREQ). This delay option creates an effective 300-baud serial transmission rate when addressing the teleprinter section of the Terminal through a 1200-baud interface. A logic zero inhibits the delay action and allows the WRITE REQUEST (WREQ) in its normal manner, i.e., as soon as the module is ready to accept another USASCII character from the computer.

Stop Bit Select (SBS)

Bit 10 is not used.

Data Terminal Ready (DTR)

A logic one in bit 11 will maintain the communications module DATA TERMINAL READY (DTR) circuit in the ON condition. This circuit drives the DATA SET READY input line of the Terminal and, in effect, enables the transmit and receive capabilities of the Terminal. A logic zero maintains the DTR circuit in the OFF condition.

Request To Send (RTS)

A logic one in bit 12 will maintain the communications module REQUEST TO SEND (RTS) circuit in the ON condition. This circuit drives the DATA CARRIER DETECT input line of the Terminal and instructs the Terminal to accept the transmission of USASCII characters from the communications module. A logic zero maintains the RTS circuit in the OFF condition.

Bit 13 (Reverse Channel Transmit - RCT), bit 14, and bit 15 (Break - BRK) are not used.

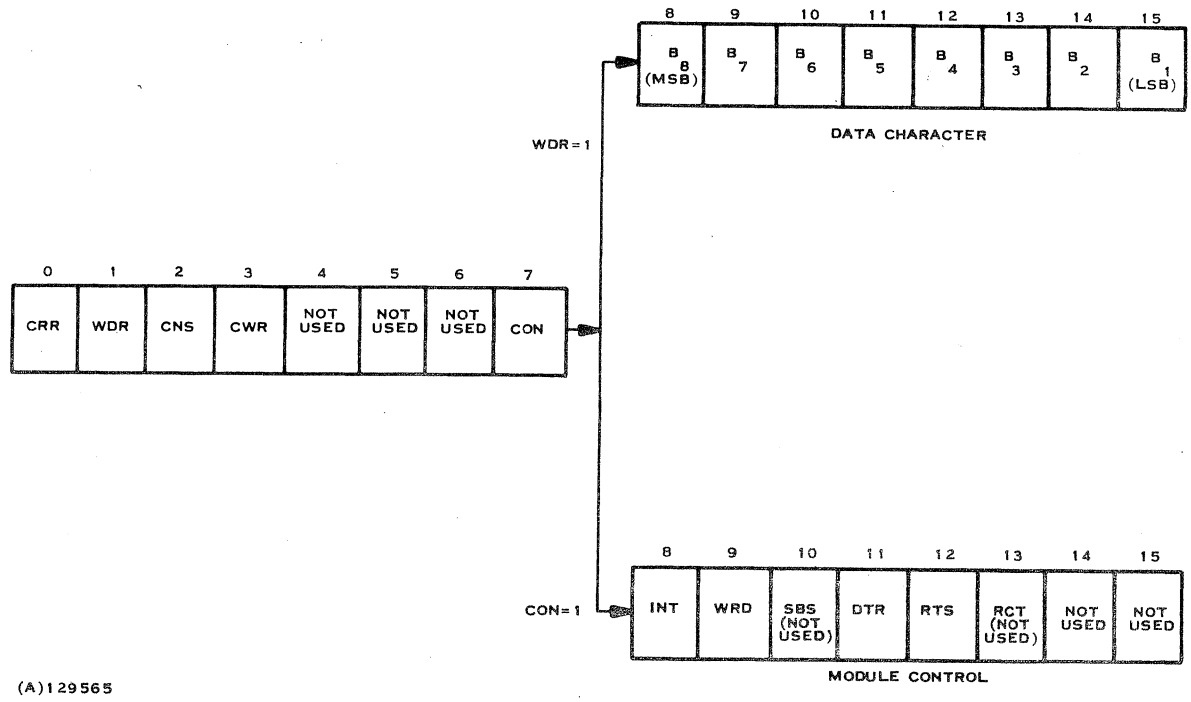


Figure 4-3. WDS Data Word Format

4.2.2 INTERFACE TO COMPUTER (FIGURE 4-4)

- READ REQUEST (RREQ)

  A logic one in bit 0 indicates that a USASCII character has been received from the terminal and stored in the communications module receive buffer register and that the character appears as bits 8 through 15 of the RDS data word. If the communications module I/O bus interrupt has been previously enabled then the I/O bus interrupt will be maintained as long as the RREQ signal is true. The RREQ flag and its associated interrupt are reset by issuing a CLEAR READ REQUEST (CCR). A logic zero indicates that a character is not being held for transfer to the computer memory and that bits 8 through 15 contain the communications module status information.

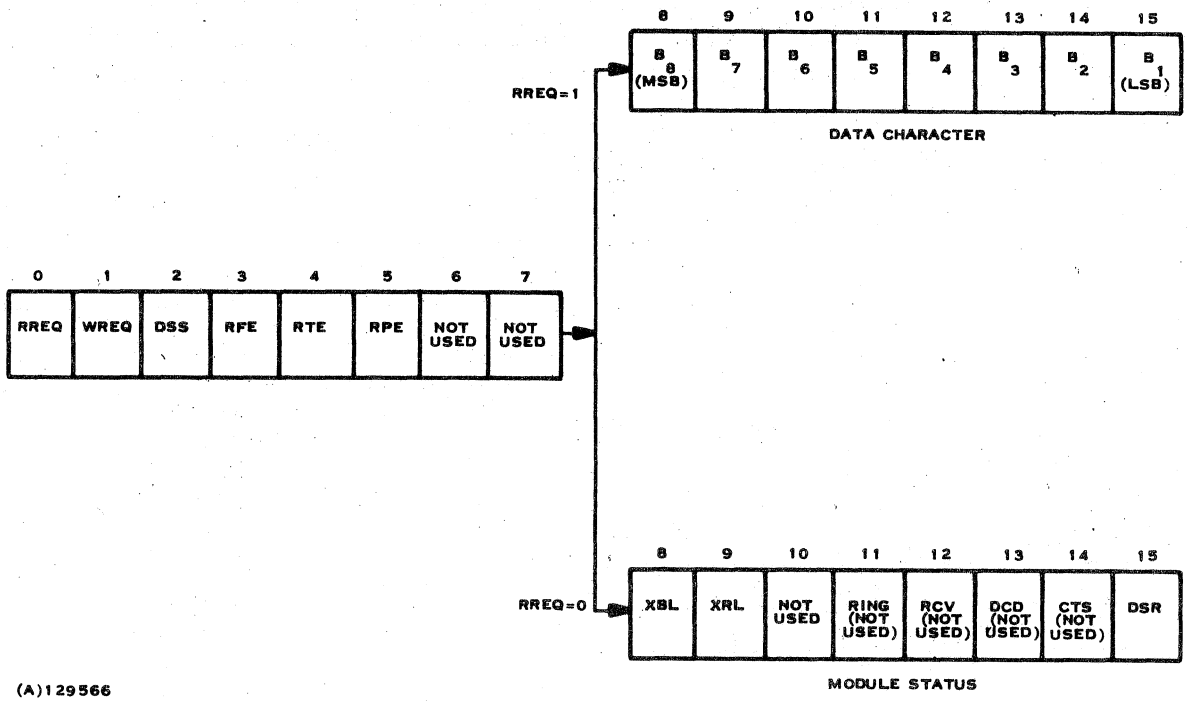


Figure 4-4. RDS Data Word Format

- WRITE REQUEST (WREQ)

  A logic one in bit 1 indicates that the transmit buffer register is presently empty and ready to accept another USASCII character for serial transmission to the Terminal. If the communications module I/O interrupt has been previously enabled, then the I/O bus interrupt will be maintained as long as the WREQ signal is true. The WREQ flag and its associated interrupt are reset by issuing a CLEAR WRITE REQUEST (CWR). A logic zero in bit 1 indicates that the communications module is not presently requesting an additional USASCII character for transmission to the Terminal. This situation may appear under two circumstances:

  1. When the transmit buffer register already contains a USASCII character as indicated by the presence of the TRANSMIT BUFFER REGISTER LOADED (XBL) signal.
  2. When the transmit buffer register is empty following the transmission of the last USASCII character in a data string, i.e., a new USASCII character was not sent to the communications module after the last WRITE REQUEST (WREQ) flag was cleared.

- NEW DATA SET STATUS (DSS)

  A logic one in bit 2 indicates that a change of state has occurred in the DATA SET READY (DSR) signal. This usually indicates that the keyboard ON-LINE/LOCAL switch of the Terminal has been repositioned. If the communications module I/O interrupt has been previously enabled, then the I/O bus interrupt will be maintained as long as the DSS signal is true. The DSS flag and its associated interrupt are reset by issuing a CLEAR NEW DATA SET STATUS (CNS). A logic zero in bit 2 indicates that no change has occurred in the DATA SET READY (DSR) signal since the last CLEAR NEW DATA SET STATUS (CNS) was issued.

- READ FRAME ERROR (RFE)

  A logic one in bit 3 indicates that improper character framing was detected by the receive circuitry. This error indicates either improper timing or erroneous stop bit(s) have been received. A logic zero indicates that no framing error is detected. This error status remains until a character with the proper framing is received or the module is reset. Bit 3 is valid only if bit 0 (RREQ) is a logic one.

- READ TIMING ERROR (RTE)

  The READ TIMING ERROR (RTE) flag is only valid as long as the READ REQUEST (RREQ) signal of the interface is true. A logic one in bit 4 indicates that the communications module has received another USASCII character from the Terminal before the computer has

completed storing the previous character. In this event, the module replaces the previous with the one most recently received and, as such, this flag indicates that one or more characters have been lost in transmission. The RTE flag is cleared when another character is properly received; provided, that a CLEAR READ REQUEST (CRR) has been previously issued. A logic zero indicates that no characters have been lost in transmission.

- READ PARITY ERROR (RPE)

  The READ PARITY ERROR (RPE) flag is only valid as long as the READ REQUEST (RREQ) signal of the interface is true. A logic one in bit 5 indicates that improper parity was detected by the communications module receive circuitry. Both the communications module and the Terminal expect odd parity. This flag indicates that the received character contained even parity. The RPE flag is cleared when another character is properly received; provided that a CLEAR READ REQUEST (CRR) has been previously issued. A logic zero indicates that the character was properly received with odd parity.

- Bits 6 and 7 are not used.

  Transmit Buffer Register Loaded (XBL)

  A logic one in bit 8 indicates that the communications module transmit buffer register is presently loaded with a USASCII character and is unable to accept another. A logic zero indicates that the USASCII character has been transferred to the transmit (shift) register and that the transmit buffer register is now ready to accept another USASCII character.

  Transmit (Shift) Register Loaded (XRL)

  A logic one in bit 9 indicates that the communications module transmit (shift) register is presently loaded with the last USASCII character supplied by the computer and that the character is in the process of being serially transmitted to the Terminal. A logic zero indicates that the module transmit (shift) register is empty and that no serial transmission is presently in progress.

  Bit 10 is not used.

  Ring Indicator (RING)

  Bit 11 is not used in this application and should always appear in the logic zero state.

Reverse Channel Receive (RCV)

Bit 12 is not used in this application and should always appear in the logic zero state.

Data Carrier Detect (DCD)

Bit 13 is not used in this application and should always appear in the logic one state.

Clear to Send (CTS)

Bit 14 is not used in this application and should always appear in the logic one state.

Data Set Ready (DSR)

A logic one in bit 15 indicates that the Terminal is in the ON-LINE mode of operation. This circuit is driven by the DATA TERMINAL READY output line of the Terminal and is maintained in the ON condition as long as the keyboard ON-LINE switch is engaged. A logic zero indicates that the Terminal is operating in the LOCAL mode.

A change of state in the DATA SET READY signal will cause the communications module to generate an I/O bus interrupt; provided that the interrupt has been previously enabled. This interrupt may be reset by issuing a CLEAR NEW DATA SET STATUS (CNS). However, the DATA SET READY (DSR) signal will remain at its last logic level until another change of state occurs in the Terminal.

Note that the Model 733 ASR may have its keyboard ON-LINE/OFF switch ON-LINE without any of the associated devices actually being on line. Therefore, it becomes necessary to perform a REQUEST STATUS function in order to determine which of the associated devices (PLAYBACK, RECORD, KEYBOARD and/or PRINTER) are actually ON-LINE.

4.3 REMOTE DEVICE CONTROL (ASR ONLY)

The Model 733 ASR data Terminal has the capability of accepting a wide variety of Remote Device Control (RDC) functions in the form of USASCII characters received over the interface lines. These control functions allow the computer to perform a multitude of operations including such mechanical tasks as rewinding and loading cassettes.

All of the RDC logic circuitry is located on a single circuit card located in slot number 6 of the KSR unit. A manually-operated ON-OFF switch, located on the top of the card and accessible through the sub-assembly cover, is provided to allow the operator to disable all of the RDC functions if desired.

The RDC functions themselves are basically divided into two categories: those activated by receipt of a single USASCII control character and those activated by receipt of the non-printable DLE character followed by a second predetermined USASCII character code. The first category is known as the Automatic Device Control (ADC) or single character subset while the second category is known as the DLE or two character subset. A list of the two categories of functions along with their activation codes is given in table 4-2.

Table 4-2. Remote Device Control Functions

Single Character Subset (ADC)	
Function	USASCII
Playback On - Keyboard Off	DC1
Playback Off - Keyboard On	DC3
Record On - Printer Off	DC2
Record Off - Printer On	DC4
Two Character Subset (DLE)	
Function	USASCII
Rewind Cassette No. 1	1
Rewind Cassette No. 2	2
Load Cassette No. 1	3
Load Cassette No. 2	4
Cassette No. 1 in Record No. 2 in Playback	5
Cassette No. 2 in Record No. 1 in Playback	6
Block Forward	7
Block Reverse	8
Printer On (Non-Operable)	9
Printer Off (Non-Operable)	0
Automatic Device Control (ADC Above) On	:
Automatic Device Control (ADC Above) Off	;
Request Status Information	<

Note that the RDC logic circuitry automatically disables the teleprinter portion of the Model 733 ASR from printing the first character received after the DLE character code. This ensures that all of the two character functions are, in effect, treated in the same manner as any non-printable USASCII control character such as those in the ADC category.

4.3.1 FUNCTIONAL DESCRIPTIONS

The following paragraphs are functional descriptions of each ADC character. Since most of these functions have self-explanatory names these descriptions are of their operation.

4.3.1.1 SINGLE CHARACTER SUBSET (ADC)

- PLAYBACK ON-KEYBOARD OFF (DC1 = 11_{16})

  The "playback on" function initiates the reading and transmitting of characters from the cassette tape; provided the playback cassette is loaded and ready as indicated by bit number 1 of the Status Character (reference paragraph 4.3.1.3). This function is performed only on data received over the communication lines or generated in the local loop.

- PLAYBACK OFF-KEYBOARD ON (DC3 = 13_{16})

  The "playback off" function terminates the reading and transmitting of characters from the cassette tape under the condition that if the DC3 character itself exists on the playback tape, then one more character after the DC3 character will be played back before the cassette is actually turned off. This function is performed on both transmitted and received data as well as data generated in the local loop.

- RECORD ON-PRINTER OFF (DC2 = 12_{16})

  The "record on" function initiates the receipt and recording of characters on the cassette tape; provided the record cassette is loaded and ready as indicated by bit number 5 of the status character.

  Upon receipt of the DC2 character, the record function is turned on and the printer enters a print cycle regardless of the fact that DC2 is a non-printable character. As such, the interface will be locked out for an additional three 1200-baud character times (approximately 30 milliseconds after receipt of the DC2 parity-bit) before the printer is actually turned off thus readying the interface for the receipt of the first character to be recorded on the cassette. The DC2 character itself is neither entered into the hardware buffer nor recorded on the tape. This function is performed only on data received over the communication lines or generated in the local loop.

- RECORD OFF-PRINTER ON (DC4 = 14_{16})

  The "record off" function terminates the receipt and recording of characters on the cassette tape. Upon receipt of the DC4 character the record function is turned off and the printer is turned on. However, a print cycle is not entered as was the case with the DC2 function. The DC4 character is then entered into the hardware record buffer and all succeeding characters sent to the printer (including the DC2 character) are written into the same buffer location or "overpunched". It is recommended that a RUBOUT (DEL) be sent following the DC4 to ensure that the overpunched character will not cause subsequent system problems.

  Note that the contents of the record buffer are not automatically recorded on the cassette tape simply by the issuance of the "record off" command. When recording in LINE tape format, a carriage return will ensure that the data is recorded on the cassette tape. When recording in CONT tape format, it is recommended to send at least 86 filler characters, usually (DEL) to the terminal after the last data entry and before the RECORD OFF command is transmitted.

4.3.1.2 TWO CHARACTER SUBSET (DLE)

- REWIND CASSETTE NO. 1 (DLE, 1 = 10_{16}, 31_{16})

  Upon receipt of the rewind command and providing that the cassette tape is not already on clear leader at either end of the tape, cassette no. 1 will run in the reverse direction until clear leader is sensed at the beginning of the tape. From the time that the cassette begins performing the rewind operation, either bit number 1 or bit number 5 of the status character (depending on whether cassette no. 1 is in the playback or record mode, respectively) will be set to a logic zero indicating the cassette is not ready. When the rewind operation has been completed then bit number 3 of the status character will become a logic one indicating the presence of the clear leader. Only the issuance of a LOAD CASSETTE no. 1 command will reset the appropriate bits of the status character and ready the cassette. If a rewind is issued for cassette unit 1 and it is already on clear leader, the RDC is automatically disabled for 1.5 seconds.

NOTE

The cassette cannot be remotely rewound once it has entered the clear leader at the far end of the tape.

- REWIND CASSETTE NO. 2 (DLE, 2 = 10_{16}, 32_{16})

  This command is identical to that found in the preceding paragraphs with the exception that bit number 4 of the status character is the bit which indicates the presence of clear leader on cassette no. 2.

- LOAD CASSETTE NO. 1 (DLE, 3 = 10_{16}, 33_{16})

  Upon receipt of the load command and under the condition that the clear leader is sensed at the beginning of the tape, cassette no. 1 will advance the tape until the beginning of tape (BOT) marker is sensed. During the time that the load operation is performed, either bit number 1 or bit number 5 of the status character (depending on whether cassette no. 1 is in the playback or record mode respectively) will be held to a logic zero indicating that the cassette is not ready. Upon completion of the load operation, the appropriate bit of the status character will become a logic one indicating that the cassette is ready to be enabled with either the "record on" or the "playback on" command.

  If the command code is received while either bit number 1 or bit number 5 of the status character indicate that the cassette is ready, then cassette no. 1 will perform a fast forward operation until the clear leader is sensed at the far end of the tape. At this time, the appropriate bit of the status character will be come a logic zero to indicate that the cassette is not ready and bit number 3 of the status character will become a logic one to indicate the presence of clear leader at the far end of the tape.

  NOTE

  The cassette cannot be remotely stopped during the fast forward operation.

- LOAD CASSETTE NO. 2 (DLE, 4 = 10_{16}, 34_{16})

  This command is identical to that found in the preceding paragraph with the exception that bit number 4 of the status character is the bit which indicates the presence of clear leader on cassette no. 2.

- CASSETTE NO. 1 IN RECORD, NO. 2 IN PLAYBACK (DLE, 5 = 10_{16}, 35_{16})

  Upon receipt of this command, cassette no. 1 will be placed in the record mode and cassette no. 2 will be placed in the playback mode. This operation will be performed regardless of the state of any bits in the status character although its execution may change the state of several bits in the status character.

- CASSETTE NO. 2 IN RECORD, NO. 1 IN PLAYBACK (DLE, 6 = 10_{16}, 36_{16})

  This command is similar to that which is found in the preceding paragraph with the exception that the result of this command is the complement of the result described in the preceding paragraph.

- BLOCK FORWARD (DLE, 7 = 10_{16}, 37_{16})

  Upon receipt of the block-forward command and under the condition that the playback ready bit of the status character is true, the cassette controller will read an 86 character block of data from the playback cassette and will initiate transmission of the resulting string of USASCII characters. Transmission of the string will continue until all 86 characters have been transmitted or until the playback-off (DC3) character is encountered in the transmission.

  In the event that the transmission is terminated by occurrence of the DC3 character on the tape, then the block forward command code may be reissued to initiate transmission of those characters remaining in the 86 character block of data originally read from the tape. The block forward command may have to be reissued a number of times depending on the number of DC3 characters in the original 86 character block of data.

  In the event that transmission was never initiated because a playback error was discovered while reading the 86 character block from the cassette tape, then this function will cause the playback error bit of the status character (bit number 2) to be reset, the block containing the error to be bypassed, a new 86 character block to be read from the cassette tape, and finally, transmission of the new block to be initiated; provided the new block did not also contain a playback error.

- BLOCK REVERSE (DLE, 8 = 10_{16}, 38_{16})

  Upon receipt of the block-reverse command and under the condition that the playback ready bit of the status character is true, the cassette controller will rewind the tape one full block of data (86 characters) and clear the contents of the hardware read buffer.

  In the event that this command is received while the playback error bit of the status character (bit number 2) is true, then this function will also reset the error flag thereby preparing the block to be reread.

- PRINTER-ON (DLE, 9 = 10_{16}, 39_{16})

  This command is non-operable since this function has already been automatically included as a part of the ADC RECORD OFF command (DC4).

- Printer-OFF (DLE, 0 = 10_{16}, 30_{16})

  This command is non-operable since this function has already been automatically included as a part of the ADC RECORD-ON command (DC2).

- AUTOMATIC DEVICE CONTROL ON (DLE, : = 10_{16}, $3A_{16}$)

  This command enables the playback on/off (DC1/DC3) and record on/off (DC2/DC4) functions to become effective after having been disabled with the ADC OFF command.

- AUTOMATIC DEVICE CONTROL OFF (DLE, ; = 10_{16}, $3B_{16}$)

  This command disables the playback on/off (DC1/DC3) and record on/off (DC2/DC4) functions. It is used when it is necessary to record the DC1 through DC4 characters onto a cassette tape without effecting the operation of the Terminal.

- REQUEST STATUS (DLE,<= 10_{16}, $3C_{16}$)

  Upon receipt of the request status command the Terminal will transmit a specially configured USASCII status character to the computer interface. This character is used to determine when menchanical functions such as rewind and load operations are completed. It also indicates other data as described in the following paragraphs.

4.3.1.3 STATUS CHARACTER

The following paragraphs describe the USASCII status character transmitted by the Terminal in response to the RDC request status command. The bit positions within the character are defined as shown in figure 4-5.

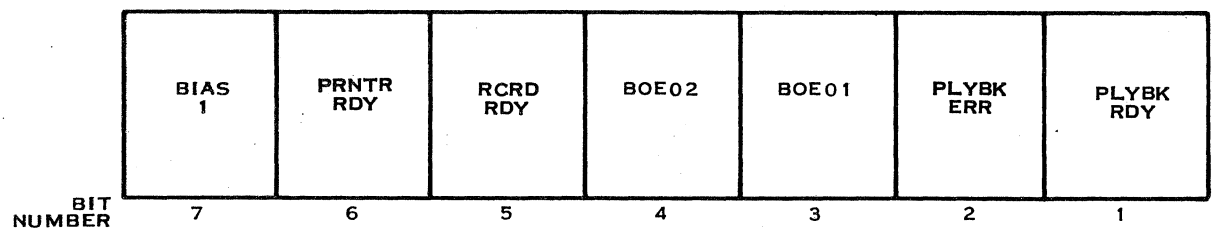


Figure 4-5. Status Character Bit Definition

- PLYBK RDY (Bit Number 1) (LSB)

  A logic one level in this bit position indicates that the playback cassette is ready to be enabled with the ADC playback on (DC1) function or the RDC block forward (DLE , 7) function. If a logic zero level is in this bit position, then one or more of the following conditions must exist:

  Cassette door open or cassette not in place

  Cassette tape on clear leader

  Playback not in line mode

  Rewind or load operation still in execution.

- PLYBK ERR (Bit Number 2)

  A logic one level in this bit position indicates that a playback error was discovered while an 86 character block of data was being read from the cassette tape. The transmission of any characters from that block of data is inhibited until the error status is reset to a logic zero level.

  The RDC block forward and block reverse commands are normally used in the recovery of a playback error. Both of these functions are capable of clearing the error status.

- BOE01 (Bit Number 3)

  A logic one level in this bit position indicates that cassette no. 1 is positioned on clear leader at either the beginning or the end of the tape.

- BOE02 (Bit Number 4)

  The description of this bit position is identical to that which is found in the preceding paragraph with the exception that the information is for cassette no. 2.

- RCRD RDY (Bit Number 5)

  A logic one level in this bit position indicates that the record cassette is ready to be enabled with the ADC record on (DC2) function. If a logic zero level is in this bit position then one or more of the following conditions must exist.

  Cassette door open or cassette not in place

  Cassette tape on clear leader

  Record not in line mode

  Rewind on load operation still in execution

  Record enable tab removed.

- PRNTR RDY (Bit Number 6)

  A logic one level in this bit position indicates that the teleprinter is enabled and ready for normal operation. If a logic zero is in this bit position then one or more of the following conditions must exist:

  Printer not in line mode.

  Printer is disabled as a result of the ADC record-on function (DC2)

- BIAS "1" (Bit Number 7)

  This bit position will always be held to a logic one level to ensure that the status character is not an element of the USASCII control character subset.

4.4 INTERFACE OPERATION

The following paragraphs describe the data transfer within the interface.

4.4.1 COMPUTER TO TERMINAL

The following is a description of the sequence of events which occur during the transmission of a USASCII data string to the Terminal and is directly applicable to the byte-by-byte transmission of any software character when addressing either the 300-baud teleprinter or the 1200-baud cassette controller. However, when utilizing the 1200-baud interface to address the 300-baud teleprinter it is necessary to precede the transmission of the data string with a WDS instruction which sets the WRITE REQUEST DELAY (WRD) bit of the module control register true. This operation enables the module to provide approximately 33 milliseconds of delay between the time that the TRANSMIT BUFFER LOADED (XBL) signal goes false and the time that the WRITE REQUEST (WRQ) signal comes true. In effect the WRITE REQUEST DELAY (WRD) option uses the 1200-baud hardware interface to create an effective 300-baud transmission rate.

It is assumed that the interface has been previously initialized by setting both the DATA TERMINAL READY (DTR) and the REQUEST TO SEND (RTS) lines of interface to their true state (logic one level).

An 8-bit character is sent out to the communications module by using a WDS instruction with the WRITE DATA READY (WDR) bit of the WDS data word set true. The communications module immediately loads the USASCII character into the transmit buffer register and the TRANSMIT BUFFER LOADED (XBL) signal of the interface comes true. If the communications module is presently in the process of transmitting a previous character, then the transmit (shift) register will not be empty and the TRANSMIT REGISTER LOADED (XRL) signal of the interface will be true. When transmission of the previous character is completed, then the transmit (shift) register becomes empty and

the TRANSMIT REGISTER LOADED (XRL) signal of the interface goes false. The transmit buffer register will now transfer the new USASCII character to the transmit (shift) register and the TRANSMIT BUFFER LOADED (XBL) signal of the interface goes false while the TRANSMIT REGISTER LOADED (XRL) signal again comes true. If the module interrupt capability has been previously enabled, then the WRITE REQUEST signal will be accompanied by an I/O bus interrupt. At this point, a CLEAR WRITE REQUEST (CRR) is then issued thereby resetting the WRITE REQUEST (WREQ) signal to its logic zero level and additionally clearing the interrupt; provided no other interrupt conditions exist (READ REQUEST) true or change in state of DATA SET READY). The interface should now be reset and ready to accept another eight bit USASCII character from the computer.

4.4.2 TERMINAL TO COMPUTER

The following is a discussion of the sequence of events that occur during the reception of a USASCII data string from the Terminal and is directly applicable to the byte-by-byte reception of any USASCII character string regardless of the baud rate used. It is assumed that the interface has been previously initialized by ensuring that the DATA SET READY line of the interface is in its true state (logic one level).

The communications module continually monitors the incoming signal lines which are normally in the marking (negative voltage) state. When these lines become positive (spacing condition) the interface accepts this as the start-bit of a sequential 10-bit USASCII character code transmission. The next eight bits are brought into a receiving shift register and upon reception of the stop bit (tenth bit) the received USASCII character code is transferred to an 8-bit buffer register and the READ REQUEST (RREQ) signal of the interface comes true. If the module interrupt capability has been previously enabled, then the READ REQUEST signal will be accompanied by an I/O bus interrupt.

At this point the received USASCII character is normally stored into a prespecified memory location by using the appropriate RDS instruction. Finally, a CLEAR READ REQUEST (CRR) is then issued thereby resetting the READ REQUEST (RREQ) signal to its logic zero level and additionally clearing the interrupt; provided, that no other interrupt conditions exist (WRITE REQUEST true or change in state of DATA SET READY). The interface should now be reset to its original state thereby preparing it to receive another character from the Terminal.

In the event that the character was transmitted at an improper baud rate or with an erroneous number of stop bits, then the READ FRAMING ERROR (RFE) signal of the interface will come true.

NOTE

The RFE flag is valid only as long as the READ REQUEST (RREQ) signal of the interface is also true. The READ FRAMING ERROR (RFE) signal is reset when another character is properly received; provided a CLEAR READ REQUEST (CRR) has been previously issued.

In the event that another character is received by the interface before the computer has stored an already present character (i.e., if the READ REQUEST (RREQ) line is still true at the time another character is received), then the previous character is replaced by the one most recently received, and the READ TIMING ERROR (RTE) signal of the interface comes true. The presence of the RTE flag implies that one or more characters may have been lost in transmission.

NOTE

The RTE flag is only valid as long as the READ REQUEST (RREQ) signal of the interface is also true. The READ TIMING ERROR (RTE) signal is reset when another character is properly received; provided a CLEAR READ REQUEST (CRR) has been previously issued.

In the event that the character was received with an erroneous parity bit, then the READ PARITY ERROR (RPE) signal of the interface will come true.

NOTE

The RPE flag is only valid as long as the READ REQUEST (RREQ) signal of the interface is also true. The READ PARITY ERROR (RPE) signal is reset when another character is properly received; provided a CLEAR READ REQUEST (CRR) has been previously issued.

SECTION V

PROGRAMMING REQUIREMENTS

Programming requirements and examples are provided in Model 980 Computer Input/Output Manual, Part Number 961961-9734.

ALPHABETICAL INDEX

ALPHABETICAL INDEX

INTRODUCTION

The following index lists key words and concepts from the subject material of the manual together with the area(s) in the manual that supply major coverage of the listed concept. The numbers along the right side of the listing reference the following manual areas:

- Sections - References to Sections of the manual appear as "Section x" with the symbol x representing any numeric quantity.
- Appendixes - References to Appendixes of the manual appear as "Appendix y" with the symbol y representing any capital letter.
- Paragraphs - References to paragraphs of the manual appear as a series of alphanumeric or numeric characters punctuated with decimal points. Only the first character of the string may be a letter; all subsequent characters are numbers. The first character refers to the section or appendix of the manual in which the paragraph is found.
- Tables - References to tables in the manual are represented by the capital letter T followed immediately by another alphanumeric character (representing the section or appendix of the manual containing the table). The second character is followed by a dash (-) and a number:

  Tx-yy

- Figures - References to figures in the manual are represented by the capital letter F followed immediately by another alphanumeric character (representing the section or appendix of the manual containing the figure). The second character is followed by a dash (-) and a number:

  Fx-yy

- Other entries in the Index - References to other entries in the index are preceded by the word "See" followed by the referenced entry.

USER'S RESPONSE SHEET

Manual Title: Model 980 Computer Terminal User's Guide

Model 733 ASR/KSR Data Terminal (943009-9701)

Manual Date: 1 September 1975 Date of This Letter: _____

User's Name: _____ Telephone: _____

Company: _____ Office/Department: _____

Street Address: _____

City/State/Zip Code: _____

Please list any discrepancy found in this manual by page, paragraph, figure, or table number in the following space. If there are any other suggestions that you wish to make, feel free to include them. Thank you.

CUT ALONG LINE

Location in Manual	Comment/Suggestion
_____	_____
	_____
	_____
	_____
_____	_____
	_____
	_____
	_____
_____	_____
	_____
	_____
	_____

NO POSTAGE NECESSARY IF MAILED IN U.S.A.
FOLD ON TWO LINES (LOCATED ON REVERSE SIDE), STAPLE AND MAIL

First Class
PERMIT NO. 3135
Austin, Texas

BUSINESS REPLY MAIL
No Postage Necessary if Mailed in the United States

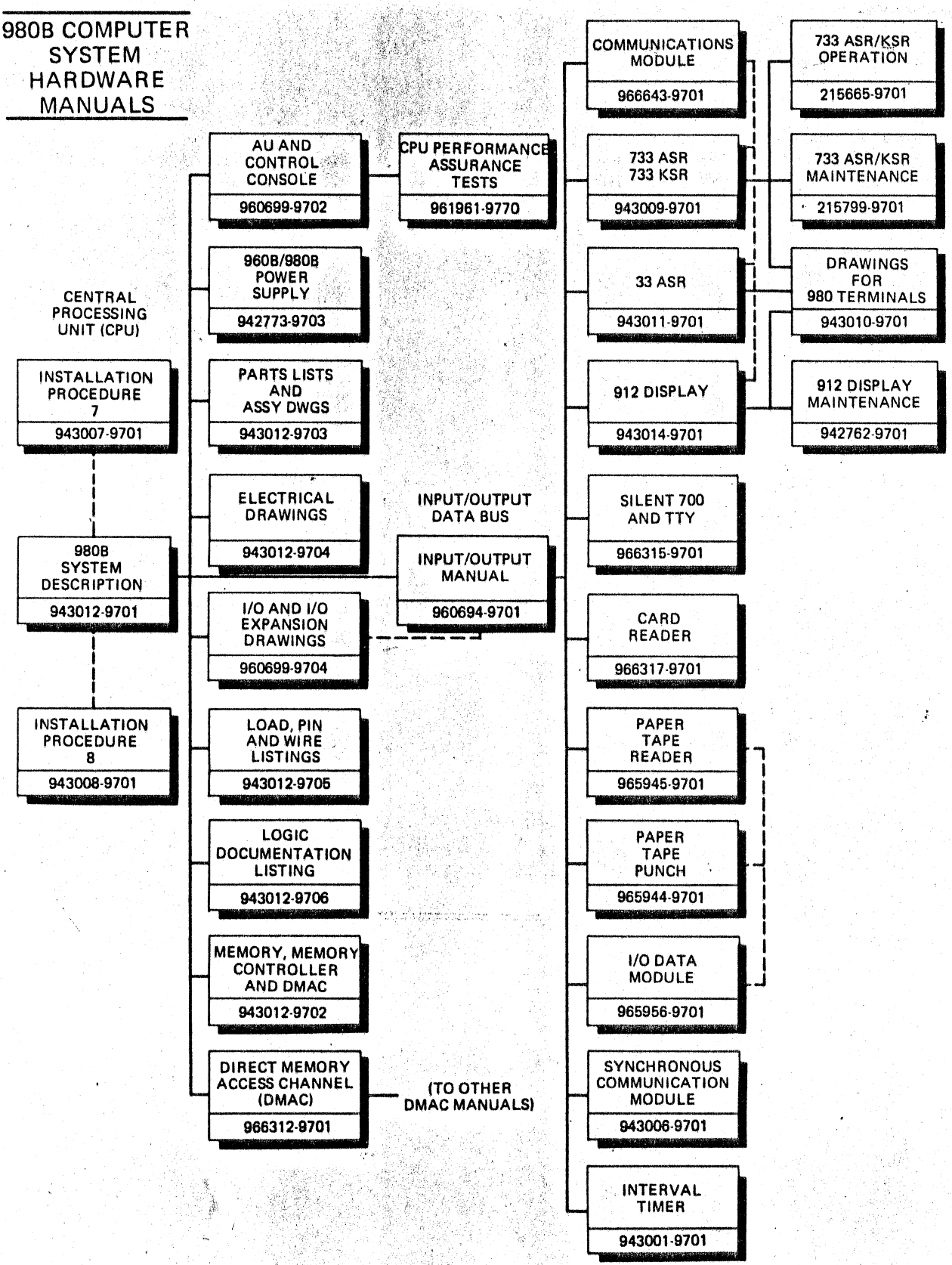
Postage Will Be Paid by

TEXAS INSTRUMENTS INCORPORATED
DIGITAL SYSTEMS DIVISION

P.O. BOX 2909 · AUSTIN, TEXAS 78767

Attn: TECHNICAL PUBLICATIONS, MS 2146

980B COMPUTER SYSTEM HARDWARE MANUALS



TEXAS INSTRUMENTS
INCORPORATED
DIGITAL SYSTEMS DIVISION
POST OFFICE BOX 2909 • AUSTIN, TEXAS 78767