

pdp11

**DZV11 asynchronous
multiplexer
user's guide**

digital

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multiplexer
user's guide**

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CHAPTER 1 GENERAL DESCRIPTION

1.1 INTRODUCTION

The DZV11, shown in Figure 1-1, is an asynchronous multiplexer that provides an interface between an LSI-11 processor and four asynchronous serial data communication channels. It can be used with the LSI-11 processor in a variety of applications that include data concentration, real time processing and cluster controlling. The DZV11 provides an EIA RS232C interface and enough data set control to permit dial-up (auto answer) operation with modems capable of full-duplex operation*, such as the Bell models 103, 113, 212, or equivalent. Remote operation over private lines for full-duplex point to point or full-duplex multipoint as a control (master) station is also possible. Figure 1-2 depicts several of the possible applications for the DZV11 in an LSI-11 system.

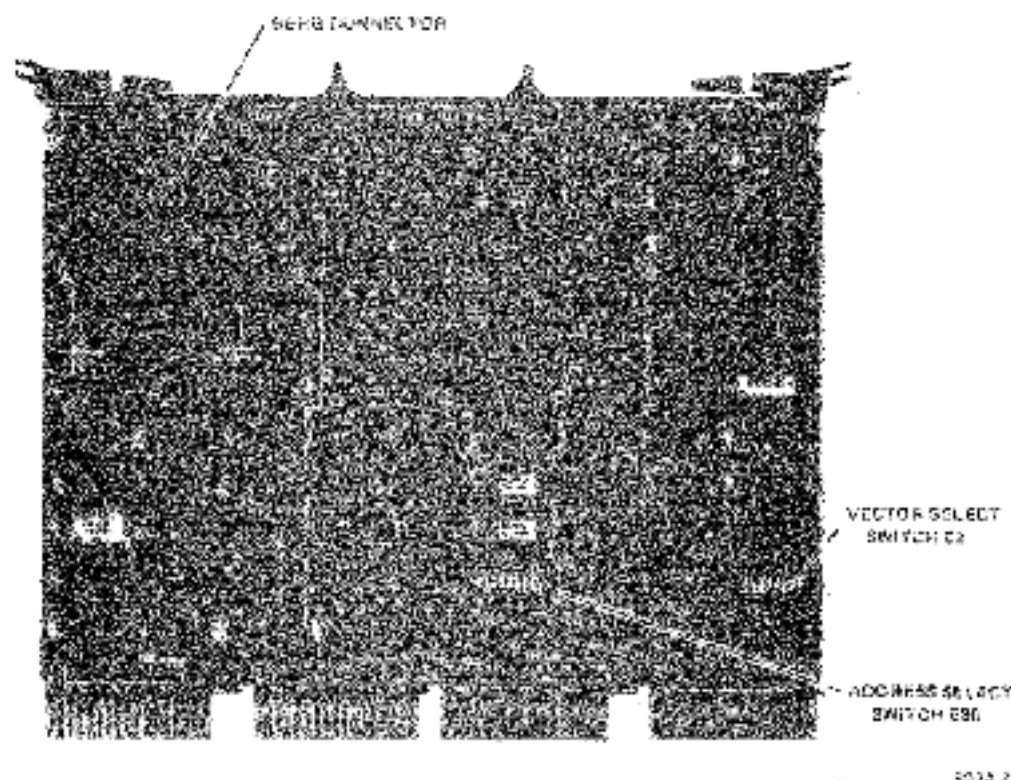
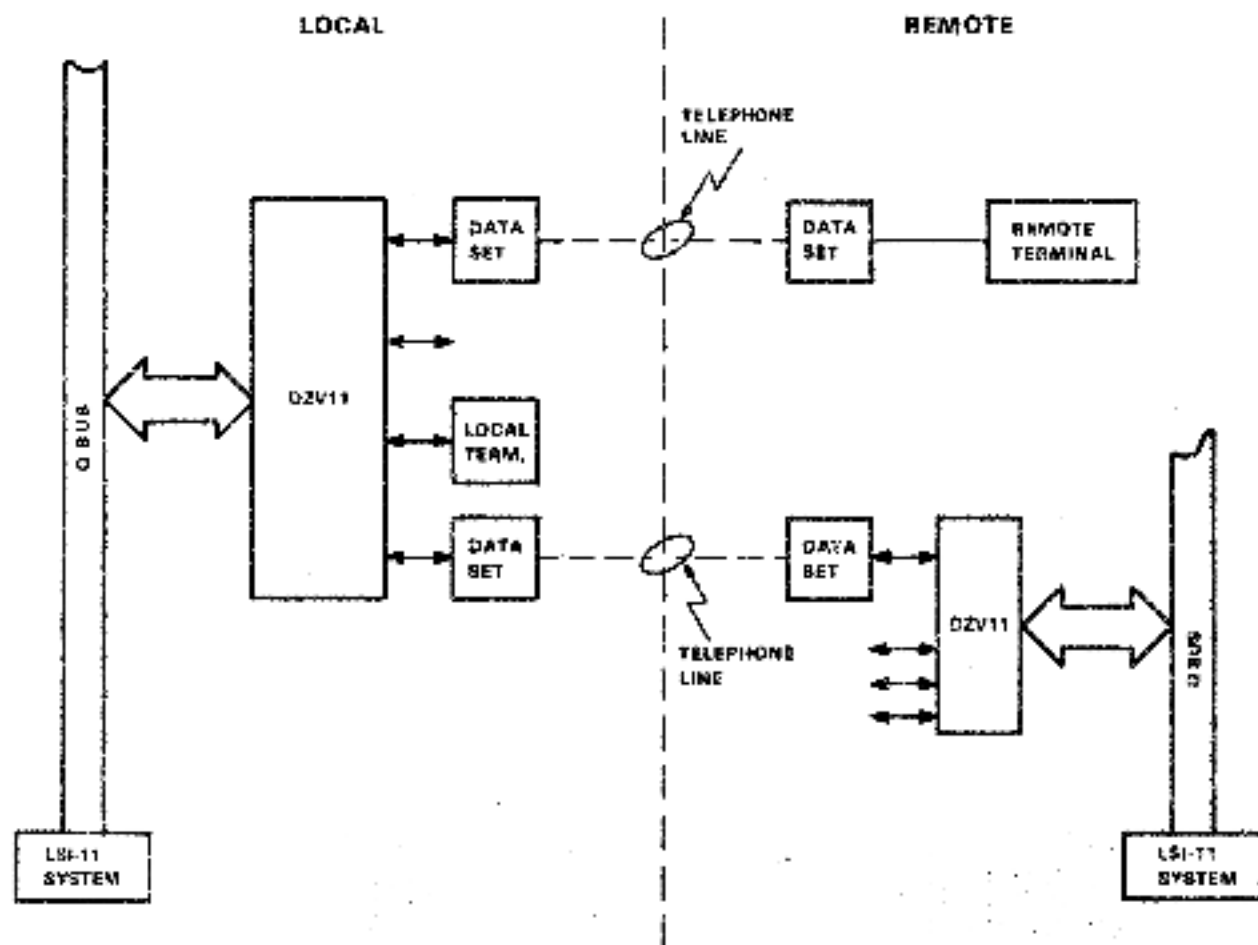


Figure 1-1 DZV11-A (M7957 Module)

*The DZV11 data set control does not support half-duplex operations or the secondary transmit and receive operations available with some modems such as the Bell 202, etc.



MA-0569

Figure 1-2 DZV11 System Applications

The DZV11 has several features that provide flexible control of parameters such as baud rate, character length, number of stop bits for each line, odd or even parity for each line, and transmitter-receiver interrupts. Additional features include limited data set control, zero receiver baud rate, break generation and detection, silo buffering of received data, and line turnaround.

Program compatibility is maintained with the Unibus option DZ11-A. The only compatibility exception is the number of serial channels supported. The DZV11 does not support 20 mA operation.

1.2 PHYSICAL DESCRIPTION

The DZV11 comprises a single quad size module, 21.6 cm × 26.5 cm (8.51 inches × 10.44 inches), and is designated as the M7957 module. All input and output leads are available on a Berg header. The DZV11 connects to the LSI-11 QBUS by the H9270 mounting panel or equivalent. All QBUS input/output signals enter and leave the module via the mounting panel pins.

1.2.1 DZV11 Configurations

The DZV11 can be supplied in two configurations. The DZV11-A, as shown in Figure 1-1, consists of the M7957 module only. Cabling assemblies for connection to terminals and modem channels are not supplied with the DZV11-A, but are available in the DZV11-B. The DZV11-B consists of an M7957 module, BC11U-25 cable assembly, and two accessory test connectors, H329 and H325. This configuration is shown in Figure 1-3.

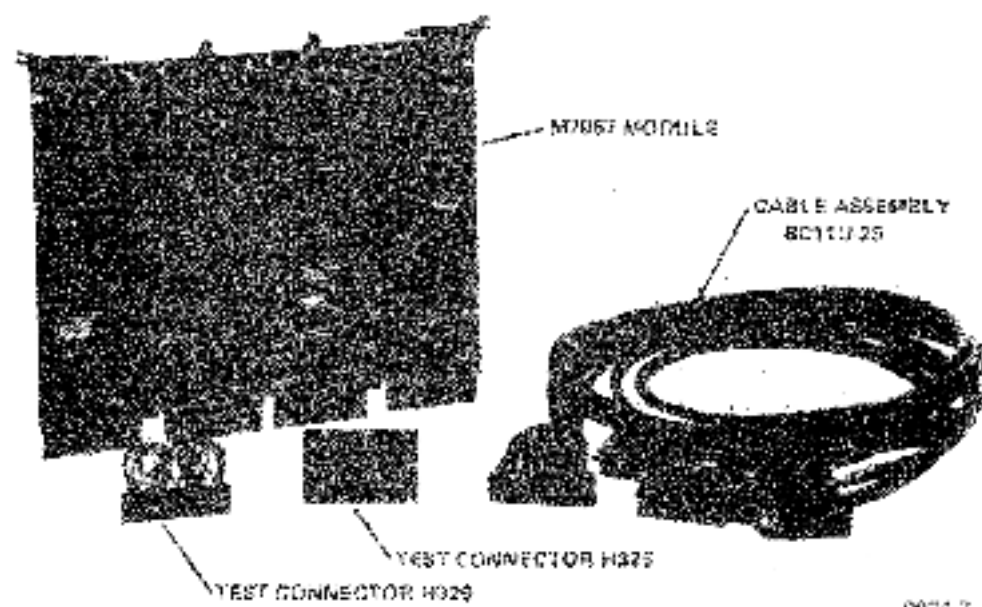


Figure 1-3 DZV11-B (M7957 Module, H325 and H329 Connectors and Cable Assembly BC11U-25)

1.2.2 BC11U Interface Cable

The interfacing cable for terminal and modem connections to the DZV11-B is provided by the BC11U cable assembly (see Figure 1-3). It consists of four separate cables, 762 cm (25 feet) in length, each terminated by a separate EIA type connector housing and a common Berg housing. Each cable within the assembly provides nine input/output leads. The EIA connector pinning conforms to EIA standard RS232C and CCITT* recommendation V.24. The leads supported by the DZV11-B are:

Circuit AA (CCITT 101)	Pin 1	Protective Ground
Circuit AB (CCITT 102)	Pin 7	Signal Ground
Circuit BA (CCITT 103)	Pin 2	Transmitted Data
Circuit BB (CCITT 104)	Pin 3	Received Data
Circuit CD (CCITT 108.2)	Pin 20	Data Terminal Ready
Circuit CE (CCITT 125)	Pin 22	Ring Indicator
Circuit CF (CCITT 109)	Pin 8	Carrier

NOTE

Signal ground and protective ground are connected together.

*CCITT - the Consultative Committee International Telegraph and Telephone is an advisory committee established under the United Nations to recommend worldwide standards

1.2.3 Test Connectors

Figure 1-4 shows the two accessory test connectors, H329 and H325, that are provided with each DZV11-B. The H325 plugs into an EIA connector on the BC11U to loopback data and modem signals onto a single line. The H329 plugs into the M7957 module socket housing and provides staggered loopback of the data and modem lines. The loopback connections are shown in Figure 1-5.

1.3 SPECIFICATIONS

Environmental, electrical, and performance specifications for the DZV11 are discussed in the following paragraphs.

1.3.1 Environmental

The DZV11 operates in an environment from 5° to 50° C (41° to 122° F) and in a relative humidity of 10% to 95%.

1.3.2 Electrical

Power Consumption	1.15 A @ +5 Vdc
	0.39 A @ +12 Vdc

For each line the DZV11 provides a voltage level interface whose levels and connections conform to EIA standard RS232C and CCITT recommendation V.24. The leads supported by the DZV11 are listed in topic 1.2.2. Each DZV11 meets the LSI-11 QBUS Interface specification and represents one unit load as an interface.

1.3.3 Performance

The following paragraphs describe the DZV11 performance capabilities and restrictions.

1.3.3.1 Maximum Configurations - The DZV11 multiplexer is assigned a device address in the floating address space. The floating address space starts at 760010 and extends to 764000. A maximum configuration of DZV11s would not be limited by floating address space, but would be limited by the rules governing an intermediate size system configuration. Therefore, a maximum of seven DZV11 multiplexers may reside in a nine by four backplane.

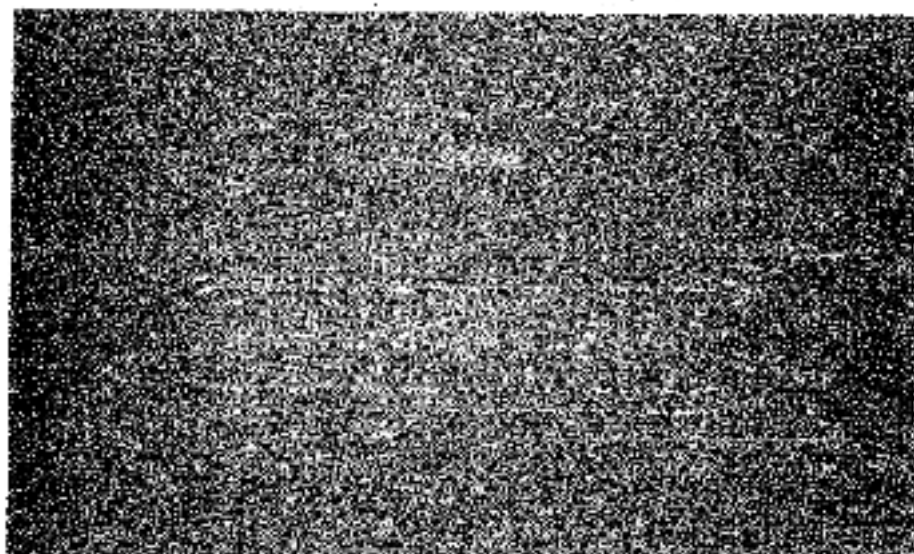
1.3.3.2 Throughput - Each DZV11 is capable of a throughput rate of 10,970 characters per second. This rate is calculated as follows:

$$\begin{aligned} & (\text{Bits/Second} \times \text{No. Lines} \times \text{Direction}) \text{ divided by Bits/Character.} \\ & (9600 \times 4 \times 2) 1/7 \text{ equals } 10,970 \text{ Characters/Second.} \end{aligned}$$

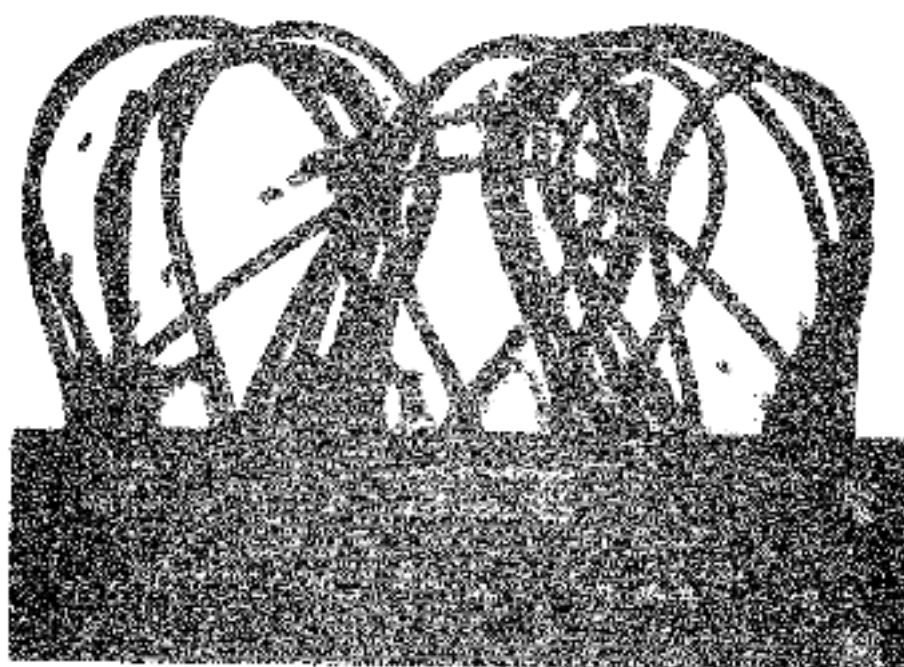
For a character service routine of 100 μ s or less, the device throughput rate can be sustained.

1.3.3.3 Receivers - The receivers provide serial to parallel conversion of 5, 6, 7, 8 level code with one start space and at least one stop mark. The character length, number of stop bits, parity generation and operating speed are programmable parameters for each line. A receiver and transmitter of a corresponding line share the same operating speed with provisions for enabling/disabling of that receive line.

Each receiver is double-buffered and has an allowable input distortion of 43.75% on any bit. Also, the accumulated character distortion must not exceed 43.75%. Break detection is provided on each receiver.



H325

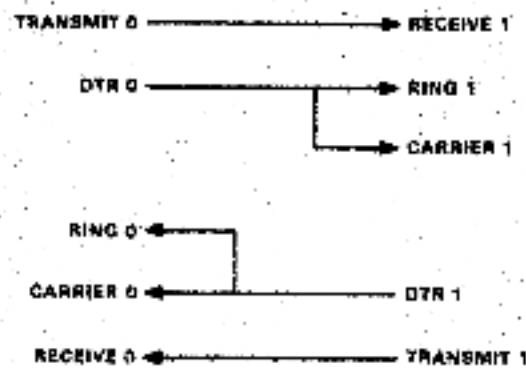


H329

0026-1

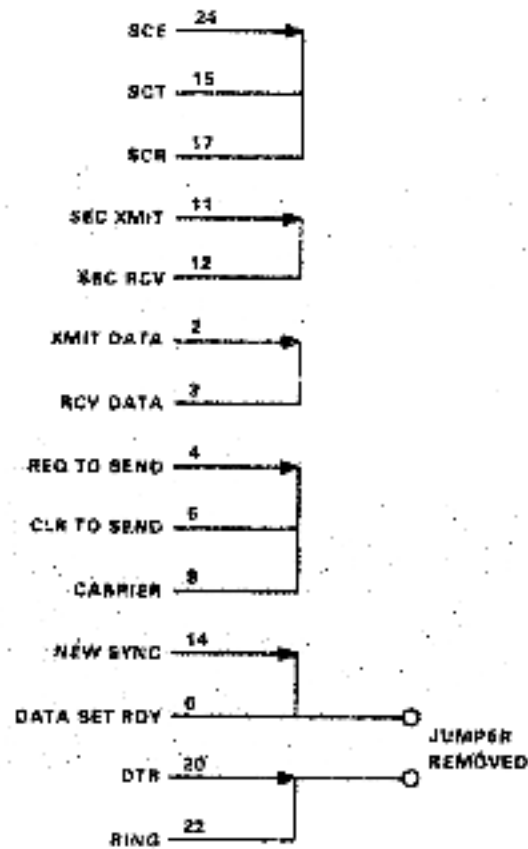
Figure 1-4 Test Connectors H323 and H329

H329 STAGGERED TURNAROUND



NOTE:
LINES 2&3 ARE STAGGERED IN THE SAME WAY.

H326 LOOPBACK CONNECTIONS



MA-0051

Figure 1-5 Loopback Connections

1.3.3.4 Transmitters - The transmitters provide parallel to serial conversion of 5, 6, 7, 8 level code with or without parity. The parity sense when selected can be either odd or even. The stop code can be either 1 or 2 units except when 5 level code is selected. When 5 level code is selected, the stop code can be set to 1 or 1.5 units. The character length, number of stop units, parity generation and sense, and operating speed are programmable parameters for each line. The operating speed for the transmitter is common with the receiver. Breaks are capable of being transmitted on any line. The gross start-stop distortion for a transmitter's TTL output will be less than 2.5% for an 8-bit character.

1.3.3.5 Baud Rate Generator - The baud rate generator is a MOS/LSI device which provides the DZV11 multiplexer with full programmable capability for operating speed selection. Each line has an independent generator capable of producing 1 of 15 selectable baud rates. Speed tolerance for all rates is less than 0.3% with a clock duty of $50\% \pm 5\%$. (See below for rates.)

1.3.3.6 Performance Summary - The following summarizes the programmable features offered for each line:

Character length	5, 6, 7, or 8 level code
Number of stop bits	1 or 2 for 6, 7, 8 level code 1 or 1.5 for 5 level code
Parity	odd, even or none
Baud rates	50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, and 9600
Breaks	Can be generated and detected on each line.

1.3.4 Interrupts

The following interrupts are available on DZV11.

Receiver Done Interrupt

Occurs every time a character appears at the output of the receiver buffer register and the Silo Alarm is disabled. Can be enabled or disabled from the bus.

Silo Alarm Interrupt

Occurs after 16 entries have been made into the receive buffer register by the scanner. This interrupt disables Receiver Done Interrupt and is rearmed when the receive buffer register has been read.

Transmit Interrupt

Occurs every time the scanner finds a UART buffer empty condition, and the transmitter control register bit is set for that line. Can be enabled or disabled from the bus.

CHAPTER 2 INSTALLATION

2.1 SCOPE

This chapter contains the procedures for the unpacking, installation, and initial checkout of the DZV11 Asynchronous Multiplexer.

2.2 UNPACKING AND INSPECTION

The DZV11 is packaged in accordance with commercial packaging practices. First, remove all packing material and check the equipment against the shipping list. (Table 2-1 contains a list of supplied items per configuration.) Report damage or shortages to the shipper immediately and notify the DIGITAL representative. Inspect all parts and carefully inspect the module for cracks, loose components, and separations in the etched paths.

Table 2-1 Items Supplied per Configuration

Quantity	Description	A	B
1	M7957 module	X	X
1	BC11U-25 cable assembly		X
1	H329 test connector		X
1	H325 test connector		X
1	Print set (B-TC-DZV11-0-1)	X	X
	DZV11-A and -B		
	Order number MP00462		
1	Software kit ZJ251-RB	X	X
1	DZV11 User's Guide (EK-DZV11-UG)	X	X

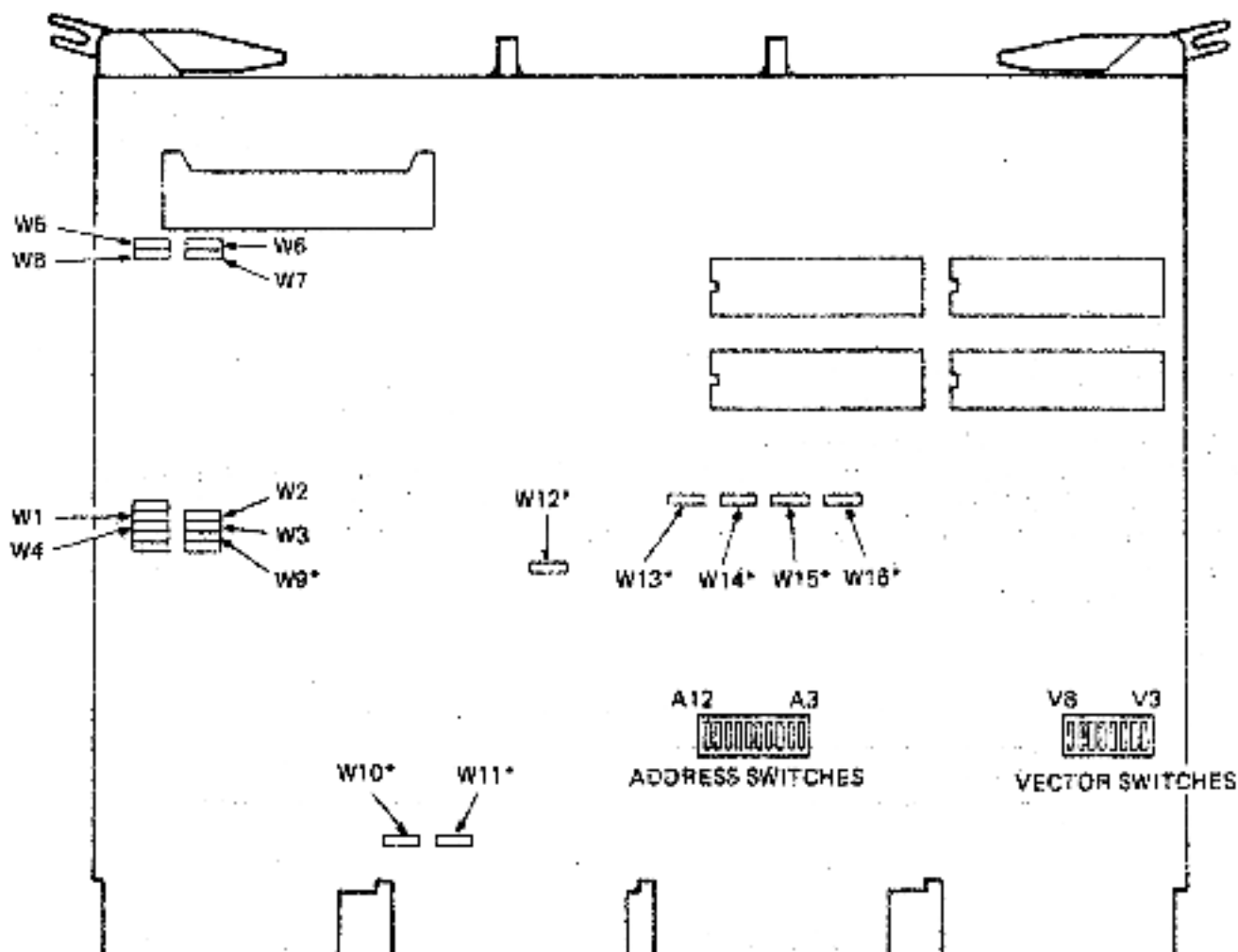
2.3 INSTALLATION PROCEDURE

The following paragraphs describe the installation of the DZV11 option in an LSI-11 system.

2.3.1 Jumper Configuration

There are 16 machine-insertable jumpers on the M7957 module (Figure 2-1).

2.3.1.1 Device Operation – Jumpers W10 and W11 must be installed only when the module is used on an H9270 backplane, or one that applies LSI-11 bus signals to the C and D sections of the module.



***NOTES:**

JUMPERS W9, W12, W13, W14, W15, AND W16 ARE REMOVED ONLY FOR MANUFACTURING TESTS. THEY SHOULD NOT BE REMOVED IN THE FIELD.

JUMPERS W10 AND W11 MUST REMAIN INSTALLED WHEN THE MODULE IS USED IN A BACKPLANE THAT SUPPLIES LSI-11 BUS SIGNALS TO THE C AND D CONNECTORS OF THE D2V11 (SUCH AS THE H92701). WHEN THE MODULE IS USED IN A BACKPLANE THAT INTERCONNECTS THE C AND D SECTIONS TO AN ADJACENT MODULE, JUMPERS W10 AND W11 MUST BE REMOVED.

MX-0064

Figure 2-1 M7957 Jumper Locations

2.3.1.2 Modem Control Jumpers - There are eight jumpers used for modem control. The jumpers labeled W1 through W4 connect Data Terminal Ready (DTR) to Request To Send (RTS). This allows the DZV11 to assert both DTR and RTS if using a modem that requires control of RTS. These jumpers must be installed to run the cable and external test diagnostic programs. The remaining four jumpers, W5 through W8, connect the Forced Busy (FB) leads to the RTS leads. With these jumpers installed, the assertion of an RTS lead places an ON or BUSY signal on the corresponding Forced Busy lead. The Forced Busy jumpers (W5 through W8) are normally cut out unless the modem requires them (Table 2-2).

Table 2-2 Jumper Configuration

Jumper	Connection	Line
W1	DTR to RTS	03
W2	DTR to RTS	02
W3	DTR to RTS	01
W4	DTR to RTS	00
W5	RTS to FB	03
W6	RTS to FB	02
W7	RTS to FB	01
W8	RTS to FB	00

2.3.2 Module Installation

To install the M7957 module, perform the following.

1. Refer to Paragraph 4.2 for descriptions of the address assignments. Set the switches at E30 so that the module responds to its assigned address. When a switch is closed (ON), a binary 1 is decoded. When a switch is open (OFF), a binary 0 is decoded. Note that the switch labeled 1 corresponds to address bit 12, 2 corresponds to address bit 11, etc. (Figure 2-2 and Table 2-3).
2. Vector selection is accomplished by the 8-position switch at E2. Switch positions 7 and 8 are not used. Switch position 6 corresponds to vector bit 3, 5 corresponds to vector bit 4, etc. When a switch is closed (ON), a binary 1 is decoded. When a switch is open (OFF), a binary 0 is decoded (Figure 2-3 and Table 2-4).
3. If the module is part of the DZV11-A option, perform step 3. If it is a part of the DZV11-B option, proceed to step 4 for testing.
 - a. Insert the module in a quad QBus slot of the backplane.

CAUTION

Insert and remove modules slowly and carefully to avoid snagging module components on the card guides and changing switch settings inadvertently.

- b. Run the DZV11 diagnostics, MAINDECs DVDZA and DVDZB, in internal mode to verify operation. Refer to the listing for assistance. Run at least three passes without error.
- c. Proceed to step 8.

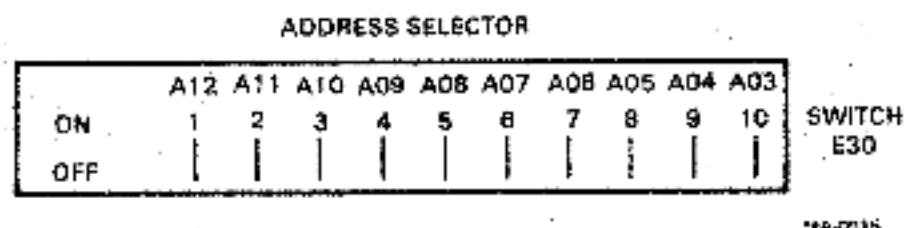


Figure 2-2 M7957 Address Selection

Table 2-3 Address Switch Selection

E30 Switch Address	1 A12	2 A11	3 A10	4 A9	5 A8	6 A7	7 A6	8 A5	9 A4	10 A3
160000	-	-	-	-	-	-	-	-	-	-
160010	-	-	-	-	-	-	-	-	-	X
160020	-	-	-	-	-	-	-	-	X	-
160030	-	-	-	-	-	-	-	-	X	X
160040	-	-	-	-	-	-	-	X	-	-
160050	-	-	-	-	-	-	-	X	-	X
160060	-	-	-	-	-	-	-	X	X	-
160070	-	-	-	-	-	-	-	X	X	X
160100	-	-	-	-	-	-	X	-	-	-
163760	-	-	X	X	X	X	X	X	X	-
163770	-	-	-	X	X	X	X	X	X	X
X										

NOTE: X = ON
- = OFF

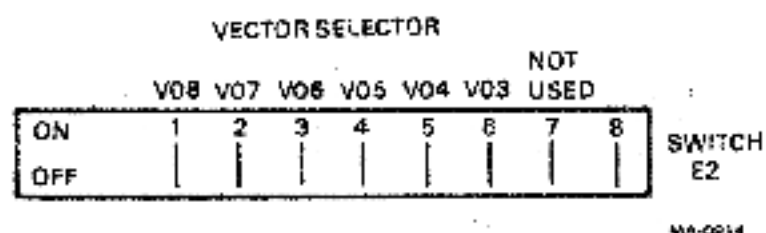


Figure 2-3 M7957 Vector Selection

Table 2-4 Vector Switch Selection

E2 Switch Vector	1 V08	2 V07	3 V06	4 V05	5 V04	6 V03
300	-	X	X	-	-	-
310	-	X	X	-	-	X
320	-	X	X	-	X	-
330	-	X	X	-	X	X
340	-	X	X	X	-	-
350	-	X	X	X	-	X
360	-	X	X	X	X	-
370	-	X	X	X	X	X
400	X	-	-	-	-	-
760	X	X	X	X	X	-
770	X	X	X	X	X	X

NOTE: X = ON
- = OFF

4. Insert the H329 test connector in J1 with the letter side facing up. J1 is the cable connector at the top of the M7957 module.
5. Insert the module in a quad QBus slot of the backplane.

CAUTION

Insert and remove modules slowly and carefully to avoid snagging module components on the card guides and changing switch settings inadvertently.

Run the DZV11 diagnostics, MAINDECs DVDZA and DVDZB, in the staggered mode to verify module operation. Refer to the diagnostic listing for the correct procedure. Run at least three passes without error.

6. Replace the H329 test connector with the Berg end of the BC11U cable assembly. Observe the "This Side Up" wording on the assembly. Refer to D-UA-DZV11-0-0 for installation help.
7. Connect the H325 test connector on the first line and run MAINDEC DVDZC. Select the cable test portion of the diagnostic. Three passes are required without error. Repeat this step for each line.
8. Run DEC/X11 system exerciser to verify the absence of QBus interference with other system devices.

9. The DZV11 is now ready for connection to external equipment. If the connection is to a local terminal through the DZV11-B option, a null modem cable assembly must be used. Use the BC03M or BC03P null modem cables for connection between the BC11U and the terminal. The H312-A null modem unit may also be used in place of the null modem cables. If connection is to a Bell 103 or equivalent modem, install the appropriate line of the BC11U connector into the connector on the modem. A BC05D cable may be required between the BC11U and the modem. Refer to Paragraph 2.3.1.2, Modem Control Jumpers, for selection of jumpers for modem options such as RTS and forced busy. All of the cables mentioned, excluding the BC11U, must be ordered separately as they are not components of a standard DZV11 shipment. When possible, run the diagnostic DVDZC in echo test mode to verify the cable connections and the terminal equipment.

CHAPTER 3 DEVICE REGISTERS

3.1 SCOPE

This chapter provides a description of each DZV11 register, its format, and bit functions.

3.2 DEVICE REGISTERS

The DZV11 contains six addressable registers. A comprehensive pictorial of these registers' bit assignments is shown in Figure 3-1. Table 3-1 lists the registers and associated DZV11 addresses.

Table 3-1 DZV11 Register Address Assignments

Register	Mnemonic	Address	Program Capability
Control and Status Register	CSR	76XXX0	Read/Write
Receiver Buffer	RBUF	76XXX2	Read Only
Line Parameter Register	LPR	76XXX2	Write Only
Transmitter Control Register	TCR	76XXX4	Read/Write
Modem Status Register	MSR	76XXX6	Read Only
Transmit Data Register	TDR	76XXX6	Write Only

XXX = Selected in accordance with floating device address scheme.

3.2.1 Control and Status Register

The control and status register (CSR) is a byte and word addressable register. All bits in the CSR are cleared by an occurrence of BINIT or by setting device Master Clear (CSR 04). The format is shown in Figure 3-1 and the bit assignments are listed in Table 3-2.

3.2.2 Receiver Buffer

The Receiver Buffer (RBUF) is a 16-bit read only register which contains the received character at the output of the FI/FO buffer. A read of the register causes the character entry to be extracted from the buffer and all other entries to bubble down to the lowest unoccupied location. Only the Valid Data bit (RBUF 15) is cleared by BINIT or by setting device Master Clear (CSR 04). Bits 00-14 are not affected. The bit assignments for the RBUF register are listed in Table 3-3.

		BYTES															
		HIGH								LOW							
		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
DR0	CONTROL & STATUS (CSR)	RO	RW	RO	RW	NOT USED	NOT USED	RO	RO	RO	RW	RW	RW	RW	NOT USED	NOT USED	NOT USED
		TRDY	TIE	SA	SAF			TLINE B	TLINE A	RDONE	RIF	MSE	CLR	MAINT			
DR2	RECEIVER BUFFER (RRUF)	RO	RO	RO	RO	NOT USED	NOT USED	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO
		DATA VALID	OVN ERR	FRAM ERR	PAR ERR			RX LINE B	RX LINE A	RBUF D7	RBUF D6	RBUF D5	RBUF D4	RBUF D3	RBUF D2	RBUF D1	RBUF D0
DR4	LINE PARAMETER (LPR)	NOT USED	NOT USED	NOT USED	WO	WO	WO	WO	WO	WO	WO	WO	WO	WO	NOT USED	WO	WO
					RK ENAB	SPEED CODE D	SPEED CODE C	SPEED CODE B	SPEED CODE A	OOD PAR	PAR ENAB	STOP CODE	CHAR LGTH B	CHAR LGTH A		LINE B	LINE A
DR6	TRANSMIT CONTROL (TCR)	NOT USED	NOT USED	NOT USED	NOT USED	RW	RW	RW	RW	NOT USED	NOT USED	NOT USED	NOT USED	RW	RW	RW	RW
						DTR 3	DTR 2	DTR 1	DTR 0					LINE ENAB 3	LINE ENAB 2	LINE ENAB 1	LINE ENAB 0
DR6	MODEM STATUS (MSR)	NOT USED	NOT USED	NOT USED	NOT USED	RO	RO	RO	RO	NOT USED	NOT USED	NOT USED	NOT USED	RO	RO	RO	RO
						CO 3	CO 2	CO 1	CO 0					RI 3	RI 2	RI 1	RI 0
DR6	TRANSMIT DATA (TDR)	NOT USED	NOT USED	NOT USED	NOT USED	WO	WO	WO	WO	WO	WO	WO	WO	WO	WO	WO	WO
						BRK 3	BRK 2	BRK 1	BRK 0	TBUF 7	TBUF 6	TBUF 5	TBUF 4	TBUF 3	TBUF 2	TBUF 1	TBUF 0

MA 0562

Figure 3-1 Register Bit Assignments

Table 3-2. CSR Bit Assignments

Bit	Title	Function
00-02	Not used	
03	Maintenance	This bit, when set, loops all the transmitter's serial output leads to the corresponding receiver's serial input leads on a TTL basis. While operating in maintenance mode, the EJA received data leads are disabled. Normal operating mode is assumed when this bit is cleared. This bit is read/write.
04	Master Clear	When written to a 1, generates "Initialize" within the DZV11. A read-back of the CSR with this bit set, indicates initialize in progress within the device. This bit is self-clearing. All registers, silos, and UARTS are cleared with the following exceptions: 1. Only bit 15 of the receiver buffer register (VALID DATA); the remaining bits 00-14 are not. 2. The high byte of the transmitter control register is not cleared by Master Clear. 3. The modem status register is not cleared by Master Clear.
05	Master Scan Enable	This read/write bit must be set to permit the receiver and transmitter control sections to begin scanning. When cleared, Transmitter Ready (CSR 15) will be inhibited from setting and the received character buffers (silos) will be cleared.
06	Receiver Interrupt Enable	This bit, when set, permits the setting of CSR 07 or CSR 13 to generate a receiver interrupt request. This bit is read/write.
07	Receiver Done	This is a read only bit that will set when a character appears at the output of the FI/FO buffer. To operate in interrupt per character mode, CSR 06 must be set and CSR 12 must be cleared. With CSR 06 and CSR 12 cleared, character flag mode would be indicated. Receiver Done will clear when the receiver buffer register (RBUF) is read or when Master Scan Enable (CSR 05) is cleared. If the FI/FO buffer contains an additional character, the Receiver Done flag will stay cleared a minimum of 1 μ s before presenting that character.
08-09	Transmitter Line Number	These read only bits indicate the line number whose transmit buffer requires servicing. These bits are valid only when Transmitter Ready (CSR 15) is set and will be cleared when Master Scan Enable is cleared. Bit 08 is the least significant bit.
10-11	Not used	

Table 3-2 CSR Bit Assignments (Cont)

Bit	Title	Function
12	Silo Enable Alarm	This is a read/write bit, when set, enables the silo alarm counter to keep count of the number of characters stored in the FI/FO buffer. The counter will be cleared when the Silo Alarm Enable bit is cleared. Conditioning of this bit must occur prior to any character reception.
13	Silo Alarm	This is a read only bit set by the hardware after 16 characters have been entered into the FI/FO buffer. Silo Alarm will be held cleared when Silo Alarm Enable (CSR 12) is cleared. This bit will be reset by a read to the receiver buffer register and will not set until 16 additional characters are entered into the buffer. If Receiver Interrupt Enable (CSR 06) is set, the occurrence of Silo Alarm will generate a receiver interrupt request. Reception with CSR 06 cleared, permits flag mode operation of the Silo Alarm bit.
14	Transmitter Interrupt Enable	This bit must be set for Transmitter Ready to generate an interrupt. It is read/write.
15	Transmitter Ready	This bit is read only and is set by the hardware. This bit will set when the transmitter clock stops on a line whose transmit buffer may be loaded with another character and whose associated TCR bit is set. The Transmitter Line Number, specified in CSR 08 and CSR 09, is only valid when Transmitter Ready is set. Transmitter Ready will be cleared by any of the following conditions: 1. Master Scan Enable cleared. 2. When the associated TCR bit is cleared for the line number pointed to in CSR 08 and CSR 09. 3. At the conclusion of the load instruction of the transmit data register (low byte only). If additional transmit lines require service, Transmitter Ready will reappear within 1.4 μs from the completion of the transmit data register load instruction. The occurrence of Transmitter Ready with Transmitter Interrupt Enable set, will generate a transmitter interrupt request.

Table 3-3 RBUF Bit Assignments

Bit	Title	Function
00-07	Received Character	These bits contain the received character, right justified. The least significant bit is bit 00. Unused bits are 0. The parity bit is not shown.
08-09	Received Character Line Number	These bits contain the line number upon which the aforementioned character was received. Bit 08 is the least significant bit.
10-11	Not used	
12	Parity Error	This bit is set if the sense of the parity of the received character does not agree with that designated for that line.
13	Framing Error	This bit is set if the received character did not have a stop bit present at the proper time. This bit is usually interpreted as indicating the reception of a break.
14	Overflow Error	This bit is set if the received character was preceded by a character that was lost due to the inability of the receiver scanner to service the UART receiver holding buffer on that line.
15	Valid Data	This bit, when set, indicates that the data presented in bits 00-14 is valid. This bit permits the use of a character handling program that takes characters from the FI/FO buffer until there are no more available. This is done by reading this register and checking bit 15 until the program obtains a word for which bit 15 is zero.

3.2.3 Line Parameter Register

The line parameter register (LPR) controls the operating parameters associated with each line in the DZV11. The LPR is a word addressable, write only register. The line parameters for all lines must be reloaded following an occurrence of either BINIT or device Master Clear. Table 3-4 lists bit assignments.

3.2.4 Transmitter Control Register

The transmitter control register (TCR) is a byte and word addressable register. The low byte of the TCR register contains the transmitter control bits which must be set to initiate transmission on a line. Each TCR bit position corresponds to a line number. For example, TCR bit 00 corresponds to line 00, bit 01 to line 01, etc. Setting of a TCR bit causes the transmitter scanner clock to stop if the UART for this line has a transmit buffer empty condition. An interrupt will then be generated if Transmitter Interrupt Enable is set. The scanner clock will restart when either the transmit data register is loaded with a character or the TCR bit is cleared for the line on which the clock has stopped. TCR bits must only be cleared when the scanner is not running, (i.e., Transmitter Ready is set or Master Scan Enable is cleared.)

The TCR bits are represented in bits 00-03. These bits are read/write and are cleared by BINIT or device Master Clear. Bits 04-07 are unused and read as zero.

The high byte of the TCR register contains the writable modem control lead, data terminal ready (DTR). Bit designations are as follows:

Bit	Name
08	DTR Line 00
09	DTR Line 01
10	DTR Line 02
11	DTR Line 03
12-15	Unused; read as zero

Assertion of a DTR bit puts an ON condition on the appropriate modem circuit for that line. DTR bits are read/write and are cleared only by BINIT. Jumpers have been provided to allow the Request to Send circuits to be asserted with Data Terminal Ready assertions.

Table 3-4 LPR Bit Assignments

Bit	Title	Function															
00-01	Parameter Line Number	These bits specify the line number for which the parameter information (bits 3-12) is to apply. Bit 00 is the least significant bit.															
02	Not used	Must always be written as a zero when specifying the parameter line number. Writing this bit as a one will extend the parameter line number field into nonexistent lines. Parameters for lines 00-03 will not be affected.															
03-04	Character Length	These bits are set to receive and transmit characters of the length (excluding parity) as shown below. <table> <tr> <td>04</td><td>03</td><td></td></tr> <tr> <td>0</td><td>0</td><td>5 bit</td></tr> <tr> <td>0</td><td>1</td><td>6 bit</td></tr> <tr> <td>1</td><td>0</td><td>7 bit</td></tr> <tr> <td>1</td><td>1</td><td>8 bit</td></tr> </table>	04	03		0	0	5 bit	0	1	6 bit	1	0	7 bit	1	1	8 bit
04	03																
0	0	5 bit															
0	1	6 bit															
1	0	7 bit															
1	1	8 bit															
05	Stop Code	This bit sets the stop code length (0 = 1 unit stop, 1 = 2 unit stop or 1.5 unit stop if a 5-level code is employed).															
06	Parity Enable	If this bit is set, characters transmitted on the line have an appropriate parity bit affixed, and characters received on the line have their parity checked.															
07	Odd Parity	If this bit is set and bit 06 is set, characters of odd parity are generated on the line and incoming characters are expected to have odd parity. If this bit is not set, but bit 06 is set, characters of even parity are generated on the line and incoming characters are expected to have even parity. If bit 06 is not set, the setting of this bit is immaterial.															

Table 3-4 LPR Bit Assignments (Cont)

Bit	Title	Function																																																																																					
08-11	Speed Code	The state of these bits determine the operating speed for the transmitter and receiver of the selected line. <table><tr><th>11</th><th>10</th><th>09</th><th>08</th><th>Baud Rate</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>50</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>75</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td><td>110</td></tr><tr><td>0</td><td>0</td><td>1</td><td>1</td><td>134.5</td></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td><td>150</td></tr><tr><td>0</td><td>1</td><td>0</td><td>1</td><td>300</td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td><td>600</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1</td><td>1200</td></tr><tr><td>1</td><td>0</td><td>0</td><td>0</td><td>1800</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td><td>2000</td></tr><tr><td>1</td><td>0</td><td>1</td><td>0</td><td>2400</td></tr><tr><td>1</td><td>0</td><td>1</td><td>1</td><td>3600</td></tr><tr><td>1</td><td>1</td><td>0</td><td>0</td><td>4800</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td><td>7200</td></tr><tr><td>1</td><td>1</td><td>1</td><td>0</td><td>9600</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>Invalid</td></tr></table>	11	10	09	08	Baud Rate	0	0	0	0	50	0	0	0	1	75	0	0	1	0	110	0	0	1	1	134.5	0	1	0	0	150	0	1	0	1	300	0	1	1	0	600	0	1	1	1	1200	1	0	0	0	1800	1	0	0	1	2000	1	0	1	0	2400	1	0	1	1	3600	1	1	0	0	4800	1	1	0	1	7200	1	1	1	0	9600	1	1	1	1	Invalid
11	10	09	08	Baud Rate																																																																																			
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1	1	0	1	7200																																																																																			
1	1	1	0	9600																																																																																			
1	1	1	1	Invalid																																																																																			
12	Receiver Enable	This bit must be set before the UART receiver logic can assemble characters from the serial input line. This bit will be cleared following a BINIT or device Master Clear.																																																																																					
13-15	Not used																																																																																						

3.2.5 Modem Status Register

The modem status register (MSR) is a 16-bit read only register. A read to this register results in the status of the readable modem control leads, Ring and Carrier. The ON condition of a modem control lead is interpreted as a logical one. Bits 04-07 and 12-15 are unused and read as a zero. Remaining bit designations are as follows:

Bit	Name
00	Ring Line 00
01	Ring Line 01
02	Ring Line 02
03	Ring Line 03
04-07	Unused; read as zero.
08	Carrier Line 00
09	Carrier Line 01
10	Carrier Line 02
11	Carrier Line 03
12-15	Unused; read as zero.

3.2.6 Transmit Data Register

The transmit data register (TDR) is a byte and word addressable, write only register. Characters for transmission are loaded into the low byte. TDR bit 00 is the least significant bit. Loading of a character should occur only when Transmitter Ready (CSR 15) is set. That character which is loaded into this register is directed to the line defined in CSR bits 08 and 09. The high byte of the TDR is designated as the break control register.

Each of the four multiplexer lines has a corresponding break bit for that line. TDR bit 08 represents the break bit for line 00, TDR bit 09 for line 01, etc. TDR bits 12-15 are unused. Setting a break bit will force that line's output to space. This condition will remain until cleared by the program. This register is cleared by BINIT or device Master Clear. The break control register can be utilized regardless of the state of the device Maintenance bit (CSR 03).

CHAPTER 4 PROGRAMMING

4.1 SCOPE

This chapter contains information for programming the DZV11 in the most efficient manner. To do so, the programming controls must be fully understood. The following paragraphs discuss the DZV11 from the programming point of view and describe recommended programming methods.

4.2 DEVICE ADDRESS ASSIGNMENTS

The device address assigned to the DZV11 resides in the floating address space of the LSI-11. This address space ranges from 160010₈ to 163776₈. Each DZV11 requires increments of 10₈ address locations and the first option should be configured with an address of 160010₈. The initial configured address assumes that the system consists of only DZV11s in the floating address field. If the DUV11 option is also configured in the floating address field, assign the DZV11 an address which establishes a gap of 10₈ address locations between the last DUV11 and the first DZV11. For example: If the system consisted of one DUV11 located at 160010₈, the DZV11 should be configured with an address of 160030₈.

4.3 INTERRUPT VECTOR ADDRESS ASSIGNMENTS

The DZV11 device vector address is selected from the floating vector space. This space ranges from address 300₈ to address 776₈. Each DZV11 requires increments of 10₈ address locations for its two contiguous interrupt vectors. If the DZV11 is the only option in the floating vector area, configure it for a vector of 300₈. If there are options other than the DZV11 residing in the floating vector area, other configuration rules must be applied. When configuring the device vector, only the first vector address must be considered. The first vector, or base vector, must start on a zero boundary.

A zero boundary is one which has the three least significant bits equal to zero. The second vector is controlled by the first vector and data bit 02. Data bit 02 is generated by the M7957 hardware.

Any option ahead of DZV11 in the floating vector space which is not in the configuration should not occupy any vector space gap. For example, if only one DZV11 is in the system the vector for the DZV11 should be 300. The simplest case is as follows:

Option	Address	Vector	Comment
GAP	160010	-	No QBUS compatible DJ11
GAP	160020	-	No QBUS compatible DH11
GAP	160030	-	No QBUS compatible DQ11
GAP	160040	-	No DUV11
GAP	160050	-	No QBUS compatible DUP11
GAP	160060	-	No QBUS compatible LK11
GAP	160070	-	No QBUS compatible DMC11
DZV11	160100	300	
GAP	160110	-	No more DZV11s

Each DZV11 requires two interrupt vectors, one for the transmitter section and one for the receiver section. If simultaneous interrupt requests were generated from each section, the receiver section would have priority in placing its vector onto the LSI bus. A receiver interrupt to address XX0 will be generated from having either a Receiver Done (CSR 07) or Silo Alarm (CSR 13) occurrence. A transmitter interrupt to address XX4 will be generated by Transmitter Ready (CSR 15). Additional prerequisites for generating interrupts are that the individual interrupt enable bits (CSR 06 and CSR 14) be set. The recommended method of clearing interrupt enable bits is to first raise the processor status word to level four, next clear these interrupt enable bits and then lower the processor status word to zero. Using this method prevents false interrupts from being generated.

4.4 PROGRAMMING FEATURES

The DZV11 has several programming features that allow control of baud rate, character length, stop bits, parity, and interrupts. This section discusses the application of these controls to achieve the desired operating parameters.

4.4.1 Baud Rate

Selection of the desired transmission and reception speed is controlled by the conditions of bits 08-11 of the LPR. Table 4-1 depicts the required bit configuration for each operating speed. The baud rate for each line is the same for both the transmitter and receiver. The receiver clock is turned on and off by setting and clearing bit 12 in the LPR for the selected line.

Table 4-1 Baud Rate Selection Chart

Bits				Baud Rate
11	10	09	08	
0	0	0	0	50
0	0	0	1	75
0	0	1	0	110
0	0	1	1	134.5
0	1	0	0	150
0	1	0	1	300
0	1	1	0	600
0	1	1	1	1200
1	0	0	0	1800
1	0	0	1	2000
1	0	1	0	2400
1	0	1	1	3600
1	1	0	0	4800
1	1	0	1	7200
1	1	1	0	9600
1	1	1	1	Not used

4.4.2 Character Length

The selection of one of the four available character lengths is controlled by bits 03 and 04 of the LPR. The bit conditions for bits 04 and 03, respectively, are as follows: 00 (5-level), 01 (6-level), 10 (7-level), and 11 (8-level). For character lengths of 5, 6, and 7, the high-order bits of the received character are forced to zero.

4.4.3 Stop Bits

The length of the stop bits in a serial character string is determined by bit 05 of the LPR. If bit 05 is a zero, the stop length is one unit; bit 05 set to a one selects a 2-unit stop unless the 5-level character length (bits 03 and 04 at zero) is selected, in which case the stop bit length is 1.5 units.

4.4.4 Parity

The parity option is selected by bit 06 of the LPR. Parity is enabled on transmission and reception by setting bit 06 to a one. Bit 07 of the LPR allows selection of even or odd parity, and bit 06 must be set for bit 07 to be significant. The parity bit is generated and checked by hardware and does not appear in the RBUF or TBUF. The parity error (bit 12, RBUF) flag is set when the received character has a parity error.

4.4.5 Interrupts

The receiver interrupt enable (RIE) and silo alarm enable (SAE) bits in the CSR control the circumstances upon which the DZV11 receiver interrupts the LSI-11 processor.

If RIE and SAE are both clear, the DZV11 never interrupts the LSI-11 processor. In this case, the program must periodically check for the availability of data in the silo and empty the silo when data is present. If the program operates off a clock, it should check for characters in the silo at least as often as the time it takes for the silo to fill, allowing a safety factor to cover processor response delays and time to empty the silo. The RDONE bit in the CSR will set when a character is available in the silo. The program can periodically check this bit with a TSTB or BIT instruction. When RDONE is set, the program should empty the silo.

If RIE is set and SAE is clear, the DZV11 will interrupt the LSI-11 processor to the DZV11 receiver vector address when RDONE is set, indicating the presence of a character at the bottom of the silo. The interrupt service routine can obtain the character by performing a MOV instruction from the RBUF. If the program then dismisses the interrupt, the DZV11 will interrupt when another character is available (which may be immediately if additional characters were placed in the silo while the interrupt was being serviced.) Alternatively, the interrupt service routine may respond to the interrupt by emptying the silo before dismissing the interrupt.

If RIE and SAE are both set, the DZV11 will interrupt the LSI-11 processor to the DZV11 receiver vector when the silo alarm (SA) bit in the CSR is set. The SA bit will be set when 16 characters have been placed in the silo since the last time the program has accessed the RBUF. Accessing the RBUF will clear the SA bit and the associated counter. The program should follow the procedure described in Paragraph 4.4.6 to empty the silo completely in response to a silo alarm interrupt. This will ensure that any characters placed in the silo while it is being emptied are processed by the program.

NOTE

If the program processes only 16 entries in response to each silo alarm interrupt, characters coming in while interrupts are being processed will build up without being counted by the silo alarm circuit and the silo may eventually overflow without the alarm being issued.

If the silo alarm interrupt is used, the program will not be interrupted if fewer than 16 characters are received. In order to respond to short messages during periods of moderate activity, the LSI-11 program should periodically empty the silo. The scanning period will depend on the required responsiveness to received characters. While the program is emptying the silo, it should ensure that DZV11 receiver interrupts are inhibited. This should be done by raising the LSI-11 processor priority. The silo alarm interrupt feature can significantly reduce the LSI-11 processor overhead required by the DZV11 receiver by eliminating the need to enter and exit an interrupt service routine each time a character is received.

The transmitter interrupt enable (TIE) bit controls transmitter interrupts to the LSI-11 processor. If enabled, the DZV11 will interrupt the LSI-11 processor at the DZV11 transmitter interrupt vector when the transmitter ready (TRDY) bit in the CSR is set, indicating that the DZV11 is ready to accept a character to be transmitted.

4.4.6 Emptying the Silo

The program can empty the silo by repeatedly performing MOV instructions from the RBUF to temporary storage. Each MOV instruction will copy the bottom character in the silo so it will not be lost and will clear out the bottom of the silo, allowing the next character to move down for access by a subsequent MOV instruction. The program can determine when it has emptied the silo by testing the data valid bit in each word moved out of the RBUF. A zero value indicates that the silo has been emptied. The test can be performed conveniently by branching on the condition code following each MOV instruction. The TST or BIT instruction must not access the RBUF because these instructions will cause the next entry in the silo to move down without saving the current bottom character. Furthermore, following a MOV from the RBUF, the next character in the silo will not be available for at least one μ s. Therefore, on fast CPUs, the program must use sufficient instructions or NOPs to ensure that successive MOVs from the RBUF are separated by a minimum of one μ s. This will prevent a false indication of an empty silo.

4.4.7 Transmitting a Character

The program controls the DZV11 transmitter through four registers on the QBUS: the control and status register (CSR), the line parameter register (LPR), the transmit control register (TCR), and the transmit data register (TDR).

Following DZV11 initialization, the program must use the LPR to specify the speed and character format for each line to be used and must set the master scan enable (MSE) bit in the CSR. The program should set the transmitter interrupt enable (TIE) bit in the CSR if it wants the DZV11 transmitter to operate on a program interrupt basis.

The TCR is used to enable and disable transmission on each line. One bit in this register is associated with each line. The program can set and clear bits by using MOV, MOVB, BIS, BISH, BIC, and BICB instructions. (If word instructions are used, the line enable bits and the DTR bits are simultaneously accessed.)

The DZV11 transmitter is controlled by a scanner which is constantly looking for an enabled line (line enable bit set) which has an empty UART transmitter buffer. When the scanner finds such a line, it loads the number of the line into the 2-bit transmit line number (TLIN) field of the CSR and sets the TRDY bit, interrupting the LSI-11 processor if the TIE bit is set. The program can clear the TRDY bit by moving a character for the indicated line into the TBUF or by clearing the line enable bit. Clearing the TRDY bit frees the scanner to resume its search for lines needing service.

To initiate transmission on an idle line, the program should set the TCR bit for that line and wait for the scanner to request service on the line, as indicated by the scanner loading the number of the line into TLINE and setting TRDY. The program should then load the character to be transmitted into the TBUF by using a MOVB instruction. If interrupts are to be used, a convenient way of starting up a line is to set the TCR bit in the main program and let the normal transmitter interrupt routine load the character into the TBUF.

NOTE

The scanner may find a different line needing service before it finds the line being started up. This will occur if other lines request service before the scanner can find the line being started. The program must always check the TLINE field of the CSR when responding to TRDY to ensure it loads characters for the correct line. Assuming the program services lines as requested by the scanner, the scanner will eventually find the line being started. If several lines require service, the scanner will request service in priority order as determined by line number. Line 3 has the highest priority and line 0 the lowest.

To continue transmission on a line, the program should load the next character to be transmitted into the TBUF each time the scanner requests service for the line as indicated by TLINE and TRDY.

To terminate transmission on a line, the program loads the last character normally and waits for the scanner to request an additional character for the line. The program clears the line enable bit at this time instead of loading the TBUF.

The normal rest condition of the transmitted data lead for any line is the one state. The break bits are used to apply a continuous zero signal to the line. One bit in the TDR is associated with each line. The line will remain in this condition as long as the bit remains set. The program should use a MOVB instruction to access the BRK bits. If the program continues to load characters for a line after setting the break bit, transmitter operation will appear normal to the program despite the fact that no characters can be transmitted while the line is in the continuous zero sending state. The program may use this facility for sending precisely timed zero signals by setting the break bit and using transmit ready interrupts as a timer.

It should be remembered that each line in the DZV11 is double buffered. The program must not set the BRK bit too soon or the two data characters preceding the break may not be transmitted. The program must also ensure that the line returns to the one state at the end of the zero sending period before transmitting any additional data characters. The following procedure will accomplish this. When the scanner requests service the first time after the program has loaded the last data character, the program should load an all-zero character. When the scanner requests service the second time, the program should set the BRK bit for the line. At the end of the zero sending period, the program should load an all-zero character to be transmitted. When the scanner requests service, indicating this character has begun transmission, the program should clear the BRK bit and load the next data character.

4.4.8 Data Set Control

The program may sense the state of the carrier and ring indicator signals for each data set and may control the state of the data terminal ready signal to each data set. The program uses two registers to access the DZV11 data set control logic. There are no hardware interlocks between the data set control logic and the receiver and transmitter logic. Any required coordination should be done under program control.

The data terminal ready (DTR) bits in the TCR are read/write bits. Setting or clearing a bit in this register will turn the appropriate DTR signal on or off. The program may access this register with word or byte instructions. (If word instructions are used, the DTR and line enable bits will be simultaneously accessed.) The DTR bits are cleared by the INIT signal on the QBUS but is not cleared if the program clears the DZV11 by setting the CLR bit of the CSR.

The carrier (CO) and ring (RI) bits in the MSR are read-only bits. The program can determine the current state of the carrier signal for a line by examining the appropriate bit in the MSR. It can determine the current state of the ring signal by examining the appropriate bit of the ring register. The program can examine these registers separately by using MOVB or BITB instructions or can examine them as a single 16-bit register by using MOV or BIT instructions. The DZV11 data set control logic does not interrupt the LSI-11 processor when a carrier or ring signal changes state. The program should periodically sample these registers to determine the current status. Sampling at a high rate is not necessary.

APPENDIX A GLOSSARY

BBS7 L - Bussed Bank 7 Select

BDAL00 L through BDAL15 L - Bussed Data/Address Lines

BDIN L - Bussed Data Input

BDOUT L - Bussed Data Out

BIAKI L - Bussed Interrupt Acknowledge In

BIAKO L - Bussed Interrupt Acknowledge Out

BINIT L - Bussed Initialize

BIRQ L - Bussed Interrupt Request

Break - A continuous spacing condition on the serial data line, interpreted as a framing error.

BRK 3 through BRK 0 - TDR bits 11 through 08. When set, the Break bit causes the transmission of a Break signal.

BRPLY L - Bussed Reply

BSYNC L - Bussed Sync

BWTBT L - Bussed Write Byte

Carrier - A carrier is a continuous frequency capable of being modulated or impressed with a signal. The name Carrier, however, is used in the DZV11 print set to refer to the received line signal detector input from the modem. This signal is referred to as "Carrier Detect" and "Carrier On" in some books.

CCITT - The Consultative Committee International Telegraph and Telephone is an advisory committee established under the United Nations to recommend worldwide standards.

CHAR LGTH A, CHAR LGTH B - LPR bits 03 and 04. These bits determine the length of the characters the DZV11 receives and transmits (Table 3-4).

CLR - CSR bit 04. Controls the device Master Clear signal (Table 3-2).

CO - Carrier On. Also referred to as "Carrier" or "Carrier Detect." Some sources abbreviate Carrier Detect to CD. Do not confuse CD or CO with EIA signal CD. EIA signal CD is Data Terminal Ready. The EIA signal designation for Carrier On (or Carrier Detect) is CF.

CO3 through CO0- MSR bits 11 through 08, representing the Carrier signal for lines 03 through 00.

CONTROL STROBE H - This signal is generated by the speed and format control circuits on circuit schematic sheet D8. It loads the speed parameters into the baud rate generators on sheet D8, and loads the data format parameters into the UARTs on sheets D13 and D14.

CSR - Control and Status Register (Table 3-2).

DA00 through DA03 - Data Available. These signals come from the R DONE pins on the UARTs (sheets D13 and D14).

DATA IN 00 H through DATA IN 03 H - These signals are the received data from the EIA signal lines. They originate at the EIA/TTL receivers (sheet D7) and go to the maintenance mode data selector (sheet D10).

DATA TERM RDY 00 through DATA TERM RDY 03 - Data Terminal Ready signals for lines 00 through 03 (sheet D6).

Data Valid - Bit 15 in the RBUF. The Output Ready signals from the four sifo memory chips are ANDed to form RECEIVER DONE H. When the RBUF is addressed, RECEIVER DONE H is latched as VALID DATA H (sheet D12). VALID DATA H becomes Data Valid (bit 15) in the RBUF.

DATI - Data input bus cycle.

DATIO - Data input/output bus cycle.

DATIOB - Data input/output bus cycle involving a byte.

DATO - Data output bus cycle involving a word.

DATOB - Data output bus cycle involving a byte.

DCE - Data communication equipment.

DEVICE DATA BUS - The bidirectional tri-state bus internal to the module; signal lines DEVICE DATA BUS 00 through DEVICE DATA BUS 15.

DEVICE SELECT H - This signal is the wired-AND of the MATCH signals from all four bus transceiver chips (sheet D2). It enables the protocol chip (sheet D4).

DTE - Data terminal equipment.

DTR - Data Terminal Ready.

DTR0 through DTR3 - Bits 08 through 11 in the transmitter control register. They represent the state of Data Terminal Ready for each of the four lines.

EIA - Electronic Industries Association.

FB - Forced Busy.

FE00 through FE 03 - Framing Error signals from the UARTs (sheets D13 and D14).

FIFO - First-In/First-Out.

Forced Busy - Used with some modem equipment such as Bell models 103E and 113B. Signals a modem controller to switch to another channel.

FRAM ERR - Framing Error; RBUF bit 13.

Framing Error - This error occurs when a UART receiver does not detect a stop bit at the time it tests for one. This may be caused by a transmission error or by a Break signal.

INITIALIZE H, INITIALIZE L - These are the device initialization signals. They are generated by either the CLR bit (CSR bit 04) or by BINIT from the LSI-11 bus (sheet D5).

LD BREAK REGISTER H - Load pulse for the high byte of the transmit data register. (sheets D4 and D10).

LD CSR HIGH BYTE H - Load pulse for the high byte of the control and status register (sheet D4).

LD CSR LOW BYTE H - Load pulse for the low byte of the control and status register (sheet D4).

LD LPR REGISTER L - Load pulse for the line parameter register (sheets D4 and D8).

LD TCR HIGH BYTE H - Load pulse for the high byte of the transmit control register (sheet D4).

LD TCR LOW BYTE H - Load pulse for the low byte of the transmit control register (sheet D4).

LD TDR REGISTER H - Load pulse for the low byte of the transmit data register (sheet D4).

LINE A, LINE B - Bits 00 and 01 of the line parameter register. This is a 2-bit code that specifies the number of the line to which the parameters apply.

LINE ENAB0 through LINE ENAB3 - Bits 00 through 03 in the transmit control register. Each of these bits enables transmission on the corresponding line.

LOAD IN PROGRESS L - Indicates that either the line parameter register or the transmit data register is being loaded. BRPLY is delayed 300 ns while a load is in progress for either of these two registers (sheet D4).

LOAD SILO H - Enables silo buffers to load data (sheets D11 and D12).

LPR - Line parameter register. Refer to Table 3-4.

MAINT - Maintenance bit (CSR bit 03). Enables the internal loop-back maintenance mode.

MAINTENANCE H - This signal is set by the MAINT bit (sheet D5) and controls the maintenance mode data selector (sheet D10).

MASTER CLEAR H - This signal is derived from the clear bit CLR (CSR bit 04). See sheet D5.

MASTER SCAN CLOCK H - This signal is produced by dividing the master oscillator clock signal (sheet D8). It drives the receiver scanner (sheet D11).

MASTER SCAN ENABLE H - Set by the MSE bit. Enables both transmitter and receiver control circuitry (sheets D5, D9, D11).

MASTER SCAN ENABLE L - Set by the MSE bit. Enables the master scan clock (sheets D5 and D8).

MSE - Master Scan Enable. CSR bit 05.

MSR - Modem Status Register. Refer to Paragraph 3.2.5.

ODD PAR - Odd Parity. Line parameter register bit 07. Refer to Table 3-4.

OR 00 through OR 03 - Overrun error signals from UARTs (sheets D13 and D14) to silo buffer (sheet D12).

OUT HB - Output high byte. Indicates that an output data transfer will be made to the high byte of the selected register (sheet D4).

OUT LB - Output low byte. Indicates that an output data transfer will be made to the low byte of the selected register (sheet D4).

OVRN ERR - Overrun Error. RBUF bit 14. Refer to Table 3-3.

PAR ENAB - Parity Enable. Line parameter register bit 06. Refer to Table 3-4.

PAR ERR - Parity Error. RBUF bit 12. Refer to Table 3-3.

PE 00 through PE 03 - Parity error signals from the UARTs (sheets D13 and D14) to silo the buffer (sheet 12).

PSW - Processor Status Word.

QBUS - LSI-11 Bus.

RBUF - Receiver Buffer. Refer to Table 3-3.

RBUF D0 through RBUF D7 - Received data bits. RBUF bits 0 through 7.

RCV CLOCK 00 H through RCV CLOCK 03 H - Receiver clocks from the baud rate generators (sheet D8) to the UARTs (sheets D13 and D14).

RCV DATA 00 through RCV DATA 03 - Received data bits from the silo buffer (sheet D12) to the multiplexers (sheet D3).

RCV DATA ENABLE 00 through RCV DATA ENABLE 03 - These signals enable the UARTs for the selected lines. They originate in the receiver control circuitry (sheet D11) and go to the UARTs (sheets D13 and D14).

RD1 through RD8 - Received data bits from the UARTs (sheets D13 and D14) to the silo buffer (sheet D12).

RDONE - Receiver Done. CSR bit 07. Refer to Table 3-2.

READ DEVICE H and READ L - These signals control the operating mode of the bus transceivers (sheets D2 and D4).

READ RCV BUFFER H - This signal controls the unloading of the silo buffer (sheets D4 and D12).

RECEIVER DONE H - In the DZV11, this signal does not come from the UARTs. It is the result of anding the Output Ready signals from each of the four FIFO memory chips (sheet 12). It sets the RDONE bit in the CSR (sheet D3) to indicate that a character of received data is ready in the silo buffer.

RECEIVER INTR ENABL - Receiver Interrupt Enable (sheet D5).

RESET DA00 through DA03 - These signals are made up in the receiver control circuitry (sheet D11) to reset the Data Available signals in the UART (sheets D13 and D14) for the selected line.

RI - Ring Indicator.

RI0 through RI3 - Modem status register bits 0 through 3, indicating the states of the Ring signal on the corresponding lines.

RIE - Receiver Interrupt Enable. CSR bit 05. Refer to Table 3-2.

RING 00 through RING 03 - The Ring Indicator signals for lines 0 through 3, after having been converted from EIA to TTL levels (sheet D7).

RO - Read-Only.

RTS - Request to Send.

RW - Read/Write.

RX ENAB - Receiver Enable. Line parameter register bit 12. Refer to Table 3-4.

RX LINE A, RX LINE B - Receiver Line A and B, respectively. RBUF bits 08 and 09. Refer to Table 3-3.

SA - Silo Alarm. CSR bit 13. Refer to Table 3-2.

SAE - Silo Alarm Enable. CSR bit 12. Refer to Table 3-2.

SEL 0 - Select line for device register 0 (the CSR). See sheet D4.

SEL 2 - Select line for device register 2. For an input (read) operation, this is the RBUF. For an output (write) operation, this is the LPR. See sheet D4.

SEL 4 - Select line for device register 4 (the TCR). See sheet D4.

SEL 6 - Select line for device register 6. For an input (read) operation, this is the MSR. For an output (write) operation, this is the TDR. See sheet D4.

SERIAL IN00 H through SERIAL IN03 H - Serial input data from each of the four lines. It is called Data In between the receivers (sheet D7) and the maintenance mode data selector (sheet D10). From there to the UARTs (sheets D13 and D14), it is called Serial In.

SERIAL OUT00 through SERIAL OUT03 - Serial data out of the UARTs (sheets D13 and D14). It goes to the EIA drivers and the maintenance mode data selector (sheet D10).

SILO - This term refers to a buffer that automatically shifts data from its input end to its output end. When a silo is loaded, the data does not queue up from the input end toward the output end, as in a shift register. Instead, it stacks up at the output end, and is immediately available for unloading.

SILO ALARM H - This signal is the output of a latch that is set when 16 characters have entered the silo (sheet D11). It is cleared by either reading the RBUF or clearing the Silo Alarm Enable bit in the CSR.

SILO LOAD REQUEST H - This signal is asserted when the Data Available signal for the selected line is set and the In Ready signals from the silo buffer chips are set. See sheet D12.

SPEED CODE A through SPEED CODE D - Bits 08 through 11 of the line parameter register. Refer to Table 3-4.

STOP CODE - Bit 05 of the line parameter register. Refer to Table 3-4.

TBMT - Transmitter Buffer Empty.

TBMT00 through TMBT03 - These are Transmitter Ready signals from the UARTs (sheets D13 and D14) to the transmitter control circuitry (sheet D9).

TBUF0 through TBUF7 - Transmit data bits; bits 0 through 7 of the TDR.

TCR - Transmitter control register. Refer to Paragraph 3.2.4.

TDR - Transmit data register. Refer to Paragraph 3.2.6.

THRL00 L through THRL03 L - Transmitter Holding Register Load signal for lines 0 through 3. From the transmitter control circuitry (sheet D9) to the UARTs (sheets 13 and 14).

TIE - Transmitter Interrupt Enable. CSR bit 14. Refer to Table 3-2.

TLINE A, TLINE B - CSR bits 08 and 09. Indicate which line is selected for transmission. Refer to Table 3-2.

TRAN INTR ENBL H - Transmitter Interrupt Enable signal (sheet D5).

TRANSMITTER READY H - This signal indicates that a line has been selected and that the corresponding UART transmitter is ready to be loaded.

TRDY - Transmitter Ready. CSR bit 15. Refer to Table 3-2.

TTL - Transistor-Transistor Logic. The normal logic levels are approximately 4 V for one state and 0 V for the other.

TX CLOCK 00 H through TX CLOCK 03 H - Transmitter clocks for lines 0 through 3. They come from the baud rate generators (sheet D8) and go to the UARTs (sheets D13 and D14).

UART - Universal Asynchronous Receiver/Transmitter. Refer to Appendix A.

UNLOAD SILO H - The unload signal to the Shift Out pin on the silo buffer memory chips.

VECTOR BIT 02 - Bit 02 of the vector term. This determines whether the computer uses a receiver interrupt service routine or a transmitter interrupt service routine. See sheets D5 and D2.

VECTOR-TO-BUS H - This signal asserts the vector selected by the switch pack at E2 (sheet D5). It also goes to the protocol chip (sheet D4) to cause assertion of BRPLY.

XMIT DATA 00 through XMIT DATA 03 - Transmitted data leaving the EIA drivers.

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