Model MX-420

Programmable Terminal Interface

Technical Manual

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REVISION HISTORY

ECO No.	Date	Description	Pages
0010	03/19/82	Changed Page 10-5	
0110	04/21/83	Changed Pages 2-1, 2-3, 3-1, 8-2	
0328	06/28/84	New ZETACO Cover	
0535	11/22/85	Addition of DG Panel	
0555	02/07/86	Update manual to ZETACO name	

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1.0 INTRODUCTION

The MX-420 Programmable Terminal Interface (PTI) is a multi-line communications controller designed to interface any Data General Nova® or Eclipse® to sixteen local displays, serial printers or Bell 103 modems (manual answer only). The MX-420's programmable features allow the user to re-configure for different terminal types without making hardware changes.

Several MX-420 units may be combined with a Data Control Unit to provide a complete multiprocessor communications system residing within the CPU chassis. Other features of the MX-420 include Full/Half Duplex Operation, Line Speeds from 50 to 19,200 baud, Programmable Line Characteristics (parity, stop bits, character length) and Switch Selectable 20MA Current Loop or EIA RS-232C Line Interface.

2.0 INSTALLATION PROCEDURES

2.1 UNPACKING

Upon receiving the MX-420 package, unpack the contents and inspect the board for visual damage. If any damage is apparent, do not attempt to install the Controller, but notify ZETACO, Inc. immediately.

2.2 BOARD INSTALLATION

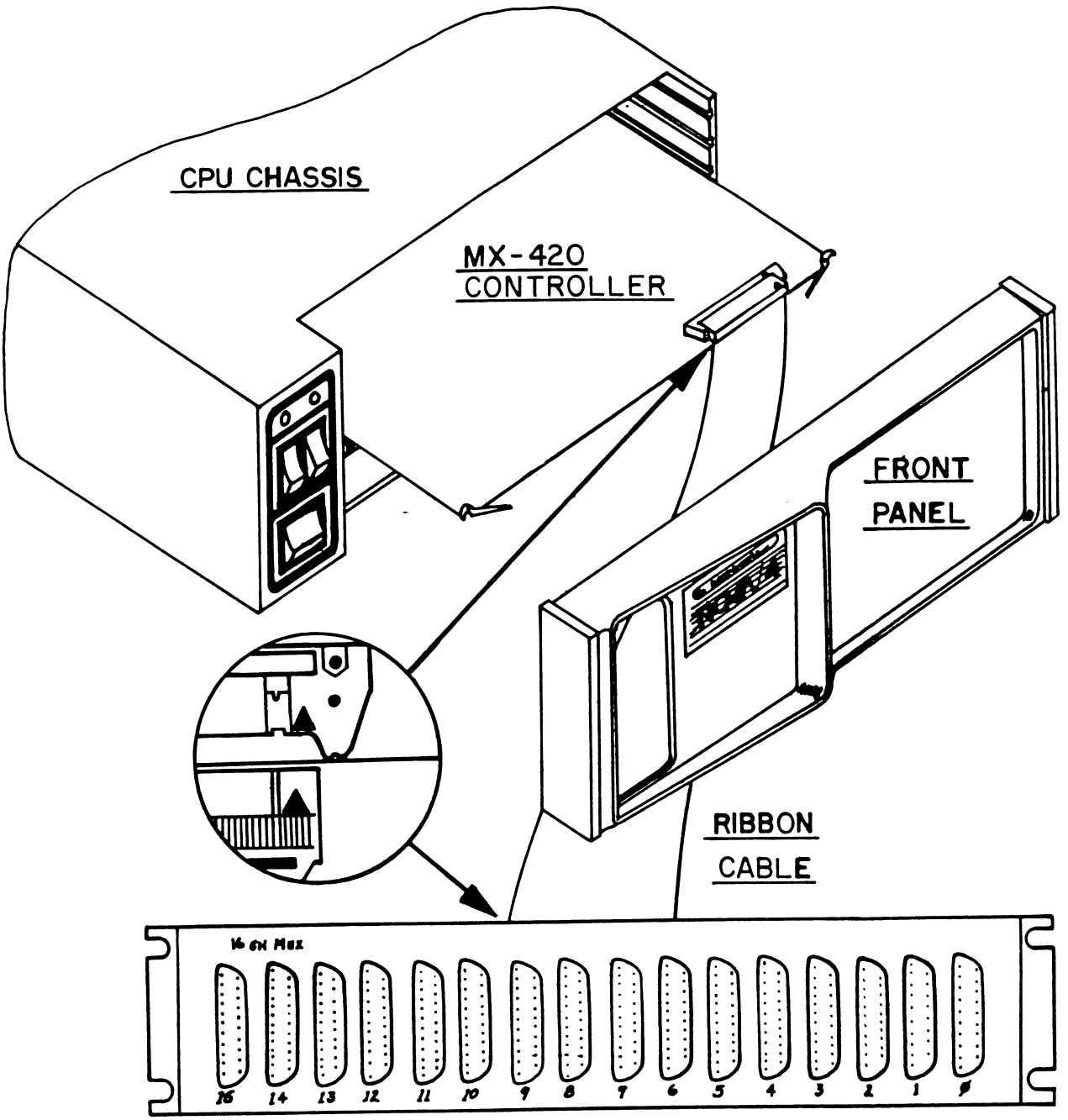
The Controller may be installed in any general I/O, Memory I/O or I/O Only slot of the DG's Nova or Eclipse minicomputer. Install the Controller into the desired slot, component side up and lock into position with release levers (see Figure 2.1).

CAUTION: Be sure keyways in backplane connectors line up with slots in Controller edge connector, and arrows on ribbon cable plug match arrows on cable connector (see Inset, Figure 2.1).

If, with the selection of the I/O slot, a vacant slot or slots exist between the Controller and the board below it, the DCHP (Data Channel Priority) and the INTP (Interrupt Priority) signals must be physically jumpered on the computer backpanel to maintain priority interrupt continuity. Install one end of a wirewrap jumper to the DCHP - OUT signal at pin 93 at the "A" connector occupied by the Controller, bridging the vacant slot or slots. Similarly, connect the INTP - OUT signal (pin A-95) from the lower device to the INTP - IN signal at pin A-96 of the Controller. This will complete the priority interrupt continuity to the card. If vacant slots exist between the Controller and the device above the Controller, perform similar strapping of the DCHP and INTP signals to maintain interrupt priority.

CAUTION: Be sure NO existing cabling or devices are connected to the backplane of the slot in which the MX-420 is to be installed.

FIGURE 2.1 Board Installation



2.3 COMPUTER BACKPANEL

The backpanel of the computer provides a means for interconnecting the computer, memory, console and various controller boards and cabling to external peripheral equipment. The backpanel is the vertical printed circuit board mounted on the left side of the computer chassis when viewed from the front.

On the side of the backpanel, facing into the chassis, are pairs of printed circuit board female edge connectors: one pair for each slot. The contact of these connectors protrudes through the backpanel to the left side of the minicomputer chassis.

When the male edge connectors of a printed circuit board are inserted into the female edge connectors of a slot, finger contacts on the male edge connectors meet contacts in the female edge connectors. Electrical connections to boards can, therefore, be made to pins on the backpanel.

For each Controller slot, there are two horizontal, parallel rows of 100 pins on the backpanel. The left group of pins is the A connector, and the right group (as viewed from the left side of the computer) is called the B connector. The numbering of each group of 100 pins is as indicated below (shown only for connector A).

"A" SIDE BACKPANEL NUMBERING

A1	A3	A5	A7	A9	A11	A13	A15	A17	A19	A21	A23	A25	A27	A29	A31	A33	A35	A37	A39	A41	A43	A45	A47	A49	A51	A53	A55	A57	A59	A61	A63	A65	A67	A69	A71	A73	A75	A77	A79	A81	A83	A85	A87	A89	A91	A93	A95	A97	A99
A2	A4	A6	A8	A10	A12	A14	A16	A18	A20	A22	A24	A26	A28	A30	A32	A34	A36	A38	A40	A42	A44	A46	A48	A50	A52	A54	A56	A58	A60	A62	A64	A66	A68	A70	A72	A74	A76	A78	A80	A82	A84	A86	A88	A90	A92	A94	A96	A98	A100

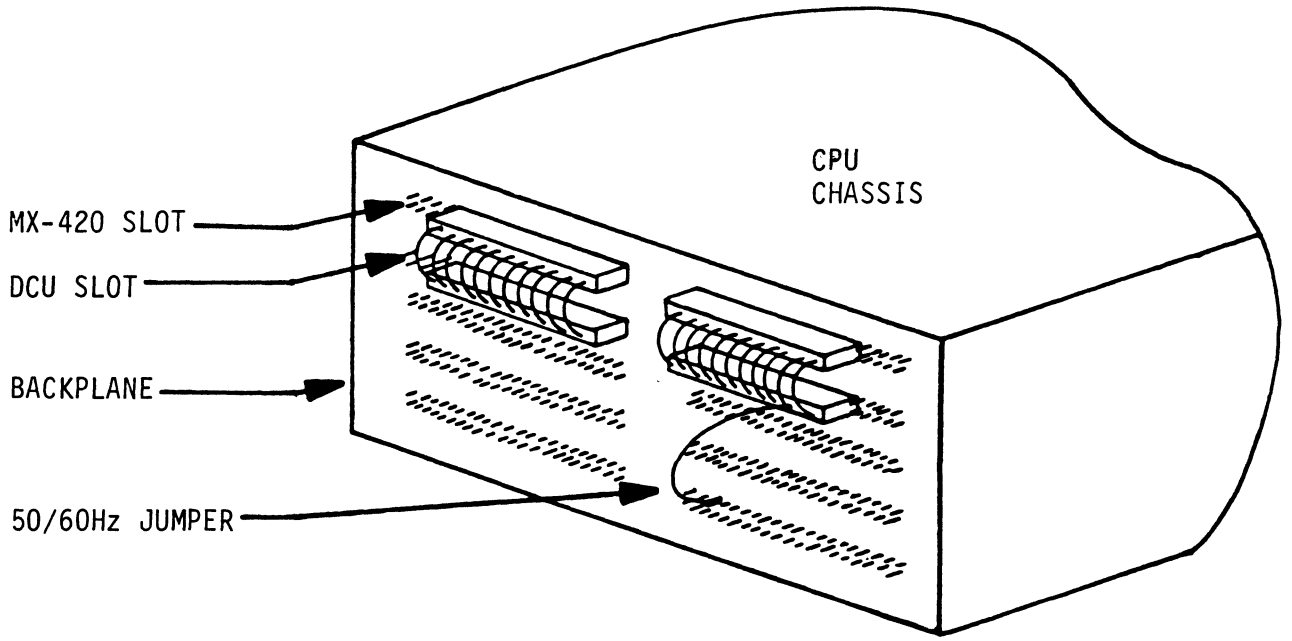
3.0 CONFIGURATION

The MX-420 may be configured to operate in one of two modes: the first is the CPU Mode. In this mode, the Controller responds to commands from the CPU via the backplane. This requires the CPU to handle all communications on a character by character basis - greatly increasing processor overhead.

The second mode, or DCU Mode, allows a Data Control Unit to directly control the MX-420. The MX-420 uses only power from the backplane. A jumper plug is used to pass signals from the DCU/50 or DCU/200 to the Controller. Up to sixteen MX-420 units (256 total lines) may be daisy-chained off the DCU to provide a complete communications system with minimal system overhead.

When operating with the DCU, be sure jumper J3-1 is OUT or cut. (J3-1 is located near chip location A-1.) Refer to Figure 3.1 for installation of DCU to MX-420 backplane jumper plug.

FIGURE 3.1 DCU Jumper Installation



3.1 CUSTOMER SUPPORT HOTLINE

ZETACO, Inc. provides a Customer Support Hotline (612-941-9480) to answer technical questions and to assist with installation and trouble-shooting problems. The Hotline is manned by a technical team from 8:00 a.m. to 5:00 p.m. (Central Time) Monday through Friday.

3.2 WARRANTY INFORMATION

All ZETACO controllers and couplers are warranted free from manufacturing and material defects , when used in a normal and proper manner, for a period of up to two years from date of shipment. Except for the express warranties, stated above, ZETACO disclaims all warranties including all implied warranties of merchantability and fitness. The stated expressed warranties are in lieu of all obligations of liabilities on the part of ZETACO for damages, including but not limited to, special, indirect or consequential arising out of or in connection with the use or performance of ZETACO's products.

3.3 PRODUCT RETURN AUTHORIZATION

When Controller malfunction has been confirmed, the board can be returned to ZETACO for warranty repair or for time-and-material repair if the product has been damaged or is out of warranty. A Return Material Authorization (RMA) number is required before shipment and should be referenced on all packaging correspondence.

To ensure prompt response, the information outlined in the Material Return Information form on the following page should be gathered before calling the ZETACO Hotline for the RMA number. Please include a completed copy of the Material Return Information form with the product. Each product to be returned requires a separate RMA number and Material Return Information form.

To safeguard the Controller during shipment, please use packaging that is adequate to protect it from damage. Mark the box "Delicate Instrument" and indicate the RMA number(s) on the shipping label.

MATERIAL RETURN INFORMATION

All possible effort to test a suspected malfunctioning controller should be made before returning the Controller to ZETACO for repair. This will: 1) determine if the board is actually defective; 2) increase the speed and accuracy of a product's repair, which is often dependent upon a complete understanding of the user's checkout test results, problem characteristics, and the user system configuration. Test results for the Controller should be obtained by performing the tests below. (Use back of page if more space is needed.)

TEST	RESULT
Self-test	_____
Formatter	_____
Diagnostics	_____
Reliability	_____

Other tests performed (system operation, erros, etc.):

Please allow our service department to do the best job possible by answering the following questions thoroughly and returning this information with the malfunctioning board.

1. Does the problem appear to be intermittent or heat sensitive? (If yes, explain.)

2. Under which operating system are you running? (RDOS, AOS) Include Revision Number.

3. Describe the system configuration, (i.e., peripherals, controllers, model of computer, etc.).

4. Has the Controller been returned before? Same problem?

To be filled out by CUSTOMER:

Model #:_____
Serial #:_____
RMA #:_____(Call ZETACO to obtain an RMA number.)

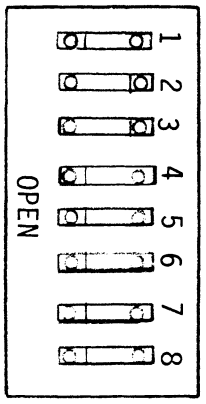
Returned by:

Your name:_____
Firm:_____
Address:_____
Phone:_____

4.0 ADDRESSING

The MX-420 is accessed via a single device code with sixteen (16) lines residing within the Controller. The primary and secondary device codes are 34_8 and 44_8 respectively, with a mask bit of 8. The line addresses of the board represent sixteen consecutive lines of a possible 256. The Controller's line select logic may be disabled for any reason simply by closing a switch (see below for switch layout).

ADDRESSING SWITCH - (Location L-4)



O=Open C=Closed

SW1 = Device Code Sel		O=34, C=44
SW2 = Line Sel 3		
SW3 = Line Sel 2		O=Logic "1"
SW4 = Line Sel 1		C=Logic "0"
SW5 = Line Sel 0		
SW6 = Line Sel Control		O=Enabled, C=Disabled
SW7 = NU		
SW8 = NU		

NOTE: Line Select Control must be enabled for board to function properly.

SHOWN: Device Code 34 - Select
Lines 60_8 to 77_8 - Decoded
Line Select Enabled

5.0 OPERATION

5.1 GENERAL

Each line of the MX-420 is split into two individual sections: a transmitter and a receiver. Each of these sections may be enabled to set DONE if it requires service.

The MX-420 operates in two modes, Off-Line (diagnostic) Mode or On-Line Mode. In Diagnostic Mode, the program provides the timing pulses via an NIOP mux instruction, allowing the testing of on-board counters and sequenced logic. In the On-Line Mode, all timing is provided by a crystal and each individual line section is being scanned on a prioritized basis to see if any service is required.

There are six device commands/flags that control or indicate conditions within the MX-420. These are:

BUSY — Active during initiation of MX-420 after a start or I/O reset.

DONE — Active whenever an enabled line section of the board requires service.

F = S — Start Pulse - Sets busy active; clears done; puts board On-Line while initiation occurs; puts board Off-Line and then clears busy.

F = C — Clears Pulse - Clears Done and/or puts board On-Line (if it is not already).

F = P — I/O Pulse - Diagnostic Mode Clock Stepper - no effect on On-Line Mode.

I/O RESET — Same as start; however, goes to all boards in chassis (same as Power On).

5.2 INITIALIZATION

The MX-420 is initialized by executing a Start or IORESET Command. This will put the board Off-Line, loop back, done flag, and all the scanner logic will be cleared. All lines should be configured per system requirements before it is placed On-Line.

5.3 RECEIVER

The receiver section does the conversion from the peripheral's serial data stream to the CPU's parallel character format. When a character has been received, a program interrupt is initiated (if enabled). A Data-In-A is executed to determine which line and section requires service. If data bit 15 is a One, then a receiver has a character. If it is a Zero, a transmitter needs service. A Data-In-C will pass the status of the received character: parity error, framing error (missing stop bits) or overrun error. A Data-In-B will pass the character - right justified onto the CPU's data bus. DONE should be cleared using a NIOC mux or DIBC mux instruction to allow the remaining line sections to be scanned.

5.4 TRANSMITTER

The transmitter handles the serialization of data characters being passed to the peripheral. If enabled it will initiate a program interrupt whenever it can transmit another character. If used, the "Clear To Send" handshake signal from the peripheral must be active in addition to the line being enabled before DONE will set for an empty transmitter. If "Clear To Send" is not used (as in Current Loop), its input is forced active. Data is transmitted via a Data-Out-B instruction to a selected line. A transmitter DONE condition can be cleared by a NIOC mux or a DOBC mux. A line break condition may be forced by executing a transmit break instruction forcing all zeros to be sent. The break condition is cleared by transmitting another character.

Since there are sixteen lines of the MX-420, a prioritized scanning technique is used to resolve any conflicts. The lines are scanned as follows:

LINE 0	Receiver -	Top Priority
LINE 15	Receiver -	
LINE 0	Transmitter -	
LINE 15	Transmitter -	Lowest Priority

It takes approximately 325 microseconds to scan each line section requiring up to 104 microseconds, or one bit time, at 9,600 buad to find a line section requiring service. Care should be taken to avoid lost data errors resulting from a low priority line being pre-empted by a higher speed-high priority line.

The DONE flag is set and an interrupt occurs, if the mask is off, whenever any of the following conditions are met:

RECEIVER	The specific receiver section is enabled and the receive character buffer is full (one character time is allowed before an overrun condition occurs).
TRANSMITTER	The specific transmitter section is enabled and the transmitter holding register is empty and the lines "Clear To Send" input is active or left open (not used).

5.5 LOOP BACK

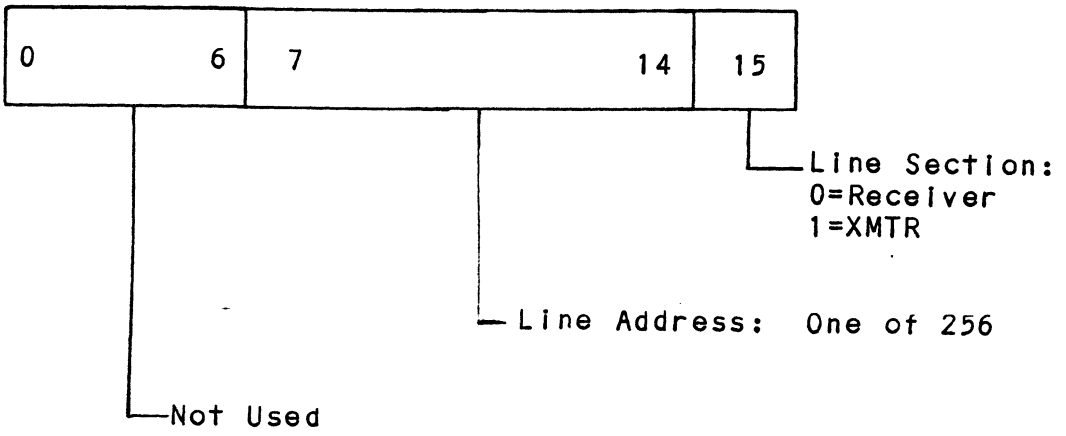
Testing of the Async line is essential to ensure data integrity. Loop Back Mode connects the transmit data path to the receive data input allowing a short test to ensure operation or a full blown block compare test, which tests all parameters, such as a reliability test. Loop Back "ON" forces "Clear To Send" active.

6.0 PROGRAMMING

The MX-420 Controller will respond to eight (8) instructions that control the various functions of serial communications. However, some instructions use the same data out command with the contents of the specified accumulator determining how the Controller will function. All instructions affect only the "Current Line Address" once it has been specified by a set line and section instruction or a read line and section requesting service instruction. The instructions are as follows:

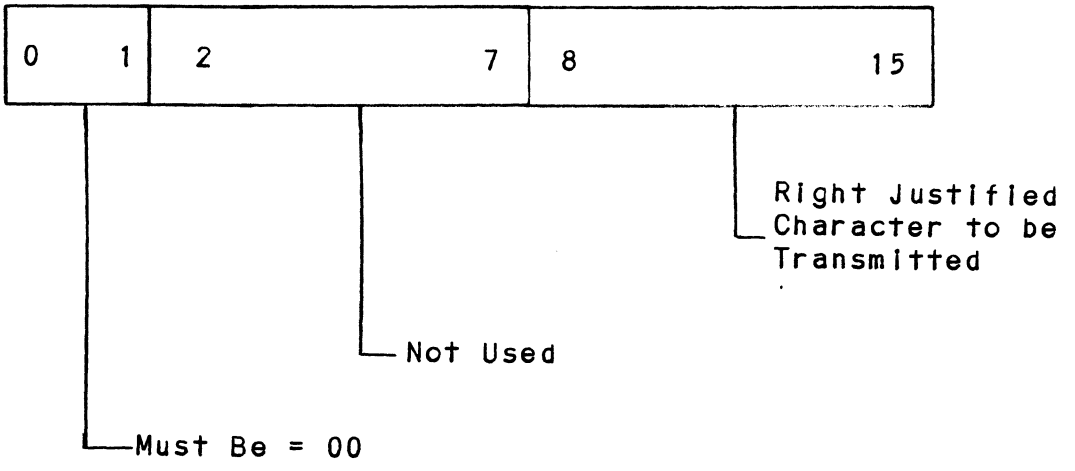
1. Set Line and Section

   DOA (f) AC, MUX



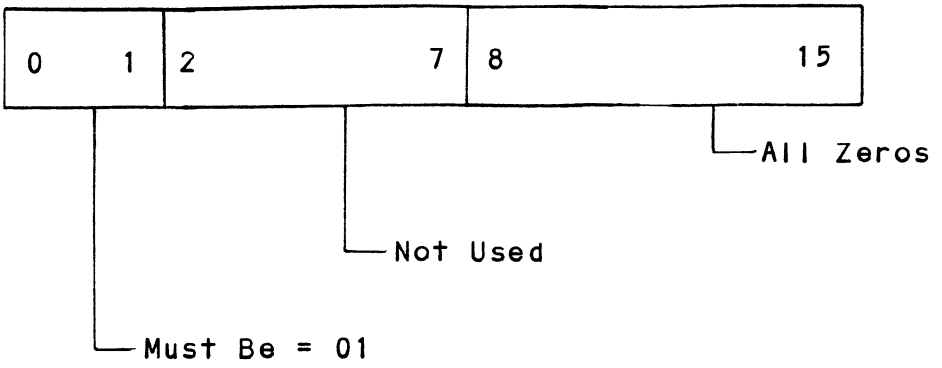
2. Transmit Data

   DOB (f) AC, MUX



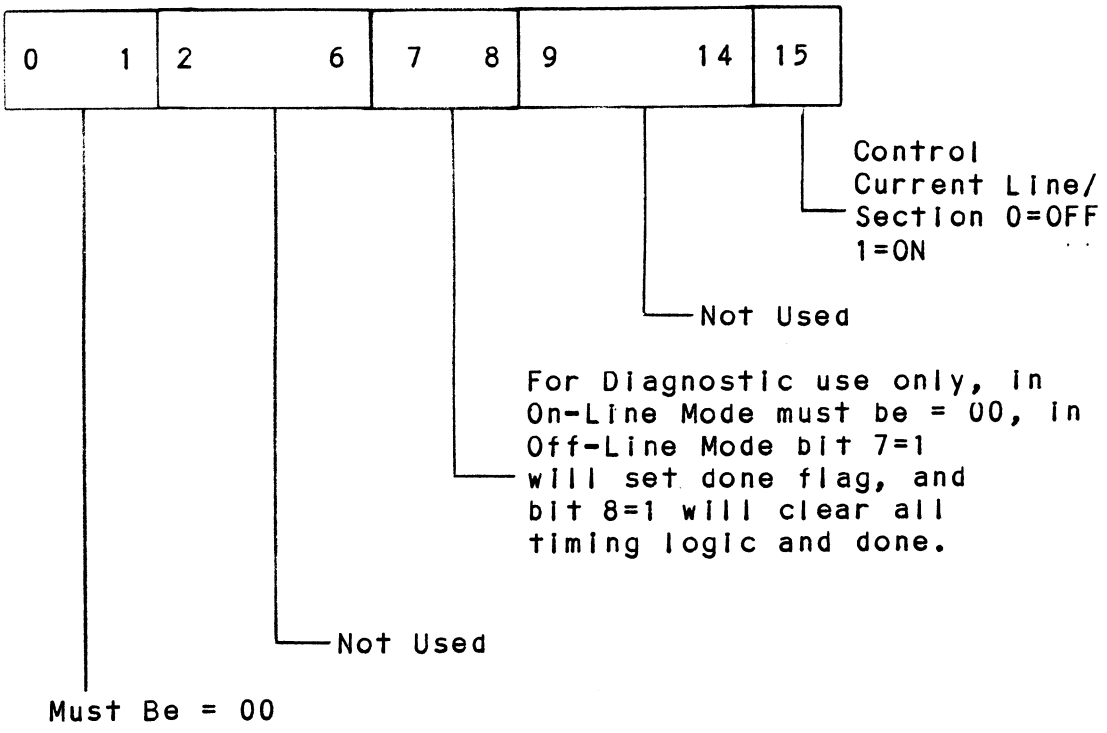
3. Transmit Break (All Zeros)

DOB (f) AC, MUX



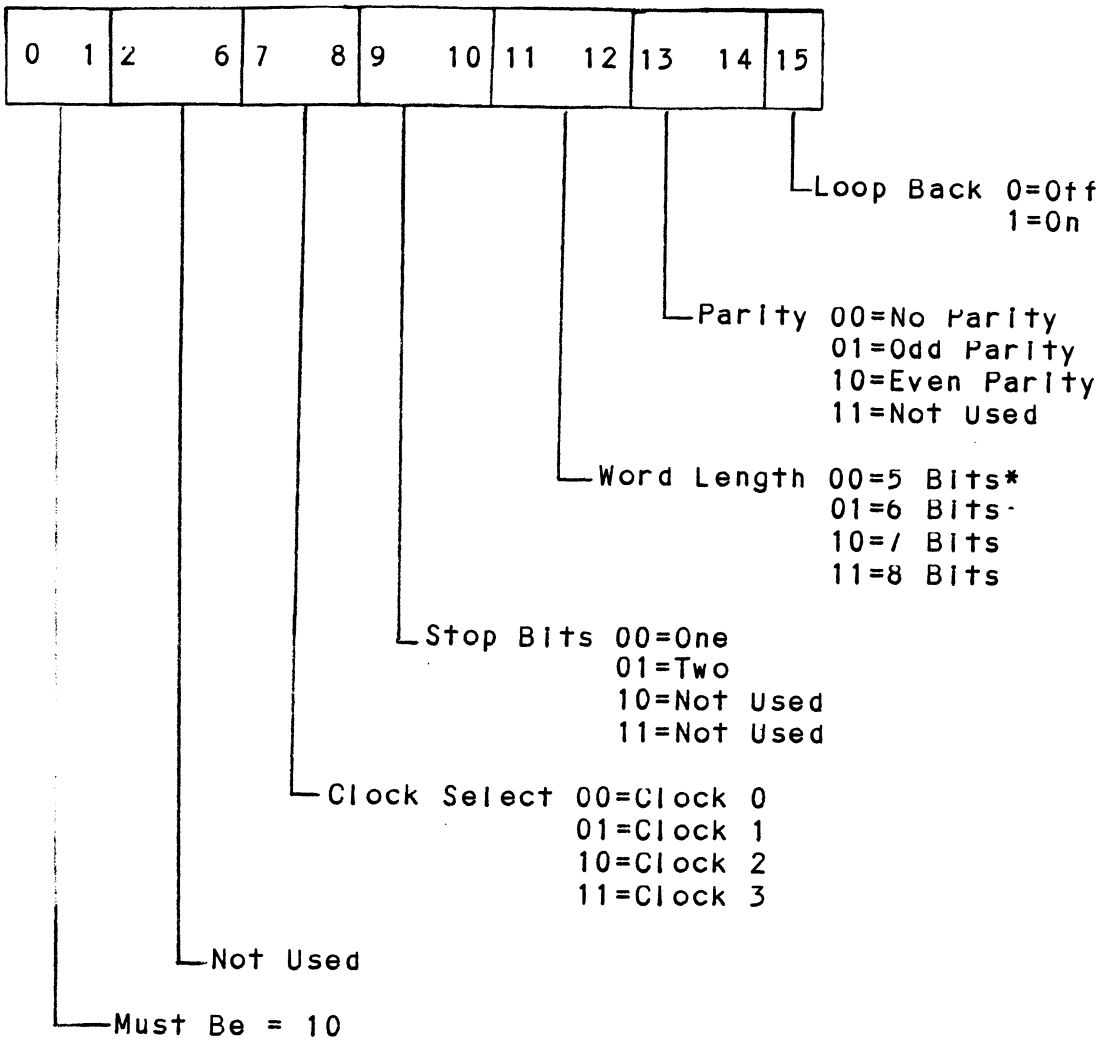
4. Control Line Section

DOC (f) AC, MUX



5. Specify Line Characteristics

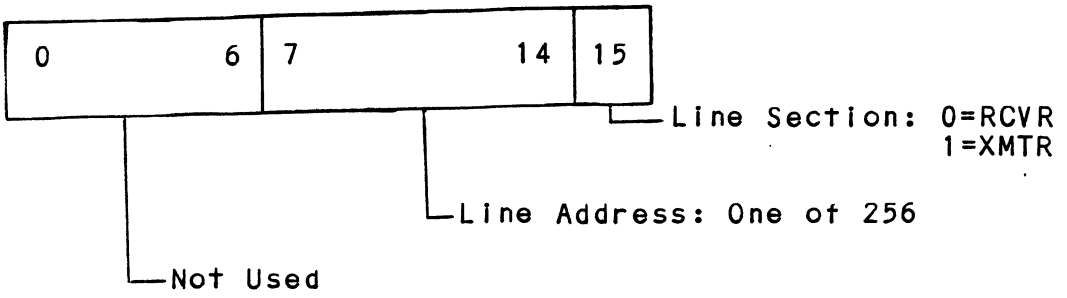
DOC (f) AC, MUX



* In 5 Bit Character Length only one or one and one-half stop bits may be selected.

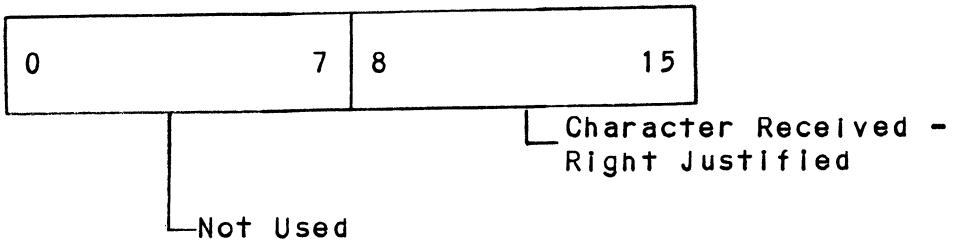
6. Read Line and Section Requesting Service

DIA (f) AC, MUX



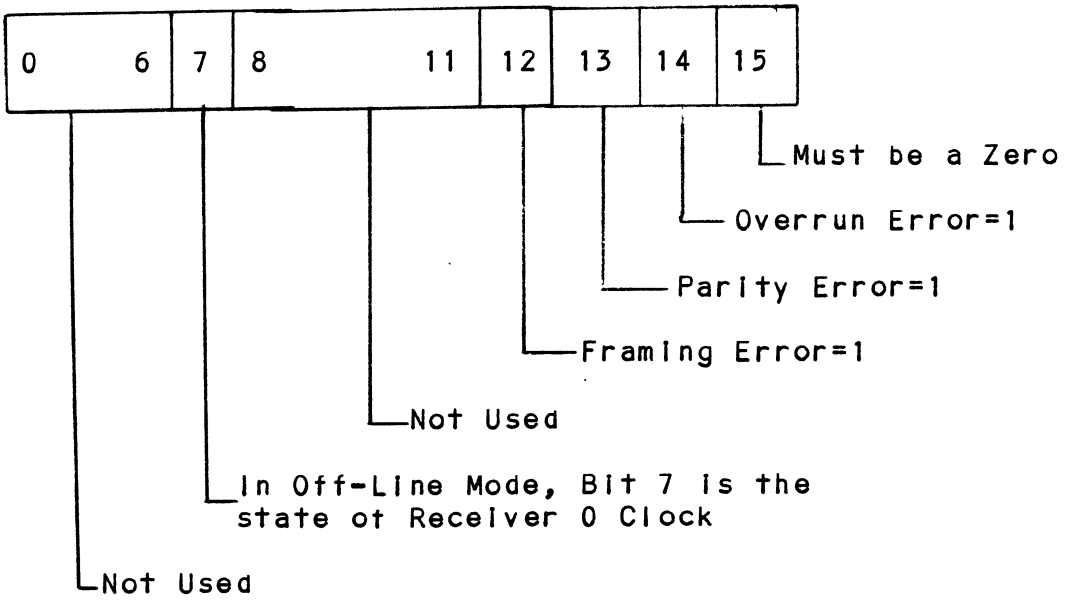
7. Read Receive Data

DIB (f) AC, MUX



8. Read Receiver Status

DIC (f) AC, MUX



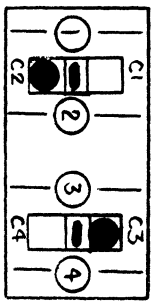
7.0 OPTIONS

7.1 GENERAL

Three major options are present on the MX-420. The first is Switch Selectable Line Interface (20MA current loop or EIA RS-232C). The second is the board's ±12V power source. And the third is the configuration of the 4 clock sources.

7.2 LINE INTERFACE SELECTION

Line Interface Selection is accomplished by setting the respective line interface select switch to either the EIA position (RS-232C) or the 20MA position (current loop). Both interfaces are shown below:



LINES
0 & 1

Line 0 - Left side of switch depressed: selects RS-232C line interface

Line 1 - Right side of switch depressed: selects 20MA current loop line interface

SHOWN: Line 0 = EIA
Line 1 = 20MA

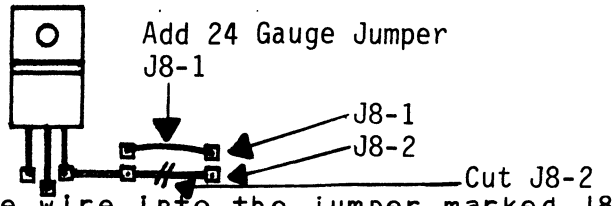
NOTE 1: Even line number is always on top half of double switch, odd line number on bottom half.

NOTE 2: Lines not being used should be left in EIA MODE, since the Current Loop interface pulls up the unused inputs causing the receiver to "see" null characters with framing errors.

7.3 12 VOLT POWER SOURCE

The MX-420 requires +12V for proper operation. The source of this 12 volts depends on which machine is being used. On older machines (Nova - 1200, 2, 3, etc.), the 12 volts is regulated down from +15 volts (VINH - pin A10). In a newer machine (Nova 4, Eclipse S140), +12 volts is available on backplane pin B90. Jumpers J8-1 and J8-2 are used to select between the two.

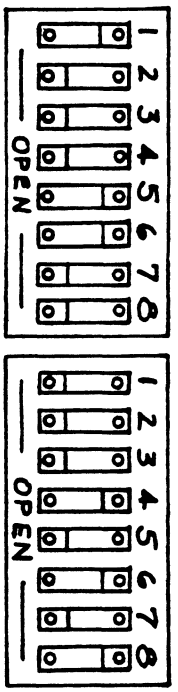
Jumper J8-2 is a heavy foil already in place. This selects the +15 volts to be regulated down to +12 volts. To alter the source to a straight +12 volts, simply cut the foil marked J8-2 on the right of the voltage regulator in location Z F. (See diagram below.)



Then add 24 gauge wire into the jumper marked J8-1.

7.4 BAUD RATE SELECTION

Each line may be set up for one of four Baud Rate Clocks. Each of these clocks (CLK 0 - CLK 3) may be set to any rate from 50 to 19.2K bps. The switches are set in the following manner:



		SEL 0	SEL 1	SEL 2	SEL 3	BAUD RATE
CLK 0	SEL 0	0	0	0	0	50
	SEL 1	1	0	0	0	75
	SEL 2	0	1	0	0	110
	SEL 3	1	1	0	0	134.5
CLK 1	SEL 0	0	0	1	0	150
	SEL 1	1	0	1	0	300
	SEL 2	0	1	1	0	600
	SEL 3	1	1	1	0	1200
CLK 2	SEL 0	0	0	0	1	1800
	SEL 1	1	0	0	1	2000
	SEL 2	0	1	0	1	2400
	SEL 3	1	1	0	1	3600
CLK 3	SEL 0	0	0	1	1	4800
	SEL 1	1	0	1	1	7200
	SEL 2	0	1	1	1	9600
	SEL 3	1	1	1	1	19.2K

0=CLOSED, 1=OPEN

SHOWN: CLK 0 = 9600 Baud CLK 1 = 4800 Baud
CLK 2 = 1200 Baud CLK 3 = 300 Baud

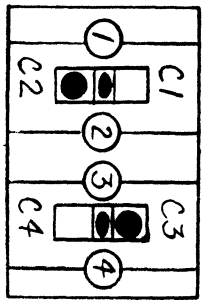
NOTE: 1. When running diagnostics CLK 0 and CLK 1 must be at different rates.

2. Excessive errors may result from running the reliability test (P-MUX-RELI) with any clocks at 19,200 baud.

7.5 DISTRIBUTION PANELS

Two distribution panels are offered with the product. ZETACO Standard, which has sixteen 25-socket (female) D Connectors and a DG Compatible panel which has sixteen 25-pin (male) D Connectors. The DG panel contains 16 switches that are used to configure between EIA and Current Loop. These switch settings must always match the Controller switch settings for proper operation of either EIA or Current Loop communications.

DG Distribution Panel interface selection is accomplished by setting the respective line interface select switch to either the EIA position (RS-232C) or the 20MA position (Current Loop). Both interfaces are shown below.



LINES 0 & 1

Line 0 - Left side of switch depressed: selects RS-232C line interface

Line 1 - Right side of switch depressed: selects 20MA Current Loop line interface

SHOWN: LINE 0 = EIA
LINE 1 = 20MA

NOTE 1: Even line number is always on top half of double switch, odd line number on bottom half.

NOTE 2: Lines not being used should be left in EIA MODE, since the Current Loop interface pulls up the unused inputs causing the receiver to "see" null characters with framing errors.

8.0 DIAGNOSTICS

8.1 GENERAL

A Diagnostic Tape (400-246-00) is provided with the MX-420, which contains the Diagnostic and Reliability tests as well as a program to exercise a single line connected to a CRT. The tape itself is 800 BPI format with a "T-BOOT" loader. The Reliability Test should be run first to determine if any lines are not working properly. If errors occur, the Diagnostic should be run to isolate and fix the specific problem.

8.2 LOADING DIAGNOSTICS

With the tape loaded on the drive and ready (at load point), initiate a Program Load from tape. If using a machine with a front panel, set the switches to 100022 and hit program load. If a newer machine (Nova 4, S140) is being used, the monitor program resident in the machine will give an exclamation point prompt "!". Enter 100022L and hit return. Both of the above procedures will result in the message "From MTO:" being displayed on the console. Enter file desired; and when loaded in, start answering the questions in the Menu. The files and a brief description of each are explained below.

Diagnostic Tape
400-246-00

File 0	"T-Boot"	- Loader Program
File 1	Directory	- The listing of what is on the tape.
File 2	PTI Diagnostic	- Diagnostic for PTI. Requires eight (8) 400T test plugs, to be used for trouble-shooting the hardware.

CAUTION: Before running either the PTI Diagnostic or PMUX REL1, the user should read the prefix for the specific program (found in the rear of this manual).

File 3 — PMUX RELI - A Reliability Test to be used to isolate any faulty lines and determine if the diagnostics should be run.

File 4 — PTI XMIT/ECHO - An applications type program to exercise a terminal from the MX-420 board.

File 5 — The previous four save files in Dump Format for storage on a disk.

NOTE: If for any reason the Reliability Test cannot be loaded and run, Data General's 4200 RELI Test may be used.

8.3 USING THE PTI XMIT/ECHO PROGRAM

The PTI XMIT/ECHO Program is used to drive a CRT or similar Serial Device without an operating system. The Program is menu-driven and can be set to interface to any Async Serial Data Format. The Program is controlled completely from the console requiring no front panel.

The PTI XMIT/ECHO Program is on File 4 of the Diagnostic Tape. It is loaded in the same manner described in Section 8.2. Once loaded, the operator should set the program's parameters to match the Serial Device being interfaced (see Section 10 on attaching devices to the Controller). The Program is controlled with the following key sequences:

CONTROL "R" - Re-enter all Program Parameters

CONTROL "L" - To change Line Address Only

CONTROL "E" - To change to Transmit Data or Echo Keyboard

CONTROL "D" - To change Data being Transmitted

9.0 INTERFACE SIGNALS, DISTRIBUTION PANEL SIGNALS

9.1 INTERFACE SIGNALS (CPU)

SIGNAL NAME	ACTIVE LEVEL	PIN NUMBERS
Data 0	L	B62
Data 1	L	B65
Data 2	L	B82
Data 7	L	B55
Data 8	L	B60
Data 9	L	B63
Data 10	L	B75
Data 11	L	B58
Data 12	L	B59
Data 13	L	B64
Data 14	L	B56
Data 15	L	B66
DS0	L	B72
DS1	L	B68
DS2	L	A66
DS3	L	A46
DS4	L	A62
DS5	L	A64
DATIA	H	A44
DATIB	H	A42
DATIC	H	A54
DATOA	H	A58
DATOB	H	A56

DATOC	H	A48
START	H	A52
CLEAR	H	A50
INTA	H	A40
IOPLS	H	A74
IORST	H	A70
MASKO	L	A38
RQENB	L	B41
INTR	L	B29
SELB	L	A82
SELD	L	A80
INTP-IN	L	A96
INTP-OUT	L	A95
DCHP-IN	L	A94
DCHP-OUT	L	A93

9.2 INTERFACE SIGNALS (DCU)

SIGNAL NAME	ACTIVE LEVEL	PIN NUMBER
DDATA 0	L	A69
DDATA 1	L	A75
DDATA 2	L	A91
DDATA 7	L	A47
DDATA 8	L	A65
DDATA 9	L	A71
DDATA 10	L	A78
DDATA 11	L	A61
DDATA 12	L	A63

DDATA 13	L	A73
DDATA 14	L	A57
DDATA 15	L	A67
DDS0	L	B13
DDS1	L	B19
DDS2	L	B23
DDS3	L	B51
DDS4	L	B27
DDS5	L	B25
DDATIA	H	B52
DDATIB	H	B53
DDATIC	H	B38
DDATOA	H	B34
DDATOB	H	B36
DDATOC	H	B49
DSTART	H	B40
DCLEAR	H	B48
DINTA	H	B54
DIOPLS	H	B11
DIORST	H	B15
DMASKO	L	B67
DRQENB	L	A49
DINTR	L	A86
DSELB	L	A90
DSELD	L	B6
DINTP-IN	L	A87

DINTP-OUT	L	A89
COMMON SIGNALS:		
PRI-IN	H	A84
PRI-OUT	H	A83

9.3 DISTRIBUTION PANEL RIBBON CABLE SIGNALS

SIGNAL NAME	PIN NUMBER
GROUND	1
20MA/EIA XMT-DATA-9	2
20MA/EIA RCV-DATA-9	3
EIA CTS-9	4
20MA/EIA XMT-DATA-10	5
20MA/EIA RCV-DATA-10	6
EIA CTS-10	7
20MA/EIA XMT-DATA-11	8
20MA/EIA RCV-DATA-11	9
EIA CTS-11	10
EIA CTS-12	11
20MA/EIA RCV-DATA-12	12
20MA/EIA XMT-DATA-12	13
EIA CTS-8	14
20MA/EIA RCV-DATA-8	15
20MA/EIA XMT-DATA-8	16
20MA/EIA XMT-DATA-2	17
20MA/EIA RCV-DATA-2	18
EIA CTS-2	19

SIGNAL NAME	PIN NUMBER
20MA/EIA XMT-DATA-1	20
20MA/EIA RCV-DATA-1	21
EIA CTS-1	22
20MA/EIA XMT-DATA-0	23
20MA/EIA RCV-DATA-0	24
EIA CTS-0	25
20MA/EIA XMT-DATA-15	26
20MA/EIA RCV-DATA-15	27
EIA CTS-15	28
20MA/EIA XMT-DATA-14	29
20MA/EIA RCV-DATA-14	30
EIA CTS-14	31
20MA/EIA XMT-DATA-13	32
20MA/EIA RCV-DATA-13	33
EIA CTS-13	34
20MA/EIA XMT-DATA-3	35
20MA/EIA RCV-DATA-3	36
EIA CTS-3	37
20MA/EIA XMT-DATA-4	38
20MA/EIA RCV-DATA-4	39
EIA CTS-4	40
20MA/EIA XMT-DATA-7	41
20MA/EIA RCV-DATA-7	42
EIA CTS-7	43
20MA/EIA XMT-DATA-5	44

SIGNAL NAME	PIN NUMBER
20MA/EIA RCV-DATA-5	45
EIA CTS-5	46
20MA/EIA XMT-DATA-6	47
20MA/EIA RCV-DATA-6	48
EIA CTS-6	49
-5V-20MA RCV-RETURN	50

9.4 ZETACO DISTRIBUTION PANEL, 25-PIN CONNECTORS

(All Connectors are the same for lines 0-15)

SIGNAL NAME	PIN NUMBER
Not Used	1
20MA/EIA XMT-DATA	2
20MA/EIA RCV-DATA	3
Not Used	4
EIA CTS	5
Not Used	6
GROUND/20MA-XMT RETURN	7
Not Used	8-12
-5V/20MA-RCV RETURN	13
Not Used	14-25

9.5 DG COMPATIBLE DISTRIBUTION PANEL, 25-PIN CONNECTOR

(All Connectors are the same for lines 0-15)

SIGNAL NAME	PIN NUMBER
Not Used	1
XMIT-DATA, EIA/-XMIT, CL	2
RCV DATA EIA/RCV DATA +CL	3
Not Used	4
EIA CTS	5
Not Used	6
GROUND	7
Not Used	8-10
+XMIT CL	11
Not Used	12-17
RCV DATA - (-5V)	18
Not Used	19-25

10.0 APPLICATION INFORMATION

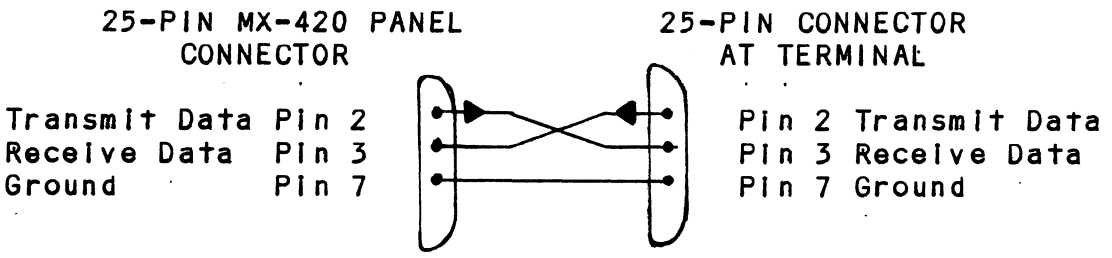
10.1 GENERAL

Devices may be attached directly to the MX-420 via the Distribution Panel. The ZETACO Distribution Panel contains sixteen 25-pin EIA female connectors, and the DG-Compatible Panel contains sixteen 20-pin male connectors, one for each line. Both EIA RS-232C and 20MA Current Loop interfaces are provided for each line. Clear to Send (CTS) is also supported to provide a means of handshaking between the MX-420 and a peripheral. The following sections explain the use of the MX-420 in several applications, including the use of multiple MX-420 units in a single system.

10.2 RS-232C TERMINAL

Terminals that have an RS-232C interface may be directly connected to the MX-420 Distribution Panel. Care must be taken to ensure that the receivers and transmitters are properly connected and the line on the Controller being used is in EIA Mode (see Sections 7.2 and 7.5).

Since Transmit Data flows out from the MX-420 on Pin 2 of each 25-pin connector, this should go to the receiver input of the terminal that is normally Pin 3. The terminal sends data out on Pin 2 of its 25-pin connector and the MX-420 expects that data to be present on Pin 3 of the 25-pin connector on the Distribution Panel. This hook-up is shown below:



The cable should have the following internal connections:

Pin 2 (PTI End)	to	Pin 3 (Terminal End)
Pin 3 (PTI End)	to	Pin 2 (Terminal End)
Pin 7 (PTI End)	to	Pin 7 (Terminal End)

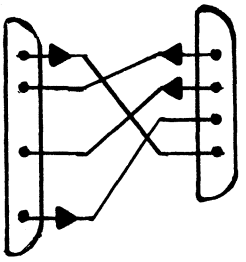
10.3 CURRENT LOOP TERMINALS

Terminals using the Current Loop Interface may also be used with the MX-420. This hook-up requires the line being used to be set to Current Loop Mode (see Sections 7.2 and 7.5) and an interface cable, which provides return loops for the transmitter and receiver. Ther terminal being used should have a "passive" interface, meaning that the MX-420 provides the current for the drivers and receivers. Since each half of the interface requires a complete loop for the current to flow, a different wiring scheme from RS-232C must be employed.

10.3.1 CURRENT LOOP USING ZETACO DISTRIBUTION PANEL

Transmit Data flows out of the MX-420 on Pin 2 of the 25-pin connector and returns on Pin 7, thus completing the transmit loop. The Receive Data Loop is similar, data flows into the MX-420 on Pin 3 and uses Pin 13 as a return path. A typical current loop cable configuration is shown below.

25-PIN MX-420 PANEL CONNECTOR		25-PIN CONNECTOR CURRENT LOOP TERMINAL
CL-XMIT DATA Pin 2		Pin 17 Transmit Data
CL-REC DATA Pin 3		Pin 23 Receive Return
GND/XMIT RETURN Pin 7		Pin 24 Transmit Return
-5V/REC RETURN Pin 13		Pin 25 Receive Data

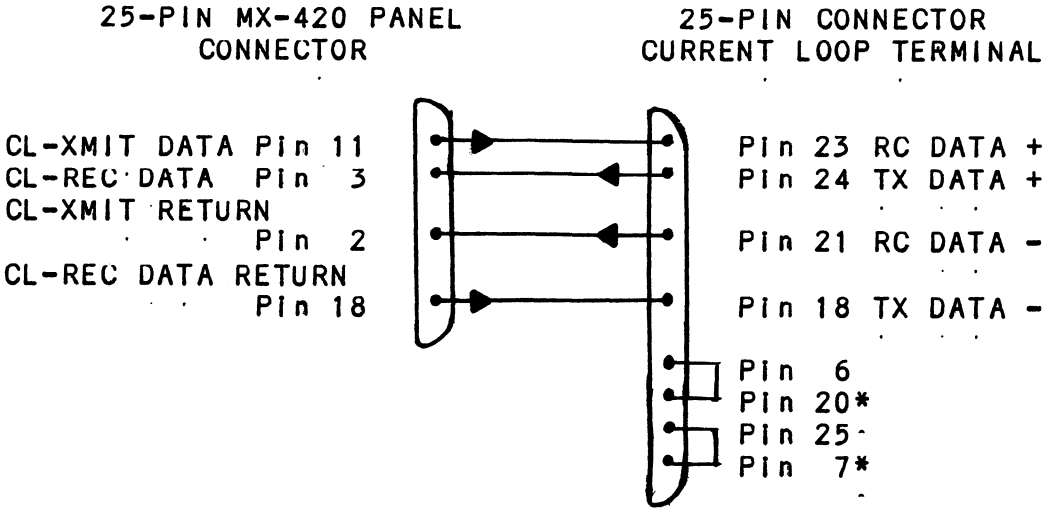


The cable should have the following internal connections:

Pin 2 (PTI End)	to	Pin 25 (Terminal End)
Pin 3 (PTI End)	to	Pin 17 (Terminal End)
Pin 7 (PTI End)	to	Pin 23 (Terminal End)
Pin 13 (PTI End)	to	Pin 24 (Terminal End)

10.3.2 CURRENT LOOP USING DG-COMPATIBLE DISTRIBUTION PANEL

Transmit Data flows out of the MX-420 on Pin 11 of the 25-pin connector and returns on Pin 2, thus completing the transmit loop. The Receive Data loop is similar, data flows into the MX-420 on Pin 3 and uses Pin 18 as a return path. A typical current loop cable configuration is shown below.



* Required on most Data General terminals.

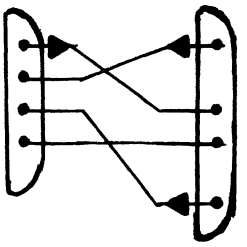
10.4 SERIAL PRINTER CONNECTION

When attaching Serial Interface Printers to the MX-420, a means of starting and stopping the flow of characters must be provided. Since most printers can only buffer a line or a page of information, the CPU must be signaled to prevent characters from being lost. This signaling method is called Handshaking.

This Handshaking process is achieved by connecting the Ready, Bust or "Data Terminal Ready" signal of the printer to the "Clear to Send" input of the line being used. Typically, these signals are at an active "High" level (+3.5 to +12V) whenever the printer can accept data and low (+.4V to -12V) when its buffer is full. This signal may go low at any time during the last character the printer can accept without causing any lost data. Two examples of the "Handshaking" interface are shown on the following page.

DIABLO HYTERM" MODEL 1610

25-PIN MX-420 PANEL CONNECTOR		25-PIN CONNECTOR AT PRINTER
Transmit Data	Pin 2	Pin 2 Transmit Data (if needed)
Receive Data	Pin 3	Pin 3 Receive Data
Clear to Send	Pin 5	
Ground	Pin 7	Pin 7 Ground
		Pin 20 Data Terminal Ready



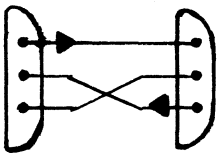
The cable should have the following internal connections:

Pin 2 (PTI End)	to	Pin 3 (Printer End)
Pin 3 (PTI End)	to	Pin 2 (Printer End)
Pin 5 (PTI End)	to	Pin 20 (Printer End)
Pin 7 (PTI End)	to	Pin 7 (Printer End)

GENERAL ELECTRIC TERMINET" PRINTERS

The Terminet" Printer interfaces easily to the MX-420. However, for best results, the Busy Signal must be jumpered for an active low level and switch in the middle of the parity bit. The electrical connections are shown below.

25-PIN MX-420 PANEL CONNECTOR		25-PIN CONNECTOR ON PRINTER
Transmit Data	Pin 2	Pin 2 Receive Data
Clear to Send	Pin 5	
Ground	Pin 7	Pin 7 Ground
		Pin 15 Busy



The cable should have the following internal connections:

Pin 2 (PTI End)	to	Pin 2 (Printer End)
Pin 5 (PTI End)	to	Pin 15 (Printer End)
Pin 7 (PTI End)	to	Pin 7 (Printer End)

10.5 USING MULTIPLE MX-420 PTI CONTROLLERS

In systems that require more than 16 serial interfaces, two or more MX-420 Controllers may be used to provide a maximum of 256 total lines. (This is a physical limitation only; the system limit may be less.) This is achieved by setting the Line Address for the next highest group of sixteen on the second board, and the same for the third unit (see Section 4.0) and so on. The Controllers should be placed in the chassis with the highest priority Controller (usually lines 0-15) closest to the CPU; the next highest priority unit in the next slot, etc. An Inter-Board Priority Jumper must be added to establish the DINA Priority scheme as follows:

Jumper Pin A83 (PRI-OUT) of the higher priority board to Pin A84 (PRI-IN) of the lower priority board. Repeat for as many MX-420's as are in the system.

NOTE: In the above configuration, transmitters on units 0-15 have a higher priority than the receivers on subsequent boards. This can cause excessive overrun errors on the low priority receivers.

```
;
;
;
;
;*****************************************************************************
;
;
; DESCRIPTION:  16 CHANNEL PROGRAMABLE TERMINAL INTERFACE (PTI) DIAGNOSTIC
;
;
; Product of ZETACO, 1987
;*****************************************************************************
        .TITL   PTID
        .DUSR   X=1
        .NOMAC  X
;1.     PROGRAM NAME PTID.SR
;
;2. REVISION HISTORY
;
;       REV.                DATE
;        00              07/08/81
;        01              09/16/81   ;TEXT CORRECTIONS, STARTING LINE ADDR 0-240
;        02              07/06/87   ;AOS BOOTSTRAP, DELETE C004 (UART REC
;                                   ;BUFFER),C071 2 STOP BITS, S120 2 NOP
;
;3.     MACHINE REQUIREMENTS:
;3.1     NOVA/ECLIPSE FAMILY PROCESSOR
;3.2     16K READ/WRITE MEMORY
;3.3     CONSOLE DEVICE
;3.4     PROGRAMABLE TERMINAL INTERFACE (PTI)
;3.5     8 TEST PLUGS

;3.6    OPTIONAL HARDWARE SUPPORTED:
;       DCU 50 OR DCU 200(DCU TO PTI BACKPLANE JUMPER PLUG REQUIRED)
;
;4.0   TEST REQUIREMENTS
;       JUMPER PLUGS ARE REQUIRED FOR FULL TEST, NO PLUGS ARE NEEDED
;       FOR BAUD TEST ONLY.
;
;5.     SUMMARY
;         THE PTI DIAGNOSTIC PERFORMS A GATE BY GATE TEST OF THE PTI
;         CONTROLLER. THE TEST INCLUDES MOST OF THE LOGIC(CURRENT LOOP
;         IS NOT TESTED) ON THE 15X15 INCH ASYNCHRONOUS BOARD. THE TEST
;         IS EXECUTED USING JUMPER PLUGS WHICH CONNECT LINE 0 TRANS-
;         MITTER TO LINE 1 RECEIVER,LINE 1 TRANSMITTER TO LINE 0
;         RECEIVER, LINE 2 TRANSMITTER TO LINE 3 RECEIVER, ETC.
;         ANOTHER TEST JUMPER ALSO CONNECTS THE CTS INPUTS TO SWITCHES
;         ON THE TEST PLUG TO CONTROL THE LEVEL OF THAT INPUT, THIS TEST
;         PLUG DOES NOT USE THE DISTRIBUTION PANEL.
;
;6.     RESTRICTIONS    NONE
```

```
;7.  PROGRAM DESCRIPTION/ THEORY OF OPERATION

;7.1     THE PTI DIAGNOSTIC IS A GATE BY GATE
;          TEST OF MOST OF THE CONTROLLER LOGIC. THE CONTROL
;          SECTIONS ARE DONE IN THE DIAGNOSTIC MODE,
;          WITH CLOCKING VIA THE IOPLS. MOST TRANSMIT/RECEIVE
;          TESTS ARE DONE ON LINE. EACH ROUTINE BEGINS
;          WITH AN INITIALIZING SUBROUTINE (SETUP) AND ENDS
;          WITH AN ITERATION SUBROUTINE (LOOP).  MOST TESTS
;          ISSUE AN I/O RESET.  IN SOME CASES, THIS MAY BE
;          USED TO SYNC A SCOPE.  IN OTHER CASES, IT MAY BE BEST
;          TO SYNC ON THE CONTROLLER INSTRUCTIONS.

;7.2     THE ORDER OF FUNCTION TESTING IS AS FOLLOWS:
;          CONTROL LOGIC COMMON LOGIC TO ALL LINES, INTERRUPT
;            CONTROL, DONE AND BUSY SET AND RESET, BOARD CLEAR
;            (NIOC).  TIMING LOGIC - CHECKS SCANNER BY USING IO
;            PULSE TO STEP THROUGH EACH TIME STATE AND LINE ADD-
;            RESS, AND CORRECT TIMING OF EACH BAUD CLOCK, USING
;            LINE 0 TRANSMIT CLOCK OUTPUT THROUGH BIT 7 OF DIC
;            WORD (DIAGNOSTIC MODE).
;        TRANSMITTER/RECEIVER TESTING- ALL BAUD CLOCKS,
;            AND ALL LINE CHARACTERISTICS (INCLUDING LOOPBACK)
;            AND TRANSMIT BREAK ARE TESTED HERE, FIRST ON
;            LINE 0.

;7.3     THE TRANSMIT/RECEIVE TESTS ARE REPEATED FOR
;          EACH LINE TO COMPLETE A FULL PASS.
;8.      OPERATING MODES/SWITCHES
.NOMAC 0
S?WPD   8.1
O?DTD   8.2
.NOMAC X

;9.      OPERATING PROCEDURE
;9.1      TURN POWER OFF
;9.1.1    SET ALL LINES TO RS232
;9.1.2    CONNECT TEST PLUGS
;9.1.3    TURN POWER ON
;9.2      LOAD THE PROGRAM
;9.3      SET SWITCHES TO 000200 (RESTART ONLY)
;9.4      PRESS START (RESTART ONLY)

;9.4.1   THE PROGRAM WILL RESPOND BY REQUESTING THE OPERATOR
;          TO TYPE 1 TO RUN BAUD RATE TEST ONLY. THE OPERATOR
;          MUST TYPE A 1 TO RUN BAUD RATE ONLY, TYPING ANYTHING
;          ELSE WILL CAUSE PROGRAM TO ASSUME FULL TEST IS DESIRED.

;9.4.2   THE PROGRAM WILL NEXT ASK THE OPERATOR
;          TO TYPE THE DEVICE CODE. A 2 DIGIT OCTAL NUMBER FOL-
;          LOWED BY A CARRIAGE RETURN IS EXPECTED.  THIS NUMBER
;          SHOULD CORRESPOND TO THE PTI CONTROLLER DEVICE CODE
;          (EITHER 34 OR 44).
;9.4.3   THE PROGRAM WILL NEXT ASK THE OPERATOR TO TYPE THE
;          ADDRESS OF THE FIRST LINE (IN DECIMAL).  THIS IS THE
;          *RIGHT JUSTIFIED*(!) BOUNDARY ADDRESS AS DEFINED BY
;          SWITCH SETTINGS ON TEST PLUG,(0,16,32...240) CONSULT
;          CONFIGURATION SHEET.  TYPE DECIMAL ADDRESS OF FIRST
;          LINE AND CARRIAGE RETURN.
;

;9.4.4   THE PROGRAM WILL ASK IF THERE IS A DCU IN SYSTEM
;        TYPE A 1 OTHERWISE 0. IF A ONE IS TYPED THE PROG
;          WILL FIRST REQUEST THE OPERATOR TO TYPE THE DCU
```

```
;          DEVICE CODE.  A 2 DIGIT OCTAL NUMBER FOLLOWED BY A
;          CARRIAGE RETURN IS EXPECTED.  THIS NUMBER SHOULD
;          CORRESPOND TO THE DCU DEVICE CODE (ANY NUMBER
;          FROM 1 TO 76 OCTAL).

;
;9.5       WHEN OPERATOR INPUT IS COMPLETE, EXECUTION OF THE
;          TEST PROGRAM BEGINS. THE FIRST PASS THROUGH THE
;          PROGRAM WILL PRODUCE A LISTING OF THE BAUD RATE
;          OF CLOCKS 0 THROUGH 3. CONSULT THE HARDWARE
;          INSTALLATION INSTRUCTIONS IF THESE ARE TO BE
;          CHANGED. RESTARTING THE PROGRAM WILL REPEAT
;          THE BAUD PRINTOUT.

;          WHEN ALL LINES ARE TESTED, THE WORD "PASS" WILL BE TYPED
;          ON THE CONSOLE DEVICE.
;
;9.6       RESTART PROCEDURE
;          THE PROGRAM MAY BE RESTARTED AT 200 FOR REPEAT
;          EXECUTION. THIS MAY BE DONE MANUALLY OR VIA ^ R
;          OR ^D.
;
;          IF THE PROGRAM IS RUNNING IN A DCU THE RESET
;          SWITCH MUST BE PRESSED TO RESTART MANUALLY AT
;          200. ALSO TWO ^R'S  OR ^D'S ARE REQUIRED TO
;          BRING THE HOST BACK. THE FIRST CONTROL R OR D
;          WILL PUT THE MACHINE IN A SPECIAL SWITCH INPUT
;          MODE WHERE THE SWITCHES MAY BE SET OR EXAMINED
;          USING THE "M" COMMAND.
;
;9.6.1     THE MESSAGE TYPE 1 FOR NEW PARAMETERS WILL APPEAR
;          ON RESTART. TYPING A 1 WILL PRODUCE ALL OF THE
;          QUESTIONS INITIALLY ANSWERED. TYPING ANY OTHER
;          CHARACTER WILL BEGIN TESTS USING THE PREVIOUSLY
;          GIVEN PARAMETERS.

;9.7       CTS TESTING
;          FOR INITIAL TESTING, IF USING TEST PLUG WITH SWITCHES, ALL SWTS
;          SHOULD BE ON. AFTER SUCCESSFULLY RUNNING THE DIAGNOSTIC,
;          THE CTS LINES MAY BE INDIVIDUALLY TESTED BY TURNING OFF ITS
;          ASSOCIATED SWITCH ON THE TEST PLUG. (ONLY ONE SWITCH SHOULD
;          BE OFF AT A TIME)
;          A FLAGGED ERROR MESSAGE WILL IDENTIFY THE CTS LINE THAT
;          HAS BEEN DISABLED. TO TEST OTHER LINES, SWITCH TESTED LINE ON,
;           DISABLE NEXT LINE, AND RESTART PROGRAM. (CONTROL D)
;
;10.       PROGRAM OUTPUT/ERROR DESCRIPTION
;10.1      IF A MALFUNCTION IS DETECTED, THE PROGRAM WILL CYCLE
;          IN A SCOPE LOOP IN ACCORDANCE WITH THE SWITCHES.
;          PROGRAM WILL PRINT THE LINE NUMBER BEING TESTED
;          AT THAT TIME (PRIME LINE), AND IF TRANSMITTING AND
;          RECEIVING USING 2 DIFFERENT LINES, "PRIME LINE" WILL
;          BE THE TRANSMITTING LINE, AND "SECONDARY LINE"
;          WILL BE THE RECEIVER LINE ADDRESS.
;10.2      WHEN THE PROGRAM IS IN A SCOPE LOOP SETTING, SWITCH 3(1)
;          WILL CAUSE THE FAILURE RATE TO BE PRINTED.  SETTING
;          SWITCH 1(1) WILL CAUSE THE PROGRAM TO PROCEED TO
;          THE NEXT TEST.
;

;11.       DEBUG HELP

;11.1      DESCRIPTION OF COMMUNICATION SYSTEM I/O FUNCTIONS:
;
```

```
;11.1.1 DEVICE CODE MUX = 34 (OCTAL)
;
;
;11.1.2 DOA AC,MUX       SPECIFIES THE ABSOLUTE LINE ADDRESS TO
;                        BE USED IN CONJUNCTION WITH A DATA OUT
;                        INSTRUCTION TO TRANSMIT OR RECEIVE.
;
;               BITS 0-6         NOT USED
;
;               BITS 7-14        ABSOLUTE LINE ADDRESS
;
;                                0=RECEIVE CONTROL
;                                1=TRANSMIT CONTROL
;
;11.1.3 DOB AC,MUX       SPECIFIES TRANSMIT DATA OR TRANSMIT MODE
;                        (TRANSPARENT OR BREAK).
;
;               BITS 0-1         TRANSMIT CONTROL
;                                10=NOT USED
;                                00=NORMAL TRANSMIT DATA
;                                01=TRANSMIT BREAK(ASYNC ONLY)
;
;               BITS 2-7         NOT USED
;
;               BITS 8-15        TRANSMIT DATA (IN TRANSMIT MODE)
;
;
;11.1.4 DOC AC,MUX       SPECIFIES ON/OFF CONTROL OF TRANSMITTER
;                        OR RECEIVER, OUTPUT LINE CHARACTER-
;                        ISTICS.
;
;
;               BITS 0-1         00=XMIT/RECV CONTROL
;
;               BITS 2-14        NOT USED
;
;               BIT 15           0=OFF
;                                1=ON
;
;
;
;               BITS 0-1         10= SPECIFIES PARITY, STOP BITS,
;                                LINE SPEED, CHAR CODE LEVEL, AND
;                                LOOPBACK CONTROL.
;
;               BITS 2-6         NOT USED
;
;               BITS 7-8         CLOCK SELECT
;
;                                00 = CLOCK 0
;                                01 = CLOCK 1
;                                10 = CLOCK 2
;                                11 = CLOCK 3
;
;               BITS 9-10        SPECIFY NUMBER OF STOP BITS
;
;
;                                00 = 1 STOP BIT
;                                01 = 2 STOP BITS
;                                10 = RESERVED
;                                11 = RESERVED
;
;               BITS 11-12       SPECIFY CODE LEVEL
;
```

```
;                                   00 = 5 LEVEL CODE
;                                   01 = 6 LEVEL CODE
;                                   10 = 7 LEVEL CODE
;                                   11 = 8 LEVEL CODE
;
;                   BITS 13-14      PARITY SELECT
;
;                                   00 = NO PARITY
;                                   01 = ODD PARITY
;                                   10 = EVEN PARITY
;                                   11 = RESERVED
;
;                   BIT 15          LOOPBACK CONTROL
;
;                                   0 = LOOPBACK OFF
;                                   1 = LOOPBACK ON
;11.1.5 DIA AC,MUX       SPECIFIES IMPLICIT ADDRESS OF INT-
;                        ERRUPTING LINE, RECEIVE, OR
;                        TRANSMIT, AND FORCES A DOA AS EXPLICIT
;                        ADDRESS FOR OUTPUTTING.
;
;
;                   BITS 0-6        NOT USED
;
;                   BITS 7-14       EXPLICIT ADDRESS
;
;                   BIT 15          TRANSMIT OR RECEIVE CONTROL
;
;                                   0= RECEIVE  INTERRUPT
;                                   1= TRANSMIT INTERRUPT
;
;
;11.1.6 DIB AC,MUX       SPECIFIES RECEIVED DATA ON RECEIVE INT-
;                        ERRUPT.
;
;                   BITS 0-7        NOT USED
;
;                   BITS 8-15       RECEIVE DATA
;
;
;11.1.7 DIC AC,MUX       SPECIFIES RECEIVER DONE/STATUS
;
;                   BITS 0-11       NOT USED
;
;
;                           RECEIVER STATUS
;
;                   BIT 12          FRAMING ERROR
;
;                   BIT 13          PARITY ERROR
;
;                   BIT 14          OVERRUN
;
;                   BIT 15          0=RECEIVER STATUS
;11.1.8 EFFECT OF 'BUSY' AND 'DONE' ON COMMUNICATIONS CONTROL
;
;
;       BUSY:   BUSY IS SET ON THE ASYNC LINES ON AN I/O RESET
;               OR START PULSE.  THIS STARTS AN ICLR CYCLE WHICH
;               PRESETS THE SCAN ADDRESS
;               COUNTER.  ON COMPLETION OF THE ICLR CYCLE,
;               BUSY RESETS, AND THE BOARD IS PLACED IN THE
;               'DIAGNOSTIC' MODE.
;
```

```
;       DONE:   DONE SETS ON   LINES WHEN ONE
;               OF THE FOLLOWING EVENTS OCCURS:
;                 1. CHARACTER RECEIVED.
;                 2. TRANSMIT BUFFER EMPTY
;               INTERRUPTS OCCUR IN THE ABOVE ORDER OF PRIORITY,
;               AND FROM LOWEST TO HIGHEST NUMBERED LINES.  A
;               'NIOC MUX' WILL CLEAR DONE, AS WELL AS A
;               'NIOS MUX' AND 'IORST'.
;
;       IORESET:  CLEARS LOGIC AND PLACES CONTROLLERS IN OFFLINE
;               DIAGNOSTIC MODE.  ALSO SETS 'BUSY' (ASYNC ONLY).
;
;       START:  SAME AS IORESET  .
;
;       CLEAR:  CLEARS 'DONE' AND INTERRUPT LOGIC AND PLACES
;               CONTROLLERS IN ONLINE MODE.
;
;       IOPLS(MUX):     STEPS INTERNAL CLOCKS IN
;                       'DIAGNOSTIC' MODE.
;
;
;12.    SPECIAL NOTES/SPECIAL FEATURES
;12.1   IF THE ASYNC CONTROLLER IS BEING RUN VIA A DCU, ALL
;         CODE WILL BE EXECUTED BY THE DCU, AND THE DCU WILL
;         TRANSFER CONTROL OF THE PROGRAM TO THE MAIN PROCESSOR
;         FOR ALL OPERATOR AND CONSOLE INTERFACING

;       ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;       ; NOTE:   THE DCU DIAGNOSTIC AND EXERCISER SHOULD BE              ;
;       ; RUN PRIOR TO RUNNING THIS PROGRAM TO INSURE ITS                 ;
;       ; RELIABILITY                                                     ;
;       ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;
;         IF THE CONTROL O INPUT IS MADE TO TRANSFER
;         CONTROL TO THE HARDWARE ODT IN A DCU SYSTEM
;         THE ODT IS EXECUTED FROM THE DCU AND WILL REFERECE
;         DCU LOCAL MEMORY. AVOID RESTARTING THE PROGRAM
;         WITH A 200R COMMAND IN THIS CASE AS THE DCU WILL
;         BE EXECUTING THE INITIAL CODE NOT INTENDED FOR ITSELF
;         AND WILL PRODUCE THE "UNANTICIPATED DCU HALT"
;         MESSAGE.

;12.2   IN THE EVENT OF SUCCESSFUL OPERATION OF THIS TEST, THE
;         COMMUNICATIONS RELIABILITY TEST SHOULD BE
;         RUN IF A PROBLEM STILL EXISTS..
;12.3   DON'T RUN TEST ROUTINES OUT OF SEQUENCE, AS A TEST MAY
;         REQUIRE SCRATCH PAD DATA OR SETUP SEQUENCING FROM A
;         PREVIOUS TEST.  AFTER A POWER DOWN, RESTART THE PROG-
;         RAM FROM THE BEGINNING.
;12.4   THE FOLLOWING FUNCTIONS ARE NOT TESTED BY THIS PROGRAM:
;       INTERRUPT PRIORITY AND MUX DEVICE PRIORITY.
;12.5   THE FOLLOWING IS A TABLE OF THE
;       FREQUENCIES FOR BAUD CLOCKS
;       AND THE SWITCH SETTING REQUIRED
;       BY THE DIAGNOSTIC:

;               CLK 1,3         5 6 7 8
; BAUD RATE     CLK 0,2         1 2 3 4         0=CLOSED  1=OPEN
;
;         50                    0 0 0 0
;         75                    1 0 0 0
;        110                    0 1 0 0
;        134.5                  1 1 0 0
;        150                    0 0 1 0
```

```
;          300                    1 0 1 0
;          600                    0 1 1 0
;         1200                    1 1 1 0
;         1800                    0 0 0 1
;         2000                    1 0 0 1
;         2400                    0 1 0 1
;         3600                    1 1 0 1
;         4800                    0 0 1 1
;         7200                    1 0 1 1
;         9600                    0 1 1 1
;         19.2K                   1 1 1 1
;
;12.6     ON ALL INPUT REQUESTS THE OPERATOR MAY ELECT
;         TO ALTER FLOW OF THE PROGRAM BY STRIKING A
;         CONTROL O, R OR D.
;
;13. RUNTIME  DEPENDS UPON THE BAUD RATE OF CLK 0, WITH
;         19.2K BAUD AS CLOCK 0, WILL PRINT PASS IN LESS
;         THAN 3 MINUTES.
          .EOT
```

```
;
;
;
;
;*****************************************************************************
;
;
; DESCRIPTION:  PROGRAMABLE TERMINAL INTERFACE (PTI) XMIT/ECHO PROGRAM
;
;
; Product of ZETACO, 1987
;*****************************************************************************
        .TITL   PTIE
        .DUSR   X=1
;1.     PROGRAM NAME PTIE.SR
;
;2. REVISION HISTORY
;
;       REV.                DATE
;        00              09/17/81
;        01              07/06/87        ;AOS BSTRAP, XMIT STRING
;
;3.     MACHINE REQUIREMENTS:
;3.1     NOVA/ECLIPSE FAMILY PROCESSOR
;3.2     16K READ/WRITE MEMORY
;3.3     CONSOLE DEVICE
;3.4     PROGRAMABLE TERMINAL INTERFACE (PTI)
;3.5     CRT TERMINAL AND CABLE

;4.     SUMMARY
;       THIS PROGRAM IS INTENDED FOR USE WITH THE 16 CHANNEL PTI BOARD
;       TO AID TESTING OF CURRENT LOOP PORTIONS OF THE BOARD. TO TEST
;       ANY OF THE LINES, ATTACH TERMINAL TO THAT LINE, LOAD PROGRAM,
;       SET PARAMETERS TO SELECT THAT LINE WHEN PROGRAM ASKS.
;        NOTE: (TERMINAL MUST BE SET TO LINCHR)
;
;5.     RESTART PROCEDURE
;5.1     THE PROGRAM MAY BE RESTARTED AT 200 FOR REPEAT EXECUTION. THIS
;       MAY BE DONE MANUALLY OR VIA ^ R.
;5.2     THE LINE SELECTION MAY BE CHANGED DIRECTLY VIA ^ L.
;5.3     THE XMIT/ECHO FUNCTION MAY BE CHANGED DIRECTLY VIA ^ E.
;5.4     THE XMIT DATA MAY BE CHANGED DIRECTLY VIA ^ D.
**.EJECT
        .NOMAC  X
        .EOT
```

```
;*****************************************************************
;
; DESCRIPTION:  PROGRAMABLE MUX RELIABILITY
;
;
; Product of ZETACO, 1987
;*****************************************************************
        .TITL   PMUXR
        .DUSR   X=1
;1.0    PROGRAM NAME - PMUXR.SR
;
;2.0    REVISION HISTORY:
;               REV             DATE            COMMENTS
;               00              06/26/81
;               01              09/17/81  ;TEXT CORRECTIONS, AND OUTPUT XFERS
;
;3.0    MACHINE REQUIREMENTS
;3.1     NOVA/ECLIPSE FAMILY PROCESSOR
;3.2     CONSOLE DEVICE
;3.3     16K READ/WRITE MEMORY
;3.4     HOST OR EXPANSION CHASIS CONTAINING ANY COMBO OF
;        PTI OR PSI CONTROLLERS NOT TO EXCEED 256 LINES.
;3.5     OPTIONAL HAREWARE SUPPORTED:
;        DCU 50 OR DCU 200 (BACKPLANE JUMPER PLUG REQUIRED)
;
;4.0    TEST REQUIREMENTS -
;        JUMPER PLUGS REQUIRED FOR MODEM SIGNAL TESTING.
;
;5.0    SUMMARY
;
;        THE PROGRAMABLE MUX RELIABILITY TEST IS DESIGNED TO EXERCISE
;       THE COMMUNICATIONS SYSTEM.  THE METHOD OF TEST CONSISTS OF
;       TRANSMITTING AND RECEIVING (VIA MAINTENANCE FEATURES OF
;       THE HARDWARE) PSEUDO RANDOM CHARACTERS.  SINCE CHAR-
;       ACTERISTICS ARE DETERMINED VIA RANDOM NUMBER GENERATORS
;       AND ARE CHANGED PERIODICALLY, SELECTION OF LINES FOR
;       TESTING IS VIA THE CONSOLE TELETYPE.
;
;6.0    RESTRICTIONS
;6.1    THE PTID AND/OR PSID PROGRAMS SHOULD BE RUN BEFORE RUNNING PMUXR.
;6.2    IT MAY BE NECESSARY ON A LARGE NUMBER OF HIGH BAUD RATE LINES(>4800)
;       TO TEST SMALLER GROUPS OF LINES AT A TIME OR THROUGHPUT OF THIS
;       PROGRAM WILL BE EXCEEDED.
**.EJECT
;7.0    PROGRAM DESCRIPTION/THEORY OF OPERATION
;       IN EACH CONFIGURATION THE PROGRAM HAS 3 BASIC PARTS:
;       1) INITIALIZATION, 2) DCU OR MONITOR SECTION, 3) DONE
;       CHECK OR INTERRUPT ROUTINE.
;
;7.1    INITIALIZATION:  THE PROGRAM ASKS THE USER TO DEFINE
;         THE SYSTEM CONFIGURATION BY USING A SERIES OF QUESTIONS.
;       THE INFORMATION IS THEN STORED IN TABLES AND FLAG
;       LOCATIONS FOR LATER USE.
;
;7.2    DCU PROGRAM:  THIS DESCRIBES THE PROGRAM FOR CONFIGURATIONS
;        WITH A DCU.  THE PROGRAM IS IN FOUR BASIC PARTS:
;       HOST NON-INTERRUPT, HOST INTERRUPT, DCU NON-INTERRUPT,
;       AND DCU INTERRUPT.  FOR SYSTEMS WITHOUT A DCU, THE HOST
;       INTERRUPT PROGRAM IS REPLACED BY THE DCU INTERRUPT
;       ROUTINE, AND THE DCU NON-INTERRUPT PACKAGE BECOMES A
;       SUBROUTINE, CALLED PERIODICALLY BY THE HOST MONITOR.  THE
;       OPERATION AND INTERACTIONS OF THESE ROUTINES IS AS
;       FOLLOWS:
;
```

```
;           INITIALIZATION - OPERATOR INPUTS DEFINE THE COM-
;       MUNICATIONS CONTROLLERS AND DCU DEVICE CODES, LINES TO
;       BE TESTED, AND MODEM AND CRC LINES.  THE PROGRAM WILL THEN
;       DEFINE THE LCB BLOCKS (SEE 11.9) FOR ACTIVE LINES, ALLOCATE
;       TRANSMIT AND RECEIVE BUFFERS, CHOOSE RANDOM LINE CHAR-
;       ACTERISTICS AND BLOCK LENGTHS, AND FILL THE TRANSMIT
;       BUFFERS WITH RANDOM DATA.  RANDOM DLE WORDS, SPECIFIC
;       ALLOWABLE SYNC WORDS (SEE STABLE), FORCED UNDER-RUNS,
;       ENTER AND LEAVE TRANSPARENCY, AND BREAK CHARACTERS
;       ARE ALSO LOADED AT VARIOUS INTERVALS IN THE TRANSMIT
;       TABLES.  IF MODEM IS SELECTED, RANDOM CHANGE SEQUENCES
;       ARE SELECTED FOR THE SYNC LINES AND A SPECIFIC ON/OFF
;       SEQUENCE FOR ASYNC ARE LOADED (SEE GMOD AND GAMOD).
;           AFTER ALL INITIALIZATION IS COMPLETED, THE
;       DCU PROGRAM IS LOADED INTO DCU SC MEMORY (IF APPLICABLE)
;       AND THE START-UP PORTION OF THE DCU ROUTINE (DMAIN) IS
;       EXECUTED.  IF NO DCU, DMAIN IS CALLED AS A SUBROUTINE.
;       DMAIN OUTPUTS LINE CHARACTERISTICS (AFTER TURNING OFF
;       AND INITIALIZING ALL LINES), TURNS ON ACTIVE TRANSMITTERS
;       AND RECEIVERS, AND OUTPUTS INITIAL MODEM STATES.
;           THE ACTUAL PROGRAM OPERATION HAS NOW BEGUN.
;       IT IS A CAUSE-AND-EFFECT INTERACTION BETWEEN THE HOST
;       MONITOR AND CHECKING ROUTINES AND DCU (OR DMAN6 SUB-
;       ROUTINE) MONITOR ROUTINE.  DATA IS TRANSMITTED FROM THE
;       BUFFERS ON A TRANSMIT INTERRUPT AND RECEIVED AND STORED
;       (ALONG WITH ERROR STATUS) IN THE INTERRUPT ROUTINE WITH
;       A MINIMUM OF ERROR CHECKING.  THE DCU MONITOR ROUTINE
;       WILL MONITOR AND DETECT WHEN A LINE HAS TRANSMITTED AND
;       RECEIVED (VIA EOT CHARACTER) A FULL BLOCK OF DATA, THEN
;       SHUT DOWN THE LINE AND SET A BLOCK DONE BIT IN THE MCW
;       FOR THE HOST.  THE HOST WILL MONITOR LINE ACTIVITY, AND,
;       UPON RECEIPT OF THE BLOCK DONE BIT, WILL COMPARE THE
;       TRANSMIT AND RECEIVE DATA AND RECORD AND PRINT OUT ANY
;       ERROR CONDITION.  AFTER CHECKING ALL DATA, THE HOST WILL
;       CHANGE LINE CHARACTERISTICS (IF NO ERRORS AND SWITCH
;       1(1)), GENERATE A NEW BLOCK OF DATA, AND SIGNAL THE DCU
;       (VIA BIT 1 OF THE MCW) TO START THE LINE AGAIN.  THIS
;       PROCESS IS REPEATED CONTINUALLY ON ALL LINES.  MODEMS
;       ARE HANDLED IN A SIMILAR MANNER.
;           CERTAIN ERRORS ARE DETECTED DURING DCU INTERRUPT
;       TIME, AND, WHEN FOUND, THE DCU WILL INTERRUPT THE HOST
;       TO ALLOW PRINTING OF THE ERROR MESSAGE.
```

```
        S?WPD   8.

;8.2.2  SWITCHES DEFINED FOR PMUXR (ADDENDUM TO 8.2)
;
;       BIT     OCTAL   BINARY  INTERPRETATION
;               VALUE   VALUE
;        F              1       REQUEST OPERATOR PARAMS
;               000001  0       NO PARAMS
;
;        E      000002  1       PROCEED FROM ERROR
;                       0       -------
;
;        D      000004  1       SKIP PHASE 5 FOR DUAL MODE
;                       0       -------
;
;        C      000010  1       INHIBIT LINE ASSIGN PRINTOUT
;                       0       -------
```

```
;9.0       OPERATING PROCEDURE
;
;9.1     CONNECT MODEM TEST PLUGS IF IT IS DESIRED
;        TO TEST ANY MODEM LINES
;
;9.2     LOAD THE TEST PROGRAM VIA THE BINARY LOADER OR
;        DIAGNOSTIC OPERATING SYSTEM.IF AN ECLIPSE IOP IS TO BE USED
;        THE PROGRAM WILL RUN IN THE HOST DIRECTORY ,IF THE
;        COMMUNICATIONS LINES ARE CONNECTED TO THE IOP. IF THE
;        LINES ARE CONNECTED TO A DCU WHICH IS CONNECTED TO THE
;        IOP, THEN THE PROGRAM MUST BE RUN FROM THE IOP DIRECT-
;        ORY.
;
;9.3     SET CONSOLE SWITCHES TO 200.  PRESS START.
;
;9.4     THE PROGRAM WILL OUTPUT A MESSAGE TO INDICATE
;        IF MANUAL INPUT TO SPECIFY DETAILED LINE PARAMETERS
;        IS REQUIRED. TYPING  A ONE WILL RESULT IN QUESTIONS
;        ABOUT DETAILED LINE SPECIFATIONS LATER.TYPING ANY
;        OTHER CHARACTER ALLOWS THE PROGRAM TO SPECIFY ITS
;        OWN RANDOMLY SELECTED CHARACTERISTICS.
;
;9.5     ;THE PROGRAM WILL ASK TO SELECT THE SYSTEM CONFIGURATION
;        EITHER A DCU/50/200,AN ECLIPSE IOP
;        OR NONE . THE OPERATOR SHOULD TYPE THE PROPER RESPONSE
;
;9.6     THE PROGRAM WILL REQUEST THE DEVICE CODE TO BE
;        TYPED.  THE OPERATOR SHOULD RESPOND WITH THE TWO
;        DIGIT OCTAL  DEVICE CODE ASSIGNED TO THE COMM
;        SYSTEM (EITHER 34 OR 44) FOLLOWED BY A CARRIAGE
;        RETURN.
;
;9.7     IF A DCU IS IN THE SYSTEM THE PROGRAM WILL REQUEST
;        THE 2 DIGIT OCTAL NUMBER OF THE DCU DEVICE CODE
;        (0-76 ACCEPTABLE)
;
;9.8     "TYPE 1 IF MODEM CONTROL, 0 IF NOT."  IF
;        MODULES ARE TO BE TESTED ENTER 1, IF NOT ENTER 0.
;
;9.9     "TYPE 1 IF CRC OPTION, 0 IF NOT."  IF CRC
;        OPTIONS ARE TO BE TESTED TYPE 1, IF NOT TYPE 0.
;
;9.10    "TYPE THE FIRST LINE ADDRESS AND THE LAST LINE
;        ADDRESS OF EACH LINE MODULE IN THE SYSTEM IN THIS
;        FORM FLA/LLA,FLA/LLA,."  IN ORDER TO TELL WHICH LINE
;        ADDRESSES DELIMIT LINE MODULES THE OPERATOR MUST
;        TYPE IN THE FIRST LINE ADDRESS FOLLOWED BY A /
;        FOLLOWED BY THE LAST LINE ADDRESS FOR EACH LINE MODULE
;        IN THE SYSTEM.  FOR EXAMPLE, IF THE SYSTEM CONTAINED
;        TWO LINE MODULES WITH ADDRESSES.  0 THRU 8 AND 98 THRU 99
;        THE ENTRY WOULD BE 0/8,98/99
;NOTE:   THE PROGRAM WILL DETECT AN ERROR AND REPEAT THE INPUT
;        REQUEST IF ANY OF THE FOLLOWING INPUT ERRORS ARE
;        COMMITTED:
;                1. A LINE NUMBER GREATER THAN 256 (DECIMAL) IS
;                   TYPED.
;                2. MULTIPLY DEFINED LINES.
;                3. A SYNC LINE THAT IS ALREADY DEFINED AS ASYNC.
;                4. A SECOND LINE (FOLLOWING SLASH) LESS THAN
;                   FIRST LINE.
;9.11    "TYPE ASYNCHRONOUS LINES TO BE TESTED"
;        ENTER THE LINE ADDRESS OF LINES TO BE TESTED.
;
```

```
;9.12    "TYPE SYNCHRONOUS LINES TO BE TESTED"
;        ENTER THE LINE ADDRESSES OF SYNC LINES TO BE
;        TESTED.  IF NONE, TYPE N
;
;9.13    "TYPE MODEM LINES TO BE TESTED"  THIS IS
;        ONLY ASKED IF QUESTION # 9.8 IS ANSWERED YES.
;
;9.14    "TYPE CRC LINES TO BE TESTED"  THIS IS ONLY
;        ASKED IF QUESTION #9.9 IS ANSWERED YES.
;
;9.15    IF OPERATOR INPUT IS DESIRED THE PROGRAM WILL
;        ASK A SERIES OF QUESTION TO BE ANSWERED AS OPERATOR
;        INPUTS THE QUESTIONS ARE:
;        "ALL LINES OF THIS TYPE?"
;        "ENTER LINE NO" ONLY ACTIVE LINES ARE ALLOWED IF
;        INACTIVE LINE NO IS TYPED, ERROR MESSAGE "NOT AN
;        ACTIVE LINE" APPEARS FOLLOWED BY LINE NO QUESTION.
;
;        "ENTER BAUD CLOCK" 0,1,2,3 ALLOWED
;        "ENTER # OF STOP BITS# 1 OR 2 ALLOWED
;        "ENTER # OF BITS PER WORD" 0-7 ALLOWED
;        "ENTER PARITY (0=NO PARITY 1=ODD 2=EVEN)
;        "ENTER CRC POLY" ASKED ONLY IF APPLICABLE
;        "ENTER DATA (N=RANDOM)"
;        "ANY OTHER LINES"
;        THIS CONTINUES UNTIL 0 IS ANSWERED OR ANY OTHER LINE
;        QUESTION.
```

```
;10.0    PROGRAM OUTPUT/ERROR DESCRIPTION -
;
;10.1    "DCU FAILED TO START" THIS MESSAGE WILL
;        INDICATE THAT THE DCU UPON LOADING ITS MEMORY
;        OR WHEN STARTING THE PROGRAM DID NOT GO BUSY
;        AFTER A CERTAIN DELAY TIME.
;
;        HINT - COULD BE WRONG DEVICE CODE -
;
;10.2    "DCU FAILED TO STOP" INDICATES THAT DCU UPON
;        LOADING ITS MEMORY OR UPON EXECUTING A STOP SUBROUTINE
;        DID NOT STOP OR GO NOT BUSY AFTER A CERTAIN DELAY
;        TIME.
;
;10.3    "POWER FAIL" INDICATES A POWER FAIL ON THE
;        HOST CHASIS-
;
;10.4    THE FOLLOWING ERROR MESSAGES REFER TO MODES
;        (ABCD) WHEN TESTING LINE MODULES -
;
;        10.4.1 "TRANSMITTER (OR RECEIVER) FAILED TO SET DONE"
;        -APPEARS WHEN TRANSMIT OR RECEIVE COUNT FOR AN ACTIVE
;        LINE REMAINS 0 AFTER A SPECIFIC TIME INTERVAL AS DE-
;        TERMINED BY THE COUNTER IN MCW WORD.
;
;
;        10.4.2 "LOSS OF LINE ACTIVITY" - APPEARS WHEN A LINE
;        FAILS TO SET BLOCK DONE AFTER STARTING FOR A SPECIFIC
;        AMOUNT OF TIME.  A MAXIMUM TIME COUNTER IS PROVIDED
;        FOR THIS PURPOSE WHICH IS COUNTED EVERY TIME THE
;        MONITOR ROUTINE (DMN6) IS CALLED.  ITS TIME OUT VALUE
;        IS GIVEN IN "TIMEX".
;
;        10.4.3 ANY STATUS ERROR IS REPORTED AS "PARITY ERROR",
;        "FRAMING ERROR" OR "OVERRUN ERROR".
;
;        10.4.4 AN ERROR MESSAGE APPEARS WHEN TRANSMITTED AND
;        RECEIVED DATA DEFER FROM EACH OTHER, IN WHICH "GOOD"
;        REFERS TO THE TRANSMITTED AND "BAD" REFERS TO THE
;        RECEIVED DATA.
;
;        10.4.5 "FAILED TO DETECT BREAK" - APPEARS WHEN AN ASYNC
;        LINE RECEIVES FIVE NULL CHARACTERS IN A ROW WITHOUT
;        A FRAMING ERROR DURING A BREAK SEQUENCE.  (A BREAK
;        SEQUENCE CONSISTS OF OUTPUTTING A SEQUENCE OF A NULL,
;        TWO BREAK AND TWO NULL CHARACTERS.)
;
;        10.4.6 "FAILURE TO OPERATE IN XPARENCY" - APPEARS WHEN
;        THE FIRST CHARACTER RECEIVED AFTER CHANGING XPARENCY
;        MODE IN A SYNC LINE IN NOT A DLE CHARACTER.
```

```
;
;       10.4.7 "UNDERRUN IN XPARENT MODE WITH DLE" - APPEARS
;       WHEN TWO SUCCESSIVE SYNC CHARACTERS ARE RECEIVED WHILE
;       UNDERRUNNING IN TRANSPARENT MODE.
;
;       10.4.8 "LINE FAILED TO UNDERRUN" - APPEARS WHEN THE
;       UNDERRUN SEQUENCE OF DLE AND SYNC IN TRANSPARENT MODE
;       OR SYNC CHARACTERS IN NON-TRANSPARENT MODE IS BROKEN
;       BY A NON-SYNC CHARACTER.
;
;       10.4.9 "RECEIVE BUFFER OVERFLOW" - APPEARS WHEN THE END
;       OF RECEIVE BUFFER IS REACHED BEFORE THE END OF TRANSMIT
;       BUFFER.
;
;       10.4.10 "CRC DOES NOT CHECK" - APPEARS WHEN THE CAL-
;       CULATED CRC DOES NOT MATCH WITH THE HARDWARE'S CRC.
;
;       10.4.11 "MODEM LINE FAILED TO INTERRUPT" - APPEARS WHEN
;       NO MODEM INTERRUPT IS RECEIVED FROM AN ACTIVE LINE AFTER
;       SENDING OUT NEW MODEM STATUS AND WAITING FOR A SPECIFIC
;       AMOUNT OF TIME.
;
;       10.4.12 "MODEM INTERRUPT FROM ILLEGAL LINE" - APPEARS
;       AFTER RECEIVING MODEM INTERRUPT FROM AN INACTIVE LINE.
;
;       10.4.13 "FALSE INTERRUPT - NO CHANGE IN STATUS" - APPEARS
;       WHEN MODEM INTERRUPT IS RECEIVED FROM A LINE WITHOUT
;       CHANGE IN MODEM STATUS.
;
;       10.4.14 ANY MODEM STATUS RECEIVED THAT DEFERS FROM THE
;       THE STATUS SEND OUT IS REPORTED AS AN ERROR WITH A MES-
;       SAGE THAT, FOR EXAMPLE, MAY READ LIKE - "CHANGE IN RING
;       NO CHANGE IN RTS".
;
;       10.4.15 ANY INTERRUPT FROM A DEVICE OTHER THAN MUX OR
;       FROM AN INACTIVE LINE CAUSES AN ERROR MESSAGE TO APPEAR
;       WITH THE INTERRUPTING DEVICE CODE OR LINE NUMBER IN THE
;       MESSAGE.
;
;       10.4.16 "UNIDENTIFIABLE ERROR-XMITS RECVS TOO FAR APART"
;       -APPEARS WHEN XMIT COUNT<1/2(RECV COUNT) OR RECV COUNT
;       <1/2(XMIT COUNT).
```

```
;10.5    THE FOLLOWING MESSAGES WILL APPEAR FOR MODES
;        (CD).  THEY INDICATE START OF WDT WITH WATCH DOG TIMER
;        OCCURRED.
;
;        10.5.1 "SUCCESS END OF PART ONE" THIS MEANS THAT BOTH
;        WATCH DOG TIMERS (MASTER & SLAVE) HAVE BEEN TURNED ON
;        AND ARE CORRECTLY SERVICING THEIR RESPECTIVE DOG TIMERS.
;
;        10.5.2 "POWER FAIL ON COMM CHASIS" INDICATES THAT WATCH
;        DOG TIMER DETECTED ITS POWER FAIL BIT SET
;
;        10.5.3 "BAD DONE SET" THIS INDICATES THAT THE WDT WAS
;        EXPECTED TO SET DONE AND SOMETHING ELSE DID.
;
;        10.5.4 "WRONG TYPE DONE SET ON WDT" THIS INDICATES THAT
;        WDT WAS EXPECTING A RECEIVE DONE AND GOT A TXDONE OR
;        VICE-VERSA.  THE PROGRAM HANDLES DONE CORRECTLY.
;
;        10.5.5 "DONE NOT SET IN TIME" INDICATES NO DONE SET AFTER
;        WATCH DOG TIMER SHOULD HAVE BEEN TURNED ON.
;
;        10.5.6 "UNKNOWN BIT SET IN WDT STATUS" THIS INDICATES THAT
;        AN ERROR BIT WAS DETECTED BY WATCH DOG TIMER BUT WAS NOT
;        ONE OF THE 4 KNOWN ONES.
;
;        10.5.7 "OPPOSITE WATCH DOG TIMER OFF" THIS INDICATES THAT
;        THE OPPOSITE DOG TIMER HAS NOT BEEN TURNED ON.
;
;        10.5.8 "DATA ERROR ON OPP WATCH DOG TIMER" & TIME OUT
;        ERROR ON OPP WATCH DOG TIMER INDICATES JUST THAT.
```

```
;10.6    THE FOLLOWING MESSAGES REFER TO MODE (D)
;        (FULL DUAL PORT)
;
;        10.6.1 "HALT COMM LINK DONE IN ERROR" INDICATES
;        DCU PROGRAM HALTED BECAUSE THE COMM LINE GOT A DONE
;        WHEN IT SHOULD NOT HAVE
;
;        10.6.2 "HALT CHECKSUM ERROR" INDICATES THAT A BIT
;        OR BITS WAS DROPPED OR ADDED WHEN COMM LINE WAS BEING
;        USED TO TRANSMIT LINE CONTROL BLOCK DATA FROM MASTER
;        TO SLAVE.
;
;        10.6.3 "COMM LINK DATA ERROR GOOD BAD DATA TO FOLLOW"
;        INDICATES THAT COMM LINK FAILED WHILE SENDING SPECIFIC
;        PATTERN FROM MASTER TO SLAVE AND BACK
;
;        10.6.4 "PREVIOUS ERROR ON COMM LINK" INDICATES THAT DATA ERROR
;        OCCURRED PREVIOUSLY.
;
;        10.6.5 "NO. OF MODULES ASSIGNED IS..."
;        "NO. OF LINES ASSIGNED IS..."  THIS INDICATES THE
;        LINES AND MODULES ASSIGNED TO EACH SIDE IN MODE D
;        OR TO ONE SIDE IN MODE C.  AS LINES ARE SWAPPED BE-
;        TWEEN PROCESSORS THIS IS UPDATED.
;
;        10.6.6 "END OF PART FOUR" INDICATES ALL LINE MODULES
;        HAVE BEEN SWAPPED FROM ONE PROCESSOR TO THE OTHER
;        AND BACK AGAIN.
;
;        10.6.7 "NO. OF PASSES COMPLETED IS..." THIS INDICATES
;        THE NUMBER OF TIMES PART 4 & 5 HAVE BEEN CYCLED.
```

```
;11.0.  MISCELLANEOUS

;11.1   MODEM CONTROL TEST PLUG CONNECTS:
;               ASYNC (PTI)                          SYNC (PSI)
;
;       RTS X   TO RING X   AND  DSR X+1  DTR   TO      RING
;       RTS X+1 TO RING X+1 AND  DSR X    RTS   TO      DSR
;       DTR X   TO CTS X    AND  CD X+1   SPA   TO      CD
;       DTR X+1 TO CTS X+1  AND  CD X     SPB   TO      CTS
;
;               X= ANY EVEN NUMBERED LINE
;
;11.2   TO AID IN TROUBLE SHOOTING, EXAMINE THE LCB'S FOR
;       THE FAILING LINE(S) FOR ADDITIONAL INFORMATION.  TO
;       FIND THE APPROPRIATE LCB STARTING ADDRESS, ADD THE LINE
;       NUMBER TO LCBPTR AND EXAMINE THAT LOCATION. A DESCRIP-
;       TION OF LCB WORDS IS FOUND IN  11.9.
;
;11.3   THE RELIABILITY OF THE DCU SHOULD BE ESTABLISHED
;       BEFORE THIS PROGRAM IS RUN.
;
;11.4   A PERIODIC PRINTOUT OF THE ACCUMULATED TRANSMIT AND
;       RECEIVED WORDS IS PROVIDED AFTER EACH PASS.  THESE
;       NUMBERS ARE JUST AN INDICATION THAT ACTIVITY IS
;       TAKING PLACE, AND SHOULD BE APPROXIMATELY EQUAL
;       (WITHIN ONE ORDER OF MAGNITUDE).
;
;11.5   AN "OVERRUN" OR "RECEIVE BUFFER OVERFLOW" ERROR
;       PRINTOUT MAY BE AN INDICATION THAT THE THROUGHPUT
;       OF THIS PROGRAM (APPROXIMATELY 10000 CPS, FULL
;       DUPLEX) IS BEING EXCEEDED.  IT MAY BE NECESSARY
;       ON A LARGE NUMBER OF HIGH BAUD RATE LINES (>4800)
;       TO TEST SMALLER GROUPS OF LINES AT A TIME.
;
;11.6   A MAXIMUM TIME COUNTER IS PROVIDED TO DETECT A LOSS
;       OF ACTIVITY ON A LINE (BLOCK DONE NEVER SETS AFTER
;       STARTING).  FOR EXCEEDINGLY LOW BAUD RATES (<100) ON
;       A SMALL NUMBER OF LINES (4 OR LESS), THE TIME COUNT
;       (TIMEX) SHOULD BE INCREASED, IF "LOSS OF LINE
;       ACTIVITY" ERROR MESSAGES APPEAR.
;
;11.7   THE RANDOM NUMBERS ARE TRANSMITTED IN BLOCKS AT
;       A TIME AND COMPARED IN NON-INTERRUPT TIME.  THE
;       TRANSMIT/RECEIVE BUFFER AREAS ARE DIVIDED
;       ACCORDING TO HOW MANY LINES ARE ACTIVE-  THEN EACH
;       LINE IS GIVEN A RANDOM BLOCK LENGTH EVERY TIME
;       A NEW BLOCK IS SENT, WITHIN THE CONSTRAINTS OF THE
;       MAXIMUM BLOCK SIZE.  TO TRANSMIT LARGER BLOCKS
;       OF CHARACTERS AT A TIME, THE OPERATOR MAY WANT TO
;       SELECT FEWER LINES TO ACTIVATE.
```

```
;11.8    DESCRIPTION OF COMMUNICATION SYSTEM I/O FUNCTIONS:
;
;        DEVICE CODES MUX = 34 (OCTAL)
;                     CRC = 35 (OCTAL)
;
;
;        DOA AC,MUX       SPECIFIES THE ABSOLUTE LINE ADDRESS TO
;                         BE USED IN CONJUNCTION WITH A DATA OUT
;                         INSTRUCTION TO TRANSMIT,RECEIVE, OR
;                         MODEM.
;
;                 BITS 0-6          NOT USED
;
;                 BITS 7-14         ABSOLUTE LINE ADDRESS
;
;                                   0=RECEIVE OR MODEM CONTROL
;                                   1=TRANSMIT CONTROL
;
;        DOB AC,MUX       SPECIFIES TRANSMIT DATA, TRANSMIT MODE
;                         (TRANSPARENT OR BREAK), AND MODEM OUT.
;
;                 BITS 0-1          TRANSMIT OR MODEM CONTROL
;                                   10=MODEM CONTROL
;                                   00=NORMAL TRANSMIT DATA
;                                   01=TRANSMIT BREAK(ASYNC ONLY)
;
;                 BITS 2-3          TRANSPARENCY CONTROL (SYNC ONLY)
;
;                                   00=NORMAL TRANSMIT
;                                   10=TRANSMIT AND LEAVE XPARENT
;                                   11=TRANSMIT AND ENTER XPARENT
;
;                 BITS 4-7          NOT USED
;
;                 BITS 8-15         TRANSMIT DATA (IN TRANSMIT MODE)
;
;
;                                   MODEM CONTROL SIGNALS
;
;                 BIT 12            1=TURN ON SPA (SYNC ONLY)
;                                   0=TURN OFF SPA (SYNC ONLY)
;
;                 BIT 13            1=TURN ON SPB (SYNC ONLY)
;                                   0=TURN OFF SPB (SYNC ONLY)
;
;                 BIT 14            1=TURN ON RTS
;                                   0=TURN OFF RTS
;
;                 BIT 15            1=TURN ON DTR
;                                   0=TURN OFF DTR
;
```

```
;
;       DOC AC,MUX      SPECIFIES ON/OFF CONTROL OF TRANSMITTER
;                       OR RECEIVER, OUTPUT SYNC AND DLE CHARAC-
;                       TERS (SYNC ONLY), AND LINE CHARACTER-
;                       ISTICS.
;
;
;               BITS 0-1        00=XMIT/RECV CONTROL
;
;               BITS 2-14       NOT USED
;
;               BIT 15          0=OFF
;                               1=ON
;
;
;               BITS 0-1        01=SYNC CHARACTER (SYNC ONLY)
;
;               BITS 2-7        NOT USED
;
;               BITS 8-15       SYNC CHARACTER
;
;
;               BITS 0-1        11=DLE CHARACTER (SYNC ONLY)
;
;               BITS 2-7        NOT USED
;
;               BITS 8-15       DLE CHARACTER
```

```
;       DOC AC,MUX (CONTINUED)
;
;               BITS 0-1        10 SPECIFIES PARITY, STOP BITS,
;                               LINE SPEED, CHAR CODE LEVEL, AND
;                               LOOPBACK CONTROL.
;
;               BITS 2-5        NOT USED
;
;               BIT 6           SELECT ONE OF TWO POLYNOMIALS
;                               (SYNC ONLY)
;
;               BITS 7-8        CLOCK SELECT (ASYNC ONLY)
;
;                               00 = CLOCK 0
;                               01 = CLOCK 1
;                               10 = CLOCK 2
;                               11 = CLOCK 3
;
;               BITS 9-10       SPECIFY NUMBER OF STOP BITS
;                               (ASYNC ONLY)
;
;                               00 = 1 STOP BIT
;                               01 = 2 STOP BITS
;                               10 = RESERVED
;                               11 = RESERVED
;
;               BITS 11-12      SPECIFY CODE LEVEL
;
;                               00 = 5 LEVEL CODE (ASYNC ONLY)
;                               01 = 6 LEVEL CODE
;                               10 = 7 LEVEL CODE
;                               11 = 8 LEVEL CODE
;
;               BITS 13-14      PARITY SELECT
;
;                               00 = NO PARITY
;                               01 = ODD PARITY
;                               10 = EVEN PARITY
;                               11 = RESERVED
;
;               BIT 15          LOOPBACK CONTROL
;
;                               0 = LOOPBACK OFF
;                               1 = LOOPBACK ON
```

```
;
;       DIA AC,MUX      SPECIFIES IMPLICIT ADDRESS OF INT-
;                       ERRUPTING LINE, RECEIVE, MODEM, OR
;                       TRANSMIT, AND FORCES A DOA AS EXPLICIT
;                       ADDRESS FOR OUTPUTTING.
;
;
;               BITS 0-6        NOT USED
;
;               BITS 7-14       EXPLICIT ADDRESS
;
;               BIT 15          TRANSMIT OR RECV/MODEM CONTROL
;
;                               0= RECEIVE OR MODEM INTERRUPT
;                               1= TRANSMIT INTERRUPT
;
;
;       DIB AC,MUX      SPECIFIES RECEIVED DATA ON RECEIVE INT-
;                       ERRUPT.
;
;               BITS 0-7        NOT USED
;
;               BITS 8-15       RECEIVE DATA
;
;
;       DIC AC,MUX      SPECIFIES RECEIVER DONE/STATUS OR
;                       MODEM DONE/STATUS
;
;               BITS 0-11       NOT USED
;
;
;                       RECEIVER STATUS
;
;               BIT 12          FRAMING ERROR (ASYNC ONLY)
;
;               BIT 13          PARITY ERROR
;
;               BIT 14          OVERRUN
;
;               BIT 15          0=RECEIVER STATUS
```

```
;       DIC AC,MUX (CONTINUED)
;
;                       MODEM STATUS
;
;               BIT 11          CD STATUS
;
;                               1=CD IS ON
;                               0=CD IS OFF
;
;               BIT 12          CTS STATUS
;
;                               1=CTS ON
;                               0= CTS OFF
;
;               BIT 13          DSR STATUS
;
;                               1= DSR ON
;                               0= DSR OFF
;
;               BIT 14          RING STATUS
;
;                               1= RING ON
;                               0= RING OFF
;
;               BIT 15          MODEM STATUS CONTROL
;
;                               1= MODEM STATUS
```

```
;       EFFECT OF 'BUSY' AND 'DONE' ON COMMUNICATIONS CONTROL
;
;
;       BUSY:   BUSY IS SET ON THE ASYNC LINES ON AN I/O RESET
;               OR START PULSE.  THIS STARTS AN ICLR CYCLE WHICH
;               CLEARS MODEM MEMORY AND PRESETS THE IMPLIED ADD-
;               RESS COUNTER.  ON COMPLETION OF THE ICLR CYCLE,
;               BUSY RESETS, AND THE BOARD IS PLACED IN THE
;               'DIAGNOSTIC' MODE.  THERE IS NO 'BUSY' FLOP
;               ON SYNC LINES.
;
;       DONE:   DONE SETS ON BOTH SYNC AND ASYNC LINES WHEN ONE
;               OF THE FOLLOWING EVENTS OCCURS:
;                 1. CHARACTER RECEIVED.
;                 2. TRANSMIT BUFFER EMPTY
;                 3. MODEM STATUS HAS CHANGED.
;               INTERRUPTS OCCUR IN THE ABOVE ORDER OF PRIORITY,
;               AND FROM LOWEST TO HIGHEST NUMBERED LINES.  A
;               'NIOC MUX' WILL CLEAR DONE, AS WELL AS A
;               'NIOS MUX' AND 'IORST'.
;
;       IORESET:  CLEARS LOGIC AND PLACES CONTROLLERS IN OFFLINE
;               DIAGNOSTIC MODE.  ALSO SETS 'BUSY' (ASYNC ONLY).
;
;       START:  SAME AS IORESET (SELECTIVE ON PER CARD BASIS).
;
;       CLEAR:  CLEARS 'DONE' AND INTERRUPT LOGIC AND PLACES
;               CONTROLLERS IN ONLINE MODE.
;
;       IOPLS(MUX):     STEPS INTERNAL CLOCKS IN
;                       'DIAGNOSTIC' MODE.
;
;       IOPLS(CRC):     STEPS TRANSMIT/RECEIVE CLOCK AND CRC
;                       CLOCK IN 'DIAGNOSTIC MODE'
;                       (SYNC ONLY).
```

```
;11.9   FORMAT OF PROGRAM INTERNAL CONTROL WORDS (LCB BLOCKS)
;
;                MASTER CONTROL WORD (MCW)
;
;       BIT 0           LINE ACTIVE
;
;       BIT 1           LINE SHOULD BE STARTED (DCU OR MONITOR
;                       PROGRAM)
;
;       BITS 2-7        TIME OUT COUNTER FOR XMIT OR RECEIVE INTR.
;
;       BITS 8-9           IN DUAL PORT INDICATES FIRST MIDDLE OR LAST LINE
;                          ADDRESS ACCORDING TO THE FOLLOWING TABLE.
;                               BIT8            BIT9
;                                1               1       FIRST LINE
;                                1               0       MIDDLE LINE(S)
;                                0               1       LAST LINE
;       BITS 10-13      NOT USED
;
;       BIT 14          BLOCK IS READY FOR CHECKING (BLOCK DONE)
;
;       BIT 15          0=ASYNC LINE
;                       1=SYNC LINE
;
;
;
;                CONTROL REGISTER (CONT)
;
;       BIT 0           ERROR OCCURRED
;
;       BIT 1           USER SELECTED DATA LOADED
;
;       BITS 2-5        NOT USED
;
;       BIT 6           CRC POLYNOMIAL FOR THIS LINE (SYNC ONLY)
;
;       BITS 7-8        CLOCK SELECT (ASYNC ONLY)
;
;       BIT 9           NOT USED
;
;       BIT 10          STOP BITS (ASYNC ONLY)
;
;       BITS 11-12      CODE LEVEL
;
;       BITS 13-14      PARITY
;
;       BIT 15          CRC OPTION (SYNC ONLY)
```

```
;
;               MODEM OUTPUT REGISTER (MOD)
;
;       BIT 0           MODEM ACTIVE
;
;       BIT 1           OUTPUT NEW MODEM STATUS
;
;       BITS 2-11       NOT USED
;
;       BITS 12-15      NEW MODEM STATUS TO BE OUTPUTTED
;
;
;               MODEM REGISTER (MODS)
;
;       BIT 0           NEW MODEM STATUS HAS BEEN RECEIVED
;
;       BITS 1-3        NOT USED
;
;       BITS 4-7        OLD (PREVIOUS) MODEM STATUS
;
;       BITS 8-11       NOT USED
;
;       BITS 12-15      NEW (PRESENT) MODEM STATUS
```

```
;
;           TRANSMIT TABLE POINTER (XTP)
;
;   BITS 0-15       STARTING ADDRESS OF TRANSMIT BLOCK
;                   FOR THIS LINE
;
;
;           TRANSMIT TABLE SIZE (XTS)
;
;   BITS 0-15       NUMBER OF CHARACTERS IN BLOCK TO
;                   BE TRANSMITTED
;
;
;           TRANSMITTED WORD COUNT (XC)
;
;   BITS 0-15       NUMBER OF CHARACTERS IN BLOCK
;                   ALREADY TRANSMITTED
;
;
;           RECEIVE TABLE POINTER (RTP)
;
;   BITS 0-15       STARTING ADDRESS OF RECEIVE BLOCK
;                   FOR THIS LINE
;
;
;           RECEIVE TABLE SIZE (RTS)
;
;   BITS 0-15       MAXIMUM ALLOWABLE NUMBER OF
;                   RECEIVE WORDS (2*XTS)
;
;
;           RECEIVED WORD COUNT (RC)
;
;   BITS 0-15       NUMBER OF CHARACTERS RECEIVED
;                   IN THIS BLOCK
;
```

```
;
;           SYNC WORD (SYNC)
;
;       BITS 0-7        NOT USED
;
;       BITS 8-15       SYN CHARACTER
;
;
;
;           DLE WORD (DLE)
;
;       BITS 0-7        NOT USED
;
;       BITS 8-15       DLE CHARACTER
;
;
;
;           CRC TEMPORARY (SCRC)
;
;       BITS 0-15       PRESENT CRC TEMPORARY
;
;
;
;           TIME COUNTER (TIME)
;
;       BITS 0-15       RTC READING AT LAST BLOCK DONE
;                       IF DCU SYSTEM, ELSE NUMBER
;                       OF TIMES THROUGH MONITOR ROUTINE
;
;
;
;           TRANSMIT WORD TABLE (XTBL)
;
;       BIT 0           NOT USED
;
;       BIT 1           UNDERRUN FOR THE REST OF THE BLOCK SIZE
;
;       BIT 2           DLE CHARACTER FOLLOWS
;
;       BIT 3           0=LEAVE TRANSPARENCY
;                       1=ENTER TRANSPARENCY
;
;       BITS 4-7        NOT USED
;
;       BITS 8-15       TRANSMIT DATA
;
;
;
;           RECEIVE WORD TABLE (XTBL+BL)
;
;
;       BITS 0-3        NOT USED
;
;       BITS 4-7        ERROR STATUS
;
;       BITS 8-15       RECEIVE DATA WORD
```

```
;12.0    SPECIAL FEATURES
;        NONE
;
;13.0    RUN TIME
;        RUN TIME IS DEPENDENT ON MODE OF OPERATION AND NUMBER
;        AND TYPE OF LINES BEING TESTED.
```