Model MX-402

Asynchronous Line Multiplexor

Technical Manual

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REVISION HISTORY

ECO No.	Date	Description	Pages
	9-17-85	RELEASE	

PREFACE

This manual contains information regarding installation, testing and operation of the ZETACO Model MX-402 Asynchronous Line Multiplexor.

The technical contents of the manual have been written based on the assumptions that the reader 1) has a working knowledge of Data General (DG), Nova and/or Eclipse series computer hardware and their associated operating systems; 2) is familiar with printed circuit board installation procedures; 3) is familiar with, and has information regarding the installation and setup of the peripheral equipment; and 4) has been supplied with all required interface cabling and installation instructions.

The information in this manual is organized into five major sections:

SECTION 1	PRODUCT OVERVIEW - Describes the Model MX-402 Controller's features, capabilities, specifications and power and interface requirements.
SECTION 2	INSTALLATION - Describes and illustrates the procedures required to install the MX-402 in the computer chassis.
SECTION 3	TEST PROGRAMS, TROUBLESHOOTING and CUSTOMER SERVICE - Contains information useful in analyzing equipment faults and how to get help.
SECTION 4	USAGE GUIDELINES - Contains application information on special controller features and guidelines for connection of the controller to popular interfaces.
SECTION 5	PROGRAMMING NOTES - Contains detailed technical information for those involved in fault analysis or programming.
APPENDIX A	SCHEMATIC DIAGRAMS
APPENDIX B	DIAGNOSTIC PROGRAM TEXT - Detailed instructions written by programming personnel for use with the diagnostic tape.
APPENDIX C	PROGRAM LISTINGS - Source listings of the diagnostic program for analysis of errors detected by the program. (Optional)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

1.0 PRODUCT OVERVIEW

1.1 GENERAL DESCRIPTION

The MX-402 asynchronous interface provides half or full duplex communication between Data General Eclipse-based computers and up to eight serial input-output devices. The controller occupies one I/O-ONLY chassis slot and emulates DG Model 4241 ULM-5 Subsystem programming format.

The MX-402 is a plug-compatible replacement for the multiplexor-only version of ZETACO's Model 400 controller. This model is intended to satisfy applications requiring RS-232C compatible device interface at the computer backplane. The controller has also been equipped with features that provide added protection against the loss of received data (overrunning). To help prevent receiver overruns during heavy system activity or high speed data bursts, the controller incorporates the following:

1) Independent receiver buffers on each line capable of buffering up to forty (40) characters.

2) Buffer control, transparent to the CPU, available on each line to control the flow of data from the input device.

1.2 FEATURES - ADVANTAGES

* Fully programmable line characteristics including baud rate, word length, framing control, all on an individual line basis.

* Configurable to any usable device code.

* Individual line-section interrupt control.

* Independent, 40-character by 9-bit FIFO buffering on each line helps to prevent receiver data overrunning. Ninth bit retains parity error status.

* Independent buffer control output signal (Hardware Clear To Send) available on each line for additional overrun protection.

* Full modem control for support of half or full duplex operation.

* Device interface at the chassis backplane to accommodate FCC-compliant cabling.

1.3 SPECIFICATIONS

1.3.1 FUNCTIONAL

Emulation:	Data General 4241 (ULM-5).
Device Code:	Any usable in the range 00-77 (octal).
Transfer rate:	75 to 19,200 Baud.
Word length:	5,6,7 or 8 bits per character.
Framing control:	1 or 2 stop bits (6-8 bit words), 1 or 1-1/2 stop bits (5 bit words).
Parity:	Odd, even or none.

1.3.2 COMPUTER INTERFACE

Commands and data transfer are via Data General's standard programmed I/O. The controller may be installed in any I/O-ONLY slot of a Data General Nova 4 or Eclipse (Non-MV) Model minicomputer.

1.3.3 SERIAL DEVICE INTERFACE

All device data and modem control communication is via the chassis backplane. See Table 1.1 for pin assignments. The interface is compatible with EIA Standard RS-232C specification.

TABLE 1.1 Device Interface Backplane Pin Assignments

SIGNAL NAME	LINE 0	LINE 1	LINE 2	LINE 3
Transmit Data	A47	A59	A65	A71
Receive Data	A49	A61	A67	A73
Request To Send (Hardware CTS)	A7	A11	A19	A21
Clear To Send	A57	A63	A69	A75
Data Terminal Ready	A8	A12	A16	A20
Data Set Ready	A9	A13	A18	A22
Carrier Detect	B11	B15	B23	B27
Ring Indicator	B13	B19	B25	B31

SIGNAL NAME	LINE 4	LINE 5	LINE 6	LINE 7
Transmit Data	A77	A83	A76	A86
Receive Data	A79	A87	A78	A88
Request To Send (Hardware CTS)	A23	A27	A29	A39
Clear To Send	A81	A89	A84	A92
Data Terminal Ready	A24	A28	A31	A43
Data Set Ready	A26	A30	A32	A53
Carrier Detect	B32	B38	B48	B49
Ring Indicator	B36	B40	B52	B51

1.3.4 MECHANICAL

Dimensions:	15" x 15" x 0.5" (38.1 cm x 38.1 cm x 1.3 cm)
Shipping Weight:	7 lbs. (3.18 kg) Includes controller, tape, full documentation and shipping carton.

1.3.5 POWER REQUIREMENTS

+5 VDC ±.25V @ 4 Amps max.
+12 VDC, or +15 VDC ±2V @ 0.5 Amps max.

1.3.6 ENVIRONMENTAL REQUIREMENTS

Operating Temperature:	0 to 55 degrees Centigrade
Operating Humidity:	10% to 90% non-condensing

2.0 INSTALLATION

Carefully read the following installation instructions before installing the MX-402 and applying chassis power. Although many of the controller's switches and jumpers may have been pre-configured to your requirements, we recommend that installation personnel be familiar with the various setup configurations and precautions to ensure proper operation and prevent any damage to the controller or equipment. To verify the controller is operational prior to system testing we recommend that diagnostic testing be performed per the instructions in Section 3.1.

CAUTION: THE MX-402 CONTROLLER MAY ONLY BE INSERTED IN AN "I/O ONLY" SLOT. THE CONTROLLER WILL NOT OPERATE AND COMPONENT DAMAGE MAY OCCUR IF THE CONTROLLER IS INSERTED IN A SLOT OTHER THAN "I/O ONLY".

2.1 UNPACKING AND INSPECTION

Each MX-402 shipment consists of :

A) MX-402 Asynchronous Line Multiplexor PCB Assembly P/N 500-407-00

B) Diagnostics on 1/2" Magnetic Tape P/N 400-407-00

C) Technical Manual P/N 600-407-00

Upon receipt of the shipment from the carrier, inspect the carton immediately for any evidence of damage or mishandling in transit.

If the shipping carton is water stained or damaged, contact the carrier and shipper immediately, specify the nature and extent of the damage and request that the carrier's agent be present when the carton is opened.

ZETACO's warranty does not cover shipping damage.

For repair or replacement of any ZETACO product damaged in shipment, call ZETACO to obtain Return Authorization instructions.

2.2 CHASSIS PREPARATION

2.2.1 SLOT SELECTION

Below is a list of many of the Data General minicomputers in which the controller may be used. To the right are the slot numbers of the I/O-ONLY slots within each chassis.

MODEL	I/O ONLY SLOTS
Nova 4 (5 slot)	3-5
Nova 4 (16 slot)	12-16
Eclipse S120 (5 slot)	3-5
Eclipse S120 (16 slot)	12-16
Eclipse S140	12-16
Eclipse S280	11-19
Eclipse S250 and C350	2-16 (optional, add-on slots)

Other factors that should be considered when selecting a slot include interrupt priority level with respect to other programmed I/O controllers; Data Channel devices such as disk and tape controllers usually require higher priority and are placed closer to the CPU slot. Current loading rules should also be considered for groups of slots within the chassis. See Section 1.3.5 for controller current requirements. Refer to your computer's configuration rules reference for additional information.

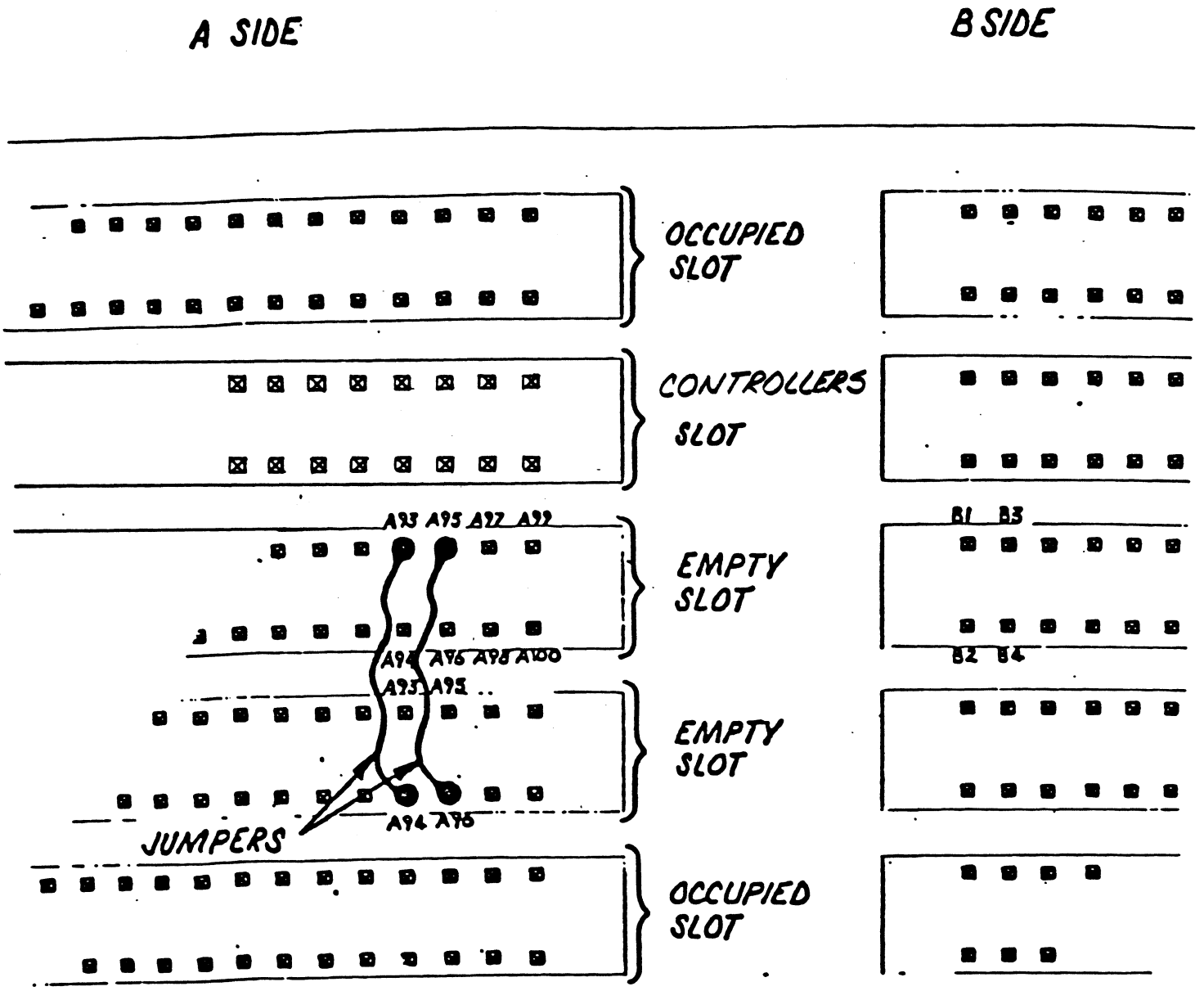
2.2.2 PRIORITY JUMPERS

The MX-402 controller must be furnished with Interrupt Priority-In on pin A96 of the chassis backplane; the controller, in turn, drives the signal Interrupt Priority-Out on pin A95. Data Channel access is not used by the controller and is passed through within the controller to maintain continuity within the chassis. It may be neccessary to add or alter existing backplane priority jumpers when installing the controller. Because the controller can only occupy an I/O ONLY slot, it may be neccessary to leave one or more empty slots below it.

To jumper across unused slots, see Figure 2.1. Preferably using wire-wrapping wire and tool, connect pin A93 (DCHP-OUT) of the top empty slot to pin A94 (DCHP-IN) of the bottom empty slot.

Next, connect pin A95 (INTP-OUT) of the top empty slot to pin A96 (INTP-IN) of the bottom empty slot. If empty slots exist between the controller and any device above it, perform similar strapping of the DCHP and INTP signals to maintain priority continuity.

FIGURE 2.1 Backplane Priority Jumpers



2.2.3 SYNC PRIORITY

When using the MX-402 with a ULM-5 Sync-only board (DG Model 4242) or a ZETACO Model 352 Programmable Sync Interface at the same device code address, a jumper must be added to establish interboard priorities between the Sync board and the MX-402. This allows the sync line to pre-empt the async lines if it requires service.

To jumper the priorities between the controller boards, add a backplane jumper from pin B6 of the ULM/5 board or pin A83 of the Model 352 board to pin B34 of the MX-402 board.

2.3 CONTROLLER PREPARATION

Figure 2.3 shows the MX-402 board layout. Use this as a guide in locating the necessary switches and jumpers discussed in the following sections. X-Y coordinates along the perimeter are used in locating the region the components are found.

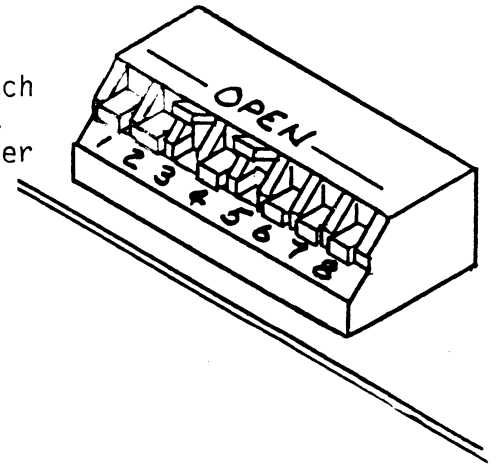
2.3.1 DEVICE CODE

The MX-402 may be configured to any usable device code. It is selectable via the Device Code Switch located on the left-hand side of the front edge of the PC board. This gives accessibility without having to shut down power and remove the controller from the chassis.

Standard software requires the controller to be set to either a primary device code of 34 or a secondary device code of 44 (octal). To setup the controller device code refer to figure 2.2. The individual bit switches are numbered 1-8 from left to right; the code is right-justified with positions 3-8 corresponding to binary device code bits DS0-DS5. An UP switch translates to a "1"; DOWN translates to a "0". The table in the figure shows the possible switch combinations.

FIGURE 2.2 Device Code Switch

Device Code Switch located on front edge of controller board.



NOTES:

1. Switch 3 is most significant bit, (DS0); Switch 8 is least significant, (DS5).
2. An UP Switch corresponds to binary "1".
3. A DOWN Switch corresponds to binary "0".
4. Switches 1 and 2 are reserved and should be DOWN.

DEVICE CODE SELECTION TABLE

Device Code (Octal)	SW3 DS0	SW4 DS1	SW5 DS2	SW6 DS3	SW7 DS4	SW8 DS5
0X	DOWN	DOWN	DOWN			
1X	DOWN	DOWN	UP			
2X	DOWN	UP	DOWN			
3X	DOWN	UP	UP			
4X	UP	DOWN	DOWN			
5X	UP	DOWN	UP			
6X	UP	UP	DOWN			
7X	UP	UP	UP			
X0				DOWN	DOWN	DOWN
X1				DOWN	DOWN	UP
X2				DOWN	UP	DOWN
X3				DOWN	UP	UP
X4				UP	DOWN	DOWN
X5				UP	DOWN	UP
X6				UP	UP	DOWN
X7				UP	UP	UP

2.3.2 +12V POWER SOURCE

The MX-402 requires +12 VDC from the chassis for operation. The source of +12V depends on the type of chassis being used and the controller must be setup accordingly. In a newer chassis (Nova 4, Eclipse S280), +12V is available directly on backplane pin B90. On an older chassis, +12V must be derived and regulated from VINH (+15V), available on pin A10.

Jumpers W8-1 and W8-2, near location A4, are used to select between the two sources. Only one jumper must be in place at the same time. W8-2 is a jumper already in place; this sets the controller to accept a +12V directly for use with newer models, (Nova 4, Eclipse S280). To switch to regulate +12V from +15V (older models), remove jumper W8-2 and insert in W8-1.

2.3.3 SOFTWARE RTS/HARDWARE CTS

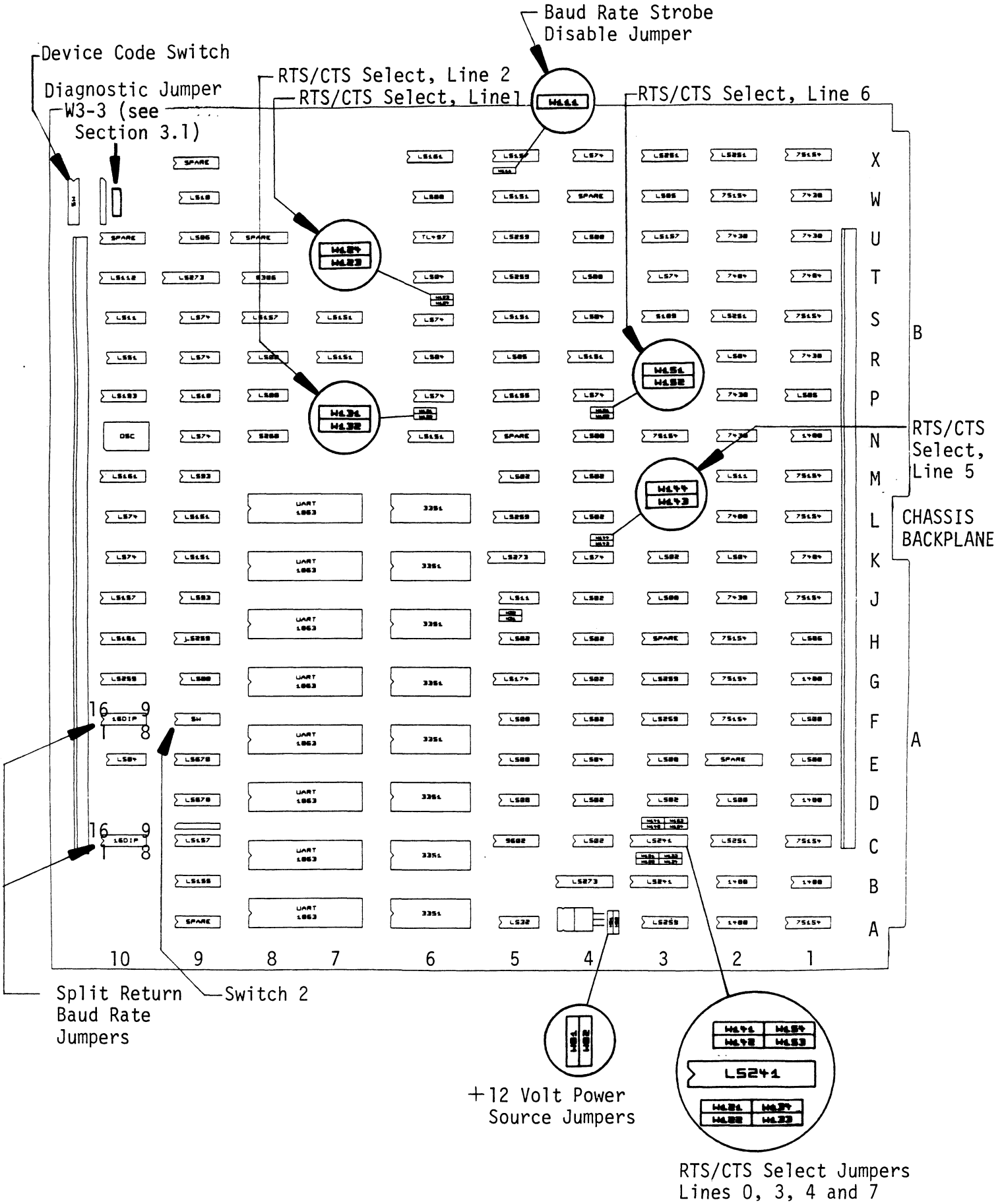
Each line's RTS (Request To Send) output is a dual function, RS-232C level signal configurable via jumpers to operate in one of two ways; under hardware control as a means of regulating the flow of data from the input device to help reduce or eliminate overrun errors, or under software control, whereby the signal is the standard RTS (Request To Send) as defined by 4241 emulation for modem control. For a more detailed discussion, refer to Section 4, "Usage Guidelines".

Each line is independently configured for Hardware or Software control of its RTS output via a pair of jumpers. Which of the two is in place determines the mode of operation for that line, and must be configured accordingly if the RTS output is used. Only one of the two must be in at a time. Refer to the following Table and Figure 2.3 for jumper location and setup.

LINE NUMBER	JUMPER INSERTED FOR HARDWARE (CTS) MODE	JUMPER INSERTED FOR SOFTWARE (RTS) MODE
0	*W12-1	W12-2
1	*W12-3	W12-4
2	*W13-1	W13-2
3	*W13-3	W13-4
4	*W14-1	W14-2
5	*W14-3	W14-4
6	*W15-1	W15-2
7	W15-3	*W15-4

*Indicates jumpers in for standard factory configuration.

FIGURE 2.3 MX-402 Board and Jumper Layout



2.3.4 DEFAULT BAUD RATE

When each line is initialized during Busy, the baud rate for all lines is set to a default value. This value is selectable by setting switches 5, 2, 3 and 4 of the DIP switch in location F9. The following table indicates the switch setting for each default baud rate:

BOARD LOCATION F9				SWITCHES 1-4
SW5	SW2	SW3	SW4	DEFAULT BAUD RATE:
ON	ON	ON	ON	0
ON	ON	ON	OFF	19.2K
ON	ON	OFF	ON	19.2K
ON	ON	OFF	OFF	75
ON	OFF	ON	ON	19.2K
ON	OFF	ON	OFF	19.2K
ON	OFF	OFF	ON	600
ON	OFF	OFF	OFF	2400
OFF	ON	ON	ON	9600
OFF	ON	ON	OFF	4800
OFF	ON	OFF	ON	19.2K
OFF	ON	OFF	OFF	1200
OFF	OFF	ON	ON	2400
OFF	OFF	ON	OFF	300
OFF	OFF	OFF	ON	150
OFF	OFF	OFF	OFF	110

2.3.5 SPLIT RETURN RATE

The Split Return Rate option allows connection of the controller to specialized data communication equipment. This allows a high transmit rate and a low receive rate, which, for example, enables a line to transmit at 1200 baud and receive at 300 baud.

The receive rate is selected by setting the remaining four switches 1, 7, 8 and 6 of the DIP switch at location F9 as follows:

Switch 1	ON	-	9600 Baud
Switch 7	ON	-	300 Baud
Switch 8	ON	-	150 Baud
Switch 6	ON	-	110 Baud

NOTE: Only one switch must be ON at a time.

In addition, to enable a line for Split Rates, one associated jumper must be removed and one added per the following table:

LINE NUMBER	REMOVE JUMPER AT LOC. F10 BETWEEN PINS	ADD JUMPER AT LOC. C10 BETWEEN PINS
0	1 and 16	1 and 16
1	2 and 15	2 and 15
2	3 and 14	3 and 14
3	4 and 13	4 and 13
4	8 and 9	8 and 9
5	7 and 10	7 and 10
6	6 and 11	6 and 11
7	5 and 12	5 and 12

2.3.6 BAUD RATE STROBE (DOC) DISABLE

The Baud Rate Strobe may be disabled in cases where all lines are the same speed and never change and only line characteristics are altered. The Default Rate only is programmed (Section 2.3.4).

Inserting jumper W11-1, located near X5, will disable any attempts to alter the Default Baud Rate for all lines.

2.4 INSTALLATION OF CONTROLLER

As previously mentioned, the MX-402 may only be used in I/O ONLY slots of the computer chassis. Never insert or remove the PC board from the chassis with power applied. After selecting the proper slot, insert the controller board by fitting the board edges between the slot guides and allowing the board to follow the guides evenly. Use the ejectors on the two outside corners of the board to provide leverage when the board meets the connector, and use equal pressure on both ejectors until the board seats firmly into the backplane connectors.

2.5 PERIPHERAL PREPARATION

The input-output devices associated with each line must be setup with characteristics identical to those specified for the MX-402 during system generation. These include baud rate, word length, framing control (stop bits) and parity generation and checking.

NOTE: FOR PROPER OPERATION WITH A MODEM, A LINE'S REQUEST TO SEND OUTPUT SIGNAL MUST BE CONFIGURED FOR "SOFTWARE RTS". REFER TO SECTION 2.3.3.

3.0 TEST PROGRAMS, TROUBLESHOOTING AND CUSTOMER SERVICE

ZETACO products are supported in many ways:

-Diagnostic, Reliability and Echo program on 9-track tape for use during installation and troubleshooting.

-48-hour turnaround policy on most factory repairs or replacement.

-Customer Support Hotline, manned from 8:00 a.m. to 5:00 p.m. (Central Time) to answer your questions.

-Two year warranty on all controllers on materials and workmanship.

3.1 DIAGNOSTICS

Diagnostic support programs are supplied on 1/2" magnetic tape, P/N 400-407-00. Tapes are available in either 800 or 1600 BPI density. The following sections contain information for loading and using the programs. All programs are "stand-alone", meaning that they do not require, nor can they be used concurrently with the operating system running. Directions are also provided for transfer of the "dump" file containing the programs to, and executing them from disk.

NOTE: If test plugs are used when running the diagnostic or reliability tests, jumper W3-3, located behind the Device Code Switch, must be IN to force software control of RTS on all lines.

3.1.1 SYSTEM REQUIREMENTS

Minimum system requirements for loading the tape are:

1) Data General Nova or Eclipse series CPU
2) Minimum 16K words of RAM memory
3) Console device at device codes 10/11
4) 1/2", 800 or 1600 BPI tape subsystem
5) Printer (LPT) at device 17 for hard copy (optional)

3.1.2 LOADING THE PROGRAMS

Mount the tape and place the drive on-line. If your drive is dual-density, be sure it is set to match that shown on the tape label. Boot the tape:

-For S120 or S280 virtual console, enter 22H (or 62H if secondary).

-For S140, set 11A to 100022 (100062 for secondary). Enter 100022L (or 100062L) to load tape.

-For Eclipse MV series, enter full virtual console and respond to the prompt (SCP-CLI>) with BOOT 22 (62 for secondary).

The tape menu will appear on the console as follows:

```
FILE #          PROGRAM                     FILENAME

  2             MX-402 DIAGNOSTIC             MX402D.SV
  3             MX-402 RELIABILITY            MX402R.SV
  4             MX-402 ECHO                   MX402E.SV
  5             ".SV" files in
                    RDOS dump format
  6             ".SV" files in
                    AOS dump format

FILE NUMBER?
```

Enter the file number you wish to execute followed by Return. The program will load and text will appear on the console. Refer to the following sections for program operation.

3.1.3 "DUMPING" PROGRAMS TO DISK

The last two files on the tape are RDOS and AOS "dump" versions of the executable programs contained on the tape. To load the files from tape onto a disk drive, place the tape on-line and at load point, and use the standard CLI commands for loading from tape:

```
FOR RDOS:       DIR %MDIR%
                INIT MT0
                LOAD/A/R/V MT0:5
                RELEASE MT0
```

FOR AOS OR
AOS/VS:

```
SUPERUSER ON
DIR :
LOAD/V/R @MTn:6   (where n is your tape
                   unit)
REWIND @MTn
SUPERUSER OFF
```

The files can now be booted from disk. For RDOS, enter the filename (see menu in the previous section) in response to FILENAME?. For AOS, enter the full pathname (including .SV) in response to PATHNAME?

3.1.4 DIAGNOSTIC TEST

File 2 of the tape is the MX-402 Diagnostic Test. Its function is to test as much of the controller's hardware as possible for malfunctions in a pass/fail method of operation. The test may be run in one of two parts. The first is the baud clock test only, which tests the timing and baud counter sections of the board. The second tests both the baud clocks and the data transmitting and receiving capabilities of the board. This test also allows the modem control section and signal drivers and receivers to be optionally tested if test plugs are used. If test plugs are used, jumper W3-3 must be IN.

For more information on the Diagnostic Test and test plug wiring requirements, refer to the program text in Appendix B.

Once the program is located and loaded, it comes up with a menu for the operator to satisfy. The questions are self-explanatory and are also discussed in Appendix A.

NOTE 1: When the program requests the Default Baud Clock Switches in octal, enter the octal representation of Switch 5 (most significant), Switches 2, 3, and 4 (least significant) of the switch at board location F9. An "ON" switch = 0; an "OFF" switch = 1. See the table in Section 2.3.4. A value of 0 to 17 (octal) is expected. For example, for a setting of 9600 baud, enter "01".

NOTE 2: Test plugs must be used if the answer to Using Modems is "0" (yes); the plugs must interconnect lines 0 & 1, 2 & 3, 4 & 5 and 6 & 7. The plugs are discussed further in the program text found in Appendix B. If plugs are used, jumper W3-3 must be IN.

3.1.5 RELIABILITY TEST

This test resides in file 3 of the tape. The test is a simulation of an actual applications program where blocks of data are transferred and compared and all errors are reported. It is generally used to determine if any of the 8 communications lines are faulty. It can be setup for all lines passing random data, or may be set for specific line characteristics where the user has found a single bad line or has detected data dependent errors. The operator must answer the questions in the menu before the test may be executed. See the UMUXR program text in Appendix B for further information.

NOTE 1: To the question on lines to be tested, answering with a "0/7" will test all lines. Alternately, individual lines may be specified by separating with commas: "2,5,6".

NOTE 2: If test plugs are not used, the modem control section will not be tested. If test plugs are used, jumper W3-3 must be IN.

NOTE 3: If running a sync controller board (DG 4242 or ZETACO 352) simultaneously at the same device code, the interboard priority jumper must be in place. (Section 2.2.3)

3.1.6 ECHO TEST

The ECHO program (file 3) will test a single line of the MX-402 at a time. This test can be very useful for verifying that cabling to each device is correct as well as the RS-232C drivers and receivers are working. The program is menu driven and requires the the operator to know the serial data format requirements of the device associated with the line. These parameters are entered via the console along with the portion of the test desired, either the Transmit Only routine or the Echo Key Strokes routine. The transmit routine simply sends data continuously to the device while the echo routine accepts key strokes from the device and sends them back to be displayed.

The program may also be 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 or Echo routine
Control "D" - To change data being transmitted

3.2 CUSTOMER SUPPORT HOTLINE

ZETACO, Inc. provides a Customer Support Hotline (612-941-9480) to answer technical questions and to assist with installation and troubleshooting problems.

The Hotline is manned by a technical team from 8:00 a.m. to 5:00 p.m. (Central Time) Monday through Friday.

3.3 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 express 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 damages arising out of, or in connection with, the use or performance of ZETACO's products.

3.4 PRODUCT RETURN AUTHORIZATION

When product malfunction has been confirmed using the tests outlined above, 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 Returned Material Authorization (RMA) number is required before shipment and should be referenced on all packaging and correspondence.

Each product to be returned requires a separate RMA number. To ensure fastest 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.

To safeguard the product 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 sheet if more space is needed.)

TEST	RESULTS
1. Diagnostic Test	_____
2. Reliability Test	_____
3. Echo Test	_____

Other tests performed:

Please allow our Service Department to do the best job possible by answering the following questions thoroughly and returning this sheet with the malfunctioning board.

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

2. What operating system are you running under? (AOS, RDOS).

3. Describe the system configuration (i.e. peripherals, I/O 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 for RMA number)

Returned by:

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

4.0 USAGE GUIDELINES

4.1 DEVICE CONTROL INTERFACE

The device data and control interface is designed for operation with local Data Terminal Equipment (DTE) as well as full or half-duplex Data Communication Equipment (DCE), such as modems. All signals are EIA RS-232C compatible, functionally and electrically, for use with DCE. All control signals, with the exception of Request To Send, are arranged in a DTE configuration for connection to DCE (modems). Each line's RTS output signal may be independently configured as either the standard RTS, for use with modems, or as a Clear To Send handshake output for use in controlling the rate of incoming data. See Section 2.3.3 for controller setup instructions. All control signals use +12 VDC to represent a "True" condition, and -12 VDC to represent a "False" condition.

4.1.1 REQUEST TO SEND/CLEAR TO SEND OUTPUT OPERATION

When setup for "Software Request To Send", a line's RTS output may be directly connected to the RTS input of a modem or other DCE for handshaking control of transmitted data from the controller. The signal is under program control via a Set Modem Control Status instruction. The program will typically set the signal true when it needs to transmit data, then wait for a true Clear To Send from the modem to indicate that it may begin transmitting. When the program finishes and sets the signal false, the controller automatically holds it true until current transmission is complete.

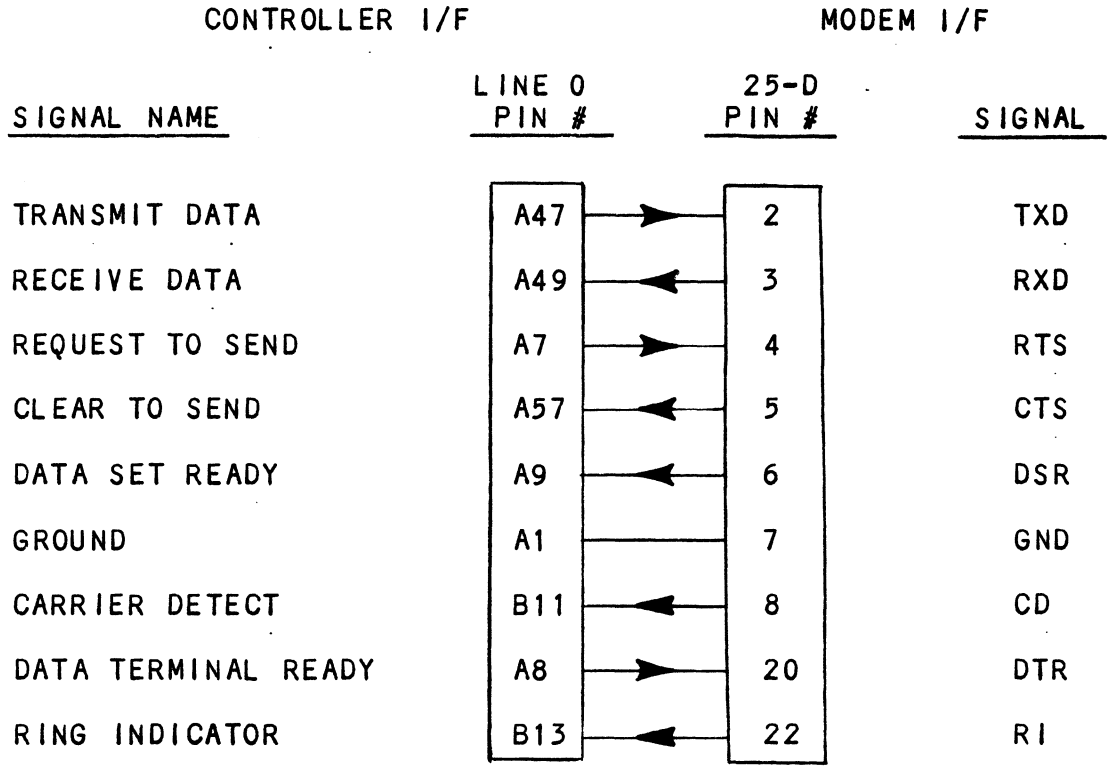
When setup for "Hardware Clear To Send", the RTS output assumes a role similar to a modem's CTS output. Its purpose is to control the flow of data from the input device to help prevent overruns (loss of received data) from occuring in the event that the CPU cannot service the receiver due to heavy activity. In this mode, when a receiver buffer contains no data, the RTS output is true. Upon reception of a character of data, the signal goes false, indicating to the input device to stop transmission until the CPU has serviced the receiver. The false condition remains until the CPU has read in the last character in the receiver's buffer, at which time it will return to true.

4.2 DEVICE INTERFACE EXAMPLES

See Section 1.3.3 for controller backplane pin assignments. The following configurations use Line 0 as an example.

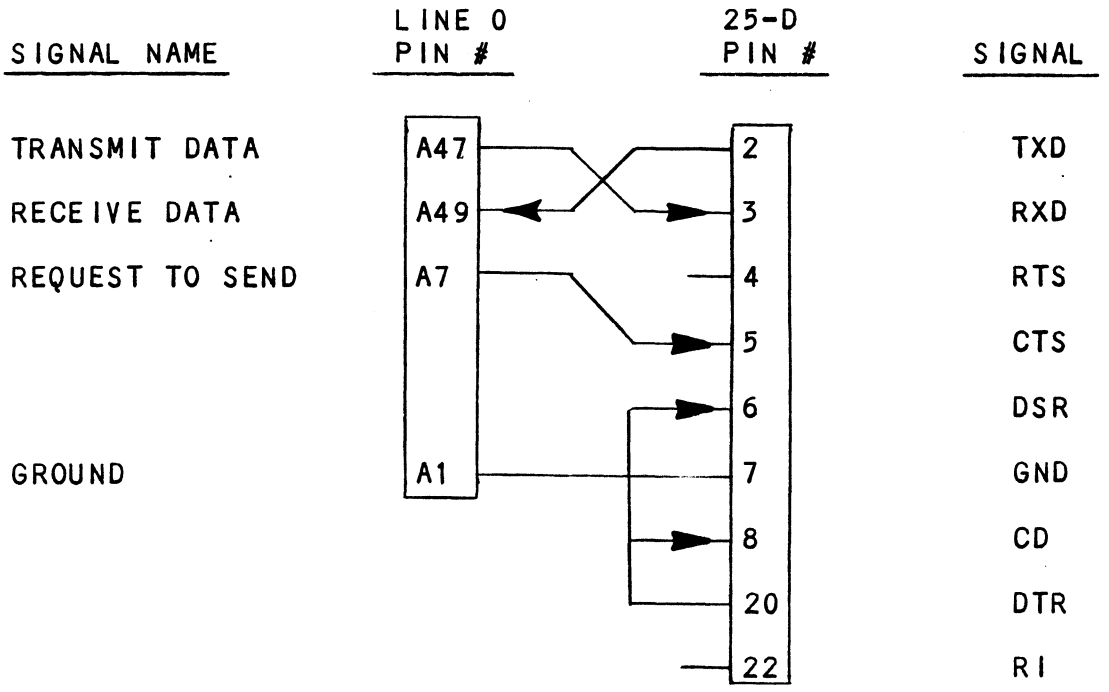
4.2.1 RS-232C MODEM

The following illustrates connection of a line with a modem that uses a standard 25-pin D-SUB connector and EIA pin configuration for DCE. The RTS output of the controller line must be configured for Software RTS control (Section 2.3.3).



4.2.2 RS-232C DATA TERMINAL EQUIPMENT WITH CLEAR TO SEND

With the line configured for Hardware Clear To Send, the RTS output would connect to the CTS input, pin 5 of a standard 25-pin DTE interface. Note that the direction of data flow on pins 2 and 3 of the DTE is reversed from that of a DCE modem interface. The Data Terminal Ready output of the terminal is looped back to Data Set Ready and Carrier Detect to simulate the presence of a modem.



5.0 PROGRAMMING NOTES

This section discusses, in detail, the assembly level programming characteristics of the MX-402 Asynchronous Multiplexor (also referred to as MUX). Contained here are descriptions of controller operation, in general and by section, and instruction breakdown. This information is of most use to technical personnel involved in system maintenance, development or programming.

5.1 OPERATION

Each individual line of the MUX is broken down into 3 discrete sections: Receiver, Transmitter and Modem. Each section may be turned on or off at the programmers discretion. The controller operates in 2 modes; on line and off line. In off line, or diagnostic mode, the program provides all timing pulses via an I/O Pulse to the MUX. Once the board has been placed on line, the board's crystal oscillator provides all timing pulses.

5.1.1 DEVICE COMMAND/FLAGS

There are six Device Command/Flags that control or indicate conditions within the controller; these are:

F = S START PULSE - Sets BUSY active, puts board on line, clears DONE and initializes board, then places board off line and clears BUSY.

F = C CLEAR PULSE - Clears DONE, restarts the priority scanner and places board on line.

F = P I/O PULSE - When board is off line, used to simulate internal 4.91 MHz clock for diagnostic purposes.

IORST IORESET Instruction - Same function as START, however, resets all MUX's in system.

BUSY FLAG - Active during board initialization, only after START or IORESET.

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

The DONE flag is set, and an interrupt occurs, if enabled, whenever any of the following conditions exist:

RECEIVER	The receiver is turned on and it has one or more characters in its buffer. (Up to 40 may be stored before an overrun occurs.)
TRANSMITTER	The transmitter is enabled AND can accept a character AND "Clear To Send" is active.
MODEM	The modem is enabled and one of its input status lines has changed state, or the status line was active when the board was placed on line.

5.1.2 LINE AND SECTION PRIORITY

The MUX's internal logic requires a scanning method to determine if any sections require service. Each line section takes approximately 3.25 microseconds to scan, requiring up to 52.0 microseconds to find one section requesting service. Specific priorities are assigned to each line section and dictate the order in which they are scanned. The scanning and priority sequence is as follows:

LINE #	SECTION
00	ASYNC RECEIVER
01	ASYNC RECEIVER
02	ASYNC RECEIVER
03	ASYNC RECEIVER
04	ASYNC RECEIVER
05	ASYNC RECEIVER
06	ASYNC RECEIVER
07	ASYNC RECEIVER
00	ASYNC TRANSMITTER
00	ASYNC MODEM
01	ASYNC TRANSMITTER
01	ASYNC MODEM
02	ASYNC TRANSMITTER
02	ASYNC MODEM
03	ASYNC TRANSMITTER
03	ASYNC MODEM
04	ASYNC TRANSMITTER
04	ASYNC MODEM
05	ASYNC TRANSMITTER
05	ASYNC MODEM
06	ASYNC TRANSMITTER
06	ASYNC MODEM
07	ASYNC TRANSMITTER
07	ASYNC MODEM

The priority scanner begins at the TOP following initialization. When a section is found that requires service, the scanner stops, the controller sets DONE, and sets Interrupt Request, if enabled. After the section is serviced and DONE cleared, the scanner either a) continues from where it left off if the section serviced was a receiver, or b) begins at TOP priority if the section serviced was a transmitter or modem. This method of scanning is used to more evenly distribute priority among the 8 receivers to ensure each line's performance and protection against receiver overrun errors.

5.1.3 INITIALIZATION

Generally, each line is initialized to operating parameters specified by the system. The board is placed off line by issuing a START or IORESET. Since all lines on the board are now off line, they should all be initialized together. While the board is BUSY, it has set its own default parameters to: Software RTS OFF, Hardware CTS ON, word length = 7 bits, even parity, 2 stop bits, and the baud rate specified by the default switches (Section 2.3.4). After all lines are set as desired, a CLEAR pulse will place the current board on line.

5.1.4 RECEIVER OPERATION

The receiver does all the conversion from the serial data stream to the CPU's parallel character format. When a character has arrived, a program interrupt is initiated (if interrupts and the receiver are enabled). The program then must execute a Data In A to determine which line requires service. If data bit 15 is a 1, a transmitter is requesting service. If 0, a receiver or modem section requires service, and a Data In C is then executed to determine which. A 0 in data bit 15 dictates the receiver has a character, and a 1 means a modem input signal has changed state. Receiver status is contained in bits 12-14 of the DIC, and modem status in bits 11-14. If, in fact, the receiver has a character, it can be read and the interrupt cleared by executing a Data In B w/Clear (DIBC MUX).

It should be noted that if a receiver buffer contains additional characters, the DIBC is required to shift the contents of the buffer one and generate another interrupt. To completely clear a buffer of its contents, the program must re-initialize by issuing a Start pulse or IORESET. If Hardware CTS is selected (section 2.3.3), the output signals will follow the status of the buffers; a buffer containing data produces a FALSE (-12V) on the line's RTS and an empty condition will return the CTS output TRUE (+12V).

5.1.5 TRANSMITTER OPERATION

The transmitters handle the serialization of data from the CPU to be sent to the serial devices. A transmitter will initiate a program interrupt if it is enabled, its transmit holding buffer is empty, its Clear To Send input signal is true and interrupts are enabled. When connected to a modem the transmitter will not set Done until the modem is ready and asserts Clear To Send.

A transmitter done condition is cleared by executing a Transmit Data instruction with a Clear pulse (DOBC MUX). The transmitter may be disabled by executing a Transmit Break instruction (DOB) to send all zeros. The break condition is cleared by transmitting another character.

5.1.6 MODEM OPERATION

The modem controls the handshaking and electrical interface to the phone lines. Modems generally provide four handshake input signals, "Data Set Ready", "Clear To Send", "Carrier Detect", and "Ring Indicator". The controller in turn provides to the modem the signals "Data Terminal Ready" and "Request To Send".

NOTE: FOR PROPER OPERATION WITH A MODEM, THE LINE'S "REQUEST TO SEND" OUTPUT SIGNAL MUST BE CONFIGURED FOR "SOFTWARE RTS". REFER TO SECTION 2.3.3.

Whenever the modem section of a line is enabled and an input signal has changed state or the input is active when the board goes from off line to on line, the Done flag will set. The status is read by the CPU via a Read Receiver Or Modem Status (DIC) instruction. If a NIOC is executed, the pending interrupt is cancelled. The two output signals, Data Terminal Ready and Request To Send, are used to tell the modem the controller's condition. They are controlled via a Set Modem Control Status (DOB) instruction. The DTR signal is controlled directly by bit 15. The RTS signal is controlled by bit 14 and may be turned on at any time, but will not turn off unless the transmitter has finished transmitting.

5.1.7 LOOPBACK (DIAGNOSTIC) MODE

Testing of the async lines is essential to ensure data integrity. Loopback provides the means of connecting the transmitter of a line to its receiver to test data flow. Loopback is controlled individually for each line via a Specify Line Characteristics (DOC) instruction.

5.2 4241 PROGRAM CONTROL

5.2.1 INSTRUCTION FORMAT

Symbolic Form For I/O Instructions

DXXF AC,MUX

DXX = DOA, DOB, DOC, DIA, DIB, DIC

F = Function: Start, Clear or Pulse (section 5.1.1)

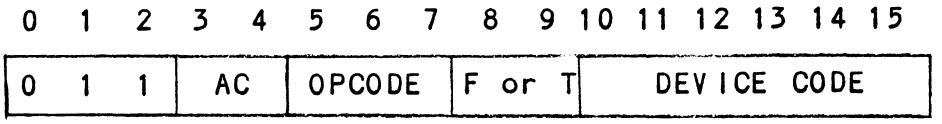
AC = Acumulator: 0,1,2, Or 3

MUX = Mnemonic - 4241 Emulating Line Multiplexor

Device Codes (octal): Primary = 34
Secondary = 44

Interrupt Mask Bit: 8

Binary Representation of Instruction:



"F" Field:

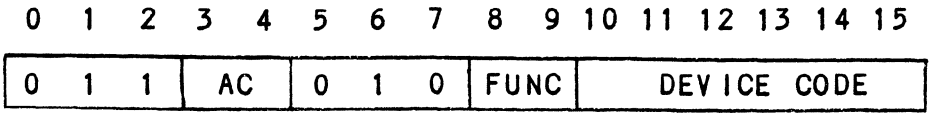
Function	Bit 8	Bit 9
Start	0	1
Clear	1	0
Pulse	1	1

"T" Field (w/opcode = 111):

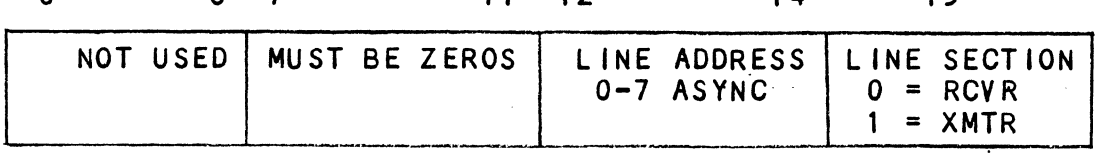
Test	Bit 8	Bit 9
SKPBN - Skip If Busy Is Set	0	0
SKPBZ - Skip If Busy Is Not Set	0	1
SKPDN - Skip If Done Is Set	1	0
SKPDZ - Skip If Done Is Not Set	1	1

5.2.2 SET LINE AND SECTION

DOAF AC,MUX

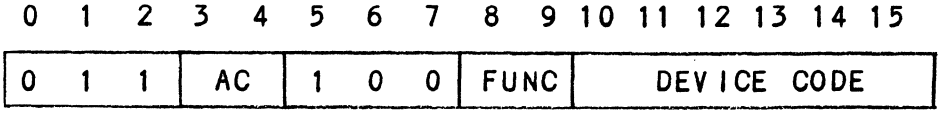


ACCUMULATOR:

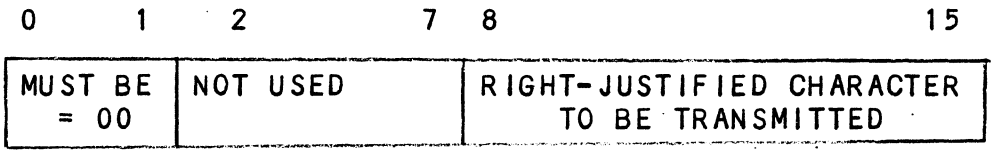


5.2.3 TRANSMIT DATA

DOBF AC,MUX

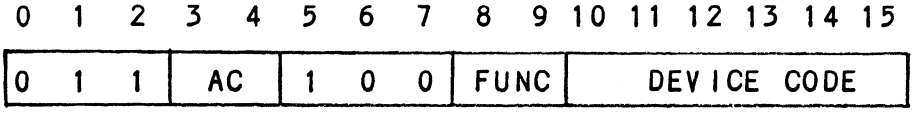


ACCUMULATOR:

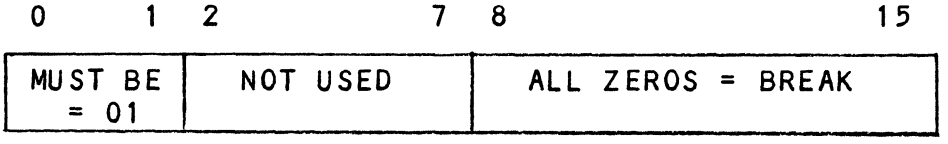


5.2.4 TRANSMIT BREAK

DOBF AC,MUX



ACCUMULATOR:



5.2.5 SET MODEM CONTROL STATUS

DOBF AC,MUX

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC		1	0	0	FUNC		DEVICE CODE					

ACCUMULATOR:

0	1	2	13	14	15
MUST BE = 10	NOT USED			RTS	DTR

RTS = REQUEST TO SEND
0 = OFF, 1 = ON

DTR = DATA TERMINAL READY
0 = OFF, 1 = ON

5.2.6 CONTROL LINE SECTION

DOCF AC,MUX

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC		1	1	0	FUNC		DEVICE CODE					

ACCUMULATOR:

0	1	2	3	6	7	8	9	14	15
MUST BE = 000	NOT USED		SEE BELOW		NOT USED				SEE BELOW

BITS 7-8: For diagnostic use; in on line mode, must be = 00; in off line mode, bit 7 = 1 will set Done flag and bit 8 = 1 will clear all timing logic.

BIT 15: Control Current Line/Section
0 = Disable, 1 = Enable

5.2.7 CONTROL MODEM SECTION

DOCF AC,MUX

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC		1	1	0	FUNC		DEVICE CODE					

ACCUMULATOR:

0	1	2	3	6	7	8	9	14	15
MUST BE = 001		NOT USED		SEE BELOW		NOT USED			SEE BELOW

BITS 7-8: For diagnostic use; in on line mode must be = 00, in off line mode bit 7 = 1 will set the Done flag and bit 8 = 1 will clear all timing logic.

BIT 15: Control Current Lines Modem Section:

0 = Enabled, 1 = Disabled

5.2.8 SPECIFY LINE CHARACTERISTICS

DOCF AC,MUX

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC					1	1	0	FUNC	DEVICE CODE			

ACCUMULATOR:

0	1	2	4	5	8	9	10	11	12	13	14	15
MUST BE = 10		NOT USED		BAUD RATE		STOP BITS		WORD LENGTH		PARITY		LOOP-BACK

BITS 5-8 - BAUD RATE:

0000 - Not Used	1000 - 9600
0001 - 19,200	1001 - 4800
0010 - Not Used	1010 - Not Used
0011 - 75	1011 - 1200
0100 - Not Used	1100 - 2400
0101 - Not Used	1101 - 300
0110 - 600	1110 - 150
0111 - 2400	1111 - 110

BITS 9-10 - STOP BITS:

00 - 1 Stop Bit
01 - 2 Stop Bits
10 - Not Used
11 - Not Used

BITS 11-12 - WORD LENGTH:

00 - 5 Bits (1 or 1-1/2 Stop Bits Only)
01 - 6 Bits
10 - 7 Bits
11 - 8 Bits

BITS 13-14 - PARITY:

00 - No Parity
01 - Odd Parity
10 - Even Parity
11 - Not Used

BIT 15 - LOOPBACK: 0 = Disabled, 1 = Enabled

5.2.9 READ LINE AND SECTION REQUESTING SERVICE

DIAF AC,MUX

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC		0	0	1	FUNC			DEVICE CODE				

ACCUMULATOR:

0	...	10	11	...	14	15
NOT USED			LINE ADDRESS 0-7 ASYNC			SECTION: 0=RCVR OR MODEM 1= TRANSMITTER

5.2.10 RECEIVE DATA

DIBF AC,MUX

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC		0	1	1	FUNC			DEVICE CODE				

ACCUMULATOR:

0	...	7	8	...	15
NOT USED			RIGHT-JUSTIFIED RECEIVED DATA		

5.2.11 READ RECEIVER OR MODEM STATUS

DICF AC,MUX

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC		1	0	1	FUNC			DEVICE CODE				

ACCUMULATOR (FOR RECEIVER STATUS; BIT 15 = 0):

0	...	15
--- SEE FOLLOWING ---		0

BITS 0-6 - Not Used

BIT 7 - In Off Line Mode, Bit 7 = the state of Receiver Clock 0.

BITS 8-11 - Not Used

BIT 12 - Framing Error = 1

BIT 13 - Parity Error = 1

BIT 14 - Overrun Error = 1

BIT 15 - A 0 Indicates Accumulator = Receiver Status

ACCUMULATOR (FOR MODEM STATUS; BIT 15 = 1)

BITS 0-6 - Not Used

BIT 7 - In Off Line Mode, Bit 7 = the state of Receiver Clock 0.

BIT 8-10 - Not Used

BIT 11 - Carrier Detect - 0 = Off, 1 = On

BIT 12 - Clear To Send - 0 = Off, 1 = On

BIT 13 - Data Set Ready - 0 = Off, 1 = On

BIT 14 - Ring Indicator - 0 = Off, 1 = On

BIT 15 - A 1 Indicates Accumulator = Modem Status

NOTE: Status information is irrelevent if the Current Line Section is a Transmitter or if the Current Line Section was set with a Set Line and Section instruction rather than a Read Line and Section Requesting Service instruction.