Model SS-264

Slot Saver IV Controller

Technical Manual

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NOTICE

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If installation problems arise after you thoroughly review the manual, please contact the ZETACO Customer Support Hotline at (612) 941-9480.

REVISION HISTORY

ECO No.	Date	Description	Pages
0160	7/21/83	Typo's	
0172	8/8/83	Per ECO	2-6
0328	6/28/84	New ZETACO Cover	
0523	3/4/86	New Cover	
0701	9/30/86	Replace jumpers with switches to the Distribution Panel	4-13,4-14, 5-15

This Manual describes the two available Models of the Custom Systems, Inc. Model 26X Slot Saver IV.

Model 264 contains the following controllers:

1) Serial Port
2) Real Time Clock
3) Parallel Line Printer
4) Eight Channels of QTY Multiplexer

Model 262 contains the following controller:

1) Eight Channels of QTY Multiplexer

When this Manual is used with the Model 262, the referencing of the additional controllers in the Manual, Logic Schematics and Diagnostics are not applicable.

CUSTOMER SERVICE

Our warranty attests the quality of materials and workmanship in our products. If a malfunction does occur, our service personnel will assist you in any way possible. If the difficulty cannot be eliminated by use of the following service instructions and technical advise is required, please telephone the Custom Systems' Engineering Department (612-941-9480) giving the serial number, board name, model number and problem description. You will be placed in contact with the appropriate technical assistance.

PRODUCT RETURN

Pre-return Checkout.

If a controller malfunction is suspected, the use of test software is needed to determine if the controller is the problem and what in particular is wrong with the controller. The tests applicable to this board are listed on the next page of the manual. Please run the test sequence BEFORE considering product return.

Returned Material Authorization.

Before returning a product to Custom Systems for repair, please ask our Engineering Secretary for a "Returned Material Authorization" number. Each product returned requires a separate RMA number. Use of this number in correspondence and on a tag attached to the product will ensure proper handling and avoid unnecessary delays.

Returned Material Information.

Information concerning the problem description, system configuration, diagnostic program name, revision level, and results, i.e., error program counter number should be included with the returning material. A form is provided for this information on the next page of the manual.

Packaging.

To safeguard your materials 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 malfunction controller should be made before returning the controller to Custom Systems, Inc. for repair. This will: 1) Determine if in fact the board is defective (many boards returned for repair are not defective, causing the user unnecessary system down-time, paperwork and handling while proper testing would indicate the board is working properly). 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. Checkout results for the Slot Saver IV should be obtained by performing the following tests. (Include error program counter numbers and accumulator contents if applicable).

FUNCTION	TEST	RESULTS
Serial Port	GNSTP	
Real Time Clock	RTCD	
Line Printer	LPTD	
MUX	QTYDR	

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, DDOS, DTOS.)

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 #:

Returned by:

(company name)

TABLE OF CONTENTS

1.0 INTRODUCTION

This technical manual contains the information required to install, operate and maintain the Custom Systems, Inc. Model 264 Multipurpose Controller. The Controller is compatible with the Data General (Nova or Eclipse) minicomputers or Data General emulating computers.

This manual is organized in eight sections. Section I contains general information about the functional and physical characteristics of the Controller. Section II contains installation information. Section III contains programming details. Section IV contains option jumpers and switch settings required to configure the various controllers. Section V contains quick maintenance and trouble shooting helps. Section VI lists the interface Signals, I/O Pin Assignments and Distribution Panel Cabling Section VII contains diagnostic programs and listings. Section VIII contains the logic drawings.

1.1 GENERAL

Physically, the Controller comprises logic contained on a 15" x 15" printed circuit board suitable for installation in one slot of a Data General, or equivalent, computer chassis. Electrically, the Controller may contain the following interfaces:

A. Eight, asynchronous, full duplex communications channels for local/remote terminals or 103 data sets.

B. A parallel line printer interface to a Data Products, Centronics, Printronix, General Electric, Control Data and other manufacturers of parallel line printers.

C. A programmable Real Time Clock with selectable frequencies of AC line, 10 Hz, 100 Hz or 1000 Hz.

D. A Serial I/O Channel.

E. The Model 264 can be populated to the Custom Systems' Model 262. The Model 262 contains only the eight asynchronous communications channels.

Connection between the controllers on the board and external equipment is via 1) a cable harness for the communication multiplexer channels and the teletype and 2) a 20 foot cable for the line printer. The Real Time Clock is not connected to an external device. The communication multiplexer cable harness terminates at the computer end in a printed circuit board connector that plugs over the pins of the backpanel. The line printer cable terminates at the computer end in an amphenol block. At the device end the mutiplexer cable harness terminates in DB25 type connectors mounted on a panel suitable for mounting in the rear of a RETMA rack. The nine pin teletype connector is also on the RETMA panel. The line printer cable terminates at the printer end in a connector compatible with the connector on the line printer.

1.2 SPECIFICATIONS

The following are the physical and electrical specifications for the multipurpose controller:

PHYSICAL	One 15" x 15" printed circuit board that plugs into one slot of a Data General NOVA series 1200, 2, 3, 4 or Eclipse computer.
POWER	+5 volts at .0 Amps. +15 volts at .2 Amps. -5 volts at .2 Amps. All from computer power supply.
MAXIMUM INTERFACE CONFIGURATION ON ONE BOARD	A. 8 asynchronous communications channels. B. 1 parallel line printer interface. C. 1 Real Time Clock. D. 1 Serial I/O channel.
ENVIRONMENT	0 to 55 C operating. To 90% relative humidity, non-condensing, operating.
WEIGHT	8 pounds includes mounting panel and manual.

DEVICE INTER-CONNECT	A. Cable harness that terminates at "plug-over" connectors at computer backplane and at DB25 connectors mounted on a bracket suitable for mounting rails on a RETMA cabinet. This harness brings the communications channels and the teletype channel to the rack mounted panel. B. A 20 foot cable connects the printer interface to a selected line printer.
ASYNCHRONOUS	Up to 8 full duplex channels on the Controller board; multiple boards can be used in a computer system. Eight switch-selectable baud rates per channel (110, 300, 600, 1200, 2400, 4800, 9600 and 19200). Byte configuration switch-selectable on a per-channel basis are: a. bits per word (5 - 8). b. type of parity (even, odd or none). c. 1, 1-1/2 or 2 stop bits per character.

	Selectable on a per-channel basis via switches for either RS232 or 20 ma current loop. Software compatible with the Data General 4060 multiplexer.
	Device code 30_8 standard, device code 70_8 jumper selectable. Interrupt mask bit 14.
REAL TIME CLOCK	Program selectable frequencies of AC line, 10 Hz, 100 Hz, 1000 Hz. Software compatible with Data General 4008 Real Time Clock.
	Device code 14_8 standard, device code 54_8 jumper selectable. Real Time Clock can be disabled via a jumper. Interrupt mask bit 13.
LINE PRINTER CONTROLLER	Compatible with Data Products Centronics, and other popular manufacturers of line printers. Full ASCII parallel interface.
	Device code 17_8 standard, device code 57_8 jumper selectable. Interrupt mask bit 12, or mask bit 6.

SERIAL DEVICE CONTROLLER	Eight position switch to select baud rates from 110 baud to 19,200 baud. Switch selectable to be either 20 ma current loop or RS232-C. Device code 10/11 standard. 2^8 Any device code can be jumper selectable. Interrupt mask bit 15 (TTY out), 14 (TTY in). If used to support a Serial Line Printer the interrupt mask can be jumper selectable to be mask bit 12, or mask bit 6.

2.0 INSTALLATION

This section contains installation instructions for the Controller. Details of the installation or operation of an associated line printer or terminal will be found in an instruction manual associated with the respective device.

2.1 UNPACKING AND INSPECTION

All parts comprising the Model 264 are shipped in one package consisting of:

a) Controller

b) Line Printer Cable

c) Communications Panel and associated Cabling

d) Diagnostic Software

e) Technical Manual

On receipt of the Model 264 from the carrier, inspect the shipping 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, specifying the nature and extent of the damage and request that the carrier agent be present when the carton is opened.

Custom Systems' warranty does not cover shipping damage.

For repair or replacement of any Custom Systems' product damaged in shipment, call Custom Systems to obtain return authorization instructions.

2.2 BOARD INSTALLATION

To install the Controller, perform the following steps in the order listed:

1. Remove the Controller printed circuit board, cable assemblies and manuals from the packing carton.
2. Verify that the computer power is off. Do not insert or remove the board with power on.
3. Reference Section IV (Board Switch and Jumper Options) to ensure the switch and jumper options selected match your requirements.
4. Select a board slot into which the controller is to be plugged; the controller can be plugged into any unused I/O slot in the computer chassis.
   Once the slot to insert the board has been selected, the interrupt and data channel priority pins A94 and A96 on the computer backplane should come from the card below it. If there isn't any card below it, A94 and A96 should be jumpered to A93 and A95, respectively, of the first active slot below it.
5. The board should be carefully inserted into the proper slot in the computer with the locking tabs extended. If the card is properly seated in the track, very little pressure is required to seat the board in the edge plane connectors. The card should be removed and the alignment checked if resistance to seating is observed.

6. Cable installation. Electrical connections between the Slot Saver IV controller board and peripheral equipment located outside the minicompuer chassis are made with external cable assemblies to the backplane of the computer.

For each controller card slot, there are two horizontal parallel rows of 100 pins on the back-plane. 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. Numbering of each group of 100 pins is as indicated below (shown only for A connector).

BACK PANEL 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

Pin 1 is on the top left of the connector; pin 2 is on the bottom left directly below pin 1. Pin 99 is the top right pin of the connector, and pin 100 is the bottom right.

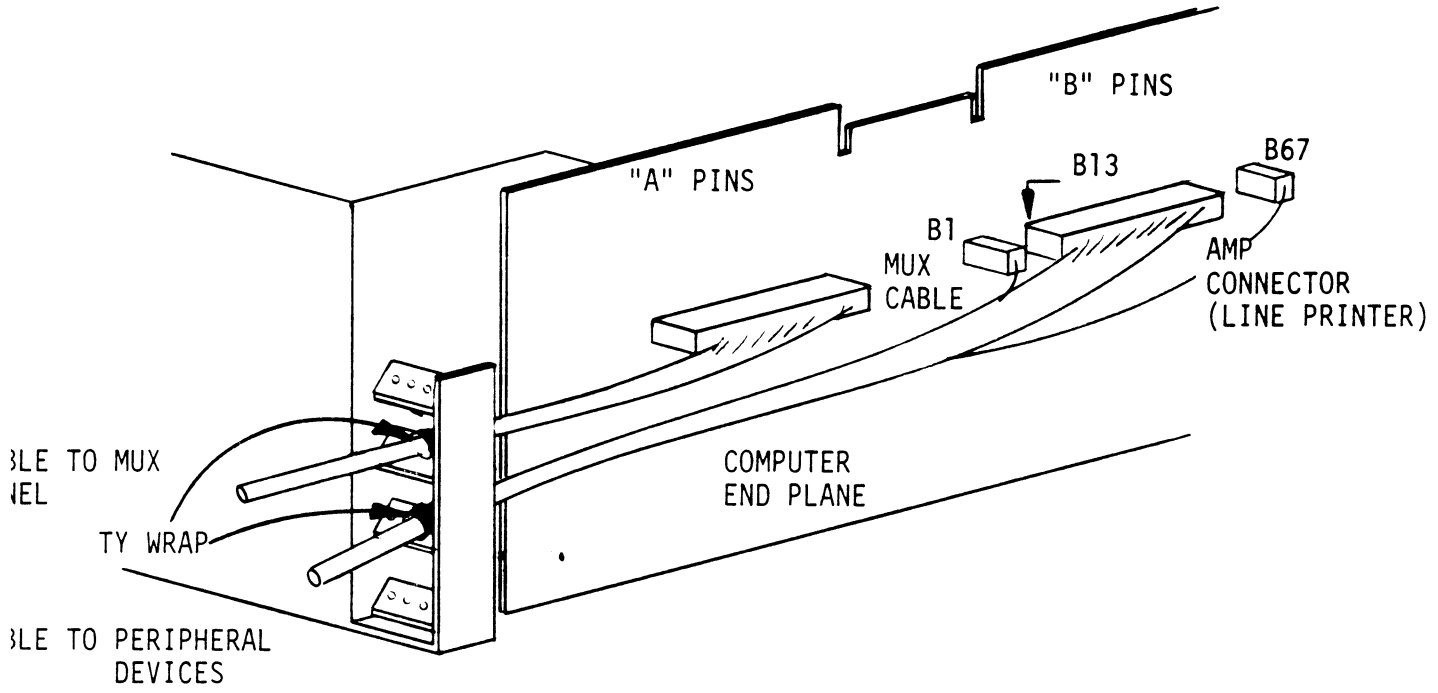
ASYNCHRONOUS MULTIPLEXER CABLING. Plug the printed circuit connector over the pins of the backplane connectors. The mux harness cable plugs over the pins on the "A" side connector covering pins 47 through 99. Be sure to connect to the pins of the same connector slot and not to one half of the pins of two adjacent connector slots. (See Figure 2.1).

LINE PRINTER CABLING. Plug the amphenol connector over the pins of the backplane connectors. The line printer cable plugs over the "B" side covering pins 13 through 51 with single plugs at B1 and B67. (See Figure 2.1)

7. Press connectors toward the backplane until fully seated. When fully seated, the I/O connector assembly should be flush against the backplane.
8. Mount connector panel to RETMA rails at the rear of the rack into which the computer is installed.
9. Connect printer connector to the printer.
10. Power may now be applied to the computer.

NOTES

A. AC power for the Real Time Clock may not be wired to the slot selected for the controller. The Real Time Clock requires a source of AC to develop one of the frequencies. To wire AC to the controller board, connect pin B-6 of the normal Teletypewriter slot to pin B-6 of the slot into which the board is plugged. (Customer has to provide this wire).



TYPICAL PERIPHERAL CABLE ASSEMBLIES

FIGURE 2.1

B. If the serial port is to be used as the primary console (10/11) the controller should use the slot allocated for the teletype, i.e., NOVA 1200, NOVA 2 or NOVA 3/4 use slot 3, NOVA 800 or NOVA 3/12 use slot 4. Two wires on the harness are terminated on the computer end using box pins, one red wire and one yellow wire. If the standard I/O slot is used for the controller, the red wire is to be connected to the wire wrap pin on the computer backpanel at pin A101. The yellow wire is to be connected to the wire wrap pin on the computer backpanel at pin A103. If a slot other than the standard I/O slot is to be used for the controller, the red wire must be connectd to pin B69 of the slot used and the yellow wire connected to either pin A6 or B81, these pins are -5 volts (A6 and B81). The black wire is Clear to Send and should be connected to B11 of the computer backpanel. If Clear to Send is not needed do not install the black wire.

3.0 PROGRAMMING

All device interfaces on the controller operate under program control. This section contains the information required to program the computer to process information through the communications multiplexer channels, provide data to the line printer, provide data to and accept data from the serial port and set the frequency of the Real Time Clock.

3.1 REAL TIME CLOCK

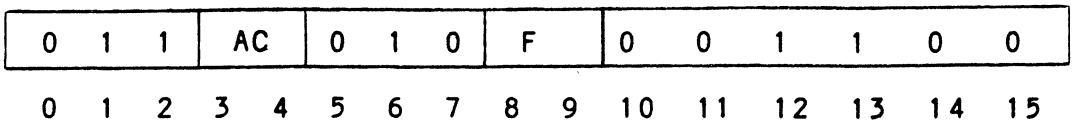
The Real Time Clock (RTC) generates a sequence of pulses that are independent of processor timing. It uses only one I/O transfer instruction to set the RTC frequency. Busy and Done flags are controlled or sensed by bits 8 and 9 in all I/O transfer instructions with device code 14_8 (Jumper Selectable), mnemonic RTC. Interrupt disable is controlled by interrupt priority mask bit 13. The frequencies that may be selcted are as follows:

1. AC line frequency (60 or 50 Hz)
2. 10 Hz
3. 100 Hz
4. 1000 Hz

The following is the configuration of the transfer instruction for the RTC:

DATA OUT A, REAL TIME CLOCK

DOA -, RTC



Perform the function specified by F and select the clock frequency as defined by AC bits 14 and 15 as follows:

AC BITS 14	15	FREQUENCY
0	0	AC line frequency (60 or 50 Hz)
0	1	10 Hz
1	0	100 Hz
1	1	1000 Hz

Setting Busy allows the next pulse from the RTC to set Done, requesting an interrupt if interrupt disable is clear. A DOA to select the frequency need be given only once; following each interrupt an NIOS sets up the clock for the next pulse.

When Busy is first set, the first interrupt can come at any time up to the clock period. But once one interrupt has occurred, further interrupts are at the clock frequency, provided that the progrm always sets Busy before the next clock period expires.

RTC is used primarily for low resolution timing (compared to processor speed) but it has high long-term accuracy. Power up and the I/O reset function generated by the program or from the console reset the clock to line frequency.

3.2 LINE PRINTER

The line printer interface provides parallel-by-bit, serial-by-character data to either line or character printers with interfaces equivalent to either the Data Products or Centronics printers. The printing speed is a function of the printer chosen for use with the interface; the interface has no inherent speed limitations. Functionally, the printer interface buffers data between the computer I/O bus and the input of the printer, synchronizes the character transfers to the printer and transfers status information from the printer to the computer I/O bus.

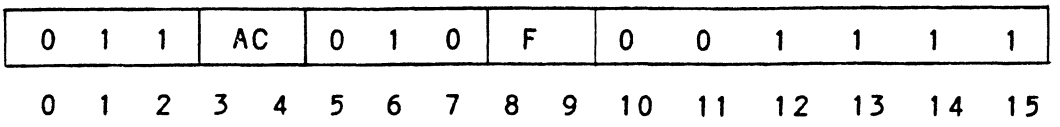
Normally 64 character set printers are used in systems. Therefore, logic within the interface converts the codes for lower case characters to the equivalent upper case character codes. This feature can be disabled by adding jumper J9-1 on the controller board.

The line printer interface uses two I/O transfer instructions, one to load a single character into an eight-bit buffer in the interface, the other to read status from the printer. Busy and Done flags are controlled or sensed by bits 8 and 9 in all I/O instructions with device code 17_8 (Jumper Selectable), mnemonic LPT. Interrupt is controlled by interrupt mask bit 12_8, or mask bit 6.

The following are the configurations of the I/O transfer instructions for the printer:

DATA OUT A, LINE PRINTER

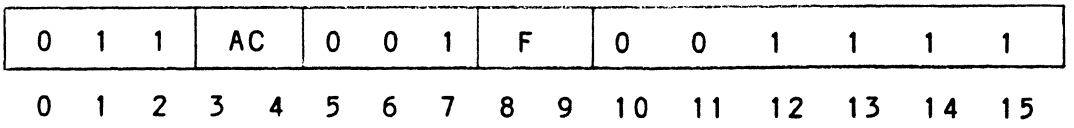
DOA -, LPT



Load AC bits 8 - 15 into the interface character buffer and perform the function specified by F.

DATA IN A, LINE PRINTER

DIA -, LPT



Read the Ready status into AC bit 15, clear AC bits 0 - 1 and perform the function specified by F. A 1 bit read into AC bit 15 indicates the printer is available to the program (i.e., it is on-line with power on and with paper loaded).

At the beginning of a print operation the program should check Ready and send a form feed to get rid of anything that may have been left in the buffers, then start a new page. The program begins operation by issuing DOA's that send the desired characters. A Start command sets the Busy flag and sends the character in the controller buffer to the printer. If the character sent neither fills the printer buffer nor is a valid control character, the printer acknowledge signal clears the Busy flag and sets Done. The program can then send additional characters. When either the printer buffer is full or the control character is detected, the busy flag remains set while the printer prints the contents of the printer buffer. When the buffer again becomes available, Busy clears and Done sets. This requests an interrupt if interrupt disable is clear and subsequent received characters will be loaded starting in the first buffer position.

3.3 TELETYPEWRITER

The TTY separates the input and output functions into two distinct devices, each with its own device code, its own Busy, Done and Interrupt flags and its own interrupt mask assignment.

Placing a character code in the output buffer and setting Output Busy causes the TTO to print the character or perform the designated control function. Striking a key places the code for the associated character in the input buffer of the TTI for retrieval by the program.

3.3.1 SERIAL PORT OUTPUT

The TTO output uses only one I/O transfer instruction. Output Busy and Done are controlled or sensed by bits 8 and 9 in all I/O instructions with device code 11-8 (Jumper Selectable) mnemonic TTO. Output interrupt disable is controlled by interrupt mask bit 15, mask bit 12 or mask bit 6. The configuration of the instruction is as follows:

DATA OUT A, TELETYPE OUTPUT

DOA -, TTO

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

Load the contents of AC bits 8 - 15 into the teletype output buffer and perform the function specified by F. Setting Output Busy turns on the transmitter, causing it to send the contents of the output buffer serially to the Serial Device (the buffer is cleared during transmission). The printer prints the character or performs the indicated control function. Completion of transmission clears output Busy and sets output Done, requesting an interrupt if output interrupt disable is clear.

Do not give an NIOS without first loading the buffer. To transmit any character, including null, either give a DOAS or give a DOA followed by an NIOS. Clearing output Busy while the transmitter is running (as with an NIOC) terminates the transmission. But the printer still prints whatever character is represented by the indeterminate code it receives.

A carriage return and a line feed must be given to position the printer at the beginning of a new line.

3.3.2 SERIAL DEVICE INPUT

The TTI input uses only one I/O transfer instruction. Input Busy and Done are controlled or sensed by bits 8 and 9 in all I/O instructions with device code 10, (Jumper Selectable) mnemonic TTI. Input interrupt disable is controlled by interrupt mask bit 14. The configuration of the transfer instruction is as follows:

DATA IN A, TELETYPE INPUT

DIA -, TTI

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

Transfer the contents of the input buffer into AC bits 8 - 15 and perform the function specified by F.

Reception from the keyboard requires no initiating action by the program; striking a key transmit the code for the character serially to the input buffer. The completion of reception clears input Busy (if set) and sets input Done, requesting an interrupt if input interrupt disable is clear.

After Done sets, the character is available for retrieval by a DIA.

3.4 ASYNCHRONOUS COMMUNICATIONS MULTIPLEXER

Each communications multiplexer board may have up to eight full duplex channels for the simultaneous serial transmission and reception of data at selectable speeds and character configurations. The computer software will handle a total of 64 channels of communications (eight boards). Each channel within a system operates simultaneously and independently of each other channel.

The serial manipulation of the data is done by the channels; the computer program is involved only in moving parallel characters to or from the communications system via the I/O bus. To transmit data the program outputs a word that specifies the channel and supplies the characters. To receive data the program responds to a "System Done Interrupt" then reads a word that contains both the data character and the number of the channel on which the character was received.

The characteristics of the individual terminals connected to the system are selected by switches or jumpers within each channel. Selectable characteristics on an individual channel basis are as follows:

1. Selection of either RS232-C or 20 ma current loop, input/output.
2. Selection of one of eight baud rates from 110 to 19200 baud.
3. Selection of 5, 6, 7 or 8-bits per data character.
4. Selection of even, odd or no parity.
5. Selection of 1, 1 1/2 or 2 stop bits in each character.

The entire system (a maximum of 64 full duplex channels) appears as one device to the program with one Done flag (no Busy flag). Internally a Receive flag and a Transmit flag are associate with each channel. The Receive flag is set when a character has been assembled from the serial input stream; the Transmit flag is set when the terminal has accepted one character and is ready to accept another character. The individual channel Receive and Transmit flags are OR-ed to generate a system Done. Therefore, to the program, Done appears set either if any receive lines have completely assembled characters ready for transfer to the computer or if any transmit lines have transmitted a character and are ready for a new character from the computer. I/O Reset clears all Transmit and Receive flags.

When multiple boards are used in a computer, channel priority lines must be wired from board to board. The entire system responds as a single unit to the INTA instruction. The multiplexer uses three I/O instructions, one for input and two for output with device code 30_8 (Jumper Selectable), mnemonic QTY. The interrupt mask bit is 14_8.

The DIAC reads input characters, determines the address of the highest priority channel to be read and clears the Receive flag of the line when it is read. Upon issuance of a DIAC, system Done will be cleared if there are no other lines with data assembled to be read and if all Transmit flags are cleared.

A DOA instruction supplies a character for output on an addressed line and clears the Transmit flag for that line. If no new character is to be output, a DOB instruction is used to clear the Transmit flag without sending a new character.

Busy and Done are sensed by bits 8 and 9 in the I/O skip instructions. The Clear function is used only to clear received flags with the input instruction. Start is not used.

Following are the configurations of the instructions for the multiplexer:

DATA IN A, ASYNCHRONOUS MULTIPLEXER

DIAC -, QTY

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

Read the information from the multiplexer into AC as follows and clear the Receive Done Flag;

RCVR READY	XMIT READY	CHANNEL #	CHARACTER

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

BIT DESCRIPTION

0 The receiver for the channel specified by bits 2 - 7 has assembled a right-justified character in bits 8 - 15. The instruction clears the Receiver flag for the channel specified by bits 2 - 7.

1 The transmitter for the channel specified by bits 2 - 7 has moved a character from its shift register and is free to receive a new character.

2-7 The number of the highest priority channel that has either a Transmit or Receive Ready flag set.

8-15 If bit 0 is a 1, these bits contain the right-justified data part of a character just received by the channel specified by bits 2 - 7.

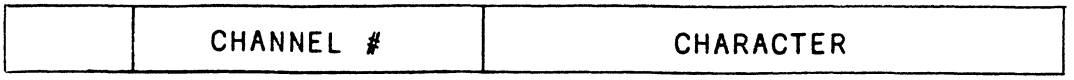
DATA OUT A, ASYNCHRONOUS MULTIPLEXER

DOA -, QTY

0 1 1	AC	0 1 0 0 0 0 1 1 0 0 0

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

Load the contents of AC bits 8 - 15 into the transmitter buffer and clear the XMTR Ready flag for the channel specified by AC bits 2 - 7.

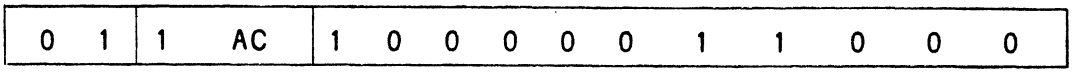


0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

BITS	DESCRIPTION
2-7	The channel through which data is to be transmitted.
8-15	The data to be transmitted, right justified.

DATA OUT B, ASYNCHRONOUS MULTIPLEXER

DOB -, QTY



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

Clear the XMTR Ready flag for the channel specified by AC bits 2 - 7.

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

BITS	DESCRIPTION
2-7	Clear the XMTR Ready flag in the channel specified by bits 2 - 7.

4.0 OPTION JUMPERS

This Section contains the jumper and switch settings required to configure the controller for each of the devices available on the board. The jumper and switch setting options are in paragraphs for ease in locating the jumpers associated with a specific device. Note that the jumper/switch locations are also referenced to sheets of the logic diagrams. Also reference jumper sheet option page in logic schematics to further ease jumper and switch physical locations on the board.

4.1 SERIAL PORT

A. Device Code Selection.

The device code for the serial port is usually set at 10/11. For special applications, other device codes may be used. The device code is determined by five hard wire jumpers J4-1 through J4-5 (sheet 4). The table provides a guide to selecting non-standard device codes.

DEVICE CODE SELECTION TABLE

DEVICE	J4-1 (DS0)	J4-2 (DS1)	J4-3 (DS2)		J4-4 (DS3)	J4-5 (DS4)
0X	IN	IN	IN	X0+1	IN	IN
1X	IN	IN	OUT	X2+3	IN	OUT
2X	IN	OUT	IN	X4+5	OUT	IN
3X	IN	OUT	OUT	X6+7	OUT	OUT
4X	OUT	IN	IN			
5X	OUT	IN	OUT			
6X	OUT	OUT	IN			
7X	OUT	OUT	OUT			

Jumper OUT = 1 bit; Jumper IN = 0 bit.

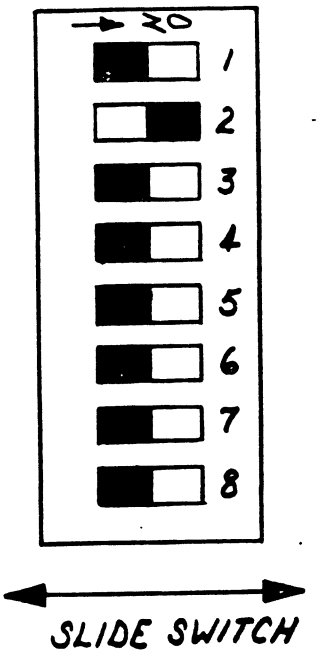
B. Disable Serial Port

JUMPER	STATUS	SHEET	PURPOSE
J4-6	IN	4	Disable Serial Port
J4-6	OUT	4	Enable Serial Port

C. Baud Rate Selection

Baud Rates for the Serial Device are selectable by a switch at Location U9. Only one switch position can be in the "ON" position and that must correspond to the desired baud rate.

LOCATION U9

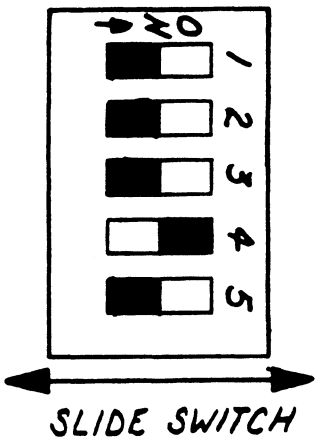


Switch 1 ON - 19200 Baud
Switch 2 ON - 9600 Baud
Switch 3 ON - 4800 Baud
Switch 4 ON - 2400 Baud
Switch 5 ON - 1200 Baud
Switch 6 ON - 600 Baud
Switch 7 ON - 300 Baud
Switch 8 ON - 110 Baud

9600 BAUD SHOWN

D. UART Characteristics

LOCATION U12

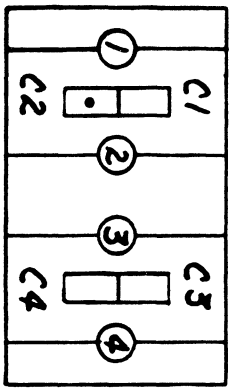


	ON	OFF	
Switch 1	Odd Parity	Even Parity	
	SW2	SW3	BITS/WORD
Switch 2 & 3	ON	ON	5
	OFF	ON	6
	ON	OFF	7
	OFF	OFF	8
Switch 4	1 Stop Bit	2 Stop Bits	
Switch 5	Enable Parity	Inhibit Parity	

Even Parity, 8 Bit Character, 1 Stop Bit, Inhibit Parity Shown

E. RS232 or 20 ma

LOCATION T8



ROCKER SWITCH

Switch Depressed toward C1 = 20 MA

Switch Depressed toward C2 = RS232-C

NOT USED

RS232-C SHOWN

F. Mask Bit Selection

The following Jumpers are Jumper Pairs, only one of the Jumpers can be installed at a time.

	JUMPER	STATUS	SHEET	PURPOSE
Jumper Pair	J3-3	IN	3	Mask TTO Bit 15
	J3-4	IN	3	Mask TTO Bit 6

G. Serial Line Printer

The Serial Port can support communications to a serial line printer. The following jumpers are applicable for jumper pairs, only one of the jumpers can be installed at a time.

	JUMPER	STATUS	SHEET	PURPOSE
Jumper Pair	J4-8	IN	4	Disable TTI
	J4-7	IN	4	Enable TTI
Jumper Pair	J6-2	IN	6	Mask Bit 12
	J6-1	IN	6	Mask Bit 15 or Bit 6
Jumper Pair	J6-3	IN	6	Enable TTI INT REQ
	J6-4	IN	6	Disable TTI INT REQ

4.2 REAL TIME CLOCK

A. Device Code Selection

	JUMPER	STATUS	SHEET	PURPOSE
Jumper Pair	J7-1	IN	7	Select Device 14-8
	J7-2	IN	7	Select Device 54-8
	J7-5	IN	7	INTA 54-8
	J7-5	OUT	7	INTA 14-8

B. RTC Selection

	JUMPER	STATUS	SHEET	PURPOSE
Jumper Pair	J7-3	IN	7	Disable RTC
	J7-4	IN	7	Enable RTC

C. Clock Frequency Selection

JUMPER	STATUS	SHEET	PURPOSE
J7-6	IN	7	Data 15 always Zero
J7-6	OUT	7	Normal Clock Select
J7-7	IN	7	Data 14 always One
J7-7	OUT	7	Normal CLK Select

4.3 PARALLEL LINE PRINTER

(For Jumper Pairs, only one of the Jumpers can be installed at a time).

A. Device Code Selection

	JUMPER	STATUS	SHEET	PURPOSE
Jumper Pair	J8-1	IN	8	Select Device 17-8
	J8-2	IN	8	Select Device 57-8
Jumper Pair	J8-5	IN	8	INTA 17-8
	J8-6	IN	8	INTA 57-8

B. Printer Disable

	JUMPER	STATUS	SHEET	PURPOSE
Jumper Pair	J8-3	IN	8	Enable LPT
	J8-4	IN	8	Disable LPT

C. Status and Strobe Polarity

	JUMPER	STATUS	SHEET	PURPOSE
	J8-7	IN	8	Install if only one Status Line from printer
	J8-8	IN	8	Status Line is +3V Active
	J8-8	OUT	8	Status Line is 0V Active
Jumper Pair	J8-10	IN	8	Printer Select Status
	J8-11	IN	8	Clear to Send Status
	J8-9	IN	8	Status Line is +3V Active
	J8-9	OUT	8	Status Line is 0V Active
Jumper Pair	J10-3	IN	10	Strobe is 0V Active (Centronics)
	J10-4	IN	10	Strobe is +3V Active (Data Products)
	J10-5	IN	10	Printer Data is +3V Active
	J10-5	OUT	10	Printer is 0V Active

D. Miscellaneous Printer

	JUMPER	STATUS	SHEET	PURPOSE
	J8-12	IN	8	Disable Busy/ Done Interrupt
	J9-1	IN	9	Both Upper and Lower Case
	J9-1	OUT	9	Lower Case converted to Upper Case
	J10-1	IN	10	No LF to CR conversion
	J10-1	OUT	10	Convert LF to CR
Jumper	J3-1	IN	3	Select Mask Bit 12
Pair	J3-2	IN	3	Select Mask Bit 6

4.4 EIGHT CHANNEL MULTIPLEXER

(For Jumper Pairs, only one of the Jumpers can be installed at a time).

A. Device Code Selection

JUMPER	STATUS	SHEET	PURPOSE
J11-2	OUT	11	Select Device Code 30-8
J11-2	IN	11	Select Device Code 70-8

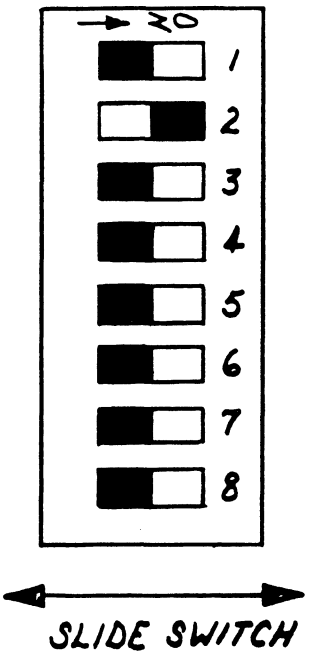
B. Line Selection

J18-3	J18-2	J18-1	RESULTS
OUT	OUT	OUT	Lines 0 thru 7
IN	OUT	OUT	Lines 8 thru 15
OUT	IN	OUT	Lines 16 thru 23
IN	IN	OUT	Lines 24 thru 31
OUT	OUT	IN	Lines 32 thru 39
IN	OUT	IN	Lines 40 thru 47
OUT	IN	IN	Lines 48 thru 55
IN	IN	IN	Lines 56 thru 63

C. Baud Rate Selection

Baud rate for each channel of the multiplexer are switch selectable.

Channel 0 - Switch Position B9
Channel 1 - Switch Position D9
Channel 2 - Switch Position F9
Channel 3 - Switch Position H9
Channel 4 - Switch Position K9
Channel 5 - Switch Position M9
Channel 6 - Switch Position P9
Channel 7 - Switch Position S9

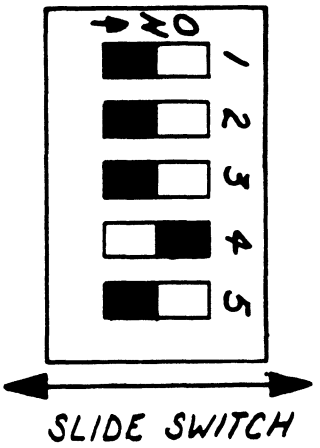


Switch 1 ON - 19200 Baud
Switch 2 ON - 9600 Baud
Switch 3 ON - 4800 Baud
Switch 4 ON - 2400 Baud
Switch 5 ON - 1200 Baud
Switch 6 ON - 600 Baud
Switch 7 ON - 300 Baud
Switch 8 ON - 110 Baud

9600 Baud Shown

D. UART Characteristics

Channel 0 - Switch Location B11
Channel 1 - Switch Location D11
Channel 2 - Switch Location F11
Channel 3 - Switch Location H11
Channel 4 - Switch Location K11
Channel 5 - Switch Location M11
Channel 6 - Switch Location P11
Channel 7 - Switch Location S11



	ON	OFF	
Switch 1	Odd Parity	Even Parity	
	SW2	SW3	BITS/WORD
Switch 2 & 3	ON	ON	5
	OFF	ON	6
	ON	OFF	7
	OFF	OFF	8
Switch 4	1 Stop Bit	2 Stop Bits	
Switch 5	Enable Parity	Inhibit Parity	

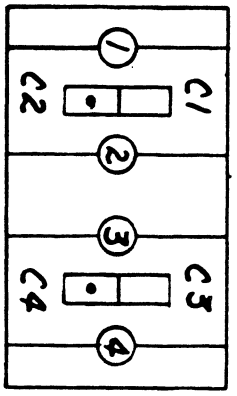
Even Parity, 8 Bit Character, 1 Stop Bit, Inhibit Parity Shown

E. RS23-C or 20 ma

Channel 0 - Switch Location C8
Channel 1 - Switch Location C8
Channel 2 - Switch Location G8
Channel 3 - Switch Location G8
Channel 4 - Switch Location L8
Channel 5 - Switch Location L8
Channel 6 - Switch Location R8
Channel 7 - Switch Location R8

Switch Depressed toward C1 or C3 = 20 MA

Switch Depressed toward C2 or C4 = RS232-C



ROCKER SWITCH

Even Line Number

Odd Line Number

RS232-C Shown

F. Transmitter Clock, Done F/F Gating two modes of operation are possible.

Mode 1 - Clear to Send may inhibit the setting of the Done F/F.

Mode 2 - Clear to Send controls Transmitter Clock.

For jumper pairs, only one of the jumpers can be installed at a time.

	JUMPER	STATUS	SHEET	PURPOSE
Jumper Pair	J13-1	IN	13	Mode 1 Line 0
	J3-2	IN	13	Mode 2 Line 0
Jumper Pair	J13-5	IN	13	Mode 1 Line 0
	J13-6	IN	13	Mode 2 Line 0
Jumper Pair	J13-8	IN	13	Mode 1 Line 0
	J13-7	IN	13	Mode 2 Line 0
Jumper Pair	J13-3	IN	13	Mode 1 Line 1
	J13-4	IN	13	Mode 2 Line 1
Jumper Pair	J13-11	IN	13	Mode 1 Line 1
	J13-12	IN	13	Mode 2 Line 1
Jumper Pair	J13-14	IN	13	Mode 1 Line 1
	J13-13	IN	13	Mode 2 Line 1
Jumper Pair	J14-1	IN	14	Mode 1 Line 2
	J14-2	IN	14	Mode 2 Line 2
Jumper Pair	J14-6	IN	14	Mode 1 Line 2
	J14-7	IN	14	Mode 2 Line 2
Jumper Pair	J14-9	IN	14	Mode 1 Line 2
	J14-8	IN	14	Mode 2 Line 2
Jumper Pair	J14-3	IN	14	Mode 1 Line 3
	J14-4	IN	14	Mode 2 Line 3
Jumper Pair	J14-11	IN	14	Mode 1 Line 3
	J14-12	IN	14	Mode 2 Line 3
Jumper Pair	J14-14	IN	14	Mode 1 Line 3
	J14-13	IN	14	Mode 2 Line 3
Jumper Pair	J15-1	IN	15	Mode 1 Line 4
	J15-2	IN	15	Mode 2 Line 4
Jumper Pair	J15-6	IN	15	Mode 1 Line 4
	J15-7	IN	15	Mode 2 Line 4
Jumper Pair	J15-9	IN	15	Mode 1 Line 4
	J15-8	IN	15	Mode 2 Line 4

Jumper Pair	J15-3	IN	15	Mode 1 Line 5
	J15-4	IN	15	Mode 2 Line 5
Jumper Pair	J15-11	IN	15	Mode 1 Line 5
	J15-12	IN	15	Mode 2 Line 5
Jumper Pair	J15-14	IN	15	Mode 1 Line 5
	J15-13	IN	15	Mode 2 Line 5
Jumper Pair	J16-1	IN	16	Mode 1 Line 6
	J16-2	IN	16	Mode 2 Line 6
Jumper Pair	J16-6	IN	16	Mode 1 Line 6
	J16-7	IN	16	Mode 2 Line 6
Jumper Pair	J16-9	IN	16	Mode 1 Line 6
	J16-8	IN	16	Mode 2 Line 6
Jumper Pair	J16-3	IN	16	Mode 1 Line 7
	J16-4	IN	16	Mode 2 Line 7
Jumper Pair	J16-11	IN	16	Mode 1 Line 7
	J16-12	IN	16	Mode 2 Line 7
Jumper Pair	J16-14	IN	16	Mode 1 Line 7
	J16-13	IN	16	Mode 2 Line 7

G. Clear to Send Connected.

With the respective jumper in, Clear to Send is connected to the logic. With the jumpers out, Clear to Send is not used.

JUMPER	SHEET	PURPOSE
J13-9	13	LINE 0 CTS
J13-10	13	LINE 1 CTS
J14-5	14	LINE 2 CTS
J14-10	14	LINE 3 CTS
J15-5	15	LINE 4 CTS
J15-10	15	LINE 5 CTS
J16-5	16	LINE 6 CTS
J16-10	16	LINE 7 CTS

H. Communications Panel - RCV/XMIT Switches

There is a switch pack (with 4 switches) associated with each channel on the Communications Panel. These switches determine to which pins on teh channel connector the RCV and XMIT signals will be assigned. See Figure 4.1.

Consult the documentation for the CRT you are going to connect to each channel to determine its pin locations for the RCV and XMIT signals. Generally, RCV will be at pin 2 and XMIT at pin 3, but on some models these may be reversed.

1. If pin 2 = RCV and pin 3 = XMIT, then: SW 2 & 4 OFF
   SW 1 & 3 ON

2. If pin 2 = XMIT and pin 3 = RCV, then: SW 2 & 4 ON
   SW 1 & 3 OFF

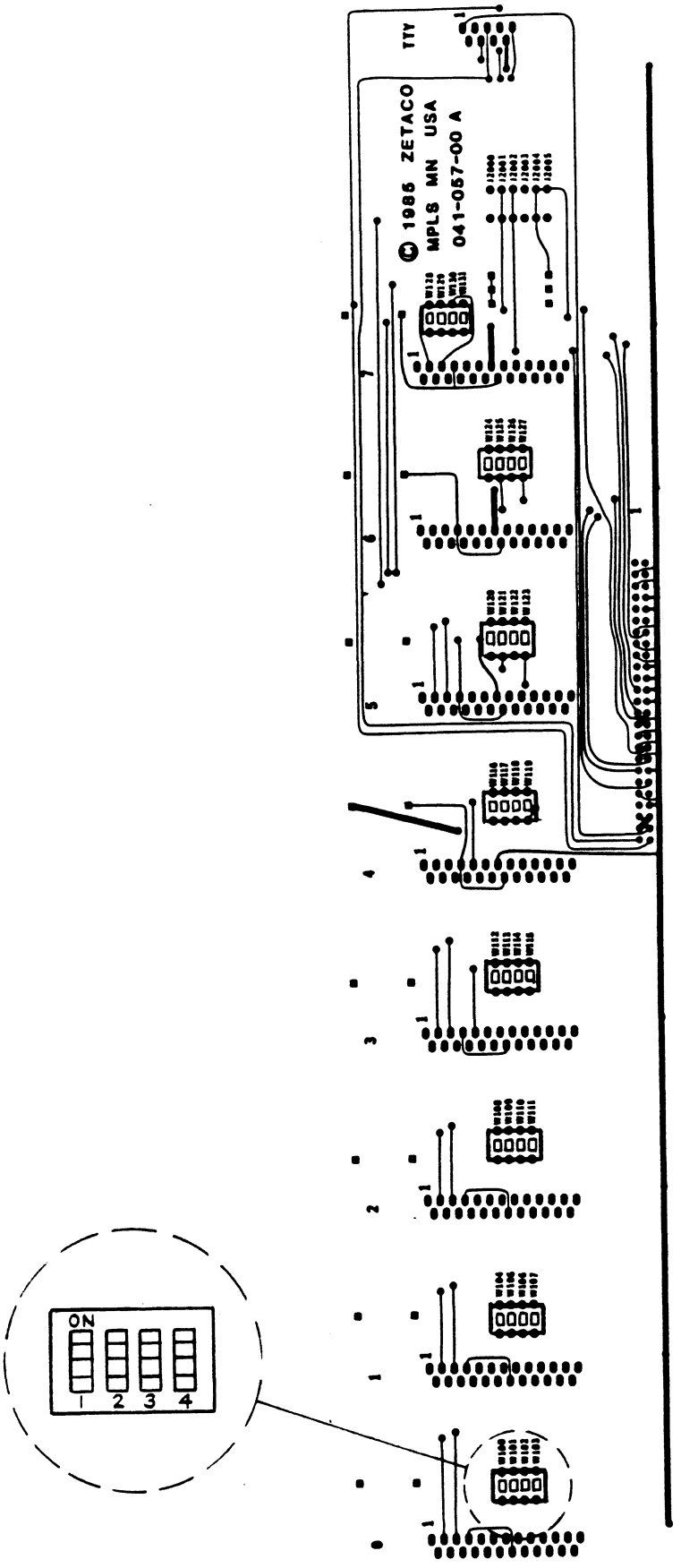
4.5 POWER JUMPERS

(For Jumper Pairs, only one of the jumpers can be installed at a time).

Some Data General Minicomputers (I.e. NOVA 4) supply +12V to the backplane while others (I.e. NOVA 3) supply +15V to the backplane.

	JUMPER	STATUS	SHEET	PURPOSE
Jumper	J19-1	IN	19	Use +12V from backplane
Pair	J19-2	IN	19	Regulate +15V to +12V

FIGURE 4.1 Communications Panel Switch Locations



5.0

This section contains quick maintenance and trouble shooting tips that may be helpful to isolate problems.

5.1 SERIAL PORT

Test A: Program to Repeatedly Output a Single Character Using BUSY/DONE Logic.

The octal program listed below is entered through the console data switches starting at location 100. The starting address (100) is set in the switches and then the EXAMINE switch is hit to load this address. The console switches can then be set to the ASCII value of the character to be printed (i.e. octal 100 = @, octal 101 = A, etc). The program is started by pressing the CONTINUE switch.

The program reads the selected character from the computer data switches, sends out the character to the teletype or CRT and then waits in a SKIP BUSY (or DONE) loop for the serial shifting of the character to the terminal to be completed. The process requires no response from the terminal and will repeatedly send out the same character. If the terminal does not have an automatic line feed, it will be necessary to take the terminal off line to advance the line. If proper transmission is occurring, the console switches can be changed on the fly to change the character sent out.

MEMORY LOCATION	OCTAL PROGRAM	SYMBOLIC CODE		COMMENTS
100	062677	IORST		
101	060477	READS	0,CPU	Reads console switches
102	061111	DOAS	0,TTO	Send out character
103	063511	SKPBZ	TTO	
104	000777	JMP	.-1	Wait for completion
105	773	JMP	.-5	Repeat

To run uner DONE logic, change the instruction in location 103 to 063611. If no output occurs, a problem exists with one of the following:

1. The cable has been improperly installed. Carefully check installation.
2. Terminal not on line.
3. Wrong baud rate selected.
4. A problem exists with the controller. Check that controller and cable are plugged to the same slot.

Test B: Device Output Under Interupt Control

MEMORY LOCATION	OCTAL PROGRAM	SYMBOLIC CODE		COMMENTS
1	70	JMP	Location 70	
60	062677	IORST		
	060177	INTEN		Enables interrupts
	072077	MSKO	2,CPU	Mask intruction
	061111	DOAS	0,TTO	Output a character
	400	JMP	*	Wait for interrupt
70	065477	INTA	1,CPU	Device code AC1
	063077	HALT		

The program is started at location 60, and the interrupt processing routine is placed at location 70. Before starting the program, the operator must first place a mask word (all zeros for normal operation or 000001 for teletype output disable) in accumulator 2. The character to be printed must also be placed in AC0.

The program sends out one character and then waits for an interrupt. When the interrupt occurs, the program passes through location 1 to get to the interrupt routine at location 70. The INTA instruction places the device code of the interrupting device (device 11 in this case) in AC1 and then halts. By changing the halt to JMP 60 or JMP *-8 (770), the program will run continuously.

If bit 15 in the mask word is equal to one, the TELETYPE OUTPUT flag is disabled and the program will hang on the JMP * instruction at locations 64. If bit 15 is unequal to one, the program will run normally.

Test C: Read One Character Under Either BUSY or DONE Logic

MEMORY LOCATION	OCTAL PROGRAM	SYMBOLIC CODE	COMMENTS
110	062677	IORST	
	060110	NIOS	Enable CRT Interface Controller
	063510	SKPBZ	Wait for character to be struck on keyboard
	777	JMP *-1	
	060410	DIA 0,TTI	Read character AC0
	063077	HALT	Halt, display AC0
	773	JMP *-5	

The program enables the controller and then waits for a key to be struck on the keyboard. The ASCII code for the character is placed in the accumulator zero (i.e. A = 101). By hitting the CONTINUE switch, the next character tape is read. By changing the third instruction to 063610 SKPDN, you may run under DONE logic.

Test D: Read One Character Using INTERRUPT Logic

The program is started at location 40, and location 50 contains the interrupt processing routine. Before starting the program, the operator must first place a mask word (all zeros for normal operation or 000002 for teletype input disable) in accumulator 2. After the program is started at location 40, the operator should strike a key on the keyboard.

MEMORY LOCATION	OCTAL PROGRAM	SYMBOLIC CODE	COMMENTS
1	50	JMP Location 50	
40	062677	IORST	
	060177	INTEN	Enable interrupts
	072077	MSKO 2,CPU	Mask instruction
	060110	NIOS TTI	Start paper tape reader
	400	JMP *	Wait for interrupt
50	065477	INTA 1,CPU	Device code AC1
	060410	DIA 0,TTI	Character AC0
	063077	HALT	
	060210	NIOC TTI	Clear interrupt and continue
	41	JMP Location 41	

The character read and the device code are placed in accumulators 0 and 1, respectively. If mask bit 14 = 1, the reader will advance tape to the next character and load the controller registers, but it will not generate an interrupt. The program will hang on the JMP * instruction at location 44.

5.2 REAL TIME CLOCK

Following installation of the Slot Saver IV controller into the general I/O slot of the computer, the machine should be powered up. Proper functioning of the Real Time Clock controller can be determined within a few minutes by entering a few octal diagnostic routines through the computer console data switches. These routines should be checked using all selectable frequencies before proceeding to Custom Systems' Real Time Clock Timing Diagnostic program.

The Real Time Clock has four operating frequencies; namely, 60, 10, 100 and 1000 Hz, which are selectable under program control. The diagnostic programs should be run for all frequencies to verify proper operation.

BIT 14	BIT 15	SELECTED FREQUENCY
0	0	60 Hz
0	1	10 Hz
1	0	100 Hz
1	1	1000 Hz

Test A: Program to Test BUSY/DONE Logic

The octal program is entered through the console data switches starting at location 100. The starting address is also 100. Before beginning the program, the operator must first place the code for the selected clock frequency in accumulator 0. The program will then start the clock. If the clock is operating properly, the BUSY flip flop will be reset and the program will halt at location 105. Accumulator 0 can then be changed to a different frequency selection. Operation using DONE logic can be determined by changing the SKIP instruction to SKPDN (063614).

MEMORY LOCATION	OCTAL PROGRAM	SYMBOLIC CODE	COMMENTS
100	062677	IORST	
	061014	DOA 0,RTC	Select frequency from AC0
	060114	NIOS RTC	Start clock
	063514	SKPBZ	
	777	JMP *-1	Wait for clock response
	063077	HALT	
	772	JMP *-6	Repeat if desired

Test B: Clock Operation Under Interrupts

MEMORY LOCATION	OCTAL PROGRAM	SYMBOLIC CODE	COMMENTS
1	70	JMP 70	
60	062677	IORST	
	061014	DOA 0,RTC	Select frequency
	072077	MSKO 2,CPU	Mask instruction
	060177	INTEN	Enable interrupts
	060114	NIOS RTC	Start clock
	400	JMP *	Wait for interrupts
70	065477	INTA 1,CPU	Device code AC1
	603077	HALT	
	60	JMP 60	

The program is started at location 60 and location 70 contains the interupt processing routine. Before starting the program, the operator must first place a mask word (all zeros for normal operation or 000004 for clock disable) in accumulator 2.

After receiving the interrupt, the device code is placed in accumulator 1. If mask bit 13 = 1, the device will not generate an interrupt. The program will hang on the JMP * instruction at location 65.

5.3 LINE PRINTER

Checkout of a Line Printer and Controller. The majority of the causes of not being able to print data from a computer lie with the printer itself. The first things to check when first hooking up a printer are the obvious; such as:

1. Is the printer powered?
2. Has the printer been placed on line?
3. Is there paper in the unit?
4. Is the cable from the computer plugged in tightly?
5. Is the front gate closed?

If these conditions are satisfied, the next step is to exercise the printer by itself. Many models of line printers can be ordered with the self-test option. If this option is not available, an external exerciser test box may be available from your serviceman. If no printing occurs using the self-test option, a malfunction exists within the printer. Please note which lights work, whether the motor comes on and any other symptoms before calling for service. If, on the other hand, the printer operates satisfactorily with the self-test feature, then you should proceed to the next step of the checkout process.

Initial Checkout of Computer Controller. Following installation of the controller board and cable (see installation instructions), the next step in the checkout process is to power up the computer with the cable to the printer disconnected at the printer end. If no adverse effects are noted, the computer should be turned off and the cable connected to the printer. The computer can then be turned on again and power applied to the printer.

A few short diagnostic routines entered through the data switches of the computer console will establish within minutes whether the controller, cable and printer have been properly connected and are functioning correctly. These programs should be used to verify proper operation before proceeding the Custom Systems' Comprehensive Printer Diagnostic program.

Test A: Program to Repeatedly Print a Single Character Using BUSY/DONE Logic

The octal program is entered through the console data switches starting at location 100 through location 110. The starting address (100) is set in the switches and then the EXAMINE switch is hit to load this address. The console switches can then be reset to the ASCII value of the character to be printed (i.e. octal 100 = @, octal 101 = A, etc). The program should be started by pressing the CONTINUE switch.

The program reads the data switches, sends out the character to the printer and then waits in a SKIP BUSY (or DONE) loop for the printer to request the next character. When the printer acknowledges, a line feed character is sent, thereby initiating a print cylce and advancing the paper. If proper printing is occurring, the console switches can be changed on the fly to change the character printed.

Note that a line feed code octal 012 must be loaded into accumulator 1 before the program is started.

MEMORY LOCATION	OCTAL PROGRAM	SYMBOLIC CODE	COMMENTS
100	062677	IORST	
101	060477	READS 0	Read console switches into AC0
102	061117	DOAS 0,LPT	Output character
103	063517	SKPBZ LPT	Wait for printer response
104	000777	JMP .-1	
105	065117	DOAS 1,LPT	Send line feed
106	063517	SKPBZ	
107	777	JMP .-1	Repeat
110	771	JMP .-1	

To run under DONE logic, change the instruction in location 103 to 063617.

If the program does not cause printing, hit the console stop switch. Then press the instruction step switch several times and observe the program addresses being executed. If the program just cycles in the two instruction BUSY loops (locations 103 and 104), then a problem exists with one of the following:

1. The printer is not working. Test by itself with self-test feature or external test plug.
2. The cable has been improperly installed. Carefully check installation.
3. A problem exists with the controller. Check that controller is in the correct slot.

Prior to calling Custom Systems, run Test A and Test B and note results of these tests plus all symptoms (lights on in printer, prints but doesn't advance paper, runs Tests A and B but not C, etc.).

Test B: Program to Read Printer Status Bit

MEMORY LOCATION	OCTAL PROGRAM	SYMBOLIC CODE	COMMENTS
120	062677	IORST	
	064417	DIA 1,17	
	063077	HALT	
	000775	JMP .-3	

Enter octal program into memory through console data switches. Start at location 120. The program reads a printer status word and then halts. If the printer is powered, has paper and is on line, examine bit 15 of AC1. The result should be a binary one.

Test C: Operation Under Interrupts

MEMORY LOCATION	OCTAL PROGRAM	SYMBOLIC CODE		COMMENTS
1	210	JMP	210	
200	062677	IORST		
	076077	MSKO	3,CPU	Mask out device
	061117	DOAS	0,LPT	
	063617	SKPDN	LPT	
	777	JMP	.-1	
	065117	DOAS	1,LPT	
	060177	INTEN		Enable interrupts
	400	JMP	.+0	Wait
210	071477	INTA	2,CPU	Acknowledge
	060217	NIOC	LPT	
	063077	HALT (or JMP .-10, 000766)		

The program starts at location 200. Prior to beginning, a printable character must be placed in AC0 and line feed code (012) in AC1. A mask word must also be placed in AC3. The program outputs the first character under DONE logic and then waits for an interrupt from the print cycle at the JMP .+0 instruction. Upon receiving the interrupt, the program goes through location 1 to the interrupt processing routine at location 210. The INTERRUPT ACKNOWLEDGE instruction should place the printer octal device code (017) in AC2 and then halt. By changing the halt to a jump instruction, the program can be made to run continuously.

The printer mask bit is bit 12. If there is a binary one in bit 12 of AC3, the printer interrupt scheme is disabled and the program will loop on the JMP .+0 instruction. If bit 12 of AC3 is zero, the program runs normally.

Test D: Program to Print Characters From Data Switches

MEMORY LOCATION	OCTAL PROGRAM	SYMBOLIC CODE		COMMENTS
100	062677	IORST		
	063077	HALT		Set data switches, press CONTINUE
	020115	LDA	0,CNT	
	040116	STA	0,TEMP	
	060477	READS	0	Read console switches
	061117	DOAS	0,LPT	Output a character
	063617	SKPDN	LPT	
	777	JMP	.-1	
	014116	DSZ	TEMP	Decrement counter
	774	JMP	.-4	
	065117	DOAS	1,LPT	LF character
	063617	SKPDN		
	777	JMP	.-1	
	765	JMP	.-11	
	10	CNT:	10	# characters to be printed
	0	TEMP:	0	

This program has proven useful in printing out the full character set, since the character to be printed can be changed on the fly by changing the console data switches. A line feed code (012) must be set into AC1 before beginning. The program starts at location 100 and halts immediately for a character to be set on the data switches. Press the CONTINUE switch to start again. The program then sends out eight characters followed by a line feed, thereby causing a print cylce. After each line, the character to be printed is read from the code set in the console data switches. The number of characters printed on a line can be varied by changing the octal constant CNT in core.

Test E: Program to Output Four Characters

This program provides a means of selectively sending out various combinations of letters, control characters and paper feed commands to test the VFU and paperfeed characteristics of the printer.

MEMORY LOCATION	OCTAL PROGRAM	SYMBOLIC CODE		COMMENTS
100	062677	IORST		
	061117	DOAS	0,LPT	
	063517	SKPBZ	LPT	
	777	JMP	.-1	
	065117	DOAS	1,LPT	
	063517	SKPBZ	LPT	
	777	JMP	.-1	
	071117	DOAS	2,LPT	
	063517	SKPBZ	LPT	
	777	JMP	.-1	
	075117	DOAS	3,LPT	
	063517	SKPBZ	LPT	
	777	JMP	.-1	
	763	JMP	.-13	

The four characters to be printed are placed in AC0-AC3. A typical example is A, B, VTAB, CC (101, 102, 013, 002). Here the letters AB are printed on each line, and the control code for a double line feed is used.

Special Notes: Common Difficulties. The most frequent reason for an inoperable interface is an internal cable which has been improperly plugged onto the computer end plane. Double checking of this cable cannot be overstressed.

The second most comon difficulty encountered is caused by operating the printer board. This can occur quite by accident long after the interface has been fully verified if another controller or memory board is temporarily removed from the computer. The symptom of this condition is that the printer will run using BUSY/DONE logic but will not operate under interrupt control. The cause is the fact that the interrupt priority continuity is broken by an empty board slot. The condition is corrected by replacing a missing board or jumpering the INTP and DCHP lines (see section on installation).

5.4 EIGHT CHANNEL ASYNCHRONOUS MULTIPLEXER

Test A: Program to Repeatedly Output a Single Character Using BUSY/DONE Logic

The octal program listed below is enterd through the console data switches starting at location 100. The starting address (100) is set in the switches and then the EXAMINE switch is hit to load this address. The console switches can then be reset to the ASCII value of the character to be printed (i.e. octal 100 = @, octal 101 = A, etc.). The program is started by pressing the CONTINUE switch.

The program reads the selected character from the computer data switches, sends out the character to the CRT and then waits in a SKIP BUSY (or DONE) loop for the serial shifting of the character to the terminal to be completed. The process requires no response from the terminal and will repeatedly send out the same character. If the terminal does not have an automatic line feed, it will be necessary to take the terminal off line to advance the line. If proper transmission is occurring, the console switches can be changed on the fly to change the character sent out.

MEMORY LOCATION	OCTAL PROGRAM	SYMBOLIC CODE		COMMENTS
100	062677	IORST		
101	060477	READS	0,CPU	Reads console switches
102	061130	DOAS	0,QTY	Send out character and line number
103	063530	SKPBZ	QTY	
104	000777	JMP	.-1	Wait for completion
105	773	JMP	.-5	Repeat

Output line numbers are controlled by switch positions 7 thru 2 wih bit 7 being least significant. To run uner DONE logic, change the instruction in location 103 to 063630. If no output occurs, a problem exists with one of the following:

1. The cable has been improperly installed. Carefully check installation. Are pins 2 and 3 correct for your CRT? (See Page 4-12.)
2. Terminal not on line.
3. Wrong baud rate selected.
4. A problem exists with the controller. Check that controller and cable are plugged to the same slot.

Test B: Echo Test

The program reads the character sent by the CRT as the result of depressing a key on the CRT keyboard. The program then transmits the received character back to the CRT. If proper communications have been established every time a key is struck on the keyboard it will be displayed on the CRT.

MEMORY LOCATION	OCTAL PROGRAM	SYMBOLIC CODE	COMMENTS
100	062677	IORST	
101	063630	SKPDZ QTY	Wait for CRT
102	777	JUMP-1	Input
103	060430	DIA Q,QTY	Load Input to AC0
104	061130	DOAS Q,QTY	Output AC0
105	063530	SKPBZ QTY	
106	777	JUMP-1	Wait for completion
107	100	JUMP I0100	Repeat

6.0 INTERFACE SIGNALS, PIN ASSIGNMENT AND CABLING ASSEMBLY

Listed below are the computer interface and external interface signals used by the Slot Saver IV controller board. A brief description for the cable panel assembly for the Slot Saver IV is also included.

6.1 COMPUTER INTERFACE SIGNALS

SIGNAL	BACKPANEL PIN
CLR	A50
DATA 0	B62
$\overline{\text{DATA 1}}$	B65
$\overline{\text{DATA 2}}$	B82
$\overline{\text{DATA 3}}$	B73
$\overline{\text{DATA 4}}$	B61
$\overline{\text{DATA 5}}$	B57
$\overline{\text{DATA 6}}$	B95
$\overline{\text{DATA 7}}$	B55
$\overline{\text{DATA 8}}$	B60
$\overline{\text{DATA 9}}$	B63
$\overline{\text{DATA 10}}$	B75
$\overline{\text{DATA 11}}$	B58
$\overline{\text{DATA 12}}$	B59
$\overline{\text{DATA 13}}$	B64
$\overline{\text{DATA 14}}$	B56
$\overline{\text{DATA 15}}$	B66
DATIA	A44
DATOA	A58
DATOB	A56

*$\overline{\text{DCHP IN}}$	A94
*$\overline{\text{DCHP OUT}}$	A93
$\overline{\text{DS0}}$	A72
$\overline{\text{DS1}}$	A68
$\overline{\text{DS2}}$	A66
$\overline{\text{DS3}}$	A46
$\overline{\text{DS4}}$	A62
$\overline{\text{DS5}}$	A64
INTA	A40
*$\overline{\text{INTP IN}}$	A96
*$\overline{\text{INTP OUT}}$	A95
$\overline{\text{INTR}}$	B29
IORST	A70
$\overline{\text{MSK0}}$	A38
$\overline{\text{RQENB}}$	B41
$\overline{\text{SELB}}$	A82
$\overline{\text{SELD}}$	A80
STRT	A52

*For the two pairs of priority-determining signals, the IN signal comes from the processor or the preceeding device, the OUT signal goes to the next device. If the computer is operated with an interface board removed (or a slot is not used), jumper pin A93 to A94 to A96 to maintain bus continuity.

6.2 DEVICE INTERFACE SIGNALS

SIGNAL	BACKPANEL PIN
SERIAL PORT	
SERIAL DATA OUT (+) (20 MA)	A83
SERIAL DATA OUT (-) (RS232-C)	A85
SERIAL DATA IN (+) (RS232-C)	B69
SERIAL DATA IN (-) (20 MA)	A99
CLEAR TO SEND	B84
READER RUN (OPTIONAL JUMPER)	A89
REAL TIME CLOCK	
50/60Hz SIGNAL	B6
PRINTER	
BIT 1	B67
BIT 2	B40
BIT 3	B52
BIT 4	B48
BIT 5	B38
BIT 6	B49
BIT 7	B25
BIT 8	B31
SELECTED	B51
STROBE	B27
PAPER EMPTY	B36
DEMAND	B34

EIGHT CHANNEL MULTIPLEXER

LINE 0	SERIAL DATA OUT	A49
LINE 0	SERIAL DATA IN	A57
LINE 0	CLEAR TO SEND	A47
LINE 1	SERIAL DATA OUT	A61
LINE 1	SERIAL DATA IN	A63
LINE 1	CLEAR TO SEND	A59
LINE 2	SERIAL DATA OUT	A67
LINE 2	SERIAL DATA IN	A65
LINE 2	CLEAR TO SEND	A71
LINE 3	SERIAL DATA OUT	A76
LINE 3	SERIAL DATA IN	A73
LINE 3	CLEAR TO SEND	A78
LINE 4	SERIAL DATA OUT	A92
LINE 4	SERIAL DATA IN	A91
LINE 4	CLEAR TO SEND	A90
LINE 5	SERIAL DATA OUT	A75
LINE 5	SERIAL DATA IN	A84
LINE 5	CLEAR TO SEND	A88
LINE 6	SERIAL DATA OUT	A87
LINE 6	SERIAL DATA IN	A81
LINE 6	CLEAR TO SEND	A86
LINE 7	SERIAL DATA OUT	A69
LINE 7	SERIAL DATA IN	A77
LINE 7	CLEAR TO SEND	A79

CABLING FROM PANEL TO EXTERNAL DEVICES

A. SERIAL PORT (TTY CONNECTOR - 9 PIN)

J9-1	Reader Run
J9-2	+5V
J9-3	Data from CRT (+)
J9-4	Data from CRT (-)
J9-5	Clear to Send
J9-6	Data to CRT (-)
J9-7	Data to CRT (+)
J9-8	Not Used
J9-9	GND

RS232 Cable

J9-3	Data from CRT
J9-5	Clear to Send
J9-6	Data to CRT
J9-9	GND

20 MA Cable

J9-1	Reader Run
J9-3	Data from CRT (+)
J9-4	Data from CRT (-)
J9-6	Data to CRT (-)
J9-7	Data to CRT (+)
J9-9	GND

B. 8 CHANNEL MULTIPLEXER (25 PIN)

Channel 0 is representative of the other 7 Channels

J1-2	Data from CRT
J1-3	Data to CRT
J1-4	Request to Send (pulled high)
J1-5	Clear to Send
J1-7	GND
J1-20	Data Terminal Ready (pulled high)

```
;
;
;
;*****************************************************************
;
; DESCRIPTION:  QTY DIAGNOSTIC & RELIABILITY TEST
;
;
; CUSTOM SYSTEMS INC, 1981
;*****************************************************************
        .TITL   QTYDR
000001  .DUSR   Y=1
000000  .TXTM 0
;1.     PROGRAM NAME:   QTYDR.SR
;
;2.     REVISION HISTORY:
;
;       REV.      DATE
;        00     08/10/81
;        01     08/06/82        CHANGE TO RUN HIGHER THAN 4800 B
;        02     08/06/84        NO AUTO INC, A21-A25 2 NO-OP'S F
;                               S120,
;        03     08/20/84        CHANGE TO RUN BAUD RATE WITH MOD
;                               (MODIFIED) BOARD
;
;3.     MACHINE REQUIREMENTS
;3.1        NOVA(EXCEPT MICRO)/ECLIPSE  PROCESSOR
;3.2        4K READ/WRITE MEMORY
;3.3        CONSOLE TELETYPE
;3.4        QTY MULTIPLEXER BOARD
;3.5        TEST PLUG (SEE SECTION 7.)
;4.     DIAGNOSTIC OPERATING PROCEDURE

;4.1        DISCONNECT THE COMMUNICATIONS EQUIPMENT AND IN-
;          SERT THE TEST PLUG INTO THE CONNECTOR ON THE
;          NOVA BACK PANNEL.
;4.2        LOAD THE PROGRAM VIA THE BINARY LOADER
;4.3        LOAD STARTING ADDRESS
;4.4        PRESS START
;4.5        THE PROGRAM WILL REQUEST THE DEVICE CODE. THE
;          OPERATOR SHOULD TYPE THE DEVICE CODE (30 OR 70)
;          CORRESPONDING TO HIS MULTIPLEXER.
;          THE PROGRAM WILL REQUEST THE NUMBER OF THE FIRST
;          TELETYPE LINE. THE OPERATOR SHOULD TYPE ,IN DECI-
;          MAL, THE NUMBER OF THE FIRST TELETYPE LINE.
;          THE PROGRAM WILL REQUEST THE NUMBER OF THE LAST
;          TELETYPE LINE. THE OPERATOR SHOULD TYPE IN THE
;          NUMBER OF THE LAST LINE IN THE SYSTEM.
;          THE PROGRAM WILL REQUEST THE NUMBER OF LEVELS
;          USED. THIS REFERS TO THE NUMBER OF BAUDS
;          CONTAINED IN ONE WORD, NEGLECTING START AND STOP
;          BAUDS. THE OPERATOR SHOULD TYPE ,IN DECIMAL
;          THE NUMBER OF CODE BAUDS PER WORD.
;          THE PROGRAM WILL REQUEST THE NO OF STOP BAUDS IF
;          THE NUMBER OF LEVELS IS NOT 5. THE OPERATOR SHOULD
;          THEN TYPE 1 OR 2 DEPENDING UPON THE JUMPERS
;          INSTALLED ON HIS BOARD.
;          THE PROGRAM WILL REQUEST THE TTO BAUD RATE, IF THERE
;          IS NO REAL TIME CLOCK IN THE SYSTEM.
;          THE OPERATOR WILL RESPOND WITH A DECIMAL VALUE OF
```

```
02  GTYDR
                :           THE BAUD RATE OF THE CONSOLE DEVICE BEING USED
                :           FOR OPERATOR INTERFACE. E.G., RESPOND "110" FOR
                :           ASR33, "4800", "2400", ETC. FOR DISPLAY.
```

```
;
;4.6        EXECUTION OF THE PROGRAM WILL NOW BEGIN.
;4.7        THE PROGRAM WILL NOT REQUEST OPERATOR PARA-
;          METERS UPON RESTARTING UNLESS SWITCH 0 IS SET.
;4.8        IF NO ERRORS ARE DETECTED THE INTERVAL BETWEEN
;          QTY CLOCK PULSES WILL BE PRINTED EVERY
;          PROGRAM PASS. THE TIME PRINTED IS ONLY AN
;          APPROXIMATE VALUE AND IS DEPENDENT ON THE
;          CONSOLE TELETYPE AS A REFERENCE.
;NOTE:      THE TIME PRINTED EQUALS THE NUMBER OF
;          MICRO-SECONDS NEEDED TO TRANSMIT A BAUD
;          REFERENCED TO THE CONSOLE TELETYPE. TO CONVERT
;          THIS VALUE INTO THE BAUD RATE, DIVIDE THIS
;          NUMBER INTO ONE MILLION.
;          WHILE THE ACTUAL VALUE OF THIS PARAMETER
;          GIVES AN INDICATION OF THE PROPER CRYSTAL
;          FREQUENCY AND DIVIDER OPERATION OF GREATER
;          IMPORTANCE IS THE FACT THAT THERE ARE NO LARGE
;          VARIATIONS IN THE MEASURED VALUE VERSUS TIME SINCE
;          THIS WOULD INDICATE INTERMITTENT OPERATION OF A PART
;5.       DIAGNOSTIC ERROR DESCRIPTION
;5.1        IF A MALFUNCTION IS DETECTED THE PROGRAM WILL
;          HALT AT LOCATION "ERR1+1". THE OPERATOR MAY
;          CHANGE SWITCH SETTINGS AT THIS TIME IF DESIRED.
;          IF SWITCHS 1 AND 2 ARE ZERO PRESSING CONTINUE
;          WILL CAUSE A TTY PRINTOUT OF THE ERROR LOCATION.
;          THE ROUTINE WILL ENTER  A LOOP SUITABLE FOR
;          SCOPING THE MALFUNCTION.
;5.2        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.

;6.       DIAGNOSTIC THEORY OF OPERATION
;          THIS PROGRAM PERFORMS A GATE BY GATE CHECK OF
;          THE QTY INTERFACE LOGIC.  THE DATA LINE
;          TRANSMITTERS AND RECEIVERS ARE CHECKED IN THE
;          FOLLOWING MANNER. THE PROGRAM SENDS INFORMATION
;          TO THE OUTPUT DRIVERS. THE TEST PLUG PROVIDES
;          A RETURN PATH TO THE DTA INPUTS. THE
;          PROGRAM IS THUS ABLE TO CHECK ON THE INPUT'S
;          DATA SENT TO THE OUTPUT. THE OUTPUT MAY BE
;          CONNECTED TO THE 20 MILLIAMPERE OR EIA
;          STANDARD LEVEL.

;7.       MISC
;7.1        THE TEST PLUG FOR EIA LEVELS CONSISTS OF A WIRE
;          CONNECTING LINE 0 OUTPUT TO LINE 0 INPUT, ETC..
;          THE TEST PLUG FOR 20 MA LINES MUST CONTAIN
;          A TRANSISTOR INVERTER IN EACH LINE. THE
;          SEQUENCE IS REPEATED FOR EACH LINE IN THE SYSTEM.

;7.2        JUMPER CONNECTIONS
;              LEVELS   STOP BAUDS       WIRES NEEDED
;                5         1.5              17,28
;                6          1               13-17-29
;                             2             13-17-18-29
;                7          1               12-16-18-29
;                             2             12-15-16-18-29
;                8          1               12-13-15-16-19-29
```

```
:8.     RELIABILITY OPERATING INSTRUCTIONS

;       IF THE DIAGNOSTIC TEST HAS BEEN RUN, THE PROGRAM
;       IS READY TO RUN. IF NOT REMOVE THE COMMUNICATIONS
;       EQUIPMENT AND INSERT THE TEST PLUG.
;       LOAD THE PROGRAM VIA THE BINARY LOADER.
;       SET SWITCHES AND PRESS START.

;9.     RELIABILITY STARTING ADDRESSES

;       STARTING ADDRESS=000013-        USE LINES LAST TESTED,
;               THE PROGRAM PRINTS THE DEVICE CODE AND STARTS.

;       STARTING ADDRESS=000014-        CHECKS FOR ACTIVE LINES
;               AND PRINTS THE LINE NUMBER, CODE LEVEL,
;               NO. OF STOP BITS, AND BAUD RATE FOR EACH
;               LINE AVAILABLE. IT THEN PRINTS THE DEVICE CODE.

;       STARTING ADDRESS=000015-        PROGRAM PRINTS "LINE".
;               TYPE A LINE NUMBER TO BE TESTED FOLLOWED BY A
;               CARRIAGE RETURN.  PROGRAM RESPONDS WITH
;               LINE NUMBER, CODE LEVEL, NO. OF STOP BITS,
;               AND BAUD RATE, THEN ASKS FOR ANOTHER LINE.
;               TYPE (ESC) TO START THE PROGRAM. IT THEN PRINTS
;               THE DEVICE CODE.

:10.    REMARKS

;       MANY DIFFERENT BAUD RATES CAN BE USED DEPENDING
;       UPON THE CRYSTAL AND JUMPER CONFIGURATION.
;       THE PROGRAM MEASURES THE TRANSMISSION TIME AND
;       COMPARES IT TO THE CONSOLE TELETYPE TRANSMISSION
;       TIME TO DETERMINE THE BAUD RATE.  ALLOW +-5%
;       TOLERANCE IN CALCULATED VALUES.

;       THE BAUD RATE AS DETERMINED FROM THE TRANSMISSION
;       TIME IS DEPENDENT UPON THE CODE LEVEL AND THE NUMBER
;       OF STOP AND START UNITS.  THE TABLE BELOW DISPLAYS
;       ALL POSSIBLE COMBINATIONS OF CODE LEVELS AND
;       UNITS.

;       CODE LEVEL      ,# UNITS
;       ----------       --------
;       5                7.5
;       6                8
;       6                9
;       7                9
;       7                10
;       8                10
;       8                11

;       THE PROGRAM DETERMINES THE CODE LEVEL BY EXAMINING
;       THE CHARACTER RECEIVED FROM A TRANSMISSION.
;       THE NUMBER OF STOP BITS ARE DETERMINED FROM A
;       COMPARISON OF THE TIME REQUIRED TO TRANSMIT AND
;       THE TIME REQUIRED TO RECEIVE A CHARACTER.
```

```
:11.    RELIABILITY PROGRAM DESCRIPTION
;
;       ON STARTING, ALL LINES TO BE TESTED ARE GIVEN
;       A RANDOM CHARACTER TO TRANSMIT.  WITH EACH
;       SUCCESSFUL "RECEIVE DONE" INTERRUPT A DIFFERENT
;       RANDOM NUMBER IS SELECTED AND OUTPUTTED TO
;       THAT LINE.  EACH "RECEIVE DONE" INTERRUPT IS
;       VERIFIED BY LINE NUMBER/RANDOM CHARACTER
;       COMBINATION.  THE PROGRAM RUNS INDEFINITELY.

;       A COUNT OF THE TRANSMITTED AND RECEIVED
;       CHARACTERS FOR EACH LINE CAN BE REQUESTED
;       BY PRESSING THE TELETYPE SPACE BAR WHILE
;       THE PROGRAM IS RUNNING.  ALL COUNTS ARE
;       MODULO 32,768. (1/2 OF 1 16 BIT WORD/COUNTER)

:12.    RELIABILITY PROGRAM ERRORS

;       AN IDLE LOOP WATCH DOG TIMER IS USED TO INSURE
;       THAT NO LINE BEING TESTED HANGS UP SUCH THAT
;       DATA TRANSMISSION STOPS.  IF THIS OCCURS THE
;       LINE NUMBER IS PRINTED ALONG WITH AN ERROR
;       MESSAGE AND TRANSMISSION IS TRIED AGAIN.

;       DATA ERRORS AT THE RECEIVER RESULT IN A PRINTOUT
;       OF THE LINE NUMBER AND THE GOOD & BAD CHARACTERS.
;       THE PROGRAM CONTINUES REPEATEDLY SENDING THE FAILING
;       CHARACTER (SCOPE LOOP) FOR THE FAILING LINE.
;       ALL OTHER RANDOM TESTING CONTINUES.  SET SW1 TO "1"
;       TO RESUME RANDOM TESTING ON "ALL" LINES BEING
;       TESTED.  WHILE IN A SCOPE LOOP SET SW3 TO "1"
;       TO GET A PRINTOUT OF THE FAILURE RATE.  (I.E. 89%).

:13.    STARTING LOCATIONS
:13.1           000012-DIAGNOSTIC (100012 IF NEW PARAMETERS DESI
:13.2           000013-RELIABILITY (USING LAST LINES TESTED)
:13.3           000014-   "        (DETERMINES ACTIVE LINES)
:13.4           000015-   "        (ENTER LINE NUMBERS)

:14.    SWITCH SETTINGS

;       1       PROCEED FROM ERROR LOOP.
;       2       INHIBIT PRINTING ON CONSOLE TELETYPE.
;       3       PRINT THE FAILURE RATE.
;       -
;       5       OUTPUT TO LPT
```