

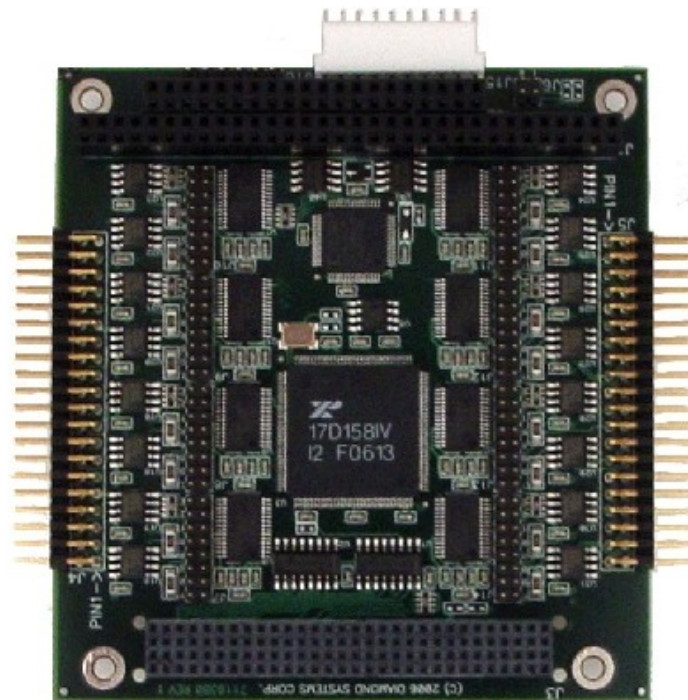


DIAMOND SYSTEMS CORPORATION

Emerald-MM-8Plus

PC/104-Plus 8-Port Multi-Protocol Serial Port Module

User Manual v1.00



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Introduction

Emerald-MM-8Plus is a PC/104-Plus module with four or eight serial ports connected through the PCI bus. Each port supports RS-232, RS-422, RS-485 and 5V TTL interfaces using jumper configuration. The board also has eight digital I/O lines and a 16-bit counter/timer.

Emerald-MM-8Plus is connector compatible with the Emerald-MM-8P, Emerald-MM-8M, and Emerald-MM-8232 boards. It is compatible with all Diamond Systems Corporation CPUs with PC/104-Plus connectors. The board is intended to be compatible with any CPU with a PC/104-Plus expansion socket and operates with both 3.3V and 5V PCI I/O voltage buses.

Description and Features

Two I/O headers are provided, with four serial ports on each header. The board operates on +5V only, eliminating the need for a +12V supply that is often required for serial port operation.

Emerald-MM-8P is based on the Exar XR17D158IV Octal UART. This device contains eight identical sets of registers, one set for each port. The registers are compatible with the standard PC serial port. Each port contains a 64-byte FIFO.

The Emerald-MM-8Plus has the following features.

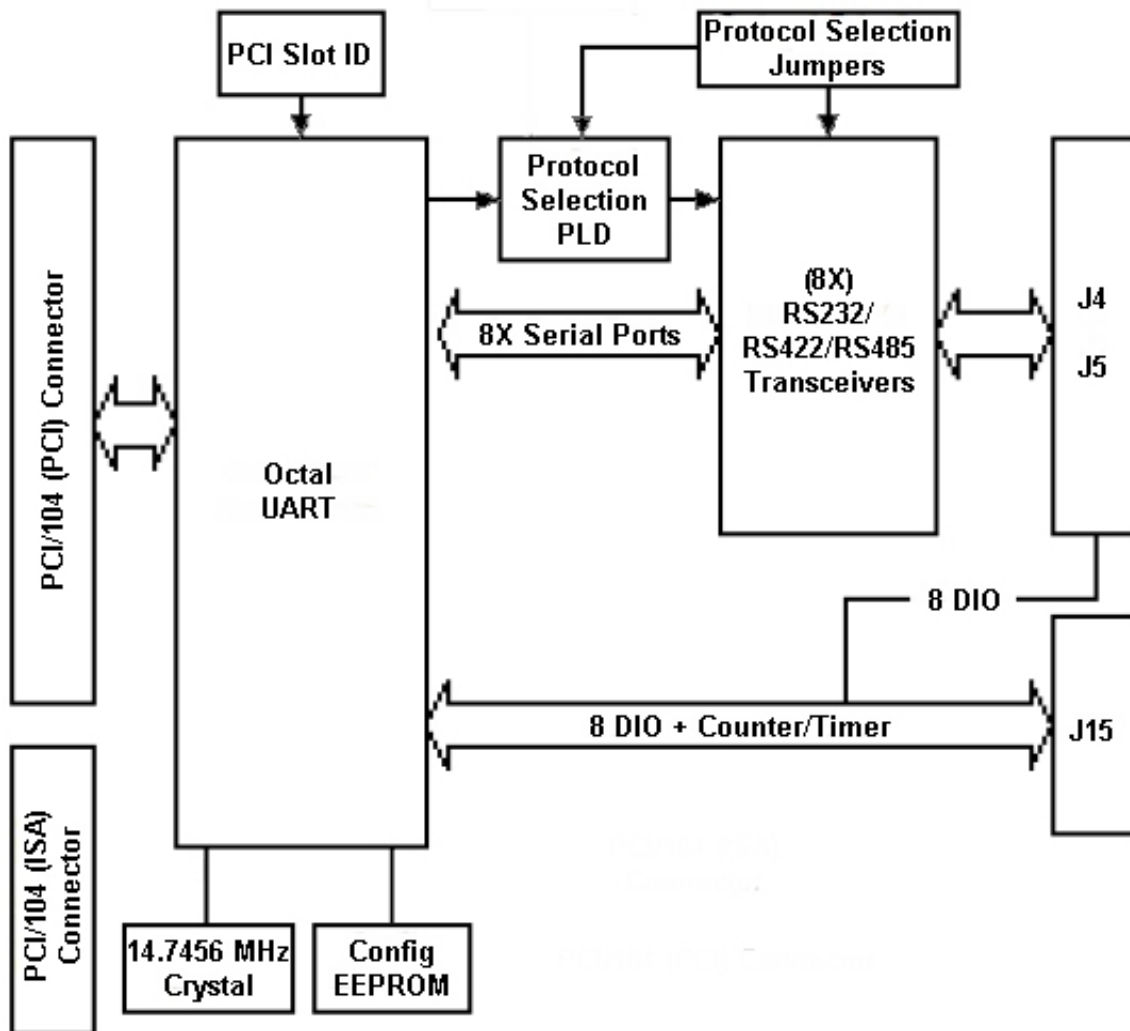
- I/O connectors compatible with Emerald-MM-8P (two connectors, 40 pins, four ports per connector).
- Eight serial ports based on Exar XR17D158IV Octal UART with 64-byte FIFOs.
- RS-232, RS-422, RS-485, and TTL interfaces supported: RS-232/422/485 jumper selectable; TTL available as a custom assembly configuration.
- Baud rates to 921.6Kbps in RS-232 or TTL mode, 1.8432Mbps in RS-422/RS-485 modes.
- Jumper-selected protocol and line termination.
- EEPROM storage of configuration data for instant availability on power-up.
- I/O lines are short circuit protected.
- Eight digital I/O lines with 5V logic.
- LED connected to digital I/O line 0.
- Programmable counter/timer with selectable clock source.
- Dual 40-pin I/O headers, 4 ports per header.
- +5V only operation.
- Extended temperature (-40 to +85°C) operation.
- PC/104-Plus form factor.
- Stackthrough PC/104 and PC/104-Plus connectors installed.

Refer to the Exar XR17D158IV datasheet, listed in the Additional Information section of this document, for detailed information about using the UART, DIO and EEPROM functionality with the PC/104-Plus bus.

Block Diagram

Figure 1 shows the Emerald-MM-8Plus functional blocks.

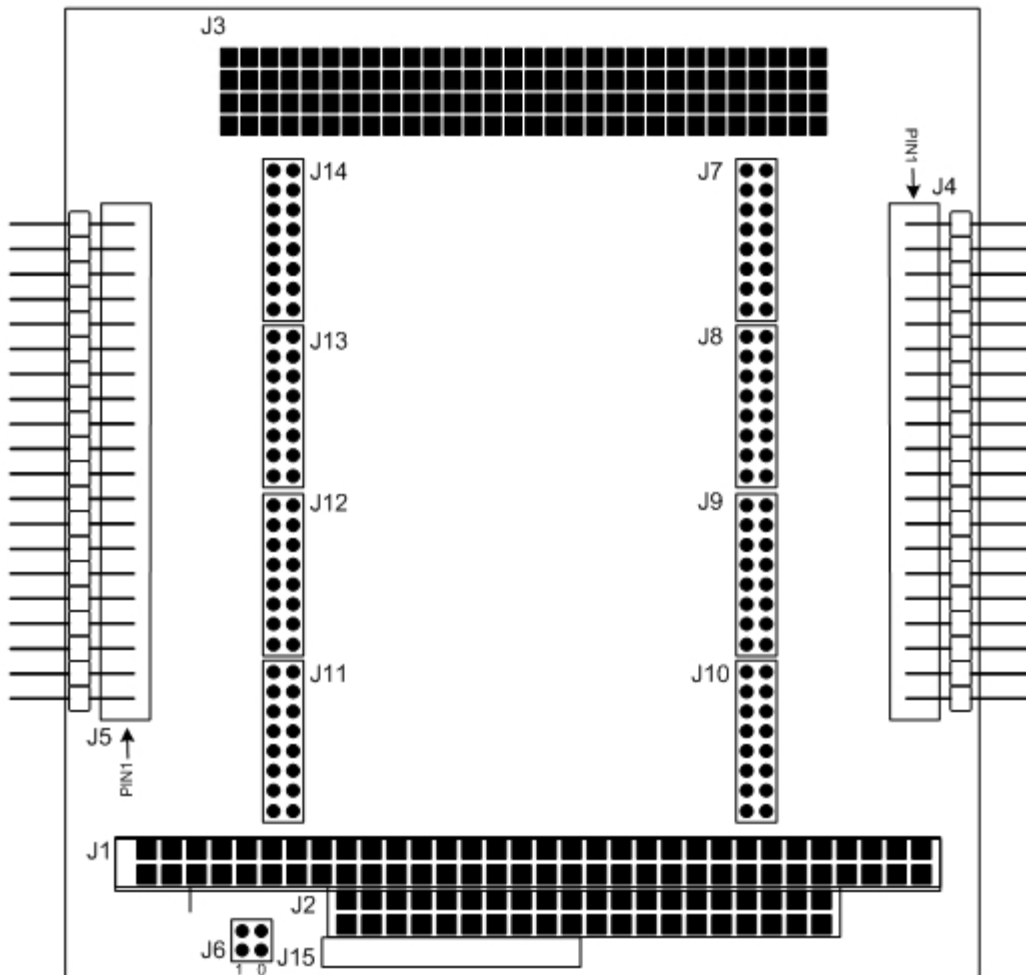
Figure 1: EMM-8Plus Functional Block Diagram



Board Description

Figure 2 shows the Emerald-MM-8Plus board connectors and jumpers.

Figure 2: EMM-8Plus Board Layout



Connector Summary

The following tables list the Emerald-MM-8Plus board connectors.

<i>Connector</i>	<i>Description</i>	<i>Manufacturer Part No.</i>
J1	PC/104, ISA bus A,B	EPT 962-60323-12
J2	PC/104, ISA bus C,D	EPT 962-60203-12
J3	PC/104-Plus PCI bus connector	-
J4	Serial ports 1-4	
J5	Serial ports 5-8	
J15	Digital I/O and counter/timer	

Jumper Summary

The following table lists the Emerald-MM-8Plus jumpers.

<i>Jumper</i>	<i>Description</i>
J6	PCI bus slot selection.
J7-J10	Serial port configuration (Serial ports 1-4, respectively).
J11-J14	Serial port configuration (Serial ports 5-8, respectively).

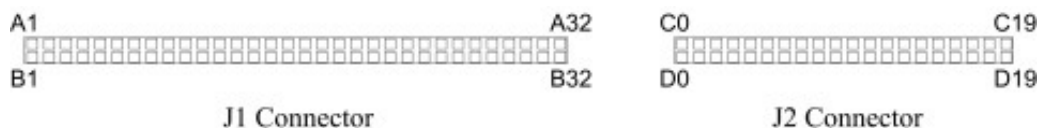
Connectors

This section describes the connectors on the Emerald-MM-8Plus board.

PC/104 ISA Bus

Connectors J1 and J2 carry the ISA bus signal. Figure 3 shows the PC/104 A and B pin layout for J1, and the C and D pin layout for J2. These signals are not used to communicate with the CPU but are pass to other cards on the PC/104 stack.

Figure 3: PC/104 ISA Bus Connectors - J1, J2



<i>J1 Connector Pinout</i>			
IOCHCHK-	A1	B1	GND
SD7	A2	B2	RESETDRV
SD6	A3	B3	+5V
SD5	A4	B4	IRQ9
SD4	A5	B5	-5V
SD3	A6	B6	DRQ2
SD2	A7	B7	-12V
SD1	A8	B8	ENDXFR-
SD0	A9	B9	+12V
IOCHRDY	A10	B10	keyed
AEN	A11	B11	SMEMW-
SA19	A12	B12	SMEMR-
SA18	A13	B13	IOW-
SA17	A14	B14	IOR-
SA16	A15	B15	DACK3-
SA5	A16	B16	DRQ3
SA14	A17	B17	DACK1-
SA13	A18	B18	DRQ1
SA12	A19	B19	REFRESH-
SA11	A20	B20	SYSCLK
SA10	A21	B21	IRQ7
SA9	A22	B22	IRQ6
SA8	A23	B23	IRQ5
SA7	A24	B24	IRQ4
SA6	A25	B25	IRQ3
SA5	A26	B26	DACK2-
SA4	A27	B27	TC
SA3	A28	B28	BALE
SA2	A29	B29	+5V
SA1	A30	B30	OSC
SA0	A31	B31	GND
GND	A32	B32	GND

<i>J2 Connector Pinout</i>			
GND	C0	D0	GND
SBHE-	C1	D1	MEMCS16--
LA23	C2	D2	IOCS16-
LA22	C3	D3	IRQ10
LA21	C4	D4	IRQ11
LA20	C5	D5	IRQ12
LA19	C6	D6	IRQ15
LA18	C7	D7	IRQ14
LA17	C8	D8	DACK0-
MEMR-	C9	D9	DRQ0
MEMW-	C10	D10	DACK5-
SD8	C11	D11	DRQ5
SD9	C12	D12	DACK6-
SD10	C13	D13	DRQ6
SD11	C14	D14	DACK7-
SD12	C15	D15	DRQ7
SD13	C16	D16	+5
SD14	C17	D17	MASTER-
SD15	C18	D18	GND
keyed	C19	D19	GND

PC/104-Plus PCI Bus

The PC/104-Plus bus is essentially identical to the PCI Bus except for the physical design. A single pin and socket connector is specified for the bus signals. A 120-pin header, J3, arranged as four 30-pin rows incorporates a full 32-bit, 33MHz PCI Bus. The additional pins on the PC/104-Plus connectors are used as ground or key pins. The female sockets on the top of the board enable stacking another PC/104-Plus board on top of the Emerald-MM-8Plus board. The Emerald-MM-8Plus board should be the bottom board of a PC/104-Plus stackup.

In the connector J3 pinout table, below, the top corresponds to the left edge of the connector when the board is viewed from the primary side (the side with the female end of the PC/104-Plus connector), and the board is oriented so that the PC/104 connectors are along the bottom edge of the board and the PC/104-Plus connector is in the top of the Emerald-MM-8Plus board.

Figure 4: PC/104-Plus PCI Connector - J3



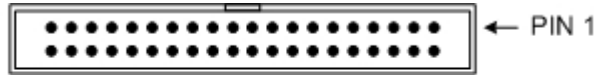
	A	B	C	D
1	GND/5.0V KEY	Reserved	+5V	AD00
2	VI/O	AD02	AD01	+5V
3	AD05	GND	AD04	AD03
4	C/BE0*	AD07	GND	AD06
5	GND	AD09	AD08	GND
6	AD11	VI/O	AD10	M66EN
7	AD14	AD13	GND	AD12
8	+3.3V	C/BE1*	AD15	+3.3V
9	SERR*	GND	Reserved	PAR
10	GND	PERR*	+3.3V	Reserved
11	STOP*	+3.3V	LOCK*	GND
12	+3.3V	TRDY*	GND	DESEL*
13	FRAME*	GND	IRDY*	+3.3V
14	GND	AD16	+3.3V	C/BE2*
15	AD18	+3.3V	AD17	GND
16	AD21	AD20	GND	AD19
17	+3.3V	AD23	AD22	+3.3V
18	IDSEL0	GND	IDSEL1	IDSEL2
19	AD24	C/BE3*	VI/O	IDSEL3
20	GND	AD26	AD25	GND
21	AD29	+5V	AD28	AD27
22	+5V	AD30	GND	AD31
23	REQ0*	GND	REQ1*	VI/O
24	GND	REQ2*	+5V	GNT0*
25	GNT1*	VI/O	GNT2*	GND
26	+5V	CLK0	GND	CLK1
27	CLK2	+5V	CLK3	GND
28	GND	INTD*	+5V	RST*
29	+12V	INTA*	INTB*	INTC*
30	-12V	~REQ3	~GNT3	GND/3.3V KEY

On the Emerald-MM-8Plus, the octal UART is connected to the PCI bus and is powered by 5V with its PCI interface powered by the PCI bus VIO, which can be 3.3V or 5V. For this reason, the connector is not keyed (to prevent certain types of cards from being inserted).

I/O Header Connectors

Emerald-MM-8Plus provides two identical 40-pin headers labeled J4 and J5 for the serial ports. Four ports are contained on each header.

Figure 5: I/O Header Connectors - J4, J5



Connector, J4, is for ports 1-4 and is located along the right side of the board.

<i>J4 Port No.</i>	<i>Pin Assignment</i>
PORT1	Pins 1 - 10
PORT2	Pins 11 - 20
PORT3	Pins 21 - 30
PORT4	Pins 31 - 40

Connector, J5, is for ports 5-8 and is located along the left side of the board.

<i>J5 Port No.</i>	<i>Pin Assignment</i>
PORT5	Pins 1 - 10
PORT6	Pins 11 - 20
PORT7	Pins 21 - 30
PORT8	Pins 31 - 40

Pin numbers are marked on the board to assist with connector orientation.

Diamond Systems Corporation Cable Assembly Number C-DB9M-4 connects this header to four DE-9 Male connectors, for direct connection to RS-232-C signaling. The following tables list the signals for the appropriate mode of operation, as well as the DE-9 pin numbers to which these signals are wired.

RS-232 Pin Assignment

J5				J4					
Port1:	DCD1	1	2	DSR1	Port5:	DCD5	1	2	DSR5
	RXD1	3	4	RTS1		RXD5	3	4	RTS5
	TXD1	5	6	CTS1		TXD5	5	6	CTS5
	DTR1	7	8	RI1		DTR5	7	8	RI5
	GND	9	10	DIO0		GND	9	10	DIO4
Port2:	DCD2	11	12	DSR2	Port6:	DCD6	11	12	DSR6
	RXD2	13	14	RTS2		RXD6	13	14	RTS6
	TXD2	15	16	CTS2		TXD6	15	16	CTS6
	DTR2	17	18	RI2		DTR6	17	18	RI6
	GND	19	20	DIO1		GND	19	20	DIO5
Port3:	DCD3	21	22	DSR3	Port7:	DCD7	21	22	DSR7
	RXD3	23	24	RTS3		RXD7	23	24	RTS7
	TXD3	25	26	CTS3		TXD7	25	26	CTS7
	DTR3	27	28	RI3		DTR7	27	28	RI7
	GND	29	30	DIO2		GND	29	30	DIO6
Port4:	DCD4	31	32	DSR4	Port8:	DCD8	31	32	DSR8
	RXD4	33	34	RTS4		RXD8	33	34	RTS8
	TXD4	35	36	CTS4		TXD8	35	36	CTS8
	DTR4	37	38	RI4		DTR8	37	38	RI8
	GND	39	40	DIO3		GND	39	40	DIO7

<i>Signal</i>	<i>Definition</i>	<i>DE-9 Pin</i>	<i>Direction</i>
DCD n	Data Carrier Detect	pin 1	Input
DSR n	Data Set Ready	pin 6	Input
RXD n	Receive Data	pin 2	Input
RTS n	Request to Send	pin 7	Output
TXD n	Transmit Data	pin 3	Output
CTS n	Clear to Send	pin 8	Input
DTR n	Data Terminal Ready	pin 4	Output
RI n	Ring Indicator	pin 9	Input
GND	Ground	-	-
DIO n	Digital I/O	-	-

RS-485 Pin Assignment

J5				J4					
Port1:	NC	1	2	NC	Port5:	NC	1	2	NC
	TXD/RXD+1	3	4	TXD/RXD-1		TXD/RXD+5	3	4	TXD/RXD-5
	GND	5	6	NC		GND	5	6	NC
	NC	7	8	NC		NC	7	8	NC
	GND	9	10	DIO0		GND	9	10	DIO4
Port2:	NC	11	12	NC	Port6:	NC	11	12	NC
	TXD/RXD+2	13	14	TXD/RXD-2	RXD6	TXD/RXD+6	13	14	TXD/RXD-6
	GND	15	16	NC		GND	15	16	NC
	NC	17	18	NC		NC	17	18	NC
	GND	19	20	DIO1		GND	19	20	DIO5
Port3:	NC	21	22	NC	Port7:	NC	21	22	NC
	TXD/RXD+3	23	24	TXD/RXD-3		TXD/RXD+7	23	24	TXD/RXD-7
	GND	25	26	NC		GND	25	26	NC
	NC	27	28	NC		NC	27	28	NC
	GND	29	30	DIO2		GND	29	30	DIO6
Port4:	NC	31	32	NC	Port8:	NC	31	32	NC
	TXD/RXD+4	33	34	TXD/RXD-4		TXD/RXD+8	33	34	TXD/RXD-8
	GND	35	36	NC		GND	35	36	NC
	NC	37	38	NC		NC	37	38	NC
	GND	39	40	DIO3		GND	39	40	DIO7

<i>Signal</i>	<i>Definition</i>	<i>DE-9 Pin</i>	<i>Direction</i>
TXD/RXD+ <i>n</i>	Differential Transceiver Data (HIGH)	pin 2	bi-directional
TXD/RXD- <i>n</i>	Differential Transceiver Data (LOW)	pin 7	bi-directional
GND	Ground	-	-
NC	(not connected)	-	-
DIO <i>n</i>	Digital I/O	-	-

RS-422 Pin Assignment

J5				J4					
Port1:	NC	1	2	NC	Port5:	NC	1	2	NC
	TXD+1	3	4	TXD-1		TXD+5	3	4	TXD-5
	GND	5	6	RXD-1		GND	5	6	RXD-5
	RXD+1	7	8	NC		RXD+5	7	8	NC
	GND	9	10	DIO0		GND	9	10	DIO4
Port2:	NC	11	12	NC	Port6:	NC	11	12	NC
	TXD+2	13	14	TXD-2		TXD+6	13	14	TXD-6
	GND	15	16	RXD-2		GND	15	16	RXD-6
	RXD+2	17	18	NC		RXD+6	17	18	NC
	GND	19	20	DIO1		GND	19	20	DIO5
Port3:	NC	21	22	NC	Port7:	NC	21	22	NC
	TXD+3	23	24	TXD-3		TXD+7	23	24	TXD-7
	GND	25	26	RXD-3		GND	25	26	RXD-7
	RXD+3	27	28	NC		RXD+7	27	28	NC
	GND	29	30	DIO2		GND	29	30	DIO6
Port4:	NC	31	32	NC	Port8:	NC	31	32	NC
	TXD+4	33	34	TXD-4		TXD+8	33	34	TXD-8
	GND	35	36	RXD-4		GND	35	36	RXD-8
	RXD+4	37	38	NC		RXD+8	37	38	NC
	GND	39	40	DIO3		GND	39	40	DIO7

<i>Signal</i>	<i>Definition</i>	<i>DE-9 Pin</i>	<i>Direction</i>
TXD+n/TXD-n	Differential transmit data	-	Output
RXD+n/RXD-n	Differential receive data	-	Input
GND	Ground	-	-
NC	(not connected)	-	-
DIO _n	Digital I/O	-	-

Digital I/O and Counter/timer Connector

Connector J15 is a 1x10, single-row, right-angle connector that provides the following digital I/O and counter/timer signals.

1	DIO7
2	DIO5
3	DIO3
4	DIO1
5	Counter/timer In
2	DIO 6
4	DIO 4
6	DIO 2
8	DIO 0/Counter/timer Out
10	GND

<i>Signal</i>	<i>Definition</i>
DIO 0-7	Digital I/O; programmable direction
Counter/timer In	Counter/timer input
Counter/timer Out	Counter/timer output
GND	Ground

Board Configuration

The board provides jumper blocks to configure the following functions.

- Serial port protocol RS-232/422/485/TTL: 2 positions for each port.
- RS-422/485 RX and TX termination: 4 positions for each port.
- RS-485 echo yes/no per port: 1 position for each port.
- PCI slot ID: 2 positions for slot 0-3 selection.

For hardwired configuration, locations are provided on the PCB for 0-ohm resistors to be installed to replace each valid jumper position.

Serial Protocol Selection

Jumper blocks J7 through J14 are used to select the protocol for each serial port. Each jumper block configures one port, and each port may have its protocol set independently of the other ports.

In RS-422 or RS-485 networks, termination resistors are normally installed at the endpoints of the cables to minimize reflections on the lines. Emerald-MM-8Plus provides 150Ω resistors for this purpose. To enable resistor termination for a port, install jumpers in the locations *T* and *R* of that port's corresponding configuration jumper block as shown, below.

Note: Termination is only needed, and should only be used, at the cable endpoints. Enabling these termination resistors at each end of the cable results in an effective impedance of 60Ω. Installing termination resistors at additional points in the network may cause overloading and failure of the line drivers due to the lower impedance caused by multiple resistors in parallel.

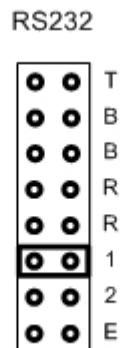
In RS-422 or RS-485 networks, biasing resistors are normally installed at the endpoints of the cables to force a known inactive state on the lines to reduce noise and eliminate line float by pulling the Data+ line to +5V and the Data- line to ground. Emerald-MM-8Plus provides 4.7KΩ resistors for this purpose. To enable resistor termination for a port, install jumpers in the locations *B* of that port's corresponding configuration jumper block as shown above. For RS422 networks the RX termination always has biasing resistors connected when used and the TX termination has the biasing resistor connections optional when used.

Note: Biasing is only needed, and should only be used, at one of the cable endpoints. Installing biasing resistors at additional points in the network may cause overloading and failure of the line drivers due to the lower impedance caused by multiple resistors in parallel.

RS-232 Selection

Figure 6 shows the J6 jumper setting to select the RS-232 protocol.

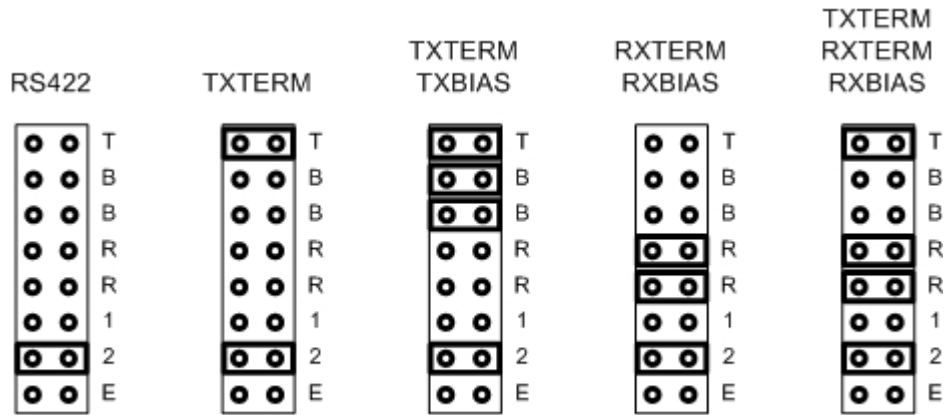
Figure 6: RS-232 Protocol Selection



RS-422 Selection

Figure 7 shows the J6 jumper settings to select the RS-422 protocol options.

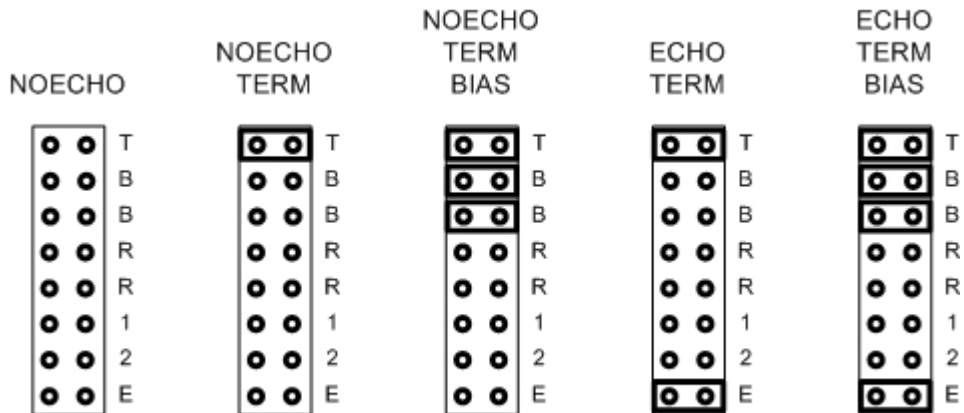
Figure 7: RS-422 Protocol Selection Options



RS-485 Selection

Figure 8 shows the J6 jumper settings to select the RS-485 protocol options.

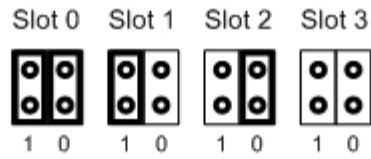
Figure 8: RS-485 Protocol Selection Options



PCI Slot ID Selection

Jumper block J6 sets the PCI slot ID using two jumpers, as shown in Figure 9. Take care in selecting the correct PCI slot to avoid resource conflicts in the software driver.

Figure 9: PCI Slot ID Selection Jumper



EEPROM Programming

Emerald-MM-8P has a 256-byte EEPROM, of which the lowest 64 bytes are addressable. The first eight locations are used to store the PCI vendor and device IDs, and the remaining bytes are available for user-defined functions.

<i>EEPROM Address</i>	<i>Function</i>
0	PCI Vendor ID, low byte
1	PCI Vendor ID, high byte
2	PCI Device ID, low byte
3	PCI Device ID, high byte
4	PCI Subsystem Vendor ID, low byte
5	PCI Subsystem Vendor ID, high byte
6	PCI Subsystem Device ID, low byte
7	PCI Subsystem Device ID, high byte
8-63	User-defined

Refer to the Exar Corporation datasheet for the XR17D158 UART, listed in the Additional Information section of this document, for EEPROM programming procedures.

Serial Communication

Eight serial ports are provided by the XR17D158 octal PCI UART chip. The input clock is driven by a 14.7456MHz crystal.

Serial Port Operation

Each port can be independently configured for RS-232, RS-422, RS-485 or TTL interface using jumpers or assembly options. RS-232 and TTL are mutually exclusive due to signal level incompatibility. If one transceiver is installed for a port, the other set is not. The standard configuration is RS-232/422/485 transceivers installed. Any individual port can be configured for TTL line levels as a custom assembly option.

Transceiver control is managed using the eight identical 2x8 jumper blocks, J7-J14.

In RS-485 mode, both local ECHO and NO ECHO modes are supported. In local echo mode the receiver is always on. In no echo mode, the receiver and transmitter are enabled alternately so that no echo is received during transmission. The output transceiver can be automatically enabled/disabled by setting a control bit in the modem status register (MSR) of the XR17D158. This causes RTS to automatically turn on before transmission starts and turn off after transmission ends. The transmitter disable delay after last bit transmission is programmable using bits in the MSR.

The RS-232 and RS-422/485 transceivers have built-in ESD protection. The TTL transceivers do not have ESD protection, however, they serve as protection for the UART in TTL mode.

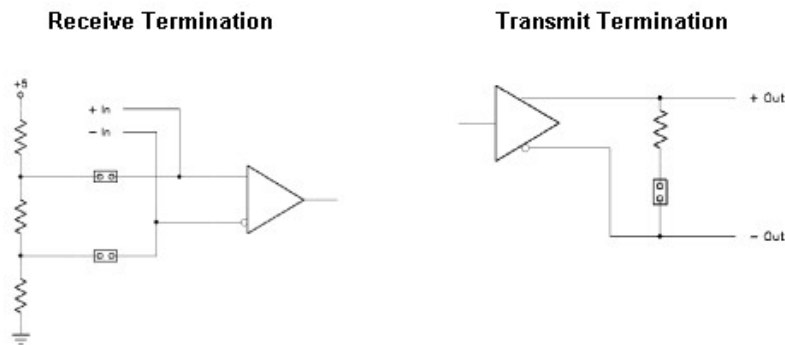
Line Termination

In RS-422 and RS-485 modes, 120-ohm, 0.25 watt termination resistors may be connected across the differential transceiver lines with jumpers. (One for transmit pair, one for receive pair in RS-422, one only for RS-485).

All UART port inputs have pull-up/pull-down resistors to force the inputs to their inactive state when the RS-422 or RS-485 protocol is selected. All TTL inputs have pull-up/pull-down resistors to force them to their inactive state when unconnected.

All RS-422/485 inputs have jumper-selectable pull-up/pull-down (bias) resistors to force them to their inactive states when unconnected. The pull-up/pull-down resistors must be high enough to prevent a false signal due to the voltage divider resulting from the pull-up, pull-down and line termination resistors (50mV threshold). See the example schematics for line termination and bias resistors, below.

Figure 10: Line Termination Schematics



Digital I/O and Counter/Timer

The XR17D158 UART offers 8 built-in digital I/O lines and a programmable counter/timer. The 8 DIO lines and the counter/timer signals are brought out to an 8-pin connector on the lower edge of the board.

The DIO and counter/timer signals are 3.3V nominal logic signals and have ESD protection.

The 8 DIO lines are also available on the 8 extra pins on the two serial I/O connectors to provide compatibility with EMM-8P. The user must be made aware of the limitation that only one source can be used for input, either the serial port connector or the dedicated DIO connector.

The counter/timer's output is multiplexed under software control to DIO 0. The counter/timer's input is programmable for either an internal clock or an external signal. The external signal is available on a pin on the digital I/O connector.

Specifications

Serial Ports

- No. of serial ports: 8
- Protocols: RS-232, RS-422, RS-485
- Maximum baud rate: 115kbps standard version (460.8kbps available by special order – contact factory)
- Communications parameters: 5, 6, 7, or 8 data bits; even, odd, or no parity
- Short circuit protection: All outputs protected against continuous short circuit

RS-232 mode

- Input impedance: 3K Ω min
- Input voltage swing: ± 30 V max
- Display type: ± 5 V min, ± 7 V typical

RS-422/RS-485 modes

- Differential input threshold: -0.2V min, +0.2V max
- Input impedance: 123K Ω min
- Input current: +1.0mA max ($V_{IN} = 12$ V)
-0.8mA max ($V_{IN} = -7$ V)
- Differential output voltage: 2.0V min ($R_L = 50\Omega$)
- High/low states differential output voltage symmetries: 0.2V max

Digital I/O

- No. of I/O lines: 8 in, 8 out
- Input voltage: Low: -0.3V min, 0.8V max
High: 2.0V min, 5.3V max
- Output voltage: Low: 0.0V min, 0.4V max ($I_{OL} = 6$ mA max)
High: 3.7V min, 5.0V max ($I_{OH} = -4$ mA max)

General

- Dimensions: 3.55" x 3.775" LxW (PC/104 standard)
- Power supply: +5VDC $\pm 10\%$
- Current consumption: 160mA typical, all outputs unloaded
- Operating temperature: -40° to +85° C
- Operating humidity: 5% to 95% non-condensing
- PC/104 bus: 8-bit and 16-bit bus headers are installed and used (16-bit header is used for interrupt levels only)
- I/O header: 2 40-position (2x20) .025" square pin header on .1" centers;
Headers mate with standard ribbon cable (IDC) connectors

Additional Information

Additional information can be found at the following websites.

1. Diamond Systems Corporation (<http://www.diamondsystems.com/>)
2. Datasheet, [XR17D158 Universal \(3.3V and 5V\) PCI Bus Octal UART](#), Exar Corporation, August 2005. (.pdf)

Technical Support

For technical support, please email support@diamondsystems.com or contact Diamond Systems Corporation technical support at 1-650-810-2500.