TS-SER4 Manual

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All modifications from previous versions are listed in the appendix.

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Fill out the RMA form completely and include it and dated proof of purchase with the defective unit being returned. Clearly print the RMA number on the outside of the package.

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Repairs made after the expiration of the warranty period are subject to a flat rate repair charge and the cost of return shipping. Please contact Technologic Systems to arrange for any repair service.

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1. Introduction

The TS-SER4 is a PC/104 expansion card with four serial ports using the PC standard 16C550 type UARTs (with 16-byte FIFOs). All four COM ports support RS-232 levels and two of these COM ports can optionally support RS-422/ RS-485 levels.

A flexible interrupt sharing design allows for a large number of COM ports using a minimum number of interrupts. An interrupt status register allows rapid identification of the interrupt source.

This product uses a multi-layer PCB with power and ground planes to minimize noise and EMI issues. The TS-SER4 only requires a single 5V power supply.

2. PC/104 Bus Interface

The TS-SER4 features a 16-bit PC/104 bus interface that allows access up to 11 IRQ lines. A lower cost version with an 8-bit PC/104 bus interface limits the interrupt selection to 6 IRQ lines (IRQ3, IRQ4, IRQ5, IRQ6, IRQ7, and IRQ9). A Xilinx programmable Logic Device (PLD) is used to decode the COM port addresses. This allows for a great amount of flexibility in the standard product and allows for custom configurations if they are necessary.

3. Serial Ports

The two serial ports that are labeled COM_A and COM_B support RS-232 levels only. These two ports support the full complement of standard RS-232 handshakes as shown in Table 1.

The two serial ports labeled COM_C and COM_D support a subset of RS-232C handshakes lines that is sufficient for the vast majority of applications. In addition these two ports can optionally have RS-485/RS-422 drivers. Table 2 lists the pin-outs for these ports.

The serial ports all use 16C550 UARTs, which provide 16 byte send and receive FIFOs, reducing the CPU overhead of high-speed serial communications.

The serial baud clock (common to all four serial ports) is derived from the PC/104 OSC (14.318 MHz) signal. If this signal is not present on the bus (all Technologic Systems products have this signal), it will be necessary to add a 3.6864 MHz crystal oscillator in the position labeled X1. This supplemental crystal oscillator can also be used to generate very high-speed baud rates

Pin #	RS-232 Signal
1	DCD
2	RX data
3	TX data
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI
10	-

Table 1
Pin-out for COM_A and COM_B Headers

(up to 1 Megabit/sec) or non-standard baud rates easily. The PC/104 OSC signal is always used as the clock source except when a crystal oscillator is installed. When a crystal oscillator is installed, it is always used to derive the baud clock.

5	4	3	2	1
10	9	8	7	6

Figure 1 - Serial Port Header Pin Location

Pin 1 is labeled with a dot in the legend

Pin	RS-232	RS-422	RS-485
1		TX+	RX/TX+
2	RXD		
3	TXD		
4		RX+	
5	GND	GND	GND
6		TX-	RX/TX-
7	RTS		
8	CTS		
9		RX-	
10			

Table 2

Pinout for COM_C and COM_D Headers

PLEASE NOTE: Not all serial adapter cables are alike! We are aware of at least two 'standard' pinouts for these cables. If you did not purchase your serial adapter cables from us, this may be an issue if the serial ports are not working.

4. COM Port Selection

The four COM ports can be configured as COM1 thru COM24. Jumpers (labeled COM1, COM2, COM4 and JP3) are used to select the base COM port using a binary weighting. COMA is always the base COM port selected. For example, if the four COM ports are to be configured as COM5 thru COM8 then jumpers “COM1” and “COM4” should be installed (1 + 4 = 5). In this case COMA would be COM5 and COMB, COMC, and COMD would be COM ports COM6, COM7, and COM8 respectively.

Table 3 documents jumper settings and the base COM port selected.

Jumper COM1	Jumper COM2	Jumper COM4	Jumper JP3	Control Reg. Base Address	Base COM Port Address
Yes	No	No	No	230h	COM1
No	Yes	No	No	230h	COM2
Yes	Yes	No	No	230h	COM3
No	No	Yes	No	230h	COM4
Yes	No	Yes	No	234h	COM5
No	Yes	Yes	No	234h	COM6
Yes	Yes	Yes	No	234h	COM7
No	No	No	No	238h	COM9
Yes	No	No	Yes	240h	COM13
No	Yes	No	Yes	240h	COM14
Yes	Yes	No	Yes	240h	COM15
No	No	Yes	Yes	240h	COM16
Yes	No	Yes	Yes	244h	COM17
No	Yes	Yes	Yes	244h	COM18
Yes	Yes	Yes	Yes	244h	COM19
No	No	No	Yes	248h	COM21

Table 3 – Base COM port Selection

Table 4 documents the physical I/O address locations for COM ports COM1 thru COM12. Since a Xilinx programmable logic device (PLD) is used to decode the I/O locations, it is possible to have the COM ports decoded at any location. Call Technologic Systems for more details.

There are four status registers associated with each TS-SER4 board. These registers contain the status of all the jumpers and also the status of the interrupts for each COM port. These four registers have different I/O locations depending upon the Base COM port selected. This allows for multiple TS-SER4 boards to be installed. Table 3 documents where the base address for these control and status registers is located. There are a total of six different Base locations to allow a total of six TS-SER4 boards in a single system. Using a custom configuration in the Xilinx PLD, it is possible to have more than three boards in a system.

COM Port	I/O location (Hex)
COM1	3F8
COM2	2F8
COM3	3E8
COM4	2E8
COM5	3A8
COM6	2A8
COM7	3A0
COM8	2A0
COM9	398
COM10	298
COM11	390
COM12	290
COM13	378
COM14	278
COM15	368
COM16	268
COM17	328
COM18	228
COM19	320
COM20	220
COM21	318
COM22	218
COM23	310
COM24	210

Table 4 – COM port I/O locations

5. Control and Status Registers

There are four registers on each TS-SER4 board (unrelated to the UARTs). These registers are documented in Table 5 below. The first three registers are “Read Only” while in the fourth register bit 7 is “Read/Write” and bits 0-6 are “Read Only”. For all registers, if a condition is true, a logic “1” is returned. For example, when a jumper is present, a logic “1” is returned. For the Base + 1 address, if an interrupt is pending, the respective status bit is set to a logic “1”.

The Base address (Base + 0) always returns a fixed value of 7A (Hex).

The Base + 1 address returns the status of the 4 interrupt sources from COM_A, COM_B, COM_C, and COM_D. This is essential for sharing interrupts and allows the interrupt service routine to determine which COM port has an interrupt pending. When any of these sources has an interrupt pending, the respective status bit is set.

The Base + 2 address returns the status of the jumpers that determine the Base COM port location (jumpers J_com1 thru J_com4) and the Base IRQ selected (jumpers J_irq1 thru J_irq8).

The Base + 3 address has the RS-485 option bit returned on bit 6. Bits 0-4 return the status of other miscellaneous jumpers. Bit 7 of this register is readable and writeable. When set, bit 7 enables RS-485 and RS-422 operation. At power-up or system reset, bit 7 is initialize to a zero (RS-485 disabled). Note bit 6 must set (RS-485 option is populated) in order for RS-485 or RS-422 to function.

Address	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Base + 0	0	1	1	1	1	0	1	0
Base + 1					INT_D	INT_C	INT_B	INT_A
Base + 2		J_com4	J_com2	J_com1	J_irq8	J_irq4	J_irq2	J_irq1
Base + 3	En_485	OP_485		J_JP3	J_JP2	J_JP1	J_2xBaud	J_2irq

Table 5 - TS-SER4 Control and Status Registers

6. Interrupt Selection

The TS-SER4 has four interrupt sources (COM_A thru COM_D) that can be routed to one or two of 11 possible PC/104 interrupts. Jumpers are used to select which interrupts are used.

The jumpers use a simple addition algorithm to select the interrupt. For example, if you wish to use IRQ6, then the jumpers labeled IRQ2 and IRQ4 should be installed (4 + 2 = 6).

Either a single interrupt or two interrupts may be used. All four sources are mapped to a single interrupt when jumper “2-IRQs” is not installed. When this jumper is installed, the COM_A and COM_C interrupts are routed to the lower IRQ and COM_B and COM_D interrupts are routed to the higher IRQ as shown in Table 6. The Interrupt status register can be read to determine which COM port is the source of the interrupt.

See Section 5.

Jumper IRQ1	Jumper IRQ2	Jumper IRQ4	Jumper IRQ8	Jumper 2-IRQs	IRQ Selected
Yes	Yes	No	No	No	IRQ3
No	No	Yes	No	No	IRQ4
Yes	No	Yes	No	No	IRQ5
No	Yes	Yes	No	No	IRQ6
Yes	Yes	Yes	No	No	IRQ7
Yes	No	No	Yes	No	IRQ9
No	Yes	No	Yes	No	IRQ10
Yes	Yes	No	Yes	No	IRQ11
No	No	Yes	Yes	No	IRQ12
No	Yes	Yes	Yes	No	IRQ14
Yes	Yes	Yes	Yes	No	IRQ15
Yes	Yes	No	No	Yes	3 and 4
No	No	Yes	No	Yes	4 and 5
Yes	No	Yes	No	Yes	5 and 6
No	Yes	Yes	No	Yes	6 and 7
Yes	Yes	Yes	No	Yes	7 and 9
Yes	No	No	Yes	Yes	9 and 10
No	Yes	No	Yes	Yes	10 and 11
Yes	Yes	No	Yes	Yes	11 and 12
No	No	Yes	Yes	Yes	12 and 14
No	Yes	Yes	Yes	Yes	14 and 15

Table 6 – Interrupt Selection

7. RS-485 and RS-422

COM_C and COM_D can support RS-232 or RS-485 or RS-422 protocols. Jumpers are used to select which mode is to be used for each port. There are also jumpers to add 120 ohm termination resistors for the TX and RX pairs. Termination resistors may be required when running very long distances at high baud rates. The TS-SER4 board supports either half-duplex or full duplex operation. The jumpers are labeled “RS-485” to select half-duplex (single pair operation) and the jumpers are labeled “RS-422” for full duplex operation (two pairs required).

The transmit enable for the RS-485 driver is controlled by the RTS signal. The RTS signal must be asserted true to enable the RS-485 driver. When RTS is deasserted it disables the transmit driver and enables the RS-485 receiver. The RTS signal has no effect on the RS-422 receiver. The RS-422 receiver is always functional. But RTS must be asserted to enable the RS-422 driver.

There is a control bit (See Section 5) that must be set for proper RS-485 or RS-422 operation. This bit must be set once and does not need to be updated. This enable bit solves a problem when RTS is asserted during boot. The BIOS and some Operating Systems toggle RTS during boot, which could cause it to “jam” the RS-485 bus.

There is also a status bit indicates if the TS-SER4 is populated with the RS-485 option.

8. 2X Baud Clock

The Jumper labeled “2x Baud” can be installed to cause all baud rates to be twice as high as the standard UART programming would indicate. For example, when a divisor of “1” written into the UART baud rate register, this would normally provide a baud rate of 115.2 Kbaud. But when jumper “2x Baud” is installed, this same divisor will yield a baud rate of 230.4 Kbaud.

When the external crystal oscillator is installed, this jumper also doubles the effective baud rate. If a 3.6864 MHz oscillator is installed, standard baud rates are obtained. If a 16.0 MHz oscillator is installed and jumper “2x Baud” is installed, a baud rate of 1 Megabit/second is obtained. This is the maximum clock rate that the TL16C554 chip can handle.

By adjusting the frequency of the external crystal oscillator (and also the divisor in the UART), any non-standard baud rate can be obtained.

9. Jumpers JP1, JP2

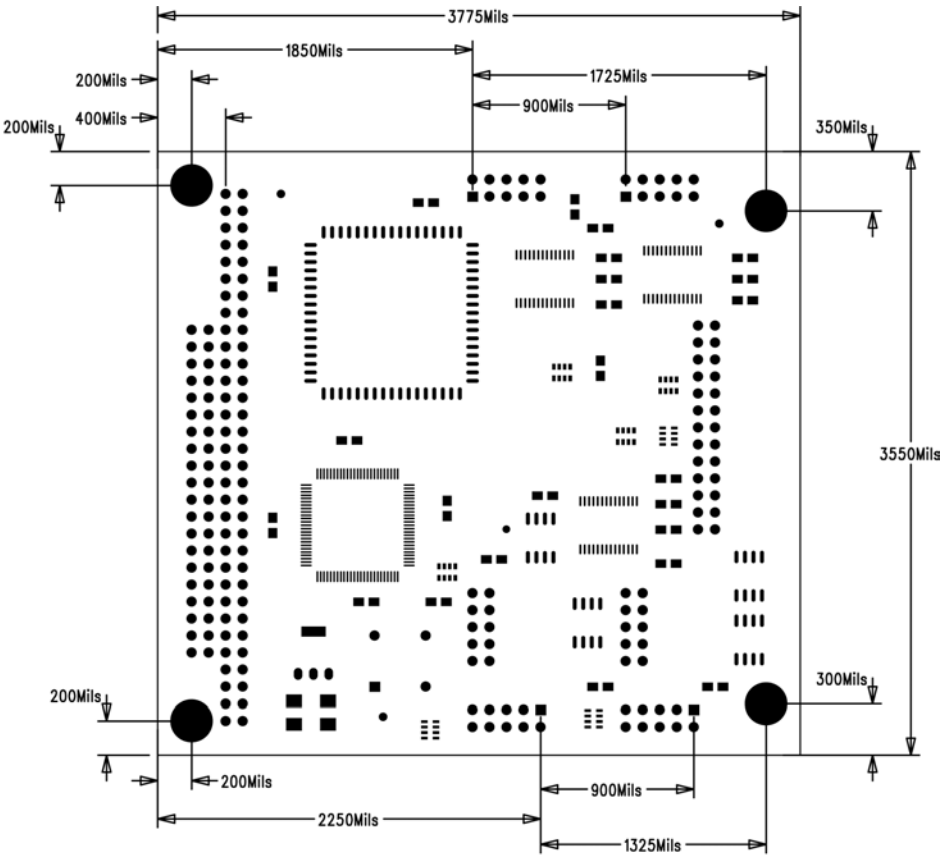
These jumpers are not defined at this time. We may have some special functions for these jumpers in the future. For example, we had intended to support automatic RS-485 on the TS-SER4. The board was designed to allow for this capability, but the limited number of macrocells in the Xilinx PLD has forced us to forgo this functionality. The flexibility of the Xilinx PLD allows us to change this if required. For example, if we limited the number of IRQs that could be selected, we could gain enough macrocells to implement automatic RS-485 capability.

These jumpers can be read back in the status register, so they can be used as “User Jumpers” If there is a special feature you require, contact Technologic Systems.

10. Temperature Range

The TS-SER4 is available in both standard temperature (0-70 degrees Celsius) and in extended temperature range of –40 to +85 degrees Celsius.

Appendix A Visuals



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Appendix B Manual Revisions

Date	Revision
04.30.2003	Document Created
06.05.2009	Updated mailing address