

November 2003

EXAR XR16L580 COMPARED WITH TI'S TL16C550C (48-TQFP)

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1.0 INTRODUCTION

This application note describes the major differences between Exar's XR16L580 and TI's TL16C550C (PT and PFB packages). This application note is applicable to the 48-TQFP package only. These devices are very similar, with a few minor hardware, bus timing and firmware-related differences. In most applications, the XR16L580IM will fit and operate in a TL16C550CPT or TL16C550CPFB socket.

1.1 HARDWARE DIFFERENCES (48-TQFP)

- The XR16L580 and TL16C550C are both available in the 48-pin TQFP package. Additionally, the XR16L580 is available in the 32-pin QFN package and the TL16C550C is available in the 44-pin PLCC and 40-pin PDIP packages. In the 48-pin TQFP package, the XR16L580 and TL16C550C are pin-to-pin compatible, but some legacy signals are not available ("No Connects") in the XR16L580 (see Table 1). These legacy signals are typically not used in most applications, hence they are likely not needed.
- The XR16L580 has two new pins, 16/68# pin to select Intel or Motorola bus and PwrSave pin to reduce I_{sleep} (sleep current) to less than 30 uA in Sleep mode. The Power-Save feature is perfect for battery operated designs. These two pins are 'No Connects' in the TL16C550C. Since the 16/68# pin has an internal pull-up resistor and the PwrSave pin has an internal pull-down resistor in the XR16L580IM, these pins can be left open when installing the XR16L580 into the TL16C550C socket. The pads on the PCB for these two pins should have no connection.
- The 32-pin QFN package of the XR16L580 is a new package and should be considered for new designs. It is the industry's smallest package full-featured UART well suited for limited board space designs.
- The oscillator circuitry is similar, but there are some differences when using a crystal oscillator and when using an external clock. See Figure 1 below for the differences in the oscillator circuitry for a crystal oscillator. For most cases, the XR16L580 will work with the oscillator circuitry for the TL16C550C. When using an external clock input for frequencies greater than 24 MHz, the XR16L580 will require a 2K pull-up resistor on the XTAL2 pin. For applications using crystal clock frequencies in the range 1.8432-14.7456MHz, there is virtually no difference in the set up.

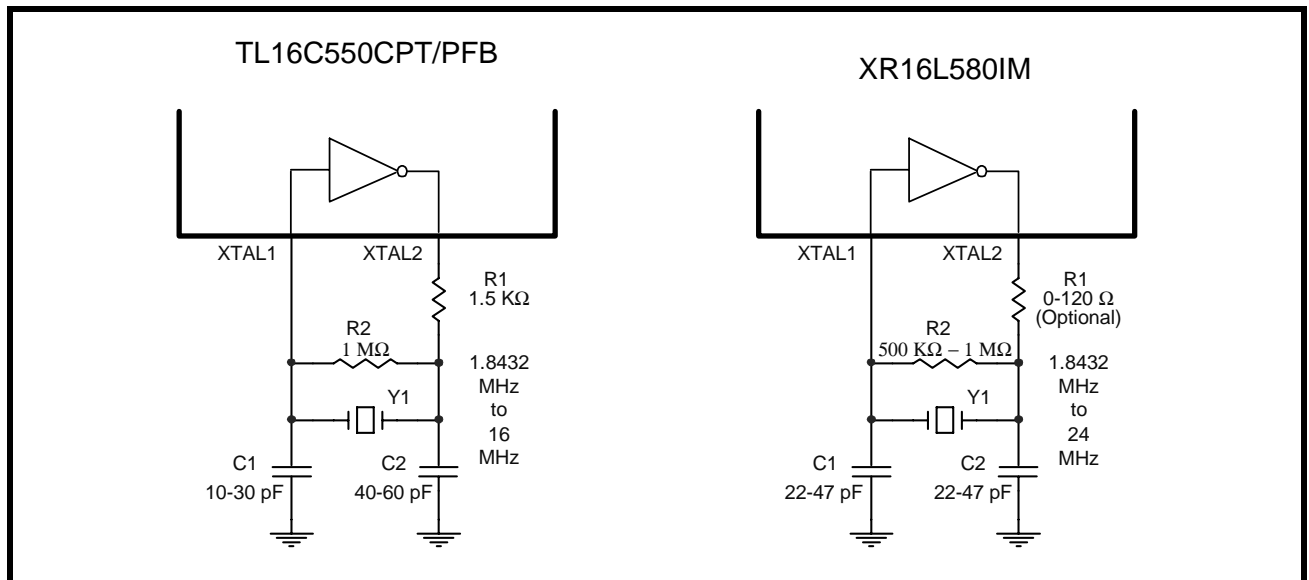
1.2 BUS TIMING DIFFERENCES**1.2.1 Chip Select (-CS) and Read (-IOR) / Write (-IOW) Timing**

The TL16C550C requires that the -CS pin be asserted first before the -IOR or -IOW pin and the -IOR or -IOW pin must be de-asserted before the -CS pin is de-asserted. During a read, the Exar UARTs can have either the -CS or the -IOR signal asserted first and have either signal be de-asserted first. The signals are wire-ORed in the Exar UARTs, therefore the second signal asserted will initiate the read cycle and the first signal de-asserted terminates the read cycle. The same is true during a write for -CS and -IOW. The flexibility of the Exar UARTs timing can be important in DSP, ARM, and MIPS designs. Also, because of this flexibility, the Exar UARTs will work with the timing used for the TL16C550C.

TABLE 1: LEGACY SIGNALS IN THE TL16C550C, 48-TQFP PACKAGE

PIN NAMES	48-TQFP PIN#	DESCRIPTION
RCLK	5	The RCLK needs to be connected to the BAUDOUT external to the uart on the TL16C550C. This is done internally in the XR16L580.
-BAUDOUT	12	
CS0	9	These are redundant Chip Select signals on the TL16C550C and have been removed in the XR16L580.
CS1	10	
IOR	20	These are redundant control signals on the TL16C550C and have been removed in the XR16L580.
IOW	17	
-TXRDY	23	These are status indicator outputs on the TL16C550C that are rarely used in most applications and have been removed in the XR16L580.
-RXRDY	29	
-AS	24	The Address Strobe signal is used to latch the address inside the uart on the TL16C550C. The XR16L580 automatically latches the address internally and hence this signal has been removed.
-DDIS	22	Data Disable output. Rarely used in today's applications.
-OP1	34	General Purpose outputs. Rarely used in today's applications.
-OP2	31	

FIGURE 1. CRYSTAL OSCILLATOR CIRCUITRY DIFFERENCES



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1.3 FIRMWARE DIFFERENCES BETWEEN THE XR16L580 AND TL16C550C

The internal registers in the XR16L580 and TL16C550C are similar with some exceptions:

TABLE 2: XR16L580 AND TL16C550C REGISTER SET DIFFERENCES

A2:A0	R/W	XR16L580	TL16C550C
LCR Bit-7 = 0			
001	R/W	Interrupt Enable Register (IER) <ul style="list-style-type: none"> • Bit-7 = Auto CTS# Interrupt Enable • Bit-6 = Auto RTS# Interrupt Enable • Bit-5 = Xoff Interrupt Enable • Bit-4 = Sleep Mode Enable 	Interrupt Enable Register (IER) <ul style="list-style-type: none"> • Bit-7 = Not Used • Bit-6 = Not Used • Bit-5 = Not Used • Bit-4 = Not Used
010	W	FIFO Control Register (FCR) <ul style="list-style-type: none"> • Bit-5 = TX FIFO Trigger Level Select Bit-1 • Bit-4 = TX FIFO Trigger Level Select Bit-0 	FIFO Control Register (FCR) <ul style="list-style-type: none"> • Bit-5 = Not Used • Bit-4 = Not Used
010	R	Interrupt Status Register (ISR) <ul style="list-style-type: none"> • Bit-5 = RTS/CTS Interrupt • Bit-4 = Xoff or Special Character Interrupt 	Interrupt Status Register (ISR) <ul style="list-style-type: none"> • Bit-5 = Not Used • Bit-4 = Not Used
100	R/W	Modem Control Register (MCR) <ul style="list-style-type: none"> • Bit-7 = BRG Prescaler Select • Bit-6 = IR Mode Enable • Bit-5 = Xon any (while in Xoff state, start transmission upon receiving any character) • Bit-2 = control OP1 output (in internal loopback)/ Invert Infrared RX signal polarity (if EFR bit-4 = 1) 	Modem Control Register (MCR) <ul style="list-style-type: none"> • Bit-7 = Not Used • Bit-6 = Not Used • Bit-5 = Auto RTS/CTS Flow Control Enable • Bit-2 = control OP1 output
LCR = 0xBF			
010	R/W	Enhanced Feature Register (EFR) <ul style="list-style-type: none"> • Auto RTS/CTS Enable, Enhanced Functions Enable, Software Flow Control Select 	N/A
100	R/W	XON1	N/A
101	R/W	XON2	N/A
110	R/W	XOFF1	N/A
111	R/W	XOFF2	N/A

R = Read-Only, W = Write-Only, R/W = Read/Write

2.0 SUMMARY OF DIFFERENCES BETWEEN THE XR16L580 AND TL16C550C

The differences between the XR16L580 and TL16C550C are summarized in the table below.

TABLE 3: DIFFERENCES BETWEEN EXAR'S XR16L580 AND TI'S TL16C550C

COMPARISON	XR16L580	TL16C550C
Data Bus Standard	Intel or Motorola	Intel
Power Supply Operation	2.5, 3.3 and 5 V	3.3 and 5 V
5V Tolerant Inputs	Yes	No
Max Frequency on XTAL1	24 MHz @ 2.5V 33 MHz @ 3.3V 50 MHz @ 5V	14 MHz @ 3.3V 16 MHz @ 5V
BRG Prescaler	1 or 4	1
Package	32-QFN, 48-TQFP	44-PLCC, 48-TQFP, 40-PDIP
Extra Pins Available in XR16L580	16/68#, PwrSave	N/A
Extra Pins Available in TL16C550C and ST1C550	N/A (RCLK is internally connected to Baudout)	RCLK, CS0, CS1, Baudout, WR2, RD2, DDIS, -TXRDY, -ADS, -RXRDY, -OUT1, -OUT2
Operating Temperature Ranges	Industrial	Commercial and Industrial
48-pin package thickness	1.2 mm (TQFP)	1.6 mm (LQFP)
TX/RX FIFO Size	16	16
TX/RX Trigger Tables	1 Trigger Table	1 Trigger Table
TX FIFO Interrupt Trigger Levels	4 Selectable	1
RX FIFO Interrupt Trigger Levels	4 Selectable	4 Selectable
Wake-up Interrupt	Yes	No
Hardware Flow Control	Auto RTS/CTS Flow Control	Auto RTS/CTS Flow Control
Software Flow Control	Auto Xon/Xoff Flow Control	No
Infrared Mode	IrDA encoder/decoder (ver 1.0)	No
Invert Infrared RX signal control	Yes	No
Sleep Mode	Sleep Mode with Auto Wake-up	No
Low Power Mode	Yes (Power-Save)	No
Diagnostic Modes	Local Loopback	Local Loopback

3.0 REPLACING THE TL16C550CPT/PFB WITH THE XR16L580IM IN THE 48-TQFP PACKAGE

You can install the XR16L580IM into the TL16C550C socket with no hardware changes when using the 48-TQFP package under these conditions: crystal oscillator frequency of 1.8432 - 14.7456 MHz, the legacy signals in Table 1 are unused and the pads for the 16/68# and PwrSave pins have no connections.

When replacing the TL16C550CPT/PFB with the XR16L580IM and if Auto RTS/CTS flow control feature is used (MCR bit-5), the software will need to be modified since Auto RTS/CTS Hardware Flow Control is enabled differently in the XR16L580. Also, one can take advantage of the enhanced features in the XR16L580 that are not available in the TL16C550C, like Sleep Mode with Power-Save, Automatic Xon/Xoff Software Flow Control, and Infrared Mode.

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