

November 2003

**EXAR'S XR16L580 COMPARED WITH INDUSTRY STANDARD 16550 UART**

Author: PY

**1.0 INTRODUCTION**

This application note describes the major differences between Exar's XR16L580 and the industry standard 16550 UART (referred to as "16550" in this document). 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 16550 are both available in the 48-pin TQFP package. Additionally, the 16550 can also be found in the 40-pin PDIP and 44-pin PLCC packages. The XR16L580 is not available in those packages but is available in the 32-pin QFN package. In the 48-pin TQFP package, the XR16L580 is pin-to-pin compatible with the industry standard 16550, 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 16550. Since the 16/68# pin has an internal pull-up resistor and the PwrSave pin has an internal pull-down resistor in the XR16L580, these pins can be left open when installing the XR16L580 into any 16550 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 only. It is the industry's smallest package UART.
- For most cases, the XR16L580 will work with the oscillator circuitry for any industry standard 16550 UART. 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 1.8432-14.7456 MHz, 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**

Some of the 16550 UARTs require 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 XR16L580, 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 XR16L580 timing can be important in DSP, ARM, and MIPS designs. Also, because of this flexibility, the XR16L580 will work with the timing used for the 16550.

**TABLE 1: LEGACY SIGNALS IN THE INUDSTRY STANDARD 16550, 48-TQFP PACKAGE**

<b>PIN NAMES</b>	<b>48-TQFP PIN#</b>	<b>DESCRIPTION</b>
RCLK	5	The RCLK needs to be connected to the BAUDOUT external to the uart on the 16550. This is done internally in the XR16L580.
-BAUDOUT	12	
CS0	9	These are redundant Chip Select signals on the 16550 and have been removed in the XR16L580.
CS1	10	
IOR	20	These are redundant control signals on the 16550 and have been removed in the XR16L580.
IOW	17	
-TXRDY	23	These are status indicator outputs on the 16550 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 16550. 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	

# DATA COMMUNICATIONS APPLICATION NOTE

## DAN139



### 1.3 FIRMWARE DIFFERENCES BETWEEN THE XR16L580 AND INDUSTRY STANDARD 16550

The internal registers in the XR16L580 and 16550 are similar with some exceptions:

**TABLE 2: XR16L580 AND 16550 REGISTER SET DIFFERENCES**

A2:A0	R/W	XR16L580	STANDARD 16550
<b>LCR Bit-7 = 0</b>			
001	R/W	<b>Interrupt Enable Register (IER)</b> <ul style="list-style-type: none"> <li>• Bit-7 = Auto CTS# Interrupt Enable</li> <li>• Bit-6 = Auto RTS# Interrupt Enable</li> <li>• Bit-5 = Xoff Interrupt Enable</li> <li>• Bit-4 = Sleep Mode Enable</li> </ul>	<b>Interrupt Enable Register (IER)</b> <ul style="list-style-type: none"> <li>• Bit-7 = Not Used</li> <li>• Bit-6 = Not Used</li> <li>• Bit-5 = Not Used</li> <li>• Bit-4 = Not Used</li> </ul>
010	W	<b>FIFO Control Register (FCR)</b> <ul style="list-style-type: none"> <li>• Bit-5 = TX FIFO Trigger Level Select Bit-1</li> <li>• Bit-4 = TX FIFO Trigger Level Select Bit-0</li> </ul>	<b>FIFO Control Register (FCR)</b> <ul style="list-style-type: none"> <li>• Bit-5 = Not Used</li> <li>• Bit-4 = Not Used</li> </ul>
010	R	<b>Interrupt Status Register (ISR)</b> <ul style="list-style-type: none"> <li>• Bit-5 = RTS/CTS Interrupt</li> <li>• Bit-4 = Xoff or Special Character Interrupt</li> </ul>	<b>Interrupt Status Register (ISR)</b> <ul style="list-style-type: none"> <li>• Bit-5 = Not Used</li> <li>• Bit-4 = Not Used</li> </ul>
100	R/W	<b>Modem Control Register (MCR)</b> <ul style="list-style-type: none"> <li>• Bit-7 = BRG Prescaler Select</li> <li>• Bit-6 = IR Mode Enable</li> <li>• Bit-5 = Xon any (while in Xoff state, start transmission upon receiving any character)</li> <li>• Bit-2 = control OP1 output (in internal loopback mode only) / Invert Infrared RX signal polarity (if EFR bit-4 = 1)</li> </ul>	<b>Modem Control Register (MCR)</b> <ul style="list-style-type: none"> <li>• Bit-7 = Not Used</li> <li>• Bit-6 = Not Used</li> <li>• Bit-5 = Not Used</li> <li>• Bit-2 = control OP1 output</li> </ul>
<b>LCR = 0xBF</b>			
010	R/W	<b>Enhanced Feature Register (EFR)</b> <ul style="list-style-type: none"> <li>• Auto RTS/CTS Enable, Enhanced Functions Enable, Software Flow Control Select</li> </ul>	N/A
100	R/W	<b>XON1</b>	N/A
101	R/W	<b>XON2</b>	N/A
110	R/W	<b>XOFF1</b>	N/A
111	R/W	<b>XOFF2</b>	N/A

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

### 2.0 SUMMARY OF DIFFERENCES BETWEEN THE XR16L580 AND INDUSTRY STANDARD 16550 UART

The differences between the XR16L580 and most industry standard 16550 UARTs are summarized in the table below.

**TABLE 3: DIFFERENCES BETWEEN EXAR'S XR16L580 AND INDUSTRY STANDARD 16550**

COMPARISON	XR16L580	STANDARD 16550
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	16 MHz @ 2.5V 32 MHz @ 3.3V 48 MHz @ 5V	16 MHz @ 3.3V 24 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	No
Extra Pins Available in 16550	N/A (RCLK is internally connected to Baudout)	RCLK, CS0, CS1, Baudout, IOW, IOR, DDIS, -TXRDY, -AS, -RXRDY, -OP1, -OP2
Operating Temperature Ranges	Industrial	Commercial and Industrial
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	No
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 INDUSTRY STANDARD 16550 UART WITH THE XR16L580 IN THE 48-TQFP PACKAGE

The XR16L580 can be installed into any industry standard 16550 UART 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.

The software will need to be updated to take advantage of the enhanced features in the XR16L580 that are not available in the industry standard 16550 like Sleep Mode with Power-Save, Automatic RTS/CTS Hardware Flow Control, Automatic Xon/Xoff Software Flow Control, and Infrared Mode.

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