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GENERAL DESCRIPTION

The XR16L2550[1] (L2550) is a dual universal asynchronous receiver and transmitter (UART). The XR16L2550 is an improved version of the ST16C2550 UART with lower operating voltages and 5 volt tolerant inputs. The L2550 provides enhanced UART functions with 16 byte FIFOs, a modem control interface and data rates up to 4 Mbps. Onboard status registers provide the user with error indications and operational status. System interrupts and modem control features may be tailored by external software to meet specific user requirements. Independent programmable baud rate generators are provided to select transmit and receive clock rates up to 3.125 Mbps. The Baud Rate Generator can be configured for either crystal or external clock input. An internal loopback capability allows onboard diagnostics. The L2550 is available in a 44-pin PLCC, 48-pin TQFP and 32-pin QFN packages. The L2550 is fabricated in an advanced CMOS process.

NOTE: *1 Covered by U.S. Patent #5,649,122.*

APPLICATIONS

- Portable Appliances
- Medical Monitors
- Base Stations
- Micro Servers
- Telecommunication Network Routers
- Industrial Automation Controls

FEATURES

- **2.25 to 5.5 Volt operation**
- **5 Volt tolerant inputs**
- Pin-to-pin compatible to Exar's ST16C2450, ST16C2550 and XR16L2750 in 44-PLCC and 48-TQFP packages
- Pin-to-pin compatible to XR16C2850 in 44-PLCC
- Pin alike XR16L2551, XR16L2751 and XR16C2850 in 48-TQFP package
- Two independent UART channels
  - Up to 3.125Mbps with external clock of 50 MHz
  - Register Set compatible to 16C550
  - 16 byte Transmit FIFO to reduce the bandwidth requirement of the external CPU
  - 16 byte Receive FIFO with error tags to reduce the bandwidth requirement of the external CPU
  - 4 selectable Receive FIFO interrupt trigger levels
  - **Automatic RTS/CTS hardware flow control**
  - **Automatic Xon/Xoff software flow control**
  - **Wireless infrared encoder/decoder**
  - Full Modem Interface (CTS#, RTS#, DSR#, DTR#, RI#, CD#)
  - Programmable character lengths (5, 6, 7, 8) with even, odd, or no parity
- **Tiny 32-QFN, no lead package (5x5x0.9mm)**
- 44-PLCC and 48-TQFP packages also available

FIGURE 1. XR16L2550 BLOCK DIAGRAM

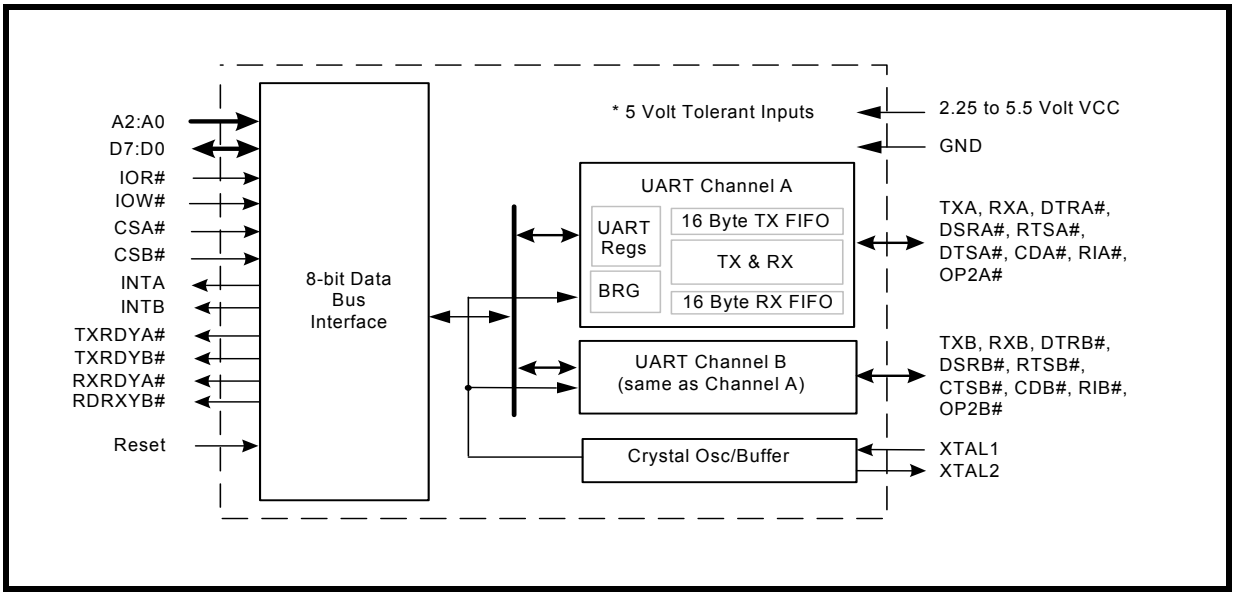
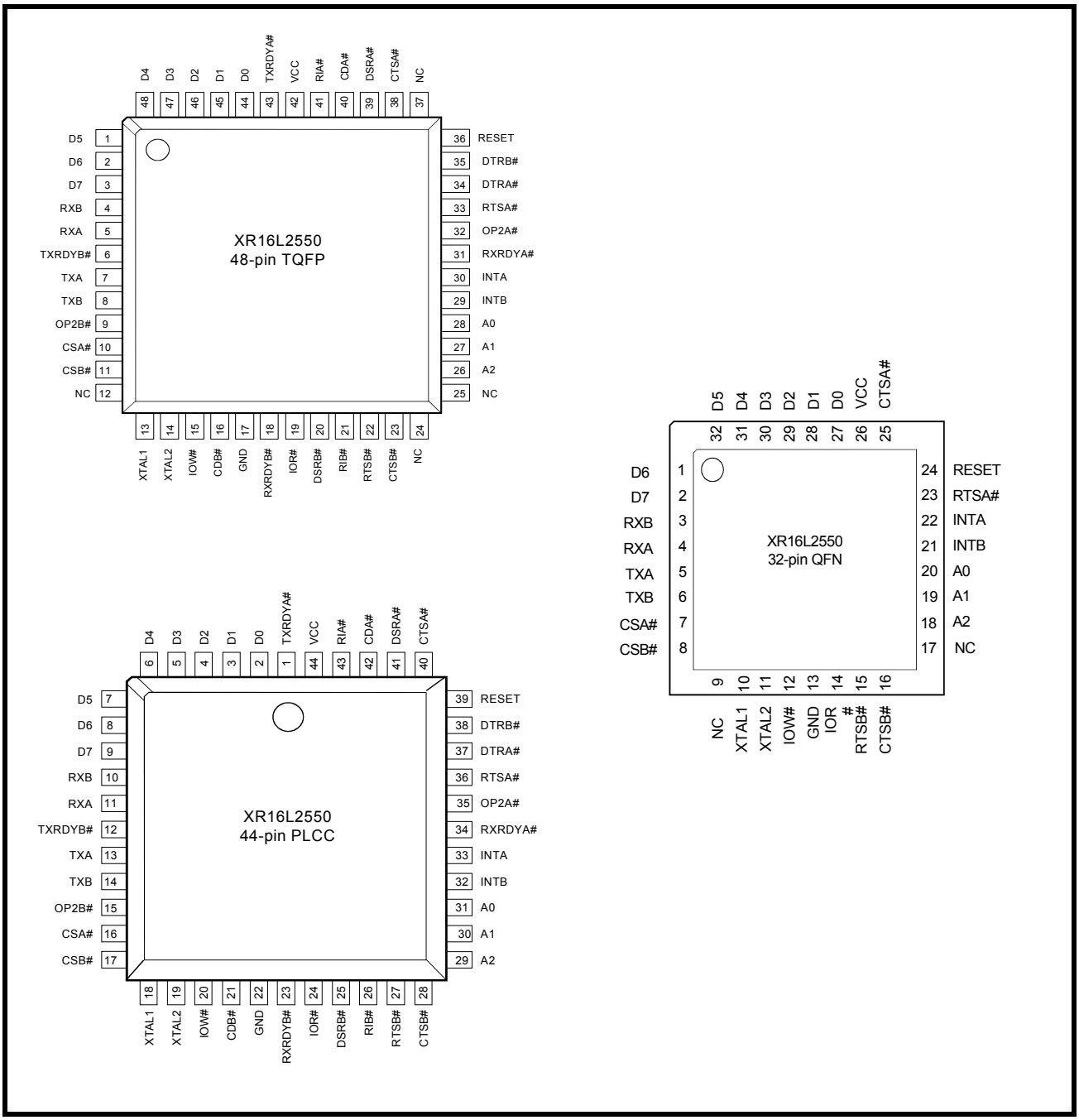


FIGURE 2. PIN OUT ASSIGNMENT



ORDERING INFORMATION

PART NUMBER	PACKAGE	OPERATING TEMPERATURE RANGE	DEVICE STATUS
XR16L2550IL	32-Lead QFN	-40°C to +85°C	Active
XR16L2550IJ	44-Lead PLCC	-40°C to +85°C	Active
XR16L2550IM	48-Lead TQFP	-40°C to +85°C	Active

PIN DESCRIPTIONS

Pin Description

NAME	32-QFN PIN #	44-PLCC PIN #	48-TQFP PIN #	TYPE	DESCRIPTION
DATA BUS INTERFACE					
A2 A1 A0	18 19 20	29 30 31	26 27 28	I	Address data lines [2:0]. These 3 address lines select one of the internal registers in UART channel A/B during a data bus transaction.
D7 D6 D5 D4 D3 D2 D1 D0	2 1 32 31 30 29 28 27	9 8 7 6 5 4 3 2	3 2 1 48 47 46 45 44	IO	Data bus lines [7:0] (bidirectional).
IOR#	14	24	19	I	Input/Output Read Strobe (active low). The falling edge instigates an internal read cycle and retrieves the data byte from an internal register pointed to by the address lines [A2:A0]. The data byte is placed on the data bus to allow the host processor to read it on the rising edge.
IOW#	12	20	15	I	Input/Output Write Strobe (active low). The falling edge instigates an internal write cycle and the rising edge transfers the data byte on the data bus to an internal register pointed by the address lines.
CSA#	7	16	10	I	UART channel A select (active low) to enable UART channel A in the device for data bus operation.
CSB#	8	17	11	I	UART channel B select (active low) to enable UART channel B in the device for data bus operation.
INTA	22	33	30	O	UART channel A Interrupt output. The output state is defined by the user and through the software setting of MCR[3]. INTA is set to the active mode (active high) and OP2A# output to a logic 0 when MCR[3] is set to a logic 1. INTA is set to the three state mode and OP2A# to a logic 1 when MCR[3] is set to a logic 0 (Default).
INTB	21	32	29	O	UART channel B Interrupt output. The output state is defined by the user and through the software setting of MCR[3]. INTB is set to the active mode and OP2B# output to a logic 0 when MCR[3] is set to a logic 1. INTB is set to the three state mode and OP2B# to a logic 1 when MCR[3] is set to a logic 0 (Default).
TXRDYA#	-	1	43	O	UART channel A Transmitter Ready (active low). The output provides the TX FIFO/THR status for transmit channel A. If it is not used, leave it unconnected.
RXRDYA#	-	34	31	O	UART channel A Receiver Ready (active low). This output provides the RX FIFO/RHR status for receive channel A. If it is not used, leave it unconnected.

Pin Description

NAME	32-QFN PIN #	44-PLCC PIN #	48-TQFP PIN #	TYPE	DESCRIPTION
TXRDYB#	-	12	6	O	UART channel B Transmitter Ready (active low). The output provides the TX FIFO/THR status for transmit channel B. If it is not used, leave it unconnected.
RXRDYB#	-	23	18	O	UART channel B Receiver Ready (active low). This output provides the RX FIFO/RHR status for receive channel B. If it is not used, leave it unconnected.
MODEM OR SERIAL I/O INTERFACE					
TXA	5	13	7	O	UART channel A Transmit Data. If it is not used, leave it unconnected.
RXA	4	11	5	I	UART channel A Receive Data. Normal receive data input must idle at logic 1 condition. If it is not used, tie it to VCC or pull it high via a 100k ohm resistor.
RTSA#	23	36	33	O	UART channel A Request-to-Send (active low) or general purpose output. This output must be asserted prior to using auto RTS flow control, see EFR[6], MCR[1] and IER[6]. If it is not used, leave it unconnected.
CTSA#	25	40	38	I	UART channel A Clear-to-Send (active low) or general purpose input. It can be used for auto CTS flow control, see EFR[7] and IER[7]. This input should be connected to VCC when not used.
DTRA#	-	37	34	O	UART channel A Data-Terminal-Ready (active low) or general purpose output. If it is not used, leave it unconnected.
DSRA#	-	41	39	I	UART channel A Data-Set-Ready (active low) or general purpose input. This input should be connected to VCC when not used. This input has no effect on the UART.
CDA#	-	42	40	I	UART channel A Carrier-Detect (active low) or general purpose input. This input should be connected to VCC when not used. This input has no effect on the UART.
RIA#	-	43	41	I	UART channel A Ring-Indicator (active low) or general purpose input. This input should be connected to VCC when not used. This input has no effect on the UART.
OP2A#	-	35	32	O	Output Port 2 Channel A - The output state is defined by the user and through the software setting of MCR[3]. INTA is set to the active mode and OP2A# output to a logic 0 when MCR[3] is set to a logic 1. INTA is set to the three state mode and OP2A# to a logic 1 when MCR[3] is set to a logic 0. This output should not be used as a general output else it will disturb the INTA output functionality. If it is not used at all, leave it unconnected.
TXB	6	14	8	O	UART channel B Transmit Data. If it is not used, leave it unconnected.
RXB	3	10	4	I	UART channel B Receive Data. Normal receive data input must idle at logic 1 condition. If it is not used, tie it to VCC or pull it high via a 100k ohm resistor.

Pin Description

NAME	32-QFN PIN #	44-PLCC PIN #	48-TQFP PIN #	TYPE	DESCRIPTION
RTSB#	15	27	22	O	UART channel B Request-to-Send (active low) or general purpose output. This output must be asserted prior to using auto RTS flow control, see EFR[6], MCR[1] and IER[6]. If it is not used, leave it unconnected.
CTSB#	16	28	23	I	UART channel B Clear-to-Send (active low) or general purpose input. It can be used for auto CTS flow control, see EFR[7] and IER[7]. This input should be connected to VCC when not used.
DTRB#	-	38	35	O	UART channel B Data-Terminal-Ready (active low) or general purpose output. If it is not used, leave it unconnected.
DSRB#	-	25	20	I	UART channel B Data-Set-Ready (active low) or general purpose input. This input should be connected to VCC when not used. This input has no effect on the UART.
CDB#	-	21	16	I	UART channel B Carrier-Detect (active low) or general purpose input. This input should be connected to VCC when not used. This input has no effect on the UART.
RIB#	-	26	21	I	UART channel B Ring-Indicator (active low) or general purpose input. This input should be connected to VCC when not used. This input has no effect on the UART.
OP2B#	-	15	9	O	Output Port 2 Channel B - The output state is defined by the user and through the software setting of MCR[3]. INTB is set to the active mode and OP2B# output to a logic 0 when MCR[3] is set to a logic 1. INTB is set to the three state mode and OP2B# to a logic 1 when MCR[3] is set to a logic 0. This output should not be used as a general output else it will disturb the INTB output functionality. If it is not used, leave it unconnected.
ANCILLARY SIGNALS					
XTAL1	10	18	13	I	Crystal or external clock input.
XTAL2	11	19	14	O	Crystal or buffered clock output.
RESET	24	39	36	I	Reset (active high) - A longer than 40 ns logic 1 pulse on this pin will reset the internal registers and all outputs. The UART transmitter output will be held at logic 1, the receiver input will be ignored and outputs are reset during reset period.
VCC	26	44	42	Pwr	2.25V to 5.5V power supply. All inputs are 5V tolerant.
GND	13	22	17	Pwr	Power supply common, ground.
GND	Center Pad	N/A	N/A	Pwr	The center pad on the backside of the 32-QFN package is metallic and should be connected to GND on the PCB. The thermal pad size on the PCB should be the approximate size of this center pad and should be solder mask defined. The solder mask opening should be at least 0.0025" inwards from the edge of the PCB thermal pad.
N.C.	9, 17	-	12, 24, 25, 37		No Connection. These pins are open, but typically, should be connected to GND for good design practice.

Pin type: I=Input, O=Output, IO= Input/output, OD=Output Open Drain.

1.0 PRODUCT DESCRIPTION

The XR16L2550 (L2550) provides serial asynchronous receive data synchronization, parallel-to-serial and serial-to-parallel data conversions for both the transmitter and receiver sections. These functions are necessary for converting the serial data stream into parallel data that is required with digital data systems. Synchronization for the serial data stream is accomplished by adding start and stop bits to the transmit data to form a data character (character orientated protocol). Data integrity is ensured by attaching a parity bit to the data character. The parity bit is checked by the receiver for any transmission bit errors. The electronic circuitry to provide all these functions is fairly complex especially when manufactured on a single integrated silicon chip. The L2550 represents such an integration with greatly enhanced features. The L2550 is fabricated with an advanced CMOS process.

Transmit and Receive FIFOs (16 Bytes each)

The L2550 is an upward solution that provides a dual UART capability with 16 bytes of transmit and receive FIFO memory, instead of none in the 16C2450. The L2550 is designed to work with high speed modems and shared network environments, that require fast data processing time. Increased performance is realized in the L2550 by the transmit and receive FIFO's. This allows the external processor to handle more networking tasks within a given time. For example, the ST16C2450 without a receive FIFO, will require unloading of the RHR in 93 microseconds (This example uses a character length of 11 bits, including start/stop bits at 115.2 Kbps). This means the external CPU will have to service the receive FIFO less than every 100 microseconds. However with the 16 byte FIFO in the L2550, the data buffer will not require unloading/loading for 1.53 ms. This increases the service interval giving the external CPU additional time for other applications and reducing the overall UART interrupt servicing time. In addition, the 4 selectable receive FIFO trigger interrupt levels is uniquely provided for maximum data throughput performance especially when operating in a multi-channel environment. The FIFO memory greatly reduces the bandwidth requirement of the external controlling CPU, increases performance, and reduces power consumption.

Data Rate

The L2550 is capable of operation up to 3.125 Mbps with a 50 MHz clock. With a crystal or external clock input of 14.7456 MHz the user can select data rates up to 921.6 Kbps.

Enhanced Features

The XR16L2550 integrates the functions of 2 enhanced 16C550 Universal Asynchronous Receiver and Transmitter (UART). Each UART is independently controlled having its own set of device configuration registers. The configuration registers set is 16550 UART compatible for control, status and data transfer. Additionally, each UART channel has automatic RTS/CTS hardware flow control, automatic Xon/Xoff and special character software flow control, infrared encoder and decoder (IrDA ver 1.0), programmable baud rate generator with a prescaler of divide by 1 or 4, and data rate up to 4 Mbps at 5V.

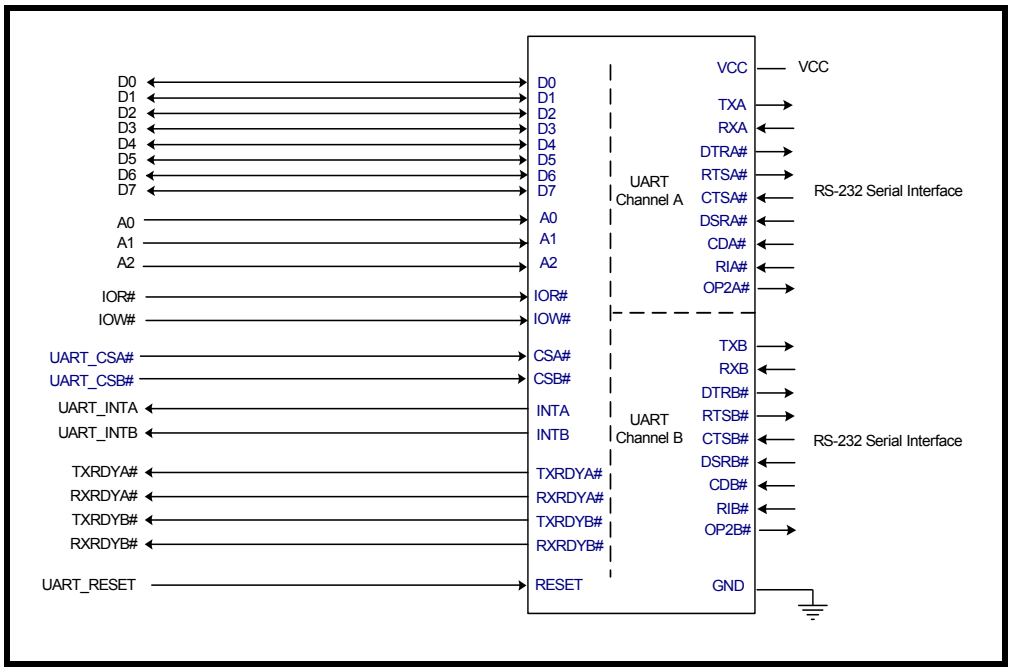
The rich feature set of the L2550 is available through internal registers. Selectable receive FIFO trigger levels, selectable TX and RX baud rates, and modem interface controls are all standard features. Following a power on reset or an external reset, the L2550 is functionally and software compatible with the previous generation ST16C2450 and ST16C2550.

2.0 FUNCTIONAL DESCRIPTIONS

2.1 CPU Interface

The CPU interface is 8 data bits wide with 3 address lines and control signals to execute data bus read and write transactions. The L2550 data interface supports the Intel compatible types of CPUs and it is compatible to the industry standard 16C550 UART. No clock (oscillator nor external clock) is required to operate a data bus transaction. Each bus cycle is asynchronous using CS#, IOR# and IOW# signals. Both UART channels share the same data bus for host operations. The data bus interconnections are shown in Figure 3.

FIGURE 3. XR16L2550 DATA BUS INTERCONNECTIONS



2.2 5-Volt Tolerant Inputs

The L2550 can accept up to 5V inputs even when operating at 3.3V or 2.5V. But note that if the L2550 is operating at 2.5V, its V_{OH} may not be high enough to meet the requirements of the V_{IH} of a CPU or a serial transceiver that is operating at 5V.

2.3 Device Reset

The RESET input resets the internal registers and the serial interface outputs in both channels to their default state (see Table 13). An active high pulse of at least 40 ns duration will be required to activate the reset function in the device.

2.4 Device Identification and Revision

The L2550 provides a Device Identification code and a Device Revision code to distinguish the part from other devices and revisions. To read the identification code from the part, it is required to set the baud rate generator registers DLL and DLM both to 0x00. Now reading the content of the DLM will provide 0x02 to indicate L2550 and reading the content of DLL will provide the revision of the part; for example, a reading of 0x01 means revision A.

2.5 Channel A and B Selection

The UART provides the user with the capability to bi-directionally transfer information between an external CPU and an external serial communication device. A logic 0 on chip select pins, CSA# or CSB#, allows the user to select UART channel A or B to configure, send transmit data and/or unload receive data to/from the UART. Selecting both UARTs can be useful during power up initialization to write to the same internal registers,

but do not attempt to read from both uarts simultaneously. Individual channel select functions are shown in Table 1.

TABLE 1: CHANNEL A AND B SELECT

CSA#	CSB#	FUNCTION
1	1	UART de-selected
0	1	Channel A selected
1	0	Channel B selected
0	0	Channel A and B selected

2.6 Channel A and B Internal Registers

Each UART channel in the L2550 has a standard register set for controlling, monitoring and data loading and unloading. The configuration register set is compatible to those already available in the standard single 16C550. These registers function as data holding registers (THR/RHR), interrupt status and control registers (ISR/IER), a FIFO control register (FCR), receive line status and control registers (LSR/LCR), modem status and control registers (MSR/MCR), programmable data rate (clock) divisor registers (DLL/DLM), and a user accessible scratch pad register (SPR).

2.7 DMA Mode

The device does not support direct memory access. The DMA Mode (a legacy term) in this document doesn't mean "direct memory access" but refers to data block transfer operation. The DMA mode affects the state of the RXRDY# A/B and TXRDY# A/B output pins. The transmit and receive FIFO trigger levels provide additional flexibility to the user for block mode operation. The LSR bits 5-6 provide an indication when the transmitter is empty or has an empty location(s) for more data. The user can optionally operate the transmit and receive FIFO in the DMA mode (FCR bit-3=1). When the transmit and receive FIFO are enabled and the DMA mode is disabled (FCR bit-3 = 0), the L2550 is placed in single-character mode for data transmit or receive operation. When DMA mode is enabled (FCR bit-3 = 1), the user takes advantage of block mode operation by loading or unloading the FIFO in a block sequence determined by the programmed trigger level. The following table show their behavior. Also see Figure 18 through Figure 23.

TABLE 2: TXRDY# AND RXRDY# OUTPUTS IN FIFO AND DMA MODE

PINS	FCR BIT-0=0 (FIFO DISABLED)	FCR BIT-0=1 (FIFO ENABLED)	
		FCR Bit-3 = 0 (DMA Mode Disabled)	FCR Bit-3 = 1 (DMA Mode Enabled)
RXRDY# A/B	0 = 1 byte. 1 = no data.	0 = at least 1 byte in FIFO 1 = FIFO empty.	1 to 0 transition when FIFO reaches the trigger level, or time-out occurs. 0 to 1 transition when FIFO empties.
TXRDY# A/B	0 = THR empty. 1 = byte in THR.	0 = FIFO empty. 1 = at least 1 byte in FIFO.	0 = FIFO has at least 1 empty location. 1 = FIFO is full.

2.8 INTA and INTB Outputs

The INTA and INTB interrupt output changes according to the operating mode and enhanced features setup. Table 3 and Table 4 summarize the operating behavior for the transmitter and receiver. Also see Figure 18 through Figure 23.

TABLE 3: INTA AND INTB PINS OPERATION FOR TRANSMITTER

	FCR BIT-0 = 0 (FIFO DISABLED)	FCR BIT-0 = 1 (FIFO ENABLED)
INTA/B Pin	0 = a byte in THR 1 = THR empty	0 = at least 1 byte in FIFO 1 = FIFO empty

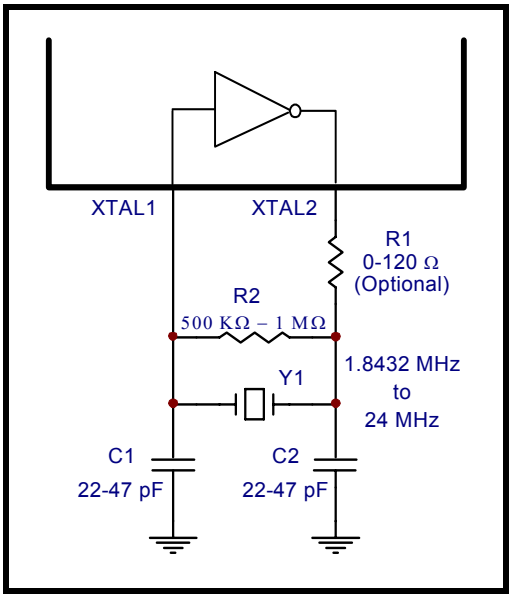
TABLE 4: INTA AND INTB PIN OPERATION FOR RECEIVER

	FCR BIT-0 = 0 (FIFO DISABLED)	FCR BIT-0 = 1 (FIFO ENABLED)
INTA/B Pin	0 = no data 1 = 1 byte	0 = FIFO below trigger level 1 = FIFO above trigger level

2.9 Crystal Oscillator or External Clock Input

The L2550 includes an on-chip oscillator (XTAL1 and XTAL2) to produce a clock for both UART sections in the device. The CPU data bus does not require this clock for bus operation. The crystal oscillator provides a system clock to the Baud Rate Generators (BRG) section found in each of the UART. XTAL1 is the input to the oscillator or external clock buffer input with XTAL2 pin being the output. For programming details, see "Programmable Baud Rate Generator."

FIGURE 4. TYPICAL OSCILLATOR CONNECTIONS

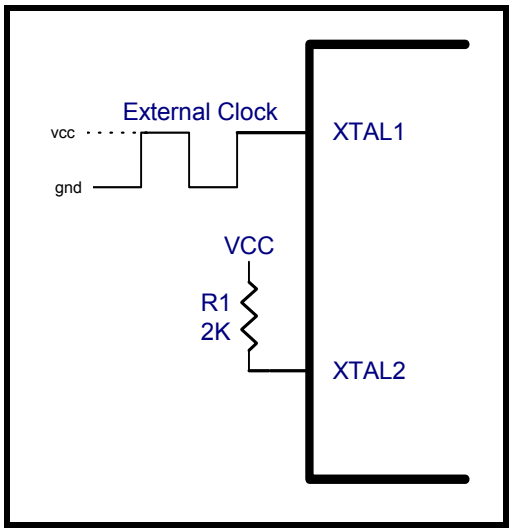


The on-chip oscillator is designed to use an industry standard microprocessor crystal (parallel resonant, fundamental frequency with 10-22 pF capacitance load, ESR of 20-120 ohms and 100 ppm frequency tolerance) connected externally between the XTAL1 and XTAL2 pins (see **Figure 4**), with an external 500 kΩ to 1 MΩ resistor across it. Alternatively, an external clock can be connected to the XTAL1 pin to clock the internal baud rate generator for standard or custom rates. Typical oscillator connections are shown in **Figure 4**. For further reading on oscillator circuit please see application note DAN108 on EXAR's web site.

2.10 Programmable Baud Rate Generator

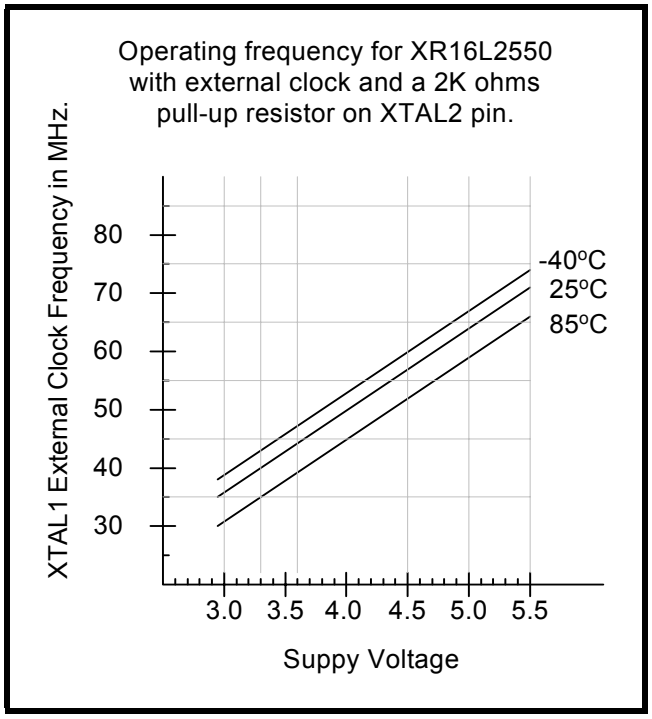
A single baud rate generator is provided for the transmitter and receiver, allowing independent TX/RX channel control. The programmable Baud Rate Generator is capable of operating with a crystal frequency of up to 24 MHz. However, with an external clock input on XTAL1 pin and a 2K ohms pull-up resistor on XTAL2 pin (as shown in Figure 5) it can extend its operation up to 64 MHz (4Mbps serial data rate) at room temperature and 5.0V.

FIGURE 5. EXTERNAL CLOCK CONNECTION FOR EXTENDED DATA RATE



To obtain maximum data rate, it is necessary to use full rail swing on the clock input. See external clock operating frequency over power supply voltage chart in Figure 6.

FIGURE 6. OPERATING FREQUENCY CHART. REQUIRES A 2K OHMS PULL-UP RESISTOR ON XTAL2 PIN TO INCREASE OPERATING SPEED



The L2550 divides the basic external clock by 16. The basic 16X clock provides table rates to support standard and custom applications using the same system design. The Baud Rate Generator divides the input 16X clock by any divisor from 1 to 2^{16} -1. The rate table is configured via the DLL and DLM internal register functions. Customized Baud Rates can be achieved by selecting the proper divisor values for the MSB and LSB sections of baud rate generator.

Table 5 shows the standard data rates available with a 14.7456 MHz crystal or external clock at 16X sampling rate. When using a non-standard frequency crystal or external clock, the divisor value can be calculated for DLL/DLM with the following equation.

divisor (decimal) = (XTAL1 clock frequency) / (serial data rate x 16)

TABLE 5: TYPICAL DATA RATES WITH A 14.7456 MHZ CRYSTAL OR EXTERNAL CLOCK

OUTPUT Data Rate MCR Bit-7=0	DIVISOR FOR 16x Clock (Decimal)	DIVISOR FOR 16x Clock (HEX)	DLM PROGRAM VALUE (HEX)	DLL PROGRAM VALUE (HEX)	DATA RATE ERROR (%)
400	2304	900	09	00	0
2400	384	180	01	80	0
4800	192	C0	00	C0	0
9600	96	60	00	60	0
19.2k	48	30	00	30	0
38.4k	24	18	00	18	0
76.8k	12	0C	00	0C	0
153.6k	6	06	00	06	0
230.4k	4	04	00	04	0
460.8k	2	02	00	02	0
921.6k	1	01	00	01	0

2.11 Transmitter

The transmitter section comprises of an 8-bit Transmit Shift Register (TSR) and 16 bytes of FIFO which includes a byte-wide Transmit Holding Register (THR). TSR shifts out every data bit with the 16X internal clock. A bit time is 16 clock periods. The transmitter sends the start-bit followed by the number of data bits, inserts the proper parity-bit if enabled, and adds the stop-bit(s). The status of the FIFO and TSR are reported in the Line Status Register (LSR bit-5 and bit-6).

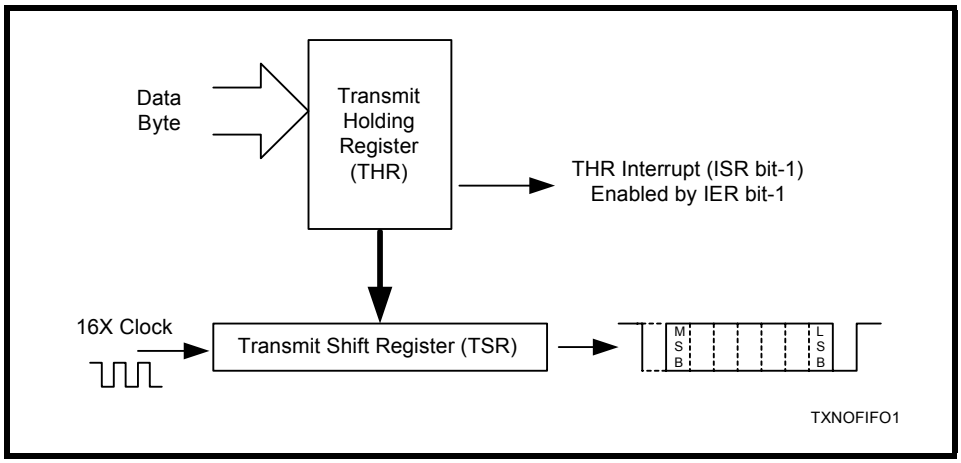
2.11.1 Transmit Holding Register (THR) - Write Only

The transmit holding register is an 8-bit register providing a data interface to the host processor. The host writes transmit data byte to the THR to be converted into a serial data stream including start-bit, data bits, parity-bit and stop-bit(s). The least-significant-bit (Bit-0) becomes first data bit to go out. The THR is the input register to the transmit FIFO of 16 bytes when FIFO operation is enabled by FCR bit-0. Every time a write operation is made to the THR, the FIFO data pointer is automatically bumped to the next sequential data location.

2.11.2 Transmitter Operation in non-FIFO Mode

The host loads transmit data to THR one character at a time. The THR empty flag (LSR bit-5) is set when the data byte is transferred to TSR. THR flag can generate a transmit empty interrupt (ISR bit-1) when it is enabled by IER bit-1. The TSR flag (LSR bit-6) is set when TSR becomes completely empty.

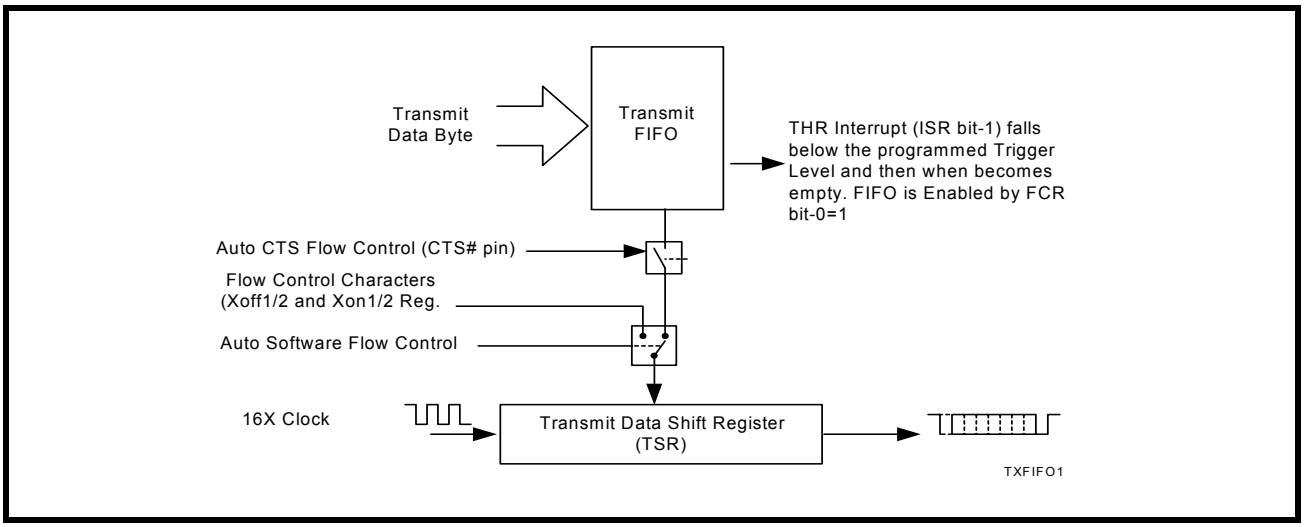
FIGURE 7. TRANSMITTER OPERATION IN NON-FIFO MODE



2.11.3 Transmitter Operation in FIFO Mode

The host may fill the transmit FIFO with up to 16 bytes of transmit data. The THR empty flag (LSR bit-5) is set whenever the FIFO is empty. The THR empty flag can generate a transmit empty interrupt (ISR bit-1) when the transmit empty interrupt is enabled by IER bit-1. The TSR flag (LSR bit-6) is set when the FIFO and the TSR become empty.

FIGURE 8. TRANSMITTER OPERATION IN FIFO AND FLOW CONTROL MODE



2.12 Receiver

The receiver section contains an 8-bit Receive Shift Register (RSR) and 16 bytes of FIFO which includes a byte-wide Receive Holding Register (RHR). The RSR uses the 16X for timing. It verifies and validates every bit on the incoming character in the middle of each data bit. On the falling edge of a start or false start bit, an internal receiver counter starts counting at the 16X. After 8 clocks the start bit period should be at the center of the start bit. At this time the start bit is sampled and if it is still a logic 0 it is validated. Evaluating the start bit in this manner prevents the receiver from assembling a false character. The rest of the data bits and stop bits are sampled and validated in this same manner to prevent false framing. If there were any error(s), they are reported in the LSR register bits 2-4. Upon unloading the receive data byte from RHR, the receive FIFO pointer is bumped and the error tags are immediately updated to reflect the status of the data byte in RHR register. RHR can generate a receive data ready interrupt upon receiving a character or delay until it reaches the FIFO trigger level. Furthermore, data delivery to the host is guaranteed by a receive data ready time-out interrupt

when data is not received for 4 word lengths as defined by LCR[1:0] plus 12 bits time. This is equivalent to 3.7-4.6 character times. The RHR interrupt is enabled by IER bit-0.

2.12.1 Receive Holding Register (RHR) - Read-Only

The Receive Holding Register is an 8-bit register that holds a receive data byte from the Receive Shift Register. It provides the receive data interface to the host processor. The RHR register is part of the receive FIFO of 16 bytes by 11-bits wide, the 3 extra bits are for the 3 error tags to be reported in LSR register. When the FIFO is enabled by FCR bit-0, the RHR contains the first data character received by the FIFO. After the RHR is read, the next character byte is loaded into the RHR and the errors associated with the current data byte are immediately updated in the LSR bits 2-4.

FIGURE 9. RECEIVER OPERATION IN NON-FIFO MODE

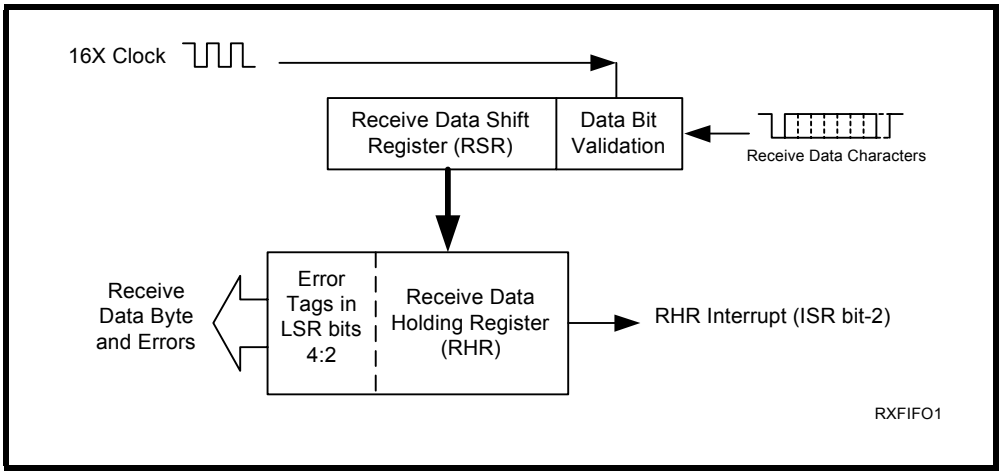
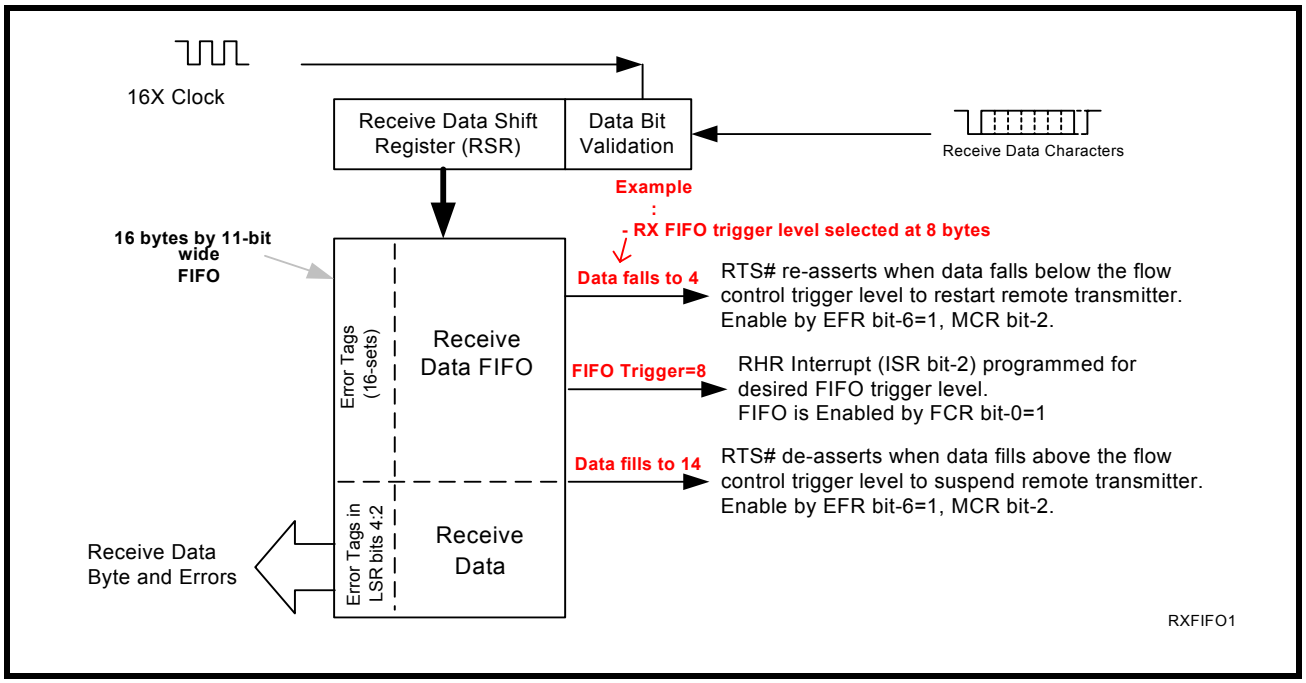


FIGURE 10. RECEIVER OPERATION IN FIFO AND AUTO RTS FLOW CONTROL MODE



2.13 Auto RTS (Hardware) Flow Control

Automatic RTS hardware flow control is used to prevent data overrun to the local receiver FIFO. The RTS# output is used to request remote unit to suspend/resume data transmission. The auto RTS flow control features is enabled to fit specific application requirement (see **Figure 11**):

- Enable auto RTS flow control using EFR bit-6.
- The auto RTS function must be started by asserting RTS# output pin (MCR bit-1 to logic 1 after it is enabled).

If using the Auto RTS interrupt:

- Enable RTS interrupt through IER bit-6 (after setting EFR bit-4). The UART issues an interrupt when the RTS# pin makes a transition from low to high: ISR bit-5 will be set to logic 1.

2.14 Auto CTS Flow Control

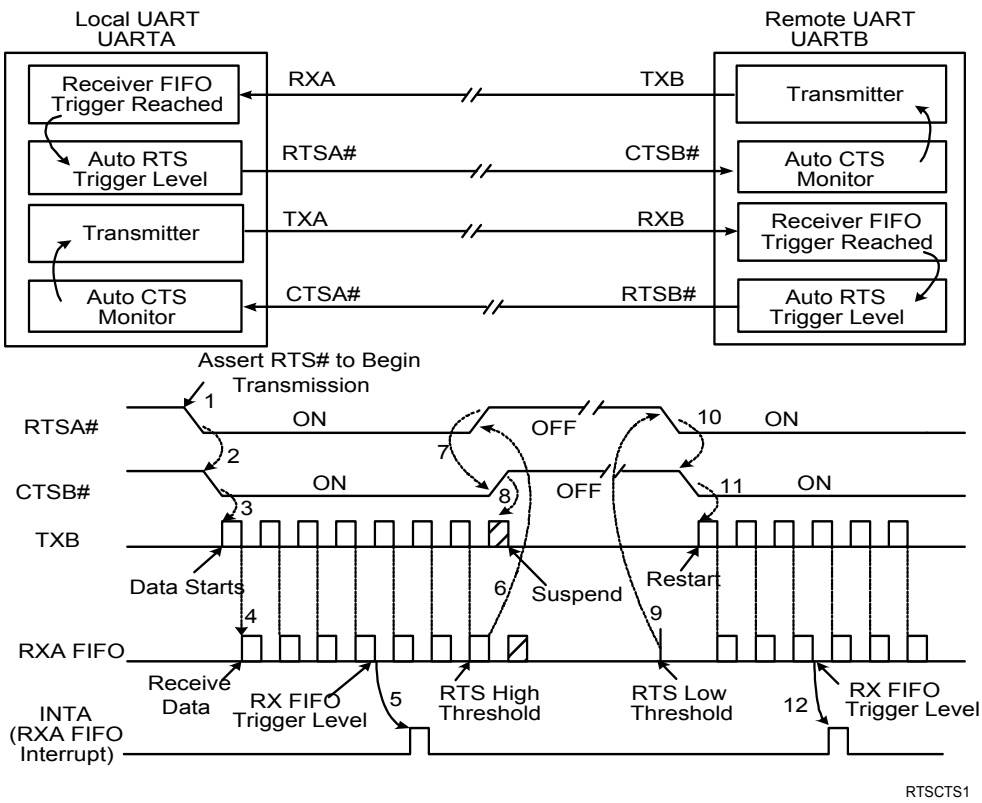
Automatic CTS flow control is used to prevent data overrun to the remote receiver FIFO. The CTS# input is monitored to suspend/restart the local transmitter. The auto CTS flow control feature is selected to fit specific application requirement (see **Figure 11**):

- Enable auto CTS flow control using EFR bit-7.

If using the Auto CTS interrupt:

- Enable CTS interrupt through IER bit-7 (after setting EFR bit-4). The UART issues an interrupt when the CTS# pin is de-asserted (HIGH): ISR bit-5 will be set to 1, and UART will suspend transmission as soon as the stop bit of the character in process is shifted out. Transmission is resumed after the CTS# input is re-asserted (LOW), indicating more data may be sent.

FIGURE 11. AUTO RTS AND CTS FLOW CONTROL OPERATION



The local UART (UARTA) starts data transfer by asserting RTSA# (1). RTSA# is normally connected to CTSB# (2) of remote UART (UARTB). CTSB# allows its transmitter to send data (3). TXB data arrives and fills UARTA receive FIFO (4). When RXA data fills up to its receive FIFO trigger level, UARTA activates its RXA data ready interrupt (5) and continues to receive and put data into its FIFO. If interrupt service latency is long and data is not being unloaded, UARTA monitors its receive data fill level to match the upper threshold of RTS delay and de-assert RTSA# (6). CTSB# follows (7) and request UARTB transmitter to suspend data transfer. UARTB stops or finishes sending the data bits in its transmit shift register (8). When receive FIFO data in UARTA is unloaded to match the lower threshold of RTS delay (9), UARTA re-asserts RTSA# (10), CTSB# recognizes the change (11) and restarts its transmitter and data flow again until next receive FIFO trigger (12). This same event applies to the reverse direction when UARTA sends data to UARTB with RTSB# and CTSA# controlling the data flow.

2.15 Auto Xon/Xoff (Software) Flow Control

When software flow control is enabled (See Table 12), the L2550 compares one or two sequential receive data characters with the programmed Xon or Xoff-1,2 character value(s). If receive character(s) (RX) match the programmed values, the L2550 will halt transmission (TX) as soon as the current character has completed transmission. When a match occurs, the Xoff (if enabled via IER bit-5) flag will be set and the interrupt output pin will be activated. Following a suspension due to a match of the Xoff character, the L2550 will monitor the receive data stream for a match to the Xon-1,2 character. If a match is found, the L2550 will resume operation and clear the flags (ISR bit-4).

Reset initially sets the contents of the Xon/Xoff 8-bit flow control registers to a logic 0. Following reset the user can write any Xon/Xoff value desired for software flow control. Different conditions can be set to detect Xon/Xoff characters (See Table 12) and suspend/resume transmissions. When double 8-bit Xon/Xoff characters are selected, the L2550 compares two consecutive receive characters with two software flow control 8-bit values (Xon1, Xon2, Xoff1, Xoff2) and controls TX transmissions accordingly. Under the above described flow control mechanisms, flow control characters are not placed (stacked) in the user accessible RX data buffer or FIFO.

In the event that the receive buffer is overfilling and flow control needs to be executed, the L2550 automatically sends an Xoff message (when enabled) via the serial TX output to the remote modem. The L2550 sends the Xoff-1,2 characters two-character-times (= time taken to send two characters at the programmed baud rate) after the receive FIFO crosses the programmed trigger level. To clear this condition, the L2550 will transmit the programmed Xon-1,2 characters as soon as receive FIFO is less than one trigger level below the programmed trigger level. See Table 6 below.

TABLE 6: AUTO XON/XOFF (SOFTWARE) FLOW CONTROL

RX TRIGGER LEVEL	INT PIN ACTIVATION	XOFF CHARACTER(S) SENT (CHARACTERS IN RX FIFO)	XON CHARACTER(S) SENT (CHARACTERS IN RX FIFO)
1	1	1*	0
4	4	4*	1
8	8	8*	4
14	14	14*	8

** After the trigger level is reached, an xoff character is sent after a short span of time (= time required to send 2 characters); for example, after 2.083ms has elapsed for 9600 baud and 8-bit word length, no parity and 1 stop bit setting.*

2.16 Special Character Detect

A special character detect feature is provided to detect an 8-bit character when bit-5 is set in the Enhanced Feature Register (EFR). When this character (Xoff2) is detected, it will be placed in the FIFO along with normal incoming RX data.

The L2550 compares each incoming receive character with Xoff-2 data. If a match exists, the received data will be transferred to FIFO and ISR bit-4 will be set to indicate detection of special character. Although the Internal Register Table shows Xon, Xoff Registers with eight bits of character information, the actual number of bits is dependent on the programmed word length. Line Control Register (LCR) bits 0-1 defines the number of character bits, i.e., either 5 bits, 6 bits, 7 bits, or 8 bits. The word length selected by LCR bits 0-1 also determines the number of bits that will be used for the special character comparison. Bit-0 in the Xon, Xoff Registers corresponds with the LSB bit for the receive character.

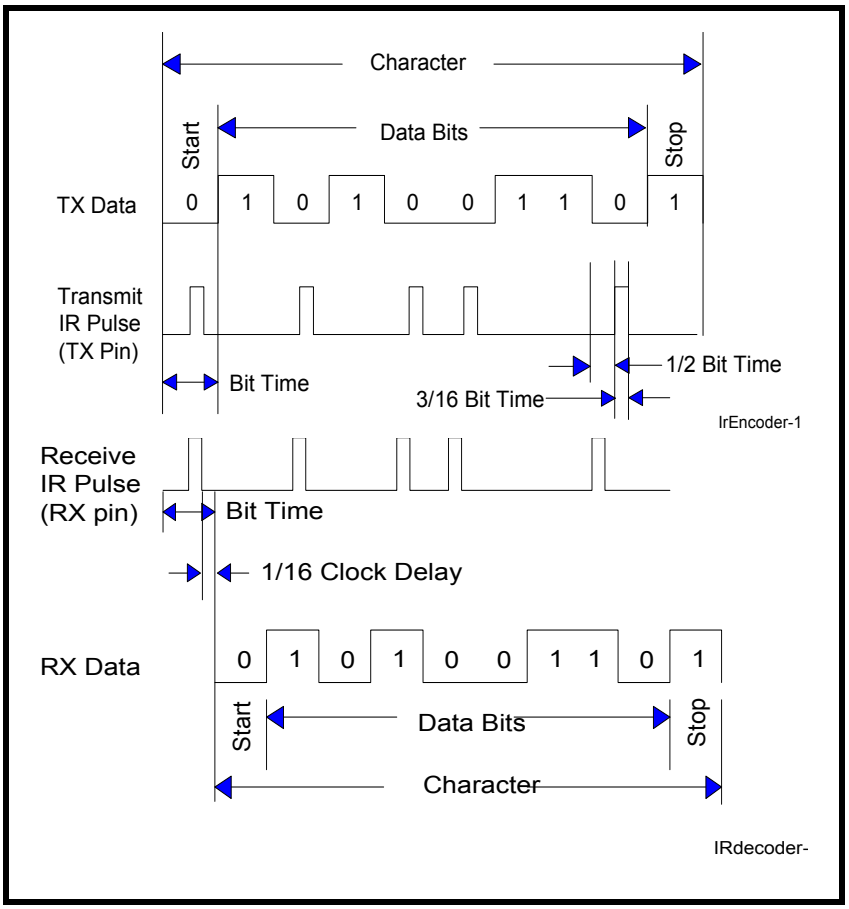
2.17 Infrared Mode

The L2550 UART includes the infrared encoder and decoder compatible to the IrDA (Infrared Data Association) version 1.0. The IrDA 1.0 standard that stipulates the infrared encoder sends out a 3/16 of a bit wide HIGH-pulse for each “0” bit in the transmit data stream. This signal encoding reduces the on-time of the infrared LED, hence reduces the power consumption. See **Figure 12** below.

The infrared encoder and decoder are enabled by setting MCR register bit-6 to a ‘1’. When the infrared feature is enabled, the transmit data output, TX, idles at logic zero level. Likewise, the RX input assumes an idle level of logic zero from a reset and power up, see **Figure 12**.

Typically, the wireless infrared decoder receives the input pulse from the infrared sensing diode on the RX pin. Each time it senses a light pulse, it returns a logic 1 to the data bit stream.

FIGURE 12. INFRARED TRANSMIT DATA ENCODING AND RECEIVE DATA DECODING



2.18 Sleep Mode with Auto Wake-Up

The L2550 supports low voltage system designs, hence, a sleep mode is included to reduce its power consumption when the chip is not actively used.

All of these conditions must be satisfied for the L2550 to enter sleep mode:

- no interrupts pending for both channels of the L2550 (ISR bit-0 = 1)
- divisor is a non-zero value (ie. DLL = 0x1)
- sleep mode of both channels are enabled (IER bit-4 = 1)
- modem inputs are not toggling (MSR bits 0-3 = 0)
- RX input pins are idling at a logic 1

The L2550 stops its crystal oscillator to conserve power in the sleep mode. User can check the XTAL2 pin for no clock output as an indication that the device has entered the sleep mode.

The L2550 resumes normal operation by any of the following:

- a receive data start bit transition (logic 1 to 0)
- a data byte is loaded to the transmitter, THR or FIFO
- a change of logic state on any of the modem or general purpose serial inputs: CTS#, DSR#, CD#, RI#

If the L2550 is awakened by any one of the above conditions, it will return to the sleep mode automatically after all interrupting conditions have been serviced and cleared. If the 2750 is awakened by the modem inputs, a read to the MSR is required to reset the modem inputs. In any case, the sleep mode will not be entered while an interrupt is pending from channel A or B. The L2550 will stay in the sleep mode of operation until it is disabled by setting IER bit-4 to a logic 0.

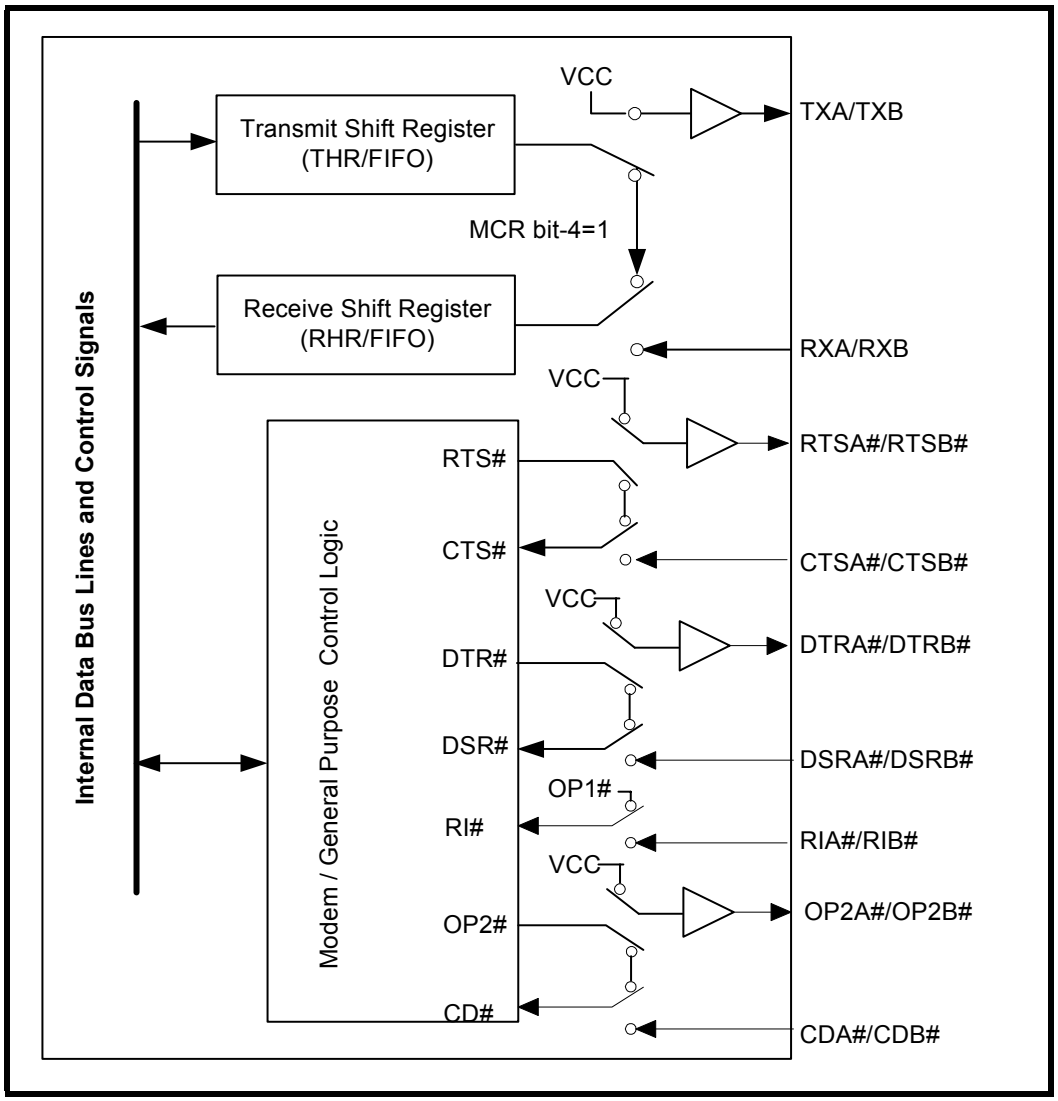
If the address lines, data bus lines, IOW#, IOR#, CSA#, CSB#, and modem input lines remain steady when the L2550 is in sleep mode, the maximum current will be in the microamp range as specified in the DC Electrical Characteristics on page 34. If the input lines are floating or are toggling while the L2550 is in sleep mode, the current can be up to 100 times more. If any of those signals are toggling or floating, then an external buffer would be required to keep the address, data and control lines steady to achieve the low current. As an alternative, please refer to the XR16L2551 which is pin-to-pin and software compatible with the L2550 but with (some additional pins and) the PowerSave feature that eliminates any unnecessary external buffer.

Important: owing to the starting up delay of the crystal oscillator after waking up from sleep mode, the first few receive characters may be lost. The number of characters lost during the restart also depends on your operating data rate. More characters are lost when operating at higher data rate. Also, it is important to keep RX A/B inputs idling at logic 1 or “marking” condition during sleep mode to avoid receiving a “break” condition upon the restart. This may occur when the external interface transceivers (RS-232, RS-485 or another type) are also put to sleep mode and cannot maintain the “marking” condition. To avoid this, the designer can use a 47k-100k ohm pull-up resistor on the RXA and RXB pins.

2.19 Internal Loopback

The L2550 UART provides an internal loopback capability for system diagnostic purposes. The internal loopback mode is enabled by setting MCR register bit-4 to logic 1. All regular UART functions operate normally. Figure 13 shows how the modem port signals are re-configured. Transmit data from the transmit shift register output is internally routed to the receive shift register input allowing the system to receive the same data that it was sending. The TX pin is held at logic 1 or mark condition while RTS# and DTR# are de-asserted, and CTS#, DSR# CD# and RI# inputs are ignored. Caution: the RX input pins must be held to a logic 1 during loopback test else upon exiting the loopback test the UART may detect and report a false “break” signal. Also, Auto RTS/CTS is not supported during internal loopback.

FIGURE 13. INTERNAL LOOP BACK IN CHANNEL A AND B



3.0 UART INTERNAL REGISTERS

Each of the UART channel in the L2550 has its own set of configuration registers selected by address lines A0, A1 and A2 with CSA# or CSB# selecting the channel. The registers are 16C550 compatible. The complete register set is shown on Table 7 and Table 8.

TABLE 7: UART CHANNEL A AND B UART INTERNAL REGISTERS

A2,A1,A0 ADDRESSES	REGISTER	READ/WRITE	COMMENTS
16C550 COMPATIBLE REGISTERS			
0 0 0	RHR - Receive Holding Register THR - Transmit Holding Register	Read-only Write-only	LCR[7] = 0
0 0 0	DLL - Div Latch Low Byte	Read/Write	LCR[7] = 1, LCR ≠ 0xBF
0 0 1	DLM - Div Latch High Byte	Read/Write	
0 0 0	DREV - Device Revision	Read/Write	LCR[7] = 1, LCR ≠ 0xBF, DLL = 0x00, DLM = 0x00
0 0 1	DVID - Device ID	Read/Write	
0 0 1	IER - Interrupt Enable Register	Read/Write	LCR[7] = 0
0 1 0	ISR - Interrupt Status Register FCR - FIFO Control Register	Read-only Write-only	LCR ≠ 0xBF
0 1 1	LCR - Line Control Register	Read/Write	
1 0 0	MCR - Modem Control Register	Read/Write	LCR ≠ 0xBF
1 0 1	LSR - Line Status Register Reserved	Read-only Write-only	
1 1 0	MSR - Modem Status Register Reserved	Read-only Write-only	
1 1 1	SPR - Scratch Pad Register	Read/Write	
ENHANCED REGISTERS			
0 1 0	EFR - Enhanced Function Register	Read/Write	LCR = 0xBF
1 0 0	Xon-1 - Xon Character 1	Read/Write	
1 0 1	Xon-2 - Xon Character 2	Read/Write	
1 1 0	Xoff-1 - Xoff Character 1	Read/Write	
1 1 1	Xoff-2 - Xoff Character 2	Read/Write	

TABLE 8: INTERNAL REGISTERS DESCRIPTION. SHADED BITS ARE ENABLED WHEN EFR BIT-4=1

ADDRESS A2-A0	REG NAME	READ/ WRITE	BIT-7	BIT-6	BIT-5	BIT-4	BIT-3	BIT-2	BIT-1	BIT-0	COMMENT
16C550 Compatible Registers											
0 0 0	RHR	RD	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0	
0 0 0	THR	WR	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0	
0 0 1	IER	RD/WR	0/ CTS Int. Enable	0/ RTS Int. Enable	0/ Xoff Int. Enable	0/ Sleep Mode Enable	Modem Stat. Int. Enable	RX Line Stat. Int. Enable	TX Empty Int Enable	RX Data Int. Enable	LCR[7] = 0
0 1 0	ISR	RD	FIFOs Enabled	FIFOs Enabled	0/ INT Source Bit-5	0/ INT Source Bit-4	INT Source Bit-3	INT Source Bit-2	INT Source Bit-1	INT Source Bit-0	LCR ≠ 0xBF
0 1 0	FCR	WR	RXFIFO Trigger	RXFIFO Trigger	0	0	DMA Mode Enable	TX FIFO Reset	RX FIFO Reset	FIFOs Enable	
0 1 1	LCR	RD/WR	Divisor Enable	Set TX Break	Set Par-ity	Even Parity	Parity Enable	Stop Bits	Word Length Bit-1	Word Length Bit-0	
1 0 0	MCR	RD/WR	0/ BRG Pres-caler	0/ IR Mode ENable	0/ XonAny	Internal Lopback Enable	OP2#/ INT Output Enable	Rsvd (OP1#)	RTS# Output Control	DTR# Output Control	
1 0 1	LSR	RD	RX FIFO Global Error	THR & TSR Empty	THR Empty	RX Break	RX Fram-ing Error	RX Parity Error	RX Over-run Error	RX Data Ready	LCR ≠ 0xBF
1 1 0	MSR	RD	CD# Input	RI# Input	DSR# Input	CTS# Input	Delta CD#	Delta RI#	Delta DSR#	Delta CTS#	
1 1 1	SPR	RD/WR	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0	
Baud Rate Generator Divisor											
0 0 0	DLL	RD/WR	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0	LCR[7]=1
0 0 1	DLM	RD/WR	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0	
0 0 0	DREV	RD	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0	LCR[7]=1 DLL=0x00 DLM=0x00
0 0 1	DVID	RD	0	0	0	0	0	0	1	0	

TABLE 8: INTERNAL REGISTERS DESCRIPTION. SHADED BITS ARE ENABLED WHEN EFR BIT-4=1

ADDRESS A2-A0	REG NAME	READ/ WRITE	BIT-7	BIT-6	BIT-5	BIT-4	BIT-3	BIT-2	BIT-1	BIT-0	COMMENT
Enhanced Registers											
0 1 0	EFR	RD/WR	Auto CTS Enable	Auto RTS Enable	Special Char Select	Enable IER [7:4], ISR [5:4], FCR[5:4], MCR[7:5]	Soft-ware Flow Cntl Bit-3	Soft-ware Flow Cntl Bit-2	Soft-ware Flow Cntl Bit-1	Soft-ware Flow Cntl Bit-0	LCR=0xBF
1 0 0	XON1	RD/WR	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0	
1 0 1	XON2	RD/WR	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0	
1 1 0	XOFF1	RD/WR	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0	
1 1 1	XOFF2	RD/WR	Bit-7	Bit-6	Bit-5	Bit-4	Bit-3	Bit-2	Bit-1	Bit-0	

4.0 INTERNAL REGISTER DESCRIPTIONS

4.1 Receive Holding Register (RHR) - Read- Only

SEE"RECEIVER" ON PAGE 12.

4.2 Transmit Holding Register (THR) - Write-Only

SEE"TRANSMITTER" ON PAGE 11.

4.3 Interrupt Enable Register (IER) - Read/Write

The Interrupt Enable Register (IER) masks the interrupts from receive data ready, transmit empty, line status and modem status registers. These interrupts are reported in the Interrupt Status Register (ISR).

4.3.1 IER versus Receive FIFO Interrupt Mode Operation

When the receive FIFO (FCR BIT-0 = 1) and receive interrupts (IER BIT-0 = 1) are enabled, the RHR interrupts (see ISR bits 2 and 3) status will reflect the following:

A. The receive data available interrupts are issued to the host when the FIFO has reached the programmed trigger level. It will be cleared when the FIFO drops below the programmed trigger level.

B. FIFO level will be reflected in the ISR register when the FIFO trigger level is reached. Both the ISR register status bit and the interrupt will be cleared when the FIFO drops below the trigger level.

C. The receive data ready bit (LSR BIT-0) is set as soon as a character is transferred from the shift register to the receive FIFO. It is reset when the FIFO is empty.

4.3.2 IER versus Receive/Transmit FIFO Polled Mode Operation

When FCR BIT-0 equals a logic 1 for FIFO enable; resetting IER bits 0-3 enables the XR16L2550 in the FIFO polled mode of operation. Since the receiver and transmitter have separate bits in the LSR either or both can be used in the polled mode by selecting respective transmit or receive control bit(s).

A. LSR BIT-0 indicates there is data in RHR or RX FIFO.

B. LSR BIT-1 indicates an overrun error has occurred and that data in the FIFO may not be valid.

C. LSR BIT 2-4 provides the type of receive data errors encountered for the data byte in RHR, if any.

D. LSR BIT-5 indicates Transmit FIFO is empty.

E. LSR BIT-6 indicates when both the transmit FIFO and TSR are empty.

F. LSR BIT-7 indicates a data error in at least one character in the RX FIFO.

IER[0]: RHR Interrupt Enable

The receive data ready interrupt will be issued when RHR has a data character in the non-FIFO mode or when the receive FIFO has reached the programmed trigger level in the FIFO mode.

- Logic 0 = Disable the receive data ready interrupt (default).
- Logic 1 = Enable the receiver data ready interrupt.

IER[1]: THR Interrupt Enable

This bit enables the Transmit Ready interrupt which is issued whenever the Transmit FIFO becomes empty. If the Transmit FIFO is empty when this bit is enabled, an interrupt will be generated.

- Logic 0 = Disable Transmit Ready interrupt (default).
- Logic 1 = Enable Transmit Ready interrupt.

IER[2]: Receive Line Status Interrupt Enable

If any of the LSR register bits 1, 2, 3 or 4 is a logic 1, it will generate an interrupt to inform the host controller about the error status of the current data byte in FIFO. LSR bit-1 generates an interrupt immediately when the character has been received. LSR bits 2-4 generate an interrupt when the character with errors is read out of the FIFO.

- Logic 0 = Disable the receiver line status interrupt (default).
- Logic 1 = Enable the receiver line status interrupt.

IER[3]: Modem Status Interrupt Enable

- Logic 0 = Disable the modem status register interrupt (default).
- Logic 1 = Enable the modem status register interrupt.

IER[4]: Sleep Mode Enable (requires EFR bit-4 = 1)

- Logic 0 = Disable Sleep Mode (default).
- Logic 1 = Enable Sleep Mode. See Sleep Mode section for further details.

IER[5]: Xoff Interrupt Enable (requires EFR bit-4=1)

- Logic 0 = Disable the software flow control, receive Xoff interrupt. (default)
- Logic 1 = Enable the software flow control, receive Xoff interrupt. See Software Flow Control section for details.

IER[6]: RTS# Output Interrupt Enable (requires EFR bit-4=1)

- Logic 0 = Disable the RTS# interrupt (default).
- Logic 1 = Enable the RTS# interrupt. The UART issues an interrupt when the RTS# pin makes a transition from low to high.

IER[7]: CTS# Input Interrupt Enable (requires EFR bit-4=1)

- Logic 0 = Disable the CTS# interrupt (default).
- Logic 1 = Enable the CTS# interrupt. The UART issues an interrupt when CTS# pin makes a transition from low to high.

4.4 Interrupt Status Register (ISR) - Read-Only

The UART provides multiple levels of prioritized interrupts to minimize external software interaction. The Interrupt Status Register (ISR) provides the user with six interrupt status bits. Performing a read cycle on the ISR will give the user the current highest pending interrupt level to be serviced, others are queued up to be serviced next. No other interrupts are acknowledged until the pending interrupt is serviced. The Interrupt

Source Table, Table 9, shows the data values (bit 0-5) for the interrupt priority levels and the interrupt sources associated with each of these interrupt levels.

4.4.1 Interrupt Generation:

- LSR is by any of the LSR bits 1, 2, 3 and 4.
- RXRDY is by RX trigger level.
- RXRDY Time-out is by a 4-char plus 12 bits delay timer.
- TXRDY is by TX FIFO empty.
- MSR is by any of the MSR bits 0, 1, 2 and 3.
- Receive Xoff/Special character is by detection of a Xoff or Special character.
- CTS# is when its transmitter toggles the input pin (from low to high) during auto CTS flow control enabled by EFR bit-7.
- RTS# is when its receiver toggles the output pin (from low to high) during auto RTS flow control enabled by EFR bit-6.

4.4.2 Interrupt Clearing:

- LSR interrupt is cleared by a read to the LSR register (but flags and tags not cleared until character(s) that generated the interrupt(s) has been emptied or cleared from FIFO).
- RXRDY interrupt is cleared by reading data until FIFO falls below the trigger level.
- RXRDY Time-out interrupt is cleared by reading RHR.
- TXRDY interrupt is cleared by a read to the ISR register or writing to THR.
- MSR interrupt is cleared by a read to the MSR register.
- Xoff interrupt is cleared by a read to ISR or when Xon character(s) is received.
- Special character interrupt is cleared by a read to ISR or after the next character is received.
- RTS# and CTS# flow control interrupts are cleared by a read to the MSR register.

TABLE 9: INTERRUPT SOURCE AND PRIORITY LEVEL

PRIORITY LEVEL	ISR REGISTER STATUS BITS						SOURCE OF INTERRUPT
	BIT-5	BIT-4	BIT-3	BIT-2	BIT-1	BIT-0	
1	0	0	0	1	1	0	LSR (Receiver Line Status Register)
2	0	0	1	1	0	0	RXRDY (Receive Data Time-out)
3	0	0	0	1	0	0	RXRDY (Received Data Ready)
4	0	0	0	0	1	0	TXRDY (Transmit Ready)
5	0	0	0	0	0	0	MSR (Modem Status Register)
6	0	1	0	0	0	0	RXRDY (Received Xoff or Special character)
7	1	0	0	0	0	0	CTS#, RTS# change of state
-	0	0	0	0	0	1	None (default)

ISR[0]: Interrupt Status

- Logic 0 = An interrupt is pending and the ISR contents may be used as a pointer to the appropriate interrupt service routine.
- Logic 1 = No interrupt pending (default condition).

ISR[3:1]: Interrupt Status

These bits indicate the source for a pending interrupt at interrupt priority levels (See Interrupt Source Table 9).

ISR[4]: Xoff or Special Character Interrupt Status

This bit is enabled when EFR bit-4 is set to a logic 1. ISR bit-4 indicates that the receiver detected a data match of the Xoff character(s). If this is an Xoff interrupt, it can be cleared by a read to the ISR or when an Xon character is received. If it is a special character interrupt, it will automatically clear after the next character is received.

ISR[5]: RTS#/CTS# Interrupt Status

This bit is enabled when EFR bit-4 is set to a logic 1. ISR bit-5 indicates that the CTS# or RTS# has changed state from low to high.

ISR[7:6]: FIFO Enable Status

These bits are set to a logic 0 when the FIFOs are disabled. They are set to a logic 1 when the FIFOs are enabled.

4.5 FIFO Control Register (FCR) - Write-Only

This register is used to enable the FIFOs, clear the FIFOs, set the transmit/receive FIFO trigger levels, and select the DMA mode. The DMA, and FIFO modes are defined as follows:

FCR[0]: TX and RX FIFO Enable

- Logic 0 = Disable the transmit and receive FIFO (default).
- Logic 1 = Enable the transmit and receive FIFOs. This bit must be set to logic 1 when other FCR bits are written or they will not be programmed.

FCR[1]: RX FIFO Reset

This bit is only active when FCR bit-0 is a ‘1’.

- Logic 0 = No receive FIFO reset (default)
- Logic 1 = Reset the receive FIFO pointers and FIFO level counter logic (the receive shift register is not cleared or altered). This bit will return to a logic 0 after resetting the FIFO.

FCR[2]: TX FIFO Reset

This bit is only active when FCR bit-0 is a ‘1’.

- Logic 0 = No transmit FIFO reset (default).
- Logic 1 = Reset the transmit FIFO pointers and FIFO level counter logic (the transmit shift register is not cleared or altered). This bit will return to a logic 0 after resetting the FIFO.

FCR[3]: DMA Mode Select

Controls the behavior of theTXRDY# and RXRDY# pins. See DMA operation section for details.

- Logic 0 = Normal Operation (default).
- Logic 1 = DMA Mode.

FCR[5:4]: Reserved