

## Wireless Infrared Data Communications Using the IRM3XXX Family of IrDA Compatible Infrared Transceivers

### Appnote 68

#### Introduction

Data interchange, computer to computer and computer to peripherals, requires compatibility at hardware and software levels. Standards agencies, IEEE, EIA, and others, have developed ISO interface standards to aid in system inter connectivity. Infrared wireless standards are currently under development by the Infrared Data Association, (IrDA).

This Appnote discuss the IrDA Serial Infrared Data Link Standard - Version 1.0 and the Siemens IRM3001, and IRM3105 transceiver module.

#### IrDA Protocol

The Infrared Data Association IrDA® has coordinated and developed a serial data interface standard that follows the standard ISO structure. The overall structure is shown in Figure 1. The first layer is called the Serial Infrared (SIR) Physical Layer. It follows the Physical Link Specification Version 1.0 which discusses the characteristics and performances requirements of the electro-optical interface modules.

Compliance to the physical layer is only part of the total IrDA specification. The next layer is the Link Access Protocol, (IrLAP). The data link layer protocol is similar to standard asynchronous HDLC and SDLC half duplex protocols. It

establishes the link connect services, operational modes, data frame structure, addressing, and supervisory issues.

For a complete specification of the IrDA specification:  
<http://www.irda.org>

#### The Infrared Modem

The IrDA serial interface is often compared to an RS232 serial data communication system. However, Figure 2. shows a data modem as a more compatible comparison. The modem accepts data from the CPU and converts it into a serial infrared data stream. The Siemens IRM3XXX optical transceiver deals with the primary data conversion for optical to electrical and electrical to optical. The Data Formatter encodes to be transmitted and received data. The output of this module provides the signal for the UART function. IrDA literature offers the "16550" USART family as a recommended interface, however, such elder statesmen as the Motorola MC6850 can also be used.

The IrDA Data Modem is compatible with the physical layer specification and sections of the IrLAP layer.

Figure 1. ISO structure of IrDA protocol

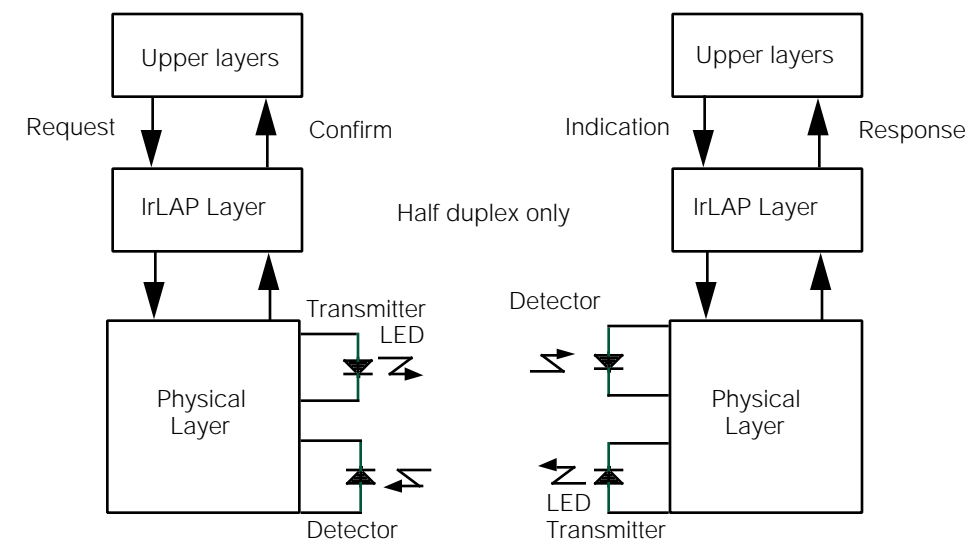


Figure 2. IrDA data modem

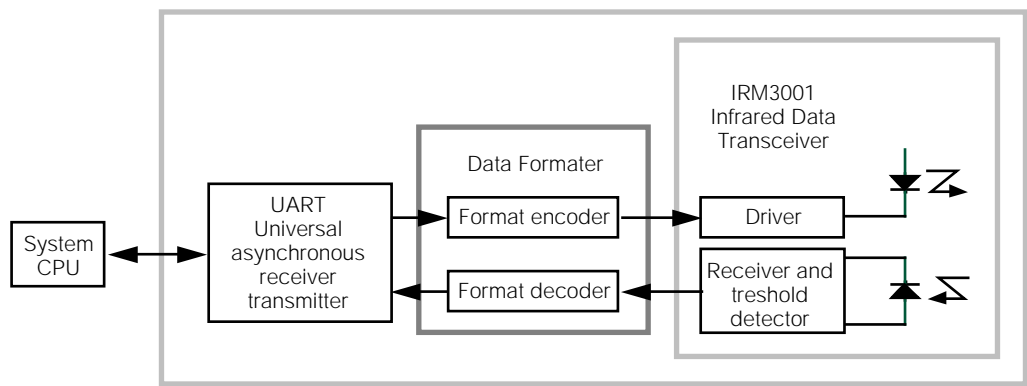
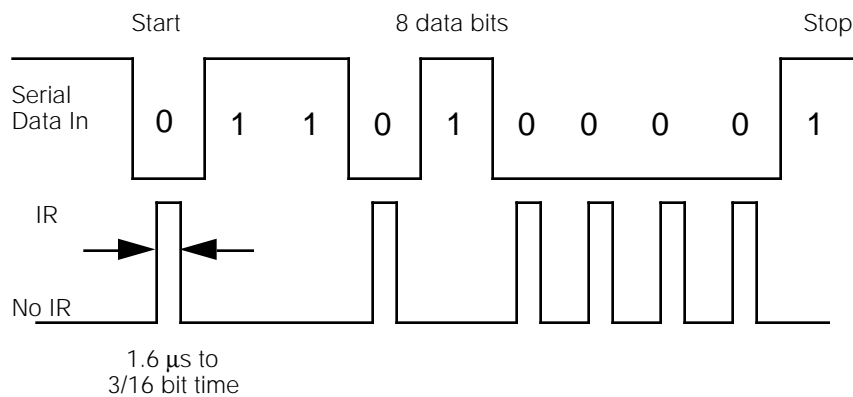


Figure 3. SIR data formatting



Physical Layer

The IrDA physical layer SIR 1.0 specification describes a half duplex, point-to-point, 0 –1 meter, 2.4 to 115.2 kbits/s, infrared data link. Each of these point warrant amplification. The link is half duplex, which means that only one transceiver is transmitting at a time. This transmission scheme permits simple direct optical modulation of the optical source (LED).

The SIR version 1.0 is intended for point to point data interchange between a notebook and a printer, or notebook to desktop computer. The IrDA link eliminated cables, and interconnect mechanical issues. For this reason the operational distance is kept under one meter (3 ft.)

The benefit of direct modulation of the LED is three fold. First, it is simple, both in data formatting and data detection. Second, it makes maximum use of the available bandwidth of the LED, and third, direct amplitude modulation maximized optical output power, while minimizing power consumption.

Figure 3 shows the basic data formatting for the IrDA v1.0 standard. A data formatter receives serial data that is converted to a return to zero inverted (RZI) signal. Thus, only data zeros (0) result in LED activation. The figure also shows that data format includes one start bit (0), eight data bits (8), one stop bit (1).

Table 1 shows basic truth table for the data flow within the Data Modem. Note that IRM3XXX transceiver transmits an optical pulse when the input is a logical one (High). The corresponding IRM3XXX optical receiver converts this high optical pulse into a logical zero (0). The data decoder maintains this logical sense throughout its decoding process.

Figure 3 illustrates that not only is the optical data RZI but that there are min/max specifications for the pulse width. The 1.6 μs pulse width is derived from the 3/16 timing of the maximum data rate or v1.0 of 115.2 kBits/s. Data recovery of the UART sets the maximum pulse of  $\frac{3}{16}$  of the bit rate agreed upon in the IrLAP protocol. Most battery operated computers will seek to transmit at the maximum bit rate, and thus the minimum pulse width. Again this will maximized data transfer while at the same time conserve battery power.

Table 1. IrDA Modem Truth Table

Data In Encoder	Data In IRM3XXX	Flux-Out Φ <sub>e</sub>	Data Out IRM3XXX	Data Out Decoder
0	1	high	0	0
1	0	low	1	1

Siemens IrDA Transceiver

Figure 4 shows the block diagrams of the IRM3XXX IrDA transceivers. The module is a hybrid consisting of three discrete semiconductors. A separate PIN photodetector and high speed infrared LED are mounted behind their respective optical lenses. Mounted between them is the integrated circuit that interfaces these two semiconductor to the data encoder/decoder.

The integrated circuit consists of five function elements. Starting with the receive section, the photodiode is connected to a transimpedance amplifier with a DC suppression circuit to eliminate ambient light. The output of the amplifier is converted to a logic signal by the comparator section. The One Zero detection thresholds are adjusted based upon the magnitude of the input optical signal. This threshold adjustment permits minimum pulse distortion assuring best error rate performance. Recall that the photodiode amplifier/comparator function as an inverter of the applied optical signal.

All of the circuits on the chip are enabled by a bias generator. Quiescent power can be conserved by applying a logic 1 (High). This power down mode reduces power consumption to 1.25 mW maximum.

An LED driver is also included on the IC. This driver switches an internal current source through the LED. This feature minimizes the need for an external resistor and insures proper current limiting. Again, a logical " 1 " at the transmit input will activate the LED.

Operational Hints

As with all ICs operating the device below absolute rating is always encouraged and will insure long term operation.

The use of power supply decoupling capacitors is highly recommended. Failure to do so may result in oscillation of the detector amplifier. The use of low inductance 0.1 μF capacitors satisfies this need.

Figure 4. Siemens IRM3001/3105 and IRM3000/3100 block diagrams

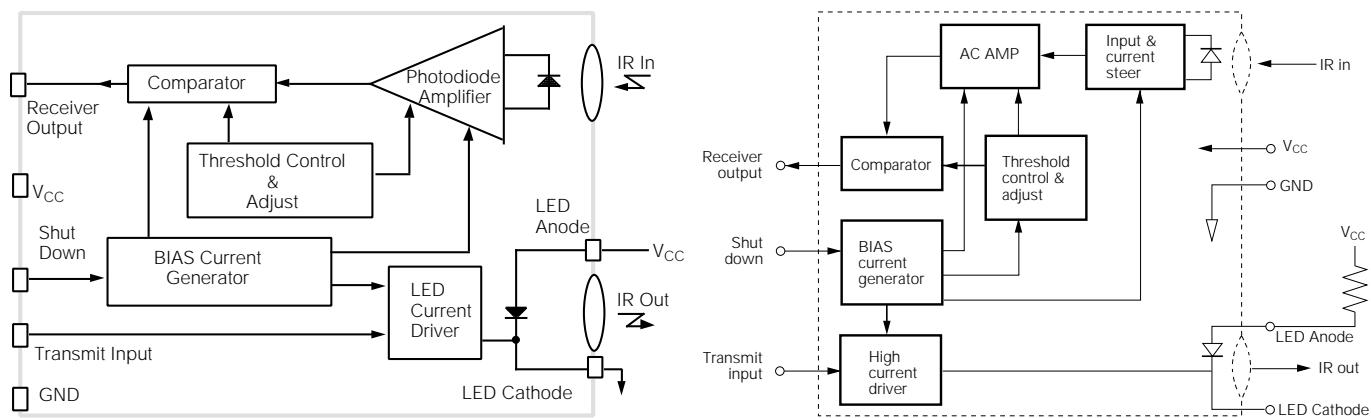


Figure 5. Data formatte

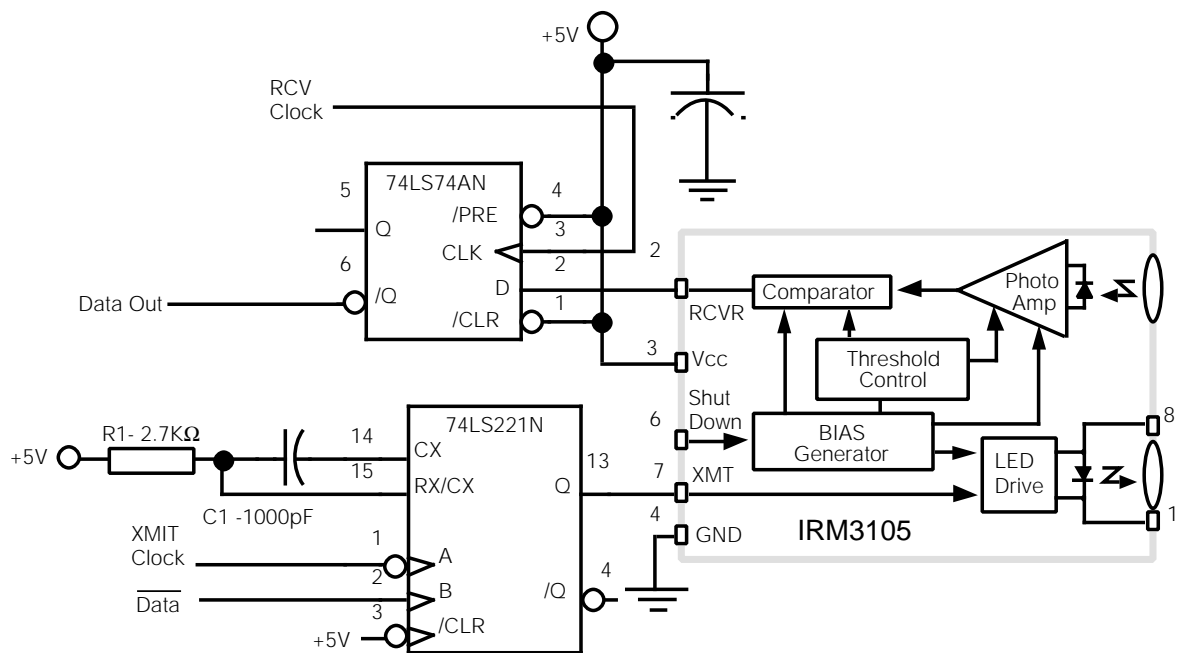
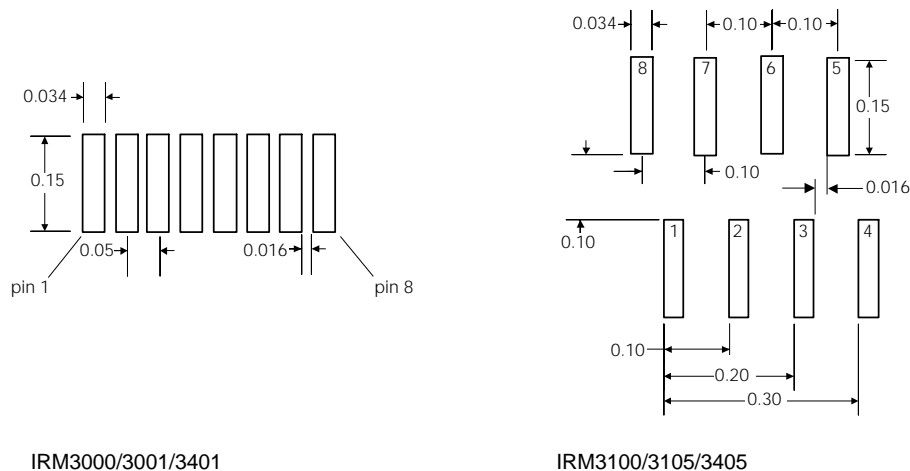


Figure 6. Pad layout



## Interconnecting the IRM 3XXX

Figure 5 shows a simple encode/decode formatter for the IRM3XXX family of IrDA transceiver module. The encoder creates the RZI data by using inverted data from the UART and data clock. The formatting is accomplished with a low cost 74221 dual monostable multi. This is shown in Figure 7.

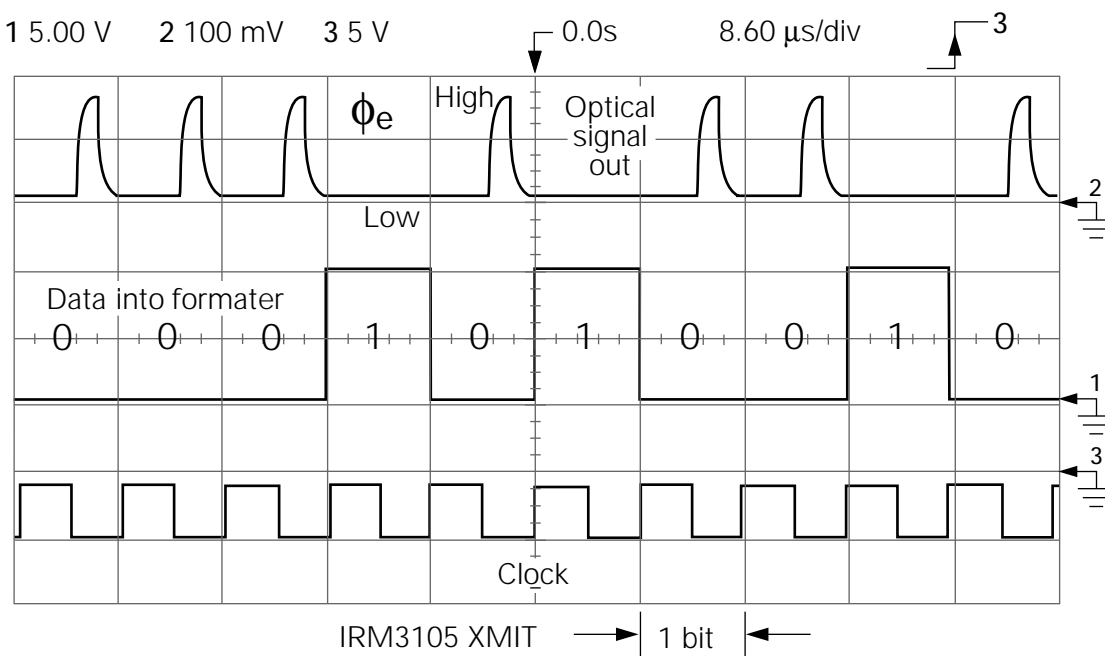
The decoder part of the simple data formatter consists of nothing more than a "D" flip-flop. The RCVR output of the IRM 3XXX is set in the "D" input and is clocked out by a delayed 1/16 wide clock pulse. This pulse is obtained from UART or baud rate generator. Figure 8 shows the composite timing for data applied to the input of the data formatter and the resulting recovered data at the output of the /Q output of

the 7474 "D" FF. The two lower traces illustrate the receive output of the IRM3XXX and the delayed clock used to recover the data.

## Conclusion

This Appnote has just scratched the surface of the use of the Siemens IRM3XXX serial data communications transceiver modules. These modules were developed to be compatible with IrDA v1.0; however given the data transparency of the transmitter and receiver their applications are not limited to the IrDA format. Designers are encouraged to apply these simple modules where short distance data interchange requirements exist.

**Figure 7. Encoder timing**



**Figure 8. Receive data formatter timing**

