

# IrDA Physical Layer Implementation for Hewlett- Packard's Infrared Products

## Application Note 1119

An IrDA physical layer implementation will include the data host (UART, RS232, microprocessor, or microcontroller), the IrDA modulator/demodulator (I/O chip, ASIC, or discrete IC), and the infrared transceiver. The exact implementation for each block will depend upon the chosen bit rate for data communication, and upon the application system's architecture. Bit rates at or below 115.2 kbits/second can utilize serial ports of UARTs, RS232 ports, microprocessors, or microcontrollers for the data host. Infrared data communication hardware for bit rates above 115.2 kbits/second must interface to the microprocessor or microcontroller data and address buses. The application system's architecture will help determine whether the infrared hardware interface should be to a UART, RS232, microprocessor, or microcontroller. See Figure 1.

### IrDA Data Modulation

UART, RS232, microprocessor, or microcontroller data needs to be modulated for infrared data communication. The infrared transceiver requires discrete pulses to represent data bits. UART, RS232, microprocessor, and microcontroller data bits are

expressed in NRZ data format. Not-Return to Zero (NRZ) data is 100% duty cycle, and so does not contain discrete pulses representing data bits. See Figure 2.

If NRZ data were sent directly to the IR transmitter, the IR emitter would dissipate power for several bit periods in the case of a long sequence of 1 bits. The lengthy power dissipation could overstress the IR emitter if it exceeds the datasheet's absolute maximum ratings. Emitter current for infrared transmission is typically in the 100's of milliamps, and bulk resistance of typical IR emitters is 1-3 ohms. Power dissipation as heat in the IR emitter can be as high as 0.7-1.5 watts for continuous bias. Return to Zero (RZ) data

made up of  $\leq 50\%$  duty cycle pulses would limit the heating time period, and allow for IR emitter cooling after each pulse. IrDA data modulations use  $\leq 25\%$  duty cycle RZ pulses for all data rates.

### Data Rates of 9.6-115.2 kbits/second

Infrared data communication at data rates  $\leq 115.2$  kbits/s is designed to utilize the serial port function of various devices. The serial port data is Not-Return-to-Zero (NRZ) modulation format, and so needs to be modulated further for use with infrared components. The IrDA modulation/demodulation function is available in 8-16 pin EnDec (Encode/Decode) chips, or is

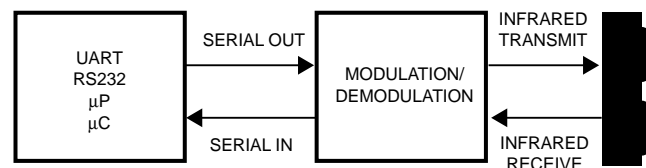


Figure 1.

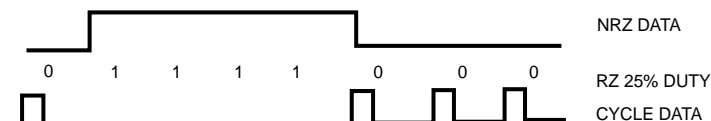


Figure 2.

embedded into several common I/O chips manufactured by National Semiconductor, SMC, VLSI, or Winbond.

Systems requiring I/O chips for non-IrDA applications can often make use of I/O chips containing the embedded IrDA modulation/demodulation. Notebook PC's and desktop PC's are examples of systems which would use such I/O chips. The infrared enabled I/O chip can then interface directly to the infrared transceiver for data communication. Figure 3 is an example implementation using the National Semiconductor PC87334 Super I/O chip and the Hewlett-Packard HSDL-1001 infrared transceiver.

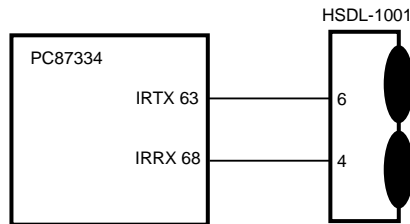


Figure 3.

Systems which use ASICs that could contain peripheral functions can implement infrared communication with the IrDA EnDec's netlist along with a Hewlett-Packard transceiver. The EnDec netlist can be embedded into the ASIC, and the Hewlett-Packard HSDL-1001 transceiver can be connected directly to the ASIC. The EnDec netlist is available from Hewlett-Packard for customers also implementing Hewlett-Packard's infrared transceivers into their system. See Figure 4.

Infrared data communication driven from the UART, RS232, or microcontroller can be implemented with an 8-16 pin EnDec

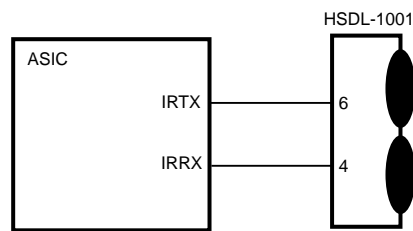


Figure 4.

(HSDL-7000 or HSDL-7001), and an infrared transceiver (HSDL-1001). Products such as handheld PCs, pocket organizers, pagers, cellular phones, electronic measurement instruments, and medical equipment are examples of systems that would use such an implementation.

A UART implementation example is shown in Figure 5. UARTs which provide a 16xBaud pin can use the

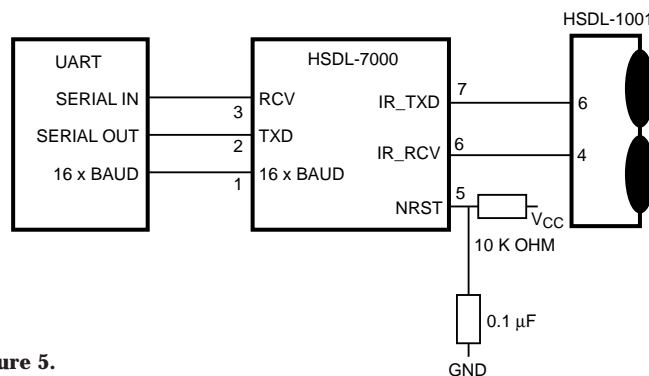


Figure 5.

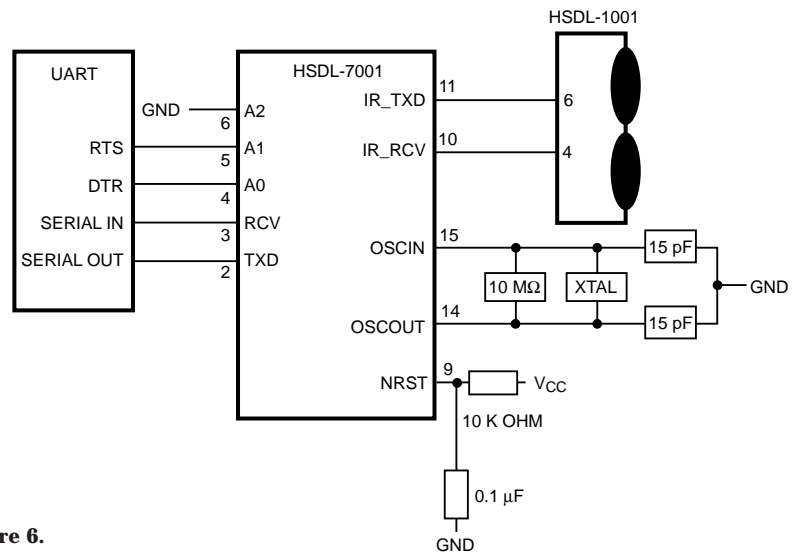


Figure 6.

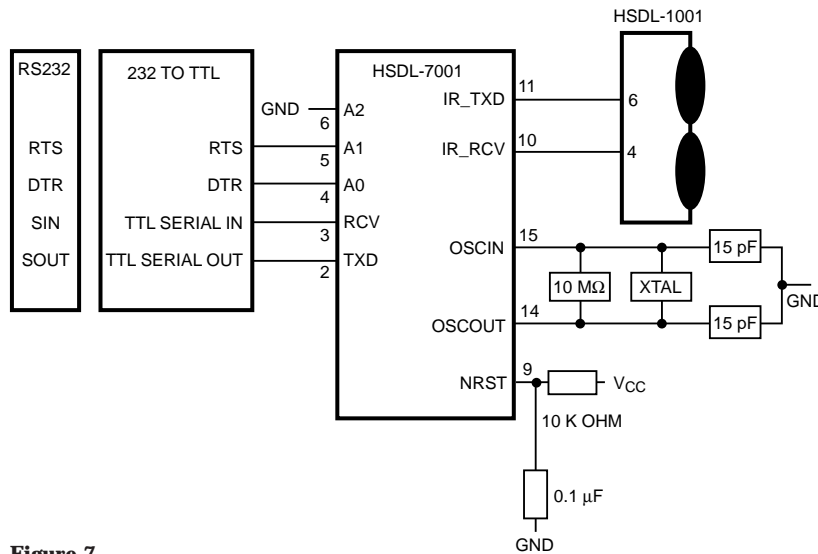
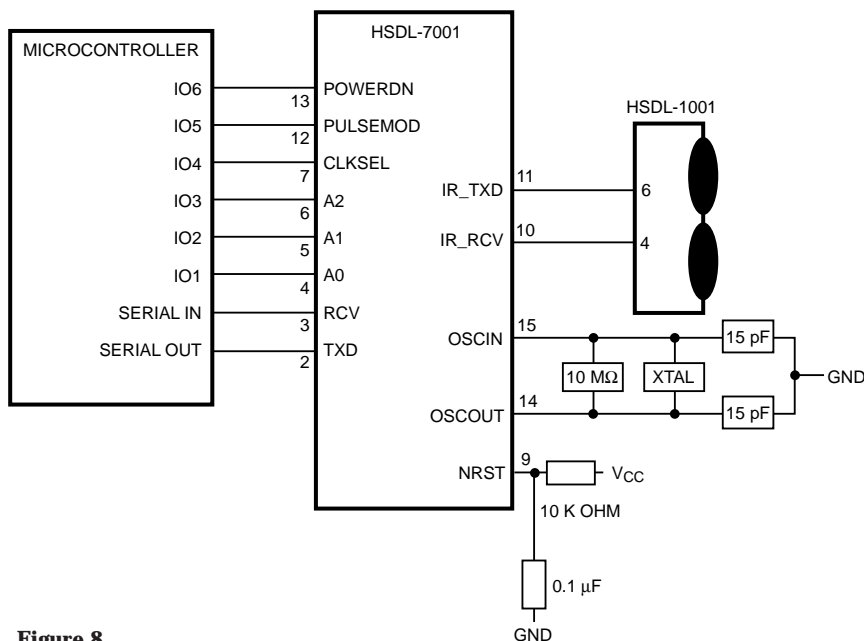
HSDL-7000 EnDec with no external 16xBaud generator.

UARTs with no 16xBaud pin available should use the HSDL-7001 and its internally generated 16xBaud signal. The HSDL-7001's A0-A1 baudrate address lines can be programmed through the DTR and RTS lines of the UART, or hard wired for a fixed 9600 bits/s data rate. Baudrate address line A2 should be pulled low. See Figure 6 and Table 1.

An example of an RS232 driven infrared system is shown in the diagram below. The HSDL-7001's baudrate address lines should be set using the DTR and RTS lines of the RS232 port, just as in the UART case above. See Figure 7.

**Table 1.**

DTR (A0) Programmed	RTS (A1) Programmed	Data Rate (bits/s)
Low	Low	115200
Low	High	57600
High	Low	19200
High	High	9600

**Figure 7.****Figure 8.**

A microcontroller implementation would also use the HSDL-7001 EnDec, and HSDL-1001 transceiver, as shown in Figure 8.

The CLKSEL pin can be pulled down to ground to enable the HSDL-7001 internal 16xBaud generator, instead of programming it through the microcontroller. The PULSEMOD pin can be pulled high for 1.63  $\mu$ s pulse mode or pulled low for 3/16 modulation. Programming the POWERDN pin high shuts down the HSDL-7001 internal oscillator, which accounts for most of the EnDec's power consumption. See the HSDL-7001 datasheet for information on setting the baudrate address lines A0-A2.

### Data Rates of 0.576, 1.15, and 4.0 Mbits/second

Infrared data communication implementations using data rates  $\geq 115.2$  kbits/s need to interface to the microprocessor or microcontroller data bus. The system bus data is typically in NRZ format and so IrDA modulation/demodulation is necessary. Each IrDA data rate  $\geq 115.2$  kbits/s requires a specific modulation format, which can be provided by an infrared controller chip or an I/O chip with embedded IrDA modulation/demodulation.

The data transfer to the microprocessor or microcontroller can either be through Direct Memory Access (DMA), or through interrupts.

Each implementation makes use of either the HSDL-1100 or the HSDL-2100 infrared transceiver. The HSDL-2100 is specifically designed for applications requiring small package height. Both transceivers have a data receive pin (RxD) for

data rates up to 115.2 kbits/s, and a data receive pin (RxdB) for data rates above 115.2 kbits/s.

Systems such as notebook PCs and desktop PCs, which require an I/O chip for non-IrDA applications can use I/O chips with embedded IrDA modulation/demodulation. The I/O chip connects directly to the infrared transceiver. I/O chips with up to 4 Mbits/s IrDA modulation/demodulation include: National Semiconductor PC87338, SMC FDC37C669FR or FDC37C95xFR, VLSI VL82C147. Implementations using these I/O chips and the HSDL-1100 or HSDL-2100 infrared transceiver are shown in Figure 9 and Table 2.

Refer also to the application note titled General Application Guide for the HSDL-1100 4 Mbits/s Infrared Transceiver, and the note titled Report on HSDL-1100 Interoperability with 4 Mbits/s Infrared Controllers.

Systems needing to drive infrared communication from the microprocessor or microcontroller bus can use an infrared controller (PC87109, SMC35C44) connected to the infrared transceiver (HSDL-1100 or HSDL-2100). Products such as handheld PCs, pocket organizers, pagers, cellular phones, electronic measurement instruments, and medical equipment are examples of systems that would use such an implementation.

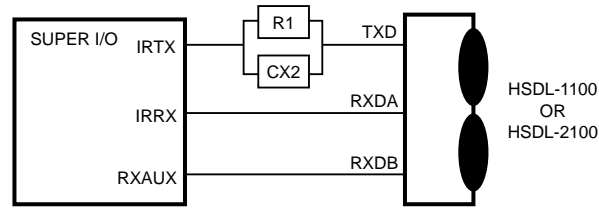


Figure 9.

Table 2.

Super I/O	Txd	RxdA	RxdB
NS PC87338	IRTX pin 39	IRRX <sub>1</sub> pin 38	IRSLO/IRRX <sub>2</sub> pin 37
SMC FDC37C669	TXD2/IRTX pin 89	RXD2/IRRX pin 88	IR_Mode/IRRX3 pin 23
SMC FDC37C95x	IRTX pin 204	IRRX pin 203	IR_Mode pin 190
VLSI VL82C147	IROUT pin 66	SIRIN pin 67	FIRIN pin 65

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Data Subject to Change

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