Make Your Own USB HART Modem

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1. Introduction

You can make a HART™ Modem that connects to a USB port. The combination of the Modem and PC form a HART Primary Master. The Modem is isolated from the HART network and meets most HART specifications. It is powered through the USB port so that no power supply is needed.

A diagram of the modem is shown below. The USB part of the modem is purchased (for about $30). You need to add a modest amount of additional circuitry to complete the modem. A PIC16F876A microcontroller buffers the data between the PC and the HART network. The microcontroller code is available on the Nesebar website. The added circuitry includes the A5191HRT modem chip [1].

The USB interface is an Olimex PIC P28-USB [2]. This may be purchased (and its schematic and instructions downloaded) from any of several distributors. It contains the socket for the PIC16F876A microcontroller, which is also available from several sources.

The microcontroller may be programmed in a number of ways. One is to use an In-Circuit-Debugger (ICD) made by Microchip [3]. A programming cable that connects the ICD to the Olimex PIC P28-USB is available as the Olimex PIC-ICSP, also available from distributors.

Notice that the microcontroller has two serial ports: (1) A PC/USB port that uses only Tx and Rx lines and runs at 9600 bps, and (2) a HART serial port that connects to the HART modem chip using 4 signal lines and runs at 1200 bps. The PIC16F876A microcontroller has just one hardware serial port, which is used as the HART port. The PC/USB port is a software port that
uses two of the microcontroller I/O lines.

2. **Modem Schematic and Code**

A schematic of the modem is given on the Nesebar web site at


The microcontroller code, including both a hex file and the source, is located at


The compiler used is available from CCS [ 4 ].

3. **Changes to the PIC P28-USB Board**

As shipped, the USB-to-Serial converter chip of the P28-USB is connected to the microcontroller hardware port (Pins 17 and 18 of the microcontroller). Since these pins are to be used as the HART port, the existing two connections must be cut and moved. This is illustrated below.
Additionally, the components D1 and R12 on the PIC P28-USB board should be removed.

4. **Setting Up USB Connection**

   Once the modem circuit is complete, connect the PIC P28-USB to a USB port on the PC using the supplied USB cable. Bring up the “hardware manager” window of the PC. This is done in different ways, depending on which version of Windows is being used. Go to “ports”. There should be a new serial port present. This indicates that USB chip in the P28-USB is connected to the PC. This serial port should be set up for 9600 bps, one start bit, one stop bit, no parity, and no flow control. HART Master software should now be able to communicate with the HART modem.

   If the PC says that a driver must be installed, this can usually be downloaded from the distributor that sells the PIC P28-USB or from Olimex.

5. **Compatible Languages**

   Software to communicate with HART devices can be written in any language that supports serial port communication. Examples are VBA, MATLAB, Python, Perl.

   There is a command that can be issued to the modem itself as a test of whether the modem is connected and operating. The modem does not pass this command on to the HART network. The command consists of 0xFF, 0xFF, 0x8A. Upon receiving these 3 bytes in order, the modem echoes these same bytes back to the PC.

6. **References**


   2. PIC P28-USB Data Sheet, Olimex, Ltd., 2 Pravda St., P.O. Box 237, Plovdiv 4000 Bulgaria, www.olimex.com.
