

PIC-E Plus

Updating a Classic

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Abstract

This paper expands on the PIC-Encoder concept by porting the software from the original project to the recently released PIC 18F4550. The result is an expanded PIC-E with more flash and RAM memory, a USB interface, and enough horsepower to directly implement software defined modem functions.

Introduction

The original PIC-Encoder (PIC-E) broke new ground as the first fully user programmable “engine” capable of providing a generic interface between the digital world and the amateur packet world. Advances in microcontrollers since the PIC-E’s introduction in 1998 now make it possible to expand the PIC-E concept with more memory, a USB interface, and software defined modem functions, all by using a commercially available evaluation kit from Microchip.

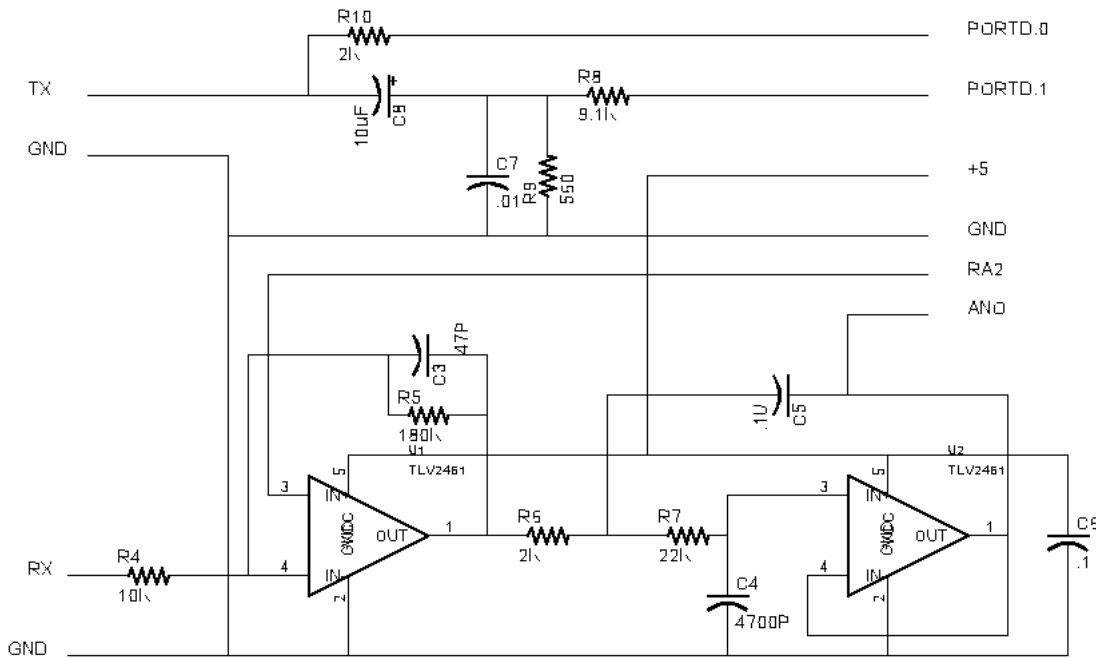
The 18F4550

The PICDEM FS USB Demo Board

Our friends at Microchip were kind enough to package the 18F4550 in a convenient Demo board. For only \$59, the developer gets a 5.7x2.2 inch PCB with the 18F4550, a RS232 serial port, USB connector, 5V regulator, 4 user LEDs, 3 pushbuttons and a potentiometer. All 18F4550 connections are brought out to a through hole field for connections to other circuitry. The demo board also comes with software to download the users program via the USB connection, as well as the necessary cable. The necessary assembler and linker can be downloaded from Microchip’s web site.

Turning the PICDEM FS USB Demo Board into a PIC-E Plus

Since the 18F4550 is more than capable of performing all the functions necessary for 1200 baud packet, including modulation and demodulation, the only thing needed is the circuitry to interface to the radio itself. The following circuitry accomplishes this to interface to a Yeasu VX-5 HT. Radio connections are on the left and Demo PCB connections are on the right.



Converting Code

The PIC-E Plus is intended as an upgrade to the original PIC-E. As a test of this, the program packet.zip by Byon Garrabrant, N6BG, was modified to run on the 18F4550. Packet.zip is an assembly routine to send packet radio with a Hello World sample.

The original PIC-E used an 8 bit 16F84. Microchip's 8 bit assembler implemented a number of macros which were not carried forward to the 18Fx family. These had to be converted to new instructions provided on the 18Fx or explicitly declared. The 18Fx family also has considerably more configuration registers to set up. Fortunately, the PICDEM FS USB Demo Board comes with good documentation for making that transition.

Perhaps the greatest impact to the original code was in the way data in program space was handled. Packet.zip stores the packet to be sent in program space and uses a series of "RETW" instructions to fetch it. The 18Fx family implements a much more flexible table pointer allowing the user to put the unaltered packet anywhere in program memory that is convenient.

The enhanced feature set of the 18Fx family allows direct implementation of both Bell 202 FSK modulation and demodulation. Modulation is implemented with the second timer by simply reloading the appropriate time for the mark and space tones at time out. Demodulation also uses the second timer, but as a period timer timing the zero crossings of the incoming audio. As a further enhancement, the 18Fx has an on board analog comparator and a 16 tap comparator reference which allows direct implementation of both the zero crossing function with a variable threshold to prevent false triggering. While packet.zip does not make use of FSK demodulation, future application certainly will.

Downloading and Operation

In marked contrast to previous Microchip development tools, the PICDEM FS USB Demo Board requires no external programmer pod. The 18F4550 comes preloaded with a protected boot routine that works through the USB port. After properly installing the necessary drivers, it was easy to assemble the program and load it into the demo board. One caution, however. Because of the USB boot routine, actual user program execution begins at 0x0800 instead of 0x0000. Thus absolute assembly location of the reset location must be changed from 0x0000 to 0x0800 when going from simulation to execution, respectively.

Conclusion

The 18F4550 and its attendant PICDEM FS USB demo board can reinvigorate the PIC-E community. Besides porting existing PIC-E software to the new platform, developers can now take advantage of the added memory, functionality, and high speed USB capability. Furthermore, the 18F4550 uses Microchip's "nanoWatt Technology", making interesting low power applications possible. Applications can be prototyped on the PICDEM FS USB demo board and released on PCB assemblies specifically designed for the applications. Some ideas that come to mind are;

1. A "bump in the cable" TNC, connected between a GPS and HT.
2. A plug in digipeater no bigger than a small speaker mike.
3. A full function, USB TNC small enough to be practical with a PDA or notebook computer.
4. Packet using standards other than Bell 202 (BPSK or wider FSK modes come to mind).
5. Sensor based packet. Using packet to monitor light, heat, salinity, pH, RF or just about anything else.
6. Packet based control. Using packet to remotely control functions or start and stop processes such as repeater battery charging or remote spectrum monitoring.

The possibilities are endless.

References

MSP430 Software Modem

<http://focus.ti.com/docs/apps/catalog/resources/appnoteabstract.jhtml?abstractName=slaa204>

Microchip PICDEM FS USB (\$59)

http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=1406&dDocName=en021940

TAPR PIC-E software library

<ftp://ftp.tapr.org/picsig/software/>

TAPR PIC-E assembly and operating manual

ftp://ftp.tapr.org/picsig/docs/pic-e_assy_manual.pdf