

Doppler Speed Radar

(2007 Microchip Embedded Control Design Contest)

Abstract #MT1623

In the 2007 Microchip 16-Bit Embedded Control Design Contest, I will construct my own speed radar by connecting a microwave transceiver to a dsPIC processor. A radio signal will be “bounced” off a target and the frequency (Doppler) shift will be measured to determine the target’s speed.

The Hardware

My Doppler Radar hardware consists of a microwave Gunnplexer hooked to a modified Microchip 28-pin Starter Board. The Gunnplexer provides the microwave front end. An op-amp based amplifier section conditions the receive signal. The Microchip Starter Board pulls together the digital hardware components of the system.

Eligible Part(s)

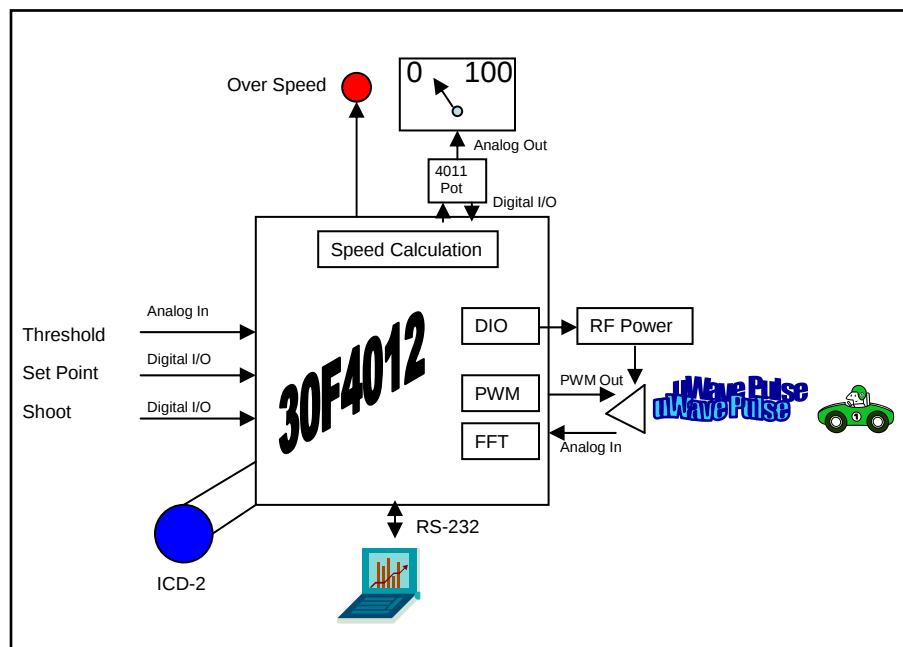
dsPIC30F4012 Microchip CPU w/DSP

Bonus Part(s)

MCP4011	Used as a D/A converter
TC4427A	Low-Side MOSFET Driver
MCP6022	Dual Rail-To-Rail OP-AMP

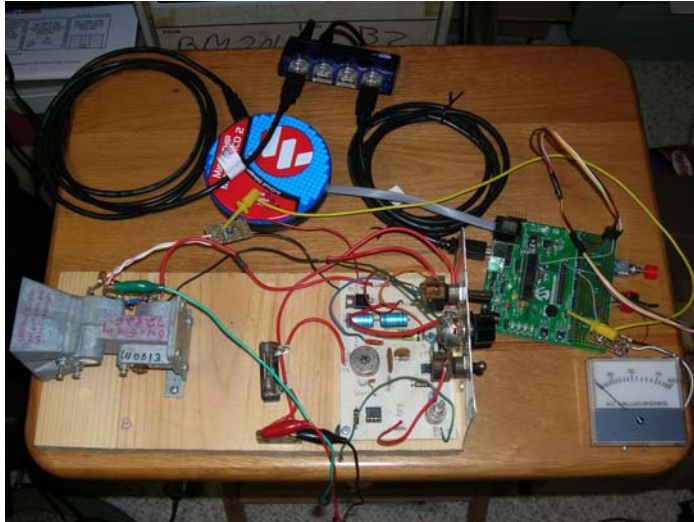
The System

My speed radar will generate a microwave energy burst using a 10 Ghz Gunnplexer transceiver. The energy burst can be modulated using a PWM output. The microwave signal will bounce off of a moving object, creating a Doppler shift of the transmitted frequency. The received signal will be fed to a Fast Fourier Transform (FFT) to determine the shift frequency.



Doppler Radar Block Diagram

The shift frequency will be converted to a target speed in miles per hour, and the target speed will be displayed on an analog display and transmitted to a serial port.



A Prototype Homemade Doppler Radar

The Software

The Software was developed using the following tools:

MPLAB IDE v7.52

Microchip C30 C Compiler

ICD2 Device Programmer/Debugger

A Gunnplexer will return a frequency that is proportional to the speed of the target that is reflecting the transmitted signal. This applies in both an unmodulated (CW) signal and a modulated FM signal. In its simplest form, the software needs to activate the transmitter, modulate it if FM is used, then determine the frequency of the received signal. The receive signal frequency is then converted to a target speed in miles per hour, and the speed is presented to the user. (See the code listing below.) Transmitter activation is accomplished by controlling a digital output pin. Modulation is accomplished by programming a PWM output pin.

```
Chirp_On();                //Modulate the transmitter
ADC_Collect_uWave();        //Collect samples from receiver

//Wait for ADC sampling to complete
while (!ADC_SamplingComplete()){};

Chirp_Off();               //Stop Transmitter modulation

if ( Cals.FunctionEnable.SpeedFFT ) {    //Execute FFT on receive data
    FFT_main(&F1, &F2, &M1, &M2);

    //Calculate Speed
    S2 = F1 * SHOOT_FFT_SLOPE;
    ScaledSpeedInput = S2 + SHOOT_FFT_INTERCEPT;
    TargetSpeed = ScaledSpeedInput;      //Remember Last speed for user Inquiry.
} else {
    TargetSpeed = ScaledSpeedInput;      //Remember Last speed for user Inquiry.
}

Needle_Speed(TargetSpeed);    //Display Target Speed & Set Speeding LED
```

Complete Schematic

The schematic is divided into functional areas. Off Page markers indicate interconnections between the various sheets of the schematic.

Schematic Pages

dsPIC30 CPU

Microwave

RX Amp

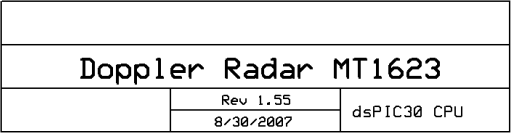
RS-232

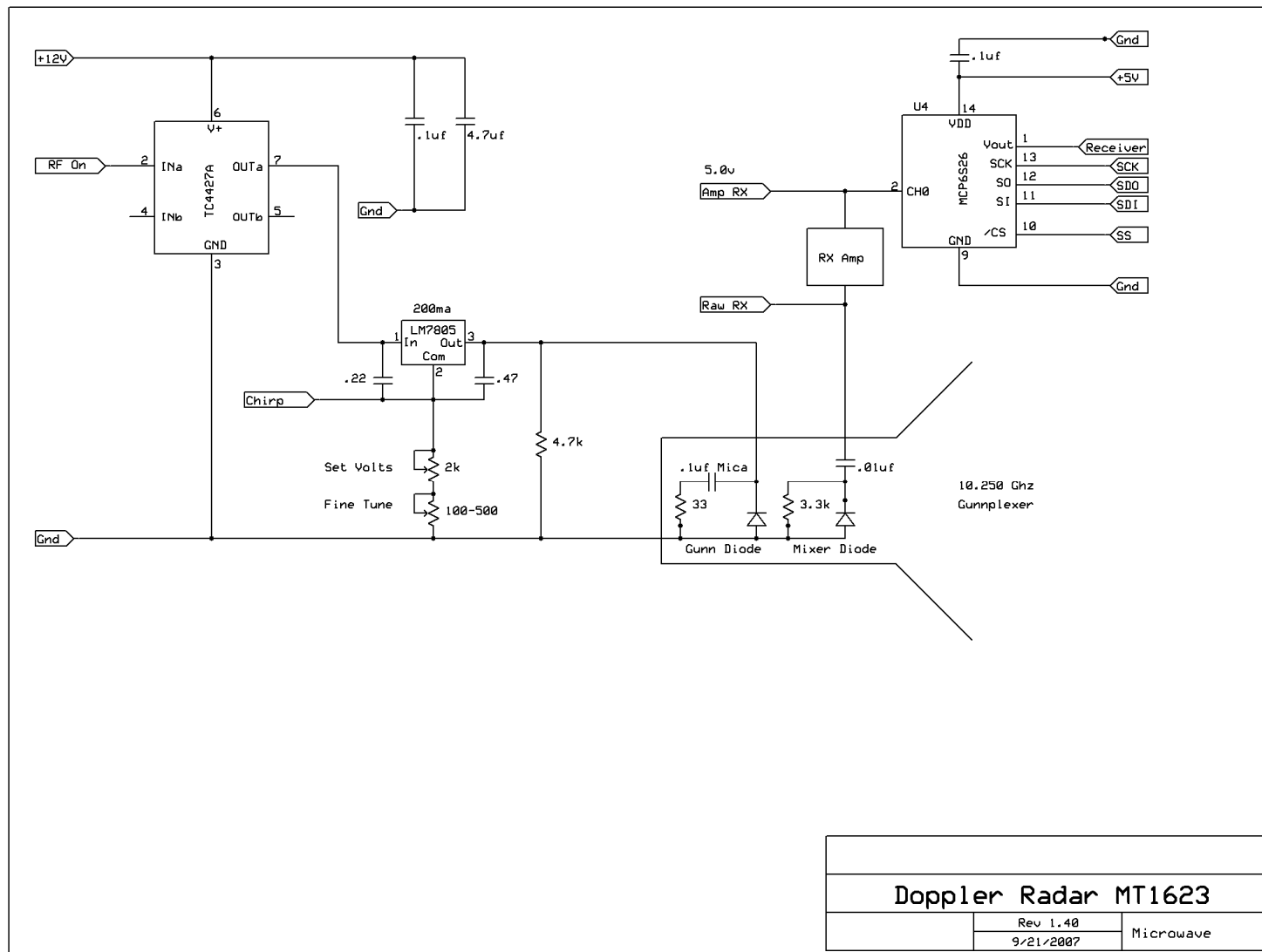
- dsPIC Processor and Interfaces

- Gunnplexer Based RF Section

- Receiver filtering and amplification

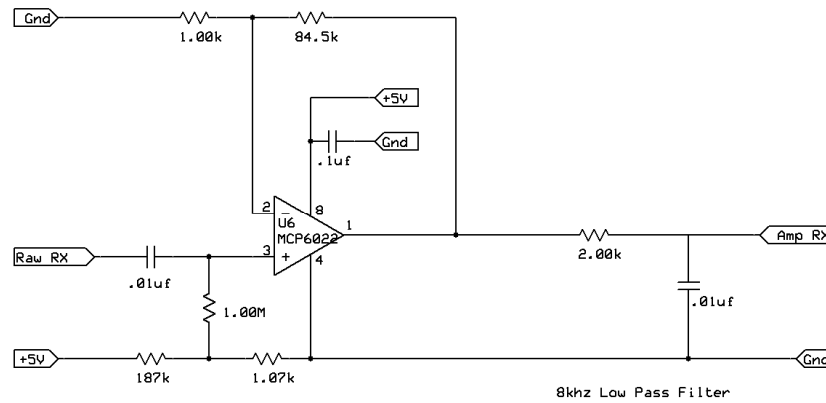
- Serial Interface







Reserved for Possible Active LPF



Doppler Radar MT1623		
	Rev 2.0	RX Amplifier
	9/11/2007	

