Hardware Description

For my senior project, I am developing an ATV instrumentation display. This device will be used by the rider to see important information such as the speed, a tachometer, odometer and a clock. The device is composed of several components: a micro-controller, VF display, wheel rotation detector, pulse detection circuit, real time clock, 2 leds, 3 user interface buttons and source voltage circuitry. Following is a description of how each component is implemented.

Micro-Controller

The micro-controller I am using is the Motorola MC9S12C32. It is a 16 bit micro-controller that has 32k bytes of flash EEPROM and 2k bytes of RAM. The MC9S12C32’s I/O pins are used to interact with the external circuitry. PortAD(0-7) and PortT(0-2) are used to communicate to the VF display. PortT(3) is the input for the pulse detection circuitry. The wheel rotation sensor is connected to PortT(4) as an input. The 3 user interface buttons are inputs to PortT(5-7). And the Real Time Clock is connected through the SPI: MISO, MOSI, SCK and SS_L.

VF Display

I chose to use a 2x16 vacuum fluorescent display (VF Display) to display all the data to the user. I feel that with the display’s large characters, 9.22x3.85mm, and bright letters, it would be easiest for the user to read while riding the atv. The display has a black background and bright blue-green characters. The data bytes are transferred from the micro-controller using PAD(0-7) and the RS, R/W and E pins of the display are
connected to PT(0-2). The VF display will be used to display the speed, RPM’s, odometer and clock.

**Pulse Detection Circuitry**

A pulse from the ignition pulse generator will be detected by splicing into the wire that goes for the ignition pulse generator to the ignition control module (ICM). The pulse is generated every time the engine makes one revolution, and the pulse is used to tell the ICM when to fire the spark plug. The pulse itself is a 1.4 volt pulse. Two diodes, one referenced to ground and the other to +5V are connected to the pulse wire to protect the circuitry from unexpected voltage spikes. And the pulse is ran through a current limiting resistor to further protect the circuitry. The pulse is put into a MAX931 comparator with a reference voltage of 1.1 volts. So every time there is a pulse, it detects that the voltage went above 1.1 volts and the comparator outputs a 5 volt square wave. So for each pulse there is one 5V square wave. And the 0-5V square wave is put in to PT(3), where it is used to calculate the RPM’s.

**Wheel Rotation Detector**

A magnetic reed switch is used to detect each revolution of the front tire. A bolt with a magnetic head is installed in the wheel, so it spins with the wheel, and the reed switch is mounted on the brake caliper so the magnet goes by right in front of it. +5V is applied to the reed switch, and every time the wheel makes one revolution, the magnet trips the reed switch and a 5V square wave is generated. And this 0-5V square wave is connected to PT(4), where it is used to calculate speed for the speedometer and distance traveled for the odometer.
**Real Time Clock**

A DS1305 real time clock (RTC) is used to keep time for the clock on the display. The SPI is used to communicate with the RTC. The SDO, SDI, SCLK, CE are connected to the MISO, MOSI, SCK, and SS_L pins respectively on the MCU. A 3V backup battery is connected to Vbat and Gnd, so if the MCU loses power, the time will be saved using the battery. And a 32.7658 kHz crystal oscillator is connected to X1 and X2, it has a capacitance of 6 pF to match the capacitance of the oscillator to improve long term accuracy of the clock.

**Buttons and LEDs**

There are three user interface buttons that are used to control the device. There is an “UP”, “MODE” and “DOWN” button. They are connected to PT(4-6) in an active high setup, and the MCU pull-down resistors are used to tie the inputs low when buttons are not pressed.

There are two LEDs, a yellow LED and a red LED. The yellow LED is a shift light, which will indicate when the RPMs are at the desired level for shifting. And the red LED is a red-line light, which will indicate when the RPMs have reached a level that could become dangerous to the engine. Each LED has a current limiting 200 ohm resistor and they are connected to PM(0-1).

**Power Supply**

The ATV’s 12V battery is used to power the instrumentation display. A LM2940T-5.0 is used to regulate the voltage to +5V and the regulator is rated up to 1 amp. The voltage regulator is a good automotive regulator, because it has built in
protection against reverse polarization and good noise immunity. Two capacitors are connected to the voltage regulator to bypass any noise to ground.

**Crystal Oscillator and BDM**

The micro-controller has a built in 8 MHz crystal oscillator that is connected to EXTAL and XTAL. And a 6 pin BDM connector is used. It is connected to the MODC/BKGD pin and RESET_L pin using active low setups for both.