GPIO How To Guide

In many embedded controller applications, there is a need to interface with external devices, including simple LEDs and pushbuttons, LCD displays, motor controllers, and sensors.

To use a GPIO pin on the TM4C123GXL board, you should look at the documentation on the class web page. Pins PF0-4 (LEDs and pushbuttons), PA0-1 (UART0 to virtual COM port), and PC0-3 (JTAG) are connected to devices on the board. The schematics show the connections.

On the TM4C123GXL board, be advised that pins PD0 and PB6 are connected together by default. Also PD1 and PB7 are connected together by default. If you try to use both pins in the pair without realizing there is an interconnection, the pins will not function as planned. If you really need to use both pins in the pair, remove resistors R9 or R10 on the board (see the schematic for details).

The ports are labeled A-F, with each port having up to 8 I/O pins. Most of the pins can be used easily, but there are some pins requiring special attention (see Table 10-5). In particular, you should not use the PC0-3 pins as those are used by the JTAG interface which is used to program and debug code on the target board.

Before using any pin on a port, the clock for a port must be gated on. This is done by setting the appropriate bit in SYSCTL_RCGCGPIO_R. The data sheet states that 3 clock cycles must occur before accessing any GPIOx_* registers for port x.

In class, we will use the advanced peripheral bus (APB). You should make sure the the appropriate bit for the port is cleared in SYSCTL_GPIOHBCTL_R (this is the power-on default setting).

After the clocks are enabled, you will need to configure the pin for the intended operation.

To make a pin a digital push-pull output, the appropriate bits in GPIOx_DIR_R and GPIOx_DEN_R should be set.

To make a pin a digital open drain output , the appropriate bits in GPIOx_DIR_R, GPIOx_DEN_R, and GPIOx_ODR_R should be set.

To make a pin a digital input, the appropriate bit in GPIOx_DIR_R should be cleared and the appropriate bit in GPIOx_DEN_R should be set. If a pull-up or pull-down is needed for the digital input, set the appropriate bit in GPIOx_PUR_R or GPIOx_PDR_R.

To make a pin an analog input, the appropriate bits in GPIOx_DIR_R and GPIOx_DEN_R should be cleared and the appropriate bits in GPIOx_AFSEL_R and GPIOx_AMSEL_R should be set.

For a digital output (push-pull or open drain) or a digital input, if you want a peripheral such as a UART, SSI, or PWM modules to control the pin, the appropriate bit in GPIOx_AFSEL_R should be set and the appropriate nibble in GPIOx_PCTL_R should be set to 1-15 (see table in 23.4 for the value to use).