Lab 2/3: GPIO Interrupts

External Interrupts

Lab 3: GPIO Interrupts

Program the Tiva LaunchPad to be able to perform the following:

Seq	Change LED colour to …	Followed by a ….
1	RED	LONG BEEP
2	YELLOW	SHORT BEEP
3	GREEN (default)	SHORT BEEP
4	CYAN	SHORT BEEP
5	BLUE	LONG BEEP

- Program SW1 & SW2 to generate a **GPIO external interrupt** to the ARM CPU upon SW1 or SW2 pressed.
    - Interrupt Handler: `GPIOF_Handler( void)`.
- Check the RIS/MIS register to identify source of interrupt.
- **Debounce** SW1 & SW2 => Each switch press should be detected ONLY once!

- Each detection of SW1 or SW2 pressed should trigger a change in the LED colour together with a short/long audio beep. *(see table)*

- If SW1 trigger is detected, move <u>down</u> the table sequence (1->2->3->4->5; stay at Seq 5 if SW1 is pressed while at Seq 5).

- If SW2 trigger is detected, move <u>up</u> the table sequence (5->4->3->2->1; stay at Seq 1 if SW2 is pressed while at Seq 1).

- Default LED colour is **GREEN** upon Reset.

- Short beep = **2 ms**; Long beep = **15 ms**. Do not use delay loop(s) that may hold up the program execution.

- *You will be penalized if your code do not make use of interrupts processing.*

LaunchPad: User Switches & LED

- 2 switches, **SW1** & **SW2**:
    - SW1 connected to PF4; SW2 connected to PF0
    - Logic '0' when switch pressed.
    - Requires internal pull-up configuration (through the GPIOPUR register.
- Color **LED**:
    - Port pins PF1, PF2 & PF3 controls a single colour LED.
    - **PF1 (red)**; **PF2 (blue)**; **PF3 (green)**.

GPIO Pin	Pin Function	USB Device
PF4	GPIO	SW1
PF0	GPIO	SW2
PF1	GPIO	RGB LED (Red)
PF2	GPIO	RGB LED (Blue)
PF3	GPIO	RGD LED (Green)

Tiva LaunchPad – SW1, SW2, LED
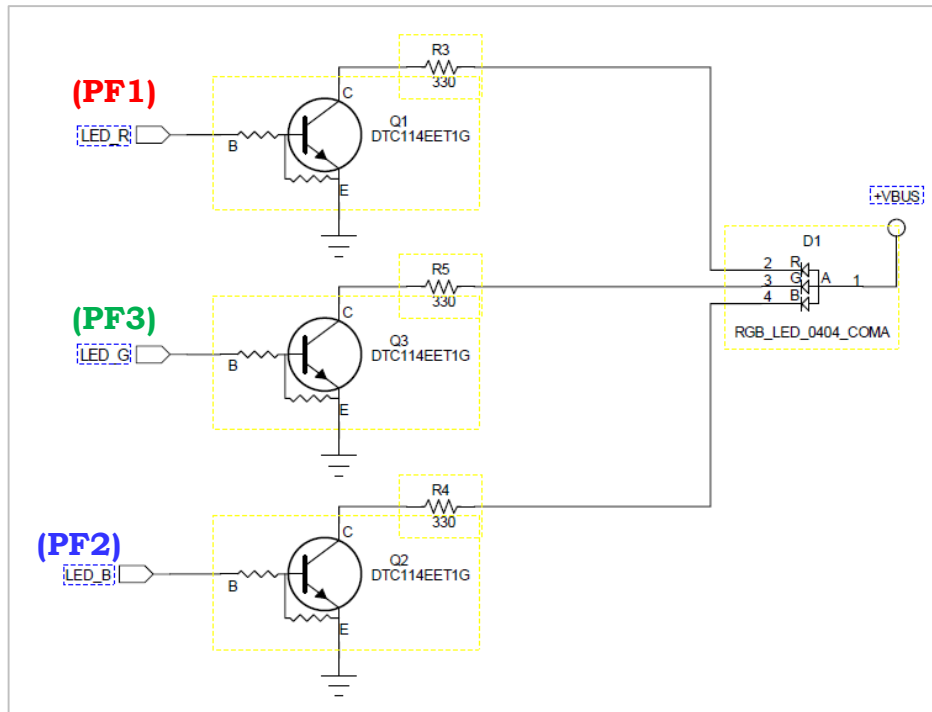
RGB LED::

- A logic '1' at any of the GPIO pins for the RGB LED will turn on the transistor and will turn on the LED.
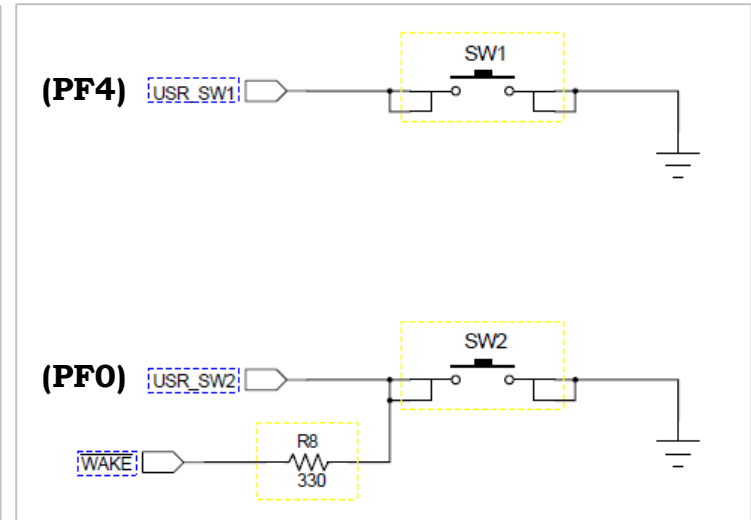
SW1 & **SW2**:

- During initialization, set SW1 & SW2 to be at logic 'H' by default.

- When either of the push-buttons is pressed, the GPIO pin will read a logic '0'.

<u>Source</u>: Tiva C Series TM4C123G LaunchPad Evaluation Board – User Guide (spmu296.pdf)

Buzzer on Tiva Base Board

- Use the buzzer to create a short or long beep.
- The buzzer is on the Tiva baseboard. It is connected to **GPIO PA4**.
- Note that it is an <u>Active Buzzer</u>: it turns ON or OFF through a '1' or '0' output from the GPIO pin. There is no need to drive the Buzzer through a square wave.
- The output frequency is fixed (about 2.3kHz in the audible range) (not programmable).
- Buzzer: ABI-042-RC. Datasheet in Moodle.

| Pin	PORT						Pin
	A	B	C	D	E	F	
0	RX_PC	IR_OUT	JTAG-TCK/ SWCLK	KEY_ROW0	IR_IN	SW2	0
1	TX_PC	LCD_BL	JTAG-TMS/ SWDIO	KEY_ROW1	KEY_COL0	RED_LED	1
2	LCD_SCK	I2C0_SCL	JTAG-TDI	KEY_ROW2	KEY_COL1	BLUE_LED	2
3	LCD_CS	I2C0_SDA	JTAG-TDO/ SWO	KEY_ROW3	KEY_COL2	GREEN_LED	3
4	BUZZER	DRIVE / SS2_SCK	STEPPER0	USB_D-	AIN9_LDR	SW1	4
5	LCD_MOSI	SS2_CS / AIN11_TEMP	STEPPER1	USB_D+	AIN8_POT		5
6	LCD_DC / I2C1_SCK	SS2_MISO / US_TRIGGER	STEPPER2	UART2_RX			6
7	LCD_RESET/ I2C1_SDA	SS2_MOSI / US_ECHO	STEPPER3	UART2_TX			7
Pin	A	B	C	D	E	F	Pin
	PORT						

Tiva Base Board – BUZZER

- Buzzer is turned on through a MOSFET transistor.

- When **PA4** is at logic 'H', MOSFET turn ON which in turns causes current to flow through the Buzzer which produces an audible tone.

- When **PA4** is at logic 'L', Buzzer is turned OFF.
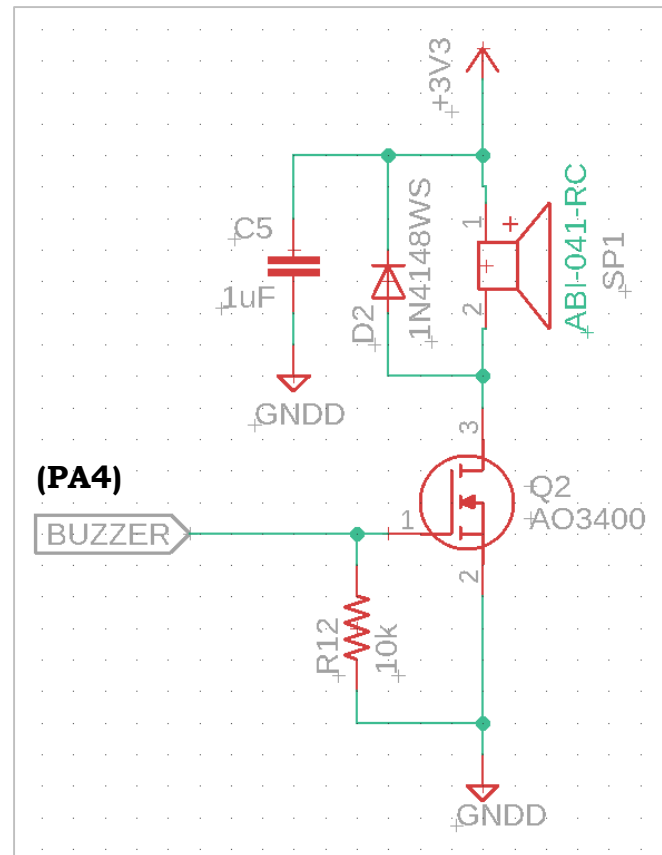
Switch Bounce

- **SW1** & **SW2** are mechanical push-button switches.
- When pressed and/or released, there may be some signal bounce on the GPIO signals (PF4, PF0).
- <u>Software De-bounce</u>:
  - Read switch status after bounce period (usually 5-15 ms) to ascertain that it is a valid switch press/released.
  - <u>Note</u>: Any delay implemented for time delay (for example, bounce period) should not hold up your program in a loop.

Switch Bounce

SW1, SW2

GPIO Interrupt when SW1/ SW2 Pressed

Read SW1/SW2 status after bounce period
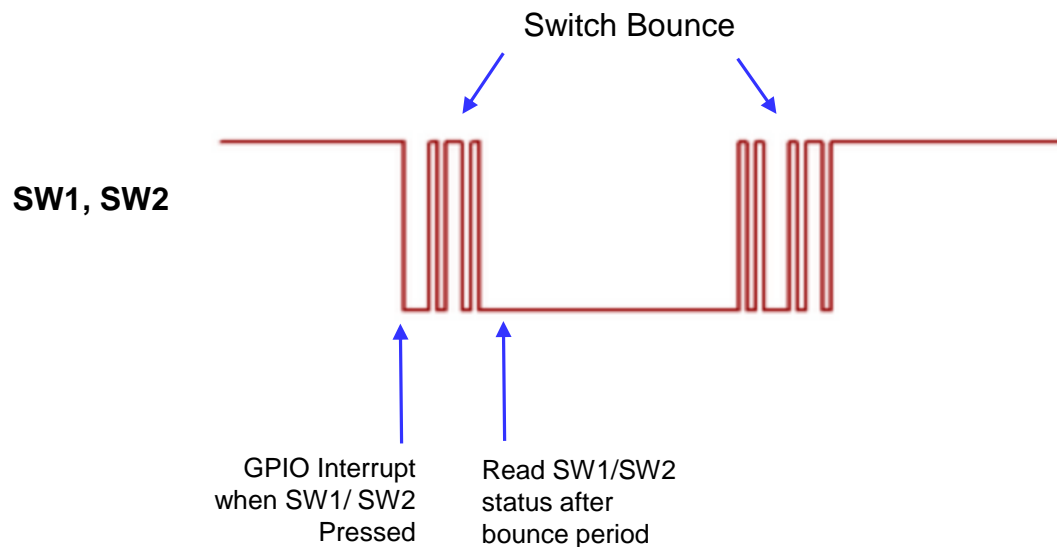
Lab Submission

- Submit the following:
  - Zip file of your μVision KEIL program directory.
- Submission Dateline:
  - Sunday, 29 May 22, 23:59 hrs.
  - Upload Zipped folder to Moodle