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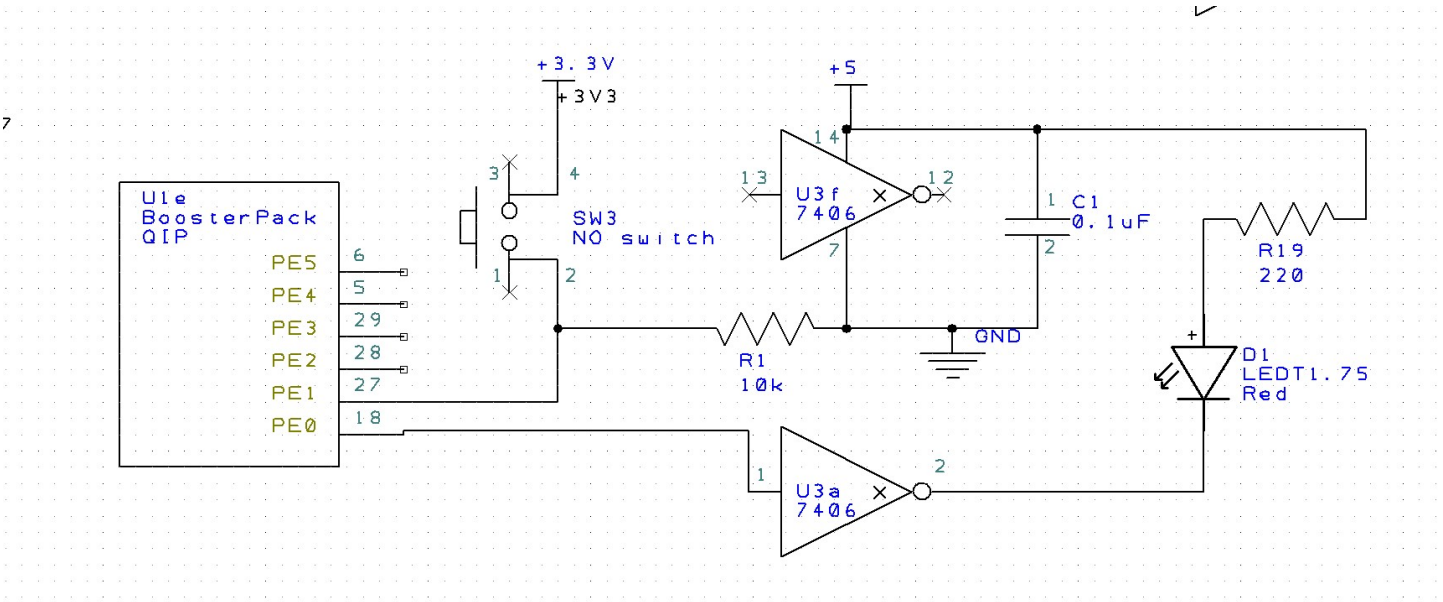
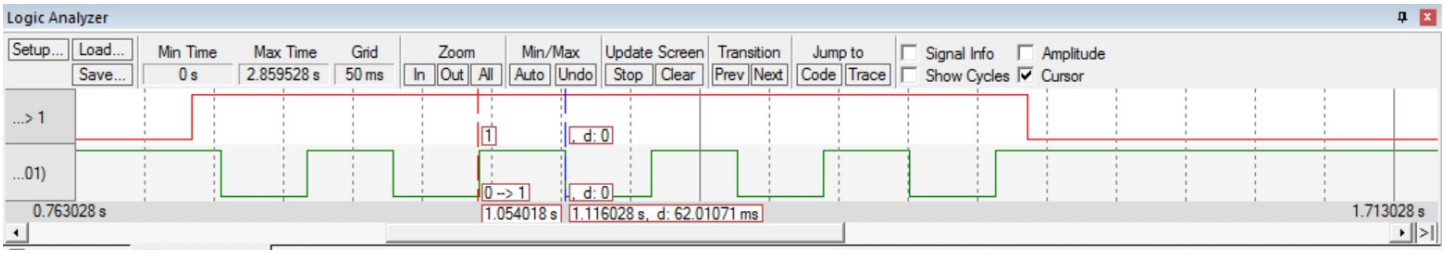
Circuit Diagram



Simulator



Switch Measurements

Parameter	Value	Units	Conditions
Resistance of the 10kΩ resistor, R1	9.87k	ohms	with power off and disconnected from circuit (measured with ohmmeter)
Supply Voltage, $V_{+3.3}$	3.3	volts	Powered (measured with voltmeter)
Input Voltage, V_{PE1}	0	volts	Powered, but with switch not pressed (measured with voltmeter)

Resistor current	0	mA	Powered, but switch not pressed $I=V_{PE1}/R1$ (calculated and measured with an ammeter)
Input Voltage, V_{PE1}	3.3	volts	Powered and with switch pressed (measured with voltmeter)
Resistor current	0.33	mA	Powered and switch pressed $I=V_{PE1}/R1$ (calculated and measured with an ammeter)

LED Measurements

Row	Parameter	Value	Units	Conditions
1	Resistance of the 220Ω resistor, R19	217	ohms	with power off and disconnected from circuit (measured with ohmmeter)
2	+5 V power supply V_{+5}	4.97	volts	(measured with voltmeter relative to ground, *notice that the +5V power is not exactly +5 volts*)
3	TM4C123 Output, V_{PE0} input to 7406	3.3	volts	with **PE0** = 0 (measured with voltmeter relative to ground)
4	7406 Output, V_{k-} LED k-	0.16	volts	with **PE0** = 0 (measured with voltmeter relative to ground)
5	LED a+, V_{a+} Bottom side of R19	2.11	volts	with **PE0** = 0 (measured with voltmeter relative to ground)
6	LED voltage	1.95	volts	calculated as $V_{a+} - V_{k-}$
7	LED current	13	mA	calculated as $(V_{+5} - V_{a+})$/R19 and measured with an ammeter
8	TM4C123 Output, V_{PE0} input to 7406	2-1.3	volts	with **PE0** = 1 (measured with voltmeter relative to ground)
9	7406 Output, V_{k-} LED k-	2.3-1.4	volts	with **PE0** = 1 (measured with voltmeter relative to ground)

10	LED a+, V_{a+} Bottom side of R19	3.8-3.1	volts	with **PE0** = 1 (measured with voltmeter relative to ground)
11	LED voltage	1.4-1.1	volts	calculated as V_{a+} - V_{k-}
12	LED current	5-8	mA	calculated as $(V_{+5}$ - $V_{a+})$/R19 and measured with an ammeter

Assembly Code

```
;****************** main.s ***************
; Program written by: Chimezie Iwuanyanwu & Xinyuan Pan
; Date Created: 1/22/2016
; Last Modified: 2/20/2016
; Section: Wednesday 5-6
; Instructor: Ramesh Yerraballi
; Lab number: 3
; Brief description of the program
;   If the switch is presses, the LED toggles at 8 Hz
; Hardware connections
;  PE1 is switch input  (1 means pressed, 0 means not pressed)
;  PE0 is LED output (1 activates external LED on protoboard)
;Overall functionality of this system is the similar to Lab 2, with six changes:
;1-  the pin to which we connect the switch is moved to PE1,
;2-  you will have to remove the PUR initialization because pull up is no longer needed.
;3-  the pin to which we connect the LED is moved to PE0,
;4-  the switch is changed from negative to positive logic, and
;5-  you should increase the delay so it flashes about 8 Hz.
;6-  the LED should be on when the switch is not pressed
; Operation
;   1) Make PE0 an output and make PE1 an input.
;   2) The system starts with the LED on (make PE0 =1).
;   3) Wait about 62 ms
;   4) If the switch is pressed (PE1 is 1), then toggle the LED once, else turn the LED on.
;   5) Steps 3 and 4 are repeated over and over


GPIO_PORTE_DATA_R      EQU   0x400243FC
GPIO_PORTE_DIR_R       EQU   0x40024400
GPIO_PORTE_AFSEL_R     EQU   0x40024420
GPIO_PORTE_DEN_R       EQU   0x4002451C
GPIO_PORTE_AMSEL_R     EQU   0x40024528
GPIO_PORTE_PCTL_R      EQU   0x4002452C
SYSCTL_RCGCGPIO_R      EQU   0x400FE608
COUNT                  EQU       1240000
    IMPORT  TExaS_Init
    AREA    |.text|, CODE, READONLY, ALIGN=2
    THUMB
    EXPORT  Start
```

```
Start
 ; TExaS_Init sets bus clock at 80 MHz
                    BL  TExaS_Init ; voltmeter, scope on PD3
; you initialize PE1 PE0
        LDR R1, =SYSCTL_RCGCGPIO_R
        LDR R0, [R1]
        ORR R0, #0x10
        STR R0, [R1]
        NOP
        NOP

        LDR R1, =GPIO_PORTE_AMSEL_R
        LDR R0, [R1]
        AND R0, #0xFC
        STR R0, [R1]

        LDR R1, =GPIO_PORTE_PCTL_R
        LDR R0, [R1]
        AND R0, #0xFC
        STR R0, [R1]

        LDR R1, =GPIO_PORTE_DIR_R
        LDR R0, [R1]
        AND R0, #0xFC
        ORR R0, #0x01
        STR R0, [R1]

        LDR R1, =GPIO_PORTE_AFSEL_R
        LDR R0, [R1]
        AND R0, #0xFC
        STR R0, [R1]

        LDR R1, =GPIO_PORTE_DEN_R
        LDR R0, [R1]
        ORR R0, #
        STR R0, [R1]

        B set_LED

        CPSIE  I

loop
        BL delay

        LDR R1, =GPIO_PORTE_DATA_R
        LDR R0, [R1]

        AND R2, #0
        AND R2, R0, #0x02
        LSR R2, #1
        CMP R2, #1

        BNE set_LED
```

```
        EOR R3, R0, #0x01
        STR R3, [R1]

        B loop

set_LED
        LDR R1, =GPIO_PORTE_DATA_R
        LDR R0, [R1]
        ORR R0, #0x01
        STR R0, [R1]

        B loop

delay
        LDR R1, =COUNT
delay_loop
        SUBS R1, #1
        BNE delay_loop
        BX LR

        ALIGN
        END
```