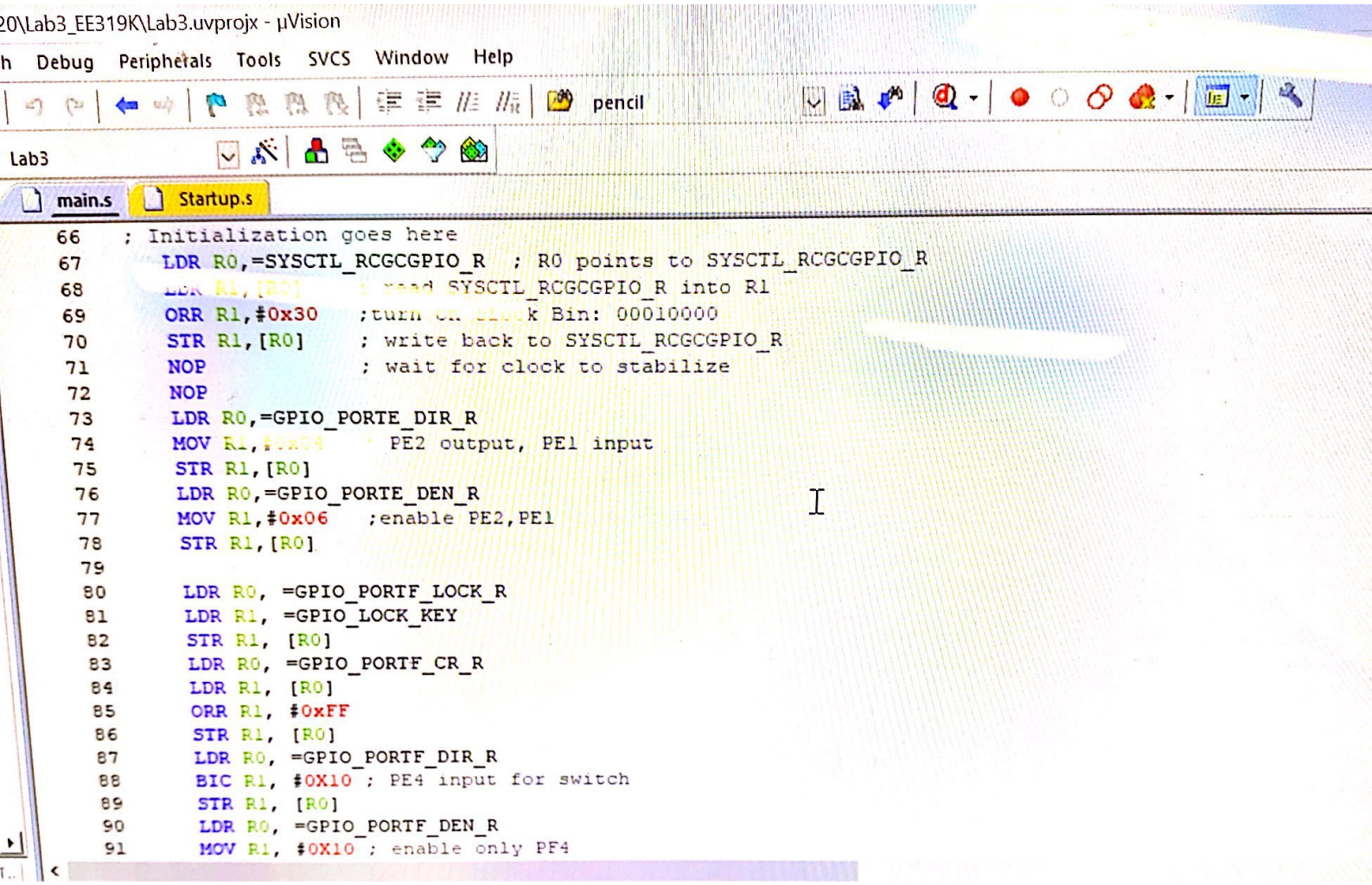
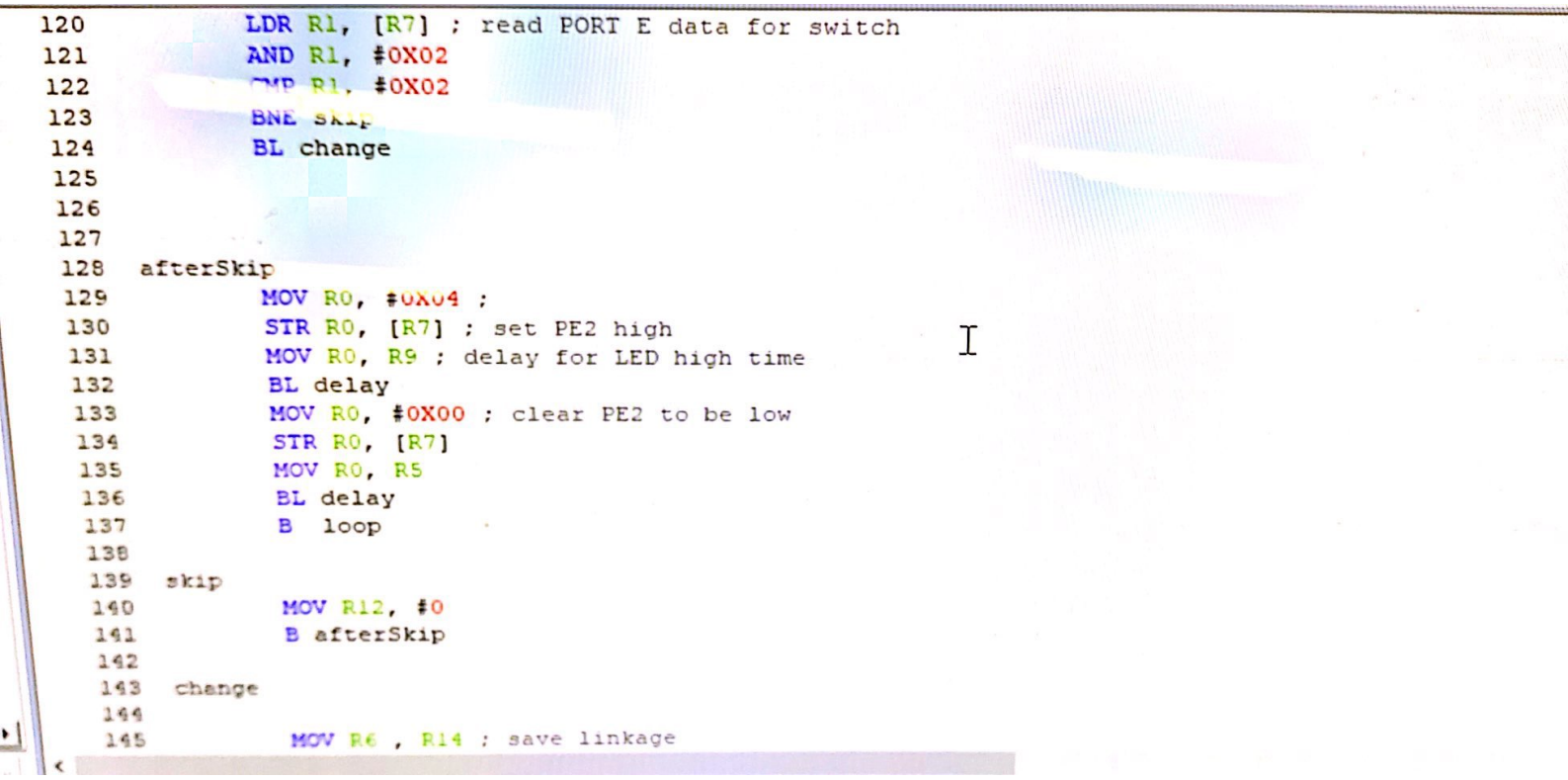
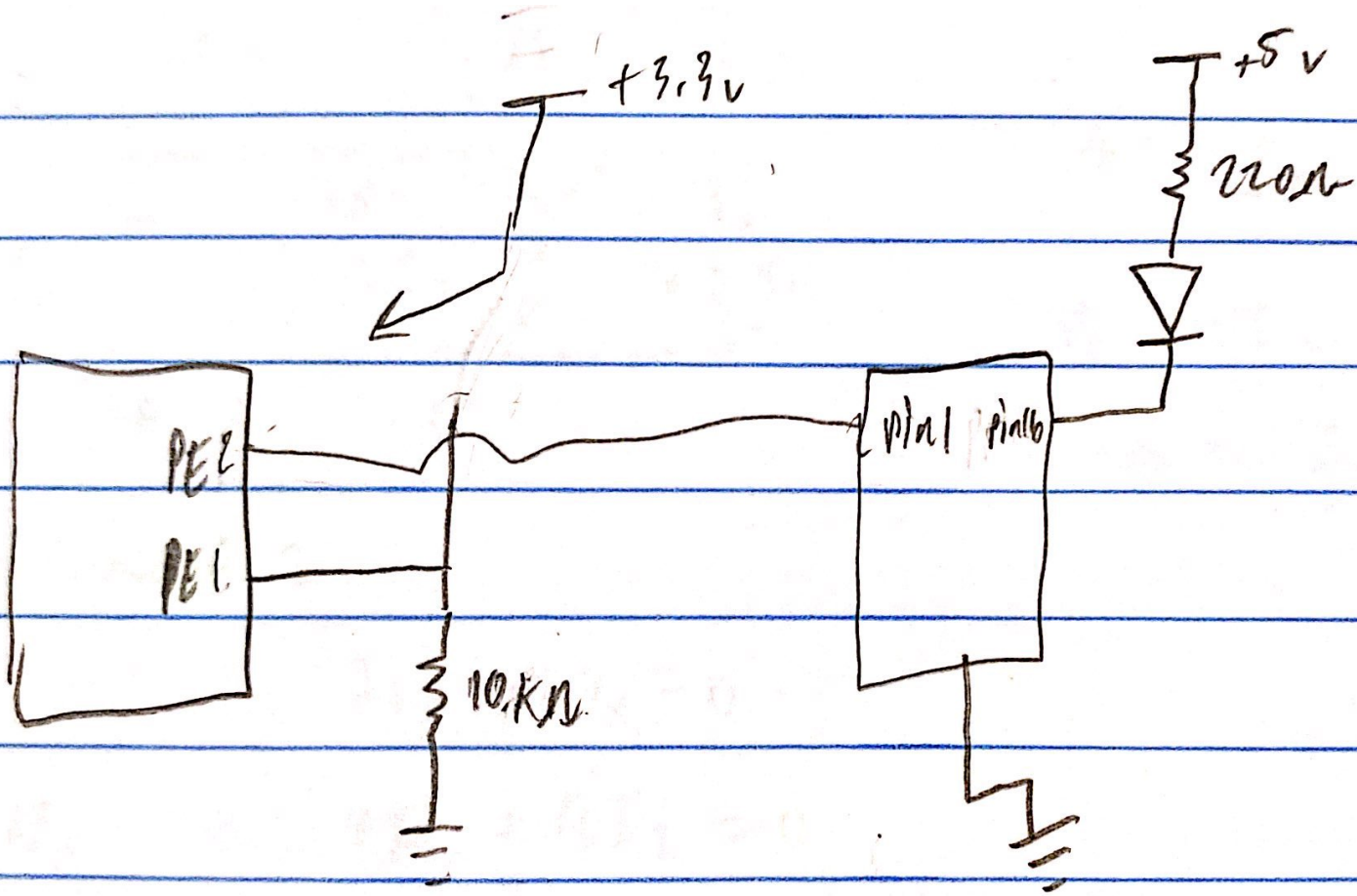




```
120          LDR R1, [R7] ; read PORT E data for switch
121          AND R1, #0X02
122          CMP R1, #0X02
123          BNE skip
124          BL change
125
126
127
128  afterSkip
129          MOV R0, #0X04 ;
130          STR R0, [R7] ; set PE2 high
131          MOV R0, R9 ; delay for LED high time
132          BL delay
133          MOV R0, #0X00 ; clear PE2 to be low
134          STR R0, [R7]
135          MOV R0, R5
136          BL delay
137          B  loop
138
139  skip
140          MOV R12, #0
141          B afterSkip
142
143  change
144
145          MOV R6 , R14 ; save linkage
```

```
174          SUBS R5, R11, R9
175          MOV R12, #1
176          BX LR
177
178  beforeBreathe
179          LDR R0, =comparison
180          CMP R9, R0
181          BLE breathe
182          MOV R0, #100
183          UDIV R9, R9, R0
184          UDIV R5, R5, R0
185          UDIV R11, R11, R0
186
187  breathe
188
189
190          CMP R6, #1       ;R3 = flag for "is it decrementing" 1= yes , 0 = no
191          BEQ decrement
192
193          LDR R2, =breathIncrement ; increase duty cycle by only 20%
194          ADD R9, R2
195          SUBS R5, R11, R9
196          CMP R9, R11
197          BGE decrement    ;If R9 becomes greater than or equal to total, then go to decrement
198
199
```

```
216          MOV R6, #1              ;set Flag R3 for "is it decrementing"
217          B afterSkip
218
219
220  delay
221
222  dloop   SUBS R0, #1
223          BNE dloop
224          BX LR
225
226
227
228  breatheReset
229          LDR R0, =comparison
230          CMP R9, R0
231          BGE go
232          MOV R0, #100
233          LDR R9, =initHighPulse
234          LDR R5, =initLowPulse
235          LDR R11, =total
236  go
237          B readE
238
239
240
241          ALIGN       ; make sure the end of this section is aligned
```



dware Interfacing LED/Switch

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Warning: NEVER INSERT/REMOVE WIRES/CHIPS WHEN THE POWER IS ON.

Row	Parameter	Value	Units	Conditions
1	Resistance of the 220Ω resistor, R19	216	ohms	with power off and disconnected from circuit (measured with ohmmeter)
2	+5 V power supply V_{+5}	5.14	volts	(measured with voltmeter relative to ground, *notice that the +5V power is not exactly +5 volts*)
3	TM4C123 Output, V_{PE2} input to ULN2003B	0	volts	with **PE2** = 0 (measured with voltmeter relative to ground). We call this V_{OL} of the TM4C123.
4	ULN2003B Output, pin 16, V_{k-} LED k-	3.77	volts	with **PE2** = 0 (measured with voltmeter relative to ground). This measurement will be weird, because it is floating.
5	LED a+, V_{a+} Bottom side of R19 (anode side of LED)	5.2	volts	with **PE2** = 0 (measured with voltmeter relative to ground). This measurement is also weird, because it too is floating.
6	LED voltage	1.35	volts	calculated as $V_{a+} - V_{k-}$
7	LED current (off)	0	mA	calculated as $(V_{+5} - V_{a+})/R19$ and measured with an ammeter
	TM4C123 Output, V_{PE2}	3.17		with **PE2** = 1 (measured with voltmeter relative to ground). We call this V_{OH} of the

	of LED)			
6	LED voltage	1.35	volts	calculated as $V_{a+} - V_{k-}$
7	LED current (off)	0	mA	calculated as $(V_{+5} - V_{a+})$/R19 and measured with an ammeter
8	TM4C123 Output, V_{PE2} input to ULN2003B	3.17	volts	with **PE2** = 1 (measured with voltmeter relative to ground). We call this V_{OH} of the TM4C123.
9	ULN2003B Output pin 16, V_{k-} LED k-	0.82	volts	with **PE2** = 1 (measured with voltmeter relative to ground). We call this V_{OL} or $V_{CE(sat)}$ of the ULN2003B.
10	LED a+, V_{a-} Bottom side of R19 (anode side of LED)	2.68	volts	with **PE2** = 1 (measured with voltmeter relative to ground)
11	LED voltage	1.9	volts	calculated as $V_{a+} - V_{k-}$
12	LED current (on)	10	mA	calculated as $(V_{+5} - V_{a+})$/R19 and measured with an ammeter

# of Lab 3 - Hardware Interfacing LED/Switch

Parameter	Value	Units	Conditions
Resistance of the 10kΩ resistor, R1	9840	ohms	with power off and disconnected from circuit (measured with ohmmeter)
Supply Voltage, $V_{+3.3}$	3.299	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}	3.29	volts	Powered and with switch pressed (measured with voltmeter)
			Powered and switch pressed

Resistance of the 10kΩ resistor, R1	9840	ohms	with power off and disconnected from circuit (measured with ohmmeter)
Supply Voltage, $V_{+3.3}$	3.299	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}	3.29	volts	Powered and with switch pressed (measured with voltmeter)
Resistor current	.34	mA	Powered and switch pressed $I=V_{PE1}/R1$ (calculated and