Kill Switch

Welcome back to Cypress Academy, PSoC 6 101. In this video, I will show you how to add custom digital logic to our BLE-controlled robotic arm to safely stop the servos and bypass any UART or I2C commands. We will also use the RGB LED on the PSoC 6 Pioneer Board to show the kill-switch status.

Why a kill switch in a BLE-controlled robotic arm you might ask? Well 1) because all robots should always have a kill switch—has anyone seen the Terminator movies; and 2) because my son, bless his heart, is an avid engineer and tinker much like his dad and while working on the robotic arm assembly, he most certainly will be tinkering with the control interfaces and swinging the robot arm every which way.

All joking aside, the real reason for a kill switch is to remove the CPU from a safety critical decision. Our digital logic responds in nanoseconds, CPUs are much slower, microseconds or even more depending on what’s going on in your application.

So, we’re going to make a simple t-flip-flop controlled by an external switch on the PSoC 6 BLE Pioneer board. The t-flip-flop will be implemented in the digital logic in the PSoC 6, called the Universal Digital Block, or UDB for short. There’s a lot more documentation on this and entire video series on this that you can find here: <point>.

Let’s get started.

I’ll create a new project called “BasicKillSwitch”. For this project I want to use the switch on the PSoC 6 BLE Pioneer board to act as the kill switch. When I enable the kill switch, I expect the red led to immediately turn on and blink. When I disable the kill switch, I expect to see a solid green LED indicating all is well.

To do this, I’ll drag and drop a t-flip-flop from the digital logic folder in the components catalog over. Add a digital input pin component. Let’s rename that pin “SW” and set the drive mode to resistive pull-up on the general tab of the pin dialog. I’m doing that because the switch on the PSoC 6 BLE kit is active low.

Now I’ll connect the switch to the t-flip-flop. I also need an logic high for the t-input of the flip-flop. To enable a blinking LED we’re going to need a PWM. So, I’ll drag and drop a PWM into my design and configure it. I’ll rename the PWM, LEDBlink. I’ll set the period to 1,000 and compare value to 500. I need a clock to input to the PWM, so another drag and drop, configure and now we have a 1KHz clock.

Now I have two LEDs in this project, a RED LED and a Green LED. So, let’s grab two digital output pins and rename them RED and GREEN. One thing to note with the LEDs is that they are active low, zero is on.

Now for a little logic fun. When the t-flip-flop output is high, disabled, I want to turn the Green LED on. So, a simple inverter logic block will do the trick. Drag and drop, wire that up, and good. Now if the t-flip-flop is low, enabled, I want to blink the red LED, so we’ll use a digital multiplexer and the output of the t-flip-flop to select the channel to send to the LED. We’ll send the LEDBlink PWM output to the multiplexer input 0 and a logic high to the multiplexer input 1. So, when the t-flip-flop output is low then the PWM output is feeding the RED LED, making it blink.

Let’s not forget to assign the pins for the switch, the red LED and green LED to P0[4], P0[3], and P1[1]; respectively.

And that’s it. Build, program and test…again, love those blinky leds!

Now let’s add that same kill switch functionality to our BLE-controlled arm project. Copy all of the schematic contents of the BasicKillSwitch project over to the schematic of the BLE-controlled arm project. To enable a hardware kill and start function on the PWMs, we need to double click and configure the PWMs. I’ll click on the advanced tab, and set the kill input to falling edge and start input to rising edge. Back to the schematic, I can now connect the q-output of the flip flop to the kill and start inputs of both PWMs.

And that’s it…isn’t that awesome?!

Now we have our Kill Switch, aka Nicholas Safety Switch, in place. In the next video I will walk through how to use the capacitive sensing interface on the PSoC 6 BLE Pioneer Kit to control the robotic arm with our CapSense technology.

You can post your comments and questions in our PSoC 6 community or as always you are welcome to email me at alan\_hawse@cypress.com or tweet me at @askioexpert with your comments, suggestions, criticisms and questions.