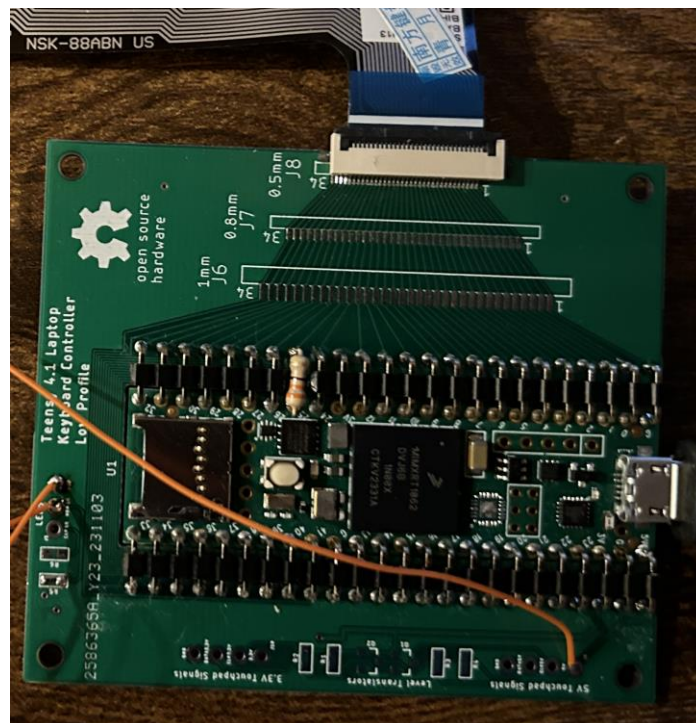


## Galaxy Book Flex 15.6" Laptop Keyboard with Keypad and Backlight

The unmodified keyboard for a Galaxy Book Flex 15.6" is shown below. The square opening next to the right shift key is for a fingerprint reader that will not be installed. The hole will be plugged so the light from the backlight doesn't bleed thru. There is a Caps Lock LED indicator on the key. The keyboard FPC cable has 30 bottom contacts with a 0.5mm pitch. There are locking nubs which must be trimmed with scissors so a generic FPC connector can be used.



I trimmed the FPC cable locking nubs and installed the cable into a 30 pin, 0.5mm pitch, bottom contact connector that I soldered to a Teensy 4.1 low profile connector board. The Teensy is soldered to the board with "U" shaped header pins.



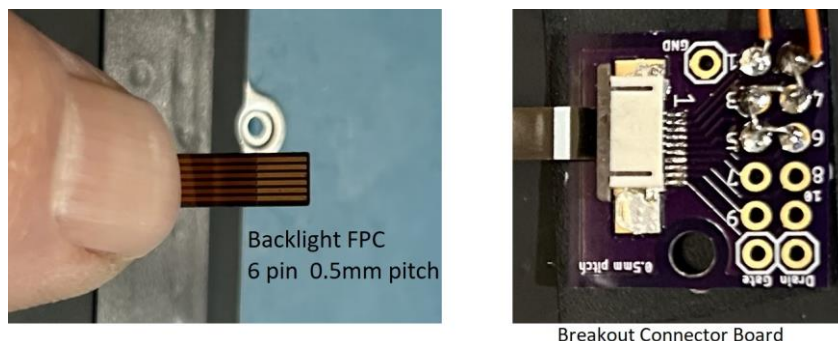
The matrix decoder code was loaded into the Teensy 4.1 and all keys were pressed to give the key list connections. The results were transferred to the 8 x 16 matrix table shown below. The FPC connector pin number is given first, followed by the Teensy I/O number. KP stands for keypad

FPC-I/O	5	21	7	20	8	3	9	19	10	4	12	5	14	6	15	16
1	23								Caps lck				R-Shift		L-Shift	
2	0								R-Cntrl		L-Cntrl		left		Fn Lock	
3	22			Fn		R-Alt		L-Alt								
4	1			GUI									right			
6	2	z		a		q		tab	1		tilde		F1		esc	
11	18			x		s		w	2		F4		F3		F2	
13	17			d		c		e	3		F7		F6		F5	
16	7	v		b		f		g	r		t		4		5	
17	15	m		n		j		h	u		y		7		6	
18	8	down		comma		k		i	8		F10		F9		F8	
19	14			period		L		quote	o		[		9		=	
20	9	space		slash		;		p	0		Bckspc		F12		F11	
21	10	up		KP 0												
22	11	KP 1		KP 4		enter		KP 7	Numlock		-				ins	
23	12			KP 2		KP 5		KP +	KP 8		KP /		KP -		del	
24	24	KP ENT		KP .		KP 3		KP 6	\		]		KP 9		KP *	

There is a left arrow key above Num Lock that gives the same pin connections as Backspace. Fn Lock is not used in the code because the only usable media keys are for volume.

There are traces at pin 25 and pin 28 on the FPC cable that are not used by the keyboard keys so I suspected them to be for the Caps Lock LED. I tried testing these pins with a DMM set to diode mode but I got a diode voltage in both directions due to the ESD diodes in the Teensy 4.1. I soldered a 30 pin FPC connector to a second board without a Teensy. This allowed me to probe for the Caps Lock LED and it showed pin 25 is the anode and 28 is the cathode. The “U” shaped header pin from Teensy I/O 25 to the board was removed so a dropping resistor could be inserted to set the LED current. I tried 1K down to 220 ohm and found 330 ohm gave good brightness. With this resistor, the LED voltage was 2.8 volts and the current was 1.5ma. When Caps Lock is pressed, the code drives I/O 25 to 3.3 volts. I/O 28 is always driven low.

The backlight connector on the Galaxy Book Flex 15.6" keyboard is a 6 pin, 0.5mm pitch FPC cable.



A compatible bottom contact FPC connector was soldered to a breakout board so I could probe the signals with a meter. Unfortunately I couldn't measure any diodes or resistance with my meter so I looked at the old motherboard for clues. The backlight FPC connector on the motherboard has traces going to an MP3372 IC. The datasheet for this Monolithic Power Systems chip showed it is a boost switching supply that drives up to 8 channels of series connected white LEDs. I confirmed pin 1 on the FPC connector goes to the high voltage output pin on the chip. Pins 2 thru 6 on the FPC connector have traces to the LED1 thru LED5 pins on the chip to control the current of each diode string.

Armed with this information, I used a MT3608 adjustable regulator board to boost the USB 5 volts to a high voltage on Pin 1 of the FPC breakout board (thru a current meter). Pins 2 thru 6 were tied to ground so all 5 diode strings would be active. Gradually increasing the boost voltage, I saw the current go above 1ma at 22 volts. At 26.4 volts, the backlight LEDs were nice and bright. A PWM control could be added to this circuit in the future. The boost regulator board was modified by cutting the trace that ties the enable signal high on pin 4 of the MT3608. A wire was soldered to the MT3608 enable pin and brought back to Teensy I/O 38 so the code can toggle the backlight on and off when Fn and F9 are pushed.

With the backlight off and the Teensy 4.1 programmed to run at 24MHz, the 5 volt USB current is about 30ma. The current goes up to about 40ma when the backlight is turned on.

This is the finished Teensy 4.1 keyboard controller and MT3608 boost supply driving the backlight.

