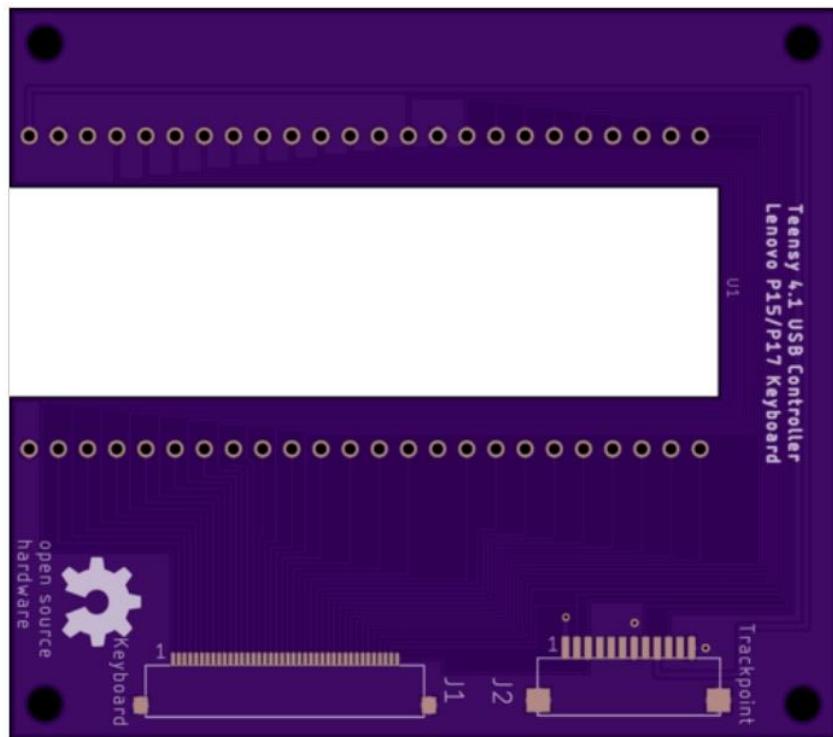


Lenovo ThinkPad P15/P17 Gen 1 USB Keyboard and Trackpoint Controller

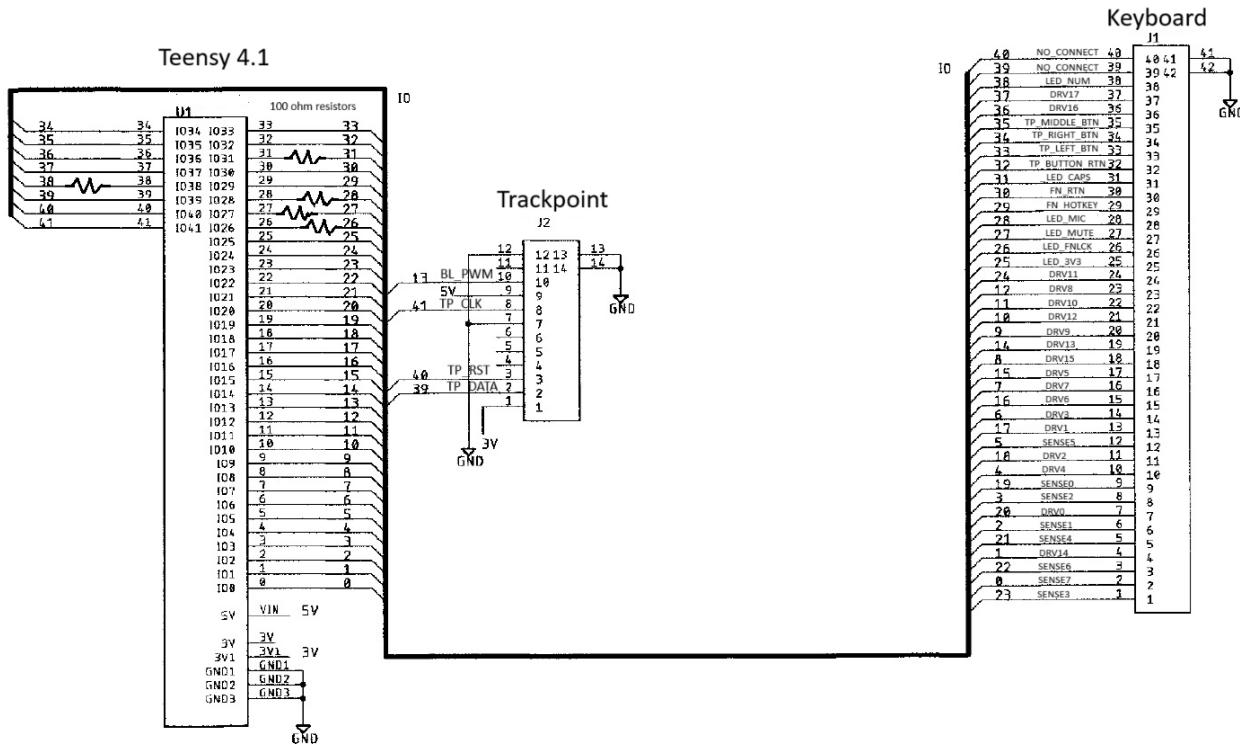
The keyboard shown below is from a Lenovo Thinkpad P17 gen 1 laptop. The same keyboard will also fit in a P15 gen 1 laptop.



The circuit board shown below was designed in Eagle and fabricated by OSH Park. The Eagle files, Teensy code, and documentation are at my [GitHub repo](#). A Teensy 4.1 sits in the cutout to make the assembled board a low profile to fit inside the laptop case. The 40 pin 0.5mm pitch and 12 pin 1mm pitch FPC connectors were unsoldered from the motherboard. The 12 pin FPC connector had 2 registration posts on the bottom that I removed instead of putting holes in the board. The FPC cables have locking notches that would need to be trimmed if generic FPC connectors are used instead of unsoldering the connectors from the motherboard.

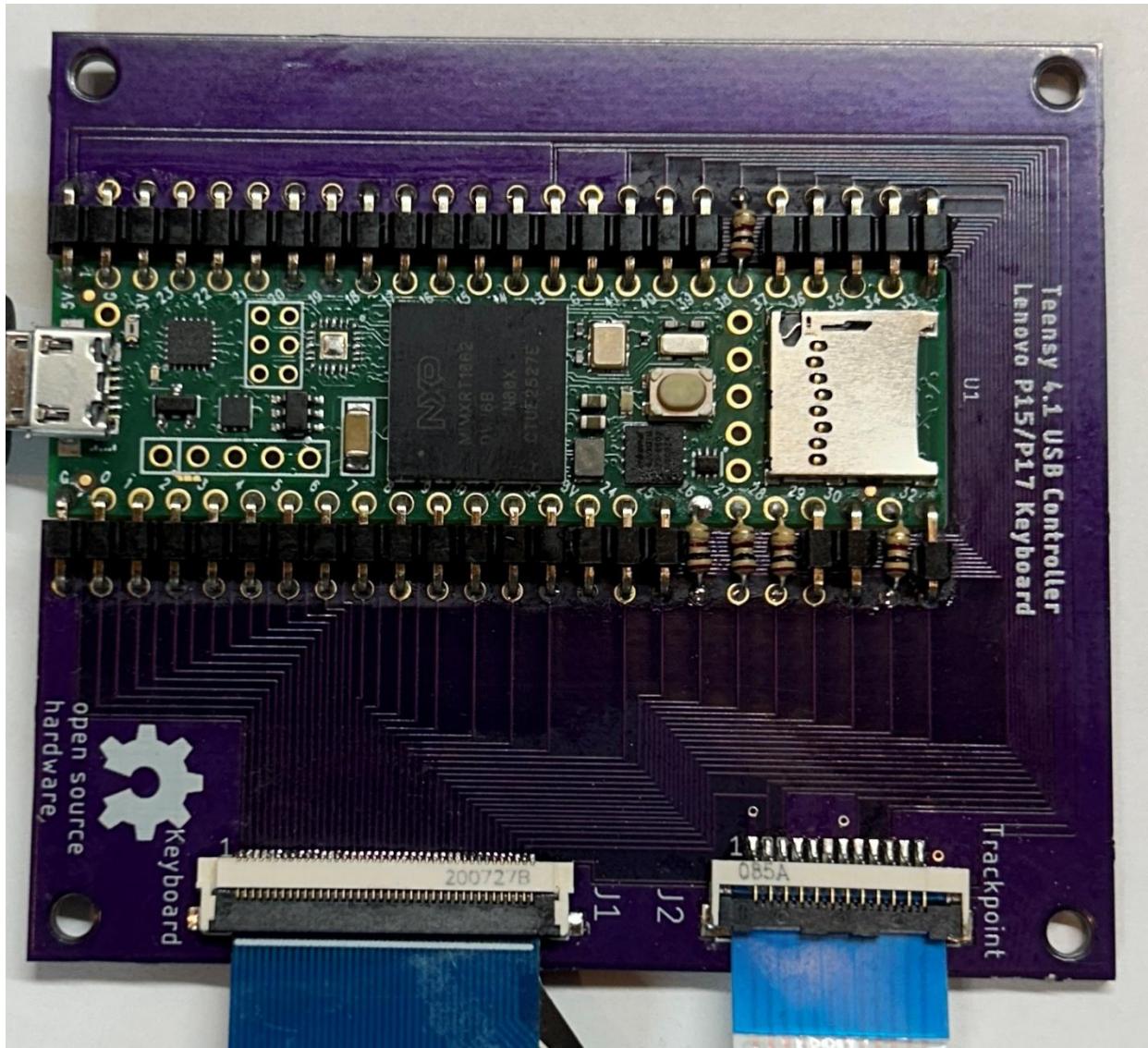


6mm wide "U" shaped header pins are installed for most of the Teensy I/O's with the exception of 100 ohm resistors installed for I/O's 26, 27, 28, 31, and 38. These dropping resistors are for the various keyboard LEDs. The Eagle circuit board schematic below shows how the Teensy 4.1 and FPC connectors are wired.



The trackpoint connector has 3.3 volts on pin 1 to power the internal circuitry. The PS/2 clock and data signals are on pins 2 and 8. At power up, the Teensy code sends an active high reset pulse on pin 3 to initialize the trackpoint circuitry. 5 volts is provided on pin 9 for the keyboard backlight. The backlight PWM control signal on pin 10 provides brightness control to the user. I have coded the backlight to be off when the Teensy is first powered up. To turn on the backlight, the Fn key is held down and the space bar is pressed. Repeat this sequence to turn off the backlight.

The assembled circuit board with all components is shown below



Matrix decoder code was run which showed how each key is wired to the FPC connector. The connection pin list was translated into the matrix table shown below. The 40 pin FPC pin number is listed first, followed by the connection to the Teensy GPIO numbers.

P15/P17 Keyboard Matrix

FPC pins – GPIO #	1-23	2-0	3-22	5-21	6-2	8-3	9-19	12-5
4-1	L-SHIFT		R-SHIFT					
7-20	TAB		Z	A	1	Q	TILDE	ESC
10-4	Y	N	M	J	7	U	6	H
11-18	F3		C	D	3	E	F2	F4
13-17	CAPS		X	S	2	W	F1	
14-6	T	B	V	F	4	R	5	G
15-16	F7		PERIOD	L	9	O	F8	
16-7	[SLASH		;	0	P	MINUS	QUOTE
17-15]		COMMA	K	8	i	=	F6
18-8			R-CNTL				L-CNTL	
19-14		R-ALT			PNTSCN			L-ALT
20-9	GUI	RIGHT			F12	KP .	INS	
21-10	KP =	LEFT			END	KP [HOME	UP
22-11		DOWN			F11		DEL	
23-12	BKSPC	SPACE	ENTER	\	F10		F9	F5
24-24	KP]				PGDN	KP BK	PGUP	
36-36	KP /	KP +	KP 9	KP 7	KP 8	KP *	KP -	NUMLK
37-37	KP 5	KP 0	KP ENT	KP 2	KP 3	KP 6	KP 1	KP 4

The Fn “Hot Key” is connected to pin 29 (GPIO 29) and the Fn return is on Pin 30 (GPIO 30). Instead of grounding the return pin, the code drives the Fn return pin low always and then reads the Fn pin with a pull up.

The left, right, and middle trackpoint buttons are part of the keyboard. The return for these buttons is on pin 32 connected to GPIO 32 and is driven low always in the code. The left button is on pin 33 which is read on GPIO 33. The right button is on pin 34 which is read on GPIO 34. The middle button is on pin 35 which is read on GPIO 35. The code programs these 3 buttons to have a pull ups.

The keyboard attached to the controller board is shown below. Normally the FPC cables are flipped back 180 degrees to attach to the controller board underneath the keyboard.



There is some play to the 40 pin FPC cable when attaching it to the connector. It will make good connection if the FPC cable is pushed to the right away from pin 1 and toward pin 40.