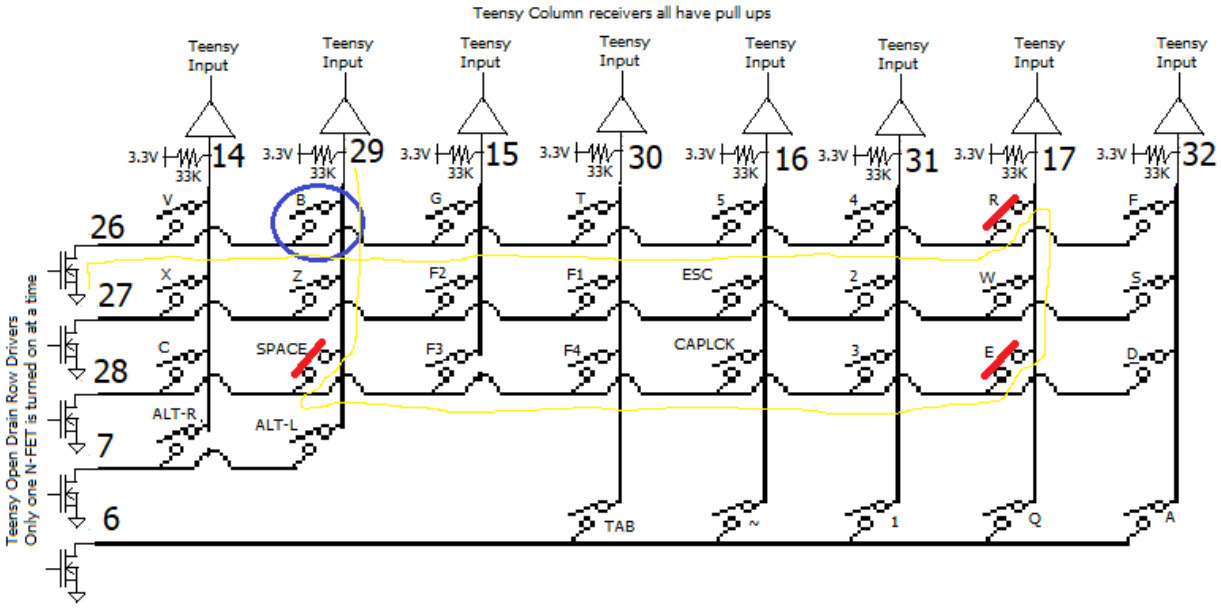
Keyboard Ghosting

Ghosting will occur if 3 or more normal keys are pressed at the same time which causes a sneak path for current flow which looks like a 4th key is pressed. In order to avoid ghosting, the keyboard would need diodes in line with each key switch to block the sneak path. Keyboards with diodes are common for a mechanical keyboard but too costly and hard to build on a standard laptop keyboard that uses a flexible printed circuit. The key matrix should be designed so that commonly used multi-key combinations (used by gamers) are purposely placed so they will not cause ghosting. In the partial matrix example below, if the E, R, and Space keys are all pushed, a B will be detected. The easiest way to see if ghosting will happen is to look for a rectangle as shown in the partial matrix below. The Space, R, and E keys are 3 sides to the rectangle so the 4th side, the letter B will be incorrectly detected as pushed.

I/O #	14	29	15	30	16	31	17	32
26	V	B	G	T	5	4	R	F
27	X	Z	F2	F1	Esc	2	W	S
28	C	Space	F3	F4	CapsLck	3	E	D
7	Alt-R	Alt-L						
6				Tab	Tilde	1	Q	A



The schematic above shows the SPACE, R, and E closed switches in red and the ghost B switch in blue. The Teensy grounds each row, one at a time by turning on only one N-FET and leaving the other rows floating. The Teensy reads the 8 column inputs after each row is driven low. The Teensy inputs have internal pull ups so an open switch is a “1” and a closed switch is a “0”. The yellow line shows when Teensy row 26 is driven low, the closed “R” switch passes the low down column 17. The closed “E” switch passes the low across row 28 where it goes thru the closed “Space” switch and up column 29. The Teensy sees a low on column 29 and thinks is was caused by the “B” key. Alt, Shift, and Control modifier keys are less susceptible to ghosting because a well-designed matrix will not put any normal keys on the same row as modifier keys. In the matrix above, pushing both Alt keys is not a normal key sequence but if you did push them both and also the V key, the B key would be seen as a ghost. Another variation would be to push the V, B, and Alt right keys, causing the Alt left key to be seen as a ghost but usually the host doesn’t care which Alt key is received so this ghosting does no harm.