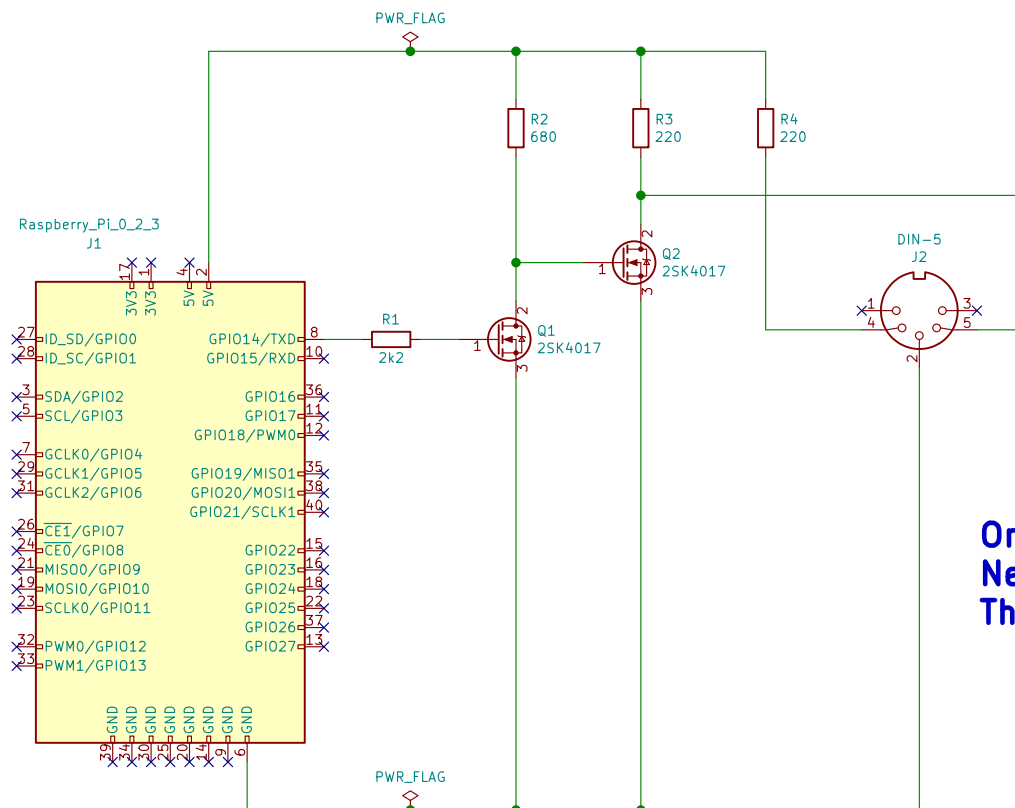


Square wave from the output needs to hold its form, even if it's amplified. Capacitance easily makes square wave transformed to triangle wave which causes missing bytes in the receiver. Delayed rectangular gives the issue too. The buffer needs to act as a binary switch. To do so, Schmitt-trigger and/or nonlinearity of a transistor are used. SN74LS14, a set of TTL Schmitt-trigger inverters, is typically used as a buffer in MIDI OUT. Nowadays, although SN74LS14 is still on sale, we can look out SN74HC14, a set of CMOS Schmitt-trigger inverters. However, we would get into a mess about the difference of output resistance between TTL one and CMOS one. TTL one can source more current than CMOS one.

The ideal of the output resistance of the buffer should be zero. I think two N-channel Enhancement-mode MOSFETs can make a buffer as long as these are driven in saturation region, which utilize its nonlinearity, to hold square wave. These also gives us level shifting, 3.3 volts to 5 volts. However, driving these in saturation region needs low resistance on gates. I think the SoC can source at most 1 to 2 milliamperes on each GPIO for its enough stability. 2200 ohms of R1 is close to the maximum value in my regulation. 680 ohms of R2 is not only for saturation region of Q2, but also for matching with the input impedance of SN74LS14.

Note that Q2 can be altered to SN74LS14, with changing its wiring. Make sure that SN74LS14 is not open-drain like Q2. I used 2SK4017 for Q1 and Q2. This sinks large current, however the parasitic capacitance is also large. So far, I don't test this circuit using other MOSFETs like 2N7000 which has different characteristics from 2SK4017.



**Only for The Purpose of Research and Development:  
Never Connect with Your Instrument.  
This Circuit May Damage Your Instrument.**

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**JimmyKenMerchant**

Sheet: /  
File: midi\_out.sch

**Title: MIDI OUT with Level Shifting 3.3V to 5V**

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**Rev: 1.0.0**

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