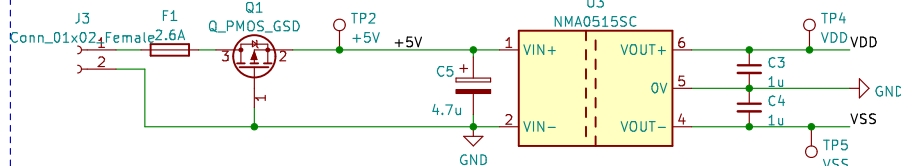


## Power

Board can be powered by external +5 V connected to J3. MOSFET Q1 is for reverse voltage protection. Expect ~3 A current, so use MOSFET with low  $R_{DS(on)}$ . Red Pitaya has TVS diode for over-voltage protection.

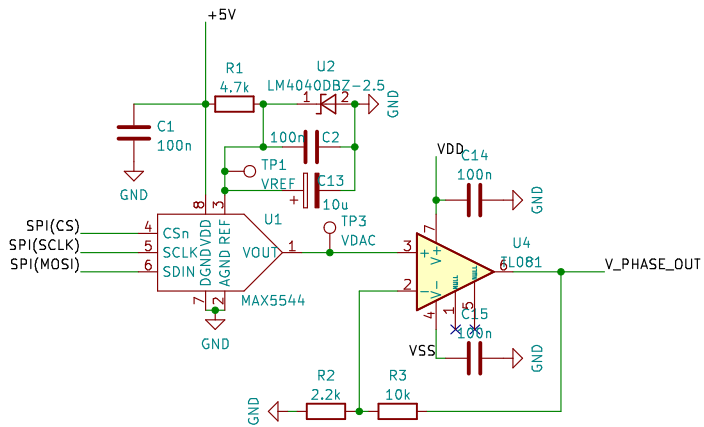
Alternatively, If the Red Pitaya is connected to power through USB then the board will draw power from the Red Pitaya pin (+5V net). No reverse voltage protection is needed here.

+/-15 V is generated from DC-DC converter, used to power ICs on board. Converter has a minimum current output of +/-4 mA. The quad op-amp in this design draws a quiescent current of 8 mA. If this is changed, ensure that the minimum draw on the +/-15 V supply is at least 4 mA.



## Auxiliary control voltage

Possible future addition for phase-locking outputs from laser system. Red Pitaya generates a voltage to be applied to another EOM in series with the IQ modulator to adjust the relative phase between the CS-SSB path and the carrier-only path. Higher-speed control without PWM harmonics may be desirable. This DAC has a 1  $\mu$ s settling time, and the amplifier has a GBW of 5 MHz. DAC is programmed using the SPI interface. DAC output is [0.2,5] V, and non-inverting amplifier gain has been chosen to give output of [0.13,8] V.



## PWM filtering and amplification.

Red Pitaya PWM outputs are low-pass filtered with a 100 Ohm resistor and 8.2 nF capacitor, giving a corner frequency of 194 kHz. The addition of the extra 4.7  $\mu$ F capacitor and second low-pass filter creates an effective second-order low-pass filter with a corner frequency of 200 Hz. For a PWM frequency of 244 kHz (10 bits at 250 MHz), this suppresses the fundamental by 57 dB. Choosing capacitances of 2.2  $\mu$ F and 0.22  $\mu$ F increases the corner frequency to 430 Hz with a PWM frequency suppression of 50 dB.

Non-inverting amplifier resistors are chosen to give a maximum output voltage of 14.9 V (from 1.6 V), which should be within the compliance of the op-amps. For the specified filter values, the amplitude of the PWM fundamental should be about 14  $\mu$ V.

