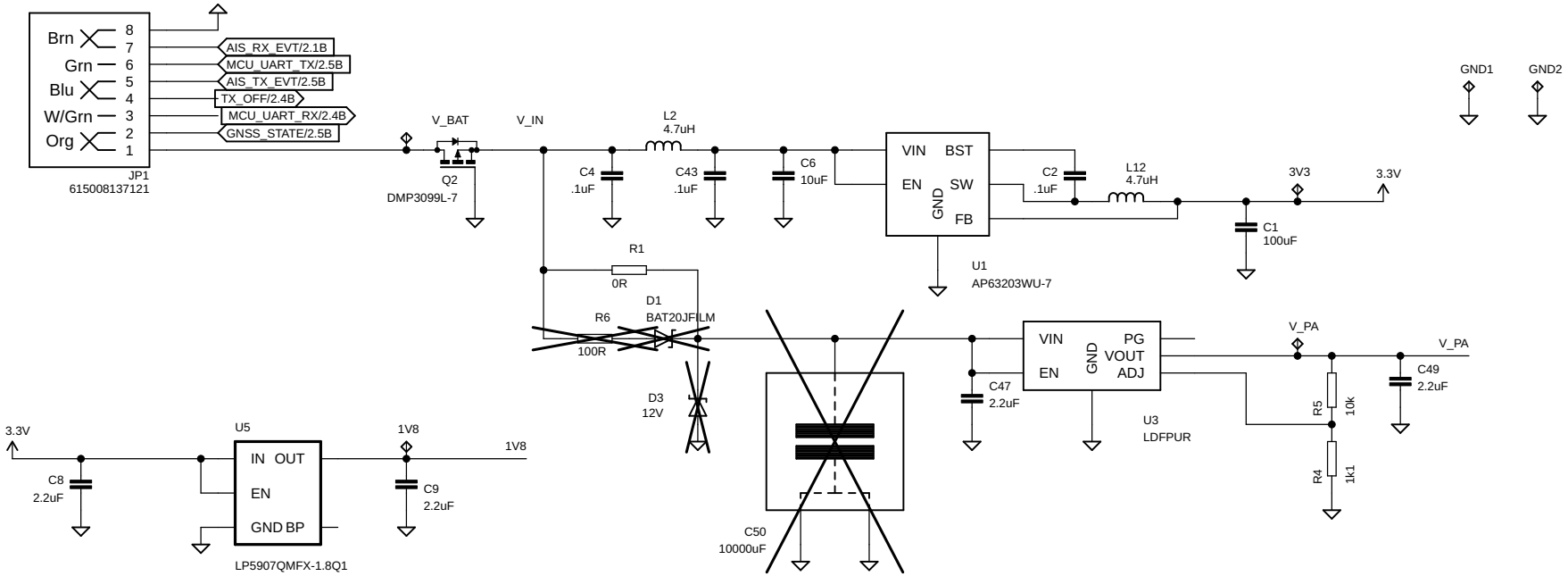
The device needs 3 voltages: 3.3V, 1.8V and 8V with 700mA burst capacity.

Since V_IN must be over 10V, a buck regulator is used to derive the 3.3V. Bucks present a lot of noise at their input, so there is an LC filter there to avoid turning the cable into a broadband EMI antenna.

The 10,000uF supercapacitor delivers all burst current to the PA for packet transmission, so the quality of the cabling is no longer important. D1 prevents the supercap from powering the system while discharging, and the D3 Zener keeps the voltage at 12V even with fully charged marine batteries or alternators often going above 14.5V.



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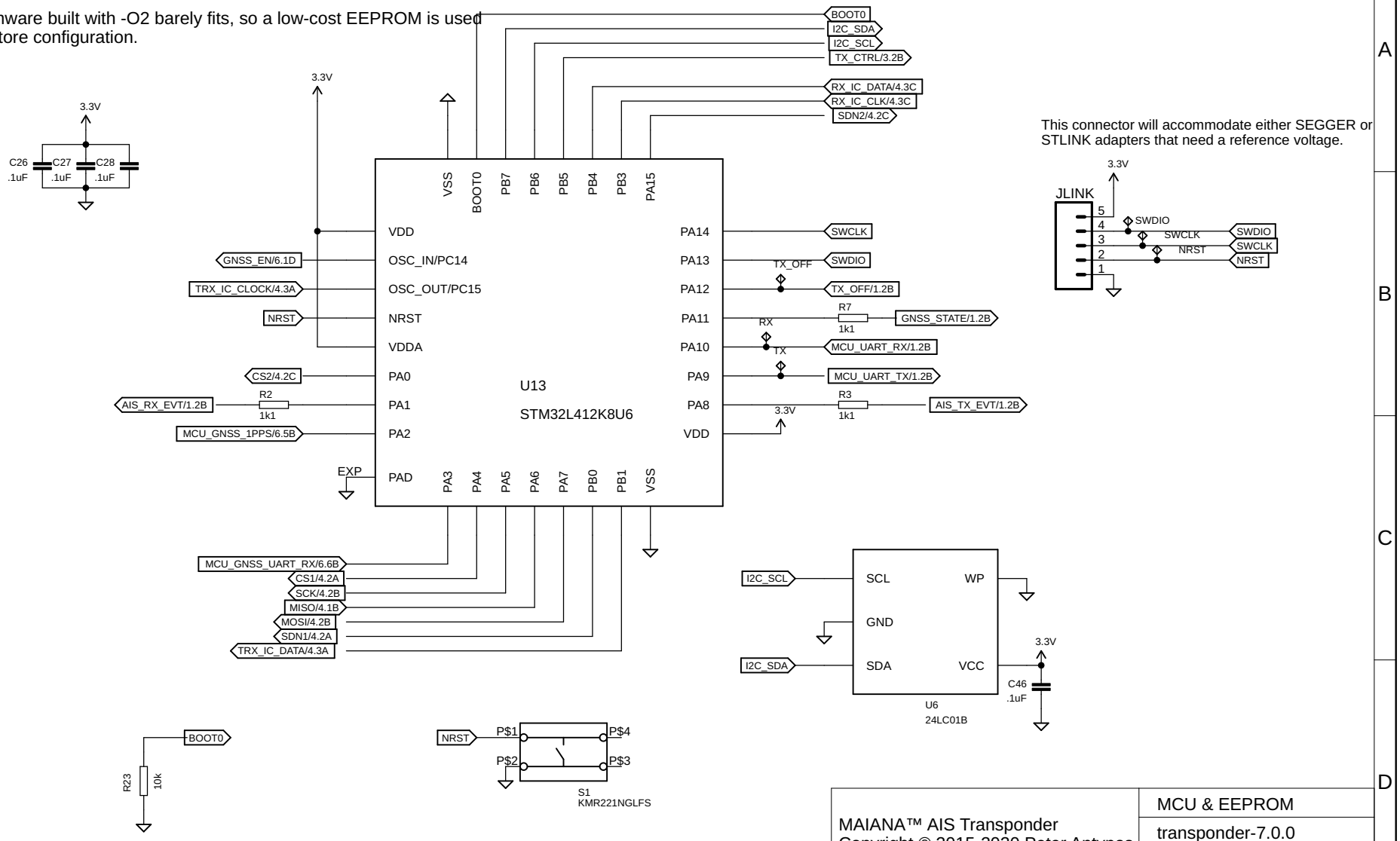
The STM32L412K8U6 is a reasonably priced M4 MCU with 64K of flash.

Firmware built with -O2 barely fits, so a low-cost EEPROM is used to store configuration.



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MCU & EEPROM	
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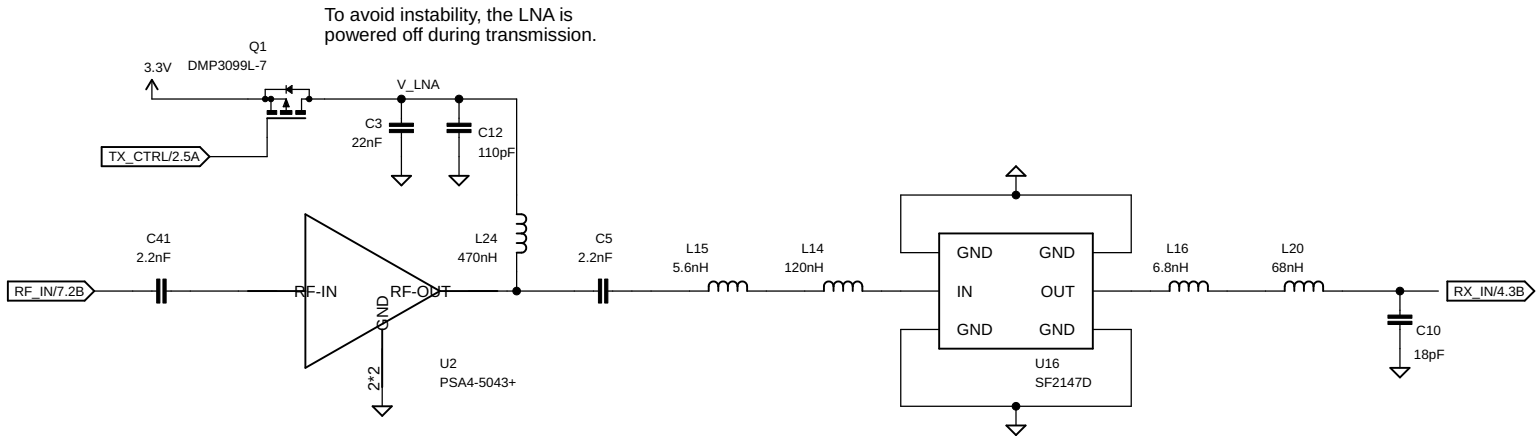

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LNA & SAW Filter

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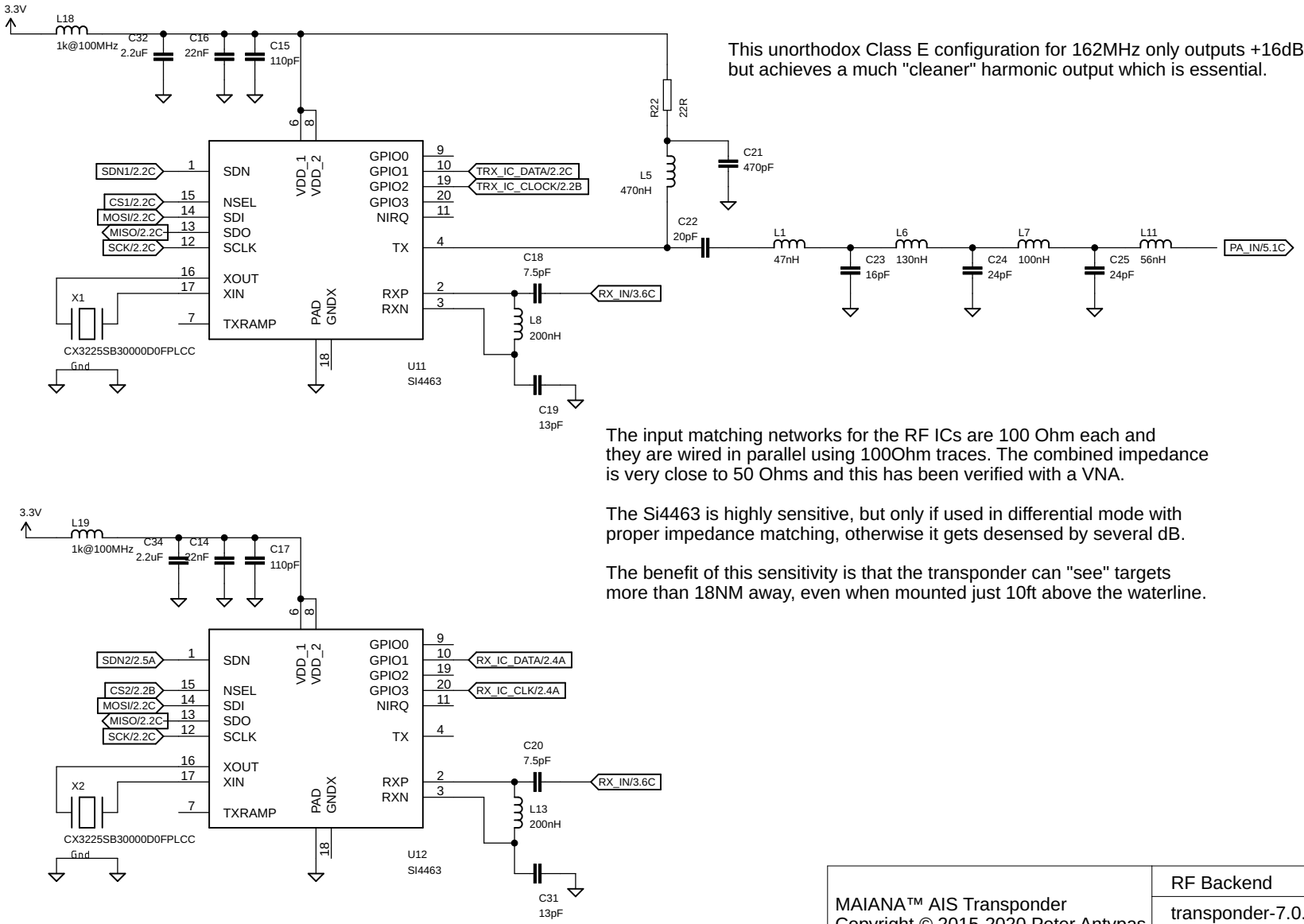

This unorthodox Class E configuration for 162MHz only outputs +16dBm, but achieves a much "cleaner" harmonic output which is essential.

The input matching networks for the RF ICs are 100 Ohm each and they are wired in parallel using 100Ohm traces. The combined impedance is very close to 50 Ohms and this has been verified with a VNA.

The Si4463 is highly sensitive, but only if used in differential mode with proper impedance matching, otherwise it gets desensed by several dB.

The benefit of this sensitivity is that the transponder can "see" targets more than 18NM away, even when mounted just 10ft above the waterline.

RF Backend	
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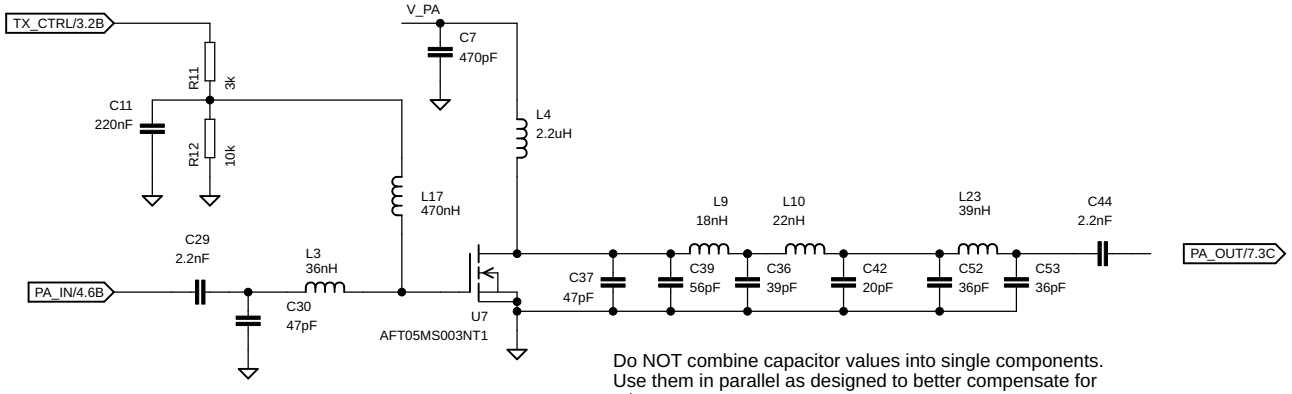
This power amplifier adds more than 17dB of gain for a total conducted output power of +33dBm.

It is based on the reference designs in the datasheet, but includes a narrowband input matching network to reduce BOM and a very steep Chebyshev low pass filter to deal with a pesky 2nd harmonic that falls in the restricted aviation band (324MHz).

The MOSFET drain is always powered, but the gate bias voltage is turned on via R11, R12 and C11. The RC delay is essential for suppressing spurious emissions during ramp up and ramp down.

This MOSFET is at End Of Life. NXP suggests the AFT05MS004N as a replacement, but it's not a drop-in; it will need different matching networks, biasing and input power. On the upside, that part is more efficient and capable of 5W output, so it might be possible to support class B+.



Do NOT combine capacitor values into single components. Use them in parallel as designed to better compensate for tolerances.

RF Power Amplifier

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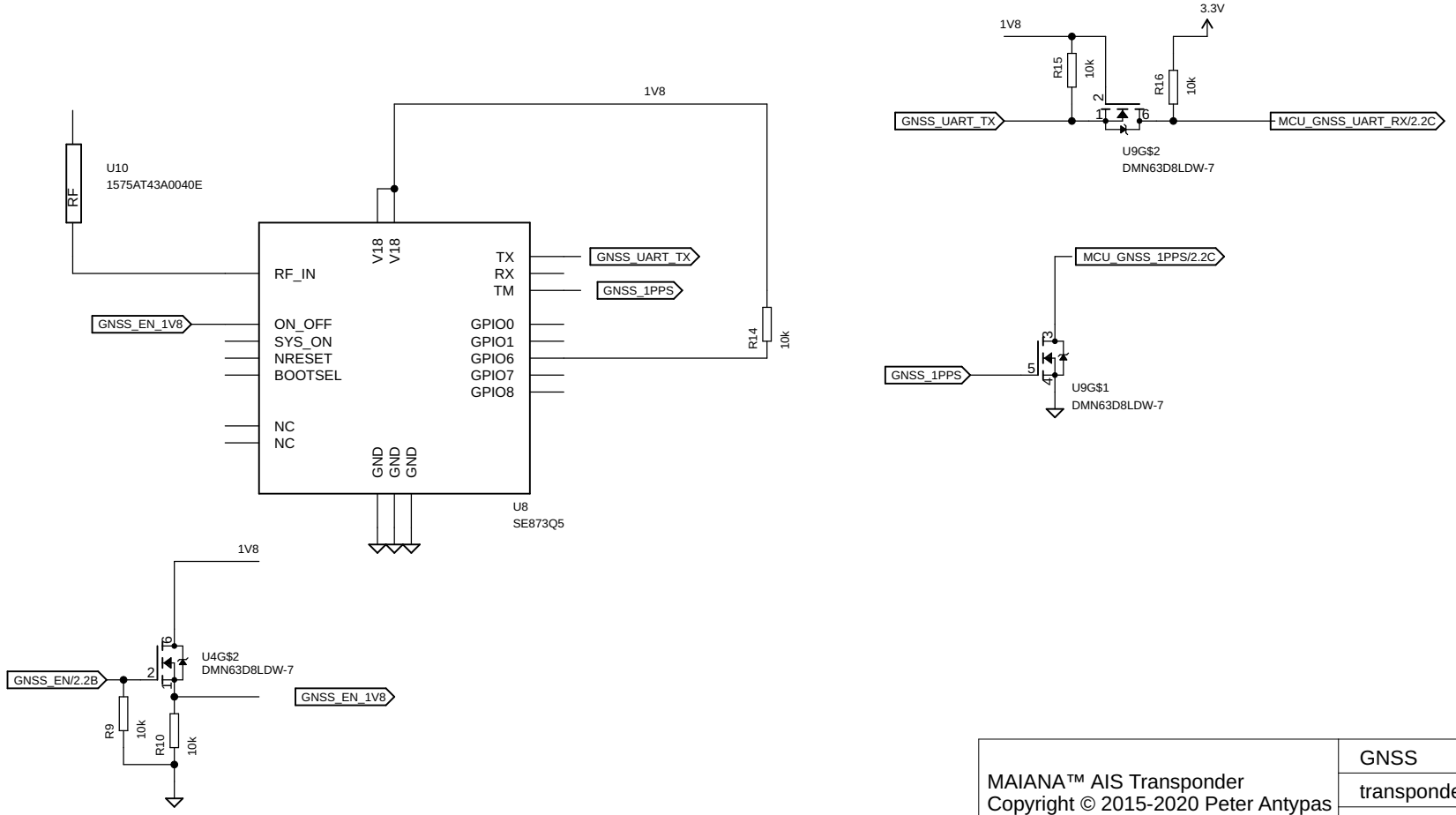
The Telit SE873Q5 GNSS module is a 1.8V device so it needs level shifting for both the UART and the 1PPS signal. Simple N-Channel MOSFETs do the trick. No dedicated ICs required.

The 1PPS signal is inverted, so the MCU IO is configured with an internal pullup and reacts to a falling edge instead.



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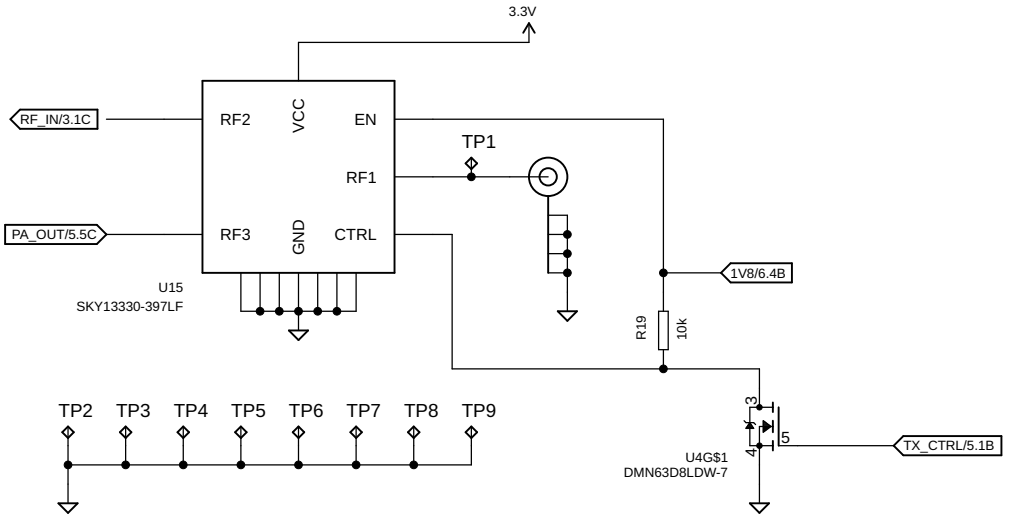
This type of RX/TX switch needs no DC blocking caps.
Although it runs on 3.3V, all logic inputs must be well below
3V, so 1.8V is used for them.



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