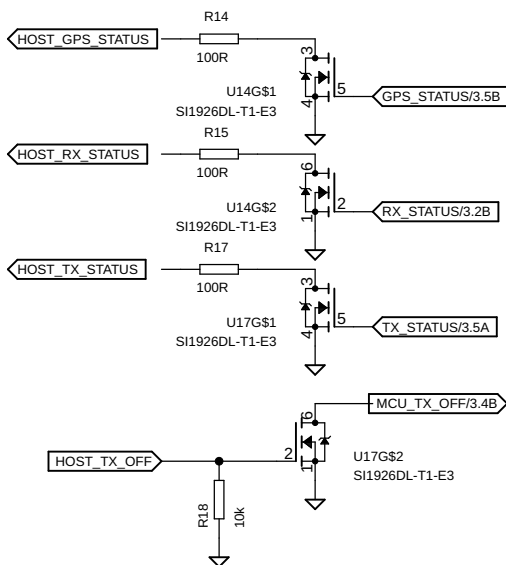
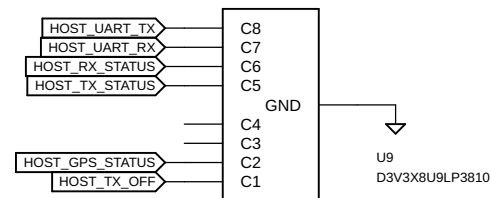


JP1
95501-2821



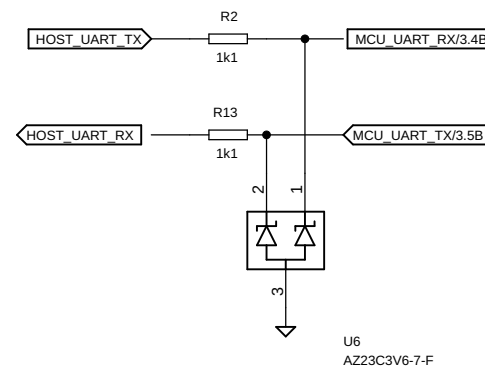
R18 is necessary to prevent the signal from floating when there is no external hardware switch. This may be the case with the "bare bones" UART breakout, for instance, where the switch is optional.



General purpose TVS diodes for each I/O (except UART). They add an extra layer of protection to the buffer MOSFETs.

This is a cost effective UART pin protection scheme. Since the UART is not buffered, it must be protected from excess voltages in case it's miswired.

These Zeners will clamp to ~3.6V. Both MCU pins are 5V tolerant, so there is no risk.



Fiducials for the Pick and Place machine



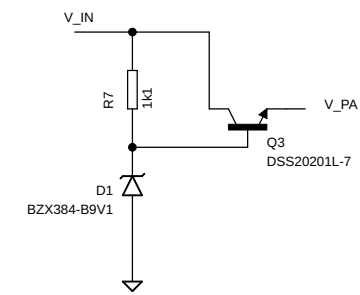
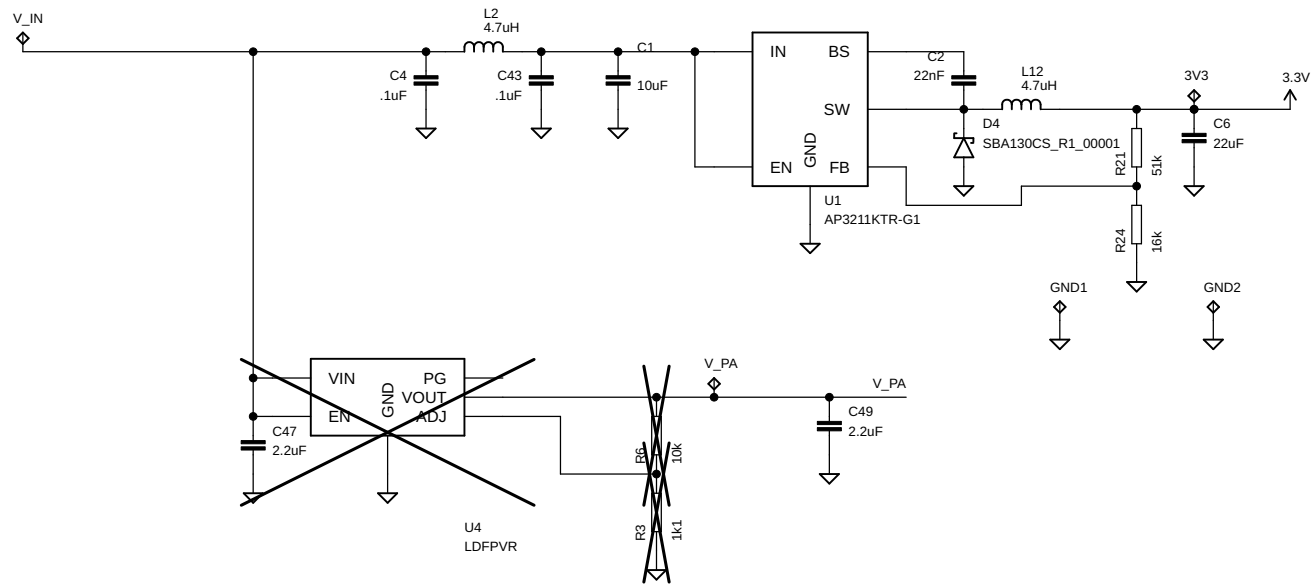
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External Connections

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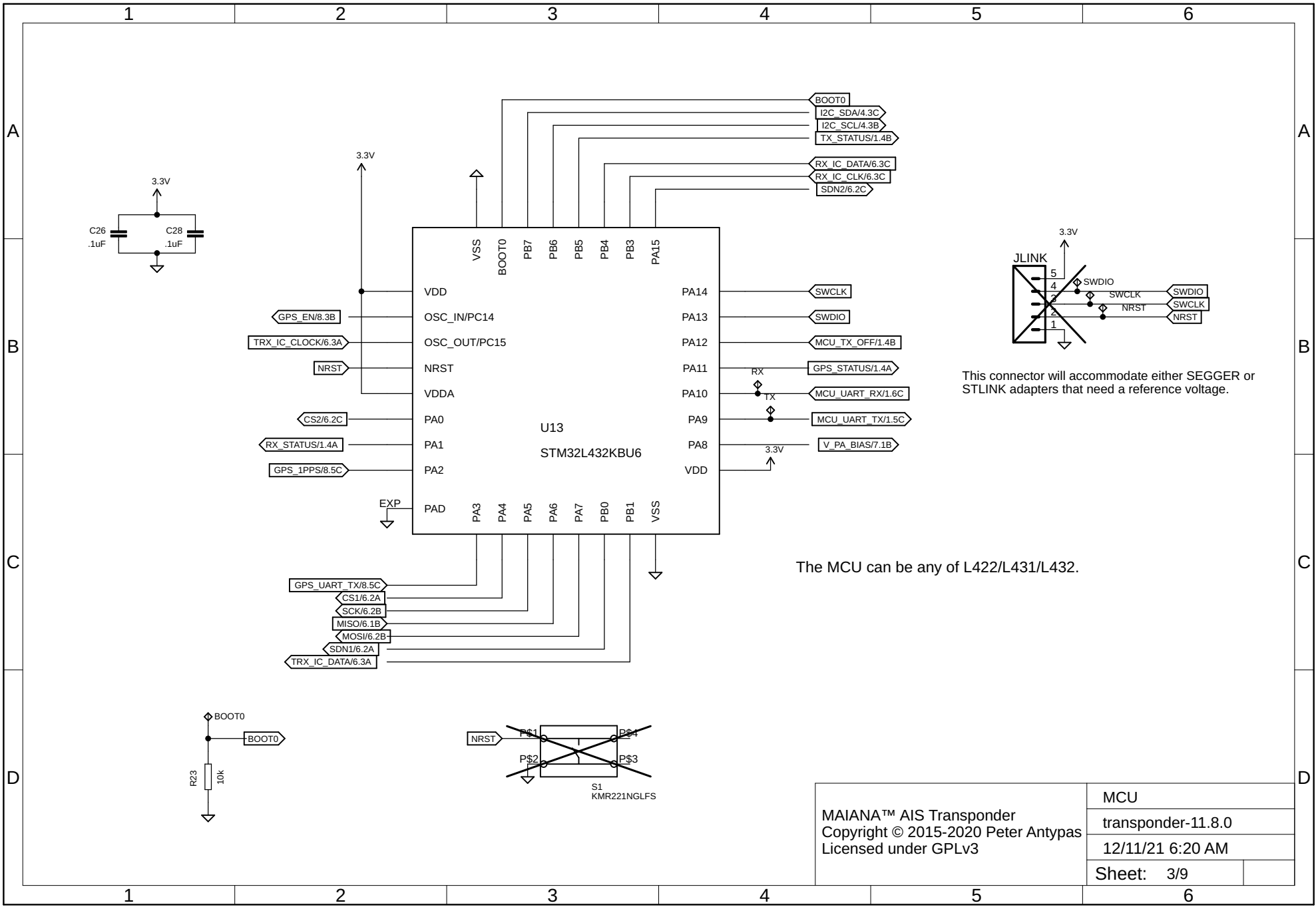
Sheet: 1/9



To hedge against shortages of the LDFPVR, there are two stuffing options for powering the PA: The regulator or the Zener + NPN combo. Both have been validated with a "normal" 12V battery range (11.5-14.5V).

The regulator option will work with voltages down to 9V. The Zener option will need a much smaller inline resistor to regulate under load with a 9V input, but this will also increase quiescent current way too much. So tightening the input voltage requirement is the most reasonable thing to do. There is no real need for an AIS unit to operate from 9V. Such batteries have poor energy density anyway and shouldn't be used here.

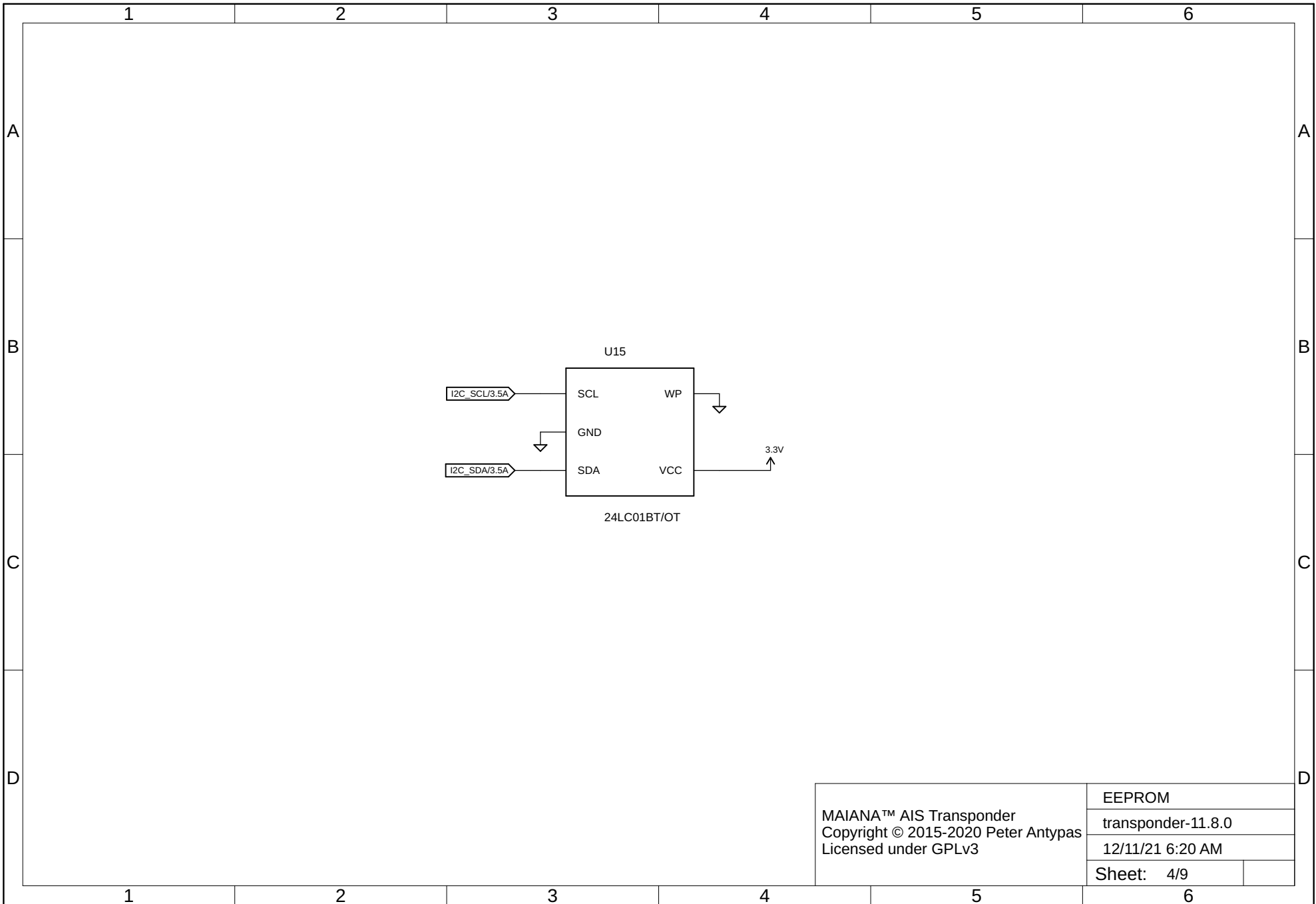
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	transponder-11.8.0
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This connector will accommodate either SEGGER or STLINK adapters that need a reference voltage.

The MCU can be any of L422/L431/L432.

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1 2 3 4 5 6

A

A

B

B

C

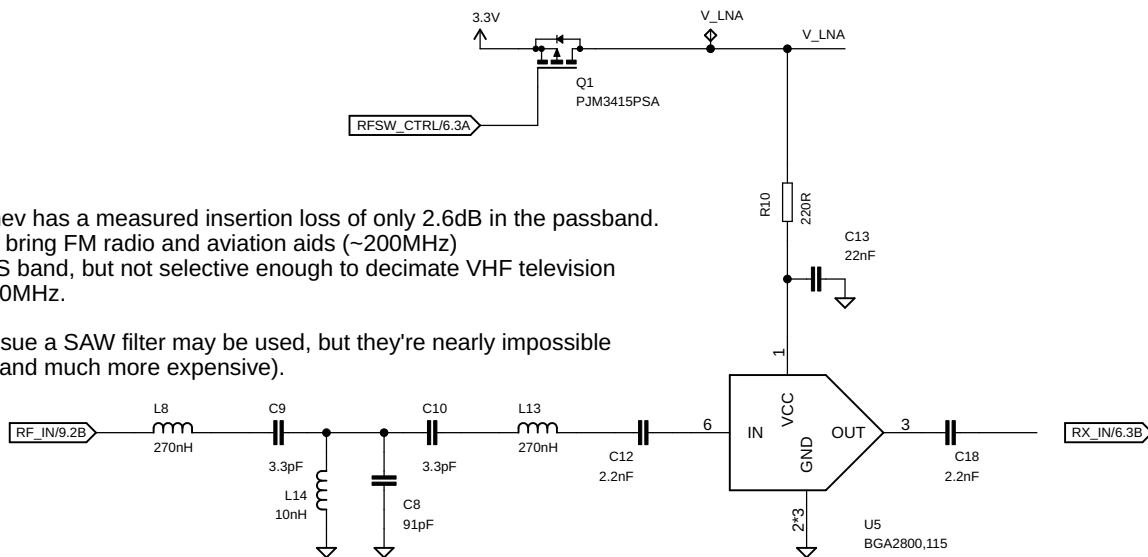
C

D

D

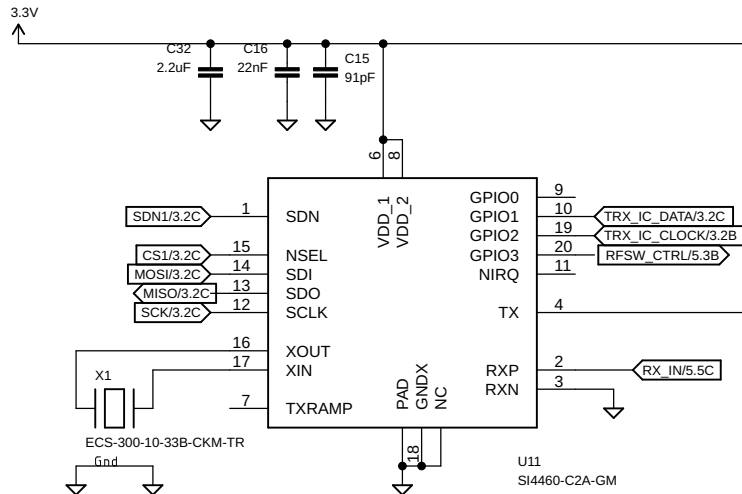
This 3-pole Chebyshev has a measured insertion loss of only 2.6dB in the passband. It is sharp enough to bring FM radio and aviation aids (~200MHz) near or below the AIS band, but not selective enough to decimate VHF television between 174 and 180MHz.

If this becomes an issue a SAW filter may be used, but they're nearly impossible to source right now (and much more expensive).



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	transponder-11.8.0
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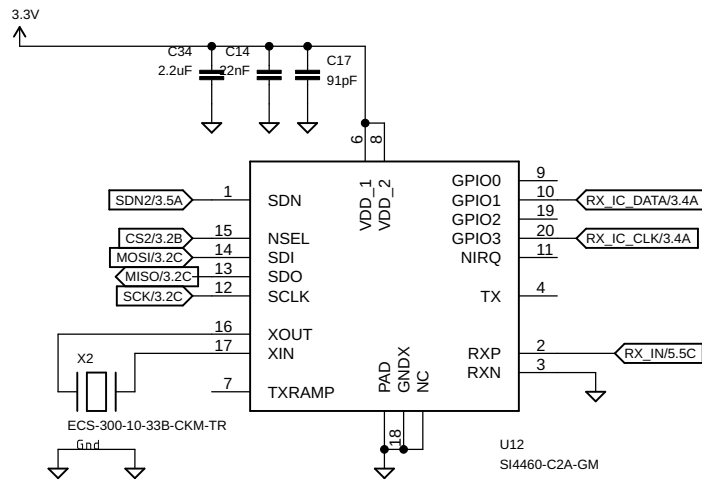
1 2 3 4 5 6



The design uses a Class E configuration for 162MHz. Practical testing proved that it yields adequate power to drive the PA stage.

Any of these ICs will work here:
Si4463
Si4460
Si4467

Firmware sets the TX power level differently for each.



For RX, both IC inputs are configured as single-ended with no matching network. Practical field testing suggests there is no need for one.

Any of these ICs can work here: Si4460, Si4467, Si4362, Si4463.

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RF Backend
transponder-11.8.0
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1 2 3 4 5 6

A

A

This power amplifier adds almost 20dB 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).

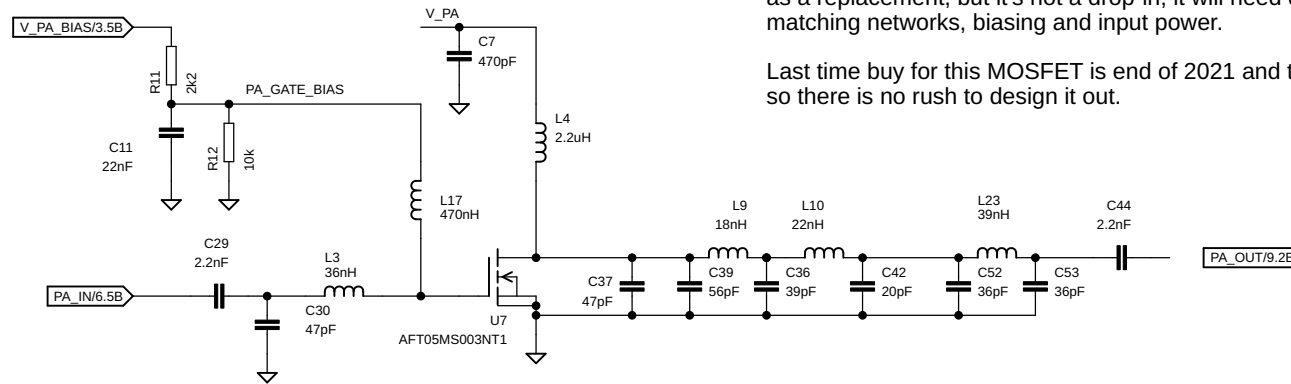
The MOSFET drain is always powered, but the gate bias voltage is turned on via R11, R12, C11 and L17. The RC delay is essential for suppressing spurious emissions during ramp up and ramp down.

This MOSFET is at End Of Life. NXP recommends the AFT05MS004N as a replacement, but it's not a drop-in; it will need different matching networks, biasing and input power.

Last time buy for this MOSFET is end of 2021 and there is ample supply, so there is no rush to design it out.

B

B



C

C

D

D

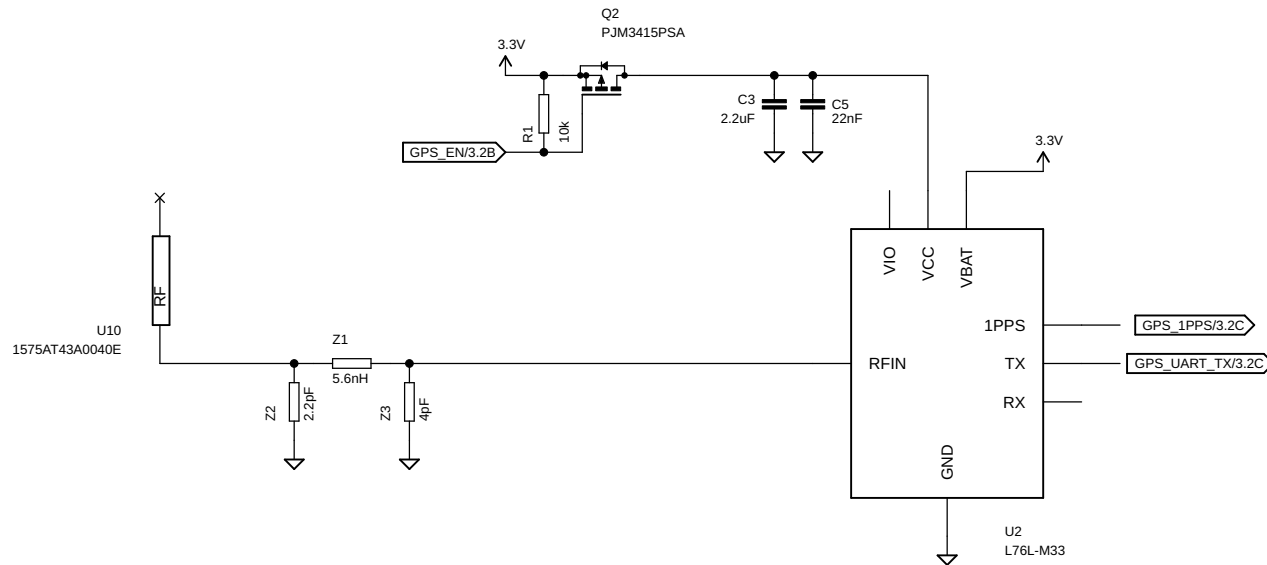
MAIANA™ AIS Transponder Copyright © 2015-2020 Peter Antypas Licensed under GPLv3	RF Power Amplifier
	transponder-11.8.0
	12/11/21 6:20 AM
	Sheet: 7/9

1 2 3 4 5 6

The GNSS RTC is always powered, but its main voltage rail is only turned on explicitly via firmware. This scheme was necessary to prevent the UART output from hijacking the ST ROM bootloader during firmware update. With the migration to a new bootloader this isn't necessary anymore, but I'm leaving it in for now.

The matching network adjusts the tuning of the antenna in the PVC enclosure which is very different from free space.

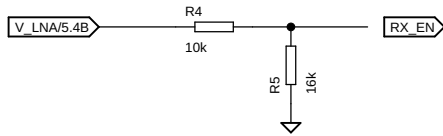
There is no VIO pin in the Quectel modules, so it's left unconnected. I added this to accommodate UBlox as possible substitutes, but that's not going to happen. The L76L-M33 performs better than any of them at half the price.



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1 2 3 4 5 6

A

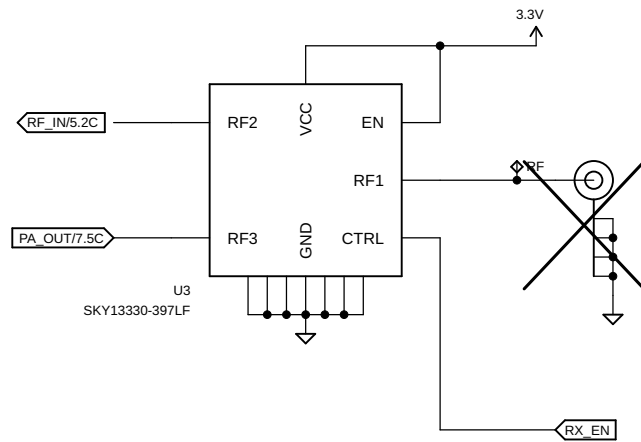


This is a reasonably good RF switch which does not need DC blocking caps.

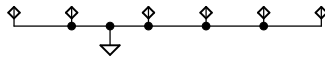
That said, it requires control voltages to be below 2.7V, so a voltage divider was added. RX_EN must be high during RX

The 9 test pads here form a footprint for a coaxial pogo pin probe in the test jig.

B



C



D

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1 2 3 4 5 6

A

B

C

D