Schematic and PCB review

The Things Industries - Generic Node Rev 2.0.2

Application based on STM32WL (QFN)

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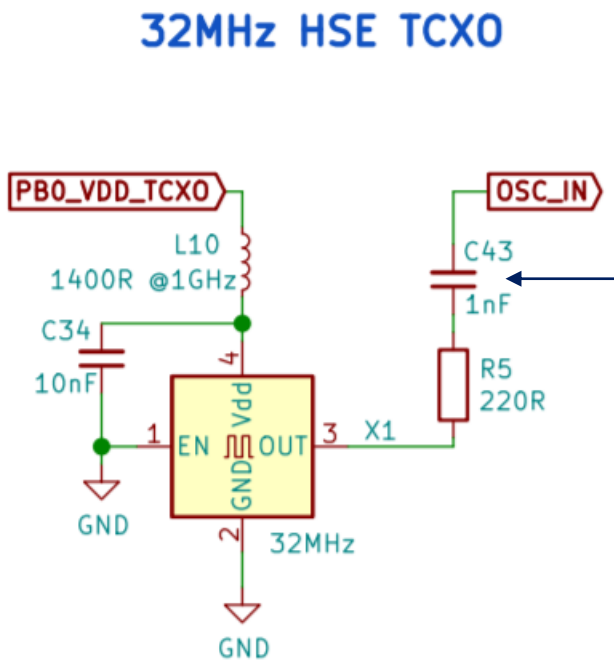
Grenoble / France

Schematic Review

HSE Source

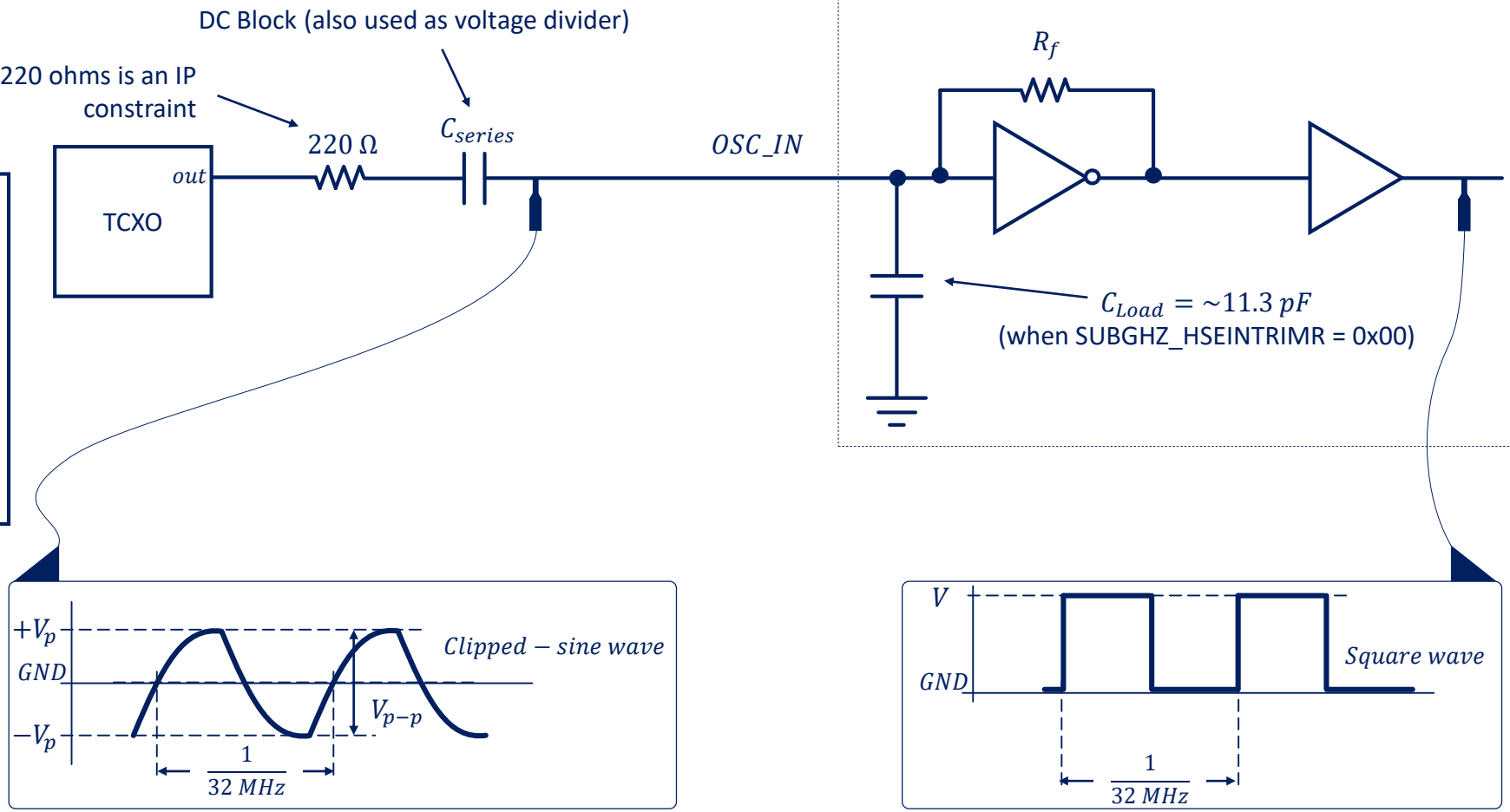


C43: When using NDK NT2016SA-32M-END4263A with an output of 0.8 V-pk-pk this capacitor must have **10 pF** of capacitance. See next page for more detail.

HSE Source (cont'd)

Amplitude voltage for external TCXO applied to OSC_IN pin must not exceed 1.2 Vpk-pk. An amplitude of 0.4 to 0.5 V pk-pk is recommended for minimizing spurious injection. The series capacitor (C_{series})should be used as voltage divider in order to get the recommended voltage level on OSC_IN:

$$V_{OSC\_IN} = \frac{\frac{1}{\omega C_{HSE\_IN\_TRIMR}}}{\sqrt{(220+\frac{1}{\omega C_{series}})^2+(\frac{1}{\omega C_{HSE\_IN\_TRIMR}})^2}} V_{TCXO\_Out}$$



How to determine the value of Cseries?

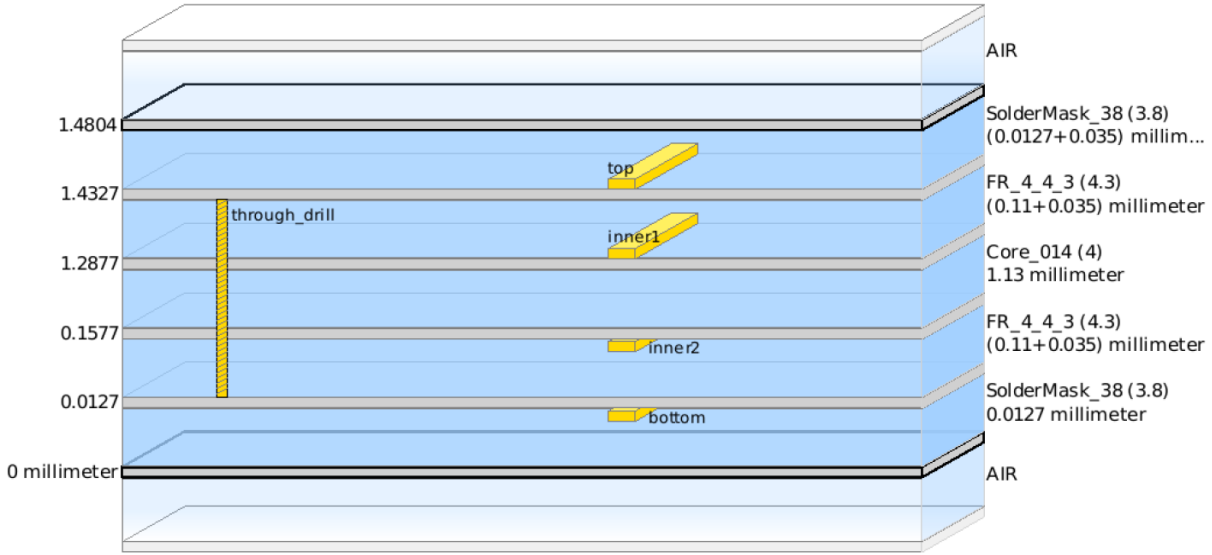
A: $$C_{series} = \frac{1}{\omega\left(\sqrt{\left(\frac{1}{\omega C_{HSE_{IN_{TRIMR}}}} \times \frac{V_{TCXO_{Out}}}{V_{OSC_{IN}}}\right)^2 - \left(\frac{1}{\omega C_{HSE_{IN_{TRIMR}}}}\right)^2} - 220\right)}$$

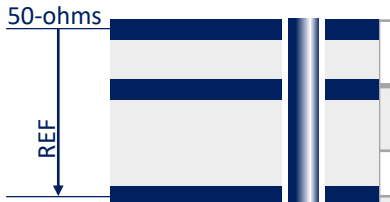
PCB Review

RF lines

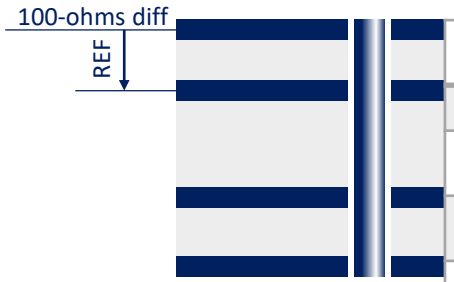
Impedances have been checked:

Stack-up reported and recreated in the EM simulation tool





Single-ended TML Properties simulated (2D solver)		
	50-ohms	
	Real	Imag
Zc (ohm)	49.59	-0.0017
Effective Dielectric Constant	2.91	0

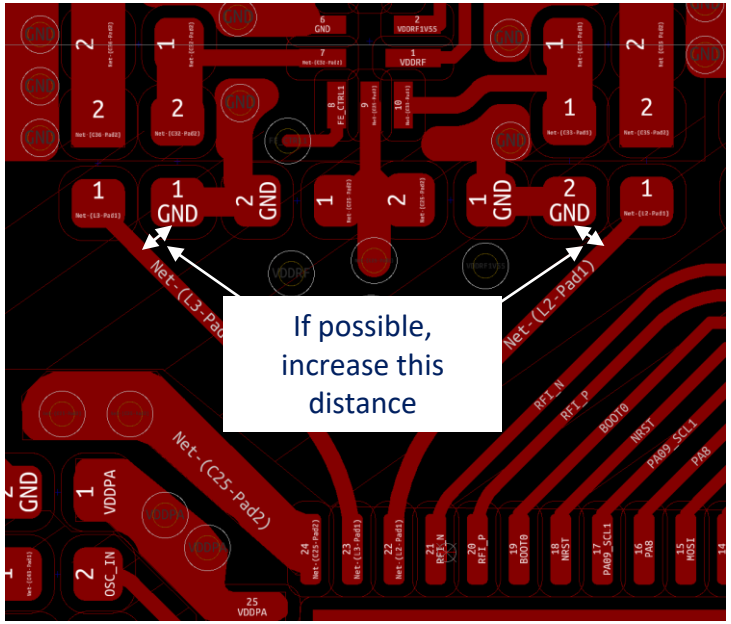


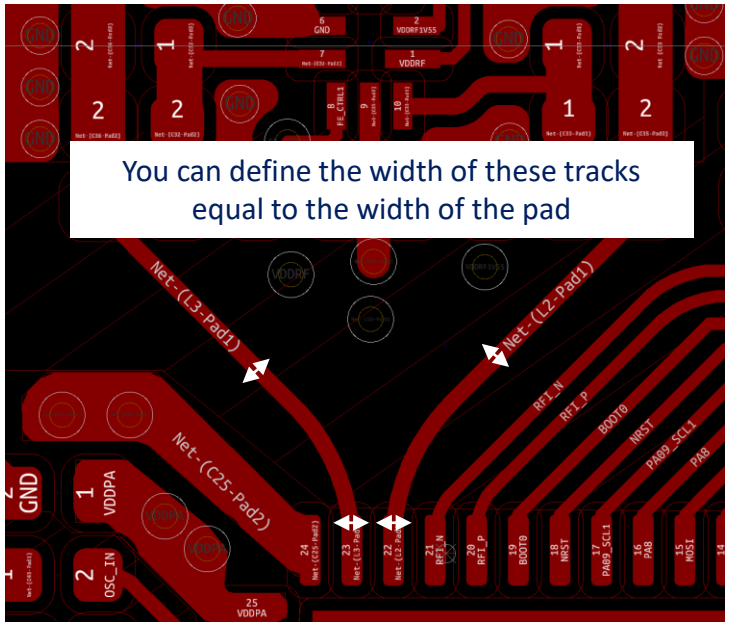
Differential TML Properties simulated (2D solver)				
	Real	Imag		
Zc Common (ohm)	28.99	-0.14		
Zc Differential (ohm)	91.45	-0.55		
	Real (Even)	Imag (Even)	Real (Odd)	Imag (Odd)
Zc (ohm)	57.98	-0.28	45.72	-0.27
Effective Dielectric Constant	3.71	0		

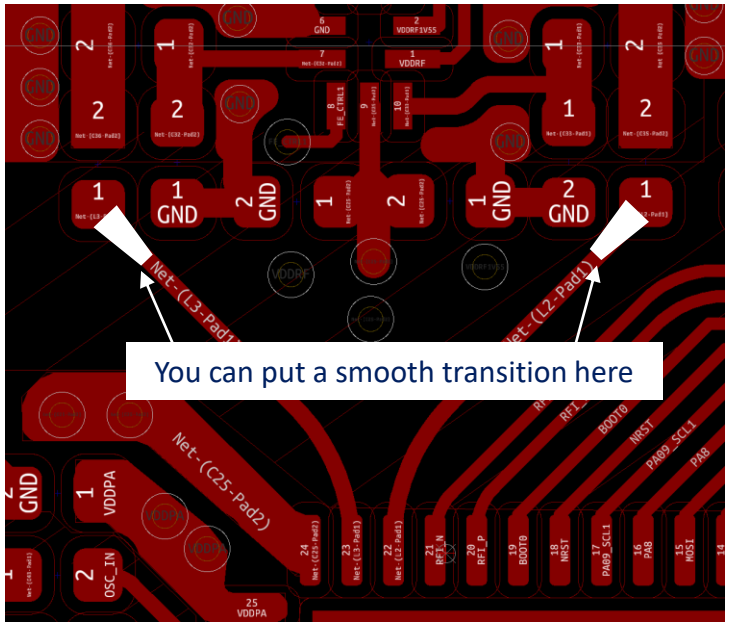
Comment: RF lines are OK

RFOs

Some recommendations

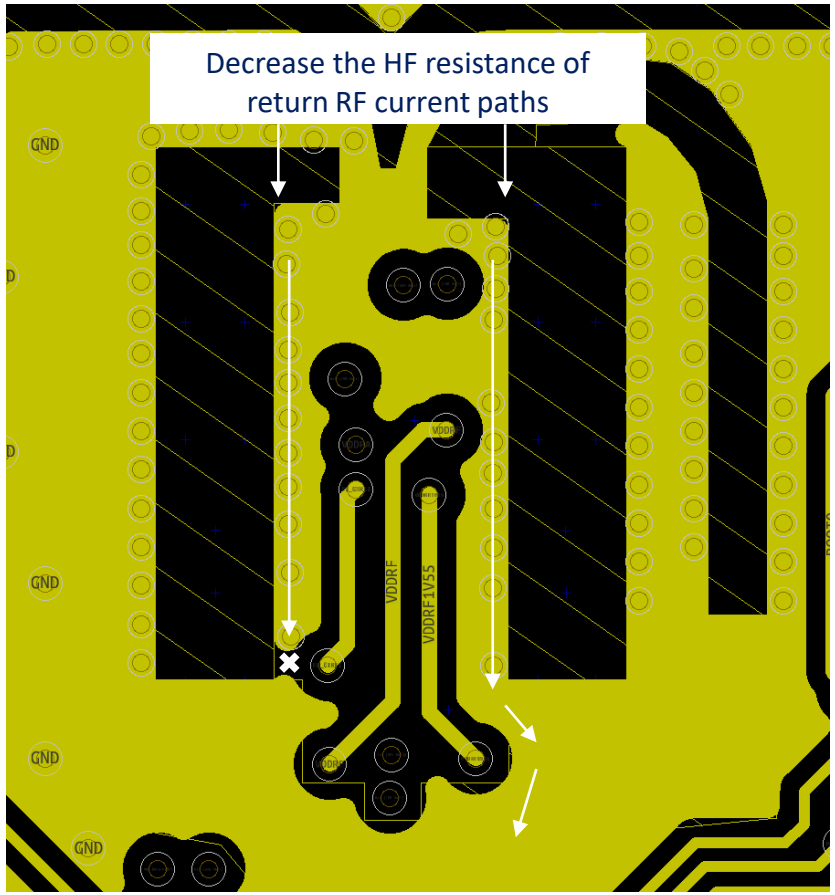


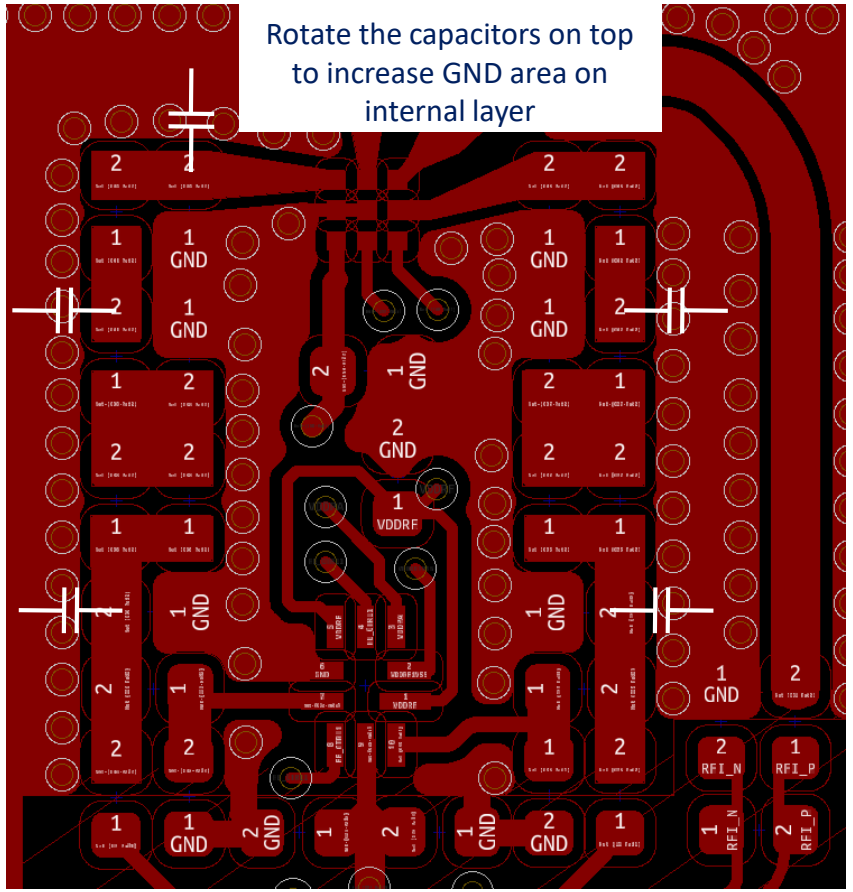


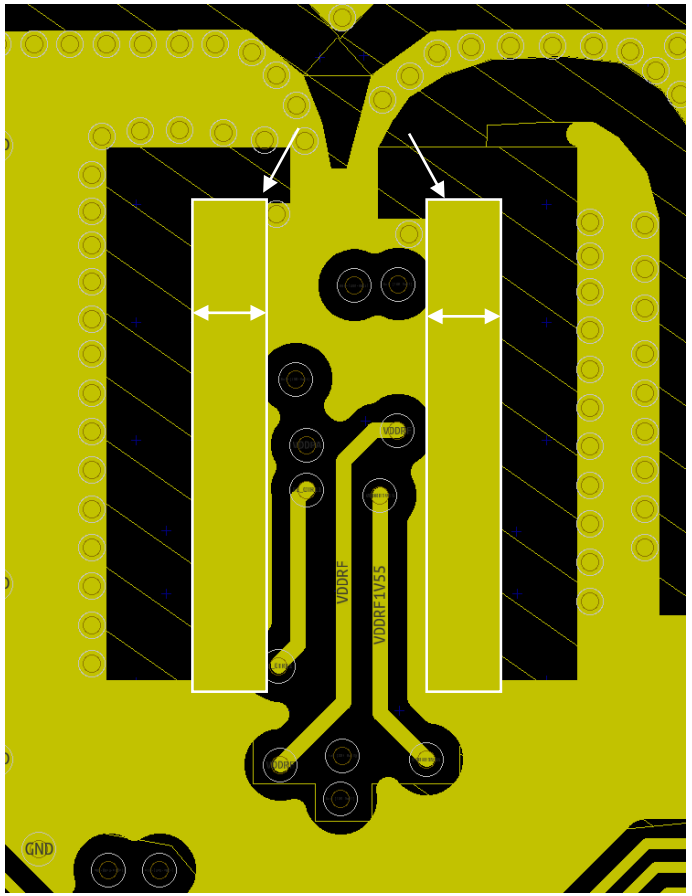


RF return path

Some recommendations

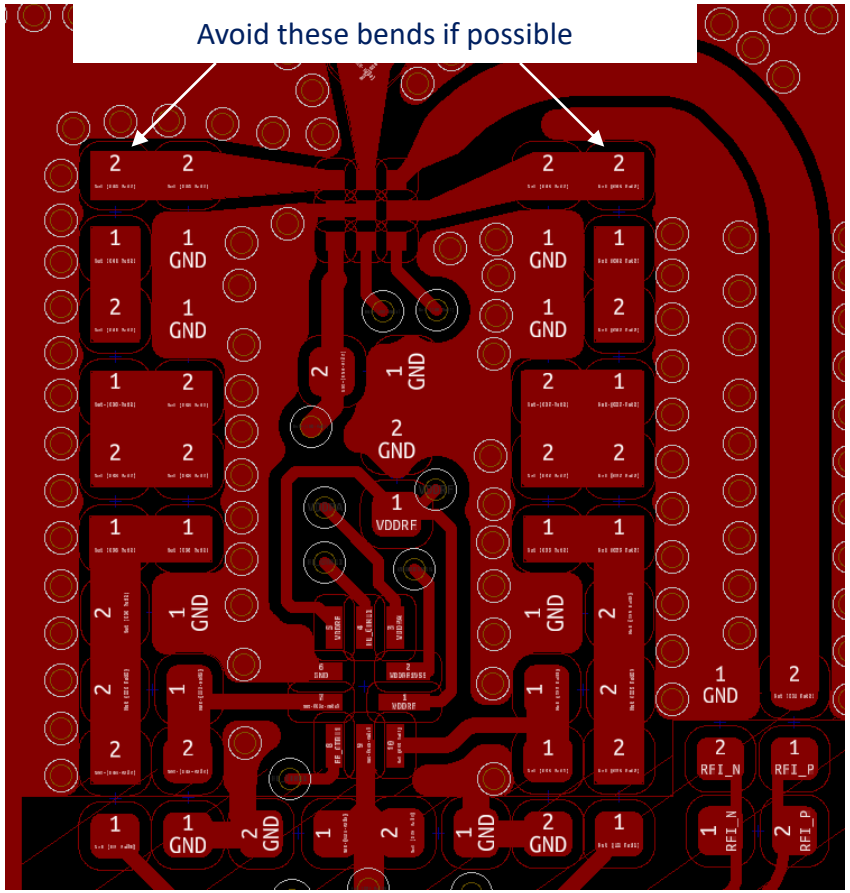






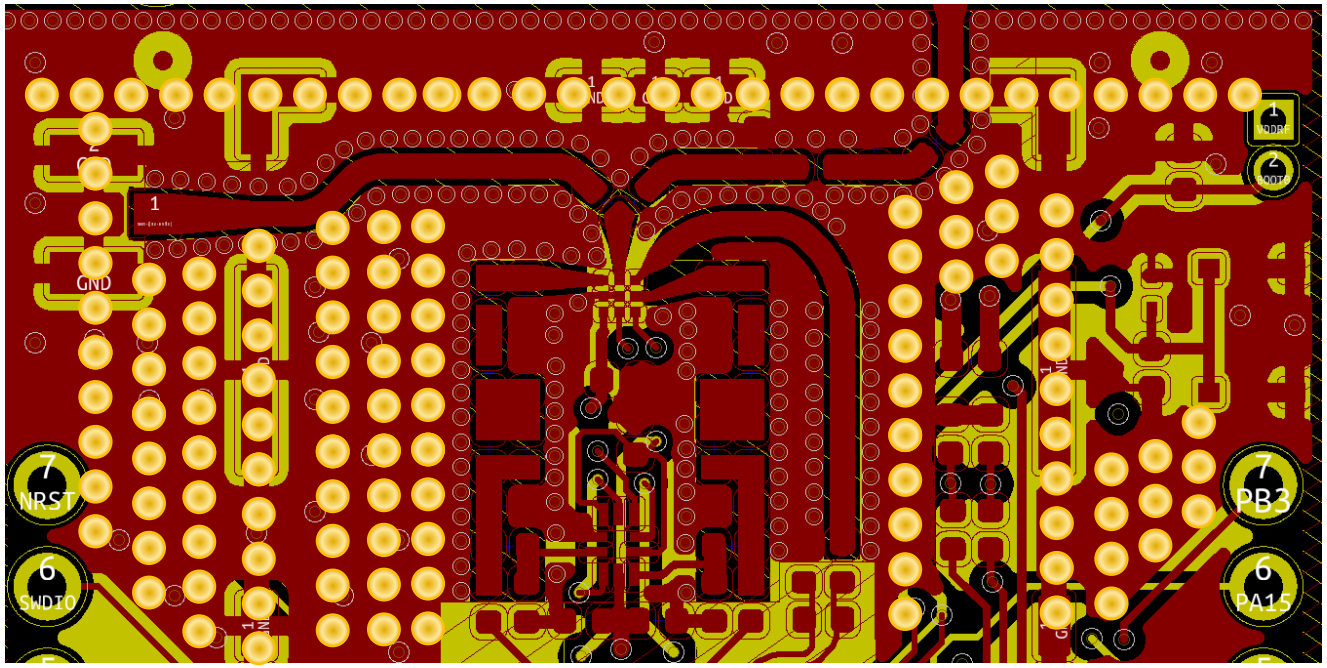
Bend on RF lines

Some recommendations



GND Vias

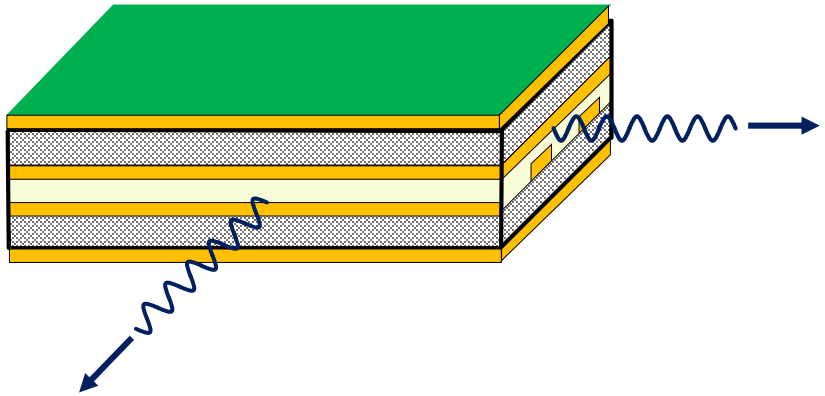
Increase as much as possible the GND Vias throughout the board and in specially around the RF lines.



GND Vias

In order to avoid high-frequency issues increase the ground planes around the board and put a via guard ring. It was found by EM simulation that an important amount of unintentional radiation occurs from board profile due to high frequency currents induced on metal planes and in order to avoid it proceed as recommended below.

Unintentional radiation from board profile



Recommendation

Spacing < 1 mm, the closest possible