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Wideband Multi Paction detection

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ing. Onno de Meijer

Other High Power RF-presentations

- 2010 Ku band Multi Carrier Testbed for the European Space Agency, ESA

  Generation of a Multi Carrier test signal for MultiPactor Research

- 2016 High Power, S-Band PIM test system for CAST504

  Passive Intermodulation Measurement 2 * 50dBm

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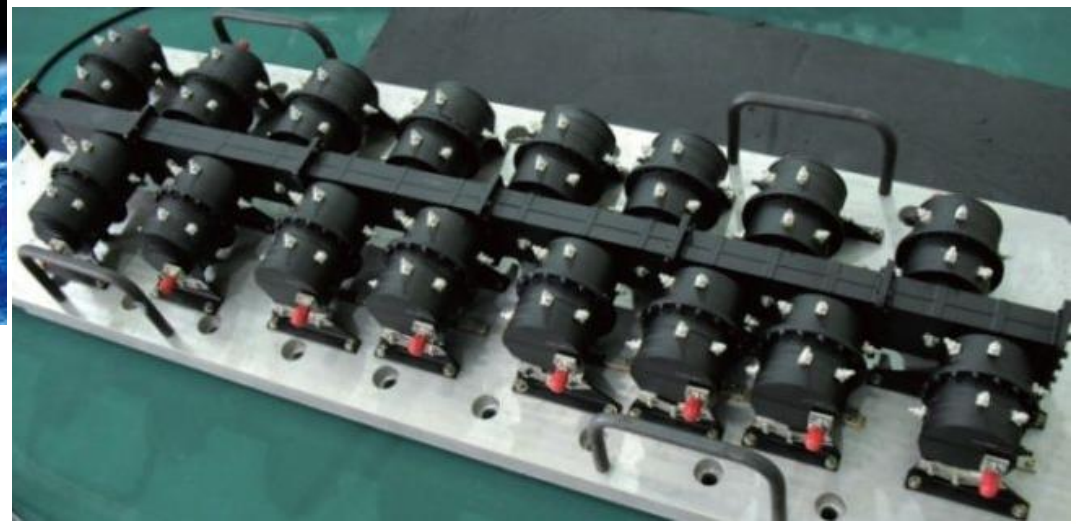
Wideband Multipaction Detection

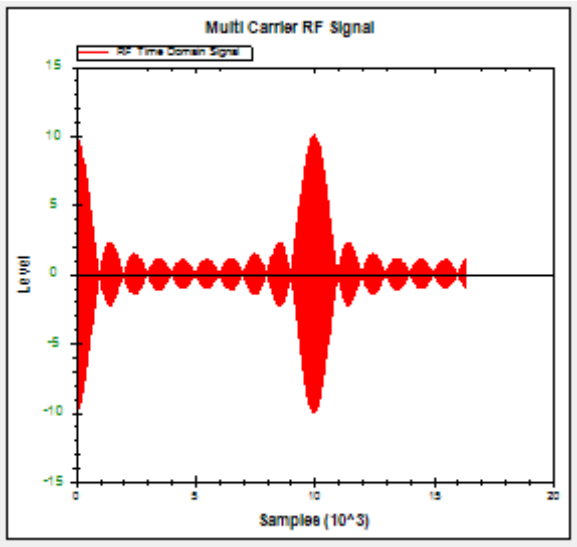
- *What is MultiPaction?*
  - The generation of free electrons in vacuum.
  - Happens under certain High Power Multi Carrier conditions (CW or modulated)
  - Or High Power pulse modulated
    - *Why does it happen?*
    - *Where does it happen?*

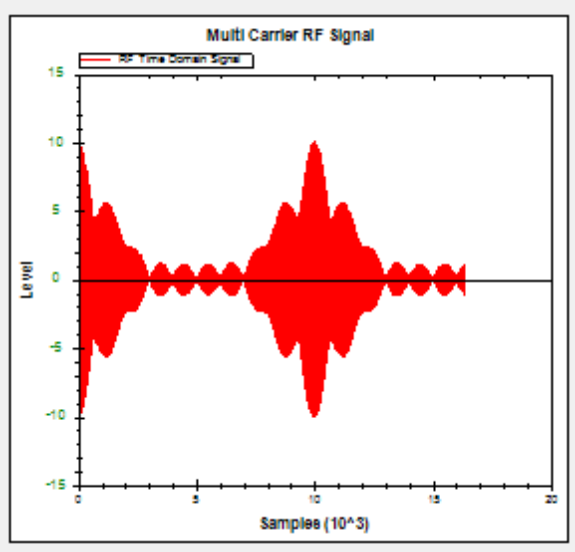
Where can MultiPaction happen?

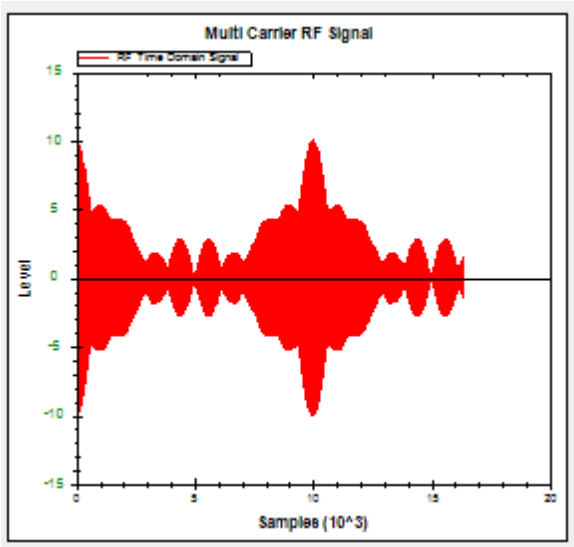


What are suitable signal conditions?

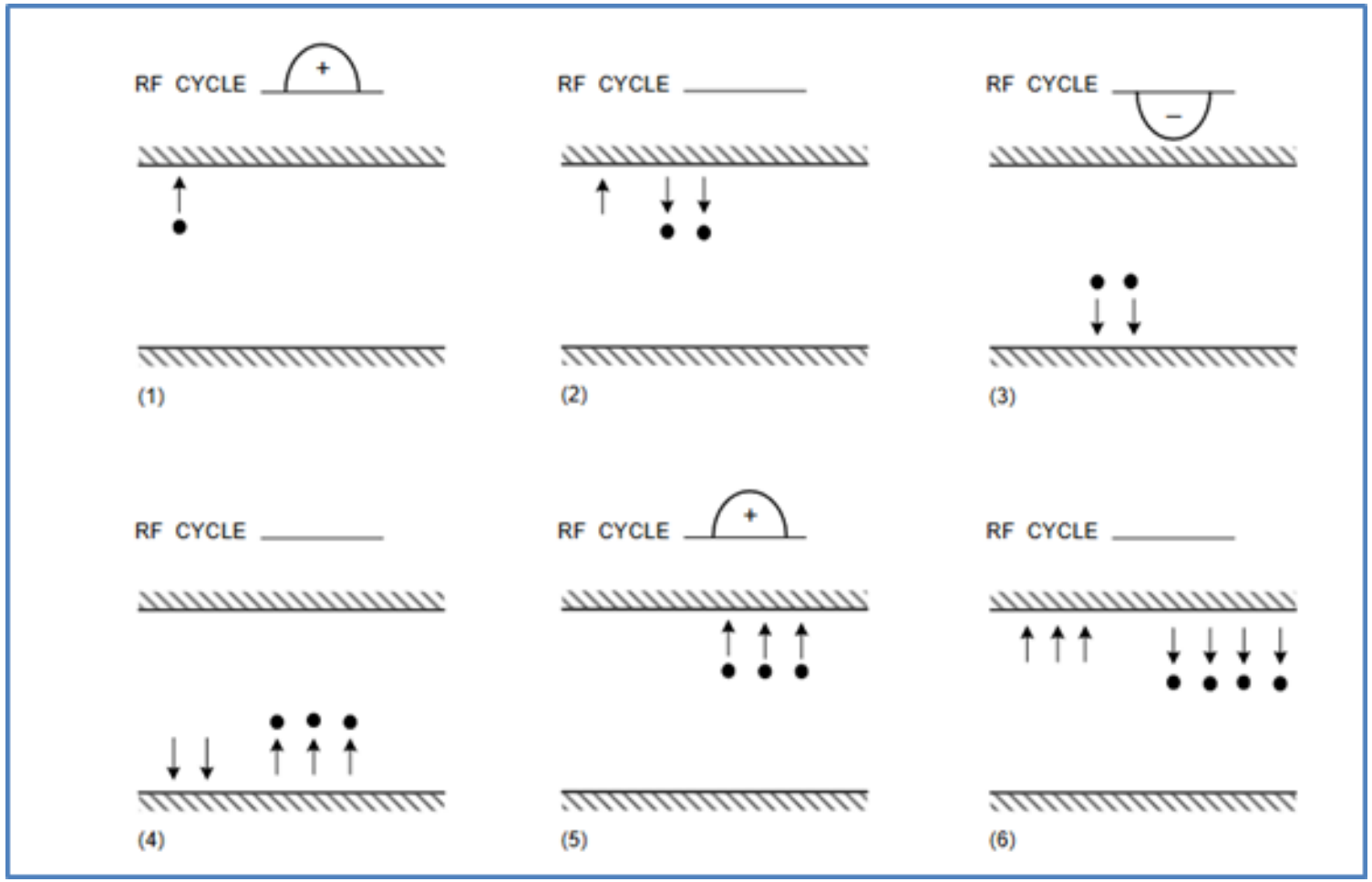
- Multiple signals on a single transmission line, coaxial or waveguide
- Sometimes,….. they have ***certain phase phase conditions*** and create a favorable power profile for the generation of free electrons





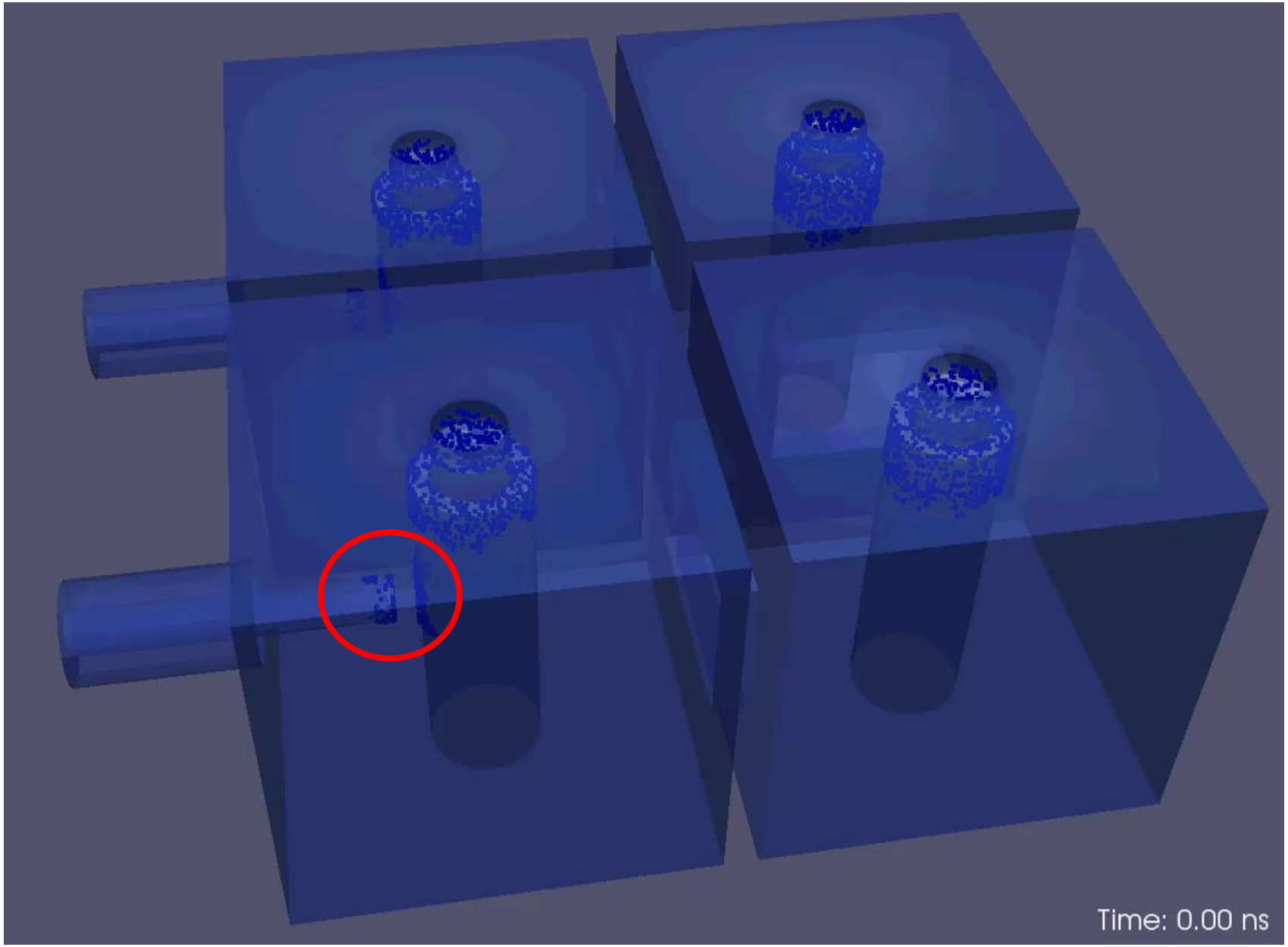


Physics in vacuum



This process depends on:

- RF Power level
- The GAP (distance between the plates)
- Phase settings of carriers



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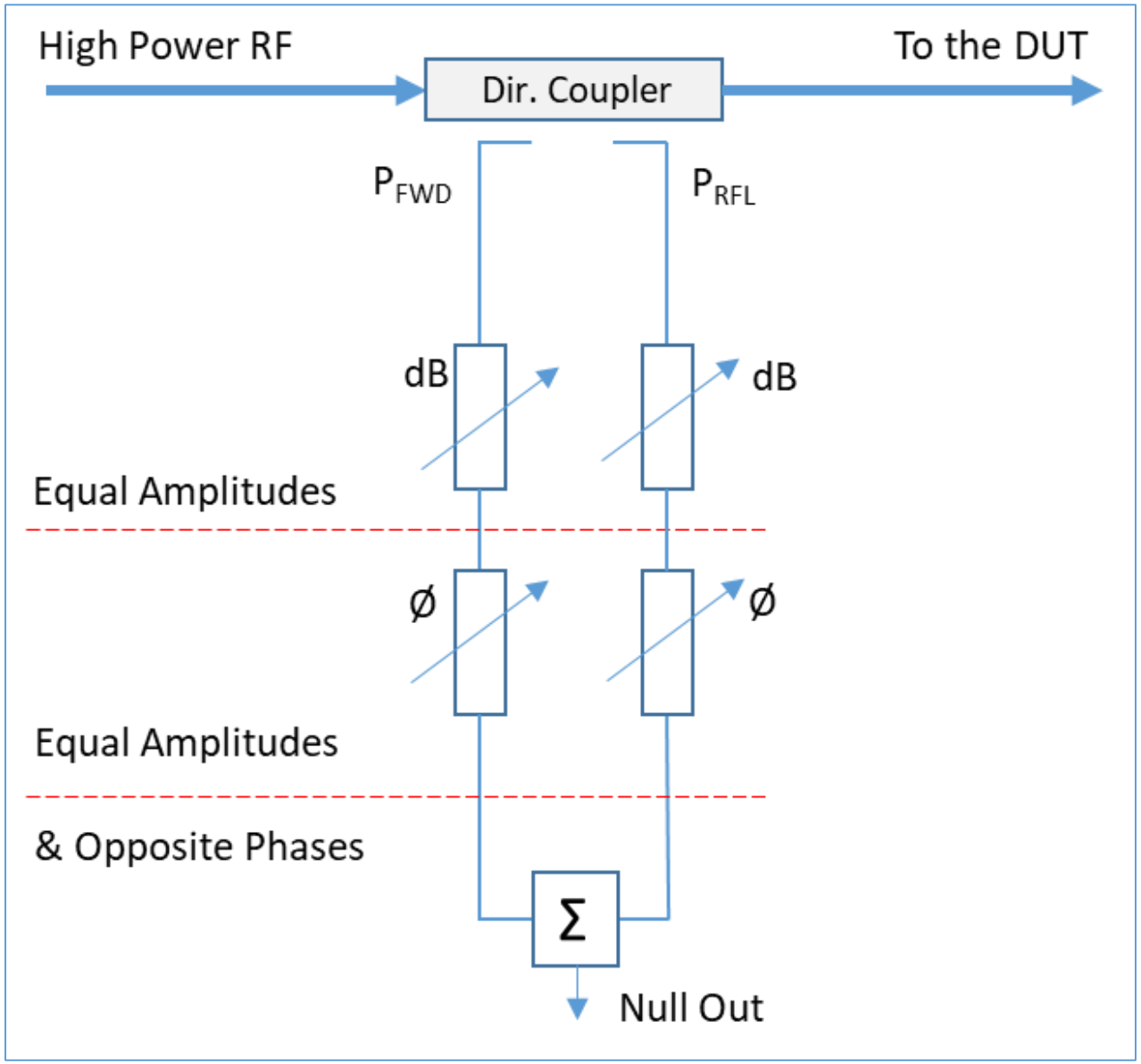
A detection method



The classic way

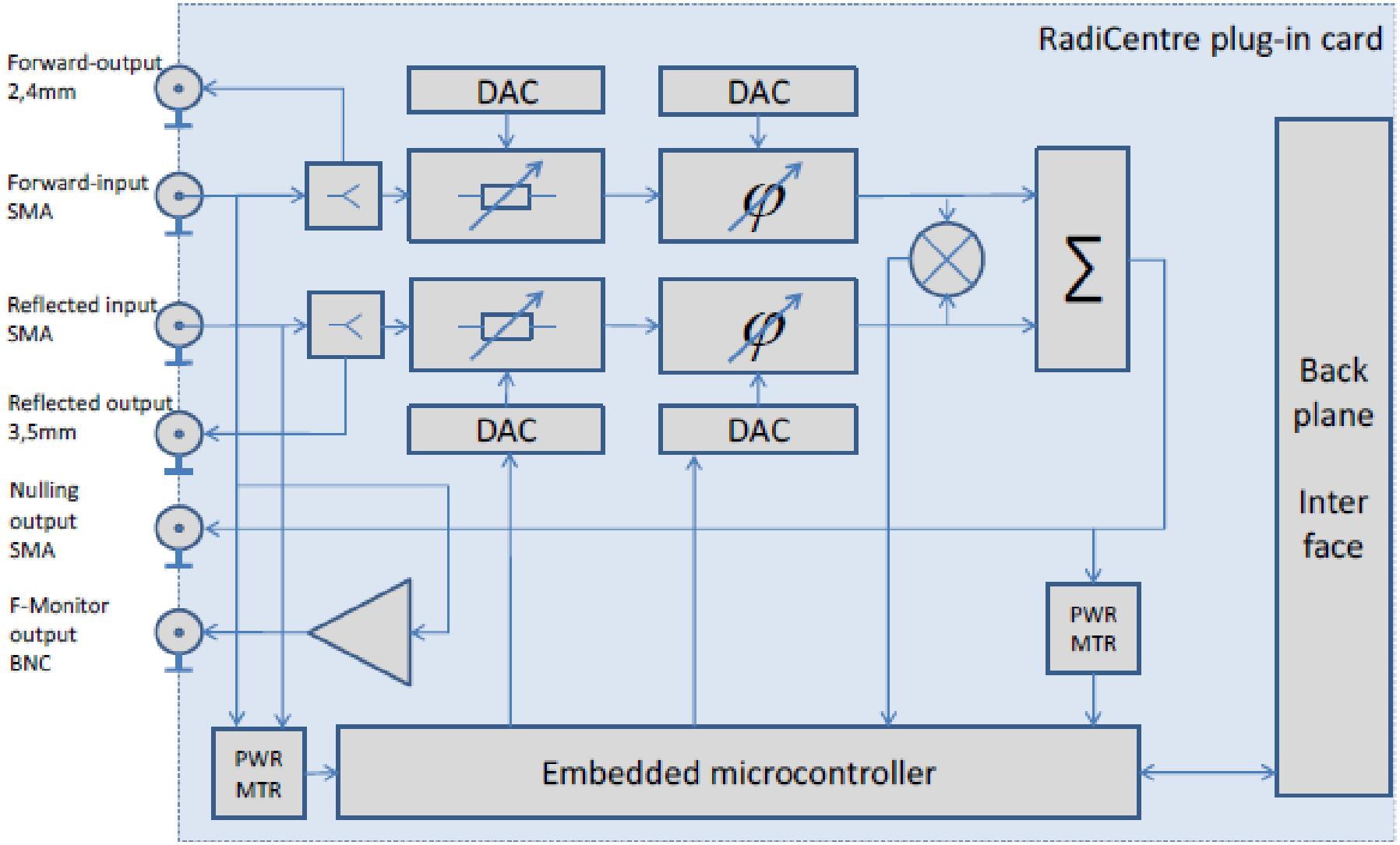
- Set up the detector with Waveguide components
- ***Narrow-band*** and connected to the ***WaveGuide frequency bands***

WR650	WG6	R14	1.15 to 1.72 GHz	0.908 GHz	1.816 GHz	6.5 [165.1]	3.25 [82.55]
WR510	WG7	R18	1.45 to 2.20 GHz	1.157 GHz	2.314 GHz	5.1 [129.54]	2.55 [64.77]
WR430	WG8	R22	1.72 to 2.60 GHz	1.372 GHz	2.745 GHz	4.3 [109.22]	2.15 [54.61]
	WG9		2.20 to 3.30 GHz	1.686 GHz	3.372 GHz	3.5 [88.9]	1.75 [44.45]
WR340	WG9A	R26	2.20 to 3.30 GHz	1.736 GHz	3.471 GHz	3.4 [86.36]	1.7 [43.18]
WR284	WG10	R32	2.60 to 3.95 GHz	2.078 GHz	4.156 GHz	2.84 [72.136]	1.34 [34.036]
	WG11		3.30 to 4.90 GHz	2.488 GHz	4.976 GHz	2.372 [60.2488]	1.122 [28.4988]
WR229	WG11A	R40	3.30 to 4.90 GHz	2.577 GHz	5.154 GHz	2.29 [58.166]	1.145 [29.083]
WR187	WG12	R48	3.95 to 5.85 GHz	3.153 GHz	6.305 GHz	1.872 [47.5488]	0.872 [22.1488]

The classic way, disadvantages

- All parts are ***MANUALY*** controlled
- ***Narrow band*** and bound to the waveguide bands
- ***Multiple*** setups to cover 1-6 GHz and higher bands

A 1 to 6 GHz ***broad-band*** design



A 1-6 GHz Broadband, modular nulling card

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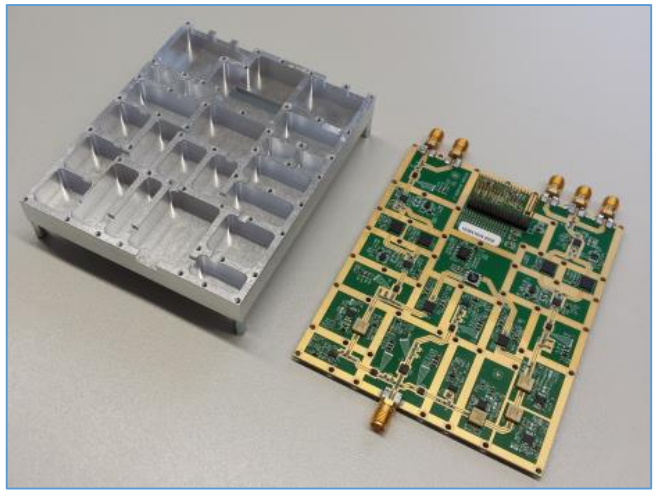
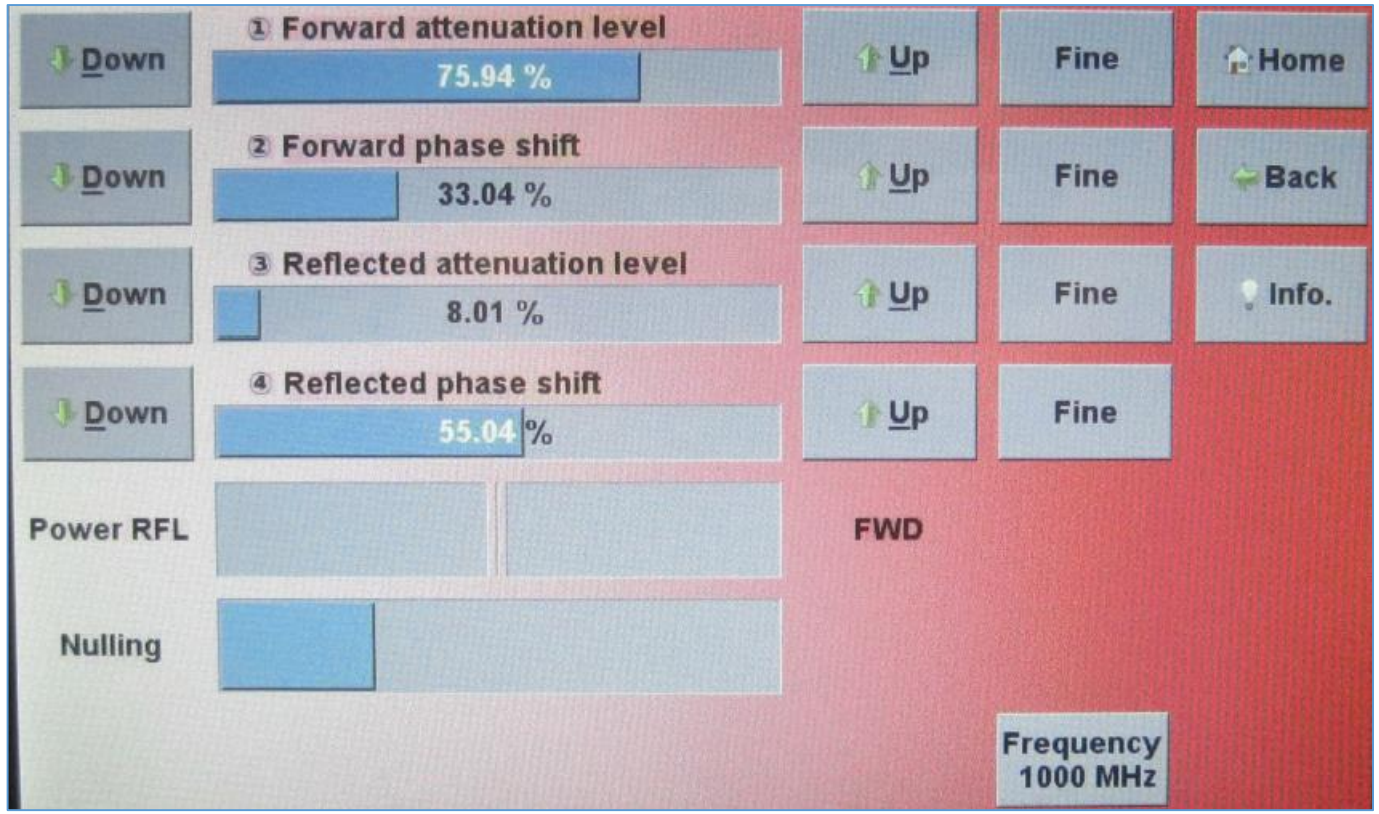
Hardware Design



Touchscreen control



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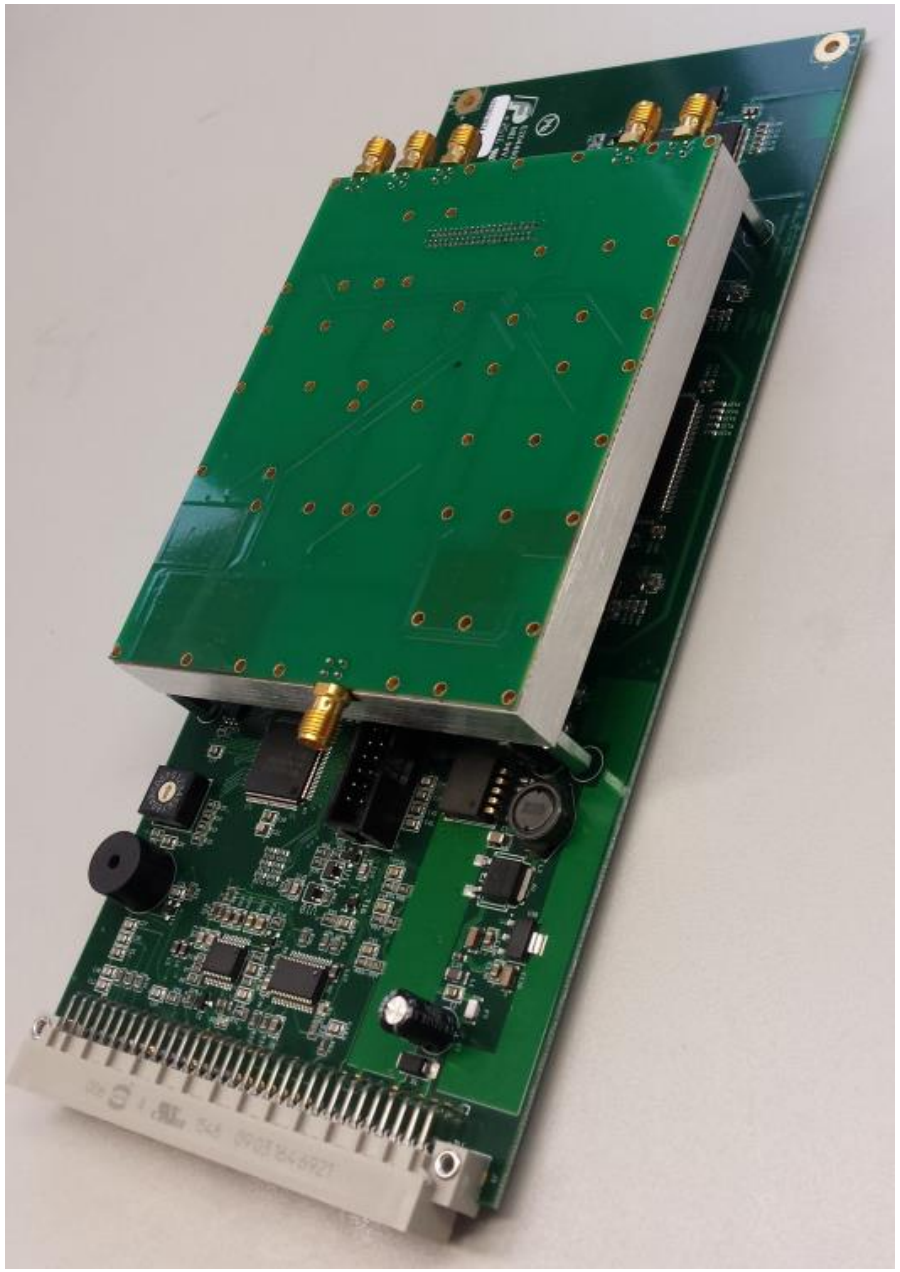

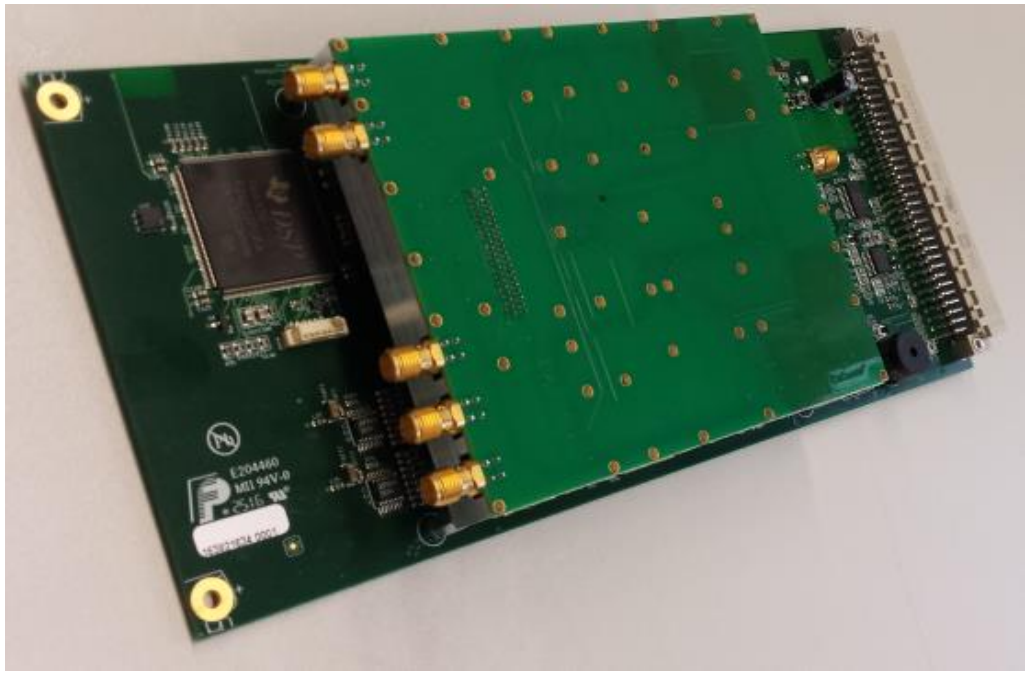

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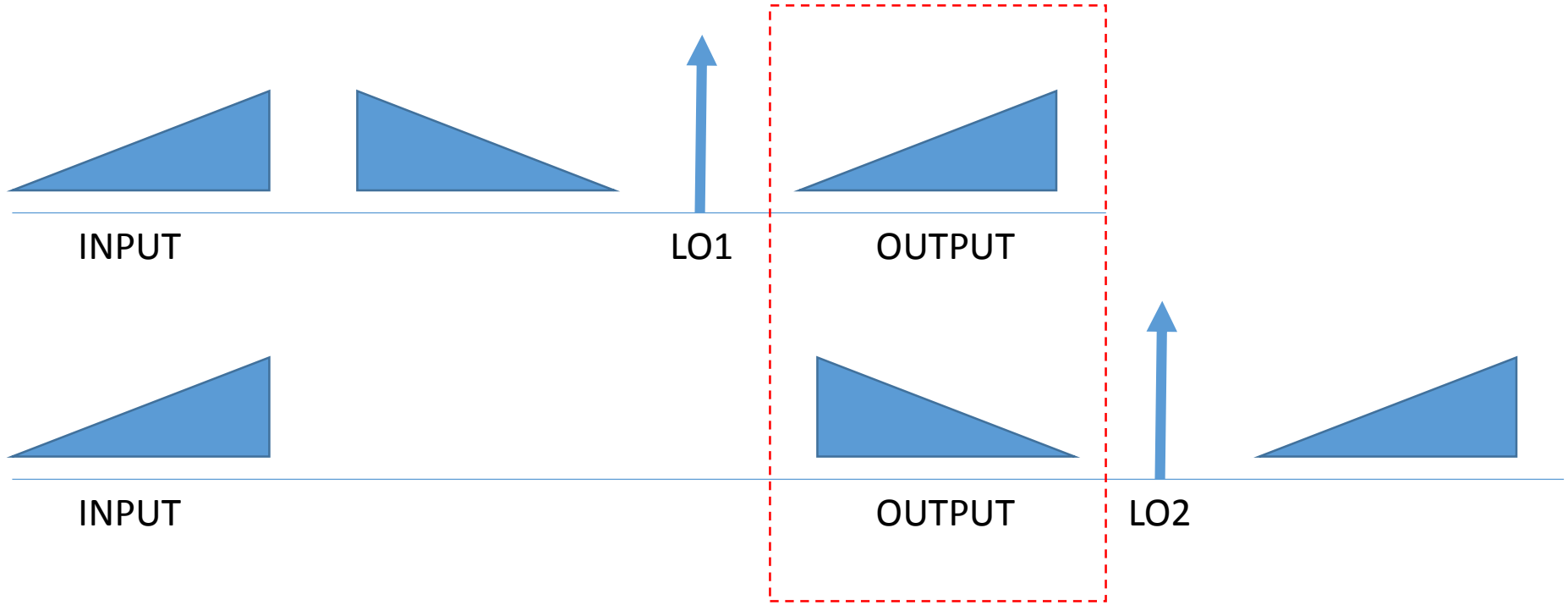
Frequency conversion considerations

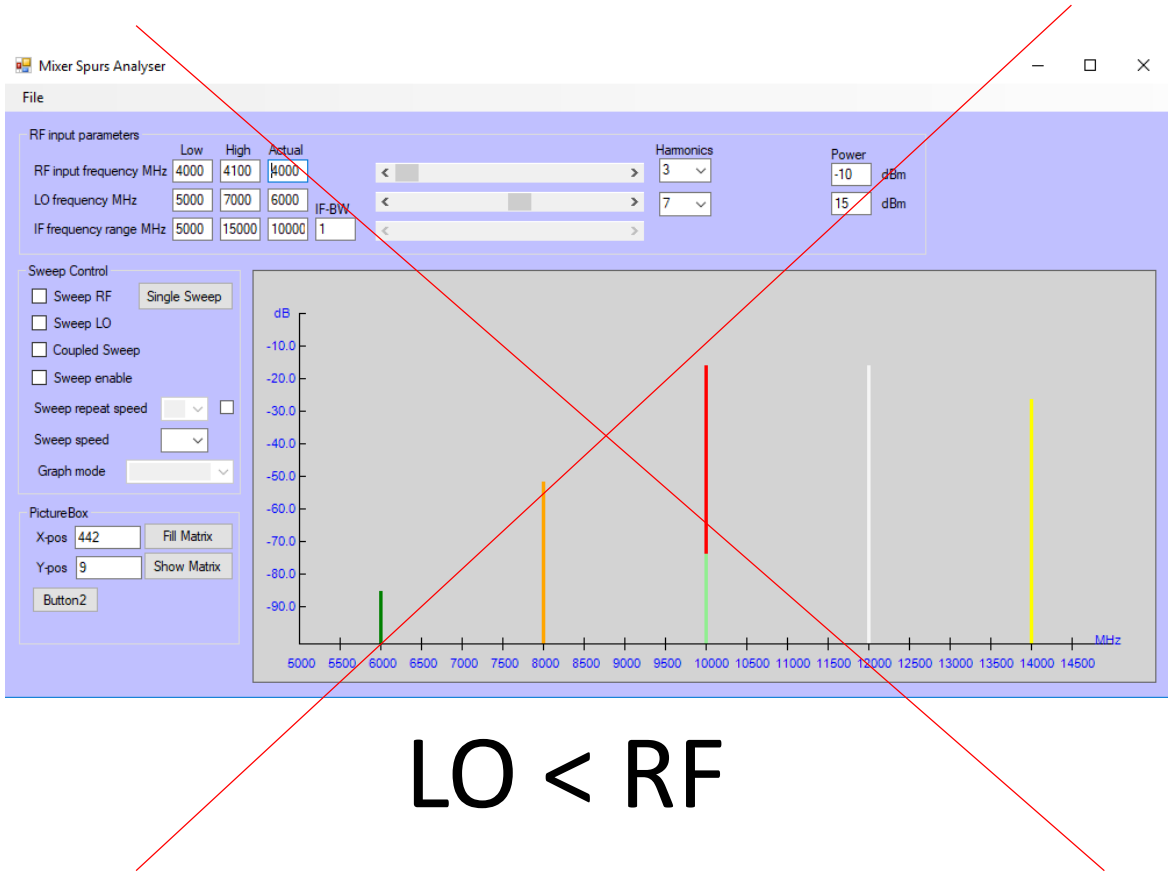
- Take care of ***spurious responses*** when mixing
- Converting 22-28 GHz down to 1-6 GHz in two steps
  - 22 to 28 GHz down to 10GHz first IF
  - 32 to 38 GHz LO
- Nulling system fixed to frequency 4 GHz

A good Broad Band Mixing rule

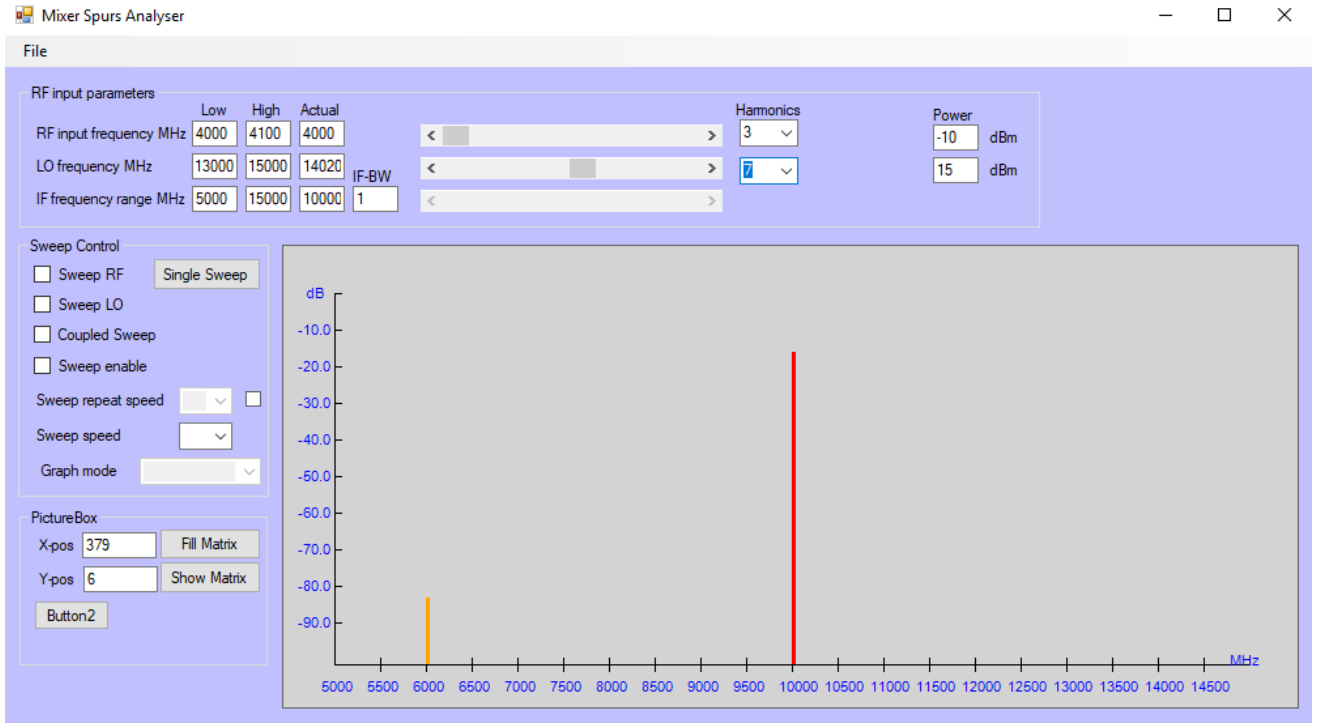
- Place the LOCAL OSCILLATOR above the target frequency
- Select the ***LOWER*** SIDEBAND



Convert 4 GHz to 10 GHz, 1st IF



LO < RF



LO > RF

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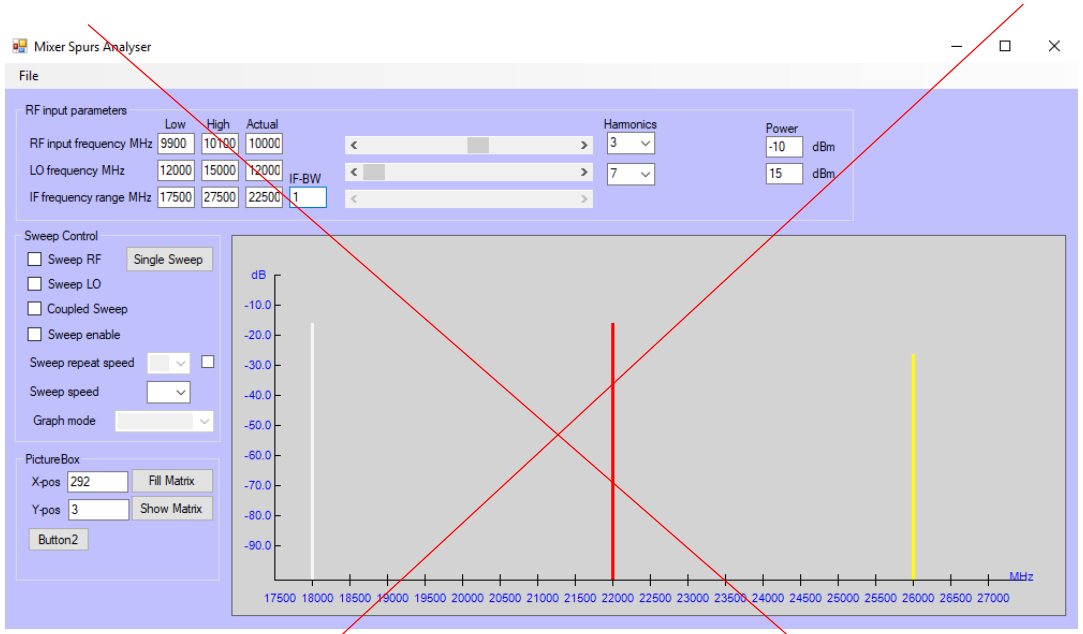
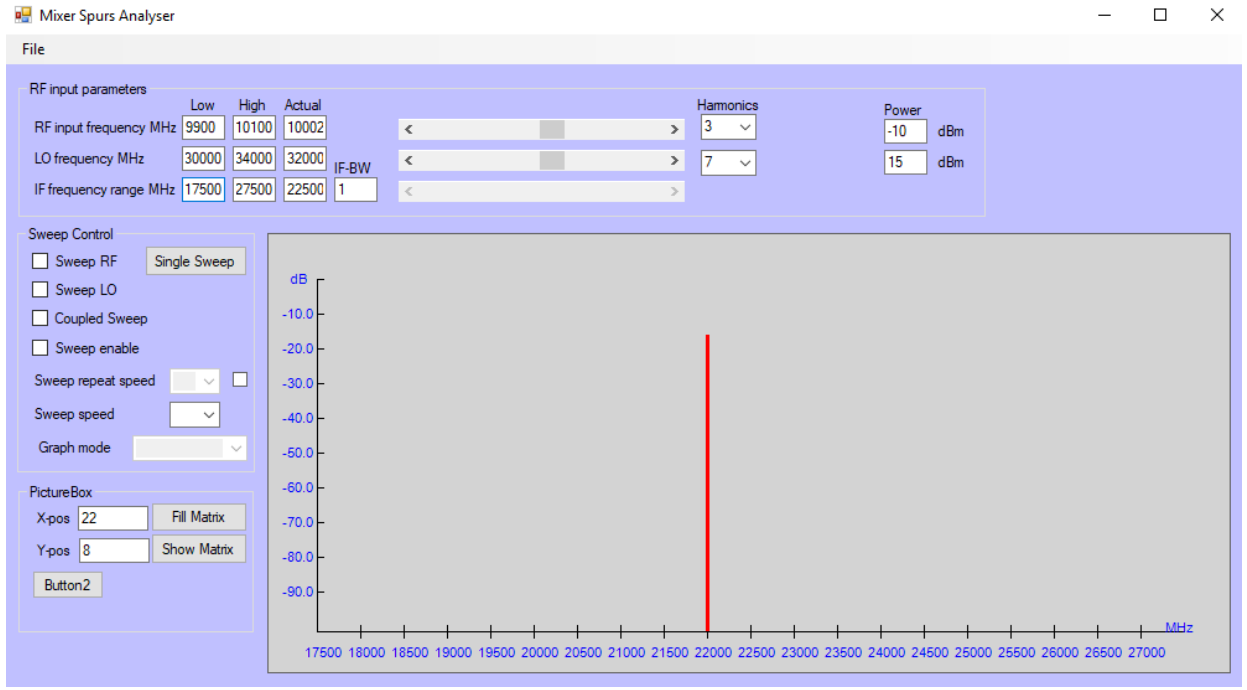
Convert 10G 1st IF to 25G



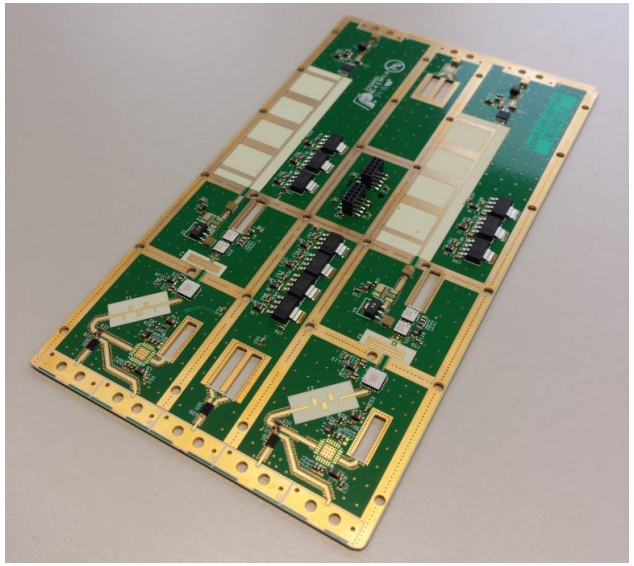
LO < RF

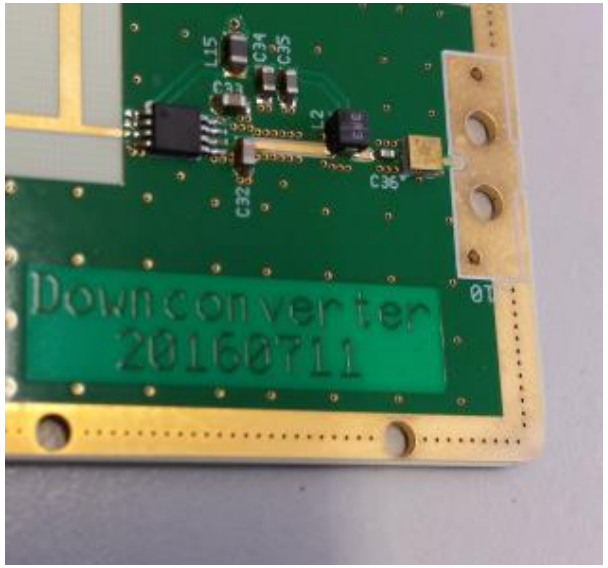


LO > RF

Extended Frequency Ranges

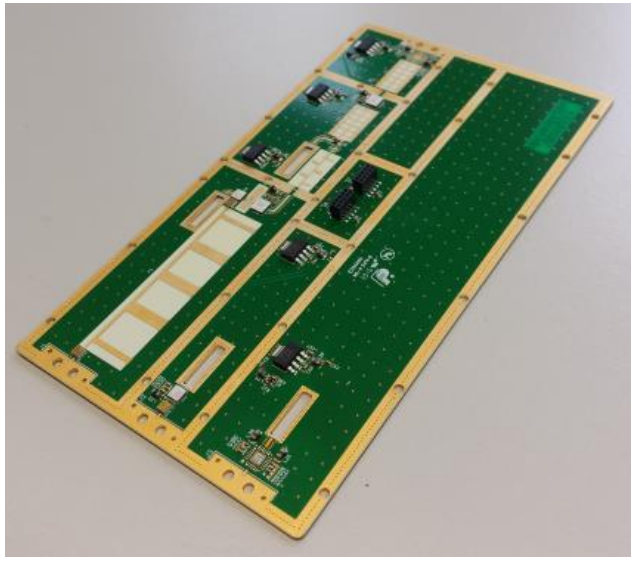
- K band Nulling Down-Converter
  - Coherent down-conversion of both nulling channels from 22-28 GHz to 1-6 GHz





Extended Frequency Ranges

- K band modulator up-converter
  - Up Conversion to 22-28 GHz



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Questions?

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Ing. Onno de Meijer