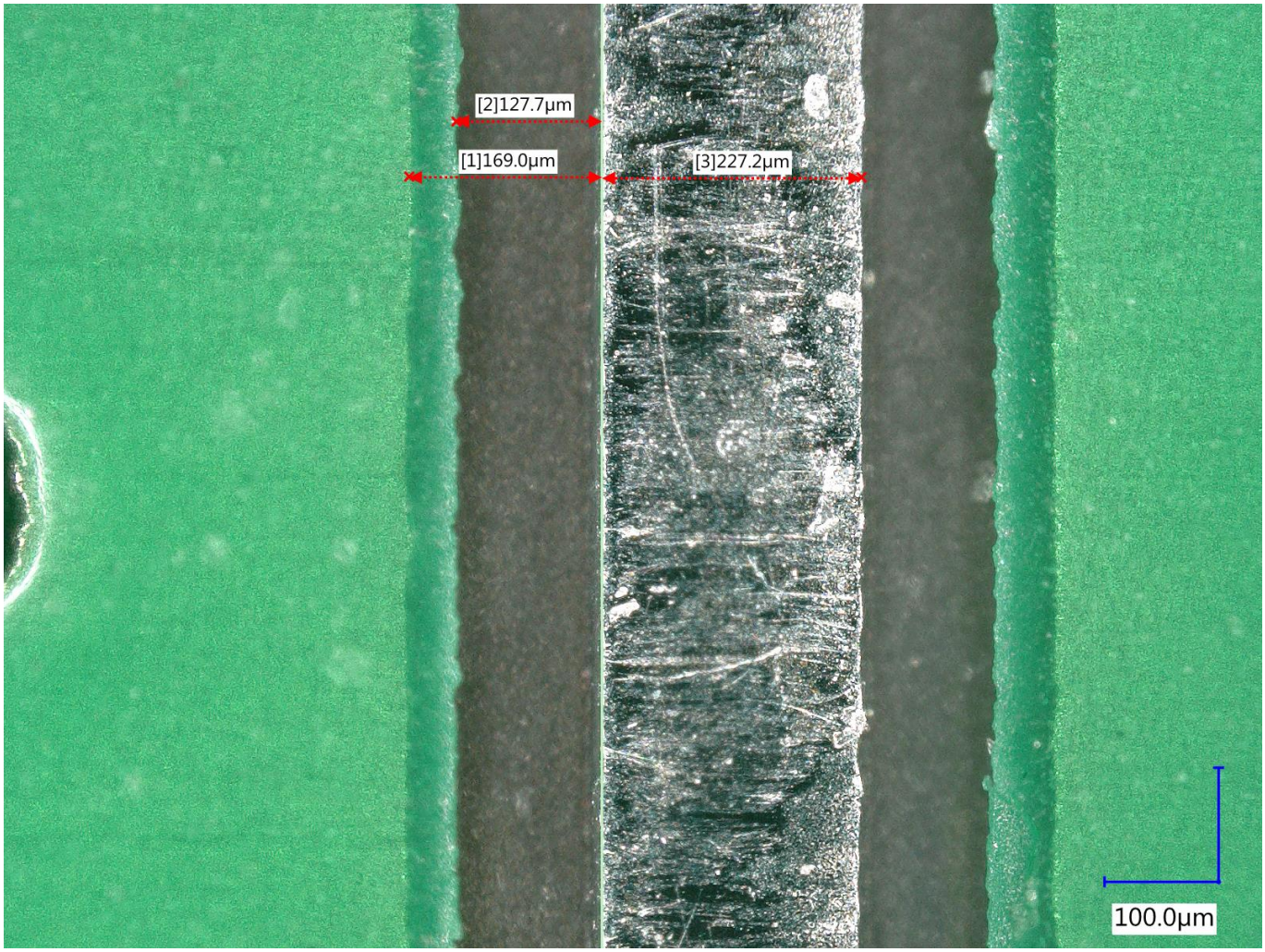
Measurements of JLC7628 RF test PCBs

Pretext: For the 10 GHz transverter board, an eyeballed test PCB was grossly off. SMA-MS transitions did not work usefully at all at RF, with return loss hitting >-10dB at 3 GHz already. Though 'good quality' SMA connectors were used, their large PTFE dielectric diamater on the PCB interface presents a major problem when the top and reference layer are spaced only 0.18 mm.

Optical Measurements

Some images were taken checking the quality of the various process steps of the JLCPCB process. Typical measurements obtained are summarized in one picture as below:



The expected characteristics for this geometry were:

- Soldermask ends on ground plane
- Width of tranmission line: 240 um
- Spacing to ground plane: 150 um

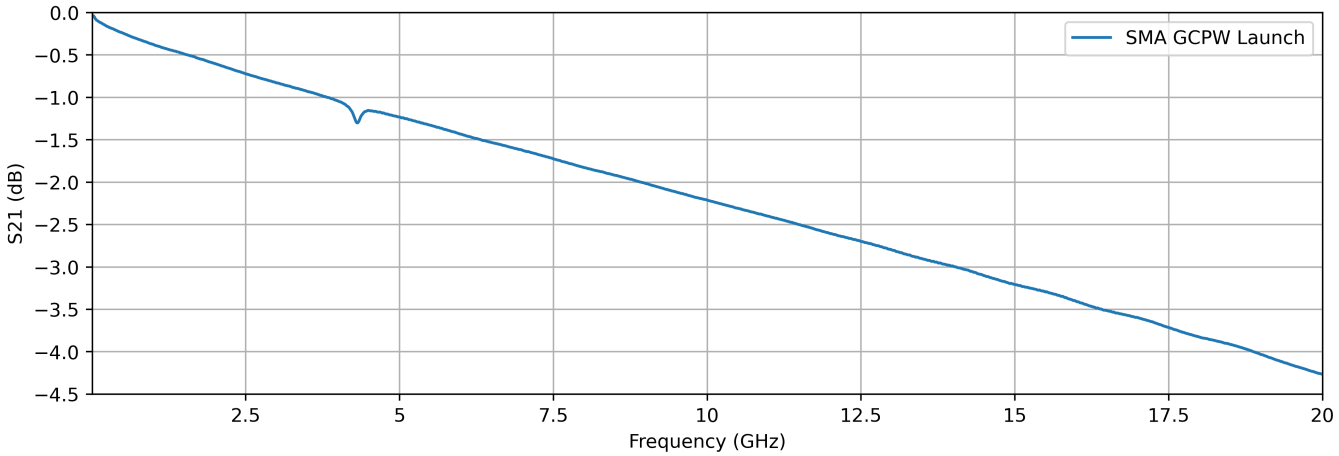
The PCBs measured tend to be slightly overetched, which decreases metal line width and increases gap width. However, it can not be said with confidence how this varies over batches. The soldermask tends to slightly enlarge around its nominal dimensions, but is generally well aligned.

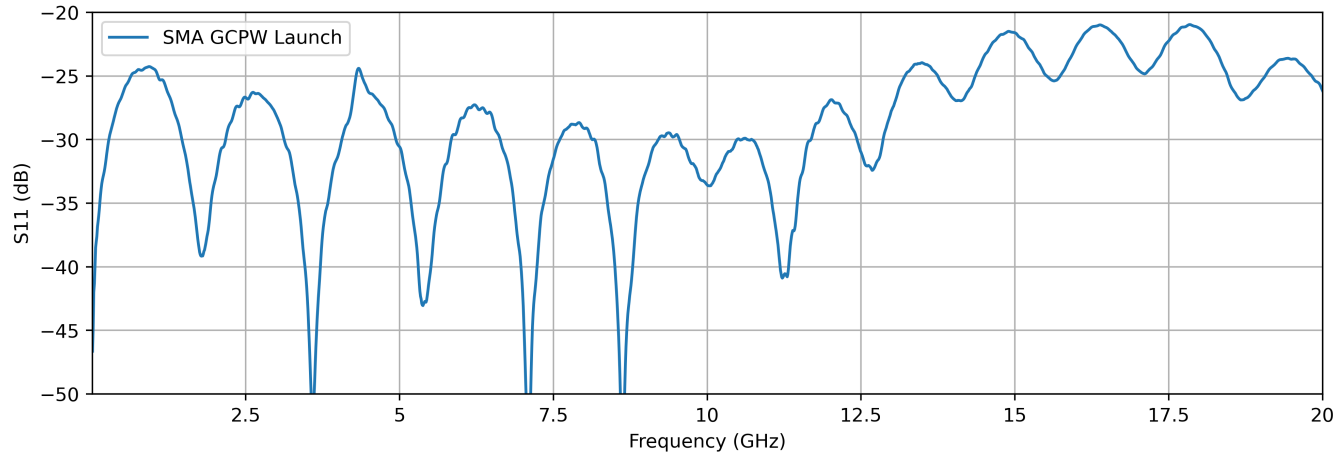
SMA launch into GCPW

The first structure to measure is the SMA launch to grounded coplanar waveguide. Return loss is rather good, reaching a worst case around -30 dB in the 10 GHz area, and degrading not further than -20 dB up to 20 GHz.

Loss at 11 GHz was predicted to be 1.5 dB with one SMA connector, while it measures around 2.5 dB instead. This increase likely stems from optimistic loss tangents in simulations as well as a second connector being present. For calculations, a value of 0.5 dB/cm still is reasonable.

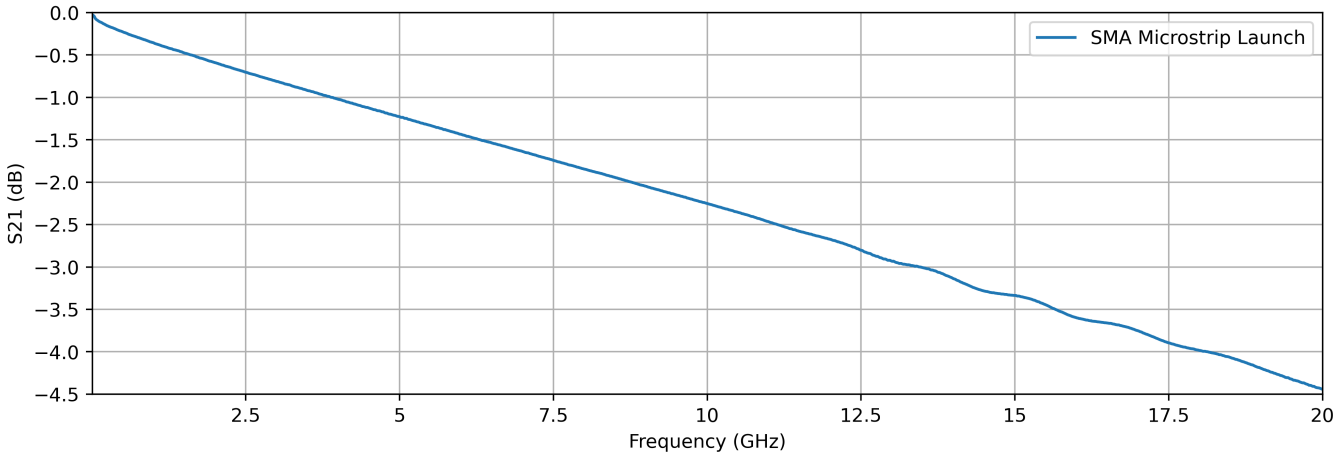
The only other notable feature is a minor (0.2 dB) notch around 4 GHz - most likely caused by excitation of a substrate mode in the FR4 core, something that could be mitigated by ground plane cutting in the lower layers.

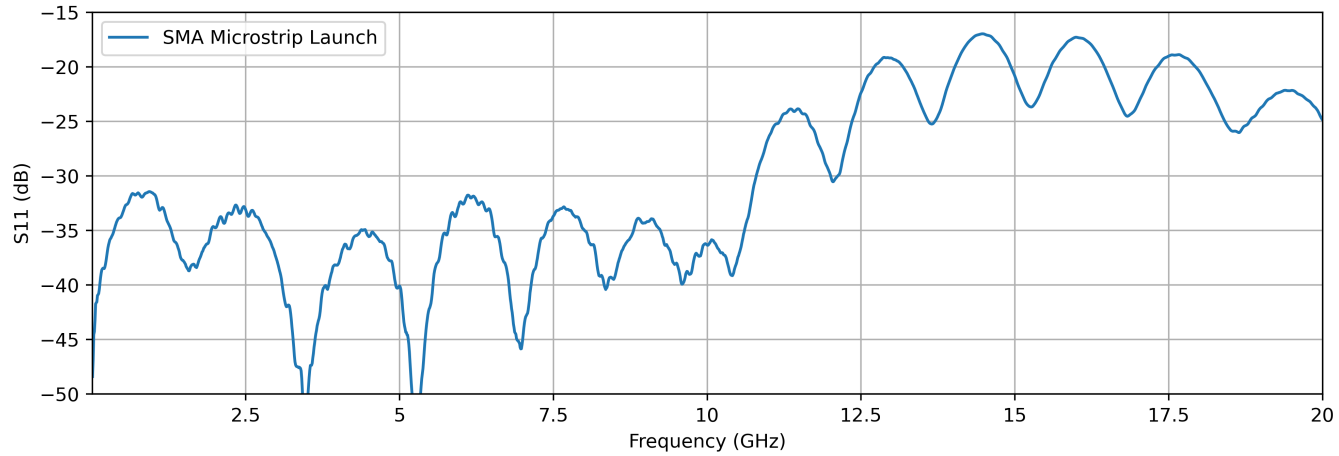




SMA launch into Microstrip

The SMA microstrip transition appears to be similarly well-behaved, with return loss below -30 dB up to 11 GHz. Beyond that, return loss slightly degrades, but not further than -15 dB. Insertion loss is virtually identivally to the GCPW, 0.5 dB/cm can be used for realistic calculations.

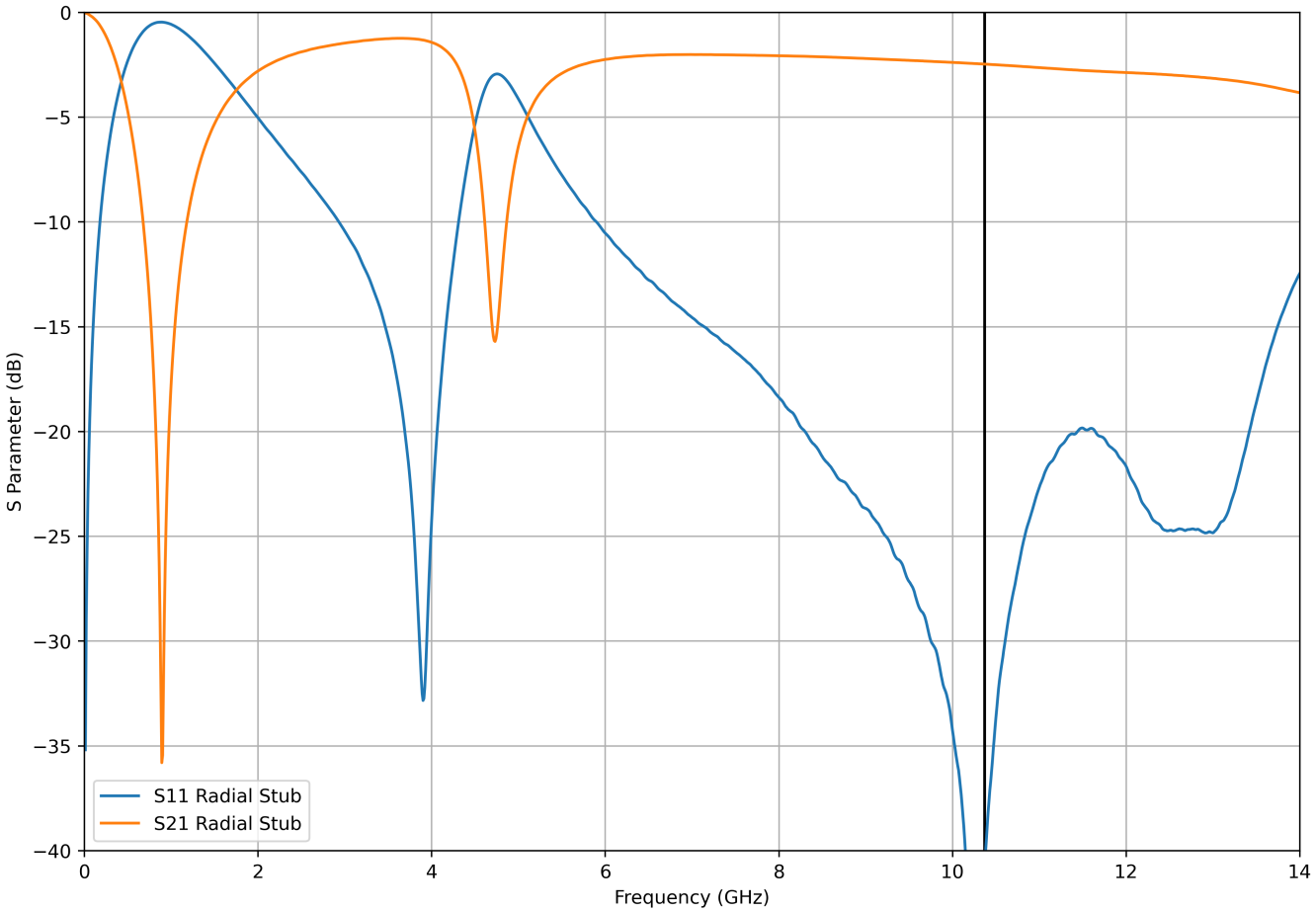




Microstrip with Radial Stub

The radial stub designed for 10.368 MHz was measured as well, as it is a nice structure to establish correct electrical length of printed circuits (and therefore errors in relative permittivity).

The deviation from its design resonance frequency is only slightly less than 1%, which can be considered very good for a low-cost FR4 PCB.


0
−5
−10
−15
−20
−25
−30
−35
−40
S Parameter (dB)
0
2
4
6
8
10
12
14
Frequency (GHz)
S11 Radial Stub
S21 Radial Stub