

Probe Contact Solutions for WLCSP RF Applications



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Introduction:

- RF devices are the core of wireless connections, and it is heavily used by mobile phone. The typical RF module in a mobile phone including antenna tuner, antenna switch, Antenna Switch multiplexer, Diplexer, filter (such as SAW, BAW, FBAR), PA power amplifier and low noise amplifier LNA. 5G is driving this to be stronger and stronger. We are starting put more and more channel into one device, and this makes the signal intrusion from adjacent channels becomes more and more servant.

Materials & Method:

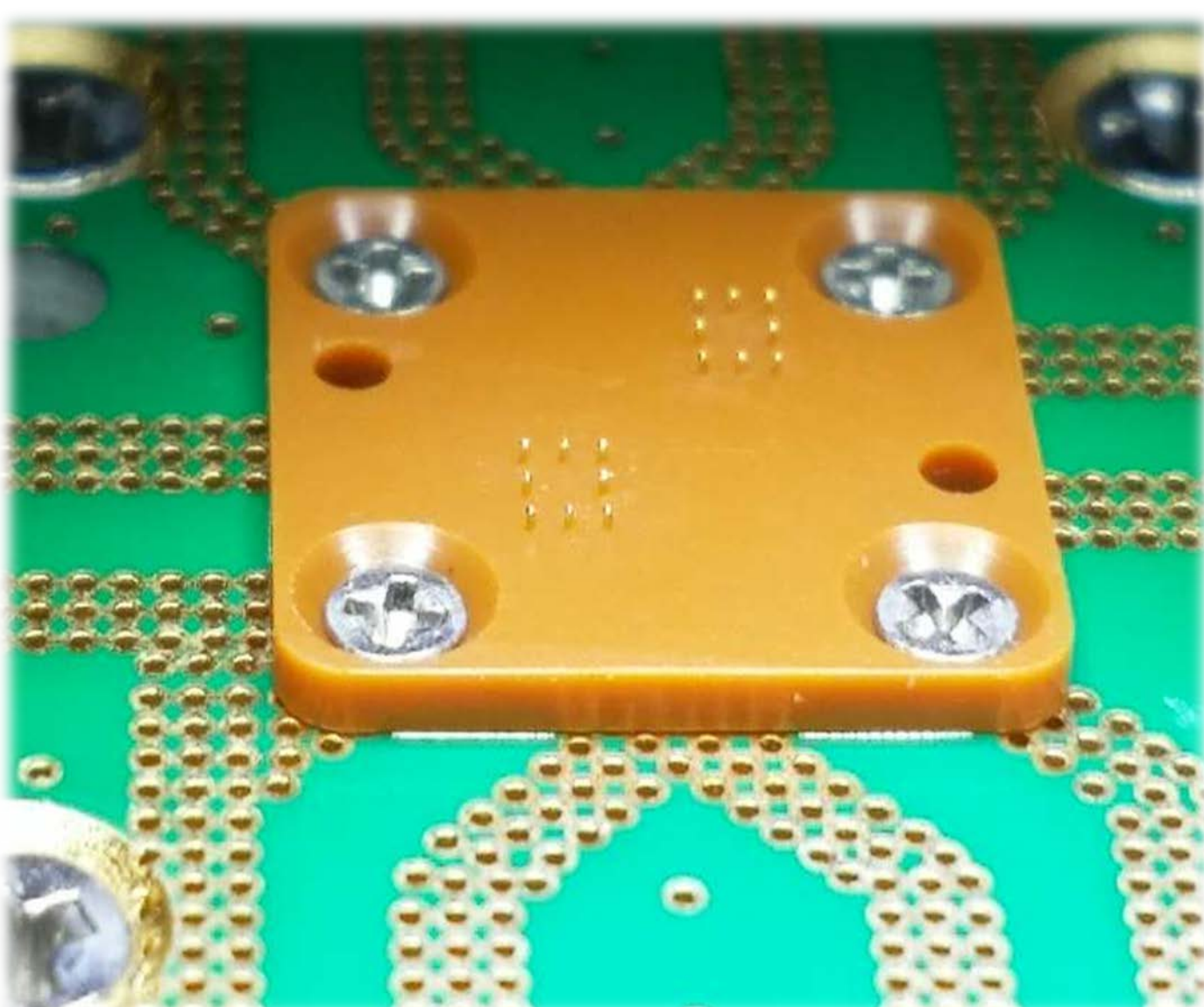
■ Challenges

- Previous probe head is using the spring pin is too long, and the isolation is sometime not meet the expectation especial for RF filter device which is very sensitive to the inductance of the contactors.
- The other solution is using flex PCB board and Pyramid bump. It is very good for signal integrity control. However on the contrary it require much work on the planarity adjust of the prober and so does the probe card, setup and etc.

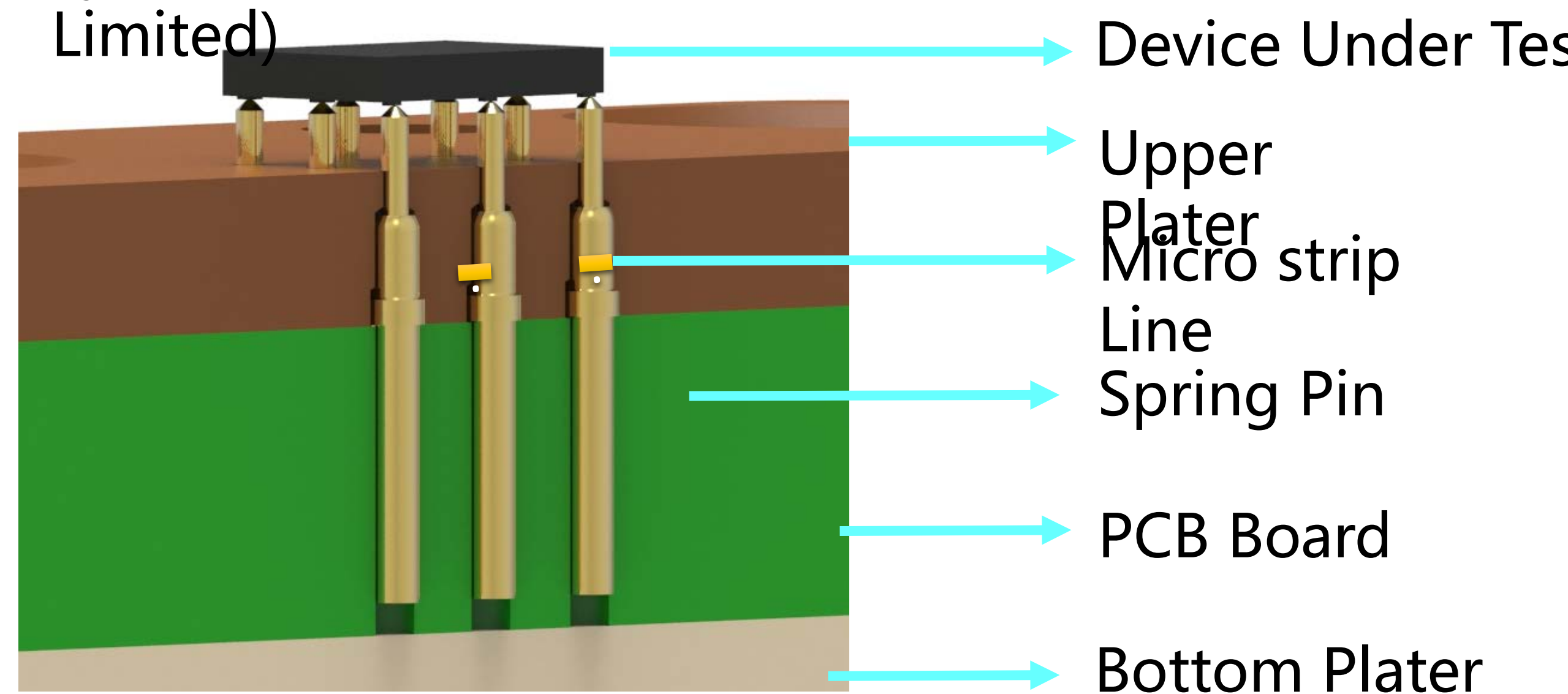
■ Solutions

- New concept of the probe head put the normal spring pin reverse direction and insert it into the PCB board. Since the bottom plunger is much smaller compare with the spring pin body, so it have a better isolation performance compare with the normal spring pin even the pin length is 1.72mm length. In this case, the bottom plunger diameter is 0.16mm, and the spring pin body diameter is 0.30mm under 500um pitch.
- Advantages of this solutions:
 - Spring pin with spring in the bottom this provide a longer over drive which is nearly 200um to 300um. It is easily to leverage the planarity issue cause by the installation, and short the significant setup time for the prober.
 - Bottom spring can provide enough contact force unlike the very short spring pin, this makes the contact more robust and firmly. This is essential for RF testing as well.
 - A smaller diameter and short length of the plunger decrease the cross talk significantly.
 - Combination of the spring pin and PCB board short the signal trace also contribute to the signal performance.
 - Spring pin is much easier for future maintenance and replacement.

Probe Head Photo

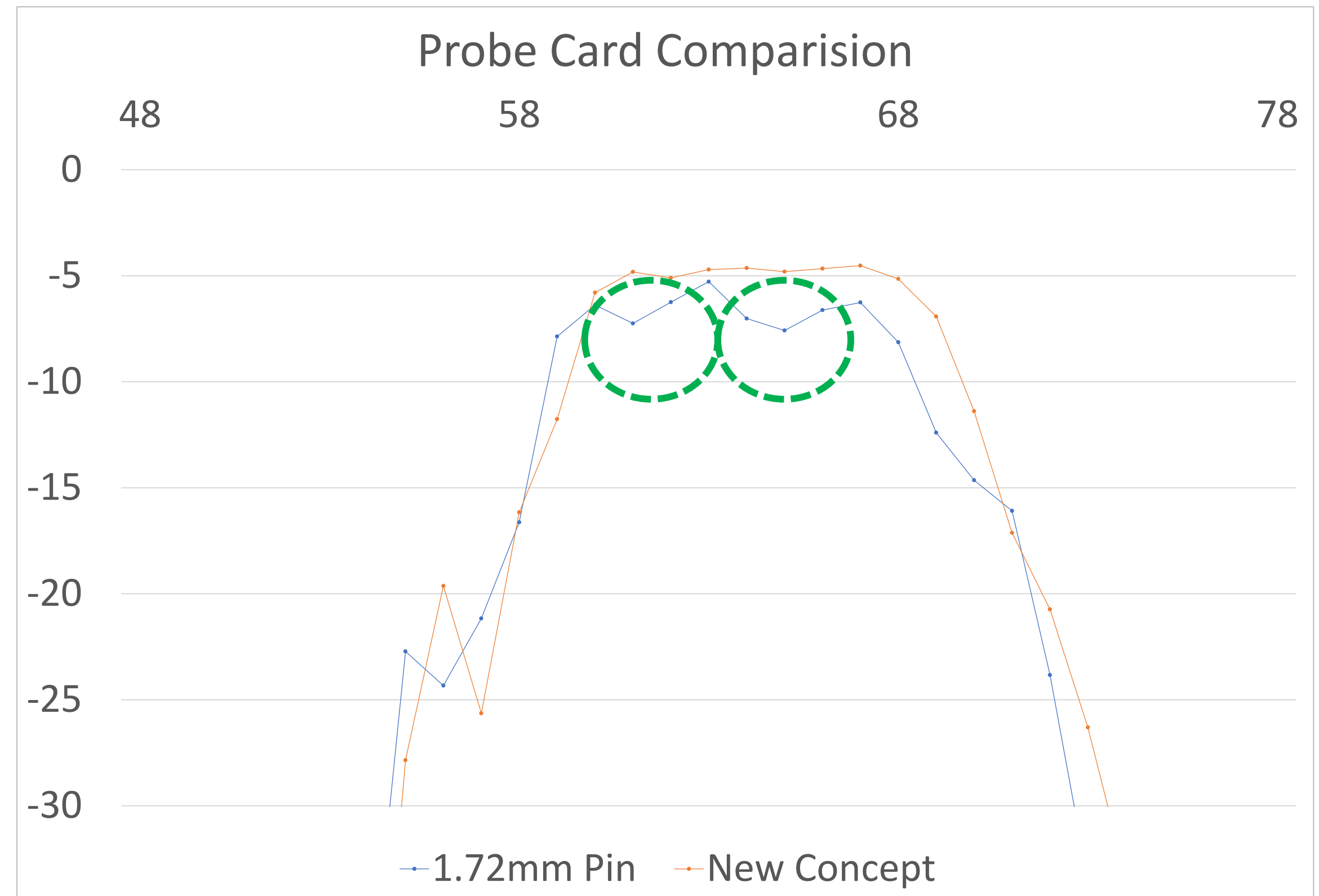
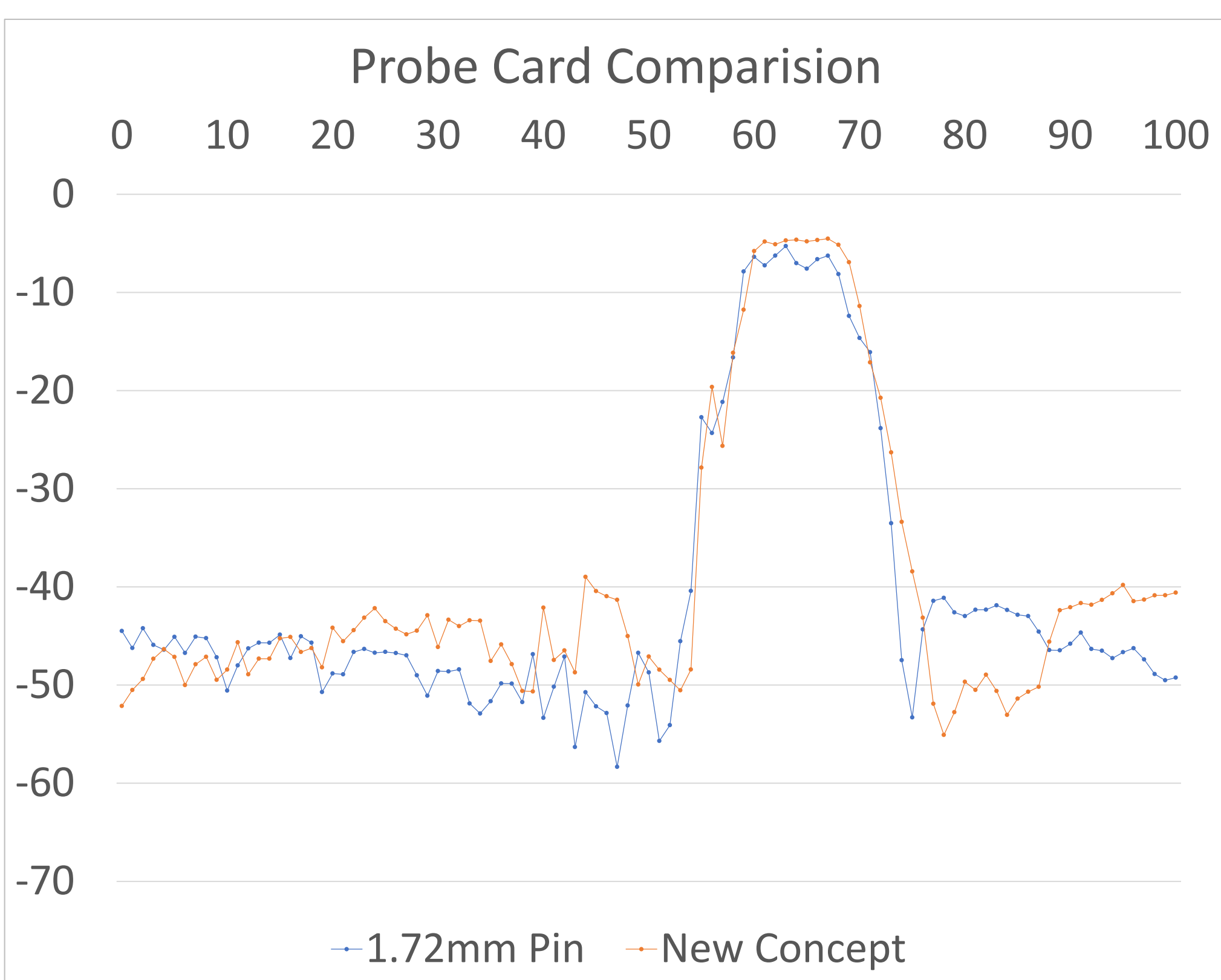
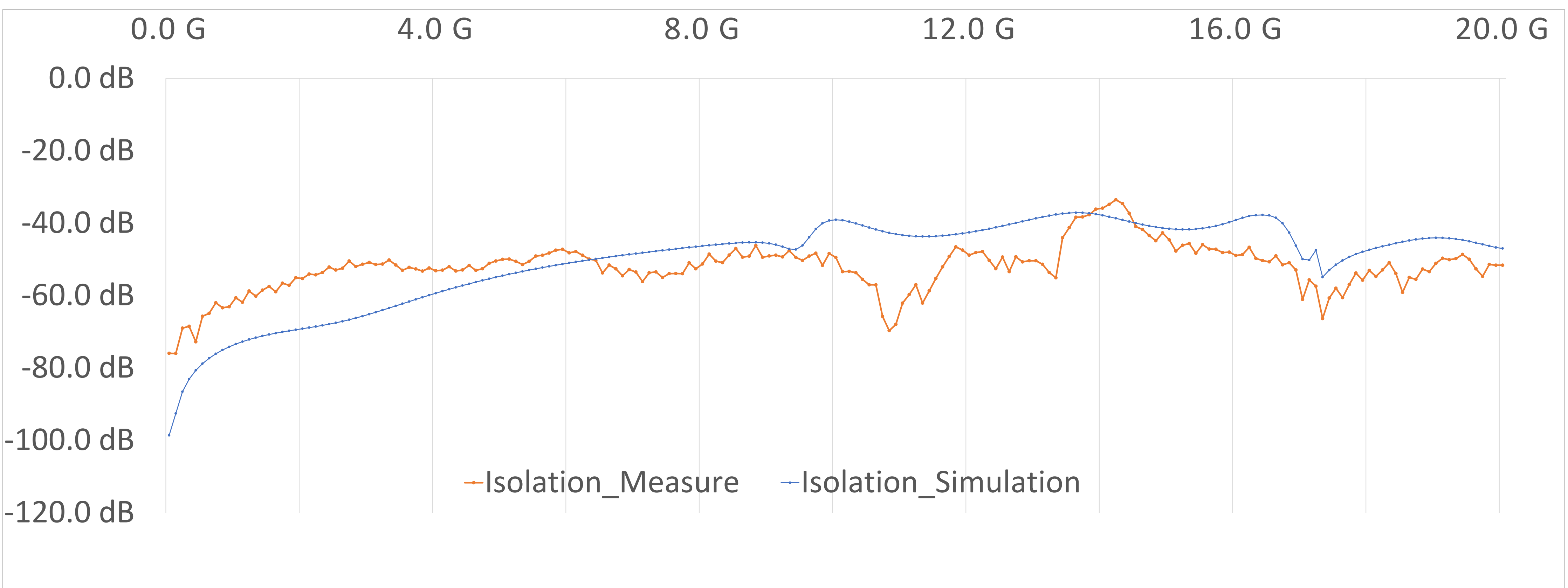
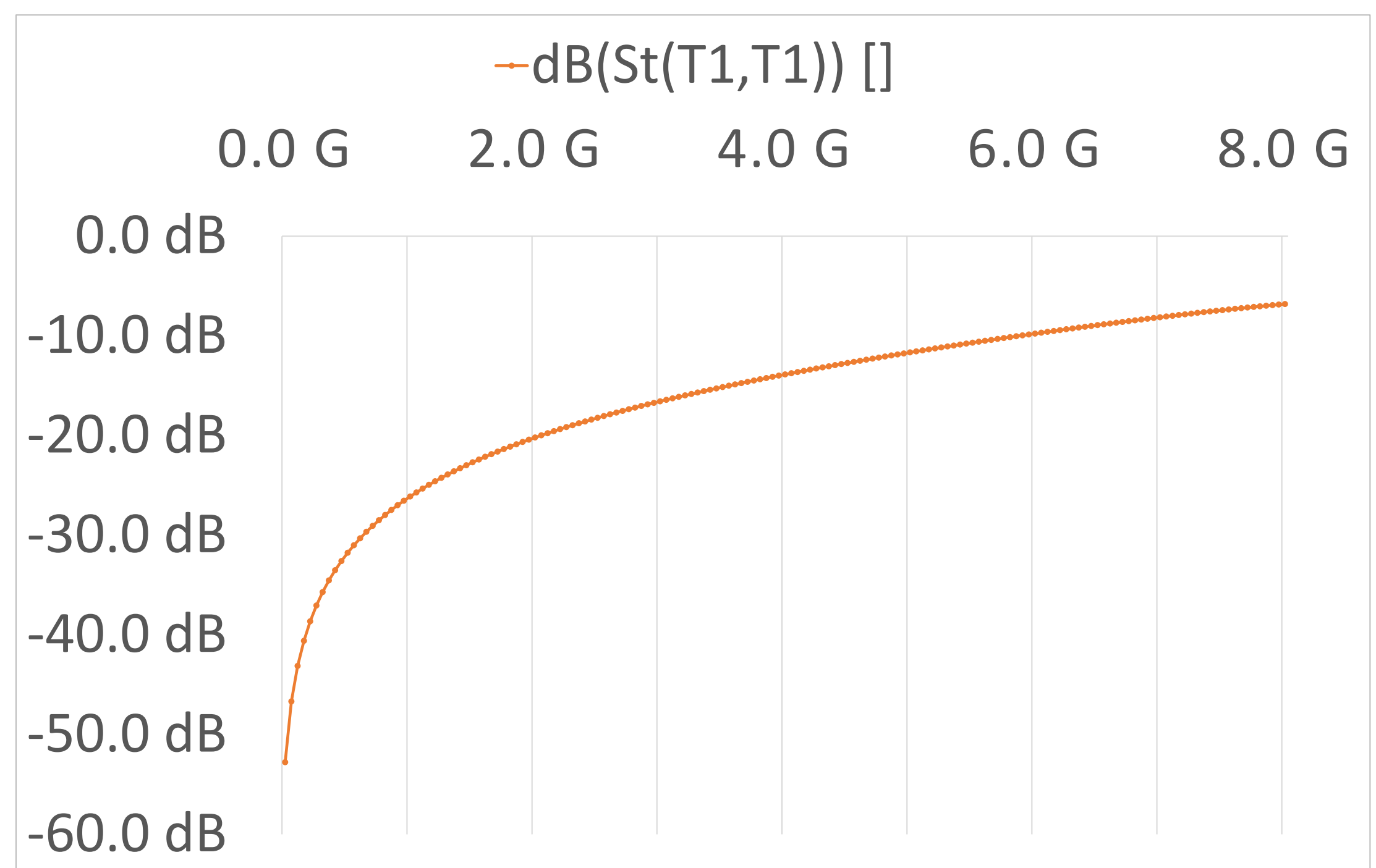
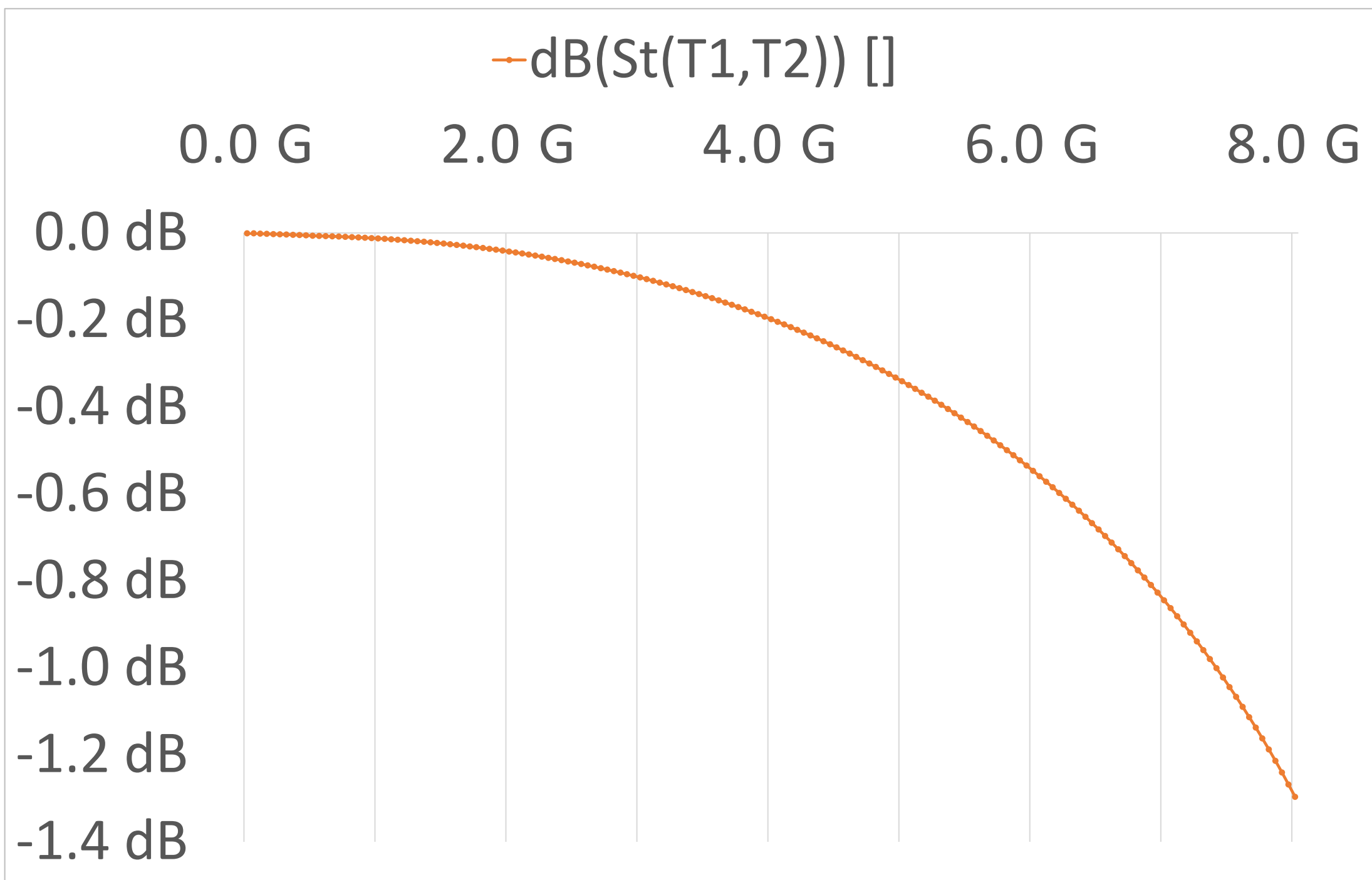


Typical Structure (Not Limited)



Results:

- S-Parameter of probe head
- Isolation of probe head Vs. measurement
- Testing result comparison (1.72mm Vs. embedded pin)

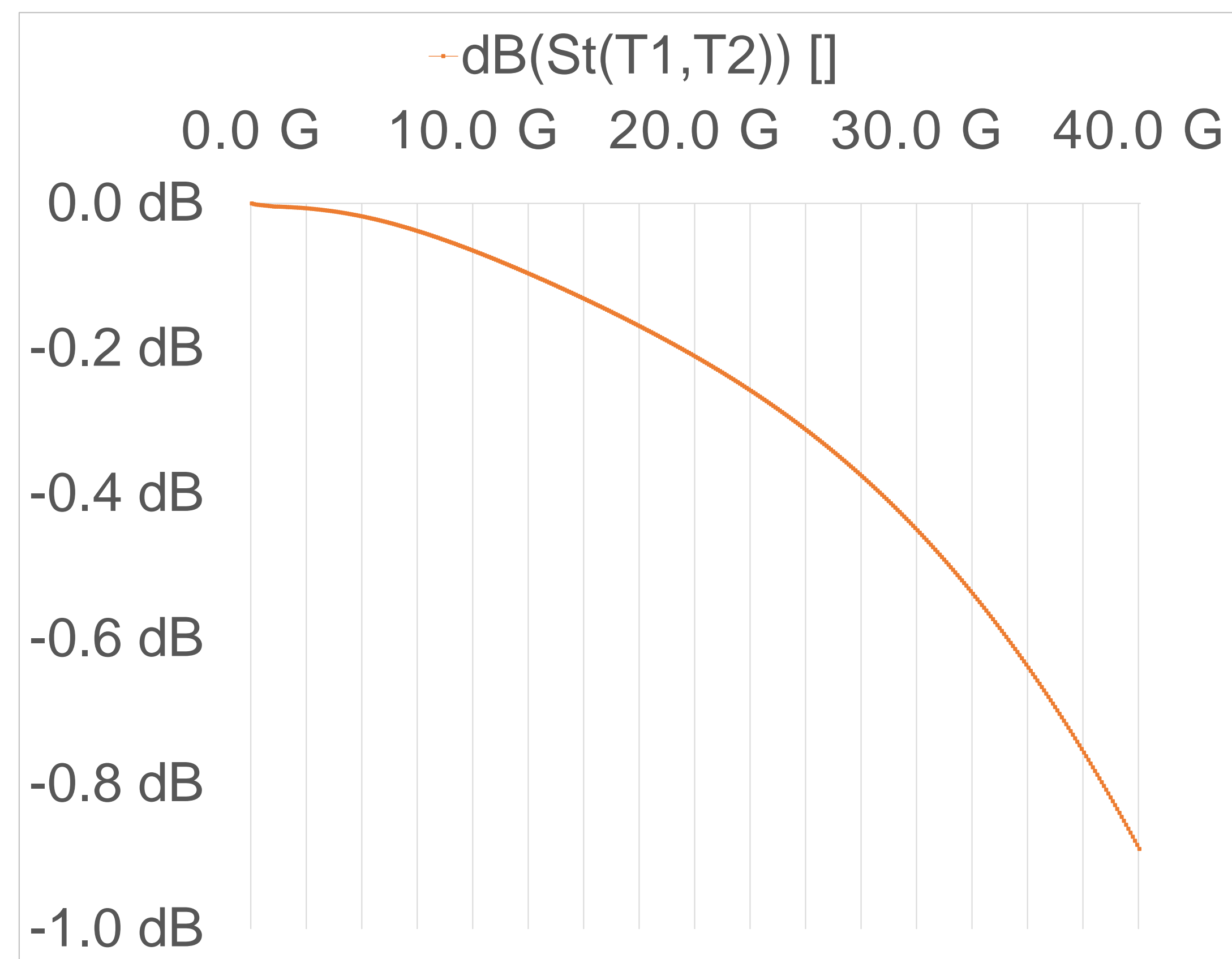
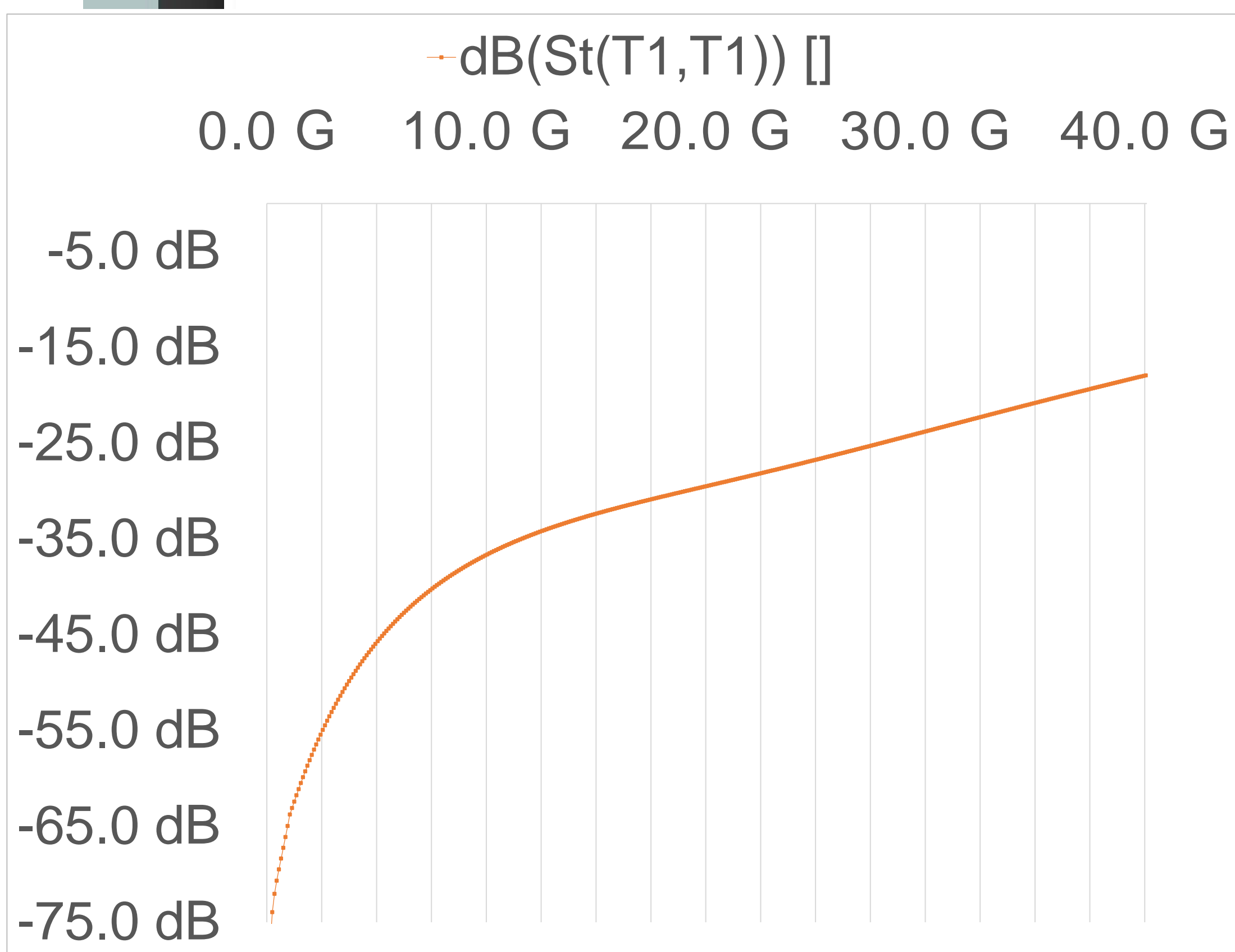
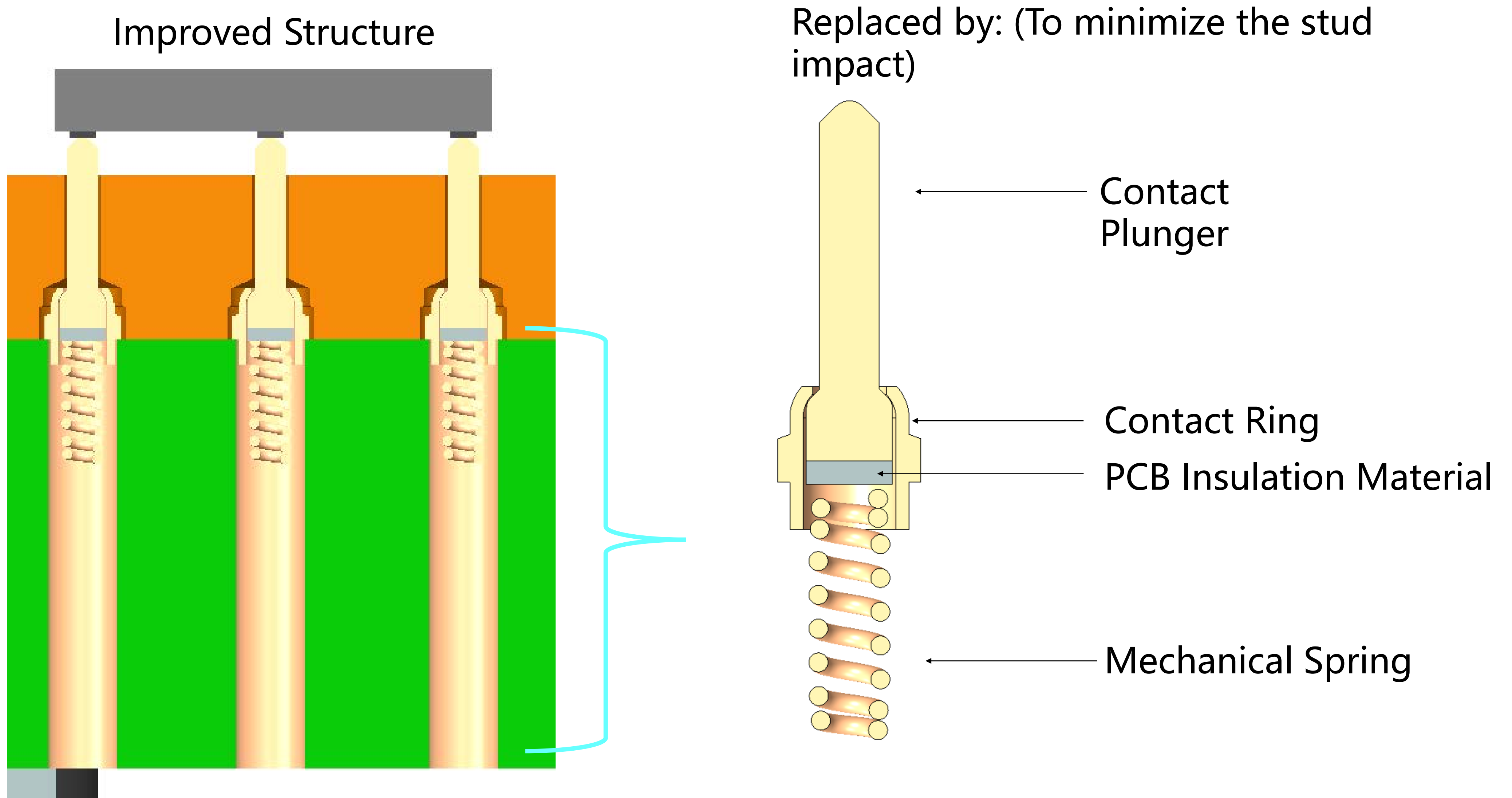


Discussion:

- By using existing spring pin, since the dimension and the design is not best fit to the application. We can see a good improvement on the isolation, however S11/S12 is not perform very good.
- By replace existing spring pin with a plunger + spring + rubber will improve the S12 significantly.

Discussion:

- Below is the improved structure



Pin Length	0.9mm	0.7mm	0.5mm	0.42mm
Inductance	0.43nH	0.32nH	0.198nH	0.163nH
Capacitance	0.094pF	0.08pF	0.062pF	0.063pF
Impedance	67ohm	63ohm	54ohm	50.9ohm

Conclusions:

- Isolation data by measurement is correlated to the simulation data.
- Embedded pin design improved on the flatness of the pass area.
- Embedded pin design improved the isolation between pass and no go area.

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