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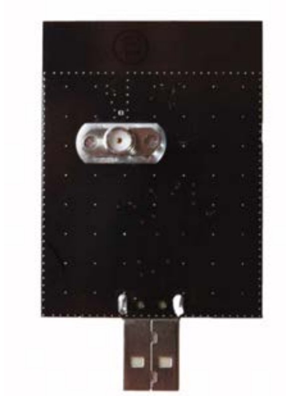
antenna solutions

Front


Back

DTAD.01.A.50

Specification

Patent Pending

Part No.	**DTAD.01.A.50**
Product Name	Compact Evaluation Boards for Evolution DTA.01.A Digital Tunable Antenna for 3G and 4G Cellular Applications
Feature	Complete Reference Design Increases antenna efficiency from ~7% to ~28% Perfect for smaller ground plane sizes down to 50x45 mm Enables better transmission and reception for 3G and 4G USB interface SMA(F) Connector for Antenna Measurement RoHS Compliant

1. Introduction

The DTAD.01.A.50 is an evaluation board for Taoglas new patent pending series of Evolution DTA tunable antennas. DTA antennas deliver higher efficiency on smaller ground-plane than traditional passive antennas, enabling a new miniaturized generation of high performance wireless devices. Typical applications would be 3G On Board Diagnostic (OBDII) Devices in automotive, medical telemetry devices, 4G dongles, access points and routers.

The board contains a surface-mount ceramic antenna DTA.01, a tunable capacitor PE64102 DuNE™ (32 state capacitance) from Peregrine Semiconductor and a matching circuit. Via a USB connection to the board, the antenna frequency response is shifted via a command from a PC with Peregrine supplied software and driver.

The antenna parameters itself can be measured via the on-board SMA connector.

A new generation of M2M devices with as little as a 50mm ground-plane in length can now achieve wide frequency coverage and higher data rates with bandwidth beating any passive antenna in the market with the same footprint and volume.

The DTAD.01.A.50 board (60.50x45mm) with ground plane size of 50x45 mm can perform efficiently at a bandwidth from 698-960 MHz and from 1710-2170 MHz, covering all worldwide cellular 3G/4G bands in a tiny form factor. In combination with your device's microprocessor it has the ability to dynamically improve the efficiency of a given antenna band in real time.

Using a combination of the DTA.01 and the PE64102 we can cover the entire bandwidth for 3G and 4G cellular bands. Using the State 03 (2.58 pF) we can cover the 700/850/1800/1900 and 2100 MHz Band only and with the State 13 (6.52) pF we can cover a penta-band solution 850/900/1800/1900 and 2100 MHz. The optimal states will change depending on the ground-plane, device's board and mechanical environment.

Please download the Peregrine's full set of support information. See our full links in the appendix at the end of the document.

The DTAD01 board with a ground plane of 50x45 mm has not been designed with the intention of passing the cellular carrier's minimum requirements. The integration is to achieve the maximum performance possible in the smallest form factor.

2. Specification

Electrical

State	State 03 (2.58pF)			State 13 (6.52pF)		
Band (MHz)	700	850	900	1800	1900	2100
Return Loss (dB)	-7	-11	-11	-13	-14	-8
Efficiency (%)	26	28	27	60	55	48
Average Gain (dB)	-5.5	-5.3	-5.4	-2.2	-2.8	-2.9
Peak Gain (dBi)	1.3	1.8	1.8	2.5	2.5	2.2
Impedance	50Ω					
Ground Size	50x45 mm					
Board Size	60.50x45 mm					
Radiation Pattern	Omni-Directional					
Input Power	26 dBm max					

Mechanical

Antenna Dimension	40x6x5 mm
Board Dimension	60.50x45x1.57 mm
Weight	20 g
Connector	SMA-Female

* Based 50x45 mm ground plane size, on State 03 and State 13 respectively.

3. Antenna Setup

Figure 1. Impedance Test

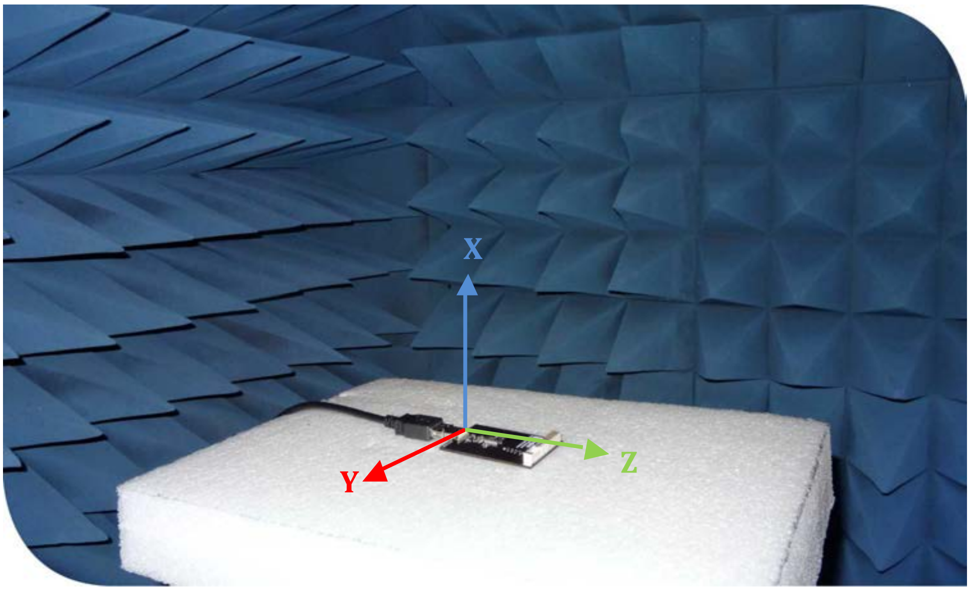


Figure 2. Over the air test

4. Antenna Parameters

4.1 Return Loss

Figure 3. Return Loss of DTA.01

4.2 Efficiency

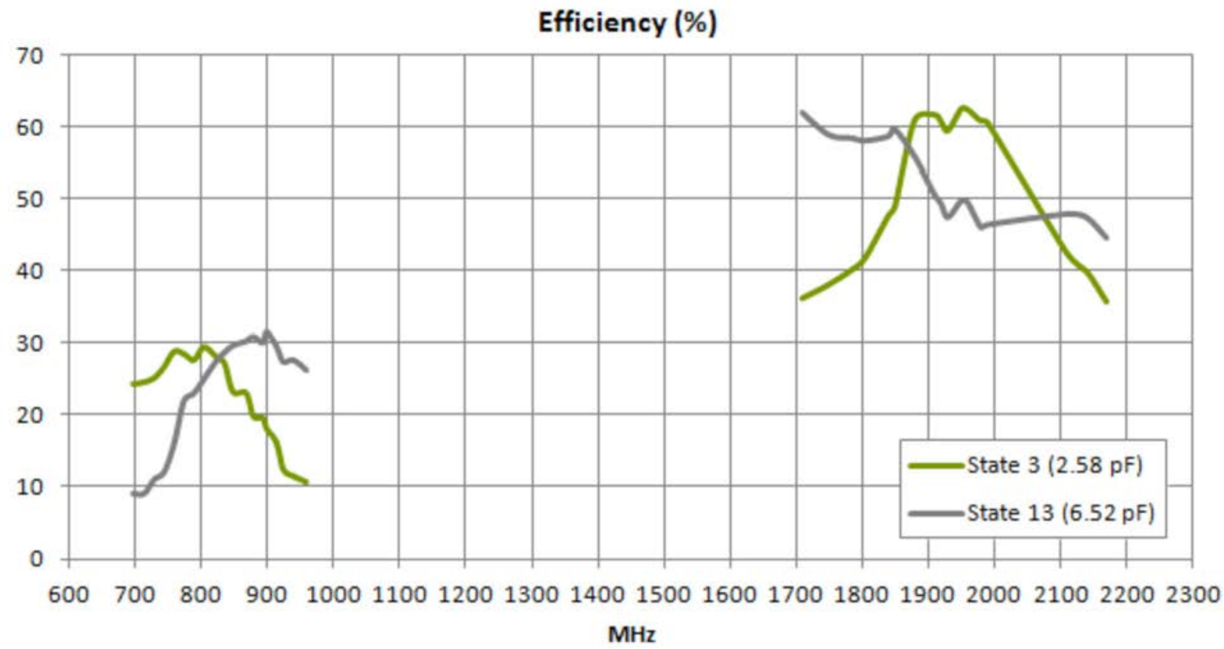


Figure 4. Efficiency of the DTA.01 Antenna

4.3 Peak Gain

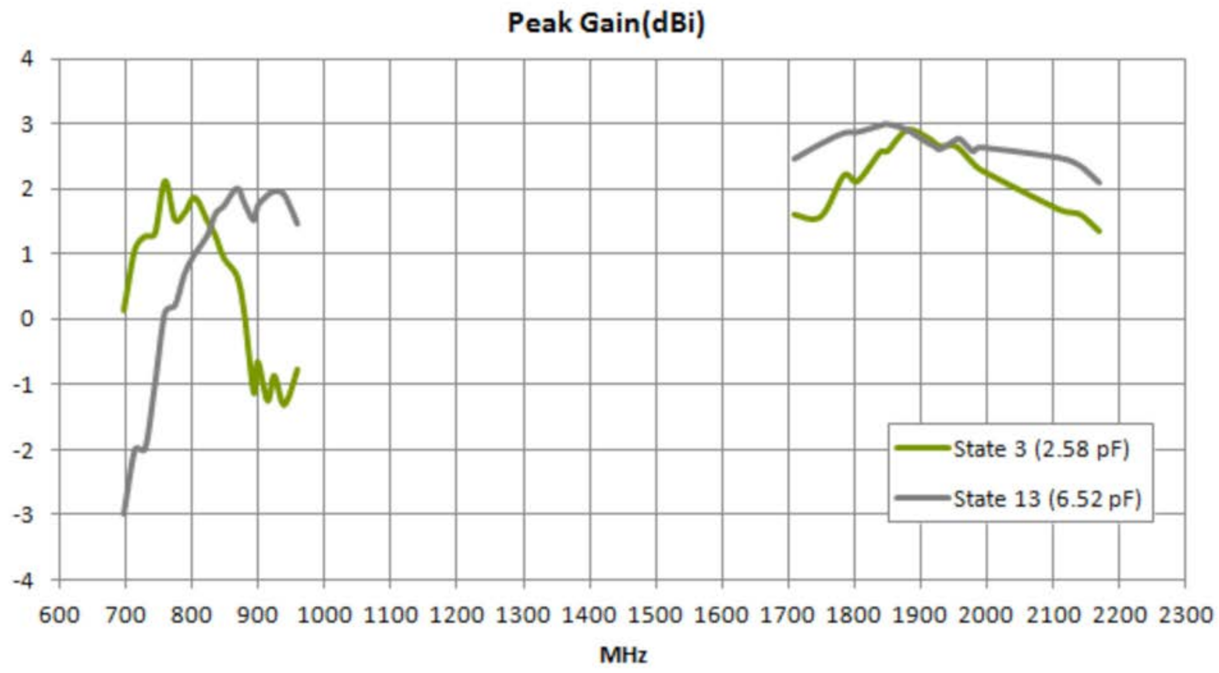


Figure 5. Peak Gain of DTA.01 Antenna

4.4 Average Gain

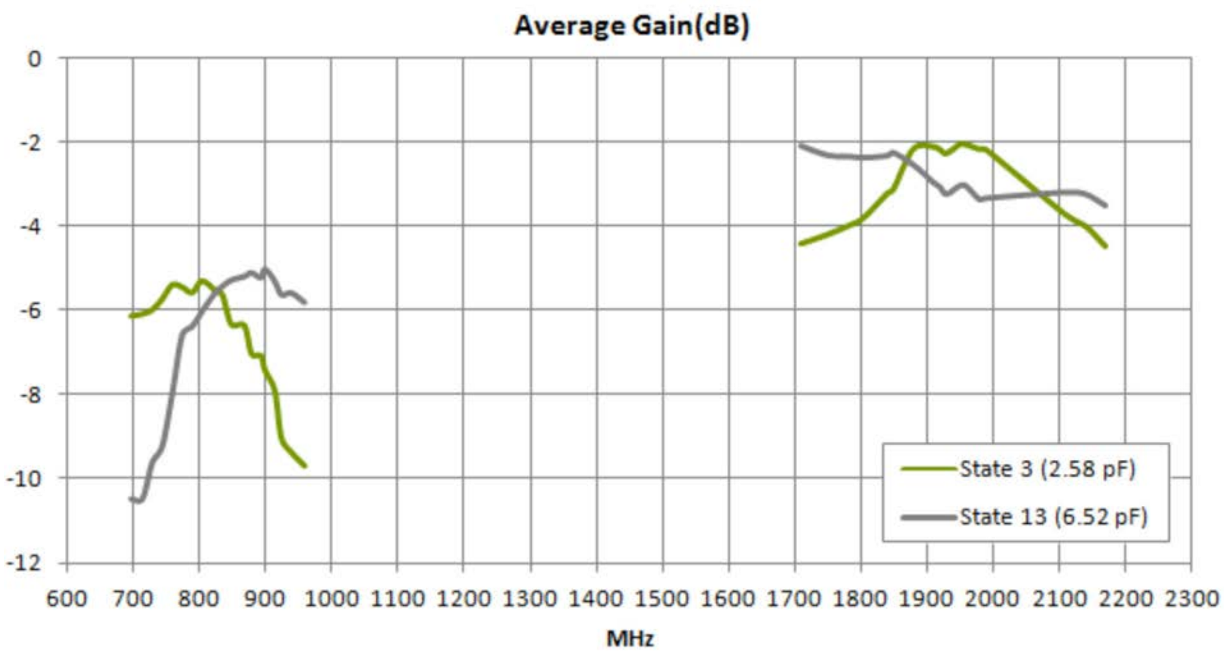


Figure 6. Average Gain of DTA.01 Antenna

5. Comparison Performance

5.1 Return Loss (dB)

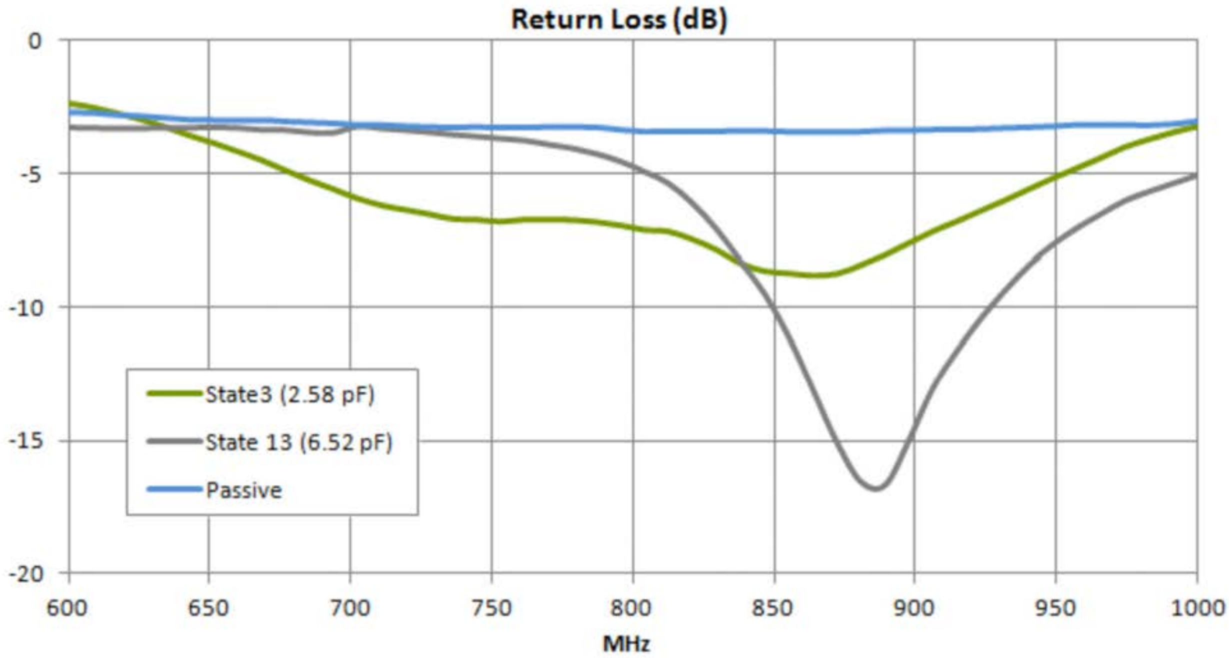


Figure 7. Return Loss Comparison of DTA.01 vs. PA.710 Antenna

5.2 Efficiency (%)

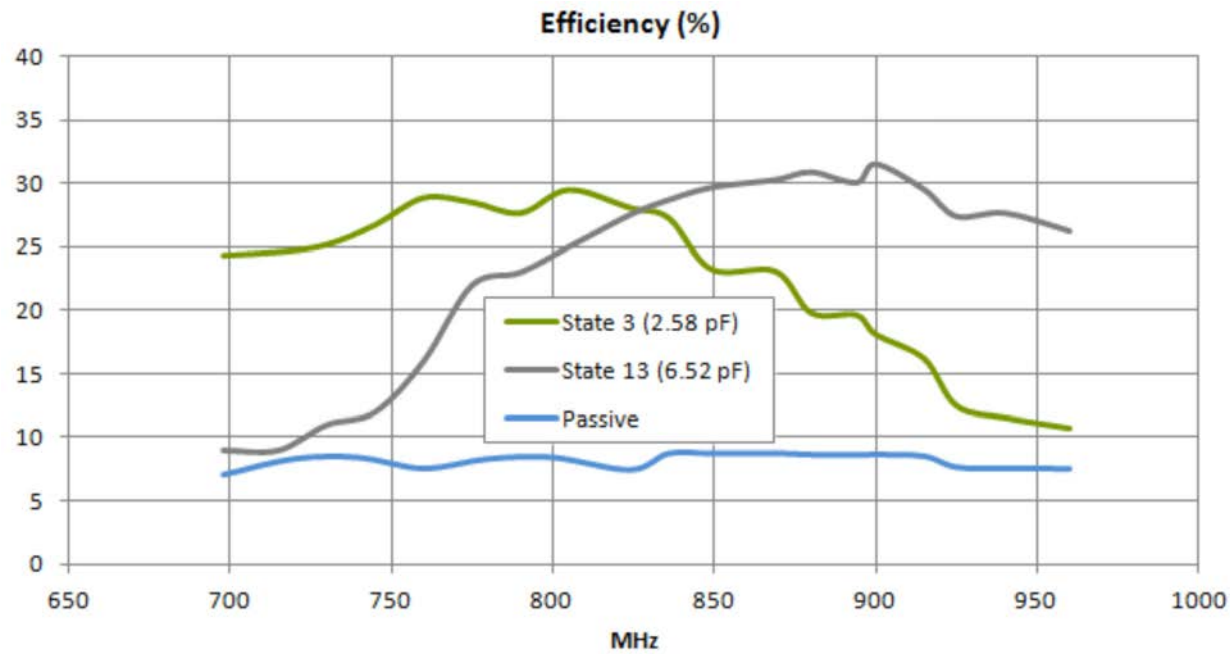


Figure 8. Return Loss Comparison of DTA.01 vs. PA.710 Antenna

6. Antenna Radiation Patterns

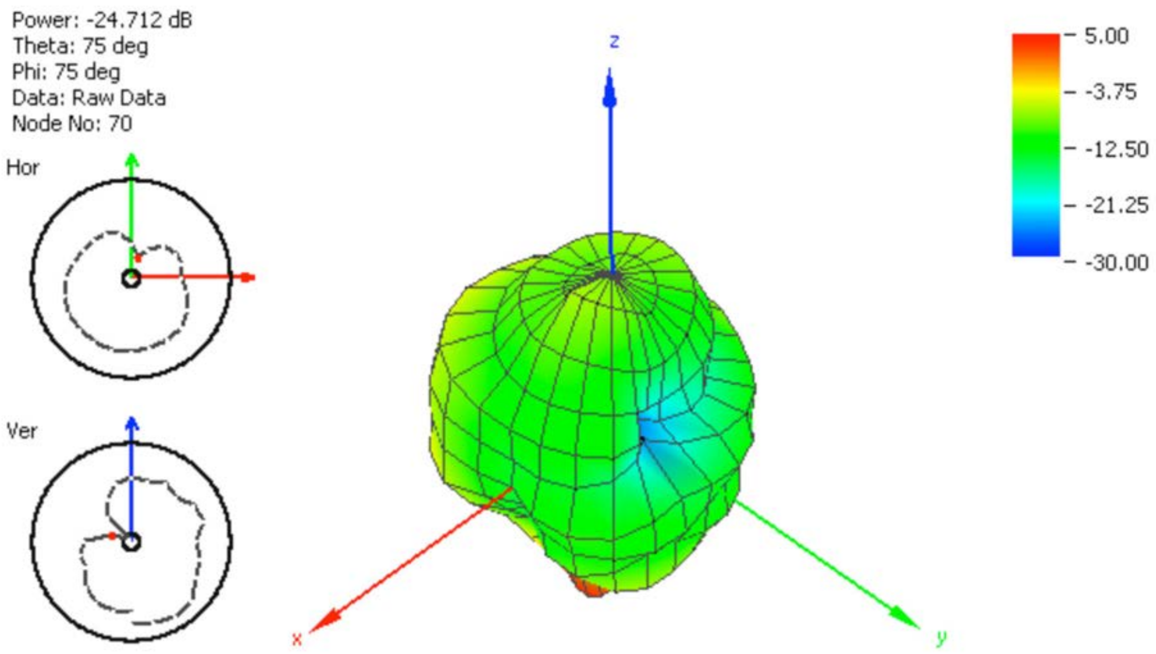


Figure 9. Radiation Pattern at 750 MHz, State 3.

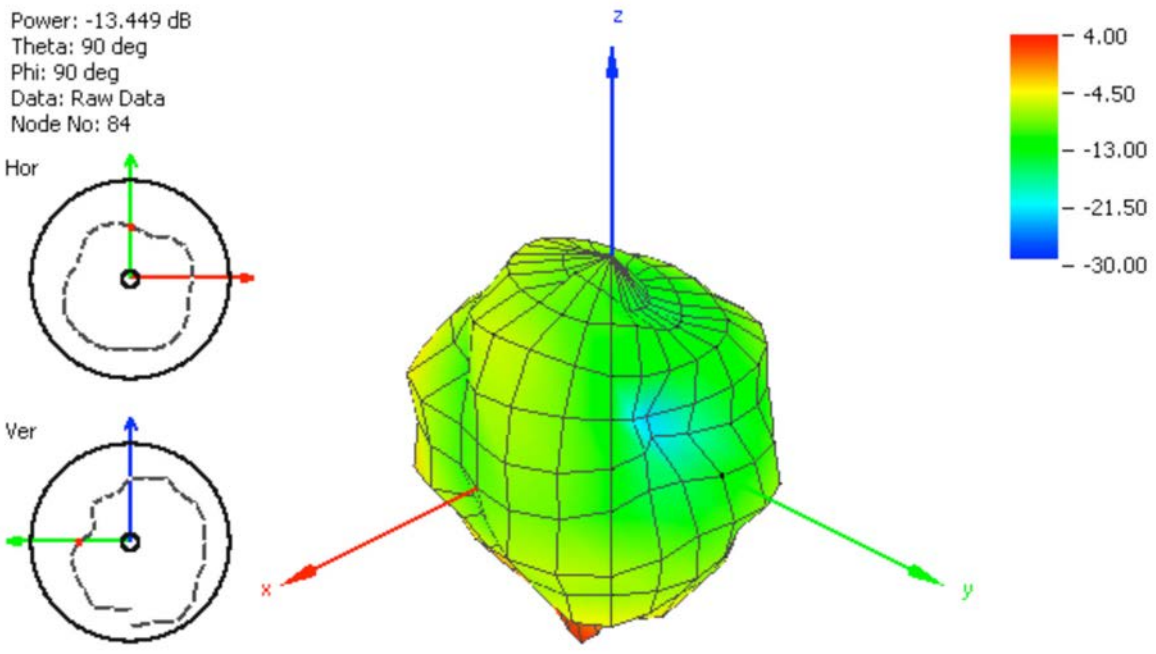


Figure 10. Radiation Pattern at 849 MHz, State 13.

6. Antenna Radiation Patterns

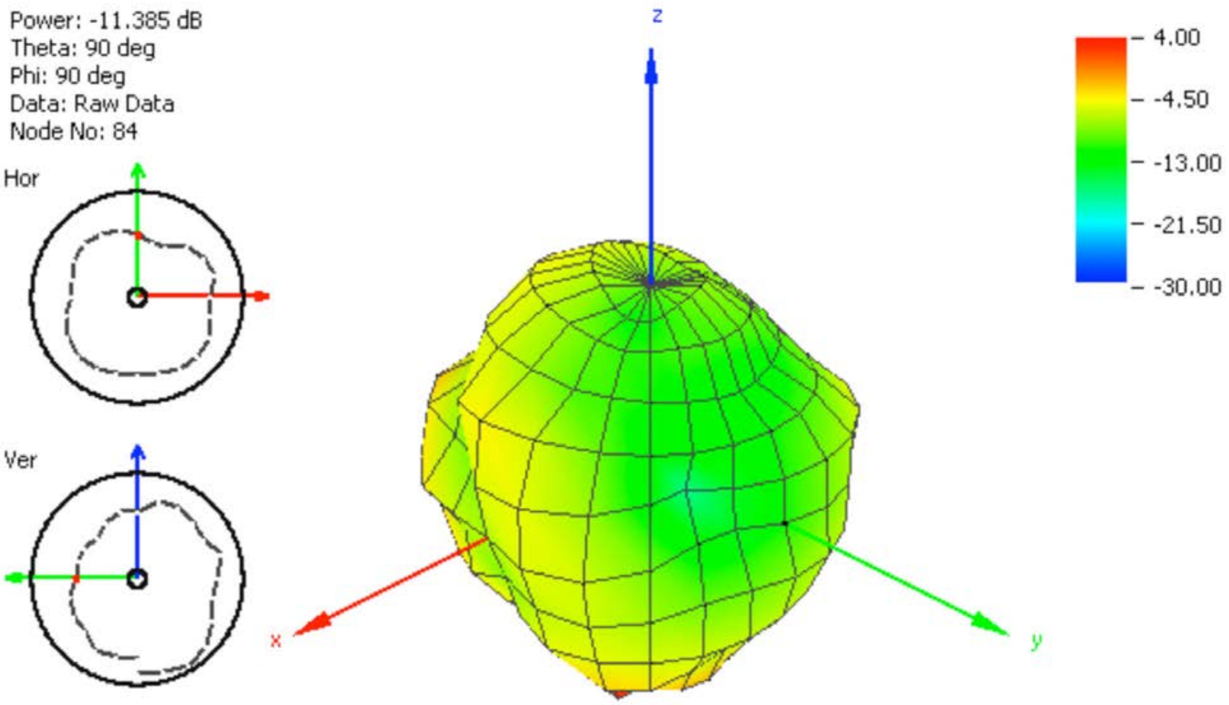


Figure 11. Radiation Pattern at 915 MHz, State 13.

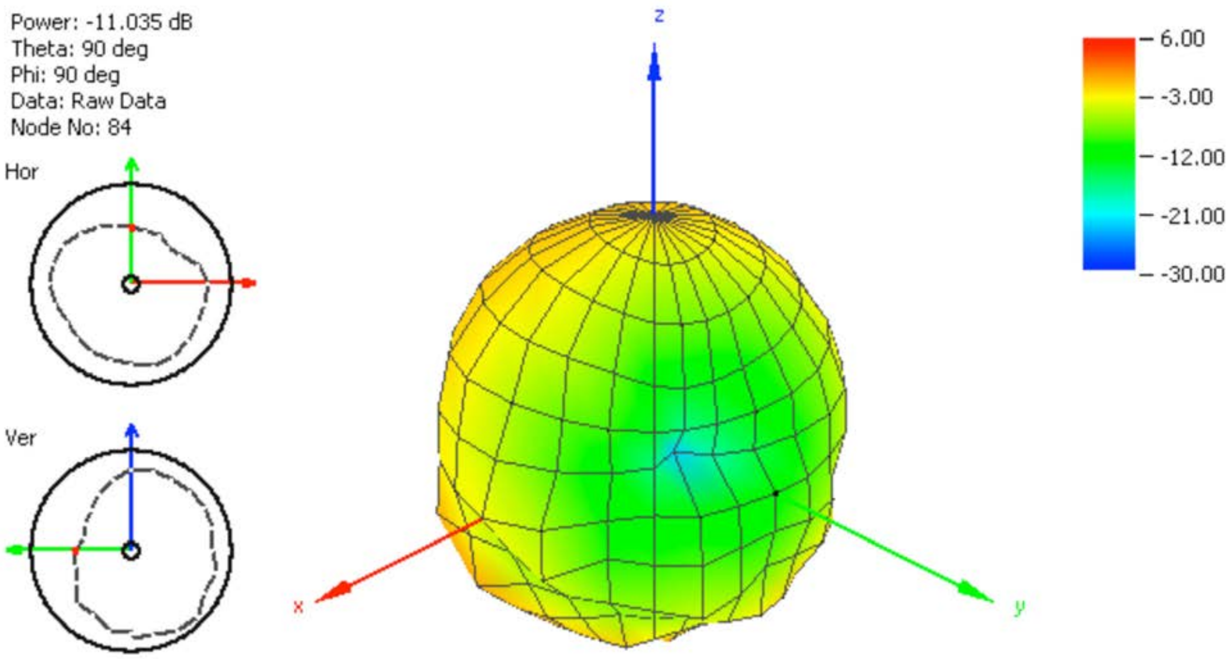


Figure 12. Radiation Pattern at 1850 MHz, State 13.

6. Antenna Radiation Patterns

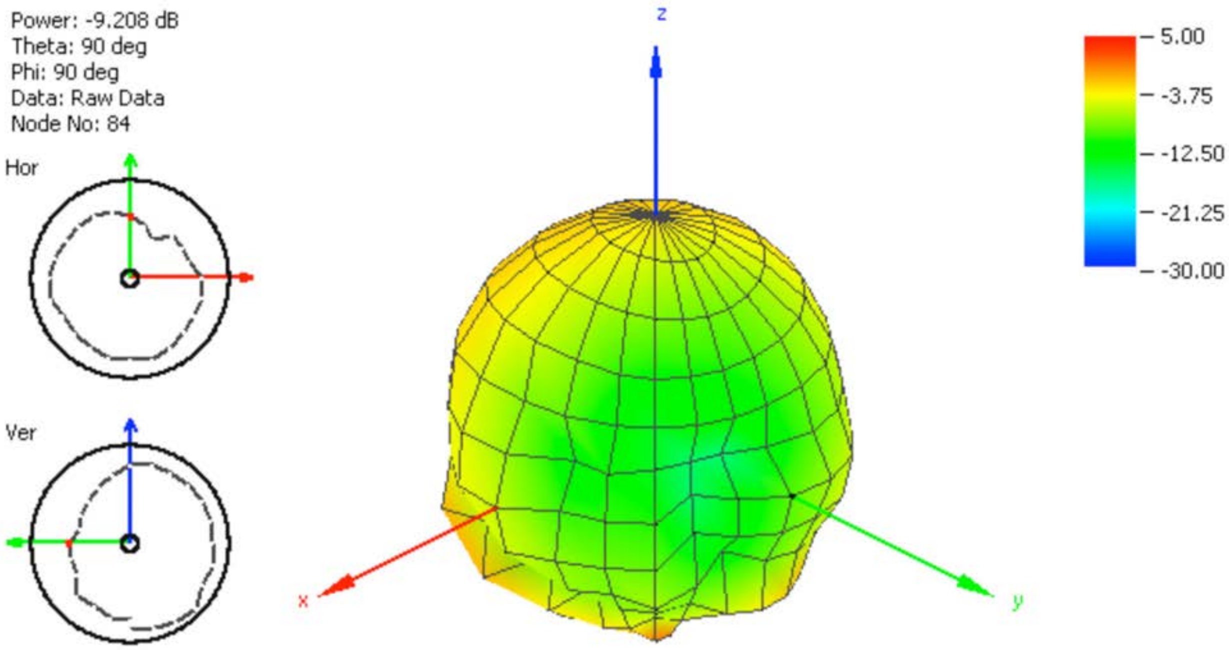


Figure 13. Radiation Pattern at 1950 MHz, State 13.

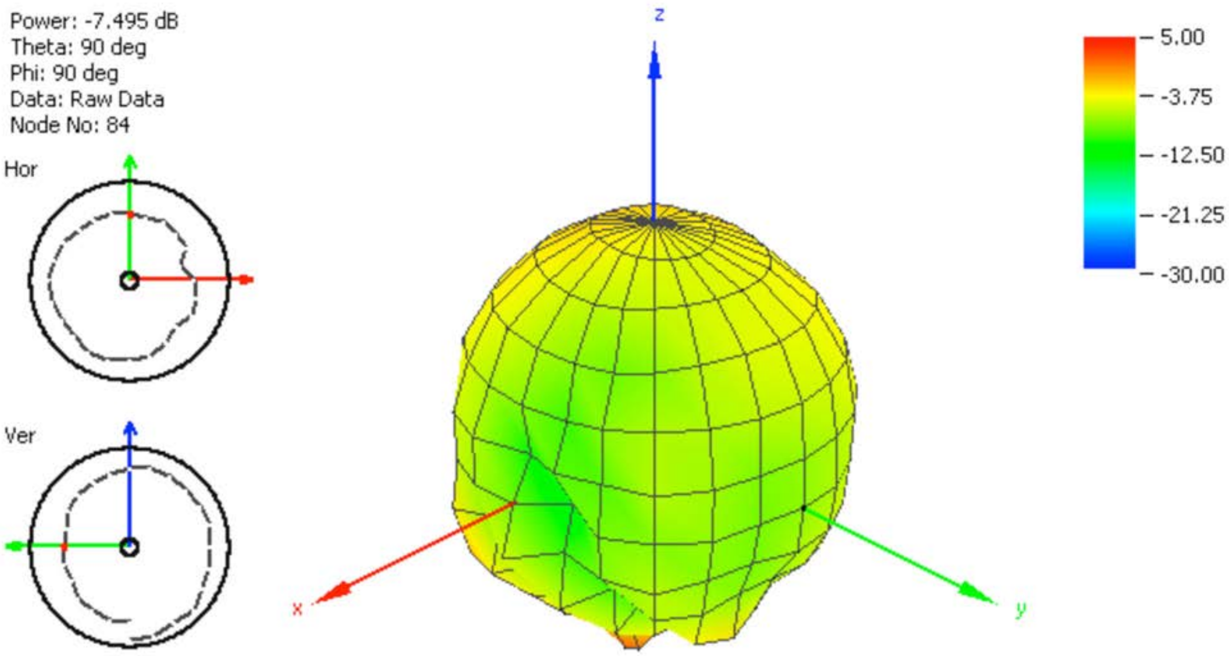


Figure 14. Radiation Pattern at 2140 MHz, State 13.

7. Matching Circuit

The antenna matching for a ground plane of 50x50 mm is a combination of capacitors and inductors as follows;

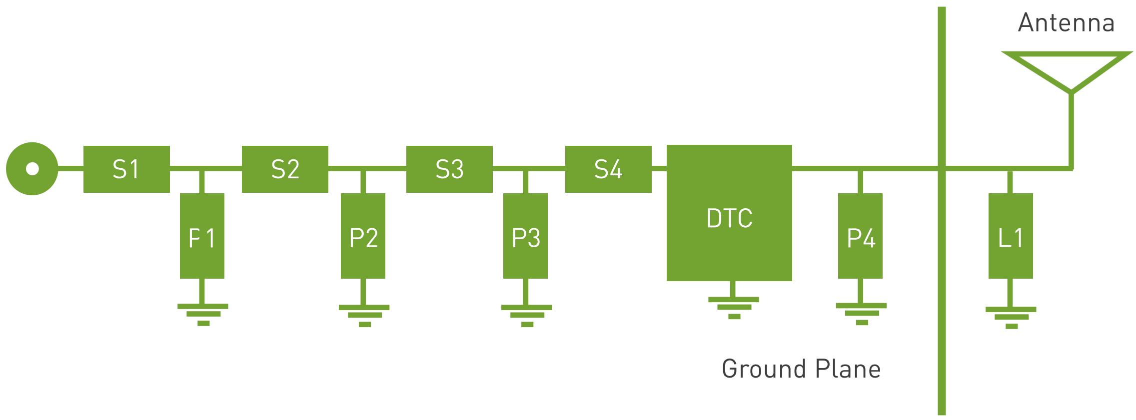


Figure 15. Antenna Matching

Inductor Outside of Ground Plane

L1= reserved for later use if required

Series Elements

S1 = 0 Ohm, **S2** = 10 pF, **S3** = 0.5 nH, **S4** = 0.5 nH,

Parallel Elements

P1 = 47 nH, **P2** = 6.2 nH, **P3** = 1 pF, **P4** = 3.9nH

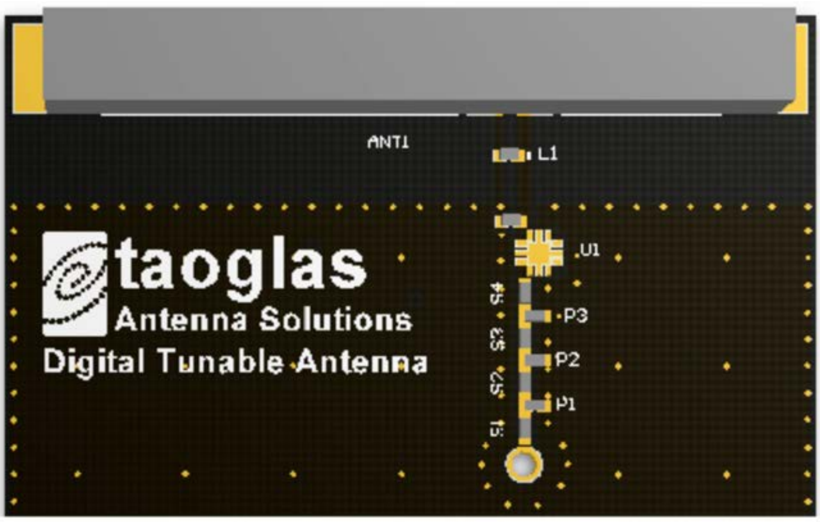


Figure 16. Lumped Component Spaces

8. Transmission Line

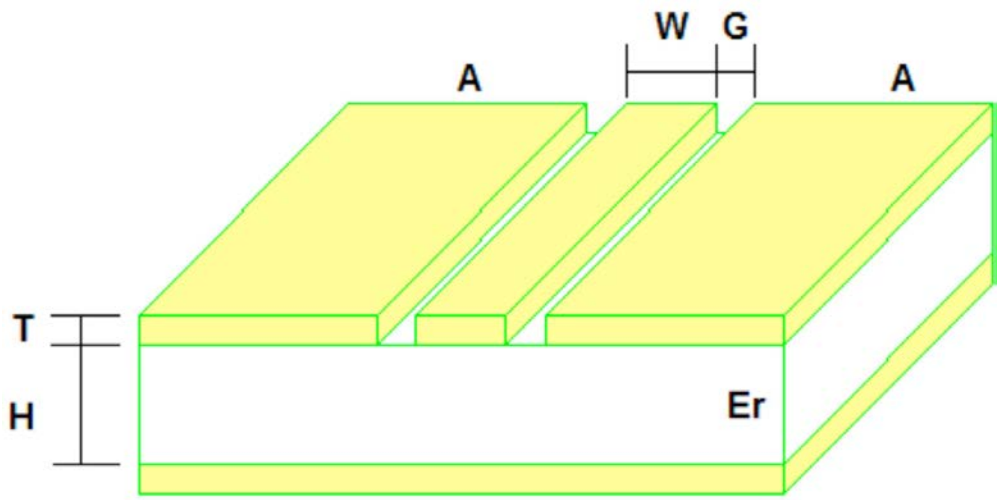


Figure 17. Co-Planar Waveguide

Follow the below transmission line dimensions for optimal performance.

Dimensions

W = 0.8 mm, **G** = 0.3 mm, **H** = 21 mils, **T** = 0.36 mm

Dielectric Constant

Er = 4.4

The dimension of the ground aside of the signal track (A), must be at least 3 times the width (W). For those cases where the transmission line have to be curved, bent or close to the board's edge, the 3xW relation to each side of the signal track needs to be followed.

In order to maintain the proposed Co-Planar Waveguide (CPW) design, the height from first middle layer (ground) to the top layer, must be 21 mils +/-1 10%.

The computation of the above values gives an impedance of 49.83 ohms.

9. Drawings

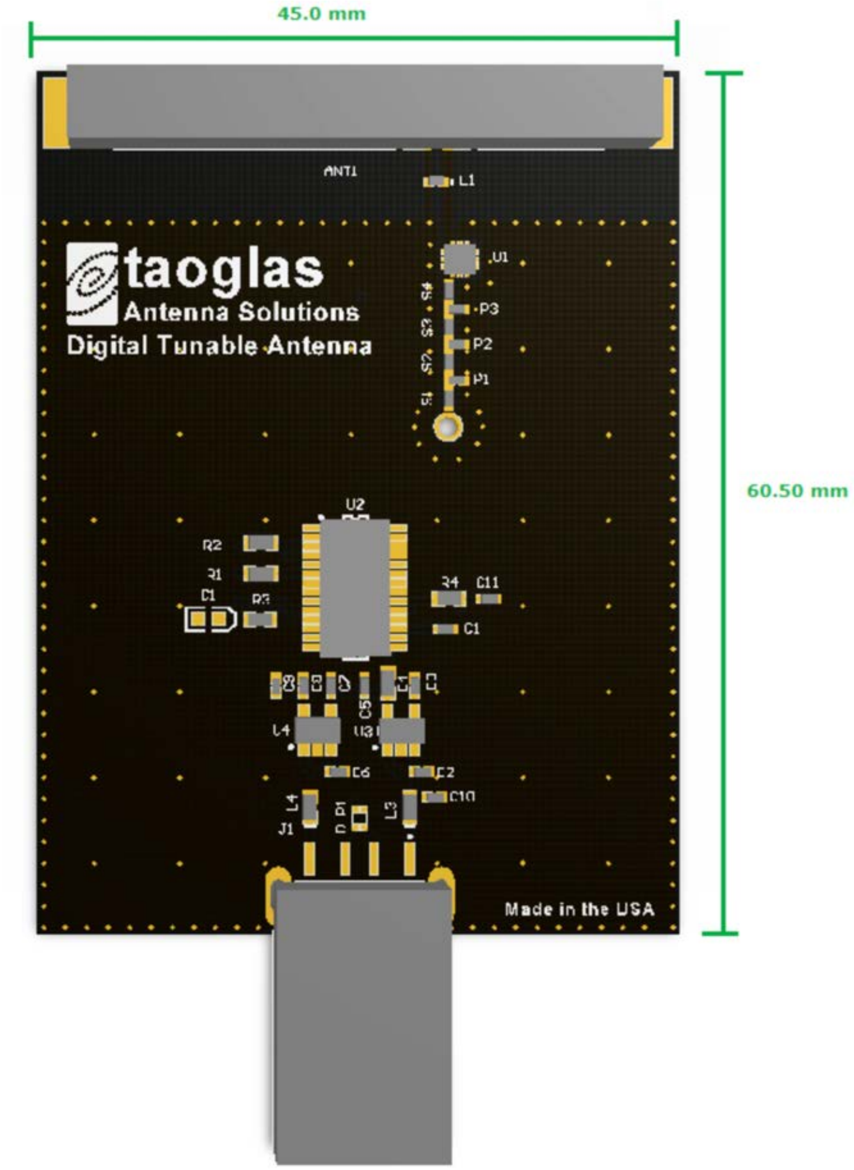


Figure 18. Board Size

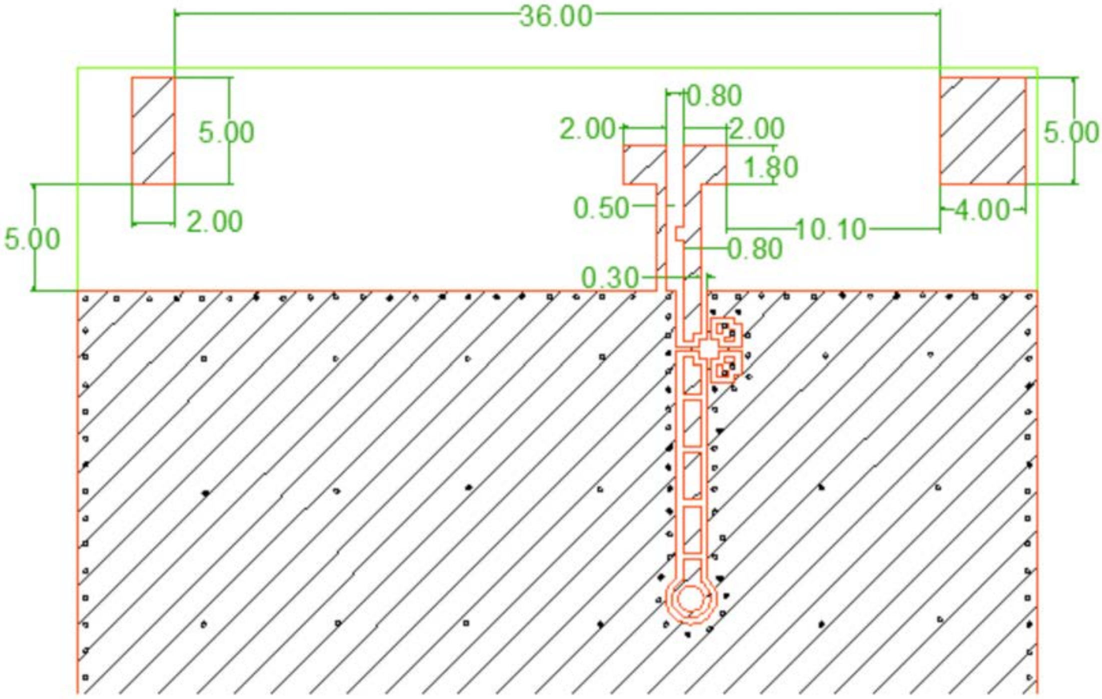


Figure 19. Antenna Layout

Top View

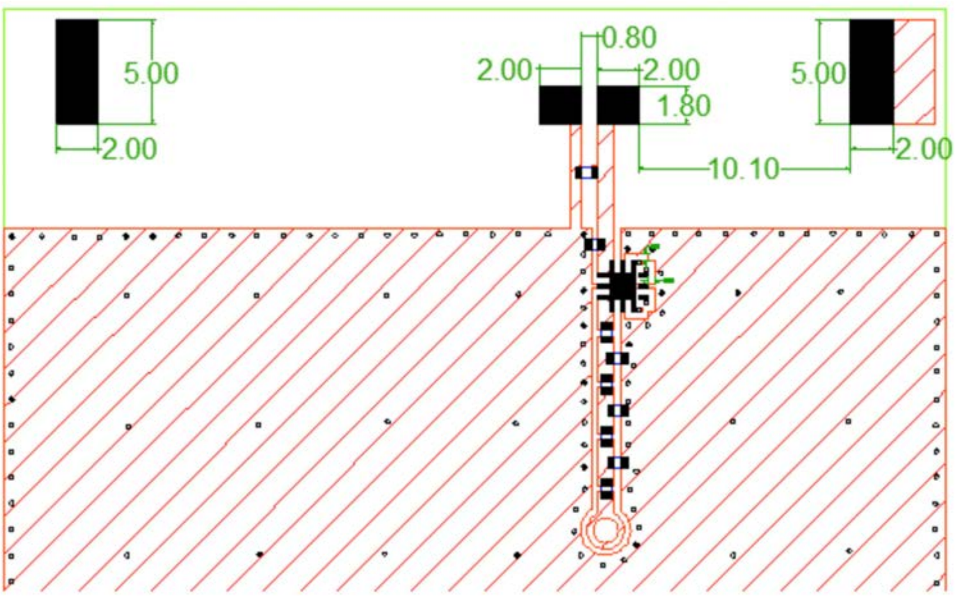


Figure 20. Solder area for the antenna

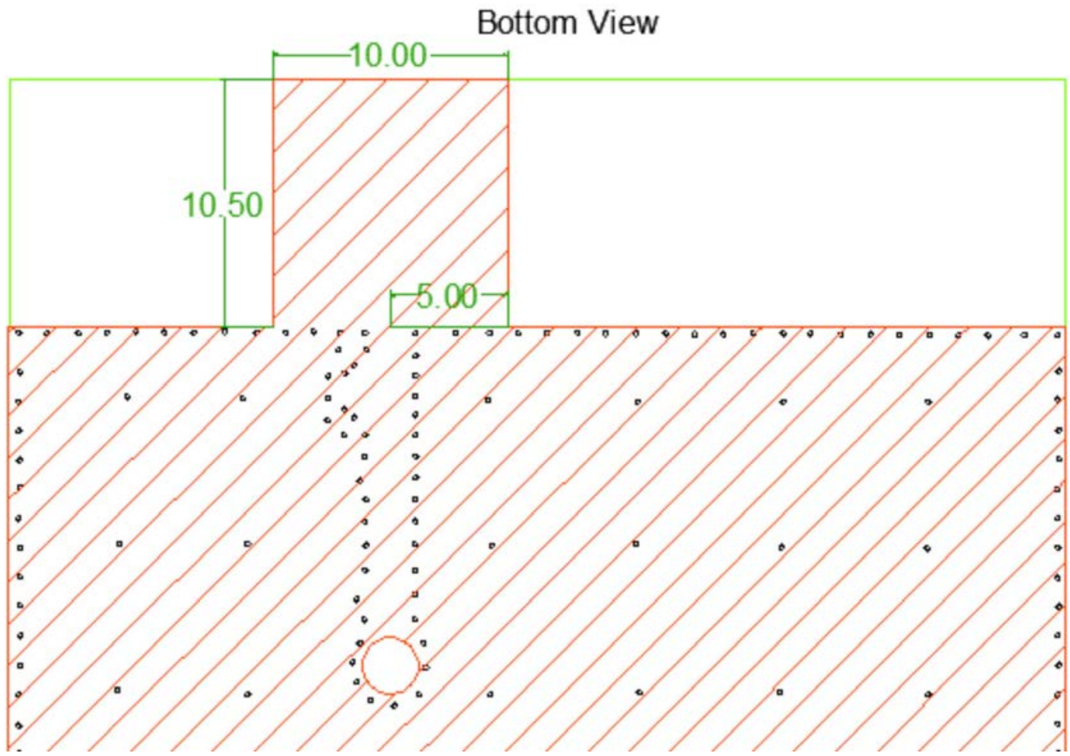


Figure 21. Bottom Layout

At the bottom layer we need to add a portion of ground plane underneath the antenna, this portion measures 10x10.5 mm and is centered to the signal track of the transmission line at the top layers (5 mm to each side).

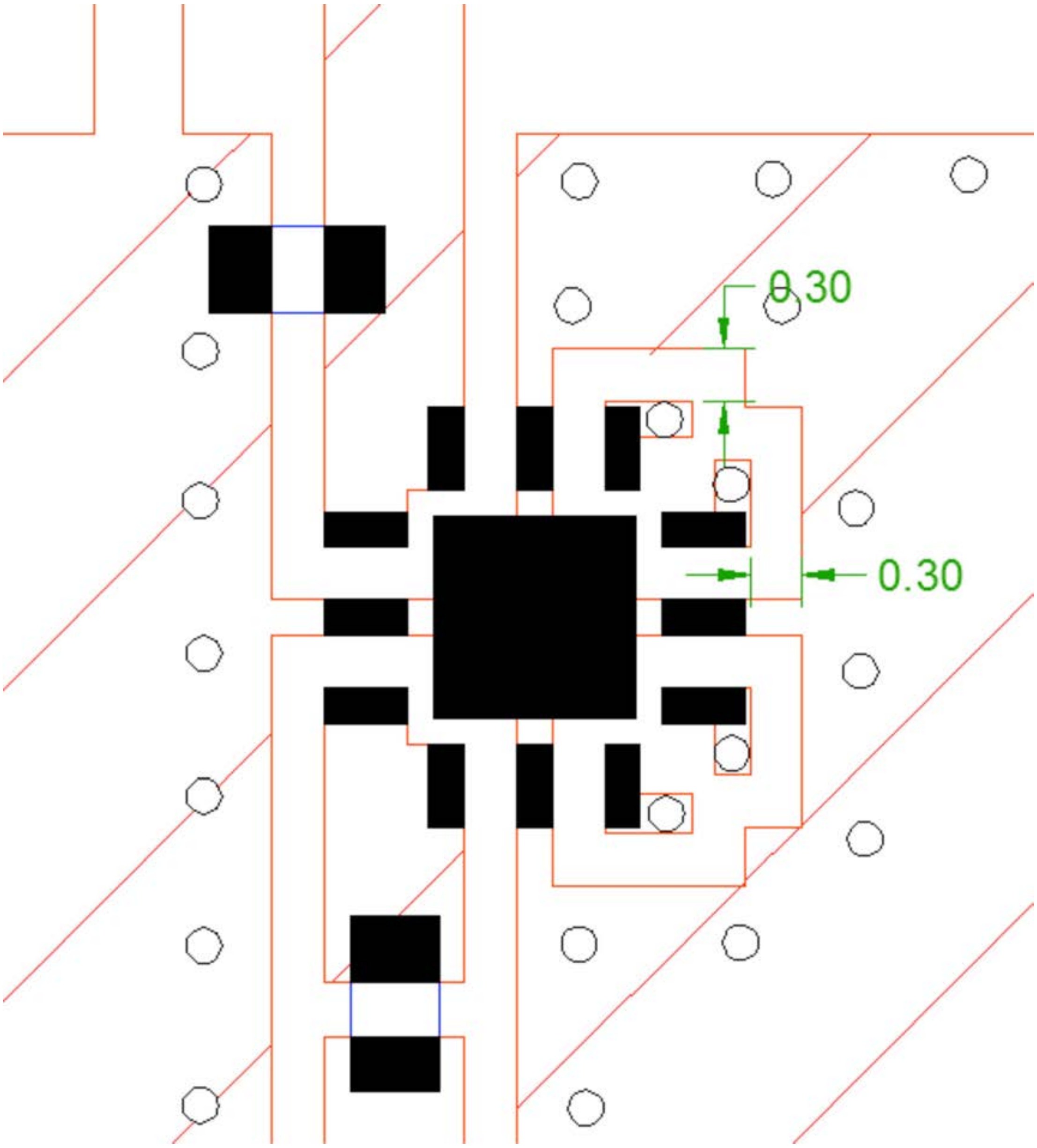


Figure 22. Recommended layout of the PE64102

For the solder pads of the PE64102 and the lumped components please check their respective specifications.
We recommend 0402 size parts. (see the appendix)

10. Schematics

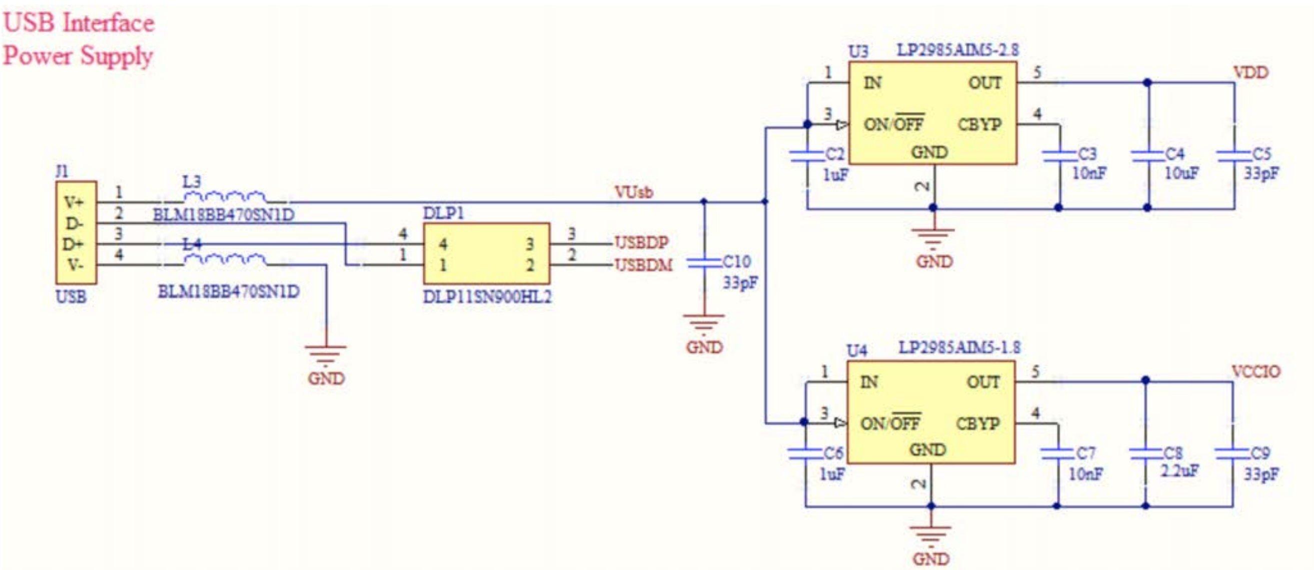


Figure 23. USB interface and power supply

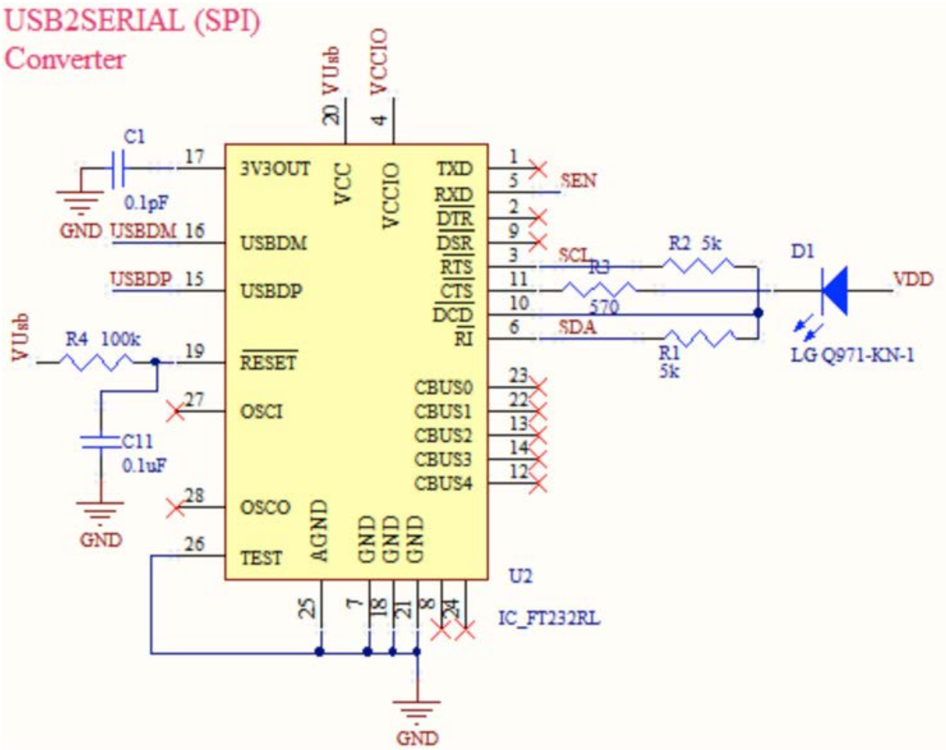


Figure 24. USB to SPI Converter

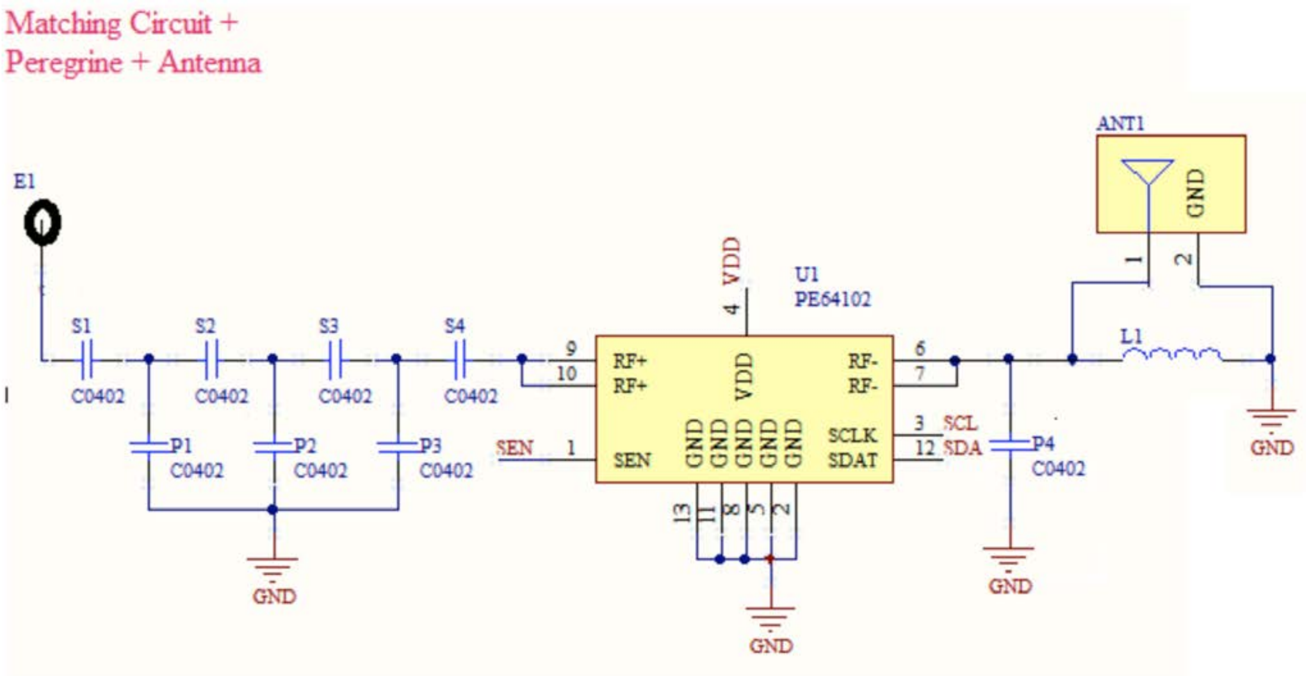


Figure 25. Matching Circuit, PE64102 and DTA01 Antenna.

11. Gerbers

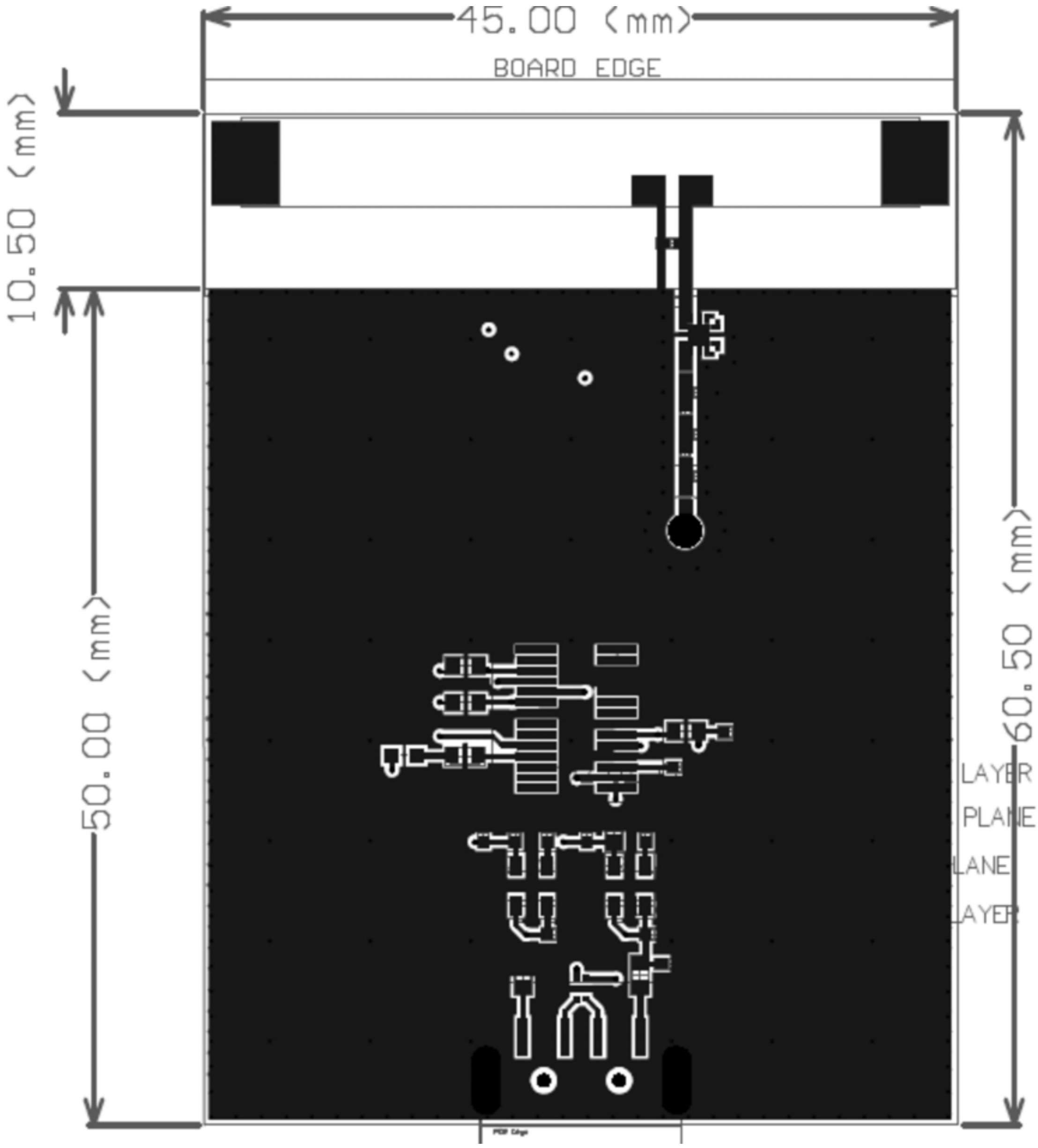


Figure 26. DTA01 Top Layer (Ground-Components)

11. Gerbers

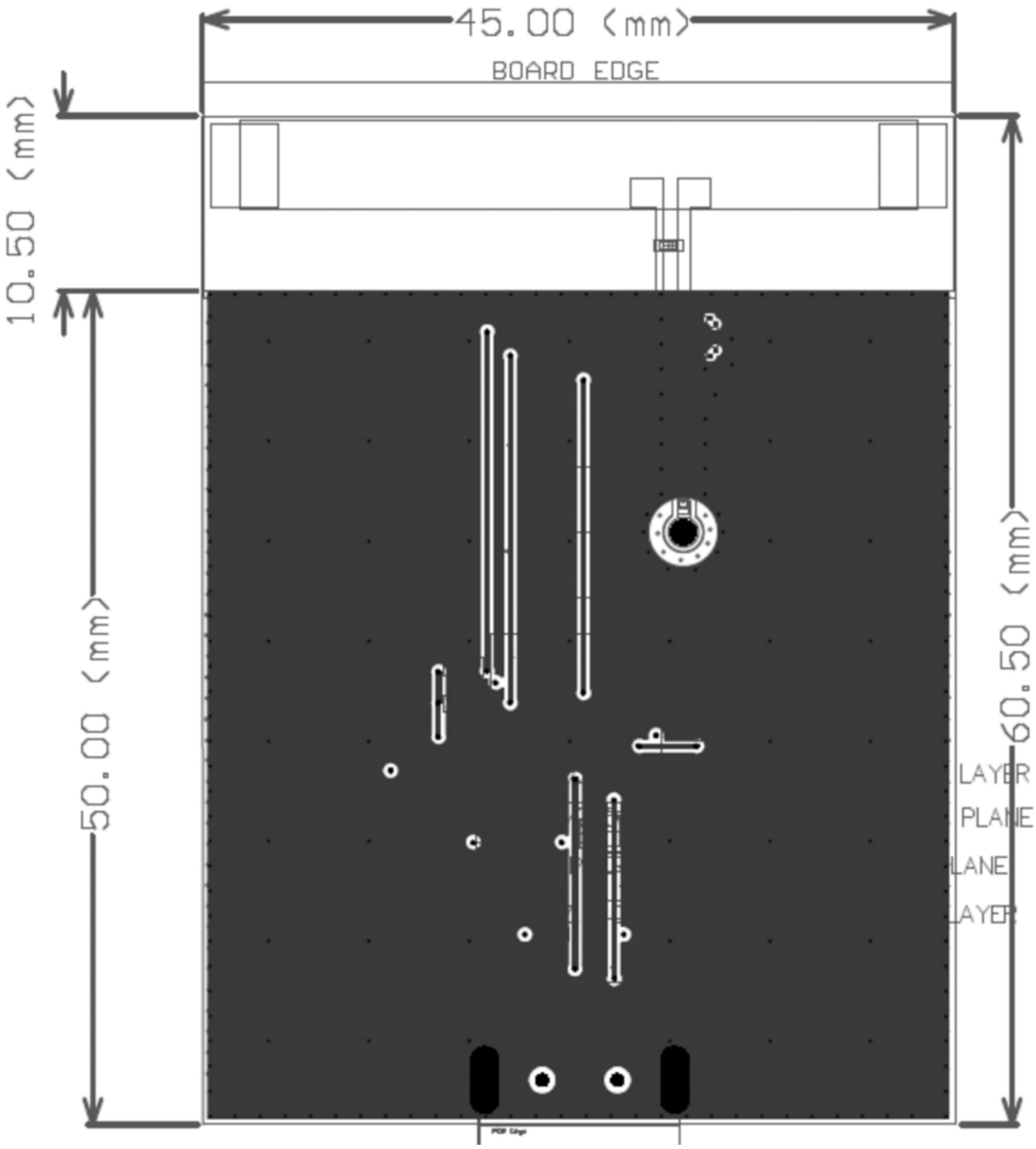


Figure 27. DTA01 First Middle Layer (Ground-Signal)

11. Gerbers

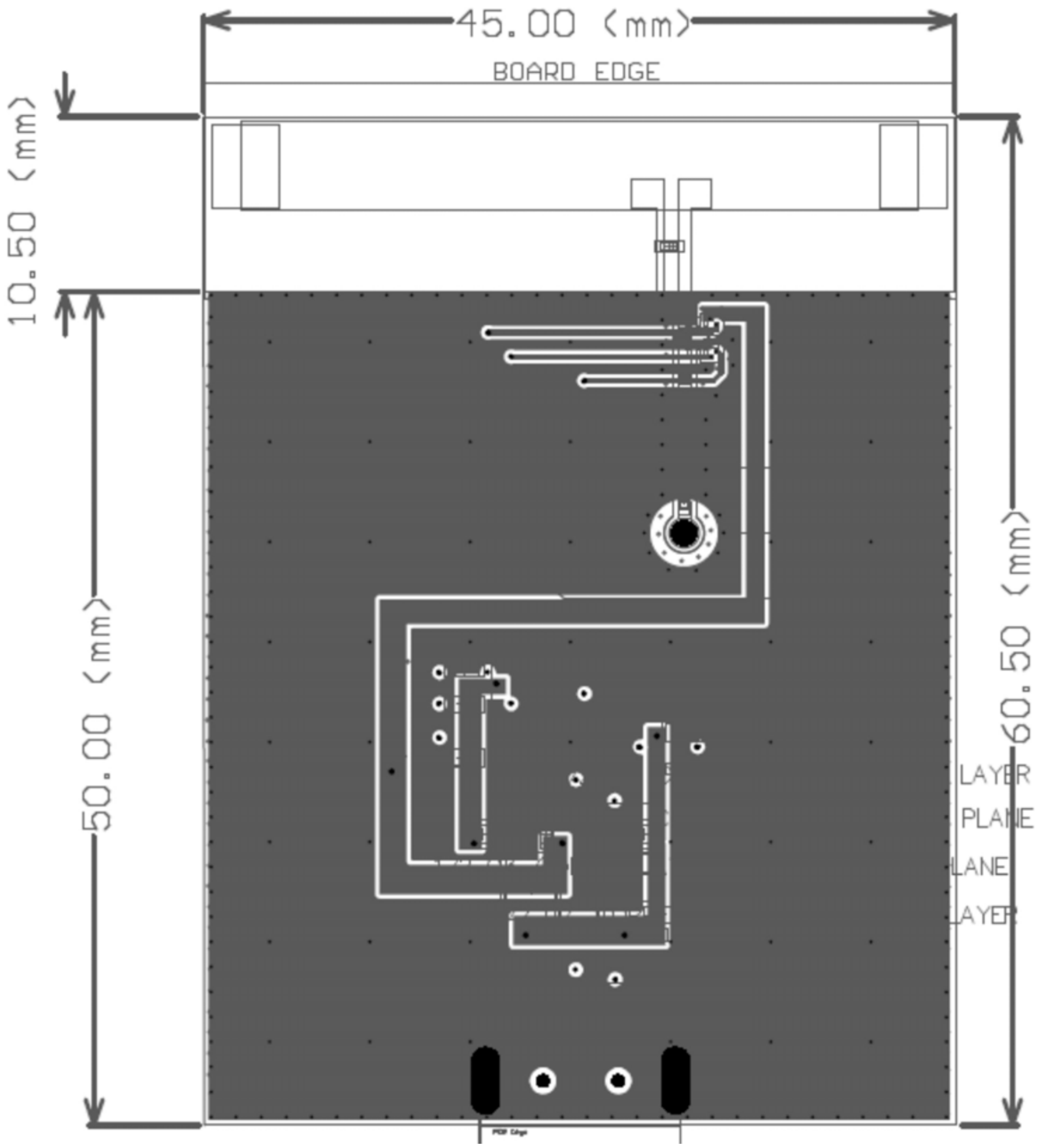


Figure 28. DTA01 Second Middle Layer (Ground-Signal-Power)

11. Gerbers

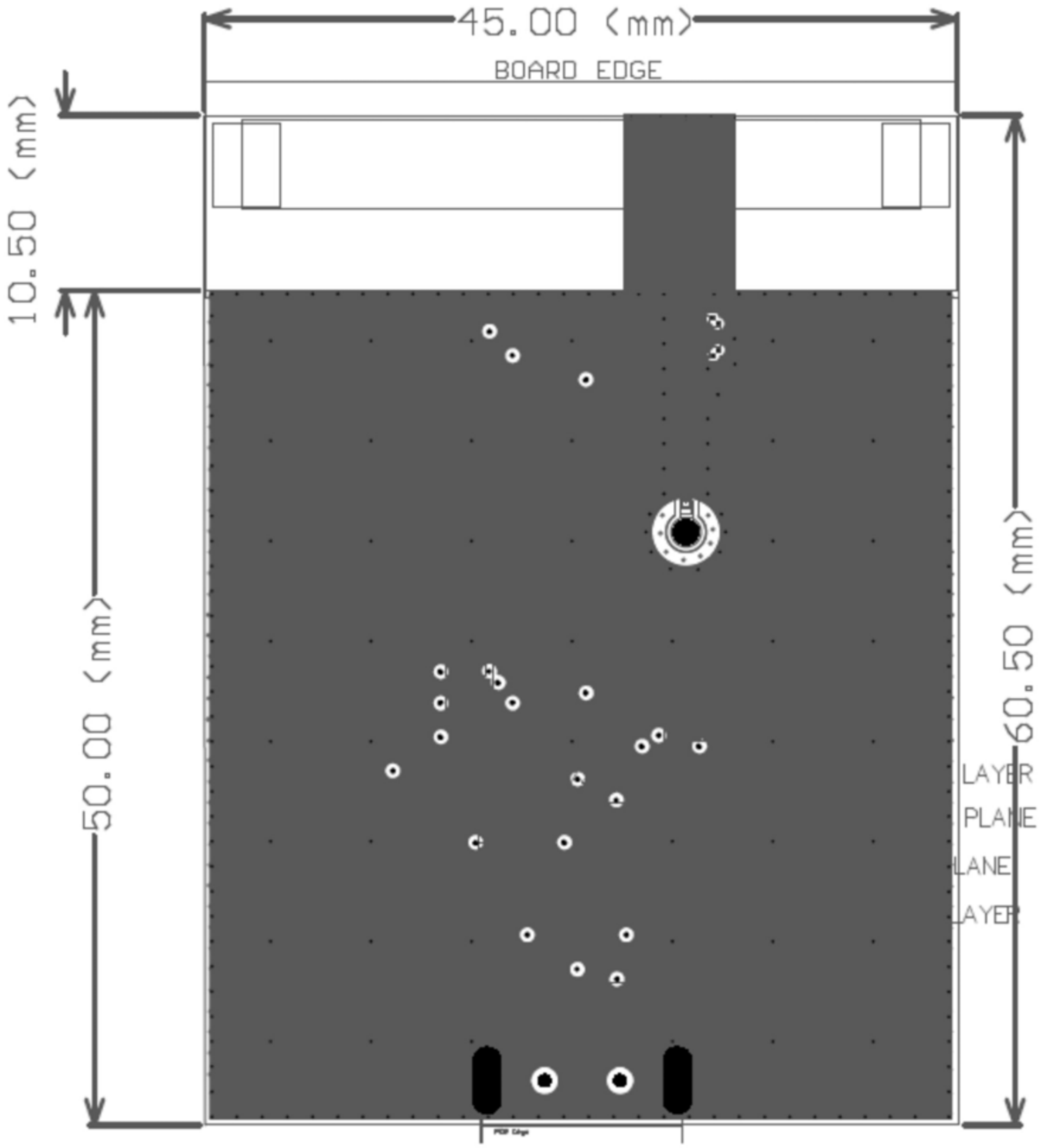


Figure 29. DTA01 Bottom Layer (Ground-Components)

12. Bill of Materials

Comment	Pattern	QTY	Components	Provider	Provider Part	Manufacturer	Manufacturer Part
0.1pF Capacitor	0402	1	C1	Digikey	490-6259-2-ND	Murata	GRM1555C1HR10WA01D
1uF Capacitor	0402	2	C2, C6	Digikey	490-3890-1-ND	Murata	GRM155R61A105KE15D
10nF Capacitor	0402	2	C3, C7	Digikey	490-1312-1-ND	Murata	GRM155R71E103KA01D
10uF Capacitor	0603	1	C4	Digikey	490-3896-1-ND	Murata	GRM188R60J106ME47D
33pF Capacitor	0402	3	C5, C9, C10	Digikey	490-6177-1-ND	Murata	GRM1555C1E330JA01D
2.2uF Capacitor	0402	1	C8	Digikey	490-4518-1-ND	Murata	GRM155R60G225ME15D
100nF Capacitor	0402	1	C11	Digikey	490-1318-1-ND	Murata	GRM155R61A104KA01D
0 Ohm Resistor	0402	1	S1	Digikey	P0.0JCT-ND	Panasonic	ERJ-2GE0R00X
10pF Capacitor	0402	1	S2	Digikey	490-5921-1-ND	Murata	GRM1555C1H100JA01D
0.5nH Inductor	0402	2	S3, S4	Digikey	445-6306-1-ND	TDK	MLG1005S0N5C
47nH Inductor	0402	1	P1	Digikey	490-6820-1-ND	Murata	LQW15AN47NH00D
6.2nH Inductor	0402	1	P2	Digikey	490-2620-1-ND	Murata	LQG15HS6N2S02D
1pF Capacitor	0402	1	P3	Digikey	490-3083-1-ND	Murata	GJM1555C1H1R0CB01D
3.9nH Inductor	0402	1	P4	Digikey	490-2617-1-ND	Murata	LQG15HS3N9S02D
5k Resistor	0603	2	R1, R2	Digikey	RR08P4.99KDCT-ND	Susumu	RR0816P-4991-D-68H
570 Resistor	0603	1	R3	Digikey	RR08P560DCT-ND	Susumu	RR0816P-561-D
100k Resistor	0402	1	R4	Digikey	RR08P100KDCT-ND	Susumu	RR0816P-104-D
Ferrite	0603	2	L3, L4	Digikey	490-5208-1-ND	Murata	BLM18BB470SN1D
PE64102	SMT	1	U1	Digikey	1046-1066-1-ND	Peregrine	PE64102MLAA-Z
IC_FT232RL	28-SSOP	1	U2	Digikey	768-1007-1-ND	FTDI	FT232RL-REEL
LP2985AIM5-2.8	SOT-23-5	1	U3	Digikey	LP2985AIM5-2.8/NOPBCT-ND	TI	LP2985AIM5-2.8/NOPB
LP2985AIM5-1.8	SOT-23-5	1	U4	Digikey	LP2985AIM5-1.8/NOPBCT-ND	TI	LP2985AIM5-1.8/NOPB
LG Q971-KN-1	0603	1	D1	Digikey	475-1409-1-ND	OSRAM	LG Q971-KN-1
DLP11SN900HL2L	0504	1	DLP1	Mouser	DLP11SN900HL2L	Murata	81-DLP11SN900HL2L
PA710.A	SMT	1	Ant1	Digikey	PA.720.A	Taoglas	PA.720.A
SMA female	Flange	1	Con1	Digikey	931-1179-ND	Taoglas	PCB.SMAFST.2H.B.HT
USB A SINGLE SMT	USB/SM 2.5-4H4	1	USB/CONN	Mouser	855-M701-280442	Harwin	M701-280442

13. Appendix

Product Overview Peregrine PE64102

http://www.psemi.com/pdf/sell_sheet-psg/73-0039.pdf

Datasheet Peregrine PE64102

http://www.psemi.com/pdf/datasheets/PE64102_70-0428-01.pdf

Application Note Peregrine PE64102

http://www.psemi.com/pdf/app_notes/an29.pdf

Software and driver for the Peregrine PE64102

http://www.psemi.com/content/products/product.php?product=PE64102

Design Files for the DTAD01

http://taoglas.com/files/DTAD01-Design-Files.zip

Software and Driver for the DTAD01

http://taoglas.com/files/DTAD01-Eval-Board-Software.zip