

TEST REPORT

FOR

Product Type:	Plymouth Wi-Fi/Bluetooth location Tag
Company Name:	Extronics
Model Number:	Plymouth – Prototype 1
Report No:	RL/2019/29
Issue Date:	August 13 .2019
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Test Date:	August 08/12 .2019

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1. Test Description

Conducted impedance measurement, tuning and radiated performance testing of Plymouth Wi-Fi and Bluetooth antennas.

Initially, conducted VNA testing was carried out to establish the impedance of each of the antennas. The antennas were then each tuned and remeasured.

Once tuning was complete, radiated testing was carried out. Four different measurement results are provided for each test antenna:

- Efficiency plot – Shows the antenna efficiency across the 2GHz to 3Gz frequency band
- 3D Scan plot – Shows the 3D radiation pattern at the desired antenna center frequency (2.45 GHz). A wire model of a perfect dipole is superimposed on each 3D plot to provide a visual reference.
- 2D Azimuth scan plot – Shows the 2D polar pattern in the Azimuth plane of the antenna – In this case, the view looking down on the top of the unit (Side with shortest width at the end where the antenna is mounted) – Plot shown for Azimuth cut with peak gain.
- 2D Elevation scan plot – Shows the 2D polar pattern in the Elevation plane of the antenna – In this case, the view looking at the side of the unit (Sides with longest widths) Plot shown for Elevation cut with peak gain.

2. Test Facility

Radtenna Ltd (Southampton)

3. Test Equipment

Conducted tests			
Equipment	Manufacturer	Model	Serial No
VNA	Anritsu	MS46122A	1511303

TABLE 1 CONDUCTED MEASUREMENT EQUIPMENT

Radiated Tests			
Equipment	Manufacturer	Model	Serial No
VNA	Anritsu	MS46122A	1511303
Ref Antenna	AARONIA	Hyperlog 4060	N/A
Positioner	Dimond Engineering	DAMS 6000	N/A
RF Chamber	Radtenna	1.5 m x 2.5 m	N/A

TABLE 2 RADIATED TEST SITE EQUIPMENT

4. Conducted Measurements and Tuning

4.1. BT Antenna

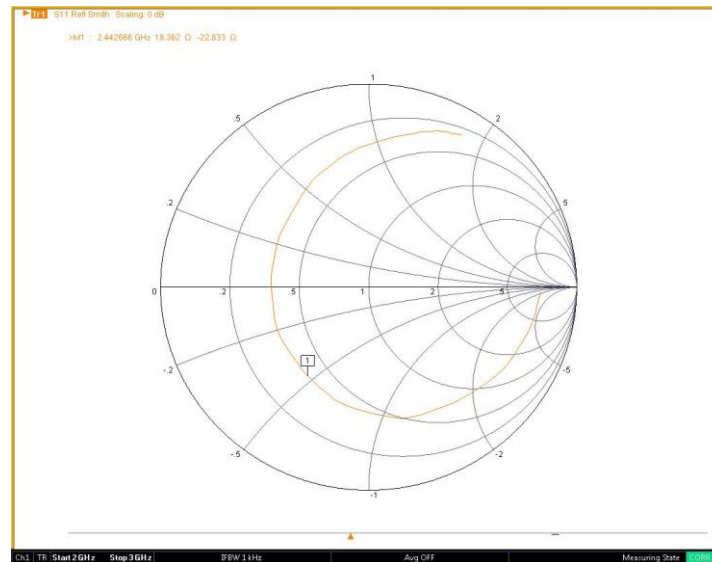


FIGURE 1 SMITH CHART -UNMODIFIED BT ANTENNA

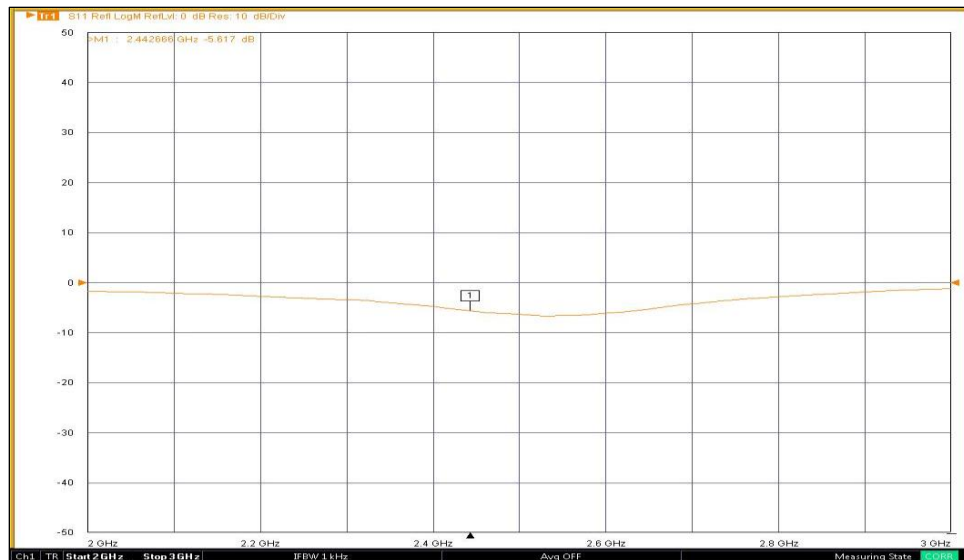


FIGURE 2 MAGNITUDE PLOT – UNMODIFIED BT ANTENNA

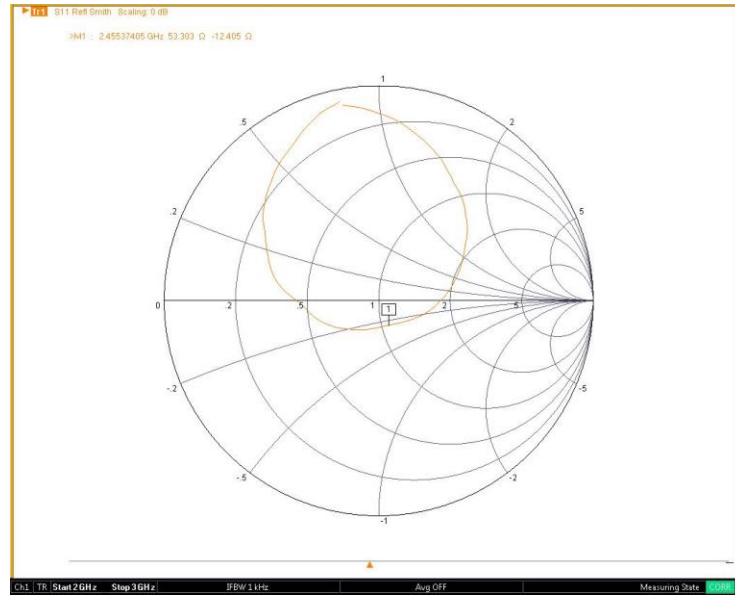


FIGURE 3 SMITH CHART -TUNED BT ANTENNA (C26 = 3n3 INDUCTOR & LENGTH REDUCED BY 0.2MM)

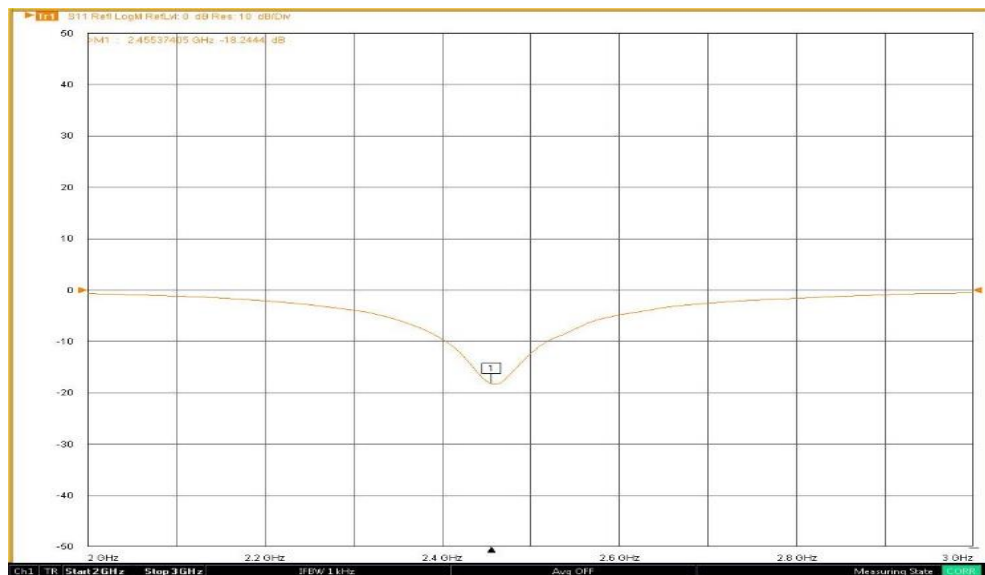


FIGURE 4 MAGNITUDE PLOT - TUNED BT ANTENNA (C26 = 3n3 INDUCTOR & LENGTH REDUCED BY 0.2MM)

4.2. Wi-Fi Antenna

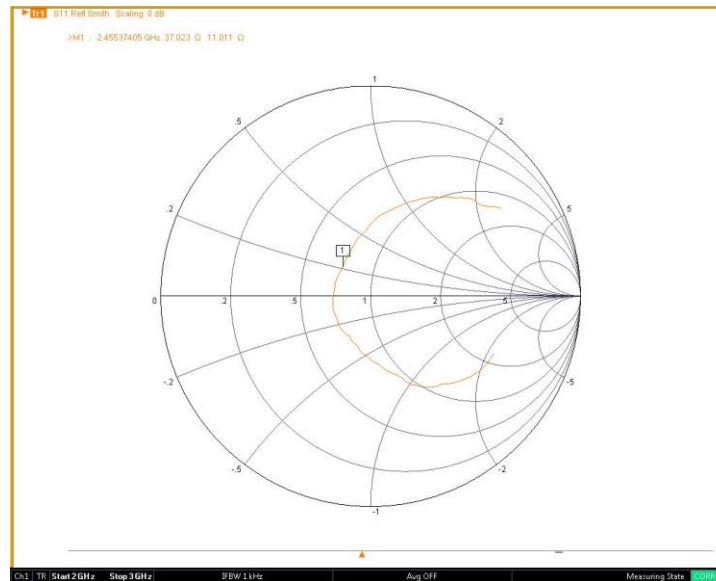


FIGURE 5 SMITH CHART -UNMODIFIED WI-FI ANTENNA

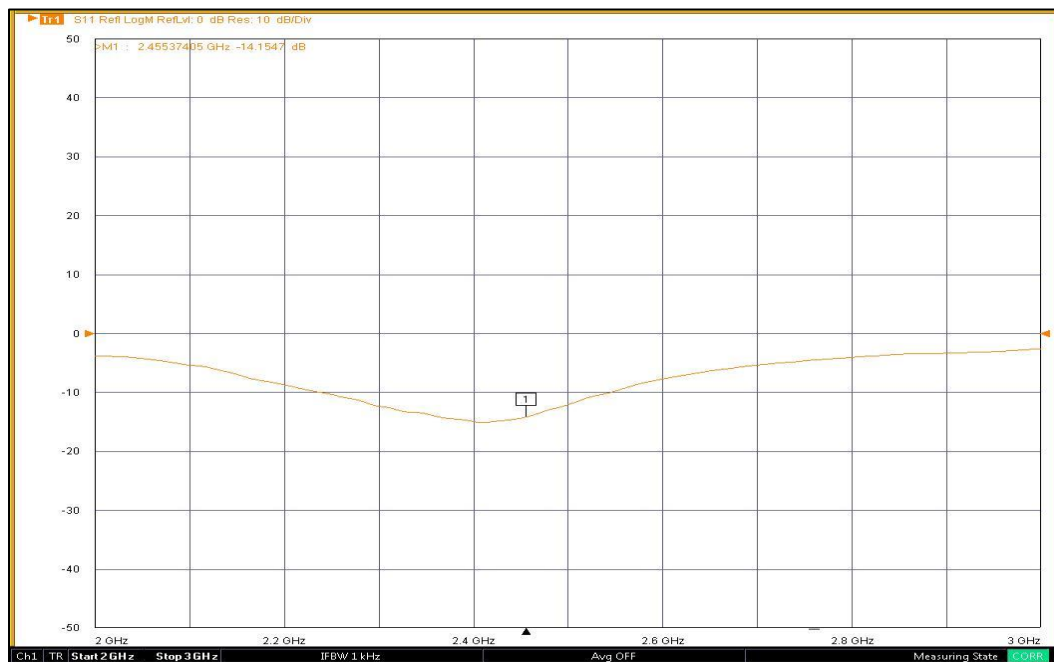


FIGURE 6 MAGNITUDE PLOT – UNMODIFIED WI-FI ANTENNA

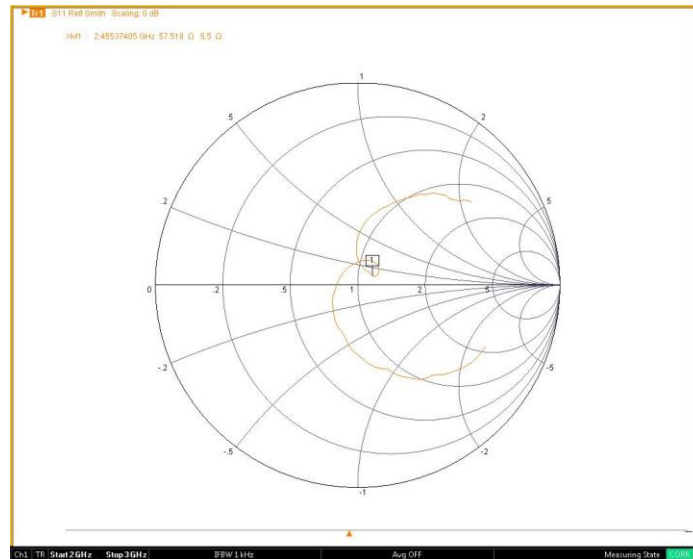


FIGURE 7 SMITH CHART - TUNED BT ANTENNA (LENGTH REDUCED BY 0.1MM)

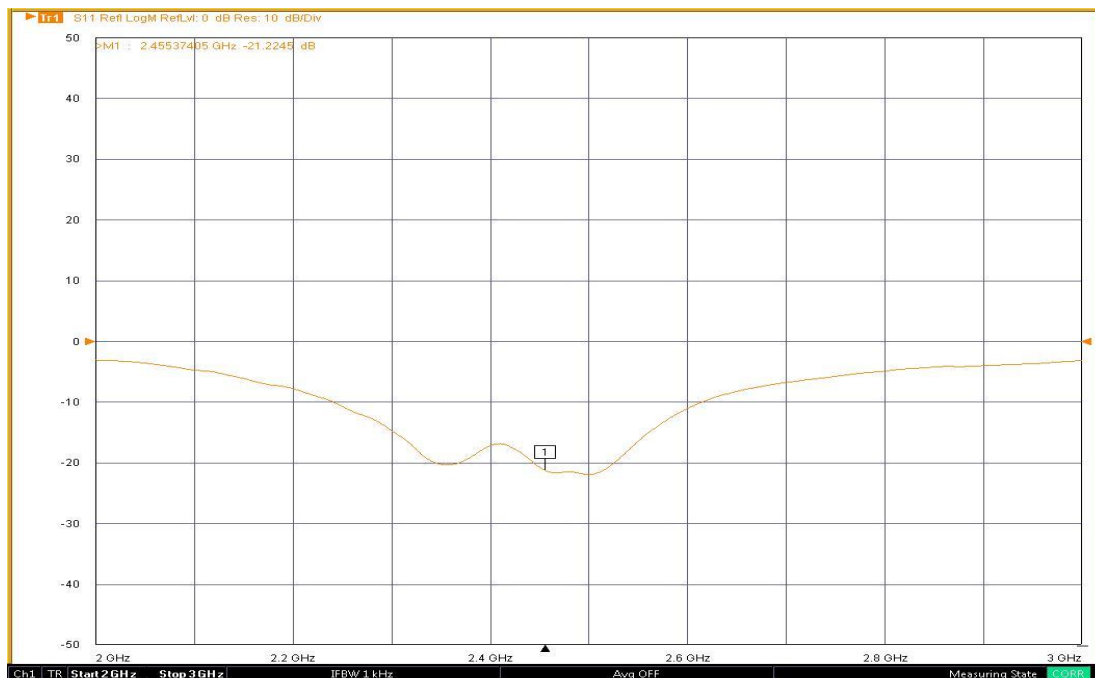


FIGURE 8 MAGNITUDE PLOT - TUNED BT ANTENNA (LENGTH REDUCED BY 0.1MM)

5. Radiated Test Results

5.1. BT Antenna

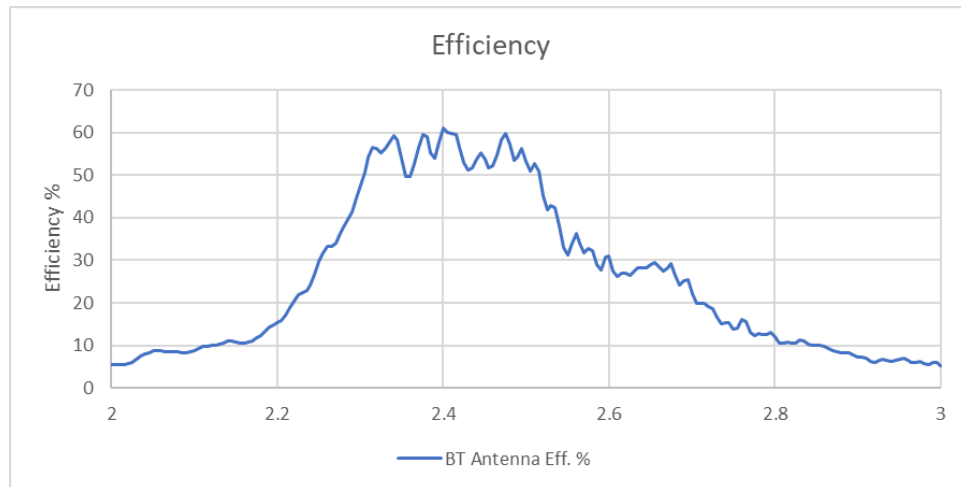


FIGURE 9 EFFICIENCY – BT ANTENNA

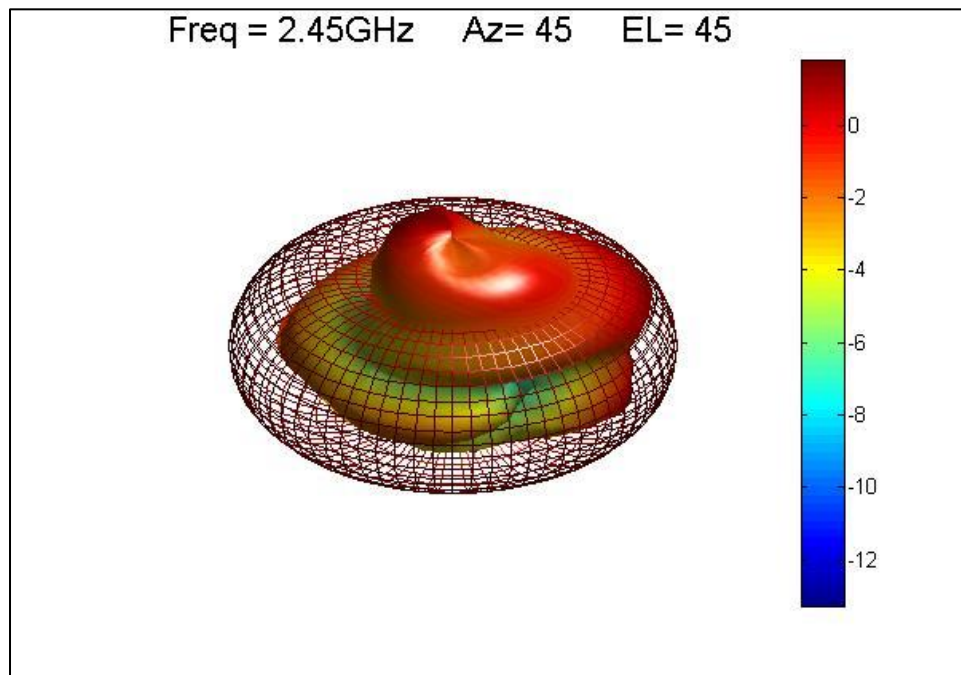
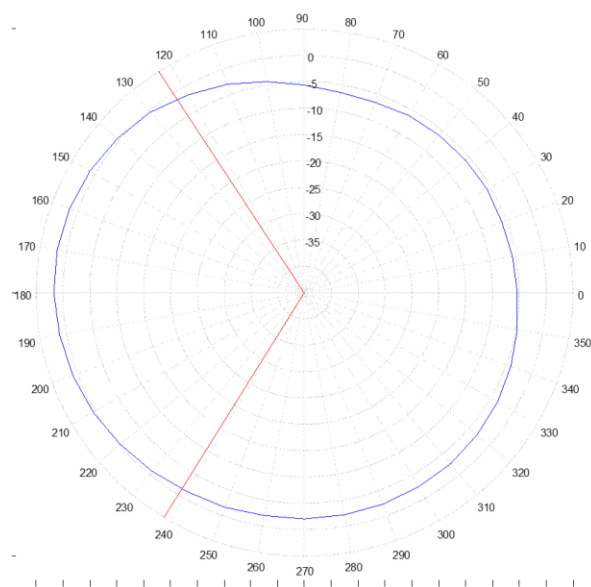


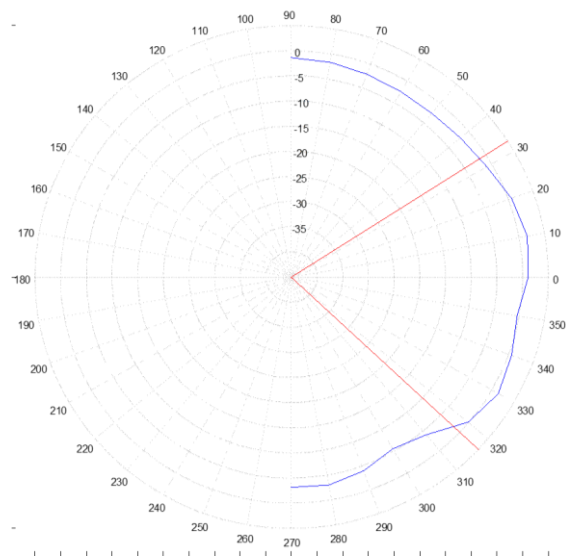
FIGURE 10 3D SCAN PLOT – BT ANTENNA



Name: Name
Date/Time = 12/08/2019 10:26:54
Plot Scale: 5 dB/Div
Beamwidth: 115.4 Degrees

Frequency: 2455 MHz
MAX dB= 1.7204 @ 170 Deg.
MIN dB= -6.553 @ 70 Deg.
dB Min/Max Delta = 8.2735 dB

FIGURE 11 2D POLAR PLOT AZIMUTH PEAK GAIN – BT ANTENNA



Name: Name
Date/Time = 12/08/2019 10:27:42
Plot Scale: 5 dB/Div
Beamwidth: 76.03 Degrees

Frequency: 2455 MHz
MAX dB= 1.5765 @ 10 Deg.
MIN dB= -5.633 @ -60 Deg.
dB Min/Max Delta = 7.2105 dB

FIGURE 12 2D POLAR PLOT ELEVATION PEAK GAIN – BT ANTENNA

5.2. Wi-Fi Antenna

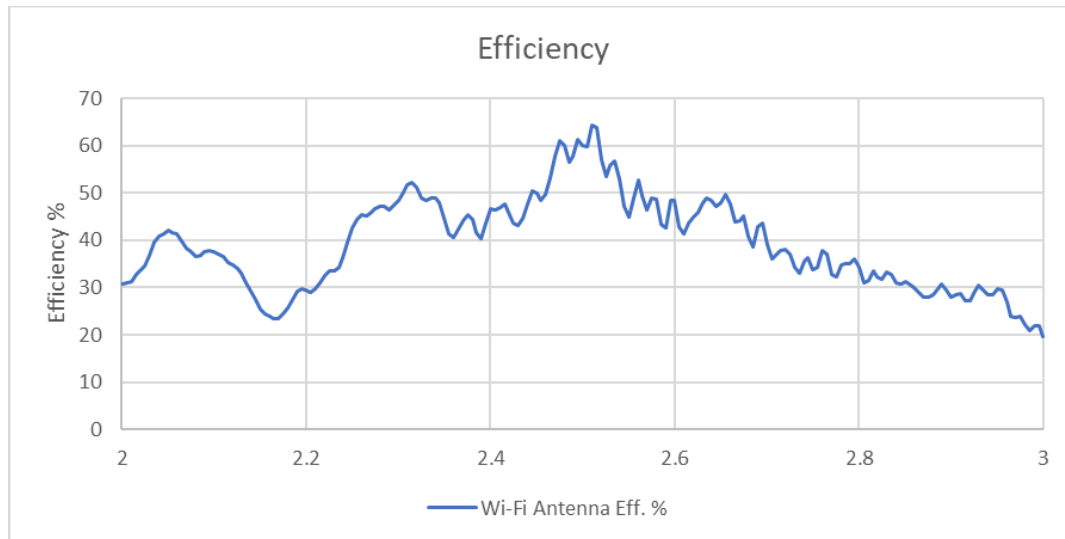


FIGURE 13 EFFICIENCY – WI-FI ANTENNA

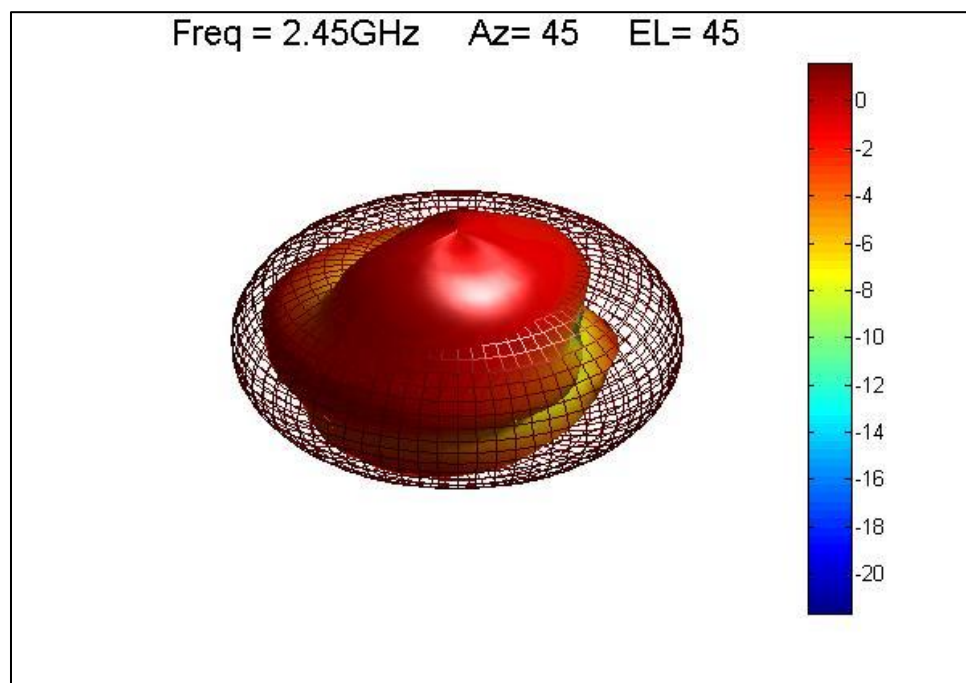


FIGURE 14 3D SCAN PLOT – WI-FI ANTENNA

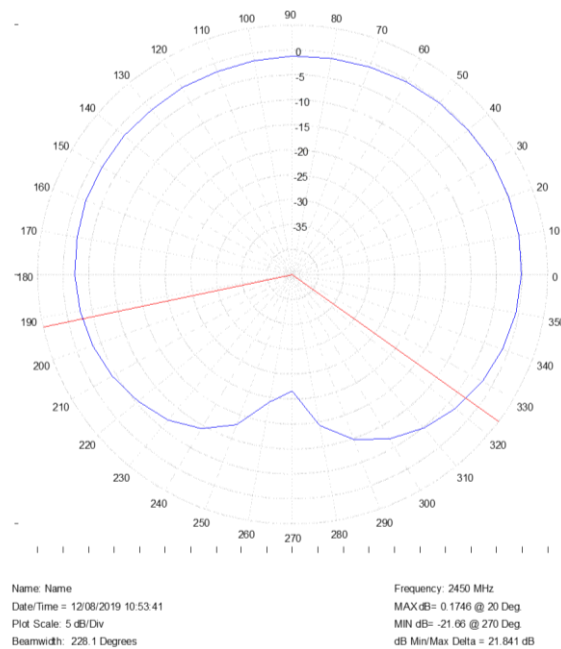


FIGURE 15 2D POLAR PLOT AZIMUTH PEAK GAIN – WI-FI ANTENNA

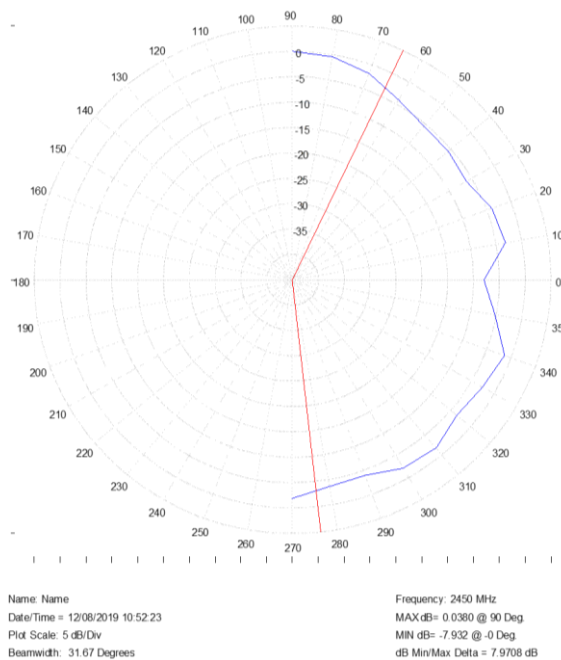


FIGURE 16 2D POLAR PLOT ELEVATION PEAK GAIN – WI-FI ANTENNA

6. Radiated Efficiency and Peak Gain summary

Antenna	Test Frequency MHz	Peak Gain dBi	Efficiency
BT Antenna	2445	1.7	54%
Wi-Fi Antenna	2445	0	50%

TABLE 3 ANTENNA PEAK GAIN & EFFICIENCY

7. Results Observations

7.1. BT Antenna

Measurements of the unmodified Bluetooth antenna show that it is not ideally matched at the BT center frequency. Adding a parallel 3n3H Inductor (C26) and reducing the length of the main antenna element resolved this. During testing, the antenna was cut by 0.2mm, however this was slightly too much for optimum performance. It is therefore recommended that the length is reduced by just 0.1mm

7.2. Wi-Fi Antenna

Measurements of the unmodified Wi-fi antenna show that it is marginally off frequency. Reducing the length of the main antenna element by 0.1mm resolved this. No matching components were necessary.

8. Appendix A– Test configurations

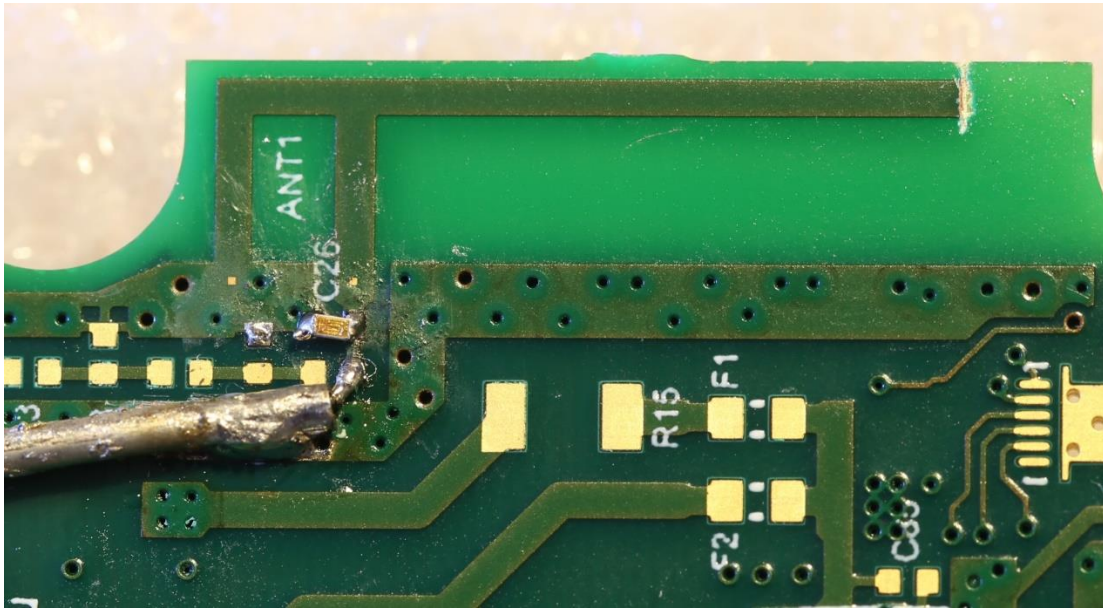


FIGURE 17 CONDUCTED TEST CONFIGURATION FOR BT ANTENNA

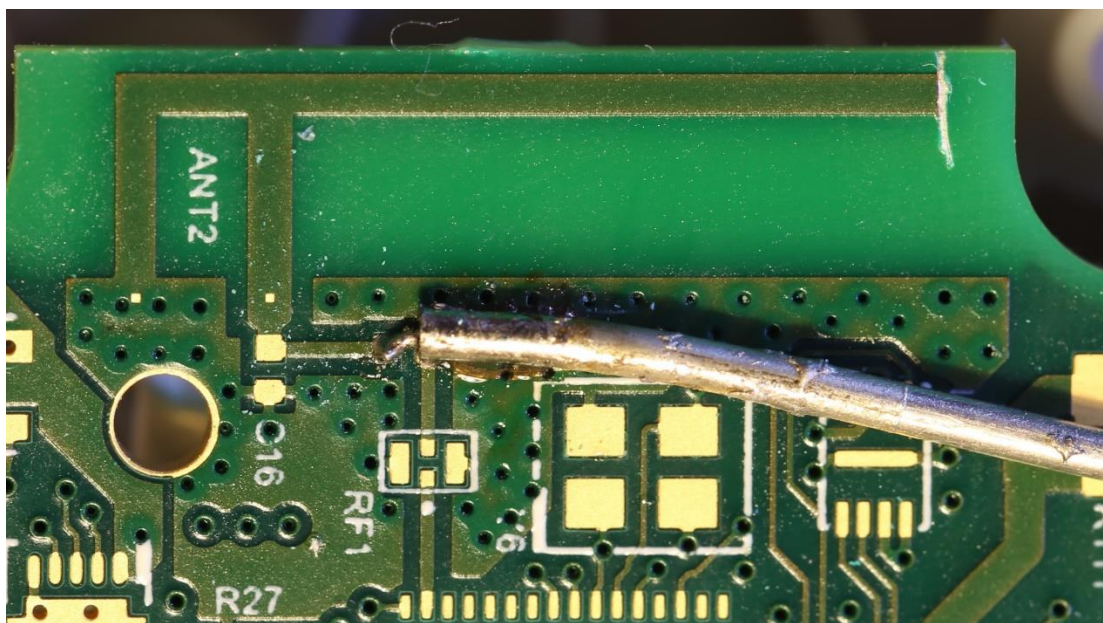


FIGURE 18 CONDUCTED TEST CONFIGURATION FOR WI-FI ANTENNA

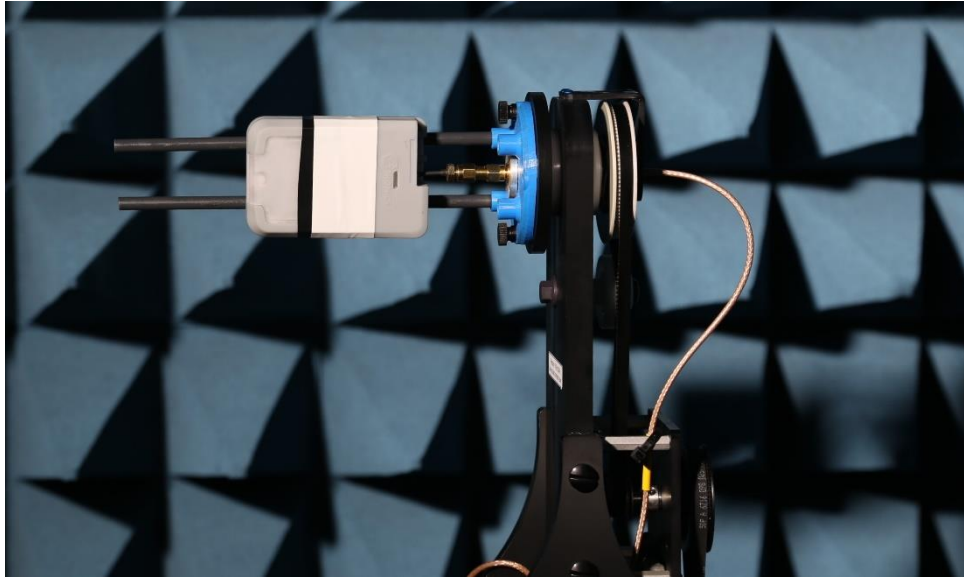


FIGURE 19 CHAMBER TEST CONFIGURATION FOR PLYMOUTH BT AND WI-FI ANTENNAS - SHOWN IN POSITION FOR 0 DEGREES EL VERTICAL CUT