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**
Prepared for:	**Dave Lambert**
Prepared By:	**Andy Knowles (Radtenna Ltd)**
Test Date:	**August 08/12 .2019**

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

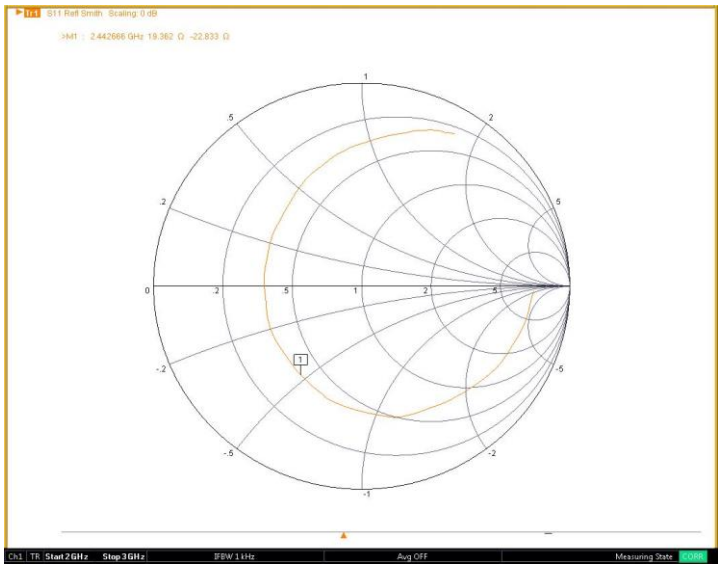

FIGURE 1 SMITH CHART -UNMODIFIED BT ANTENNA

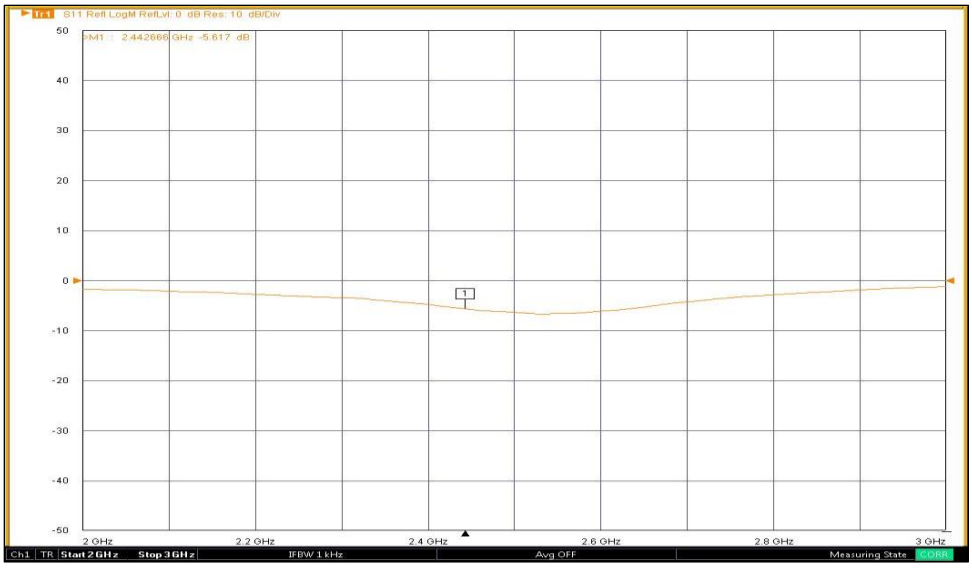

FIGURE 2 MAGNITUDE PLOT – UNMODIFIED BT ANTENNA

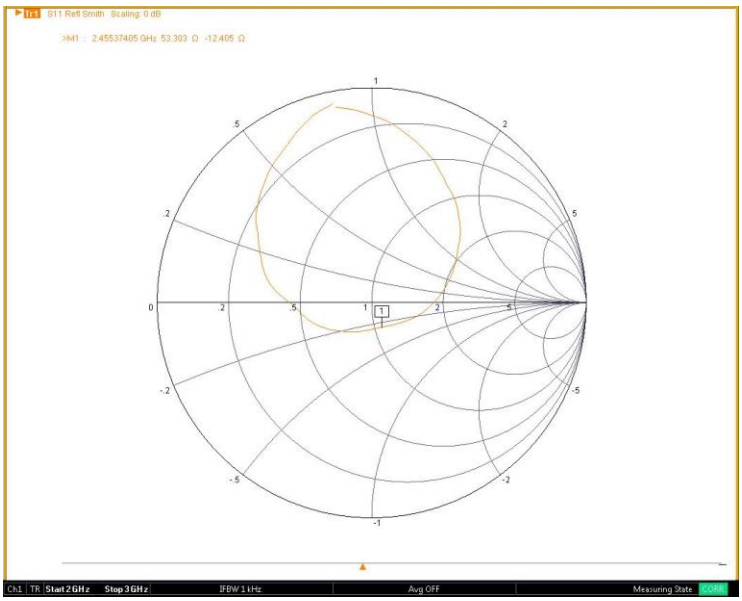

FIGURE 3 SMITH CHART -TUNED BT ANTENNA (C26 = 3N3 INDUCTOR & LENGTH REDUCED BY 0.2MM)

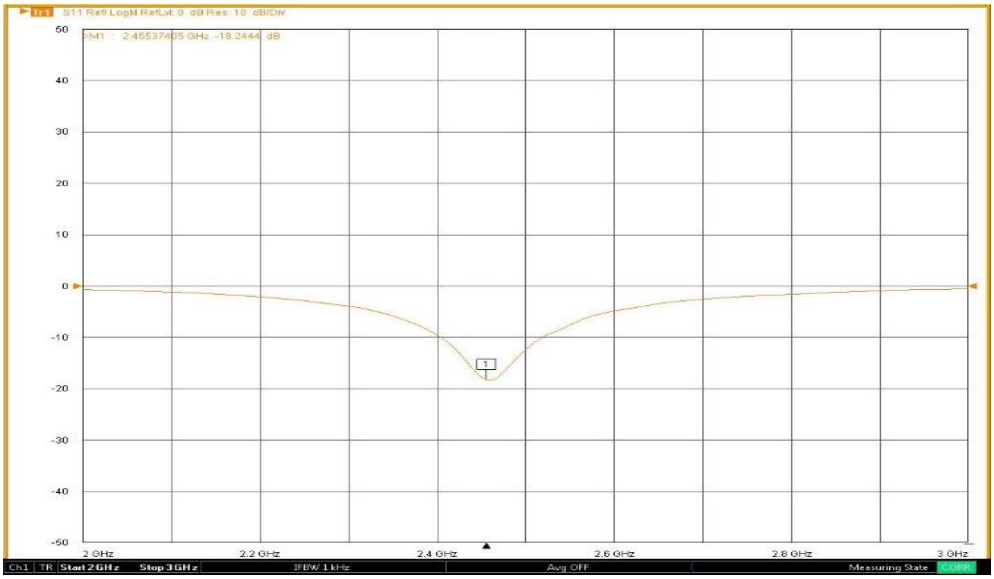

FIGURE 4 MAGNITUDE PLOT - TUNED BT ANTENNA (C26 = 3N3 INDUCTOR & LENGTH REDUCED BY 0.2MM)

4.2. Wi-Fi Antenna

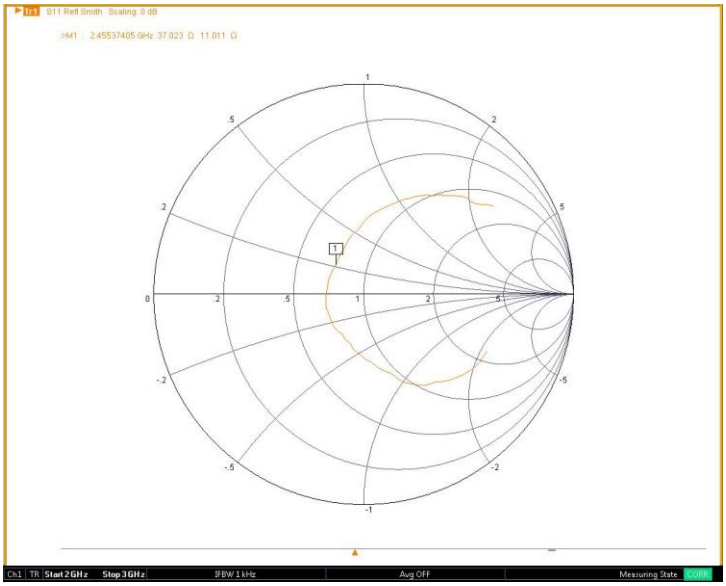

FIGURE 5 SMITH CHART -UNMODIFIED WI-FI ANTENNA

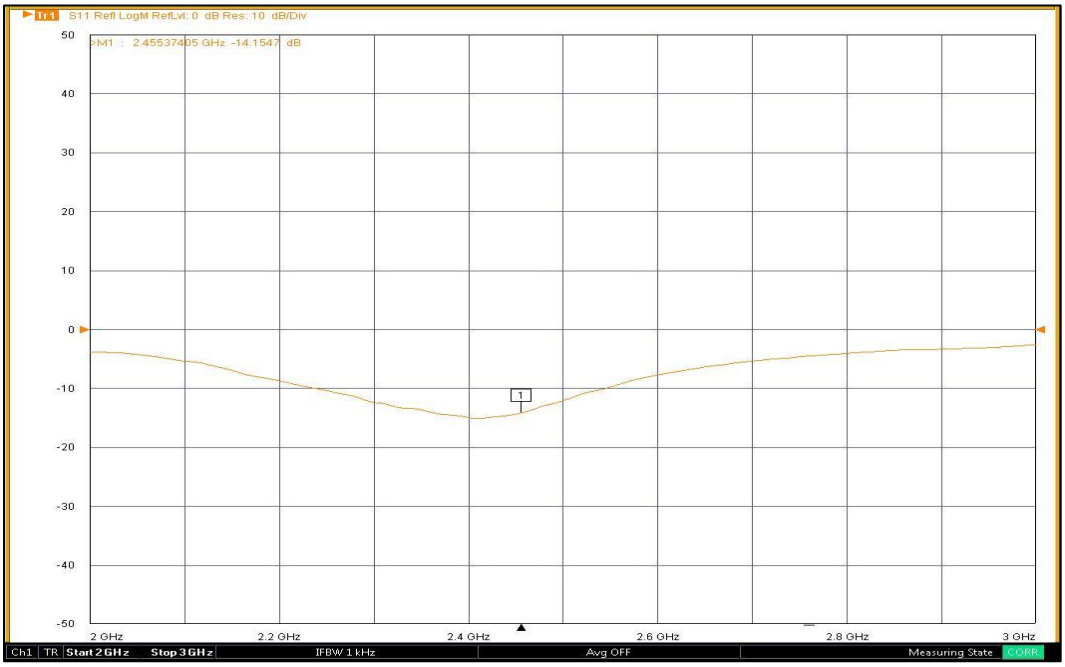

FIGURE 6 MAGNITUDE PLOT – UNMODIFIED WI-FI ANTENNA

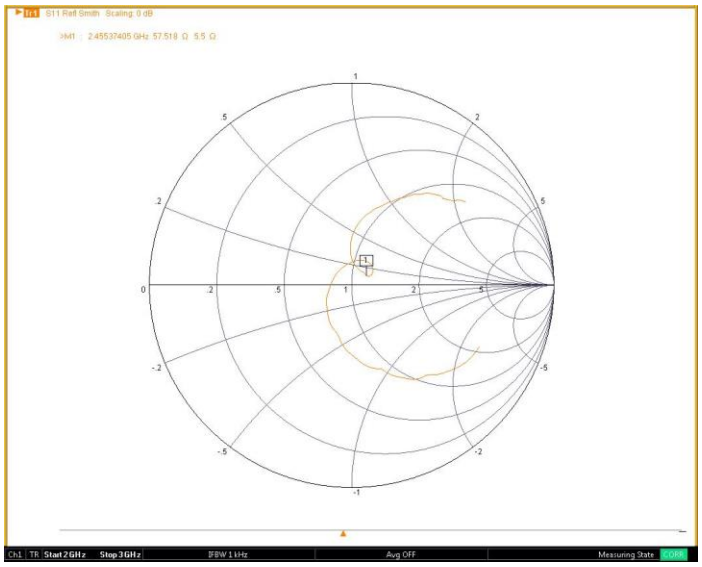

FIGURE 7 SMITH CHART -TUNED BT ANTENNA (LENGTH REDUCED BY 0.1MM)

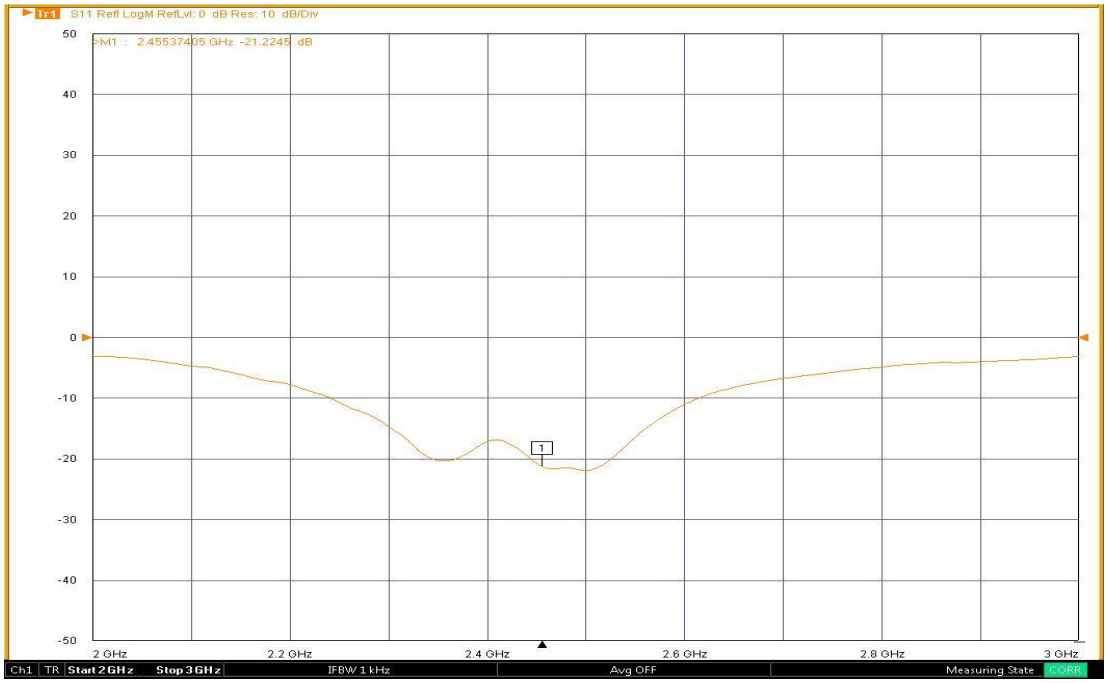

FIGURE 8 MAGNITUDE PLOT - TUNED BT ANTENNA (LENGTH REDUCED BY 0.1MM)

5. Radiated Test Results

5.1. BT Antenna

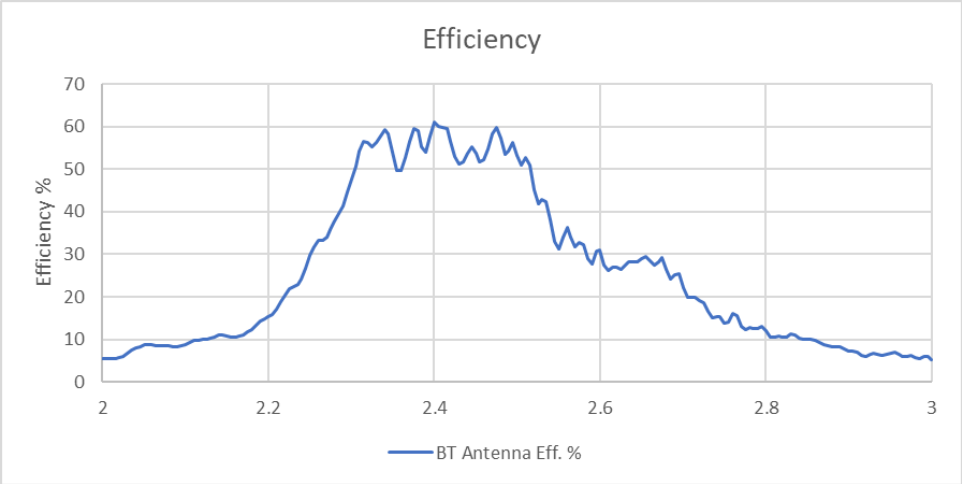

FIGURE 9 EFFICIENCY – BT ANTENNA

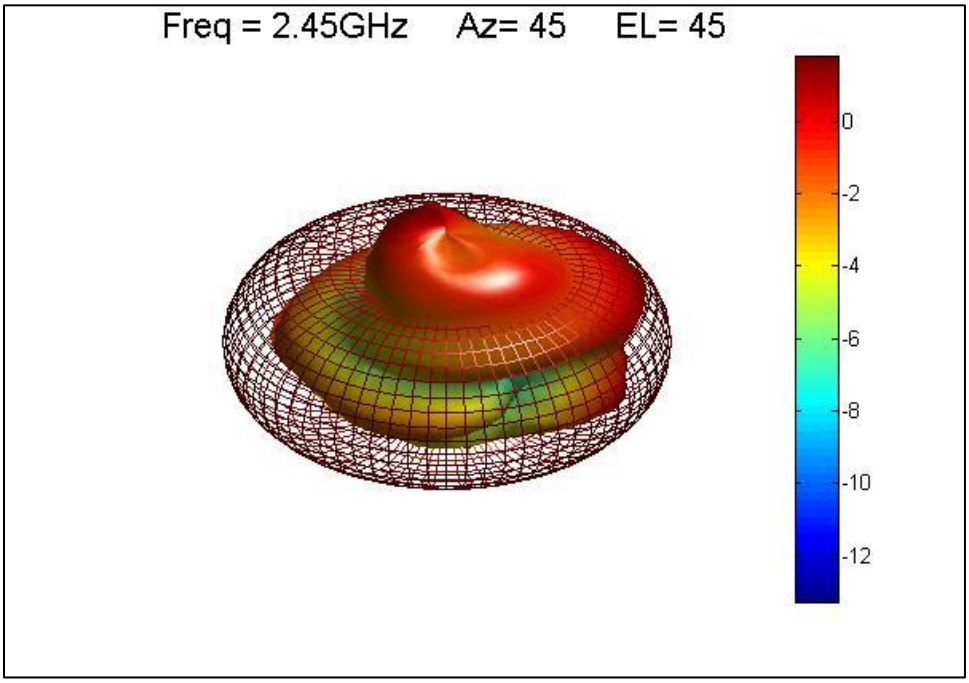

FIGURE 10 3D SCAN PLOT – BT ANTENNA

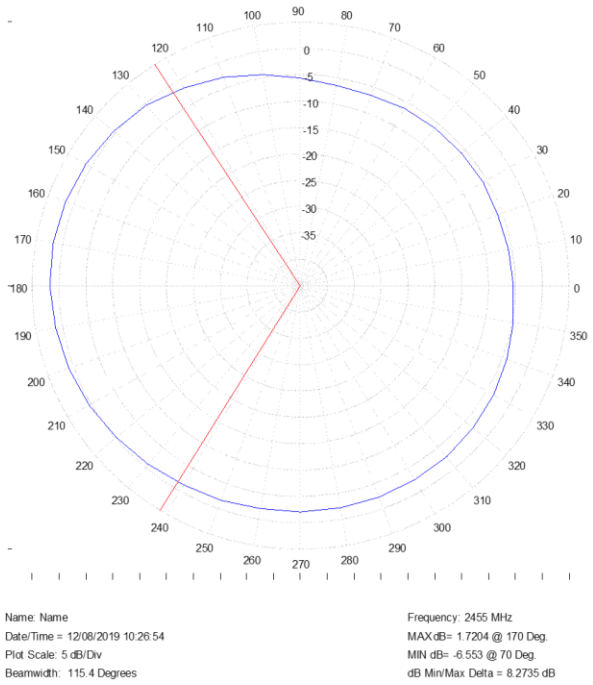

FIGURE 11 2D POLAR PLOT AZIMUTH PEAK GAIN – BT ANTENNA

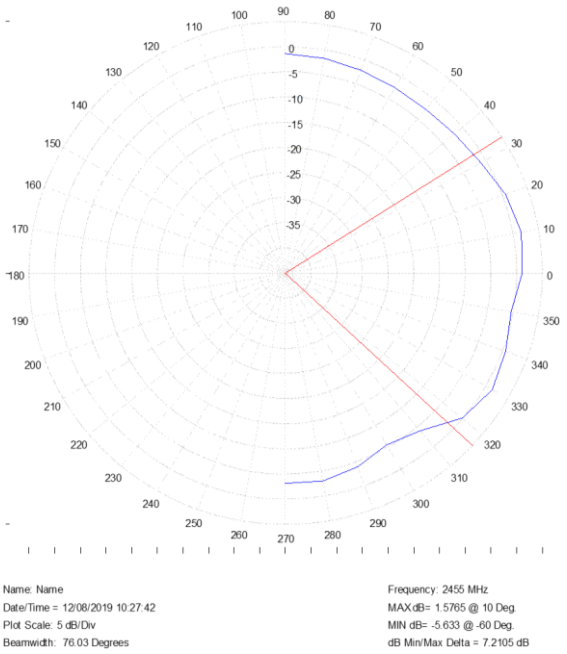

FIGURE 12 2D POLAR PLOT ELEVATION PEAK GAIN – BT ANTENNA

5.2. Wi-Fi Antenna

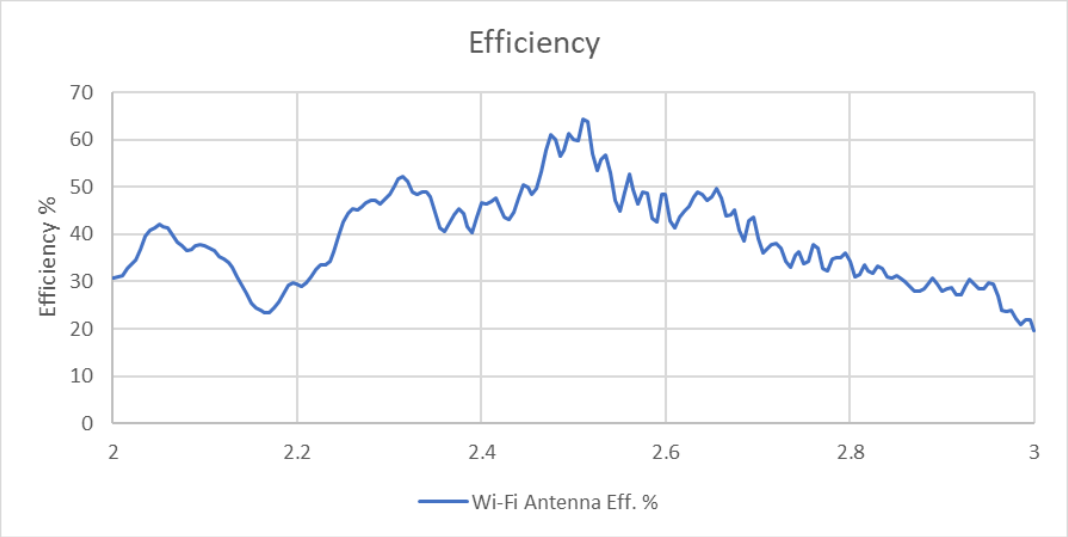

FIGURE 13 EFFICIENCY – WI-FI ANTENNA

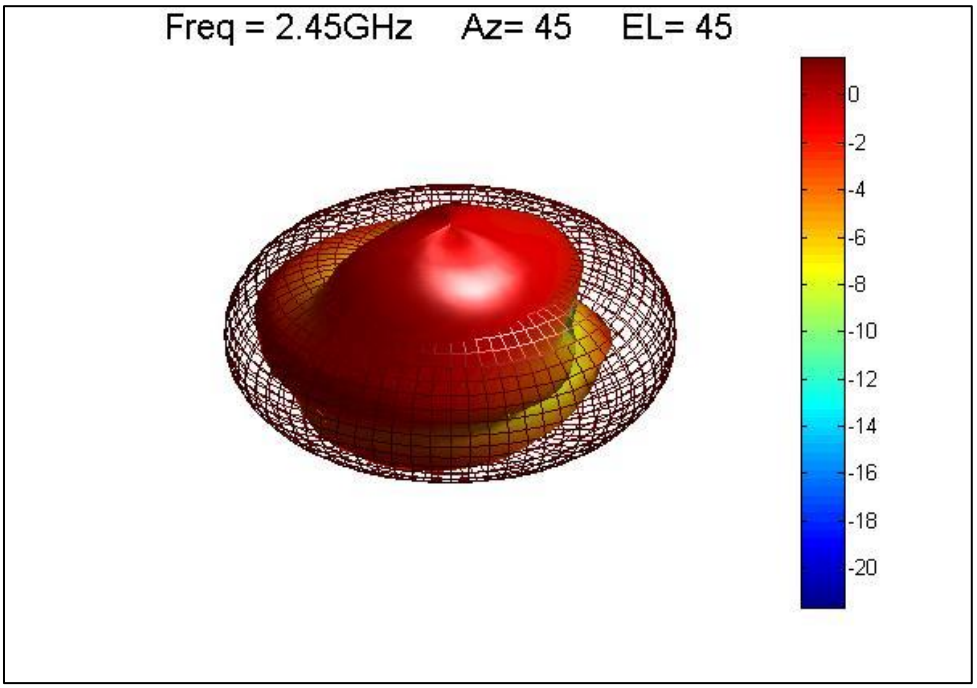

FIGURE 14 3D SCAN PLOT – WI-FI ANTENNA

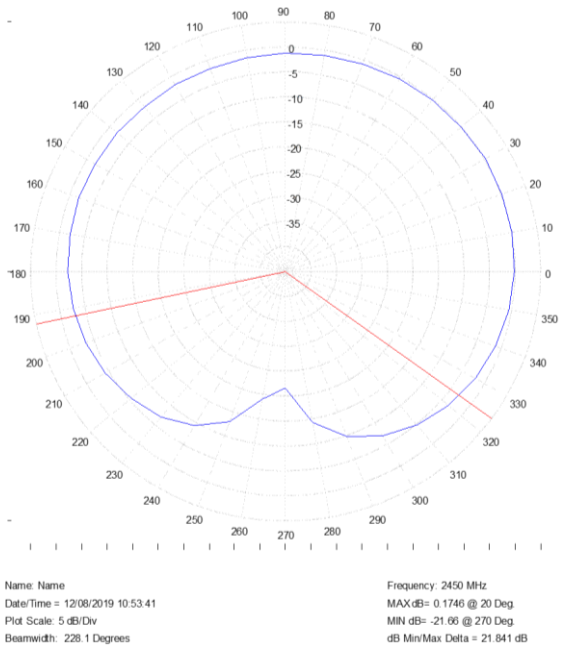

FIGURE 15 2D POLAR PLOT AZIMUTH PEAK GAIN – WI-FI ANTENNA

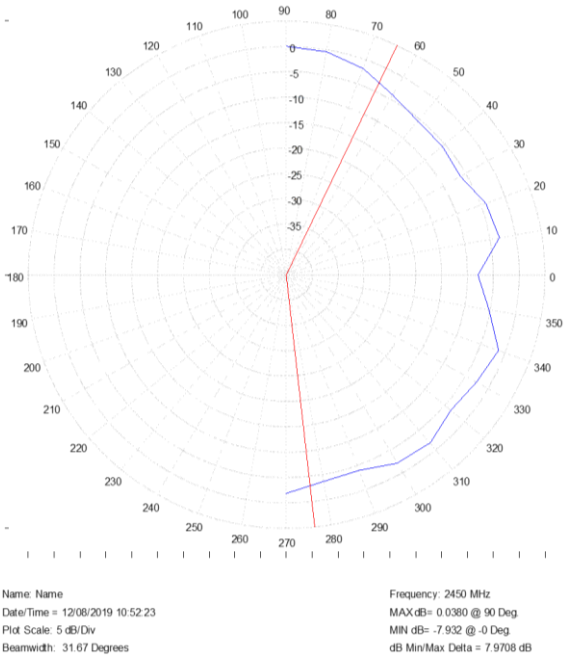

FIGURE 16 2D POLAR PLOT ELEVATION PEAK GAIN – WI-FI ANTENNA

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

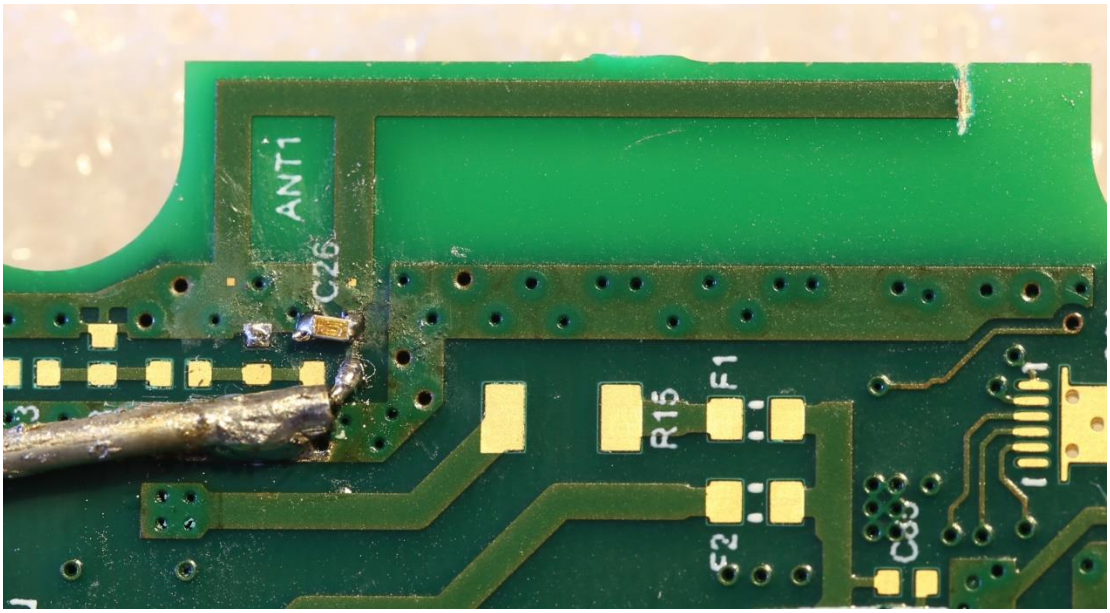

FIGURE 17 CONDUCTED TEST CONFIGURATION FOR BT ANTENNA

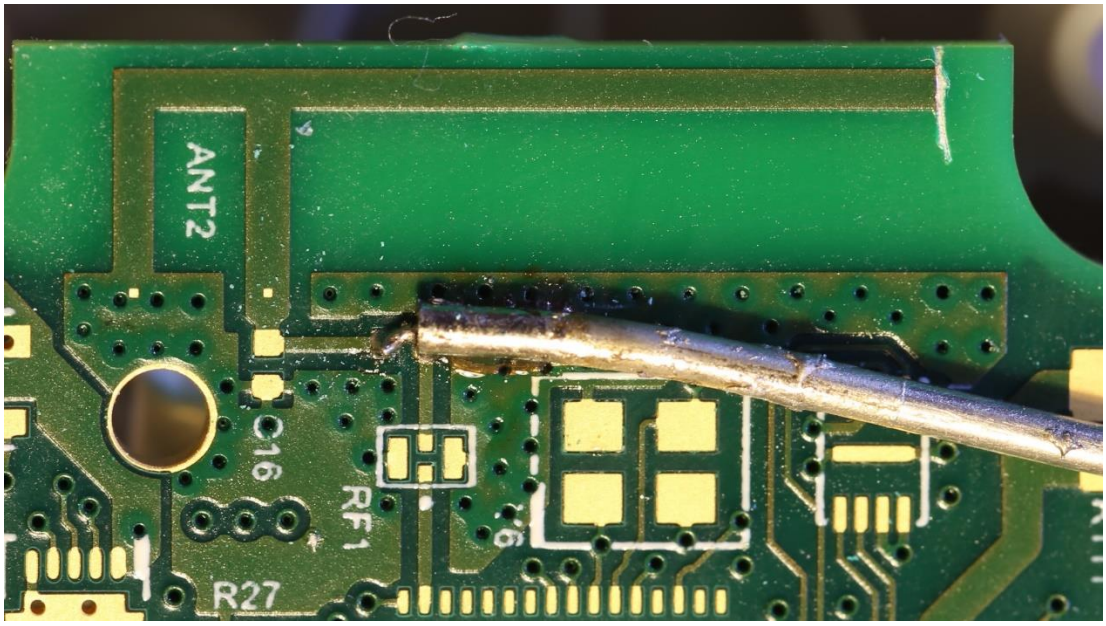

FIGURE 18 CONDUCTED TEST CONFIGURATION FOR WI-FI ANTENNA

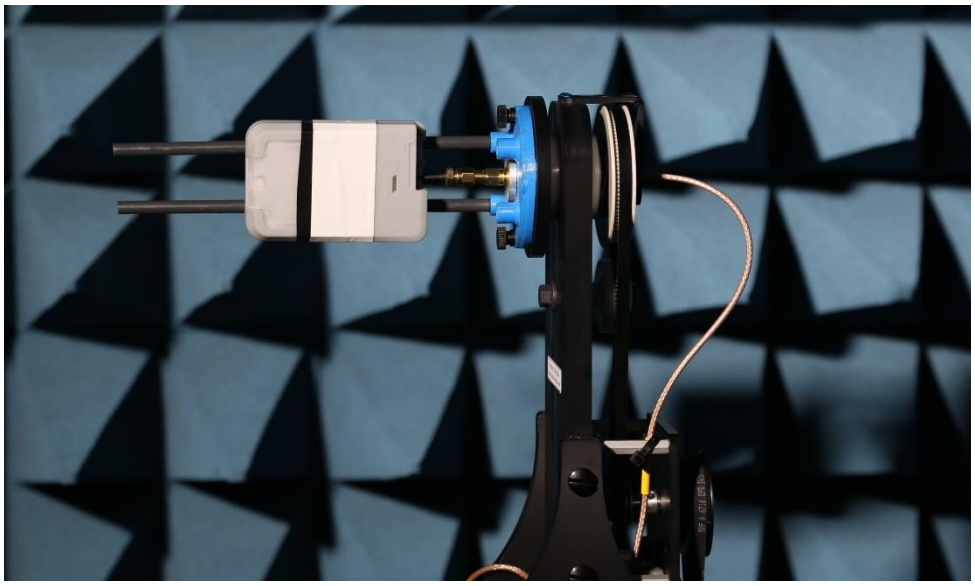

FIGURE 19 CHAMBER TEST CONFIGURATION FOR PLYMOUTH BT AND WI-FI ANTENNAS - SHOWN IN POSITION FOR 0 DEGREES EL VERTICAL CUT