TEST REPORT

Product Type:	**Cycle BT Controller on AL/CF frame**
Company Name:	**SRAM GE**
Project:	**Apollo**
Report No:	**RL/2021/90B**
Issue Date:	**August 12 .2021**
Prepared for:	**Sven Baumann**
Test Engineer:	**Andy Knowles (Radtenna Ltd)**
Test Date:	**August 04/05/11 .2021**

Test Engineer Signature:

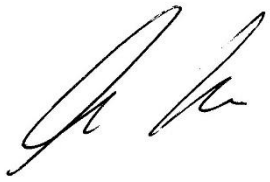

FIGURE 1 PRODUCT UUT

1. Test Description

Conducted and Radiated testing of SRAM Bluetooth Cycle Controller fitted to Aluminum and Carbon Fiber cycle frame material. For the Aluminum frame, the antenna was tested in both the open and blocked tube condition.

Radiated testing used the products internal BTE IC to provide the RF test source. The conducted TX power was measured at -2dB at 2426 MHz

2. Test Equipment

Conducted tests				
Equipment	**Manufacturer**	**Model**	**Serial No**	**Cal Due Date**
VNA	Anritsu	MS46122A	1511303	26/07/2022

TABLE 1 CONDUCTED MEASUREMENT EQUIPMENT

Radiated Tests				
Equipment	**Manufacturer**	**Model**	**Serial No**	**Cal Due Date**
VNA	Anritsu	MS46122A	1511303	26/07/2022
Ref Antenna	RF Echo	OBH - 690	D20-4005901	19/10/2022
Positioner	Dimond Engineering	DAMS 6000	N/A	N/A
RF Chamber	Radtenna	SIDRAT 1.5 m x 2.5 m	N/A	N/A

TABLE 2 RADIATED TEST SITE EQUIPMENT

3. Modification

The supplied antenna was modified as shown in Figure 2

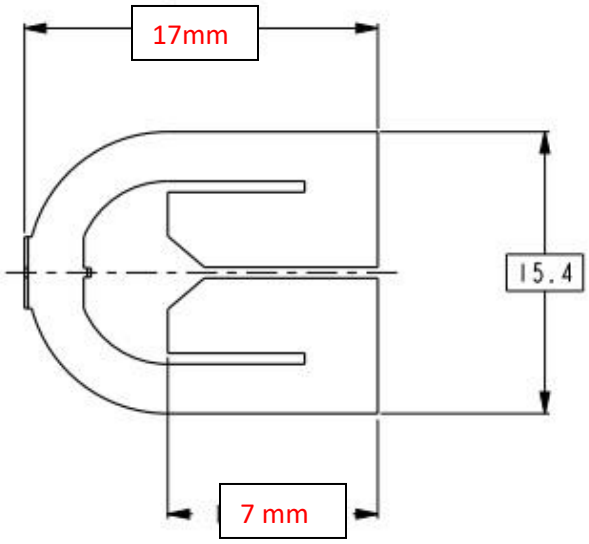

FIGURE 2 ANTENNA MODIFICATION

FIGURE 3 MODIFIED UNIT

4. Conducted tests

4.1. Unit on Aluminum and Carbon Fiber frames

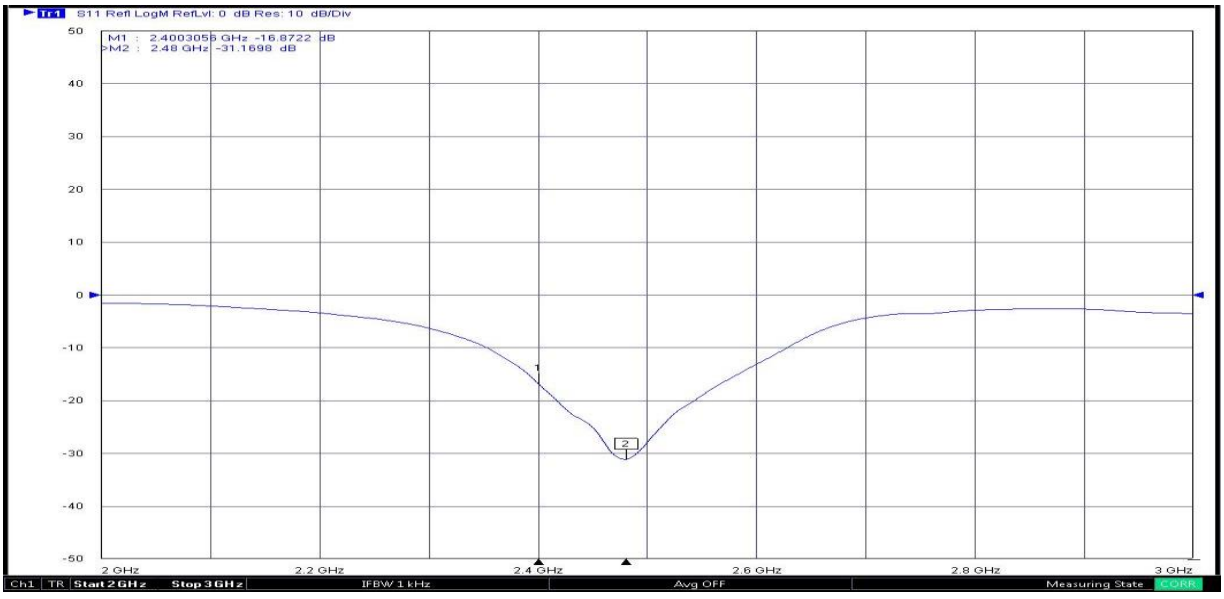

FIGURE 4 MODIFIED SAMPLE UNIT, ON ALUMINUM FRAME

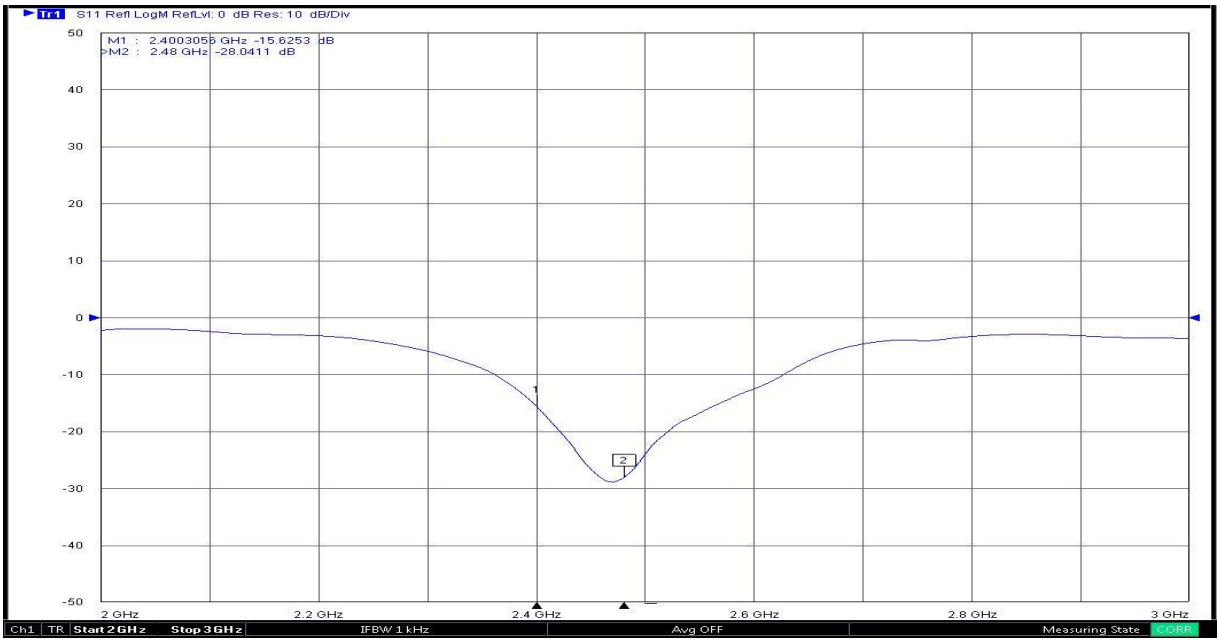

FIGURE 5 MODIFIED SAMPLE UNIT, ON CARBON FIBER FRAME

6. Radiated efficiency and peak gain

Test Condition	Peak Gain	Efficiency
2402 MHz	-2.6 dBi	35%
2426 MHz	-3.6 dBi	33%
2480 MHz	-5.5 dBi	28%

TABLE 3 ALUMINUM FRAME

Test Condition	Peak Gain	Efficiency
2402 MHz	-0.5 dBi	36%
2426 MHz	-0.7 dBi	34%
2480 MHz	-1.3 dBi	29%

TABLE 4 COVERED ALUMINUM FRAME

Test Condition	Peak Gain	Efficiency
2402 MHz	0.3 dBi	38%
2426 MHz	0.3dBi	37%
2480 MHz	-1.6 dBi	30%

TABLE 5 CARBON FIBER FRAME

Note: Peak gain shown in tables above may not align with peak gain shown in 2D polar plots. This is because the peak may not have occurred in the 0° Elevation position and was therefore not captured in the Azimuth rotation @ 0° Elevation.

7. Results observations

Modification of the antenna as detailed in section 3 increases the resonate frequency and brings it on center in the desired 2.4GHz BLE frequency band.

Antenna radiation measurements show that the antenna is horizontally polarized and performs similarly on both Aluminum and Carbon Fiber frames, with a channel dependent efficiency of between 30% - 40%, which is in line with expectations.

8. Appendix – Test configuration

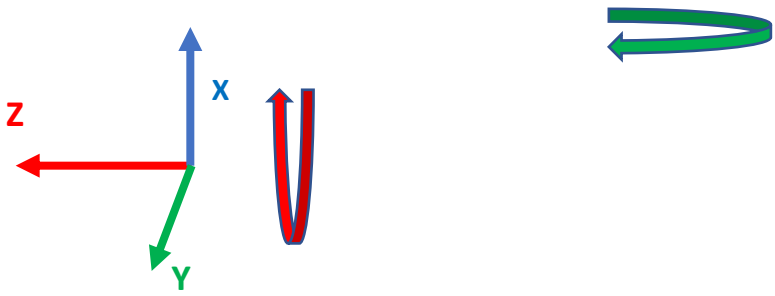

FIGURE 18 CHAMBER TEST CONFIGURATION, ALUMINUM FRAME- SHOWN IN POSITION FOR 0 DEGREES EL, 0 DEGREES AZ

FIGURE 19 CHAMBER TEST CONFIGURATION, COVERED ALUMINUM FRAME- SHOWN IN POSITION FOR 0 DEGREES EL, 0 DEGREES AZ

FIGURE 20 CHAMBER TEST CONFIGURATION, CARBON FIBER FRAME -SHOWN IN POSITION FOR 0 DEGREES EL, 0 DEGREES AZ

With reference to **FIGURE 18**, the green arrow shows the direction for rotation in the Elevation plane and the Red arrow shows the direction for rotation in the Azimuth plane.