GPS/WIFI (2.4/5GHZ) COMBO BALANCE FLEX ANTENNA

1.0 SCOPE

This specification describes the antenna application and surrounding. The information in this document is for reference and benchmark purposes only. The user is responsible for validating antenna RF performance based on the user's actual implementation.

All measurements are done of the antenna mounted on a PC/ABS material block of 1mm thickness with VNA Agilent 5071C and OTA chamber. All measurements are done with the part no. 146186-0100 with a cable length of 100mm.

Antenna illustrations in this document are generic representations. They are not intended to be an image of any antenna listed in the scope.

2.0 PRODUCT DESCRIPTION

A. DEFINITIONS OF TERMS

The overall antenna size is 53mm*18mm (figure 1).

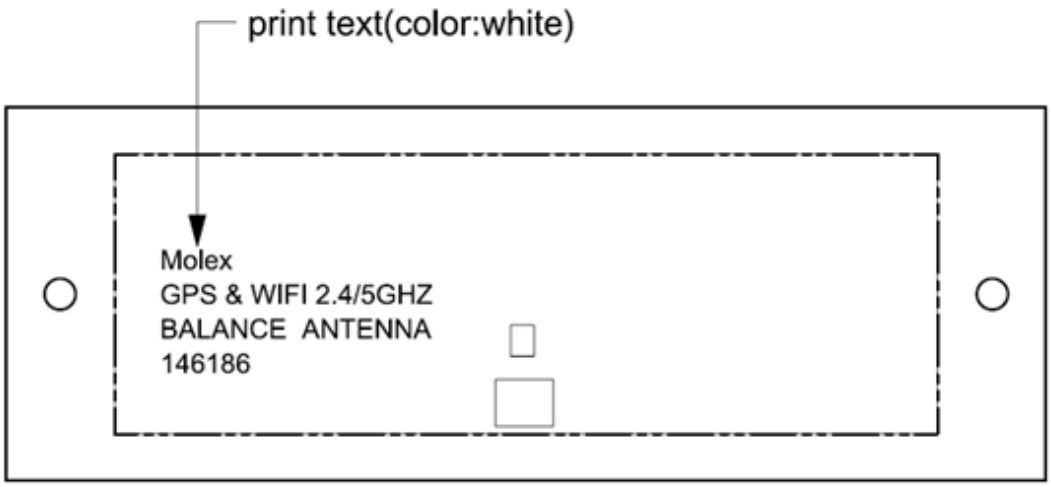


FIGURE 1. DIMENSION OF THE GPS/WIFI (2.4/5GHZ) COMBO BALANCE FLEX ANTENNA

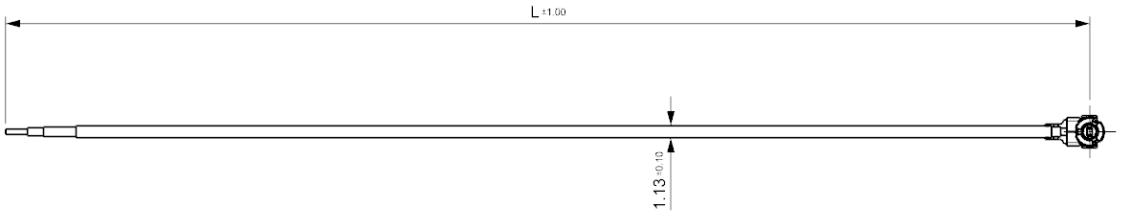


FIGURE 2. CABLE LINE VIEW OF GPS/WIFI (2.4/5GHZ) COMBO BALANCE FLEX ANTENNA

B. RF PERFORMANCE OF ANTENNA LOADED WITH PC/ABS MATERIAL BLOCK OF 1MM THICKNESS IN FREE SPACE

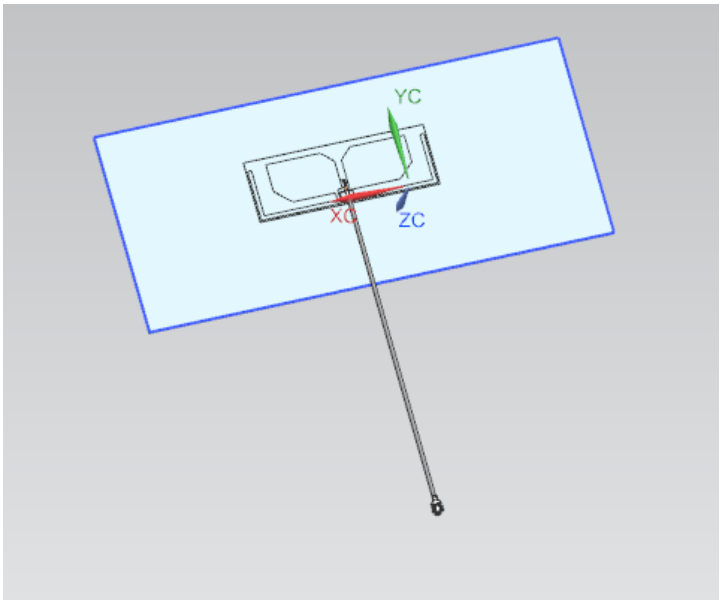
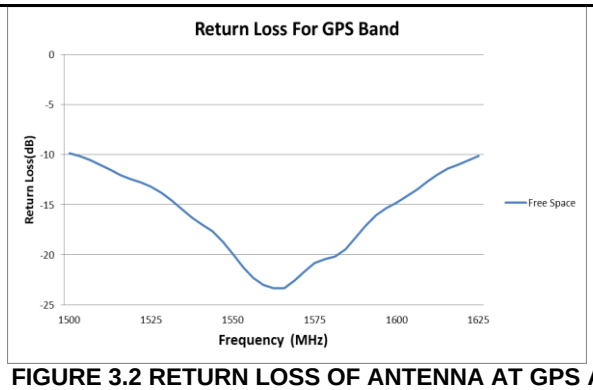


FIGURE3.1 ANTENNA LOADED WITH PC/ABS BLOCK OF 1MM THICKNESS

DESCRIPTION	TEST CONDITION	REQUIREMENTS			
Frequency Range	1575.42MHz~1602MHz / 2.4GHz~6GHz	1575.42-1602MHz	2.4-2.5GHz	5.15-5.85GHz	3-6GHz
Return Loss	Antenna loads on PC/ABS housing (thickness 1mm) with 100mm; 1.13mm diameter micro coax cable. Measured by VNA5071C	< -10 dB			
Peak Gain	Measure antenna on recommended PC/ABS housing through OTA chamber	3.0 dBi	3.0 dBi	4.0 dBi	4.7dBi
Total Efficiency	Measure antenna on recommended PC/ABS housing through OTA chamber	>70%	>75%	>70%	>80%
Polarization	Measure antenna through the OTA chamber	Linear			
Input Impedance	Measure antenna on recommended PC/ABS housing through VNA E5071C	50 Ohms			



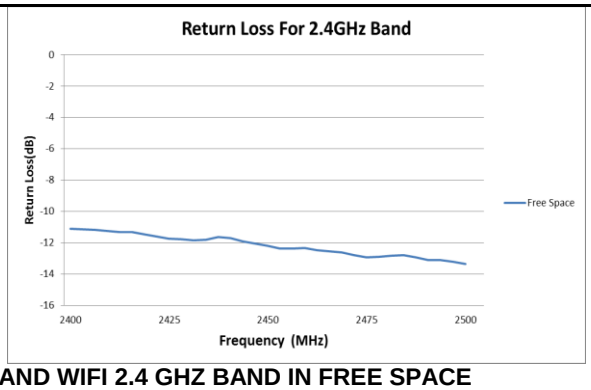
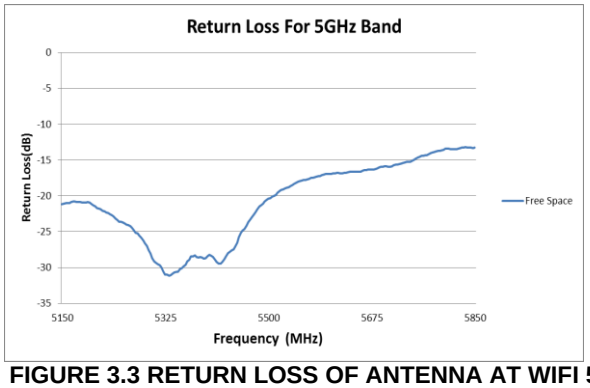


FIGURE 3.2 RETURN LOSS OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND IN FREE SPACE



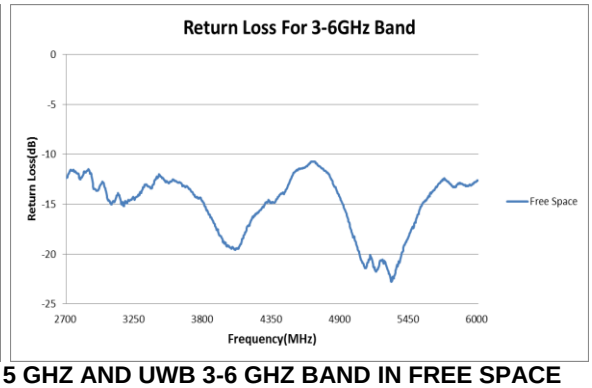
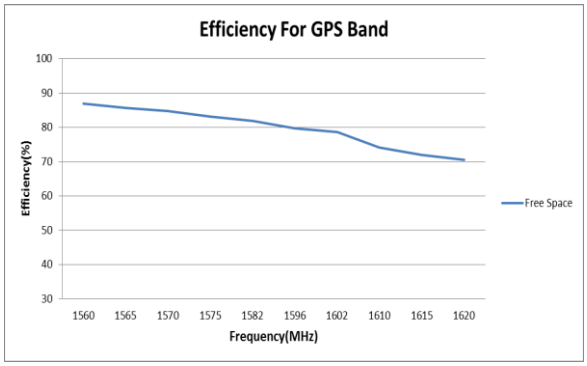


FIGURE 3.3 RETURN LOSS OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND IN FREE SPACE



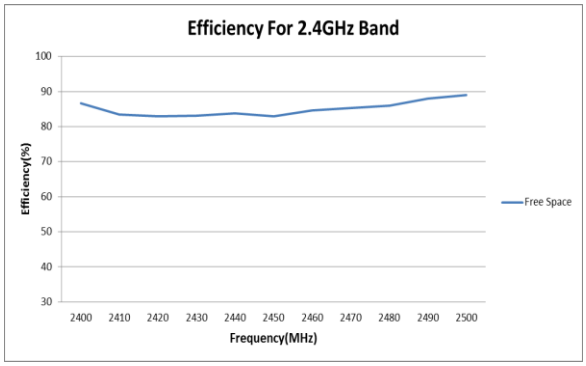
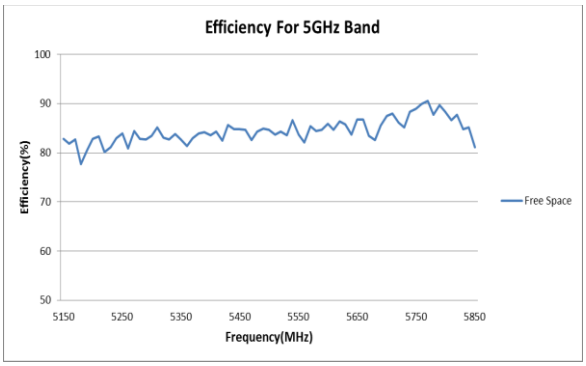


FIGURE 3.4 EFFICIENCY OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND IN FREE SPACE



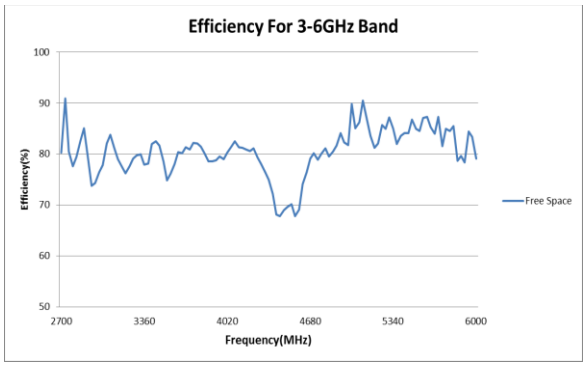


FIGURE 3.5 EFFICIENCY OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND IN FREE SPACE

3.0 REFERENCE DOCUMENTS

- ENGINEERING DRAWING – AS-146186-100
- PRODUCT SPECIFICATION – PS-146186-100
- PACKAGING INFORMATION – REFER TO THE MOLEX RELATED PACKAGING DRAWINGS.

4.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

4.1 ANTENNA RF PERFORMANCE AS A FUNCTION OF DIFFERENT LOCATIONS WITH PARALLEL GROUND

Four ground locations with parallel ground have been evaluated and these locations are shown in figure 4.1. The PCB size is 90mm*90mm and we move the PCB to four locations for each test. The antenna performance is better with larger distance between antenna and parallel ground. The minimum distance between antenna and PCB ground is recommended to be 20mm to achieve acceptable RF performance.

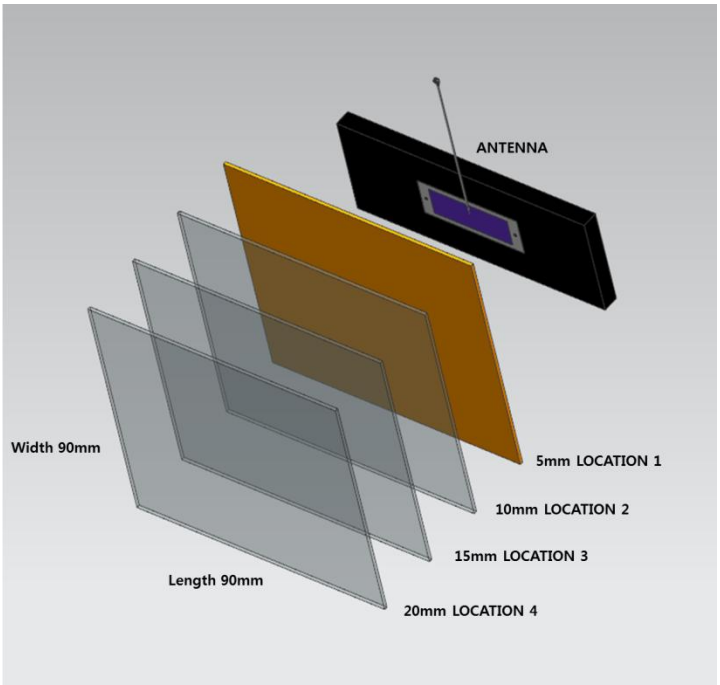


FIGURE 4.1 FOUR LOCATIONS WITH PARALLEL GROUND

Ground Size: 90mm*90mm
Location 1: Distance between antenna and ground is about 5mm.
Location 2: Distance between antenna and ground is about 10mm
Location 3: Distance between antenna and ground is about 15mm.
Location 4: Distance between antenna and ground is about 20mm.

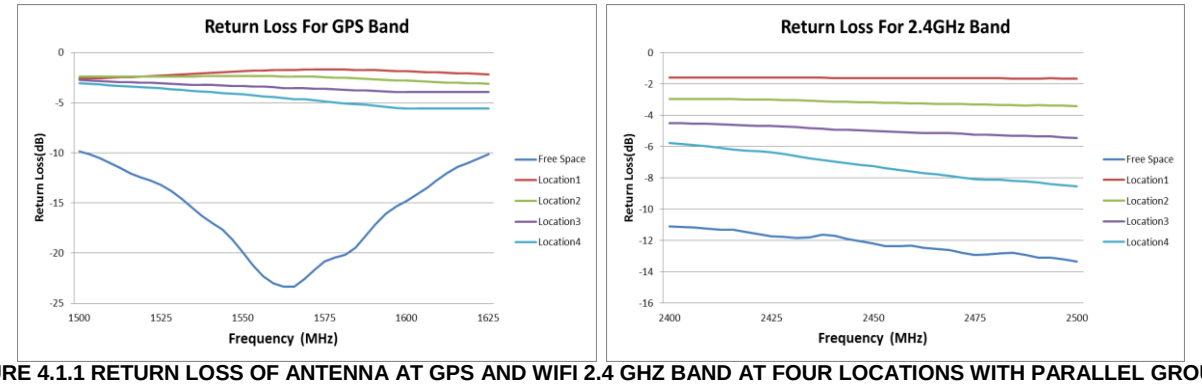


FIGURE 4.1.1 RETURN LOSS OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND AT FOUR LOCATIONS WITH PARALLEL GROUND

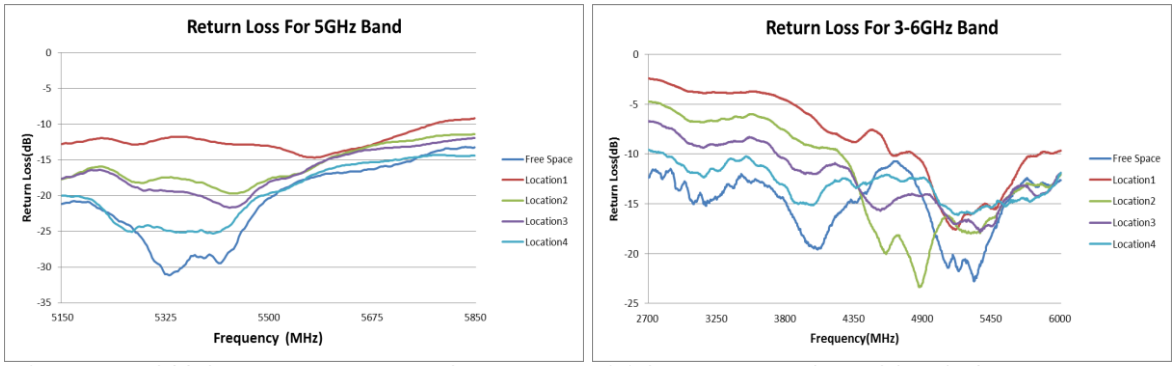


FIGURE 4.1.2 RETURN LOSS OF ANTENNA AT WIFI 5GHZ AND UWB 3-6 GHZ BAND AT FOUR LOCATIONS WITH PARALLEL GROUND

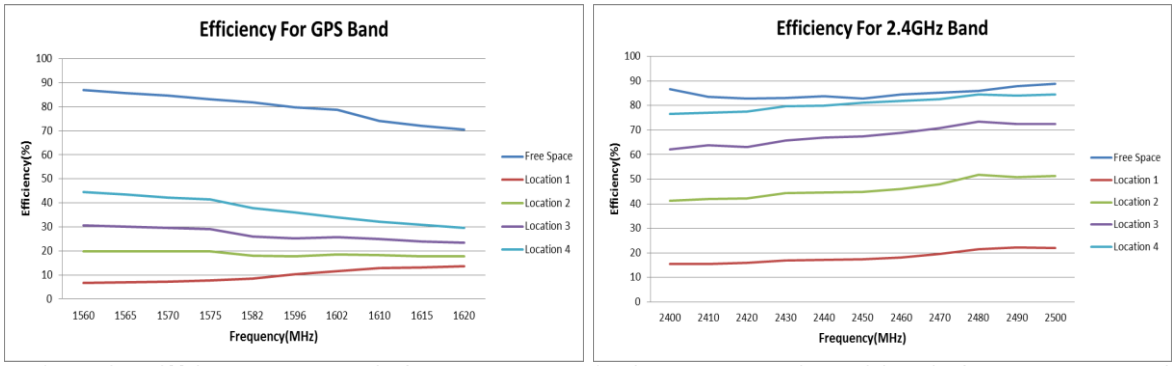


FIGURE 4.1.3 EFFICIENCY OF ANTENNA AT GPS BAND AND WIFI 2.4 GHZ BAND AT FOUR LOCATIONS WITH PARALLEL GROUND

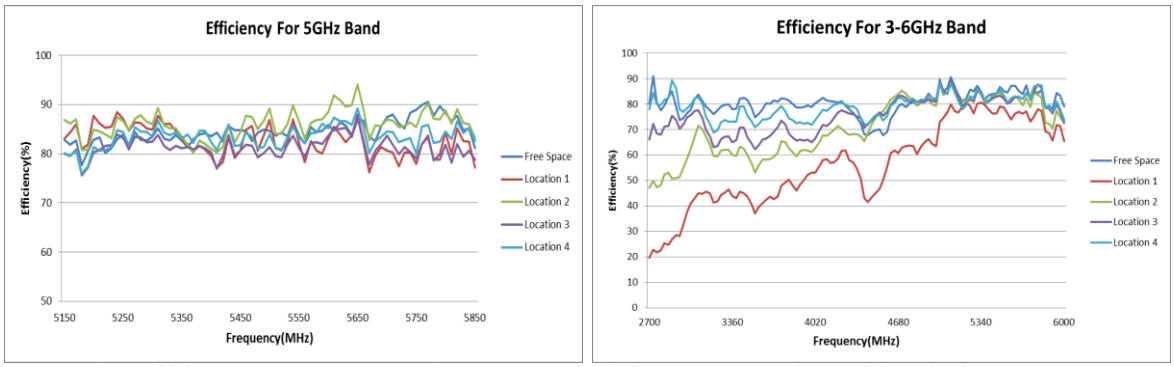


FIGURE 4.1.4 EFFICIENCY OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND AT FOUR LOCATIONS WITH PARALLEL GROUND

4.2 ANTENNA RF PERFORMANCE AS A FUNCTION OF DIFFERENT LOCATIONS WITH VERTICAL GROUND

Four ground locations with vertical ground have been evaluated and these locations are shown in figure 4.2. The PCB size is 90mm*90mm and we move the PCB to four locations for each test. The minimum distance between antenna and PCB ground is recommended to be 20mm to achieve good RF performance.

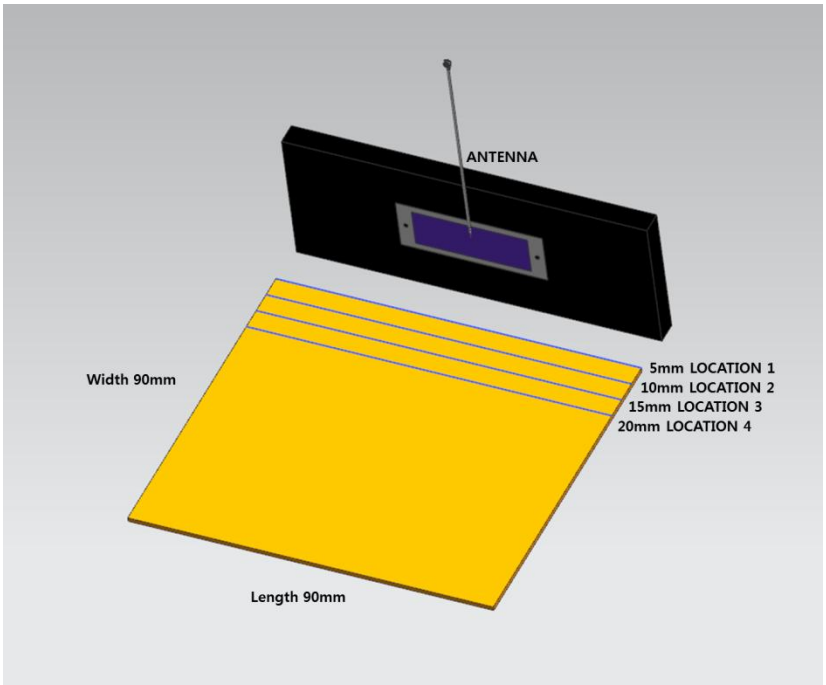


FIGURE 4.2 FOUR LOCATIONS WITH VERTICAL GROUND

Ground Size: 90mm*90mm
Location 1: Distance between antenna and ground is about 5mm
Location 2: Distance between antenna and ground is about 10mm.
Location 3: Distance between antenna and ground is about 15mm.
Location 4: Distance between antenna and ground is about 20mm.

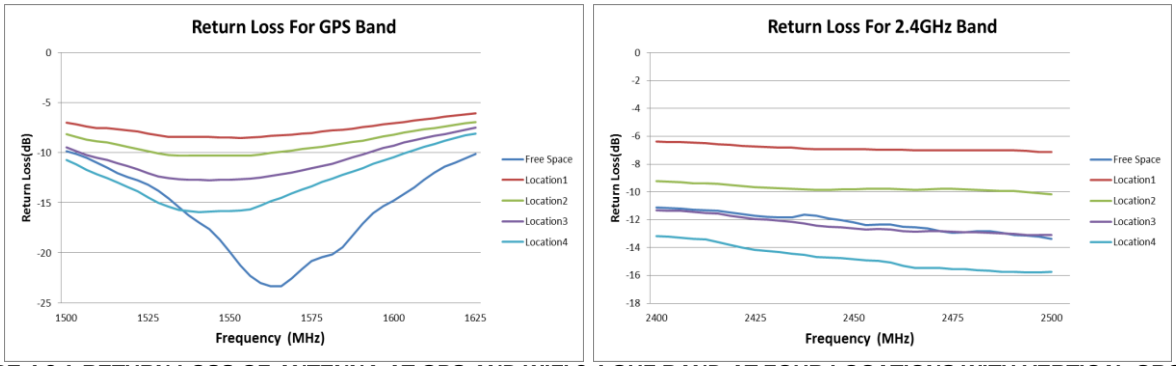


FIGURE 4.2.1 RETURN LOSS OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND AT FOUR LOCATIONS WITH VERTICAL GROUND

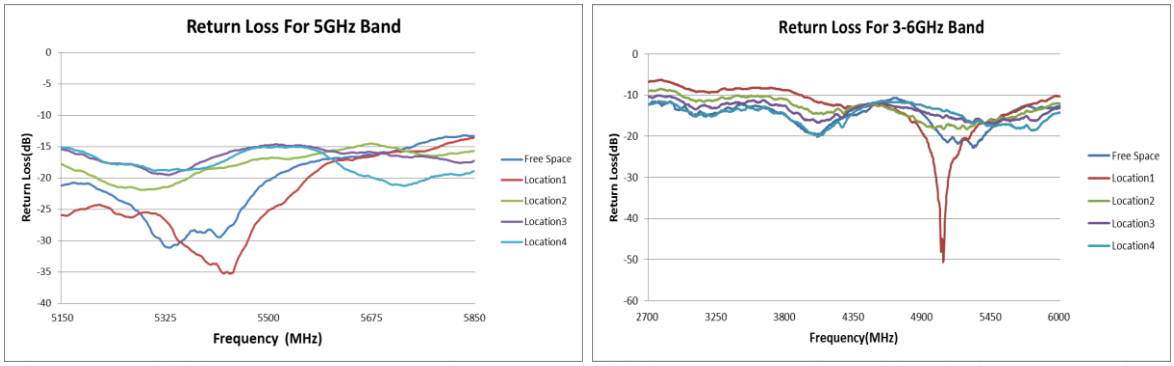


FIGURE 4.2.2 RETURN LOSS OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND AT FOUR LOCATIONS WITH VERTICAL GROUND

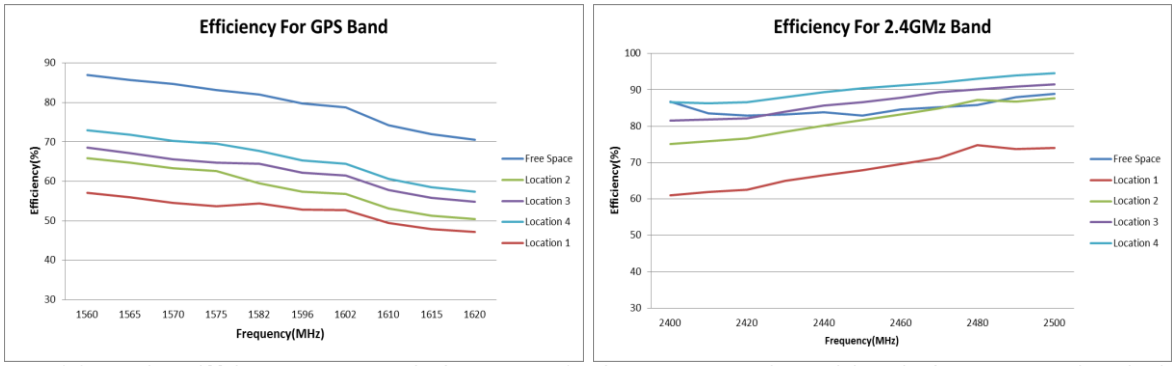


FIGURE 4.2.3 EFFICIENCY OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND AT FOUR LOCATIONS WITH VERTICAL GROUND

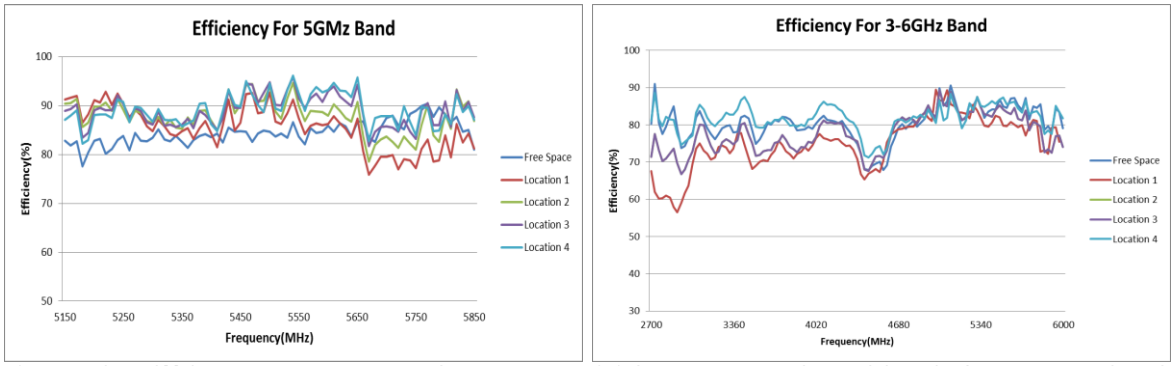


FIGURE 4.2.4 EFFICIENCY OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND AT FOUR LOCATIONS WITH VERTICAL GROUND

4.3 ANTENNA RF PERFORMANCE AS A FUNCTION OF DIFFERENT DISTANCE TO THE GROUND IN THE SAME PLANE AS THE ANTENNA

Four ground locations with same plane ground have been evaluated and these locations are shown in figure 4.3. The PCB size is 90mm*90mm and we move the PCB to four locations for each test. The antenna performance is better with larger distance between antenna and parallel ground. The minimum distance between antenna and PCB ground is recommended to be 20mm to achieve acceptable RF performance.

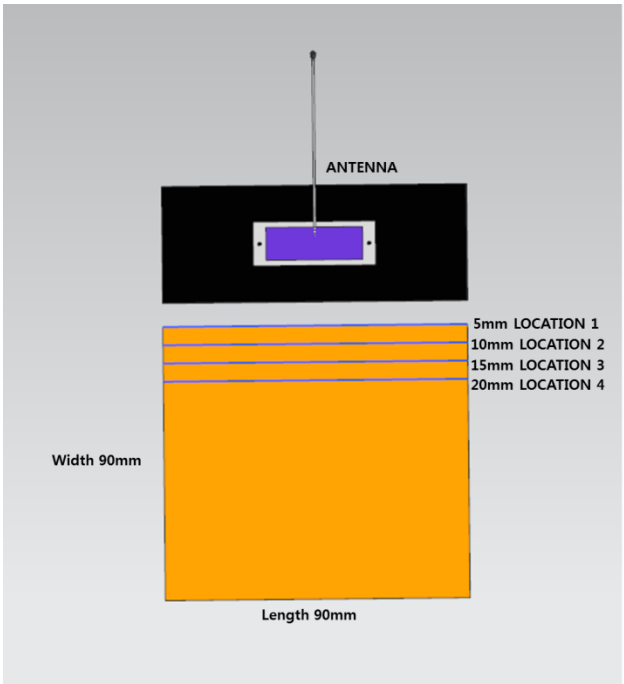


FIGURE 4.3 FOUR LOCATIONS WITH SAME PLANE GROUND

Ground Size: 90mm*90mm
Location 1: Distance between antenna and ground is about 5mm.
Location 2: Distance between antenna and ground is about 10mm
Location 3: Distance between antenna and ground is about 15mm.
Location 4: Distance between antenna and ground is about 20mm.

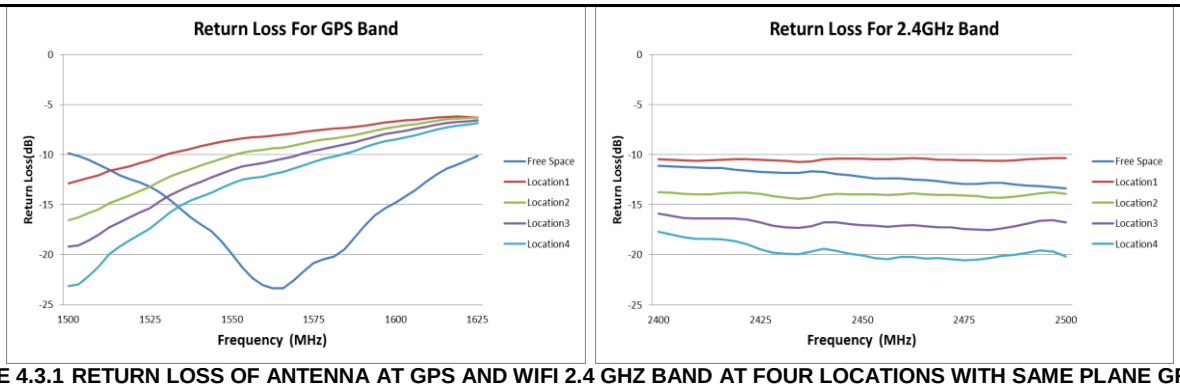


FIGURE 4.3.1 RETURN LOSS OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND AT FOUR LOCATIONS WITH SAME PLANE GROUND

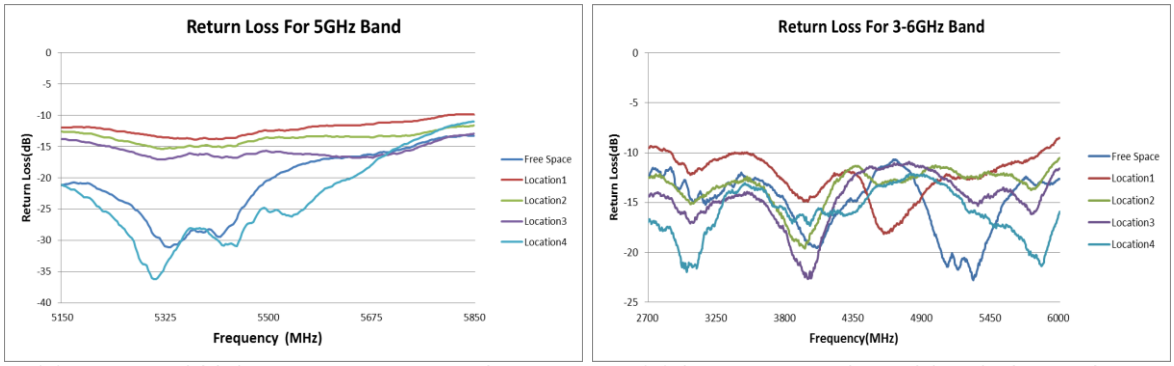


FIGURE 4.3.2 RETURN LOSS OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND AT FOUR LOCATIONS WITH SAME PLANE GROUND

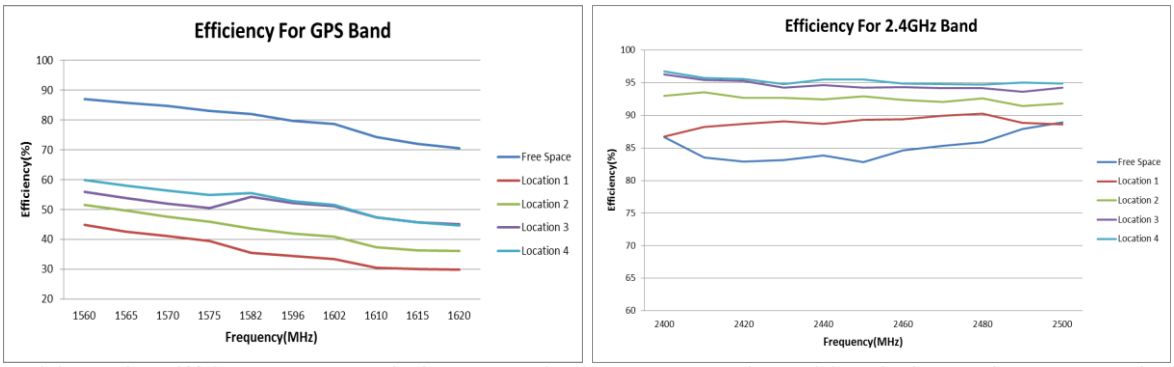


FIGURE 4.3.3 EFFICIENCY OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND AT FOUR LOCATIONS WITH SAME PLANE GROUND

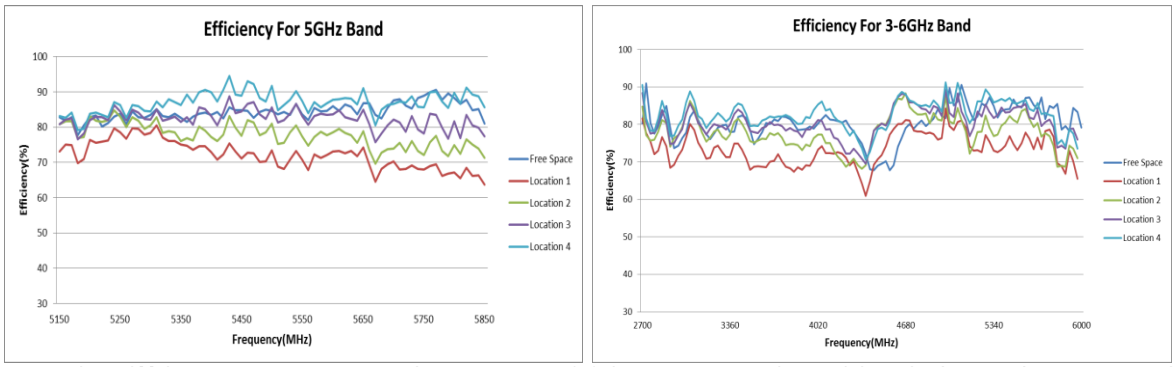


FIGURE 4.3.4 EFFICIENCY OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND AT FOUR LOCATIONS WITH SAME PLANE GROUND

5.0 RADIATION PATTERN

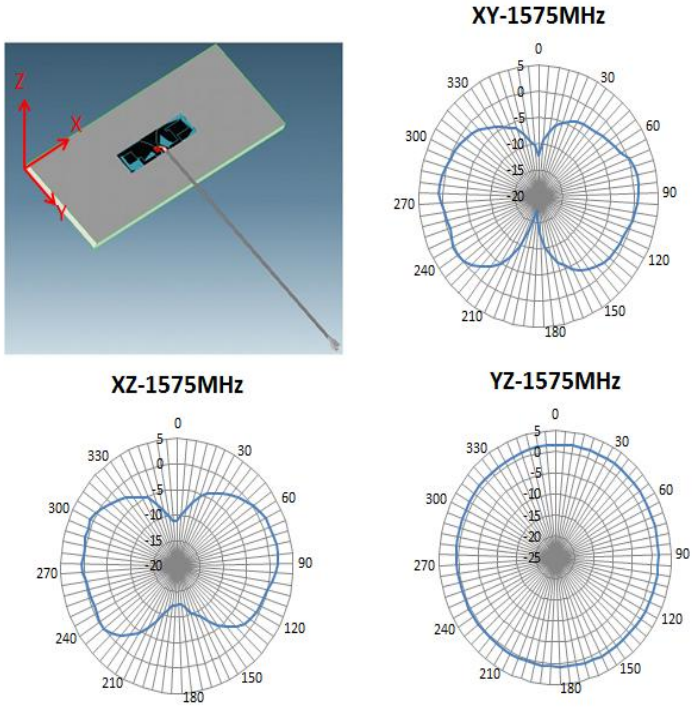


Figure 5.1 Radiation Pattern of antenna at 1.575GHz in Free space

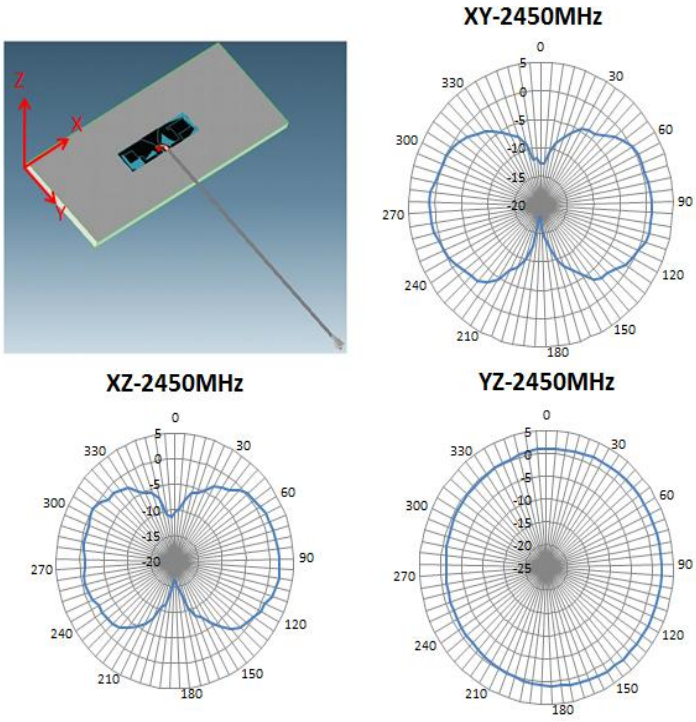
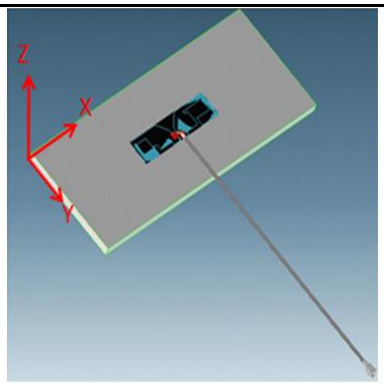
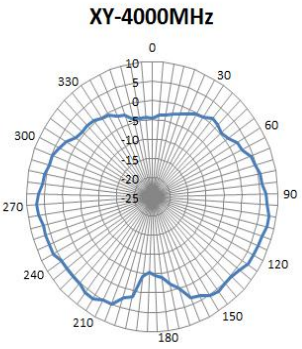
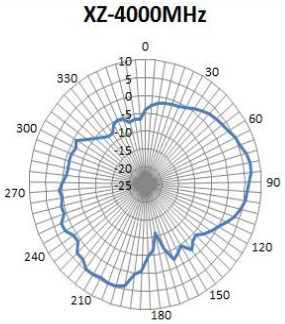


Figure 5.2 Radiation Pattern of antenna at 2.45GHz in Free space







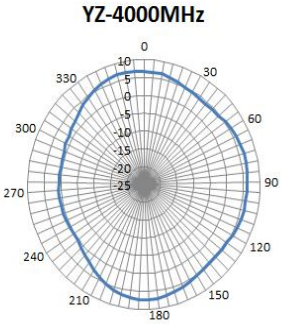
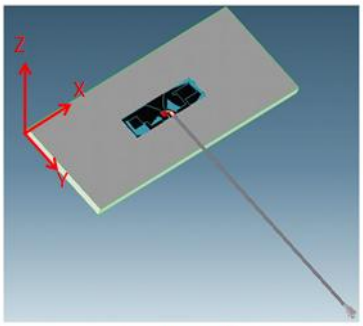
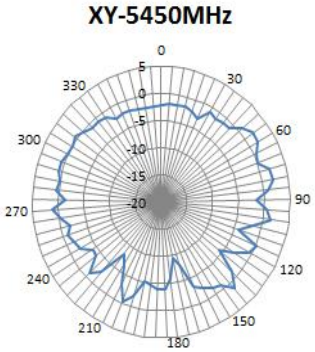
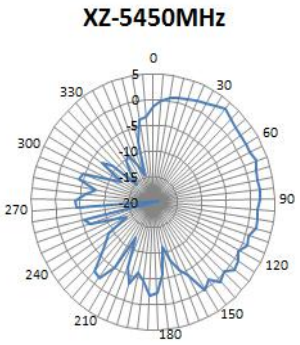


Figure 5.3 Radiation Pattern of antenna at 4GHz in Free space







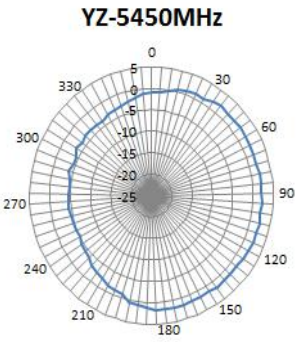


Figure 5.4 Radiation Pattern of antenna at 5.45GHz in Free space

6.0 THE ANTENNA PERFORMANCE VARIATION WITH CABLE LENGTH

6.0.1 CABLE LOSS

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENTS		
	Frequency Range	1.5 GHz~6GHz	1.5GHz~3GHz	3GHz~5GHz	5GHz~6GHz
6.0.1.1	Attenuation	1m cable measured by VNA5071C	≤3.5dB/m	≤4dB/m	≤5dB/m

6.0.2 CABLE LENGTH AFFECT THE ANTENNA PERFORMANCE

Balance antenna resonance is insensitive by cable's length, but the cable's loss will affect the total efficiency. Refer to 6.0.1

6.0.3 FOR EXAMPLE

	100mm cable			300mm cable	
Frequency (MHz)	Efficiency (dB)	Efficiency (%)	Cable Loss	Efficiency (dB)	Efficiency (%)
	X		X-LOSS=Y	Y	
1575	-1.30	74.08	0.2m*3.5dB/m	-2.00	63.05
1589	-0.92	80.84		-1.62	68.80
1602	-1.04	78.69		-1.74	66.97
2400	-0.83	82.51		-1.53	70.23
2410	-0.87	81.91		-1.57	69.72
2420	-1.00	79.45		-1.70	67.62
2430	-0.89	81.50		-1.59	69.37
2440	-0.86	82.05		-1.56	69.84
2450	-1.00	79.36		-1.70	67.54
2460	-0.94	80.52		-1.64	68.53
2470	-0.93	80.72		-1.63	68.70
2480	-0.90	81.22		-1.60	69.13
2490	-0.86	81.99		-1.56	69.79
2500	-0.81	83.08		-1.51	70.71
2700	-0.96	80.22		-1.66	68.23
2820	-1.00	79.46		-1.70	67.61
2910	-1.02	79.13		-1.72	67.30
3000	-1.17	76.40	0.2m*4dB/m	-1.97	63.55
3090	-0.77	83.73		-1.57	69.65
3180	-1.11	77.49		-1.91	64.45
3300	-0.99	79.70		-1.79	66.29
3420	-0.86	82.00		-1.66	68.21

3510	-1.05	78.57		-1.85	65.35
3600	-1.08	77.98		-1.88	64.86
3690	-0.90	81.35		-1.70	67.66
3780	-0.86	82.03		-1.66	68.23
3900	-1.05	78.60		-1.85	65.37
4000	-1.03	78.93		-1.83	65.65
4100	-0.90	81.38		-1.70	67.69
4200	-0.94	80.54		-1.74	66.99
4290	-1.08	78.07		-1.88	64.93
4380	-1.41	72.20		-2.21	60.05
4500	-1.58	69.58		-2.38	57.88
4590	-1.60	69.12		-2.40	57.49
4680	-1.02	79.05		-1.82	65.75
4800	-0.91	81.06		-1.71	67.42
4890	-0.88	81.61		-1.68	67.88

	100mm cable			300mm cable	
Frequency (MHz)	Efficiency (dB)	Efficiency (%)	cable loss	Efficiency (dB)	Efficiency (%)
	X		X-LOSS=Y	Y	
5000	-0.88	81.70	0.2m*5dB/m	-1.88	64.86
5100	-0.43	90.54		-1.43	71.94
5150	-1.04	78.64		-2.04	62.46
5170	-1.07	78.21		-2.07	62.13
5210	-1.13	77.13		-2.13	61.27
5230	-1.18	76.27		-2.18	60.58
5270	-1.17	76.31		-2.17	60.61
5290	-1.13	77.04		-2.13	61.20
5330	-1.17	76.44		-2.17	60.72
5370	-1.09	77.76		-2.09	61.76
5390	-1.29	74.27		-2.29	59.00
5410	-1.16	76.52		-2.16	60.79
5430	-1.09	77.89		-2.09	61.87
5490	-1.02	79.00		-2.02	62.75
5510	-1.06	78.42		-2.06	62.29
5530	-1.01	79.34		-2.01	63.02
5570	-1.07	78.10		-2.07	62.04
5610	-1.18	76.28		-2.18	60.59
5630	-1.00	79.40		-2.00	63.07
5650	-1.13	77.04		-2.13	61.19
5690	-1.16	76.55		-2.16	60.81
5710	-1.18	76.21		-2.18	60.54

5750	-1.19	76.10		-2.19	60.45
5770	-1.25	74.97		-2.25	59.55
5810	-1.10	77.65		-2.10	61.68
5830	-1.20	75.86		-2.20	60.26
5850	-1.17	76.33		-2.17	60.63
5880	-0.99	79.57		-1.99	63.24
5910	-1.06	78.29		-2.06	62.23
5940	-0.73	84.44		-1.73	67.14
5970	-0.79	83.40		-1.79	66.22
6000	-1.02	79.14		-2.02	62.80

- The data is just for your reference, all accurate performance should be according to the test results in the OTA chamber.

7.0 ASSEMBLY GUIDELINES

During the assembly of the antenna in a device, the cable needs to be positioned away from the antenna flex. The antenna cable should not go close to the antenna flex. The cable has to be away from the pattern at least 5mm.

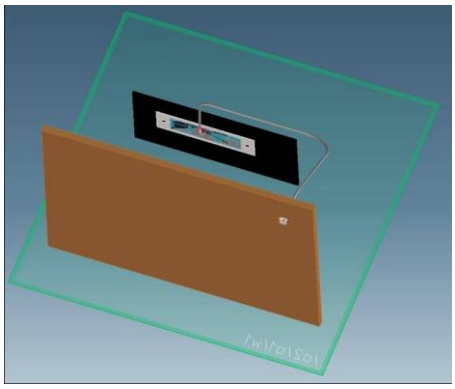


FIGURE 7.1 ASSEMBLY GUIDELINE

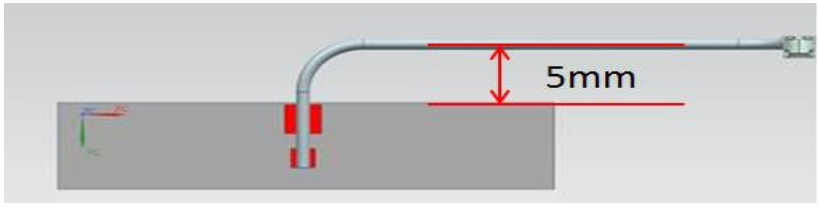


FIGURE 7.2 CABLE BENDING