



APPLICATION SPECIFICATION

GPS/WIFI (2.4/5GHZ) COMBO BALANCE PCB 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 in free space with VNA Agilent 5071C and OTA chamber. All measurements are done with the part no. **146220-0100** 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 53.5mm*16.6mm (figure 1).

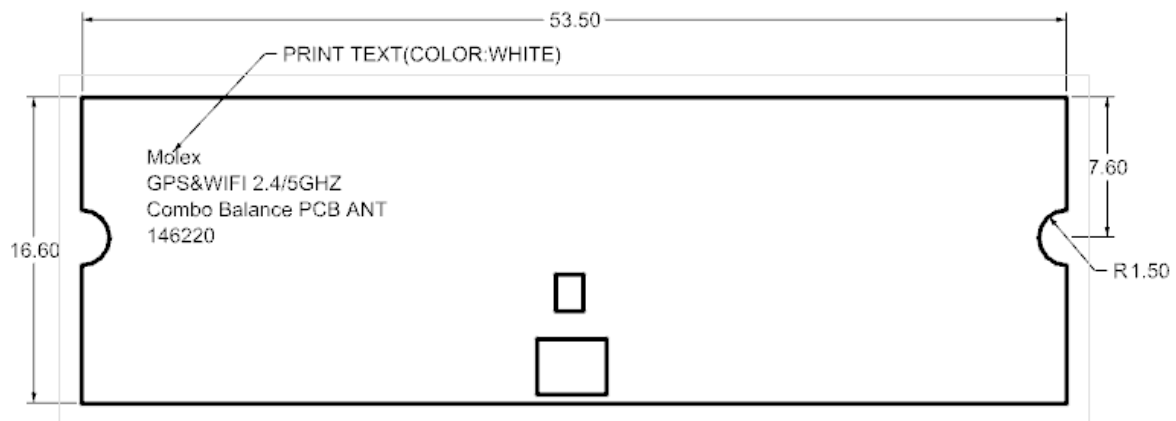


FIGURE 1. DIMENSION OF THE GPS/WIFI (2.4/5GHZ) COMBO BALANCE PCB ANTENNA

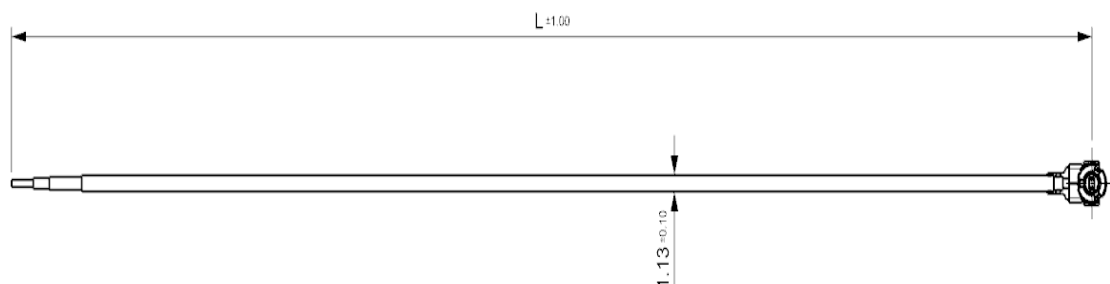
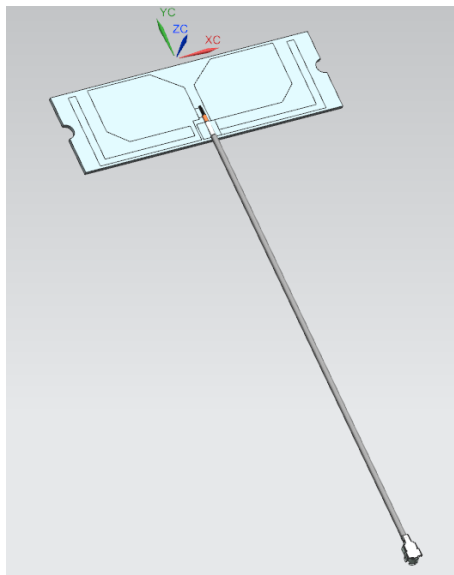


FIGURE 2. CABLE LINE VIEW OF GPS/WIFI (2.4/5GHZ) COMBO BALANCE PCB ANTENNA

REVISION: C	ECR/ECN INFORMATION: EC No: 122478 DATE: 2017/09/26	TITLE: GPS/WIFI (2.4/5GHz) COMBO BALANCE PCB ANTENNA	SHEET No. 1 of 15
DOCUMENT NUMBER: AS-146220-0100	CREATED / REVISED BY: Oh ChangHeon2016/02/22	CHECKED BY: Kang Cheng2017/09/26	APPROVED BY: Chris Zhong 2017/09/26

B. RF PERFORMANCE OF ANTENNA IN FREE SPACE



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 with 100mm long, 1.13mm diameter micro coaxial cable in free space Measured by VNA5071C	< -8 dB			
Peak Gain	Measure antenna in free space through OTA chamber	2.4dBi	2.9dBi	3.8dBi	3.5dBi
Total Efficiency	Measure antenna in free space through OTA chamber	>82%	>80%	>83%	>78%
Polarization	Measure antenna in free space through OTA chamber	Linear			
Input Impedance	Measure antenna in free space through VNA E5071C	50 Ohms			

FIGURE3.1 ANTENNA IN FREE SPACE

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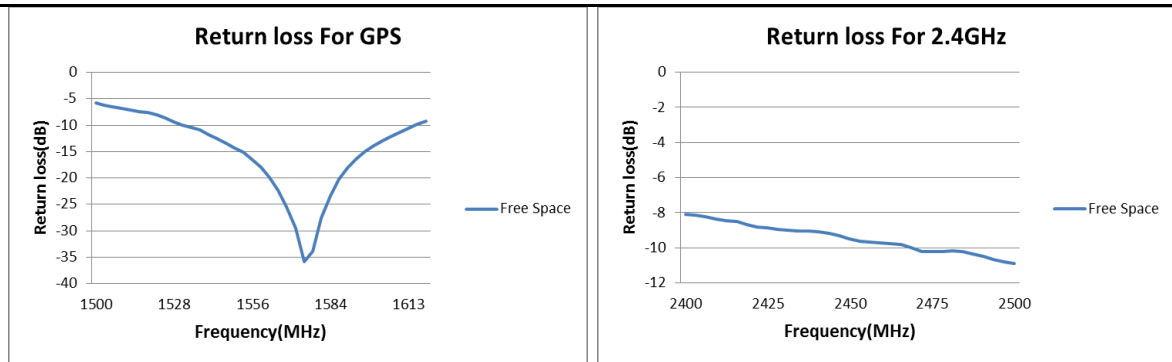


FIGURE 3.2 RETURN LOSS OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND IN FREE SPACE

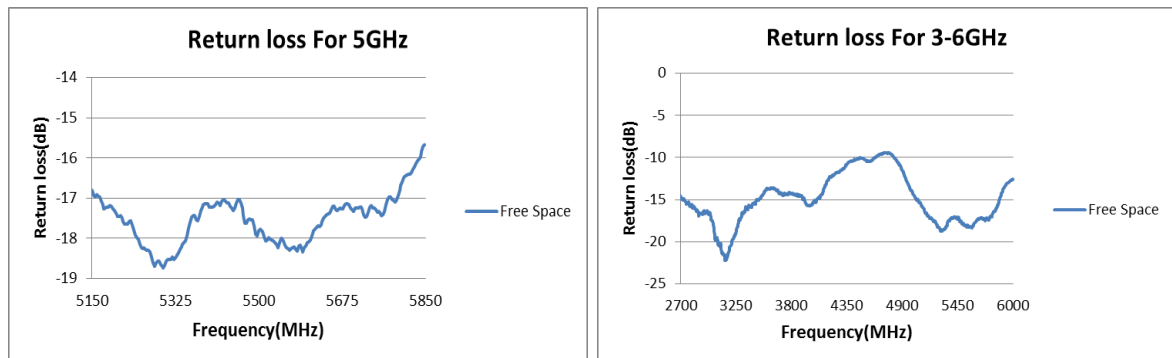


FIGURE 3.3 RETURN LOSS OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND IN FREE SPACE

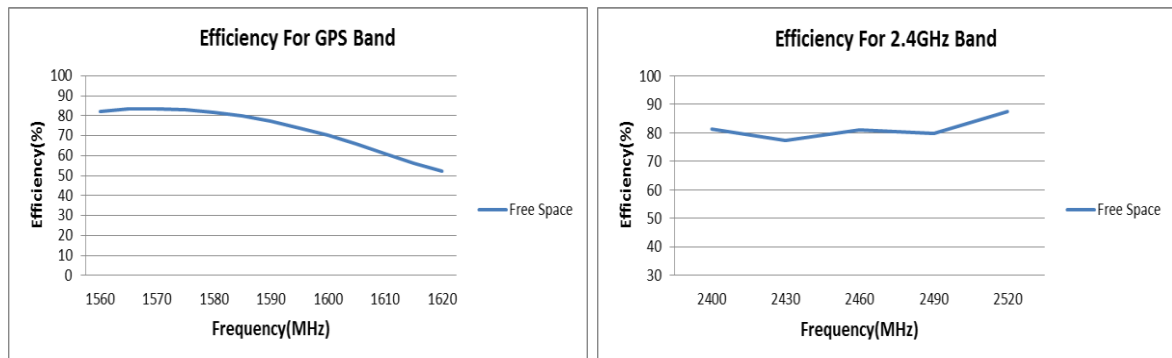


FIGURE 3.4 EFFICIENCY OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND IN FREE SPACE

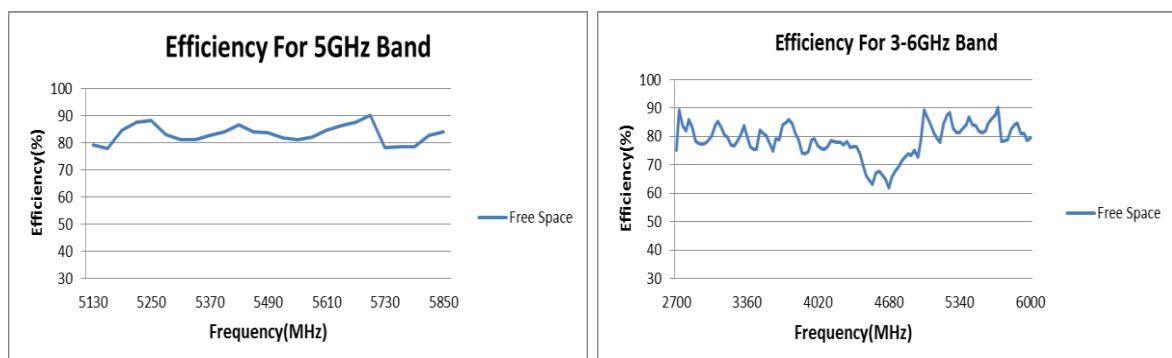


FIGURE 3.5 EFFICIENCY OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND IN FREE SPACE

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3.0 REFERENCE DOCUMENTS

- ENGINEERING DRAWING – AS-146220-0100
- PRODUCT SPECIFICATION – PS-146220-0100
- 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.

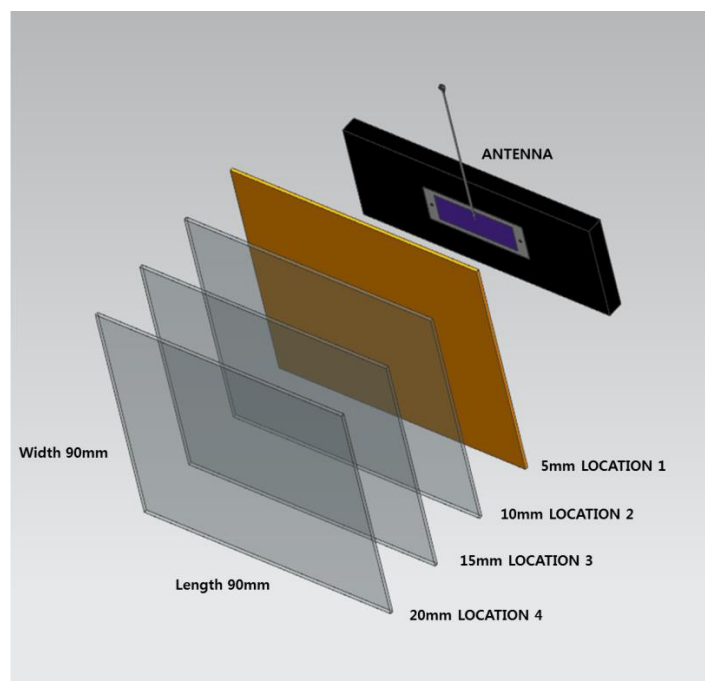


FIGURE 4.1 FOUR LOCATIONS WITH PARALLEL GROUND

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.

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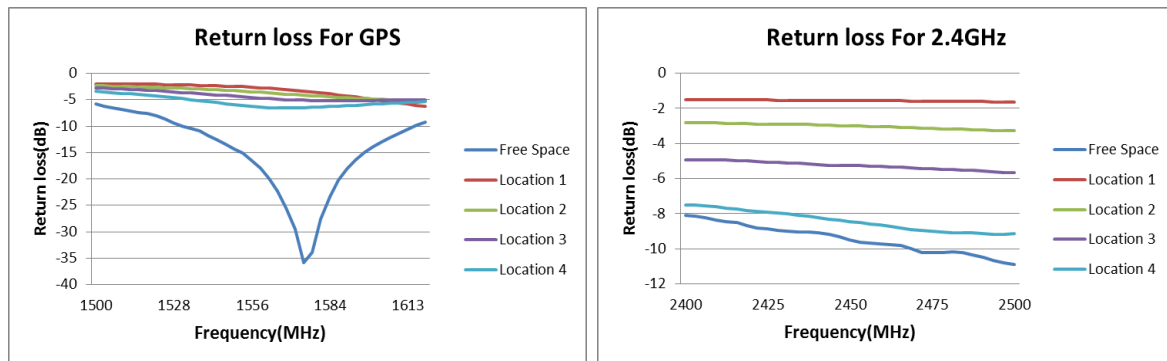


FIGURE 4.1.1 RETURN LOSS OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND AT FOUR LOCATIONS WITH PARALLEL GROUND

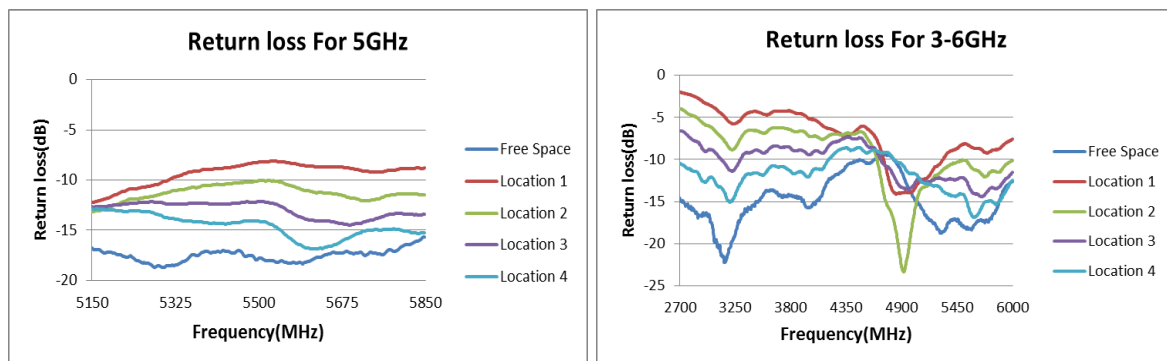


FIGURE 4.1.2 RETURN LOSS OF ANTENNA AT WIFI 5GHz AND UWB 3-6 GHZ BAND AT FOUR LOCATIONS WITH PARALLEL GROUND

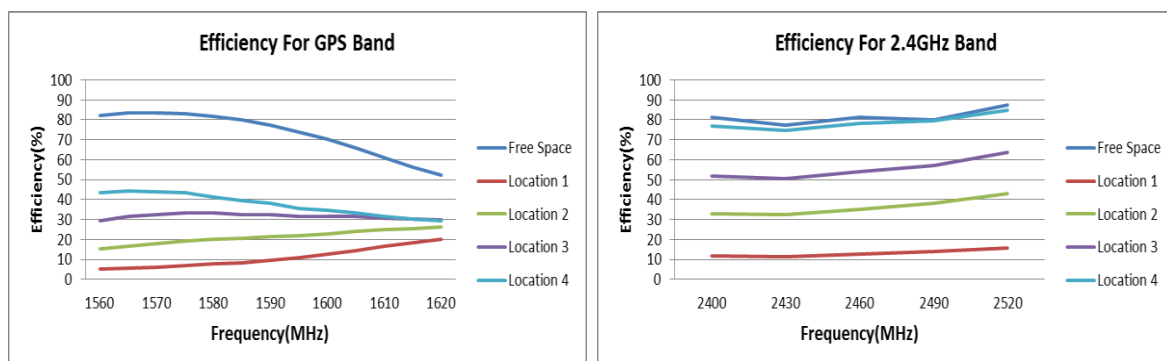


FIGURE 4.1.3 EFFICIENCY OF ANTENNA AT GPS BAND AND WIFI 2.4 GHZ BAND AT FOUR LOCATIONS WITH PARALLEL GROUND

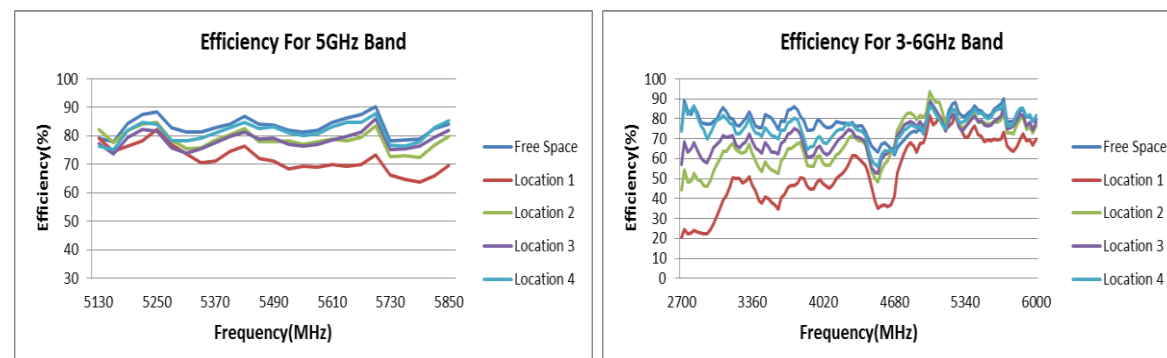


FIGURE 4.1.4 EFFICIENCY OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND AT FOUR LOCATIONS WITH PARALLEL GROUND

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

Four ground locations with vertical ground have been evaluated, with different distances from the antenna and these locations are shown in figure 4.2. The PCB size is 90mm*90mm and we move

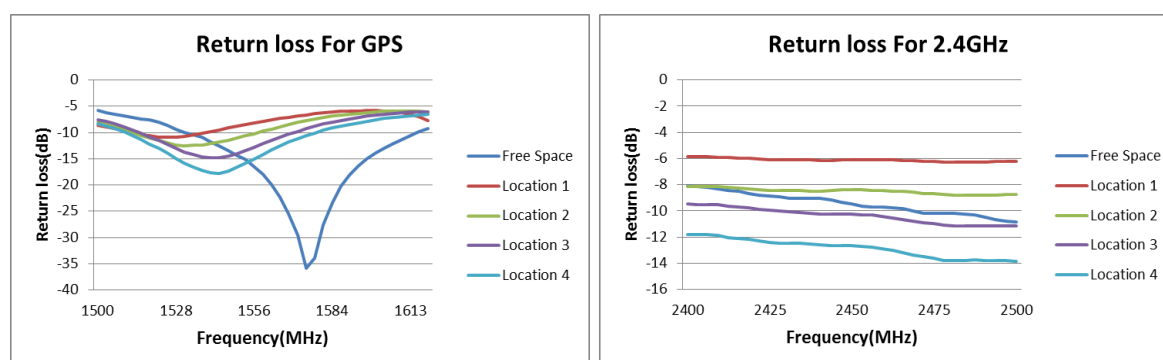


FIGURE 4.2.1 RETURN LOSS OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND AT FOUR LOCATIONS WITH VERTICAL GROUND

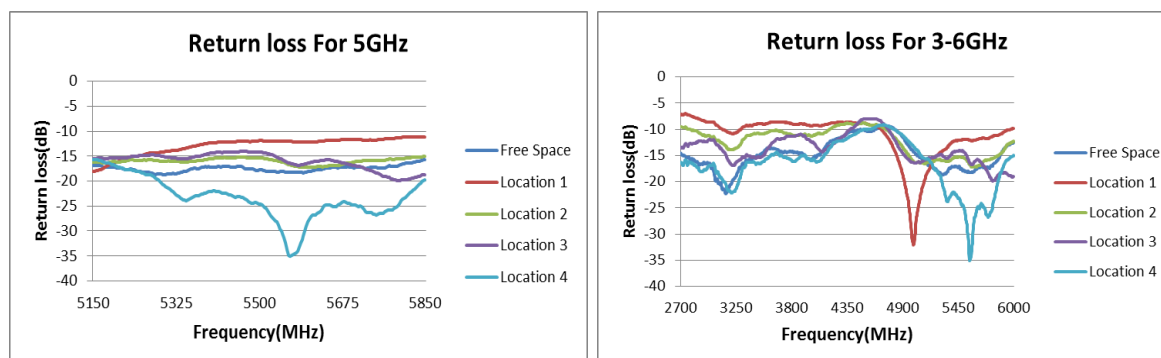


FIGURE 4.2.2 RETURN LOSS OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND AT FOUR LOCATIONS WITH VERTICAL GROUND

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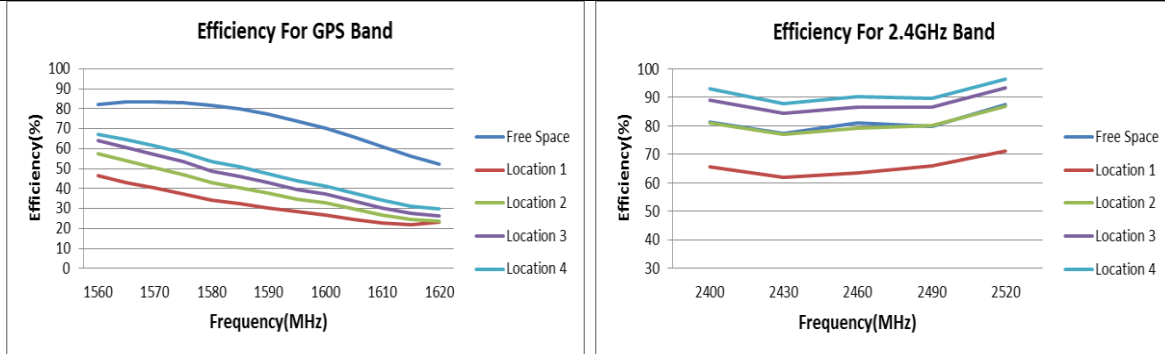


FIGURE 4.2.3 EFFICIENCY OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND AT FOUR LOCATIONS WITH VERTICAL GROUND

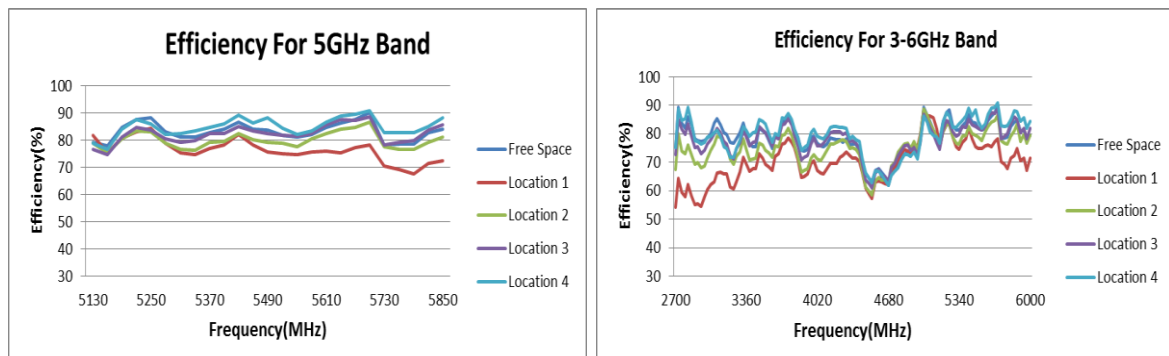


FIGURE 4.2.4 EFFICIENCY OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND AT FOUR LOCATIONS WITH VERTICAL GROUND

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.

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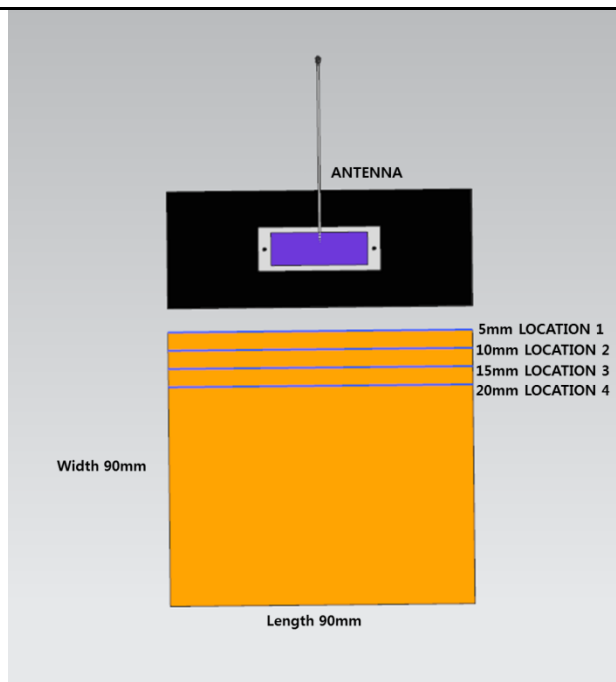


FIGURE 4.3 FOUR LOCATIONS WITH SAME PLANE GROUND

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.

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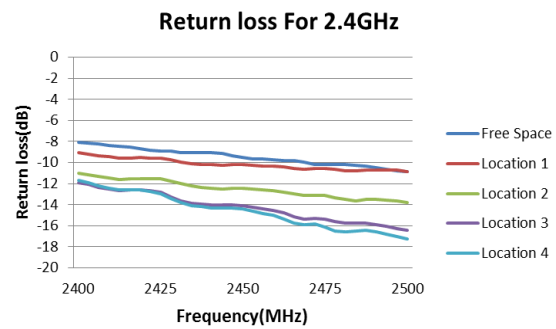
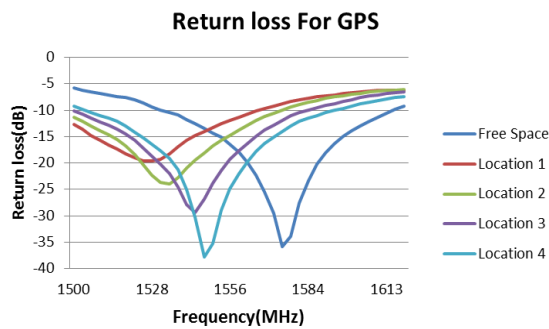


FIGURE 4.3.1 RETURN LOSS OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND AT FOUR LOCATIONS WITH SAME PLANE GROUND

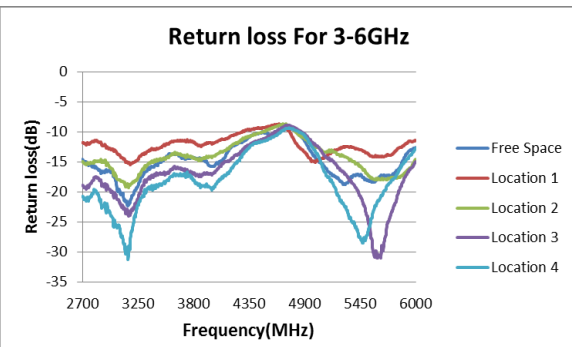
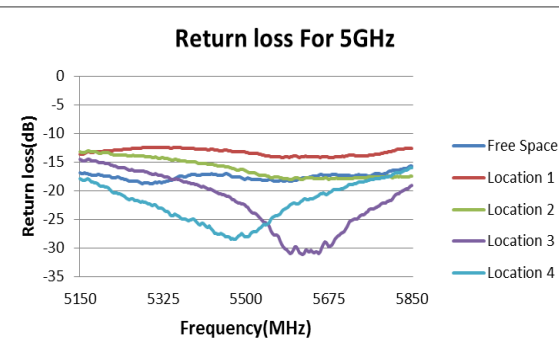


FIGURE 4.3.2 RETURN LOSS OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND AT FOUR LOCATIONS WITH SAME PLANE GROUND

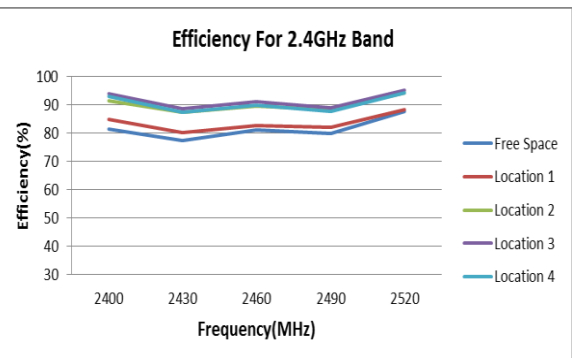
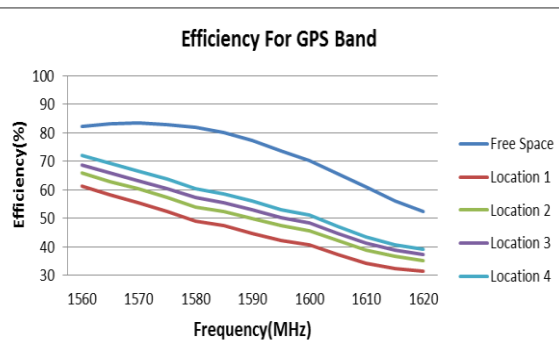


FIGURE 4.3.3 EFFICIENCY OF ANTENNA AT GPS AND WIFI 2.4 GHZ BAND AT FOUR LOCATIONS WITH SAME PLANE GROUND

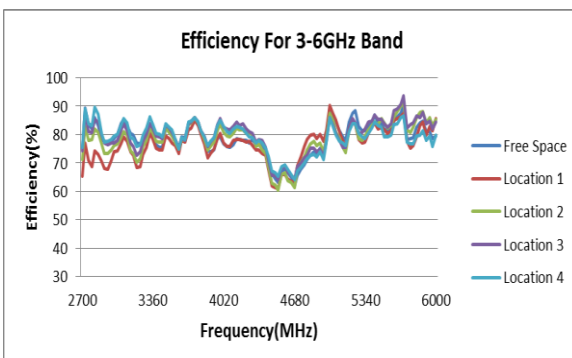
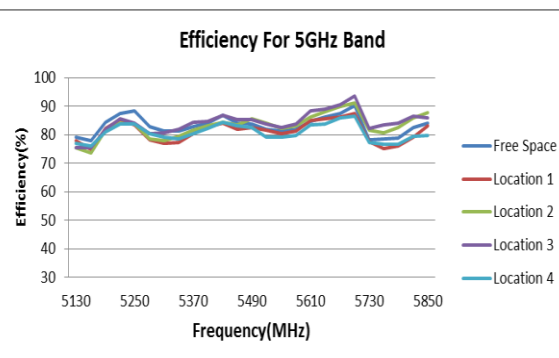


FIGURE 4.3.4 EFFICIENCY OF ANTENNA AT WIFI 5 GHZ AND UWB 3-6 GHZ BAND AT FOUR LOCATIONS WITH SAME PLANE GROUND

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C

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GPS/WIFI (2.4/5GHz) COMBO BALANCE
PCB ANTENNA

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DOCUMENT NUMBER:

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CREATED / REVISED BY:

Oh ChangHeon2016/02/22

CHECKED BY:

Kang Cheng2017/09/26

APPROVED BY:

Chris Zhong 2017/09/26

5.0 RADIATION PATTERN

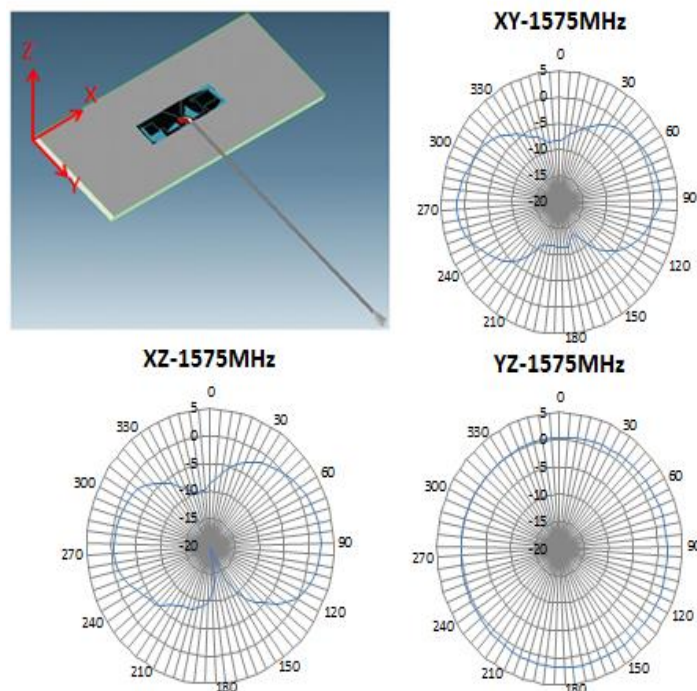


Figure 5.1 Radiation Pattern of antenna at 1.575GHz in Free space

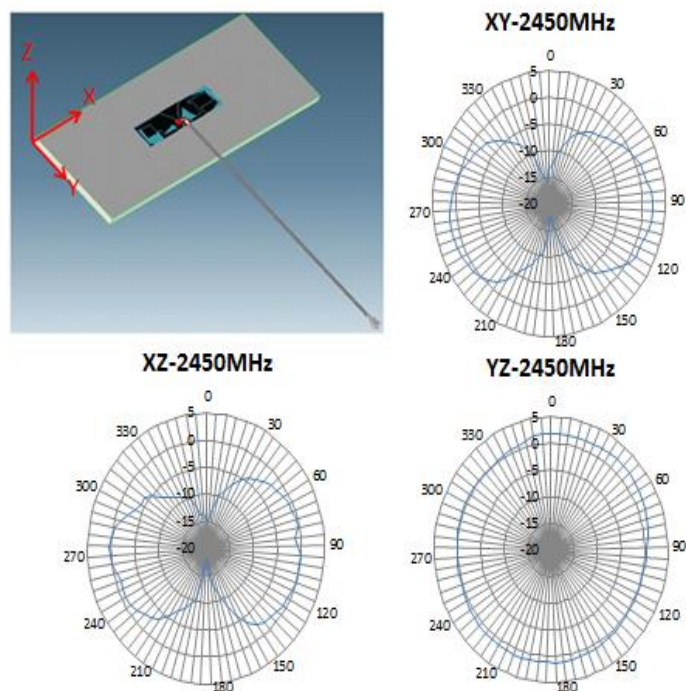


Figure 5.2 Radiation Pattern of antenna at 2.45GHz in Free space

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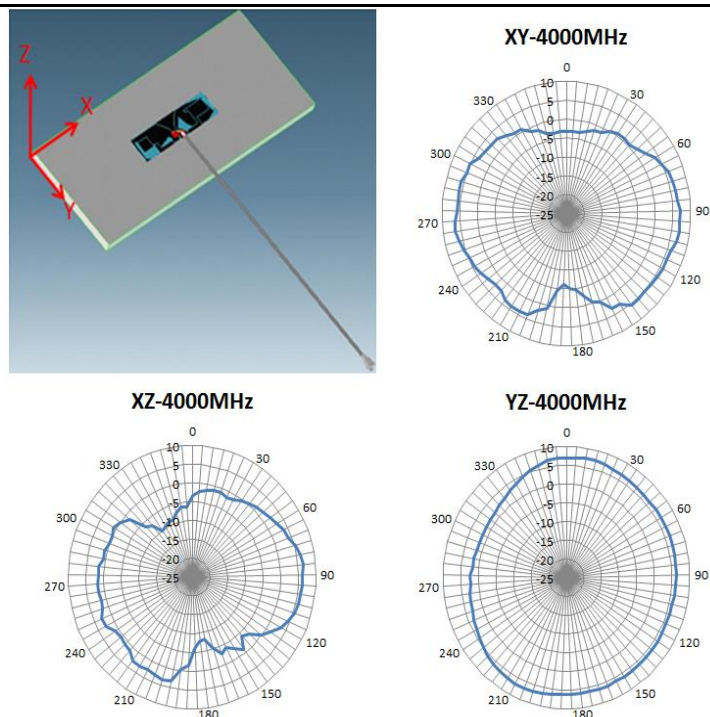


Figure 5.3 Radiation Pattern of antenna at 4GHz in Free space

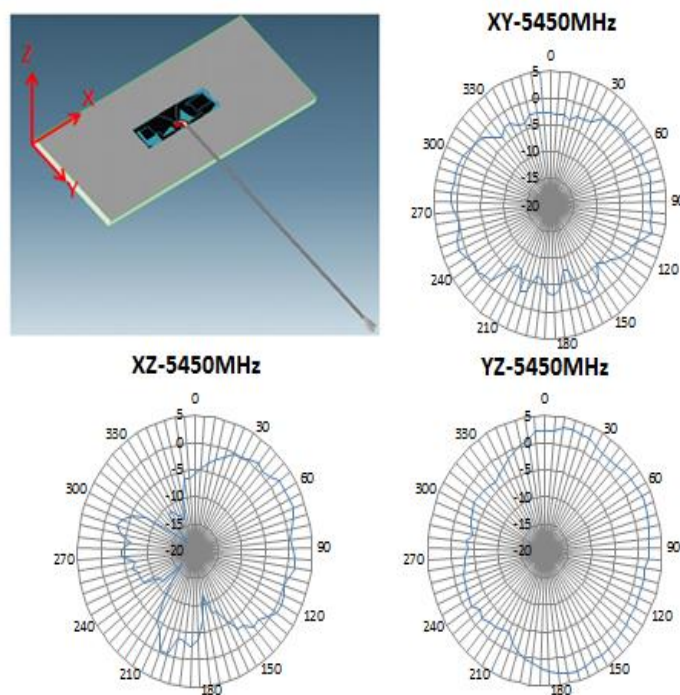


Figure 5.4 Radiation Pattern of antenna at 5.45GHz in Free space

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6.0 THE ANTENNA PERFORMANCE VARIATION WITH CABLE LENGTH

6.0.1 CABLE LOSS

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENT		
	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	-0.81	82.99	0.2m*3.5dB/m	-1.51	70.64
1589	-1.04	78.66		-1.74	66.95
1602	-1.62	68.91		-2.32	58.65
2400	-0.81	82.94		-1.51	70.60
2410	-0.99	79.59		-1.69	67.74
2420	-0.96	80.17		-1.66	68.23
2430	-1.02	79.14		-1.72	67.36
2440	-0.85	82.24		-1.55	70.00
2450	-0.88	81.57		-1.58	69.43
2460	-0.84	82.49		-1.54	70.21
2470	-0.88	81.70		-1.58	69.53
2480	-0.99	79.61		-1.69	67.76
2490	-0.78	83.55		-1.48	71.11
2500	-0.69	85.36		-1.39	72.65
2700	-1.17	76.42		-1.87	65.04
2800	-0.93	80.80		-1.63	68.77
2900	-1.21	75.73		-1.91	64.45
3000	-0.90	81.19	0.2m*4dB/m	-1.70	67.53
3100	-0.79	83.28		-1.59	69.27
3200	-1.26	74.76		-2.06	62.18
3300	-1.23	75.31		-2.03	62.64

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3400	-1.56	69.80		-2.36	58.06
3500	-1.14	76.86		-1.94	63.93
3600	-1.47	71.35		-2.27	59.35
3700	-1.10	77.55		-1.90	64.50
3800	-0.99	79.58		-1.79	66.19
3900	-1.30	74.16		-2.10	61.68
4000	-0.99	79.68		-1.79	66.28
4100	-0.96	80.15		-1.76	66.67
4200	-0.72	84.79		-1.52	70.53
4300	-1.06	78.39		-1.86	65.20
4400	-1.23	75.37		-2.03	62.69
4500	-1.92	64.29		-2.72	53.48
4600	-1.61	68.98		-2.41	57.38
4700	-1.65	68.42		-2.45	56.91
4800	-1.45	71.55		-2.25	59.52
4900	-1.68	67.97		-2.48	56.54

	100mm cable			300mm cable	
Frequency (MHz)	Efficiency (dB)	Efficiency (%)	cable loss	Efficiency (dB)	Efficiency (%)
	X		X-LOSS=Y	Y	
5000	-0.74	84.37		-1.74	67.01
5030	-0.66	86.00		-1.66	68.31
5060	-0.66	85.97		-1.66	68.29
5090	-0.80	83.12		-1.80	66.03
5120	-0.93	80.80		-1.93	64.18
5150	-0.84	82.36		-1.84	65.42
5180	-0.82	82.71		-1.82	65.70
5210	-0.58	87.60		-1.58	69.58
5240	-0.62	86.68		-1.62	68.86
5270	-0.57	87.62		-1.57	69.60
5300	-0.74	84.29		-1.74	66.95
5330	-0.71	84.88		-1.71	67.42
5360	-0.73	84.56		-1.73	67.17
5390	-0.52	88.76		-1.52	70.50
5420	-0.59	87.22		-1.59	69.28
5450	-0.53	88.54		-1.53	70.33
5480	-0.55	88.01		-1.55	69.91
5510	-0.70	85.12		-1.70	67.61
5540	-0.59	87.36		-1.59	69.39
5570	-0.72	84.65		-1.72	67.24
5600	-0.62	86.76		-1.62	68.92
5630	-0.55	88.14		-1.55	70.01
5660	-0.42	90.82		-1.42	72.14
5690	-0.52	88.64		-1.52	70.41

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5720	-0.87	81.78		-1.87	64.96
5750	-0.80	83.16		-1.80	66.05
5780	-1.04	78.78		-2.04	62.57
5810	-0.77	83.75		-1.77	66.52
5840	-0.61	86.95		-1.61	69.07
5850	-0.64	86.40		-1.64	68.63
5870	-0.84	82.44		-1.84	65.49
5900	-0.77	83.71		-1.77	66.49
5930	-0.90	81.35		-1.90	64.61
5960	-1.06	78.29		-2.06	62.19
6000	-0.76	83.97		-1.76	66.70

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

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DOCUMENT NUMBER: AS-146220-0100	CREATED / REVISED BY: Oh ChangHeon2016/02/22	CHECKED BY: Kang Cheng2017/09/26	APPROVED BY: Chris Zhong 2017/09/26

7.0 ASSEMBLY GUIDELINES

During the assembly of the antenna in a device, the cable needs to be positioned away from the antenna as shown in Figure 7.1. The cable has to be away from the pattern at least 5mm as shown in Figure 7.2. The PCB has to be away from the housing height at least 5mm as shown in Figure 7.3. If customer would like to paste this product on a plastic cover, we suggest using flex version of this standard antenna, whose part number is 1461860100.

The columnar material can be plastic with metal nut or pure plastic. However, pure metal for columnar is not recommended. During the assembly of the PCB, twist force must be less than 3kgf.

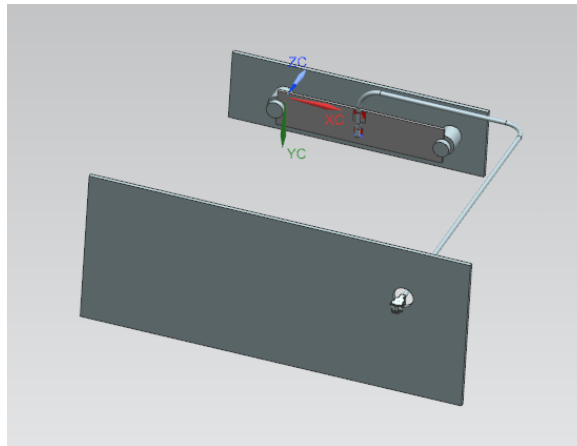


FIGURE 7.1 ASSEMBLY GUIDELINE

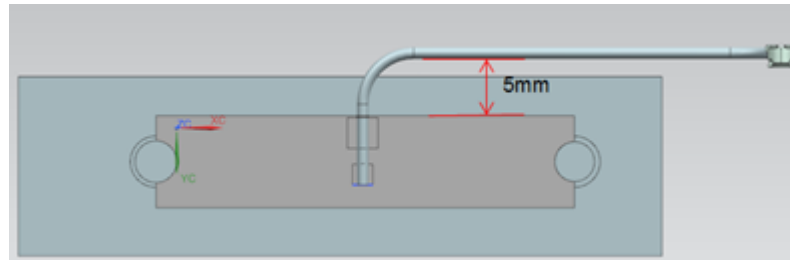
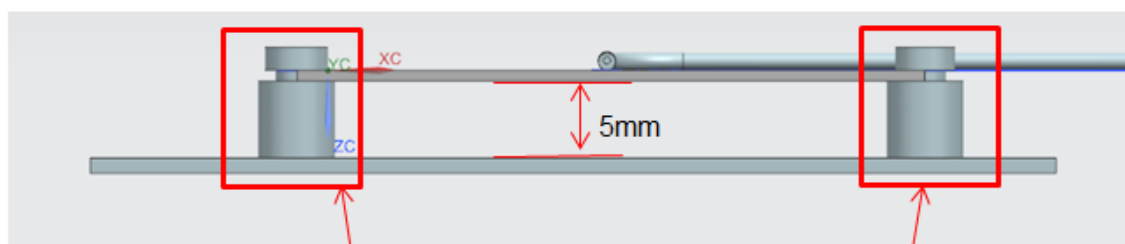


FIGURE 7.2 CABLE BENDING



These two columnar materials: plastic+ nut & pure plastic. Pure metal is not recommended.
During the assembly of the PCB, twist force must be less than 3kgf

FIGURE 7.3 ANTENNA ASSEMBLY HEIGHT

REVISION:	ECR/ECN INFORMATION:	TITLE:	SHEET No.
C	EC No: 122478 DATE: 2017/09/26	GPS/WIFI (2.4/5GHz) COMBO BALANCE PCB ANTENNA	15 of 15
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