

Customer	Model	Customer Code	Date	Document Revision
BLUEBIRD	X40	352010171	25' 10. 16	Rev 0.0

APPROVAL SHEET

X40 ASSY COVERBACK ANTENNA

CUSTOMER	BLUEBIRD
MODEL	X40 COVERBACK FCC
ANTENNA TYPE	WWAN ANTENNA
ANTENNA MAKER	KDT
DOCUMENT REVISION	Rev 0.0
CUSTOMER CODE	352010171
PART NAME	COVERBACK ANT/ X40,WWAN_COVERBACK,REV0,KDT

	Name	Date	Sign
RF Engineer			
ME Engineer			

Development Team Manager	Q.A Team Manager	Operation Manager	Customer

KDT R&D Center

413ho, Dongtan-daero 23-gil, Hwaseong-si, Gyeonggi-do, Republic of Korea

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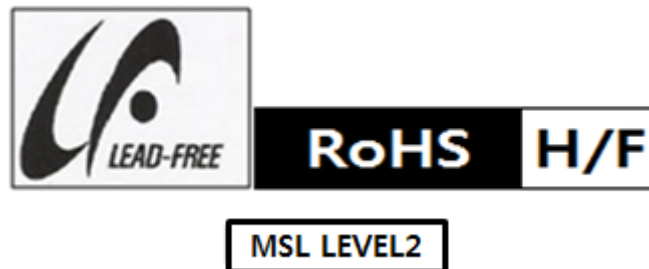
	TOP	BOTTOM
PRODUCT PHOTO		

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PRODUCT SPECIFICATION

BLUEBIRD X40 COVERBACK

WWAN ANTENNA



- Written by

	Name	Date	Sign
RF Engineer			
ME Engineer			

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1. Change History

Change History		
Revision	Date	Change List
Rev 0.0	25' 10. 16	Rev 0.0 APPROVAL SHEET

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2. 제품 도면

CODE : 352010171

MODEL : ASSY BRACKET ANT/ X40,VWAN_EU,REV0,KDT

Rev.	D-DATE	Contents	Engineer	Checker
1	06.05.03	-	-	-
2	06.05.03	-	-	-

NOTES

1. The exterior surface of the product must be free from damage and harmful defects.
2. The material and color of parts must comply with the design specifications.
3. When mass producing, make sure to obtain approval before proceeding with production.
4. The appearance inspection of this product shall be based on standard samples.
5. Dimensions with * * shall be applied as critical management (CP) items.
6. Tolerances for unspecified and singular dimensions shall comply with ISO 2768-F.
7. Any other matters must be discussed with the designer.

NOTES

1. 外観 品質検査 必ずしも 確認 事項 あり 注意 事項
2. 材質 色 形状 公差 等 設計 仕様 準拠 必須
3. 量産 時 必ず 承認 取得 後 生産 開始 必須
4. 外観 検査 標準 品 参照 必須
5. * * 寸法 公差 厳格 管理 (CP) 項目 として 管理 必須
6. 寸法 公差 指定 されていない 寸法 公差 規格 ISO 2768-F 準拠 必須
7. その他 事項 必ず 設計 担当者 へ 相談 必須

Drawing Specification		Approval	
Item	Unit	Design	Check
1	mm	H.S. CHO	
2	mm		

Customer Information		Approval	
Item	Unit	Design	Check
1	mm	H.S. CHO	
2	mm		

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Item	Unit	Design	Check
1	mm	H.S. CHO	
2	mm		

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3. PART – LIST

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4. Product Specification

4-1. Electrical Specification (Frequency Band & Passive Spec.)

- 4-1-1. Antenna 0 – LB/MB/HB TRx/UHB DRx

Mode	Set – Antenna							
Frequency	894 MHz	960 MHz	1710 MHz	2110 MHz	2300 MHz	2700 MHz	4400 MHz	5000 MHz
VSWR Spec.	≤3.3:1	≤4.5:1	≤3.8:1	≤3.3:1	≤6.5:1	≤3.1:1	≤5.4:1	≤2.1:1
3D Gain Spec	Peak ≥-2.1dB	Peak ≥-2.9dB	Peak ≥0.5dB	Peak ≥-1.0dB	Peak ≥-4.2dB	Peak ≥-4.0dB	Peak ≥-6.5dB	Peak ≥-11.2dB

- 4-1-2. Antenna 1 – GPS L5/UHB TRx

Mode	Set – Antenna			
Frequency	1175MHz	3300MHz	3800MHz	5000MHz
VSWR Spec.	≤5.8:1	≤2.6:1	≤3.7:1	≤1.8:1
3D Gain Spec	Peak ≥-11.0dB	Peak ≥-3.0dB	Peak ≥-7.8dB	Peak ≥-5.8dB

- 4-1-3. Antenna 2 – LB DRx/HB DM/UHB/PMRx

Mode	Set – Antenna						
Frequency	869MHz	2300MHz	2700MHz	3300MHz	3800MHz	4400MHz	5000MHz
VSWR Spec.	≤10.2:1	≤11.1:1	≤2.0:1	≤6.9:1	≤2.4:1	≤4.8:1	≤5.1:1
3D Gain Spec	Peak ≥-10.0 dB	Peak ≥-9.5dB	Peak ≥-3.0dB	Peak ≥-4.5dB	Peak ≥-2.0dB	Peak ≥-1.9dB	Peak ≥-4.5dB

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- 4-1-4. Antenna 3 –MB/HB/DRx

Mode	Set – Antenna				
Frequency	1805MHz	1990MHz	2170MHz	2300MHz	2700MHz
VSWR Spec.	≤2.7:1	≤2.8:1	≤5.4:1	≤4.2:1	≤4.6:1
3D Gain Spec	Peak ≥-2.3dB	Peak ≥-2.1dB	Peak ≥-4.5dB	Peak ≥-4.0dB	Peak ≥-3.2dB

- 4-1-5. Antenna 4 – HB PM/UHB/DMRx

Mode	Set – Antenna						
Frequency	2300MHz	2500MHz	2700MHz	3300MHz	3800MHz	4400MHz	5000MHz
VSWR Spec.	≤3.1:1	≤4.5:1	≤3.8:1	≤1.9:1	≤2.8:1	≤2.2:1	≤7.0:1
3D Gain Spec	Peak ≥-13.8dB	Peak ≥-13.1dB	Peak ≥-10.2dB	Peak ≥-1.0dB	Peak ≥-2.5dB	Peak ≥-2.8dB	Peak ≥-5.1dB

- 4-1-6 Antenna 5 – RFID/WiFi(WiFi-6E)

Mode	Set – Antenna							
Frequency	865 MHz	2400 MHz	2500 MHz	5150 MHz	5500 MHz	5825 MHz	6425 MHz	7125 MHz
VSWR Spec.	≤2.1:1	≤1.8:1	≤2.4:1	≤2.6:1	≤2.0:1	≤3.3:1	≤4.3:1	≤3.5:1
3D Gain Spec	Peak ≥-4.3dB	Peak ≥-4.0dB	Peak ≥-3.7dB	Peak ≥-1.0dB	Peak ≥-2.5dB	Peak ≥-3.4dB	Peak ≥-0.5dB	Peak ≥-2.2dB

- 4-1-7 Antenna 6 – GPS L1/WiFi(WiFi-6E)

Mode	Set – Antenna							
Frequency	1575.42 MHz	2400 MHz	2500 MHz	5150 MHz	5500 MHz	5825 MHz	6425 MHz	7125 MHz
VSWR Spec.	≤3.3:1	≤2.4:1	≤1.7:1	≤2.9:1	≤1.6:1	≤3.7:1	≤8.6:1	≤2.5:1
3D Gain Spec	Peak ≥-3.5dB	Peak ≥-2.9dB	Peak ≥-2.3dB	Peak ≥-2.1dB	Peak ≥-1.6dB	Peak ≥-4.2dB	Peak ≥-8.8dB	Peak ≥-6.6dB

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Mode	Set – Antenna					
Frequency	1575.42MHz	2400MHz	2500MHz	5150MHz	5500MHz	5825MHz
VSWR Spec.	≤3.3:1	≤3.0:1	≤1.8:1	≤1.8:1	≤1.8:1	≤3.5:1
3D Gain Spec	Peak ≥-3.3dB	Peak ≥-1.7dB	Peak ≥-2.1dB	Peak ≥-3.4dB	Peak ≥-1.0dB	Peak ≥-3.5dB

- 4-1-8 2nd BLE

Mode	Set – Antenna	
Frequency	2400MHz	2500MHz
VSWR Spec.	≤3.7:1	≤3.5:1
3D Gain Spec	Peak ≥-8.0dB	Peak ≥-7.0dB

- 장비, 환경, Jig에 따른 편차가 존재하므로 Marker(Setting 주파수)는 Master Sample의 VSWR 값을 기준으로 적용함.

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4-2. 기구적 특성

DIMENSION	72.00 X 151.77 X 5.09 mm
ANTENNA – BASE	LUCKY ENPLA / LPC1001F 9306(BK)
ANTENNA – PATTERN	LDS
WEIGHT	12.4g
OPERATING TEMP	20 ± 5 °C
OPERATING HUMIDITY	55 ± 15 %

- 안테나 도금 부분의 산화 방지를 위해 습도 관리를 한다

도금 부분의 단순 변색은 특성에 영향이 없다.

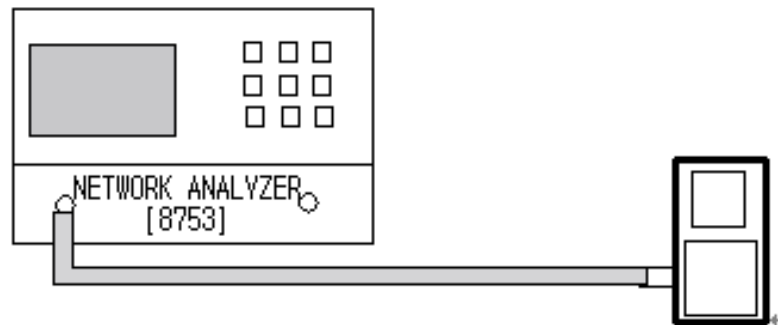
- 제품 보관의 온도 및 습도는 원칙적으로 관리하며, 품질 보증 기간은 1년으로 하나 충격에 의한 제품 손상은 제외한다.

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5. 전기적 시험 환경(조건/방법)

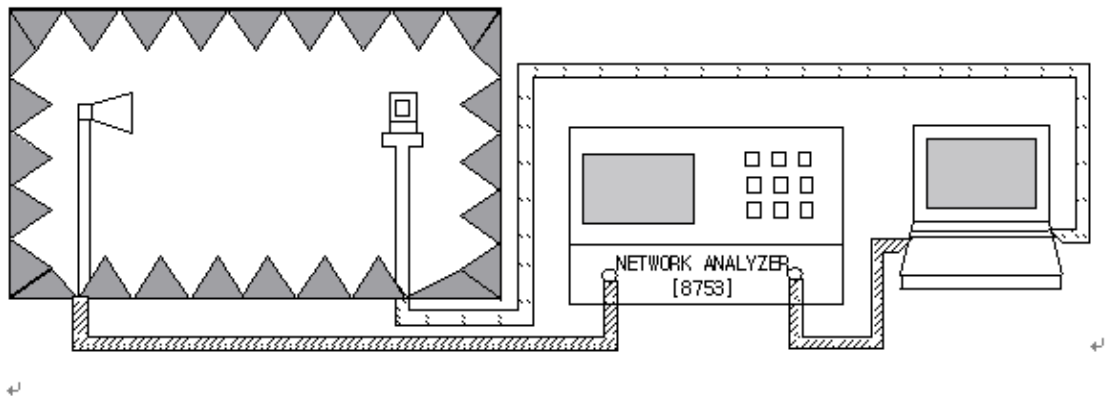
5-1. 정재파비(VSWR)

- Step 1. Network analyzer에 측정 Cable을 연결한다.
- Step 2. 측정하고자 하는 주파수에 맞도록 Network analyzer를 Setting하고 Calibration한다.
- Step 3. Set를 장착하고 정재파비(VSWR)를 측정한다.



5-2. Radiation pattern & GAIN

- Step 1. Reference 안테나를 이용하여 Chamber system을 Calibration하고, Chamber system을 Control 하기 위한 Software를 측정하고자 하는 주파수 대역으로 Setting 한다.
- Step 2. 측정할 안테나를 장착한다.
- Step 3. Gain과 Efficiency 및 Radiation Pattern을 측정한다.



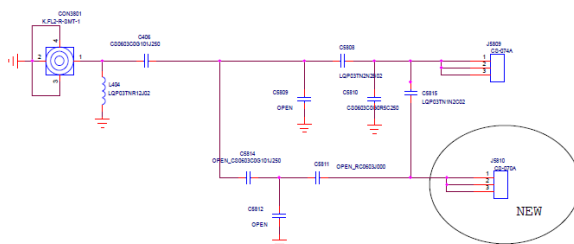
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5-3. Normal Spec.

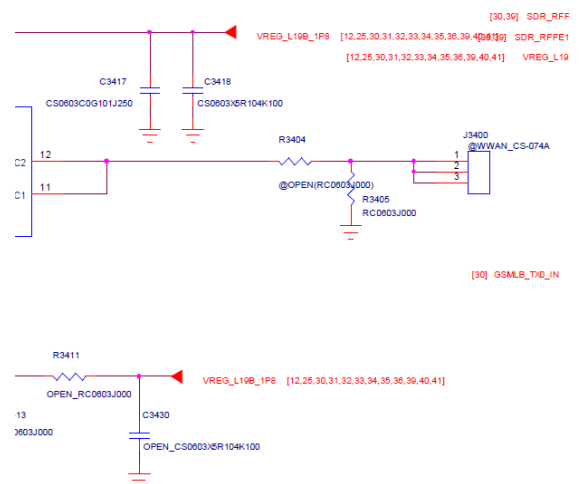
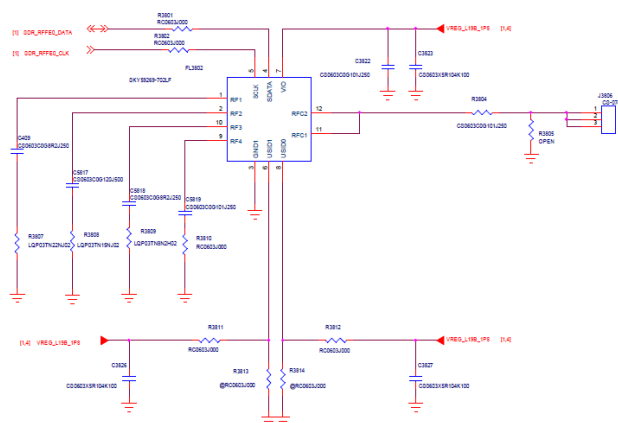
INPEDANCE	50 ohm
RADIATION PATTERN	Omni – Directional
POLARIZATION	Linear
POWER HANDLING	2W
MATCHING CIRCUIT	회로도 참조

5-4. Matching Circuit

- **5-4-1. Antenna 0 – LB/MB/HB TRx/UHB DRx**



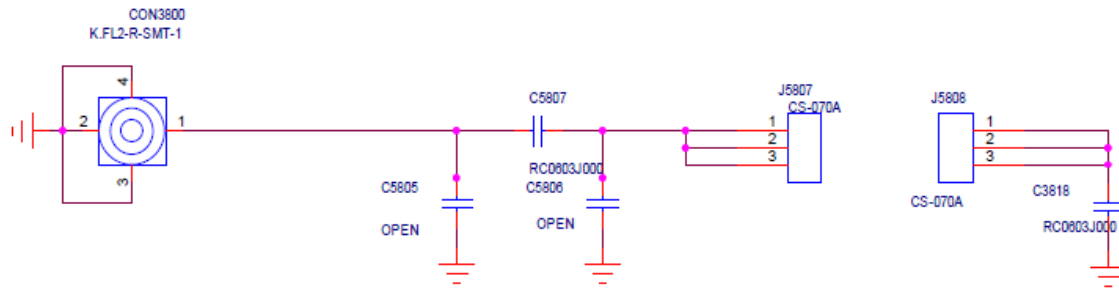
SP4T For ANT



* GND 연결은 SP4T 사용 안함. R3405에 0R을 연결한 후 테스트 진행 함.

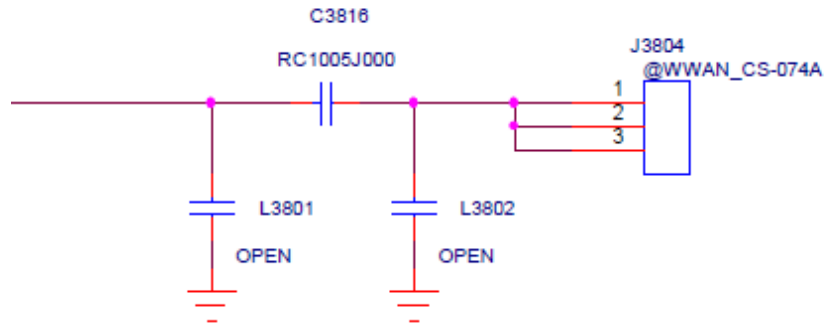
- **5-4-2. Antenna 1 – GPS L5/UHB TRx**

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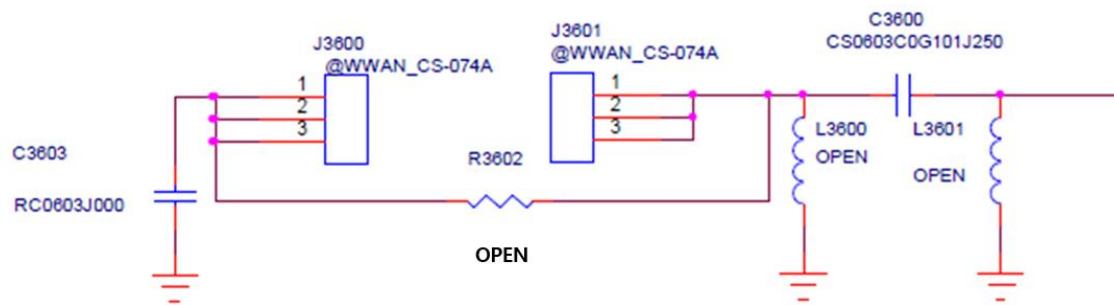


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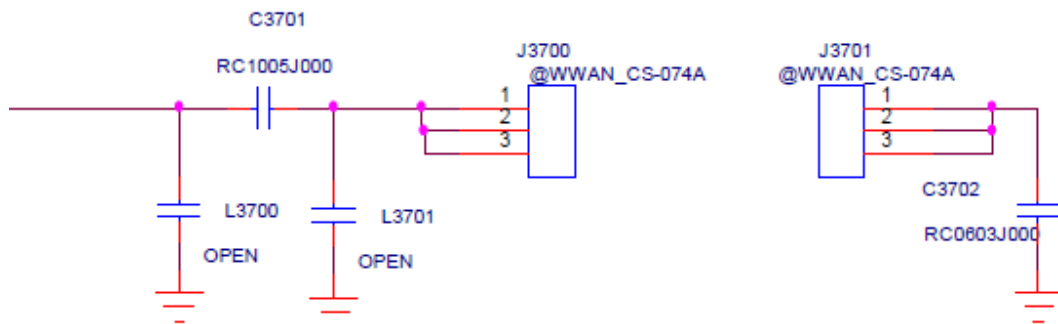
- 5-4-3. Antenna 2 – LB DRx/HB DM/UHB/PMRx



- 5-4-4. Antenna 3 –MB/HB/DRx

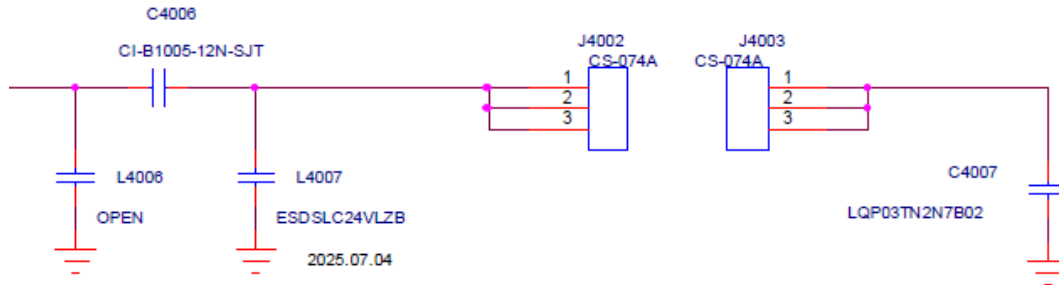


- 5-4-5. Antenna 4 – HB PM/UHB/DMRx

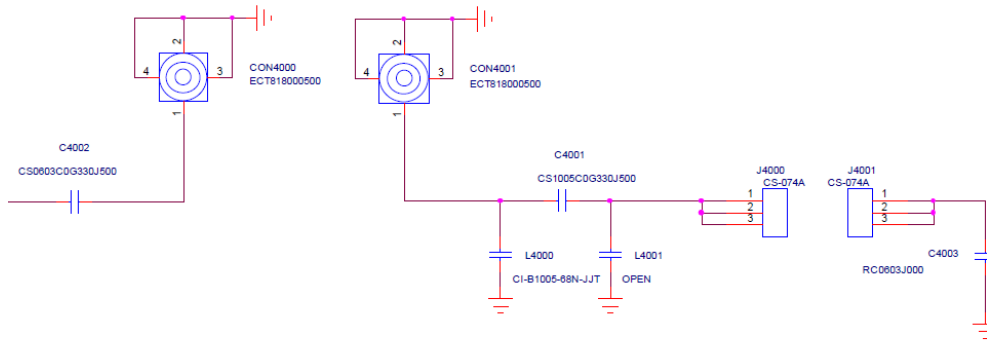


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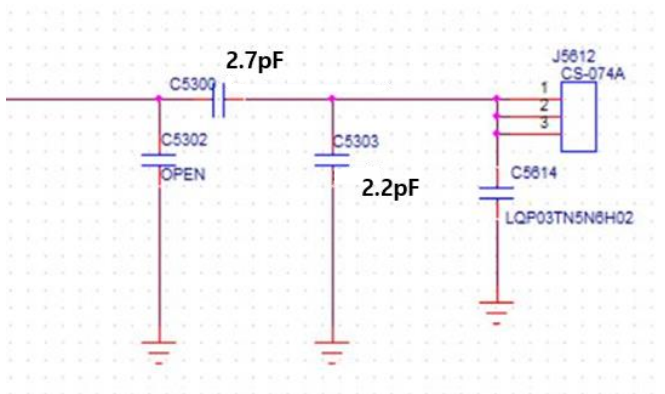
- 5-4-6 Antenna 5 – RFID/WiFi



- 5-3-7 Antenna 6 – GPS L1/WiFi



- 5-4-8 BLE

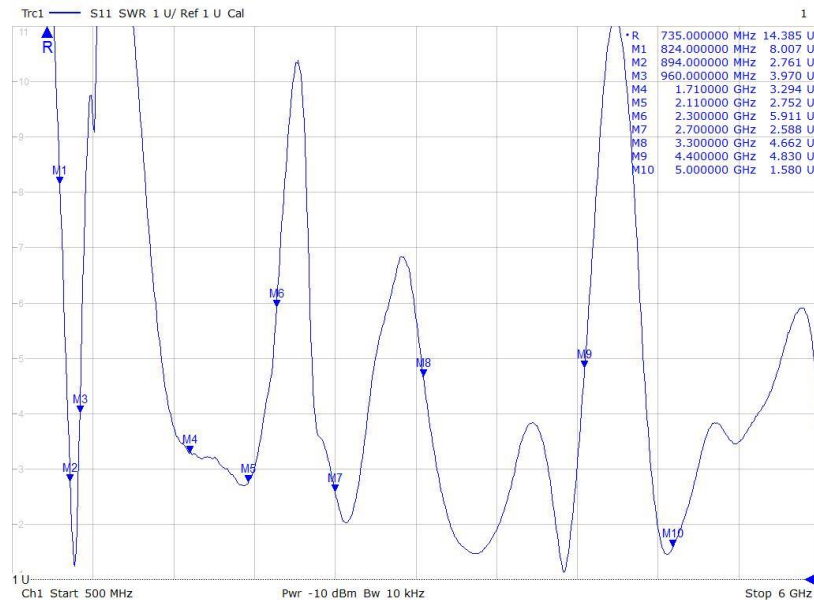


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6. 전기적 특성

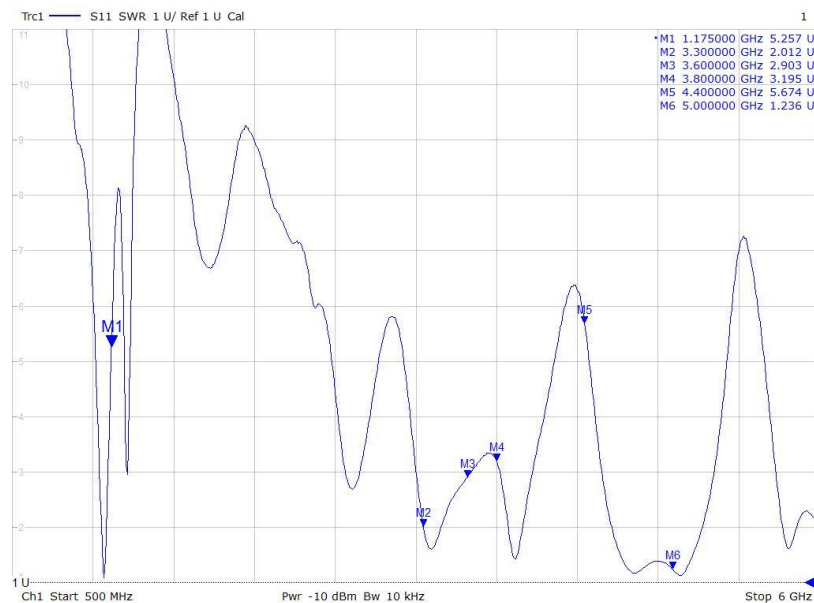
6-1. VSWR – Set 기준

- 6-1-1. Antenna 0 – LB/MB/HB TRx/UHB DRx



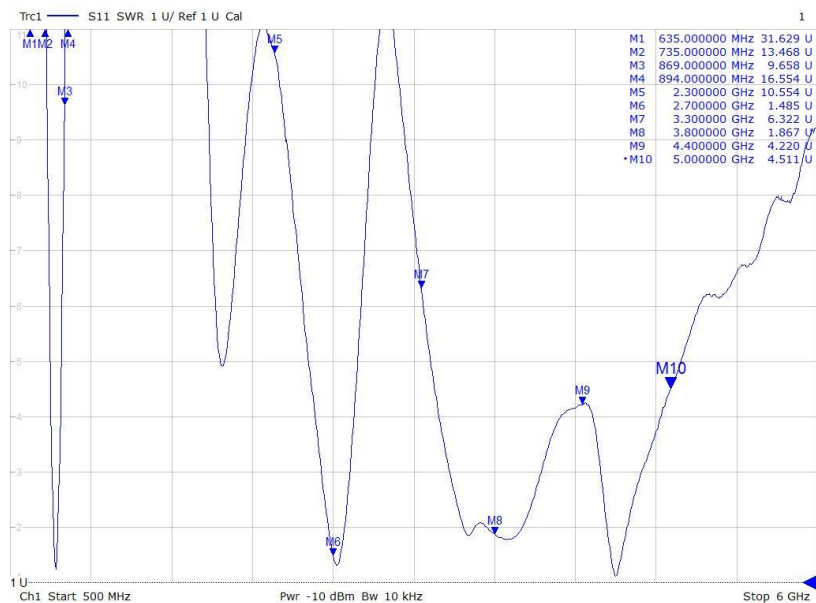
* GND 연결은 SP4T 사용 안함. R3405에 0R을 연결한 후 테스트 진행 함.

- 6-1-2. Antenna 1 – GPS L5/UHB TRx

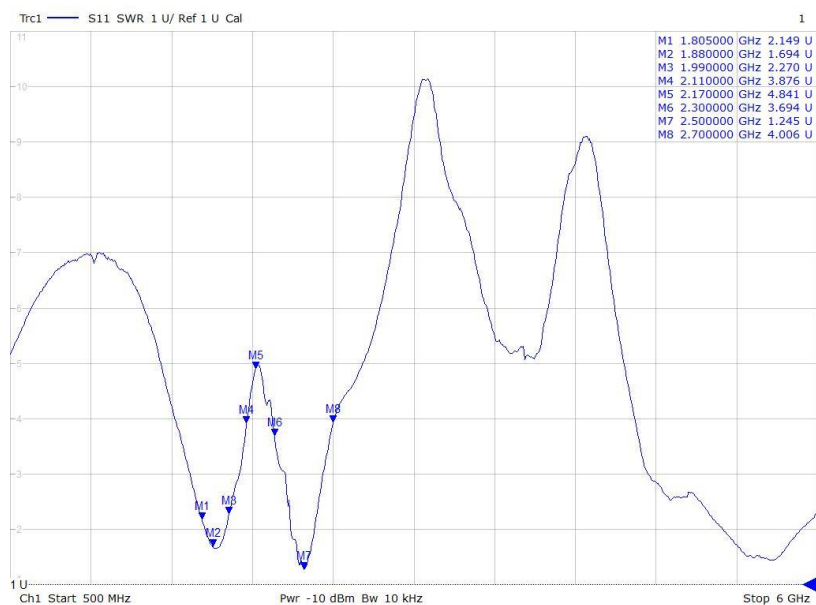


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- 6-1-3. Antenna 2 – LB DRx/HB DM/UHB/PMRx

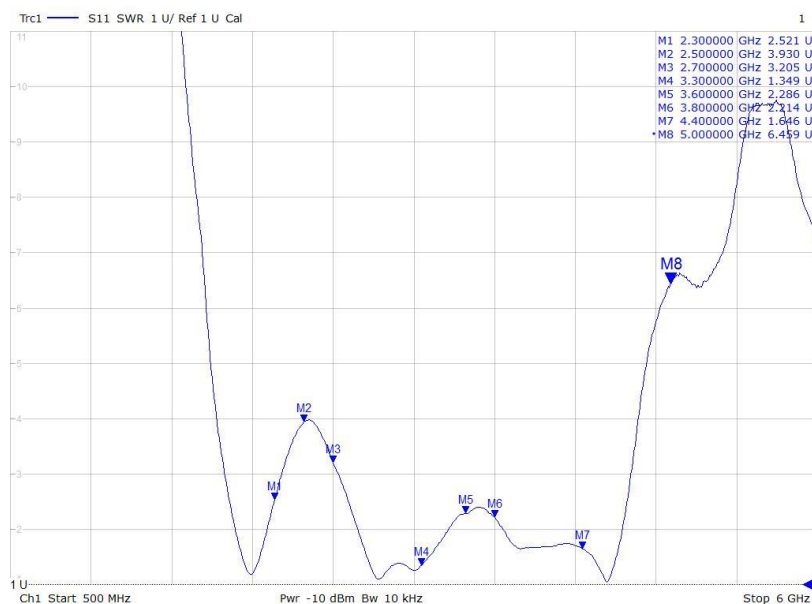


- 6-1-4. Antenna 3 –MB/HB/DRx

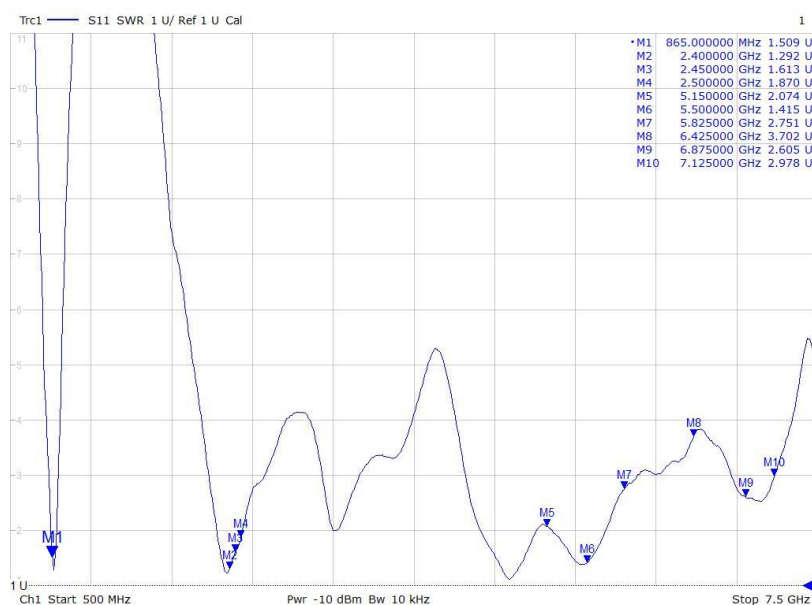


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- 6-1-5. Antenna 4 – HB PM/UHB/DMRx

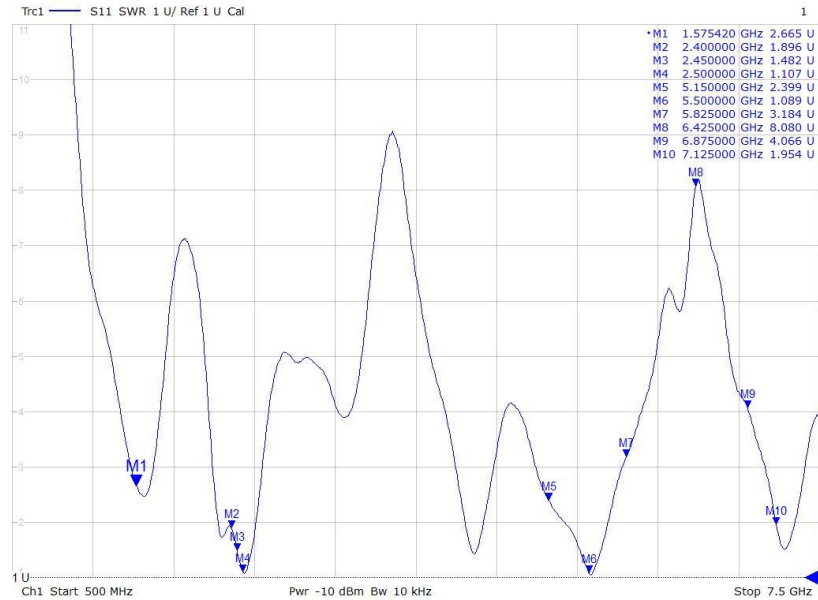


- 6-1-6 Antenna 5 – RFID/WiFi(WiFi-6E)

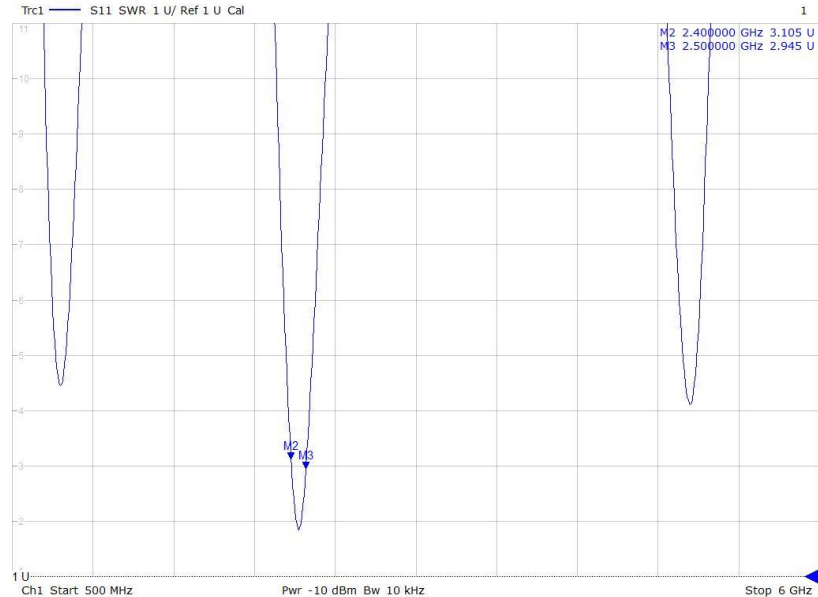


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- 6-1-7 Antenna 6 – GPS L1/WiFi(WiFi-6E)



- 6-1-8 BLE



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7. 3D GAIN DATA

7-1 Efficiency

- 7-1-1. Antenna 0 – LB/MB/HB TRx/UHB DRx

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Frequency [MHz]	635	705	735	790	824	869	894	960	1710	1805	1920	2110	2170	2300	2500	2700	3300	3800	4400	5000
Efficiency [dB]	-23.26	-17.92	-14.63	-11.42	-9.14	-6.79	-4.39	-5.52	-5.29	-4.88	-5.67	-6.15	-5.61	-9.00	-13.72	-7.11	-8.83	-8.86	-10.24	-15.23
Efficiency [%]	0.5	1.6	3.4	7.2	12.2	20.9	36.4	28.1	29.6	32.5	27.1	24.3	27.5	12.6	4.2	19.4	13.1	13.0	9.5	3.0
TRG _θ [dB]	-24.80	-18.88	-15.48	-12.16	-9.92	-7.67	-5.32	-6.68	-7.90	-7.77	-8.83	-8.90	-8.48	-11.51	-17.55	-9.34	-10.66	-10.86	-11.55	-18.81
Gain _{θ Peak} [dB]	-20.96	-16.39	-12.94	-9.34	-6.89	-3.77	-0.97	-1.40	0.09	0.49	-0.57	-2.63	-2.66	-6.21	-10.22	-2.83	-4.39	-3.21	-6.09	-14.67
Gain _{θ Min} [dB]	-42.23	-26.65	-23.93	-24.77	-24.08	-28.55	-24.04	-30.36	-17.45	-28.33	-31.40	-28.08	-24.01	-35.60	-32.00	-29.92	-21.45	-30.00	-23.20	-29.60
TRG _φ [dB]	-28.50	-24.93	-22.12	-19.48	-17.01	-14.17	-11.51	-11.81	-8.75	-8.00	-8.54	-9.43	-8.76	-12.57	-16.05	-11.09	-13.46	-13.19	-16.06	-17.73
Gain _{φ Peak} [dB]	-22.72	-20.04	-16.71	-13.07	-10.03	-7.69	-5.40	-7.39	1.04	1.63	0.66	-0.01	0.51	-3.33	-9.07	-4.09	-7.83	-7.15	-7.95	-10.03
Gain _{φ Min} [dB]	-44.18	-41.90	-46.96	-41.98	-36.76	-30.40	-27.76	-41.99	-34.99	-35.91	-26.66	-31.88	-33.39	-34.89	-35.65	-33.41	-30.39	-36.30	-46.37	-32.53
UHRG [dB]	-27.87	-21.72	-18.31	-15.20	-13.12	-11.08	-8.73	-9.66	-12.03	-11.65	-12.05	-11.73	-11.19	-14.87	-16.35	-11.64	-12.93	-14.33	-14.29	-17.77
UHRG/TRG [%]	34.6	41.7	42.8	41.9	40.0	37.3	36.8	38.5	21.2	21.0	23.0	27.7	27.7	25.9	54.7	35.3	38.9	28.4	39.3	55.7
H-Plane	-24.21	-17.38	-13.88	-10.95	-8.63	-5.97	-3.38	-4.82	-12.06	-11.14	-13.84	-11.18	-10.43	-13.18	-18.15	-9.08	-13.31	-14.46	-12.75	-19.20
E1-Plane, AVG [dB]	-25.98	-20.16	-16.69	-13.25	-10.92	-8.67	-6.37	-8.22	-9.19	-9.71	-10.54	-11.79	-11.29	-13.41	-20.82	-9.33	-11.18	-11.44	-11.85	-20.26
E2-Plane, AVG [dB]	-25.36	-19.63	-16.30	-13.09	-10.84	-8.45	-5.98	-6.57	-5.83	-5.62	-7.07	-7.04	-6.81	-9.90	-14.38	-6.61	-9.16	-9.33	-10.17	-16.94
Peak Gain [dB]	-19.84	-15.35	-12.05	-8.42	-5.55	-2.91	-0.52	-1.39	2.08	2.53	1.27	0.48	1.04	-2.69	-8.78	-2.46	-3.75	-2.69	-4.95	-9.63
Directivity [dB]	3.42	2.57	2.57	3.01	3.59	3.88	3.87	4.13	7.37	7.40	6.94	6.63	6.64	6.31	4.95	4.65	5.08	6.17	5.29	5.60
Minimum Gain [dB]	-32.90	-26.30	-23.22	-21.22	-18.72	-18.22	-16.82	-14.94	-16.11	-21.28	-16.31	-15.29	-17.48	-22.36	-25.54	-17.44	-15.64	-16.12	-19.37	-24.63
Test Condition	FS																			
Antenna Type																				
Average Efficiency	-7.88 dB 16.31 %																			

* GND 연결은 SP4T 사용 안함.(R3405에 OR 적용 한 후 테스트 진행 함.)

- 7-1-2. Antenna 1 – GPS L5/UHB TRx

	1	2	3	4	5	6	7	8	9
Frequency [MHz]	1170	1175	1180	3300	3400	3600	3800	4400	5000
Efficiency [dB]	-12.90	-13.82	-14.62	-6.32	-6.66	-10.62	-9.87	-10.21	-9.57
Efficiency [%]	5.1	4.2	3.5	23.4	21.6	8.7	10.3	9.5	11.0
TRG _θ [dB]	-14.73	-15.65	-16.44	-9.95	-10.37	-13.51	-11.64	-12.11	-11.79
Gain _{θ Peak} [dB]	-8.53	-9.51	-10.47	-4.80	-6.10	-9.53	-6.44	-4.06	-5.50
Gain _{θ Min} [dB]	-35.05	-34.64	-33.87	-24.34	-26.77	-33.19	-29.23	-37.90	-35.40
TRG _φ [dB]	-17.53	-18.46	-19.28	-8.78	-9.07	-13.76	-14.62	-14.73	-13.56
Gain _{φ Peak} [dB]	-13.18	-14.16	-14.90	-2.00	-2.73	-7.98	-8.08	-7.89	-7.42
Gain _{φ Min} [dB]	-31.97	-32.69	-33.25	-24.47	-31.69	-39.34	-44.97	-34.37	-42.76
UHRG [dB]	-17.81	-18.70	-19.45	-10.09	-10.31	-14.11	-12.75	-15.60	-14.19
UHRG/TRG [%]	32.2	32.5	32.9	42.0	43.1	44.8	51.5	28.9	34.5
H-Plane	-17.32	-18.36	-19.32	-10.10	-10.19	-12.75	-9.74	-12.67	-14.86
E1-Plane, AVG [dB]	-15.60	-16.50	-17.34	-8.97	-9.22	-13.07	-12.10	-11.27	-12.67
E2-Plane, AVG [dB]	-13.59	-14.59	-15.44	-11.33	-11.71	-14.74	-13.73	-14.15	-11.41
Peak Gain [dB]	-8.48	-9.46	-10.38	-1.44	-2.32	-7.29	-6.28	-3.85	-4.28
Directivity [dB]	4.42	4.36	4.24	4.87	4.34	3.33	3.59	6.36	5.29
Minimum Gain [dB]	-24.47	-24.89	-25.22	-13.66	-12.71	-17.03	-18.59	-19.31	-18.34
Test Condition	FS								
Antenna Type									
Average Efficiency	-9.67 dB 10.80 %								

Customer	Model	Customer Code	Date	Document Revision
BLUEBIRD	X40	352010171	25' 10. 16	Rev 0.0

- 7-1-3. Antenna 2 – LB DRx/HB DM/UHB/PMRx

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Frequency [MHz]	635	735	790	869	894	960	2300	2400	2500	2700	3300	3800	4400	5000
Efficiency [dB]	-25.45	-12.78	-5.67	-12.31	-14.19	-19.00	-12.83	-10.53	-8.38	-5.77	-8.40	-6.17	-5.86	-9.16
Efficiency [%]	0.3	5.3	27.1	5.9	3.8	1.3	5.2	8.8	14.5	26.5	14.4	24.1	25.9	12.1
TRG _θ [dB]	-27.09	-13.71	-6.56	-13.28	-15.20	-20.35	-16.28	-13.90	-11.45	-8.48	-10.14	-8.08	-8.05	-11.48
Gain _{θ Peak} [dB]	-21.06	-9.14	-2.26	-8.60	-10.76	-15.04	-10.13	-8.06	-6.42	-2.79	-3.93	-2.12	-0.86	-5.95
Gain _{θ Min} [dB]	-40.78	-38.42	-29.22	-31.56	-31.86	-38.97	-40.54	-34.01	-27.46	-20.21	-28.83	-21.43	-30.16	-40.01
TRG _φ [dB]	-30.47	-19.94	-12.97	-19.29	-21.04	-24.75	-15.44	-13.22	-11.33	-9.10	-13.22	-10.66	-9.88	-12.99
Gain _{φ Peak} [dB]	-25.91	-14.11	-7.27	-12.86	-14.43	-19.09	-9.27	-6.90	-4.77	-2.68	-5.64	-3.11	-4.76	-4.70
Gain _{φ Min} [dB]	-43.83	-34.08	-35.61	-39.73	-37.39	-45.80	-42.42	-36.83	-29.78	-24.87	-31.49	-44.34	-26.59	-26.85
UHRG [dB]	-29.82	-16.27	-8.97	-15.51	-17.34	-22.48	-14.25	-11.82	-9.80	-7.72	-9.64	-7.54	-7.22	-10.93
UHRG/TRG [%]	36.5	44.8	46.7	47.9	48.5	44.9	72.1	74.4	72.1	63.8	75.3	73.0	73.2	66.6
H-Plane	-27.02	-12.80	-6.20	-12.70	-14.26	-19.50	-21.46	-17.99	-12.66	-6.44	-12.54	-7.93	-9.47	-11.56
E1-Plane, AVG [dB]	-29.19	-15.17	-7.78	-14.37	-16.24	-21.96	-17.18	-14.64	-11.99	-9.18	-10.21	-8.39	-8.42	-11.44
E2-Plane, AVG [dB]	-26.40	-13.79	-6.72	-13.36	-15.31	-19.86	-14.03	-11.99	-10.49	-7.40	-9.36	-7.56	-7.42	-11.27
Peak Gain [dB]	-20.68	-8.78	-1.93	-8.45	-10.47	-14.70	-7.95	-5.37	-4.10	-1.46	-2.97	-0.49	-0.33	-2.94
Directivity [dB]	4.77	4.00	3.74	3.86	3.72	4.30	4.88	5.17	4.28	4.30	5.43	5.69	5.53	6.22
Minimum Gain [dB]	-32.16	-23.70	-12.93	-21.92	-24.12	-35.54	-29.76	-24.75	-23.83	-13.38	-26.95	-18.55	-18.50	-26.65
Test Condition	FS													
Antenna Type														
Average Efficiency	-9.02 dB 12.53 %													

- 7-1-4. Antenna 3 –MB/HB/DRx

	1	2	3	4	5	6	7	8	9
Frequency [MHz]	1805	1880	1990	2110	2170	2300	2400	2500	2700
Efficiency [dB]	-7.82	-6.34	-5.45	-7.21	-7.24	-6.06	-5.12	-4.51	-6.10
Efficiency [%]	16.5	23.2	28.5	19.0	18.9	24.8	30.7	35.4	24.5
TRG _θ [dB]	-12.07	-10.64	-9.29	-9.80	-9.42	-7.15	-5.92	-5.23	-6.87
Gain _{θ Peak} [dB]	-5.05	-3.51	-2.52	-3.88	-3.15	-2.90	-0.23	0.27	-1.97
Gain _{θ Min} [dB]	-35.11	-24.02	-21.60	-33.52	-32.44	-19.80	-23.82	-21.26	-42.06
TRG _φ [dB]	-9.87	-8.36	-7.76	-10.69	-11.26	-12.63	-12.87	-12.66	-14.00
Gain _{φ Peak} [dB]	-2.00	-0.64	-0.60	-3.47	-3.74	-5.43	-3.78	-4.84	-7.21
Gain _{φ Min} [dB]	-34.87	-28.93	-31.86	-33.62	-29.69	-34.17	-31.57	-46.65	-36.57
UHRG [dB]	-12.99	-12.23	-10.98	-12.45	-12.19	-8.93	-9.18	-7.25	-8.66
UHRG/TRG [%]	30.4	25.8	28.0	29.9	32.0	51.7	39.3	53.1	55.5
H-Plane	-13.44	-10.42	-8.69	-7.79	-6.87	-6.56	-4.41	-4.02	-6.42
E1-Plane, AVG [dB]	-12.77	-11.90	-10.49	-10.73	-10.49	-8.24	-7.11	-5.84	-7.81
E2-Plane, AVG [dB]	-8.92	-7.77	-7.33	-8.79	-8.46	-6.65	-6.28	-5.89	-7.20
Peak Gain [dB]	-1.79	-0.49	-0.54	-2.87	-3.00	-2.47	0.12	0.61	-1.61
Directivity [dB]	6.03	5.86	4.91	4.34	4.23	3.60	5.25	5.11	4.49
Minimum Gain [dB]	-17.17	-15.98	-15.28	-17.23	-19.98	-12.85	-16.49	-15.66	-32.09
Test Condition	FS								
Antenna Type									
Average Efficiency	-6.09 dB 24.62 %								

Customer	Model	Customer Code	Date	Document Revision
BLUEBIRD	X40	352010171	25' 10. 16	Rev 0.0

- 7-1-5. Antenna 4 – HB PM/UHB/DMRx

	1	2	3	4	5	6	7	8	9	10
Frequency [MHz]	2300	2400	2500	2700	3300	3400	3600	3800	4400	5000
Efficiency [dB]	-15.85	-19.05	-16.98	-12.66	-5.59	-5.66	-5.89	-7.32	-5.76	-9.37
Efficiency [%]	2.6	1.2	2.0	5.4	27.6	27.2	25.8	18.5	26.5	11.5
TRG _θ [dB]	-18.15	-21.37	-18.86	-14.07	-6.66	-7.11	-7.57	-9.43	-9.89	-11.92
Gain _{θ Peak} [dB]	-12.93	-14.06	-13.43	-8.66	0.44	0.00	-0.96	-1.40	-4.02	-5.07
Gain _{θ Min} [dB]	-33.14	-44.95	-38.83	-28.34	-25.36	-35.57	-22.62	-28.02	-30.83	-26.38
TRG _φ [dB]	-19.71	-22.89	-21.53	-18.23	-12.21	-11.12	-10.82	-11.46	-7.88	-12.90
Gain _{φ Peak} [dB]	-13.80	-14.83	-13.35	-13.07	-5.06	-4.56	-5.01	-5.69	-1.76	-7.91
Gain _{φ Min} [dB]	-39.41	-48.59	-36.68	-39.73	-34.92	-27.78	-38.89	-38.39	-34.41	-28.71
UHRG [dB]	-18.65	-20.53	-18.62	-15.73	-10.02	-10.04	-10.28	-10.74	-9.97	-14.34
UHRG/TRG [%]	52.6	71.2	68.7	49.3	36.0	36.4	36.4	45.5	37.9	31.9
H-Plane	-17.19	-22.24	-19.44	-12.61	-11.96	-10.90	-11.40	-17.95	-14.82	-14.04
E1-Plane, AVG [dB]	-18.49	-20.32	-18.52	-14.60	-6.04	-6.77	-7.73	-9.04	-9.91	-12.23
E2-Plane, AVG [dB]	-17.42	-21.10	-19.27	-15.24	-5.37	-5.90	-6.20	-7.25	-7.59	-12.16
Peak Gain [dB]	-12.20	-12.23	-11.52	-8.66	0.63	0.28	-0.70	-0.93	-1.29	-3.54
Directivity [dB]	3.65	6.82	5.46	4.00	6.22	5.94	5.18	6.39	4.47	5.83
Minimum Gain [dB]	-19.93	-31.56	-34.18	-23.17	-21.41	-18.71	-18.48	-17.79	-17.94	-23.24
Test Condition	FS									
Antenna Type										
Average Efficiency	-8.28 dB 14.85 %									

- 7-1-6 Antenna 5 – RFID/WiFi(WiFi-6E)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Frequency [MHz]	900	915	930	2400	2450	2500	5150	5300	5500	5700	585	5925	6270	6425	6525	6875	7000	7125
Efficiency [dB]	-7.00	-6.62	-6.62	-6.79	-6.10	-6.13	-4.47	-5.50	-5.24	-5.31	-6.04	-6.27	-7.43	-5.12	-5.47	-5.70	-6.90	-5.77
Efficiency [%]	20.0	21.3	21.8	21.0	24.6	24.4	35.7	28.2	29.9	29.4	24.9	23.6	18.1	30.8	28.4	26.9	20.4	26.5
TRG _θ [dB]	-9.04	-8.98	-8.22	-8.71	-8.02	-8.07	-6.08	-7.41	-7.54	-7.19	-7.68	-7.95	-10.07	-7.17	-7.58	-8.69	-9.71	-8.95
Gain _{θ Peak} [dB]	-4.65	-4.31	-4.31	-3.88	-3.82	-3.92	0.18	-2.06	-2.07	-1.86	-1.99	-2.11	-4.90	-1.03	-0.98	-2.62	-3.37	-2.49
Gain _{θ Min} [dB]	-27.70	-34.26	-31.10	-20.69	-16.47	-18.09	-19.44	-23.03	-27.04	-31.01	-30.91	-34.28	-27.99	-36.68	-26.29	-39.75	-30.93	-50.01
TRG _φ [dB]	-11.26	-10.39	-10.07	-11.26	-10.58	-10.54	-9.57	-10.00	-9.10	-9.87	-11.06	-11.20	-10.84	-9.36	-9.62	-8.74	-10.12	-8.62
Gain _{φ Peak} [dB]	-6.92	-5.57	-5.55	-4.71	-5.21	-4.79	-3.76	-4.50	-2.88	-3.84	-6.13	-7.21	-2.67	-2.62	-2.47	-1.55	-3.21	-2.94
Gain _{φ Min} [dB]	-26.55	-27.55	-27.24	-32.85	-44.37	-24.48	-21.86	-23.37	-25.56	-31.79	-24.38	-25.48	-24.73	-22.16	-24.94	-28.69	-23.96	-30.60
UHRG [dB]	-10.55	-10.05	-9.95	-10.33	-9.18	-9.97	-6.55	-7.45	-7.11	-7.41	-8.23	-8.49	-9.53	-7.30	-7.71	-8.38	-9.69	-8.68
UHRG/TRG [%]	44.1	45.4	45.4	44.2	49.1	41.3	62.0	63.8	65.0	61.8	60.3	59.9	61.6	60.6	59.6	54.0	52.6	51.2
H-Plane	-8.22	-8.15	-8.35	-8.49	-7.12	-7.35	-4.69	-6.53	-7.45	-7.46	-7.89	-8.42	-9.44	-8.29	-6.94	-7.58	-8.59	-7.51
E1-Plane, AVG [dB]	-11.13	-11.49	-12.20	-7.99	-7.61	-7.98	-9.05	-9.57	-9.09	-8.24	-8.68	-8.79	-10.00	-8.92	-7.55	-7.78	-8.68	-7.87
E2-Plane, AVG [dB]	-8.19	-7.74	-7.52	-8.01	-7.61	-7.41	-6.86	-7.67	-7.21	-7.13	-7.99	-8.06	-10.88	-8.50	-9.42	-10.12	-11.98	-11.45
Peak Gain [dB]	-3.41	-3.05	-3.24	-2.44	-2.94	-2.13	0.42	-0.95	-0.91	-1.12	-1.85	-1.88	-0.63	0.90	0.20	0.74	-0.72	-0.61
Directivity [dB]	3.59	3.53	3.36	4.35	3.16	4.00	4.90	4.55	4.33	4.20	4.19	4.39	6.80	6.02	5.67	6.44	6.18	5.16
Minimum Gain [dB]	-18.50	-18.99	-19.31	-17.43	-13.86	-14.54	-15.08	-15.31	-20.16	-15.21	-16.36	-16.45	-18.21	-16.13	-13.09	-14.83	-19.82	-17.29
Test Condition	FS																	
Antenna Type																		
Average Efficiency	-5.93 dB 25.52 %																	

Customer	Model	Customer Code	Date	Document Revision
BLUEBIRD	X40	352010171	25' 10. 16	Rev 0.0

- 7-1-7 Antenna 6 – GPS L1/WiFi(WiFi-6E)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Frequency [MHz]	1570	1575	1580	1600	1615	2400	2450	2500	5150	5300	5500	5700	5825	5925	6270	6425	6525	6875	7000	7125
Efficiency [dB]	-5.92	-5.68	-5.46	-5.56	-5.95	-5.16	-4.38	-4.71	-5.55	-4.74	-5.50	-6.32	-8.09	-10.45	-10.08	-11.93	-8.65	-13.10	-10.97	-9.98
Efficiency [%]	25.6	27.1	28.4	27.8	25.4	30.5	36.5	33.8	27.9	33.6	28.2	23.3	15.5	9.0	9.8	6.4	13.6	4.9	8.0	10.1
TRG _θ [dB]	-10.73	-10.49	-10.30	-10.32	-10.59	-8.30	-7.66	-7.93	-11.89	-10.67	-10.68	-10.41	-11.54	-13.58	-14.22	-16.83	-13.93	-18.42	-15.95	-15.39
Gain _{θ Peak} [dB]	-4.67	-4.43	-4.21	-4.31	-4.54	-0.59	-0.17	-0.96	-6.54	-4.18	-5.15	-4.37	-5.42	-6.80	-6.72	-10.41	-7.85	-12.52	-9.84	-9.67
Gain _{θ Min} [dB]	-33.82	-33.52	-32.31	-27.20	-25.35	-27.25	-28.39	-25.47	-28.66	-29.23	-23.77	-31.65	-30.02	-33.34	-35.11	-30.04	-34.33	-34.59	-37.23	-30.91
TRG _φ [dB]	-7.66	-7.42	-7.19	-7.33	-7.78	-8.04	-7.13	-7.51	-6.70	-6.02	-7.08	-8.47	-10.71	-13.34	-12.20	-13.62	-10.18	-14.61	-12.63	-11.45
Gain _{φ Peak} [dB]	-2.62	-2.36	-2.09	-2.13	-2.51	-2.42	-1.42	-2.12	-1.00	0.30	-0.97	-2.15	-4.93	-7.90	-5.66	-7.67	-4.12	-7.94	-5.85	-5.44
Gain _{φ Min} [dB]	-19.27	-19.00	-18.60	-18.68	-18.52	-22.32	-26.17	-23.85	-34.56	-41.62	-23.64	-27.25	-46.38	-33.16	-26.25	-31.36	-27.43	-30.49	-29.48	-27.07
UHRG [dB]	-9.32	-9.06	-8.82	-8.84	-9.18	-7.30	-6.57	-7.04	-8.48	-8.22	-9.01	-9.72	-11.04	-13.09	-11.67	-14.34	-11.67	-17.22	-14.71	-13.66
UHRG/TRG [%]	45.8	45.9	46.1	47.0	47.6	61.0	60.5	58.4	50.9	44.9	44.6	45.7	50.8	54.4	69.3	57.5	49.9	38.7	42.3	42.9
H-Plane	-11.50	-11.32	-11.23	-11.77	-12.45	-9.47	-8.59	-8.47	-11.78	-9.79	-9.96	-9.61	-10.32	-11.78	-14.73	-17.74	-14.43	-18.89	-16.22	-16.11
E1-Plane, AVG [dB]	-14.91	-14.58	-14.35	-14.11	-14.09	-12.89	-13.10	-14.47	-14.64	-12.83	-12.71	-11.08	-11.22	-13.15	-14.02	-18.39	-13.46	-16.71	-14.87	-15.73
E2-Plane, AVG [dB]	-6.89	-6.66	-6.48	-6.67	-7.13	-6.00	-5.19	-5.39	-10.62	-10.45	-10.63	-10.39	-12.23	-14.64	-13.49	-15.70	-13.80	-19.29	-16.83	-14.92
Peak Gain [dB]	-2.19	-1.92	-1.66	-1.66	-2.00	-0.35	0.12	-0.77	-0.58	0.97	-0.02	-0.62	-2.62	-5.07	-3.94	-7.30	-3.70	-7.00	-5.60	-5.03
Directivity [dB]	3.73	3.76	3.80	3.90	3.95	4.81	4.50	3.94	4.97	5.71	5.48	5.71	5.47	5.39	6.15	4.63	4.95	6.10	5.37	4.95
Minimum Gain [dB]	-13.64	-13.20	-12.80	-12.21	-12.22	-16.64	-16.35	-14.15	-20.77	-20.61	-17.77	-22.96	-27.97	-25.91	-25.69	-20.50	-19.53	-20.94	-22.50	-21.61
Test Condition	FS																			
Antenna Type																				
Average Efficiency	-6.72 dB 21.27 %																			

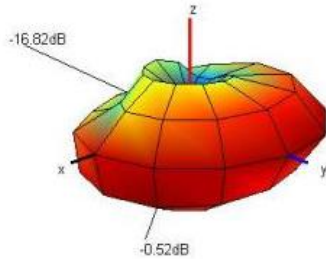
- 7-1-8 2nd BLE

	1	2	3	4	5	6	7	8	9	10	11
Frequency [MHz]	2400	2410	2420	2430	2440	2450	2460	2470	2480	2490	2500
Efficiency [dB]	-11.31	-10.85	-10.50	-10.06	-9.60	-9.27	-9.42	-9.68	-10.11	-9.91	-10.10
Efficiency [%]	7.4	8.2	8.9	9.9	11.0	11.8	11.4	10.8	9.8	10.2	9.8
TRG _θ [dB]	-18.51	-18.14	-17.84	-17.34	-16.84	-16.43	-16.46	-16.68	-16.95	-16.70	-16.94
Gain _{θ Peak} [dB]	-11.30	-10.98	-10.74	-10.32	-10.00	-9.51	-9.72	-9.93	-10.36	-10.01	-10.35
Gain _{θ Min} [dB]	-33.42	-34.85	-35.37	-36.90	-36.42	-36.11	-32.94	-33.05	-32.73	-33.07	-36.45
TRG _φ [dB]	-12.22	-11.74	-11.38	-10.96	-10.51	-10.20	-10.38	-10.65	-11.12	-10.93	-11.11
Gain _{φ Peak} [dB]	-6.49	-6.11	-5.78	-5.38	-4.95	-4.65	-4.90	-5.15	-5.54	-5.36	-5.49
Gain _{φ Min} [dB]	-30.64	-30.41	-29.77	-28.87	-28.09	-27.40	-27.42	-28.08	-30.73	-31.08	-36.05
UHRG [dB]	-14.59	-14.06	-13.65	-13.17	-12.68	-12.33	-12.48	-12.73	-13.16	-12.92	-13.07
UHRG/TRG [%]	47.0	47.7	48.3	48.9	49.2	49.4	49.5	49.6	49.6	50.0	50.4
H-Plane	-22.22	-21.71	-21.32	-20.83	-20.48	-20.28	-20.45	-20.67	-21.14	-20.81	-21.21
E1-Plane, AVG [dB]	-15.48	-15.09	-14.70	-14.18	-13.61	-13.13	-13.13	-13.31	-13.63	-13.34	-13.53
E2-Plane, AVG [dB]	-19.96	-19.55	-19.28	-18.86	-18.45	-18.20	-18.44	-18.77	-19.13	-19.02	-19.21
Peak Gain [dB]	-6.43	-6.05	-5.70	-5.29	-4.86	-4.57	-4.81	-5.06	-5.46	-5.28	-5.41
Directivity [dB]	4.87	4.80	4.79	4.77	4.74	4.71	4.61	4.62	4.65	4.63	4.69
Minimum Gain [dB]	-23.20	-22.52	-22.09	-21.68	-20.76	-19.88	-19.68	-19.57	-20.36	-19.35	-19.72
Test Condition	FS										
Antenna Type											
Average Efficiency	-10.03 dB 9.92 %										

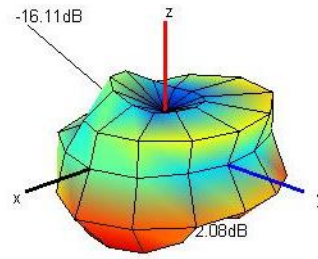
Customer	Model	Customer Code	Date	Document Revision
BLUEBIRD	X40	352010171	25' 10. 16	Rev 0.0

7-2 Radiation Pattern

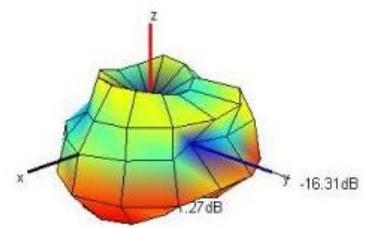
- 7-2-1. Antenna 0 – LB/MB/HB TRx/UHB DRx



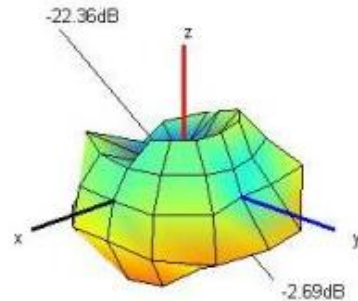
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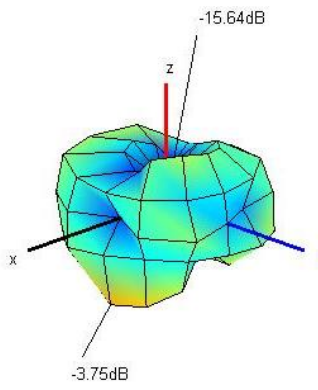
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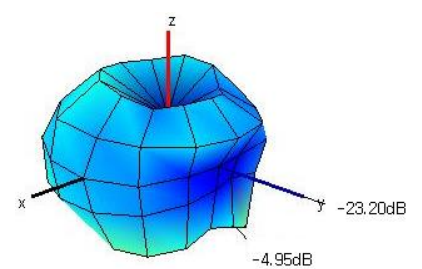
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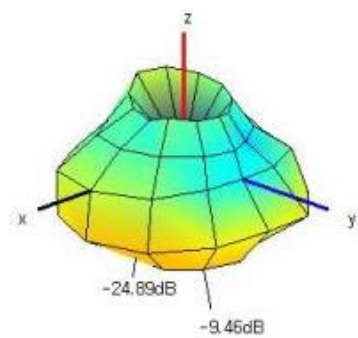


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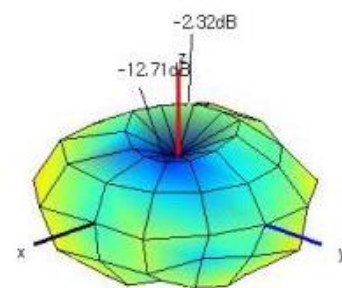


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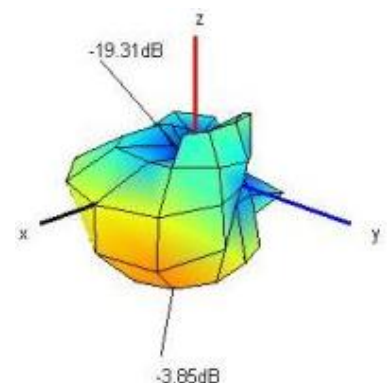
- 7-2-2. Antenna 1 – GPS L5/UHB TRx



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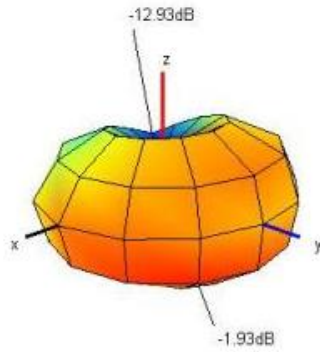
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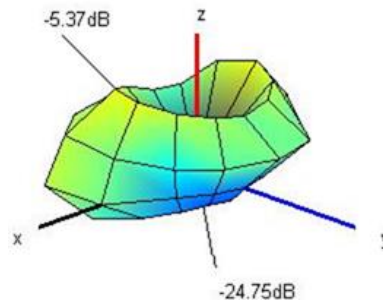
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Customer	Model	Customer Code	Date	Document Revision
BLUEBIRD	X40	352010171	25' 10. 16	Rev 0.0

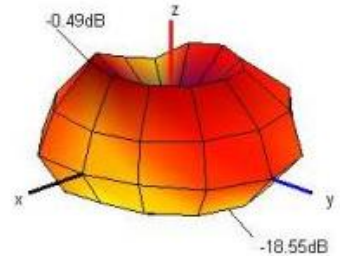
- 7-2-3. Antenna 2 – LB DRx/HB DM/UHB/PMRx



<894MHz>

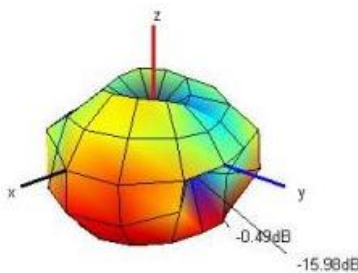


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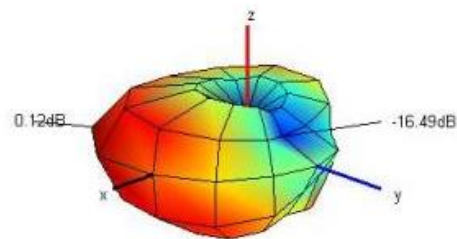


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- 7-2-4. Antenna 3 –MB/HB/DRx

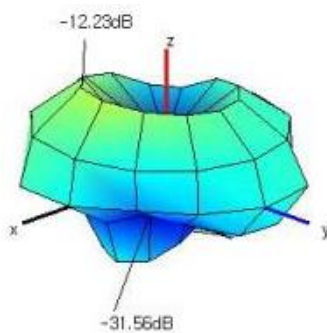


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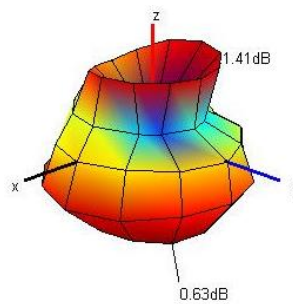


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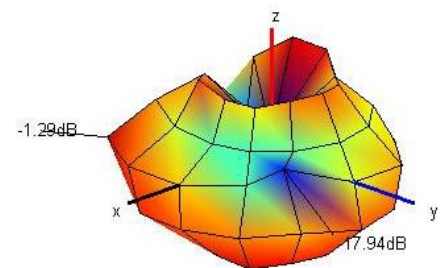
- 7-2-5. Antenna 4 – HB PM/UHB/DMRx



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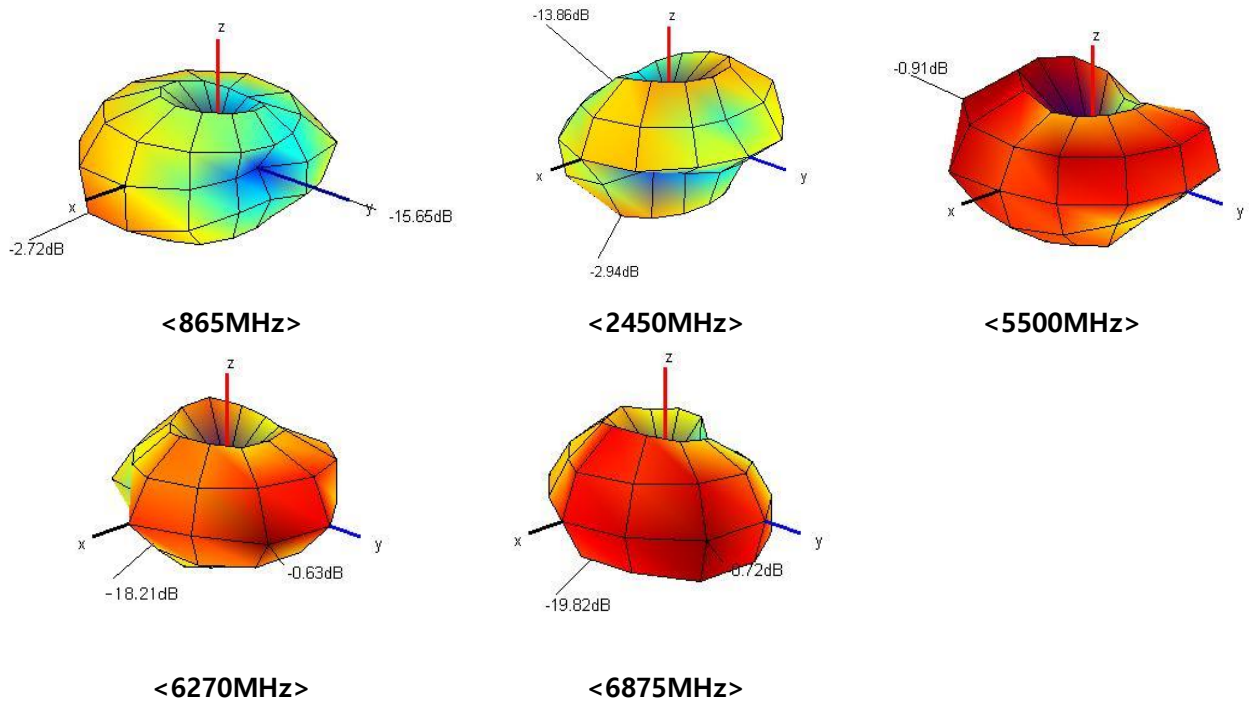
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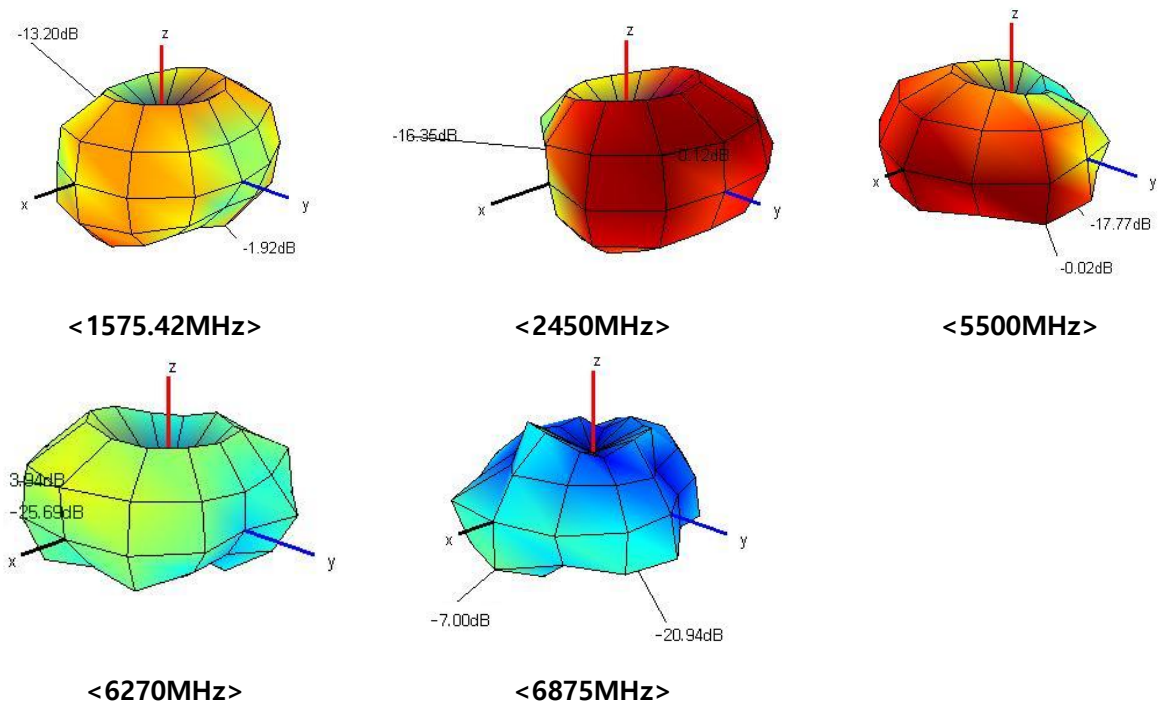
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Customer	Model	Customer Code	Date	Document Revision
BLUEBIRD	X40	352010171	25' 10. 16	Rev 0.0

- 7-2-6 Antenna 5 – RFID/WiFi(WiFi 6E)



- 7-2-7 Antenna 6 – GPS L1/WiFi(WiFi-6E)



Customer	Model	Customer Code	Date	Document Revision
BLUEBIRD	X40	352010171	25' 10. 16	Rev 0.0

- 7-2-8 2nd BLE

