



# Preliminary Approval Sheet

Type : Stacked Patch Antenna  
 AMOTECH Part No. : AGGA42K42-48-L1L2E5b-D150  
 Customer Part No. : L1 + L2&E5b Stacked Antenna

-	Designed	Checked		Approved
Date	. .	. . .	. . .	. . .

Revision no	Content	Page	Date	Name
0	First, documented	-	2019.05.03	H.B Bong

	■ HEAD OFFICE 5B-1L, 617, NAMCHON-DONG, NAMDONG-GU, INCHOEN-CITY, KOREA TEL : 82-32-821-0363 FAX : 82-32-811-0283 ■ CHINA FACTORY WAISHANGGONGYEYUAN HIGH NEW TECHNOLOGY DEVELOPMENT AREA ZIBO SHANDONG P.R.CHINA 255086 TEL: 86-0533-358-7691 FAX: 86-0533-358-7689	Designed	Checked		Approved
	. .	. . .	. . .	. . .	

# 1. Specification

## 1.1 Electrical characteristic

No	Item	Specification	Unit	Remarks	
1	Frequency (Fc)	L1	1559.0 ~ 1610.0	MHz	Notes : 1)
		L2&E5b	1194.0 ~ 1255.0	MHz	
		L1	TBD	MHz	Notes : 2)
		L2&E5b	TBD	MHz	
2	Return-Loss @ Fc	L1	Min. 10 @ 1559.0 ~ 1610.0 MHz	dB	Notes : 1)
		L2&E5b	Min. 10 @ 1194.0 ~ 1255.0 MHz	dB	Notes : 2)
		L1	TBD	dB	
		L2&E5b	TBD	dB	
3	Axial Ratio @ Zenith	L1	Typ. 3.0 @ 1559.0 ~ 1610.0 MHz	dB	Notes : 1)
		L2&E5b	Typ. 3.0 @ 1194.0 ~ 1255.0 MHz	dB	
4	Gain @ Zenith	L1	Typ. 4.0 @ 1559.0 ~ 1570.0 MHz Typ. 5.0 @ 1573.0 ~ 1585.0 MHz Typ. 4.0 @ 1587.0 ~ 1597.0 MHz Typ. 3.0 @ 1602.0 ~ 1610.0 MHz	dBic	Notes : 1)
		L2&E5b	Typ. 0.0~2.5 @ 1194.0 ~ 1207.0 MHz Typ. 3.5 @ 1215.0 ~ 1227.0 MHz Typ. 2.5~3.0 @ 1237.5 ~ 1240.0 MHz Typ. 2.0 @ 1242.0 ~ 1245.0 MHz Typ. 0.5~1.5 @ 1250.0 ~ 1255.0 MHz	dBic	
5	Polarization	L1	RHCP	-	-
		L2&E5b	RHCP	-	-
6	Isolation	-	Typ. 15 @ 1159.0 ~ 1610.0MHz Typ. 15 @ 1194.0 ~ 1255.0MHz	dB	Notes : 1)
7	Phase Center Stability	-	$\leq \pm 5.0 @ (0 \leq \theta \leq 75)$	cm	Notes : 1)
8	Impedance	-	50	$\Omega$	-
9	Operating Temperature	-	-40 / +90	$^{\circ}\text{C}$	-

※ Notes: 1) Measured on Dia.150mm ground plane with hybrid coupler.

Notes: 2) Measured on AMOTECH FR4 ground plane with adhesive tape and release liner. (Stack state)

- Fc is mid Point of loop/cusp in smith chart.

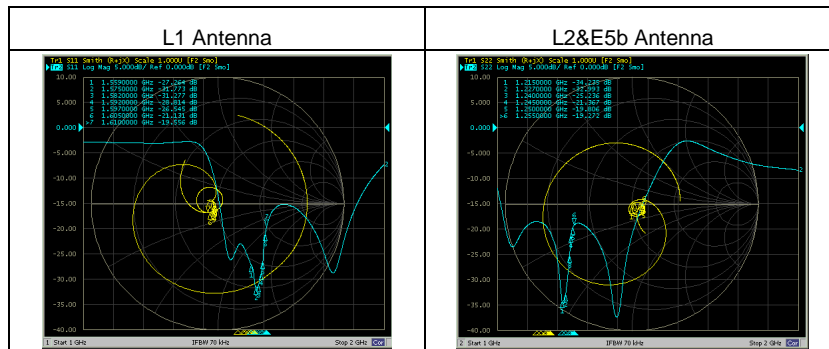
- All Products in Mass Production Pass through the Inspection Process (100%)

➔ Inspection List : Frequency(MHz), Return Loss(-dB)

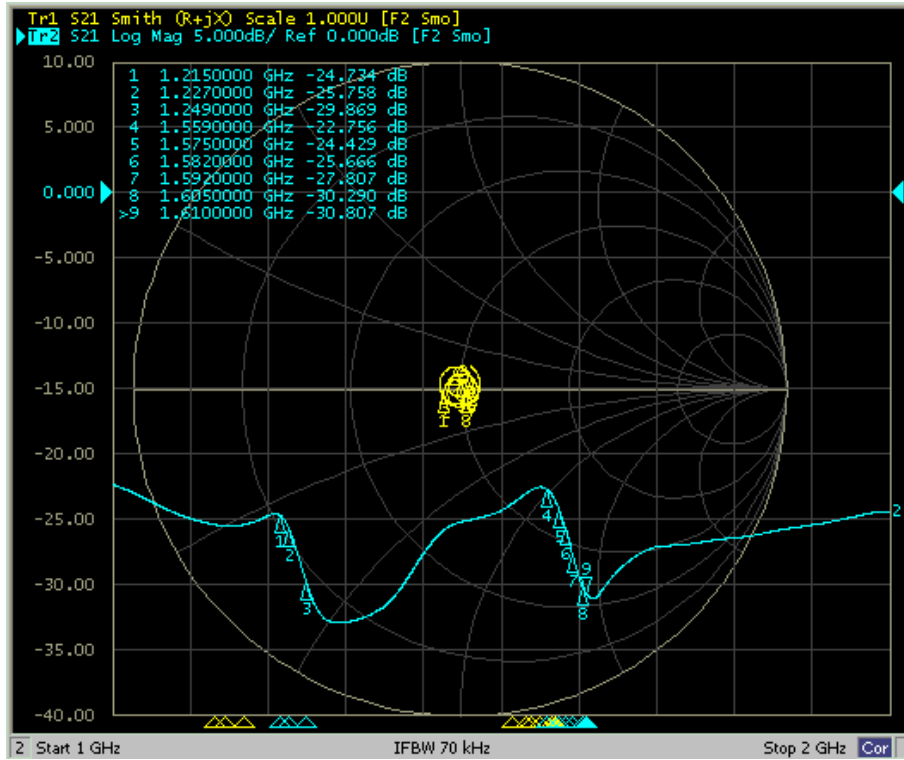
### 1.2.1 Typical S-Parameter (S11)

※ Measured on Dia.150mm Ground Plane with Hybrid Coupler.

#### 1.2.1.1 L1 + L2&E5b Antenna Log mag & Smith chart



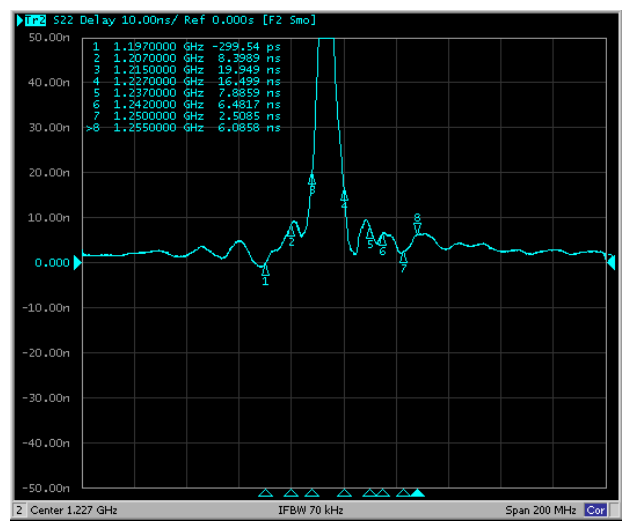
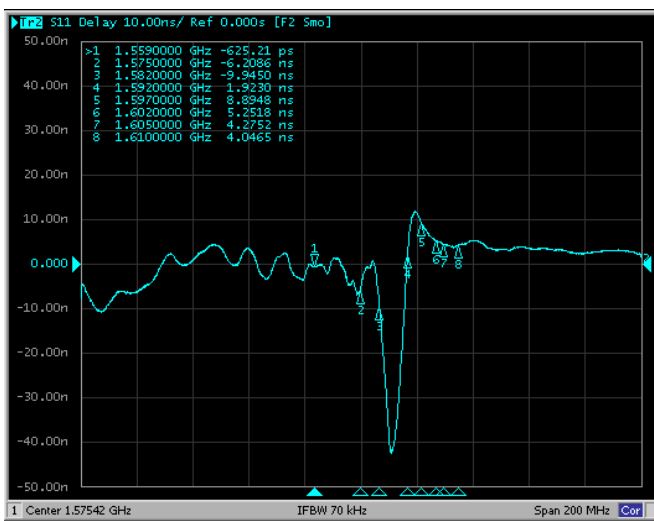
1.2.1.2 Stacked State\_ Isolation



1.2.1.3 Group delay

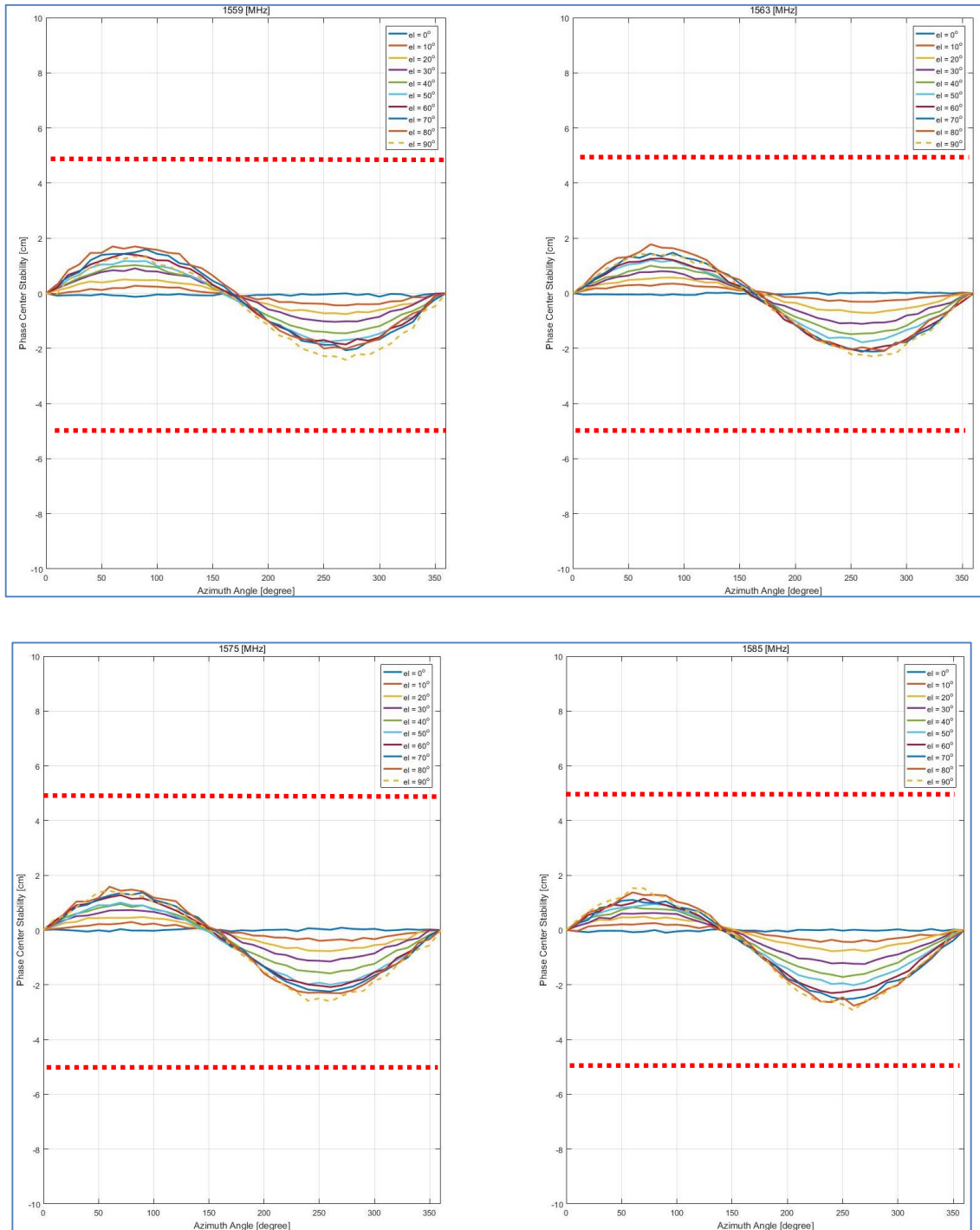
L1 Antenna

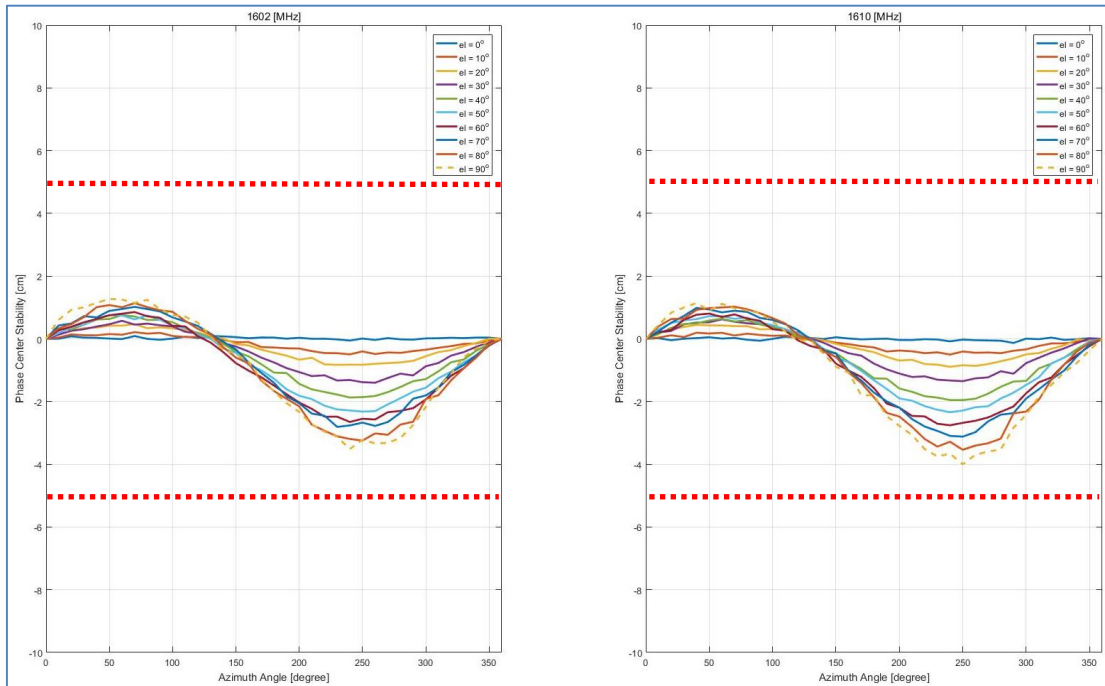
L2&E5b Antenna



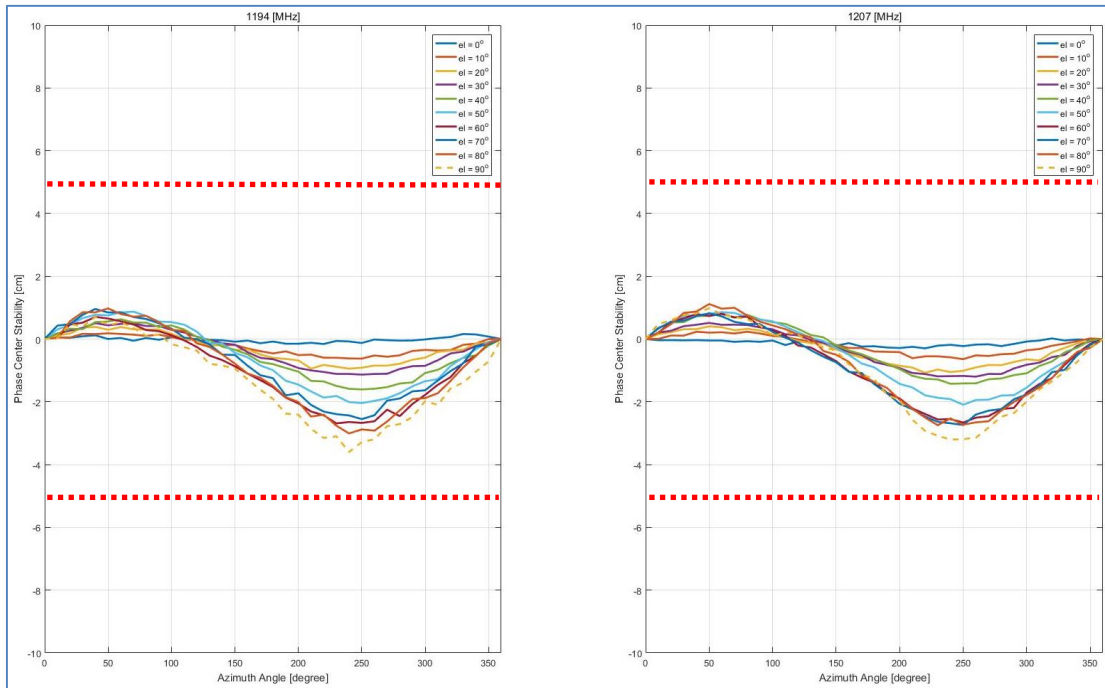
1.2.2 Phase Center Stability (PCS)

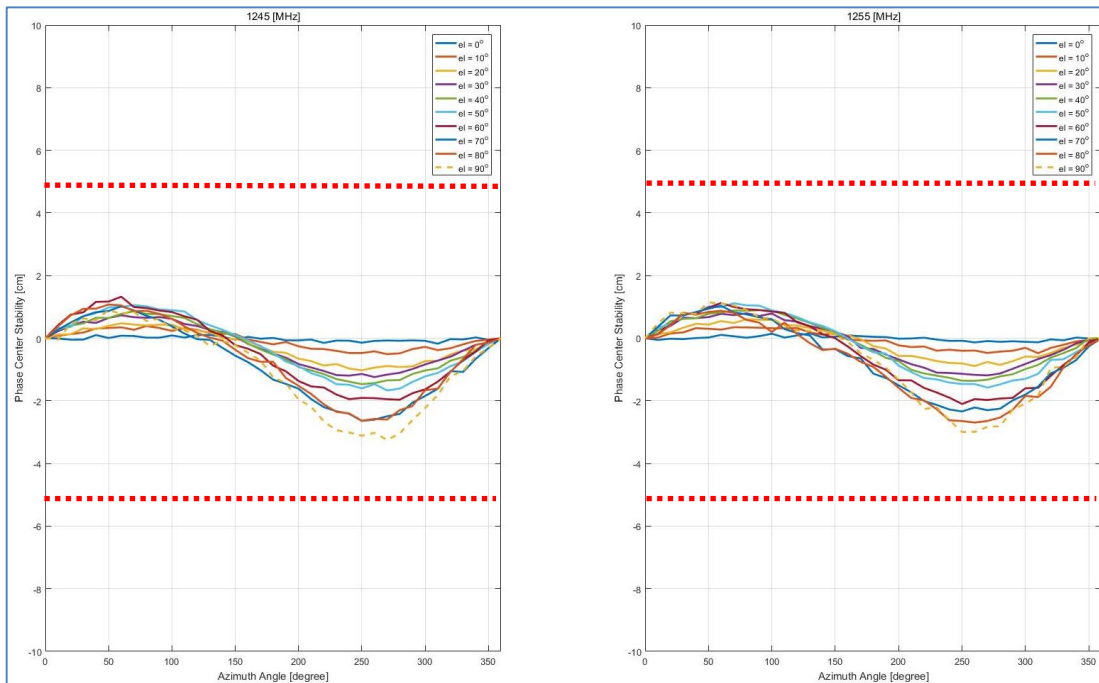
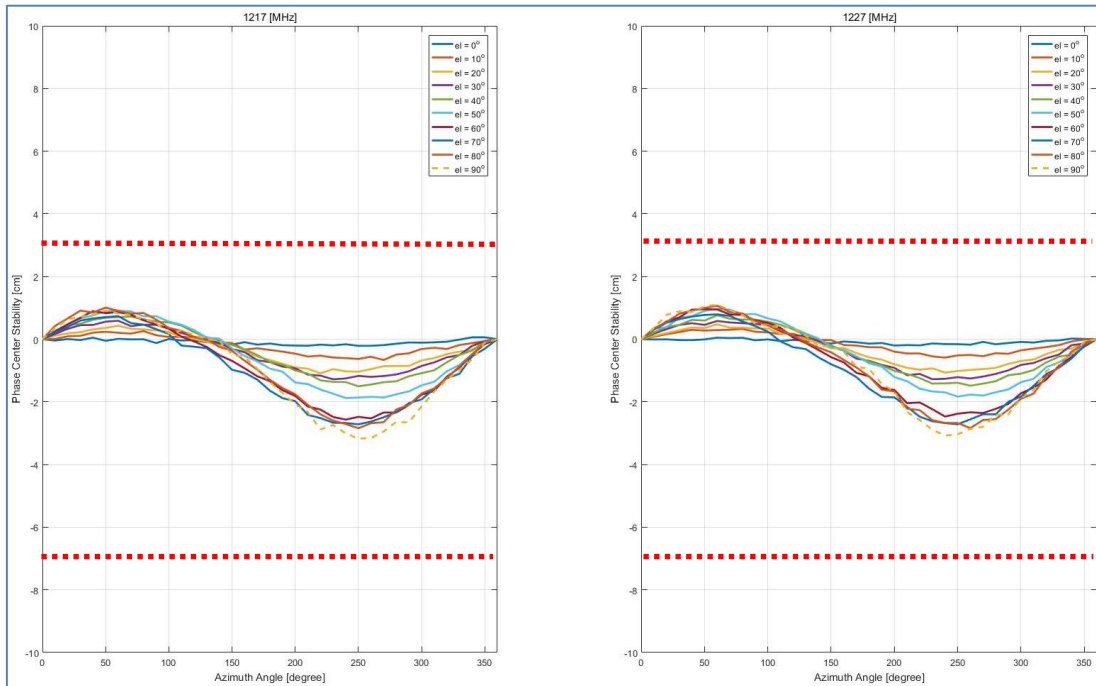
1.2.2.1 L1 Band Antenna PCS data



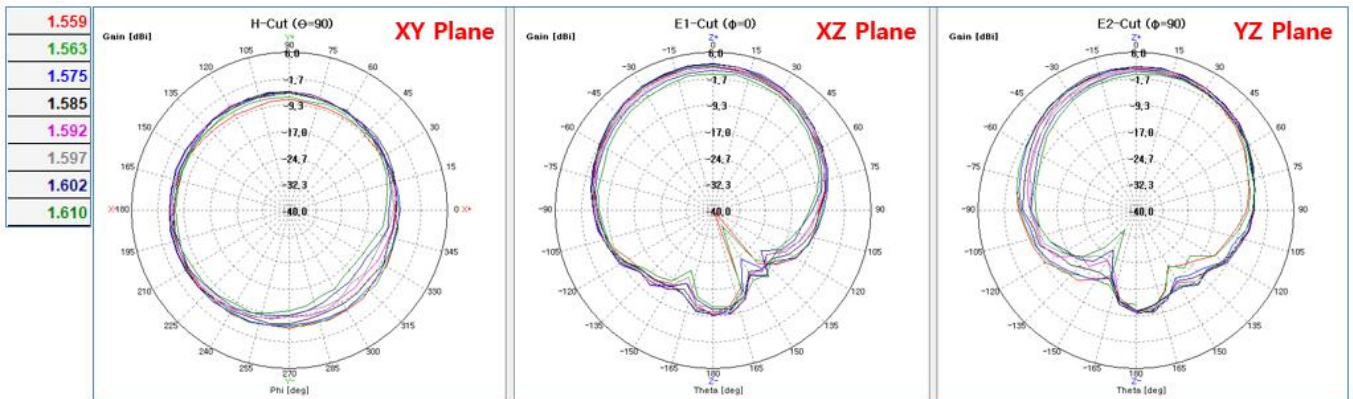
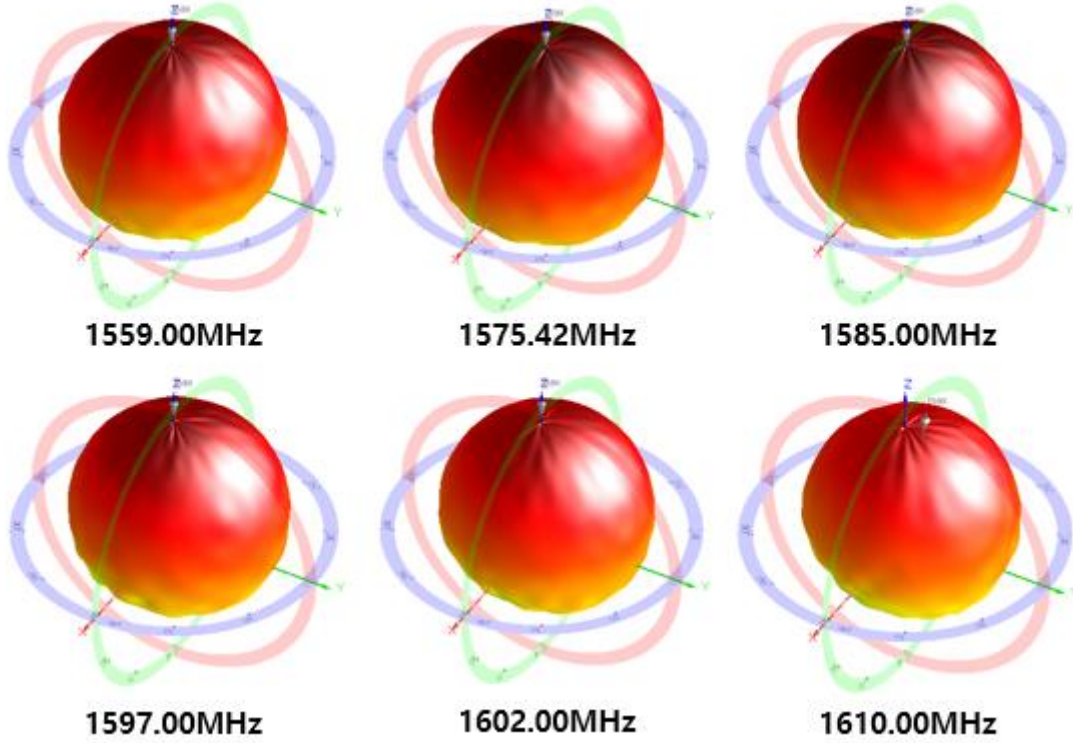


1.2.2.2 L2&E5b Band Antenna PCS data





1.3.1.1 Right Hand Circular Polarization (RHCP) 3D&2D Radiation Patterns (Stacked Antenna \_L1 Band).



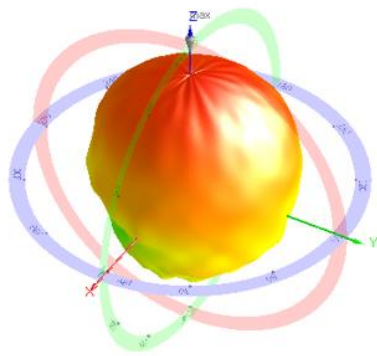
1.3.1.2 Right Hand Circular Polarization (RHCP) Gain & Axial Ratio (Stacked Antenna \_ L1 Band).

RHCP Gain @ Average [dBic]															
Theta(°)	1559MHz	1563MHz	1565MHz	1570MHz	1573MHz	1575MHz	1577MHz	1580MHz	1585MHz	1587MHz	1592MHz	1597MHz	1602MHz	1605MHz	1610MHz
0	4.04	4.44	4.65	5.28	5.59	5.74	5.86	6.01	5.97	5.96	5.77	5.38	4.88	4.70	4.25
10	3.89	4.31	4.49	5.12	5.43	5.56	5.69	5.83	5.81	5.81	5.62	5.21	4.75	4.52	4.04
20	3.39	3.74	3.96	4.62	4.91	5.08	5.22	5.38	5.41	5.36	5.18	4.75	4.20	3.98	3.47
30	2.53	2.92	3.12	3.79	4.08	4.23	4.35	4.52	4.51	4.48	4.29	3.91	3.38	3.17	2.68
40	1.34	1.72	1.92	2.58	2.85	3.03	3.13	3.31	3.32	3.28	3.18	2.76	2.21	1.97	1.49
50	0.08	0.44	0.63	1.32	1.60	1.74	1.86	2.01	1.95	1.92	1.68	1.25	0.70	0.48	-0.03
60	-1.56	-1.21	-0.94	-0.33	-0.05	0.11	0.24	0.36	0.43	0.34	0.14	-0.27	-0.83	-1.07	-1.60
70	-3.09	-2.70	-2.48	-1.87	-1.56	-1.39	-1.29	-1.12	-1.12	-1.13	-1.42	-1.86	-2.47	-2.73	-3.24
80	-5.01	-4.68	-4.40	-3.79	-3.49	-3.35	-3.27	-3.10	-3.05	-3.11	-3.38	-3.76	-4.38	-4.62	-5.23
90	-6.35	-5.98	-5.79	-5.13	-4.79	-4.65	-4.62	-4.43	-4.46	-4.53	-4.82	-5.23	-5.86	-6.12	-6.70

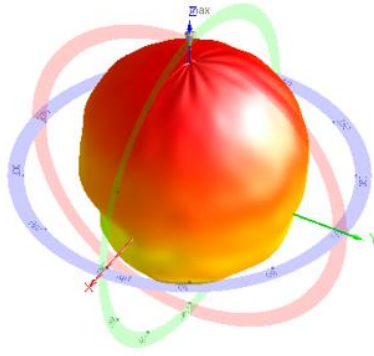
Axial Ratio @ Average [dB]															
Theta(°)	1559MHz	1563MHz	1565MHz	1570MHz	1573MHz	1575MHz	1577MHz	1580MHz	1585MHz	1587MHz	1592MHz	1597MHz	1602MHz	1605MHz	1610MHz
0	1.18	1.16	1.13	1.05	1.06	1.05	1.04	0.97	1.04	0.94	1.02	1.15	1.23	1.34	1.44
10	1.14	1.12	1.08	1.08	1.06	1.08	1.08	1.07	1.09	1.08	1.11	1.20	1.32	1.42	1.55
20	1.31	1.22	1.27	1.21	1.18	1.16	1.13	1.13	1.11	1.11	1.18	1.33	1.50	1.56	1.59
30	1.75	1.70	1.69	1.55	1.59	1.56	1.57	1.61	1.57	1.52	1.57	1.66	1.76	1.82	1.93
40	2.30	2.35	2.25	2.34	2.31	2.31	2.26	2.27	2.25	2.33	2.25	2.38	2.37	2.41	2.47
50	2.70	2.76	2.72	2.73	2.72	2.78	2.80	2.92	2.84	2.78	2.93	3.03	3.07	3.19	3.28
60	3.48	3.51	3.54	3.55	3.45	3.49	3.44	3.47	3.57	3.48	3.62	3.67	3.69	3.77	3.84
70	4.23	4.32	4.44	4.41	4.52	4.59	4.70	4.61	4.71	4.71	4.99	5.04	5.15	5.16	5.16
80	5.72	5.82	5.93	6.07	6.15	6.25	6.25	6.25	6.31	6.27	6.41	6.65	6.60	6.49	6.68
90	5.89	6.17	6.35	6.29	6.46	6.53	6.76	6.76	6.97	7.08	7.56	7.61	7.91	8.30	8.78



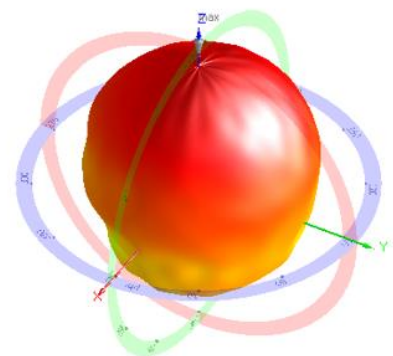
1.3.2.1 Right Hand Circular Polarization (RHCP) 3D&2D Radiation Patterns (Stacked Antenna \_ L2&E5b Band).



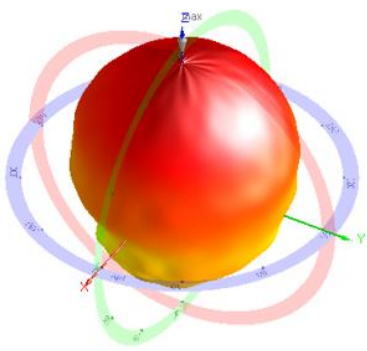
**1194.00MHz**



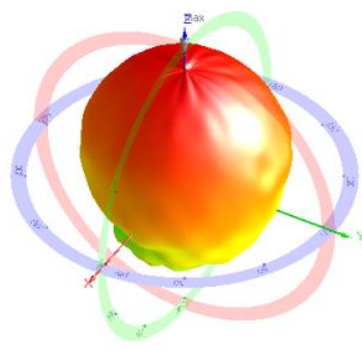
**1207.00MHz**



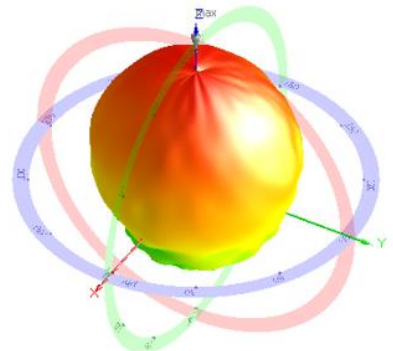
**1217.00MHz**



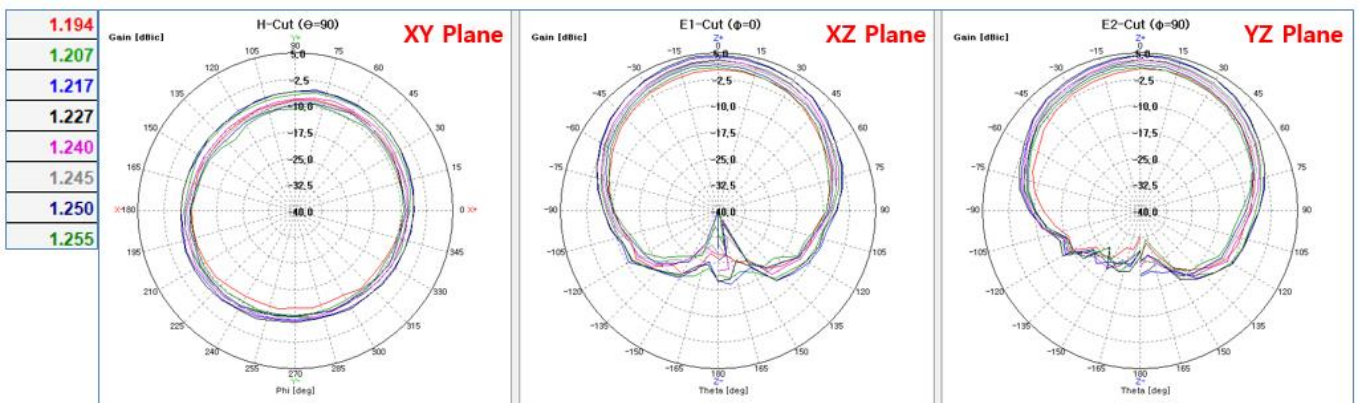
**1227.00MHz**



**1245.00MHz**



**1255.00MHz**



1.3.2.2 Right Hand Circular Polarization (RHCP) Gain & Axial Ratio (Stacked Antenna \_ L2&E5b Band).

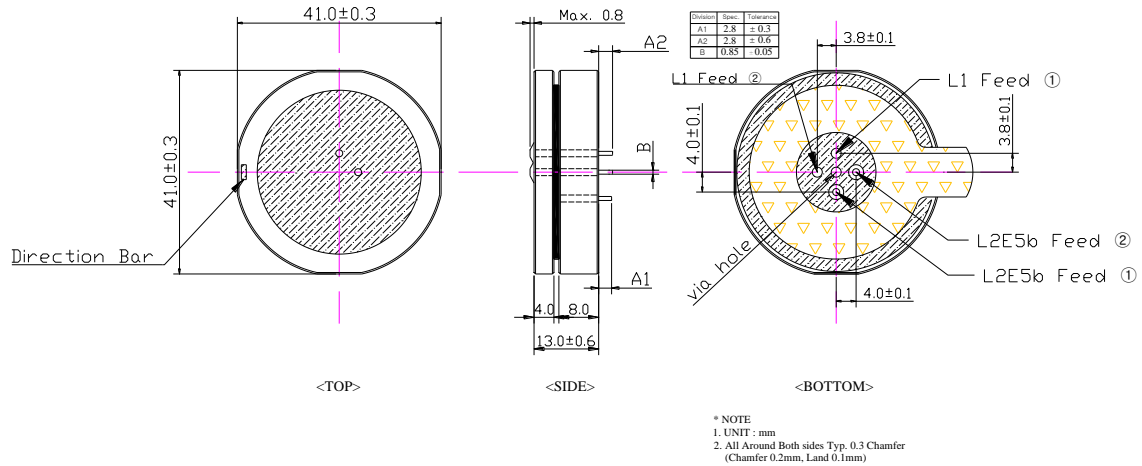
RHCP Gain @ Average [dBic]												
Theta(°)	1194MHz	1197MHz	1207MHz	1215MHz	1217MHz	1227MHz	1237MHz	1240MHz	1242MHz	1245MHz	1250MHz	1255MHz
0	0.34	0.89	2.86	3.86	4.07	4.41	3.50	3.03	2.75	2.36	1.75	1.00
10	0.15	0.69	2.62	3.58	3.77	4.12	3.20	2.77	2.52	2.11	1.45	0.73
20	-0.32	0.24	2.11	3.04	3.25	3.50	2.54	2.07	1.80	1.44	0.79	0.08
30	-0.92	-0.38	1.47	2.39	2.56	2.79	1.78	1.28	0.98	0.59	-0.08	-0.77
40	-1.93	-1.38	0.55	1.48	1.68	1.92	0.92	0.42	0.13	-0.27	-0.95	-1.70
50	-3.41	-2.86	-0.91	0.02	0.26	0.53	-0.42	-0.89	-1.18	-1.57	-2.20	-2.97
60	-5.10	-4.51	-2.68	-1.76	-1.58	-1.31	-2.24	-2.70	-2.98	-3.36	-3.93	-4.68
70	-6.34	-5.75	-4.01	-3.12	-2.99	-2.74	-3.81	-4.29	-4.57	-4.92	-5.53	-6.27
80	-8.06	-7.56	-5.75	-4.91	-4.72	-4.55	-5.56	-6.06	-6.35	-6.72	-7.31	-7.99
90	-10.09	-9.52	-7.95	-7.17	-7.01	-6.86	-7.94	-8.41	-8.68	-9.07	-9.58	-10.22

Axial Ratio @ Average [dB]												
Theta(°)	1194MHz	1197MHz	1207MHz	1215MHz	1217MHz	1227MHz	1237MHz	1240MHz	1242MHz	1245MHz	1250MHz	1255MHz
0	0.68	0.65	0.75	0.79	0.81	0.97	1.32	1.40	1.46	1.44	1.51	1.60
10	0.81	0.73	0.79	0.85	0.82	0.93	1.30	1.36	1.40	1.44	1.44	1.52
20	1.18	1.20	1.15	1.13	1.08	1.11	1.30	1.44	1.40	1.42	1.43	1.43
30	1.39	1.42	1.31	1.39	1.37	1.37	1.51	1.53	1.53	1.50	1.54	1.55
40	1.39	1.46	1.40	1.45	1.50	1.50	1.68	1.72	1.67	1.64	1.65	1.72
50	1.95	1.94	1.78	1.77	1.67	1.59	1.71	1.76	1.79	1.74	1.75	1.68
60	2.86	2.72	2.62	2.62	2.63	2.43	2.50	2.44	2.44	2.38	2.18	2.14
70	3.20	3.08	3.17	3.04	3.04	2.99	2.99	2.83	2.90	2.78	2.54	2.43
80	3.07	3.06	3.05	2.92	2.90	2.79	2.82	2.82	2.73	2.55	2.66	2.50
90	4.56	4.42	4.20	4.23	4.04	4.00	3.92	3.92	3.72	3.65	3.35	3.20

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## 2. Mechanical Outline

### 2.1 Dimension

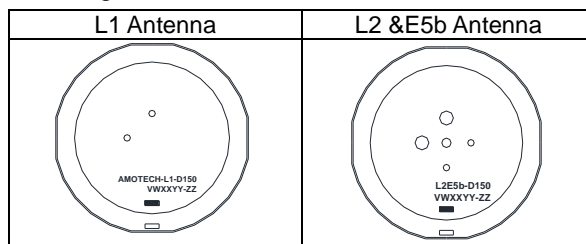


### 2.2 Tuning : Top & Bottom (According to Procedure of AMOTECH document)

### 2.3 Mechanical characteristic

No	Item	Specification	Unit	Remarks	
1	Dielectric constant	L1	$9.5 \pm 0.5$	-	Ceramic
		L2&E5b	$20.5 \pm 0.5$		
2	Electrode	-	Silver	-	-
3	Probe	-	brass	-	-
4	Tape	L1	Double sided adhesive tape	-	Thickness = 1.0T
		L2&E5b	Double sided adhesive tape	-	3M-468MP

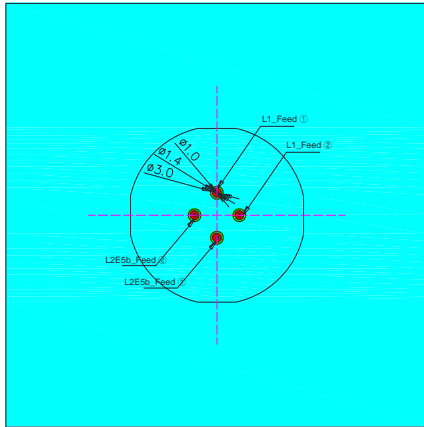
### 2.4 Marking



- V : Line section
- W : Year
- XX : Month
- YY : Day
- ZZ : Serial number of daily

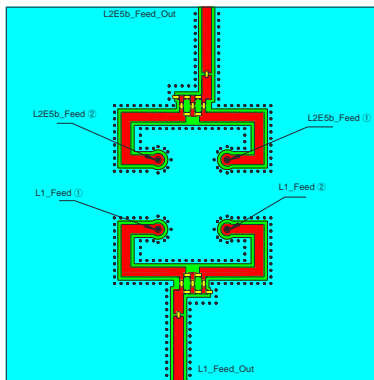
5. Recommended Land Pattern

5.1 Top Pattern



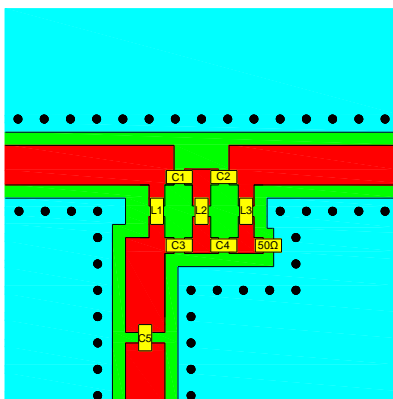
- VIA Thru Hole
- Ground Pattern
- No Ground (Clearance)
- Feeding Point

5.2 Bottom Pattern




- VIA Thru Hole
- Ground
- No Ground (Clearance)
- 50Ω Feeding Line
- Component

5.3 Component Value for Hybrid Coupler



L1 Band		L2&E5b Band	
C1,C2,C3,C4	1.5 pF	C1,C2,C3,C4	2.7 pF
Ln	4.7 nH	Ln	6.8 nH
C5	100 pF	C5	100 pF
R	50 ohm	R	50 ohm

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### 3. Reliability Test

No	Item	Test condition	Requirement
1	Drop Test	1. Place antenna on set 2. 1.5m height 3. Drop 5 times	1. No Visible defect 2. S11 satisfy
2	Vibration Test	1. 5-55-5 Hz, 1 Octave/min, Amp.=1.5mm, acceleration=2g, Crossover Freq.=18 Hz, Hold time = 2H.R	1. No Visible defect 2. S11 satisfy
3	Humidity	1. 60°C, 95%RH, 96Hr	1. No Visible defect 2. S11 satisfy
4	Thermal Shock	1. +80°C (30min)→5min →-40°C (30min) 2. 10 cycle	1. No Visible defect 2. S11 satisfy
5	High Temperature Resistance	1. +90°C, 96Hr	1. No Visible defect 2. S11 satisfy
6	Low Temperature Resistance	1. -40°C, 96Hr	1. No Visible defect 2. S11 satisfy
7	Adhesion Strength of Soldering	1. Used of pull push gauge.	1. Spec( min. 5kgf)

※ The sample must satisfy Requirement after 24 hours of test

※ Be base on IEC Climatic category (IEC68-1) -40°C / +90°C / 56h

### 4. Soldering Condition

- Wettability to IEC 68-2-58 : ≥75%(After Aging)

#### 4.1 Manual Soldering( By Iron) – Pb free

- Soldering Temperature : 360°C ± 5°C, 5sec max.

(Solder : Sn/Ag/Cu:96.5/3.0/0.5 )

- Must comply with above soldering condition to prevent from degradation of antenna performance.

### 5. Caution and Warranty

5.1 Electrode metallizations are unprotected silver and will tarnish during storage due to sulphuric compounds (namely H<sub>2</sub>S) in the atmosphere. Elevated temperature and humidity will accelerate this process. Human skin contact, wool etc. also cause tarnishing. This has no effect whatsoever on the electrical performance of the patches. Tarnishing of the silver plated feed pins may affect solderability. Because of this normal and to be expected process, AMOTECH accepts no warranty claims for tarnished products.

AMOTECH uses vacuum packaging to reduce atmospheric influence and to extend shelf life.

5.2 Patch Antennas must avoid shock and drop, to prevent cracking of the antenna.

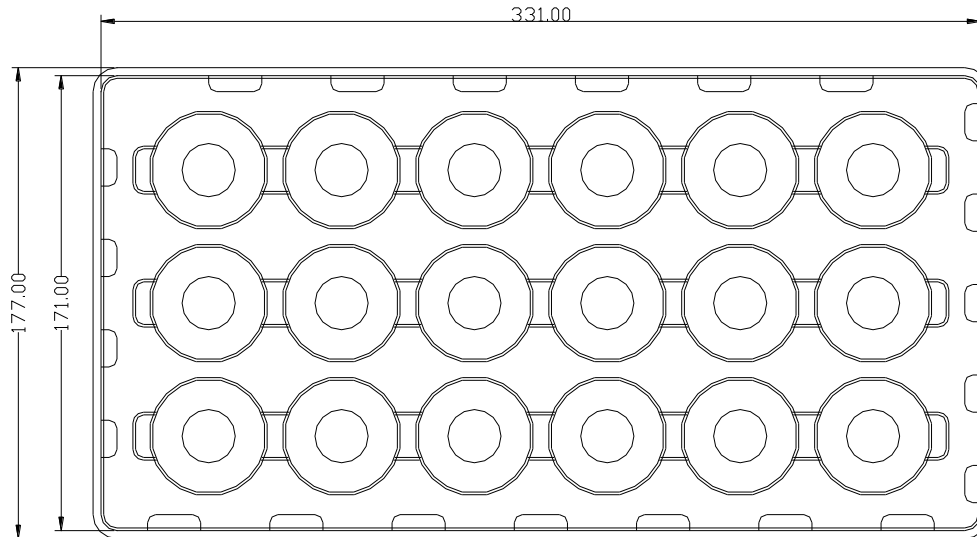
5.3 Patch Antennas should be used within 6 months after delivery, antennas older than 6 months should be checked for solderability before using.

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## 6. Package

### 6.1 Tray

#### 6.1.1 Quantity



- 18ea/tray

### 6.2 Box package

#### 6.2.1 Inner box

- Dimension: 370 (W) x 195 (D) x 130 (T) (mm)
- Quantity : 5 tray (18ea/ tray x5 tray = 90ea)

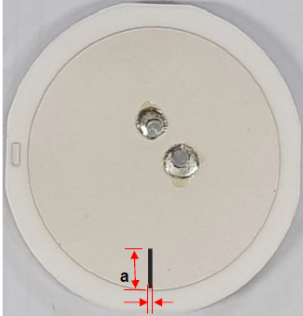
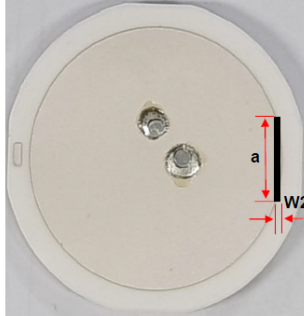



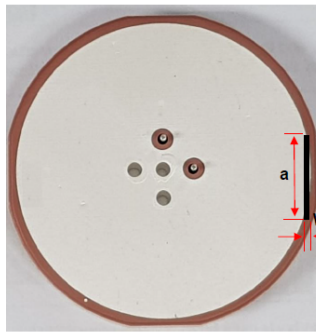
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6.2.2 Outer box

- Dimension : 390 (W) x 620 (D) x 150 (T) (mm)
- Quantity : 3 inner box (90ea/ inner box x3 inner box = 270ea)




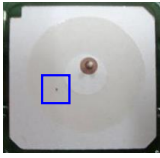







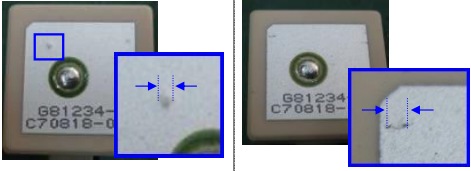
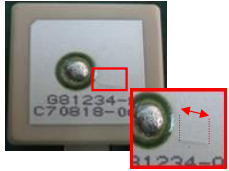
DOC. No.	19-Tuning Boundary-001						
Standard process	Measurement process						
Product	Ceramic Patch Antenna						
Written by	Q.A PART						
Original Date	2019.02.21	Rev. No.	0	Rev. Date	-	Page	1/1
<b>Top Tuning method 1</b>				<b>Top Tuning method 2</b>			
							
<p>◆ <b>Tuning standard</b></p> <ul style="list-style-type: none"> <li>- Tuning Point: Max 4 points only with method1</li> <li>- Tuning Length : <math>a \leq 6.00\text{mm}</math></li> <li>- Tuning Wide: <math>W1 \leq 1.00\text{mm}</math></li> </ul>				<p>◆ <b>Tuning standard</b></p> <ul style="list-style-type: none"> <li>- Tuning Point: Max 4 points only with method1</li> <li>- Tuning Length : <math>a \leq 20.00\text{mm}</math></li> <li>- Tuning Wide: <math>W1 \leq 1.50\text{mm}</math></li> </ul>			
<p>◆ Total tuning points with all above 2 methods : Max 4 points</p> <p>◆ Criteria of defective parts</p> <p>- If tuned antennas do not meet above standard, Amotech will regard them as defective part</p>							

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	<b>SPECIFICATION</b>	<b>PAGE</b>
	<b>AGGA42K42-48-L1L2E5b-D150</b>	<b>17/18</b>

Doc No.	10Patch-Boundary-001	<b>Limited Boundary (No Printing / Scratch)</b>				Write	Check	Approve
Process	Appearance Inspect							
Product	All Model					202.17	2.17	2.07
Write Dept	Quality Dept.					Page	1 / 3	
Origin Date	2010. 02. 08	Revision Date	2018. 02. 07	Revision No	Rev. 2			
Item	O K		N G			Etc		
No Printing								
	No printing must have entered allow SPEC. [SPEC : No limit on the number of size≤1mm / 1mm<size≤ 2mm:Allow Q'ty:2ea / 2mm<size:NG]							
Item	O K		N G			Etc		
Scratch								
	Handle badness if there is <u>shape that rake</u> with picture.							
<b>Noted items</b>								

Doc No.	10Patch-Boundary-001	<b>Limited Boundary (Foreign body)</b>				Write	Check	Approve
Process	Appearance Inspect							
Product	All Model							
Write Dept	Quality Dept.							
Origin Date	2010. 02. 08	Revision Date	2018. 02. 07	Revision No	Rev. 2	Page	2 / 3	
Item	O K		N G			Etc		
Foreign body (Bottom)								
	The protruding foreign body is NG, and the non-protruding Foreign body must have entered allow SPEC [SPEC : No limit on the number of size≤2mm / 2mm<size≤ 3mm:Allow Q'ty:2ea / 3mm<size:NG]							
Item	O K		N G			Etc		
Foreign body (Top)								
	Foreign body must have entered allow SPEC. [SPEC : No limit on the number of size≤1mm / 1mm<size≤ 2mm:Allow Q'ty:2ea / 2mm<size:NG]							
<b>Noted items</b>								

Doc No.	10Patch-Boundary-001	Limited Boundary (Chipping / Solder ball)					Page	3 / 3
Process	Appearance Inspect							
Product	All Model							
Write Dept	Quality Dept.							
Origin Date	2010. 02. 08	Revision Date	2018. 02. 07	Revision No	Rev. 2			
Item	O K		N G		Etc			
Chipping								
	Chipping must have entered allow SPEC. [SPEC : No limit on the number of chipping≤1mm / 1mm<chipping size≤ 2mm:Allow Q'ty:2ea / 2mm<chipping:NG]							
Item	O K	N G	N G		Etc			
Solder ball								
	Solder vall must have entered allow SPEC. [SPEC : Solder ball ≤ 0.3mm]		Solder ball of GND size irrelatively badness.					
<u>Noted items</u>								