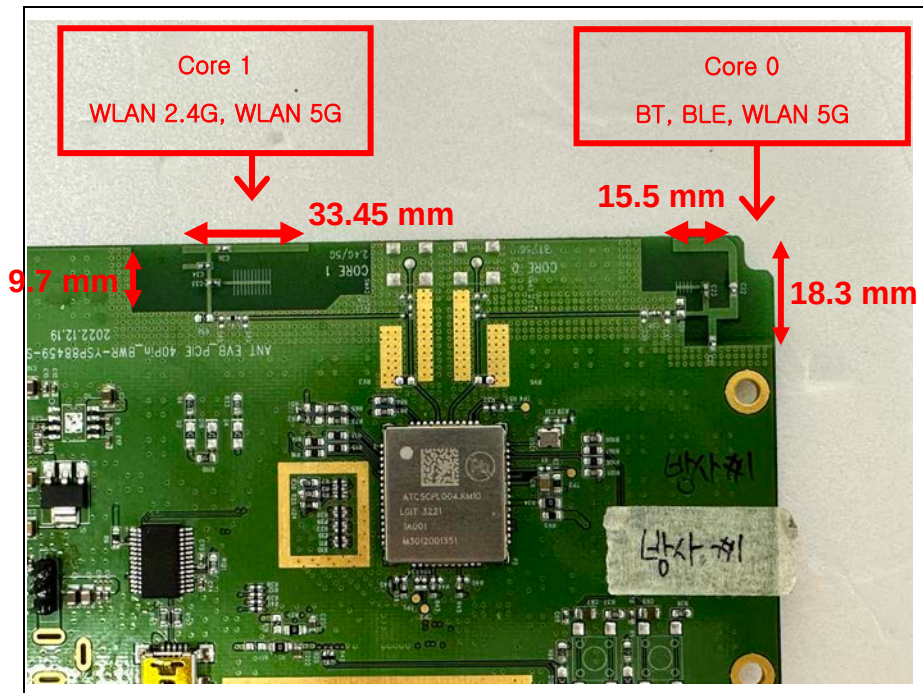


Antenna Information

Item		Contents
Antenna Type		Pattern Antenna
Antenna peak gain		Core 0 2 400 MHz ~ 2 483.5 MHz: 2.28 dBi 5 150 MHz ~ 5 250 MHz: 1.68 dBi 5 250 MHz ~ 5 350 MHz: 1.68 dBi 5 470 MHz ~ 5 725 MHz: 2.38 dBi 5 725 MHz ~ 5 850 MHz: 3.04 dBi
		Core 1 2 400 MHz ~ 2 483.5 MHz: 1.84 dBi 5 150 MHz ~ 5 250 MHz: 1.90 dBi 5 250 MHz ~ 5 350 MHz: 2.92 dBi 5 470 MHz ~ 5 725 MHz: 3.55 dBi 5 725 MHz ~ 5 850 MHz: 3.32 dBi
Manufacturer / Model name		LG Innoteck Co., Ltd. / ATC5CPL004.KM10
Address of manufacturer		26, Hanamsandan 5beon-ro Gwangsan-gu, Gwangju, South Korea
Test laboratory		LG Innoteck Co., Ltd.
Core 0	Length	18.3 mm
	Width	15.5 mm
Core 1	Length	33.45 mm
	Width	9.7 mm



CUSTOMER : HYUNDAI MOBIS.

DATE : 2022.08.29.

SPECIFICATIONS FOR APPROVAL

PRODUCT NAME : WiFi Dual Band & BT Antenna

MODEL NAME : ATC5CPL004.KM10

CUSTOMER P/N : M3012001351

APPROVAL	REMARK

APPENDIX

Designed	Checked	Approved	LG Innotek Co., Ltd.	
				
Y. H. KIM	K. Y. LEE	W. K. JUNG	DOCUMENT No.	
			PAGE	13

Revision History

Revision	Date	Contents of Revision Change	Remark
1.0	2023.02.20	Wi-Fi & BT ANT Specifications	

Table of Contents

No	Description	Page
1	ANT Features(WiFi)	4
	1.1 Antenna Characteristics	4
2	ANT Features(BT)	5
	2.1Antenna Characteristics	5
3	Test Data(WiFi & BT)	6
	3.1 Network Data(BT Core0 + WiFi 5GHz Antenna)	6
	3.2 Network Data(WiFi Core1 WiFi Only 2.4GHz 5GHz Dual Antenna)	7
	3.3 Efficiency BT	8
	3.4 Efficiency WiFi	9
	3.5 Radiation Pattern(WiFi & BT)	10
4	Mechanical Specification	11
5	ANT Test Condition	12
	5.1 Antenna Return Loss measurement	13

1. ANT Features(WiFi)

- Dual Bands Wi-Fi ANT
- Main Frequency: 2.45GHz, 5.5GHz
- Frequency range
: From 2.40 to 2.50GHz, 5GHz~6GHz
- Operating temperature range
: -35 to +95°C (typ.)
- Wi-Fi ANT Material : Printed on FR-4
- Core0 ANT Size (18.3mm x 15.5 mm)
- Core1 ANT Size (33.45mm x 9.7 mm)

1.1. Antenna Characteristics

WiFi Core0 5GHz, Core1 2.4GHz + 5GHz

Antenna Performance				
Parameter	Min	Typ	Max	Unit
Frequency Range	2400	2450	2500	MHz
	5000	5500	6000	MHz
Directivity	-	Omni	-	-
Full Bands Average Gain(core0)	-	-	-3.31	dBi
Full Bands Average Gain(core1)	-	-	-2.38	
Full Bands Average Peak Gain(core0)		-	2.02	
Full Bands Average Peak Gain(core1)		-	2.52	
V.S.W.R 2GHz	3:1	-	-	Under
V.S.W.R 5GHz	4:1	-	-	Under
Impedance		50		Ohm
Radiation Material		Printed		

2. ANT Features(BT)

- Single Bands Bluetooth ANT
- Main Frequency: 2.45GHz
- Frequency range
 - : From 2.40 to 2.50GHz
- Operating temperature range
 - : -35 to +95°C (typ.)
- Wireless audio ANT Material : Printed on FR-4
- Core0 ANT Size (18.3mm x 15.5 mm)

2.1. Antenna Characteristics

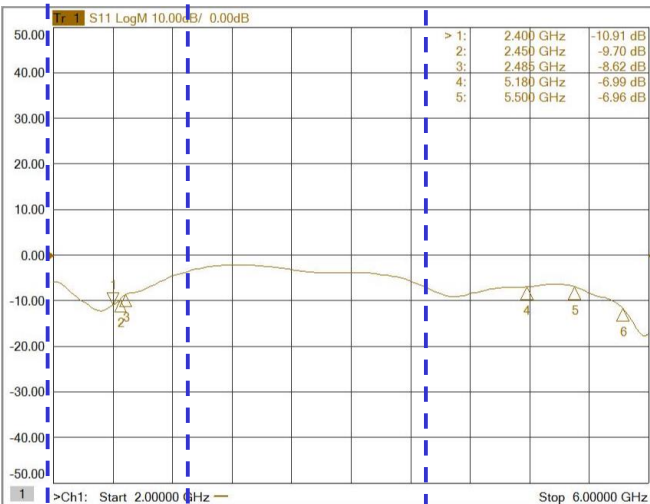
BT ANT(Core 0 2GHz)

Antenna Performance				
Parameter	Min	Typ	Max	Unit
Frequency Range	2400	2450	2500	MHz
Directivity	-	Omni	-	-
Full Bands Average Gain	-	-	-1.54	dBi
Full Bands Average Peak Gain		-	2.00	
V.S.W.R	3:1	-	-	Under
Impedance		50		Ohm
Radiation Material		Printed		

3. Test Data

3.1 Network Data (BT Core0 + WiFi 5GHz Antenna)

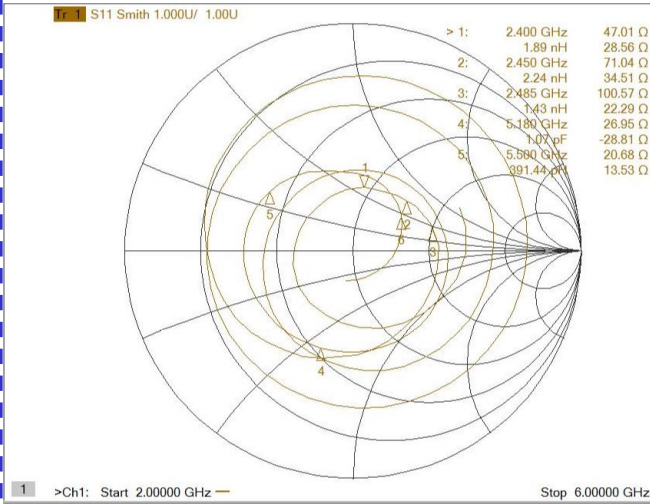
Return Loss



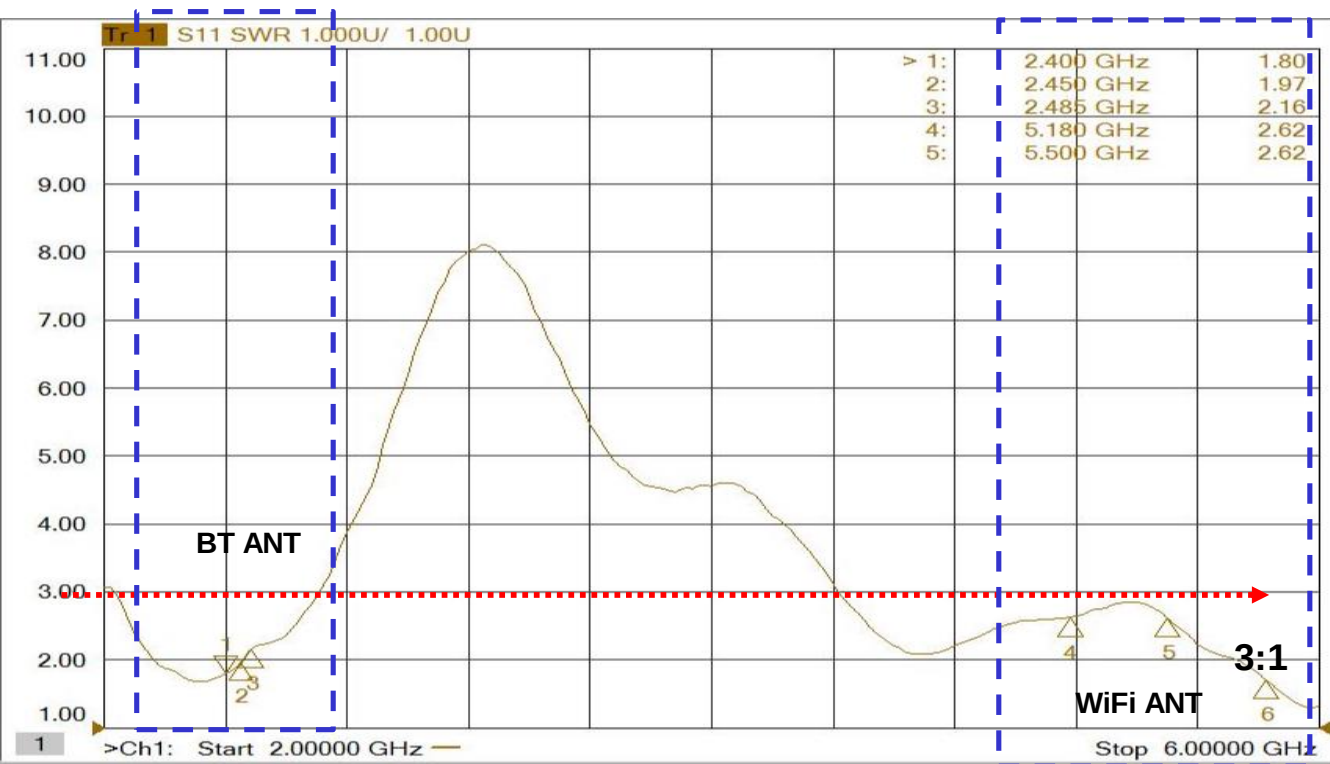
BT ANT

WiFi ANT

Smith Chart



SWR



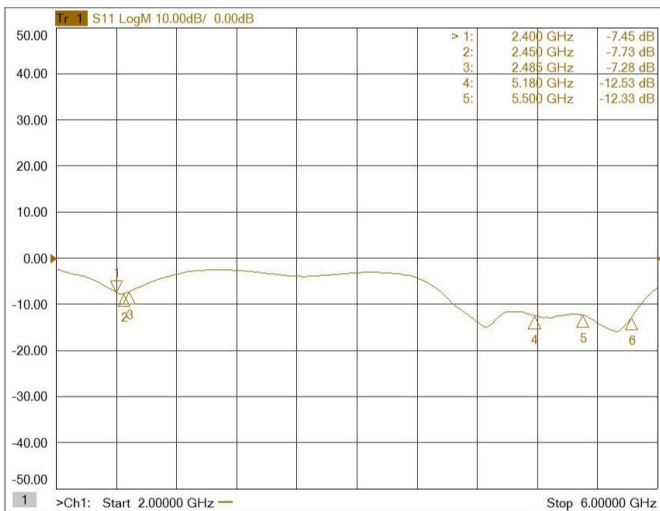
BT ANT

WiFi ANT

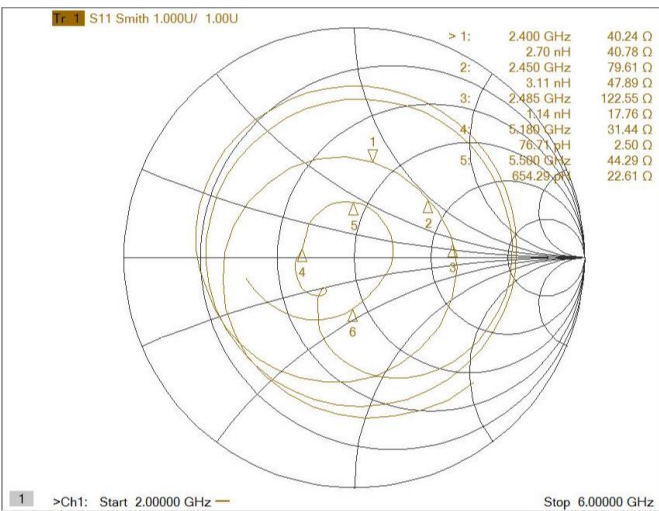
3:1

3.2 Network Data(WiFi Core1 WiFi Only 2.4GHz 5GHz Dual Antenna)

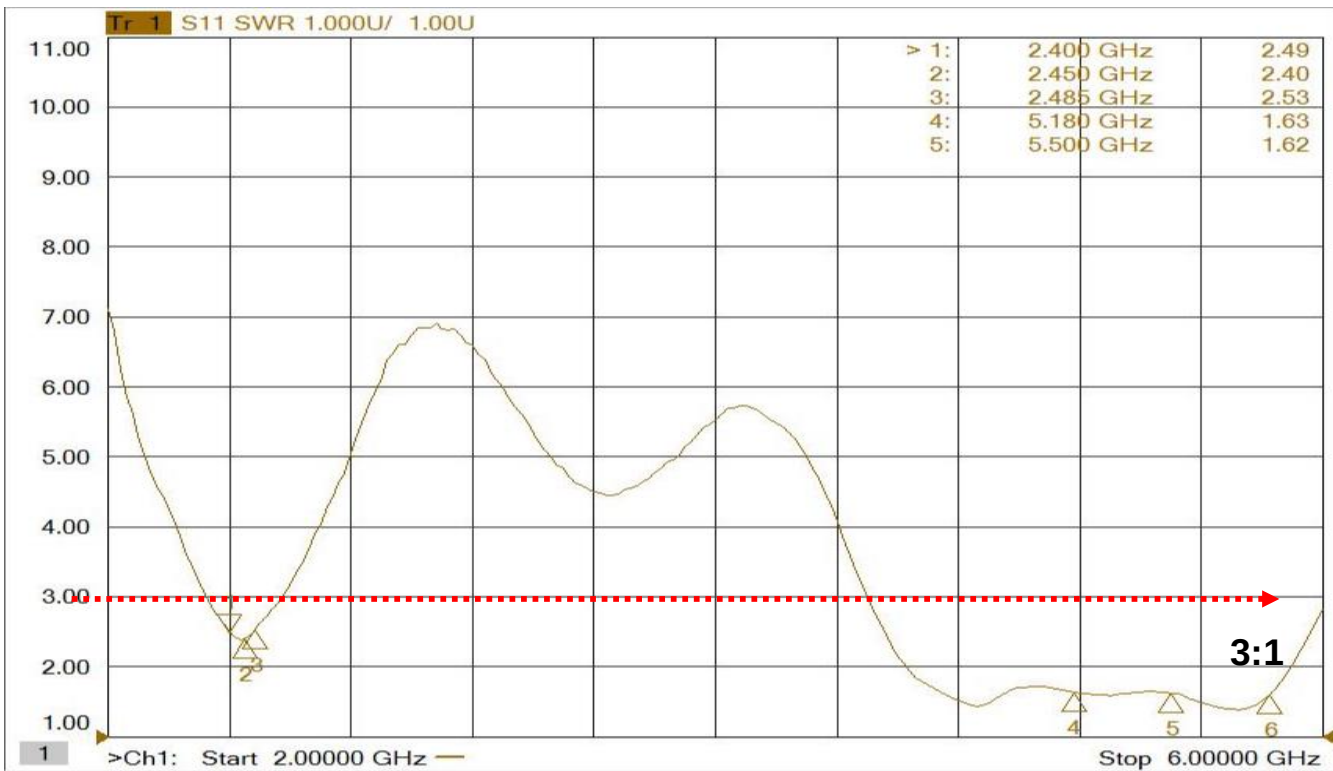
Return Loss



Smith Chart



SWR



3.3 Efficiency (BT : core 0 2.4GHz)

BT Core0 2.4GHz Antenna

	1	2	3	4	5	6	7	8	9
Frequency [MHz]	2400	2410	2420	2430	2440	2450	2460	2470	2480
Efficiency [dB]	-1.59	-1.70	-1.48	-1.48	-1.49	-1.16	-1.29	-1.85	-1.89
Efficiency [%]	69.3	67.6	71.1	71.1	70.9	76.6	74.2	65.3	64.8
TRG _g [dB]	-4.23	-4.32	-4.07	-4.03	-4.00	-3.62	-3.72	-4.25	-4.28
Gain _{g Peak} [dB]	1.06	0.92	1.09	1.04	0.95	1.28	1.11	0.51	0.41
Gain _{g Min} [dB]	-21.95	-21.46	-20.53	-20.47	-23.10	-25.31	-26.80	-26.01	-23.29
TRG _p [dB]	-5.01	-5.13	-4.95	-5.01	-5.07	-4.79	-4.98	-5.57	-5.62
Gain _{p Peak} [dB]	0.50	0.43	0.65	0.59	0.51	0.73	0.44	-0.27	-0.38
Gain _{p Min} [dB]	-25.55	-26.23	-25.07	-26.39	-27.76	-29.08	-31.36	-32.02	-31.42
UHRG [dB]	-4.83	-4.94	-4.76	-4.81	-4.89	-4.62	-4.82	-5.44	-5.51
UHRG/TRG [%]	47.5	47.4	47.0	46.5	45.8	45.0	44.4	43.8	43.4
H-Plane	-2.66	-2.73	-2.46	-2.40	-2.38	-2.01	-2.14	-2.67	-2.67
E1-Plane, AVG [dB]	-6.01	-6.37	-6.38	-6.56	-6.66	-6.33	-6.39	-6.86	-6.92
E2-Plane, AVG [dB]	-2.49	-2.50	-2.18	-2.08	-2.02	-1.63	-1.73	-2.28	-2.33
Peak Gain [dB]	2.18	2.02	2.17	2.04	1.95	2.28	2.14	1.61	1.62
Directivity [dB]	3.77	3.72	3.65	3.52	3.44	3.43	3.43	3.46	3.50
Minimum Gain [dB]	-8.16	-8.44	-8.18	-7.97	-7.73	-7.68	-8.25	-9.17	-9.54
Average Efficiency	-1.54 dB		70.11 %						

3.4 Efficiency (WiFi : core 0 5GHz, Core 1 2.4GHz + 5GHz)**WiFi core1 2GHz Antenna**

	1	2	3	4	5
Frequency [MHz]	2412	2420	2450	2460	2485
Efficiency [dB]	-3.06	-2.72	-2.07	-2.32	-2.41
Efficiency [%]	49.5	53.5	62.0	58.7	57.4
TRG _g [dB]	-6.33	-5.96	-5.27	-5.53	-5.68
Gain _{g Peak} [dB]	0.11	0.49	1.18	0.95	0.87
Gain _{g Min} [dB]	-26.22	-24.64	-25.19	-26.53	-33.15
TRG _p [dB]	-5.82	-5.50	-4.90	-5.13	-5.17
Gain _{p Peak} [dB]	-0.08	0.21	0.66	0.38	0.35
Gain _{p Min} [dB]	-35.94	-34.69	-31.95	-33.52	-39.93
UHRG [dB]	-6.07	-5.71	-5.00	-5.21	-5.26
UHRG/TRG [%]	49.9	50.2	51.0	51.3	51.9
H-Plane	-5.40	-5.06	-4.42	-4.66	-4.74
E1-Plane, AVG [dB]	-11.69	-11.46	-10.85	-11.20	-11.59
E2-Plane, AVG [dB]	-3.47	-3.10	-2.53	-2.83	-3.06
Peak Gain [dB]	1.00	1.30	1.84	1.59	1.60
Directivity [dB]	4.05	4.02	3.92	3.91	4.01
Minimum Gain [dB]	-15.80	-15.67	-15.25	-15.77	-19.42
Average Efficiency	-2.37 dB		57.94 %		

WiFi core1 5GHz Antenna

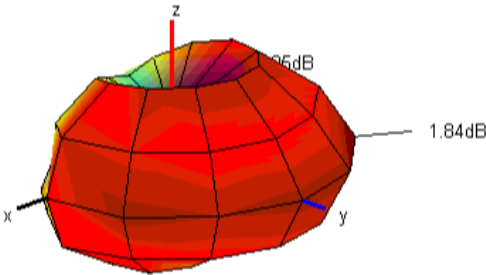
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Frequency [MHz]	5150	5200	5250	5300	5350	5400	5450	5500	5550	5600	5650	5700	5750	5800	5850
Efficiency [dB]	-1.96	-2.06	-2.18	-2.13	-2.12	-2.08	-2.46	-2.36	-2.23	-2.62	-2.22	-2.42	-2.92	-2.68	-2.58
Efficiency [%]	63.6	62.2	60.5	61.3	61.4	61.9	56.8	58.1	59.8	54.7	60.0	57.3	51.0	53.9	55.2
TRG _g [dB]	-4.58	-4.78	-4.86	-4.73	-4.66	-4.56	-4.99	-4.89	-4.79	-5.07	-4.63	-4.74	-5.20	-4.96	-4.83
Gain _{g Peak} [dB]	1.73	1.81	1.75	2.05	2.32	2.59	2.27	2.47	2.83	2.87	3.34	3.18	2.66	2.87	3.19
Gain _{g Min} [dB]	-15.97	-20.25	-21.98	-17.42	-29.81	-20.26	-19.16	-19.35	-20.90	-20.21	-19.32	-22.10	-21.85	-19.55	-17.86
TRG _p [dB]	-5.41	-5.38	-5.55	-5.58	-5.65	-5.69	-6.01	-5.91	-5.75	-6.28	-5.93	-6.25	-6.82	-6.58	-6.52
Gain _{p Peak} [dB]	-0.73	-0.38	-0.38	-0.30	-0.07	0.68	0.90	1.31	1.69	1.51	2.21	2.29	2.12	2.26	2.40
Gain _{p Min} [dB]	-33.40	-33.47	-29.59	-27.83	-26.55	-30.17	-29.58	-30.75	-32.73	-31.77	-34.03	-41.37	-36.73	-42.33	-39.31
UHRG [dB]	-4.52	-4.61	-4.74	-4.60	-4.53	-4.52	-4.91	-4.87	-4.74	-5.10	-4.69	-4.87	-5.39	-5.13	-5.01
UHRG/TRG [%]	55.5	55.6	55.5	56.6	57.4	57.1	56.9	56.1	56.1	56.5	56.6	56.9	56.7	56.8	57.2
H-Plane	-4.37	-4.53	-4.61	-4.64	-4.43	-4.28	-4.68	-4.49	-4.58	-4.87	-4.42	-4.50	-4.94	-4.75	-4.69
E1-Plane, AVG [dB]	-7.11	-7.21	-7.04	-6.76	-6.53	-6.09	-6.16	-5.58	-5.18	-5.36	-4.85	-4.90	-5.24	-4.97	-4.86
E2-Plane, AVG [dB]	-2.64	-2.92	-3.03	-2.97	-2.90	-2.94	-3.49	-3.53	-3.48	-3.75	-3.26	-3.47	-4.04	-3.77	-3.52
Peak Gain [dB]	1.88	1.83	1.90	2.69	2.92	3.14	2.79	2.87	3.13	2.92	3.55	3.52	3.21	3.30	3.32
Directivity [dB]	3.85	3.89	4.08	4.82	5.04	5.22	5.25	5.23	5.36	5.54	5.77	5.94	6.13	5.98	5.91
Minimum Gain [dB]	-9.39	-8.83	-11.57	-14.72	-15.94	-14.70	-12.70	-13.71	-12.12	-14.03	-14.00	-13.11	-13.15	-13.94	-14.87
Average Efficiency	-2.34 dB		58.51 %												

WiFi core0 5GHz Antenna

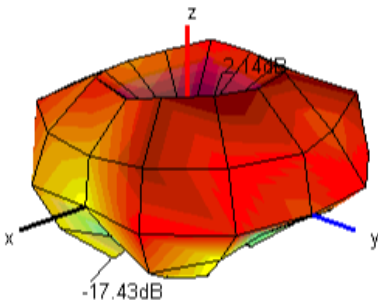
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Frequency [MHz]	5150	5200	5250	5300	5350	5400	5450	5500	5550	5600	5650	5700	5750	5800	5850
Efficiency [dB]	-3.91	-3.45	-3.53	-4.00	-3.56	-3.16	-3.84	-3.18	-3.17	-3.63	-3.07	-3.00	-2.88	-2.84	-2.48
Efficiency [%]	40.7	45.2	44.4	39.8	44.0	48.3	41.3	48.1	48.2	43.4	49.3	50.1	51.5	52.0	56.5
TRG _g [dB]	-6.15	-5.86	-5.97	-6.48	-6.16	-5.80	-6.55	-5.99	-6.04	-6.54	-6.06	-6.03	-5.87	-5.80	-5.39
Gain _{g Peak} [dB]	-0.65	0.18	0.61	0.66	1.19	1.60	0.88	1.38	1.33	0.84	1.58	1.52	1.90	2.26	2.88
Gain _{g Min} [dB]	-22.02	-20.49	-22.06	-22.41	-19.84	-19.51	-19.71	-17.84	-19.37	-22.43	-23.14	-25.02	-35.83	-29.12	-28.65
TRG _p [dB]	-7.85	-7.14	-7.19	-7.61	-7.03	-6.58	-7.17	-6.41	-6.33	-6.74	-6.10	-6.00	-5.91	-5.91	-5.59
Gain _{p Peak} [dB]	-0.34	0.66	0.80	0.68	1.52	1.84	0.88	1.25	1.00	0.44	0.78	0.80	0.51	0.29	0.38
Gain _{p Min} [dB]	-36.37	-31.69	-31.25	-33.30	-33.69	-37.01	-34.54	-29.59	-30.67	-32.89	-42.16	-38.04	-39.53	-39.84	-33.59
UHRG [dB]	-5.38	-4.90	-4.94	-5.39	-4.93	-4.52	-5.20	-4.51	-4.49	-4.93	-4.36	-4.28	-4.15	-4.11	-3.74
UHRG/TRG [%]	71.2	71.5	72.2	72.5	73.0	73.1	73.2	73.6	73.8	74.1	74.3	74.5	74.7	74.7	74.8
H-Plane	-6.42	-6.20	-6.38	-6.88	-6.63	-6.20	-6.85	-6.40	-6.54	-7.17	-6.72	-6.61	-6.42	-6.54	-6.15
E1-Plane, AVG [dB]	-11.21	-11.13	-11.79	-12.51	-11.68	-11.13	-11.79	-10.86	-10.97	-11.42	-10.83	-10.90	-10.71	-10.88	-10.46
E2-Plane, AVG [dB]	-4.98	-4.46	-4.34	-4.68	-4.21	-3.82	-4.64	-4.04	-4.19	-4.74	-4.19	-4.05	-3.66	-3.40	-2.84
Peak Gain [dB]	1.12	1.68	1.49	1.23	1.68	2.27	1.49	2.14	2.21	1.77	2.27	2.38	2.78	2.76	3.04
Directivity [dB]	5.03	5.13	5.01	5.22	5.24	5.43	5.33	5.32	5.38	5.40	5.34	5.38	5.66	5.61	5.52
Minimum Gain [dB]	-18.97	-18.31	-17.17	-17.72	-17.18	-16.59	-18.15	-17.43	-19.04	-21.17	-22.81	-24.81	-33.42	-25.64	-25.66
Average Efficiency	-3.31 dB		46.85 %												

3.5 Radiation Pattern

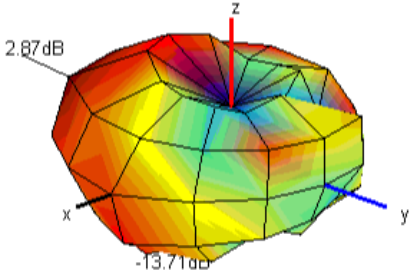
WiFi



<2.45GHz core1>

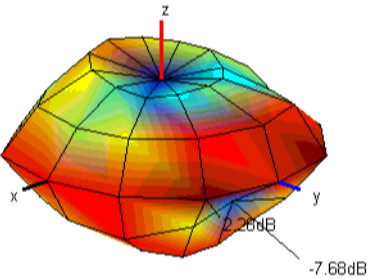


<5.50GHz core0>



<5.50GHz core1>

BT

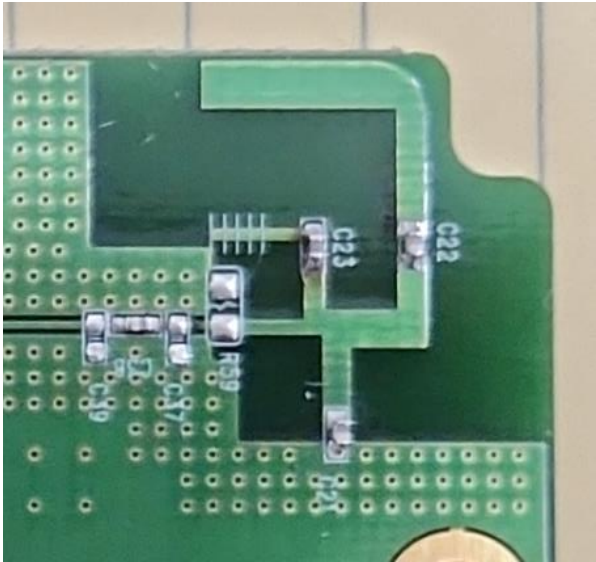


<2.45GHz>

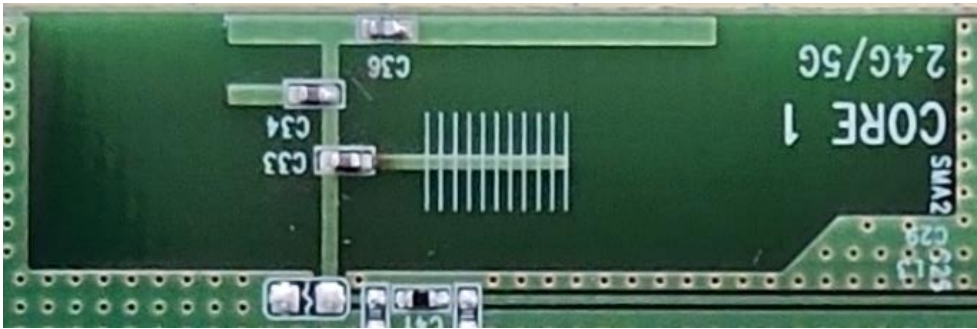
4. Mechanical Specification

Part	Specification	Unit
Antenna Dimension(Core0) BT + WiFi 5GHz	18.3 x 15.5	[mm]
Antenna Dimension(Core1) WiFi 2.4GHz 5GHz Dual	33.45 x 9.7	[mm]

BT + WiFi 5GHz Antenna



WiFi Only Core 1 2.4GHz 5GHz Dual Antenna

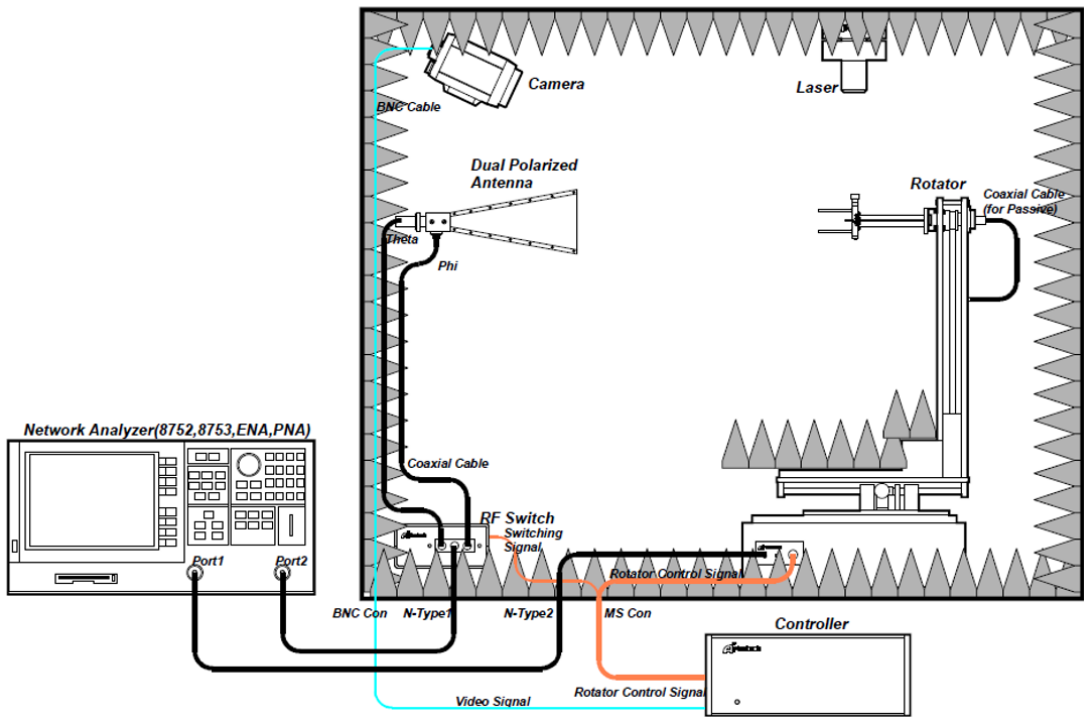


5. ANT Test Condition

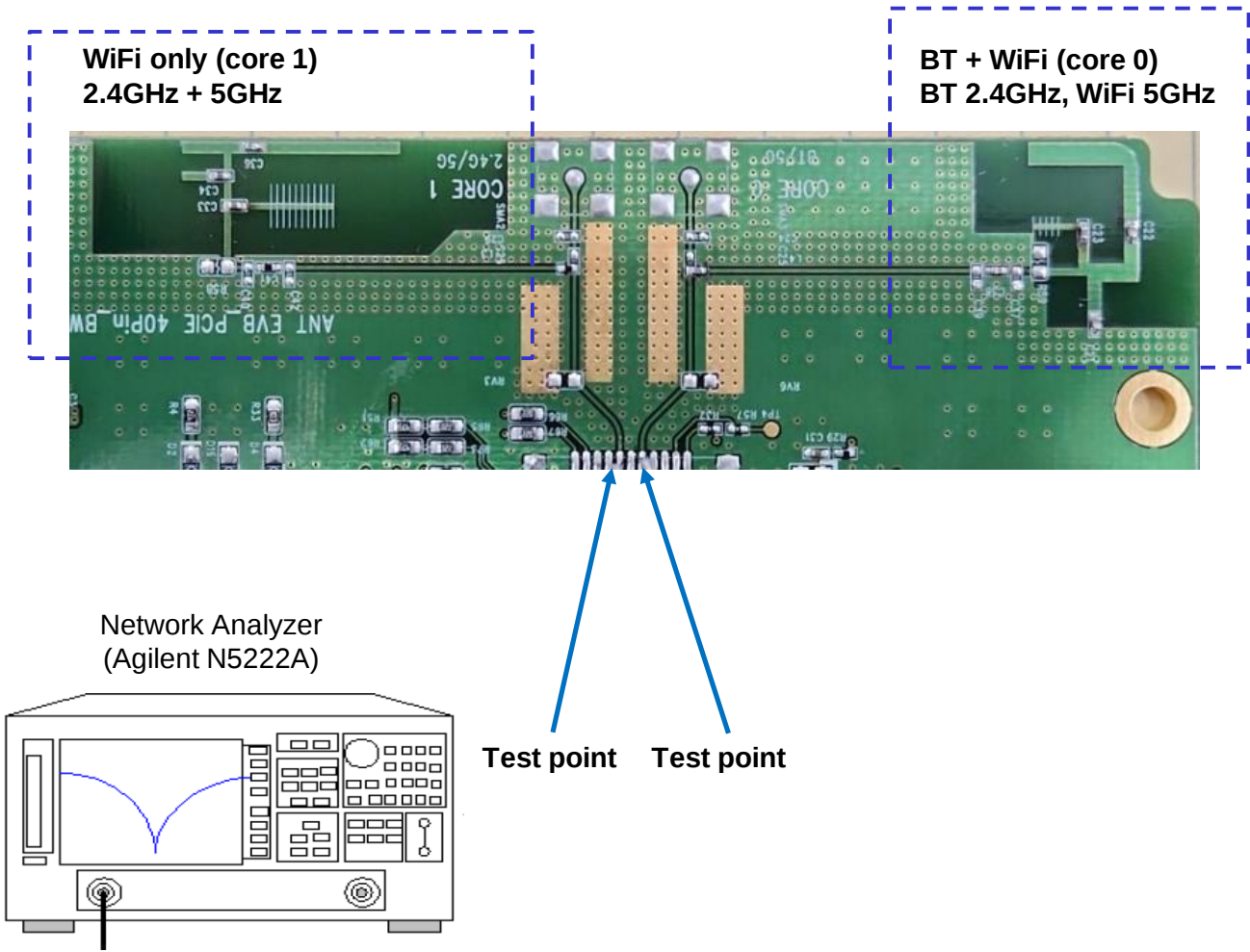
❑ A-Plustech Test System



CTIA OTA (Over The Air)TEST 3D Anechoic Chamber
(4 ×2.5×2.5 m)



4.1 Antenna Return Loss measurement



Additive Semi-rigid Cable for measeurment

- A) 1-port network calibration for RF Cable.
- B) Port Extension for semi-rigid cable effect.
- C) Connect RF cable to semi-rigid cable of module.
- D) Set frequency range and Data format of network analyzer
- E) Verify return loss of the antenna below -6[dB]