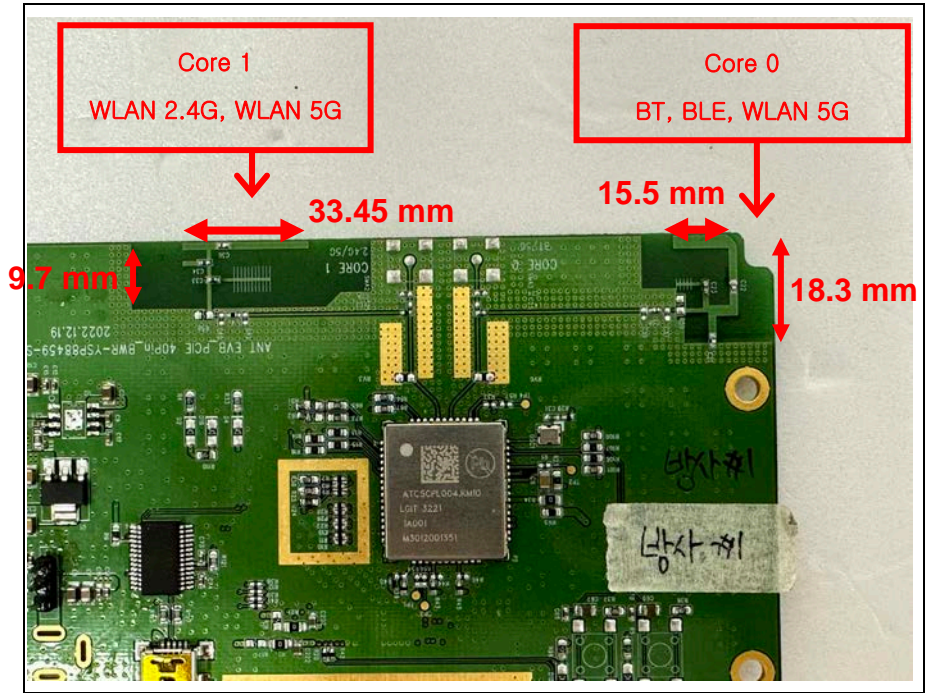


Antenna Information

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.	
			DOCUMENT No.	
Y. H. KIM	K. Y. LEE	W. K. JUNG	PAGE	13

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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)

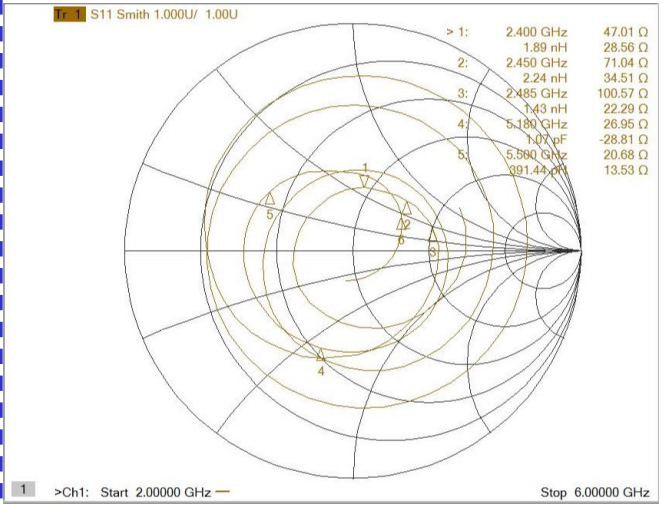
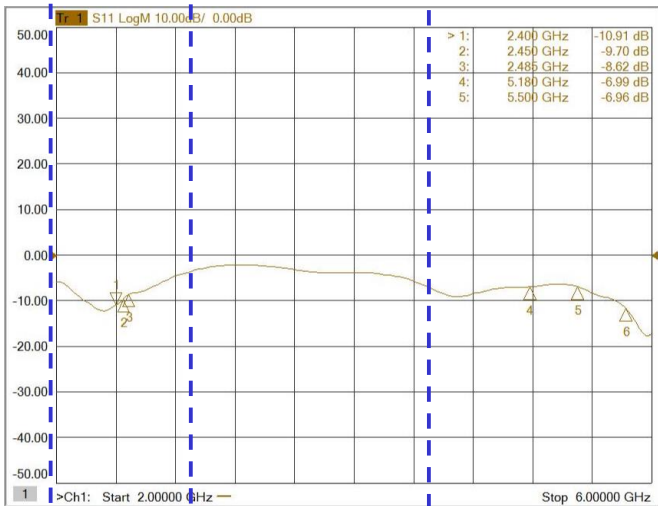
Antenna Performance				
Parameter	Min	Typ	Max	Unit
Frequency Range	2400	2450	2500	MHz
Directivity	-	Omni	-	-
Full Bands Average Gain	-	-	-1.54	dBi
Full Bands Average Peak Gain		-	2.00	
V.S.W.R	3:1	-	-	Under
Impedance		50		Ohm
Radiation Material		Printed		

3. Test Data

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

Return Loss

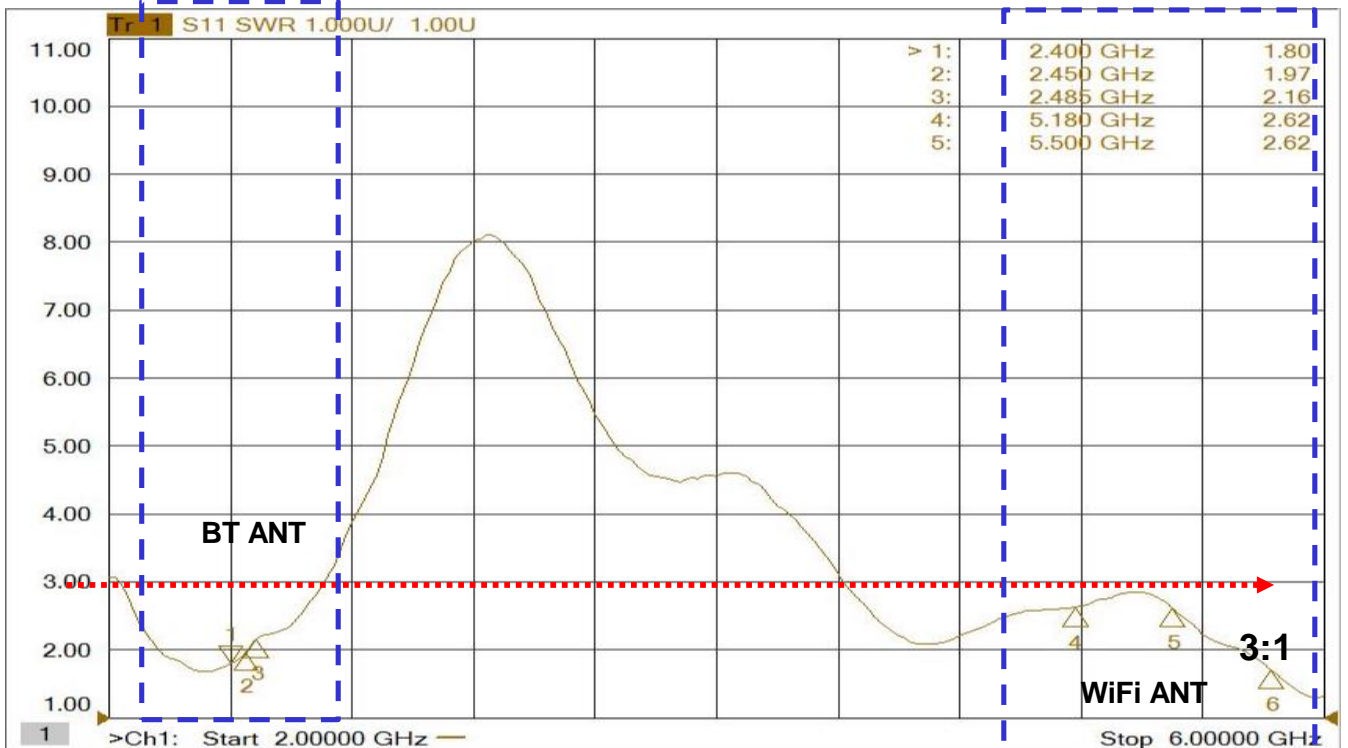
Smith Chart



BT ANT

WiFi ANT

SWR



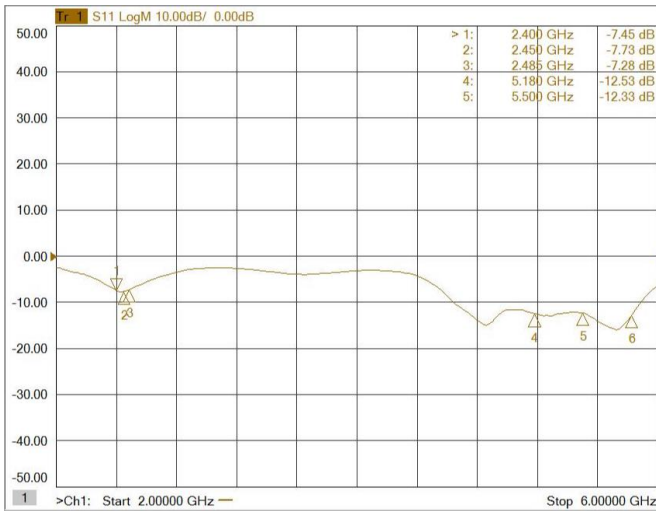
BT ANT

WiFi ANT

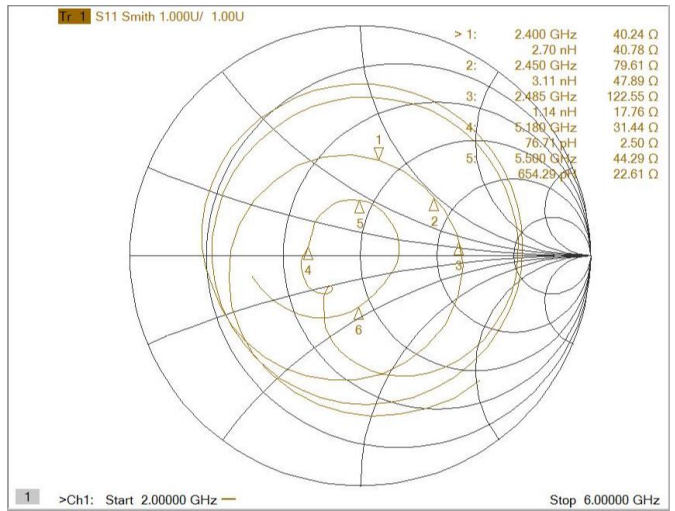
3:1

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

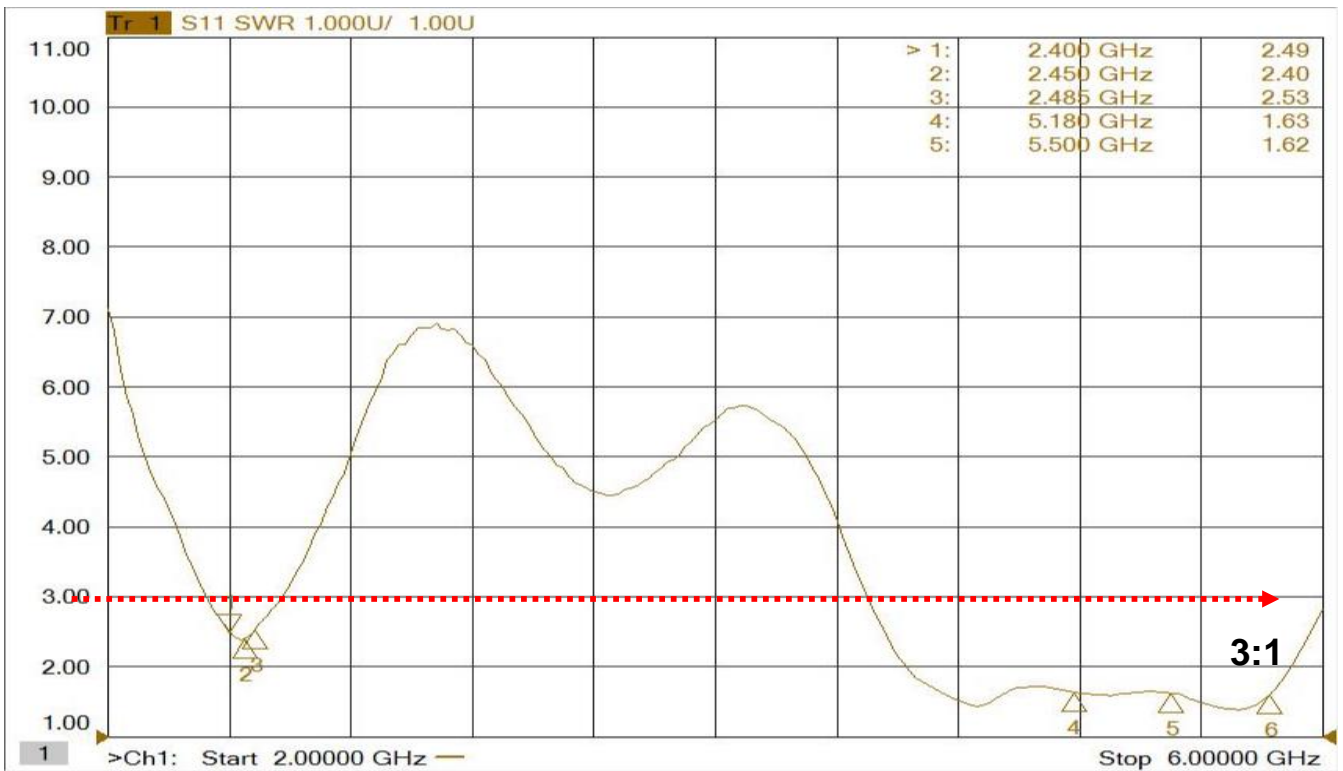
Return Loss



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

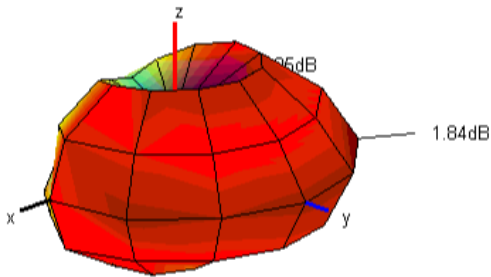
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Frequency [MHz]	5150	5200	5250	5300	5350	5400	5450	5500	5550	5600	5650	5700	5750	5800	5850
Efficiency [dB]	-1.96	-2.06	-2.18	-2.13	-2.12	-2.08	-2.46	-2.36	-2.23	-2.62	-2.22	-2.42	-2.92	-2.68	-2.58
Efficiency [%]	63.6	62.2	60.5	61.3	61.4	61.9	56.8	58.1	59.8	54.7	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

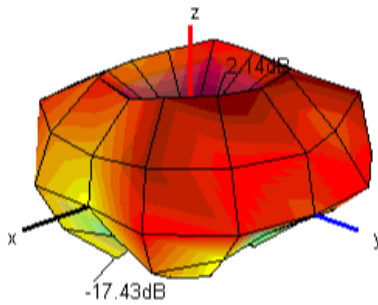
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Frequency [MHz]	5150	5200	5250	5300	5350	5400	5450	5500	5550	5600	5650	5700	5750	5800	5850
Efficiency [dB]	-3.91	-3.45	-3.53	-4.00	-3.56	-3.16	-3.84	-3.18	-3.17	-3.63	-3.07	-3.00	-2.88	-2.84	-2.48
Efficiency [%]	40.7	45.2	44.4	39.8	44.0	48.3	41.3	48.1	48.2	43.4	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

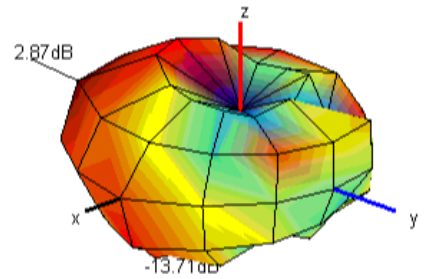
WiFi



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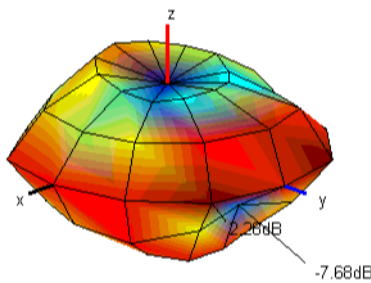


<5.50GHz core0>



<5.50GHz core1>

BT

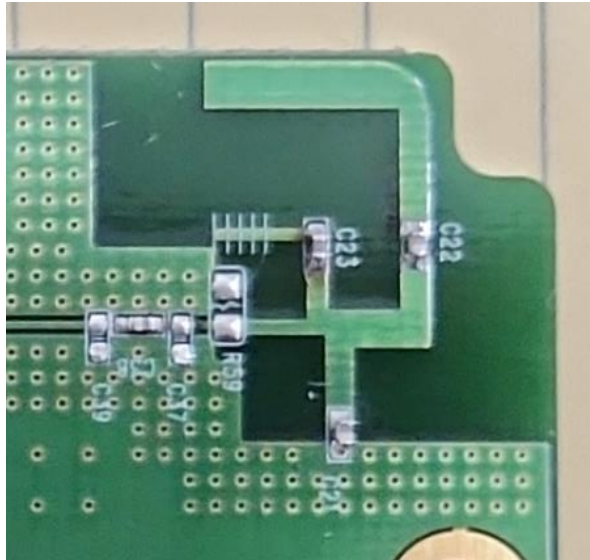


<2.45GHz>

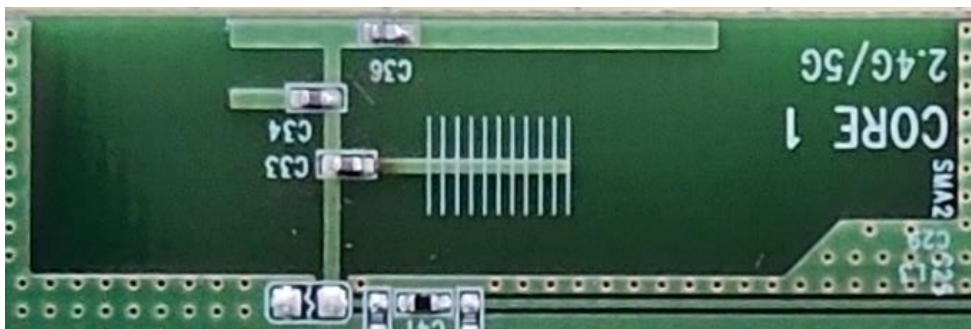
4. Mechanical Specification

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

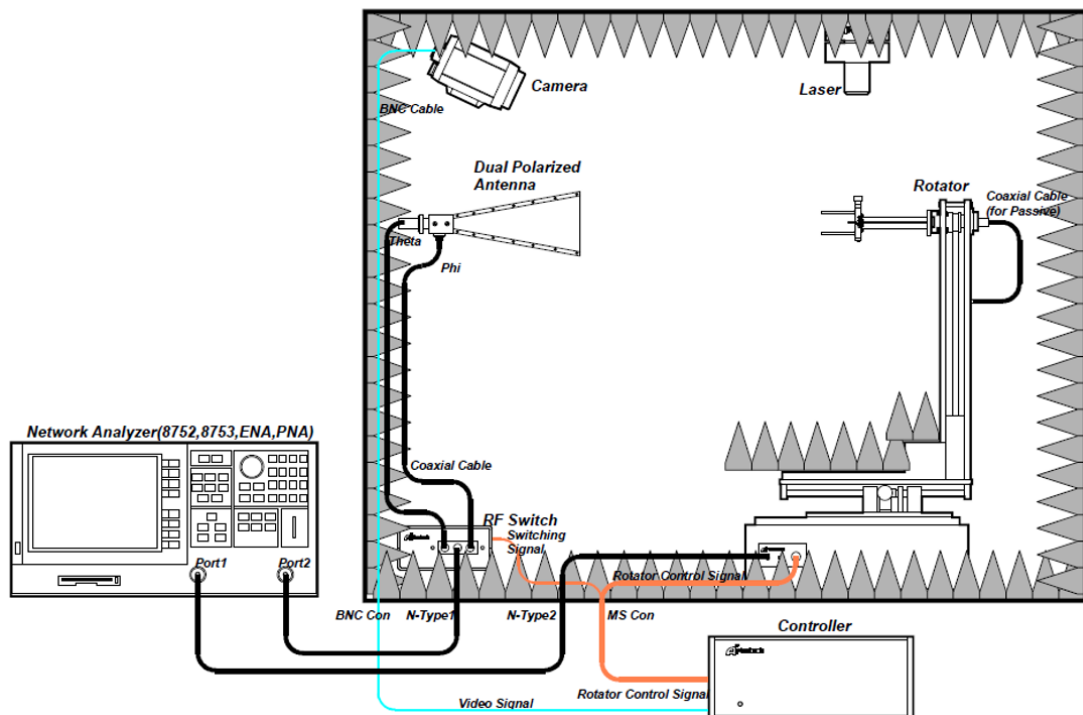


5. ANT Test Condition

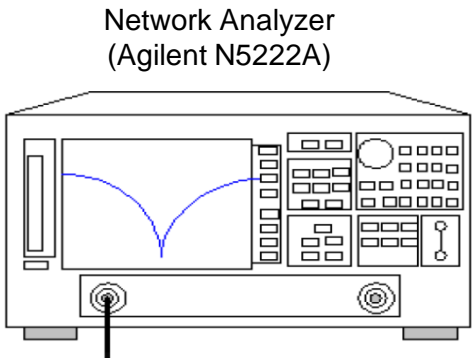
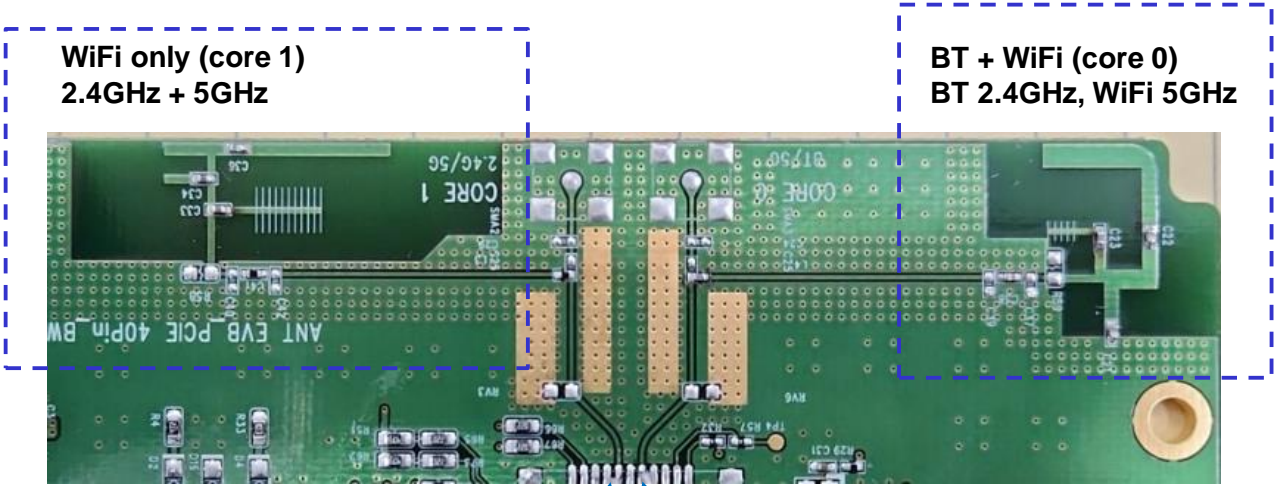
☐ A-Plustech Test System



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



4.1 Antenna Return Loss measurement



Network Analyzer
(Agilent N5222A)

Test point Test point

Additive Semi-rigid Cable for measurement

- 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]