

TITLE : Specifications for approval

REV 0.1 (3 / 13)

(CUSTOMER P/NO : M3012001351)

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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)	-	-	-5.03	dBi
Full Bands Average Gain(core1)	-	-	-6.28	
Full Bands Average Peak Gain(core0)		-	1.96	
Full Bands Average Peak Gain(core1)		-	1.19	
V.S.W.R 2GHz	3:1	-	-	Under
V.S.W.R 5GHz	4:1	-	-	Under
Impedance		50		Ohm
Radiation Material		Printed		

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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	-	-	-7.16	dBi
Full Bands Average Pick Gain		-	-2.09	
V.S.W.R	3:1	-	-	Under
Impedance		50		Ohm
Radiation Material		Printed		

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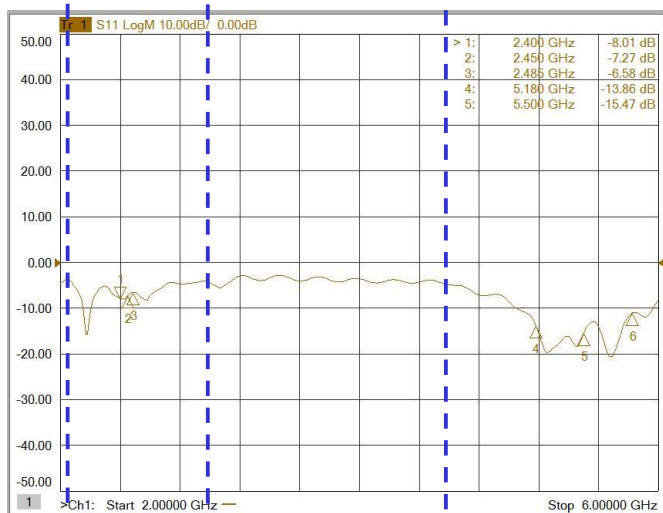
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3. Test Data

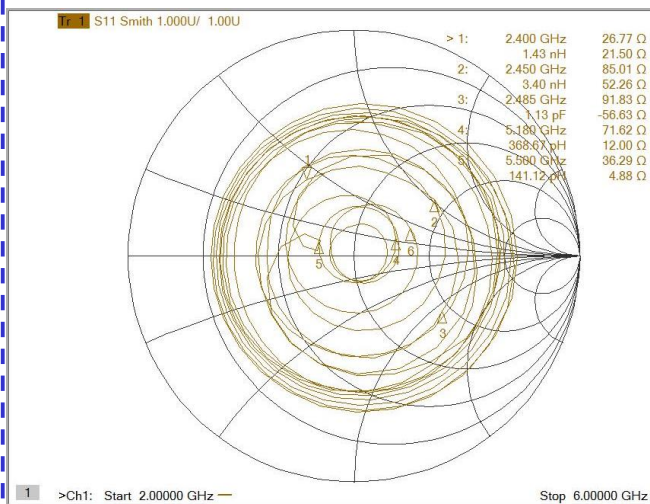
3.1 Network Data (BT Core0 + WiFi 5GHz Antenna)

Return Loss



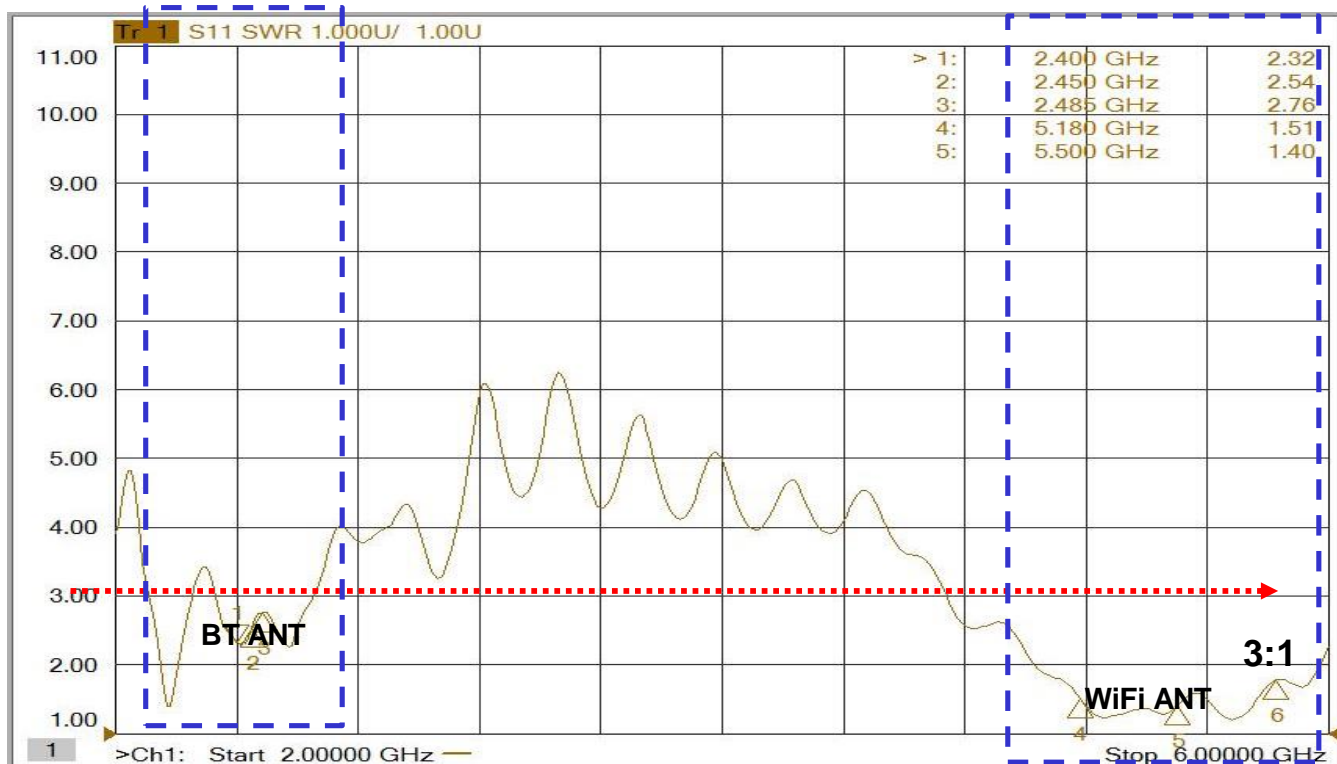
BT ANT

Smith Chart



WiFi ANT

SWR



BT ANT

WiFi ANT

3:1

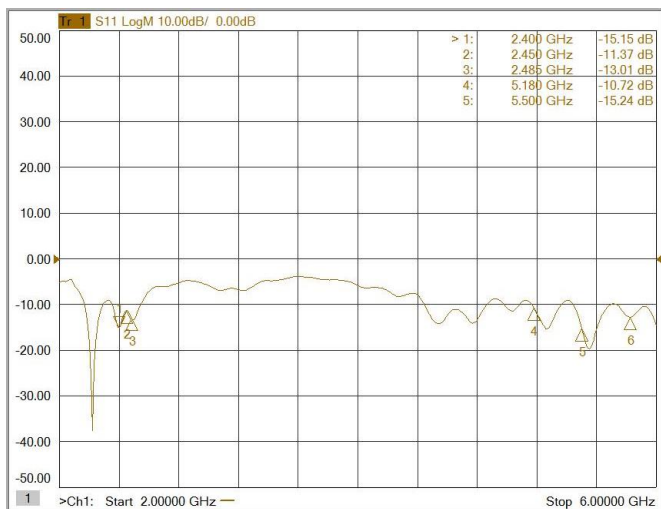
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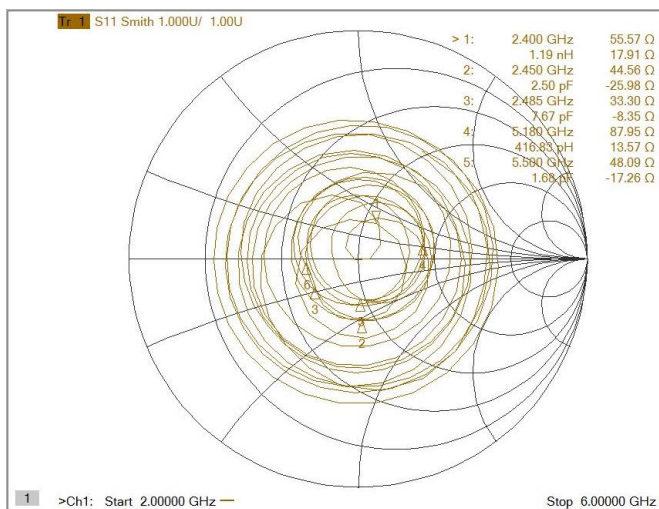
(CUSTOMER P/NO : M3012001351)

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

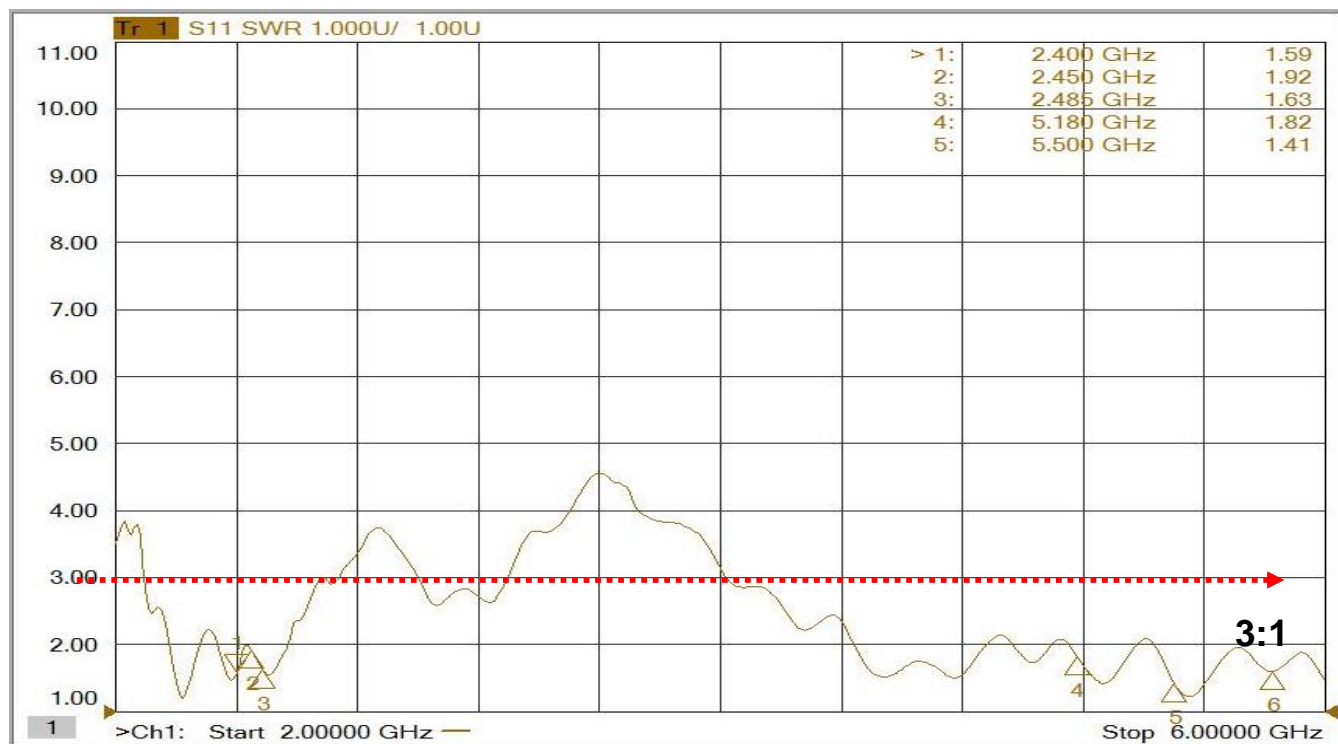
Return Loss



Smith Chart



SWR



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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]	-8.44	-8.44	-7.42	-6.66	-5.90	-5.54	-6.53	-7.91	-8.99
Efficiency [%]	14.3	14.3	18.1	21.6	25.7	27.9	22.2	16.2	12.6
TRG _θ [dB]	-9.80	-9.74	-8.72	-8.08	-7.43	-7.09	-8.25	-9.88	-11.06
Gain _{θ Peak} [dB]	-2.31	-2.04	-1.67	-1.54	-1.68	-1.47	-2.64	-4.49	-4.94
Gain _{θ Min} [dB]	-31.88	-32.72	-33.27	-25.32	-24.13	-27.70	-28.91	-32.69	-32.03
TRG _φ [dB]	-14.13	-14.32	-13.31	-12.19	-11.18	-10.75	-11.38	-12.29	-13.22
Gain _{φ Peak} [dB]	-7.43	-6.91	-5.34	-3.90	-2.81	-2.51	-3.97	-5.99	-7.02
Gain _{φ Min} [dB]	-40.98	-27.53	-35.71	-24.09	-28.35	-29.35	-31.83	-31.88	-44.48
UHRG [dB]	-11.00	-11.02	-10.08	-9.40	-8.75	-8.46	-9.49	-10.76	-11.79
UHRG/TRG [%]	55.5	55.3	54.3	53.2	51.9	51.0	50.6	51.8	52.5
H-Plane	-9.05	-9.10	-8.08	-7.32	-6.78	-6.59	-7.77	-8.98	-9.70
E1-Plane, AVG [dB]	-8.30	-8.17	-7.63	-8.33	-8.31	-7.65	-8.74	-9.87	-9.82
E2-Plane, AVG [dB]	-15.25	-14.86	-13.73	-12.69	-11.54	-11.17	-12.23	-13.95	-15.27
Peak Gain [dB]	-2.22	-1.89	-1.48	-1.34	-1.48	-1.38	-2.63	-3.56	-2.85
Directivity [dB]	6.22	6.55	5.94	5.32	4.42	4.16	3.90	4.35	6.15
Minimum Gain [dB]	-21.96	-20.78	-16.40	-13.56	-13.35	-13.37	-17.03	-22.21	-22.37
Average Efficiency	-7.16 dB		19.22 %						



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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]	-5.54	-5.58	-5.85	-5.36	-4.42
Efficiency [%]	28.0	27.7	26.0	29.1	36.1
TRG _θ [dB]	-7.69	-7.62	-7.57	-7.06	-6.36
Gain _{θ Peak} [dB]	-0.43	-1.13	-2.32	-1.81	-0.65
Gain _{θ Min} [dB]	-26.23	-29.77	-29.45	-26.12	-25.85
TRG _φ [dB]	-9.62	-9.84	-10.70	-10.24	-8.86
Gain _{φ Peak} [dB]	-2.67	-2.05	-1.51	-1.53	-1.23
Gain _{φ Min} [dB]	-26.96	-33.32	-30.25	-29.34	-27.13
UHRG [dB]	-8.18	-8.13	-8.32	-7.84	-6.89
UHRG/TRG [%]	54.4	55.6	56.5	56.4	56.7
H-Plane	-7.12	-7.03	-7.49	-7.32	-6.05
E1-Plane, AVG [dB]	-7.22	-7.41	-6.63	-5.87	-6.15
E2-Plane, AVG [dB]	-11.29	-11.71	-12.43	-11.70	-10.35
Peak Gain [dB]	0.19	-0.46	-0.61	-0.26	0.14
Directivity [dB]	5.72	5.12	5.24	5.10	4.57
Minimum Gain [dB]	-13.55	-14.60	-26.68	-22.35	-13.45
Average Efficiency	-5.35 dB		29.37 %		

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]	-6.43	-7.11	-7.78	-6.67	-5.50	-5.12	-6.49	-6.00	-5.50	-5.38	-6.80	-6.65	-6.55	-6.34	-5.93
Efficiency [%]	22.7	19.5	16.7	21.5	28.2	30.8	22.4	25.1	28.2	29.0	20.9	21.6	22.1	23.2	25.5
TRG _θ [dB]	-10.66	-11.93	-12.38	-10.39	-8.96	-8.60	-9.80	-9.26	-9.09	-8.95	-10.52	-9.83	-10.05	-10.66	-10.69
Gain _{θ Peak} [dB]	-2.42	-4.57	-5.90	-1.56	-0.16	0.04	-1.66	0.61	0.67	-0.68	-1.92	-0.26	-1.67	-3.07	-3.30
Gain _{θ Min} [dB]	-26.40	-33.07	-27.75	-28.67	-61.75	-28.94	-36.68	-30.66	-33.15	-26.18	-28.47	-29.49	-31.80	-33.11	-53.57
TRG _φ [dB]	-8.49	-8.84	-9.62	-9.07	-8.10	-7.70	-9.22	-8.77	-8.01	-7.89	-9.21	-9.50	-9.12	-8.34	-7.69
Gain _{φ Peak} [dB]	-1.54	-2.21	-1.99	-0.84	-0.85	0.28	-2.65	-0.69	0.69	0.95	0.31	0.85	0.61	1.03	2.28
Gain _{φ Min} [dB]	-32.51	-29.02	-32.54	-37.06	-28.83	-39.79	-40.13	-35.05	-23.34	-27.16	-34.57	-23.23	-23.69	-28.60	-28.99
UHRG [dB]	-10.41	-10.47	-10.59	-10.18	-9.42	-9.04	-10.46	-10.38	-10.02	-9.45	-10.59	-10.62	-10.93	-10.80	-10.07
UHRG/TRG [%]	40.0	46.1	52.3	44.5	40.6	40.5	40.1	36.5	35.4	39.1	41.9	40.1	36.4	35.8	38.5
H-Plane	-9.86	-11.02	-11.21	-9.92	-8.66	-8.91	-9.54	-9.36	-9.43	-9.95	-12.16	-11.87	-12.41	-13.05	-14.22
E1-Plane, AVG [dB]	-12.67	-12.68	-13.80	-9.66	-8.63	-8.41	-9.73	-7.52	-7.16	-7.86	-9.66	-7.86	-8.68	-10.98	-11.52
E2-Plane, AVG [dB]	-12.37	-13.67	-13.81	-12.42	-10.61	-9.99	-12.34	-12.74	-12.95	-12.23	-13.20	-13.60	-14.50	-13.51	-12.86
Peak Gain [dB]	0.77	-0.62	-1.75	0.23	1.89	2.91	0.49	2.30	2.41	1.86	0.57	1.66	1.25	1.52	2.39
Directivity [dB]	7.20	6.48	6.03	6.90	7.39	8.03	6.98	8.30	7.92	7.24	7.38	8.31	7.80	7.86	8.32
Minimum Gain [dB]	-19.51	-20.50	-24.40	-21.65	-19.17	-18.05	-24.56	-23.68	-22.91	-19.88	-25.47	-18.49	-19.13	-25.20	-22.71
Average Efficiency	-6.28 dB		23.8 %												

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]	-4.53	-5.22	-5.04	-4.48	-4.21	-4.44	-5.80	-5.32	-4.87	-5.19	-6.07	-5.68	-4.80	-4.54	-5.21
Efficiency [%]	35.2	30.1	31.4	35.7	37.9	36.0	26.3	29.4	32.6	30.2	24.7	27.0	33.1	35.1	30.2
TRG _θ [dB]	-9.33	-10.52	-10.53	-9.97	-9.42	-9.12	-10.54	-9.70	-8.54	-8.66	-10.09	-10.03	-8.87	-8.57	-8.99
Gain _{θ Peak} [dB]	0.03	-1.56	-1.93	-0.51	-2.29	-1.81	-2.27	-0.27	0.95	1.93	-1.54	-2.91	-1.35	-0.42	0.58
Gain _{θ Min} [dB]	-25.75	-26.65	-35.33	-26.74	-32.24	-32.89	-25.69	-40.26	-33.07	-31.32	-35.02	-24.40	-32.51	-24.50	-26.14
TRG _φ [dB]	-6.28	-6.74	-6.48	-5.92	-5.77	-6.25	-7.57	-7.28	-7.31	-7.79	-8.26	-7.67	-6.97	-6.73	-7.56
Gain _{φ Peak} [dB]	0.94	1.15	1.63	1.44	0.92	1.70	1.24	1.08	-0.23	0.07	0.51	0.76	1.25	-0.08	
Gain _{φ Min} [dB]	-28.51	-25.07	-23.97	-23.50	-40.26	-23.19	-25.46	-30.40	-27.95	-23.53	-34.85	-24.14	-44.61	-24.15	-29.12
UHRG [dB]	-8.10	-9.06	-8.42	-8.00	-7.82	-8.25	-9.33	-8.97	-8.46	-9.79	-10.42	-9.67	-8.94	-8.64	-9.20
UHRG/TRG [%]	43.9	41.3	45.9	44.5	43.6	41.6	44.3	43.1	43.8	34.7	36.7	40.0	38.6	38.9	39.8
H-Plane	-8.99	-10.30	-10.05	-8.57	-8.27	-8.62	-10.03	-9.39	-9.06	-9.79	-9.88	-9.90	-9.60	-8.93	-9.41
E1-Plane, AVG [dB]	-11.04	-11.75	-10.94	-11.07	-9.42	-8.50	-10.08	-7.79	-7.00	-7.37	-8.89	-9.84	-7.71	-7.65	-8.24
E2-Plane, AVG [dB]	-12.56	-13.64	-12.12	-11.25	-10.46	-10.40	-12.53	-13.40	-15.53	-12.89	-12.65	-13.72	-14.47	-12.92	-12.15
Peak Gain [dB]	2.15	2.04	2.15	1.88	1.77	2.57	1.83	1.70	1.83	2.39	1.19	1.17	2.76	2.16	1.79
Directivity [dB]	6.68	7.25	7.18	6.35	5.98	7.01	7.63	7.02	6.70	7.59	7.26	6.86	7.57	6.70	6.99
Minimum Gain [dB]	-17.76	-16.67	-17.88	-18.63	-20.47	-17.49	-19.30	-22.33	-23.74	-18.28	-24.20	-18.01	-23.88	-16.33	-16.33
Average Efficiency	-5.03 dB		31.7 %												

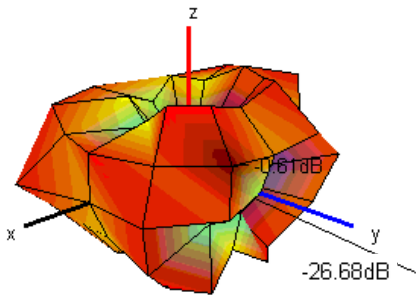
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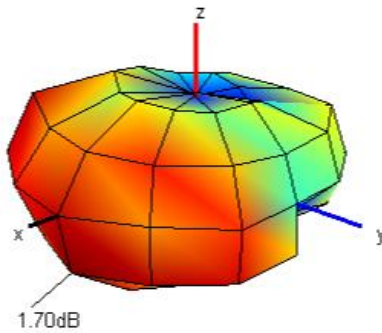
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3.5 Radiation Pattern

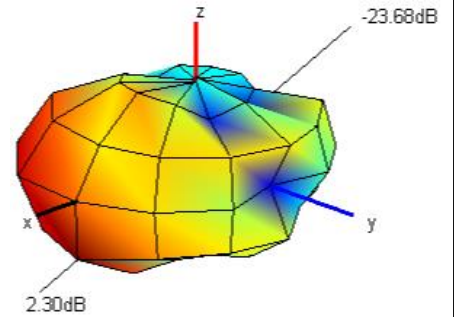
WiFi



<2.45GHz core1>

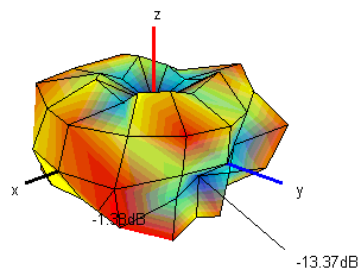


<5.50GHz core0>



<5.50GHz core1>

BT



<2.45GHz>

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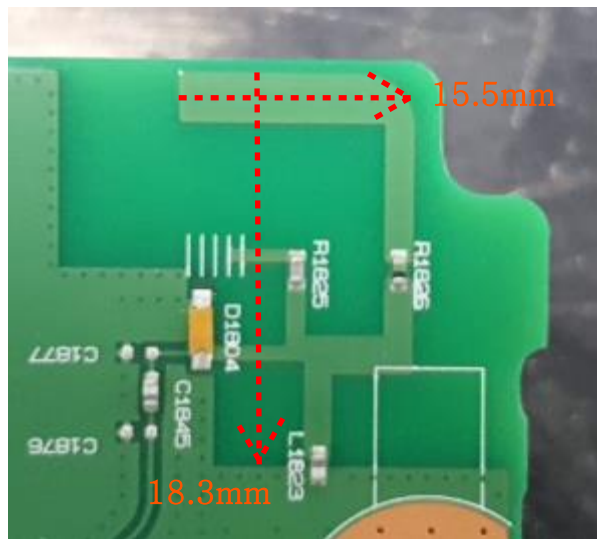
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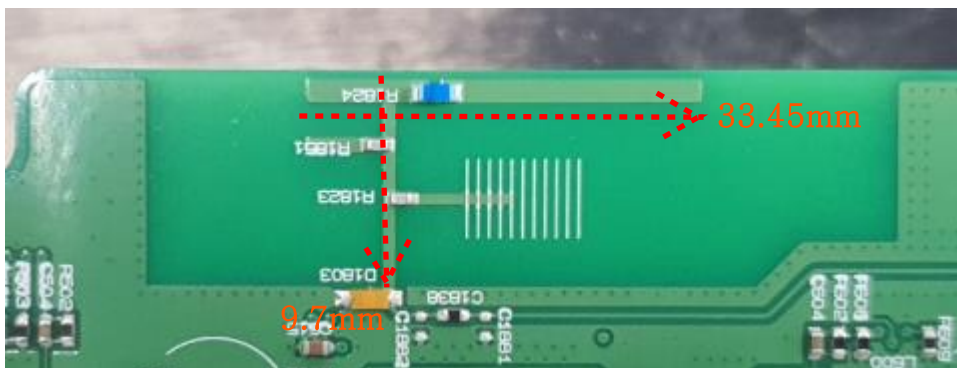
4. Mechanical Specification

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



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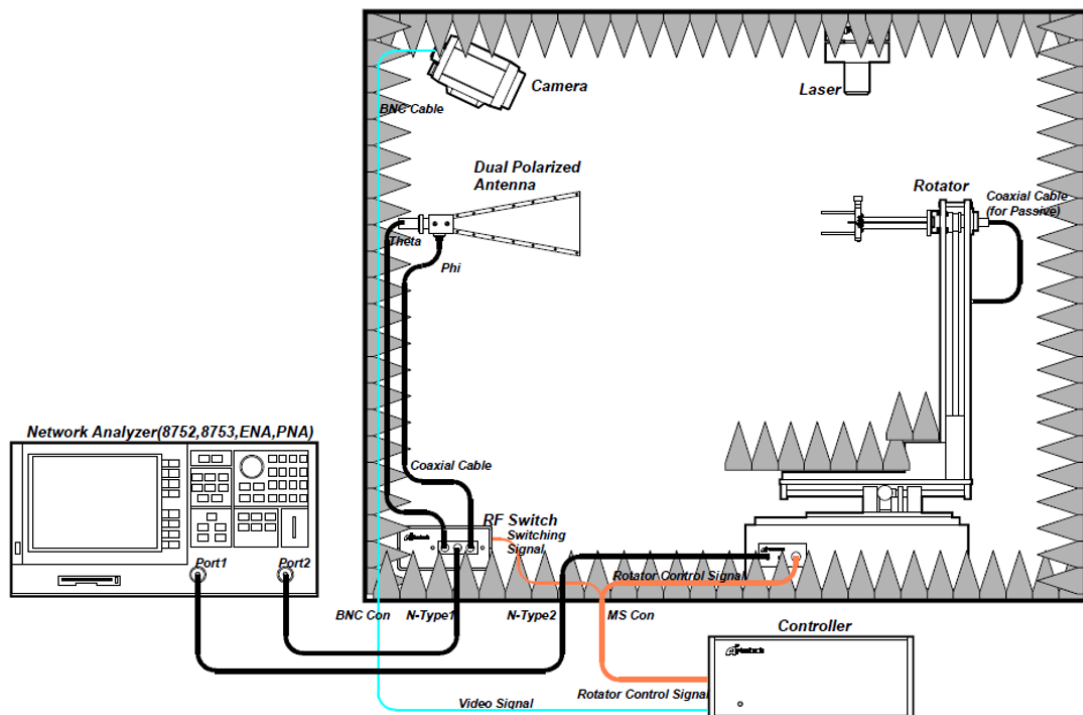
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5. ANT Test Condition

□ A-Plustech Test System



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

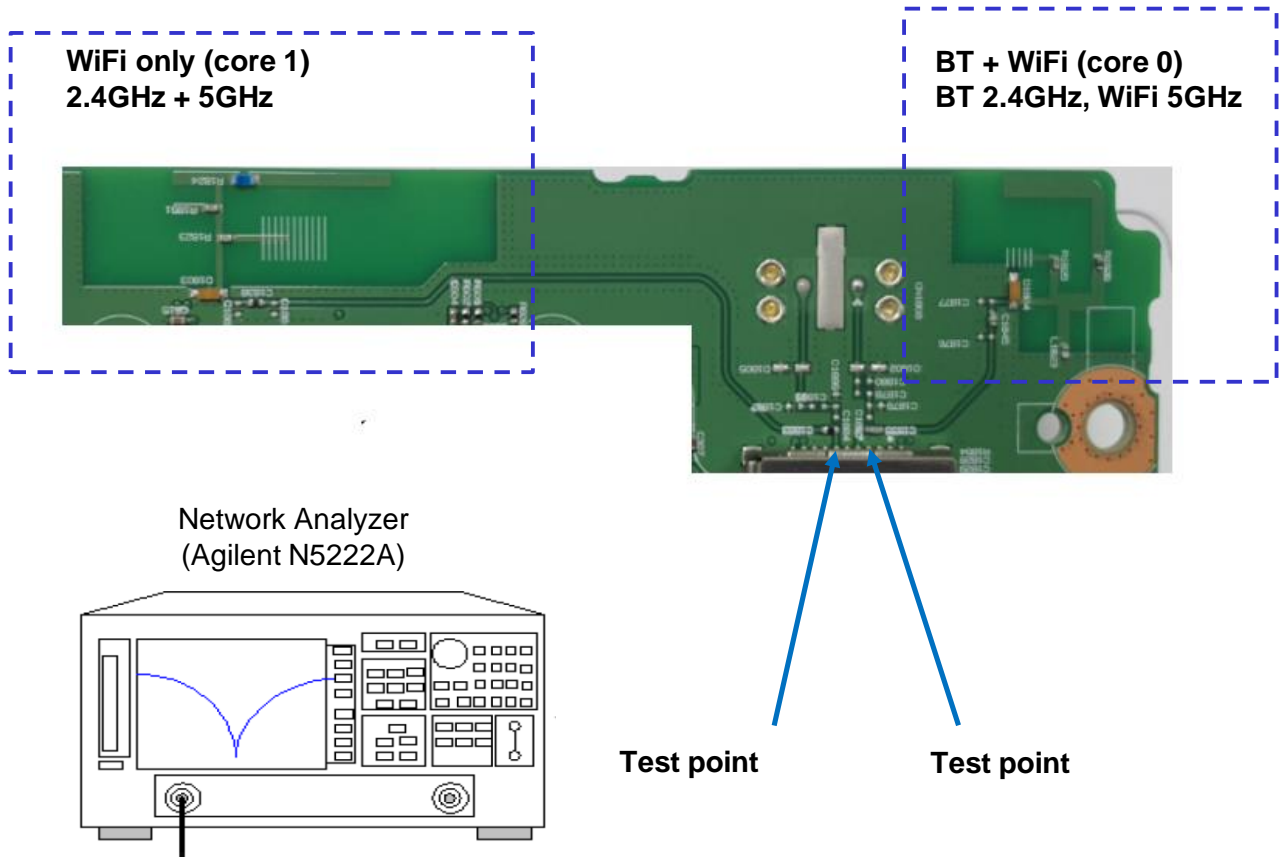


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4.1 Antenna Return Loss measurement



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]