Declared Antenna Specification

Model : **XR100-RQ**

Antenna Type : **PCB Pattern Antenna**

Maximum Peak Gain : **2.15 dBi**

Radiated Measurements

Total radiated power:
Radiated spurious emissions

Introduction

Purpose of this test is to measure:
Radiated output power of each radio port.
Out of band emissions for each radio port
The DUT radiation is measured using a reference antenna placed at 1m distance, in a anechoic chamber.
The DUT is enclosed in the designated enclosure and batteries, i.e. as the final product will operate.

Performance Requirements

Total Radiated output power
TRP within 2 dB ± 1dB of conducted power.
Antenna efficiency batter than -2 dB ± 1dB

Radiated spurious emissions
For EIRP ≤ 20dBm, the 2nd, 3rd, 4th and 5th TX harmonic are measured since these power levels have to meet the regulatory standard.
For EIRP ≤ 10dBm, the 2nd and 3rd TX harmonic are measured since these power levels have to meet the regulatory standard.

FCC Average Spurious Emissions
The FCC part 15 requirements for radiated spurious emissions are **-41.2dBm** average power measured with a **normal modulated signal and 1MHz resolution bandwidth**.
To achieve the best possible measurement accuracy, measurements at Greenpeak are conducted with an **unmodulated CW signal** instead of normal modulated signal.
1) Since CW is used, a correction factor should be used to compensate for the BW difference in measurement setup. GreenPeak estimated this factor to be **4dB**.
2)The FCC requires a continuous signal for the spurious emission measurements but the average spurious emission level should be corrected using the DUT normal operation duty cycle correction(see FCC part 15.35)
For the RF4CE, MSO profile, GreenPeak has measured the maximum duty cycle(RC paired, out-of-range) for RF1 and RF2, and based on these measurements, the correction factors are 11 -12 dB for both RF1 and RF2

FCC Peak Spurious Emissions
The FCC part 15.23(b) specifies the limit on peak radio emissions to be **20dB** above maximum permitted average emission limit applicable using modulated signal and minimum 1MHz resolution bandwidth.
With the above correction the **-41.2dBm** limit (modulated CW signal) becomes: **-21.2dBm**

ETSI Spurious Emissions
The limits on harmonic spurious emissions in the ETSI domain are -30 dBm in 1MHz BW measured with 3 MHz RBW, with a peak detector in max hold mode.
The unmodulated CW signal as used by GreenPeak is providing the same results as s modulated signal measured with the ETSI settings, no correction needed.

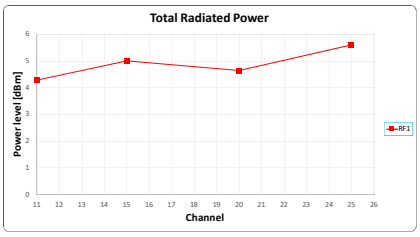
Results

Test: Total Radiated Power, CW

Measurement condition:
Channels CH 11 (2405MHz), CH15 (2425MHz), CH 20 (2450MHz) and CH 25 (2475MHz)
TX power setting w 3 (3dBm)
Unmodulated CW signal used
RBW set to 300KHz, VBW set to 300KHz.

Channel	TRP [dBm]
	RF1
11	4.29
15	5.00
20	4.65
25	5.60
Avg. TRP [dBm]	4.89

Expected TRP [dBm	RF1
Conducted pwr [dBm]	7.77
Antenna eff. Gcal [dB]	-3.00
Expected TRP [dBm	4.77
Measured TRP [dBm]	4.89
Margin	0.1



Conclusion:

- The total radiated powers are within the expected range.

Analysis: Antenna efficiency estimation

Measurement condition:
Conducted TX power setting, W 8 (8dBm)
Radiated TX power setting, W 8 (8dBm)

Channel	Antenna Efficiency [dB]
	RF1
11	-3.29
15	-2.68
20	-3.17
25	-2.29
Avg. AE [dB]	-2.86

Conclusion:

- The antenna efficiencies are within the expected range.

Test: Radiated Spurious, Average Power, CW

Measurement condition:
Channels CH 11 (2405MHz), CH15 (2425MHz), CH 20 (2450MHz) and CH 25 (2475MHz)
TX power settings W 8 (8dBm)
CW, un-modulated CH11, 15, 20 and 25(2405, 2425, 2450 and 2475 MHz)
RBW: 300Hz, VBW: 300Hz

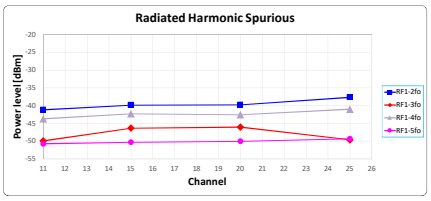
FCC Pass limit [dBm] (average power)	-41.2
FCC Pass limit [dBm] (peak power)	-21.2
ETSI Pass limit [dBm]	-30.0

Duty Cycle @Zigbee	50.0%
Duty Cycle @BLE	13.0%

(a) 20dBm, Closed Loop Mode

Channel	2nd Harmonic Pout [dBm]	3rd Harmonic Pout [dBm]	4th Harmonic Pout [dBm]	5th Harmonic Pout [dBm]
	RF1	RF1	RF1	RF1
11	-41.2	-49.9	-43.7	-50.8
15	-39.9	-46.3	-42.3	-50.4
20	-39.8	-46.1	-42.6	-50.1
25	-37.7	-49.6	-41.0	-49.3
Max. [dBm]	-37.7	-46.1	-41.0	-49.3
ETSI Margin [dB]	7.7	16.1	11.0	19.3
FCC BW Correction @Zigbee [dB]	6	6	6	6
FCC Duty Cycle Correction @Zigbee [dB]	6	6	6	6
FCC Max Corrected @Zigbee [dBm]	-49.7	-58.1	-53.0	-61.4
FCC Margin @Zigbee [dB]	8.5	16.9	11.8	20.2
FCC BW Correction @Bluetooth LE 1Mbps [dB]	0	2	6	6
FCC Duty Cycle Correction @Bluetooth LE [dB]	18	18	18	18
FCC Max Corrected @Bluetooth LE [dBm]	-55.4	-65.8	-61.0	-69.3
FCC Margin @Bluetooth LE [dB]	14.2	24.6	19.8	28.1

PASS
MARGINAL
FAIL



Conclusion:

- No issue with FCC and ETSI requirements on the radiated spurious emissions in TX mode.

Summary | Multiple Frequency | Multiple Cut | 3D-View | Reserved

Operator : Operator Name Date : 2023-07-11

Customer : Customer Name Time : 오후 4:03:01

Description : Test Descriptions

Antenna Type

- (•) Linear Polarization Type
- ( ) Circular Polarization Type

Sphere Type

- (•) Sphere
- ( ) Upper Hemi-Sphere

MIMO Analysis

3D Result Summary :

		Theta-Pc					Phi-Pol(\					PwrSum				
No	Freq.[MHz]	Eff.[%]	Avg.[dBi]	Peak[dBi]	Theta	Phi[de	Eff.[%]	Avg.[dBi]	Peak[dBi]	Theta	Phi[de	Eff.[%]	Avg.[dBi]	Peak[dBi]	Theta	Phi[de
1	2400.000	40.63	-3.91	1.61	90.00	285.00	9.20	-10.36	-3.92	15.00	120.00	49.83	-3.03	2.15	90.00	285.00
2	2410.000	36.28	-4.40	0.96	90.00	285.00	8.46	-10.73	-4.67	60.00	105.00	44.74	-3.49	1.57	90.00	285.00
3	2420.000	35.61	-4.48	0.72	90.00	285.00	8.52	-10.70	-4.53	60.00	105.00	44.13	-3.55	1.42	90.00	285.00
4	2430.000	32.79	-4.84	0.26	105.00	270.00	8.14	-10.89	-4.71	60.00	105.00	40.93	-3.88	0.98	90.00	285.00
5	2440.000	27.02	-5.68	-0.52	105.00	270.00	6.97	-11.57	-5.51	60.00	105.00	33.99	-4.69	0.26	105.00	270.00
6	2450.000	26.33	-5.80	-0.73	105.00	270.00	7.16	-11.45	-5.41	90.00	135.00	33.49	-4.75	0.18	105.00	270.00
7	2460.000	24.26	-6.15	-1.25	45.00	15.00	6.89	-11.62	-5.59	90.00	135.00	31.15	-5.07	-0.31	105.00	270.00
8	2470.000	22.30	-6.52	-1.14	45.00	15.00	6.42	-11.92	-5.52	30.00	270.00	28.72	-5.42	-0.90	105.00	270.00
9	2480.000	23.43	-6.30	-0.53	45.00	15.00	6.78	-11.69	-4.81	30.00	270.00	30.21	-5.20	-0.34	45.00	15.00
10	2490.000	22.20	-6.54	-0.51	45.00	15.00	6.45	-11.91	-4.63	30.00	270.00	28.65	-5.43	-0.35	45.00	15.00
11	2500.000	23.48	-6.29	-0.11	45.00	15.00	6.66	-11.77	-4.27	30.00	270.00	30.14	-5.21	0.02	45.00	15.00

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Summary | Multiple Frequency | Multiple Cut | **3D-View** | Reserved

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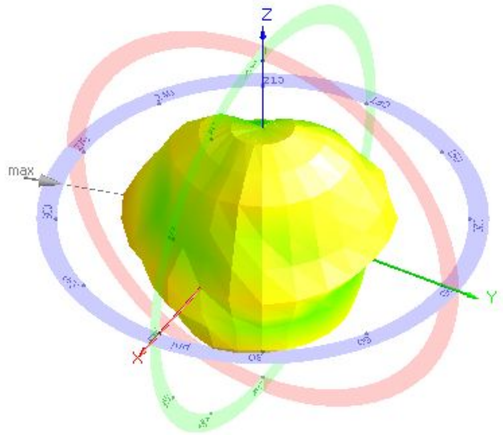
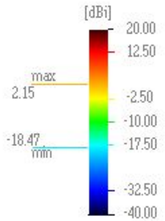
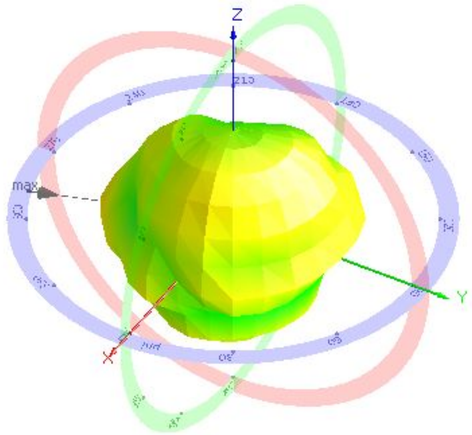
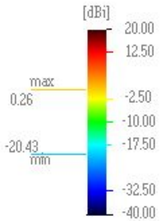
2400.000MHz



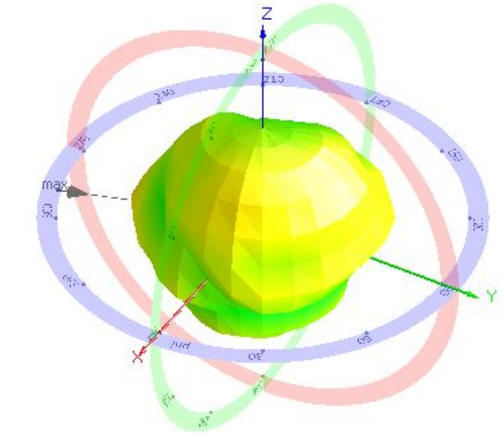


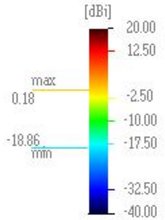
2440.000MHz



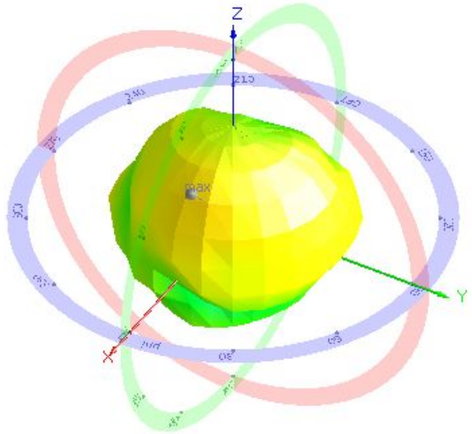


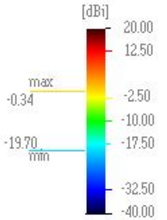
2450.000MHz





2480.000MHz





zm

zm

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Plot Data

Polarization : Powr-Sum

Frequency : [MHz]

2400,000
2410,000
2420,000
2430,000
2440,000
2450,000
2460,000
2470,000
2480,000
2490,000
2500,000

Graph Option

- ☐ AutoRotation
- ☐ View Phone
- ☐ SphereMapping
- ☐ Interpolation

x2

Scale

○ Auto ◉ User Defined

Max : 20

Min : -40

Apply

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