China

FCC - TEST REPORT

Report Number	:	60.790.22.002.01R01	Date of Issue	: October 19, 2022
Model	:	QTM-AGP10		
Product Type	:	**Quantum RTLS Gateway**		
Applicant	:	ZEROKEY INC.		
Address	:	3120 12TH ST NE, CALGARY AB T2E 8T3, CANADA		
Production Facility 1	:	ZEROKEY INC.		
Address	:	3120 12TH ST NE, CALGARY AB T2E 8T3, CANADA		
Production Facility 2	:	DYNAMIC SOURCE MANUFACTURING INC		
Address	:	6285 76 AVE SE, UNIT 130, CALGARY ALBERTA T2C 5L9, CANADA		
Test Result	:	■**Positive** ☐**Negative**		
Total pages including Appendices	:	49		

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1 Table of Contents

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2 Description of Equipment Under Test

Description of the Equipment Under Test

Product:	Quantum RTLS Gateway
Model no.:	QTM-AGP10
FCC ID:	**2AX6LQTMAGP10**
Rating:	56VDC, 3W (Power from POE) Or 56VDC, 3W (Power from DC Jack) Or 5VDC, 3W (Power from USB Type-C Jack)
Operating mode:	Enhanced Shockburst
Frequency:	2402-2480MHz (Tx and Rx)
Antenna Info.:	Internal Antenna: SMD on-board dipole antenna, 5.2dBi gain. External Antenna: SMA dipole antenna, 2.0dBi gain RF signal only can be emitted either on the internal or external antenna.
Number of operated channels:	79, 1MHz channel space
Modulation:	GFSK
Remark:	---

Auxiliary Equipment and Software Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO./ SPEC.	REMARK
POE Injector (AC/DC Adapter)	Phihong Technology Co., Ltd	Model: POE29U-1AT(PL) Input: 100-240VAC 0.8A 50-60Hz Output: 56VDC 0.536A, 30W	/
DC Supply (AC/DC Adapter)	Phihong Technology Co., Ltd	Model: PSAC30U-560L6 Input: 100-240VAC 0.8A 50-60Hz Output: 56VDC 0.536A	/
Personal Computer	Lenovo (Beijing) Co., Ltd	ThinkPad X240	/

Auxiliary Software Used during Test:

DESCRIPTION	SOFTWARE NAME	VERSION	REMARK
RF Test Mode Software	Windows Command	10.0.19044.2006	/

3 Summary of Test Standards

Test Standards
FCC Part 15 Subpart C 10-1-21 Edition Federal Communications Commission, PART 15 — Radio Frequency Devices, Subpart C —Intentional Radiators

All the test methods were according to KDB558074 D01 v05r02 DTS Measurement Guidance and ANSI C63.10 (2013).

4 Details about the Test Laboratory

Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12&13 Zhiheng Wisdomland Business Park,
Nantou Checkpoint Road 2,
Shenzhen 518052, P.R.China
FCC Registration Number: 514049
ISED test site number: 10320A

Emission Tests	
Test Item	Test Site
FCC Part 15 Subpart C	
FCC Title 47 Part 15.205, 15.209 & 15.247(d) Spurious Radiated Emission	Site 1
FCC Title 47 Part 15.207 Conduct Emission	Site 1
FCC Title 47 Part 15.247(a)(1) 6dB & 99% Bandwidth	Site 1
FCC Title 47 Part 15.247(b) Peak Output Power	Site 1
FCC Title 47 Part 2.1051 & 15.247(d) Spurious Emissions at Antenna Terminals	Site 1
FCC Title 47 Part 15.247(d) 100kHz Bandwidth of band edges	Site 1
FCC Title 47 Part 15.247(e) Power Spectral Density	Site 1
FCC Title 47 Part 15.203 & 15.247(b) Antenna Requirement	Site 1

4.1 Test Equipment Site List

Radiated Emission – Site 1

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 7	101269	2023-5-27
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2023-7-12
Horn Antenna	Rohde & Schwarz	HF907	102294	2023-6-19
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100398	2023-8-17
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2023-5-28
Attenuator	Mini-circuits	UNAT-6+	MY39264334	2023-5-27
3m Semi-anechoic chamber	TDK	SAC-3 #1	----	2023-5-28
Test software	Rohde & Schwarz	EMC32	Version9.15.00	N/A

Conducted Emission Test – Site 1

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 3	101782	2023-5-27
LISN	Rohde & Schwarz	ENV4200	100249	2023-5-27
LISN	Rohde & Schwarz	ENV432	101318	2023-5-27
LISN	Rohde & Schwarz	ENV216	100326	2023-5-27
ISN	Rohde & Schwarz	ENY81	100177	2023-5-27
ISN	Rohde & Schwarz	ENY81-CA6	101664	2023-5-27
RF Current Probe	Rohde & Schwarz	EZ-17	100816	2023-5-27
Attenuator	Shanghai Huaxiang	TS2-26-3	080928189	2023-5-31
Test software	Rohde & Schwarz	EMC32	Version9.15.00	N/A
Shielding Room	TDK	CSR #1	----	2022-11-07

20dB & 99% Bandwidth, Peak Output Power, Spurious Emissions at Antenna Terminals, 100kHz Bandwidth of band edges, Power Spectral Density – Site 1

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Generator	Rohde & Schwarz	SMB100A	108272	2023-5-27
Vector Signal Generator	Rohde & Schwarz	SMBV100A	262825	2023-5-27
Communication Synthetical Test Instrument	Rohde & Schwarz	CMW 270	101251	2023-5-27
Signal Analyzer	Rohde & Schwarz	FSV40	101030	2023-5-27
Vector Signal Generator	Rohde & Schwarz	SMU 200A	105324	2023-5-27
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2023-5-27
Power Splitter	Weinschel	1580	SC319	2023-5-28
10dB Attenuator	Weinschel	4M-10	43152	2023-5-28
10dB Attenuator	R&S	DNF	DNF-001	2023-5-27
10dB Attenuator	R&S	DNF	DNF-002	2023-5-27
10dB Attenuator	R&S	DNF	DNF-003	2023-5-27
10dB Attenuator	R&S	DNF	DNF-004	2023-5-27
Test software	Rohde & Schwarz	EMC32	Version 10.38.00	N/A
Test software	Tonscend	System for BT/WIFI	Version 2.6	N/A

4.2 Measurement System Uncertainty

Measurement System Uncertainty Emissions

System Measurement Uncertainty	
Items	**Extended Uncertainty**
Uncertainty for Radiated Emission in 3m chamber 9kHz-30MHz	4.66dB
Uncertainty for Radiated Emission in 3m chamber 30MHz-1000MHz	Horizontal: 4.26dB; Vertical: 4.25dB;
Uncertainty for Radiated Emission in 3m chamber 1000MHz-25000MHz	Horizontal: 4.51dB; Vertical: 4.50dB;
Uncertainty for Conducted Emission at AC Power Line 150kHz-30MHz	3.31dB
Uncertainty for conducted power test	1.27dB
Uncertainty for frequency test	0.6×10^{-7}

Measurement System Uncertainty Immunity

The measurement expanded uncertainties for defined systems are for a 95% confidence level, in accordance with the recommendations of ISO 17025.

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2007, clause 4.4.3 and 4.5.1.

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5 Summary of Test Results

Emission Tests				
FCC Part 15 Subpart C				
Test Condition	Pages	Test Result		
		Pass	Fail	N/A
FCC Title 47 Part 15.205, 15.209 & 15.247(d) Spurious Radiated Emission	12-19	☒	☐	☐
FCC Title 47 Part 15.207 Conduct Emission	20-21	☒	☐	☐
FCC Title 47 Part 15.247(a)(2) 6dB & 99% Bandwidth	22-24	☒	☐	☐
FCC Title 47 Part 15.247(b) Peak Output Power	25-27	☒	☐	☐
FCC Title 47 Part 2.1051 & 15.247(d) Spurious Emissions at Antenna Terminals	28-33	☒	☐	☐
FCC Title 47 Part 15.247(d) 100kHz Bandwidth of band edges	34-35	☒	☐	☐
FCC Title 47 Part 15.247(e) Power Spectral Density	36-38	☒	☐	☐
FCC Title 47 Part 15.203 & 15.247(b) Antenna Requirement	39	☒	☐	☐

6 General Remarks

Remarks

EUT can be powered by 56VDC from the POE port or DC jack, and 5VDC form the USB Type-C jack. Pre-test was performed on these three cases, results between them have no obvious deviation, so finally DC jack power was chosen to perform the full test.

EUT has an internal antenna and an external antenna, radiated test was performed on both antennas. Conducted RF pre-test was performed at the connector of both antennas, but no obvious deviation found, so all conducted RF test was performed at the connector of external antenna.

This submittal(s) (test report) is intended for **FCC ID: 2AX6LQTMAGP10,** complies with Section 15.203, 15.205, 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C rules for the DTS grant.

The TX and RX range is 2402MHz-2480MHz.

SUMMARY:

- All tests according to the regulations cited on page 8 were

■ - Performed

☐ - **Not** Performed

- The Equipment Under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date: January 12, 2022

Testing Start Date: January 20, 2022

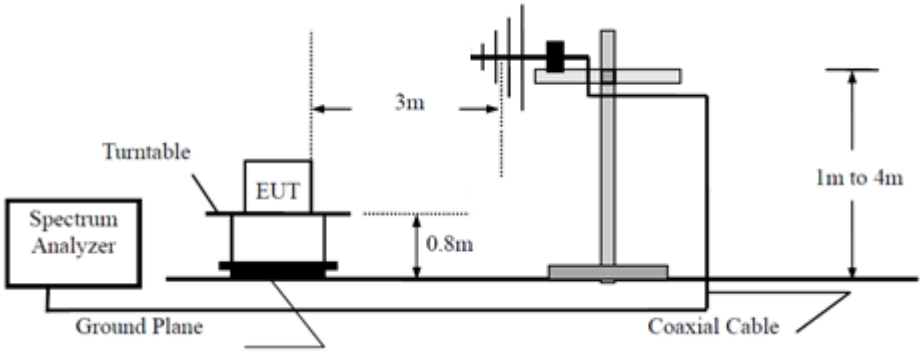
Testing End Date: February 16, 2022

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch -

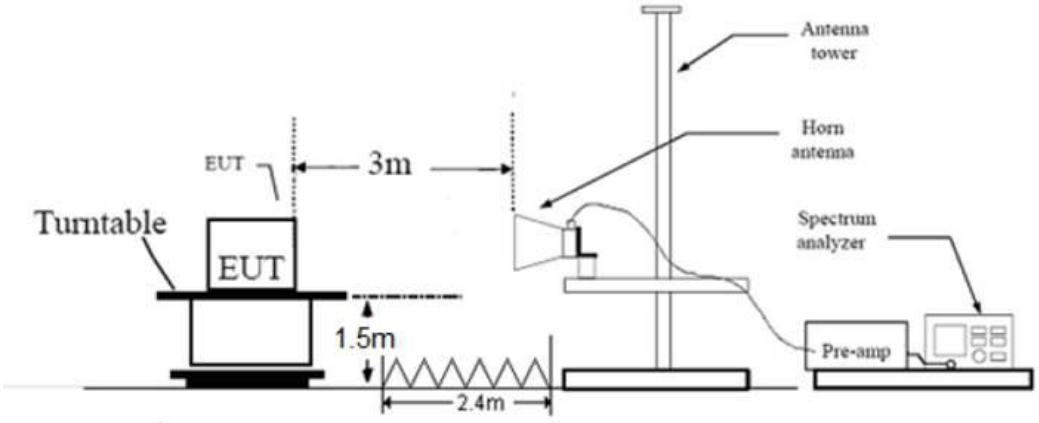
Reviewed by:	Prepared by:	Tested by:
Eric LI	Hosea CHAN	Louise Liu
EMC Project Manager	EMC Project Engineer	EMC Test Engineer

7 Test Setups

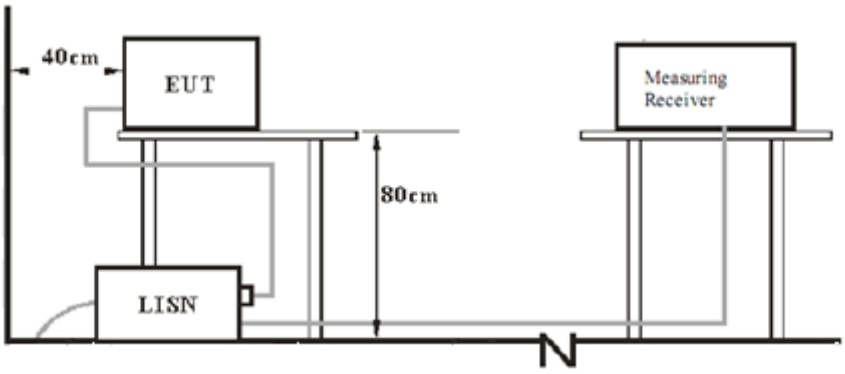
7.1 Radiated test setups Below 1GHz



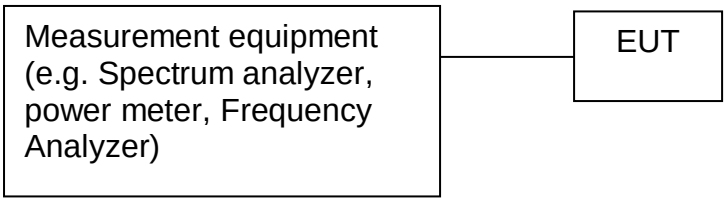
7.2 Radiated test setups Above 1GHz



7.3 AC Power Line Conducted Emission test setups



7.4 Conducted RF test setups



8 Emission Test Results

8.1 Spurious Radiated Emission

EUT: QTM-AGP10
Op Condition: Operated, TX Mode
(Middle channel is the worst case)
Test Specification: FCC15.205, 15.209 & 15.247(d)
Comment: 56VDC
Remark: Below 1GHz, Internal Antenna Chain

Test Result
☒ Passed
☐ Not Passed

Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Detector PK/QP/AV	Ant. Polarity H/V	Corr. (dB)
49.278750	19.64	40.00	20.36	Peak	H	20.96
93.231875	18.18	43.50	25.32	Peak	H	17.90
201.083750	19.90	43.50	23.60	Peak	H	19.21
349.978750	27.22	46.00	18.78	Peak	H	23.50
391.203750	31.79	46.00	14.21	Peak	H	24.02
449.706875	33.10	46.00	12.90	Peak	H	25.22
32.121875	24.94	40.00	15.06	Peak	V	17.16
58.433125	22.04	40.00	17.96	Peak	V	20.26
103.538125	20.08	43.50	23.42	Peak	V	19.39
199.992500	23.68	43.50	19.82	Peak	V	19.34
397.569375	26.73	46.00	19.27	Peak	V	24.10
927.128750	33.89	46.00	12.11	Peak	V	32.67

Remark:
1. As the measured peak value not exceeded the Quasi-peak limit, Quasi-peak value no need to be measured.
2. Result Level=Reading Level + Correction Factor
   Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
   Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
   (The Reading Level is recorded by software which is not shown in the sheet)
3. No obvious difference between 1Mbps mode data and 2Mbps mode data, therefore we shown here 2Mbps mode data.

Spurious Radiated Emission

EUT: QTM-AGP10
Op Condition: Operated, TX Mode (2402MHz)
Test Specification: FCC15.205, 15.209 & 15.247(d)
Comment: 56VDC
Remark: 1GHz to 25GHz, Internal Antenna Chain

Test Result
☒ Passed
☐ Not Passed

Frequency	Result	Limit	Margin	Detector	Ant. Polarity	Corr.
MHz	dBµV/m	dBµV/m	dB	PK/QP/AV	H/V	(dB)
1300.000000	38.46	74.00	35.54	Peak	H	-8.39
1983.500000	40.08	74.00	33.92	Peak	H	-4.75
3157.000000	45.27	74.00	28.73	Peak	H	-0.81
4767.500000	47.61	74.00	26.39	Peak	H	2.83
5557.500000	48.94	74.00	25.06	Peak	H	4.37
1236.500000	38.48	74.00	35.52	Peak	V	-8.77
1931.000000	40.21	74.00	33.79	Peak	V	-4.72
3057.000000	43.43	74.00	30.57	Peak	V	-0.89
4568.000000	45.95	74.00	28.05	Peak	V	2.33
9837.500000	42.79	74.00	31.21	Peak	V	11.42

Remark:
1. According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in data table if the peak value complies with average limit.
2. Consequence Level=Reading Level + Correction Factor
   Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
   Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
   (The Reading Level is recorded by software which is not shown in the sheet)
3. No obvious difference between 1Mbps mode data and 2Mbps mode data, therefore we shown here 2Mbps mode data.

China

Spurious Radiated Emission

EUT: QTM-AGP10
Op Condition: Operated, TX Mode (2440MHz)
Test Specification: FCC15.205, 15.209 & 15.247(d)
Comment: 56VDC
Remark: 1GHz to 25GHz, Internal Antenna Chain

Test Result
☒ Passed
☐ Not Passed

Frequency	Result	Limit	Margin	Detector	Ant. Polarity	Corr.
MHz	dBµV/m	dBµV/m	dB	PK/QP/AV	H/V	(dB)
1257.500000	37.87	74.00	36.13	Peak	H	-8.63
1954.500000	40.77	74.00	33.24	Peak	H	-4.80
2985.000000	44.18	74.00	29.82	Peak	H	-1.38
4405.000000	46.35	74.00	27.65	Peak	H	2.04
9851.500000	43.88	74.00	30.12	Peak	H	11.66
1262.000000	36.86	74.00	37.14	Peak	V	-8.63
1832.500000	41.20	74.00	32.80	Peak	V	-5.70
3191.500000	44.00	74.00	30.00	Peak	V	-0.87
4527.500000	46.87	74.00	27.13	Peak	V	2.22
5781.500000	51.48	74.00	22.52	Peak	V	4.58

Remark:
1. According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in data table if the peak value complies with average limit.
2. Consequence Level=Reading Level + Correction Factor
   Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
   Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
   (The Reading Level is recorded by software which is not shown in the sheet)
3. No obvious difference between 1Mbps mode data and 2Mbps mode data, therefore we shown here 2Mbps mode data

China

Spurious Radiated Emission

EUT: QTM-AGP10
Op Condition: Operated, TX Mode (2480MHz)
Test Specification: FCC15.205, 15.209 & 15.247(d)
Comment: 56VDC
Remark: 1GHz to 25GHz, Internal Antenna Chain

Test Result
☒ Passed
☐ Not Passed

Frequency	Result	Limit	Margin	Detector	Ant. Polarity	Corr.
MHz	dBµV/m	dBµV/m	dB	PK/QP/AV	H/V	(dB)
1314.000000	37.95	74.00	36.05	Peak	H	-8.50
1863.500000	40.49	74.00	33.51	Peak	H	-5.42
3161.500000	44.74	74.00	29.26	Peak	H	-0.80
4108.500000	46.38	74.00	27.62	Peak	H	1.00
5379.000000	49.22	74.00	24.78	Peak	H	3.97
1314.000000	37.56	74.00	36.44	Peak	V	-8.50
1999.000000	40.38	74.00	33.62	Peak	V	-4.74
3188.500000	44.56	74.00	29.44	Peak	V	-0.86
4590.500000	46.30	74.00	27.70	Peak	V	2.40
5926.500000	48.62	74.00	25.38	Peak	V	4.93

Remark:
1. According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in data table if the peak value complies with average limit.
2. Consequence Level=Reading Level + Correction Factor
   Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
   Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
   (The Reading Level is recorded by software which is not shown in the sheet)
3. No obvious difference between 1Mbps mode data and 2Mbps mode data, therefore we shown here 2Mbps mode data

China

Spurious Radiated Emission

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode (Middle channel is the worst case)
Test Specification:	FCC15.205, 15.209 & 15.247(d)
Comment:	56VDC
Remark:	Below 1GHz, External Antenna Chain

Test Result
☒ Passed
☐ Not Passed

Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Detector PK/QP/AV	Ant. Polarity H/V	Corr. (dB)
47.641875	19.81	40.00	20.19	Peak	H	20.74
100.143125	19.54	43.50	23.96	Peak	H	19.09
167.982500	22.39	43.50	21.11	Peak	H	16.50
241.702500	25.64	46.00	20.36	Peak	H	20.39
273.470000	31.77	46.00	14.23	Peak	H	20.94
948.286875	34.16	46.00	11.85	Peak	H	32.70
31.030625	23.06	40.00	16.94	Peak	V	17.12
53.946875	19.56	40.00	20.44	Peak	V	20.90
167.982500	22.06	43.50	21.44	Peak	V	16.50
257.586250	24.26	46.00	21.74	Peak	V	20.62
418.485000	29.48	46.00	16.52	Peak	V	24.69
831.220000	35.58	46.00	10.42	Peak	V	31.03

Remark:

4. As the measured peak value not exceeded the Quasi-peak limit, Quasi-peak value no need to be measured.
5. Result Level=Reading Level + Correction Factor
   Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
   Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
   (The Reading Level is recorded by software which is not shown in the sheet)
6. No obvious difference between 1Mbps mode data and 2Mbps mode data, therefore we shown here 2Mbps mode data.

Spurious Radiated Emission

EUT: QTM-AGP10
Op Condition: Operated, TX Mode (2402MHz)
Test Specification: FCC15.205, 15.209 & 15.247(d)
Comment: 56VDC
Remark: 1GHz to 25GHz, External Antenna Chain

Test Result
☒ Passed
☐ Not Passed

Frequency	Result	Limit	Margin	Detector	Ant. Polarity	Corr.
MHz	dBµV/m	dBµV/m	dB	PK/QP/AV	H/V	(dB)
1302.500000	37.56	74.00	36.44	Peak	H	-8.41
2219.500000	42.49	74.00	31.51	Peak	H	-3.87
2968.500000	45.75	74.00	28.25	Peak	H	-1.48
4434.000000	47.24	74.00	26.76	Peak	H	2.04
9438.500000	44.07	74.00	29.93	Peak	H	9.81
1258.500000	37.39	74.00	36.61	Peak	V	-8.63
1861.500000	40.83	74.00	33.17	Peak	V	-5.44
3238.000000	44.68	74.00	29.32	Peak	V	-0.99
5203.000000	48.39	74.00	25.61	Peak	V	3.78
9830.500000	43.02	74.00	30.98	Peak	V	11.31

Remark:
4. According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in data table if the peak value complies with average limit.
5. Consequence Level=Reading Level + Correction Factor
   Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
   Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
   (The Reading Level is recorded by software which is not shown in the sheet)
6. No obvious difference between 1Mbps mode data and 2Mbps mode data, therefore we shown here 2Mbps mode data.

Spurious Radiated Emission

EUT: QTM-AGP10
Op Condition: Operated, TX Mode (2440MHz)
Test Specification: FCC15.205, 15.209 & 15.247(d)
Comment: 56VDC
Remark: 1GHz to 25GHz, External Antenna Chain

Test Result
☒ Passed
☐ Not Passed

Frequency	Result	Limit	Margin	Detector	Ant. Polarity	Corr.
MHz	dBµV/m	dBµV/m	dB	PK/QP/AV	H/V	(dB)
1398.000000	42.58	74.00	31.42	Peak	H	-9.09
1905.500000	40.42	74.00	33.58	Peak	H	-4.89
4787.500000	46.90	74.00	27.10	Peak	H	2.81
7715.000000	41.08	74.00	32.92	Peak	H	8.23
9841.000000	44.57	74.00	29.43	Peak	H	11.48
1325.000000	38.81	74.00	35.19	Peak	V	-8.58
1972.000000	42.14	74.00	31.86	Peak	V	-4.74
4875.500000	46.16	74.00	27.84	Peak	V	3.36
10283.000000	44.05	74.00	29.95	Peak	V	10.68
16654.000000	47.67	74.00	26.33	Peak	V	19.18

Remark:

4. According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in data table if the peak value complies with average limit.
5. Consequence Level=Reading Level + Correction Factor
   Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
   Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
   (The Reading Level is recorded by software which is not shown in the sheet)
6. No obvious difference between 1Mbps mode data and 2Mbps mode data, therefore we shown here 2Mbps mode data

Spurious Radiated Emission

EUT: QTM-AGP10
Op Condition: Operated, TX Mode (2480MHz)
Test Specification: FCC15.205, 15.209 & 15.247(d)
Comment: 56VDC
Remark: 1GHz to 25GHz, External Antenna Chain

Test Result
☒ Passed
☐ Not Passed

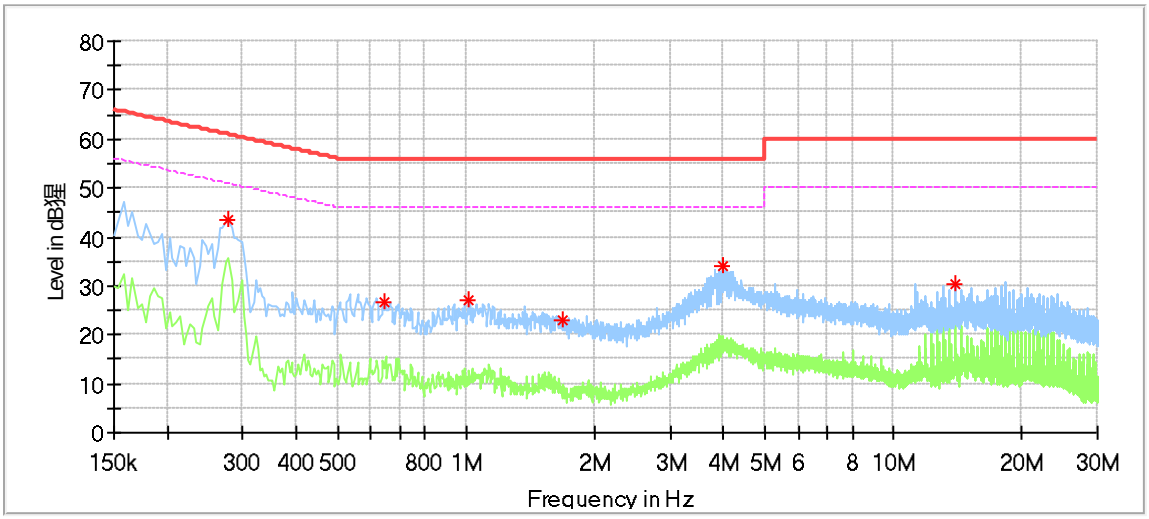
Frequency	Result	Limit	Margin	Detector	Ant. Polarity	Corr.
MHz	dBµV/m	dBµV/m	dB	PK/QP/AV	H/V	(dB)
1251.000000	36.71	74.00	37.29	Peak	H	-8.73
1915.500000	41.13	74.00	32.87	Peak	H	-4.81
3072.000000	44.08	74.00	29.92	Peak	H	-0.95
5039.000000	46.34	74.00	27.66	Peak	H	3.14
9837.000000	43.66	74.00	30.34	Peak	H	11.41
4880.000000	46.44	74.00	-10.99	Peak	V	-2.76
5892.500000	49.85	74.00	27.56	Peak	V	3.33
7487.000000	38.82	74.00	24.15	Peak	V	4.96
9896.500000	42.95	74.00	35.18	Peak	V	7.78
14582.000000	45.60	74.00	31.05	Peak	V	11.21

Remark:
4. According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in data table if the peak value complies with average limit.
5. Consequence Level=Reading Level + Correction Factor
   Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
   Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
   (The Reading Level is recorded by software which is not shown in the sheet)
6. No obvious difference between 1Mbps mode data and 2Mbps mode data, therefore we shown here 2Mbps mode data

8.2 Conducted Emission at AC Power line

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode
Test Specification:	FCC15.207
Comment:	AC mains, 120V AC, 60Hz, L line, Powered by DC supply, External antenna chain
Remark:	This is the worst case of the three power supply modes This is the worst case of the two antennas chain modes

Test Result
☒ Passed
☐ Not Passed



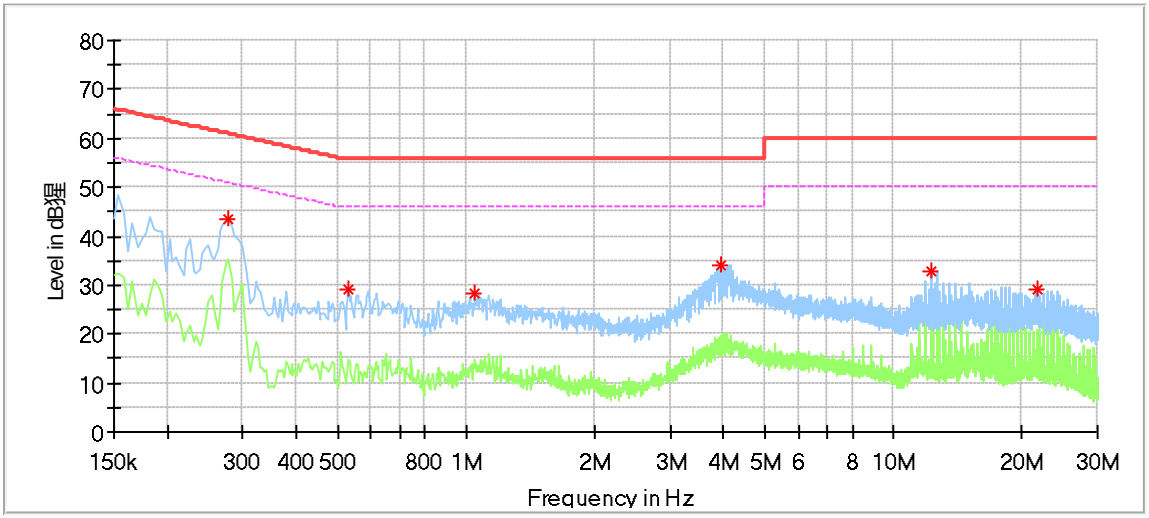
Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Corr. (dB)
0.278000	43.57	---	60.88	17.31	9.22
0.646000	26.49	---	56.00	29.51	9.20
1.018000	27.10	---	56.00	28.90	9.20
1.690000	22.99	---	56.00	33.01	9.22
4.002000	34.06	---	56.00	21.94	9.28
13.974000	30.51	---	60.00	29.49	9.39

China

Conducted Emission Test

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode
Test Specification:	FCC15.207
Comment:	AC mains, 120V AC, 60Hz, N Line, Powered by DC supply, External antenna chain
Remark:	This is the worst case of the three power supply modes This is the worst case of the two antennas chain modes

Test Result
☒ Passed
☐ Not Passed

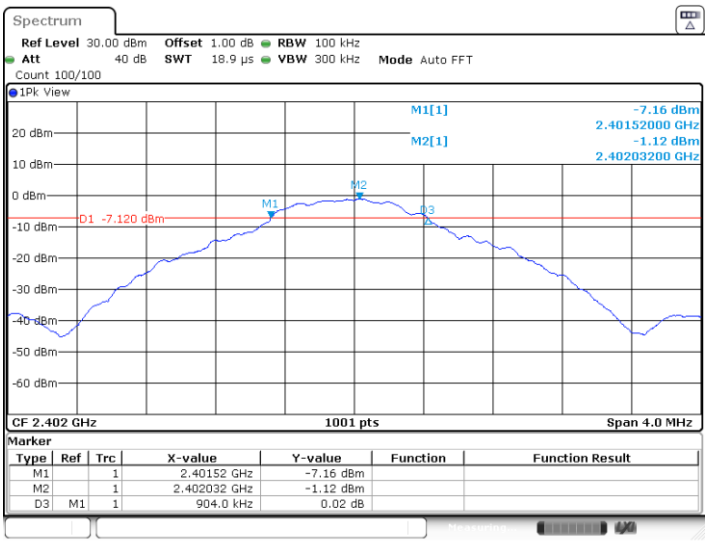


Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Corr. (dB)
0.278000	43.63	---	60.88	17.25	9.39
0.530000	29.00	---	56.00	27.00	9.40
1.046000	28.48	---	56.00	27.52	9.39
3.934000	34.19	---	56.00	21.81	9.47
12.282000	33.01	---	60.00	26.99	9.62
21.666000	29.00	---	60.00	31.00	9.80

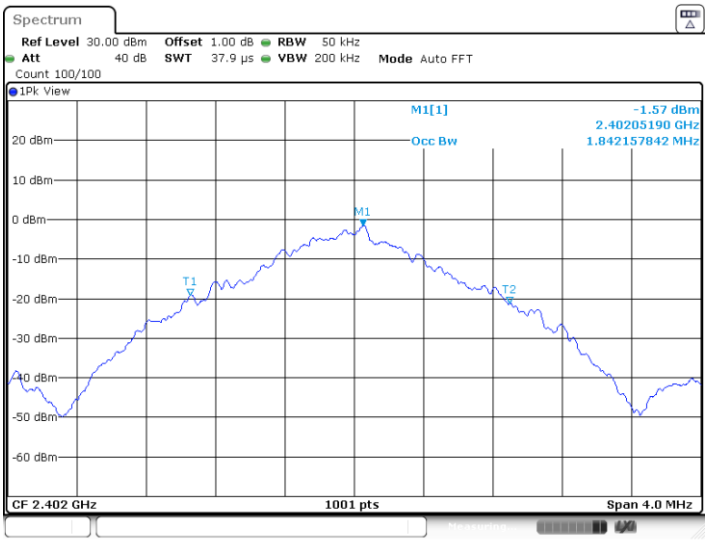
8.3 6dB & 99% Bandwidth

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode (2402MHz)
Test Specification:	FCC15.247(a)(2), 6dB Bandwidth & 99% Bandwidth
Comment:	56VDC

Test Result
☒ Passed
☐ Not Passed



Date: 25.JAN.2022 16:46:56



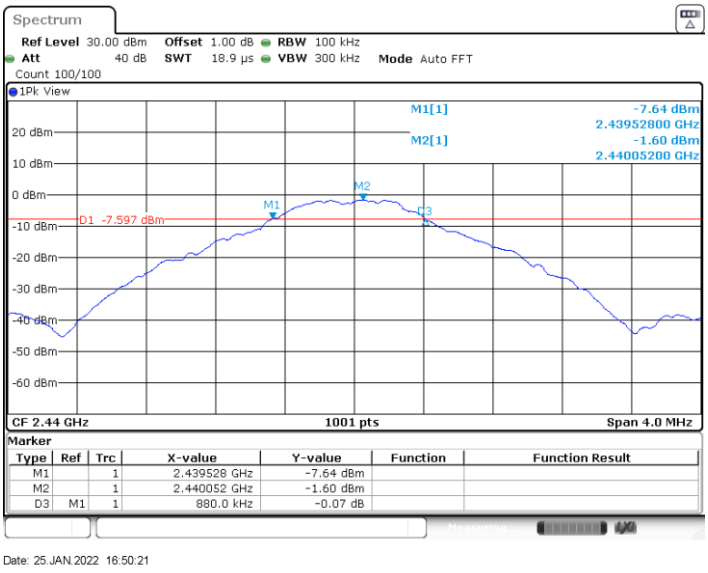
Date: 25.JAN.2022 16:47:06

Bandwidth	Measured Value	Limit
6dB bandwidth	0.904 MHz	> 0.5MHz
99% OCB	1.842 MHz	NA

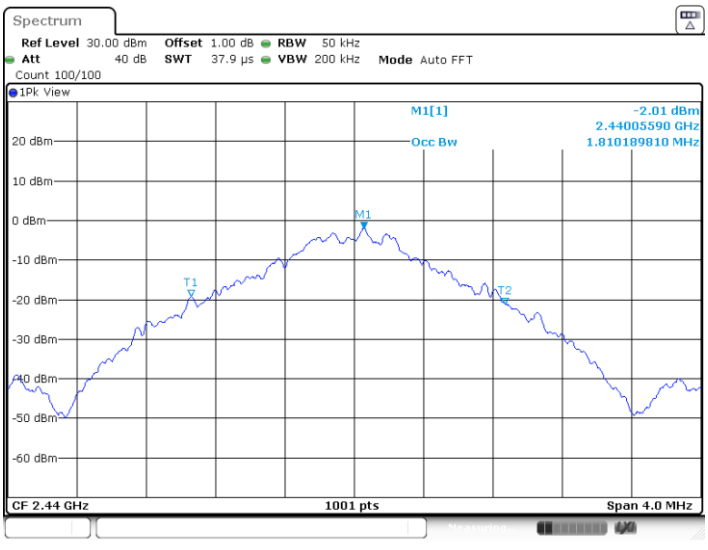
6dB & 99% Bandwidth

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode (2440MHz)
Test Specification:	FCC15.247(a)(2), 6dB Bandwidth & 99% Bandwidth
Comment:	56VDC

Test Result
☒ Passed
☐ Not Passed



Date: 25.JAN.2022 16:50:21



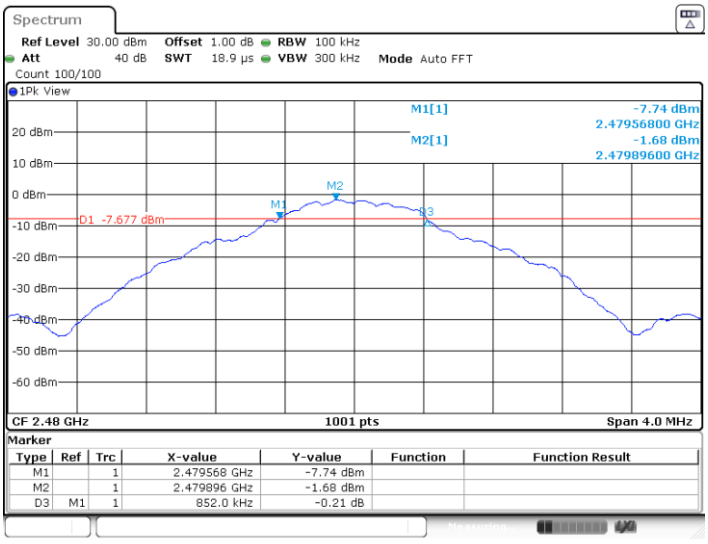
Date: 25.JAN.2022 16:50:31

Bandwidth	Measured Value	Limit
6dB bandwidth	0.880 MHz	> 0.5 MHz
99% OCB	1.810 MHz	NA

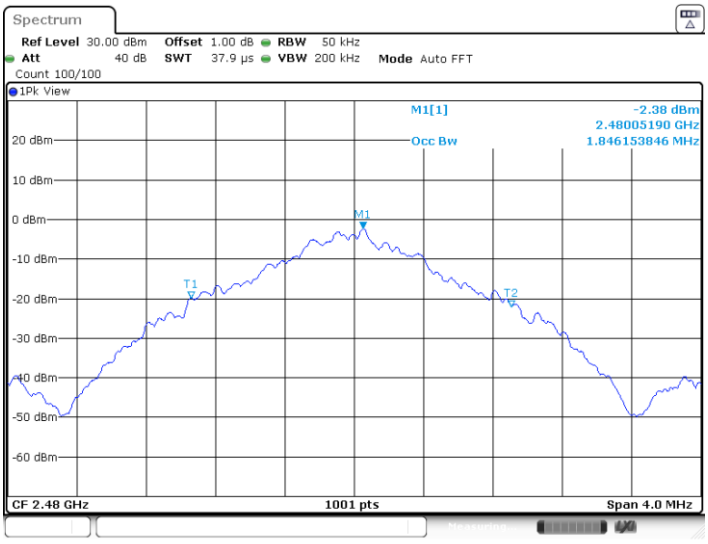
6dB & 99% Bandwidth

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode (2480MHz)
Test Specification:	FCC15.247(a)(2), 6dB Bandwidth & 99% Bandwidth
Comment:	56VDC

Test Result
☒ Passed
☐ Not Passed



Date: 25.JAN.2022 16:52:09



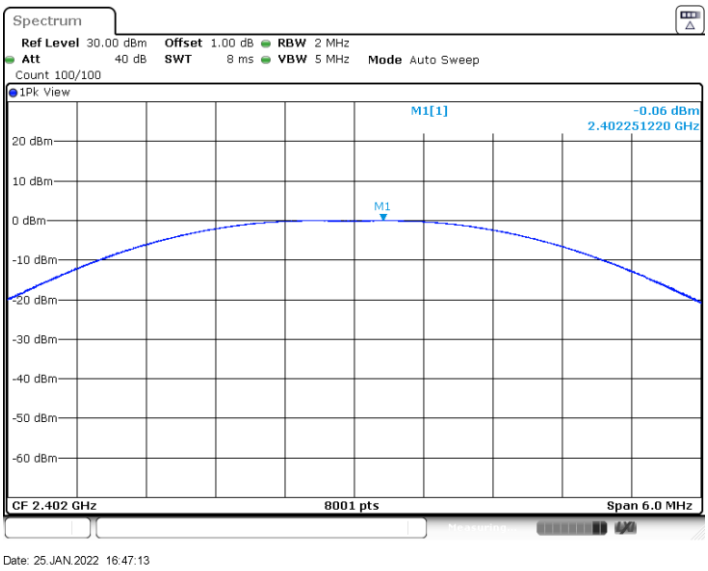
Date: 25.JAN.2022 16:52:19

Bandwidth	Measured Value	Limit
6dB bandwidth	0.852 MHz	> 0.5 MHz
99% OCB	1.846 MHz	NA

8.4 Peak Output Power

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode (2402MHz)
Test Specification:	FCC15.247(b)
Comment:	56VDC

Test Result
☒ Passed
☐ Not Passed

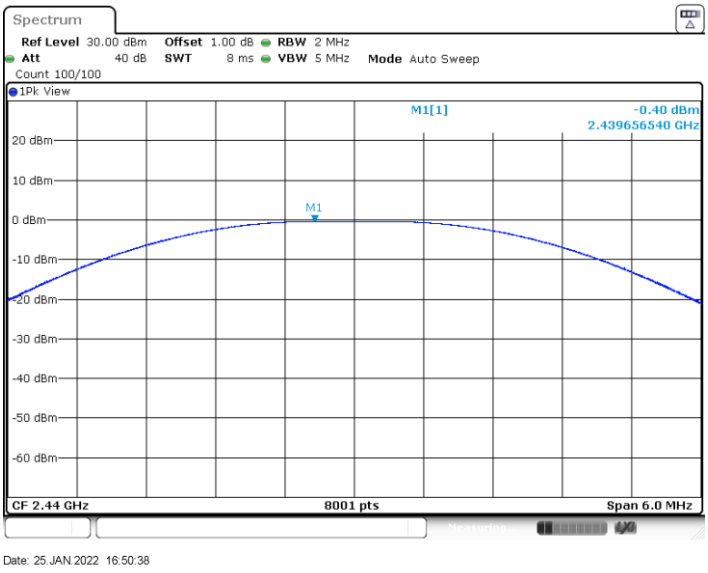


Conducted Output Power	Limit
-0.06 dBm	< 30dBm

Peak Output Power

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode (2440MHz)
Test Specification:	FCC15.247(b)
Comment:	56VDC

Test Result
☒ Passed
☐ Not Passed

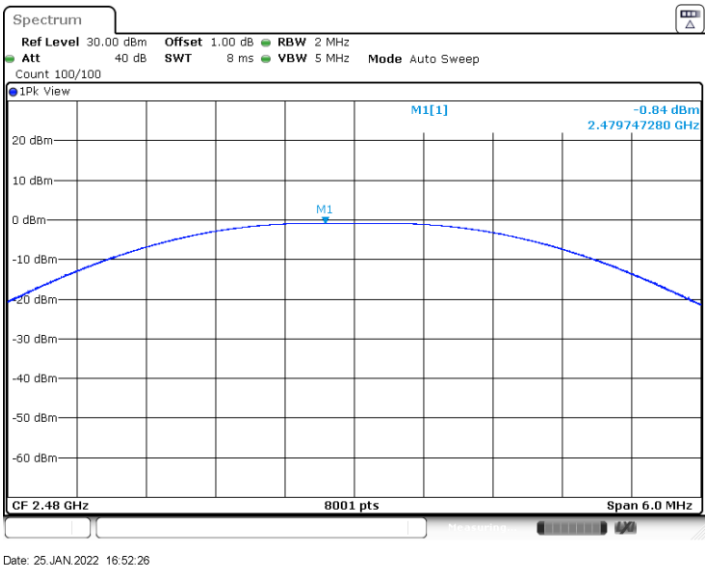


Conducted Output Power	Limit
-0.40 dBm	< 30dBm

Peak Output Power

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode (2480MHz)
Test Specification:	FCC15.247(b)
Comment:	56VDC

Test Result
☒ Passed
☐ Not Passed



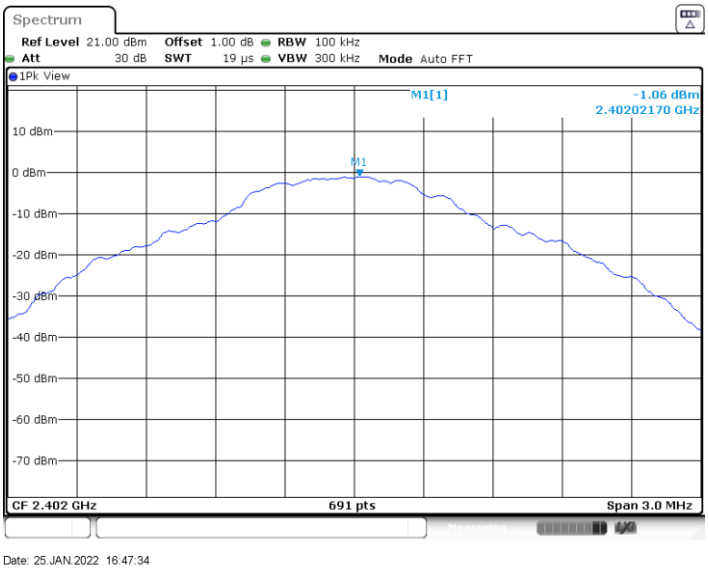
Conducted Output Power	Limit
-0.84 dBm	< 30dBm

8.5 Spurious Emissions at Antenna Terminals

EUT: QTM-AGP10
Op Condition: Operated, TX Mode (2402MHz)
Test Specification: FCC2.1051 & 15.247(d)
Comment: 56VDC

Test Result
☒ Passed
☐ Not Passed

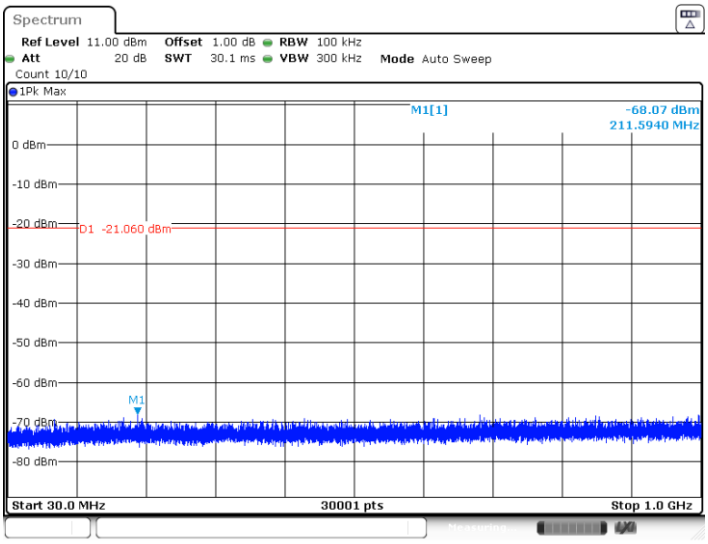
Channel	FreqRange MHz	RefLevel dBm	Result dBm	Limit dBm	Verdict
2402	2402	-1.06	-1.06	---	PASS
2402	30~1000	-1.06	-68.07	<=-21.06	PASS
2402	1000~26500	-1.06	-31.61	<=-21.06	PASS



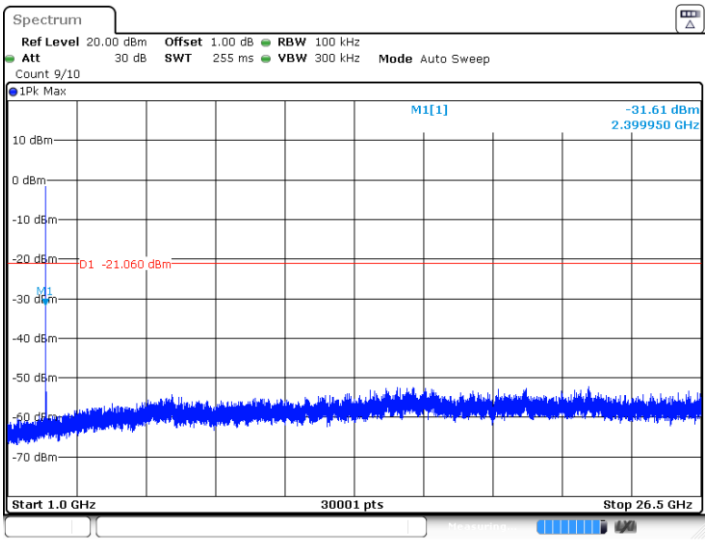
Spurious Emissions at Antenna Terminals

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode (2402MHz)
Test Specification:	FCC2.1051 & 15.247(d)
Comment:	56VDC

Test Result
☒ Passed
☐ Not Passed



Date: 25.JAN.2022 16:47:40



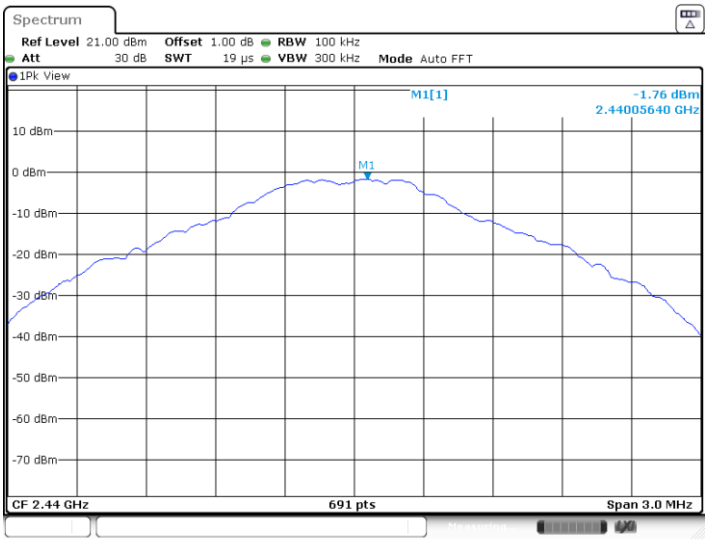
Date: 25.JAN.2022 16:47:48

Spurious Emissions at Antenna Terminals

EUT: QTM-AGP10
Op Condition: Operated, TX Mode (2440MHz)
Test Specification: FCC2.1051 & 15.247(d)
Comment: 56VDC

Test Result
☒ Passed
☐ Not Passed

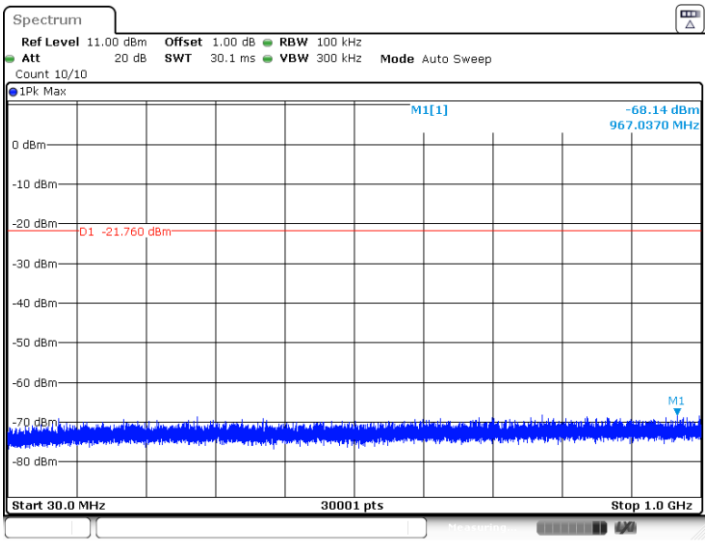
Channel	FreqRange MHz	RefLevel dBm	Result dBm	Limit dBm	Verdict
2440	2440	-1.76	-1.76	---	PASS
2440	30~1000	-1.76	-68.14	<=-21.76	PASS
2440	1000~26500	-1.76	-52.36	<=-21.76	PASS



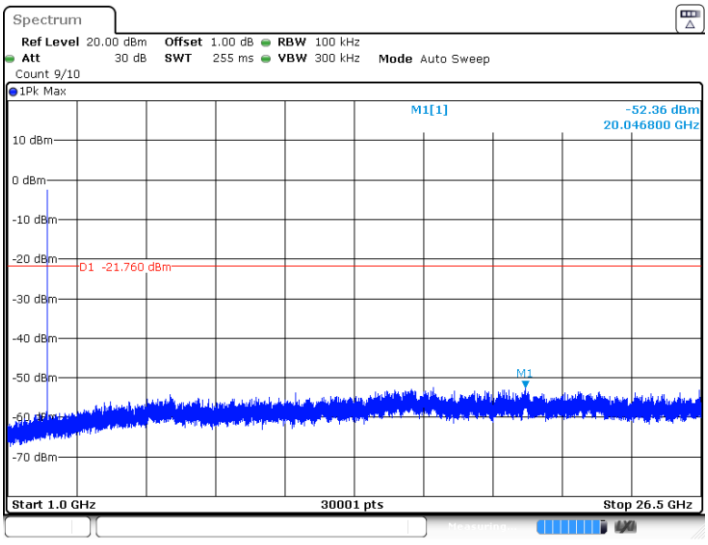
Spurious Emissions at Antenna Terminals

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode (2440MHz)
Test Specification:	FCC2.1051 & 15.247(d)
Comment:	56VDC

Test Result
☒ Passed
☐ Not Passed



Date: 25.JAN.2022 16:50:55



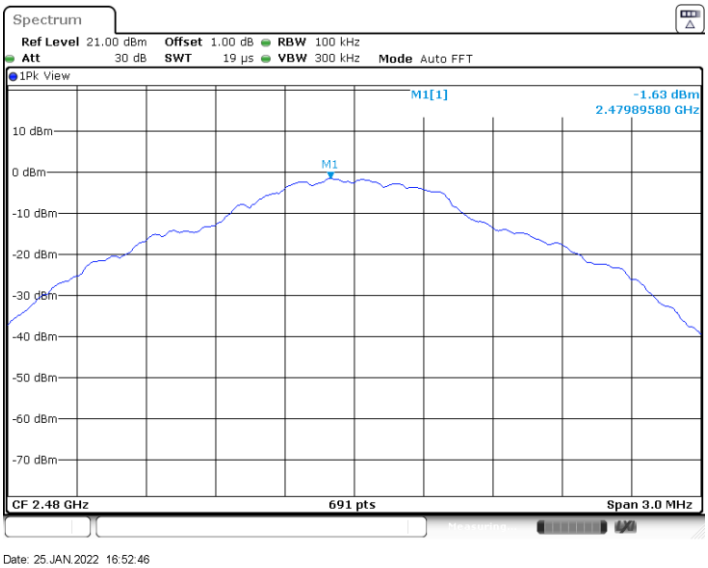
Date: 25.JAN.2022 16:51:03

Spurious Emissions at Antenna Terminals

EUT: QTM-AGP10
Op Condition: Operated, TX Mode (2480MHz)
Test Specification: FCC2.1051 & 15.247(d)
Comment: 56VDC

Test Result
☒ Passed
☐ Not Passed

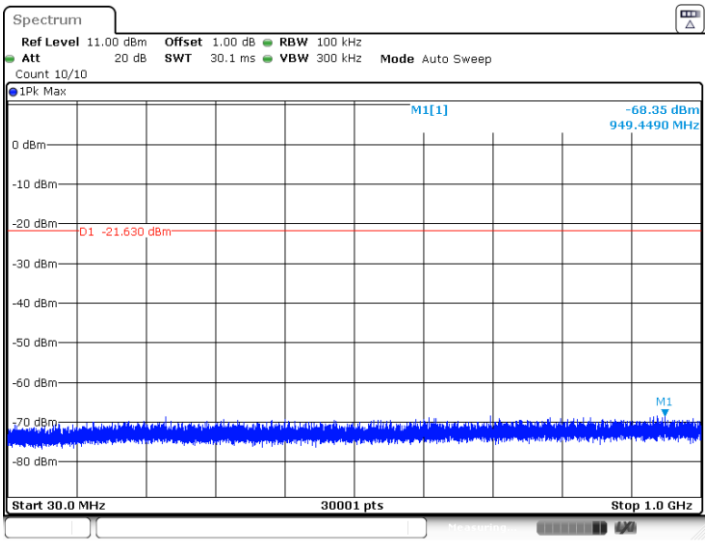
Channel	FreqRange MHz	RefLevel dBm	Result dBm	Limit dBm	Verdict
2480	2480	-1.63	-1.63	---	PASS
2480	30~1000	-1.63	-68.35	<=-21.63	PASS
2480	1000~26500	-1.63	-51.37	<=-21.63	PASS



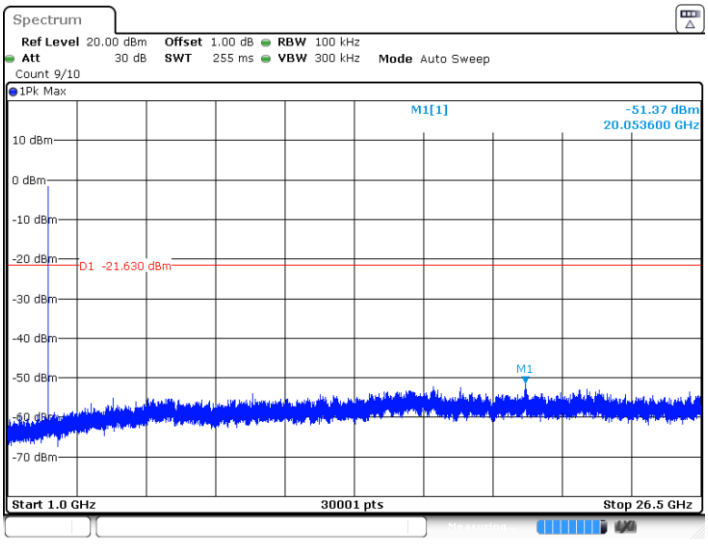
Spurious Emissions at Antenna Terminals

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode (2480MHz)
Test Specification:	FCC2.1051 & 15.247(d)
Comment:	56VDC

Test Result
☒ Passed
☐ Not Passed



Date: 25.JAN.2022 16:52:52

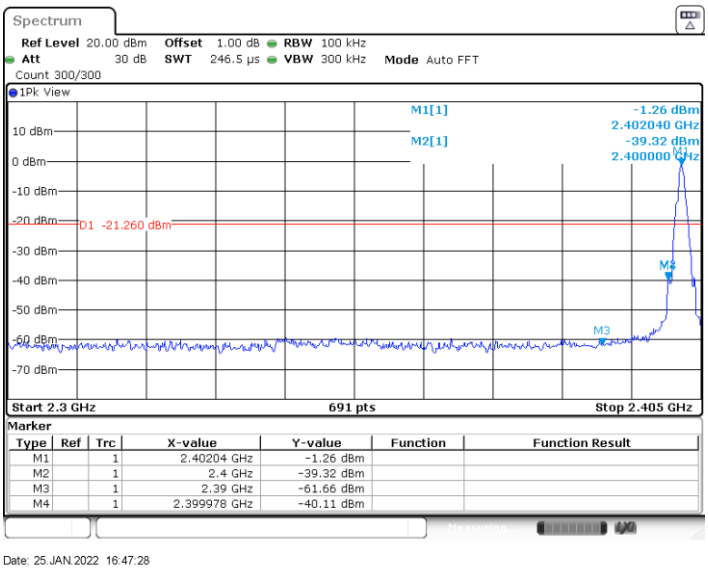


Date: 25.JAN.2022 16:53:00

8.6 100kHz Bandwidth of band edges

EUT: QTM-AGP10
Op Condition: Operated, TX Mode (2402MHz)
Test Specification: FCC15.247(d), Conducted
Comment: 56VDC

Test Result
☒ Passed
☐ Not Passed



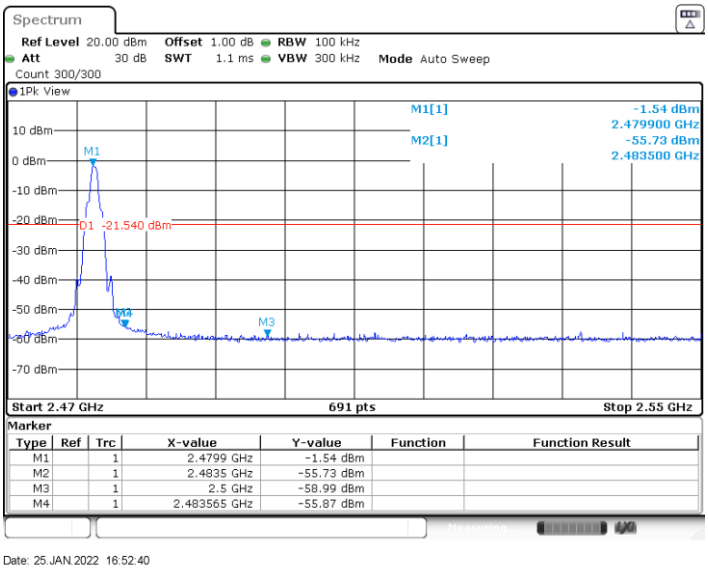
Band edges	Limit
38.06 dB	> 20dB

China

100kHz Bandwidth of band edges

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode (2480MHz)
Test Specification:	FCC15.247(d), Conducted
Comment:	56VDC

Test Result
☒ Passed
☐ Not Passed

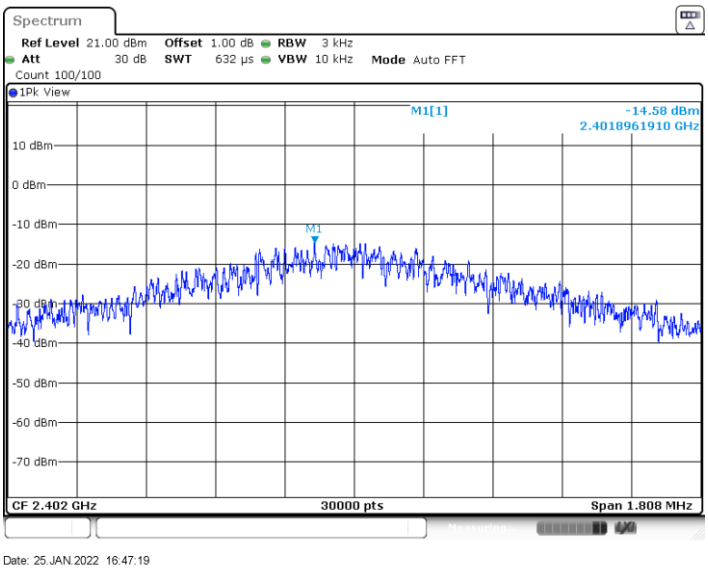


Band edges	Limit
54.19 dB	> 20dB

8.7 Power Spectral Density

EUT: QTM-AGP10
Op Condition: Operated, TX Mode (2402MHz)
Test Specification: FCC15.247(e)
Comment: 56VDC

Test Result
☒ Passed
☐ Not Passed

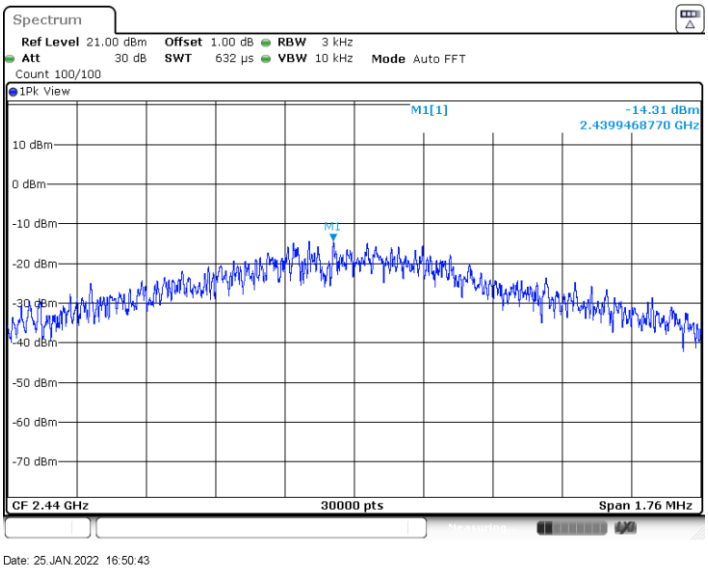


PSD	Limit
-14.58 dBm/3kHz	< 8 dBm/3kHz

Power Spectral Density

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode (2440MHz)
Test Specification:	FCC15.247(e)
Comment:	56VDC

Test Result
☒ Passed
☐ Not Passed

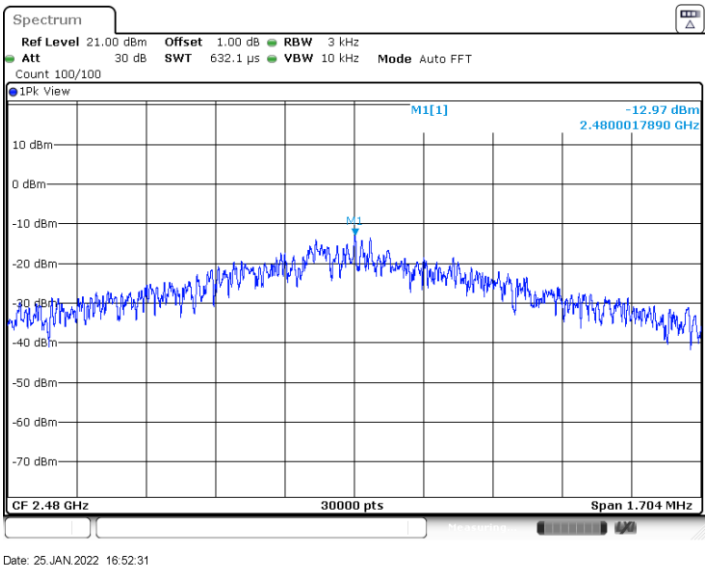


PSD	Limit
-14.31 dBm/3kHz	< 8 dBm/3kHz

Power Spectral Density

EUT: QTM-AGP10
Op Condition: Operated, TX Mode (2480MHz)
Test Specification: FCC15.247(e)
Comment: 56VDC

Test Result
☒ Passed
☐ Not Passed



PSD	Limit
-12.97 dBm/3kHz	< 8 dBm/3kHz

8.8 Antenna Requirement

EUT:	QTM-AGP10
Op Condition:	Operated, TX Mode
Test Specification:	FCC15.203 & 15.247(b)
Comment:	56VDC

Test Result
☒ Passed
☐ Not Passed

Limit

For intentional device, according to FCC Title 47 Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC Title 47 Part 15.247(b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

There are two antenna chains, the external antenna is antenna with non-standard SMA connector, the maximum gain of this it is 2.0 dBi. The internal antenna is SMD on-board antenna, the maximum gain of it is 5.2 dBi. So EUT fulfill with 15.203 requirements.

9 Test setup procedure

9.1 Spurious Radiated Emission

Test Method

1: The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3: The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4: For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5: Use the following spectrum analyzer settings According to C63.10:
For Below 1GHz
Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 100 KHz to 120KHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Peak unwanted emissions Above 1GHz:

Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 1MHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.
Procedures for average unwanted emissions measurements above 1000 MHz
a) RBW = 1MHz.
b) VBW \ [3 × RBW].
c) Detector = RMS (power averaging), if [span / (# of points in sweep)] \ RBW / 2. Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
e) Sweep time = auto.
f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of 1 / D, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:

1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is [10 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.
2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is [20 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.
3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Limit

The radio emission outside the operating frequency band shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Radiated emissions which fall in the restricted bands, as defined in section RSS-GEN 8.10, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

9.2 Conducted Emission at AC Power line

Test Method

1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. A EMI test receiver is used to test the emissions from both sides of AC line

Limit

According to §15.207 & RSS-GEN 8.8, conducted emissions limit as below:

Frequency MHz	QP Limit dBµV	AV Limit dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Remark: "*" Decreasing linearly with logarithm of the frequency

9.3 6dB & 99% Bandwidth

Test Method

1. Use the following spectrum analyzer settings:
RBW=100K, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, may be employed using the X dB bandwidth mode with X set to 6 dB, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

Limit

Limit [kHz]
≥500

9.4 Peak Output Power

Test Method

1. Connect the spectrum analyzer to the EUT
   a) The EUT is configured to transmit continuously, or to transmit with a constant duty factor.
   b) At all times the EUT is transmitting at its maximum power control level.
   c) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
2. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
3. Adjust the measurement in dBm by adding 10log (1/x), where x is the duty cycle to the measurement result.

Limits

According to §15.247 (b) (1) & RSS-247 5.4(d), conducted peak output power limit as below:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

For e.i r.p:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤4	≤30

9.5 Spurious Emissions at Antenna Terminals

Test Method

1. Establish a reference level by using the following procedure:
   a. Set RBW=100 kHz. VBW≥3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
   b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
2. Use the maximum PSD level to establish the reference level.
   a. Set the center frequency and span to encompass frequency range to be measured.
   b. Use the peak marker function to determine the maximum amplitude level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements, report the three highest emissions relative to the limit.
3. Repeat above procedures until other frequencies measured were completed.

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

9.6 100kHz Bandwidth of band edges

Test Method

1 Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW≥RBW, Sweep = auto, Detector function = peak, Trace = max hold.
2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
3 The level displayed must comply with the limit specified in this Section.

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

9.7 Power Spectral Density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW≥3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
2. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
3. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm/3KHz]
≤8

10 Appendix A - General Product Information

Radiofrequency radiation exposure evaluation

This exposure evaluation is intended for **FCC ID: 2AX6LQTMAGP10**

According to FCC CFR 47 part1 §1.1310, Part 2 §2.1091, and KDB447498 D01 General RF Exposure Guidance v06, As specified in Table 1B of 47 CFR 1.1310 – Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	$*180/f^2$	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

MPE calculation method:
Pd = (P*G) / (4*Pi* R^2), where
Pd = power density in mW/cm^2
P = output power to antenna in mW
G = gain of antenna in linear scale
Pi = 3.1416
R= calculation distance in cm

>> The limit of Power density in 2402-2480MHz band is 1 mW/cm^2

>> The external antenna gain is 2.0dBi (=1.58 in linear scale).
The internal antenna gain is 5.2dBi (=3.31 in linear scale).
Manufacturer specified the separation distance is: 20cm
The max. power (calculated power + tune up tolerance) of EUT in 2402-2483.5MHz band is: 0.99mW

>> The calculated Pd for the EUT in 2402-2480MHz band is 0.00065mW/cm^2

Which is smaller than the threshold of the limit.
Therefore, the device is exempt from stand-alone SAR test requirements.

China

Calculated Data

Maximum peak output power at antenna input terminal (dBm):	**-0.06**
Maximum peak output power at antenna input terminal (mW):	**0.99**
Prediction distance (cm):	**20**
Antenna Gain, typical (dBi): External Antenna:	**2.0**
Maximum Antenna Gain (numeric): External Antenna:	**1.58**
Antenna Gain, typical (dBi): Internal Antenna:	**5.2**
Maximum Antenna Gain (numeric): Internal Antenna:	**3.31**
The worst case is power density at predication frequency at 20 cm (mW/cm2):	**0.00065**

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