



FCC- TEST REPORT

Report Number : **64.790.20.05491.01** Date of Issue: January 7, 2021

Model : TREKC1

Product Type : Temperature Data logger

Applicant : Parsyl Inc.

Manufacturer : Parsyl Inc.

Address : 2825 Larimer Street, Denver CO 80205 USA

Test Result : **Positive** **Negative**

Total pages including
Appendices : 29

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2 Details about the Test Laboratory

Details about the Test Laboratory

Test 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, Nanshan District,
Shenzhen City, 518052,
P. R. China

FCC Registration Number: 514049

IC Registration Number: 10320A

Telephone: 86 755 8828 6998
Fax: 86 755 828 5299

3 Description of the Equipment under Test

Product: Temperature Data logger

Model no.: TREKC1

FCC ID: 2AQ8LTREKC1

Battery type: 3V, CR2032

Operating Frequency Range: 2402~2480MHz

Modulation: GFSK

Antenna Type: PCB Antenna

Antenna Gain: 2.23dBi

Description of the EUT: EUT is a Temperature Data logger, 2.4GHz Bluetooth technology was used for communicating.

4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2020 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

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

5 Summary of Test Results

Technical Requirements				
FCC Part 15 Subpart C				
Test Condition		Pages	Test Result	Test Site
§15.207	Conducted emission AC power port	10	N/A	N/A
§15.247(b)(1)	Conducted peak output power	11-12	Pass	Site 1
§15.247(e)	Power spectral density	17-18	Pass	Site 1
§15.247(a)(2)	6dB bandwidth and 99% occupied bandwidth	13-16	Pass	Site 1
§15.247(d)	Spurious RF conducted emissions	19-22	Pass	Site 1
§15.247(d)	Band edge	23-24	Pass	Site 1
§15.247(d) & §15.209 & §15.205	Spurious radiated emissions for transmitter	25-27	Pass	Site 1
§15.203	Antenna requirement	See note 1	Pass	--

Note 1: The EUT uses an PCB Antenna, which gain is 2.23dBi. According to §15.203, it is considered sufficiently to comply with the provisions of this section.

6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2AQ8LTREKC1 complies with Section 15.247,15.209, 15.205 and 15.203 of the FCC Part 15, Subpart C.
This report is for the BLE part.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

□ - **Not** Performed

The Equipment under Test

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

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

Sample Received Date: November 9, 2020

Testing Start Date: November 27, 2020

Testing End Date: December 15, 2020

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

Reviewed by:

Prepared by:

Tested by:



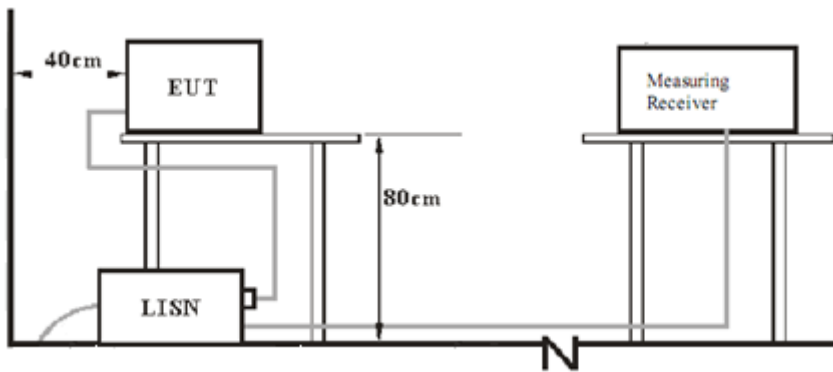
Peter Jia

Matt Zhang

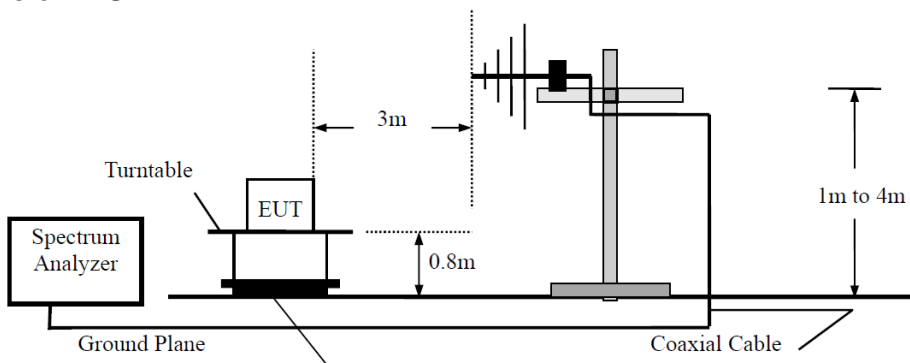
Tree Zhan

7 Test Setups

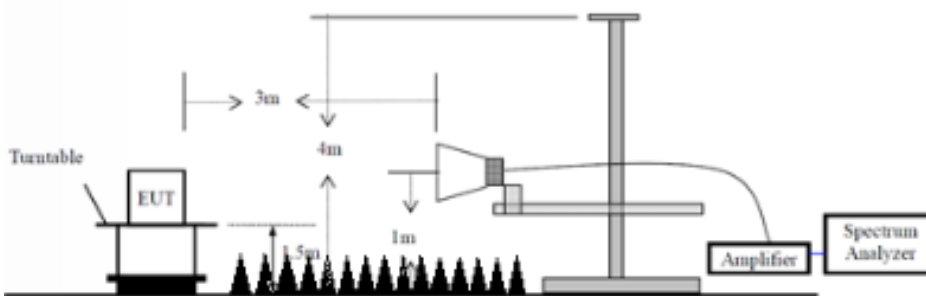
7.1 AC Power Line Conducted Emission test setups



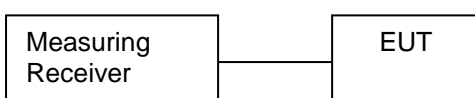
7.2 Radiated test setups Below 1GHz



Above 1GHz



7.3 Conducted RF test setups



8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
Laptop	Lenovo	X240	L34015282

9 Technical Requirement

9.1 Conducted Emission

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

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

* Decreasing linear

Test result: Not Performed

9.2 Conducted peak output power

Test Method

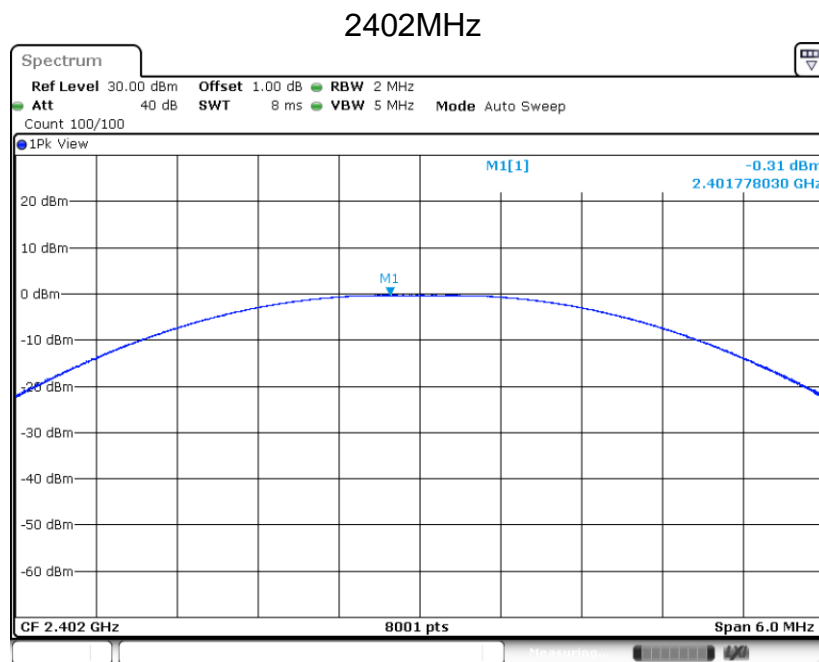
1. Use the following spectrum analyzer settings:
RBW > the 6 dB bandwidth of the emission being measured, VBW \geq 3RBW, Span \geq 3RBW
Sweep = auto, Detector function = peak, Trace = max hold.
2. Add a correction factor to the display.
3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

Limits

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

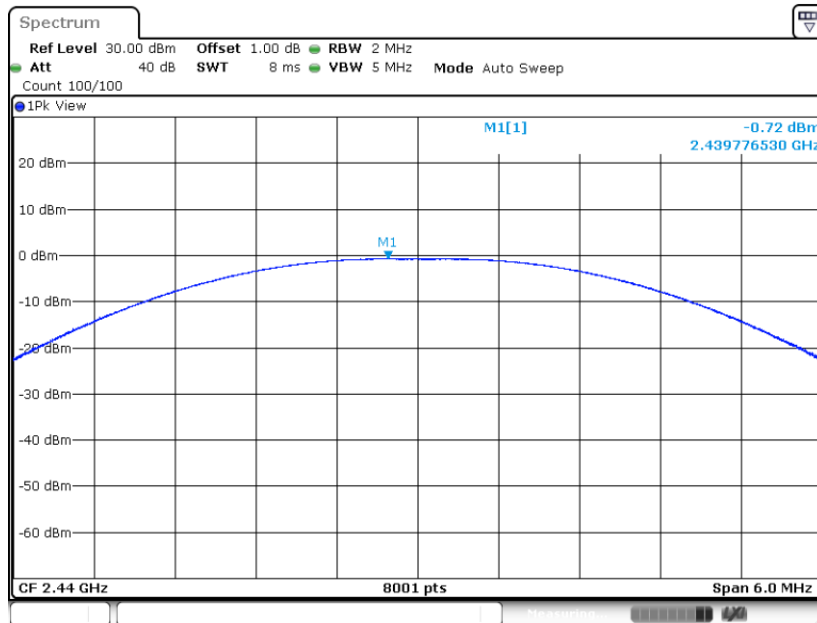
Test result as below table

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	-0.31	Pass
Middle channel 2440MHz	-0.72	Pass
High channel 2480MHz	-0.7	Pass



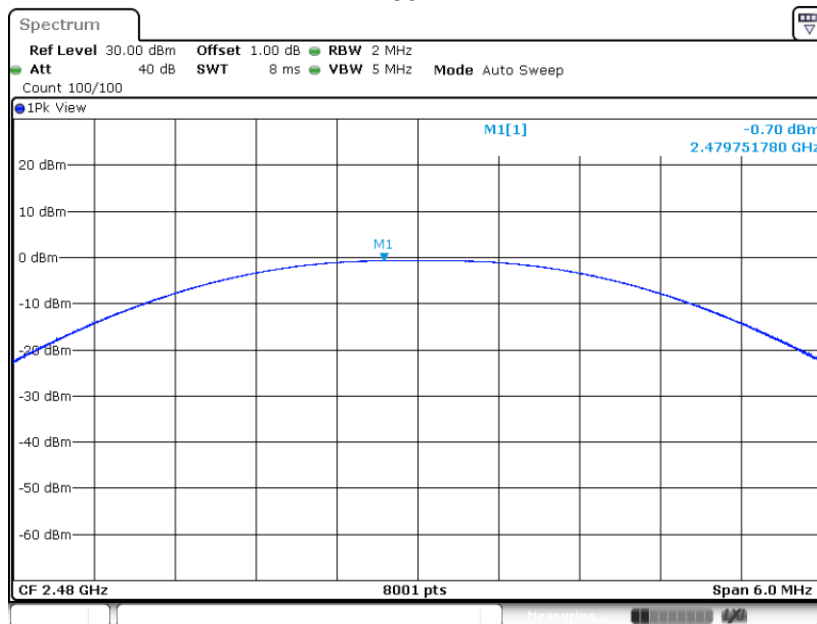
Date: 30.NOV.2020 13:52:40

2440MHz



Date: 30.NOV.2020 13:54:39

2480MHz



Date: 30.NOV.2020 13:56:35

9.3 6dB bandwidth and 99% Occupied 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.

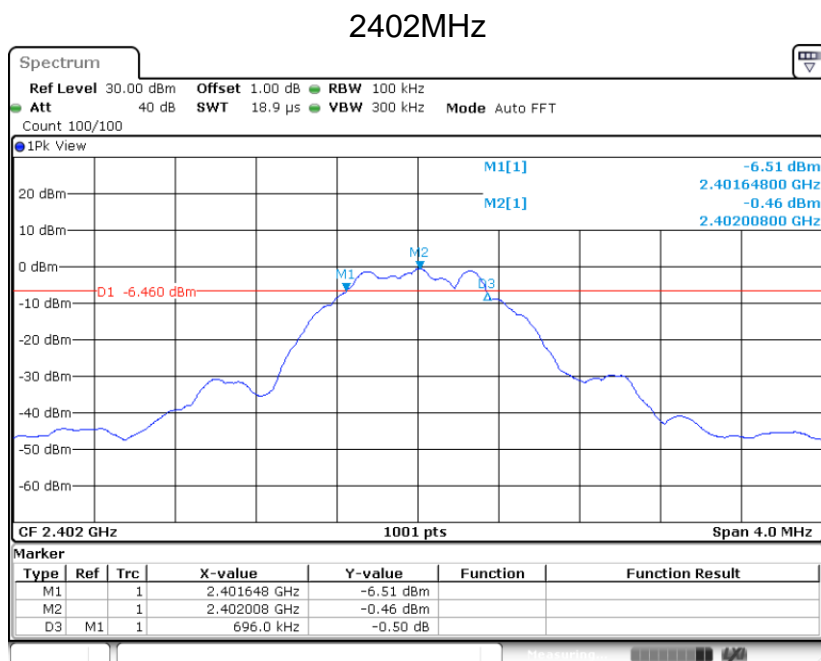
Limit

Limit [kHz]

≥ 500

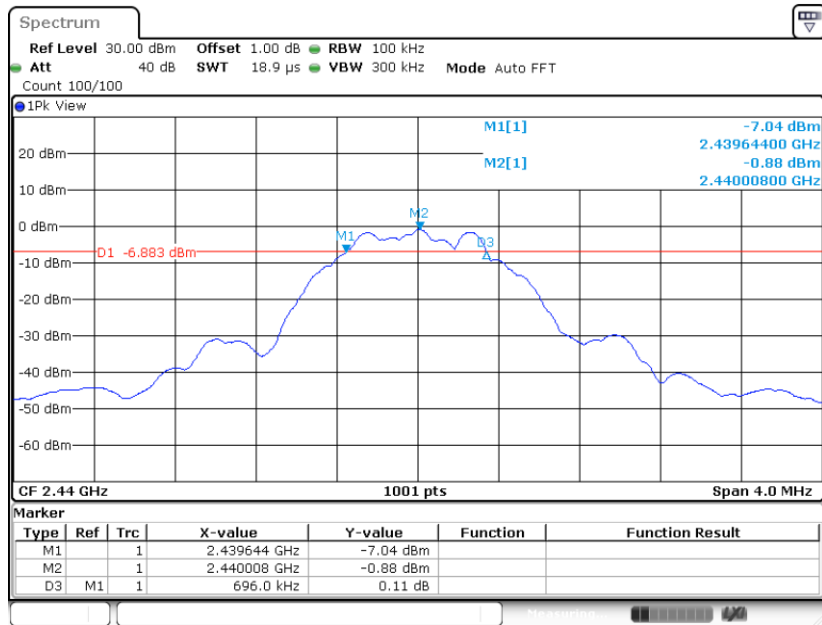
Test result

TestMode	Channel [MHz]	DTS BW [MHz]	FL[MHz]	FH[MHz]	Verdict
BLE	2402	0.696	2401.648	2402.344	PASS
	2440	0.696	2439.644	2440.340	PASS
	2480	0.696	2479.644	2480.340	PASS



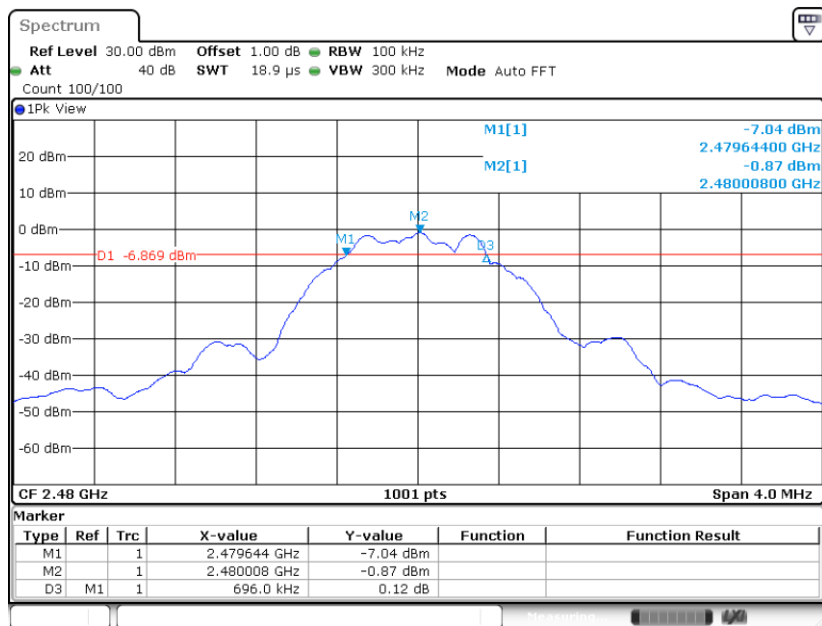
Date: 30.NOV.2020 13:52:22

2440MHz



Date: 30.NOV.2020 13:54:21

2480MHz



Date: 30.NOV.2020 13:56:18

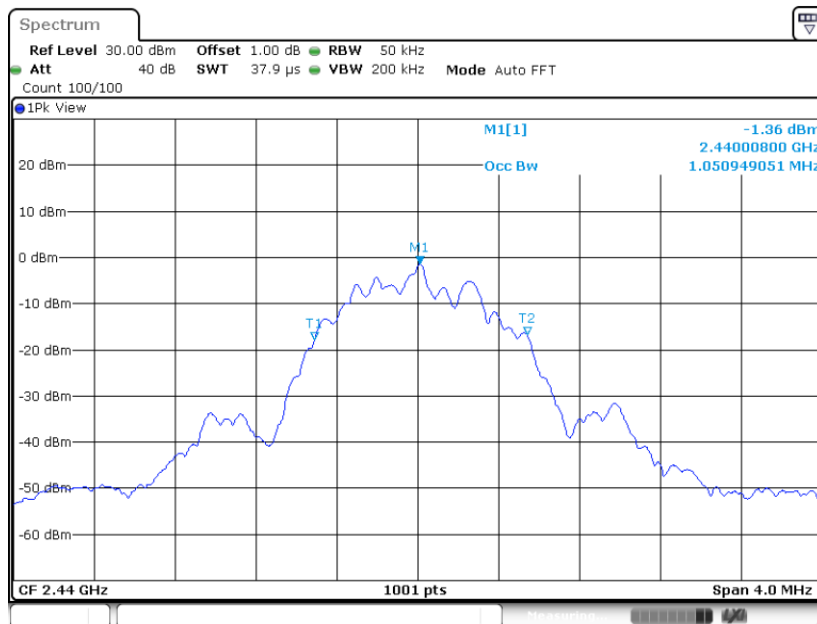
TestMode	Channel [MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Verdict
BLE	2402	1.051	2401.489	2402.539	PASS
	2440	1.051	2439.489	2440.539	PASS
	2480	1.051	2479.489	2480.539	PASS

2402MHz



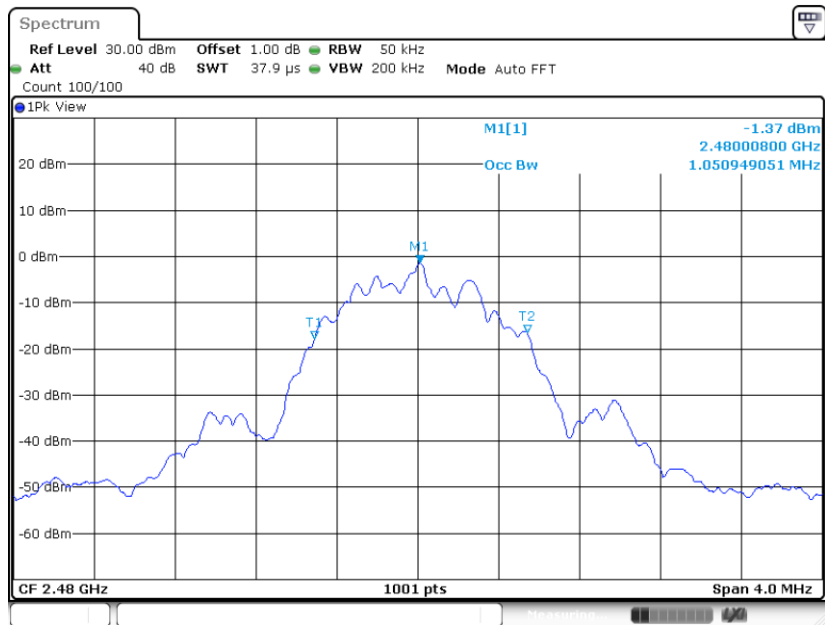
Date: 30.NOV.2020 13:52:33

2440MHz



Date: 30.NOV.2020 13:54:32

2480MHz



Date: 30.NOV.2020 13:56:29

9.4 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 \geq 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

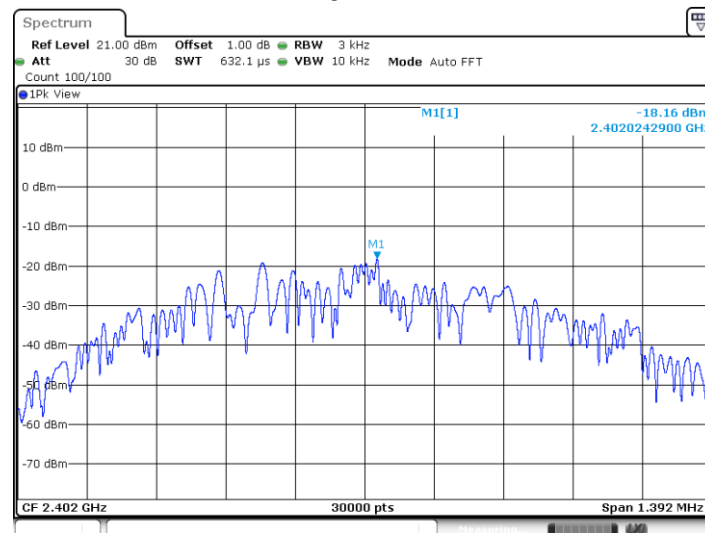
Limit [dBm/3KHz]

≤ 8

Test result

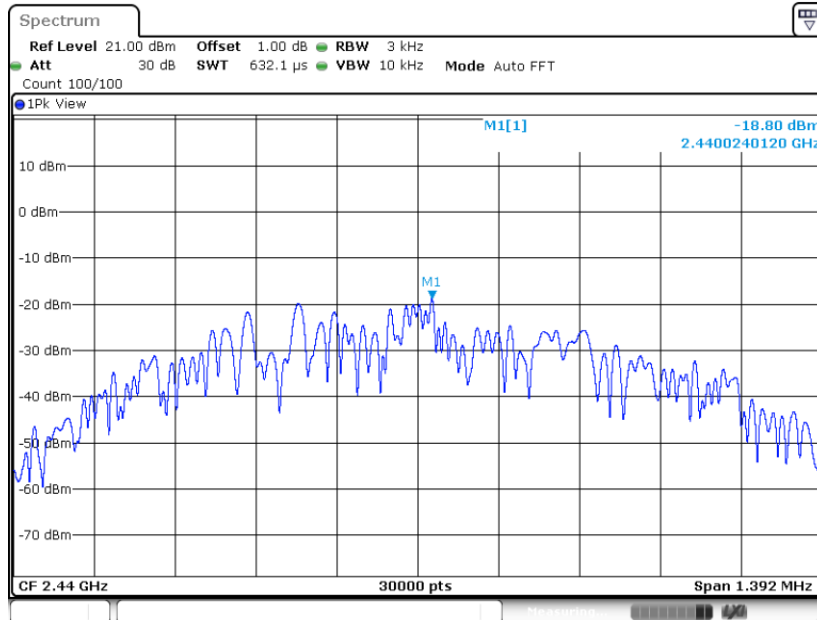
Frequency MHz	Power spectral density dBm/3KHz	Result
Top channel 2402MHz	-18.16	Pass
Middle channel 2440MHz	-18.8	Pass
Bottom channel 2480MHz	-18.58	Pass

2402MHz



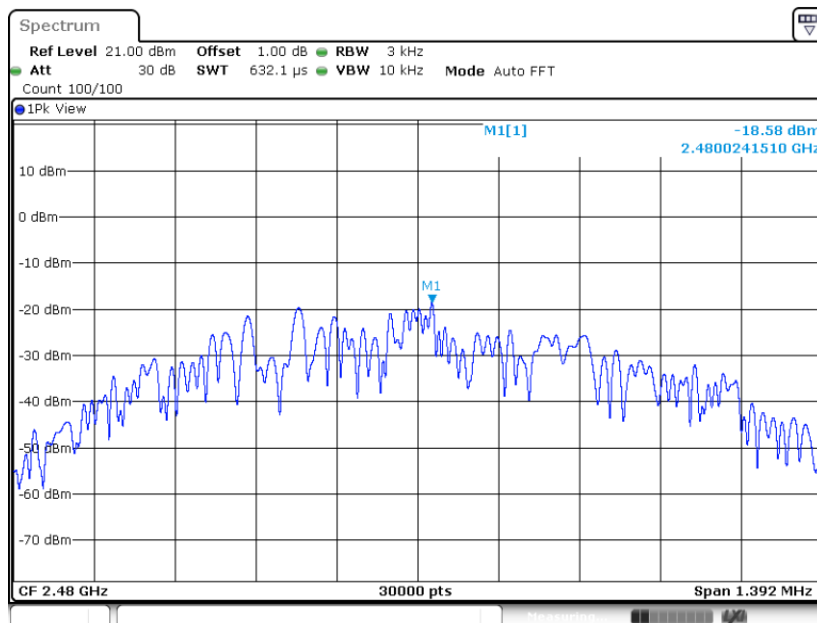
Date: 30 NOV 2020 13:52:46

2440MHz



Date: 30.NOV.2020 13:54:44

2480MHz



Date: 30.NOV.2020 13:56:41

9.5 Spurious RF conducted emissions

Test Method

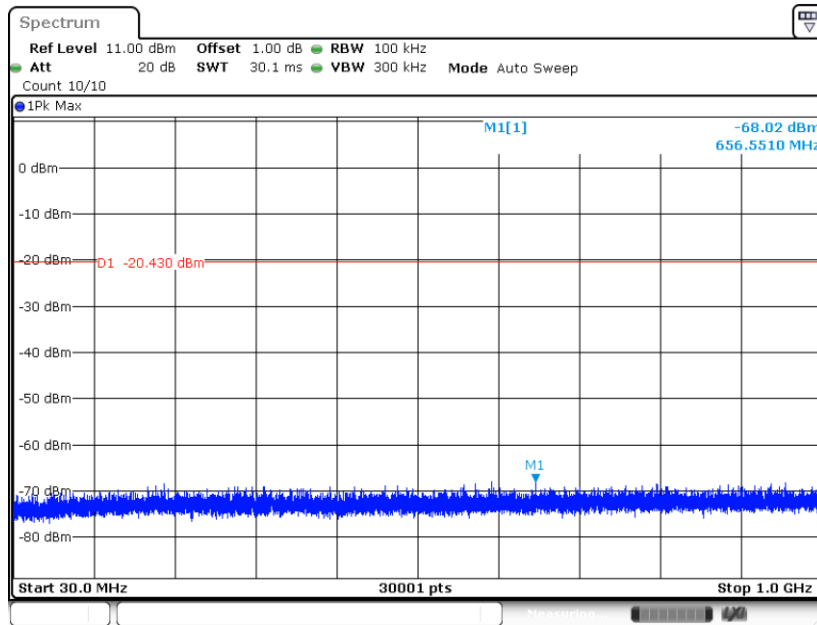
1. Establish a reference level by using the following procedure:
 - a. Set RBW=100 kHz. VBW \geq 3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
 - b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
2. Use the maximum PSD level to 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

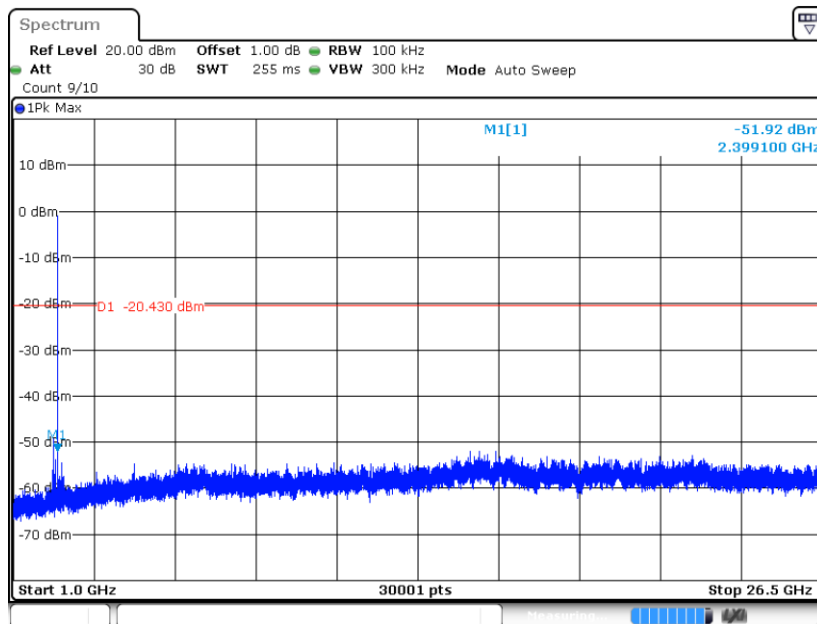
Frequency Range MHz	Limit (dBc)
30-25000	-20

Spurious RF conducted emissions

2402MHz

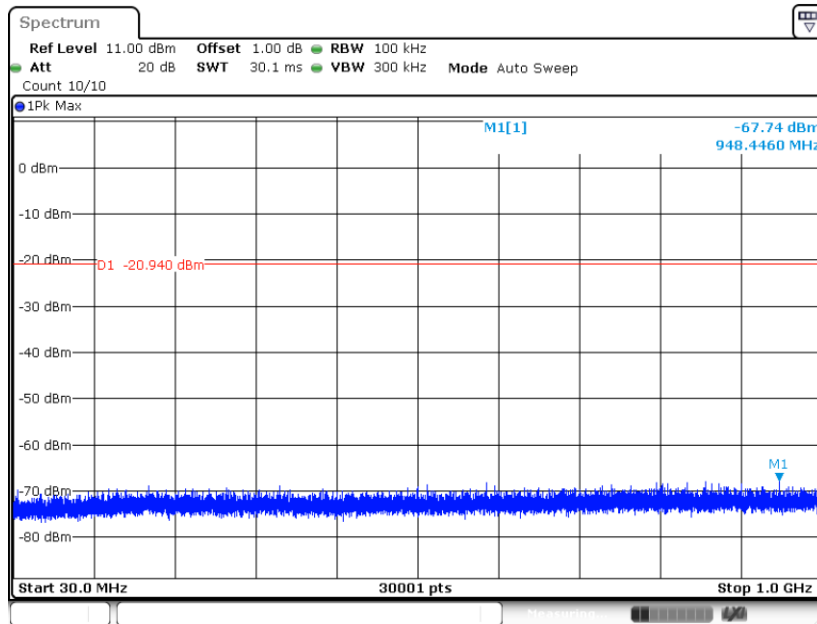


Date: 30.NOV.2020 13:53:07

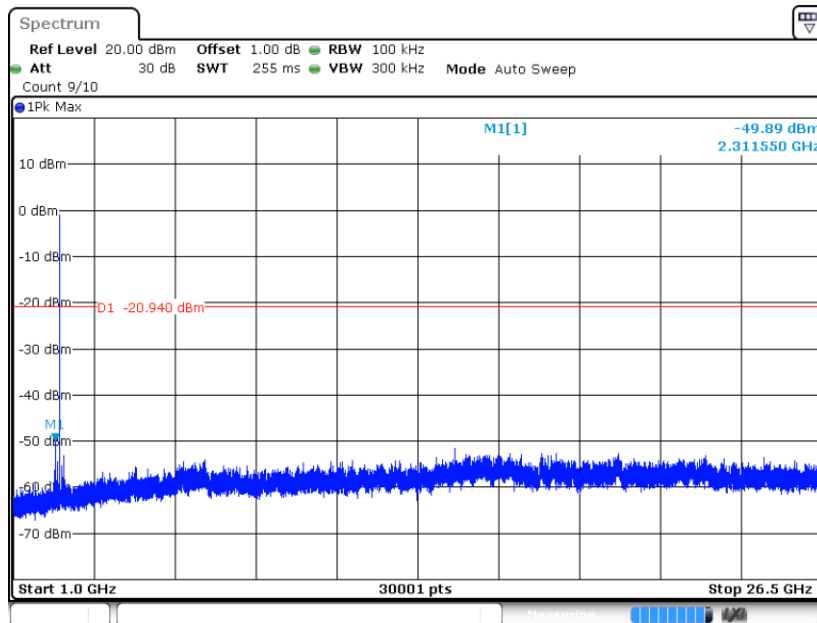


Date: 30.NOV.2020 13:53:15

2440MHz

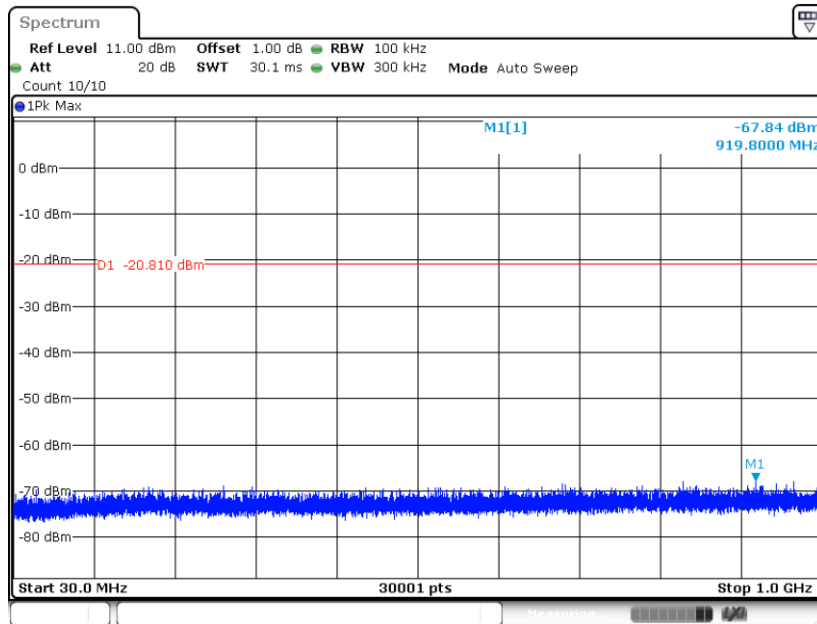


Date: 30.NOV.2020 13:54:56

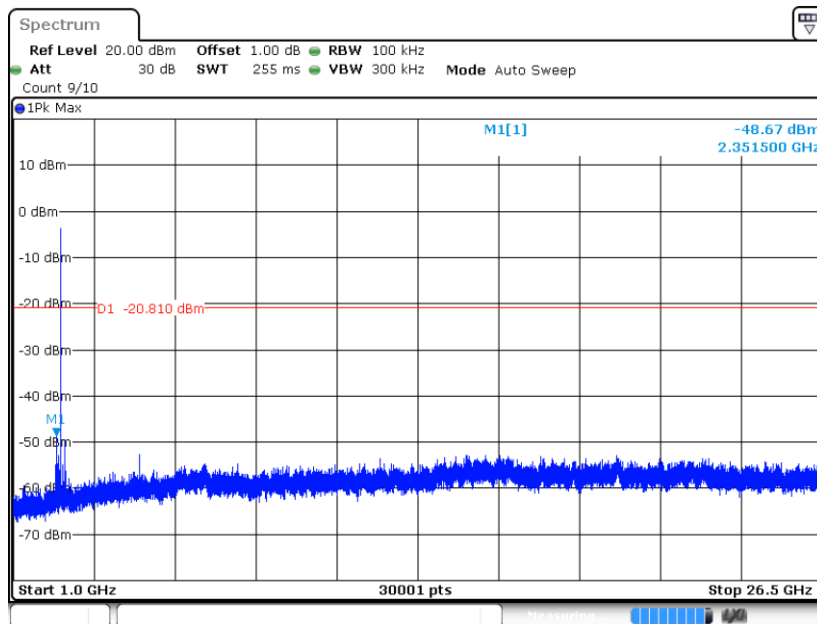


Date: 30.NOV.2020 13:55:04

2480MHz



Date: 30.NOV.2020 13:57:02



Date: 30.NOV.2020 13:57:10

9.6 Band edge

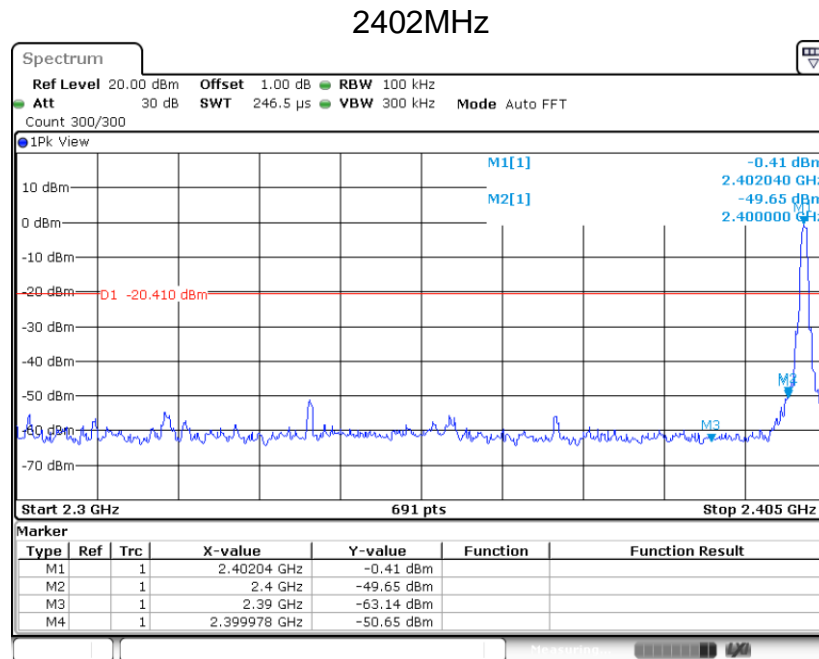
Test Method

- 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 \geq 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

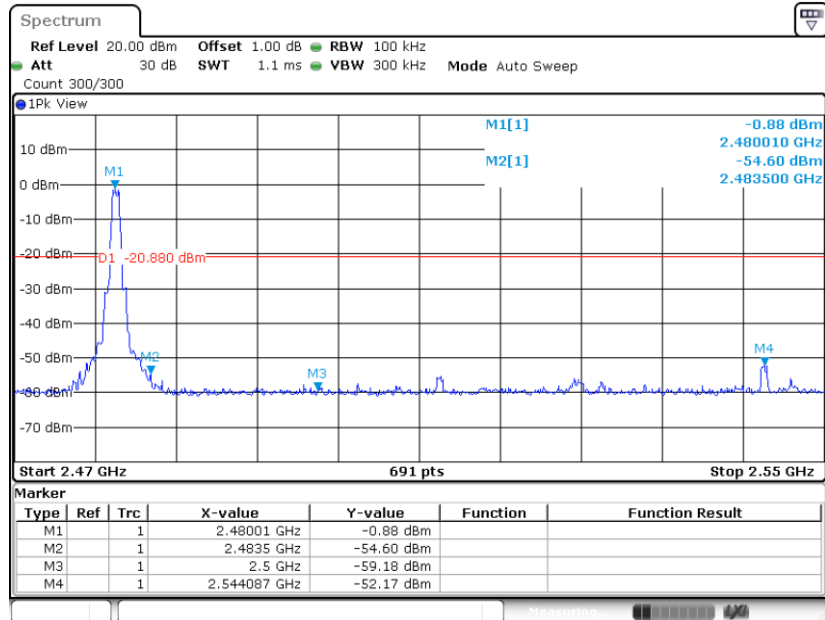
Frequency Range MHz	Limit (dBc)
30-25000	-20

Test result



Date: 30.NOV.2020 13:52:55

2480MHz



Date: 30.NOV.2020 13:56:50

9.7 Spurious radiated emissions for transmitter

Test Method

1: The EUT was placed 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 \geq 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 \geq RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

Procedures for average unwanted emissions measurements above 1000 MHz

a) RBW = 1 MHz.

b) VBW \leq [3 \times RBW].

c) Detector = RMS (power averaging), if [span / (# of points in sweep)] \leq 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 15.205, 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

Spurious radiated emissions for transmitter

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.

Transmitting spurious emission test result as below:

2402MHz (30MHz – 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBµV/m	Detector	Result
654.84	31.63	Horizontal	46.00	QP	Pass
598.04	30.98	Vertical	46.00	QP	Pass

2402MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBµV/m	Detector	Result
1020.00*	43.90	Horizontal	74.00	PK	Pass
7206.50	47.85	Horizontal	74.00	PK	Pass
2802.38	43.77	Vertical	74.00	PK	Pass
10176.50	45.10	Vertical	74.00	PK	Pass

2440MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBµV/m	Detector	Result
2839.04	44.67	Horizontal	74	PK	Pass
16043.50*	49.33	Horizontal	74	PK	Pass
3996.50	40.75	Vertical	74	PK	Pass
7032.50	41.13	Vertical	74	PK	Pass

2480MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBµV/m	Detector	Result
2927.14	44.31	Horizontal	74.00	PK	Pass
2302.38	48.65	Vertical	74.00	PK	Pass

Remark:

- (1) “**” means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
- (2) Data of measurement within this frequency range shown “--” in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
- (3) Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss

10 Test Equipment List

List of Test Instruments

	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
CE	EMI Test Receiver	Rohde & Schwarz	ESR 3	101782	2021-6-29
	LISN	Rohde & Schwarz	ENV4200	100249	2021-6-12
	LISN	Rohde & Schwarz	ENV216	100326	2021-6-12
	ISN	Rohde & Schwarz	ENY81	100177	2021-6-12
	ISN	Rohde & Schwarz	ENY81-CAT6	101664	2021-6-12
	High Voltage Probe	Rohde & Schwarz	TK9420(VT9420)	9420-584	2021-6-23
	RF Current probe	Rohde & Schwarz	EZ-17	100816	2021-6-28
C	Signal Generator	Rohde & Schwarz	SMB100A	108272	2021-6-21
	Signal Analyzer	Rohde & Schwarz	FSV40	101030	2021-6-21
	Vector Signal Generator	Rohde & Schwarz	SMU 200A	105324	2021-6-22
	RF Switch Module	Rohde & Schwarz	OSP120/OS P-B157	101226/100851	2021-6-21
RE	EMI Test Receiver	Rohde & Schwarz	ESR 7	102176	2021-6-29
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2021-8-4
	Horn Antenna	Rohde & Schwarz	HF907	102294	2021-7-4
	Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2021-6-21
	3m Semi-anechoic chamber	TDK	9X6X6	----	2022-10-28

C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth
- Power spectral density
- Spurious RF conducted emissions
- Band edge
- Conducted emission AC power port

RE - Radiated RF tests

- Spurious radiated emissions for transmitter

11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Radiated Emission in 3m chamber 30MHz-1000MHz	Horizontal: 5.12dB; Vertical: 5.10dB;
Uncertainty for Radiated Emission in 3m chamber 1000MHz-25000MHz	Horizontal: 5.01dB; Vertical: 5.00dB;
Uncertainty for Conducted Emission 150KHz-30MHz	U=3.21dB
Uncertainty for conducted power test	1.16dB
Frequency test involved:	0.6×10^{-7}