

FCC - TEST REPORT

Report Number : **60.790.19.048.01R01** Date of Issue : January 31, 2020

Model : **E41227**

Product Type : **E-Bike HMI**

Applicant : DAYTON INDUSTRIAL CO., LTD

Address : 2-12 Kwai Fat Road, 11-A Kwai Chung, New Territories, Hong Kong

Production Facility : KENDY ENTERPRISE LTD

Address : 2-12 Kwai Fat Road, 11-A Kwai Chung, New Territories, Hong Kong

Test Result : **nPositive** **o Negative**

Total pages including Appendices : 36

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2 Description of Equipment Under Test

Description of the Equipment Under Test

Product: E-Bike HMI

Model no.: E41227

FCC ID: O4GRE

Rating: 12V DC (E-Bike battery)

Frequency: 2402MHz-2480MHz (Tx and Rx)

Antenna gain: 0 dBi

Number of operated channel: 40

Modulation: GFSK

Auxiliary Equipment and Software Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.	S/N
Computer	Lenovo	X220	0A72168

Auxiliary Software Used during Test:

DESCRIPTION	SOFTWARE NAME	VERSION	REMARK
RF Test Mode Software	nRFgo	1.16	Provided by applicant

3 Summary of Test Standards

Test Standards
FCC Part 15 Subpart C 10-1-18 Edition Federal Communications Commission, PART 15 — Radio Frequency Devices, Subpart C — Unintentional Radiators
All the tests were performed using the procedures from ANSI C63.4(2014) 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: 502708

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	NIL
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 Test – Site 1

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2020-6-28
Signal Analyzer	Rohde & Schwarz	FSV40	101031	2020-6-28
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100398	2020-7-7
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2020-7-5
Horn Antenna	Rohde & Schwarz	HF907	102294	2020-6-22
Wideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	12827	2020-7-5
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2020-6-28
Pre-amplifier	Rohde & Schwarz	SCU 40A	100432	2020-6-28
Attenuator	Agilent	8491A	MY39264334	2020-6-28
3m Semi-anechoic chamber	TDK	9X6X6	----	2020-7-7
Test software	Rohde & Schwarz	EMC32	Version 9.15.00	N/A

Conducted Emission Test – Site 1

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 3	101782	2020-6-28
LISN	Rohde & Schwarz	ENV4200	100249	2020-6-28
LISN	Rohde & Schwarz	ENV432	101318	2020-7-19
LISN	Rohde & Schwarz	ENV216	100326	2020-6-28
ISN	Rohde & Schwarz	ENY81	100177	2020-6-28
ISN	Rohde & Schwarz	ENY81-CA6	101664	2020-6-28
High Voltage Probe	Rohde & Schwarz	TK9420(VT9420)	9420-584	2020-6-24
RF Current Probe	Rohde & Schwarz	EZ-17	100816	2020-7-2
Attenuator	Shanghai Huaxiang	TS2-26-3	080928189	2020-6-28
Test software	Rohde & Schwarz	EMC32	Version9.15.00	N/A

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 Analyzer	Rohde & Schwarz	FSV40	101030	2020-6-28
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2020-6-28

4.2 Measurement System Uncertainty

Measurement System Uncertainty Emissions

System Measurement Uncertainty	
Items	Extended Uncertainty
Uncertainty for Radiated Emission in 3m chamber 9kHz-30MHz	4.46dB
Uncertainty for Radiated Emission in 3m chamber 30MHz-1000MHz	Horizontal: 4.91dB; Vertical: 4.89dB;
Uncertainty for Radiated Emission in 3m chamber 1000MHz-25000MHz	Horizontal: 4.80dB; Vertical: 4.79dB;
Uncertainty for Conducted Emission at AC Power Line 150kHz-30MHz	3.21dB
Uncertainty for frequency test	0.6×10^{-7}

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	12-15	☒	☐	☐
FCC Title 47 Part 15.207 Conduct Emission (1)	16	☐	☐	☒
FCC Title 47 Part 15.247(a)(2) 6dB & 99% Bandwidth	17-19	☒	☐	☐
FCC Title 47 Part 15.247(b) Peak Output Power	20-22	☒	☐	☐
FCC Title 47 Part 2.1051 & 15.247(d) Spurious Emissions at Antenna Terminals	23-28	☒	☐	☐
FCC Title 47 Part 15.247(d) 100kHz Bandwidth of band edges	29-31	☒	☐	☐
FCC Title 47 Part 15.247(e) Power Spectral Density	32-34	☒	☐	☐
FCC Title 47 Part 15.203 & 15.247(b) Antenna Requirement	35	☒	☐	☐

Remark:

- (1) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines.

6 General Remarks

Remarks

This submittal(s) (test report) is intended for **FCC ID: O4GRE**, 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

n - Performed

o - **Not** Performed

- The Equipment Under Test

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

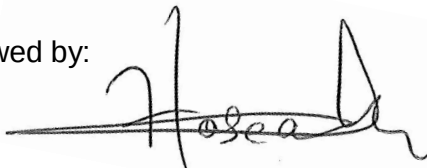
o - **Does not** fulfill the general approval requirements.

Sample Received Date: December 18, 2019

Testing Start Date: December 20, 2019

Testing End Date: January 7, 2020

Reviewed by:



Hosea CHAN
EMC Project Engineer

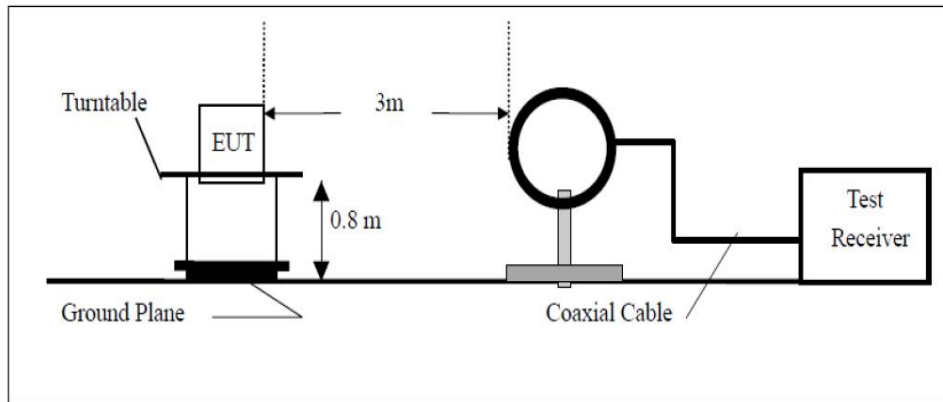
Prepared by:



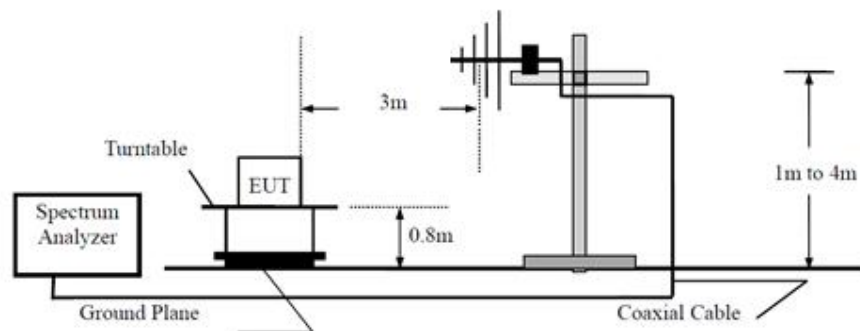
Eric LI
EMC Senior Project Engineer

7 Test Setups

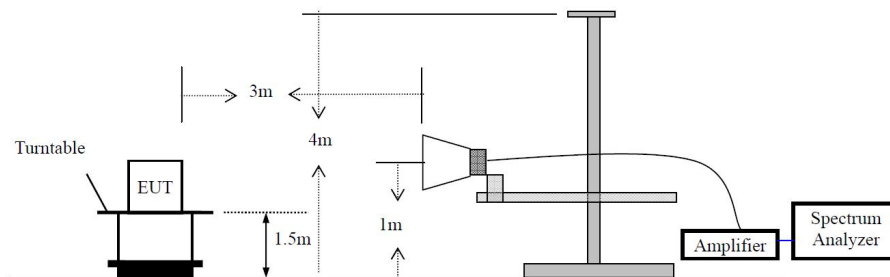
7.1 Radiated test setups 9kHz-30MHz



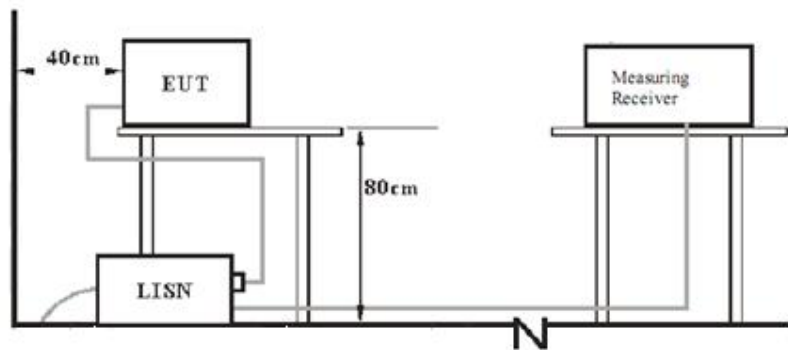
7.2 Radiated test setups Below 1GHz



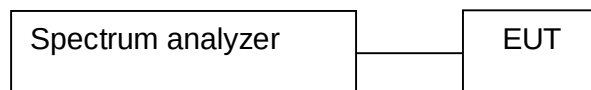
7.3 Radiated test setups Above 1GHz



7.4 AC Power Line Conducted Emission



7.5 Conducted RF test



8 Emission Test Results

8.1 Spurious Radiated Emission

EUT: E41227
 Op Condition: Operated, TX Mode
 (Low channel is the worst case)
 Test Specification: FCC15.205, 15.209 & 15.247(d)
 Comment: 12V DC
 Remark: 9kHz to 1GHz

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)
54.142222	21.00	40.00	-19.00	Peak	H	-24.4
111.480000	16.93	43.50	-26.57	Peak	H	-28.7
194.684444	19.56	43.50	-23.94	Peak	H	-28.6
246.363889	20.04	46.00	-25.96	Peak	H	-26.9
570.397778	25.41	46.00	-20.59	Peak	H	-20.8
937.327222	32.02	46.00	-13.98	Peak	H	-15.8
43.310556	22.13	40.00	-17.87	Peak	V	-24.3
52.795000	21.61	40.00	-18.39	Peak	V	-24.2
105.660000	17.45	43.50	-26.05	Peak	V	-28.3
292.061667	21.90	46.00	-24.10	Peak	V	-26.1
633.124444	27.71	46.00	-18.29	Peak	V	-19.5
866.678889	33.07	46.00	-12.93	Peak	V	-16.6

Remark:

1. As the measured peak value not exceeded the Quasi-peak limit, Quasi-peak value no need to be measured.

Spurious Radiated Emission

EUT: E41227
 Op Condition: Operated, TX Mode (2402MHz)
 Test Specification: FCC15.205, 15.209 & 15.247(d)
 Comment: 12V DC
 Remark: 1GHz to 25GHz

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)
1238.125000	37.18	54.00	-16.82	Peak	H	-13.1
1815.750000	39.65	54.00	-14.35	Peak	H	-9.1
2817.340000	38.65	54.00	-15.35	Peak	H	-6.5
4804.000000	45.91	54.00	-8.09	Peak	H	1.3
8216.250000	36.51	54.00	-17.49	Peak	H	6.4
15947.812500	49.63	54.00	-4.37	Peak	H	20.8
1257.625000	37.59	54.00	-16.41	Peak	V	-13.0
1993.312500	44.96	54.00	-9.04	Peak	V	-7.9
2234.564300	41.32	54.00	-12.68	Peak	V	-7.2
4804.000000	37.61	54.00	-16.39	Peak	V	1.3
9955.781250	39.68	54.00	-14.32	Peak	V	8.5
15958.125000	48.97	54.00	-5.03	Peak	V	20.6

Remark:

1.As the measured peak value not exceeded the average limit, average value no need to be measured.

Spurious Radiated Emission

EUT: E41227
 Op Condition: Operated, TX Mode (2440MHz)
 Test Specification: FCC15.205, 15.209 & 15.247(d)
 Comment: 12V DC
 Remark: 1GHz to 25GHz

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)
1245.000000	37.23	54.00	-16.77	Peak	H	-13.1
1822.437500	40.58	54.00	-13.42	Peak	H	-9.1
4880.000000	44.73	54.00	-9.27	Peak	H	1.8
9996.093750	40.55	54.00	-13.45	Peak	H	8.7
15968.437500	48.34	54.00	-5.66	Peak	H	20.4
1239.000000	38.86	54.00	-15.14	Peak	V	-13.1
1984.375000	44.58	54.00	-9.42	Peak	V	-7.9
4880.000000	41.21	54.00	-12.79	Peak	V	1.8
9957.187500	39.91	54.00	-14.09	Peak	V	8.5
15952.031250	48.75	54.00	-5.25	Peak	V	20.7

Remark:

1.As the measured peak value not exceeded the average limit, average value no need to be measured.

Spurious Radiated Emission

EUT: E41227
 Op Condition: Operated, TX Mode (2480MHz)
 Test Specification: FCC15.205, 15.209 & 15.247(d)
 Comment: 12V DC
 Remark: 1GHz to 25GHz

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)
1243.187500	37.35	54.00	-16.65	Peak	H	-13.1
1828.875000	38.62	54.00	-15.38	Peak	H	-9.0
2712.812500	37.89	54.00	-16.11	Peak	H	-5.4
4960.000000	41.30	54.00	-12.70	Peak	H	1.7
9301.875000	38.48	54.00	-15.52	Peak	H	8.1
15914.062500	48.36	54.00	-5.64	Peak	H	20.1
1251.000000	38.66	54.00	-15.34	Peak	V	-13.0
2002.937500	44.99	54.00	-9.01	Peak	V	-7.8
2512.062500	42.68	54.00	-11.32	Peak	V	-6.3
4960.000000	42.17	54.00	-11.83	Peak	V	1.7
11402.812500	41.33	54.00	-12.67	Peak	V	10.7
15928.593750	48.79	54.00	-5.21	Peak	V	20.6

Remark:

1.As the measured peak value not exceeded the average limit, average value no need to be measured.

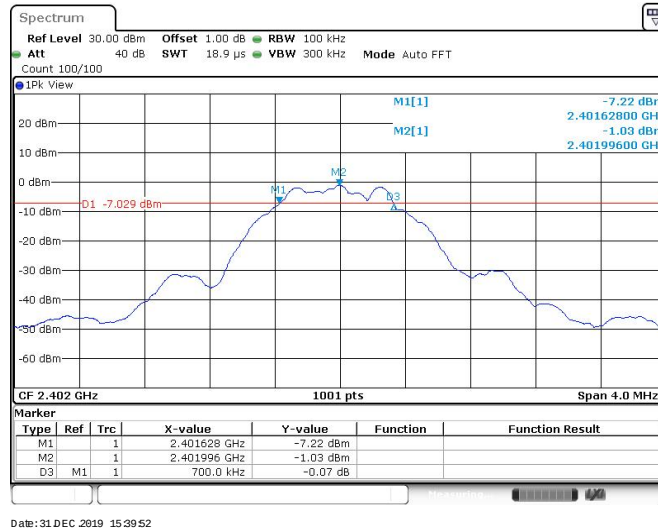
8.2 Conducted Emission at AC Power line

Conducted Emission testing is not applicable for this device as it is a battery operating device.

8.3 6dB & 99% Bandwidth

EUT: E41227
 Op Condition: Operated, TX Mode (2402MHz)
 Test Specification: FCC15.247(a)(2), 6dB Bandwidth & 99% Bandwidth
 Comment: 12V DC

Test Result
☒ Passed
☐ Not Passed

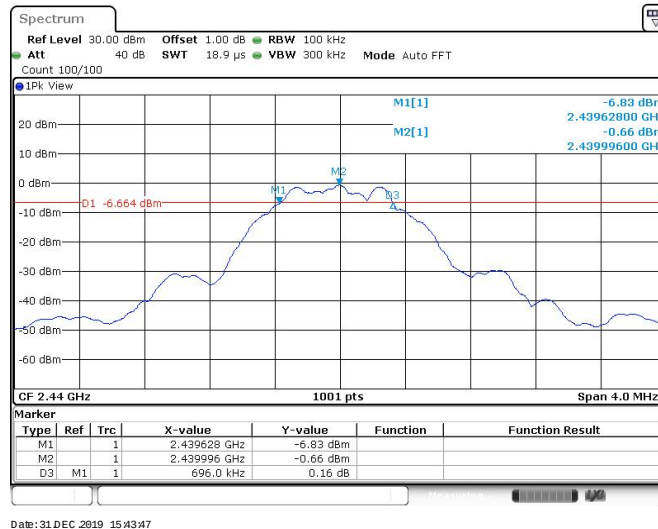


Bandwidth	Measured Value	Limit
6dB bandwidth	0.700 MHz	> 0.5MHz
99% OCB	1.047 MHz	NA

6dB & 99% Bandwidth

EUT: E41227
 Op Condition: Operated, TX Mode (2440MHz)
 Test Specification: FCC15.247(a)(2), 6dB Bandwidth & 99% Bandwidth
 Comment: 12V DC

Test Result
☒ Passed
☐ Not Passed

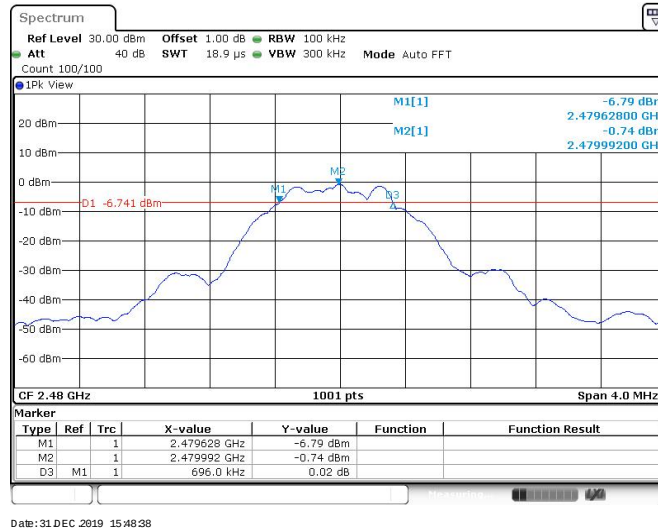


Bandwidth	Measured Value	Limit
6dB bandwidth	0.696 MHz	> 0.5 MHz
99% OCB	1.051 MHz	NA

6dB & 99% Bandwidth

EUT: E41227
 Op Condition: Operated, TX Mode (2480MHz)
 Test Specification: FCC15.247(a)(2), 6dB Bandwidth & 99% Bandwidth
 Comment: 12V DC

Test Result
☒ Passed
☐ Not Passed

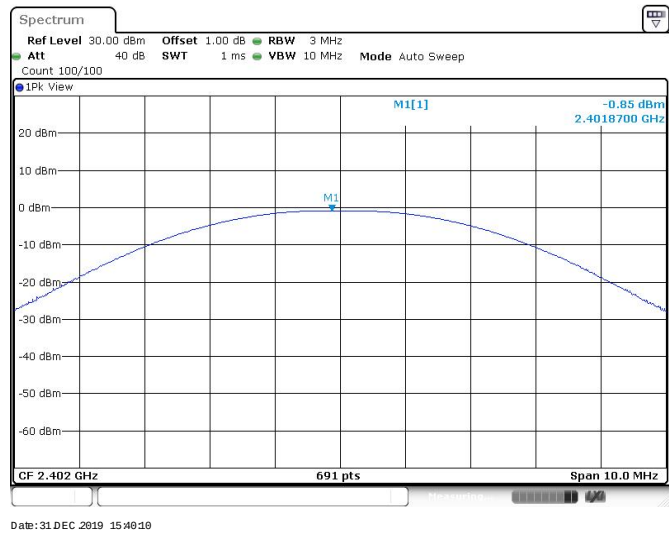


Bandwidth	Measured Value	Limit
6dB bandwidth	0.696 MHz	> 0.5 MHz
99% OCB	1.051 MHz	NA

8.4 Peak Output Power

EUT: E41227
Op Condition: Operated, TX Mode (2402MHz)
Test Specification: FCC15.247(b)
Comment: 12V DC

Test Result
☒ Passed
☐ Not Passed

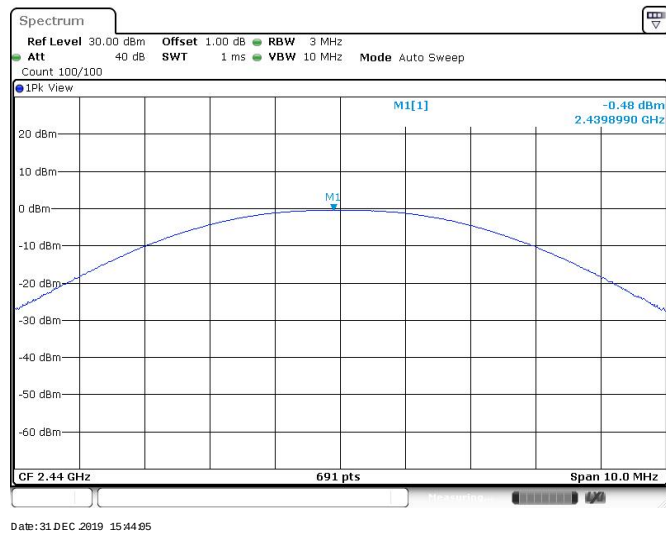


Conducted Output Power	Limit
-0.85 dBm	< 30dBm

Peak Output Power

EUT: E41227
Op Condition: Operated, TX Mode (2440MHz)
Test Specification: FCC15.247(b)
Comment: 12V DC

Test Result
☒ Passed
☐ Not Passed

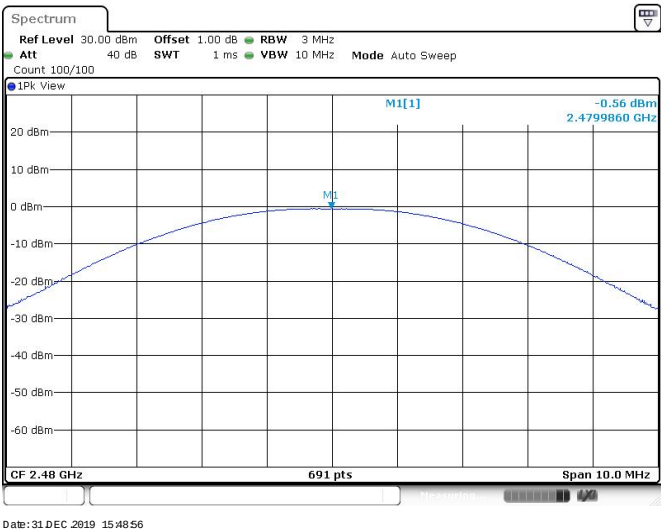


Conducted Output Power	Limit
-0.48 dBm	< 30dBm

Peak Output Power

EUT: E41227
Op Condition: Operated, TX Mode (2480MHz)
Test Specification: FCC15.247(b)
Comment: 12V DC

Test Result
☒ Passed
☐ Not Passed



Conducted Output Power	Limit
-0.56 dBm	< 30dBm

8.5 Spurious Emissions at Antenna Terminals

EUT: E41227

Op Condition: Operated, TX Mode (2402MHz)

Test Specification: FCC2.1051 & 15.247(d)

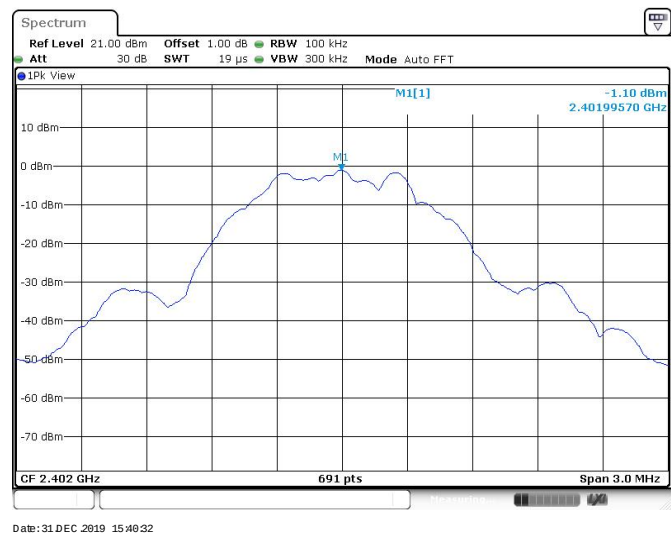
Comment: 12V DC

Test Result

☒ Passed

☐ Not Passed

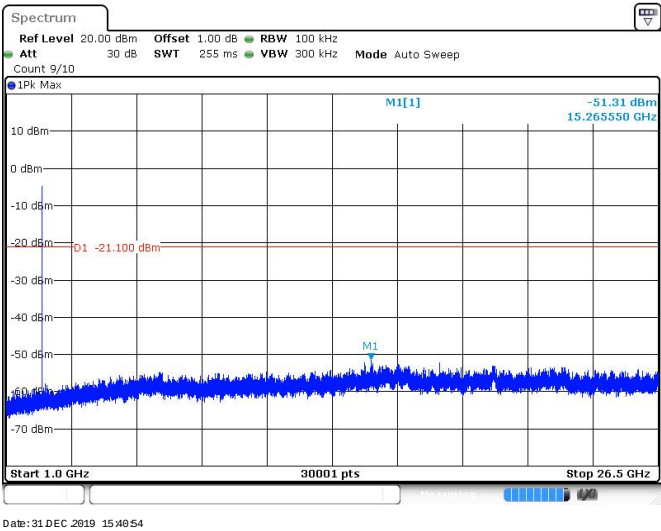
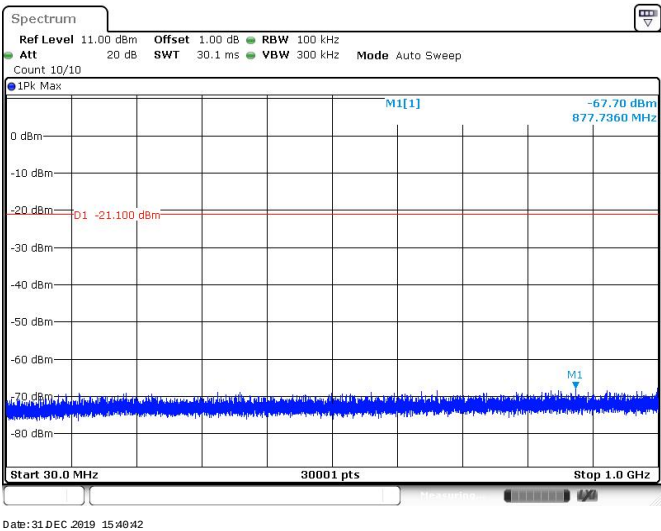
Channel	FreqRange	RefLevel	Result	Limit	Verdict
2402	Reference	-1.10	-1.10	---	PASS
2402	30~1000	-1.10	-67.7	<=-21.1	PASS
2402	1000~26500	-1.10	-51.31	<=-21.1	PASS



Spurious Emissions at Antenna Terminals

EUT: E41227
Op Condition: Operated, TX Mode (2402MHz)
Test Specification: FCC2.1051 & 15.247(d)
Comment: 12V DC

Test Result
☒ Passed
☐ Not Passed



Spurious Emissions at Antenna Terminals

EUT: E41227
 Op Condition: Operated, TX Mode (2440MHz)
 Test Specification: FCC2.1051 & 15.247(d)
 Comment: 12V DC

Test Result

☒ Passed☐ Not Passed

Channel	FreqRange	RefLevel	Result	Limit	Verdict
2440	Reference	-0.61	-0.61	---	PASS
2440	30~1000	-0.61	-67.52	<=-20.61	PASS
2440	1000~26500	-0.61	-52.17	<=-20.61	PASS

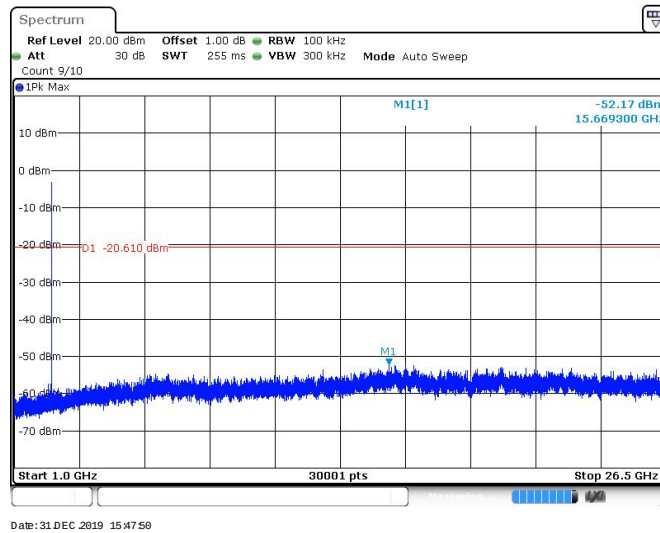
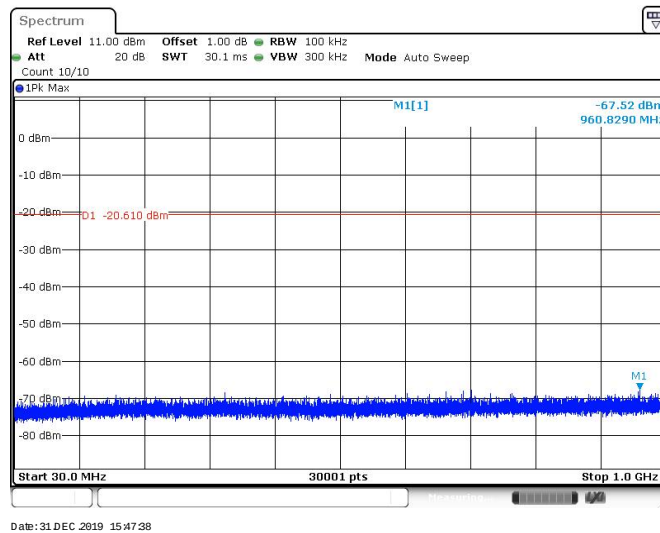


Date: 31 DEC 2019 15:47:28

Spurious Emissions at Antenna Terminals

EUT: E41227
Op Condition: Operated, TX Mode (2440MHz)
Test Specification: FCC2.1051 & 15.247(d)
Comment: 12V DC

Test Result
☒ Passed
☐ Not Passed

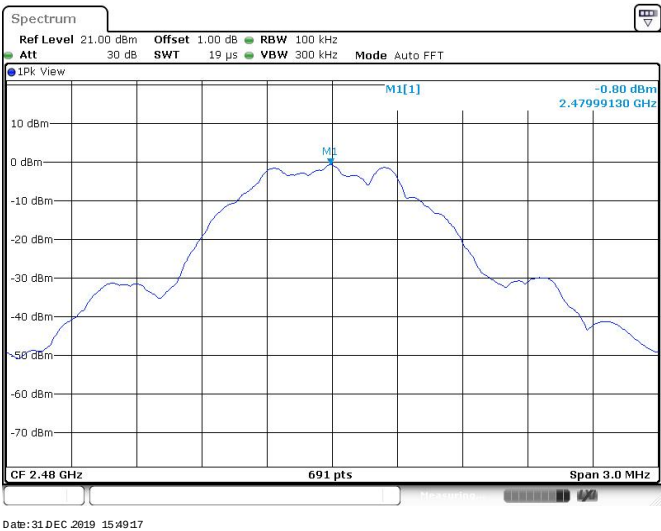


Spurious Emissions at Antenna Terminals

EUT: E41227
Op Condition: Operated, TX Mode (2480MHz)
Test Specification: FCC2.1051 & 15.247(d)
Comment: 12V DC

Test Result
☒ Passed
☐ Not Passed

Channel	FreqRange	RefLevel	Result	Limit	Verdict
2480	Reference	-0.61	-0.80	---	PASS
2480	30~1000	-0.61	-67.37	<=-20.8	PASS
2480	1000~26500	-0.61	-51.72	<=-20.8	PASS

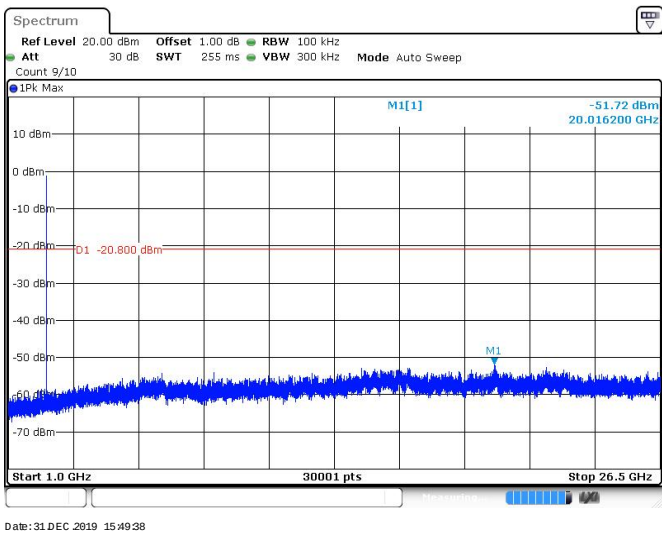
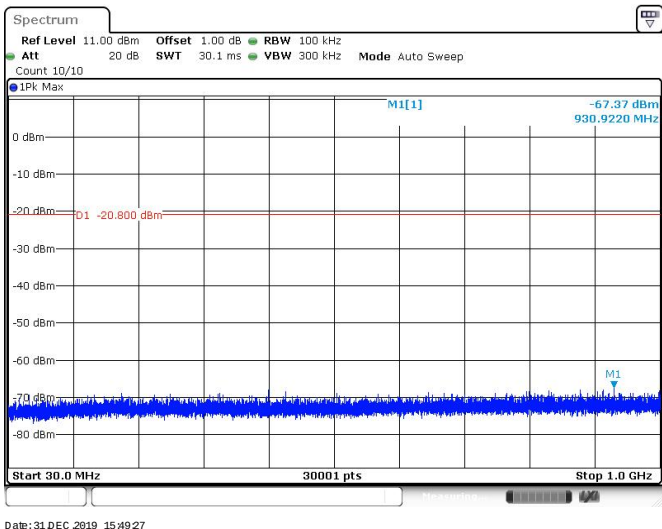


Date: 31 DEC 2019 15:49:17

Spurious Emissions at Antenna Terminals

EUT: E41227
Op Condition: Operated, TX Mode (2480MHz)
Test Specification: FCC2.1051 & 15.247(d)
Comment: 12V DC

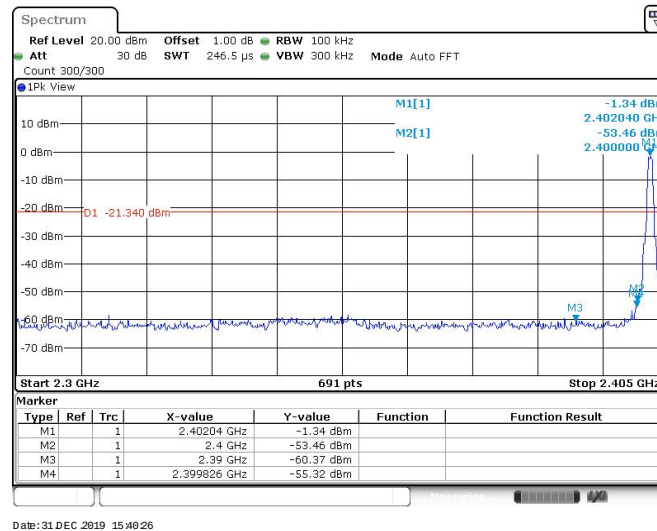
Test Result
☒ Passed
☐ Not Passed



8.6 100kHz Bandwidth of band edges

EUT: E41227
Op Condition: Operated, TX Mode (2402MHz)
Test Specification: FCC15.247(d), Conducted
Comment: 12V DC

Test Result
☒ Passed
☐ Not Passed

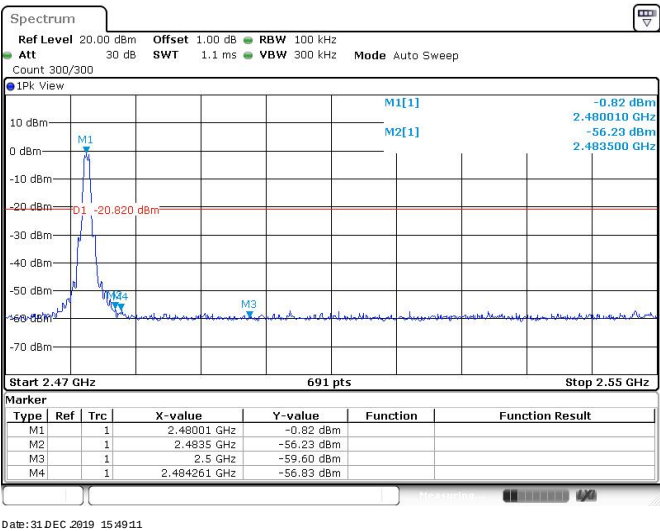


Band edges	Limit
52.12 dB	> 20dB

100kHz Bandwidth of band edges

EUT: E41227
Op Condition: Operated, TX Mode (2480MHz)
Test Specification: FCC15.247(d), Conducted
Comment: 12V DC

Test Result
☒ Passed
☐ Not Passed



Band edges	Limit
55.41 dB	> 20dB

100kHz Bandwidth of band edges

EUT: E41227
 Op Condition: Operated, TX Mode (2402MHz & 2480MHz)
 Test Specification: FCC15.247(d), Radiated method
 Comment: 12V DC

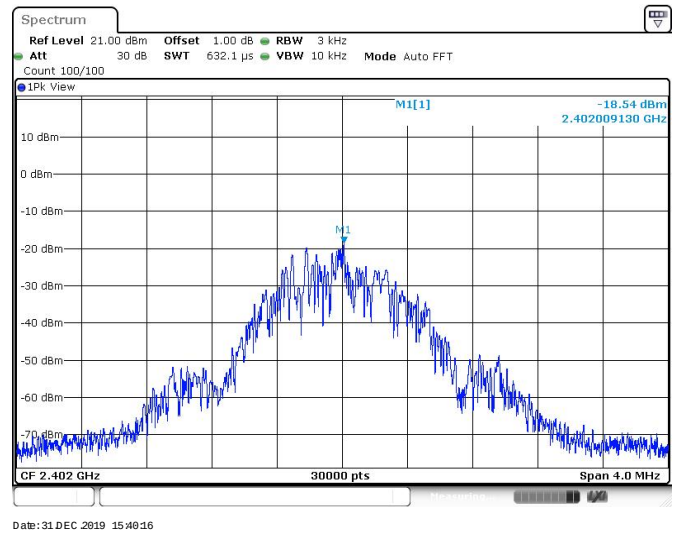
Test Result	
☒	Passed
☐	Not Passed

Channel	Frequency MHz	Result dBμV/m	Limit dBμV/m	Margin dB	Detector PK /AV	Ant. Polarity H/V	Corr. (dB)
2402	2400.00	55.31	74.00	-18.69	Peak	H	-5.5
2402	2400.00	46.34	54.00	-7.66	Average	H	-5.5
2402	2400.00	53.81	74.00	-20.19	Peak	V	-5.5
2402	2400.00	47.22	54.00	-6.78	Average	V	-5.5
2480	2483.50	52.24	74.00	-21.76	Peak	H	-4.8
2480	2483.50	40.68	54.00	-13.32	Average	H	-4.8
2480	2483.50	53.25	74.00	-20.75	Peak	V	-4.8
2480	2483.50	44.77	54.00	-9.23	Average	V	-4.8

8.7 Power Spectral Density

EUT: E41227
Op Condition: Operated, TX Mode (2402MHz)
Test Specification: FCC15.247(e)
Comment: 12V DC

Test Result	
☒	Passed
☐	Not Passed

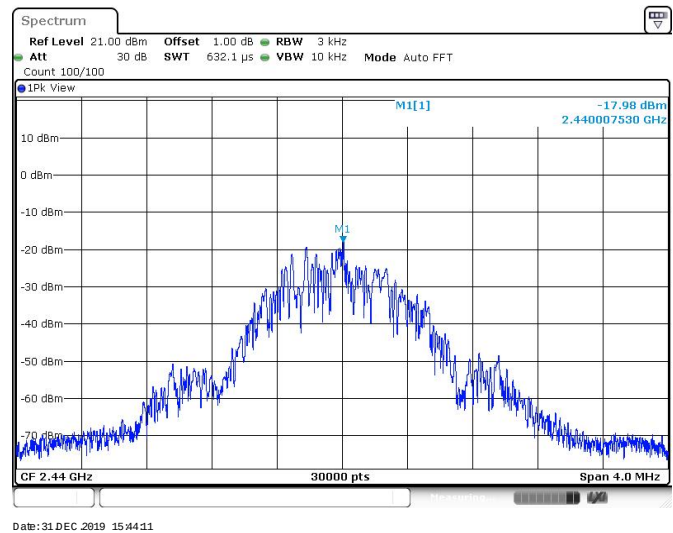


PSD	Limit
-18.54 dBm	< 8 dBm

Power Spectral Density

EUT: E41227
Op Condition: Operated, TX Mode (2440MHz)
Test Specification: FCC15.247(e)
Comment: 12V DC

Test Result
☒ Passed
☐ Not Passed

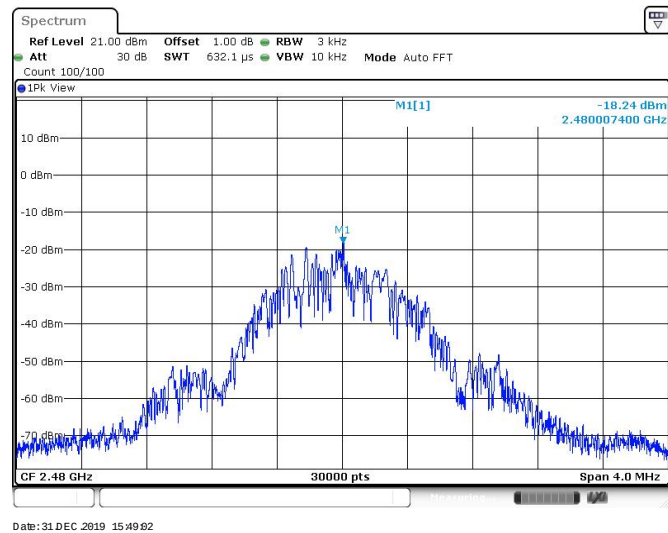


PSD	Limit
-17.98 dBm	< 8 dBm

Power Spectral Density

EUT: E41227
Op Condition: Operated, TX Mode (2480MHz)
Test Specification: FCC15.247(e)
Comment: 12V DC

Test Result
☒ Passed
☐ Not Passed



PSD	Limit
-18.24 dBm	< 8 dBm

8.8 Antenna Requirement

EUT: E41227
Op Condition: Operated, TX Mode
Test Specification: FCC15.203 & 15.247(b)
Comment: 12V DC

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

The antenna used in this product is build-in antenna on PCB, and the maximum gain of this antenna is 0.0 dBi.

9 Appendix A - General Product Information

Radiofrequency radiation exposure evaluation

This exposure evaluation is intended for **FCC ID: O4GRE**

According to KDB 447498 D01v06 section 4.3.1, For frequencies between 100 MHz to 6GHz and test separation distances ≤ 50 mm, the Numeric threshold is determined as:

Step a)

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR

>> The fundamental frequency of the EUT is 2402-2480MHz,
the test separation distance is ≤ 50 mm.
(Manufacturer specified the separation distance is: 5mm)

Step a)

>> Numeric threshold (2402MHz), $\text{mW} / 5\text{mm} \cdot \sqrt{2.402\text{GHz}} \leq 3.0$
Numeric threshold (2402MHz) $\leq 9.678\text{mW}$

>> Numeric threshold (2440MHz), $\text{mW} / 5\text{mm} \cdot \sqrt{2.440\text{GHz}} \leq 3.0$
Numeric threshold (2440MHz) $\leq 9.602\text{mW}$

>> Numeric threshold (2480MHz), $\text{mW} / 5\text{mm} \cdot \sqrt{2.480\text{GHz}} \leq 3.0$
Numeric threshold (2480MHz) $\leq 9.525\text{mW}$

>> The power of EUT measured (2402MHz) is: $-0.85\text{dBm} = 0.822\text{mW}$
The power of EUT measured (2440MHz) is: $-0.48\text{dBm} = 0.895\text{mW}$
The power of EUT measured (2480MHz) is: $-0.56\text{dBm} = 0.879\text{mW}$

Which is smaller than the Numeric threshold.

Therefore, the device is exempt from stand-alone SAR test requirements.