

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION REPORT

OF

Applicant: Universal Electronics Inc.
201 East Sandpoint Ave 8th Floor Santa Ana CA 92707
USA

Product Name: UE878 LGA Module

Brand Name: Universal Electronics Inc.

Model No.: 59007

Model Difference: N/A

Report Number: ER/2020/20098

FCC ID: MG3-59007

IC: 2575A-59007

FCC Rule Part: §15.247, Cat: DTS

IC RSS: RSS-247 issue 2 Feb 2017

Issue Date: Mar. 26, 2020

Date of Test: Feb. 15, 2020

Date of EUT Received: Feb. 05, 2020

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Approved By: _____



Jim Chang / Manager



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Revision History

Report Number	Revision	Description	Issue Date	Remark
ER/2020/20098	Rev.00	Original.	Mar. 26, 2020	Revised By: Karen Huang

Note:

- 1、Radiated measurement results in the original test report **ER/2020/20008** are fully leveraged in this test report to demonstrate compliance.
- 2、Host Multiple Model numbers or Trademarks
The variant model numbers are assessed as identical in hardware and software to each other, hence all variants are fully covered by the test results in this test report without further verification test.
- 3、Disclaimer
Variant information among host model numbers is provided by the applicant, test results of this report are applicable to the sample EUT received.

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1 GENERAL INFORMATION

1.1 Product Description

Product Name of Host:	Wired Remote Controller
Brand Name of Host:	Daikin
Marketing Name of Host:	BRC1H
FCC Model No. of Host:	BRC1H**** (* can 0 to 9 or A to Z or blank for marketing use only)
IC Model No. of Host:	BRC1H71W
FCC Model Difference of Host:	For marketing purpose
Hardware Version of Host:	N/A
Software Version of Host:	N/A
Model No. of BT/WLAN Module:	59007
Class II & Class IV Permissive change:	UE878 LGA Module INSTALLED IN Wired Remote Controller
Power Supply:	17.6Vdc from DC power supply

Radio Technology:	Bluetooth LE Single mode
Frequency Range:	2402 – 2480MHz
Channel number:	40 channels
Modulation type:	GFSK

1.2 Antenna Designation

Antenna Type	Supplier	Antenna Part No.	Freq.	Peak Antenna Gain (dBi)	Worst Antenna Gain
PCB	Universal Electronics Inc.	N/A	2.4GHz	1.37	-

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1.3 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247
FCC KDB 558074 D01 DTS Meas. Guidance v05r02
RSS-247 issue 2 Feb. 2017
RSS-Gen. issue 5, Amendment 1, March 2019
ANSI C63.10:2013

1.4 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory (TAF code 0513)
No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803

FCC Designation number: TW0001

ISED CAB identifier: TW0513

1.5 Special Accessories

There are no special accessories used while test was conducted.

1.6 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

2.4 Measurement Results Explanation Example

2.4.1 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

2.4.2 For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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2.5 Configuration of Tested System

Fig 2-1 Radiated Emission

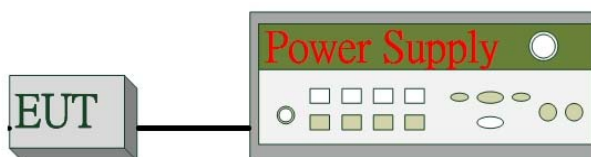


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1	Bluetooth LE Test Software	N/A	N/A	N/A	N/A	N/A
2	DC Power Supply	Agilent	E3640A	MY40000811	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§15.247(d) §15.205	RSS-247 §5.5 RSS-Gen §8.10	Radiated Band Edge	Compliant
§15.247(d) §15.209	RSS-247 §5.5 RSS-Gen §8.9	Radiated Spurious Emission	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operated in 2400 ~ 2483.5MHz Band

40 channels are provided for Bluetooth LE

ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY
1	2402 MHz	15	2430 MHz	29	2458 MHz
2	2404 MHz	16	2432 MHz	30	2460 MHz
3	2406 MHz	17	2434 MHz	31	2462 MHz
4	2408 MHz	18	2436 MHz	32	2464 MHz
5	2410 MHz	19	2438 MHz	33	2466 MHz
6	2412 MHz	20	2440 MHz	34	2468 MHz
7	2414 MHz	21	2442 MHz	35	2470 MHz
8	2416MHz	22	2444 MHz	36	2472 MHz
9	2418 MHz	23	2446 MHz	37	2474 MHz
10	2420 MHz	24	2448 MHz	38	2476 MHz
11	2422 MHz	25	2450 MHz	39	2478 MHz
12	2424 MHz	26	2452 MHz	40	2480 MHz
13	2426 MHz	27	2454 MHz		
14	2428 MHz	28	2456 MHz		

4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case.

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MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	DATA RATE (Mbps)
RADIATED EMISSION TEST (BELOW 1 GHz)				
Bluetooth LE	2402 to 2480	2442	GFSK	1
RADIATED EMISSION TEST (ABOVE 1 GHz)				
Bluetooth LE	2402 to 2480	2402, 2442, 2480	GFSK	1
Note: The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth LE Transmitter for channel Low, Mid and High, the worst case H position for radiated band edge and E2 position for radiated spurious emission was reported.				

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5 MEASUREMENT UNCERTAINTY

Radiated Spurious Emission Measurement Uncertainty	
Polarization: Vertical	9kHz~30MHz: +/-2.3dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB
Polarization: Horizontal	9kHz~30MHz: +/-2.3dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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6 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

6.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 and RSS-Gen §8.9 Table 5 and 6 limit as below.

And according to §15.33(a) (1) & RSS-Gen §6.13.2.a for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (dBμV/m)

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6.2 Measurement Equipment Used

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Horn Antenna	Schwarzbeck	BBHA9170	184	12/25/2019	12/24/2020
Horn Antenna	Schwarzbeck	BBHA9120D	D803	12/20/2019	12/19/2020
Bi-log Antenna	TESEO	CBL 6112D	35242 & AT-N0555	01/13/2020	01/12/2021
Loop Antenna	ETS.LINDGREN	6502	148045	10/15/2019	10/14/2020
Spectrum Analyzer	Agilent	E4446A	MY51100003	10/23/2019	10/22/2020
DC Power Supply	Agilent	E3640A	MY40005907	10/22/2019	10/21/2020
EMI Test Receiver	R&S	ESCI 7	1166.5950.07	07/04/2019	07/03/2020
Pre-Amplifier	EMC Instruments	EMC184045B	980135	01/02/2020	01/01/2021
Pre-Amplifier	EMC Instruments	EMC051825	980152	01/02/2020	01/01/2021
Pre-Amplifier	HP	8447D	2944A09469	01/02/2020	01/01/2021
Attenuator	Mini-Circuit	BW-S10W2+	4	01/02/2020	01/01/2021
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M1	01/02/2020	01/01/2021
High Pass Filter	WI	WHKX4.0/18G-10SS	22	01/02/2020	01/01/2021
Coaxial Cable	Huber Suhner	succoflex 102	MY2622/2	01/02/2020	01/01/2021
Coaxial Cable	Huber Suhner	succoflex 104A	800086/4a	01/02/2020	01/01/2021
Coaxial Cable	Huber Suhner	EMC 104-SM-SM-2000	160123	01/02/2020	01/01/2021

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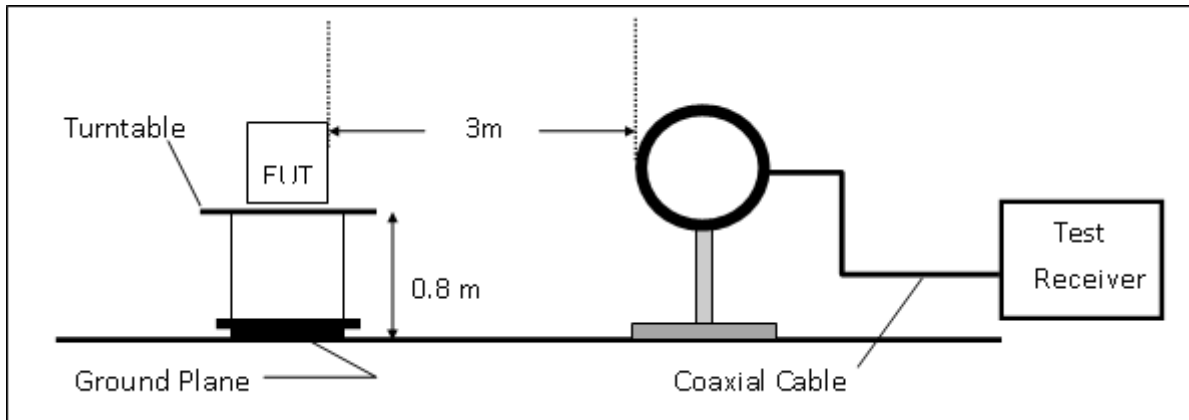
f (886-2) 2298-0488

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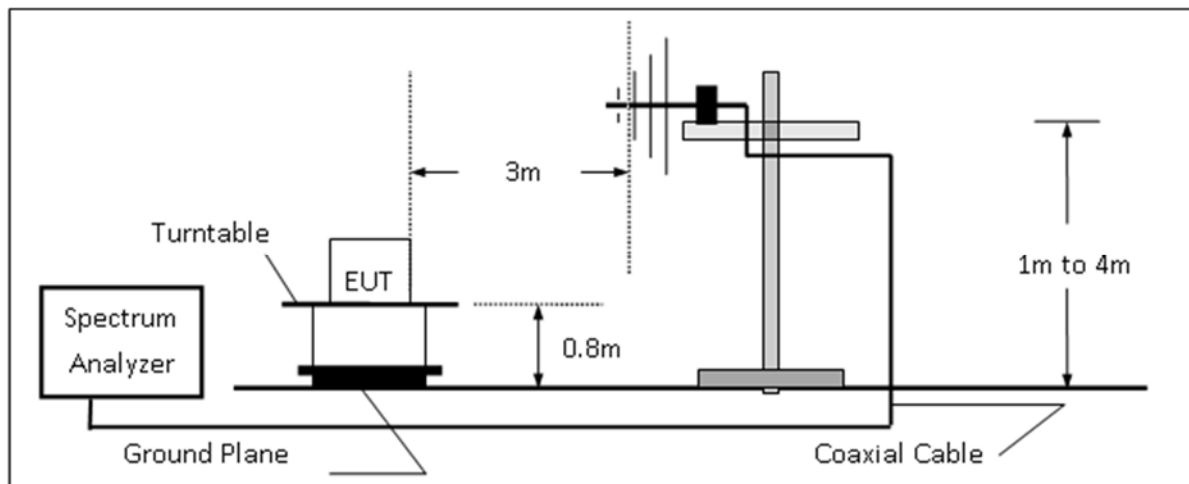
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6.3 Test SET-UP

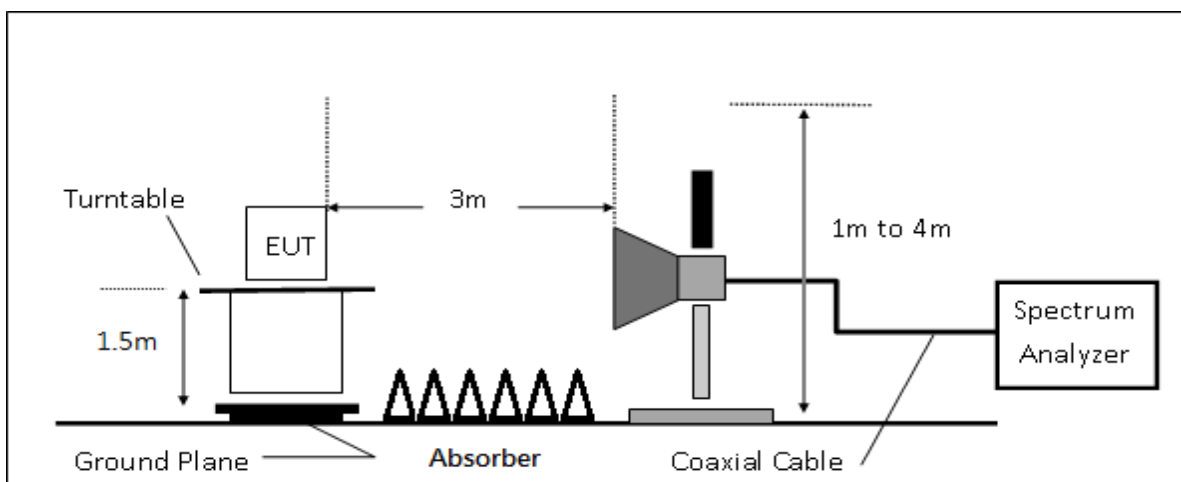
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-Up, Frequency form 30MHz to 1000MHz



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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6.4 Measurement Procedure

1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
2. The EUT was placed on a turn table with 0.8m for frequency < 1GHz and 1.5m for frequency > 1GHz above ground plan.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
6. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
7. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
8. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
9. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
10. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
11. Repeat above procedures until all default test channel measured were complete.

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6.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where *FS* = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

The limit of the emission level is expressed in dBuV/m, which converts $20 \cdot \log(\mu\text{V/m})$

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

6.6 Test Results of Radiated Spurious Emissions form 9 kHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

6.7 Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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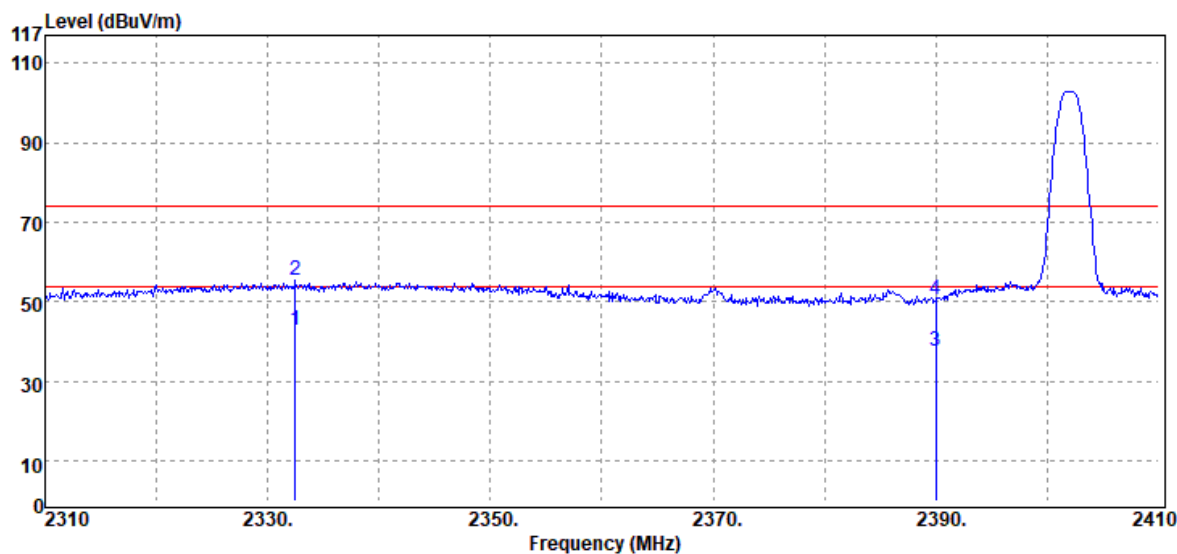
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6.7.1 Radiated Band Edge Measurement Result

Report Number :ER/2020/20008
Operation Mode :BLE(1M)
Test Channel :2402 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Date :2020-02-15
Temp./Humi. :21.6/70
Antenna Pol. :VERTICAL
Engineer :Thomas



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2332.50	Average	35.21	7.71	42.92	54.00	-11.08
2332.50	Peak	47.77	7.71	55.48	74.00	-18.52
2390.00	Average	30.02	7.57	37.59	54.00	-16.41
2390.00	Peak	42.97	7.57	50.54	74.00	-23.46

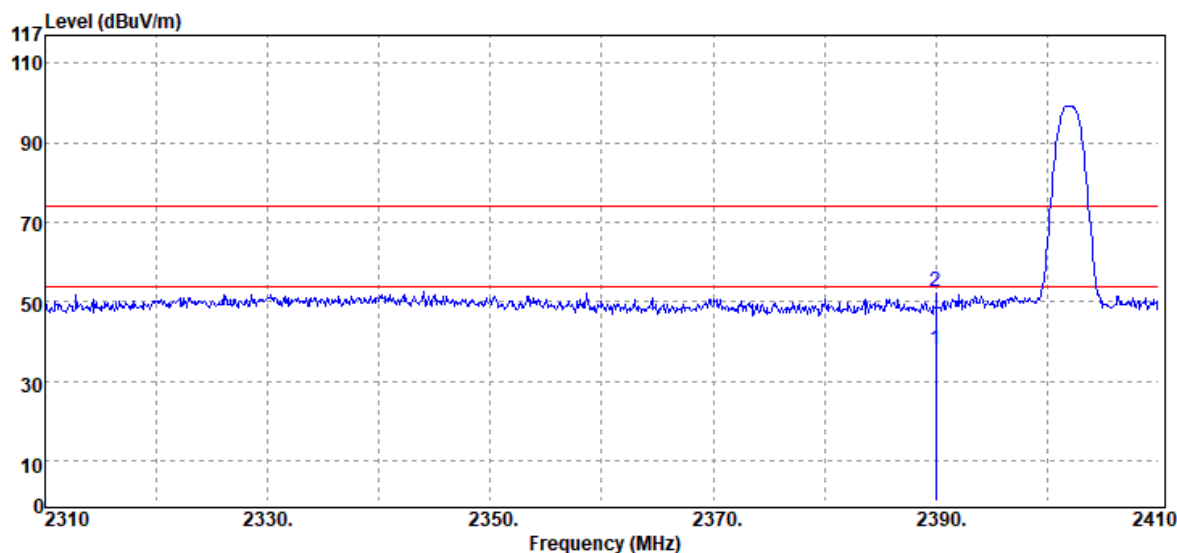
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Report Number :ER/2020/20008
Operation Mode :BLE(1M)
Test Channel :2402 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Date :2020-02-15
Temp./Humi. :21.6/70
Antenna Pol. :HORIZONTAL
Engineer :Thomas



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	Average	30.41	7.57	37.98	54.00	-16.02
2390.00	Peak	45.16	7.57	52.73	74.00	-21.27

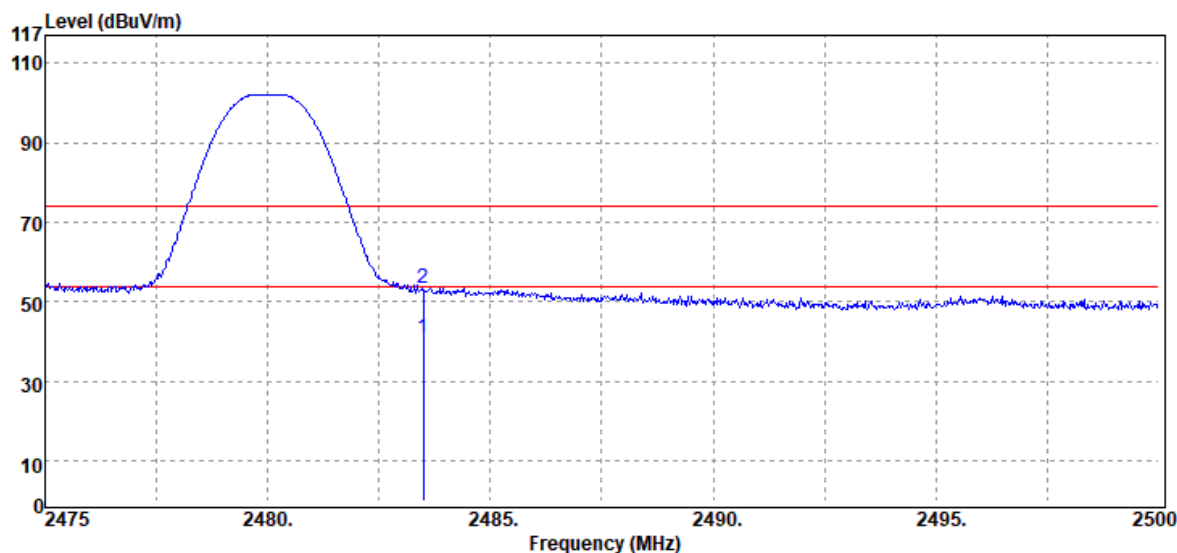
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Report Number :ER/2020/20008
Operation Mode :BLE(1M)
Test Channel :2480 MHz
Test Mode :Bandedge CH High
EUT Pol :H Plane

Test Date :2020-02-15
Temp./Humi. :21.6/70
Antenna Pol. :VERTICAL
Engineer :Thomas



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Average	34.11	6.94	41.05	54.00	-12.95
2483.50	Peak	46.39	6.94	53.33	74.00	-20.67

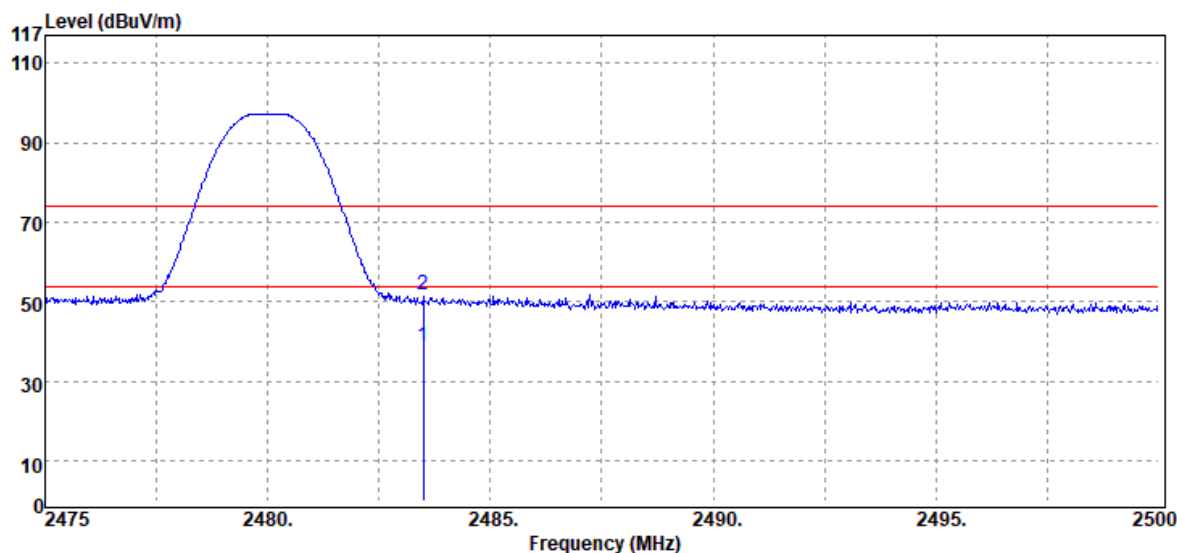
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Report Number :ER/2020/20008
Operation Mode :BLE(1M)
Test Channel :2480 MHz
Test Mode :Bandedge CH High
EUT Pol :H Plane

Test Date :2020-02-15
Temp./Humi. :21.6/70
Antenna Pol. :HORIZONTAL
Engineer :Thomas



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Average	32.11	6.94	39.05	54.00	-14.95
2483.50	Peak	44.87	6.94	51.81	74.00	-22.19

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6.7.2 Radiated Spurious Emission from 30MHz to 1000MHz

Report Number :ER/2020/20008

Test Date :2020-02-15

Operation Mode :BLE(1M)

Temp./Humi. :21.6/70

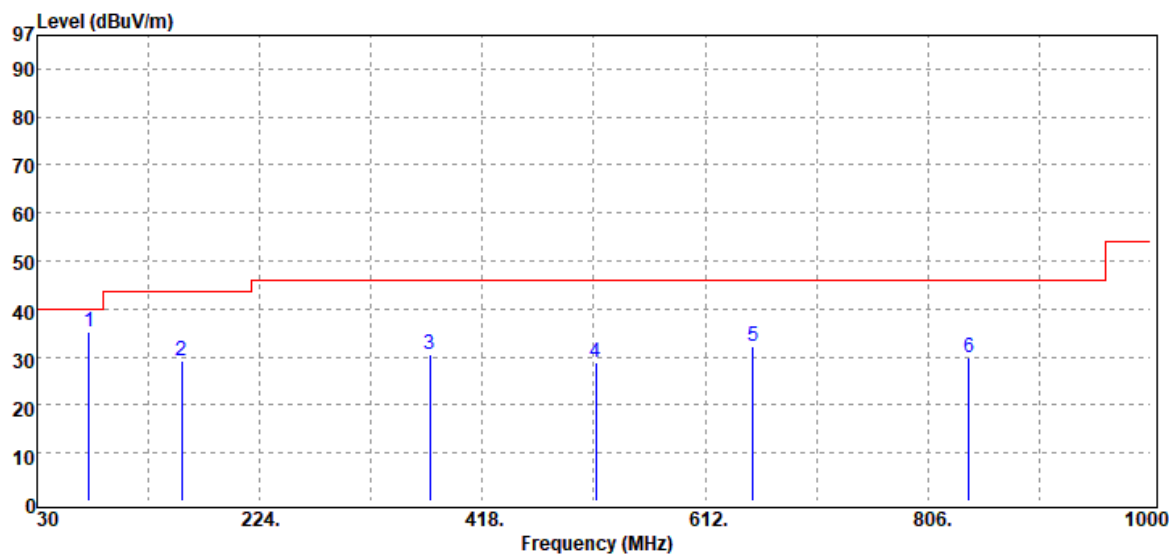
Test Channel :2442 MHz

Antenna Pol. :VERTICAL

Test Mode :TX CH Mid

Engineer :Thomas

EUT Pol :E2 Plane



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
75.59	Peak	51.82	-16.74	35.08	40.00	-4.92
156.10	Peak	41.45	-12.30	29.15	43.50	-14.35
372.41	Peak	37.40	-6.98	30.42	46.00	-15.58
516.94	Peak	33.33	-4.40	28.93	46.00	-17.07
653.71	Peak	34.84	-2.57	32.27	46.00	-13.73
841.89	Peak	29.82	0.12	29.94	46.00	-16.06

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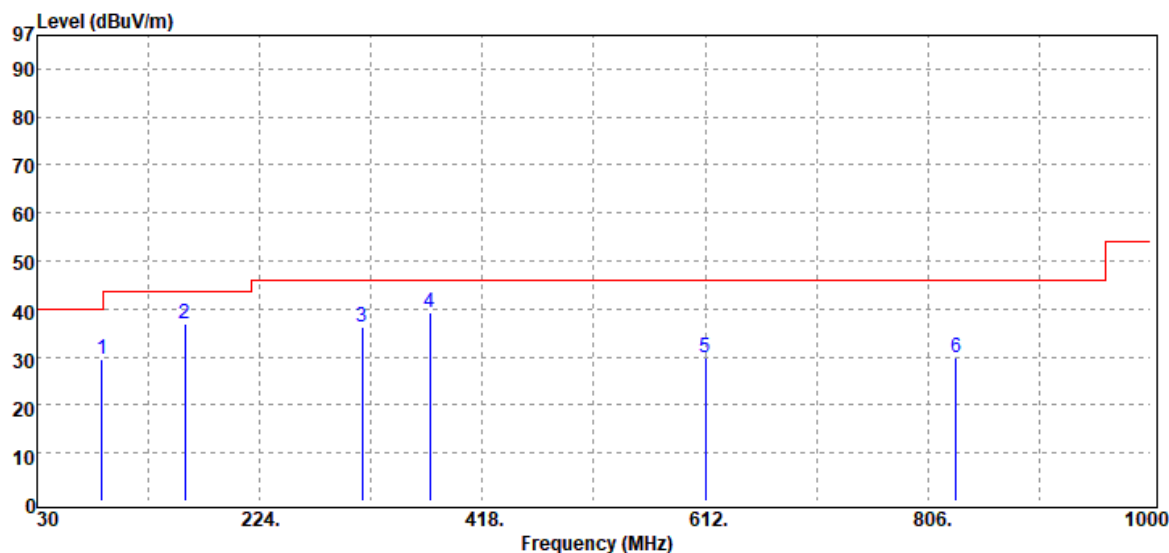
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Report Number :ER/2020/20008
Operation Mode :BLE(1M)
Test Channel :2442 MHz
Test Mode :TX CH Mid
EUT Pol :E2 Plane

Test Date :2020-02-15
Temp./Humi. :21.6/70
Antenna Pol. :HORIZONTAL
Engineer :Thomas



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
86.26	Peak	45.04	-15.62	29.42	40.00	-10.58
159.01	Peak	49.31	-12.35	36.96	43.50	-6.54
313.24	Peak	44.50	-8.12	36.38	46.00	-9.62
372.41	Peak	46.19	-6.98	39.21	46.00	-6.79
612.00	Peak	33.34	-3.37	29.97	46.00	-16.03
830.25	Peak	30.35	-0.38	29.97	46.00	-16.03

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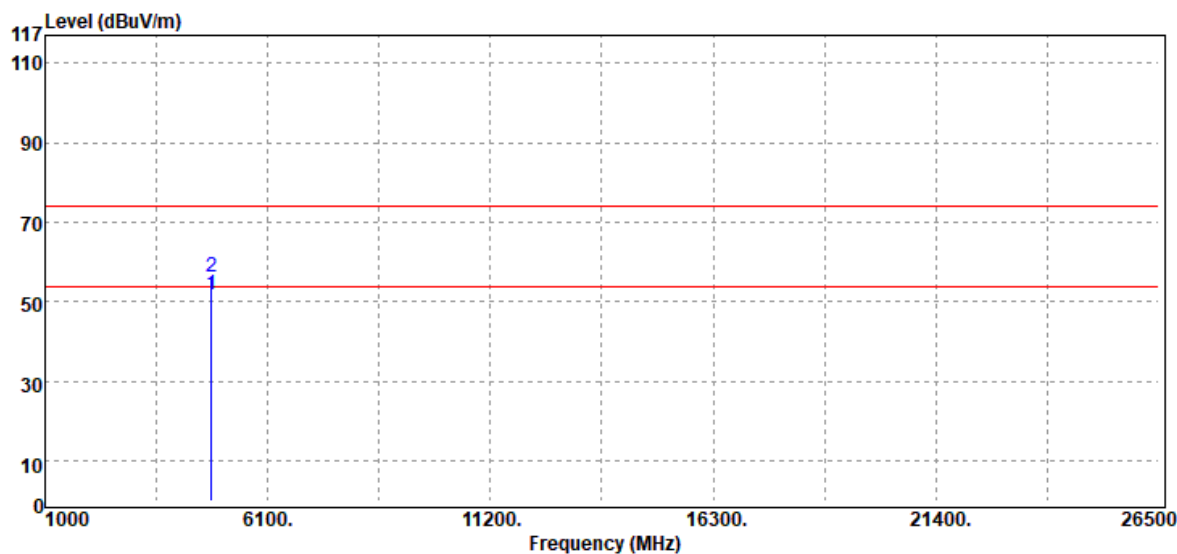
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6.7.3 Radiated Spurious Emission above 1GHz

Report Number :ER/2020/20008
 Operation Mode :BLE(1M)
 Test Channel :2402 MHz
 Test Mode :TX CH Low
 EUT Pol :E2 Plane

Test Date :2020-02-15
 Temp./Humi. :21.6/70
 Antenna Pol. :VERTICAL
 Engineer :Thomas



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBUV/m	Limit @3m dBUV/m	Margin dB
4804.00	Average	37.44	14.57	52.01	54.00	-1.99
4804.00	Peak	41.51	14.57	56.08	74.00	-17.92

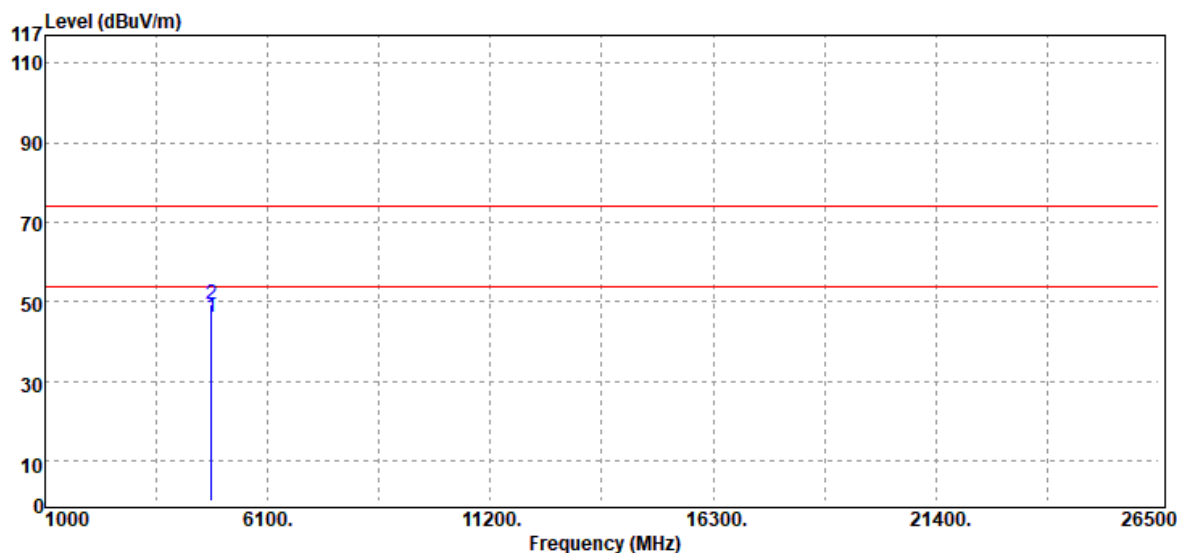
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Report Number :ER/2020/20008
Operation Mode :BLE(1M)
Test Channel :2402 MHz
Test Mode :TX CH Low
EUT Pol :E2 Plane

Test Date :2020-02-15
Temp./Humi. :21.6/70
Antenna Pol. :HORIZONTAL
Engineer :Thomas



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	Average	31.51	14.57	46.08	54.00	-7.92
4804.00	Peak	34.65	14.57	49.22	74.00	-24.78

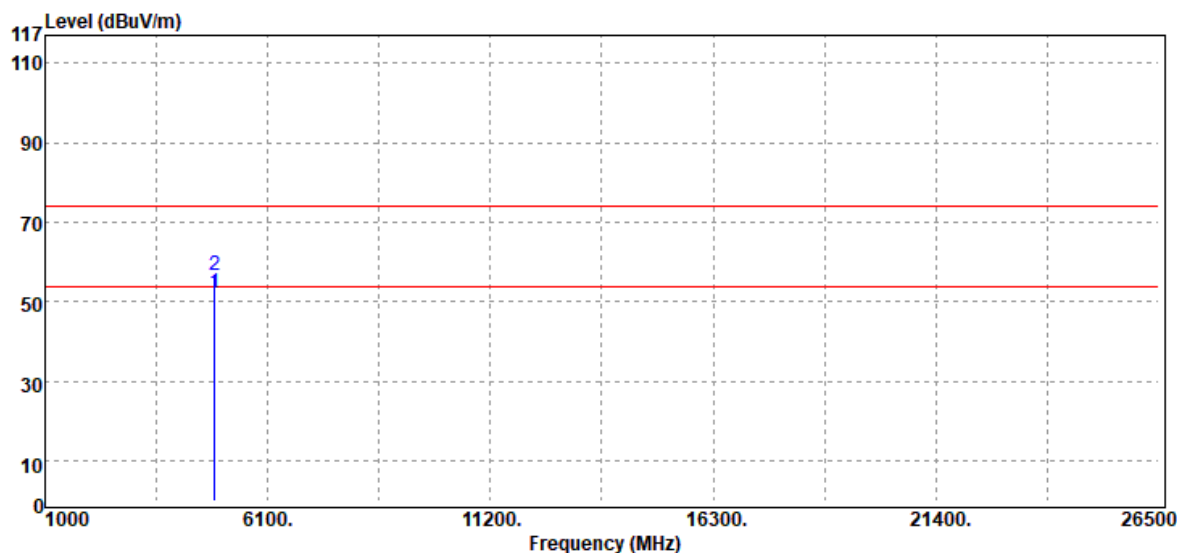
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Report Number :ER/2020/20008
Operation Mode :BLE(1M)
Test Channel :2442 MHz
Test Mode :TX CH Mid
EUT Pol :E2 Plane

Test Date :2020-02-15
Temp./Humi. :21.6/70
Antenna Pol. :VERTICAL
Engineer :Thomas



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4884.00	Average	37.10	15.09	52.19	54.00	-1.81
4884.00	Peak	41.48	15.09	56.57	74.00	-17.43

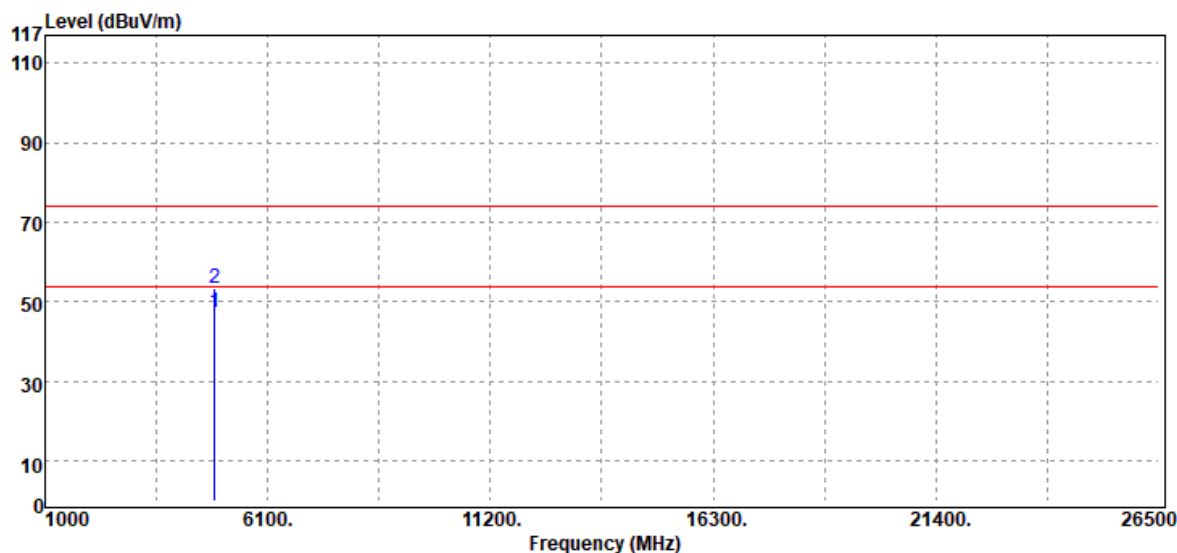
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Report Number :ER/2020/20008
Operation Mode :BLE(1M)
Test Channel :2442 MHz
Test Mode :TX CH Mid
EUT Pol :E2 Plane

Test Date :2020-02-15
Temp./Humi. :21.6/70
Antenna Pol. :HORIZONTAL
Engineer :Thomas



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4884.00	Average	32.40	15.09	47.49	54.00	-6.51
4884.00	Peak	38.35	15.09	53.44	74.00	-20.56

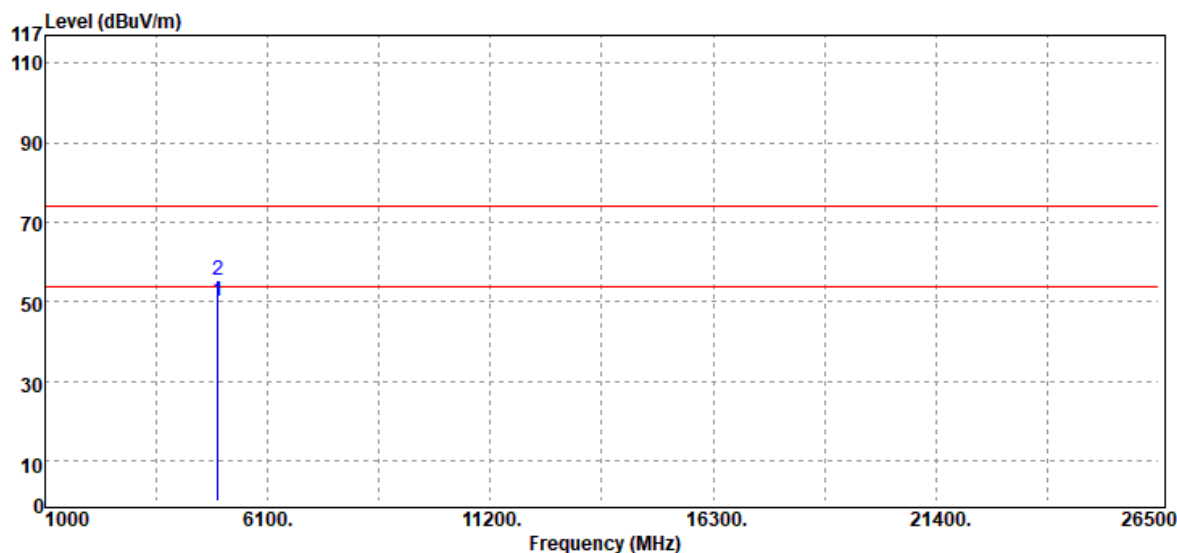
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Report Number :ER/2020/20008
Operation Mode :BLE(1M)
Test Channel :2480 MHz
Test Mode :TX CH High
EUT Pol :E2 Plane

Test Date :2020-02-15
Temp./Humi. :21.6/70
Antenna Pol. :VERTICAL
Engineer :Thomas



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.00	Average	35.01	15.13	50.14	54.00	-3.86
4960.00	Peak	40.34	15.13	55.47	74.00	-18.53

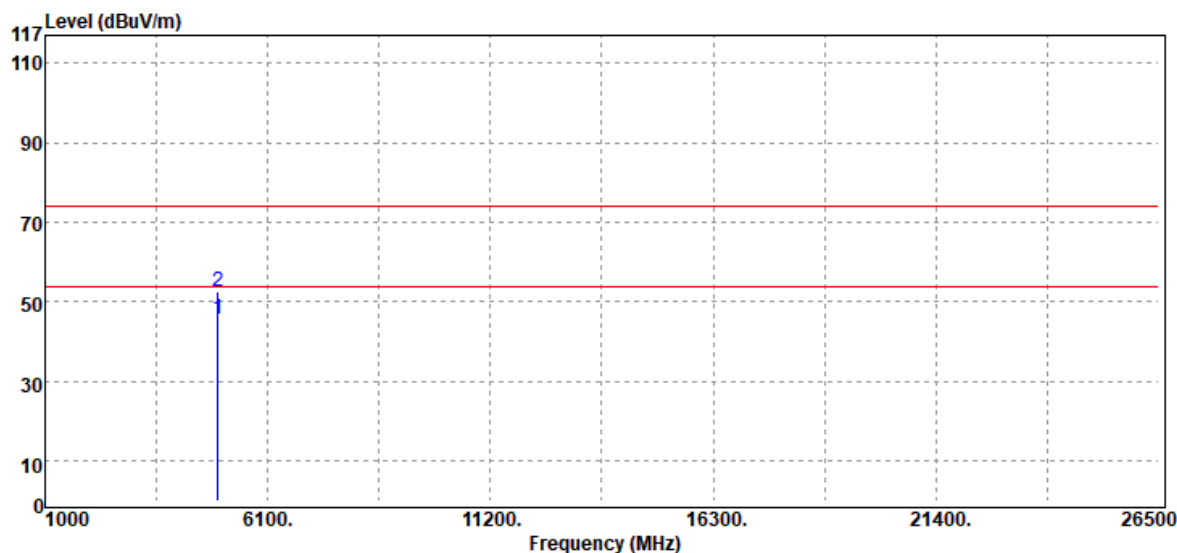
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Report Number :ER/2020/20008
Operation Mode :BLE(1M)
Test Channel :2480 MHz
Test Mode :TX CH High
EUT Pol :E2 Plane

Test Date :2020-02-15
Temp./Humi. :21.6/70
Antenna Pol. :HORIZONTAL
Engineer :Thomas



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.00	Average	30.66	15.13	45.79	54.00	-8.21
4960.00	Peak	37.56	15.13	52.69	74.00	-21.31

~ End of Report ~

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