

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT CLASS II PC REPORT

OF

Applicant: Bitatek Co., Ltd.
6F., No. 115, Wugong 3rd Rd., Wugu Dist., New Taipei City
248, Taiwan

Product Name: Frey

Brand Name: Bitatek

Model No.: Frey M1-0000, Frey M1-0010

Model Difference: Frey M1-0000 with GPS, Frey M1-0010 without GPS

FCC ID: SPYIM0002

Report Number: ER/2018/90170

FCC Rule Part: §15.247, Cat: DTS

Issue Date: Dec. 13, 2018

Date of Test: Sep. 28, 2018 ~ Oct. 29, 2018

Date of EUT Received: Sep. 28, 2018

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.

Test By: CHUN-CHIEH, CHEN
Chun Chieh Chen / Asst. Supervisor

Approved By: Jay Lin
Jay Lin / Asst. Supervisor



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Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
ER/2018/90170	Rev.00	Initial creation of document	All	Nov. 22, 2018	Violetta Tang
ER/2018/90170	Rev.01	Add statements of worst case testing on page 8	All	Dec. 13, 2018	Violetta Tang

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1 GENERAL INFORMATION

1.1 Product description

General:

Product Name of Host:	Mobile Computers	
Brand Name of Host:	Opticon	
Model No. of Host:	H-28 NCSA	
Model Difference:	N/A	
Hardware Version:	ES1	
Software Version:	0.1.25.12	
Scope:	The test report covers the radiated emissions requirements of the standards referenced in the report to allow system level approval of the module in this specific host.	
Class II Permissive change:	Frey INSTALLED IN Mobile Computers	
USB Cable:	Model No.: 3C10-00000583, Supplier: Bitatek	
Power Supply:	3.7Vdc from Rechargeable Li-polymer Battery or 5V from AC/DC Adapter	
	Battery:	1. Model No.: BTBAT2, Supplier: Leung's Communication & Electric Products (Guangzhou) LTD. 2. Model No.: BTBAT1, Supplier: Leung's Communication & Electric Products (Guangzhou) LTD.
	Adapter:	Model No.: S018BDV0900200, Supplier: Ten Pao Industrial Co., Ltd.

Bluetooth Version:	V4.1 dual mode
Channel number:	40 channels
Modulation type:	GFSK
Frequency Range:	2.402GHz – 2.480GHz
Antenna Designation:	IFA Antenna, Gain: 2dBi

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1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247
FCC KDB 558074 D01 DTS Meas. Guidance
ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards.

1.3 Test Facility

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

FCC Registration Numbers are: 509634 / TW0001

1.4 Special Accessories

There are no special accessories used while test was conducted.

1.5 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 for DSS & DTS

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.

2.3.2 Radiated Emissions (ERP/EIRP) for PCE

According to measurement procured TIA/EIA 603C, The EUT is placed on a turn table which is 0.8 m above ground plane. 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 according to the requirements in Section 8 and 13.

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2.4 Configuration of Tested System

Fig. 2-1 Radiated Emission Configuration



Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A

3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.247(d)	Radiated Band Edge and Spurious Emission	Compliant
§15.203 §15.247(b)	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

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.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
RADIATED EMISSION TEST (BELOW 1 GHz)				
Bluetooth LE	0 to 39	0,20,39	GFSK	1
RADIATED EMISSION TEST (ABOVE 1 GHz)				
Bluetooth LE	0 to 39	0,20,39	GFSK	1

RADIATED BAND EDGE EMISSION TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,39	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 was reported.

Note: Pre-scanned was done on rechargeable Li-polymer battery model no.: BTBAT2 & BTBAT1 and BTBAT2 results higher emission. Therefore, the completed set of measurement was done on BTBAT2 to be presented on this test report.

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5 MEASUREMENT UNCERTAINTY

Radiated Spurious Emission:

Measurement uncertainty (Polarization : Vertical)	9kHz – 30MHz: +/- 2.87 dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

Measurement uncertainty (Polarization : Horizontal)	9kHz – 30MHz: +/- 2.87 dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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6 RADIATED 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 limit as below.

And according to §15.33(a) (1), 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:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Bi-log Antenna	SCHWAZBECK	VULB9168	378	12/29/2017	12/28/2018
Horn Antenna	Schwarzbeck	BBHA9120D	1441	08/16/2018	08/15/2019
Horn Antenna	Schwarzbeck	BBHA9170	184	12/12/2017	12/11/2018
Loop Antenna	ETS.LINDGREN	6502	148045	10/08/2018	10/07/2019
3m Site NSA	SGS	966 chamber	N/A	01/02/2018	01/01/2019
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/15/2018	05/14/2019
EMI Test Receiver	R&S	ESCI7	100335	02/02/2018	02/01/2019
Pre-Amplifier	HP	8449B	3008A00578	01/02/2018	01/01/2019
Pre-Amplifier	HP	8447D	2944A07676	01/02/2018	01/01/2019
Pre-Amplifier	EMC Instru-ments	EMC184045B	980135	10/22/2018	10/21/2019
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2018	01/01/2019
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M1	01/02/2018	01/01/2019
Low Loss Cable	Huber Suhner	966_RX	9	01/02/2018	01/01/2019
Notebook	Lenovo	L420	LR-7HXZA	N/A	N/A

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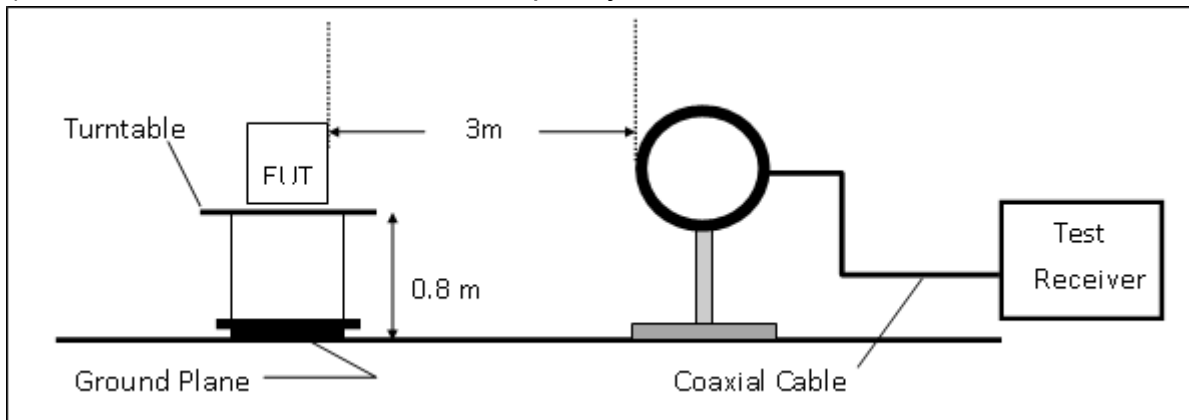
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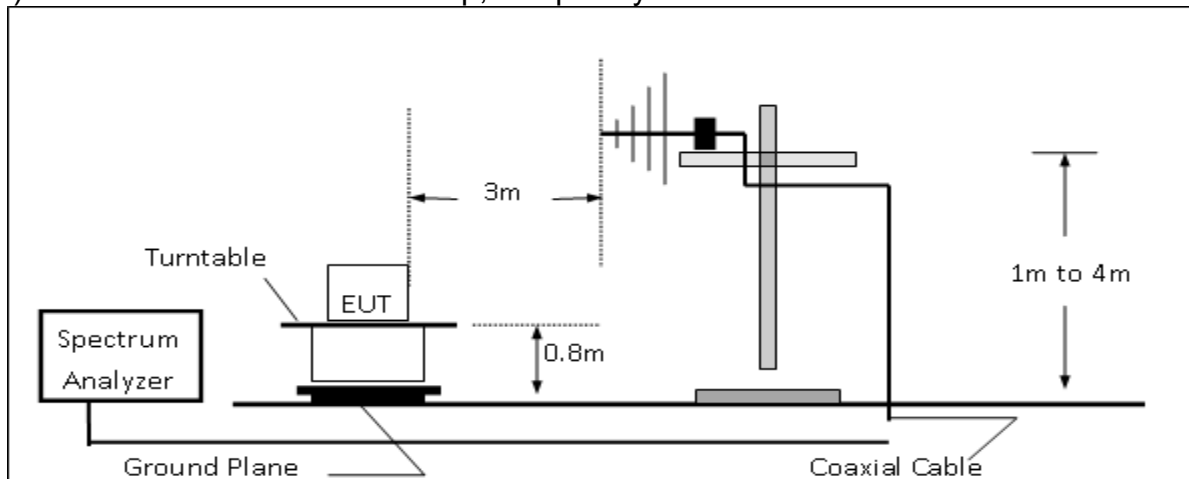
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6.3 Test SET-UP

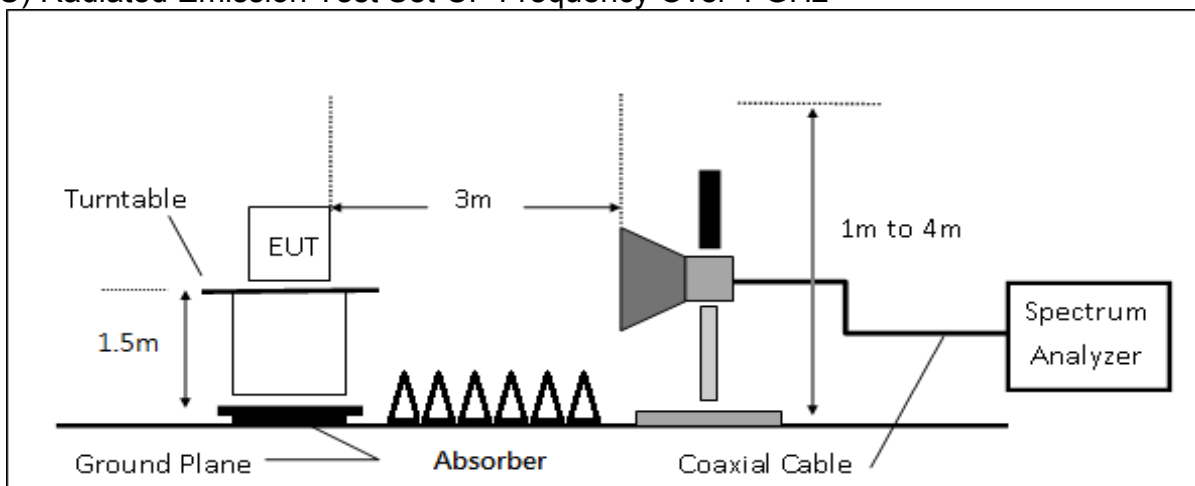
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(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

Radiated Emission

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.

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	

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.

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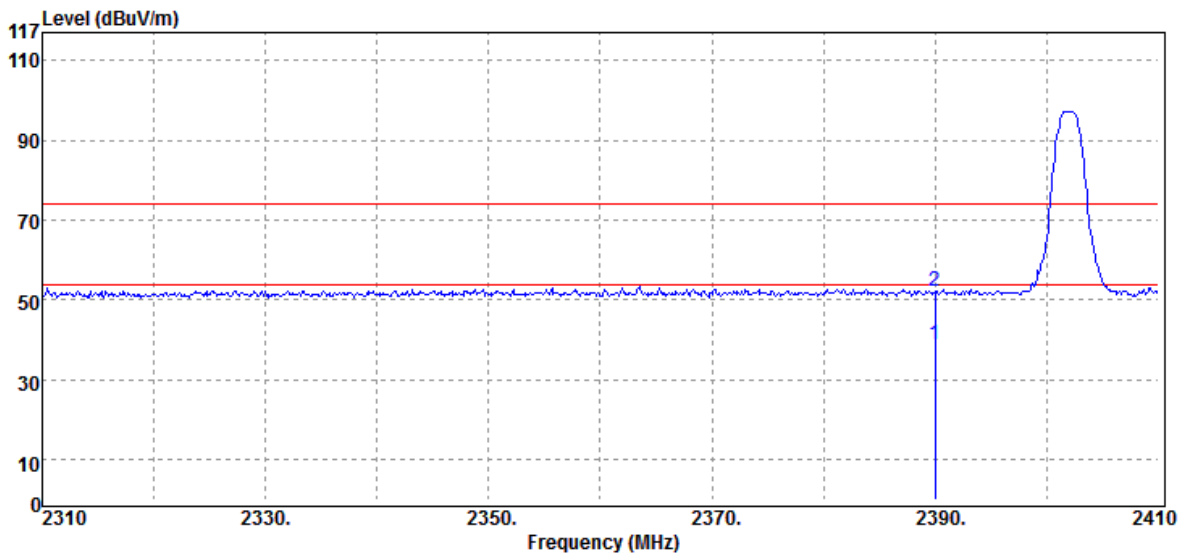
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6.7 Measurement Result:

6.7.1 Radiated Band Edge Measurement Result

Operation Band	:BLE	Test Date	:2018-10-26
Fundamental Frequency	:2402 MHz	Temp./Humi.	:24.1 deg_C / 65 RH
Operation Mode	:Bandedge CH LOW	Engineer	:Wei
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
MHz	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
2390.00	Average	38.48	0.20	38.68	54.00	-15.32
2390.00	Peak	51.99	0.20	52.19	74.00	-21.81

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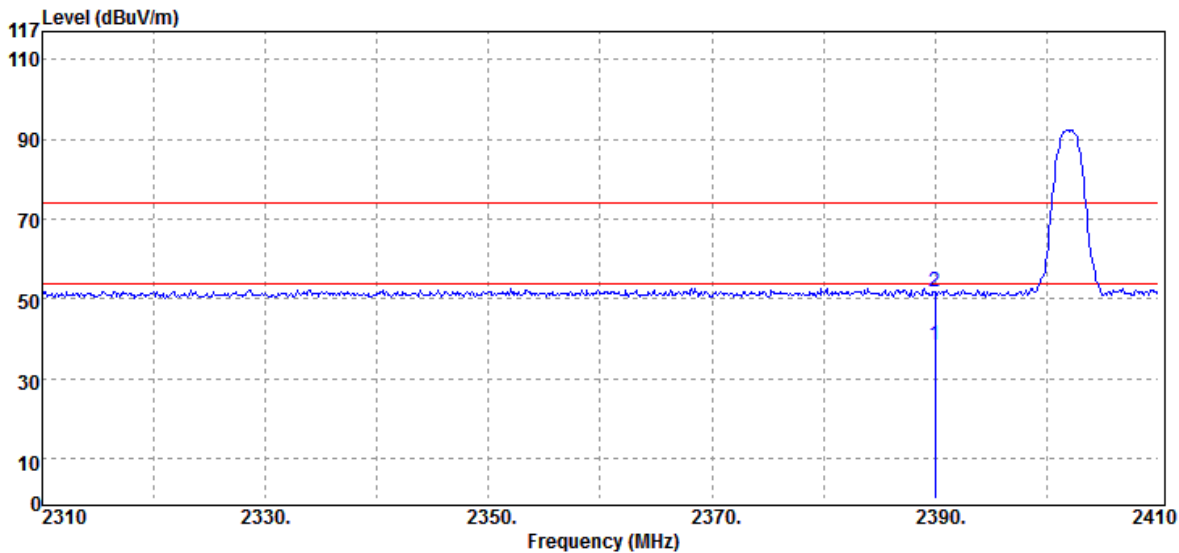
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Operation Band	:BLE	Test Date	:2018-10-26
Fundamental Frequency	:2402 MHz	Temp./Humi.	:24.1 deg_C / 65 RH
Operation Mode	:Bandedge CH LOW	Engineer	:Wei
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
MHz	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
2390.00	Average	38.43	0.20	38.63	54.00	-15.37
2390.00	Peak	51.82	0.20	52.02	74.00	-21.98

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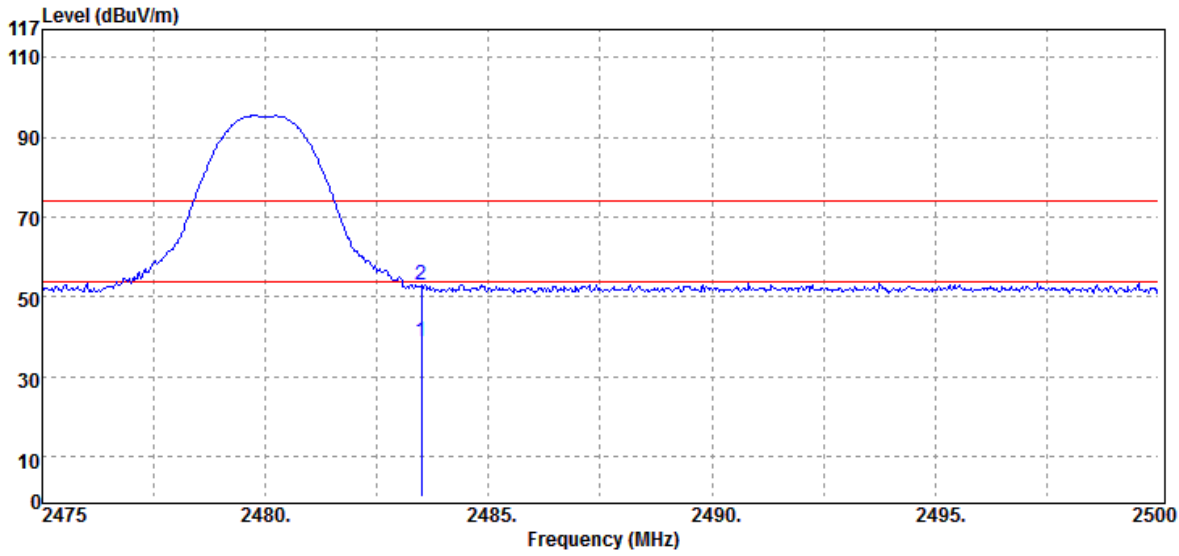
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Operation Band	:BLE	Test Date	:2018-10-26
Fundamental Frequency	:2480 MHz	Temp./Humi.	:24.1 deg_C / 65 RH
Operation Mode	:Bandedge CH HIGH	Engineer	:Wei
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	38.53	0.53	39.06	54.00	-14.94
2483.50	Peak	52.57	0.53	53.10	74.00	-20.90

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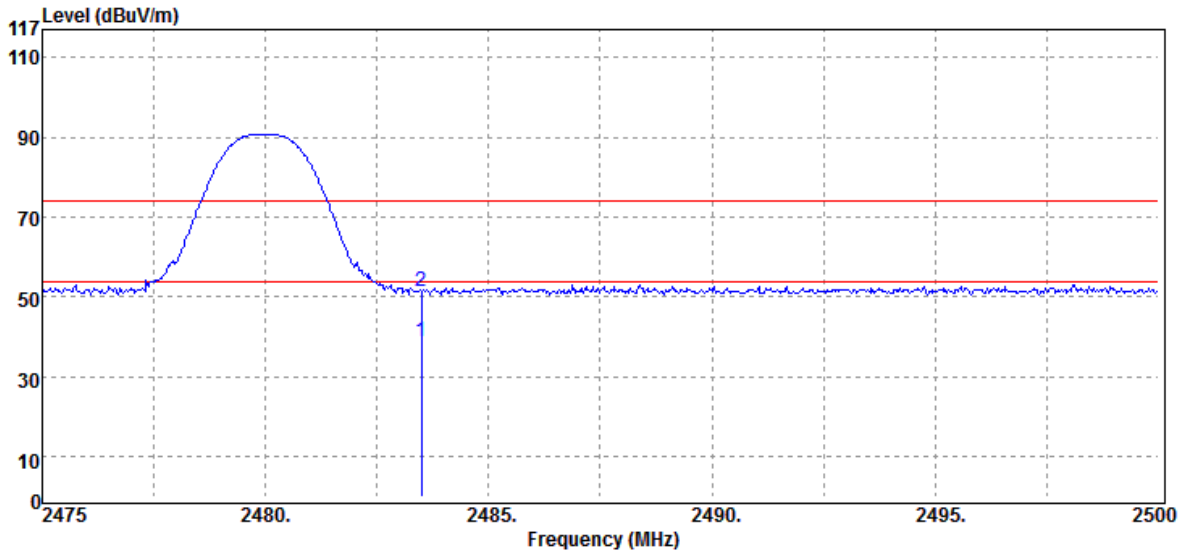
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Operation Band	:BLE	Test Date	:2018-10-26
Fundamental Frequency	:2480 MHz	Temp./Humi.	:24.1 deg_C / 65 RH
Operation Mode	:Bandedge CH HIGH	Engineer	:Wei
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	Average	38.41	0.53	38.94	54.00	-15.06
2483.50	Peak	50.95	0.53	51.48	74.00	-22.52

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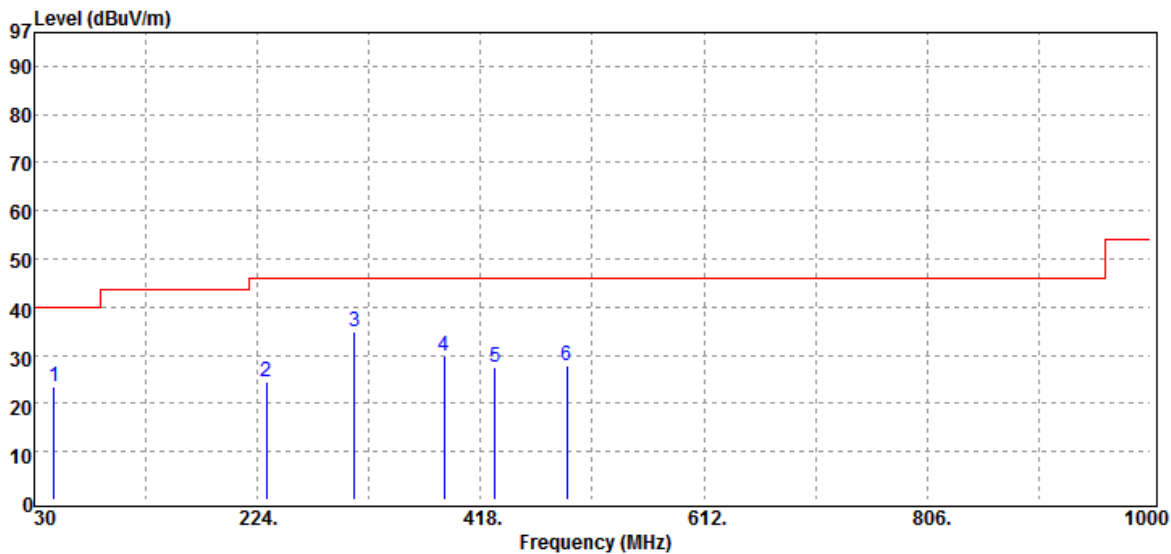
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6.7.2 Radiated Spurious Emission Measurement Result

For Frequency from 30MHz to 1000MHz

Operation Band	:BLE	Test Date	:2018-10-26
Fundamental Frequency	:2442 MHz	Temp./Humi.	:24.1 deg_C / 65 RH
Operation Mode	:Tx CH MID	Engineer	:Wei
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
47.46	Peak	31.03	-7.64	23.39	40.00	-16.61
231.76	Peak	32.76	-8.42	24.34	46.00	-21.66
308.39	Peak	40.31	-5.28	35.03	46.00	-10.97
385.99	Peak	33.55	-3.77	29.78	46.00	-16.22
430.61	Peak	30.09	-2.73	27.36	46.00	-18.64
492.69	Peak	30.27	-2.58	27.69	46.00	-18.31

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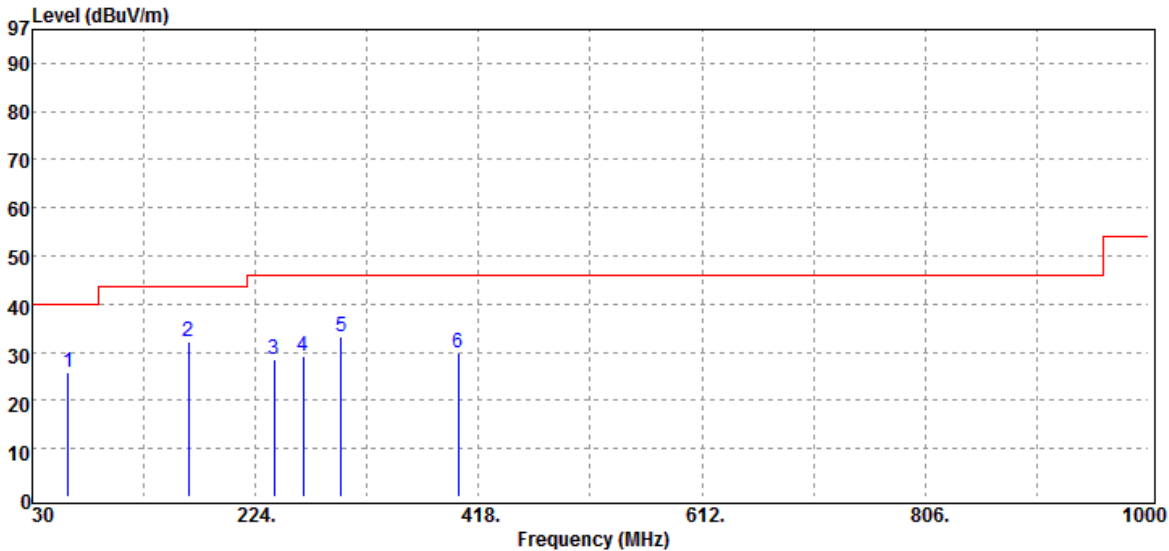
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Operation Band	:BLE	Test Date	:2018-10-26
Fundamental Frequency	:2442 MHz	Temp./Humi.	:24.1 deg_C / 65 RH
Operation Mode	:Tx CH MID	Engineer	:Wei
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Detector Mode	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
61.04	Peak	33.98	-8.05	25.93	40.00	-14.07
165.80	Peak	39.70	-7.32	32.38	43.50	-11.12
240.49	Peak	36.24	-7.79	28.45	46.00	-17.55
265.71	Peak	36.00	-6.80	29.20	46.00	-16.80
298.69	Peak	38.61	-5.55	33.06	46.00	-12.94
400.54	Peak	33.21	-3.37	29.84	46.00	-16.16

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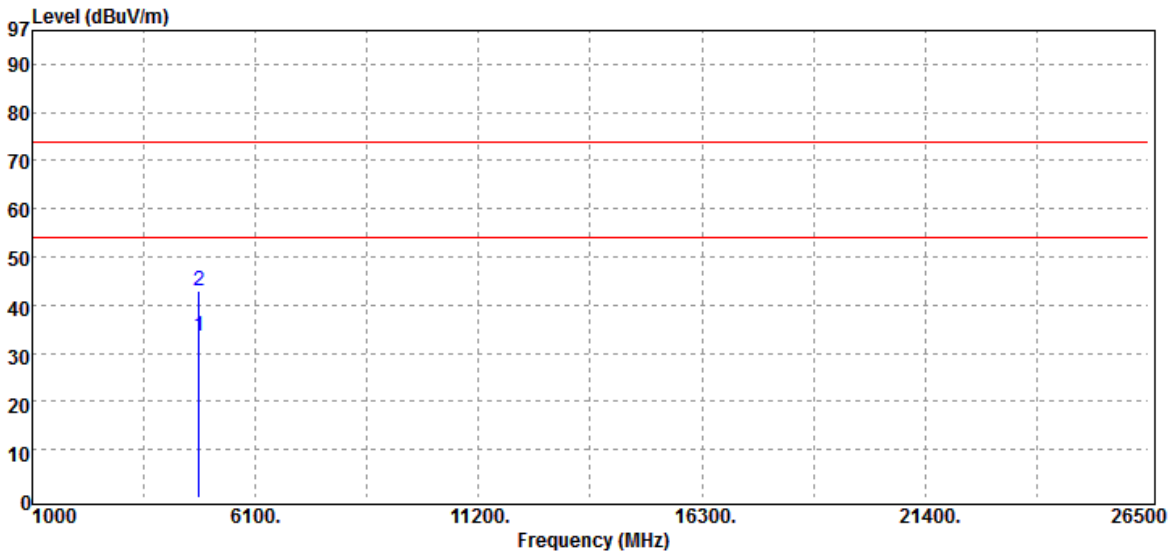
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6.7.3 Radiated Spurious Emission Measurement Result

For Frequency above 1GHz

Operation Band	:BLE	Test Date	:2018-10-26
Fundamental Frequency	:2402 MHz	Temp./Humi.	:24.1 deg_C / 65 RH
Operation Mode	:Tx CH LOW	Engineer	:Wei
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
MHz	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
4804.00	Average	27.81	5.65	33.46	54.00	-20.54
4804.00	Peak	37.20	5.65	42.85	74.00	-31.15

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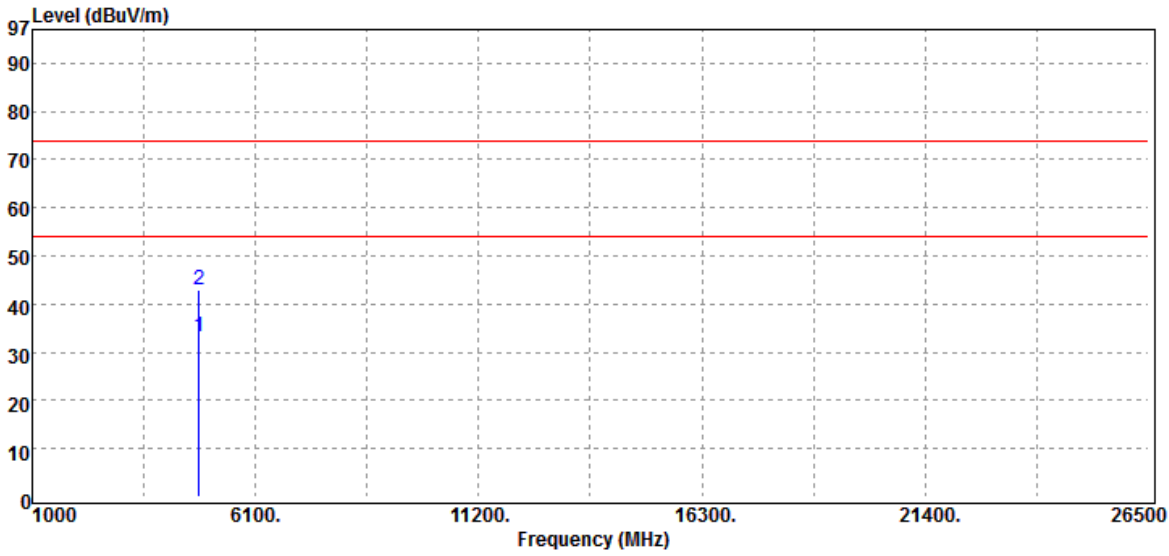
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Operation Band	:BLE	Test Date	:2018-10-26
Fundamental Frequency	:2402 MHz	Temp./Humi.	:24.1 deg_C / 65 RH
Operation Mode	:Tx CH LOW	Engineer	:Wei
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dBμV		dBμV/m	dBμV/m	
4804.00	Average	27.52	5.65	33.17	54.00	-20.83
4804.00	Peak	37.33	5.65	42.98	74.00	-31.02

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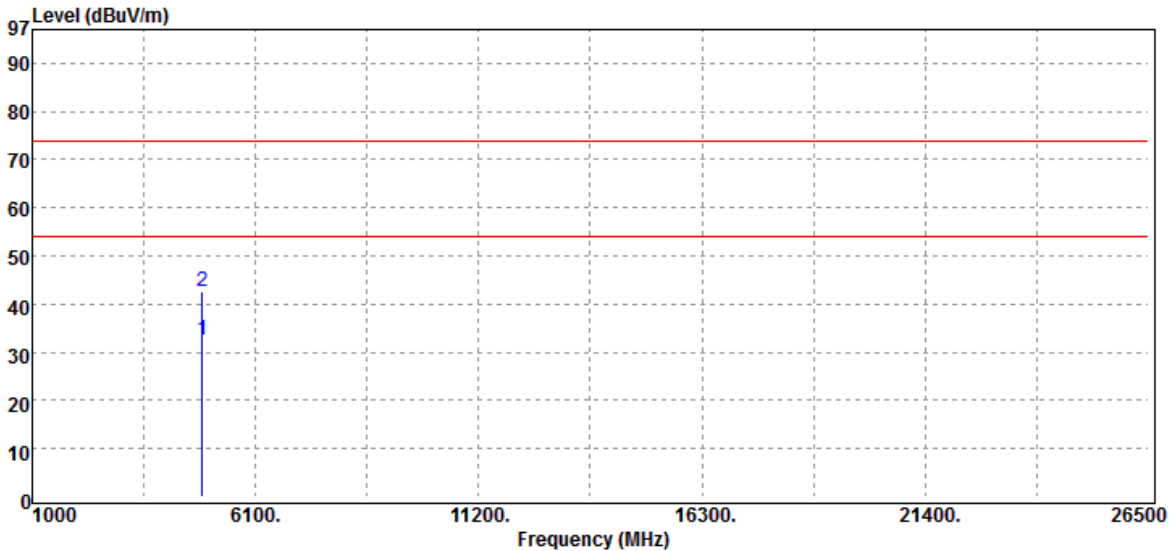
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Operation Band	:BLE	Test Date	:2018-10-26
Fundamental Frequency	:2442 MHz	Temp./Humi.	:24.1 deg_C / 65 RH
Operation Mode	:Tx CH MID	Engineer	:Wei
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dBμV		dBμV/m	dBμV/m	
4884.00	Average	26.72	5.89	32.61	54.00	-21.39
4884.00	Peak	36.60	5.89	42.49	74.00	-31.51

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台灣檢驗科技股份有限公司

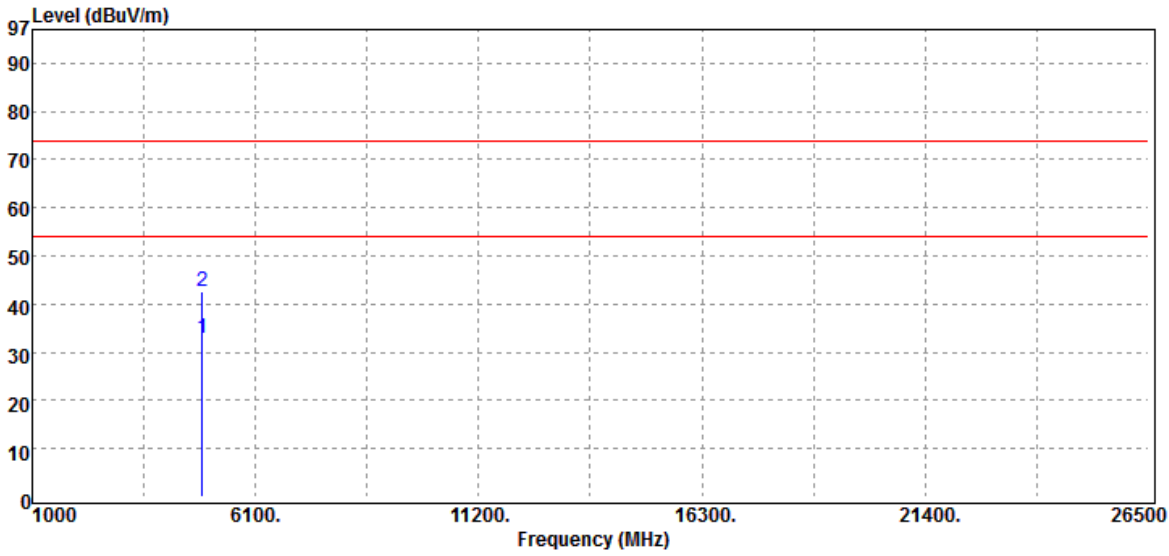
t (886-2) 2299-3279

f (886-2) 2298-0488

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Operation Band	:BLE	Test Date	:2018-10-26
Fundamental Frequency	:2442 MHz	Temp./Humi.	:24.1 deg_C / 65 RH
Operation Mode	:Tx CH MID	Engineer	:Wei
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dBμV		dBμV/m	dBμV/m	
4884.00	Average	26.86	5.89	32.75	54.00	-21.25
4884.00	Peak	36.77	5.89	42.66	74.00	-31.34

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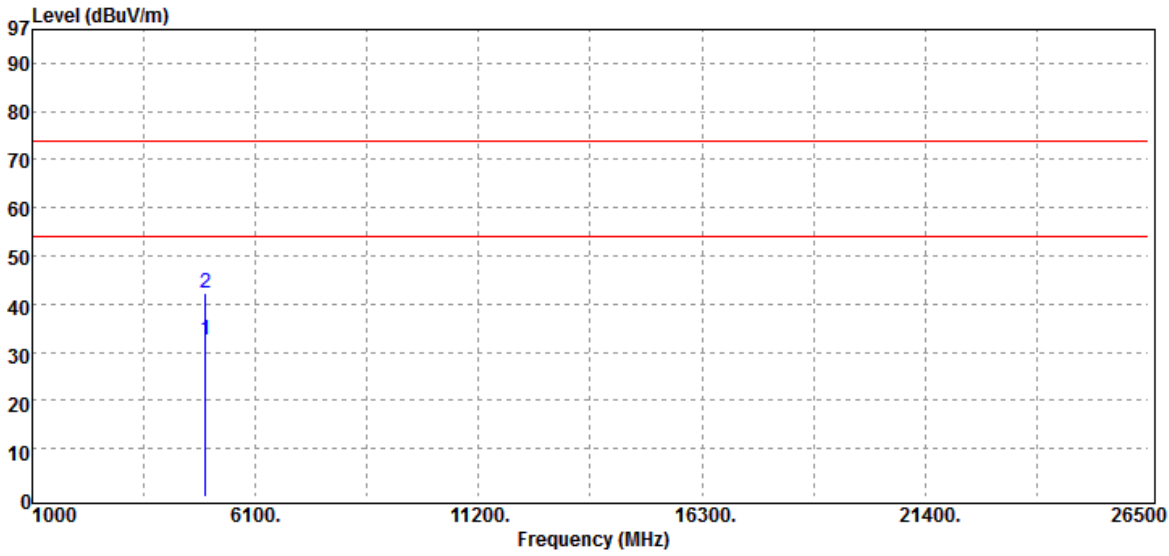
t (886-2) 2299-3279

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Operation Band	:BLE	Test Date	:2018-10-26
Fundamental Frequency	:2480 MHz	Temp./Humi.	:24.1 deg_C / 65 RH
Operation Mode	:Tx CH HIGH	Engineer	:Wei
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dBμV		dBμV/m	dBμV/m	
4960.00	Average	26.62	6.05	32.67	54.00	-21.33
4960.00	Peak	36.33	6.05	42.38	74.00	-31.62

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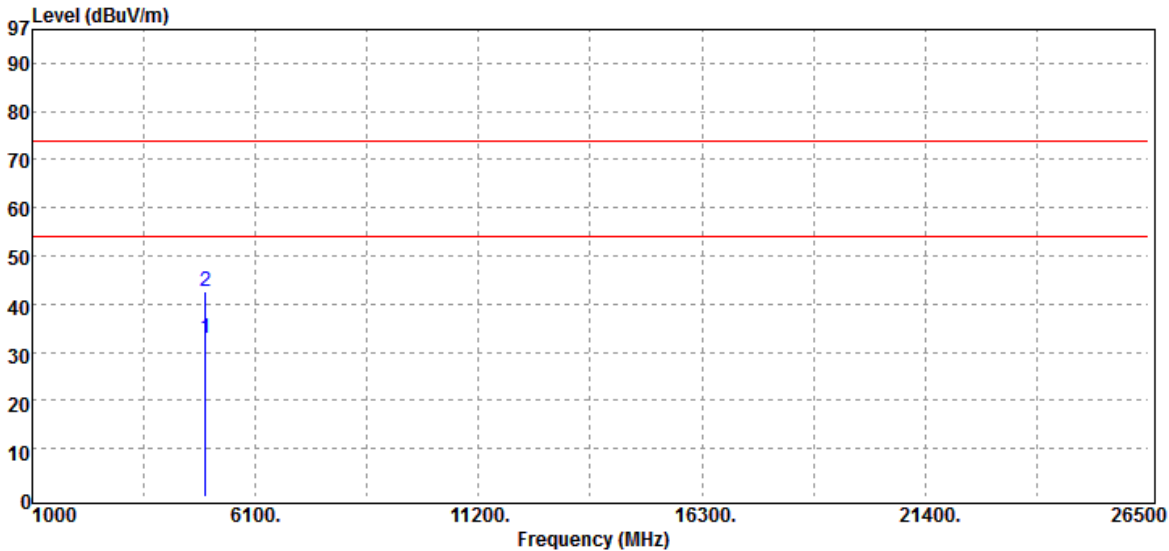
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Operation Band	:BLE	Test Date	:2018-10-26
Fundamental Frequency	:2480 MHz	Temp./Humi.	:24.1 deg_C / 65 RH
Operation Mode	:Tx CH HIGH	Engineer	:Wei
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dBμV		dBμV/m	dBμV/m	
4960.00	Average	26.74	6.05	32.79	54.00	-21.21
4960.00	Peak	36.59	6.05	42.64	74.00	-31.36

~ End of Report ~

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