



### FCC - TEST REPORT

Report Number : **68.940.16.009.01** Date of Issue: November 08, 2018

Model : **BUSTER 2000; BUSTER 2000 HL; BUSTER 2000-1; BUSTER 2000 HL-1;**

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Product Type : Rechargeable LED Bike Light

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Applicant : Sigma Sport USA LLC

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Address : 1860B Dean St., St. Charles, IL 60174, United States

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Manufacture : SHENZHEN MINJUN ELECTRONIC Technology CO., LTD.

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Address : Libang technology Park, 3rd Xitian Industrial Zone,  
Guangming, New District, 518106 Shenzhen,  
PEOPLE'S REPUBLIC OF CHINA.

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

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Total pages including Appendices : 21

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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-1

Telephone: 86 755 8828 6998  
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### 3 Description of the Equipment Under Test

#### Description of the Equipment Under Test

Product:	Rechargeable LED Bike Light
Model no.:	BUSTER 2000
FCC ID:	M5LB2000
Options and accessories:	NIL
Ratings:	DC 3V (1*CR2025 Button battery)
RF Transmission Frequency:	2405MHz
Modulation:	GFSK
Antenna Type:	PCB
Antenna Gain:	2dBi
Description of the EUT:	The Equipment Under Test (EUT) is a Bicycle light remote controller operating at 2.4GHz

#### Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	RATINGS	MODEL NO.(SHIELD)
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## 4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2017 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to ANSI C63.10-2013.

## 5 Summary of Test Results

Technical Requirements					
FCC Part 15 Subpart C 15.249					
Test Condition	Pages	Test Site	Test Result		
			Pass	Fail	N/A
§15.207 Conducted emission AC power port	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.205(a), §15.209(a), §15.249(a), §15.249(c) Field strength of emissions and Restricted bands	9	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.249(d) Out of band emissions	12	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FCC §15.215(c) 20dB bandwidth	17	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.203 Antenna requirement	See note 1		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Remark 1: N/A- Not Applicable;

Note 1: The EUT used an integral PCB antenna, which gain is 2dBi. 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:M5LB2000 complies with Section, 15.205, 15.209, 15.249 of the FCC Part 15, Subpart C Rules;

BUSTER 2000-1 and BUSTER 2000 HL-1 are identical to BUSTER 2000 and BUSTER 2000 HL respectively except for battery capacity.

BUSTER 2000 HL is the same as main model: BUSTER 2000 except for mounting accessory.

So the EMC full tests were applied on BUSTER 2000, another model was deemed to fulfil the EMC requirement without the further test.

### 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.

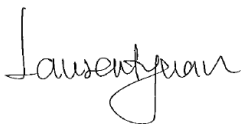
Sample Received Date: 28 May, 2016

Testing Start Date: 28 May, 2016

Testing End Date: 27 June, 2016

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

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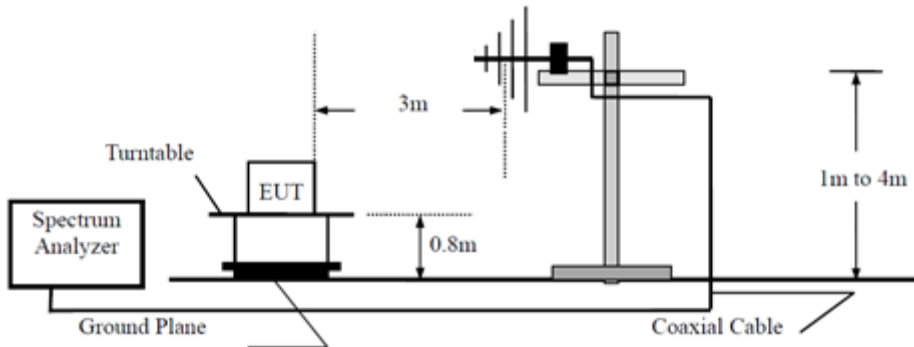


Louise Liu  
EMC Test Engineer

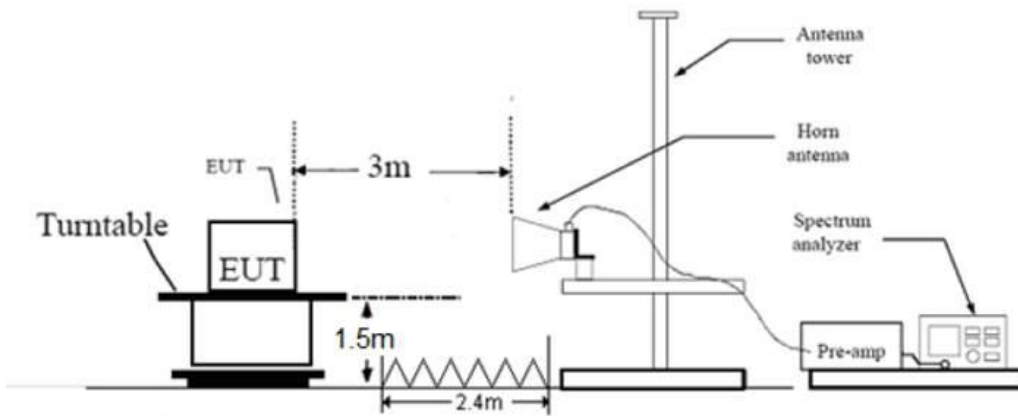
## 7 Test setups

### 7.1 Radiated test setups

Below 1GHz



Above 1GHz





## 8 Technical Requirement

### 8.1 Field strength of emissions and Restricted bands

#### 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 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 and VBW = 10Hz for average measurement, Sweep = auto, Detector function = peak, Trace = max hold.

#### 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, VBW $\geq$ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

#### Note:

- 1: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 KHz for Quasi-peak detection (QP) at frequency below 1GHz.
- 2: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for peak detection (PK) at frequency above 1GHz.
- 3: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average ((duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor (20log (1/duty cycle)).
- 4: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.

## Field strength of emissions and Restricted bands

### Limits

According to §15.249 (a), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

According to §15.249 (c), Field strength limits are specified at a distance of 3 meters.

According to §15.249 (d, Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

According to §15.205 Unwanted emissions falling into restricted bands in §15.205 (a) Table 7 shall comply with the limits specified in §15.209.

Frequency MHz	Field Strength uV/m	Field Strength dB $\mu$ V/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

## Field strength of emissions and Restricted bands

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.

EUT: Rechargeable LED Bike Light  
M/N: BUSTER 2000  
Operating Condition: Tx; 2405MHz

### Below 1GHz

Frequency (MHz)	Emission Level (dB $\mu$ V/m)	E-Field Polarity	Limits (dB $\mu$ V/m)	Margin (dB)	Value Type	Corr. (dB)	Emission Type
276.002778*	17.81	H	46.00	28.19	QP	-21.9	Spurious
274.332222*	17.59	V	46.00	28.41	QP	-22.0	Spurious
886.402222	25.71	H	46.0	20.29	QP	-15.8	Spurious
862.745000	25.81	V	46.0	20.19	QP	-16.3	Spurious
Remark:							
Corrector Factor = Antenna Factor + Cable Loss							

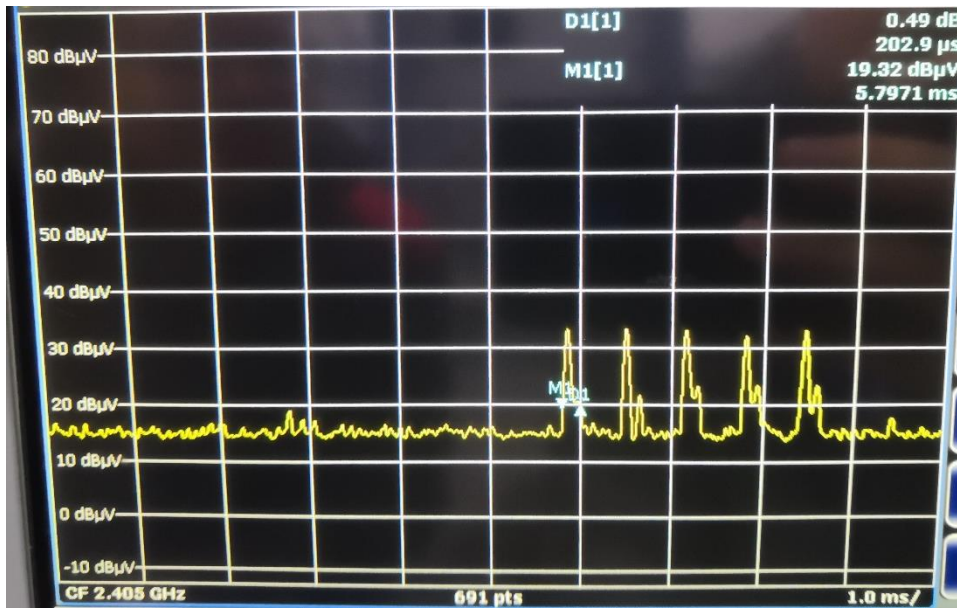
### Above 1GHz

Frequency (MHz)	Peak Emission (dB $\mu$ V/m)	Factor (dB)	AV Emission (dB $\mu$ V/m)	E-Field Polarity	Limits (dB $\mu$ V/m)	Margin (dB)	Corr. (dB)	Value Type	Emission Type
2405.000000	80.83	0.00	---	H	114.00	33.17	-6.5	Peak	Fundamental
2405.000000	80.83	-40.00	40.83	H	94.00	53.17	-6.5	AV	Fundamental
2405.000000	74.95	0.00	---	V	114.00	39.05	-6.5	Peak	Fundamental
2405.000000	74.95	-40.00	34.95	V	94.00	59.05	-6.5	AV	Fundamental
14013.500000	40.92	0.00	---	H	74.00	33.08	15.1	Peak	Spurious
14013.500000	40.92	-40.00	0.92	H	54.00	53.08	15.1	AV	Spurious
13483.500000	44.66	0.00	---	V	74.00	29.34	13.4	Peak	Spurious
13483.500000	44.66	-40.00	4.66	V	54.00	49.34	13.4	AV	Spurious
Remark:									
Corrector Factor = Antenna Factor + Cable Loss – Amplifier Gain Factor=20log(dutycycle), dutycycle=1.45%									

### Remark

- 1: AV Emission Level= PK Emission Level+20log(dutycycle)
- 2: "\*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
- 3: Below 1GHz: Corrector factor=Antenna Factor + Cable loss
- 4: Above 1GHz: Corrector factor=Antenna Factor + Cable loss-Amplifier Gain

Duty Cycle  $= [(0.2 \times 5) / 100] \text{ (ms)} = 1\%$   
Duty Cycle Factor  $= 20 \log (\text{Duty Cycle}) = -40.0$



## 8.2 Out of Band Emissions

### Test Method

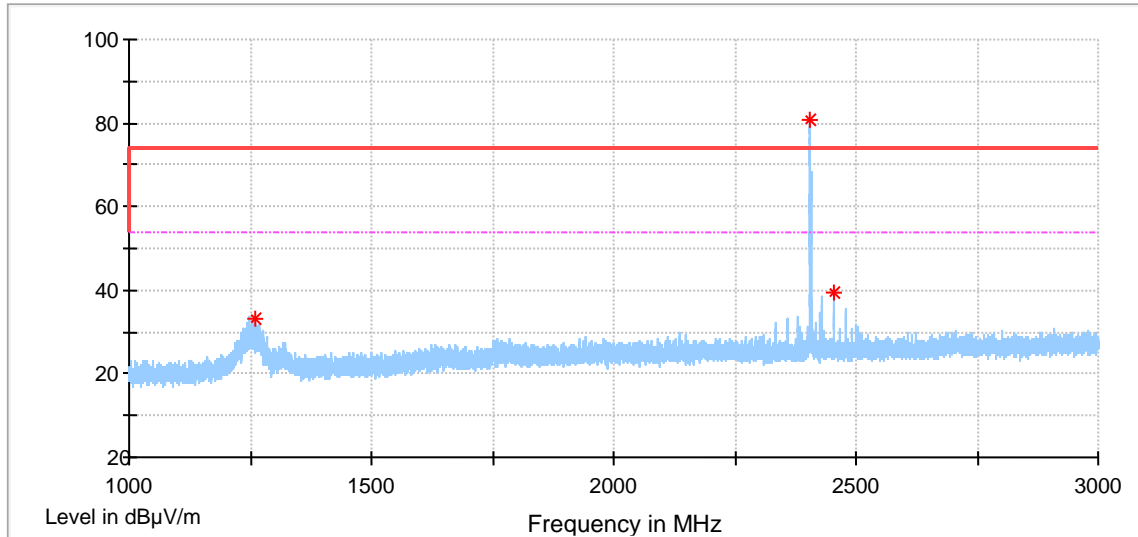
- 1 Use the following spectrum analyzer settings:  
Span = wide enough to capture the peak level of the in-band emission and all spurious  
RBW = 100 kHz, VBW  $\geq$  RBW, Sweep = auto, Detector function = peak, Trace = max hold.
- 2 Allow the trace to stabilize, use the peak and delta measurement to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

### Limits

According to §15.249(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

## Out of Band Emissions

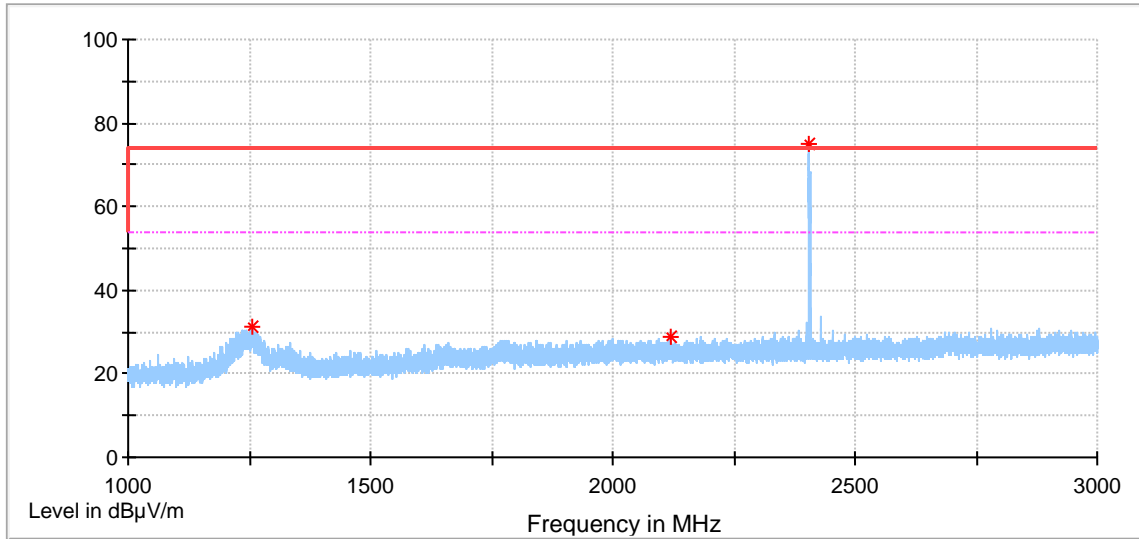
EUT: Rechargeable LED Bike Light  
 M/N: BUSTER 2000  
 Operating Condition: Tx; 2405MHz  
 Polarization: Horizontal



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV /m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1258.866667	33.25	74.00	40.75	154.0	H	127.0	-12.1
2406.200000	80.83	74.00	-6.83	154.0	H	79.0	-6.5
2453.866667	39.62	74.00	34.38	154.0	H	73.0	-6.3

## Out of Band Emissions

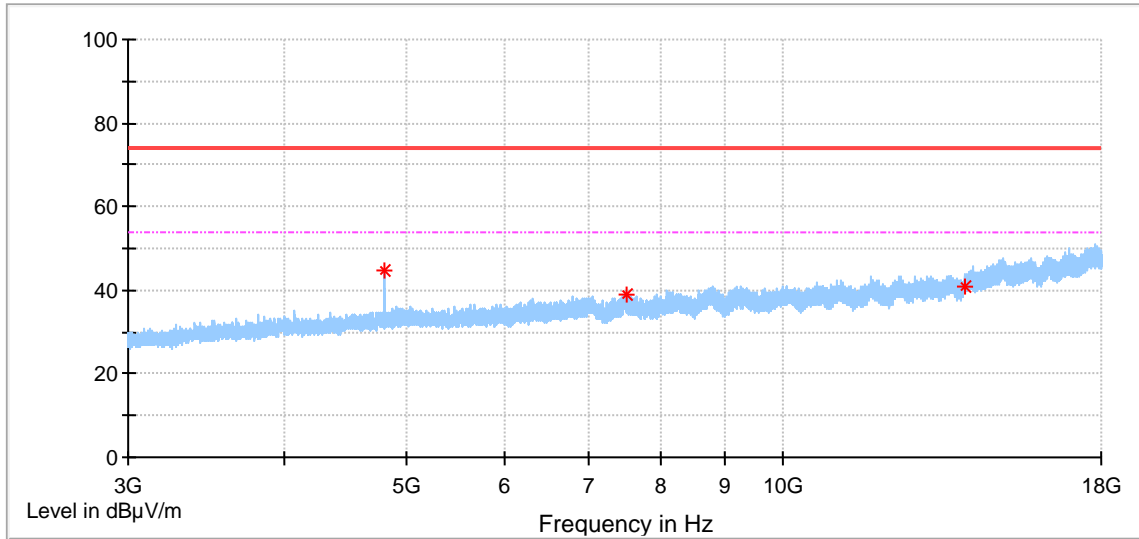
EUT: Rechargeable LED Bike Light  
 M/N: BUSTER 2000  
 Operating Condition: Tx; 2405MHz  
 Polarization: Vertical



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1255.400000	31.13	74.00	42.87	154.0	V	329.0	-12.2
2120.933333	28.82	74.00	45.18	154.0	V	0.0	-7.1
2405.800000	74.95	74.00	-0.95	154.0	V	315.0	-6.5

## Out of Band Emissions

EUT: Rechargeable LED Bike Light  
 M/N: BUSTER 2000  
 Operating Condition: Tx; 2405MHz  
 Polarization: Horizontal

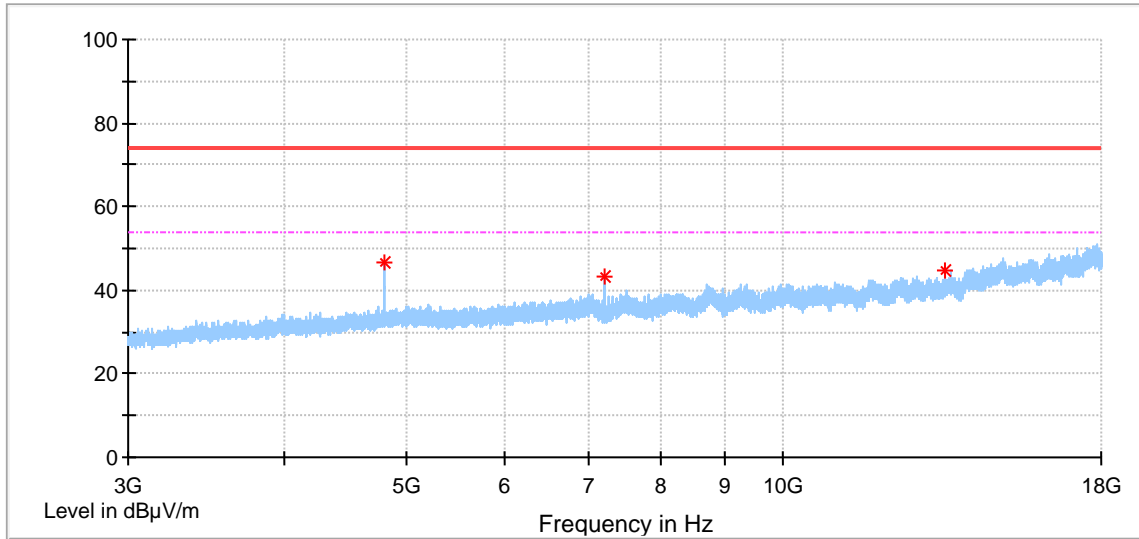


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4811.500000	44.69	74.00	29.31	154.0	H	76.0	1.9
7505.000000	39.08	74.00	34.92	154.0	H	76.0	6.4
14013.500000	40.92	74.00	33.08	154.0	H	190.0	15.1



## Out of Band Emissions

EUT: Rechargeable LED Bike Light  
 M/N: BUSTER 2000  
 Operating Condition: Tx; 2405MHz  
 Polarization: Vertical



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4811.500000	46.86	74.00	27.14	154.0	V	312.0	1.9
7217.500000	43.39	74.00	30.61	154.0	V	356.0	5.1
13483.500000	44.66	74.00	29.34	154.0	V	359.0	13.4

## 8.3 20dB Bandwidth

### Test Method

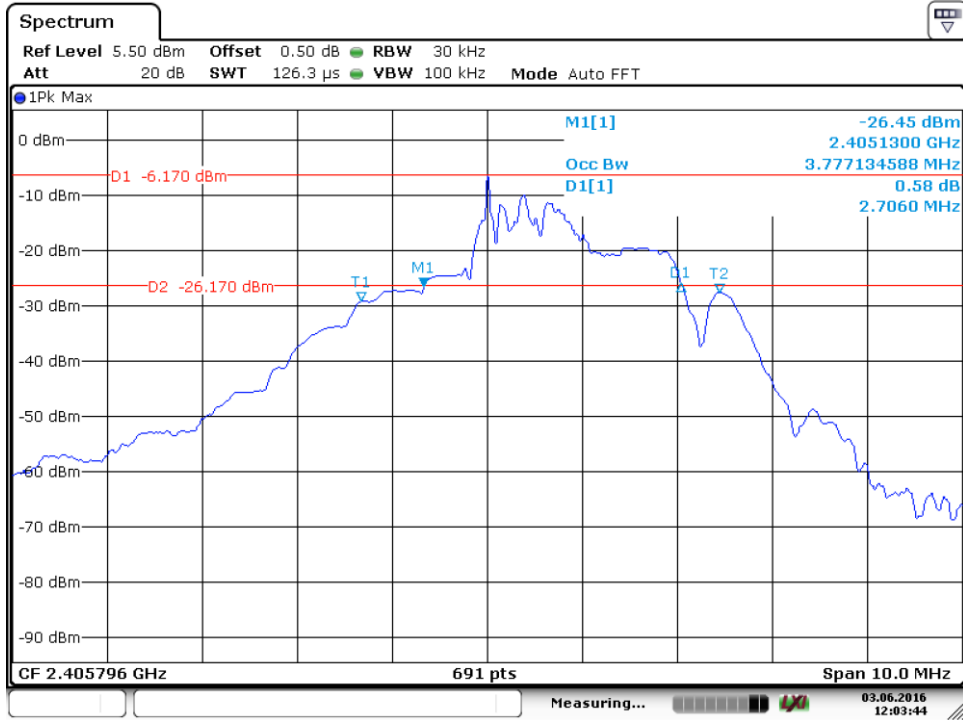
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.

### Limits:

According to 15.215 (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

**20dB Bandwidth & 99% Occupied Bandwidth**

Frequency	20dB Bandwidth	99% Bandwidth	Limit
MHz	KHz	kHz	kHz
2405	2706	--	--



Date: 3.JUN.2016 12:03:45

## 9 Test equipment lists

### List of Test Instruments

	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
C	Signal Generator	Rohde & Schwarz	SMB100A	108272	2016-7-24
RE	Signal Analyzer	Rohde & Schwarz	FSV40	101030	2016-7-24
	Vector Signal Generator	Rohde & Schwarz	SMU 200A	105324	2016-7-24
	RF Switch Module	Rohde & Schwarz	OSP120/OS P-B157	101226/10085 1	2016-7-24
	EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2016-7-24
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2016-8-14
	Horn Antenna	Rohde & Schwarz	HF907	102294	2016-7-24
	Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2016-7-24
	3m Semi-anechoic chamber	TDK	9X6X6	----	2019-5-29

#### C - Conducted RF tests

- 20dB bandwidth and 99% Occupied Bandwidth
- Dwell Time

## 10 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

Items		Extended Uncertainty
RE	Field strength (dB $\mu$ V/m)	U=4.32dB (30MHz-1GHz) U=2.27dB (1GHz-25GHz)
CE	Disturbance Voltage (dB $\mu$ V)	U=2.4dB
Bandwidth test	--	$1 \cdot 10^{-9}$
Conducted emission	--	2.4dB