



FCC PART 15, SUBPART C





TEST AND MEASUREMENT REPORT

For

iControl Incorporated

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FCC ID: W2E-ISCAN10

Report Type: Original Report	Product Type: Wireless barcode scanner equipped with 2.4GHz 802.14.5 radio
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* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk “*”

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1604253-247	Original Report	2016-07-19

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report has been compiled on behalf of *iControl Incorporated*, and their product, *FCC ID: W2E-ISCAN10*, model number: *iSCAN1.0*, which henceforth is referred to as the EUT (Equipment under Test). The EUT is a Wireless barcode scanner equipped with 2.4GHz 802.14.5 radio for use in industrial warehouses to remotely scan barcodes and send the data to a server via an iControl, Inc. router.

1.2 Mechanical Description of EUT

The EUT measures approximately 18.01 cm (L) x 8.62 cm (W) x 4.50 cm (H) and weighs approximately 0.2 kg.

The data gathered are from a typical production sample provided by the manufacturer with serial number: R1604253-01, assigned by BAACL.

1.3 Objective

This report is prepared on behalf of *iControl Incorporated*, in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission's rules.

The objective is to determine compliance with FCC Part 15.247 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, power spectral density, 100 kHz Bandwidth of Band Edges Measurement, Spurious Emissions, Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB 558074 D01 DTS Meas Guidance v03r05: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR16-4-2:2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from ± 2.0 dB for Conducted Emissions tests and ± 4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BAACL Corp.

1.7 Test Facility

Bay area compliance Laboratories Corp. (BACL) is:

1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminaires and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to **ISO 17065: 2012** by **A2LA** to certify:

1. Radio and Telecommunication Equipment in scopes A1, A2, AA3, A4, B1, B2, B3, B4, & C for the Federal Communications Commission.
2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
3. Radio Communication Equipment for Singapore.
4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s), Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.10-2013, ANSI C63.4-2014, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

<http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b>

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013 and FCC KDB 558074 D01 DTS Meas Guidance v03r05.

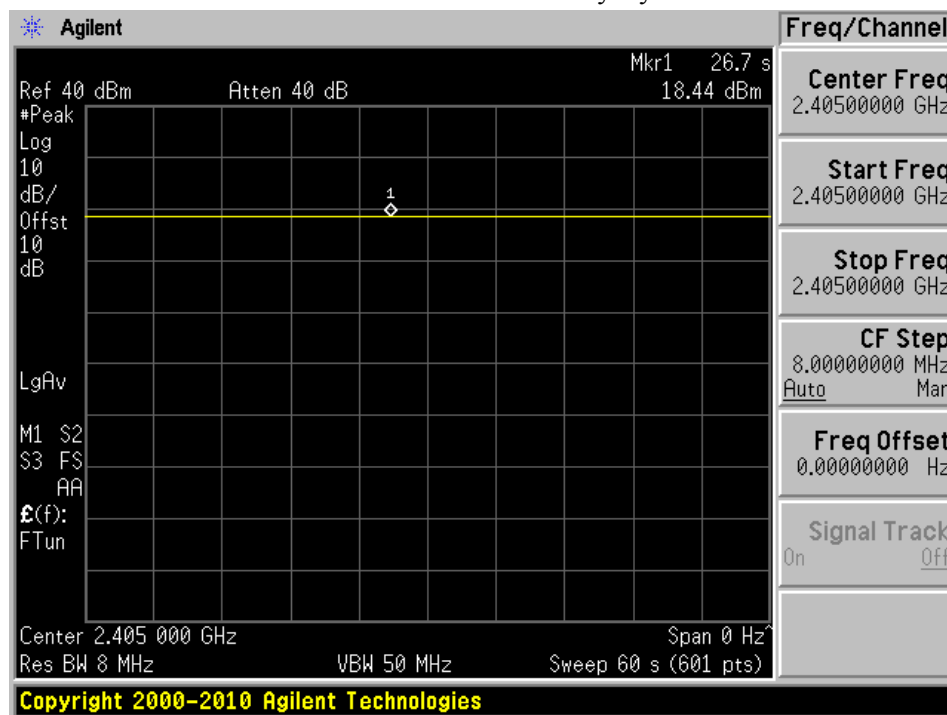
The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

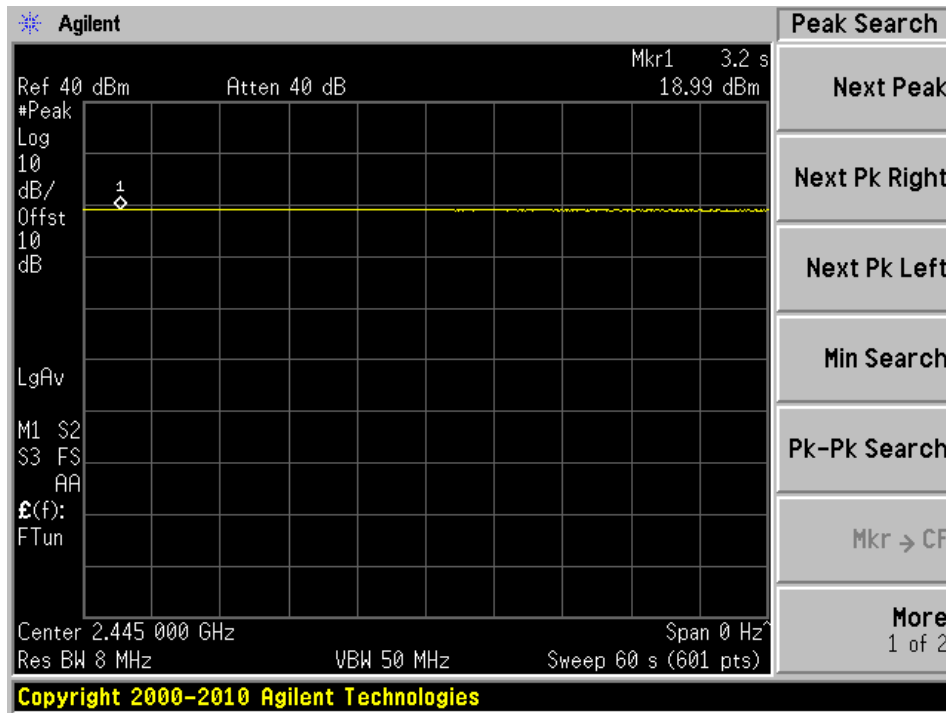
2.2 EUT Exercise Software

The software “icontrol.ht” was provided by customer. The worst case Duty cycle for the EUT was greater than 98%.

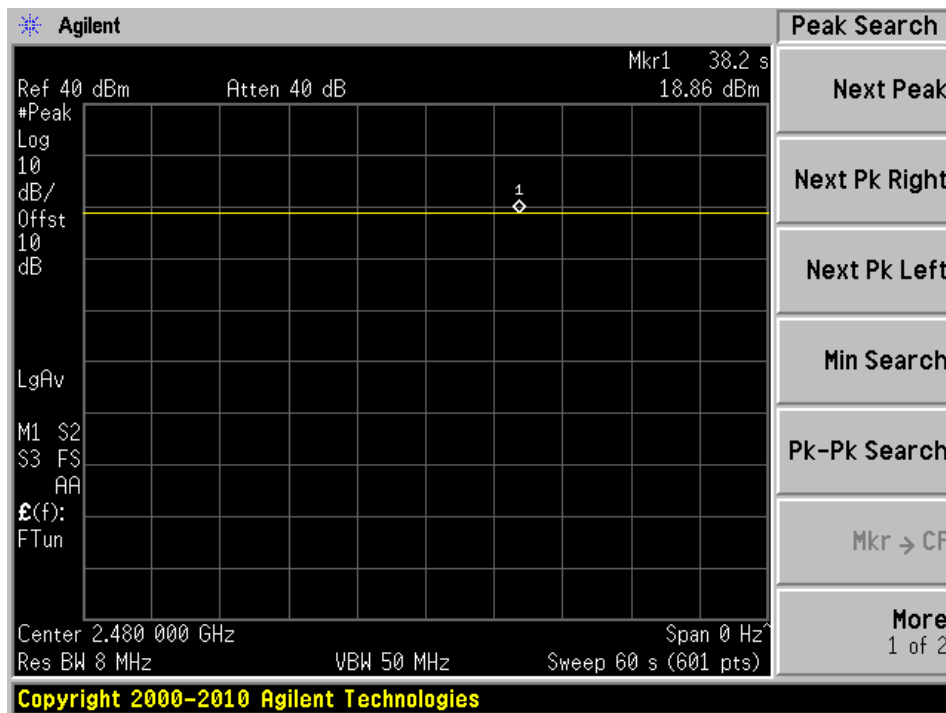
802.15.4 Low Channel Duty Cycle



802.15.4 Middle Channel Duty Cycle



802.15.4 High Channel Duty Cycle



2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Local Support Equipment

Manufacturer	Description	Model	Serial Number
iControl, Inc.	Programming / Comms Board	-	-

2.5 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
Texas Instruments	Microcontroller	CC2530F256RHAT	-
Texas Instruments	Radio Front End	CC2592RGVR	-
Analog Devices	Linear Voltage Regulator	ADP160AUJZ-3.3-R7	-
Intersil	Boost Voltage Regulator	ISL9111EH50Z-T7A	-
Microscan	MS-1 Barcode Scan Engine	FIS-0001-8003G	-
Microchip Technology	Microcontroller	PIC18F67J50T-I/PT	-
Newhaven Display	LCD Display	NHD-0208AZ-RN-GBW	-
Freescale Semiconductor	Li-Ion Charge Controller	MC34673AEPR2	-

2.6 Power Supply and Line Filter

N/A

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB-Serial	< 1m	EUT	Laptop

3 Summary of Test Results

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
FCC §15.203	Antenna Requirement	Compliant
FCC §15.247(i)	RF Exposure	Compliant
FCC §15.247 (d)	Spurious Emissions at Antenna Port	Compliant
FCC §15.205	Restricted Bands	Compliant
FCC §15.209, §15.247 (d)	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2)	6 dB&99% Emission Bandwidth	Compliant
FCC §15.247(b)(3)	Maximum Peak Output Power	Compliant
FCC §15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e)	Power Spectral Density	Compliant

4 FCC §2.1093, §15.247(i) &- RF Exposure

1.1 Applicable Standards

According to FCC KDB 447498 D01 General RF Exposure Guidance v05r02 Section 4.3.1, Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition, listed below, is satisfied. These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions. The minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander (see 5) of section 4.1). To qualify for SAR test exclusion, the test separation distances applied must be fully explained and justified by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, typically in the SAR measurement or SAR analysis report, according to the required published RF exposure KDB procedures. When no other RF exposure testing or reporting is required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for the SAR test exclusion. When required, the device specific conditions described in the other published RF exposure KDB procedures must be satisfied before applying these SAR test exclusion provisions; for example, handheld PTT two-way radios, handsets, laptops & tablets etc.

- 1) The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$$\left[\frac{\text{(max. power of channel, including tune-up tolerance, mW)}}{\text{(min. test separation distance, mm)}} \right] \cdot \sqrt{f(\text{GHz})} \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where}$$

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

- 2) At 100 MHz to 6 GHz and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B:
- a) [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm) · ($f(\text{MHz})/150$)] mW, at 100 MHz to 1500 MHz
 - b) [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm) · 10] mW at > 1500 MHz and ≤ 6 GHz
- 3) At frequencies below 100 MHz, the following may be considered for SAR test exclusion, and as illustrated in Appendix C:
- a) The power threshold at the corresponding test separation distance at 100 MHz in step 2) is multiplied by $[1 + \log(100/f(\text{MHz}))]$ for test separation distances > 50 mm and < 200 mm
 - b) The power threshold determined by the equation in a) for 50 mm and 100 MHz is multiplied by $\frac{1}{2}$ for test separation distances ≤ 50 mm

- c) SAR measurement procedures are not established below 100 MHz. When SAR test exclusion cannot be applied, a KDB inquiry is required to determine SAR evaluation requirements for any test results to be acceptable.

1.2 Test Results

The highest measured peak conducted power as reported in Section 7.5 of this report was 14.86 dBm (30.62 mW) at 2445 MHz. This device is a Scanner, it only operate when user press the scan button, once the scanner scan the barcode, it will stop the transmission immediately. Due to the duty cycle of transmission in this device's normal operation is 50%, the calculated maximum average output power is $14.86 \text{ dBm} - 10 \cdot \log(1/50\%) = 11.85 \text{ dBm}$ (15.31 mW).

Based on the $[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR

$(15.31/5) \cdot \sqrt{2.445} = 4.79$ which is less than 7.5

Conclusion:

The maximum average output power is lower than both FCC Extremity SAR Exemption limit. Thus, SAR was exempted for this device.

5 FCC §15.203 - Antenna Requirements

5.1 Applicable Standards

According to FCC §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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to FCC §15.247 (b) (4), 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.

5.2 Antenna List and Details

Frequency Range (MHz)	External/ Internal/Integral	Max Gain (dBi)	Antenna Type/ Pattern
2400 – 2483.5	Integral	3.5	OMNI
2400 – 2500	Internal	4.4	OMNI

Note: 4.4 dBi antenna was used for radiated emission testing.

6 FCC §15.209, §15.247(d) - Spurious Radiated Emissions

6.1 Applicable Standards

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	960 – 1240	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5.35 – 5.46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 – 167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3.3458 – 3.358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As per FCC §15.247 (d) 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

6.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15 Subpart C limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

6.3 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords was connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 meter, and the EUT is placed on a turntable, which is 0.8 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

- (1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
- (2) Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

6.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

$$CA = Ai + AF + CL + Atten - Ga$$

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

6.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US 42221851	2015-06-23	1 year
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100044	2015-07-23	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB1	A013105-3	2015-07-11	2 year
A.R.A	Antenna, Horn	DRG-118/A	1132	2015-09-21	2 year
HP	Pre-Amplifier	8447D	2944A06639	2015-06-08	1 year
Suirong	30 Ft Conducted Emission Cable	LMR 400	694	Cal. Not required	N/A
-	SMA cable	-	C0001	Each time ¹	N/A
IW Microwave	High Frequency Cable	DC-1531	KPS-1501A3960KPS	2015-08-10	1 year
Agilent	Pre-Amplifier	8449B	3008A01978	2015-09-02	1year

Note¹: cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: *BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.*

6.6 Test Environmental Conditions

Temperature:	22.9° C
Relative Humidity:	46 %
ATM Pressure:	102.2 kPa

The testing was performed by Jin Yang on 2016-06-07 in 5m chamber3.

6.7 Test software

Vasona software Version 6.0023 was used for 30MHz-1GHz testing, above 1 GHz testing was preformed manually

6.8 Summary of Test Results

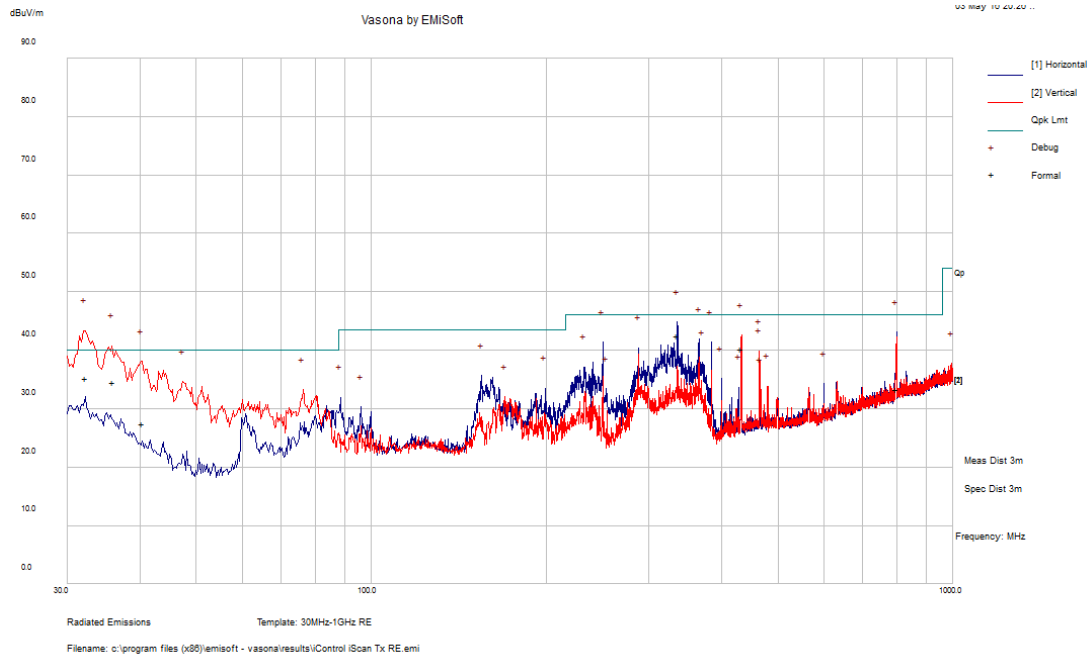
According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15C standard's radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Mode, Channel
-0.51	7335	Horizontal	Middle

Please refer to the following table and plots for specific test result details

6.9 Radiated Emissions Test Data and Plots

1) 30 MHz – 1 GHz



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comments (PK/QP/Ave.)
32.27875	35.31	122	V	183	40	-4.69	QP
35.932	34.55	108	V	43	40	-5.45	QP
336.0315	42.56	100	H	119	46	-3.44	QP
40.38075	27.5	219	V	200	40	-12.5	QP
799.6435	33.29	207	H	196	46	-12.71	QP
433.0795	40.23	205	V	76	46	-5.77	QP

2) 1 – 25 GHz

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2405 MHz, power setting: 101											
2405	68.4	237	161	H	29.06	5.22	0.00	102.68	N/A	N/A	Peak
2405	66.26	237	161	H	29.06	5.22	0.00	100.54	N/A	N/A	Ave
2405	66.34	265	104	V	29.06	5.22	0.00	100.62	N/A	N/A	Peak
2405	64.17	265	104	V	29.06	5.22	0.00	98.45	N/A	N/A	Ave
2390	26.06	265	104	H	28.98	5.22	0.00	60.26	74.00	-13.74	Peak
2390	14.73	265	104	H	28.98	5.22	0.00	48.93	54.00	-5.07	Ave
4810	56.18	360	300	H	32.49	7.89	36.64	59.92	74.00	-14.08	Peak
4810	49.41	360	300	H	32.49	7.89	36.64	53.15	54.00	-0.85	Ave
7215	47.29	0	100	H	36.76	10.47	36.42	58.10	74.00	-15.90	Peak
7215	35.05	0	100	H	36.76	10.47	36.42	45.86	54.00	-8.14	Ave
9620	48.55	72	250	H	37.78	11.38	36.66	61.05	74.00	-12.95	Peak
9620	35.55	72	250	H	37.78	11.38	36.66	48.05	54.00	-5.95	Ave
Middle Channel 2445 MHz, power setting: 163											
2445	69.59	217	179	H	29.21	5.22	0.00	104.02	N/A	N/A	Peak
2445	67.44	217	179	H	29.21	5.22	0.00	101.87	N/A	N/A	Ave
2445	67.93	231	192	V	29.21	5.22	0.00	102.36	N/A	N/A	Peak
2445	65.86	231	192	V	29.21	5.22	0.00	100.29	N/A	N/A	Ave
4890	53.45	0	332	H	32.62	7.93	36.63	57.37	74.00	-16.63	Peak
4890	46.87	0	332	H	32.62	7.93	36.63	50.79	54.00	-3.21	Ave
7335	49.3	288	100	H	37.14	10.70	36.43	60.71	74.00	-13.29	Peak
7335	42.08	288	100	H	37.14	10.70	36.43	53.49	54.00	-0.51	Ave
9780	49.95	268	285	H	37.91	11.47	36.69	62.64	74.00	-11.36	Peak
9780	39.97	268	285	H	37.91	11.47	36.69	52.66	54.00	-1.34	Ave
25 Channel 2475 MHz, power setting: 160											
2475	68.13	32	258	H	29.32	5.22	0.00	102.67	N/A	N/A	Peak
2475	66.11	32	258	H	29.32	5.22	0.00	100.65	N/A	N/A	Ave
2475	68.02	304	304	V	29.32	5.22	0.00	102.56	N/A	N/A	Peak
2475	66.01	304	304	V	29.32	5.22	0.00	100.55	N/A	N/A	Ave
2483.5	27.78	304	304	H	29.35	5.35	0.00	62.48	74.00	-11.52	Peak
2483.5	15.21	304	304	H	29.35	5.35	0.00	49.91	54.00	-4.09	Ave
4950	53.55	172	134	H	32.81	7.97	36.59	57.74	74.00	-16.26	Peak
4950	46.79	172	134	H	32.81	7.97	36.59	50.98	54.00	-3.02	Ave
7425	47.26	265	203	H	37.08	10.82	36.45	58.71	74.00	-15.29	Peak
7425	39.26	265	203	H	37.08	10.82	36.45	50.71	54.00	-3.29	Ave
9900	46.12	0	100	H	37.99	11.53	36.70	58.94	74.00	-15.06	Peak
9900	33.7	0	100	H	37.99	11.53	36.70	46.52	54.00	-7.48	Ave
High Channel 2480 MHz, power setting: 35											
2480	56.13	66	193	H	29.34	5.22	0.00	90.69	N/A	N/A	Peak
2480	54.06	66	193	H	29.34	5.22	0.00	88.62	N/A	N/A	Ave
2480	56.93	321	333	V	29.34	5.22	0.00	91.49	N/A	N/A	Peak
2480	54.92	321	333	V	29.34	5.22	0.00	89.48	N/A	N/A	Ave
2483.5	27.82	321	333	H	29.35	5.35	0.00	62.52	74.00	-11.48	Peak
2483.5	18.55	321	333	H	29.35	5.35	0.00	53.25	54.00	-0.75	Ave

7 FCC §15.247(a)(2) - 6 dB & 99% Emission Bandwidth

7.1 Applicable Standards

According to FCC §15.247(a)(2), systems using digital modulation techniques may operate in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz

7.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v03r05: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8: DTS bandwidth

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2016-03-24	1 year
-	SMA Cable	-	C0001	Each Time ¹	N/A
Mini-Circuits	Attenuator	BW-S10W5	1430	Each Time ¹	N/A

Note¹: cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

7.4 Test Environmental Conditions

Temperature:	23.6° C
Relative Humidity:	49 %
ATM Pressure:	102.2 kPa

The testing was performed by Jin Yang on 2016-06-07 in RF site.

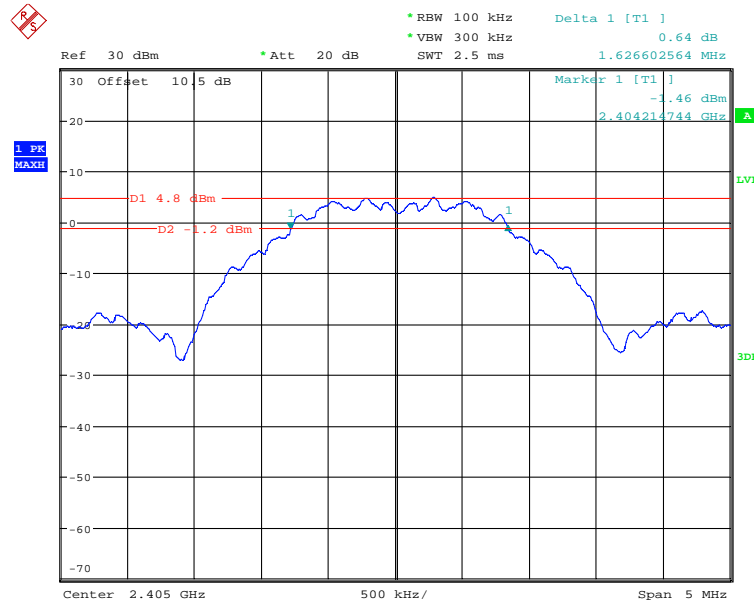
7.5 Test Results

Channel	Frequency (MHz)	99 % OBW (MHz)	6 dB OBW (MHz)	6 dB OBW Limit (kHz)	Result
Low	2405	2.604	1.627	≥ 500	Pass
Middle	2445	2.925	1.651	≥ 500	Pass
High	2480	2.564	1.643	≥ 500	Pass

Please refer to the following plots for detailed test results

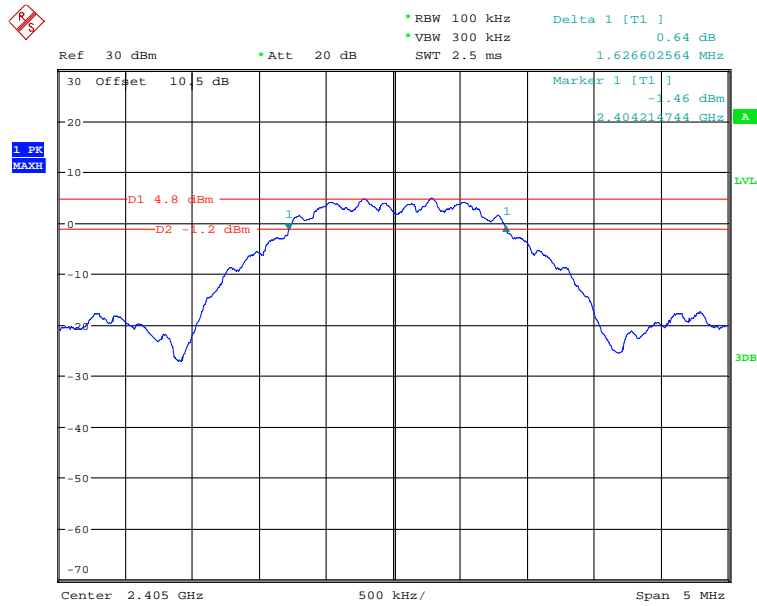
6dB Bandwidth:

802.15.4 - 2405 MHz



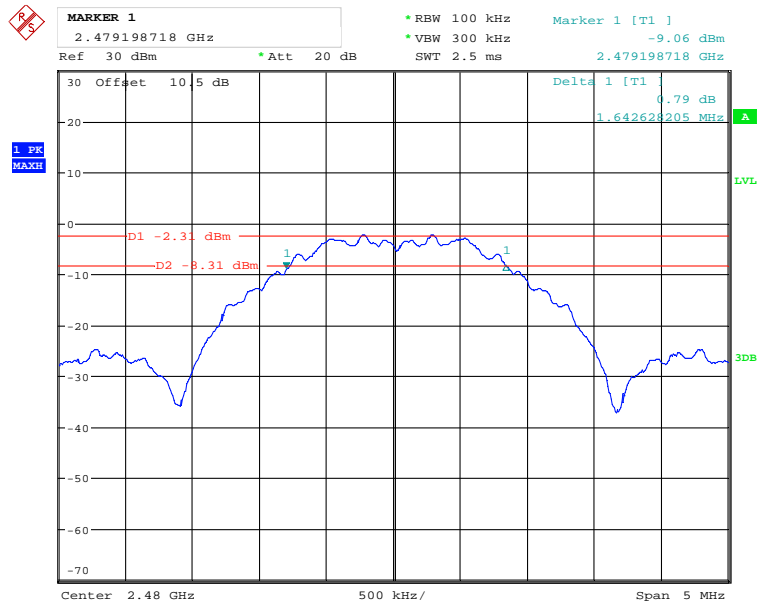
Date: 7.JUN.2016 07:48:21

802.15.4 - 2445 MHz



Date: 7.JUN.2016 07:48:21

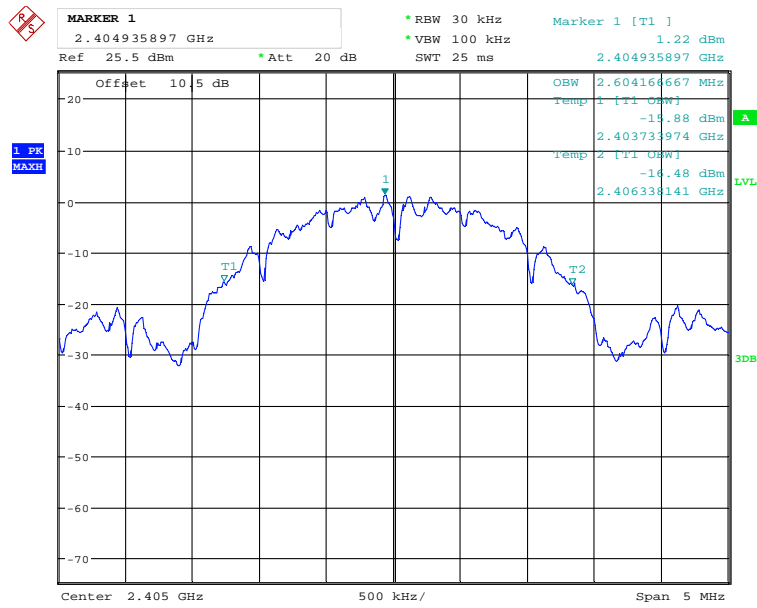
802.15.4 - 2480 MHz



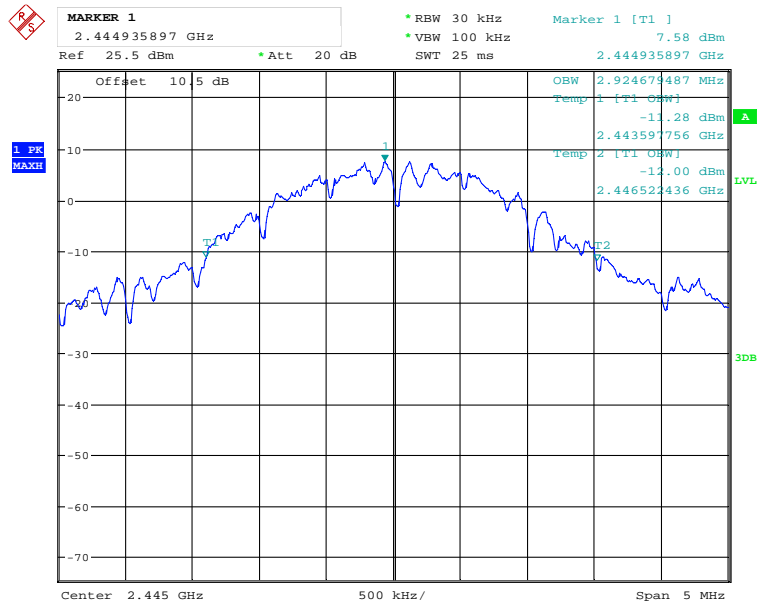
Date: 7.JUN.2016 08:07:28

99% OBW:

802.15.4 - 2405 MHz



802.15.4 - 2445 MHz



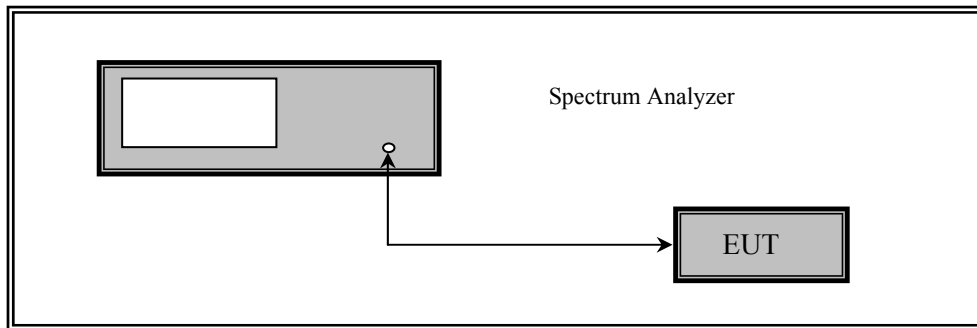
8 FCC §15.247(b) - Output Power Measurement

8.1 Applicable Standards

According to FCC §15.247(b) for systems using digital modulation in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands: 1 Watt.

8.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v03r05: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Fundamental emission output power



8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2016-03-24	1 year
-	SMA Cable	-	C0001	Each Time ¹	N/A
Mini-Circuits	Attenuator	BW-S10W5	1430	Each Time ¹	N/A

¹ cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

8.4 Test Environmental Conditions

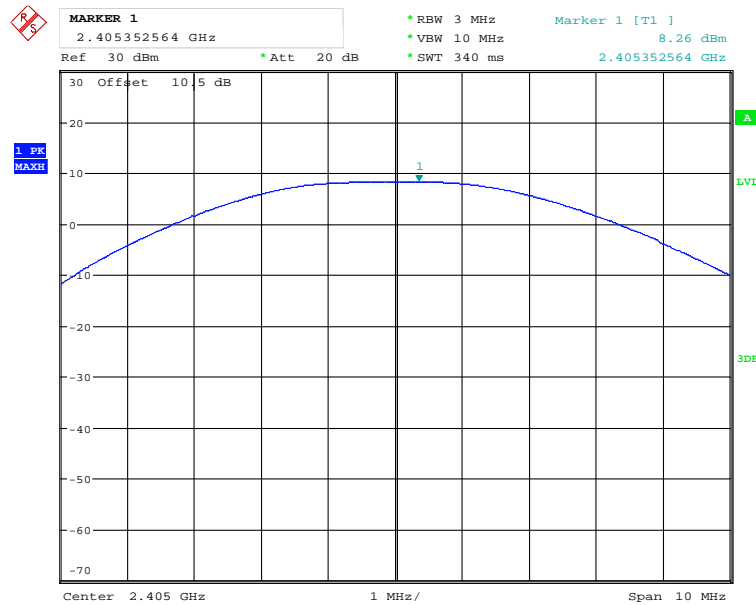
Temperature:	23.6° C
Relative Humidity:	49 %
ATM Pressure:	102.2 kPa

The testing was performed by Jin Yang on 2016-06-07 in RF site.

8.5 Test Results

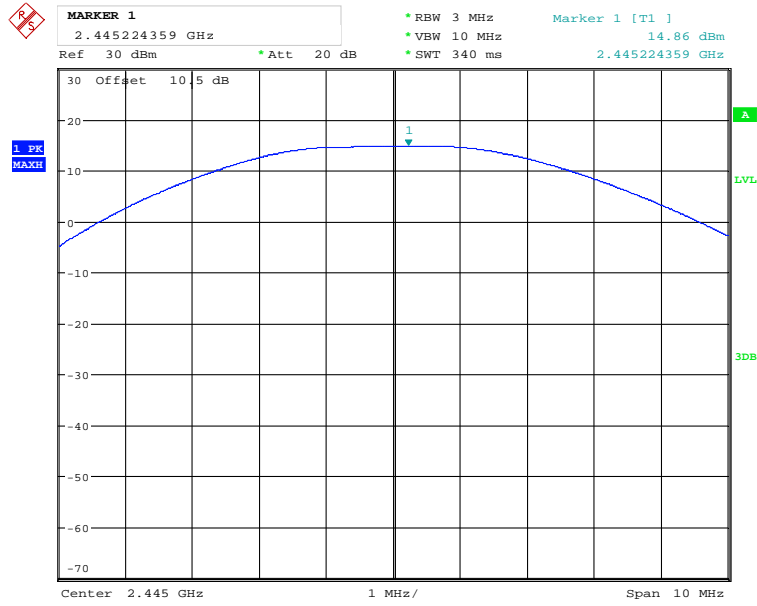
Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)	Limit (dBm)
Low	2405	8.26	30
Middle	2445	14.86	30
25	2475	13.81	30
High	2480	1.3	30

802.15.4 - 2405 MHz



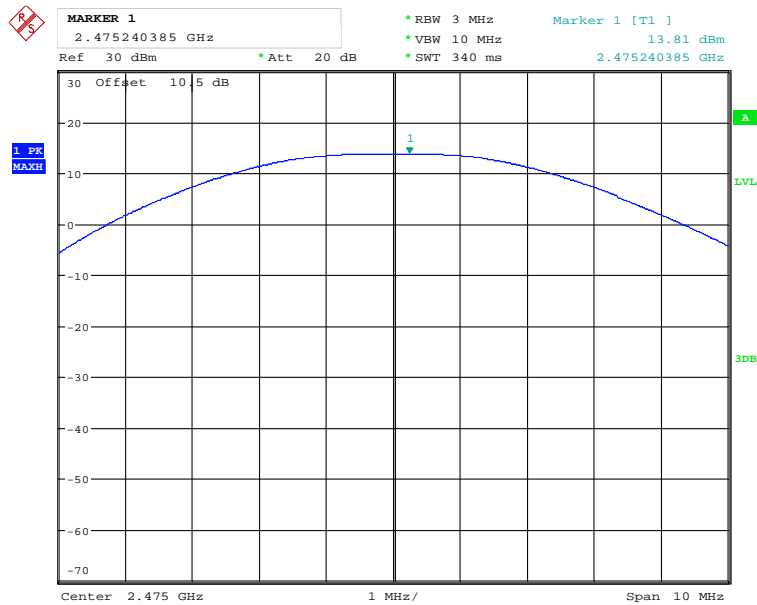
Date: 7.JUN.2016 08:25:46

802.15.4 - 2445 MHz



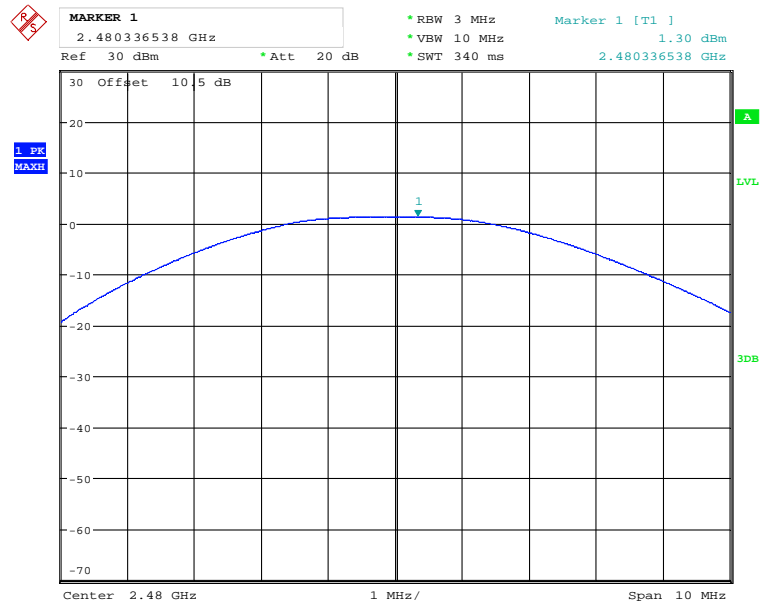
Date: 7.JUN.2016 08:24:11

802.15.4 - 2475 MHz



Date: 7.JUN.2016 08:22:12

802.15.4 - 2480 MHz



Date: 7.JUN.2016 08:10:06

9 FCC §15.247(d) - Spurious Emissions at Antenna Port & Band Edges

9.1 Applicable Standards

According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c).

9.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v03r05: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 13: Band-edge measurements

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2016-03-24	1 year
-	SMA Cable	-	C0001	Each Time ¹	N/A
Mini-Circuits	Attenuator	BW-S10W5	1430	Each Time ¹	N/A

Note¹: cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: *BACL Corp.* attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

9.4 Test Environmental Conditions

Temperature:	23.6° C
Relative Humidity:	49 %
ATM Pressure:	102.2 kPa

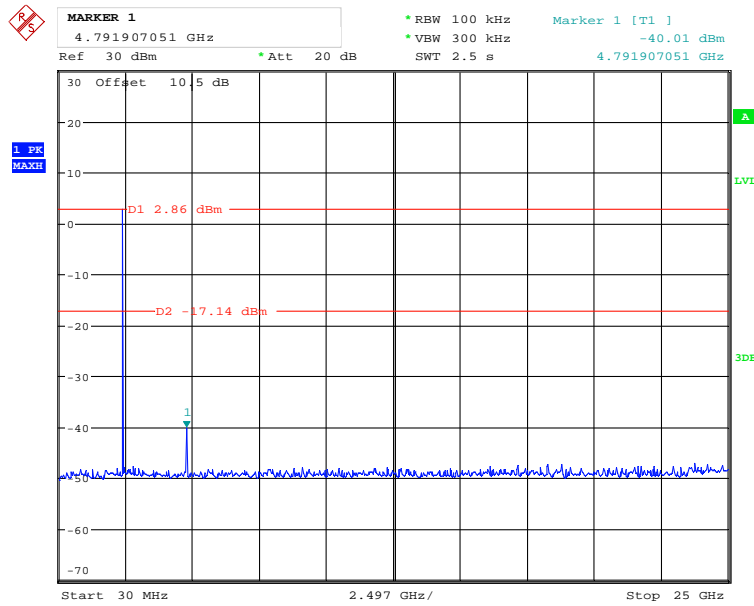
The testing was performed by Jin Yang on 2016-06-07 in RF site.

9.5 Test Results

Please refer to the following plots.

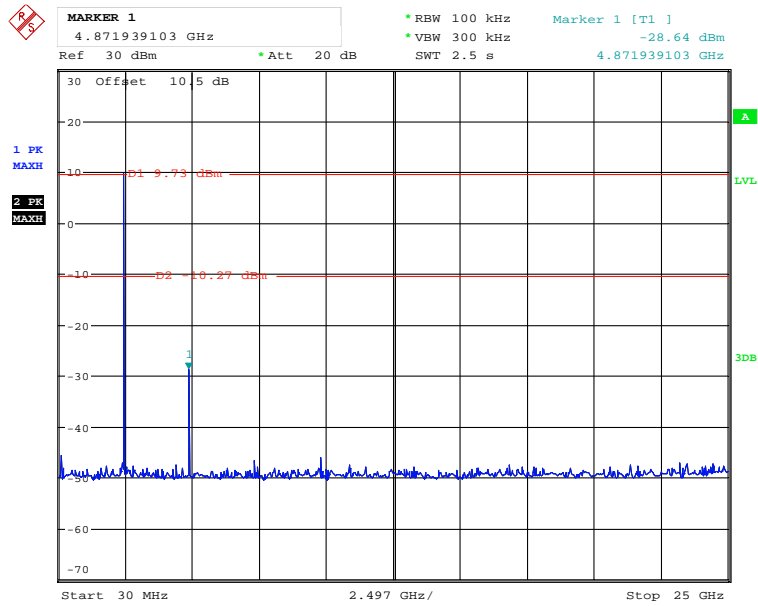
Conducted Spurious Emissions

802.15.4-2405 MHz



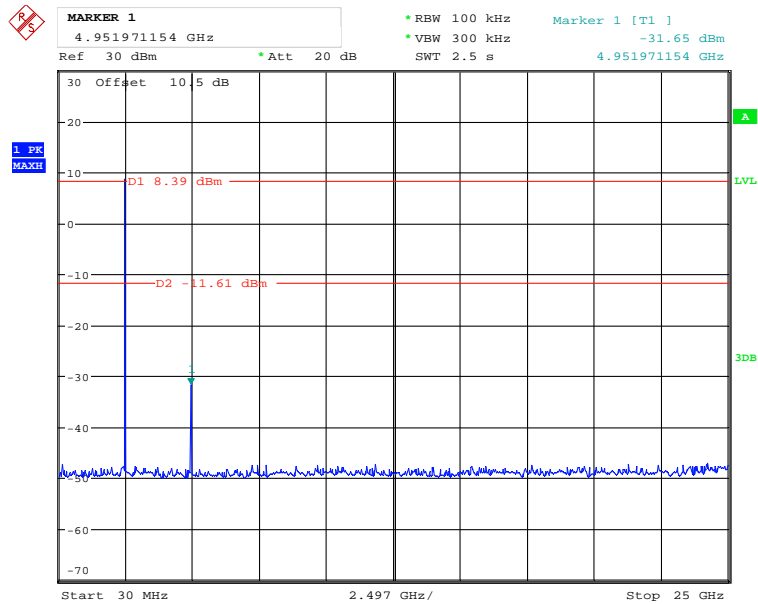
Date: 7.JUN.2016 08:57:37

802.15.4-2445 MHz



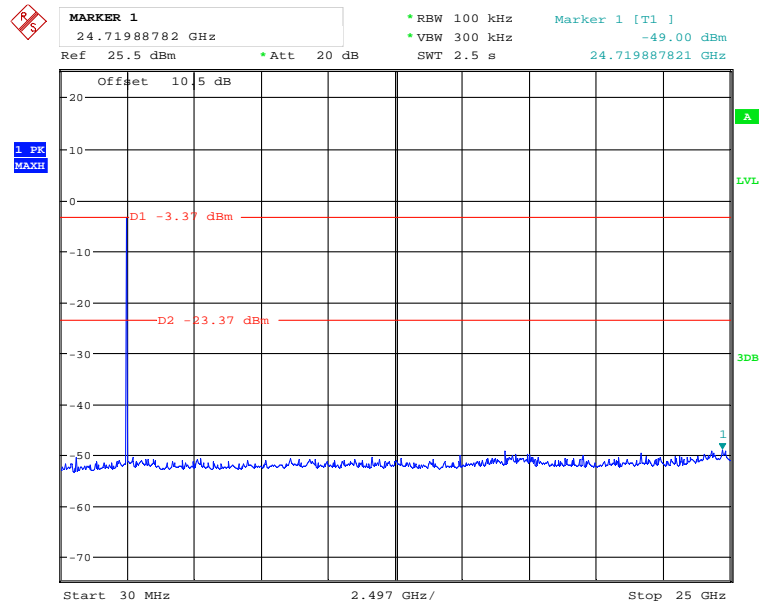
Date: 7.JUN.2016 09:09:05

802.15.4-2475 MHz



Date: 7.JUN.2016 09:04:57

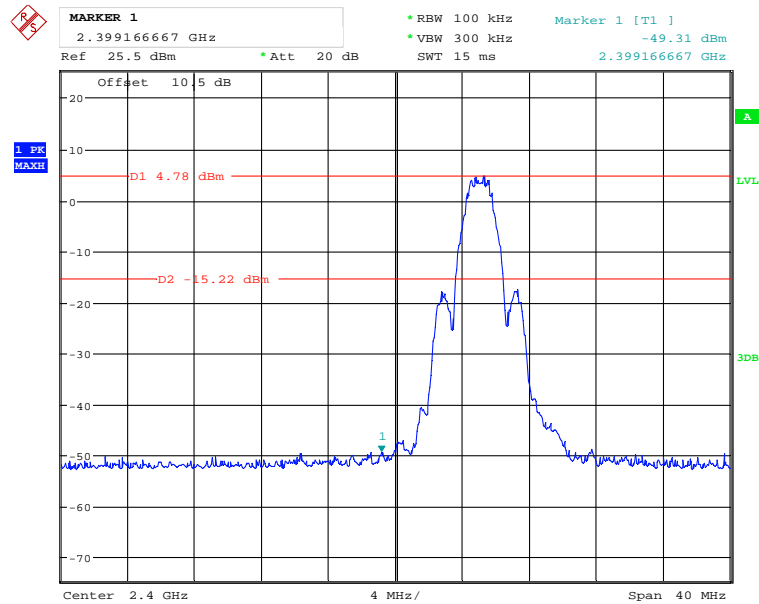
802.15.4-2480 MHz



Date: 7.JUN.2016 09:14:02

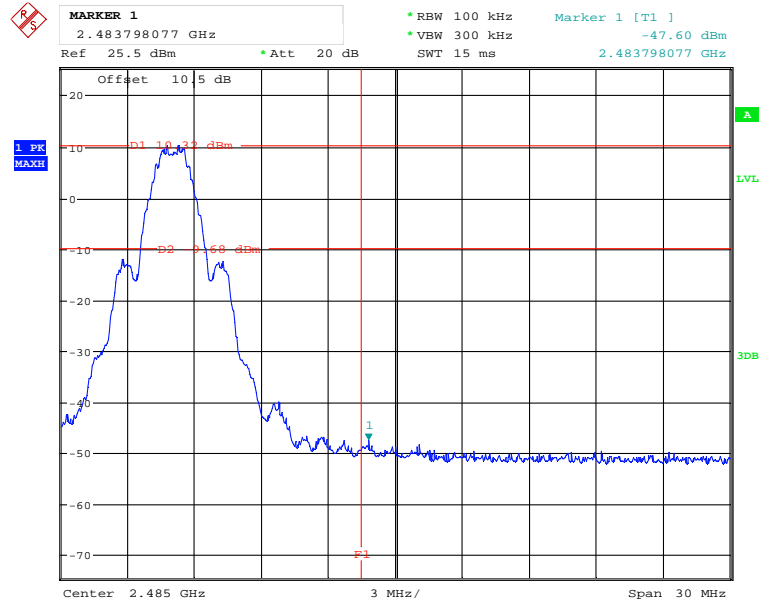
Band Edge

802.15.4-2405 MHz - Low Band Edge



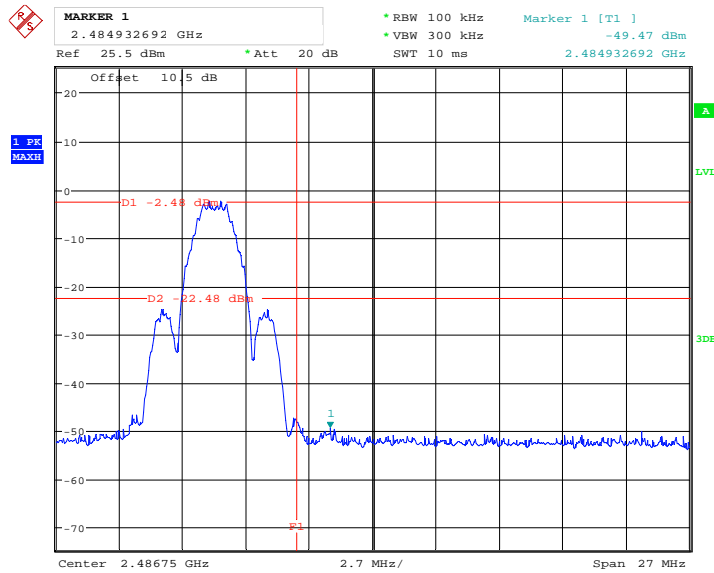
Date: 7.JUN.2016 09:35:47

802.15.4-2475 MHz - High Band Edge



Date: 7.JUN.2016 09:27:22

802.15.4-2480 MHz - High Band Edge



Date: 7.JUN.2016 09:22:14

10 FCC §15.247(e) - Power Spectral Density

10.1 Applicable Standards

According to FCC §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

10.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v03r05: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 10: Maximum power spectral density level in the fundamental emission

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2016-03-24	1 year
-	SMA Cable	-	C0001	Each Time ¹	N/A
Mini-Circuits	Attenuator	BW-S10W5	1430	Each Time ¹	N/A

Note¹: cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: *BACL Corp.* attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

10.4 Test Environmental Conditions

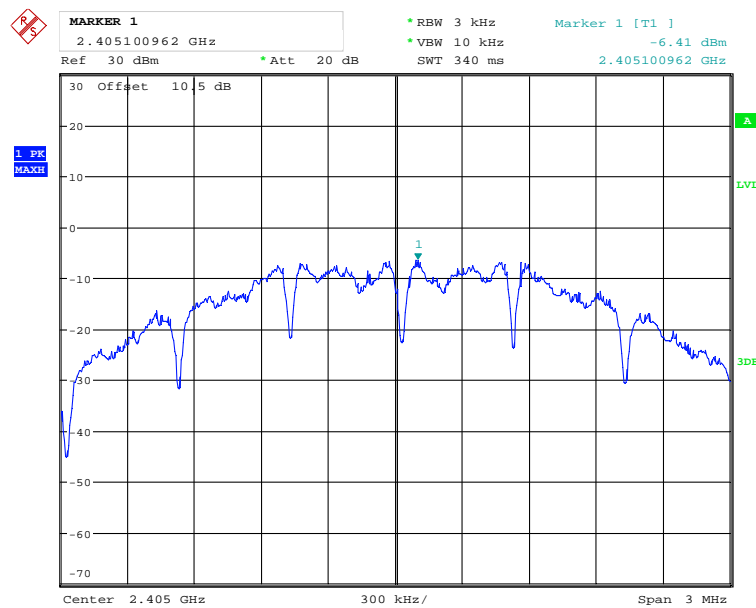
Temperature:	23.6° C
Relative Humidity:	49 %
ATM Pressure:	102.2 kPa

The testing was performed by Jin Yang on 2016-06-07 in RF site.

10.5 Test Results

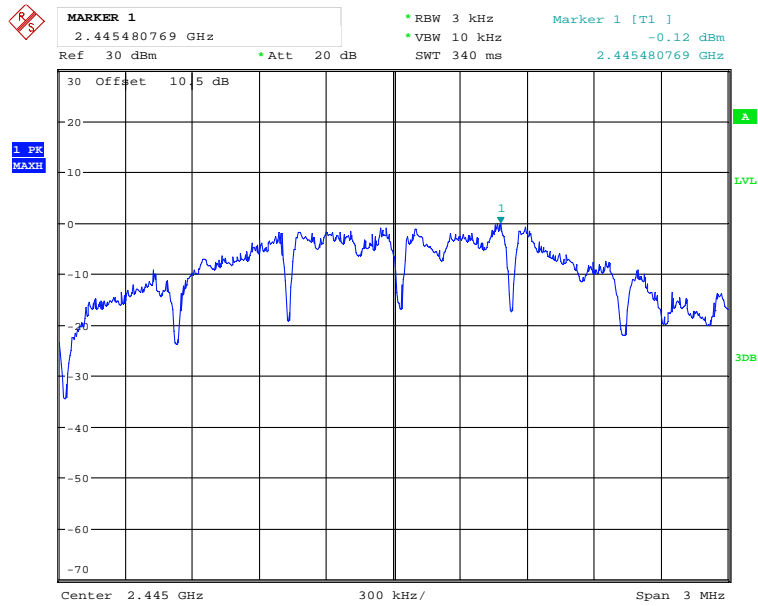
Channel	Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
Low	2405	-6.41	8
Middle	2445	-0.12	8
25	2475	-1.87	8
High	2480	-13.11	8

802.15.4-2405 MHz



Date: 7.JUN.2016 08:34:16

802.15.4-2445 MHz



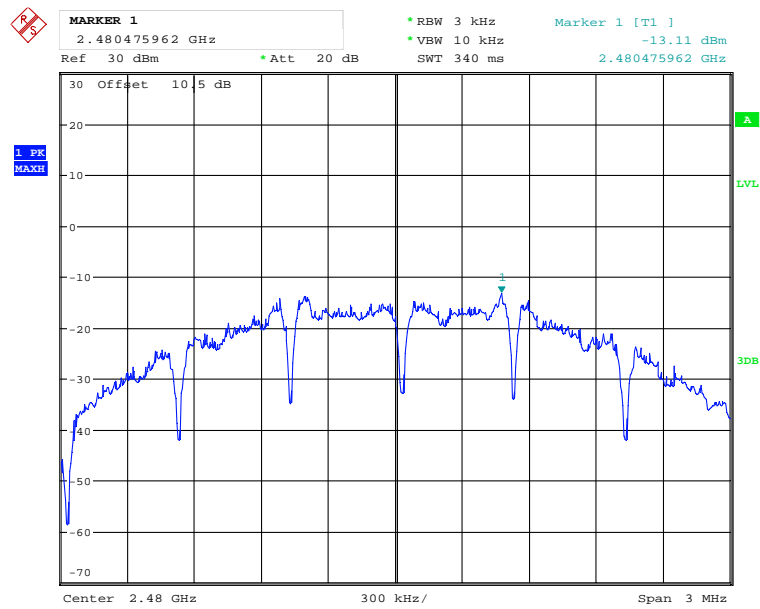
Date: 7.JUN.2016 08:37:15

802.15.4-2475 MHz



Date: 7.JUN.2016 08:40:56

802.15.4-2480 MHz



Date: 7.JUN.2016 08:46:19

--END OF REPORT--