ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Applicant:	Opticon Sensors Europe B.V. Opaallaan 35, 2132 XV Hoofddorp, The Netherlands
Product Name:	ESL Electronic Shelf Label
Brand Name:	OPTICON
Model No.:	PE-292
Model Difference:	N/A
Report Number:	T190311W04-RP2
FCC ID:	Q2QPE292
FCC Rule Part:	§15.249
Issue Date:	Apr. 10, 2019
Date of Test:	Mar. 13, 2019 ~ Mar. 18, 2019
Date of EUT Received:	Mar. 13, 2019
Issued by:	Compliance Certification Services Inc.Wugu Lab. No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.) service@ccsrf.com

The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.10: 2013 and compliance standards.
The test results of this report relate only to the tested sample (EUT) identified in this re-port. The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc. (Wugu Laboratory).

Tested By: Jerry Lu

Jerry Lu / Engineer

Approved By: Kevin Tsai

Kevin Tsai / Deputy Manager

Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
T190311W04-RP2	Rev.00	Initial creation of document	All	Apr. 10, 2019	Elle Chang

Contents

1 GENERAL INFORMATION

1.1 Product Description

Product Name:	ESL Electronic Shelf Label
Brand Name:	OPTICON
Model No.:	PE-292
Model Difference:	N/A
Hardware Version:	DVT
Software Version:	SW v1.53
Power Supply:	5Vdc from power supply

Radio Technology:	2.4GHz Short Range Radio
Frequency Range:	2405 – 2480MHz
Channel number:	16 channels
Modulation type:	DSSS
Transmit Power:	89.46 dBμV/m

1.2 Antenna Designation

Antenna Designation:	PIFA Antenna, 2 dBm

1.3 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.249

ANSI C63.10:2013

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

1.4 Test Facility

Compliance Certification Services Inc. Wugu Lab. No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.) (TAF code 1309)
FCC Designation number: TW1309

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.

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 Conducted Emissions

The EUT is a placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 Radiated Emissions

The EUT is a 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

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.

2.5 Limitation

(2) Radiated Emission

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following.

Frequency (MHz)	Field strength of Fundamental	Field strength of Harmonics	Distance (m)
902 – 928	50 mV/m (94dBuV/m)	500 uV/m (54dBuV/m)	3
2400 – 2483.5	50 mV/m (94dBuV/m)	500 uV/m (54dBuV/m)	3
5725 – 5875	50 mV/m (94dBuV/m)	500 uV/m (54dBuV/m)	3
24.0 – 24.25 GHz	250 mV/m (107.95dBuV/m)	2500 uV/m (67.95dBuV/m)	3

(3) Radiated Emission

Emission Radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits as below, whichever is the lesser attenuation.

Frequency (MHz)	Field strength μV/m	Distance (m)	Field strength at 3m dBμV/m
1.705-30	30	30	69.54
30-88	100	3	40
88-216	150	3	43.5
216-960	200	3	46
Above 960	500	3	54

(4) Radiated Emission

For frequencies above 1000MHz, the above field strength limits are based on average limits. The peak filed strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20dB under any condition of modulation.

Remark:
1. Emission level in dBuV/m=20 log (uV/m)
2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of ξ 15.205.
4. Emission spurious frequency which appearing within the Restricted Bands specified in provision of ξ15.205, then the general radiated emission limits in ξ 15.209 apply.

2.6 Configuration of Tested System

Fig. 2-1 Radiated Emission & Conducted (Antenna Port) Configuration

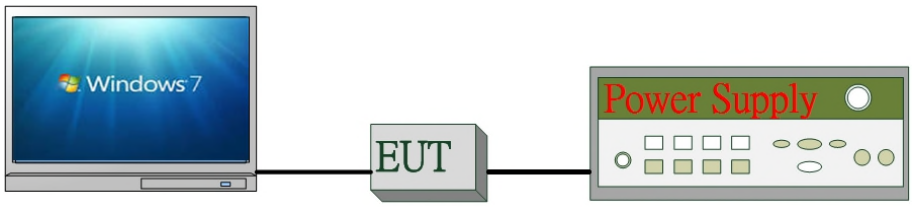


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	2.4GHz Wireless Test Software	N/A	N/A	N/A	N/A	N/A
2.	Notebook	Lenovo	L430	PK-OCGFF	Shielded	Unshielded
3.	DC Power Supply	Agilent	E3640A	MY53140006	N/A	Unshielded

3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	N/A
§15.249(a)(e)	Field Strength of the Fundamental signal	Compliant
§15.249(a), 15.209	Spurious Emission	Compliant
15.249(a), 15.205	Restricted bands around fundamental frequency (Radiated Emission)	Compliant
§15.215(c)	20dB Bandwidth Measurement	Compliant
15.249(b)(2)	Frequency Stability	Compliant

4 DESCRIPTION OF TEST MODES

4.1 Operated in 2405 ~ 2480MHz Band

16 channels are provided.

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2405 MHz	5	2425MHz	9	2445 MHz	13	2465 MHz
2	2410 MHz	6	2430 MHz	10	2450 MHz	14	2470 MHz
3	2415 MHz	7	2435 MHz	11	2455 MHz	15	2475 MHz
4	2420 MHz	8	2440 MHz	12	2460 MHz	16	2480 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.

RADIATED EMISSION TEST:

RADIATED EMISSION TEST (BELOW 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED FREQUENCY	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
2.4G	1 to 16	2410, 2440, 2480	DSSS	N/A	MAIN
RADIATED EMISSION TEST (ABOVE 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED FREQUENCY	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
2.4G	1 to 16	2410, 2440, 2480	DSSS	N/A	MAIN

Note:
The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for 2.4GHz Wireless Transmitter for channel Low, Mid and High, the worst case E2 position was reported.

ANTENNA PORT CONDUCTED MEASUREMENT:

CONDUCTED TEST					
MODE	AVAILABLE CHANNEL	TESTED FREQUENCY	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
2.4G	1 to 16	2410, 2440, 2480	DSSS	N/A	MAIN

5 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	+/- 1.2575 dB
Peak Output Power	+/- 1.924 dB
20dB Bandwidth	+/- 147.256 Hz
100 kHz Bandwidth of Frequency Band Edges	+/- 1.924 dB
Frequency Separation	+/- 147.256 Hz
Number of hopping frequency	+/- 147.256 Hz
Time of Occupancy	+/- 147.256 Hz
3M Semi Anechoic Chamber / 30M~200M	+/- 4.12 dB
3M Semi Anechoic Chamber / 200M~1000M	+/- 4.68 dB
3M Semi Anechoic Chamber / 1G~8G	+/- 5.18 dB
3M Semi Anechoic Chamber / 8G~18G	+/- 5.47 dB
3M Semi Anechoic Chamber / 18G~26G	+/- 3.81 dB
3M Semi Anechoic Chamber / 26G~40G	+/- 3.87 dB

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report.
3. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

6 CONDUCTED EMISSION TEST

6.1 Standard Applicable:

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

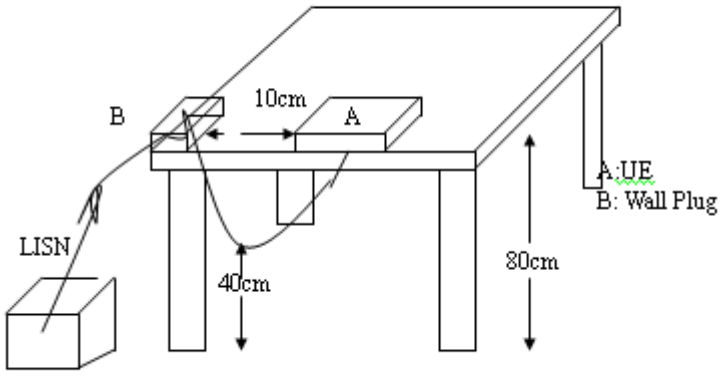
6.2 Measurement Equipment Used:

N/A

6.3 EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

6.6 Measurement Result:

N/A; Powered from AA battery.

7 RADIATED EMISSION TEST

7.1. Standard Applicable

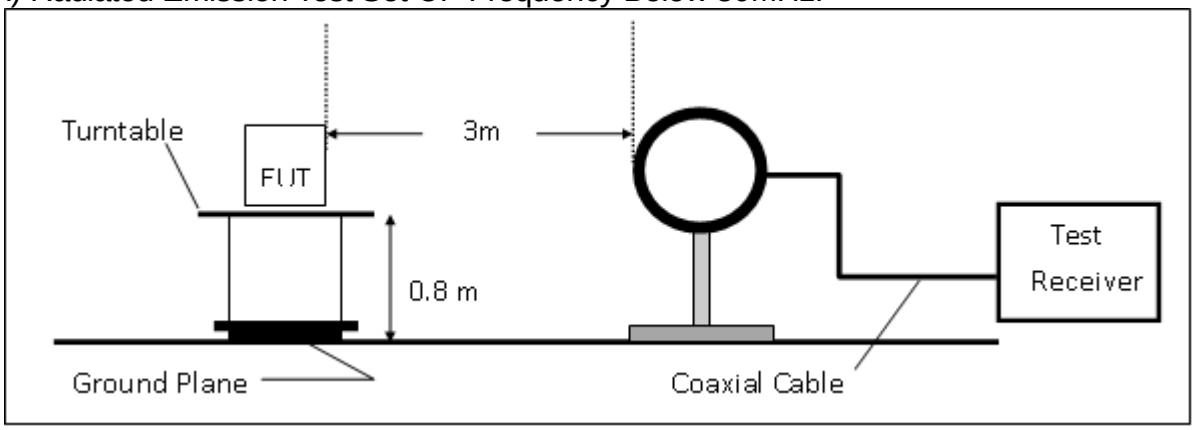
7.2. Measurement Procedure

1. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m for frequency> 1GHz above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

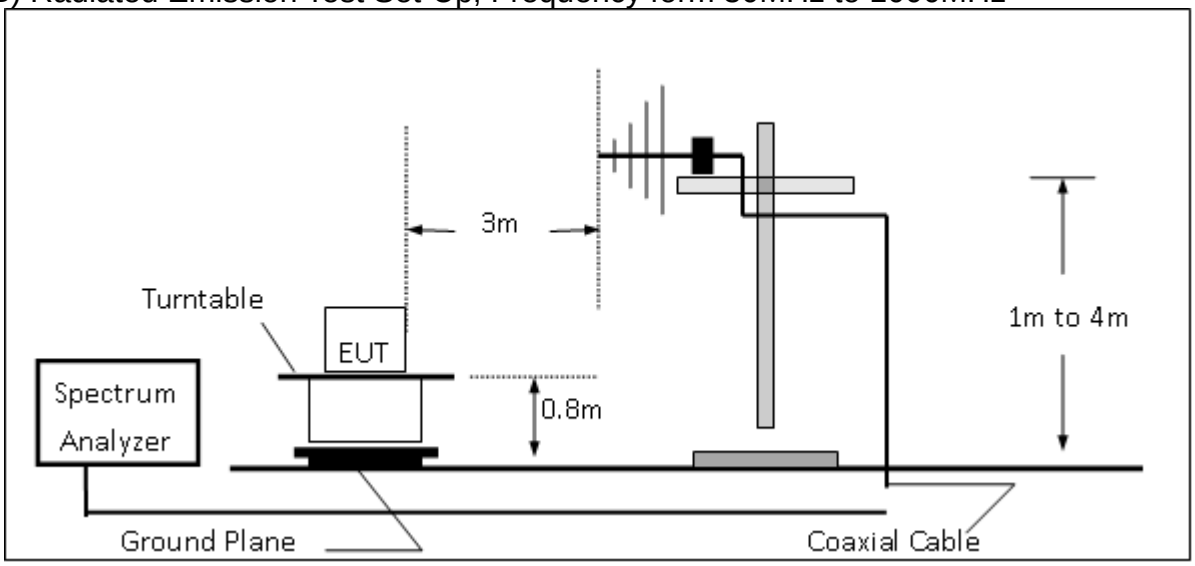
4. Repeat above procedures until all frequency measured were complete.

7.3. Test SET-UP (Block Diagram of Configuration)

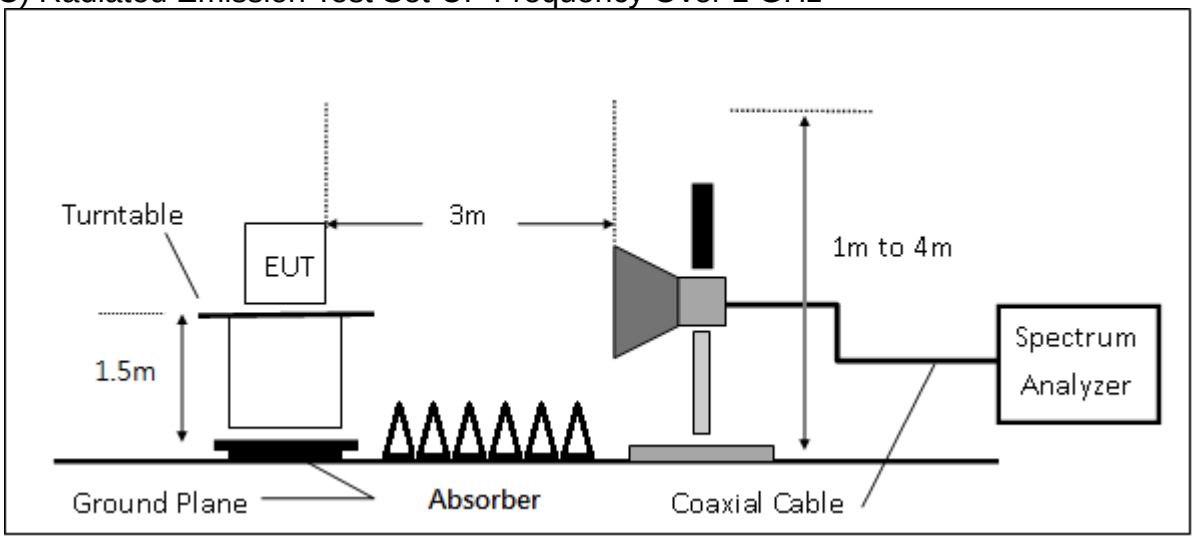
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



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



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



7.4. Measurement Equipment Used:

966A Chamber					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
Band Reject Filters	MICRO TRON-ICS	BRM 50702	120	02/26/2019	02/25/2020
Bilog Antenna	Sunol Sciences	JB3	A030105	07/13/2018	07/12/2019
Cable	HUBER SU-HNER	SUCOFLEX 104PEA	25157	02/26/2019	02/25/2020
Cable	HUBER SU-HNER	SUCOFLEX 104PEA	20995	02/26/2019	02/25/2020
Digital Thermo-Hygro Meter	WISEWIND	1206	D07	01/30/2019	01/29/2020
double Ridged Guide Horn Antenna	ETC	MCTD 1209	DRH13M02003	08/20/2018	08/19/2019
Loop Ant	COM-POWER	AL-130	121051	03/21/2018	03/20/2019
Pre-Amplifier	EMEC	EM330	060609	02/26/2019	02/25/2020
Pre-Amplifier	HP	8449B	3008A00965	02/26/2019	02/25/2020
PSA Series Spectrum Analyzer	Agilent	E4446A	MY46180323	05/31/2018	05/30/2019
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R
Software	e3 V6.11-20180413				

Note: N.C.R refers to Not Calibrated Required

7.5. 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

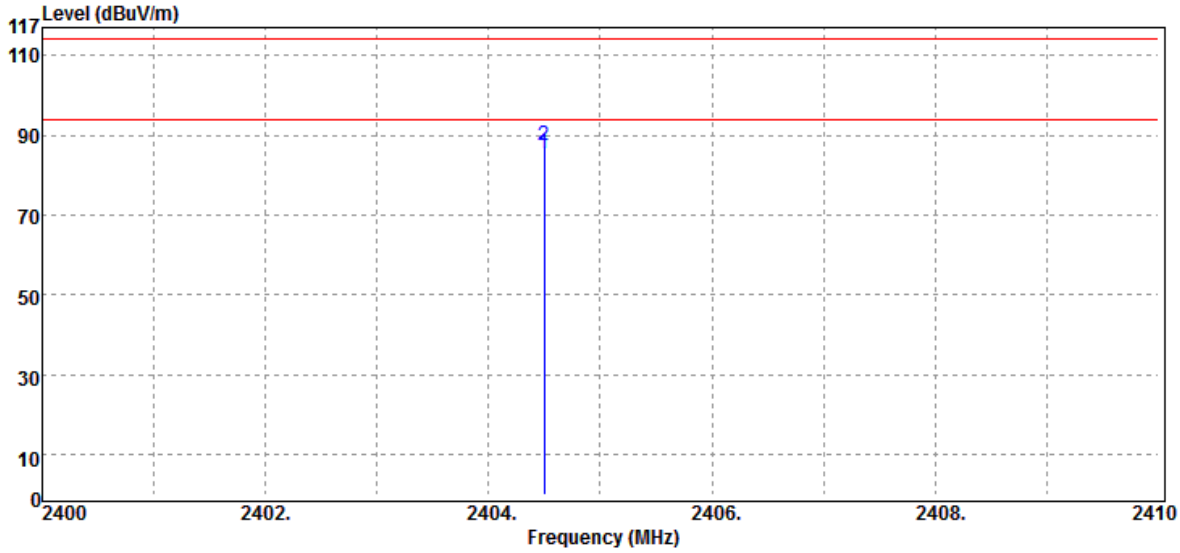
Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)
Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

7.6. Measurement Result

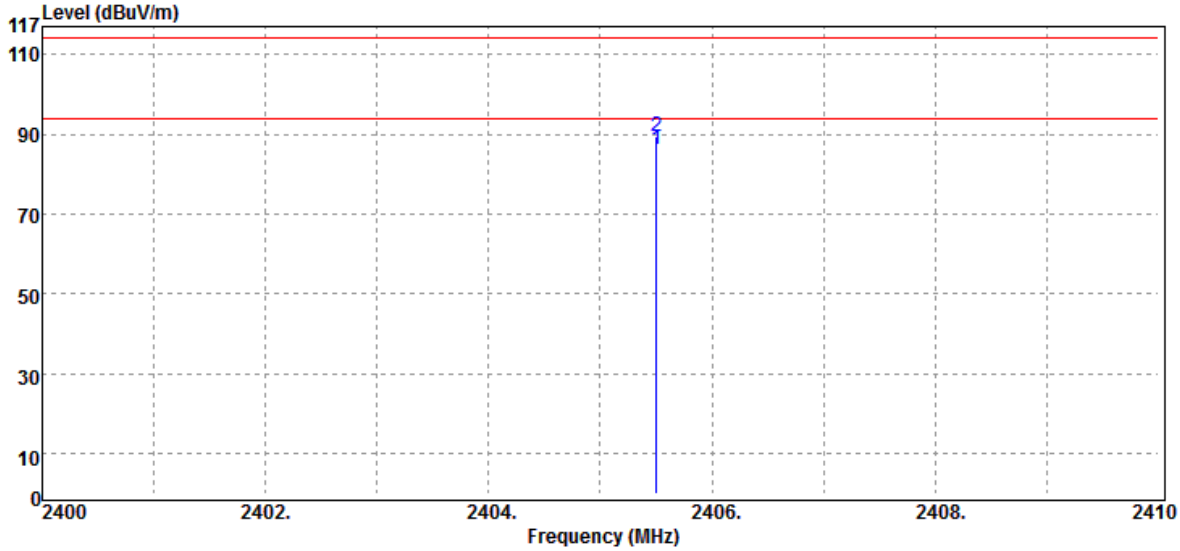
Field Strength of the Fundamental Signal

Operation Band	:Zigbee	Test Date	:2019-03-18
Fundamental Frequency	:2405 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Main CH LOW	Engineer	:Jerry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL



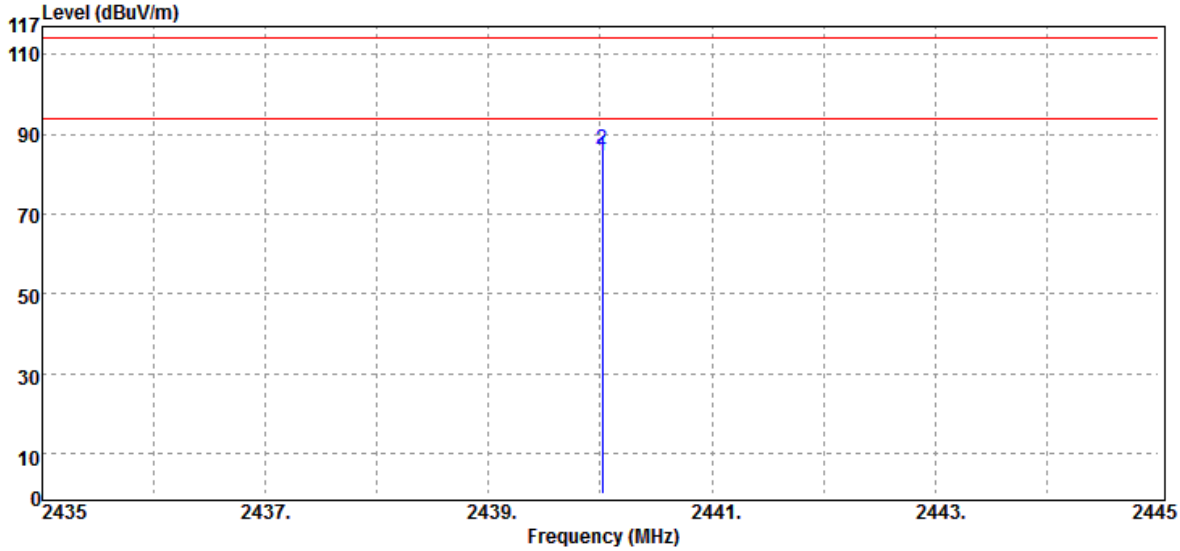
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2404.50	Average	88.56	-3.34	85.22	94.00	-8.78
2404.50	Peak	90.82	-3.34	87.48	114.00	-26.52

Operation Band	:Zigbee	Test Date	:2019-03-18
Fundamental Frequency	:2405 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Main CH LOW	Engineer	:Jerry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL



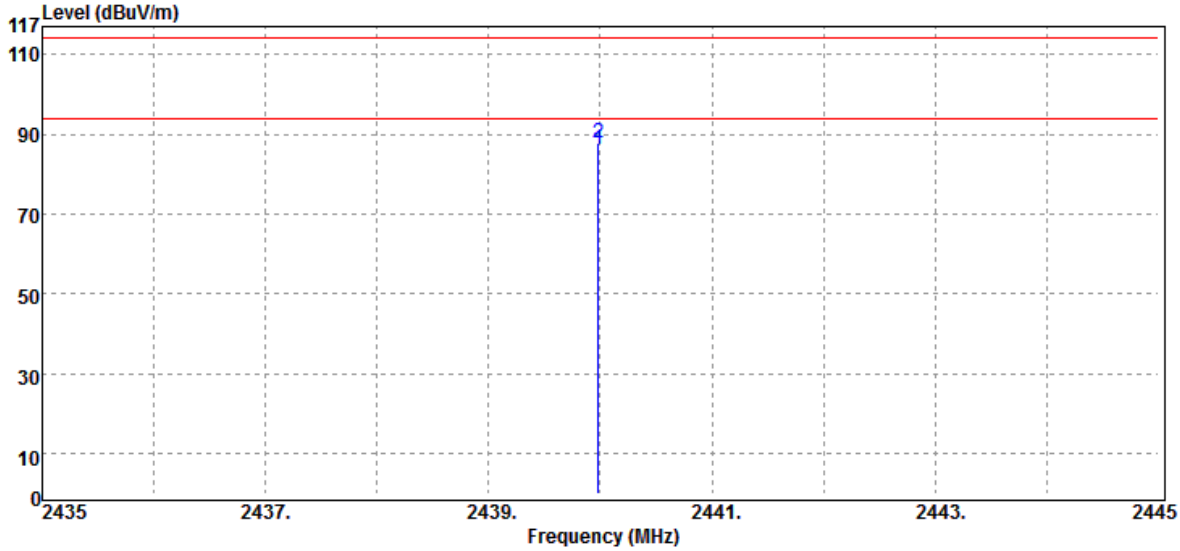
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2405.50	Average	89.47	-3.34	86.13	94.00	-7.87
2405.50	Peak	92.80	-3.34	89.46	114.00	-24.54

Operation Band	:Zigbee	Test Date	:2019-03-18
Fundamental Frequency	:2440 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Main CH MID	Engineer	:Jerry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL



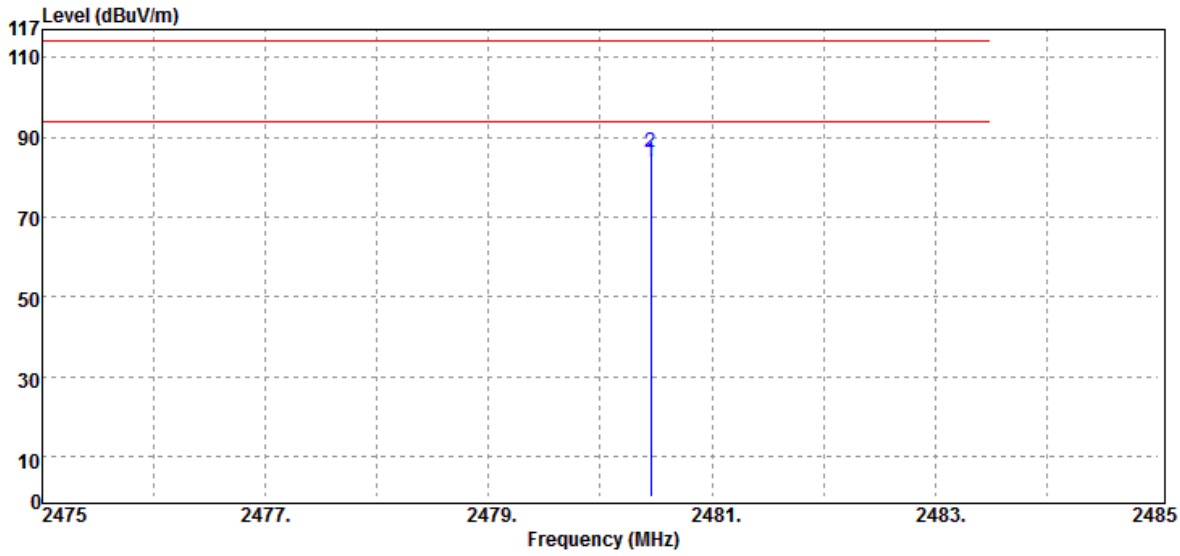
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2440.02	Average	87.89	-3.37	84.52	94.00	-9.48
2440.02	Peak	89.56	-3.37	86.19	114.00	-27.81

Operation Band	:Zigbee	Test Date	:2019-03-18
Fundamental Frequency	:2440 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Main CH MID	Engineer	:Jerry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL



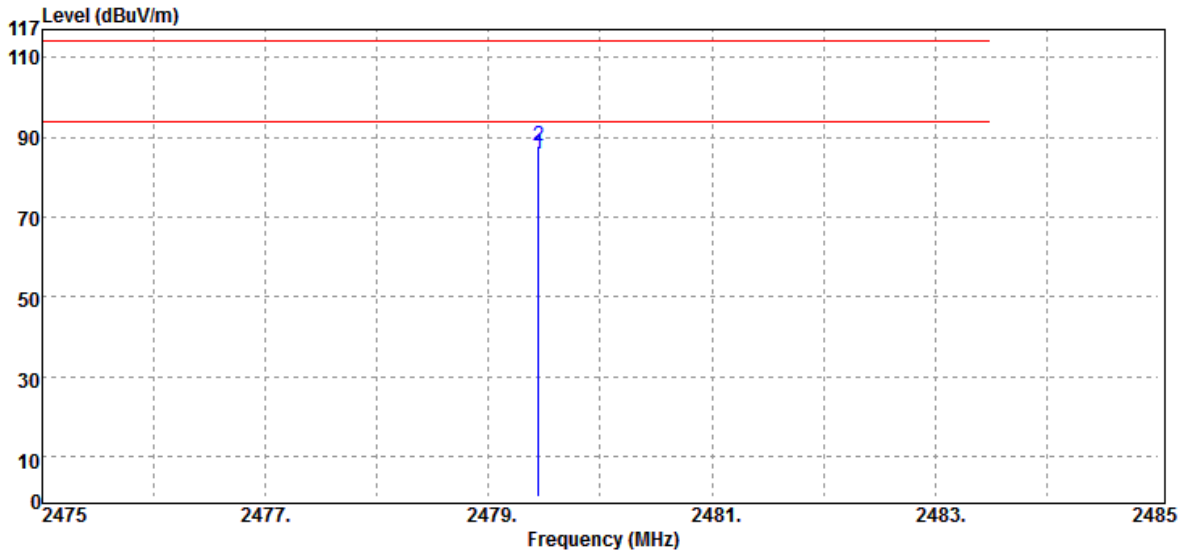
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2439.98	Average	89.49	-3.37	86.12	94.00	-7.88
2439.98	Peak	91.38	-3.37	88.01	114.00	-25.99

Operation Band	:Zigbee	Test Date	:2019-03-18
Fundamental Frequency	:2480 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Main CH HIGH	Engineer	:Jerry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2480.45	Average	86.37	-2.74	83.63	94.00	-10.37
2480.45	Peak	88.81	-2.74	86.07	114.00	-27.93

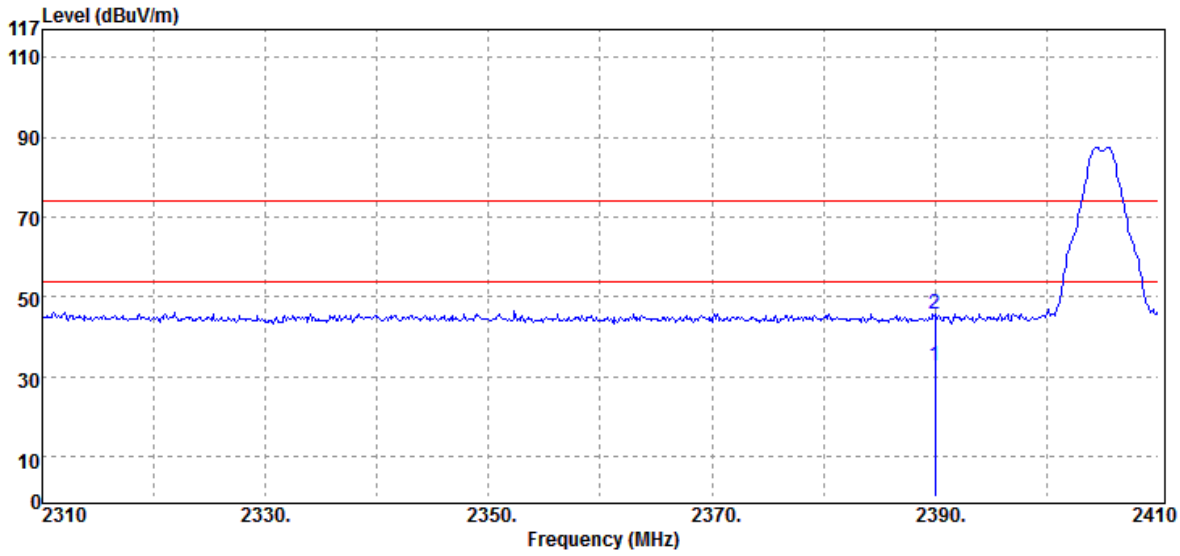
Operation Band	:Zigbee	Test Date	:2019-03-18
Fundamental Frequency	:2480 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Main CH HIGH	Engineer	:Jerry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2479.45	Average	88.66	-2.76	85.90	94.00	-8.10
2479.45	Peak	90.77	-2.76	88.01	114.00	-25.99

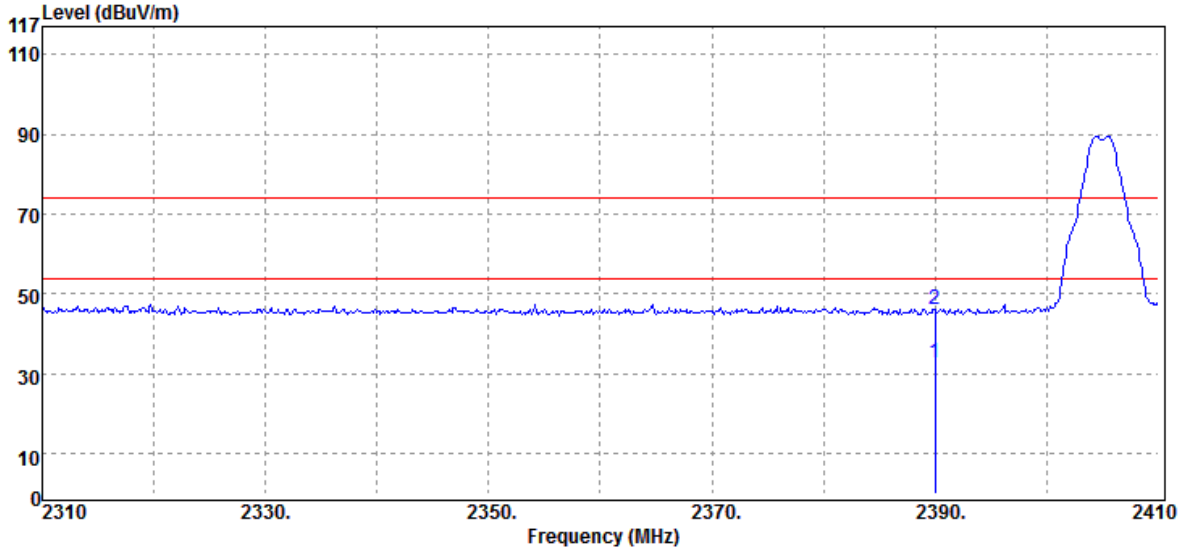
Restricted bands around fundamental frequency

Operation Band	:Zigbee	Test Date	:2019-03-14
Fundamental Frequency	:2405 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Bandedge CH LOW	Engineer	:Jerry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL



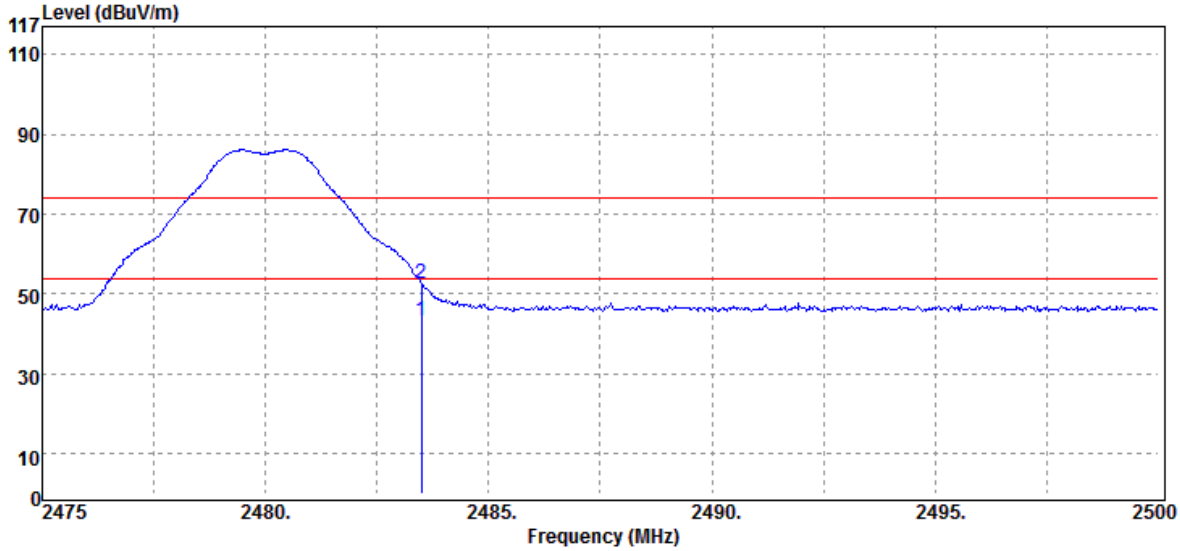
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	36.15	-3.33	32.82	54.00	-21.18
2390.00	Peak	49.00	-3.33	45.67	74.00	-28.33

Operation Band	:Zigbee	Test Date	:2019-03-14
Fundamental Frequency	:2405 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Bandedge CH LOW	Engineer	:Jerry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL



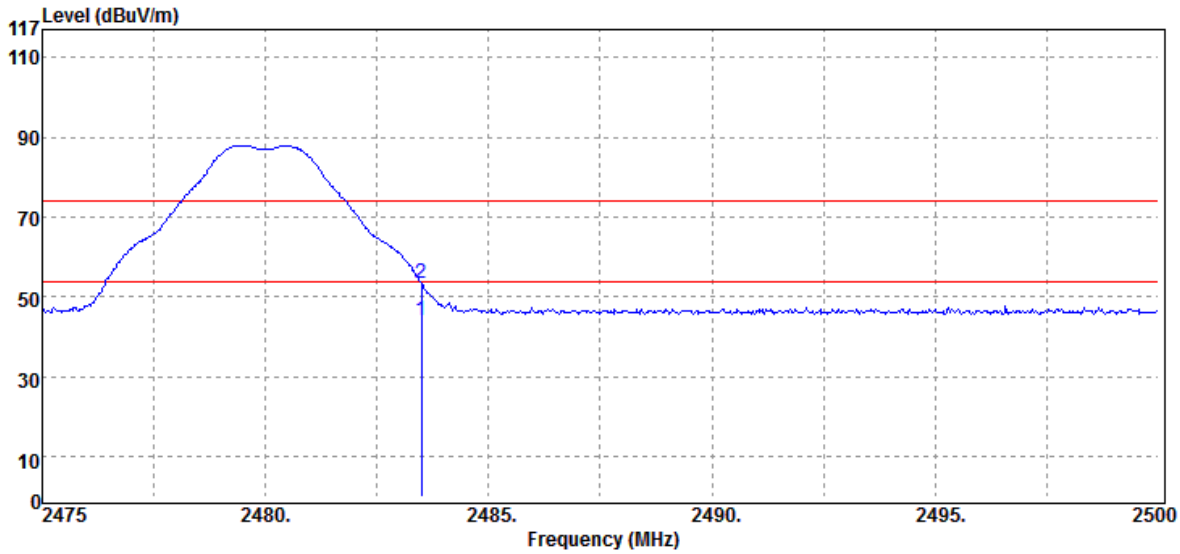
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	36.22	-3.33	32.89	54.00	-21.11
2390.00	Peak	49.34	-3.33	46.01	74.00	-27.99

Operation Band	:Zigbee	Test Date	:2019-03-14
Fundamental Frequency	:2480 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Bandedge CH HIGH	Engineer	:Jerry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL



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	45.98	-2.72	43.26	54.00	-10.74
2483.50	Peak	55.52	-2.72	52.80	74.00	-21.20

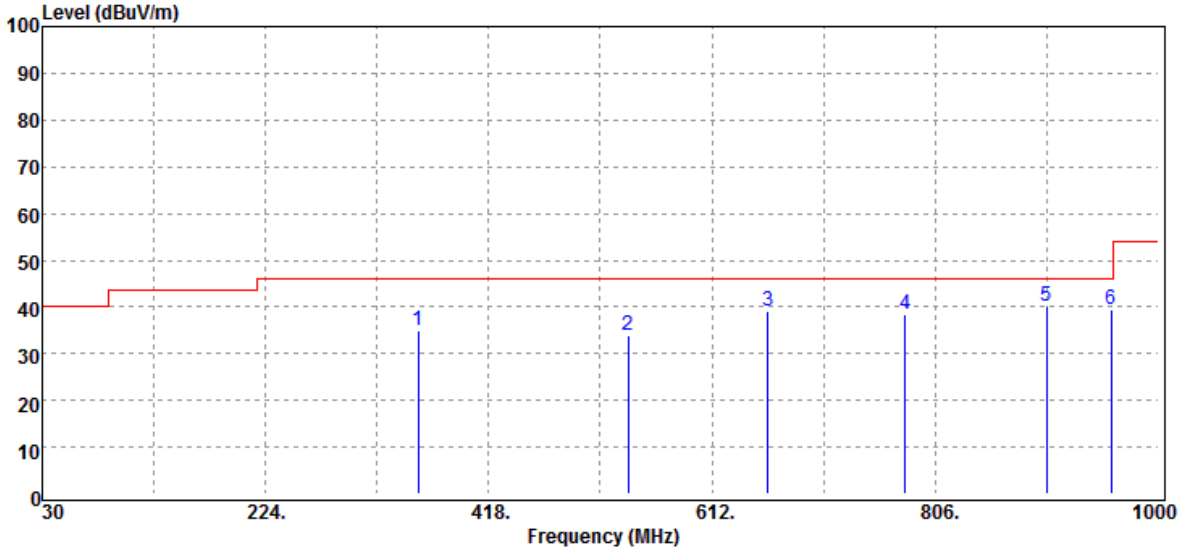
Operation Band	:Zigbee	Test Date	:2019-03-14
Fundamental Frequency	:2480 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Bandedge CH HIGH	Engineer	:Jerry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL



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	46.95	-2.72	44.23	54.00	-9.77
2483.50	Peak	56.11	-2.72	53.39	74.00	-20.61

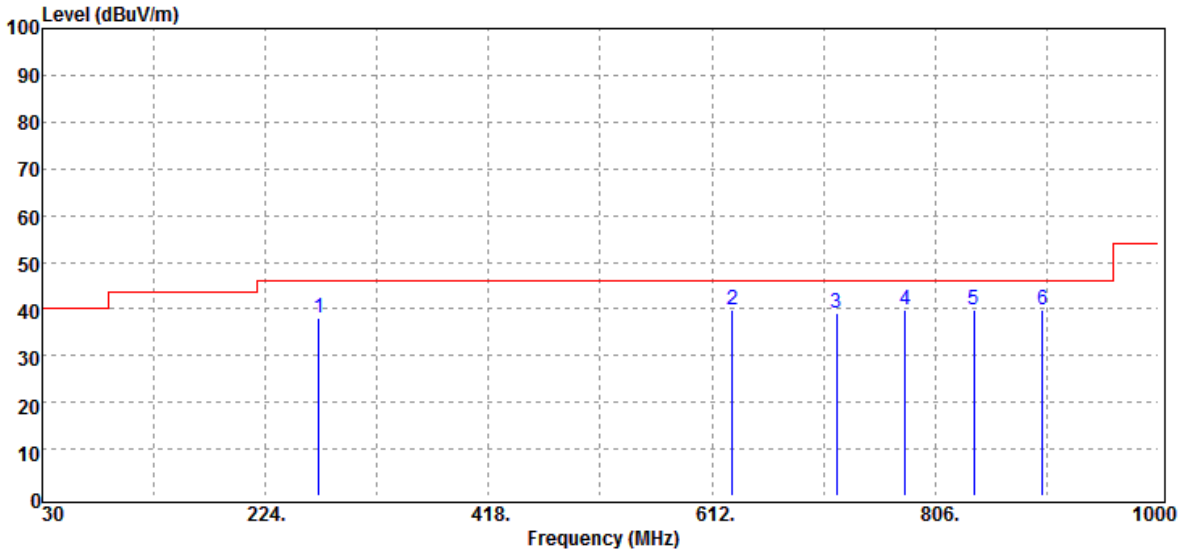
Radiated Spurious Emission Measurement Result (Below 1GHz)

Operation Band	:ZIGBEE	Test Date	:2019-03-14
Fundamental Frequency	:2405 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH LOW	Engineer	:Jerry
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL



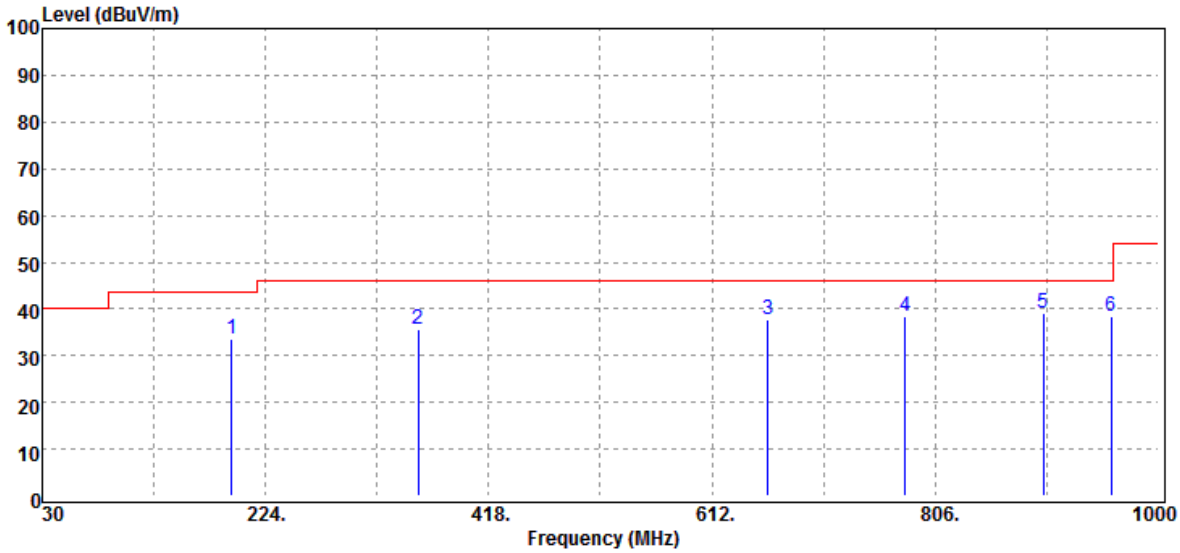
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
356.89	Peak	40.74	-5.87	34.87	46.00	-11.13
539.25	Peak	34.90	-1.14	33.76	46.00	-12.24
660.50	Peak	38.34	0.68	39.02	46.00	-6.98
779.81	Peak	35.70	2.68	38.38	46.00	-7.62
903.00	Peak	35.16	4.83	39.99	46.00	-6.01
959.26	Peak	33.61	5.85	39.46	46.00	-6.54

Operation Band	:ZIGBEE	Test Date	:2019-03-14
Fundamental Frequency	:2405 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH LOW	Engineer	:Jerry
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL



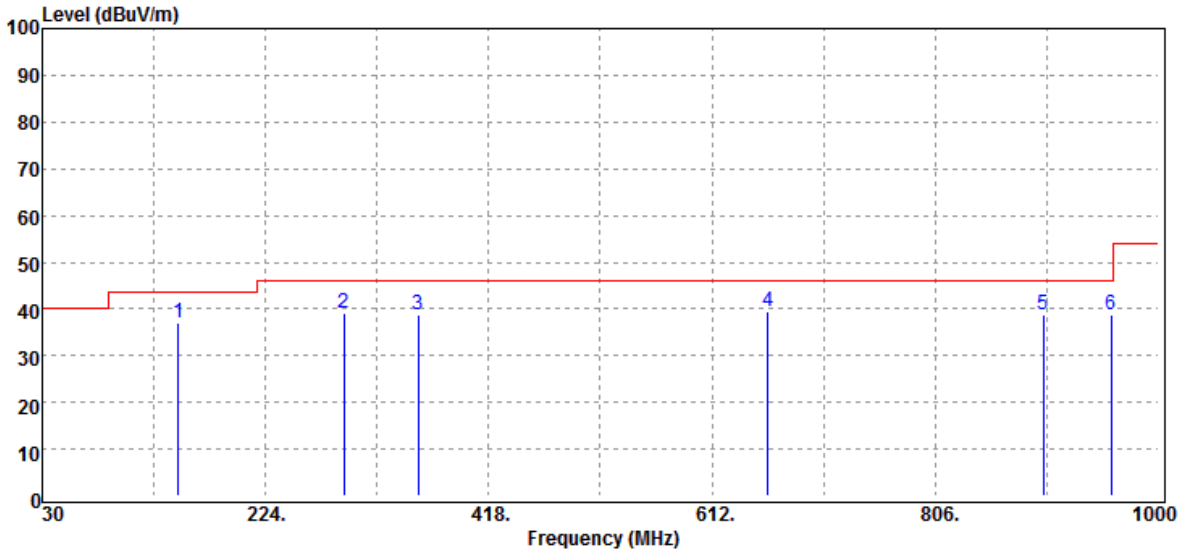
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
270.56	Peak	45.88	-7.83	38.05	46.00	-7.95
629.46	Peak	38.93	0.83	39.76	46.00	-6.24
720.64	Peak	37.86	1.33	39.19	46.00	-6.81
779.81	Peak	37.05	2.68	39.73	46.00	-6.27
839.95	Peak	35.23	4.72	39.95	46.00	-6.05
899.12	Peak	35.03	4.78	39.81	46.00	-6.19

Operation Band	:ZIGBEE	Test Date	:2019-03-14
Fundamental Frequency	:2440 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Jerry
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL



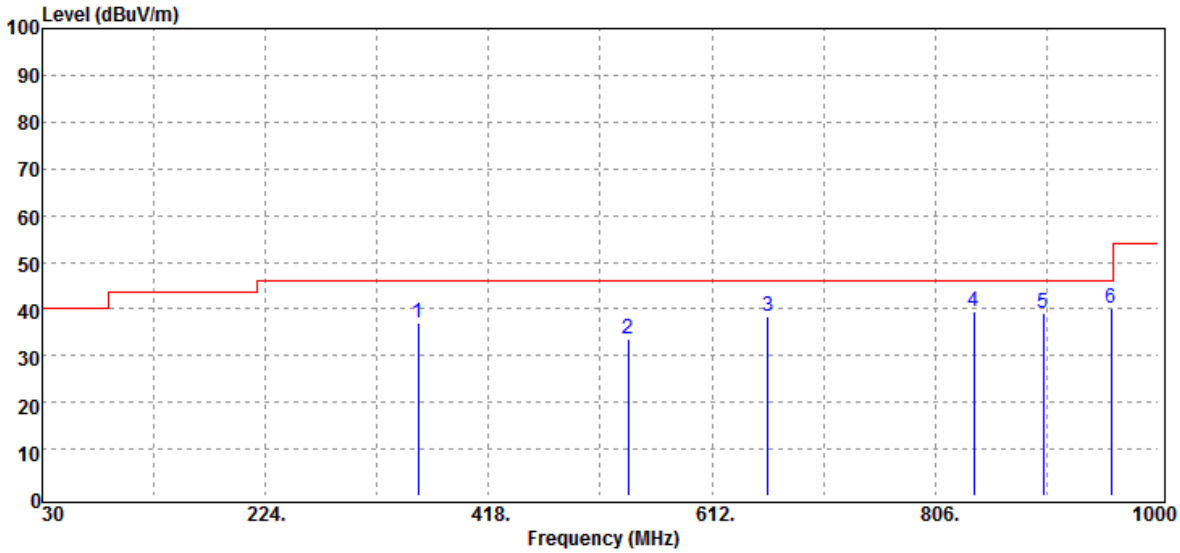
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
194.90	Peak	43.09	-9.44	33.65	43.50	-9.85
356.89	Peak	41.34	-5.87	35.47	46.00	-10.53
660.50	Peak	37.08	0.68	37.76	46.00	-8.24
779.81	Peak	35.87	2.68	38.55	46.00	-7.45
900.09	Peak	34.26	4.80	39.06	46.00	-6.94
959.26	Peak	32.51	5.85	38.36	46.00	-7.64

Operation Band	:ZIGBEE	Test Date	:2019-03-14
Fundamental Frequency	:2440 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Jerry
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL



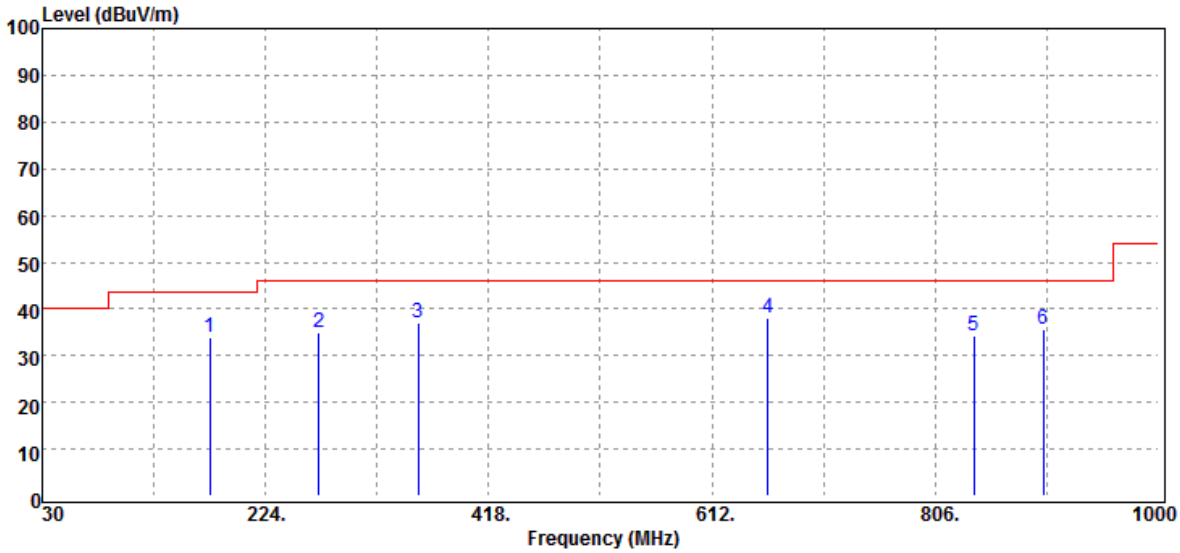
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
148.34	Peak	46.54	-9.44	37.10	43.50	-6.40
291.90	Peak	46.87	-7.63	39.24	46.00	-6.76
356.89	Peak	44.49	-5.87	38.62	46.00	-7.38
660.50	Peak	38.73	0.68	39.41	46.00	-6.59
900.09	Peak	33.98	4.80	38.78	46.00	-7.22
959.26	Peak	32.96	5.85	38.81	46.00	-7.19

Operation Band	:ZIGBEE	Test Date	:2019-03-14
Fundamental Frequency	:2480 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH HIGH	Engineer	:Jerry
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
356.89	Peak	42.90	-5.87	37.03	46.00	-8.97
539.25	Peak	34.58	-1.14	33.44	46.00	-12.56
660.50	Peak	37.69	0.68	38.37	46.00	-7.63
839.95	Peak	34.56	4.72	39.28	46.00	-6.72
900.09	Peak	34.35	4.80	39.15	46.00	-6.85
959.26	Peak	34.13	5.85	39.98	46.00	-6.02

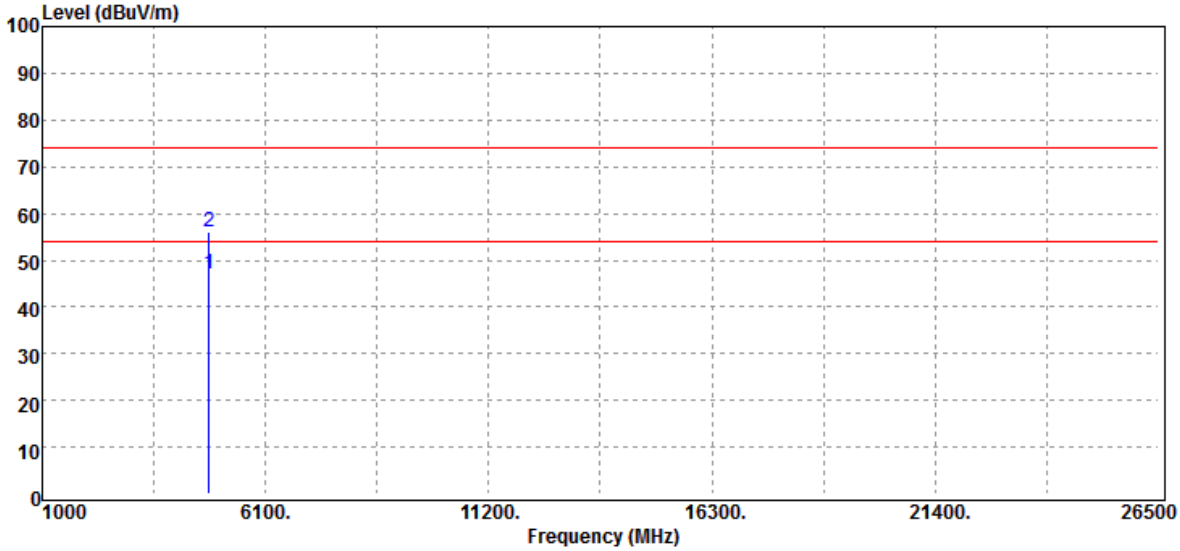
Operation Band	:ZIGBEE	Test Date	:2019-03-14
Fundamental Frequency	:2480 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH HIGH	Engineer	:Jerry
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
175.50	Peak	46.75	-12.79	33.96	43.50	-9.54
270.56	Peak	45.78	-10.72	35.06	46.00	-10.94
356.89	Peak	46.36	-9.22	37.14	46.00	-8.86
660.50	Peak	42.07	-4.05	38.02	46.00	-7.98
839.95	Peak	35.08	-0.66	34.42	46.00	-11.58
900.09	Peak	35.77	-0.19	35.58	46.00	-10.42

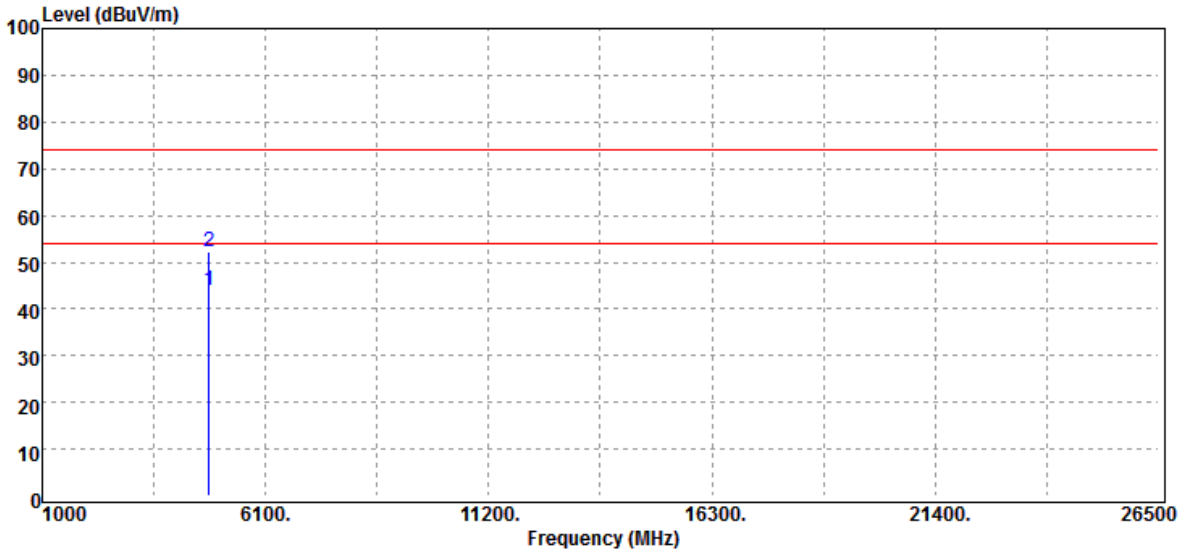
Radiated Spurious Emission Measurement Result (Above 1GHz)

Operation Band	:ZIGBEE	Test Date	:2019-03-14
Fundamental Frequency	:2405 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH LOW	Engineer	:Jerry
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL



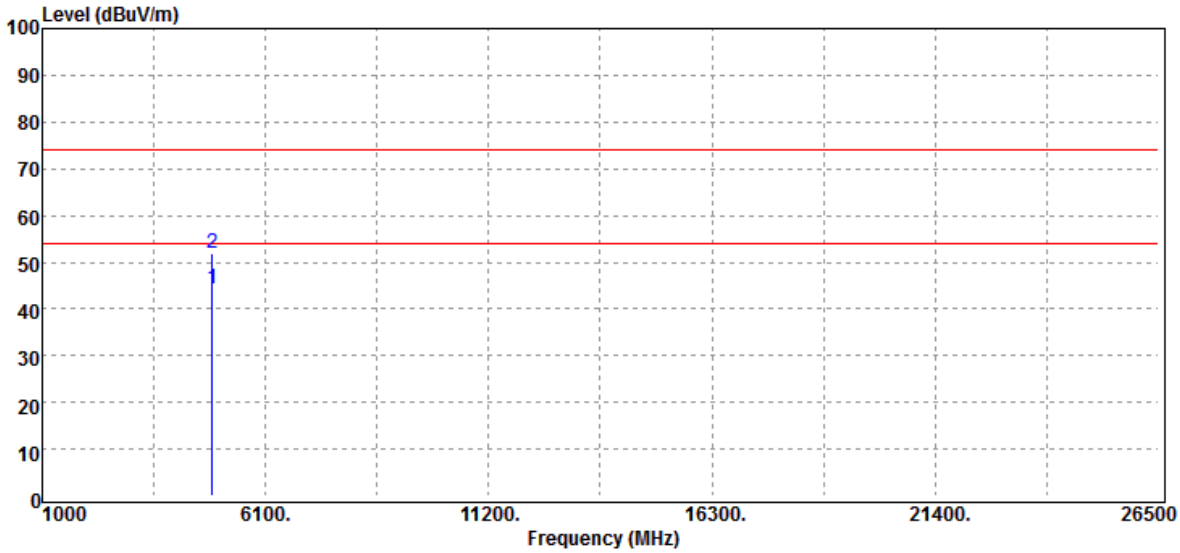
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4810.00	Average	43.93	3.08	47.01	54.00	-6.99
4810.00	Peak	52.97	3.08	56.05	74.00	-17.95

Operation Band	:ZIGBEE	Test Date	:2019-03-14
Fundamental Frequency	:2405 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH LOW	Engineer	:Jerry
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL



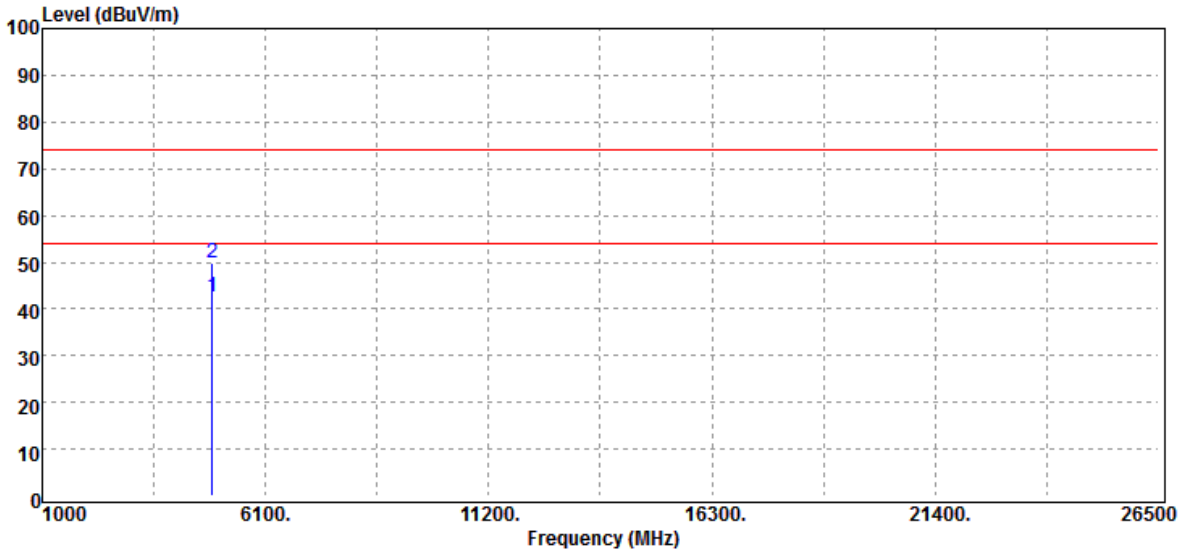
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4810.00	Average	40.95	3.08	44.03	54.00	-9.97
4810.00	Peak	49.22	3.08	52.30	74.00	-21.70

Operation Band	:ZIGBEE	Test Date	:2019-03-14
Fundamental Frequency	:2440 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Jerry
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL



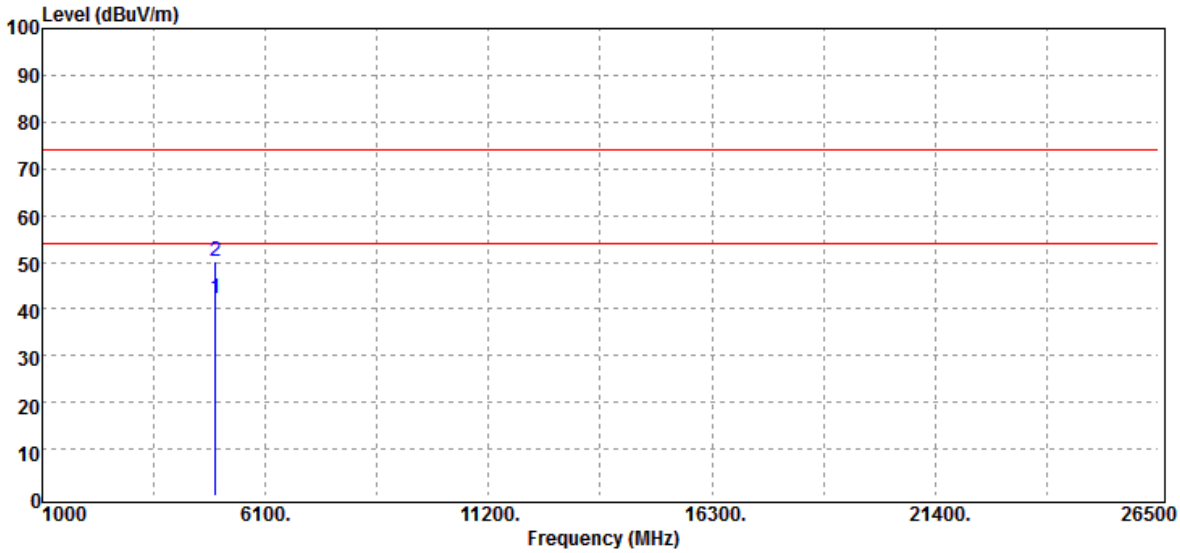
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4880.00	Average	40.89	3.44	44.33	54.00	-9.67
4880.00	Peak	48.42	3.44	51.86	74.00	-22.14

Operation Band	:ZIGBEE	Test Date	:2019-03-14
Fundamental Frequency	:2440 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Jerry
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL



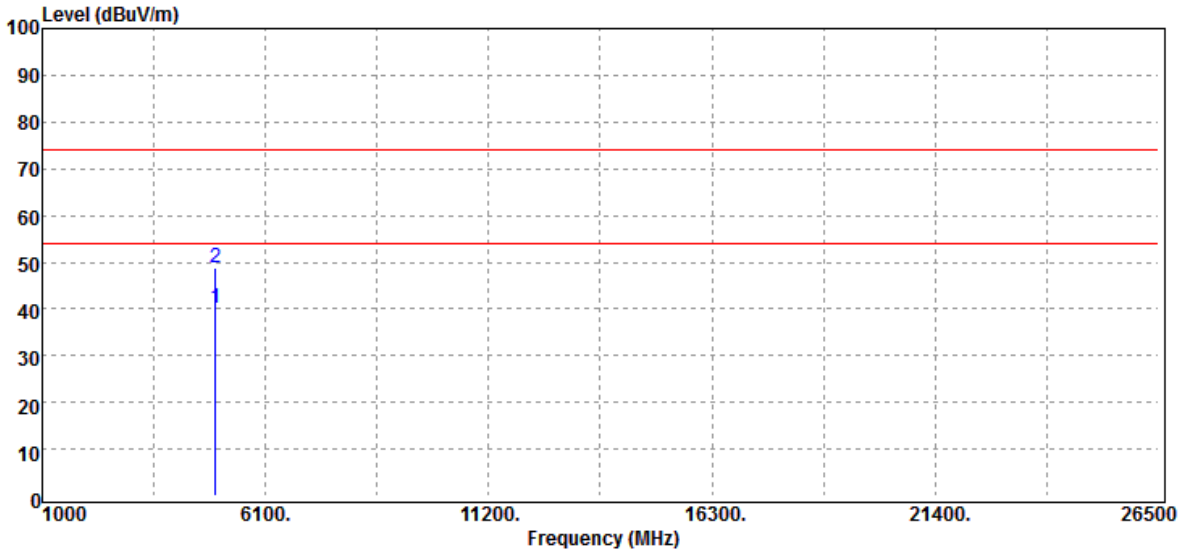
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4880.00	Average	39.22	3.44	42.66	54.00	-11.34
4880.00	Peak	46.30	3.44	49.74	74.00	-24.26

Operation Band	:ZIGBEE	Test Date	:2019-03-14
Fundamental Frequency	:2480 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH HIGH	Engineer	:Jerry
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:VERTICAL



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.00	Average	37.86	4.48	42.34	54.00	-11.66
4960.00	Peak	45.53	4.48	50.01	74.00	-23.99

Operation Band	:ZIGBEE	Test Date	:2019-03-14
Fundamental Frequency	:2480 MHz	Temp./Humi.	:21 deg_C / 62 RH
Operation Mode	:Tx CH HIGH	Engineer	:Jerry
EUT Pol.	:E2 Plan	Measurement Antenna Pol.	:HORIZONTAL



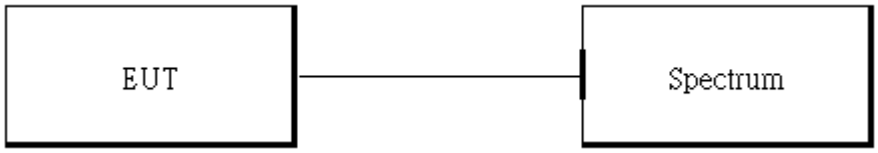
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.00	Average	35.71	4.48	40.19	54.00	-13.81
4960.00	Peak	44.18	4.48	48.66	74.00	-25.34

8 20 dB BANDWIDTH MEASUREMENT

8.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set ETU normal operating mode.
3. Set SPA Center Frequency = fundamental frequency, RBW = 100kHz, VBW = 300kHz, Span = 5MHz.
4. Set SPA Max hold. Mark peak, -20dB.

8.2 Test SET-UP (Block Diagram of Configuration)



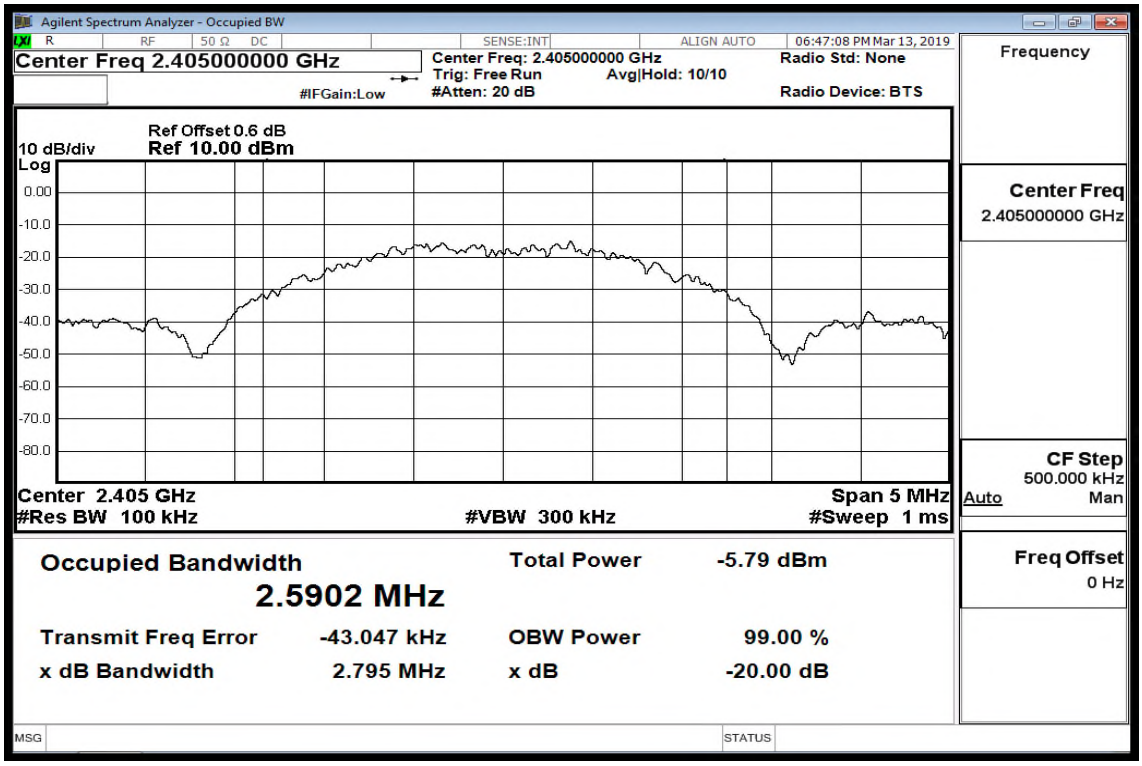
8.3 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	N9010A	MY53400256	11/21/2018	11/20/2019
DC Power Supply	Agilent	E3640A	KR93300208	08/15/2018	08/14/2019

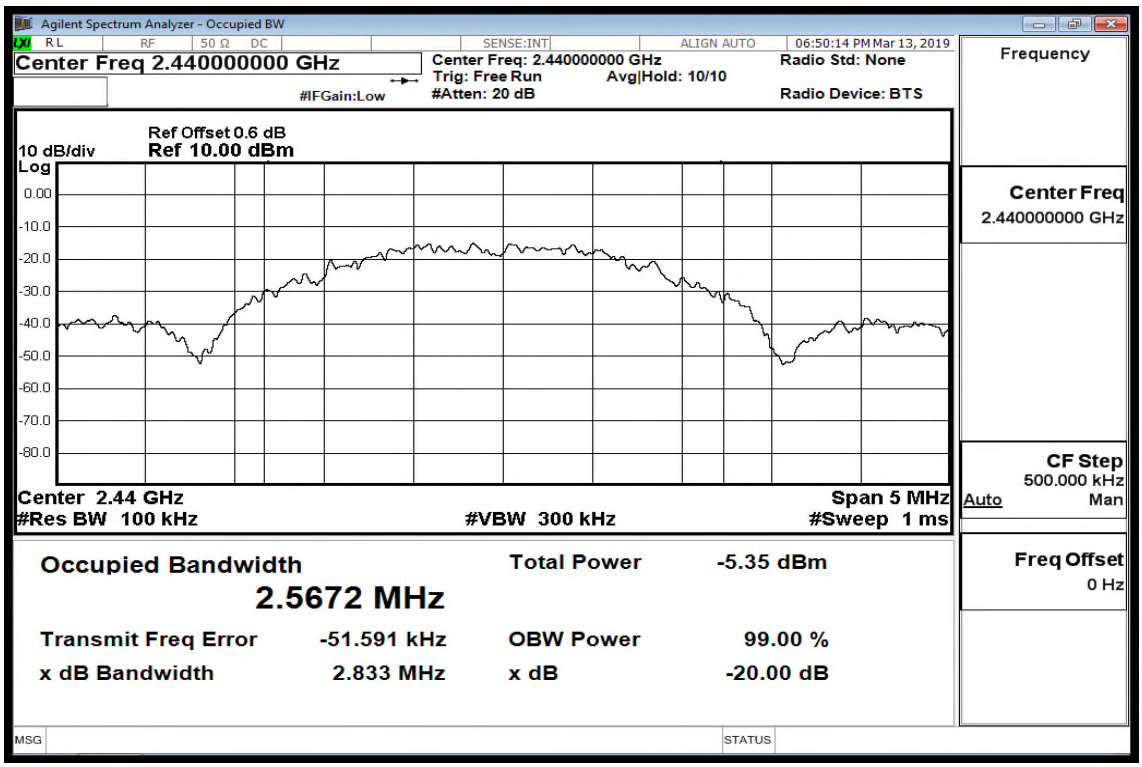
8.4 Measurement Results:

Frequency (MHz)	20dB Bandwidth (MHz)
2405	2795
2440	2833
2480	2857

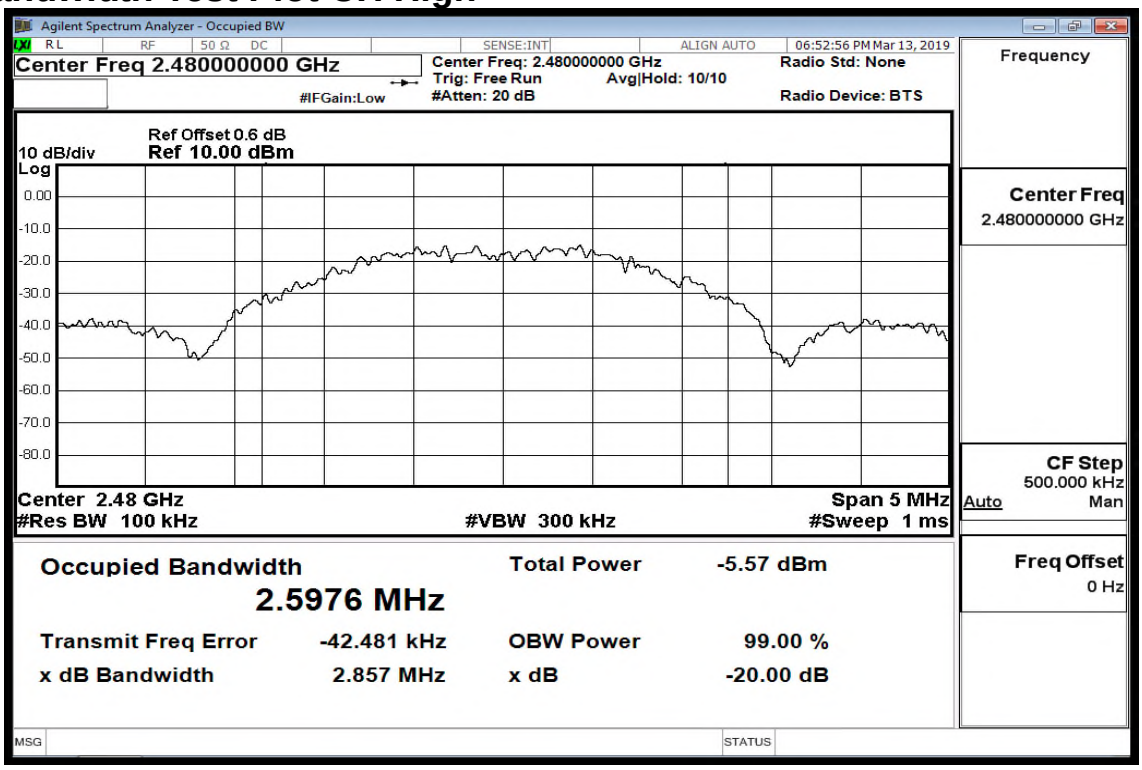
20dB Bandwidth Test Plot CH Low



20dB Bandwidth Test Plot CH Mid



20dB Bandwidth Test Plot CH High



9 FREQUENCY STABILITY

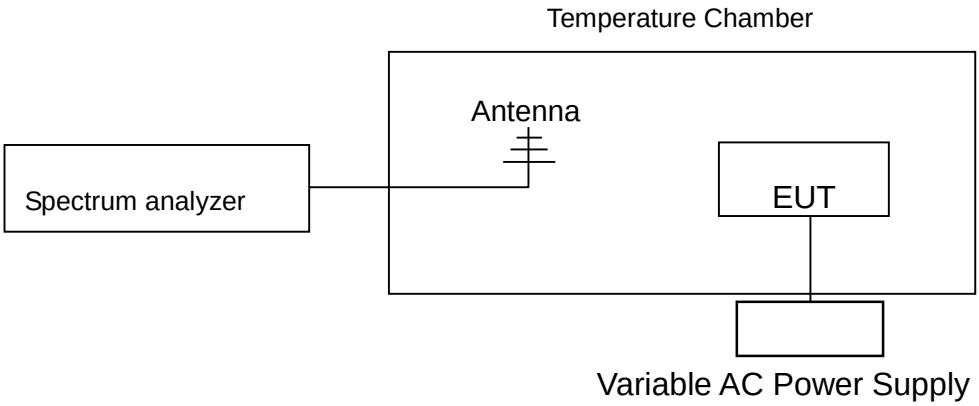
9.1 Standard Applicable

The frequency tolerance of the carrier signal shall be maintained within ±0.001% of the operating frequency over a temperature variation of −20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

9.2 Measurement Procedure

1. The EUT was placed inside temperature chamber and powered and powered by nominal DC voltage.
2. Set EUT as normal operation.
3. Turn the EUT on and couple its output to spectrum.
4. Turn the EUT off and set the chamber to the highest temperature specified.
5. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT and measure the operating frequency.
6. Repeat step with the temperature chamber set to the lowest temperature.

9.3 Test SET-UP (Block Diagram of Configuration)



9.4 Measurement Results:

2405 MHz

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (℃)	(MHz)		
3.3	25	2405.045	-30.00000	+/- 240.5
5.5	25	2405.034	-19.00000	+/- 240.5
5	25	2405.015	0.00000	+/- 240.5
5	10	2405.005	10.00000	+/- 240.5
5	50	2405.064	-49.00000	+/- 240.5

2440 MHz

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (℃)	(MHz)		
3.3	25	2440.049	-28.00000	+/- 244.0
5.5	25	2440.031	-10.00000	+/- 244.0
5	25	2440.021	0.00000	+/- 244.0
5	10	2440.011	10.00000	+/- 244.0
5	50	2440.071	-50.00000	+/- 244.0

2480 MHz

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (℃)	(MHz)		
3.3	25	2480.041	-23.00000	+/- 248.0
5.5	25	2480.029	-11.00000	+/- 248.0
5	25	2480.018	0.00000	+/- 248.0
5	10	2480.011	7.00000	+/- 248.0
5	50	2480.052	-34.00000	+/- 248.0

10 ANTENNA REQUIREMENT

10.1 Standard Applicable:

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

In case of point-to-point operation, the power shall be reduced by the one dB for every 3 dB that the directional gain of antenna exceeds 6dBi.

10.2 Antenna Connected Construction:

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~