FCC PART 15.247

TEST REPORT

For

Kirale Technologies SL

Av. General Vara de Rey 9, 5B, Logrono, Spain

FCC ID: 2AG3IM102

Report Type:	Product Type:
Original Report	Radio Module

Test Engineer:	Max Min
Report Number:	RKSA171026001-00A
Report Date:	2017-12-19
Reviewed By:	Oscar Ye RF Leader
Prepared By:	Bay Area Compliance Laboratories Corp. (Kunshan) No.248 Chenghu Road,Kunshan,Jiangsu province,China Tel: +86-0512-86175000 Fax: +86-0512-88934268 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Kirale Technologies SL
Tested Model	KTWM102-11
Series Model	KTWM102-21
Product Type	Radio Module
Dimension	16.6 mm(L)×11.4 mm(W)×2.2 mm(H)
Power Supply	DC 3.3V

** Note: The difference between tested model and series model was explained in the declaration letter.*

******All measurement and test data in this report was gathered from production sample serial number: 20171026001 (Assigned by the BACL. The EUT supplied by the applicant was received on 2017-10-26)*

Objective

This report is prepared on behalf of Kirale Technologies SL in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

No Related Submittal(s)/Grant(s).

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB558074 D01 DTS Meas Guidance v04.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19 dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
	18GHz~40GHz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0℃
Humidity		6%

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road,Kunshan,Jiangsu province,China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

802.15.4 Channel list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
11	2405	19	2445
12	2410	……	……
……	……	……	……
17	2435	25	2475
18	2440	26	2480

EUT was tested with Channel 11, 18 and 26.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

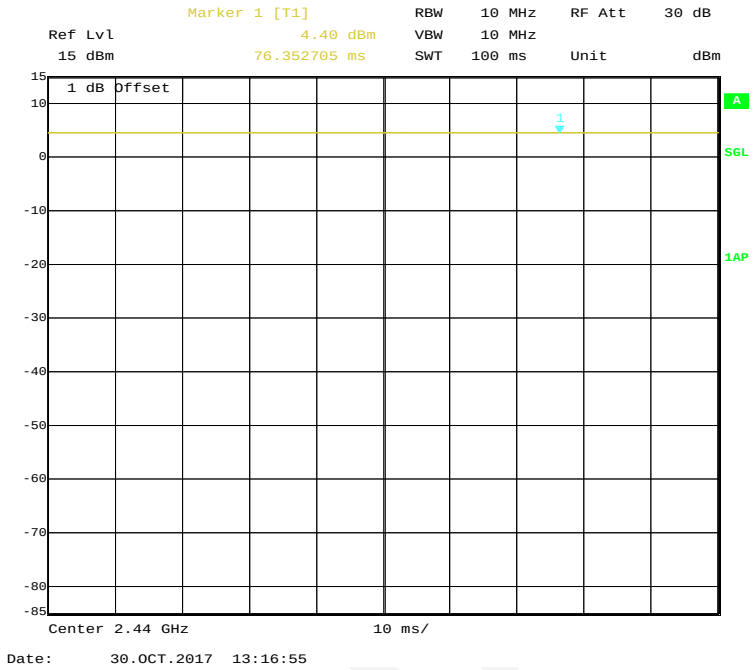
RF test tool: Termite 3.3

The device was tested with 100% duty cycle and the worst case was performed as below:
(Max setting is 0: 4 dBm; min setting is 15: -17 dBm)

Channel	Power Level
Low	0
Middle	0
High for KTWM102-11	0
High for KTWM102-21	11

Duty Cycle:

Middle Channel



Duty Cycle	T(ms)	1/T(kHz)	10log(1/x)
100%	/	/	0

Note: “x” means the duty cycle.

Support Equipment List and Details

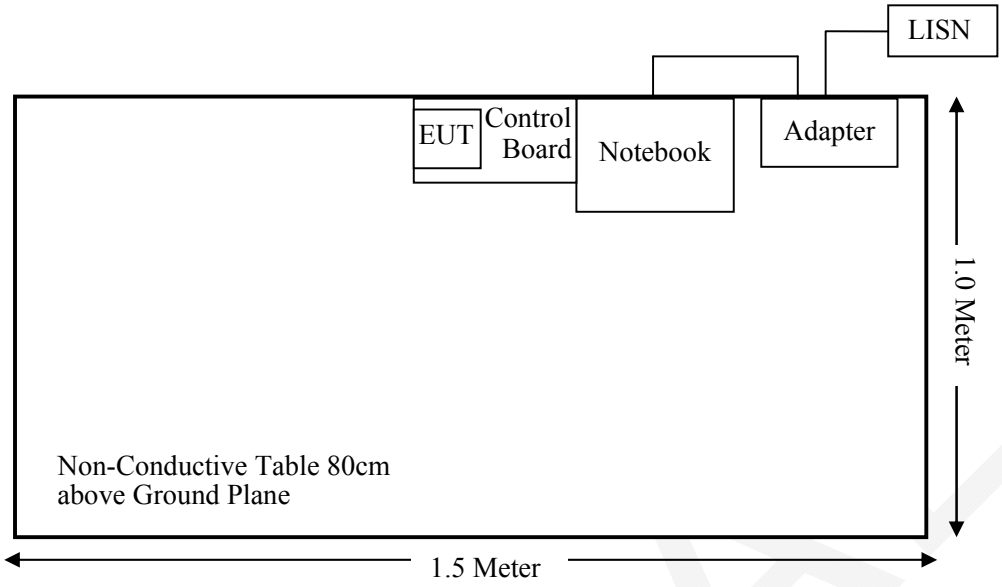
Manufacturer	Description	Model	Serial Number
DELL	Notebook	GX620	D65874152
Kirale	Control Board	KTDG102	/

External I/O Cable

Cable Description	Length (m)	From Port	To
/	/	/	/

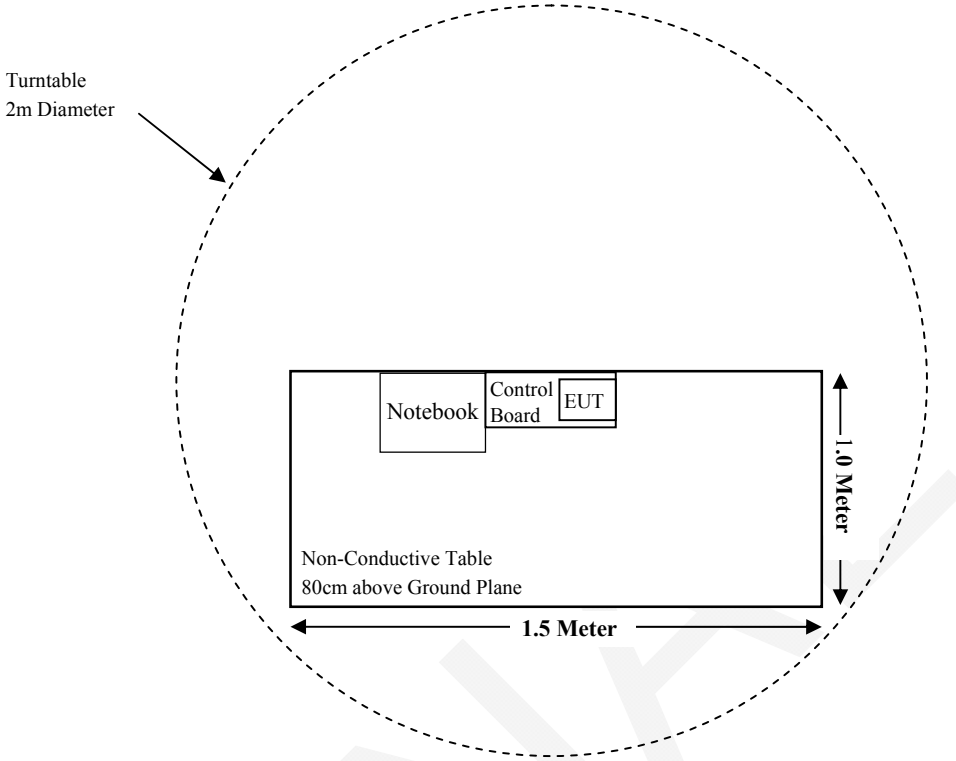
Block Diagram of Test Setup

For Conducted Emissions:

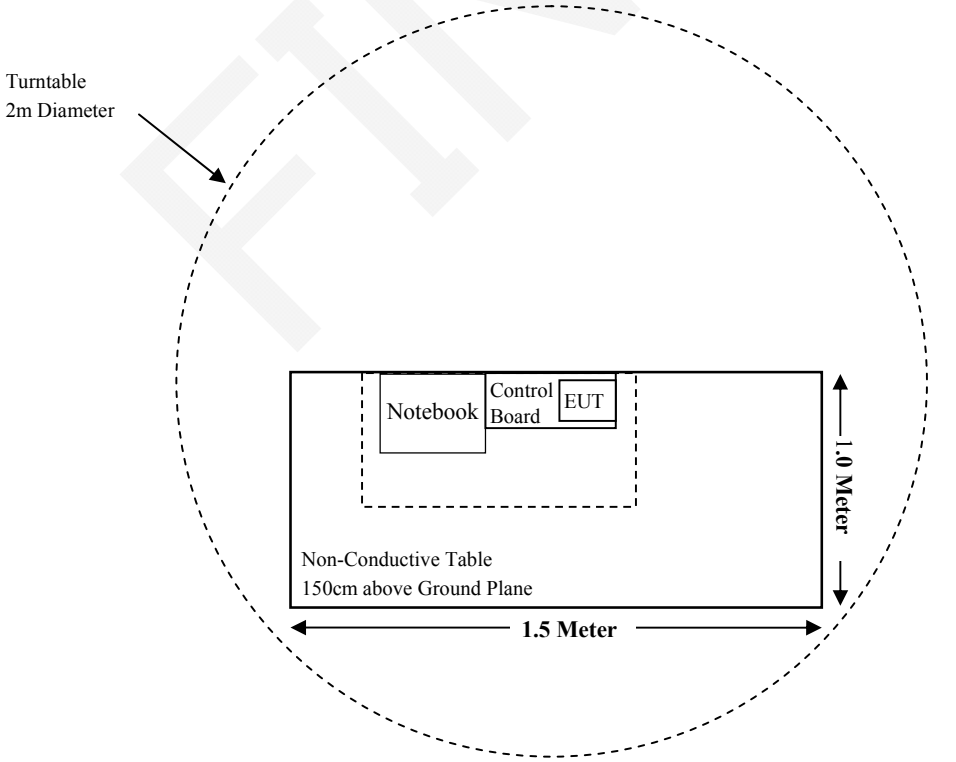


Block Diagram of Test Setup

For Radiated Emissions(Below 1GHz):



For Radiated Emissions(Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.247(d)	Spurious Emissions at Antenna Port	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions & Restricted Bands Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Conducted Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test（Chamber 1#）					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2017-10-25	2018-10-24
Sunol Sciences	Broadband Antenna	JB3	A040914-2	2016-01-09	2019-01-08
Sonoma Instrunent	Pre-amplifier	310N	171205	2017-08-15	2018-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2017-08-15	2018-08-14
Radiated Emission Test（Chamber 2#）					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2017-08-27	2018-08-26
ETS-LINDGREN	Horn Antenna	3115	6229	2016-01-11	2019-01-10
ETS-LINDGREN	Horn Antenna	3116	00084159	2016-10-18	2019-10-17
Narda	Pre-amplifier	AFS42-00101800	2001270	2016-12-22	2017-12-21
Heatsink Required	Amplifier	QLW-18405536-J0	15964001009	2016-12-22	2017-12-21
SINOSCITE	Band Reject Filter	BSF2402-2480MN-0898	/	/	/
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2017-08-15	2018-08-14
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2017-09-21	2018-09-20
Picosecond	DC Block	5500A-110	131047	2017-09-23	2018-09-22
Taoglas	RF Cable	CAB.AB02	/	/	/
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2017-10-25	2018-10-24
Rohde & Schwarz	LISN	ESH3-Z5	862770/011	2017-10-10	2018-10-09
Rohde & Schwarz	LISN	ENV216	3560655016	2016-11-25	2017-11-24
BACL	BACL-EMC	V1.0	CE001	/	/
Narda	Attenuator/6dB	10690812-2	26850-6	2017-01-10	2018-01-09
MICRO-COAX	Coaxial Cable	Cable-15	015	2017-08-15	2018-08-14

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §1.1310& §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247(i)and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f^2)	30
30-300	27.5	0.073	0.2	30
300-1500	/		f/1500	30
1500-100,000	/		1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:

Predication of MPE limit at a given distance
$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm^2);
P = power input to the antenna (in appropriate units, e.g., mW);
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Calculated Data:

Frequency Range (MHz)	**Antenna Gain**		**Output Power**		**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**MPE Limit (mW/cm^2)**
	(dBi)	**(numeric)**	**(dBm)**	**(mW)**			
2405~2480	2.15	1.64	5.00	3.16	20	0.0010	1.00

Note: The target output power is declared by the manufacturer.

Result: The device meet FCC MPE at 20 cm distance as a mobile device specified in §2.1091. If the device built into a host as a portable usage, the additional RF exposure evaluation may be required as specified in §2.1093.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 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 user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.
And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The model number: KTWM102-11 used one permanently attached ceramic antenna with 0.5 dBi.
The model number: KTWM102-21 used one Omni-directional antennas with 2.15 dBi gain and a RP-SMA female connector and W.FL to RP-SMA male cable (95mm in length),which fulfill the requirements of this section. Please refer to EUT photo for detail.

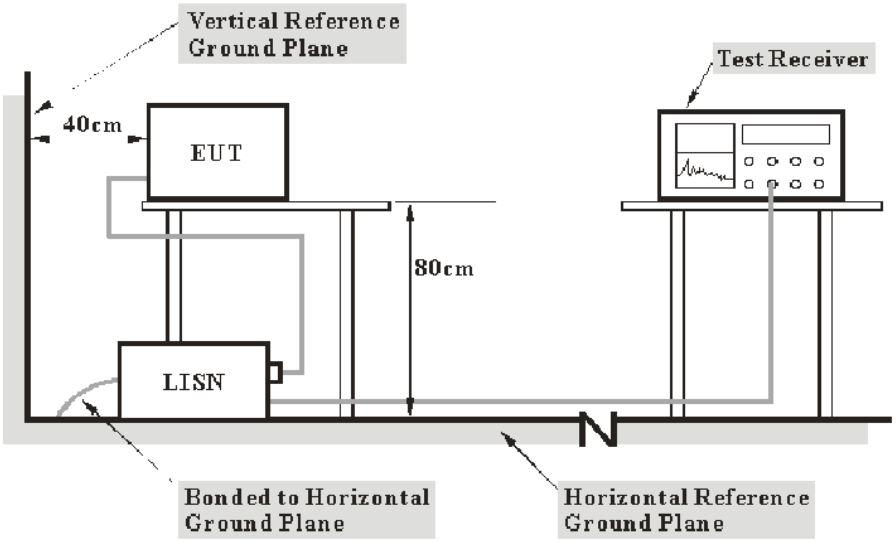
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Correction Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

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

Margin = Limit – Reading

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207.

Test Data

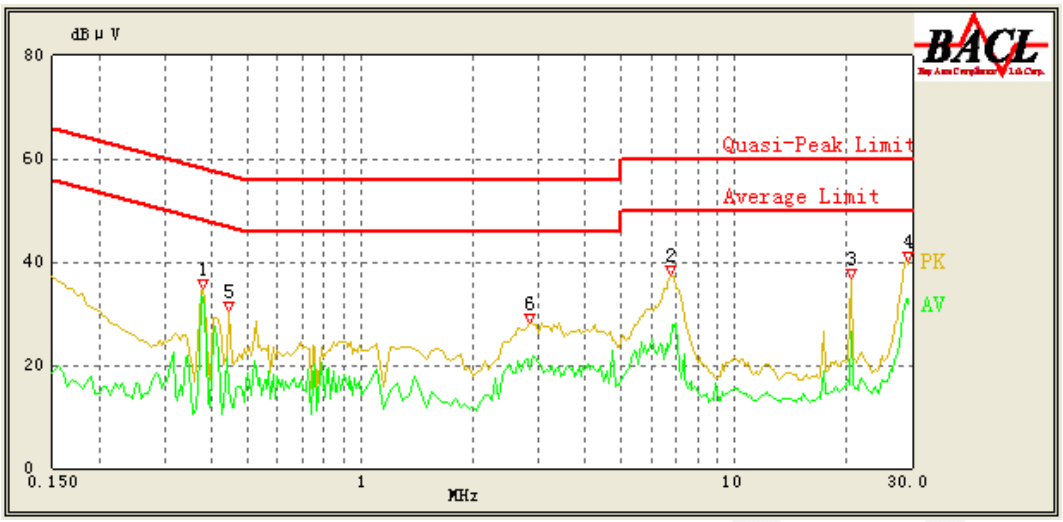
Environmental Conditions

Temperature:	24.1 ℃
Relative Humidity:	50 %
ATM Pressure:	101.2kPa

The testing was performed by Max Min on 2017-10-30.

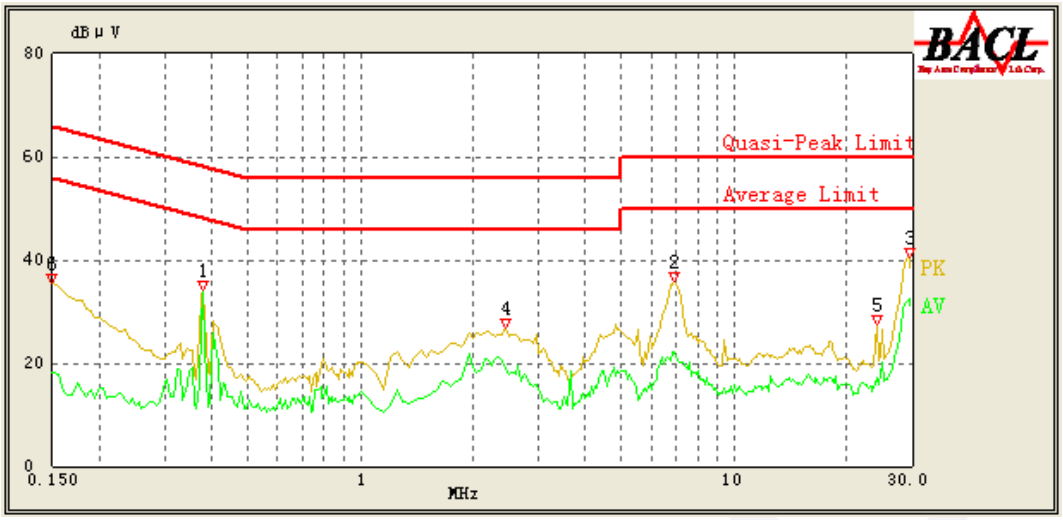
EUT operation mode: Transmitting in high channel (Worst case)

AC 120V/60 Hz, Line



Frequency (MHz)	Reading (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Correction (dB)	Limit (dBµV)	Margin (dB)	Comment
0.380	34.85	QP	9.000	L1	16.05	59.43	24.58	Compliance
0.380	33.04	AV	9.000	L1	16.05	49.43	16.39	Compliance
6.800	37.36	QP	9.000	L1	15.97	60.00	22.64	Compliance
6.750	24.38	AV	9.000	L1	15.96	50.00	25.62	Compliance
20.700	36.84	QP	9.000	L1	16.44	60.00	23.16	Compliance
20.600	26.44	AV	9.000	L1	16.44	50.00	23.56	Compliance
29.100	40.20	QP	9.000	L1	16.57	60.00	19.80	Compliance
29.100	32.67	AV	9.000	L1	16.57	50.00	17.33	Compliance
0.445	30.39	QP	9.000	L1	16.07	57.57	27.18	Compliance
0.445	15.09	AV	9.000	L1	16.07	47.57	32.48	Compliance
2.850	28.06	QP	9.000	L1	15.85	56.00	27.94	Compliance
2.850	19.11	AV	9.000	L1	15.85	46.00	26.89	Compliance

AC 120V/60 Hz, Neutral



Frequency (MHz)	Reading (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Correction (dB)	Limit (dBµV)	Margin (dB)	Comment
0.380	34.20	QP	9.000	N	16.09	59.43	25.23	Compliance
0.380	34.08	AV	9.000	N	16.09	49.43	15.35	Compliance
6.950	35.94	QP	9.000	N	15.92	60.00	24.06	Compliance
6.950	22.20	AV	9.000	N	15.92	50.00	27.80	Compliance
29.400	40.39	QP	9.000	N	16.33	60.00	19.61	Compliance
29.400	32.48	AV	9.000	N	16.33	50.00	17.52	Compliance
2.450	26.78	QP	9.000	N	15.90	56.00	29.22	Compliance
2.450	18.76	AV	9.000	N	15.90	46.00	27.24	Compliance
24.050	27.60	QP	9.000	N	16.22	60.00	32.40	Compliance
24.050	17.07	AV	9.000	N	16.22	50.00	32.93	Compliance
0.150	35.37	QP	9.000	N	16.06	66.00	30.63	Compliance
0.150	18.25	AV	9.000	N	16.06	56.00	37.75	Compliance

Note:
1) Corr.=LISN VDF (Voltage Division Factor) + Cable Loss
2) Margin = Limit – Reading

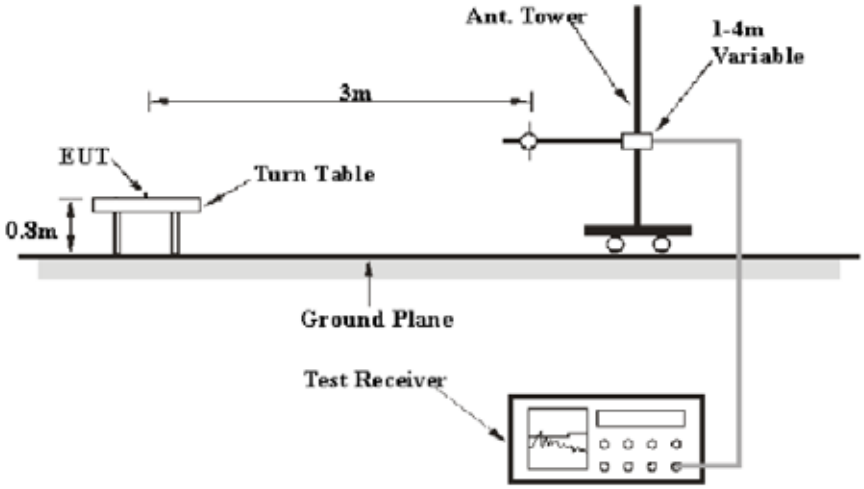
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

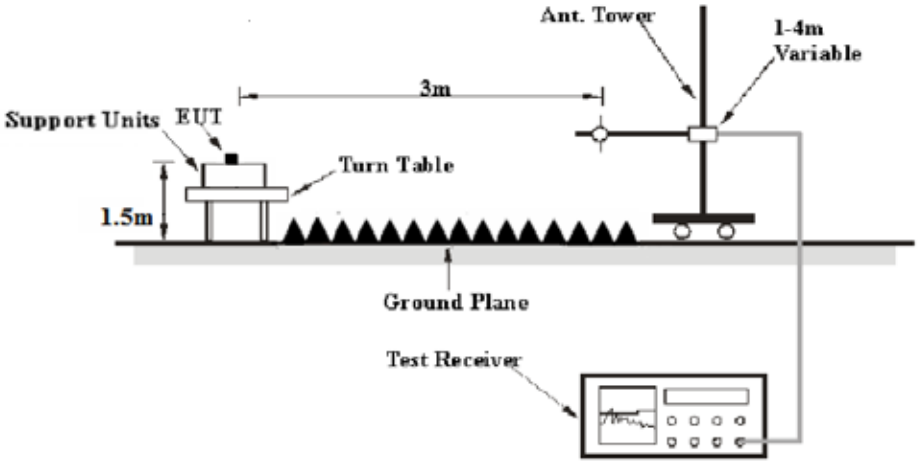
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

EMI Test Receiver Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1GHz	1MHz	3 MHz	/	PK
	1MHz	3 MHz	/	Ave

Test Procedure

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

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection mode for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

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

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the recorded data in following table, the EUT is compliant with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Test Data

Environmental Conditions

Temperature:	24.1 °C
Relative Humidity:	50 %
ATM Pressure:	101.2kPa

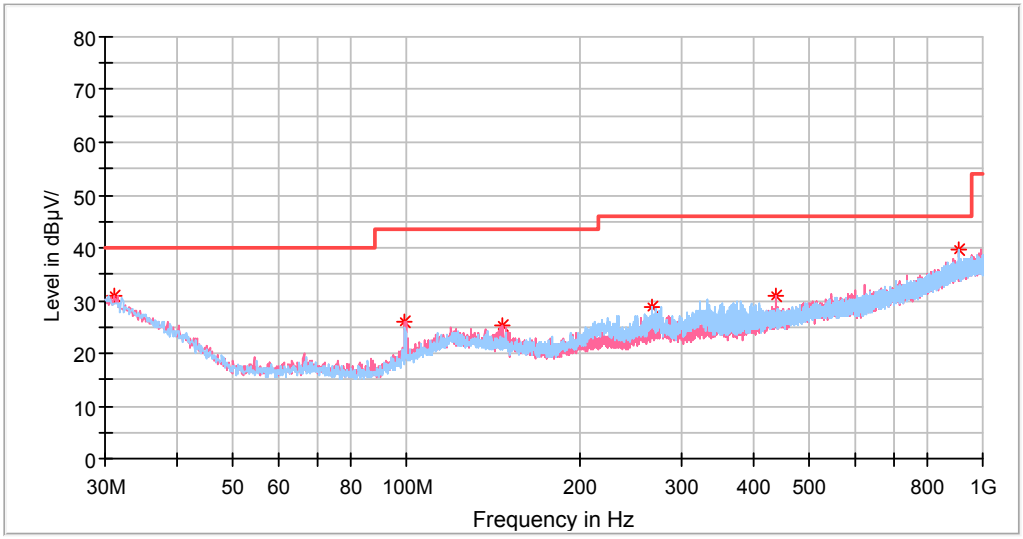
The testing was performed by Max Min on 2017-10-30 to 2017-12-19.

EUT operation mode: Transmitting

Spurious Emission Test for KTWM102-11(Chip antenna)

30MHz-1GHz:

*Pre-scan with Low, middle, high channel of operation in the X,Y and Z axes of orientation, the worst case **high channel in X-axis of orientation** was recorded*



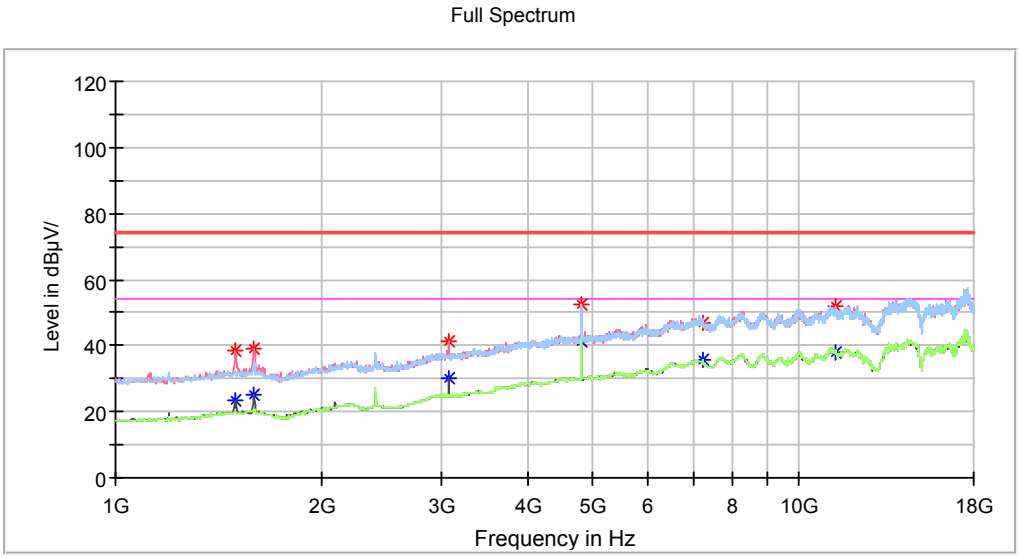
Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	QuasiPeak (dB µ V/m)	Height (cm)	Polar (H/V)				
31.091250	30.95	100.0	V	141.0	-5.1	40.00	9.05
99.476250	26.08	100.0	V	90.0	-15.5	43.50	17.42
147.127500	25.43	100.0	V	157.0	-12.7	43.50	18.07
267.407500	28.90	100.0	H	126.0	-12.0	46.00	17.10
437.885000	30.90	200.0	V	200.0	-7.7	46.00	15.10
905.788750	39.81	200.0	H	185.0	0.3	46.00	6.19

1GHz-18GHz:

*Pre-scan with X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded*

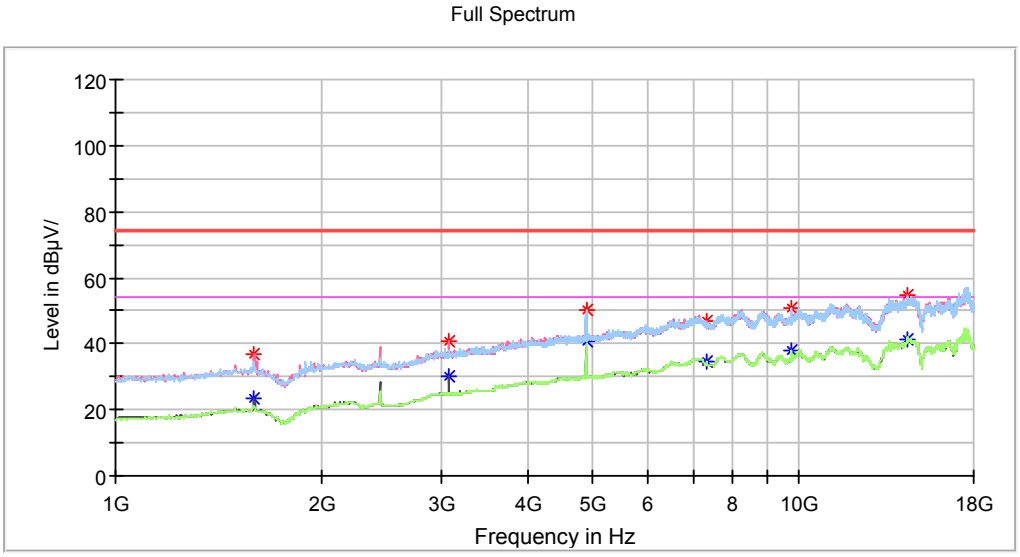
Note:
1. This test is performed with the 2.4-2.4835GHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
   Corrected Amplitude = Corrected Factor + Reading
   Margin = Limit - Corrected. Amplitude

Low Channel: 2405MHz



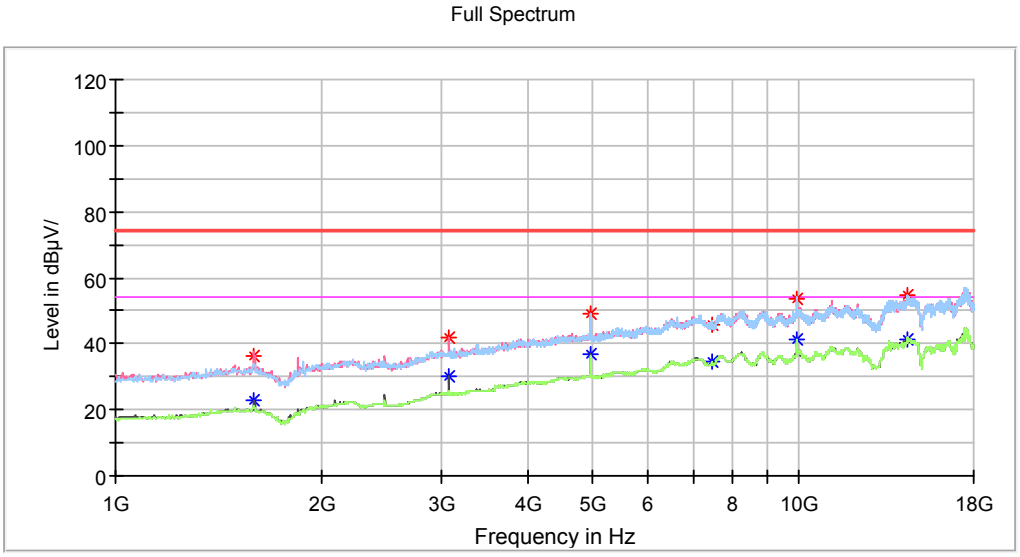
Frequency (MHz)	MaxPeak (dBµV /m)	Average (dBµV /m)	Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
			Height (cm)	Polar (H/V)				
1499.800000	---	23.55	250.0	V	185.0	-10.3	54.00	30.45
1499.800000	38.36	---	250.0	V	185.0	-10.3	74.00	35.64
1591.600000	---	25.23	150.0	V	184.0	-9.8	54.00	28.77
1591.600000	39.05	---	200.0	V	176.0	-9.8	74.00	34.95
3070.600000	41.30	---	150.0	V	184.0	-4.6	74.00	32.70
3070.600000	---	30.09	150.0	V	184.0	-4.6	54.00	23.91
4810.000000	52.43	---	150.0	H	175.0	-0.6	74.00	21.57
4810.000000	---	41.47	150.0	H	175.0	-0.6	54.00	12.53
7215.000000	47.13	---	250.0	V	7.0	6.3	74.00	26.87
7215.000000	---	35.95	250.0	V	7.0	6.3	54.00	18.05
11305.400000	---	38.12	150.0	V	0.0	12.1	54.00	15.88
11305.400000	52.06	---	250.0	V	185.0	12.1	74.00	21.94

Middle Channel: 2440MHz



Frequency (MHz)	MaxPeak (dBµV /m)	Average (dBµV /m)	Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
			Height (cm)	Polar (H/V)				
1595.000000	37.06	---	200.0	V	128.0	-9.8	74.00	36.94
1595.000000	---	23.23	200.0	V	128.0	-9.8	54.00	30.77
3070.600000	---	30.18	250.0	V	111.0	-4.6	54.00	23.82
3070.600000	40.90	---	250.0	V	111.0	-4.6	74.00	33.10
4880.000000	---	40.95	250.0	V	232.0	-0.4	54.00	13.05
4880.000000	50.35	---	250.0	V	232.0	-0.4	74.00	23.65
7320.000000	---	34.42	250.0	V	232.0	6.6	54.00	19.58
7320.000000	46.70	---	200.0	V	128.0	6.6	74.00	27.30
9761.800000	---	37.98	250.0	H	7.0	8.9	54.00	16.02
9761.800000	50.52	---	250.0	H	7.0	8.9	74.00	23.48
14426.600000	---	41.45	250.0	V	0.0	16.7	54.00	12.55
14426.600000	54.49	---	200.0	V	249.0	16.7	74.00	19.51

High Channel: 2480MHz

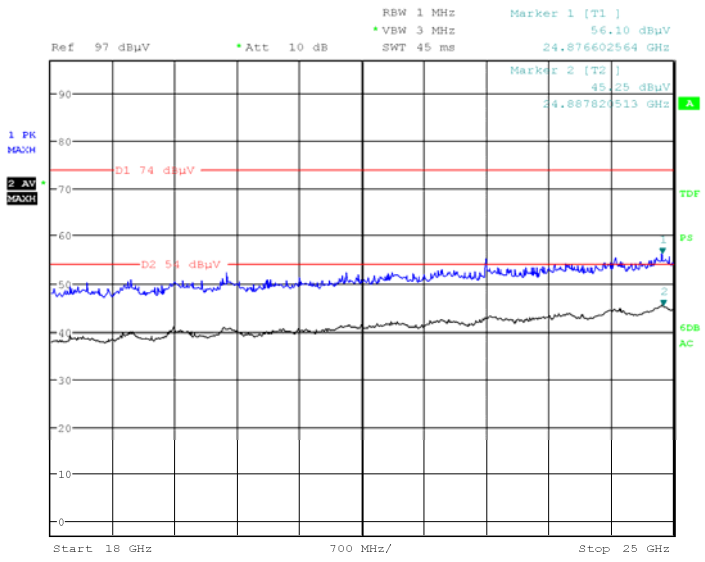


Frequency (MHz)	MaxPeak (dBµV /m)	Average (dBµV /m)	Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
			Height (cm)	Polar (H/V)				
1595.000000	36.05	---	200.0	V	128.0	-9.8	74.00	37.95
1595.000000	---	23.08	200.0	V	128.0	-9.8	54.00	30.92
3070.600000	---	29.99	250.0	V	111.0	-4.6	54.00	24.01
3070.600000	41.65	---	250.0	V	111.0	-4.6	74.00	32.35
4960.000000	48.93	---	200.0	V	7.0	-0.3	74.00	25.07
4960.000000	---	36.61	200.0	V	7.0	-0.3	54.00	17.39
7440.000000	45.58	---	250.0	H	0.0	7.0	74.00	28.42
7440.000000	---	34.80	250.0	H	0.0	7.0	54.00	19.20
9918.200000	53.43	---	250.0	H	7.0	9.0	74.00	20.57
9918.200000	---	41.03	250.0	H	7.0	9.0	54.00	12.97
14389.200000	---	41.47	200.0	H	353.0	16.7	54.00	12.53
14389.200000	54.62	---	250.0	H	248.0	16.7	74.00	19.38

18GHz-25GHz:

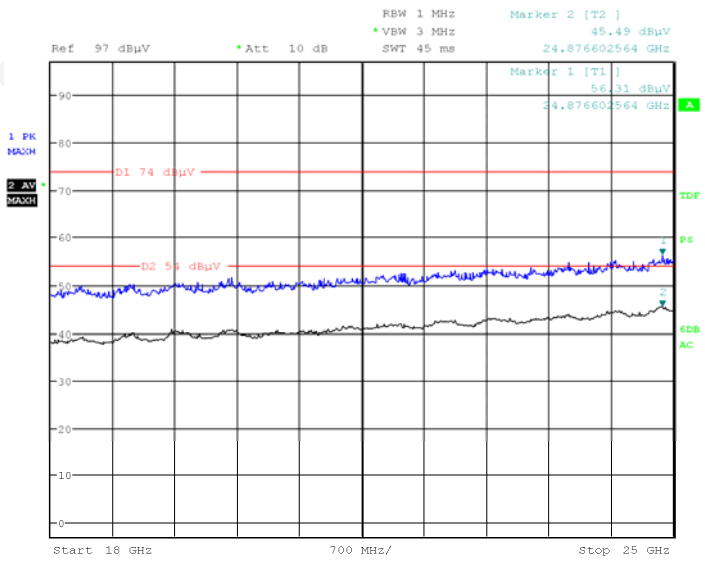
Pre-scan with Low, middle, high channel of operation in the X,Y and Z axes of orientation, the worst case ***high channel in X-axis of orientation*** *was recorded*

Horizontal



Date: 19.DEC.2017 10:54:38

Vertical



Date: 19.DEC.2017 10:55:02

Restricted Bands Emissions Test for KTWM102-11(Chip antenna):

*Pre-scan with X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded*

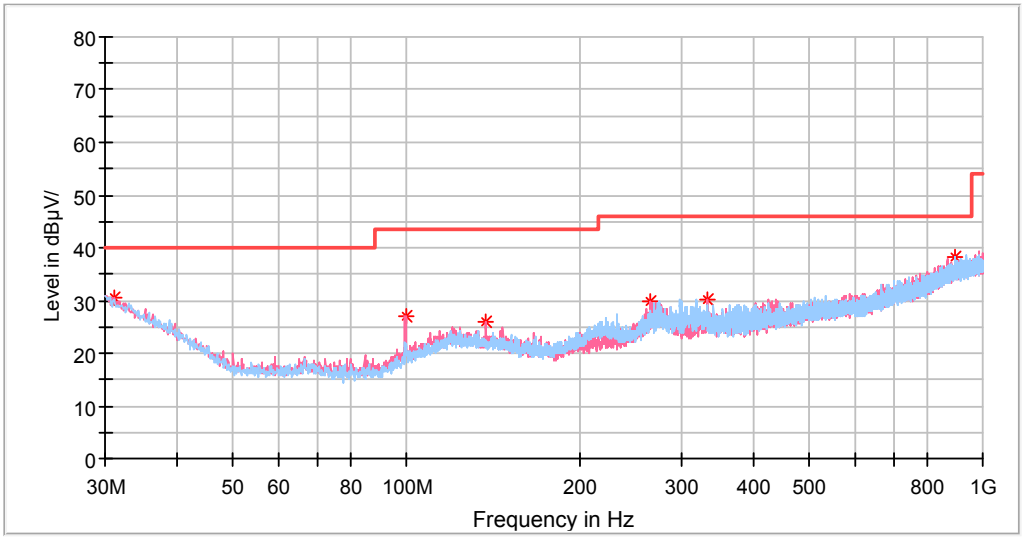
Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
Left Restricted Band Edge								
2390.00	---	25.55	200.0	H	0.0	-7.4	54.00	28.45
2390.00	37.96	---	200.0	H	0.0	-7.4	74.00	36.04
Right Restricted Band Edge								
2483.50	55.02	---	250.0	V	349.0	-7.2	74.00	18.98
2483.50	---	46.07	250.0	V	349.0	-7.2	54.00	7.93

Spurious Emission Test for KTWM102-21(W.FL Connector)

30MHz-1G:

Pre-scan with Low, middle, high channel of operation in the X,Y and Z axes of orientation, the worst case ***middle channel in X-axis of orientation*** *was recorded*



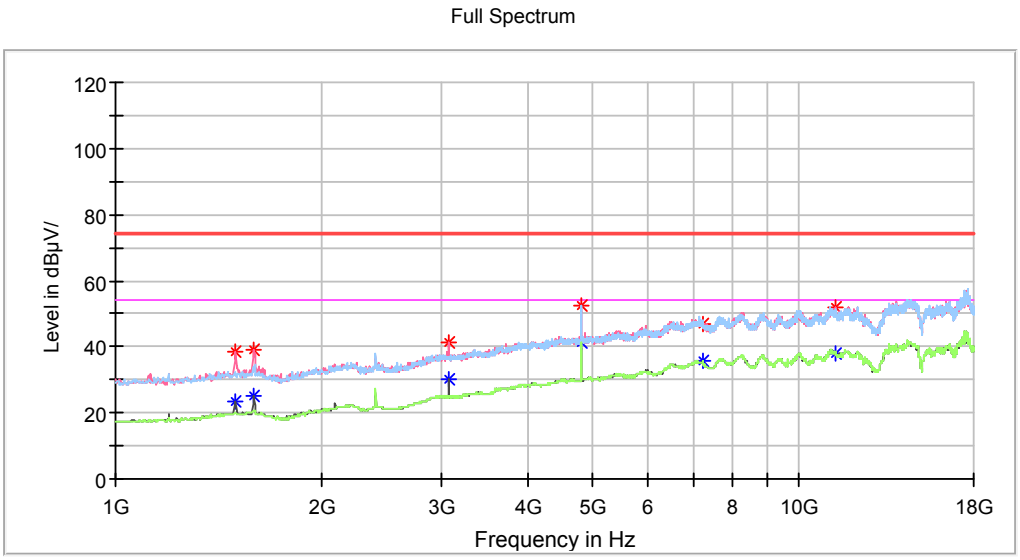
Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	QuasiPeak (dB µ V/m)	Height (cm)	Polar (H/V)				
31.212500	30.69	100.0	V	33.0	-5.2	40.00	9.31
99.597500	27.12	100.0	V	141.0	-15.5	43.50	16.38
137.306250	25.90	100.0	V	330.0	-12.3	43.50	17.60
265.710000	29.76	200.0	V	138.0	-12.1	46.00	16.24
331.791250	30.01	200.0	V	179.0	-10.3	46.00	15.99
896.937500	38.33	200.0	H	252.0	0.1	46.00	7.67

1GHz-18GHz:

*Pre-scan with X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded*

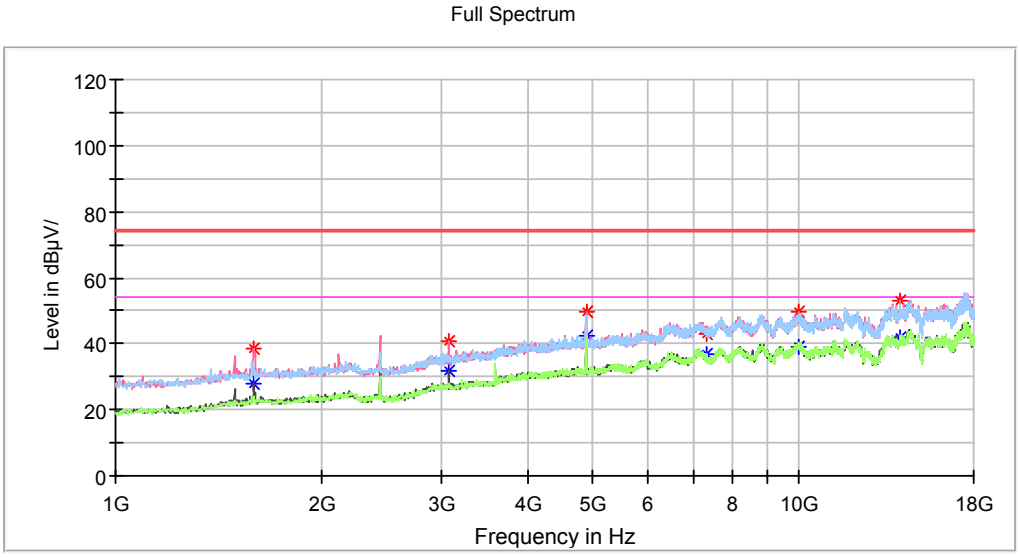
Note:
1. This test is performed with the 2.4-2.4835GHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
   Corrected Amplitude = Corrected Factor + Reading
   Margin = Limit - Corrected. Amplitude

Low Channel: 2405MHz



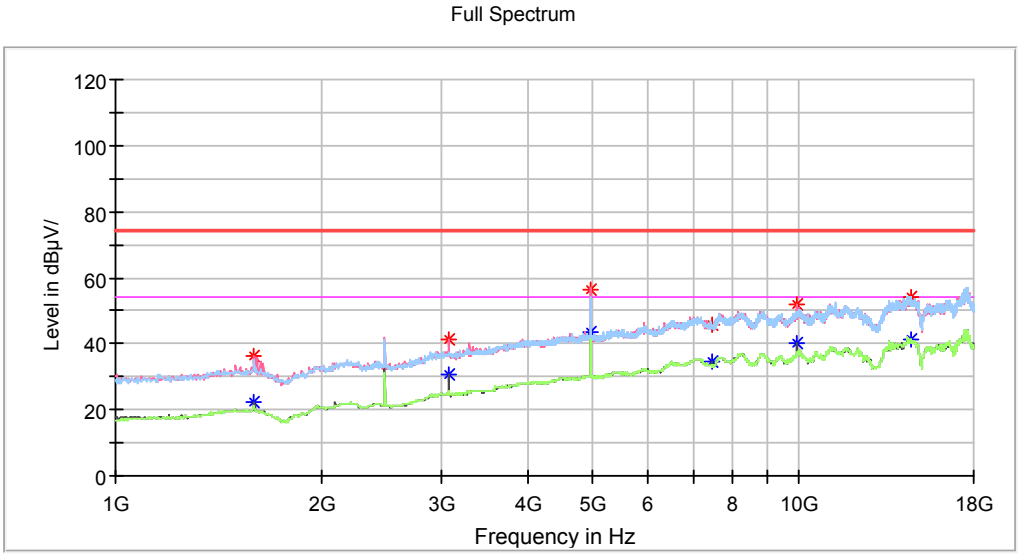
Frequency (MHz)	MaxPeak (dBµV /m)	Average (dBµV /m)	Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
			Height (cm)	Polar (H/V)				
1499.800000	---	23.55	250.0	V	185.0	-10.3	54.00	30.45
1499.800000	38.36	---	250.0	V	185.0	-10.3	74.00	35.64
1591.600000	---	25.23	150.0	V	184.0	-9.8	54.00	28.77
1591.600000	39.05	---	200.0	V	176.0	-9.8	74.00	34.95
3070.600000	41.30	---	150.0	V	184.0	-4.6	74.00	32.70
3070.600000	---	30.09	150.0	V	184.0	-4.6	54.00	23.91
4810.000000	52.43	---	150.0	H	175.0	-0.6	74.00	21.57
4810.000000	---	41.47	150.0	H	175.0	-0.6	54.00	12.53
7215.000000	47.13	---	250.0	V	7.0	6.3	74.00	26.87
7215.000000	---	35.95	250.0	V	7.0	6.3	54.00	18.05
11305.400000	---	38.12	150.0	V	0.0	12.1	54.00	15.88
11305.400000	52.06	---	250.0	V	185.0	12.1	74.00	21.94

Middle Channel: 2440MHz



Frequency (MHz)	MaxPeak (dBµV /m)	Average (dBµV /m)	Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
			Height (cm)	Polar (H/V)				
1591.600000	---	27.77	150.0	V	172.0	-9.8	54.00	26.23
1591.600000	38.40	---	200.0	V	143.0	-9.8	74.00	35.60
3070.600000	---	31.60	200.0	V	203.0	-4.6	54.00	22.40
3070.600000	40.57	---	200.0	V	203.0	-4.6	74.00	33.43
4880.000000	---	42.57	150.0	V	67.0	-0.4	54.00	11.43
4880.000000	49.62	---	150.0	V	67.0	-0.4	74.00	24.38
7320.000000	43.17	---	150.0	V	172.0	6.6	74.00	30.83
7320.000000	---	36.56	150.0	V	172.0	6.6	54.00	17.44
10010.000000	---	39.00	200.0	V	34.0	9.1	54.00	15.00
10010.000000	49.70	---	200.0	V	34.0	9.1	74.00	24.30
14018.600000	---	42.04	200.0	V	7.0	16.7	54.00	11.96
14018.600000	53.29	---	200.0	V	7.0	16.7	74.00	20.71

High Channel: 2480MHz

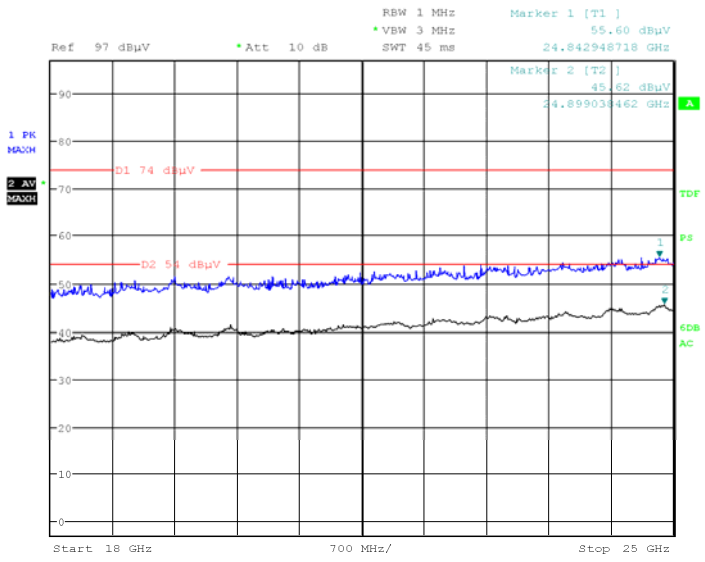


Frequency (MHz)	MaxPeak (dBµV /m)	Average (dBµV /m)	Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
			Height (cm)	Polar (H/V)				
1591.600000	---	22.42	200.0	V	128.0	-9.8	54.00	31.58
1591.600000	36.14	---	200.0	V	128.0	-9.8	74.00	37.86
3070.600000	---	30.42	250.0	V	110.0	-4.6	54.00	23.58
3070.600000	41.07	---	250.0	V	110.0	-4.6	74.00	32.93
4960.000000	56.39	---	200.0	V	128.0	-0.3	74.00	17.61
4960.000000	---	43.75	200.0	V	128.0	-0.3	54.00	10.25
7440.000000	45.86	---	250.0	V	232.0	7.0	74.00	28.14
7440.000000	---	34.53	250.0	V	232.0	7.0	54.00	19.47
9921.600000	---	39.99	250.0	V	232.0	9.0	54.00	14.01
9921.600000	52.06	---	250.0	V	232.0	9.0	74.00	21.94
14542.200000	---	41.27	200.0	H	111.0	16.6	54.00	12.73
14542.200000	54.35	---	200.0	H	111.0	16.6	74.00	19.65

18GHz-25GHz:

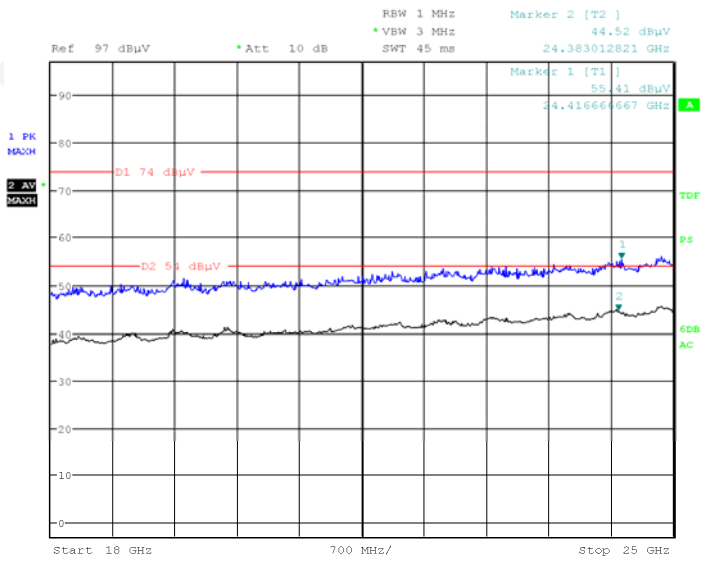
Pre-scan with Low, middle, high channel of operation in the X,Y and Z axes of orientation, the worst case ***middle channel in X-axis of orientation*** *was recorded*

Horizontal



Date: 19.DEC.2017 10:53:59

Vertical



Date: 19.DEC.2017 10:54:24

Restricted Bands Emissions Test for KTWM102-21(W.FL Connector):

*Pre-scan with X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded*

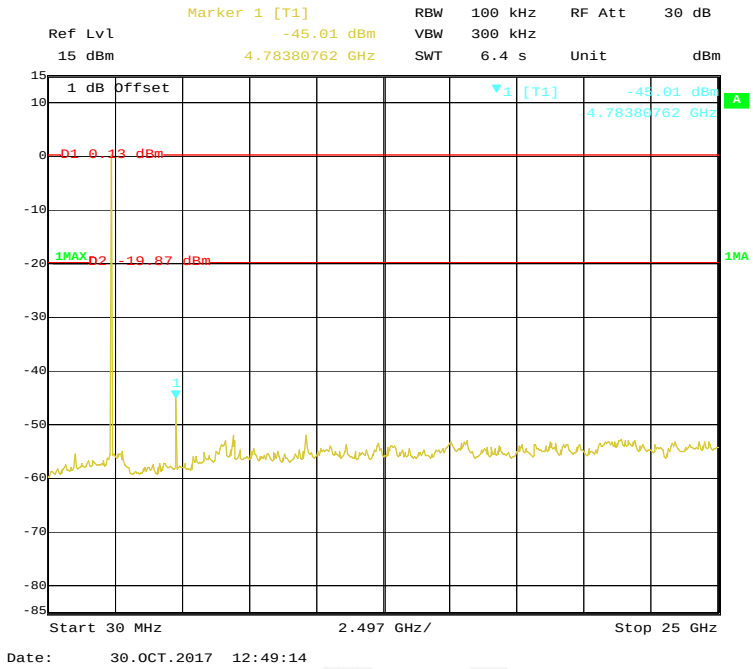
Note1:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude

Note2:
Channel 26, 2480 MHz, with Kirale power setting 11 (-2 dBm)

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Correct Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
Left Restricted Band Edge								
2390.00	---	35.99	200.0	V	127.0	-7.4	54.00	18.01
2390.00	44.17	---	200.0	V	127.0	-7.4	74.00	29.83
Right Restricted Band Edge								
2483.50	60.31	---	250.0	V	260.0	-7.2	74.00	13.69
2483.50	---	53.65	250.0	V	260.0	-7.2	54.00	0.35

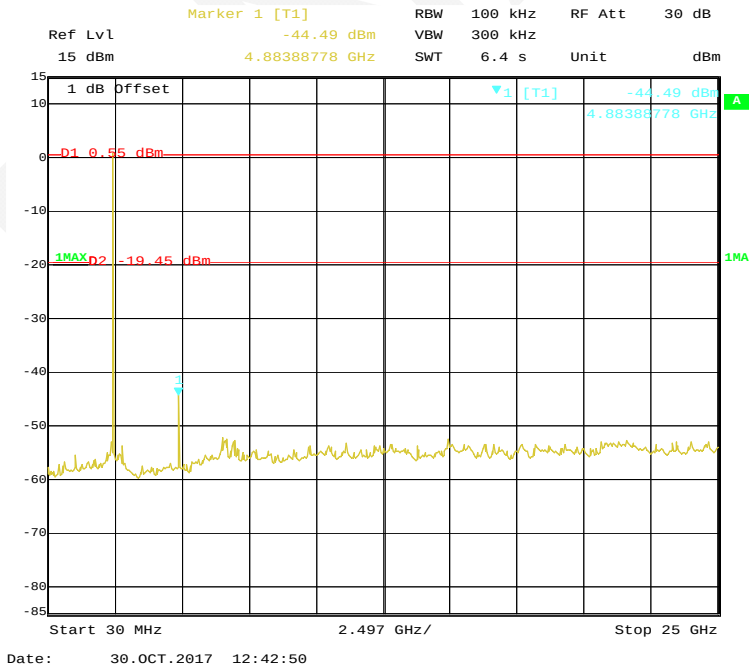
Conducted Spurious Emissions at Antenna Port

Low Channel



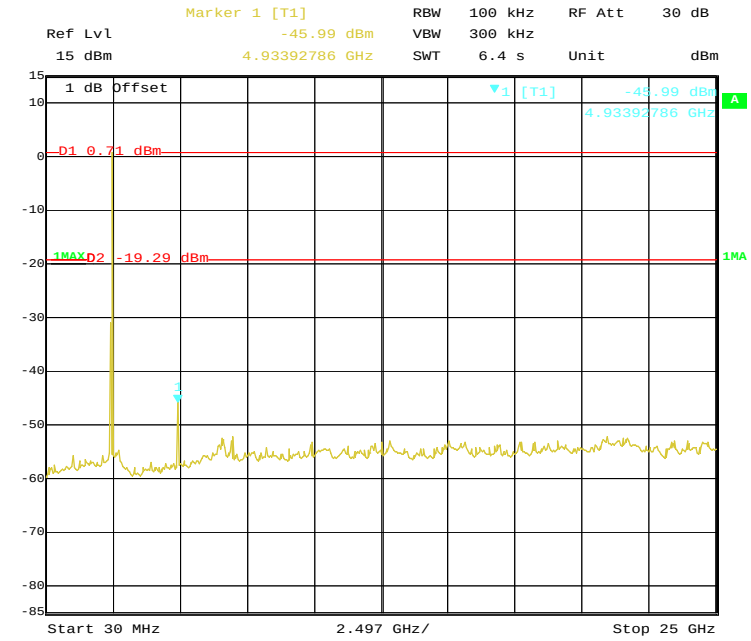
Date: 30.OCT.2017 12:49:14

Middle Channel



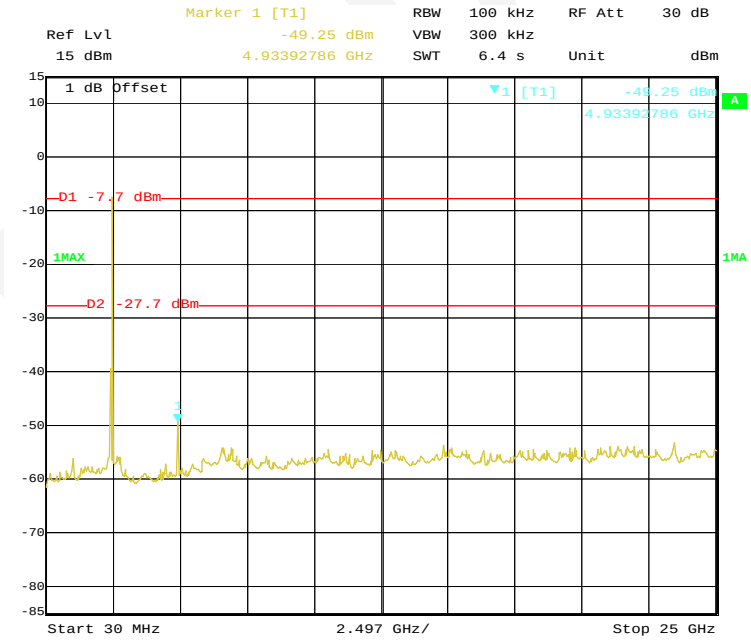
Date: 30.OCT.2017 12:42:50

High Channel for KTWM102-11



Date: 30.OCT.2017 12:46:10

High Channel for KTWM102-21



Date: 18.DEC.2017 19:29:28

FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

Applicable Standard

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.

Test Procedure

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Data

Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

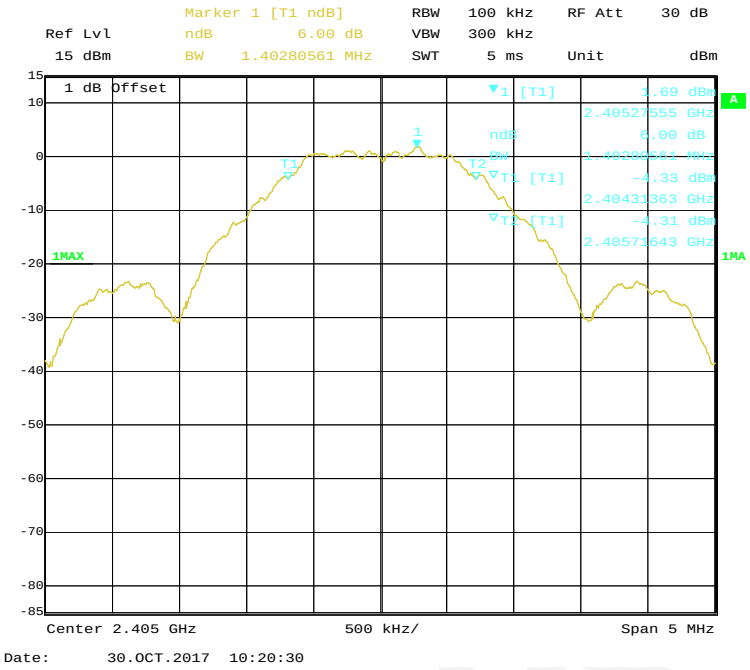
The testing was performed by Max Min on 2017-10-30 to 2017-12-18.

Test Result: Pass.

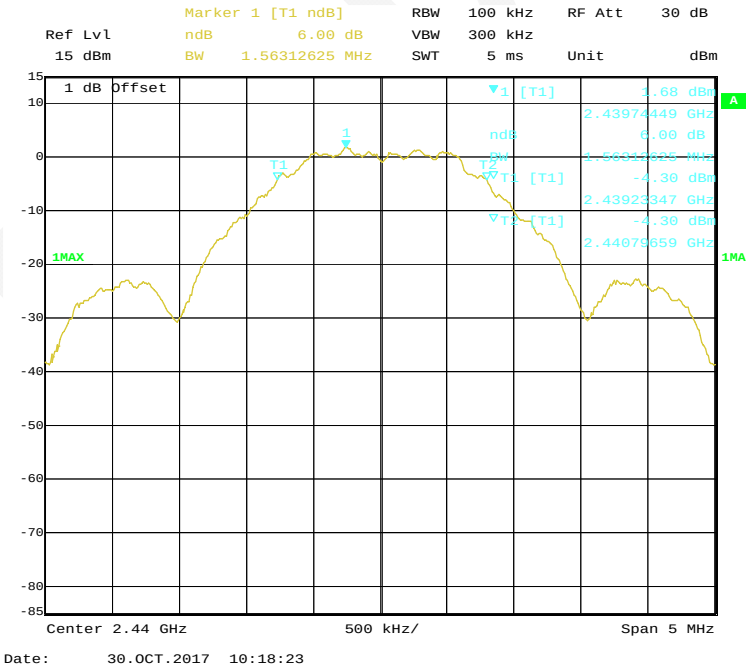
EUT operation mode: Transmitting

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)
Low	2405	1.40	≥0.5
Middle	2440	1.56	≥0.5
High for KTWM102-11	2480	1.56	≥0.5
High for KTWM102-21	2480	1.55	≥0.5

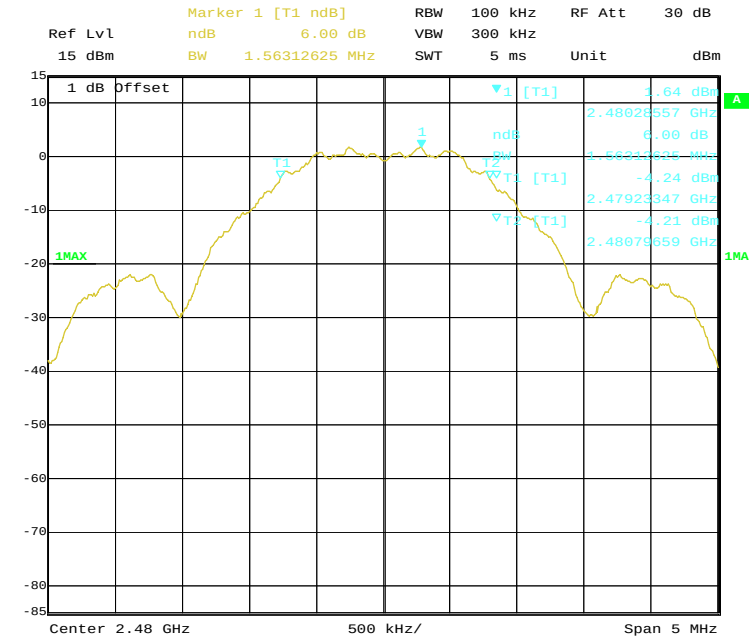
Low Channel



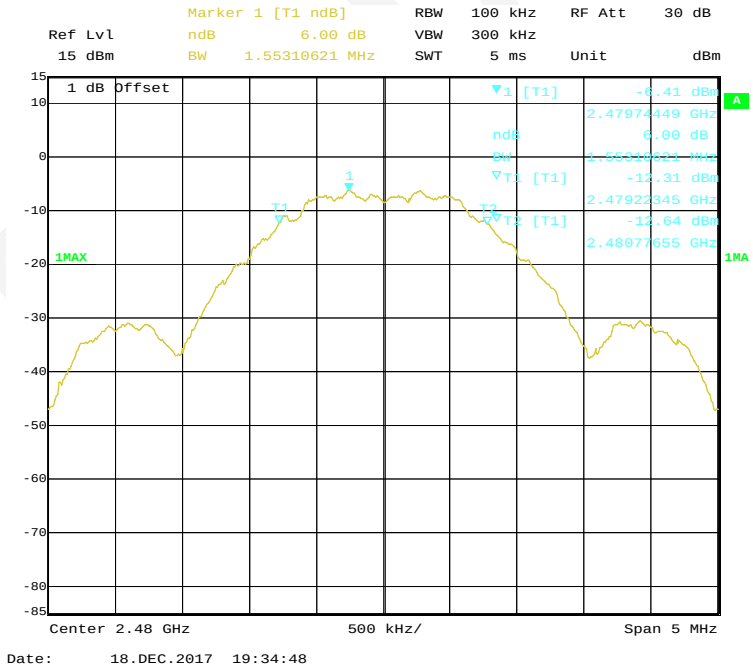
Middle Channel



High Channel for KTWM102-11



High Channel for KTWM102-21



FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure

1. Set the RBW ≥ *DTS bandwidth.*
2. Set VBW ≥ 3 x RBW.
3. Set span ≥ 3 x RBW
4. Sweep time = auto couple.
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use peak marker function to determine the peak amplitude level.

Test Data

Environmental Conditions

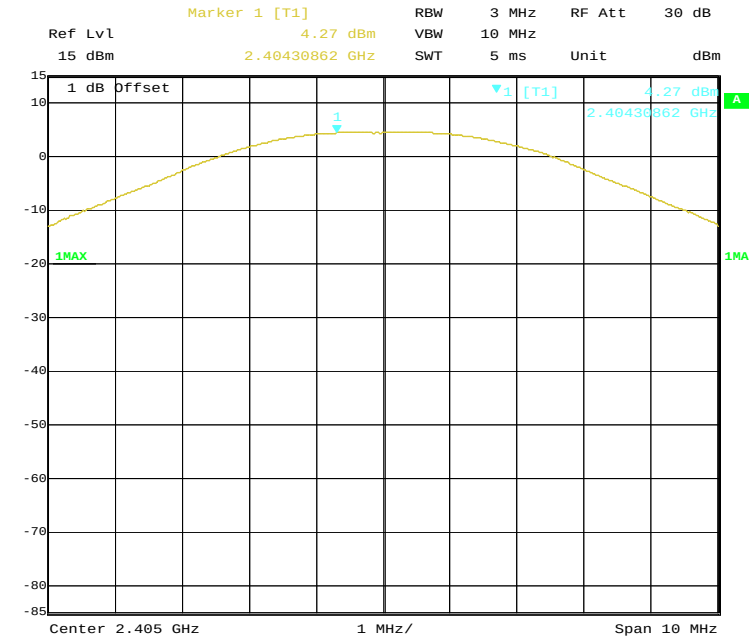
Temperature:	23.8℃
Relative Humidity:	54 %
ATM Pressure:	101.2 kPa

The testing was performed by Max Min on 2017-10-30 to 2017-12-18.

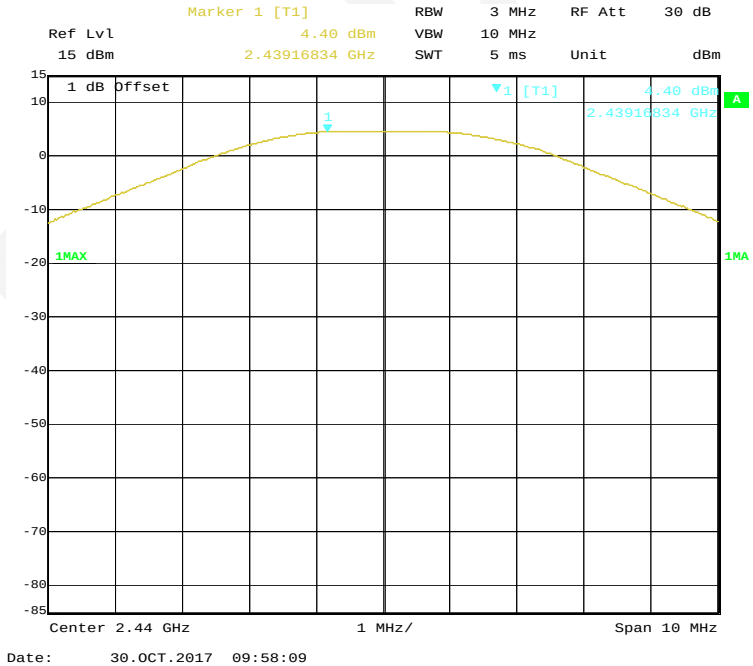
EUT operation mode: Transmitting

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)	Result
Low	2405	4.27	30	Pass
Middle	2440	4.40	30	Pass
High for KTWM102-11	2480	4.66	30	Pass
High for KTWM102-21	2480	-2.07	30	Pass

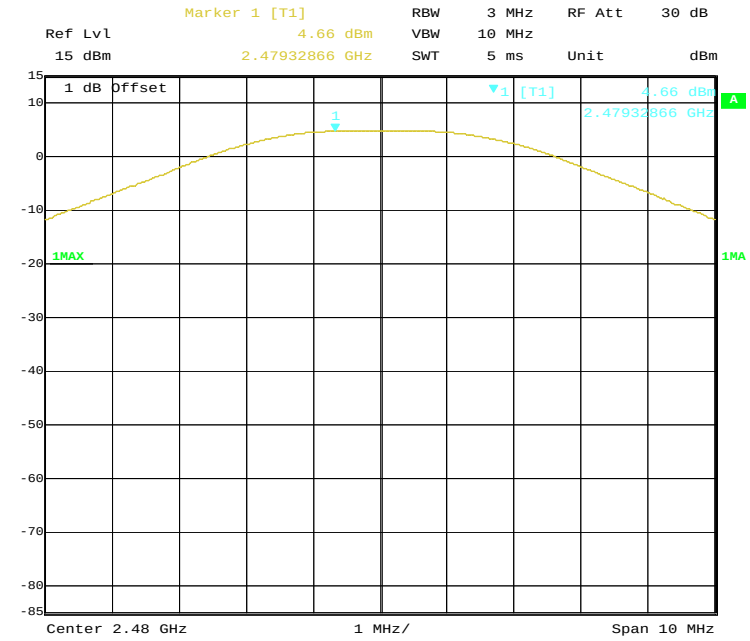
Low Channel



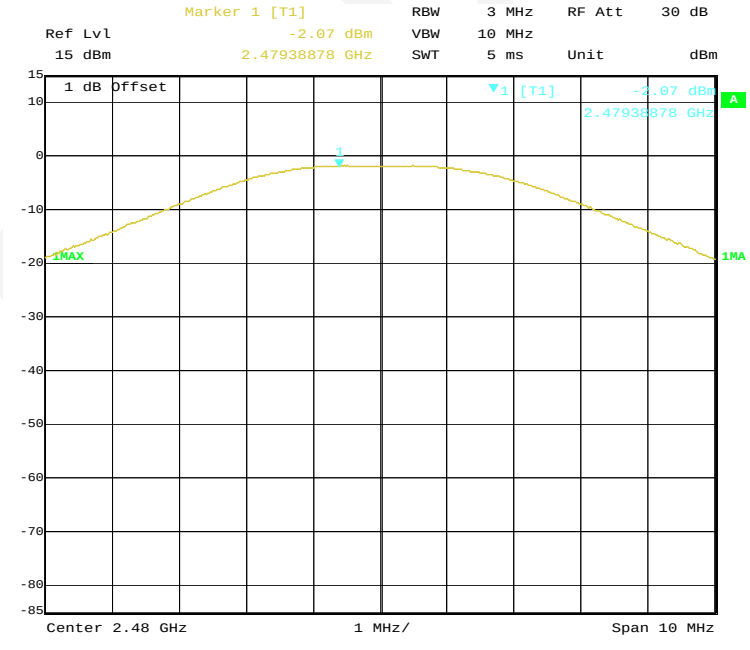
Middle Channel



High Channel for KTWM102-11



High Channel for KTWM102-21



FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

Applicable Standard

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)).

Test Procedure

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 its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Data

Environmental Conditions

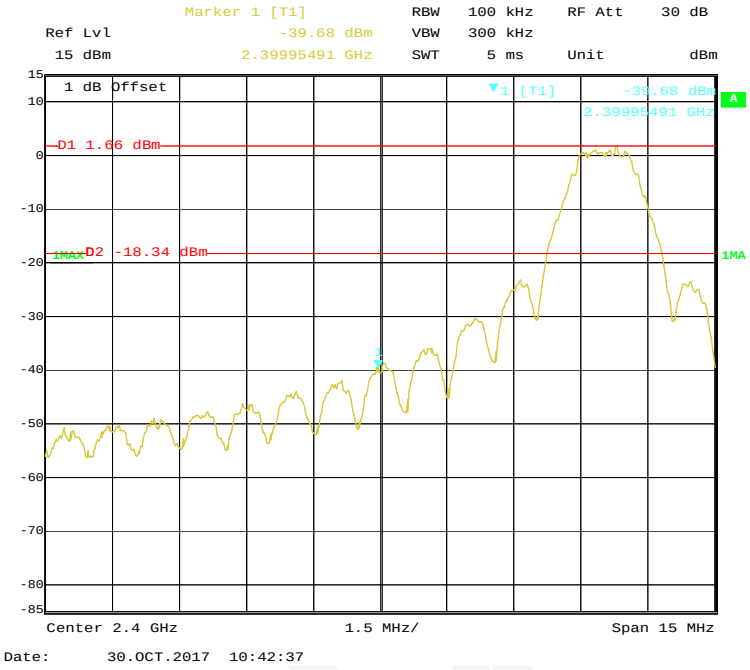
Temperature:	24.3 ℃
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

The testing was performed by Max Min on 2017-10-30 to 2017-12-18.

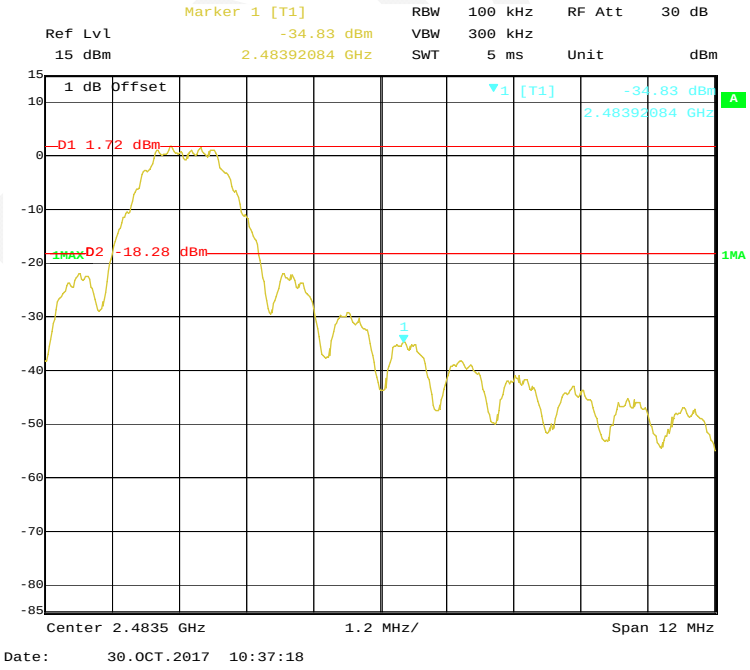
Test Result: *Compliance*

Band Edge

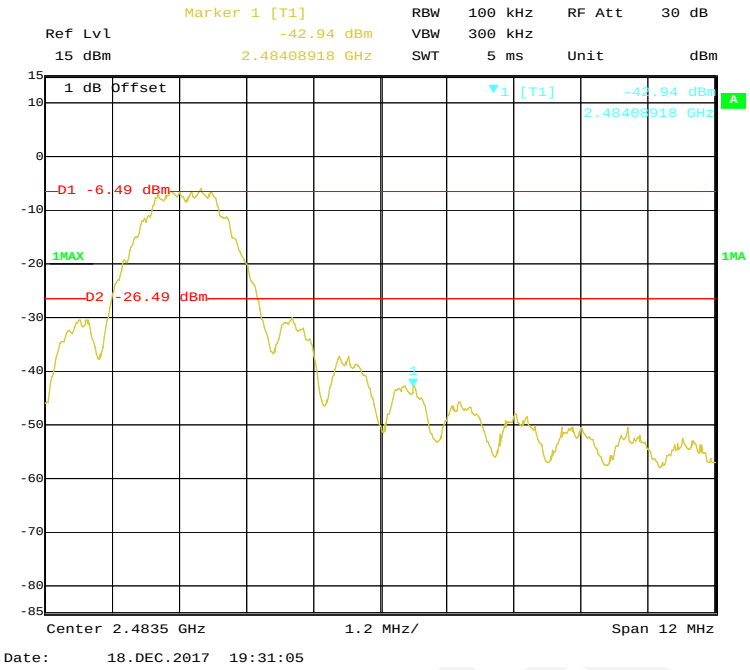
Left Side



Right Side for KTWM102-11



Right Side for KTWM102-21



FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test Procedure

According to KDB558074 D01 DTS Meas Guidance v04.

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 1.5 times the DTS bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Test Data

Environmental Conditions

Temperature:	24.1 ℃
Relative Humidity:	50%
ATM Pressure:	101.3 kPa

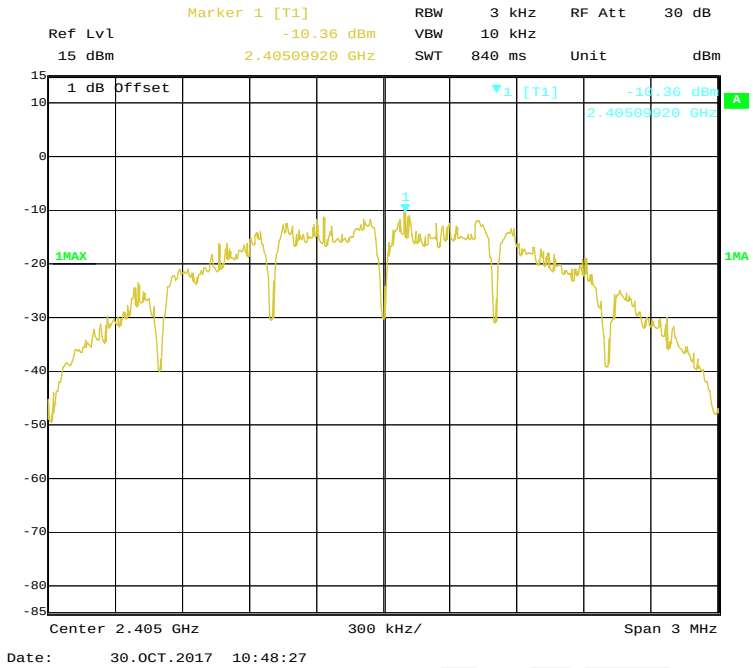
The testing was performed by Max Min on 2017-10-30 to 2017-12-18.

EUT operation mode: Transmitting

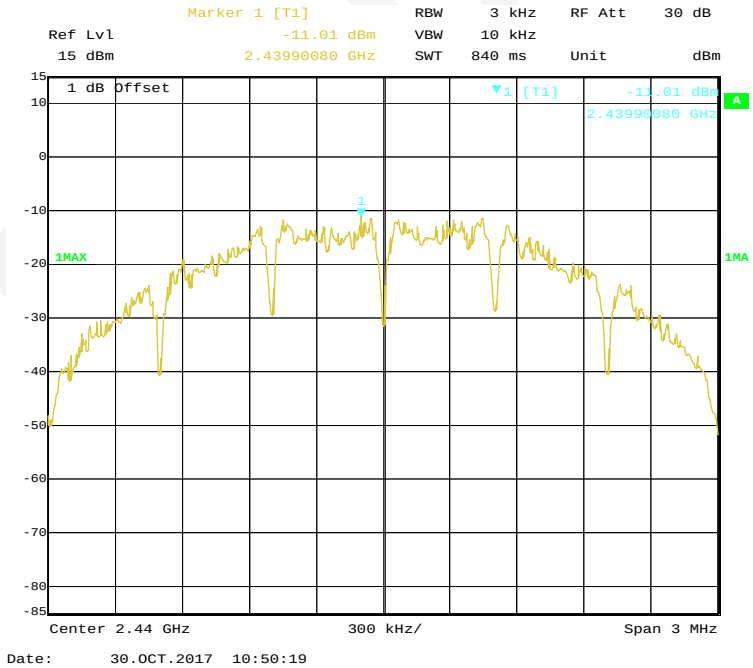
Test Result: Pass

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
Low	2405	-10.36	≤8
Middle	2440	-11.01	≤8
High for KTWM102-11	2480	-11.59	≤8
High for KTWM102-21	2480	-19.31	≤8

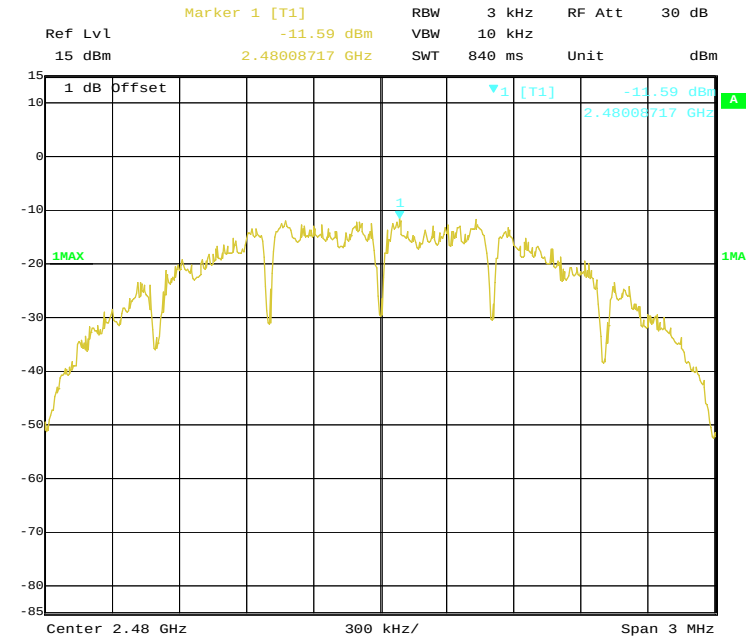
Low Channel



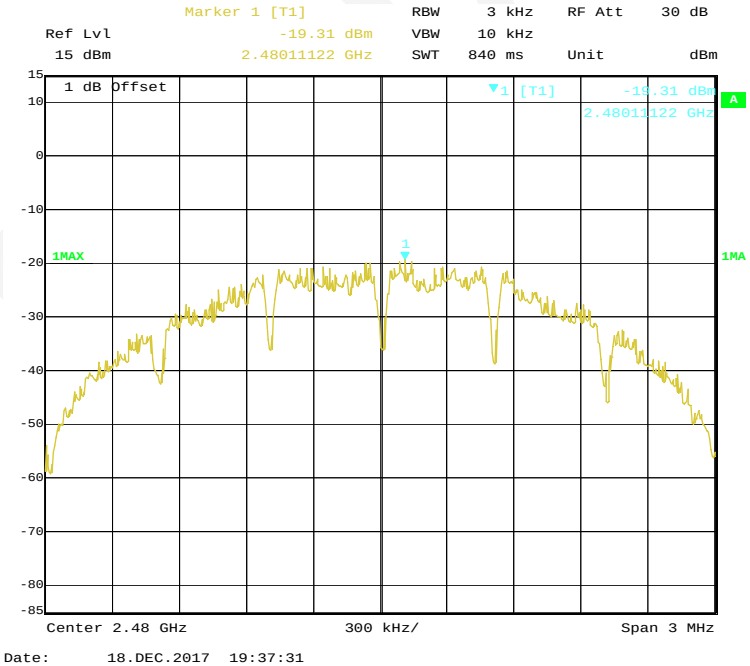
Middle Channel



High Channel for KTWM102-11



High Channel for KTWM102-21



******* END OF REPORT *******