FCC Part 15.247

TEST REPORT

For

Kurt Manufacturing Company

5280 Main Street NE Minneapolis, MN 55421 United States

FCC ID: 2AO8MT2005

Report Type:	**Product Type:**
Original Report	Kinetic inRide 3.0

Report Producer:	Kaylee Chiang
Report Number:	RXZ1803007-00A
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Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Taiwan)

REVISION HISTORY

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
1.0	RXZ1803007	RXZ1803007-00A	2018.04.10	Original Report	Kaylee

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1 General Information

1.1 Product Description for Equipment Under Test (EUT)

Applicant:	Kurt Manufacturing Company 5280 Main Street NE Minneapolis, MN 55421 United States
Manufacturer:	ALATECH Technology Limited 39F., No.758,Jungming S.Rd. Taichung 40255, Taiwan, R.O.C.
Product:	Kinetic inRide 3.0
Model:	T-2005
Trade Name:	KINETIC
Frequency Range:	2402-2480 MHz
Transmit Power:	BLE Mode: -2.29 dBm
Modulation Technique:	BLE Mode: GFSK
Transmit Data Rate:	BLE Mode: 1 Mbps
Number of Channels:	BLE Mode: 40 Channels
Antenna Specification:	PCB Antenna/Gain: 1.98 dBi
Voltage Range:	3Vdc from Battery
Date of Test:	Mar 19, 2018 ~ Mar 26, 2018

**All measurement and test data in this report was gathered from production sample serial number: 1803007 (Assigned by BACL, Taiwan) The EUT supplied by the applicant was received on 2018-03-12.*

1.2 Objective

This report is prepared on behalf of *Kurt Manufacturing Company* in accordance with Part 2, Subpart J, Part 15, Subparts A 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, Conducted and Radiated Spurious Emissions.

1.3 Related Submittal(s)/Grant(s)

FCC Part 15.249 DXX submission with FCC ID: 2AO8MT2005

1.4 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

1.5 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Taiwan) to collect test data is located on

☒70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

☐68-3, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Bay Area Compliance Laboratories Corp. (Taiwan) Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3180) and the FCC designation No.TW3180 under the Mutual Recognition Agreement (MRA) in FCC Test. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.10.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 974454. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

2 System Test Configuration

2.1 Description of Test Configuration

For BT BLE mode, there are totally 40 channels.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2402	21	2442
2	2404	--	--
3	2406	--	--
4	2408	38	2476
--	--	39	2478
20	2440	40	2480

For BLE Modes were tested with channel 1, 20 and 40

2.2 Equipment Modifications

No modification was made to the EUT

2.3 EUT Exercise Software

No test software was used.

2.4 Support Equipment List and Details

Description	Manufacturer	Model Number	FCC ID/DOC	S/N
Power supply	KIKUSUI	PMC35-2	N/A	MK002127

2.5 External Cable List and Details

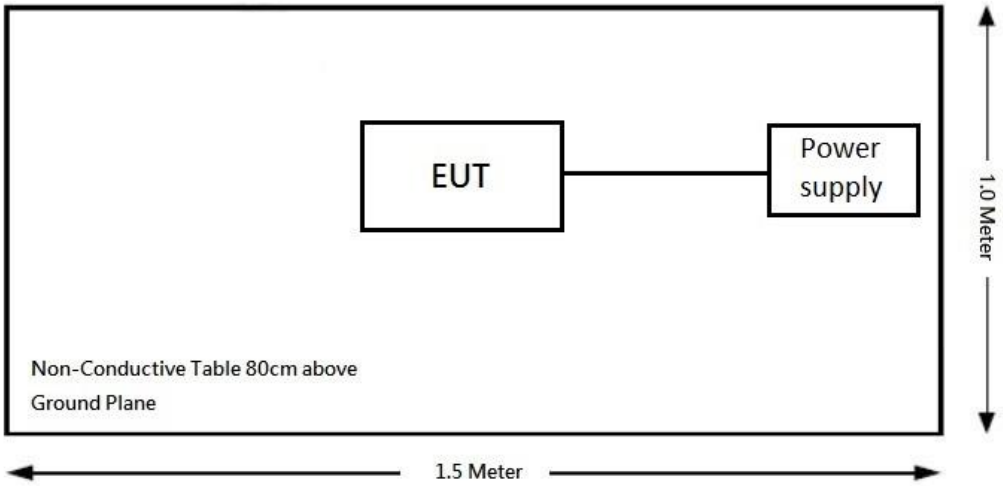
Cable Description	Length (m)	From	To
Alligator clamp	0.5	Power supply	EUT

2.6 Block Diagram of Test Setup

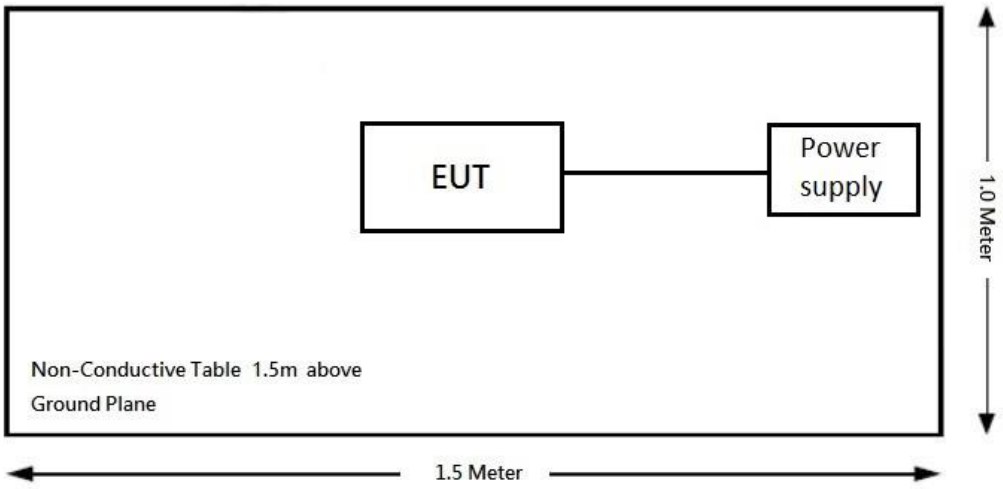
See test photographs attached in Exhibit A for the actual connections between EUT and support equipment.

Radiation:

Below 1GHz:



Above 1GHz:



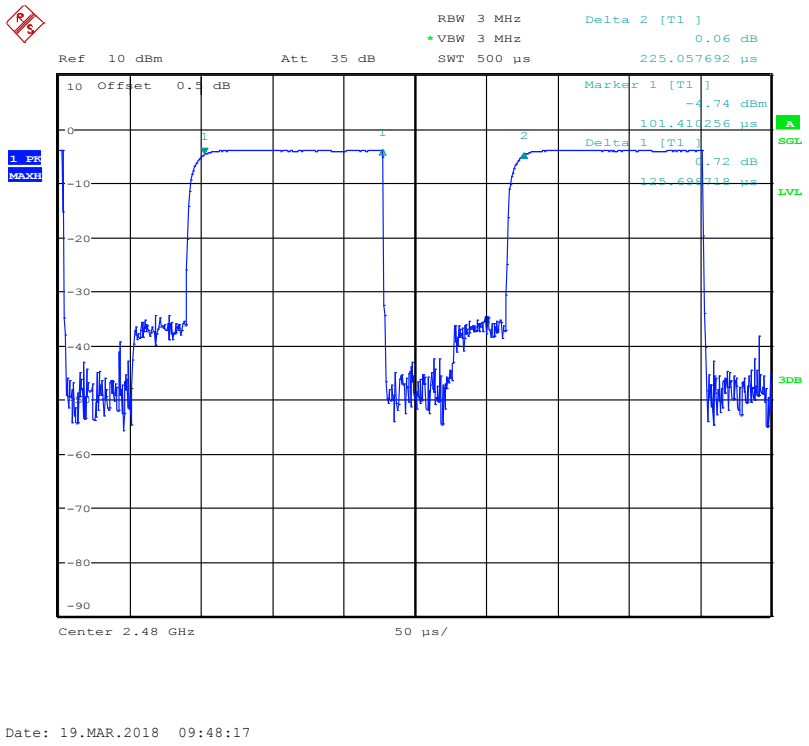
2.7 Duty Cycle

According to KDB 558074 D01 DTS Meas Guidance v04 section 6.0:

All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximumpower transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
BLE	0.125	0.225	56	2.52

Note: Duty Cycle Correction Factor = 10*log(1/duty cycle)



3 Summary of Test Results

FCC Rules	Description of Test	Result
§15.247(i), § 1.1310, §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Not applicable
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247(a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Peak Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

Not applicable: Device only supports battery.

4 FCC § 15.247(i), §1.1310, § 2.1091 - Maximum Permissible Exposure (MPE)

4.1 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);

4.2 RF Exposure Evaluation Result

MPE evaluation:

Mode	Frequency Range (MHz)	Antenna Gain		Target Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE	2480	1.98	1.58	-2.00	0.63	20	0.0002	1

Result: MPE evaluation meet 20 cm the requirement of standard.

5 FCC §15.203 – Antenna Requirements

5.1 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.

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 exceed 6 dBi.

5.2 Antenna List and Details

Manufacturer	Type	Antenna Gain	Result
Alatech Technology Limited	PCB Antenna	1.98 dBi	Compliance

The EUT has an internal antenna arrangement, which was permanently attached, fulfill the requirement of this section.

6 FCC §15.209, §15.205, §15.247(d) – Spurious Emissions

6.1 Applicable Standard

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 §15.205(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 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

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 §15.247 (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).

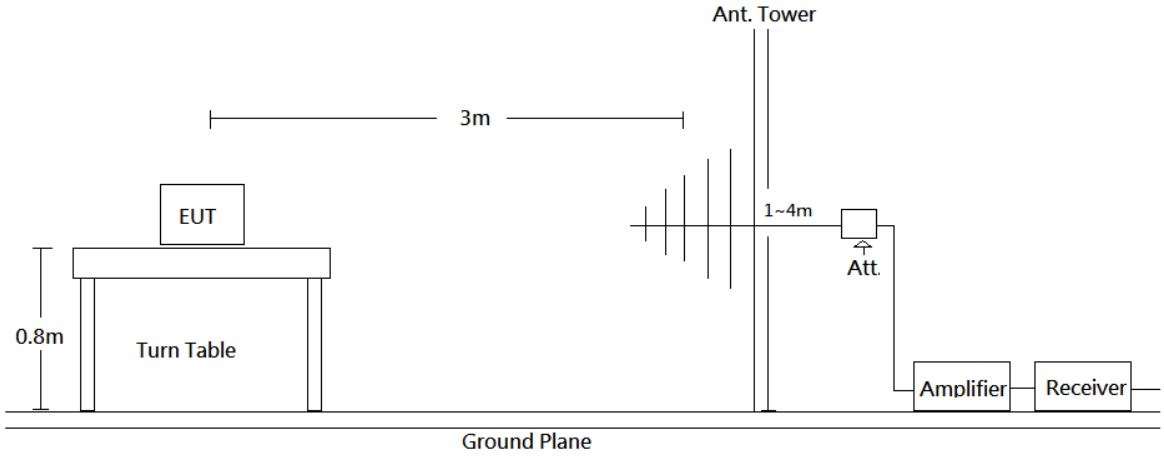
6.2 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in 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 CISPR 16-4-2:2011, the expended combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Taiwan) is shown in below table. And the uncertainty will not be taken into consideration for the test data recorded in the report.

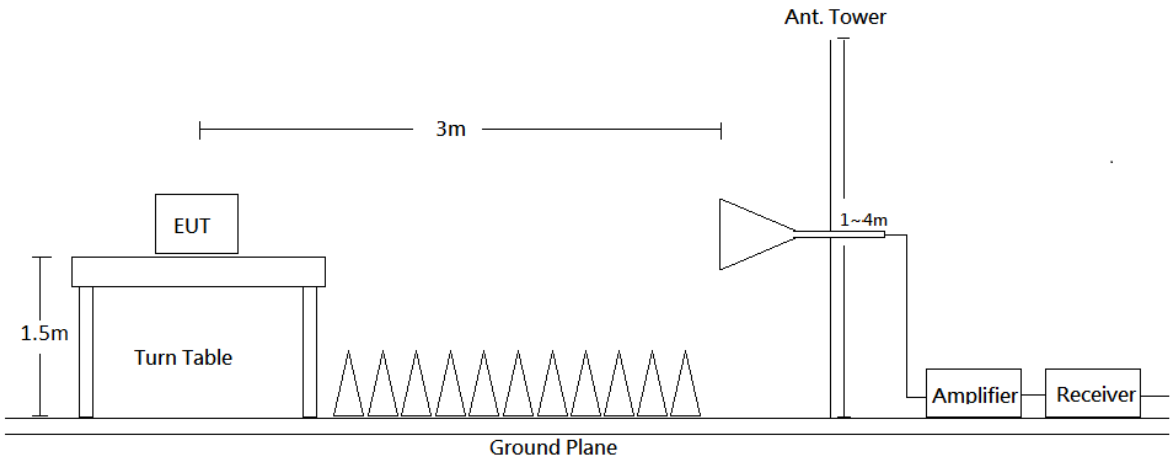
Frequency	Measurement uncertainty
30 MHz~200 MHz	3.76 dB (k=2, 95% level of confidence)
200 MHz~1 GHz	4.12 dB (k=2, 95% level of confidence)
1 GHz~6 GHz	4.84 dB (k=2, 95% level of confidence)
6 GHz~18 GHz	5.16 dB (k=2, 95% level of confidence)
18 GHz~26 GHz	4.84 dB (k=2, 95% level of confidence)
26 GHz~40 GHz	4.30 dB (k=2, 95% level of confidence)

6.3 EUT Setup

Blow 1 GHz:



Above 1 GHz:



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

6.4 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 26.5 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations measurement method 6.3 in ANSI C63.10.

Frequency Range	RBW	VBW	Detector	Duty cycle	Measurement method
30-1000 MHz	120 kHz	/	QP		QP
Above 1 GHz	1 MHz	3 MHz	PK		PK
	1 MHz	3 MHz	RMS	>98%	Ave
	1 MHz	1/T	PK	<98%	Ave

6.5 Test Procedure

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

All data was recorded in the Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

6.6 Corrected Factor & Margin Calculation

The Correct Factor 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:

Correct Factor = 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 -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Result –Limit

6.7 Test Results Summary

According to the data in the following table, the EUT complied with the FCC §15.209 Limit. Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$Lm + U(Lm) \leq Llim + Ucispr$$

In BACL, U(Lm) is less than Ucispr, if Lm is less than Llim, it implies that the EUT complies with the limit.

6.8 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
Radiation 3M Room (966-A)					
Bilog Antenna	Sunol & Mini-Circuits	JB6/UNAT-6+	A050115/15542_01	2017/12/20	2018/12/19
Horn Antenna	EMCO	3115	9311-4158	2017/05/24	2018/05/23
Horn Antenna	ETS-Lindgren	3116	62638	2017/09/13	2018/09/12
Preamplifier	Sonoma	310N	130602	2017/07/03	2018/07/02
Preamplifier	EMEC	EM01G18G	60697	2017/04/14	2018/04/13
Preamplifier	EMEC	EM18G40G	060656	2018/01/15	2019/01/14
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2017/11/06	2018/11/05
Spectrum Analyzer	Rohde & Schwarz	FSV40	101203	2017/07/13	2018/07/12
Microflex Cable	UTIFLEX	UFB311A-Q-1440-300300	220490-006	2017/10/31	2018/10/30
Microflex Cable	UTIFLEX	UFA210A-1-3149-300300	MFR64639 226389-001	2017/11/10	2018/11/09
Microflex Cable	ROSNOL	K1K50-UP0264-K1K50-450CM	160309-1	2018/03/05	2019/03/04
Microflex Cable	ROSNOL	K1K50-UP0264-K1K50-80CM	160309-2	2018/01/17	2019/01/16
Turn Table	Champro	TT-2000	060772-T	N.C.R	N.C.R
Antenna Tower	Champro	AM-BS-4500-B	060772-A	N.C.R	N.C.R
Controller	Champro	EM1000	60772	N.C.R	N.C.R
Software	Farad	EZ_EMC	BACL-03A1	N.C.R	N.C.R
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSU26	200268	2017/05/08	2018/05/07
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements.*

6.9 Test Environmental Conditions

Temperature:	25.2° C
Relative Humidity:	58 %
ATM Pressure:	1010 hPa

The testing was performed by Andy Shih on 2018-03-19

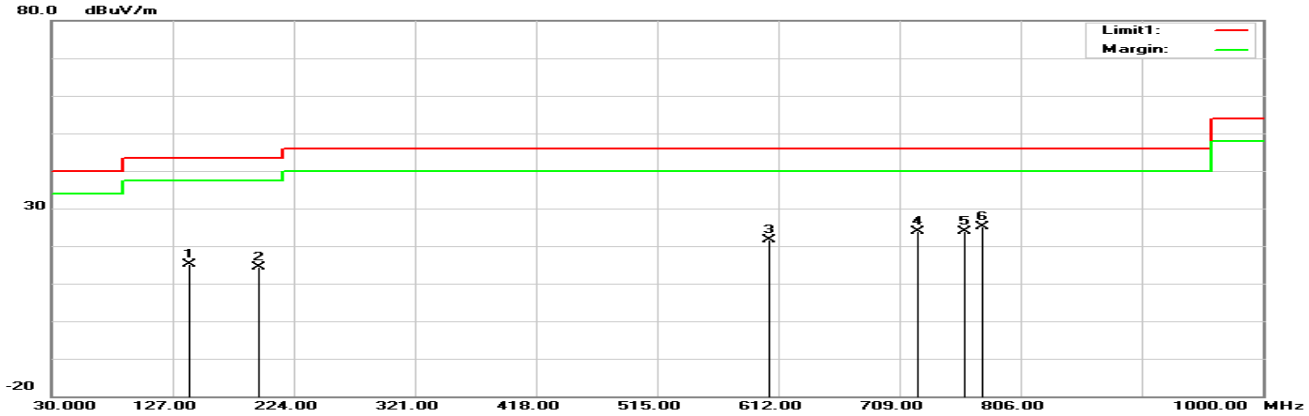
6.10 Test Results

Test Mode: Transmitting

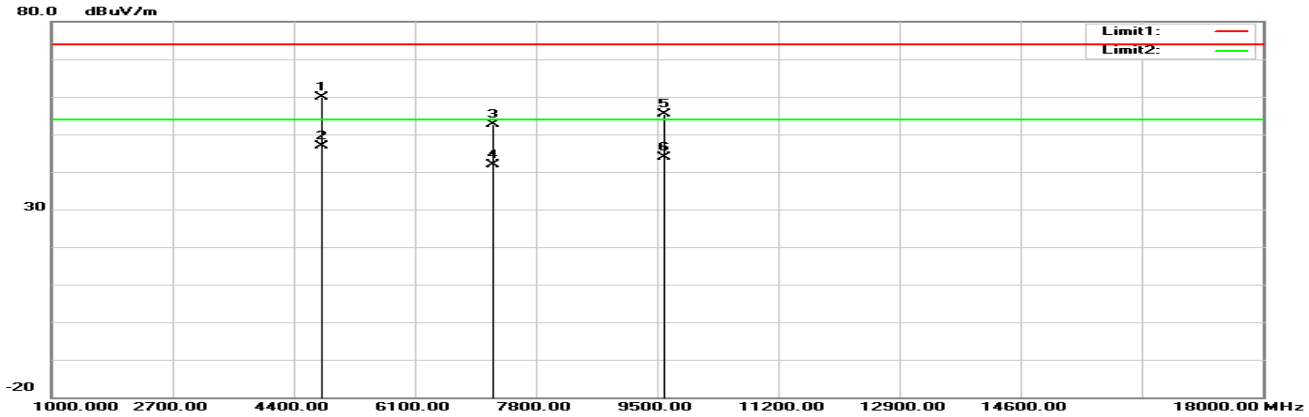
BLE Mode

Horizontal (*worst case is BLE mode low channel*)

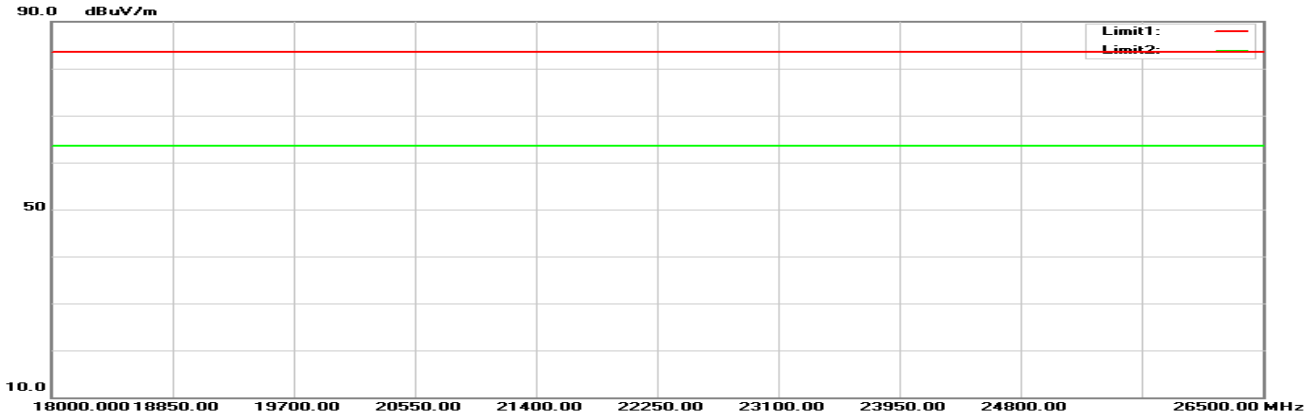
30MHz-1GHz:



1GHz-18GHz:

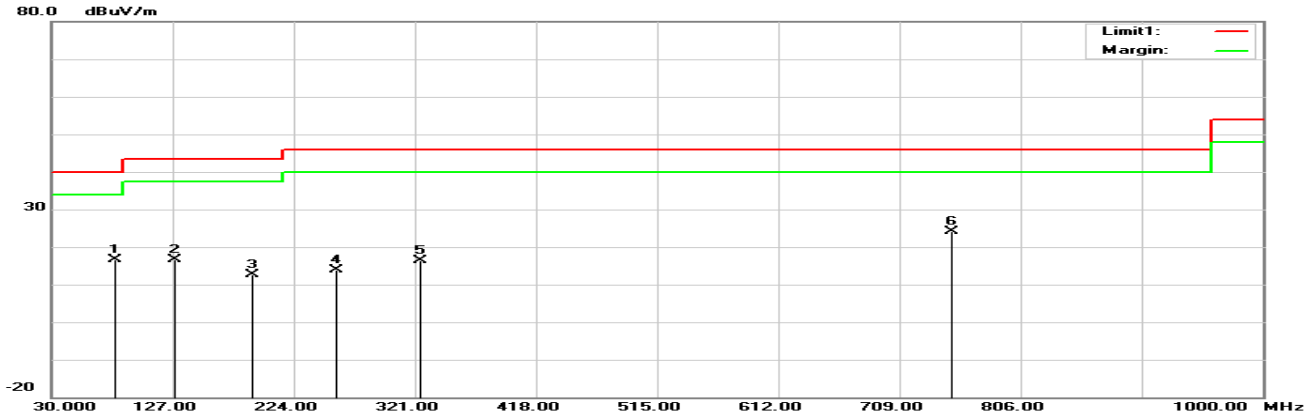


18GHz-26.5GHz:

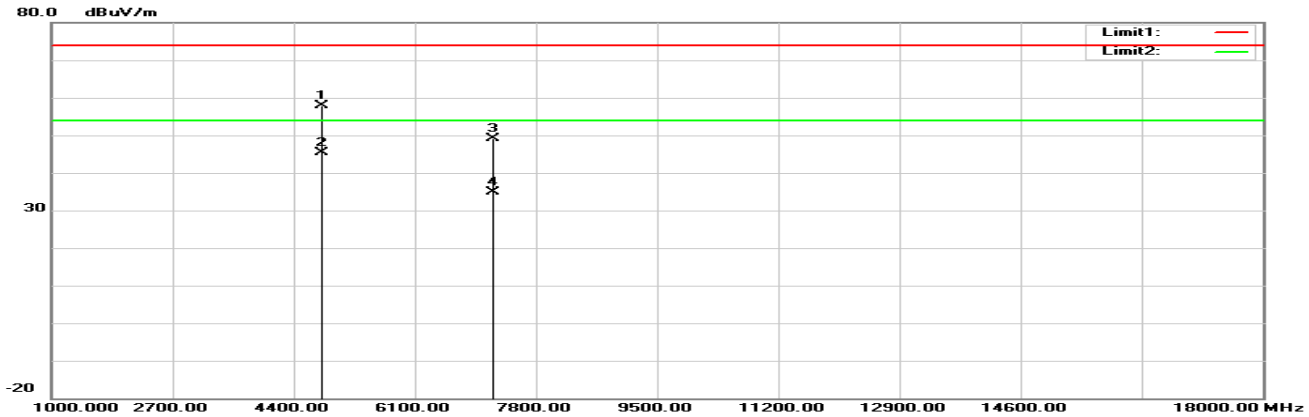


Vertical (*worst case is BLE mode low channel*)

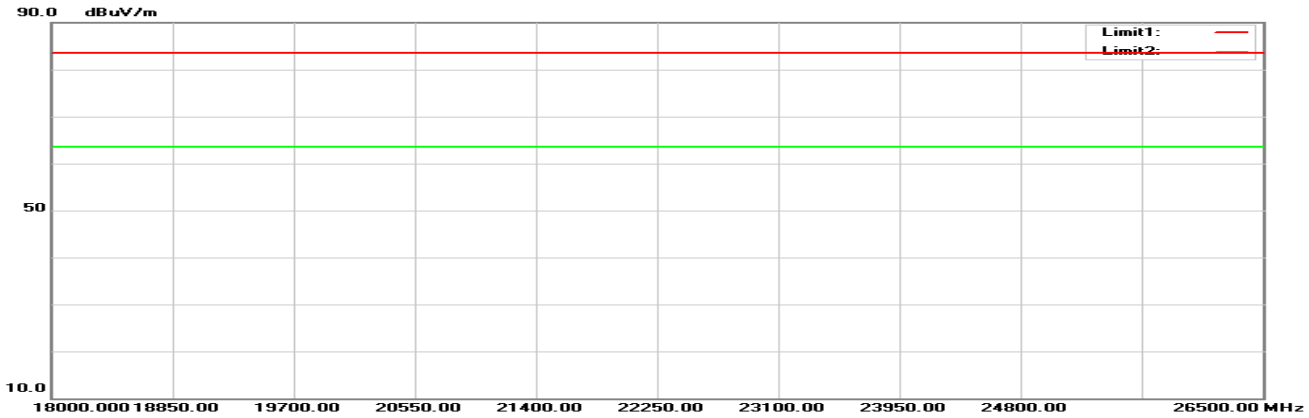
30MHz-1GHz:



1GHz-18GHz:



18GHz-26.5GHz:



Horizontal

Frequency (MHz)	Reading (dB μV)	Correct Factor(dB/m)	Result (dB μV/m)	Limit (dB μV/m)	Margin (dB)	Height (cm)	Degree (˚)	Remark
BLE, Low channel								
140.5800	25.71	-10.66	15.05	43.50	-28.45	100	96	QP
195.8700	26.20	-11.70	14.50	43.50	-29.00	100	154	QP
605.2100	26.16	-4.57	21.59	46.00	-24.41	100	200	QP
723.5500	26.50	-2.68	23.82	46.00	-22.18	100	178	QP
761.3800	26.01	-2.06	23.95	46.00	-22.05	100	278	QP
775.9300	26.96	-1.77	25.19	46.00	-20.81	100	146	QP
2381.820	69.38	-7.55	61.83	74.00	-12.17	100	174	peak
2381.820	51.64	-7.55	44.09	54.00	-9.91	100	174	AVG
2402.000	101.39	-7.46	93.93	N/A	N/A	162	211	peak
2402.000	84.24	-7.46	76.78	N/A	N/A	162	211	AVG
4804.000	58.85	1.09	59.94	74.00	-14.06	160	359	peak
4804.000	45.90	1.09	46.99	54.00	-7.01	160	359	AVG
7206.000	45.55	7.07	52.62	74.00	-21.38	156	352	peak
7206.000	34.83	7.07	41.90	54.00	-12.10	156	352	AVG
9608.000	46.49	8.89	55.38	74.00	-18.62	100	27	peak
9608.000	35.10	8.89	43.99	54.00	-10.01	100	27	AVG
BLE, Middle channel								
230.4300	35.26	-12.23	23.03	46.00	-22.97	100	37	QP
504.3300	25.78	-5.83	19.95	46.00	-26.05	100	289	QP
624.6100	26.78	-4.19	22.59	46.00	-23.41	100	1	QP
816.6700	26.46	-0.94	25.52	46.00	-20.48	100	267	QP
938.8900	24.67	1.85	26.52	46.00	-19.48	100	287	QP
964.1100	24.25	2.59	26.84	54.00	-27.16	100	319	QP
2442.000	101.30	-7.29	94.01	N/A	N/A	128	176	peak
2442.000	85.49	-7.29	78.20	N/A	N/A	128	176	AVG
4884.000	56.53	1.45	57.98	74.00	-16.02	189	270	peak
4884.000	43.86	1.45	45.31	54.00	-8.69	189	270	AVG
7326.000	45.05	7.33	52.38	74.00	-21.62	100	1	peak
7326.000	34.10	7.33	41.43	54.00	-12.57	100	1	AVG
9768.000	43.56	9.17	52.73	74.00	-21.27	232	32	peak
9768.000	30.76	9.17	39.93	54.00	-14.07	232	32	AVG
BLE, High channel								
264.7400	25.27	-10.94	14.33	46.00	-31.67	100	322	QP
295.7800	26.85	-10.09	16.76	46.00	-29.24	100	339	QP
477.1700	26.02	-6.28	19.74	46.00	-26.26	100	278	QP
531.4900	27.03	-5.46	21.57	46.00	-24.43	100	52	QP
555.7400	25.42	-5.14	20.28	46.00	-25.72	100	246	QP
879.1100	19.26	0.35	19.61	46.00	-26.39	100	246	QP
2480.000	99.52	-7.12	92.40	N/A	N/A	140	204	peak
2480.000	82.76	-7.12	75.64	N/A	N/A	140	204	AVG
2483.500	68.56	-7.11	61.45	74.00	-12.55	100	360	peak
2483.500	51.85	-7.11	44.74	54.00	-9.26	100	360	AVG
4960.000	55.67	1.79	57.46	74.00	-16.54	161	1	peak
4960.000	43.33	1.79	45.12	54.00	-8.88	161	1	AVG
7440.000	42.97	7.57	50.54	74.00	-23.46	100	56	peak
7440.000	32.06	7.57	39.63	54.00	-14.37	100	56	AVG
9920.000	42.40	9.44	51.84	74.00	-22.16	100	73	peak
9920.000	29.96	9.44	39.40	54.00	-14.60	100	73	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

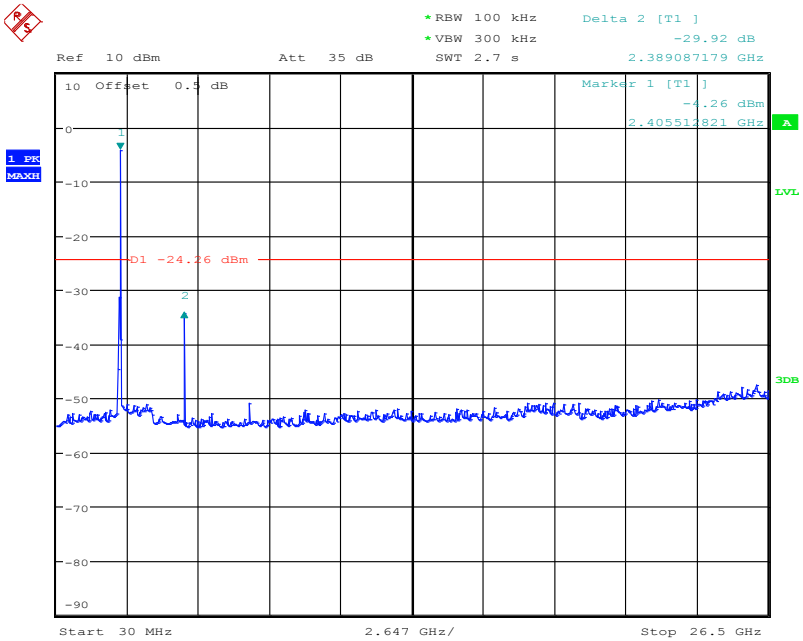
Frequency (MHz)	Reading (dB μV)	Correct Factor(dB/m)	Result (dB μV/m)	Limit (dB μV/m)	Margin (dB)	Height (cm)	Degree (˚)	Remark
BLE, Low channel								
81.1800	33.34	-16.60	16.74	40.00	-23.26	100	191	QP
128.9400	26.43	-9.83	16.60	43.50	-26.90	100	343	QP
191.0200	25.09	-12.52	12.57	43.50	-30.93	100	269	QP
257.9500	25.38	-11.50	13.88	46.00	-32.12	100	290	QP
325.8500	25.83	-9.41	16.42	46.00	-29.58	100	281	QP
750.7100	26.48	-2.27	24.21	46.00	-21.79	100	82	QP
2381.820	67.25	-7.55	59.70	74.00	-14.30	100	133	peak
2381.820	51.57	-7.55	44.02	54.00	-9.98	100	133	AVG
2402.000	94.79	-7.46	87.33	N/A	N/A	107	163	peak
2402.000	78.91	-7.46	71.45	N/A	N/A	107	163	AVG
4804.000	56.81	1.09	57.90	74.00	-16.10	189	214	peak
4804.000	44.30	1.09	45.39	54.00	-8.61	189	214	AVG
7206.000	42.08	7.07	49.15	74.00	-24.85	100	94	peak
7206.000	27.72	7.07	34.79	54.00	-19.21	100	94	AVG
BLE, Middle channel								
117.3000	27.27	-10.50	16.77	43.50	-26.73	100	76	QP
217.2100	26.31	-12.73	13.58	46.00	-32.42	100	97	QP
245.3400	26.84	-11.83	15.01	46.00	-30.99	100	56	QP
314.2100	26.81	-9.69	17.12	46.00	-28.88	100	276	QP
753.6200	25.79	-2.22	23.57	46.00	-22.43	100	100	QP
896.2100	25.28	0.67	25.95	46.00	-20.05	100	261	QP
2442.000	91.58	-7.29	84.29	N/A	N/A	100	86	peak
2442.000	76.86	-7.29	69.57	N/A	N/A	100	86	AVG
4884.000	53.92	1.45	55.37	74.00	-18.63	100	169	peak
4884.000	41.67	1.45	43.12	54.00	-10.88	100	169	AVG
7326.000	42.17	7.33	49.50	74.00	-24.50	100	304	peak
7326.000	29.25	7.33	36.58	54.00	-17.42	100	304	AVG
BLE, High channel								
504.3300	25.87	-5.83	20.04	46.00	-25.96	100	211	QP
533.4300	27.30	-5.43	21.87	46.00	-24.13	100	311	QP
691.5400	26.33	-3.15	23.18	46.00	-22.82	100	276	QP
745.8600	25.66	-2.34	23.32	46.00	-22.68	100	170	QP
762.3500	26.72	-2.04	24.68	46.00	-21.32	100	341	QP
909.7900	25.08	1.02	26.10	46.00	-19.90	100	24	QP
2480.000	94.46	-7.12	87.34	N/A	N/A	107	300	peak
2480.000	78.65	-7.12	71.53	N/A	N/A	107	300	AVG
2483.500	67.70	-7.11	60.59	74.00	-13.41	100	128	peak
2483.500	51.77	-7.11	44.66	54.00	-9.34	100	128	AVG
4960.000	52.64	1.79	54.43	74.00	-19.57	132	176	peak
4960.000	40.72	1.79	42.51	54.00	-11.49	132	176	AVG
7440.000	41.64	7.57	49.21	74.00	-24.79	100	297	peak
7440.000	28.64	7.57	36.21	54.00	-17.79	100	297	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Conducted Spurious Emissions:

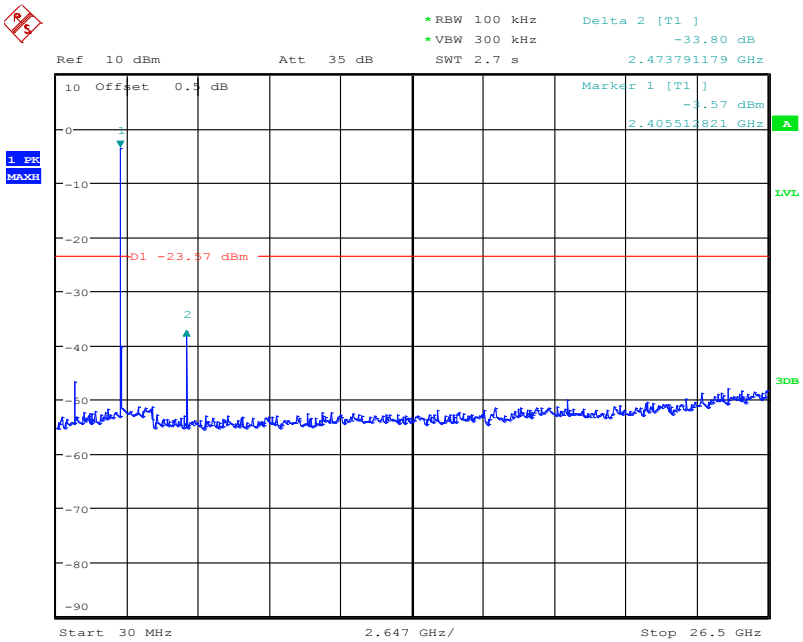
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	RESULT
Low	2402	29.92	≥ 20	PASS
Mid	2442	33.80	≥ 20	PASS
High	2480	35.75	≥ 20	PASS

Low Channel



Date: 19.MAR.2018 09:22:55

Middle Channel



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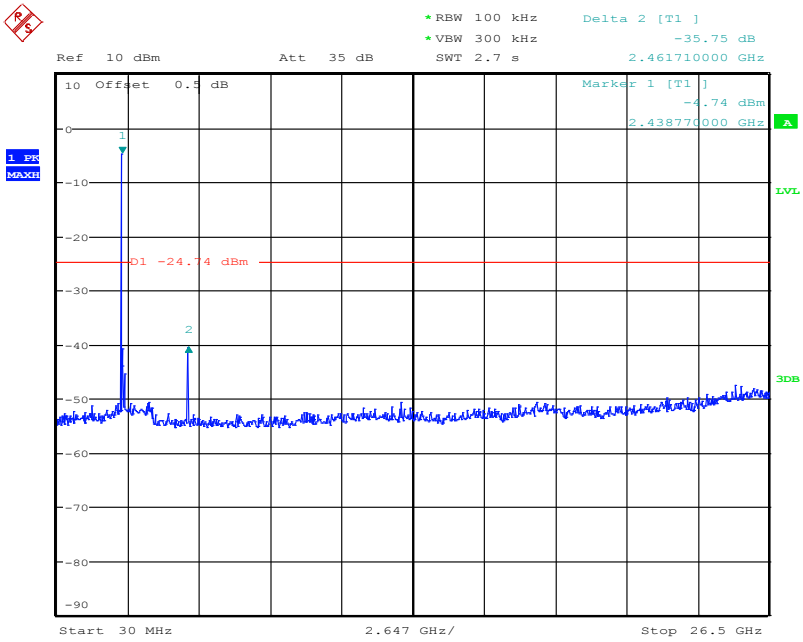
High Channel



Date: 19.MAR.2018 10:04:49

7 FCC §15.247(a)(2) – 6 dB Emission Bandwidth

7.1 Applicable Standard

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 Test Procedure

The steps for the first option are as follows:

a) Set RBW = 100 kHz.

b) Set the VBW ≥ [3 × RBW].

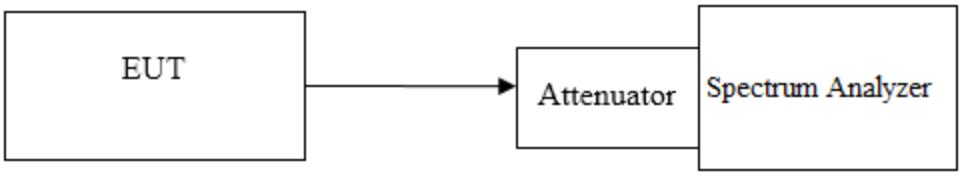
c) Detector = peak.

d) Trace mode = max hold.

e) Sweep = auto couple.

f) Allow the trace to stabilize.

g) 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.



7.3 Test Equipment List and Details

Descriptions	Manufacturers	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSU26	200268	2017/05/08	2018/05/07
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

**** Statement of Traceability:*** BACL Corp. attests that all calibrations have been performed according to TAF requirements, traceable to the ETC.

7.4 Test Environmental Conditions

Temperature:	26° C
Relative Humidity:	58 %
ATM Pressure:	1010 hPa

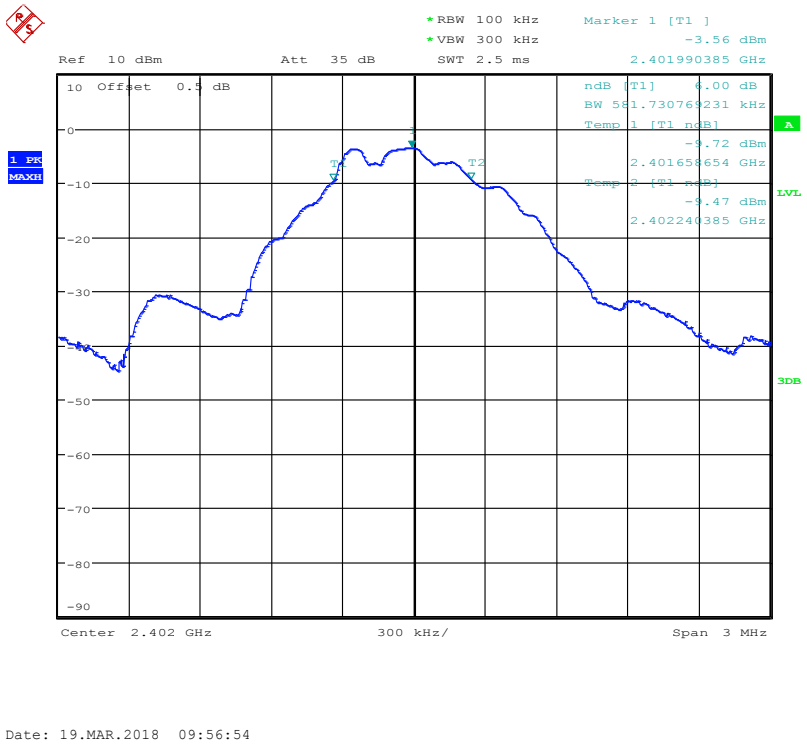
The testing was performed by Andy Shih on 2018-03-19.

7.5 Test Results

Channel	Frequency (MHz)	6 dB OBW (kHz)	Limit (kHz)	Result
Low	2402	581	> 500	Compliance
Middle	2442	576	> 500	Compliance
High	2480	572	> 500	Compliance

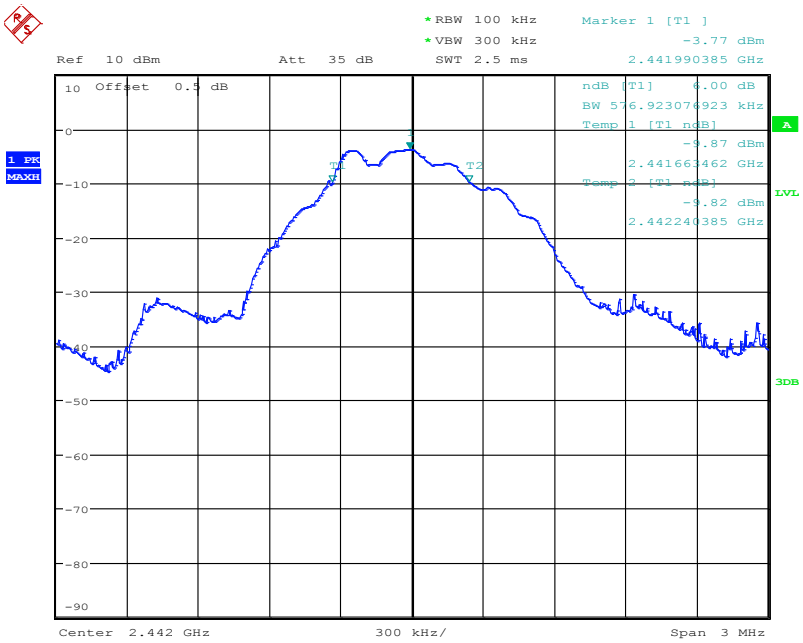
Please refer to the following plots

Low Channel



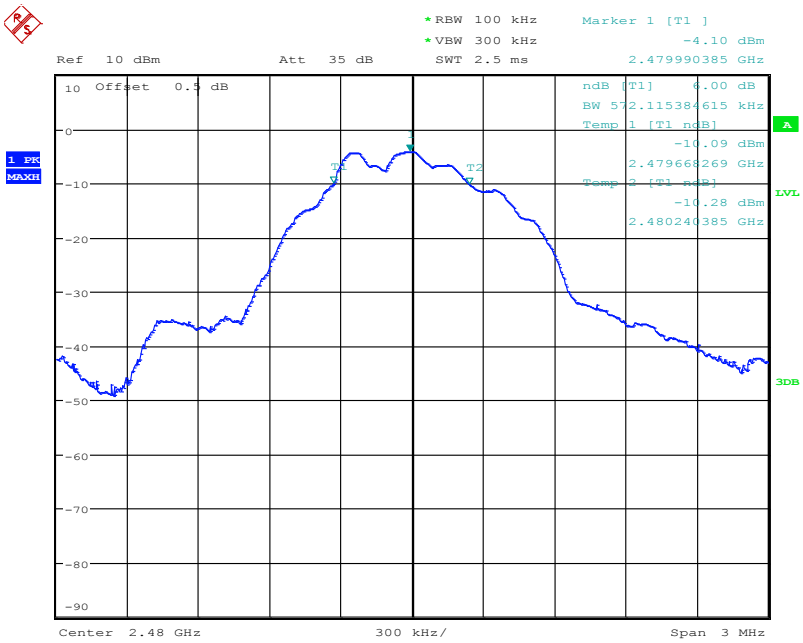
Date: 19.MAR.2018 09:56:54

Middle Channel



Date: 19.MAR.2018 09:39:37

High Channel



Date: 19.MAR.2018 09:42:15

8 FCC §15.247(b)(3) – Maximum Output Power

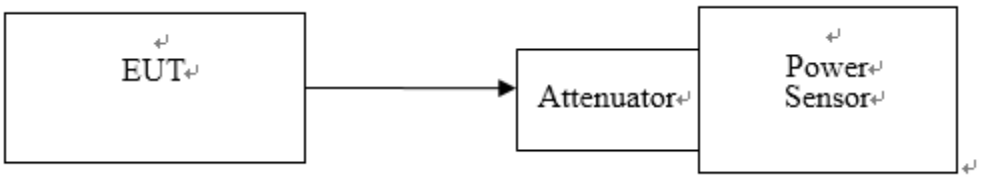
8.1 Applicable Standard

According to FCC §15.247(b) (3).

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.

8.2 Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to measuring equipment.



8.3 Test Equipment List and Details

Descriptions	Manufacturers	Models	Serial Numbers	Calibration Date	Calibration Due Date
Power Sensor	KEYSIGHT	U2021XA	MY54080018	2018/03/07	2019/03/06
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

*** *Statement of Traceability:*** BACL Corp. attests that all calibrations have been performed according to TAF requirements, traceable to the ETC.

8.4 Test Environmental Conditions

Temperature:	26° C
Relative Humidity:	58 %
ATM Pressure:	1010 hPa

The testing was performed by Andy Shih on 2018-03-19.

8.5 Test Results

Channel	Frequency	Maximum peak Conducted Output Power		Limit	Result
	(MHz)	(dBm)	(W)	(W)	
BLE Mode					
Low	2402	-2.29	0.0006	1	PASS
Middle	2442	-2.49	0.0006	1	PASS
High	2480	-3.42	0.0005	1	PASS

9 FCC §15.247(d) – 100 kHz Bandwidth of Frequency Band Edge

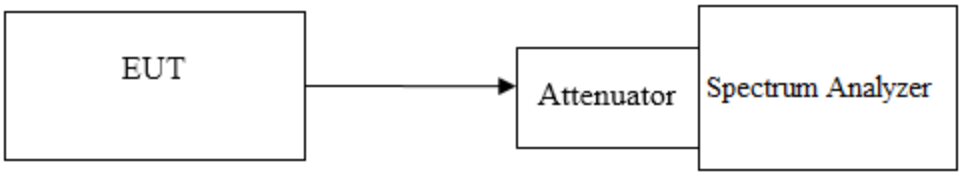
9.1 Applicable Standard

According to 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)).

9.2 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.



9.3 Test Equipment List and Details

Descriptions	Manufacturers	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSU26	200268	2017/05/08	2018/05/07
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements*

9.4 Test Environmental Conditions

Temperature:	26° C
Relative Humidity:	58 %
ATM Pressure:	1010 hPa

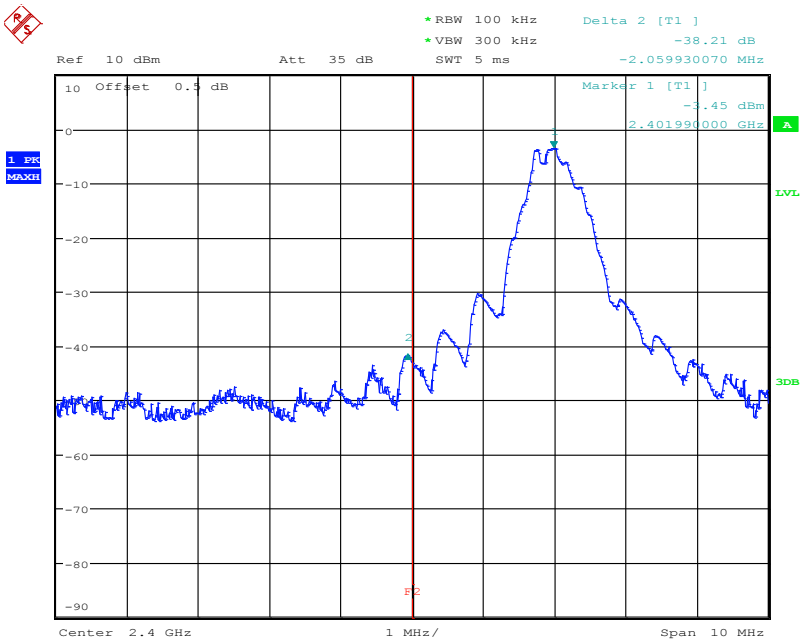
The testing was performed by Andy Shih on 2018-03-19.

9.5 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	RESULT
Low	2402	38.21	≥ 20	PASS
High	2480	46.46	≥ 20	PASS

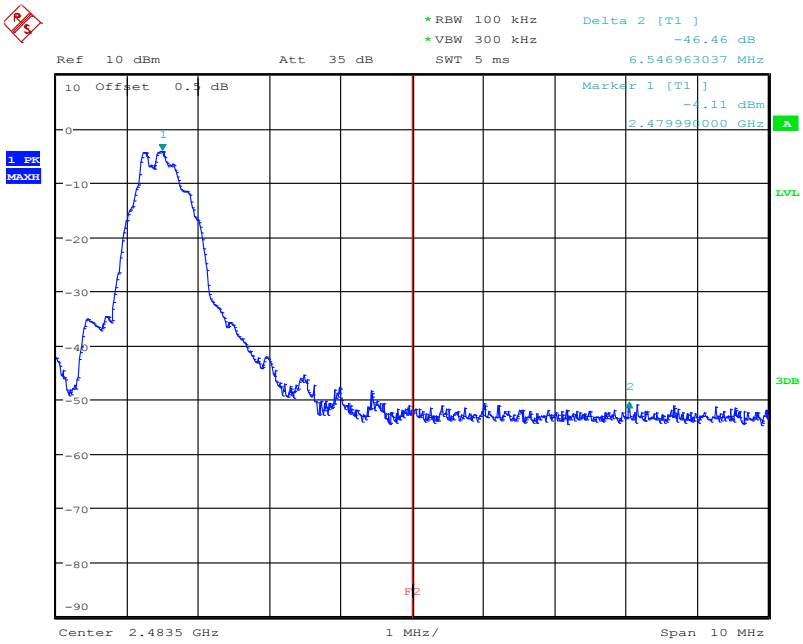
Please refer to the following plots

Band Edge, Left Side



Date: 19.MAR.2018 09:22:23

Band Edge, Right Side



Date: 19.MAR.2018 09:43:09

10 FCC §15.247(e) – Power Spectral Density

10.1 Applicable Standard

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. 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.

10.2 Test Procedure

According to ANSI C63.10-2013

a) Set analyzer center frequency to DTS channel center frequency.

b) Set the span to 1.5 times the DTS bandwidth.

c) Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.

d) Set the VBW ≥ [3 × RBW].

e) Detector = peak.

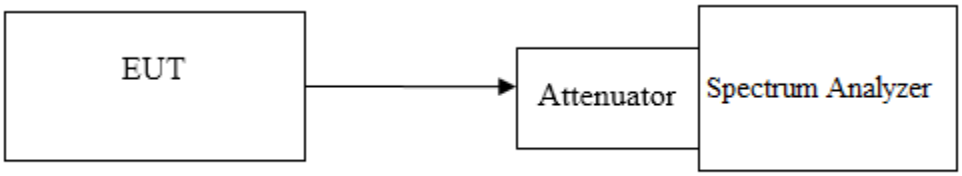
f) Sweep time = auto couple.

g) Trace mode = max hold.

h) Allow trace to fully stabilize.

i) Use the peak marker function to determine the maximum amplitude level within the RBW.

j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat



10.3 Test Equipment List and Details

Descriptions	Manufacturers	Models	Serial Numbers	Calibration Date	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	FSU26	200268	2017/05/08	2018/05/07
Cable	WOKEN	SFL402	S02-160323-07	2018/02/12	2019/02/11

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements*

10.4 Test Environmental Conditions

Temperature:	26° C
Relative Humidity:	58 %
ATM Pressure:	1010 hPa

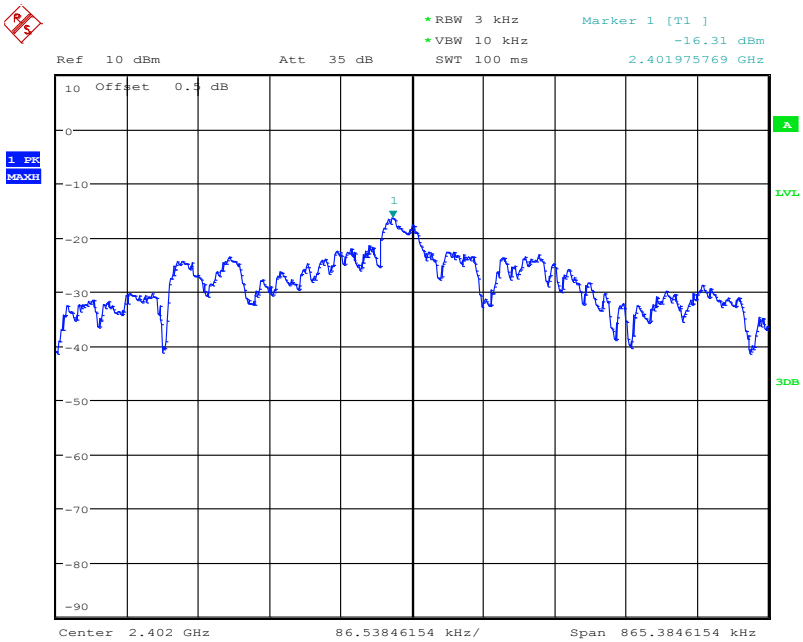
The testing was performed by Andy Shih on 2018-03-19.

10.5 Test Results

Channel	Frequency (MHz)	Power Spectral Density (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
Low	2402	-16.31	8	Compliance
Middle	2442	-16.75	8	Compliance
High	2480	-15.59	8	Compliance

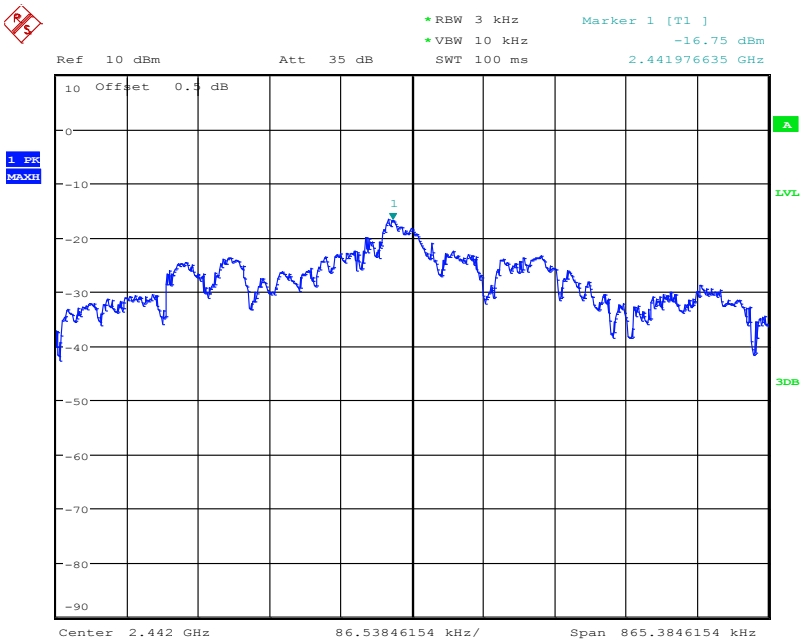
Please refer to the following plots

Low Channel



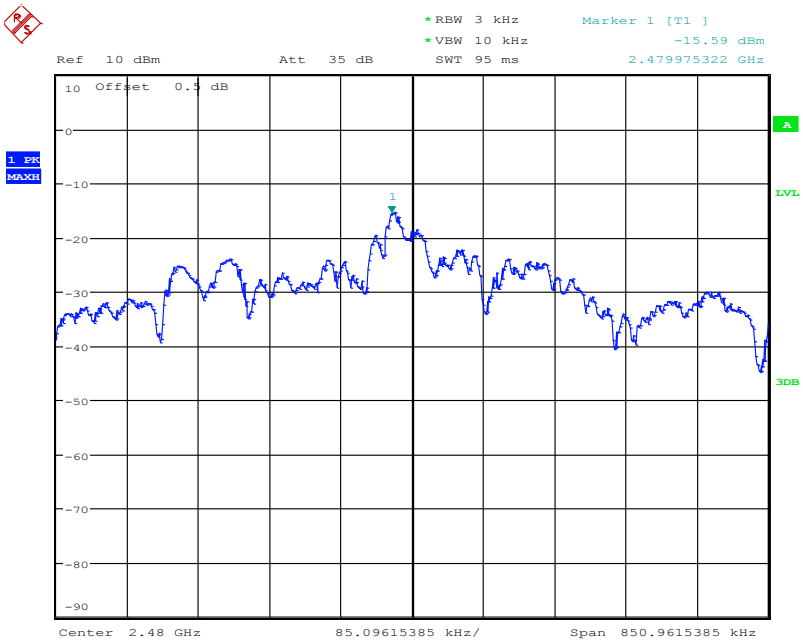
Date: 19.MAR.2018 09:57:21

Middle Channel



Date: 19.MAR.2018 09:40:00

High Channel



Date: 19.MAR.2018 09:42:38

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