

**FCC PART 15.249
RSS-GEN ISSUE 4, NOVEMBER 2014
RSS-210, ISSUE 9, AUGUST 2016**

TEST REPORT

For

Flyability SA

Flyability SA, Avenue de Sevelin 20, Lausanne, Switzerland, CH-1004

FCC ID: 2AL7M-MAGICREX IC: 22887-MAGICREX
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Report Type: Original Report	Product Name: Range Extender (REx)
Report Number: RDG180328002-00B	
Report Date: 2018-05-04	
Reviewed By: Jerry Zhang EMC Manager	<i>Jerry Zhang</i>
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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. (Dongguan).

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	Range Extender (REx)
EUT Model:	No.2
FCC ID:	2AL7M-MAGICREX
IC:	22887-MAGICREX
Rated Input Voltage:	Remote Controller: DC 7.4V from lithium rechargeable battery or DC 17.4V from adapter Antenna Module: DC 11.1V from lithium rechargeable battery
Serial Number:	180328002
EUT Received Date:	2018.03.28

Objective

This type approval report is prepared on behalf of *Flyability SA* in accordance with Part 2-Subpart J, and Part 15-Subparts A and C of the Federal Communication Commissions rules and RSS-210, Issue 9, August 2016, RSS-Gen Issue 4, November 2014 of the Innovation, Science and Economic Development Canada.

The tests were performed in order to determine compliance with FCC Rules Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.249 rules and RSS-210, Issue 9, August 2016, RSS-Gen Issue 4, November 2014 of the Innovation, Science and Economic Development Canada.

Related Submittal(s)/Grant(s)

FCC submissions with Part 15C DTS, FCC ID: 2AL7M-MAGICREX.
ISED submissions with RSS-247, IC: 22887-MAGICREX.

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 RSS-210, Issue 9, AUGUST 2016, RSS-Gen Issue 4, November 2014

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
Unwanted Emissions, radiated	30M~200MHz: 4.58 dB for Horizontal, 4.59 dB for Vertical 200M~1GHz: 4.83 dB for Horizontal, 5.85 dB for Vertical 1G~6GHz: 4.45 dB, 6G~26.5GHz: 5.23 dB
Temperature	±1 °C
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	3.12 dB (150 kHz to 30 MHz)

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218, the FCC Designation No. : CN1220.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062D.

SYSTEM TEST CONFIGURATION

Justification

The EUT was configured for testing in an engineering mode which was provided by the manufacturer.

The Range Extender system is composed of different elements: Remote Controller(RC), Antenna Module, RC Cable, Adaptor, and Module Cable. Please refer to the user manual for detail.

For 5.8GHz band, the system employed 17 channels, which were provided by the manufacturer:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	5738	6	5762	11	5783	16	5803
2	5743	7	5763	12	5788	17	5808
3	5748	8	5768	13	5793	/	/
4	5753	9	5773	14	5796	/	/
5	5758	10	5778	15	5798	/	/

EUT was tested with Channel 5738 MHz, 5773 MHz and 5808 MHz

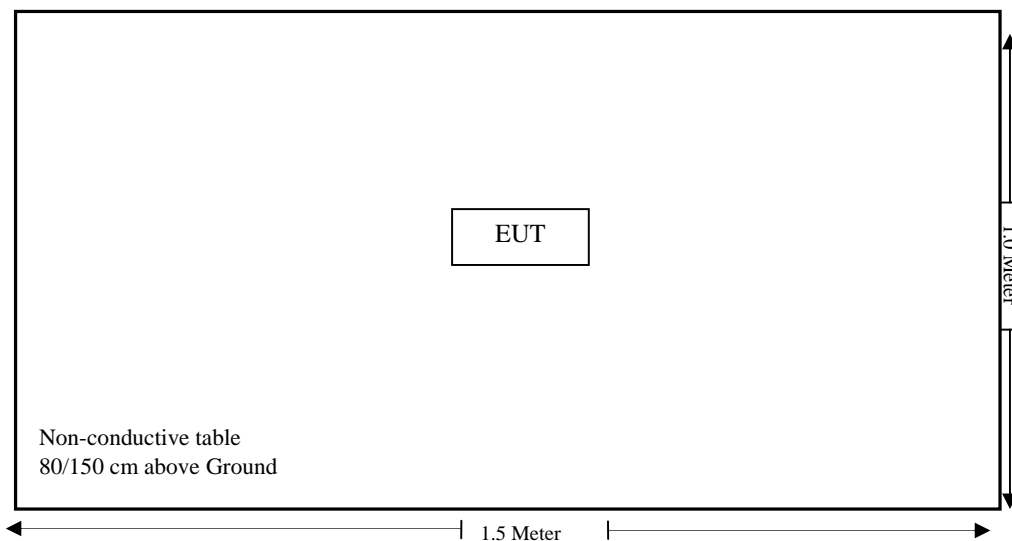
EUT Exercise Software

The software: SScom32 was used in the test. The system configured maximum power as default setting and switched the channel by software commands.

Equipment Modifications

No modifications were made to the EUT.

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
RSS-102 §2.5.1	Exemption Limits for Routine Evaluation -SAR Evaluation	Compliance
§15.203 RSS-Gen Clause 8.3	Antenna Requirement	Compliance
§15.207(a) RSS-Gen Clause 8.8	Conduction Emissions	Not Applicable
15.205, §15.209, §15.249 RSS-210 Clause B10, RSS-Gen Clause 8.9	Radiated Emissions	Compliance
§15.215 (c) RSS-Gen Clause 6.6	20 dB Bandwidth 99% Occupied Bandwidth	Compliance

Note:

Not Applicable: the device powered by battery.

RSS-102 § 2.5.1 EXEMPTION LIMITS FOR ROUTINE EVALUATION – SAR EVALUATION

Applicable Standard

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance^{4,5}

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤ 5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤ 300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥ 50 mm
≤ 300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Result:

The EUT is a low power device (maximum average field strength is 77.57dBuV/m @ 3m), exemption Limits for Routine Evaluation – SAR Evaluation.

FCC §15.203 & RSS-GEN§8.3 - ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

According to RSS-Gen §8.3, The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the licence-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. Licence-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level. When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

Antenna Connector Construction

The EUT has an internal PCB antenna for 5.8GHz, the antenna gain is 1.5 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

FCC§15.205, §15.209&§15.249&RSS-210§B10, RSS-Gen§8.9- RADIATED EMISSIONS

Applicable Standard

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

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

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

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

According to RSS-210 §B10

Devices shall comply with the following requirements:

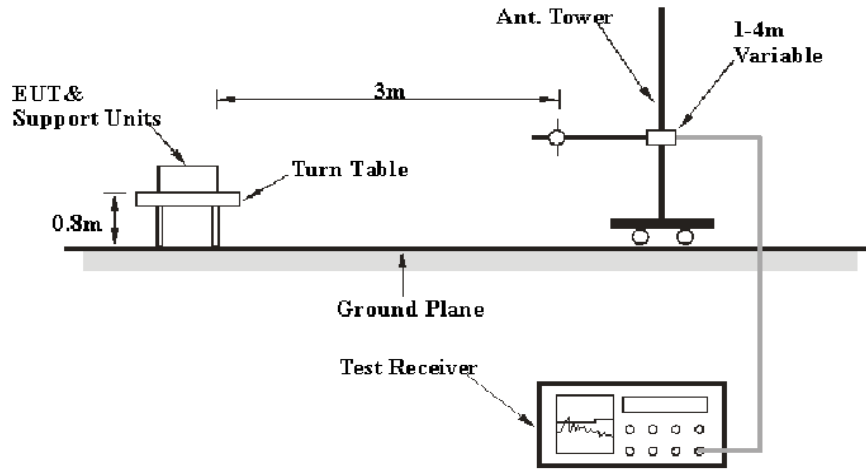
The field strength of fundamental and harmonic emissions, measured at 3 m, shall not (a)exceed 50 mV/m and 0.5 mV/m respectively.

The field strength limits shall be measured using an average detector, except for the fundamental emission in the frequency band 902-928 MHz, which is based on measurements using an International Special Committee on Radio Interference (CISPR) quasi-peak detector.

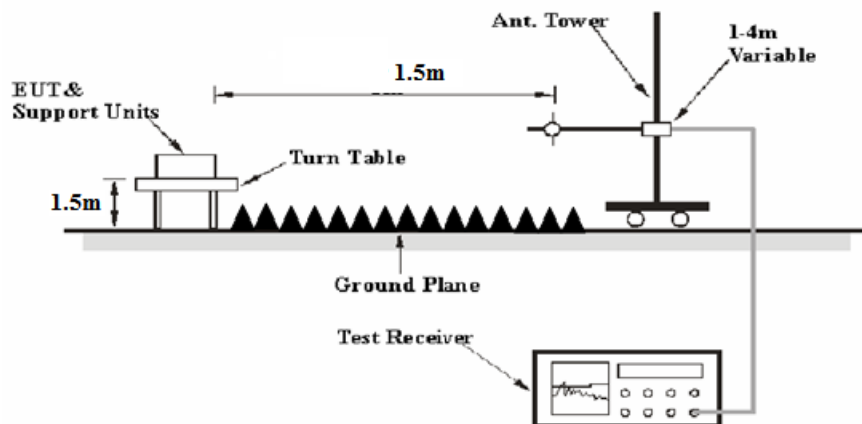
Emissions radiated outside of the specified frequency bands, except for harmonic emissions, (b)shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

EUT Setup

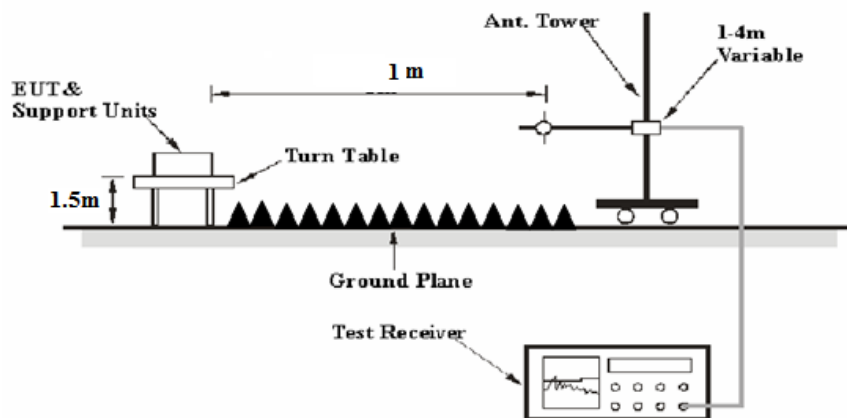
Below 1 GHz:



1-26.5 GHz:



26.5-40 GHz:



The 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 15.209, FCC 15.249 and RSS-210, RSS-Gen limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

Test Equipment Setup

The system was investigated from 30 MHz to 40 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	AV

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 detection mode from 30 MHz to 1GHz, peak and average detection mode above 1 GHz.

According to C63.10, the above 1G test result shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade from 3m to 1.5m or 1m

Distance extrapolation factor = $20 \log (\text{specific distance [3m]}/\text{test distance [1.5m]})$ dB = 6.02 dB

or

Distance extrapolation factor = $20 \log (\text{specific distance [3m]}/\text{test distance [1m]})$ dB = 9.54 dB

All emissions under the average limit and under the noise floor have not recorded in the report.

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:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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:

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
R&S	EMI Test Receiver	ESCI	100224	2017-12-11	2018-12-11
HP	Amplifier	8447D	2727A05902	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1000-01	2017-09-05	2018-09-05
ETS-Lindgren	Horn Antenna	3115	000 527 35	2016-01-05	2019-01-04
Sinoscite	Bandstop Filters	BSF5150-5850MN-0899-003	N/A	2017-05-06	2018-05-06
Mini Circuits	High Pass Filter	VHF-6010+	31118	2017-06-16	2018-06-16
Ducommun Technologies	Horn Antenna	ARH-2823-02	1007726-01 1302	2016-11-18	2019-11-18
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2017-06-27	2018-06-27
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-2.4J2.4J-50	C-0700-02	2017-06-27	2018-06-27
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2017-09-05	2018-09-05
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A

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

Test Data**Environmental Conditions**

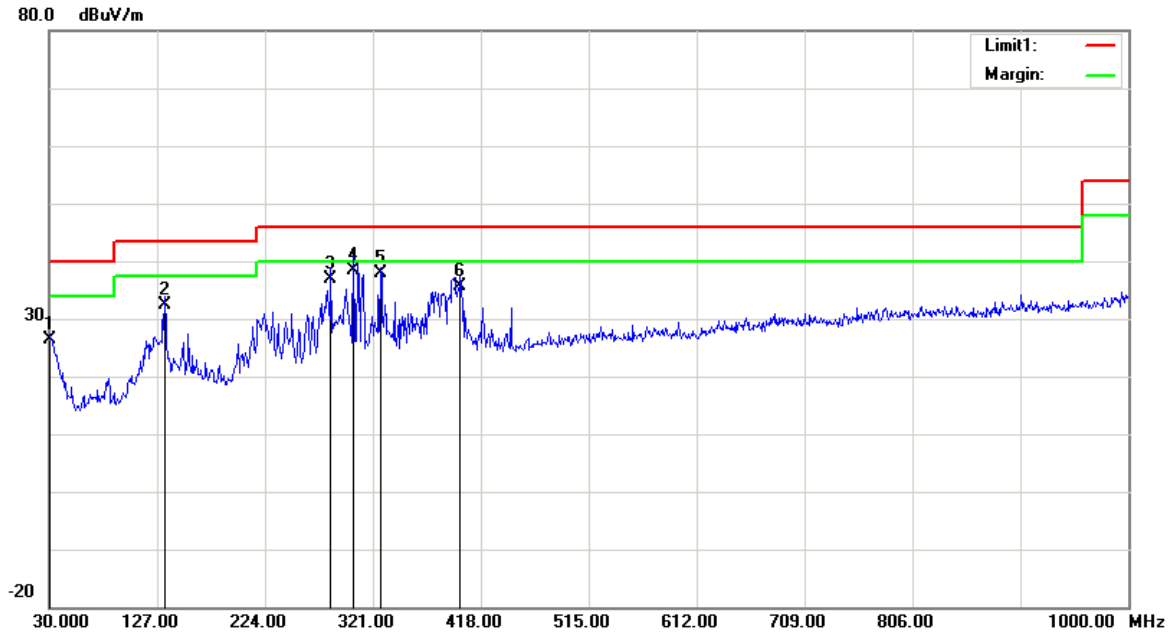
Temperature:	25.1 °C
Relative Humidity:	41 %
ATM Pressure:	100.7 kPa

The testing was performed by Sunny Cen 2018-04-25.

Test Mode: Transmitting

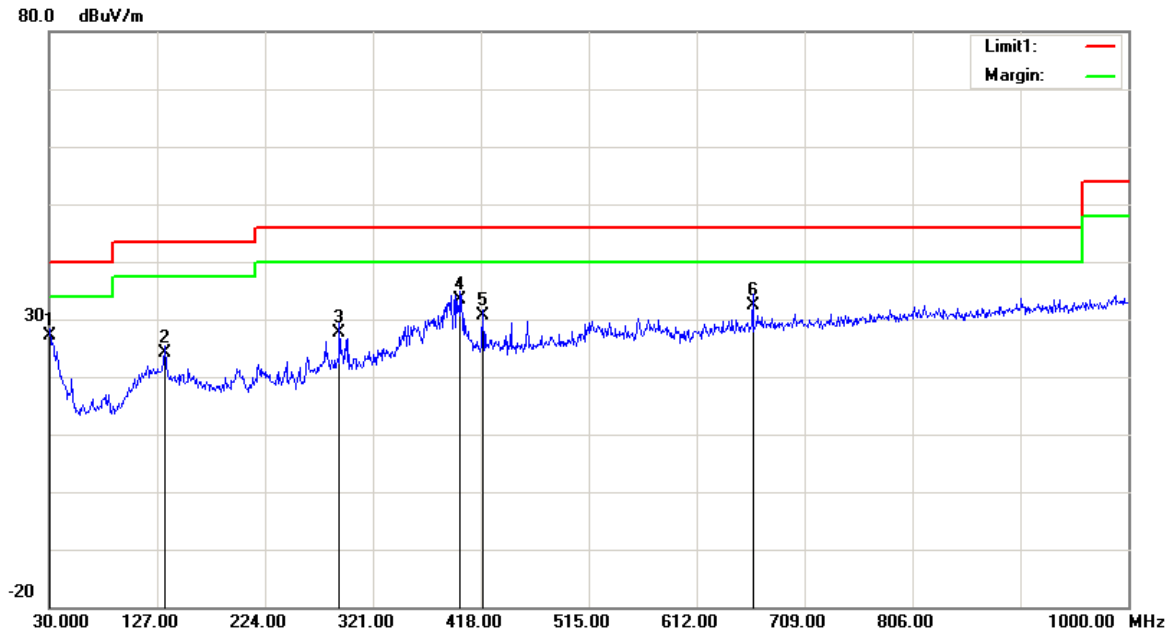
1) 30MHz-1GHz(Middle channel was the worst):

Horizontal:



Frequency (MHz)	Receiver Reading (dBμV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30.0000	24.76	QP	1.54	26.30	40.00	13.70
133.7900	37.53	QP	-5.13	32.40	43.50	11.10
283.1700	40.99	QP	-4.09	36.90	46.00	9.10
303.5400	42.36	QP	-3.96	38.40	46.00	7.60
327.7900	41.24	QP	-3.44	37.80	46.00	8.20
399.5700	37.63	QP	-2.03	35.60	46.00	10.40

Vertical:

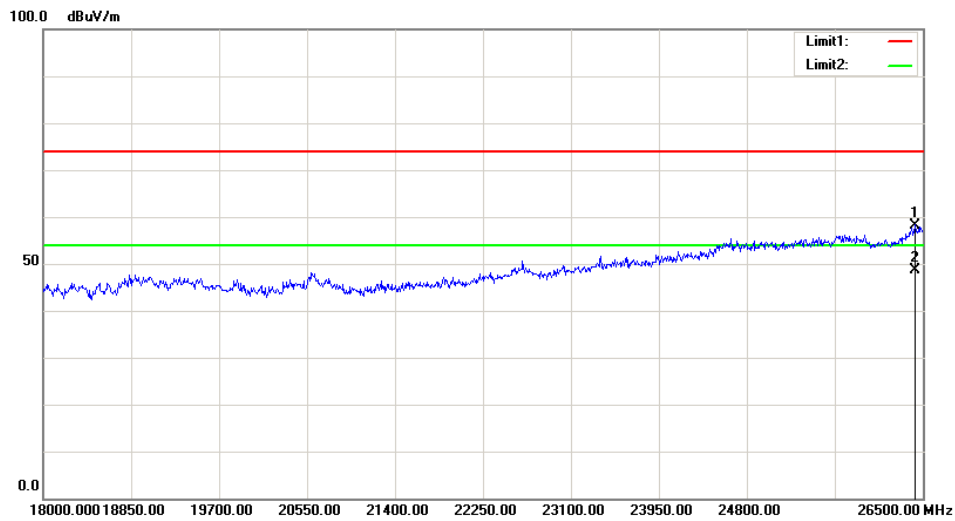
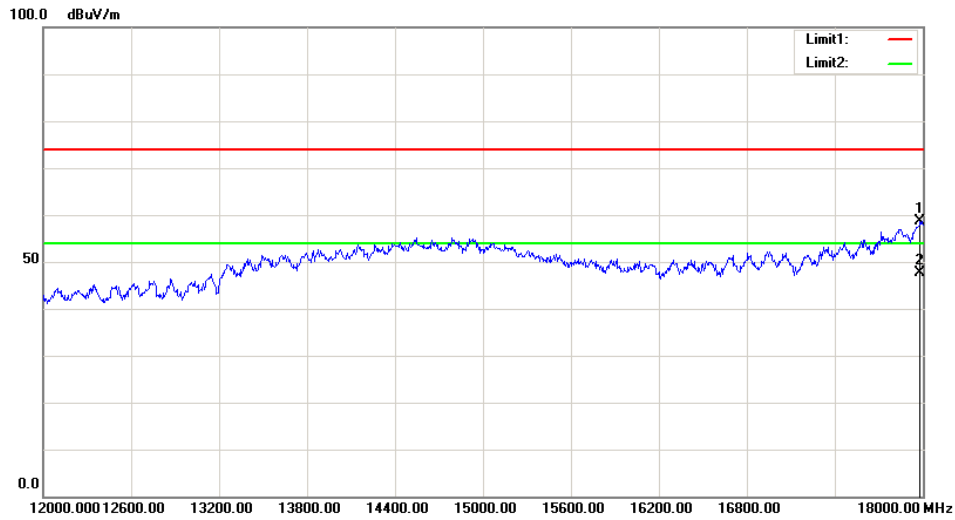
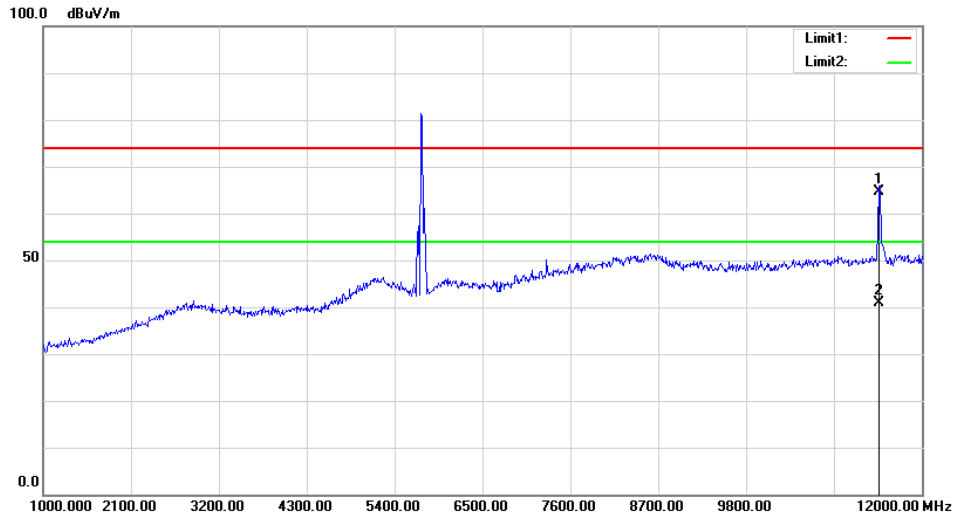


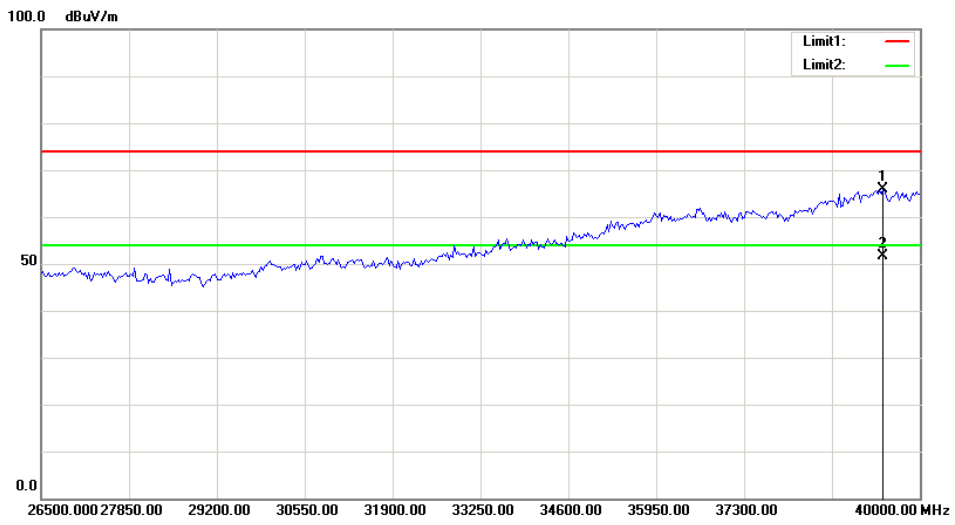
Frequency (MHz)	Receiver Reading (dBμV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30.9700	26.39	QP	0.81	27.20	40.00	12.80
133.7900	29.23	QP	-5.13	24.10	43.50	19.40
290.9300	31.70	QP	-4.10	27.60	46.00	18.40
399.5700	35.53	QP	-2.03	33.50	46.00	12.50
419.9400	32.28	QP	-1.68	30.60	46.00	15.40
662.4400	30.16	QP	2.34	32.50	46.00	13.50

2) 1GHz-40 GHz

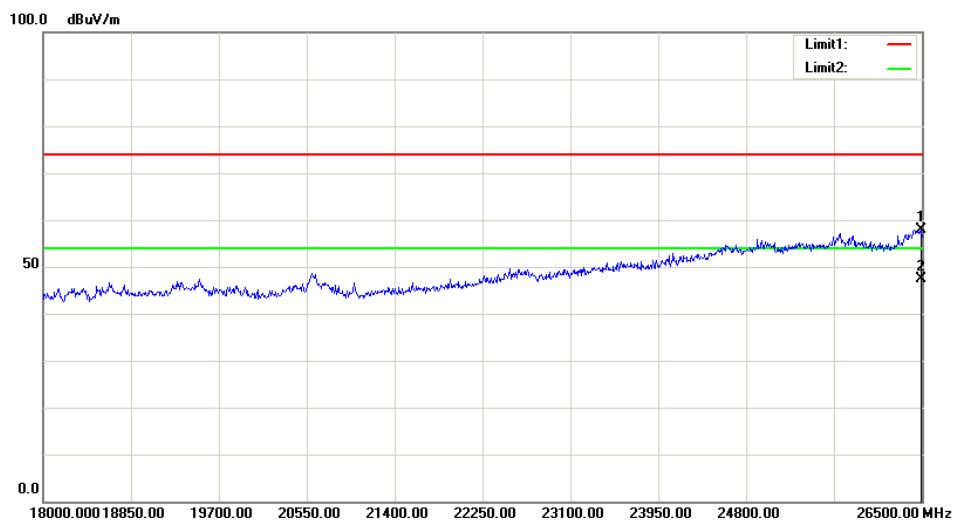
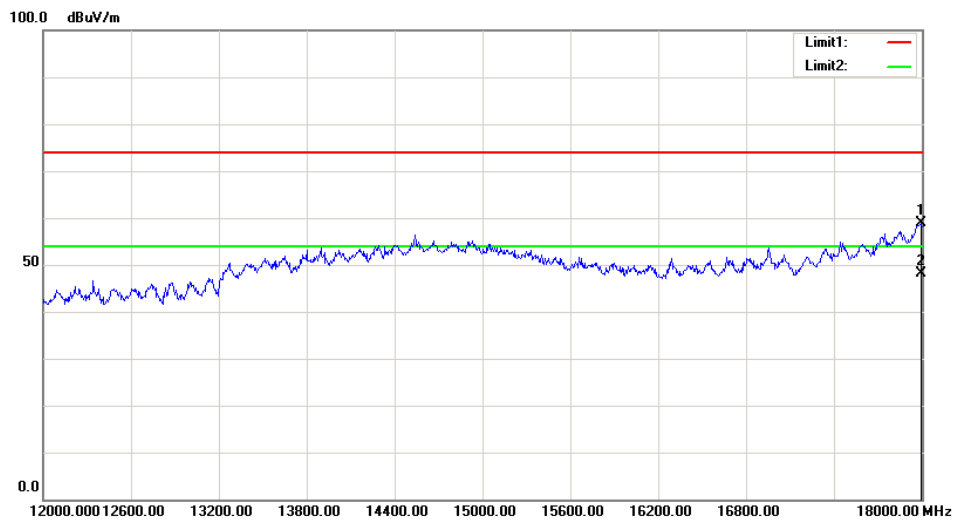
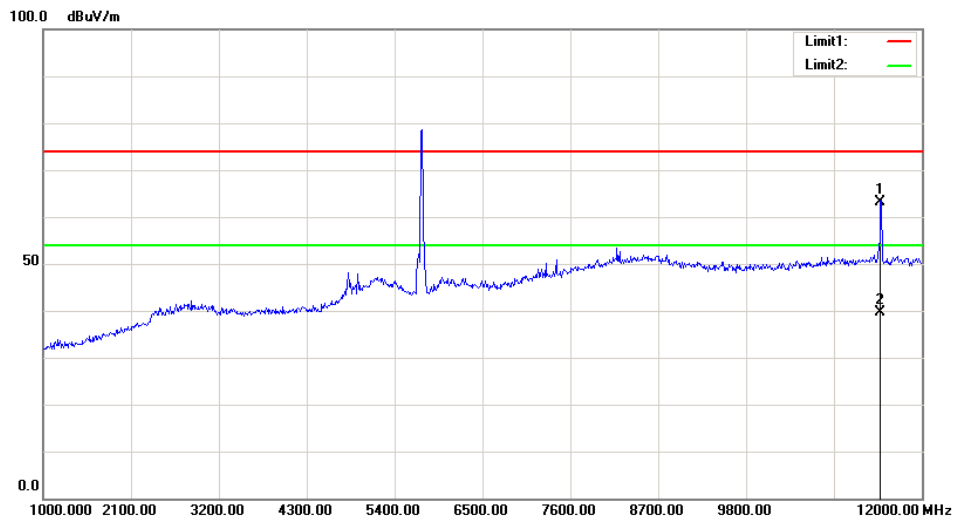
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dB μ V/m)	Extrapolation result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
	Reading (dB μ V)	Detector	Polar (H/V)	Factor (dB/m)						
Frequency: 5738MHz										
5738.00	73.11	PK	H	34.20	3.69	0.00	111.00	104.98	113.98	9.00
5738.00	45.07	AV	H	34.20	3.69	0.00	82.96	76.94	93.98	17.04
5738.00	69.51	PK	V	34.20	3.69	0.00	107.40	101.38	113.98	12.60
5738.00	41.67	AV	V	34.20	3.69	0.00	79.56	73.54	93.98	20.44
5725.00	29.44	PK	H	34.19	3.69	0.00	67.32	61.3	74.00	12.70
5725.00	15.46	AV	H	34.19	3.69	0.00	53.34	47.32	54.00	6.68
11476.00	63.53	PK	H	38.98	6.59	37.35	71.75	65.73	74.00	8.27
11476.00	38.72	AV	H	38.98	6.59	37.35	46.94	40.92	54.00	13.08
17214.00	56.12	PK	H	41.44	8.78	38.62	67.72	61.7	74.00	12.30
17214.00	31.87	AV	H	41.44	8.78	38.62	43.47	37.45	54.00	16.55
Frequency: 5773MHz										
5773.00	73.82	PK	H	34.21	3.70	0.00	111.73	105.71	113.98	8.27
5773.00	45.68	AV	H	34.21	3.70	0.00	83.59	77.57	93.98	16.41
5773.00	71.04	PK	V	34.21	3.70	0.00	108.95	102.93	113.98	11.05
5773.00	43.27	AV	V	34.21	3.70	0.00	81.18	75.16	93.98	18.82
11546.00	63.15	PK	H	39.00	6.60	37.41	71.34	65.32	74.00	8.68
11546.00	37.16	AV	H	39.00	6.60	37.41	45.35	39.33	54.00	14.67
17319.00	57.61	PK	H	42.05	8.80	38.55	69.91	63.89	74.00	10.11
17319.00	32.84	AV	H	42.05	8.80	38.55	45.14	39.12	54.00	14.88
Frequency: 5808MHz										
5808.00	70.90	PK	H	34.22	3.72	0.00	108.84	102.82	113.98	11.16
5808.00	42.91	AV	H	34.22	3.72	0.00	80.85	74.83	93.98	19.15
5808.00	68.08	PK	V	34.22	3.72	0.00	106.02	100	113.98	13.98
5808.00	40.73	AV	V	34.22	3.72	0.00	78.67	72.65	93.98	21.33
5875.00	25.58	PK	H	34.25	3.77	0.00	63.60	57.58	74.00	16.42
5875.00	15.11	AV	H	34.25	3.77	0.00	53.13	47.11	54.00	6.89
11616.00	63.30	PK	H	39.00	6.63	37.49	71.44	65.42	74.00	8.58
11616.00	38.24	AV	H	39.00	6.63	37.49	46.38	40.36	54.00	13.64
17424.00	58.46	PK	H	42.66	8.83	38.47	71.48	65.46	74.00	8.54
17424.00	33.27	AV	H	42.66	8.83	38.47	46.29	40.27	54.00	13.73

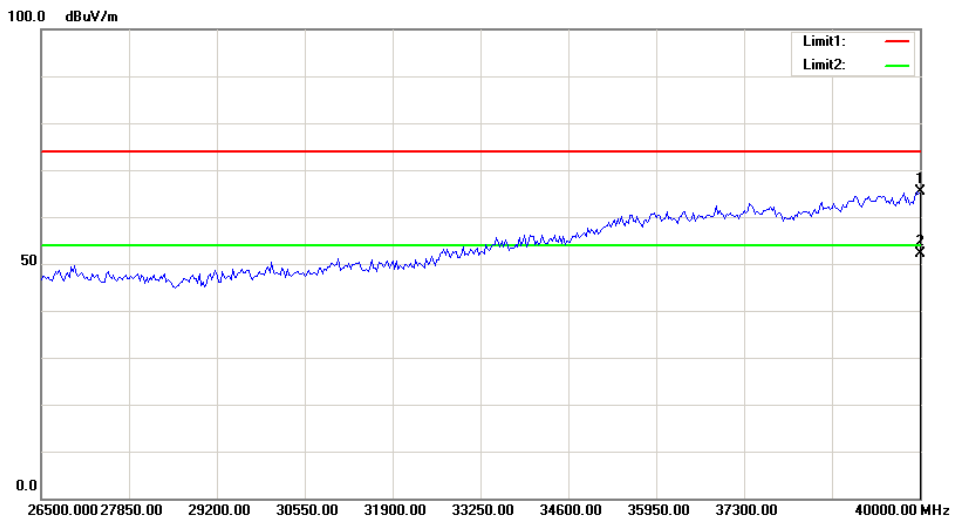
Worst Test plots(Low Channel)
Horizontal





Vertical





FCC §15.215(c) & RSS-GEN §6.6– 20 dB BANDWIDTH TESTING AND 99% OCCUPIED BANDWIDTH

Applicable Standard

As per FCC§15.215 (c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

As per RSS-Gen§6.6

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
3. Repeat above procedures until all frequencies measured were complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESPI	100120	2017-12-11	2018-12-11
TDK RF	Horn Antenna	HRN-0118	130 084	2016-01-05	2019-01-04
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2017-09-05	2018-09-05

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

Test Data**Environmental Conditions**

Temperature:	25.5~27.8 °C
Relative Humidity:	50 ~ 64 %
ATM Pressure:	100.3~101.4 kPa

The testing was performed by Kami Zhou from 2018-04-18 to 2018-05-04.

Test Result: Compliant.

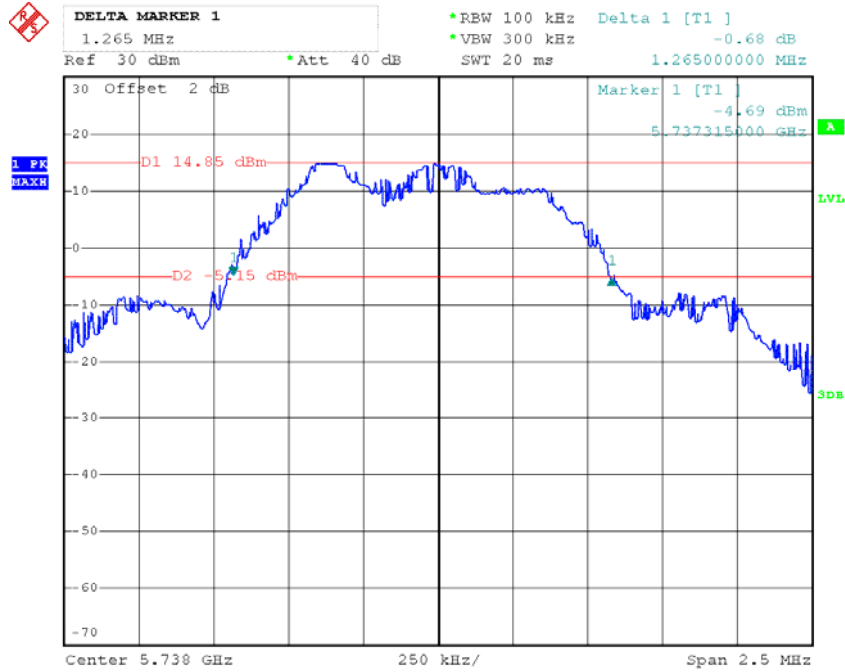
Please refer to following tables and plots

Test Mode: Transmitting

Frequency (MHz)	20 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
5738	1.265	1.135
5773	1.330	1.110
5808	1.335	1.145

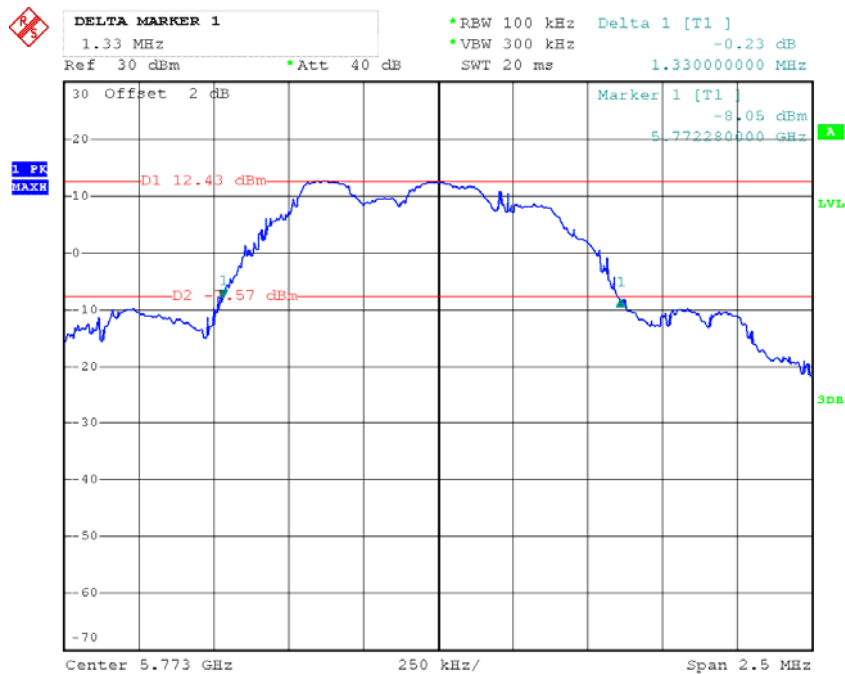
20 dB Bandwidth

Low Channel



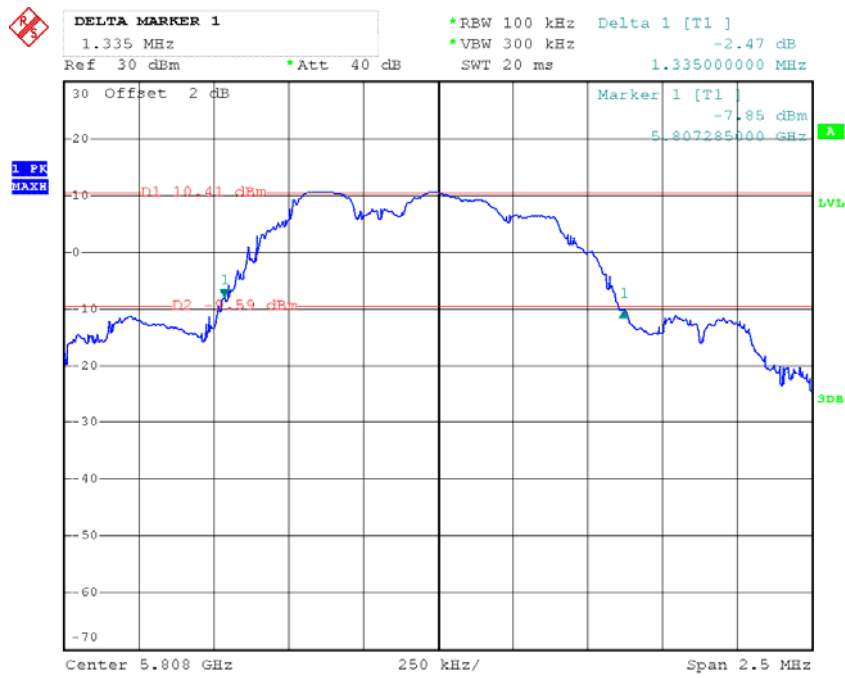
Date: 4.MAY.2018 15:00:03

Middle Channel



Date: 4.MAY.2018 15:04:00

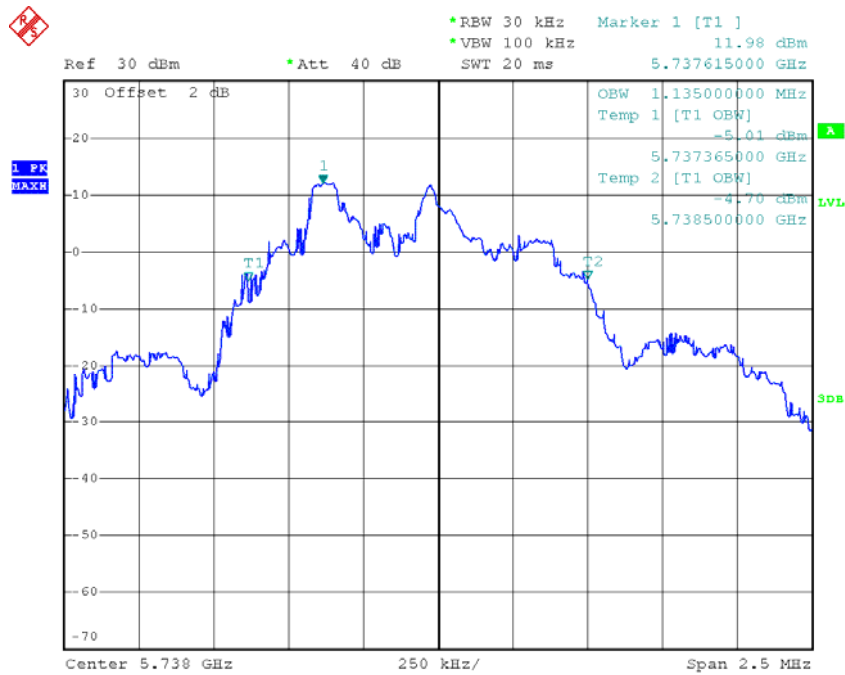
High Channel



Date: 4.MAY.2018 15:06:10

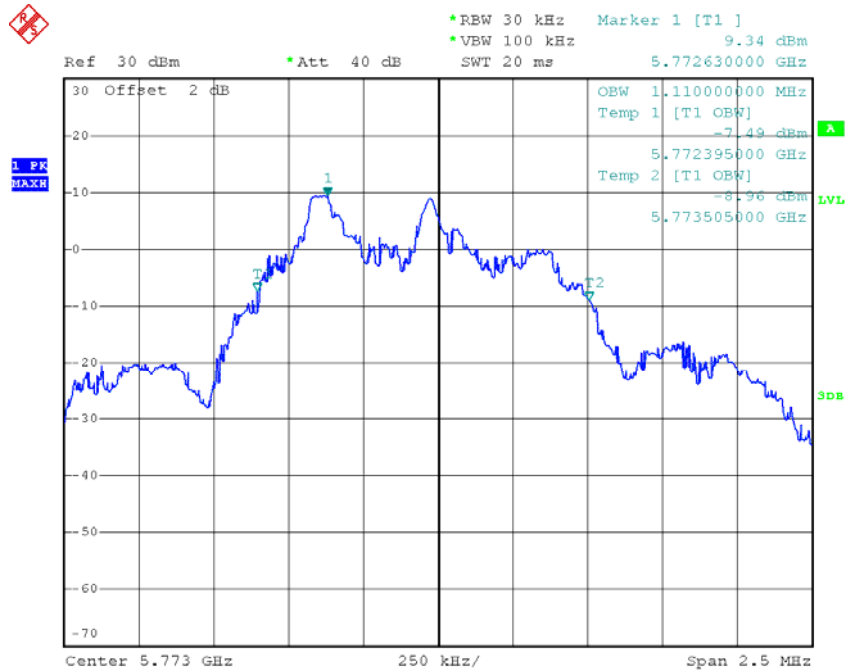
99% Occupied Bandwidth

Low Channel



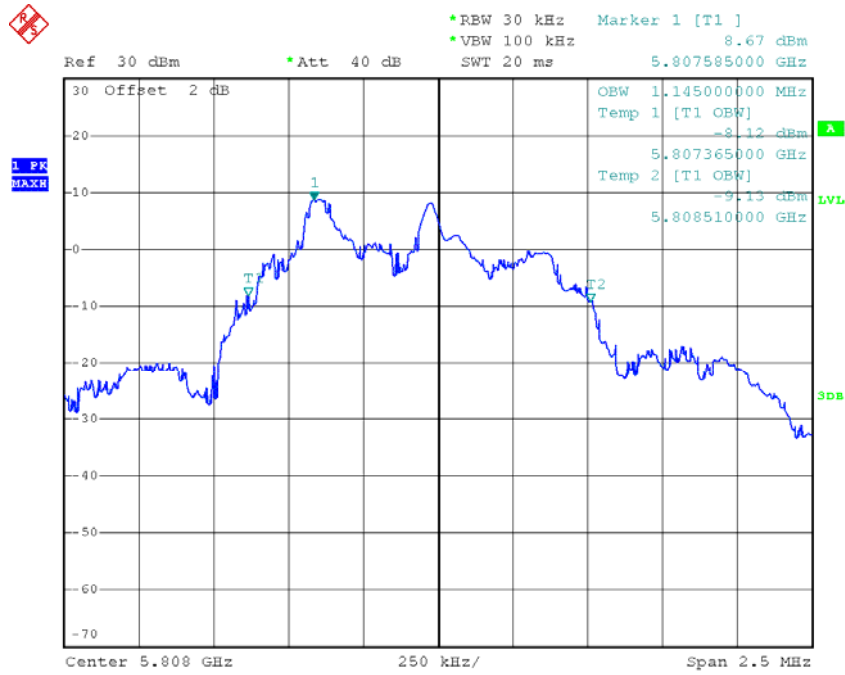
Date: 18.APR.2018 13:20:06

Middle Channel



Date: 18.APR.2018 13:21:36

High Channel



Date: 18.APR.2018 13:22:42

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