FCC RF TEST REPORT

ISSUED BY
Shenzhen BALUN Technology Co., Ltd.

FOR

Smart Recycle Bin Detector

ISSUED TO
Beijing Dingtek Technology Corp., Ltd

Room A209, Flounder Business Park, Shunbai Road 12, Chaoyang District, Beijing, China,100022

Report No.:	BL-SZ1960298-601
EUT Name:	Smart Recycle Bin Detector
Model Name:	DF702
Brand Name:	CNDingtek
Test Standard:	47 CFR Part 15 Subpart C
FCC ID:	2ATFKDF702-730
Test Conclusion:	Pass
Test Date:	Jun. 19, 2019 ~ Jun. 28, 2019
Date of Issue:	Jul. 04, 2019

Tested by: Jiang Aiping (Engineer)
Date Jul. 04. 2019

Approved by: Wei Yanquan (Chief Engineer)
Date Jul. 04. 2019

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Revision History

Version	Issue Date	Revisions Content
Rev. 01	Jul. 04, 2019	Initial Issue

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1 ADMINISTRATIVE DATA (GENERAL INFORMATION)

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100
Fax Number	+86 755 6182 4271

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1. The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196. The laboratory is a testing organization accredited by American Association for Laboratory Accreditation (A2LA) according to ISO/IEC 17025.The accreditation certificate is 4344.01. The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

1.3 Laboratory Condition

Ambient Temperature	20℃ to 25℃
Ambient Relative Humidity	45% to 55%
Ambient Pressure	100 kPa to 102 kPa

1.4 Announce

(1) The test report reference to the report template version v2.2.

(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.

(3) The test report is invalid if there is any evidence and/or falsification.

(4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.

(5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.

(6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Beijing Dingtek Technology Corp., Ltd
Address	Room A209, Flounder Business Park, Shunbai Road 12, Chaoyang District, Beijing, China, 100022

2.2 Manufacturer Information

Manufacturer	Beijing Dingtek Technology Corp., Ltd
Address	Room A209, Flounder Business Park, Shunbai Road 12, Chaoyang District, Beijing, China, 100022

2.3 Factory Information

Factory	Beijing Dingtek Technology Corp., Ltd
Address	Room A209, Flounder Business Park, Shunbai Road 12, Chaoyang District, Beijing, China, 100022

2.4 General Description for Equipment under Test (EUT)

EUT Name	Smart Recycle Bin Detector
Model Name Under Test	DF702
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	CNDINGTEK_DF702_CC_02_11
Software Version	MyDevice LoraWan V1.1.1
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.5 Technical Information

Network and Wireless connectivity	Lora

The requirement for the following technical information of the EUT was tested in this report:

Modulation Technology	Frequency hopping system, Hybrid system
Modulation Type	LoRa
Product Type	☒ Mobile ☐ Portable ☐ Fix Location
Frequency Range	The frequency range used is 902 MHz to 928 MHz.
Number of channel	64 for hopping mode, and 8 for DTS.
Tested Channel	125kHz: 0 (902.3 MHz), 32 (908.7 MHz), 63 (914.9 MHz) 500kHz: 0 (903.0 MHz), 4 (909.4 MHz), 7 (914.2 MHz)
Antenna Type	Monopole Antenna
Antenna Gain	2.5 dBi (In test items related to antenna gain, the final results reflect this figure.)
Antenna System(MIMO Smart Antenna)	N/A

All channel was listed on the following table:

125kHz for FHSS

Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)
0	902.3	20	906.3	40	910.3	60	914.3
1	902.5	21	906.5	41	910.5	61	914.5
2	902.7	22	906.7	42	910.7	62	914.7
3	902.9	23	906.9	43	910.9	63	914.9
4	903.1	24	907.1	44	911.1	-	-
5	903.3	25	907.3	45	911.3	-	-
6	903.5	26	907.5	46	911.5	-	-
7	903.7	27	907.7	47	911.7	-	-
8	903.9	28	907.9	48	911.9	-	-
9	904.1	29	908.1	49	912.1	-	-
10	904.3	30	908.3	50	912.3	-	-
11	904.5	31	908.5	51	912.5	-	-
12	904.7	32	908.7	52	912.7	-	-
13	904.9	33	908.9	53	912.9	-	-
14	905.1	34	909.1	54	913.1	-	-
15	905.3	35	909.3	55	913.3	-	-
16	905.5	36	909.5	56	913.5	-	-
17	905.7	37	909.7	57	913.7	-	-
18	905.9	38	909.9	58	913.9	-	-
19	906.1	39	910.1	59	914.1	-	-

500kHz for DTS

Channel number	Freq. (MHz)	Channel number	Freq. (MHz)
0	903.00	4	909.40
1	904.60	5	911.00
2	906.20	6	912.60
3	907.80	7	914.20

2.6 Additional Instructions

EUT Software Settings:

Mode	☒ Special software is used. The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.

During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Power level setup in software		
Test Software Version	XCOM V2.0	
Mode	Channel	Soft Set
125kHz	902.3	6
	908.7	6
	914.9	6
500kHz	903.0	9
	909.4	9
	914.2	9

Run Software

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15, Subpart C	Miscellaneous Wireless Communications Services
2	FCC PUBLIC NOTICE DA 00-705 (Mar. 30, 2000)	Filling and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
3	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
4	KDB Publication 558074 D01v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES

3.2 Verdict

No.	Description	FCC Part No.	Modulation Technology	Channel	Test Result	Verdict	Remark
1	Antenna Requirement	15.203	N/A	N/A	--	Pass	Note [1]
2	Peak Output Power	15.247(b)	Hybrid system	Low/Middle/ High	ANNEX A.1	Pass	
3	Occupied Bandwidth	15.247(a)	Hybrid system	Low/Middle/ High	ANNEX A.2	Pass	
4	Carrier Frequency Separation	15.247(a)	Frequency hopping mode	Hopping Mode	ANNEX A.3	Pass	
5	Time of Occupancy (Dwell time)	15.247(a)	Frequency hopping mode	Hopping Mode	ANNEX A.4	Pass	
6	Conducted Spurious Emission & Authorized-band band-edge	15.247(d)	Hybrid system	Low/Middle/ High, Hopping Mode	ANNEX A.5	Pass	
7	Conducted Emission	15.207	Hybrid system	Low/Middle/ High	ANNEX A.6	N/A	Note [2]
8	Radiated Spurious Emission	15.209 15.247(d)	Hybrid system	Low/Middle/ High, Hopping Mode	ANNEX A.7	Pass	
9	Band Edge(Restricted-band band-edge)	15.209 15.247(d)	Hybrid system	Low/Middle/ High, Hopping Mode	ANNEX A.8	Pass	
10	Power spectral density (PSD)	15.247(e)	Hybrid system	Low/Middle/ High	ANNEX A.9	Pass	

Note [1]: Please refer to section 5.1

Note [2]: The EUT is powered by battery, so the Conducted Emission is not applicable.

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

Relative Humidity	45% to 55%	
Atmospheric Pressure	100 kPa to 102 kPa	
Temperature	NT (Normal Temperature)	+22℃ to +25℃
Working Voltage of the EUT	NV (Normal Voltage)	3.6 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-30	103118	2019.06.13	2020.06.12
Vector Signal Generator	ROHDE&SCHWARZ	SMBV100A	260592	2019.06.13	2020.06.12
Signal Generator	ROHDE&SCHWARZ	SMB100A	177746	2019.06.13	2020.06.12
Switch Unit with OSP-B157	ROHDE&SCHWARZ	OSP120	101270	2019.06.13	2020.06.12
Spectrum Analyzer	AGILENT	E4440A	MY45304434	2018.11.08	2019.11.07
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2019.06.13	2020.06.12
LISN	SCHWARZBECK	NSLK 8127	8127-687	2019.06.13	2020.06.12
Bluetooth Tester	ROHDE&SCHWARZ	CBT	101005	2019.06.13	2020.06.12
Power Splitter	KMW	DCPD-LDC	1305003215	--	--
Power Sensor	ROHDE&SCHWARZ	NRP-Z21	103971	2019.06.13	2020.06.12
Attenuator (20 dB)	KMW	ZA-S1-201	110617091	--	--
Attenuator (6 dB)	KMW	ZA-S1-61	1305003189	--	--
DC Power Supply	ROHDE&SCHWARZ	HMP2020	018141664	2019.06.13	2020.06.12
Temperature Chamber	AHK	SP20	1412	2019.06.24	2020.06.23
Test Antenna-Loop(9 kHz-30 MHz)	SCHWARZBECK	FMZB 1519	1519-037	2017.11.07	2019.11.08
Test Antenna-Bi-Log(30 MHz-3 GHz)	SCHWARZBECK	VULB 9163	9163-624	2017.07.22	2019.07.21
Test Antenna-Horn(1-18 GHz)	SCHWARZBECK	BBHA 9120D	9120D-1148	2018.07.12	2019.07.11
Test Antenna-Horn (18-40 GHz)	A-INFO	LB-180400KF	J211060273	2019.01.05	2021.01.04
Test Antenna-Horn (18-40 GHz)	A-INFO	LB-180400KF	J211060273	N/A	2020.01.06
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2019.02.21	2021.02.20
Anechoic Chamber	EMC TECHNOLOGY LTD	21.1m*11.6m*7.35m	N/A	2018.08.09	2020.08.08
Shielded Enclosure	ChangNing	CN-130701	130703	--	--
Signal Generator	ROHDE&SCHWARZ	SMB100A	177746	2019.06.12	2020.06.11
Power Amplifier	OPHIR RF	5225F	1037	2019.02.17	2020.02.16
Power Amplifier	OPHIR RF	5273F	1016	2019.02.17	2020.02.16

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Directional Coupler	Werlantone	C5982-10	109275	N/A	N/A
Directional Coupler	Werlantone	CHP-273E	S00801z-01	N/A	N/A
Feld Strength Meter	Narda	EP601	511WX51129	2019.05.22	2020.05.21
Mouth Simulator	B&K	4227	2423931	2018.11.16	2019.11.15
Sound Calibrator	B&K	4231	2430337	2018.11.16	2019.11.15
Sound Level Meter	B&K	NL-20	00844023	2018.11.16	2019.11.15
Ear Simulator	B&K	4185	2409449	2018.11.16	2019.11.15
Ear Simulator	B&K	4195	2418189	2018.11.16	2019.11.15
Audio analyzer	B&K	UPL 16	100129	2018.11.16	2019.11.15

4.3 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

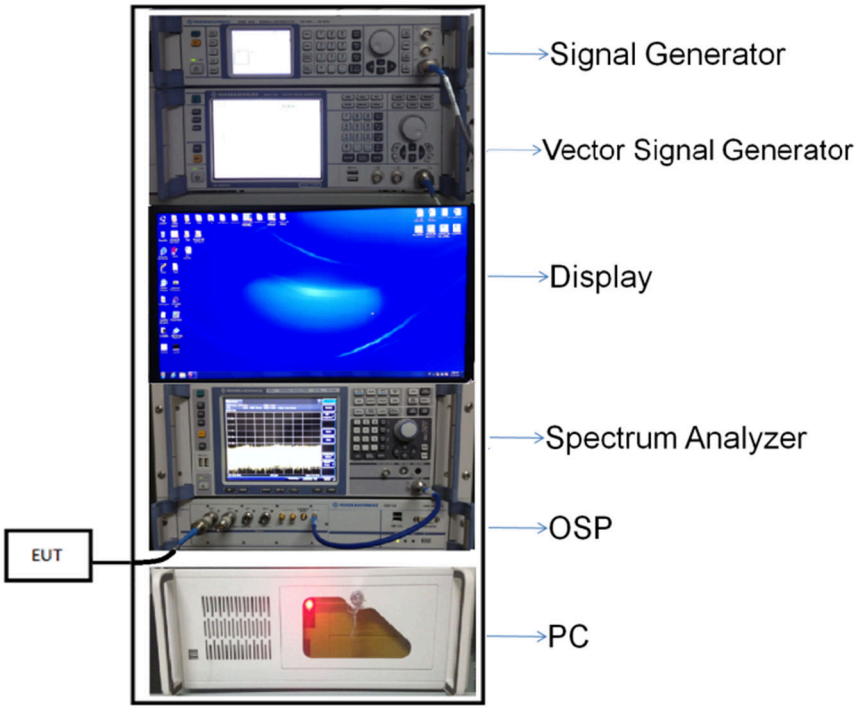
Measurement	Value
Occupied Channel Bandwidth	±4%
RF output power, conducted	±1.4 dB
Power Spectral Density, conducted	±2.5 dB
Unwanted Emissions, conducted	±2.8 dB
All emissions, radiated	±5.4 dB
Temperature	±1°C
Humidity	±4%

4.4 Description of Test Setup

4.4.1 For Antenna Port Test

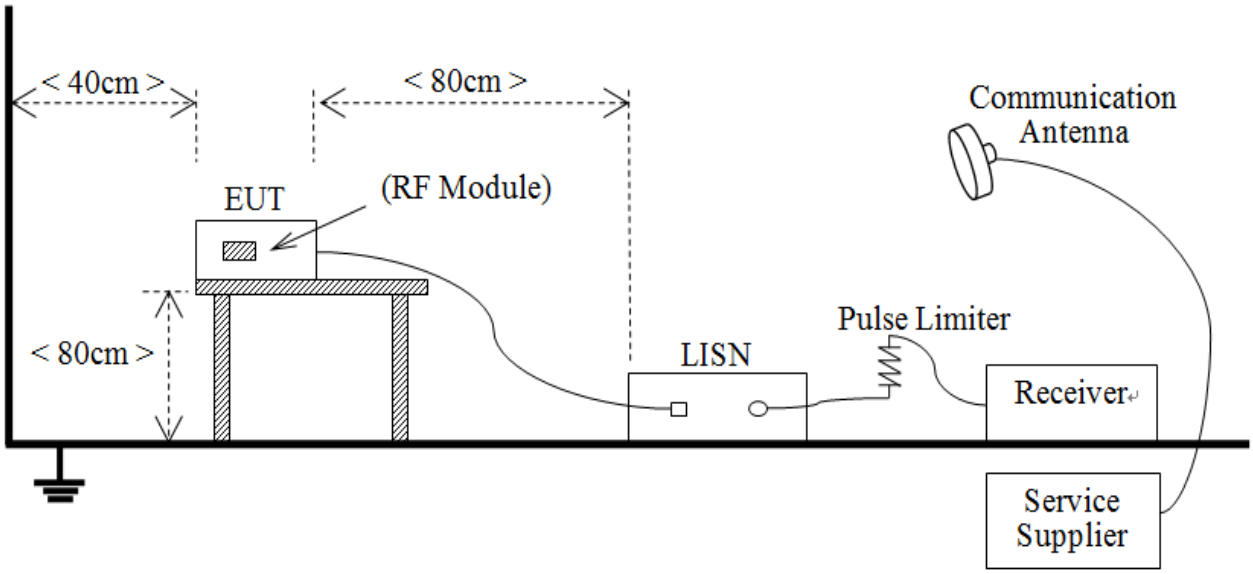
Conducted value (dBm) = Measurement value (dBm) + cable loss (dB)

For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT:
Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm



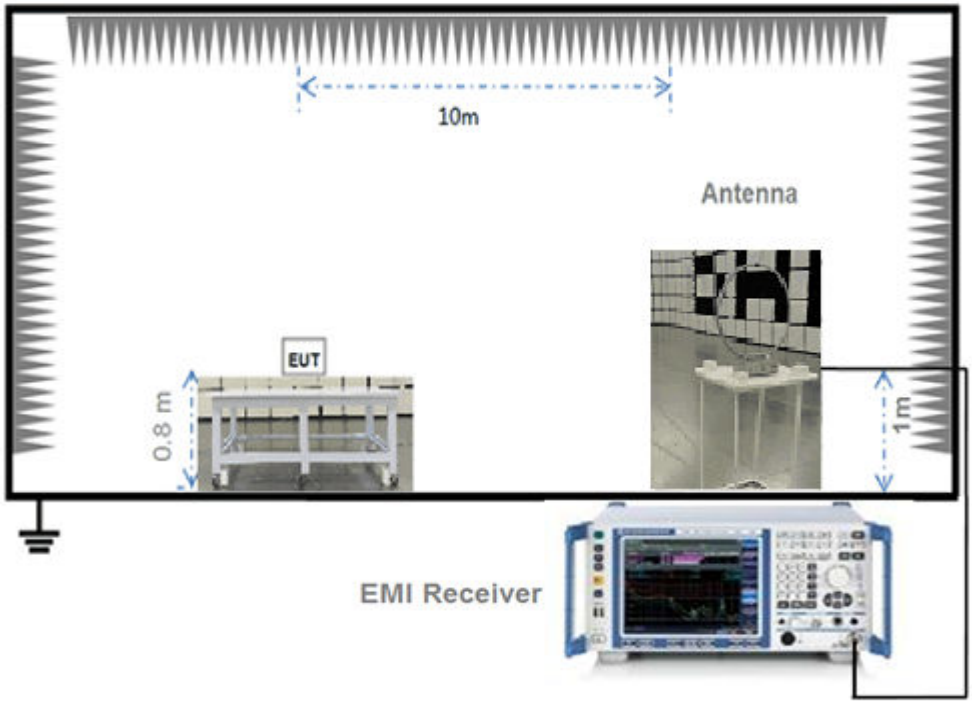
(Diagram 1)

4.4.2 For AC Power Supply Port Test



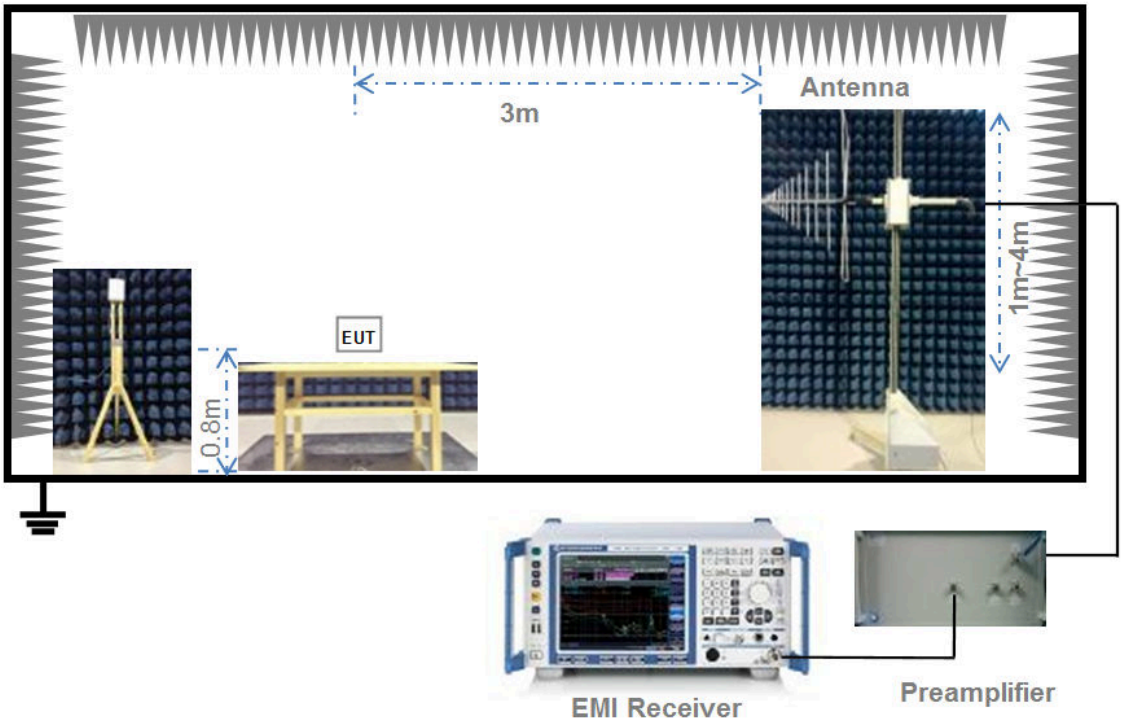
(Diagram 2)

4.4.3 For Radiated Test (Below 30 MHz)



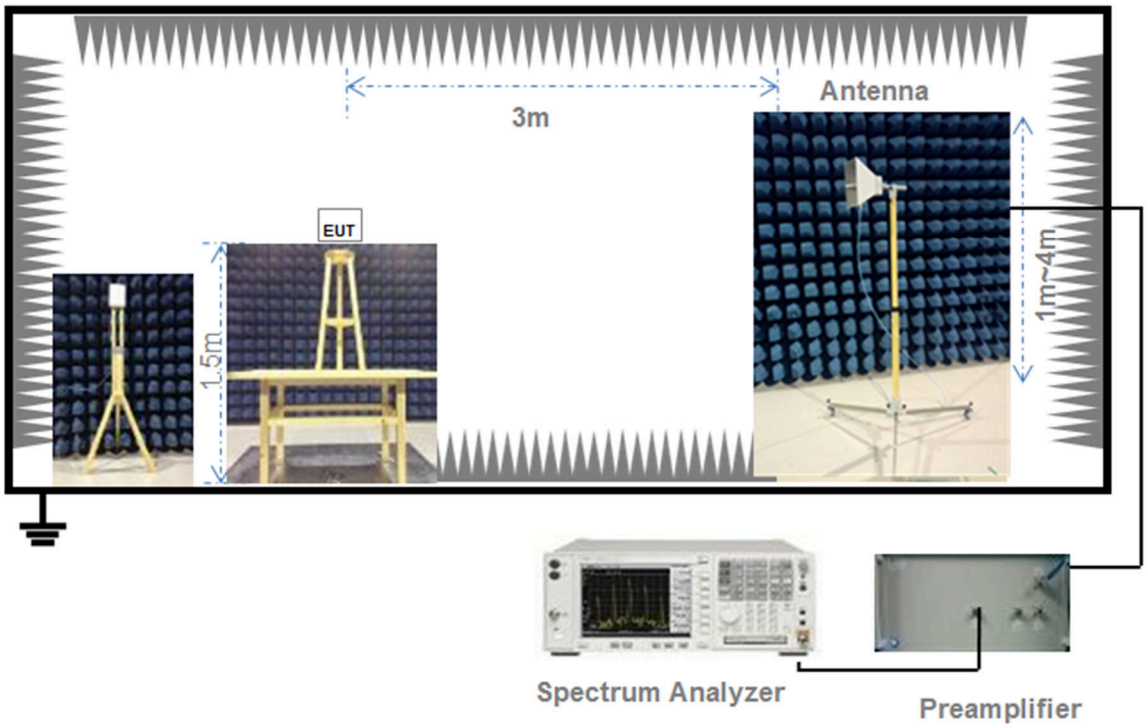
(Diagram 3)

4.4.4 For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

4.4.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

4.5 Measurement Results Explanation Example

4.5.1 For conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.

4.5.2 For radiated band edges and spurious emission test:

Per part 15.35(c), the EUT Bluetooth average emission level could be determined by the peak emission level applying duty cycle correction factor, to represent averaging over the whole pulse train.
The average level is derived from the peak level corrected with “Duty cycle correction factor”.
Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + Duty cycle correction factor (dB)
Duty cycle correction factor (dB) = 20 * log (Duty cycle).
Duty cycle = on time / 100 milliseconds
On time = dwell time * hopping number in 100 ms
For example: bluetooth with dwell time 2.9 ms and 3 hops in 100 ms, then
Duty cycle correction factor (dB) = 20 * log ((2.9 * 3) / 100) = -21.21 dB
Following shows an average computation example with duty cycle correction factor = -21.21 dB, and the peak emission level is 45.61 dBuV/m.
Example:
Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + duty cycle correction factor (dB)
= 45.61 + (-21.21) = 24.4 (dBuV/m)

5 TEST ITEMS

5.1 Antenna Requirements

5.1.1 Relevant Standards

FCC §15.203 & 15.247(b); RSS-247, 5.4 (6)

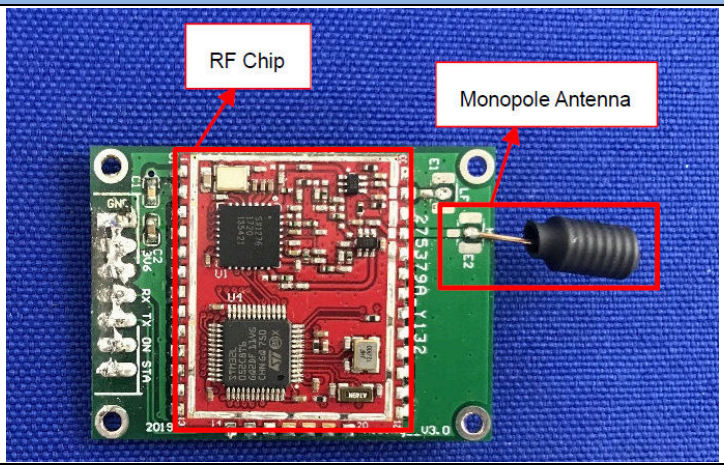
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. 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 FCC rule.

5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Protected Method	Description
The antenna is embedded in the product	The antenna is welded on the mainboard, can't be replaced by the consumer

Reference Documents	Item
Photo	

5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5.2 Peak Output Power and E.I.R.P

5.2.1 Test Limit

FCC § 15.247(b)(1)

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

RSS-247, 5.4 (2)

For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels (see Section 5.4(5) for exceptions).

5.2.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.2.3 Test Procedure

The Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.

5.2.4 Test Result

Please refer to ANNEX A.1.

5.3 Occupied Bandwidth

5.3.1 Limit

FCC §15.247(a)(1)(i); RSS-247, 5.1 (1)

Measurement of the 20dB bandwidth of the modulated signal. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

5.3.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW = in the range of 1% to 5% of the OBW

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate, Allow the trace to stabilize.

5.3.4 Test Result

Please refer to ANNEX A.2.

5.4 Carrier Frequency Separation

5.4.1 Limit

FCC §15.247(a)(1); RSS-247, 5.1 (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

5.4.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.4.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span

Video (or Average) Bandwidth (VBW) ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

5.4.4 Test Result

Please refer to ANNEX A.3.

5.5 Time of Occupancy (Dwell time)

5.5.1 Limit

FCC §15.247(a)(1)(i); RSS-247, 5.1 (4)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

5.5.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.5.3 Test Procedure

The lowest, middle and highest channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

5.5.4 Test Result

Please refer to ANNEX A.4.

5.6 Conducted Spurious Emission & Authorized-band band-edge

5.6.1 Limit

FCC §15.247(d); RSS-247, 5.5

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.

5.6.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.6.3 Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100 kHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize

5.6.4 Test Result

Please refer to ANNEX A.6 and A.5

5.7 Conducted Emission

5.7.1 Limit

FCC §15.207; RSS-GEN, 8.8

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

5.7.2 Test Setup

See section 4.4.2 for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX B.

5.7.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.
Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

5.7.4 Test Result

Please refer to ANNEX A.6.

5.8 Radiated Spurious Emission

5.8.1 Limit

FCC §15.209&15.247(d); RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 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 (μV/m)	Measurement Distance (m)
0.009 - 0.490	902/F(kHz)	300
0.490 - 1.705	9020/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

Note:

1. Field Strength (dBμV/m) = 20*log[Field Strength (μV/m)].
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
4. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

5.8.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.8.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW

Sweep = auto
Detector function = peak
Trace = max hold
For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.8.4 Test Result

Please refer to ANNEX A.7.

5.9 Band Edge (Restricted-band band-edge)

5.9.1 Limit

FCC §15.209&15.247(d)

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

5.9.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.9.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.9.4 Test Result

Please refer to ANNEX A.8.

5.10 Power Spectral density (PSD)

5.10.1 Limit

FCC §15.247(e); RSS-247, 5.2 (2)

The same method of determining the conducted output power shall be used to determine the power spectral density. If a peak output power is measured, then a peak power spectral density measurement is required. If an average output power is measured, then an average power spectral density measurement should be used.

The transmitter power spectral density conducted from the transmitter 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 Section 5.4(4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

5.10.2 Test Setup

See section 4.4.1 (Diagram 1) for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.10.3 Test Procedure

Set analyzer center frequency to DTS channel center frequency.

Set the span to 1.5 times the DTS bandwidth.

Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.

Set the VBW ≥ 3 RBW.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

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

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.10.4 Test Result

Please refer to ANNEX A.9.

ANNEX A TEST RESULT

A.1 Peak Output Power

Peak Power Test Data

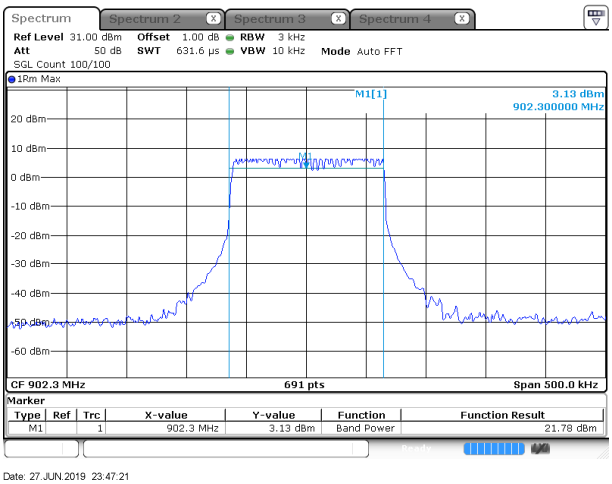
Channel	Measured Output Peak Power		Limit		Verdict
	LoRa (125kHz)		dBm	mW	
	dBm	mW			
Low	21.78	150.66	30	1000	Pass
Middle	21.80	151.36			Pass
High	21.89	154.53			Pass

Channel	Measured Output Peak Power		Limit		Verdict
	LoRa (500kHz)		dBm	mW	
	dBm	mW			
Low	21.88	154.17	30	1000	Pass
Middle	21.83	152.41			Pass
High	21.79	151.01			Pass

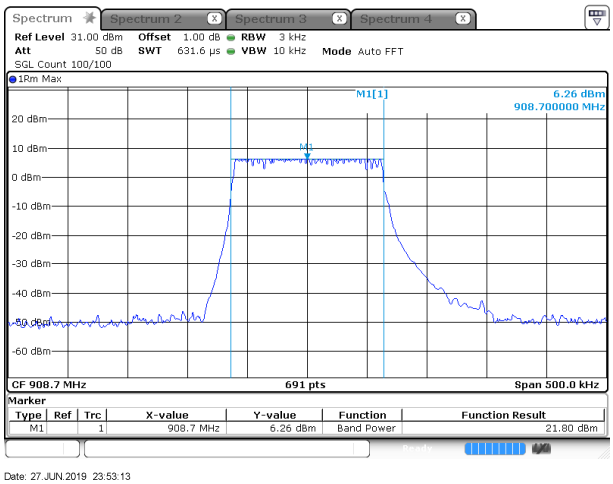
Test plots

125kHz

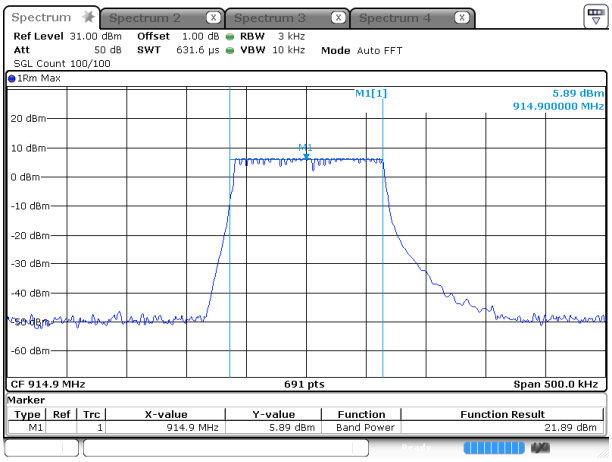
LOW CHANNEL



MIDDLE CHANNEL



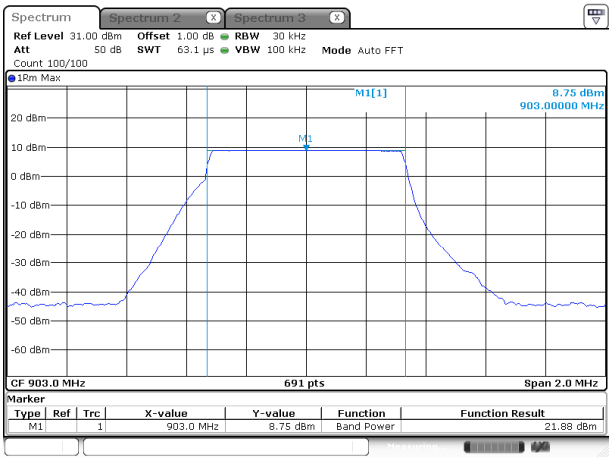
HIGH CHANNEL



Date: 27.JUN.2019 23:58:13

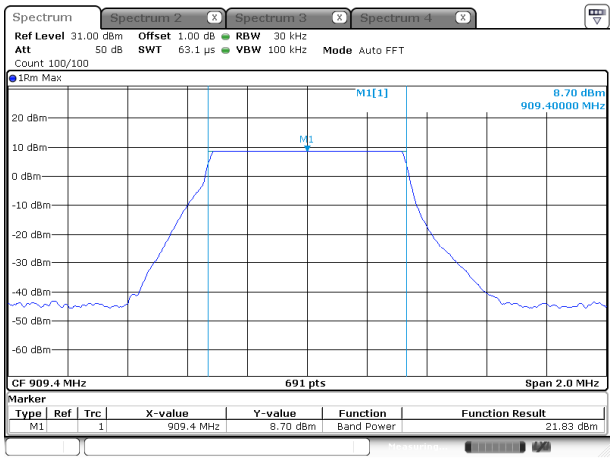
500kHz

LOW CHANNEL



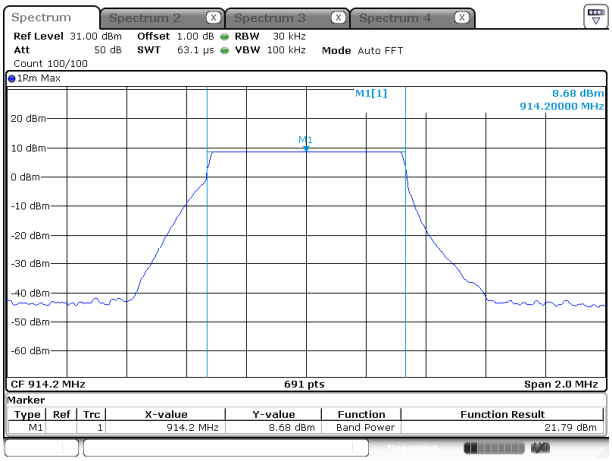
Date: 27.JUN.2019 23:08:58

MIDDLE CHANNEL



Date: 27.JUN.2019 23:20:33

HIGH CHANNEL



Date: 27.JUN.2019 23:21:39

A.2 20 dB and 99% bandwidth

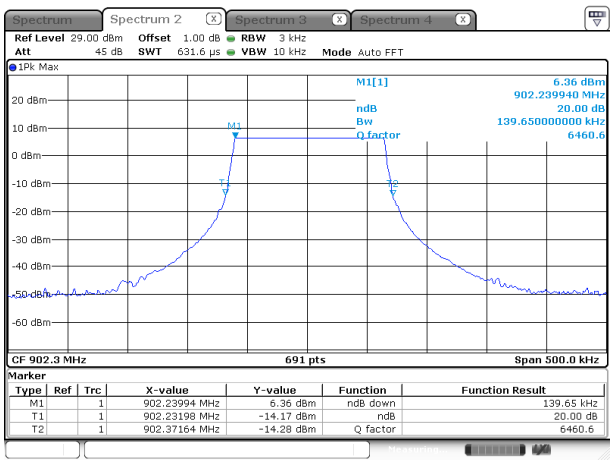
Test Data

LoRa (125kHz)			
Channel	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)	Verdict
Low	139.650000	127.351664	Pass
Middle	138.210000	127.351664	Pass
High	138.210000	127.351664	Pass

LoRa (500kHz)		
Channel	6 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	781.500000	811.866860
Middle	794.500000	803.183792
High	790.200000	811.866860

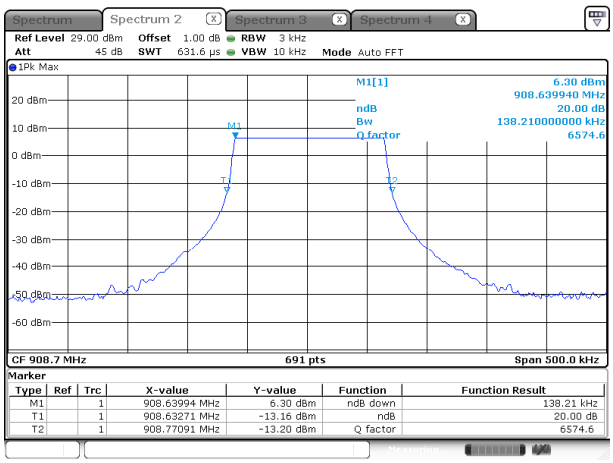
Test plots (20 dB Bandwidth) (125kHz)

LOW CHANNEL



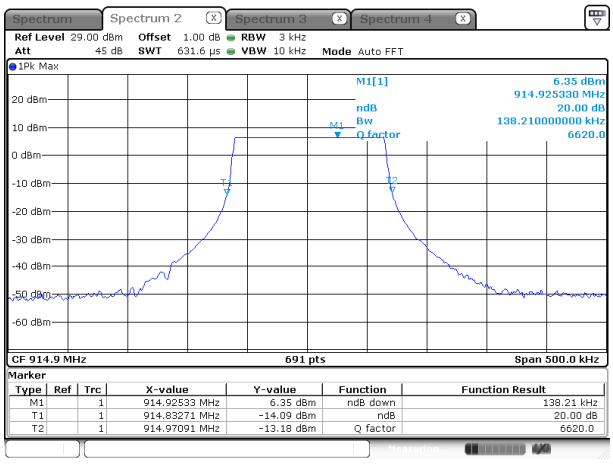
Date: 27.JUN.2019 23:49:01

MIDDLE CHANNEL



Date: 27.JUN.2019 23:54:25

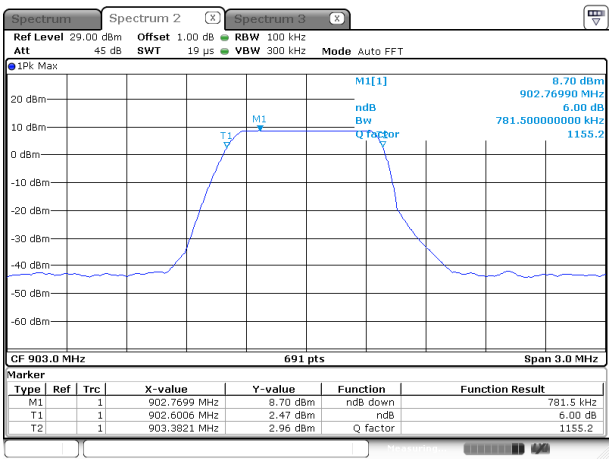
HIGH CHANNEL



Date: 27.JUN.2019 23:57:22

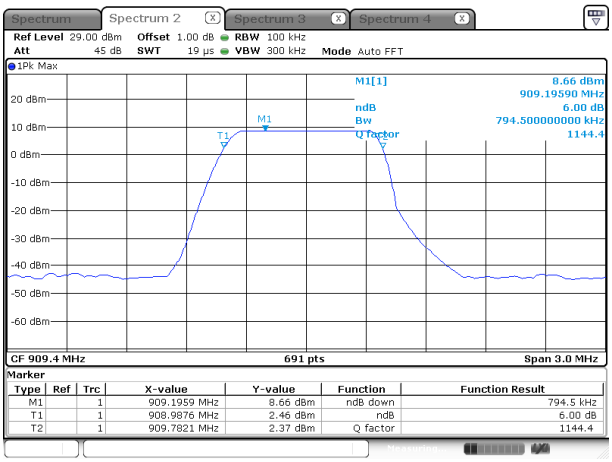
Test plots (6 dB Bandwidth) (500kHz)

LOW CHANNEL



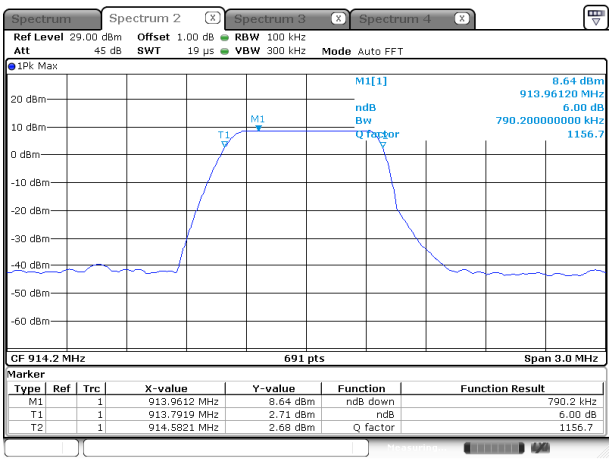
Date: 27.JUN.2019 23:12:52

MIDDLE CHANNEL



Date: 27.JUN.2019 23:19:28

HIGH CHANNEL

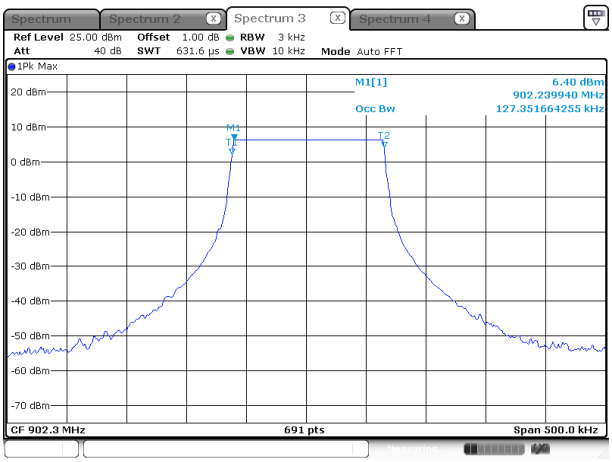


Date: 27.JUN.2019 23:22:18

Test plots (99% Bandwidth)

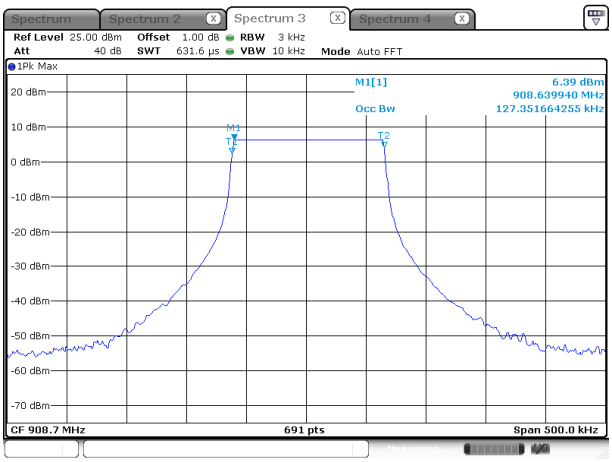
125kHz

LOW CHANNEL



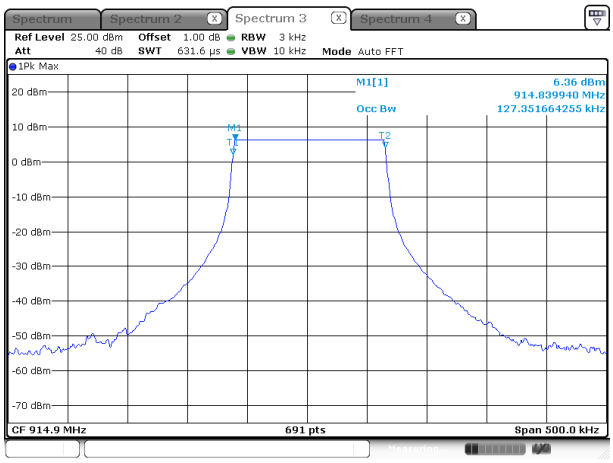
Date: 27.JUN.2019 23:49:36

MIDDLE CHANNEL



Date: 27.JUN.2019 23:55:38

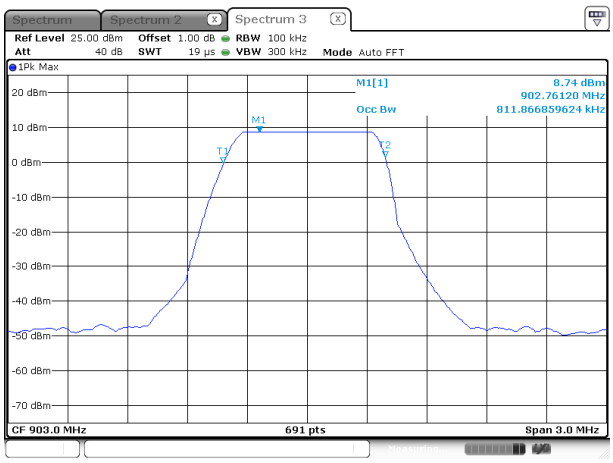
HIGH CHANNEL



Date: 27.JUN.2019 23:56:50

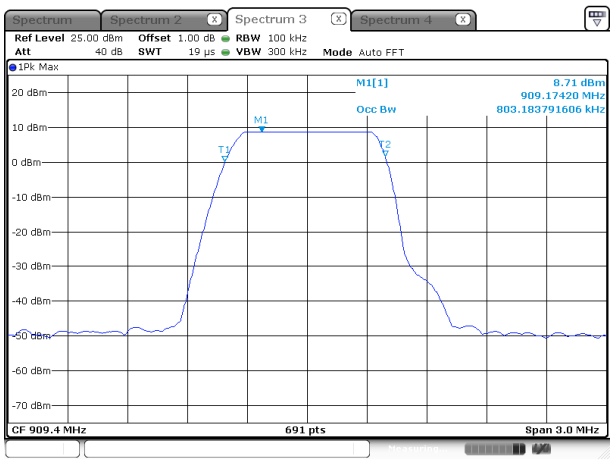
500kHz

LOW CHANNEL



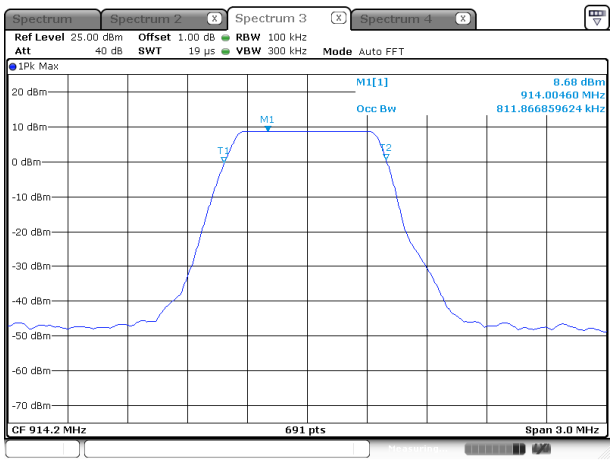
Date: 27.JUN.2019 23:13:49

MIDDLE CHANNEL



Date: 27.JUN.2019 23:18:49

HIGH CHANNEL



Date: 27.JUN.2019 23:23:22

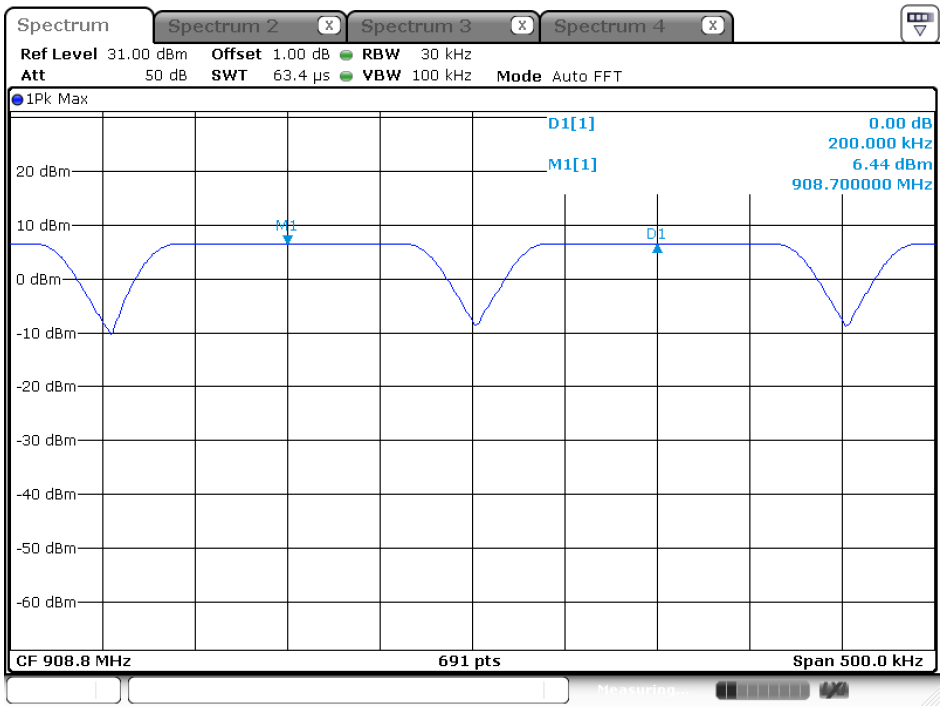
A.3 Hopping Frequency Separation

Test Data

Mode	Frequency separation (MHz)	Max 20 dB Bandwidth (MHz)	Verdict
LoRa (125kHz)	200	139.650000	Pass

Test Plots

LoRa (125kHz)

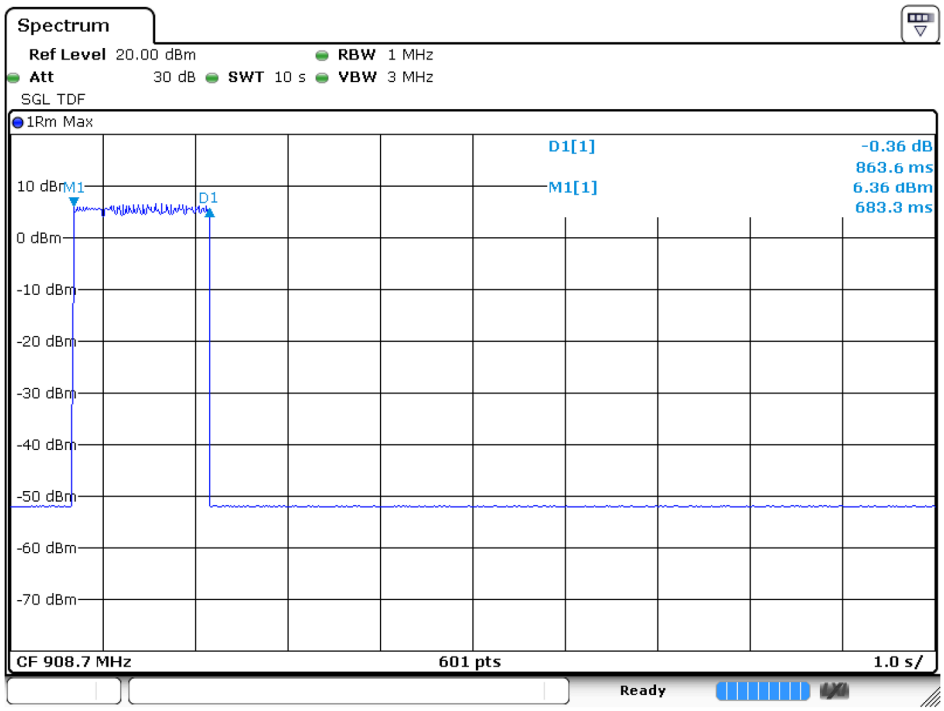


A.4 Average Time of Occupancy

Test Data

Total of Dwell(ms)	Limit (sec)	Verdict
180.30	0.4	Pass

LoRa (125kHz)



Date: 27.JUN.2019 17:34:42

A.5 Conducted Spurious Emissions & Authorized-band band-edge

Test Data

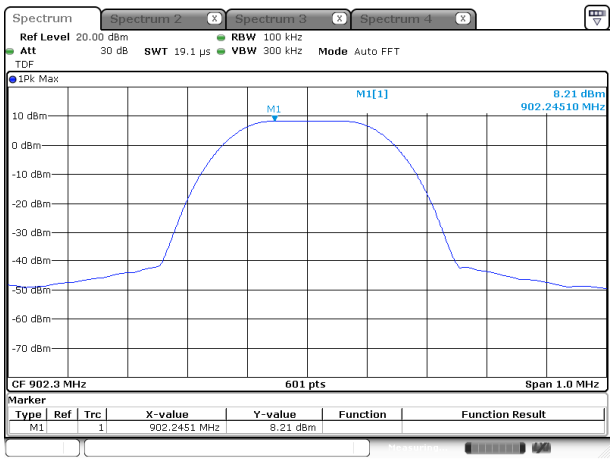
LoRa (125kHz)				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-36.51	8.21	-11.79	Pass
Middle	-37.45	8.21	-11.79	Pass
High	-36.88	8.20	-11.80	Pass

LoRa (500kHz)				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-37.36	10.49	-9.51	Pass
Middle	-36.71	10.50	-9.50	Pass
High	-36.09	10.47	-9.53	Pass

Test Plots

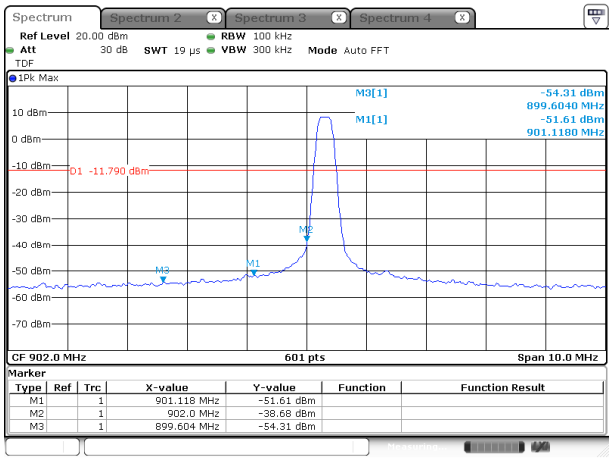
125kHz

LOW CHANNEL, CARRIER LEVEL



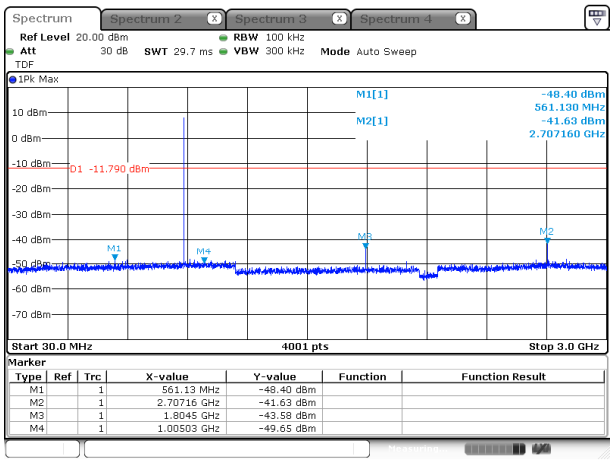
Date: 28.JUN.2019 00:34:46

LOW CHANNEL, Band Edge



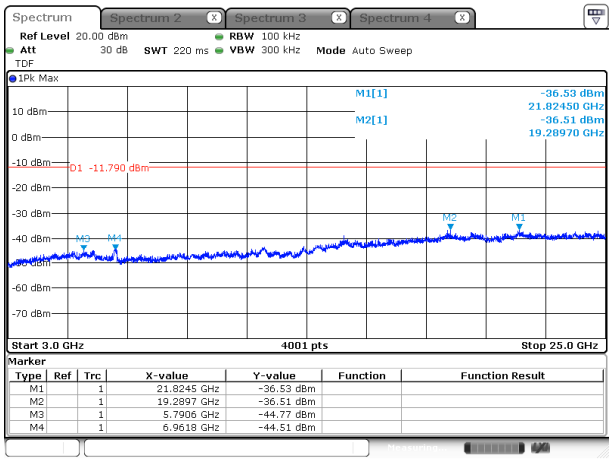
Date: 28.JUN.2019 00:41:26

LOW CHANNEL , SPURIOUS 30 MHz ~ 1 GHz



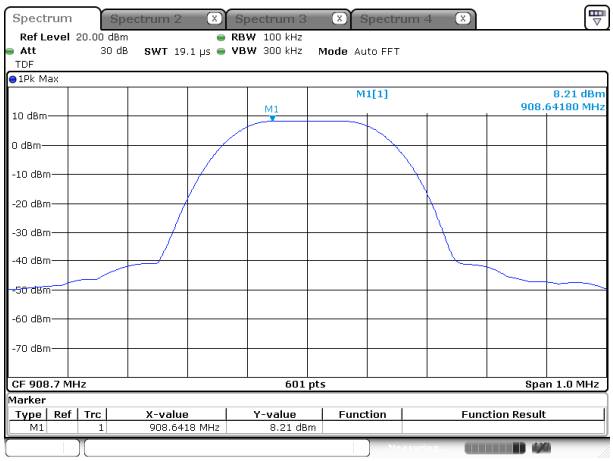
Date: 28.JUN.2019 00:36:47

LOW CHANNEL , SPURIOUS 1 GHz ~ 10 GHz



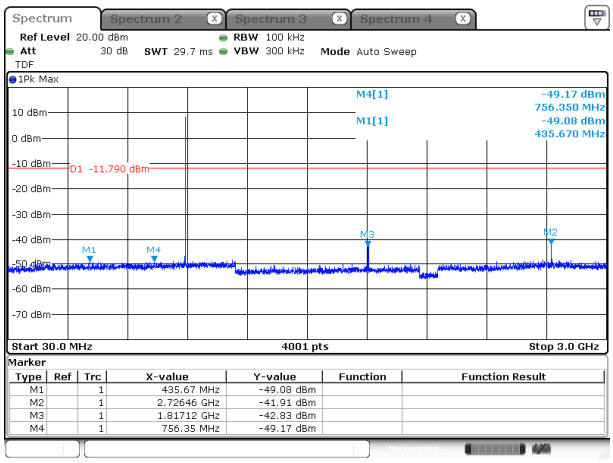
Date: 28.JUN.2019 00:38:16

MIDDLE CHANNEL, CARRIER LEVEL



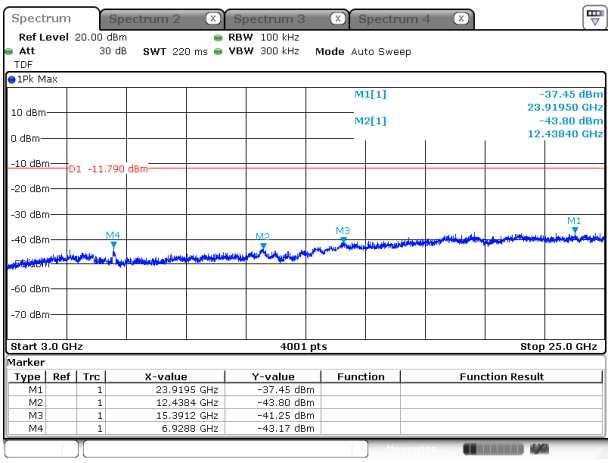
Date: 28.JUN.2019 00:42:02

MIDDLE CHANNEL , SPURIOUS 30 MHz ~ 1 GHz



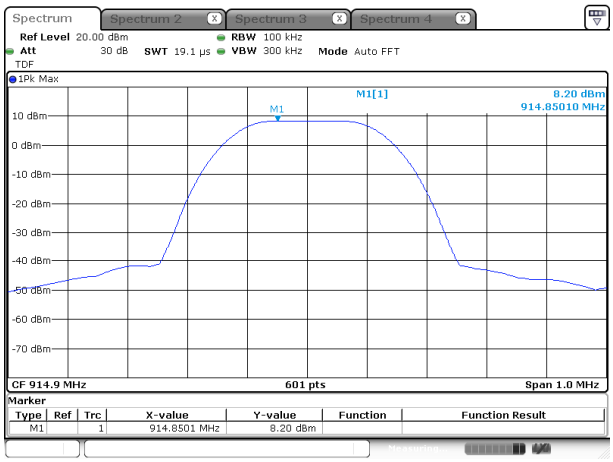
Date: 28.JUN.2019 00:42:50

MIDDLE CHANNEL , SPURIOUS 1 GHz ~ 10 GHz



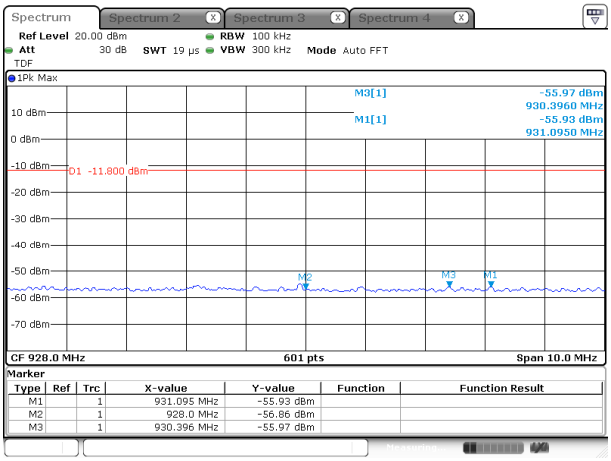
Date: 28.JUN.2019 00:43:28

HIGH CHANNEL, CARRIER LEVEL



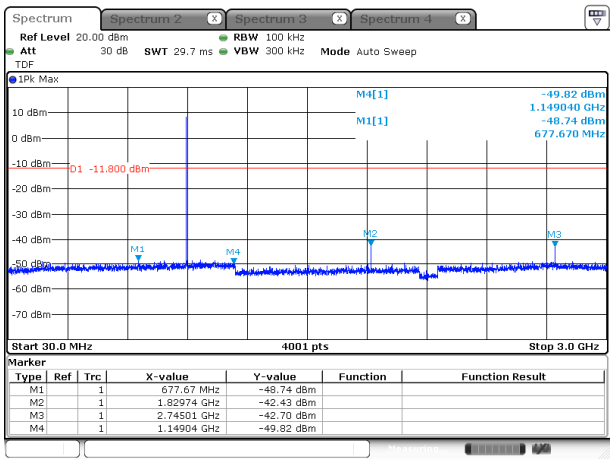
Date: 28.JUN.2019 00:44:16

HIGH CHANNEL , BAND EDGE



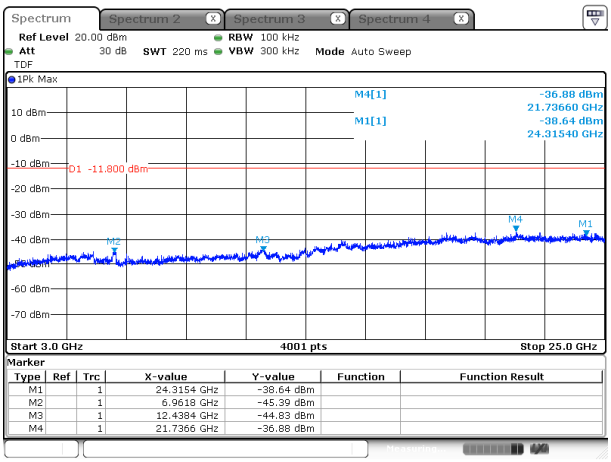
Date: 28.JUN.2019 00:46:53

HIGH CHANNEL , SPURIOUS 30 MHz ~ 1 GHz



Date: 28.JUN.2019 00:44:58

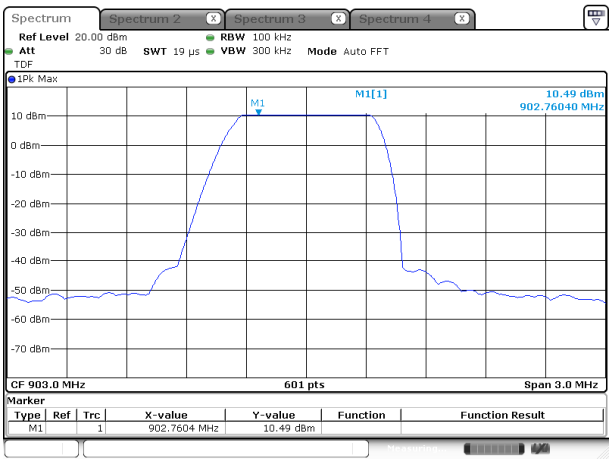
HIGH CHANNEL , SPURIOUS 1 GHz ~ 10 GHz



Date: 28.JUN.2019 00:45:34

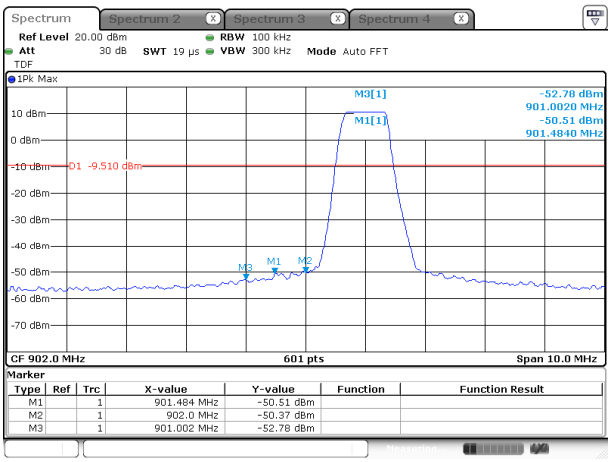
500kHz

LOW CHANNEL, CARRIER LEVEL



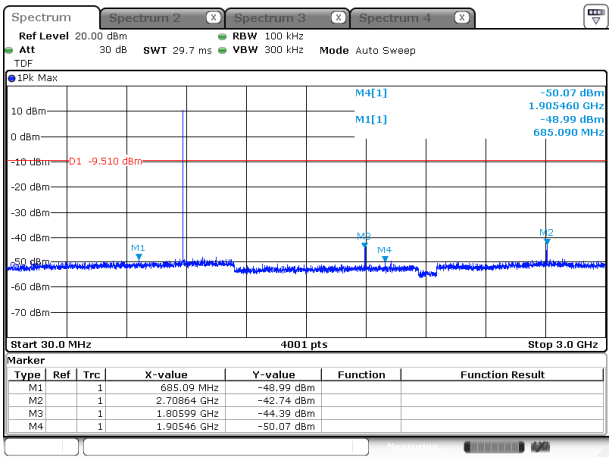
Date: 28.JUN.2019 00:49:20

LOW CHANNEL, Band Edge



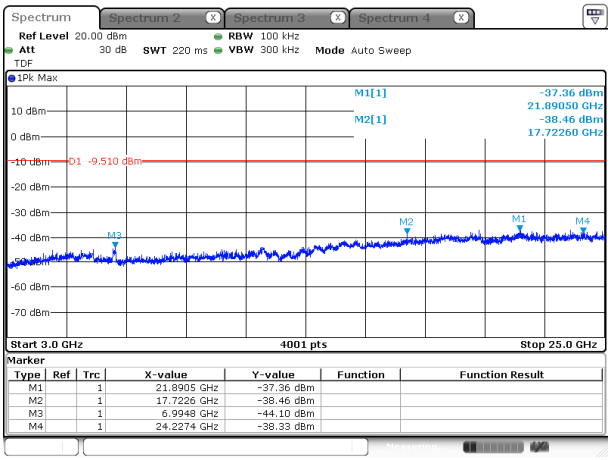
Date: 28.JUN.2019 00:51:05

LOW CHANNEL , SPURIOUS 30 MHz ~ 1 GHz



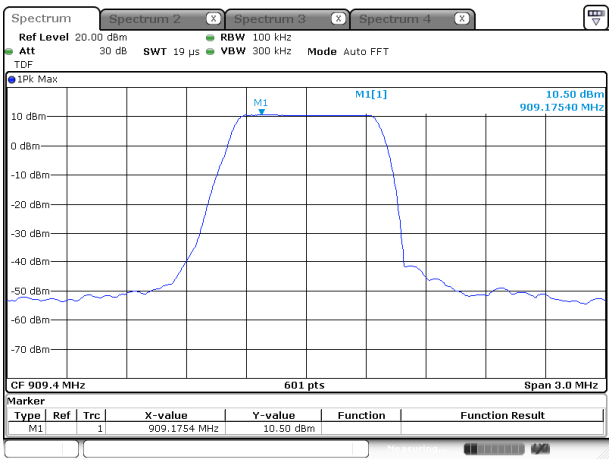
Date: 28.JUN.2019 00:50:05

LOW CHANNEL , SPURIOUS 1 GHz ~ 10 GHz



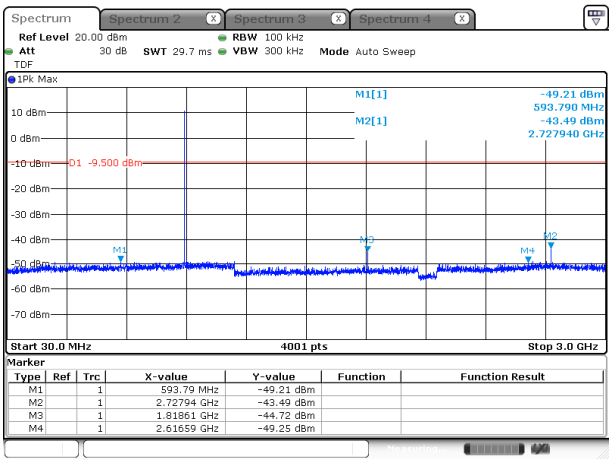
Date: 28.JUN.2019 00:50:32

MIDDLE CHANNEL, CARRIER LEVEL



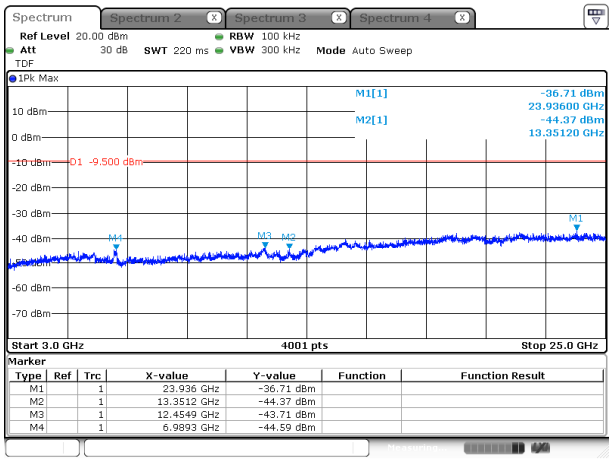
Date: 28.JUN.2019 00:51:52

MIDDLE CHANNEL , SPURIOUS 30 MHz ~ 1 GHz



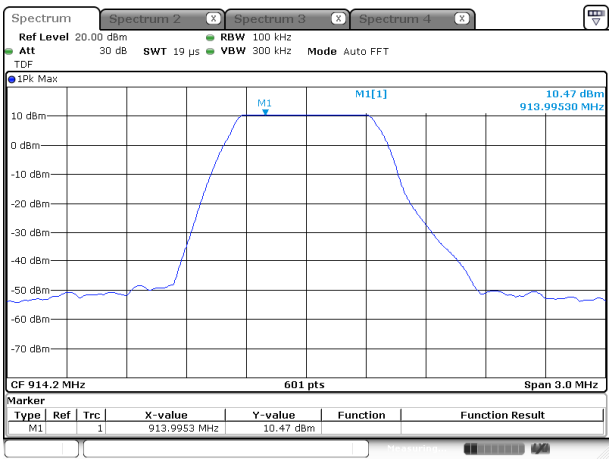
Date: 28.JUN.2019 00:52:25

MIDDLE CHANNEL , SPURIOUS 1 GHz ~ 10 GHz



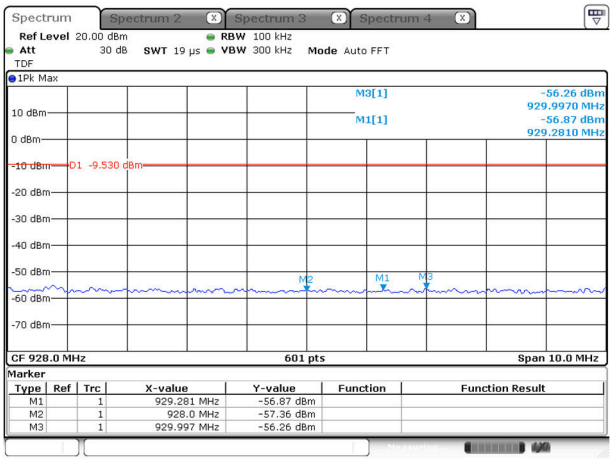
Date: 28.JUN.2019 00:52:55

HIGH CHANNEL, CARRIER LEVEL



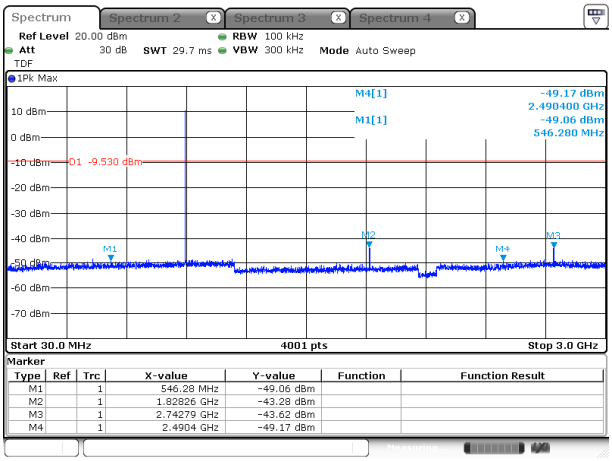
Date: 28.JUN.2019 00:53:30

HIGH CHANNEL , BAND EDGE



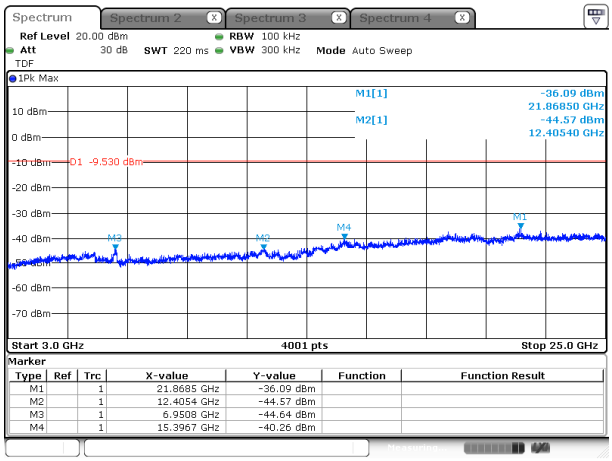
Date: 28.JUN.2019 00:46:06

HIGH CHANNEL , SPURIOUS 30 MHz ~ 1 GHz



Date: 28.JUN.2019 00:54:18

HIGH CHANNEL , SPURIOUS 1 GHz ~ 10 GHz



Date: 28.JUN.2019 00:54:49

A.6 Conducted Emissions

Note: Not Applicable.

A.7 Radiated Spurious Emission

Note [1]: The symbol of "--" in the table which means not application.

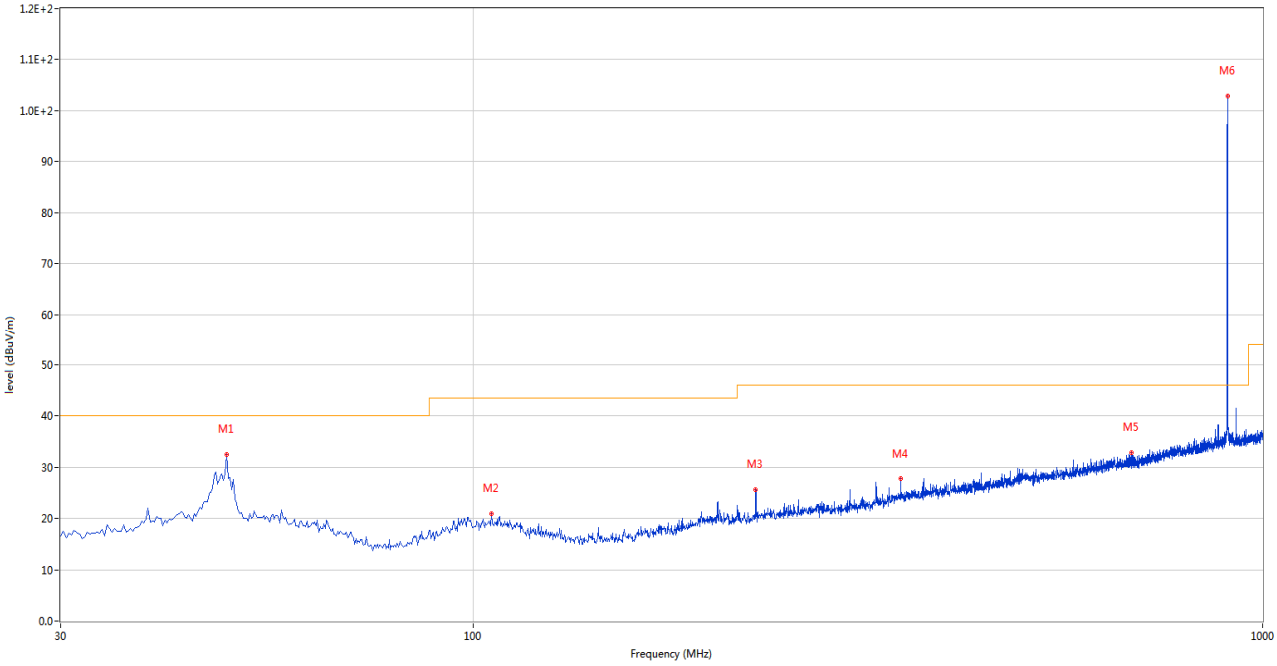
Note [2]: For the test data above 1 GHz, according the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note [3]: The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

Test Data and Plots

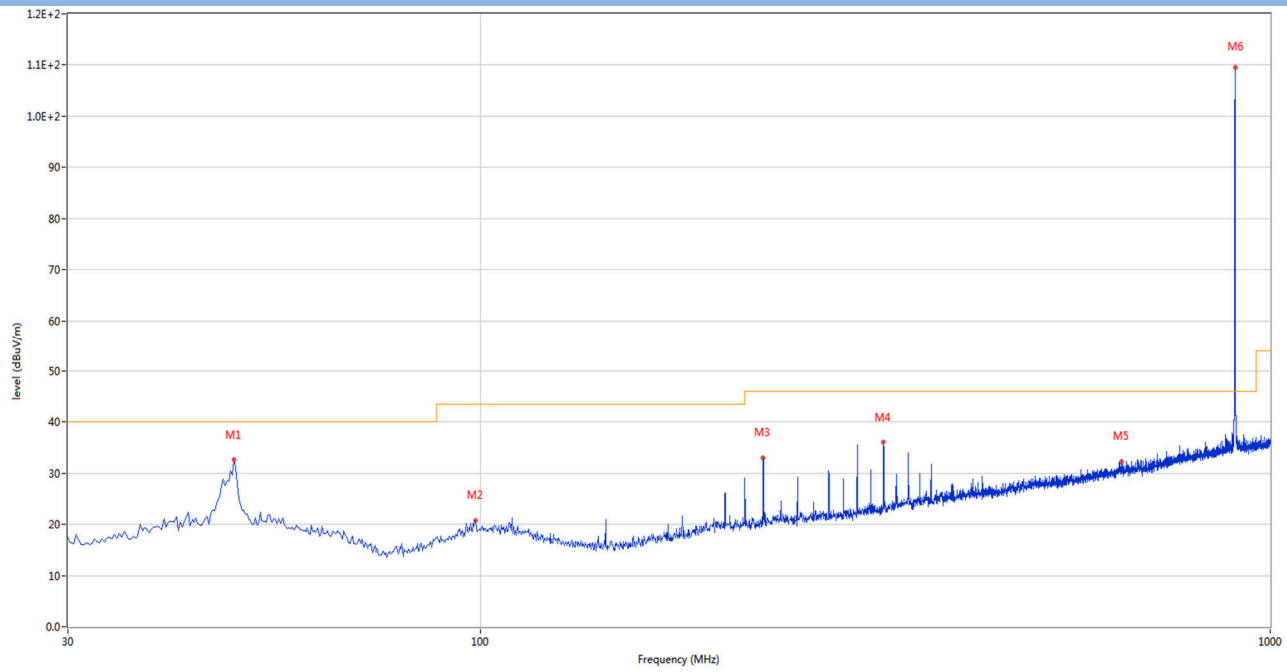
125kHz

LOW CHANNEL ANT V



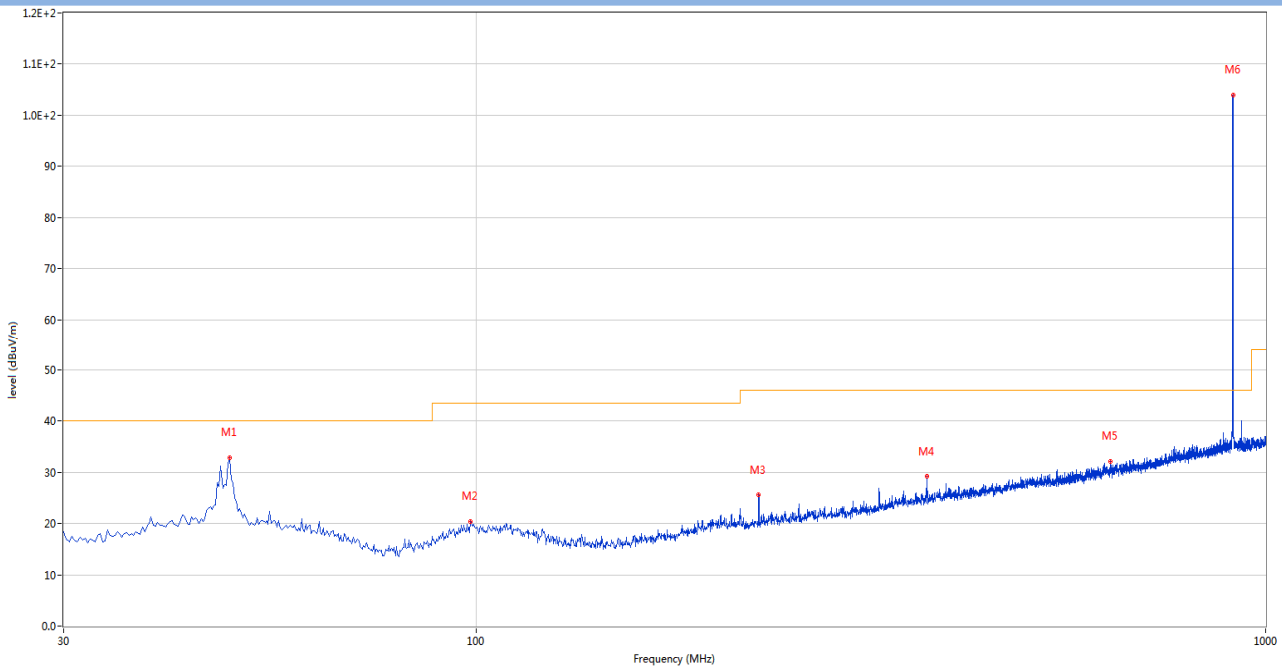
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	48.672	32.53	-23.30	40.0	-7.47	Peak	234.10	100	Vertical	Pass
2	105.418	21.01	-24.74	43.5	-22.49	Peak	69.70	200	Vertical	Pass
3	227.880	25.66	-24.11	46.0	-20.34	Peak	247.10	100	Vertical	Pass
4	347.918	27.72	-20.31	46.0	-18.28	Peak	199.20	200	Vertical	Pass
5	681.840	32.77	-13.73	46.0	-13.23	Peak	192.30	200	Vertical	Pass
6	902.273	102.92	-10.58	46.0	56.92	Peak	85.90	100	Vertical	N/A

LOW CHANNEL, ANT H



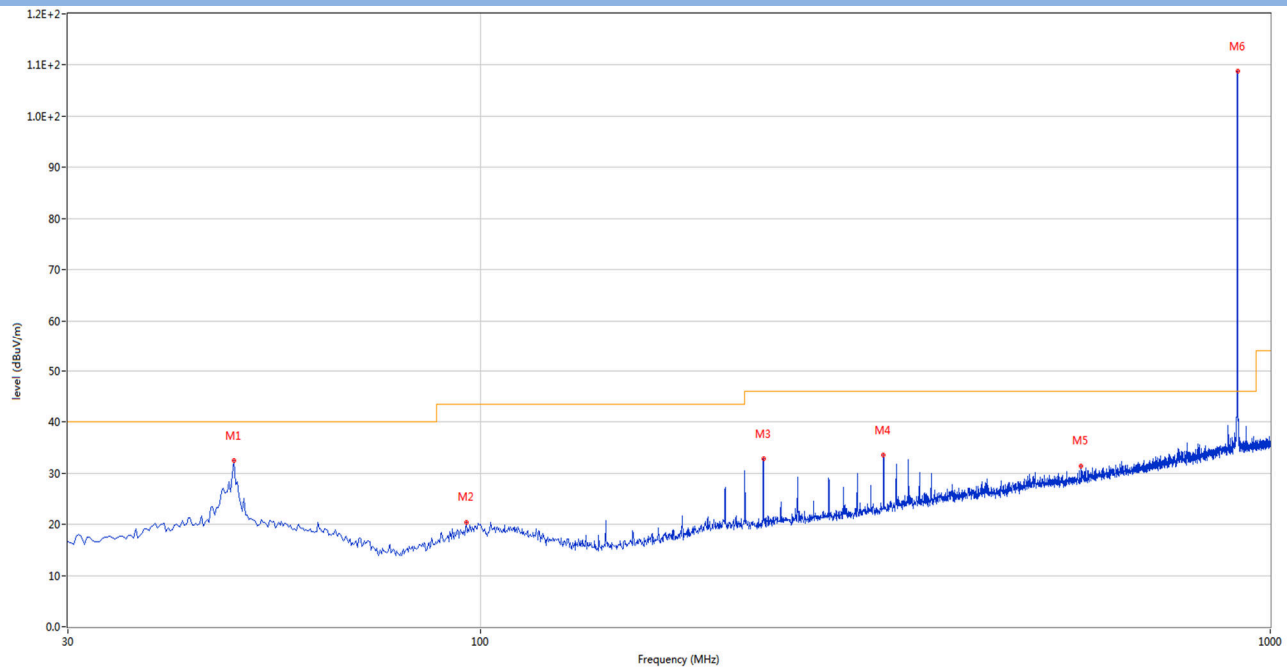
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	48.672	32.60	-23.30	40.0	-7.40	Peak	0.00	200	Horizontal	Pass
2	98.628	20.83	-24.90	43.5	-22.67	Peak	278.10	200	Horizontal	Pass
3	227.880	33.11	-24.11	46.0	-12.89	Peak	144.70	100	Horizontal	Pass
4	323.910	36.04	-21.23	46.0	-9.96	Peak	235.40	100	Horizontal	Pass
5	647.890	32.28	-14.05	46.0	-13.72	Peak	148.20	100	Horizontal	Pass
6	902.273	109.52	-10.58	46.0	63.52	Peak	138.30	100	Horizontal	N/A

MIDDLE CHANNEL ANT V



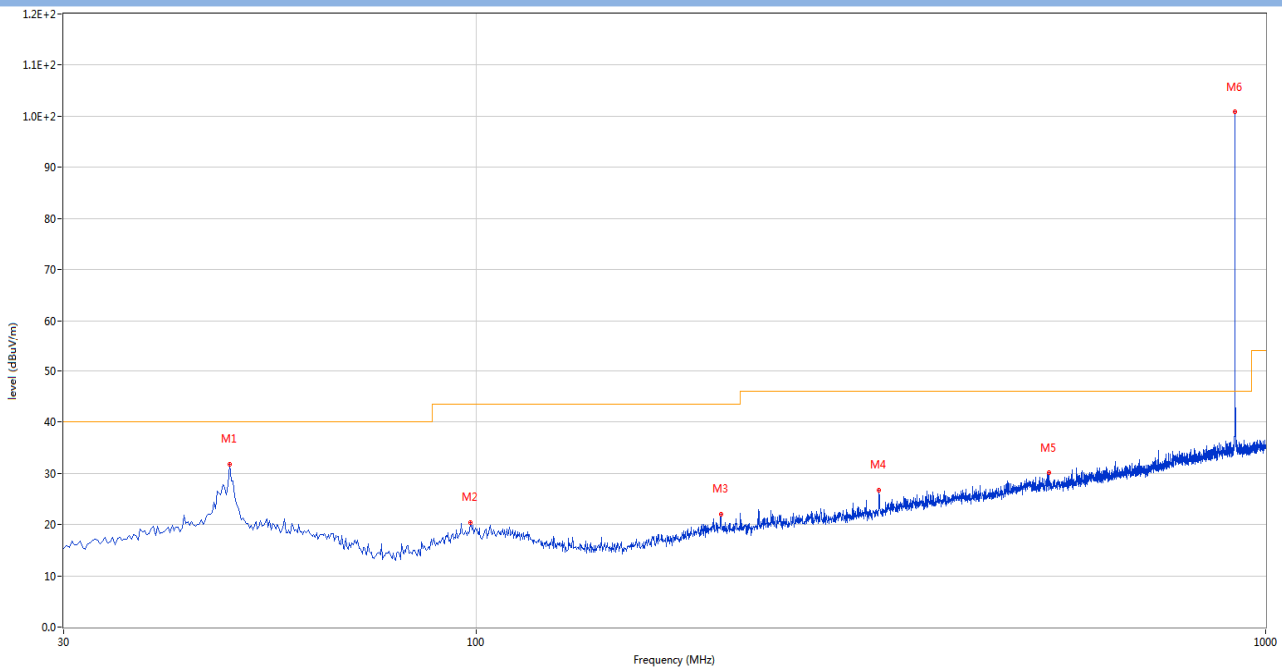
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	48.672	32.82	-23.30	40.0	-7.18	Peak	0.00	200	Vertical	Pass
2	98.385	20.36	-24.93	43.5	-23.14	Peak	342.30	200	Vertical	Pass
3	227.880	25.58	-24.11	46.0	-20.42	Peak	65.50	200	Vertical	Pass
4	371.925	29.14	-20.06	46.0	-16.86	Peak	174.40	200	Vertical	Pass
5	636.250	32.11	-14.35	46.0	-13.89	Peak	170.90	200	Vertical	Pass
6	908.820	104.02	-10.40	46.0	58.02	Peak	56.50	100	Vertical	N/A

MIDDLE CHANNEL, ANT H



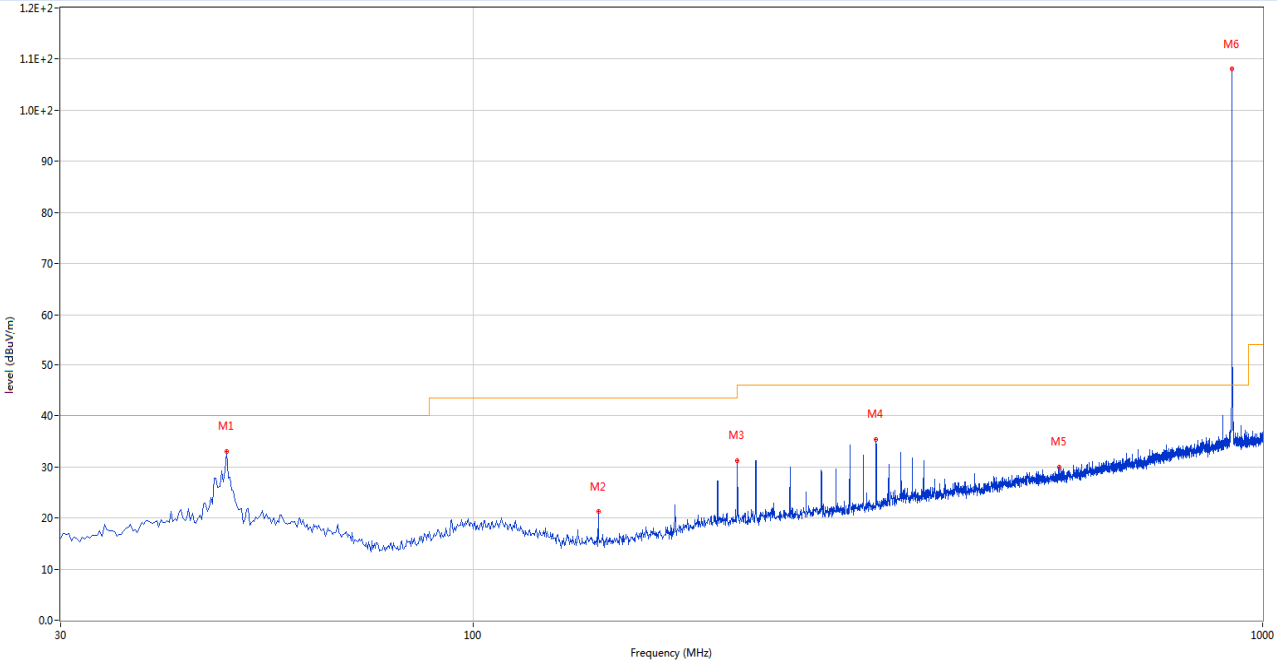
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	48.672	32.41	-23.30	40.0	-7.59	Peak	195.70	200	Horizontal	Pass
2	95.960	20.42	-25.18	43.5	-23.08	Peak	146.90	200	Horizontal	Pass
3	228.122	32.76	-24.08	46.0	-13.24	Peak	158.10	100	Horizontal	Pass
4	323.910	33.52	-21.23	46.0	-12.48	Peak	222.10	100	Horizontal	Pass
5	575.868	31.41	-15.33	46.0	-14.59	Peak	0.00	200	Horizontal	Pass
6	908.820	108.72	-10.40	46.0	62.72	Peak	147.70	100	Horizontal	N/A

HIGH CHANNEL ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	48.672	31.84	-23.30	40.0	-8.16	Peak	126.70	100	Vertical	Pass
2	98.385	20.42	-24.93	43.5	-23.08	Peak	273.10	100	Vertical	Pass
3	204.115	22.10	-24.30	43.5	-21.40	Peak	199.40	100	Vertical	Pass
4	323.910	26.71	-21.23	46.0	-19.29	Peak	150.90	100	Vertical	Pass
5	531.975	30.16	-16.36	46.0	-15.84	Peak	112.40	100	Vertical	Pass
6	914.882	100.78	-10.05	46.0	54.78	Peak	52.80	100	Vertical	N/A

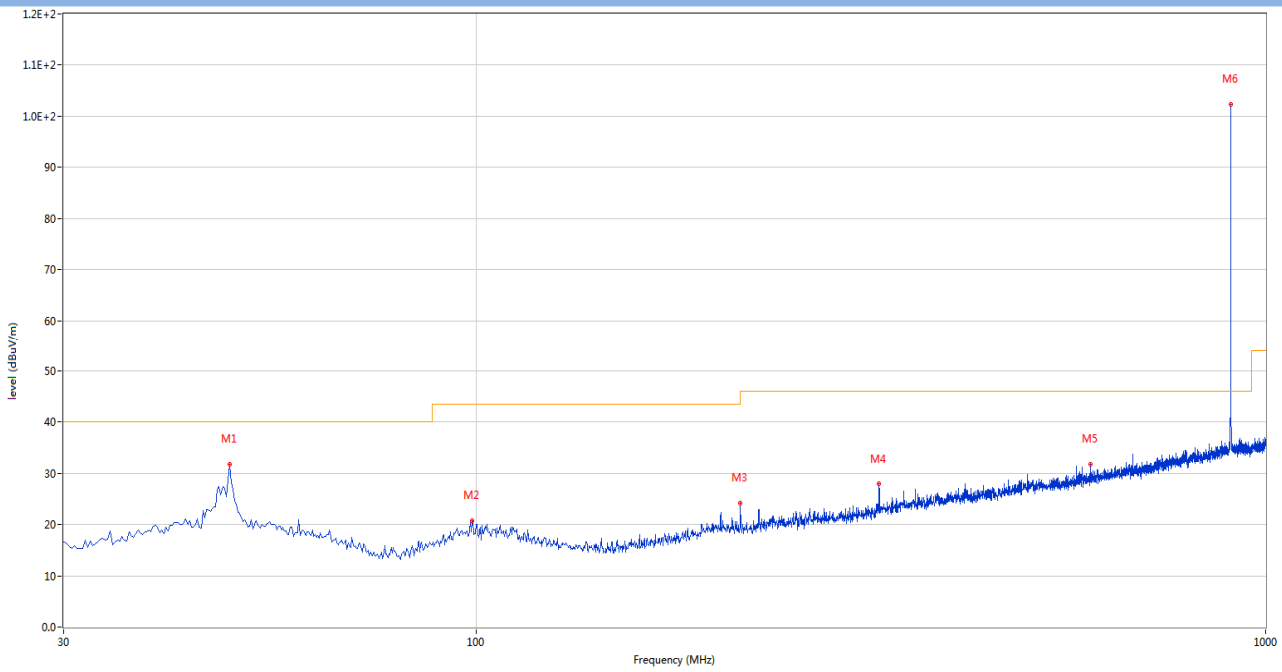
HIGH CHANNEL, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	48.672	33.10	-23.30	40.0	-6.90	Peak	0.80	100	Horizontal	Pass
2	143.975	21.23	-28.12	43.5	-22.27	Peak	158.30	100	Horizontal	Pass
3	215.998	31.30	-24.38	43.5	-12.20	Peak	140.50	100	Horizontal	Pass
4	323.910	35.42	-21.23	46.0	-10.58	Peak	231.60	100	Horizontal	Pass
5	552.830	30.01	-15.96	46.0	-15.99	Peak	359.10	100	Horizontal	Pass
6	914.882	108.02	-10.05	46.0	62.02	Peak	235.00	100	Horizontal	N/A

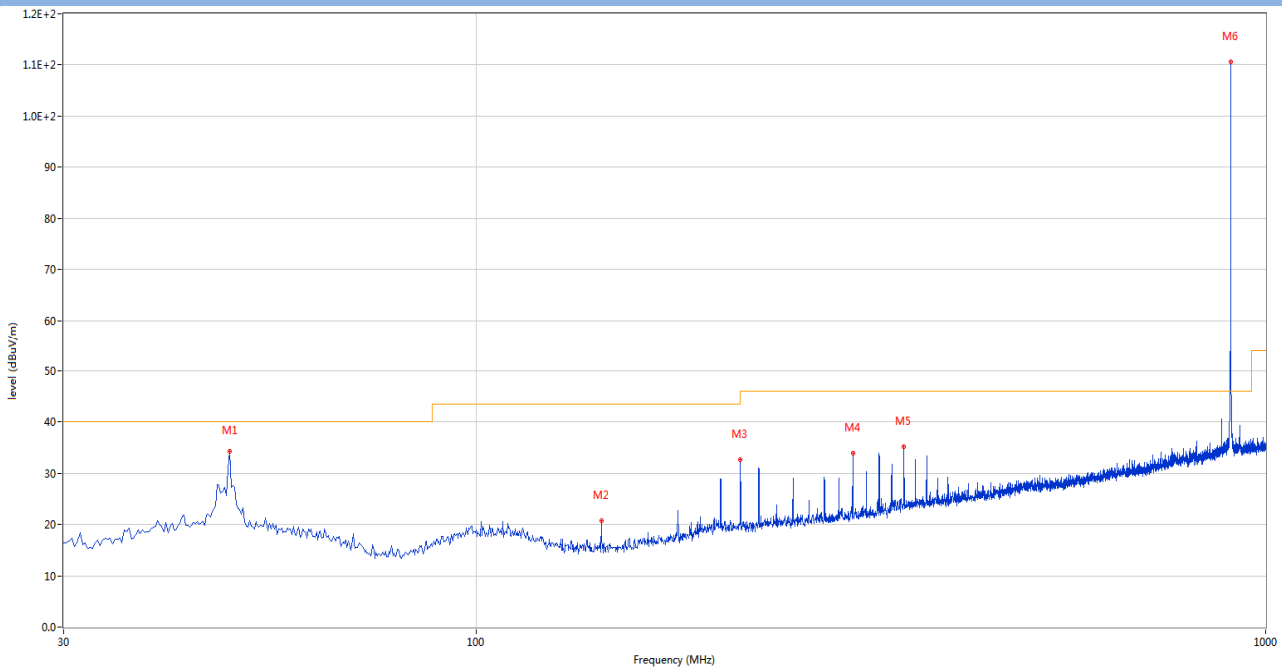
500kHz

LOW CHANNEL ANT V



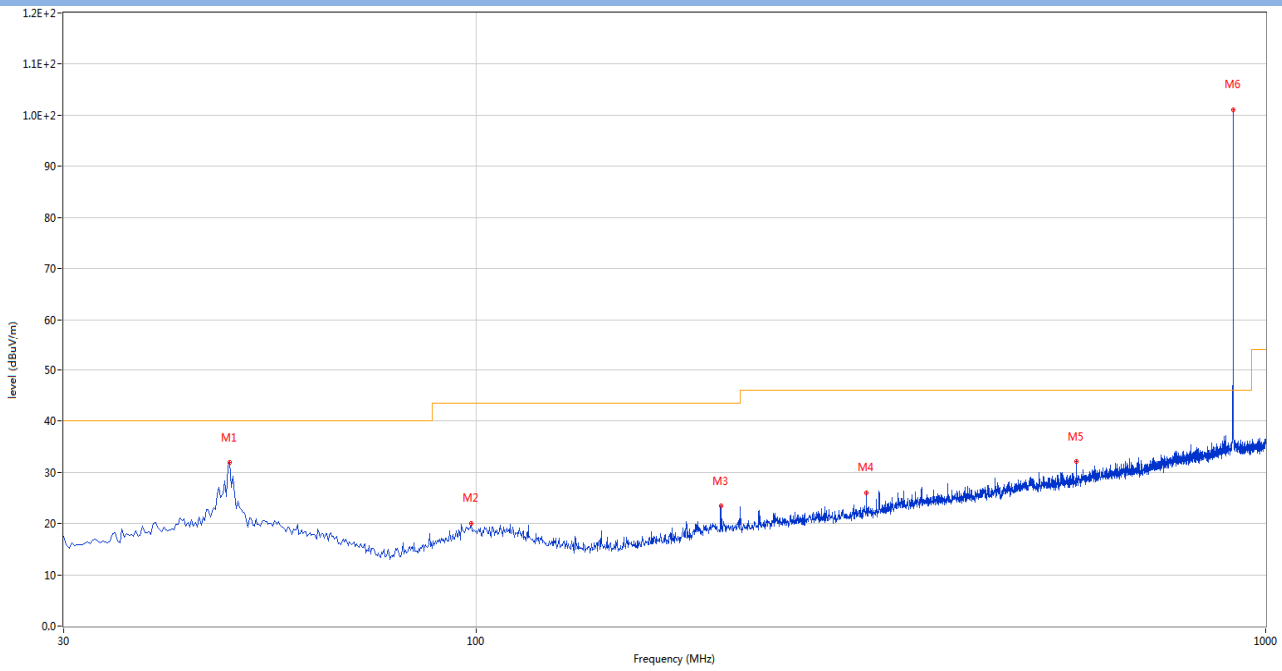
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	48.672	31.84	-23.30	40.0	-8.16	Peak	294.00	100	Vertical	Pass
2	98.870	20.74	-24.87	43.5	-22.76	Peak	360.00	100	Vertical	Pass
3	215.998	24.23	-24.38	43.5	-19.27	Peak	54.20	100	Vertical	Pass
4	323.910	27.90	-21.23	46.0	-18.10	Peak	192.30	100	Vertical	Pass
5	600.118	31.76	-14.80	46.0	-14.24	Peak	158.20	100	Vertical	Pass
6	903.000	102.36	-10.46	46.0	56.36	Peak	57.60	100	Vertical	N/A

LOW CHANNEL, ANT H



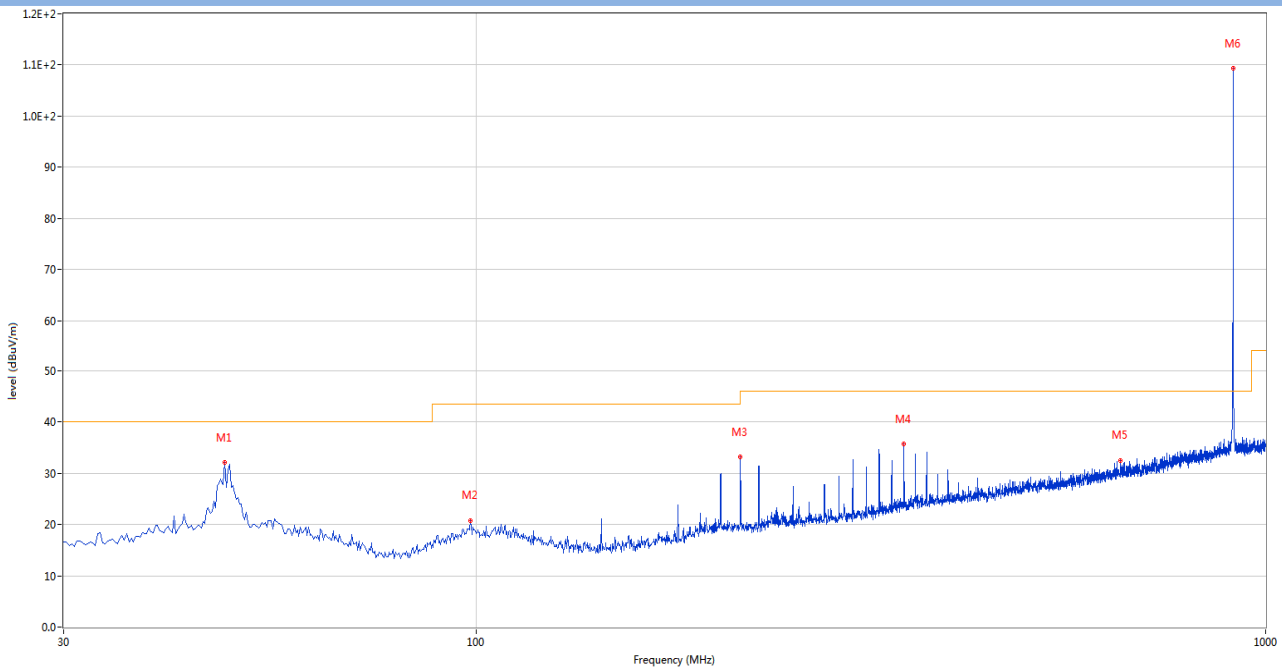
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	48.672	34.34	-23.30	40.0	-5.66	Peak	219.00	100	Horizontal	Pass
2	143.975	20.83	-28.12	43.5	-22.67	Peak	104.00	100	Horizontal	Pass
3	215.998	32.72	-24.38	43.5	-10.78	Peak	149.50	100	Horizontal	Pass
4	299.902	33.94	-22.12	46.0	-12.06	Peak	93.40	100	Horizontal	Pass
5	347.918	35.16	-20.31	46.0	-10.84	Peak	260.60	100	Horizontal	Pass
6	903.000	110.68	-10.46	46.0	64.68	Peak	236.20	100	Horizontal	N/A

MIDDLE CHANNEL ANT V



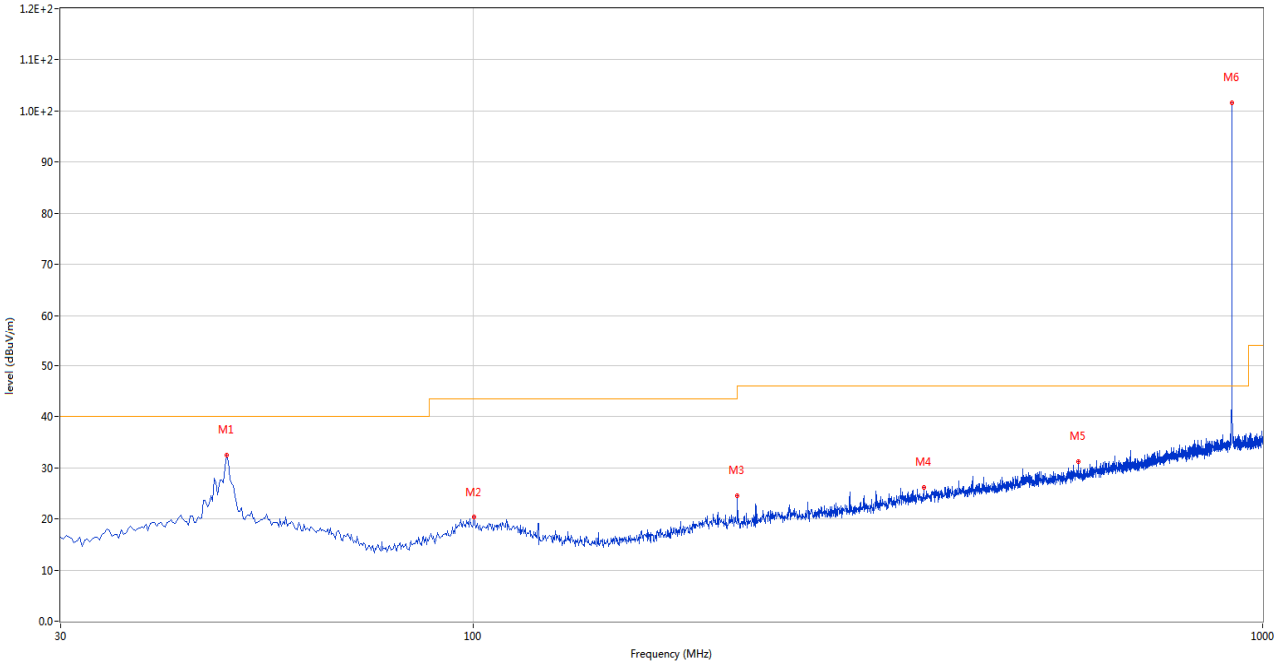
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	48.672	31.87	-23.30	40.0	-8.13	Peak	149.80	100	Vertical	Pass
2	98.628	20.02	-24.90	43.5	-23.48	Peak	219.80	100	Vertical	Pass
3	204.115	23.41	-24.30	43.5	-20.09	Peak	55.10	100	Vertical	Pass
4	312.027	26.03	-21.69	46.0	-19.97	Peak	178.20	100	Vertical	Pass
5	576.110	32.07	-15.33	46.0	-13.93	Peak	348.70	100	Vertical	Pass
6	909.547	101.10	-10.36	46.0	55.10	Peak	58.80	100	Vertical	N/A

MIDDLE CHANNEL, ANT H



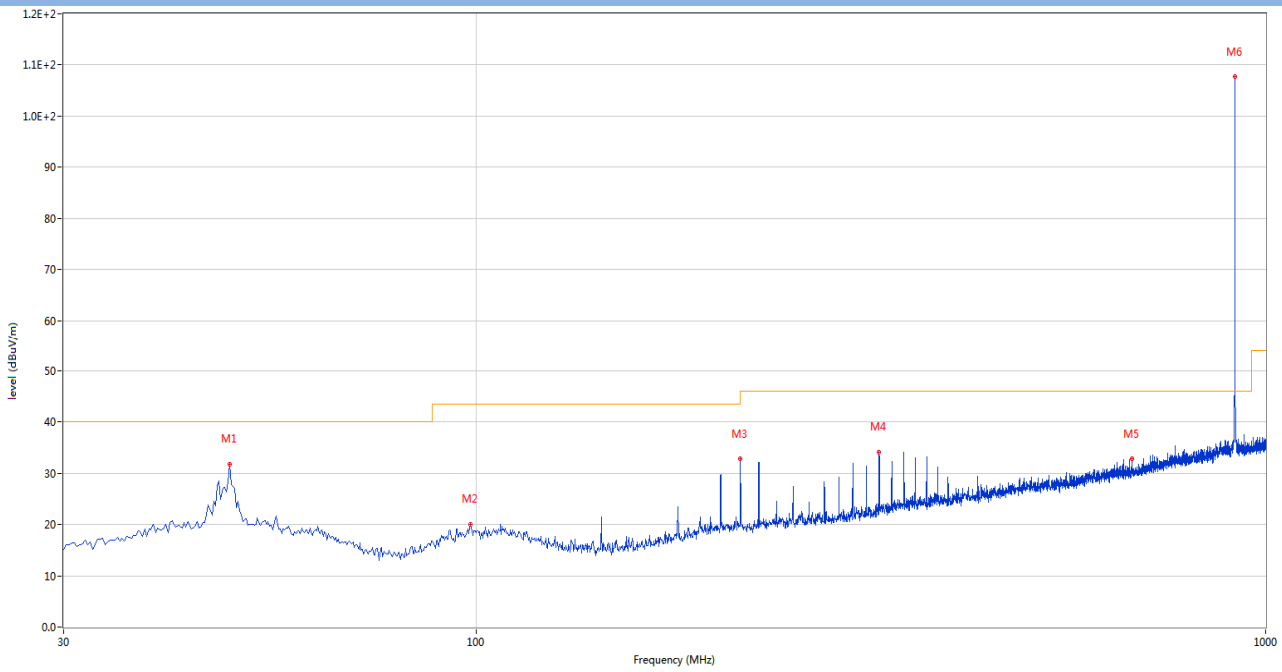
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	47.945	32.06	-23.36	40.0	-7.94	Peak	26.80	100	Horizontal	Pass
2	98.385	20.74	-24.93	43.5	-22.76	Peak	62.00	100	Horizontal	Pass
3	215.998	33.13	-24.38	43.5	-10.37	Peak	146.30	100	Horizontal	Pass
4	347.918	35.69	-20.31	46.0	-10.31	Peak	114.90	100	Horizontal	Pass
5	655.165	32.51	-14.04	46.0	-13.49	Peak	359.70	100	Horizontal	Pass
6	909.305	109.32	-10.38	46.0	63.32	Peak	238.00	100	Horizontal	N/A

HIGH CHANNEL ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	48.672	32.51	-23.30	40.0	-7.49	Peak	77.10	100	Vertical	Pass
2	100.082	20.35	-24.73	43.5	-23.15	Peak	173.70	100	Vertical	Pass
3	215.998	24.52	-24.38	43.5	-18.98	Peak	69.90	100	Vertical	Pass
4	371.925	26.23	-20.06	46.0	-19.77	Peak	203.50	100	Vertical	Pass
5	584.113	31.16	-15.14	46.0	-14.84	Peak	140.30	100	Vertical	Pass
6	914.155	101.60	-10.03	46.0	55.60	Peak	87.40	100	Vertical	N/A

HIGH CHANNEL, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	48.672	31.75	-23.30	40.0	-8.25	Peak	144.60	100	Horizontal	Pass
2	98.385	20.01	-24.93	43.5	-23.49	Peak	165.40	100	Horizontal	Pass
3	215.998	32.77	-24.38	43.5	-10.73	Peak	158.60	100	Horizontal	Pass
4	323.910	34.14	-21.23	46.0	-11.86	Peak	259.10	100	Horizontal	Pass
5	676.748	32.79	-13.81	46.0	-13.21	Peak	241.80	100	Horizontal	Pass
6	914.155	107.69	-10.03	46.0	61.69	Peak	241.80	100	Horizontal	N/A

125kHz

LOW CHANNEL 1 GHz to 10 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1804.500	42.98	-19.12	54.0	-11.02	AV	86.00	150	Vertical	Pass
1	1804.500	49.00	-19.12	74.0	-25.00	Peak	86.00	150	Vertical	Pass
2**	2707.000	37.27	-12.13	54.0	-16.73	AV	114.70	150	Vertical	Pass
2	2707.000	43.10	-12.13	74.0	-30.90	Peak	114.70	150	Vertical	Pass
3**	3609.000	35.08	-8.16	54.0	-18.92	AV	231.20	150	Vertical	Pass
3	3609.000	49.52	-8.16	74.0	-24.48	Peak	231.20	150	Vertical	Pass
4**	4512.000	39.63	-5.05	54.0	-14.37	AV	223.80	150	Vertical	Pass
4	4512.000	45.50	-5.05	74.0	-28.50	Peak	223.80	150	Vertical	Pass
5**	6316.000	37.93	-3.39	54.0	-16.07	AV	303.90	150	Vertical	Pass
5	6316.000	47.98	-3.39	74.0	-26.02	Peak	303.90	150	Vertical	Pass
6**	8029.000	38.72	15.78	54.0	-15.28	AV	312.90	150	Vertical	Pass
6	8029.000	53.45	15.78	74.0	-20.55	Peak	312.90	150	Vertical	Pass

LOW CHANNEL 1 GHz to 10 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1804.500	38.76	-19.12	54.0	-15.24	AV	243.90	150	Horizontal	Pass
1	1804.500	45.90	-19.12	74.0	-28.10	Peak	243.90	150	Horizontal	Pass
2**	2707.000	34.78	-12.13	54.0	-19.22	AV	203.00	150	Horizontal	Pass
2	2707.000	40.95	-12.13	74.0	-33.05	Peak	203.00	150	Horizontal	Pass
3**	3609.000	33.20	-8.16	54.0	-20.80	AV	101.00	150	Horizontal	Pass
3	3609.000	47.80	-8.16	74.0	-26.20	Peak	101.00	150	Horizontal	Pass
4**	4512.000	38.22	-5.05	54.0	-15.78	AV	123.30	150	Horizontal	Pass
4	4512.000	45.41	-5.05	74.0	-28.59	Peak	123.30	150	Horizontal	Pass
5**	6316.000	37.93	-3.39	54.0	-16.07	AV	179.10	150	Horizontal	Pass
5	6316.000	48.67	-3.39	74.0	-25.33	Peak	179.10	150	Horizontal	Pass
6**	9215.500	41.18	17.80	54.0	-12.82	AV	332.00	150	Horizontal	Pass
6	9215.500	52.35	17.80	74.0	-21.65	Peak	332.00	150	Horizontal	Pass

MIDDLE CHANNEL 1 GHz to 10 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1305.500	24.62	-18.99	54.0	-29.38	AV	102.10	150	Vertical	Pass
1	1305.500	35.76	-18.99	74.0	-38.24	Peak	102.10	150	Vertical	Pass
2**	1817.500	41.24	-18.55	54.0	-12.76	AV	359.70	150	Vertical	Pass
2	1817.500	45.24	-18.55	74.0	-28.76	Peak	359.70	150	Vertical	Pass
3**	2726.000	32.09	-13.02	54.0	-21.91	AV	185.20	150	Vertical	Pass
3	2726.000	40.93	-13.02	74.0	-33.07	Peak	185.20	150	Vertical	Pass
4**	3635.000	39.52	-7.23	54.0	-14.48	AV	155.80	150	Vertical	Pass
4	3635.000	47.49	-7.23	74.0	-26.51	Peak	155.80	150	Vertical	Pass
5**	5432.000	35.58	-4.49	54.0	-18.42	AV	114.20	150	Vertical	Pass
5	5432.000	46.20	-4.49	74.0	-27.80	Peak	114.20	150	Vertical	Pass
6**	7637.500	40.34	16.66	54.0	-13.66	AV	15.70	150	Vertical	Pass
6	7637.500	50.97	16.66	74.0	-23.03	Peak	15.70	150	Vertical	Pass

MIDDLE CHANNEL 1 GHz to 10 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1375.000	25.55	-19.13	54.0	-28.45	AV	354.80	150	Horizontal	Pass
1	1375.000	35.65	-19.13	74.0	-38.35	Peak	354.80	150	Horizontal	Pass
2**	1817.500	44.83	-18.55	54.0	-9.17	AV	103.10	150	Horizontal	Pass
2	1817.500	48.29	-18.55	74.0	-25.71	Peak	103.10	150	Horizontal	Pass
3**	2726.500	38.00	-12.98	54.0	-16.00	AV	211.20	150	Horizontal	Pass
3	2726.500	42.23	-12.98	74.0	-31.77	Peak	211.20	150	Horizontal	Pass
4**	3635.000	42.49	-7.23	54.0	-11.51	AV	227.90	150	Horizontal	Pass
4	3635.000	49.99	-7.23	74.0	-24.01	Peak	227.90	150	Horizontal	Pass
5**	5597.000	35.52	-4.65	54.0	-18.48	AV	330.30	150	Horizontal	Pass
5	5597.000	46.34	-4.65	74.0	-27.66	Peak	330.30	150	Horizontal	Pass
6**	9344.500	42.80	19.36	54.0	-11.20	AV	84.70	150	Horizontal	Pass
6	9344.500	52.81	19.36	74.0	-21.19	Peak	84.70	150	Horizontal	Pass

HIGH CHANNEL 1 GHz to 10 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1125.000	25.49	-20.04	54.0	-28.51	AV	11.90	150	Vertical	Pass
1	1125.000	38.59	-20.04	74.0	-35.41	Peak	11.90	150	Vertical	Pass
2**	1830.500	40.08	-18.13	54.0	-13.92	AV	273.90	150	Vertical	Pass
2	1830.500	44.95	-18.13	74.0	-29.05	Peak	273.90	150	Vertical	Pass
3**	2745.500	31.32	-12.72	54.0	-22.68	AV	123.10	150	Vertical	Pass
3	2745.500	40.24	-12.72	74.0	-33.76	Peak	123.10	150	Vertical	Pass
4**	3661.000	41.60	-7.13	54.0	-12.40	AV	148.00	150	Vertical	Pass
4	3661.000	51.55	-7.13	74.0	-22.45	Peak	148.00	150	Vertical	Pass
5**	6406.000	36.65	-3.09	54.0	-17.35	AV	106.20	150	Vertical	Pass
5	6406.000	50.88	-3.09	74.0	-23.12	Peak	106.20	150	Vertical	Pass
6**	9268.000	42.21	18.77	54.0	-11.79	AV	344.50	150	Vertical	Pass
6	9268.000	53.32	18.77	74.0	-20.68	Peak	344.50	150	Vertical	Pass

HIGH CHANNEL 1 GHz to 10 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1375.000	25.26	-19.13	54.0	-28.74	AV	70.90	150	Horizontal	Pass
1	1375.000	35.92	-19.13	74.0	-38.08	Peak	70.90	150	Horizontal	Pass
2**	1830.500	44.49	-18.13	54.0	-9.51	AV	289.30	150	Horizontal	Pass
2	1830.500	49.09	-18.13	74.0	-24.91	Peak	289.30	150	Horizontal	Pass
3**	2745.500	31.73	-12.72	54.0	-22.27	AV	282.00	150	Horizontal	Pass
3	2745.500	42.01	-12.72	74.0	-31.99	Peak	282.00	150	Horizontal	Pass
4**	3661.000	37.40	-7.13	54.0	-16.60	AV	285.70	150	Horizontal	Pass
4	3661.000	47.68	-7.13	74.0	-26.32	Peak	285.70	150	Horizontal	Pass
5**	6407.000	43.53	-3.14	54.0	-10.47	AV	232.90	150	Horizontal	Pass
5	6407.000	49.72	-3.14	74.0	-24.28	Peak	232.90	150	Horizontal	Pass
6**	7559.500	39.70	15.91	54.0	-14.30	AV	141.60	150	Horizontal	Pass
6	7559.500	51.83	15.91	74.0	-22.17	Peak	141.60	150	Horizontal	Pass

500kHz

LOW CHANNEL 1 GHz to 10 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1431.000	23.94	-19.13	54.0	-30.06	AV	23.40	150	Vertical	Pass
1	1431.000	35.56	-19.13	74.0	-38.44	Peak	23.40	150	Vertical	Pass
2**	1806.000	42.28	-19.01	54.0	-11.72	AV	358.70	150	Vertical	Pass
2	1806.000	44.50	-19.01	74.0	-29.50	Peak	358.70	150	Vertical	Pass
3**	2709.500	35.58	-12.13	54.0	-18.42	AV	181.60	150	Vertical	Pass
3	2709.500	41.71	-12.13	74.0	-32.29	Peak	181.60	150	Vertical	Pass
4**	3612.000	43.95	-7.96	54.0	-10.05	AV	131.10	150	Vertical	Pass
4	3612.000	50.04	-7.96	74.0	-23.96	Peak	131.10	150	Vertical	Pass
5**	5546.000	35.70	-4.08	54.0	-18.30	AV	195.70	150	Vertical	Pass
5	5546.000	46.57	-4.08	74.0	-27.43	Peak	195.70	150	Vertical	Pass
6**	7222.000	40.66	16.63	54.0	-13.34	AV	256.70	150	Vertical	Pass
6	7222.000	51.30	16.63	74.0	-22.70	Peak	256.70	150	Vertical	Pass

LOW CHANNEL 1 GHz to 10 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1348.500	24.73	-18.82	54.0	-29.27	AV	262.70	150	Horizontal	Pass
1	1348.500	35.00	-18.82	74.0	-39.00	Peak	262.70	150	Horizontal	Pass
2**	1805.500	42.60	-19.04	54.0	-11.40	AV	266.40	150	Horizontal	Pass
2	1805.500	48.46	-19.04	74.0	-25.54	Peak	266.40	150	Horizontal	Pass
3**	2709.500	35.94	-12.13	54.0	-18.06	AV	251.70	150	Horizontal	Pass
3	2709.500	41.34	-12.13	74.0	-32.66	Peak	251.70	150	Horizontal	Pass
4**	3611.000	34.18	-8.03	54.0	-19.82	AV	213.60	150	Horizontal	Pass
4	3611.000	50.23	-8.03	74.0	-23.77	Peak	213.60	150	Horizontal	Pass
5**	5417.000	35.55	-4.31	54.0	-18.45	AV	205.70	150	Horizontal	Pass
5	5417.000	46.37	-4.31	74.0	-27.63	Peak	205.70	150	Horizontal	Pass
6**	7267.000	40.24	16.49	54.0	-13.76	AV	87.60	150	Horizontal	Pass
6	7267.000	50.79	16.49	74.0	-23.21	Peak	87.60	150	Horizontal	Pass

MIDDLE CHANNEL 1 GHz to 10 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1360.000	24.44	-19.04	54.0	-29.56	AV	13.40	150	Vertical	Pass
1	1360.000	34.83	-19.04	74.0	-39.17	Peak	13.40	150	Vertical	Pass
2**	1819.000	42.01	-18.78	54.0	-11.99	AV	357.40	150	Vertical	Pass
2	1819.000	44.41	-18.78	74.0	-29.59	Peak	357.40	150	Vertical	Pass
3**	2728.000	33.52	-13.00	54.0	-20.48	AV	331.00	150	Vertical	Pass
3	2728.000	40.54	-13.00	74.0	-33.46	Peak	331.00	150	Vertical	Pass
4**	3638.000	44.89	-7.57	54.0	-9.11	AV	141.90	150	Vertical	Pass
4	3638.000	48.43	-7.57	74.0	-25.57	Peak	141.90	150	Vertical	Pass
5**	6364.000	35.74	-3.52	54.0	-18.26	AV	74.20	150	Vertical	Pass
5	6364.000	49.15	-3.52	74.0	-24.85	Peak	74.20	150	Vertical	Pass
6**	7180.750	40.64	16.21	54.0	-13.36	AV	10.60	150	Vertical	Pass
6	7180.750	51.09	16.21	74.0	-22.91	Peak	10.60	150	Vertical	Pass

MIDDLE CHANNEL 1 GHz to 10 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1336.500	24.45	-19.14	54.0	-29.55	AV	42.50	150	Horizontal	Pass
1	1336.500	35.60	-19.14	74.0	-38.40	Peak	42.50	150	Horizontal	Pass
2**	1819.000	47.88	-18.78	54.0	-6.12	AV	269.20	150	Horizontal	Pass
2	1819.000	49.64	-18.78	74.0	-24.36	Peak	269.20	150	Horizontal	Pass
3**	2727.500	32.21	-12.99	54.0	-21.79	AV	272.90	150	Horizontal	Pass
3	2727.500	40.79	-12.99	74.0	-33.21	Peak	272.90	150	Horizontal	Pass
4**	3637.000	42.21	-7.43	54.0	-11.79	AV	199.00	150	Horizontal	Pass
4	3637.000	50.98	-7.43	74.0	-23.02	Peak	199.00	150	Horizontal	Pass
5**	6367.000	42.36	-3.15	54.0	-11.64	AV	101.30	150	Horizontal	Pass
5	6367.000	48.58	-3.15	74.0	-25.42	Peak	101.30	150	Horizontal	Pass
6**	9349.000	42.97	19.40	54.0	-11.03	AV	335.00	150	Horizontal	Pass
6	9349.000	53.22	19.40	74.0	-20.78	Peak	335.00	150	Horizontal	Pass

HIGH CHANNEL 1 GHz to 10 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1375.000	24.51	-19.13	54.0	-29.49	AV	77.90	150	Vertical	Pass
1	1375.000	35.13	-19.13	74.0	-38.87	Peak	77.90	150	Vertical	Pass
2**	1828.500	42.93	-18.31	54.0	-11.07	AV	232.80	150	Vertical	Pass
2	1828.500	45.64	-18.31	74.0	-28.36	Peak	232.80	150	Vertical	Pass
3**	2687.500	30.18	-12.49	54.0	-23.82	AV	225.20	150	Vertical	Pass
3	2687.500	41.06	-12.49	74.0	-32.94	Peak	225.20	150	Vertical	Pass
4**	3658.000	44.86	-7.29	54.0	-9.14	AV	195.40	150	Vertical	Pass
4	3658.000	48.82	-7.29	74.0	-25.18	Peak	195.40	150	Vertical	Pass
5**	5560.000	35.54	-3.84	54.0	-18.46	AV	199.60	150	Vertical	Pass
5	5560.000	45.74	-3.84	74.0	-28.26	Peak	199.60	150	Vertical	Pass
6**	6399.000	45.61	-3.07	54.0	-8.39	AV	73.80	150	Vertical	Pass
6	6399.000	50.85	-3.07	74.0	-23.15	Peak	73.80	150	Vertical	Pass

HIGH CHANNEL 1 GHz to 10 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1454.500	24.64	-19.14	54.0	-29.36	AV	37.20	150	Horizontal	Pass
1	1454.500	35.00	-19.14	74.0	-39.00	Peak	37.20	150	Horizontal	Pass
2**	1829.000	49.29	-18.26	54.0	-4.71	AV	267.80	150	Horizontal	Pass
2	1829.000	50.48	-18.26	74.0	-23.52	Peak	267.80	150	Horizontal	Pass
3**	3657.000	47.26	-7.33	54.0	-6.74	AV	199.00	150	Horizontal	Pass
3	3657.000	50.46	-7.33	74.0	-23.54	Peak	199.00	150	Horizontal	Pass
4**	4570.000	34.33	-5.22	54.0	-19.67	AV	206.60	150	Horizontal	Pass
4	4570.000	47.23	-5.22	74.0	-26.77	Peak	206.60	150	Horizontal	Pass
5**	6401.000	43.16	-3.20	54.0	-10.84	AV	183.60	150	Horizontal	Pass
5	6401.000	49.63	-3.20	74.0	-24.37	Peak	183.60	150	Horizontal	Pass
6**	9267.250	42.47	18.75	54.0	-11.53	AV	293.30	150	Horizontal	Pass
6	9267.250	52.83	18.75	74.0	-21.17	Peak	293.30	150	Horizontal	Pass

A.8 Band Edge (Restricted-band band-edge)

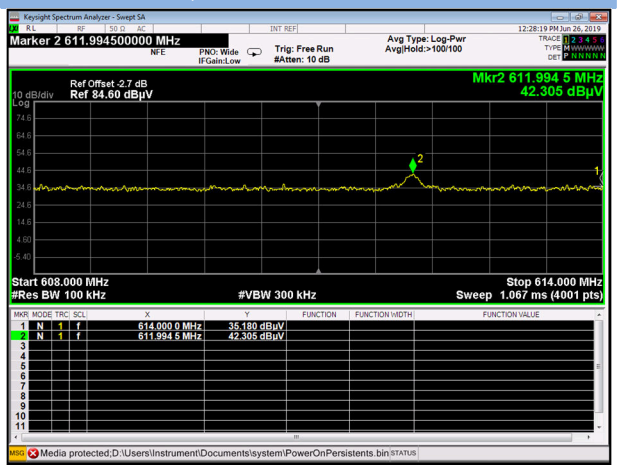
Note [1]: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.
Note [2]: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.
Note [3]: According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.
Note [4]: The Level (dBuV/m) has been corrected by factor.

Test Mode	Test Channel	Frequency (MHz)	Level (dBuV/m)	Factor (dB)	Limit Line (dBuV/m)	Margin (dB)	Remark	Verdict
LORA (125kHz)	Low	614	42.305	-2.7	74	31.695	PEAK	Pass
		614	N/A	N/A	54	N/A	AVERAGE	Pass
LORA (125kHz)	HIGH	960	53.336	29	74	20.664	PEAK	Pass
		960	N/A	N/A	54	N/A	AVERAGE	Pass
LORA (500kHz)	Low	614	41.572	-2.7	74	32.428	PEAK	Pass
		614	N/A	N/A	54	N/A	AVERAGE	Pass
LORA (500kHz)	HIGH	960	53.99	29	74	20.01	PEAK	Pass
		960	N/A	N/A	54	N/A	AVERAGE	Pass

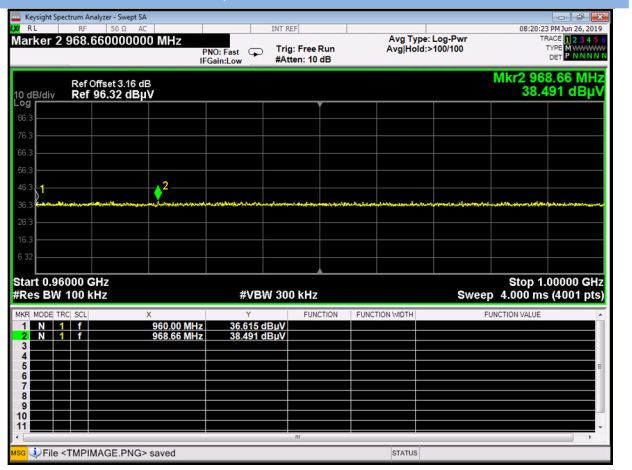
Test Plots

125kHz

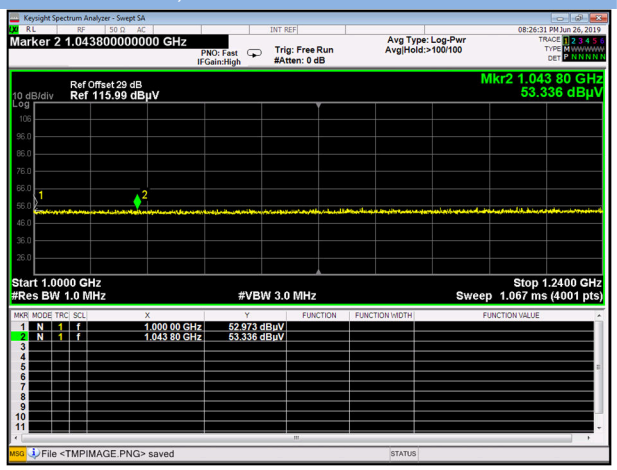
Below 30 MHz , PEAK



30 MHz ~ 1 GHz , PEAK

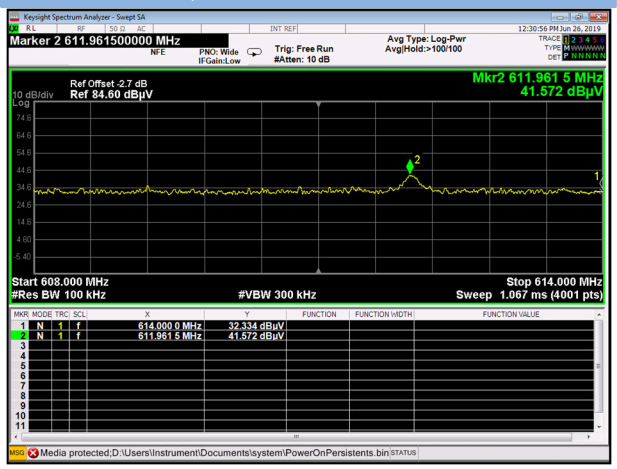


Above 1 GHz , PEAK

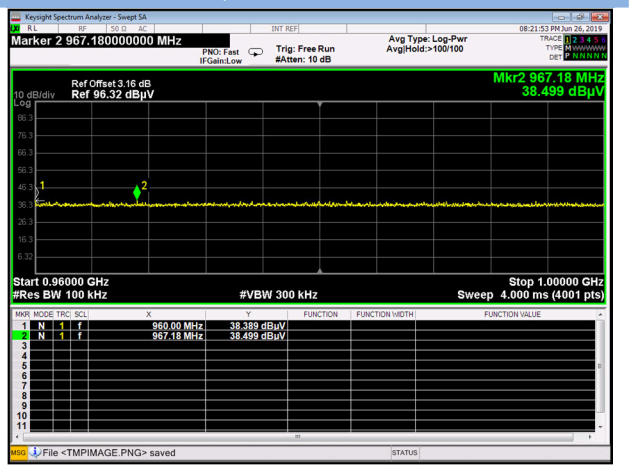


500kHz

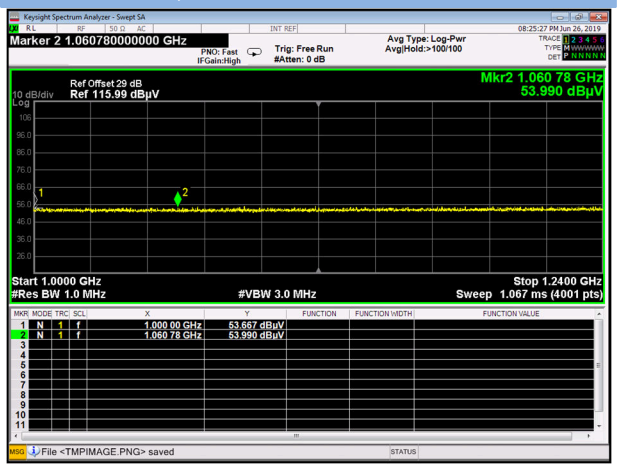
Below 30 MHz , PEAK



30 MHz ~ 1 GHz , PEAK



Above 1 GHz , PEAK



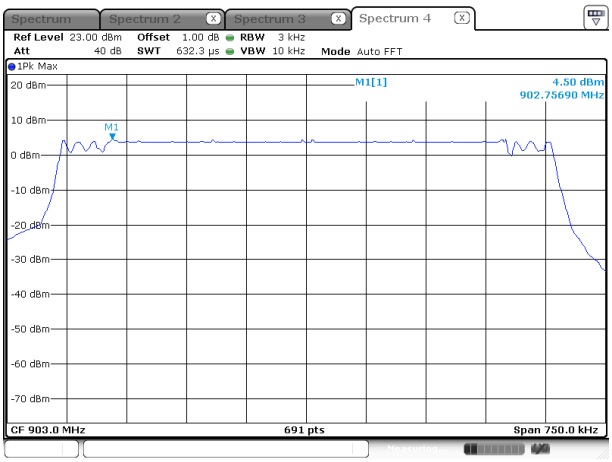
A.9 Power Spectral Density (PSD)

Test Data (500kHz)

Channel	Spectral power density (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
Low Channel	4.50	8	Pass
Middle Channel	4.49	8	Pass
High Channel	4.49	8	Pass

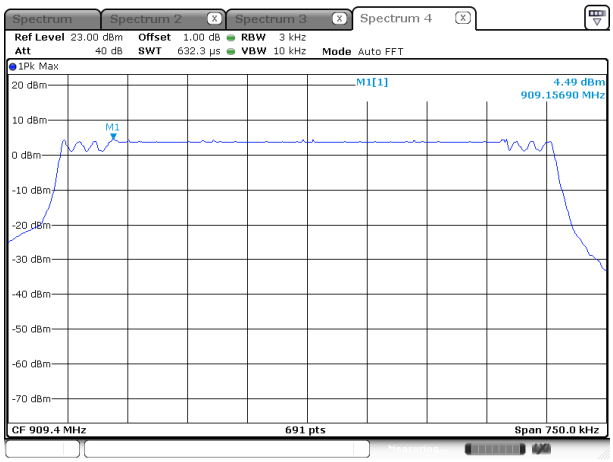
Test plots

LOW CHANNEL



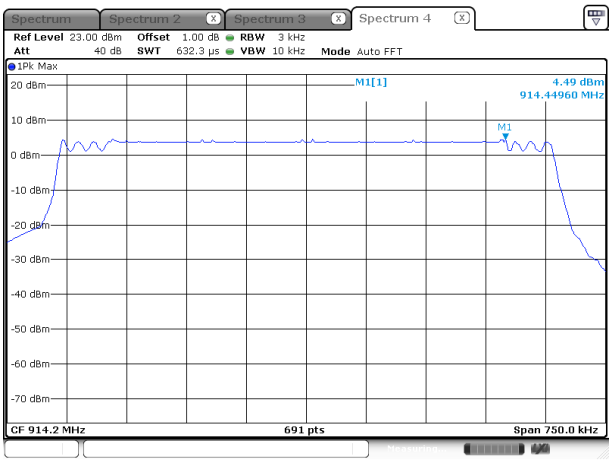
Date: 27.JUN.2019 23:16:58

MIDDLE CHANNEL



Date: 27.JUN.2019 23:18:06

HIGH CHANNEL



Date: 27.JUN.2019 23:24:02

ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ1960298-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ1960298-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ1960298-AI.PDF”.

--END OF REPORT--