FCC RADIO TEST REPORT

FCC ID	**:**	**2AVVJ-5273**
Equipment	**:**	**Digital Media Receiver**
Model Name	**:**	**L4S3RE**
Applicant	**:**	**Coral Creep LLC BROWNSBORO CROSSING 9850 VON ALLMEN COURT, SUITE 201, LOUISVILLE, KENTUCKY, 40241**
Standard	**:**	**FCC Part 15 Subpart C §15.247**

The product was received on Apr. 24, 2020 and testing was started from May 08, 2020 and completed on Jun. 29, 2020. We, SPORTON INTERNATIONAL INC., EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

Table of Contents

History of this test report

Report No.	Version	Description	Issued Date
FR012305-01E	01	Initial issue of report	Jul. 07, 2020

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)
3.1	15.247(a)(2)	6dB Bandwidth	Pass
3.1	2.1049	99% Occupied Bandwidth	Reporting only
3.2	15.247(b)(3)	Output Power	Pass
3.3	15.247(e)	Power Spectral Density	Pass
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	Pass
3.5	15.247(d)	Radiated Band Edges and Spurious Emission	Pass
3.6	15.207	AC Conducted Emission	Pass
3.7	15.203 & 15.247(b)	Antenna Requirement	Pass

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Wii Chang

Report Producer: Dara Chiu

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Digital Media Receiver
Model Name	L4S3RE
FCC ID	2AVVJ-5273
EUT supports Radios application	WLAN 11b/g/n HT20 WLAN 11a/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE Zigbee/FSK/LoRa

1.2 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	902.5 MHz ~ 926.5 MHz
Number of Channels	31
Maximum Output Power to Antenna	21.15 dBm (0.1303 W)
99% Occupied Bandwidth	0.535MHz
Antenna Type / Gain	PIFA Antenna with gain 2.92 dBi
Type of Modulation	LoRa

1.3 Modification of EUT

No modifications are made to the EUT during all test items.

1.4 Testing Location

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory	
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978	
Test Site No.	**Sporton Site No.**	
	TH05-HY	CO05-HY

Note: The test site complies with ANSI C63.4 2014 requirement.

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	03CH11-HY

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW1190 and TW0007

1.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- FCC KDB 414788 D01 Radiated Test Site v01r01
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
902 – 928 MHz	1	902.5	22	919.3
	2	903.3	23	920.1
	3	904.1	24	920.9
	4	904.9	25	921.7
	5	905.7	26	922.5
	6	906.5	27	923.3
	7	907.3	28	924.1
	8	908.1	29	924.9
	9	908.9	30	925.7
	10	909.7	31	926.5
	11	910.5		
	12	911.3		
	13	912.1		
	14	912.9		
	15	913.7		
	16	914.5		
	17	915.3		
	18	916.1		
	19	916.9		
	20	917.7		
	21	918.5		

2.2 Test Mode

a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

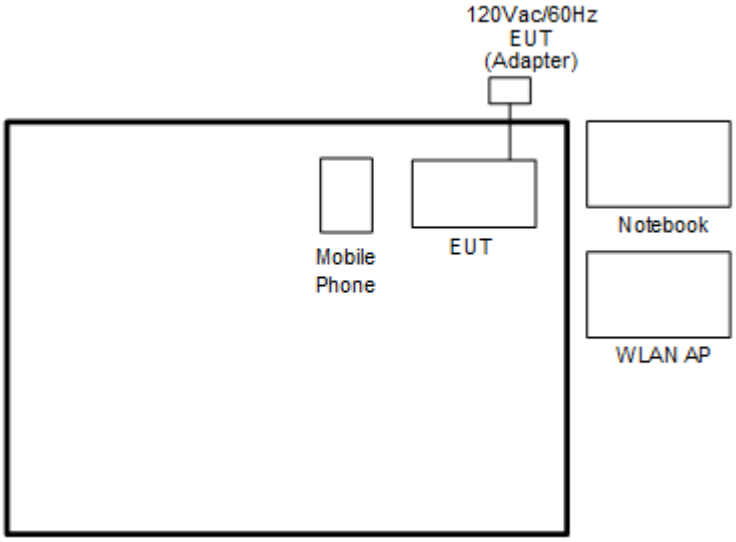
b. AC power line Conducted Emission was tested under maximum output power.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

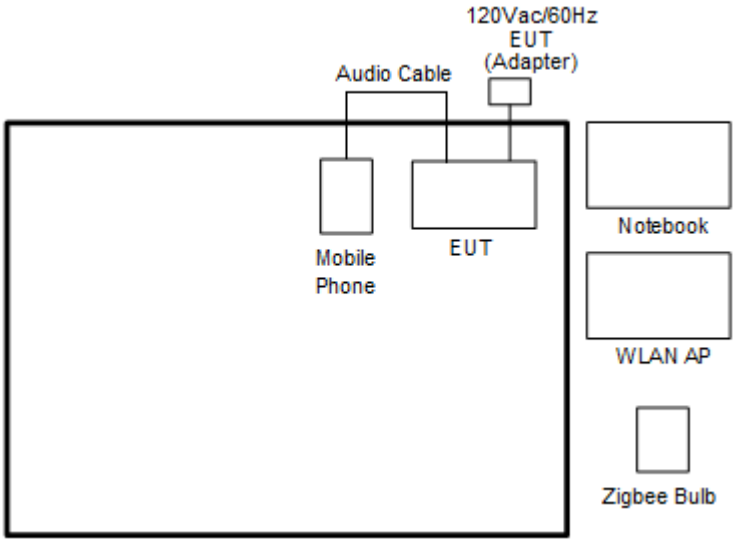
Summary table of Test Cases	
Test Item	**LoRa 500KHz DTS**
Conducted Test Cases	Mode 1: LoRa 500KHz DTS Tx CH01_902.5 MHz Mode 2: LoRa 500KHz DTS Tx CH16_914.5 MHz Mode 3: LoRa 500KHz DTS Tx CH31_926.5 MHz
Radiated Test Cases	Mode 1: LoRa 500KHz DTS Tx CH01_902.5 MHz Mode 2: LoRa 500KHz DTS Tx CH16_914.5 MHz Mode 3: LoRa 500KHz DTS Tx CH31_926.5 MHz
AC Conducted Emission	Mode 1: WLAN (2.4GHz) Link + Bluetooth Link + Internal Speaker play Bangarang + Adapter Mode 2: WLAN (2.4GHz) Link + Zigbee Link + Line in + Adapter Mode 3: LoRa Tx + Adapter
Remark: The worst case of conducted emission is mode 2; only the test data of it was reported.	

2.3 Connection Diagram of Test System

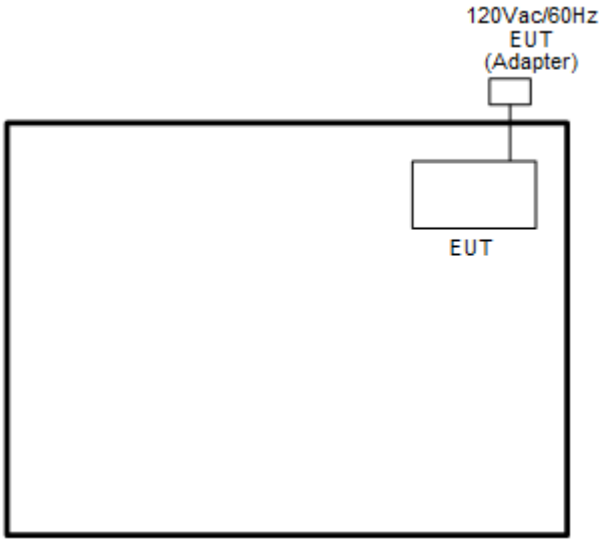
<AC Conducted Emission with Bluetooth Mode>



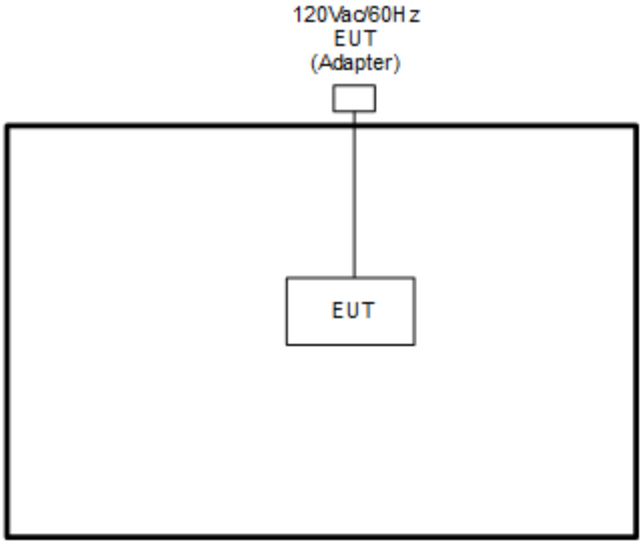
<AC Conducted Emission with Zigbee Mode>



<AC Conducted Emission Lora Tx Mode>



<LoRa Tx Mode>



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	ASUS	RT-AC66U	MSQ-RTAC66U	N/A	Unshielded,1.8m
2.	Notebook	DELL	Latitude E3400	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
3.	Zigbee Bulb	OSRAM	73674	DZO-IQHOME	N/A	N/A
4.	Smart Phone	Samsung	SM-A730F/DS	N/A	N/A	N/A

2.5 EUT Operation Test Setup

The RF test items, utility “Compliance v1.0.0.79” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

2.6 Measurement Results Explanation Example

For all conducted test items:

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

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 4.2 + 10 = 14.2 (dB)

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

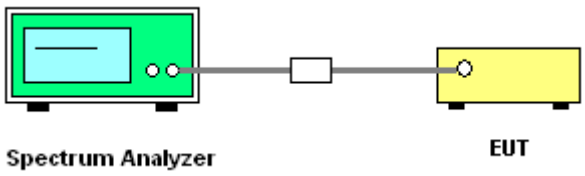
3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

3.1.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) ≥ 3 * RBW.
6. Measure and record the results in the test report.

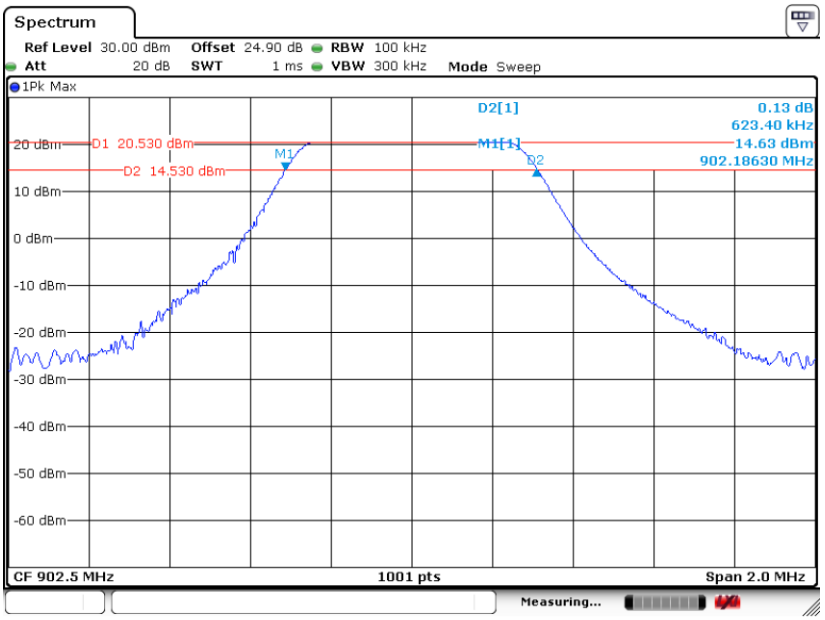
3.1.4 Test Setup



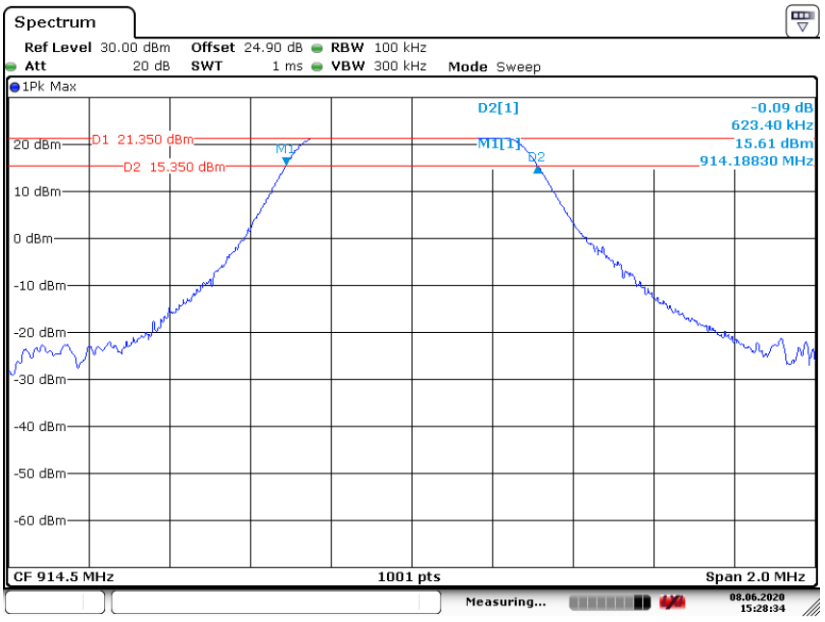
3.1.5 Test Result of 6dB Bandwidth

Please refer to Appendix A.

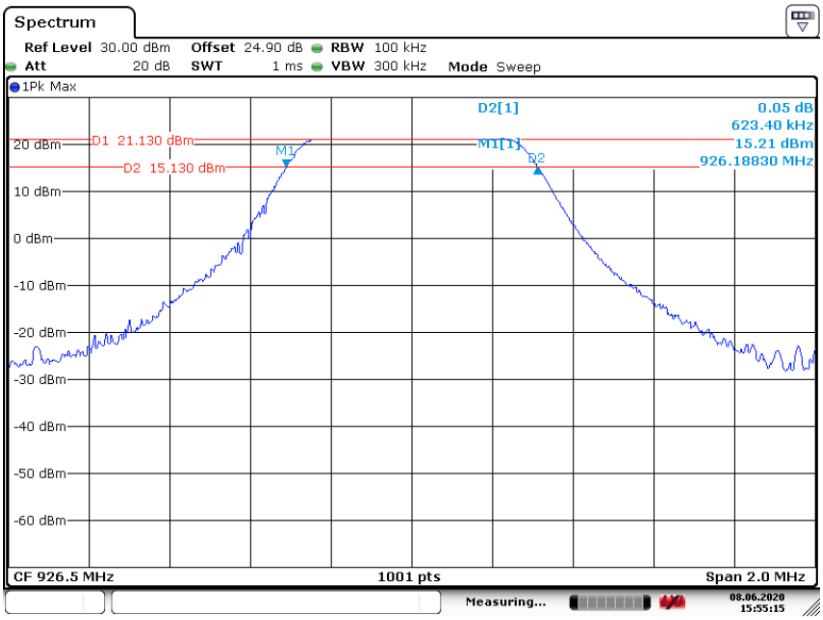
6 dB Bandwidth Plot on Channel 01



6 dB Bandwidth Plot on Channel 16



6 dB Bandwidth Plot on Channel 31

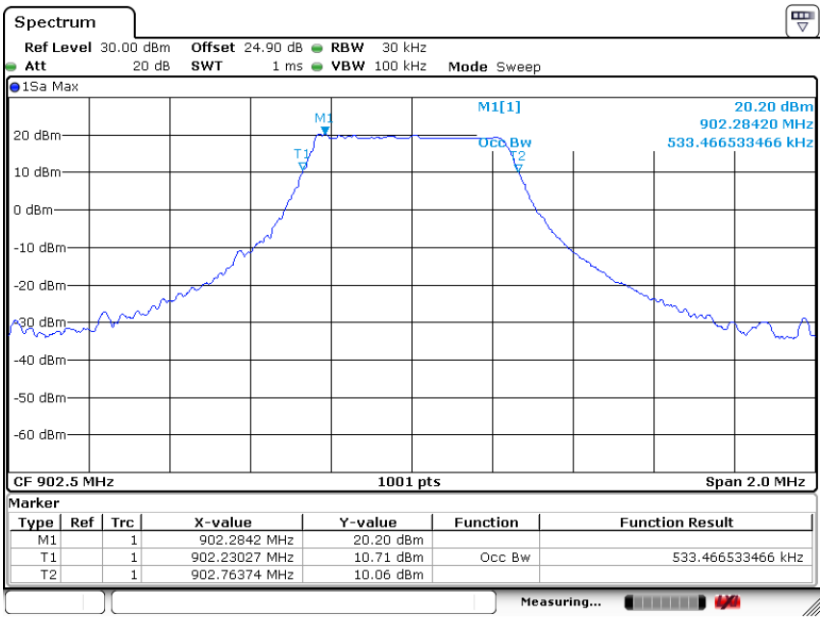


Date: 8.JUN.2020 15:55:15

3.1.6 Test Result of 99% Occupied Bandwidth

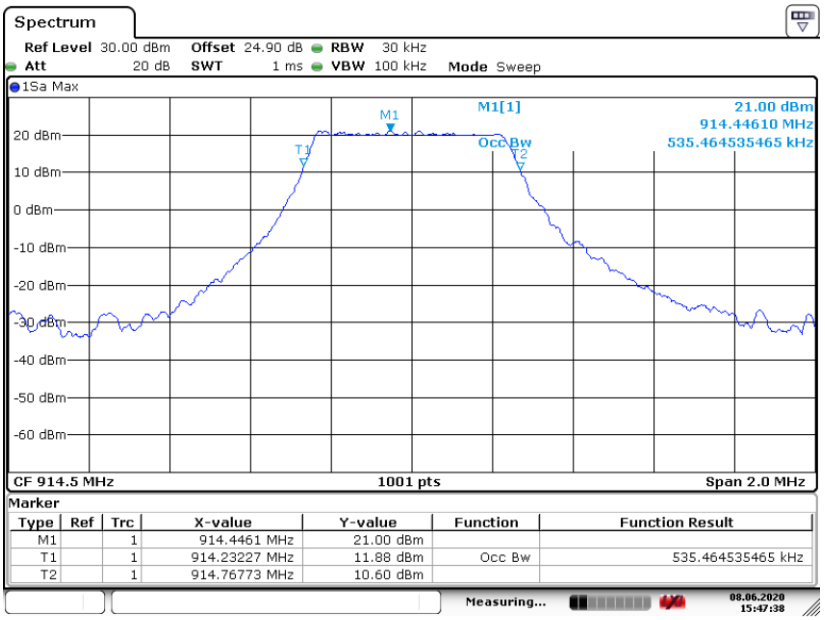
Please refer to Appendix A.

99% Bandwidth Plot on Channel 01



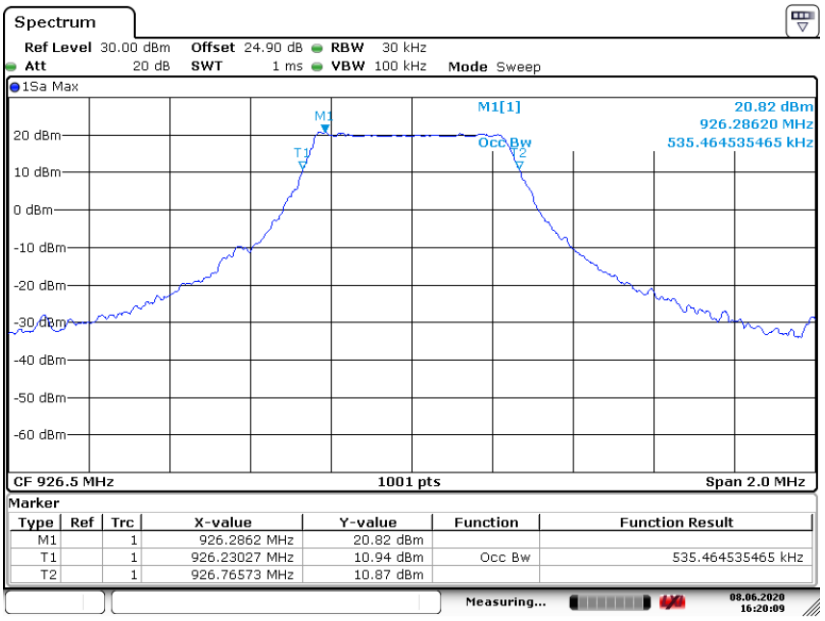
Date: 11.JUN.2020 15:17:28

99% Occupied Bandwidth Plot on Channel 16



Date: 8.JUN.2020 15:47:39

99% Occupied Bandwidth Plot on Channel 31



Date: 8.JUN.2020 16:20:10

Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Output Power Measurement

3.2.1 Limit of Output Power

Section 15.247(b)(3) For systems using digital modulation in the 902-928 MHz, the limit for peak output power is 1 watt.

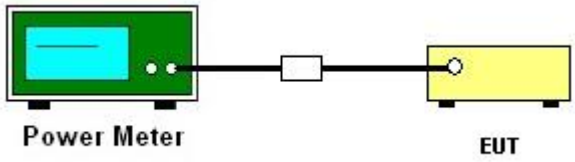
3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

3.2.3 Test Procedures

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
2. The RF output of EUT was connected to the power meter by RF cable and attenuator.
3. The path loss was compensated to the results for each measurement.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Average Output Power

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

3.3.2 Measuring Instruments

See list of measuring equipment of this test report.

3.3.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.10.3 Method AVGPSD-1.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = RMS, Sweep time = auto couple, Trace mode = Average, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100kHz is a reference level and used as 30dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

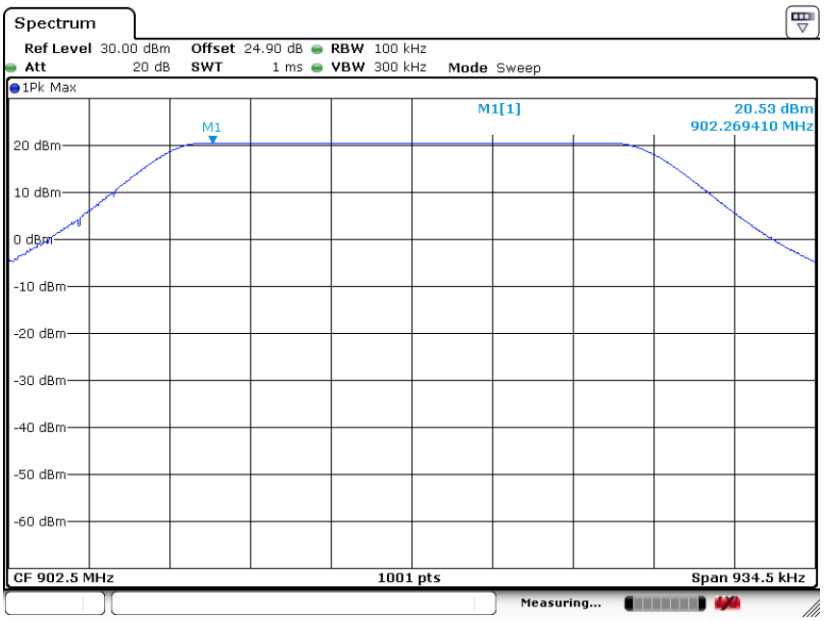
3.3.4 Test Setup

3.3.5 Test Result of Power Spectral Density

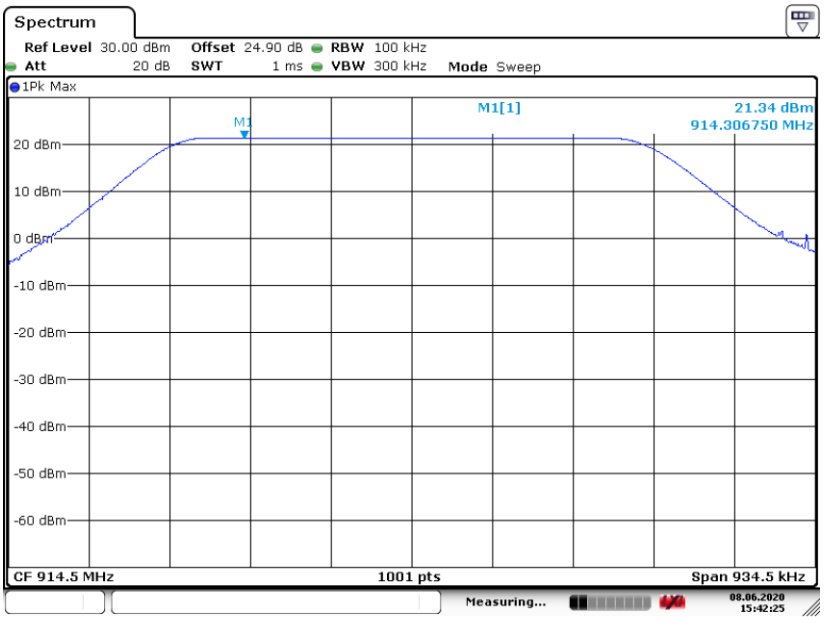
Please refer to Appendix A.

3.3.6 Test Result of Power Spectral Density Plots (100kHz)

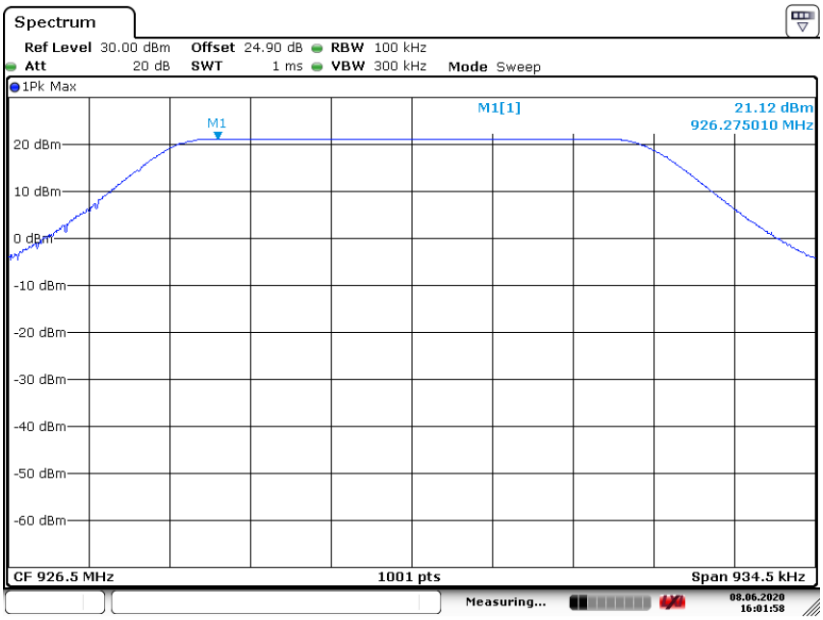
PSD 100kHz Plot on Channel 01



PSD 100kHz Plot on Channel 16



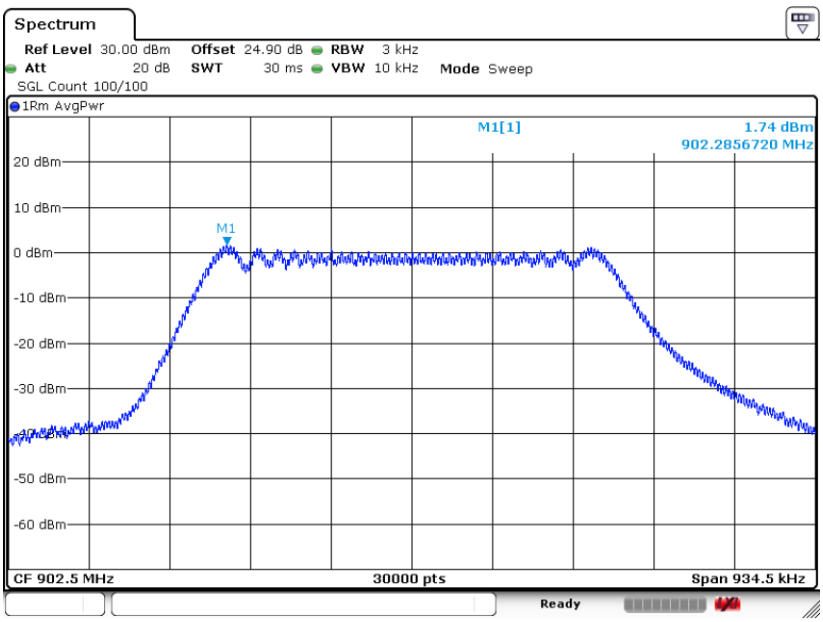
PSD 100kHz Plot on Channel 31



Date: 8.JUN.2020 16:01:58

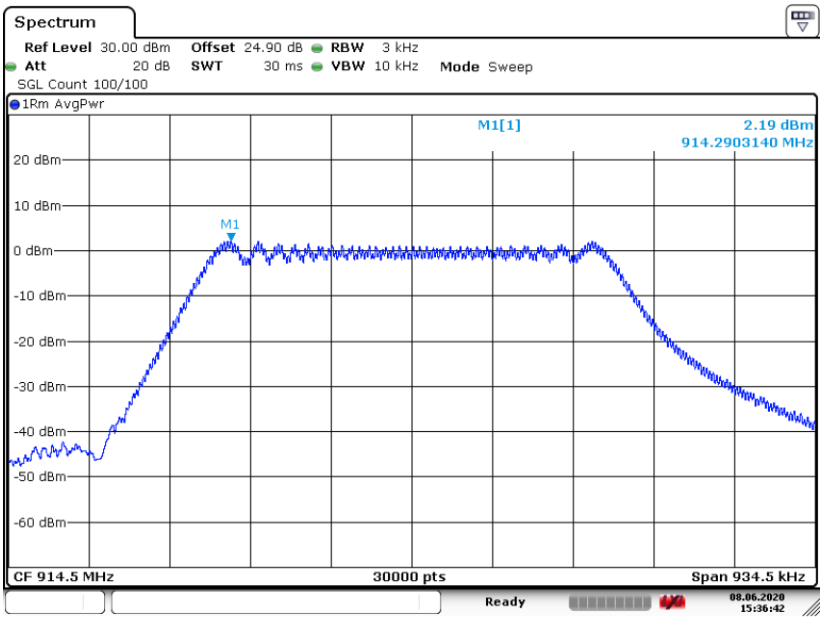
3.3.7 Test Result of Power Spectral Density Plots (3kHz)

PSD 3kHz Plot on Channel 01



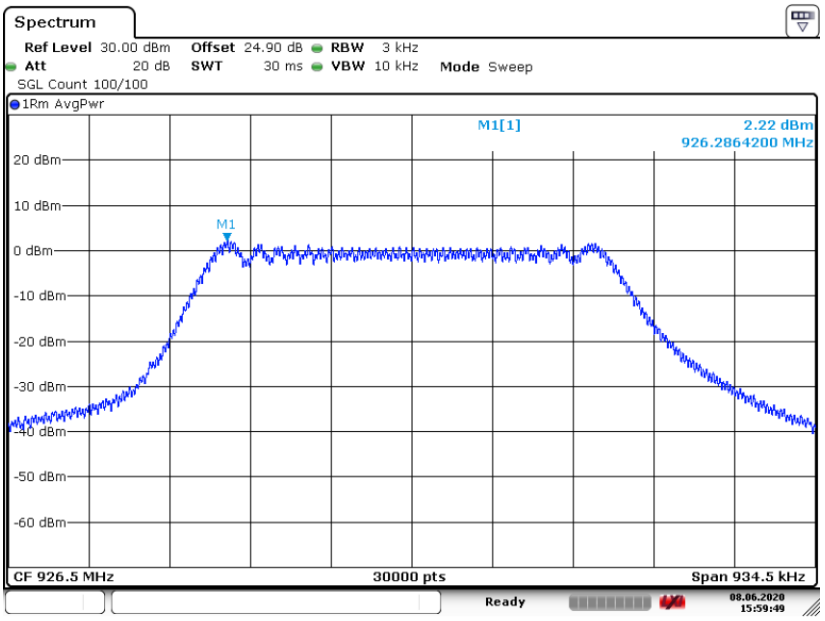
Date: 11.JUN.2020 13:05:02

PSD 3kHz Plot on Channel 16



Date: 8.JUN.2020 15:36:42

PSD 3kHz Plot on Channel 31



Date: 8.JUN.2020 15:59:49

3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

3.4.2 Measuring Instruments

See list of measuring equipment of this test report.

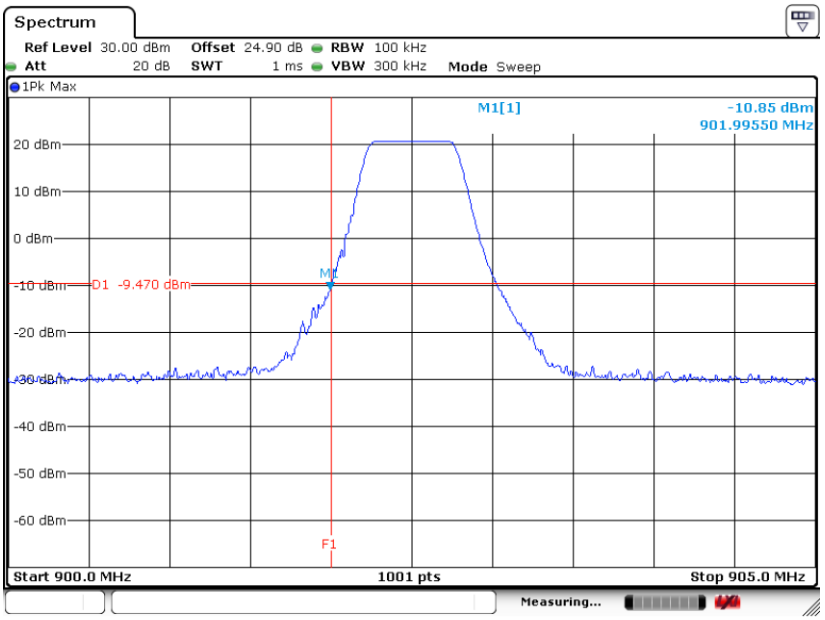
3.4.3 Test Procedure

1. The testing follows the ANSI C63.10 Section 11.11.3 Emission level measurement.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

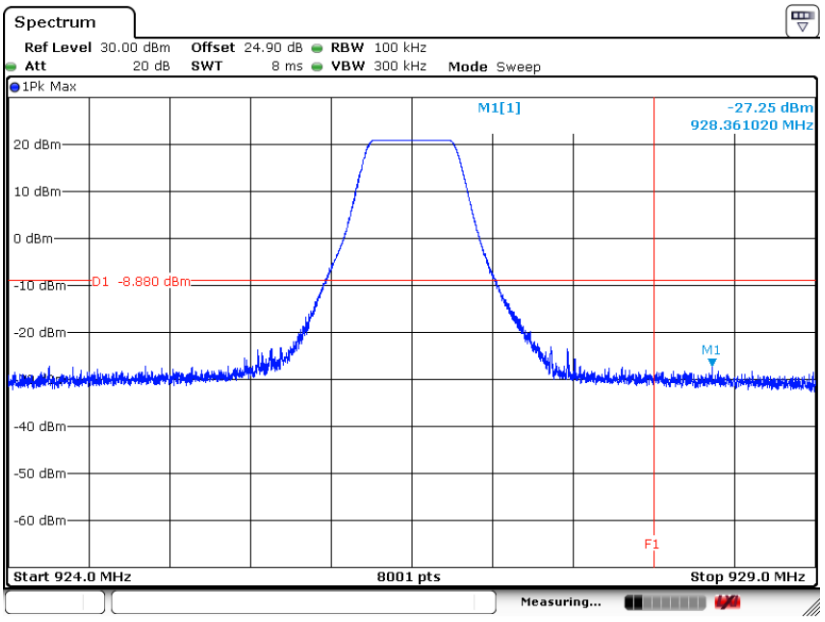
3.4.4 Test Setup

3.4.5 Test Result of Conducted Band Edges Plots

Low Band Edge Plot on Channel 01

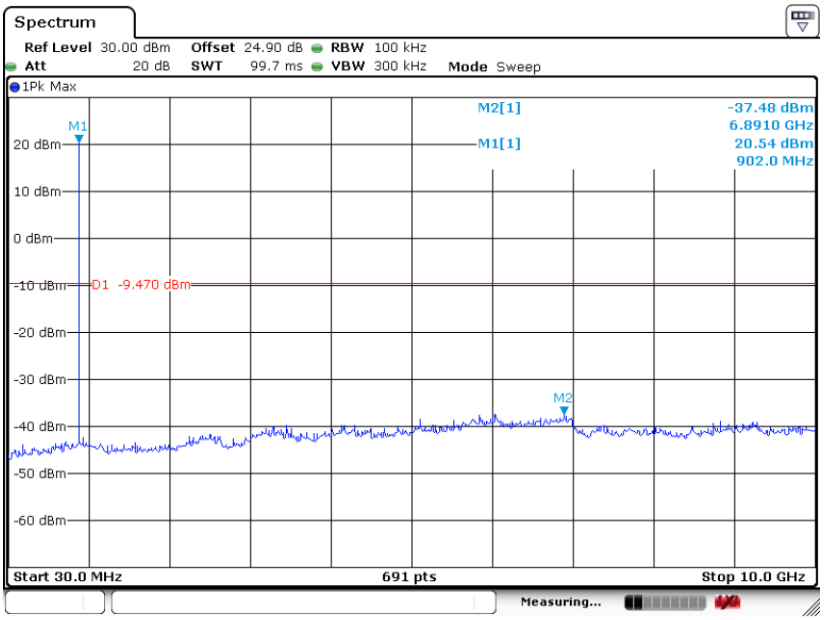


High Band Edge Plot on Channel 31

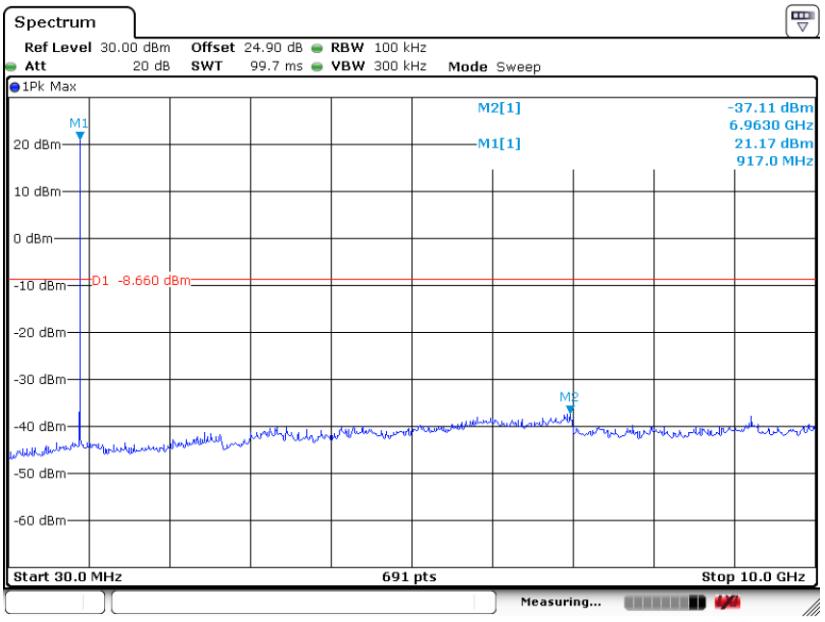


3.4.6 Test Result of Conducted Spurious Emission Plots

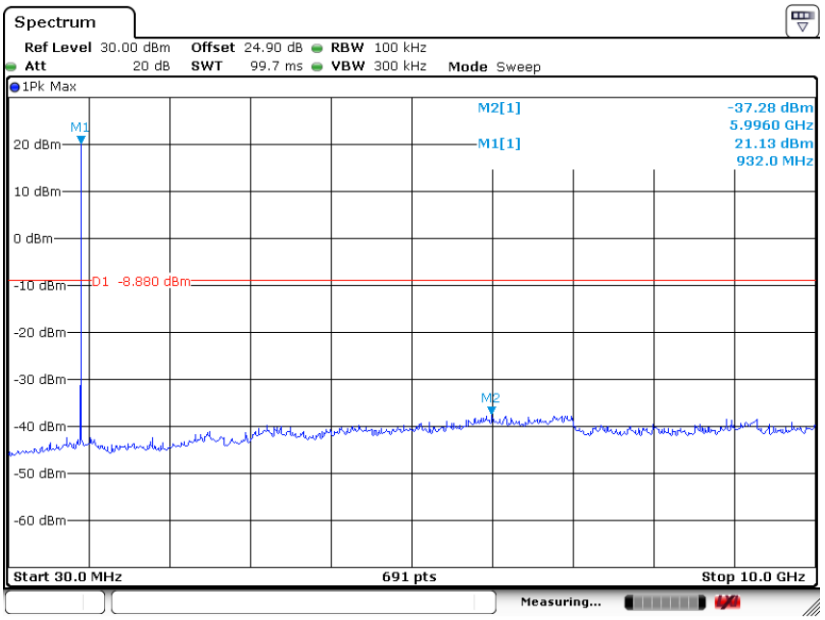
Conducted Spurious Emission Plot on Channel 01



Conducted Spurious Emission Plot on Channel 16



Conducted Spurious Emission Plot on Channel 31



3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.5.2 Measuring Instruments

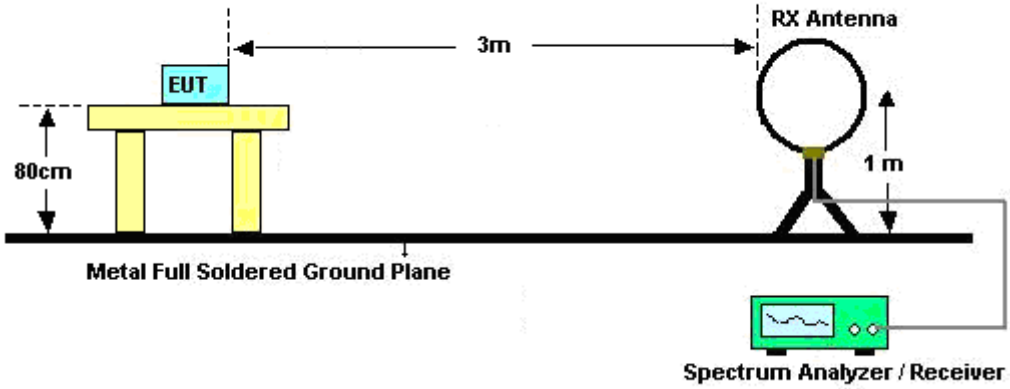
See list of measuring equipment of this test report.

3.5.3 Test Procedures

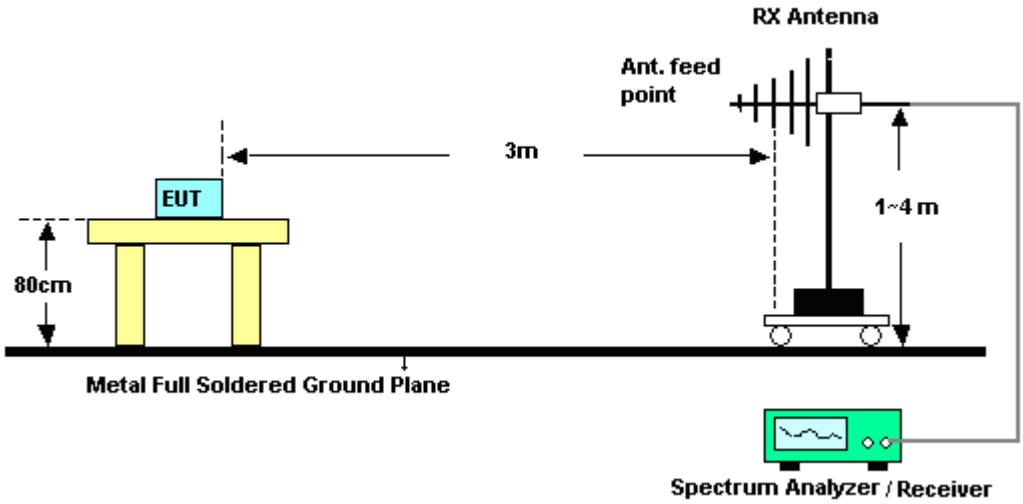
1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

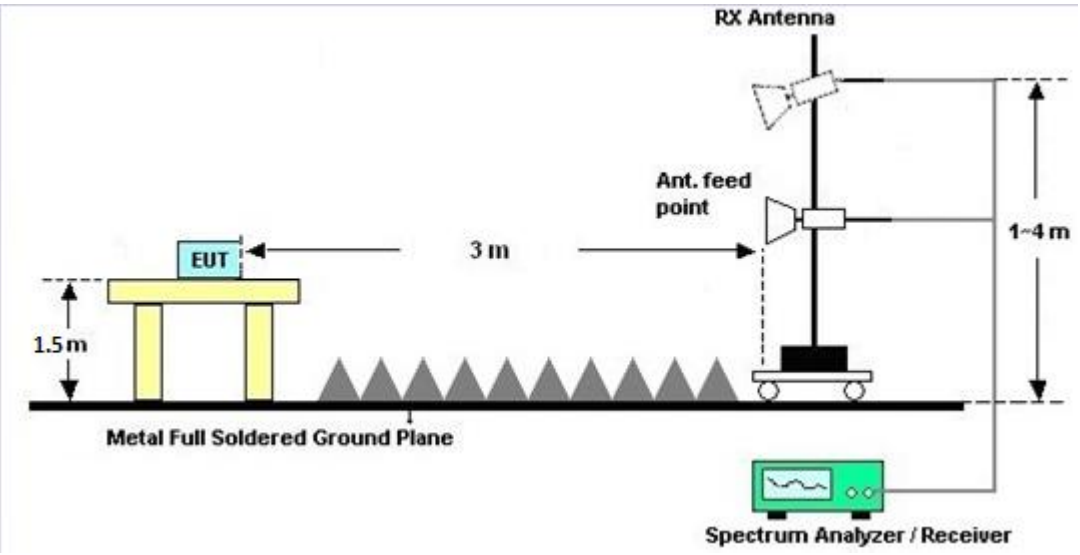
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.5.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C and D.

3.5.7 Duty Cycle

Please refer to Appendix E.

3.5.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix C and D.

3.6 AC Conducted Emission Measurement

3.6.1 Limit of AC Conducted Emission

For equipment 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 or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

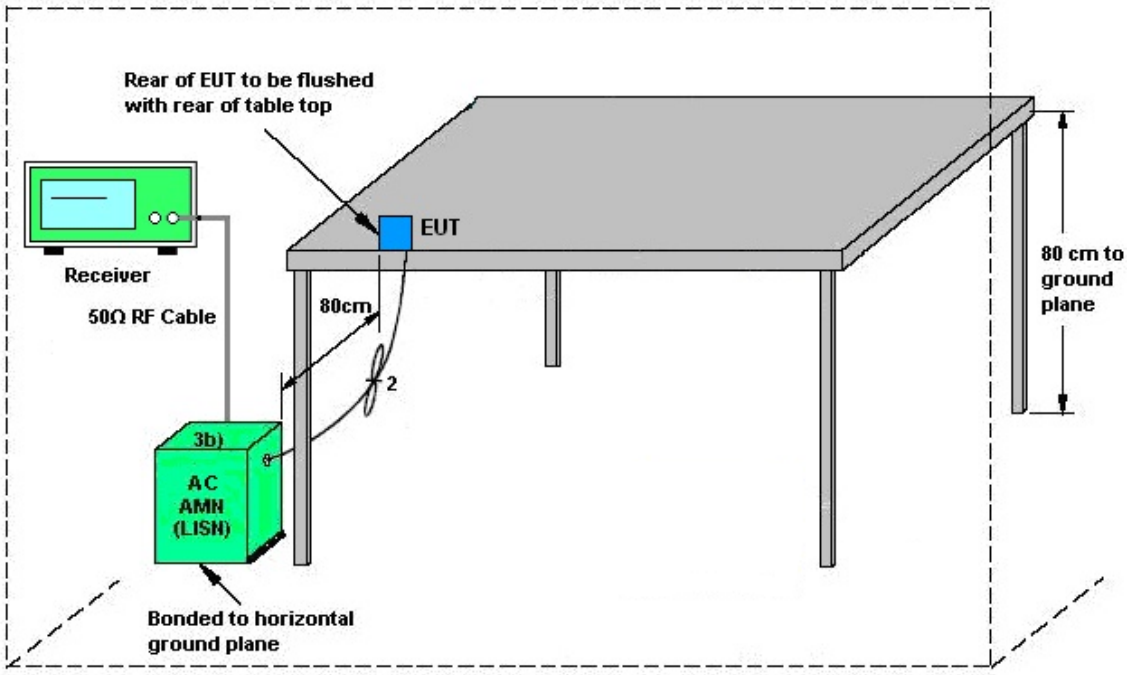
3.6.2 Measuring Instruments

See list of measuring equipment of this test report.

3.6.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.6.4 Test Setup



AMN = Artificial mains network (LISN)
AE = Associated equipment
EUT = Equipment under test
ISN = Impedance stabilization network

3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

3.7 Antenna Requirements

3.7.1 Standard Applicable

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

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 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.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Hygrometer	Testo	608-H1	34893241	N/A	Mar. 02. 2020	May 20, 2020 ~ Jun. 18, 2020	Mar. 01. 2021	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	16I00054SNO 10	10MHz~6GHz	Dec. 23, 2019	May 20, 2020 ~ Jun. 18, 2020	Dec. 22, 2020	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101566	10Hz~40GHz	Jul. 15, 2019	May 20, 2020 ~ Jun. 18, 2020	Jul. 14, 2020	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP40	100055	9kHz-40GHz	Dec. 30, 2019	May 20, 2020 ~ Jun. 18, 2020	Dec. 29, 2020	Conducted (TH05-HY)
Switch Control Manframe	Burgeon	ETF-058	EC1300484	N/A	Aug. 22, 2019	May 20, 2020 ~ Jun. 18, 2020	Aug. 21, 2020	Conducted (TH05-HY)
Power Meter	Agilent	E4416A	GB41292344	N/A	Dec. 27, 2019	May 20, 2020 ~ Jun. 18, 2020	Dec. 26, 2020	Conducted (TH05-HY)
Power Sensor	Agilent	E9327A	US40441548	50MHz~18GHz	Dec. 27, 2019	May 20, 2020 ~ Jun. 18, 2020	Dec. 26, 2020	Conducted (TH05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Jun. 26, 2020	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102388	9kHz~3.6GHz	Nov. 15, 2019	Jun. 26, 2020	Nov. 14, 2020	Conduction (CO05-HY)
Hygrometer	Testo	608-H1	34913912	N/A	Nov. 07, 2019	Jun. 26, 2020	Nov. 06, 2020	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Nov. 15, 2019	Jun. 26, 2020	Nov. 14, 2020	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32 V10.30	N/A	N/A	N/A	Jun. 26, 2020	N/A	Conduction (CO05-HY)
LF Cable	HUBER + SUHNER	RG-214/U	LF01	N/A	Jan. 02, 2020	Jun. 26, 2020	Jan. 01, 2021	Conduction (CO05-HY)
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100851	N/A	Jan. 02, 2020	Jun. 26, 2020	Jan. 01, 2021	Conduction (CO05-HY)
Preamplifier	EMCE	EM18G40G	060715	18GHz ~ 40GHz	Dec. 13, 2019	Jun. 29, 2020	Dec. 12, 2020	Radiation (03CH11-HY)
Amplifier	SONOMA	310N	187312	9kHz~1GHz	Dec. 03, 2019	May 08, 2020 ~ Jun. 29, 2020	Dec. 02, 2020	Radiation (03CH11-HY)
Bilog Antenna	TESEQ	CBL 6111D & N-6-06	35414 & AT-N0602	30MHz~1GHz	Oct. 12, 2019	May 08, 2020 ~ Jun. 29, 2020	Oct. 11, 2020	Radiation (03CH11-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1326	1GHz ~ 18GHz	Nov. 04, 2019	May 08, 2020 ~ Jun. 29, 2020	Nov. 03, 2020	Radiation (03CH11-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Dec. 26, 2019	May 08, 2020 ~ Jun. 29, 2020	Dec. 25, 2020	Radiation (03CH11-HY)
Preamplifier	Keysight	83017A	MY53270080	1GHz~26.5GHz	Nov. 13, 2019	May 08, 2020 ~ Jun. 29, 2020	Nov. 12, 2020	Radiation (03CH11-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200486	10Hz ~ 44GHz	Oct. 28, 2019	May 08, 2020 ~ Jun. 29, 2020	Oct. 27, 2020	Radiation (03CH11-HY)
Controller	EMEC	EM 1000	N/A	Control Turn table & Ant Mast	N/A	May 08, 2020 ~ Jun. 29, 2020	N/A	Radiation (03CH11-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	May 08, 2020 ~ Jun. 29, 2020	N/A	Radiation (03CH11-HY)
Turn Table	EMEC	TT 2000	N/A	0~360 Degree	N/A	May 08, 2020 ~ Jun. 29, 2020	N/A	Radiation (03CH11-HY)
Preamplifier	Jet-Power	JPA0118-55-303K	1710001800054002	1GHz~18GHz	Aug. 06, 2019	May 08, 2020 ~ Jun. 29, 2020	Aug. 05, 2020	Radiation (03CH11-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170576	18GHz- 40GHz	May 22, 2020	Jun. 29, 2020	May 21, 2021	Radiation (03CH11-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200486	10Hz~44GHz	Oct. 28, 2019	May 08, 2020 ~ Jun. 29, 2020	Oct. 27, 2020	Radiation (03CH11-HY)
Software	Audix	E3 6.2009-8-24	RK-001053	N/A	N/A	May 08, 2020 ~ Jun. 29, 2020	N/A	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4PE	9kHz-30MHz	Mar. 12, 2020	May 08, 2020 ~ Jun. 29, 2020	Mar. 11, 2021	Radiation (03CH11-HY)

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2859/2	30MHz-40GHz	Mar. 12, 2020	May 08, 2020 ~ Jun. 29, 2020	Mar. 11, 2021	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4PE	30M-18G	Mar. 12, 2020	May 08, 2020 ~ Jun. 29, 2020	Mar. 11, 2021	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY4274/2	30MHz-40GHz	Mar. 12, 2020	May 08, 2020 ~ Jun. 29, 2020	Mar. 11, 2021	Radiation (03CH11-HY)
Filter	Wainwright	WLK4-1000-1530-8000-40SS	SN11	1.53G Low Pass	Sep. 15, 2019	May 08, 2020 ~ Jun. 29, 2020	Sep. 14, 2020	Radiation (03CH11-HY)
Filter	Wainwright	WHKX12-2700-3000-18000-60SS	SN3	3GHz High Pass Filter	Sep. 15, 2019	May 08, 2020 ~ Jun. 29, 2020	Sep. 14, 2020	Radiation (03CH11-HY)
Filter	Wainwright	WHKX12-935-1000-15000-40ST	SN1	1GHz High Pass Filter	Apr. 30, 2020	May 08, 2020 ~ Jun. 29, 2020	Apr. 29, 2021	Radiation (03CH11-HY)
Hygrometer	TECPEL	DTN-303B	TP140325	N/A	Nov. 07, 2019	May 08, 2020 ~ Jun. 29, 2020	Nov. 06, 2020	Radiation (03CH11-HY)
Hygrometer	TECPEL	DTN-303B	TP161237	N/A	Oct. 25, 2019	May 08, 2020 ~ Jun. 29, 2020	Oct. 24, 2020	Radiation (03CH11-HY)

5 Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.3**

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.2**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.2**

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.3**

Appendix A. Test Result of Conducted Test Items

Test Engineer	Shiming Liu	Temperature:	21.4~23.7	°C
Test Date:	2020/5/20~2020/6/18	Relative Humidity:	51~57.8	%

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
Lora	1	1	902.5	0.533	0.623	0.50	Pass
Lora	1	16	914.5	0.535	0.623	0.50	Pass
Lora	1	31	926.5	0.535	0.623	0.50	Pass

TEST RESULTS DATA
Average Power Table

Mod.	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
Lora	1	1	902.5	20.45	30.00	2.92	23.37	36.00	Pass
Lora	1	16	914.5	21.15	30.00	2.92	24.07	36.00	Pass
Lora	1	31	926.5	20.95	30.00	2.92	23.87	36.00	Pass

TEST RESULTS DATA
Average Power Density

Mod.	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Average PSD (dBm /3kHz)	DG (dBi)	Average PSD Limit (dBm /3kHz)	Pass/Fail
Lora	1	1	902.5	20.53	1.74	2.92	8.00	Pass
Lora	1	16	914.5	21.34	2.19	2.92	8.00	Pass
Lora	1	31	926.5	21.12	2.22	2.92	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.

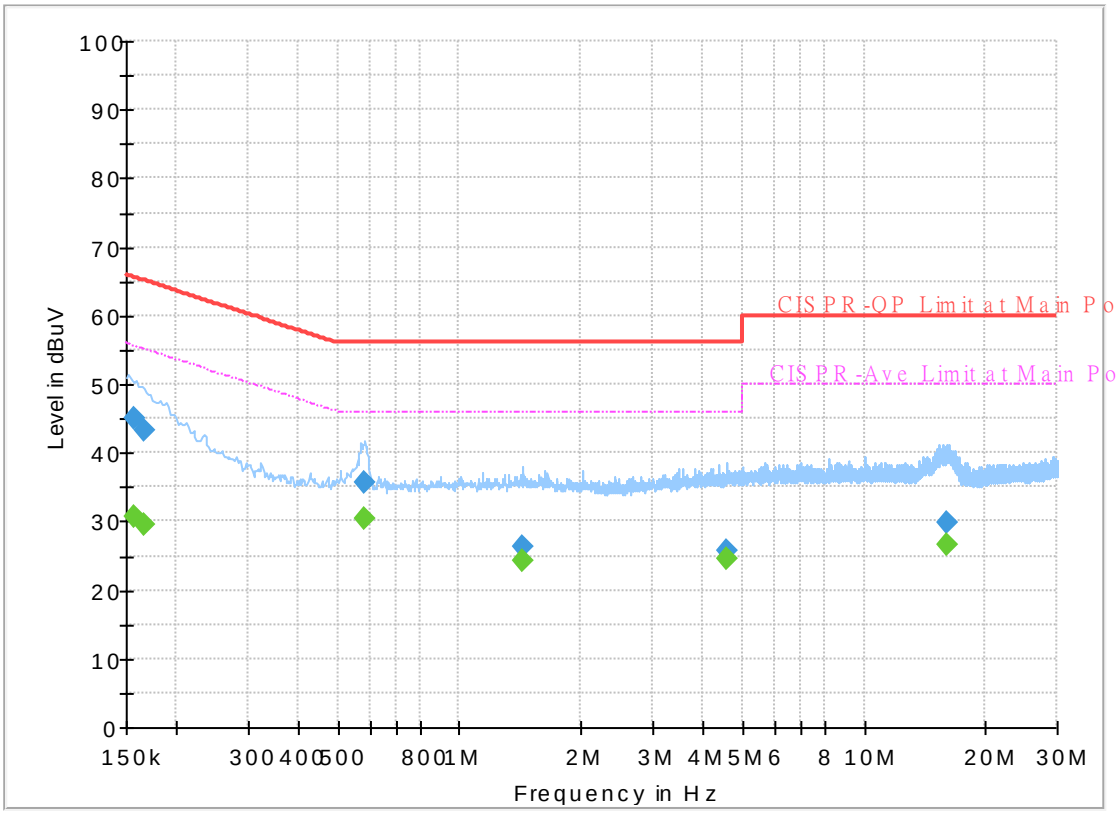
Appendix B. AC Conducted Emission Test Results

Test Engineer :	Tom Lee	**Temperature :**	23~25℃
		Relative Humidity :	42~50%

EUT Information

Report NO :	012305-01
Test Mode :	Mode 2
Test Voltage :	120Vac/60Hz
Phase :	Line

Full Spectrum



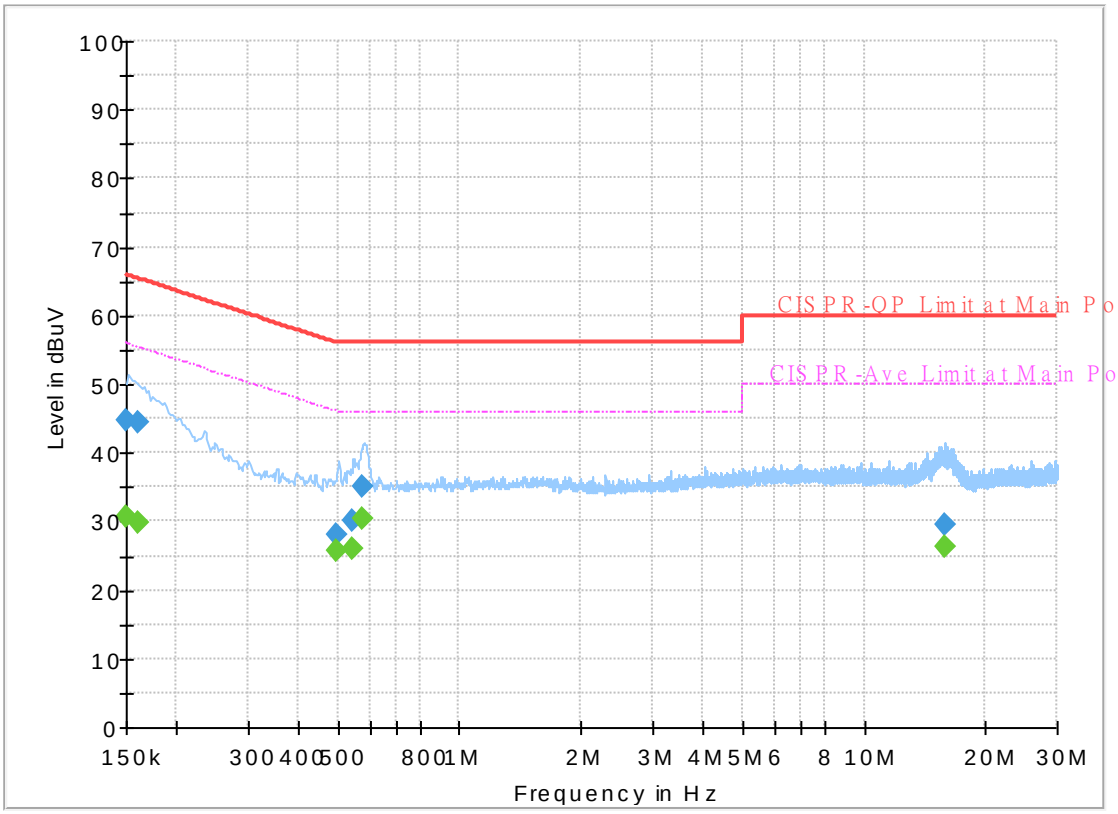
Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.156750	---	30.71	55.63	24.92	L1	OFF	19.6
0.156750	45.10	---	65.63	20.53	L1	OFF	19.6
0.165750	---	29.48	55.17	25.69	L1	OFF	19.6
0.165750	43.31	---	65.17	21.86	L1	OFF	19.6
0.582090	---	30.55	46.00	15.45	L1	OFF	19.6
0.582090	35.66	---	56.00	20.34	L1	OFF	19.6
1.432860	---	24.41	46.00	21.59	L1	OFF	19.6
1.432860	26.42	---	56.00	29.58	L1	OFF	19.6
4.564230	---	24.58	46.00	21.42	L1	OFF	19.8
4.564230	25.61	---	56.00	30.39	L1	OFF	19.8
16.052190	---	26.52	50.00	23.48	L1	OFF	20.3
16.052190	29.79	---	60.00	30.21	L1	OFF	20.3

EUT Information

Report NO :	012305-01
Test Mode :	Mode 2
Test Voltage :	120Vac/60Hz
Phase :	Neutral

Full Spectrum



Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.150000	---	30.62	56.00	25.38	N	OFF	19.6
0.150000	44.77	---	66.00	21.23	N	OFF	19.6
0.161250	---	29.96	55.40	25.44	N	OFF	19.5
0.161250	44.41	---	65.40	20.99	N	OFF	19.5
0.498750	---	25.63	46.02	20.39	N	OFF	19.5
0.498750	28.18	---	56.02	27.84	N	OFF	19.5
0.546270	---	26.13	46.00	19.87	N	OFF	19.5
0.546270	29.97	---	56.00	26.03	N	OFF	19.5
0.577950	---	30.38	46.00	15.62	N	OFF	19.5
0.577950	35.16	---	56.00	20.84	N	OFF	19.5
15.907740	---	26.18	50.00	23.82	N	OFF	19.9
15.907740	29.53	---	60.00	30.47	N	OFF	19.9

Appendix C. Radiated Spurious Emission

Test Engineer :	Cookie Ku, Fu Chen, and Troye Hsieh	Temperature :	19.1~26.3°C
		Relative Humidity :	50.2~69.1%

LoRa (Harmonic @ 3m)

LoRa ANT 4	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
LoRa CH 01 902.5Hz		2707.5	38.72	-35.28	74	65.61	27.6	8.16	62.65	100	0	P	H
		3610	39.18	-34.82	74	62.79	29.02	9.12	61.75	100	0	P	H
		2707.5	38.9	-35.1	74	65.79	27.6	8.16	62.65	100	0	P	V
		3610	40.26	-33.74	74	63.87	29.02	9.12	61.75	100	0	P	V
LoRa CH 16 914.5MHz		2743.5	39.05	-34.95	74	65.87	27.6	8.19	62.61	100	0	P	H
		3658	38.46	-35.54	74	61.87	29.08	9.19	61.68	100	0	P	H
		2743.5	37.51	-36.49	74	64.33	27.6	8.19	62.61	100	0	P	V
		3658	38.02	-35.98	74	61.43	29.08	9.19	61.68	100	0	P	V
LoRa CH 31 926.5MHz		2779.5	39.12	-34.88	74	65.67	27.78	8.23	62.56	100	0	P	H
		3706	39.86	-34.14	74	63.19	29.01	9.27	61.61	100	0	P	H
		2779.5	39.83	-34.17	74	66.38	27.78	8.23	62.56	100	0	P	V
		3706	39.12	-34.88	74	62.45	29.01	9.27	61.61	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

LoRa (LF)

LoRa	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
ANT				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
4		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
LoRa CH 01 902.5MHz LF		30.97	30.01	-9.99	40	27.91	23.86	10.66	32.42	-	-	P	H
		83.35	33.94	-6.06	40	41.53	13.63	11.21	32.43	-	-	P	H
		134.76	33.71	-9.79	43.5	37.41	17.2	11.55	32.45	-	-	P	H
		718.7	37.69	-8.31	46	29.37	26.52	13.72	31.92	-	-	P	H
		764.29	38.86	-7.14	46	29.22	27.81	13.89	32.06	-	-	P	H
		815.7	39.39	-6.61	46	29.63	27.84	14.01	32.09	-	-	P	H
	*	902.5	114.99	-	-	103.61	28.85	14.23	31.7	155	164	P	H
		42.61	31.53	-8.47	40	35.29	17.91	10.82	32.49	-	-	P	V
		83.35	33.62	-6.38	40	41.21	13.63	11.21	32.43	-	-	P	V
		126.03	30.31	-13.19	43.5	33.98	17.32	11.44	32.43	-	-	P	V
		639.16	37	-9	46	29.41	26.31	13.55	32.27	-	-	P	V
		702.21	36.9	-9.1	46	28.79	26.34	13.65	31.88	-	-	P	V
		770.11	38.63	-7.37	46	28.94	27.86	13.9	32.07	-	-	P	V
	*	902.5	115.19	-	-	103.81	28.85	14.23	31.7	204	151	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

LoRa ANT 4	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
LoRa CH 16 914.5MHz LF		61.04	29.06	-10.94	40	38.94	11.61	11.01	32.5	-	-	P	H
		111.48	31.43	-12.07	43.5	35.82	16.66	11.35	32.4	-	-	P	H
		152.22	34.72	-8.78	43.5	38.8	16.73	11.68	32.49	-	-	P	H
		634.31	37.11	-8.89	46	29.79	26.1	13.52	32.3	-	-	P	H
		741.98	37.9	-8.1	46	28.54	27.52	13.83	31.99	-	-	P	H
		796.3	39.03	-6.97	46	29.22	28.02	13.94	32.15	-	-	P	H
	*	914.5	113.72	-	-	102.11	28.89	14.26	31.54	385	135	P	H
		35.82	33.9	-6.1	40	34.33	21.29	10.73	32.45	-	-	P	V
		44.55	32.03	-7.97	40	36.83	16.87	10.84	32.51	-	-	P	V
		72.68	31.14	-8.86	40	40.32	12.18	11.11	32.47	-	-	P	V
		667.29	36.87	-9.13	46	29.15	26.2	13.61	32.09	-	-	P	V
		749.74	37.95	-8.05	46	28.34	27.75	13.87	32.01	-	-	P	V
		816.67	38.27	-7.73	46	28.51	27.83	14.02	32.09	-	-	P	V
	*	914.5	114.25	-	-	102.64	28.89	14.26	31.54	208	182	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

LoRa ANT 4	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
LoRa CH 31 926.5MHz LF		82.38	30	-10	40	37.65	13.59	11.2	32.44	-	-	P	H
		133.79	30.23	-13.27	43.5	33.82	17.31	11.55	32.45	-	-	P	H
		161.92	28.61	-14.89	43.5	33.31	16.06	11.75	32.51	-	-	P	H
		731.31	37.8	-8.2	46	28.97	27	13.79	31.96	-	-	P	H
		790.48	39.35	-6.65	46	29.55	27.99	13.94	32.13	-	-	P	H
		838.01	38.77	-7.23	46	28.43	28.25	14.09	32	-	-	P	H
	*	926.5	113.77	-	-	101.79	29.06	14.3	31.38	351	151	P	H
		42.61	32.16	-7.84	40	35.92	17.91	10.82	32.49	-	-	P	V
		79.47	31.99	-8.01	40	40.22	13.04	11.18	32.45	-	-	P	V
		135.73	28.89	-14.61	43.5	32.59	17.19	11.57	32.46	-	-	P	V
		516.94	35.45	-10.55	46	31.21	23.82	13.16	32.74	-	-	P	V
		793.39	39.02	-6.98	46	29.22	28	13.94	32.14	-	-	P	V
		843.83	39.07	-6.93	46	28.37	28.56	14.11	31.97	-	-	P	V
	*	926.5	114.56	-	-	102.58	29.06	14.3	31.38	118	173	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 00 2402MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =

Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

3. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

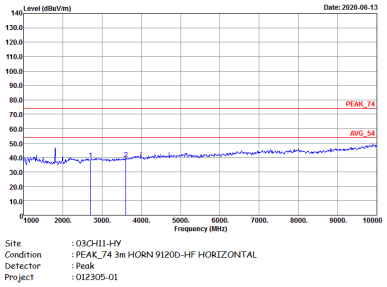
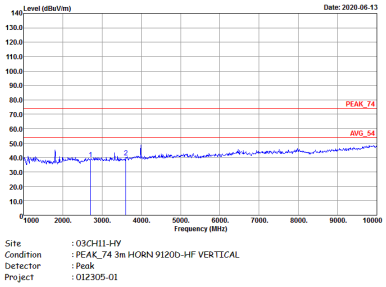
= -10.46(dB)

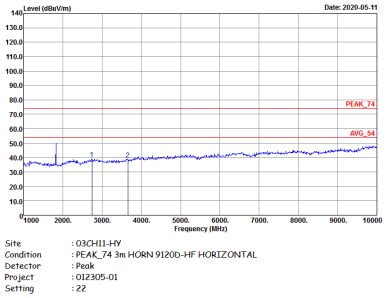
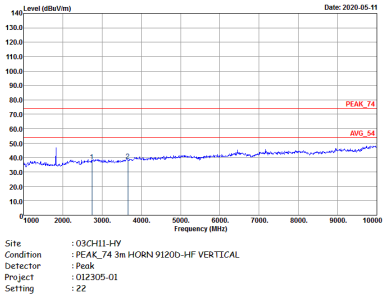
Both peak and average measured complies with the limit line, so test result is “PASS”.

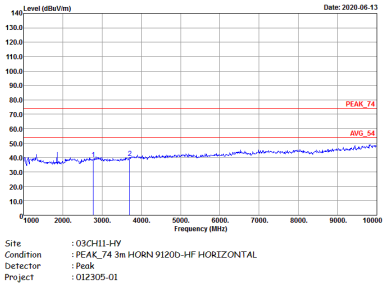
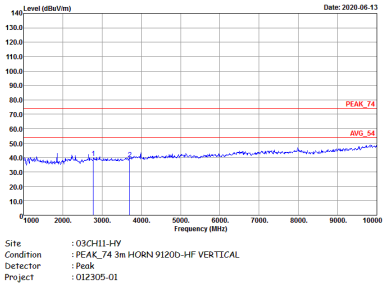
Appendix D. Radiated Spurious Emission Plots

Test Engineer :	Cookie Ku, Fu Chen, and Troye Hsieh	**Temperature :**	19.1~26.3°C
		Relative Humidity :	50.2~69.1%

LoRa (Harmonic @ 3m)

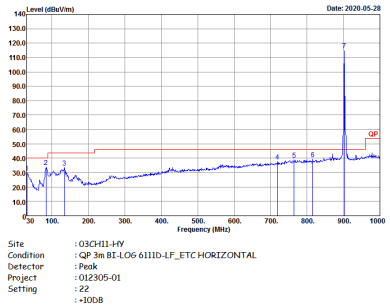
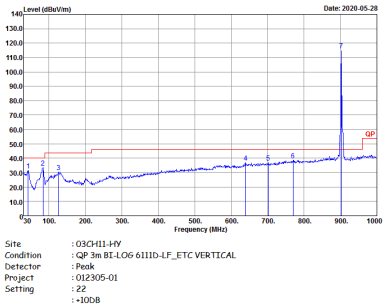
LoRa	**902~928MHz Harmonic @ 3m**	
ANT	**LoRa CH01 902.5MHz**	
4	**Horizontal**	**Vertical**
Peak **Avg.**		

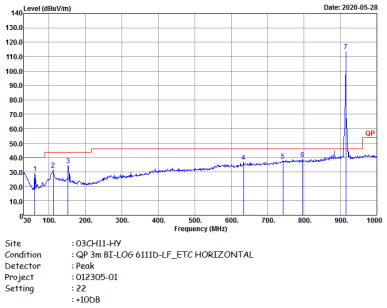
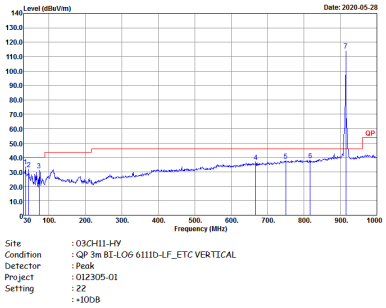
LoRa	902~928MHz Harmonic @ 3m	
ANT	LoRa CH16 914.5MHz	
4	Horizontal	Vertical
Peak Avg.		

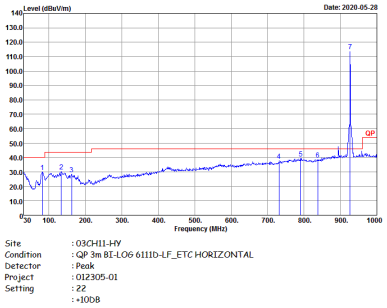
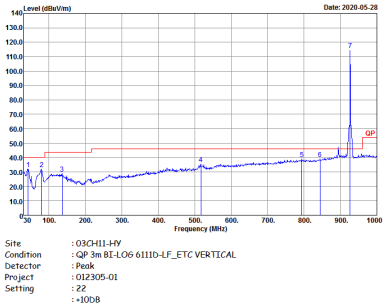
LoRa	902~928MHz Harmonic @ 3m	
ANT	LoRa CH31 926.5MHz	
4	Horizontal	Vertical
Peak		

Emission below 1GHz

LoRa (LF)

LoRa	902~928MHz	
ANT	LoRa CH01 902.5MHz LF	
4	Horizontal	Vertical
QP / Peak		

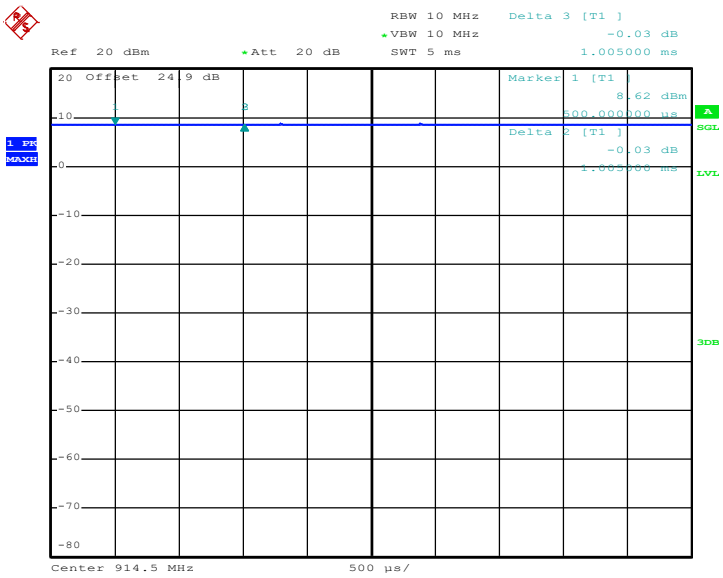
LoRa	902~928MHz	
ANT	LoRa CH16 914.5MHz LF	
4	Horizontal	Vertical
QP / Peak		

LoRa	902~928MHz	
ANT	LoRa CH31 926.5MHz LF	
4	Horizontal	Vertical
QP / Peak		

Appendix E. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor(dB)
4	LoRa (DTS)	100.00	-	-	10Hz	0.00

LoRa (DTS)



Date: 20.MAY.2020 14:31:05

THE END