

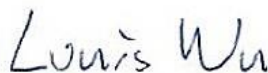
NCC RADIO TEST REPORT

Equipment : 移動式電腦
Brand Name : Zebra
Model Name : MC3300U
Applicant : 台灣斑馬科技股份有限公司
台北市信義區松高路 9 號 13 樓
Manufacturer : Zebra Technologies Corporation
1 Zebra Plaza, Holtsville, NY 11742
Standard : NCC LP0002 (2018-01-10)

The product was received on Aug. 26, 2019 and testing was started from Aug. 26, 2019 and completed on Oct. 11, 2019. 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 NCC LP0002 (2018-01-10) and has been in compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

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.



Reviewed 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.....	3
Summary of Test Result.....	4
1 General Description.....	5
1.1 Product Feature of Equipment Under Test.....	5
1.2 Product Specification of Equipment Under Test.....	6
1.3 Modification of EUT	6
1.4 Testing Location	7
1.5 Applicable Standards.....	7
2 Test Configuration of Equipment Under Test.....	8
2.1 Carrier Frequency Channel	8
2.2 Test Mode.....	8
2.3 Connection Diagram of Test System.....	9
2.4 Support Unit used in test configuration and system	10
2.5 EUT Operation Test Setup	10
2.6 Measurement Results Explanation Example.....	10
3 Test Result.....	11
3.1 Number of Channel Measurement	11
3.2 Hopping Channel Separation Measurement	13
3.3 Dwell Time Measurement.....	18
3.4 20dB and 99% Bandwidth Measurement	22
3.5 Output Power Measurement.....	31
3.6 Conducted Band Edges Measurement.....	33
3.7 Conducted Spurious Emission Measurement	38
3.8 Radiated Band Edges and Spurious Emission Measurement	42
3.9 AC Power Line Conducted Emissions Measurement.....	46
3.10 Antenna Requirements.....	48
4 List of Measuring Equipment	49
5 Uncertainty of Evaluation.....	51
Appendix A. AC Conducted Emission Test Result	
Appendix B. Radiated Spurious Emission	
Appendix C. Radiated Spurious Emission Plots	
Annex A. Receiver Radiated Emission	
Annex B. Maximum Power Density	
Appendix D. Duty Cycle Plots	
Appendix E. Setup Photographs	



History of this test report

Report No.	Version	Description	Issued Date
TR981238-01E	01	Initial issue of report	Feb. 20, 2020
TR981238-01E	02	Revising power limit and add MPE information.	Mar. 02, 2020
TR981238-01E	03	Revising MPE limit information.	Mar. 02, 2020

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	LP0002 4.8.1.4 (1)	Number of Channels	Pass	-
3.2	LP0002 4.8.1.4 (1)	Hopping Channel Separation	Pass	-
3.3	LP0002 4.8.1.4 (1)	Dwell Time of Each Channel	Pass	-
3.4	LP0002 4.8.1.4 (1)	20dB Bandwidth	Pass	-
3.4	-	99% Occupied Bandwidth	Reporting Only	-
3.5	LP0002 4.8.1.1 (1)(A) 4.8.1.1 (1)(B) 4.8.1.1 (2)	Output Power	Pass	-
3.6	LP0002 4.8.1.3	Conducted Band Edges	Pass	-
3.7	LP0002 4.8.1.3	Conducted Spurious Emission	Pass	-
3.8	LP0002 4.8.1.3	Radiated Band Edges and Radiated Spurious Emission	Pass	Under limit 3.04 dB at 935.980 MHz
3.9	LP0002 2.3	AC Conducted Emission	Pass	Under limit 16.92 dB at 0.193MHz
3.10	LP0002 4.8.1.2	Antenna Requirement	Pass	-
Annex A	LP0002 2.11	Receiver Radiated Emission	Pass	Please refer to Annex A
AnnexB	LP0002 2.2 5.20.2	Maximum Power Density	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: Yvonne Cheng

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	移動式電腦
Brand Name	Zebra
Model Name	MC3300U
EUT supports Radios application	NFC/UHF RFID WLAN 11a/b/g/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE
HW Version	DV
SW Version	RFID Manager Application Version: 2.0.10.1 123 RFID Mobile Application Version: 1.0.0.11 Terminal Version: 02-11-14.00-PG-U07-PRD
FW Version	Module Version: PAAEES00-001-N20 Radio Version: 2.0.32.0 Terminal Version: FUSION_QA_2_1.2.0.006_P
MFD	27JUL19
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer.

Specification of Accessories				
AC Adapter	Brand Name	ZEBRA	Part Number	PWR-WUA5V12W0US
U cable	Brand Name	ZEBRA	Part Number	CBL-MC33-USBCHG-01
MC32 2X battery (Inventus)	Brand Name	Symbol	Part Number	82-000012-02
MC33 2X battery (Inventus)	Brand Name	ZEBRA	Part Number	BT-000337-01
MC33 7000mA 2X (Inventus)	Brand Name	ZEBRA	Part Number	BT-000375-10
GUN Holster	Brand Name	ZEBRA	Part Number	SG-MC3021212-01R

<Sample Information>

	SKU1	SKU2	SKU3
Part Number	MC333U-GJ2EG4US	MC339U-GE2EG4US	MC339U-GF2EG4US
RFID Antenna	Middle range	Long range	Long range
Scanner	SE4770	SE4850	SE4750MR
Keypad	29	29	29
Region	US	US	US

	SKU4	SKU5	SKU6
Part Number	MC333U-GJ3EG4US	MC339U-GE3EG4US	MC339U-GF3EG4US
RFID Antenna	Middle range	Long range	Long range
Scanner	SE4770	SE4850	SE4750MR
Keypad	38	38	38
Region	US	US	US

	SKU7	SKU8	SKU9
Part Number	MC333U-GJ4EG4US	MC339U-GE4EG4US	MC339U-GF4EG4US
RFID Antenna	Middle range	Long range	Long range
Scanner	SE4770	SE4850	SE4750MR
Keypad	47	47	47
Region	US	US	US

1.2 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	922.25 MHz ~ 927.25 MHz
Number of Channels	12
Maximum Output Power to Antenna	Conducted power from antenna side: 27.88dBm (0.6138 W)
20dB Bandwidth	Long Range: 0.326 MHz Middle Range: 0.326 MHz
99% Occupied Bandwidth	Long Range: 0.313 MHz Middle Range: 0.313 MHz
Antenna Type / Gain	Long Range: Yagi Antenna with gain 5.95 dBi Middle Range: Dipole Antenna with gain 0.12 dBi
Type of Modulation	ASK

Remark: The above EUT's information was declared by manufacturer.

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:

- ♦ NCC LP0002 (2018-01-10)
- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r01
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01
- ♦ ANSI C63.10-2013

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
922.25-927.75 MHz	0	922.25	6	925.25
	1	922.75	7	925.75
	2	923.25	8	926.25
	3	923.75	9	926.75
	4	924.25	10	927.25
	5	924.75	11	927.75

2.2 Test Mode

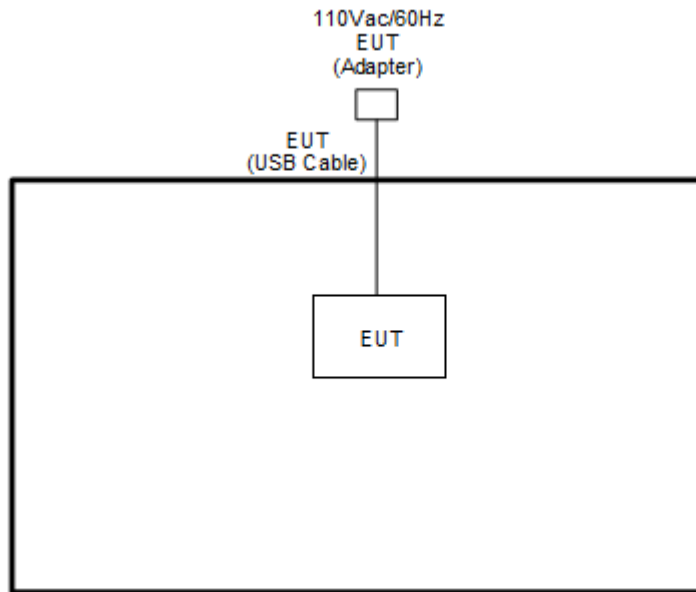
- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane) were recorded in this report.
- 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.

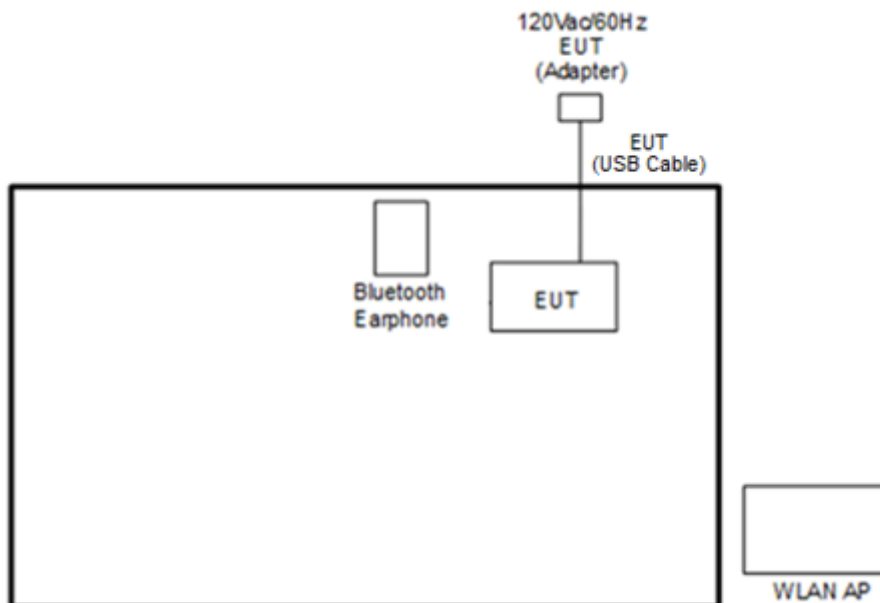
Summary table of Test Cases	
Test Item	UHF RFID
Conducted Test Cases	Mode 1: UHF RFID Tx CH00_922.25 MHz
	Mode 2: UHF RFID Tx CH06_925.25 MHz
	Mode 3: UHF RFID Tx CH11_927.75 MHz
Radiated Test Cases	Mode 1: UHF RFID Tx CH00_922.25 MHz
	Mode 2: UHF RFID Tx CH11_927.75 MHz
AC Conducted Emission	Mode 1: WLAN Link (5GHz) + Bluetooth Link + 29 keypad + Scanner + Battery (Sentry 2X) + RFID + USB cable + AC Adapter (PWR-WUA5V12W0US) for SKU 1
Remark: For Radiated Test Cases, the tests were performed with Sentry 2X battery.	

2.3 Connection Diagram of Test System

<Radiated Emission Mode>



<AC Conducted Emission Mode>



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Bluetooth Earphone	Sony Ericsson	MW600	PY7DDA-2029	N/A	N/A
2.	WLAN AP	ASUS	RT-AC66U	MSQ-RTAC66U	N/A	Unshielded, 1.8 m
3.	NOTE BOOK	DELL	Latitude E5480	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
4.	SD Card	SanDisk	MicroSD HC	FCC DoC	N/A	N/A

Remark: Applicant has ensured accessory would not be attached with the product on the market, accessory is provided by lab for testing.

2.5 EUT Operation Test Setup

The RF test items, utility "Regulatory Test application" was installed in EUT 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.

$$\begin{aligned}
 \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\
 &= 4.2 + 10 = 14.2 \text{ (dB)}
 \end{aligned}$$

3 Test Result

3.1 Number of Channel Measurement

3.1.1 Limits of Number of Hopping Frequency

Frequency hopping systems in the 922.25-927.75 MHz band shall use at least 12 channels.

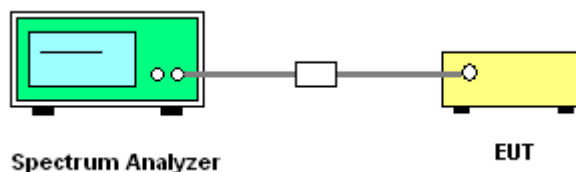
3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

3.1.3 Test Procedure

1. The testing follows ANSI C63.10-2013 clause 7.8.3.
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. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = the frequency band of operation;
RBW = 300kHz; VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. The number of hopping frequency used is defined as the number of total channel.
7. Record the measurement data derived from spectrum analyzer.

3.1.4 Test Setup

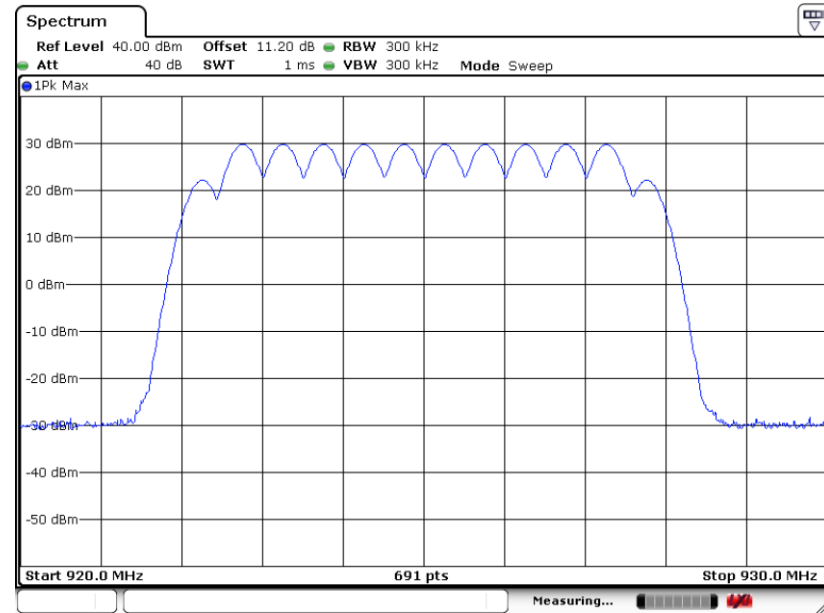


3.1.5 Test Result of Number of Hopping Frequency

Test Mode :	UHF	Temperature :	21~25°C
Test Engineer :	Tommy Lee	Relative Humidity :	51~54%
Number of Hopping (Channel)	Limits (Channel)	Pass/Fail	
12	> 12	Pass	

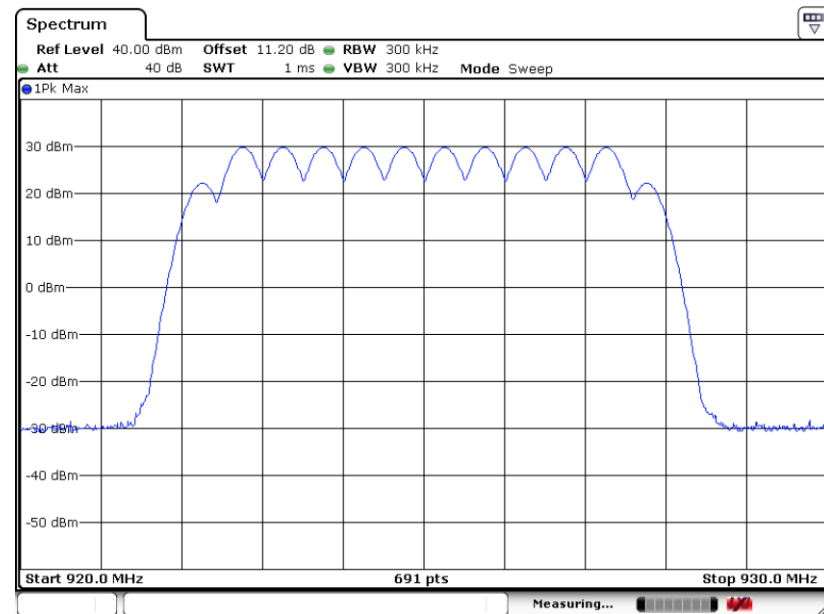
Number of Hopping Channel Plot on Channel 00 - 11

<Longe Range>



Date: 11.OCT.2019 17:38:28

<Middle Range>



Date: 11.OCT.2019 17:38:28

3.2 Hopping Channel Separation Measurement

3.2.1 Limit of Hopping Channel Separation

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.

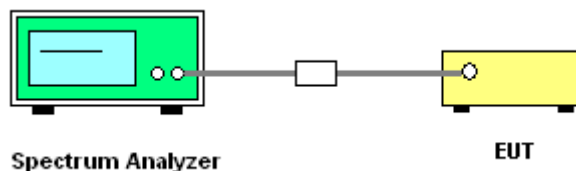
3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

3.2.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.2.
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. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings:
Span = wide enough to capture the peaks of two adjacent channels;
RBW = 300kHz; VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Hopping Channel Separation

Test Mode :	UHF	Temperature :	21~25℃
Test Engineer :	Tommy Lee	Relative Humidity :	51~54%

<Long Range>

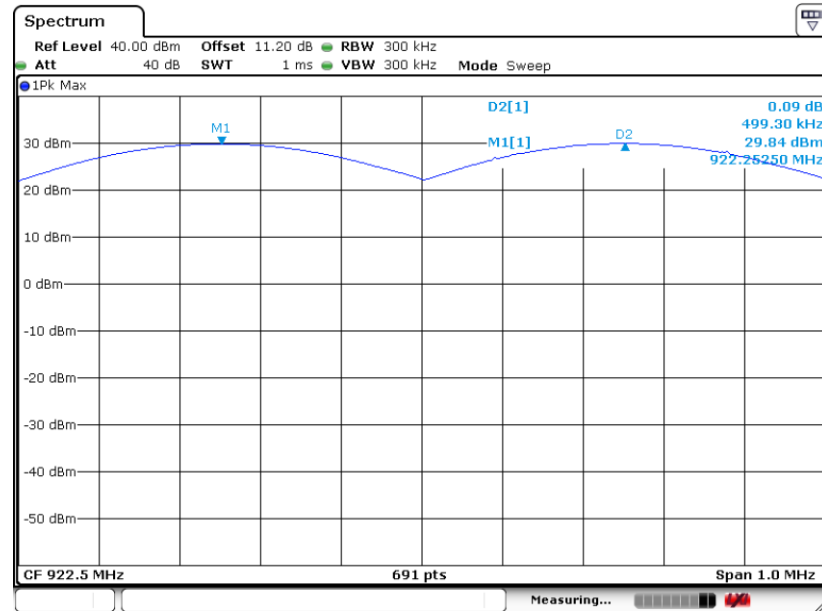
Mod.	NTX	CH.	Freq. (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
UHF RFID	1	0	922.25	0.499	0.3256	Pass
UHF RFID	1	05	924.75	0.499	0.3256	Pass
UHF RFID	1	11	927.75	0.495	0.3256	Pass

<Middle Range>

Mod.	NTX	CH.	Freq. (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
UHF RFID	1	0	922.25	0.499	0.3256	Pass
UHF RFID	1	05	924.75	0.499	0.3256	Pass
UHF RFID	1	11	927.75	0.495	0.3256	Pass

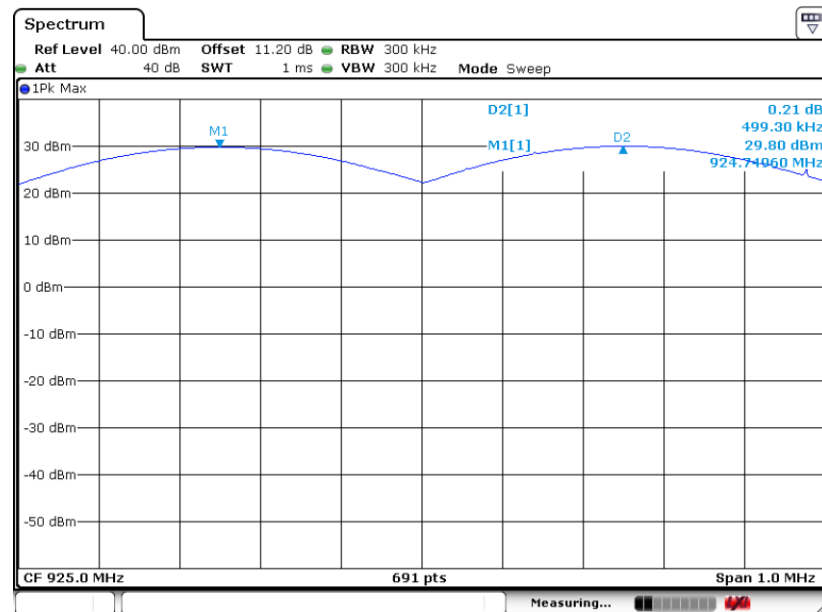
<Long Range>

Channel Separation Plot on Channel 00 - 01

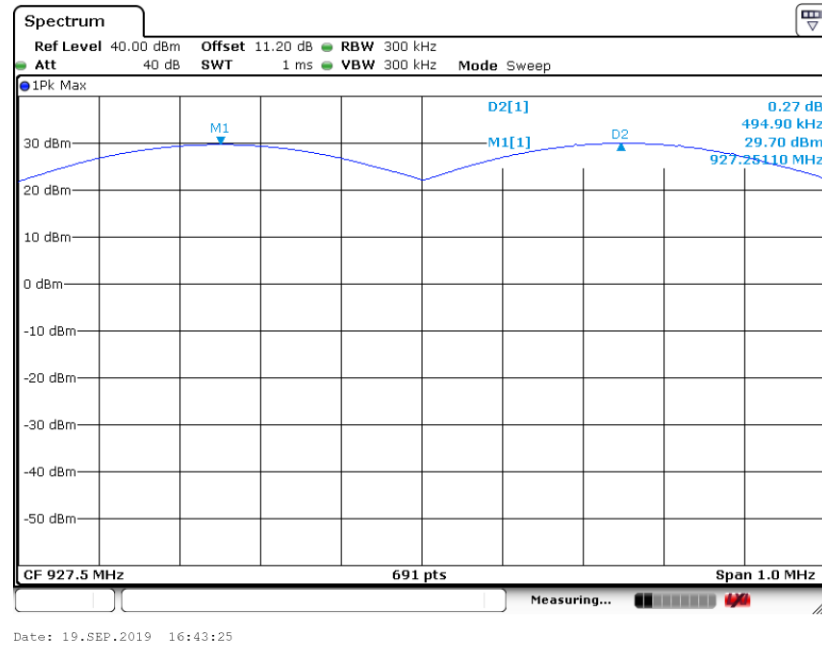
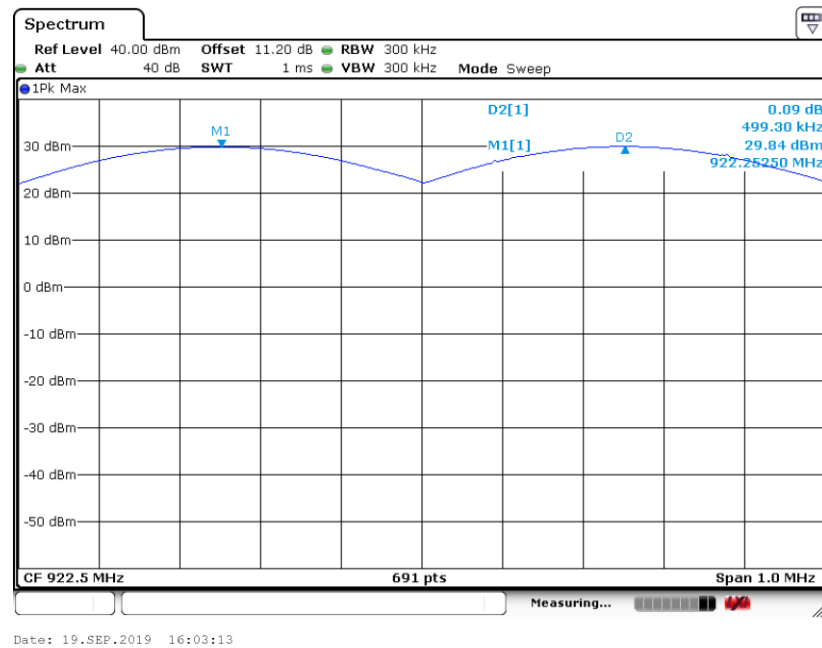


Date: 19.SEP.2019 16:03:13

Channel Separation Plot on Channel 05 - 06

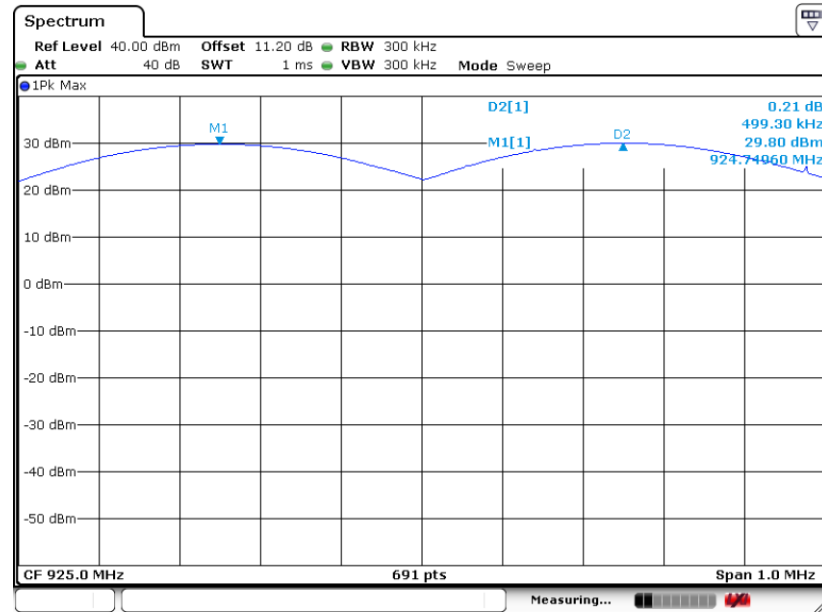


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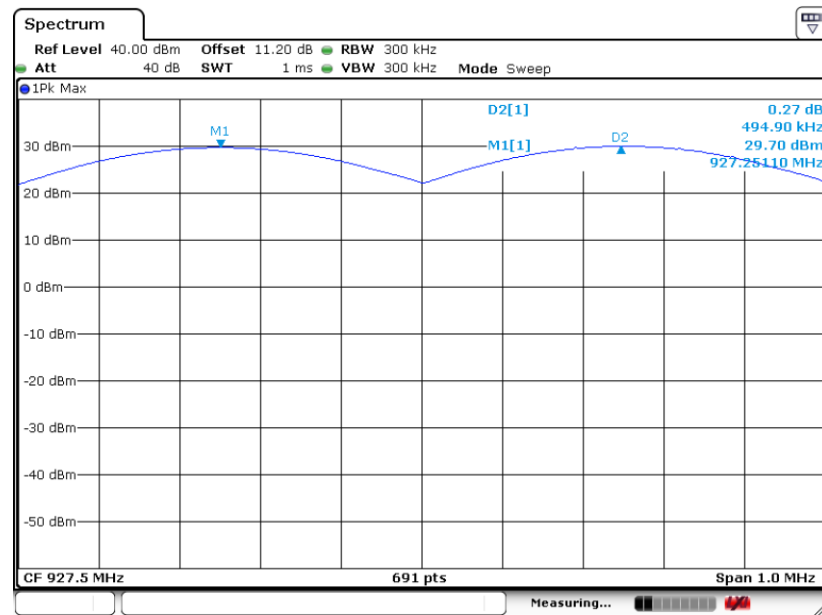
Channel Separation Plot on Channel 10 - 11

<Middle Range>
Channel Separation Plot on Channel 00 - 01




Channel Separation Plot on Channel 05 - 06



Channel Separation Plot on Channel 10 - 11



3.3 Dwell Time Measurement

3.3.1 Limit of Dwell Time

Frequency hopping systems, the average time of occupancy on any frequency each times shall be less than or equal 0.4 seconds within a time period in seconds equal to the number of hopping channels limit employed multiplied by 0.4.

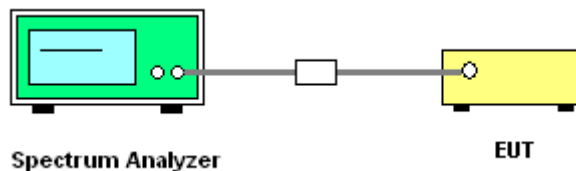
3.3.2 Measuring Instruments

See list of measuring equipment of this test report.

3.3.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.4.
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. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW = 1 MHz; VBW $\geq$ RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

3.3.4 Test Setup



3.3.5 Test Result of Dwell Time

Test Mode :	UHF	Temperature :	21~25℃
Test Engineer :	Tommy Lee	Relative Humidity :	51~54%

<Long Range>

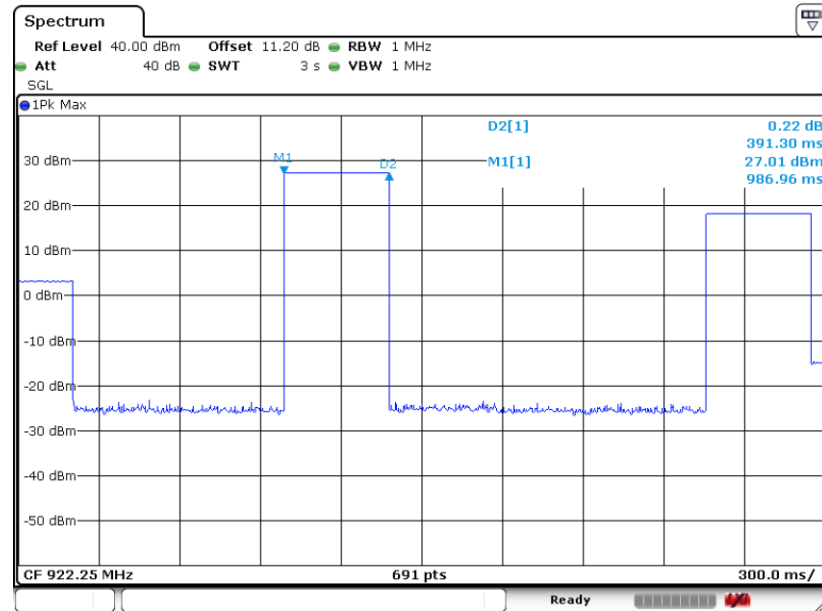
Mod.	Channel Number Rate	Package Transfer Time (msec)	Hops Over Occupancy Time (hops)	Dwell Time (sec)	Limits (sec)	Pass/Fail
Nomal	12	395.65	1.00	0.396	0.4	Pass

<Middle Range>

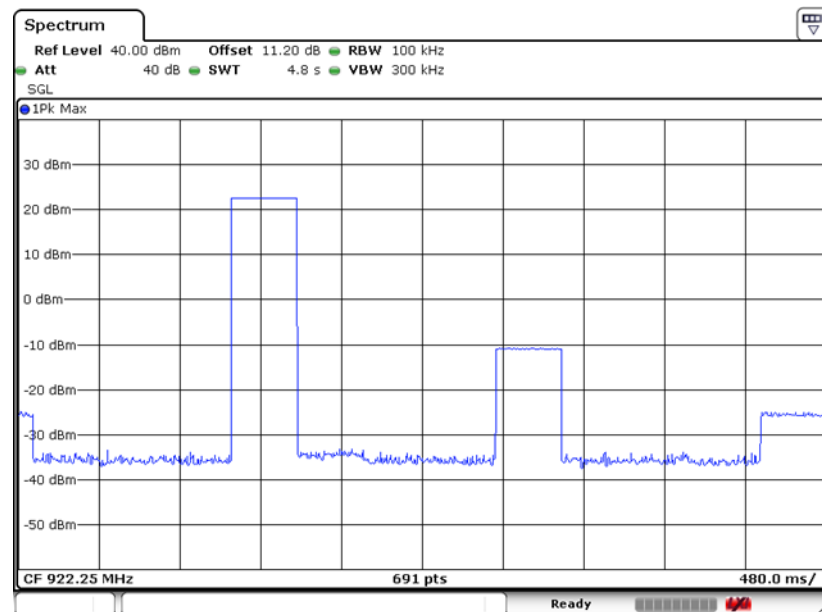
Mod.	Channel Number Rate	Package Transfer Time (msec)	Hops Over Occupancy Time (hops)	Dwell Time (sec)	Limits (sec)	Pass/Fail
Nomal	12	391.30	1.00	0.391	0.4	Pass

<Long Range>

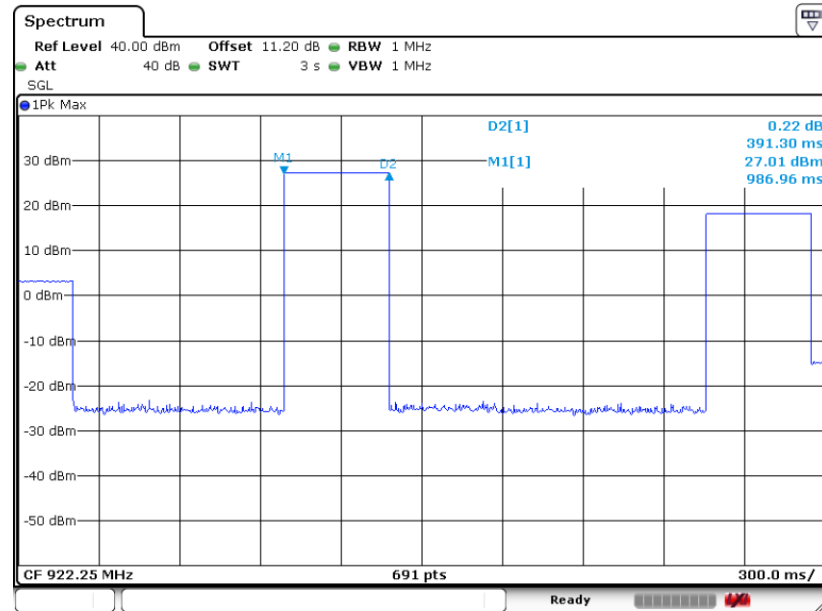
Package Transfer Time Plot



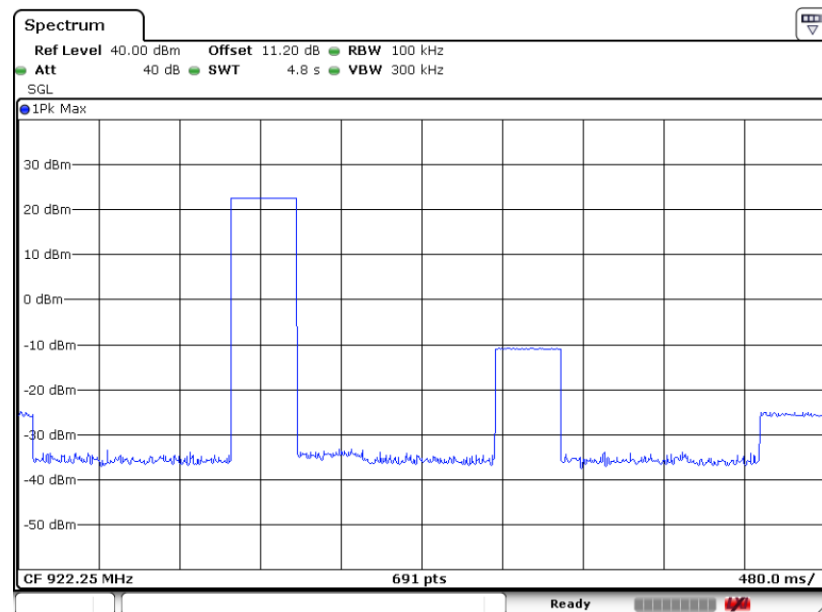
Date: 20.SEP.2019 15:02:58



Date: 20.SEP.2019 14:59:48

<Middle Range>
Package Transfer Time Plot


Date: 20.SEP.2019 15:02:58



Date: 20.SEP.2019 14:59:48

Remark: Dwell Time(s) = Hops Over Occupancy Time (hops) x Package Transfer Time

3.4 20dB and 99% Bandwidth Measurement

3.4.1 Limit of 20dB and 99% Bandwidth

Reporting only

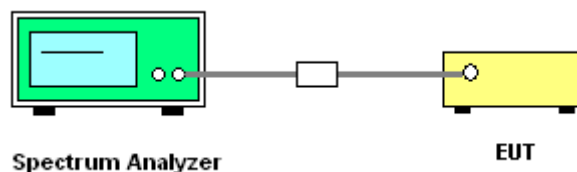
3.4.2 Measuring Instruments

See list of measuring equipment of this test report.

3.4.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 6.9.2 and 6.9.3.
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. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.
Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel;
RBW $\geq 1\%$ of the 20 dB bandwidth; VBW $\geq$ RBW; Sweep = auto; Detector function = peak;
Trace = max hold.
5. Use the following spectrum analyzer settings for 99 % Bandwidth measurement.
Span = approximately 1.5 to 5 times the 99% bandwidth, centered on a hopping channel;
RBW $\geq 1\text{--}5\%$ of the 99% bandwidth; VBW $\geq 3 * \text{RBW}$; Sweep = auto; Detector function = peak;
Trace = max hold.
6. Measure and record the results in the test report.

3.4.4 Test Setup



3.4.5 Test Result of 20dB Bandwidth

Test Mode :	UHF	Temperature :	21~25°C
Test Engineer :	Tommy Lee	Relative Humidity :	51~54%

<Long Range>

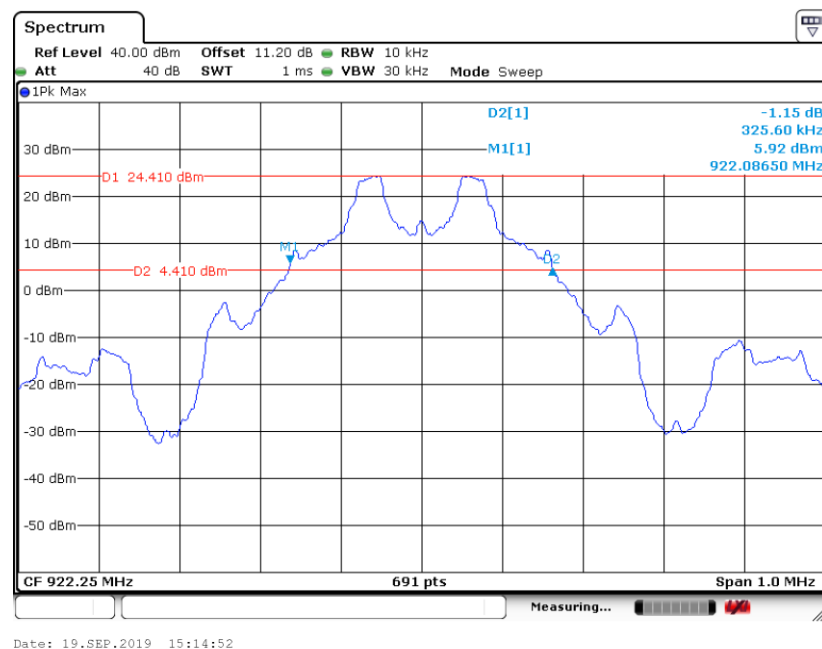
Mod.	NTX	CH.	Freq.(MHz)	20db BW (MHz)	Pass/Fail
UHF RFID	1	0	922.25	0.326	Pass
UHF RFID	1	05	924.75	0.326	Pass
UHF RFID	1	11	927.75	0.326	Pass

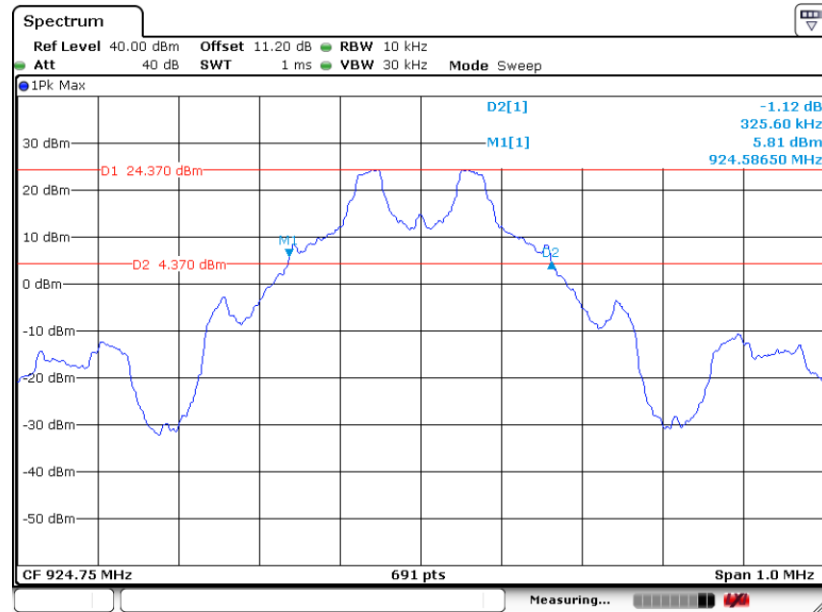
<Middle Range>

Mod.	NTX	CH.	Freq.(MHz)	20db BW (MHz)	Pass/Fail
UHF RFID	1	0	922.25	0.326	Pass
UHF RFID	1	05	924.75	0.326	Pass
UHF RFID	1	11	927.75	0.326	Pass

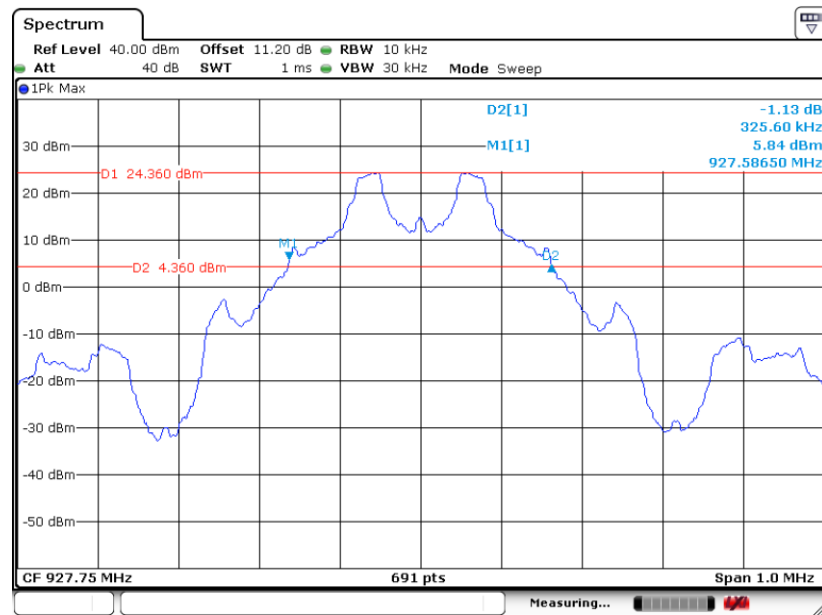
<Long Range>

20 dB Bandwidth Plot on Channel 00

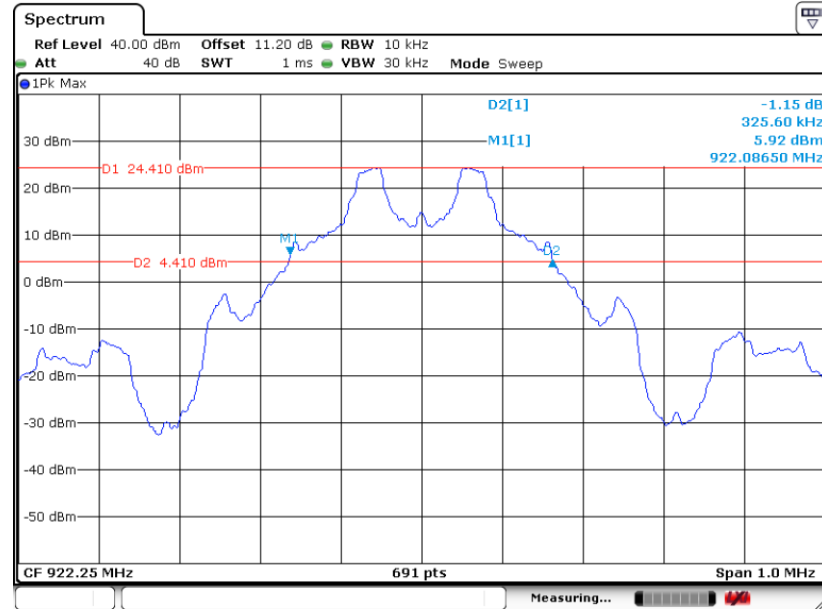


20 dB Bandwidth Plot on Channel 05


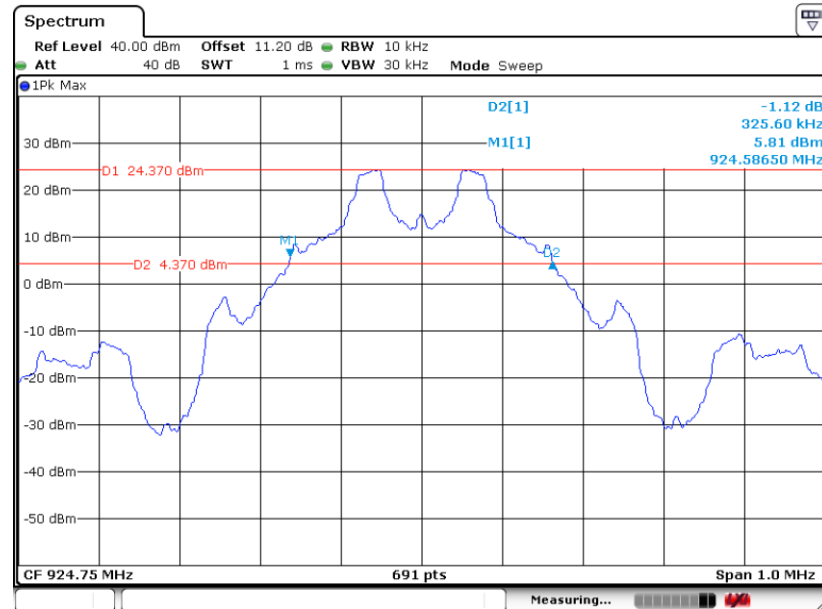
Date: 19.SEP.2019 15:16:54

20 dB Bandwidth Plot on Channel 11


Date: 19.SEP.2019 15:19:36

<Middle Range>
20 dB Bandwidth Plot on Channel 00


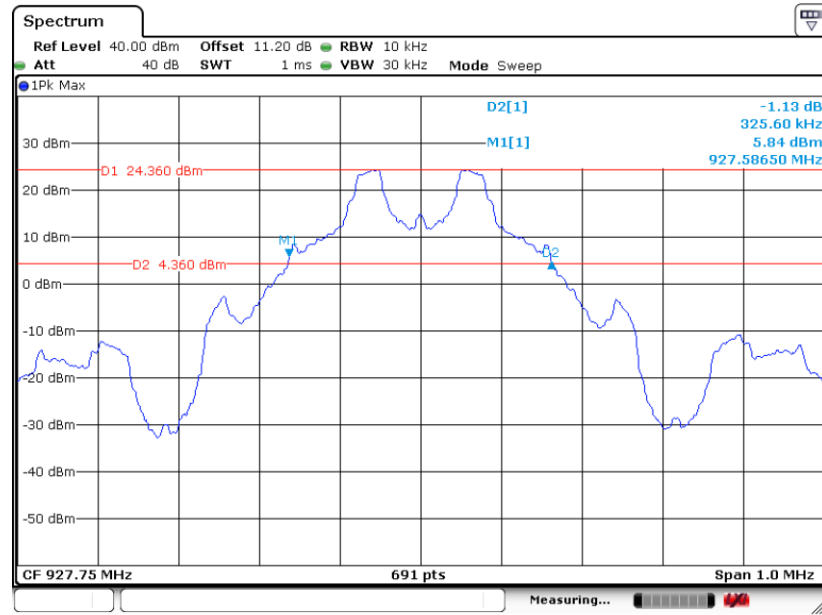
Date: 19.SEP.2019 15:14:52

20 dB Bandwidth Plot on Channel 05


Date: 19.SEP.2019 15:16:54



20 dB Bandwidth Plot on Channel 11



Date: 19.SEP.2019 15:19:36

3.4.6 Test Result of 99% Occupied Bandwidth

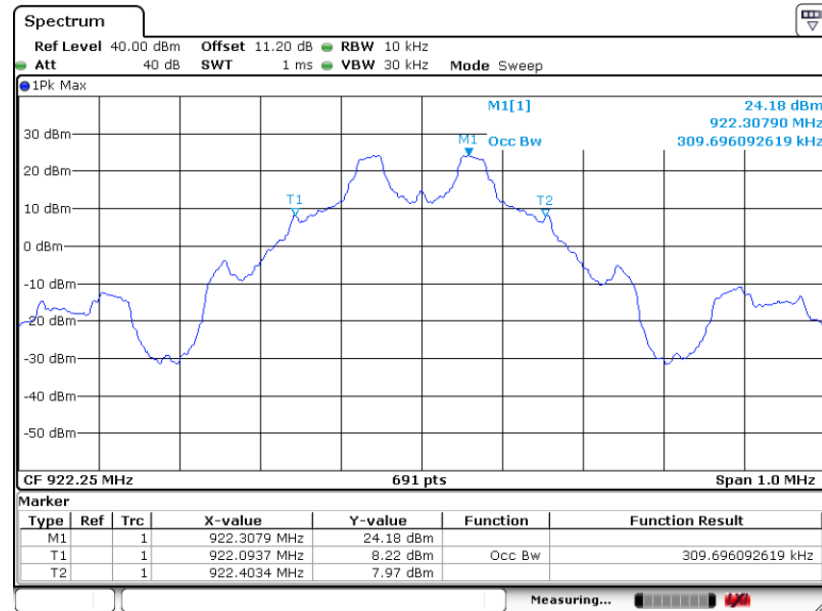
Test Mode :	UHF	Temperature :	21~25℃
Test Engineer :	Tommy Lee	Relative Humidity :	51~54%

<Long Range>

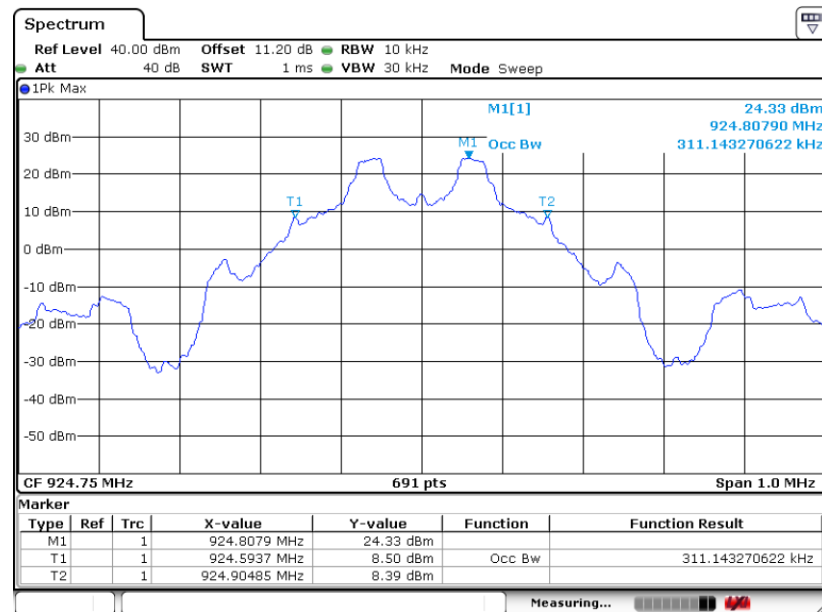
Mod.	NTX	CH.	Freq. (MHz)	99% Bandwidth (MHz)	Pass/Fail
UHF RFID	1	0	922.25	0.310	Pass
UHF RFID	1	05	924.75	0.311	Pass
UHF RFID	1	11	927.75	0.313	Pass

<Middle Range>

Mod.	NTX	CH.	Freq. (MHz)	99% Bandwidth (MHz)	Pass/Fail
UHF RFID	1	0	922.25	0.310	Pass
UHF RFID	1	05	924.75	0.311	Pass
UHF RFID	1	11	927.75	0.313	Pass

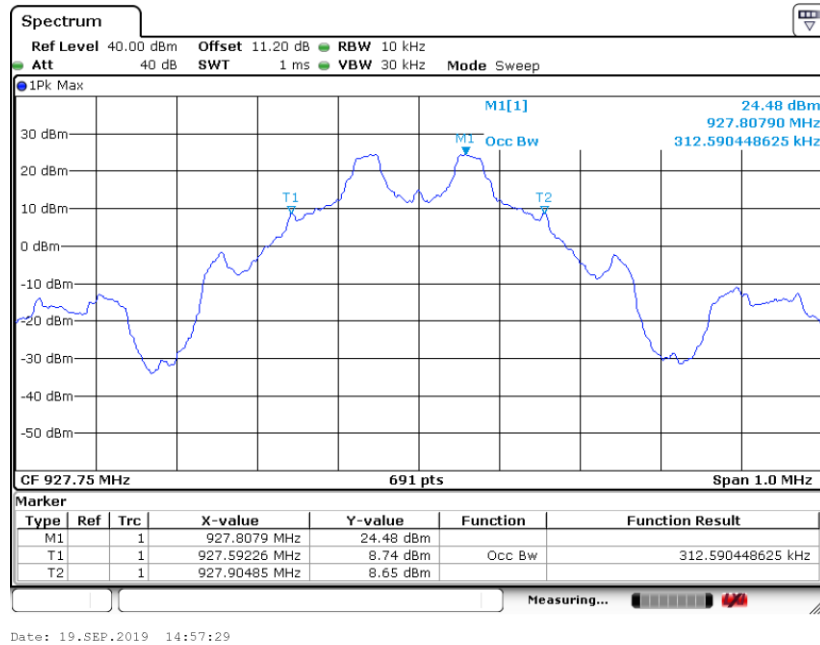
<Long Range>
99% Occupied Bandwidth Plot on Channel 00


Date: 19.SEP.2019 14:54:42

99% Occupied Bandwidth Plot on Channel 05


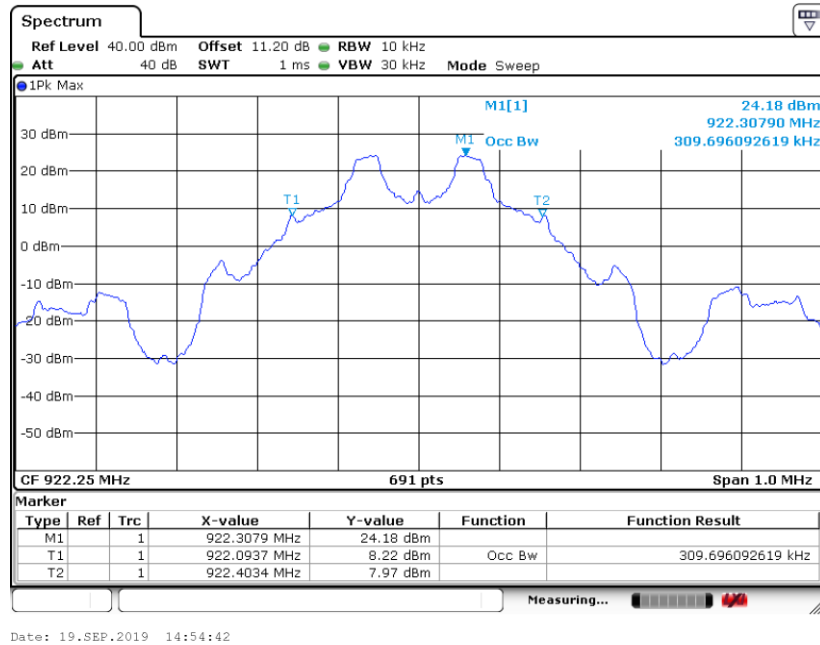
Date: 19.SEP.2019 14:56:40

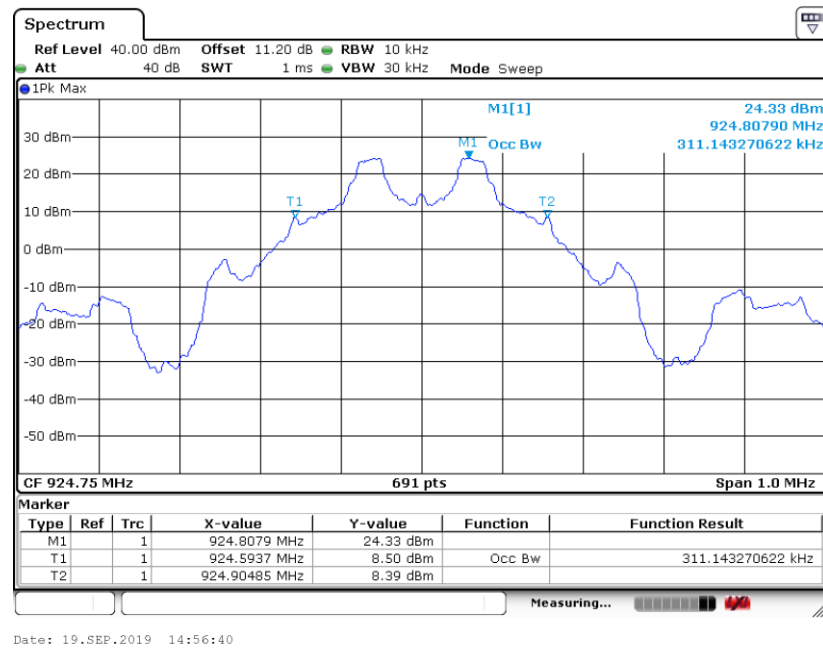
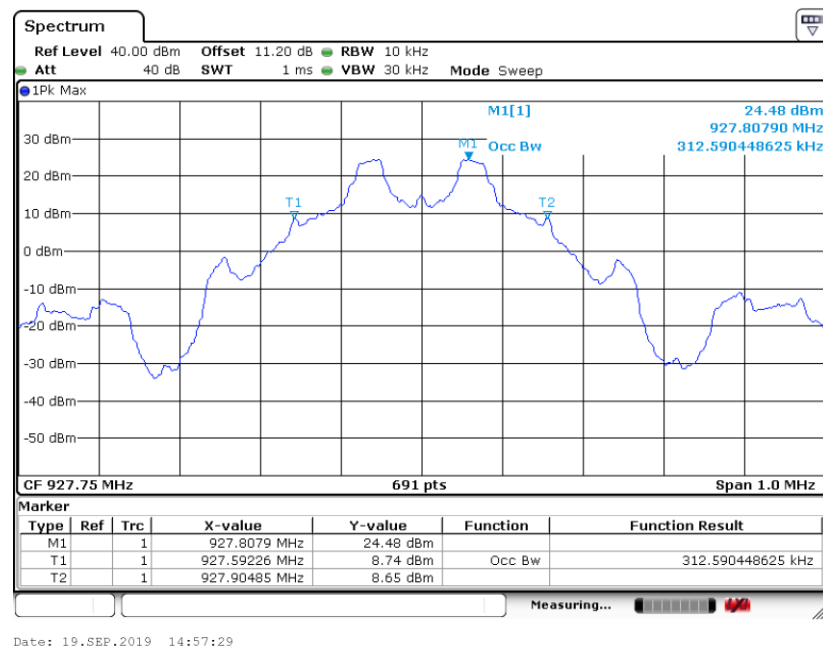
99% Occupied Bandwidth Plot on Channel 11



<Middle Range>

99% Occupied Bandwidth Plot on Channel 00



99% Occupied Bandwidth Plot on Channel 05

99% Occupied Bandwidth Plot on Channel 11


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

3.5 Output Power Measurement

3.5.1 Limit of Output Power

Installed areas and the maximum peak output power limit:

- (A) For devices installed indoor or specific area: the maximum peak output power limit up to 1 W (inclusive).
- (B) For devices installed outdoor: the maximum peak output power limit up to 0.5 W (inclusive).

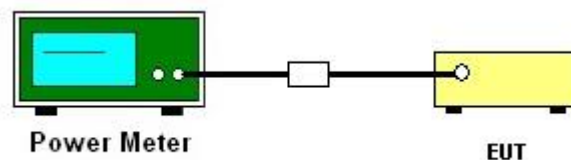
3.5.2 Measuring Instruments

See list of measuring equipment of this test report.

3.5.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.5.
2. The RF output of EUT was connected to the power meter 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. Measure the conducted output power with cable loss and record the results in the test report.
5. Measure and record the results in the test report.

3.5.4 Test Setup



3.5.5 Test Result of Output Power

Test Mode :	UHF	Temperature :	21~25℃
Test Engineer :	Tommy Lee	Relative Humidity :	51~54%

<Long Range>

Channel	Frequency (MHz)	RF Power (dBm)		
		UHF	Max. Limits (dBm)	Pass/Fail
0	922.25	27.82	30.00	Pass
05	924.75	27.83	30.00	Pass
11	927.75	27.84	30.00	Pass

<Middle Range>

Channel	Frequency (MHz)	RF Power (dBm)		
		UHF	Max. Limits (dBm)	Pass/Fail
0	922.25	27.84	30.00	Pass
05	924.75	27.88	30.00	Pass
11	927.75	27.86	30.00	Pass

3.6 Conducted Band Edges Measurement

3.6.1 Limit of Band Edges

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power shall be attenuated at least 20 dB.

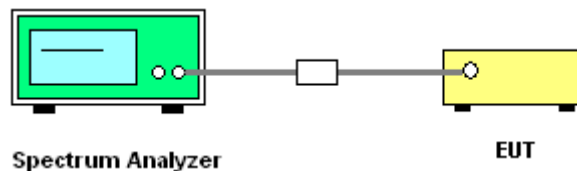
3.6.2 Measuring Instruments

See list of measuring equipment of this test report.

3.6.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.6.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100kHz, VBW = 300kHz. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
4. Enable hopping function of the EUT and then repeat step 2. and 3.
5. Measure and record the results in the test report.

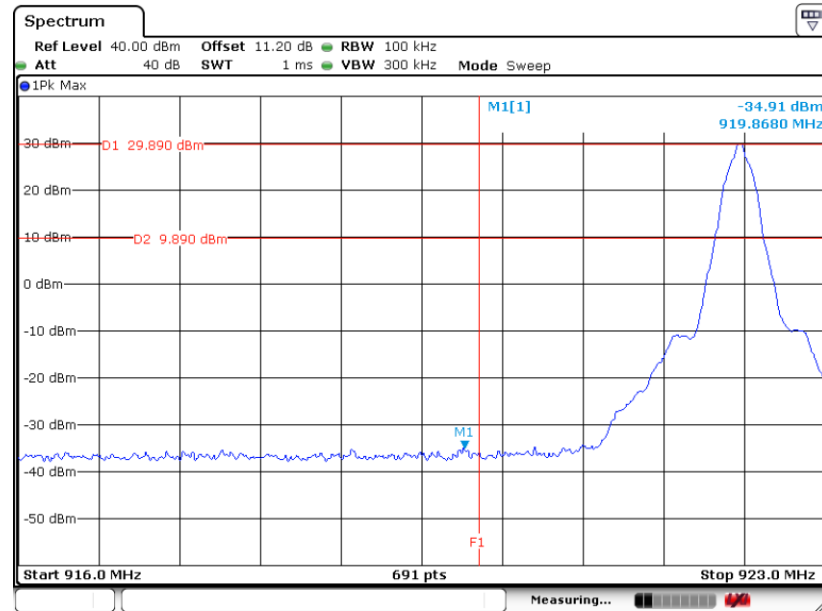
3.6.4 Test Setup



3.6.5 Test Result of Conducted Band Edges

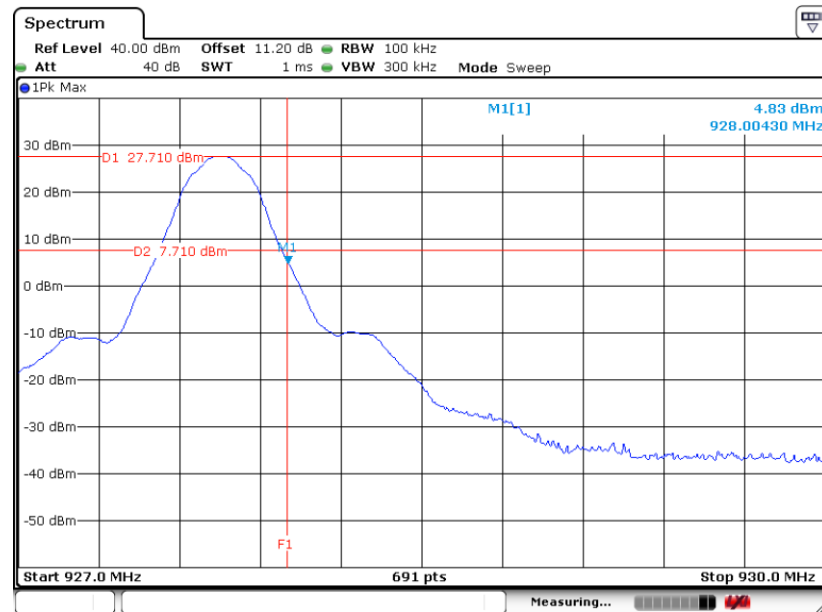
<Long Range>

Low Band Edge Plot on Channel 00



Date: 11.OCT.2019 18:01:26

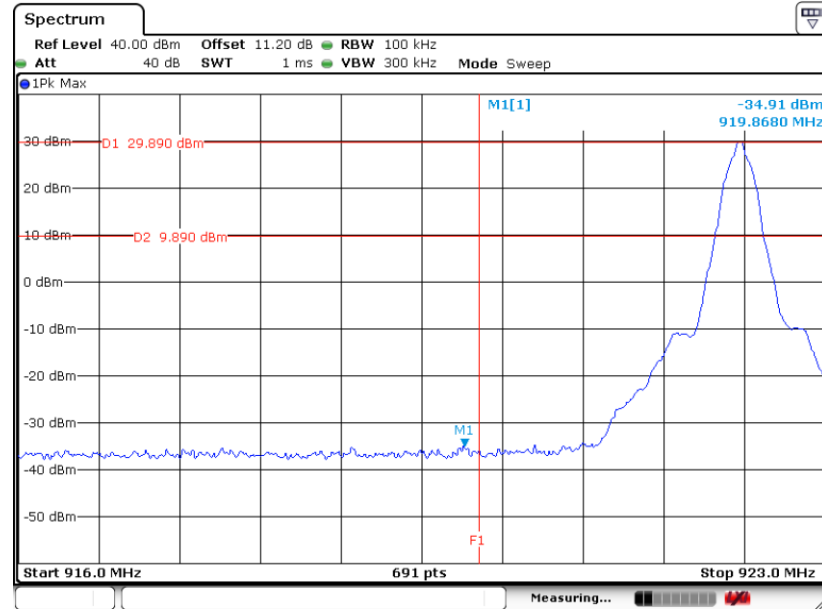
High Band Edge Plot on Channel 11



Date: 11.OCT.2019 17:58:34

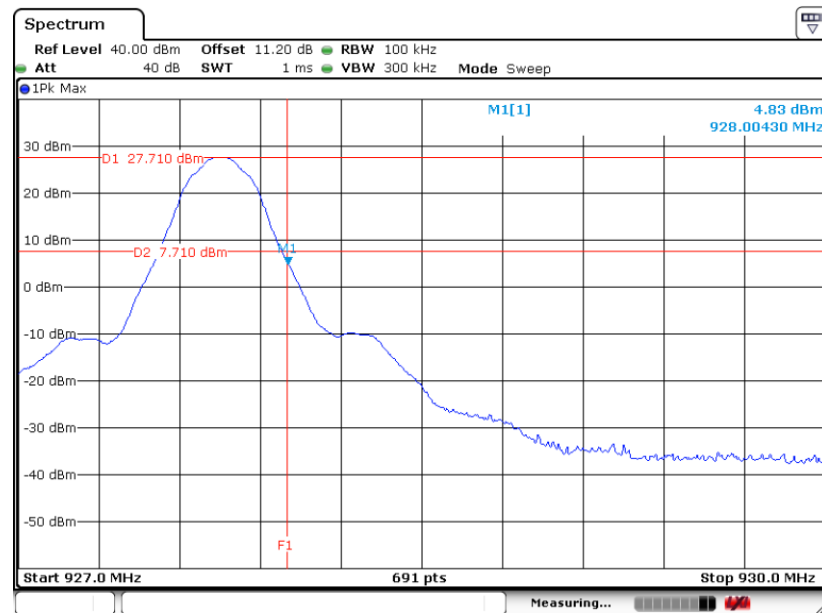
<Middle Range>

Low Band Edge Plot on Channel 00



Date: 11.OCT.2019 18:01:26

High Band Edge Plot on Channel 11

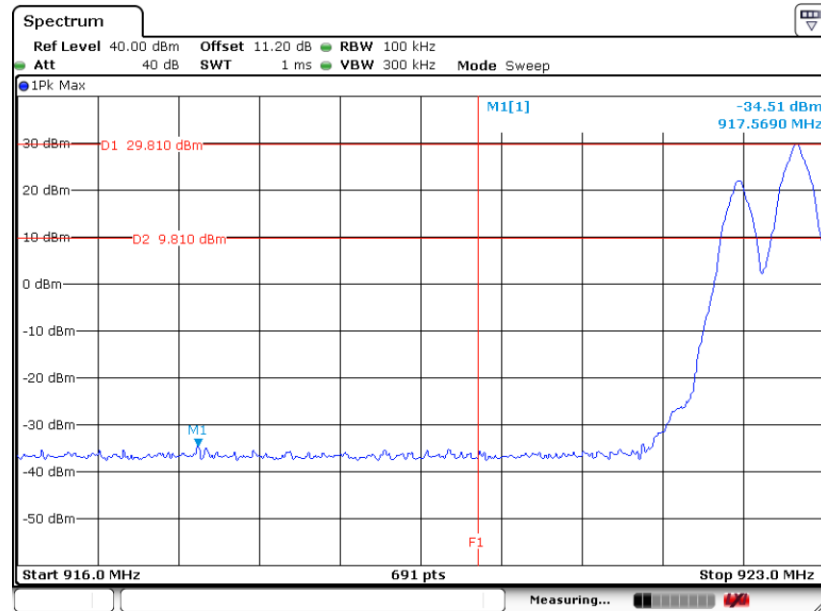


Date: 11.OCT.2019 17:58:34

3.6.6 Test Result of Conducted Hopping Mode Band Edges

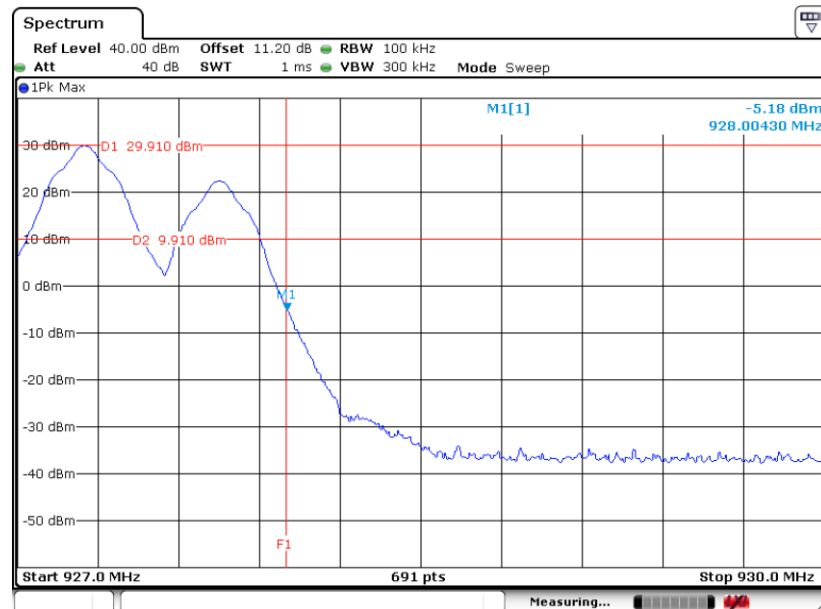
<Long Range>

Hopping Mode Low Band Edge Plot

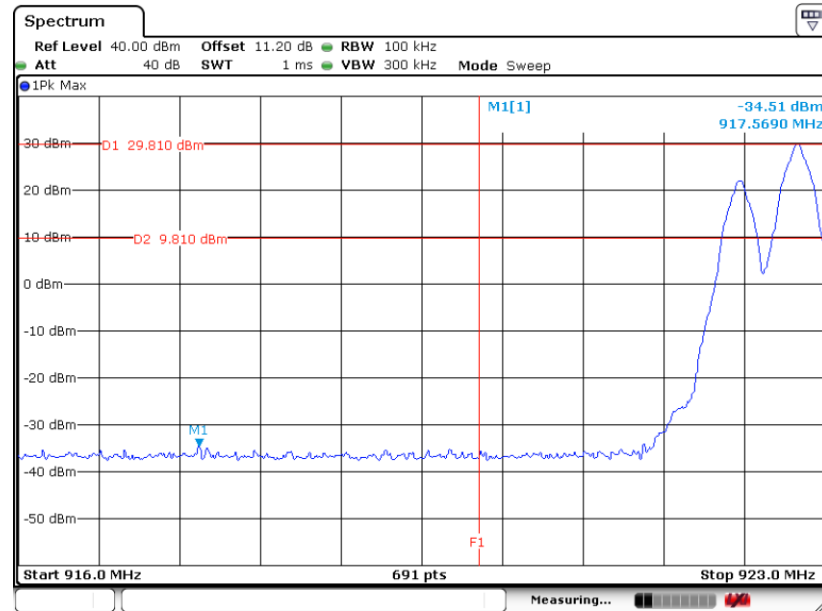
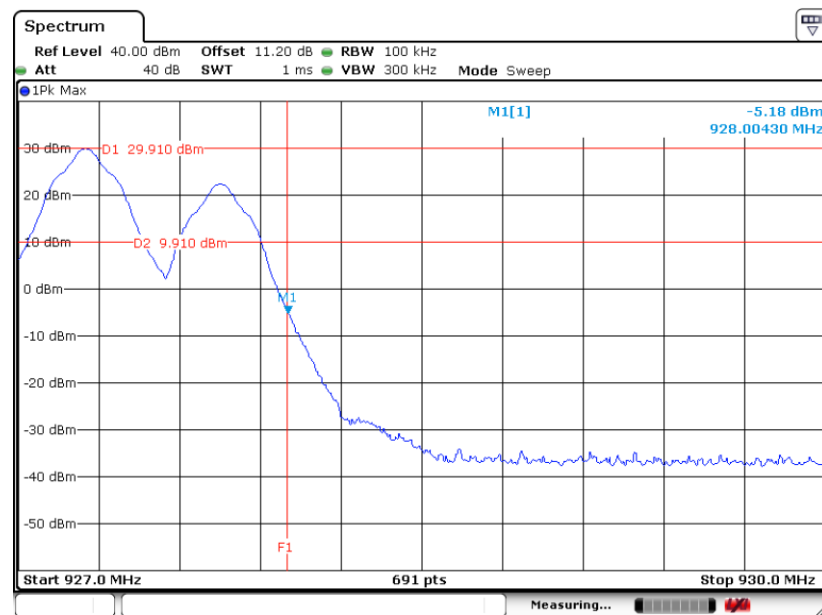


Date: 11.OCT.2019 17:47:10

Hopping Mode High Band Edge Plot



Date: 11.OCT.2019 17:49:13

<Middle Range>
Hopping Mode Low Band Edge Plot

Hopping Mode High Band Edge Plot


3.7 Conducted Spurious Emission Measurement

3.7.1 Limit of Spurious Emission Measurement

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power shall be attenuated at least 20 dB.

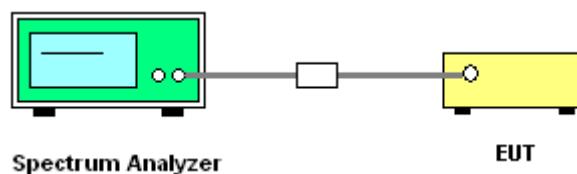
3.7.2 Measuring Instruments

See list of measuring equipment of this test report.

3.7.3 Test Procedure

1. The testing follows ANSI C63.10-2013 clause 7.8.8.
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 = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
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.

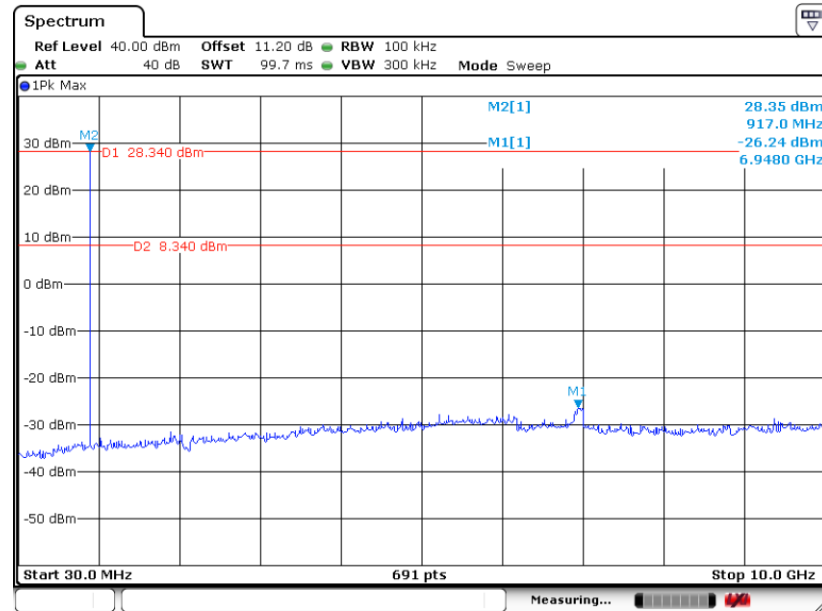
3.7.4 Test Setup



3.7.5 Test Result of Conducted Spurious Emission

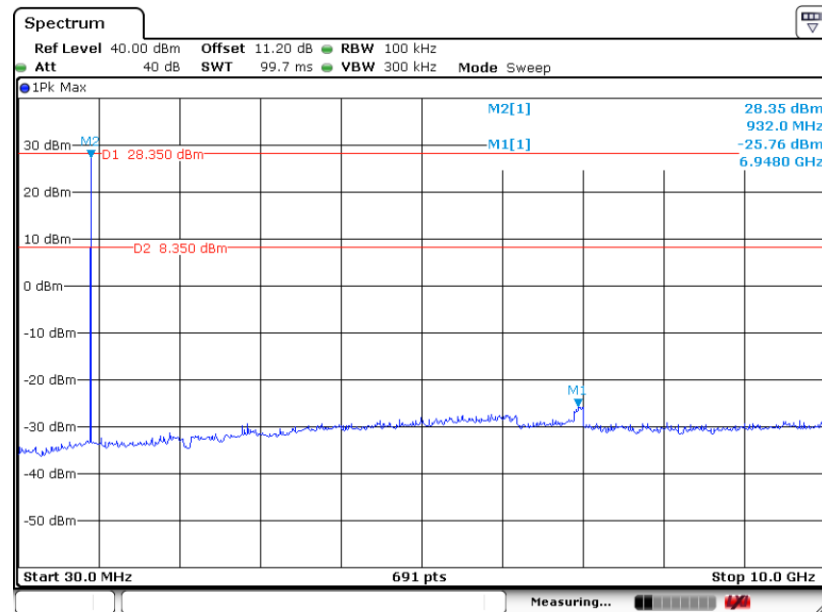
<Long Range>

CSE Plot on Ch 00 between 30MHz ~ 10 GHz

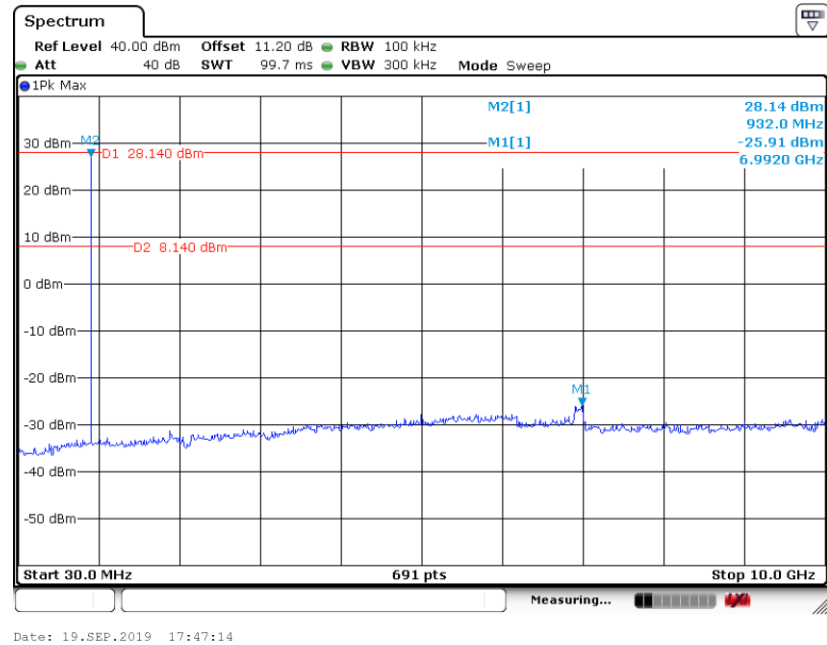
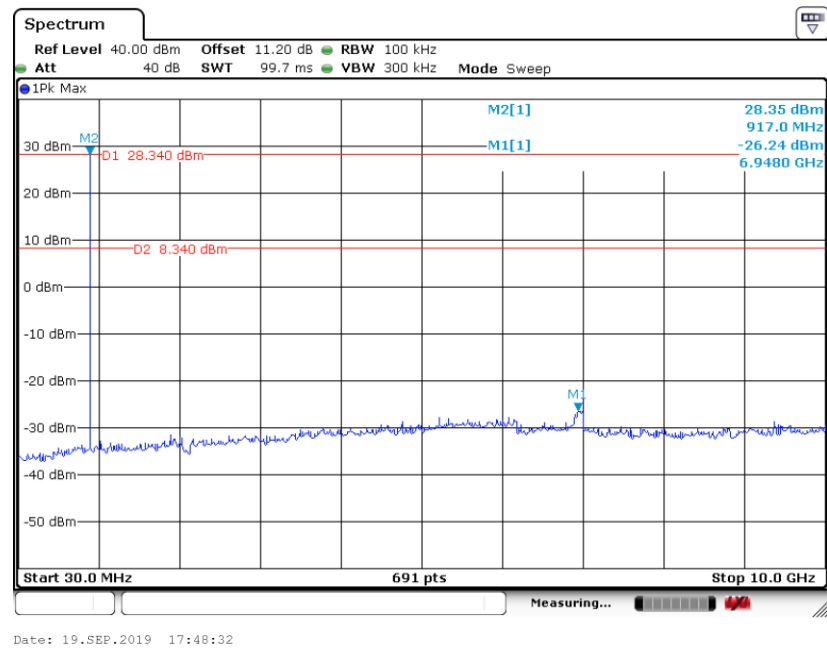


Date: 19.SEP.2019 17:48:32

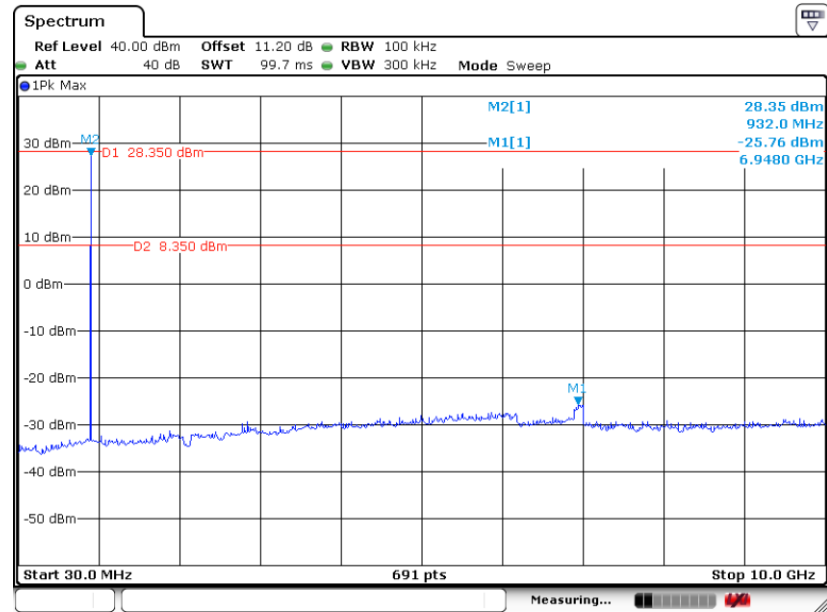
CSE Plot on Ch 05 between 30MHz ~ 10 GHz



Date: 19.SEP.2019 17:16:07

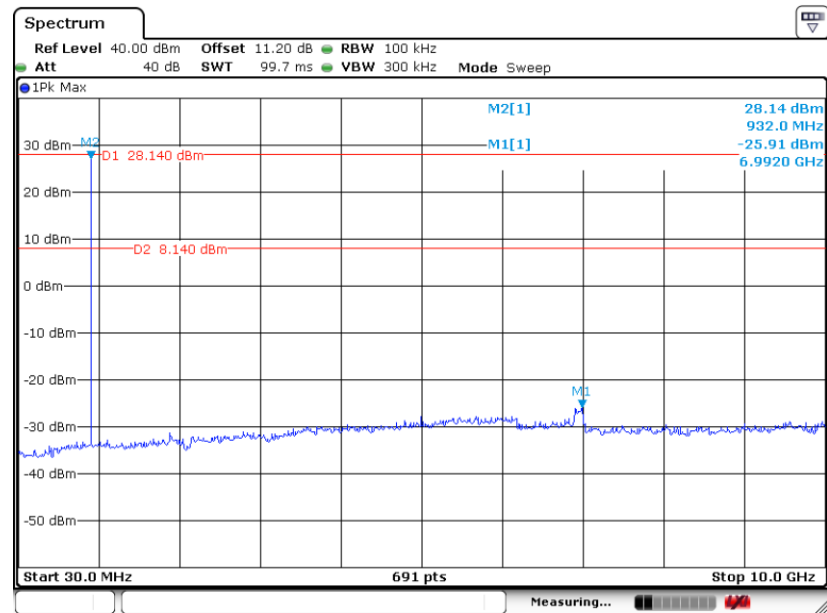
CSE Plot on Ch 11 between 30MHz ~ 10 GHz

<Middle Range>
CSE Plot on Ch 00 between 30MHz ~ 10 GHz


CSE Plot on Ch 05 between 30MHz ~ 10 GHz



Date: 19.SEP.2019 17:16:07

CSE Plot on Ch 11 between 30MHz ~ 10 GHz



Date: 19.SEP.2019 17:47:14

3.8 Radiated Band Edges and Spurious Emission Measurement

3.8.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power shall be attenuated at least 20 dB and the measured RMS shall be 30 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. In addition, for radiated emissions that fall under Section 2.7 the restricted bands must also comply with the radiated emission limit specified in Section 2.8 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

3.8.2 Measuring Instruments

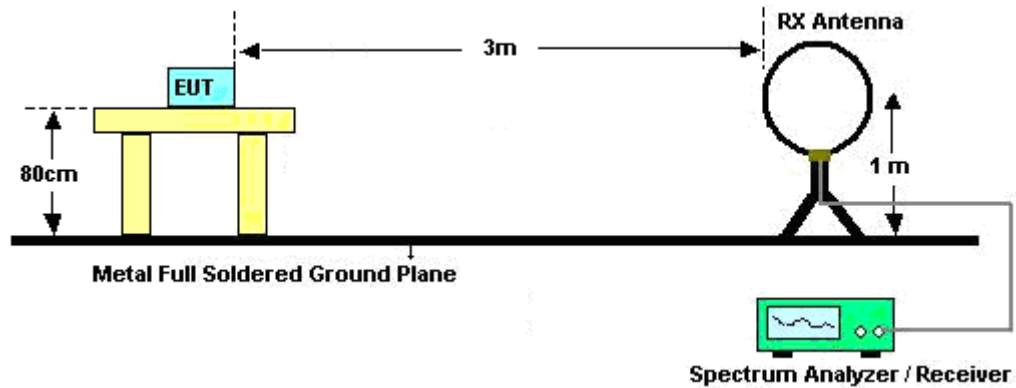
See list of measuring equipment of this test report.

3.8.3 Test Procedures

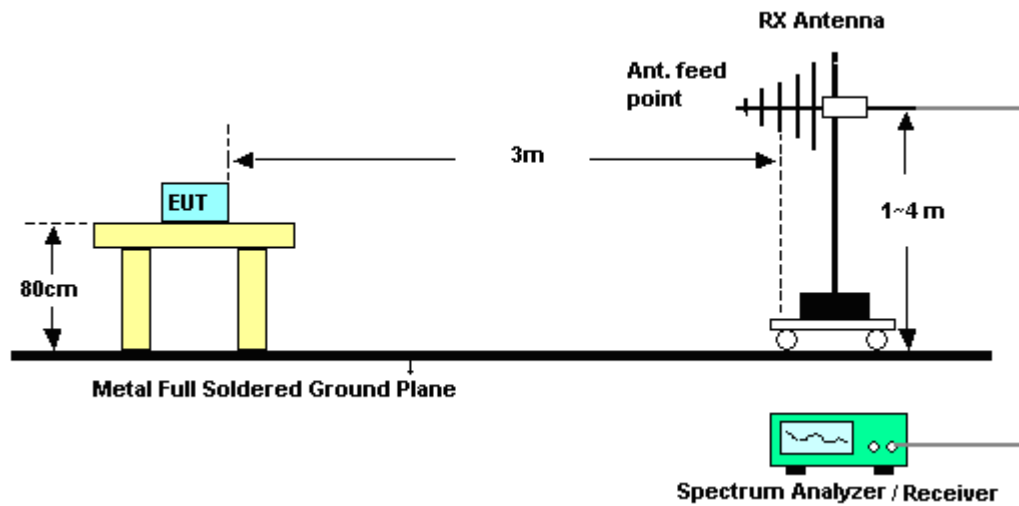
1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, 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 to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. 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, RBW=1MHz for $f > 1$ GHz ; VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
 - (3) For average measurement: use duty cycle correction factor method per 15.35(c).
Duty cycle = On time/100 milliseconds
On time = $N1*L1+N2*L2+...+Nn-1*Ln-1+Nn*Ln$
Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.
Average Emission Level = Peak Emission Level + $20*\log(\text{Duty cycle})$
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

3.8.4 Test Setup

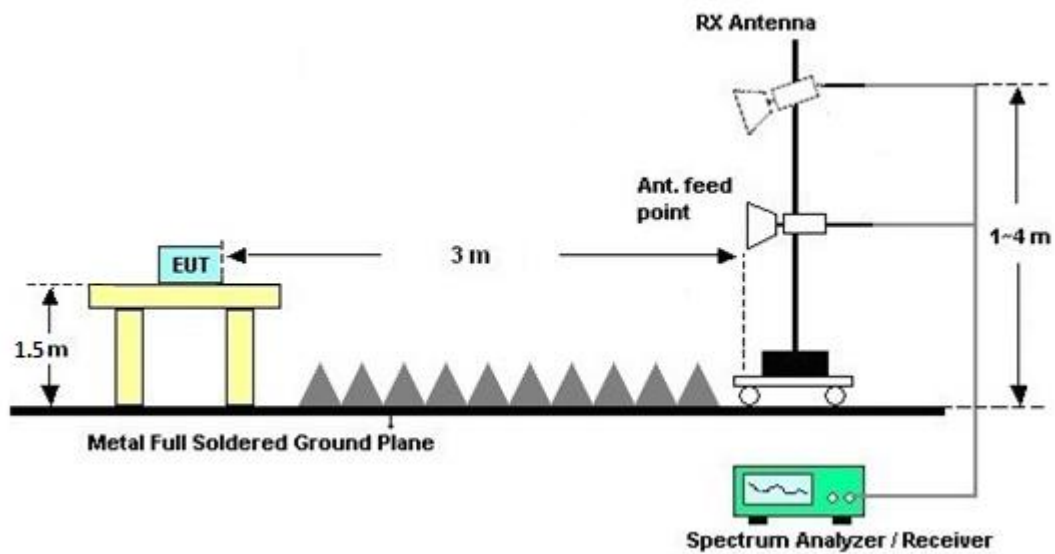
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz





3.8.5 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 per NCC LP0002 section 5.13 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.

3.8.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B and C.

3.8.7 Duty Cycle

Please refer to Appendix D.

3.8.8 Test Result of Radiated Spurious Emission

Please refer to Appendix B and C.

3.9 AC Power Line Conducted Emissions Measurement

3.9.1 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 (dB μ V)	
	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.

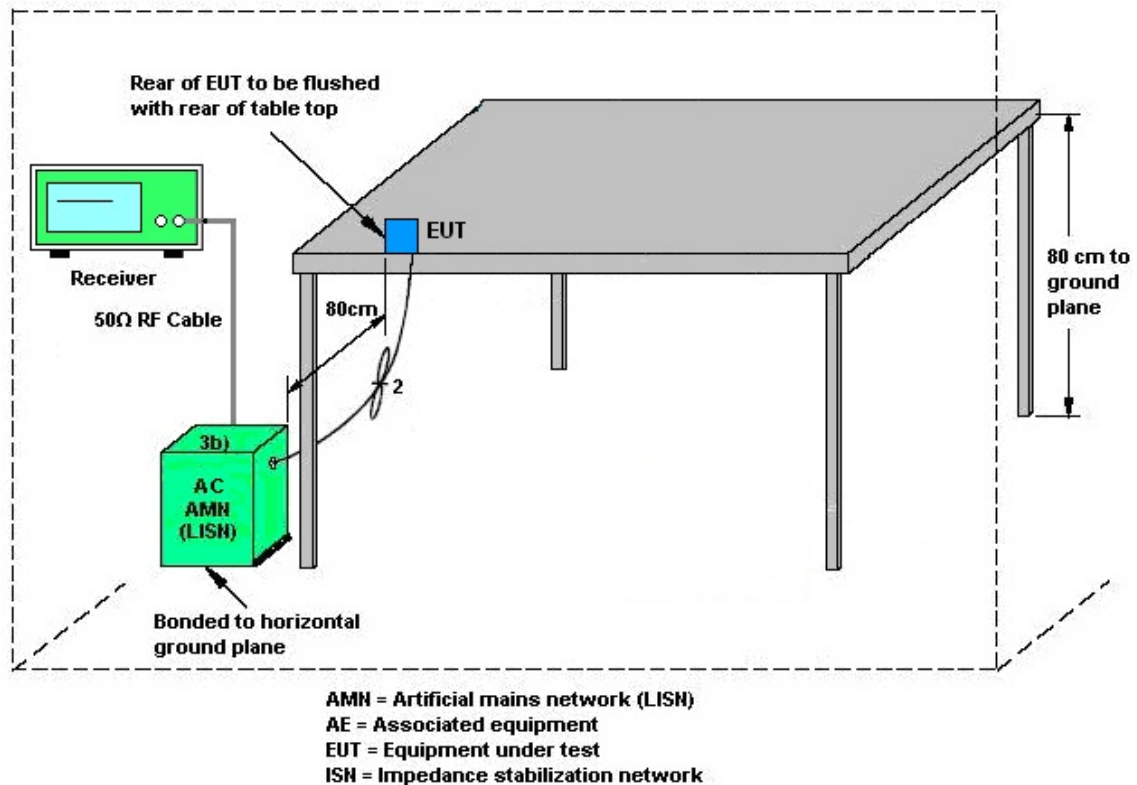
3.9.2 Measuring Instruments

See list of measuring equipment of this test report.

3.9.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room, and it 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.

3.9.4 Test setup



3.9.5 Test Result of AC Conducted Emission

Please refer to Appendix A.

3.10 Antenna Requirements

3.10.1 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.

3.10.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.10.3 Antenna Gain

The antenna peak gain of EUT is 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
Preamplifier	EMEC	EM18G40G	060715	18GHz ~ 40GHz	Dec. 06, 2018	Oct. 02, 2019~ Oct. 08, 2019	Dec. 05, 2019	Radiation (03CH11-HY)
Amplifier	SONOMA	310N	187312	9kHz~1GHz	Dec. 04, 2018	Oct. 02, 2019~ Oct. 08, 2019	Dec. 03, 2019	Radiation (03CH11-HY)
Bilog Antenna	TESEQ	CBL 6111D&N-6-0 6	35414&AT- N0602	30MHz~1GHz	Oct. 13, 2018	Oct. 02, 2019~ Oct. 08, 2019	Oct. 12, 2019	Radiation (03CH11-HY)
Horn Antenna	SCHWARZBE CK	BBHA 9120 D	9120D-132 6	1GHz ~ 18GHz	Oct. 30, 2018	Oct. 02, 2019~ Oct. 08, 2019	Oct. 29, 2019	Radiation (03CH11-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Nov. 22, 2018	Oct. 02, 2019~ Oct. 08, 2019	Nov. 21, 2019	Radiation (03CH11-HY)
Preamplifier	Keysight	83017A	MY532700 80	1GHz~26.5GHz	Nov. 14, 2018	Oct. 02, 2019~ Oct. 08, 2019	Nov. 13, 2020	Radiation (03CH11-HY)
Spectrum Analyzer	Keysight	N9010A	MY542004 86	10Hz ~ 44GHz	Oct. 19, 2018	Oct. 02, 2019~ Oct. 08, 2019	Oct. 18, 2019	Radiation (03CH11-HY)
Antenna Mast	EMEC	AM-BS-4500- B	N/A	1~4m	N/A	Oct. 02, 2019~ Oct. 08, 2019	N/A	Radiation (03CH11-HY)
Turn Table	EMEC	TT 2000	N/A	0~360 Degree	N/A	Oct. 02, 2019~ Oct. 08, 2019	N/A	Radiation (03CH11-HY)
Preamplifier	MITEQ	AMF-7D-001 01800-30-10 P	1590074	1GHz~18GHz	May 20, 2019	Oct. 02, 2019~ Oct. 08, 2019	May 19, 2020	Radiation (03CH11-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA9170 584	18GHz- 40GHz	Dec. 05, 2018	Oct. 02, 2019~ Oct. 08, 2019	Dec. 04, 2019	Radiation (03CH11-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY541300 85	N/A	Nov. 01, 2018	Oct. 02, 2019~ Oct. 08, 2019	Oct. 31, 2019	Radiation (03CH11-HY)
Software	Audix	E3 6.2009-8-24	RK-001042	N/A	N/A	Oct. 02, 2019~ Oct. 08, 2019	N/A	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4 PE	9kHz-30MHz	Mar. 13, 2019	Oct. 02, 2019~ Oct. 08, 2019	Mar. 12, 2020	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2859/2	30MHz-40GHz	Mar. 13, 2019	Oct. 02, 2019~ Oct. 08, 2019	Mar. 12, 2020	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4 PE	30M-18G	Mar. 13, 2019	Oct. 02, 2019~ Oct. 08, 2019	Mar. 12, 2020	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY4274/2	30MHz-40GHz	Mar. 13, 2019	Oct. 02, 2019~ Oct. 08, 2019	Mar. 12, 2020	Radiation (03CH11-HY)
Filter	Wainwright	WLJ4-1000-1 530-6000-40 ST	SN3	1.53GHz Low Pass Filter	Mar. 23, 2019	Oct. 02, 2019~ Oct. 08, 2019	Mar. 22, 2020	Radiation (03CH11-HY)
Filter	Wainwright	WHKX12-108 0-1200-1500 0-60ST	SN1	1.2GHz High Pass Filter	Mar. 19, 2019	Oct. 02, 2019~ Oct. 08, 2019	Mar. 18, 2020	Radiation (03CH11-HY)
Power Meter	Anritsu	ML2495A	1036004	N/A	Aug. 08, 2019	Aug. 26, 2019~ Oct. 11, 2019	Aug. 07, 2020	Conducted (TH05-HY)
Power Sensor	Anritsu	MA2411B	1027253	300MHz~40GH z	Aug. 08, 2019	Aug. 26, 2019~ Oct. 11, 2019	Aug. 07, 2020	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSV30	101749	10Hz~30GHz	Jan. 21, 2019	Aug. 26, 2019~ Oct. 11, 2019	Jan. 20, 2020	Conducted (TH05-HY)
Programmable Power Supply	GW Instek	PSS-2005	GEO82176 7	N/A	Oct. 16, 2018	Aug. 26, 2019~ Oct. 11, 2019	Oct. 15, 2019	Conducted (TH05-HY)
Switch Box & RF Cable	Burgeon	ETF-058	EC120838 2	N/A	Mar. 27, 2019	Aug. 26, 2019~ Oct. 11, 2019	Mar. 26, 2020	Conducted (TH05-HY)



Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Sep. 23, 2019	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102388	9kHz~3.6GHz	Nov. 12, 2018	Sep. 23, 2019	Nov. 11, 2019	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Nov. 14, 2018	Sep. 23, 2019	Nov. 13, 2019	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Nov. 09, 2018	Sep. 23, 2019	Nov. 08, 2019	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32 V10.30	N/A	N/A	N/A	Sep. 23, 2019	N/A	Conduction (CO05-HY)
LF Cable	HUBER + SUHNER	RG-214/U	LF01	N/A	Dec. 31, 2018	Sep. 23, 2019	Dec. 30, 2019	Conduction (CO05-HY)
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100851	N/A	Dec. 31, 2018	Sep. 23, 2019	Dec. 30, 2019	Conduction (CO05-HY)

5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.2
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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)

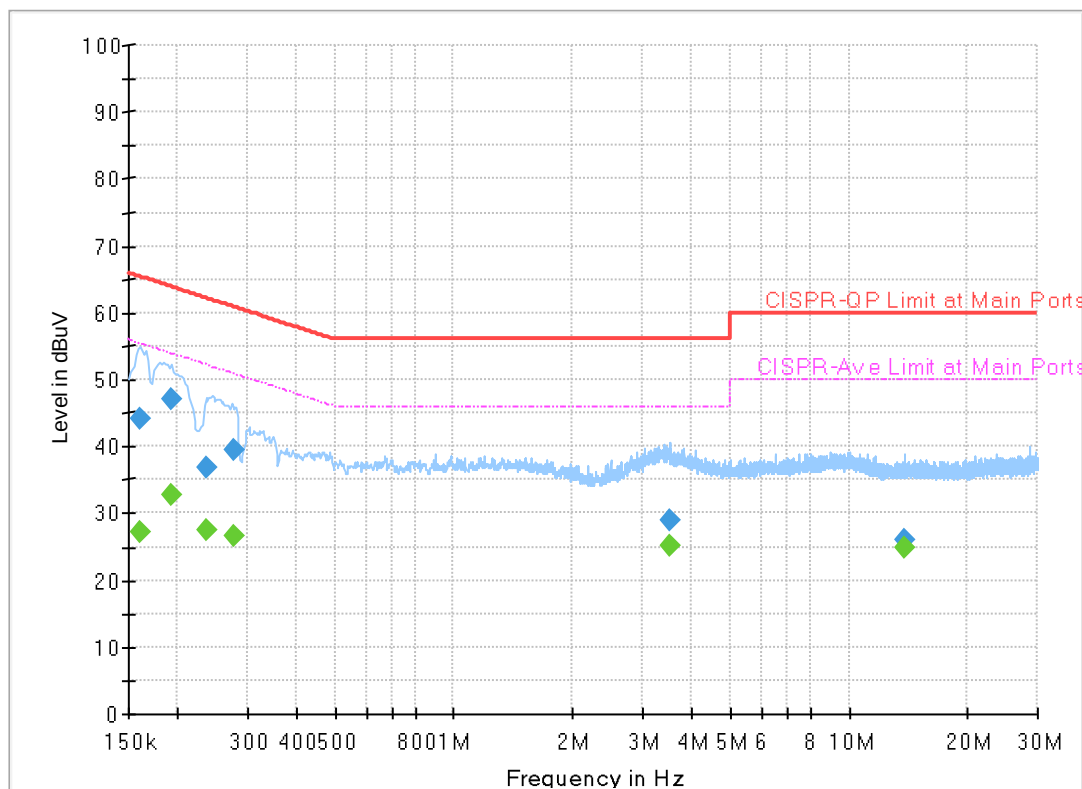
Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.5
---	-----

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

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

Appendix A. AC Conducted Emission Test Results

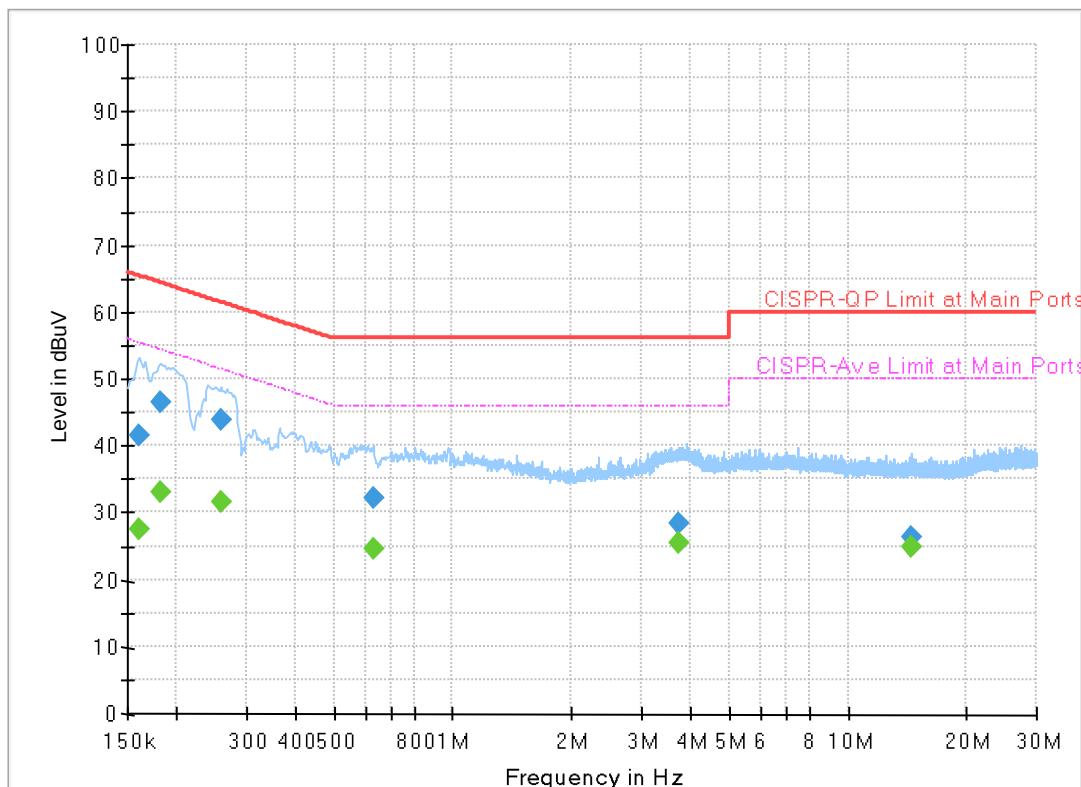
Test Engineer :	Howard Huang	Temperature :	25.9~26.2°C
		Relative Humidity :	41.8~42.7%
Test Voltage :	120Vac / 60Hz	Phase :	Line



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.161250	44.20	---	65.40	21.20	L1	OFF	19.4
0.161250	---	27.16	55.40	28.24	L1	OFF	19.4
0.192750	47.00	---	63.92	16.92	L1	OFF	19.4
0.192750	---	32.71	53.92	21.21	L1	OFF	19.4
0.235500	36.78	---	62.25	25.47	L1	OFF	19.4
0.235500	---	27.35	52.25	24.90	L1	OFF	19.4
0.278250	39.56	---	60.87	21.31	L1	OFF	19.4
0.278250	---	26.64	50.87	24.23	L1	OFF	19.4
3.509250	28.87	---	56.00	27.13	L1	OFF	19.6
3.509250	---	25.13	46.00	20.87	L1	OFF	19.6
13.800750	26.06	---	60.00	33.94	L1	OFF	20.0
13.800750	---	24.75	50.00	25.25	L1	OFF	20.0

Test Engineer :	Howard Huang	Temperature :	25.9~26.2°C
		Relative Humidity :	41.8~42.7%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral


Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.161250	---	27.45	55.40	27.95	N	OFF	19.5
0.161250	41.45	---	65.40	23.95	N	OFF	19.5
0.181500	---	32.95	54.42	21.47	N	OFF	19.5
0.181500	46.55	---	64.42	17.87	N	OFF	19.5
0.258000	---	31.58	51.50	19.92	N	OFF	19.5
0.258000	43.82	---	61.50	17.68	N	OFF	19.5
0.627000	---	24.67	46.00	21.33	N	OFF	19.5
0.627000	32.03	---	56.00	23.97	N	OFF	19.5
3.723000	---	25.45	46.00	20.55	N	OFF	19.6
3.723000	28.41	---	56.00	27.59	N	OFF	19.6
14.502750	---	24.83	50.00	25.17	N	OFF	20.1
14.502750	26.19	---	60.00	33.81	N	OFF	20.1



Appendix B. Radiated Spurious Emission

Test Engineer :	Fu Chen and Troye Hsieh	Temperature :	21.4~24.8°C
		Relative Humidity :	51~65.8%

<SKU1>
922~928MHz
(1GHz ~ 10GHz @ 3m)

	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
922.25MHz		1844.5	38.77	-35.23	74	67.61	25.19	7.02	61.05	100	0	P	H
		2766.75	36.93	-37.07	74	61.74	27.8	8.26	60.87	100	0	P	H
		3689	38.55	-35.45	74	61.07	29.2	9.39	61.11	100	0	P	H
													H
													H
		1844.5	43.2	-30.8	74	72.04	25.19	7.02	61.05	100	0	P	V
		2766.75	37.1	-36.9	74	61.91	27.8	8.26	60.87	100	0	P	V
		3689	40.43	-33.57	74	62.95	29.2	9.39	61.11	100	0	P	V
													V
													V
927.75MHz		1855.5	38.94	-35.06	74	67.73	25.22	7.05	61.06	100	0	P	H
		2783.25	36.33	-37.67	74	61.02	27.9	8.28	60.87	100	0	P	H
		3711	38.34	-35.66	74	60.79	29.22	9.42	61.09	100	0	P	H
													H
													H
		1855.5	44.26	-29.74	74	73.05	25.22	7.05	61.06	100	0	P	V
		2783.25	38.83	-35.17	74	63.52	27.9	8.28	60.87	100	0	P	V
		3711	40.82	-33.18	74	63.27	29.22	9.42	61.09	100	0	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

**922~928MHz
(30MHz ~ 1GH @3m)**

	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
922.25MHz		30.97	30.93	-9.07	40	29.06	23.58	10.66	32.37	-	-	P	H
		104.69	27.95	-15.55	43.5	32.62	16.4	11.25	32.32	-	-	P	H
		159.01	28.3	-15.2	43.5	32.53	16.41	11.63	32.27	-	-	P	H
		815.7	35.21	-10.79	46	24.94	28.15	13.92	31.8	140	265	QP	H
		909.79	38.01	-7.99	46	26.09	29.02	14.16	31.26	141	273	QP	H
	*	922.25	-	-	46	111.71	29.2	14.18	31.15	-	-	P	H
		930.16	41.17	-4.83	46	28.55	29.48	14.21	31.07	140	277	QP	H
													H
													H
		41.64	35.11	-4.89	40	38.5	18.23	10.75	32.37	100	34	QP	V
		76.56	24.76	-15.24	40	33.31	12.7	11.09	32.34	-	-	P	V
		112.45	28.17	-15.33	43.5	32.38	16.83	11.27	32.31	-	-	P	V
		914.64	41.13	-4.87	46	29.11	29.07	14.17	31.22	108	243	QP	V
	*	922.25	-	-	46	113.63	29.2	14.18	31.15	-	-	P	V
		930.16	41.37	-4.63	46	28.75	29.48	14.21	31.07	107	243	QP	V
		952.47	38.66	-7.34	46	24.59	30.68	14.26	30.87	106	292	QP	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												



	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
927.75MHz		31.94	30.57	-9.43	40	29.11	23.16	10.67	32.37	-	-	P	H
		41.64	26.95	-13.05	40	30.34	18.23	10.75	32.37	-	-	P	H
		96.93	27.07	-16.43	43.5	32.83	15.34	11.22	32.32	-	-	P	H
		866.14	36.86	-9.14	46	25.04	29.28	14.07	31.53	145	292	QP	H
		919.49	40.17	-5.83	46	28.05	29.11	14.18	31.17	142	284	QP	H
	*	927.75	-	-	46	110.99	29.39	14.21	31.09	-	-	P	H
		935.98	40.55	-5.45	46	27.59	29.76	14.22	31.02	140	269	QP	H
													H
													H
		42.61	34.48	-5.52	40	38.34	17.75	10.76	32.37	100	31	QP	V
		93.05	28.07	-15.43	43.5	34.26	14.95	11.19	32.33	-	-	P	V
		114.39	28.05	-15.45	43.5	32.21	16.87	11.28	32.31	-	-	P	V
		674.08	38.69	-7.31	46	30.88	26.48	13.48	32.15	-	-	P	V
		798.24	34.91	-11.09	46	24.75	28.18	13.86	31.88	100	232	QP	V
	*	927.75	-	-	46	112.32	29.39	14.21	31.09	-	-	P	V
		945.68	38.36	-7.64	46	24.74	30.31	14.24	30.93	100	248	QP	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												



<SKU 2>
922~928MHz
(1GHz ~ 10GHz @ 3m)

	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
922.25MHz		1844.5	46.64	-27.36	74	75.48	25.19	7.02	61.05	100	0	P	H
		2766.75	37.25	-36.75	74	62.06	27.8	8.26	60.87	100	0	P	H
		3689	41.7	-32.3	74	64.22	29.2	9.39	61.11	100	0	P	H
													H
													H
		1844.5	43.47	-30.53	74	72.31	25.19	7.02	61.05	100	0	P	V
		2766.75	37.03	-36.97	74	61.84	27.8	8.26	60.87	100	0	P	V
		3689	43.77	-30.23	74	66.29	29.2	9.39	61.11	100	0	P	V
													V
													V
927.75MHz		1855.5	47.78	-26.22	74	76.57	25.22	7.05	61.06	100	0	P	H
		2783.25	36.7	-37.3	74	61.39	27.9	8.28	60.87	100	0	P	H
		3711	41.74	-32.26	74	64.19	29.22	9.42	61.09	100	0	P	H
													H
													H
		1855.5	44.83	-29.17	74	73.62	25.22	7.05	61.06	100	0	P	V
		2783.25	37.1	-36.9	74	61.79	27.9	8.28	60.87	100	0	P	V
		3711	44.54	-29.46	74	66.99	29.22	9.42	61.09	100	0	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



922~928MHz
(30MHz ~ 1GH @3m)

	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
922.25MHz		30.97	30.52	-9.48	40	28.65	23.58	10.66	32.37	-	-	P	H
		98.87	26.38	-17.12	43.5	31.92	15.56	11.22	32.32	-	-	P	H
		159.01	27.71	-15.79	43.5	31.94	16.41	11.63	32.27	-	-	P	H
		883.6	37.66	-8.34	46	25.9	29.1	14.1	31.44	162	283	QP	H
	*	922.25	-	-	46	115.26	29.2	14.18	31.15	-	-	P	H
		930.16	42.88	-3.12	46	30.26	29.48	14.21	31.07	127	269	QP	H
		951.5	38.86	-7.14	46	24.85	30.64	14.25	30.88	118	232	QP	H
													H
													H
		42.61	32.54	-7.46	40	36.4	17.75	10.76	32.37	100	32	QP	V
		78.5	26.68	-13.32	40	35.02	12.89	11.11	32.34	-	-	P	V
		95.96	27.96	-15.54	43.5	33.83	15.24	11.21	32.32	-	-	P	V
		766.23	34.81	-11.19	46	25.1	27.88	13.79	31.96	112	324	QP	V
		891.36	36.96	-9.04	46	25.21	29.03	14.12	31.4	128	308	QP	V
	*	922.25	-	-	46	111.55	29.2	14.18	31.15	-	-	P	V
		954.41	38.86	-7.14	46	24.68	30.77	14.26	30.85	109	316	QP	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												



	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
927.75MHz		30	30.84	-9.16	40	28.56	24.01	10.65	32.38	-	-	P	H
		97.9	27.71	-15.79	43.5	33.37	15.45	11.21	32.32	-	-	P	H
		159.01	27.64	-15.86	43.5	31.87	16.41	11.63	32.27	-	-	P	H
		858.38	37.23	-8.77	46	25.46	29.28	14.06	31.57	161	301	QP	H
		919.49	42.32	-3.68	46	30.2	29.11	14.18	31.17	126	272	QP	H
	*	927.75	-	-	46	115.24	29.37	14.2	31.1	-	-	P	H
		935.98	42.96	-3.04	46	30	29.76	14.22	31.02	127	268	QP	H
													H
													H
		41.64	32.49	-7.51	40	35.88	18.23	10.75	32.37	100	162	QP	V
		77.53	26.25	-13.75	40	34.69	12.8	11.1	32.34	-	-	P	V
		95.96	27.95	-15.55	43.5	33.82	15.24	11.21	32.32	-	-	P	V
		752.65	39.92	-6.08	46	30.32	27.84	13.76	32	-	-	P	V
		852.56	36.55	-9.45	46	24.92	29.18	14.05	31.6	121	310	QP	V
	*	927.75	-	-	46	111.56	29.37	14.2	31.1	-	-	P	V
		950.53	38.82	-7.18	46	24.86	30.6	14.25	30.89	107	311	QP	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												



**<SKU 3>
922~928MHz
(1GHz ~ 10GHz @ 3m)**

	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
927.75MHz		1855.5	45.47	-28.53	74	74.26	25.22	7.05	61.06	100	0	P	H
		2783.25	37.59	-36.41	74	62.28	27.9	8.28	60.87	100	0	P	H
		3711	41.01	-32.99	74	63.46	29.22	9.42	61.09	100	0	P	H
													H
													H
		1855.5	40.68	-33.32	74	69.47	25.22	7.05	61.06	100	0	P	V
		2783.25	37.07	-36.93	74	61.76	27.9	8.28	60.87	100	0	P	V
		3711	43.02	-30.98	74	65.47	29.22	9.42	61.09	100	0	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



922~928MHz
(30MHz ~ 1GH @3m)

	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				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)
927.75MHz		30.97	30.94	-9.06	40	29.07	23.58	10.66	32.37	-	-	P	H
		97.9	27.13	-16.37	43.5	32.79	15.45	11.21	32.32	-	-	P	H
		159.98	27.71	-15.79	43.5	31.97	16.37	11.64	32.27	-	-	P	H
		759.44	39.86	-6.14	46	30.17	27.89	13.78	31.98	-	-	P	H
		850.62	37.36	-8.64	46	25.79	29.14	14.04	31.61	160	291	QP	H
	*	927.75	-	-	46	115.24	29.37	14.2	31.1	-	-	P	H
		935.98	42.26	-3.74	46	29.3	29.76	14.22	31.02	200	278	QP	H
													H
													H
		35.82	32.86	-7.14	40	33.18	21.35	10.7	32.37	-	-	P	V
		42.61	32.76	-7.24	40	36.62	17.75	10.76	32.37	100	47	QP	V
		99.84	28.57	-14.93	43.5	34.01	15.66	11.22	32.32	-	-	P	V
		762.35	34.57	-11.43	46	24.87	27.89	13.78	31.97	100	322	QP	V
		919.49	38.7	-7.3	46	26.58	29.11	14.18	31.17	100	302	QP	V
	*	927.75	-	-	46	111.02	29.37	14.2	31.1	-	-	P	V
		956.35	38.76	-7.24	46	24.49	30.85	14.25	30.83	105	317	QP	V
													V
													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.
QP/P/A	Quasi Peak or Peak or Average
H/V	H orizontal or V ertical



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

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 01													
2412MHz		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBμV/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable 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) + Cable 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”.



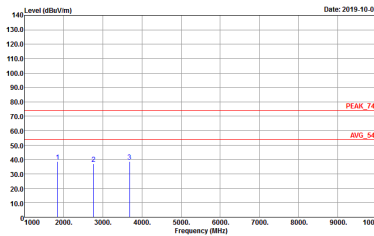
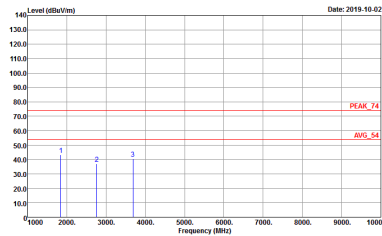
Appendix C. Radiated Spurious Emission Plots

Test Engineer :	Fu Chen and Troye Hsieh	Temperature :	21.4~24.8°C
		Relative Humidity :	51~65.8%

Note symbol

-L	Low channel location
-R	High channel location

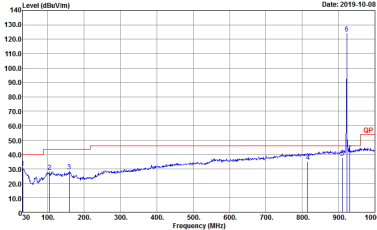
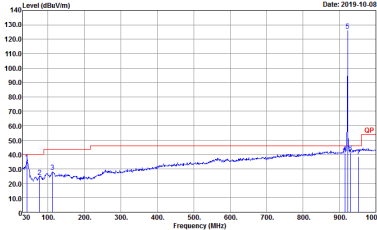
<SKU 1>
922~928MHz
(1GHz ~ 10GHz @ 3m)

ANT	922.25MHz	
	Horizontal	Vertical
Peak Avg.	 Site : 03CHI1-HY Condition : PEAK_74 3m HORN 91200-HF HORIZONTAL Detector : Peak Project : 981238	 Site : 03CHI1-HY Condition : PEAK_74 3m HORN 91200-HF VERTICAL Detector : Peak Project : 981238

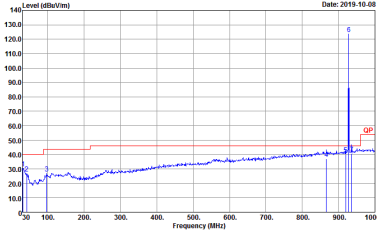
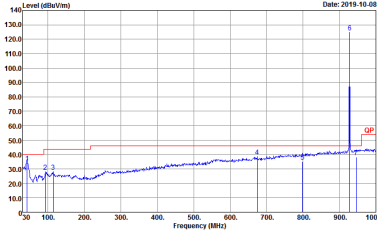


ANT	927.75MHz	
	Horizontal	Vertical
Peak Avg.	Level (dBμm) Date: 2019-10-02 Site : 03CHI1-HY Condition : PEAK_74 3m HORN 91200-HF HORIZONTAL Detector : Peak Project : 981238	Level (dBμm) Date: 2019-10-02 Site : 03CHI1-HY Condition : PEAK_74 3m HORN 91200-HF VERTICAL Detector : Peak Project : 981238

922~928MHz
(30MHz ~ 1GHz @ 3m)

ANT	922.25MHz	
	Horizontal	Vertical
QP / Peak	 Site : 03CHI1-HY Condition : QP 3m BE-LOG 6111D-LF_ETC HORIZONTAL Detector : Peak Project : 981238	 Site : 03CHI1-HY Condition : QP 3m BE-LOG 6111D-LF_ETC VERTICAL Detector : Peak Project : 981238



ANT	927.75MHz	
	Horizontal	Vertical
QP / Peak	 Site : 03CHI1-HY Condition : QP 3m BE-LOG 6111D-LF_ETC HORIZONTAL Detector : Peak Project : 981238	 Site : 03CHI1-HY Condition : QP 3m BE-LOG 6111D-LF_ETC VERTICAL Detector : Peak Project : 981238



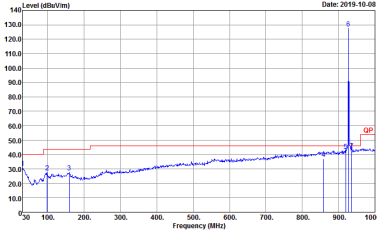
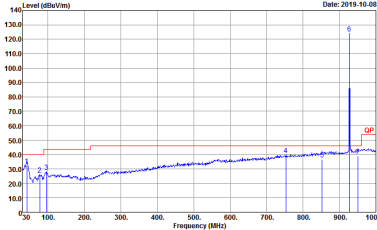
<SKU 2>
922~928MHz
(1GHz ~ 10GHz @ 3m)

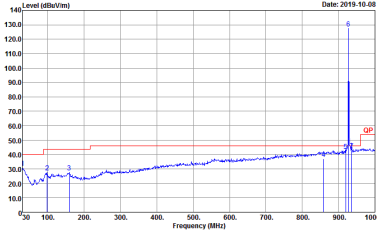
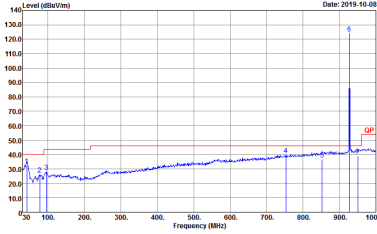
ANT	922.25MHz	
	Horizontal	Vertical
Peak Avg.	Level (dBμV/m) Date: 2019-10-02 Frequency (MHz) Site : 03CHI1-HY Condition : PEAK_74 3m HORN 91200-HF HORIZONTAL Detector : Peak Project : 981238	Level (dBμV/m) Date: 2019-10-02 Frequency (MHz) Site : 03CHI1-HY Condition : PEAK_74 3m HORN 91200-HF VERTICAL Detector : Peak Project : 981238



ANT	927.75MHz	
	Horizontal	Vertical
Peak Avg.	Level (dBμV/m) 140 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 Date: 2019-10-02 Site : 03CH11-HY Condition : PEAK_74 3m HORN 91200-HF HORIZONTAL Detector : Peak Project : 981238	Level (dBμV/m) 140 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 Date: 2019-10-02 Site : 03CH11-HY Condition : PEAK_74 3m HORN 91200-HF VERTICAL Detector : Peak Project : 981238

922~928MHz
(30MHz ~ 1GHz @ 3m)

ANT	922.25MHz	
	Horizontal	Vertical
QP / Peak	 Site : 03CHI1-HY Condition : QP 3m BE-LOG 6111D-LF_ETC HORIZONTAL Detector : Peak Project : 981238	 Site : 03CHI1-HY Condition : QP 3m BE-LOG 6111D-LF_ETC VERTICAL Detector : Peak Project : 981238

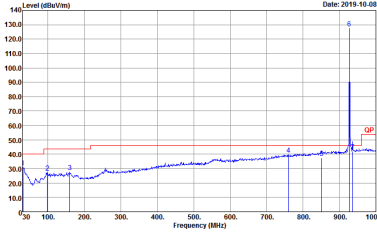
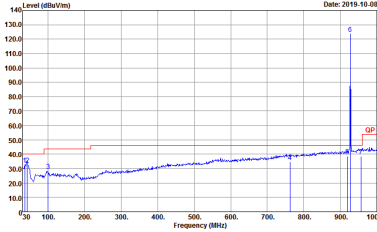
ANT	927.75MHz	
	Horizontal	Vertical
QP / Peak	 Site : 03CHI1-HY Condition : QP 3m BE-LOG 6111D-LF_ETC HORIZONTAL Detector : Peak Project : 981238	 Site : 03CHI1-HY Condition : QP 3m BE-LOG 6111D-LF_ETC VERTICAL Detector : Peak Project : 981238



<SKU 3>
922~928MHz
(1GHz ~ 10GHz @ 3m)

ANT	927.75MHz	
	Horizontal	Vertical
Peak Avg.	Level (dBμV/m) Date: 2019-10-02 Site : 03CHI1-HY Condition : PEAK_74 3m HORN 91200-HF HORIZONTAL Detector : Peak Project : 981238	Level (dBμV/m) Date: 2019-10-02 Site : 03CHI1-HY Condition : PEAK_74 3m HORN 91200-HF VERTICAL Detector : Peak Project : 981238

922~928MHz
(30MHz ~ 1GHz @ 3m)

ANT	927.75MHz	
	Horizontal	Vertical
QP / Peak	 Site : 03CHI1-HY Condition : QP 3m BT-LOG 6111D-LF_ETC HORIZONTAL Detector : Peak Project : 981238	 Site : 03CHI1-HY Condition : QP 3m BT-LOG 6111D-LF_ETC VERTICAL Detector : Peak Project : 981238

Annex. A Receiver Radiated Emission Measurement

A.1 Limit of Receiver Radiated Emission

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

A.2 Measuring Instruments

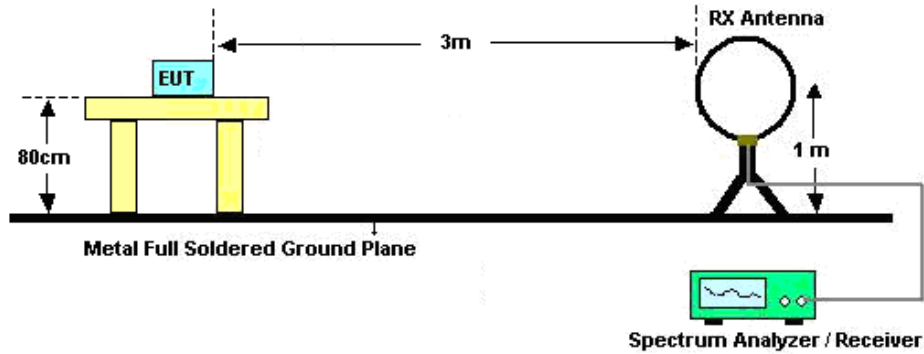
See list of measuring equipment of this test report.

A.3 Test Procedures

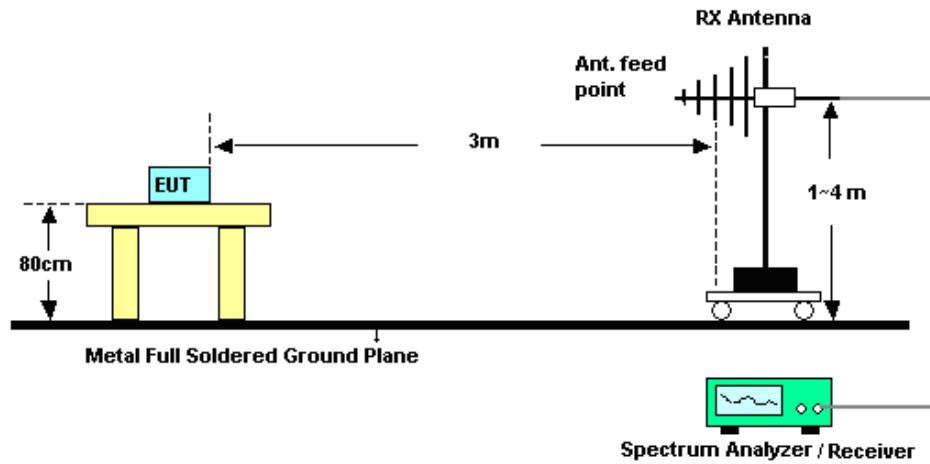
1. The EUT was placed on a turntable with 0.8 meter above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. The table was rotated 360 degrees to determine the position of the highest radiation.
4. The antenna is a Bi-Log antenna and its height is adjusted between one to four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, 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.
6. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode (RBW=120kHz/VBW=300kHz for frequency below 1GHz; RBW=1MHz VBW=3MHz (Peak), RBW=1MHz/VBW=10Hz (Average) for frequency above 1GHz).
7. If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, peak values of EUT will be reported. Otherwise, the emission will be repeated by using the quasi-peak method and reported.
8. Emission level (dBμV/m) = 20 log Emission level (μV/m)
9. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

A.4 Test Setup

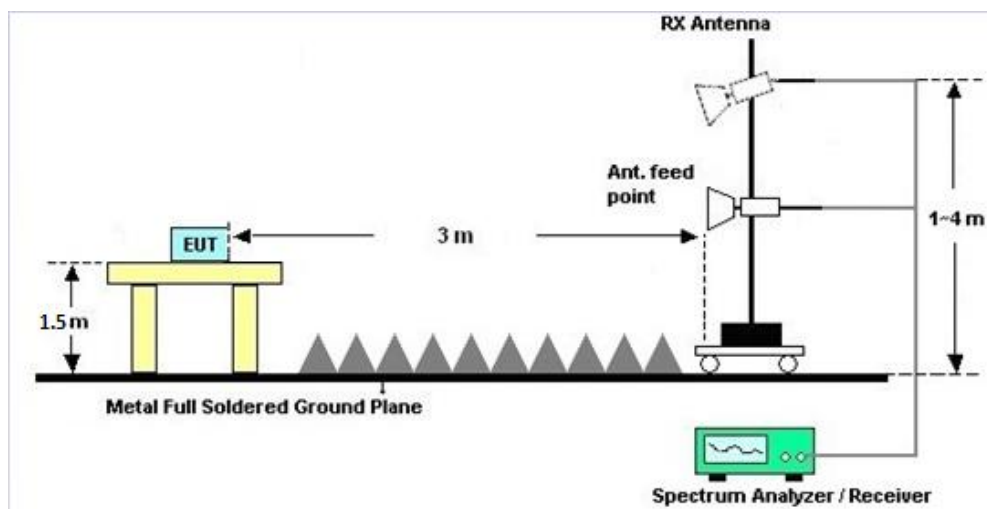
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz

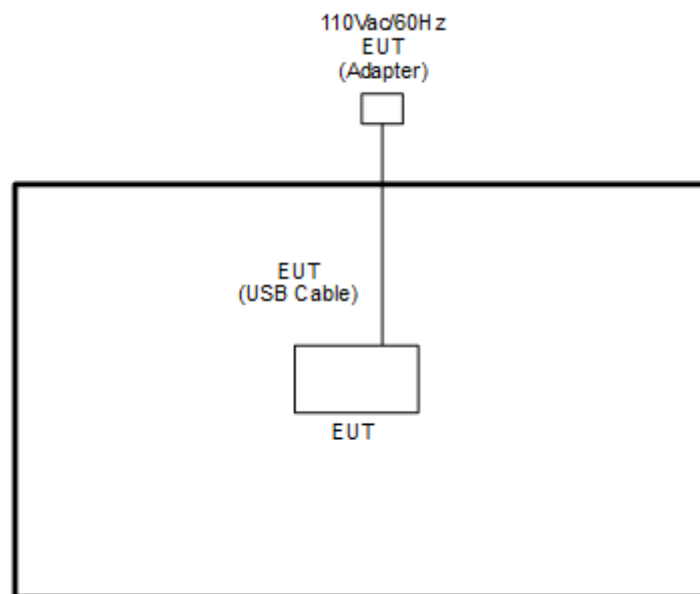


A.5 Test Result of Receiver Radiated Spurious Emissions (9kHz ~ 30MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per NCC LP0002 section 5.13 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.

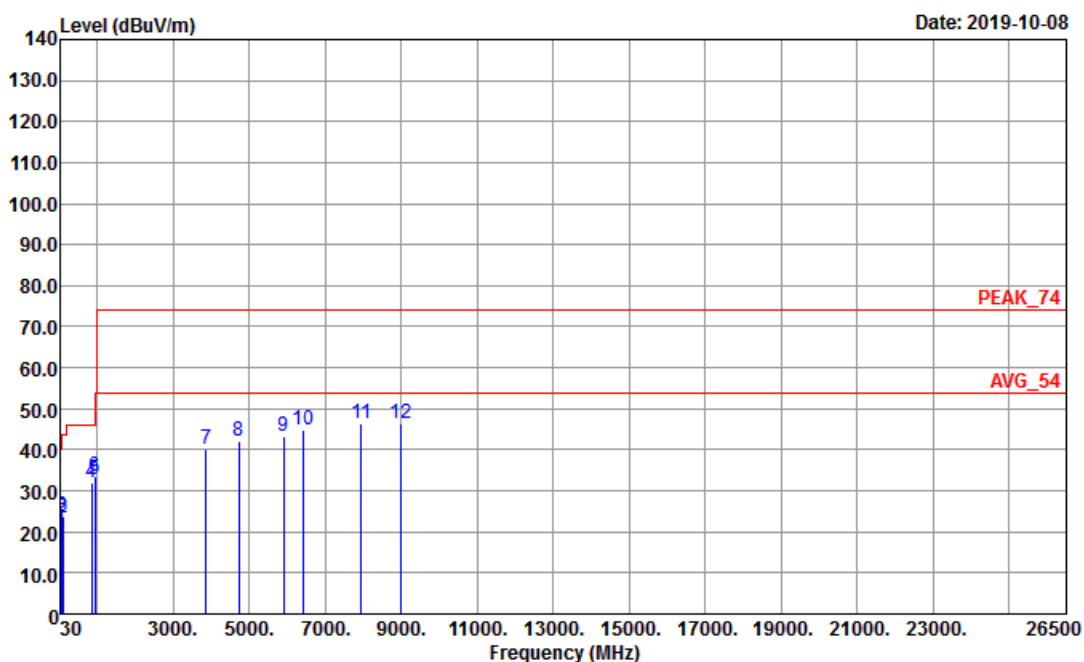
A.6 Connection Diagram of Test System



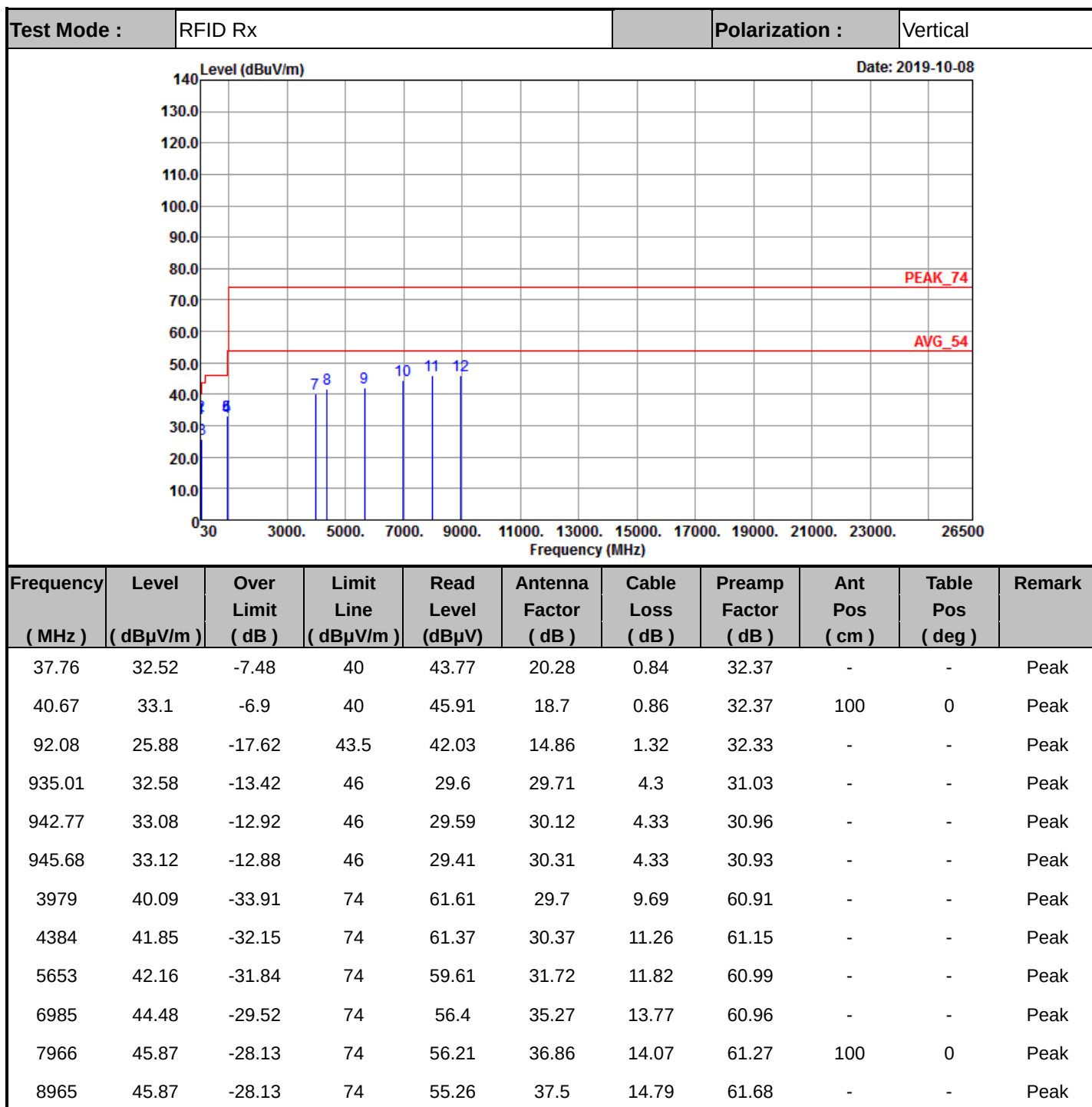
A.7 Test Result Results of Receiver Radiated Spurious Emissions

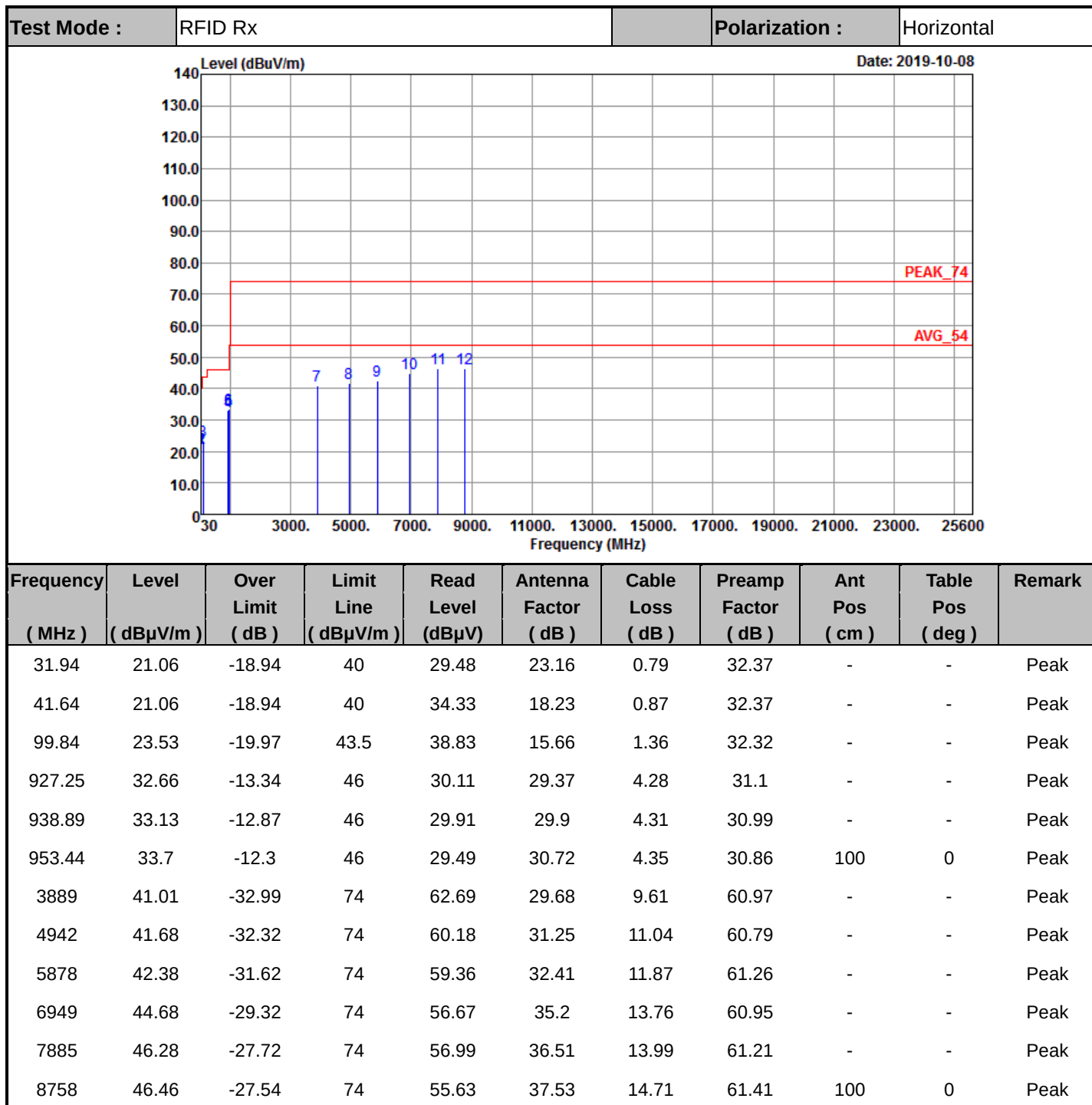
Test Engineer :	Fu Chen and Troye Hsieh	Temperature :	21.4~24.8°C
		Relative Humidity :	51~65.8%
Frequency	40.670 MHz	Margin	Under 6.52 dB

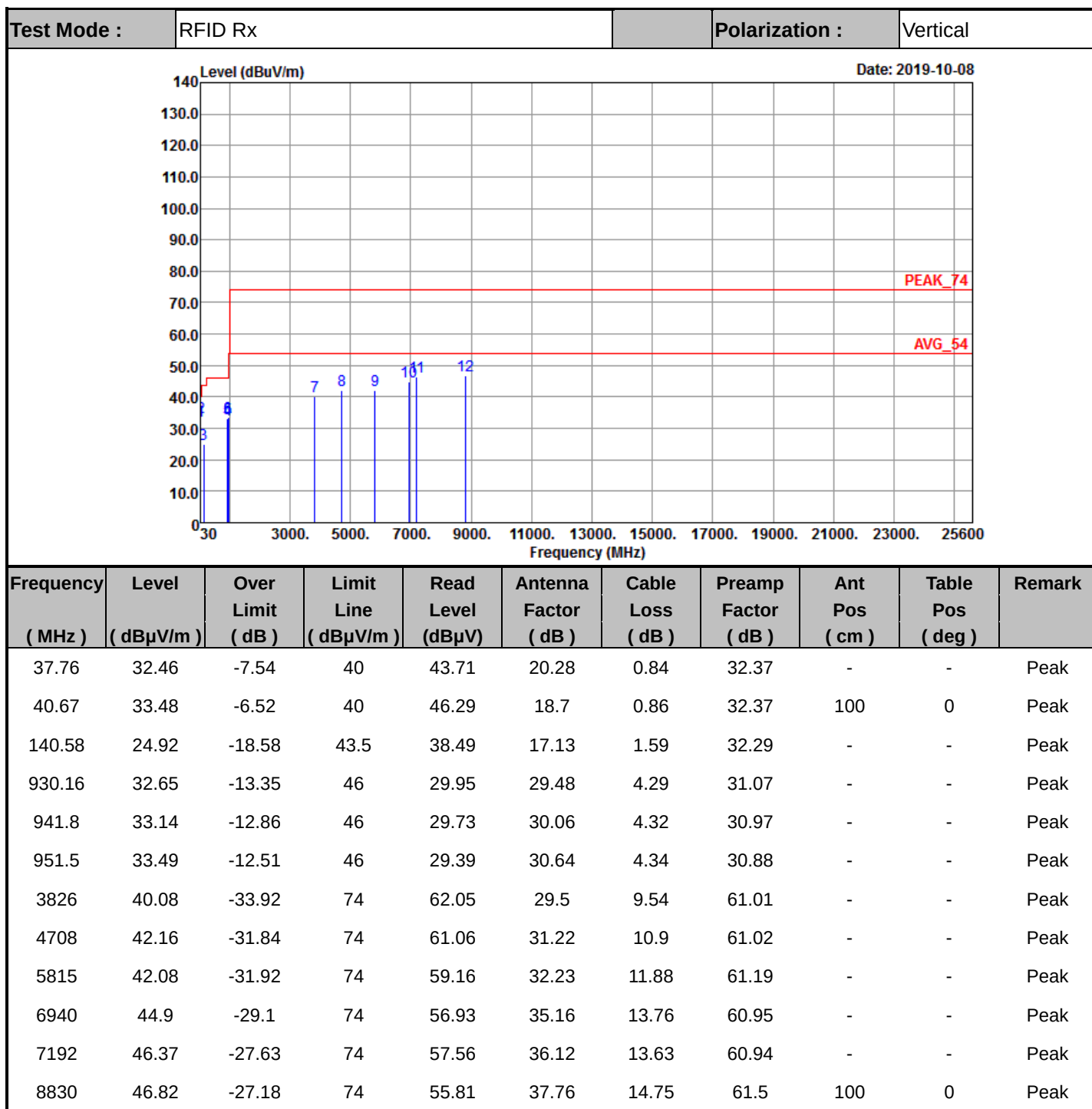
Test Mode :	RFID Rx for SKU 1	Polarization :	Horizontal
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Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
40.67	20.49	-19.51	40	33.3	18.7	0.86	32.37	-	-	Peak
92.08	23.43	-20.07	43.5	39.58	14.86	1.32	32.33	-	-	Peak
102.75	23.78	-19.72	43.5	38.62	16.1	1.38	32.32	-	-	Peak
870.99	31.93	-14.07	46	30.03	29.25	4.15	31.5	-	-	Peak
938.89	32.78	-13.22	46	29.56	29.9	4.31	30.99	-	-	Peak
949.56	33.6	-12.4	46	29.6	30.55	4.34	30.89	100	0	Peak
3862	40.01	-33.99	74	61.81	29.62	9.57	60.99	-	-	Peak
4726	42.22	-31.78	74	61.07	31.25	10.9	61	-	-	Peak
5905	43.15	-30.85	74	60.08	32.51	11.86	61.3	-	-	Peak
6436	44.77	-29.23	74	59.38	33.84	12.48	60.93	-	-	Peak
7948	46.57	-27.43	74	56.99	36.79	14.05	61.26	100	0	Peak
9001	46.49	-27.51	74	55.91	37.5	14.8	61.72	-	-	Peak



<For SKU 2>




Annex. B Maximum Power Density

B.1 RF Exposure Limit Introduction

According to NCC LP0002, the criteria listed in Table shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §5.20.2.1 and §5.20.2.2.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f ²)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:

S = Power Density

P = Output Power at Antenna Terminals

G = Gain of Transmit Antenna (linear gain)

R = Distance from Transmitting Antenna

B.2 Standalone Power Density Calculation

<Long Range>

Maximum Power Density				
Max. Power	Gain	EIRP	20 cm PSD	Limit
27.84	5.98	33.82	0.4797	0.614
dBm	dBi	dBm	mW/cm ²	mW/cm ²

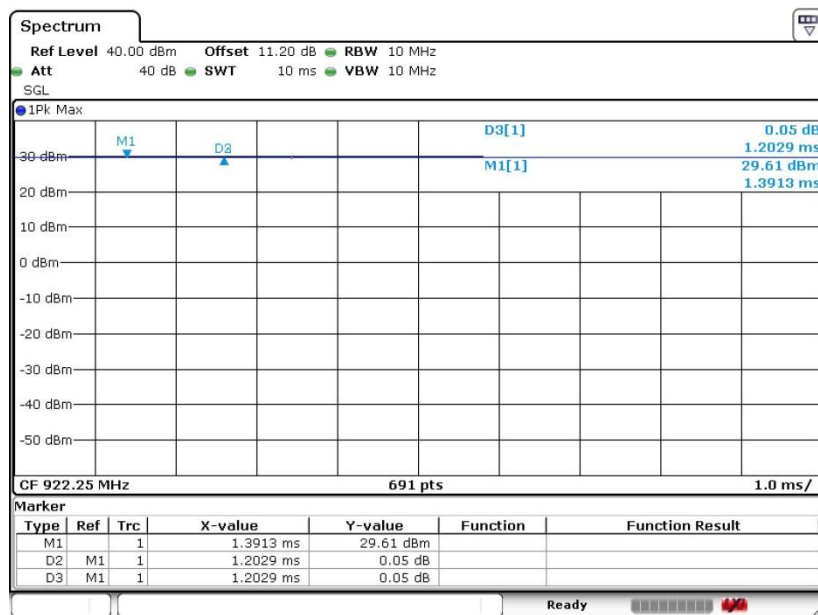
<Middle Range>

Maximum Power Density				
Max. Power	Gain	EIRP	20 cm PSD	Limit
27.88	0.12	28	0.1256	0.614
dBm	dBi	dBm	mW/cm ²	mW/cm ²

Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
UHF for Long Range	100	-	-	10Hz
UHF for Middle Range	100	-	-	10Hz

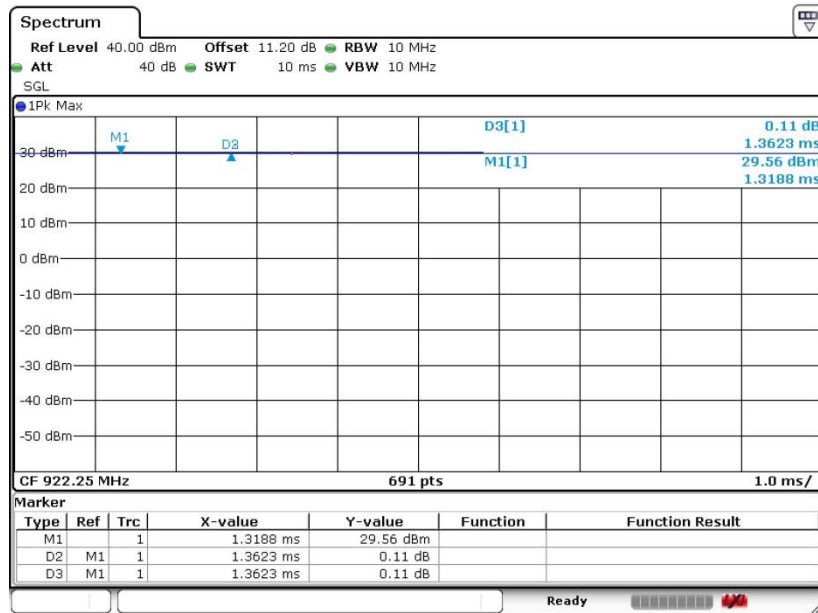
<Long Range>



Date: 26.AUG.2019 16:19:12



<Middle Range>



Date: 26.AUG.2019 16:19:00