

ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

Test Report No. : OT-181-RWD-017

AGR No. : A17DA-067

Applicant : Technology Solutions (UK) Ltd
Address : Suite A, Loughborough Technology Centre Epinal Way, Leicestershire.
Loughborough LE11 3GE United Kingdom

Manufacturer : Technology Solutions (UK) Ltd
Address : Suite A, Loughborough Technology Centre Epinal Way, Leicestershire.
Loughborough LE11 3GE United Kingdom

Type of Equipment : 2128 Bluetooth Handheld RFID Reader

FCC ID. : S6J2128

Model Name : 2128-AS0

Multiple Model Name : 2128-AX0, IH21A0014, 1190-A-EPL-CASE, IH21-EPL-D75E, 2128-CRD-01-KIT,
IH21-CB-1, 1192-A-EPL-CASE, IH21-EPL-CT50

Serial number : N/A

Total page of Report : 48 pages (including this page)

Date of Incoming : December 01, 2017

Date of issue : January 11, 2018

SUMMARY

The equipment complies with the regulation; **FCC PART 15 SUBPART C Section 15.247**

This test report only contains the result of a single test of the sample supplied for the examination.

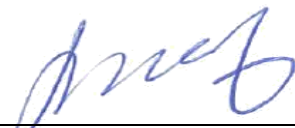
It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by:



Jae-Ho Lee / Chief Engineer
ONETECH Corp.

Approved by:



Keun-Young, Choi / Vice President
ONETECH Corp.

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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
OT-181-RWD-017	January 11, 2018	Initial Issue	All

DOCUMENT HISTORY

Revision No.	Issued Date	Revisions	Effect Section
Original	January 11, 2018	Initial Issue	-
Revision 01	February 20, 2018	Added Test data for RFID+BT Mode	13.4.3 Test data for RFID+BT Mode

1. VERIFICATION OF COMPLIANCE

APPLICANT : Technology Solutions (UK) Ltd
ADDRESS : Suite A, Loughborough Technology Centre Epinal Way, Leicestershire. Loughborough LE11 3GE
United Kingdom
CONTACT PERSON : David Evans / Managing Director
TELEPHONE NO : +441509238248
FCC ID : S6J2128
MODEL NAME : 2128-AS0
SERIAL NUMBER : N/A
DATE : January 11, 2018

EQUIPMENT CLASS	DSS – PART 15 SPREAD SPECTRUM TRANSMITTER
KIND OF EQUIPMENT	2128 Bluetooth Handheld RFID Reader
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	None
FINAL TEST WAS CONDUCTED ON	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (1)	Carrier Frequency Separation	Met the Limit / PASS
15.247 (a) (1) (iii)	Minimum Number of Hopping Channels	Met the Limit / PASS
15.247 (a) (1) (iii)	Average Time of Occupancy	Met the Limit / PASS
15.247 (b) (1)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.209	Radiated Emission Limits, General Requirement	Met the Limit / PASS
15.207	Conducted Limits	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / PASS

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.247

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666 / T-1842

IC (Industry Canada) – Registration No. Site# 3736A-3

-. Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The Technology Solutions (UK) Ltd, Model 2128-AS0 (referred to as the EUT in this report) is a 2128 Bluetooth Handheld RFID Reader. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	2128 Bluetooth Handheld RFID Reader
OPERATING FREQUENCY	902.75 MHz ~ 927.25 MHz
RF OUTPUT POWER	27.84 dBm (0.608 W)
NUMBER OF CHANNEL	50 Channels
MODULATION TYPE	ASK
ANTENNA TYPE	PCB Antenna
ANTENNA GAIN	3.0 dBi
LIST OF EACH OSC. OR CRYSTAL. FREQ.(FREQ.>=1 MHz)	8 MHz, 18.432 MHz, 24 MHz, 48 MHz
RATED SUPPLY VOLTAGE	DC 3.7 V

3.2 Alternative type(s)/model(s); also covered by this test report.

-. The following lists consist of the added model and their differences.

Model Name	Differences	Tested
2128-AS0	Basic Model (RFID reader with barcode imager)	☒
2128-AX0	This model is identical to the basic model except that the barcode module is removed. (RFID reader plastic highlights yellow)	☐
IH21A0014	This model is identical to the basic model except that the barcode module is removed. (RFID reader plastic highlights red)	☐
1190-A-EPL-CASE	This model is identical to the basic model except that it comes with accessory (Honeywell D75e) to connect to the Reader.	☐
IH21-EPL-D75E	This model is identical to the basic model except that it comes with accessory (Honeywell D75e) to connect to the Reader.	☐
2128-CRD-01-KIT	This model is identical to the base model except that it comes with a Charge dock(plastic highlights yellow) for the Reader.	☐
IH21-CB-1	This model is identical to the base model except that it comes with a Charge dock(plastic highlights red) for the Reader.	☐
1192-A-EPL-CASE	This model is identical to the basic model except that it comes with accessory (Honeywell CT50) to connect to the Reader.	☐
IH21-EPL-CT50	This model is identical to the basic model except that it comes with accessory (Honeywell CT50) to connect to the Reader.	☐

Note: 1. Applicant consigns only basic model to test. Therefore this test report just guarantees the units, which have been tested.

2. The Applicant/manufacture is responsible for the compliance of all variants.

4. EUT MODIFICATIONS

-. None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	N/A	1191A V1.4	N/A
Sub Board	N/A	1191B V1.2	N/A
Switch Board	N/A	N/A	N/A
Camera Board	N/A	N/A	N/A
Charging Board	N/A	1191N V1.0	N/A
RFID Sub Board	N/A	TSL 1128D V2.30	N/A
RFID Antenna	N/A	AQUA866S_6015_TSL1128_B	N/A
RFID Antenna CN Board	N/A	1191F V1.0	N/A
CN Board 1	N/A	TSL 1128C V2.30	N/A
CN Board 2	Technology Solutions UK Ltd	1191D V1.10	N/A
Charging Jack	N/A	1191E V1.10	N/A
Battery	VARTA Storage GmbH	EZPack XL	N/A
BT Module	Silicon Laboratories Finland Oy	BT121	QOQVT121

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
N/A	N/A	N/A	N/A

5.3 Mode of operation during the test

- . EUT does not transmitting mode during charging
- . Charging mode: The pin connector on the EUT was connected to the adapter and PDA,
then the EUT was continuously charged during the test.
- . Transmitting mode: Software of PDA used to control the EUT for staying in continuous transmitting mode is programmed.
- . For final testing, EUT was set at Low Channel (902.75 MHz), Middle Channel (915.25 MHz), and High Channel (927.25 MHz).

5.4 Configuration of Test System

Line Conducted Test: The EUT was tested in a charging mode and transmitting mode. The EUT was connected to adapter and PDA. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI 63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 m semi anechoic chamber. The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.5 Antenna Requirement

According to the rule, FCC Part 15C Section 15.203 the transmitter antenna shall be integral with the device, or the antenna coupling be so designed that no antenna other than that furnished by the party responsible for compliance shall be used.

Antenna Construction:

The transmitter antenna of the EUT is a PCB Antenna, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Tests, the following operating mode was investigated

Operation Mode	The Worse operating condition (Please check one only)
Charging Mode	X

6.2 General Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Charging Mode	-
Transmitting Mode	X

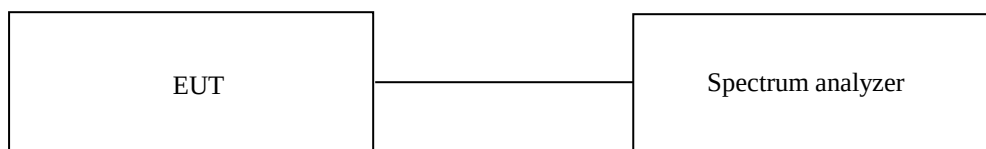
7. MINIMUM 20 dB BANDWIDTH

7.1 Operating environment

Temperature : 23 °C
Relative humidity : 44 % R.H.

7.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 10 kHz, and peak detection was used. The 20 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 20 dB.



7.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct.26, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

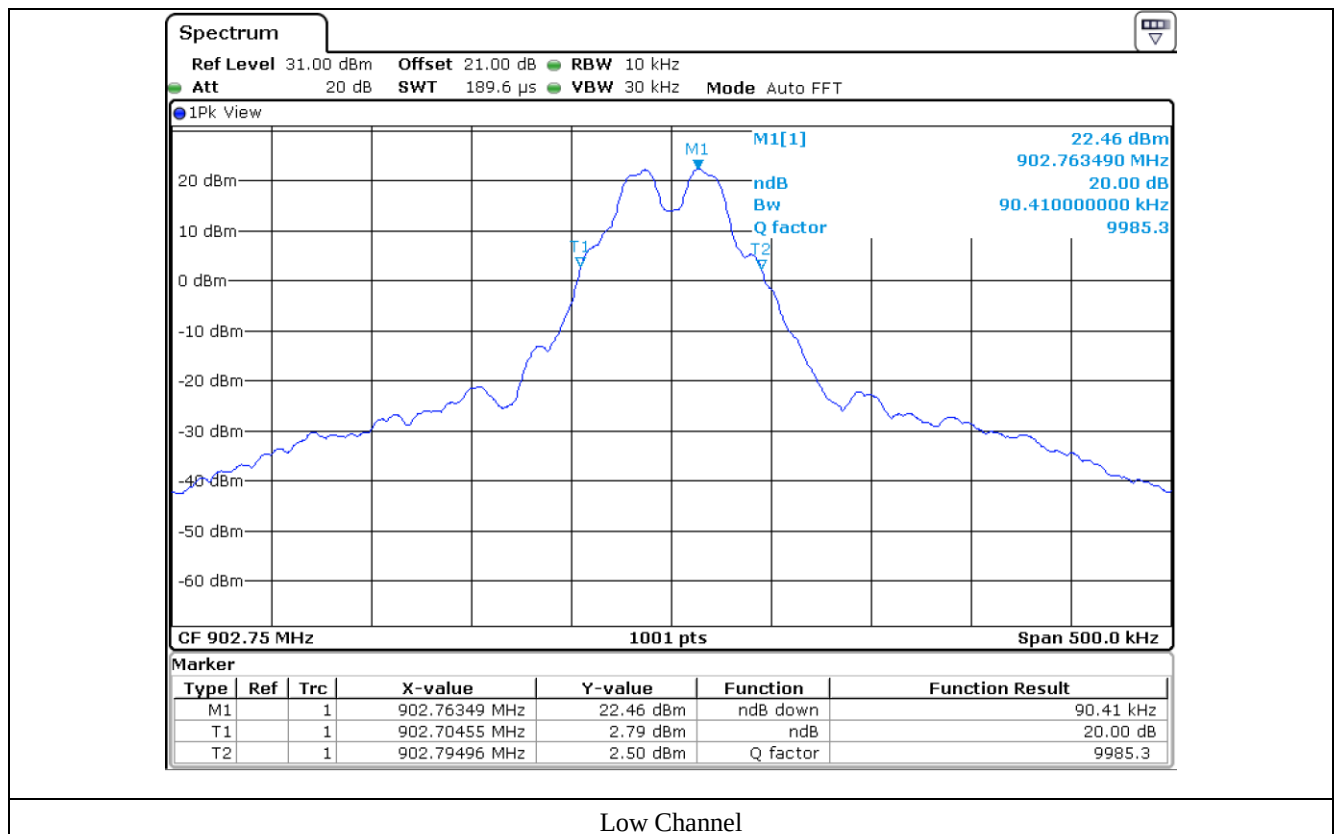
7.4 Test data

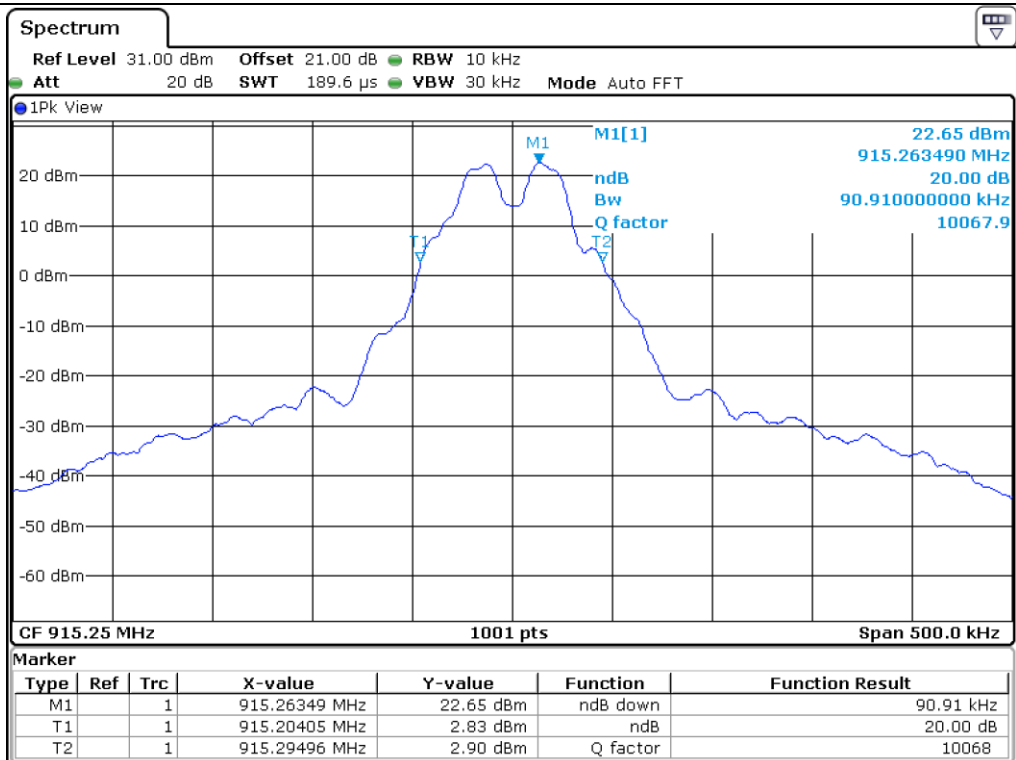
-. Test Date : December 13, 2017

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)	Limits(kHz)
Low	902.75	90.41	250
Middle	915.25	90.91	
High	927.25	93.41	

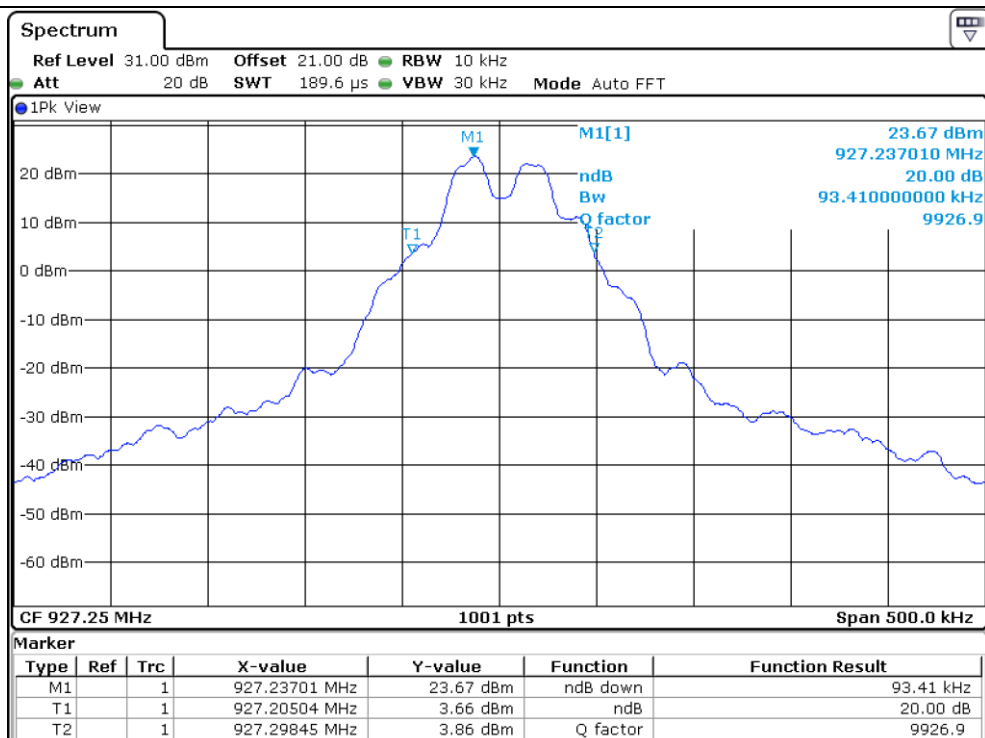


Tested by: Min-Gu Ji / Assistant Manager





Middle Channel



High Channel

8. HOPPING FREQUENCY SEPARATION

8.1 Operating environment

Temperature : 23 °C
Relative humidity : 44 % R.H.

8.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 5 MHz. The analyzer is set to peak hold then a pseudo-random hopping sequence of the transmitter is captured. The mark delta function was used to measure the frequency separation between two adjacent hopping channels.



8.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct.26, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

8.4 Test data

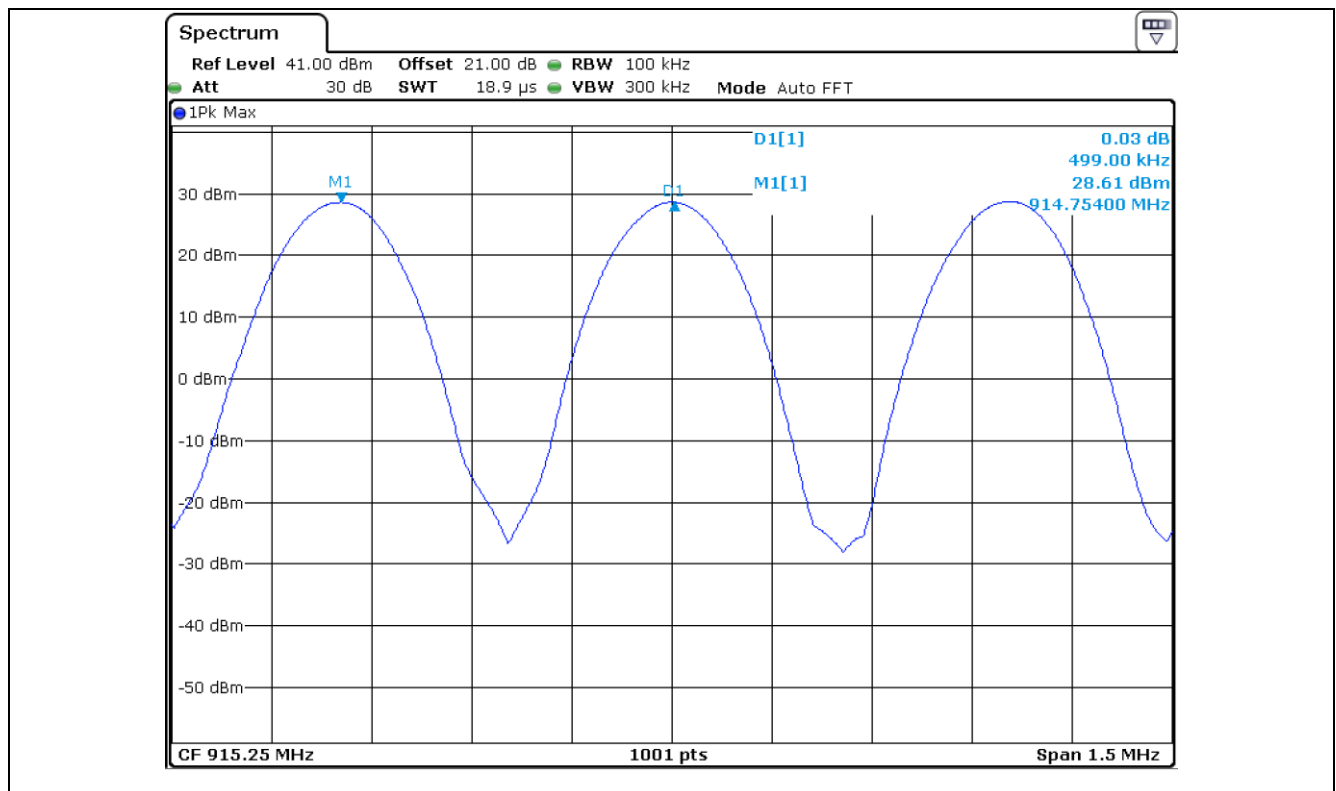
-. Test Date : December 13, 2017

-. Test Result : Pass

Frequency (MHz)	Measured Value (kHz)	LIMIT
915.25	499.00	Minimum of 25 kHz or the 20 dB Bandwidth



Tested by: Min-Gu Ji / Assistant Manager



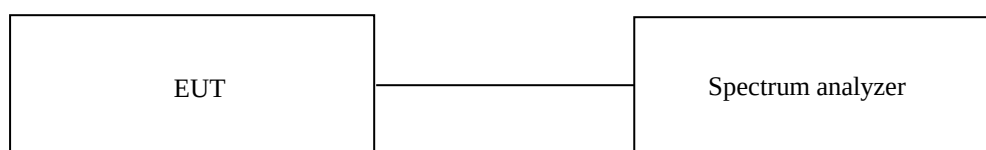
9. NUMBER OF HOPPING CHANNELS

9.1 Operating environment

Temperature : 23 °C
Relative humidity : 44 % R.H.

9.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to frequency band of operation and the resolution bandwidth is set to 100 kHz. The analyzer is set to peak hold and then complete pseudo-random hopping sequence of the transmitter is captured.



9.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct.26, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

9.4 Test data

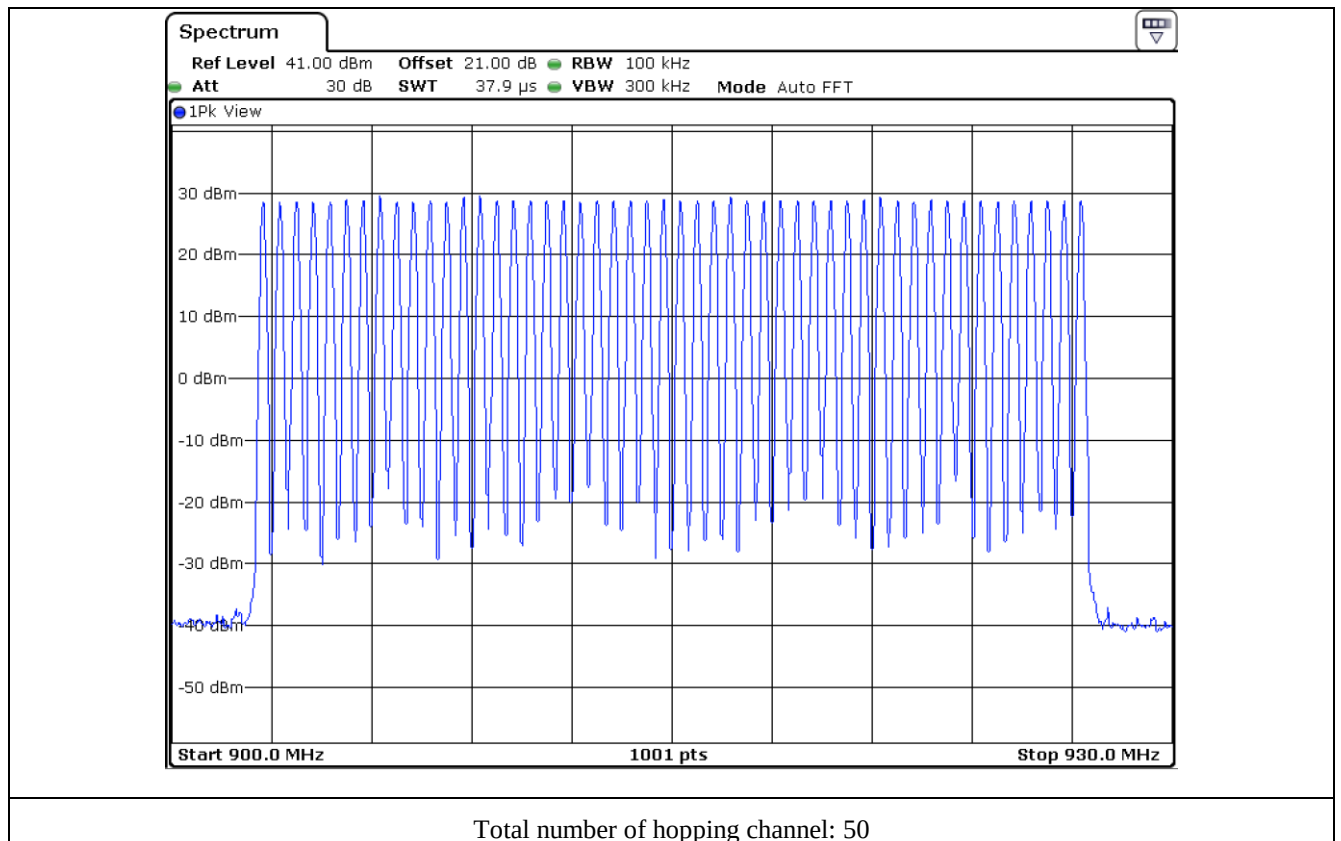
-. Test Date : December 13, 2017

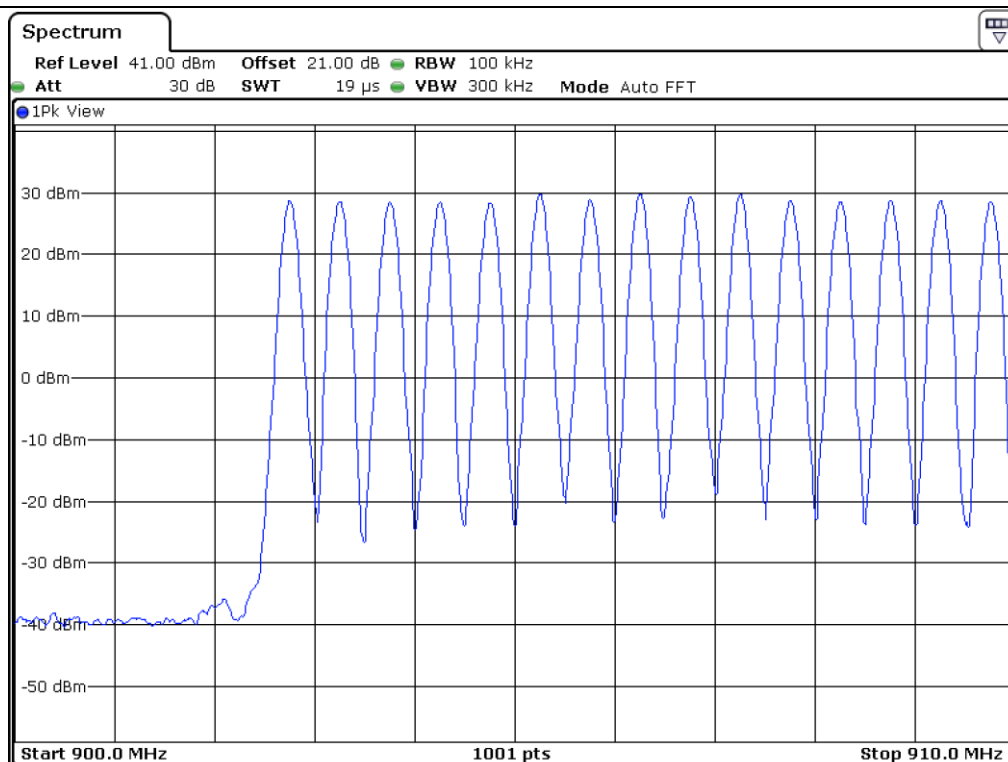
-. Test Result : Pass

Frequency Range (MHz)	Measured value (Number)	20 dB Bandwidth (kHz)	Limit
902.75 ~ 927.25	50	< 250	≥ 50

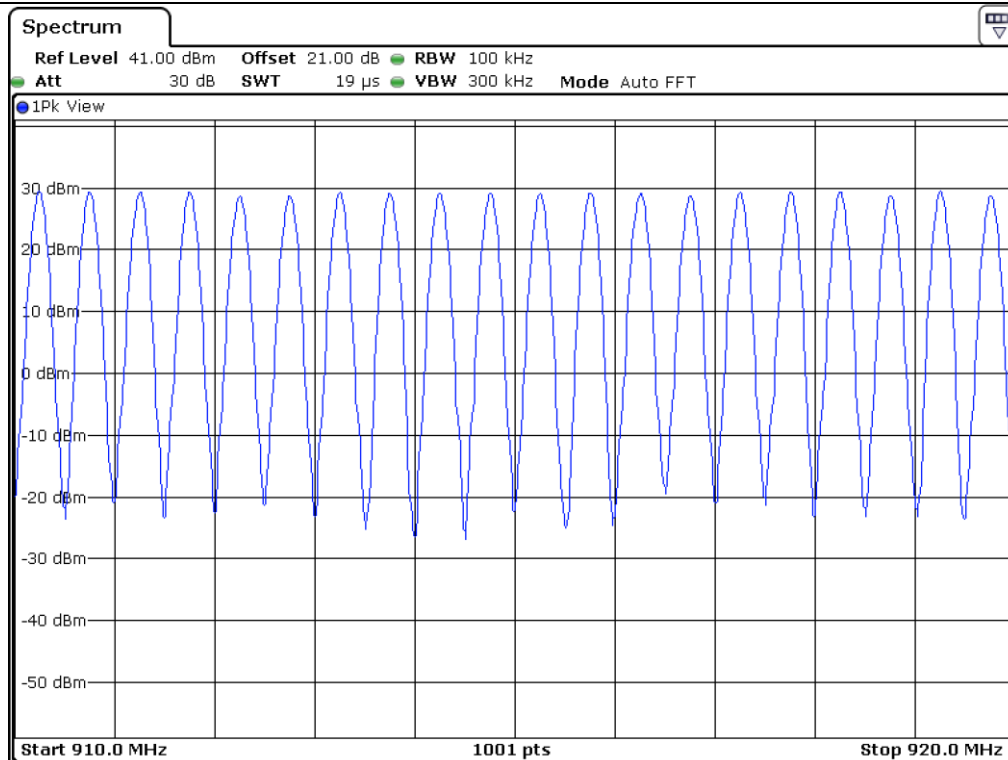


Tested by: Min-Gu Ji / Assistant Manager

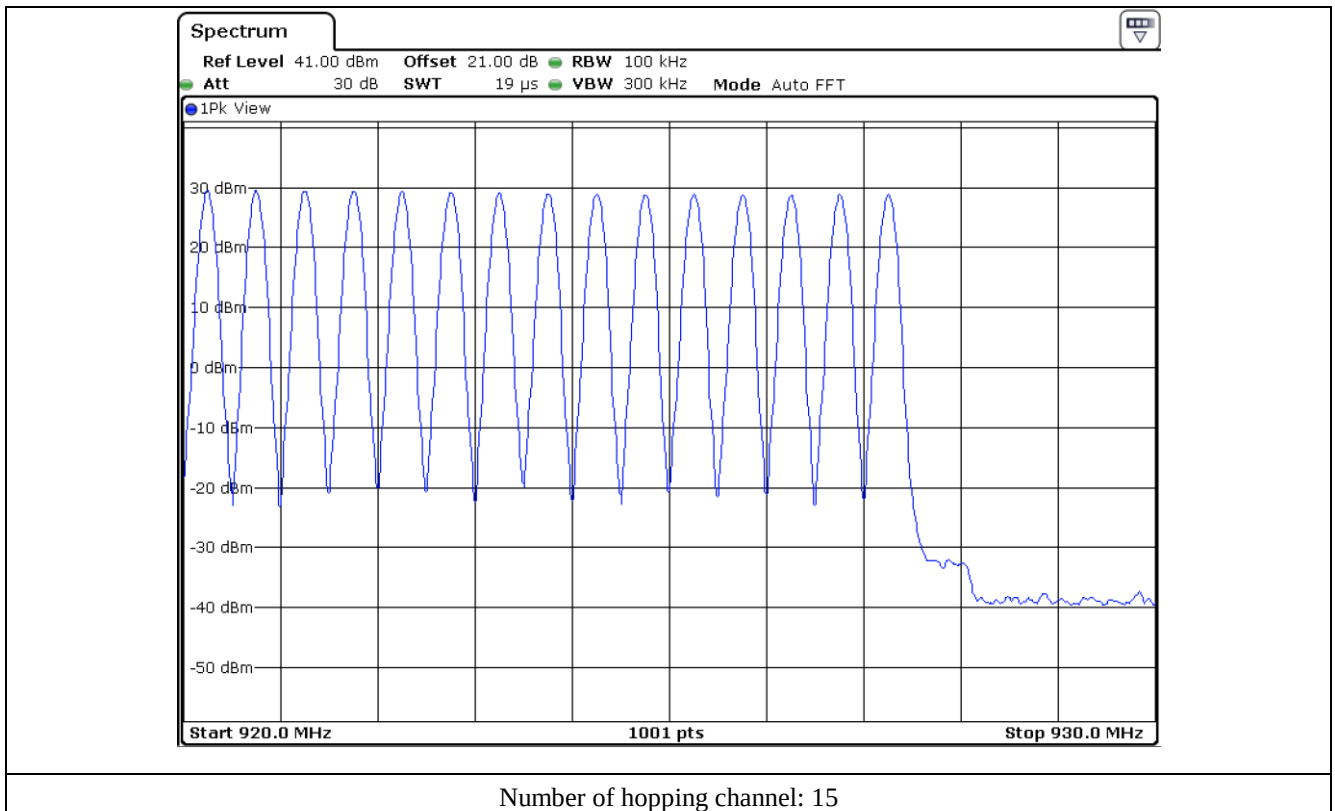




Number of hopping channel: 15



Number of hopping channel: 20



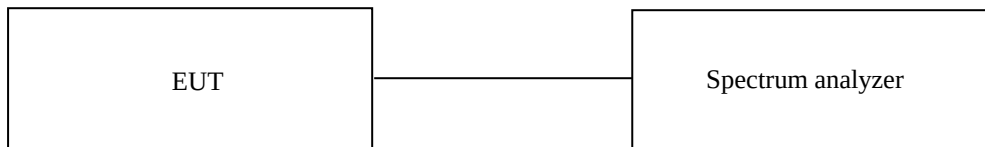
10. TIME OF OCCUPANCY

10.1 Operating environment

Temperature : 23 °C
Relative humidity : 44 % R.H.

10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The transmitter is set to operate in its normal frequency hopping mode. The center frequency of the spectrum analyzer is set to one of hopping channels near the center of the operating band and span is set to zero Hz. The sweep time is set to display one complete pulse. The mark delta function is used to measure the duration of the pulses.



10.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct.26, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

10.4 Test data

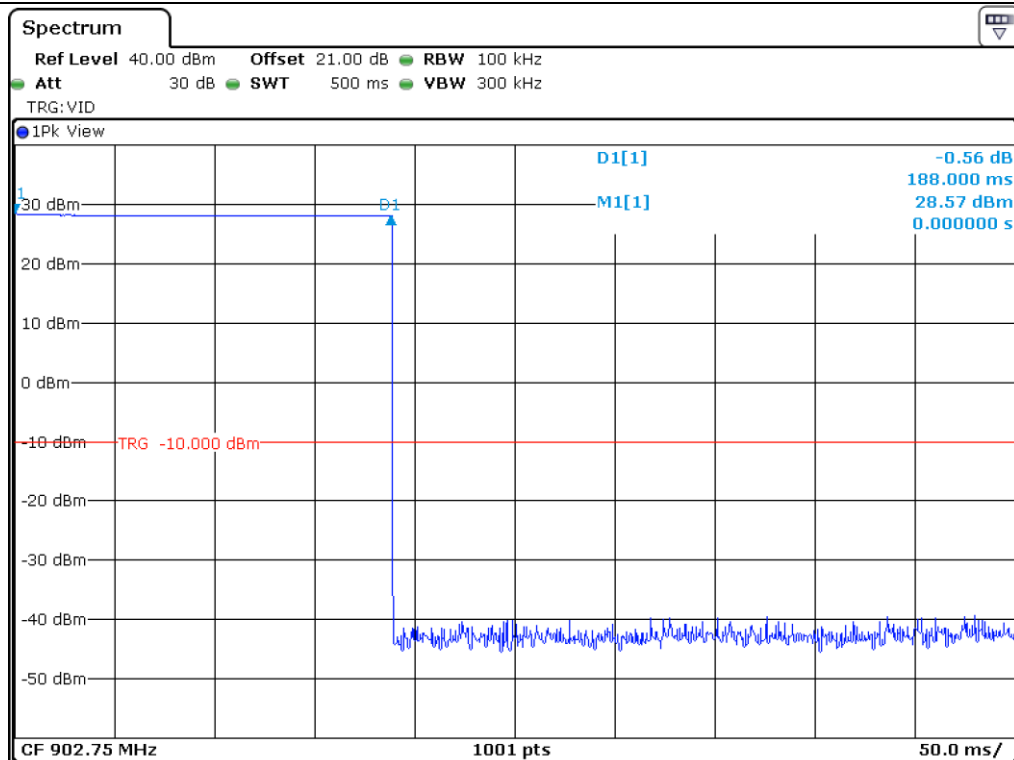
-. Test Date : December 13, 2017

Frequency Range (MHz)	Pulse Time (ms)	Number of Pulse in 20 seconds	Average Occupancy Time (ms)	Limit (ms)
902.75 ~ 927.25	188.0	2	376.0	400

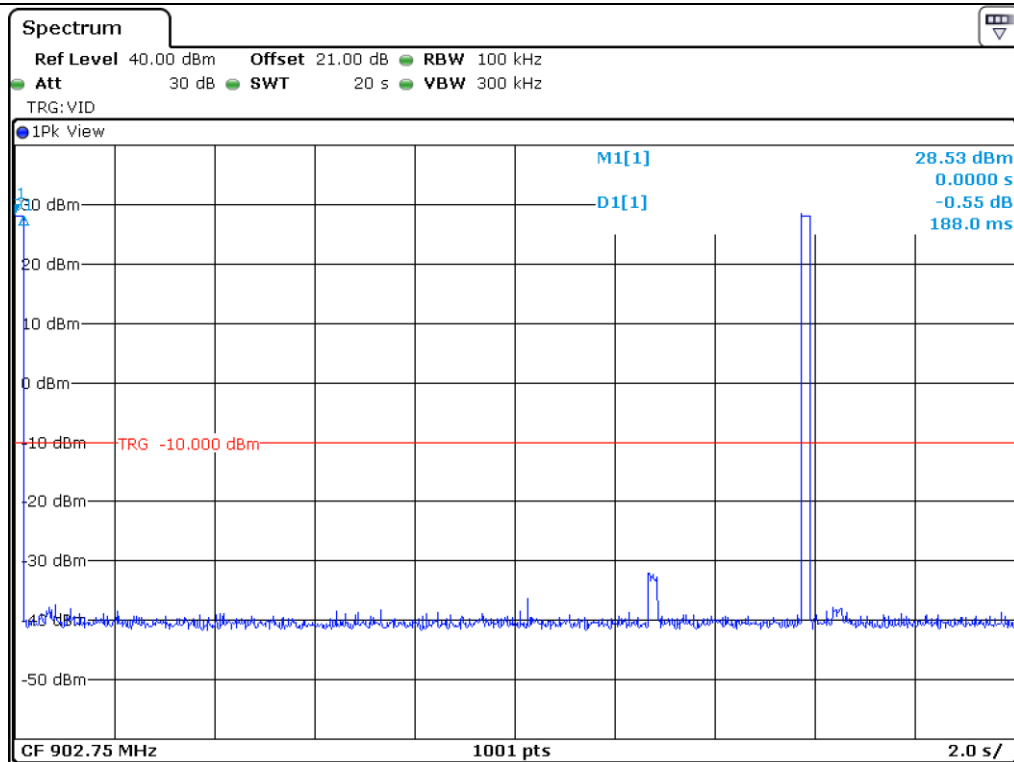
Note: Average Occupancy Time = Pulse Time * Number of Pulse in 20 seconds



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Pulse Time



Number of Transmissions during a 20 second period

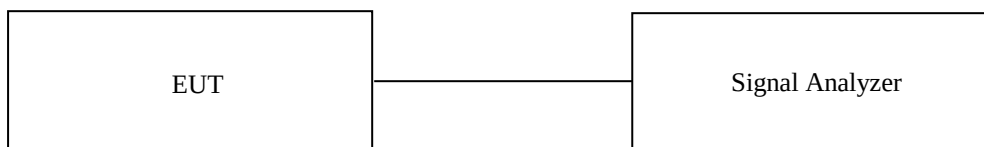
11. MAXIMUM PEAK OUTPUT POWER

11.1 Operating environment

Temperature : 23 °C
Relative humidity : 44 % R.H

11.2 Test set-up

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT.
The EUT was operating in transmit mode at the appropriate center frequency.



11.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct.26, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

11.4 Test data

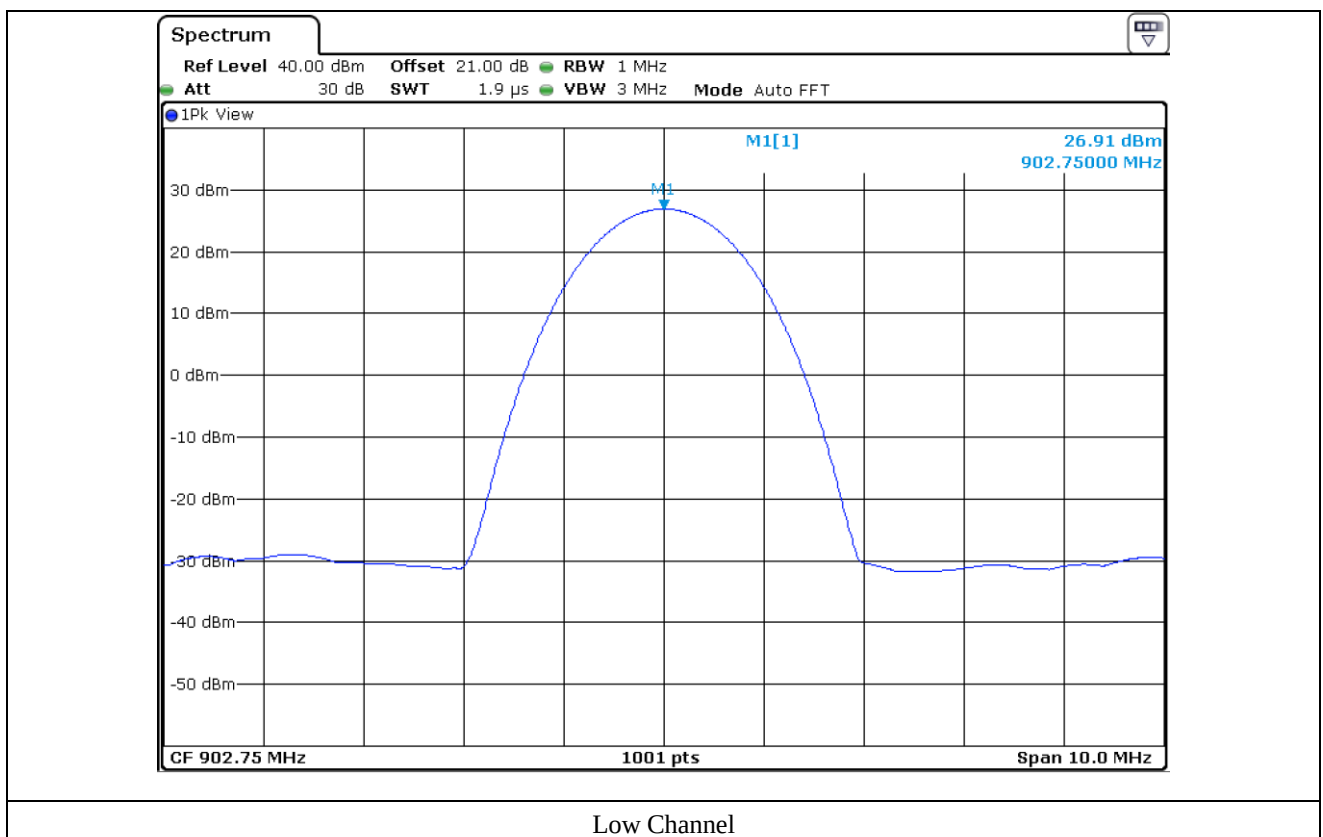
-. Test Date : December 13, 2017

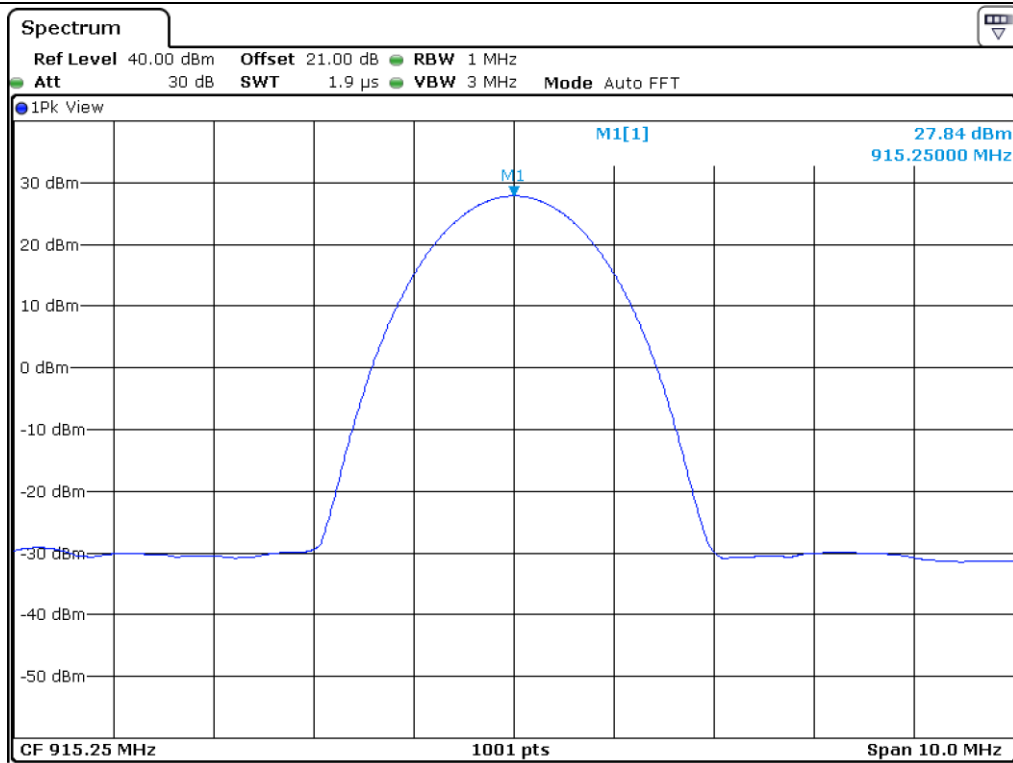
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	902.75	26.91	30.00	3.09
Middle	915.25	27.84	30.00	2.16
High	927.25	27.63	30.00	2.37

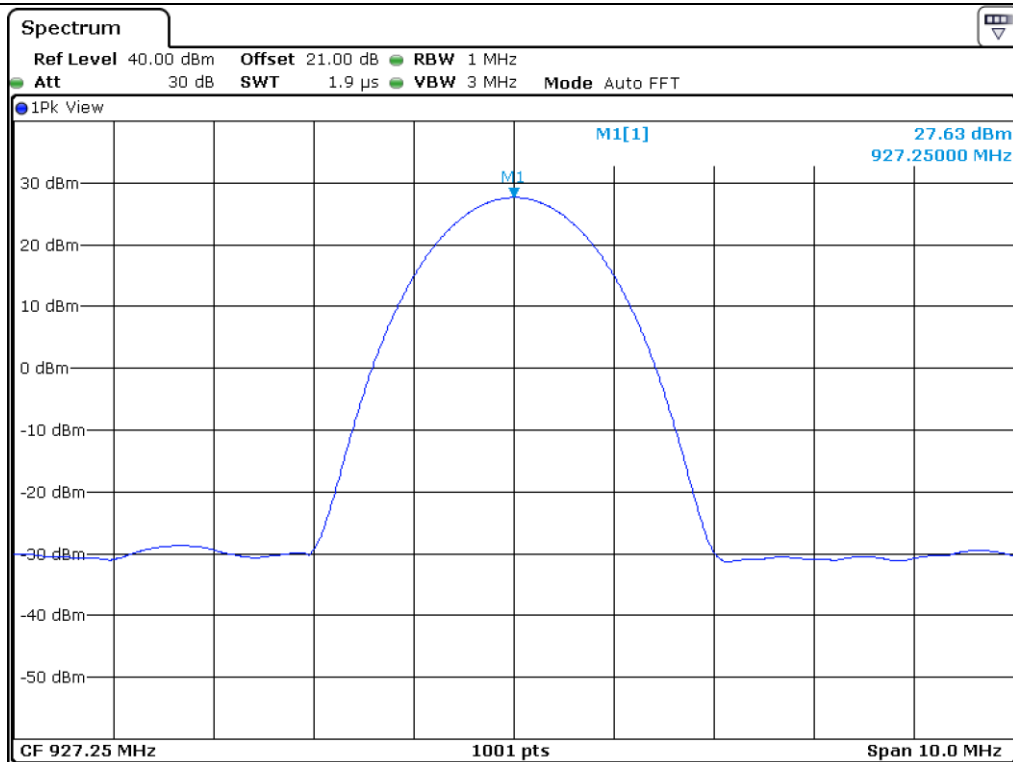


Tested by: Min-Gu Ji / Assistant Manager





Middle Channel



High Channel

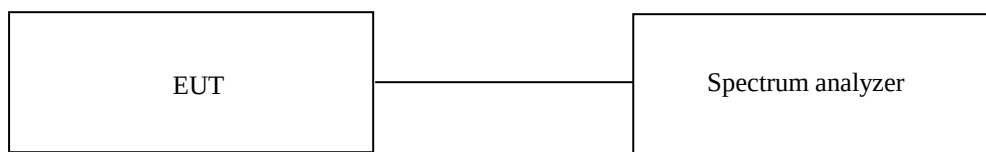
12. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

12.1 Operating environment

Temperature : 23 °C
Relative humidity : 44 % R.H

12.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.



12.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m semi anechoic chamber. The EUT was placed on a non-conductive turntable approximately 0.8 m above the ground plane.

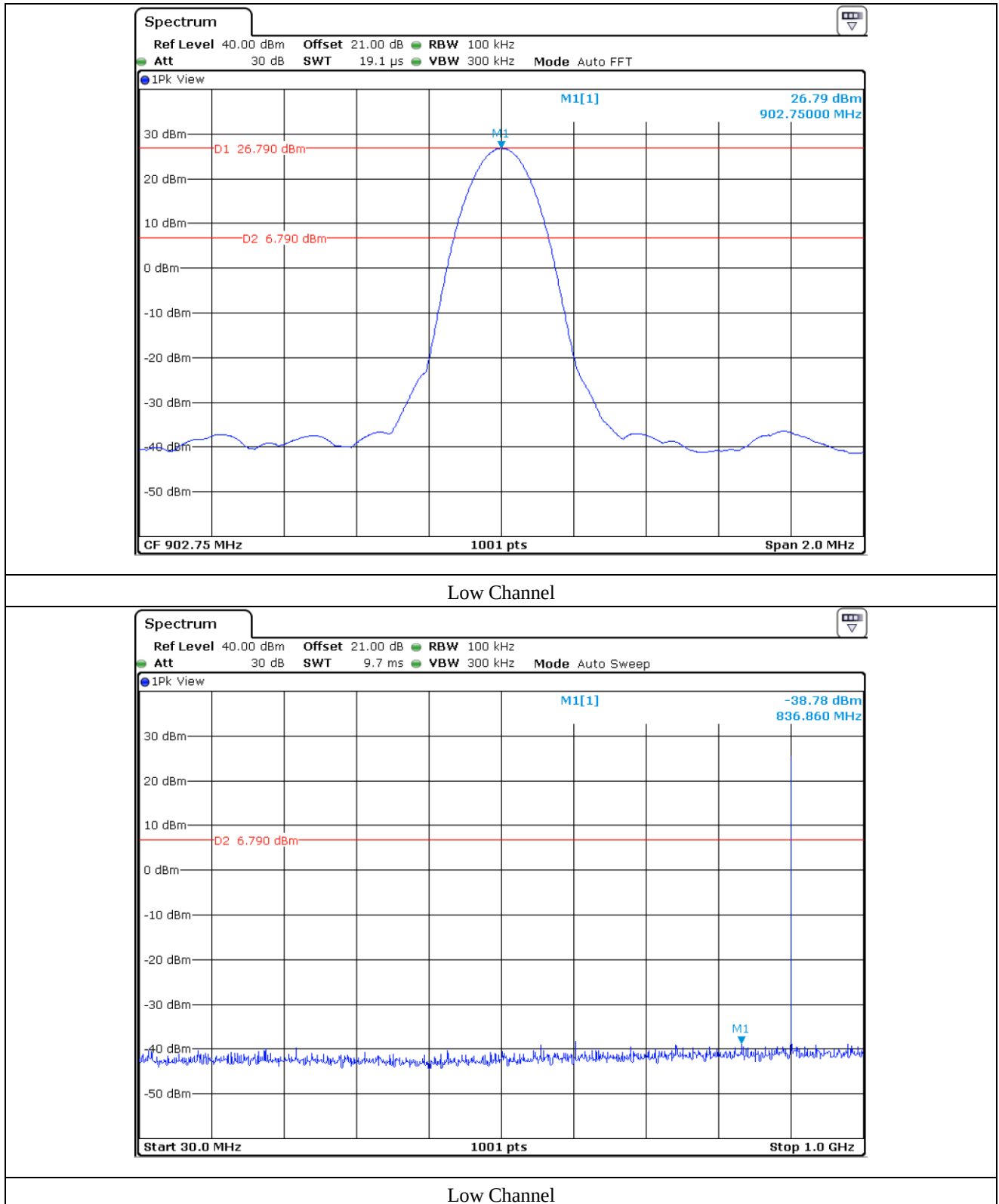
The frequency spectrum from 30 MHz to 10 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

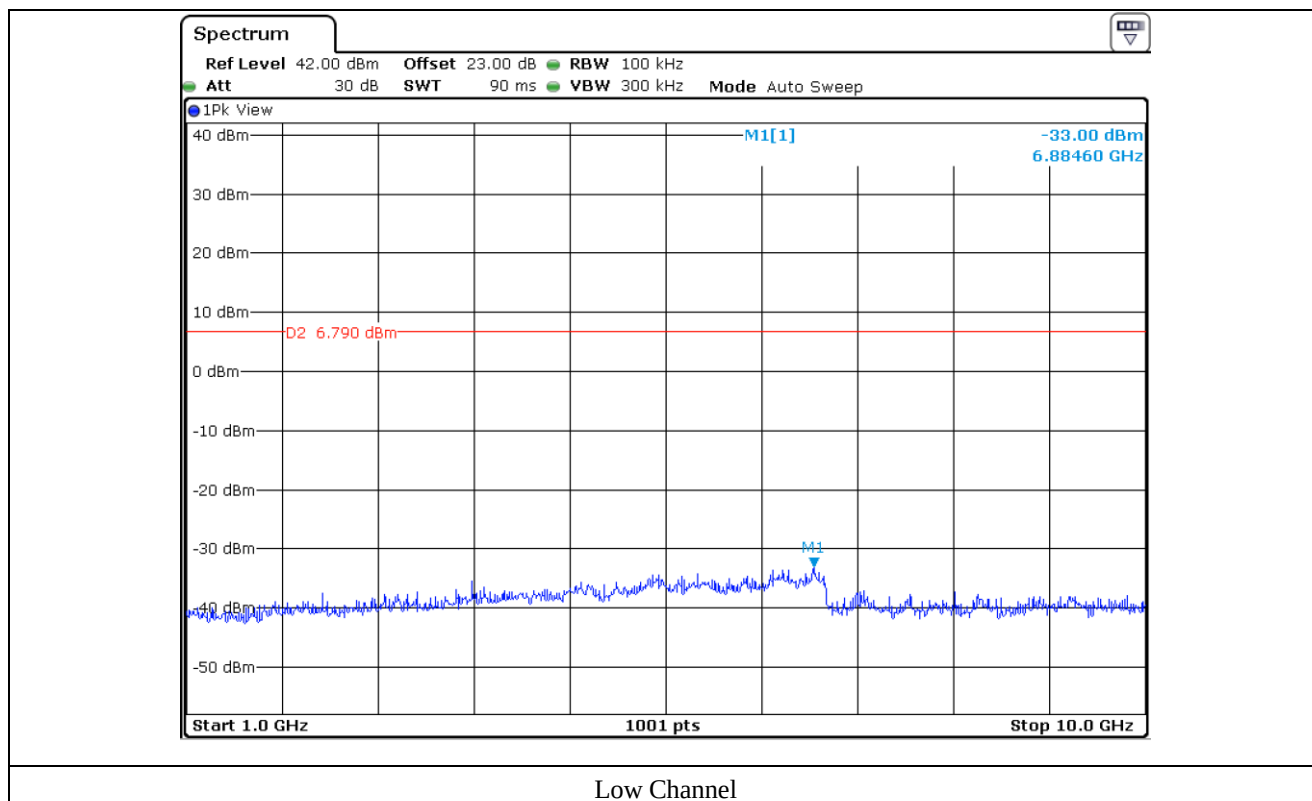
12.4 Test equipment used

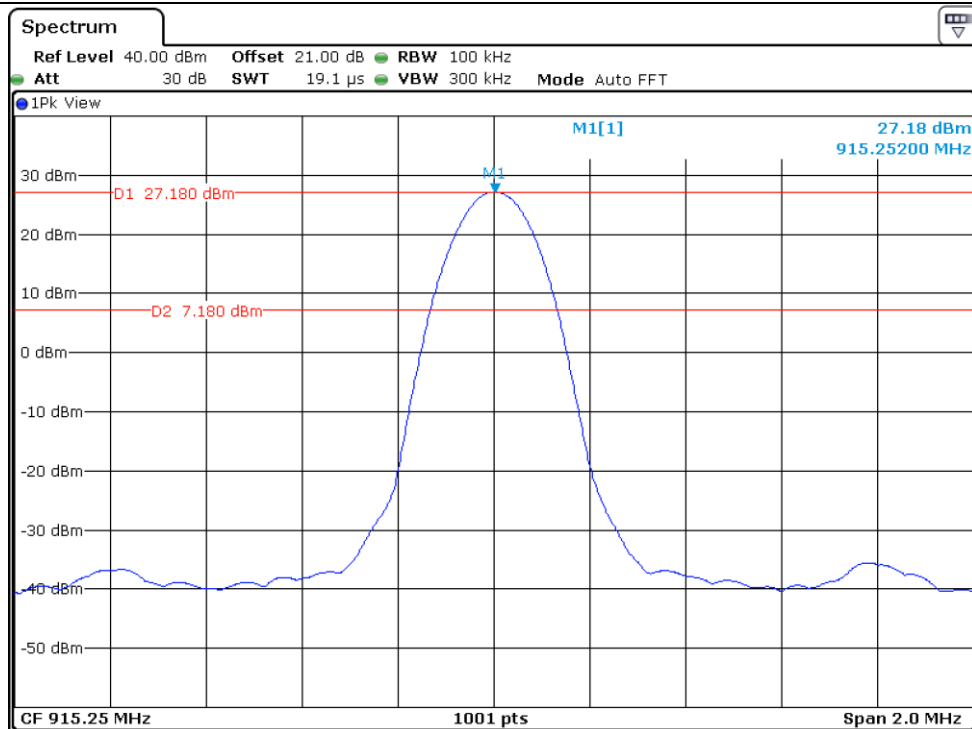
	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 27, 2017 (1Y)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 27, 2017 (1Y)
□ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Sep. 04, 2017 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Apr. 04, 2017 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (1Y)
■ -	SCU-18	Rohde & Schwarz	Pre-Amplifier	102346	Oct. 24, 2017 (1Y)
■ -	MA-4000XPET	Innco Systems GmbH	Antenna Master	MA4000/509	N/A
□ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DT3000-3t	Innco Systems GmbH	Turn Table	N/A	N/A
□ -	FMZB 1513	Schwarzbeck	LOOP ANTENNA	1513-235	Jun. 10, 2016 (2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	May 20, 2016 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA91700179	Jul. 28, 2017 (2Y)
■ -	SCU40A	Rohde & Schwarz	Pre-Amplifier	100436	Apr. 04, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

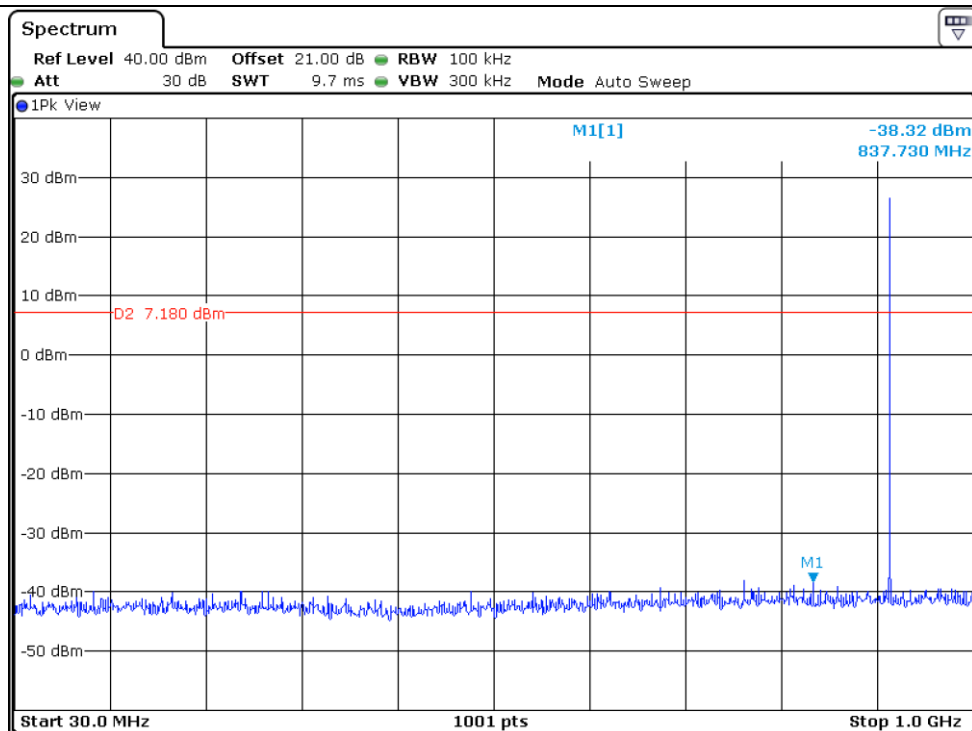
12.5 Test data for conducted emission



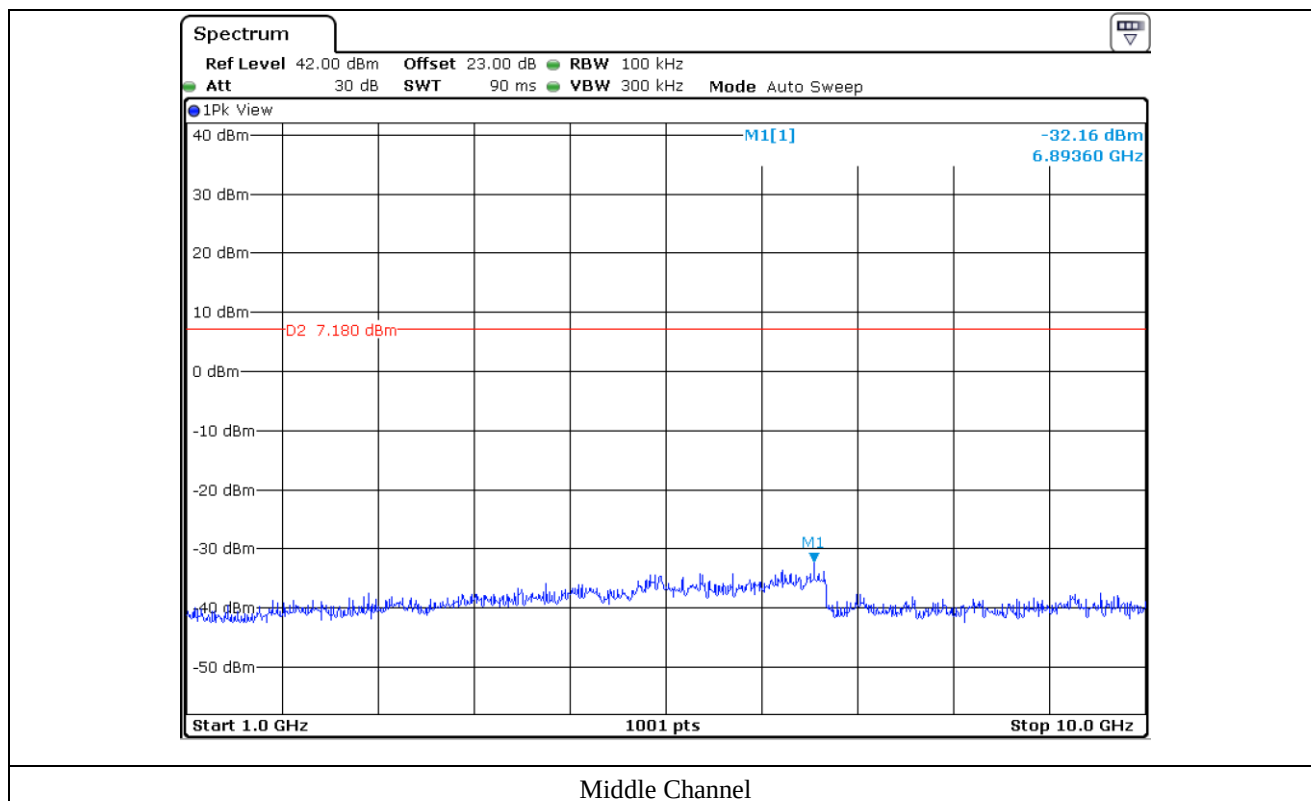


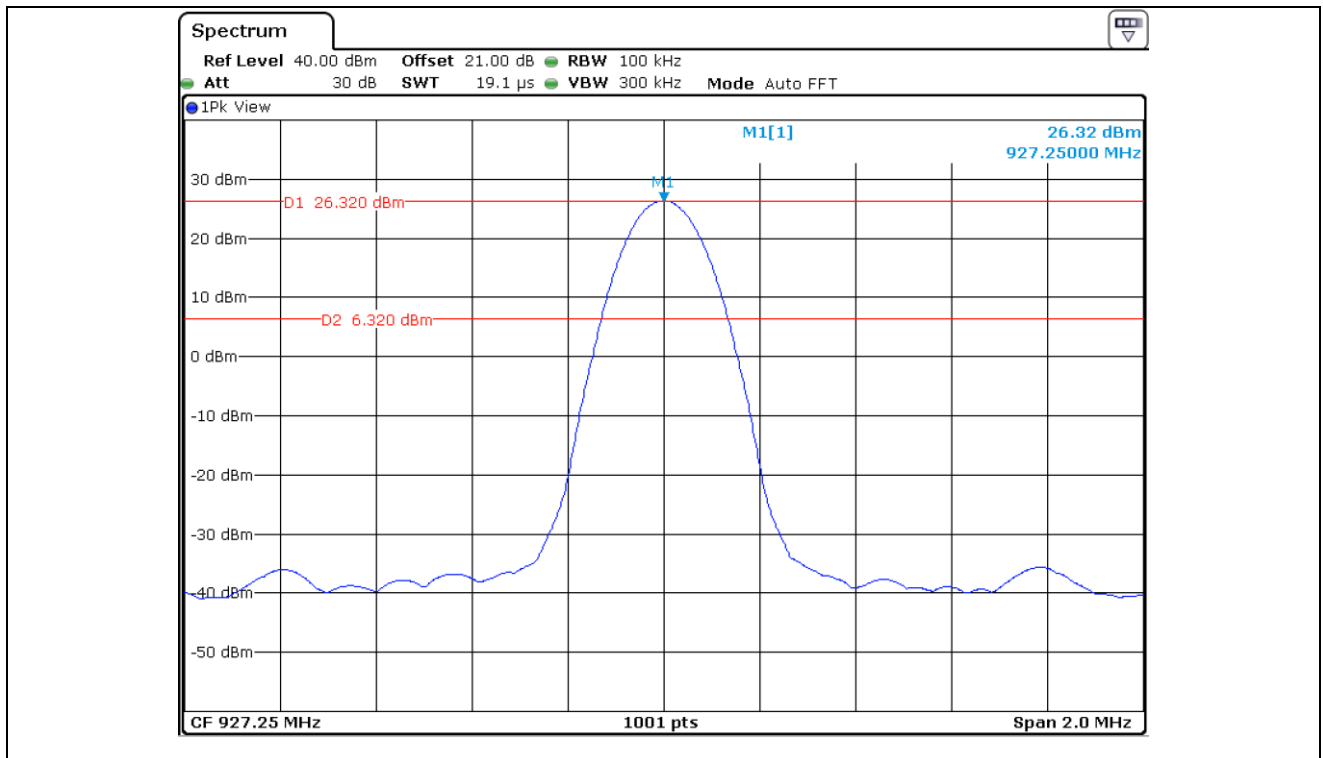


Middle Channel

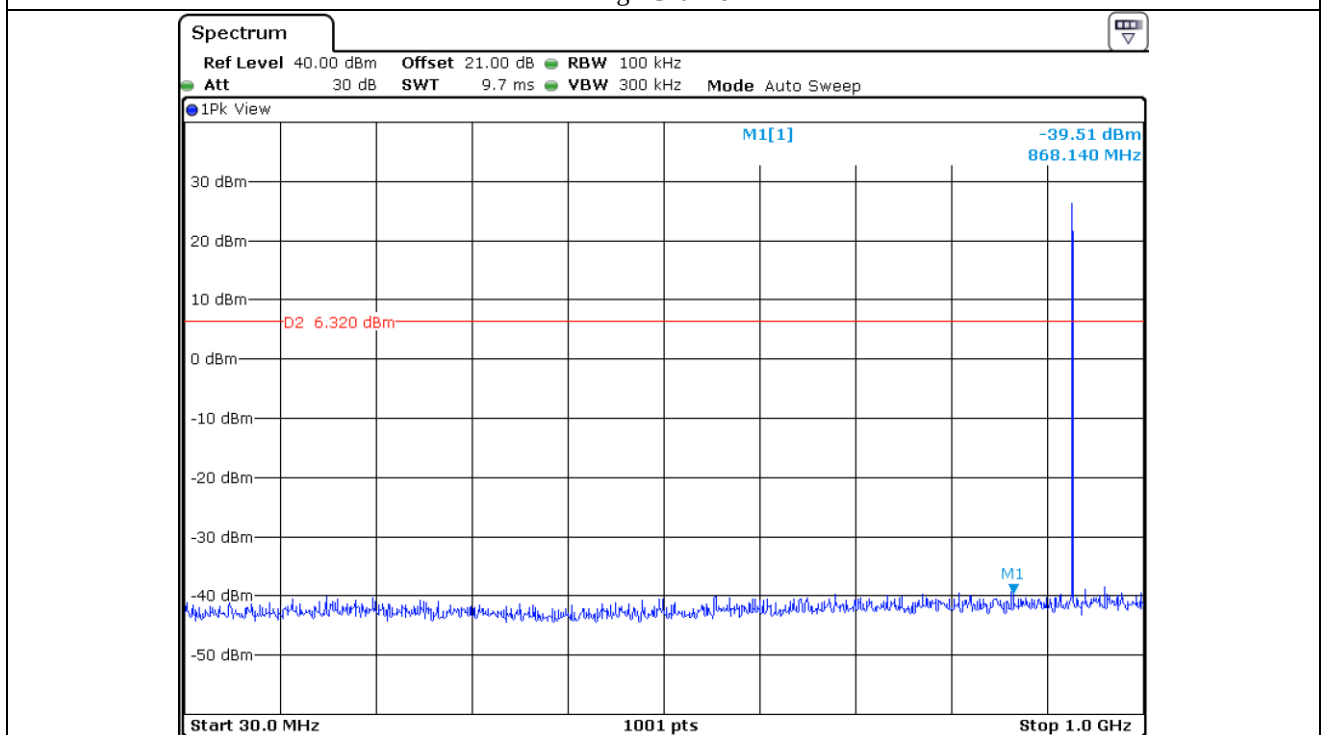


Middle Channel

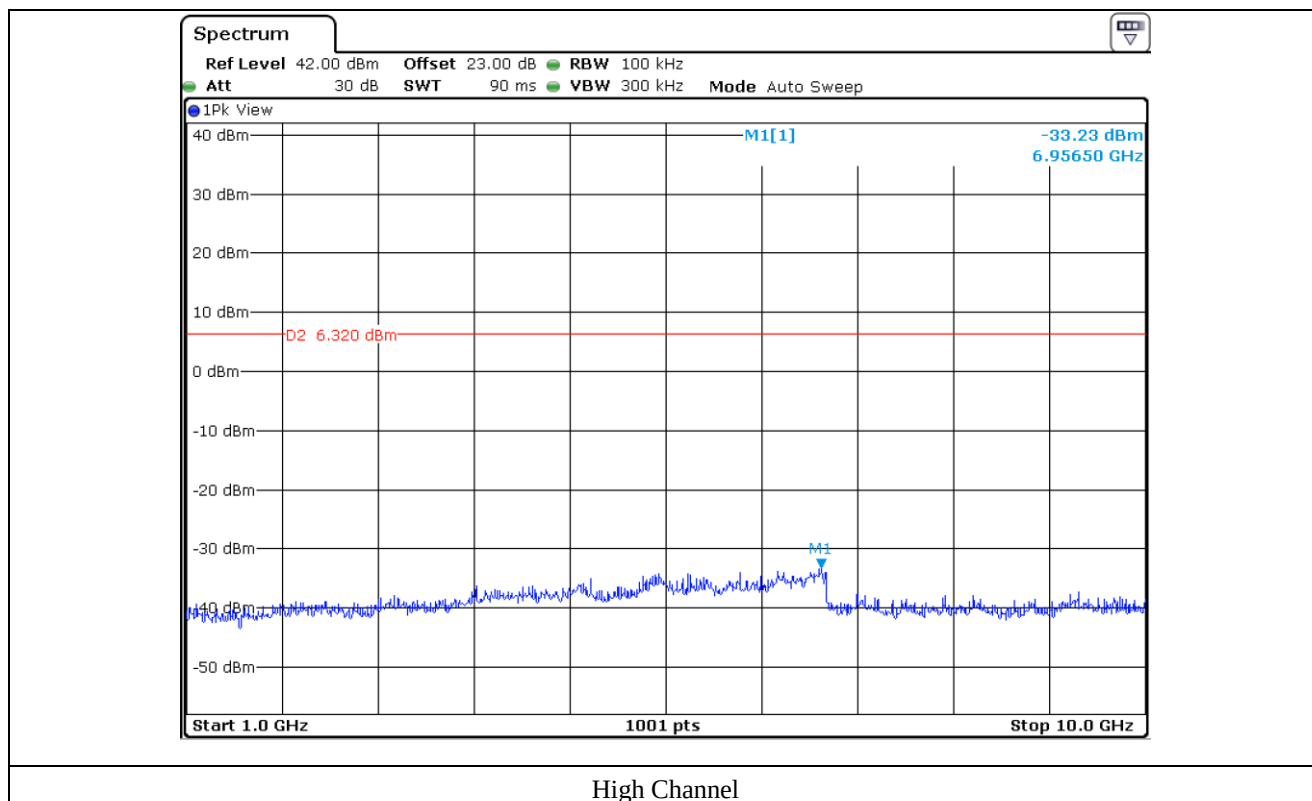




High Channel



High Channel



12.6 Test data for radiated emission at Transmitting Mode

12.6.1 Radiated Emission which fall in the Restricted Band

- . Test Date : December 15, 2017
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Detector : Peak Mode(Peak), Average Mode(RMS)
- . Measurement distance : 3 m
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 668.48	41.57	Peak	H	28.10	10.30	29.40	50.57	74.00	23.43
2 779.97	30.58	Average	H				39.58	54.00	14.42
2 842.91	42.08	Peak	V				51.08	74.00	22.92
2 839.91	30.59	Average	V				39.59	54.00	14.41
Test Data for Middle Channel									
2 827.32	41.46	Peak	H	28.10	10.30	29.40	50.46	74.00	23.54
2 824.93	30.54	Average	H				39.54	54.00	14.46
2 887.56	41.34	Peak	V				50.34	74.00	23.66
2 779.97	30.90	Average	V				39.90	54.00	14.10
Test Data for High Channel									
2 770.08	42.47	Peak	H	28.10	10.30	29.40	51.47	74.00	22.53
2 825.82	30.46	Average	H				39.46	54.00	14.54
2 887.86	41.72	Peak	V				50.72	74.00	23.28
2 667.28	30.69	Average	V				39.69	54.00	14.31

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dBμV/m)} - \text{Total Level (dBμV/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Pre-Amplifier Gain}$$



Tested by: Min-Gu Ji / Assistant Manager

12.6.2 Spurious & Harmonic Radiated Emission above 1 GHz

-. Test Date : December 15, 2017
 -. Resolution bandwidth : 1 MHz for Peak and Average Mode
 -. Video bandwidth : 3 MHz for Peak and Average Mode
 -. Detector : Peak Mode(Peak), Average Mode(RMS)
 -. Frequency range : 1 GHz ~ 26.5 GHz
 -. Measurement distance : 3 m
 -. Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
1 805.50	43.23	Peak	H	24.90	9.30	31.50	45.93	74.00	28.07
	30.72	Average	H				33.42	54.00	20.58
	42.23	Peak	V				44.93	74.00	29.07
	30.22	Average	V				32.92	54.00	21.08
Test Data for Middle Channel									
1 830.50	42.21	Peak	H	24.90	9.40	31.60	44.91	74.00	29.09
	29.40	Average	H				32.10	54.00	21.90
	41.90	Peak	V				44.60	74.00	29.40
	29.36	Average	V				32.06	54.00	21.94
Test Data for High Channel									
1 854.50	42.79	Peak	H	25.00	9.50	31.70	45.59	74.00	28.41
	29.68	Average	H				32.48	54.00	21.52
	42.67	Peak	V				45.47	74.00	28.53
	30.07	Average	V				32.87	54.00	21.13

Tabulated test data for Spurious & Harmonic

Remark: "H": Horizontal, "V": Vertical, "*" Frequency fall in restricted band



Tested by: Min-Gu Ji / Assistant Manager

13. RADIATED EMISSION TEST

13.1 Operating environment

Temperature : 23 °C
Relative humidity : 48 % R.H

13.2 Test set-up

The radiated emissions measurements were on the 3 m, semi anechoic chamber. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 1 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

13.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 27, 2017 (1Y)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 27, 2017 (1Y)
□ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Sep. 04, 2017 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Apr. 04, 2017 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (1Y)
■ -	SCU-18	Rohde & Schwarz	Pre-Amplifier	102346	Oct. 24, 2017 (1Y)
■ -	MA-4000XPET	Innco Systems GmbH	Antenna Master	MA4000/509	N/A
□ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DT3000-3t	Innco Systems GmbH	Turn Table	N/A	N/A
□ -	FMZB 1513	Schwarzbeck	LOOP ANTENNA	1513-235	Jun. 10, 2016 (2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	May 20, 2016 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA91700179	Jul. 28, 2017 (2Y)
■ -	SCU40A	Rohde & Schwarz	Pre-Amplifier	100436	Apr. 04, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

13.4 Test data

13.4.1 Test data for Charging Mode

13.4.1.1 Test data for 30 MHz ~ 1 000 MHz

Humidity Level : 48 % R.H.

Temperature: 23 °C

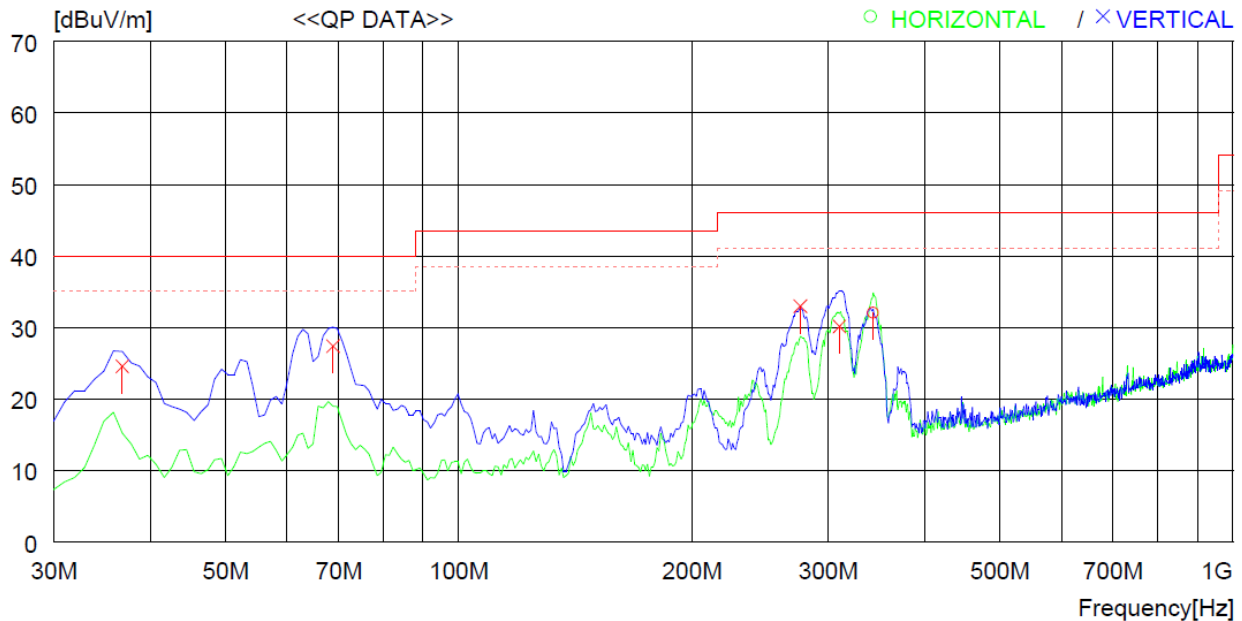
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : 2128 Bluetooth Handheld RFID Reader

Date: December 15, 2017

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	QP	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	343.310	46.2	14.6	4.3	33.1	32.0	46.0	14.0	100	121
----- Vertical -----										
2	36.790	42.5	13.6	1.5	33.1	24.5	40.0	15.5	100	5
3	68.800	48.7	9.8	2.0	33.1	27.4	40.0	12.6	200	38
4	276.380	49.1	12.9	3.9	33.0	32.9	46.0	13.1	200	348
5	310.330	45.3	13.7	4.1	33.0	30.1	46.0	15.9	200	359

Tested by: Min-Gu Ji / Assistant Manager

13.4.1.2 Test data for Below 30 MHz

- . Test Date : December 15, 2017
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating Condition : Charging Mode
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Any emissions were not observed from the EUT.									

13.4.1.3 Test data for above 1 GHz

- . Test Date : December 15, 2017
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Operating Condition : Charging Mode
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Any emissions were not observed from the EUT.									



Tested by: Min-Gu Ji / Assistant Manager

13.4.2 Test data for RFID Mode

13.4.2.1 Test data for 30 MHz ~ 1 000 MHz

Humidity Level : 48 % R.H.

Temperature: 23 °C

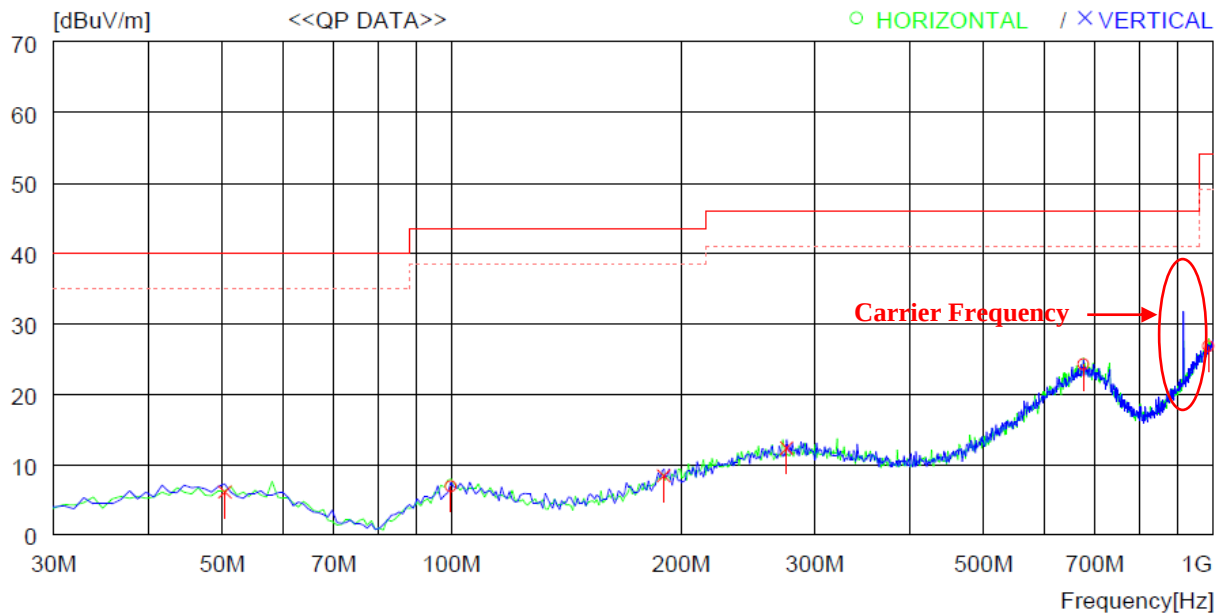
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : 2128 Bluetooth Handheld RFID Reader

Date: December 15, 2017

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA TABLE [cm]	TABLE [DEG]
----- Horizontal -----										
1	99.840	25.1	12.4	2.4	33.0	6.9	43.5	36.6	200	0
2	676.016	32.1	19.6	6.0	33.5	24.2	46.0	21.8	200	199
3	986.406	28.7	22.5	7.3	31.7	26.8	54.0	27.2	400	238
----- Vertical -----										
4	50.370	23.4	14.1	1.7	33.1	6.1	40.0	33.9	100	209
5	190.050	27.2	11.0	3.3	33.1	8.4	43.5	35.1	100	0
6	275.410	28.5	12.9	3.9	33.0	12.3	46.0	33.7	200	308



Tested by: Min-Gu Ji / Assistant Manager

13.4.2.2 Test data for Below 30 MHz

- . Test Date : December 15, 2017
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating Condition : RFID Mode
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Any emissions were not observed from the EUT.								

13.4.2.3 Test data for above 1 GHz

- . Test Date : December 15, 2017
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Operating Condition : RFID Mode
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Any emissions were not observed from the EUT.									



Tested by: Min-Gu Ji / Assistant Manager

13.4.3 Test data for RFID+BT Mode

13.4.3.1 Test data for Below 30 MHz

- . Test Date : December 15, 2017
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating Condition : RFID+BT Mode
- . Result : PASSED

Frequency (MHz)	Reading (dB μ V)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Any emissions were not observed from the EUT.								



Tested by: Min-Gu Ji / Assistant Manager

13.4.3.2 Test data for 30 MHz ~ 1 000 MHz

Humidity Level : 48 % R.H.

Temperature: 23 °C

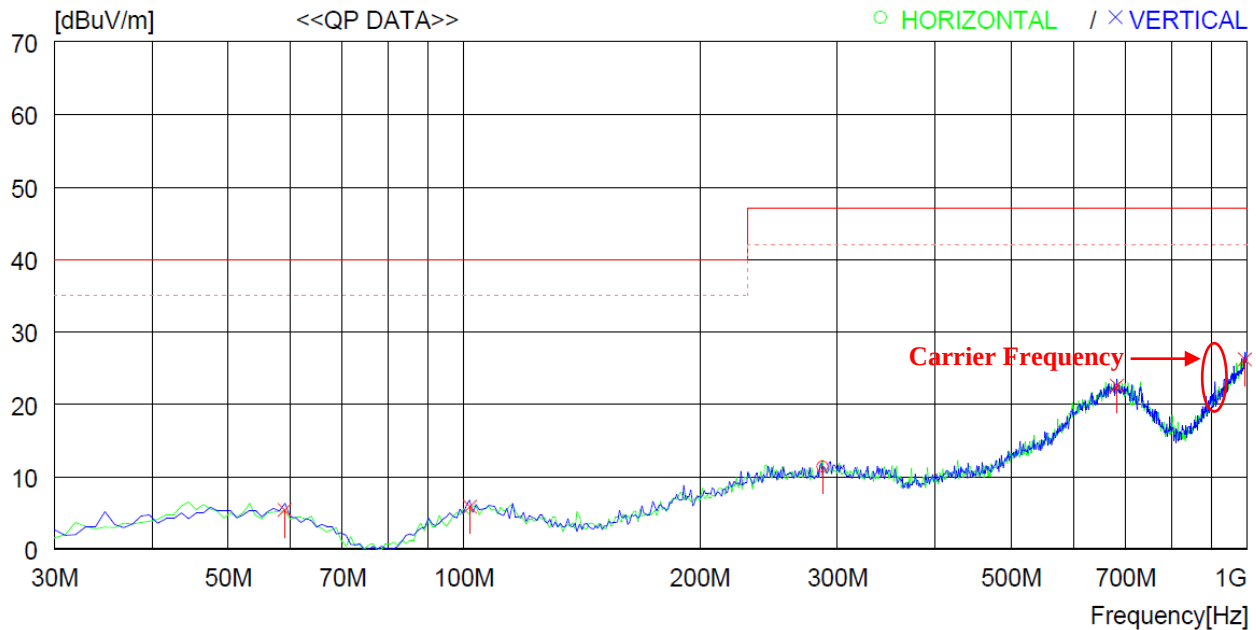
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : 2128 Bluetooth Handheld RFID Reader

Date: December 15, 2017

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	QF	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	287.050	27.7	12.8	3.9	33.0	11.4	47.0	35.6	400	0
----- Vertical -----										
2	59.100	23.2	13.4	1.9	33.1	5.4	40.0	34.6	300	0
3	101.780	24.5	12.0	2.4	33.0	5.9	40.0	34.1	400	19
4	681.835	30.8	19.3	6.0	33.5	22.6	47.0	24.4	200	352
5	994.166	27.8	22.7	7.3	31.6	26.2	47.0	20.8	100	220

Signature

Tested by: Min-Gu Ji / Assistant Manager

13.4.3.3 Test data for above 1 GHz

Humidity Level : 48 % R.H.

Temperature: 23 °C

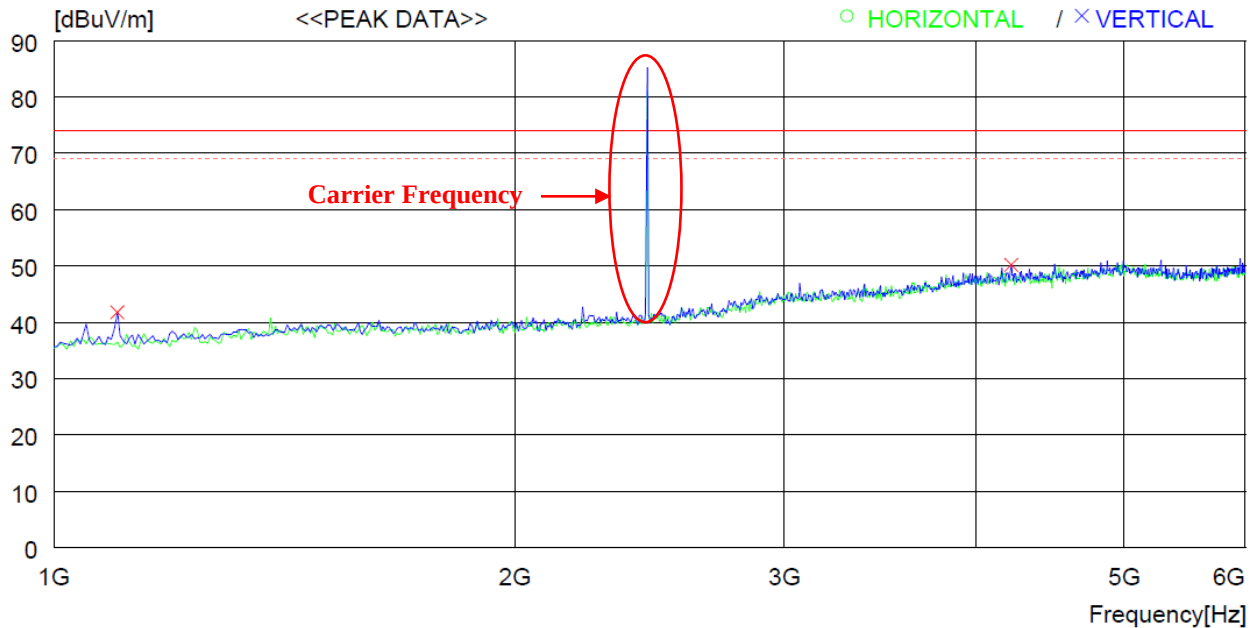
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : 2128 Bluetooth Handheld RFID Reader

Date: December 15, 2017

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ [MHz]	READING PEAK [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Vertical -----										
1	1100.000	45.8	24.9	6.8	35.7	41.8	74.0	32.2	100	359
2	4220.000	41.3	30.0	12.0	33.1	50.2	74.0	23.8	100	359

DL

Tested by: Min-Gu Ji / Assistant Manager

14. CONDUCTED EMISSION TEST

14.1 Operating environment

Temperature : 23 °C
Relative humidity : 45 % R.H

14.2 Test set-up

The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50 Ω / 50 μ H + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

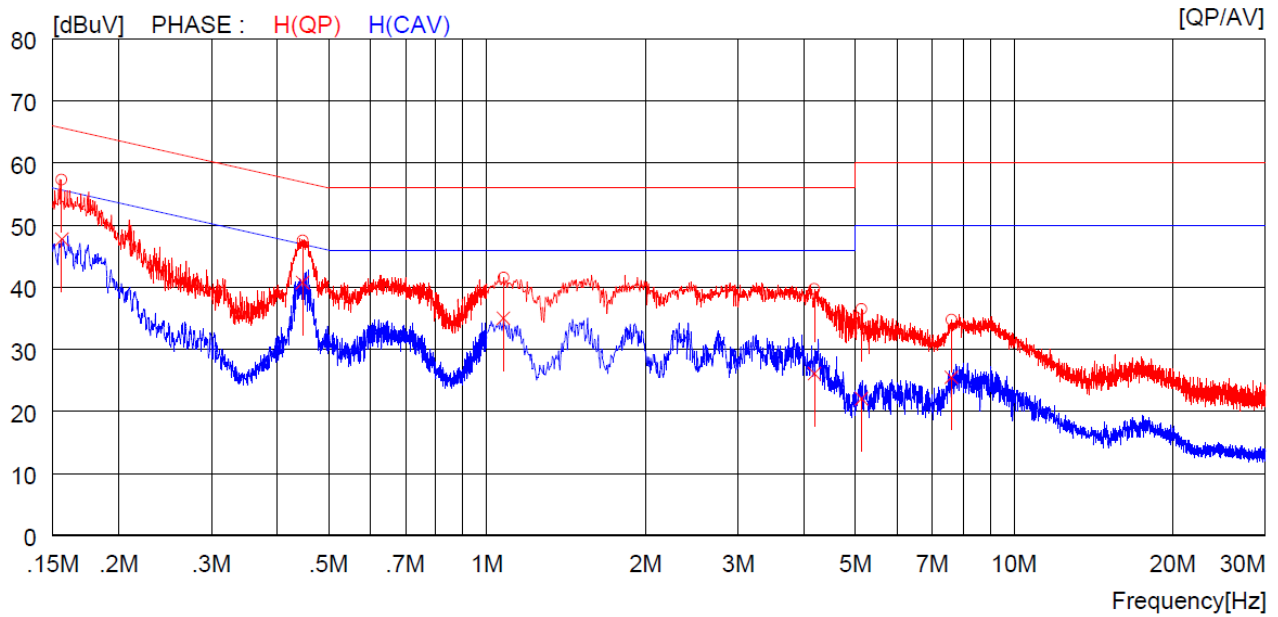
14.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 27, 2017 (1Y)
□ -	ESHS10	Rohde & Schwarz	EMI Test Receiver	834467/007	Apr. 03, 2017 (1Y)
■ -	NSLK8128	Schwarzbeck	AMN	8128-216	Apr. 05, 2017 (1Y)
□ -	NSLK8126	Schwarzbeck	AMN	8126-404	Apr. 03, 2017 (1Y)
□ -	3825/2	EMCO	AMN	9109-1869	Apr. 06, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

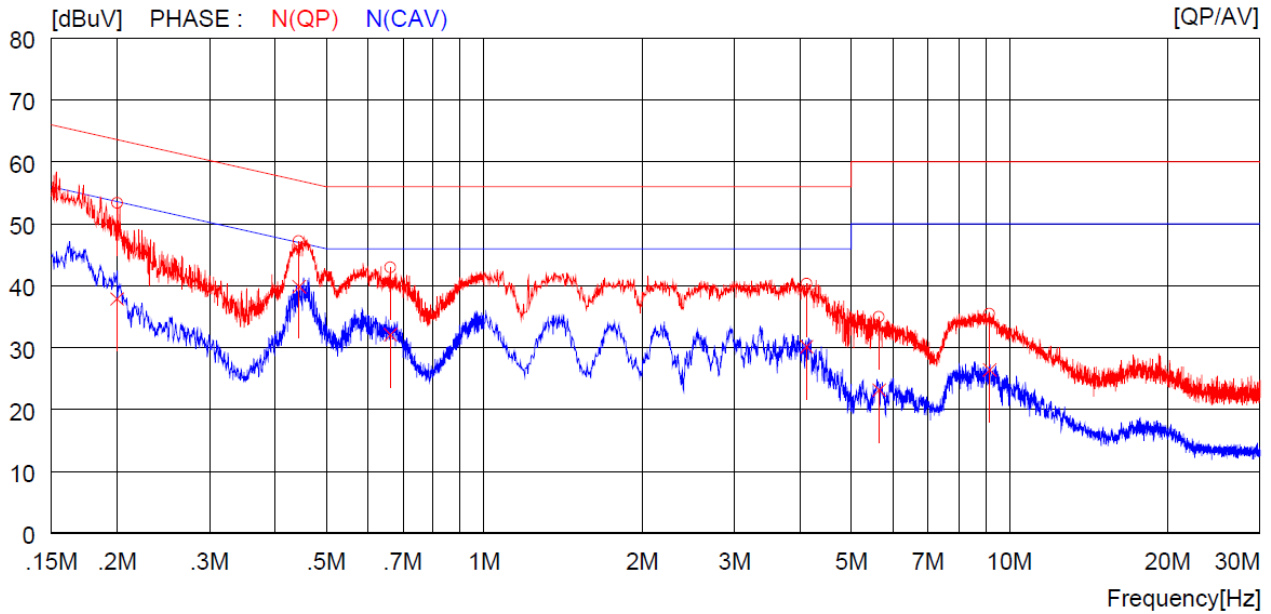
14.4 Test data for Charging Mode

- Test Date : December 15, 2017
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Tested Line : HOT LINE



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15600	47.3	----	10.0	57.3	----	65.7	----	8.4	----	H (QP)
2	0.44700	37.5	----	10.0	47.5	----	56.9	----	9.4	----	H (QP)
3	1.07600	31.4	----	10.1	41.5	----	56.0	----	14.5	----	H (QP)
4	4.18000	29.5	----	10.2	39.7	----	56.0	----	16.3	----	H (QP)
5	5.14000	26.3	----	10.2	36.5	----	60.0	----	23.5	----	H (QP)
6	7.61500	24.5	----	10.3	34.8	----	60.0	----	25.2	----	H (QP)
7	0.15600	----	37.7	10.0	----	47.7	----	55.7	----	8.0	H (CAV)
8	0.44700	----	30.8	10.0	----	40.8	----	46.9	----	6.1	H (CAV)
9	1.07600	----	24.9	10.1	----	35.0	----	46.0	----	11.0	H (CAV)
10	4.18000	----	15.9	10.2	----	26.1	----	46.0	----	19.9	H (CAV)
11	5.14000	----	11.9	10.2	----	22.1	----	50.0	----	27.9	H (CAV)
12	7.61500	----	15.2	10.3	----	25.5	----	50.0	----	24.5	H (CAV)

-. Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.20000	43.3	----	10.0	53.3	----	63.6	----	10.3	----	N (QP)
2	0.44400	37.2	----	10.0	47.2	----	57.0	----	9.8	----	N (QP)
3	0.66300	32.9	----	10.1	43.0	----	56.0	----	13.0	----	N (QP)
4	4.11200	30.1	----	10.2	40.3	----	56.0	----	15.7	----	N (QP)
5	5.64500	24.8	----	10.2	35.0	----	60.0	----	25.0	----	N (QP)
6	9.16500	25.1	----	10.4	35.5	----	60.0	----	24.5	----	N (QP)
7	0.20000	----	27.9	10.0	----	37.9	----	53.6	----	15.7	N (CAV)
8	0.44400	----	29.9	10.0	----	39.9	----	47.0	----	7.1	N (CAV)
9	0.66300	----	22.0	10.1	----	32.1	----	46.0	----	13.9	N (CAV)
10	4.11200	----	20.0	10.2	----	30.2	----	46.0	----	15.8	N (CAV)
11	5.64500	----	13.0	10.2	----	23.2	----	50.0	----	26.8	N (CAV)
12	9.16500	----	16.0	10.4	----	26.4	----	50.0	----	23.6	N (CAV)

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.


Tested by: Min-Gu Ji / Assistant Manager