FCC RADIO TEST REPORT

FCC ID	:	**2AEUPBHAFL031**
Equipment	:	**Floodlight Cam Wired Pro**
Brand Name	:	**Ring**
Model Name	:	**5B28S4**
Applicant	:	**Ring LLC** **1523 26th St Santa Monica, CA 90404 USA**
Manufacturer	:	**Ring LLC** **1523 26th St Santa Monica, CA 90404 USA**
Standard	:	**FCC Part 15 Subpart C §15.247**

The product was received on Feb. 09, 2021 and testing was started from Mar. 13, 2021 and completed on Apr. 05, 2021. We, Sporton International Inc. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

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

Louis Wu

Reviewed by: Louis Wu

Sporton International Inc. EMC & Wireless Communications Laboratory
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)

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History of this test report

Report No.	Version	Description	Issued Date
FR120337-01	01	Initial issue of report	Apr. 06, 2021
FR120337-01	02	Revise EUT information	May 11, 2021

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.247(a)(1)	Number of Channels	Pass	-
3.2	15.247(a)(1)	Hopping Channel Separation	Pass	-
3.3	15.247(a)(1)	Dwell Time of Each Channel	Pass	-
3.4	15.247(a)(1)	20dB Bandwidth	Pass	-
3.4	2.1049	99% Occupied Bandwidth	Reporting only	-
3.5	15.247(b)(2)	Output Power	Pass	-
3.6	15.247(d)	Conducted Band Edges	Pass	-
3.7	15.247(d)	Conducted Spurious Emission	Pass	-
3.8	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	Pass	Under limit 3.00 dB at 2706.600 MHz for Quasi-Peak
3.9	15.207	AC Conducted Emission	Pass	Under limit 8.54 dB at 0.499 MHz
3.10	15.203 & 15.247(b)	Antenna Requirement	Pass	-

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

Reviewed by: Wii Chang

Report Producer: Dara Chiu

1 General Description

1.1 Product Feature of Equipment Under Test

Bluetooth-LE, Wi-Fi 2.4GHz 802.11b/g/n, Wi-Fi 5GHz 802.11a/n/ac, LoRa, and 24G Radar.

Product Feature	
Antenna Type	WLAN: <Ant. 1>: FPC Antenna <Ant. 2>: FPC Antenna Bluetooth-LE: FPC Antenna LoRa: PCB Antenna 24GHz Radar: Patch Antenna

Antenna information		
902 MHz ~ 928 MHz	Peak Gain (dBi)	-0.83

Remark: The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations in report summary.

1.2 Modification of EUT

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

1.3 Testing Location

Test Site	Sporton International Inc. EMC Wireless Communications Laboratory
Test Site Location	No.52, Huaya 1st Rd., Guishan & Dist., Taoyuan City 333, 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. Wensan Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	03CH11-HY (TAF Code: 3786)
Remark	The Radiated Spurious Emission test item subcontracted to Sporton International Inc. Wensan Laboratory

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

FCC designation No.: TW1190 and TW0007

1.4 Applicable Standards

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

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

Remark:

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

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

LoRa FHSS / FSK 50 Kbps FHSS

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
902 – 928 MHz	1	902.2	28	907.6	55	913.0	82	918.4	109	923.8
	2	902.4	29	907.8	56	913.2	83	918.6	110	924.0
	3	902.6	30	908.0	57	913.4	84	918.8	111	924.2
	4	902.8	31	908.2	58	913.6	85	919.0	112	924.4
	5	903.0	32	908.4	59	913.8	86	919.2	113	924.6
	6	903.2	33	908.6	60	914.0	87	919.4	114	924.8
	7	903.4	34	908.8	61	914.2	88	919.6	115	925.0
	8	903.6	35	909.0	62	914.4	89	919.8	116	925.2
	9	903.8	36	909.2	63	914.6	90	920.0	117	925.4
	10	904.0	37	909.4	64	914.8	91	920.2	118	925.6
	11	904.2	38	909.6	65	915.0	92	920.4	119	925.8
	12	904.4	39	909.8	66	915.2	93	920.6	120	926.0
	13	904.6	40	910.0	67	915.4	94	920.8	121	926.2
	14	904.8	41	910.2	68	915.6	95	921.0	122	926.4
	15	905.0	42	910.4	69	915.8	96	921.2	123	926.6
	16	905.2	43	910.6	70	916.0	97	921.4	124	926.8
	17	905.4	44	910.8	71	916.2	98	921.6	125	927.0
	18	905.6	45	911.0	72	916.4	99	921.8	126	927.2
	19	905.8	46	911.2	73	916.6	100	922.0	127	927.4
	20	906.0	47	911.4	74	916.8	101	922.2	128	927.6
	21	906.2	48	911.6	75	917.0	102	922.4	129	927.8
	22	906.4	49	911.8	76	917.2	103	922.6	-	-
	23	906.6	50	912.0	77	917.4	104	922.8	-	-
	24	906.8	51	912.2	78	917.6	105	923.0	-	-
	25	907.0	52	912.4	79	917.8	106	923.2	-	-
	26	907.2	53	912.6	80	918.0	107	923.4	-	-
	27	907.4	54	912.8	81	918.2	108	923.6	-	-

FSK 150 Kbps FHSS

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
902 – 928 MHz	1	902.4	28	913.2	55	924.0
	2	902.8	29	913.6	56	924.4
	3	903.2	30	914.0	57	924.8
	4	903.6	31	914.4	58	925.2
	5	904.0	32	914.8	59	925.6
	6	904.4	33	915.2	60	926.0
	7	904.8	34	915.6	61	926.4
	8	905.2	35	916.0	62	926.8
	9	905.6	36	916.4	63	927.2
	10	906.0	37	916.8	64	927.6
	11	906.4	38	917.2		
	12	906.8	39	917.6		
	13	907.2	40	918.0		
	14	907.6	41	918.4		
	15	908.0	42	918.8		
	16	908.4	43	919.2		
	17	908.8	44	919.6		
	18	909.2	45	920.0		
	19	909.6	46	920.4		
	20	910.0	47	920.8		
	21	910.4	48	921.2		
	22	910.8	49	921.6		
	23	911.2	50	922.0		
	24	911.6	51	922.4		
	25	912.0	52	922.8		
	26	912.4	53	923.2		
	27	912.8	54	923.6		

FSK 250 Kbps FHSS

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
902 – 928 MHz	1	902.5	28	916.0
	2	903.0	29	916.5
	3	903.5	30	917.0
	4	904.0	31	917.5
	5	904.5	32	918.0
	6	905.0	33	918.5
	7	905.5	34	919.0
	8	906.0	35	919.5
	9	906.5	36	920.0
	10	907.0	37	920.5
	11	907.5	38	921.0
	12	908.0	39	921.5
	13	908.5	40	922.0
	14	909.0	41	922.5
	15	909.5	42	923.0
	16	910.0	43	923.5
	17	910.5	44	924.0
	18	911.0	45	924.5
	19	911.5	46	925.0
	20	912.0	47	925.5
	21	912.5	48	926.0
	22	913.0	49	926.5
	23	913.5	50	927.0
	24	914.0	51	927.5
	25	914.5		
	26	915.0		
	27	915.5		

2.2 Test Mode

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

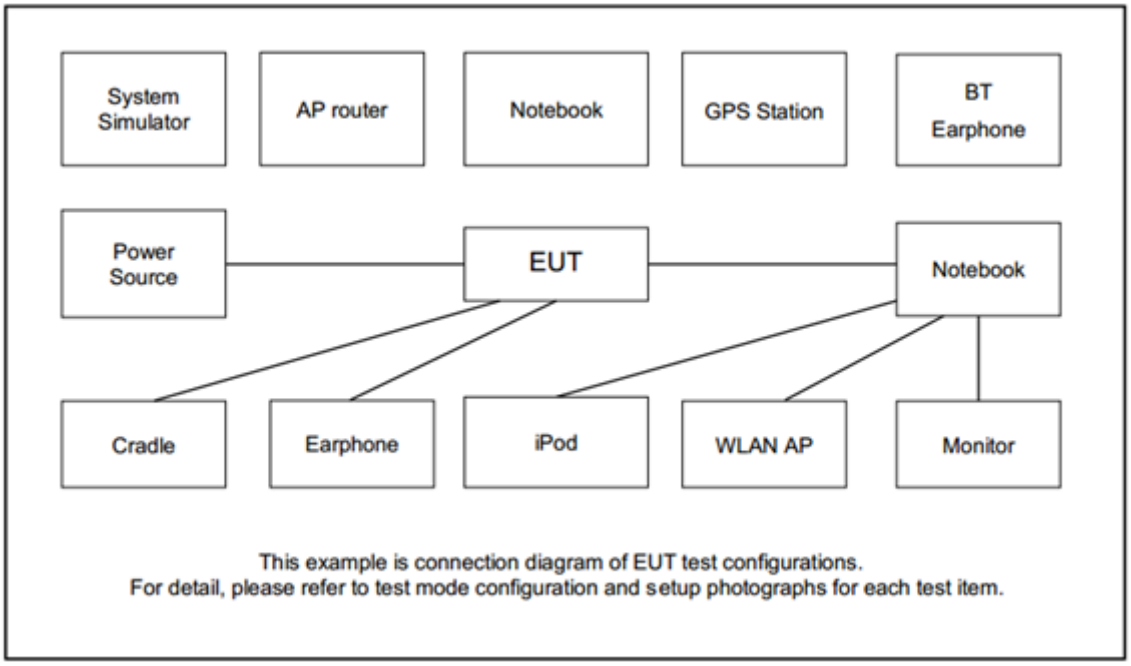
b. AC power line Conducted Emission was tested under maximum output power.

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

Summary table of Test Cases		
Test Item	**Feature**	**LoRa/FSK**
Conducted Test Cases	**LoRa 125 KHz FHSS**	Mode 1: CH01 Tx_902.20 MHz Mode 2: CH65 Tx _915.00 MHz Mode 3: CH129 Tx _927.80 MHz
	FSK 50 Kbps FHSS	Mode 4: CH01 Tx_902.20 MHz Mode 5: CH65 Tx _915.00 MHz Mode 6: CH129 Tx _927.80 MHz
	FSK 150 Kbps FHSS	Mode 7: CH01 Tx_902.40 MHz Mode 8: CH32 Tx _914.80 MHz Mode 9: CH64 Tx _927.60 MHz
	FSK 250 Kbps FHSS	Mode 10: CH01 Tx_902.50 MHz Mode 11: CH26 Tx _915.00 MHz Mode 12: CH51 Tx _927.50 MHz
Radiated Test Cases	**LoRa 125 KHz FHSS**	Mode 1: CH01 Tx_902.20 MHz Mode 2: CH65 Tx _915.00 MHz Mode 3: CH129 Tx _927.80 MHz
	FSK 50 Kbps FHSS	Mode 4: CH01 Tx_902.20 MHz Mode 5: CH65 Tx _915.00 MHz Mode 6: CH129 Tx _927.80 MHz
	FSK 150 Kbps FHSS	Mode 7: CH01 Tx_902.40 MHz Mode 8: CH32 Tx _914.80 MHz Mode 9: CH64 Tx _927.60 MHz
	FSK 250 Kbps FHSS	Mode 10: CH01 Tx_902.50 MHz Mode 11: CH26 Tx _915.00 MHz Mode 12: CH51 Tx _927.50 MHz

Summary table of Test Cases	
AC Conducted Emission	Mode 1: WLAN (2.4GHz) Tx + Bluetooth Tx + Lora Tx

2.3 Connection Diagram of Test System



2.4 EUT Operation Test Setup

The RF test items, utility “Tera Term Version 4.89 (SVN 6182)” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

2.5 Measurement Results Explanation Example

For all conducted test items:

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

Example:
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.
Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).
= 4.2 + 10 = 14.2 (dB)

3 Test Result

3.1 Number of Channel Measurement

3.1.1 Limits of Number of Hopping Frequency

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

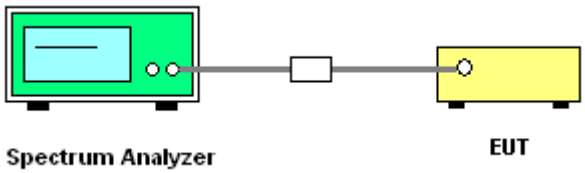
3.1.2 Measuring Instruments

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 ≥ 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

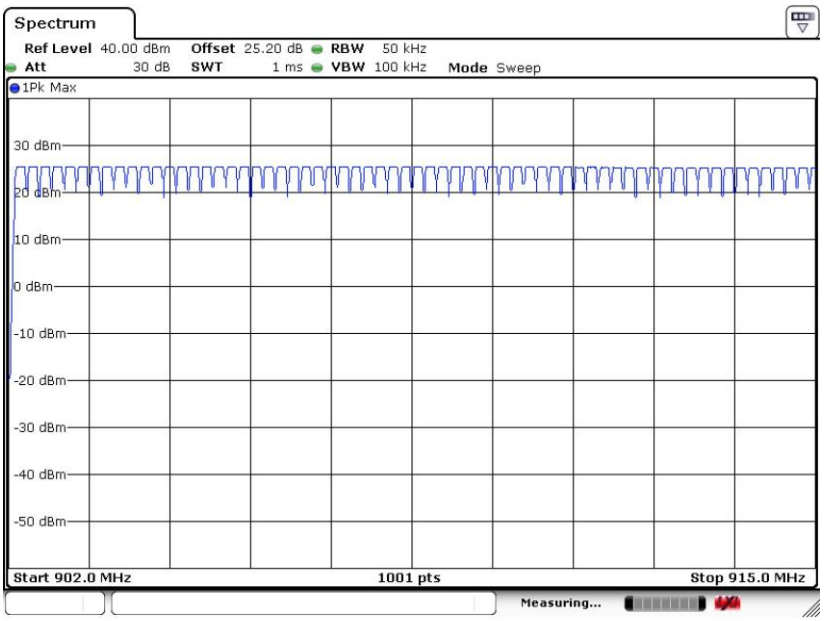


3.1.5 Test Result of Number of Hopping Frequency

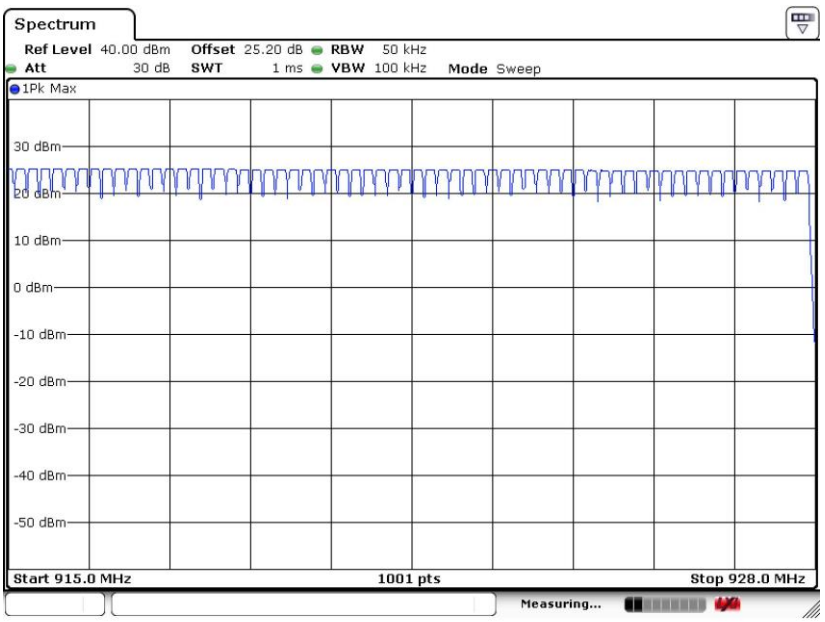
Please refer to Appendix A.

<LoRa FHSS>

Number of Hopping Channel Plot on Channel 1 - 129



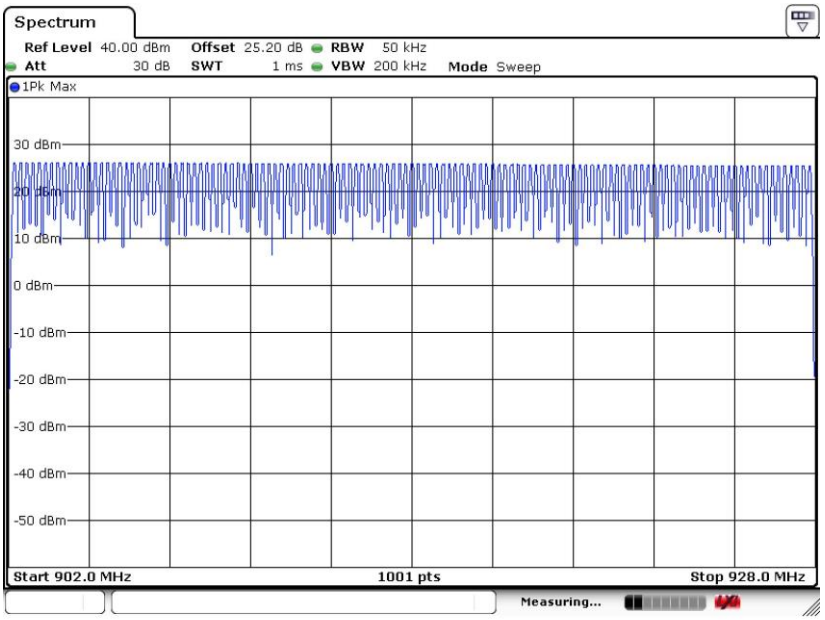
Date: 26.MAR.2021 21:12:56



Date: 26.MAR.2021 21:30:04

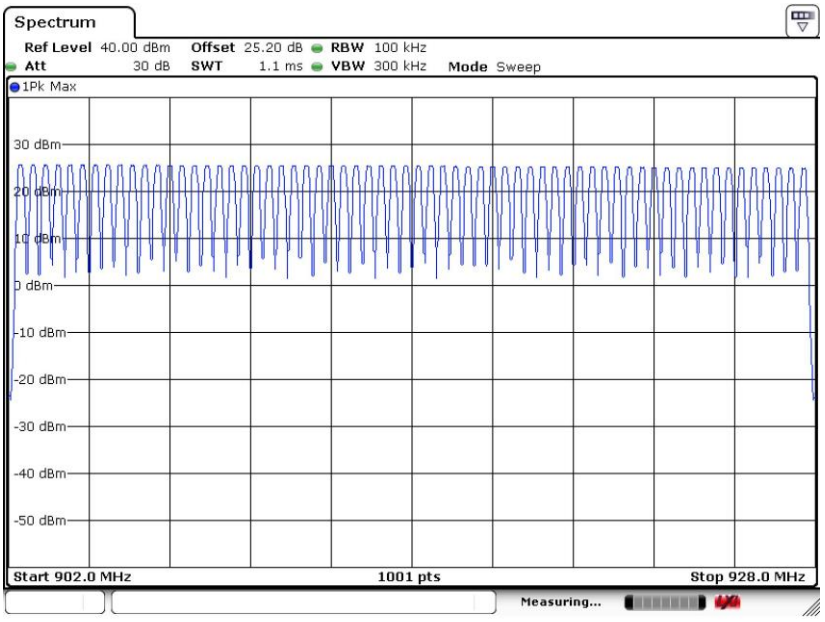
<FSK 50Kbps FHSS>

Number of Hopping Channel Plot on Channel 1 - 129



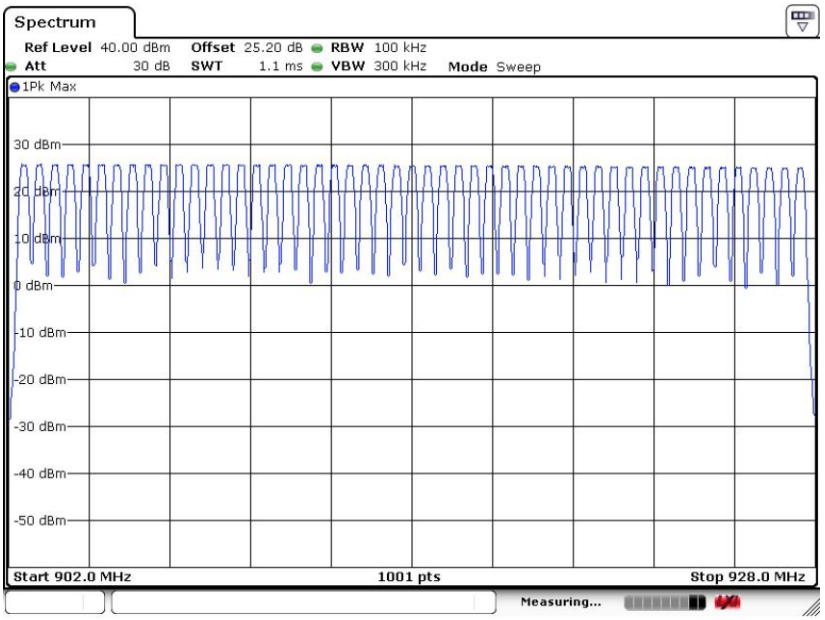
<FSK 150Kbps FHSS>

Number of Hopping Channel Plot on Channel 1 - 64



<FSK 250Kbps FHSS>

Number of Hopping Channel Plot on Channel 1 - 51



3.2 Hopping Channel Separation Measurement

3.2.1 Limit of Hopping Channel Separation

Frequency hopping systems operating in the 902 – 928 MHz band 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.

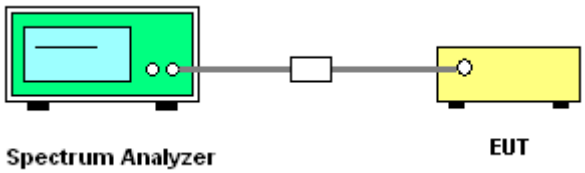
3.2.2 Measuring Instruments

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 ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

3.2.4 Test Setup

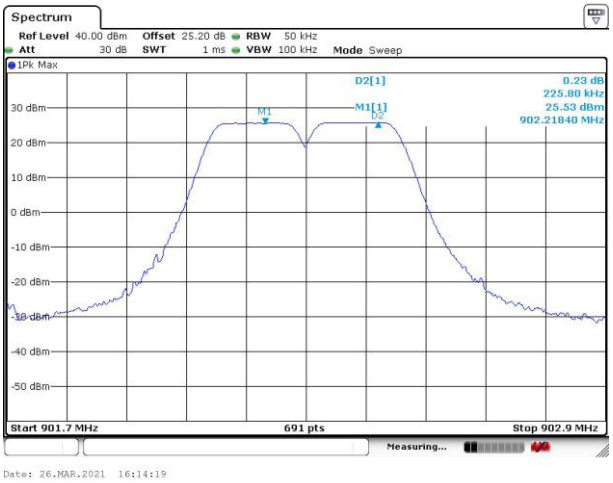


3.2.5 Test Result of Hopping Channel Separation

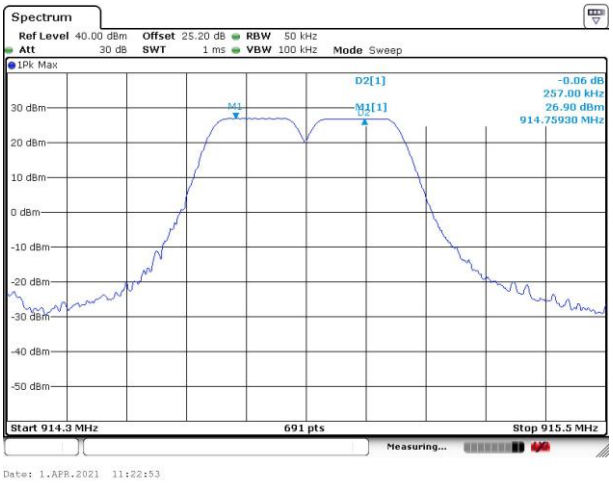
Please refer to Appendix A.

<LoRa FHSS>

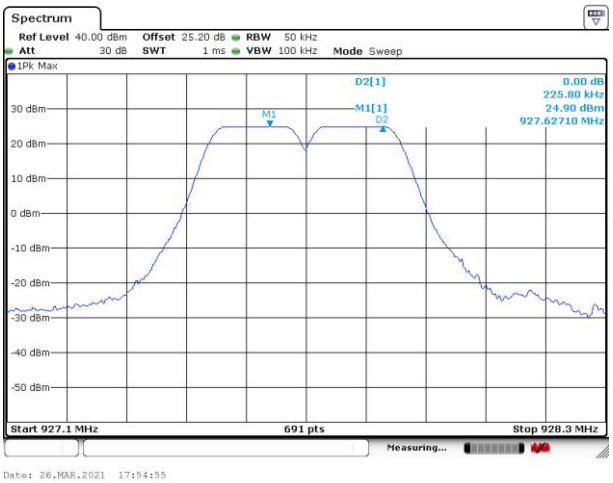
Channel Separation Plot on Channel 01 - 02



Channel Separation Plot on Channel 65 - 66

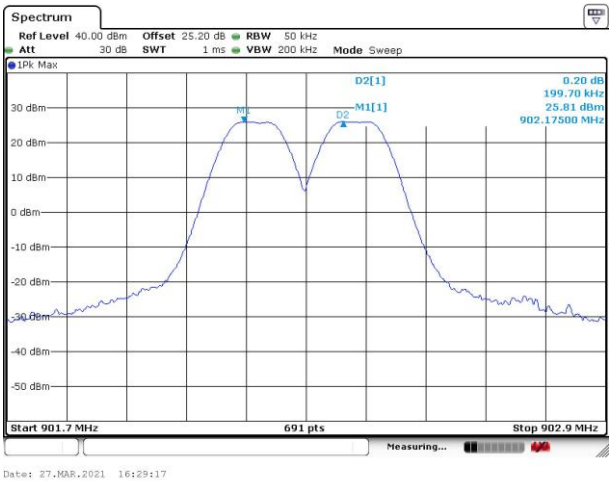


Channel Separation Plot on Channel 128 - 129

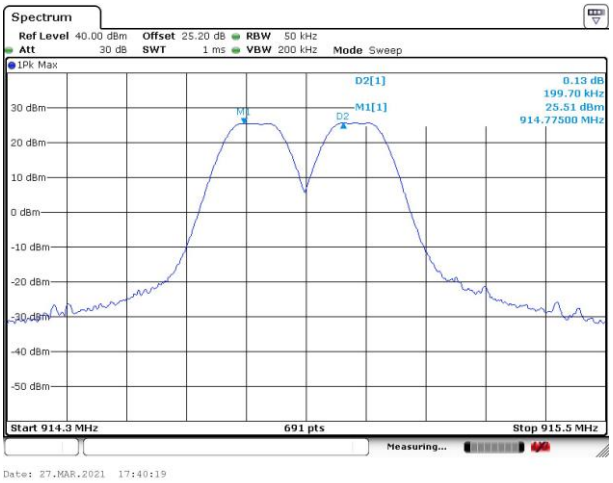


<FSK 50Kbps FHSS>

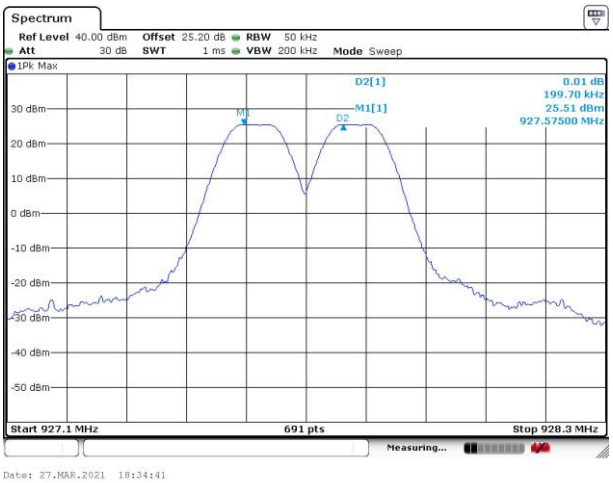
Channel Separation Plot on Channel 01 - 02



Channel Separation Plot on Channel 65 - 66

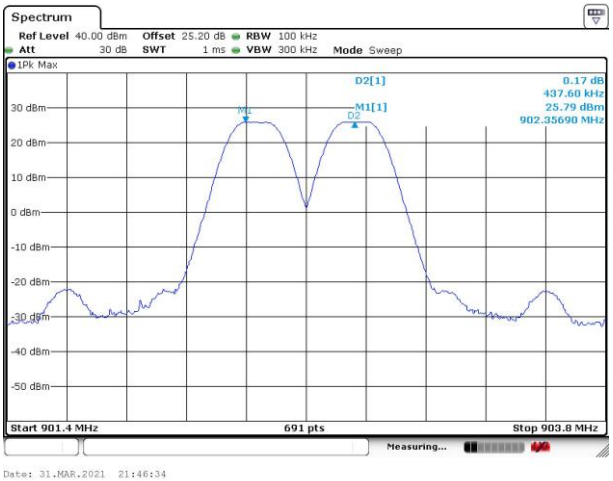


Channel Separation Plot on Channel 128 - 129

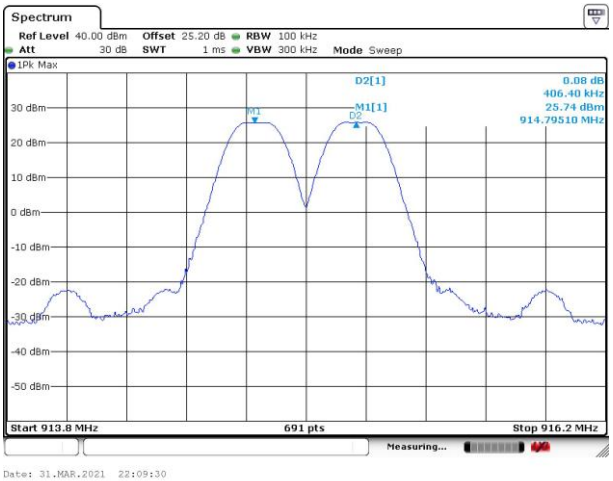


<FSK 150Kbps FHSS>

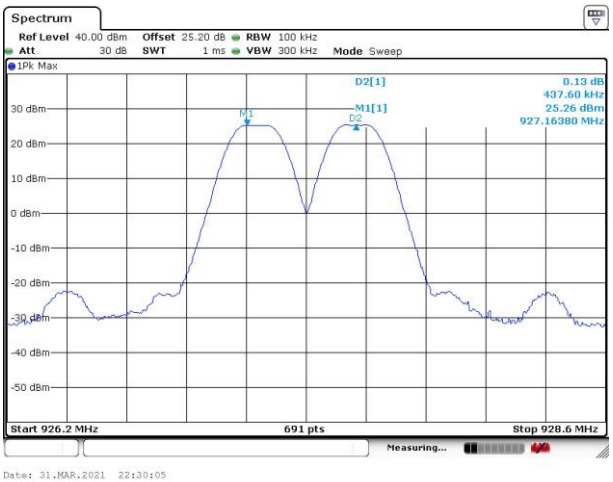
Channel Separation Plot on Channel 01 - 02



Channel Separation Plot on Channel 32 -33

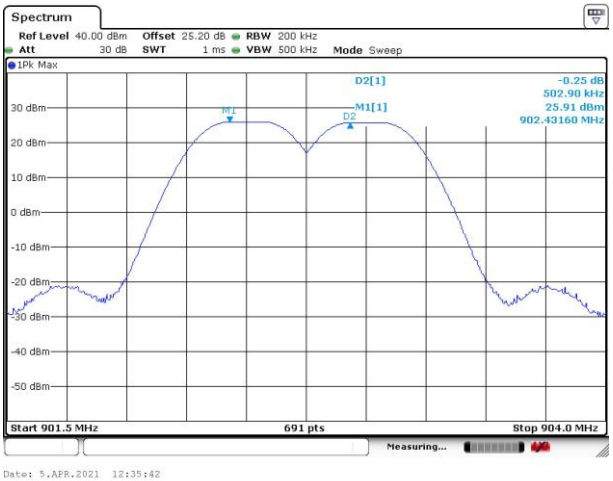


Channel Separation Plot on Channel 63 - 64

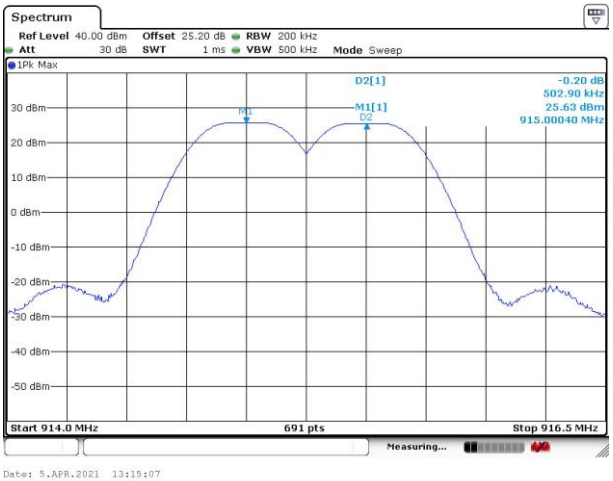


<FSK 250Kbps FHSS>

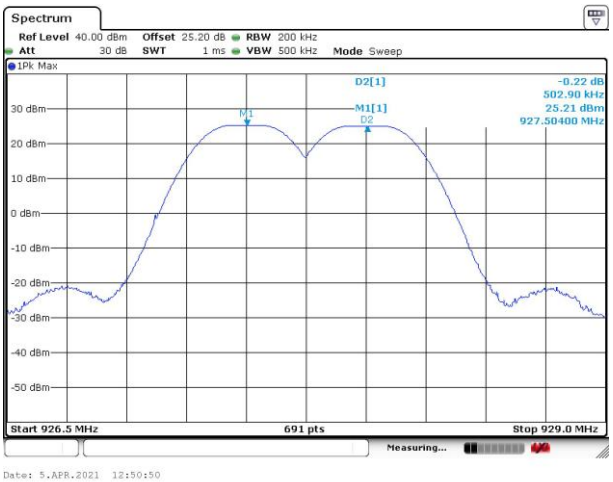
Channel Separation Plot on Channel 01 -02



Channel Separation Plot on Channel 26 - 27



Channel Separation Plot on Channel 50 -51



3.3 Dwell Time Measurement

3.3.1 Limit of Dwell Time

If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

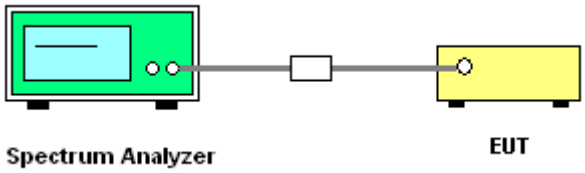
3.3.2 Measuring Instruments

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 ≥ 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

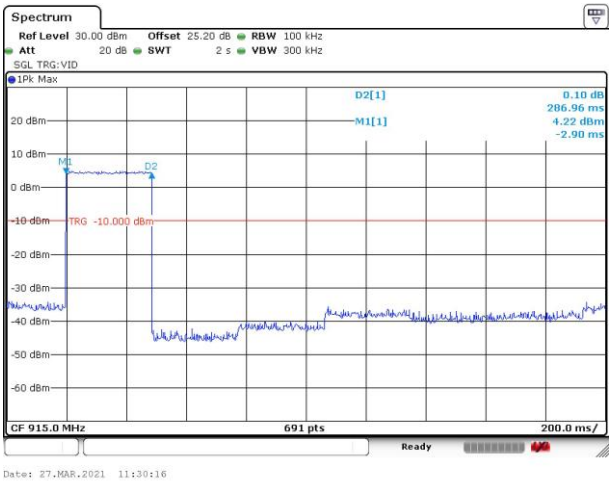


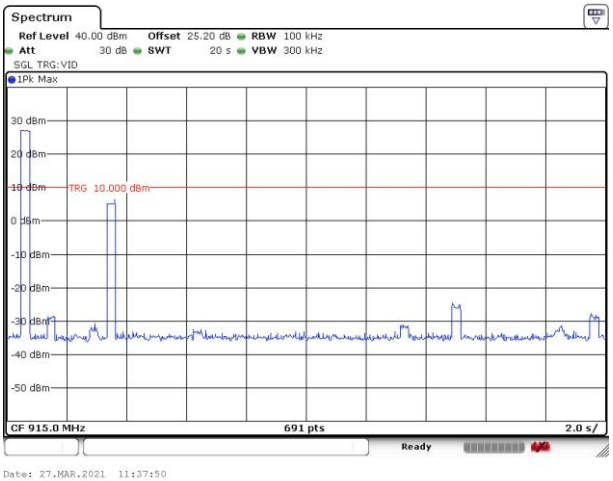
3.3.5 Test Result of Dwell Time

Please refer to Appendix A.

Package Transfer Time Plot

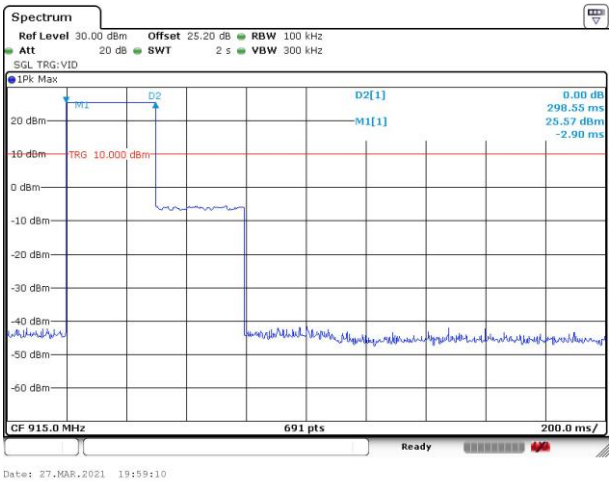
<LoRa FHSS>

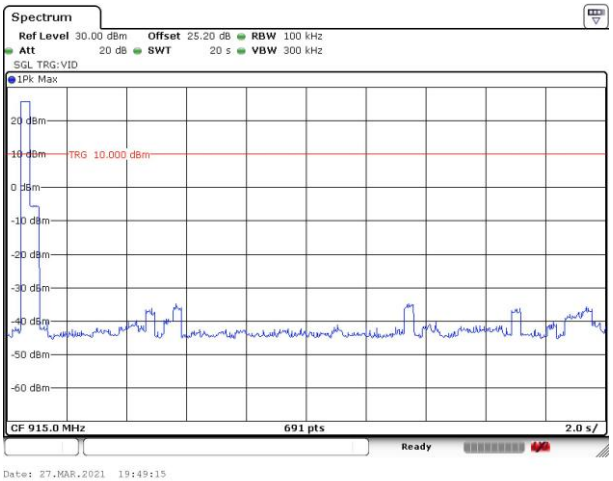




Package Transfer Time Plot

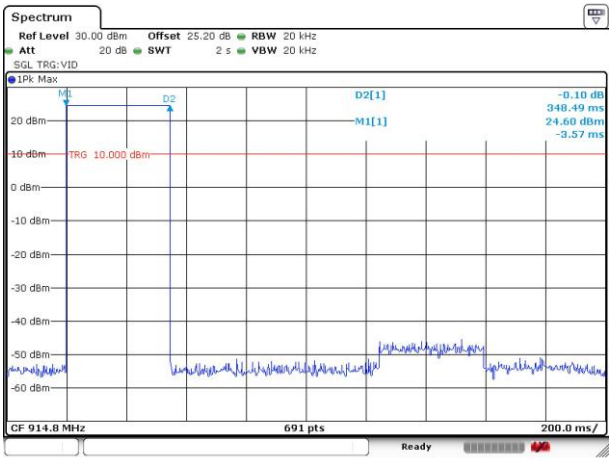
<FSK 50Kbps FHSS>

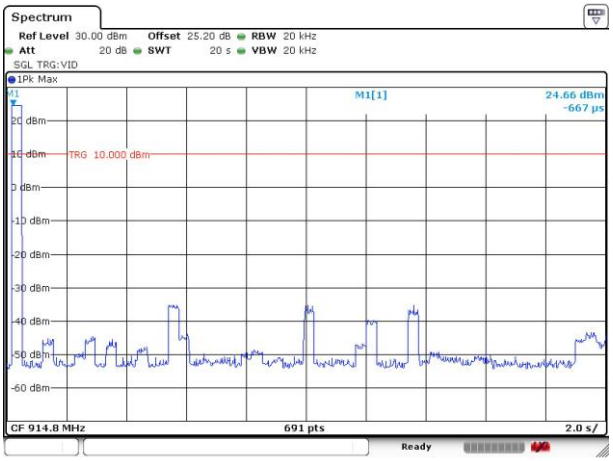




Package Transfer Time Plot

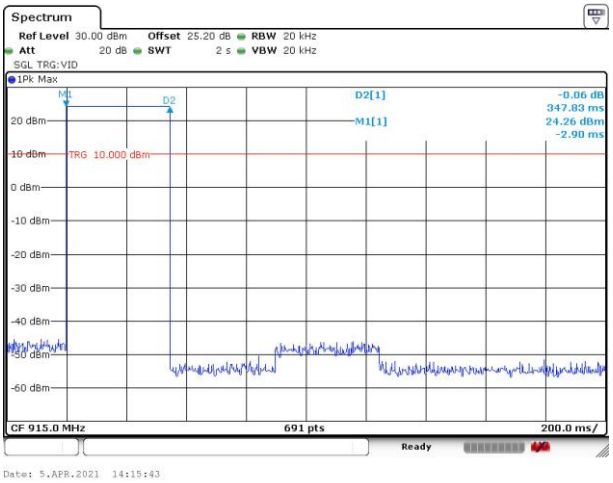
<FSK 150Kbps FHSS>

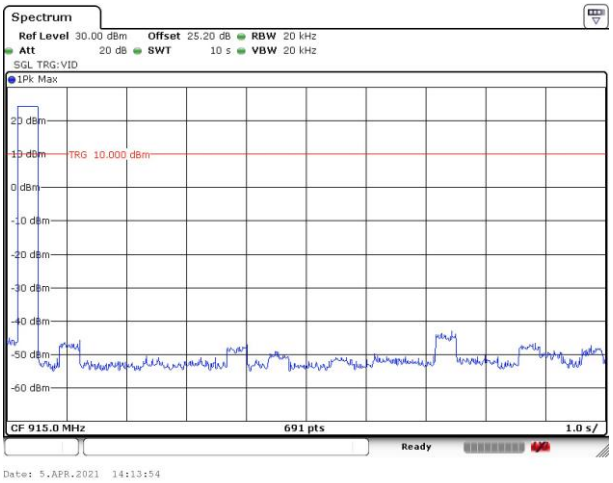




Package Transfer Time Plot

<FSK 250Kbps FHSS>





3.4 20dB and 99% Bandwidth Measurement

3.4.1 Limit of 20dB and 99% Bandwidth

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

99% Bandwidth is 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 ≥ 1% of the 20 dB bandwidth; VBW ≥ 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 ≥ 1-5% of the 99% bandwidth; VBW ≥ 3 * RBW; Sweep = auto; Detector function = peak;
   Trace = max hold.
6. Measure and record the results in the test report.

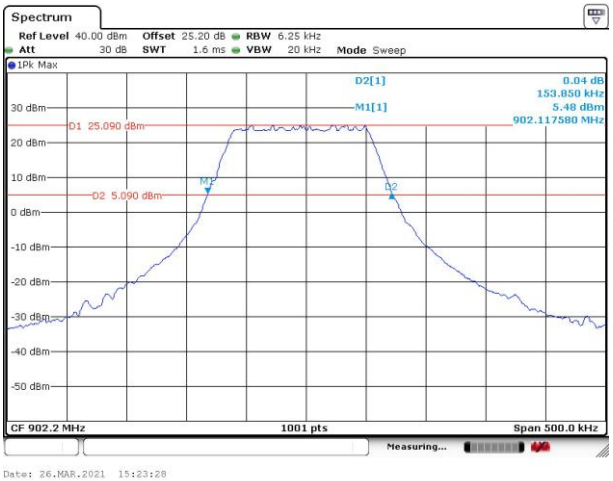
3.4.4 Test Setup

3.4.5 Test Result of 20dB Bandwidth

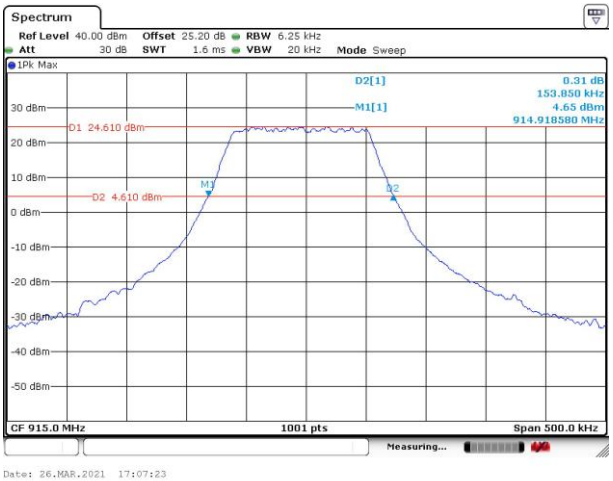
Please refer to Appendix A.

<LoRa FHSS>

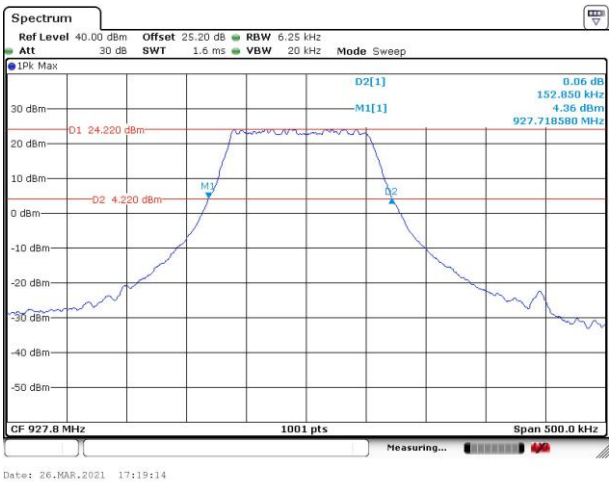
20 dB Bandwidth Plot on Channel 01



20 dB Bandwidth Plot on Channel 65

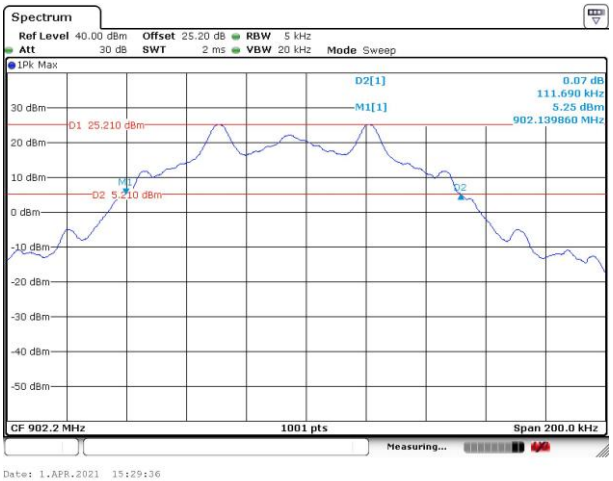


20 dB Bandwidth Plot on Channel 129

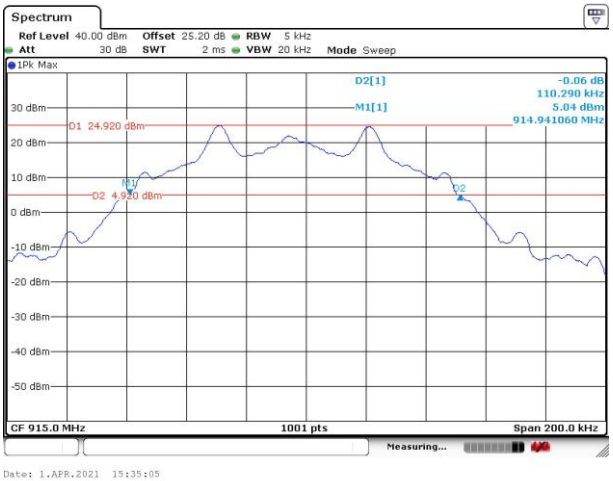


<FSK 50Kbps FHSS>

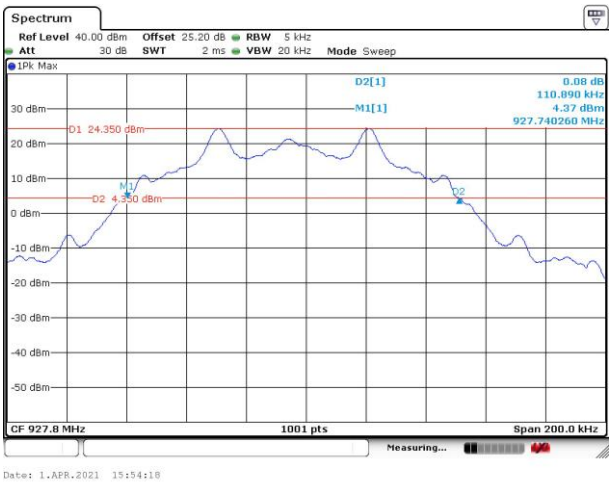
20 dB Bandwidth Plot on Channel 01



20 dB Bandwidth Plot on Channel 65

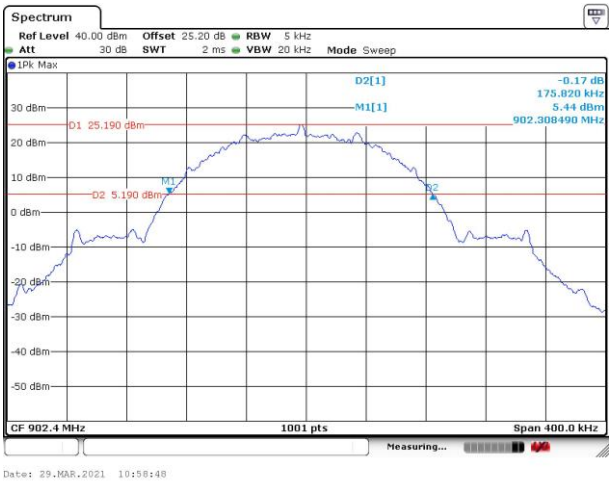


20 dB Bandwidth Plot on Channel 129

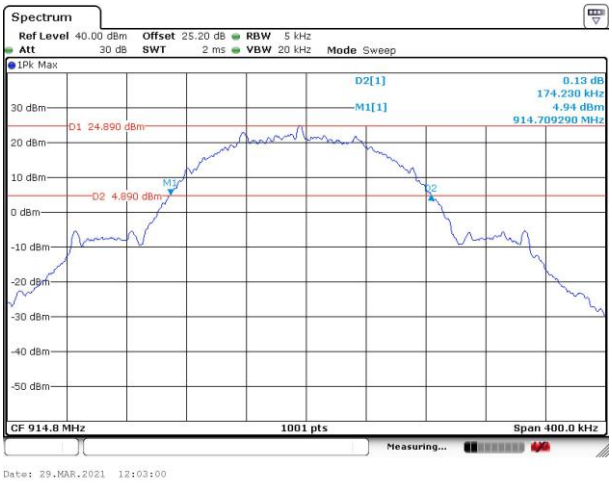


<FSK 150Kbps FHSS>

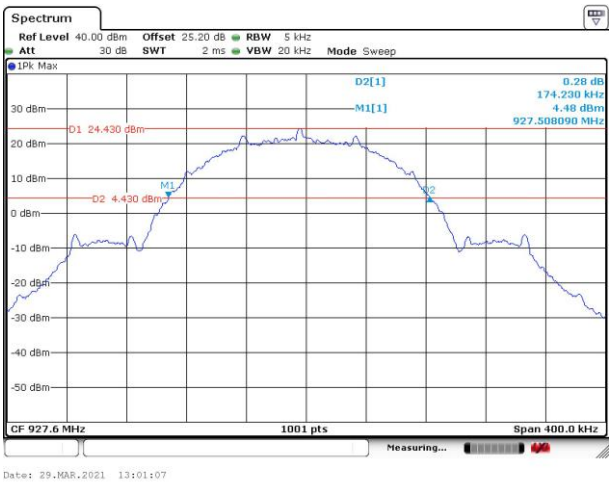
20 dB Bandwidth Plot on Channel 01



20 dB Bandwidth Plot on Channel 32

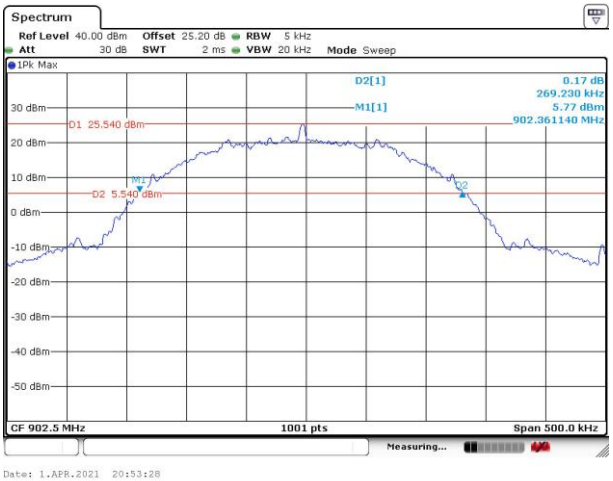


20 dB Bandwidth Plot on Channel 64

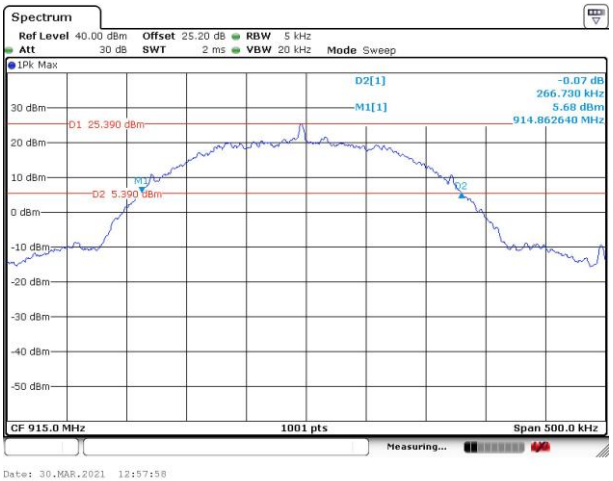


<FSK 250Kbps FHSS>

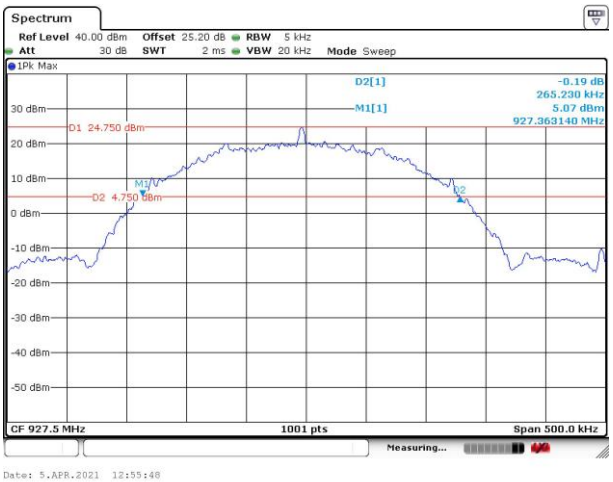
20 dB Bandwidth Plot on Channel 01



20 dB Bandwidth Plot on Channel 26



20 dB Bandwidth Plot on Channel 51

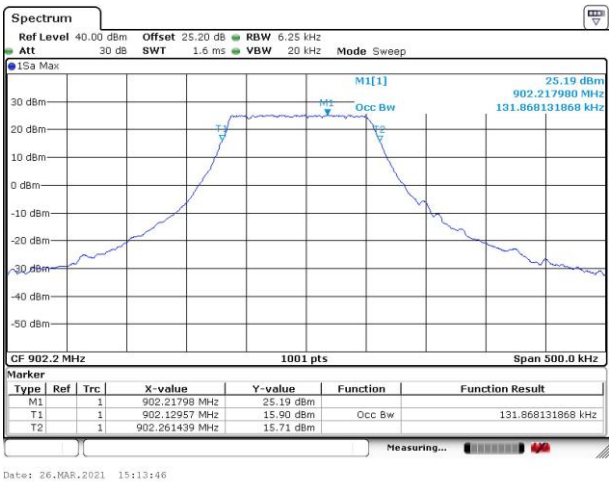


3.4.6 Test Result of 99% Occupied Bandwidth

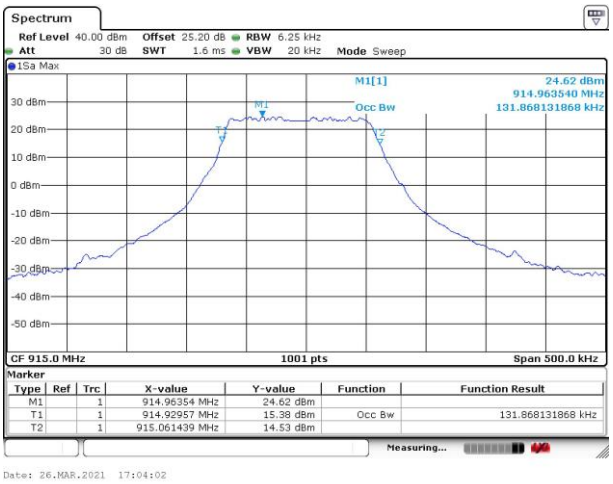
Please refer to Appendix A.

<LoRa FHSS>

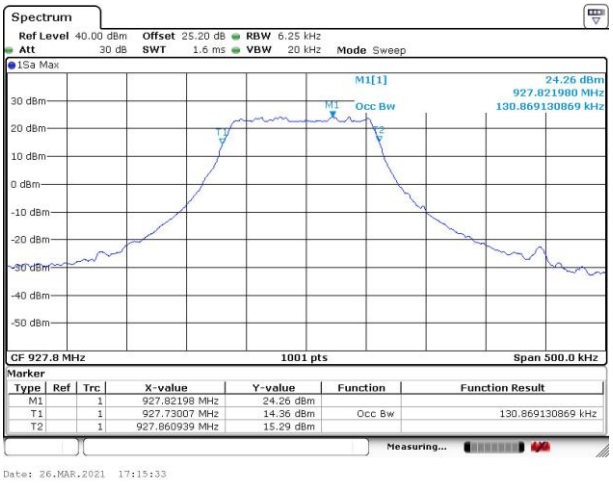
99% Occupied Bandwidth Plot on Channel 01



99% Occupied Bandwidth Plot on Channel 65



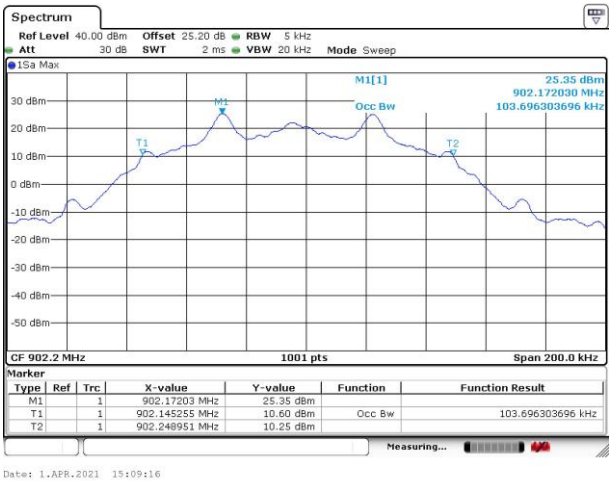
99% Occupied Bandwidth Plot on Channel 129



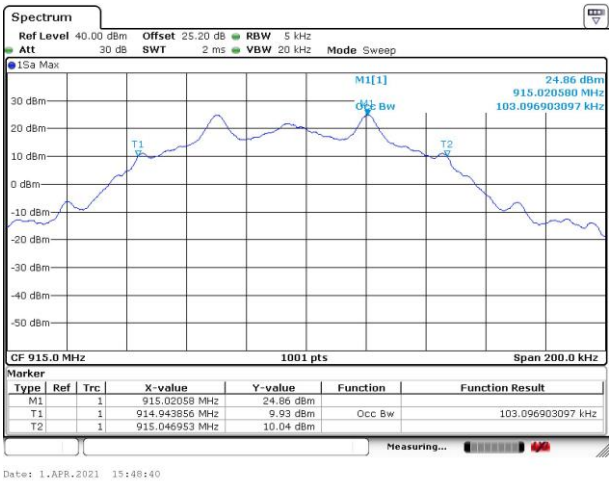
Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<FSK 50Kbps FHSS>

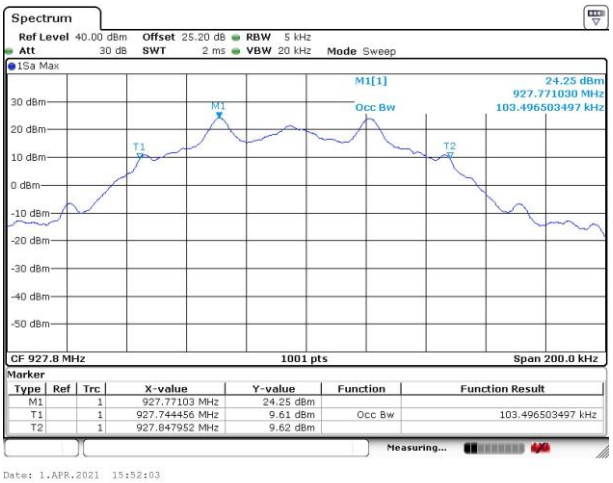
99% Occupied Bandwidth Plot on Channel 01



99% Occupied Bandwidth Plot on Channel 65



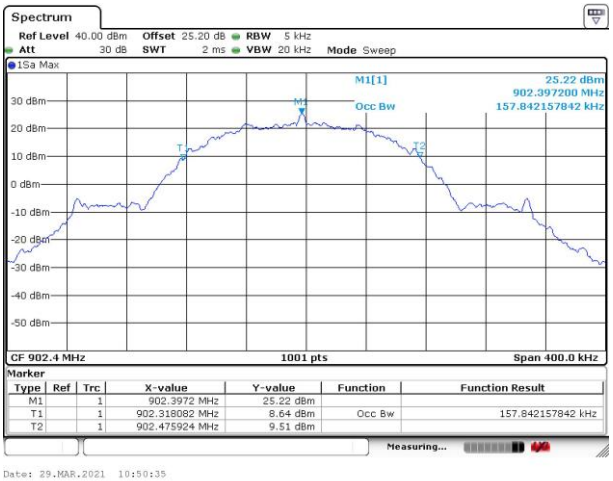
99% Occupied Bandwidth Plot on Channel 129



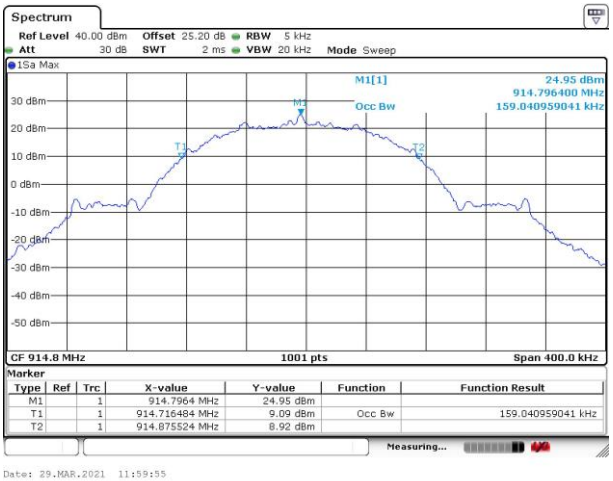
Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<FSK 150Kbps FHSS>

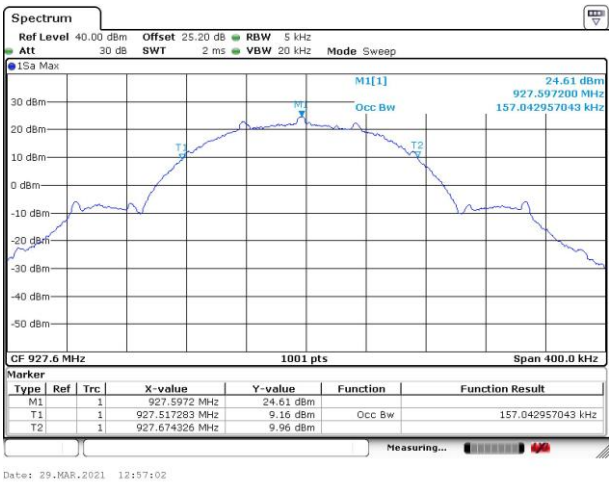
99% Occupied Bandwidth Plot on Channel 01



99% Occupied Bandwidth Plot on Channel 32



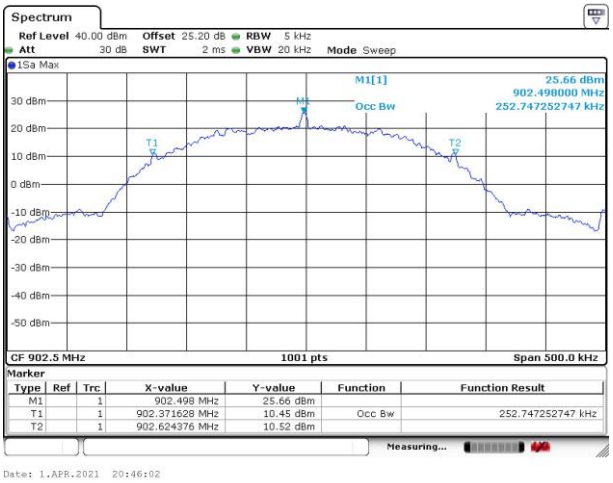
99% Occupied Bandwidth Plot on Channel 64



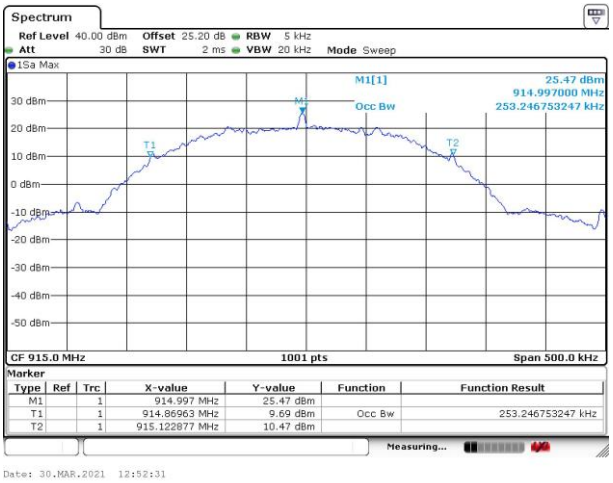
Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<FSK 250Kbps FHSS>

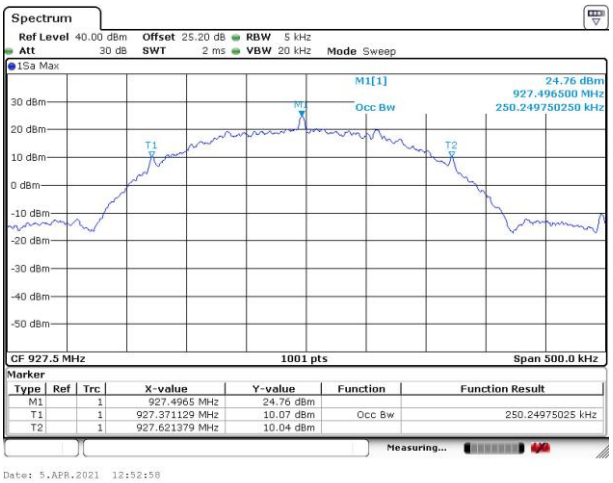
99% Occupied Bandwidth Plot on Channel 01



99% Occupied Bandwidth Plot on Channel 26



99% Occupied Bandwidth Plot on Channel 51



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

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

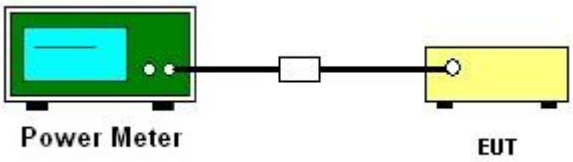
3.5.2 Measuring Instruments

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 Peak Output Power

Please refer to Appendix A.

3.5.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.

3.6 Conducted Band Edges Measurement

3.6.1 Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

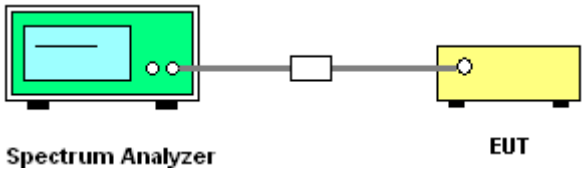
3.6.2 Measuring Instruments

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.

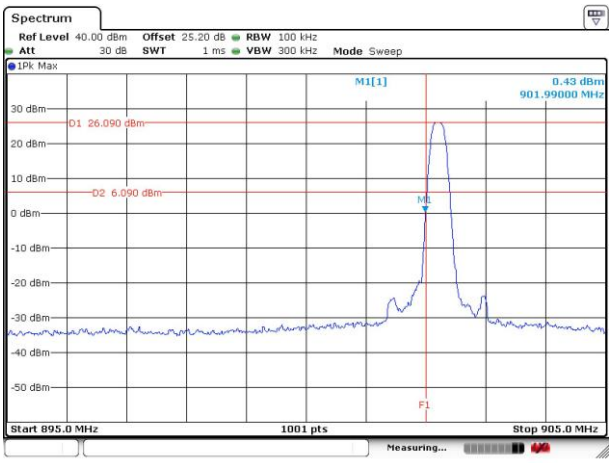
3.6.4 Test Setup



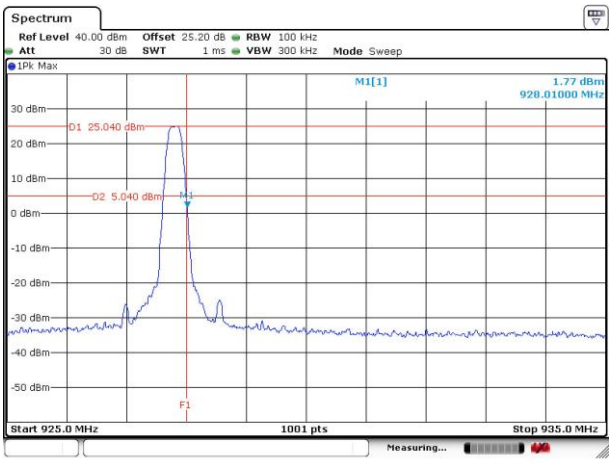
3.6.5 Test Result of Conducted Band Edges

<LoRa FHSS>

Low Band Edge Plot on Channel 01

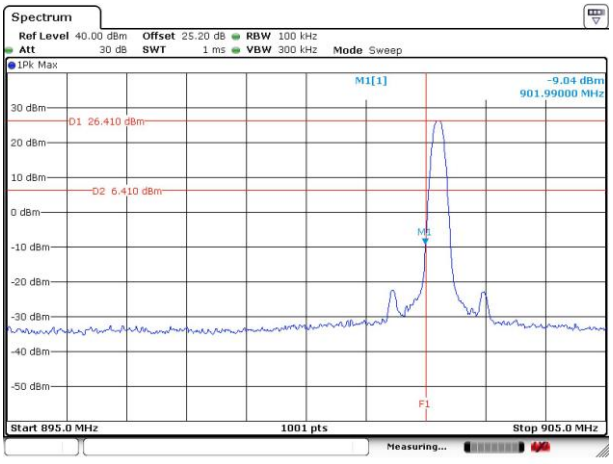


High Band Edge Plot on Channel 129

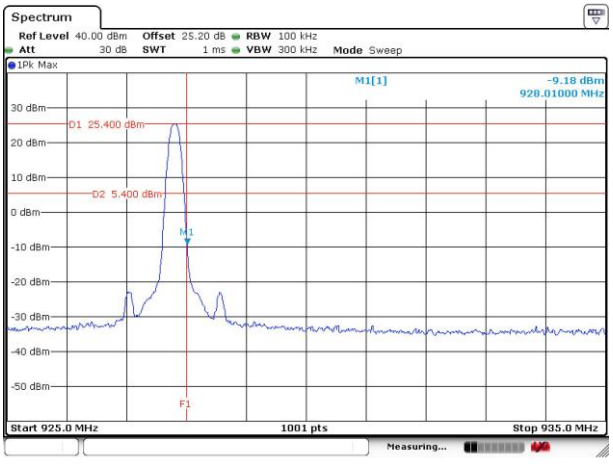


<FSK 50Kbps FHSS>

Low Band Edge Plot on Channel 01

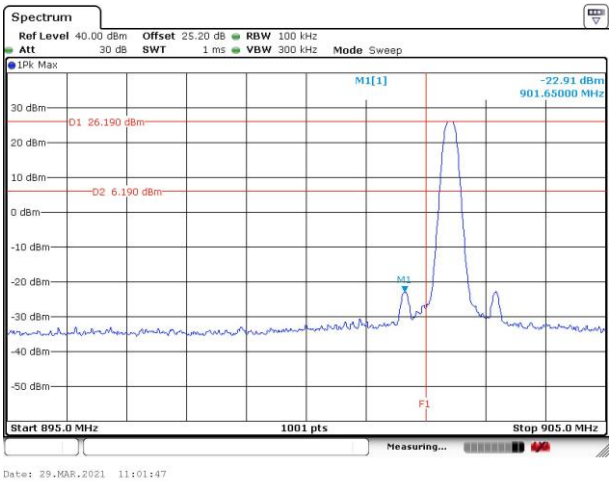


High Band Edge Plot on Channel 129

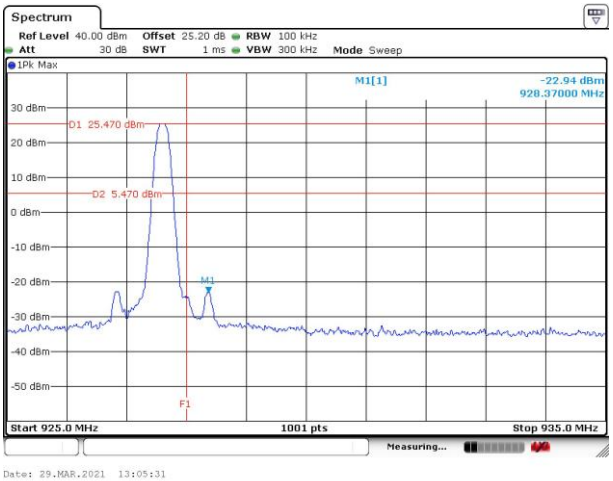


<FSK 150Kbps FHSS>

Low Band Edge Plot on Channel 01

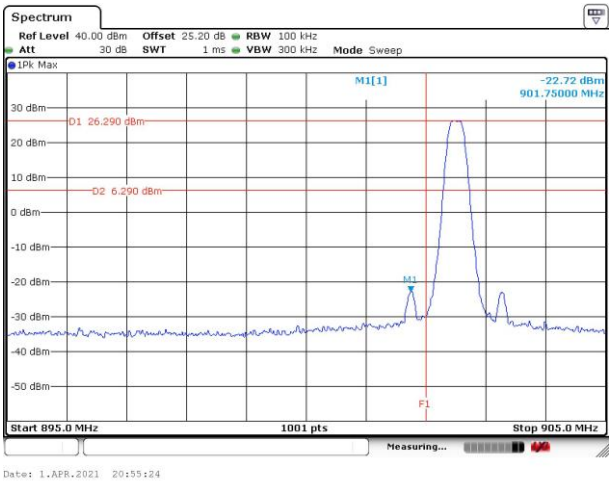


High Band Edge Plot on Channel 64

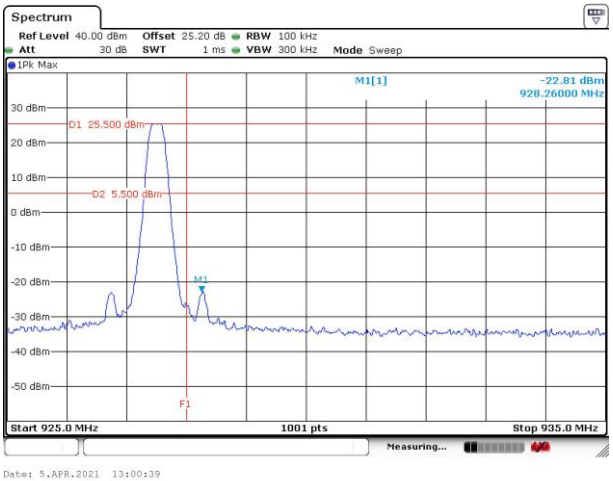


<FSK 250Kbps FHSS>

Low Band Edge Plot on Channel 01



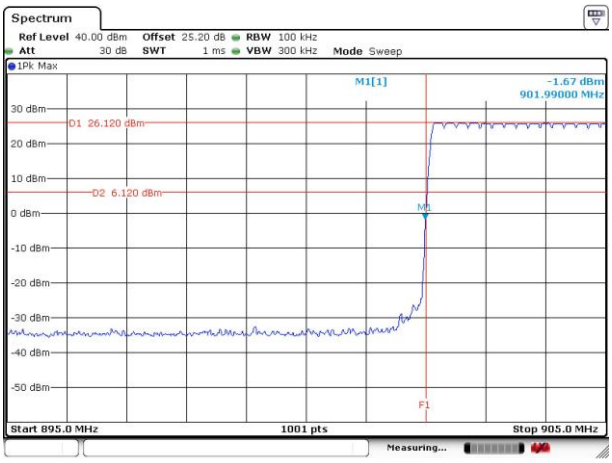
High Band Edge Plot on Channel 51



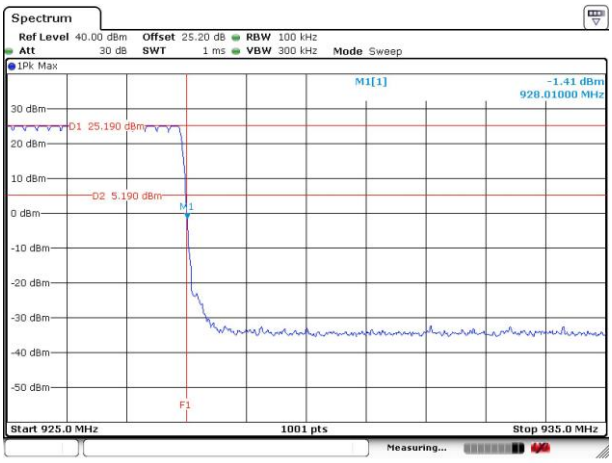
3.6.6 Test Result of Conducted Hopping Mode Band Edges

<LoRa FHSS>

Hopping Mode Low Band Edge Plot

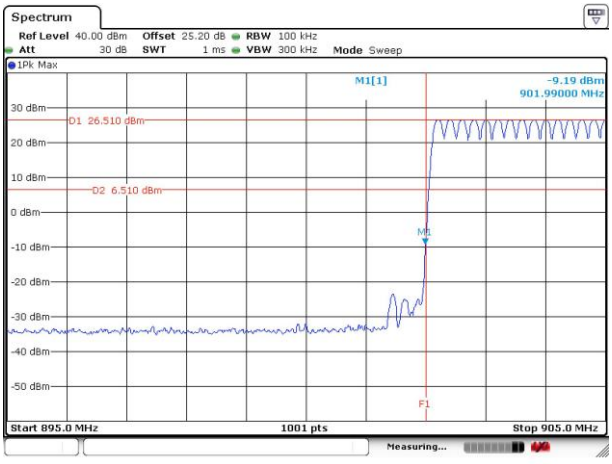


Hopping Mode High Band Edge Plot

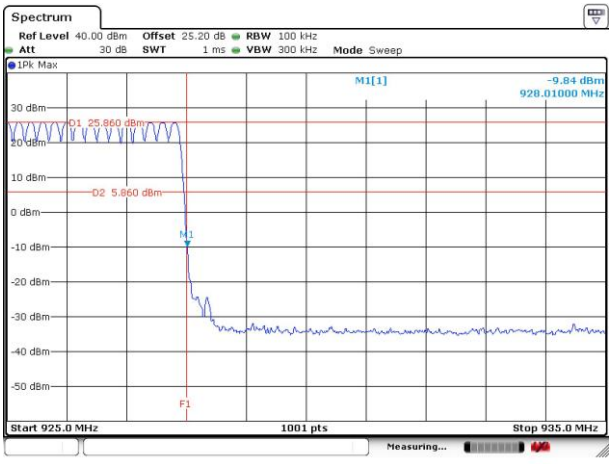


<FSK 50Kbps FHSS>

Hopping Mode Low Band Edge Plot

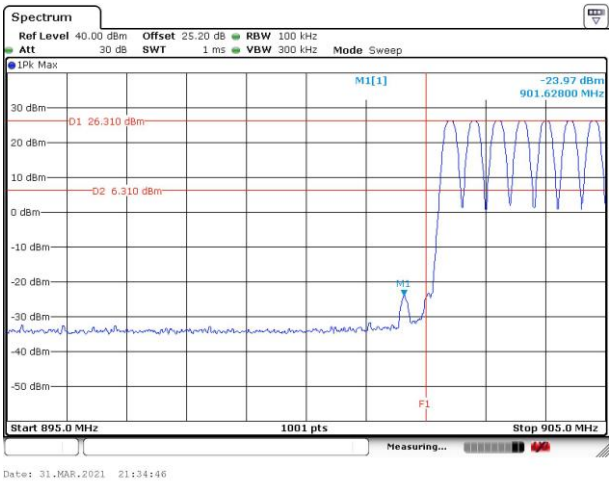


Hopping Mode High Band Edge Plot

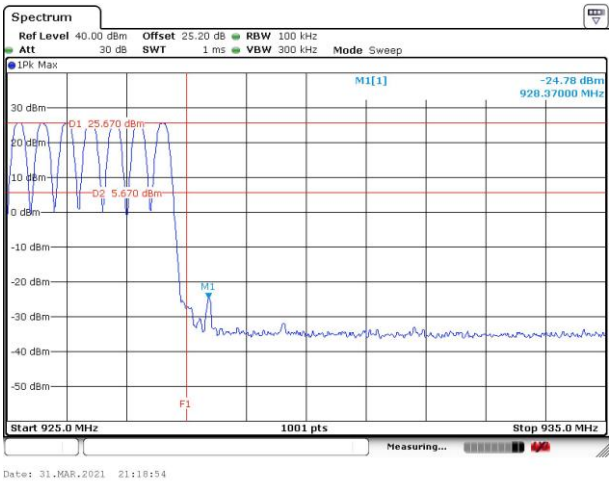


<FSK 150Kbps FHSS>

Hopping Mode Low Band Edge Plot

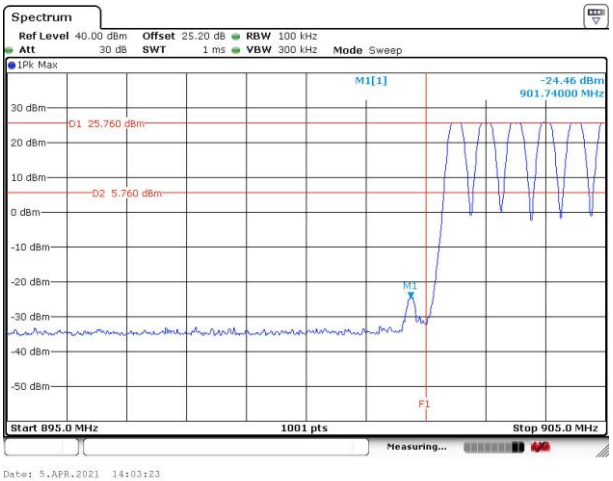


Hopping Mode High Band Edge Plot

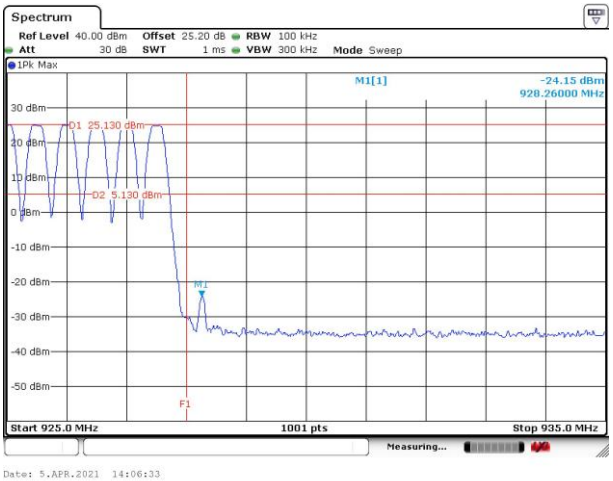


<FSK 250Kbps FHSS>

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 intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

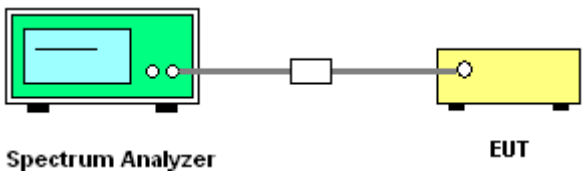
3.7.2 Measuring Instruments

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.

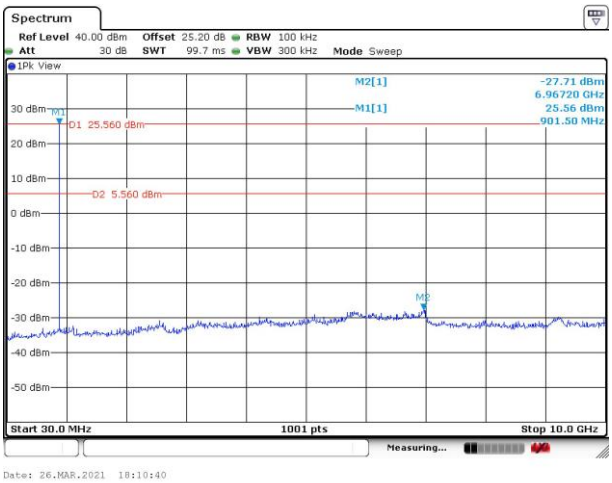
3.7.4 Test Setup



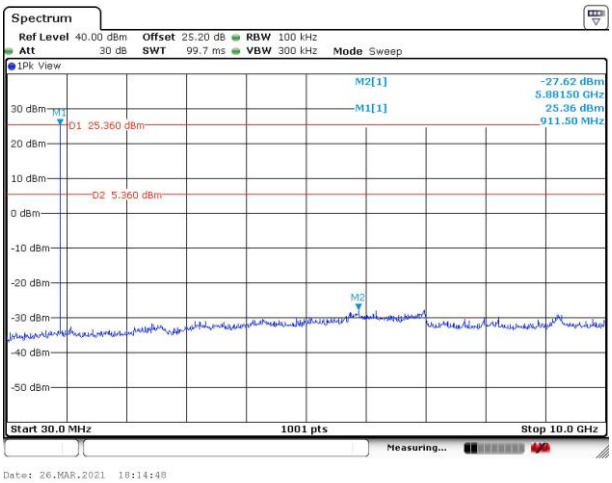
3.7.5 Test Result of Conducted Spurious Emission

<LoRa FHSS>

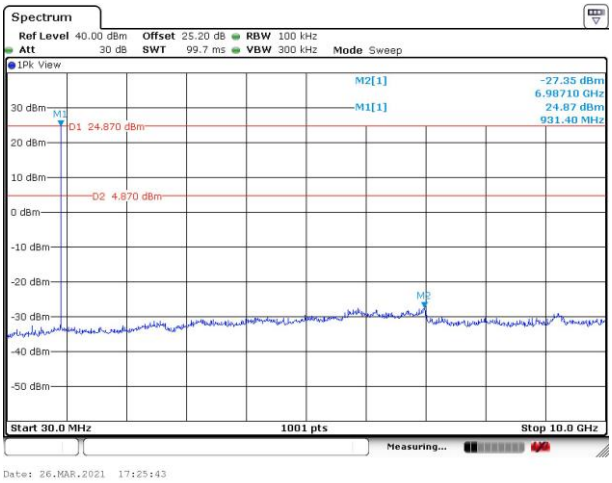
CSE Plot on Channel 01



CSE Plot on Channel 65

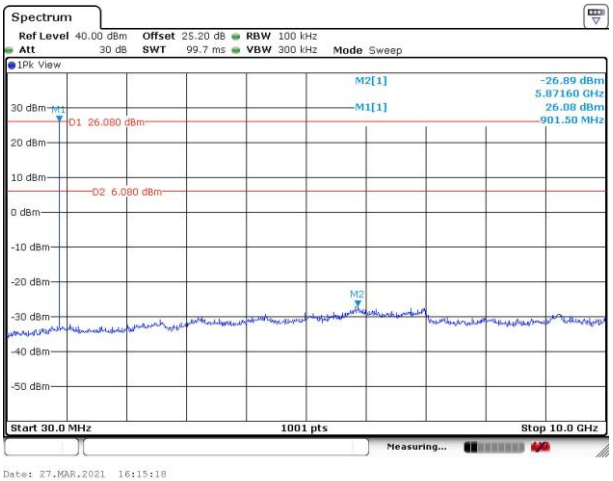


CSE Plot on Channel 129

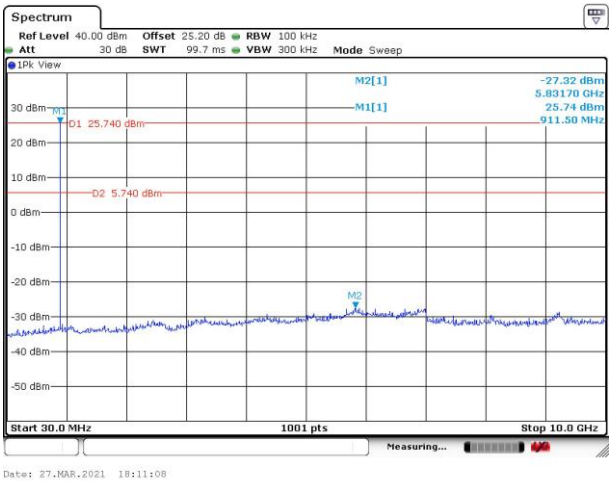


<FSK 50Kbps FHSS>

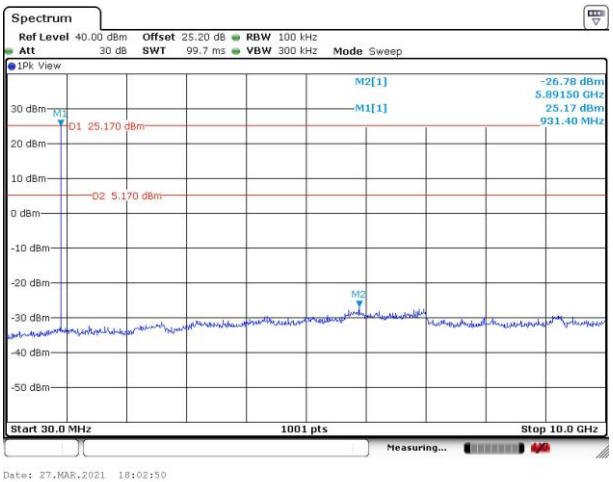
CSE Plot on Channel 01



CSE Plot on Channel 65

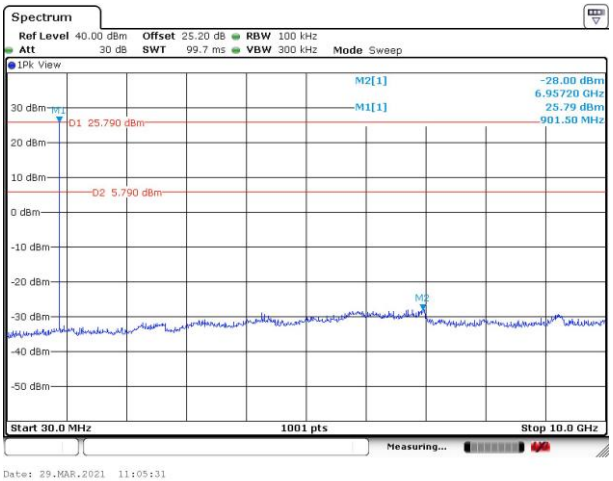


CSE Plot on Channel 129

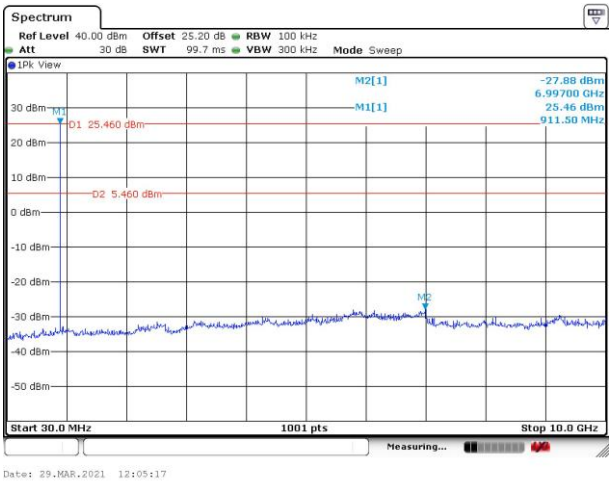


<FSK 150Kbps FHSS>

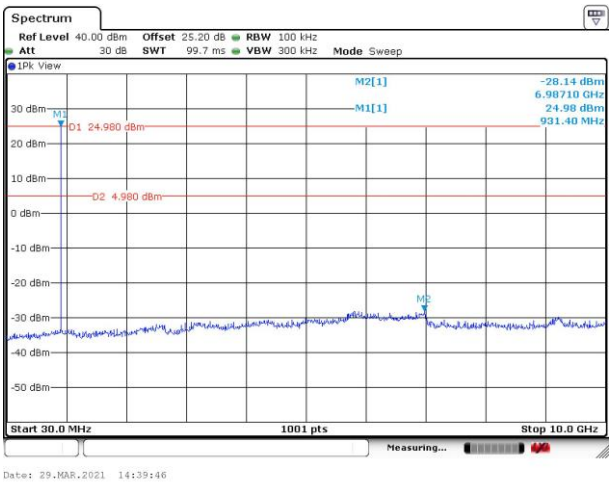
CSE Plot on Channel 01



CSE Plot on Channel 32

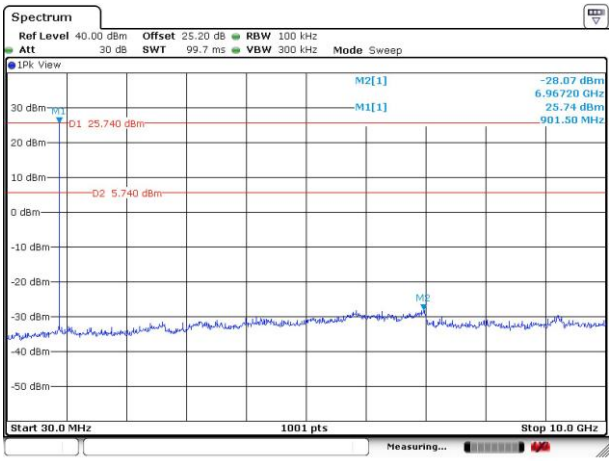


CSE Plot on Channel 64

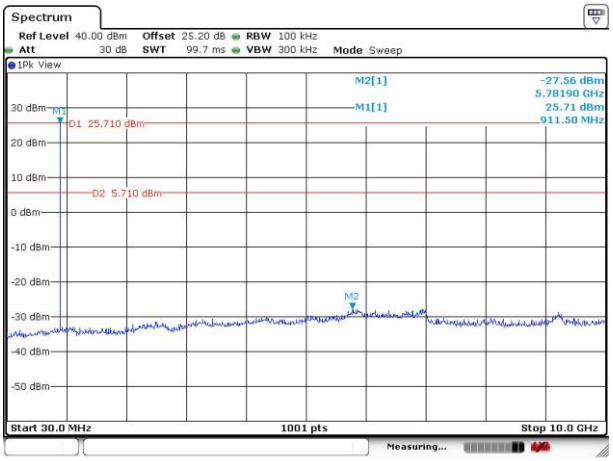


<FSK 250Kbps FHSS>

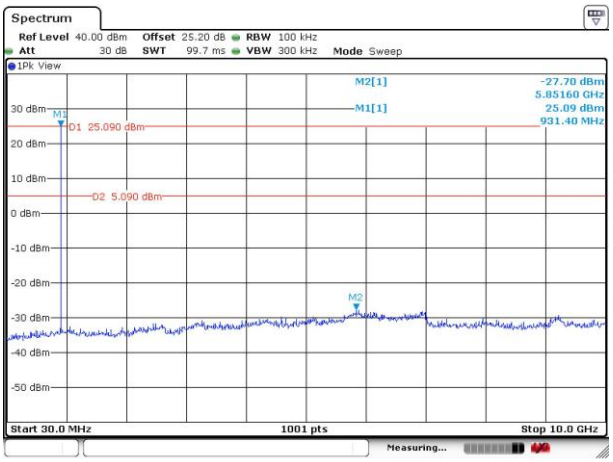
CSE Plot on Channel 01



CSE Plot on Channel 26



CSE Plot on Channel 51



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 intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

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

3.8.2 Measuring Instruments

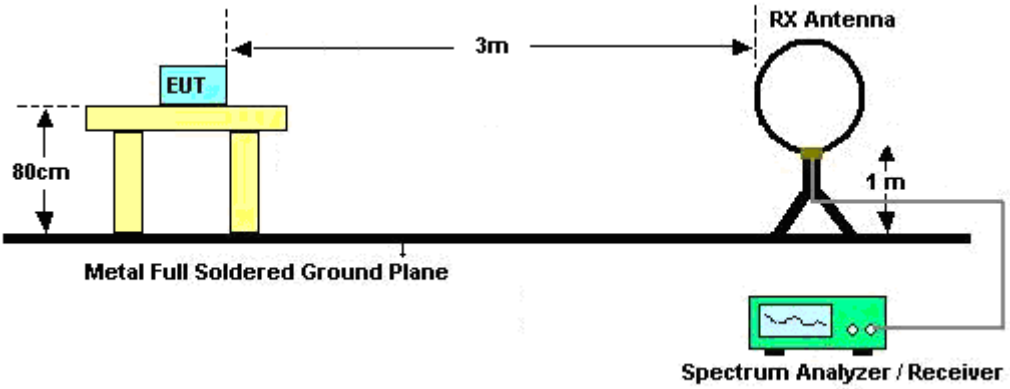
See list of measuring equipment of this test report.

3.8.3 Test Procedures

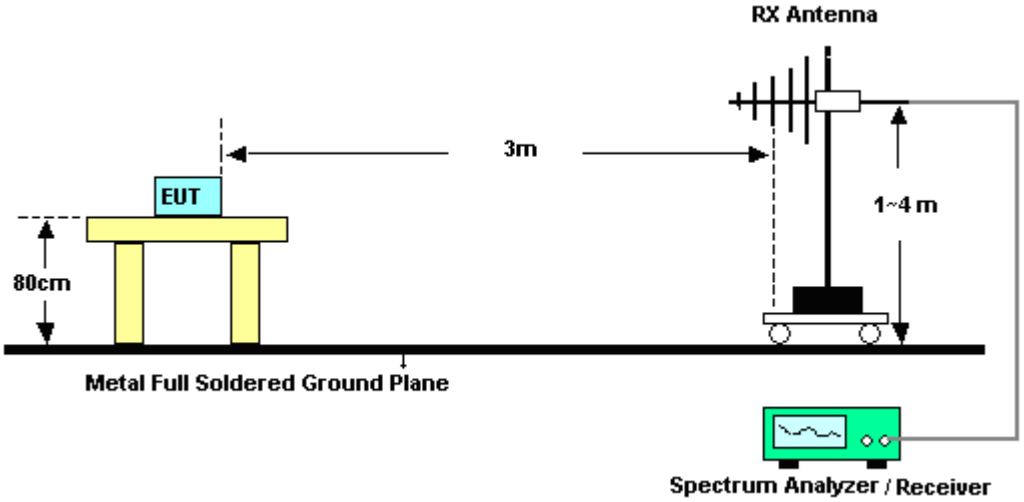
1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, 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>1GHz ; VBW ≥ 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 = $N_1*L_1+N_2*L_2+...+N_{n-1}*LN_{n-1}+N_n*L_n$
   Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.
   Average Emission Level = Peak Emission Level + 20*log(Duty cycle)
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
7. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
8. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

3.8.4 Test Setup

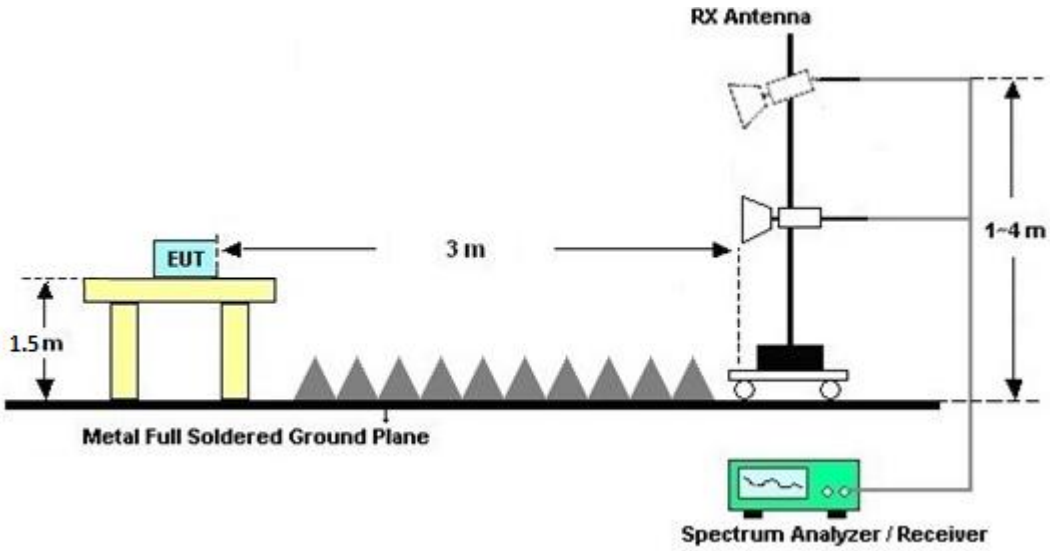
For radiated emissions below 30MHz



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 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 C and D.

3.8.7 Duty Cycle

Please refer to Appendix E.

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

Please refer to Appendix C and D.

3.9 AC Conducted Emission 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 (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

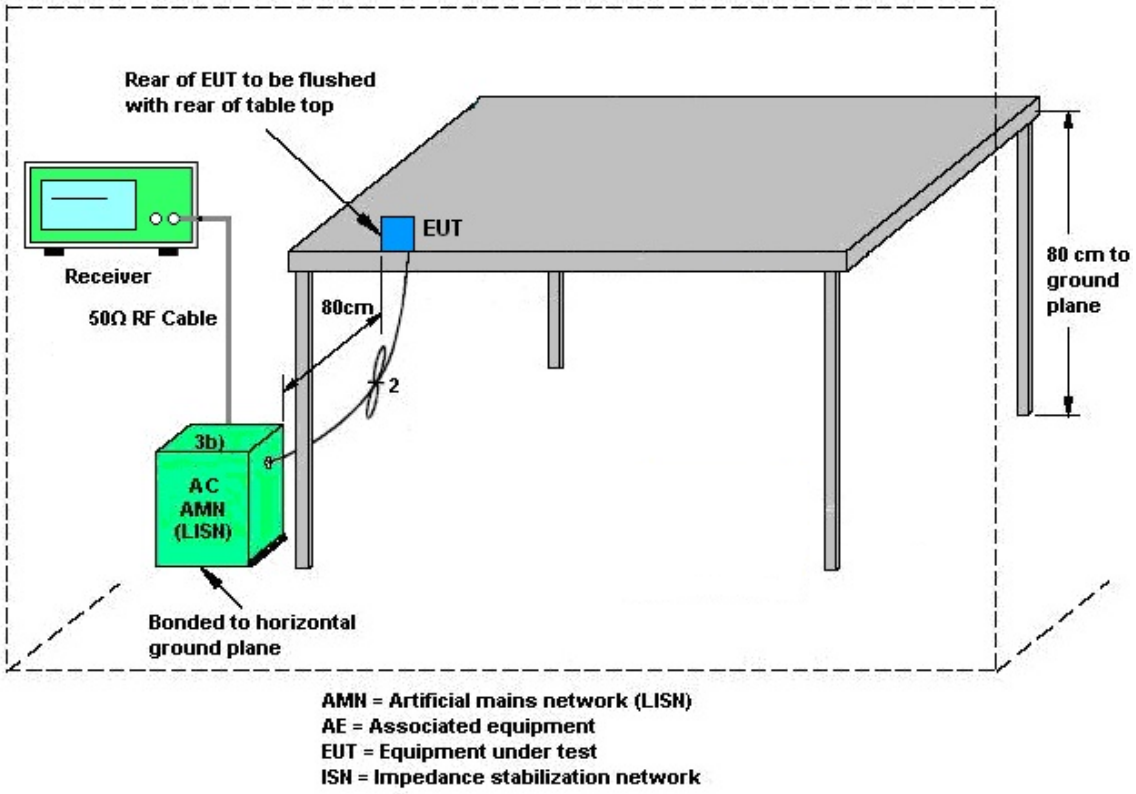
3.9.2 Measuring Instruments

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 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



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

3.9.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

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 less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Mar. 30, 2021	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102388	9kHz~3.6GHz	Nov. 30, 2020	Mar. 30, 2021	Nov. 29, 2021	Conduction (CO05-HY)
Hygrometer	Testo	608-H1	34913912	N/A	Nov. 18, 2020	Mar. 30, 2021	Nov. 17, 2021	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Nov. 16, 2020	Mar. 30, 2021	Nov. 15, 2021	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32 V10.30	N/A	N/A	N/A	Mar. 30, 2021	N/A	Conduction (CO05-HY)
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100851	N/A	Feb. 25, 2021	Mar. 30, 2021	Feb. 24, 2022	Conduction (CO05-HY)
LISN Cable	MVE	RG-400	260260	N/A	N/A	Mar. 30, 2021	N/A	Conduction (CO05-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Jul. 14, 2020	Mar. 26, 2021~ Apr. 03, 2021	Jul. 13, 2021	Radiation (03CH11-HY)
Bilog Antenna	TESEQ	CBL 6111D & N-6-06	35414 & AT-N0602	30MHz~1GHz	Oct. 11, 2020	Mar. 26, 2021~ Apr. 03, 2021	Oct. 10, 2021	Radiation (03CH11-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1326	1GHz ~ 18GHz	Nov. 03, 2020	Mar. 26, 2021~ Apr. 03, 2021	Nov. 02, 2021	Radiation (03CH11-HY)
Amplifier	SONOMA	310N	187312	9kHz~1GHz	Dec. 02, 2020	Mar. 26, 2021~ Apr. 03, 2021	Dec. 01, 2021	Radiation (03CH11-HY)
Preamplifier	Keysight	83017A	MY53270080	1GHz~26.5GHz	Nov. 12, 2020	Mar. 26, 2021~ Apr. 03, 2021	Nov. 11, 2021	Radiation (03CH11-HY)
Preamplifier	EMEC	EM1G18G	060812	1GHz~18GHz	Oct. 27, 2020	Mar. 26, 2021~ Apr. 03, 2021	Oct. 26, 2021	Radiation (03CH11-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200486	10Hz~44GHz	Oct. 23, 2020	Mar. 26, 2021~ Apr. 03, 2021	Oct. 22, 2021	Radiation (03CH11-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY55420170	20MHz~8.4GHz	May 21, 2020	Mar. 26, 2021~ Apr. 03, 2021	May 20, 2021	Radiation (03CH11-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Mar. 26, 2021~ Apr. 03, 2021	N/A	Radiation (03CH11-HY)
Turn Table	EMEC	TT 2000	N/A	0~360 Degree	N/A	Mar. 26, 2021~ Apr. 03, 2021	N/A	Radiation (03CH11-HY)
Software	Audix	E3 6.2009-8-24	RK-001053	N/A	N/A	Mar. 26, 2021~ Apr. 03, 2021	N/A	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4PE	9kHz-30MHz	Mar. 11, 2021	Mar. 26, 2021~ Apr. 03, 2021	Mar. 10, 2022	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2859/2	30MHz-40GHz	Mar. 11, 2021	Mar. 26, 2021~ Apr. 03, 2021	Mar. 10, 2022	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4PE	30M-18G	Mar. 11, 2021	Mar. 26, 2021~ Apr. 03, 2021	Mar. 10, 2022	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY4274/2	30MHz-40GHz	Mar. 11, 2021	Mar. 26, 2021~ Apr. 03, 2021	Mar. 10, 2022	Radiation (03CH11-HY)
Filter	Wainwright	WLK4-1000-1530-8000-40SS	SN11	1.53G Low Pass	Sep. 14, 2020	Mar. 26, 2021~ Apr. 03, 2021	Sep. 13, 2021	Radiation (03CH11-HY)
Filter	Wainwright	WHKX12-935-1000-15000-40ST	SN1	1GHz High Pass Filter	Apr. 30, 2020	Mar. 26, 2021~ Apr. 03, 2021	Apr. 29, 2021	Radiation (03CH11-HY)
Hygrometer	TECPEL	DTM-303B	TP140325	N/A	Nov. 18, 2020	Mar. 26, 2021~ Apr. 03, 2021	Nov. 17, 2021	Radiation (03CH11-HY)
Hygrometer	TECPEL	DTM-303B	TP200880	QA-3-031	Oct. 22, 2020	Mar. 26, 2021~ Apr. 03, 2021	Oct. 21, 2021	Radiation (03CH11-HY)

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Hygrometer	TECPEL	TR-32	HE17XB2468	N/A	Mar. 09. 2021	Mar. 13, 2021 ~ Apr. 05, 2021	Mar. 08. 2022	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101566	10Hz~40GHz	Jul. 22, 2020	Mar. 13, 2021 ~ Apr. 05, 2021	Jul. 21, 2021	Conducted (TH05-HY)
Power Meter	Anritsu	ML2495A	1218006	N/A	Oct. 18, 2020	Mar. 13, 2021 ~ Apr. 05, 2021	Oct. 17, 2021	Conducted (TH05-HY)
Power Sensor	Anritsu	MA2411B	1207363	300MHz~40GHz	Oct. 18, 2020	Mar. 13, 2021 ~ Apr. 05, 2021	Oct. 17, 2021	Conducted (TH05-HY)
Switch Box & RF Cable	Burgeon	ETF058	EC1300484	N/A	Nov. 19, 2020	Mar. 13, 2021 ~ Apr. 05, 2021	Nov. 18, 2021	Conducted (TH05-HY)

5 Uncertainty of Evaluation

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

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

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.4**

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

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

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.1**

Appendix A. Test Result of Conducted Test Items

Test Engineer	Tommy Lee	Temperature:	21.3 ~ 23.8	°C
Test Date:	2021/03/13~2021/04/05	Relative Humidity:	54.1 ~ 59.6	%

<LoRa FHSS>

TEST RESULTS DATA
20dB and 99% Occupied Bandwidth and Hopping Channel Separation

Mod.	NTX	CH.	Freq. (MHz)	20db BW (MHz)	99% Bandwidth (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
Lora 125KHz	1	1	902.2	0.154	0.132	0.226	0.1540	Pass
Lora 125KHz	1	65	915	0.154	0.132	0.257	0.1540	Pass
Lora 125KHz	1	129	927.8	0.153	0.131	0.226	0.1530	Pass

TEST RESULTS DATA
Dwell Time

Mod.	Hopping Channel Number Rate	Hops Over Occupancy Time(hops)	Package Transfer Time (msec)	Dwell Time (sec)	Limits (sec)	Pass/Fail
Lora 125KHz	129	1	286.01	0.29	0.4	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
Lora 125KHz	1	**25.45**	30.00	Pass
	1	25.30	30.00	Pass
	1	24.93	30.00	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

Mod.	NTX	Average Power (dBm)	Duty Factor (dB)
Lora 125KHz	1	**25.38**	0.03
	1	25.25	0.03
	1	24.86	0.03

TEST RESULTS DATA
Number of Hopping Frequency

Number of Hopping (Channel)	Limits (Channel)	Pass/Fail
129	> 50	Pass

<FSK 50Kbps FHSS>

TEST RESULTS DATA
20dB and 99% Occupied Bandwidth and Hopping Channel Separation

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	20db BW (MHz)	99% Bandwidth (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
FSK	50Kbps	1	1	902.2	0.112	0.104	0.200	0.1117	Pass
FSK	50Kbps	1	65	915	0.110	0.103	0.200	0.1103	Pass
FSK	50Kbps	1	129	927.8	0.111	0.103	0.200	0.1109	Pass

TEST RESULTS DATA
Dwell Time

Mod.	Hopping Channel Number Rate	Hops Over Occupancy Time(hops)	Package Transfer Time (msec)	Dwell Time (sec)	Limits (sec)	Pass/Fail
FSK	129	1.00	0.30	0.30	0.4	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
FSK	1	1	25.42	30.00	Pass
	65	1	**25.49**	30.00	Pass
	129	1	24.87	30.00	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

Mod.	CH.	NTX	Average Power (dBm)	Duty Factor (dB)
FSK	1	1	**25.38**	9.05
	65	1	25.23	9.05
	129	1	24.83	9.05

TEST RESULTS DATA
Number of Hopping Frequency

Number of Hopping (Channel)	Limits (Channel)	Pass/Fail
129	> 50	Pass

<FSK 150Kbps FHSS>

TEST RESULTS DATA
20dB and 99% Occupied Bandwidth and Hopping Channel Separation

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	20db BW (MHz)	99% Bandwidth (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
FSK	150Kbps	1	1	902.4	0.176	0.158	0.438	0.1760	Pass
FSK	150Kbps	1	32	914.8	0.174	0.159	0.406	0.1740	Pass
FSK	150Kbps	1	64	927.6	0.174	0.157	0.438	0.1740	Pass

TEST RESULTS DATA
Dwell Time

Mod.	Hopping Channel Number Rate	Hops Over Occupancy Time(hops)	Package Transfer Time (msec)	Dwell Time (sec)	Limits (sec)	Pass/Fail
FSK	64	1.00	346.69	0.35	0.4	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
FSK	1	1	**25.50**	30.00	Pass
	32	1	25.40	30.00	Pass
	64	1	24.95	30.00	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

Mod.	CH.	NTX	Average Power (dBm)	Duty Factor (dB)
FSK	1	1	**25.40**	0.80
	32	1	25.37	0.80
	64	1	24.93	0.80

TEST RESULTS DATA
Number of Hopping Frequency

Number of Hopping (Channel)	Limits (Channel)	Pass/Fail
64	> 50	Pass

<FSK 250Kbps FHSS>

TEST RESULTS DATA
20dB and 99% Occupied Bandwidth and Hopping Channel Separation

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	20db BW (MHz)	99% Bandwidth (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
FSK	250Kbps	1	1	902.5	0.269	0.253	0.503	0.2692	Pass
FSK	250Kbps	1	26	915	0.267	0.253	0.503	0.2667	Pass
FSK	250Kbps	1	51	927.5	0.265	0.250	0.503	0.2652	Pass

TEST RESULTS DATA
Dwell Time

Mod.	Hopping Channel Number Rate	Hops Over Occupancy Time(hops)	Package Transfer Time (msec)	Dwell Time (sec)	Limits (sec)	Pass/Fail
FSK	51	1.00	336.01	0.34	0.4	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
FSK	1	1	**25.48**	30.00	Pass
	26	1	25.45	30.00	Pass
	51	1	24.96	30.00	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

Mod.	CH.	NTX	Average Power (dBm)	Duty Factor (dB)
FSK	1	1	**25.39**	1.23
	26	1	25.38	1.23
	51	1	24.90	1.23

TEST RESULTS DATA
Number of Hopping Frequency

Number of Hopping (Channel)	Limits (Channel)	Pass/Fail
51	25	Pass

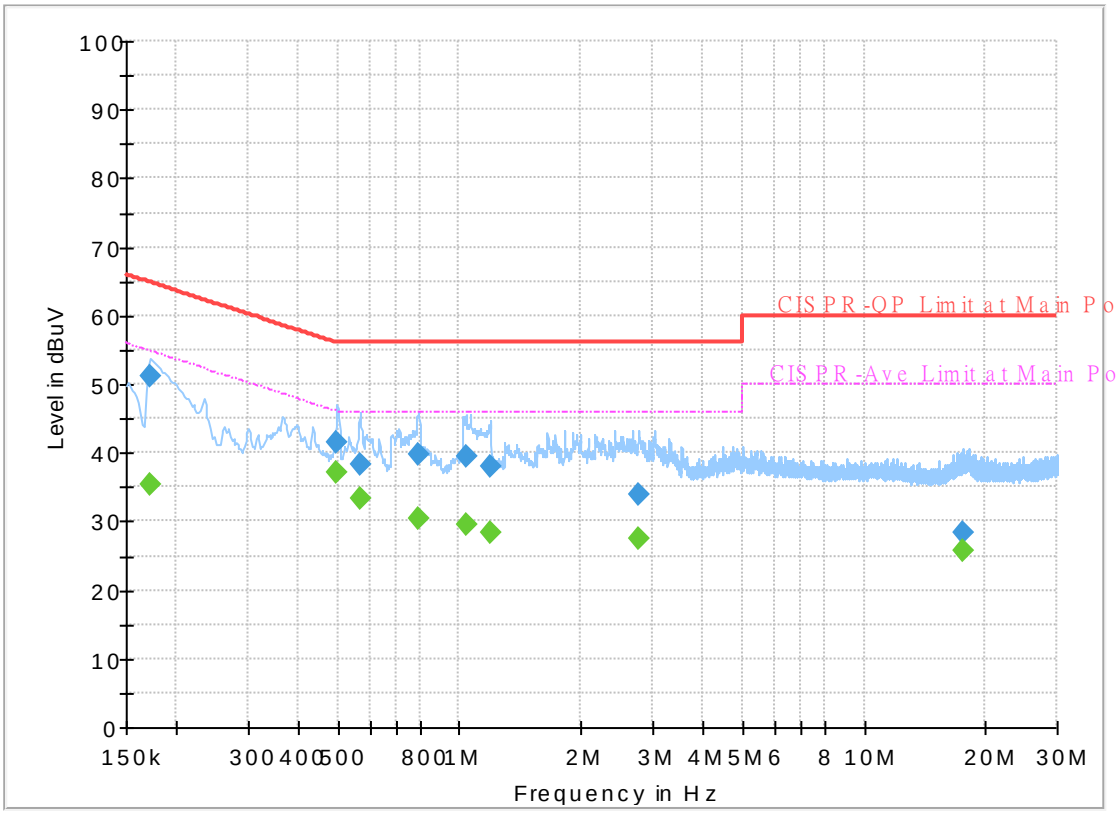
Appendix B. AC Conducted Emission Test Results

Test Engineer :	Tom Lee	**Temperature :**	23~26℃
		Relative Humidity :	40~50%

EUT Information

Report NO :	120337-01
Test Mode :	Mode 1
Test Voltage :	120Vac/60Hz
Phase :	Line

Full Spectrum



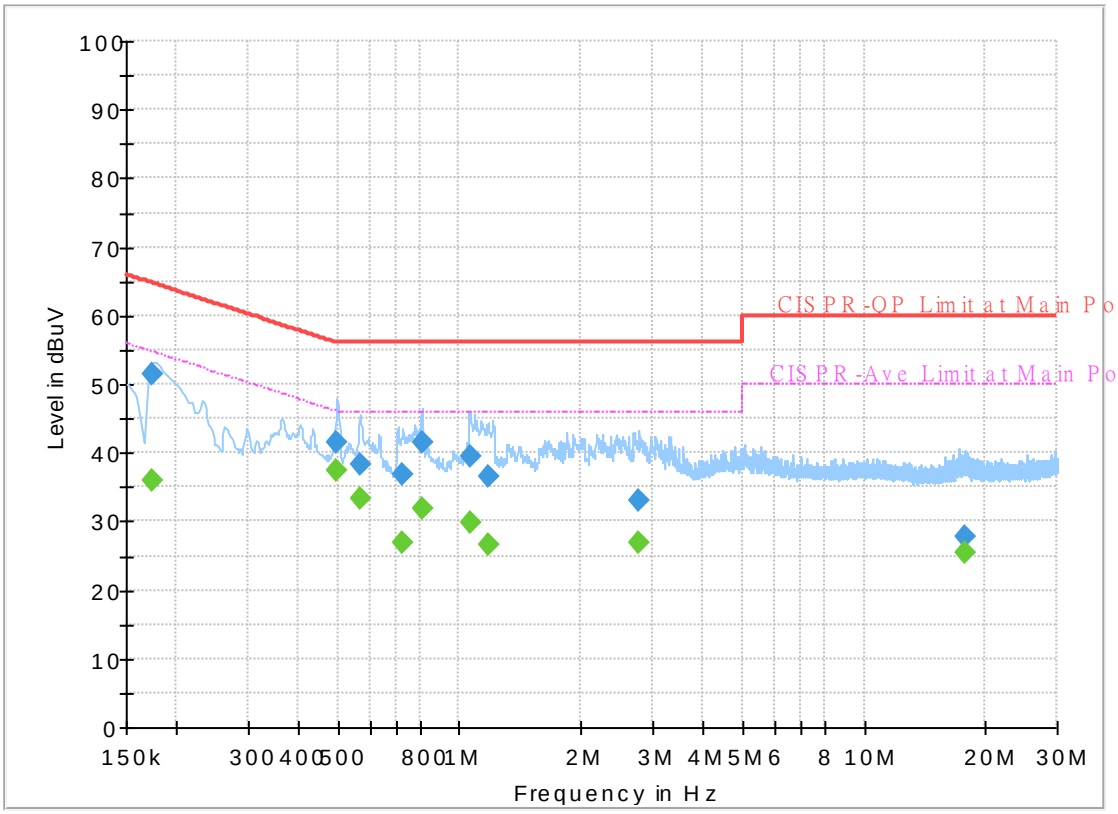
Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.172500	---	35.37	54.84	19.47	L1	OFF	19.7
0.172500	51.19	---	64.84	13.65	L1	OFF	19.7
0.498750	---	37.19	46.02	8.83	L1	OFF	19.9
0.498750	41.42	---	56.02	14.60	L1	OFF	19.9
0.568500	---	33.30	46.00	12.70	L1	OFF	19.9
0.568500	38.21	---	56.00	17.79	L1	OFF	19.9
0.793500	---	30.36	46.00	15.64	L1	OFF	20.1
0.793500	39.83	---	56.00	16.17	L1	OFF	20.1
1.036500	---	29.55	46.00	16.45	L1	OFF	20.3
1.036500	39.60	---	56.00	16.40	L1	OFF	20.3
1.194000	---	28.30	46.00	17.70	L1	OFF	20.3
1.194000	37.99	---	56.00	18.01	L1	OFF	20.3
2.766750	---	27.41	46.00	18.59	L1	OFF	20.2
2.766750	34.06	---	56.00	21.94	L1	OFF	20.2
17.607750	---	25.70	50.00	24.30	L1	OFF	20.5
17.607750	28.31	---	60.00	31.69	L1	OFF	20.5

EUT Information

Report NO :	120337-01
Test Mode :	Mode 1
Test Voltage :	120Vac/60Hz
Phase :	Neutral

Full Spectrum



Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.174750	---	35.87	54.73	18.86	N	OFF	19.7
0.174750	51.40	---	64.73	13.33	N	OFF	19.7
0.498750	---	37.48	46.02	8.54	N	OFF	19.9
0.498750	41.56	---	56.02	14.46	N	OFF	19.9
0.566250	---	33.26	46.00	12.74	N	OFF	20.0
0.566250	38.21	---	56.00	17.79	N	OFF	20.0
0.726000	---	26.80	46.00	19.20	N	OFF	20.1
0.726000	36.87	---	56.00	19.13	N	OFF	20.1
0.809250	---	31.75	46.00	14.25	N	OFF	20.2
0.809250	41.45	---	56.00	14.55	N	OFF	20.2
1.065750	---	29.77	46.00	16.23	N	OFF	20.3
1.065750	39.54	---	56.00	16.46	N	OFF	20.3
1.173750	---	26.61	46.00	19.39	N	OFF	20.3
1.173750	36.61	---	56.00	19.39	N	OFF	20.3
2.782500	---	27.00	46.00	19.00	N	OFF	20.2
2.782500	32.92	---	56.00	23.08	N	OFF	20.2
17.666250	---	25.57	50.00	24.43	N	OFF	20.6
17.666250	27.91	---	60.00	32.09	N	OFF	20.6

Appendix C. Radiated Spurious Emission

Test Engineer :	Bill Chang, Fu Chen, and Troye Hsieh	**Temperature :**	18.2 ~ 21.5°C
		Relative Humidity :	50.2 ~ 69.3%

Lora 902~928MHz

Lora 125KHz FHSS (Band Edge @ 3m)

Loa	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
Lora 125KHz FHSS CH 01 902.2MHz		117.3	37.83	-5.67	43.5	41.65	17.21	11.48	32.51	268	356	QP	H
		299.66	29.53	-16.47	46	29.94	19.19	12.53	32.13	-	-	P	H
		483.96	34.27	-11.73	46	29.5	23.72	13.16	32.11	-	-	P	H
		558.65	36.59	-9.41	46	29.65	26.08	13.46	32.6	-	-	P	H
		870.02	46.31	-55.95	102.26	33.92	29.32	14.39	31.32	-	-	P	H
	*	902.2	122.26	-	-	109.84	29.12	14.49	31.19	152	146	P	H
		934.04	44.47	-57.79	102.26	31.06	29.82	14.57	30.98	-	-	P	H
													H
													H
													H
													H
													H
		44.55	33.65	-6.35	40	38.36	16.88	10.93	32.52	100	8	QP	V
		67.83	28.75	-11.25	40	38.11	12.04	11.13	32.53	-	-	P	V
		150.28	31.47	-12.03	43.5	35.33	16.92	11.74	32.52	-	-	P	V
		832.19	47.9	-51.67	99.57	36.67	28.43	14.27	31.47	-	-	P	V
		870.02	46.58	-52.99	99.57	34.19	29.32	14.39	31.32	-	-	P	V
	*	902.2	119.57	-	-	107.15	29.12	14.49	31.19	116	260	P	V
		934.04	45.23	-54.34	99.57	31.82	29.82	14.57	30.98	-	-	P	V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. Non restricted band limit is radio frequency level down 20db

Lora	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		117.3	37.55	-5.95	43.5	41.37	17.21	11.48	32.51	265	350	QP	H
		157.07	31.08	-12.42	43.5	35.33	16.48	11.79	32.52	-	-	P	H
		441.28	33.66	-12.34	46	29.67	22.93	13	31.94	-	-	P	H
		701.24	37.82	-8.18	46	29.78	26.58	13.84	32.38	-	-	P	H
		882.63	46.49	-52.47	98.96	34.14	29.18	14.44	31.27	-	-	P	H
	*	915	118.96	-	-	106.32	29.21	14.53	31.1	136	153	P	H
		959.26	44.22	-54.74	98.96	29.3	31.11	14.62	30.81	-	-	P	H
													H
													H
													H
Lora													H
500k													H
CH 16		45.55	33.18	-6.82	40	38.41	16.36	10.94	32.53	100	18	QP	V
914.5MHz		117.3	32.21	-11.29	43.5	36.03	17.21	11.48	32.51	-	-	P	V
		481.05	36.05	-9.95	46	31.33	23.67	13.15	32.1	-	-	P	V
		744.89	39.4	-6.6	46	29.47	27.96	14.01	32.04	-	-	P	V
		882.63	46.46	-53.65	100.11	34.11	29.18	14.44	31.27	-	-	P	V
	*	915	120.11	-	-	107.47	29.21	14.53	31.1	110	146	P	V
		946.65	46.33	-53.78	100.11	32.12	30.51	14.6	30.9	-	-	P	V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. Non restricted band limit is radio frequency level down 20db

Lora	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		117.3	37.31	-6.19	43.5	41.13	17.21	11.48	32.51	278	358	QP	H
		341.37	29.67	-16.33	46	28.92	20.04	12.69	31.98	-	-	P	H
		550.89	35.44	-10.56	46	29.22	25.34	13.43	32.55	-	-	P	H
		653.71	37.36	-8.64	46	29.91	26.37	13.71	32.63	-	-	P	H
		896.21	44.55	-54.12	98.67	32.16	29.12	14.49	31.22	-	-	P	H
	*	927.8	118.67	-	-	105.57	29.56	14.56	31.02	139	145	P	H
		956.35	44.27	-54.4	98.67	29.51	30.98	14.61	30.83	-	-	P	H
													H
													H
													H
Lora													H
500k													H
CH 31		45.52	34.64	-5.36	40	39.85	16.38	10.94	32.53	100	13	QP	V
926.5MHz		117.3	32.59	-10.91	43.5	36.41	17.21	11.48	32.51	-	-	P	V
		508.21	35.12	-10.88	46	30.14	23.95	13.27	32.24	-	-	P	V
		571.26	35.8	-10.2	46	28.99	26.01	13.49	32.69	-	-	P	V
		896.21	46.86	-51.31	98.17	34.47	29.12	14.49	31.22	-	-	P	V
	*	927.8	118.17	-	-	105.07	29.56	14.56	31.02	185	179	P	V
		960.23	46.84	-51.33	98.17	31.89	31.14	14.62	30.81	-	-	P	V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. Non restricted band limit is radio frequency level down 20db

Lora 125KHz FHSS (Harmonic @ 3m)

Lora	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
Lora 125KHz FHSS CH 01 902.2MHz		1804.4	54.66	-47.6	102.26	90.35	25.1	7.18	67.97	100	0	P	H
		2706.6	46.35	-27.65	74	76.75	28	8.63	67.03	100	0	P	H
													H
													H
		1804.4	58	-41.57	99.57	93.69	25.1	7.18	67.97	100	0	P	V
		2706.6	49.18	-24.82	74	79.58	28	8.63	67.03	100	226	P	V
		2706.6	51	-3	54	81.4	28	8.63	67.03	100	226	A	V
													V
Lora 125KHz FHSS CH 65 915MHz		1828	52.16	-46.8	98.96	87.79	25.1	7.23	67.96	100	0	P	H
		2745	50.6	-23.4	74	80.93	28	8.69	67.02	100	187	P	H
		2745	49.82	-4.18	54	80.15	28	8.69	67.02	100	187	A	H
													H
		1828	54.39	-45.72	100.11	90.02	25.1	7.23	67.96	100	0	P	V
		2745	52.29	-21.71	74	82.62	28	8.69	67.02	100	261	P	V
		2745	49.6	-4.4	54	79.93	28	8.69	67.02	100	261	A	V
													V
Lora 125KHz FHSS CH 129 927.8MHz		1855.6	45.57	-53.1	98.67	81.09	25.13	7.3	67.95	100	0	P	H
		2783.4	40.03	-33.97	74	70.15	28.13	8.76	67.01	100	0	P	H
													H
													H
		1855.6	46.73	-51.44	98.17	82.25	25.13	7.3	67.95	100	0	P	V
		2783.4	42.88	-31.12	74	73	28.13	8.76	67.01	100	0	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. Non restricted band limit is radio frequency level down 20db												

FSK 902~928MHz

FSK 50Kbps FHSS (Band Edge @ 3m)

Loa	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK 50Kbps FHSS CH 01 902.2MHz		117.3	36.2	-7.3	43.5	40.02	17.21	11.48	32.51	151	4	QP	H
		306.45	29.42	-16.58	46	29.77	19.2	12.56	32.11	-	-	P	H
		471.35	34.54	-11.46	46	30	23.48	13.12	32.06	-	-	P	H
		758.47	39.77	-6.23	46	29.58	28.08	14.04	31.93	-	-	P	H
		870.02	45.72	-55.16	100.88	33.33	29.32	14.39	31.32	-	-	P	H
	*	902.2	120.88	-	-	108.46	29.12	14.49	31.19	150	157	P	H
		934.04	45	-55.88	100.88	31.59	29.82	14.57	30.98	-	-	P	H
													H
													H
													H
													H
													H
		43.58	33.05	-6.95	40	37.36	17.3	10.91	32.52	100	21	QP	V
		116.33	32.39	-11.11	43.5	36.17	17.25	11.48	32.51	-	-	P	V
		557.68	36.07	-9.93	46	29.21	26.01	13.45	32.6	-	-	P	V
		796.3	39.82	-6.18	46	29	28.29	14.16	31.63	-	-	P	V
		870.02	46.03	-56.4	102.43	33.64	29.32	14.39	31.32	-	-	P	V
	*	902.2	122.43	-	-	110.01	29.12	14.49	31.19	113	135	P	V
		934.04	45.8	-56.63	102.43	32.39	29.82	14.57	30.98	-	-	P	V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. Non restricted band limit is radio frequency level down 20db

FSK	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		30	31.71	-8.29	40	29.42	24.06	10.67	32.44	150	3	QP	H
		117.3	36.09	-7.41	43.5	39.91	17.21	11.48	32.51	-	-	P	H
		159.01	31.38	-12.12	43.5	35.73	16.36	11.81	32.52	-	-	P	H
		756.53	39.3	-6.7	46	29.13	28.07	14.04	31.94	-	-	P	H
		882.63	46.09	-54.08	100.17	33.74	29.18	14.44	31.27	-	-	P	H
	*	915	120.17	-	-	107.53	29.21	14.53	31.1	147	163	P	H
		943.74	43.35	-56.82	100.17	29.35	30.32	14.6	30.92	-	-	P	H
													H
													H
													H
													H
													H
		45.52	32.18	-7.82	40	37.39	16.38	10.94	32.53	100	20	QP	V
		117.3	31.18	-12.32	43.5	35	17.21	11.48	32.51	-	-	P	V
		155.13	30.99	-12.51	43.5	35.06	16.67	11.78	32.52	-	-	P	V
		649.83	37.35	-8.65	46	29.89	26.41	13.7	32.65	-	-	P	V
		882.63	47.13	-54.55	101.68	34.78	29.18	14.44	31.27	-	-	P	V
	*	915	121.68	-	-	109.04	29.21	14.53	31.1	112	133	P	V
		946.65	46.8	-54.88	101.68	32.59	30.51	14.6	30.9	-	-	P	V
													V
													V
													V
													V
													V

FSK 50Kbps FHSS CH 65 915MHz

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. Non restricted band limit is radio frequency level down 20db

FSK	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK 50Kbps FHSS CH 129 927.8MHz		30	30.53	-9.47	40	28.24	24.06	0.79	32.44	152	4	QP	H
		117.3	36.29	-7.21	43.5	40.11	17.21	1.64	32.51	-	-	P	H
		157.07	30.73	-12.77	43.5	34.98	16.48	1.93	32.52	-	-	P	H
		802.12	39.72	-6.28	46	28.84	28.29	4.26	31.59	-	-	P	H
		896.21	45.07	-54.17	99.24	32.68	29.12	4.56	31.22	-	-	P	H
	*	927.8	119.24	-	-	106.14	29.56	4.64	31.02	146	158	P	H
		960.23	43.91	-55.33	99.24	28.96	31.14	4.72	30.81	-	-	P	H
													H
													H
													H
													H
													H
		43.58	33.08	-6.92	40	37.39	17.3	1.03	32.52	100	20	QP	V
		117.3	31.95	-11.55	43.5	35.77	17.21	1.64	32.51	-	-	P	V
		154.16	30.64	-12.86	43.5	34.71	16.68	1.91	32.52	-	-	P	V
		747.8	39.8	-6.2	46	29.81	27.99	4.1	32.01	-	-	P	V
		896.21	47.32	-53.17	100.49	34.93	29.12	4.56	31.22	-	-	P	V
	*	927.8	120.49	-	-	107.39	29.56	4.64	31.02	107	137	P	V
		960.23	47.23	-6.77	54	32.28	31.14	4.72	30.81	-	-	P	V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. Non restricted band limit is radio frequency level down 20db

FSK 50Kbps FHSS (Harmonic @ 3m)

FSK	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK 50Kbps FHSS CH 01 902.2MHz		1804.4	55.68	-45.2	100.88	91.37	25.1	7.18	67.97	100	0	P	H
		2706.6	51.45	-22.55	74	81.85	28	8.63	67.03	100	316	P	H
		2706.6	49.73	-4.27	54	80.13	28	8.63	67.03	100	316	A	H
													H
		1804.4	58.68	-43.75	102.43	94.37	25.1	7.18	67.97	100	0	P	V
		2706.6	49.89	-24.11	74	80.29	28	8.63	67.03	100	151	P	V
		2706.6	48.81	-5.19	54	79.21	28	8.63	67.03	100	151	A	V
													V
FSK 50Kbps FHSS CH 65 915MHz		1830	55.76	-44.41	100.17	91.38	25.1	7.24	67.96	100	0	P	H
		2745	41.44	-32.56	74	71.77	28	8.69	67.02	100	0	P	H
													H
													H
		1830	57.42	-44.26	101.68	93.04	25.1	7.24	67.96	100	0	P	V
		2745	44.84	-29.16	74	75.17	28	8.69	67.02	100	0	P	V
													V
													V
FSK 50Kbps FHSS CH 129 927.8MHz		1855.6	49.02	-50.22	99.24	84.54	25.13	7.3	67.95	100	0	P	H
		2783.4	43.99	-30.01	74	74.11	28.13	8.76	67.01	100	0	P	H
													H
													H
		1855.6	49.93	-50.56	100.49	85.45	25.13	7.3	67.95	100	0	P	V
		2783.4	48.72	-25.28	74	78.84	28.13	8.76	67.01	100	0	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. Non restricted band limit is radio frequency level down 20db												

FSK 902~928MHz

FSK 150Kbps FHSS (Band Edge @ 3m)

Loa	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK 150Kbps FHSS CH 01 902.4MHz		30	30.73	-9.27	40	28.44	24.06	10.67	32.44	150	4	QP	H
		117.3	36.21	-7.29	43.5	40.03	17.21	11.48	32.51	-	-	P	H
		154.16	31.32	-12.18	43.5	35.39	16.68	11.77	32.52	-	-	P	H
		758.47	39.71	-6.29	46	29.52	28.08	14.04	31.93	-	-	P	H
		870.02	45.16	-55.22	100.38	32.77	29.32	14.39	31.32	-	-	P	H
	*	902.4	120.38	-	-	107.94	29.12	14.5	31.18	148	149	P	H
		951.5	43.38	-57	100.38	28.89	30.75	14.61	30.87	-	-	P	H
													H
													H
													H
													H
													H
		45.52	32.68	-7.32	40	37.89	16.38	10.94	32.53	100	23	QP	V
		117.3	31.05	-12.45	43.5	34.87	17.21	11.48	32.51	-	-	P	V
		155.13	30.86	-12.64	43.5	34.93	16.67	11.78	32.52	-	-	P	V
		686.69	37.98	-8.02	46	30.05	26.59	13.8	32.46	-	-	P	V
		870.02	44.68	-57.94	102.62	32.29	29.32	14.39	31.32	-	-	P	V
	*	902.4	122.62	-	-	110.18	29.12	14.5	31.18	112	136	P	V
		934.04	45.06	-57.56	102.62	31.65	29.82	14.57	30.98	-	-	P	V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. Non restricted band limit is radio frequency level down 20db

FSK	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK 150Kbps FHSS CH 32 914.8MHz		30	30.91	-9.09	40	28.62	24.06	10.67	32.44	151	2	QP	H
		117.3	36.27	-7.23	43.5	40.09	17.21	11.48	32.51	-	-	P	H
		156.1	31.2	-12.3	43.5	35.35	16.58	11.79	32.52	-	-	P	H
		736.16	39.23	-6.77	46	29.62	27.75	13.96	32.1	-	-	P	H
		882.63	44.62	-55.52	100.14	32.27	29.18	14.44	31.27	-	-	P	H
	*	914.8	120.14	-	-	107.5	29.21	14.53	31.1	142	153	P	H
		946.65	43.32	-56.82	100.14	29.11	30.51	14.6	30.9	-	-	P	H
													H
													H
													H
													H
													H
		44.55	32.73	-7.27	40	37.44	16.88	10.93	32.52	100	23	QP	V
		117.3	30.69	-12.81	43.5	34.51	17.21	11.48	32.51	-	-	P	V
		152.22	32.44	-11.06	43.5	36.52	16.69	11.75	32.52	-	-	P	V
		727.43	39.37	-6.63	46	30.18	27.42	13.94	32.17	-	-	P	V
		882.63	47.73	-54.34	102.07	35.38	29.18	14.44	31.27	-	-	P	V
	*	914.8	122.07	-	-	109.43	29.21	14.53	31.1	111	138	P	V
		946.65	45.5	-56.57	102.07	31.29	30.51	14.6	30.9	-	-	P	V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. Non restricted band limit is radio frequency level down 20db

FSK	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK 150Kbps FHSS CH 64 927.6MHz		33.88	30.13	-9.87	40	29.56	22.28	10.76	32.47	152	4	QP	H
		117.3	36.21	-7.29	43.5	40.03	17.21	11.48	32.51	-	-	P	H
		157.07	30.68	-12.82	43.5	34.93	16.48	11.79	32.52	-	-	P	H
		757.5	39.98	-6.02	46	29.8	28.08	14.04	31.94	-	-	P	H
		895.24	44.43	-54.37	98.8	32.05	29.11	14.49	31.22	-	-	P	H
	*	927.6	118.8	-	-	105.7	29.56	14.56	31.02	148	148	P	H
		958.29	43.24	-55.56	98.8	28.38	31.06	14.62	30.82	-	-	P	H
													H
													H
													H
													H
													H
		43.58	33.16	-6.84	40	37.47	17.3	10.91	32.52	100	21	QP	V
		118.27	30.6	-12.9	43.5	34.39	17.23	11.49	32.51	-	-	P	V
		153.19	30.04	-13.46	43.5	34.16	16.63	11.77	32.52	-	-	P	V
		749.74	39.17	-6.83	46	29.14	28.01	14.02	32	-	-	P	V
		895.24	47.34	-53.27	100.61	34.96	29.11	14.49	31.22	-	-	P	V
	*	927.6	120.61	-	-	107.51	29.56	14.56	31.02	111	138	P	V
		959.26	46.18	-54.43	100.61	31.26	31.11	14.62	30.81	-	-	P	V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. Non restricted band limit is radio frequency level down 20db

FSK 150Kbps FHSS (Harmonic @ 3m)

FSK	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK 150Kbps FHSS CH 01 902.4MHz		1804.8	55.93	-44.45	100.38	91.62	25.1	7.18	67.97	100	0	P	H
		2707.2	42.63	-31.37	74	73.03	28	8.63	67.03	100	0	P	H
													H
													H
		1804.8	58.45	-44.17	102.62	94.14	25.1	7.18	67.97	100	0	P	V
		2707.2	45.12	-28.88	74	75.52	28	8.63	67.03	100	0	P	V
													V
													V
FSK 150Kbps FHSS CH 32 914.8MHz		1829.6	57.93	-42.21	100.14	93.55	25.1	7.24	67.96	100	0	P	H
		2744.4	45.96	-28.04	74	76.29	28	8.69	67.02	100	0	P	H
													H
													H
		1829.6	58.39	-43.68	102.07	94.01	25.1	7.24	67.96	100	0	P	V
		2744.4	48.63	-25.37	74	78.96	28	8.69	67.02	100	0	P	V
													V
													V
FSK 150Kbps FHSS CH 64 927.6MHz		1855.2	47.73	-51.07	98.8	83.25	25.13	7.3	67.95	100	0	P	H
		2782.8	41.56	-32.44	74	71.68	28.13	8.76	67.01	100	0	P	H
													H
													H
		1855.2	48.9	-51.71	100.61	84.42	25.13	7.3	67.95	100	0	P	V
		2782.8	44.19	-29.81	74	74.31	28.13	8.76	67.01	100	0	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. Non restricted band limit is radio frequency level down 20db												

FSK 915~928MHz

FSK 250Kbps FHSS (Band Edge @ 3m)

Loa	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK 250Kbps FHSS CH 01 902.5MHz		117.3	36.15	-7.35	43.5	39.97	17.21	11.48	32.51	149	10	QP	H
		416.06	33.02	-12.98	46	29.4	22.51	12.95	31.84	-	-	P	H
		556.71	36.42	-9.58	46	29.62	25.94	13.45	32.59	-	-	P	H
		740.04	39.84	-6.16	46	29.98	27.94	13.99	32.07	-	-	P	H
		853.53	42.56	-57.3	99.86	30.41	29.2	14.34	31.39	-	-	P	H
	*	902.5	119.86	-	-	107.42	29.12	14.5	31.18	151	157	P	H
		956.35	43.99	-55.87	99.86	29.23	30.98	14.61	30.83	-	-	P	H
													H
													H
													H
													H
													H
		45.55	32.56	-7.44	40	37.79	16.36	10.94	32.53	100	18	QP	V
		117.3	32.38	-11.12	43.5	36.2	17.21	11.48	32.51	-	-	P	V
		561.56	36.61	-9.39	46	29.6	26.17	13.46	32.62	-	-	P	V
		667.29	38.27	-7.73	46	30.71	26.37	13.75	32.56	-	-	P	V
		870.02	44.92	-55.55	100.47	32.53	29.32	14.39	31.32	-	-	P	V
	*	902.5	120.47	-	-	108.03	29.12	14.5	31.18	100	144	P	V
		934.04	45.2	-55.27	100.47	31.79	29.82	14.57	30.98	-	-	P	V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. Non restricted band limit is radio frequency level down 20db

FSK	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK 250Kbps FHSS CH 25 915MHz		30.97	31	-9	40	28.97	23.79	10.69	32.45	-	-	QP	H
		117.3	36.35	-7.15	43.5	40.17	17.21	11.48	32.51	152	5	P	H
		157.07	31.72	-11.78	43.5	35.97	16.48	11.79	32.52	-	-	P	H
		760.41	40.19	-5.81	46	29.96	28.09	14.05	31.91	-	-	P	H
		882.63	44.56	-55.56	100.12	32.21	29.18	14.44	31.27	-	-	P	H
	*	915	120.12	-	-	107.48	29.21	14.53	31.1	139	151	P	H
		957.32	42.86	-57.26	100.12	28.05	31.02	14.62	30.83	-	-	P	H
													H
													H
													H
													H
													H
		44.55	32.59	-7.41	40	37.3	16.88	10.93	32.52	100	25	QP	V
		65.89	27.98	-12.02	40	37.56	11.83	11.12	32.53	-	-	P	V
		156.1	30.28	-13.22	43.5	34.43	16.58	11.79	32.52	-	-	P	V
		744.89	39.73	-6.27	46	29.8	27.96	14.01	32.04	-	-	P	V
		882.63	43.68	-57.51	101.19	31.33	29.18	14.44	31.27	-	-	P	V
	*	915	121.19	-	-	108.55	29.21	14.53	31.1	111	125	P	V
		946.65	42.92	-58.27	101.19	28.71	30.51	14.6	30.9	-	-	P	V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. Non restricted band limit is radio frequency level down 20db

FSK	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK 250Kbps FHSS CH 51 927.5MHz		117.3	36	-7.5	43.5	39.82	17.21	11.48	32.51	149	19	QP	H
		182.29	30.49	-13.01	43.5	36.27	14.74	12.01	32.53	-	-	P	H
		552.83	35.66	-10.34	46	29.22	25.56	13.44	32.56	-	-	P	H
		720.64	39.15	-6.85	46	30.37	27.1	13.91	32.23	-	-	P	H
		895.24	43.35	-55.35	98.7	30.97	29.11	14.49	31.22	-	-	P	H
	*	927.5	118.7	-	-	105.6	29.56	14.56	31.02	138	150	P	H
		939.86	43.06	-55.64	98.7	29.43	29.98	14.59	30.94	-	-	P	H
													H
													H
													H
													H
													H
		45.55	33.2	-6.8	40	38.43	16.36	10.94	32.53	100	20	QP	V
		117.3	33.78	-9.72	43.5	37.6	17.21	11.48	32.51	-	-	P	V
		445.16	33.87	-12.13	46	29.81	23.01	13.01	31.96	-	-	P	V
		763.32	39.17	-6.83	46	28.89	28.12	14.05	31.89	-	-	P	V
		895.24	46.81	-52.8	99.61	34.43	29.11	14.49	31.22	-	-	P	V
	*	927.5	119.61	-	-	106.51	29.56	14.56	31.02	100	121	P	V
		950.53	43.85	-55.76	99.61	29.41	30.7	14.61	30.87	-	-	P	V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. Non restricted band limit is radio frequency level down 20db

FSK 250KBps FHSS (Harmonic @ 3m)

FSK	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK 250Kbps FHSS CH 01 902.5MHz		1805	52.14	-47.72	99.86	87.83	25.1	7.18	67.97	100	0	P	H
		2707.5	47.19	-26.81	74	77.59	28	8.63	67.03	100	0	P	H
													H
													H
		1805	56.83	-43.64	100.47	92.52	25.1	7.18	67.97	100	0	P	V
		2707.5	44.65	-29.35	74	75.05	28	8.63	67.03	100	0	P	V
													V
													V
FSK 250Kbps FHSS CH 25 915MHz		1830	56.58	-43.54	100.12	92.2	25.1	7.24	67.96	100	0	P	H
		2745	42.08	-31.92	74	72.41	28	8.69	67.02	100	0	P	H
													H
													H
		1830	57.7	-43.49	101.19	93.32	25.1	7.24	67.96	100	0	P	V
		2745	45.64	-28.36	74	75.97	28	8.69	67.02	100	0	P	V
													V
													V
FSK 250Kbps FHSS CH 51 927.5MHz		1855	48.92	-49.78	98.7	84.44	25.13	7.3	67.95	100	0	P	H
		2782.5	47.44	-26.56	74	77.56	28.13	8.76	67.01	100	0	P	H
													H
													H
		1855	52.83	-46.78	99.61	88.35	25.13	7.3	67.95	100	0	P	V
		2782.5	53.25	-20.75	74	83.37	28.13	8.76	67.01	100	45	P	V
		2782.5	49.92	-4.08	54	80.04	28.13	8.76	67.01	100	45	A	V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. Non restricted band limit is radio frequency level down 20db												

Note symbol

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

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

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

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

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

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

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

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

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

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

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

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

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

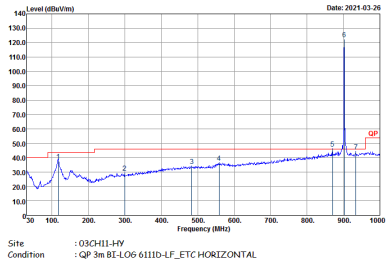
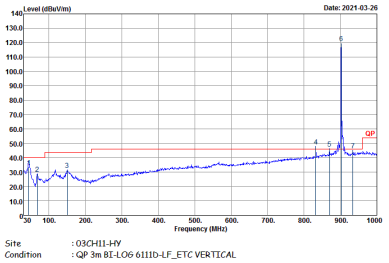
Both peak and average measured complies with the limit line, so test result is “PASS”.

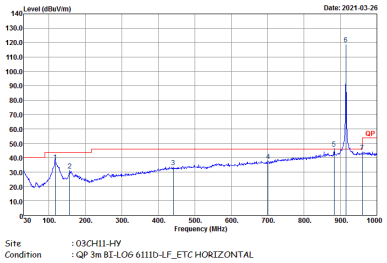
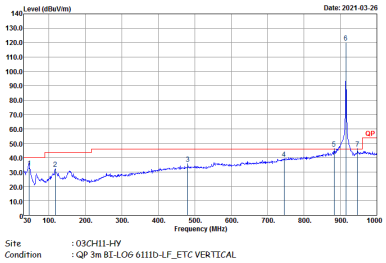
Appendix D. Radiated Spurious Emission Plots

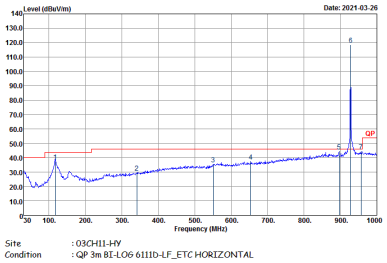
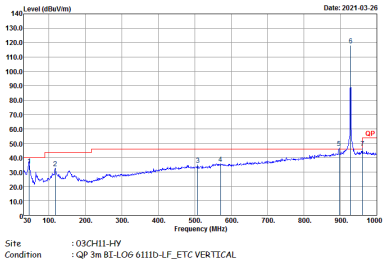
Test Engineer :	Bill Chang, Fu Chen, and Troye Hsieh	Temperature :	18.2 ~ 21.5°C
		Relative Humidity :	50.2 ~ 69.3%

Lora 902~928MHz

Lora 125KHz FHSS (Band Edge @ 3m)

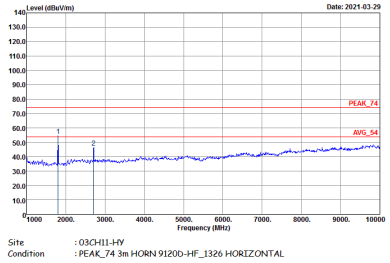
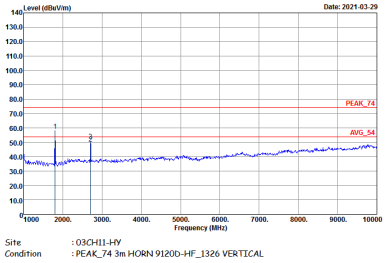
Lora	Lora 902~928MHz	
	Lora 125KHz FHSS Ch01 902.2MHz	
	Horizontal	Vertical
QP / Peak		

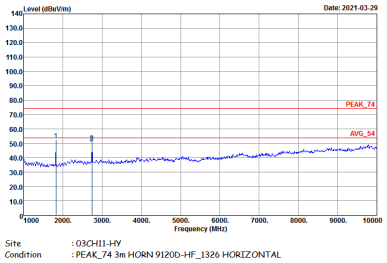
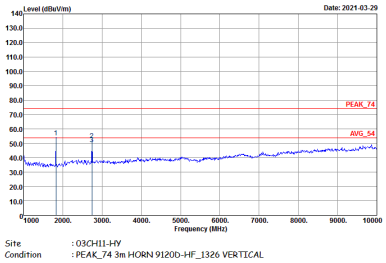
Lora	Lora 902~928MHz	
	Lora 125KHz FHSS Ch65 902 MHz	
	Horizontal	Vertical
QP / Peak		

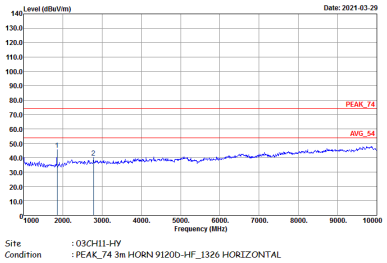
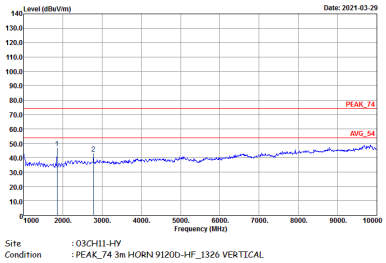
Lora	Lora 902~928MHz	
	Lora 125KHz FHSS Ch129 927.8 MHz	
	Horizontal	Vertical
Peak Avg.		

Lora 902~928MHz

Lora 125KHz FHSS (Harmonic @ 3m)

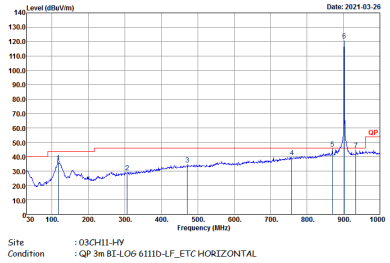
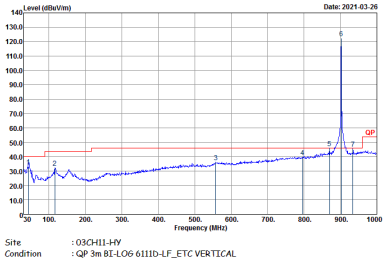
Lora	Lora 902~928MHz	
	Lora 125KHz FHSS Ch01 902.2Mhz	
	Horizontal	Vertical
Peak Avg.		

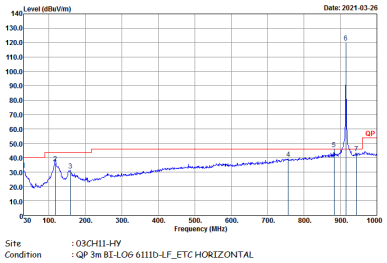
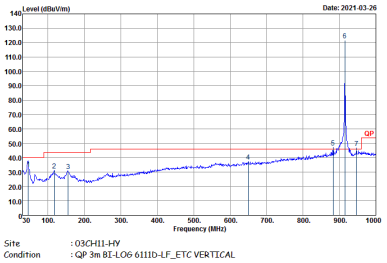
Lora	Lora 902~928MHz	
	Lora 125KHz FHSS Ch65 902Mhz	
	Horizontal	Vertical
Peak Avg.		

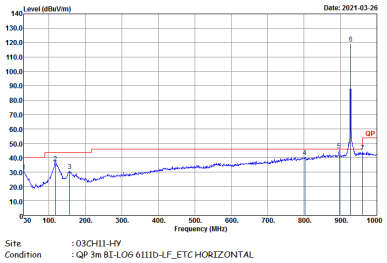
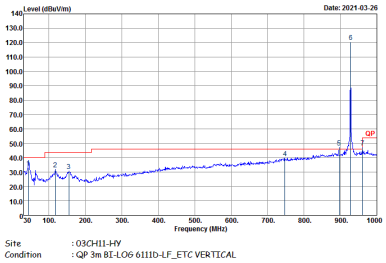
Lora	Lora 902~928MHz	
	Lora 125KHz FHSS Ch129 927.8Mhz	
	Horizontal	Vertical
Peak Avg.		

FSK 902~928MHz

FSK 50Kbps FHSS (Band Edge @ 3m)

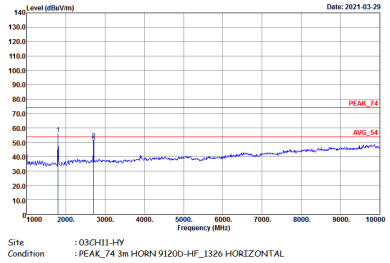
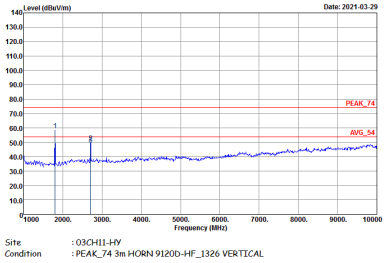
FSK	FSK 902~928MHz	
	FSK 50Kbps FHSS Ch01 902.2Mhz	
	Horizontal	Vertical
QP / Peak		

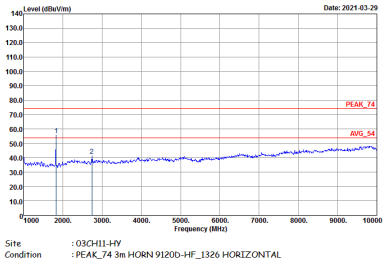
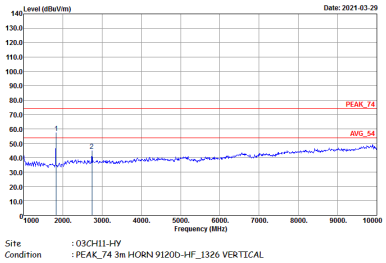
FSK	FSK 902~928MHz	
	FSK 50Kbps FHSS Ch65 902Mhz	
	Horizontal	Vertical
QP / Peak		

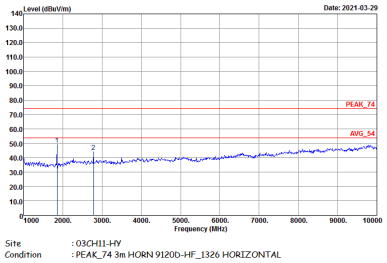
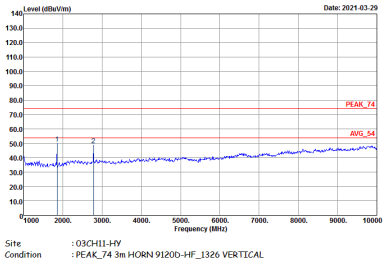
FSK	FSK 902~928MHz	
	FSK 50Kbps FHSS Ch129 927.6Mhz	
	Horizontal	Vertical
Peak Avg.		

FSK 902~928MHz

FSK 50Kbps FHSS (Harmonic @ 3m)

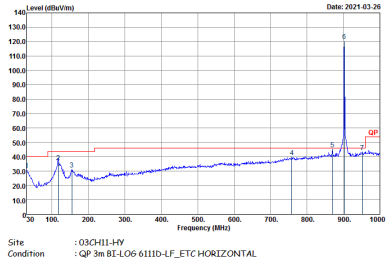
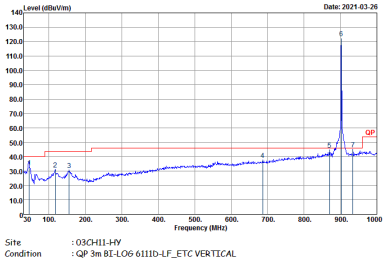
FSK	FSK 902~928MHz	
	FSK 50Kbps FHSS Ch01 902.2Mhz	
	Horizontal	Vertical
Peak Avg.		

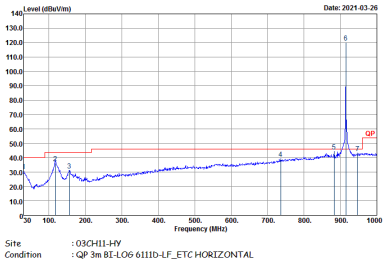
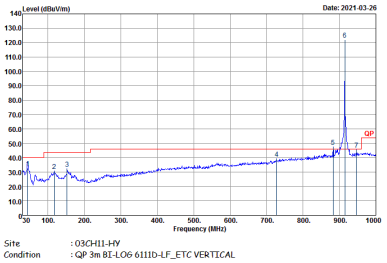
FSK	FSK 902~928MHz	
	FSK 50Kbps FHSS Ch65 902Mhz	
	Horizontal	Vertical
Peak Avg.		

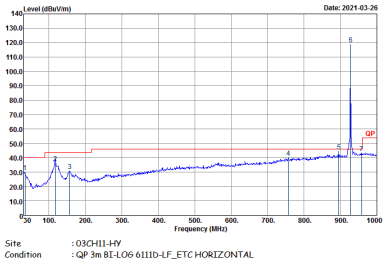
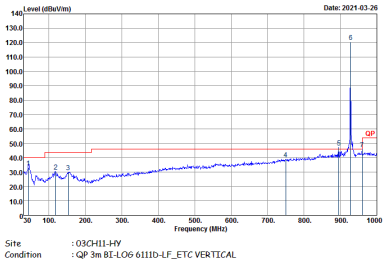
FSK	FSK 902~928MHz	
	FSK 50Kbps FHSS Ch129 927.8Mhz	
	Horizontal	Vertical
Peak Avg.		

FSK 902~928MHz

FSK 150Kbps FHSS (Band Edge @ 3m)

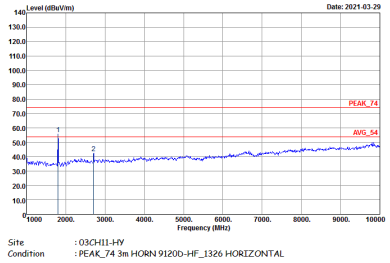
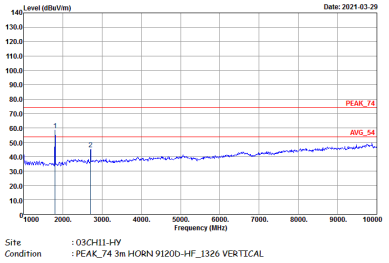
FSK	FSK 902~928MHz	
	FSK 150Kbps FHSS Ch01 902.4Mhz	
	Horizontal	Vertical
QP / Peak		

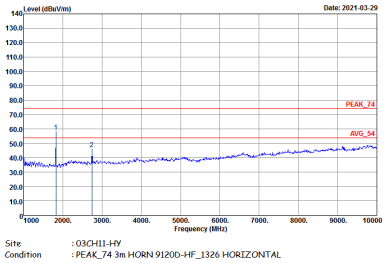
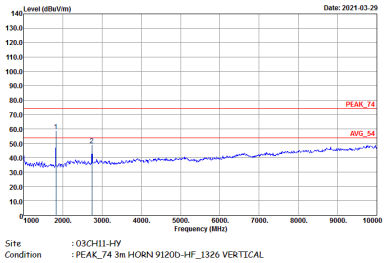
FSK	FSK 902~928MHz	
	FSK 150Kbps FHSS Ch32 914.8Mhz	
	Horizontal	Vertical
QP / Peak		

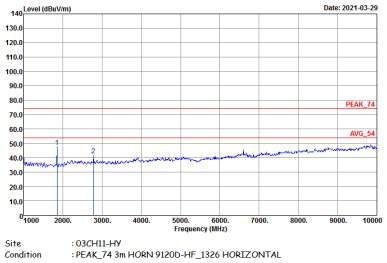
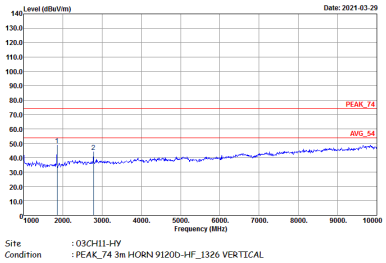
FSK	FSK 902~928MHz	
	FSK 150Kbps FHSS Ch64 927.6Mhz	
	Horizontal	Vertical
Peak Avg.		

FSK 902~928MHz

FSK 50Kbps FHSS (Harmonic @ 3m)

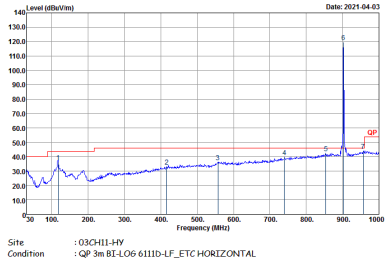
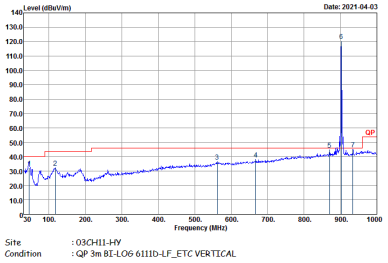
FSK	FSK 902~928MHz	
	FSK 150Kbps FHSS Ch01 902.4Mhz	
	Horizontal	Vertical
Peak Avg.		

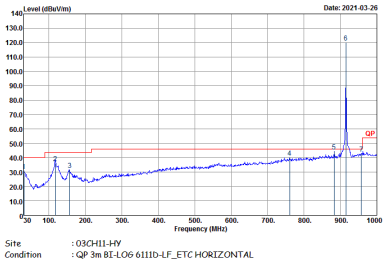
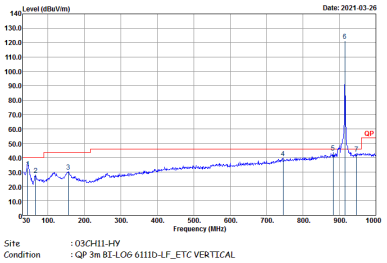
FSK	FSK 902~928MHz	
	FSK 150Kbps FHSS Ch32 914.8Mhz	
	Horizontal	Vertical
Peak Avg.		

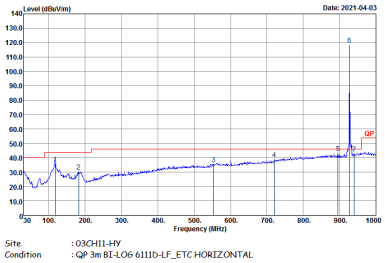
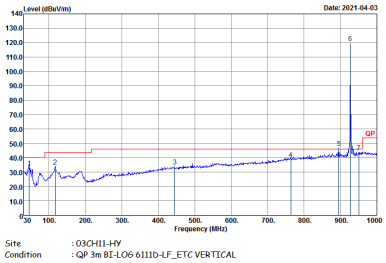
FSK	FSK 902~928MHz	
	FSK 150Kbps FHSS Ch64 927.6Mhz	
	Horizontal	Vertical
Peak Avg.		

FSK 902~928MHz

FSK 250Kbps FHSS (Band Edge @ 3m)

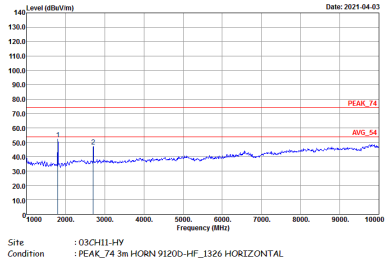
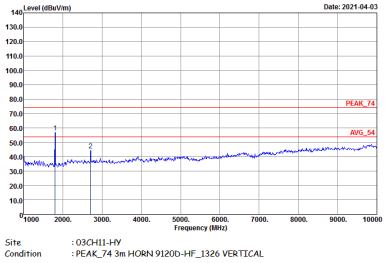
FSK	FSK 902~928MHz	
	FSK 250Kbps FHSS Ch01 902.5Mhz	
	Horizontal	Vertical
QP / Peak		

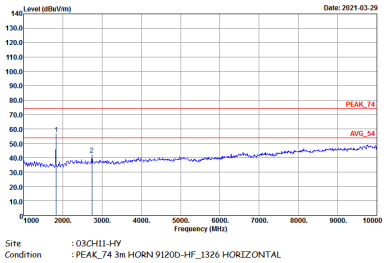
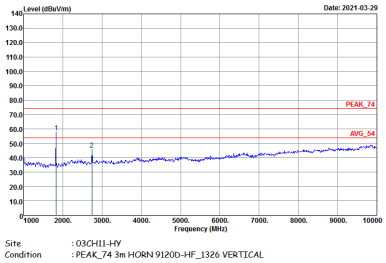
FSK	FSK 902~928MHz	
	FSK 250Kbps FHSS Ch26 915Mhz	
	Horizontal	Vertical
QP / Peak		

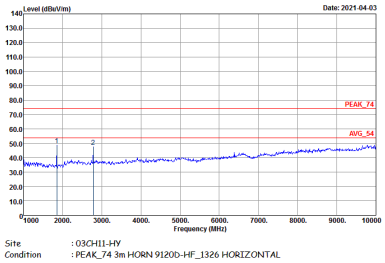
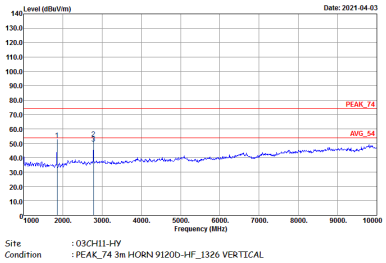
FSK	FSK 902~928MHz	
	FSK 250Kbps FHSS Ch51 927.5Mhz	
	Horizontal	Vertical
Peak Avg.		

FSK 902~928MHz

FSK 250Kbps FHSS (Harmonic @ 3m)

FSK	FSK 902~928MHz	
	FSK 250Kbps FHSS Ch01 902.5Mhz	
	Horizontal	Vertical
Peak Avg.		

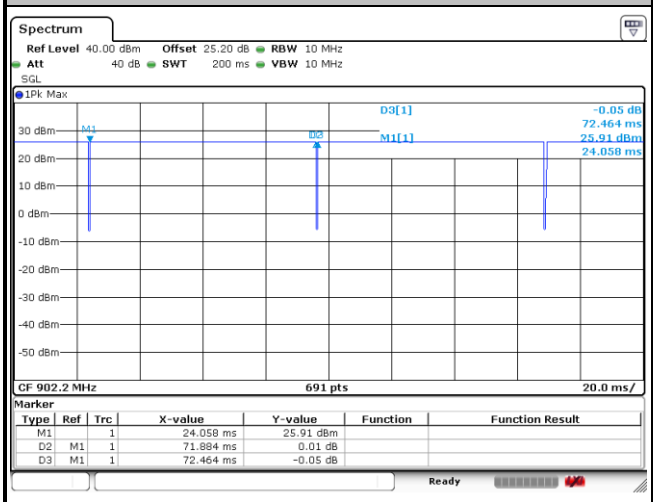
FSK	FSK 902~928MHz	
	FSK 250Kbps FHSS Ch26 915Mhz	
	Horizontal	Vertical
Peak Avg.		

FSK	FSK 902~928MHz	
	FSK 250Kbps FHSS Ch51 927.5Mhz	
	Horizontal	Vertical
Peak Avg.		

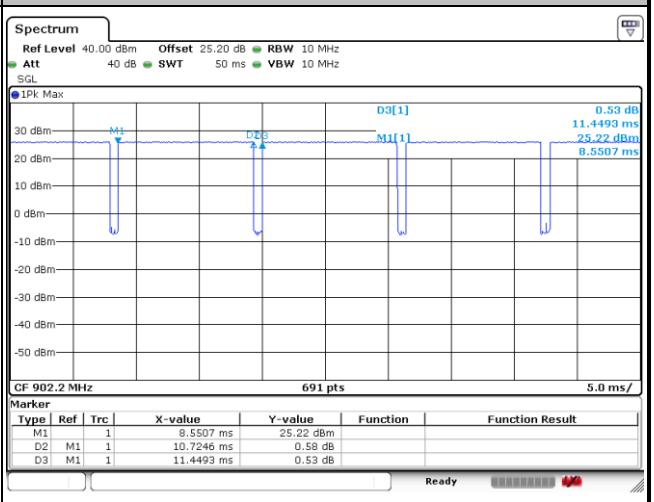
Appendix E. Duty Cycle Plots

Band	Duty Cycle (%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor (dB)
LoRa FHSS	99.20	-	-	10Hz	0.03
FSK 50Kbps FHSS	12.44	10724.6	0.09	1 kHz	9.05
FSK 150Kbps FHSS	83.22	3594.2	0.28	1 kHz	0.80
FSK 250Kbps FHSS	75.38	2173.9	0.46	1 kHz	1.23

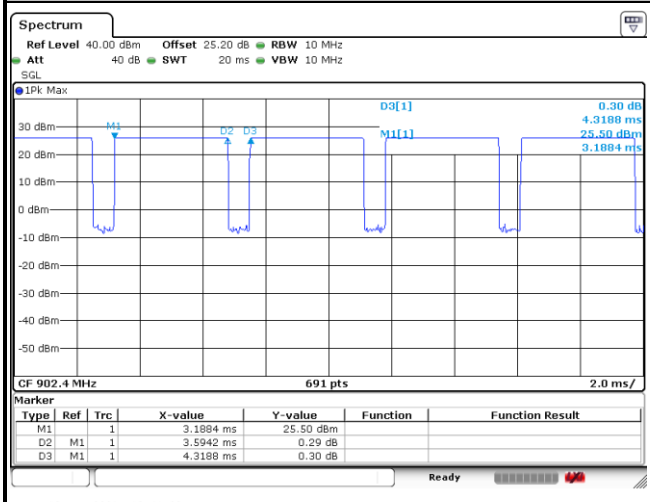
LoRa FHSS



FSK 50Kbps FHSS



FSK 150Kbps FHSS



FSK 250Kbps FHSS