FCC RADIO TEST REPORT

FCC ID	:	**2AUPE-8959**
Equipment	:	**Digital Media Receiver**
Model Name	:	**T4E4AT**
Applicant	:	**Turley White LLC 35 Village Road, Suite 100 Middleton, MA 01949 United States**
Standard	:	**FCC Part 15 Subpart C §15.247**

The product was received on May 07, 2020 and testing was started from Jun. 22, 2020 and completed on Jul. 15, 2020. We, SPORTON INTERNATIONAL INC., EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

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

Louis Wu

Reviewed by: Louis Wu

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

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History of this test report

Report No.	Version	Description	Issued Date
FR020110-01H	01	Initial issue of report	Jul. 22, 2020
FR020110-01H	02	Revise connection diagram of test system	Jul. 28, 2020

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)
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
3.9	15.207	AC Conducted Emission	Pass
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

Product Feature	
Equipment	Digital Media Receiver
Model Name	T4E4AT
FCC ID	2AUPE-8959
EUT supports Radios application	WLAN 11b/g/n HT20 WLAN 11a/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE Zigbee/FSK/LoRa

1.2 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	LoRa FHSS: 902.2 MHz ~ 927.8 MHz FSK 50Kbps FHSS: 902.2 MHz ~ 927.8 MHz FSK 150Kbps FHSS: 902.4 MHz ~ 927.6 MHz FSK 250Kbps FHSS: 902.5 MHz ~ 927.5 MHz
Number of Channels	LoRa FHSS: 129 FSK 50Kbps FHSS: 129 FSK 150Kbps FHSS: 64 FSK 250Kbps FHSS: 51
Maximum Output Power to Antenna	LoRa FHSS: 18.56 (0.0718 W) FSK 50Kbps FHSS: 18.64 (0.0731 W) FSK 150Kbps FHSS: 18.64 (0.0731 W) FSK 250Kbps FHSS: 18.65 (0.0733 W)
99% Occupied Bandwidth	LoRa FHSS: 0.127 FSK 50Kbps FHSS: 0.103 FSK 150Kbps FHSS: 0.155 FSK 250Kbps FHSS: 0.252
Antenna Type / Gain	Inverted F type Antenna with gain -0.48 dBi
Type of Modulation	LoRa FHSS: LoRa FSK 50Kbps FHSS: FSK FSK 150Kbps FHSS: FSK FSK 250Kbps FHSS: FSK

1.3 Modification of EUT

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

1.4 Testing Location

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

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

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	03CH16-HY

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

FCC designation No.: TW1190 and TW0007

1.5 Applicable Standards

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

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

Remark:

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

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

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.

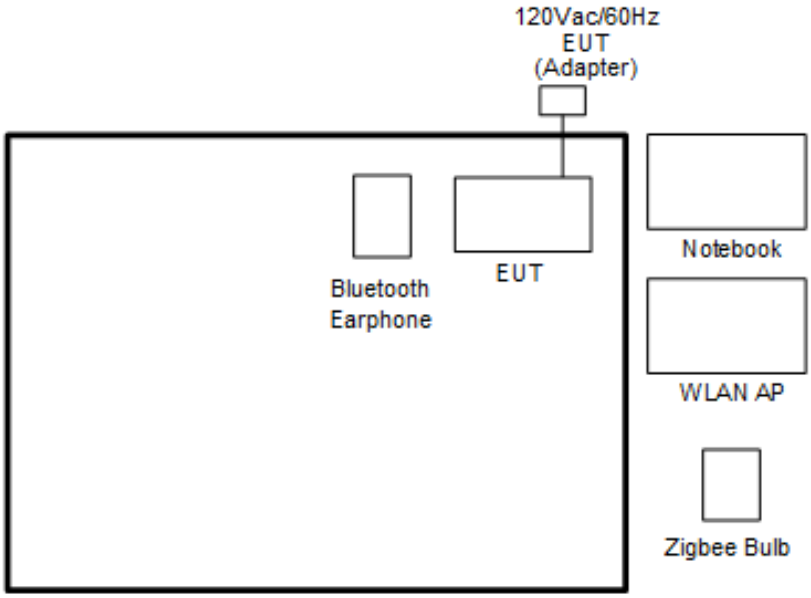
The following summary table is showing all test modes to demonstrate in compliance with the standard.

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

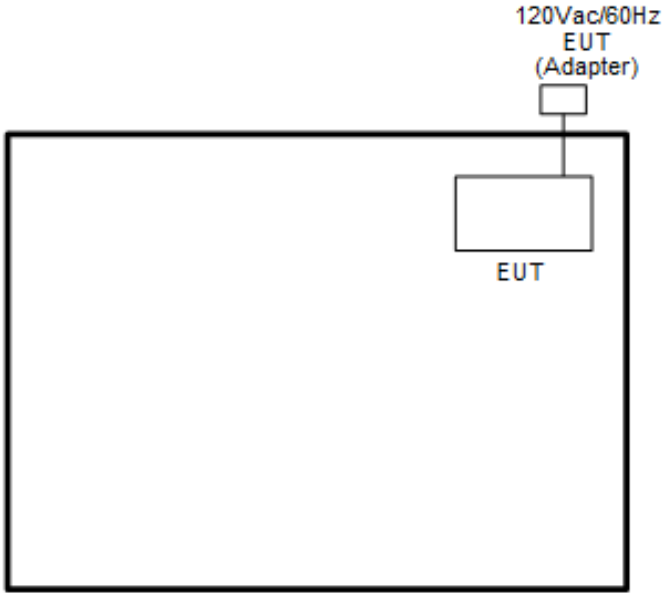
Summary table of Test Cases	
AC Conducted Emission	Mode 1: WLAN (2.4GHz) Link + Bluetooth Link + Zigbee Link + Motor + Adapter + H-Pattern + Audio + Display 40 Mode 2: Lora Tx + Adapter + Display 40
Remark: The worst case of conducted emission is mode 2; only the test data of it was reported.	

2.3 Connection Diagram of Test System

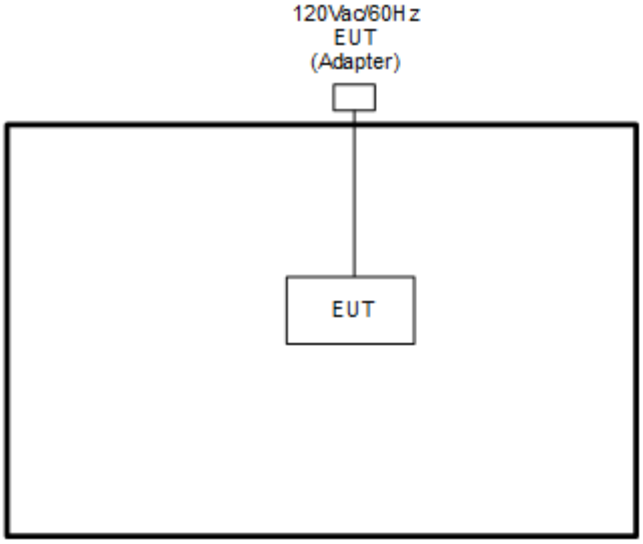
<AC Conducted Emission with WLAN(2.4GHz)/Bluetooth/Zigbee Mode>



<AC Conducted Emission Lora Tx Mode>



<LoRa and FSK Tx Mode>



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	ASUS	RT-AC66U	MSQ-RTAC66U	N/A	Unshielded,1.8m
2.	Notebook	DELL	Latitude E3400	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
3.	Zigbee Bulb	OSRAM	73674	DZO-IQHOME	N/A	N/A
4.	Bluetooth Earphone	Sony Ericsson	MW600	PY700A2029	N/A	N/A

2.5 EUT Operation Test Setup

The RF test items, utility “Compliance v1.0.0.87” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

2.6 Measurement Results Explanation Example

For all conducted test items:

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

Example:

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

Offset = RF cable loss + attenuator factor.

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

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

= 4.2 + 10 = 14.2 (dB)

3 Test Result

3.1 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.

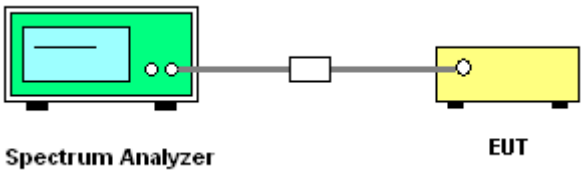
3.1.2 Measuring Instruments

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

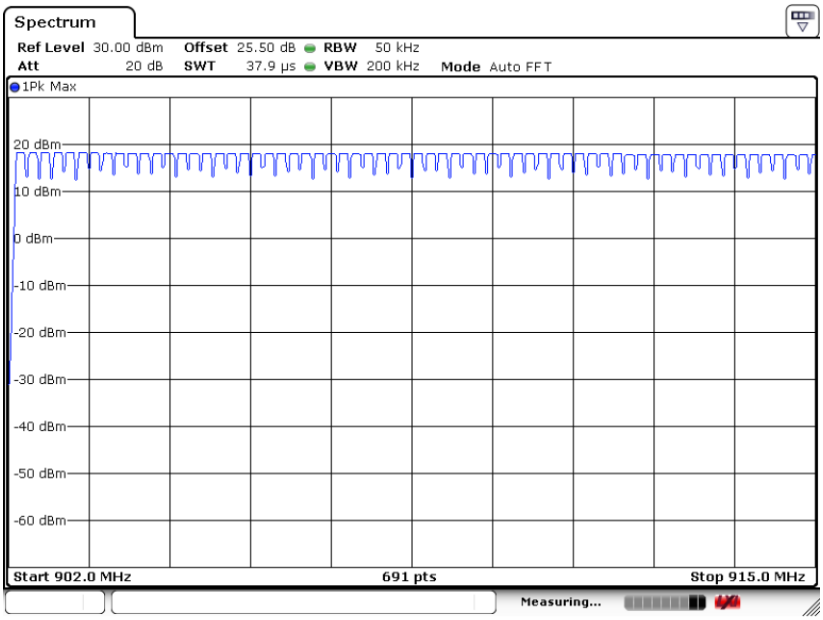


3.1.5 Test Result of Number of Hopping Frequency

Please refer to Appendix A.

<LoRa FHSS>

Number of Hopping Channel Plot on Channel 1 - 129



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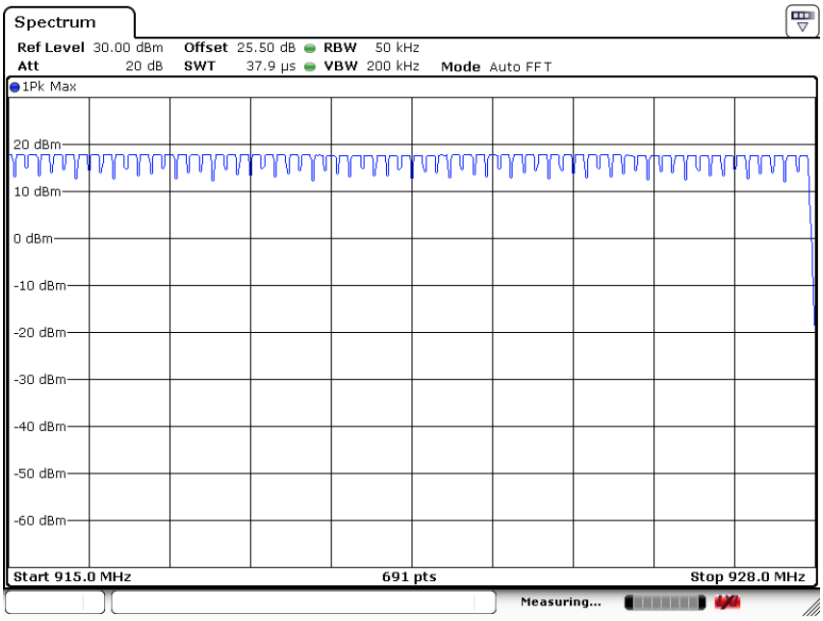
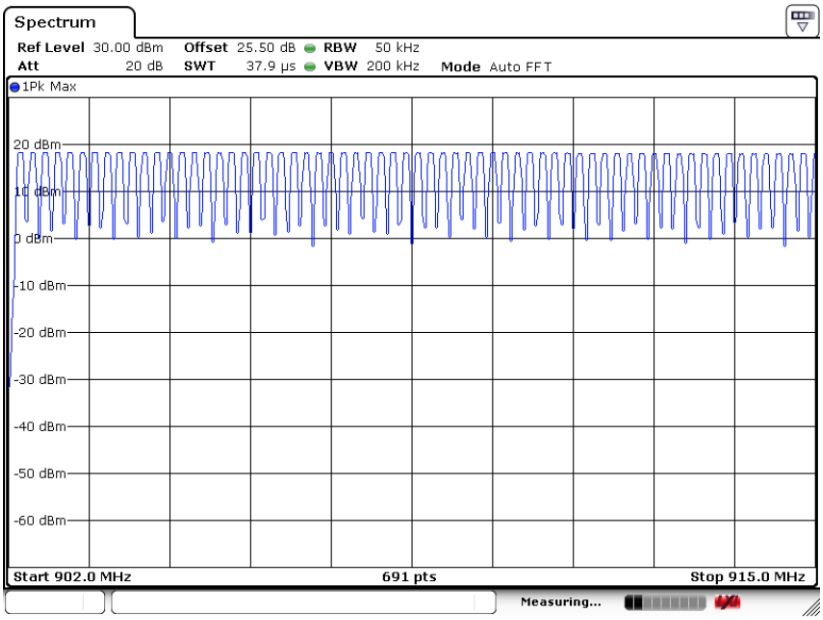


Date: 14.JUL.2020 12:05:47

<FSK 50Kbps FHSS>

Number of Hopping Channel Plot on Channel 1 - 129



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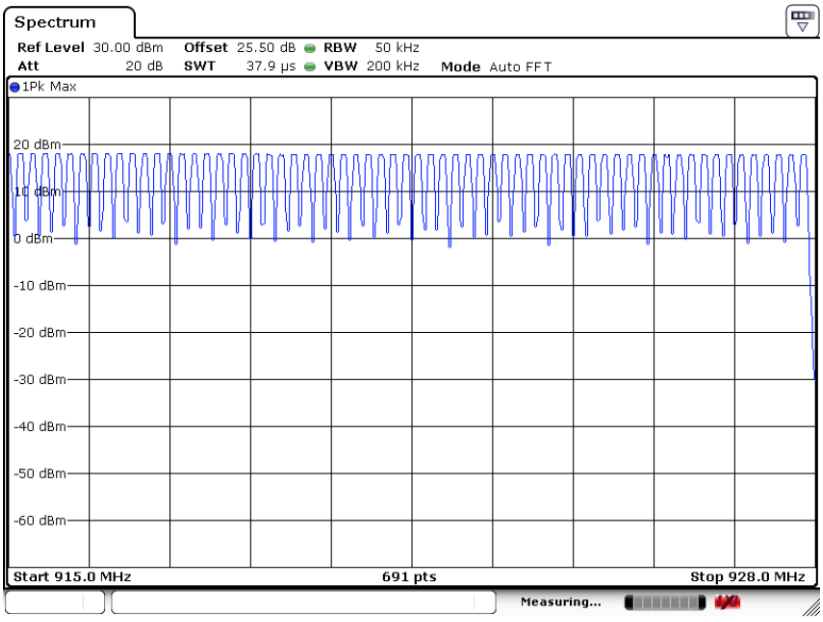

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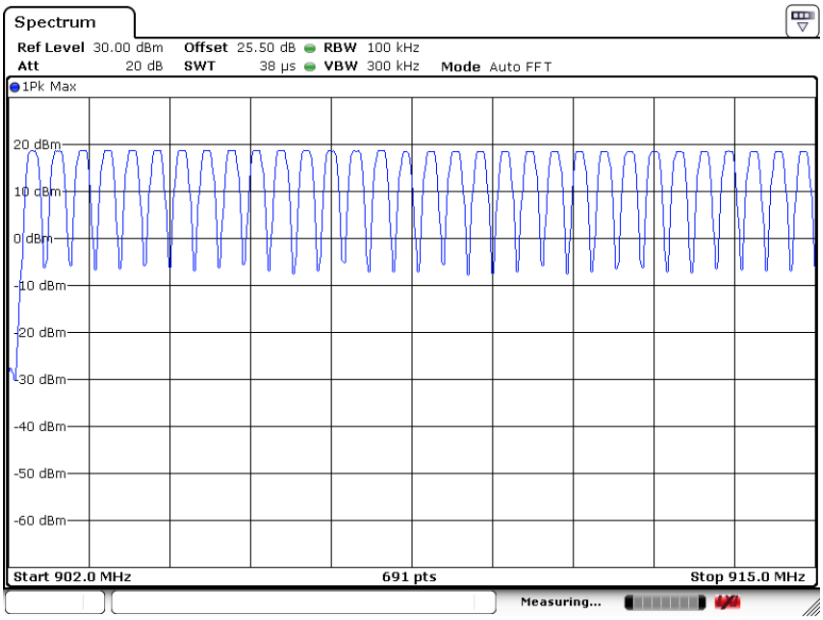
<FSK 150Kbps FHSS>

Number of Hopping Channel Plot on Channel 1 - 64



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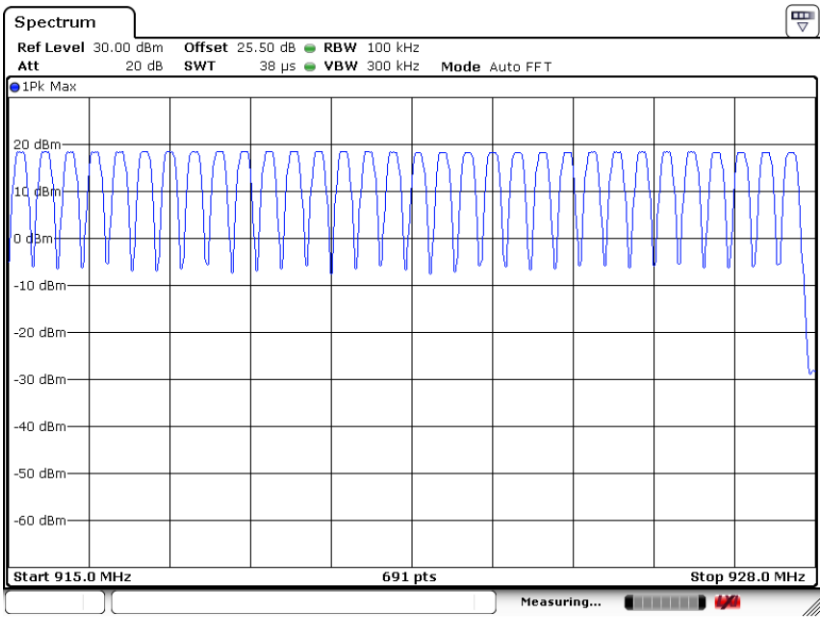
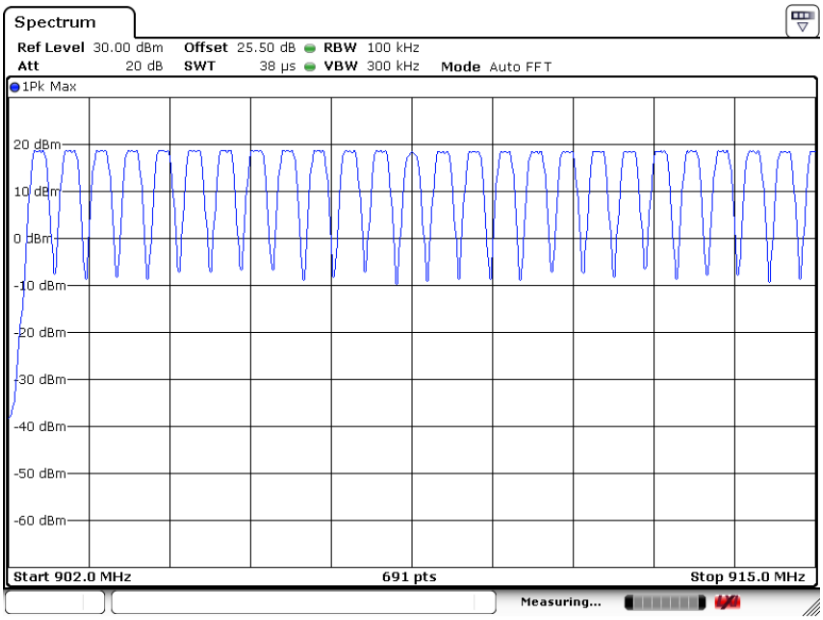


Date: 15.JUL.2020 17:48:57

<FSK 250Kbps FHSS>

Number of Hopping Channel Plot on Channel 1 - 51



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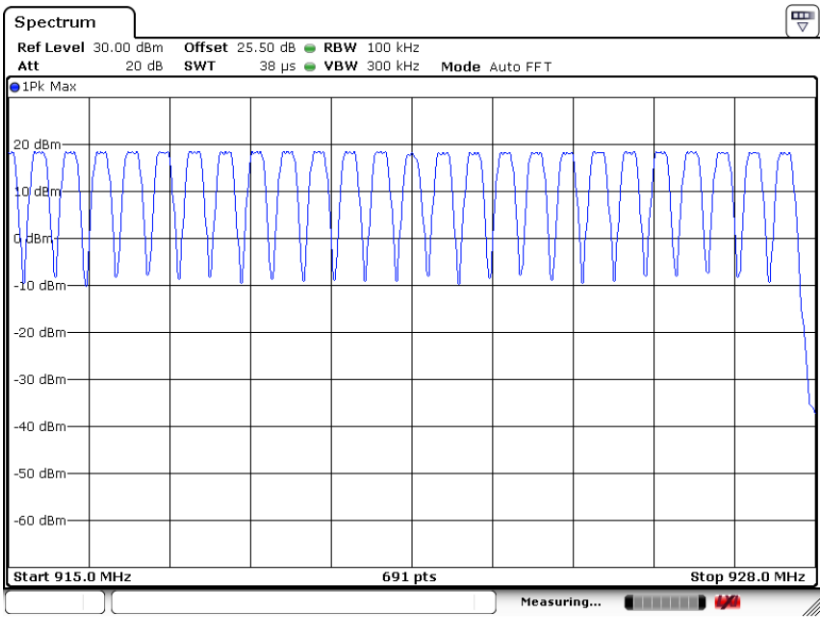


Date: 15.JUL.2020 20:57:00

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.

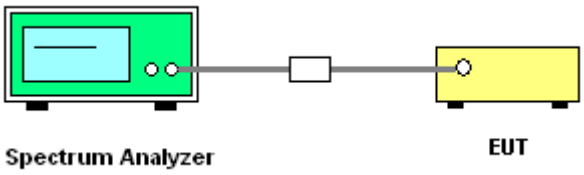
3.2.2 Measuring Instruments

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

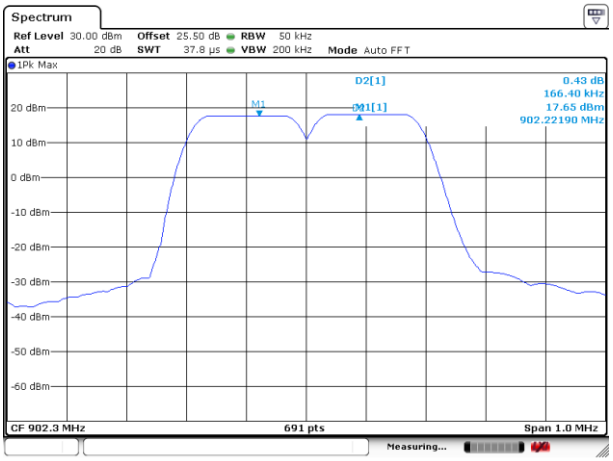


3.2.5 Test Result of Hopping Channel Separation

Please refer to Appendix A.

<LoRa FHSS>

Channel Separation Plot on Channel 01 - 02



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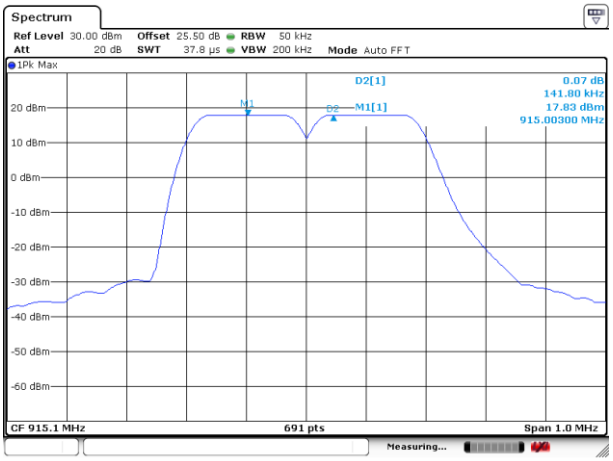
Channel Separation Plot on Channel 65 - 66



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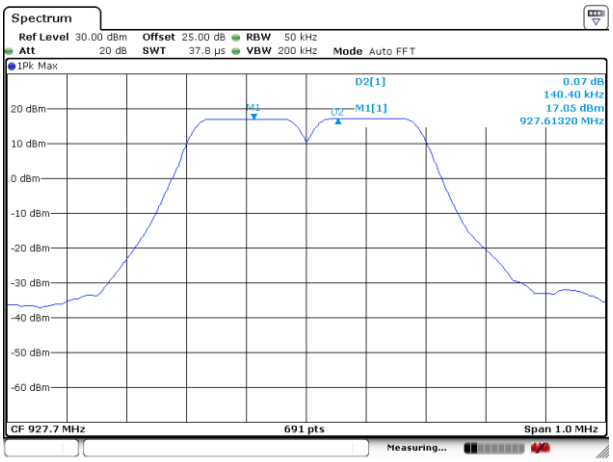
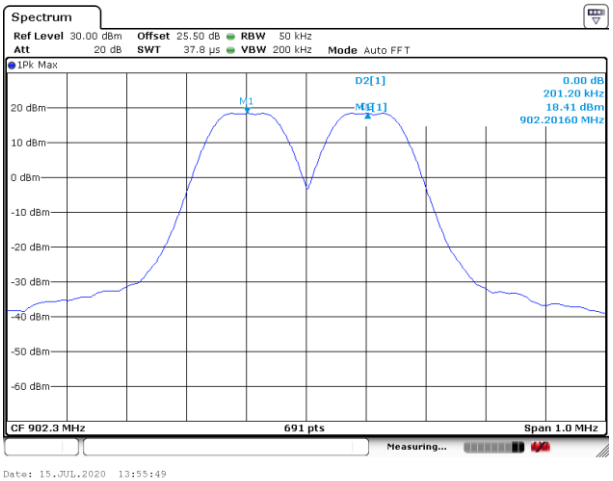
Channel Separation Plot on Channel 128 - 129



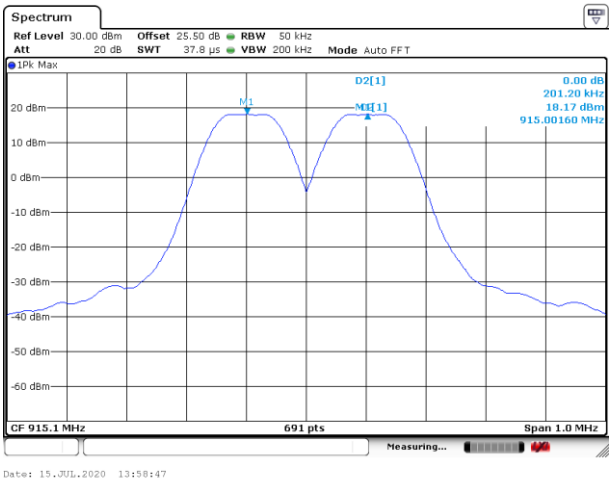
Date: 14.JUL.2020 16:17:20

<FSK 50Kbps FHSS>

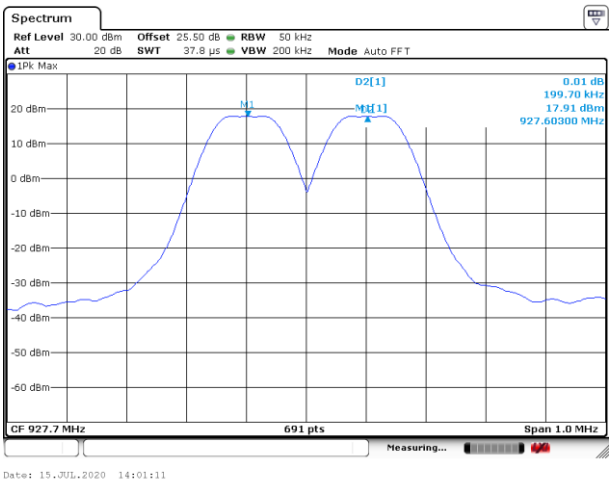
Channel Separation Plot on Channel 01 - 02



Channel Separation Plot on Channel 65 - 66

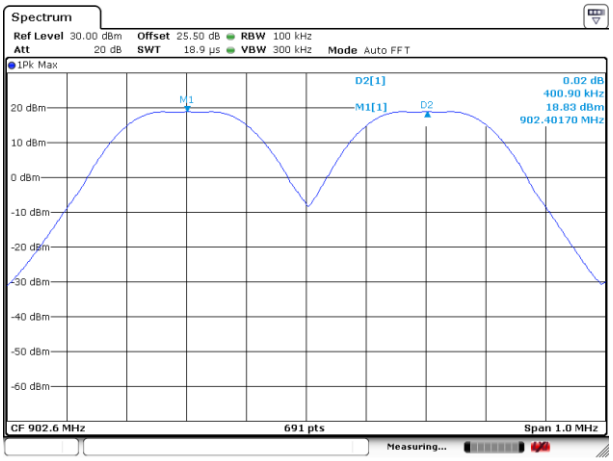


Channel Separation Plot on Channel 128 - 129



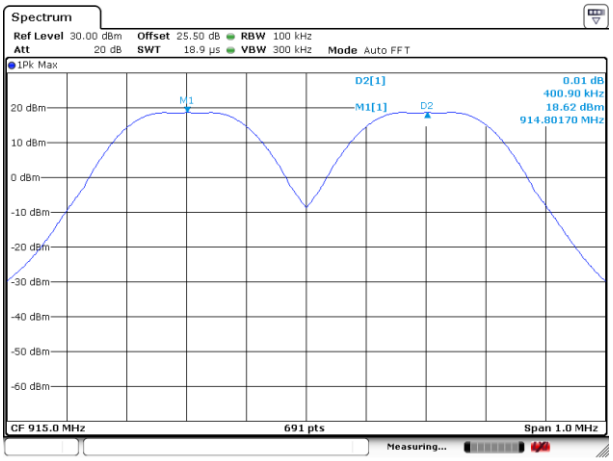
<FSK 150Kbps FHSS>

Channel Separation Plot on Channel 01 - 02



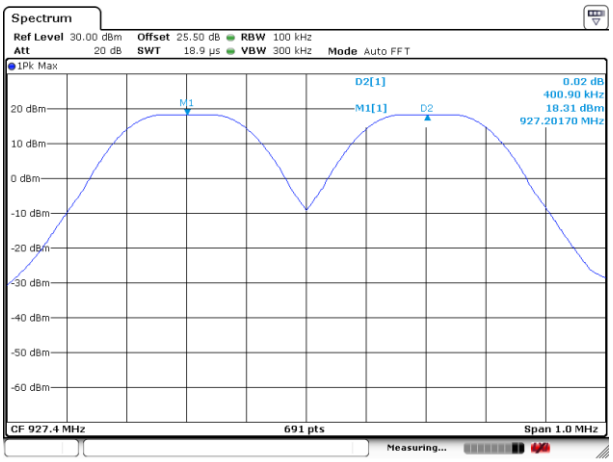
Date: 15.JUL.2020 18:07:11

Channel Separation Plot on Channel 32 -33



Date: 15.JUL.2020 18:16:28

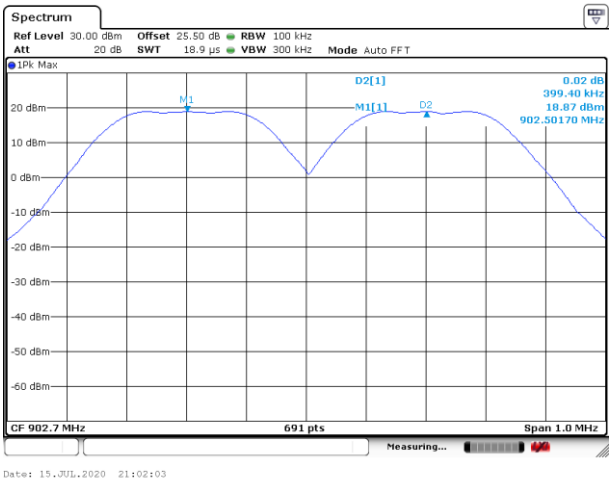
Channel Separation Plot on Channel 63 - 64



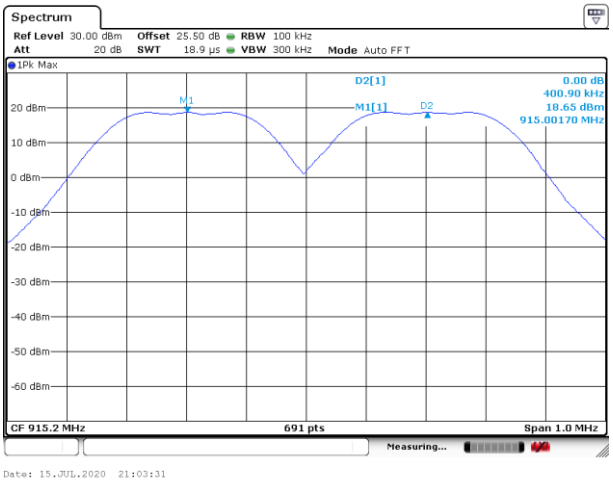
Date: 15.JUL.2020 18:18:43

<FSK 250Kbps FHSS>

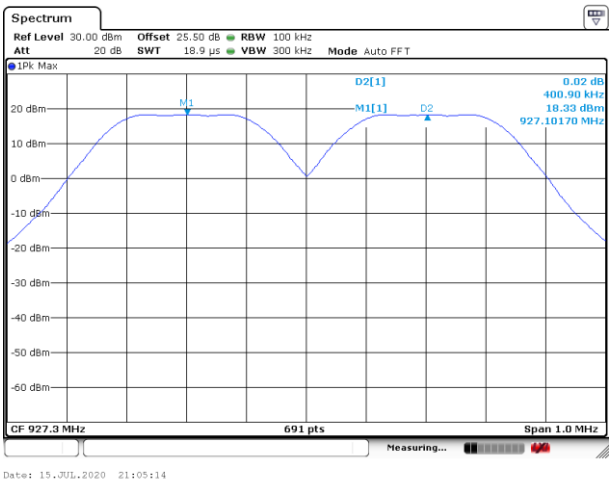
Channel Separation Plot on Channel 01 -02



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.

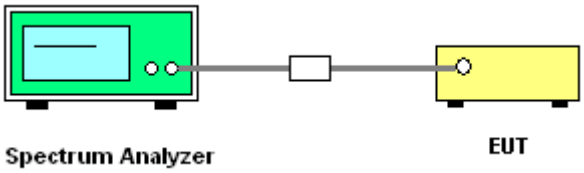
3.3.2 Measuring Instruments

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

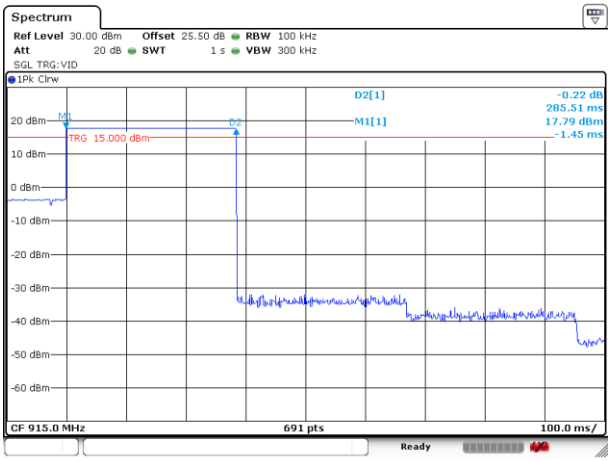


3.3.5 Test Result of Dwell Time

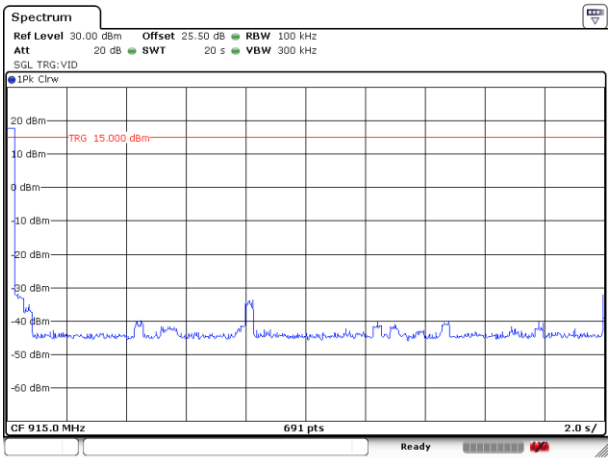
Please refer to Appendix A.

Package Transfer Time Plot

<LoRa FHSS>



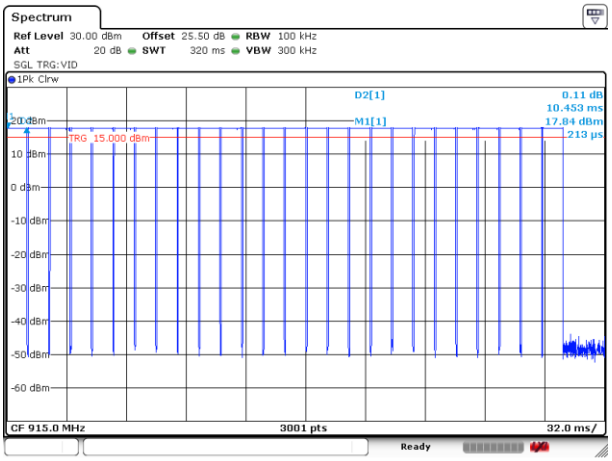
Date: 14.JUL.2020 20:06:52



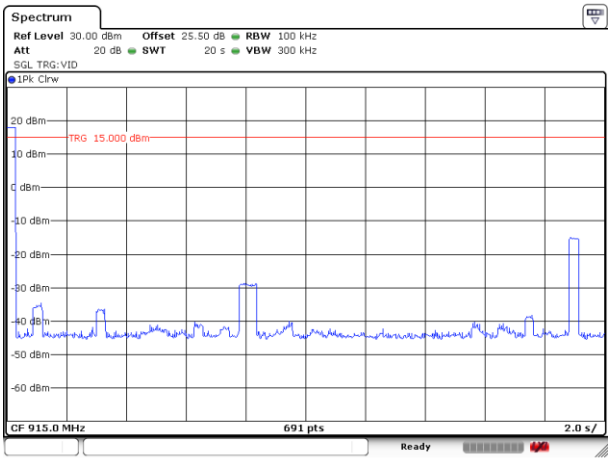
Date: 14.JUL.2020 20:00:43

Package Transfer Time Plot

<FSK 50Kbps FHSS>



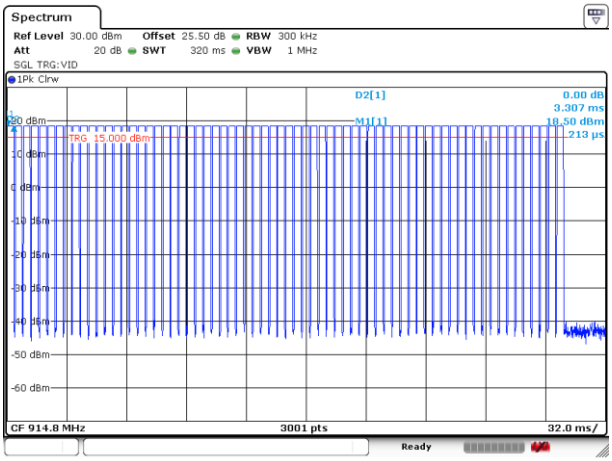
Date: 15.JUL.2020 14:59:44



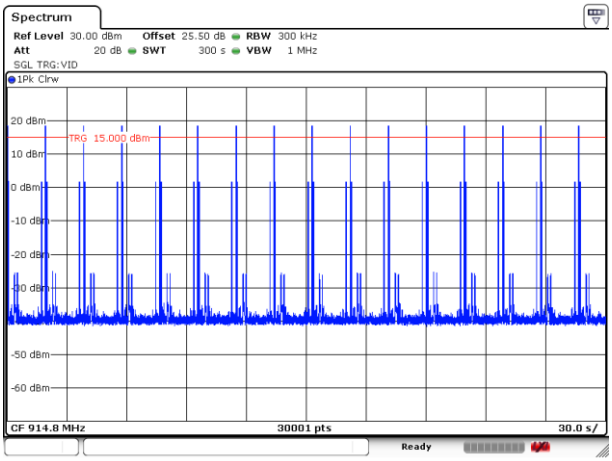
Date: 15.JUL.2020 14:53:20

Package Transfer Time Plot

<FSK 150Kbps FHSS>



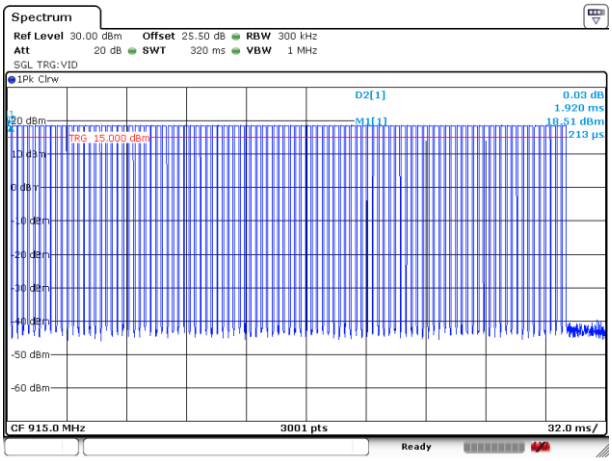
Date: 15.JUL.2020 19:29:53



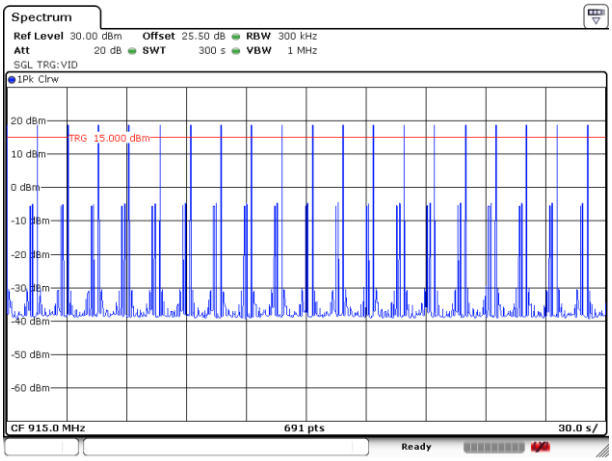
Date: 15.JUL.2020 19:27:21

Package Transfer Time Plot

<FSK 250Kbps FHSS>



Date: 15.JUL.2020 21:31:30



Date: 15.JUL.2020 21:29:28

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.

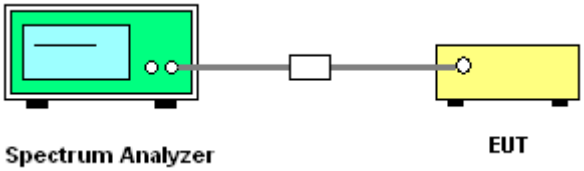
3.4.2 Measuring Instruments

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

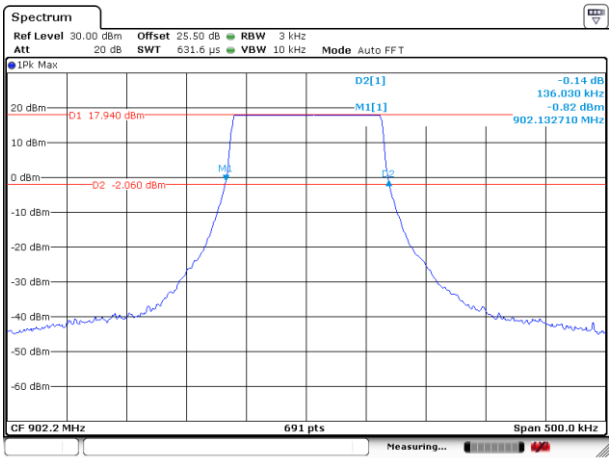


3.4.5 Test Result of 20dB Bandwidth

Please refer to Appendix A.

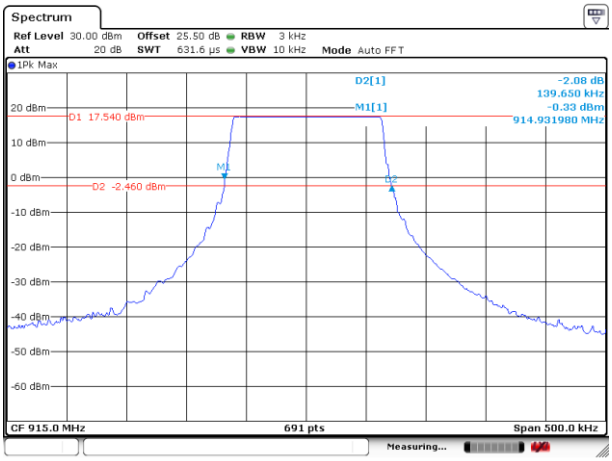
<LoRa FHSS>

20 dB Bandwidth Plot on Channel 01



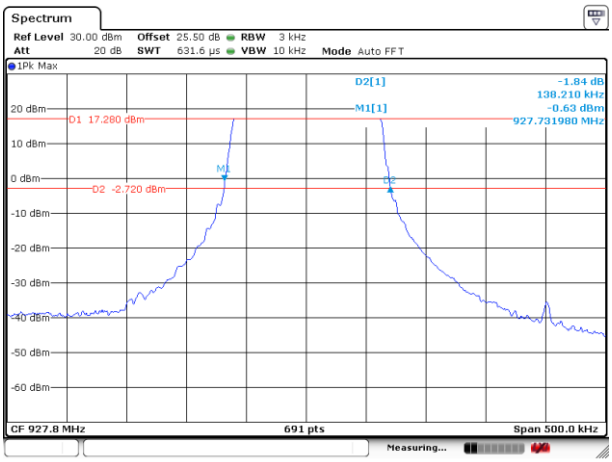
Date: 14.JUL.2020 11:39:30

20 dB Bandwidth Plot on Channel 65



Date: 14.JUL.2020 11:06:51

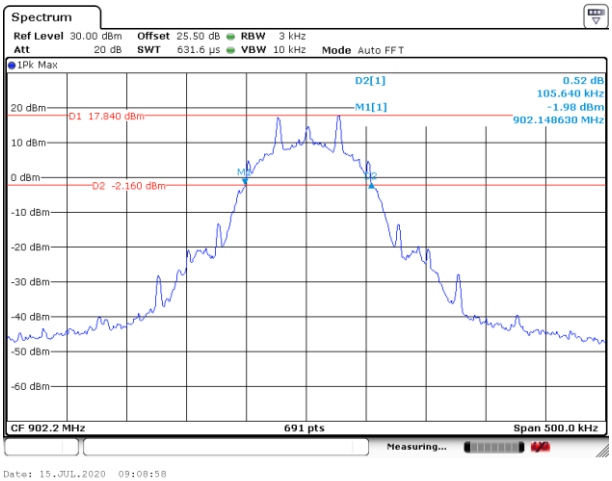
20 dB Bandwidth Plot on Channel 129



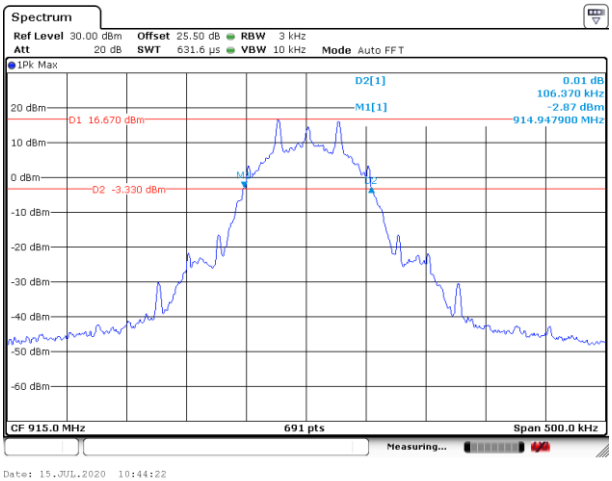
Date: 14.JUL.2020 11:32:46

<FSK 50Kbps FHSS>

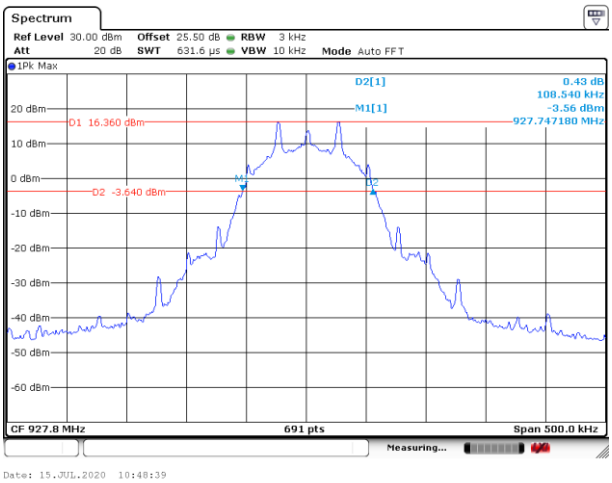
20 dB Bandwidth Plot on Channel 01



20 dB Bandwidth Plot on Channel 65

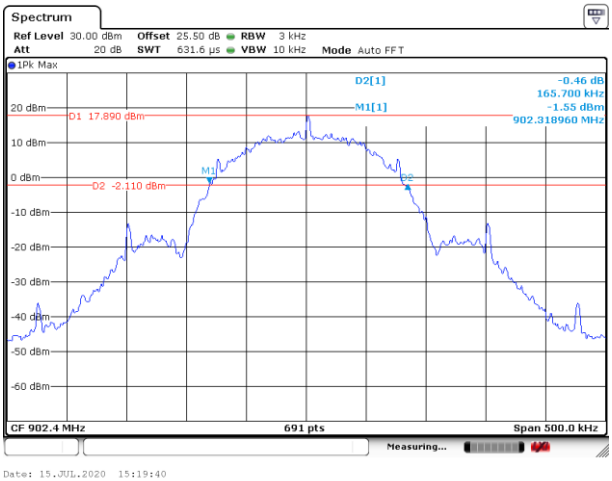


20 dB Bandwidth Plot on Channel 129

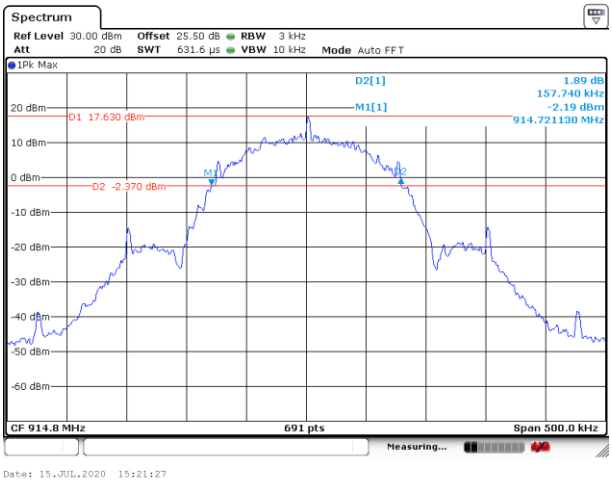


<FSK 150Kbps FHSS>

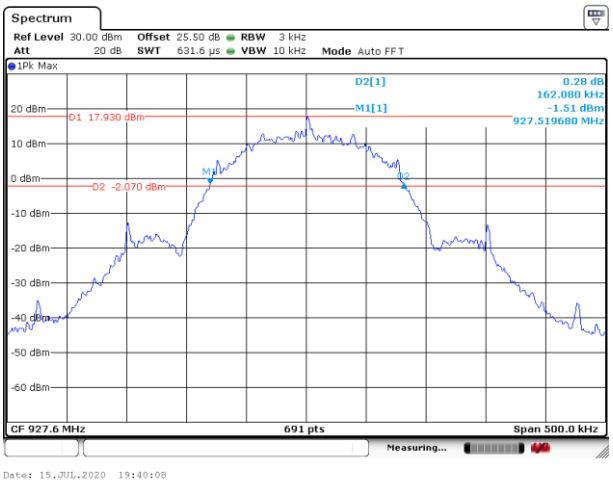
20 dB Bandwidth Plot on Channel 01



20 dB Bandwidth Plot on Channel 32

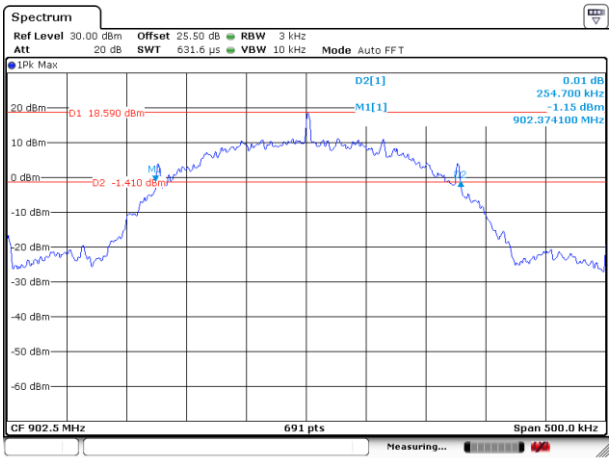


20 dB Bandwidth Plot on Channel 64



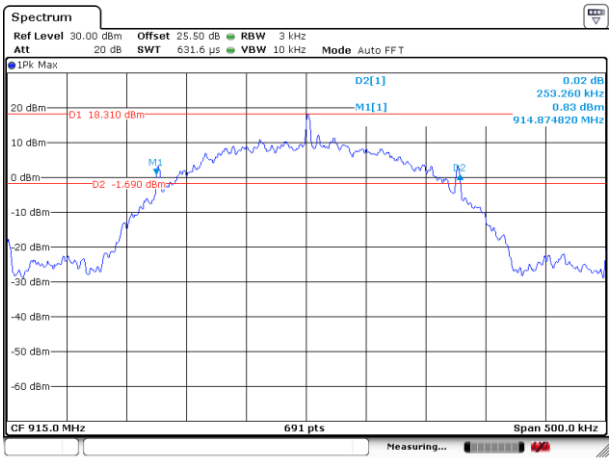
<FSK 250Kbps FHSS>

20 dB Bandwidth Plot on Channel 01



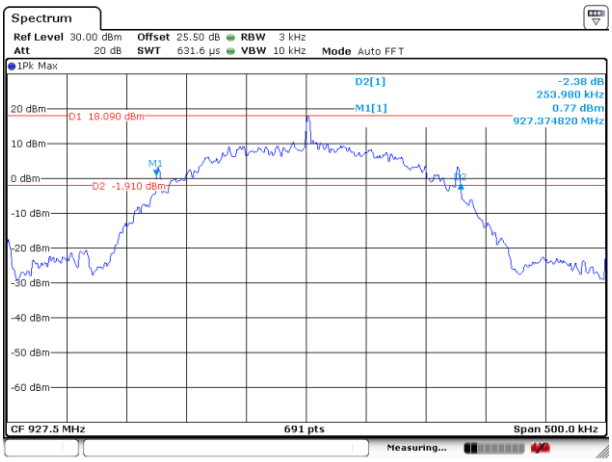
Date: 15.JUL.2020 20:06:01

20 dB Bandwidth Plot on Channel 26



Date: 15.JUL.2020 20:09:39

20 dB Bandwidth Plot on Channel 51



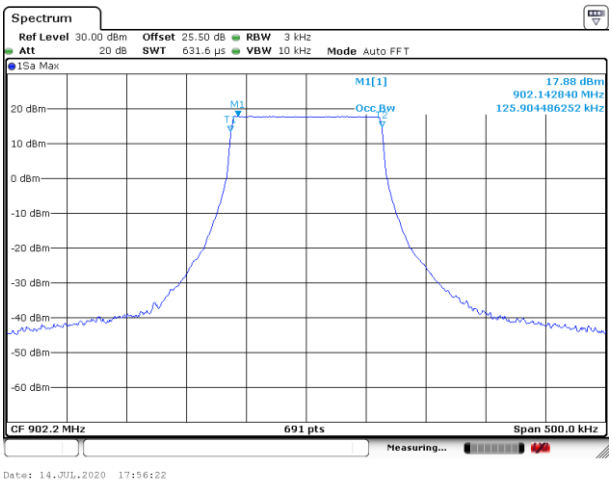
Date: 15.JUL.2020 20:14:41

3.4.6 Test Result of 99% Occupied Bandwidth

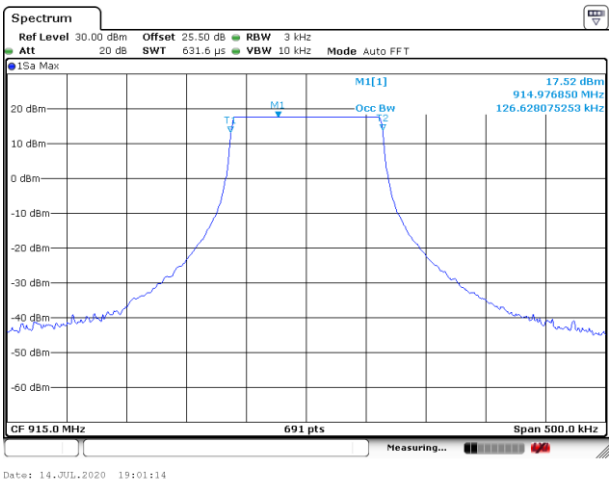
Please refer to Appendix A.

<LoRa FHSS>

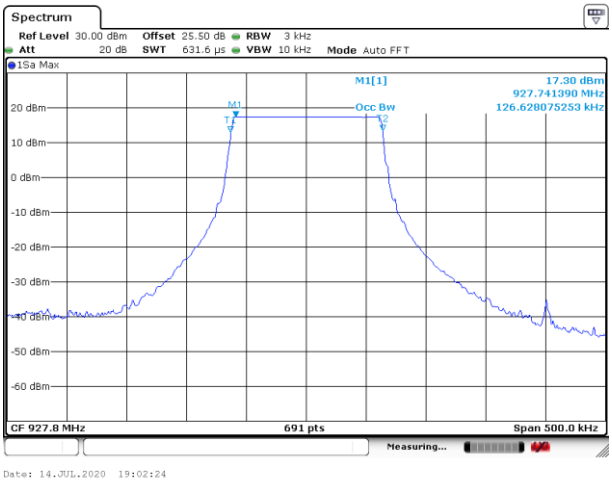
99% Occupied Bandwidth Plot on Channel 01



99% Occupied Bandwidth Plot on Channel 65



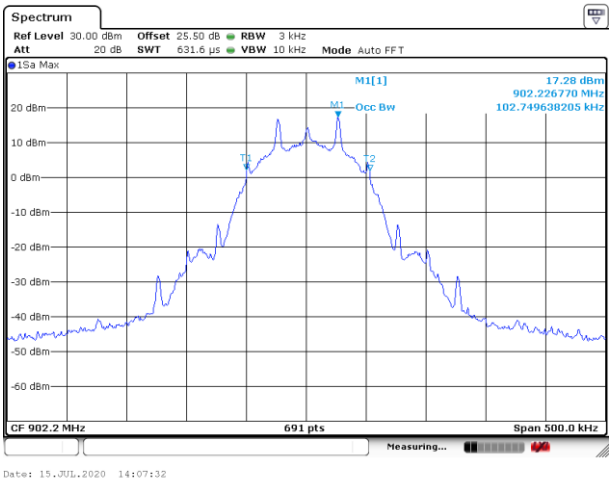
99% Occupied Bandwidth Plot on Channel 129



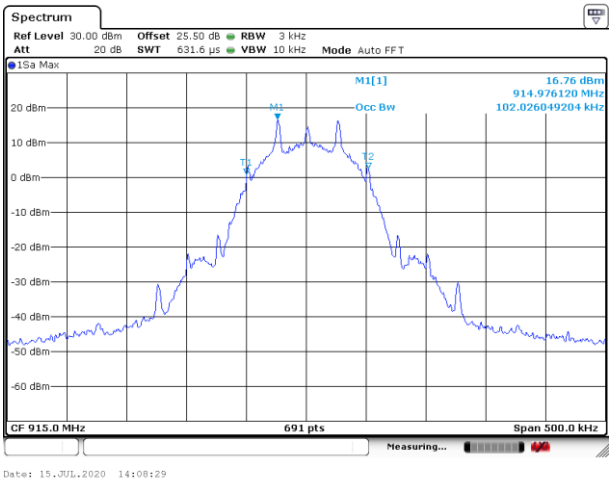
Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<FSK 50Kbps FHSS>

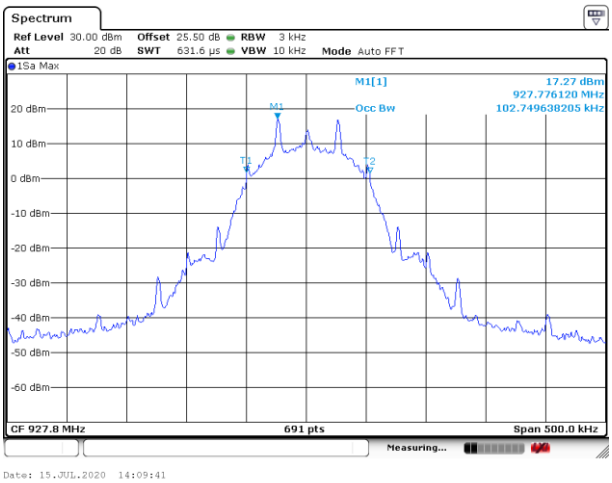
99% Occupied Bandwidth Plot on Channel 01



99% Occupied Bandwidth Plot on Channel 65



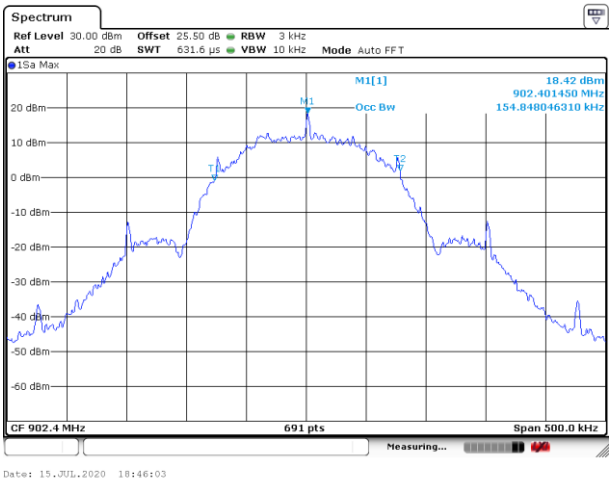
99% Occupied Bandwidth Plot on Channel 129



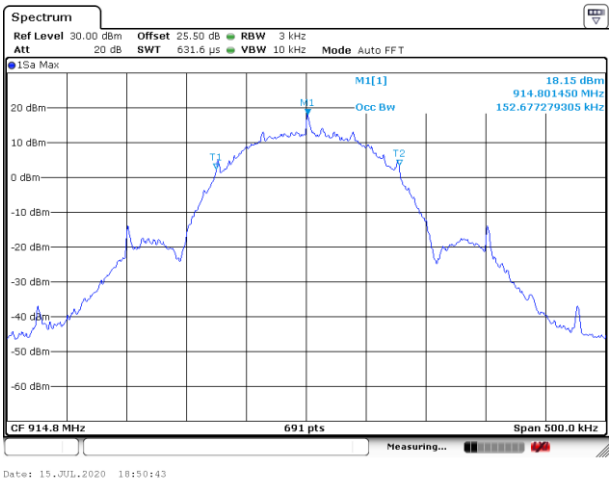
Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<FSK 150Kbps FHSS>

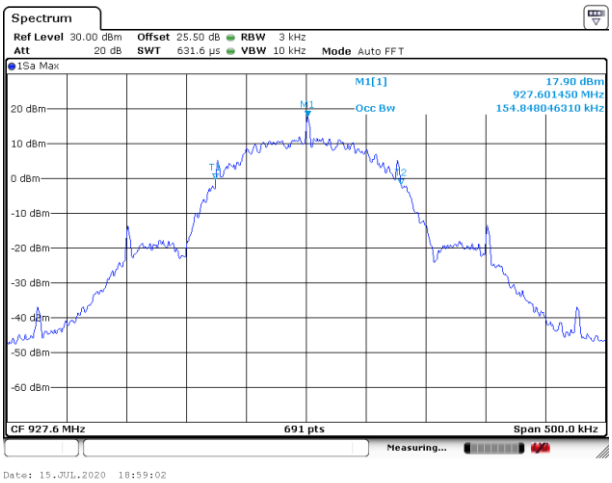
99% Occupied Bandwidth Plot on Channel 01



99% Occupied Bandwidth Plot on Channel 32



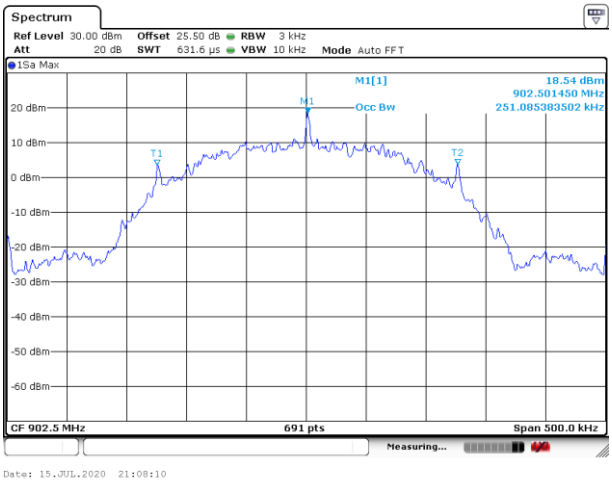
99% Occupied Bandwidth Plot on Channel 64



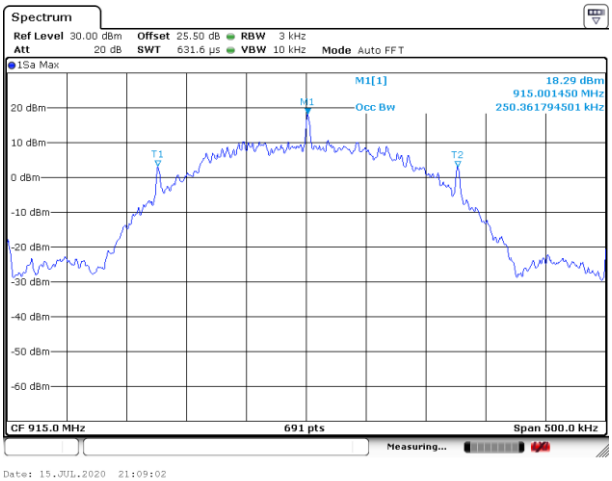
Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<FSK 250Kbps FHSS>

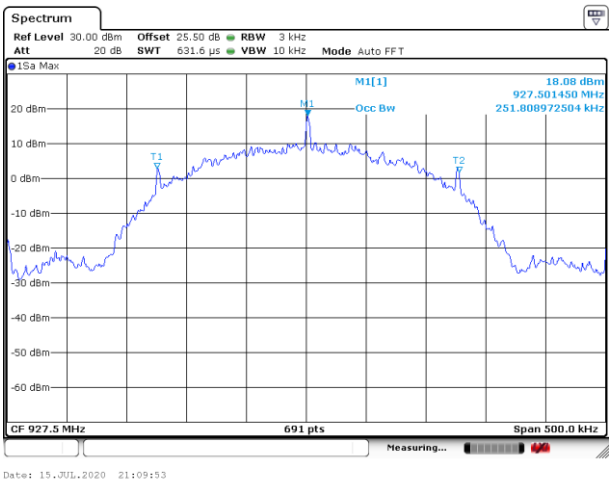
99% Occupied Bandwidth Plot on Channel 01



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.

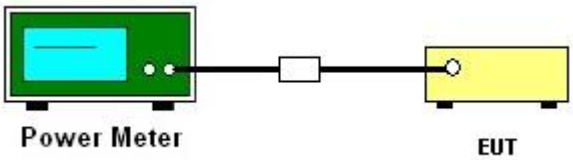
3.5.2 Measuring Instruments

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.

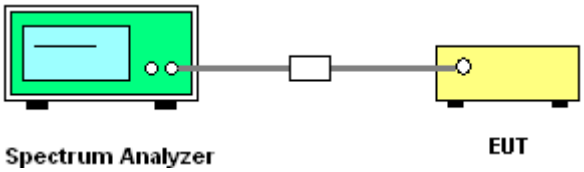
3.6.2 Measuring Instruments

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.

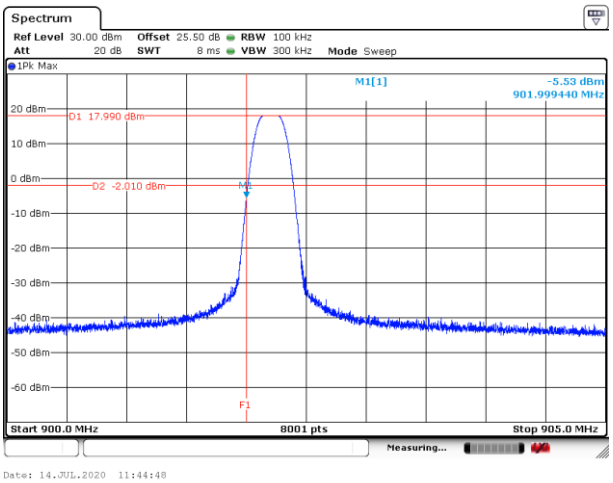
3.6.4 Test Setup



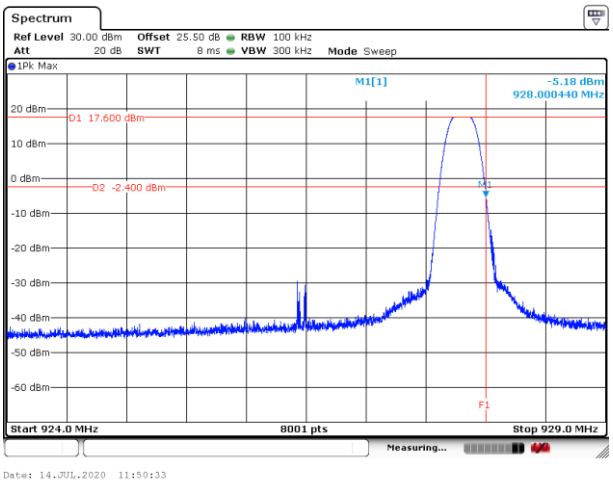
3.6.5 Test Result of Conducted Band Edges

<LoRa FHSS>

Low Band Edge Plot on Channel 01

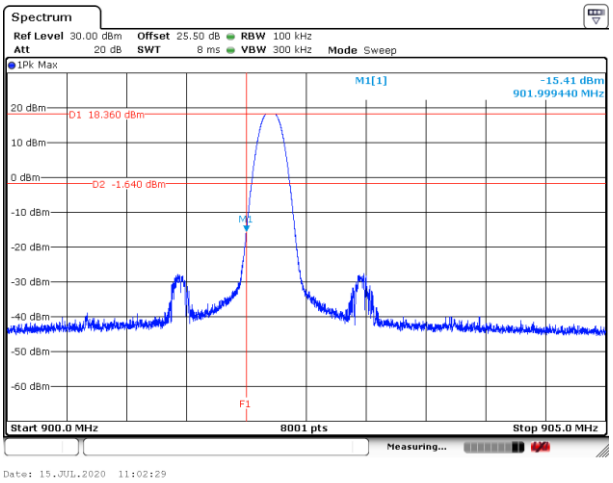


High Band Edge Plot on Channel 129

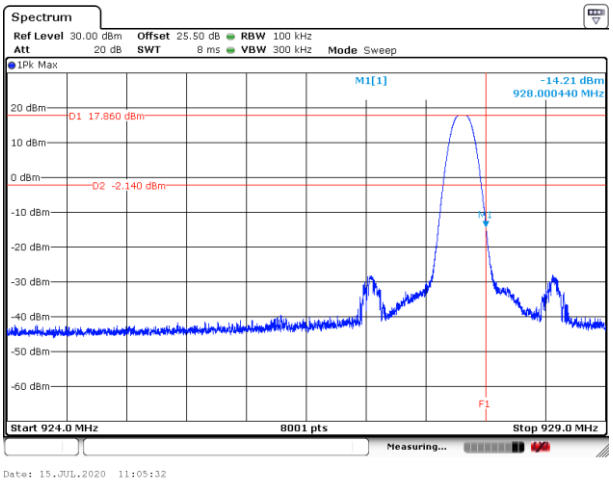


<FSK 50Kbps FHSS>

Low Band Edge Plot on Channel 01

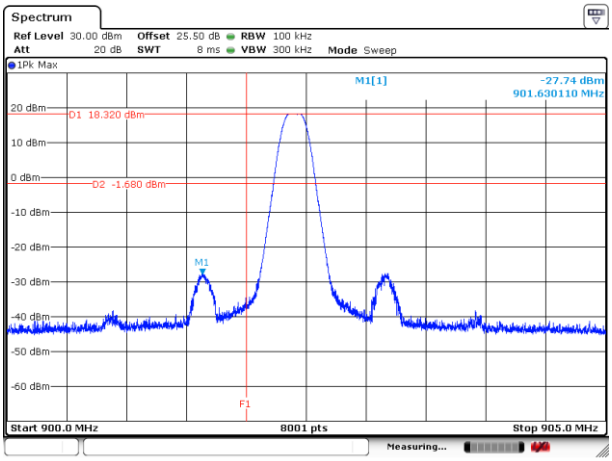


High Band Edge Plot on Channel 129



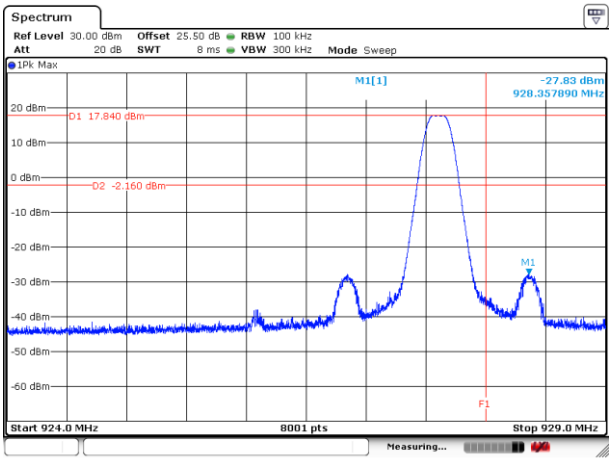
<FSK 150Kbps FHSS>

Low Band Edge Plot on Channel 01



Date: 15.JUL.2020 15:33:03

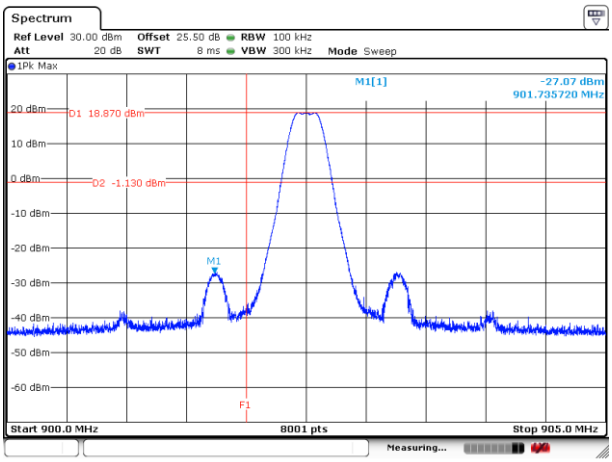
High Band Edge Plot on Channel 64



Date: 15.JUL.2020 16:06:23

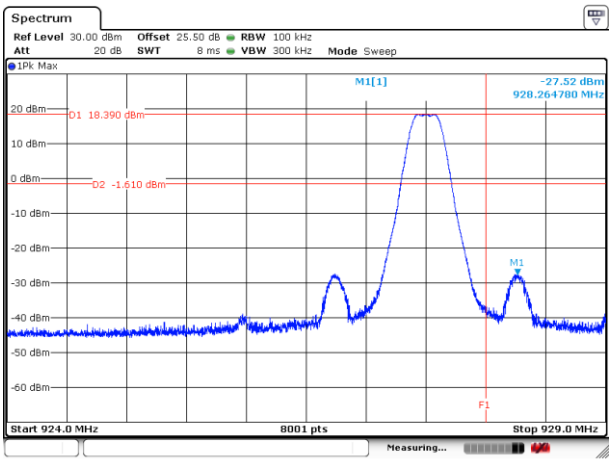
<FSK 250Kbps FHSS>

Low Band Edge Plot on Channel 01



Date: 15.JUL.2020 20:24:53

High Band Edge Plot on Channel 51

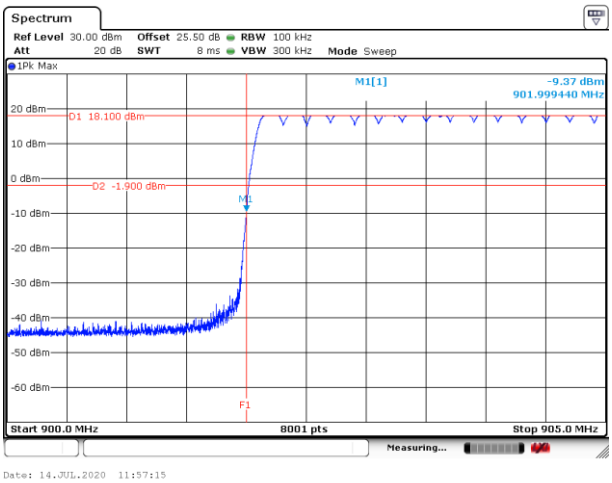


Date: 15.JUL.2020 20:31:01

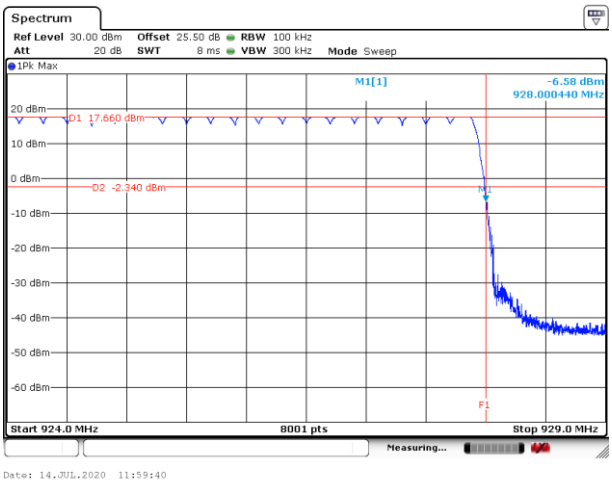
3.6.6 Test Result of Conducted Hopping Mode Band Edges

<LoRa FHSS>

Hopping Mode Low Band Edge Plot

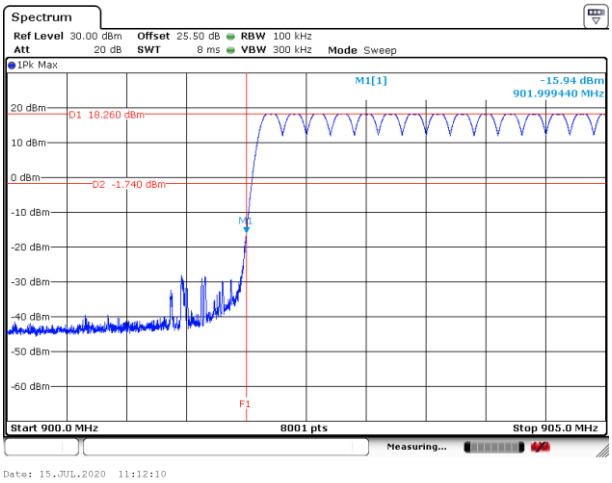


Hopping Mode High Band Edge Plot

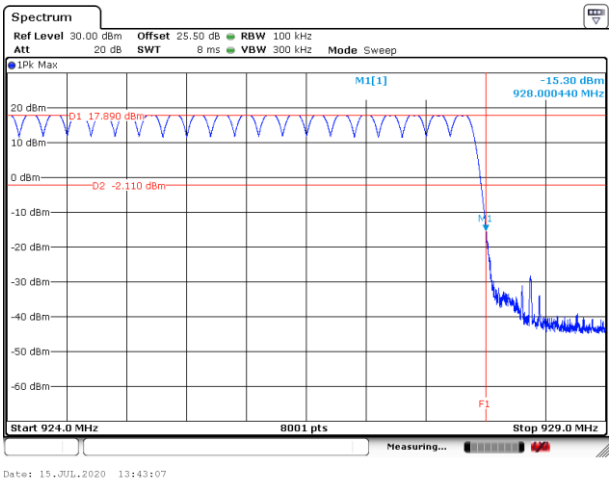


<FSK 50Kbps FHSS>

Hopping Mode Low Band Edge Plot

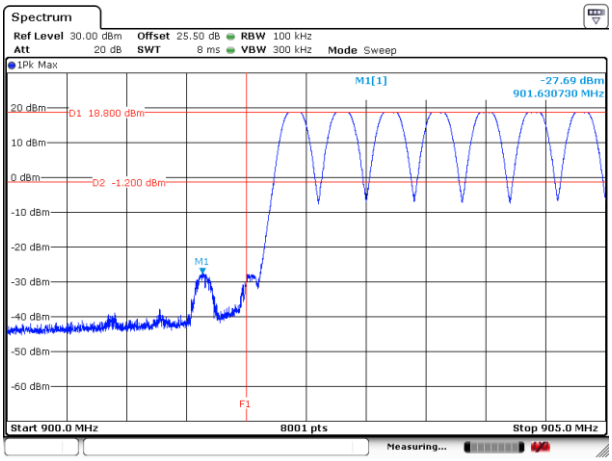


Hopping Mode High Band Edge Plot



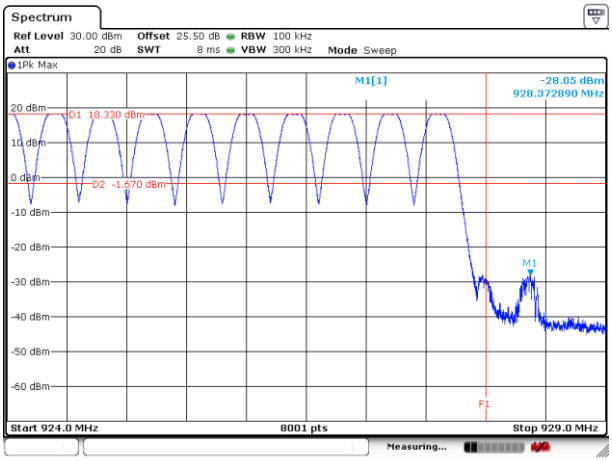
<FSK 150Kbps FHSS>

Hopping Mode Low Band Edge Plot



Date: 15.JUL.2020 17:16:59

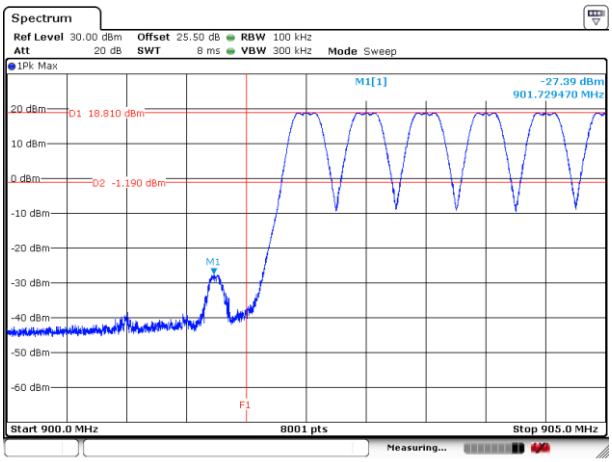
Hopping Mode High Band Edge Plot



Date: 15.JUL.2020 17:24:19

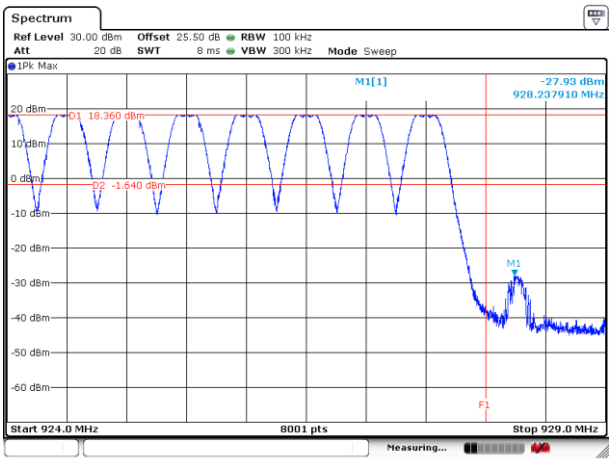
<FSK 250Kbps FHSS>

Hopping Mode Low Band Edge Plot



Date: 15.JUL.2020 20:38:57

Hopping Mode High Band Edge Plot



Date: 15.JUL.2020 20:48:58

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.

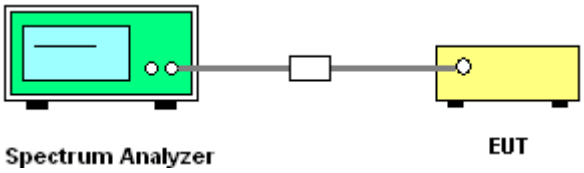
3.7.2 Measuring Instruments

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.

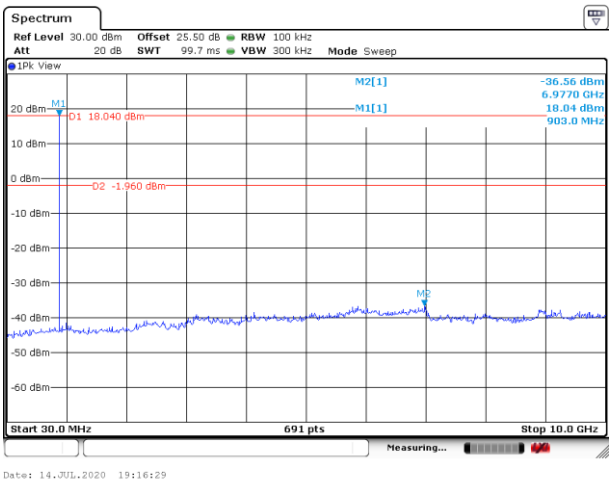
3.7.4 Test Setup



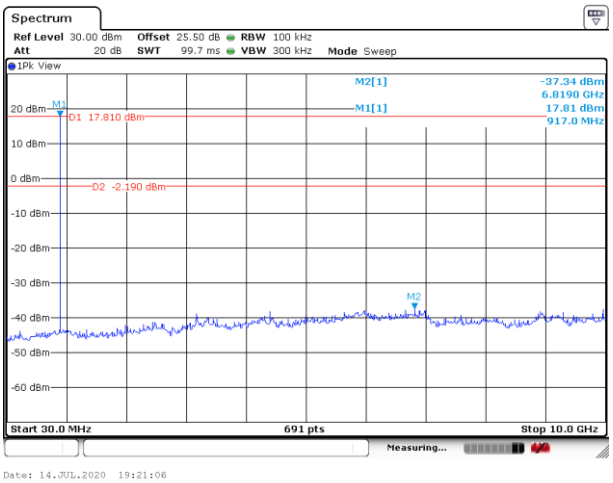
3.7.5 Test Result of Conducted Spurious Emission

<LoRa FHSS>

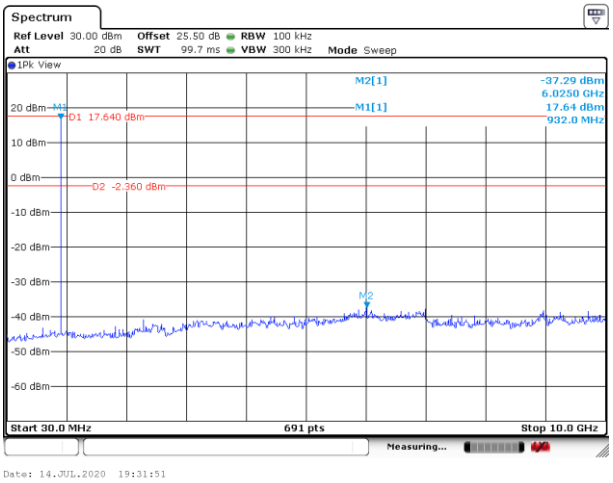
CSE Plot on Channel 01



CSE Plot on Channel 65

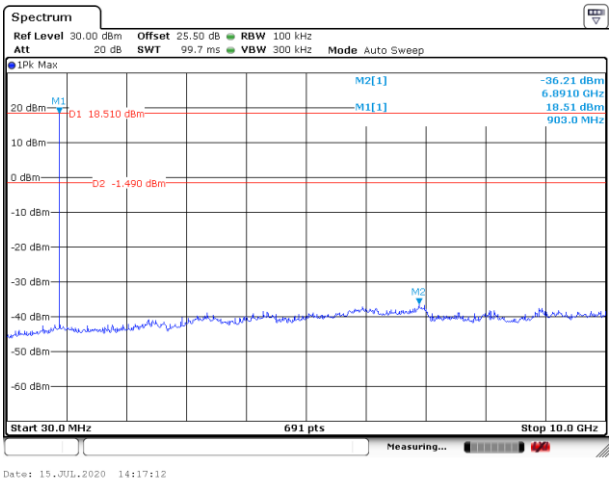


CSE Plot on Channel 129

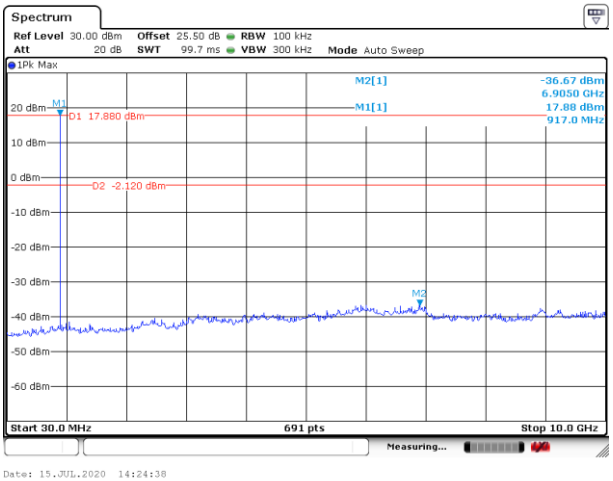


<FSK 50Kbps FHSS>

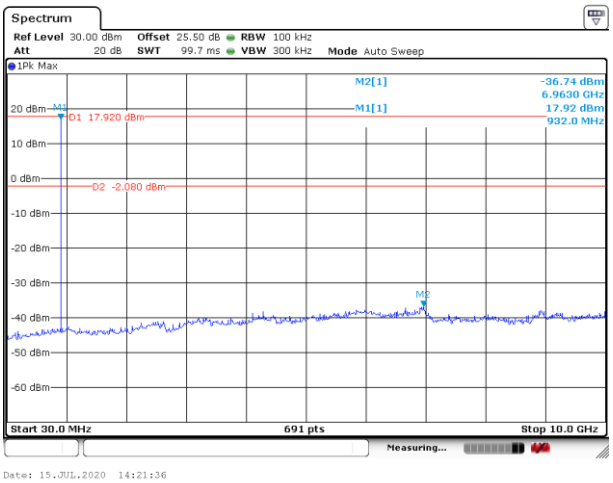
CSE Plot on Channel 01



CSE Plot on Channel 65

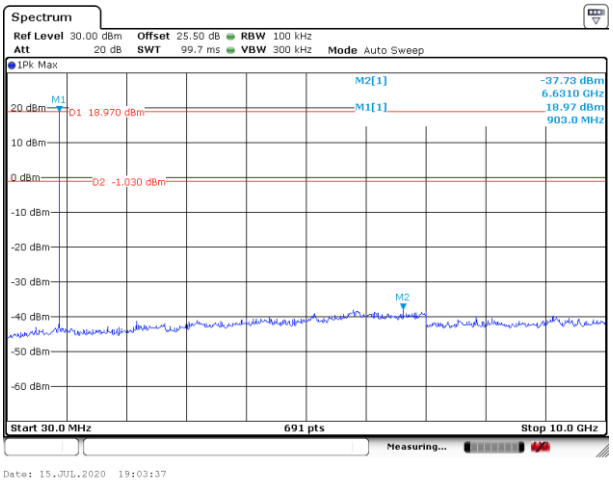


CSE Plot on Channel 129

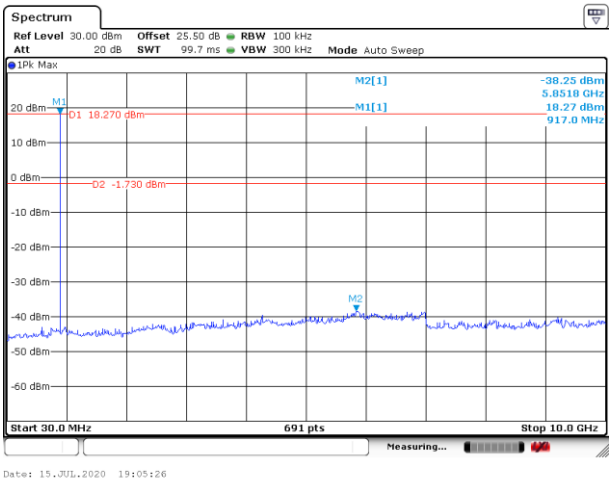


<FSK 150Kbps FHSS>

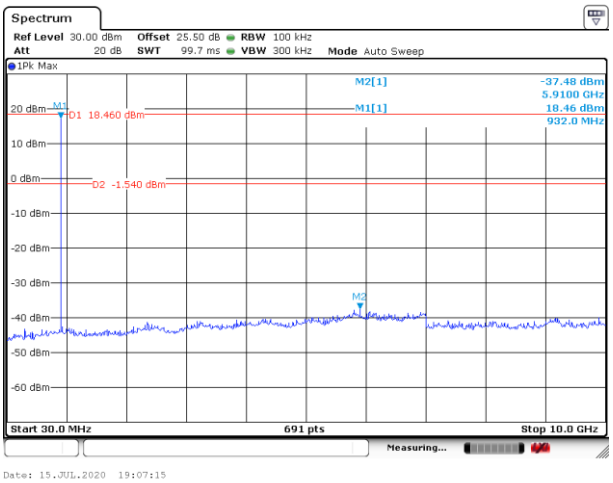
CSE Plot on Channel 01



CSE Plot on Channel 32

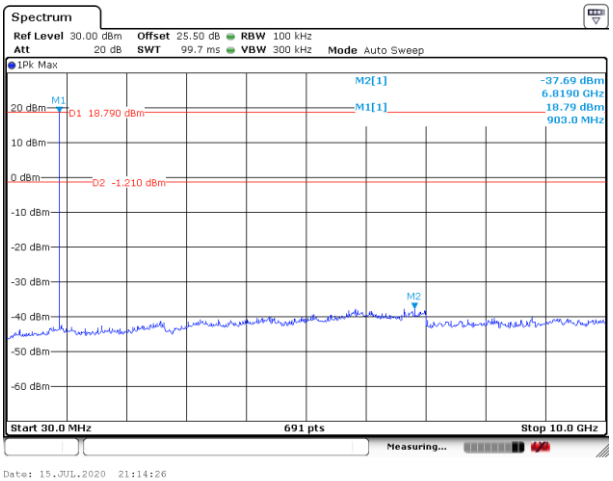


CSE Plot on Channel 64

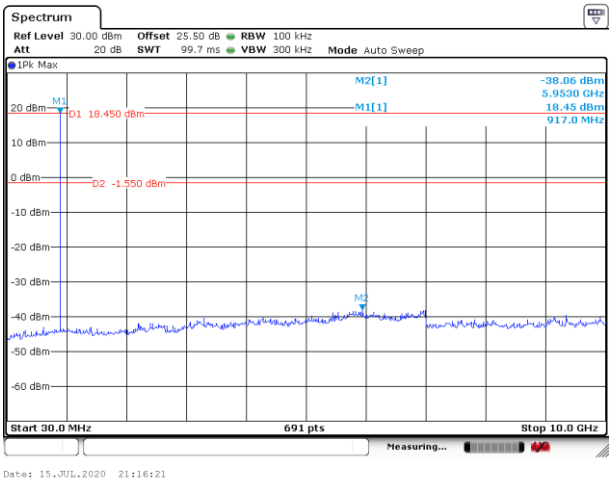


<FSK 250Kbps FHSS>

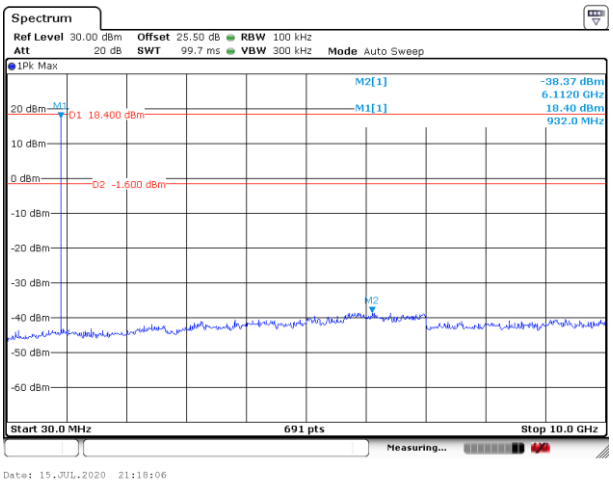
CSE Plot on Channel 01



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

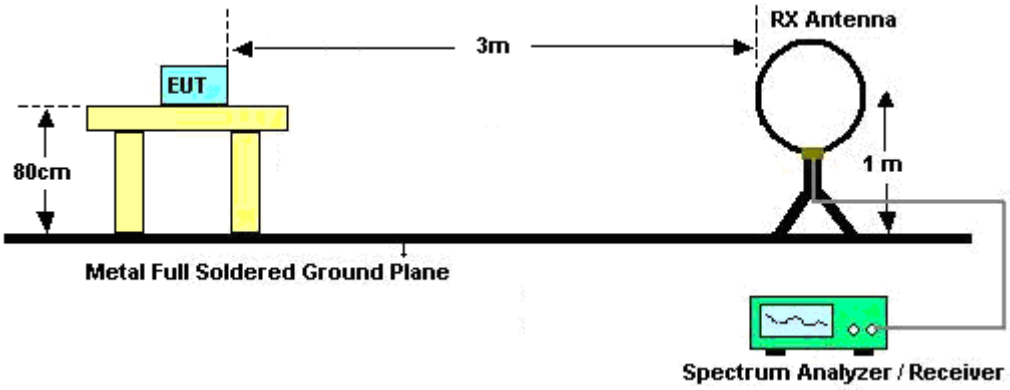
See list of measuring equipment of this test report.

3.8.3 Test Procedures

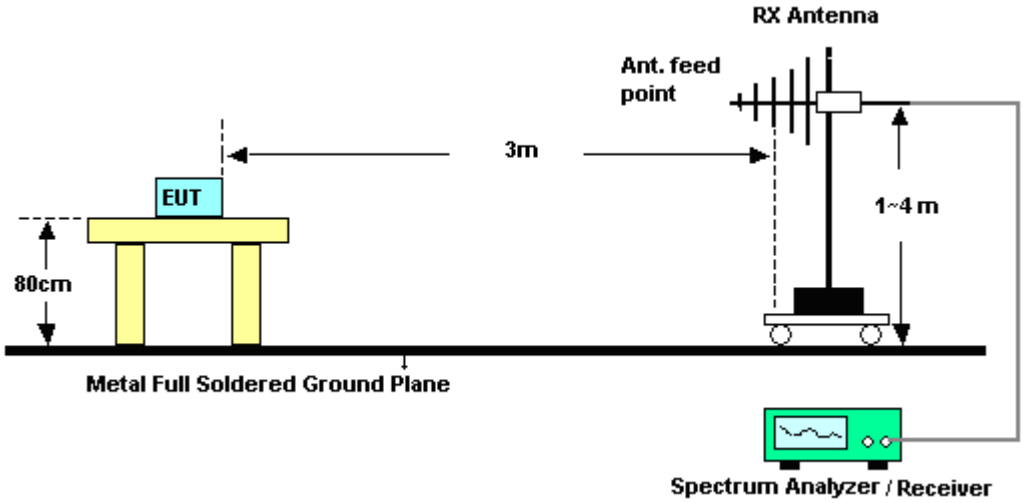
1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, 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

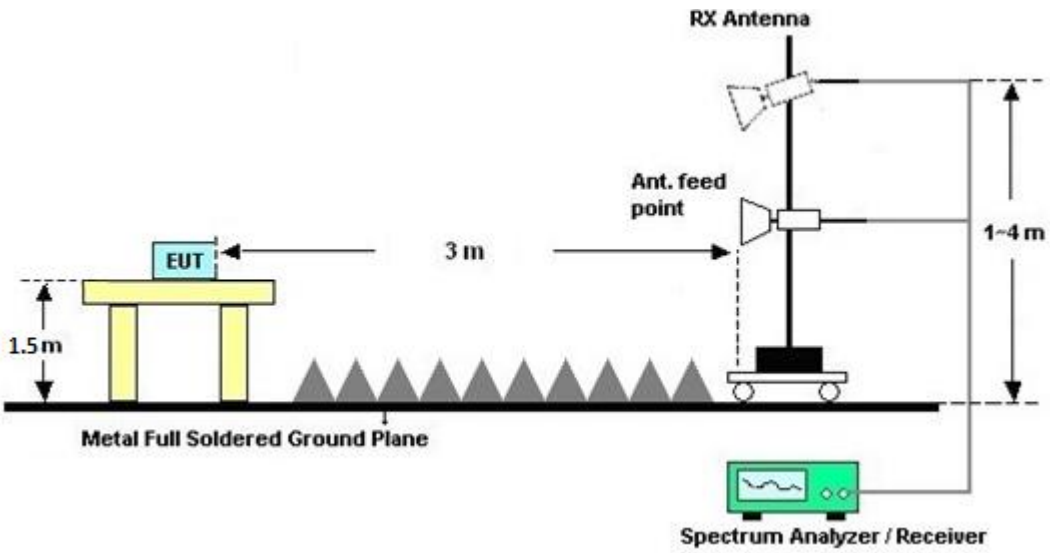
For radiated emissions below 30MHz



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.

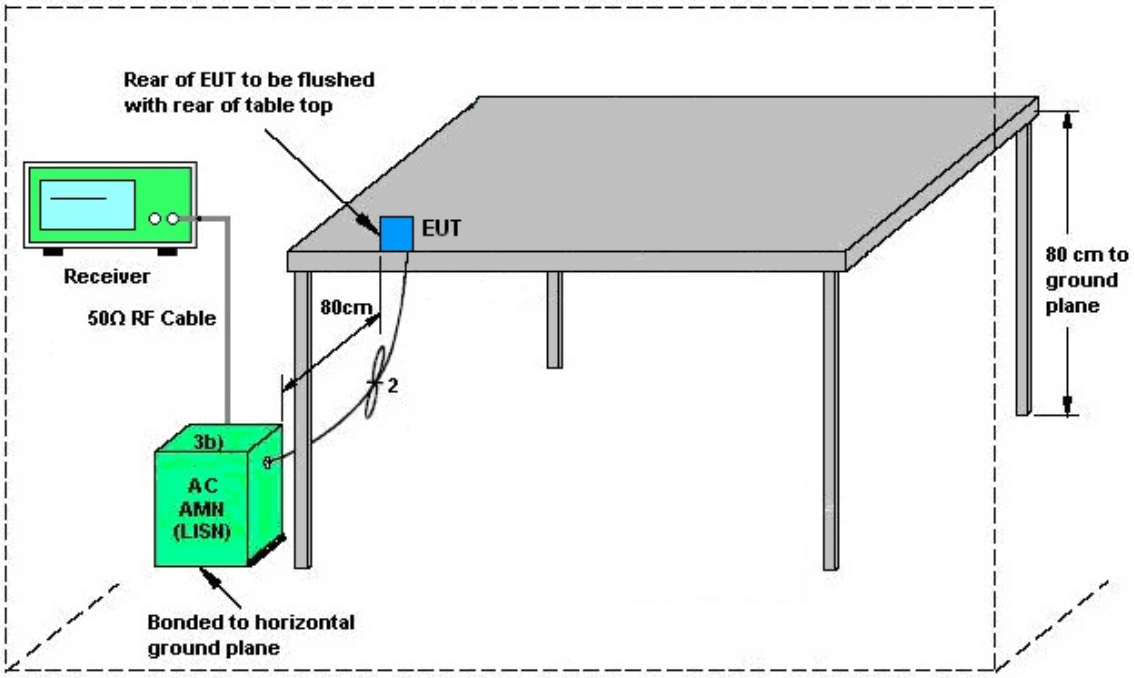
3.9.2 Measuring Instruments

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
Hygrometer	Testo	608-H1	34893241	N/A	Mar. 02. 2020	Jul. 13, 2020 ~ Jul. 15, 2020	Mar. 01. 2021	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	16I00054SNO10	10MHz~6GHz	Dec. 23, 2019	Jul. 13, 2020 ~ Jul. 15, 2020	Dec. 22, 2020	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSV30	103738	9kHz~30GHz	May 14, 2020	Jul. 13, 2020 ~ Jul. 15, 2020	May 13, 2021	Conducted (TH05-HY)
Switch Control Manframe	Burgeon	ETF-058	EC1300484	N/A	Aug. 22, 2019	Jul. 13, 2020 ~ Jul. 15, 2020	Aug. 21, 2020	Conducted (TH05-HY)
Power Meter	Agilent	E4416A	GB41292344	N/A	Dec. 27, 2019	Jul. 13, 2020 ~ Jul. 15, 2020	Dec. 26, 2020	Conducted (TH05-HY)
Power Sensor	Agilent	E9327A	US40441548	50MHz~18GHz	Dec. 27, 2019	Jul. 13, 2020 ~ Jul. 15, 2020	Dec. 26, 2020	Conducted (TH05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Jun. 22, 2020 ~ Jul. 08, 2020	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102388	9kHz~3.6GHz	Nov. 15, 2019	Jun. 22, 2020~ Jul. 08, 2020	Nov. 14, 2020	Conduction (CO05-HY)
Hygrometer	Testo	608-H1	34913912	N/A	Nov. 07, 2019	Jun. 22, 2020 ~ Jul. 08, 2020	Nov. 06, 2020	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Nov. 15, 2019	Jun. 22, 2020 ~ Jul. 08, 2020	Nov. 14, 2020	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32 V10.30	N/A	N/A	N/A	Jun. 22, 2020 ~ Jul. 08, 2020	N/A	Conduction (CO05-HY)
LF Cable	HUBER + SUHNER	RG-214/U	LF01	N/A	Jan. 02, 2020	Jun. 22, 2020 ~ Jul. 08, 2020	Jan. 01, 2021	Conduction (CO05-HY)
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100851	N/A	Jan. 02, 2020	Jun. 22, 2020 ~ Jul. 08, 2020	Jan. 01, 2021	Conduction (CO05-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Jan. 09, 2020	Jul. 13, 2020 ~ Jul. 15, 2020	Jan. 08, 2021	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL6111D&00802N1D01N-06	47020&06	30MHz to 1GHz	Oct. 12, 2019	Jul. 13, 2020 ~ Jul. 15, 2020	Oct. 11, 2020	Radiation (03CH16-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1522	1G~18GHz	Sep. 19, 2019	Jul. 13, 2020 ~ Jul. 15, 2020	Sep. 18, 2020	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1G	Oct. 01. 2019	Jul. 13, 2020 ~ Jul. 15, 2020	Sep. 30. 2020	Radiation (03CH16-HY)
Preamplifier	Jet-Power	JPA0118-55-303	17100018000 55006	1GHz~18GHz	May 07, 2020	Jul. 13, 2020 ~ Jul. 15, 2020	May 06, 2021	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 11, 2019	Jul. 13, 2020 ~ Jul. 15, 2020	Dec.10, 2020	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY57290111	3Hz~26.5GHz	Dec. 05, 2019	Jul. 13, 2020 ~ Jul. 15, 2020	Dec. 04, 2020	Radiation (03CH16-HY)
Spectrum Analyzer	Agilent	E4446A	MY50180136	3Hz~44GHz	May 04, 2020	Jul. 13, 2020 ~ Jul. 15, 2020	May 03, 2021	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11680/4PE	NA	Aug. 30, 2019	Jul. 13, 2020 ~ Jul. 15, 2020	Aug. 29, 2020	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11688/4PE	NA	Aug. 30, 2019	Jul. 13, 2020 ~ Jul. 15, 2020	Aug. 29, 2020	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300-5757	NA	Aug. 30, 2019	Jul. 13, 2020 ~ Jul. 15, 2020	Aug. 29, 2020	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Jul. 13, 2020 ~ Jul. 15, 2020	N/A	Radiation (03CH16-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))	4.9

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	6.7

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	3.9

Report Number : FR020110-01H

Appendix A. Test Result of Conducted Test Items

Test Engineer	Shiming Liu	Temperature:	23.8~24.1	°C
Test Date:	2020/7/13~2020/7/15	Relative Humidity:	52.8~53.0	%

<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	1	1	902.2	0.136	0.126	0.166	0.1360	Pass
Lora	1	65	915	0.140	0.127	0.142	0.1397	Pass
Lora	1	129	927.8	0.138	0.127	0.140	0.1382	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	129	1	285.51	0.29	0.4	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
Lora	1	18.56	30.00	Pass
	1	18.31	30.00	Pass
	1	18.09	30.00	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

Mod.	NTX	Average Power (dBm)	Duty Factor (dB)
Lora	1	18.40	0.00
	1	18.10	0.00
	1	17.90	0.00

TEST RESULTS DATA
Number of Hopping Frequency

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

Report Number : FR020110-01H

<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	0.106	0.103	0.201	0.1056	Pass
FSK	50Kbps	1	65	915	0.106	0.102	0.201	0.1064	Pass
FSK	50Kbps	1	129	927.8	0.109	0.103	0.200	0.1085	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	271.78	0.27	0.4	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
FSK	1	1	18.64	30.00	Pass
	65	1	18.37	30.00	Pass
	129	1	18.16	30.00	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

Mod.	CH.	NTX	Average Power (dBm)	Duty Factor (dB)
FSK	1	1	18.50	7.65
	65	1	18.20	7.65
	129	1	18.00	7.65

TEST RESULTS DATA
Number of Hopping Frequency

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

Report Number : FR020110-01H

<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	0.166	0.155	0.401	0.1657	Pass
FSK	150Kbps	1	32	914.8	0.158	0.153	0.401	0.1577	Pass
FSK	150Kbps	1	64	927.6	0.162	0.155	0.401	0.1621	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	1.07	224.88	0.24	0.4	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
FSK	1	1	18.64	30.00	Pass
	32	1	18.38	30.00	Pass
	64	1	18.17	30.00	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

Mod.	CH.	NTX	Average Power (dBm)	Duty Factor (dB)
FSK	1	1	18.50	11.81
	32	1	18.20	11.81
	64	1	18.00	11.81

TEST RESULTS DATA
Number of Hopping Frequency

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

Report Number : FR020110-01H

<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	0.255	0.251	0.399	0.2547	Pass
FSK	250Kbps	1	26	915	0.253	0.250	0.401	0.2533	Pass
FSK	250Kbps	1	51	927.5	0.254	0.252	0.401	0.2540	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	0.67	193.92	0.13	0.4	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
FSK	1	1	18.65	30.00	Pass
	26	1	18.39	30.00	Pass
	51	1	18.18	30.00	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

Mod.	CH.	NTX	Average Power (dBm)	Duty Factor (dB)
FSK	1	1	18.40	13.80
	26	1	18.20	13.80
	51	1	18.00	13.80

TEST RESULTS DATA
Number of Hopping Frequency

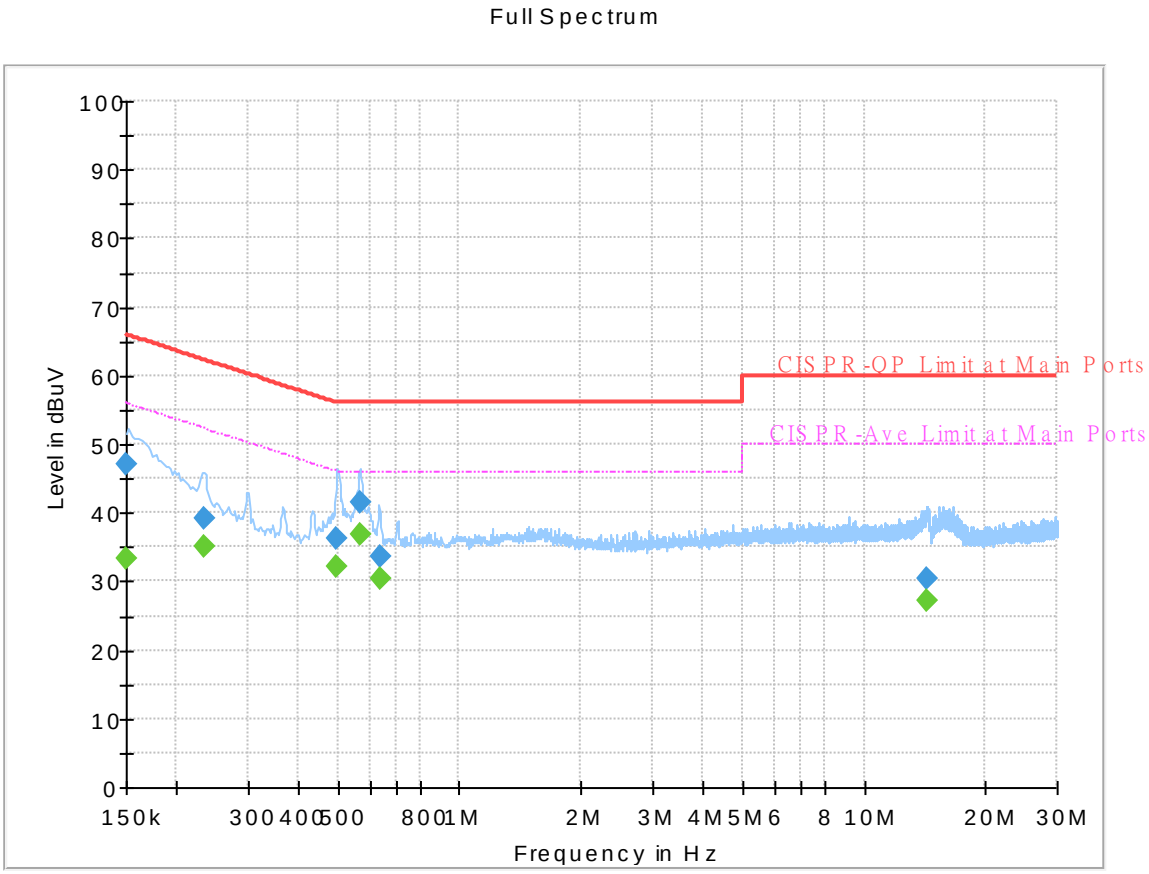
Number of Hopping (Channel)	Limits (Channel)	Pass/Fail
51	50 >	Pass

Appendix B. AC Conducted Emission Test Results

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

EUT Information

Report NO :	020110-01
Test Mode :	Mode 2
Test Voltage :	120Vac/60Hz
Phase :	Line



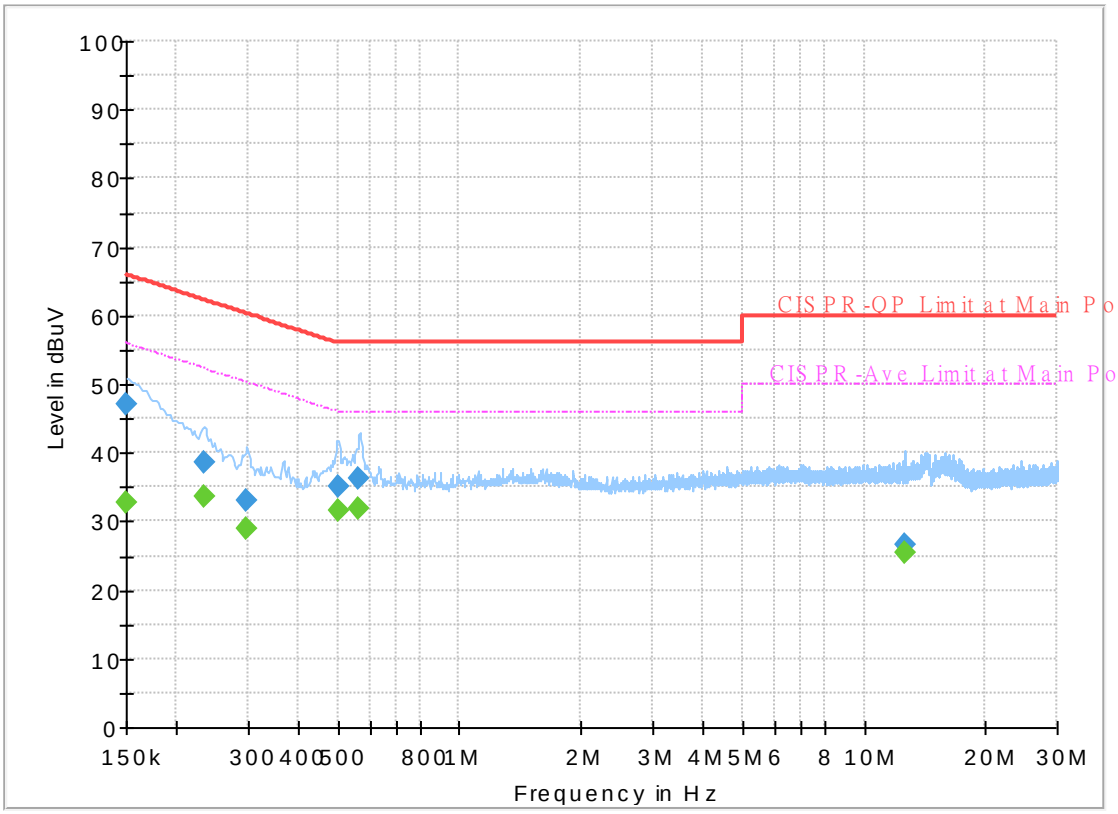
Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.150000	---	33.20	56.00	22.80	L1	OFF	19.6
0.150000	46.93	---	66.00	19.07	L1	OFF	19.6
0.233430	---	35.04	52.33	17.29	L1	OFF	19.6
0.233430	39.08	---	62.33	23.25	L1	OFF	19.6
0.498750	---	32.13	46.02	13.89	L1	OFF	19.6
0.498750	36.16	---	56.02	19.86	L1	OFF	19.6
0.566520	---	36.70	46.00	9.30	L1	OFF	19.6
0.566520	41.46	---	56.00	14.54	L1	OFF	19.6
0.634560	---	30.36	46.00	15.64	L1	OFF	19.6
0.634560	33.49	---	56.00	22.51	L1	OFF	19.6
14.364510	---	27.10	50.00	22.90	L1	OFF	20.2
14.364510	30.34	---	60.00	29.66	L1	OFF	20.2

EUT Information

Report NO :	020110-01
Test Mode :	Mode 2
Test Voltage :	120Vac/60Hz
Phase :	Neutral

Full Spectrum



Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.150000	---	32.84	56.00	23.16	N	OFF	19.6
0.150000	47.00	---	66.00	19.00	N	OFF	19.6
0.233250	---	33.74	52.33	18.59	N	OFF	19.5
0.233250	38.70	---	62.33	23.63	N	OFF	19.5
0.296070	---	28.81	50.35	21.54	N	OFF	19.5
0.296070	33.04	---	60.35	27.31	N	OFF	19.5
0.502620	---	31.54	46.00	14.46	N	OFF	19.5
0.502620	35.19	---	56.00	20.81	N	OFF	19.5
0.561750	---	31.73	46.00	14.27	N	OFF	19.5
0.561750	36.33	---	56.00	19.67	N	OFF	19.5
12.601500	---	25.30	50.00	24.70	N	OFF	19.9
12.601500	26.59	---	60.00	33.41	N	OFF	19.9

Appendix C. Radiated Spurious Emission

Test Engineer :	Karl Hou, Andy Yang, and CR Liro	Temperature :	20~25°C
		Relative Humidity :	50~60%

<LoRa FHSS>

LoRa (Harmonic @ 3m)

Lora ANT 4	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
LoRa CH 01 902.2Hz		2706.6	45.17	-28.83	74	69.64	27.81	9.05	61.33	100	0	P	H
		3608.8	39.05	-34.95	74	59.68	29.1	10.7	60.43	100	0	P	H
		2706.6	46.35	-27.65	74	70.82	27.81	9.05	61.33	100	0	P	V
		3608.8	39.6	-34.4	74	60.23	29.1	10.7	60.43	100	0	P	V
LoRa CH 65 915MHz		2745	45.05	-28.95	74	69.35	27.89	9.11	61.3	100	0	P	H
		3660	39.9	-34.1	74	60.38	29.12	10.74	60.34	100	0	P	H
		2745	46.2	-27.8	74	70.5	27.89	9.11	61.3	100	0	P	V
		3660	39.64	-34.36	74	60.12	29.12	10.74	60.34	100	0	P	V
LoRa CH 129 927.8MHz		2783.4	44.97	-29.03	74	68.96	28.1	9.18	61.27	100	0	P	H
		3711.2	39.39	-34.61	74	59.68	29.2	10.77	60.26	100	0	P	H
		2783.4	46.73	-27.27	74	70.72	28.1	9.18	61.27	100	0	P	V
		3711.2	39.09	-34.91	74	59.38	29.2	10.77	60.26	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

LoRa (LF)

Lora	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
ANT				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
4		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
LoRa CH 01 902.2MHz LF		113.42	29.45	-14.05	43.5	32.93	17.09	11.69	32.26	-	-	P	H
		215.27	29.72	-13.78	43.5	34.45	15.18	12.42	32.33	-	-	P	H
		342.34	31.07	-14.93	46	30.19	20.15	13.02	32.29	-	-	P	H
		396.66	32.7	-13.3	46	29.9	21.72	13.29	32.21	-	-	P	H
		551.86	37.17	-8.83	46	29.75	25.5	13.92	32	-	-	P	H
		667.29	39.5	-6.5	46	30.98	26.24	14.35	32.07	100	0	P	H
		902.2	115.33	-	-	103.1	29.04	15.08	31.89	191	175	P	H
		70.74	32.9	-7.1	40	41.69	12.28	11.29	32.36	104	348	Q	V
		191.99	27.35	-16.15	43.5	32.68	14.71	12.27	32.31	-	-	P	V
		357.86	30.75	-15.25	46	29.31	20.62	13.09	32.27	-	-	P	V
		482.02	35.42	-10.58	46	30.26	23.69	13.58	32.11	-	-	P	V
		563.5	38.67	-7.33	46	30.53	26.14	13.98	31.98	-	-	P	V
		650.8	38.89	-7.11	46	30.29	26.36	14.28	32.04	-	-	P	V
		902.2	113.63	-	-	101.4	29.04	15.08	31.89	106	55	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Lora ANT 4	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
LoRa CH 65 915MHz LF		71.71	29.91	-10.09	40	38.65	12.31	11.3	32.35	-	-	P	H
		215.27	28.95	-14.55	43.5	33.68	15.18	12.42	32.33	-	-	P	H
		315.18	30.21	-15.79	46	30.18	19.41	12.96	32.34	-	-	P	H
		379.2	32.87	-13.13	46	30.82	21.07	13.21	32.23	-	-	P	H
		511.12	35.97	-10.03	46	30.32	24.02	13.7	32.07	-	-	P	H
		644.01	38.53	-7.47	46	29.9	26.39	14.26	32.02	100	0	P	H
		915	115.27	-	-	102.56	29.34	15.11	31.74	189	170	P	H
		69.77	33.91	-6.09	40	42.8	12.18	11.29	32.36	100	351	Q	V
		258.92	30.11	-15.89	46	29.82	19.92	12.71	32.34	-	-	P	V
		370.47	31.01	-14.99	46	29.25	20.85	13.16	32.25	-	-	P	V
		471.35	35.72	-10.28	46	30.76	23.53	13.55	32.12	-	-	P	V
		564.47	38.36	-7.64	46	30.23	26.13	13.98	31.98	-	-	P	V
		642.07	38.6	-7.4	46	29.97	26.4	14.25	32.02	-	-	P	V
		915	113.52	-	-	100.81	29.34	15.11	31.74	101	54	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Lora ANT 4	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
LoRa CH 129 927.8Hz LF		114.39	30.09	-13.41	43.5	33.53	17.12	11.7	32.26	-	-	P	H
		213.33	30.18	-13.32	43.5	34.92	15.18	12.41	32.33	-	-	P	H
		357.86	31.56	-14.44	46	30.12	20.62	13.09	32.27	-	-	P	H
		472.32	35.68	-10.32	46	30.7	23.55	13.55	32.12	-	-	P	H
		611.03	38.43	-7.57	46	30.69	25.54	14.15	31.95	-	-	P	H
		693.48	39.67	-6.33	46	31	26.38	14.43	32.14	100	0	P	H
		927.8	114.34	-	-	101.04	29.74	15.15	31.59	184	181	P	H
		70.74	33.3	-6.7	40	42.09	12.28	11.29	32.36	108	358	Q	V
		189.08	27.76	-15.74	43.5	33.1	14.71	12.26	32.31	-	-	P	V
		323.91	30.32	-15.68	46	30.13	19.52	12.99	32.32	-	-	P	V
		455.83	34.52	-11.48	46	29.87	23.29	13.5	32.14	-	-	P	V
		613.94	38.12	-7.88	46	30.33	25.58	14.16	31.95	-	-	P	V
		708.03	39.16	-6.84	46	30.35	26.52	14.46	32.17	-	-	P	V
		927.8	112.43	-	-	99.13	29.74	15.15	31.59	100	55	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

<FSK 50Kbps FHSS>

FSK (Harmonic @ 3m)

FSK ANT 4	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK CH 01 902.2Hz		2706.6	45.88	-28.12	74	70.35	27.81	9.05	61.33	100	0	P	H
		3608.8	38.59	-35.41	74	59.22	29.1	10.7	60.43	100	0	P	H
		2706.6	48.65	-25.35	74	73.12	27.81	9.05	61.33	100	0	P	V
		3608.8	39.18	-34.82	74	59.81	29.1	10.7	60.43	100	0	P	V
FSK CH 65 915MHz		2745	45.95	-28.05	74	70.25	27.89	9.11	61.3	100	0	P	H
		3660	39.83	-34.17	74	60.31	29.12	10.74	60.34	100	0	P	H
		2745	44.14	-29.86	74	68.44	27.89	9.11	61.3	100	0	P	V
		3660	39.17	-34.83	74	59.65	29.12	10.74	60.34	100	0	P	V
FSK CH 129 927.8MHz		2783.4	48.17	-25.83	74	72.16	28.1	9.18	61.27	100	0	P	H
		3711.2	38.48	-35.52	74	58.77	29.2	10.77	60.26	100	0	P	H
		4639	40.59	-33.41	74	56.86	30.86	11.85	58.98	100	0	P	H
		2783.4	48.69	-25.31	74	72.68	28.1	9.18	61.27	100	0	P	V
		3711.2	38.65	-35.35	74	58.94	29.2	10.77	60.26	100	0	P	V
		4639	43.75	-30.25	74	60.02	30.86	11.85	58.98	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

FSK (LF)

FSK	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
ANT				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
4		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
FSK CH 01 902.2MHz LF		70.74	28.79	-11.21	40	37.58	12.28	11.29	32.36	-	-	P	H
		100.81	28.58	-14.92	43.5	33.35	15.92	11.56	32.25	-	-	P	H
		188.11	27.62	-15.88	43.5	32.95	14.73	12.25	32.31	-	-	P	H
		211.39	29.49	-14.01	43.5	34.22	15.2	12.39	32.32	-	-	P	H
		575.14	37.75	-8.25	46	29.82	25.86	14.03	31.96	-	-	P	H
		654.68	39.65	-6.35	46	31.09	26.32	14.29	32.05	100	0	P	H
		902.03	115.32	-	-	103.1	29.04	15.08	31.9	117	174	P	H
		43.58	32.52	-7.48	40	36.54	17.38	10.95	32.35	-	-	P	V
		69.77	32.73	-7.27	40	41.62	12.18	11.29	32.36	100	347	Q	V
		115.36	30.04	-13.46	43.5	33.44	17.14	11.72	32.26	-	-	P	V
		186.17	27.39	-16.11	43.5	32.7	14.76	12.24	32.31	-	-	P	V
		265.71	29.84	-16.16	46	29.54	19.9	12.75	32.35	-	-	P	V
		585.81	38.04	-7.96	46	30.01	25.9	14.07	31.94	-	-	P	V
		902.03	113.7	-	-	101.48	29.04	15.08	31.9	100	54	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

FSK ANT 4	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK CH 65 915MHz LF		70.74	29.33	-10.67	40	38.12	12.28	11.29	32.36	-	-	P	H
		95.96	29.2	-14.3	43.5	34.65	15.29	11.52	32.26	-	-	P	H
		191.99	28.52	-14.98	43.5	33.85	14.71	12.27	32.31	-	-	P	H
		215.27	29.6	-13.9	43.5	34.33	15.18	12.42	32.33	-	-	P	H
		568.35	37.35	-8.65	46	29.27	26.05	14	31.97	-	-	P	H
		696.39	39.11	-6.89	46	30.41	26.4	14.44	32.14	100	0	P	H
		914.64	115.17	-	-	102.48	29.33	15.11	31.75	121	175	P	H
		43.58	31.88	-8.12	40	35.9	17.38	10.95	32.35	-	-	P	V
		69.77	32.3	-7.7	40	41.19	12.18	11.29	32.36	100	335	Q	V
		116.33	30.39	-13.11	43.5	33.7	17.22	11.73	32.26	-	-	P	V
		189.08	27.73	-15.77	43.5	33.07	14.71	12.26	32.31	-	-	P	V
		270.56	29.82	-16.18	46	30.36	19.04	12.77	32.35	-	-	P	V
		659.53	38.5	-7.5	46	29.98	26.27	14.31	32.06	-	-	P	V
		914.64	113.22	-	-	100.53	29.33	15.11	31.75	100	52	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

FSK ANT 4	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK CH 129 927.8MHz LF		70.74	29.44	-10.56	40	38.23	12.28	11.29	32.36	-	-	P	H
		113.42	29.57	-13.93	43.5	33.05	17.09	11.69	32.26	-	-	P	H
		180.35	28.61	-14.89	43.5	33.82	14.89	12.21	32.31	-	-	P	H
		215.27	31.43	-12.07	43.5	36.16	15.18	12.42	32.33	-	-	P	H
		644.01	39.68	-6.32	46	31.05	26.39	14.26	32.02	100	0	P	H
		701.24	37.83	-8.17	46	29.1	26.43	14.45	32.15	-	-	P	H
		927.8	114.64	-	-	101.34	29.74	15.15	31.59	116	180	P	H
		69.77	32.27	-7.73	40	41.16	12.18	11.29	32.36	101	345	Q	V
		115.36	30.54	-12.96	43.5	33.94	17.14	11.72	32.26	-	-	P	V
		262.8	29.94	-16.06	46	29.49	20.07	12.73	32.35	-	-	P	V
		412.18	33.78	-12.22	46	30.3	22.32	13.35	32.19	-	-	P	V
		644.01	38.36	-7.64	46	29.73	26.39	14.26	32.02	-	-	P	V
		708.03	38.01	-7.99	46	29.2	26.52	14.46	32.17	-	-	P	V
		927.8	112.21	-	-	98.91	29.74	15.15	31.59	100	53	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

<FSK 150Kbps FHSS>

FSK (Harmonic @ 3m)

FSK ANT 4	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK CH 01 902.4Hz		2707.2	46.74	-27.26	74	71.21	27.81	9.05	61.33	100	0	P	H
		3609.6	38.96	-35.04	74	59.58	29.1	10.7	60.42	100	0	P	H
		2707.2	46.13	-27.87	74	70.6	27.81	9.05	61.33	100	0	P	V
		3609.6	39.07	-34.93	74	59.69	29.1	10.7	60.42	100	0	P	V
FSK CH 32 914.8MHz		2745	46.66	-27.34	74	70.96	27.89	9.11	61.3	100	0	P	H
		3660	38.59	-35.41	74	59.07	29.12	10.74	60.34	100	0	P	H
		2745	47.77	-26.23	74	72.07	27.89	9.11	61.3	100	0	P	V
		3660	39.47	-34.53	74	59.95	29.12	10.74	60.34	100	0	P	V
FSK CH 64 927.6MHz		2782.8	46.54	-27.46	74	70.53	28.1	9.18	61.27	100	0	P	H
		3710.4	38.92	-35.08	74	59.22	29.2	10.76	60.26	100	0	P	H
		2782.8	49.67	-24.33	74	73.66	28.1	9.18	61.27	100	0	P	V
		3710.4	38.42	-35.58	74	58.72	29.2	10.76	60.26	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

FSK (LF)

FSK	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
ANT				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
4		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
FSK CH 01 902.4MHz LF		105.66	28.94	-14.56	43.5	33.08	16.49	11.62	32.25	-	-	P	H
		215.27	30.58	-12.92	43.5	35.31	15.18	12.42	32.33	-	-	P	H
		368.53	31.4	-14.6	46	29.67	20.83	13.15	32.25	-	-	P	H
		460.68	34.75	-11.25	46	29.98	23.39	13.51	32.13	-	-	P	H
		519.85	35.76	-10.24	46	30.06	24.01	13.75	32.06	-	-	P	H
		624.61	37.71	-8.29	46	29.55	25.96	14.18	31.98	100	0	P	H
		902.4	115.06	-	-	102.82	29.05	15.08	31.89	195	180	P	H
		69.77	32.95	-7.05	40	41.84	12.18	11.29	32.36	100	359	Q	V
		249.22	28.92	-17.08	46	30.14	18.46	12.66	32.34	-	-	P	V
		365.62	31.42	-14.58	46	29.72	20.82	13.14	32.26	-	-	P	V
		418.97	33.68	-12.32	46	29.88	22.62	13.36	32.18	-	-	P	V
		561.56	37.8	-8.2	46	29.65	26.17	13.97	31.99	-	-	P	V
		671.17	39.56	-6.44	46	31	26.27	14.37	32.08	-	-	P	V
		902.4	113.47	-	-	101.23	29.05	15.08	31.89	100	52	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

FSK ANT 4	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK CH 32 914.8MHz LF		103.72	29.1	-14.4	43.5	33.47	16.29	11.59	32.25	-	-	P	H
		215.27	28.43	-15.07	43.5	33.16	15.18	12.42	32.33	-	-	P	H
		375.32	31.12	-14.88	46	29.23	20.94	13.19	32.24	-	-	P	H
		492.69	35.86	-10.14	46	30.52	23.82	13.62	32.1	-	-	P	H
		581.93	38.59	-7.41	46	30.8	25.69	14.05	31.95	-	-	P	H
		669.23	38.67	-7.33	46	30.14	26.25	14.36	32.08	100	0	P	H
		914.8	115.06	-	-	102.36	29.34	15.11	31.75	179	178	P	H
		69.77	33.48	-6.52	40	42.37	12.18	11.29	32.36	103	356	Q	V
		253.1	29.58	-16.42	46	30.25	18.99	12.68	32.34	-	-	P	V
		425.76	33.76	-12.24	46	29.73	22.81	13.39	32.17	-	-	P	V
		506.27	36.13	-9.87	46	30.51	24.03	13.67	32.08	-	-	P	V
		568.35	37.68	-8.32	46	29.6	26.05	14	31.97	-	-	P	V
		648.86	39.05	-6.95	46	30.44	26.37	14.27	32.03	-	-	P	V
		914.8	113.34	-	-	100.64	29.34	15.11	31.75	110	55	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

FSK ANT 4	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK CH 64 927.6MHz LF		114.39	29.41	-14.09	43.5	32.85	17.12	11.7	32.26	-	-	P	H
		264.74	29.84	-16.16	46	29.41	20.04	12.74	32.35	-	-	P	H
		380.17	31.66	-14.34	46	29.58	21.1	13.21	32.23	-	-	P	H
		442.25	35.11	-10.89	46	30.82	22.99	13.45	32.15	-	-	P	H
		560.59	38.87	-7.13	46	30.71	26.18	13.97	31.99	100	0	P	H
		677.96	38.62	-7.38	46	29.94	26.39	14.39	32.1	-	-	P	H
		927.6	114.31	-	-	101.02	29.73	15.15	31.59	176	172	P	H
		69.77	33.24	-6.76	40	42.13	12.18	11.29	32.36	100	352	Q	V
		189.08	28.03	-15.47	43.5	33.37	14.71	12.26	32.31	-	-	P	V
		267.65	29.61	-16.39	46	29.67	19.53	12.76	32.35	-	-	P	V
		368.53	31.19	-14.81	46	29.46	20.83	13.15	32.25	-	-	P	V
		471.35	35.39	-10.61	46	30.43	23.53	13.55	32.12	-	-	P	V
		544.1	36.36	-9.64	46	29.89	24.61	13.88	32.02	-	-	P	V
		927.6	112.37	-	-	99.08	29.73	15.15	31.59	100	47	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

<FSK 250Kbps FHSS>

FSK (Harmonic @ 3m)

FSK ANT 4	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK CH 01 902.5MHz		2707.5	45.53	-28.47	74	70	27.81	9.05	61.33	100	0	P	H
		3610	39.43	-34.57	74	60.05	29.1	10.7	60.42	100	0	P	H
		2707.5	46.79	-27.21	74	71.26	27.81	9.05	61.33	100	0	P	V
		3610	39.95	-34.05	74	60.57	29.1	10.7	60.42	100	0	P	V
FSK CH 26 915MHz		2745	43.39	-30.61	74	67.69	27.89	9.11	61.3	100	0	P	H
		3660	40.52	-33.48	74	61	29.12	10.74	60.34	100	0	P	H
		2745	46.09	-27.91	74	70.39	27.89	9.11	61.3	100	0	P	V
		3660	38.95	-35.05	74	59.43	29.12	10.74	60.34	100	0	P	V
FSK CH 51 927.5MHz		2782.5	43.38	-30.62	74	67.37	28.1	9.18	61.27	100	0	P	H
		3710	39.06	-34.94	74	59.36	29.2	10.76	60.26	100	0	P	H
		2782.5	42.79	-31.21	74	66.78	28.1	9.18	61.27	100	0	P	V
		3710	39.23	-34.77	74	59.53	29.2	10.76	60.26	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

FSK (LF)

FSK	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
ANT				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
4		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
FSK CH 01 902.5MHz LF		70.74	27.92	-12.08	40	36.71	12.28	11.29	32.36	-	-	P	H
		113.42	28.89	-14.61	43.5	32.37	17.09	11.69	32.26	-	-	P	H
		191.99	28.08	-15.42	43.5	33.41	14.71	12.27	32.31	-	-	P	H
		215.27	29.41	-14.09	43.5	34.14	15.18	12.42	32.33	-	-	P	H
		262.8	29.67	-16.33	46	29.22	20.07	12.73	32.35	-	-	P	H
		690.57	39.78	-6.22	46	31.12	26.37	14.42	32.13	100	0	P	H
		902.03	115.23	-	-	103.01	29.04	15.08	31.9	116	175	P	H
		30.97	32.43	-7.57	40	29.76	24.09	10.79	32.21	-	-	P	V
		69.77	32.82	-7.18	40	41.71	12.18	11.29	32.36	100	353	Q	V
		116.33	30.1	-13.4	43.5	33.41	17.22	11.73	32.26	-	-	P	V
		182.29	28.4	-15.1	43.5	33.69	14.8	12.22	32.31	-	-	P	V
		572.23	37.89	-8.11	46	29.89	25.95	14.02	31.97	-	-	P	V
		655.65	38.7	-7.3	46	30.14	26.31	14.3	32.05	-	-	P	V
		902.03	113.58	-	-	101.36	29.04	15.08	31.9	100	51	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

FSK ANT 4	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK CH 26 915MHz LF		99.84	29.18	-14.32	43.5	34.12	15.76	11.55	32.25	-	-	P	H
		191.02	29.87	-13.63	43.5	35.22	14.7	12.26	32.31	-	-	P	H
		326.82	30.82	-15.18	46	30.55	19.6	12.99	32.32	-	-	P	H
		453.89	34.26	-11.74	46	29.68	23.23	13.49	32.14	-	-	P	H
		559.62	37.78	-8.22	46	29.65	26.17	13.95	31.99	-	-	P	H
		626.55	38.33	-7.67	46	30.07	26.04	14.2	31.98	100	0	P	H
		915	114.92	-	-	102.21	29.34	15.11	31.74	192	181	P	H
		68.8	31.7	-8.3	40	40.76	12.03	11.27	32.36	100	353	Q	V
		259.89	29.87	-16.13	46	29.41	20.08	12.72	32.34	-	-	P	V
		371.44	31.47	-14.53	46	29.68	20.87	13.17	32.25	-	-	P	V
		449.04	33.93	-12.07	46	29.5	23.1	13.48	32.15	-	-	P	V
		554.77	37.58	-8.42	46	29.8	25.85	13.93	32	-	-	P	V
		625.58	38.61	-7.39	46	30.39	26	14.2	31.98	-	-	P	V
		915	113.34	-	-	100.63	29.34	15.11	31.74	100	60	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

FSK ANT 4	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FSK CH 51 927.5MHz LF		92.08	28.88	-14.62	43.5	34.8	14.86	11.5	32.28	-	-	P	H
		216.24	29.66	-16.34	46	34.33	15.24	12.42	32.33	-	-	P	H
		301.6	29.78	-16.22	46	29.95	19.24	12.95	32.36	-	-	P	H
		380.17	31.35	-14.65	46	29.27	21.1	13.21	32.23	-	-	P	H
		511.12	35.61	-10.39	46	29.96	24.02	13.7	32.07	-	-	P	H
		574.17	37.57	-8.43	46	29.61	25.89	14.03	31.96	100	0	P	H
		927.5	114.3	-	-	101.03	29.72	15.15	31.6	197	182	P	H
		70.74	32.47	-7.53	40	41.26	12.28	11.29	32.36	100	346	Q	V
		252.13	29.57	-16.43	46	30.39	18.85	12.67	32.34	-	-	P	V
		361.74	30.76	-15.24	46	29.17	20.74	13.11	32.26	-	-	P	V
		435.46	34.42	-11.58	46	30.26	22.89	13.43	32.16	-	-	P	V
		551.86	37.44	-8.56	46	30.02	25.5	13.92	32	-	-	P	V
		626.55	38.13	-7.87	46	29.87	26.04	14.2	31.98	-	-	P	V
		927.5	112.19	-	-	98.92	29.72	15.15	31.6	100	56	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Note symbol

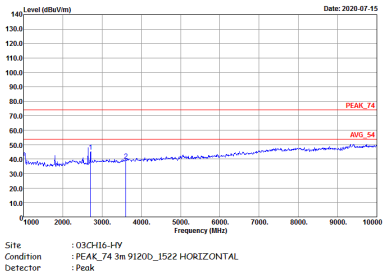
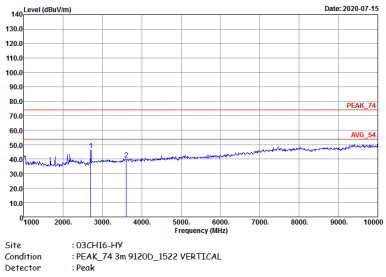
*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

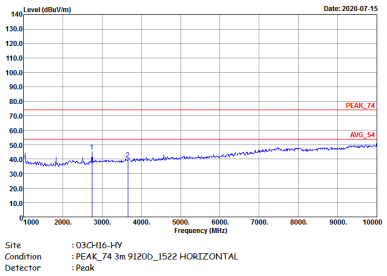
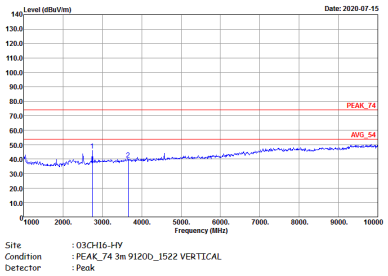
Appendix D. Radiated Spurious Emission Plots

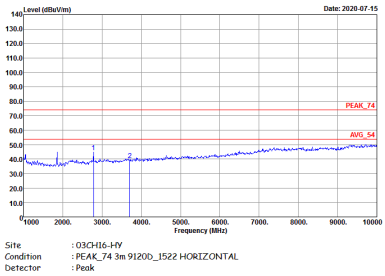
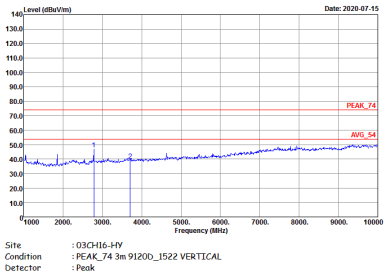
Test Engineer :	Karl Hou, Andy Yang, and CR Liro	Temperature :	20~25°C
		Relative Humidity :	50~60%

<LoRa FHSS>

LoRa (Harmonic @ 3m)

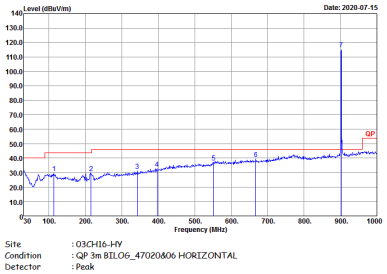
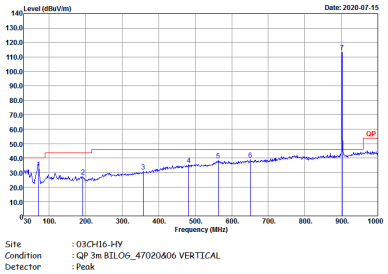
LoRa	902~928MHz Harmonic @ 3m	
ANT	LoRa CH01 902.2MHz	
4	Horizontal	Vertical
Peak Avg.	 	

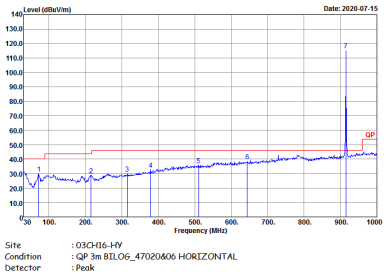
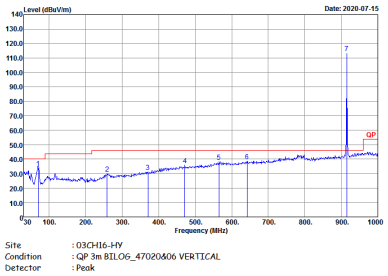
LoRa	902~928MHz Harmonic @ 3m	
ANT	LoRa Ch65 915MHz	
4	Horizontal	Vertical
Peak Avg.		

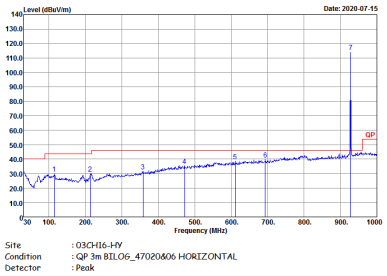
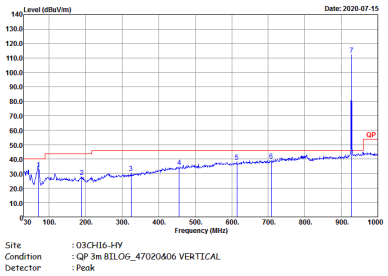
LoRa	902~928MHz Harmonic @ 3m	
ANT	LoRa Ch129 927.8MHz	
4	Horizontal	Vertical
Peak Avg.	 	

Emission below 1GHz

LoRa (LF)

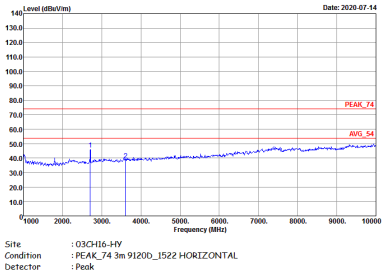
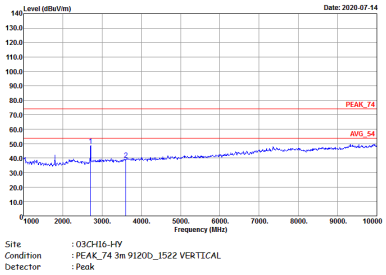
LoRa	902~928MHz	
ANT	LoRa Ch01 902.2MHz LF	
4	Horizontal	Vertical
QP / Peak		

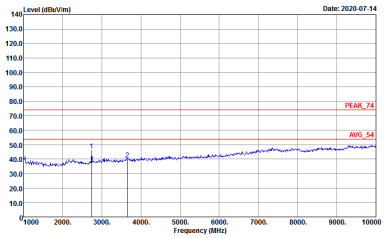
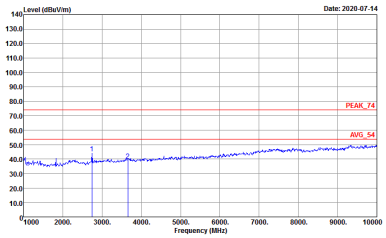
LoRa	902~928MHz	
ANT	LoRa Ch65 915MHz LF	
4	Horizontal	Vertical
QP / Peak		

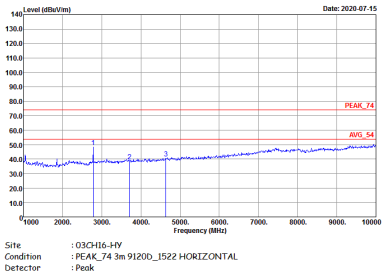
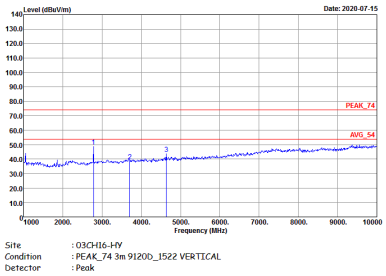
LoRa	902~928MHz	
ANT	LoRa Ch129 927.8MHz LF	
4	Horizontal	Vertical
QP / Peak		

<FSK 50Kbps FHSS>

FSK (Harmonic @ 3m)

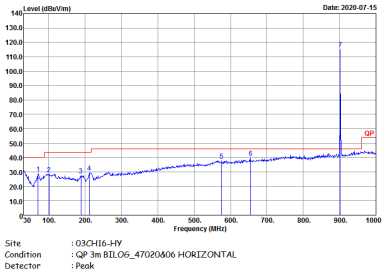
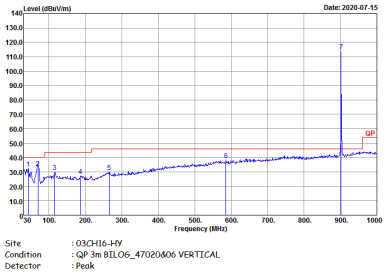
FSK	902~928MHz Harmonic @ 3m	
ANT	FSK Ch01 902.2MHz	
4	Horizontal	Vertical
Peak Avg.		

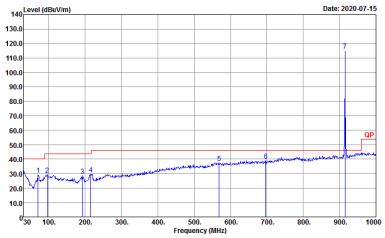
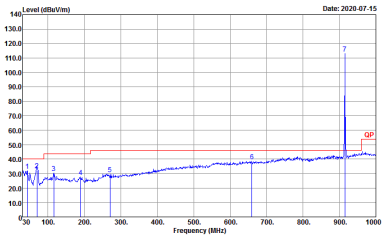
FSK	902~928MHz Harmonic @ 3m	
ANT	FSK Ch65 915MHz	
4	Horizontal	Vertical
Peak Avg.		

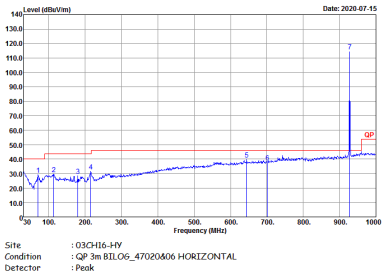
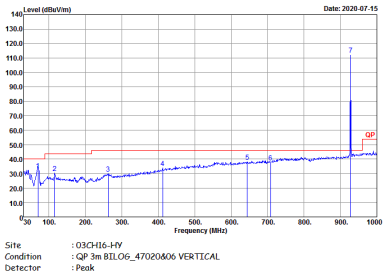
FSK	902~928MHz Harmonic @ 3m	
ANT	FSK Ch129 927.8MHz	
4	Horizontal	Vertical
Peak Avg.		

Emission below 1GHz

FSK (LF)

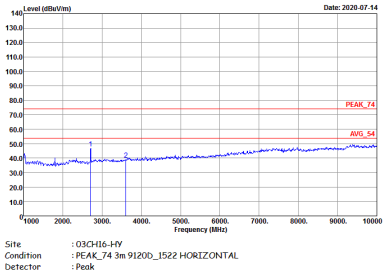
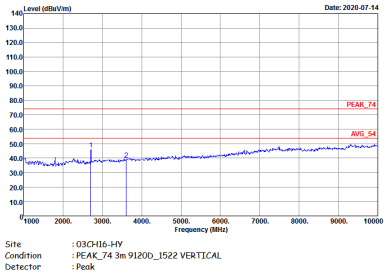
FSK	902~928MHz	
ANT	FSK Ch01 902.2MHz LF	
4	Horizontal	Vertical
QP / Peak		

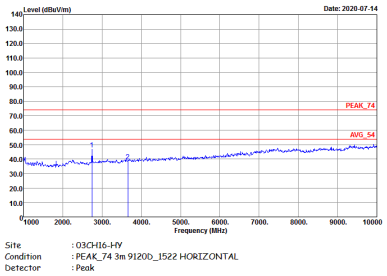
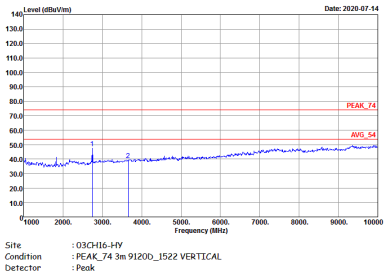
FSK	902~928MHz	
ANT	FSK Ch65 915MHz LF	
4	Horizontal	Vertical
QP / Peak	 Site : 03CH16-HY Condition : QP 3m BILOG_47020&06 HORIZONTAL Detector : Peak	 Site : 03CH16-HY Condition : QP 3m BILOG_47020&06 VERTICAL Detector : Peak

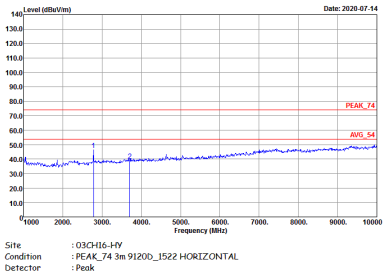
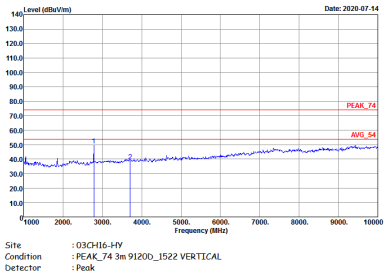
FSK	902~928MHz	
ANT	FSK Ch129 927.8MHz LF	
4	Horizontal	Vertical
QP / Peak		

<FSK 150Kbps FHSS>

FSK (Harmonic @ 3m)

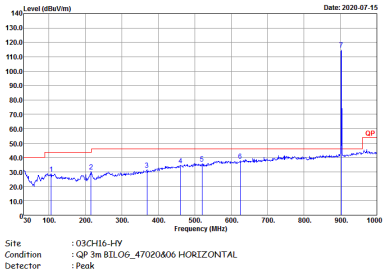
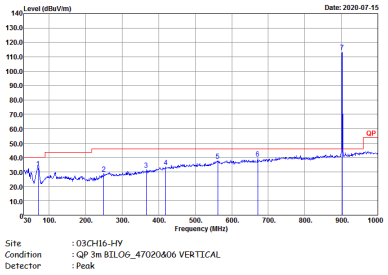
FSK	902~928MHz Harmonic @ 3m	
ANT	FSK Ch01 902.4MHz	
4	Horizontal	Vertical
Peak Avg.		

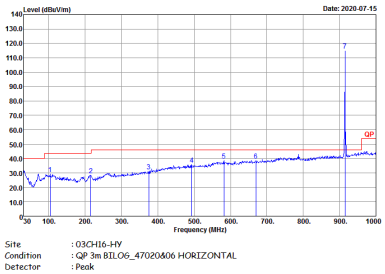
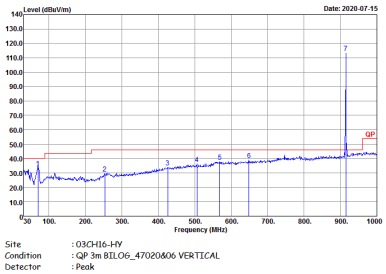
FSK	902~928MHz Harmonic @ 3m	
ANT	FSK Ch32 914.8MHz	
4	Horizontal	Vertical
Peak Avg.		

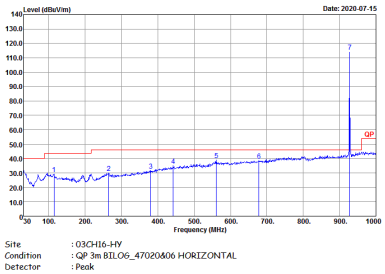
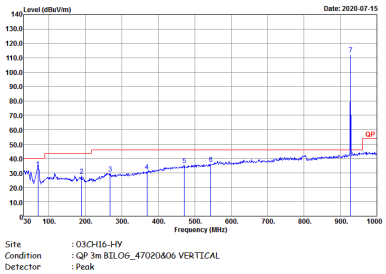
FSK	902~928MHz Harmonic @ 3m	
ANT	FSK Ch64 927.6MHz	
4	Horizontal	Vertical
Peak Avg.		

Emission below 1GHz

FSK (LF)

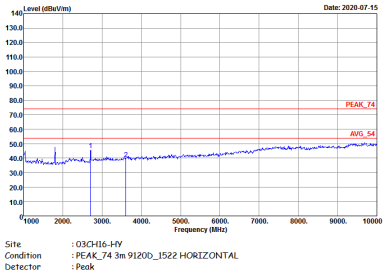
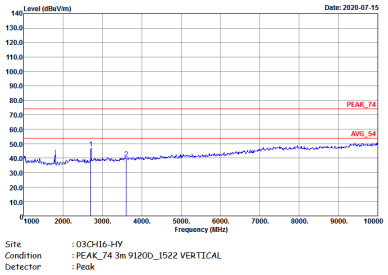
FSK	902~928MHz	
ANT	FSK Ch01 902.4MHz LF	
4	Horizontal	Vertical
QP / Peak		

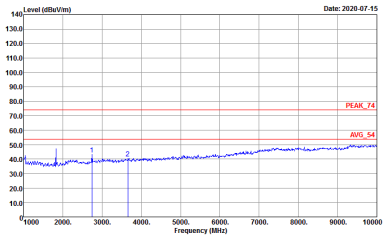
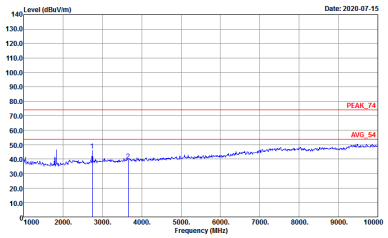
FSK	902~928MHz	
ANT	FSK Ch32 914.8MHz LF	
4	Horizontal	Vertical
QP / Peak		

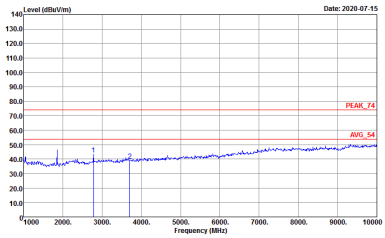
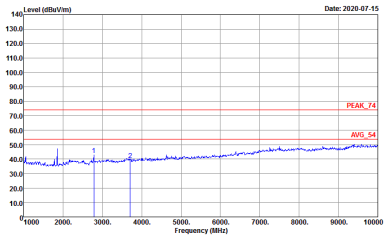
FSK	902~928MHz	
ANT	FSK Ch64 927.6MHz LF	
4	Horizontal	Vertical
QP / Peak		

<FSK 250Kbps FHSS>

FSK (Harmonic @ 3m)

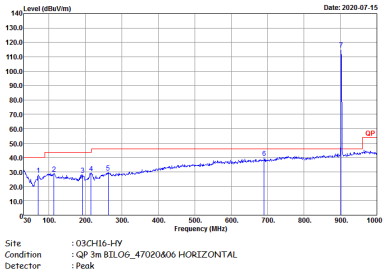
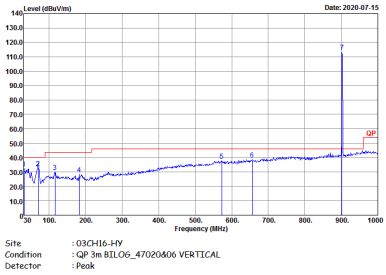
FSK	902~928MHz Harmonic @ 3m	
ANT	FSK Ch01 902.5MHz	
4	Horizontal	Vertical
Peak Avg.		

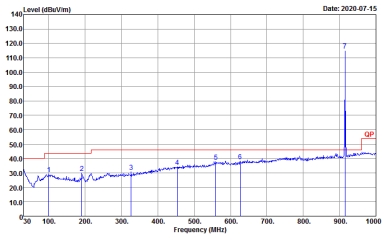
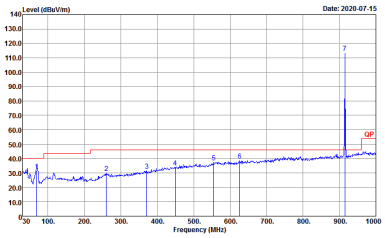
FSK	902~928MHz Harmonic @ 3m	
ANT	FSK Ch26 915MHz	
4	Horizontal	Vertical
Peak Avg.		

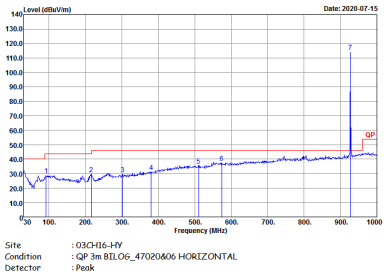
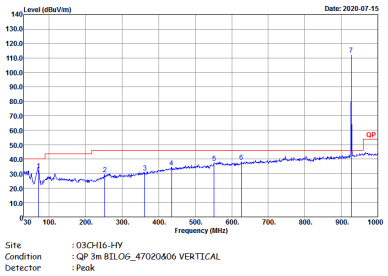
FSK	902~928MHz Harmonic @ 3m	
ANT	FSK Ch51 927.5MHz	
4	Horizontal	Vertical
Peak		

Emission below 1GHz

FSK (LF)

FSK	902~928MHz	
ANT	FSK Ch01 902.5MHz LF	
4	Horizontal	Vertical
QP / Peak		

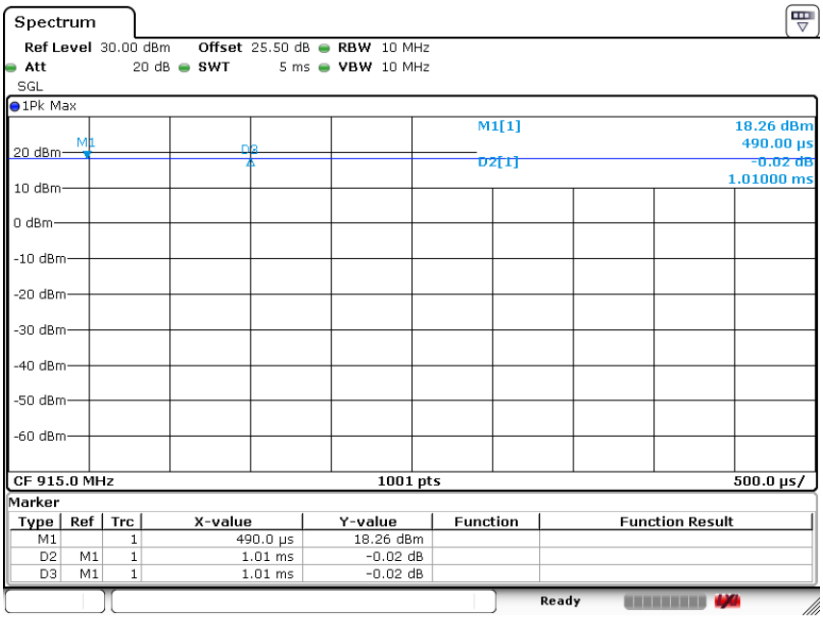
FSK	902~928MHz	
ANT	FSK Ch26 915MHz LF	
4	Horizontal	Vertical
QP / Peak	 Site : 03CH16-HY Condition : QP 3m BILOG_47020&06 HORIZONTAL Detector : Peak	 Site : 03CH16-HY Condition : QP 3m BILOG_47020&06 VERTICAL Detector : Peak

FSK	902~928MHz	
ANT	FSK Ch51 927.5MHz LF	
4	Horizontal	Vertical
QP / Peak		

Appendix E. Duty Cycle Plots

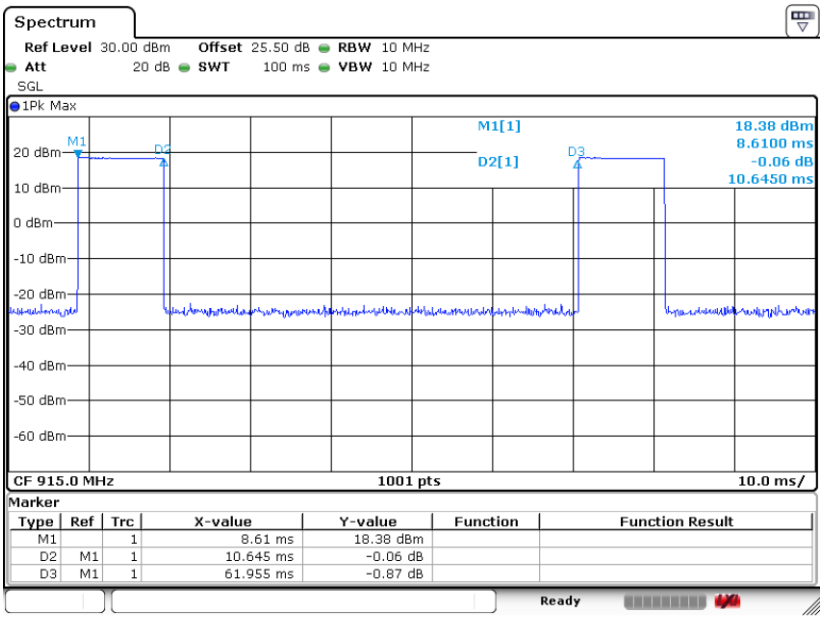
Antenna	Band	Duty Cycle (%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor (dB)
4	LoRa FHSS	100.00	-	-	10Hz	0.00
4	FSK 50Kbps FHSS	17.18	10645.00	0.09	1 kHz	7.65
4	FSK 150Kbps FHSS	6.59	3625.00	0.28	1 kHz	11.81
4	FSK 250Kbps FHSS	4.17	2230.00	0.45	1 kHz	13.80

LoRa FHSS



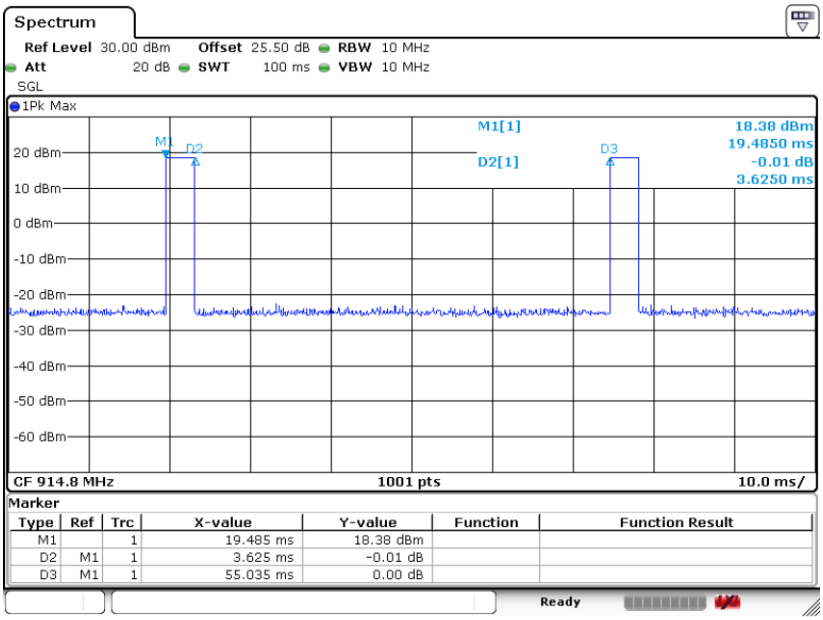
Date: 13.JUL.2020 15:10:42

FSK 50Kbps FHSS



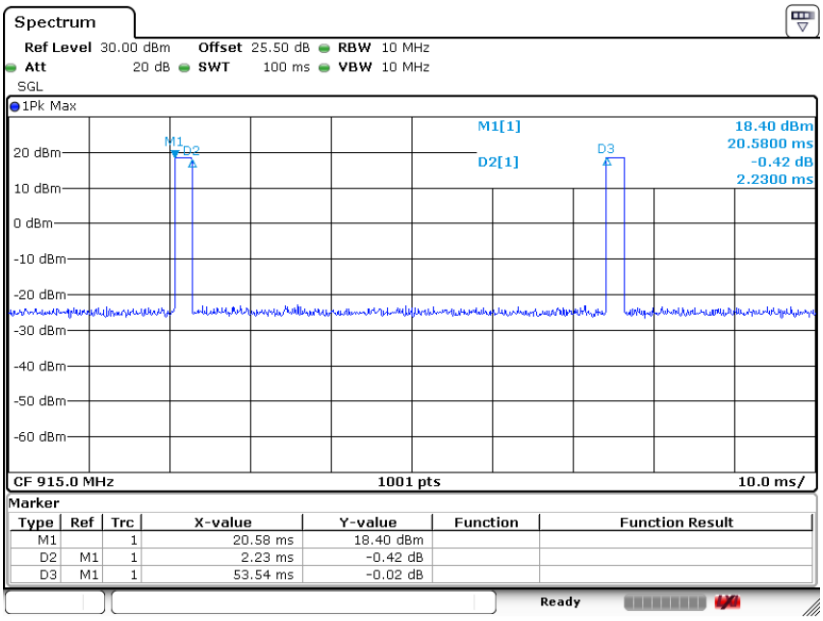
Date: 13.JUL.2020 14:31:00

FSK 150Kbps FHSS



Date: 13.JUL.2020 14:48:55

FSK 250Kbps FHSS



———THE END———