

APPENDIX REPORT

Project No.	SHT2009048102EW	Radio Specification	LORA
Test sample No.	YPHT20090481004	Model No.	ABX00029
Start test date	2020/11/27	Finish date	2020/11/27
Temperature	25°C	Humidity	50%
Test Engineer	Jiongsheng.Feng	Auditor	Xiaodong Zheo

Appendix clause	Test item	Result
A	Peak Output Power	PASS
B	20 dB Bandwidth	PASS
C	99% Occupied Bandwidth	PASS
D	Carrier Frequencies Separation	PASS
E	Hopping Channel Number	PASS
F	Dwell Time	PASS
G	Duty Cycle Correction Factor (DCCF)	PASS
H	Band edge and Spurious Emissions(coducted)	PASS

Appendix A: Peak Output Power

Modulation type	Channel	Output power (dBm)	Average Output power (dBm)	Limit (dBm)	Result
LORA	CH-L	4.22	4.16	≤ 30.00	Pass
	CH-M	3.96	3.90		
	CH-H	3.78	3.69		

Appendix B : 20 dB Bandwidth

Modulation type	Channel	20 dB Bandwidth (kHz)	Limit (kHz)	Result
LORA	CH-L	139.20	500	Pass
	CH-M	140.70		
	CH-H	139.80		

Modulation Type:

LORA

CH-L

Spectrum
Ref Level 20.00 dBm Offset 1.00 dB RBW 3 kHz
Att 30 dB SWT 632.1 μ s VBW 10 kHz Mode Auto FFT
Count 300/300

1PK View

CF 902.3 MHz 1001 pts Span 300.0 kHz

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1	1		902.2313 MHz	-17.44 dBm		
M2	1		902.2499 MHz	2.82 dBm		
D3	M1	1	139.2 kHz	-0.10 dB		

Date: 27/NOV/2020 11:28:24

CH-M

Spectrum
Ref Level 20.00 dBm Offset 1.00 dB RBW 3 kHz
Att 30 dB SWT 632.1 μ s VBW 10 kHz Mode Auto FFT
Count 300/300

1PK View

CF 908.5 MHz 1001 pts Span 300.0 kHz

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1	1		908.4316 MHz	-17.39 dBm		
M2	1		908.449 MHz	2.68 dBm		
D3	M1	1	140.7 kHz	-0.03 dB		

Date: 27/NOV/2020 14:05:51

CH-H

Spectrum
Ref Level 20.00 dBm Offset 1.00 dB RBW 3 kHz
Att 30 dB SWT 632.1 μ s VBW 10 kHz Mode Auto FFT
Count 300/300

1PK View

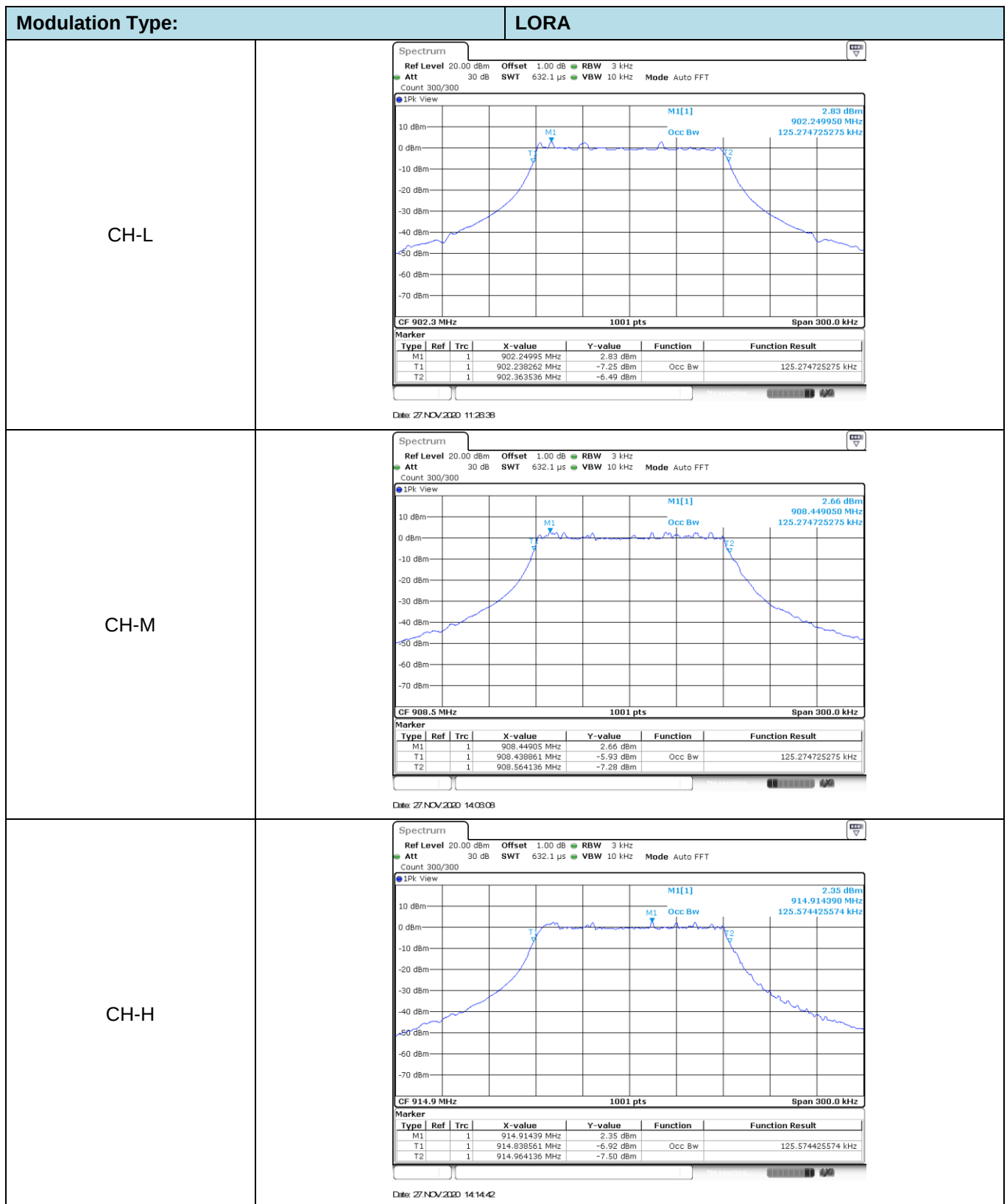
CF 914.9 MHz 1001 pts Span 300.0 kHz

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1	1		914.8316 MHz	-17.63 dBm		
M2	1		914.9432 MHz	2.42 dBm		
D3	M1	1	139.8 kHz	-0.39 dB		

Date: 27/NOV/2020 14:14:30

Appendix C: 99% Occupied Bandwidth

Modulation type	Channel	99% Occupied Bandwidth (MHz)	Limit (MHz)	Result
LORA	CH-L	0.13	-	Pass
	CH-M	0.13		
	CH-H	0.13		



Appendix D: Carrier Frequencies Separation

Modulation type	Channel	Carrier Frequencies Separation (MHz)	Limit (kHz) *	Result
LORA	CH-L	0.2	≥ 140.7	Pass
LORA	CH-M	0.2	≥ 140.7	Pass
LORA	CH-H	0.2	≥ 140.7	Pass

Note:

*: GFSK limit = The maximum 20 dB Bandwidth for GFSK modulation on the appendix B.

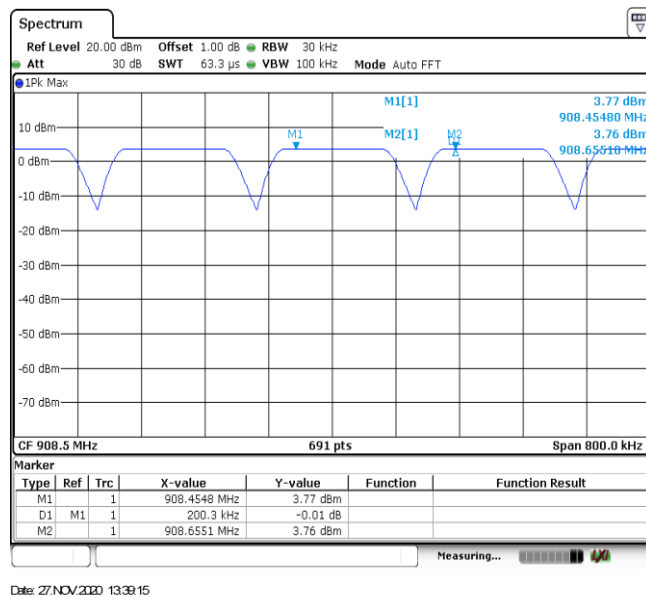
$\pi/4$ DQPSK limit = $2/3$ * The maximum 20 dB Bandwidth for $\pi/4$ DQPSK modulation on the appendix B.

8DPSK limit = $2/3$ * The maximum 20 dB Bandwidth for 8DPSK modulation on the appendix B

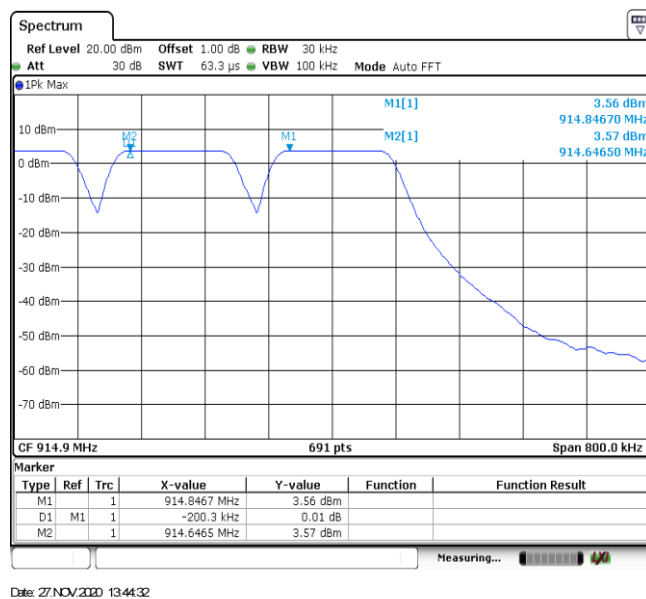
CH-L



CH-M

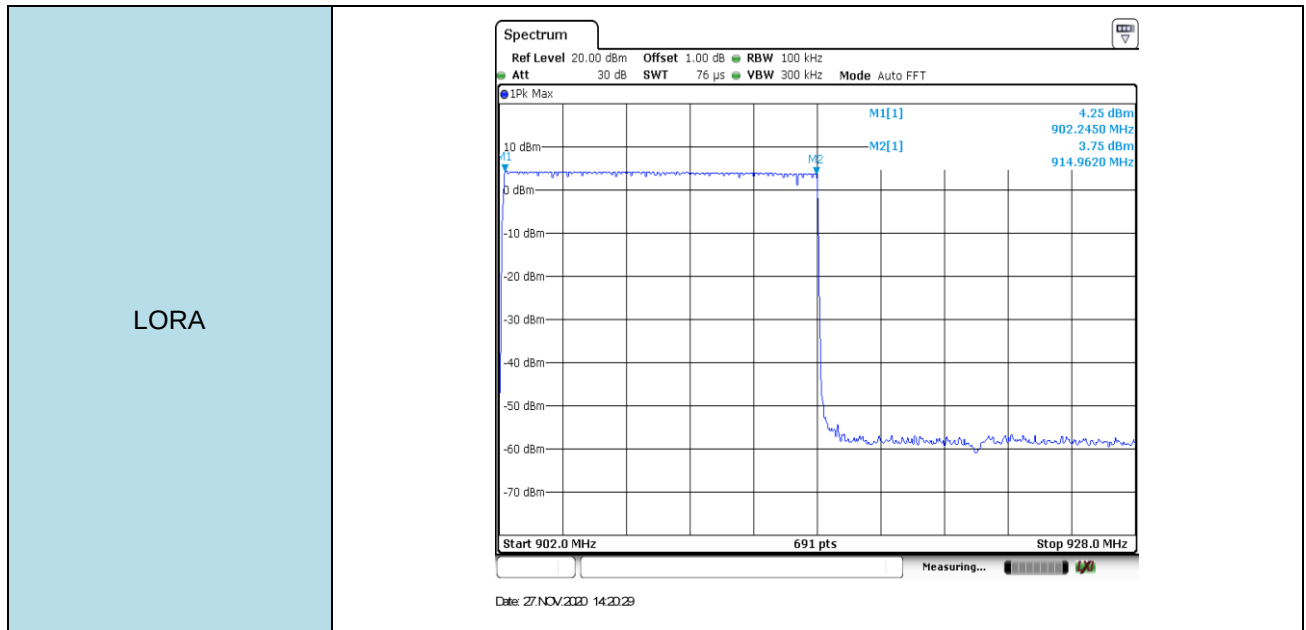


CH-H



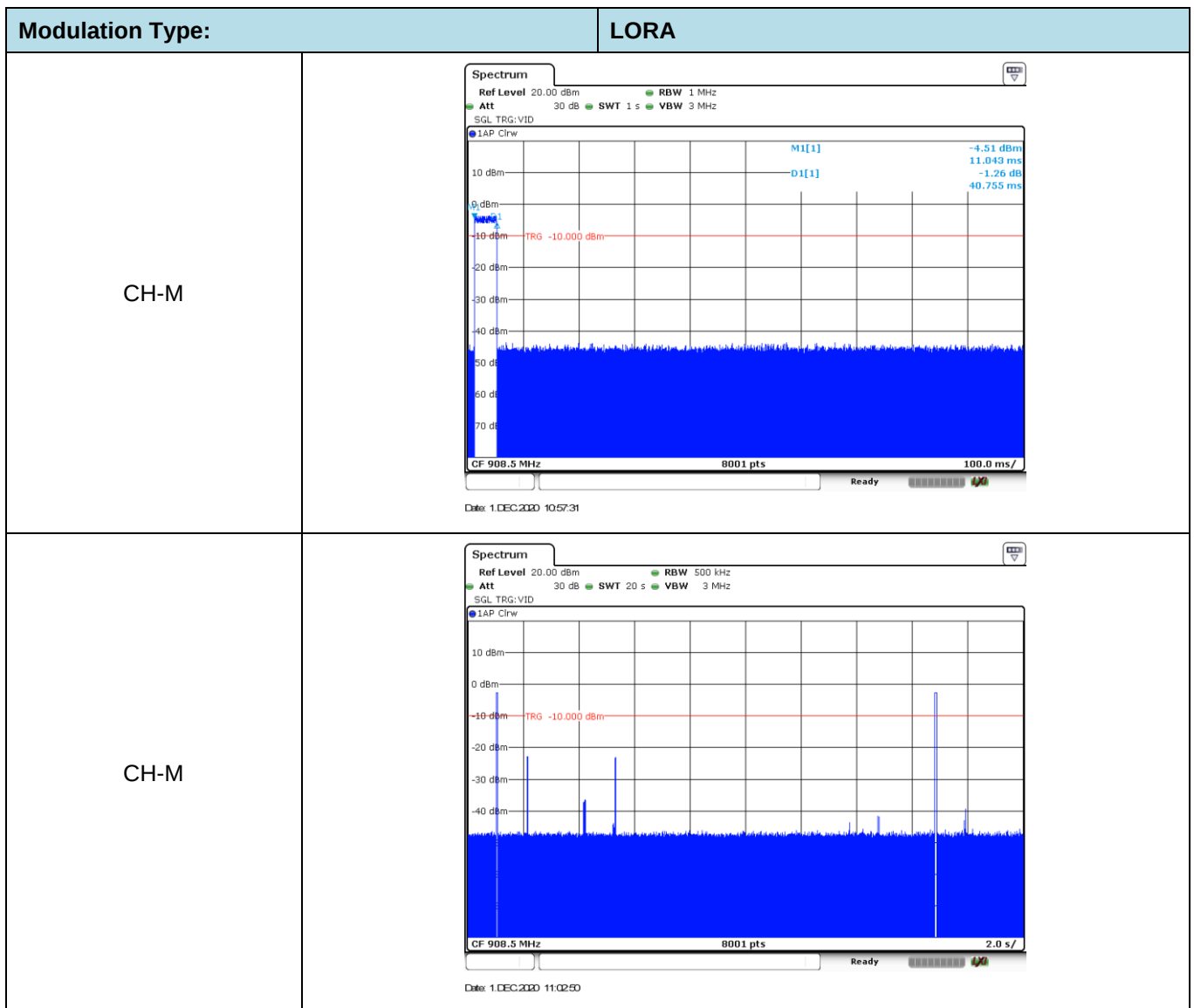
Appendix E: Hopping Channel Number

Modulation type	Channel number	Limit	Result
LORA	63	≥50	Pass



Appendix F: Dwell Time

Modulation type	Burst Width [ms]	Total Hops[hop*ch]	Dwell time (Second)	Limit (Second)	Result
LORA	40.76	4	0.16	≤ 0.40	Pass

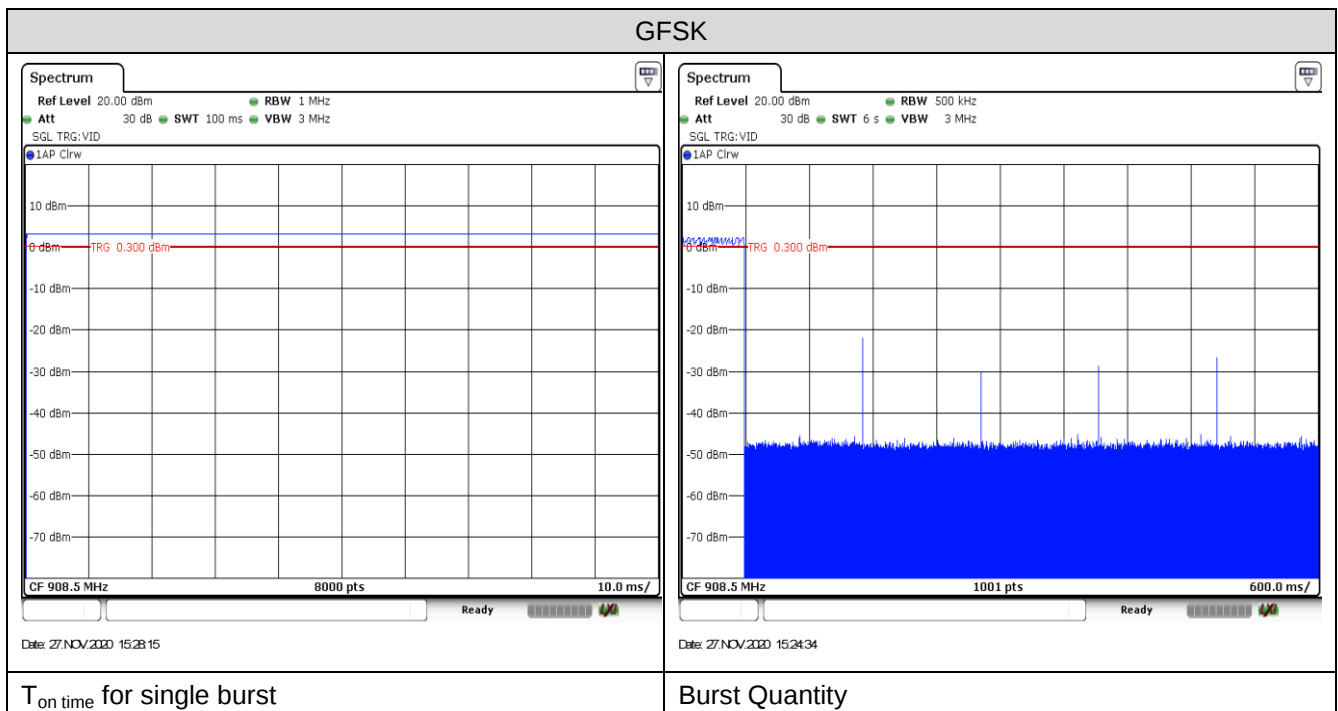


Appendix G: Duty Cycle Correction Factor (DCCF)

DCCF Calculate Formula

$$\text{DCCF} = 20 * \text{Log}(\text{duty cycle}) = 20 * \text{Log}(T_{\text{on time}} / T_{\text{period}})$$

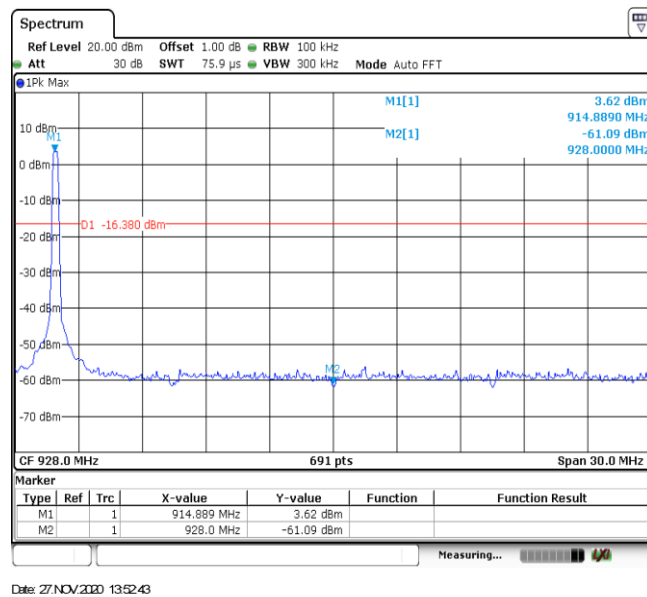
Modulation type	Test Frequency (MHz)	T _{on time} for single burst [ms]	T _{period} [ms]	Burst Quantity	DCCF [dB]
LORA	908.5	1.00	100	1.00	-40.00



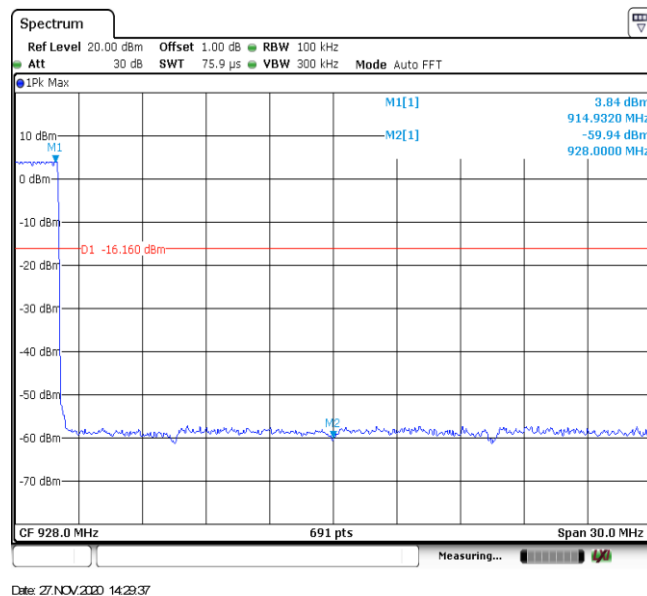
Appendix H: Band edge and Spurious Emissions (conducted)

Test Item:	Band edge	Modulation type:	LORA																					
CH-L No hopping mode	Spectrum Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWT 19 μs VBW 300 kHz Mode Auto FFT 1Pk Max M1[1] 4.05 dBm 902.24310 MHz M2[1] -39.09 dBm 902.00000 MHz D1 -15.950 dBm CF 902.0 MHz 691 pts Span 6.0 MHz <table><tr><th>Type</th><th>Ref</th><th>Trc</th><th>X-value</th><th>Y-value</th><th>Function</th><th>Function Result</th></tr><tr><td>M1</td><td>1</td><td></td><td>902.2431 MHz</td><td>4.05 dBm</td><td></td><td></td></tr><tr><td>M2</td><td>1</td><td></td><td>902.0 MHz</td><td>-39.09 dBm</td><td></td><td></td></tr></table> Measuring... Date: 27/NOV/2020 13:49:33			Type	Ref	Trc	X-value	Y-value	Function	Function Result	M1	1		902.2431 MHz	4.05 dBm			M2	1		902.0 MHz	-39.09 dBm		
Type	Ref	Trc	X-value	Y-value	Function	Function Result																		
M1	1		902.2431 MHz	4.05 dBm																				
M2	1		902.0 MHz	-39.09 dBm																				
CH-L Hopping mode	Spectrum Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWT 19 μs VBW 300 kHz Mode Auto FFT 1Pk Max M2[1] -42.48 dBm 902.00000 MHz M1[1] 4.26 dBm 902.25180 MHz D1 -15.740 dBm CF 902.0 MHz 691 pts Span 6.0 MHz <table><tr><th>Type</th><th>Ref</th><th>Trc</th><th>X-value</th><th>Y-value</th><th>Function</th><th>Function Result</th></tr><tr><td>M1</td><td>1</td><td></td><td>902.2518 MHz</td><td>4.26 dBm</td><td></td><td></td></tr><tr><td>M2</td><td>1</td><td></td><td>902.0000 MHz</td><td>-42.48 dBm</td><td></td><td></td></tr></table> Measuring... Date: 27/NOV/2020 14:24:00			Type	Ref	Trc	X-value	Y-value	Function	Function Result	M1	1		902.2518 MHz	4.26 dBm			M2	1		902.0000 MHz	-42.48 dBm		
Type	Ref	Trc	X-value	Y-value	Function	Function Result																		
M1	1		902.2518 MHz	4.26 dBm																				
M2	1		902.0000 MHz	-42.48 dBm																				

CH-H
No hopping mode

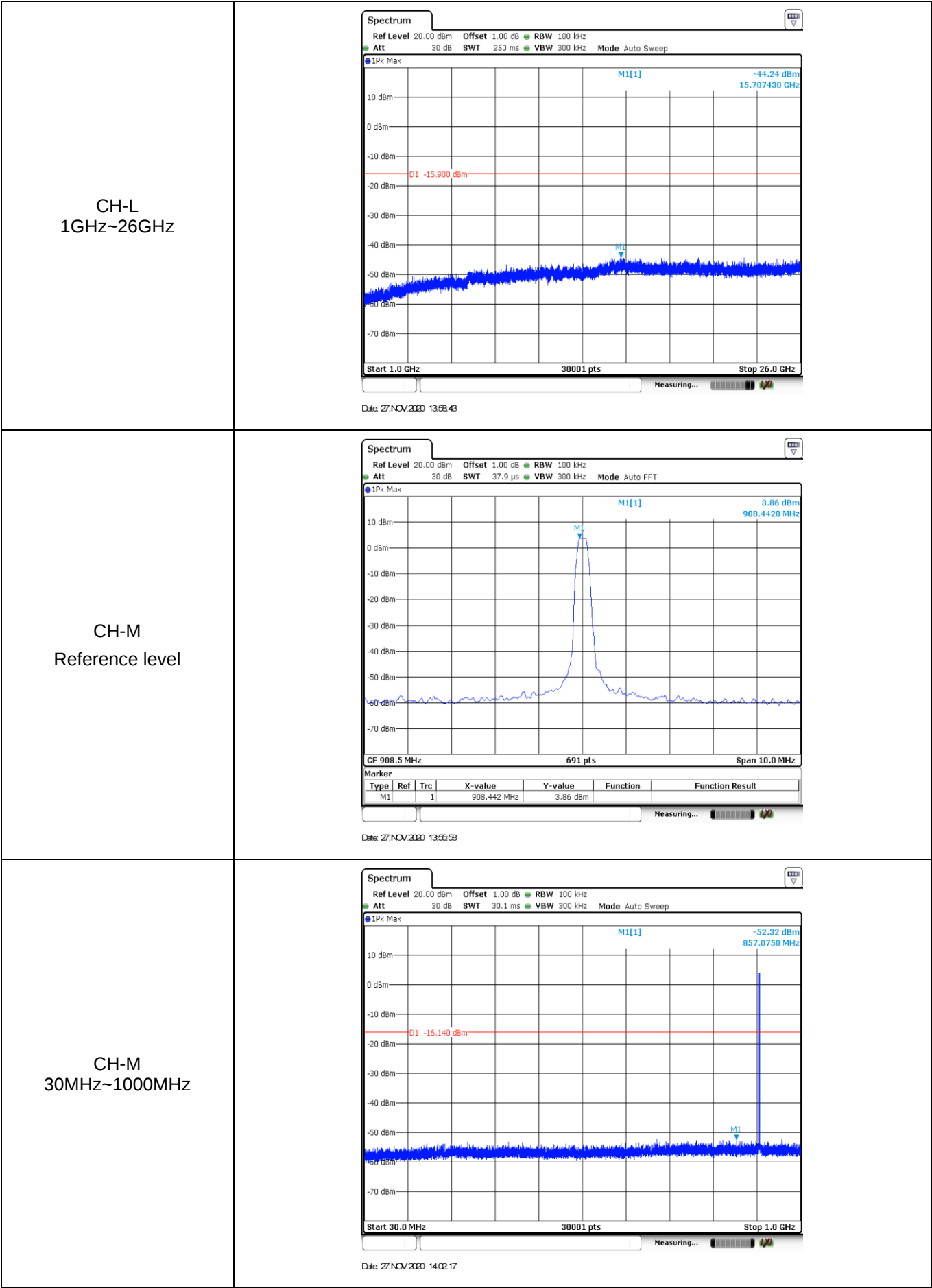


CH-H
Hopping mode



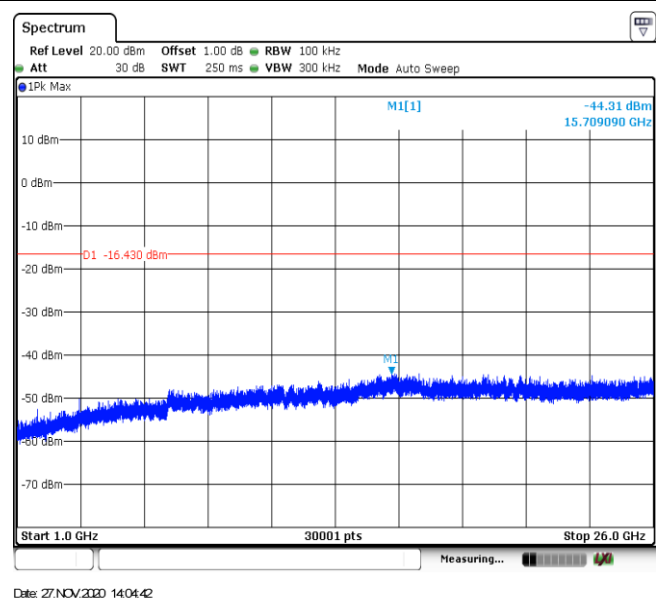
Test Item:	Spurious Emission	Modulation type:	LORA																
CH-L Reference level	Spectrum Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWT 37.9 μs VBW 300 kHz Mode Auto FFT 1Pk Max CF 902.3 MHz 691 pts Span 10.0 MHz <table><thead><tr><th>Marker</th><th>Type</th><th>Ref</th><th>Trc</th><th>X-value</th><th>Y-value</th><th>Function</th><th>Function Result</th></tr></thead><tbody><tr><td>M1</td><td></td><td></td><td>1</td><td>902.242 MHz</td><td>4.10 dBm</td><td></td><td></td></tr></tbody></table> Measuring... Date: 27/NOV/2020 13:56:39			Marker	Type	Ref	Trc	X-value	Y-value	Function	Function Result	M1			1	902.242 MHz	4.10 dBm		
Marker	Type	Ref	Trc	X-value	Y-value	Function	Function Result												
M1			1	902.242 MHz	4.10 dBm														

CH-L 30MHz~1000MHz	Spectrum Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWT 30.1 ms VBW 300 kHz Mode Auto Sweep 1Pk Max Start 30.0 MHz 30001 pts Stop 1.0 GHz Measuring... Date: 27/NOV/2020 13:57:57		
-----------------------	--	--	--



CH-M 1GHz~26GHz	Spectrum Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWT 250 ms VBW 300 kHz Mode Auto Sweep 1Pk Max M1[1] -43.85 dBm 15.749930 GHz D1 -16.140 dBm Start 1.0 GHz 30001 pts Stop 26.0 GHz Measuring... Date: 27/NOV/2020 14:03:14														
CH-H Reference level	Spectrum Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWT 37.9 μs VBW 300 kHz Mode Auto FFT 1Pk Max M1[1] 3.57 dBm 914.9140 MHz CF 914.9 MHz 691 pts Span 10.0 MHz <table><tr><th>Type</th><th>Ref</th><th>Trc</th><th>X-value</th><th>Y-value</th><th>Function</th><th>Function Result</th></tr><tr><td>M1</td><td>1</td><td></td><td>914.914 MHz</td><td>3.57 dBm</td><td></td><td></td></tr></table> Measuring... Date: 27/NOV/2020 13:55:04	Type	Ref	Trc	X-value	Y-value	Function	Function Result	M1	1		914.914 MHz	3.57 dBm		
Type	Ref	Trc	X-value	Y-value	Function	Function Result									
M1	1		914.914 MHz	3.57 dBm											
CH-H 30MHz~1000MHz	Spectrum Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWT 30.1 ms VBW 300 kHz Mode Auto Sweep 1Pk Max M1[1] -52.46 dBm 454.6030 MHz D1 -16.430 dBm Start 30.0 MHz 30001 pts Stop 1.0 GHz Measuring... Date: 27/NOV/2020 14:04:01														

CH-H
1GHz~26GHz



-----End of Report-----