

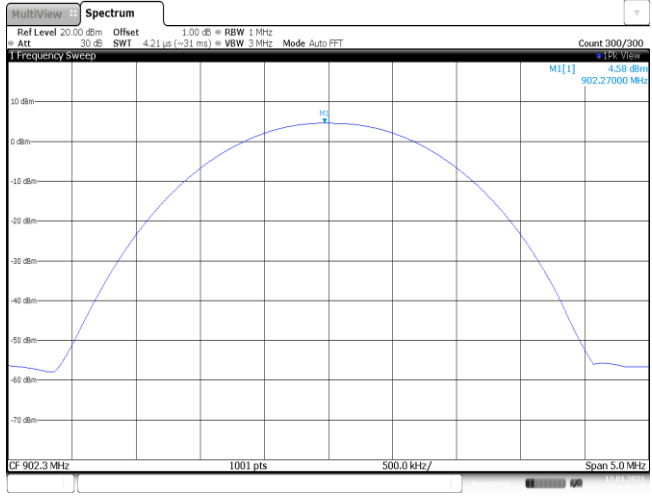
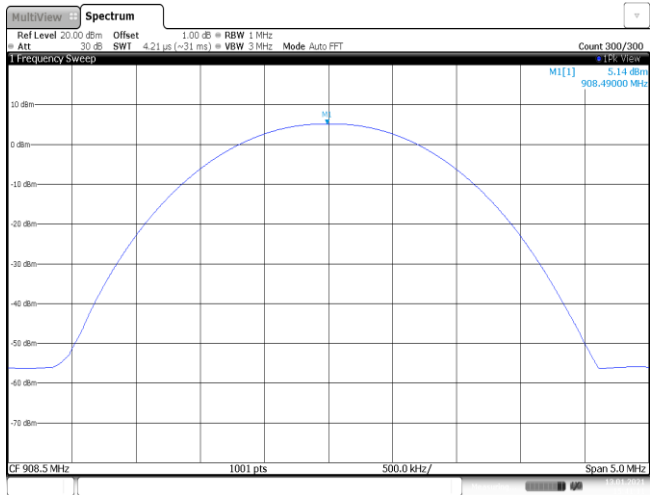
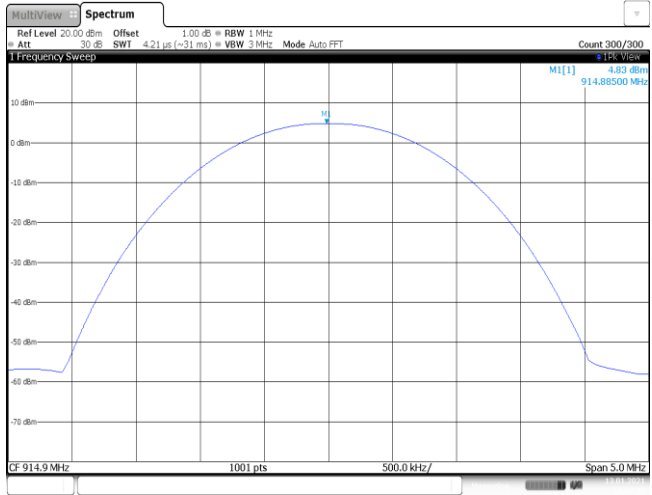
APPENDIX REPORT

Project No.	SHT1910034901EW	Radio Specification	LORA
Test sample No.	YPHT19100349002	Model No.	WA020100
Start test date	2021-01-14	Finish date	2021-01-14
Temperature	21.7°C	Humidity	26%
Test Engineer	Hailey Chen	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	4.58	4.52	≤ 30.00	Pass
	CH-M	5.14	5.06		
	CH-H	4.83	4.77		

Modulation Type:	LORA
CH-L	 MultiView Spectrum Ref Level 20.00 dBm Offset 1.00 dB RBW 1 MHz Att 30 dB SWI 4.21 μs (~31 ms) VBW 3 MHz Mode Auto FFT Count 300/300 Frequency Sweep M1[1] -4.58 dBm 902.27000 MHz CF 902.3 MHz 1001 pts 500.0 kHz/ Span 5.0 MHz Date: 13_JAN 2021 15:20:47
CH-M	 MultiView Spectrum Ref Level 20.00 dBm Offset 1.00 dB RBW 1 MHz Att 30 dB SWI 4.21 μs (~31 ms) VBW 3 MHz Mode Auto FFT Count 300/300 Frequency Sweep M1[1] -5.14 dBm 908.49000 MHz CF 908.5 MHz 1001 pts 500.0 kHz/ Span 5.0 MHz Date: 13_JAN 2021 15:41:02
CH-H	 MultiView Spectrum Ref Level 20.00 dBm Offset 1.00 dB RBW 1 MHz Att 30 dB SWI 4.21 μs (~31 ms) VBW 3 MHz Mode Auto FFT Count 300/300 Frequency Sweep M1[1] -4.83 dBm 914.88500 MHz CF 914.9 MHz 1001 pts 500.0 kHz/ Span 5.0 MHz Date: 13_JAN 2021 16:04:28

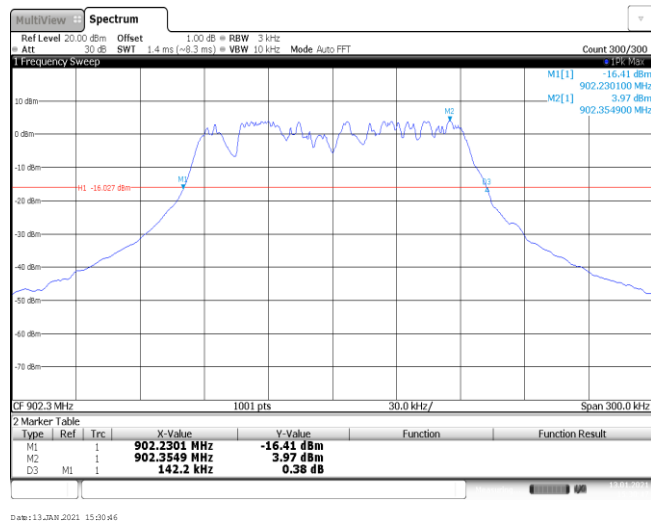
Appendix B : 20 dB Bandwidth

Modulation type	Channel	20 dB Bandwidth (kHz)	Limit (kHz)	Result
LORA	CH-L	142.20	500	Pass
	CH-M	141.90		
	CH-H	142.20		

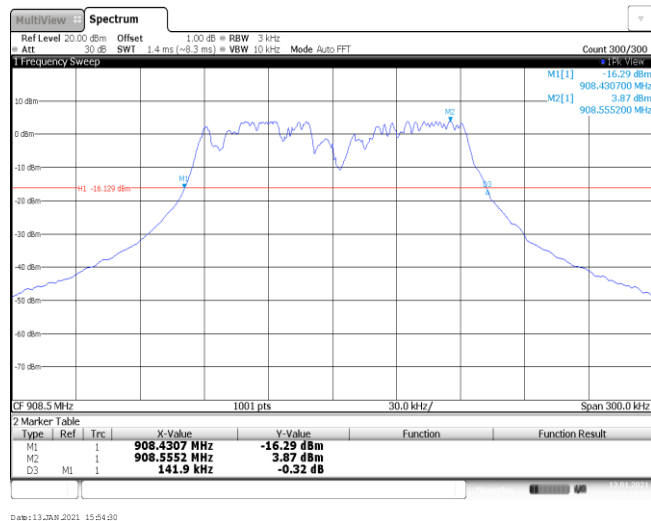
Modulation Type:

LORA

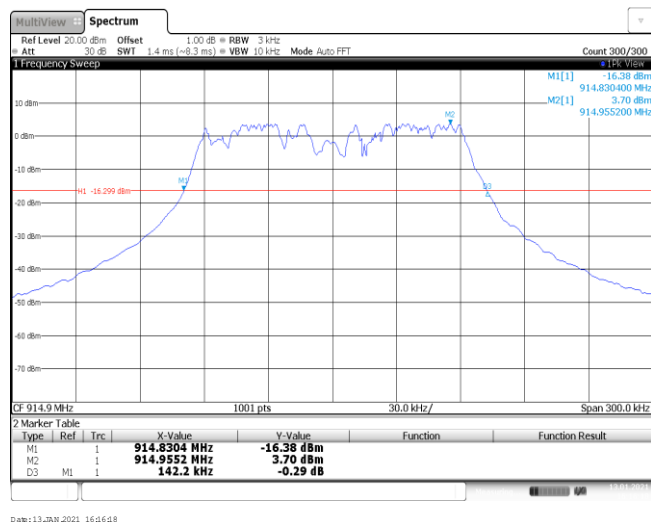
CH-L



CH-M

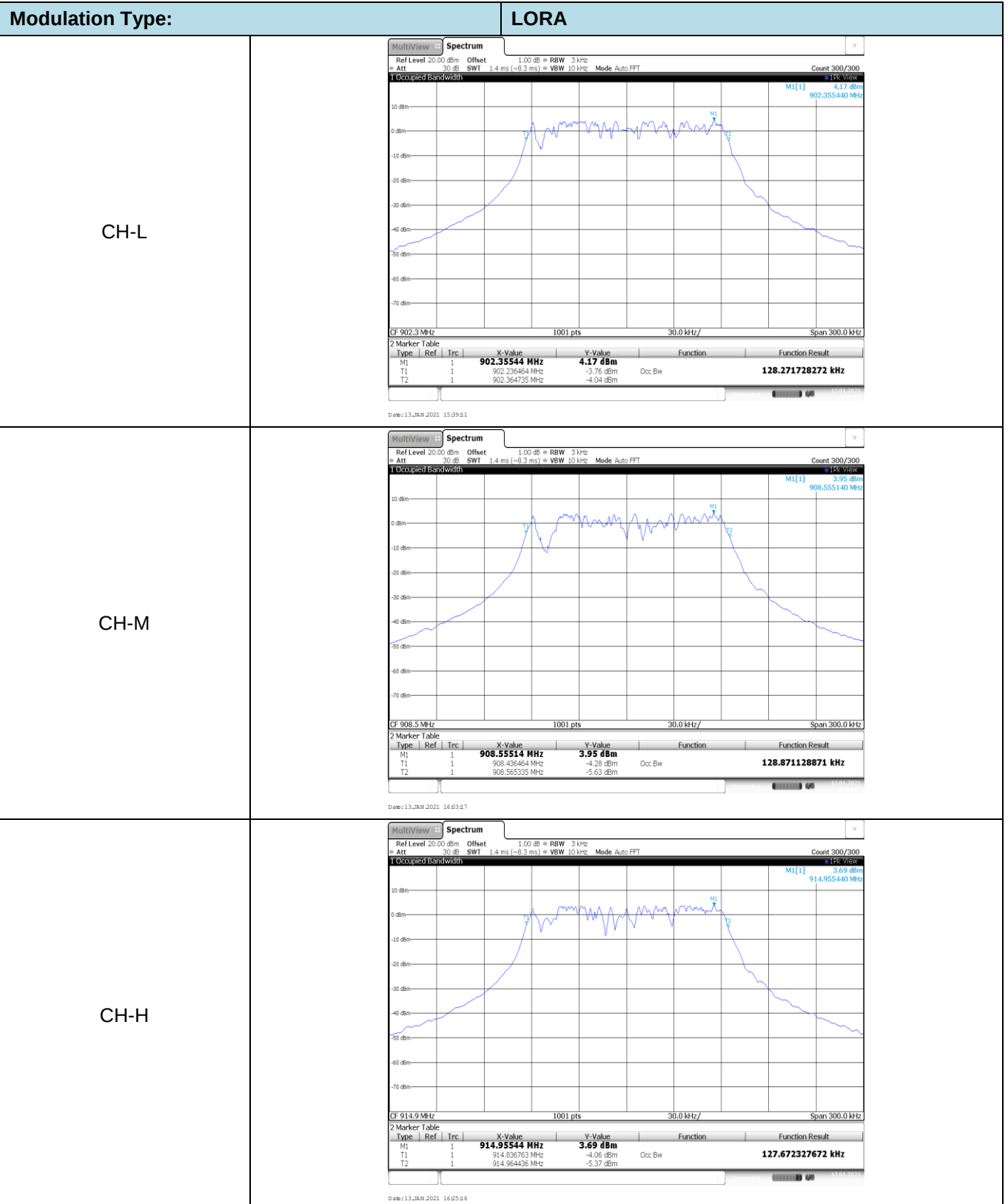


CH-H



Appendix C: 99% Occupied Bandwidth

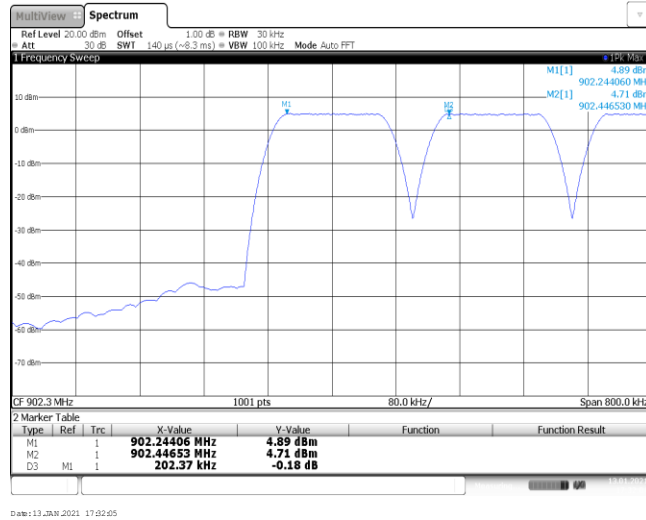
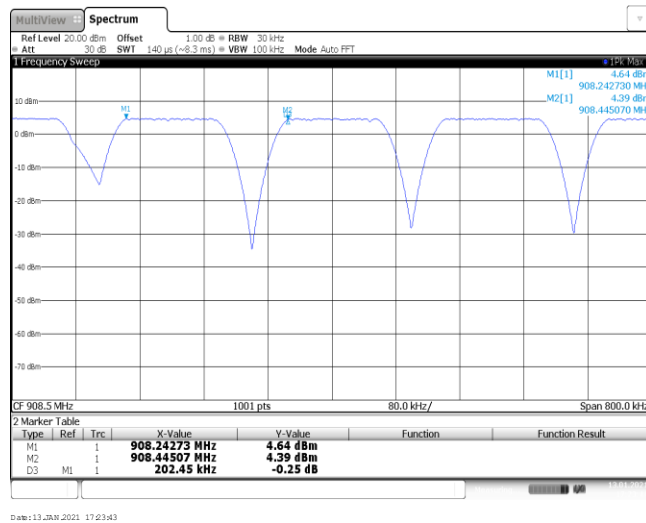
Modulation type	Channel	99% Occupied Bandwidth (MHz)	Limit (MHz)	Result
LORA	CH-L	0.13	-	Pass
	CH-M	0.13		
	CH-H	0.13		



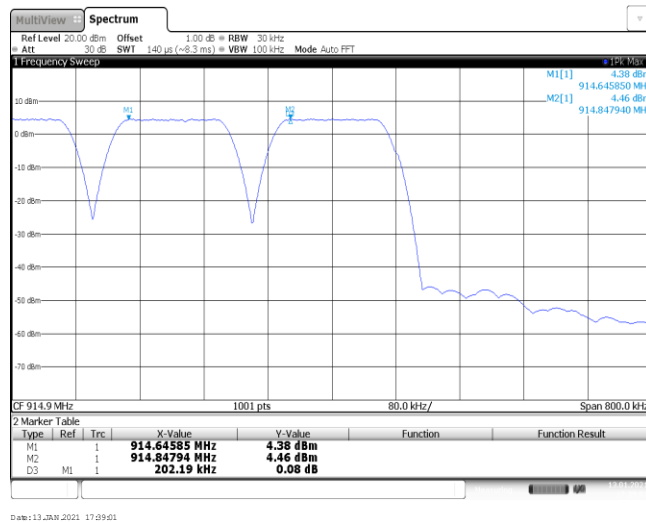
Appendix D: Carrier Frequencies Separation

Modulation type	Channel	Carrier Frequencies Separation (MHz)	Limit (kHz) *	Result
LORA	CH-L	0.2	≥ 142.20	Pass
LORA	CH-M	0.2	≥ 142.20	Pass
LORA	CH-H	0.2	≥ 142.20	Pass

GFSK

 $\pi/4$ DQPSK

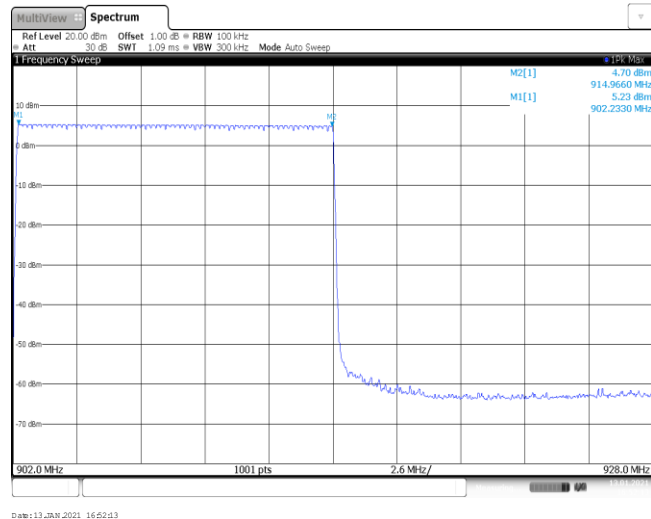
8DPSK



Appendix E: Hopping Channel Number

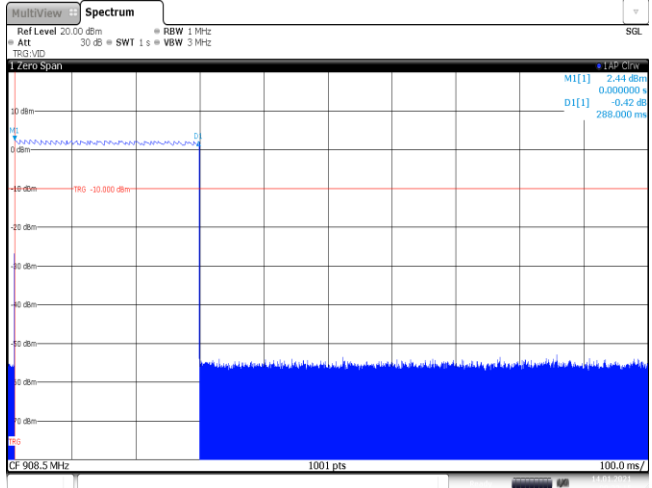
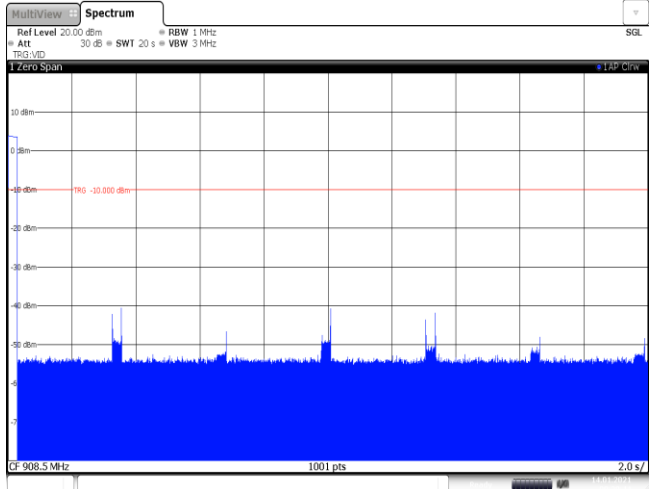
Modulation type	Channel number	Limit	Result
LORA	64	≥50	Pass

LORA



Appendix F: Dwell Time

Modulation type	Packet	Burst Width [ms]	Total Hops[hop*ch]	Dwell time (Second)	Limit (Second)	Result
LORA	CH-M	288.00	1	0.29	≤ 0.40	Pass

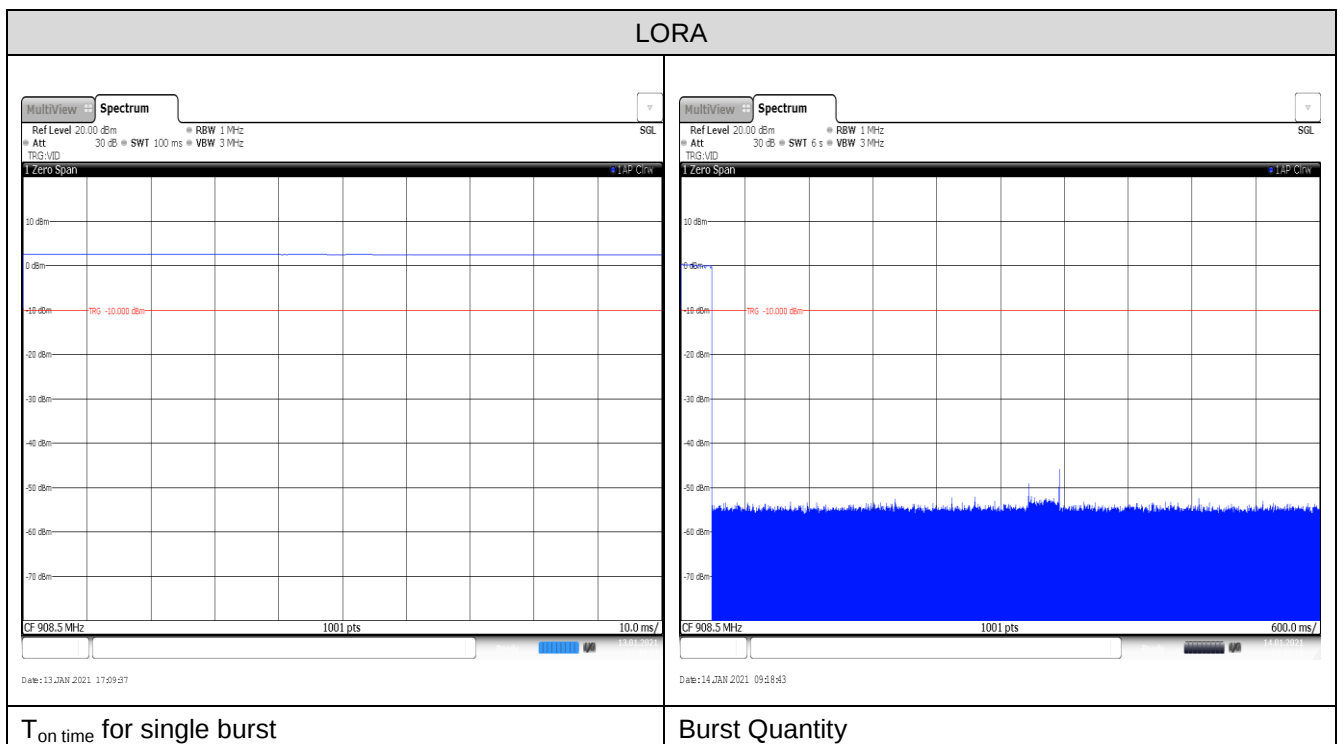
Modulation Type: LORA	
CH-M Burst width	 Ref Level 20.00 dBm Att 30 dB RBW 1 MHz SWT 1 s VBW 3 MHz TSG VID Zero Span M1[1] 2.44 dBm D1[1] -0.42 dB 288.000 ms CF 908.5 MHz 1001 pts 100.0 ms Date: 14 JAN 2021 09:23:45
CH-M Burst number	 Ref Level 20.00 dBm Att 30 dB RBW 1 MHz SWT 20 s VBW 3 MHz TSG VID Zero Span CF 908.5 MHz 1001 pts 2.0 s Date: 14 JAN 2021 09:20:44

Appendix G: Duty Cycle Correction Factor (DCCF)

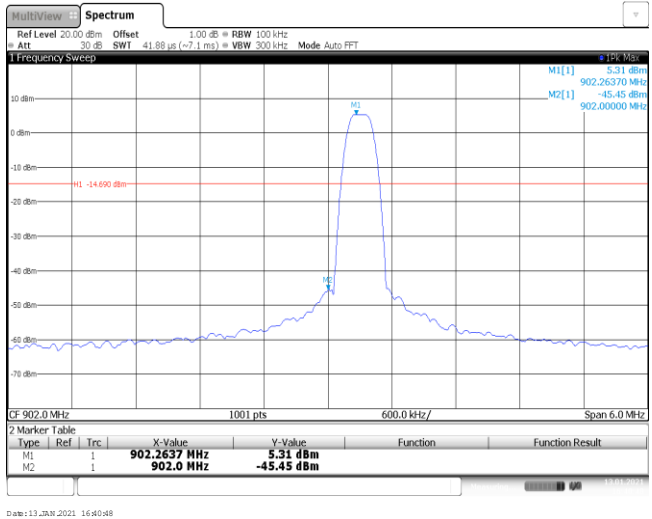
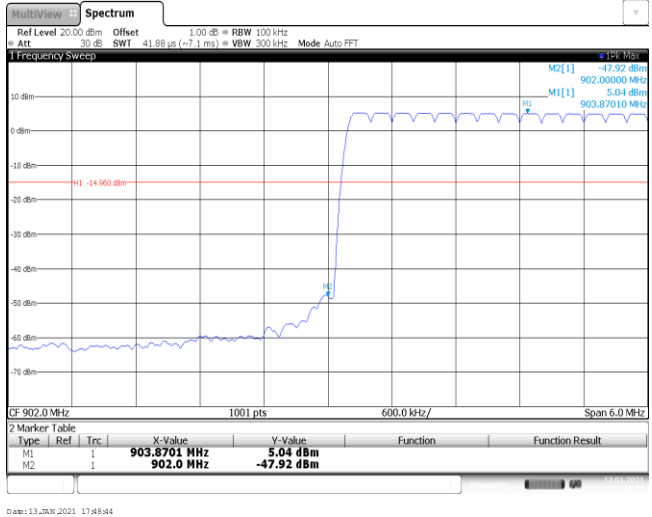
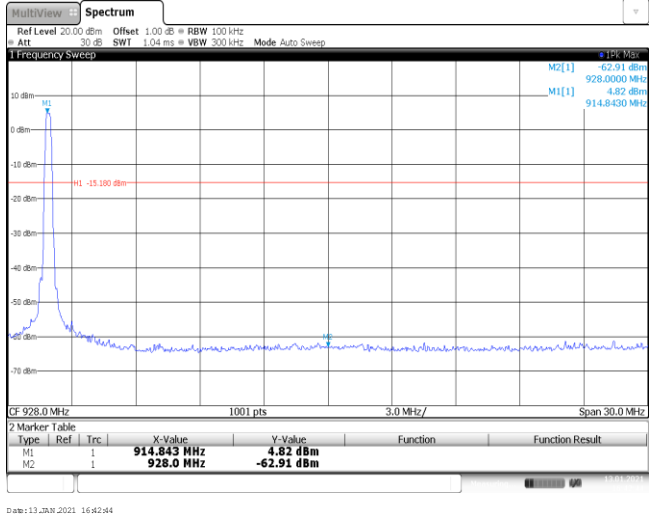
DCCF Calculate Formula

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

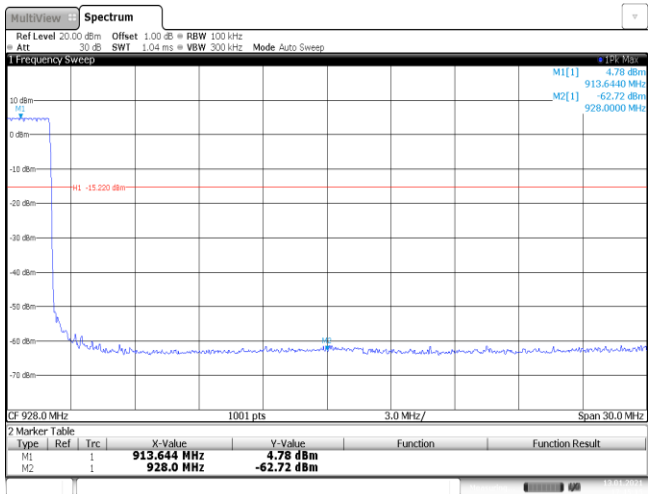
Modulation type	Test Frequency (MHz)	T _{on time} for single burst [ms]	T _{period} [ms]	Burst Quantity	DCCF [dB]
LORA	908.5	1.00	100	1	-40.00

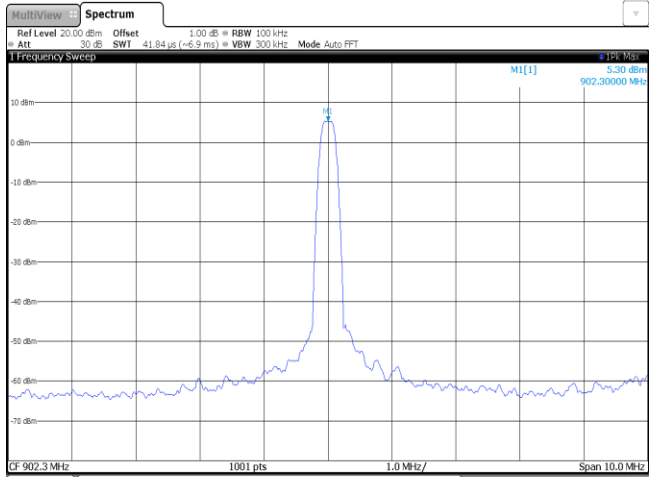
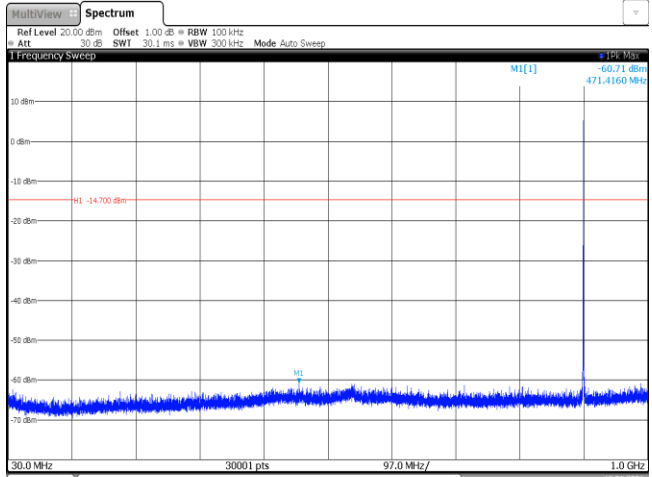
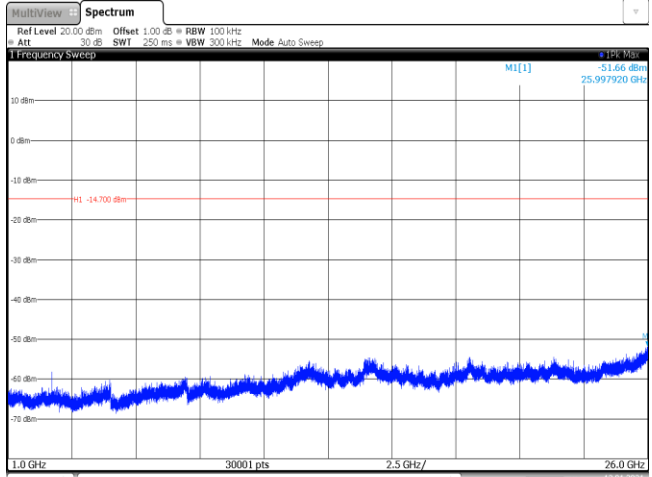


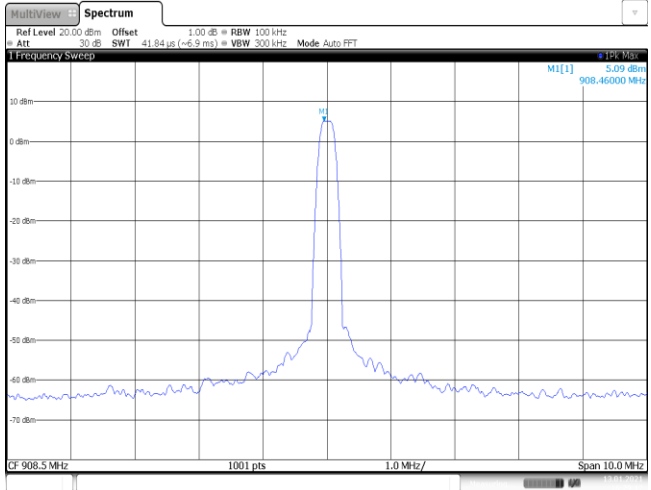
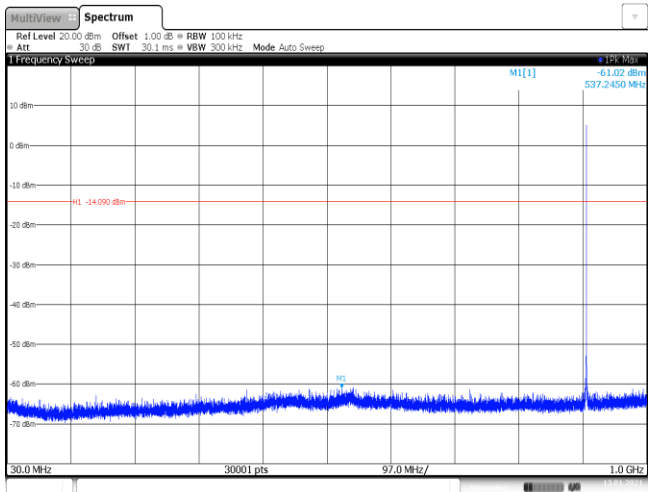
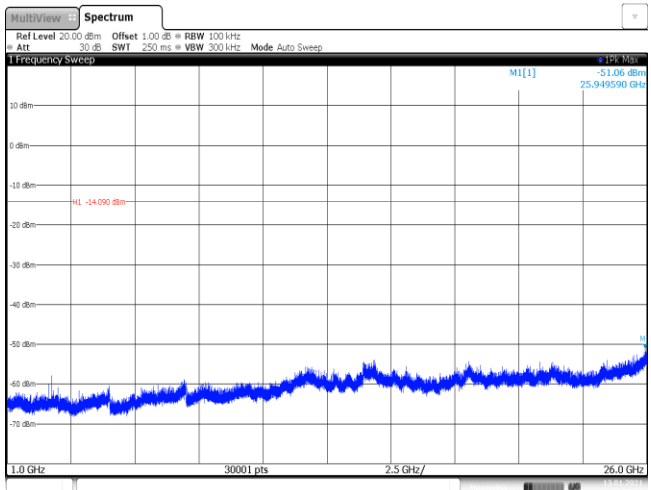
Appendix H: Band edge and Spurious Emissions (conducted)

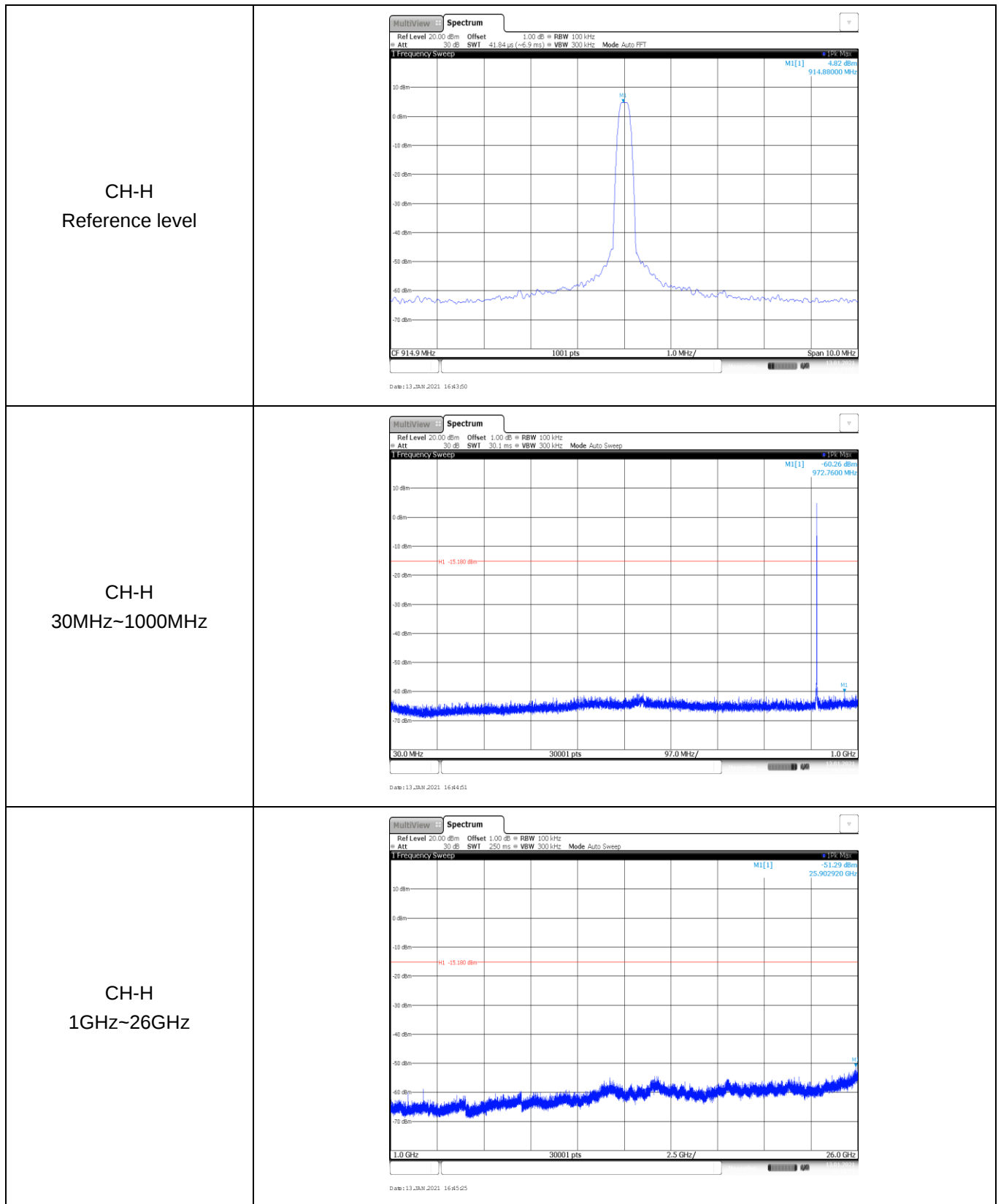
Test Item:	Band edge	Modulation type:	LORA
CH-L No hopping mode			
CH-L Hopping mode			
CH-H No hopping mode			

CH-H
Hopping mode



Test Item:	Spurious Emission	Modulation type:	LORA
CH-L Reference level	 Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWI 41.84 μs (-6.9 ms) VBW 300 kHz Mode Auto FFT 1 Frequency Sweep M1[1] 5.30 dBm 902.30000 MHz CF 902.3 MHz 1001 pts 1.0 MHz/ Span 10.0 MHz Date: 13_JAN 2021 16:25:26		
CH-L 30MHz~1000MHz	 Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWI 30.1 ms VBW 300 kHz Mode Auto Sweep 1 Frequency Sweep M1[1] -60.71 dBm 471.4160 MHz 30.0 MHz 30001 pts 97.0 MHz/ 1.0 GHz Date: 13_JAN 2021 16:06:23		
CH-L 1GHz~26GHz	 Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWI 250 ms VBW 300 kHz Mode Auto Sweep 1 Frequency Sweep M1[1] -51.66 dBm 25.997920 GHz 1.0 GHz 30001 pts 2.5 GHz/ 26.0 GHz Date: 13_JAN 2021 16:28:04		

CH-M Reference level	 The spectrum plot shows a single, sharp peak at 908.46000 MHz. The y-axis represents power in dBm, ranging from -70 to 10. The x-axis represents frequency in MHz, ranging from 900 to 910. The peak is labeled M1[1] with a value of 5.09 dBm. The plot is titled 'Spectrum' and includes parameters: Ref Level 20.00 dBm, Offset 1.00 dB, RBW 100 kHz, Att 30 dB, SWI 41.84 us (-6.9 ms), VSW 300 kHz, Mode Auto FFT. The date is 13 JAN 2021 16:29:12.
CH-M 30MHz~1000MHz	 The spectrum plot shows a peak at 537.2450 MHz. The y-axis represents power in dBm, ranging from -70 to 10. The x-axis represents frequency in MHz, ranging from 30.0 to 1000.0. The peak is labeled M1[1] with a value of -6.102 dBm. A red horizontal line is drawn at -14.000 dBm. The plot is titled 'Spectrum' and includes parameters: Ref Level 20.00 dBm, Offset 1.00 dB, RBW 100 kHz, Att 30 dB, SWI 30.1 ms, VSW 300 kHz, Mode Auto Sweep. The date is 13 JAN 2021 16:33:56.
CH-M 1GHz~26GHz	 The spectrum plot shows a peak at 25.949590 GHz. The y-axis represents power in dBm, ranging from -70 to 10. The x-axis represents frequency in GHz, ranging from 1.0 to 26.0. The peak is labeled M1[1] with a value of -51.05 dBm. A red horizontal line is drawn at -14.000 dBm. The plot is titled 'Spectrum' and includes parameters: Ref Level 20.00 dBm, Offset 1.00 dB, RBW 100 kHz, Att 30 dB, SWI 250 ms, VSW 300 kHz, Mode Auto Sweep. The date is 13 JAN 2021 16:33:56.



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