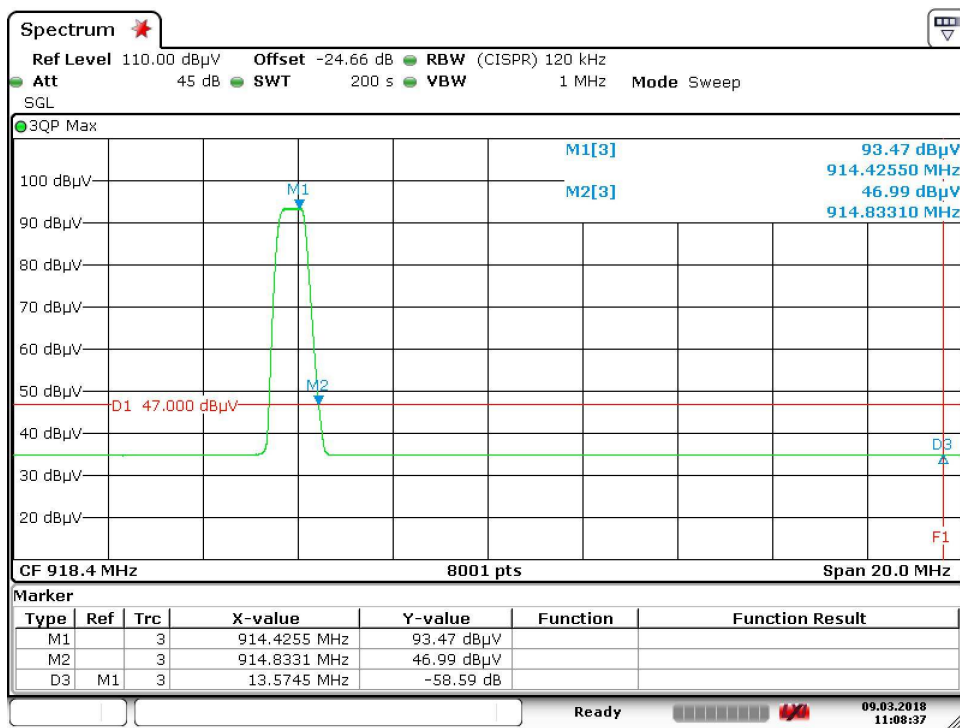


1100 E Chalk Creek Road  
Coalville, UT 84017  
(435) 336-4433  
FAX (435) 336-4436


## Radiated Emissions (Bandedge)

DNB Job Number:	86088	Date:	9 Mar 2018	Specification  [X] 15.247 (c) [X] ANSI C63.10-2013
Customer:	Vutiliti Inc.			
Model Number:	VUHDRF1			
Description:	500kHz LoRa Modular Transmitter			

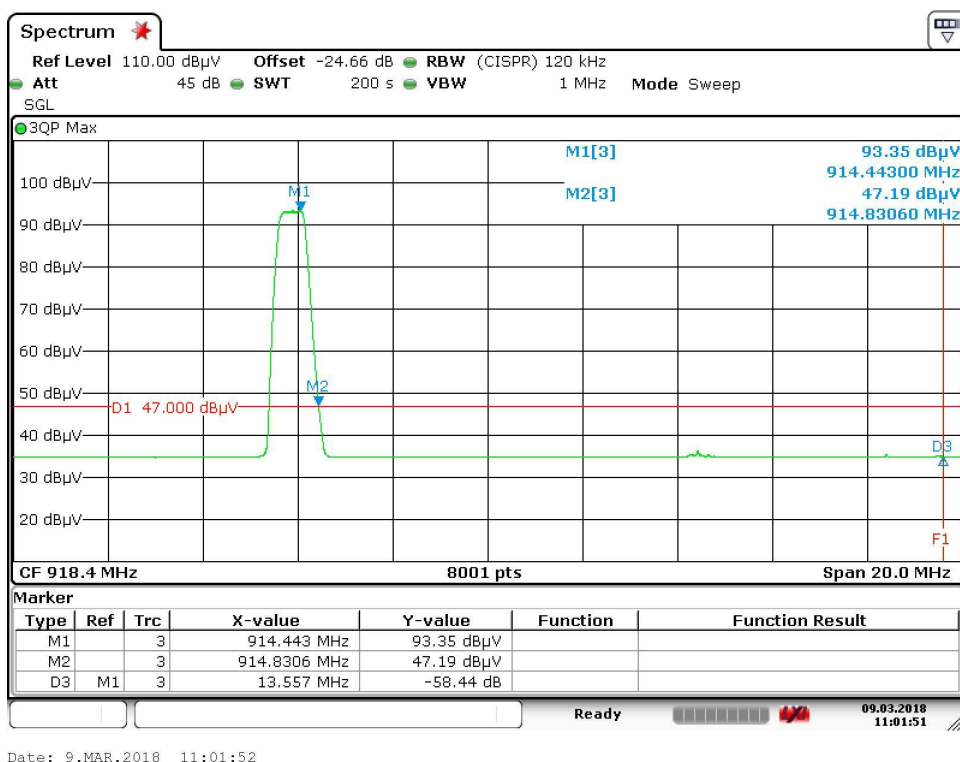
Radiated Corrected Band Edge  
Upper Edge / Z-Axis  
Receive Antenna - Horizontal  
EUT Transmit Antenna - Horizontal




Date: 9.MAR.2018 11:08:38

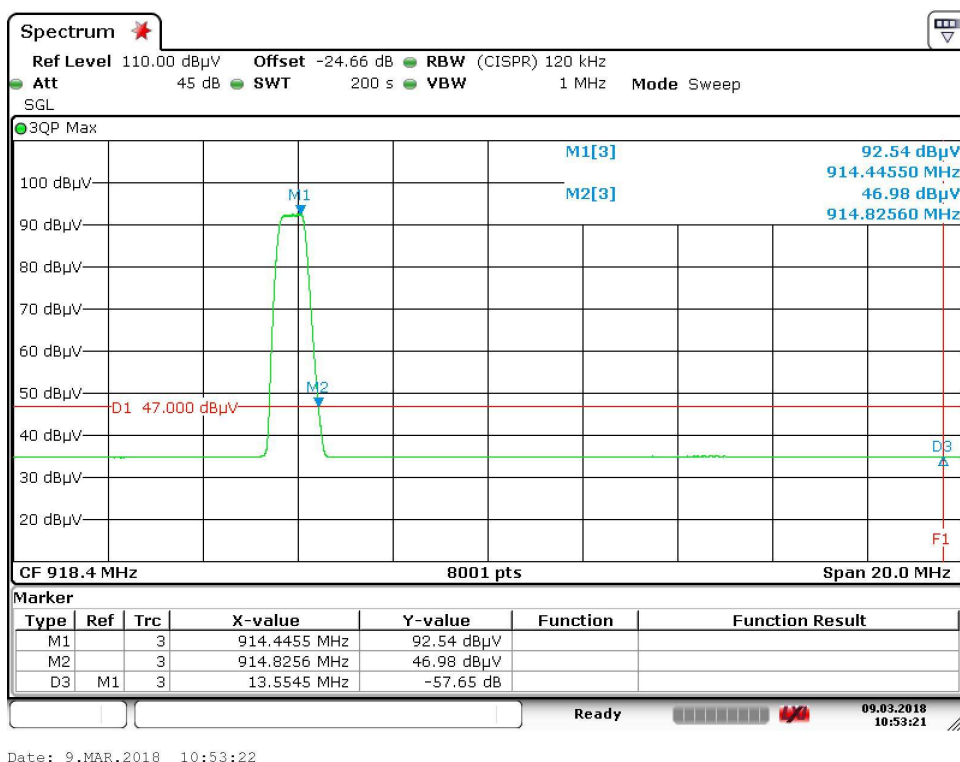
	1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436	Radiated Emissions (Bandedge)		
DNB Job Number:	86088	Date:	9 Mar 2018	Specification  [X] 15.247 (c) [X] ANSI C63.10-2013
Customer:	Vutiliti Inc.			
Model Number:	VUHDRF1			
Description:	500kHz LoRa Modular Transmitter			

Radiated Corrected Band Edge  
Upper Edge / Z-Axis  
Receive Antenna - Vertical  
EUT Transmit Antenna - Horizontal




		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		Radiated Emissions (Bandedge)	
DNB Job Number: 86088		Date: 9 Mar 2018			
Customer: Vutiliti Inc.		Specification [X] 15.247 (c) [X] ANSI C63.10-2013			
Model Number: VUHDRF1					
Description: 500kHz LoRa Modular Transmitter					

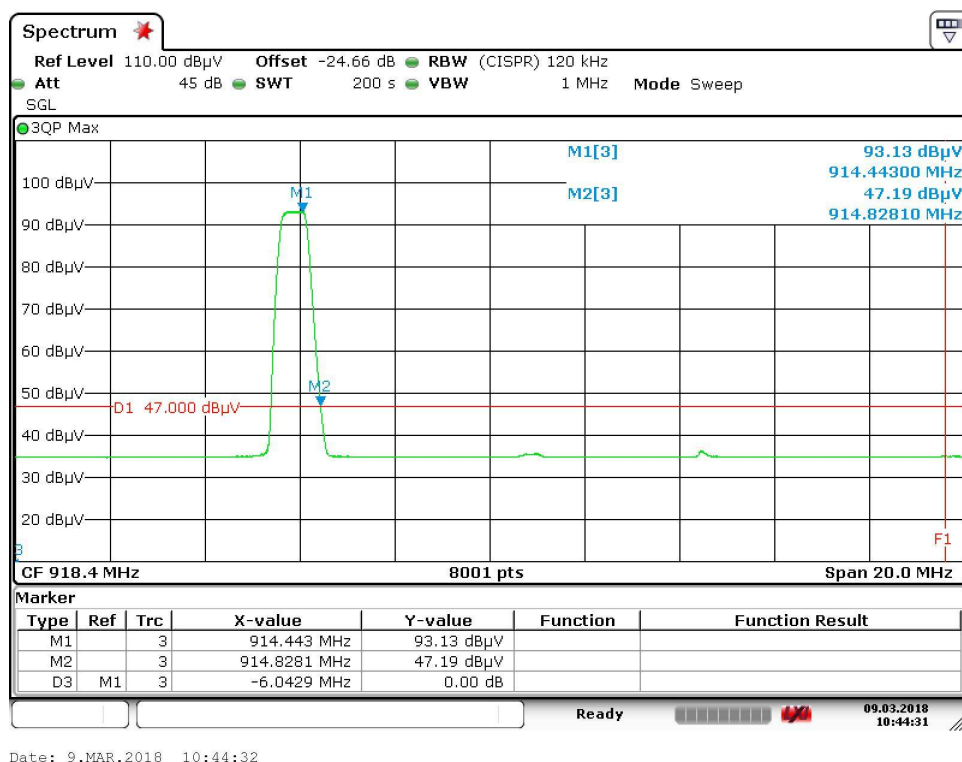
Radiated Corrected Band Edge  
Upper Edge / Z-Axis  
Receive Antenna - Horizontal  
EUT Transmit Antenna - Vertical



Date: 9.MAR.2018 10:53:22

	1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436	Radiated Emissions (Bandedge)		
DNB Job Number:	86088	Date:	9 Mar 2018	Specification  [X] 15.247 (c) [X] ANSI C63.10-2013
Customer:	Vutiliti Inc.			
Model Number:	VUHDRF1			
Description:	500kHz LoRa Modular Transmitter			

Radiated Corrected Band Edge  
Upper Edge / Z-Axis  
Receive Antenna - Vertical  
EUT Transmit Antenna - Vertical



15.247 (a,2)                      20 and 6 dB Bandwidth

Test Procedure:                      ANSI C63.10-2013

20 and 6 dB Bandwidth

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 or 6 dB bandwidth, centered on a hopping channel

RBW    1% of the 20 or 6 dB bandwidth

VBW    RBW

Sweep = auto

Detector function = peak

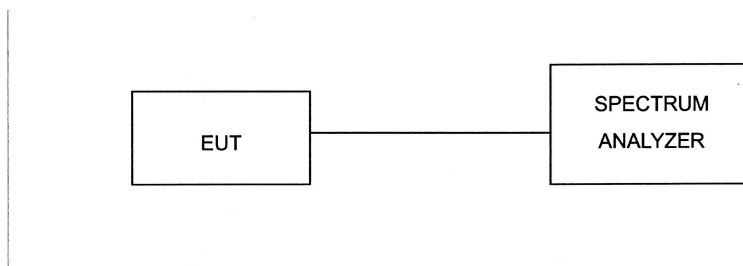
Trace = max hold


The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 or 6 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 or 6 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

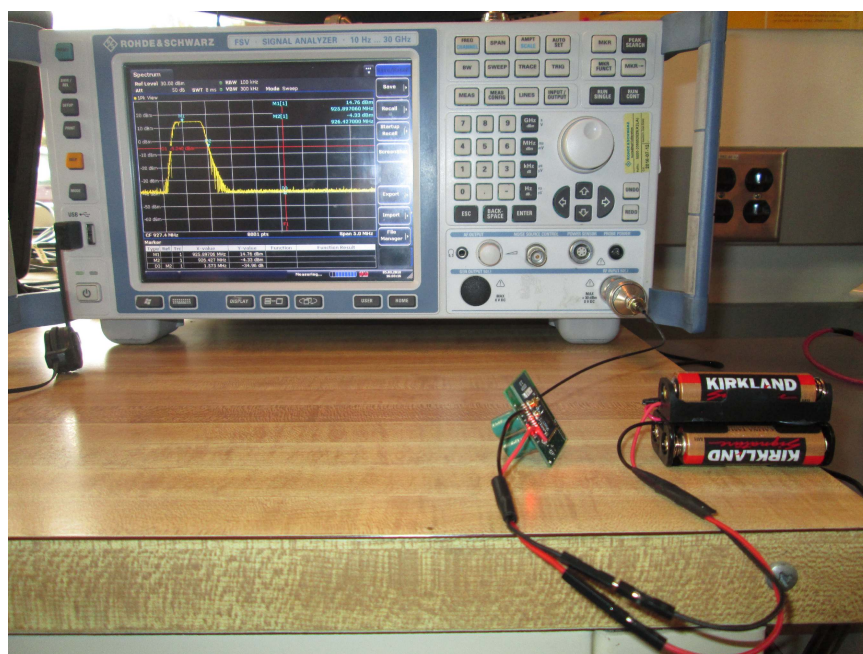
EUT operating conditions:


The software provided by the client to enable the EUT to transmit continuously.

Test Set Up: (Note following set up was used for all antenna conducted measurements)



	1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436	Measurement Test Set Up		
DNB Job Number:	86088	Date:	7 Mar 2018	Conformance Standard  FCC Part 15
Customer:				
Model Number:				
Description:	LoRa Modular Transmitter			Clause 15.247
Antenna Conducted Measurement Set Up				



		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		<b>20 dB Single Channel Bandwidth</b>	
DNB Job Number:		86088		Date: 7 Mar 2018	
Customer:		<b>Conformance Standard</b>  FCC Part 15			
Model Number:					
Description:		125kHz LoRa Modular Transmitter (FHSS)		<b>Clause</b> 15.247(a,2)	
		Test Procedure			
Environmental Conditions					
Ambient Temperature		Relative Humidity		Barometric Pressure	
21 °C		25 %		101.2 kPa	
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <i>Les Payne</i>					

## 20 dB Bandwidth

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel

RBW = 1% of the 20dB bandwidth


VBW = RBW

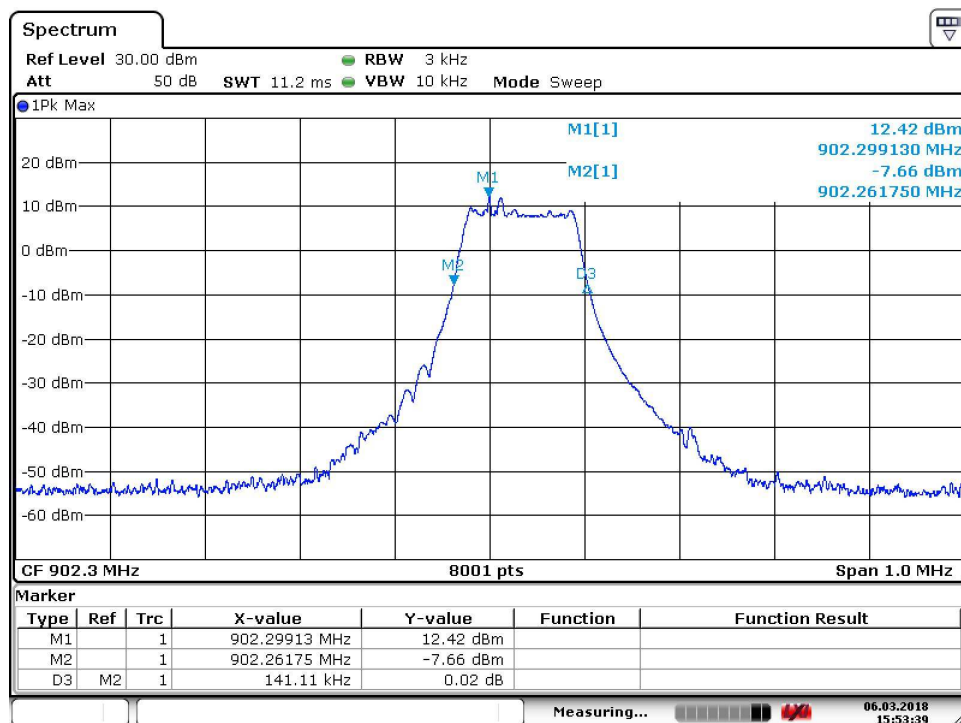
Sweep = auto

Detector function = peak

Trace = max hold


The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

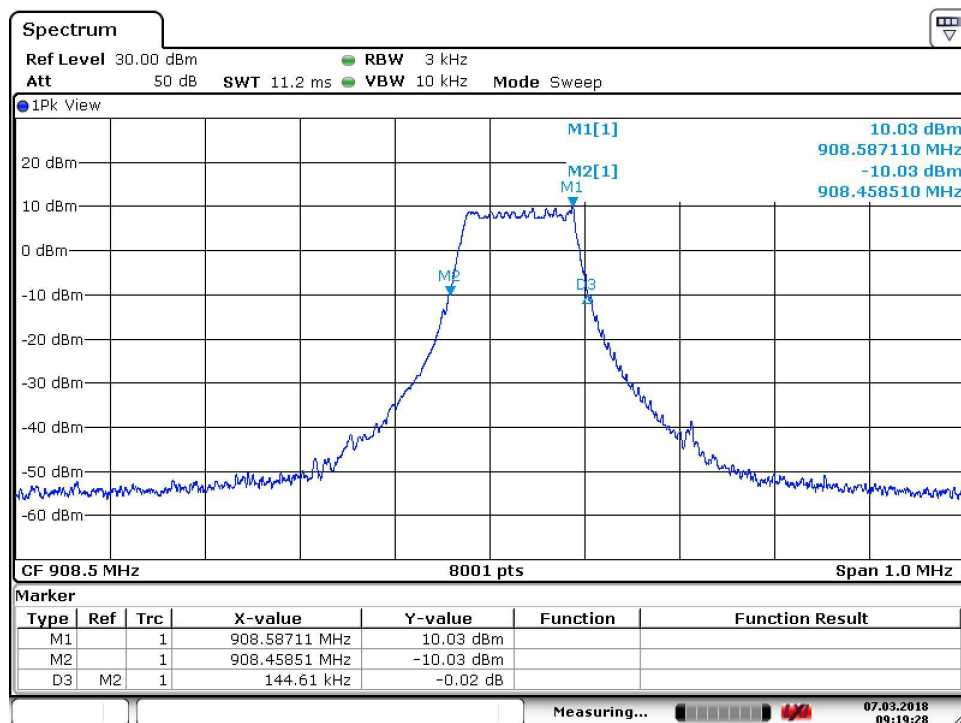
		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		<b>20 dB Single Channel Bandwidth</b>	
DNB Job Number:		86088		Date: 7 Mar 2018	
Customer:				<b>Conformance Standard</b>  FCC Part 15	
Model Number:					
Description:		125kHz LoRa Modular Transmitter (FHSS)		<b>Clause</b> 15.247(a,2)	
<b>Environmental Conditions</b>					
Ambient Temperature		Relative Humidity		Barometric Pressure	
21 °C		25 %		101.2 kPa	
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <i>Les Payne</i>					
Channel	Chl Freq (MHz)	20dB BW (kHz)	Pass/Fail		
Low	902.300	141.110	Pass		




Date: 6.MAR.2018 15:53:39

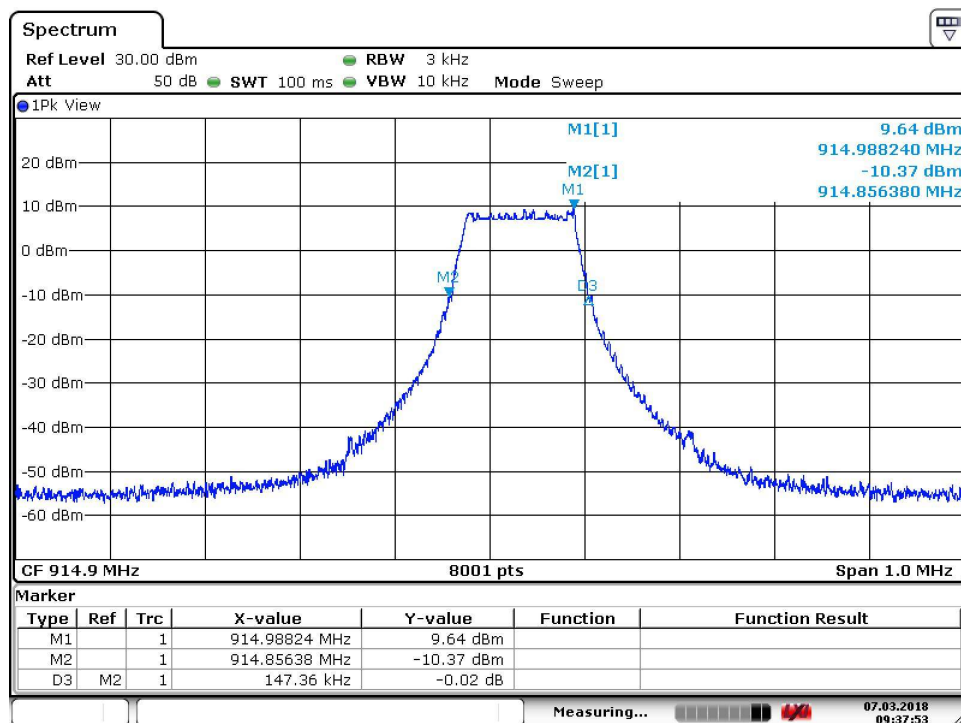


		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		<b>20 dB Single Channel Bandwidth</b>	
DNB Job Number:				Date: 7 Mar 2018	
Customer:				<b>Conformance Standard</b>  FCC Part 15	
Model Number:					
Description:		125kHz LoRa Modular Transmitter (FHSS)			
Environmental Conditions					
Ambient Temperature		Relative Humidity		Barometric Pressure	
21 °C		25 %		101.2 kPa	
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <i>Les Payne</i>					
Channel	Chl Freq (MHz)	20dB BW (kHz)	Pass/Fail		
Middle	908.500	144.610	Pass		




Date: 7.MAR.2018 09:19:28

		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		<b>20 dB Single Channel Bandwidth</b>	
DNB Job Number:				Date: 7 Mar 2018	
Customer:				<b>Conformance Standard</b>  FCC Part 15	
Model Number:					
Description:		125kHz LoRa Modular Transmitter (FHSS)		<b>Clause</b> 15.247(a,2)	
Environmental Conditions					
Ambient Temperature		Relative Humidity		Barometric Pressure	
21 °C		25 %		101.2 kPa	
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <i>Les Payne</i>					
Channel	Chl Freq (MHz)	20dB BW (MHz)	Pass/Fail		
High	914.900	147.360	Pass		



Date: 7.MAR.2018 09:37:53


	1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		6 dB Single Channel Bandwidth	
DNB Job Number:	86088	Date:	7 Mar 2018	Conformance Standard  FCC Part 15
Customer:	Vutiliti Inc.			
Model Number:	VUHDRF1			
Description:	LoRa Modular Transmitter			Clause 15.247(a,2)
	Test Procedure			
Environmental Conditions				
Ambient Temperature		Relative Humidity		Barometric Pressure
21 °C		25 %		101.2 kPa
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <i>J Payne</i>				

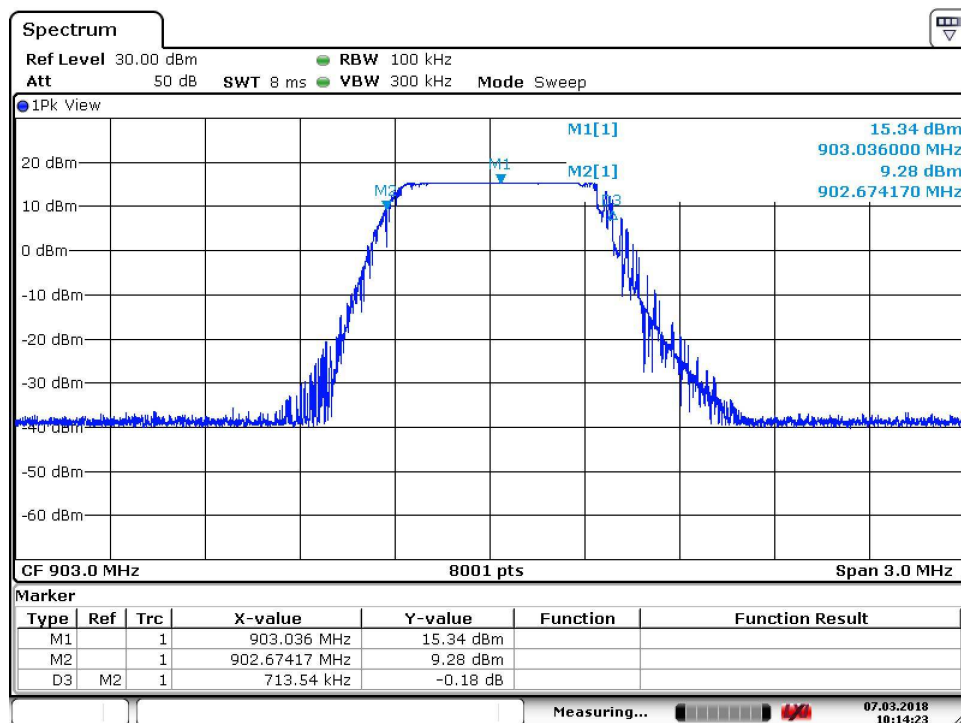
## 6 dB Bandwidth

### ANSI C63.10-2013 Clause 11.8.1


The steps are as follows:

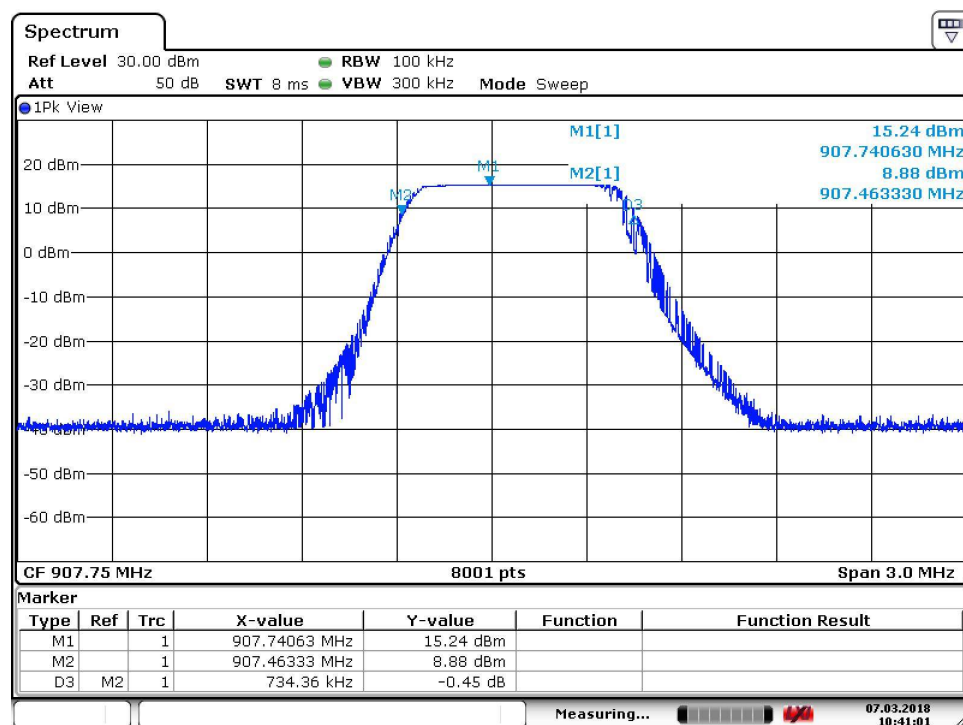
- a) Set RBW = 100 kHz
- b) Set the VBW  $\geq$  [ 3 x RBW ]  
\* per ANSI C63.10-2013 clause 6.9.2    Set the span to 2 to 5 times the OBW
- c) Detector = peak
- d) Trace mode = max hold
- e) Sweep = auto couple
- f) Allow trace to stabilize
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6dB relative to the maximum level measured in the fundamental emission.
- h) Submit this plot(s).

		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		6 dB Single Channel Bandwidth	
DNB Job Number:		86088		Date: 7 Mar 2018	
Customer:				Conformance Standard FCC Part 15	
Model Number:					
Description:		500kHz LoRa Modular Transmitter		Clause 15.247(a,2)	
Environmental Conditions					
Ambient Temperature		Relative Humidity		Barometric Pressure	
21 °C		25 %		101.2 kPa	
EUT performed within the requirements of the applicable standard [X] Yes [ ] No J Payne					
Channel	Chl Freq (MHz)	6dB BW (kHz)	Limit	Pass/Fail	
Low	903.000	713.540	> 500 kHz	Pass	




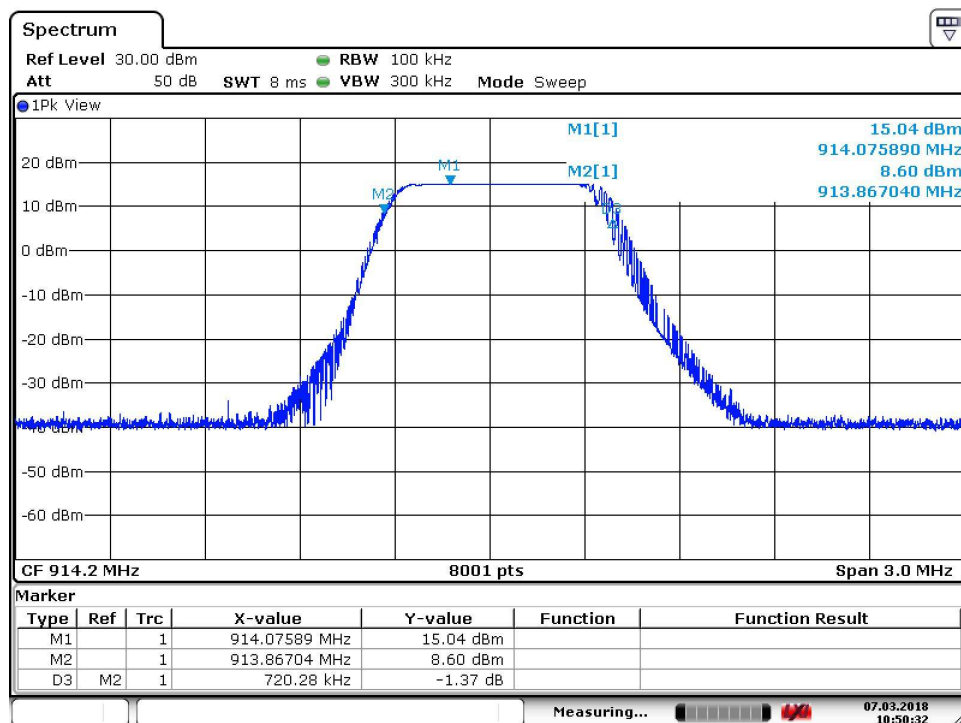
Date: 7.MAR.2018 10:14:23

		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		6 dB Single Channel Bandwidth	
DNB Job Number:		86088		Date:	
Customer:				Conformance Standard  FCC Part 15	
Model Number:					
Description:		500kHz LoRa Modular Transmitter		Clause 15.247(a,2)	
Environmental Conditions					
Ambient Temperature		Relative Humidity		Barometric Pressure	
21 °C		25 %		101.2 kPa	
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <i>J Payne</i>					
Channel	Chl Freq (MHz)	6dB BW (kHz)	Limit	Pass/Fail	
Middle	907.750	734.36	> 500 kHz	Pass	




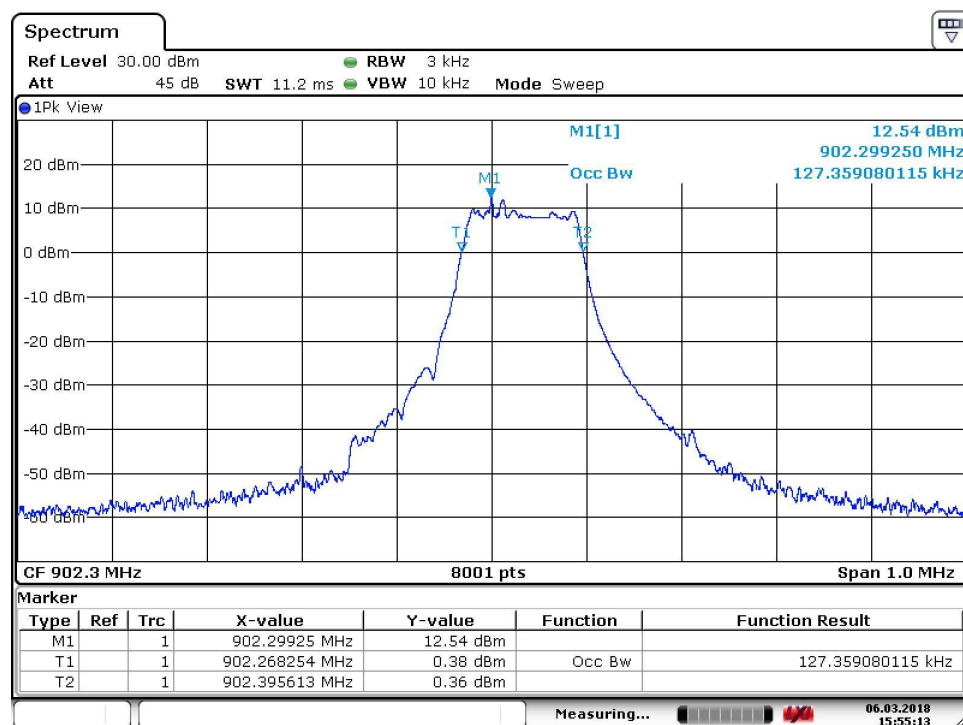
Date: 7.MAR.2018 10:41:01

		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		6 dB Single Channel Bandwidth	
DNB Job Number:		86088		Date: 7 Mar 2018	
Customer:				Conformance Standard FCC Part 15	
Model Number:					
Description:		500kHz LoRa Modular Transmitter		Clause 15.247(a,2)	
Environmental Conditions					
Ambient Temperature		Relative Humidity		Barometric Pressure	
21 °C		25 %		101.2 kPa	
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No J Payne					
Channel	Chl Freq (MHz)	6dB BW (kHz)	Limit	Pass/Fail	
High	914.076	720.280	> 500 kHz	Pass	




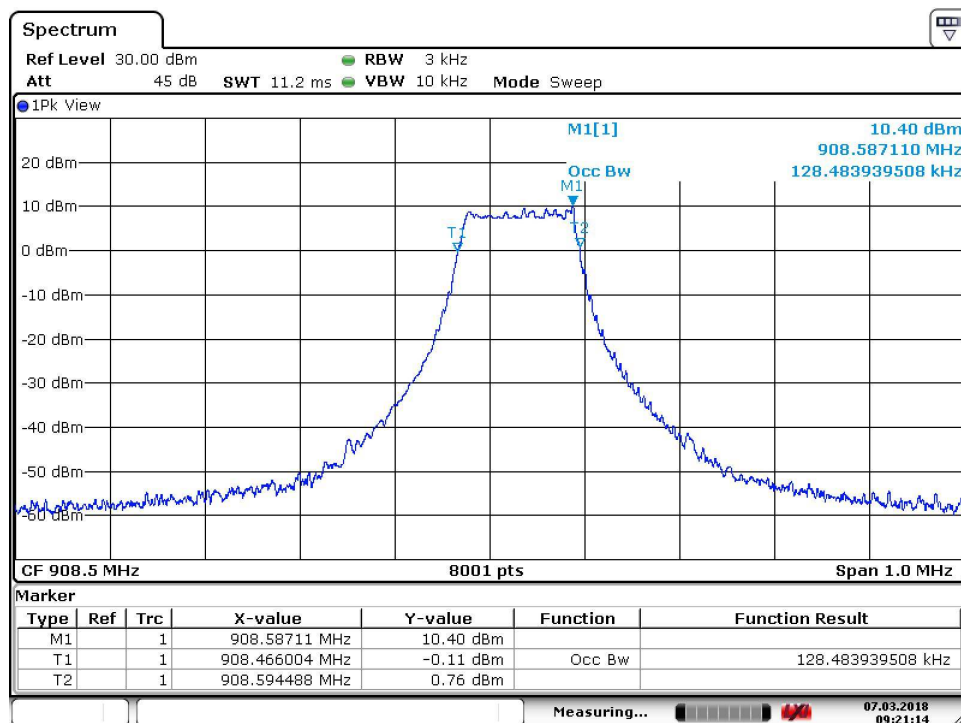
Date: 7.MAR.2018 10:50:32

		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		99% Occupied Bandwidth	
DNB Job Number:		86088		Date: 6 Mar 2018	
Customer:		Conformance Standard  RSS-Gen  Clause Section 6.6			
Model Number:					
Description:					
Environmental Conditions					
Ambient Temperature		Relative Humidity		Barometric Pressure	
26 °C		30 %		101.35 kPa	
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <i>J Payne</i>					
Channel		Chl Freq (MHz)		99% BW (MHz)	
Low		902.300		0.127359	




Date: 6.MAR.2018 15:55:14

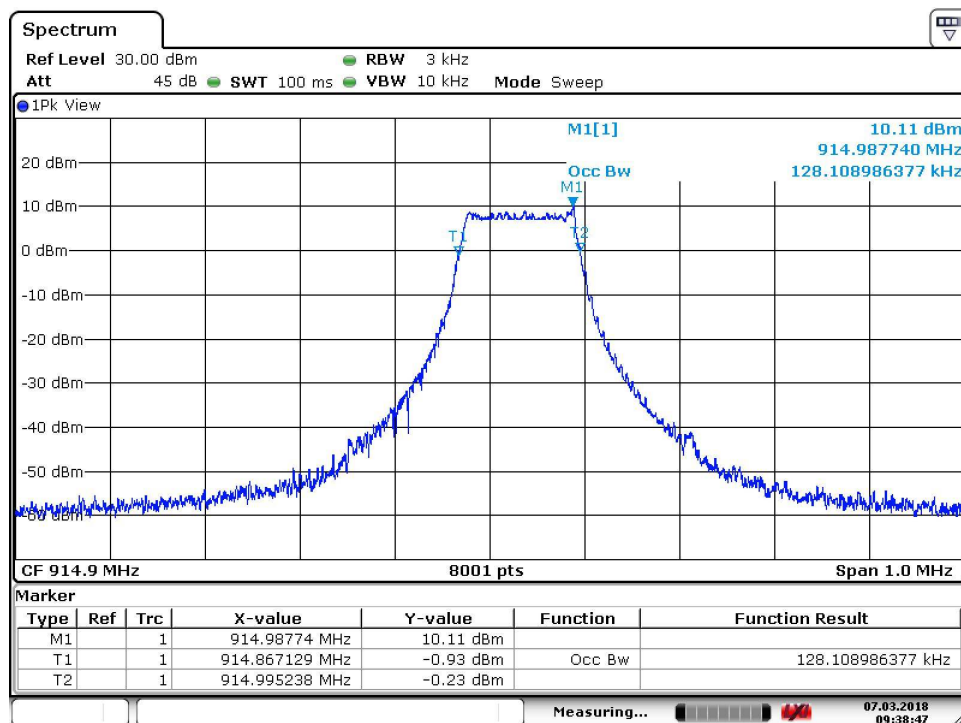
		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		99% Occupied Bandwidth	
DNB Job Number:		86088		Date: 7 Mar 2018	
Customer:		Vutiliti Inc.			
Model Number:		VUHDRF1			
Description:		LoRa Modular Transmitter			
Conformance Standard RSS-Gen Clause Section 6.6					
Environmental Conditions					
Ambient Temperature		Relative Humidity		Barometric Pressure	
21 °C		25 %		101.2 kPa	
EUT performed within the requirements of the applicable standard [X] Yes [ ] No J Payne					
Channel		Chl Freq (MHz)		99% BW (MHz)	
Middle		908.500		0.128484	



Date: 7.MAR.2018 09:21:14



		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		99% Occupied Bandwidth	
DNB Job Number:		86088		Date: 7 Mar 2018	
Customer:		Vutiliti Inc.		Conformance Standard  RSS-Gen	
Model Number:		VUHDRF1			
Description:		LoRa Modular Transmitter		Clause Section 6.6	
Environmental Conditions					
Ambient Temperature		Relative Humidity		Barometric Pressure	
21 °C		25 %		101.2 kPa	
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <i>J Payne</i>					
Channel		Chl Freq (MHz)		99% BW (MHz)	
High		914.900		0.128109	



Date: 7.MAR.2018 09:38:47

15.247 (a,2,b3) Maximum Peak Output Power (Conducted)

Test Procedure: ANSI C63.10-2013

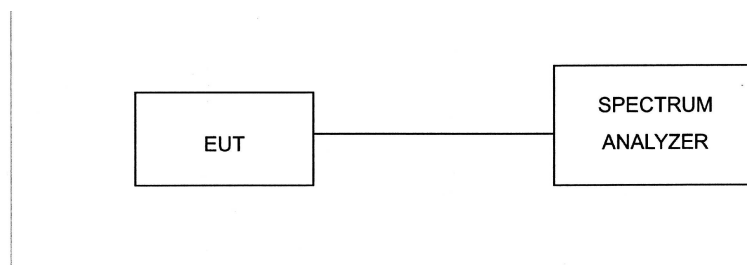
Peak Output Power


Per clause 11.9.1.1  $RBW \geq DTS \text{ Bandwidth}$

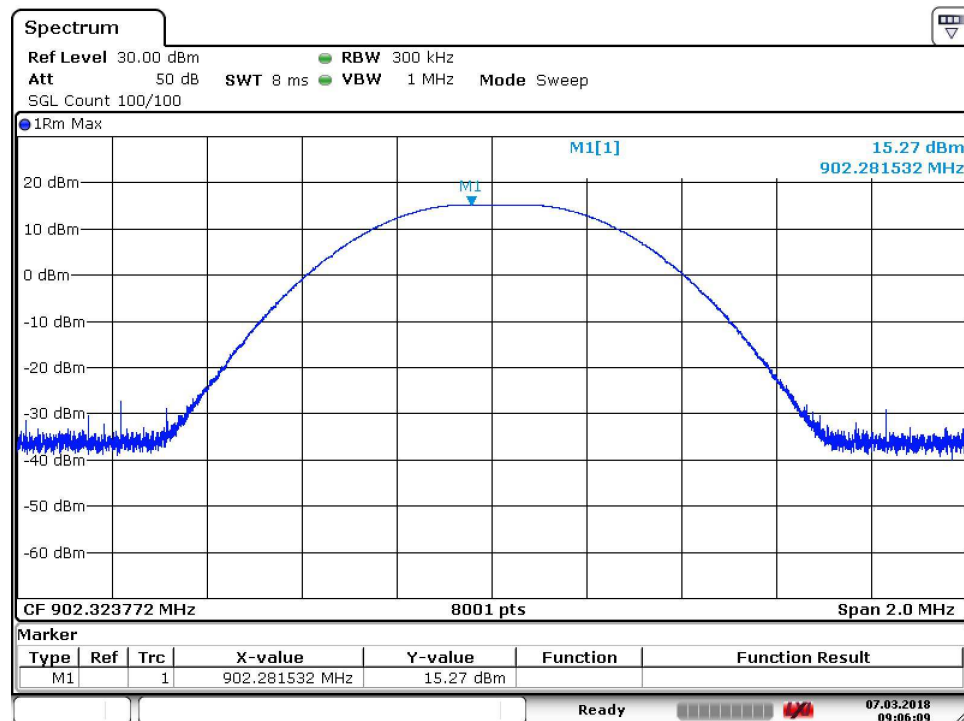
The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement.

- a) Set the  $RBW \geq DTS \text{ bandwidth}$
- b) Set the  $VBW \geq [ 3 \times RBW ]$
- c) Set  $\text{span} \geq [ 3 \times RBW ]$
- d) Sweep time = auto couple
- e) Detector = peak
- f) Trace mode = max hold
- g) Allow trace to fully stabilize
- h) Use peak marker function to determine the peak amplitude
- i) Submit plots


Test Set Up:

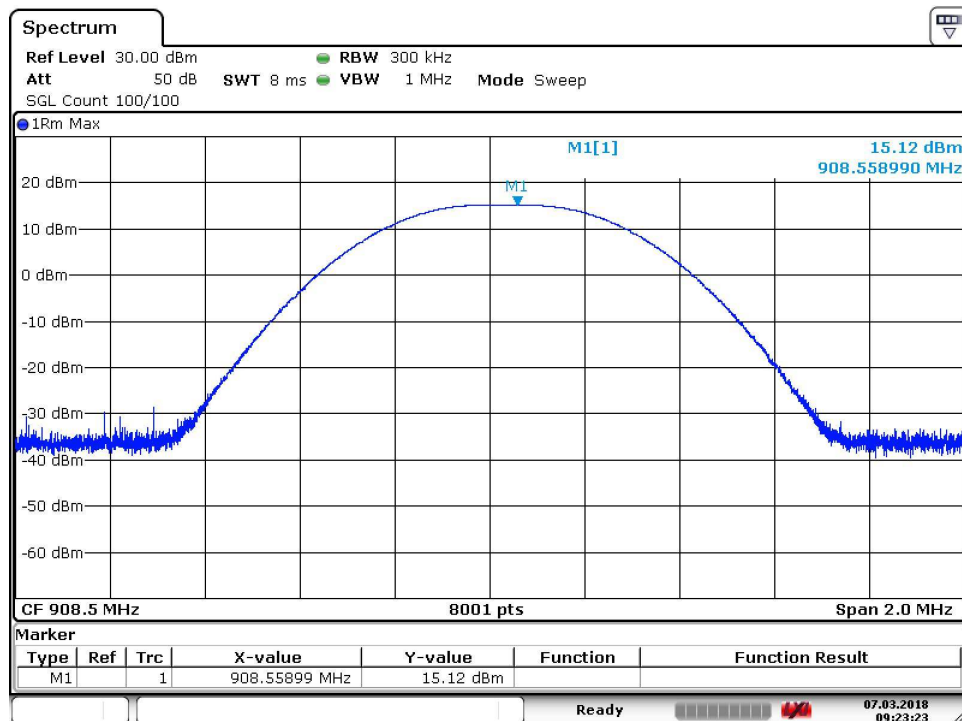


		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		<b>Peak Output Power (Cond)</b>			
DNB Job Number:		86088		Date: 7 Mar 2018			
Customer:		Vutiliti Inc.		Conformance Standard  FCC Part 15			
Model Number:		VUHDRF1					
Description:		125 kHz LoRa Modular Transmitter		Clause 15.247(b)			
Environmental Conditions							
Ambient Temperature		Relative Humidity		Barometric Pressure			
21 °C		25 %		101.2 kPa			
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No    J Payne							
Freq MHz	Meas Peak Pwr (dBm)	Limit (dBm)	Delta (dBm)	Meas Peak Pwr (mW)	Limit (mW)	Delta (mW)	Pass/Fail
902.300	15.27	30.00	-14.73	33.65	1000	-966.35	Pass




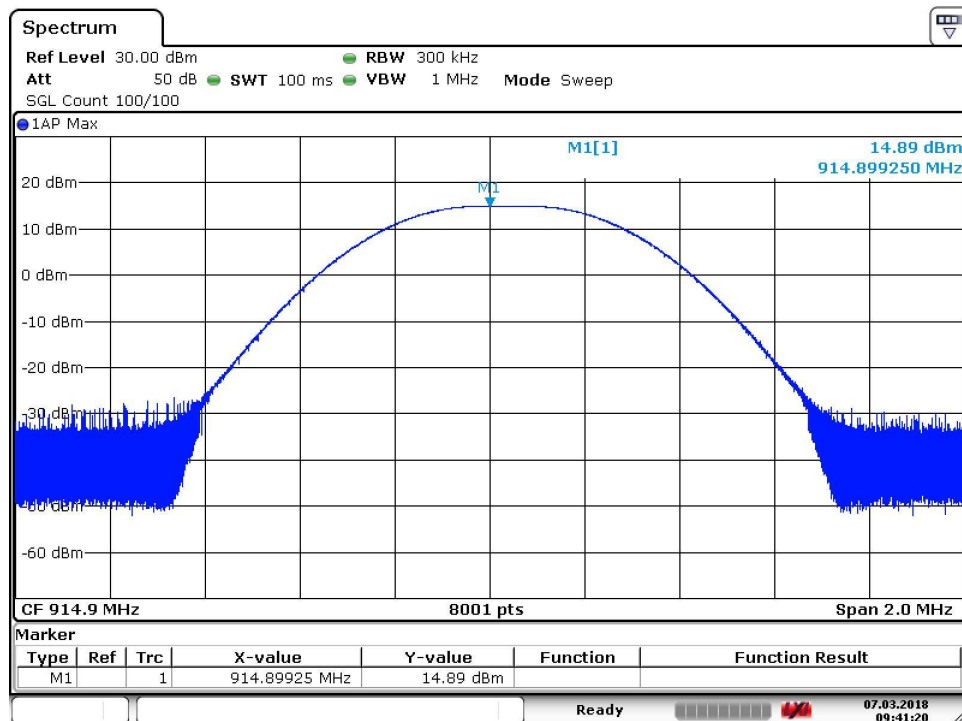
Date: 7.MAR.2018 09:06:09

		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		<b>Peak Output Power (Cond)</b>			
DNB Job Number:	86088	Date:	7 Mar 2018	Conformance Standard  FCC Part 15  Clause 15.247(b)			
Customer:	Vutiliti Inc.						
Model Number:	VUHDRF1						
Description:	125 kHz LoRa Modular Transmitter						
Environmental Conditions							
Ambient Temperature		Relative Humidity		Barometric Pressure			
21 °C		25 %		101.2 kPa			
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No    J Payne							
Freq MHz	Meas Peak Pwr (dBm)	Limit (dBm)	Delta (dBm)	Meas Peak Pwr (mW)	Limit (mW)	Delta (mW)	Pass/Fail
908.500	15.12	30.00	-14.88	32.51	1000	-967.49	Pass




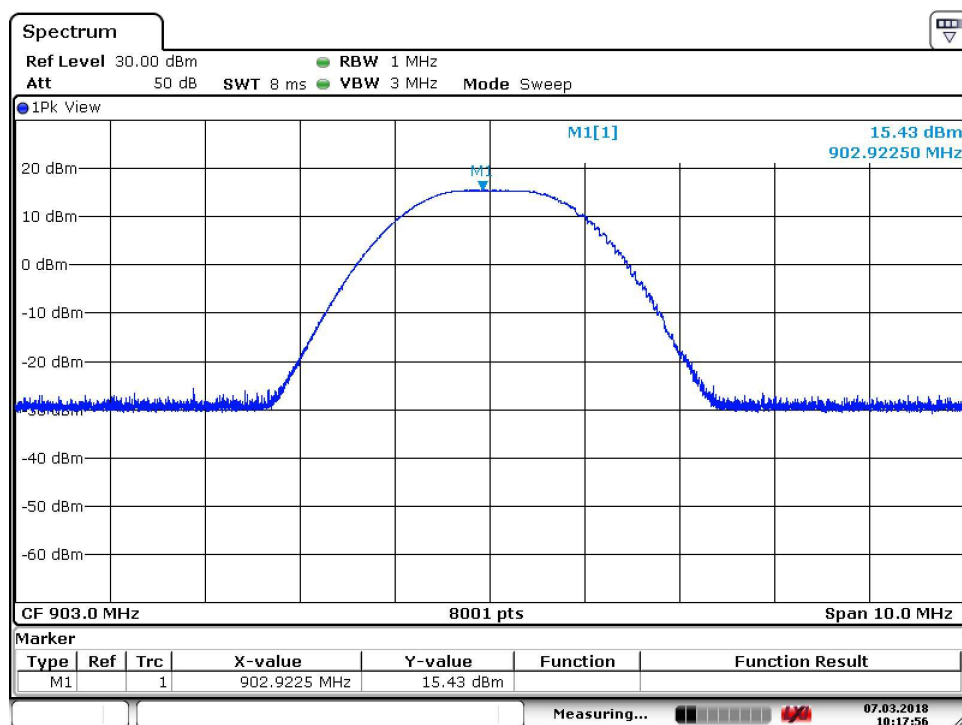
Date: 7.MAR.2018 09:23:23

		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		<b>Peak Output Power (Cond)</b>			
DNB Job Number:	86088	Date:	7 Mar 2018	Conformance Standard  FCC Part 15  Clause 15.247(b)			
Customer:	Vutiliti Inc.						
Model Number:	VUHDRF1						
Description:	125 kHz LoRa Modular Transmitter						
Environmental Conditions							
Ambient Temperature		Relative Humidity		Barometric Pressure			
21 °C		25 %		101.2 kPa			
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No    J Payne							
Freq MHz	Meas Peak Pwr (dBm)	Limit (dBm)	Delta (dBm)	Meas Peak Pwr (mW)	Limit (mW)	Delta (mW)	Pass/Fail
914.900	14.89	30.00	-15.11	30.83	1000	-969.17	Pass




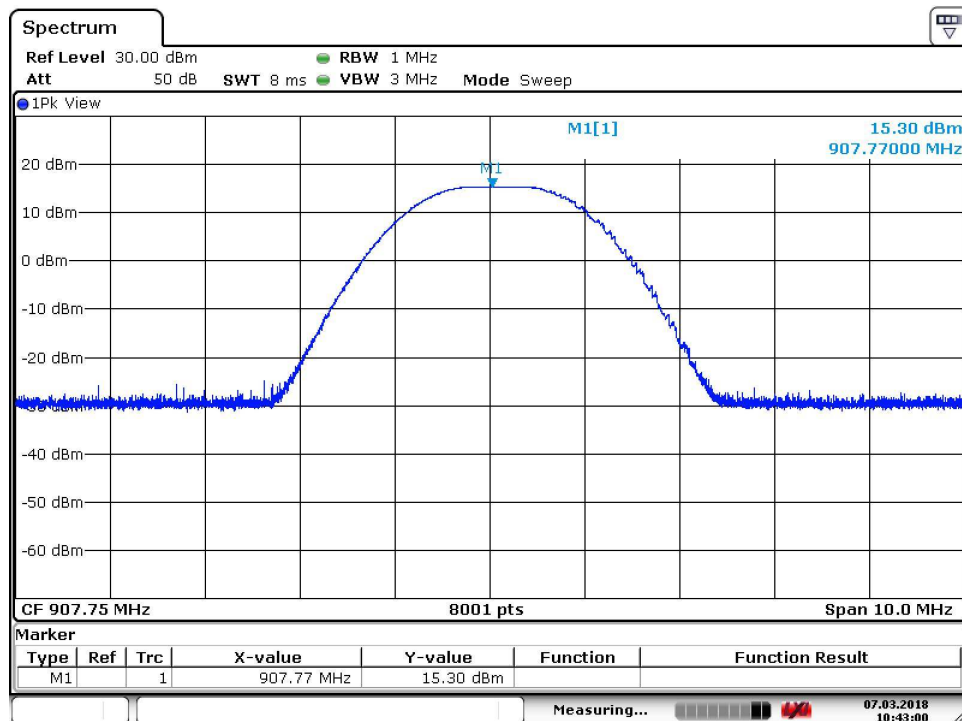
Date: 7.MAR.2018 09:41:20

		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		<b>Peak Output Power (Cond)</b>			
DNB Job Number:		86088		Date: 7 Mar 2018			
Customer:		Vutiliti Inc.		Conformance Standard  FCC Part 15			
Model Number:		VUHDRF1					
Description:		kHz LoRa Modular Transmitter		Clause 15.247(b)			
Environmental Conditions							
Ambient Temperature		Relative Humidity		Barometric Pressure			
21 °C		25 %		101.2 kPa			
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No    J Payne							
Freq MHz	Meas Peak Pwr (dBm)	Limit (dBm)	Delta (dBm)	Meas Peak Pwr (mW)	Limit (mW)	Delta (mW)	Pass/Fail
903	15.43	30.00	-14.57	34.91	1000	-965.09	Pass




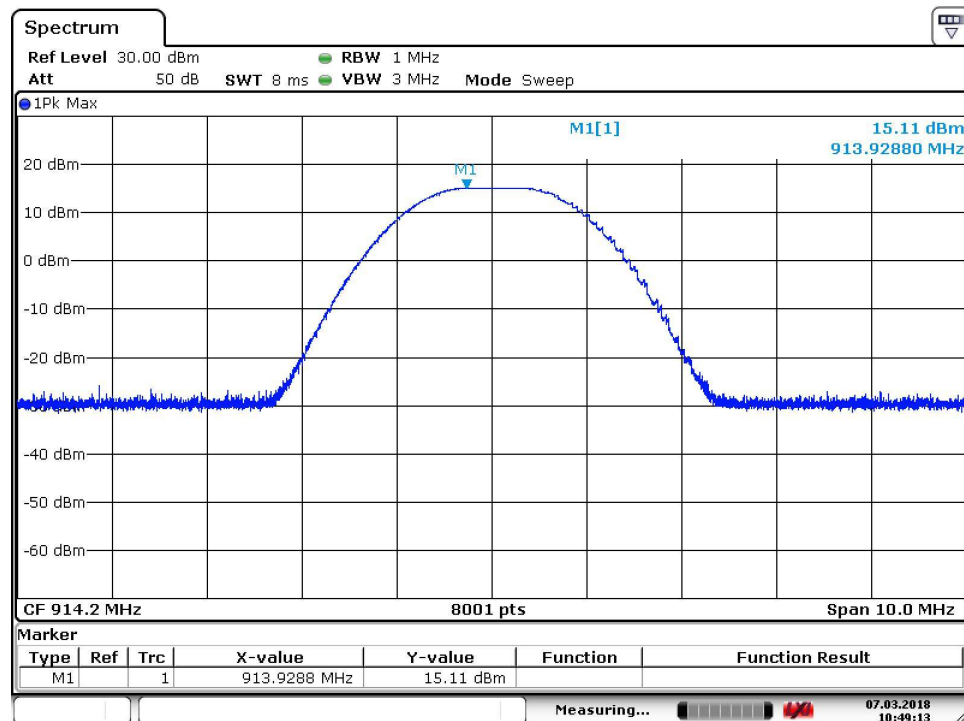
Date: 7.MAR.2018 10:17:56

		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		<b>Peak Output Power (Cond)</b>			
DNB Job Number:	86088	Date:	7 Mar 2018	Conformance Standard  FCC Part 15  Clause 15.247(b)			
Customer:	Vutiliti Inc.						
Model Number:	VUHDRF1						
Description:	500 kHz LoRa Modular Transmitter						
Environmental Conditions							
Ambient Temperature		Relative Humidity		Barometric Pressure			
21 °C		25 %		101.2 kPa			
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No    J Payne							
Freq MHz	Meas Peak Pwr (dBm)	Limit (dBm)	Delta (dBm)	Meas Peak Pwr (mW)	Limit (mW)	Delta (mW)	Pass/Fail
907.75	15.30	30.00	-14.7	33.88	1000	-966.12	Pass



Date: 7.MAR.2018 10:43:00

		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		<b>Peak Output Power (Cond)</b>			
DNB Job Number:	86088	Date:	7 Mar 2018	Conformance Standard  FCC Part 15  Clause 15.247(b)			
Customer:	Vutiliti Inc.						
Model Number:	VUHDRF1						
Description:	500 kHz LoRa Modular Transmitter						
Environmental Conditions							
Ambient Temperature		Relative Humidity		Barometric Pressure			
21 °C		25 %		101.2 kPa			
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No    J Payne							
Freq MHz	Meas Peak Pwr (dBm)	Limit (dBm)	Delta (dBm)	Meas Peak Pwr (mW)	Limit (mW)	Delta (mW)	Pass/Fail
914.900	15.11	30.00	-14.89	32.43	1000	-967.57	Pass



Date: 7.MAR.2018 10:49:13



15.247 (a,2,d)              Conducted Band Edge and Out of Band Emissions

Test Procedure:            ANSI C63.10-2013

Band-edge Compliance of RF Conducted Emissions

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation

RBW    1% of the span

VBW    RBW

Sweep = auto


Detector function = peak

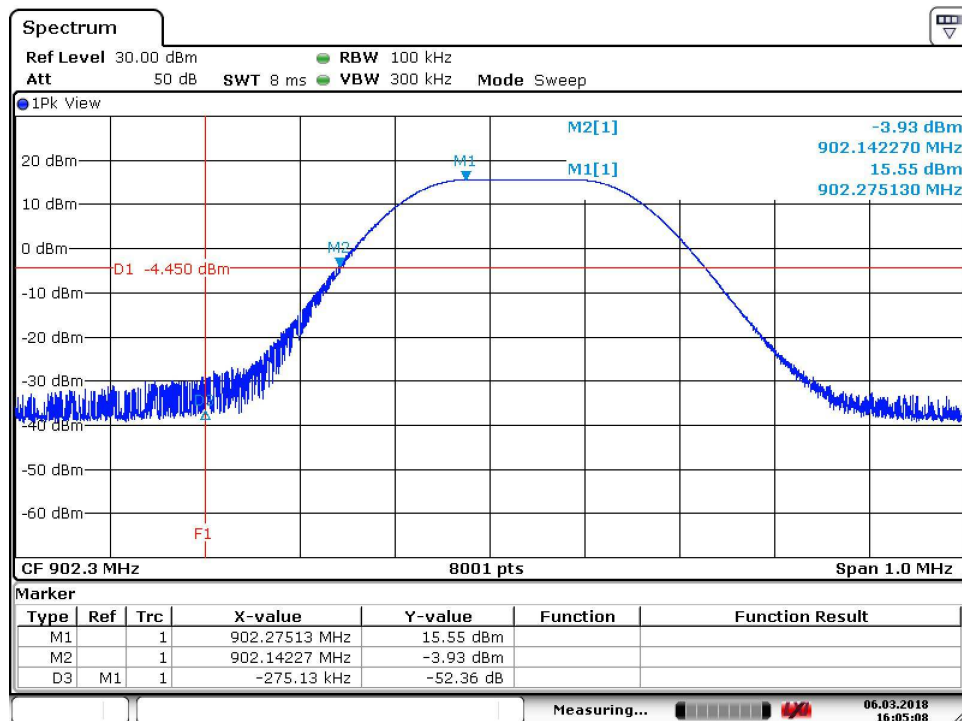
Trace = max hold

Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section. Submit this plot.


Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit. Submit this plot.

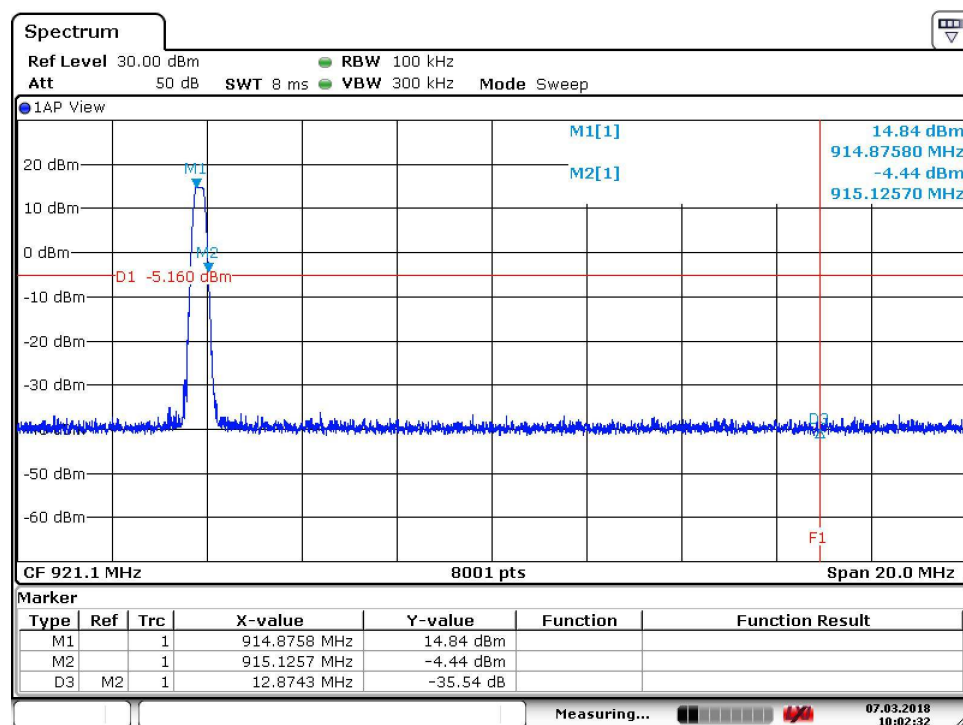
Test Set Up: Same as 15.247 (a,2) 6dB Emission Bandwidth

		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		<h2>Band Edge Measurements</h2>	
DNB Job Number:		86088		Date: 6 Mar 2018	
Customer:		Vutiliti Inc.		Conformance Standard  FCC Part 15	
Model Number:		VUHDRF1			
Description:		125 kHz LoRa Modular Transmitter		Clause 15.247(a,2,d)	
Ambient Temperature		Relative Humidity		Barometric Pressure	
26 °C		30 %		101.35 kPa	
EUT performed within the requirements of the applicable standard [X] Yes [ ] No J Payne					
Conducted Band Edge Measurement				Freq Delta (MHz)	
Limit	Lower (MHz)	Upper (MHz)	Pass/Fail		
902	902.143		0.143		Pass



Date: 6.MAR.2018 16:05:08

		1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436		<h2>Band Edge Measurements</h2>	
DNB Job Number:		86088		Date: 7 Mar 2018	
Customer:		Vutiliti Inc.		Conformance Standard  FCC Part 15	
Model Number:		VUHDRF1			
Description:		125 kHz LoRa Modular Transmitter		Clause 15.247(a,2,d)	
Ambient Temperature		Relative Humidity		Barometric Pressure	
21 °C		25 %		101.2 kPa	
EUT performed within the requirements of the applicable standard <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No    J Payne					
Conducted Band Edge Measurement				Freq Delta (MHz)	
Limit	Lower (MHz)	Upper (MHz)	14.874		Pass/Fail
930		915.126			Pass



Date: 7.MAR.2018 10:02:32