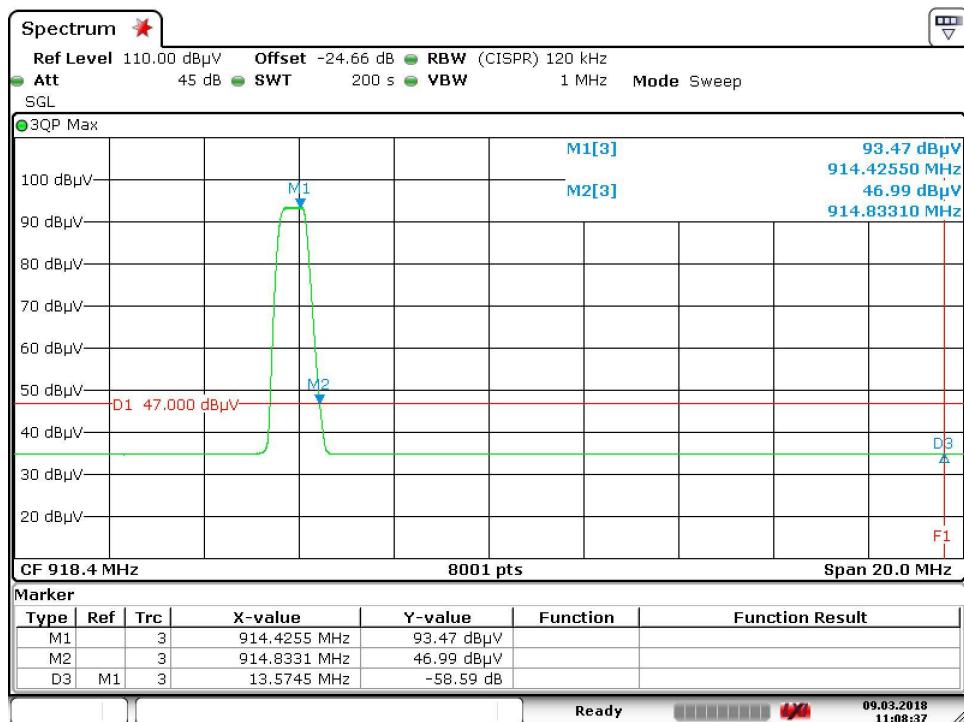


	1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436	Radiated Emissions (Bandedge)
DNB Job Number:	86088	Date: 9 Mar 2018
Customer:	Vutiliti Inc.	Specification
Model Number:	VUHDRF1	[X] 15.247 (c)
Description:	500kHz LoRa Modular Transmitter	[X] ANSI C63.10-2013

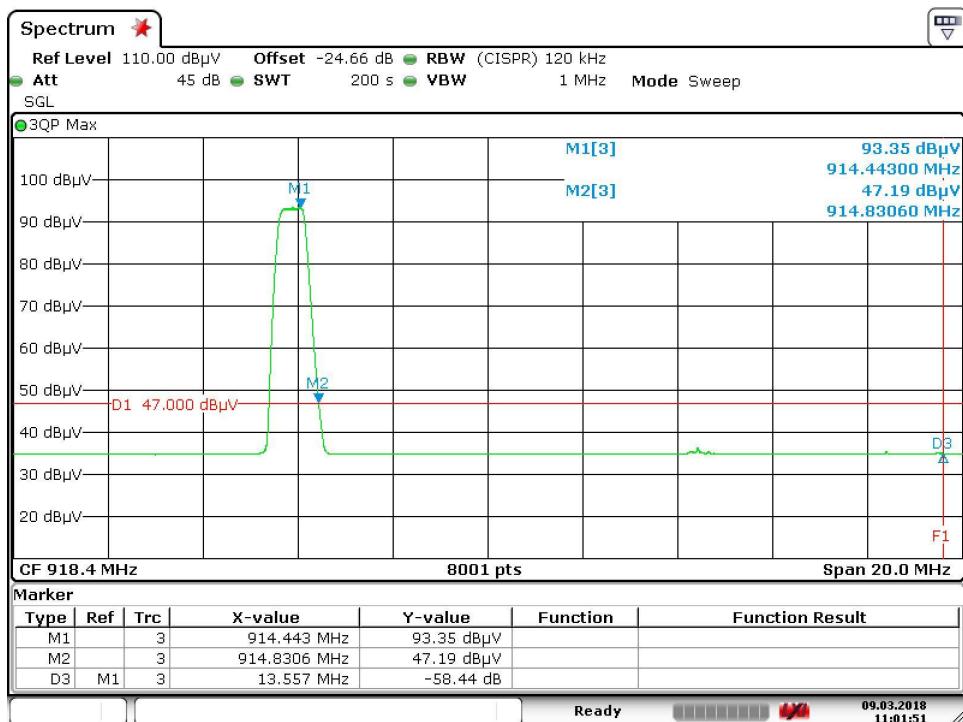
Radiated Corrected Band Edge  
Upper Edge / Z-Axis  
Receive Antenna - Horizontal  
EUT Transmit Antenna - Horizontal



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

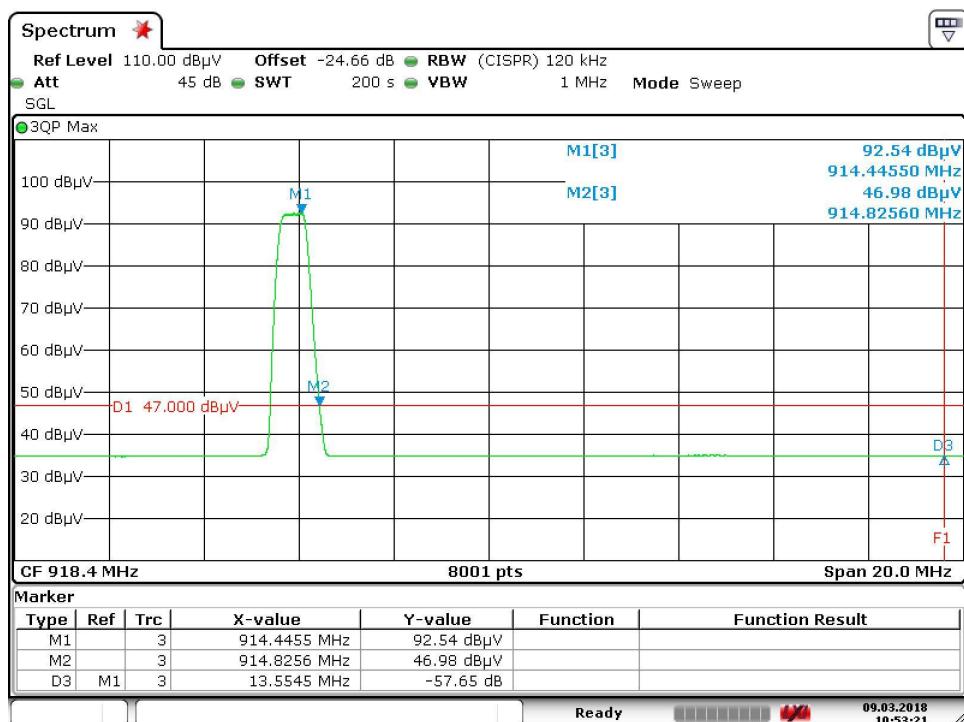
	1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436	Radiated Emissions (Bandedge)
DNB Job Number:	86088	Date: 9 Mar 2018
Customer:	Vutiliti Inc.	Specification
Model Number:	VUHDRF1	[X] 15.247 (c) [X] ANSI C63.10-2013
Description:	500kHz LoRa Modular Transmitter	

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
Model Number:	VUHDRF1	[X] 15.247 (c)
Description:	500kHz LoRa Modular Transmitter	[X] ANSI C63.10-2013

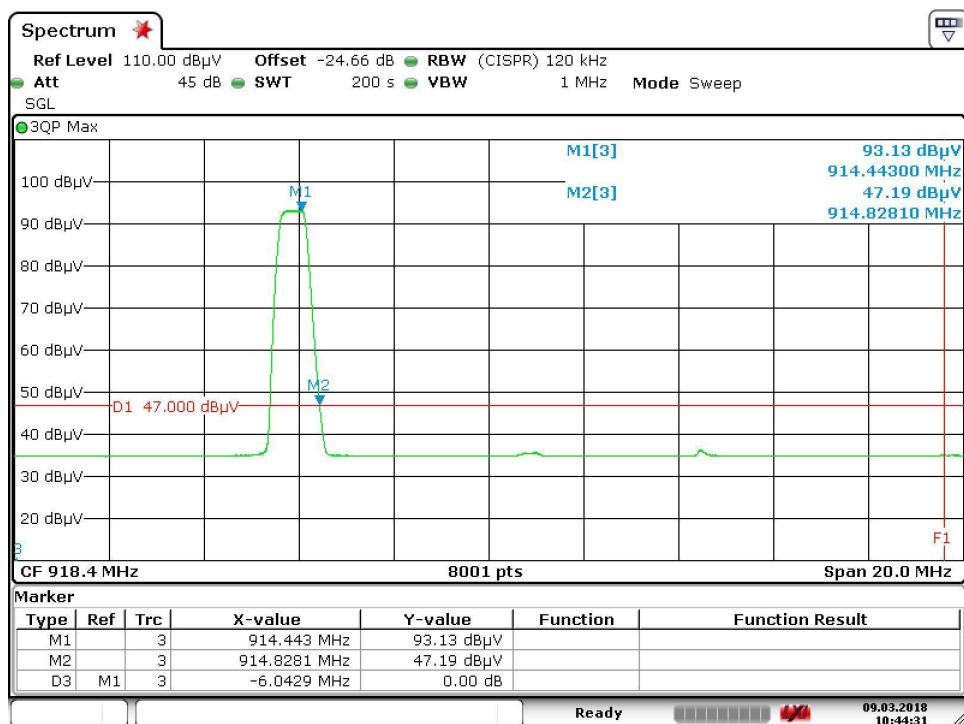
Radiated Corrected Band Edge  
Upper Edge / Z-Axis  
Receive Antenna - Horizontal  
EUT Transmit Antenna - Vertical



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
Customer:	Vutiliti Inc.	Specification
Model Number:	VUHDRF1	[X] 15.247 (c)
Description:	500kHz LoRa Modular Transmitter	[X] ANSI C63.10-2013

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



Date: 9.MAR.2018 10:44:32

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

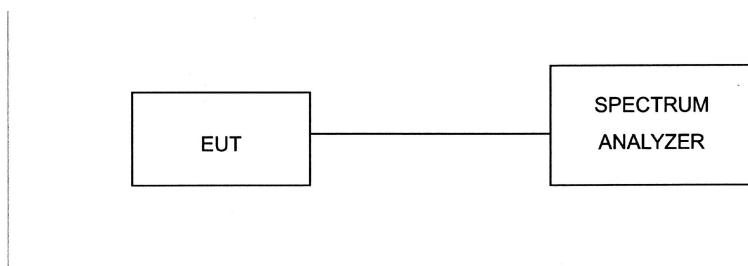
Trace = max hold

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).

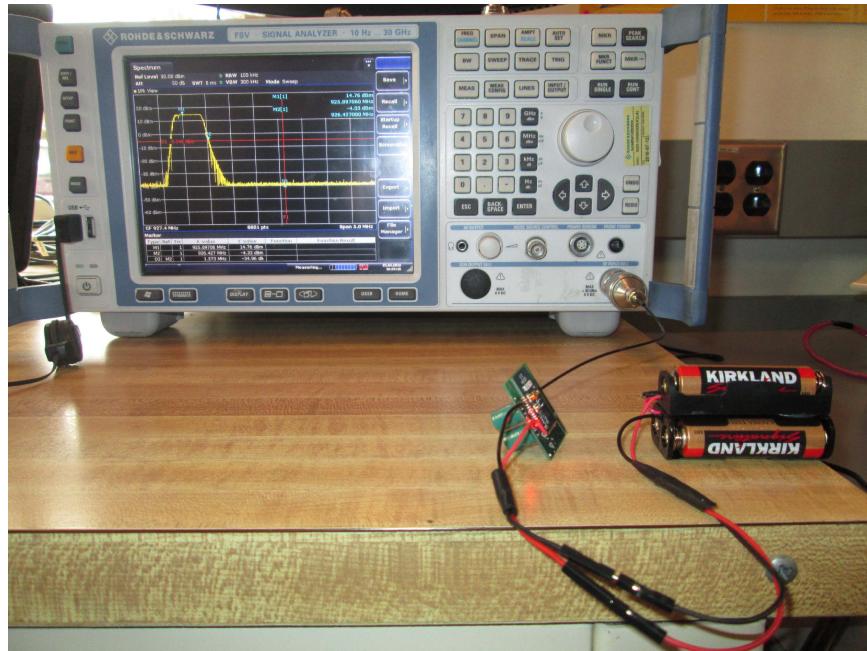
EUT operating conditions:

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
Customer:		FCC Part 15	Conformance Standard
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:			
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

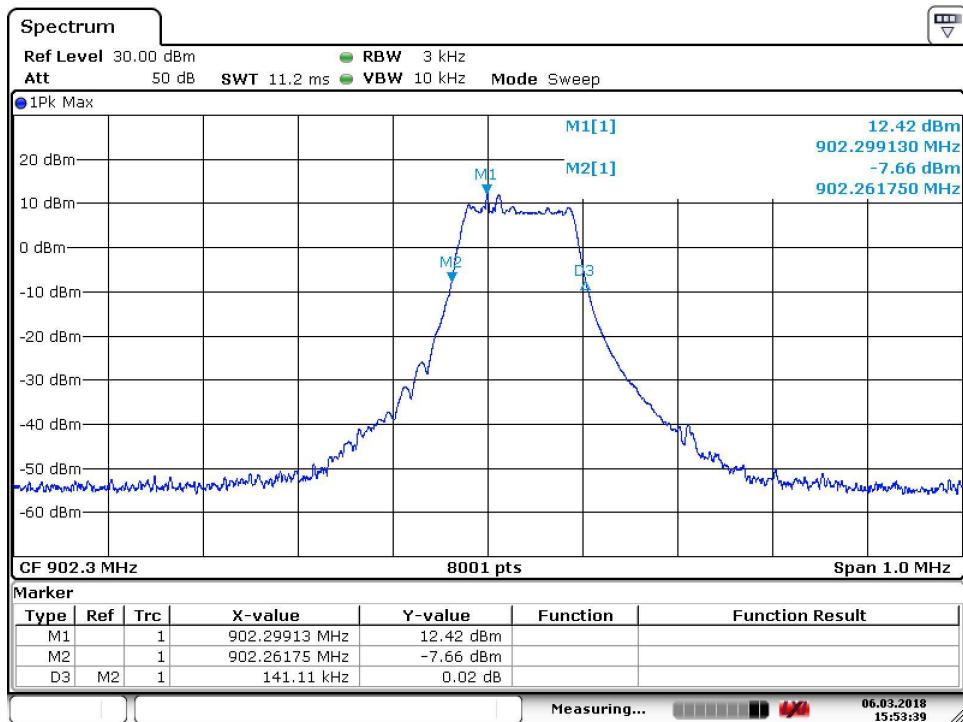
Sweep = auto

Detector function = peak

Trace = max hold

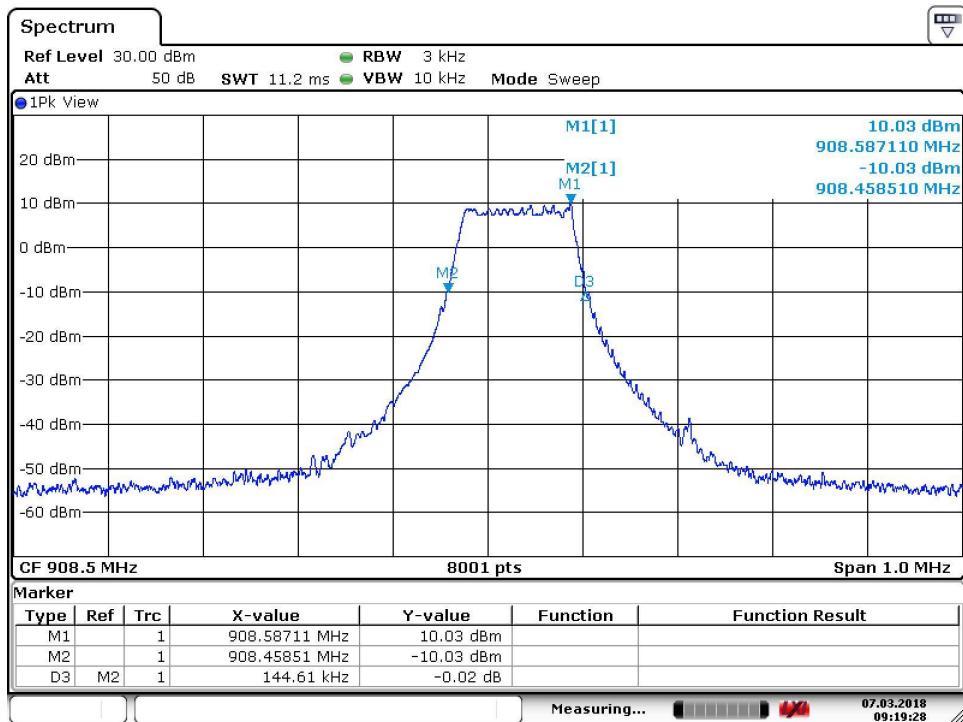
The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the 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:	<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



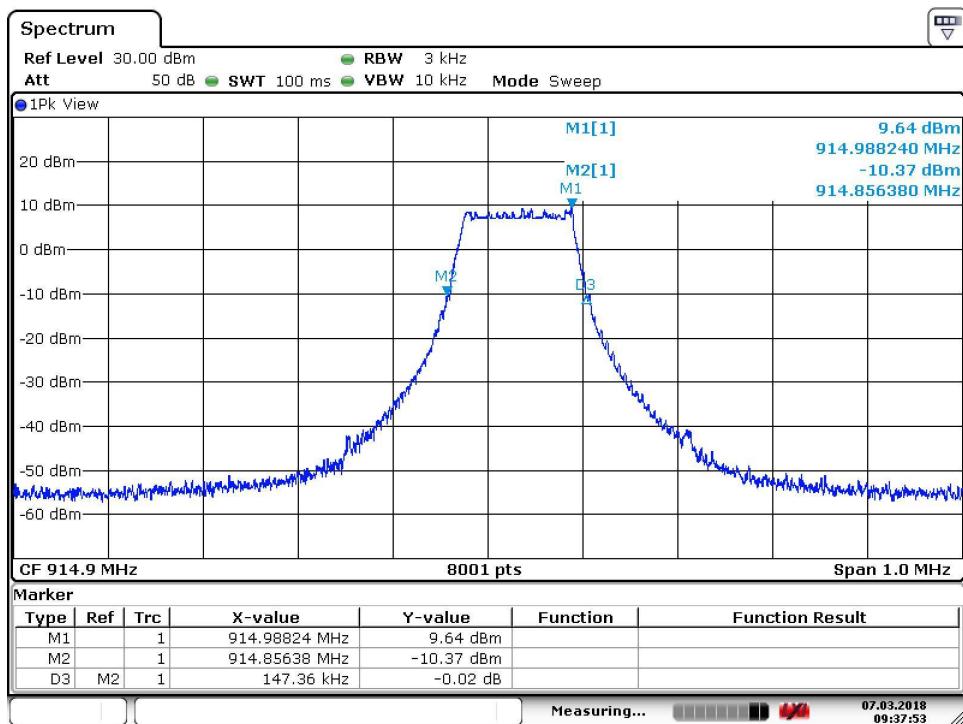
Date: 6.MAR.2018 15:53:39

	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:	Conformance Standard		
Model Number:	FCC Part 15		
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:	Conformance Standard		
Model Number:	FCC Part 15		
Description:	125kHz LoRa Modular Transmitter (FHSS)		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>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
Customer:	Vutiliti Inc.		Conformance Standard
Model Number:	VUHDRF1		FCC Part 15
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>			

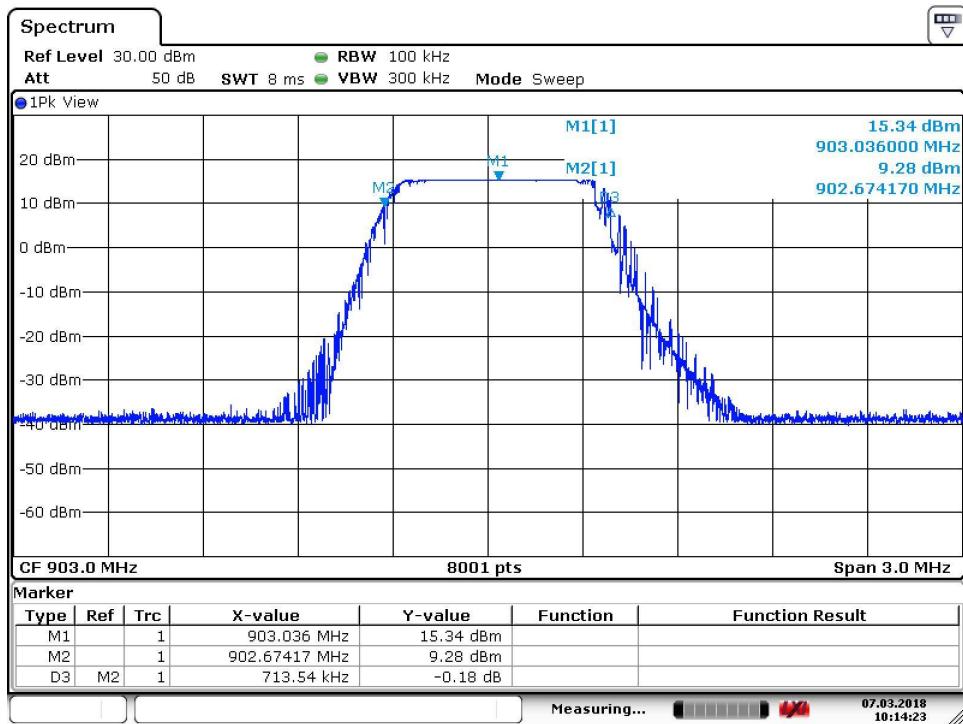
## 6 dB Bandwidth

### ANSI C63.10-2013 Clause 11.8.1

The steps are as follows:

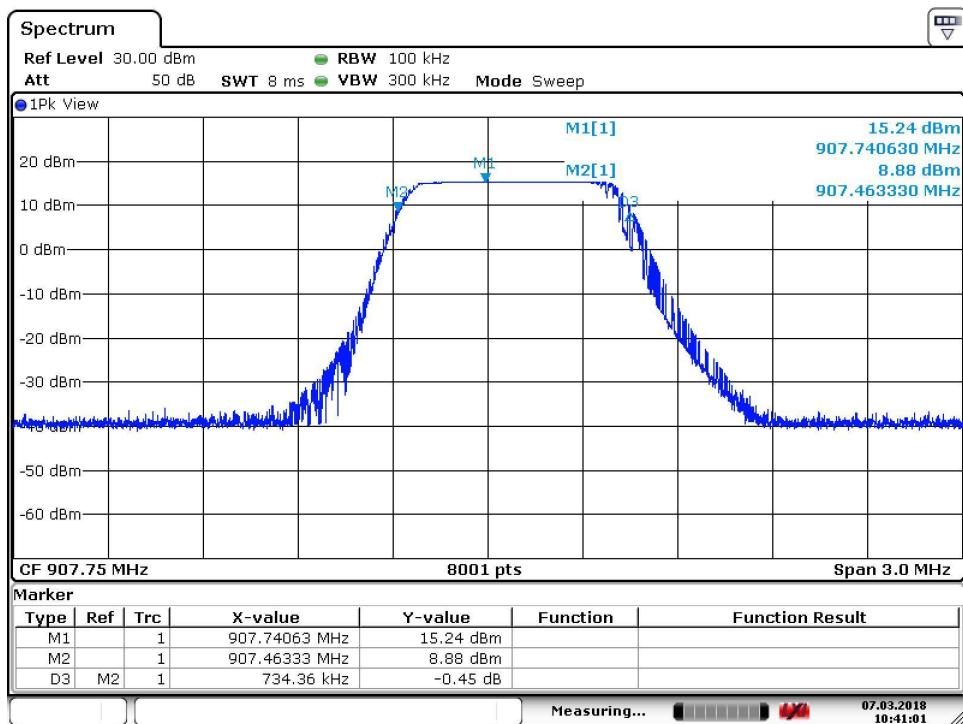
- a) Set RBW = 100 kHz
- b) Set the VBW  $\geq [ 3 \times \text{RBW} ]$   
\* per ANSI C63.10-2013 clause 6.9.2    Set the span to 2 to 5 times the OBW
- c) Detector = peak
- d) Trace mode = max hold
- e) Sweep = auto couple
- f) Allow trace to stabilize
- g) Measure the maximum width of the emission 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			
Model Number:				
Description:	500kHz LoRa Modular Transmitter	FCC Part 15		
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
Low	903.000	713.540	> 500 kHz	Pass



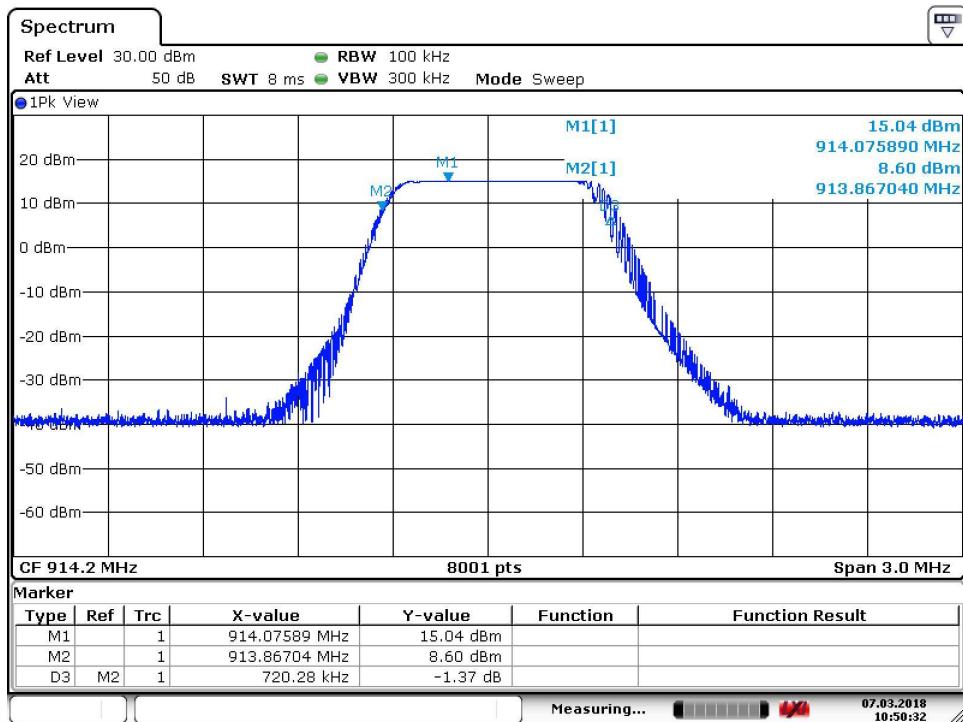
Date: 7.MAR.2018 10:14:23

	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:	Conformance Standard  FCC Part 15
Customer:			
Model Number:			Clause 15.247(a,2)
Description:	500kHz 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 <i>J Payne</i>			
Channel	Chl Freq (MHz)	6dB BW (kHz)	Limit
Middle	907.750	734.36	> 500 kHz
Pass			



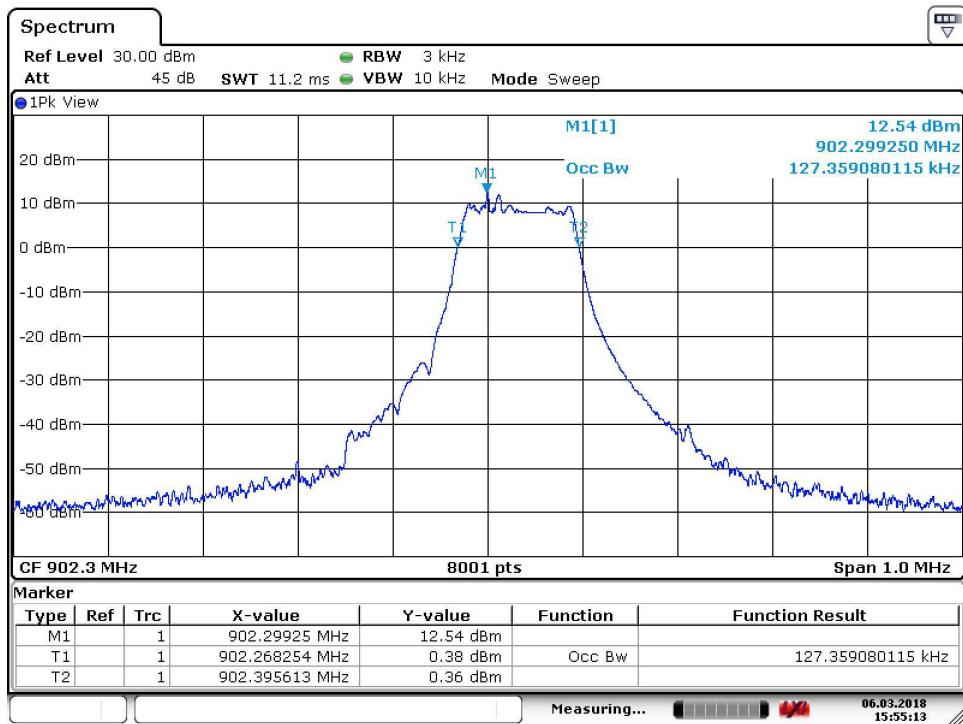
Date: 7.MAR.2018 10:41:01

 <p>1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436</p>		6 dB Single Channel Bandwidth	
DNB Job Number:	86088	Date:	7 Mar 2018
Customer:	Conformance Standard		
Model Number:			
Description:	500kHz LoRa Modular Transmitter		
	FCC Part 15		
	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
High	914.076	720.280	> 500 kHz
Pass/Fail			
Pass			



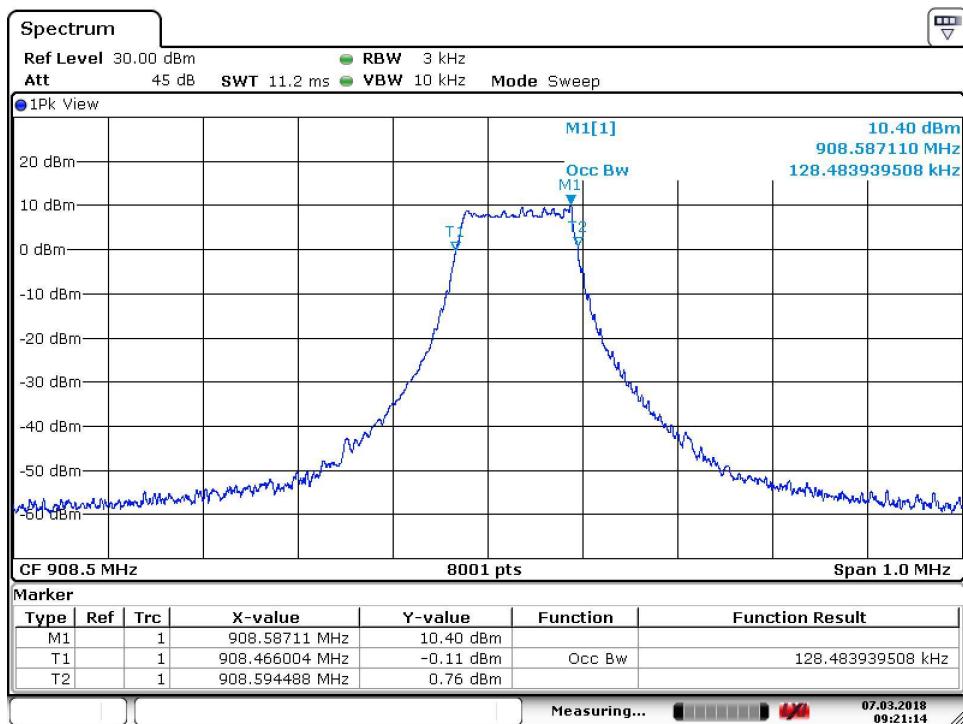
Date: 7.MAR.2018 10:50:32

	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		
Model Number:			
Description:	Clause Section 6.6		
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



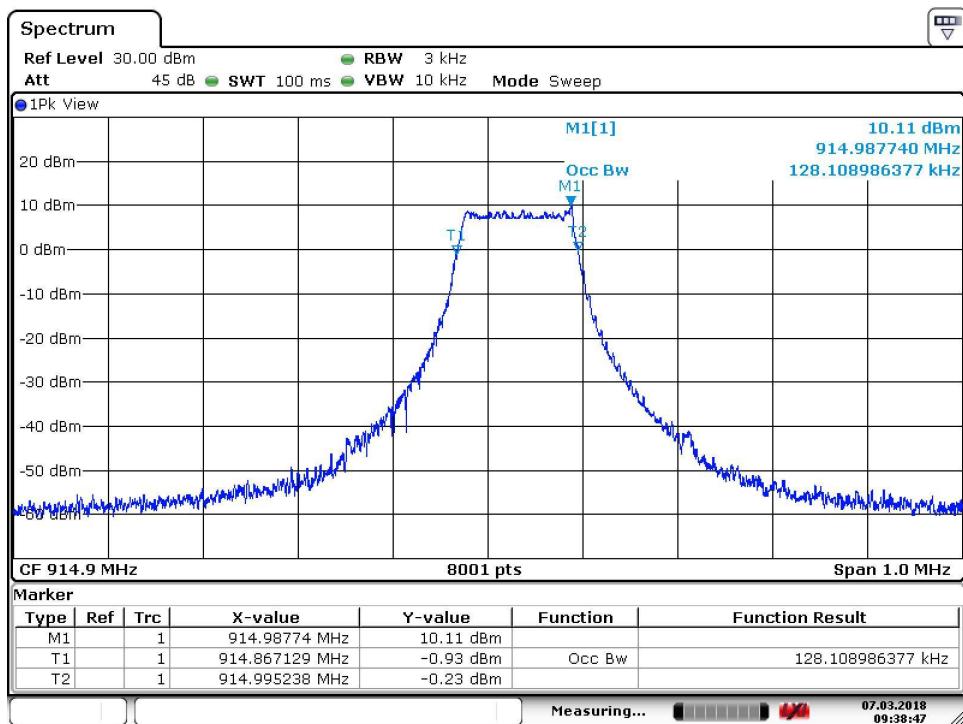
Date: 6.MAR.2018 15:55:14

	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		
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)
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	Clause Section 6.6	
Model Number:	VUHDRF1			
Description:	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 <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

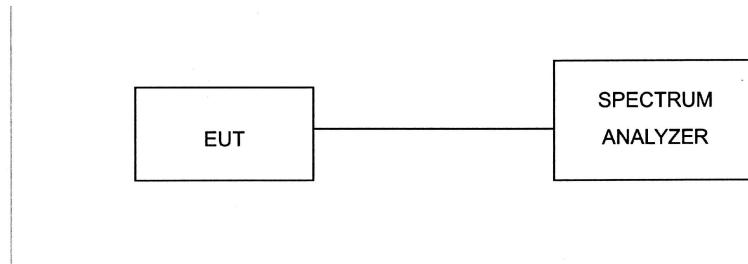
### Peak Output Power

Per clause 11.9.1.1  $RBW \geq DTS$  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  $RBW \geq DTS$  bandwidth
- b) Set the  $VBW \geq [ 3 \times RBW ]$
- c) Set 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

### Peak Output Power (Cond)

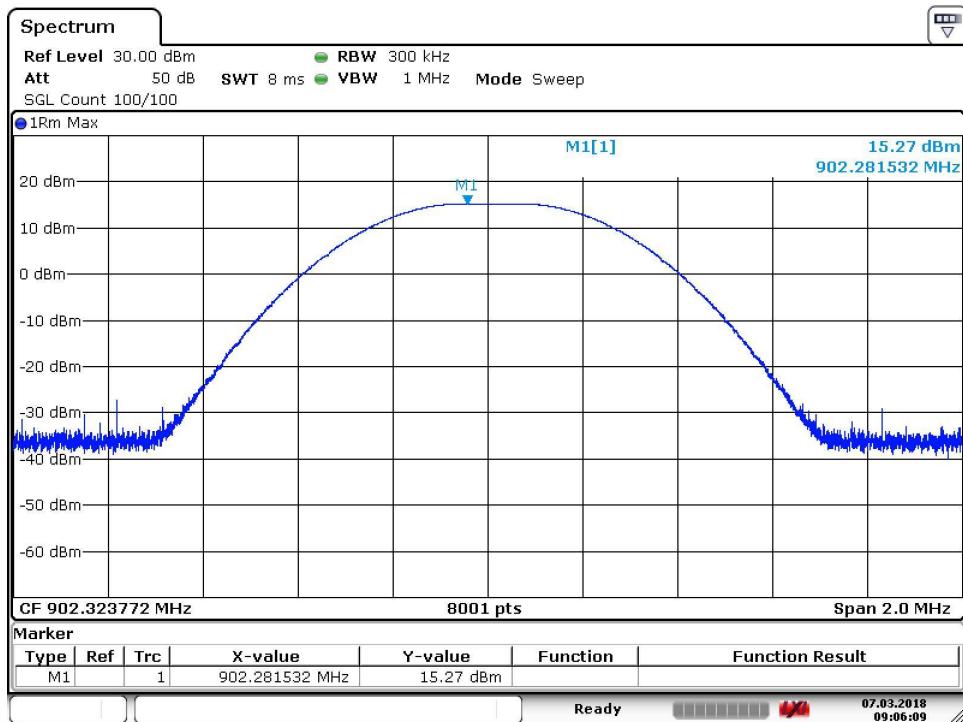
DNB Job Number:	86088	Date:	7 Mar 2018	Conformance Standard
Customer:	Vutiliti Inc.			
Model Number:	VUHDRF1			FCC Part 15
Description:	125 kHz LoRa Modular Transmitter			Clause 15.247(b)

#### Environmental Conditions

Ambient Temperature	Relative Humidity	Barometric Pressure
21 °C	25 %	101.2 kPa

EUT performed within the requirements of the applicable standard  Yes  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

### Peak Output Power (Cond)

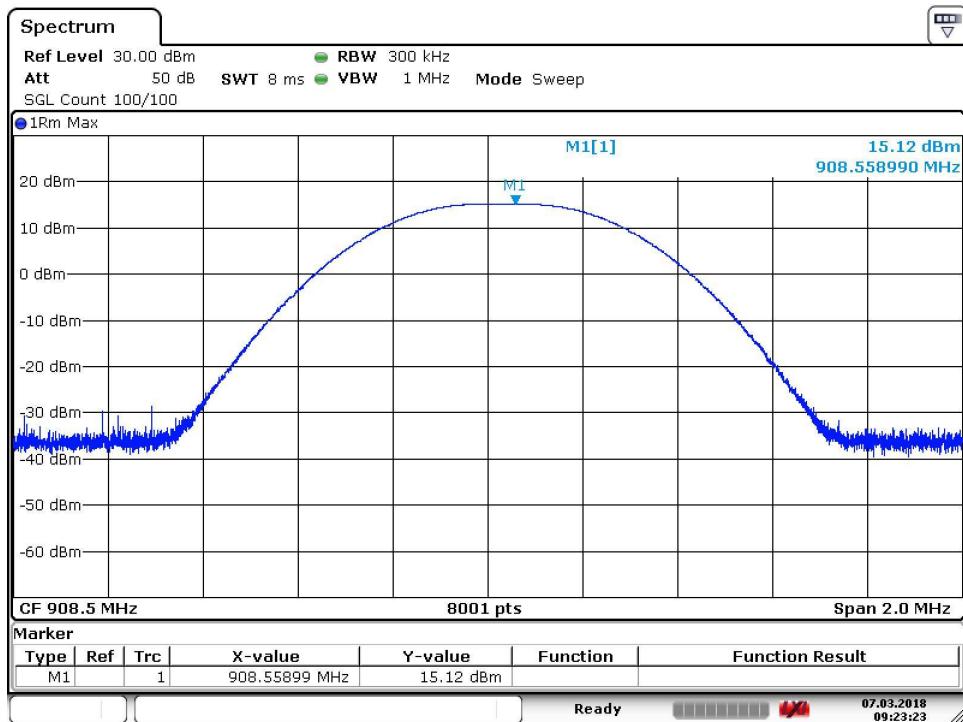
DNB Job Number:	86088	Date:	7 Mar 2018	Conformance Standard
Customer:	Vutiliti Inc.			
Model Number:	VUHDRF1			FCC Part 15
Description:	125 kHz LoRa Modular Transmitter			Clause 15.247(b)

#### Environmental Conditions

Ambient Temperature	Relative Humidity	Barometric Pressure
21 °C	25 %	101.2 kPa

EUT performed within the requirements of the applicable standard  Yes  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

### Peak Output Power (Cond)

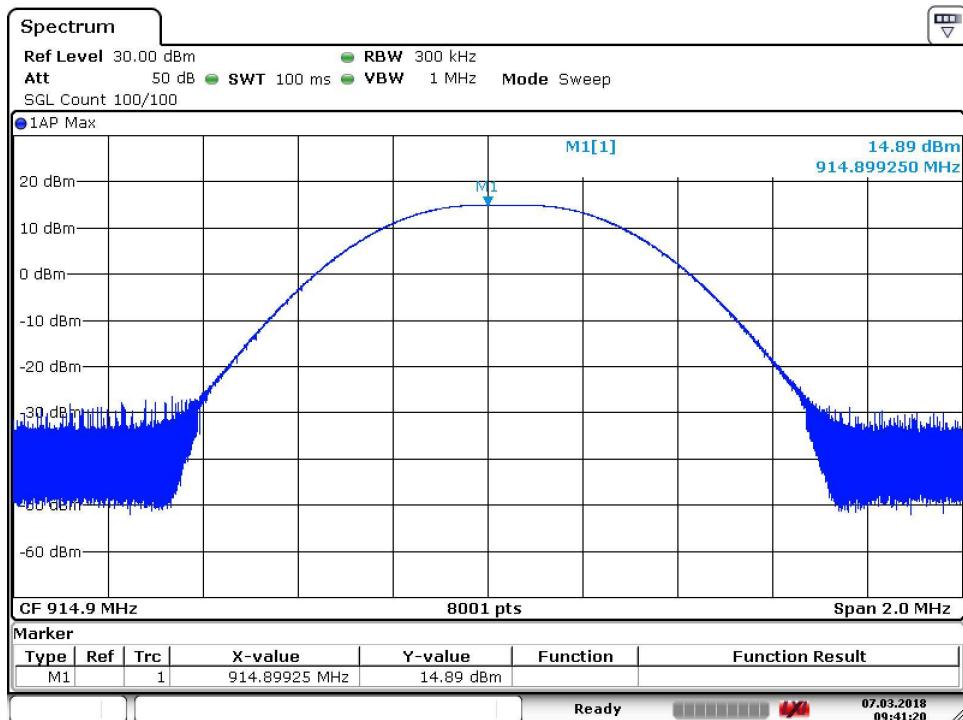
DNB Job Number:	86088	Date:	7 Mar 2018	Conformance Standard
Customer:	Vutiliti Inc.			
Model Number:	VUHDRF1			FCC Part 15
Description:	125 kHz LoRa Modular Transmitter			Clause 15.247(b)

#### Environmental Conditions

Ambient Temperature	Relative Humidity	Barometric Pressure
21 °C	25 %	101.2 kPa

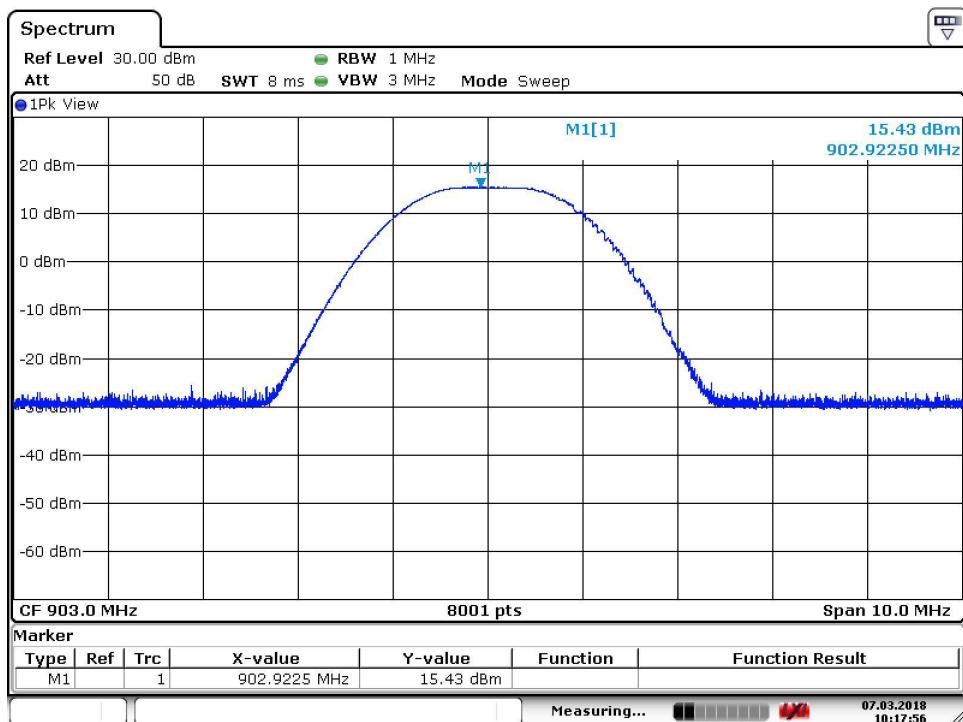
EUT performed within the requirements of the applicable standard  Yes  No J Payne

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



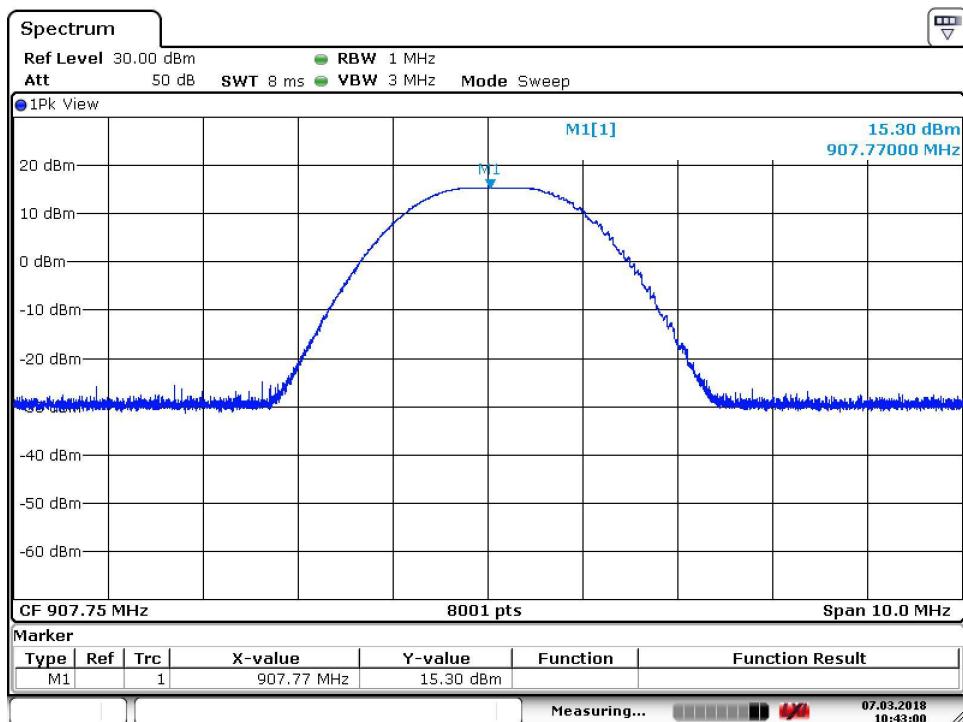
Date: 7.MAR.2018 09:41:20

 <p>1100 E Chalk Creek Road Coalville, UT 84017 (435) 336-4433 FAX (435) 336-4436</p>		Peak Output Power (Cond)					
DNB Job Number:		86088		Date: 7 Mar 2018		Conformance Standard FCC Part 15	
Customer:		Vutiliti Inc.					
Model Number:		VUHDRF1				Clause 15.247(b)	
Description:		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
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	Peak Output Power (Cond)					
DNB Job Number:	86088	Date:	7 Mar 2018	Conformance Standard			
Customer:	Vutiliti Inc.						
Model Number:	VUHDRF1			FCC Part 15			
Description:	500 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
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

### Peak Output Power (Cond)

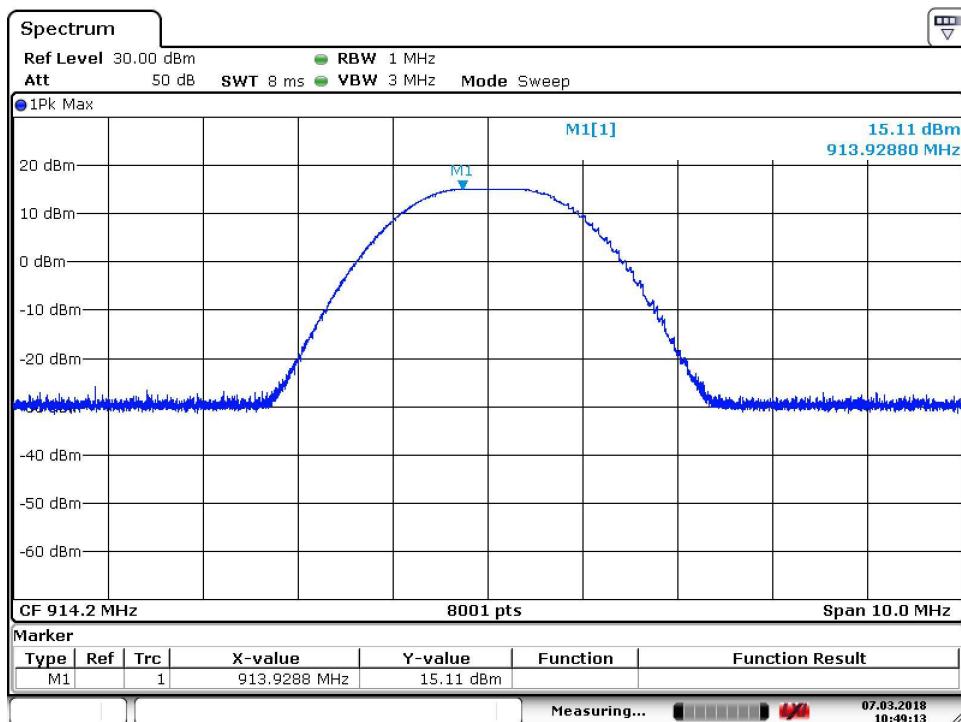
DNB Job Number:	86088	Date:	7 Mar 2018	Conformance Standard
Customer:	Vutiliti Inc.			
Model Number:	VUHDRF1			FCC Part 15
Description:	500 kHz LoRa Modular Transmitter			Clause 15.247(b)

#### Environmental Conditions

Ambient Temperature	Relative Humidity	Barometric Pressure
21 °C	25 %	101.2 kPa

EUT performed within the requirements of the applicable standard  Yes  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

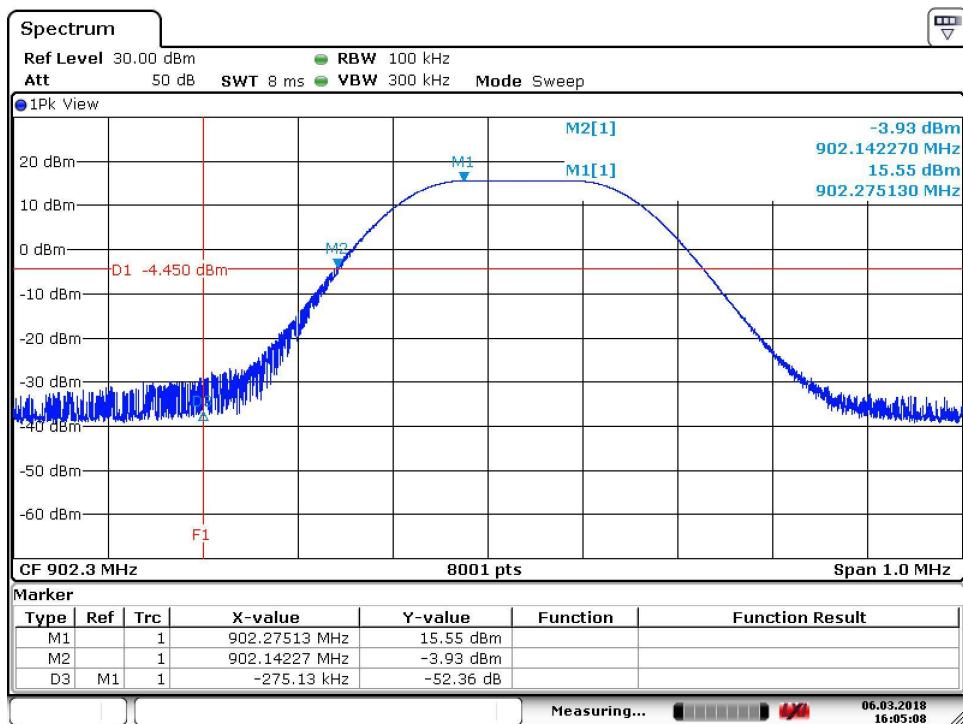
Trace = max hold

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		
<h3>Band Edge Measurements</h3>			
DNB Job Number:	86088	Date:	6 Mar 2018
Customer:	Vutiliti Inc.		
Model Number:	VUHDRF1		
Description:	125 kHz LoRa Modular Transmitter		
Ambient Temperature		Relative Humidity	
26 °C		30 %	
Barometric Pressure		101.35 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)	
902	902.143		0.143
Pass			



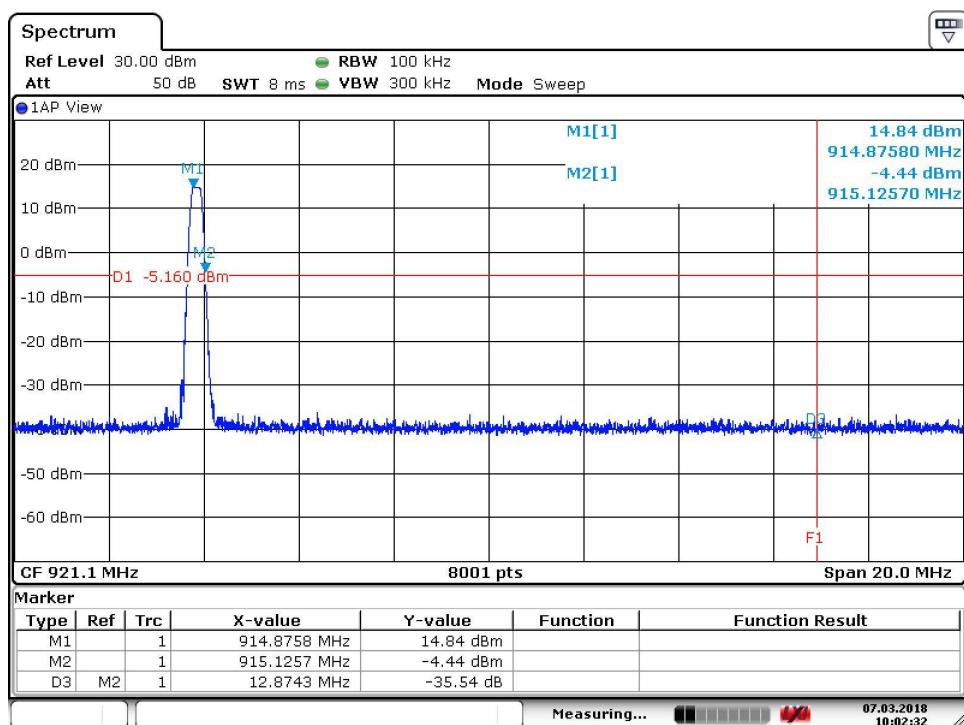
Date: 6.MAR.2018 16:05:08



1100 E Chalk Creek Road  
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FAX (435) 336-4436

## Band Edge Measurements

DNB Job Number:	86088	Date:	7 Mar 2018	Conformance Standard
Customer:	Vutiliti Inc.			
Model Number:	VUHDRF1			FCC Part 15
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		[X] Yes	[ ] No	J Payne
Conducted Band Edge Measurement			Freq Delta (MHz)	Pass/Fail
Limit	Lower (MHz)	Upper (MHz)		
930		915.126	14.874	Pass



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

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