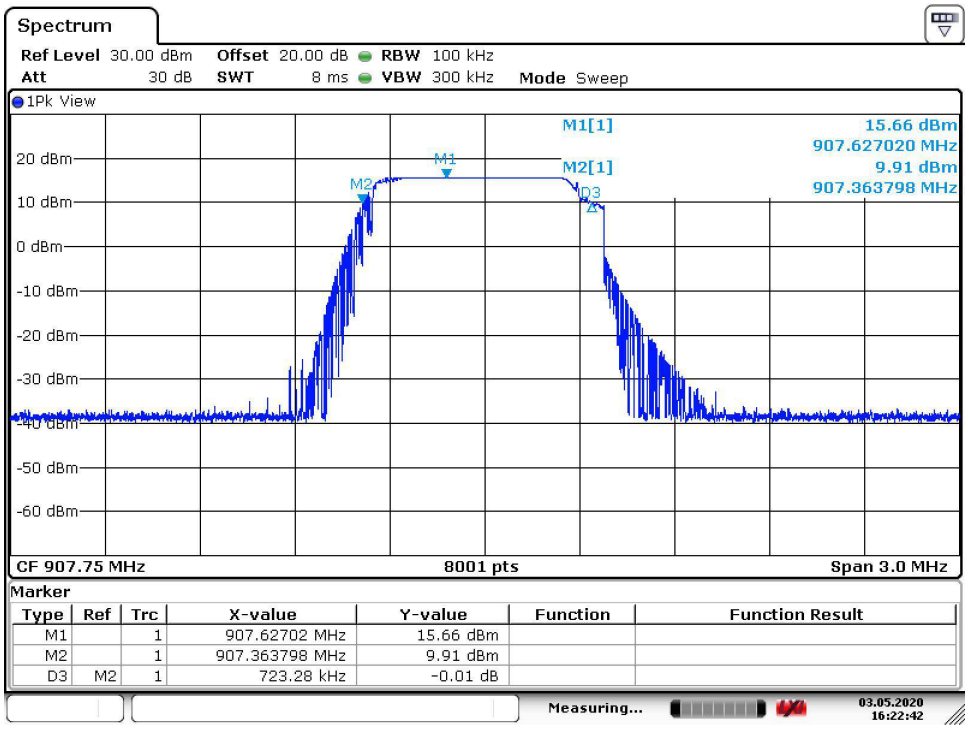
Client: Vutiliti Date: 3 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: 6dB Bandwidth greater than 500kHz Tech: CL Payne

Mid Channel: 907.75 6dB Bandwidth = 723.28kHz Result: Pass



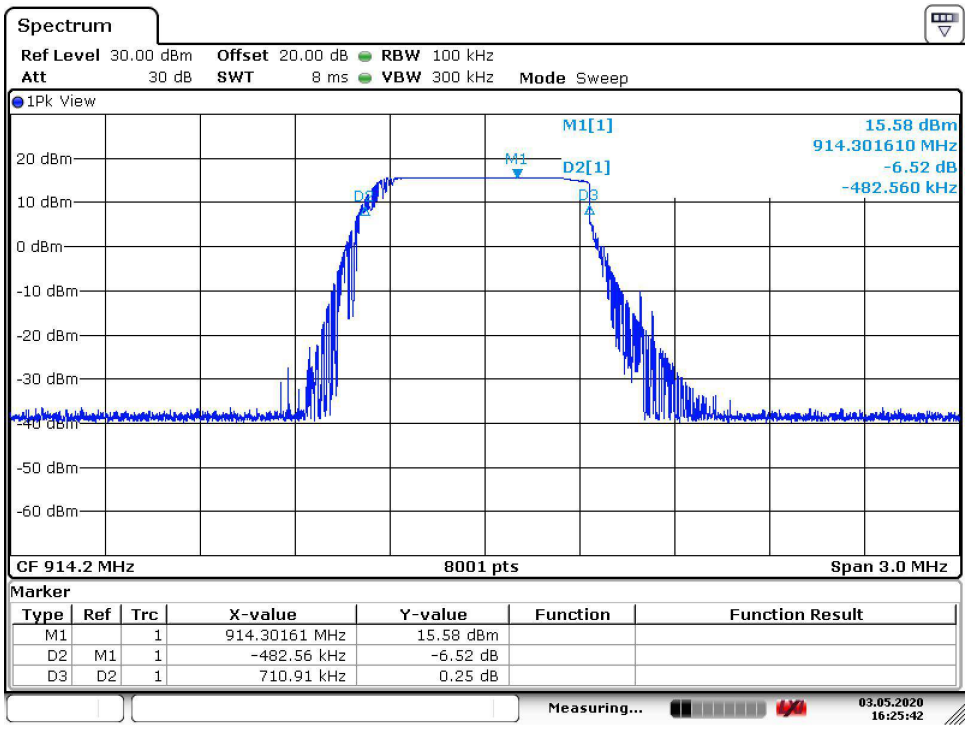
Date: 3.MAY.2020 16:22:42

Client: Vutiliti Date: 3 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: 6dB Bandwidth greater than 500kHz Tech: CL Payne

High Channel: 914.2 6dB Bandwidth = 710.91kHz Result: Pass



15.247 (d) Conducted Spurious ANSI C63.10-2013 Clause 11.11.3

Conducted spurious emissions shall be measured for the transmit frequency, per 5.5 and 5.6, and at the maximum transmit powers.

Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results, account for all losses between the unlicensed wireless device output and the spectrum analyzer. The instrument shall span 30 MHz to 10 times the operating frequency in GHz, with a resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector. The band 30 MHz to the highest frequency may be split into smaller spans, as long as the entire spectrum is covered.

Requirement: FCC Part 15.247 Clause (d)

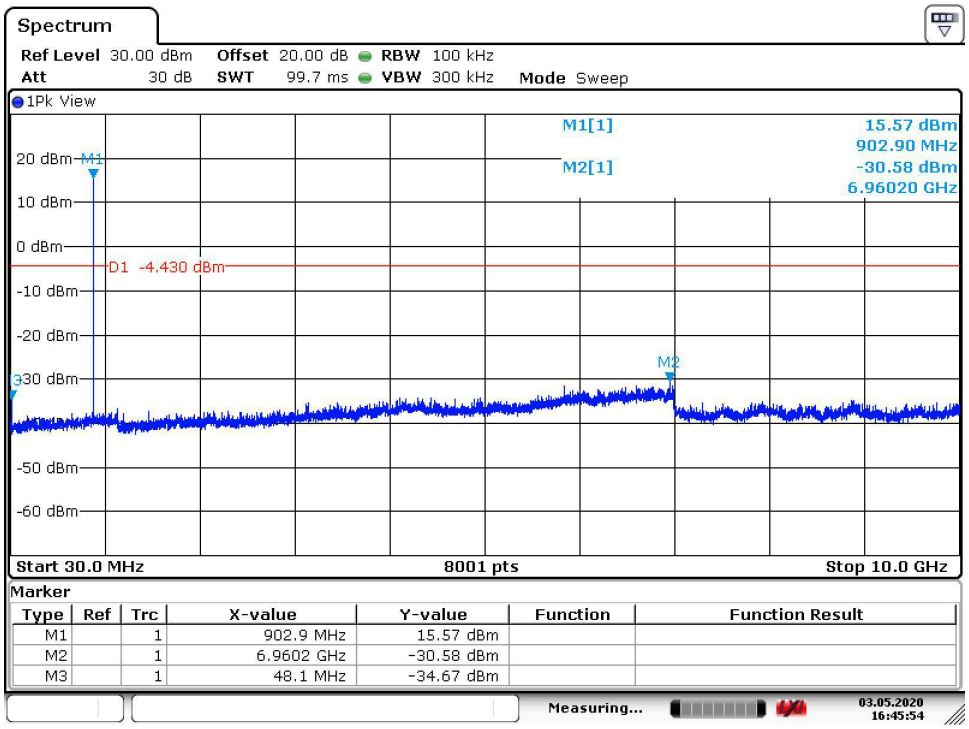
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Client: Vutiliti Date: 3 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Conducted spurious emission <20dB of peak Tech: CL Payne

Low Channel: 903 MHz Maximum Reading = 15.57 dBm
Requirement = -4.43dBm Result: Pass

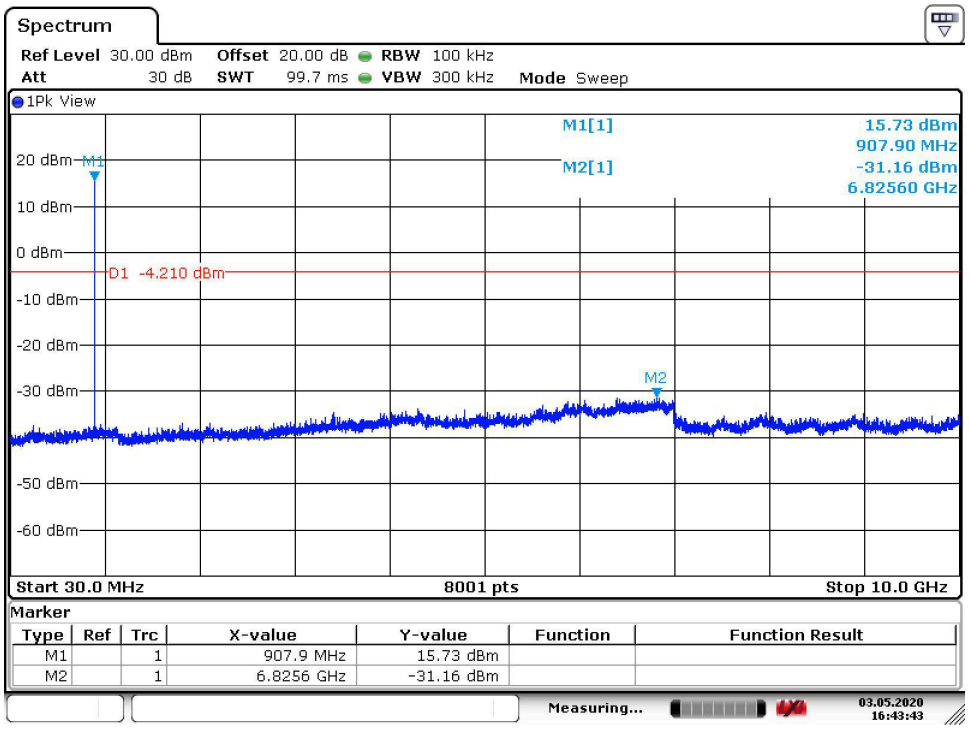


Client: Vutiliti Date: 3 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Conducted spurious emission <20dB of peak Tech: CL Payne

Mid Channel: 907.75 MHz Maximum Reading = 15.79 dBm
Requirement = -4.21 dBm Result: Pass



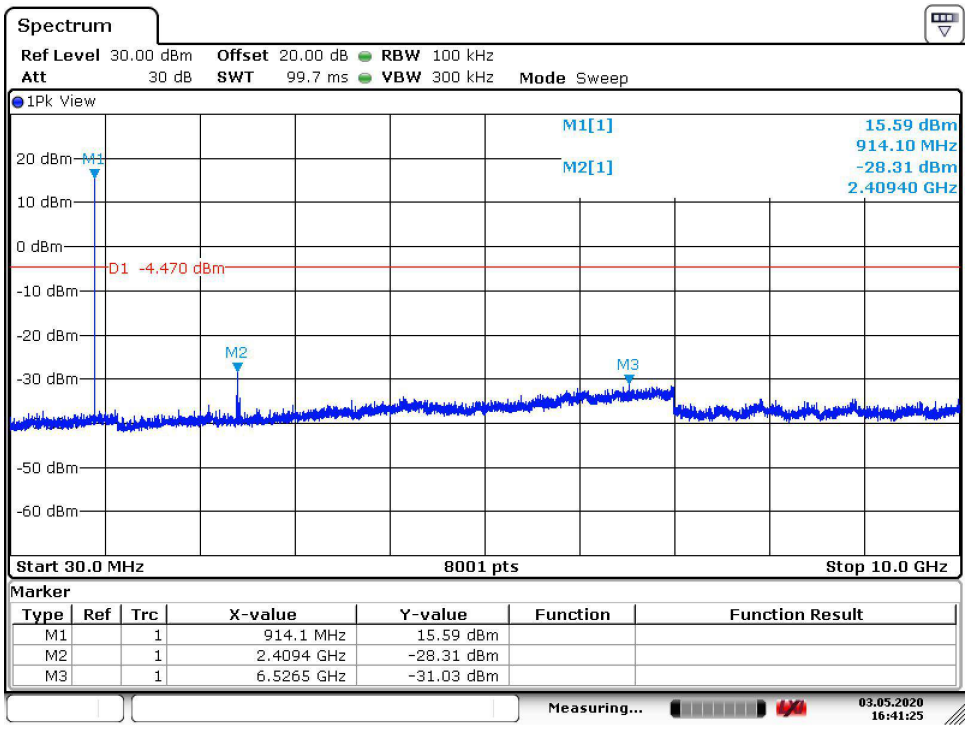
Date: 3.MAY.2020 16:43:43

Client: Vutiliti Date: 3 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Conducted spurious emission <20dB of peak Tech: CL Payne

High Channel: 914.2 MHz Maximum Reading = 15.53 dBm
Requirement = -4.47 dBm Result: Pass



Date: 3.MAY.2020 16:41:25

An additional consideration when performing conducted measurements of restricted-band emissions is that unwanted emissions radiating from the EUT cabinet, control circuits, power leads, or intermediate circuit elements will likely go undetected in a conducted measurement configuration. To address this concern, a radiated test shall be performed to ensure that emissions emanating from the EUT cabinet (rather than from the antenna port) also comply with the applicable limits.

For these cabinet radiated spurious emission measurements, the EUT transmit antenna may be replaced with a termination matching the nominal impedance of the antenna. Procedures for performing radiated measurements are specified in 6.3, 6.5, and 6.6. All detected emissions shall comply with the applicable requirements.

This test is required for any spurious emission or modulation product that falls in an Unrestricted Band, as defined in Section 15.209. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

Span	=	wide enough to fully capture the emission being measured
RBW	=	1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW	=	≥ RBW
Sweep	=	auto
Detector function	=	peak
Trace	=	max hold

Follow the guidelines in ANSI C63.10-2013with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data.

Now repeat the measurement using the average detector of the spectrum analyzer. Submit this data.

Note 1: Limit listed is the general limit as specified in 15.209 in order to show compliance with the restricted bands of operation as well as the out of band limit in 15.247. No other identifiable signals were observed in the restricted bands as specified in 15.205.

Note 2: Highest frequency investigated was the tenth harmonic of the fundamental, no radiated emissions were detected above the 3rd harmonic.

Note 3: This module can operate with the BLE and the LoRa (125kHz FHSS) simultaneously OR the BLE and the LoRa (500kHz DTS) simultaneously. The worst case of each is listed within this test report by associated transmitter. Therefore, the following data sheets are organized by 500kHz LoRa plus BLE, Low, Mid, High Channels, and X, Y, Z axis.

Note 4: For radiated spurious testing the transmitter module used the onboard BTLE chip antenna and the 2inch SMA antenna for the LoRa 125kHz FHSS and the LoRa 500kHz DTS.

Note 5: Both the 2 Inch and 8 Inch antennas were evaluated and showed no significant difference in output power. Both antennas have a published gain of 2dBi.

Requirement: FCC Part 15.247 Clause (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

Low Channel: 903 LoRa 500kHz DTS EUT Axis = X
Low Channel: 2402 BLE Receive Ant = Horizontal
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1806.000	39.6	26.2	3.3	27.1	43.80	74.0	-30.20	PK
1806.000	26.5	26.2	3.3	27.1	30.70	54.0	-23.30	AVE
2709.000	40.2	26.2	4.2	30.1	48.30	74.0	-25.70	PK
2709.000	26.4	26.2	4.2	30.1	34.50	54.0	-19.50	AVE
3612.000	41.4	26.1	5.0	31.2	51.51	74.0	-22.49	PK
3612.000	27.7	26.1	5.0	31.2	37.81	54.0	-16.19	AVE
4515.000	41.8	25.8	5.8	32.1	53.82	74.0	-20.18	PK
4515.000	28.4	25.8	5.8	32.1	40.47	54.0	-13.53	AVE
4804.000	41.7	25.7	5.9	33.1	55.04	74.0	-18.96	PK
4804.000	28.0	25.7	5.9	33.1	41.34	54.0	-12.66	AVE
7224.000	40.6	25.3	7.5	36.5	59.32	74.0	-14.68	PK
7224.000	27.0	25.3	7.5	36.5	45.72	54.0	-8.28	AVE
8127.000	41.2	25.1	8.1	37.5	61.67	74.0	-12.33	PK
8127.000	27.5	25.1	8.1	37.5	47.97	54.0	-6.03	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

Low Channel: 903 LoRa 500kHz DTS EUT Axis = X
Low Channel: 2402 BLE Receive Ant = Vertical
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1806.000	49.6	26.2	3.3	27.1	53.80	74.0	-20.20	PK
1806.000	37.0	26.2	3.3	27.1	41.20	54.0	-12.80	AVE
2709.000	40.1	26.2	4.2	30.1	48.20	74.0	-25.80	PK
2709.000	26.6	26.2	4.2	30.1	34.70	54.0	-19.30	AVE
3612.000	41.6	26.1	5.0	31.2	51.71	74.0	-22.29	PK
3612.000	27.8	26.1	5.0	31.2	37.91	54.0	-16.09	AVE
4515.000	41.8	25.8	5.8	32.1	53.91	74.0	-20.09	PK
4515.000	28.5	25.8	5.8	32.1	40.54	54.0	-13.46	AVE
4804.000	42.1	25.7	5.9	33.1	55.48	74.0	-18.52	PK
4804.000	28.1	25.7	5.9	33.1	41.44	54.0	-12.56	AVE
7224.000	40.3	25.3	7.5	36.5	59.02	74.0	-14.98	PK
7224.000	27.0	25.3	7.5	36.5	45.73	54.0	-8.27	AVE
8127.000	41.4	25.1	8.1	37.5	61.87	74.0	-12.13	PK
8127.000	27.6	25.1	8.1	37.5	48.07	54.0	-5.93	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

Low Channel: 903 LoRa 500kHz DTS EUT Axis = Y
Low Channel: 2402 BLE Receive Ant = Horizontal
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1806.000	39.9	26.2	3.3	27.1	44.13	74.0	-29.87	PK
1806.000	26.5	26.2	3.3	27.1	30.70	54.0	-23.30	AVE
2709.000	40.1	26.2	4.2	30.1	48.21	74.0	-25.79	PK
2709.000	26.4	26.2	4.2	30.1	34.50	54.0	-19.50	AVE
3612.000	41.9	26.1	5.0	31.2	52.01	74.0	-21.99	PK
3612.000	27.7	26.1	5.0	31.2	37.81	54.0	-16.19	AVE
4515.000	41.9	25.8	5.8	32.1	54.01	74.0	-19.99	PK
4515.000	28.4	25.8	5.8	32.1	40.47	54.0	-13.53	AVE
4804.000	41.6	25.7	5.9	33.1	54.94	74.0	-19.06	PK
4804.000	28.0	25.7	5.9	33.1	41.34	54.0	-12.66	AVE
7224.000	41.2	25.3	7.5	36.5	59.87	74.0	-14.13	PK
7224.000	27.0	25.3	7.5	36.5	45.67	54.0	-8.33	AVE
8127.000	40.9	25.1	8.1	37.5	61.32	74.0	-12.68	PK
8127.000	27.5	25.1	8.1	37.5	47.94	54.0	-6.06	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

Low Channel: 903 LoRa 500kHz DTS EUT Axis = Y
Low Channel: 2402 BLE Receive Ant = Vertical
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1806.000	40.5	26.2	3.3	27.1	44.70	74.0	-29.30	PK
1806.000	26.5	26.2	3.3	27.1	30.69	54.0	-23.31	AVE
2709.000	40.3	26.2	4.2	30.1	48.40	74.0	-25.60	PK
2709.000	26.5	26.2	4.2	30.1	34.60	54.0	-19.40	AVE
3612.000	41.3	26.1	5.0	31.2	51.41	74.0	-22.59	PK
3612.000	27.7	26.1	5.0	31.2	37.81	54.0	-16.19	AVE
4515.000	42.4	25.8	5.8	32.1	54.42	74.0	-19.58	PK
4515.000	28.4	25.8	5.8	32.1	40.47	54.0	-13.53	AVE
4804.000	41.8	25.7	5.9	33.1	55.14	74.0	-18.86	PK
4804.000	28.0	25.7	5.9	33.1	41.38	54.0	-12.62	AVE
7224.000	41.1	25.3	7.5	36.5	59.82	74.0	-14.18	PK
7224.000	26.9	25.3	7.5	36.5	45.62	54.0	-8.38	AVE
8127.000	41.8	25.1	8.1	37.5	62.22	74.0	-11.78	PK
8127.000	27.5	25.1	8.1	37.5	47.94	54.0	-6.06	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

Low Channel: 903 LoRa 500kHz DTS EUT Axis = Z
Low Channel: 2402 BLE Receive Ant = Horizontal
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1806.000	41.0	26.2	3.3	27.1	45.23	74.0	-28.77	PK
1806.000	26.5	26.2	3.3	27.1	30.70	54.0	-23.30	AVE
2709.000	40.2	26.2	4.2	30.1	48.30	74.0	-25.70	PK
2709.000	26.5	26.2	4.2	30.1	34.60	54.0	-19.40	AVE
3612.000	41.1	26.1	5.0	31.2	51.21	74.0	-22.79	PK
3612.000	27.7	26.1	5.0	31.2	37.81	54.0	-16.19	AVE
4515.000	42.4	25.8	5.8	32.1	54.44	74.0	-19.56	PK
4515.000	28.4	25.8	5.8	32.1	40.47	54.0	-13.53	AVE
4804.000	41.0	25.7	5.9	33.1	54.38	74.0	-19.62	PK
4804.000	28.0	25.7	5.9	33.1	41.38	54.0	-12.62	AVE
7224.000	41.1	25.3	7.5	36.5	59.86	74.0	-14.14	PK
7224.000	27.0	25.3	7.5	36.5	45.69	54.0	-8.31	AVE
8127.000	41.6	25.1	8.1	37.5	62.07	74.0	-11.93	PK
8127.000	27.5	25.1	8.1	37.5	47.97	54.0	-6.03	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

Low Channel: 903 LoRa 500kHz DTS EUT Axis = Z
Low Channel: 2402 BLE Receive Ant = Vertical
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1806.000	39.9	26.2	3.3	27.1	44.13	74.0	-29.87	PK
1806.000	26.5	26.2	3.3	27.1	30.70	54.0	-23.30	AVE
2709.000	40.0	26.2	4.2	30.1	48.10	74.0	-25.90	PK
2709.000	26.5	26.2	4.2	30.1	34.55	54.0	-19.45	AVE
3612.000	41.1	26.1	5.0	31.2	51.17	74.0	-22.83	PK
3612.000	27.7	26.1	5.0	31.2	37.81	54.0	-16.19	AVE
4515.000	42.1	25.8	5.8	32.1	54.17	74.0	-19.83	PK
4515.000	28.4	25.8	5.8	32.1	40.47	54.0	-13.53	AVE
4804.000	41.6	25.7	5.9	33.1	54.92	74.0	-19.08	PK
4804.000	28.0	25.7	5.9	33.1	41.38	54.0	-12.62	AVE
7224.000	41.1	25.3	7.5	36.5	59.81	74.0	-14.19	PK
7224.000	27.0	25.3	7.5	36.5	45.69	54.0	-8.31	AVE
8127.000	41.8	25.1	8.1	37.5	62.27	74.0	-11.73	PK
8127.000	27.5	25.1	8.1	37.5	47.97	54.0	-6.03	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

Mid Channel: 907.75 LoRa 500kHz DTS EUT Axis = X
Mid Channel: 2440 BLE Receive Ant = Horizontal
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1815.500	46.5	26.2	3.3	27.2	50.78	74.0	-23.22	PK
1815.500	36.7	26.2	3.3	27.2	40.93	54.0	-13.07	AVE
2723.250	40.4	26.2	4.2	30.1	48.49	74.0	-25.51	PK
2723.250	26.5	26.2	4.2	30.1	34.59	54.0	-19.41	AVE
3631.000	41.4	26.1	5.0	31.2	51.55	74.0	-22.45	PK
3631.000	27.7	26.1	5.0	31.2	37.85	54.0	-16.15	AVE
4538.750	42.1	25.8	5.8	32.1	54.23	74.0	-19.77	PK
4538.750	28.3	25.8	5.8	32.1	40.50	54.0	-13.50	AVE
4880.000	42.1	25.6	6.0	33.4	55.77	74.0	-18.23	PK
4880.000	28.1	25.6	6.0	33.4	41.77	54.0	-12.23	AVE
7320.000	40.5	25.3	7.5	36.7	59.42	74.0	-14.58	PK
7320.000	26.9	25.3	7.5	36.7	45.82	54.0	-8.18	AVE
8169.750	41.0	25.1	8.2	37.5	61.51	74.0	-12.49	PK
8169.750	27.0	25.1	8.2	37.5	47.52	54.0	-6.48	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

Mid Channel: 907.75 LoRa 500kHz DTS EUT Axis = X
Mid Channel: 2440 BLE Receive Ant = Vertical
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1815.500	47.2	26.2	3.3	27.2	51.45	74.0	-22.55	PK
1815.500	36.2	26.2	3.3	27.2	40.50	54.0	-13.50	AVE
2723.250	40.2	26.2	4.2	30.1	48.34	74.0	-25.66	PK
2723.250	26.4	26.2	4.2	30.1	34.54	54.0	-19.46	AVE
3631.000	40.9	26.1	5.0	31.2	51.02	74.0	-22.98	PK
3631.000	27.5	26.1	5.0	31.2	37.65	54.0	-16.35	AVE
4538.750	42.4	25.8	5.8	32.1	54.60	74.0	-19.40	PK
4538.750	28.3	25.8	5.8	32.1	40.47	54.0	-13.53	AVE
4880.000	41.4	25.6	6.0	33.4	55.07	74.0	-18.93	PK
4880.000	28.1	25.6	6.0	33.4	41.77	54.0	-12.23	AVE
7320.000	40.4	25.3	7.5	36.7	59.30	74.0	-14.70	PK
7320.000	26.9	25.3	7.5	36.7	45.80	54.0	-8.20	AVE
8169.750	40.7	25.1	8.2	37.5	61.19	74.0	-12.81	PK
8169.750	26.9	25.1	8.2	37.5	47.42	54.0	-6.58	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

Mid Channel: 907.75 LoRa 500kHz DTS EUT Axis = Y
Mid Channel: 2440 BLE Receive Ant = Horizontal
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1815.500	44.7	26.2	3.3	27.2	48.98	74.0	-25.02	PK
1815.500	32.4	26.2	3.3	27.2	36.68	54.0	-17.32	AVE
2723.250	40.0	26.2	4.2	30.1	48.11	74.0	-25.89	PK
2723.250	26.4	26.2	4.2	30.1	34.54	54.0	-19.46	AVE
3631.000	40.8	26.1	5.0	31.2	50.92	74.0	-23.08	PK
3631.000	27.5	26.1	5.0	31.2	37.65	54.0	-16.35	AVE
4538.750	41.8	25.8	5.8	32.1	53.94	74.0	-20.06	PK
4538.750	28.3	25.8	5.8	32.1	40.47	54.0	-13.53	AVE
4880.000	42.1	25.6	6.0	33.4	55.77	74.0	-18.23	PK
4880.000	28.2	25.6	6.0	33.4	41.87	54.0	-12.13	AVE
7320.000	40.6	25.3	7.5	36.7	59.52	74.0	-14.48	PK
7320.000	26.9	25.3	7.5	36.7	45.82	54.0	-8.18	AVE
8169.750	40.4	25.1	8.2	37.5	60.92	74.0	-13.08	PK
8169.750	27.0	25.1	8.2	37.5	47.48	54.0	-6.52	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

Mid Channel: 907.75 LoRa 500kHz DTS EUT Axis = Y
Mid Channel: 2440 BLE Receive Ant = Vertical
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1815.500	48.0	26.2	3.3	27.2	52.28	74.0	-21.72	PK
1815.500	36.5	26.2	3.3	27.2	40.78	54.0	-13.22	AVE
2723.250	40.5	26.2	4.2	30.1	48.64	74.0	-25.36	PK
2723.250	28.0	26.2	4.2	30.1	36.14	54.0	-17.86	AVE
3631.000	41.4	26.1	5.0	31.2	51.55	74.0	-22.45	PK
3631.000	27.5	26.1	5.0	31.2	37.65	54.0	-16.35	AVE
4538.750	42.0	25.8	5.8	32.1	54.17	74.0	-19.83	PK
4538.750	28.3	25.8	5.8	32.1	40.47	54.0	-13.53	AVE
4880.000	41.8	25.6	6.0	33.4	55.47	74.0	-18.53	PK
4880.000	28.2	25.6	6.0	33.4	41.83	54.0	-12.17	AVE
7320.000	40.8	25.3	7.5	36.7	59.73	74.0	-14.27	PK
7320.000	26.9	25.3	7.5	36.7	45.82	54.0	-8.18	AVE
8169.750	40.4	25.1	8.2	37.5	60.92	74.0	-13.08	PK
8169.750	27.0	25.1	8.2	37.5	47.50	54.0	-6.50	AVE

Client: Vutiliti Date:17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

Mid Channel: 907.75 LoRa 500kHz DTS EUT Axis = Z
Mid Channel: 2440 BLE Receive Ant = Horizontal
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1815.500	45.4	26.2	3.3	27.2	49.70	74.0	-24.30	PK
1815.500	32.8	26.2	3.3	27.2	37.08	54.0	-16.92	AVE
2723.250	40.0	26.2	4.2	30.1	48.10	74.0	-25.90	PK
2723.250	26.4	26.2	4.2	30.1	34.54	54.0	-19.46	AVE
3631.000	41.3	26.1	5.0	31.2	51.45	74.0	-22.55	PK
3631.000	27.6	26.1	5.0	31.2	37.70	54.0	-16.30	AVE
4538.750	41.9	25.8	5.8	32.1	54.07	74.0	-19.93	PK
4538.750	28.3	25.8	5.8	32.1	40.47	54.0	-13.53	AVE
4880.000	41.7	25.6	6.0	33.4	55.37	74.0	-18.63	PK
4880.000	28.2	25.6	6.0	33.4	41.87	54.0	-12.13	AVE
7320.000	40.3	25.3	7.5	36.7	59.22	74.0	-14.78	PK
7320.000	26.9	25.3	7.5	36.7	45.82	54.0	-8.18	AVE
8169.750	40.6	25.1	8.2	37.5	61.12	74.0	-12.88	PK
8169.750	27.0	25.1	8.2	37.5	47.52	54.0	-6.48	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

Mid Channel: 907.75 LoRa 500kHz DTS EUT Axis = Z
Mid Channel: 2440 BLE Receive Ant = Vertical
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1815.500	47.1	26.2	3.3	27.2	51.38	74.0	-22.62	PK
1815.500	37.2	26.2	3.3	27.2	41.50	54.0	-12.50	AVE
2723.250	40.0	26.2	4.2	30.1	48.14	74.0	-25.86	PK
2723.250	26.4	26.2	4.2	30.1	34.54	54.0	-19.46	AVE
3631.000	41.1	26.1	5.0	31.2	51.25	74.0	-22.75	PK
3631.000	27.5	26.1	5.0	31.2	37.65	54.0	-16.35	AVE
4538.750	41.7	25.8	5.8	32.1	53.87	74.0	-20.13	PK
4538.750	28.3	25.8	5.8	32.1	40.47	54.0	-13.53	AVE
4880.000	41.6	25.6	6.0	33.4	55.27	74.0	-18.73	PK
4880.000	28.1	25.6	6.0	33.4	41.77	54.0	-12.23	AVE
7320.000	40.8	25.3	7.5	36.7	59.72	74.0	-14.28	PK
7320.000	26.9	25.3	7.5	36.7	45.82	54.0	-8.18	AVE
8169.750	40.7	25.1	8.2	37.5	61.22	74.0	-12.78	PK
8169.750	27.0	25.1	8.2	37.5	47.52	54.0	-6.48	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

High Channel: 914.2 LoRa 500kHz DTS EUT Axis = X
High Channel: 2480 BLE Receive Ant = Horizontal
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1828.400	51.5	26.2	3.3	27.3	55.90	74.0	-18.10	PK
1828.400	42.7	26.2	3.3	27.3	47.10	54.0	-6.90	AVE
2742.600	40.2	26.2	4.2	30.1	48.38	74.0	-25.62	PK
2742.600	26.6	26.2	4.2	30.1	34.78	54.0	-19.22	AVE
3656.800	42.1	26.1	5.1	31.2	52.30	74.0	-21.70	PK
3656.800	27.6	26.1	5.1	31.2	37.80	54.0	-16.20	AVE
4571.000	42.0	25.8	5.8	32.3	54.31	74.0	-19.69	PK
4571.000	28.3	25.8	5.8	32.3	40.61	54.0	-13.39	AVE
4960.000	43.2	25.6	6.0	33.7	57.22	74.0	-16.78	PK
4960.000	29.0	25.6	6.0	33.7	42.97	54.0	-11.03	AVE
7440.000	41.2	25.3	7.6	36.8	60.36	74.0	-13.64	PK
7440.000	27.6	25.3	7.6	36.8	46.76	54.0	-7.24	AVE
8227.800	40.8	25.1	8.2	37.5	61.40	74.0	-12.60	PK
8227.800	27.3	25.1	8.2	37.5	47.90	54.0	-6.10	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

High Channel: 914.2 LoRa 500kHz DTS EUT Axis = X
High Channel: 2480 BLE Receive Ant = Vertical
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1828.400	55.6	26.2	3.3	27.3	60.00	74.0	-14.00	PK
1828.400	44.2	26.2	3.3	27.3	48.61	54.0	-5.39	AVE
2742.600	40.6	26.2	4.2	30.1	48.78	74.0	-25.22	PK
2742.600	26.7	26.2	4.2	30.1	34.88	54.0	-19.12	AVE
3656.800	41.1	26.1	5.1	31.2	51.30	74.0	-22.70	PK
3656.800	27.6	26.1	5.1	31.2	37.80	54.0	-16.20	AVE
4571.000	42.6	25.8	5.8	32.3	54.91	74.0	-19.09	PK
4571.000	28.3	25.8	5.8	32.3	40.61	54.0	-13.39	AVE
4960.000	42.8	25.6	6.0	33.7	56.82	74.0	-17.18	PK
4960.000	28.9	25.6	6.0	33.7	42.92	54.0	-11.08	AVE
7440.000	41.3	25.3	7.6	36.8	60.46	74.0	-13.54	PK
7440.000	27.5	25.3	7.6	36.8	46.66	54.0	-7.34	AVE
8227.800	41.1	25.1	8.2	37.5	61.70	74.0	-12.30	PK
8227.800	27.2	25.1	8.2	37.5	47.80	54.0	-6.20	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

High Channel: 914.2 LoRa 500kHz DTS EUT Axis = Y
High Channel: 2480 BLE Receive Ant = Horizontal
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1828.400	40.0	26.2	3.3	27.3	44.40	74.0	-29.60	PK
1828.400	26.7	26.2	3.3	27.3	31.10	54.0	-22.90	AVE
2742.600	40.6	26.2	4.2	30.1	48.78	74.0	-25.22	PK
2742.600	26.7	26.2	4.2	30.1	34.88	54.0	-19.12	AVE
3656.800	41.6	26.1	5.1	31.2	51.80	74.0	-22.20	PK
3656.800	27.6	26.1	5.1	31.2	37.80	54.0	-16.20	AVE
4571.000	42.1	25.8	5.8	32.3	54.41	74.0	-19.59	PK
4571.000	28.3	25.8	5.8	32.3	40.61	54.0	-13.39	AVE
4960.000	42.6	25.6	6.0	33.7	56.62	74.0	-17.38	PK
4960.000	28.9	25.6	6.0	33.7	42.92	54.0	-11.08	AVE
7440.000	41.2	25.3	7.6	36.8	60.36	74.0	-13.64	PK
7440.000	27.5	25.3	7.6	36.8	46.66	54.0	-7.34	AVE
8227.800	40.5	25.1	8.2	37.5	61.10	74.0	-12.90	PK
8227.800	27.2	25.1	8.2	37.5	47.80	54.0	-6.20	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

High Channel: 914.2 LoRa 500kHz DTS EUT Axis = Y
High Channel: 2480 BLE Receive Ant = Vertical
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1828.400	53.1	26.2	3.3	27.3	57.50	74.0	-16.50	PK
1828.400	41.5	26.2	3.3	27.3	45.90	54.0	-8.10	AVE
2742.600	41.4	26.2	4.2	30.1	49.58	74.0	-24.42	PK
2742.600	26.7	26.2	4.2	30.1	34.88	54.0	-19.12	AVE
3656.800	41.1	26.1	5.1	31.2	51.30	74.0	-22.70	PK
3656.800	27.6	26.1	5.1	31.2	37.80	54.0	-16.20	AVE
4571.000	42.5	25.8	5.8	32.3	54.81	74.0	-19.19	PK
4571.000	28.3	25.8	5.8	32.3	40.61	54.0	-13.39	AVE
4960.000	42.7	25.6	6.0	33.7	56.72	74.0	-17.28	PK
4960.000	28.9	25.6	6.0	33.7	42.92	54.0	-11.08	AVE
7440.000	40.9	25.3	7.6	36.8	60.06	74.0	-13.94	PK
7440.000	27.5	25.3	7.6	36.8	46.66	54.0	-7.34	AVE
8227.800	41.1	25.1	8.2	37.5	61.70	74.0	-12.30	PK
8227.800	27.2	25.1	8.2	37.5	47.80	54.0	-6.20	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

High Channel: 914.2 LoRa 500kHz DTS EUT Axis = Z
High Channel: 2480 BLE Receive Ant = Horizontal
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1828.400	58.0	26.2	3.3	27.3	62.36	74.0	-11.64	PK
1828.400	45.4	26.2	3.3	27.3	49.80	54.0	-4.20	AVE
2742.600	39.8	26.2	4.2	30.1	47.98	74.0	-26.02	PK
2742.600	26.7	26.2	4.2	30.1	34.88	54.0	-19.12	AVE
3656.800	41.2	26.1	5.1	31.2	51.40	74.0	-22.60	PK
3656.800	27.6	26.1	5.1	31.2	37.80	54.0	-16.20	AVE
4571.000	41.9	25.8	5.8	32.3	54.21	74.0	-19.79	PK
4571.000	28.3	25.8	5.8	32.3	40.61	54.0	-13.39	AVE
4960.000	42.1	25.6	6.0	33.7	56.12	74.0	-17.88	PK
4960.000	28.9	25.6	6.0	33.7	42.92	54.0	-11.08	AVE
7440.000	41.1	25.3	7.6	36.8	60.26	74.0	-13.74	PK
7440.000	27.5	25.3	7.6	36.8	46.66	54.0	-7.34	AVE
8227.800	41.1	25.1	8.2	37.5	61.70	74.0	-12.30	PK
8227.800	27.2	25.1	8.2	37.5	47.80	54.0	-6.20	AVE

Client: Vutiliti Date: 17 Apr 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Radiated spurious emission <20dB of peak Tech: CL Payne

High Channel: 914.2 LoRa 500kHz DTS EUT Axis = Z
High Channel: 2480 BLE Receive Ant = Vertical
Result: Pass

RADIATED SPURIOUS								
Freq (MHz)	Meter (dBuV/m)	Pre-Amp (dB)	Cable (dB)	Antenna (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Type
1828.400	46.1	26.2	3.3	27.3	50.50	74.0	-23.50	PK
1828.400	34.2	26.2	3.3	27.3	38.60	54.0	-15.40	AVE
2742.600	40.0	26.2	4.2	30.1	48.18	74.0	-25.82	PK
2742.600	26.7	26.2	4.2	30.1	34.88	54.0	-19.12	AVE
3656.800	40.7	26.1	5.1	31.2	50.90	74.0	-23.10	PK
3656.800	27.6	26.1	5.1	31.2	37.80	54.0	-16.20	AVE
4571.000	41.7	25.8	5.8	32.3	54.01	74.0	-19.99	PK
4571.000	28.3	25.8	5.8	32.3	40.61	54.0	-13.39	AVE
4960.000	42.1	25.6	6.0	33.7	56.12	74.0	-17.88	PK
4960.000	28.9	25.6	6.0	33.7	42.92	54.0	-11.08	AVE
7440.000	40.8	25.3	7.6	36.8	59.96	74.0	-14.04	PK
7440.000	27.5	25.3	7.6	36.8	46.66	54.0	-7.34	AVE
8227.800	41.5	25.1	8.2	37.5	62.10	74.0	-11.90	PK
8227.800	27.2	25.1	8.2	37.5	47.80	54.0	-6.20	AVE

15.247 (d) Restricted Bands ANSI C63.10-2013 Clause 11.12.2

11.12.2 Antenna-port conducted measurements

11.12.2.1 General

Antenna-port conducted measurements may also be used as an alternative to radiated measurements for determining compliance in the restricted frequency bands requirements. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case emissions is required.

11.12.2.2 General procedure for conducted measurements in restricted bands

The general procedure for conducted measurements in restricted bands is as follows:

a) Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency (see 11.12.2.3 through 11.12.2.5 for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).

b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP (see 11.12.2.6 for guidance on determining the applicable antenna gain).

c) Add the appropriate maximum ground reflection factor to the EIRP (6 dB for frequencies ≤ 30 MHz; 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive; and 0 dB for frequencies > 1000 MHz).

d) For MIMO devices, measure the power of each chain and sum the EIRP of all chains in linear terms (i.e., watts and mW).

e) Convert the resultant EIRP to an equivalent electric field strength using the following relationship:

$$E = \text{EIRP} - 20 \log d + 104.8$$

where
E is the electric field strength in dBμV/m
EIRP is the equivalent isotropically radiated power in dBm
d is the specified measurement distance in m

f) Compare the resultant electric field strength level with the applicable regulatory limit.

g) Perform the radiated spurious emission test.

15.247 (d) Restricted Bands - *continued*

Note: With respect to steps e) and f) a limit line (EIRP) based upon the dBuV/m limit was calculated and put on the plots to satisfy the requirement of step f) above. Formula is: (E + 20 log *d*) - 104.8 = (EIRP limit). The appropriate correction factor from step c) was included in the final calculation.

Limit Calculation:

Formula: E – 104.8 + 20log(3) – antenna gain – ground reflection factor

30 MHz - 88 MHz	40 - 104.8 + 20log(d) - 2 - 4.7	= -61.96 dBm
88 MHz - 216 MHz	43 - 104.8 + 20log(d) - 2 - 4.7	= -58.96 dBm
216 MHz - 960 MHz	46 - 104.8 + 20log(d) - 2 - 4.7	= -55.96 dBm
960 MHz - 1000 MHz	54 - 104.8 + 20log(d) - 2 - 4.7	= -47.96 dBm
> 1000 MHz	54 - 104.8 + 20log(d) - 2 - 0	= -43.26 dBm

Note: (d) = Measurement distance in meters = 3 meters

Requirement: FCC Part 15.247 Clause (d)

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

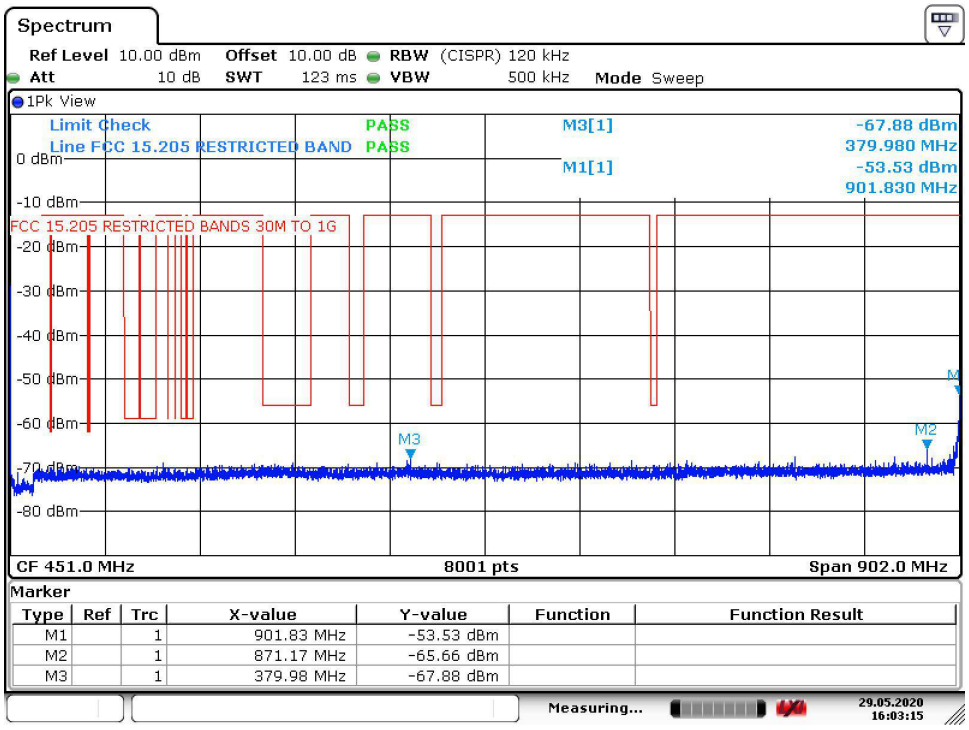
Client: Vutiliti Date: 29 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Emissions Below Restricted Band Limits Tech: CL Payne

Low Channel: 903 MHz

Frequency Range: 30MHz to 902MHz Result: Pass



Date: 29.MAY.2020 16:03:15

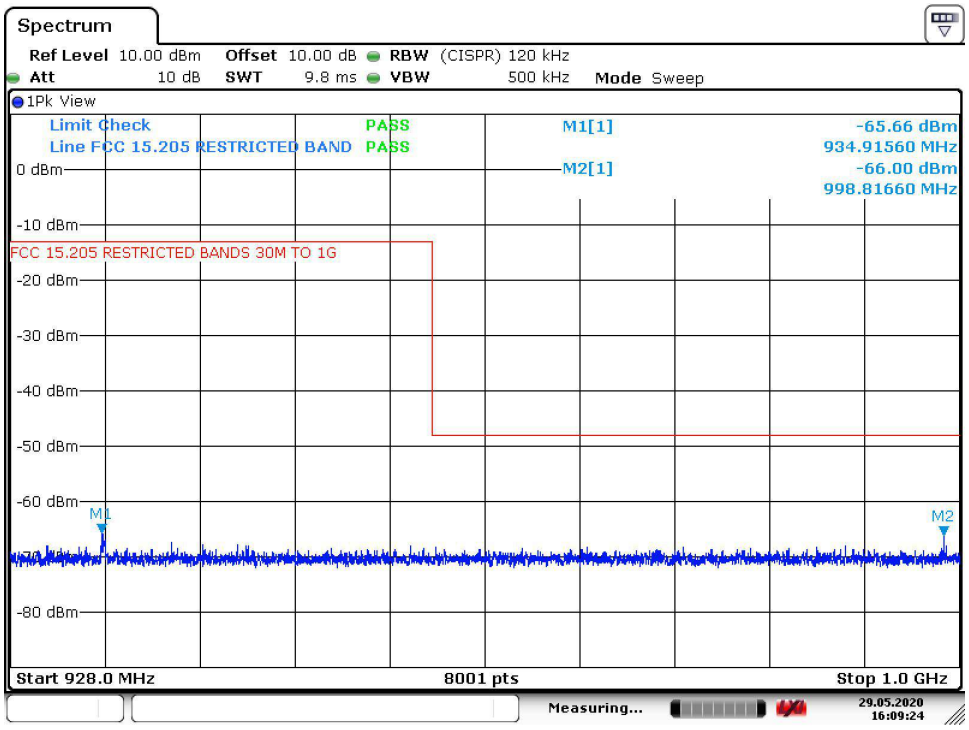
Client: Vutiliti Date: 29 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Emissions Below Restricted Band Limits Tech: CL Payne

Low Channel: 903 MHz

Frequency Range: 928MHz to 1000MHz Result: Pass



Date: 29.MAY.2020 16:09:24

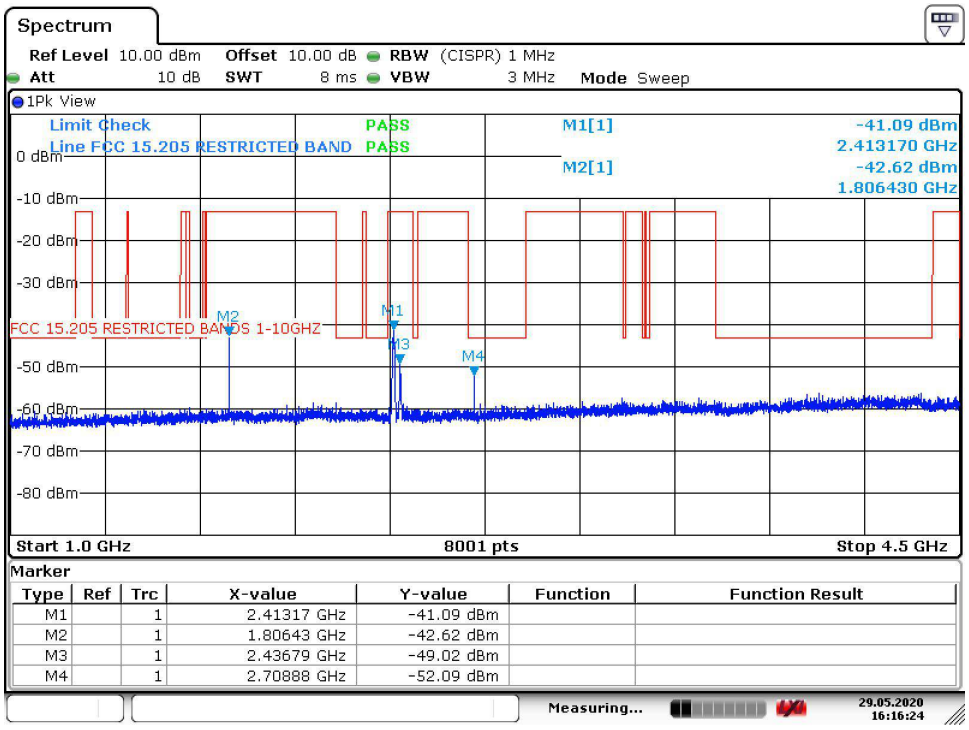
Client: Vutiliti | Date: 29 May 2020 | DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) | Model No: VUHDC1

Requirement: Emissions Below Restricted Band Limits | Tech: CL Payne

Low Channel: 903 MHz

Frequency Range: 1000MHz to 4500MHz | Result: Pass



Date: 29.MAY.2020 16:16:23

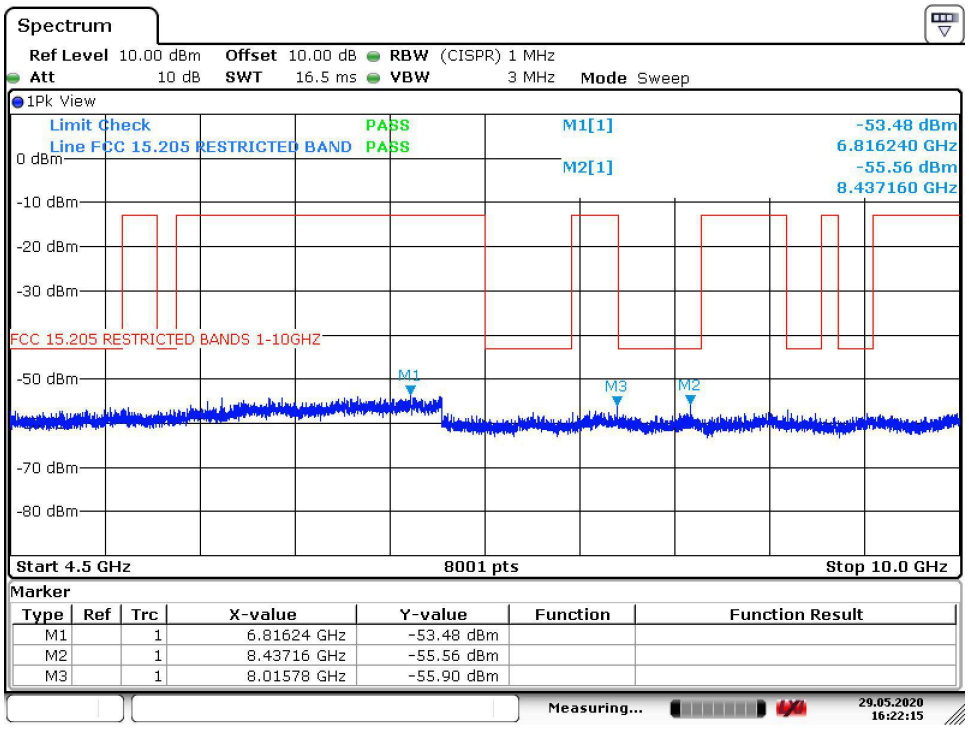
Client: Vutiliti Date: 29 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Emissions Below Restricted Band Limits Tech: CL Payne

Low Channel: 903 MHz

Frequency Range: 4500MHz to 10000MHz Result: Pass



Date: 29.MAY.2020 16:22:15

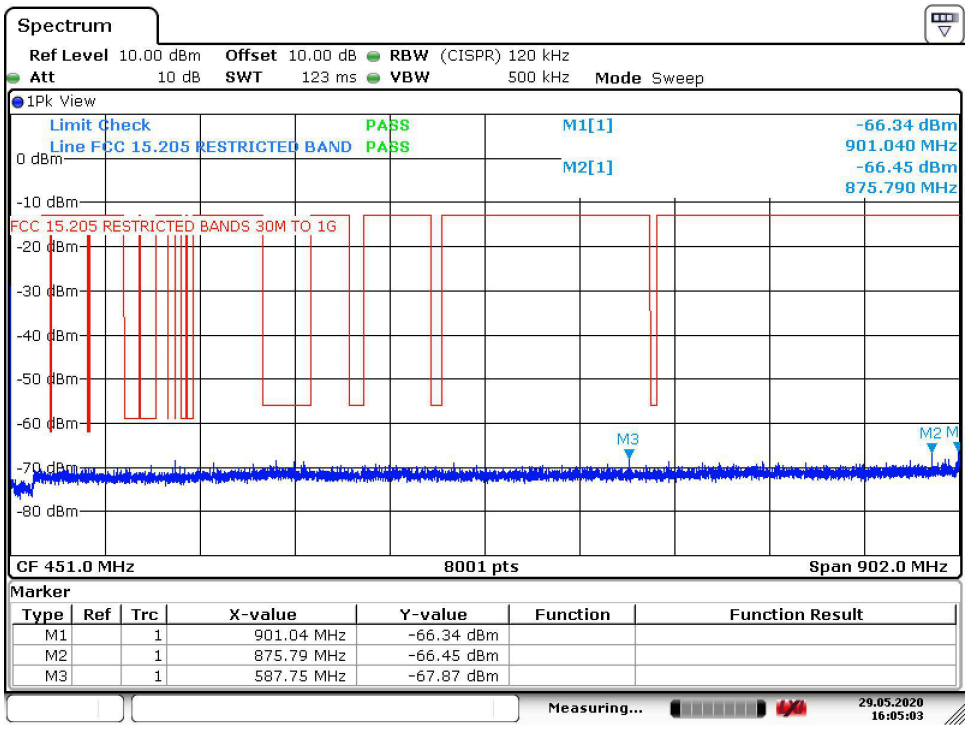
Client: Vutiliti Date: 29 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Emissions Below Restricted Band Limits Tech: CL Payne

Middle Channel: 907.75 MHz

Frequency Range: 30MHz to 902MHz Result: Pass



Date: 29.MAY.2020 16:05:02

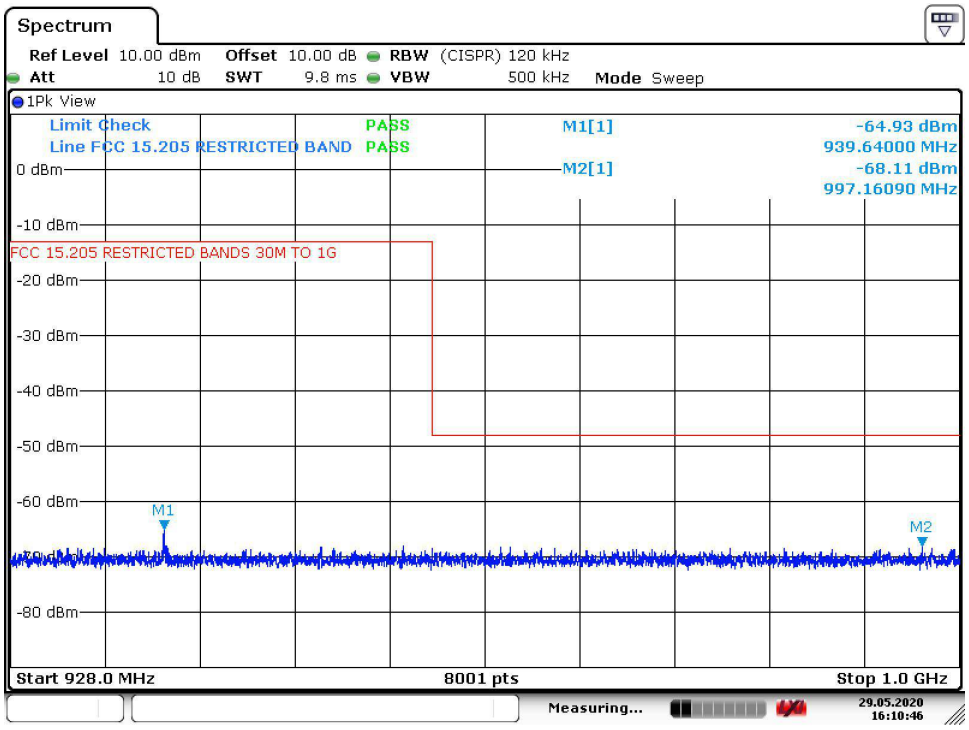
Client: Vutiliti Date: 29 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Emissions Below Restricted Band Limits Tech: CL Payne

Middle Channel: 907.75 MHz

Frequency Range: 928MHz to 1000MHz Result: Pass



Date: 29.MAY.2020 16:10:46

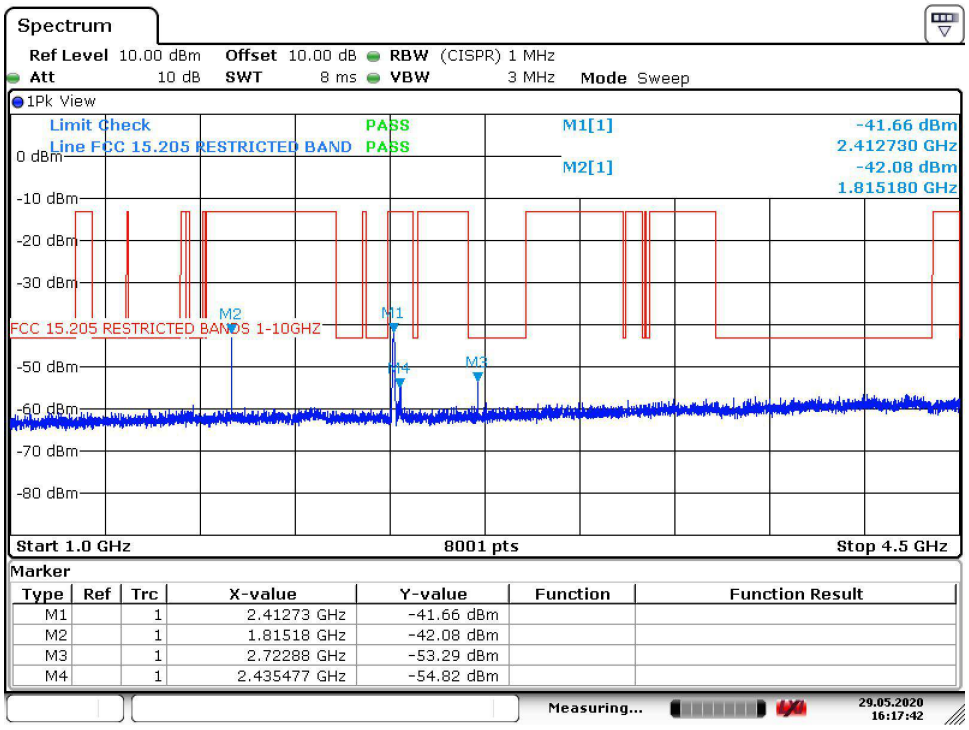
Client: Vutiliti | Date: 29 May 2020 | DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) | Model No: VUHDC1

Requirement: Emissions Below Restricted Band Limits | Tech: CL Payne

Middle Channel: 907.75 MHz

Frequency Range: 1000MHz to 4500MHz | Result: Pass



Date: 29.MAY.2020 16:17:42

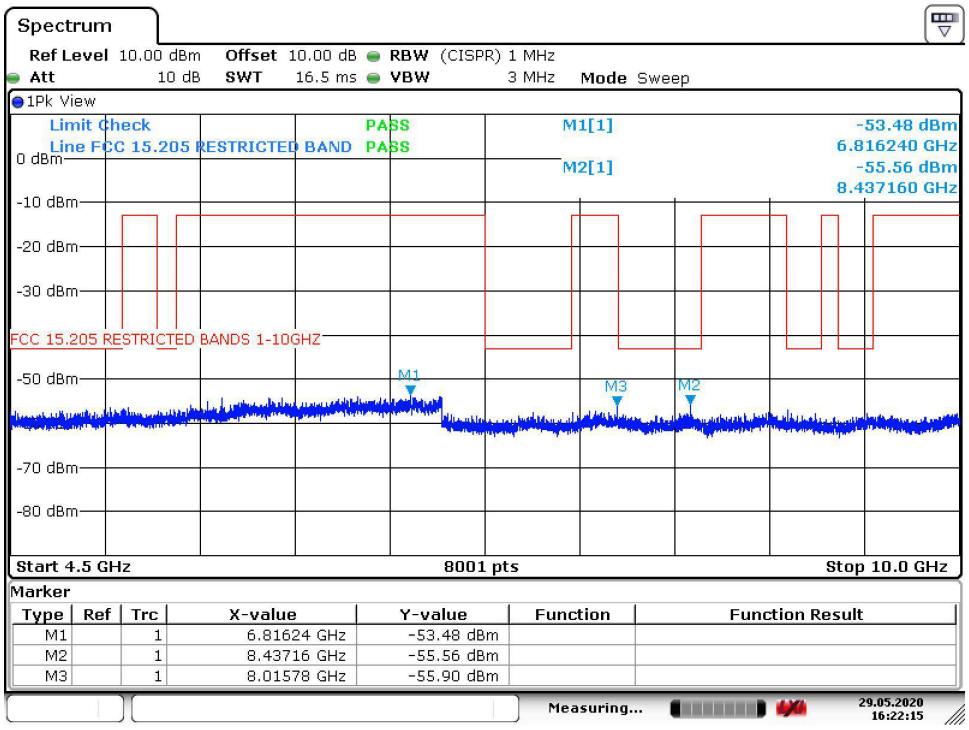
Client: Vutiliti Date: 29 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Emissions Below Restricted Band Limits Tech: CL Payne

Middle Channel: 907.75 MHz

Frequency Range: 4500MHz to 10000MHz Result: Pass



Date: 29.MAY.2020 16:22:15

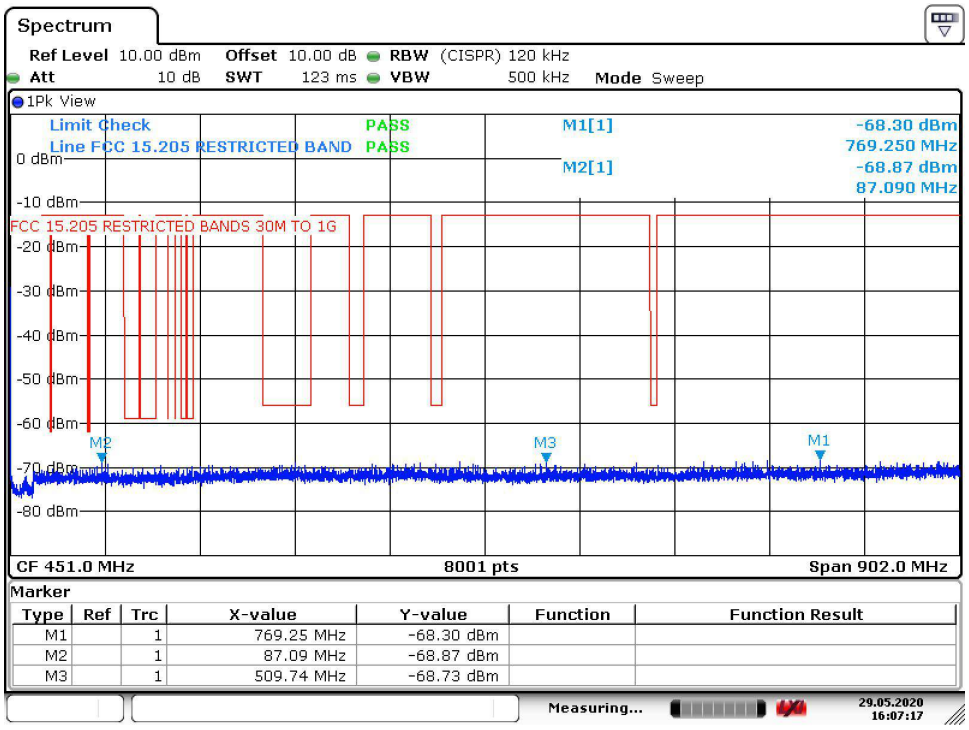
Client: Vutiliti Date: 29 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Emissions Below Restricted Band Limits Tech: CL Payne

High Channel: 914.2 MHz

Frequency Range: 30MHz to 902MHz Result: Pass



Date: 29.MAY.2020 16:07:17

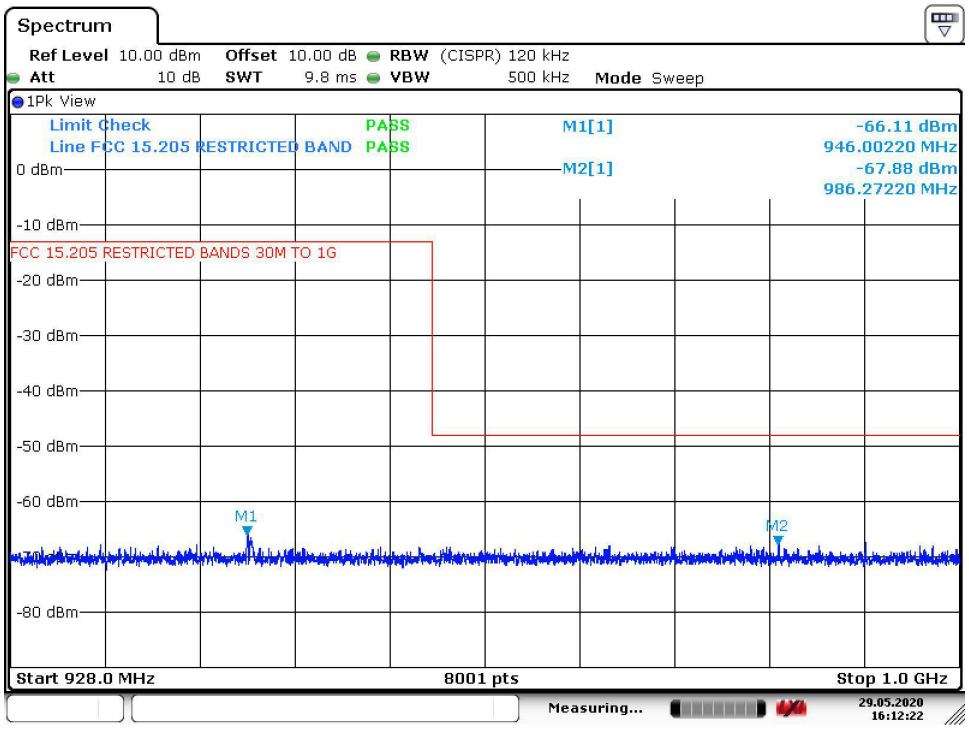
Client: Vutiliti Date: 29 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Emissions Below Restricted Band Limits Tech: CL Payne

High Channel:914.2 MHz

Frequency Range: 928MHz to 1000MHz Result: Pass



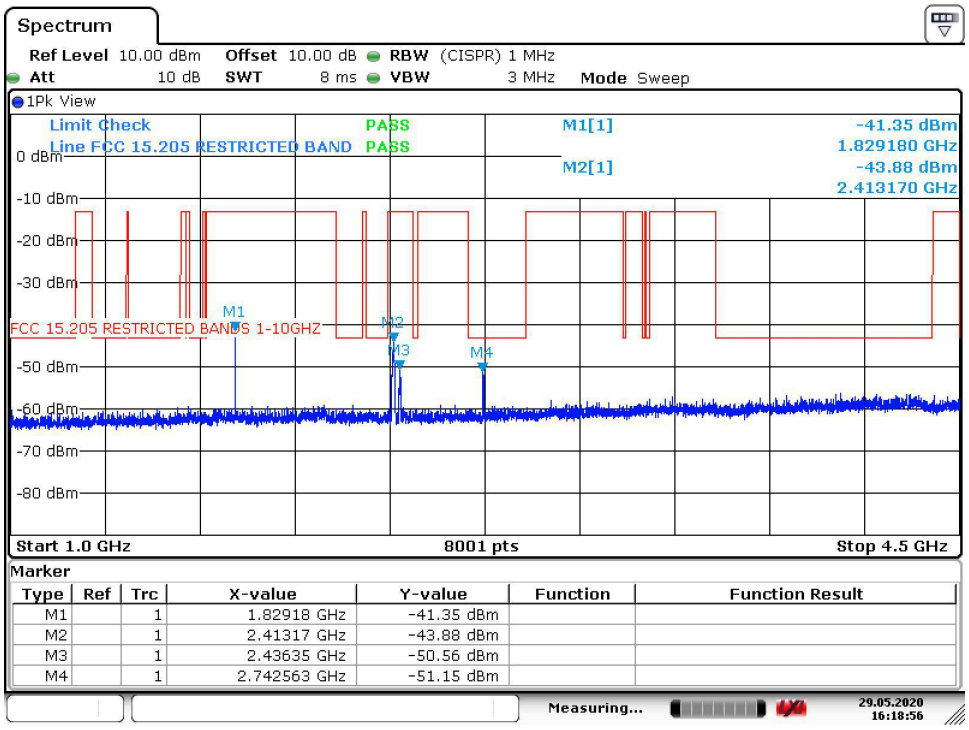
Client: Vutiliti | Date: 29 May 2020 | DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) | Model No: VUHDC1

Requirement: Emissions Below Restricted Band Limits | Tech: CL Payne

High Channel: 914.2 MHz

Frequency Range: 1000MHz to 4500MHz | Result: Pass



Date: 29.MAY.2020 16:18:56

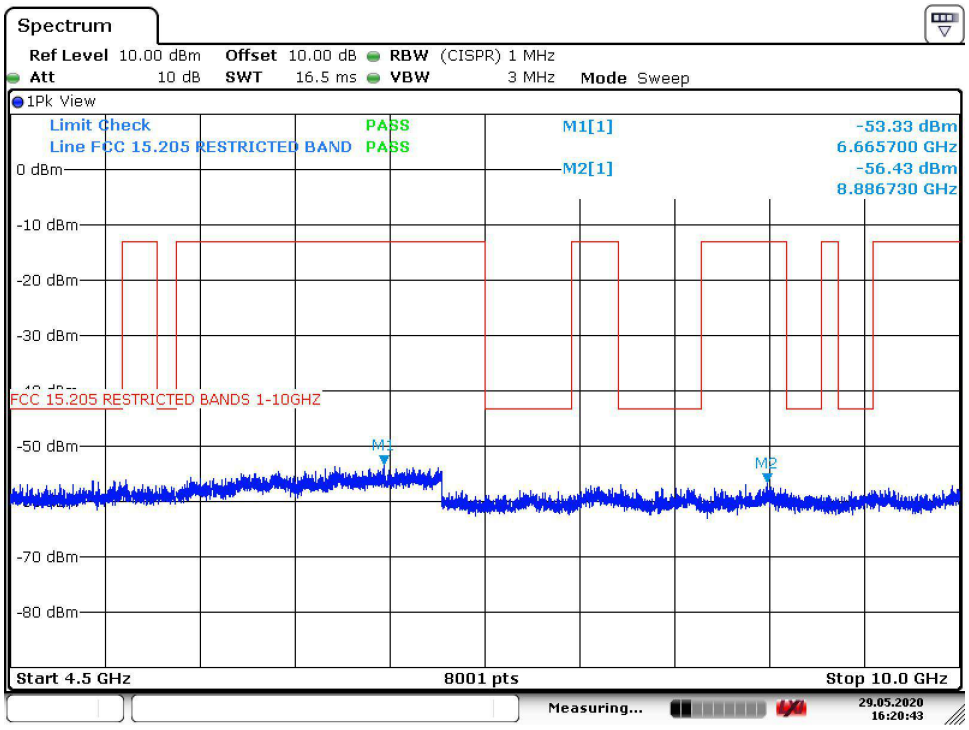
Client: Vutiliti Date: 29 May 2020 DNB Job: 06070

EUT: Limited Modular Transmitter LoRa 500 kHz (DTS) Model No: VUHDC1

Requirement: Emissions Below Restricted Band Limits Tech: CL Payne

High Channel: 914.2 MHz

Frequency Range: 4500MHz to 10000MHz Result: Pass



Date: 29.MAY.2020 16:20:43

End of Report UT06070A-004