8 26 dB Bandwidth and Occupied Bandwidth

8.1 Requirement:

Tests are performed in accordance with ANSI C63.26 and CFR47 FCC Parts 2.1049.

§2.1049: The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

8.2 Procedure:

The procedure described in FCC Publication 971168 D01 Power Meas License Digital Systems v03r01 was used. Tests are performed in accordance with ANSI C63.26 Section 5.4.3 and 5.4.4.

For 26dB bandwidth measurement, the bandwidth was determined by using the built-in xdB bandwidth function of the spectrum analyzer.

For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer. The resolution bandwidth is set to 1% of the selected span as is without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.

8.3 Results:

The sample tested was found to Comply.

Band 5, Bandwidth: 5MHz, Modulation: TM1.1-QPSK

Channel	Frequency (MHz)	Antenna Port	Occupied BW (MHz)	26dB BW (MHz)
Low	871.5	ANT0	4.504	5.03
		ANT1	4.501	5.03
Mid	881.5	ANT0	4.514	5.00
		ANT1	4.512	5.02
High	891.5	ANT0	4.504	5.03
		ANT1	4.506	5.02

Band 5, Bandwidth: 5MHz, Modulation: TM3.2-16QAM

Channel	Frequency (MHz)	Antenna Port	Occupied BW (MHz)	26dB BW (MHz)
Low	871.5	ANT0	4.502	5.00
		ANT1	4.496	5.00
Mid	881.5	ANT0	4.508	4.96
		ANT1	4.504	5.00
High	891.5	ANT0	4.500	5.00
		ANT1	4.505	4.99

Band 5, Bandwidth: 5MHz, Modulation: TM3.1-64QAM

Channel	Frequency (MHz)	Antenna Port	Occupied BW (MHz)	26dB BW (MHz)
Low	871.5	ANT0	4.556	5.03
		ANT1	4.549	5.04
Mid	881.5	ANT0	4.561	4.99
		ANT1	4.529	5.04
High	891.5	ANT0	4.534	5.04
		ANT1	4.550	5.00

Band 5, Bandwidth: 5MHz, Modulation: TM3.1a-256QAM

Channel	Frequency (MHz)	Antenna Port	Occupied BW (MHz)	26dB BW (MHz)
Low	871.5	ANT0	4.531	5.01
		ANT1	4.519	5.03
Mid	881.5	ANT0	4.523	5.04
		ANT1	4.527	5.01
High	891.5	ANT0	4.522	5.03
		ANT1	4.524	5.01

Band 5, Bandwidth: 10MHz, Modulation: TM1.1-QPSK

Channel	Frequency (MHz)	Antenna Port	Occupied BW (MHz)	26dB BW (MHz)
Low	874.0	ANT0	8.989	9.92
		ANT1	8.986	9.92
Mid	881.5	ANT0	8.999	9.95
		ANT1	8.996	9.95
High	889.0	ANT0	8.998	9.89
		ANT1	8.997	9.95

Band 5, Bandwidth: 10MHz, Modulation: TM3.2-16QAM

Channel	Frequency (MHz)	Antenna Port	Occupied BW (MHz)	26dB BW (MHz)
Low	874.0	ANT0	8.995	9.86
		ANT1	8.996	9.83
Mid	881.5	ANT0	8.995	9.89
		ANT1	9.004	9.89
High	889.0	ANT0	9.005	9.89
		ANT1	9.005	9.89

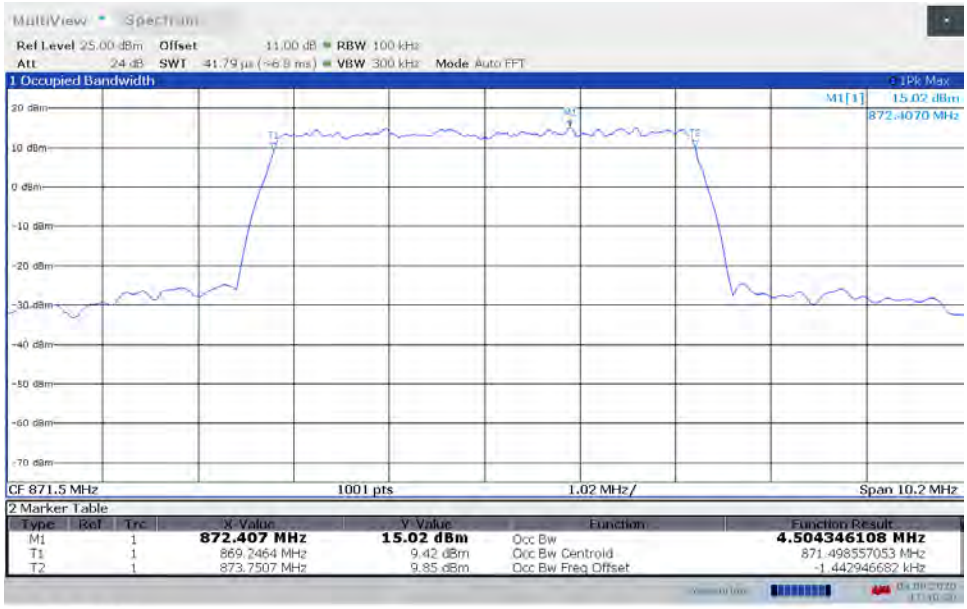
Band 5, Bandwidth: 10MHz, Modulation: TM3.1-64QAM

Channel	Frequency (MHz)	Antenna Port	Occupied BW (MHz)	26dB BW (MHz)
Low	874.0	ANT0	8.998	9.92
		ANT1	8.996	9.92
Mid	881.5	ANT0	9.000	9.95
		ANT1	9.000	9.95
High	889.0	ANT0	9.004	9.95
		ANT1	9.004	9.92

Band 5, Bandwidth: 10MHz, Modulation: TM3.1a-256QAM

Channel	Frequency (MHz)	Antenna Port	Occupied BW (MHz)	26dB BW (MHz)
Low	874.0	ANT0	8.998	9.92
		ANT1	8.996	9.92
Mid	881.5	ANT0	9.000	9.95
		ANT1	9.000	9.95
High	889.0	ANT0	9.004	9.95
		ANT1	9.004	9.92

TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT0, Low Channel, Occupied Bandwidth



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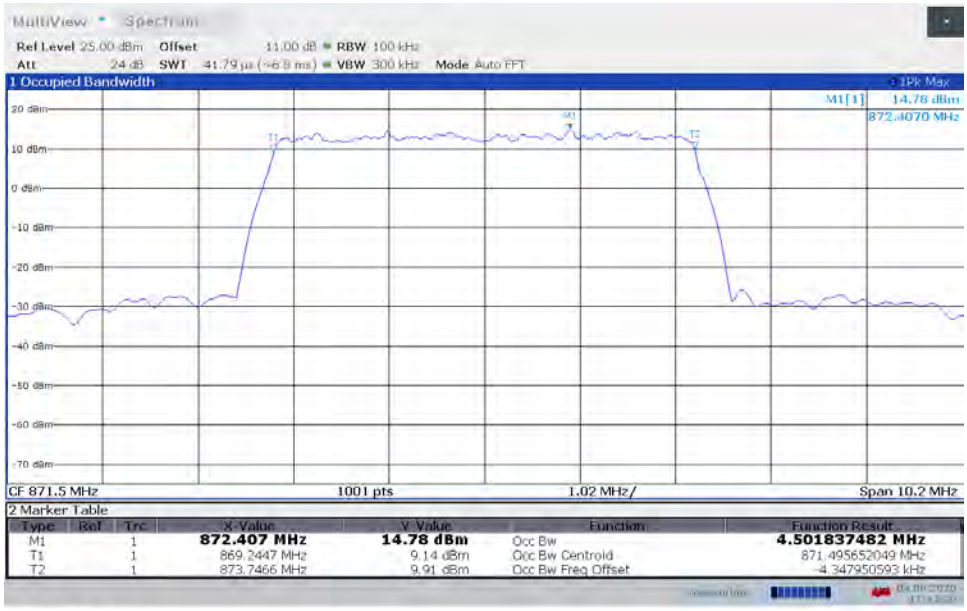
TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT1, Low Channel, Occupied Bandwidth



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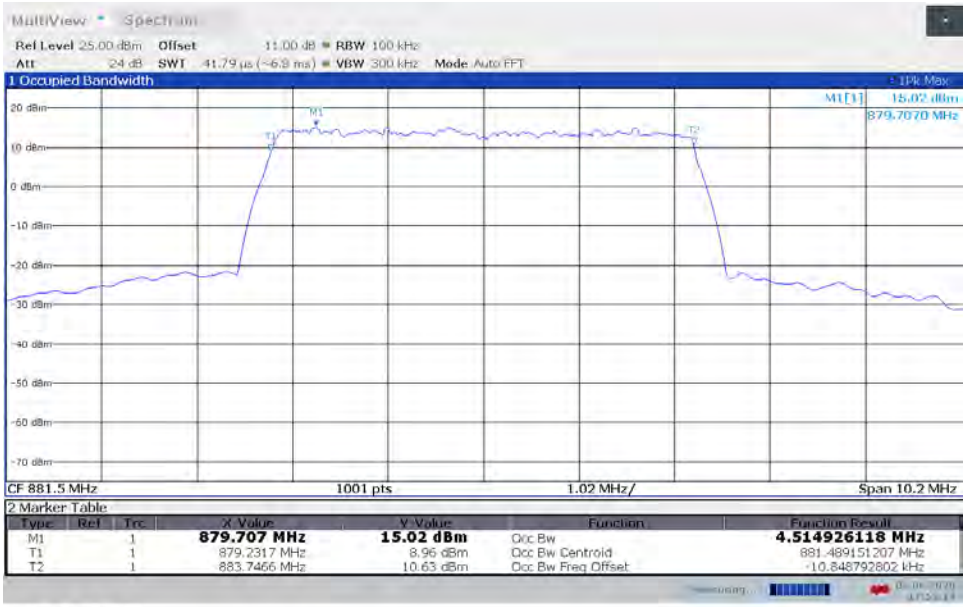
TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT0, Mid Channel, Occupied Bandwidth



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TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT1, Mid Channel, Occupied Bandwidth

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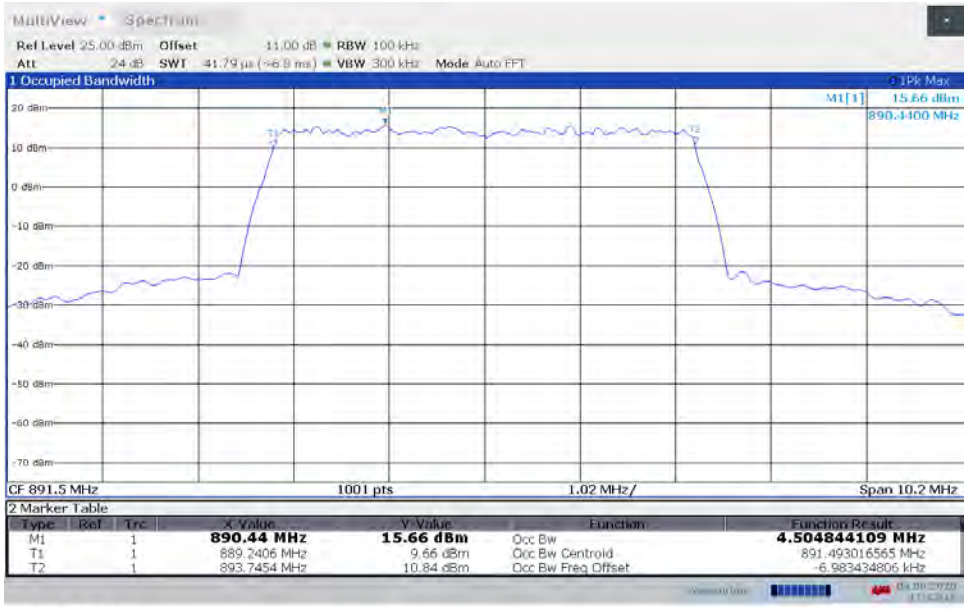
TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT0, High Channel, Occupied Bandwidth



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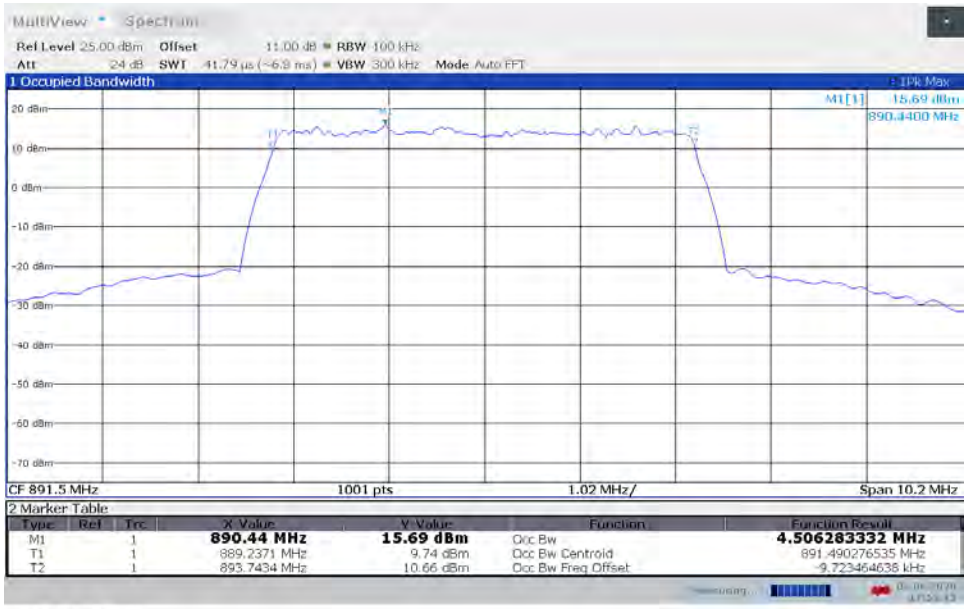
TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT1, High Channel, Occupied Bandwidth



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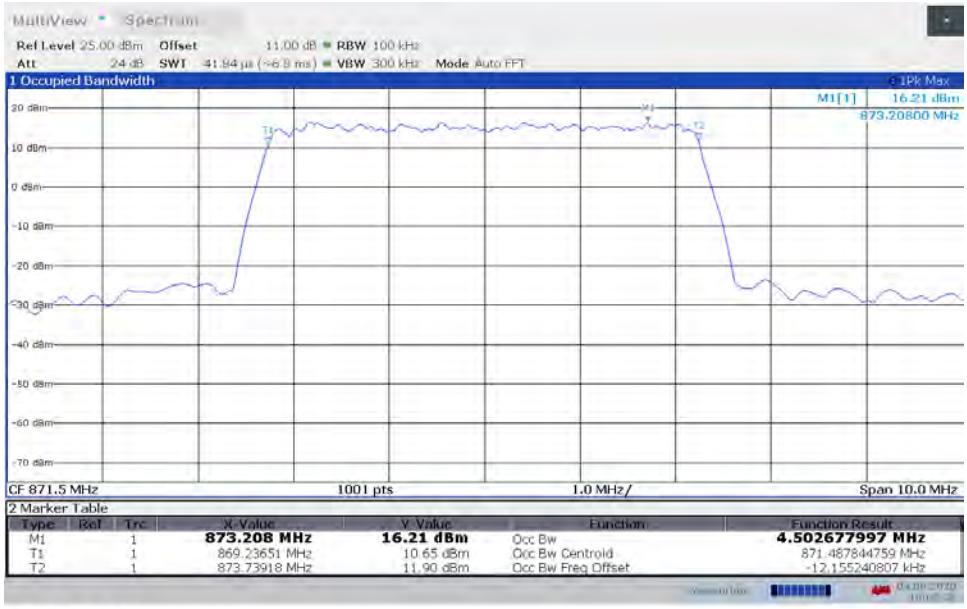
TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT0, Low Channel, Occupied Bandwidth



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TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT1, Low Channel, Occupied Bandwidth

18:06:32 04.08.2020

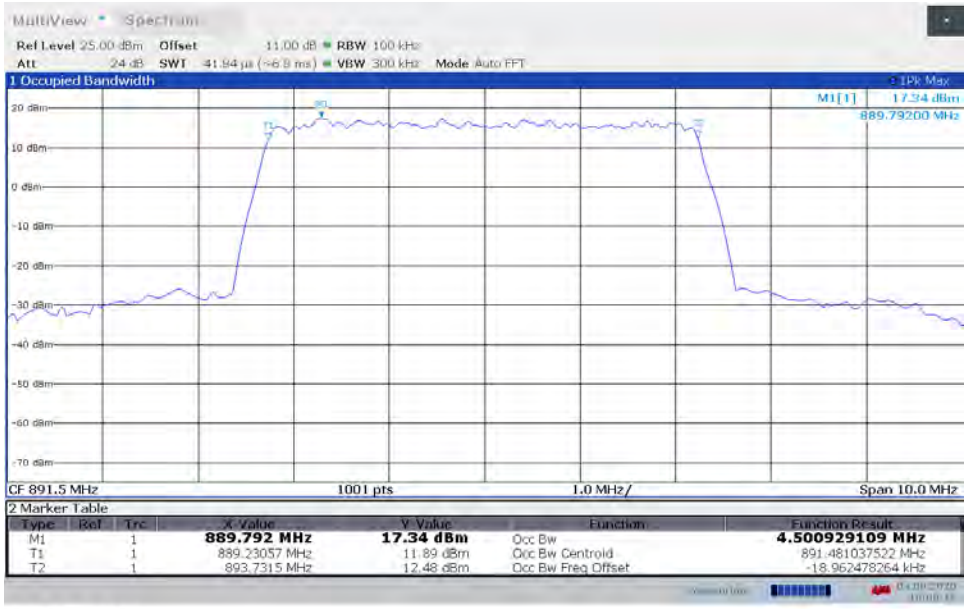
TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT0, Mid Channel, Occupied Bandwidth

18:07:47 04.08.2020

TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT1, Mid Channel, Occupied Bandwidth

18:07:23 04.08.2020

TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT0, High Channel, Occupied Bandwidth



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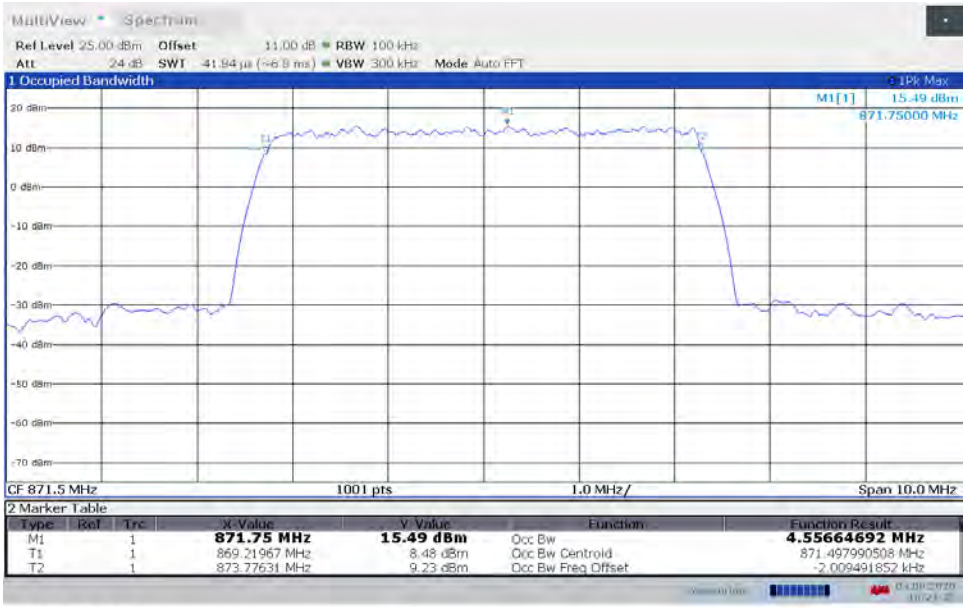
TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT1, High Channel, Occupied Bandwidth

18:09:12 04.08.2020

TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT0, Low Channel, Occupied Bandwidth



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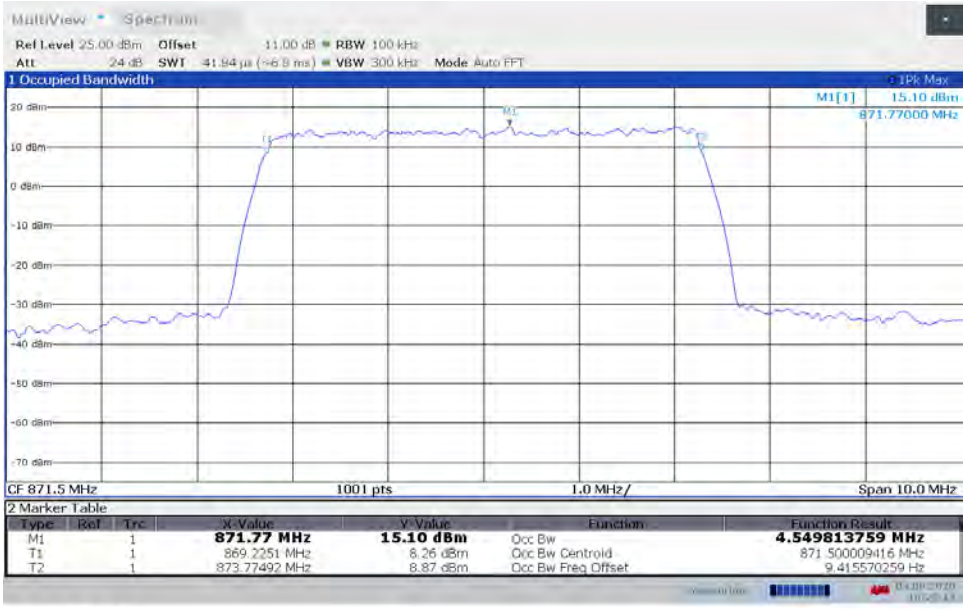
TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT1, Low Channel, Occupied Bandwidth



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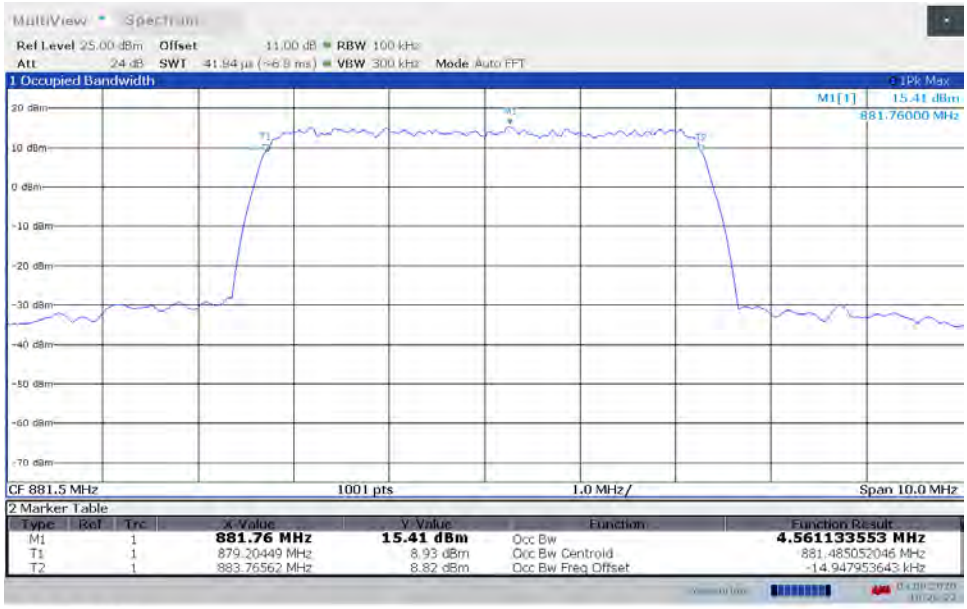
TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT0, Mid Channel, Occupied Bandwidth



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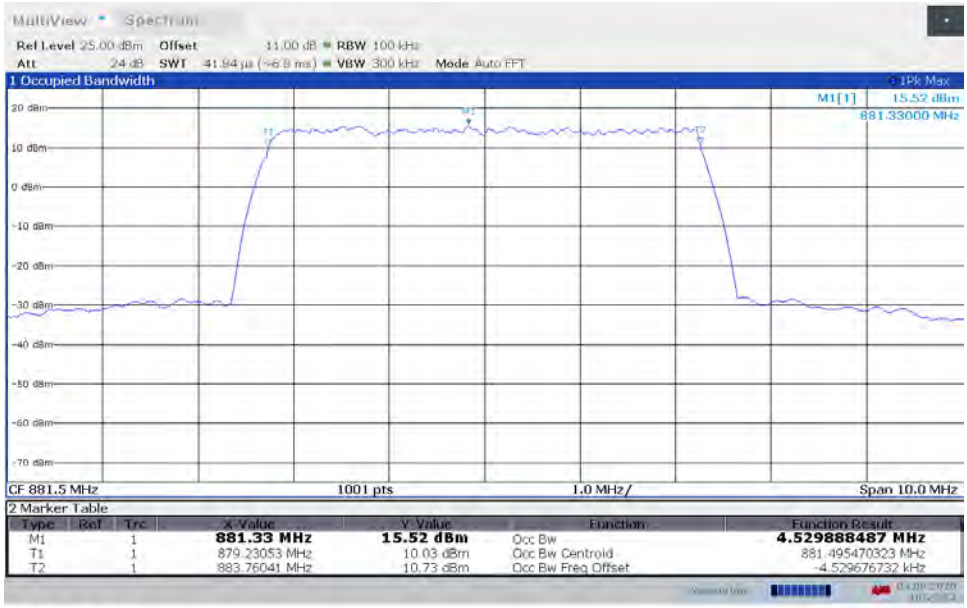
TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT1, Mid Channel, Occupied Bandwidth



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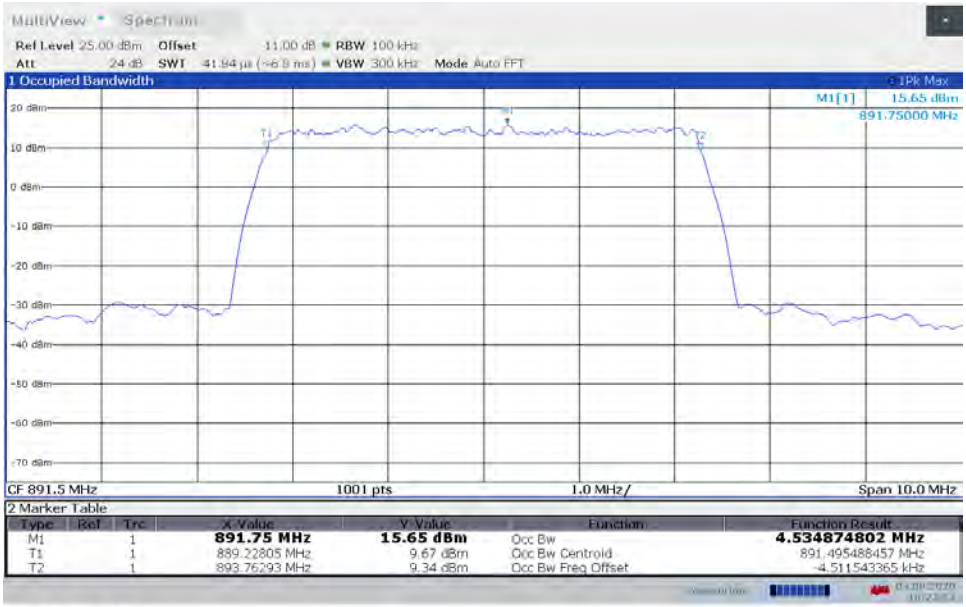
TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT0, High Channel, Occupied Bandwidth



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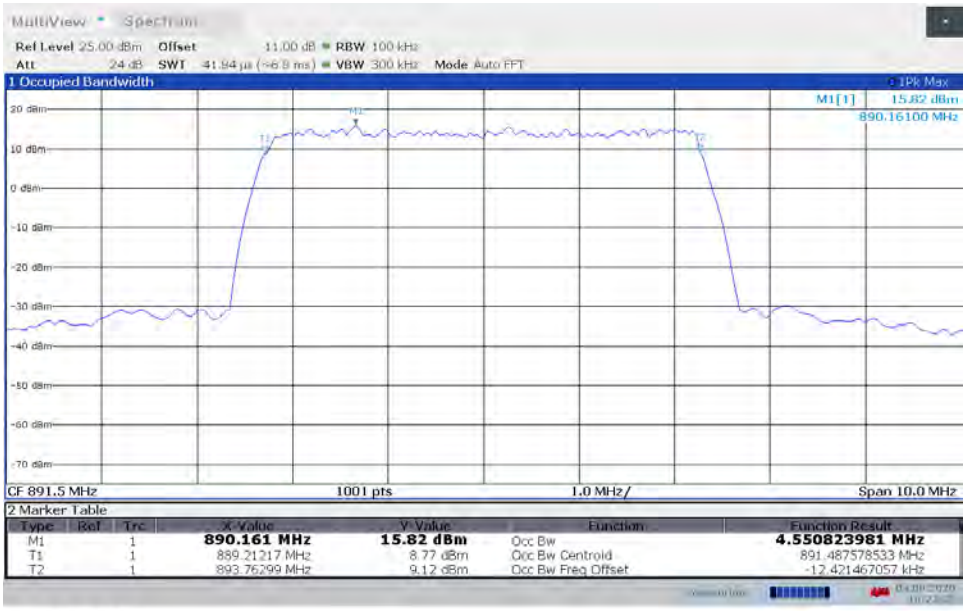
TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT1, High Channel, Occupied Bandwidth



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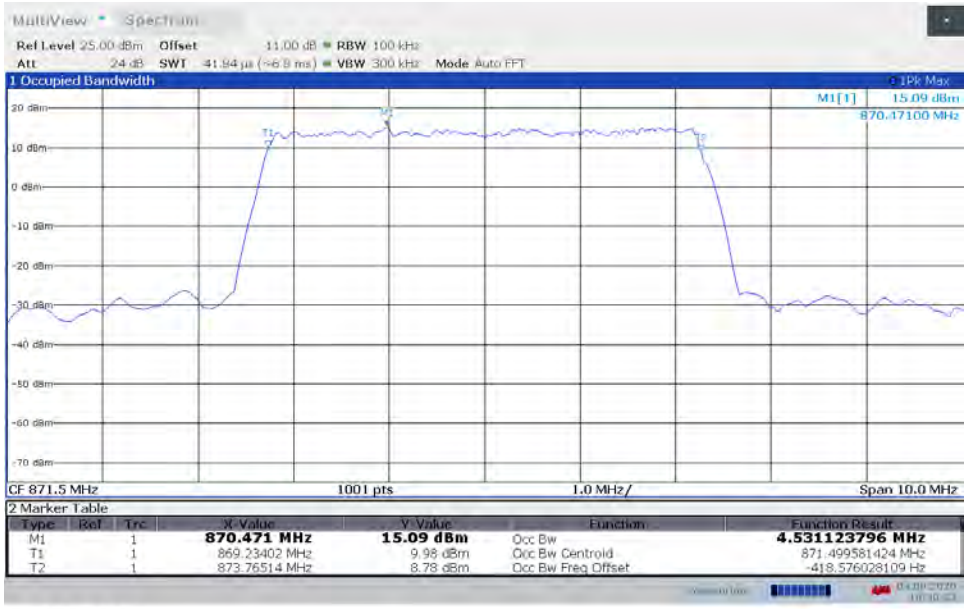
TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT0, Low Channel, Occupied Bandwidth



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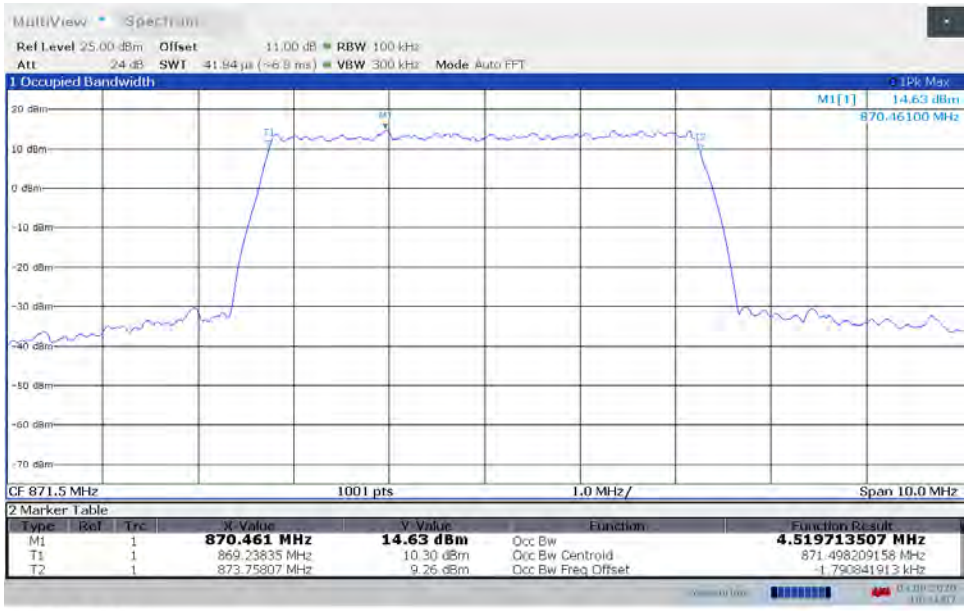
TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT1, Low Channel, Occupied Bandwidth



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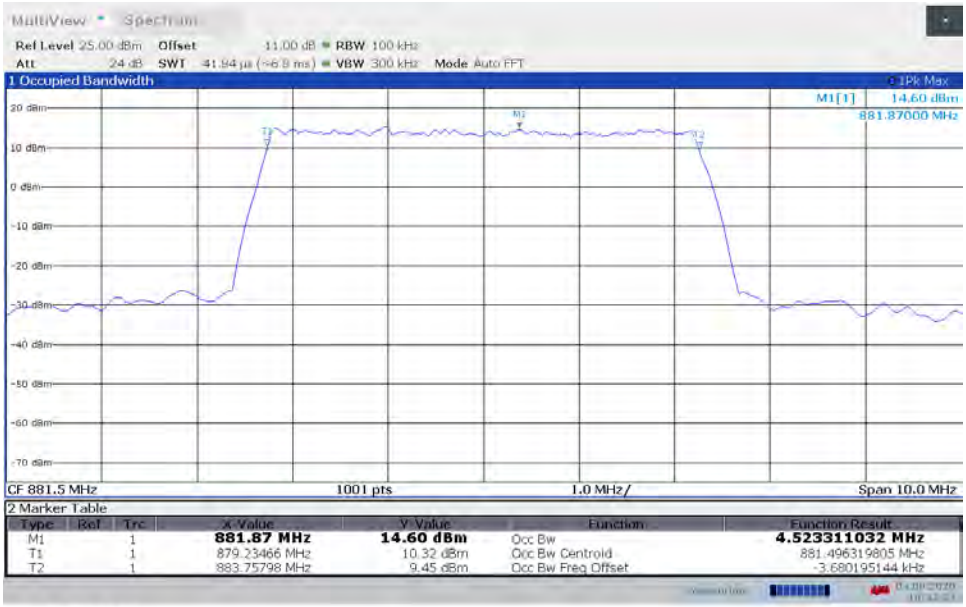
TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT0, Mid Channel, Occupied Bandwidth



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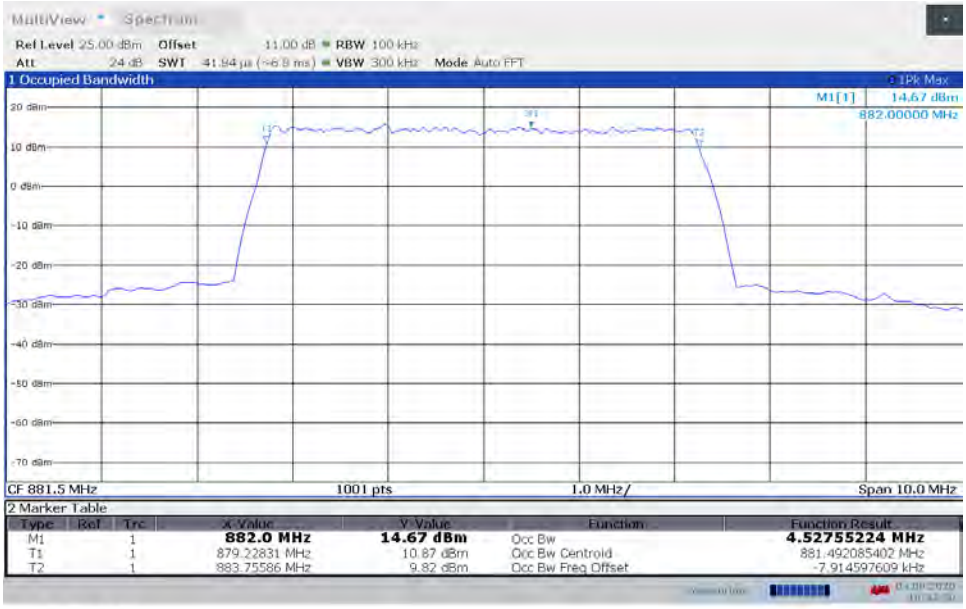
TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT1, Mid Channel, Occupied Bandwidth



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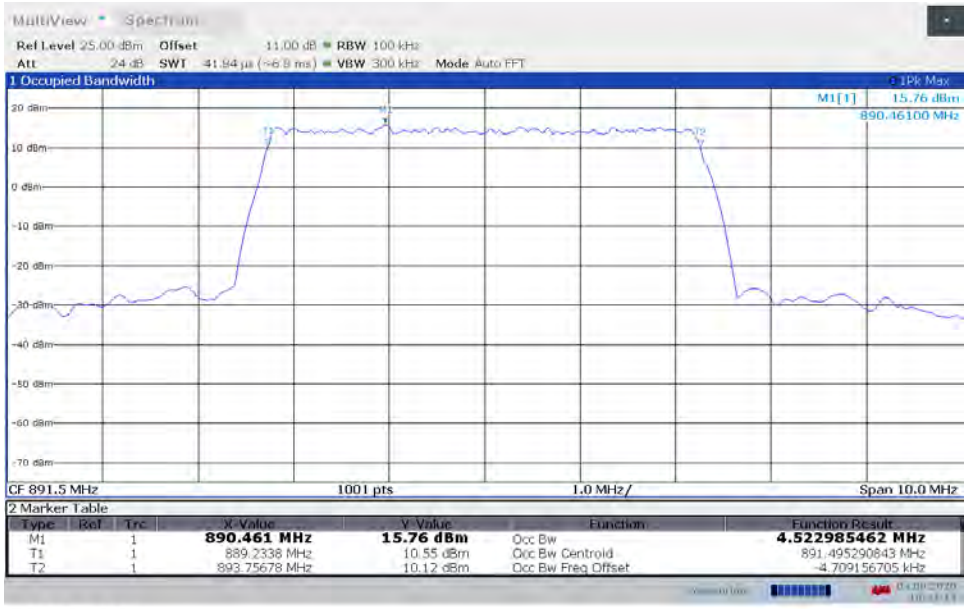
TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT0, High Channel, Occupied Bandwidth



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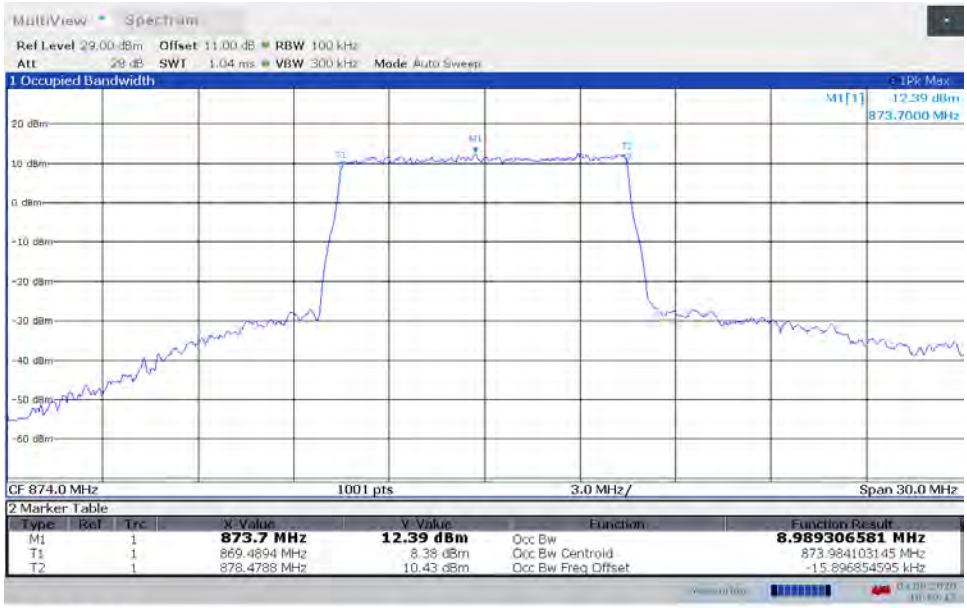
TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT1, High Channel, Occupied Bandwidth

18:34:54 04.08.2020

TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT0, Low Channel, Occupied Bandwidth



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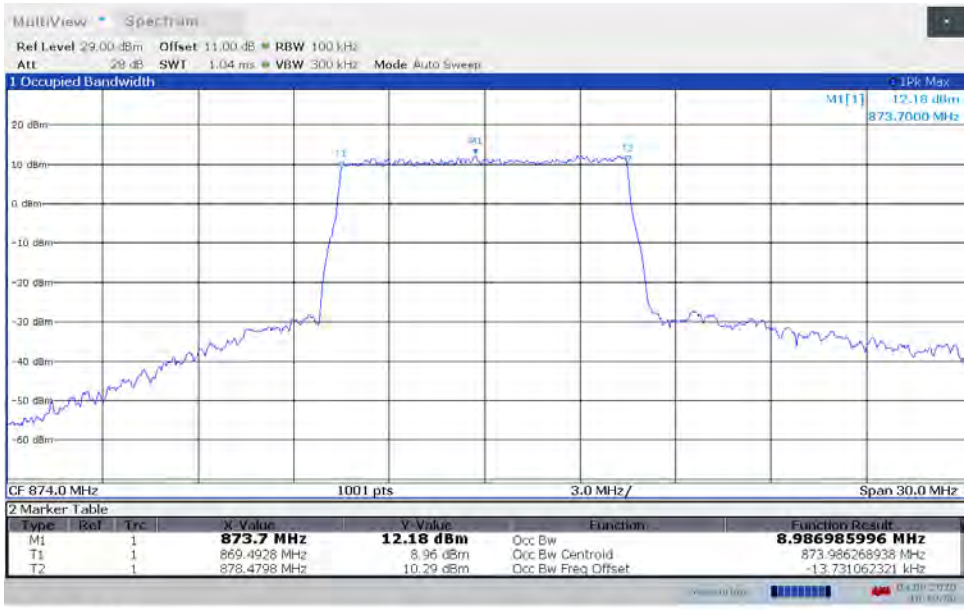
TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT1, Low Channel, Occupied Bandwidth



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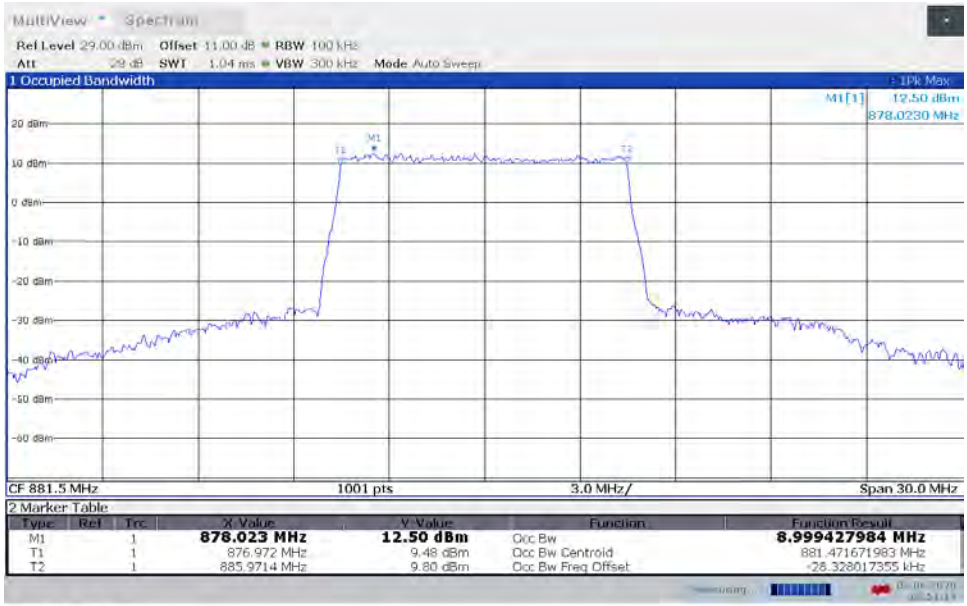
TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT0, Mid Channel, Occupied Bandwidth



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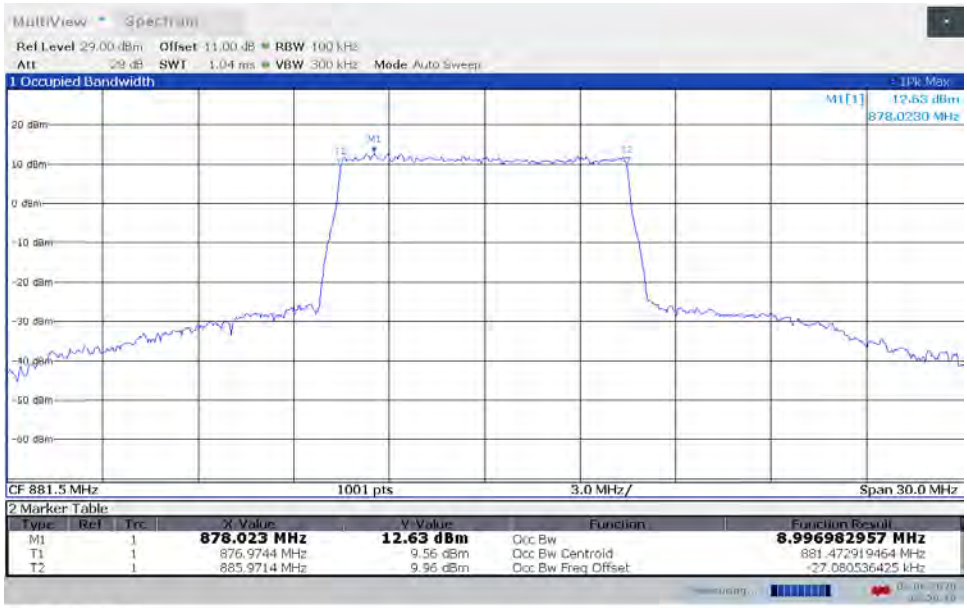
TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT1, Mid Channel, Occupied Bandwidth



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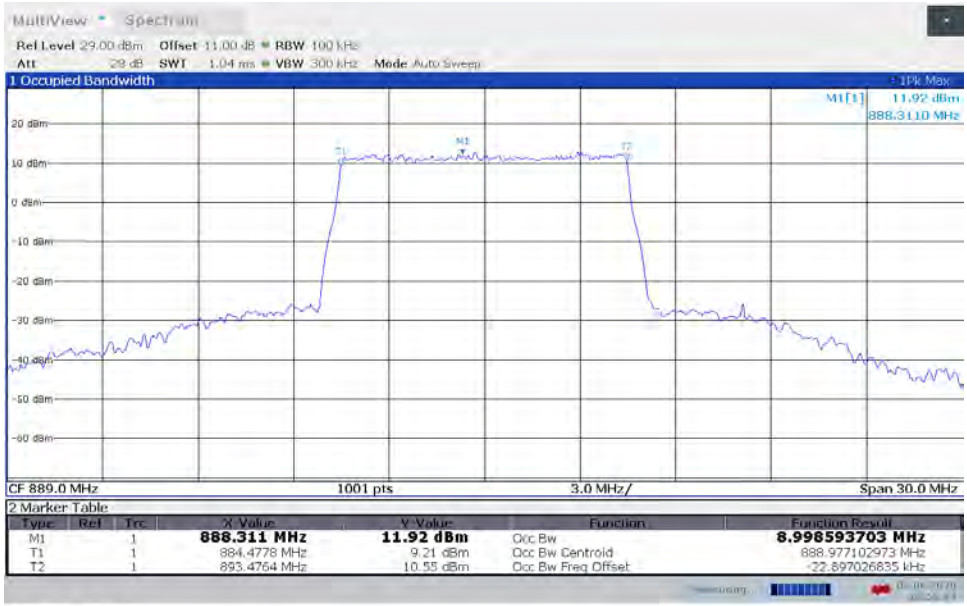
TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT0, High Channel, Occupied Bandwidth



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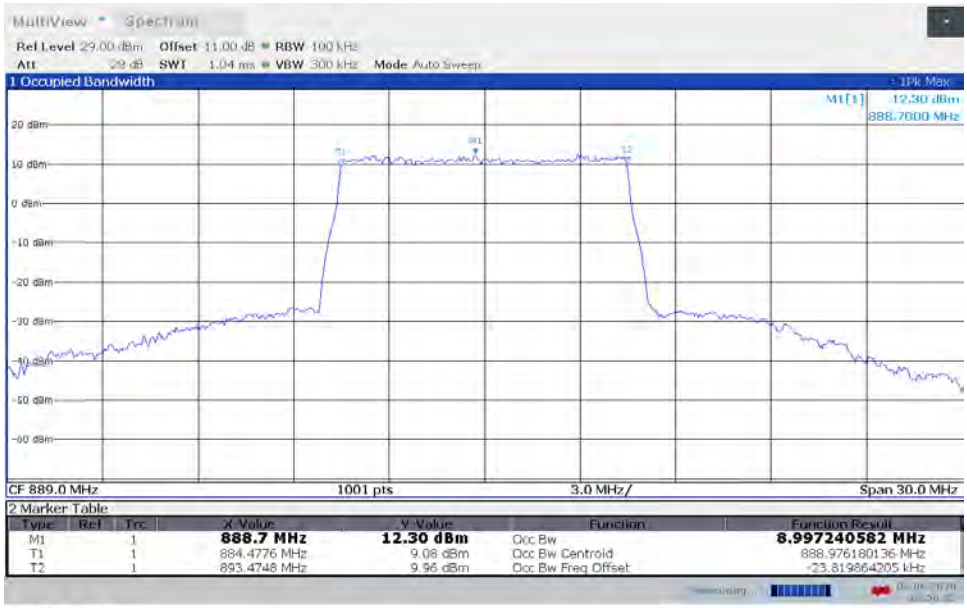
TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT1, High Channel, Occupied Bandwidth



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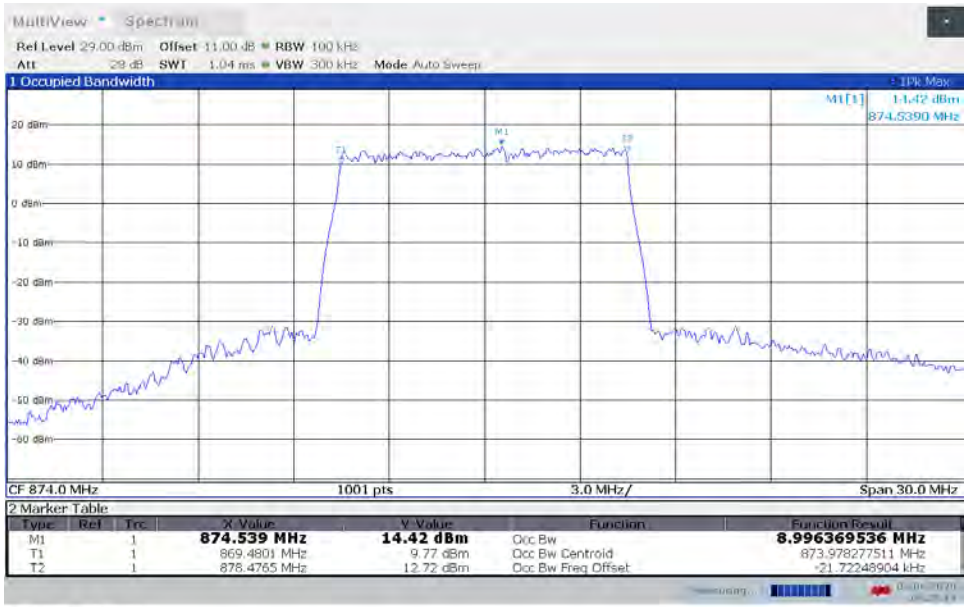
TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT0, Low Channel, Occupied Bandwidth

19:29:06 04.08.2020

TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT1, Low Channel, Occupied Bandwidth



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TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT0, Mid Channel, Occupied Bandwidth

19:25:00 04.08.2020

TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT1, Mid Channel, Occupied Bandwidth

19:26:28 04.08.2020

TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT0, High Channel, Occupied Bandwidth

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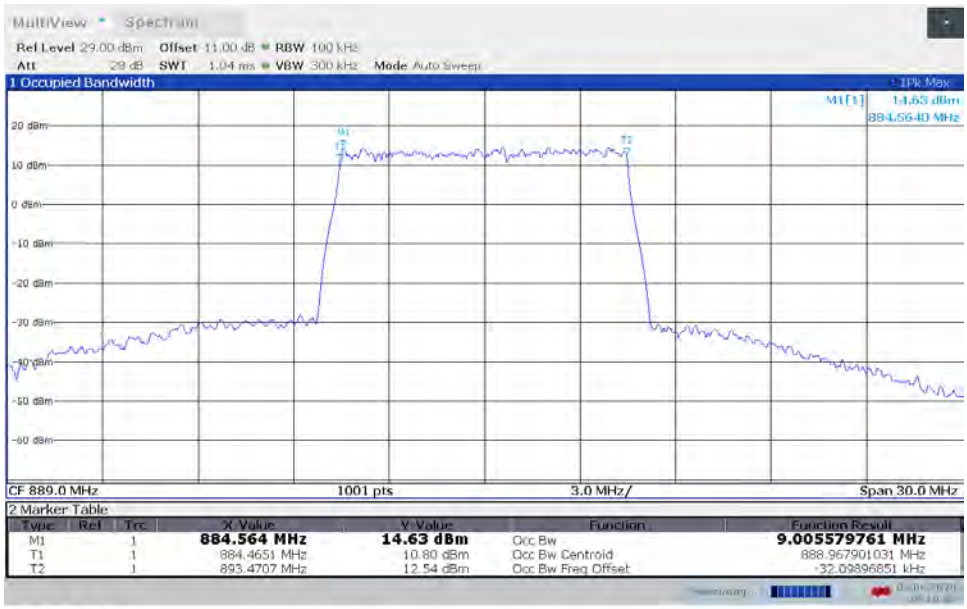
TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT1, High Channel, Occupied Bandwidth



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TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT0, Low Channel, Occupied Bandwidth

19:39:59 04.08.2020

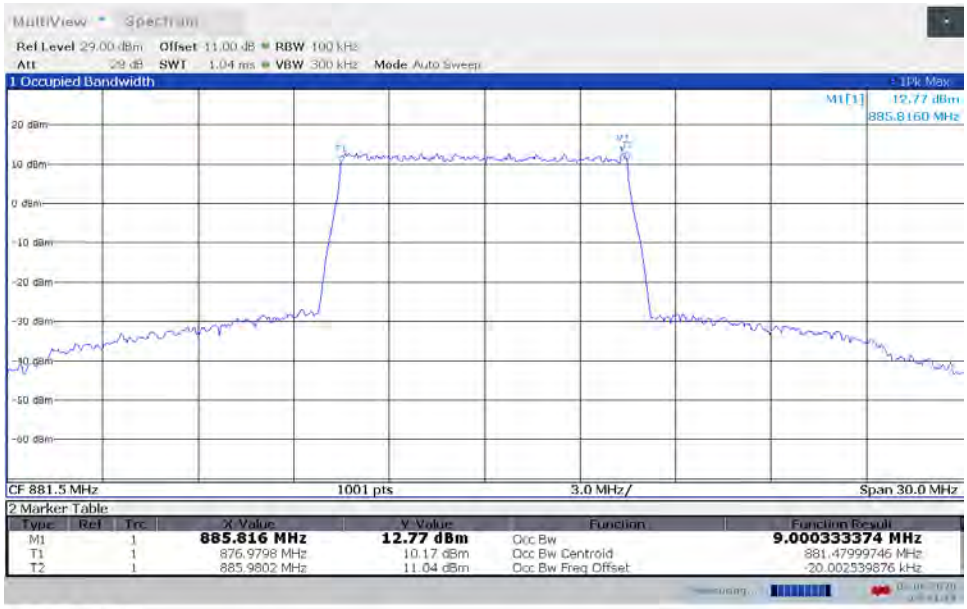
TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT1, Low Channel, Occupied Bandwidth

19:40:51 04.08.2020

TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT0, Mid Channel, Occupied Bandwidth

19:42:22 04.08.2020

TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT1, Mid Channel, Occupied Bandwidth



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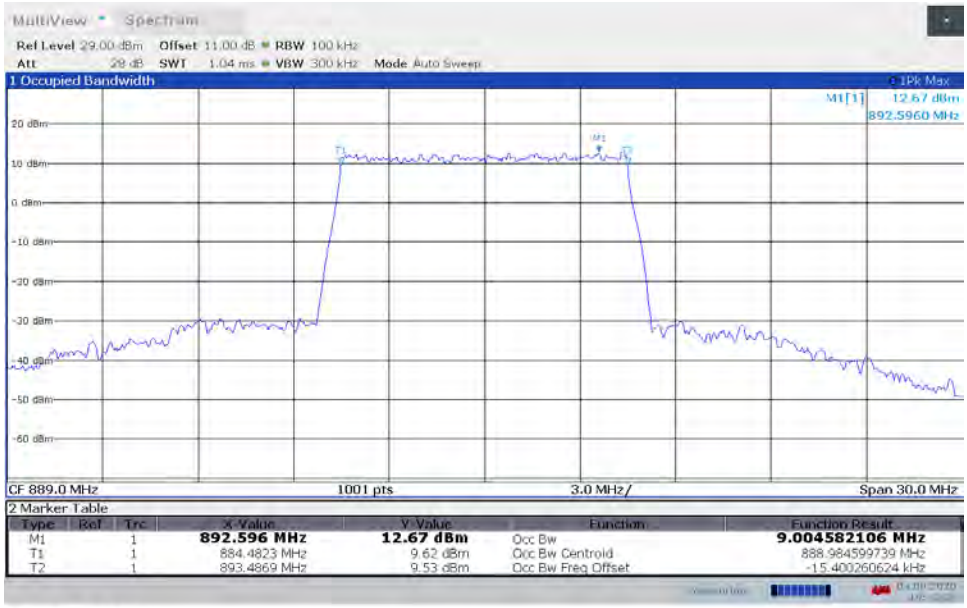
TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT0, High Channel, Occupied Bandwidth



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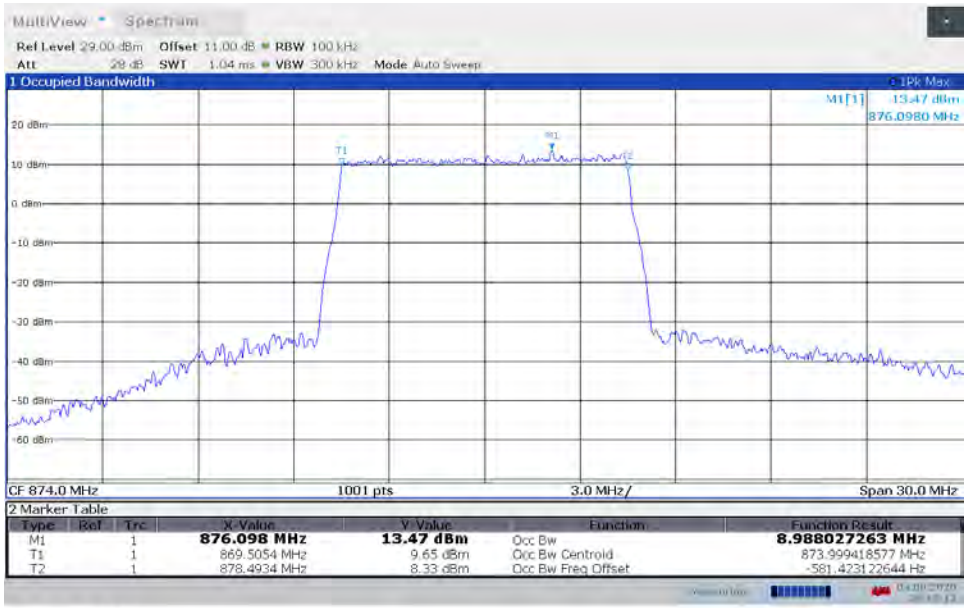
TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT1, High Channel, Occupied Bandwidth

19:44:33 04.08.2020

TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT0, Low Channel, Occupied Bandwidth

20:44:46 04.08.2020

TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT1, Low Channel, Occupied Bandwidth



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TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT0, Mid Channel, Occupied Bandwidth

20:46:42 04.08.2020

TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT1, Mid Channel, Occupied Bandwidth

20:46:06 04.08.2020

TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT0, High Channel, Occupied Bandwidth

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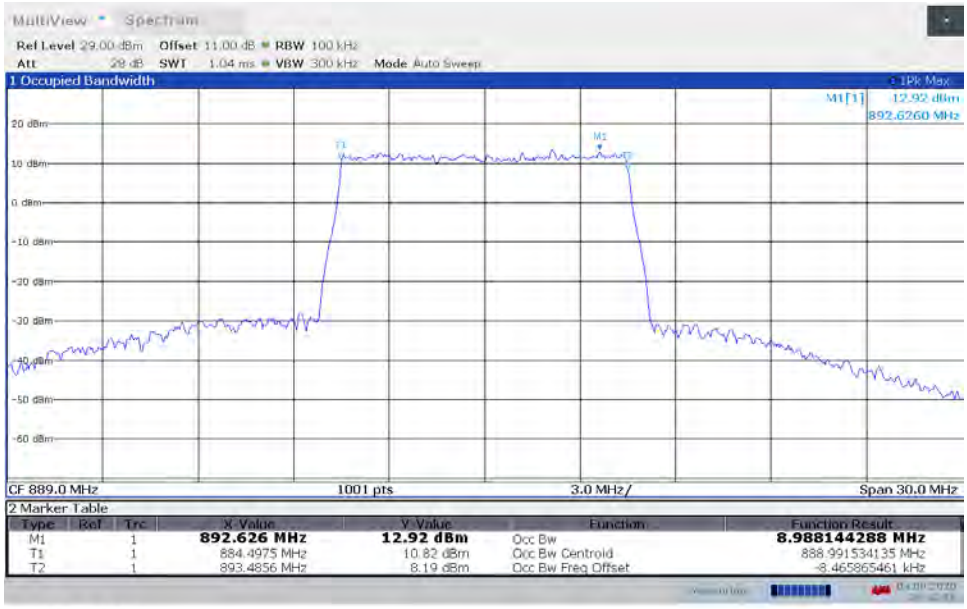
TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT1, High Channel, Occupied Bandwidth



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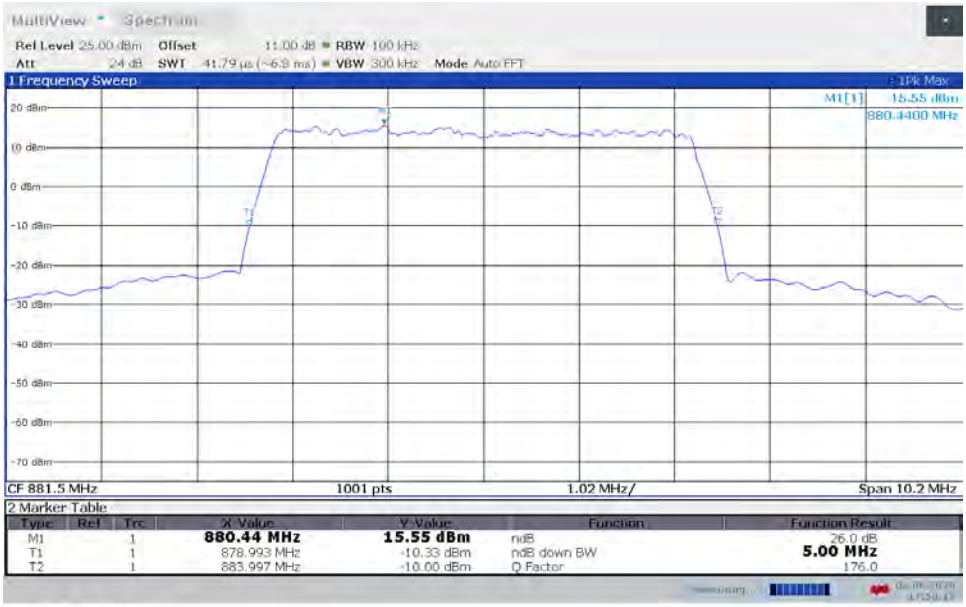
TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT0, Low Channel, 26dB Bandwidth

17:49:13 04.08.2020

TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT1, Low Channel, 26dB Bandwidth

17:48:02 04.08.2020

TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT0, Mid Channel, 26dB Bandwidth



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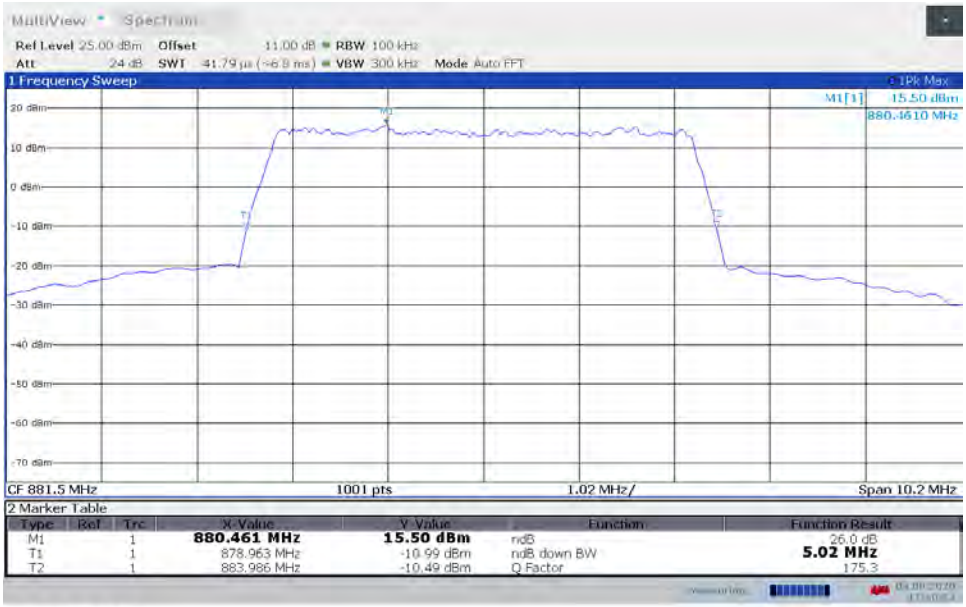
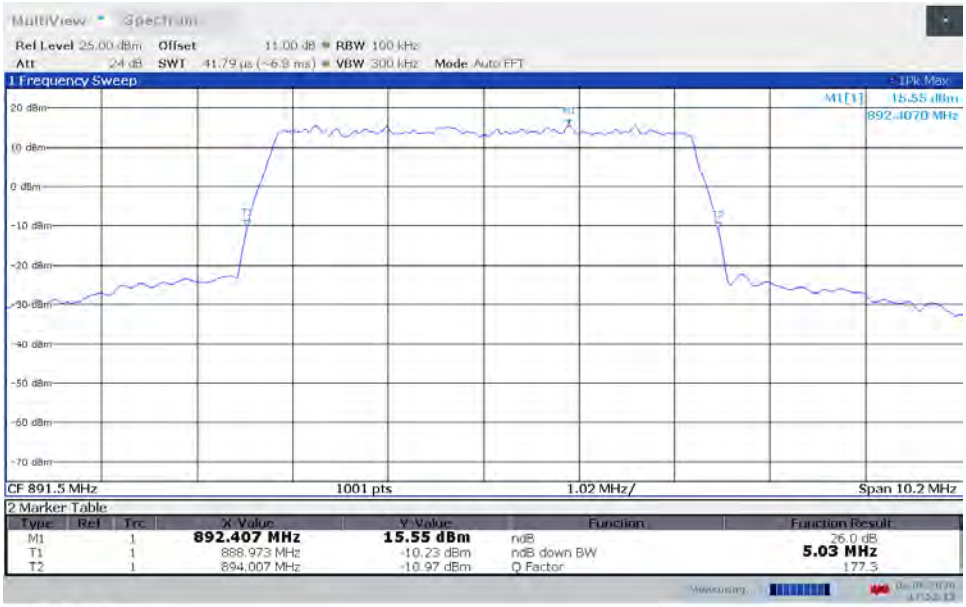
TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT1, Mid Channel, 26dB Bandwidth



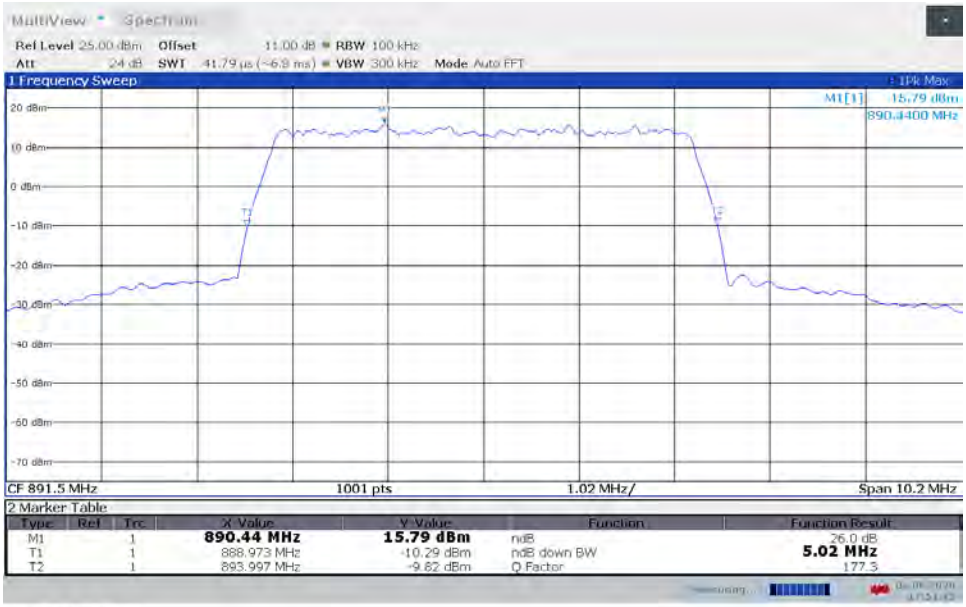
17:50:52 04.08.2020

TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT0, High Channel, 26dB Bandwidth



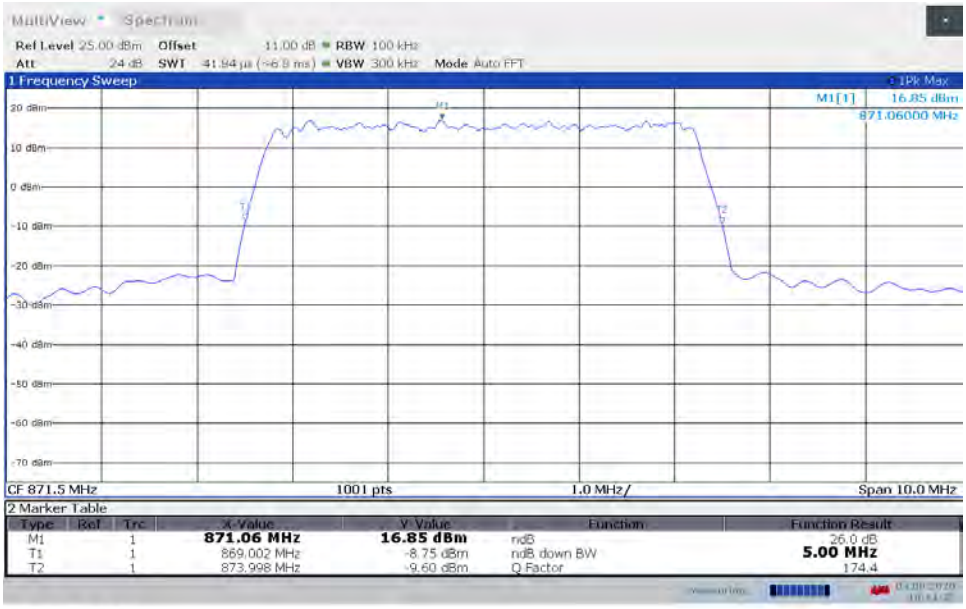
17:52:13 04.08.2020

TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT1, High Channel, 26dB Bandwidth



17:51:42 04.08.2020

TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT0, Low Channel, 26dB Bandwidth



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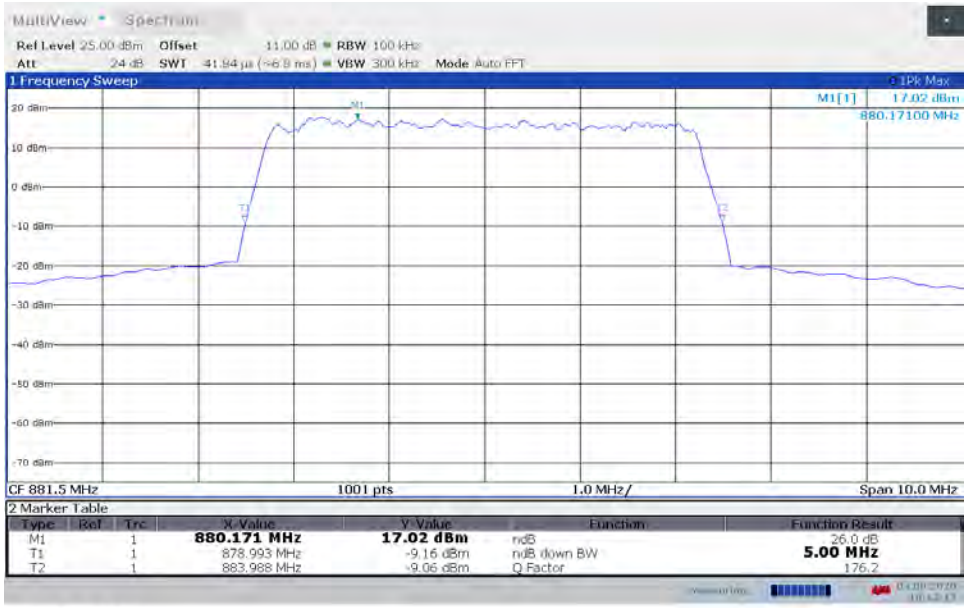
TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT1, Low Channel, 26dB Bandwidth

18:12:20 04.08.2020

TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT0, Mid Channel, 26dB Bandwidth

18:13:46 04.08.2020

TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT1, Mid Channel, 26dB Bandwidth



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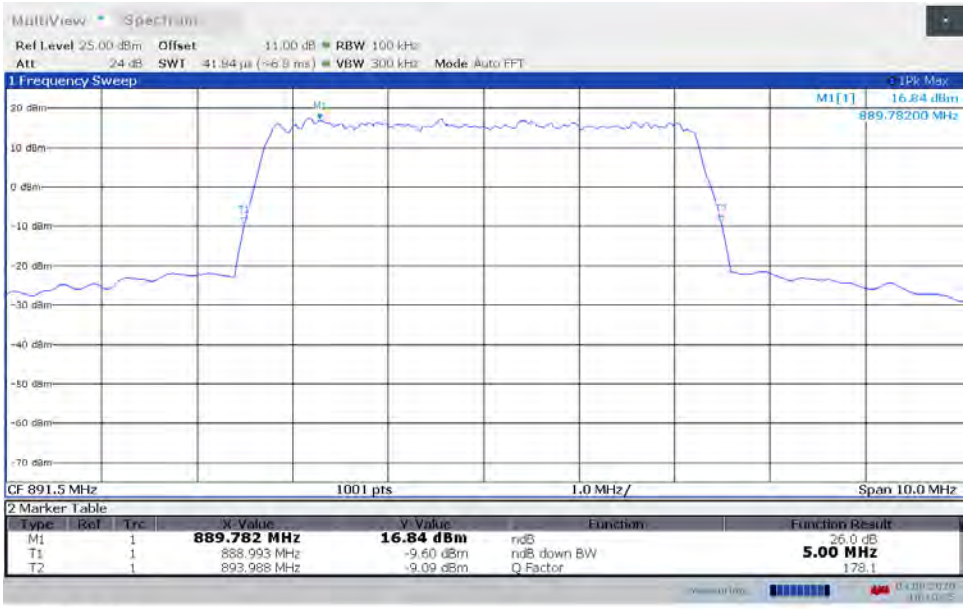
TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT0, High Channel, 26dB Bandwidth



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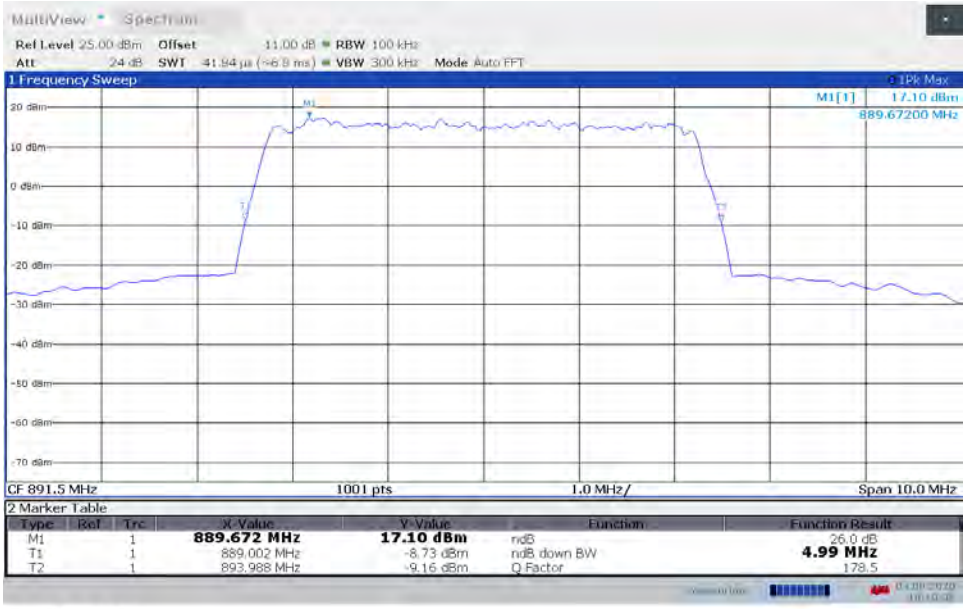
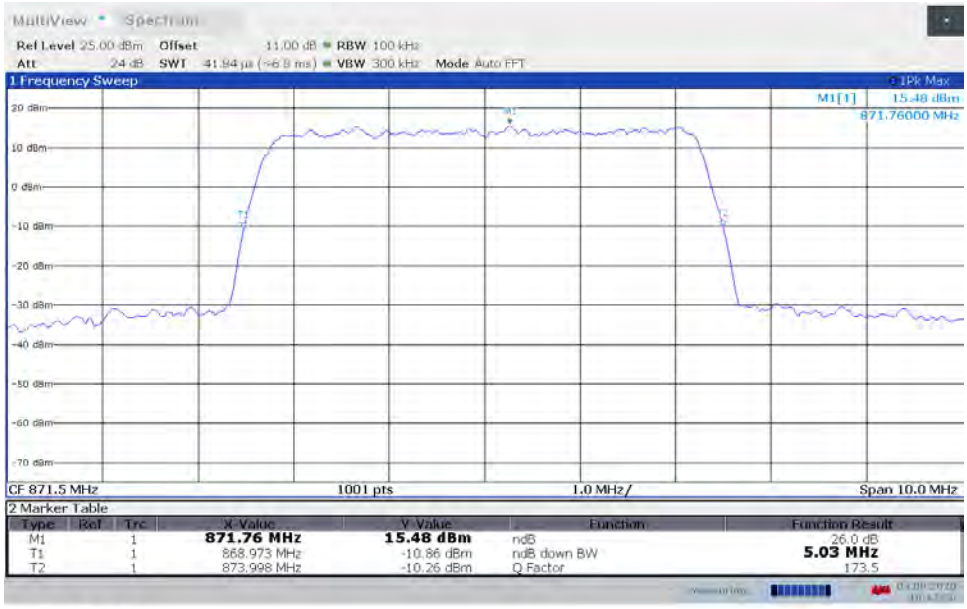
TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT1, High Channel, 26dB Bandwidth



18:10:07 04.08.2020

TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT0, Low Channel, 26dB Bandwidth



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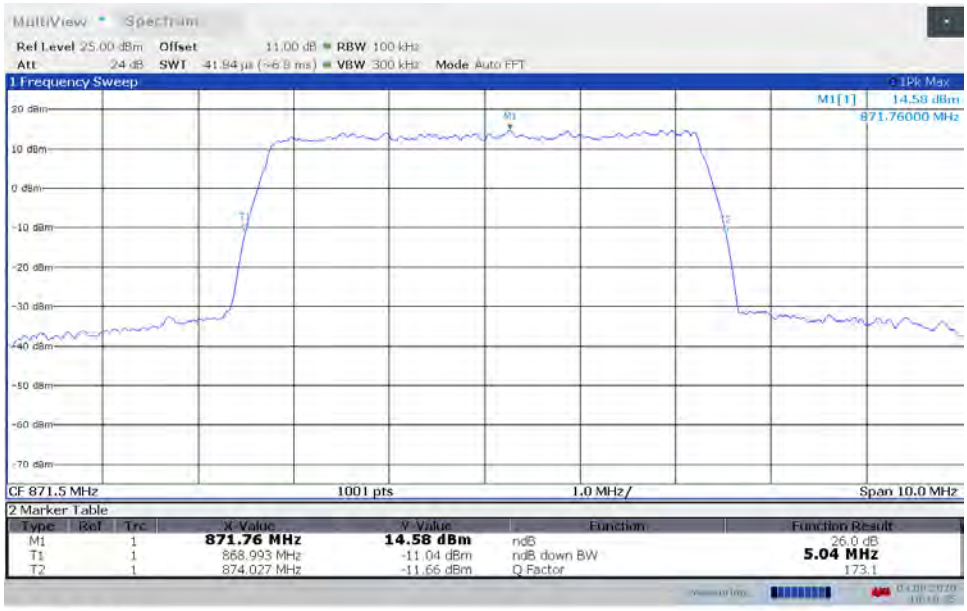
TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT1, Low Channel, 26dB Bandwidth



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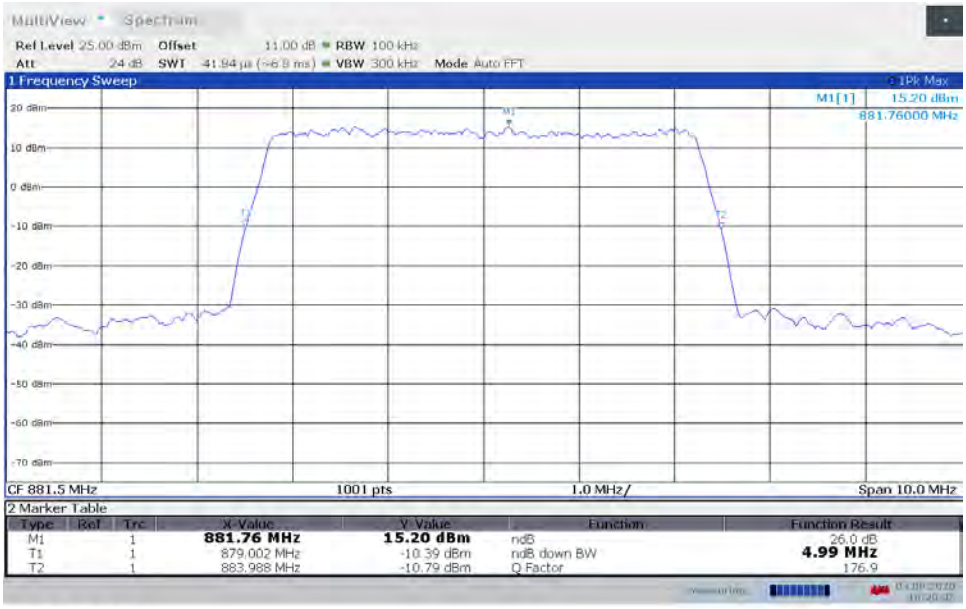
TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT0, Mid Channel, 26dB Bandwidth



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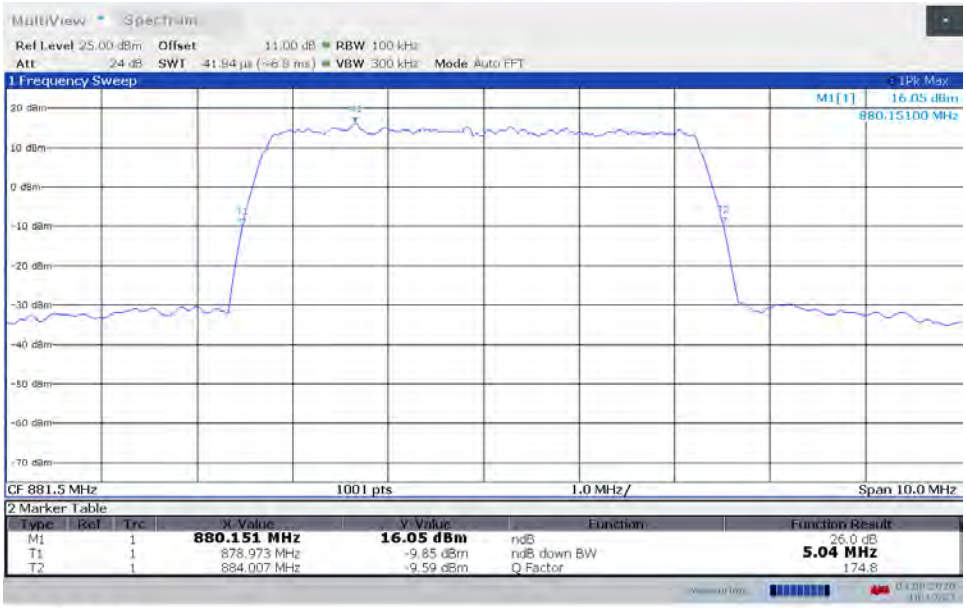
TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT1, Mid Channel, 26dB Bandwidth



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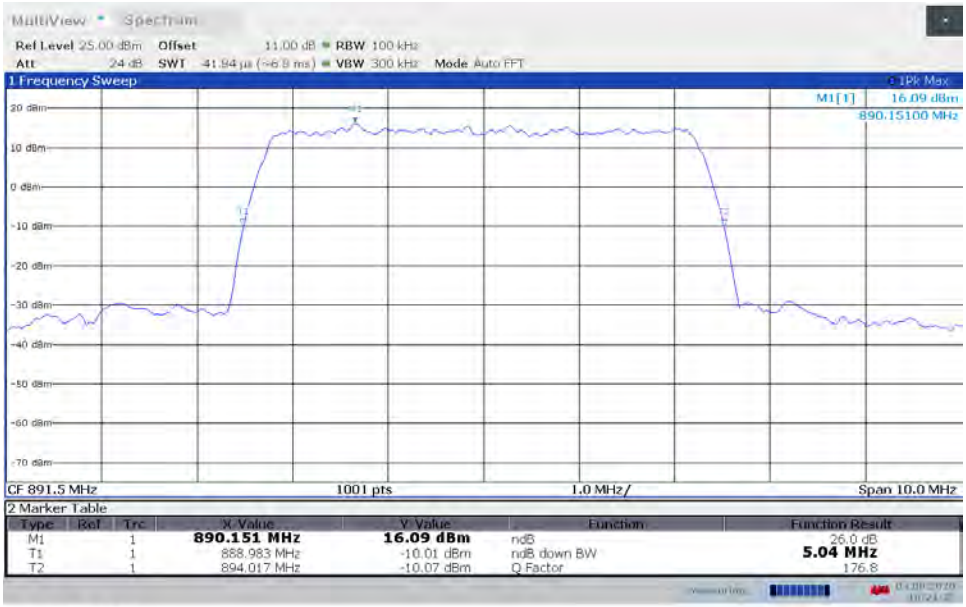
TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT0, High Channel, 26dB Bandwidth



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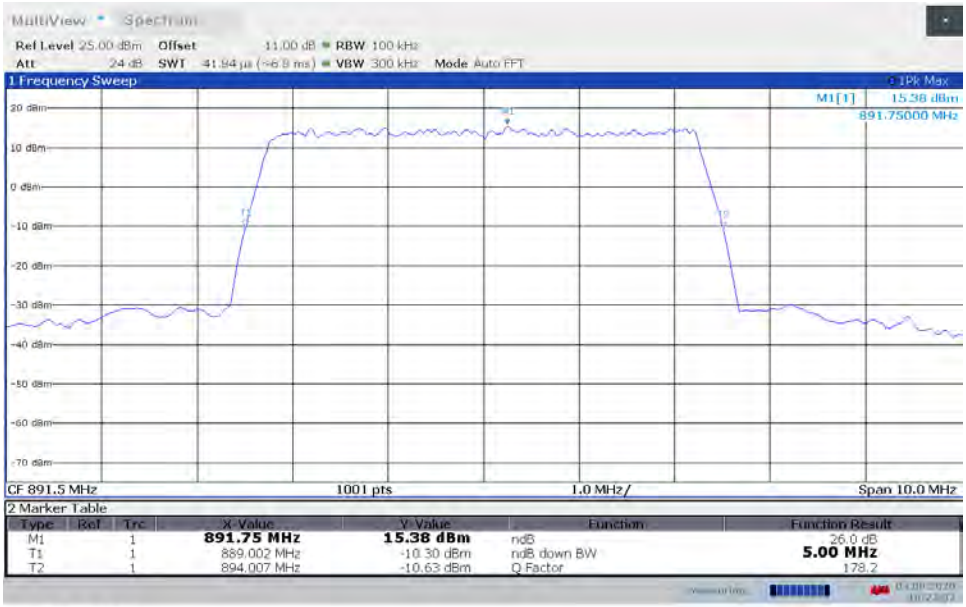
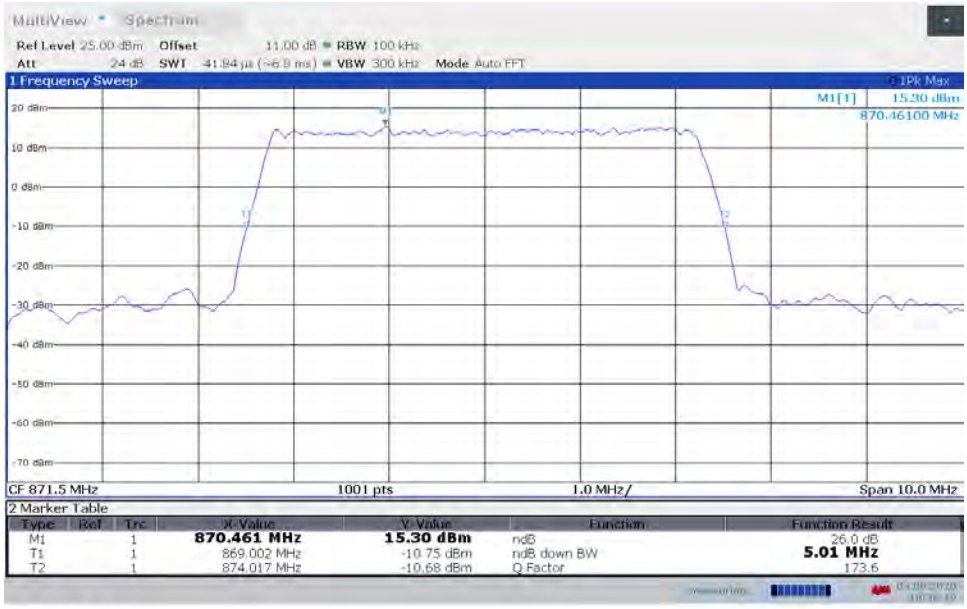
TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT1, High Channel, 26dB Bandwidth



18:22:03 04.08.2020

TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT0, Low Channel, 26dB Bandwidth



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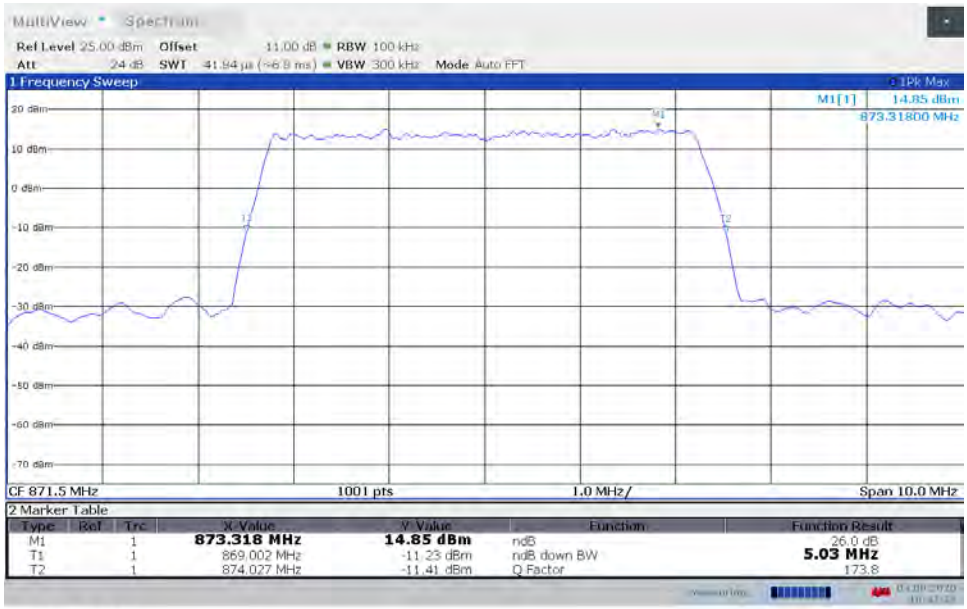
TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT1, Low Channel, 26dB Bandwidth



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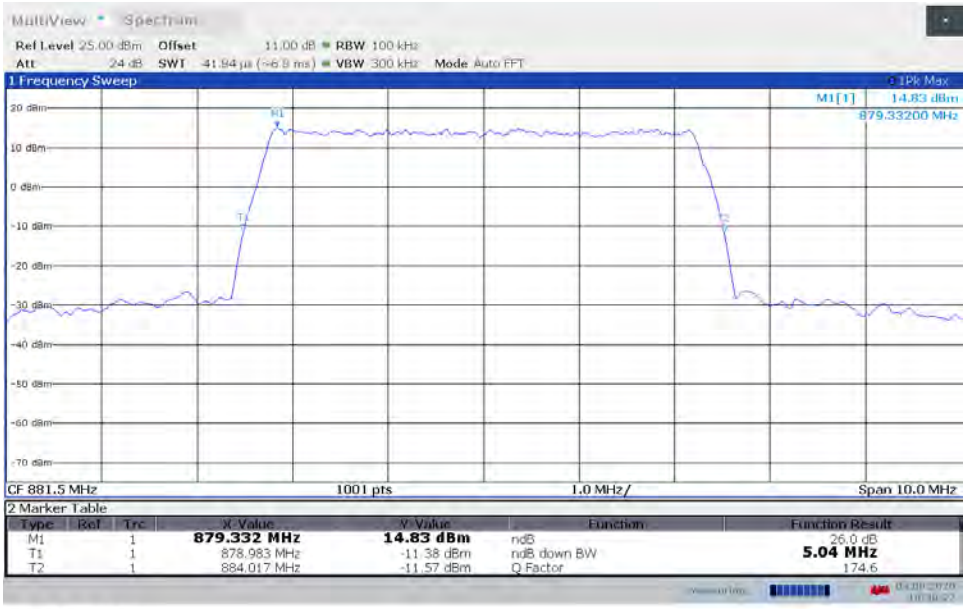
TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT0, Mid Channel, 26dB Bandwidth



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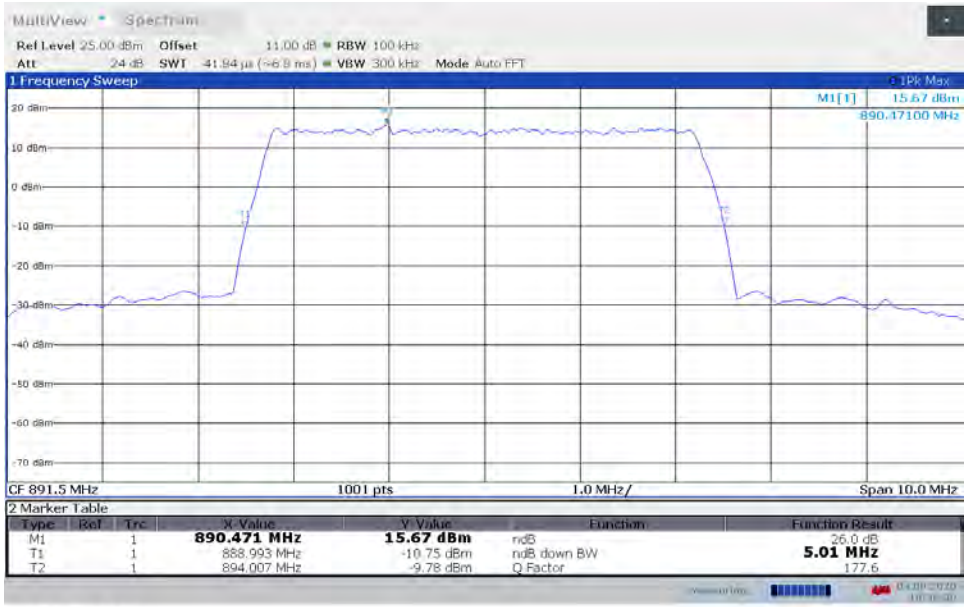
TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT1, Mid Channel, 26dB Bandwidth

18:38:00 04.08.2020

TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT0, High Channel, 26dB Bandwidth



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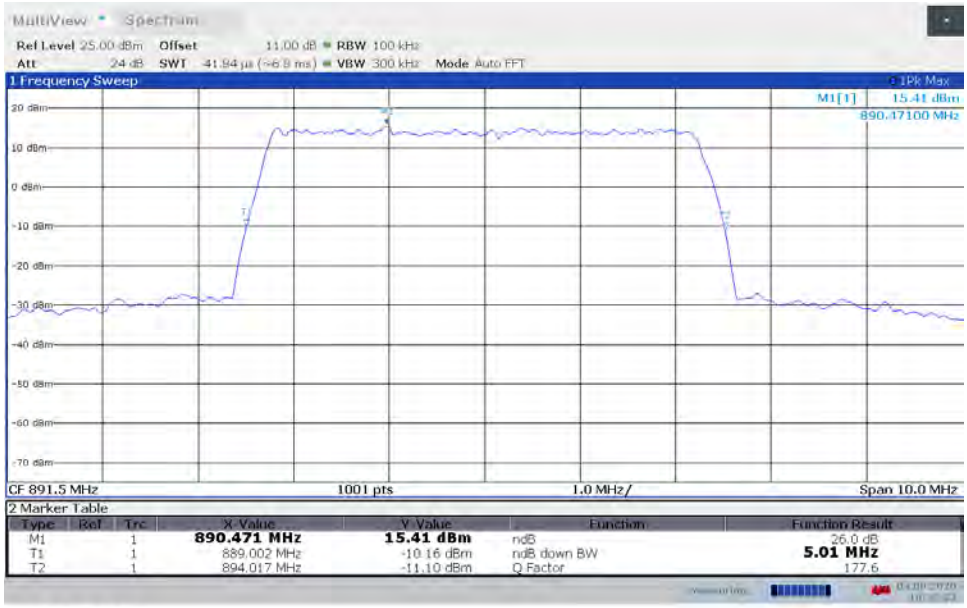
TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT1, High Channel, 26dB Bandwidth



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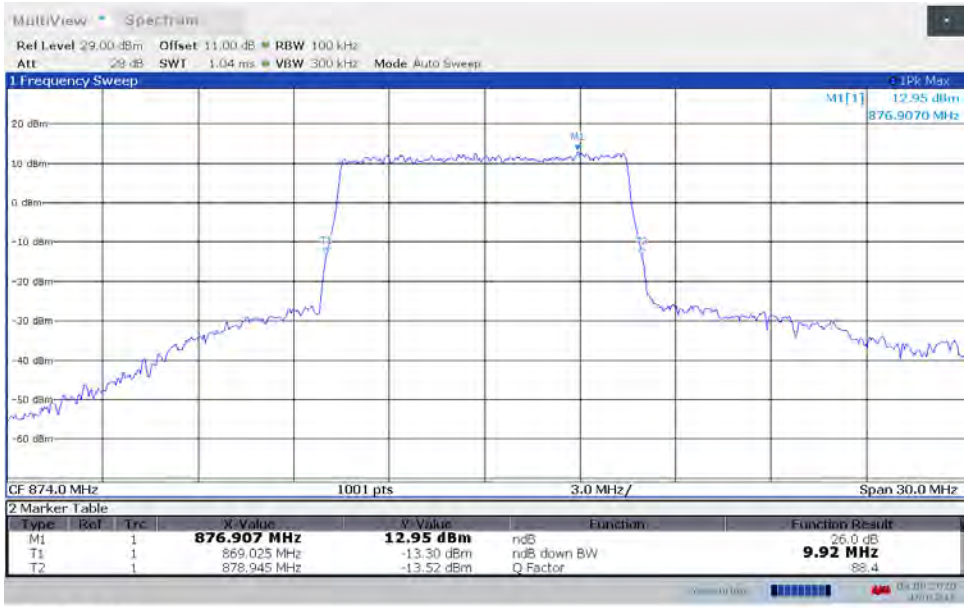
TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT0, Low Channel, 26dB Bandwidth



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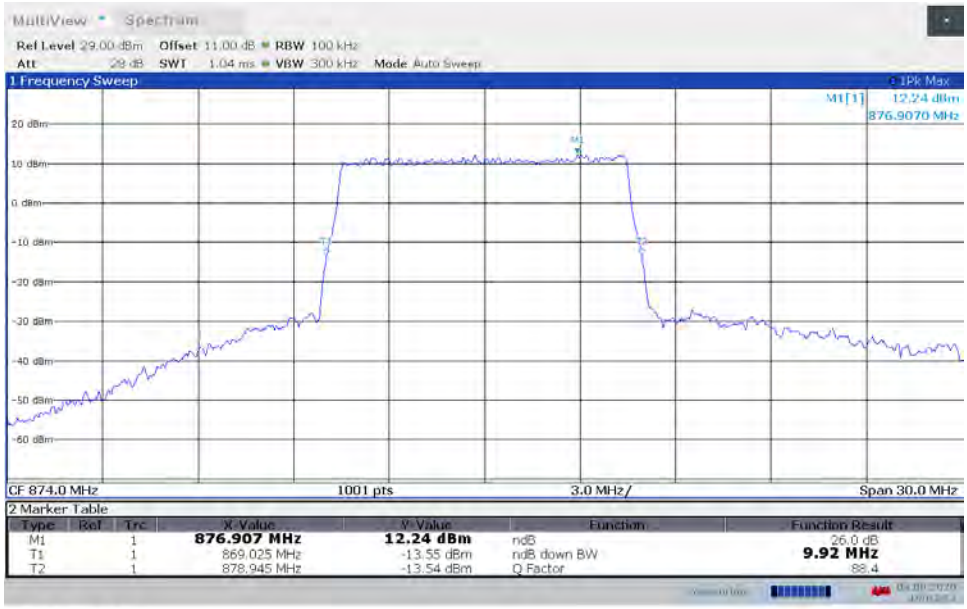
TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT1, Low Channel, 26dB Bandwidth



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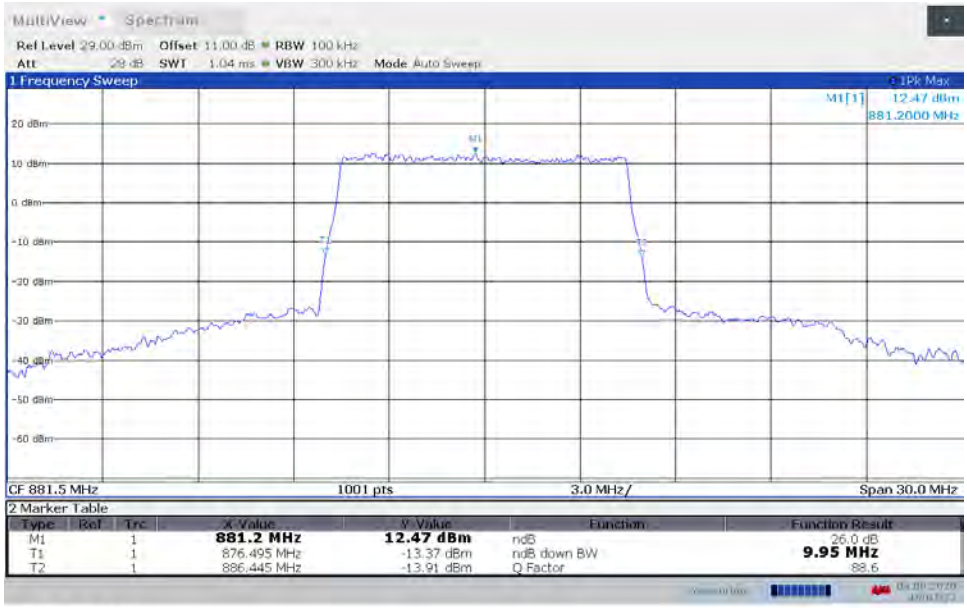
TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT0, Mid Channel, 26dB Bandwidth



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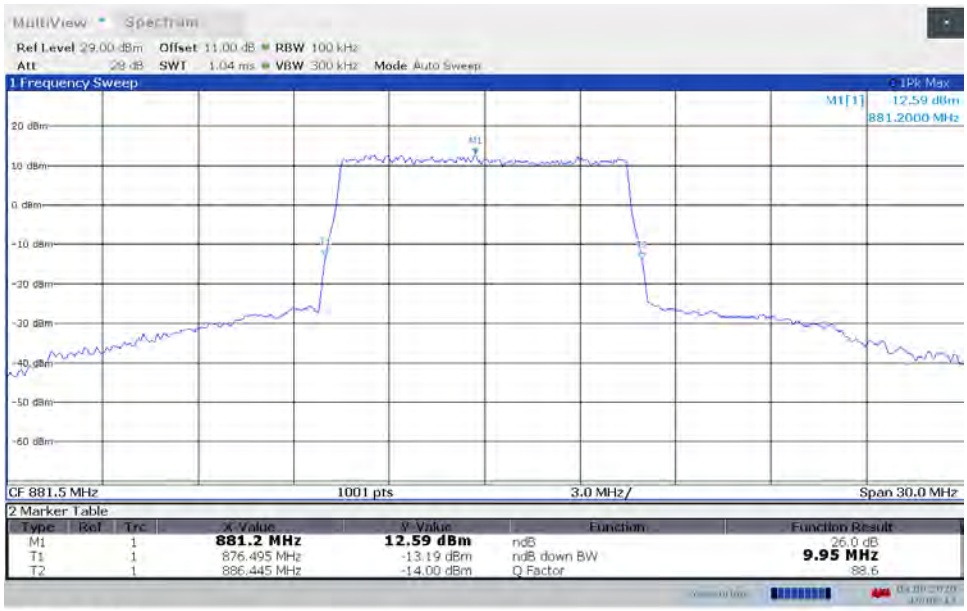
TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT1, Mid Channel, 26dB Bandwidth



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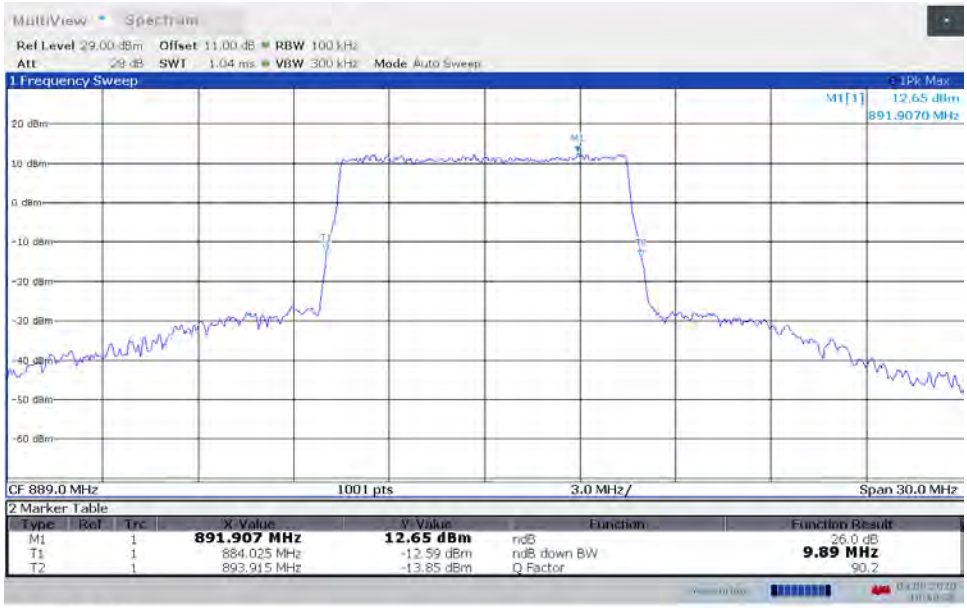
TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT0, High Channel, 26dB Bandwidth



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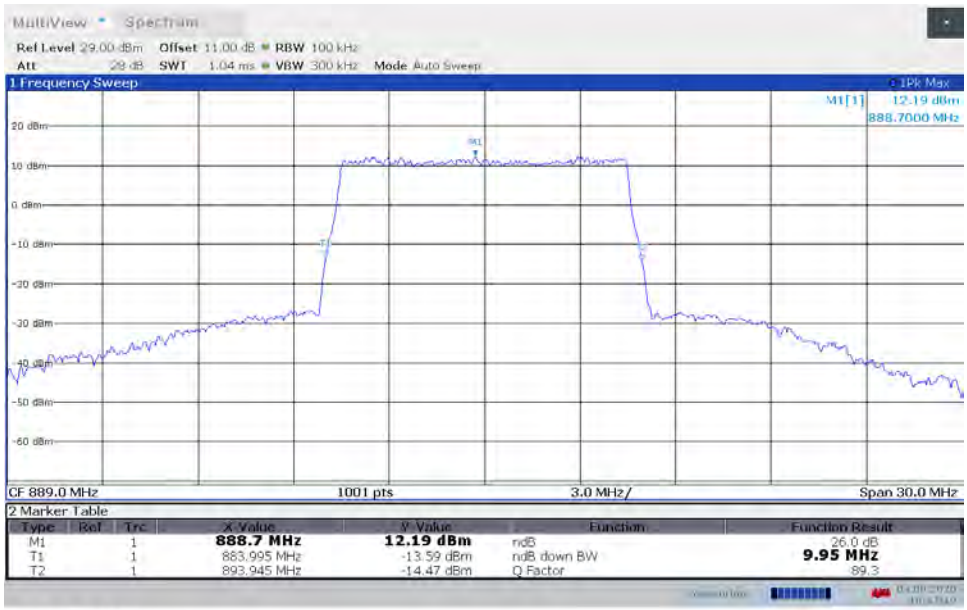
TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT1, High Channel, 26dB Bandwidth

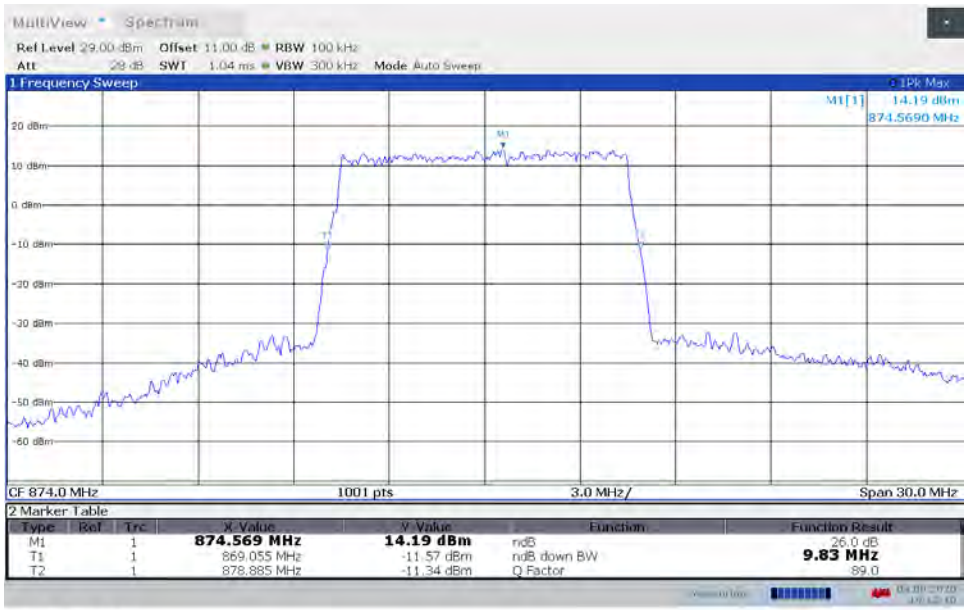


18:57:19 04.08.2020

TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT0, Low Channel, 26dB Bandwidth

19:11:49 04.08.2020

TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT1, Low Channel, 26dB Bandwidth



19:12:41 04.08.2020

TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT0, Mid Channel, 26dB Bandwidth

19:14:28 04.08.2020

TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT1, Mid Channel, 26dB Bandwidth

19:13:42 04.08.2020

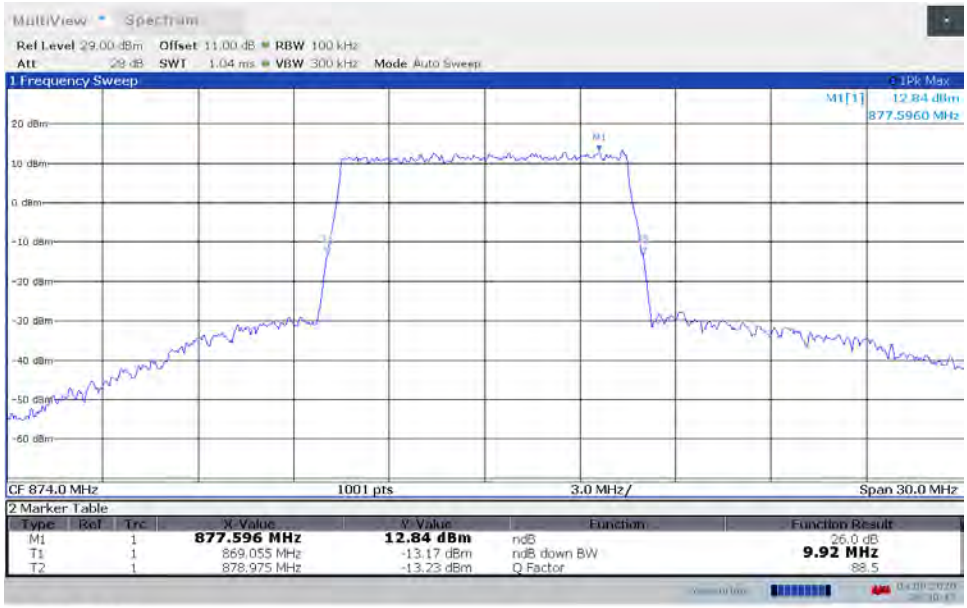
TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT0, High Channel, 26dB Bandwidth

19:15:12 04.08.2020

TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT1, High Channel, 26dB Bandwidth

19:15:36 04.08.2020

TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT0, Low Channel, 26dB Bandwidth



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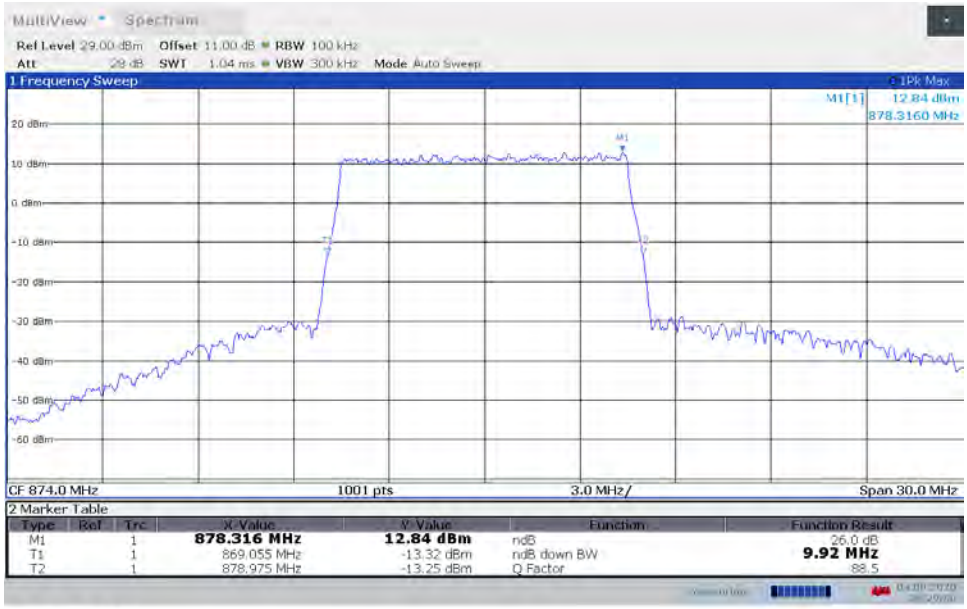
TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT1, Low Channel, 26dB Bandwidth



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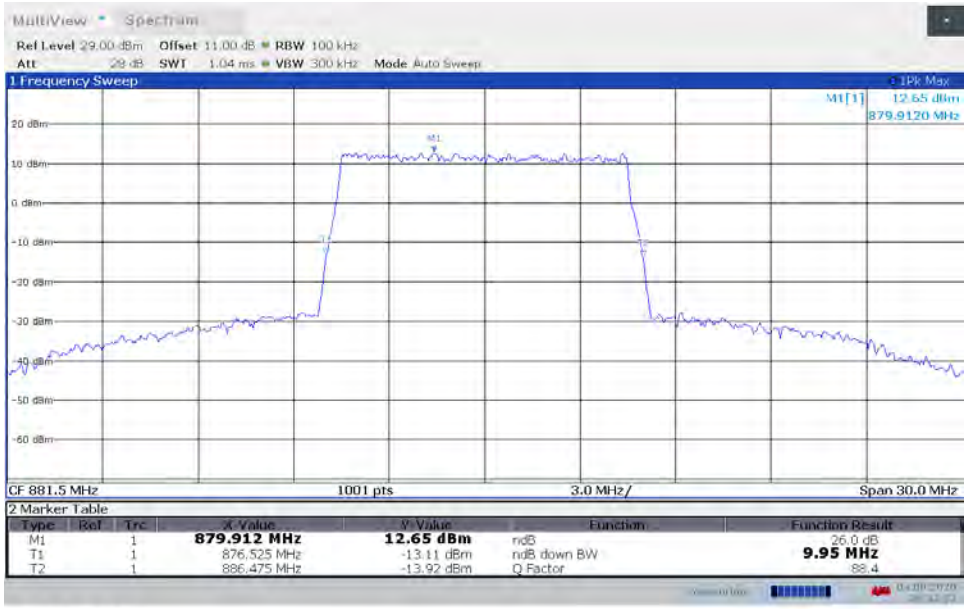
TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT0, Mid Channel, 26dB Bandwidth

20:31:55 04.08.2020

TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT1, Mid Channel, 26dB Bandwidth



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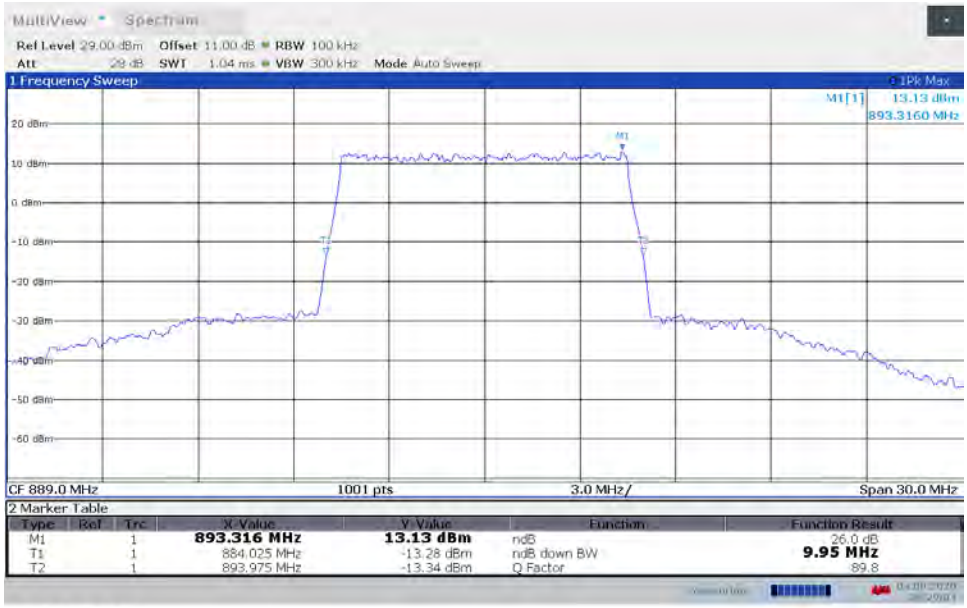
TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT0, High Channel, 26dB Bandwidth



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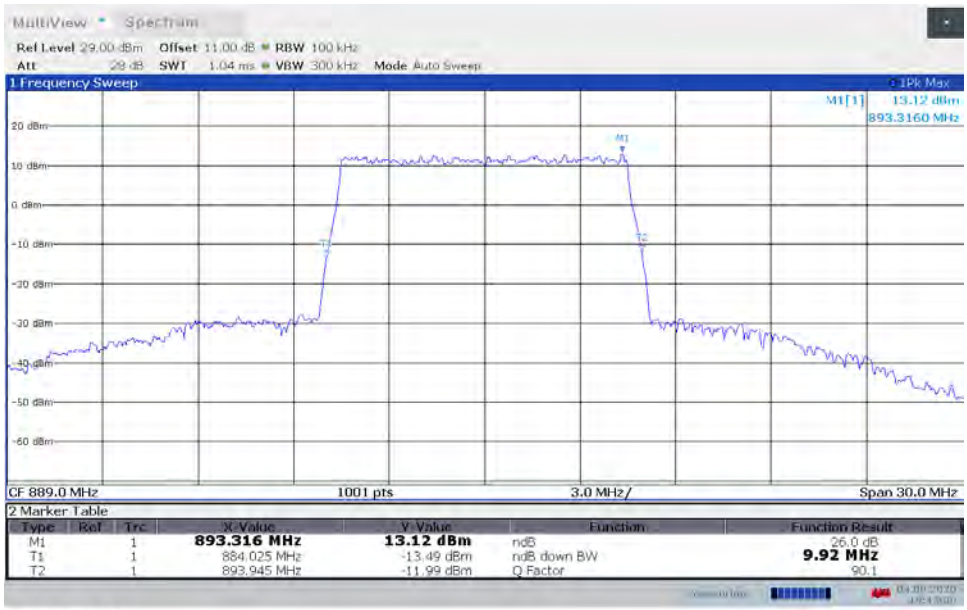
TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT1, High Channel, 26dB Bandwidth



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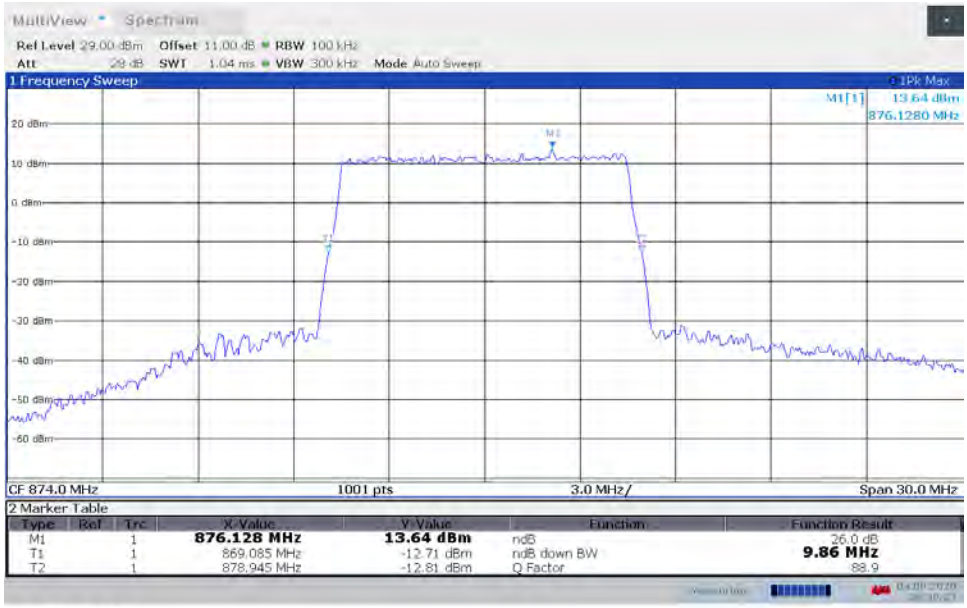
TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT0, Low Channel, 26dB Bandwidth



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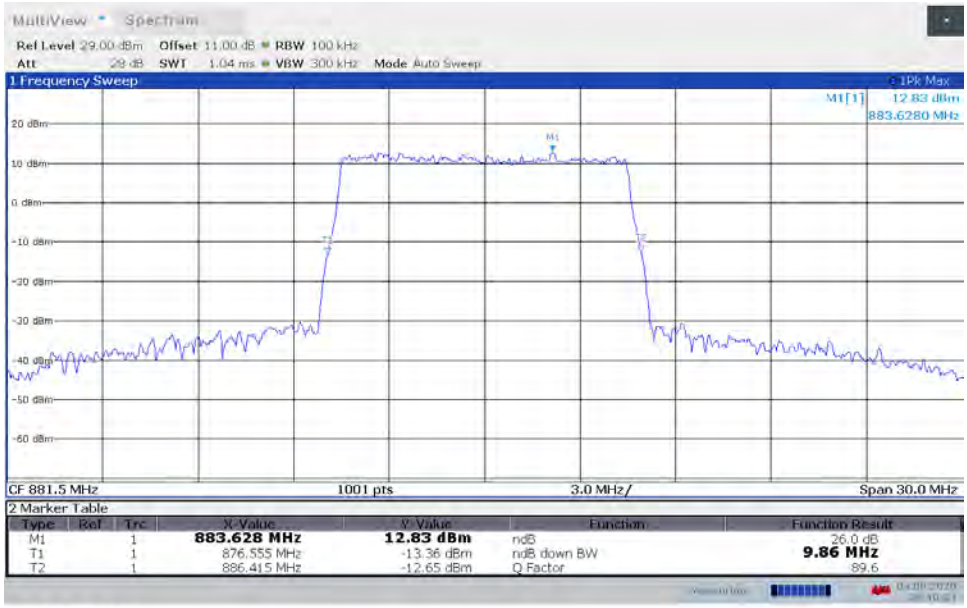
TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT1, Low Channel, 26dB Bandwidth

20:38:53 04.08.2020

TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT0, Mid Channel, 26dB Bandwidth



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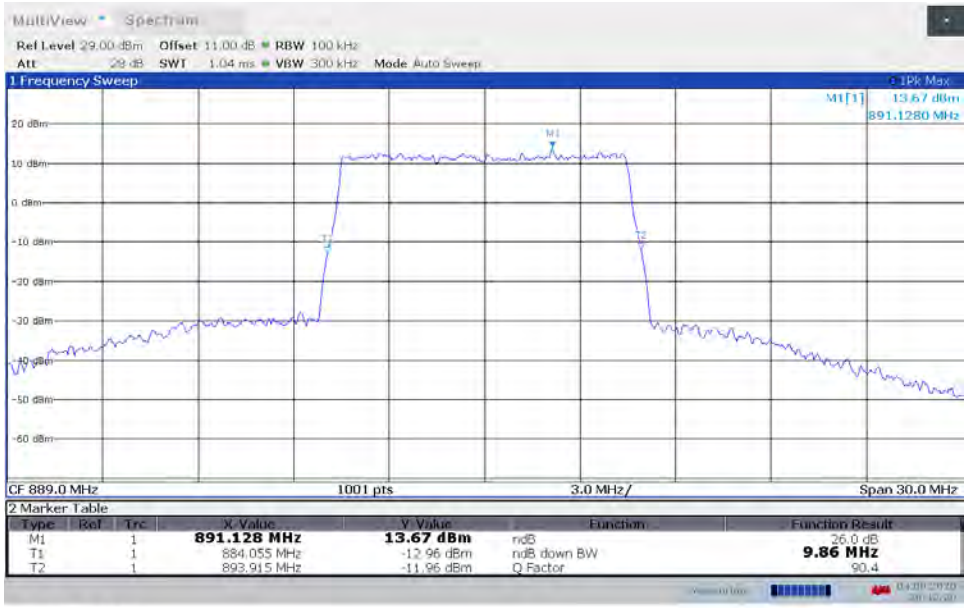
TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT1, Mid Channel, 26dB Bandwidth

20:41:11 04.08.2020

TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT0, High Channel, 26dB Bandwidth



20:42:20 04.08.2020

TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT1, High Channel, 26dB, 26dB Bandwidth

20:41:59 04.08.2020

Test Personnel:	Minh Ly	Test Date:	08/04/2020
Supervising/Reviewing Engineer: (Where Applicable)			
Product Standard:	FCC Part 22	Limit Applied:	See report section 8.3
Input Voltage:	56 VDC (POE)		
Pretest Verification w/ Ambient Signals or BB Source:	N/A	Ambient Temperature:	23ºC
		Relative Humidity:	40 %
		Atmospheric Pressure:	29.9 in Hg

9 Band Edge Compliance

9.1 Requirement:

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 +10 log(P) dB.

9.2 Procedure:

The procedure described in FCC Publication 971168 D01 Power Meas License Digital Systems v03r01 was used. Tests are performed in accordance with ANSI C63.26 Section 5.7.

In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

9.3 Results:

The sample tested was found to Comply.

Band 5, Bandwidth: 5 MHz, Modulation: TM1.1-QPSK

Band Edge	Frequency (MHz)	Antenna Port	Reading (dBm)
Low	871.5	ANT0	-29.92
		ANT1	-30.00
High	891.5	ANT0	-30.34
		ANT1	-29.67

Band 5, Bandwidth: 5 MHz, Modulation: TM3.2-16QAM

Band Edge	Frequency (MHz)	Antenna Port	Reading (dBm)
Low	871.5	ANT0	-29.63
		ANT1	-30.69
High	891.5	ANT0	-29.96
		ANT1	-30.22

Band 5, Bandwidth: 5 MHz, Modulation: TM3.1-64QAM

Band Edge	Frequency (MHz)	Antenna Port	Reading (dBm)
Low	871.5	ANT0	-29.55
		ANT1	-29.51
High	891.5	ANT0	-30.16
		ANT1	-30.93

Band 5, Bandwidth: 5 MHz, Modulation: TM3.1a-256QAM

Band Edge	Frequency (MHz)	Antenna Port	Reading (dBm)
Low	871.5	ANT0	-29.70
		ANT1	-29.87
High	891.5	ANT0	-29.59
		ANT1	-30.27

Band 5, Bandwidth: 10 MHz, Modulation: TM1.1-QPSK

Band Edge	Frequency (MHz)	Antenna Port	Reading (dBm)
Low	874.0	ANT0	-32.86
		ANT1	-33.36
High	889.0	ANT0	-32.91
		ANT1	-33.91

Band 5, Bandwidth: 10 MHz, Modulation: TM3.2-16QAM

Band Edge	Frequency (MHz)	Antenna Port	Reading (dBm)
Low	874.0	ANT0	-29.58
		ANT1	-30.59
High	889.0	ANT0	-29.45
		ANT1	-30.05

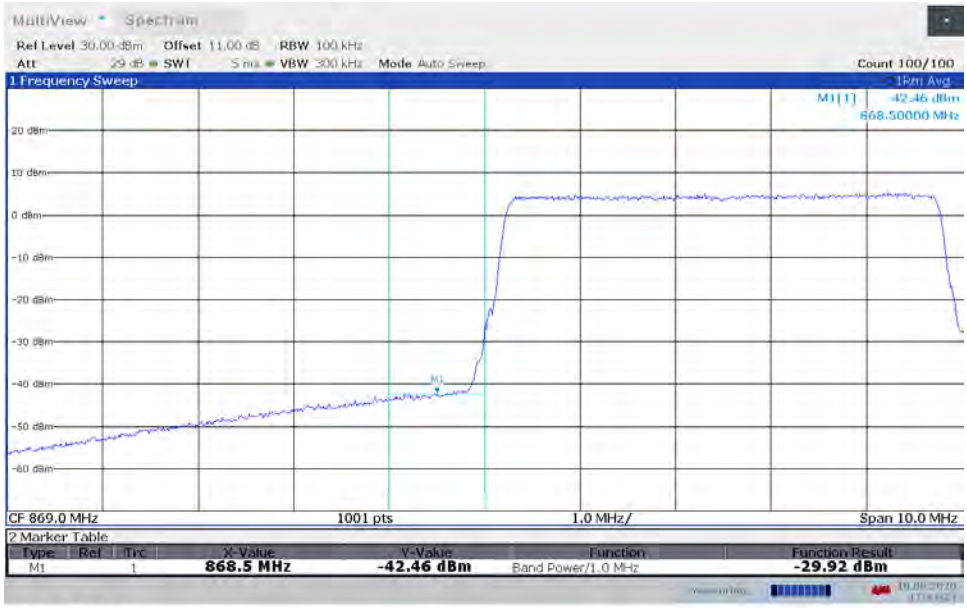
Band 5, Bandwidth: 10 MHz, Modulation: TM3.1-64QAM

Band Edge	Frequency (MHz)	Antenna Port	Reading (dBm)
Low	874.0	ANT0	-32.97
		ANT1	-33.58
High	889.0	ANT0	-33.05
		ANT1	-33.83

Band 5, Bandwidth: 10 MHz, Modulation: TM3.1a-256QAM

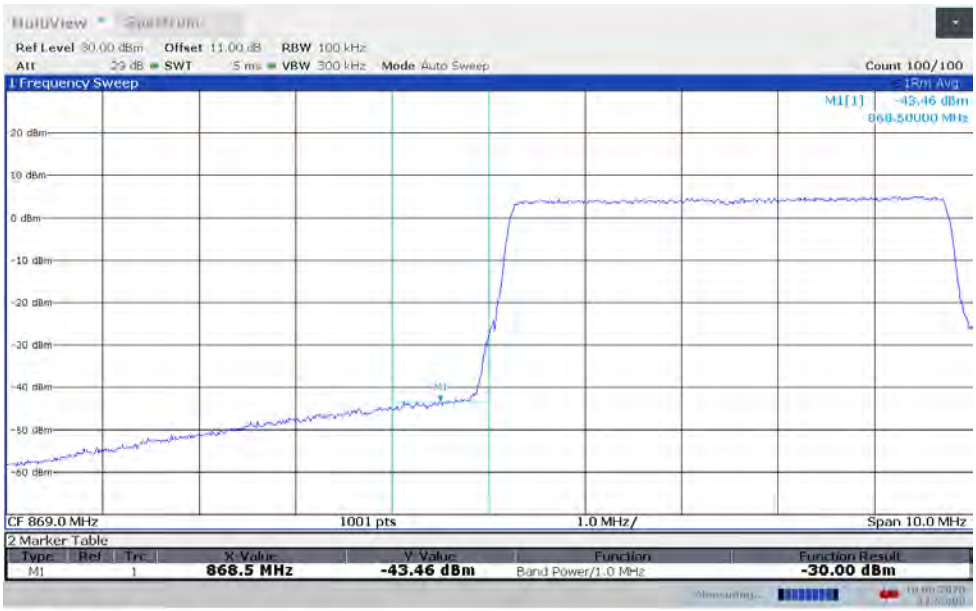
Band Edge	Frequency (MHz)	Antenna Port	Reading (dBm)
Low	874.0	ANT0	-33.05
		ANT1	-34.09
High	889.0	ANT0	-33.16
		ANT1	-33.76

TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT0, Low Channel, Lower Band Edge



17:54:25 10.08.2020

TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT1, Low Channel, Lower Band Edge

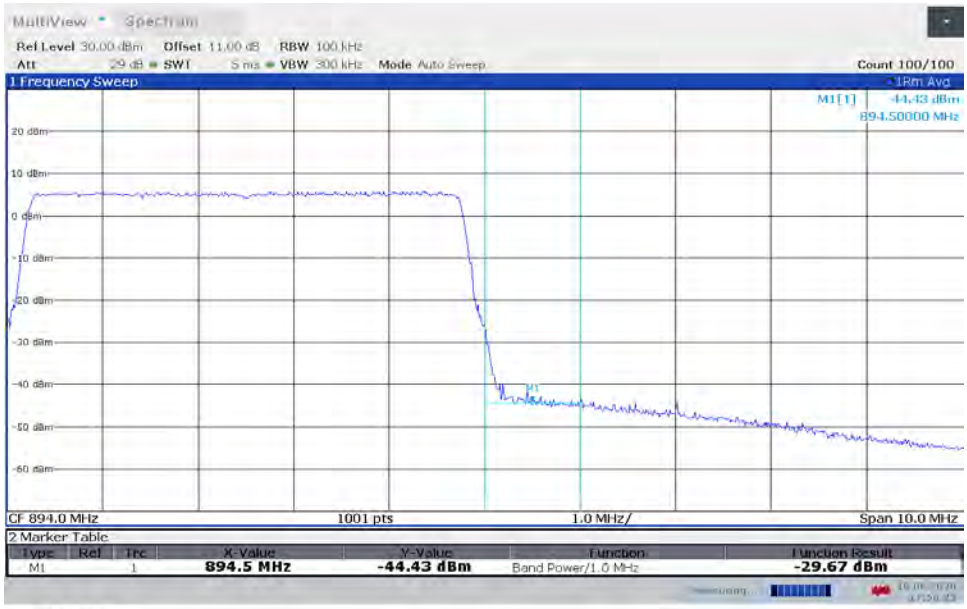


17:53:01 10.08.2020

TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT0, High Channel, Upper Band Edge

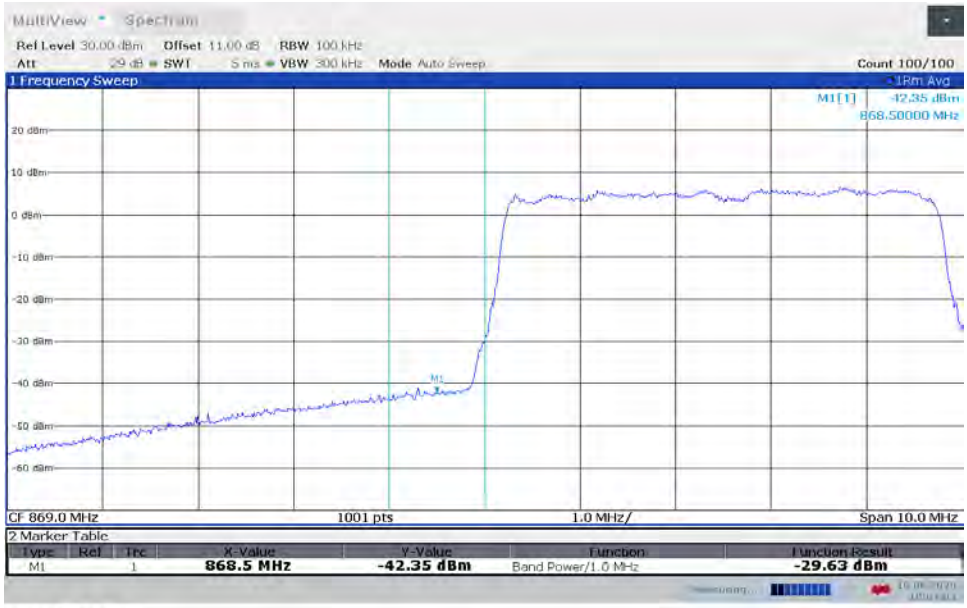
17:55:54 10.08.2020

TM1.1-QPSK_5 MHz Bandwidth
Band 5, ANT1, High Channel, Upper Band Edge



17:56:24 10.08.2020

TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT0, Low Channel, Lower Band Edge



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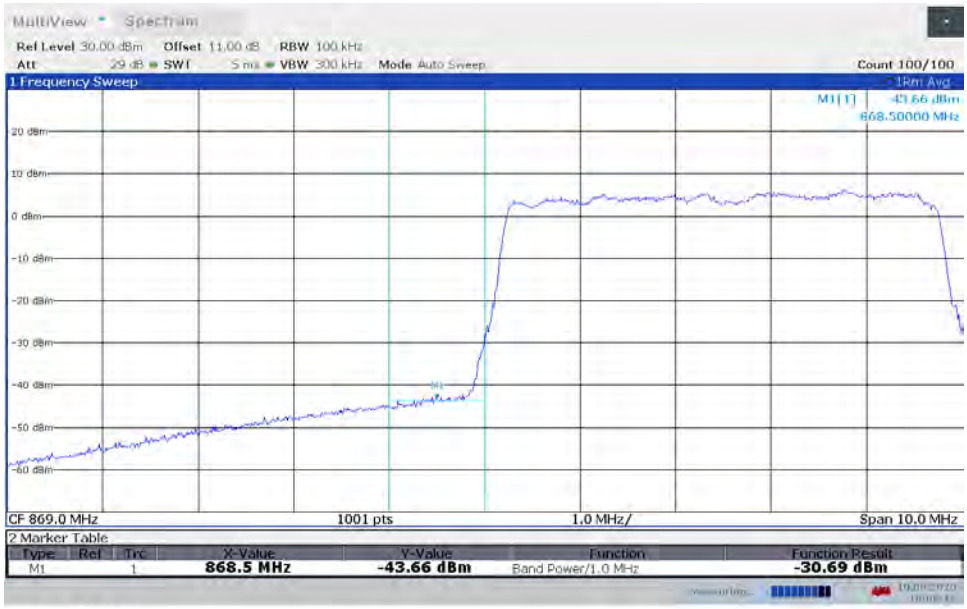
TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT1, Low Channel, Lower Band Edge



18:06:47 10.08.2020

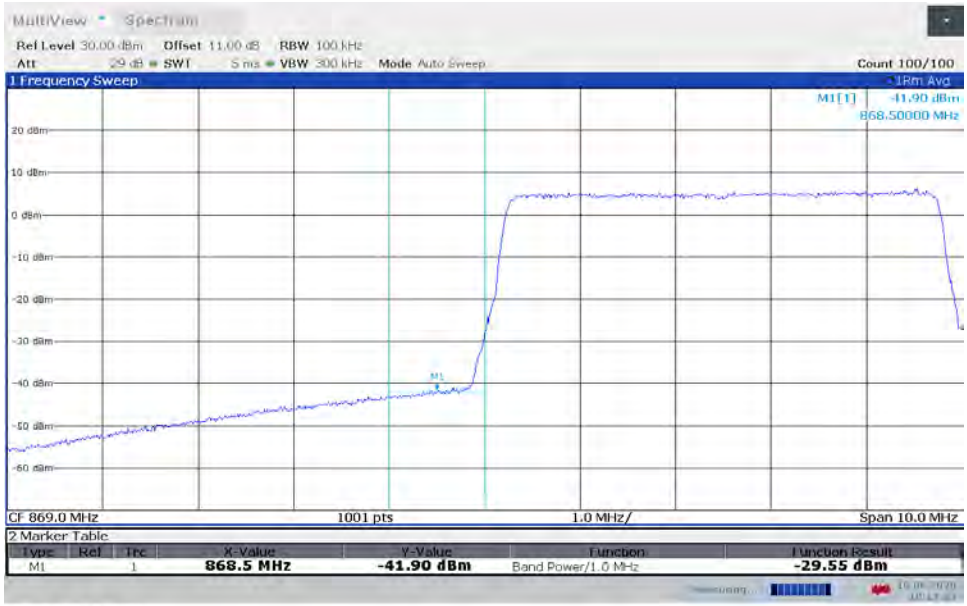
TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT0, High Channel, Upper Band Edge

18:07:42 10.08.2020

TM3.2-16QAM_5 MHz Bandwidth
Band 5, ANT1, High Channel, Upper Band Edge

18:08:04 10.08.2020

TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT0, Low Channel, Lower Band Edge



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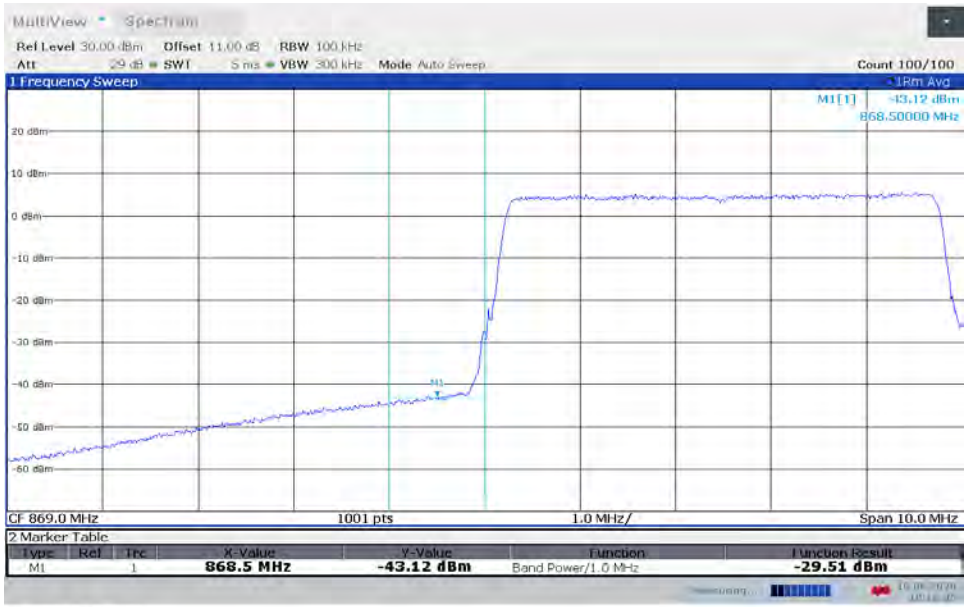
TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT1, Low Channel, Lower Band Edge



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TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT0, High Channel, Upper Band Edge

18:17:01 10.08.2020

TM3.1-64QAM_5 MHz Bandwidth
Band 5, ANT1, High Channel, Upper Band Edge

18:16:43 10.08.2020

TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT0, Low Channel, Lower Band Edge

18:21:55 10.08.2020

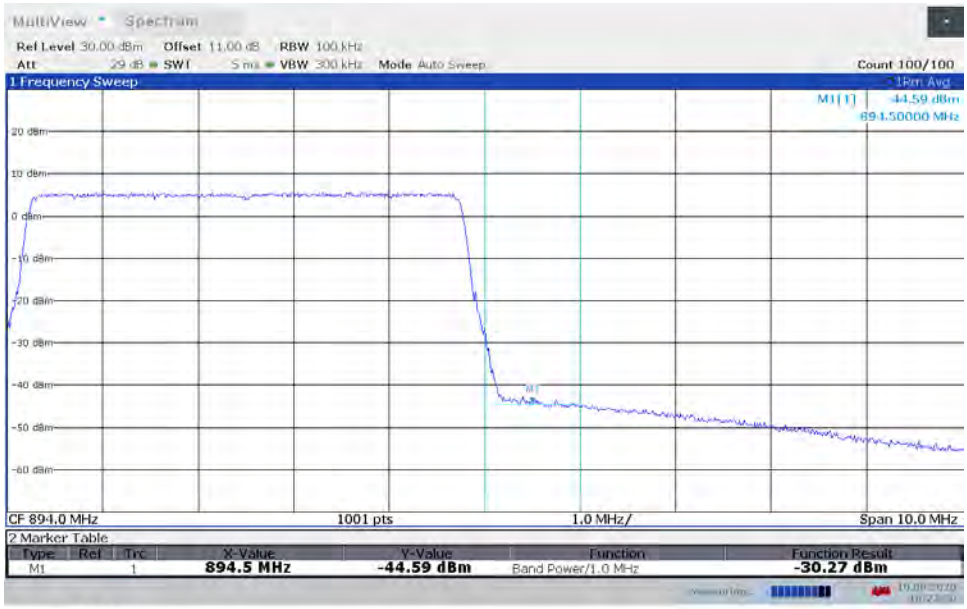
TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT1, Low Channel, Lower Band Edge

18:21:32 10.08.2020

TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT0, High Channel, Upper Band Edge

18:22:33 10.08.2020

TM3.1a-256QAM_5 MHz Bandwidth
Band 5, ANT1, High Channel, Upper Band Edge



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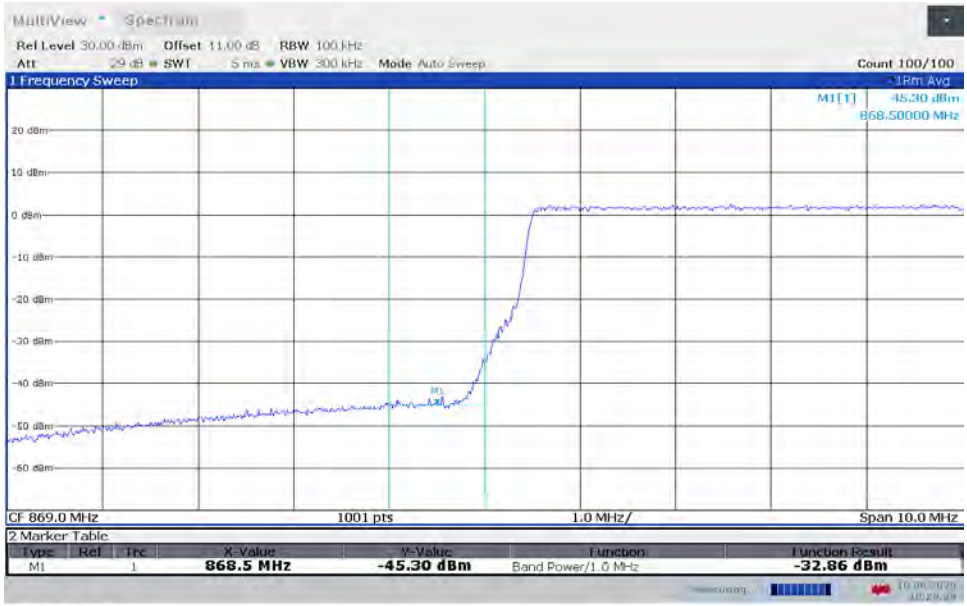
TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT0, Low Channel, Lower Band Edge



18:29:39 10.08.2020

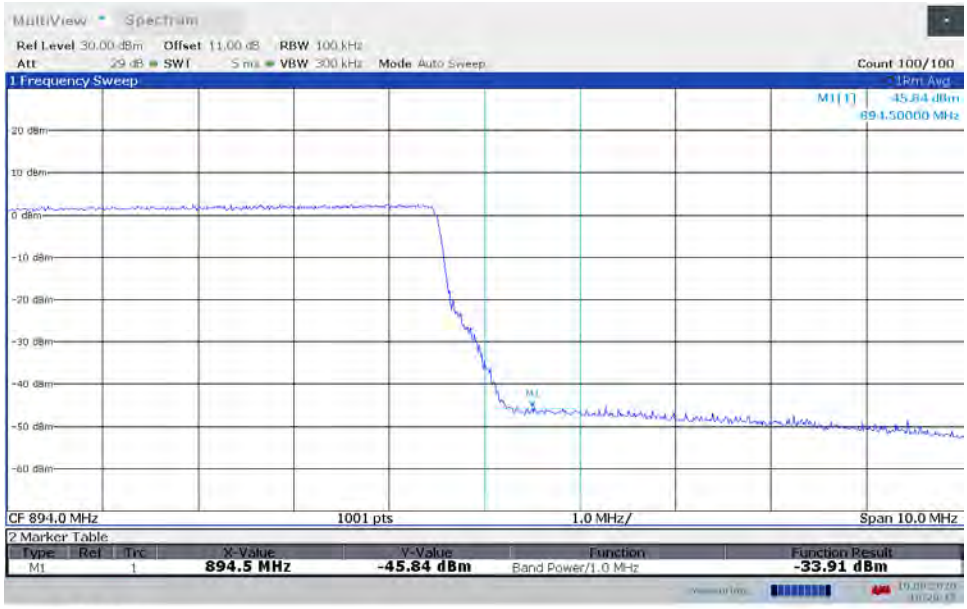
TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT1, Low Channel, Lower Band Edge

18:29:22 10.08.2020

TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT0, High Channel, Upper Band Edge

18:27:33 10.08.2020

TM1.1-QPSK_10 MHz Bandwidth
Band 5, ANT1, High Channel, Upper Band Edge



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TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT0, Low Channel, Lower Band Edge

18:33:18 10.08.2020

TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT1, Low Channel, Lower Band Edge

18:33:36 10.08.2020

TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT0, High Channel, Upper Band Edge

18:34:27 10.08.2020

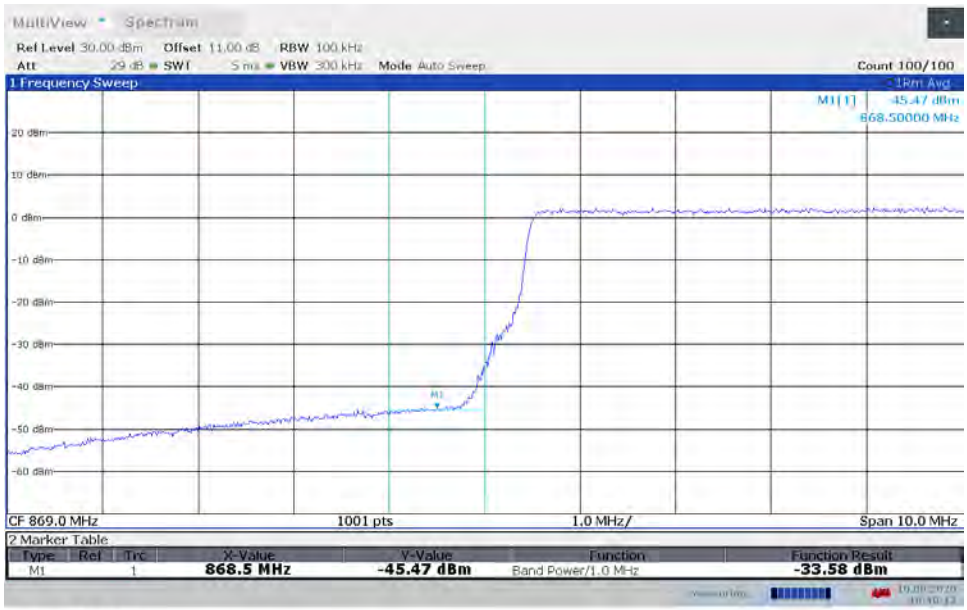
TM3.2-16QAM_10 MHz Bandwidth
Band 5, ANT1, High Channel, Upper Band Edge

18:34:06 10.08.2020

TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT0, Low Channel, Lower Band Edge

18:40:34 10.08.2020

TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT1, Low Channel, Lower Band Edge

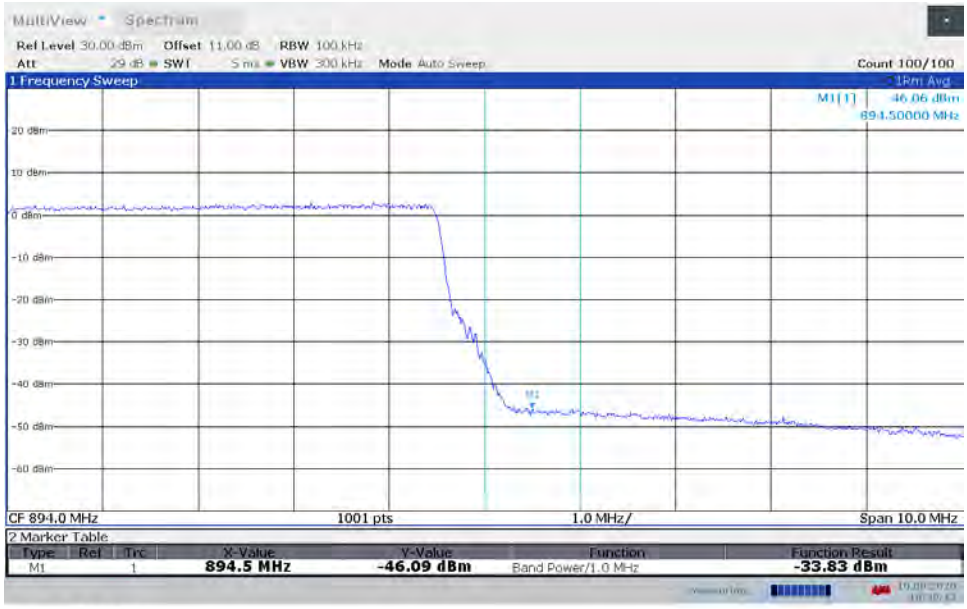


18:40:13 10.08.2020

TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT0, High Channel, Upper Band Edge

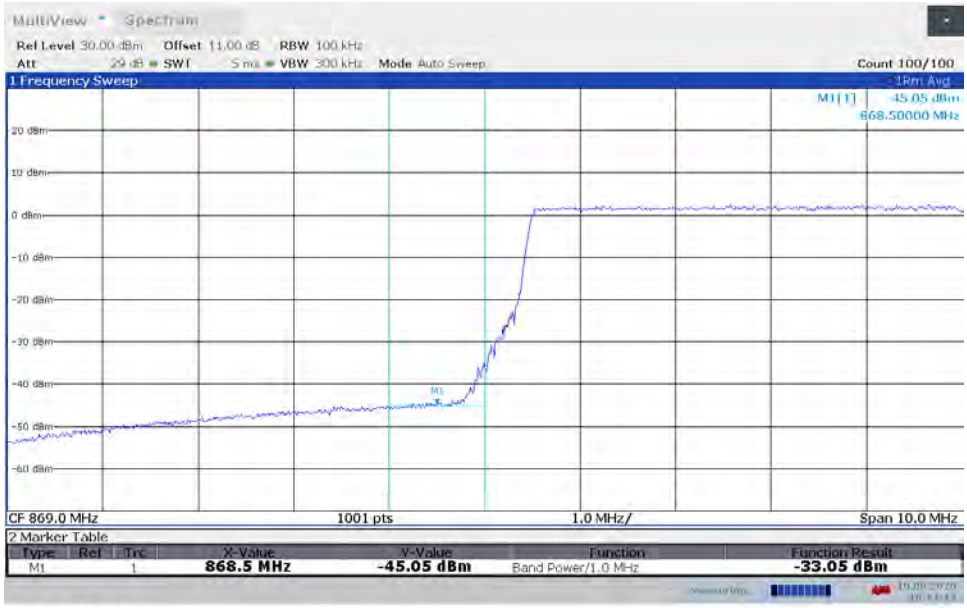
18:39:24 10.08.2020

TM3.1-64QAM_10 MHz Bandwidth
Band 5, ANT1, High Channel, Upper Band Edge



18:39:42 10.08.2020

TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT0, Low Channel, Lower Band Edge

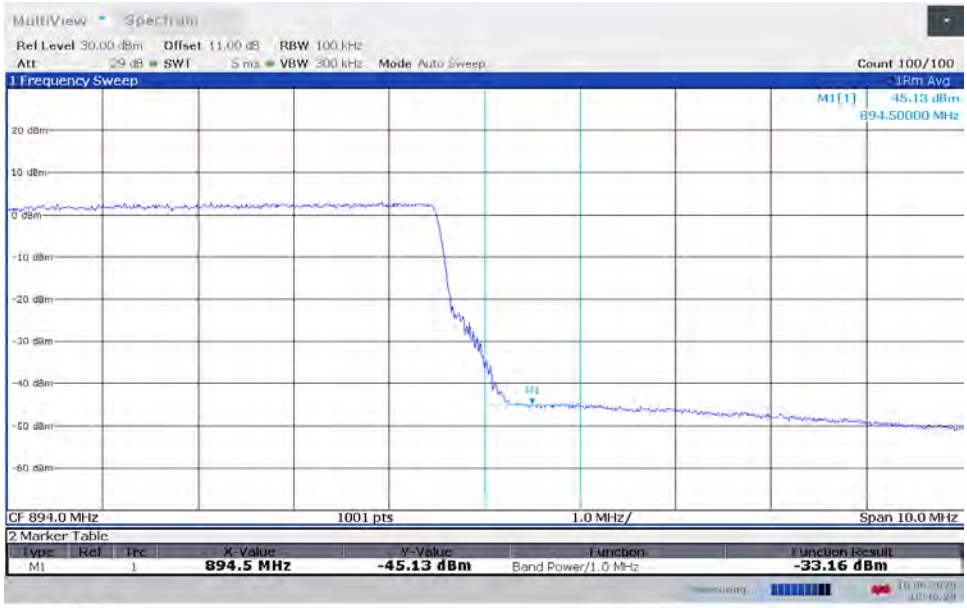


18:44:42 10.08.2020

TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT1, Low Channel, Lower Band Edge

18:45:00 10.08.2020

TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT0, High Channel, Upper Band Edge



18:46:29 10.08.2020

TM3.1a-256QAM_10 MHz Bandwidth
Band 5, ANT1, High Channel, Upper Band Edge

18:46:12 10.08.2020

Test Personnel:	Minh Ly	Test Date:	08/10/2020
Supervising/Reviewing Engineer: (Where Applicable)			
Product Standard:	FCC Part 22	Limit Applied:	See report section 9.1
Input Voltage:	56 VDC (POE)		
Pretest Verification w/ Ambient Signals or BB Source:	N/A	Ambient Temperature:	27 ºC
		Relative Humidity:	40 %
		Atmospheric Pressure:	29.9 in Hg

Deviations, Additions, or Exclusions: None

10 Frequency Stability

10.1 Requirement:

In the 821 – 896 MHz band, the Carrier frequency must be maintained within the tolerances of 1.5 ppm.

10.2 Procedure:

The procedure described in FCC Publication 971168 D01 Power Meas License Digital Systems v03r01 was used. Tests are performed in accordance with ANSI C63.26 Section 5.6 and CFR47 FCC Parts 2.1055.

The EUT was placed inside the temperature chamber. The EUT was setup to transmit the maximum power at low and high channel. After the temperature stabilized for approximately 20 minutes, the transmitting frequency was measured by using the occupied bandwidth function on the Spectrum analyzer. The center frequency was derived from $(f_H + f_L) / 2$. The measurements were made on the low and high frequency with a 10 degree increment in temperature.

At the room temperature, the frequency was measured when the EUT was powered with the nominal voltage, 48VDC (minimum), and 57VDC (maximum) voltage as declared by customer.

10.3 Result:

The sample tested was found to Comply.

Frequency Stability Over Temperatures
Band 5, Bandwidth: 5 MHz, Modulation: TM1.1-QPSK

Temperature (°C)	Frequency at nominal voltage (MHz)	Maximum deviation from frequency at 20°C, ppm
Low CH		
-30	871.497140	0.81
-20	871.497550	0.34
-10	871.497615	0.27
0	871.497250	0.69
10	871.498250	0.46
20	871.497850	0.00
30	871.497795	0.06
40	871.498650	0.92
50	871.498750	1.03
High CH		
-30	891.492950	0.56
-20	891.494205	0.85
-10	891.493900	0.50
0	891.493100	0.39
10	891.493400	0.06
20	891.493450	0.00
30	891.493100	0.39
40	891.493800	0.39
50	891.493650	0.22

Voltage (DC)	Frequency at 20°C (MHz)	Maximum deviation from 56VDC, ppm
Low CH		
48V	871.498200	0.40
57V	871.497700	0.17
High CH		
48V	891.492800	0.73
57V	891.493150	0.34

Frequency Stability Over Temperatures
Band 5, Bandwidth: 10 MHz, Modulation: TM1.1-QPSK

Temperature (°C)	Frequency at nominal voltage (MHz)	Maximum deviation from frequency at 20°C, ppm
Low CH		
-30	873.991100	0.51
-20	873.991050	0.57
-10	873.991000	0.63
0	873.992350	0.92
10	873.990900	0.74
20	873.991550	0.00
30	873.992450	1.03
40	873.991300	0.29
50	873.991500	0.06
High CH		
-30	888.986700	0.34
-20	888.987200	0.22
-10	888.986700	0.34
0	888.986500	0.56
10	888.987400	0.45
20	888.987000	0.00
30	888.986150	0.96
40	888.986250	0.84
50	888.987850	0.96

Voltage (DC)	Frequency at 20°C (MHz)	Maximum deviation from 56VDC, ppm
Low CH		
48V	873.992150	0.69
57V	873.992050	0.57
High CH		
48V	888.987050	0.06
57V	888.987100	0.11

Test Personnel:	Minh Ly	Test Date:	08/13/2020
Supervising/Reviewing Engineer: (Where Applicable)			
Product Standard:	FCC Part 22	Limit Applied:	See report section 10.1
Input Voltage:	See plots		
Pretest Verification w/ Ambient Signals or BB Source:	N/A	Ambient Temperature:	N/A
		Relative Humidity:	N/A
		Atmospheric Pressure:	N/A

Deviations, Additions, or Exclusions: None

11 Transmitter spurious emissions

11.1 Requirement:

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 +10 log(P) dB.

11.2 Procedure:

The procedure described in FCC Publication 971168 D01 Power Meas License Digital Systems v03r01 was used. Tests are performed in accordance with ANSI C63.26 Section 5.7, CFR47 FCC Parts 2.1051 and 2.1053.

Conducted Spurious Emission:
A spectrum analyzer was connected to the antenna port of the transmitter.

1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 3 x RBW.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

The unwanted emissions were measured from 30 MHz to 10 GHz for low, mid, and high channel for both 5MHz & 10MHz Bandwidth. Plots are corrected for cable loss and then compared to the limits.

Radiated Spurious Emission:
The measurement antenna was placed at a distance of 10 meters for 30MHz – 1GHz and 3 meters for 1-10GHz from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.

The frequency range up to 10th harmonic was investigated. The worst case of emissions were reported.

During the spurious emission measurement, the antenna port of the EUT was terminated by 50ohms load. The substitution method was used to investigate at the highest peak in each frequency range (30MHz – 1GHz and 1GHz – 10GHz). The EUT was substituted by a reference antenna (Biconical antenna for 30MHz – 200MHz, log-periodic for 200MHz – 1GHz, or Horn antenna - above 1GHz), connected to a signal generator. The signal generator output level ($\mathbf{V_g}$ in dBm) was adjusted to obtain the same reading as from EUT. The ERP at the spurious emissions frequency was calculated as follows.

$$ERP_{(dBm)} = \mathbf{V_g + G_{(dBd)} + CF_{(dB)}}$$

The spurious emissions attenuation is the difference between the ERP level at the fundamental frequency and the level of the spurious emissions.

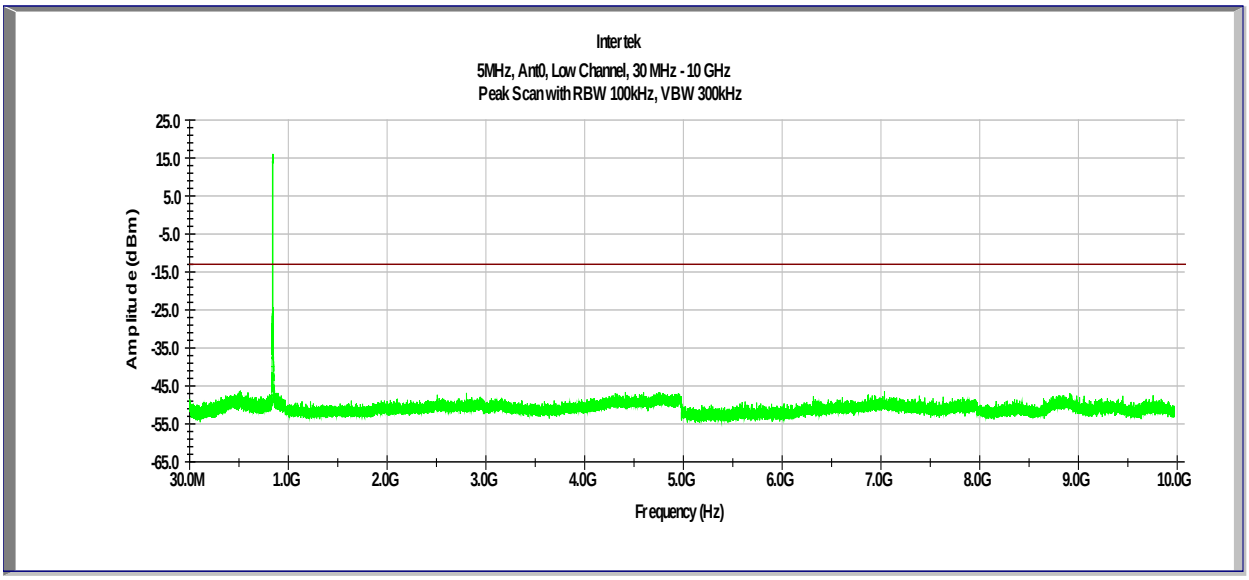
Preliminary testing was performed for all modulation/data rate modes. The worse-case data rate which resulted in the highest power and lowest spectrum were selected for final measurements:

5 MHz, Modulation: TM1.1-QPSK & 10 MHz, Modulation: TM1.1-QPSK

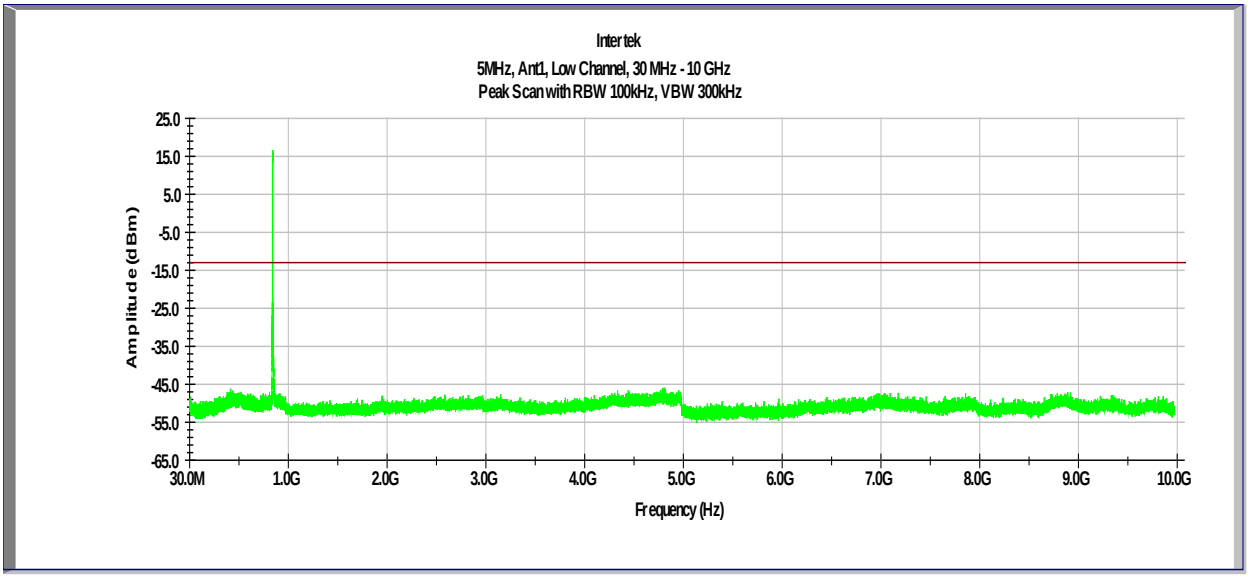
11.3 Results:

The sample tested was found to Comply.

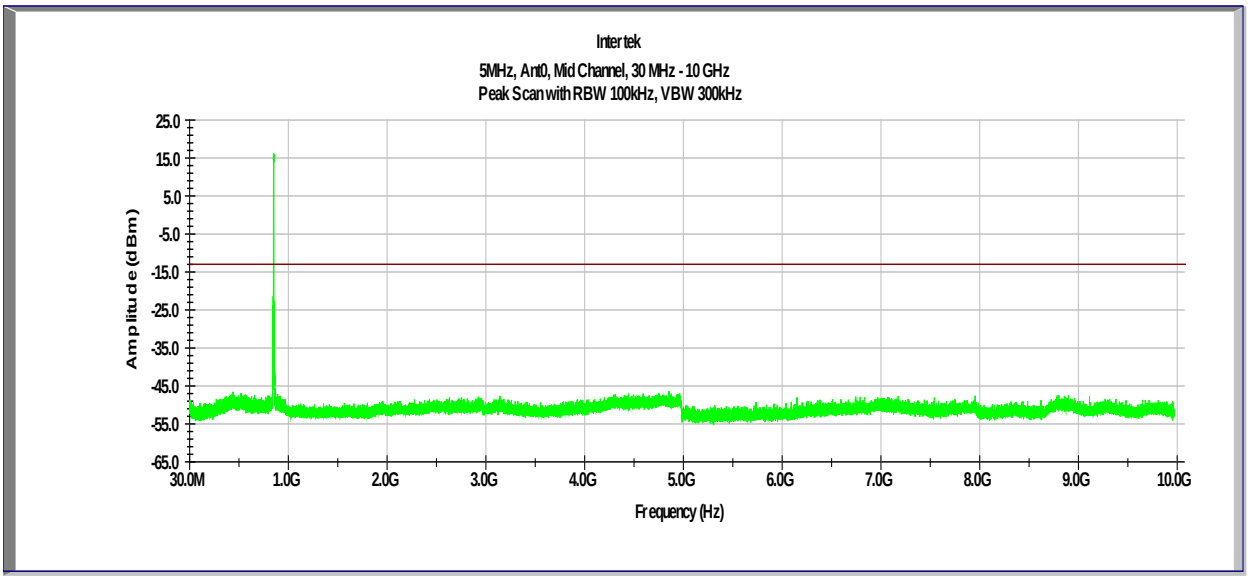
Conducted Spurious Emission
Band 5, Bandwidth: 5 MHz, Low Channel, ANT0, 30MHz-10GHz



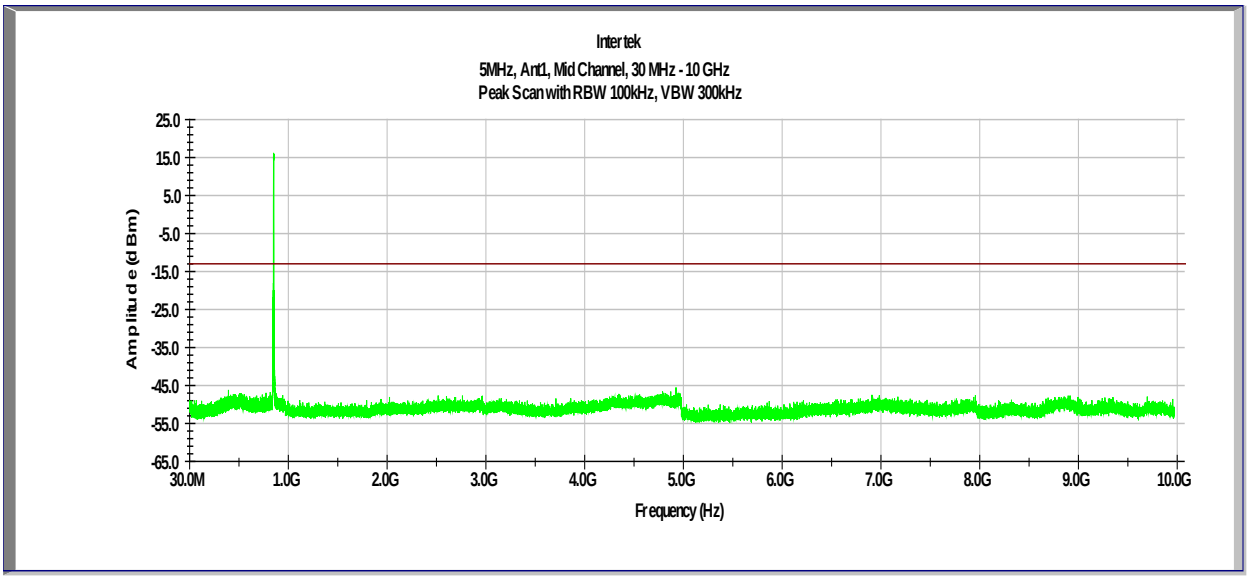
Conducted Spurious Emission
Band 5, Bandwidth: 5 MHz, Low Channel, ANT1, 30MHz-10GHz



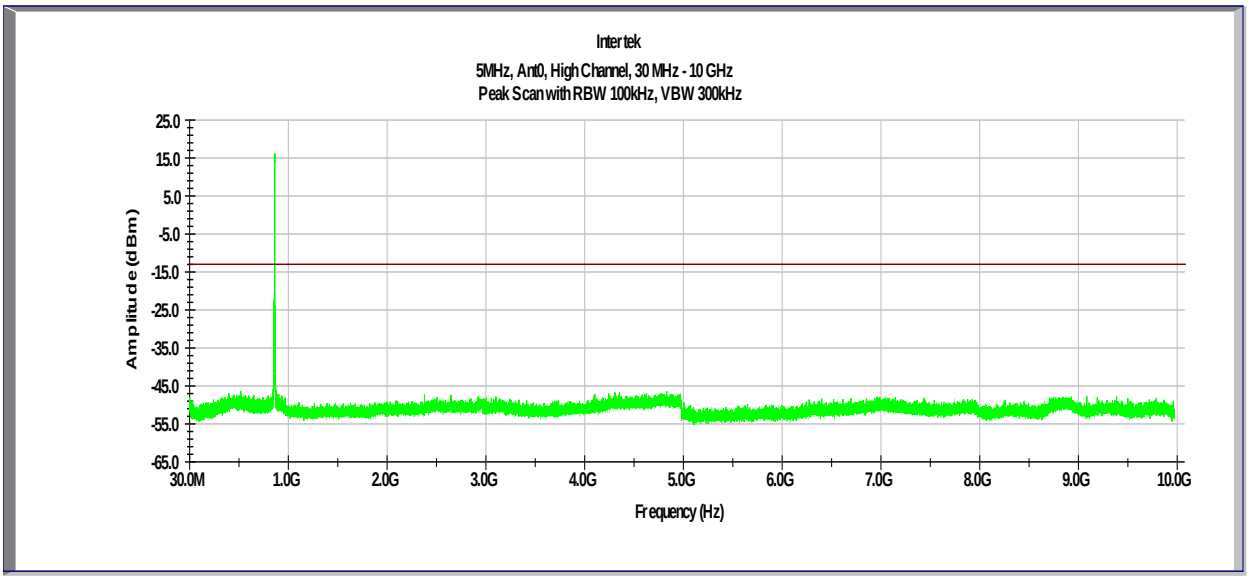
Conducted Spurious Emission
Band 5, Bandwidth: 5 MHz, Mid Channel, ANT0, 30MHz-10GHz



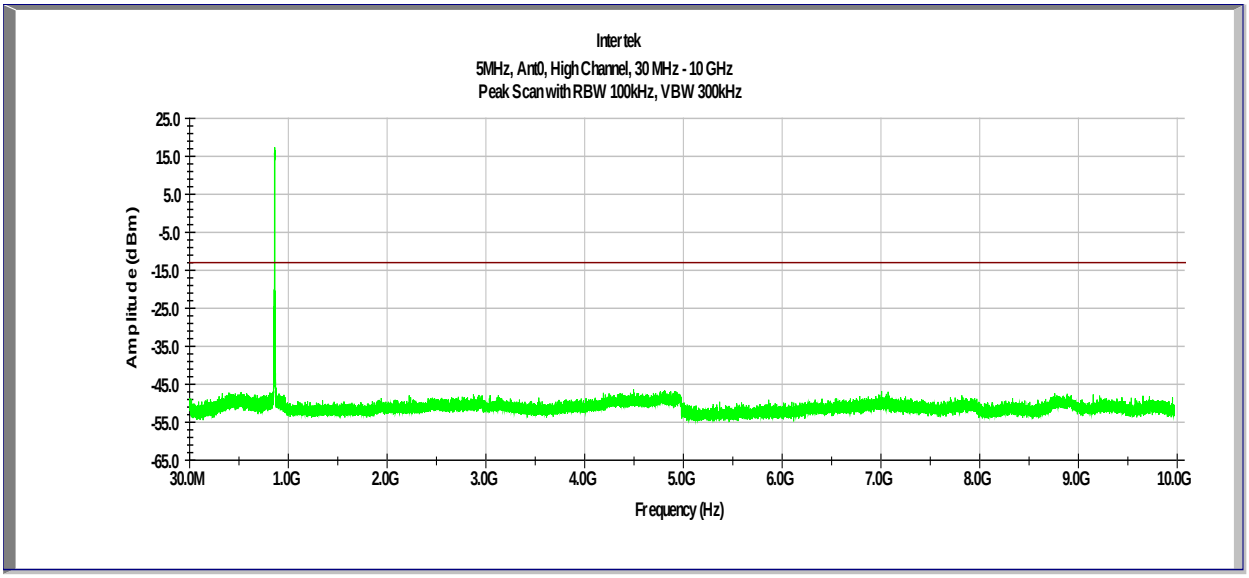
Conducted Spurious Emission
Band 5, Bandwidth: 5 MHz, Mid Channel, ANT1, 30MHz-10GHz



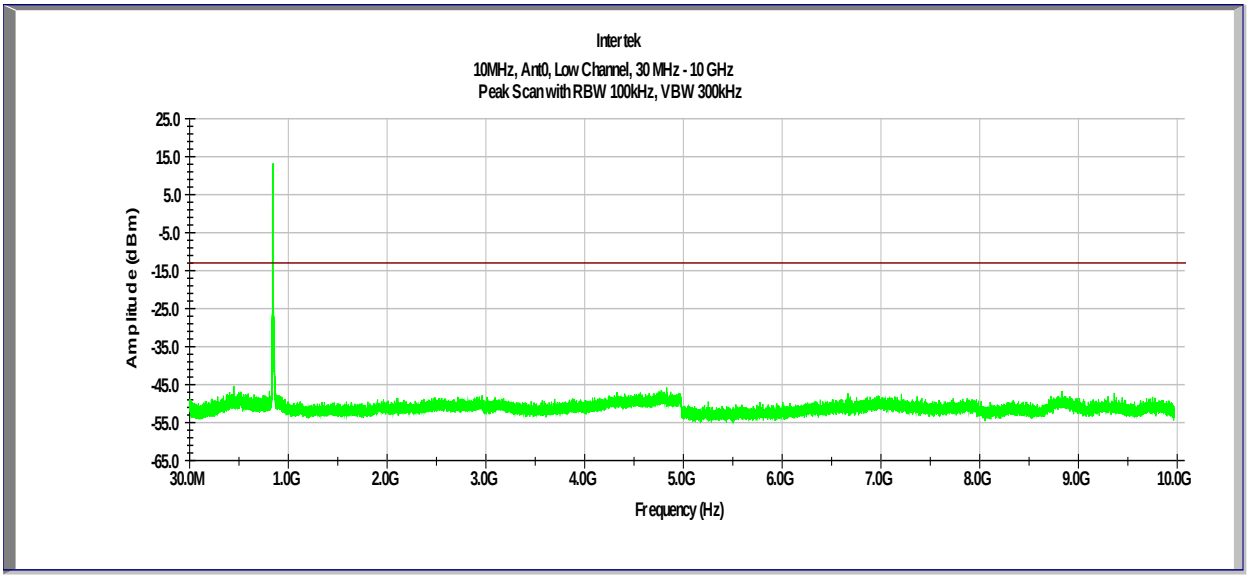
Conducted Spurious Emission
Band 5, Bandwidth: 5 MHz, High Channel, ANT0, 30MHz-10GHz



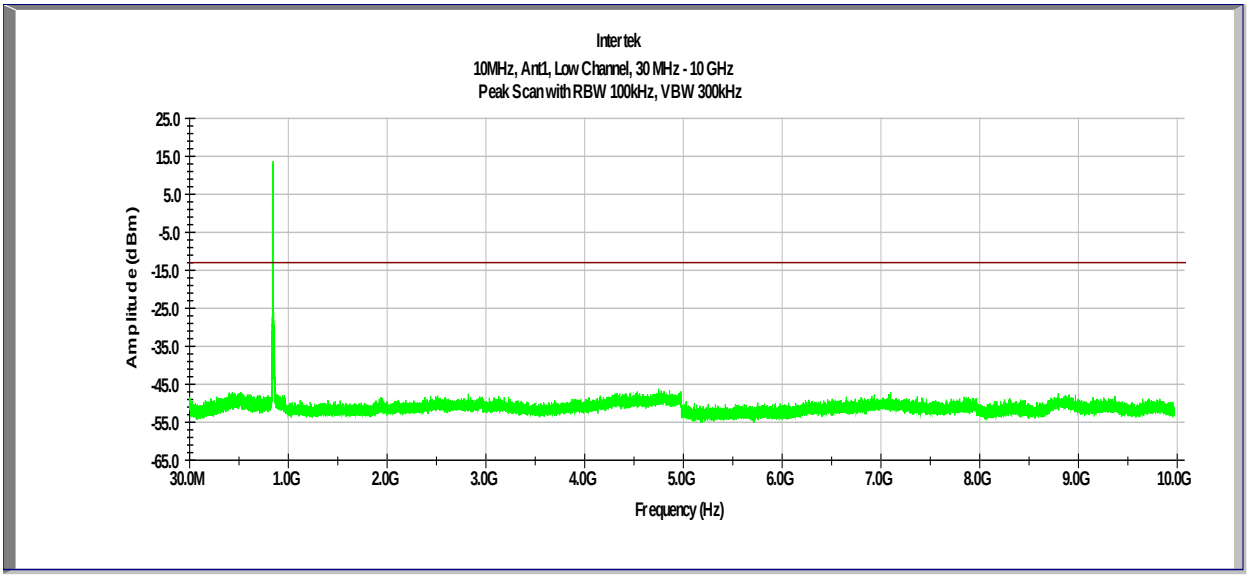
Conducted Spurious Emission
Band 5, Bandwidth: 5 MHz, High Channel, ANT1, 30MHz-10GHz



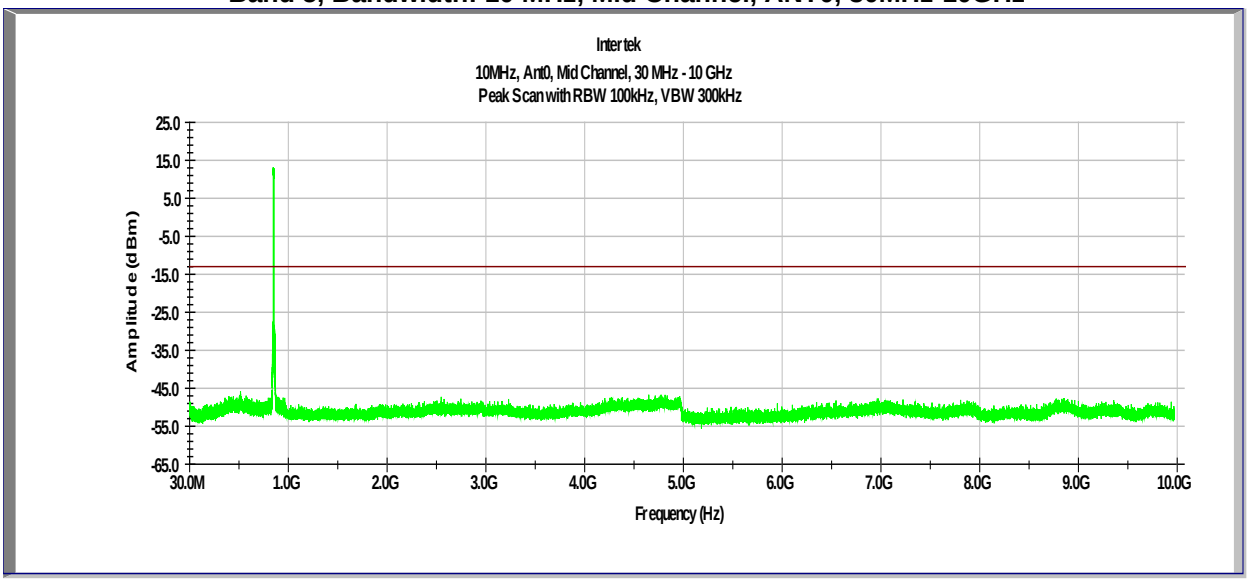
Conducted Spurious Emission
Band 5, Bandwidth: 10 MHz, Low Channel, ANT0, 30MHz-10GHz



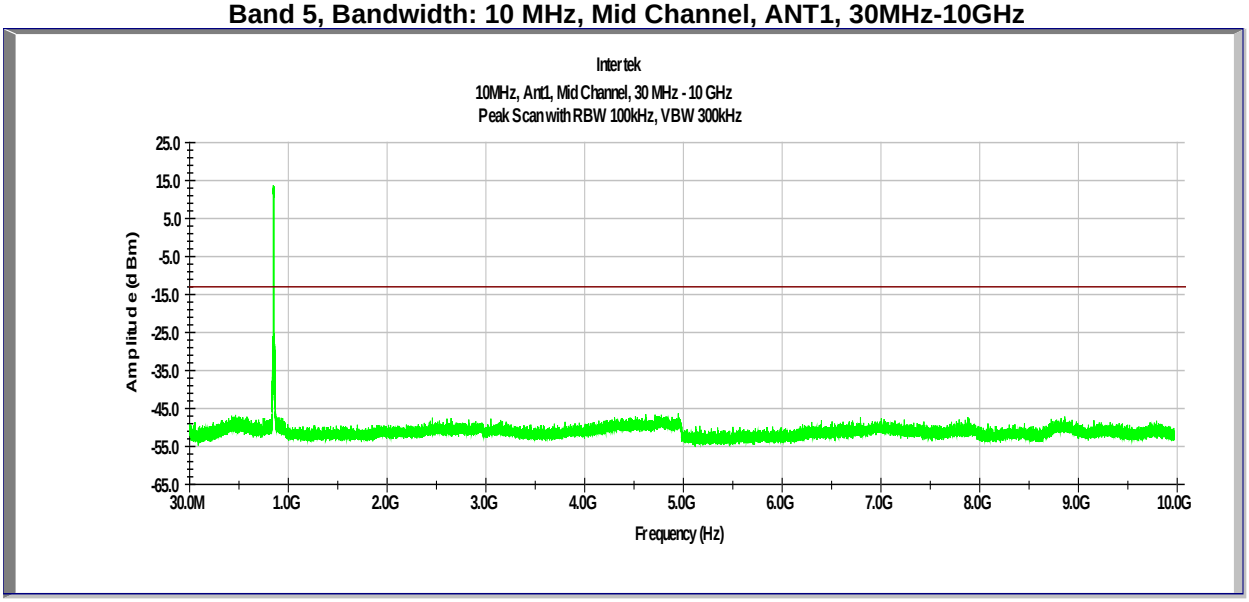
Conducted Spurious Emission
Band 5, Bandwidth: 10 MHz, Low Channel, ANT1, 30MHz-10GHz



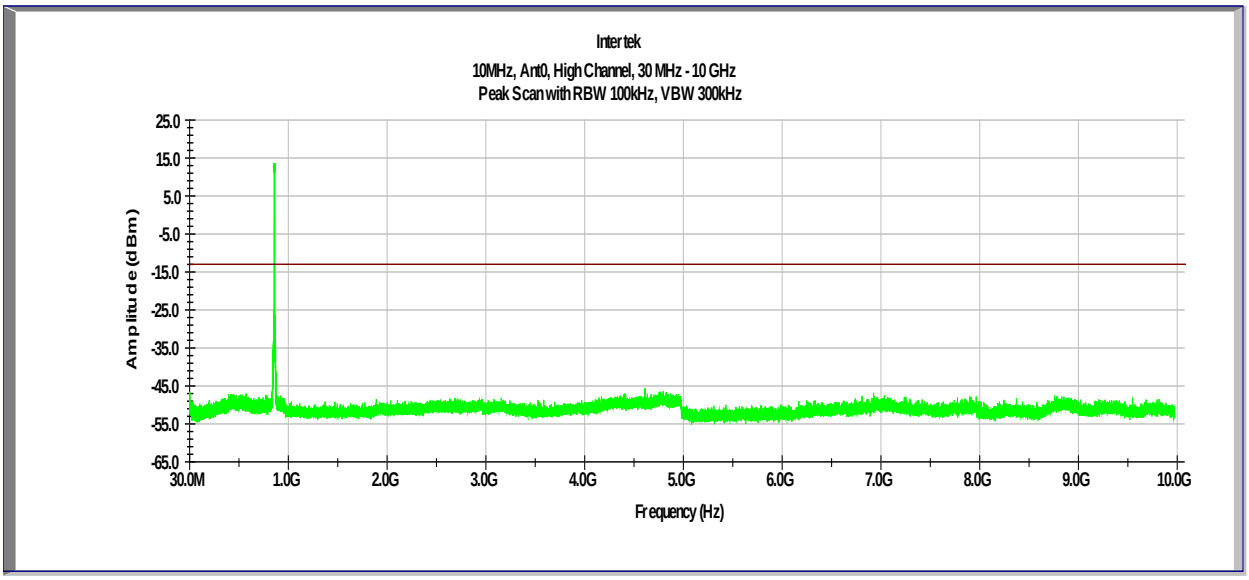
Conducted Spurious Emission
Band 5, Bandwidth: 10 MHz, Mid Channel, ANT0, 30MHz-10GHz



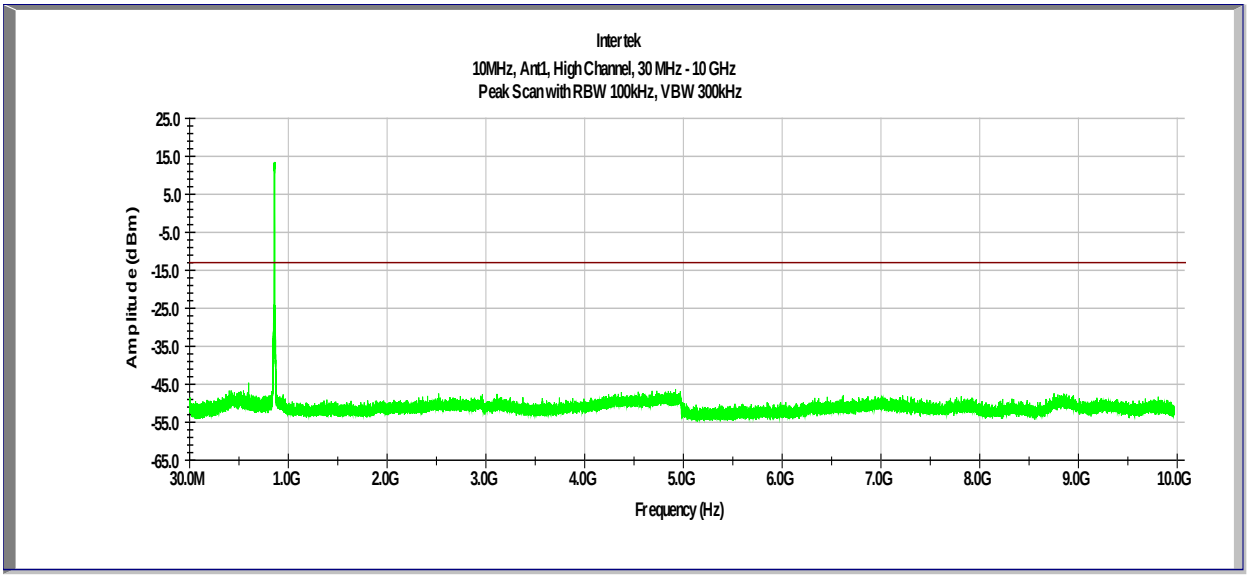
Conducted Spurious Emission
Band 5, Bandwidth: 10 MHz, Mid Channel, ANT1, 30MHz-10GHz



Conducted Spurious Emission
Band 5, Bandwidth: 10 MHz, High Channel, ANT0, 30MHz-10GHz



Conducted Spurious Emission
Band 5, Bandwidth: 10 MHz, High Channel, ANT1, 30MHz-10GHz



Transmitter Radiated Spurious Emissions
(Measured by Substitution Method)
5MHz, Low Channel

Freq.	Raw Amplitude	Sig Gen	Cable Loss	Antenna Sub Gain	EIRP	ERP	Limit	Margin
MHz	dBuV/m	dBm	dB	dBi	dBi	dBd	dBm	dB
68.1	52.7	-50.6	0.4	-2.3	-53.2	-55.3	-13	-42.3
129.2	47.7	-50.3	0.4	-1.5	-52.2	-54.3	-13	-41.3
142.4	41.2	-58.8	0.4	0.3	-59.0	-61.1	-13	-48.1
800.0	41.6	-49.8	1.4	6.4	-44.7	-46.8	-13	-33.8
1718.5	63.0	-56.0	2.8	9.6	-49.2	-51.3	-13	-38.3
2390.0	63.7	-51.9	3.1	10.2	-44.9	-47.0	-13	-34.0
3199.8	63.0	-50.4	3.6	10.5	-43.6	-45.7	-13	-32.7

Transmitter Radiated Spurious Emissions
(Measured by Substitution Method)
5MHz, Mid Channel

Freq.	Raw Amplitude	Sig Gen	Cable Loss	Antenna Sub Gain	EIRP	ERP	Limit	Margin
MHz	dBuV/m	dBm	dB	dBi	dBi	dBd	dBm	dB
66.8	52.6	-50.3	0.4	-2.8	-53.4	-55.5	-13	-42.5
130.6	47.8	-50.4	0.4	-1.4	-52.2	-54.3	-13	-41.3
143.2	40.6	-59.6	0.4	0.4	-59.6	-61.7	-13	-48.7
800.0	42.1	-49.3	1.4	6.4	-44.3	-46.4	-13	-33.4
2392.9	65.9	-49.7	3.1	10.2	-42.6	-44.7	-13	-31.7
3199.8	62.7	-50.8	3.6	10.5	-43.9	-46.0	-13	-33.0

Transmitter Radiated Spurious Emissions
(Measured by Substitution Method)
5MHz, High Channel

Freq.	Raw Amplitude	Sig Gen	Cable Loss	Antenna Sub Gain	EIRP	ERP	Limit	Margin
MHz	dBuV/m	dBm	dB	dBi	dBi	dBd	dBm	dB
64.7	51.5	-51.0	0.4	-3.4	-54.7	-56.8	-13	-43.8
130.4	47.4	-50.6	0.4	-1.4	-52.5	-54.6	-13	-41.6
142.9	40.6	-59.5	0.4	0.4	-59.6	-61.7	-13	-48.7
800.0	41.7	-49.7	1.4	6.4	-44.6	-46.7	-13	-33.7
2407.0	63.3	-52.4	3.1	10.3	-45.2	-47.3	-13	-34.3
3199.8	62.7	-50.7	3.6	10.5	-43.9	-46.0	-13	-33.0

Transmitter Radiated Spurious Emissions
(Measured by Substitution Method)
10MHz, Low Channel

Freq.	Raw Amplitude	Sig Gen	Cable Loss	Antenna Sub Gain	EIRP	ERP	Limit	Margin
MHz	dBuV/m	dBm	dB	dBi	dBi	dBd	dBm	dB
64.8	51.9	-50.7	0.4	-3.4	-54.4	-56.5	-13	-43.5
129.8	47.4	-50.6	0.4	-1.5	-52.5	-54.6	-13	-41.6
141.8	46.7	-53.2	0.4	0.2	-53.5	-55.6	-13	-42.6
800.0	41.4	-50.0	1.4	6.4	-45.0	-47.1	-13	-34.1
2390.6	62.4	-53.2	3.1	10.2	-46.1	-48.2	-13	-35.2
3199.8	62.6	-50.8	3.6	10.5	-44.0	-46.1	-13	-33.1
4999.5	57.5	-51.8	5.4	11.2	-45.9	-48.0	-13	-35.0

Transmitter Radiated Spurious Emissions
(Measured by Substitution Method)
10MHz, Mid Channel

Freq.	Raw Amplitude	Sig Gen	Cable Loss	Antenna Sub Gain	EIRP	ERP	Limit	Margin
MHz	dBuV/m	dBm	dB	dBi	dBi	dBd	dBm	dB
66.3	50.9	-51.9	0.4	-2.9	-55.2	-57.3	-13	-44.3
131.5	47.1	-51.2	0.4	-1.2	-52.9	-55.0	-13	-42.0
141.9	46.2	-53.8	0.4	0.2	-54.0	-56.1	-13	-43.1
800.0	41.0	-50.4	1.4	6.4	-45.4	-47.5	-13	-34.5
2398.5	65.1	-50.6	3.1	10.2	-43.5	-45.6	-13	-32.6
3199.8	62.9	-50.6	3.6	10.5	-43.7	-45.8	-13	-32.8

Transmitter Radiated Spurious Emissions
(Measured by Substitution Method)
10MHz, High Channel

Freq.	Raw Amplitude	Sig Gen	Cable Loss	Antenna Sub Gain	EIRP	ERP	Limit	Margin
MHz	dBuV/m	dBm	dB	dBi	dBi	dBd	dBm	dB
65.6	51.8	-50.8	0.4	-3.1	-54.3	-56.4	-13	-43.4
130.0	48.2	-49.8	0.4	-1.5	-51.7	-53.8	-13	-40.8
141.8	46.8	-53.1	0.4	0.2	-53.3	-55.4	-13	-42.4
800.0	41.1	-50.3	1.4	6.4	-45.2	-47.3	-13	-34.3
3199.8	63.0	-50.4	3.6	10.5	-43.6	-45.7	-13	-32.7
5000.1	56.2	-53.0	5.4	11.2	-47.2	-49.3	-13	-36.3

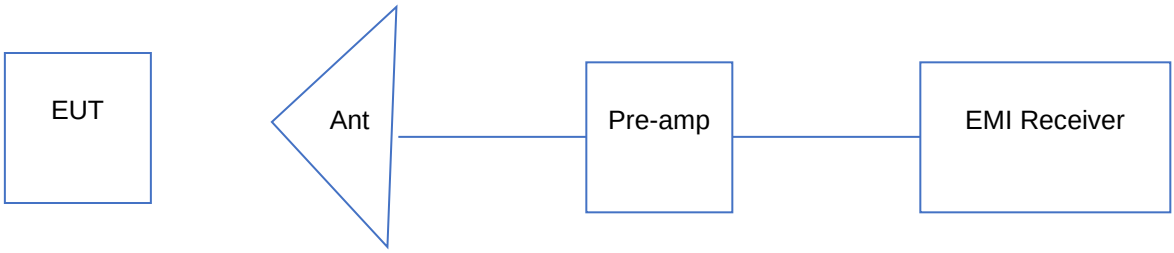
ERP is calculated as: **ERP$_{(dBm)}$= Sig Gen$_{(dBm)}$ + Antenna Gain $_{(dBi)}$ – Cable Loss $_{(dB)}$ - 2.1$_{(dB)}$**

Note: Investigation performed up to 10.0 GHz. All other emissions not reported are at least 10dB below the limits

Result: Complies by 31.7 dB

11.4 Test Setup Configuration:

The following photographs show the testing configurations used.



Test Personnel:	Minh Ly	Test Date:	08/11/2020
Supervising/Reviewing Engineer: (Where Applicable)			
Product Standard:	FCC Part 22	Limit Applied:	See report section 11.1
Input Voltage:	56 VDC (POE)		
Pretest Verification w/ Ambient Signals or BB Source:	N/A	Ambient Temperature:	23 ºC
		Relative Humidity:	44 %
		Atmospheric Pressure:	30 inHg

Deviations, Additions, or Exclusions: None

12 List of Test Equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model Tested/Type	Asset #	Cal Int	Cal Due
EMI Receiver	Rohde and Schwarz	ESU	ITS 00961	12	11/07/20
BI-Log Antenna	Teseq	CBL6111D	ITS 01505	12	03/11/21
Pre-Amplifier	Sonoma Instrument	310N	ITS 01714	12	11/11/20
RE Cable	TRU Corporation	TRU CORE 300	ITS 01462	12	08/27/20
RE Cable	TRU Corporation	TRU CORE 300	ITS 01465	12	08/27/20
RE Cable	TRU Corporation	TRU CORE 300	ITS 01470	12	08/27/20
RF Cable	TRU Corporation	TRU CORE 300	ITS 01342	12	10/07/20
Active Horn Antenna	ETS Lindgren	3117PA	ITS 0824	12	08/04/21
Log Periodic	Com-power	ALP-100	ITS 01785	12	06/26/21
Bicon	Com-power	AB-900A	ITS 01391	12	07/22/21
Horn Antenna	ETS	3115	ITS 00982	12	04/21/21
Spectrum Analyzer	Rohde and Schwarz	FSW	ITS 01818	12	07/09/21
10 Meter Chamber	Panashield	10 Meter Semi-Anechoic Chamber	ITS 00984	36	09/11/21
Environmental Chamber	Espec	BTX-475	ITS 01436	12	10/09/20

13 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	August 25, 2020	104326151MPK-010	ML	KV	Original Issue
1	November 06, 2020	104326151MPK-010	ML	KV	Updated section 6.3 with ERP power value in the tables. Also removed setup pictures from the report