	19917.51	-21.68	compliant
64QAM-Modulation ANT1			
	19919.21	-21.75	compliant
64QAM-Modulation ANT2			
	19853.11	-21.99	compliant
64QAM-Modulation ANT3			
	19779.66	-21.86	compliant
64QAM-Modulation ANT4			
	19845.76	-22.07	compliant
256QAM-Modulation ANT1			
	19918.64	-22.28	compliant
256QAM-Modulation ANT2			
	19919.21	-21.83	compliant
256QAM-Modulation ANT3			
	19912.43	-21.91	compliant
256QAM-Modulation ANT4			
	19916.38	-22.12	compliant
Measurement Uncertainty:		f < 1.0GHz: ±1.1dB, 1.0GHz ≤ f <3.6GHz: ±1.2dB, 3.6GHz ≤ f <8.0GHz: ±1.6dB, 8.0GHz ≤ f: ±1.9dB	

Table 20 Spurious Emissions (15 MHz Channel BW)

Config D Lower band edge:

Carrier Frequency: 1940.0 MHz			
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Result**
QPSK-Modulation ANT1			
	1929.99	-32.37	compliant
QPSK-Modulation ANT2			
	1930.00	-32.30	compliant
QPSK-Modulation ANT3			
	1930.00	-31.86	compliant
QPSK-Modulation ANT4			
	1929.99	-31.66	compliant
16QAM-Modulation ANT1			
	1930.00	-32.33	compliant
16QAM-Modulation ANT2			
	1929.99	-32.19	compliant

16QAM-Modulation ANT3			
	1929.99	-31.56	compliant
16QAM-Modulation ANT4			
	1930.00	-31.35	compliant
64QAM-Modulation ANT1			
	1930.00	-32.33	compliant
64QAM-Modulation ANT2			
	1930.00	-32.44	compliant
64QAM-Modulation ANT3			
	1929.98	-31.62	compliant
64QAM-Modulation ANT4			
	1929.99	-31.34	compliant
256QAM-Modulation ANT1			
	1929.99	-31.78	compliant
256QAM-Modulation ANT2			
	1929.98	-32.65	compliant
256QAM-Modulation ANT3			
	1929.98	-31.88	compliant
256QAM-Modulation ANT4			
	1930.00	-31.39	compliant
Measurement Uncertainty:		f < 1.0GHz: ±1.1dB, 1.0GHz ≤ f <3.6GHz: ±1.2dB, 3.6GHz ≤ f <8.0GHz: ±1.6dB, 8.0GHz ≤ f: ±1.9dB	

Table 21 Spurious Emissions (Lower band edge) (20 MHz CH BW)

Config D Upper band edge:

Carrier Frequency: 1985.0 MHz			
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Result**
QPSK-Modulation ANT1			
	1995.02	-31.15	compliant
QPSK-Modulation ANT2			
	1995.00	-31.71	compliant
QPSK-Modulation ANT3			
	1995.01	-32.16	compliant
QPSK-Modulation ANT4			
	1995.00	-31.69	compliant
16QAM-Modulation ANT1			
	1995.01	-31.42	compliant

16QAM-Modulation ANT2			
	1995.00	-32.09	compliant
16QAM-Modulation ANT3			
	1995.00	-31.99	compliant
16QAM-Modulation ANT4			
	1995.00	-31.64	compliant
64QAM-Modulation ANT1			
	1995.00	-31.28	compliant
64QAM-Modulation ANT2			
	1995.01	-32.10	compliant
64QAM-Modulation ANT3			
	1995.00	-31.89	compliant
64QAM-Modulation ANT4			
	1995.00	-31.32	compliant
256QAM-Modulation ANT1			
	1995.01	-30.65	compliant
256QAM-Modulation ANT2			
	1995.02	-31.96	compliant
256QAM-Modulation ANT3			
	1995.00	-31.63	compliant
256QAM-Modulation ANT4			
	1995.00	-31.06	compliant
		f < 1.0GHz: ±1.1dB, 1.0GHz ≤ f <3.6GHz: ±1.2dB, Measurement Uncertainty:3.6GHz ≤ f <8.0GHz: ±1.6dB, 8.0GHz ≤ f: ±1.9dB	

Table 22 Spurious Emissions (Upper band edge) (20 MHz CH BW)

Config D Spurious emissions:

Carrier Frequency: 1962.5 MHz			
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Result**
QPSK-Modulation ANT1			
0.009 – 19950	19925.42	-21.84	compliant
QPSK-Modulation ANT2			
	19914.69	-21.77	compliant
QPSK-Modulation ANT3			
	19912.99	-21.59	compliant
QPSK-Modulation ANT4			
	19914.69	-21.84	compliant

16QAM-Modulation ANT1			
	19921.47	-21.98	compliant
16QAM-Modulation ANT2			
	19918.64	-21.75	compliant
16QAM-Modulation ANT3			
	19846.89	-21.84	compliant
16QAM-Modulation ANT4			
	19916.95	-21.93	compliant
64QAM-Modulation ANT1			
	19921.47	-21.98	compliant
64QAM-Modulation ANT2			
	19924.29	-21.82	compliant
64QAM-Modulation ANT3			
	19915.25	-21.79	compliant
64QAM-Modulation ANT4			
	19923.16	-21.88	compliant
256QAM-Modulation ANT1			
	19920.90	-21.62	compliant
256QAM-Modulation ANT2			
	19921.47	-21.91	compliant
256QAM-Modulation ANT3			
	19915.25	-21.79	compliant
256QAM-Modulation ANT4			
	19509.60	-21.65	compliant
Measurement Uncertainty:		f < 1.0GHz: ±1.1dB, 1.0GHz ≤ f <3.6GHz: ±1.2dB, 3.6GHz ≤ f <8.0GHz: ±1.6dB, 8.0GHz ≤ f: ±1.9dB	

Table 23 Spurious Emissions (20 MHz Channel BW)

The measured conducted emission levels were found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

4.5 Test No. 5: Field Strength of Spurious Radiation (§ 2.1053, § 2.1057, § 24.238)

4.5.1. Limits

Para. No. 24.238(a) 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.

4.5.2. Test Configuration

The measurements were performed in an anechoic chamber. The radiated test site complies with the site attenuation requirements listed in ANSI C63.4 2003 and is listed with the FCC.

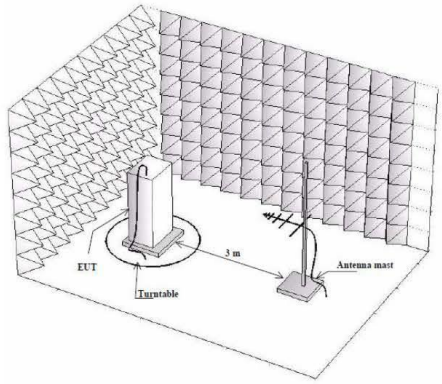

Figure 2 Test Configuration

Photographs of the EUT in the anechoic chamber are shown on page 95 of this measurement report.

4.5.3. Test Procedure and Results

TIA/EIA-603-C-2004, Section 2.2.12

The test was performed in a semi-anechoic shielded room. The EUT was placed on a non-conductive 0.8 m high table standing on the turntable. During the test in the frequency range 30 - 19950 MHz the distance from the EUT to the measuring antenna was 3 m. In order to find the maximum levels of the disturbance radiation the angle of the turntable, the height of the measuring antenna were varied during the tests. The test was performed with the measuring antenna being both in horizontal and vertical polarizations.

Vertical and horizontal polarizations in the frequency range 30 - 19950 MHz was first measured by using the peak detector. During the peak detector scan the turntable was rotated from 0° to 360° with 30° step with the antenna heights 1.0 m and 2.5 m.

The limit of -13 dBm has been calculated to correspond 84.4 dB (µV/m). Spurious emissions closer than 20 dB to the limit was measured with average detector.

According to § 2.1057, all emissions from the lowest radio frequency generated in the equipment, without going below 9 kHz, up to the 10th harmonic were investigated.

The antenna substitution method was used to determine the equivalent radiated power at spurious frequencies. The EUT was replaced with a reference substitution antenna with a known gain referenced to an isotropic radiator $G_{Antenna[dBi]}$. This antenna was fed with a signal at the spurious frequency $P_{Gen[dBm]}$. The level of the signal was adjusted to repeat the previously measured level. The resulting

EIRP is the signal level fed to the reference antenna corrected for gain referenced to an isotropic.

The formula below was used to calculate the EIRP of the EUT.

$P_{EIRP[dbm]} = P_{Gen[dBm]} - L_{Cable[dB]} + G_{Antenna[dBi]}$

Worst case detected emission levels are reported in the following table (refer to spectral plots included on pages 96 for details). The antenna factor and cable loss is according to the manufacturer's specification.

Measured laboratory room temperature and humidity during the tests				
Date	Temperature Min-Max:		Humidity Min-Max:	
31 March – 2 April 2019	22.5 °C	23.3 °C	14.2 RH%	19.5 RH%

Config A, B, C, D:

Carrier Frequency: 1962.5MHz			
Frequency Range [MHz]	**Frequency Range [MHz]**	**Frequency Range [MHz]**	**Frequency Range [MHz]**
QPSK-Modulation TX1			
30 - 19950	More than 20dB below limit -13dBm		Compliant
Measurement Uncertainty:			±5.8dB

Table 24 Field Strength of Spurious Radiation (20 MHz Channel BW)

The measured emission levels were found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

5. TEST DATA AND SCREENSHOTS

5.1 Part List of the RF Measurement Test Equipment

No.	Test Equipment	Manufacturer & Type	Serial Number	Calibration date	Calibration due	Test No.
1	Signal Analyzer	Rohde & Schwarz: FSV 30	100781	07/2018	07/2019	1, 2, 3, 4
2	Signal Analyzer	Rohde & Schwarz: FSW 43	104600	10/2018	10/2019	1, 2, 3, 4
3	Vector Network Analyzer	Rohde & Schwarz: ZVA40	100146	07/2018	07/2019	1, 2, 3, 4
4	Vector Network Analyzer	Rohde & Schwarz: ZVL13	101177	07/2018	07/2019	1, 2, 3, 4
5	Calibration Unit	Rohde & Schwarz: ZV-Z54	100125	7/2018	7/2019	1, 2, 3, 4
6	Multimeter	Fluke 83	65870302	01/2019	01/2020	1, 2, 3, 4
7	Humidity and Temperature Indicator	Vaisala: HMI 31	P3730008	01/2019	01/2020	1, 2, 3, 4
8	DC Power Supply	Sorensen SGI80/188D-1AAA	0525A00545	cnn	-	1, 2, 3, 4
9	Attenuator	SHX:DTS 100G-20dB-24G-3.5mm(F,F)-B	14111101	cnn	-	1, 2, 3, 4
10	EMI Test Receiver	R&S ESU40	100262/040	07/2018	07/2019	5
11	Horn Antenna	ETS-Lindgren 3116C-PA	150635	11/2018	11/2019	5
12	Horn Antenna	ETS-Lindgren ETS3115	6346	07/2018	08/2019	5
13	Bilog Antenna	Schaffner Chase CBL6112	2003	07/2018	07/2019	5
14	Humidity and temperature meter	Vaisala HM31	P3730008	03/2018	03/2019	5
15	Mast Controller	Maturo NCD/180 2	17210416	cnn	-	5
16	4 meter mast	Maturo TAM4.0-E	086/17210915	cnn	-	5
17	Anechoic Chamber	S&MC	B83317-C6019	09/2016	09/2019	5
18	Amplifier	Miteq 4FSX4	902638	cnn	-	5

Table 25 Part List of the RF Measurement Test Equipment

5.2 Spectral Plots

5.2.1. Test No. 2: Modulation Characteristics

No additional measurements are required for the modulation characteristics. Please refer to test no. 3, occupied bandwidth on page 18.

Screenshots below shows information about the modulations I/Q constellation form and modulation information table, displaying error to ideal modulation symbols.

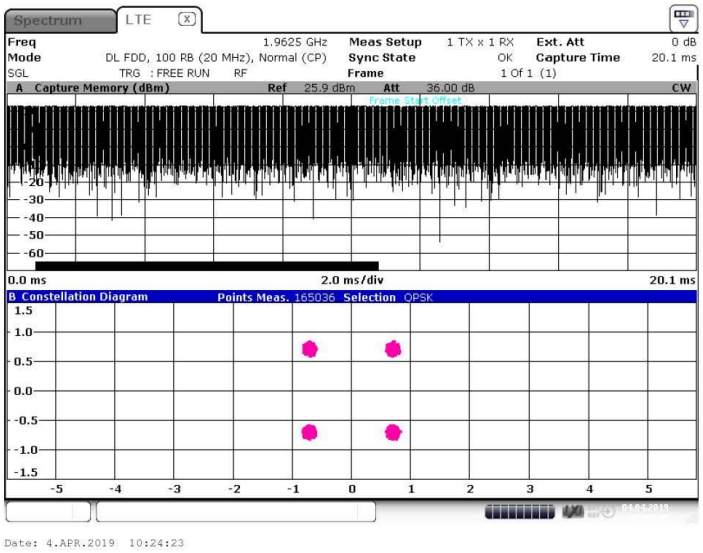

Figure 3 I/Q constellation diagram with capture buffer – QPSK (1962.5 MHz) (20MHz Channel BW)

Figure 4 I/Q constellation table with I/Q error – QPSK (1962.5 MHz) (20MHz Channel BW)

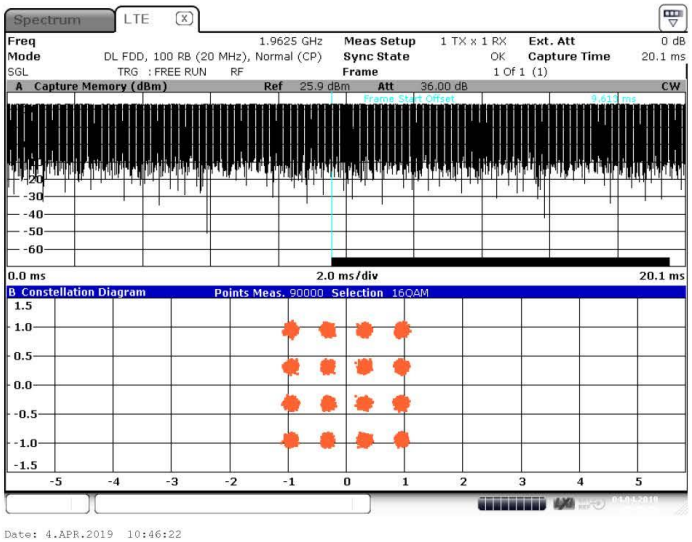

Figure 5 I/Q constellation diagram with capture buffer – 16QAM (1962.5 MHz) (20MHz Channel BW)

Figure 6 I/Q constellation table with I/Q error – 16QAM (1962.5 MHz) (20MHz Channel BW)

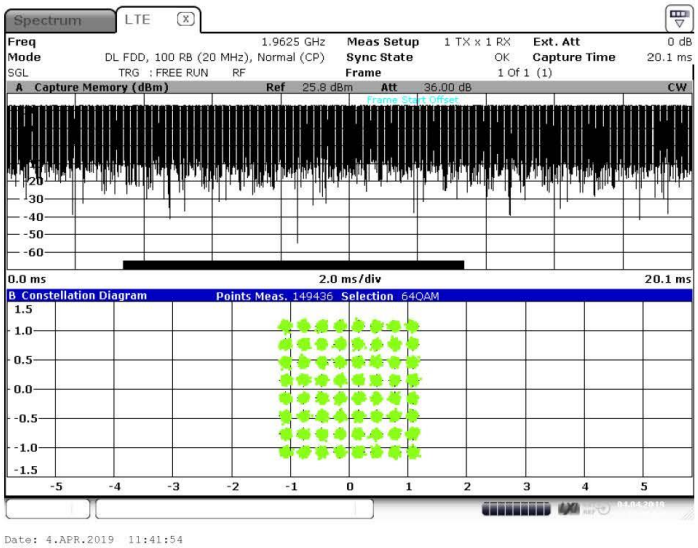

Figure 7 I/Q constellation diagram with capture buffer – 64QAM (1962.5 MHz) (20MHz Channel BW)

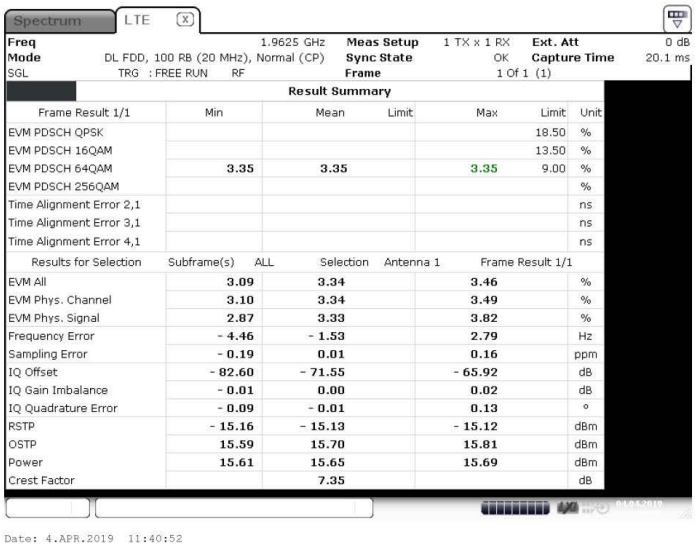

Figure 8 I/Q constellation table with I/Q error – 64QAM (1962.5 MHz) (20MHz Channel BW)

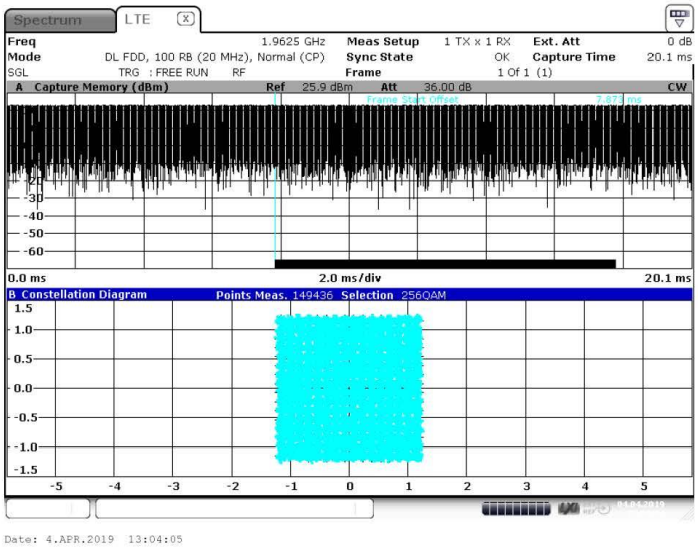

Figure 9 I/Q constellation diagram with capture buffer – 256QAM (1962.5 MHz) (20MHz Channel BW)

Spectrum | LTE

Freq	1.9625 GHz	**Meas Setup**	1 TX x 1 RX	**Ext. Att**	0 dB
Mode	DL FDD, 100 RB (20 MHz), Normal (CP)	**Sync State**	OK	**Capture Time**	20.1 ms
SGL	TRG : FREE RUN RF	**Frame**	1 Of 1 (1)		

Result Summary

Frame Result 1/1	Min	Mean	Limit	Max	Limit	Unit
EVM PDSCH QPSK					18.50	%
EVM PDSCH 16QAM					13.50	%
EVM PDSCH 64QAM					9.00	%
EVM PDSCH 256QAM	**3.51**	**3.51**		**3.51**		%
Time Alignment Error 2,1						ns
Time Alignment Error 3,1						ns
Time Alignment Error 4,1						ns

Results for Selection	Subframe(s) ALL	Selection	Antenna 1	Frame Result 1/1	
EVM All	**3.06**	**3.51**		**3.83**	%
EVM Phys. Channel	**3.03**	**3.50**		**3.84**	%
EVM Phys. Signal	**3.20**	**3.64**		**4.05**	%
Frequency Error	**- 3.23**	**- 0.94**		**0.72**	Hz
Sampling Error	**- 0.26**	**0.04**		**0.19**	ppm
IQ Offset	**- 85.46**	**- 70.45**		**- 65.39**	dB
IQ Gain Imbalance	**- 0.01**	**- 0.00**		**0.02**	dB
IQ Quadrature Error	**- 0.09**	**0.03**		**0.11**	°
RSTP	**- 15.17**	**- 15.16**		**- 15.15**	dBm
OSTP	**15.48**	**15.62**		**15.68**	dBm
Power	**15.60**	**15.63**		**15.66**	dBm
Crest Factor		**7.36**			dB

Date: 4.APR.2019 13:03:04

Figure 10 I/Q constellation table with I/Q error – 256QAM (1962.5 MHz) (20MHz Channel BW)

5.2.2. Test No. 3: Occupied Bandwidth

The value 'Occ Bw' is the measured occupied bandwidth.

Config A ANT1:

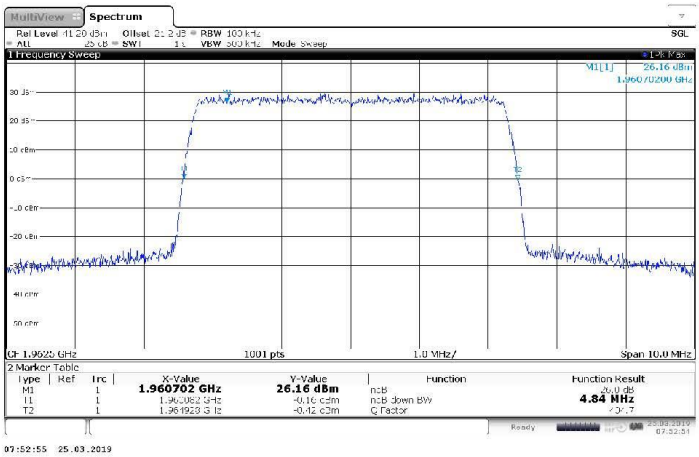

Figure 11 Occupied Bandwidth – QPSK (1962.5 MHz) (5MHz Channel BW)

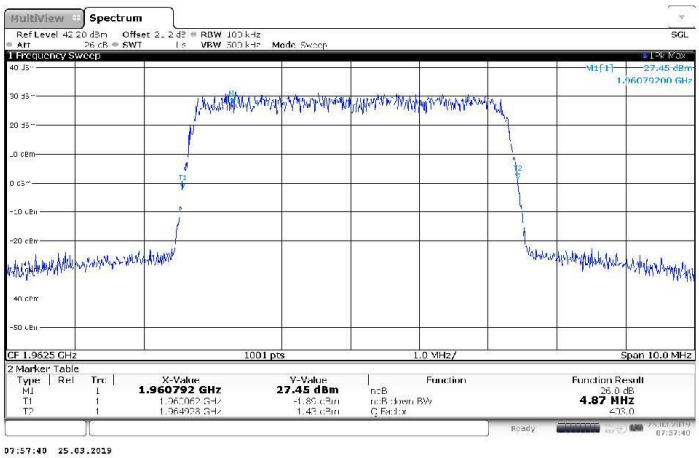

Figure 12 Occupied Bandwidth – 16QAM (1962.5 MHz) (5MHz Channel BW)

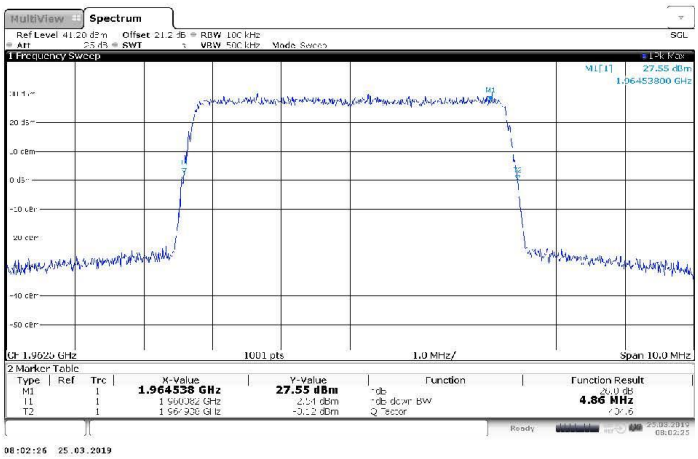

Figure 13 Occupied Bandwidth – 64QAM (1962.5 MHz) (5MHz Channel BW)

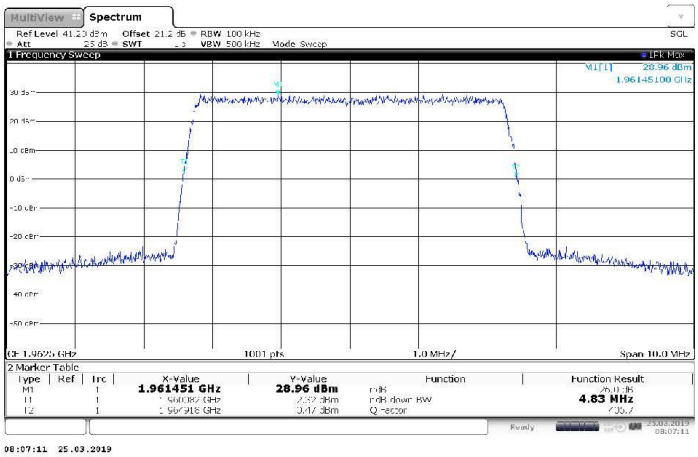

Figure 14 Occupied Bandwidth – 256QAM (1962.5 MHz) (5MHz Channel BW)

Config B ANT1:

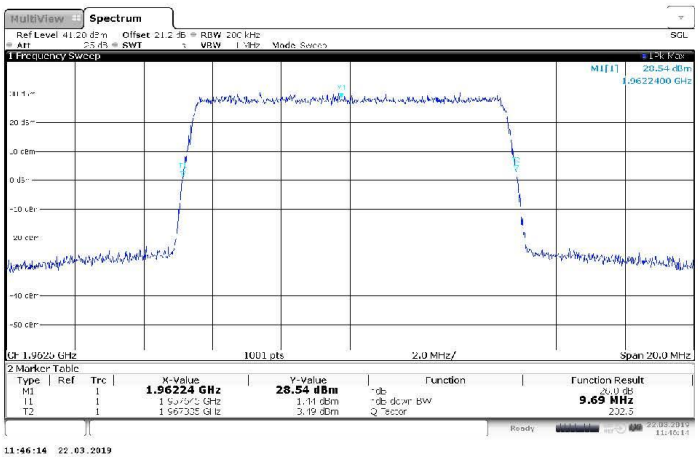

Figure 15 Occupied Bandwidth – QPSK (1962.5 MHz) (10MHz Channel BW)

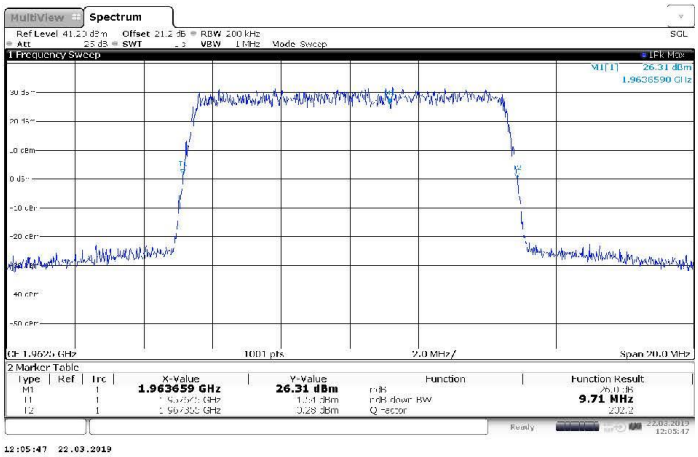

Figure 16 Occupied Bandwidth – 16QAM (1962.5 MHz) (10MHz Channel BW)

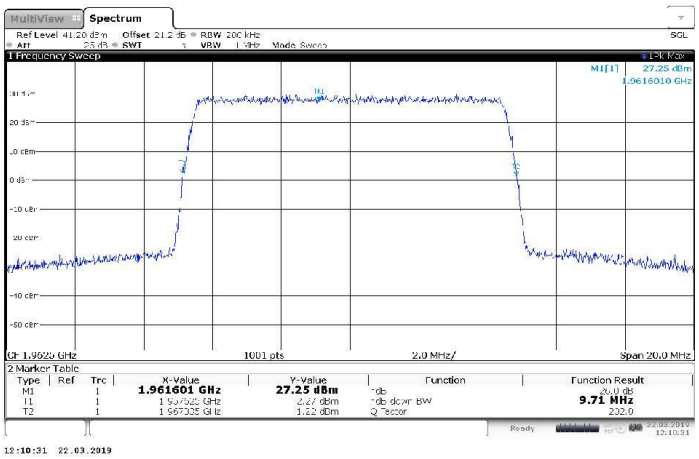

Figure 17 Occupied Bandwidth – 64QAM (1962.5 MHz) (10MHz Channel BW)

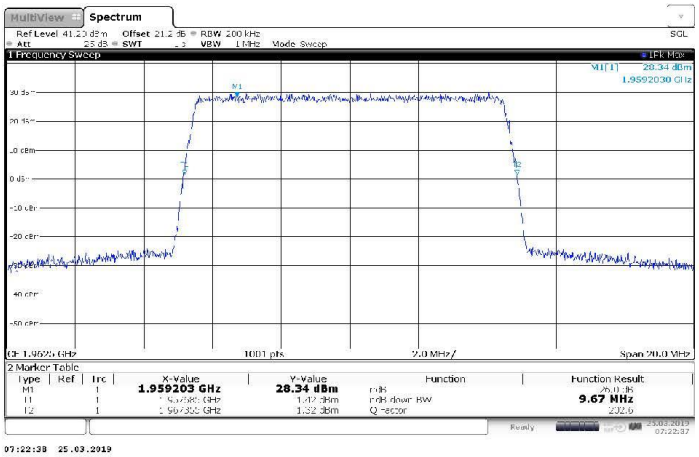

Figure 18 Occupied Bandwidth – 256QAM (1962.5 MHz) (10MHz Channel BW)

Config C ANT1:

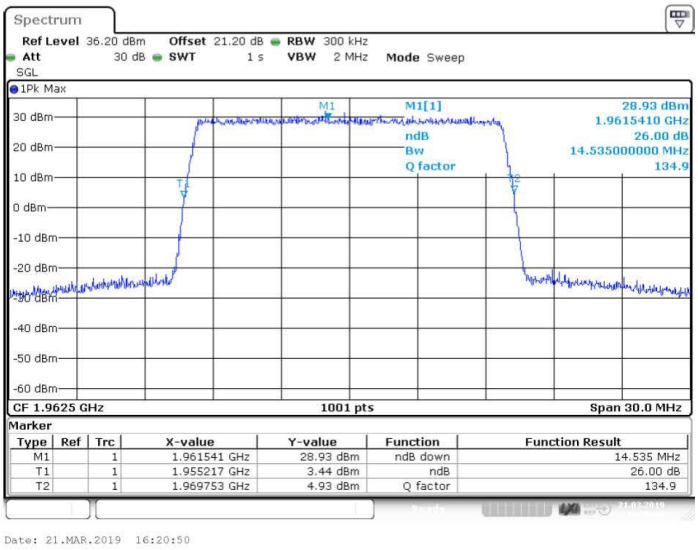

Figure 19 Occupied Bandwidth – QPSK (1962.5 MHz) (15MHz Channel BW)

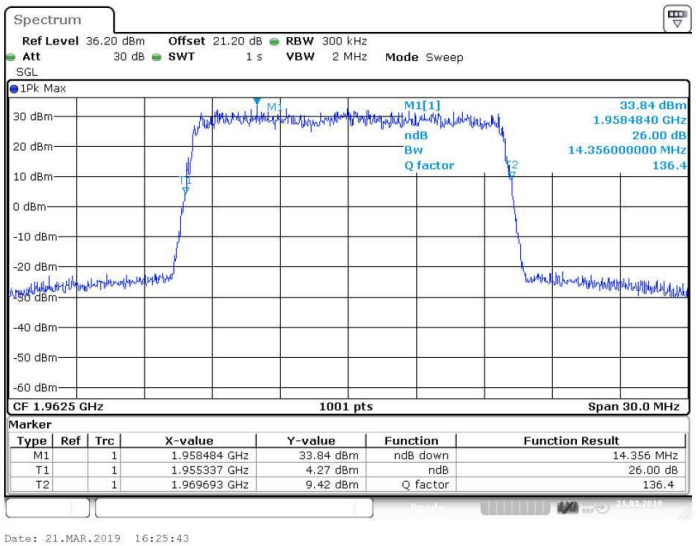

Figure 20 Occupied Bandwidth – 16QAM (1962.5 MHz) (15MHz Channel BW)

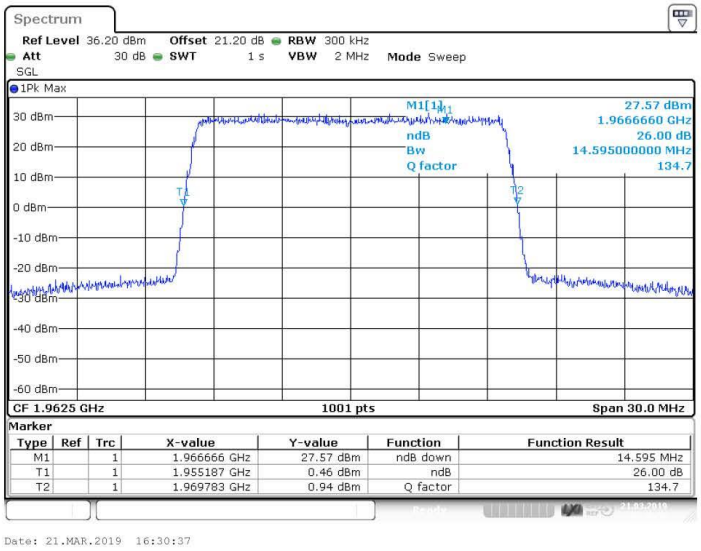

Figure 21 Occupied Bandwidth – 64QAM (1962.5 MHz) (15MHz Channel BW)

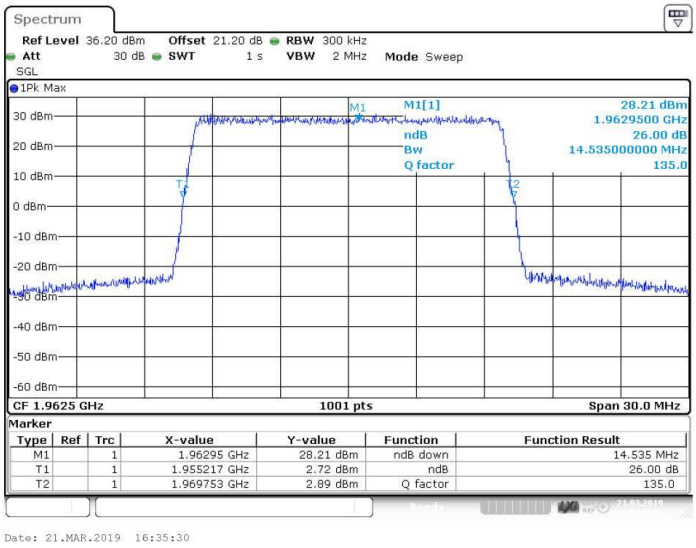

Figure 22 Occupied Bandwidth – 256QAM (1962.5 MHz) (15MHz Channel BW)

Config D ANT1:

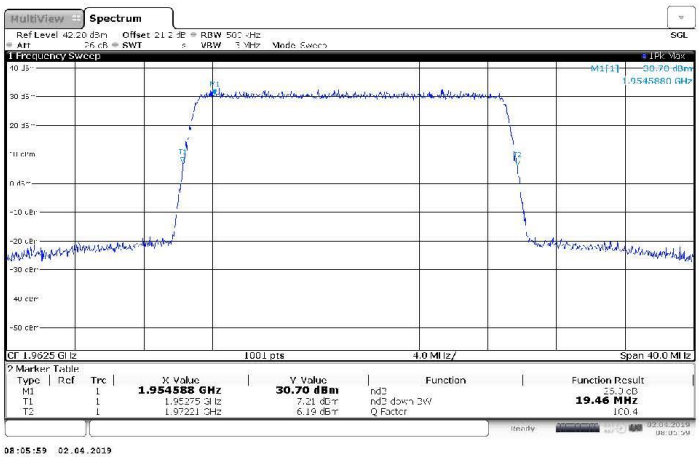

Figure 23 Occupied Bandwidth – QPSK (1962.5 MHz) (20MHz Channel BW)

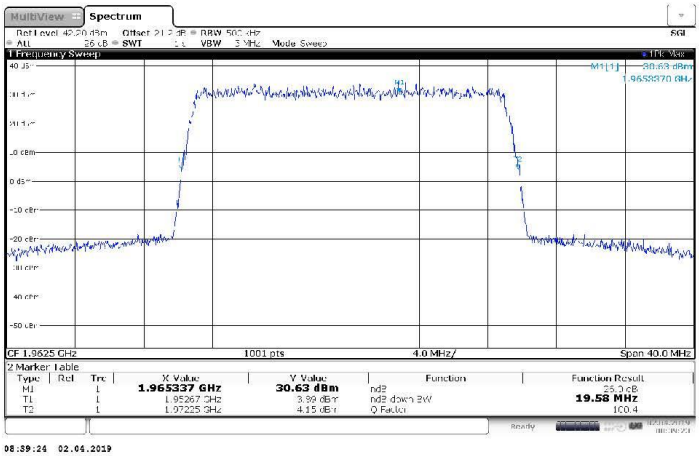

Figure 24 Occupied Bandwidth – 16QAM (1962.5 MHz) (20MHz Channel BW)