



Product Service

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120	20	-5.19145	-0.002	133	0.05	compliant
138	20	-8.70149	-0.003	133	0.05	compliant
64QAM Modulation ANT4						
102	20	-4.11355	-0.002	133	0.05	compliant
120	20	-4.20099	-0.002	133	0.05	compliant
138	20	-4.72662	-0.002	133	0.05	compliant
256QAM Modulation ANT1						
102	20	-4.50338	-0.002	133	0.05	compliant
120	20	-5.59538	-0.002	133	0.05	compliant
138	20	-5.44652	-0.002	133	0.05	compliant
256QAM Modulation ANT2						
102	20	-5.27123	-0.002	133	0.05	compliant
120	20	-6.67803	-0.003	133	0.05	compliant
138	20	-4.54109	-0.002	133	0.05	compliant
256QAM Modulation ANT3						
102	20	-5.79733	-0.002	133	0.05	compliant
120	20	-4.12998	-0.002	133	0.05	compliant
138	20	-3.62940	-0.001	133	0.05	compliant
256QAM Modulation ANT4						
102	20	-4.02977	-0.002	133	0.05	compliant
120	20	-2.92319	-0.001	133	0.05	compliant
138	20	-5.50938	-0.002	133	0.05	compliant

Table 51 Frequency stability with voltage var. (15 MHz Channel BW)**Config D:**

Supply Voltage (AC) [V]	Ambient Temperature [°C]	Carrier Frequency: 2655 MHz				Result
		[Hz]	[ppm]	[Hz]	[ppm]	
QPSK Modulation ANT1						
102	20	-7.16919	-0.003	133	0.05	compliant
120	20	-4.36011	-0.002	133	0.05	compliant
138	20	-13.05969	-0.005	133	0.05	compliant
QPSK Modulation ANT2						
102	20	-3.49061	-0.001	133	0.05	compliant
120	20	-2.84163	-0.001	133	0.05	compliant
138	20	3.76626	0.001	133	0.05	compliant
QPSK Modulation ANT3						
102	20	-4.86913	-0.002	133	0.05	compliant
120	20	-4.81464	-0.002	133	0.05	compliant
138	20	-2.97064	-0.001	133	0.05	compliant
QPSK Modulation ANT4						
102	20	-4.05721	-0.002	133	0.05	compliant
120	20	-6.52783	-0.002	133	0.05	compliant
138	20	-4.30523	-0.002	133	0.05	compliant
16QAM Modulation ANT1						
102	20	-3.45293	-0.001	133	0.05	compliant
120	20	-4.55778	-0.002	133	0.05	compliant



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138	20	-6.02839	-0.002	133	0.05	compliant
16QAM Modulation ANT2						
102	20	-6.67516	-0.003	133	0.05	compliant
120	20	-4.63496	-0.002	133	0.05	compliant
138	20	-9.96322	-0.004	133	0.05	compliant
16QAM Modulation ANT3						
102	20	-5.36525	-0.002	133	0.05	compliant
120	20	-5.61066	-0.002	133	0.05	compliant
138	20	-3.06295	-0.001	133	0.05	compliant
16QAM Modulation ANT4						
102	20	-5.84439	-0.002	133	0.05	compliant
120	20	-5.64138	-0.002	133	0.05	compliant
138	20	-2.09368	-0.001	133	0.05	compliant
64QAM Modulation ANT1						
102	20	-4.52264	-0.002	133	0.05	compliant
120	20	-4.96222	-0.002	133	0.05	compliant
138	20	-9.59941	-0.004	133	0.05	compliant
64QAM Modulation ANT2						
102	20	-5.00673	-0.002	133	0.05	compliant
120	20	-4.89811	-0.002	133	0.05	compliant
138	20	-9.01150	-0.003	133	0.05	compliant
64QAM Modulation ANT3						
102	20	2.64279	0.001	133	0.05	compliant
120	20	-5.75697	-0.002	133	0.05	compliant
138	20	-3.79287	-0.001	133	0.05	compliant
64QAM Modulation ANT4						
102	20	2.64279	-0.003	133	0.05	compliant
120	20	-5.75697	-0.001	133	0.05	compliant
138	20	-3.79287	-0.002	133	0.05	compliant
256QAM Modulation ANT1						
102	20	-6.08879	-0.002	133	0.05	compliant
120	20	-4.79701	-0.002	133	0.05	compliant
138	20	-8.71104	-0.003	133	0.05	compliant
256QAM Modulation ANT2						
102	20	-4.52979	-0.002	133	0.05	compliant
120	20	-3.82045	-0.001	133	0.05	compliant
138	20	-11.50154	-0.004	133	0.05	compliant
256QAM Modulation ANT3						
102	20	-2.74124	-0.001	133	0.05	compliant
120	20	-3.60802	-0.001	133	0.05	compliant
138	20	-3.74634	-0.001	133	0.05	compliant
256QAM Modulation ANT4						
102	20	-5.01327	-0.002	133	0.05	compliant
120	20	-4.18739	-0.002	133	0.05	compliant
138	20	-5.25562	-0.002	133	0.05	compliant

Table 52 Frequency stability with voltage var. (20 MHz Channel BW)



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The measured frequency stability was found to be compliant with the manufacturer's specifications and with all requirements of the FCC and RSS rules.

4.7 Test No.7: Receiver Spurious Emissions (RSS-Gen.)

4.7.1. Limits

RSS-Gen para. no. 7.4: Receiver-spurious emissions at any discrete frequency shall not exceed 2 nanowatts in the band 30-1000 MHz nor 5 nW above 1000 MHz.

Limit conversion: 2nW = -57dBm and 5nW = -53dBm.

4.7.2. Test Procedure and Results

According to RSS-Gen. para. no. 7, all spurious emissions from 30 MHz to 26.9 GHz, up to at least 5x the highest tunable frequency were investigated.

For the frequency range from 30 MHz to 1 GHz, a 100 kHz resolution bandwidth with peak detector was used for the measurements. Above 1 GHz a resolution bandwidth of 1 MHz with average detector was used.

The following tables summarize the worst case detected emission levels (see screenshots on pages 220 for details).

Config A:

RX Channel Frequency: 2535 MHz			
Frequency Range [MHz]	Emission Frequency [MHz]	Maximum Emission Level [dBm]	Result
ANT1			
30 – 1000	114.36	-82.52	compliant
1000 – 26900	14701.94	-70.58	compliant
ANT2			
30 – 1000	30.34	-77.30	compliant
1000 – 26900	14.708.84	-70.59	compliant
ANT3			
30 – 1000	901.52	-87.69	compliant
1000 – 26900	14707.12	-70.53	compliant
ANT4			
30 – 1000	30.34	-78.84	compliant
1000 – 26900	14666.54	-70.51	compliant
Measurement Uncertainty:		$f < 1.0\text{GHz}: \pm 1.1\text{dB}$, $1.0\text{GHz} \leq f < 3.6\text{GHz}: \pm 1.2\text{dB}$, $3.6\text{GHz} \leq f < 8.0\text{GHz}: \pm 1.6\text{dB}$, $8.0\text{GHz} \leq f: \pm 1.9\text{dB}$	

Table 53: RX Spurious Emissions (5 MHz Channel BW)



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Config B:

RX Channel Frequency: 2535 MHz			
Frequency Range [MHz]	Emission Frequency [MHz]	Maximum Emission Level [dBm]	Result
ANT1			
30 – 1000	124.83	-82.85	compliant
1000 – 26900	14684.67	-70.56	compliant
ANT2			
30 – 1000	30.05	-77.20	compliant
1000 – 26900	14696.76	-70.56	compliant
ANT3			
30 – 1000	777.26	-87.36	compliant
1000 – 26900	14688.13	-70.54	compliant
ANT4			
30 – 1000	33.51	-79.92	compliant
1000 – 26900	14712.30	-70.66	compliant
Measurement Uncertainty:		$f < 1.0\text{GHz}: \pm 1.1\text{dB}$, $1.0\text{GHz} \leq f < 3.6\text{GHz}: \pm 1.2\text{dB}$, $3.6\text{GHz} \leq f < 8.0\text{GHz}: \pm 1.6\text{dB}$, $8.0\text{GHz} \leq f: \pm 1.9\text{dB}$	

Table 54: RX Spurious Emissions (10 MHz Channel BW)**Config C:**

RX Channel Frequency: 2535 MHz			
Frequency Range [MHz]	Emission Frequency [MHz]	Maximum Emission Level [dBm]	Result
ANT1			
30 – 1000	114.36	-82.47	compliant
1000 – 26900	14695.90	-70.45	compliant
ANT2			
30 – 1000	31.58	-78.16	compliant
1000 – 26900	14695.90	-70.53	compliant
ANT3			
30 – 1000	950.98	-86.91	compliant
1000 – 26900	14671.72	-70.50	compliant
ANT4			
30 – 1000	32.83	-78.88	compliant
1000 – 26900	14641.51	-70.50	compliant
Measurement Uncertainty:		$f < 1.0\text{GHz}: \pm 1.1\text{dB}$, $1.0\text{GHz} \leq f < 3.6\text{GHz}: \pm 1.2\text{dB}$,	

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3.6GHz ≤ f <8.0GHz: ±1.6dB,
 8.0GHz ≤ f: ±1.9dB

Table 55: RX Spurious Emissions (15 MHz Channel BW)**Config D:**

RX Channel Frequency: 2535 MHz			
Frequency Range [MHz]	Emission Frequency [MHz]	Maximum Emission Level [dBm]	Result
ANT1			
30 – 1000	120.80	-82.80	compliant
1000 – 26900	14679.49	-70.41	compliant
ANT2			
30 – 1000	30.53	-77.46	compliant
1000 – 26900	14688.13	-70.51	compliant
ANT3			
30 – 1000	491.95	-87.77	compliant
1000 – 26900	14692.44	-70.57	compliant
ANT4			
30 – 1000	32.35	-79.72	compliant
1000 – 26900	14701.07	-70.44	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 56: RX Spurious Emissions (20 MHz Channel BW)**Config E:**

RX Channel Frequency: 2532.5 / 2537.5 MHz			
Frequency Range [MHz]	Emission Frequency [MHz]	Maximum Emission Level [dBm]	Result
ANT1			
30 – 1000	125.69	-82.88	compliant
1000 – 26900	14677.77	-70.49	compliant
ANT2			
30 – 1000	31.10	-75.73	compliant
1000 – 26900	14700.21	-70.55	compliant
ANT3			
30 – 1000	507.70	-88.17	compliant
1000 – 26900	14697.62	-70.45	compliant
ANT4			
30 – 1000	32.83	-78.79	compliant

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1000 – 26900	14726.11	-70.53	compliant
Measurement Uncertainty:		$f < 1.0\text{GHz}$: $\pm 1.1\text{dB}$, $1.0\text{GHz} \leq f < 3.6\text{GHz}$: $\pm 1.2\text{dB}$, $3.6\text{GHz} \leq f < 8.0\text{GHz}$: $\pm 1.6\text{dB}$, $8.0\text{GHz} \leq f$: $\pm 1.9\text{dB}$	

Table 57: RX Spurious Emissions (5+5 MHz Channel BW)

Config E:

RX Channel Frequency: 2530 / 2540 MHz			
Frequency Range [MHz]	Emission Frequency [MHz]	Maximum Emission Level [dBm]	Result
ANT1			
30 – 1000	127.52	-83.66	compliant
1000 – 26900	14693.31	-70.69	compliant
ANT2			
30 – 1000	30.24	-77.19	compliant
1000 – 26900	14699.35	-70.39	compliant
ANT3			
30 – 1000	855.62	-86.86	compliant
1000 – 26900	14701.94	-70.51	compliant
ANT4			
30 – 1000	30.82	-79.22	compliant
1000 – 26900	14711.43	-70.41	compliant
Measurement Uncertainty:		$f < 1.0\text{GHz}$: $\pm 1.1\text{dB}$, $1.0\text{GHz} \leq f < 3.6\text{GHz}$: $\pm 1.2\text{dB}$, $3.6\text{GHz} \leq f < 8.0\text{GHz}$: $\pm 1.6\text{dB}$, $8.0\text{GHz} \leq f$: $\pm 1.9\text{dB}$	

Table 58: RX Spurious Emissions (10+10 MHz Channel BW)

Config F:

RX Channel Frequency: 2527.5 / 2542.5 MHz			
Frequency Range [MHz]	Emission Frequency [MHz]	Maximum Emission Level [dBm]	Result
ANT1			
30 – 1000	115.13	-82.97	compliant
1000 – 26900	14707.12	-70.42	compliant
ANT2			
30 – 1000	31.01	-77.27	compliant
1000 – 26900	14672.59	-70.52	compliant
ANT3			
30 – 1000	616.22	-87.93	compliant



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1000 – 26900	14677.77	-70.44	compliant
ANT4			
30 – 1000	30.62	-78.50	compliant
1000 – 26900	14697.62	-70.61	compliant
Measurement Uncertainty:		$f < 1.0\text{GHz}$: $\pm 1.1\text{dB}$, $1.0\text{GHz} \leq f < 3.6\text{GHz}$: $\pm 1.2\text{dB}$, $3.6\text{GHz} \leq f < 8.0\text{GHz}$: $\pm 1.6\text{dB}$, $8.0\text{GHz} \leq f$: $\pm 1.9\text{dB}$	

Table 59: RX Spurious Emissions (15+15 MHz Channel BW)

Config G:

RX Channel Frequency: 2525 / 2545 MHz			
Frequency Range [MHz]	Emission Frequency [MHz]	Maximum Emission Level [dBm]	Result
ANT1			
30 – 1000	115.04	-82.84	compliant
1000 – 26900	14681.22	-70.61	compliant
ANT2			
30 – 1000	30.05	-76.84	compliant
1000 – 26900	14693.31	-70.55	compliant
ANT3			
30 – 1000	939.74	-87.31	compliant
1000 – 26900	14.695.90	-70.65	compliant
ANT4			
30 – 1000	30.62	-78.88	compliant
1000 – 26900	14695.90	-70.58	compliant
Measurement Uncertainty:		$f < 1.0\text{GHz}$: $\pm 1.1\text{dB}$, $1.0\text{GHz} \leq f < 3.6\text{GHz}$: $\pm 1.2\text{dB}$, $3.6\text{GHz} \leq f < 8.0\text{GHz}$: $\pm 1.6\text{dB}$, $8.0\text{GHz} \leq f$: $\pm 1.9\text{dB}$	

Table 60: RX Spurious Emissions (20+20 MHz Channel BW)

The receiver spurious emissions were found to be compliant with the manufacturer's specifications and with all requirements of the RSS specifications.



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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	06/2017	06/2018	1, 2, 3, 4, 6, 7
2	Vector Network Analyzer	Rohde & Schwarz: ZVA40	100146	01/2018	01/2019	1, 2, 3, 4, 6, 7
3	Vector Network Analyzer	Rohde & Schwarz: ZVL13	101177	07/2017	07/2018	1, 2, 3, 4, 6, 7
4	Calibration Unit	Rohde & Schwarz: ZV-Z54	100125	10/2017	10/2018	1, 2, 3, 4, 6, 7
5	Frequency Standard	Microsemi 8040C	162230101006	01/2018	01/2019	6
6	Multimeter	Fluke 83	65870302	01/2018	01/2019	1, 2, 3, 4, 6, 7
7	Humidity and Temperature Indicator	Vaisala: HMI 31	P3730008	01/2018	01/2019	1, 2, 3, 4, 6, 7
8	AC Power Supply	Chroma 6460	64600113	cnn	-	
9	Modular SSU antenna selector	Orbis	SSU-1752-3539	cnn	-	1, 2, 3, 4, 6, 7
10	Attenuator	Aeroflex/Weinschel: 66-20-33	BW3346	cnn	-	1, 2, 3, 4, 6, 7
11	EMI Test Receiver	R&S ESU40	100262/040	06/2017	06/2018	5
12	Horn Antenna	ETS-Lindgren 3116C-PA	150635	08/2017	08/2018	5
13	Horn Antenna	ETS-Lindgren ETS3115	00092148	08/2017	08/2018	5
14	Bilog Antenna	Schaffner Chase CBL6112	2003	07/2017	07/2018	5
15	Humidity and temperature meter	Vaisala HM34	G3330003	06/2017	06/2018	5
16	Mast Controller	Maturo NCD/180 2	17210416	cnn	-	5
17	4 meter mast	Maturo TAM4.0-E	086/17210915	cnn	-	5
18	Anechoic Chamber	S&MC	B83317-C6019	09/2016	09/2019	5
19	Amplifier	Miteq 4FSX4	902638	cnn	-	5

Table 61 Part List of the RF Measurement Test Equipment



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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 30.

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

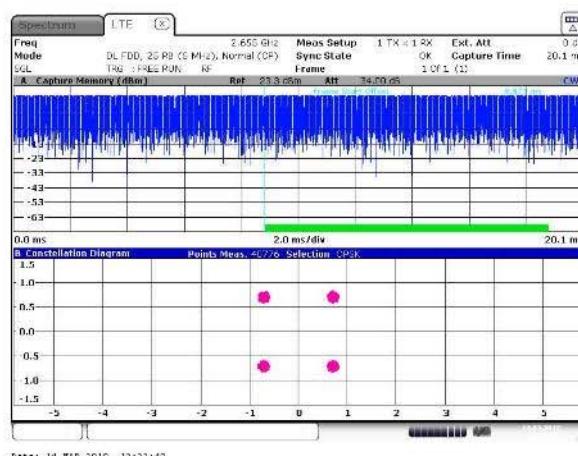


Figure 5. I/Q constellation diagram with capture buffer – QPSK (2655 MHz) (5MHz Channel BW)



Figure 6. I/Q constellation table with I/Q error – QPSK (2655 MHz) (5 MHz Channel BW)



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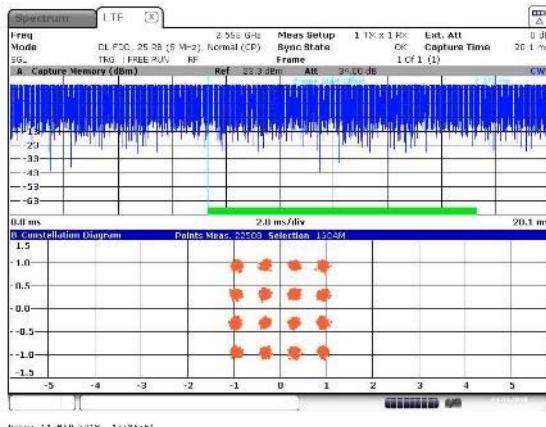


Figure 7. I/Q constellation diagram with capture buffer – 16QAM (2655 MHz) (5 MHz Channel BW)



Figure 8. I/Q constellation table with I/Q error – 16QAM (2655 MHz) (5 MHz Channel BW)



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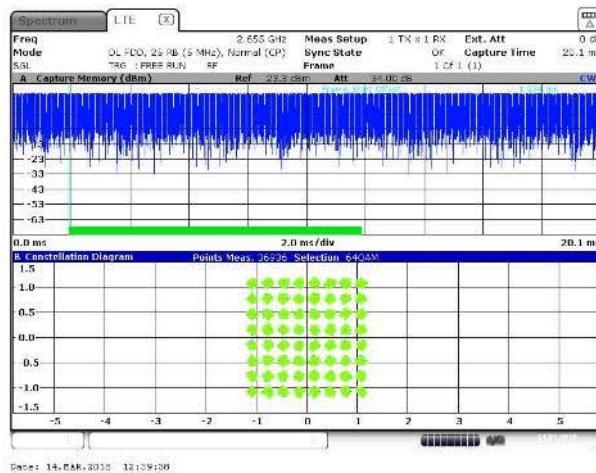


Figure 9.. I/Q constellation diagram with capture buffer – 64QAM (2655 MHz) (5 MHz Channel BW)



Figure 10. I/Q constellation table with I/Q error – 64QAM (2655 MHz) (5 MHz Channel BW)



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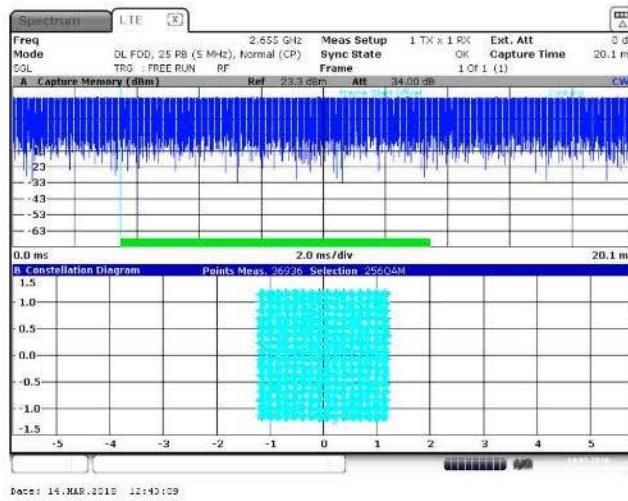


Figure 11. I/Q constellation diagram with capture buffer – 256QAM (2655 MHz) (5 MHz Channel BW)



Figure 12. I/Q constellation table with I/Q error – 16QAM (2655 MHz) (5 MHz Channel BW)



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5.2.2. Test No. 3: Occupied Bandwidth

The value ‘Occ BW’ is the measured occupied bandwidth.

Config A ANT2:

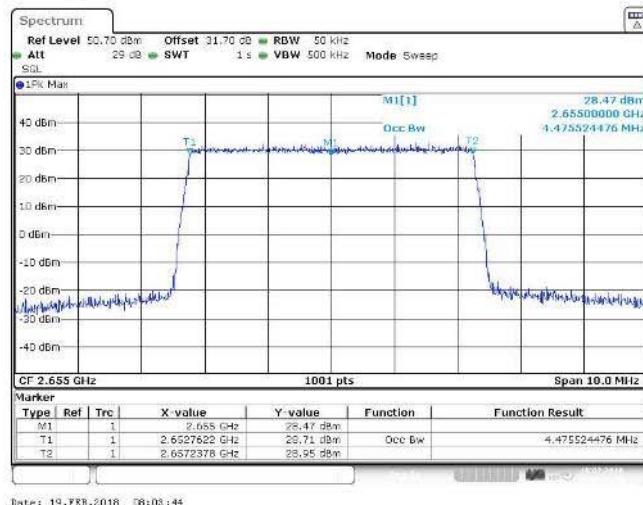


Figure 13 Occupied Bandwidth – QPSK (2655 MHz) (5 MHz Channel BW)

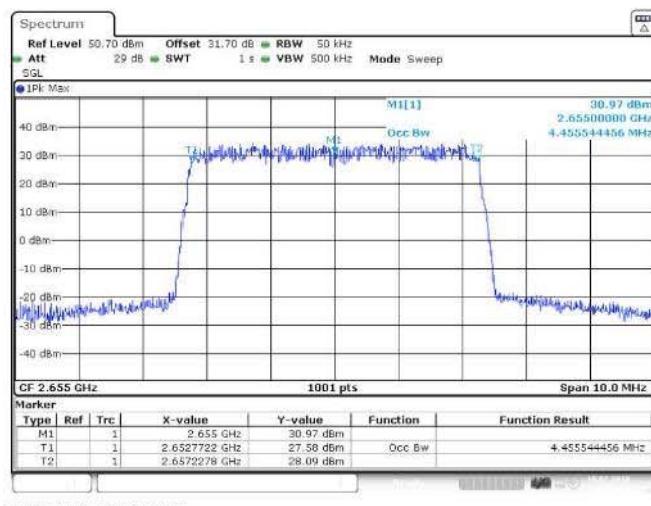


Figure 14 Occupied Bandwidth – 16QAM (2655 MHz) (5 MHz Channel BW)

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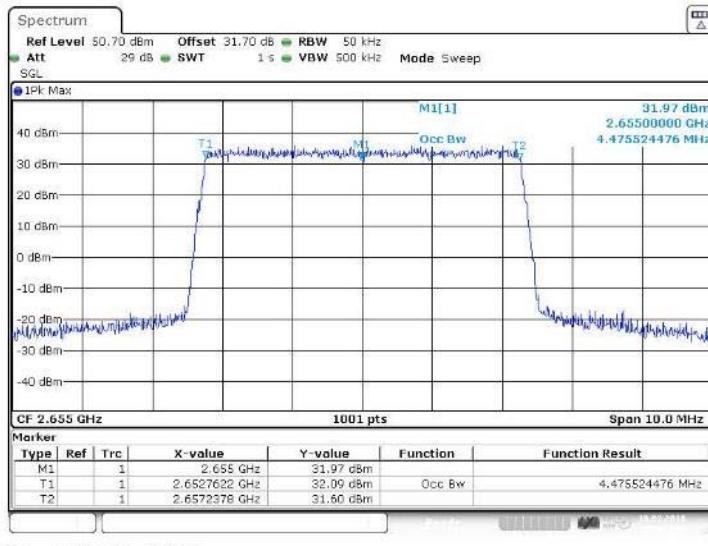


Figure 15 Occupied Bandwidth – 64QAM (2655 MHz) (5 MHz Channel BW)

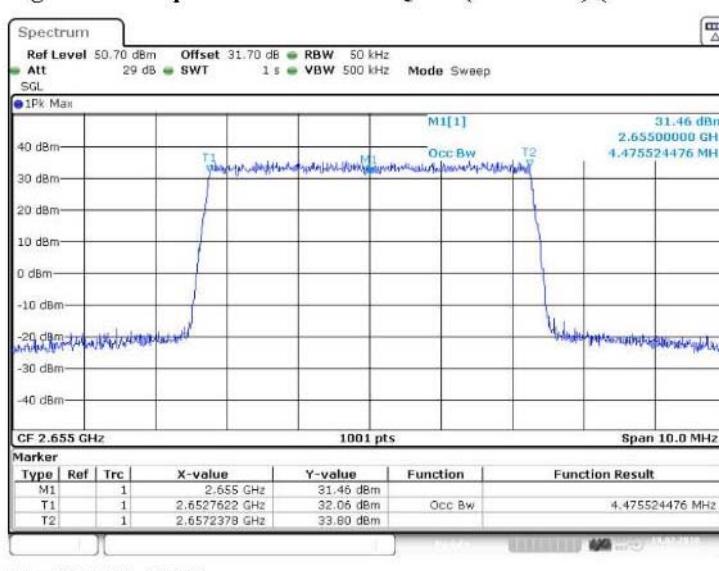


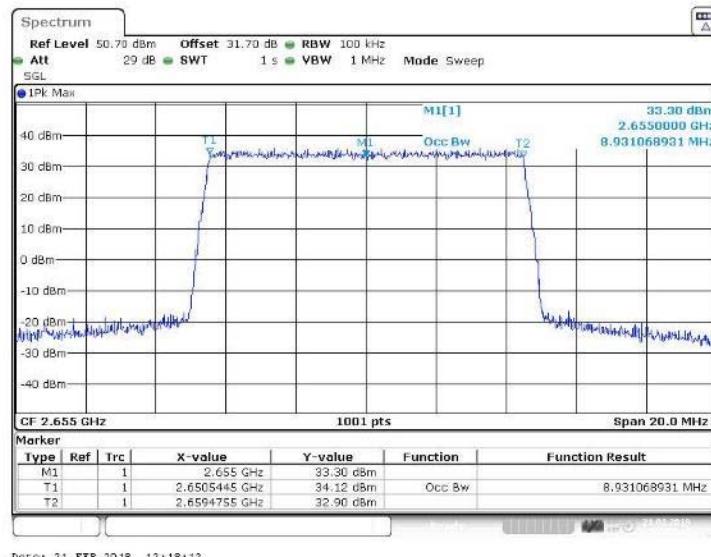
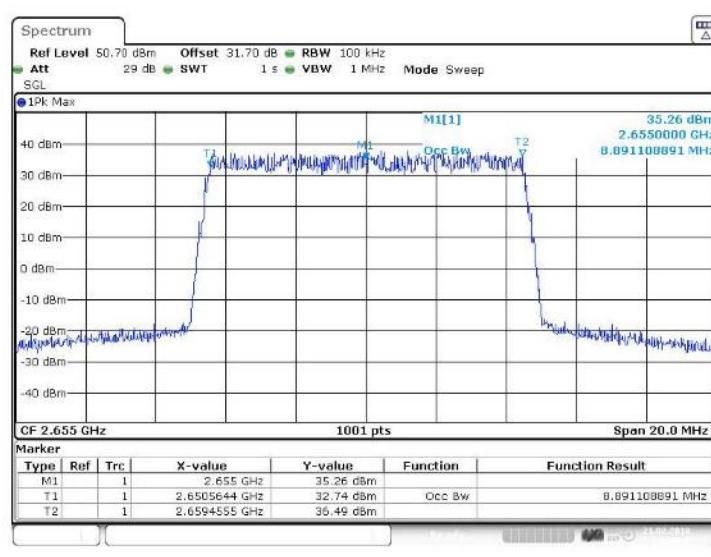
Figure 16 Occupied Bandwidth – 256QAM (2655 MHz) (5 MHz Channel BW)



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Config B ANT2:**Figure 17 Occupied Bandwidth – QPSK (2655 MHz) (10 MHz Channel BW)****Figure 18 Occupied Bandwidth – 16QAM (2655 MHz) (10MHz Channel BW)**

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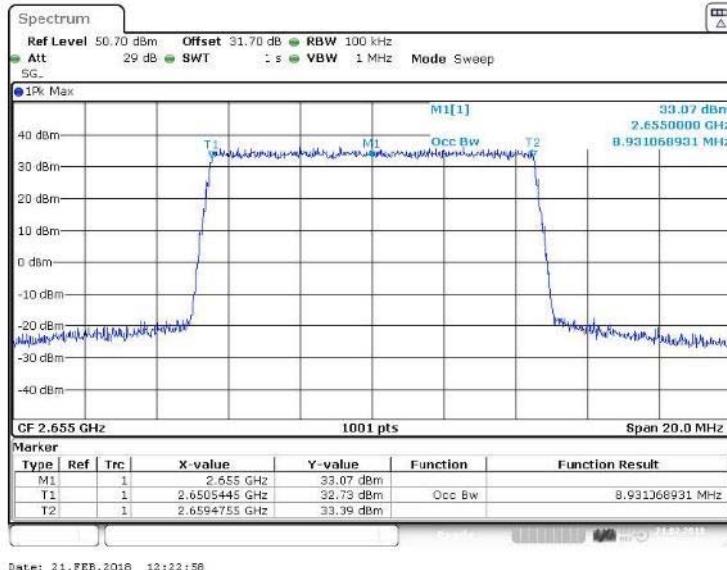


Figure 19 Occupied Bandwidth – 64QAM (2655 MHz) (5 MHz Channel BW)

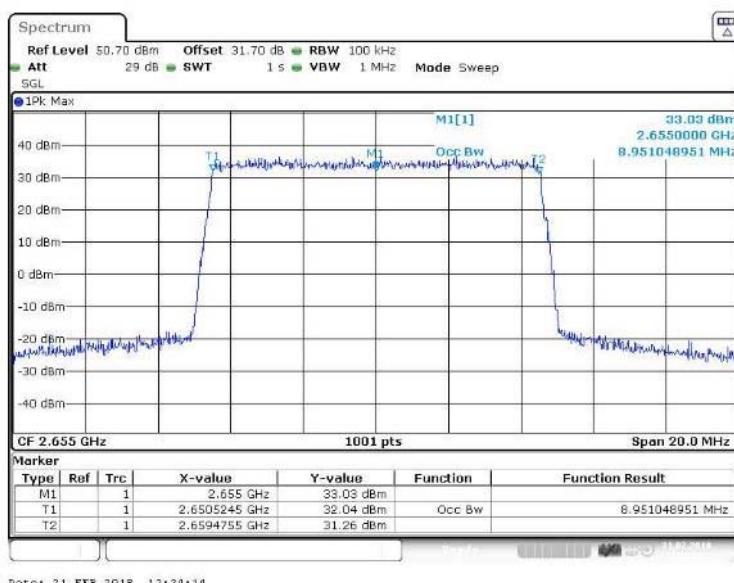


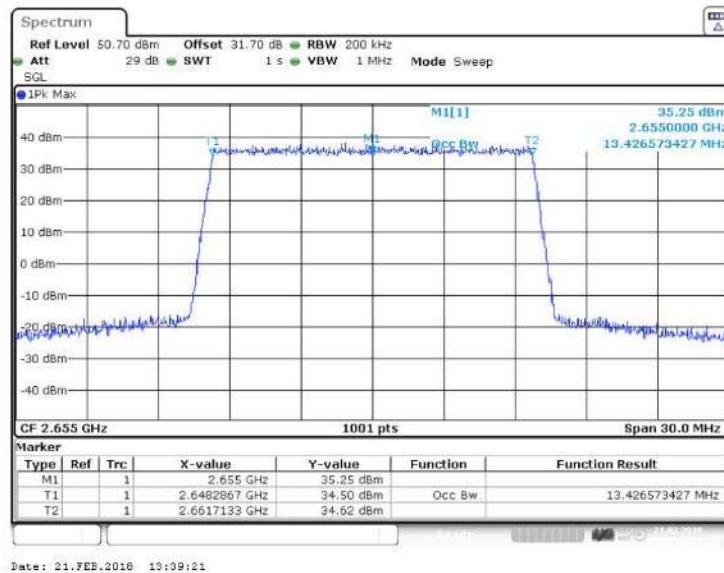
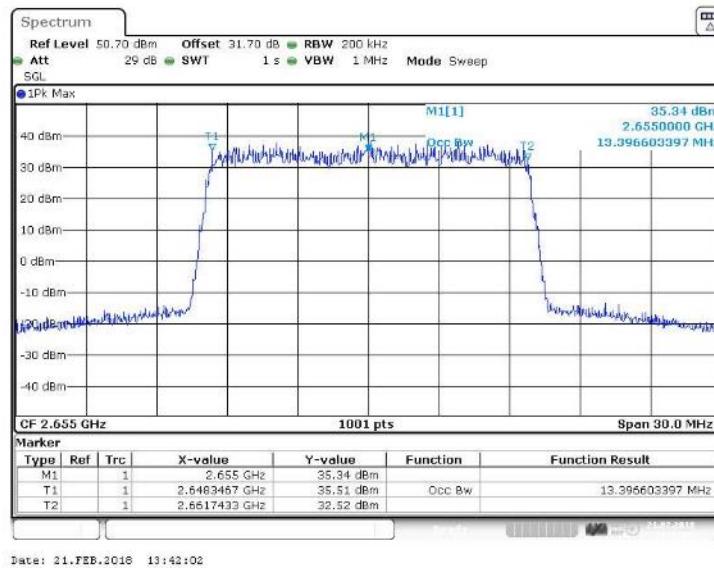
Figure 20 Occupied Bandwidth – 256QAM (2655 MHz) (5 MHz Channel BW)



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Config C ANT2:**Figure 21 Occupied Bandwidth – QPSK (2655 MHz) (15 MHz Channel BW)****Figure 22 Occupied Bandwidth – 16QAM (2655 MHz) (15 MHz Channel BW)**



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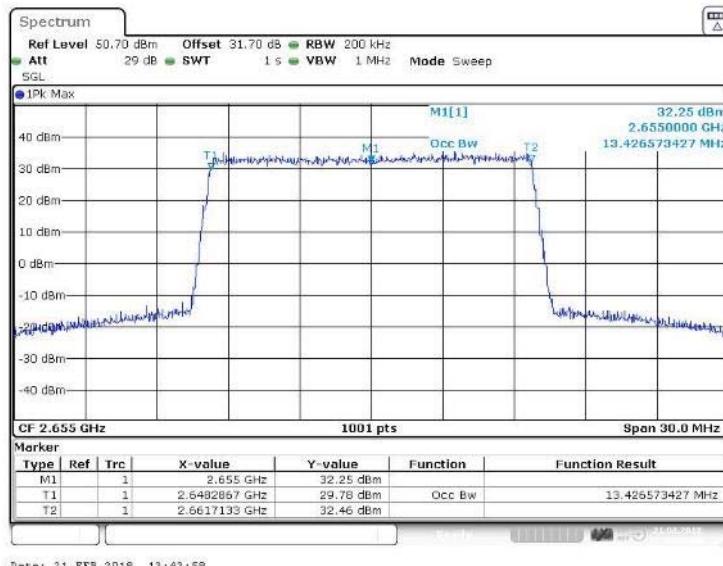


Figure 23 Occupied Bandwidth – 64QAM (2655 MHz) (15 MHz Channel BW)

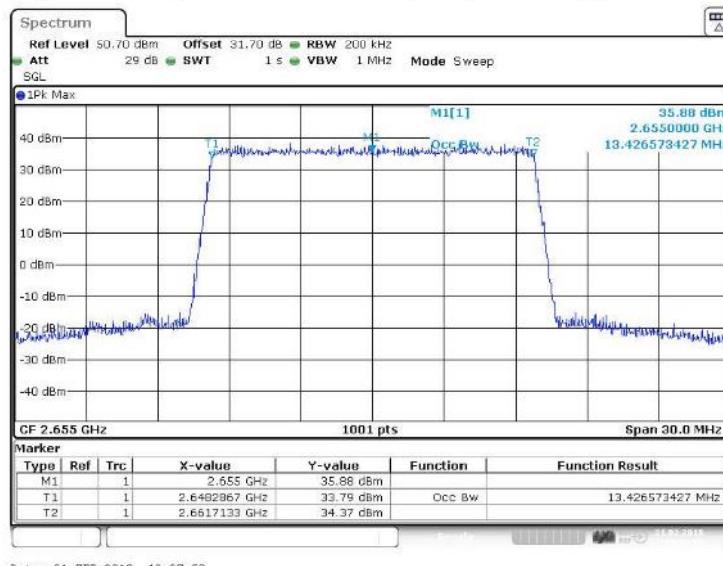


Figure 24 Occupied Bandwidth – 256QAM (2655 MHz) (15 MHz Channel BW)

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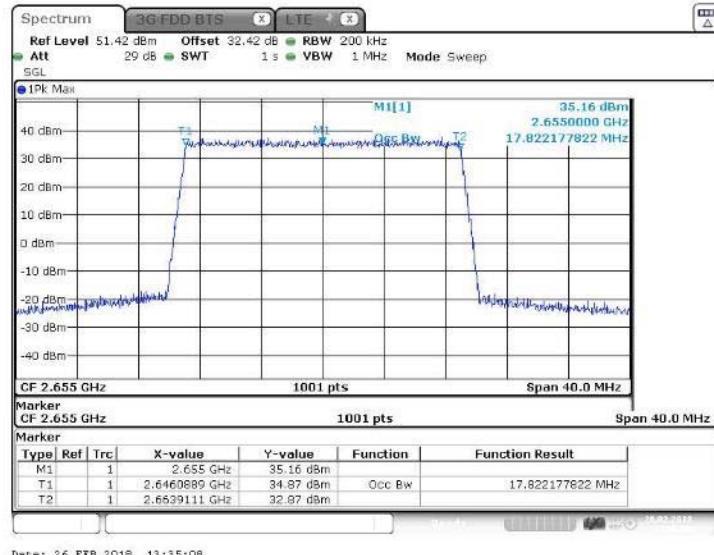
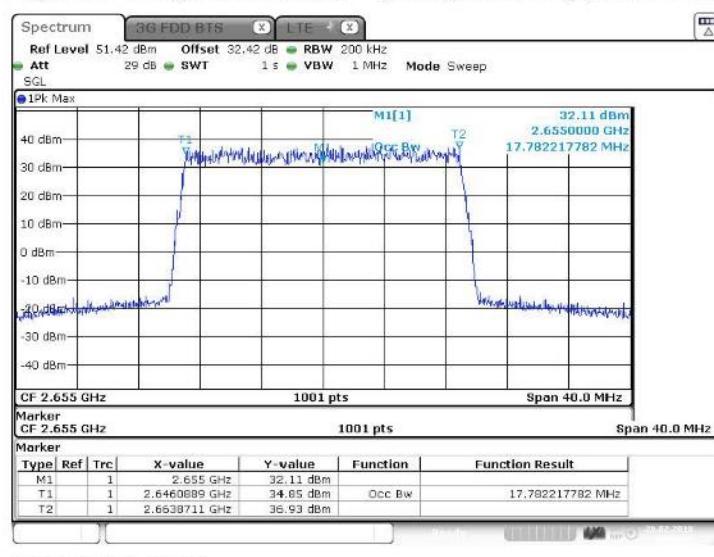
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Config D ANT2:**Figure 25 Occupied Bandwidth – QPSK (2655 MHz) (20 MHz Channel BW)****Figure 26 Occupied Bandwidth – 16QAM (2655 MHz) (20 MHz Channel BW)**



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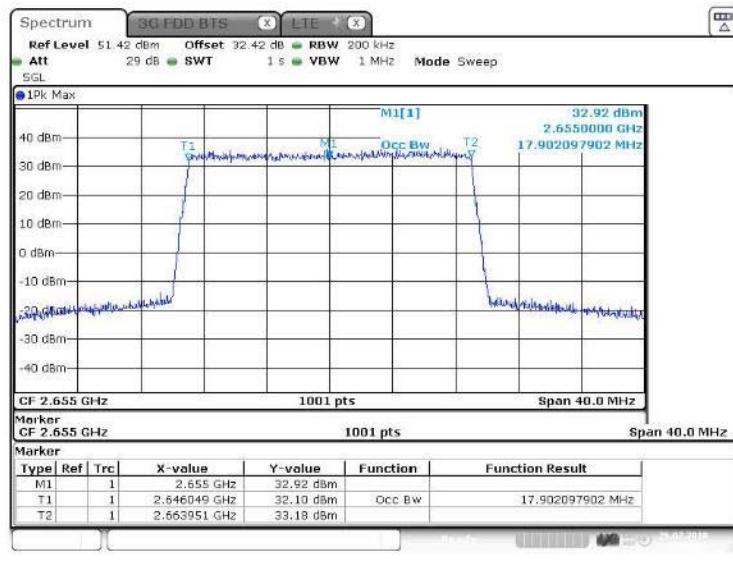


Figure 27 Occupied Bandwidth – 64QAM (2655 MHz) (20 MHz Channel BW)

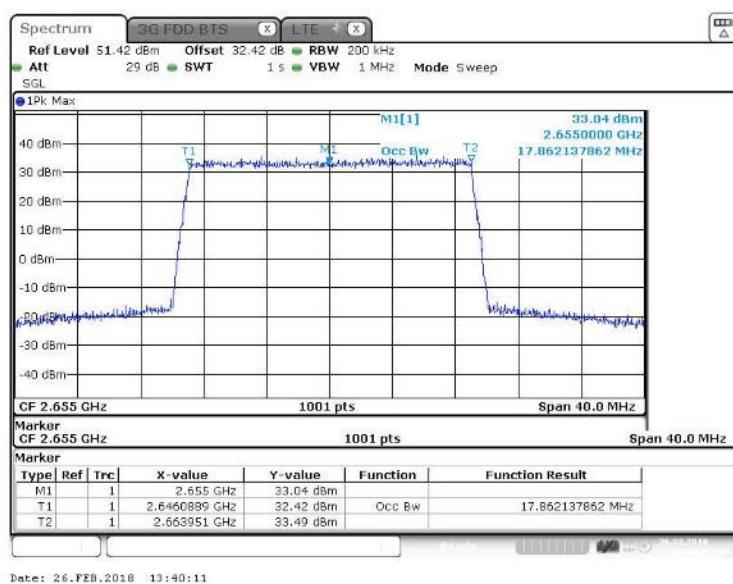


Figure 28 Occupied Bandwidth – 256QAM (2655 MHz) (20 MHz Channel BW)



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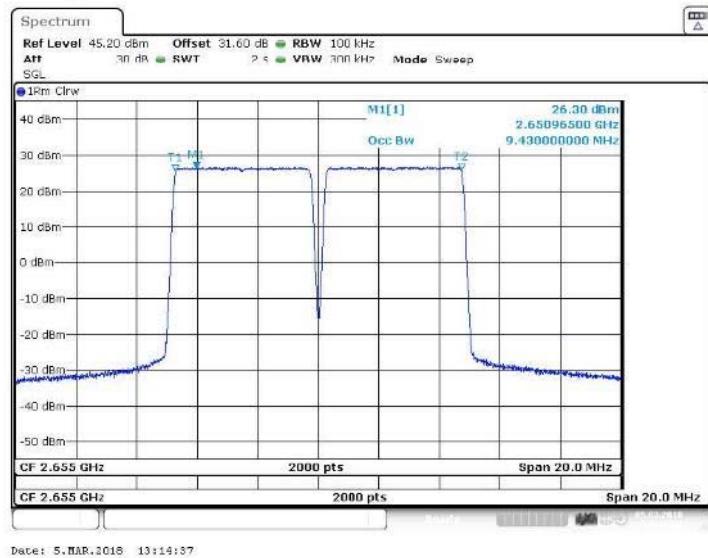
Config E ANT2:

Figure 29 Occupied Bandwidth – QPSK (2652.5 MHz, 2657.5 MHz) (2 X 5 MHz Channel BW)

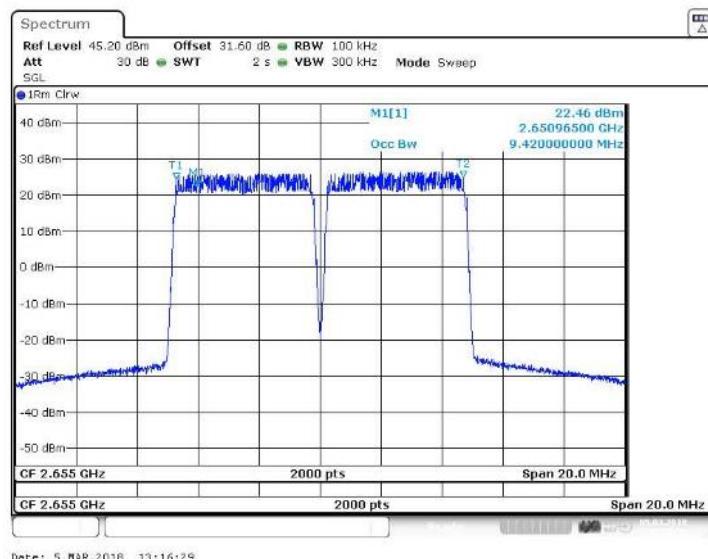


Figure 30 Occupied Bandwidth – 16QAM (2652.5 MHz, 2657.5 MHz) (2 X 5 MHz Channel BW)

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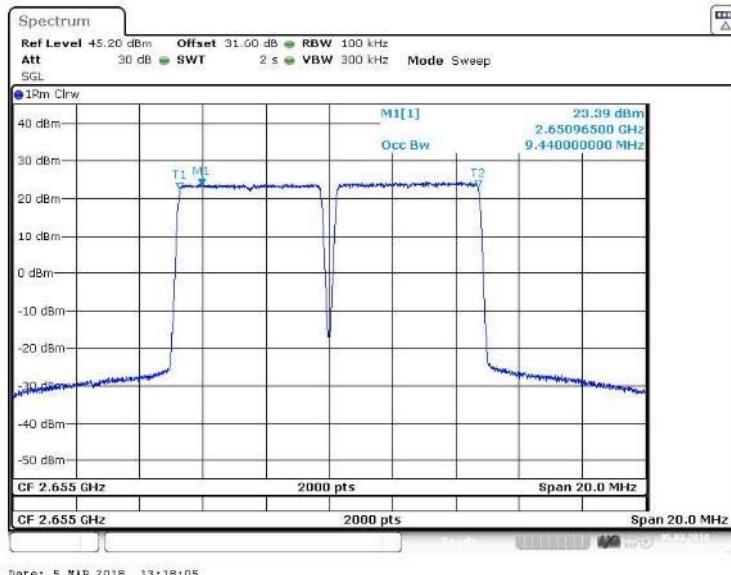


Figure 31 Occupied Bandwidth – 64QAM (2652.5 MHz, 2657.5 MHz) (2 X 5 MHz Channel BW)

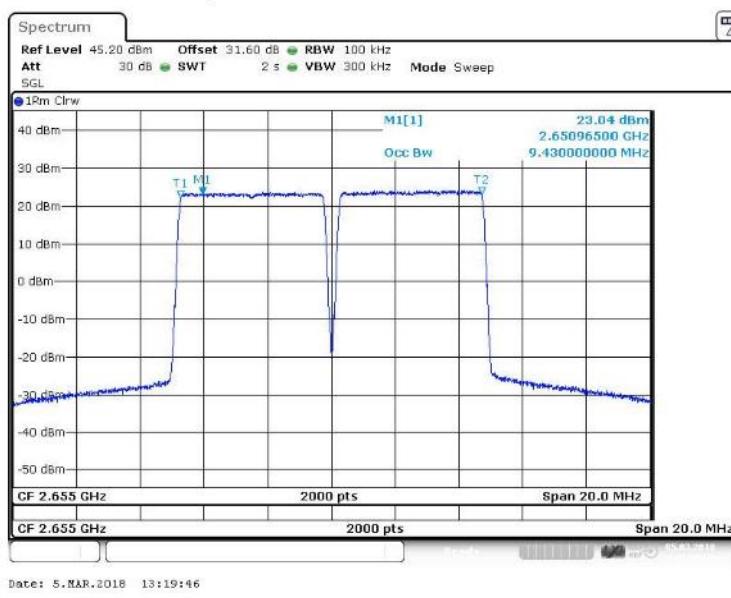


Figure 32 Occupied Bandwidth – 256QAM (2652.5 MHz, 2657.5 MHz) (2 X 5 MHz Channel BW)



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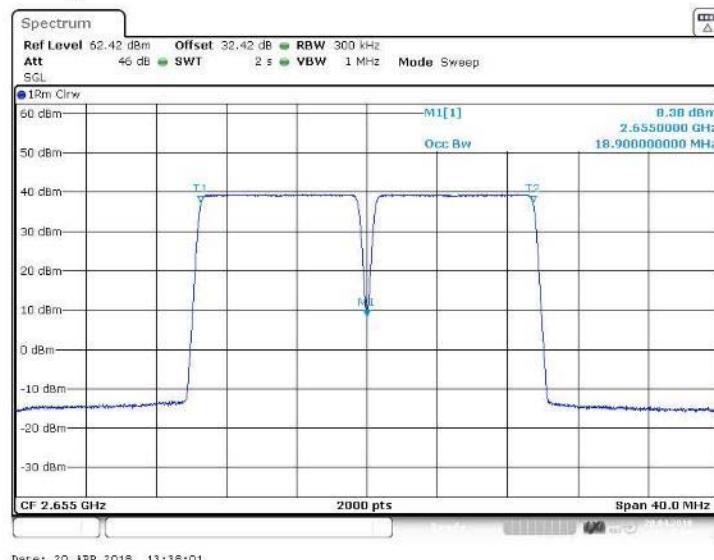
Config F ANT2:

Figure 33 Occupied Bandwidth – QPSK (2650 MHz, 2660 MHz) (2 X 10 MHz Channel BW)

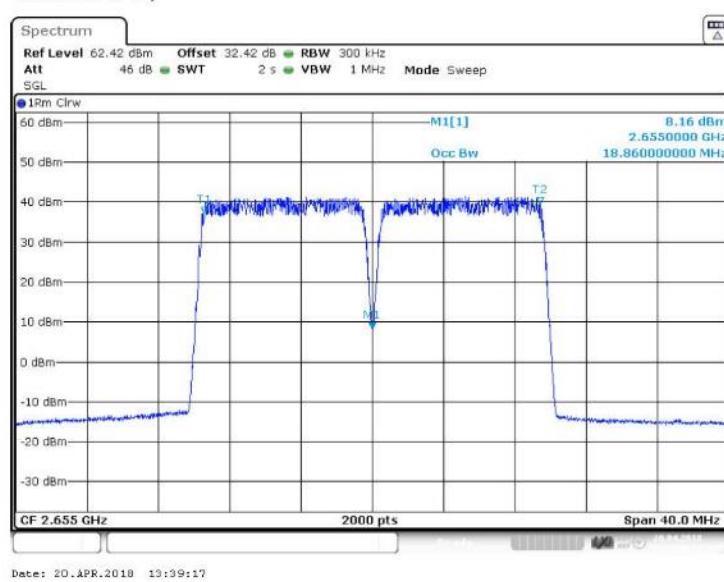


Figure 34 Occupied Bandwidth – 16QAM (2650 MHz, 2660 MHz) (2 X 10 MHz Channel BW)



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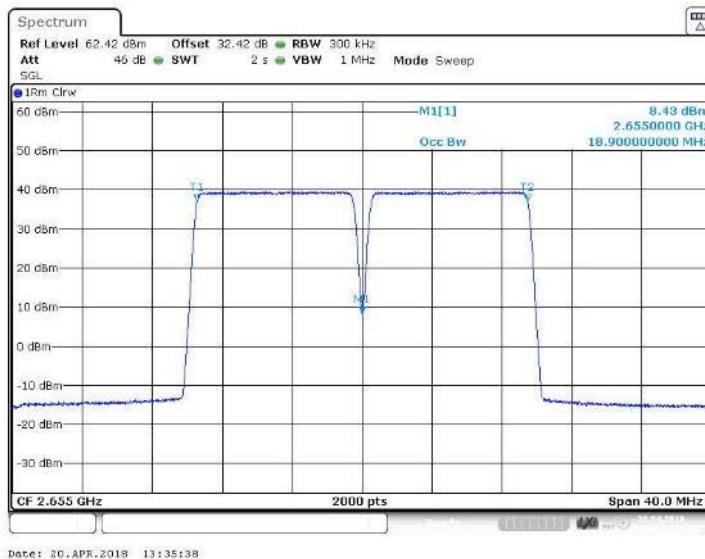


Figure 35 Occupied Bandwidth – 64QAM (2650 MHz, 2660 MHz) (2 X 10 MHz Channel BW)

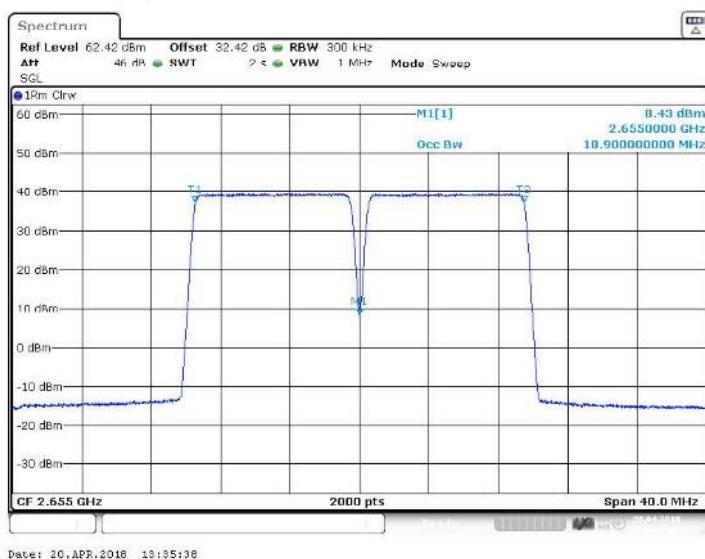


Figure 36 Occupied Bandwidth – 256QAM (2650 MHz, 2660 MHz) (2 X 10 MHz Channel BW)



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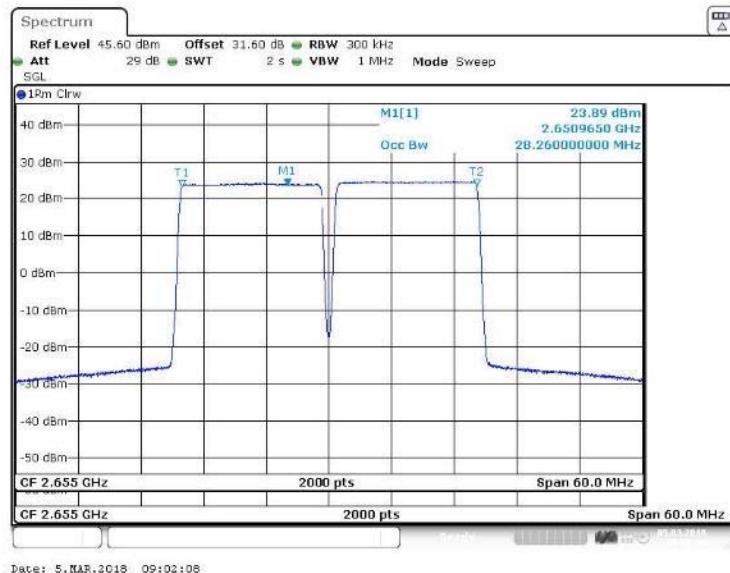
Config G ANT2:

Figure 37 Occupied Bandwidth – QPSK (2647.5 MHz, 2662.5 MHz) (2 X 15 MHz Channel BW)

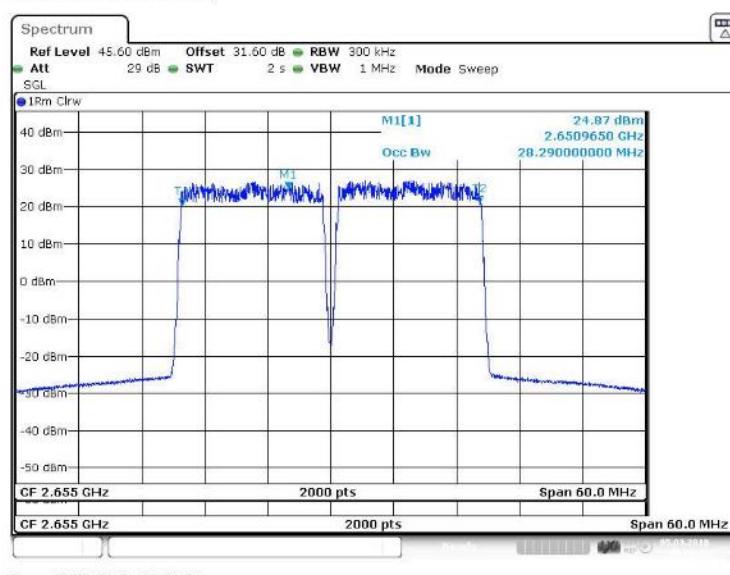


Figure 38 Occupied Bandwidth – 16QAM (2647.5 MHz, 2662.5 MHz) (2 X 15 MHz Channel BW)

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Figure 39 Occupied Bandwidth – 64QAM (2647.5 MHz, 2662.5 MHz) (2 X 15 MHz Channel BW)



Figure 40 Occupied Bandwidth – 256QAM (2647.5 MHz, 2662.5 MHz) (2 X 15 MHz Channel BW)

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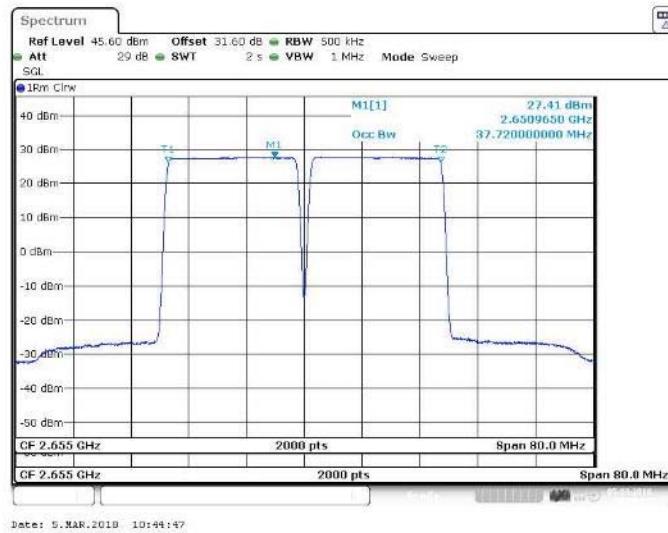
Config H ANT2:

Figure 41 Occupied Bandwidth – QPSK (2645 MHz, 2665 MHz) (2 X 20 MHz Channel BW)

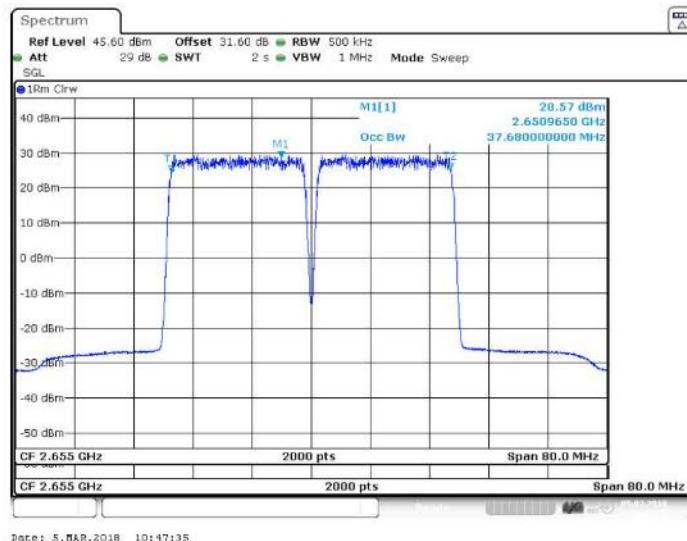


Figure 42 Occupied Bandwidth – 16QAM (2645 MHz, 2665 MHz) (2 X 20 MHz Channel BW)



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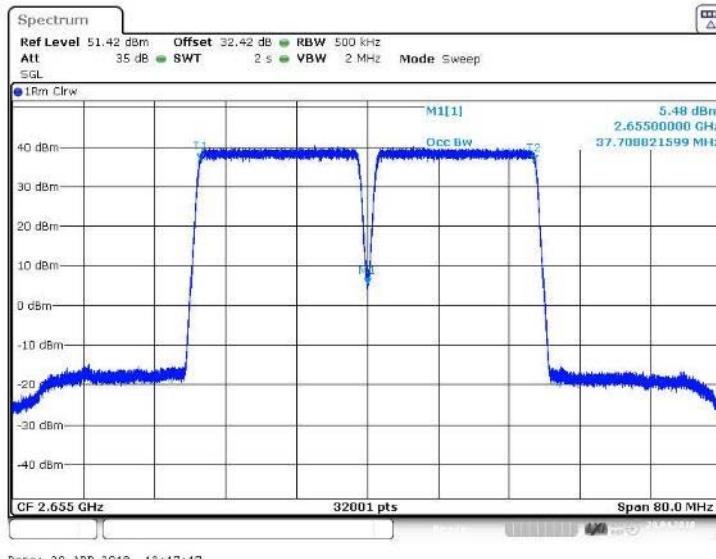


Figure 43 Occupied Bandwidth – 64QAM (2645 MHz, 2665 MHz) (2 X 20 MHz Channel BW)

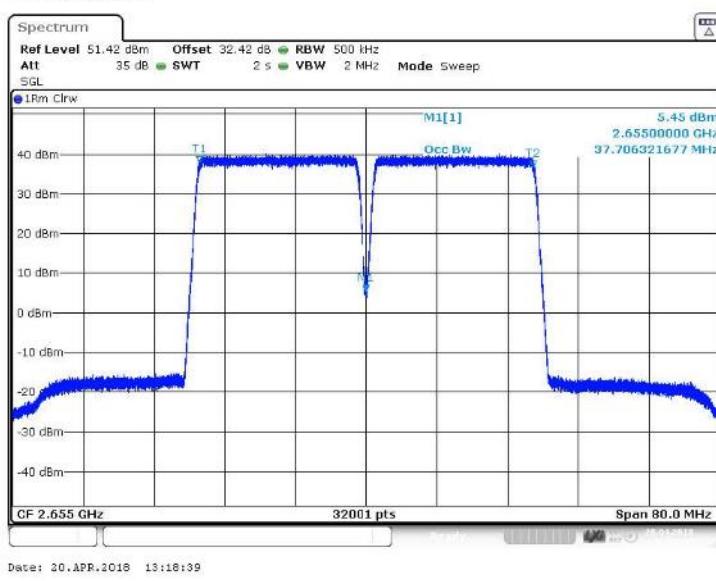


Figure 44 Occupied Bandwidth – 256QAM (2645 MHz, 2665 MHz) (2 X 20 MHz Channel BW)



Product Service

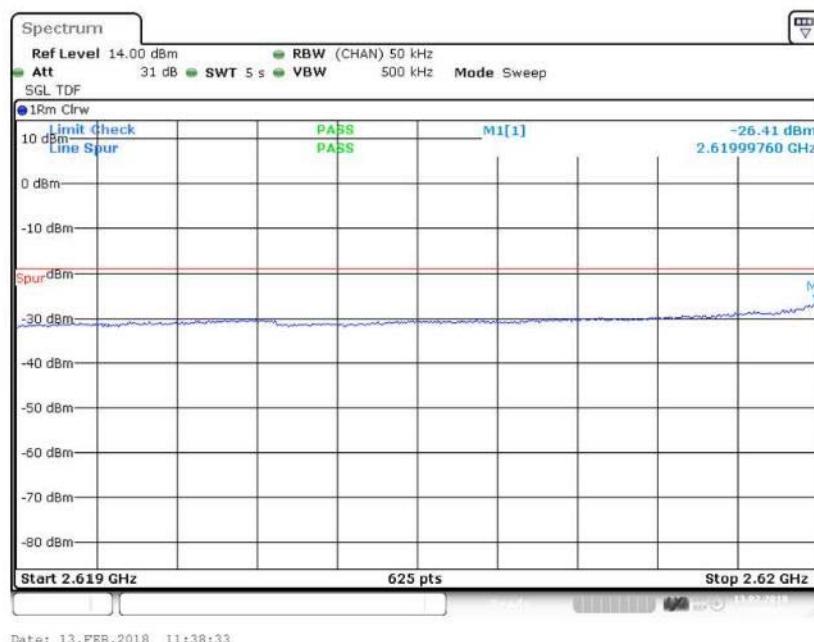
FCC ID: VBNAHHB-01
 IC ID: 661AI-AHHB

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5.2.3. Test No. 4: Spurious Emissions at the Antenna Terminals

Screenshots of highest power and emission antenna, in this unit it was antenna port 2. The external attenuation (connection loss of the set up) is already added in the results. Limit line is set fixed to level -19.02dB.

Config A ANT2:



Date: 13.FEB.2018 11:38:33

Figure 45 Spurious Emissions (Lower Band Edge) – QPSK (2622.5 MHz, 5 MHz Channel BW)



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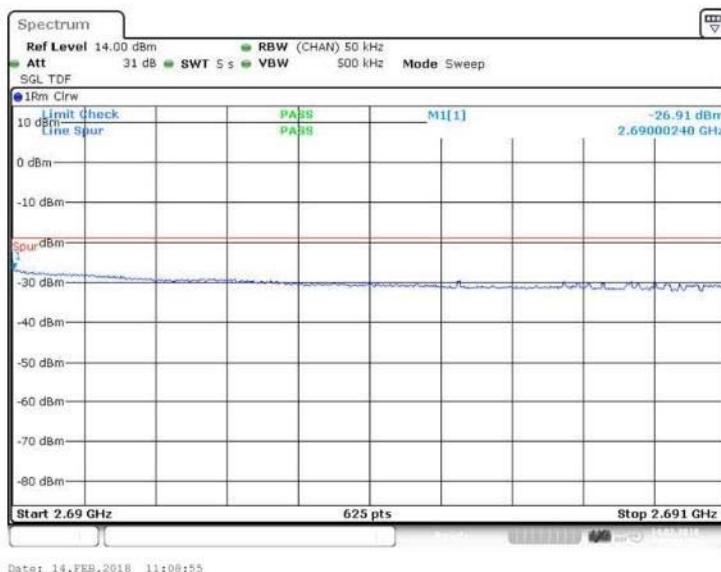


Figure 46 Spurious Emissions (Upper Band Edge) – QPSK (2687.5 MHz, 5 MHz Channel BW)

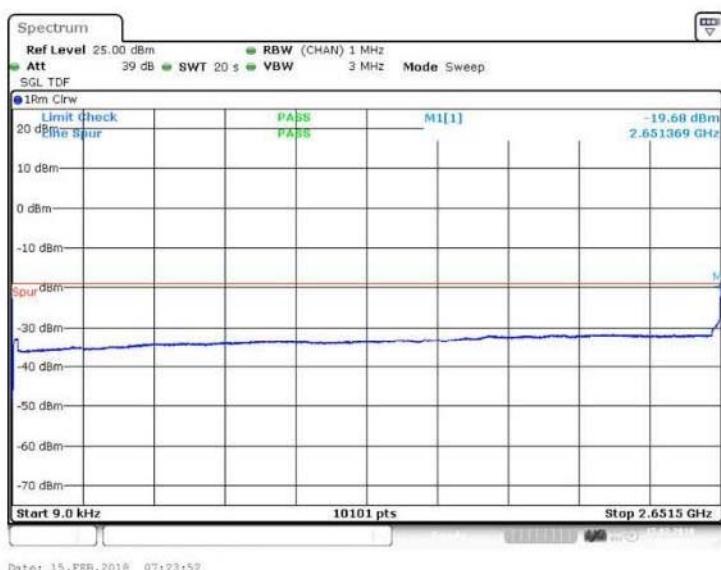


Figure 47 Spurious Emissions (9kHz – 2.6515 GHz) - QPSK (2655 MHz, 5 MHz Channel BW)