7.4 Band Edge Emissions at Antenna Terminal

§2.1051 §22.917(a) §24.238(a) §27.53(g) §27.53(h)

Test Overview

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible attenuation level of any spurious emission is 43 + $\log_{10}(P_{[Watts]})$, where P is the transmitter power in Watts.

Test Procedure Used

KDB 971168 D01 v02r02 – Section 6.0

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW ≥ 1% of the emission bandwidth
4. VBW ≥ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

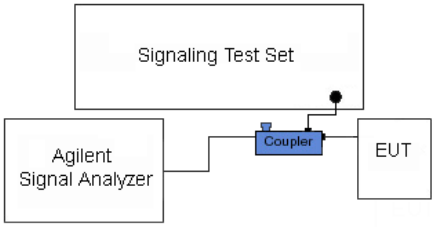


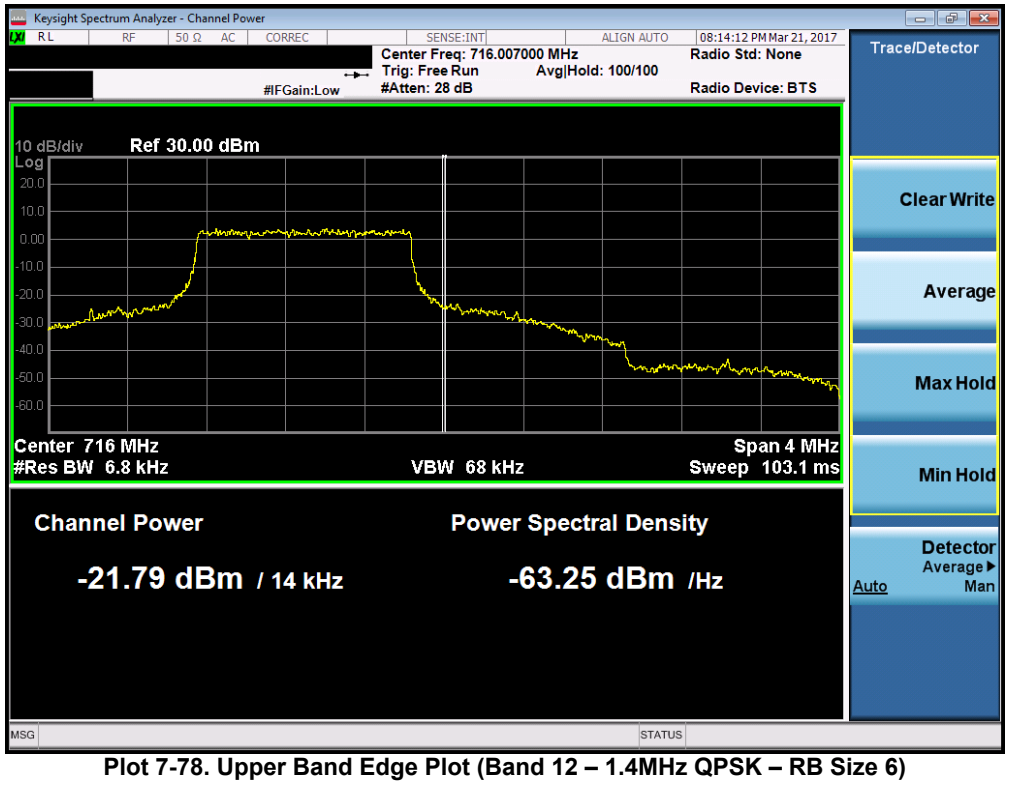
Figure 7-3. Test Instrument & Measurement Setup

Test Notes

Per 22.917(b) 24.238(a) 27.53(h) 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 to demonstrate compliance with the out-of-band emissions limit. 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 emission are attenuated at least 26 dB below the transmitter power.

Per 27.53(g) for operations in the 698-746 MHz band, in the 100 kHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least 30 kHz may be employed to demonstrate compliance with the out-of-band emissions limit.

Plot 7-77. Lower Band Edge Plot (Band 12 – 1.4MHz QPSK – RB Size 6)



Plot 7-78. Upper Band Edge Plot (Band 12 – 1.4MHz QPSK – RB Size 6)

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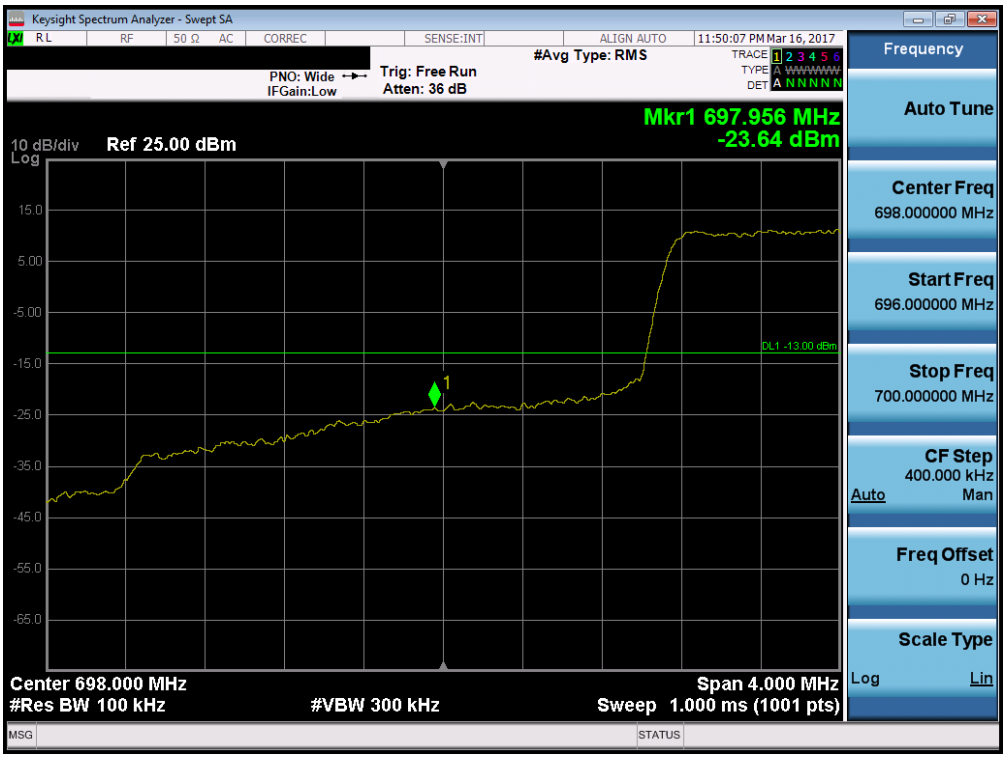
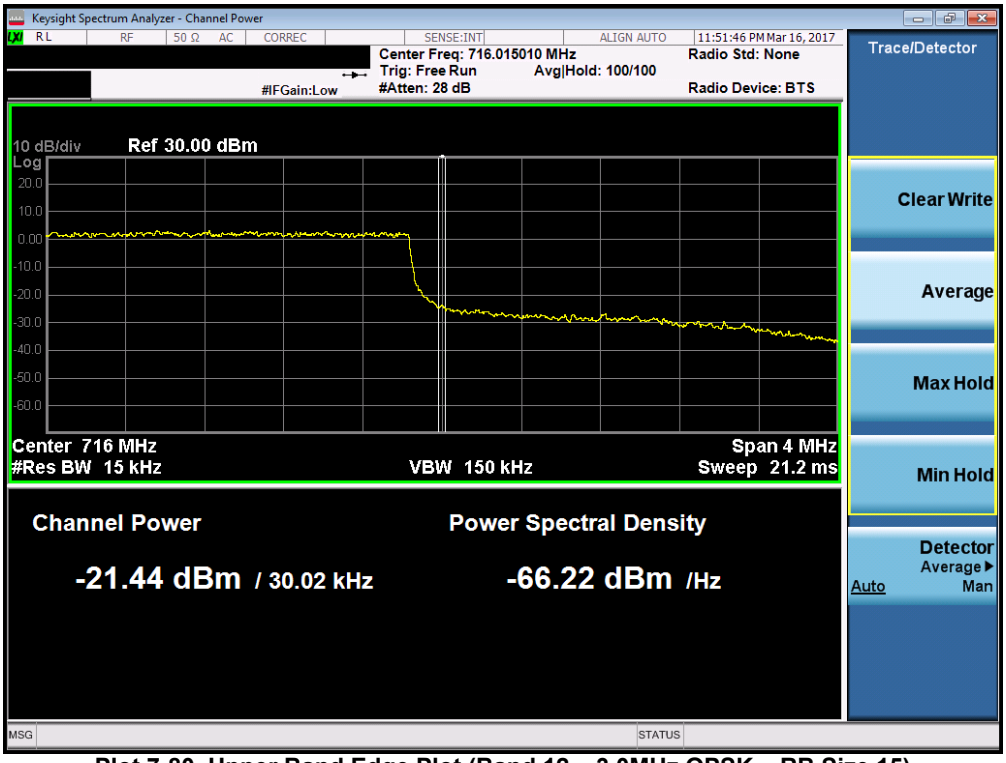
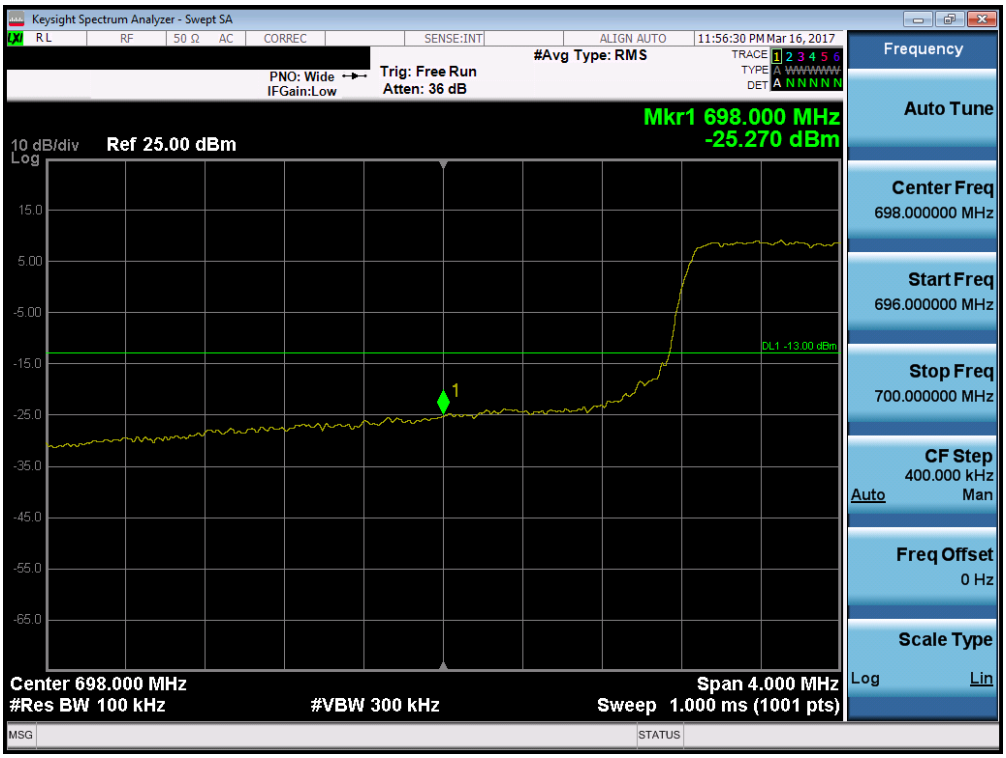


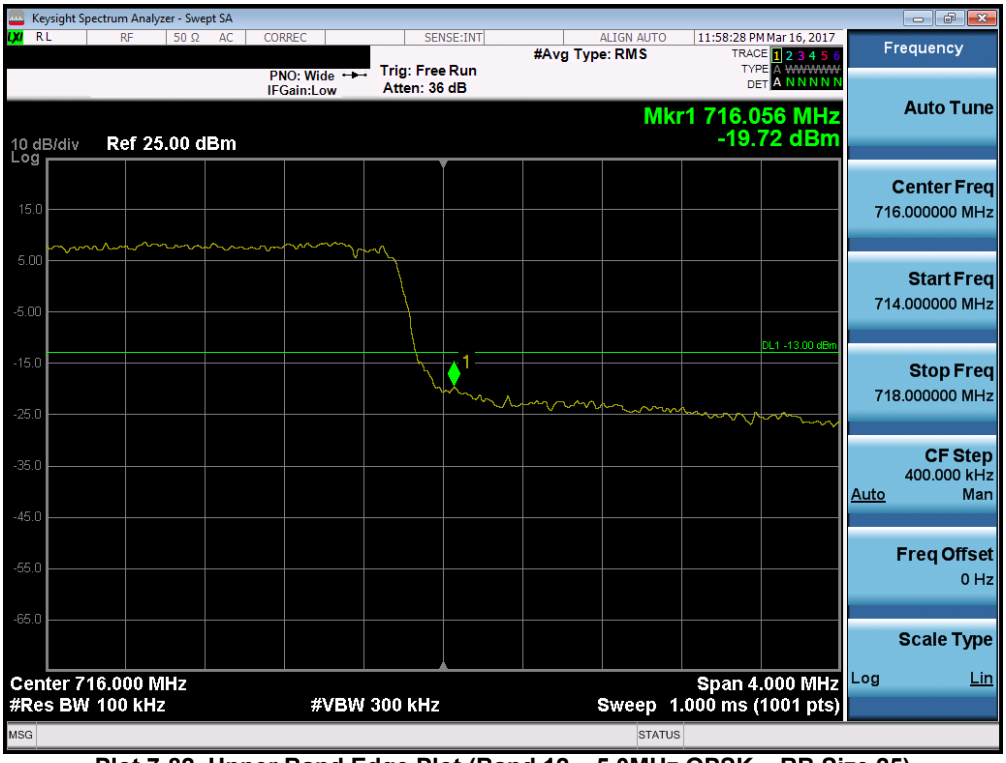
Plot 7-79. Lower Band Edge Plot (Band 12 – 3.0MHz QPSK – RB Size 15)



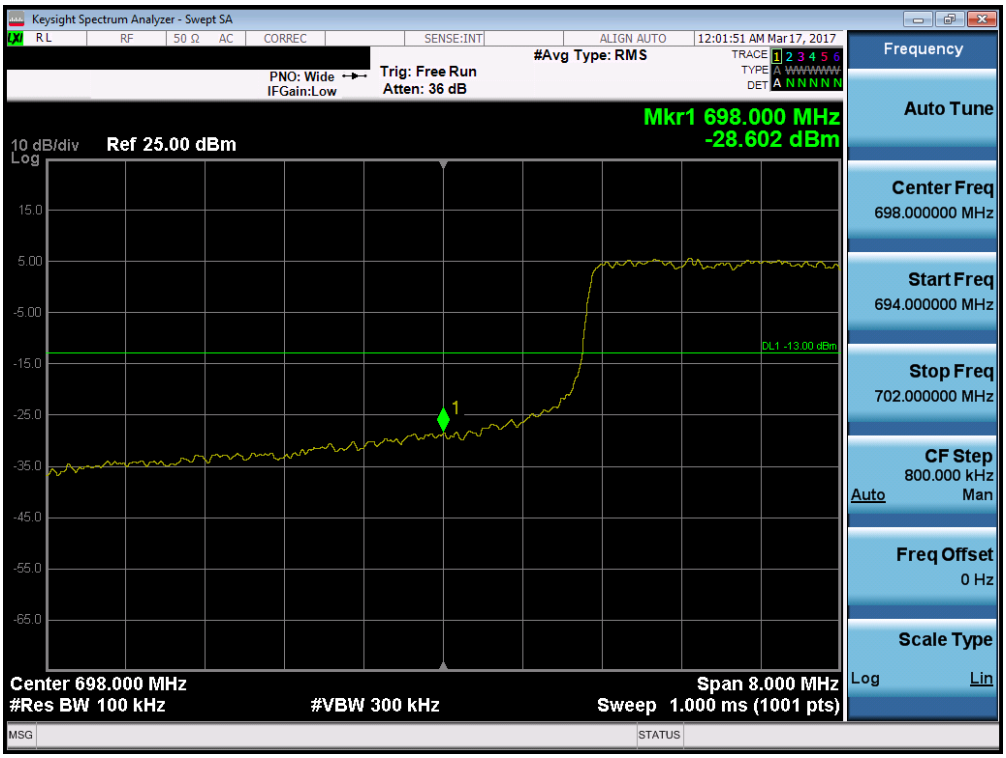
Plot 7-80. Upper Band Edge Plot (Band 12 – 3.0MHz QPSK – RB Size 15)



Plot 7-81. Lower Band Edge Plot (Band 12 – 5.0MHz QPSK – RB Size 25)

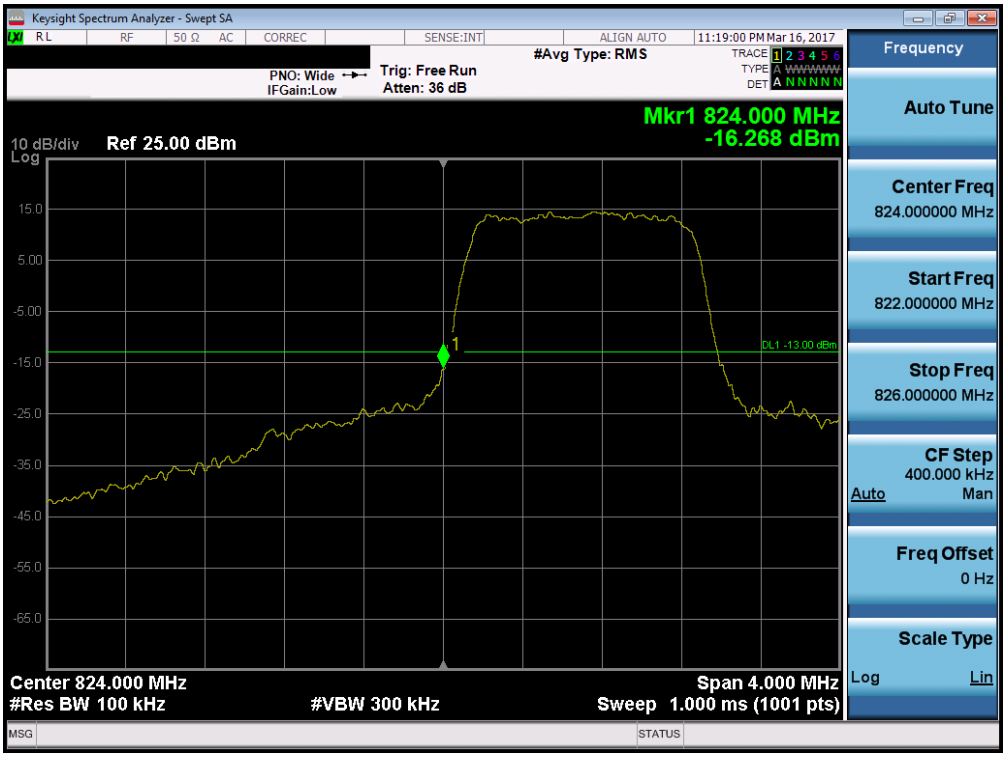


Plot 7-82. Upper Band Edge Plot (Band 12 – 5.0MHz QPSK – RB Size 25)

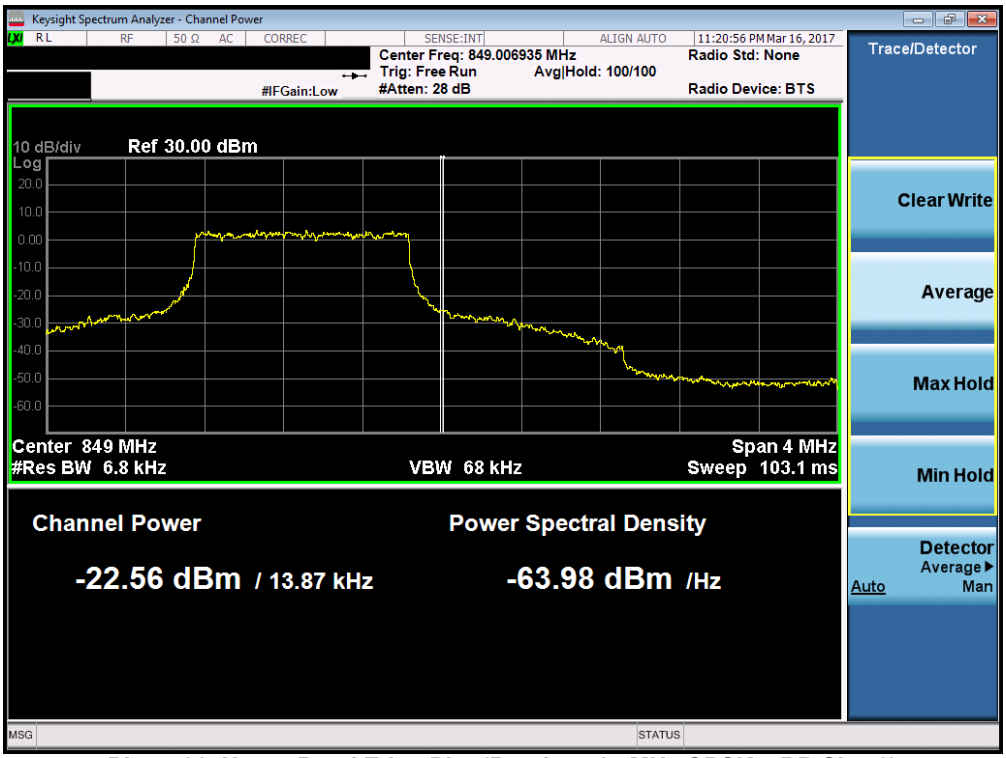


Plot 7-83. Lower Band Edge Plot (Band 12 – 10.0MHz QPSK – RB Size 50)

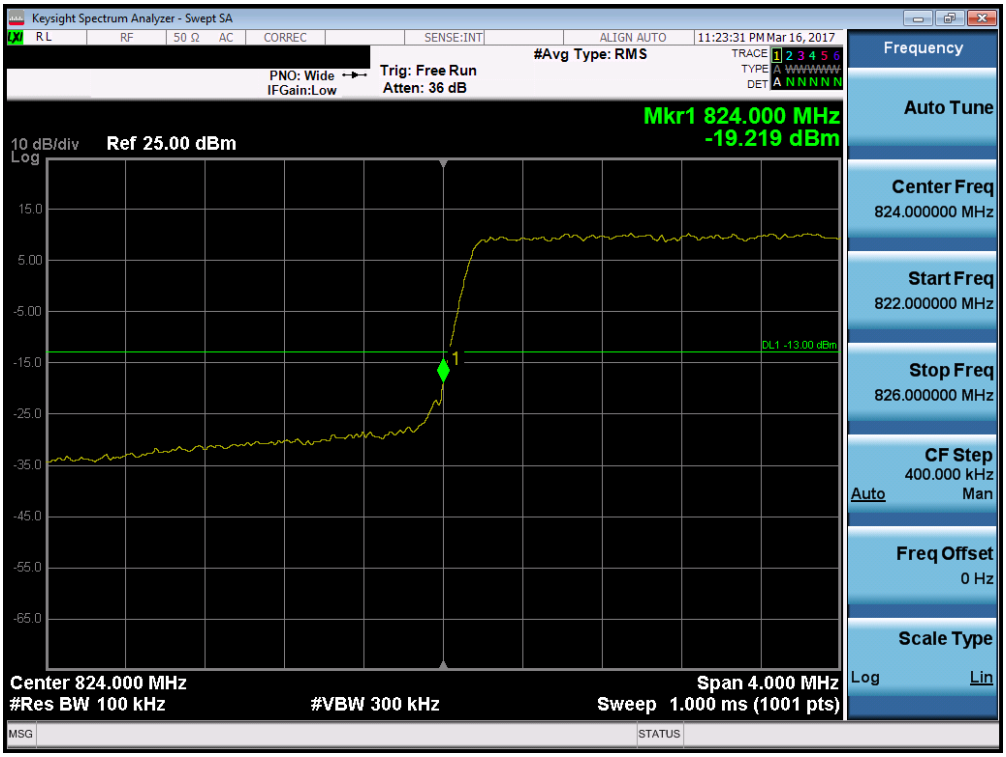
Plot 7-84. Upper Band Edge Plot (Band 12 – 10.0MHz QPSK – RB Size 50)



Plot 7-85. Lower Band Edge Plot (Band 5 – 1.4MHz QPSK – RB Size 6)

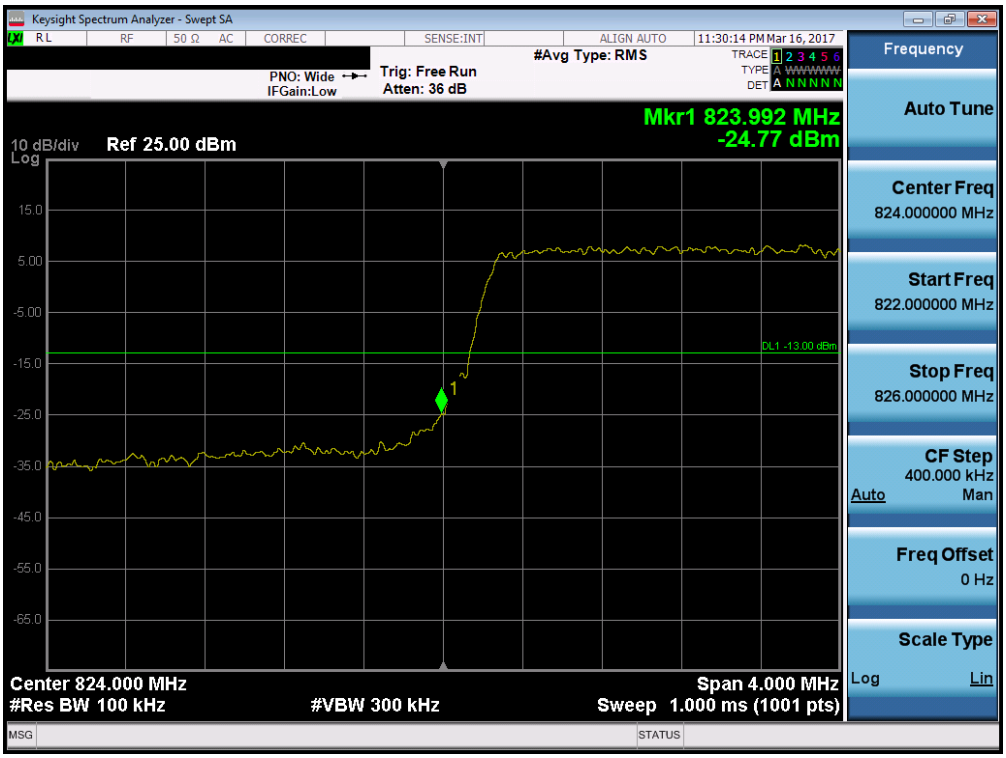


Plot 7-86. Upper Band Edge Plot (Band 5 – 1.4MHz QPSK – RB Size 6)



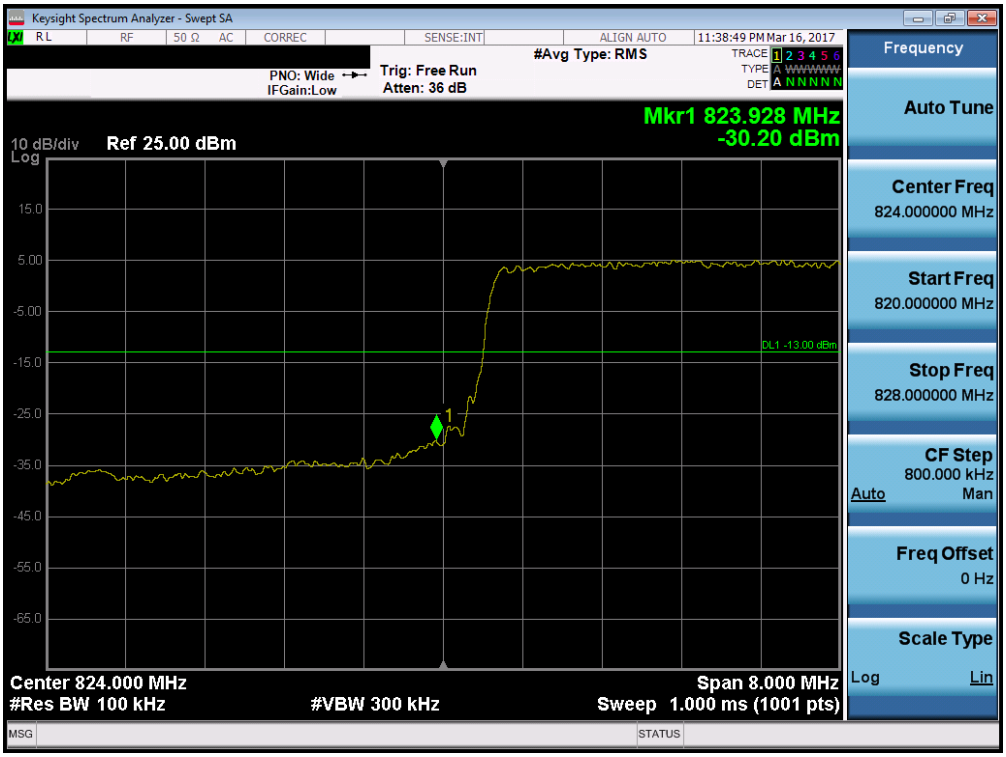
Plot 7-87. Lower Band Edge Plot (Band 5 – 3.0MHz QPSK – RB Size 15)

Plot 7-88. Upper Band Edge Plot (Band 5 – 3.0MHz QPSK – RB Size 15)



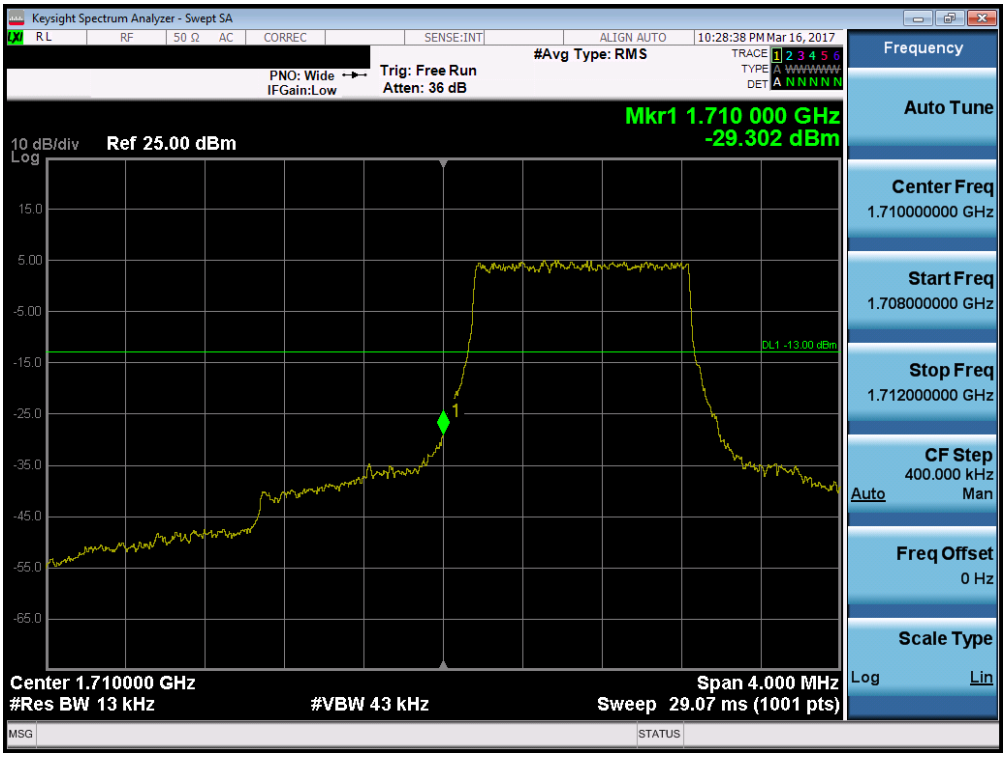
Plot 7-89. Lower Band Edge Plot (Band 5 – 5.0MHz QPSK – RB Size 25)

Plot 7-90. Upper Band Edge Plot (Band 5 – 5.0MHz QPSK – RB Size 25)

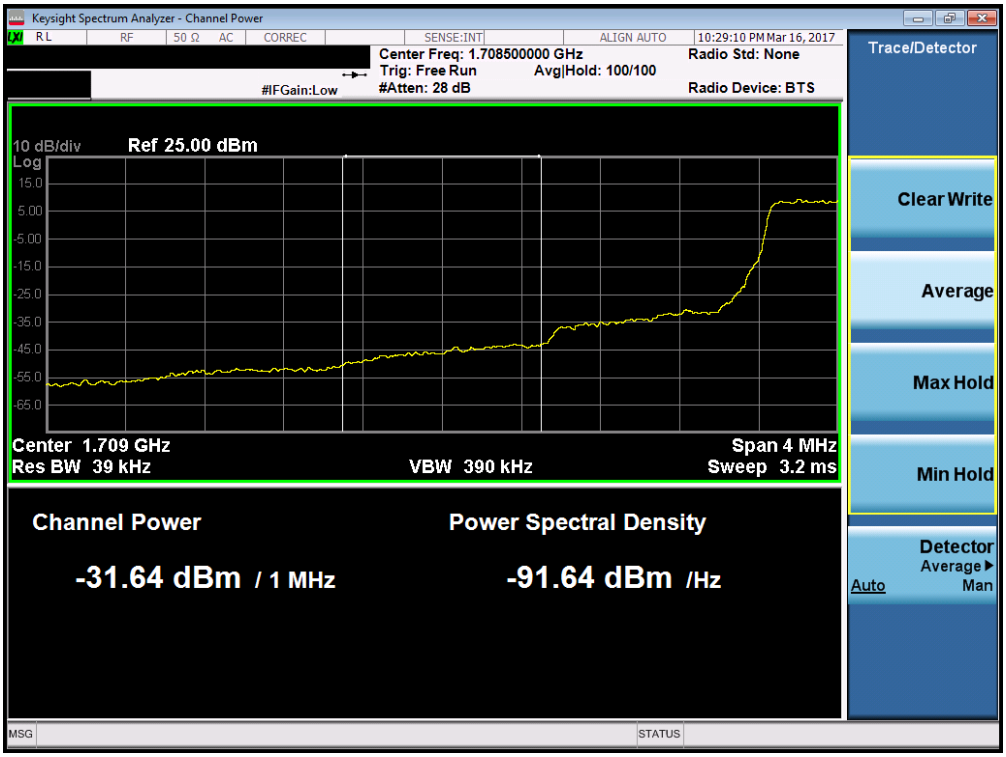


Plot 7-91. Lower Band Edge Plot (Band 5 – 10.0MHz QPSK – RB Size 50)

Plot 7-92. Upper Band Edge Plot (Band 5 – 10.0MHz QPSK – RB Size 50)

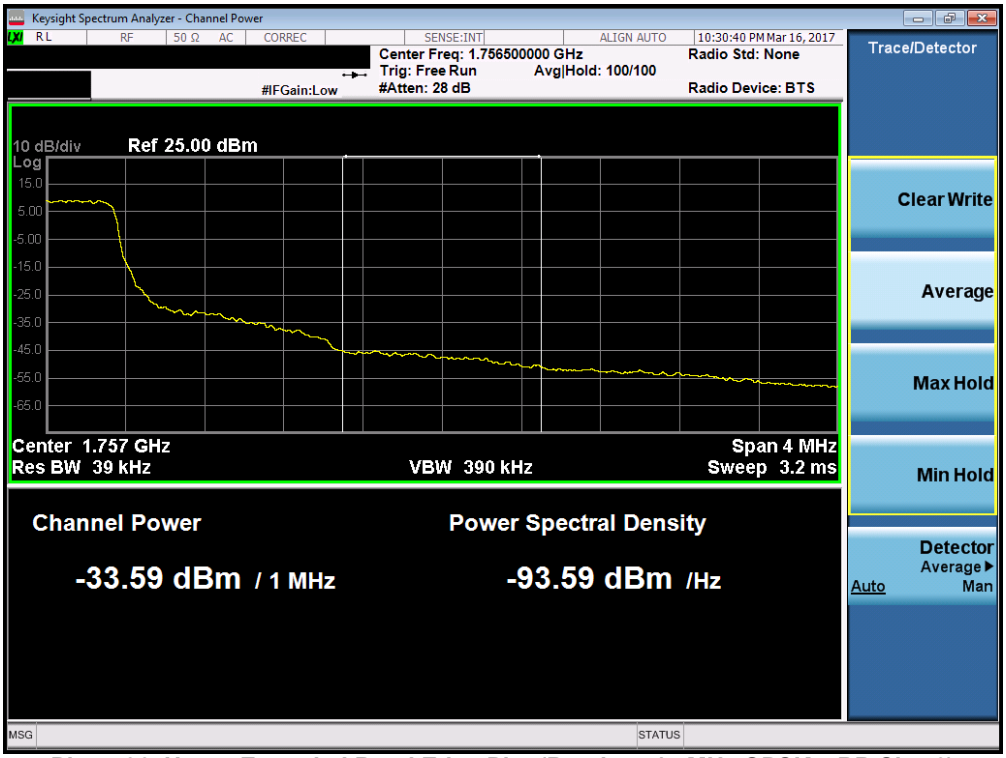


Plot 7-93. Lower Band Edge Plot (Band 4 – 1.4MHz QPSK – RB Size 6)

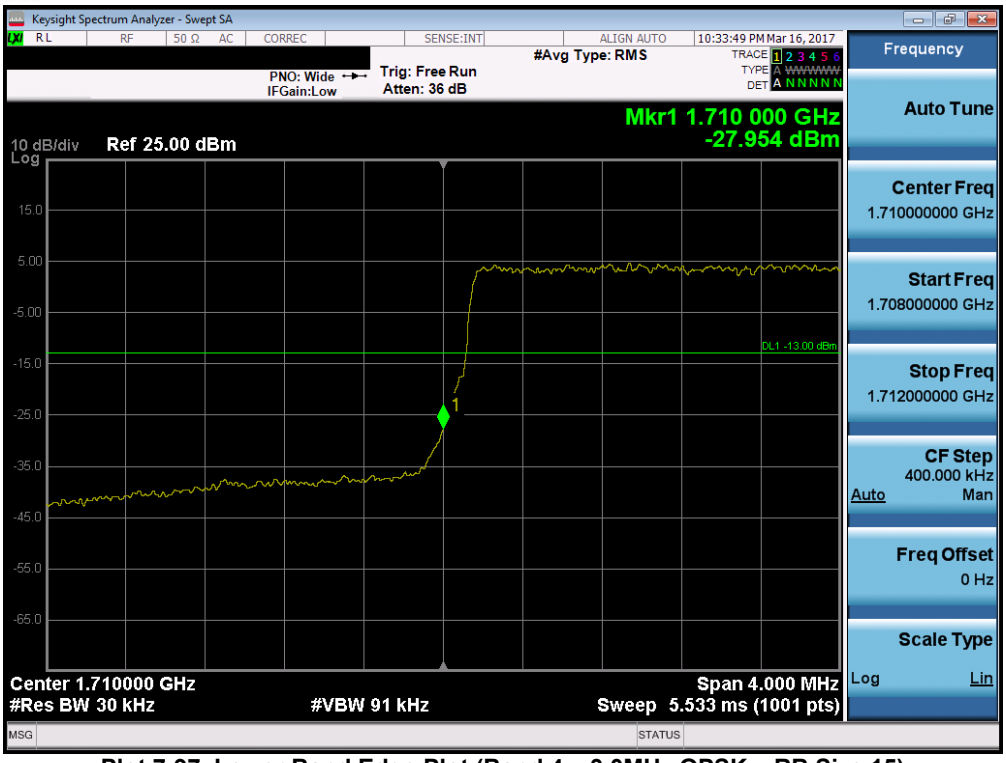


Plot 7-94. Lower Extended Band Edge Plot (Band 4 – 1.4MHz QPSK – RB Size 6)

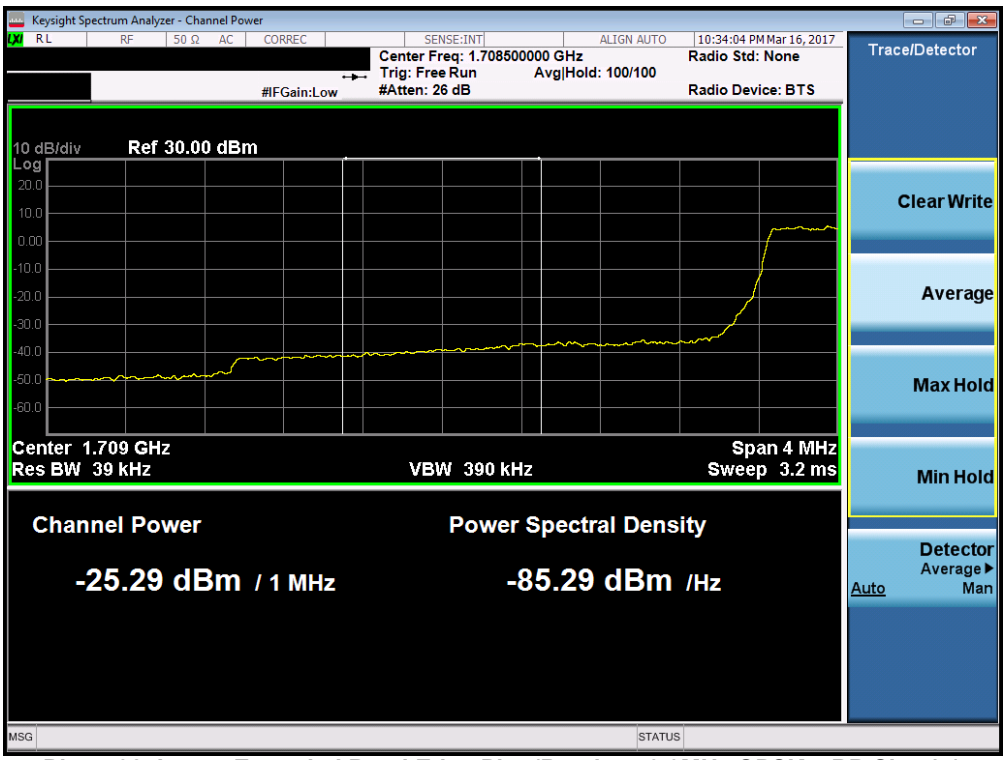
Plot 7-95. Upper Band Edge Plot (Band 4 – 1.4MHz QPSK – RB Size 6)



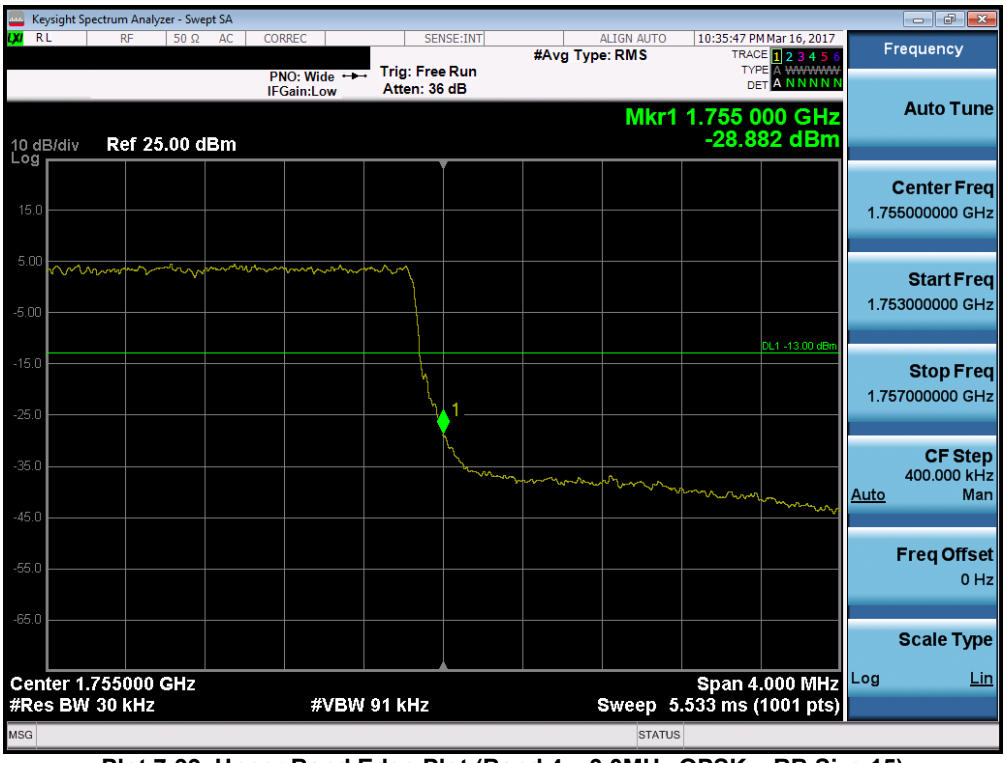
Plot 7-96. Upper Extended Band Edge Plot (Band 4 – 1.4MHz QPSK – RB Size 6)



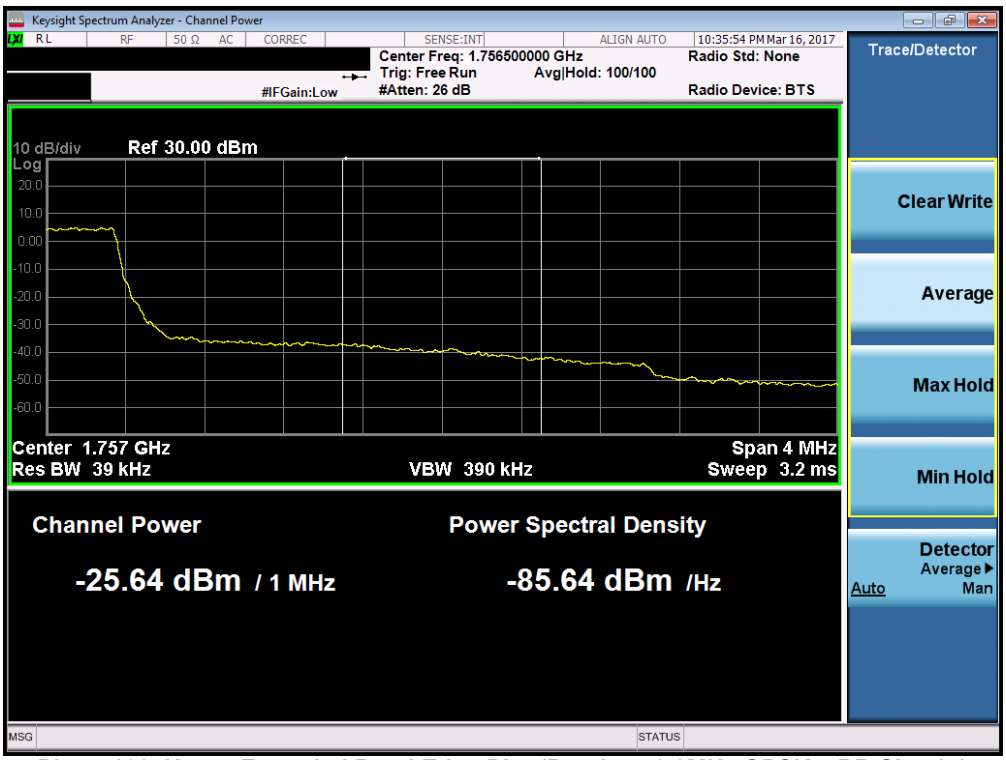
Plot 7-97. Lower Band Edge Plot (Band 4 – 3.0MHz QPSK – RB Size 15)



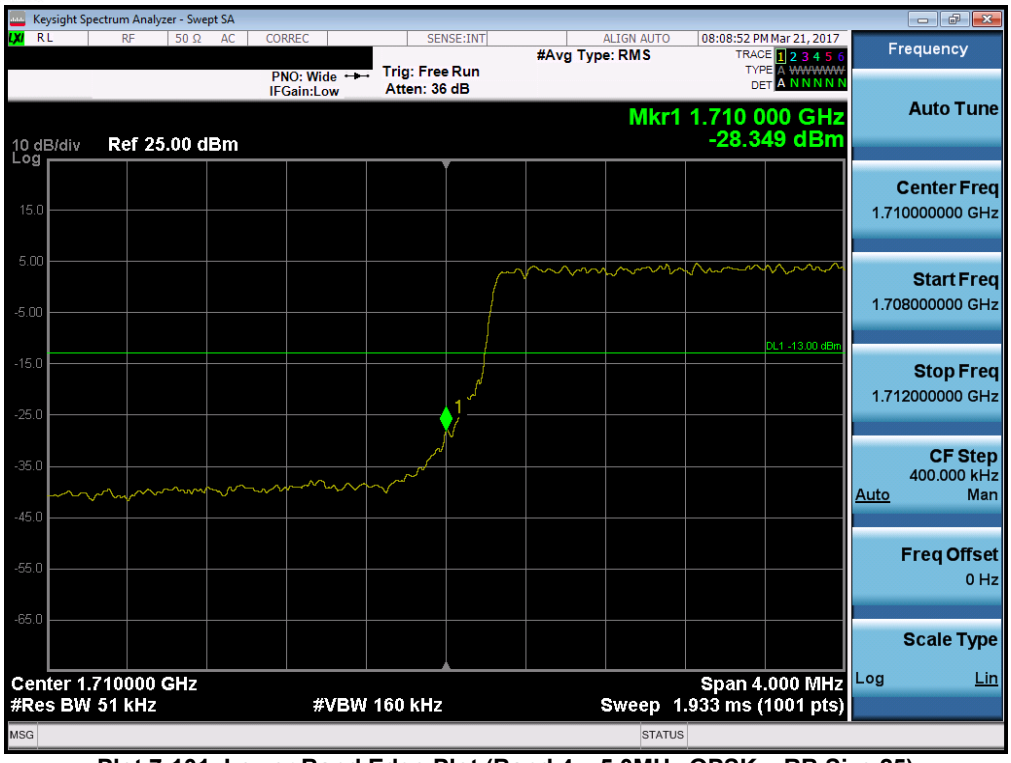
Plot 7-98. Lower Extended Band Edge Plot (Band 4 – 3.0MHz QPSK – RB Size 15)



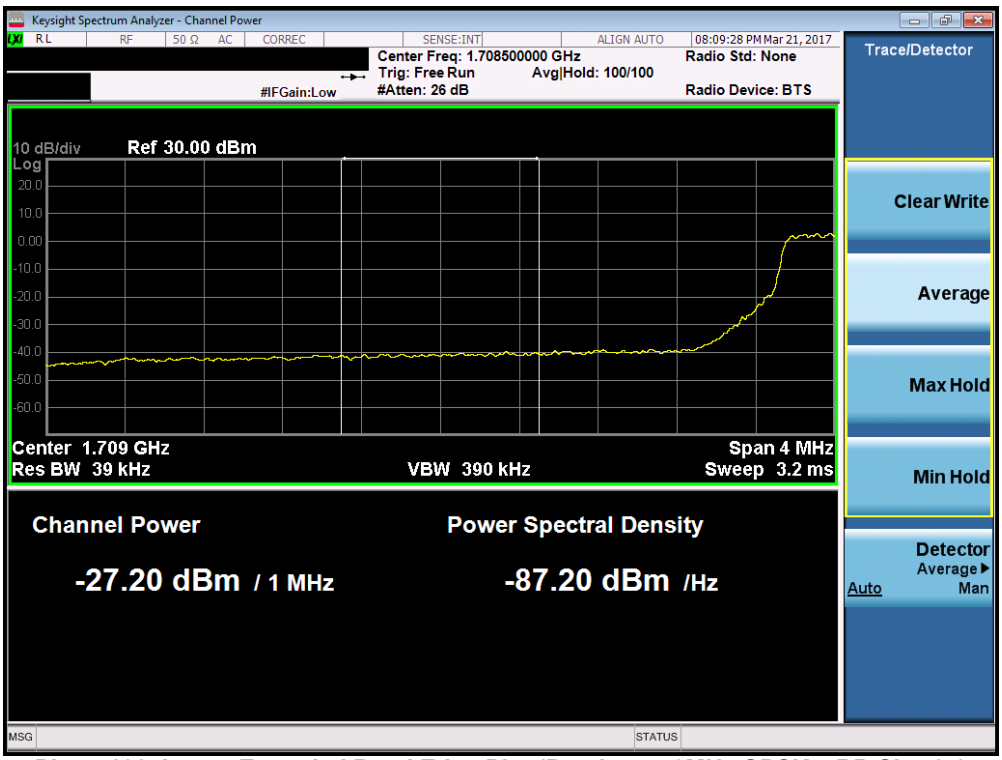
Plot 7-99. Upper Band Edge Plot (Band 4 – 3.0MHz QPSK – RB Size 15)



Plot 7-100. Upper Extended Band Edge Plot (Band 4 – 3.0MHz QPSK – RB Size 15)



Plot 7-101. Lower Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)



Plot 7-102. Lower Extended Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)

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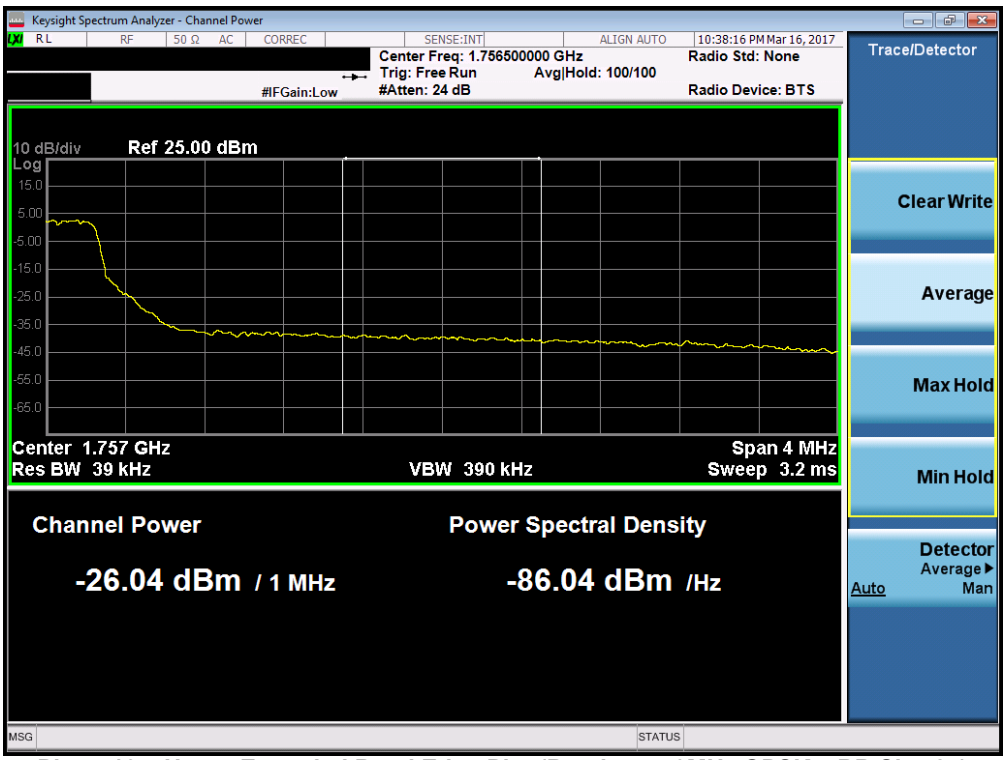
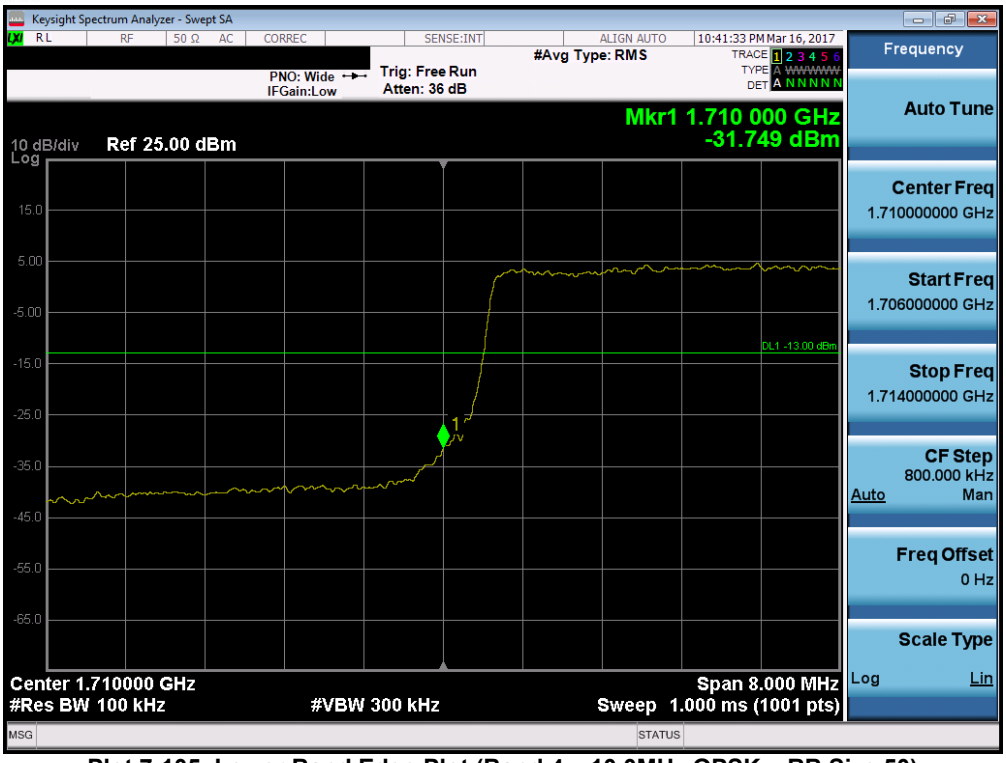
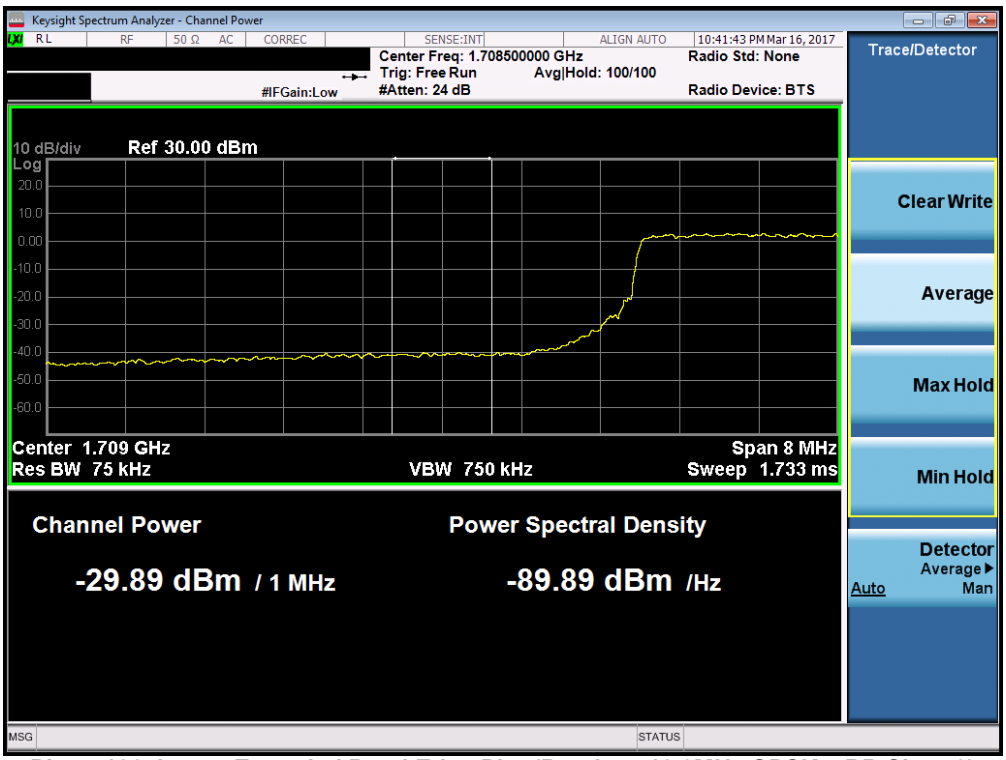
Plot 7-103. Upper Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)



Plot 7-104. Upper Extended Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)

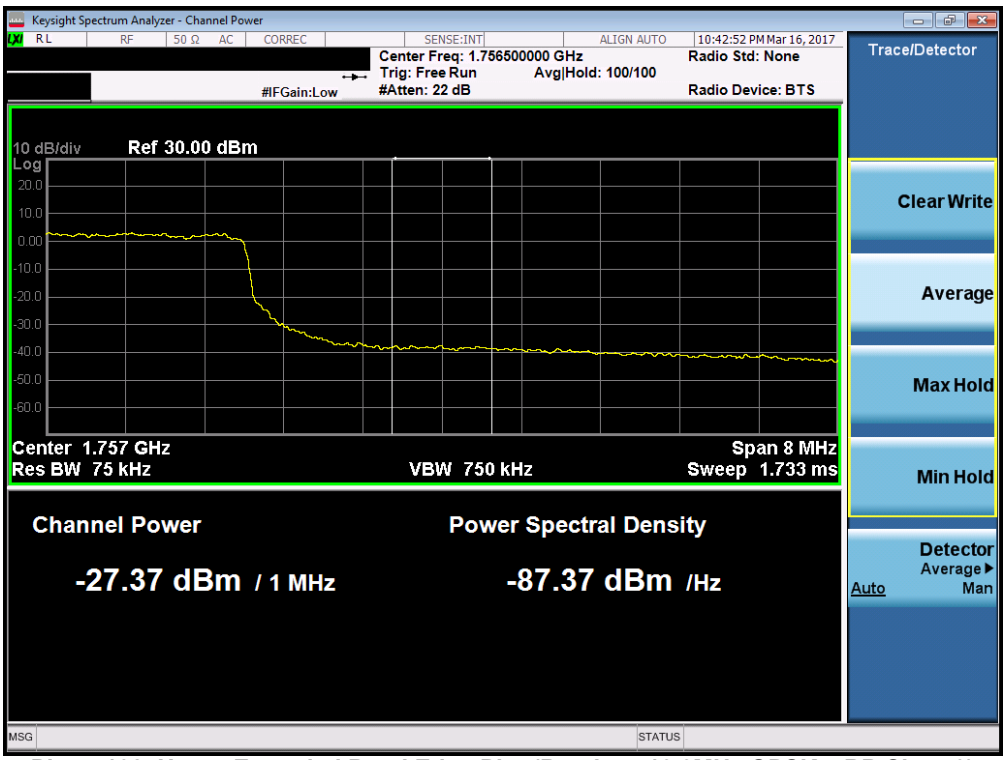


Plot 7-105. Lower Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)

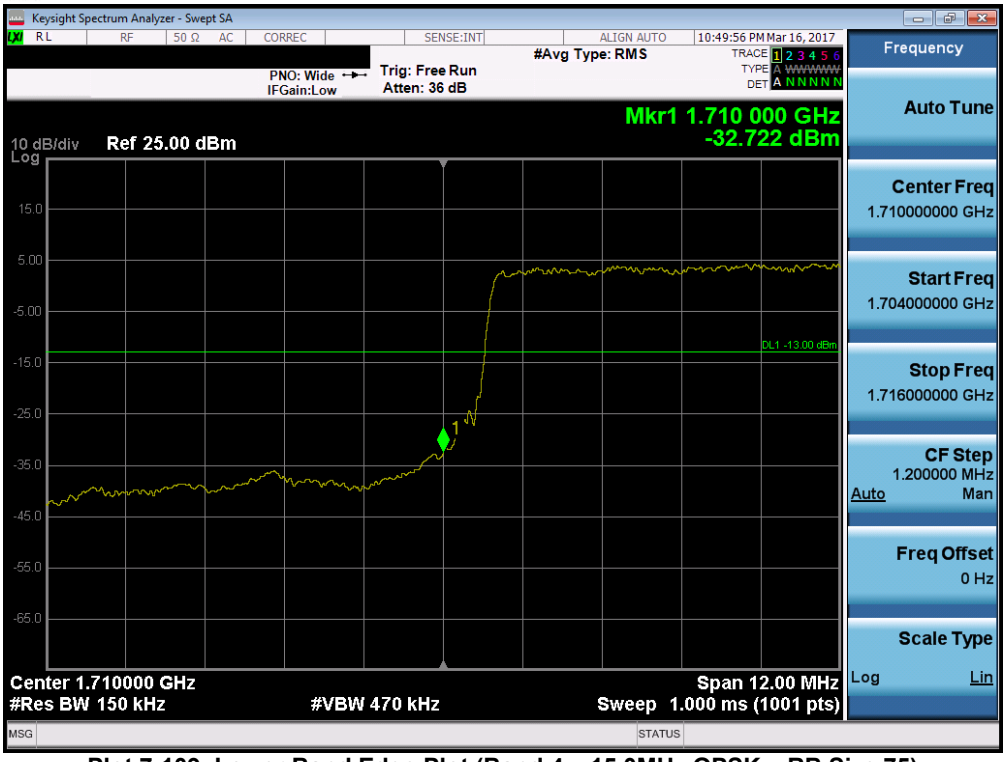


Plot 7-106. Lower Extended Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)

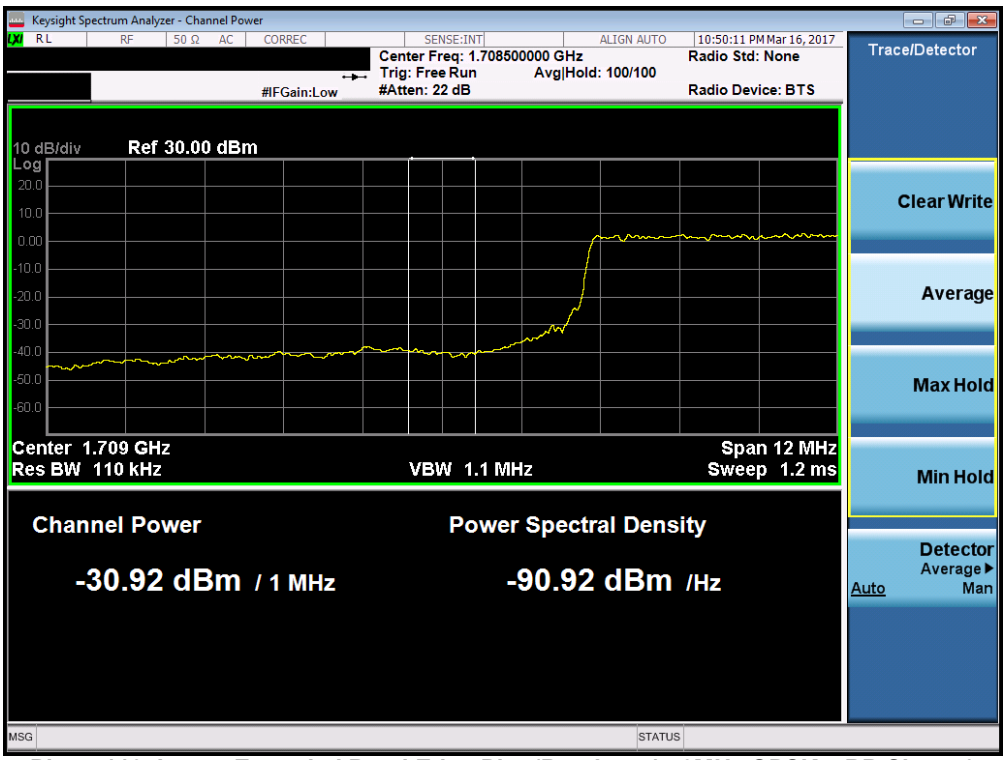
Plot 7-107. Upper Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)



Plot 7-108. Upper Extended Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)

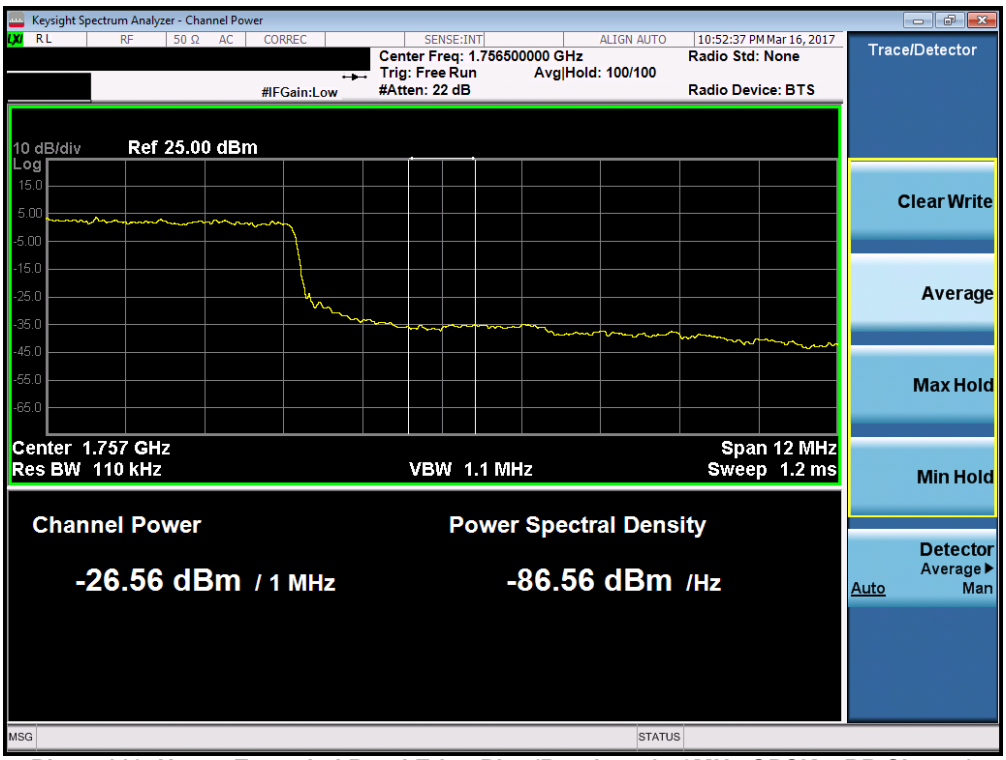


Plot 7-109. Lower Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)

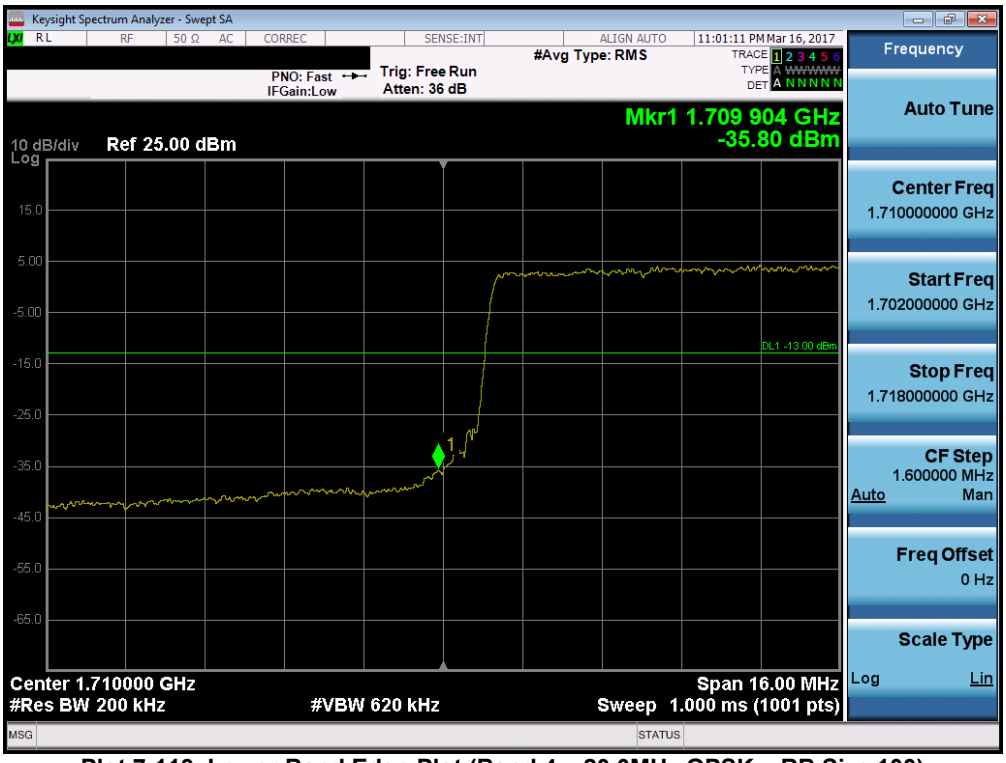


Plot 7-110. Lower Extended Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)

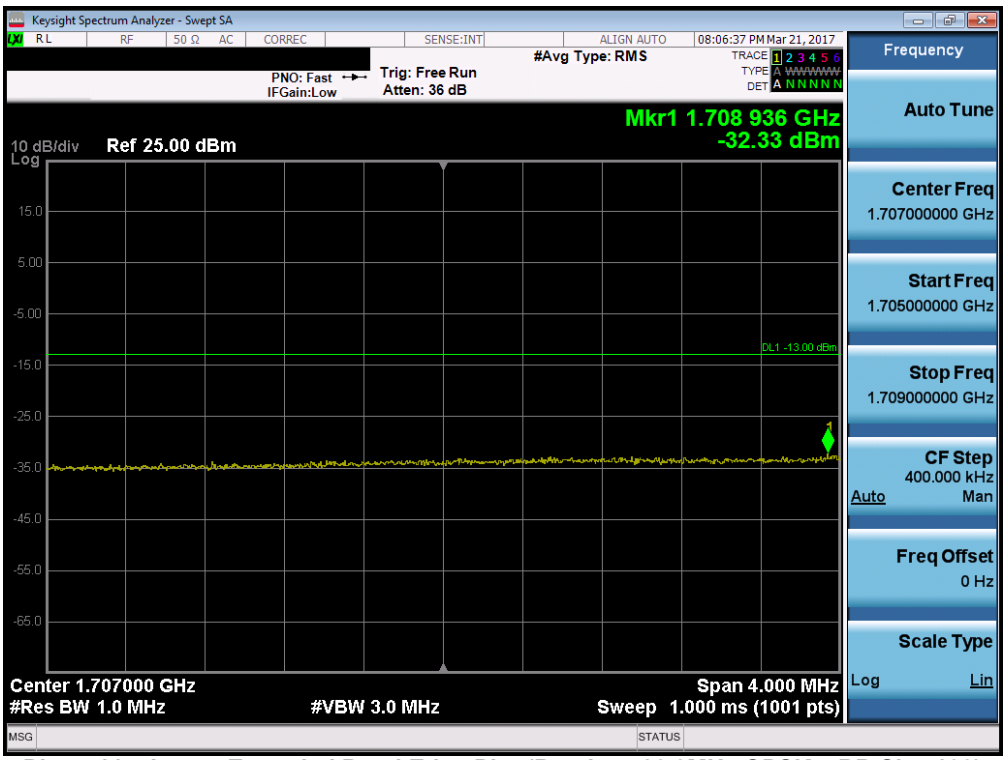
Plot 7-111. Upper Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)



Plot 7-112. Upper Extended Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)

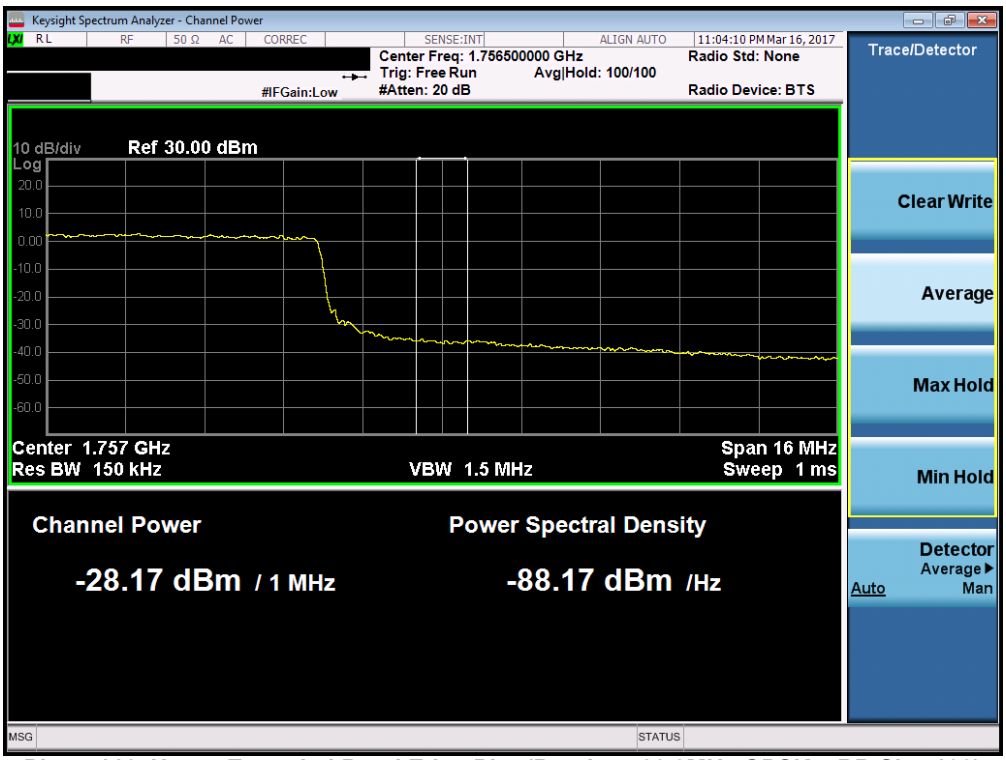


Plot 7-113. Lower Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)

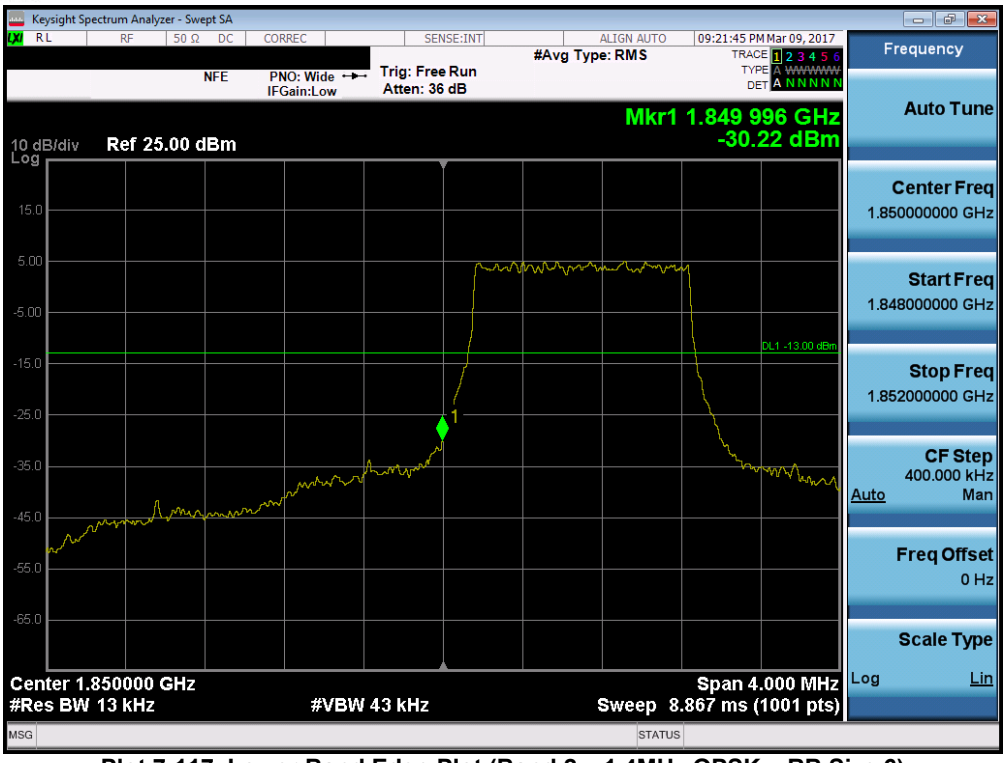


Plot 7-114. Lower Extended Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)

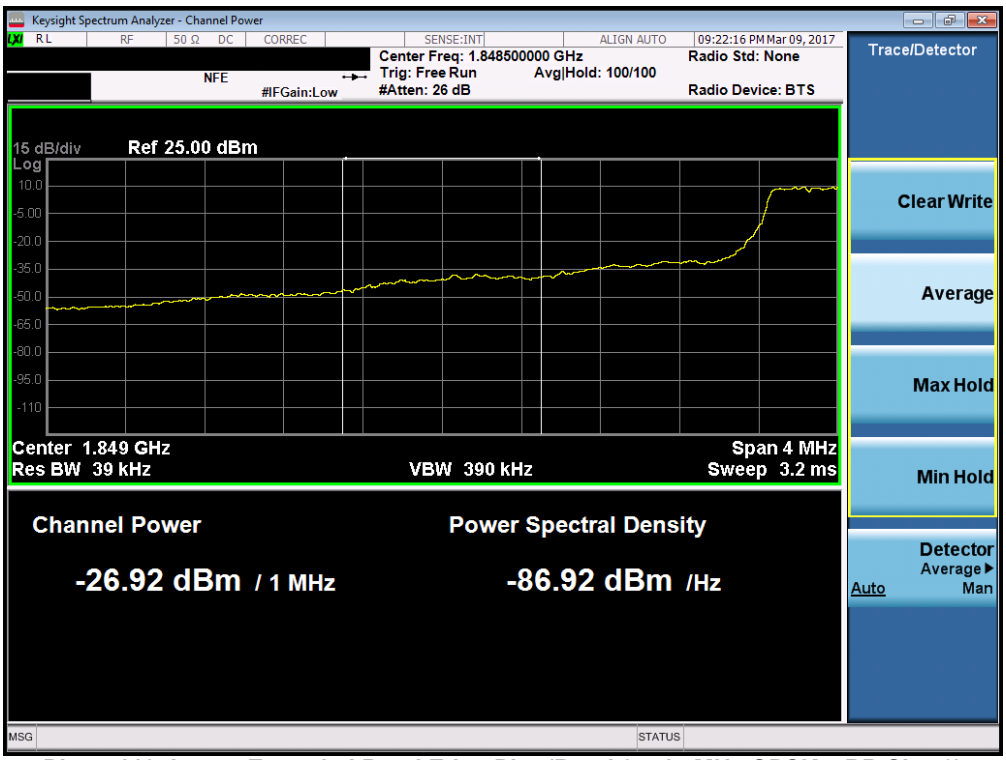
Plot 7-115. Upper Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)



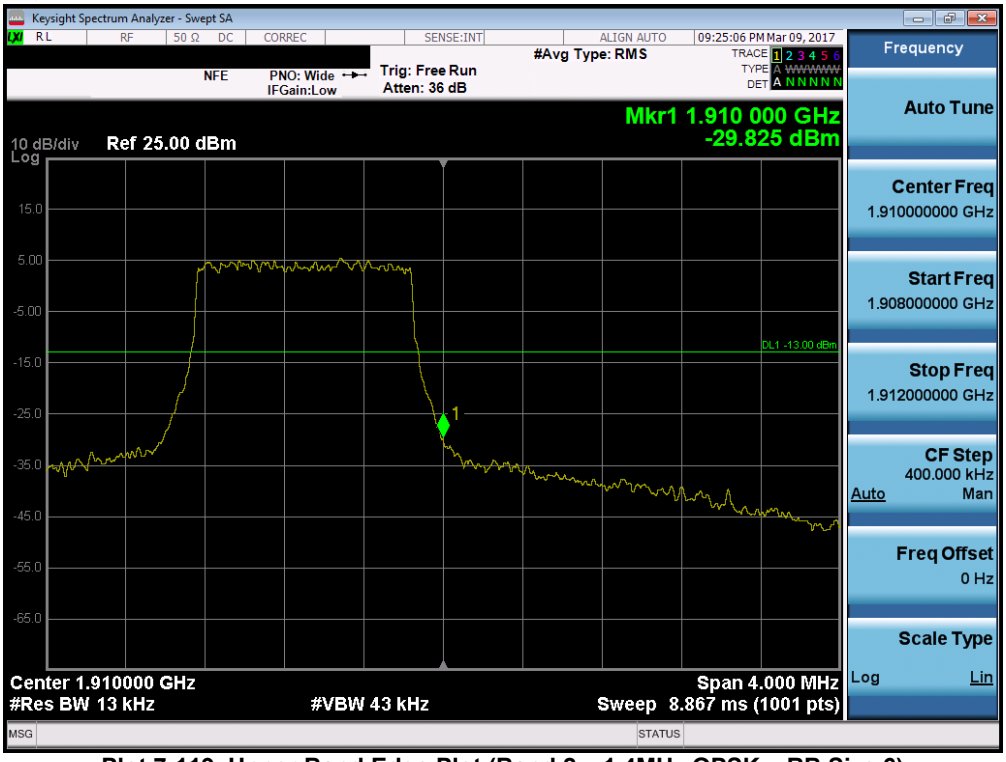
Plot 7-116. Upper Extended Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)



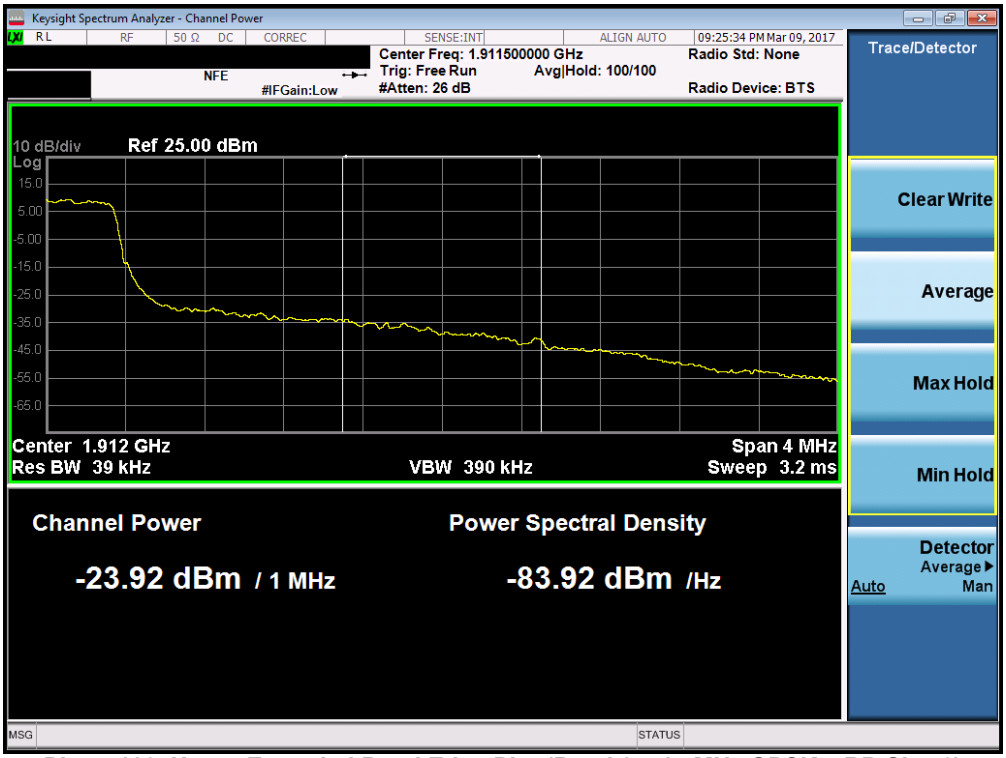
Plot 7-117. Lower Band Edge Plot (Band 2 – 1.4MHz QPSK – RB Size 6)



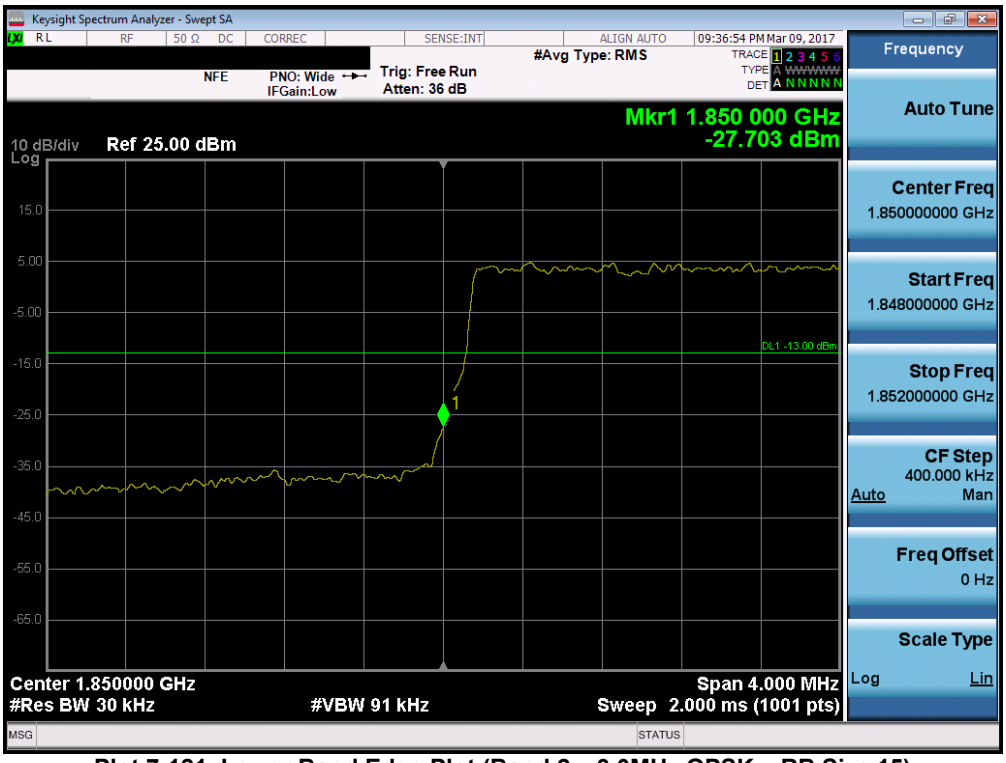
Plot 7-118. Lower Extended Band Edge Plot (Band 2 – 1.4MHz QPSK – RB Size 6)



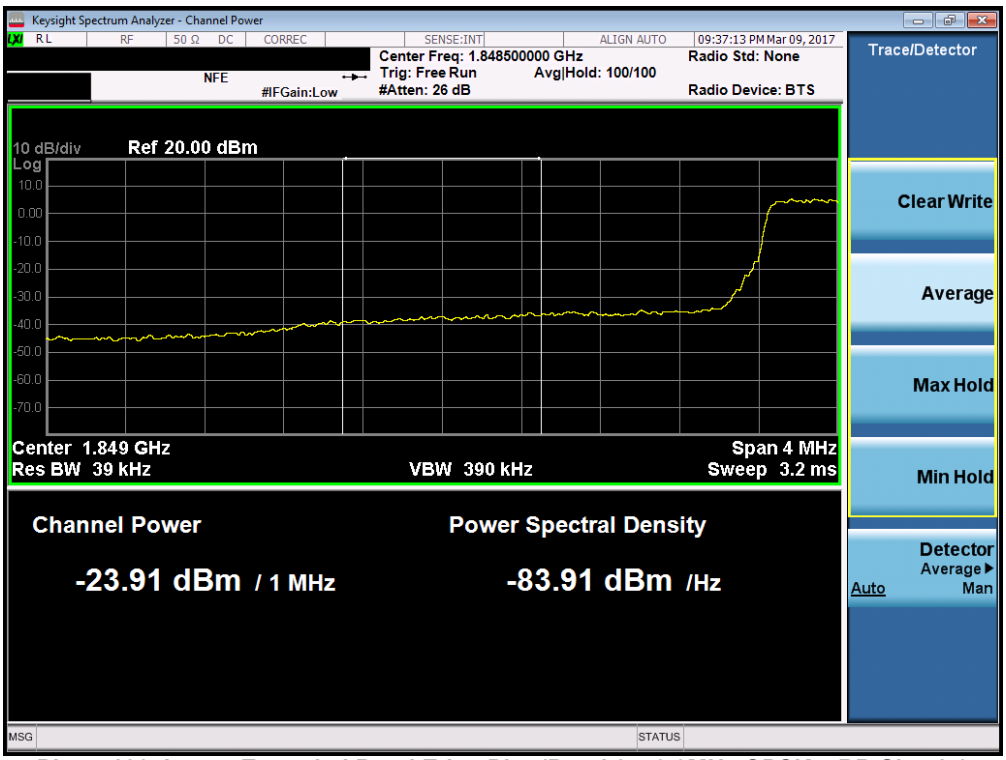
Plot 7-119. Upper Band Edge Plot (Band 2 – 1.4MHz QPSK – RB Size 6)



Plot 7-120. Upper Extended Band Edge Plot (Band 2 – 1.4MHz QPSK – RB Size 6)

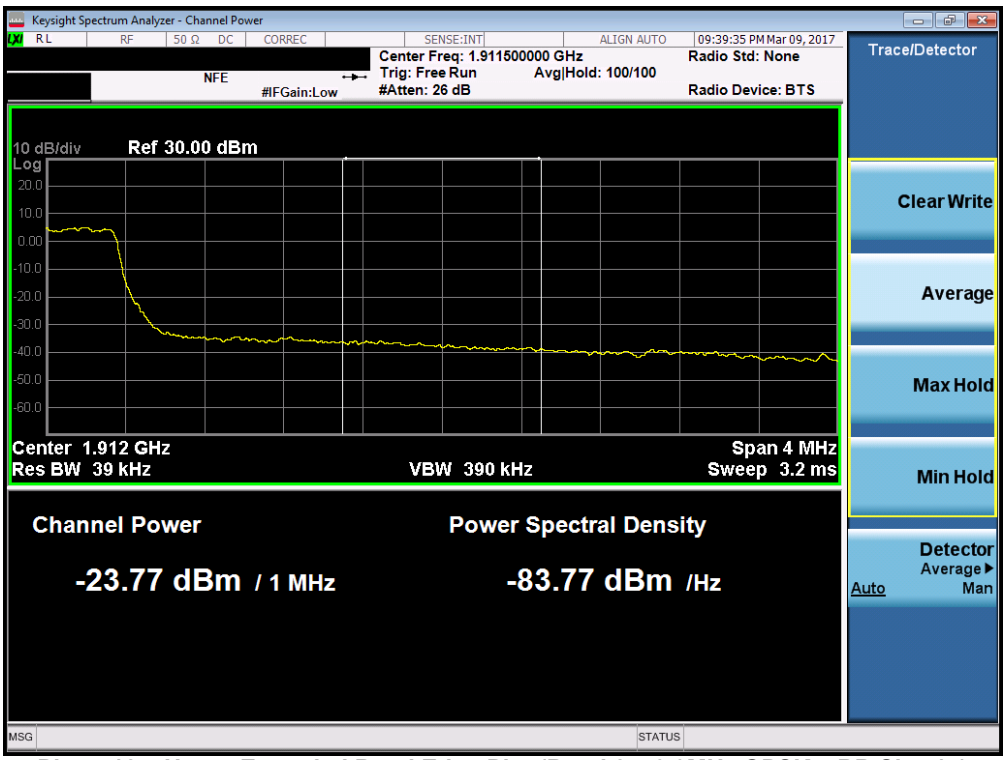


Plot 7-121. Lower Band Edge Plot (Band 2 – 3.0MHz QPSK – RB Size 15)

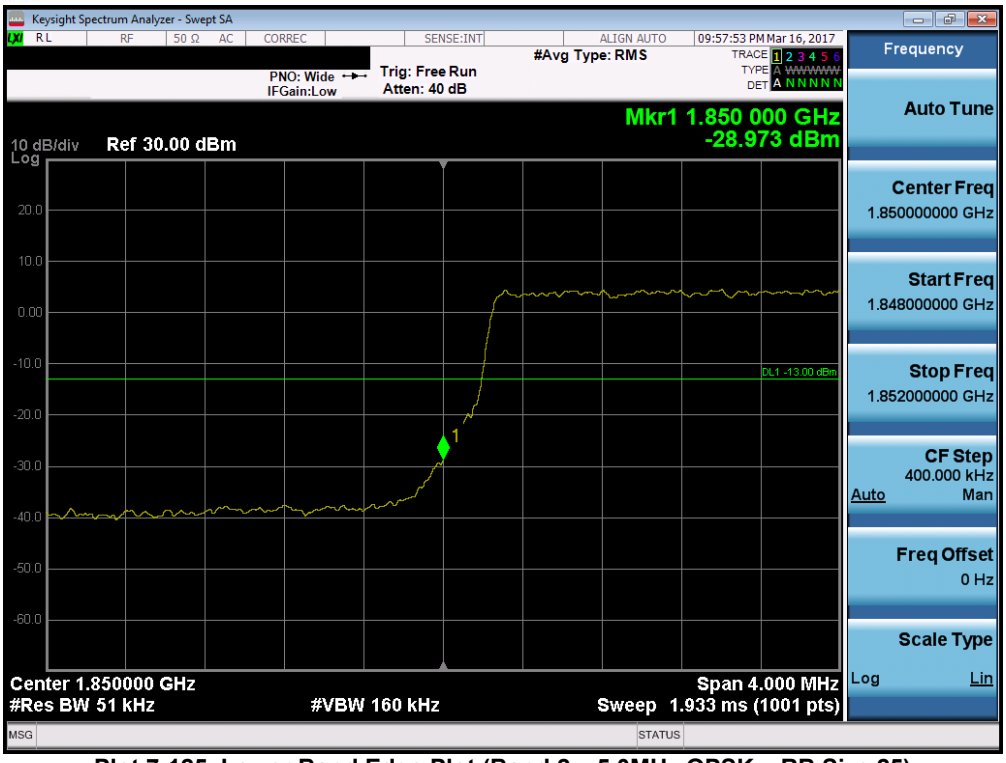


Plot 7-122. Lower Extended Band Edge Plot (Band 2 – 3.0MHz QPSK – RB Size 15)

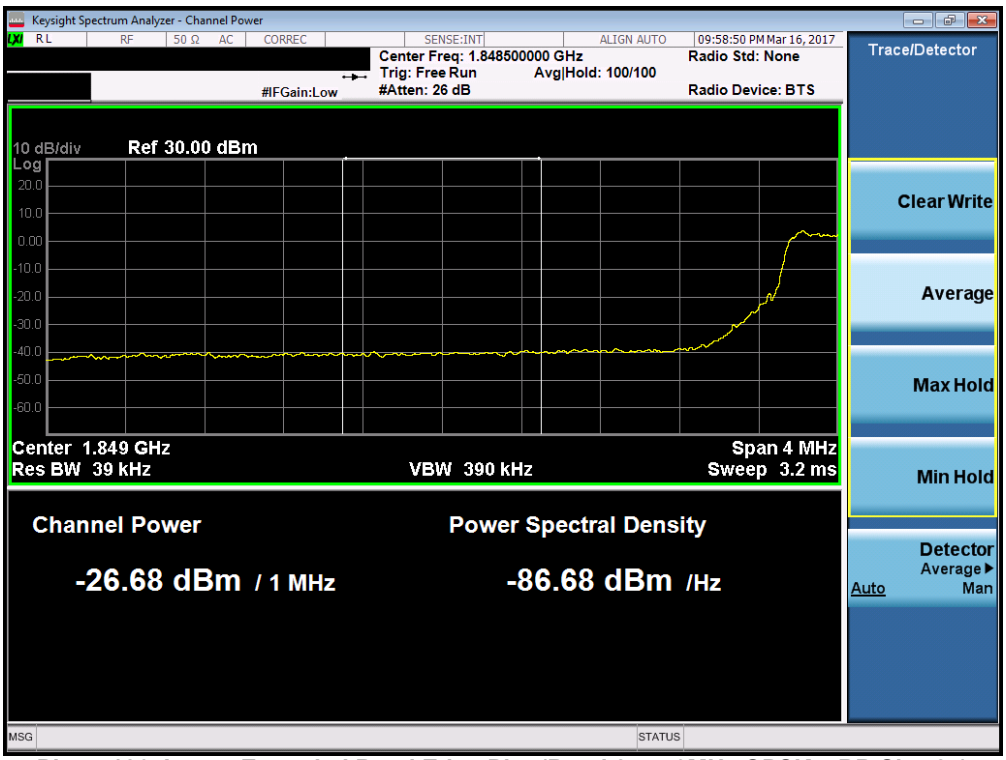
Plot 7-123. Upper Band Edge Plot (Band 2 – 3.0MHz QPSK – RB Size 15)



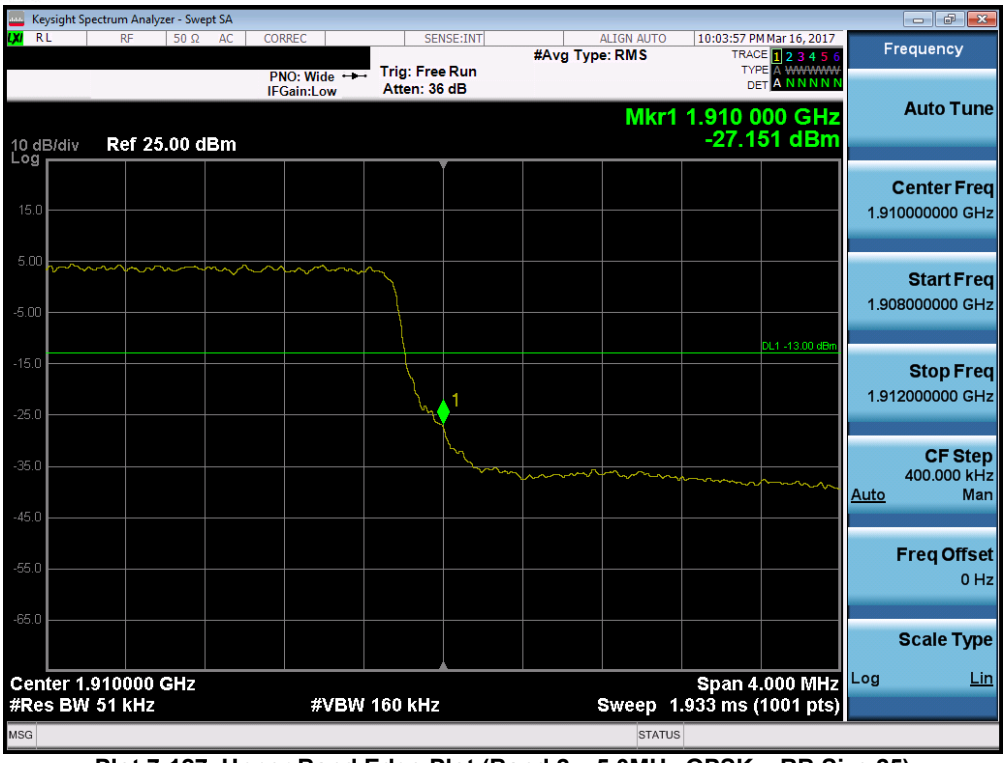
Plot 7-124. Upper Extended Band Edge Plot (Band 2 – 3.0MHz QPSK – RB Size 15)



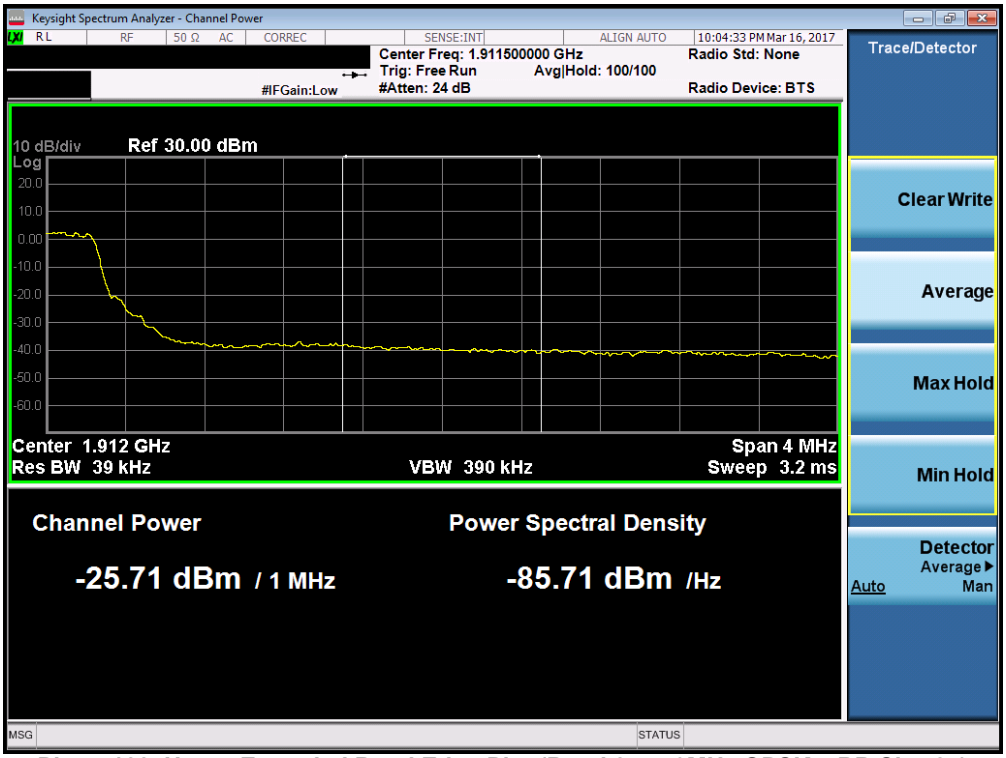
Plot 7-125. Lower Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)



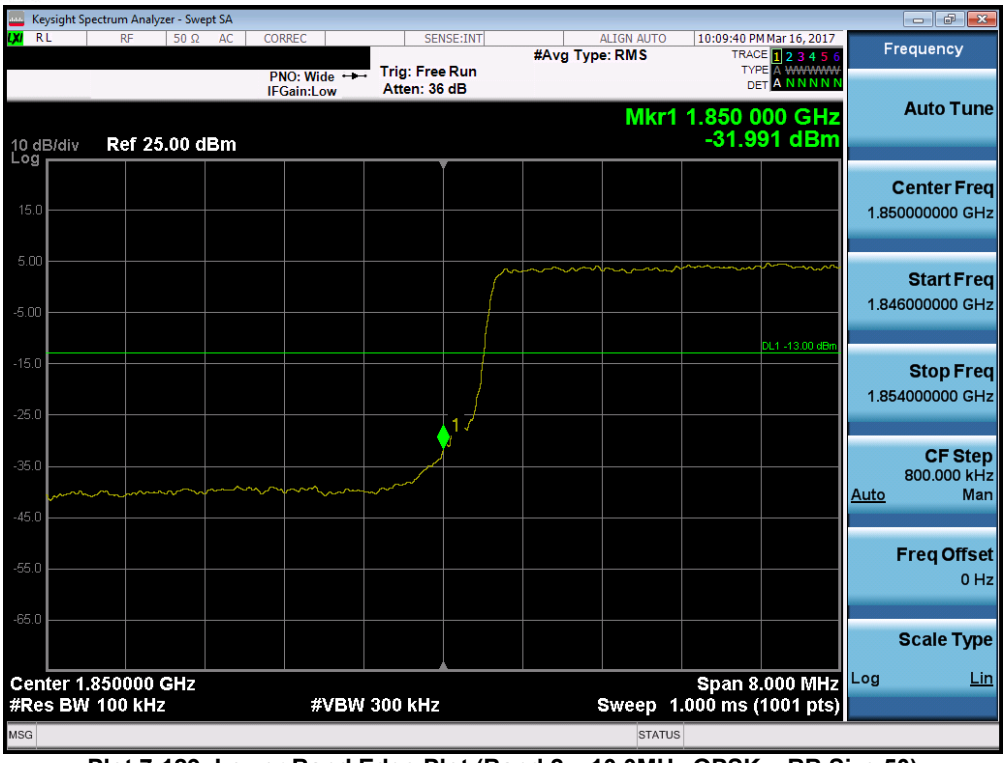
Plot 7-126. Lower Extended Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)



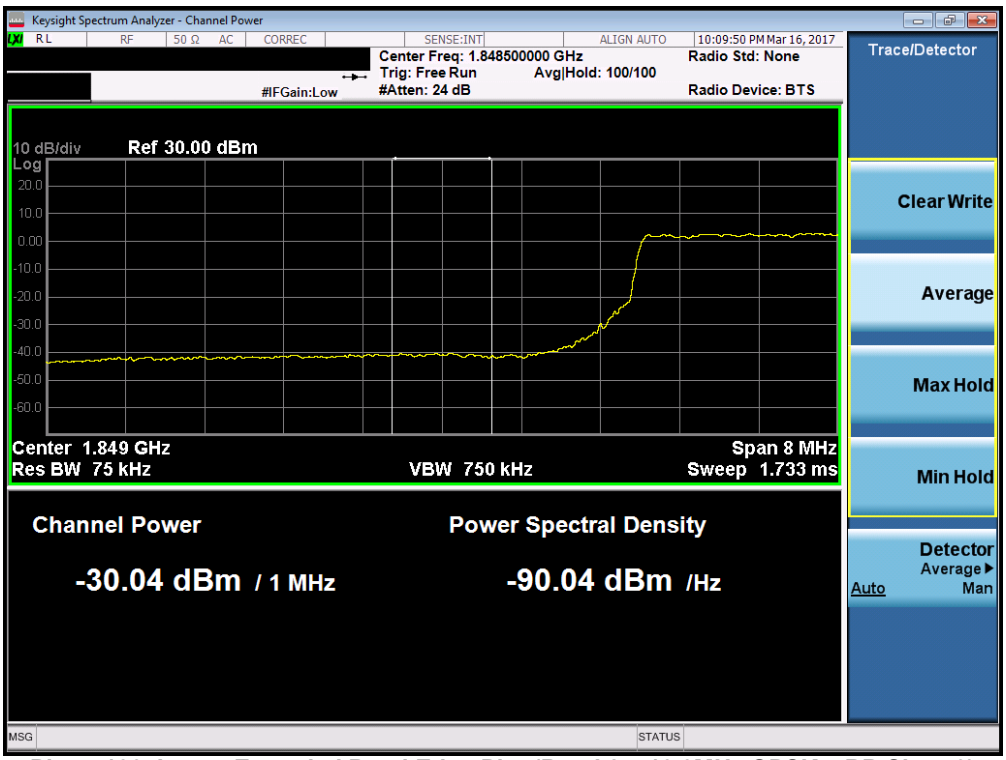
Plot 7-127. Upper Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)



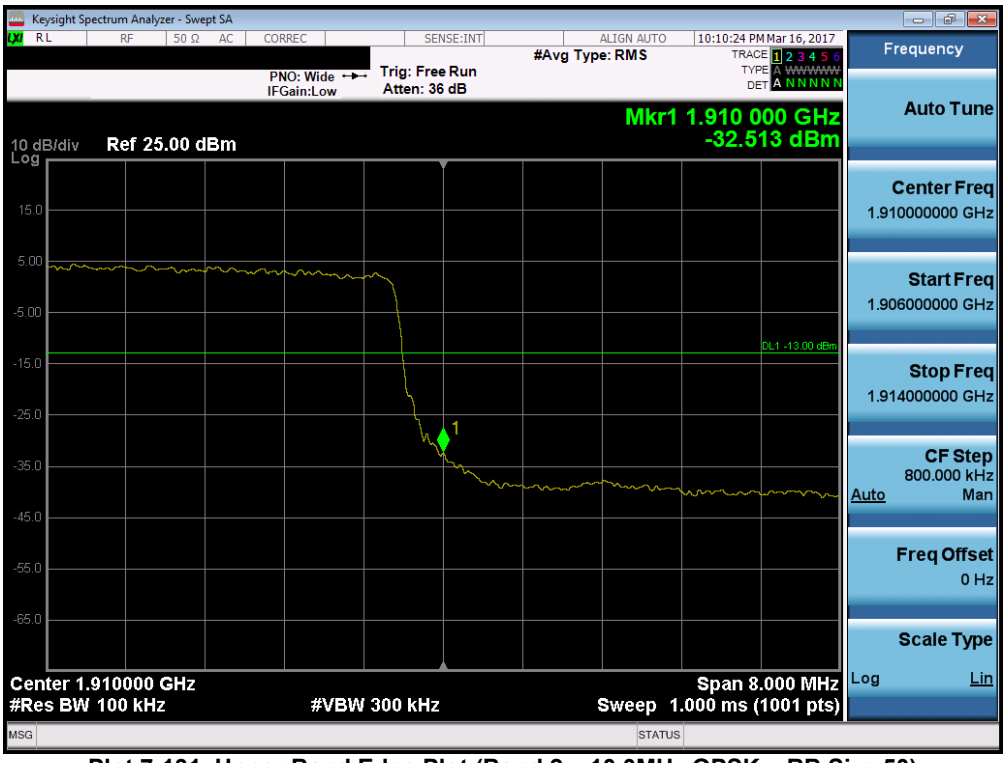
Plot 7-128. Upper Extended Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)



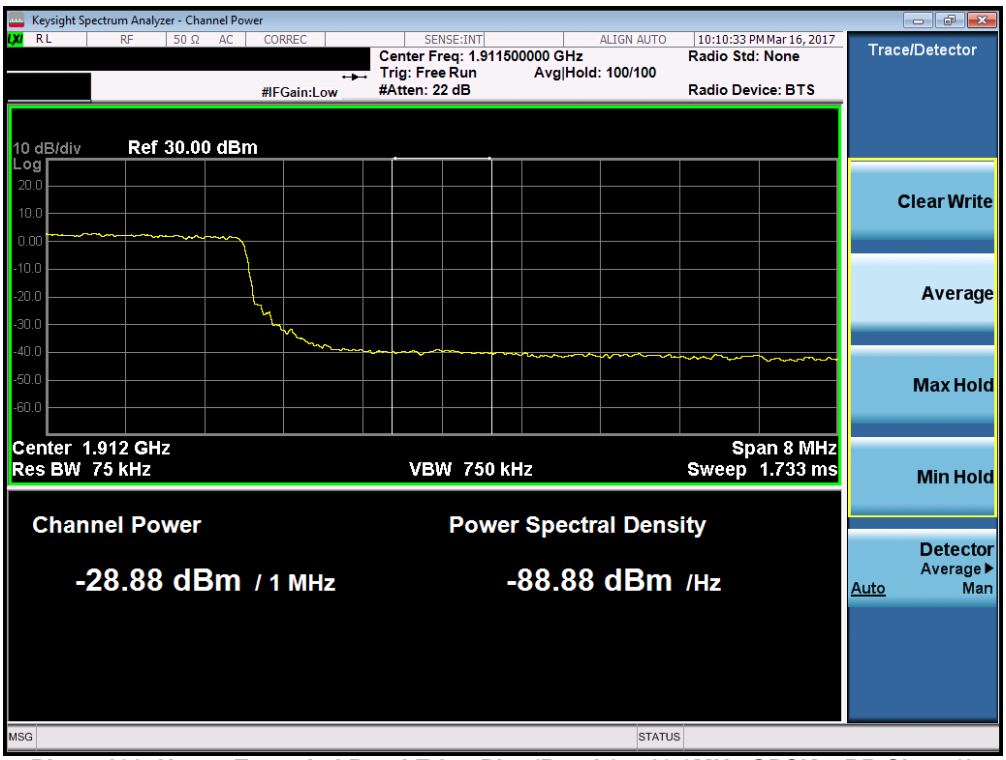
Plot 7-129. Lower Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



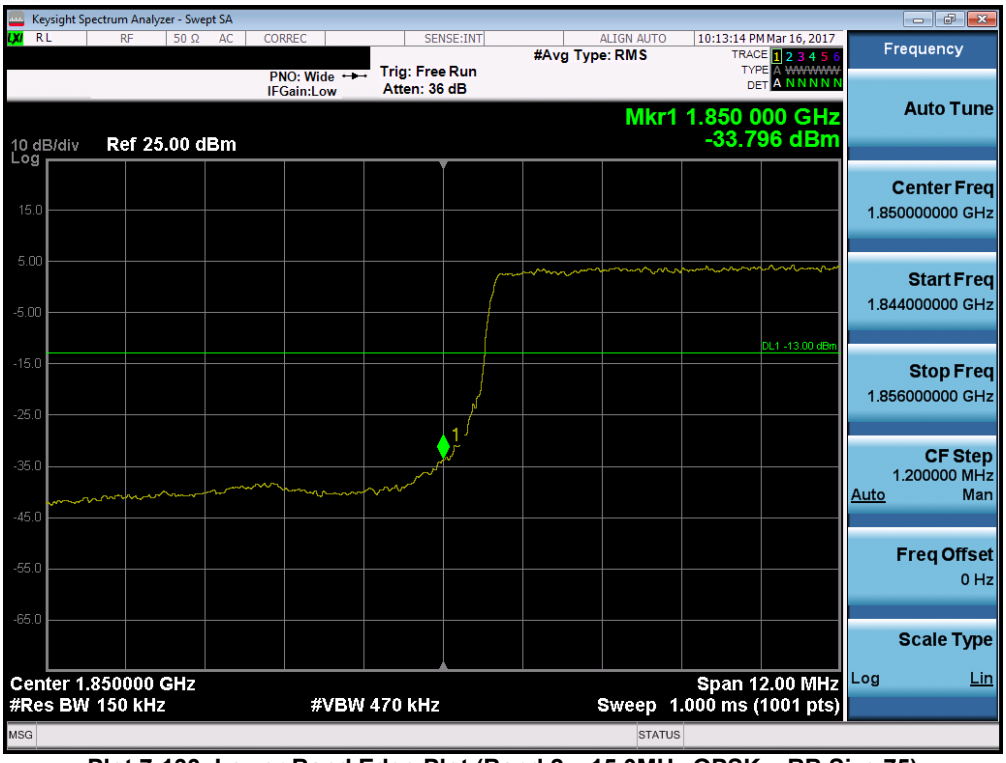
Plot 7-130. Lower Extended Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



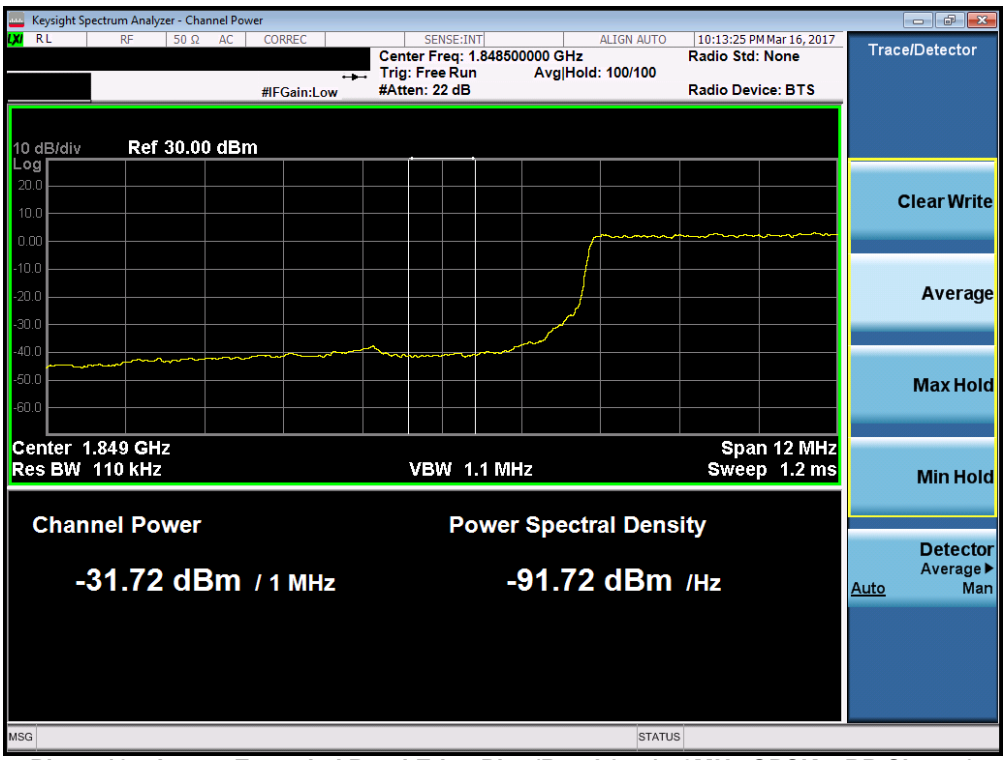
Plot 7-131. Upper Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



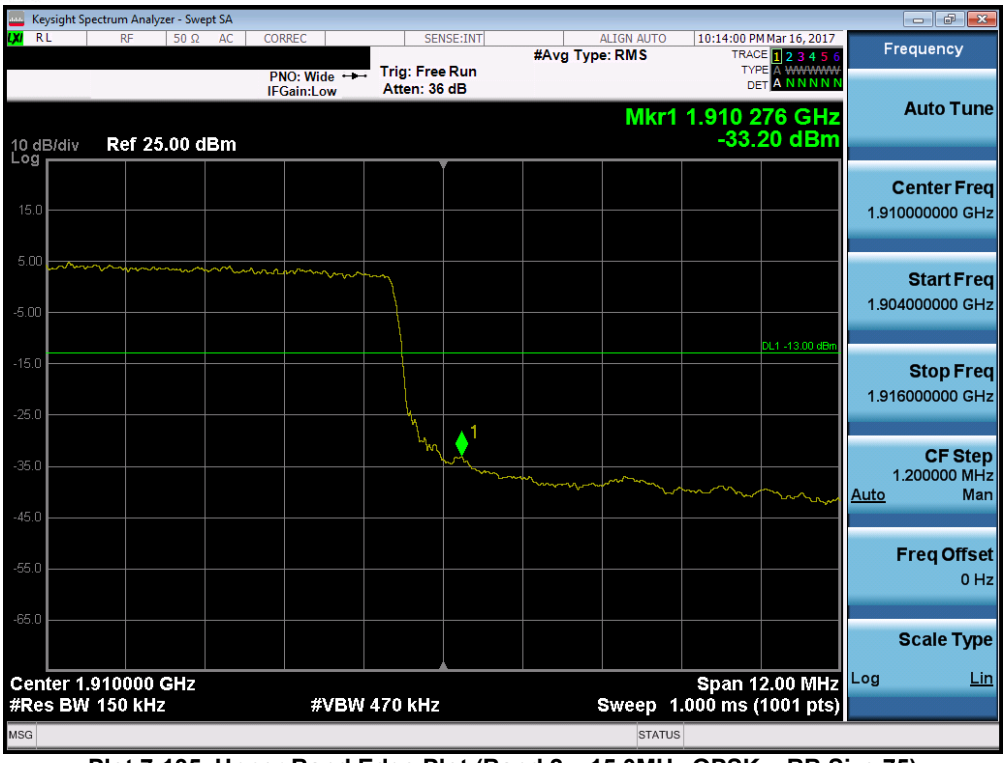
Plot 7-132. Upper Extended Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



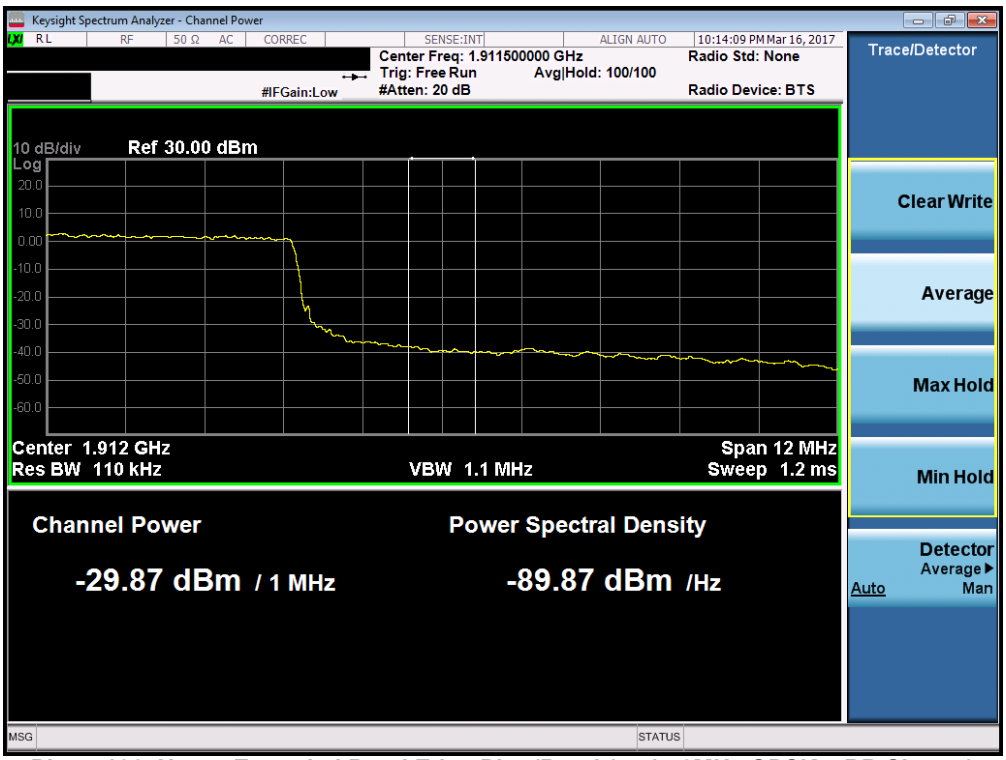
Plot 7-133. Lower Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



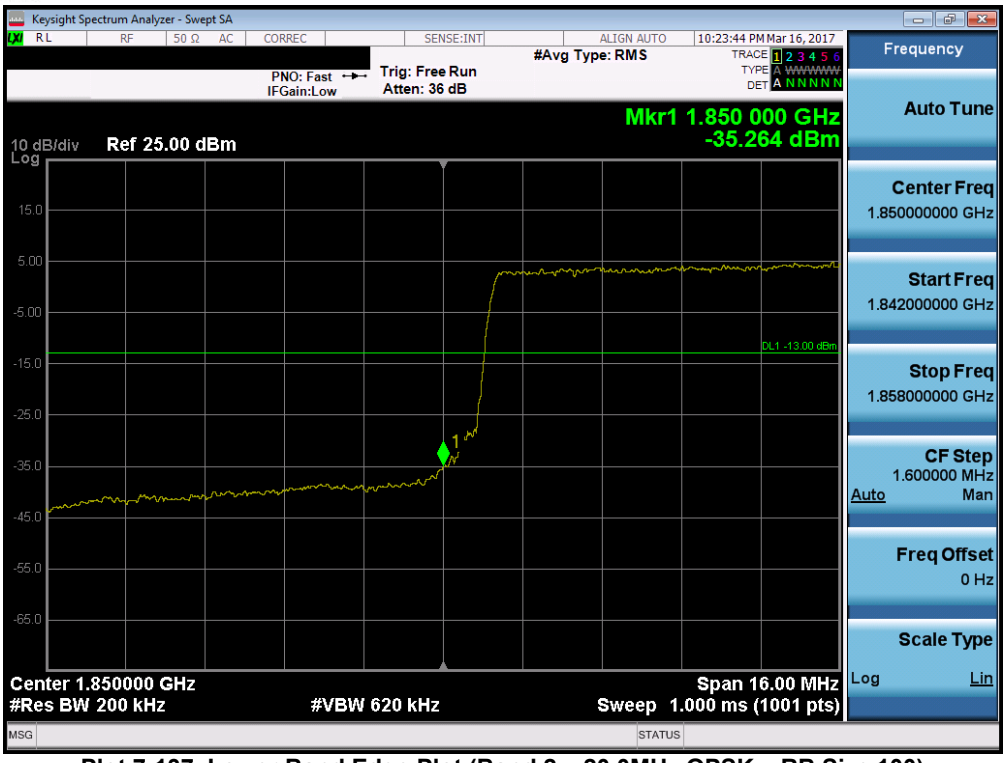
Plot 7-134. Lower Extended Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



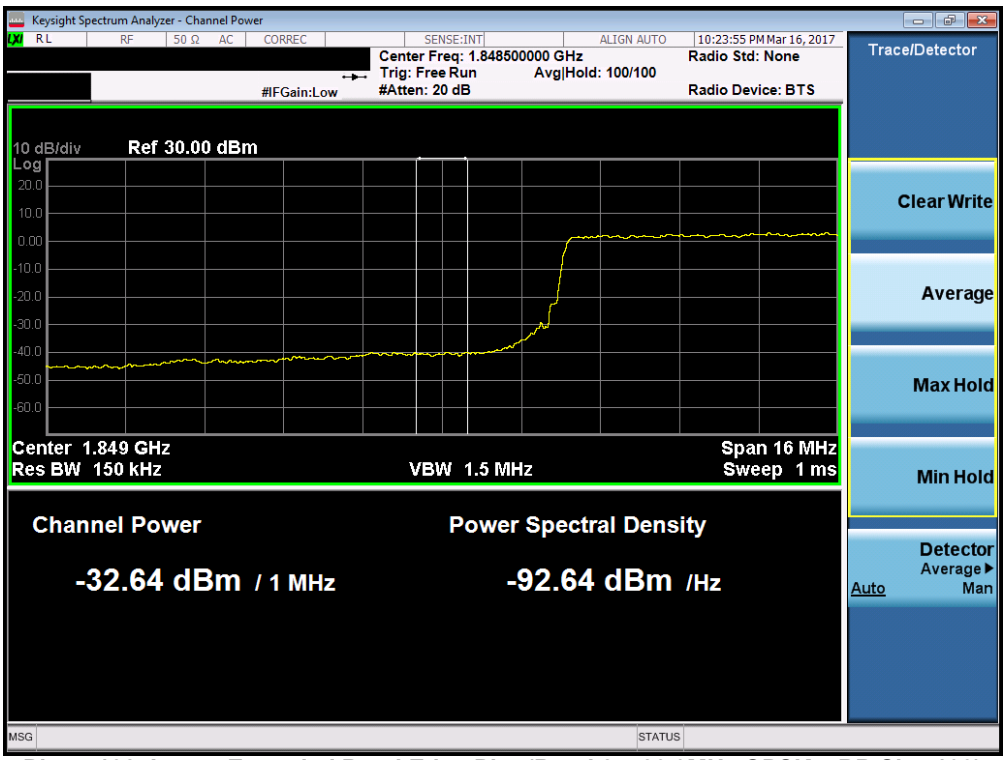
Plot 7-135. Upper Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



Plot 7-136. Upper Extended Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)

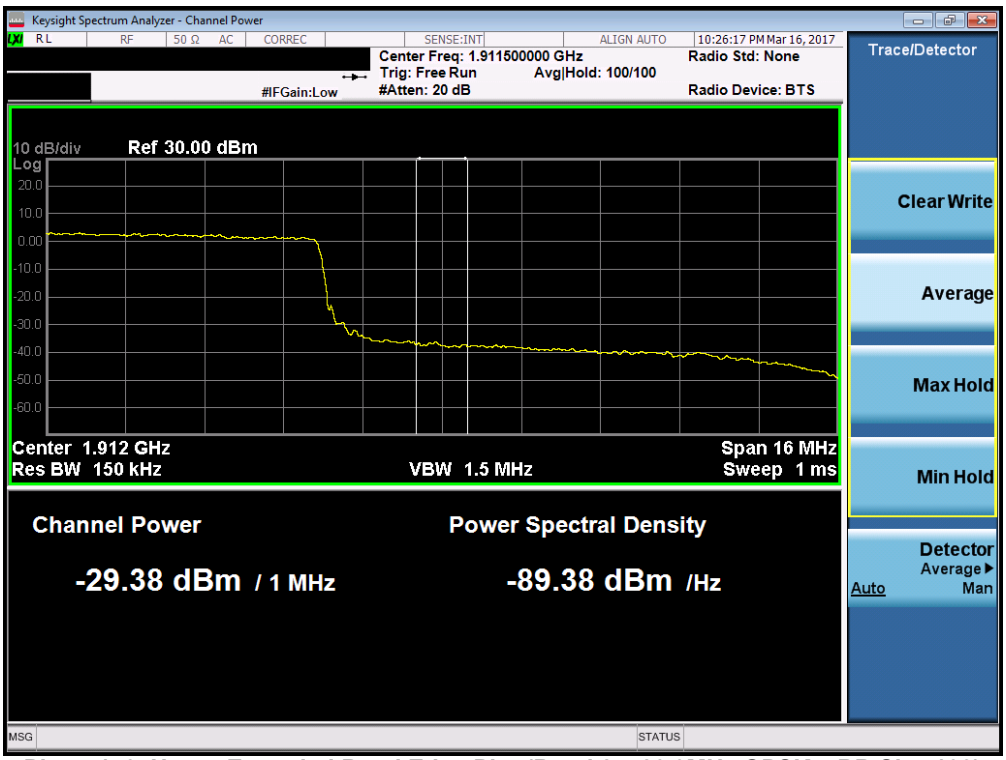


Plot 7-137. Lower Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)



Plot 7-138. Lower Extended Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)

Plot 7-139. Upper Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)



Plot 7-140. Upper Extended Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)

7.5 Peak-Average Ratio

§24.232(d)

Test Overview

A peak to average ratio measurement is performed at the conducted port of the EUT. The spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level.

Test Procedure Used

KDB 971168 D01 v02r02 – Section 5.7.1

Test Settings

1. The signal analyzer's CCDF measurement profile is enabled
2. Frequency = carrier center frequency
3. Measurement BW > Emission bandwidth of signal
4. The signal analyzer was set to collect one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analyzed. For continuous signals (>98% duty cycle), the measurement interval was set to 1ms.

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

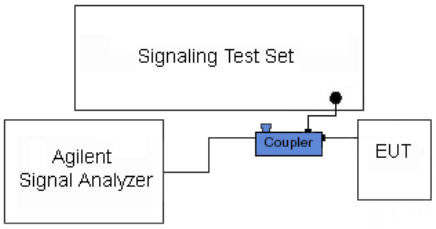
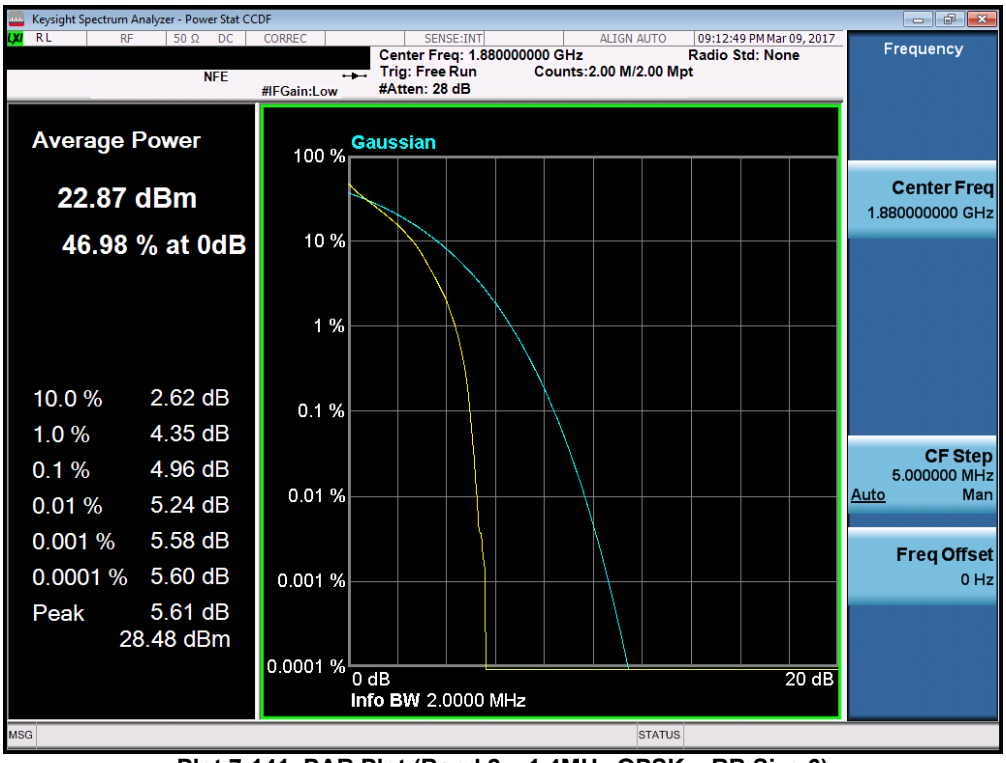


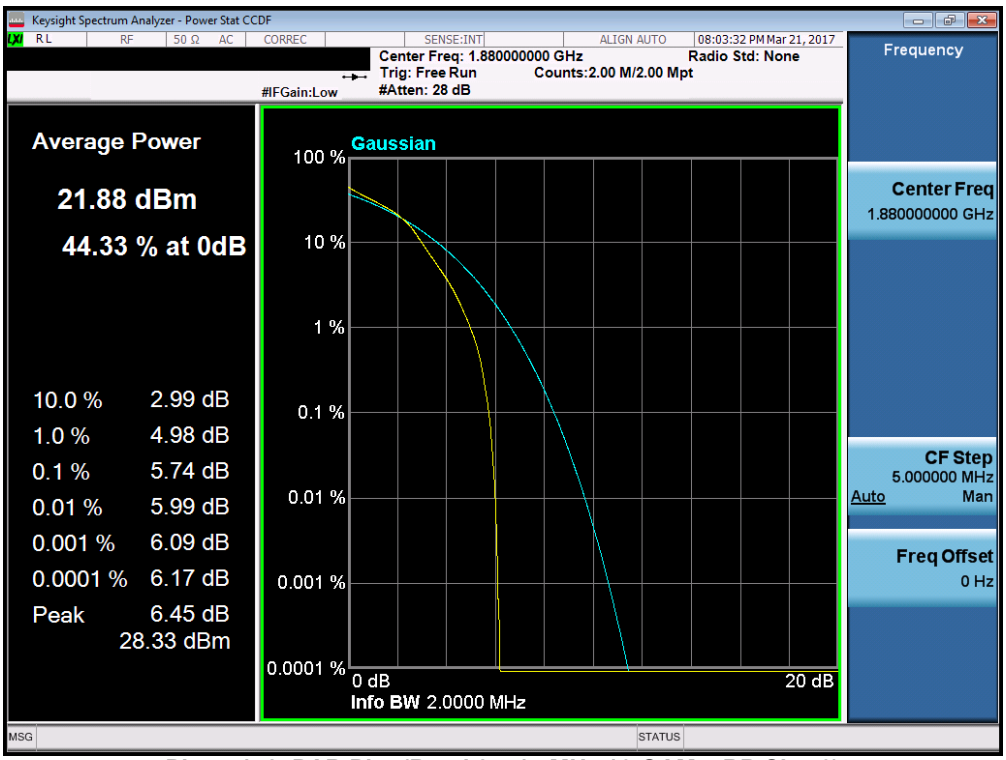
Figure 7-4. Test Instrument & Measurement Setup

Test Notes

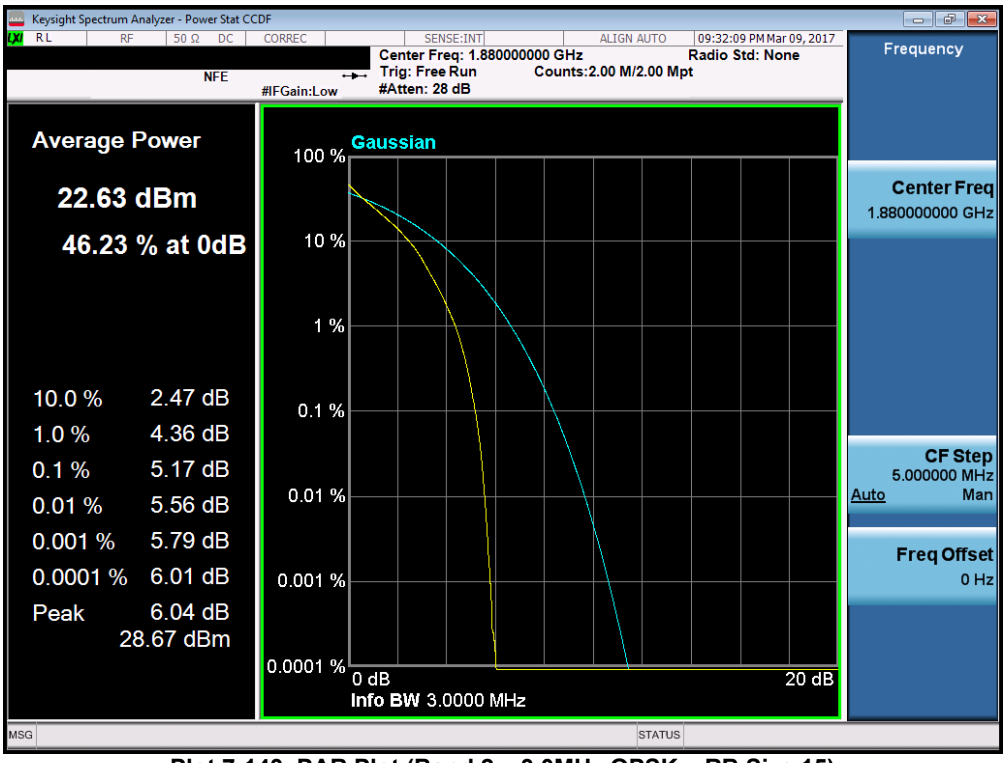
None.



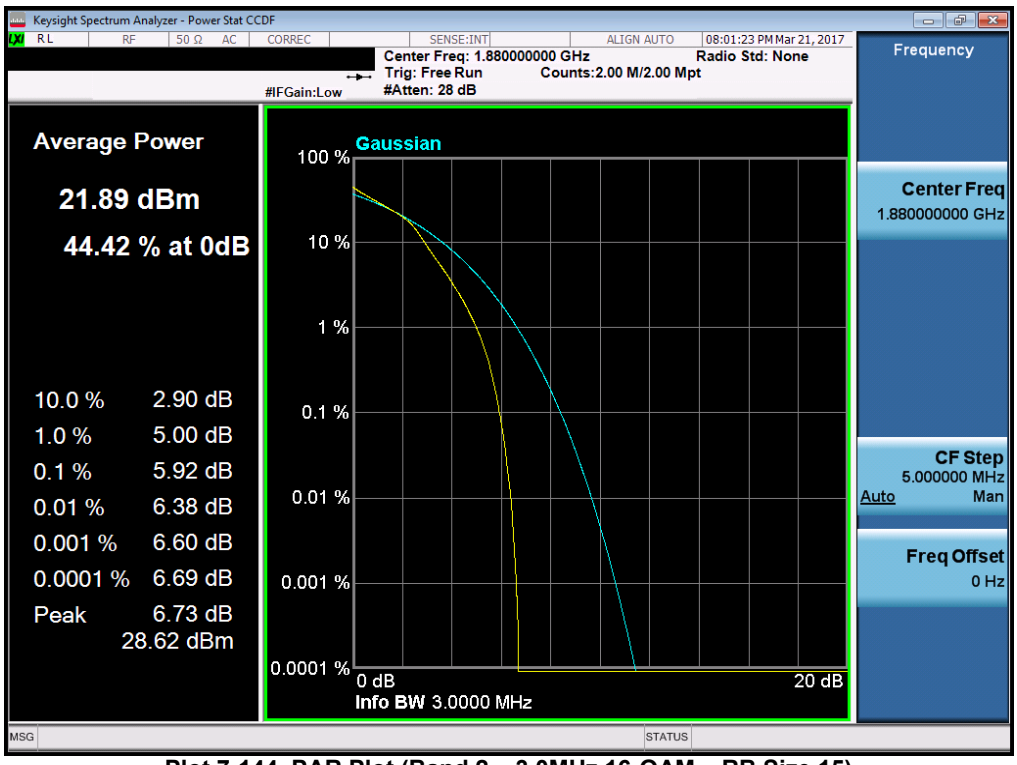
Plot 7-141. PAR Plot (Band 2 – 1.4MHz QPSK – RB Size 6)



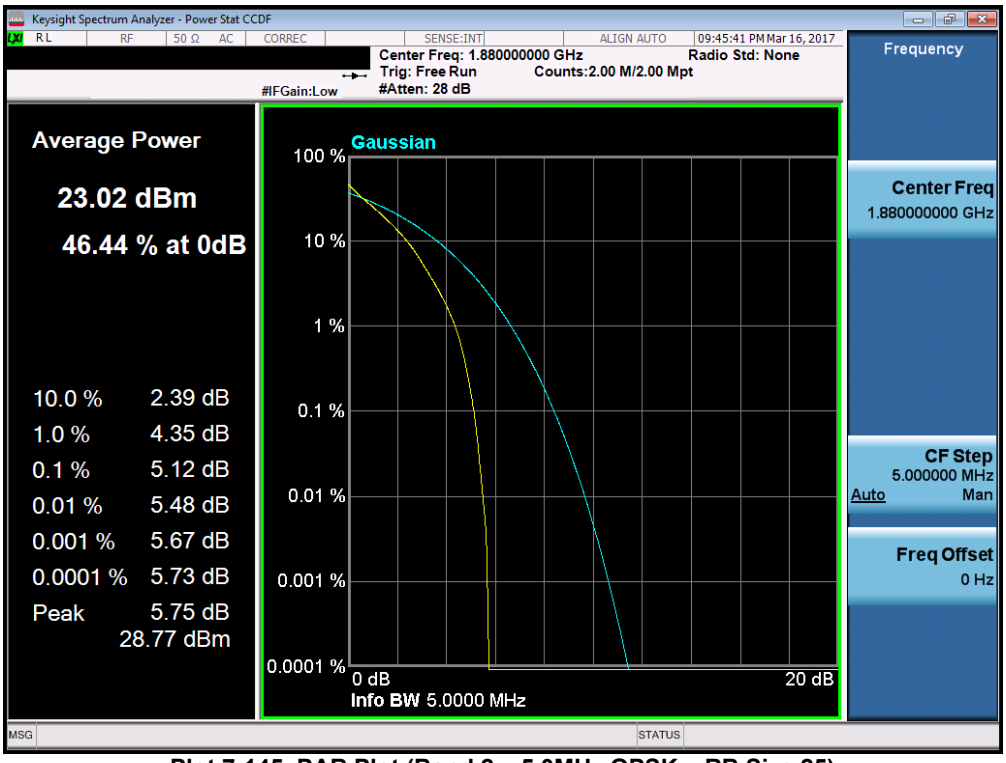
Plot 7-142. PAR Plot (Band 2 – 1.4MHz 16-QAM – RB Size 6)



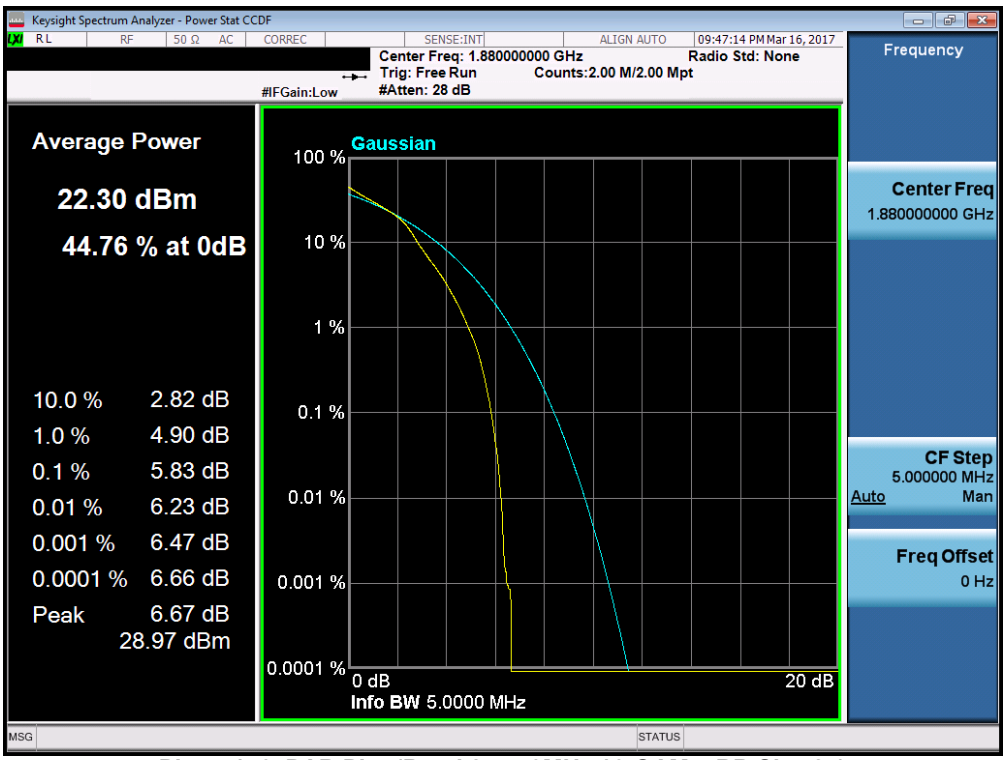
Plot 7-143. PAR Plot (Band 2 – 3.0MHz QPSK – RB Size 15)



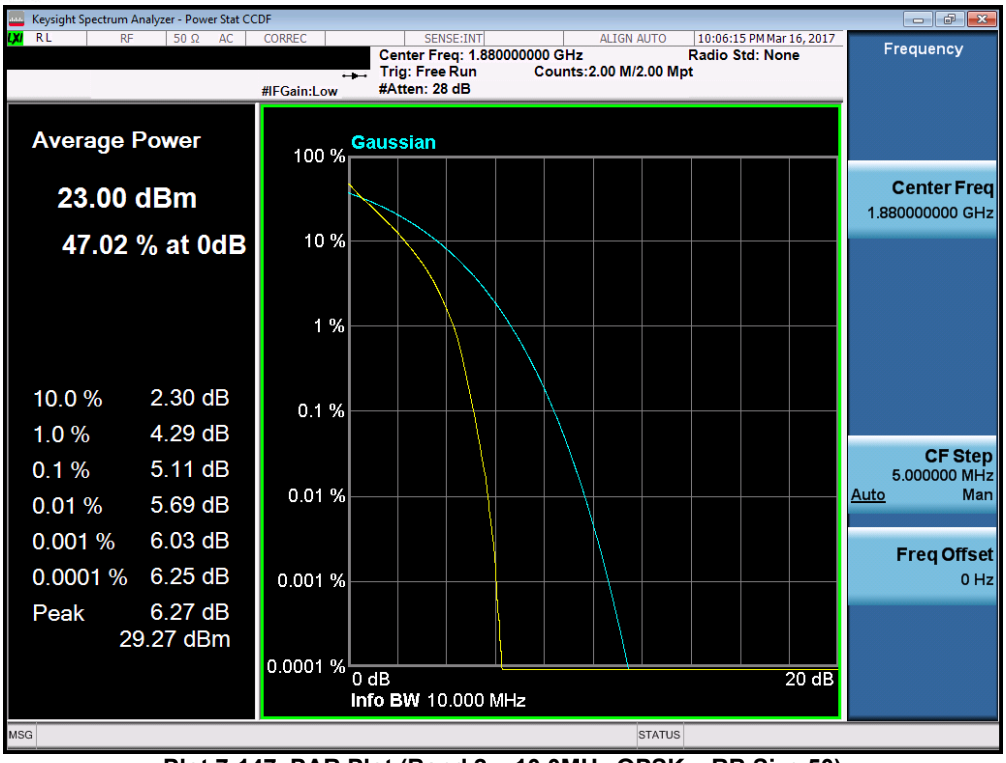
Plot 7-144. PAR Plot (Band 2 – 3.0MHz 16-QAM – RB Size 15)



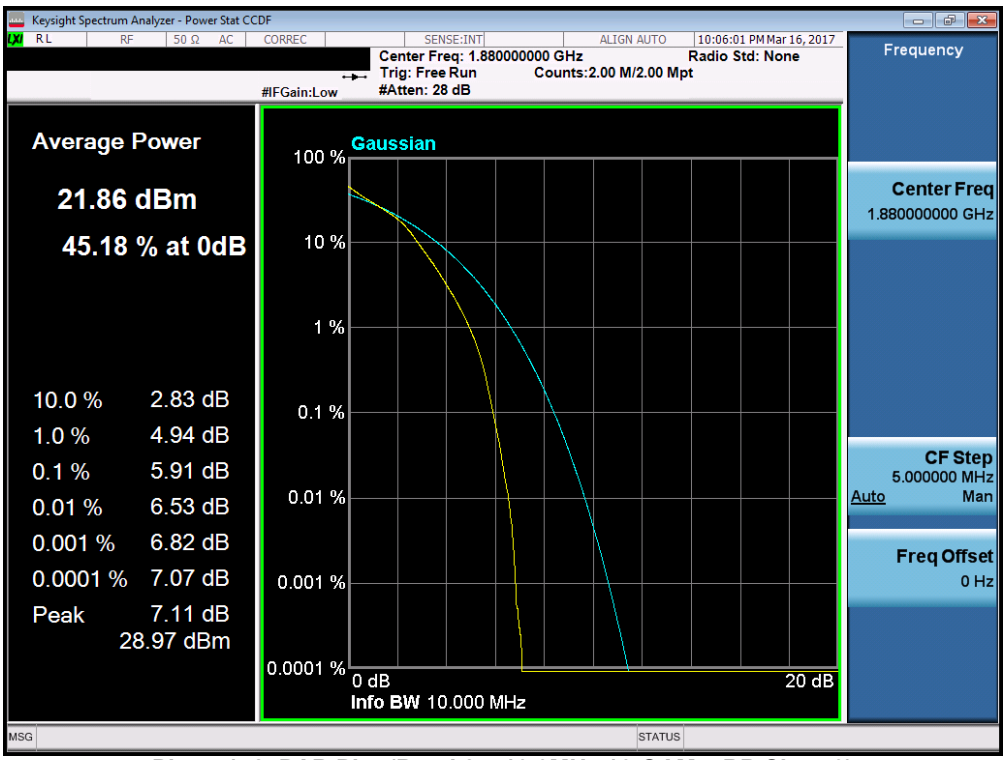
Plot 7-145. PAR Plot (Band 2 – 5.0MHz QPSK – RB Size 25)



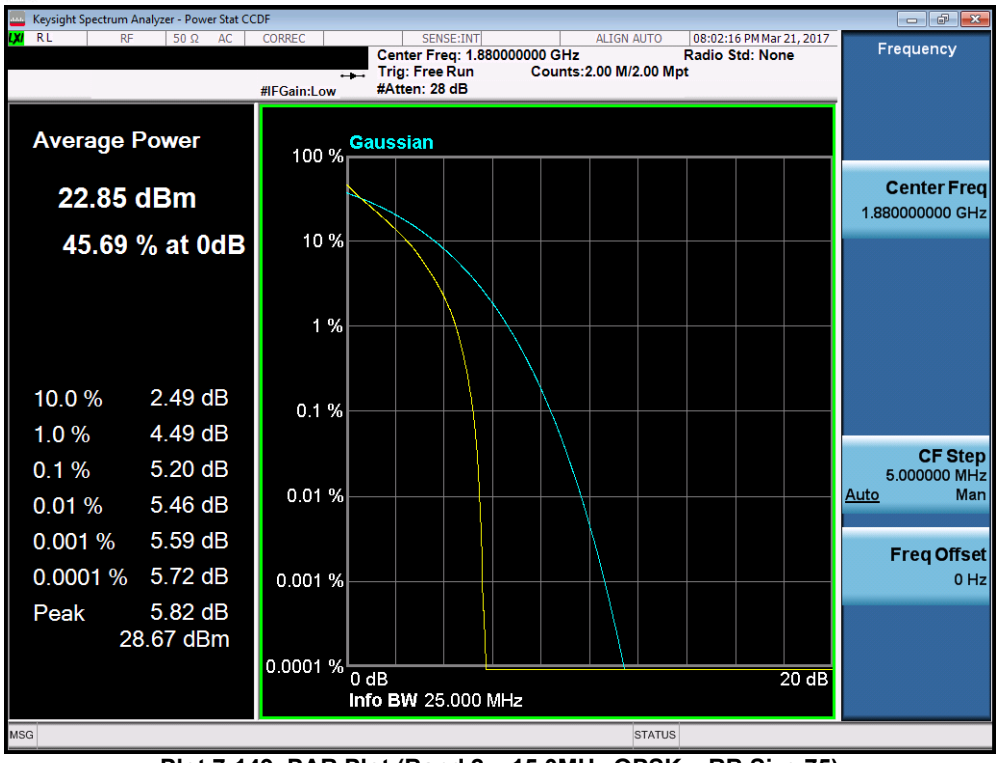
Plot 7-146. PAR Plot (Band 2 – 5.0MHz 16-QAM – RB Size 25)



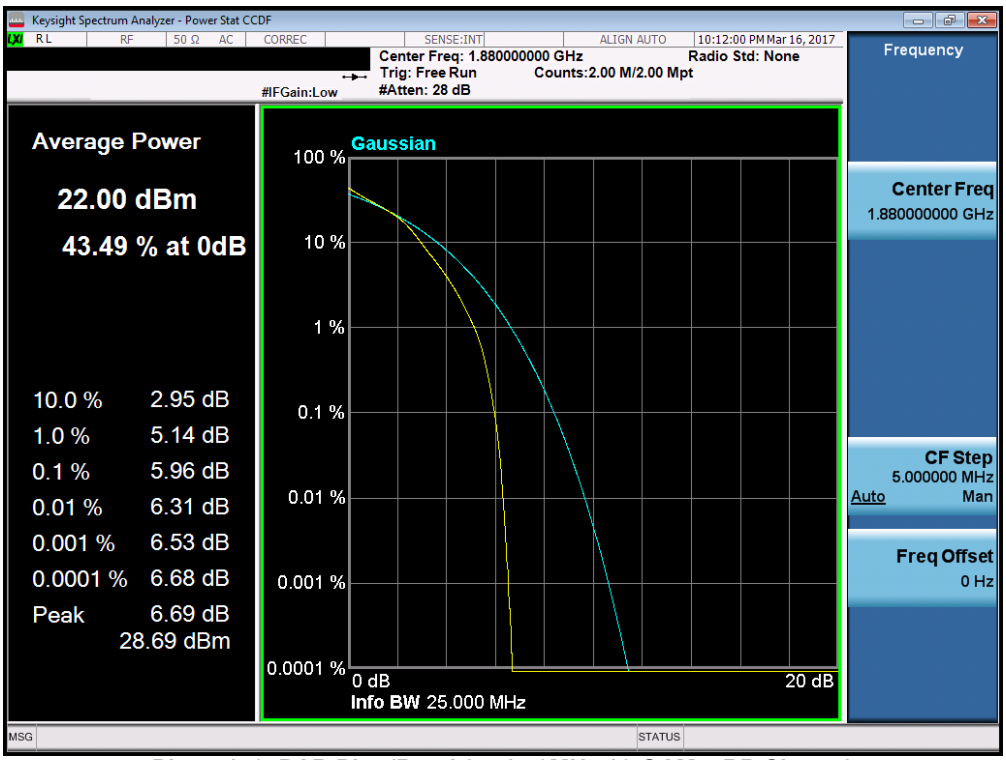
Plot 7-147. PAR Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



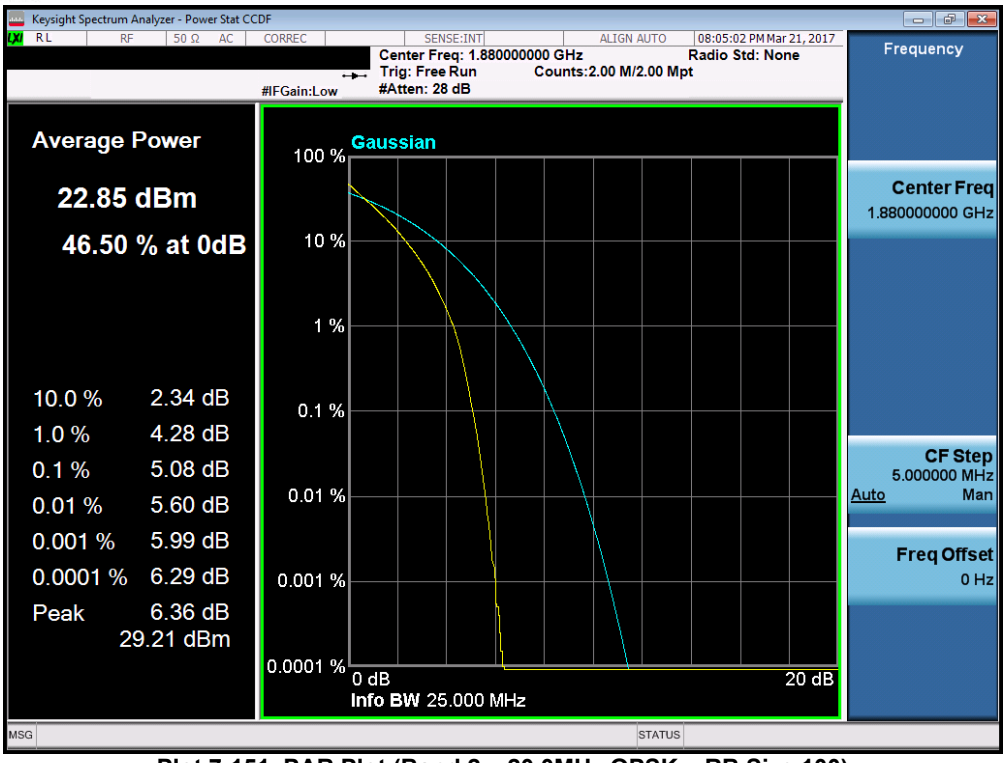
Plot 7-148. PAR Plot (Band 2 – 10.0MHz 16-QAM – RB Size 50)



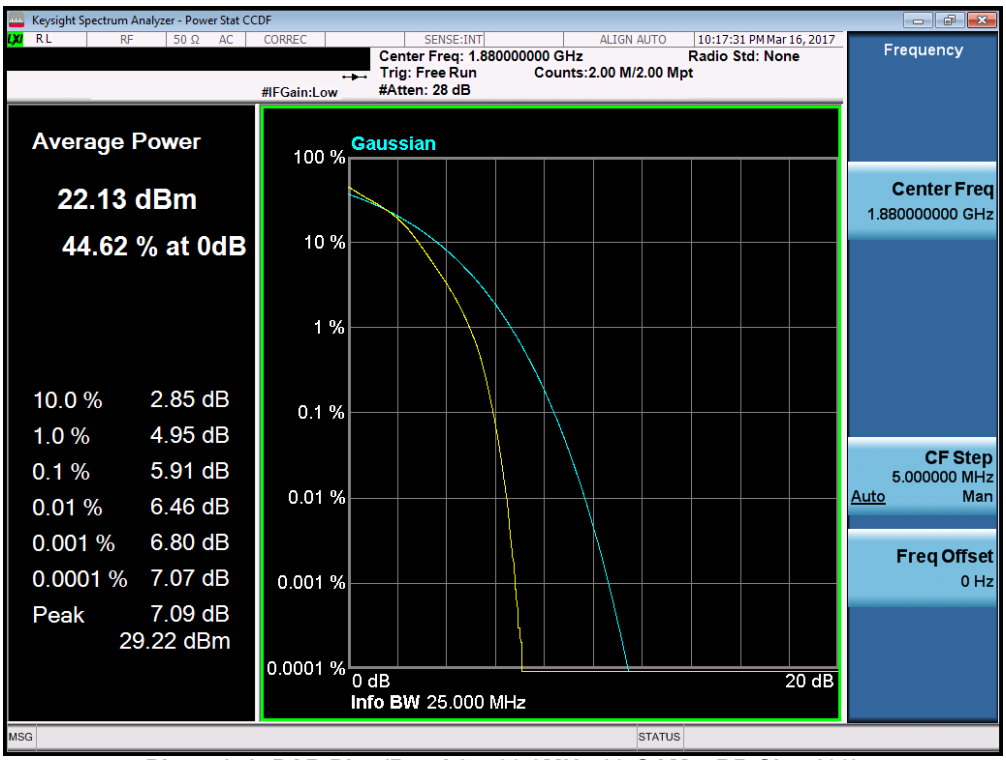
Plot 7-149. PAR Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



Plot 7-150. PAR Plot (Band 2 – 15.0MHz 16-QAM – RB Size 75)



Plot 7-151. PAR Plot (Band 2 – 20.0MHz QPSK – RB Size 100)



Plot 7-152. PAR Plot (Band 2 – 20.0MHz 16-QAM – RB Size 100)

7.6 Radiated Power (ERP/EIRP)

§22.913(a.2) §24.232(c.2) §27.50(c.10) §27.50(d.4)

Test Overview

Effective Radiated Power (ERP) and Equivalent Isotropic Radiated Power (EIRP) measurements are performed using the substitution method described in ANSI/TIA-603-D-2010 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using vertically and horizontally polarized tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 D01 v02r02 – Section 5.2.1

ANSI/TIA-603-D-2010 – Section 2.2.17

Test Settings

1. Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. RBW = 1 – 5% of the expected OBW, not to exceed 1MHz
3. VBW ≥ 3 x RBW
4. Span = 1.5 times the OBW
5. No. of sweep points ≥ 2 x span / RBW
6. Detector = RMS
7. Trigger is set to "free run" for signals with continuous operation with the sweep times set to "auto".
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
9. Trace mode = trace averaging (RMS) over 100 sweeps
10. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

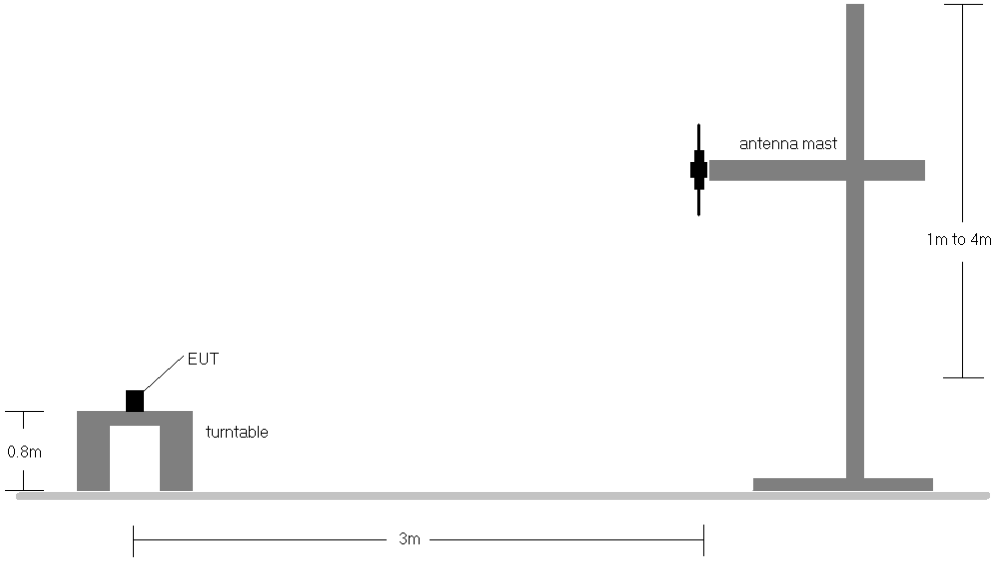


Figure 7-5. Radiated Test Setup <1GHz

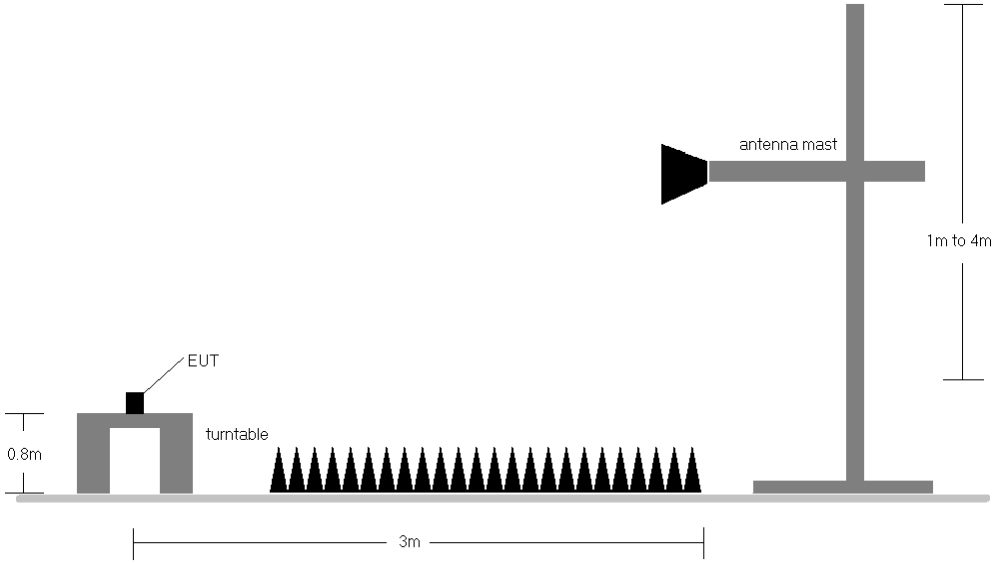


Figure 7-6. Radiated Test Setup >1GHz

Test Notes

1) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

2) This unit was tested with its standard battery.

Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	RB Size/Offset	Substitute Level [dBm]	Ant. Gain [dBd]	ERP [dBm]	ERP Limit [dBm]	Margin [dB]
699.70	1.4	QPSK	V	150	70	1 / 0	19.91	-1.15	18.76	34.77	-16.01
707.50	1.4	QPSK	V	150	73	1 / 5	20.25	-1.18	19.07	34.77	-15.70
715.30	1.4	QPSK	V	150	37	1 / 5	20.22	-1.21	19.01	34.77	-15.76
707.50	1.4	16-QAM	V	150	73	1 / 5	19.51	-1.18	18.33	34.77	-16.44
700.50	3	QPSK	V	150	65	1 / 14	20.54	-1.15	19.39	34.77	-15.38
707.50	3	QPSK	V	150	35	1 / 0	20.90	-1.18	19.72	34.77	-15.05
714.50	3	QPSK	V	150	54	1 / 14	20.84	-1.21	19.63	34.77	-15.14
707.50	3	16-QAM	V	150	35	1 / 0	20.00	-1.18	18.82	34.77	-15.95
701.50	5	QPSK	V	150	67	1 / 0	21.37	-1.16	20.21	34.77	-14.56
707.50	5	QPSK	V	150	39	1 / 0	21.86	-1.18	20.68	34.77	-14.09
713.50	5	QPSK	V	150	47	1 / 24	21.41	-1.20	20.21	34.77	-14.57
707.50	5	16-QAM	V	150	39	1 / 0	20.73	-1.18	19.55	34.77	-15.22
704.00	10	QPSK	V	150	64	1 / 49	21.52	-1.17	20.35	34.77	-14.42
707.50	10	QPSK	V	150	36	1 / 0	21.50	-1.18	20.32	34.77	-14.45
711.00	10	QPSK	V	150	34	1 / 0	21.66	-1.19	20.47	34.77	-14.31
711.00	10	16-QAM	V	150	34	1 / 0	20.83	-1.19	19.64	34.77	-15.14
707.50	5	QPSK	H	150	167	1 / 0	20.81	-0.28	20.53	34.77	-14.24

Table 7-2. ERP Data (Band 12)

Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	RB Size/Offset	Substitute Level [dBm]	Ant. Gain [dBd]	ERP [dBm]	ERP Limit [dBm]	Margin [dB]
824.70	1.4	QPSK	V	150	43	1 / 0	20.83	-1.45	19.38	38.45	-19.07
836.50	1.4	QPSK	V	150	53	1 / 5	21.52	-1.40	20.12	38.45	-18.33
848.30	1.4	QPSK	V	150	69	1 / 5	21.74	-1.36	20.38	38.45	-18.07
848.30	1.4	16-QAM	V	150	69	1 / 5	20.91	-1.36	19.55	38.45	-18.90
825.50	3	QPSK	V	150	67	1 / 14	21.63	-1.45	20.18	38.45	-18.27
836.50	3	QPSK	V	150	50	1 / 14	22.17	-1.40	20.77	38.45	-17.68
847.50	3	QPSK	V	150	45	1 / 0	22.53	-1.36	21.17	38.45	-17.28
847.50	3	16-QAM	V	150	45	1 / 0	21.67	-1.36	20.31	38.45	-18.14
826.50	5	QPSK	V	150	34	1 / 24	22.71	-1.44	21.27	38.45	-17.18
836.50	5	QPSK	V	150	67	1 / 24	23.22	-1.40	21.82	38.45	-16.63
846.50	5	QPSK	V	150	76	1 / 0	23.16	-1.36	21.80	38.45	-16.65
836.50	5	16-QAM	V	150	67	1 / 24	22.24	-1.40	20.84	38.45	-17.61
829.00	10	QPSK	V	150	39	1 / 49	22.79	-1.43	21.36	38.45	-17.09
836.50	10	QPSK	V	150	35	1 / 49	23.20	-1.40	21.80	38.45	-16.65
844.00	10	QPSK	V	150	67	1 / 49	23.17	-1.37	21.80	38.45	-16.65
836.50	10	16-QAM	V	150	35	1 / 49	22.20	-1.40	20.80	38.45	-17.65
836.50	5	QPSK	H	150	31	1 / 74	21.47	-0.84	20.63	38.45	-17.82

Table 7-3. ERP Data (Band 5)

Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	RB Size/Offset	Substitute Level [dBm]	Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	Margin [dB]
1710.70	1.4	QPSK	V	150	40	1 / 5	18.50	5.65	24.15	30.00	-5.85
1732.50	1.4	QPSK	V	150	43	1 / 5	18.11	5.41	23.52	30.00	-6.48
1754.30	1.4	QPSK	V	150	56	1 / 5	17.99	5.17	23.16	30.00	-6.84
1710.70	1.4	16-QAM	V	150	40	1 / 5	17.32	5.65	22.97	30.00	-7.03
1711.50	3	QPSK	V	150	38	1 / 14	19.11	5.64	24.75	30.00	-5.25
1732.50	3	QPSK	V	150	46	1 / 0	18.53	5.41	23.94	30.00	-6.06
1753.50	3	QPSK	V	150	50	1 / 0	18.43	5.18	23.61	30.00	-6.39
1711.50	3	16-QAM	V	150	38	1 / 14	17.85	5.64	23.49	30.00	-6.51
1712.50	5	QPSK	V	150	40	1 / 0	19.92	5.63	25.55	30.00	-4.45
1732.50	5	QPSK	V	150	57	1 / 24	19.75	5.41	25.16	30.00	-4.84
1752.50	5	QPSK	V	150	65	1 / 0	19.20	5.19	24.39	30.00	-5.61
1712.50	5	16-QAM	V	150	40	1 / 0	20.00	5.63	25.63	30.00	-4.37
1715.00	10	QPSK	V	150	47	1 / 0	20.00	5.60	25.60	30.00	-4.40
1732.50	10	QPSK	V	150	50	1 / 0	19.42	5.41	24.83	30.00	-5.17
1750.00	10	QPSK	V	150	53	1 / 0	19.66	5.22	24.88	30.00	-5.12
1715.00	10	16-QAM	V	150	47	1 / 0	19.11	5.60	24.71	30.00	-5.29
1717.50	15	QPSK	V	150	34	1 / 0	20.17	5.57	25.74	30.00	-4.26
1732.50	15	QPSK	V	150	48	1 / 0	20.00	5.41	25.41	30.00	-4.59
1747.50	15	QPSK	V	150	67	1 / 0	20.02	5.24	25.26	30.00	-4.74
1717.50	15	16-QAM	V	150	34	1 / 0	19.07	5.57	24.64	30.00	-5.36
1720.00	20	QPSK	V	150	54	1 / 0	19.93	5.54	25.47	30.00	-4.53
1732.50	20	QPSK	V	150	70	1 / 0	19.79	5.41	25.20	30.00	-4.80
1745.00	20	QPSK	V	150	72	1 / 0	20.11	5.27	25.38	30.00	-4.62
1720.00	20	16-QAM	V	150	54	1 / 0	18.84	5.54	24.38	30.00	-5.62
1717.50	15	QPSK	H	150	100	1 / 0	18.84	5.51	24.35	30.00	-5.65

Table 7-4. EIRP Data (Band 4)

Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	RB Size/Offset	Substitute Level [dBm]	Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	Margin [dB]
1850.70	1.4	QPSK	V	150	52	1 / 0	19.45	4.79	24.24	33.01	-8.77
1880.00	1.4	QPSK	V	150	35	1 / 0	19.31	4.84	24.15	33.01	-8.86
1909.30	1.4	QPSK	V	150	24	1 / 0	18.96	4.86	23.82	33.01	-9.19
1880.00	1.4	16-QAM	V	150	35	1 / 0	18.26	4.84	23.10	33.01	-9.91
1851.50	3	QPSK	V	150	34	1 / 14	19.81	4.79	24.60	33.01	-8.41
1880.00	3	QPSK	V	150	52	1 / 14	19.89	4.84	24.73	33.01	-8.28
1908.50	3	QPSK	V	150	42	1 / 14	19.40	4.86	24.26	33.01	-8.75
1908.50	3	16-QAM	V	150	42	1 / 14	19.49	4.86	24.35	33.01	-8.66
1852.50	5	QPSK	V	150	30	1 / 0	20.78	4.79	25.57	33.01	-7.44
1880.00	5	QPSK	V	150	52	1 / 0	20.45	4.84	25.29	33.01	-7.72
1907.50	5	QPSK	V	15	34	1 / 24	20.07	4.87	24.94	33.01	-8.07
1852.50	5	16-QAM	V	150	30	1 / 24	19.56	4.79	24.35	33.01	-8.66
1855.00	10	QPSK	V	150	34	1 / 49	20.90	4.80	25.70	33.01	-7.31
1880.00	10	QPSK	V	150	53	1 / 0	20.51	4.84	25.35	33.01	-7.66
1905.00	10	QPSK	V	150	53	1 / 49	20.38	4.87	25.25	33.01	-7.76
1880.00	10	16-QAM	V	150	53	1 / 0	20.30	4.84	25.14	33.01	-7.87
1857.50	15	QPSK	V	150	35	1 / 74	20.81	4.80	25.61	33.01	-7.40
1880.00	15	QPSK	V	150	35	1 / 0	20.80	4.84	25.64	33.01	-7.37
1902.50	15	QPSK	V	150	43	1 / 0	20.39	4.88	25.27	33.01	-7.74
1857.50	15	16-QAM	V	150	35	1 / 0	19.71	4.80	24.51	33.01	-8.50
1860.00	20	QPSK	V	150	37	1 / 99	19.77	4.81	24.58	33.01	-8.44
1880.00	20	QPSK	V	150	36	1 / 0	20.63	4.84	25.47	33.01	-7.54
1900.00	20	QPSK	V	15	35	1 / 0	20.73	4.88	25.61	33.01	-7.40
1880.00	20	16-QAM	V	150	36	1 / 0	19.52	4.84	24.36	33.01	-8.65
1855.00	10	QPSK	H	150	247	1 / 0	18.80	4.81	23.61	33.01	-9.40

Table 7-5. EIRP Data (Band 2)

7.7 Radiated Spurious Emissions Measurements

§2.1053 §22.917(a) §24.238(a) §27.53(g) §27.53(h)

Test Overview

Radiated spurious emissions measurements are performed using the substitution method described in ANSI/TIA-603-D-2010 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using vertically and horizontally polarized tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as peak measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 D01 v02r02 – Section 5.8

ANSI/TIA-603-D-2010 – Section 2.2.12

Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = RMS
6. Trace mode = Average (Max Hold for pulsed emissions)
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

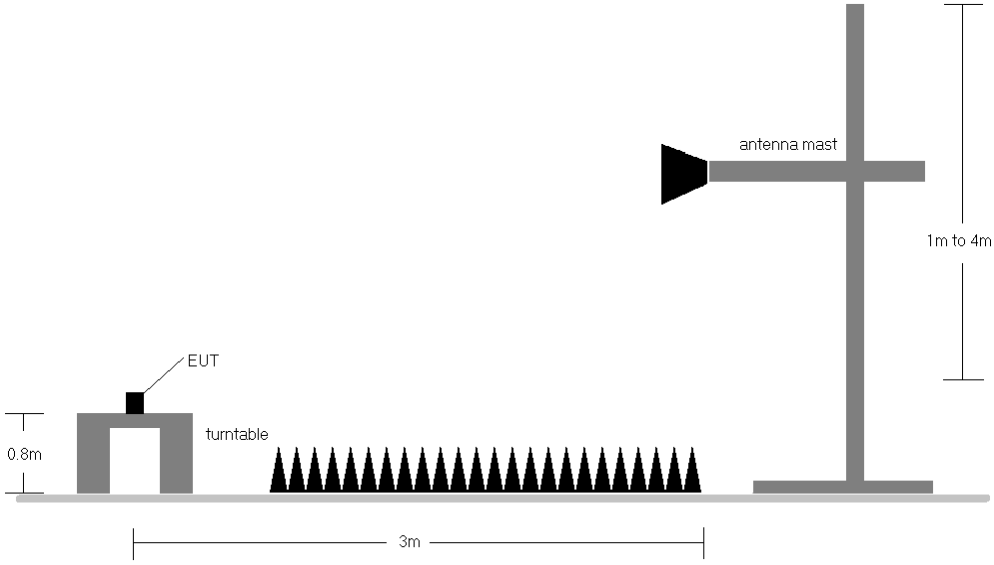


Figure 7-7. Test Instrument & Measurement Setup

Test Notes

1) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

2) This unit was tested with its standard battery.

3) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.

4) Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

5) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

OPERATING FREQUENCY:	701.50	MHz		
CHANNEL:	23035			
MEASURED OUTPUT POWER:	20.21	dBm	=	0.105 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	5.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	33.21	dBc	

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	[dBc]
1403.00	H	152	31	-58.77	5.92	-52.85	73.1
2104.50	H	129	334	-63.37	6.80	-56.57	76.8
2806.00	H	-	-	-71.44	8.12	-63.32	83.5

Table 7-6. Radiated Spurious Data (Band 12 – Low Channel)

OPERATING FREQUENCY:	707.50	MHz		
CHANNEL:	23095			
MEASURED OUTPUT POWER:	20.68	dBm	=	0.117 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	5.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	33.68	dBc	

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	[dBc]
1415.00	H	101	36	-60.85	5.96	-54.88	75.6
2122.50	H	120	340	-61.27	6.84	-54.42	75.1
2830.00	H	-	-	-71.09	8.13	-62.96	83.6

Table 7-7. Radiated Spurious Data (Band 12 – Mid Channel)

OPERATING FREQUENCY:	713.50	MHz		
CHANNEL:	23155			
MEASURED OUTPUT POWER:	20.21	dBm	=	0.105 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	5.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	33.21	dBc	

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	[dBc]
1427.00	H	101	63	-61.11	6.01	-55.10	75.3
2140.50	H	125	331	-64.24	6.89	-57.35	77.6
2854.00	H	-	-	-71.21	8.15	-63.06	83.3

Table 7-8. Radiated Spurious Data (Band 12 – High Channel)

OPERATING FREQUENCY:	826.50	MHz		
CHANNEL:	20425			
MEASURED OUTPUT POWER:	21.27	dBm	=	0.134 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	5.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	34.27	dBc	

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	[dBc]
1653.00	H	132	324	-66.65	6.28	-60.37	81.6
2479.50	H	143	33	-69.25	6.84	-62.40	83.7
3306.00	H	-	-	-67.77	7.14	-60.62	81.9

Table 7-9. Radiated Spurious Data (Band 5 – Low Channel)

OPERATING FREQUENCY:	836.50	MHz		
CHANNEL:	20525			
MEASURED OUTPUT POWER:	21.82	dBm	=	0.152 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	5.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	34.82	dBc	

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	[dBc]
1673.00	H	110	111	-62.08	6.21	-55.87	77.7
2509.50	H	154	169	-69.50	6.86	-62.64	84.5
3346.00	H	-	-	-68.03	7.26	-60.76	82.6

Table 7-10. Radiated Spurious Data (Band 5 – Mid Channel)

OPERATING FREQUENCY:	846.50	MHz		
CHANNEL:	20625			
MEASURED OUTPUT POWER:	21.80	dBm	=	0.151 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	5.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	34.80	dBc	

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	[dBc]
1693.00	H	121	24	-60.24	6.14	-54.10	75.9
2539.50	H	100	176	-68.17	6.95	-61.22	83.0
3386.00	H	-	-	-68.12	7.38	-60.74	82.5

Table 7-11. Radiated Spurious Data (Band 5 – High Channel)

OPERATING FREQUENCY:	1717.50	MHz			
CHANNEL:	20025				
MEASURED OUTPUT POWER:	25.74	dBm	=	0.375	W
MODULATION SIGNAL:	QPSK				
BANDWIDTH:	15.0	MHz			
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	38.74	dBc		

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	[dBc]
3435.00	H	130	110	-54.64	9.68	-44.96	70.7
5152.50	H	134	124	-60.98	10.89	-50.09	75.8
6870.00	H	-	-	-59.16	10.79	-48.37	74.1

Table 7-12. Radiated Spurious Data (Band 4 – Low Channel)

OPERATING FREQUENCY:	1732.50	MHz			
CHANNEL:	20175				
MEASURED OUTPUT POWER:	25.41	dBm	=	0.347	W
MODULATION SIGNAL:	QPSK				
BANDWIDTH:	15.0	MHz			
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	38.41	dBc		

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	[dBc]
3465.00	H	121	101	-58.24	9.77	-48.47	73.9
5197.50	H	194	346	-66.20	10.81	-55.39	80.8
6930.00	H	-	-	-58.81	10.89	-47.93	73.3

Table 7-13. Radiated Spurious Data (Band 4 – Mid Channel)

OPERATING FREQUENCY:	1747.50	MHz		
CHANNEL:	20325			
MEASURED OUTPUT POWER:	25.26	dBm	=	0.336 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	15.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	38.26	dBc	

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	[dBc]
3495.00	H	108	41	-58.48	9.86	-48.62	73.9
5242.50	H	108	113	-62.01	10.89	-51.12	76.4
6990.00	H	-	-	-59.67	11.03	-48.65	73.9

Table 7-14. Radiated Spurious Data (Band 4 – High Channel)

OPERATING FREQUENCY:	1855.00	MHz		
CHANNEL:	18650			
MEASURED OUTPUT POWER:	25.70	dBm	=	0.371 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	10.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	38.70	dBc	

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	[dBc]
3710.00	H	165	104	-56.60	9.99	-46.60	72.3
5565.00	H	-	-	-66.49	11.21	-55.28	81.0

Table 7-15. Radiated Spurious Data (Band 2 – Low Channel)

OPERATING FREQUENCY:	1880.00	MHz		
CHANNEL:	18900			
MEASURED OUTPUT POWER:	25.35	dBm	=	0.343 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	10.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	38.35	dBc	

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	[dBc]
3760.00	H	163	120	-50.20	9.79	-40.41	65.8
5640.00	H	-	-	-66.49	11.35	-55.14	80.5

Table 7-16. Radiated Spurious Data (Band 2 – Mid Channel)

OPERATING FREQUENCY:	1905.00	MHz		
CHANNEL:	19150			
MEASURED OUTPUT POWER:	25.25	dBm	=	0.335 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	10.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	38.25	dBc	

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	[dBc]
3810.00	H	151	123	-45.42	9.59	-35.83	61.1
5715.00	H	-	-	-66.18	11.43	-54.75	80.0

Table 7-17. Radiated Spurious Data (Band 2 – High Channel)

7.8 Frequency Stability / Temperature Variation

§2.1055 §22.355 §24.235 §27.54

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI/TIA-603-D-2010. The frequency stability of the transmitter is measured by:

a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

For Part 22, the frequency stability of the transmitter shall be maintained within ±0.00025% (±2.5 ppm) of the center frequency. For Part 24 and Part 27, the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Test Procedure Used

ANSI/TIA-603-D-2010

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

Test Setup

The EUT was connected via an RF cable to a spectrum analyzer with the EUT placed inside an environmental chamber.

Test Notes

None

Band 12 Frequency Stability Measurements

§2.1055 §27.54

OPERATING FREQUENCY:	707,500,000	Hz
CHANNEL:	23790	
REFERENCE VOLTAGE:	3.85	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.85	+ 20 (Ref)	707,499,822	-178	-0.0000252
100 %		- 30	707,499,924	-76	-0.0000107
100 %		- 20	707,500,219	219	0.0000310
100 %		- 10	707,499,821	-179	-0.0000253
100 %		0	707,499,994	-6	-0.0000008
100 %		+ 10	707,499,802	-198	-0.0000280
100 %		+ 20	707,500,278	278	0.0000393
100 %		+ 30	707,499,987	-13	-0.0000018
100 %		+ 40	707,499,895	-105	-0.0000148
100 %		+ 50	707,500,175	175	0.0000247
BATT. ENDPOINT	3.45	+ 20	707,500,087	87	0.0000123

Table 7-18. Frequency Stability Data (Band 12)

Band 12 Frequency Stability Measurements

§2.1055 §27.54

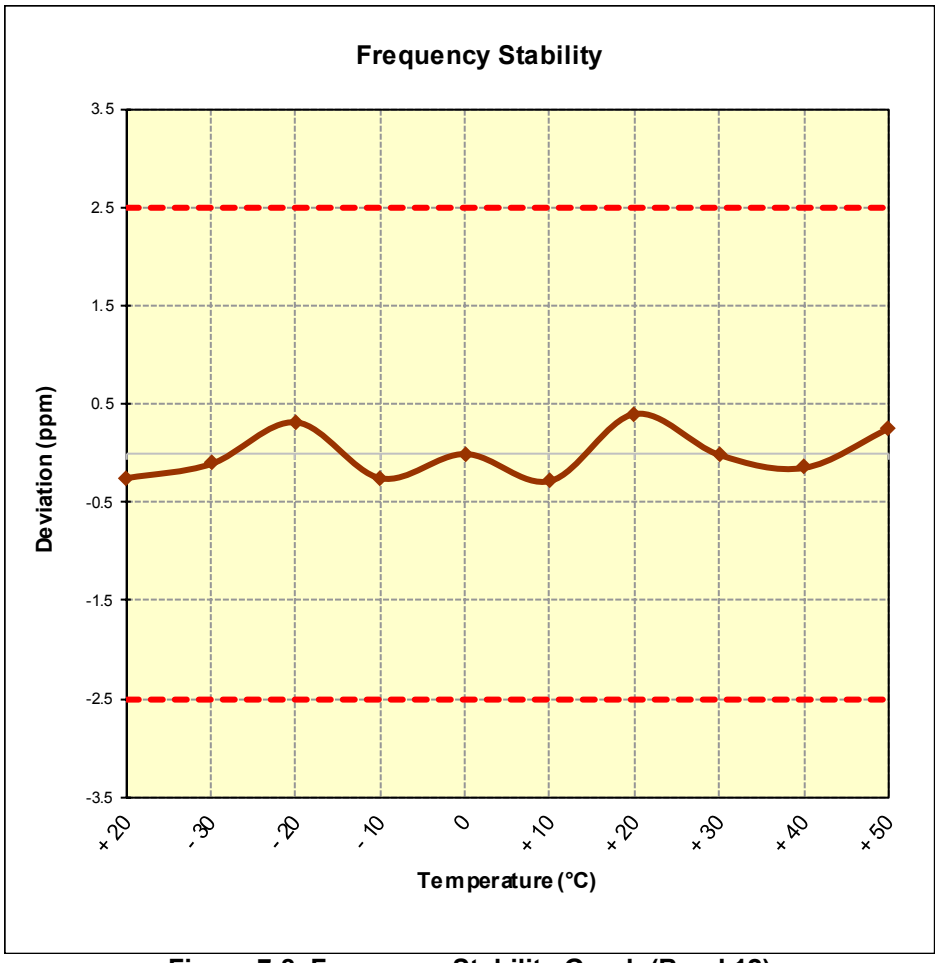


Figure 7-8. Frequency Stability Graph (Band 12)

Band 5 Frequency Stability Measurements

§2.1055 §22.355

OPERATING FREQUENCY:	836,500,000	Hz
CHANNEL:	20525	
REFERENCE VOLTAGE:	3.85	VDC
DEVIATION LIMIT:	± 0.00025 % or 2.5 ppm	

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.85	+ 20 (Ref)	836,499,955	-45	-0.0000054
100 %		- 30	836,500,104	104	0.0000124
100 %		- 20	836,499,935	-65	-0.0000078
100 %		- 10	836,499,924	-76	-0.0000091
100 %		0	836,500,046	46	0.0000055
100 %		+ 10	836,499,942	-58	-0.0000069
100 %		+ 20	836,499,743	-257	-0.0000307
100 %		+ 30	836,499,836	-164	-0.0000196
100 %		+ 40	836,500,385	385	0.0000460
100 %		+ 50	836,499,832	-168	-0.0000201
BATT. ENDPOINT	3.45	+ 20	836,500,174	174	0.0000208

Table 7-19. Frequency Stability Data (Band 5)

Band 5 Frequency Stability Measurements

§2.1055 §22.355

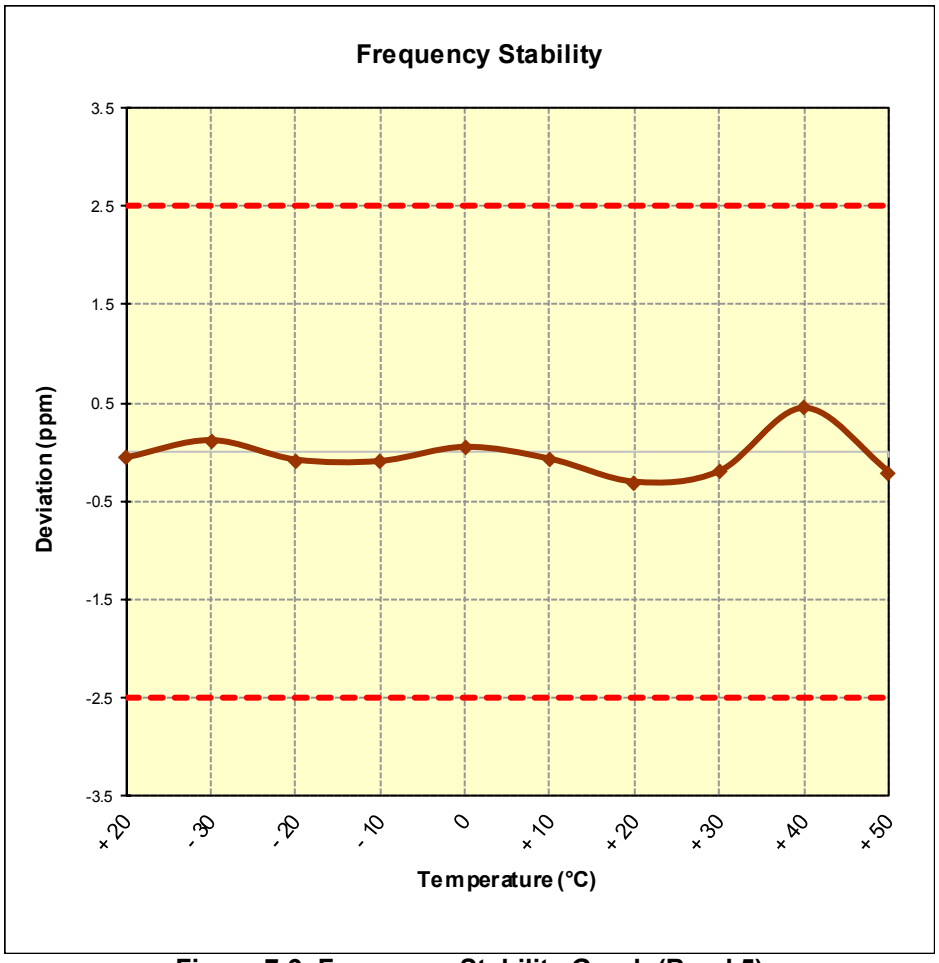


Figure 7-9. Frequency Stability Graph (Band 5)

Band 4 Frequency Stability Measurements

§2.1055 §§27.54

OPERATING FREQUENCY:	1,732,500,000	Hz
CHANNEL:	20175	
REFERENCE VOLTAGE:	3.85	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.85	+ 20 (Ref)	1,732,500,173	173	0.0000100
100 %		- 30	1,732,499,642	-358	-0.0000207
100 %		- 20	1,732,500,008	8	0.0000005
100 %		- 10	1,732,500,119	119	0.0000069
100 %		0	1,732,500,186	186	0.0000107
100 %		+ 10	1,732,500,285	285	0.0000165
100 %		+ 20	1,732,500,220	220	0.0000127
100 %		+ 30	1,732,500,272	272	0.0000157
100 %		+ 40	1,732,499,795	-205	-0.0000118
100 %		+ 50	1,732,500,112	112	0.0000065
BATT. ENDPOINT	3.45	+ 20	1,732,499,774	-226	-0.0000130

Table 7-20. Frequency Stability Data (Band 4)

Note:

Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

Band 4 Frequency Stability Measurements

§2.1055 §§27.54

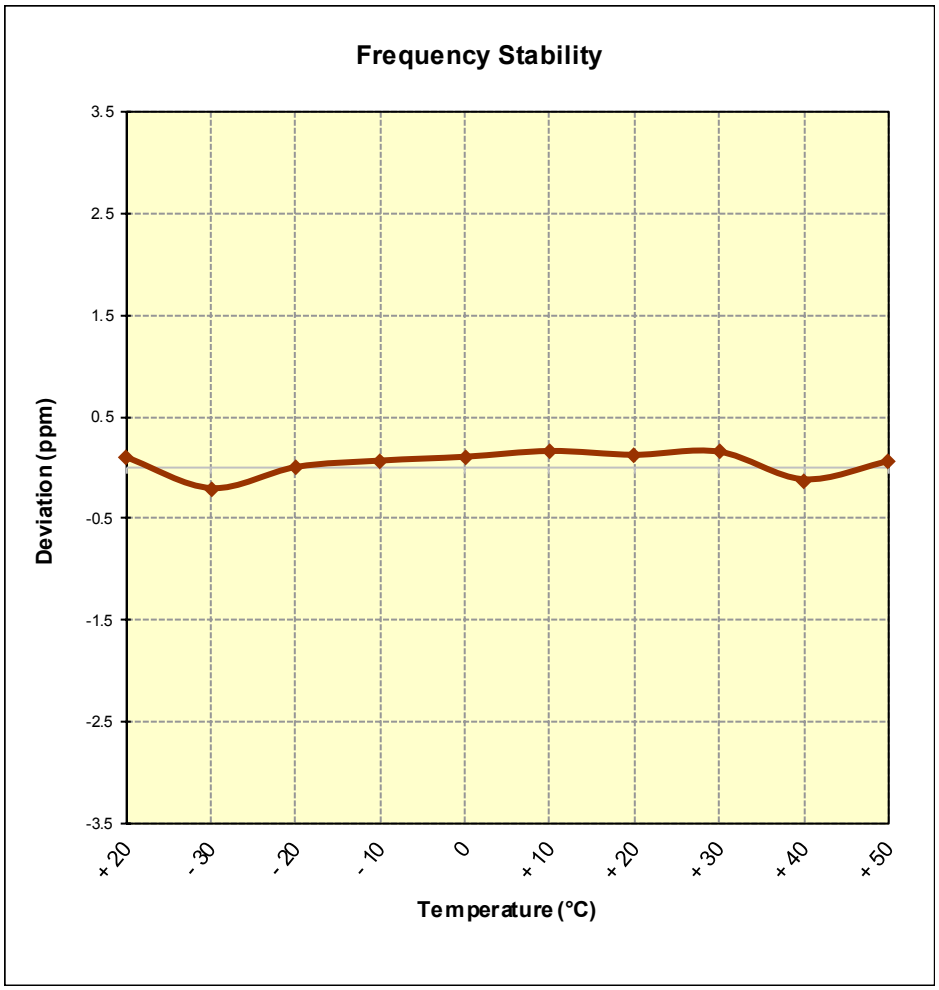


Figure 7-10. Frequency Stability Graph (Band 4)

Band 2 Frequency Stability Measurements

§2.1055 §24.235

OPERATING FREQUENCY:	1,880,000,000	Hz
CHANNEL:	18900	
REFERENCE VOLTAGE:	3.85	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.85	+ 20 (Ref)	1,880,000,246	246	0.0000131
100 %		- 30	1,879,999,974	-26	-0.0000014
100 %		- 20	1,880,000,154	154	0.0000082
100 %		- 10	1,879,999,912	-88	-0.0000047
100 %		0	1,880,000,157	157	0.0000084
100 %		+ 10	1,880,000,009	9	0.0000005
100 %		+ 20	1,880,000,050	50	0.0000027
100 %		+ 30	1,879,999,821	-179	-0.0000095
100 %		+ 40	1,879,999,982	-18	-0.0000010
100 %		+ 50	1,880,000,098	98	0.0000052
BATT. ENDPOINT	3.45	+ 20	1,879,999,836	-164	-0.0000087

Table 7-21. Frequency Stability Data (Band 2)

Note:

Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

Band 2 Frequency Stability Measurements

§2.1055 §24.235

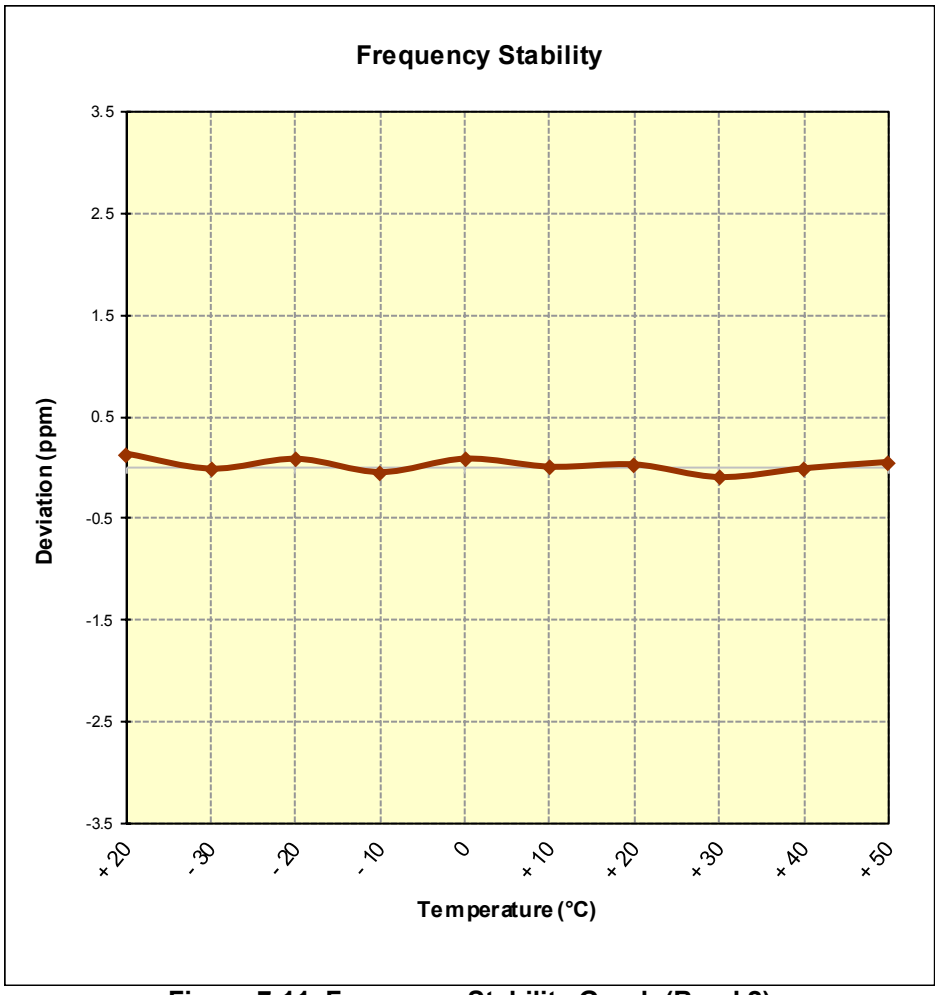


Figure 7-11. Frequency Stability Graph (Band 2)

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **LG Portable Handset** **FCC ID: ZNFM255** complies with all the requirements of Parts 22, 24, & 27 of the FCC rules for LTE operation only.