

5. Peak-Average Ratio

5.1. Limit

FCC

- §22.913(d) Measurement of the ERP of Cellular base transmitters and repeaters must be made using an average power measurement technique. The peak-to-average ratio (PAR) of the transmission must not exceed 13 dB.

- §24.232(d), power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

- §27.50(d)(5), power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

IC

- RSS-130 Issue 1

4.4, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1 % of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

- RSS-132 Issue 3

5.4, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1 % of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

- RSS-133 Issue 6

6.4, the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1 % of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

- RSS-139 Issue 3

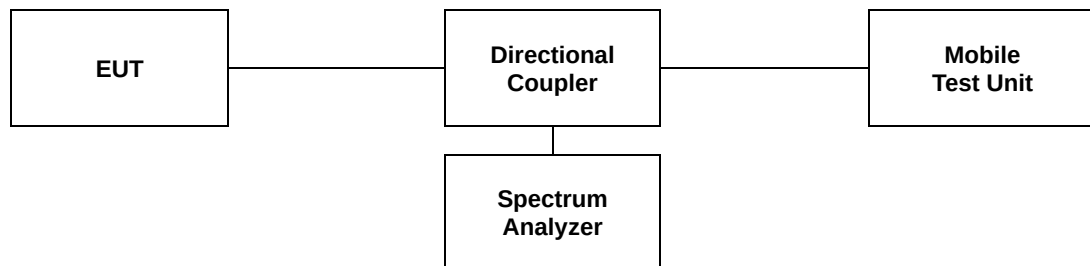
6.5, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1 % of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

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5.2. Test Procedure

The test follows section 5.7.2 of FCC KDB Publication 971168 D01 v03.

1. Refer to the instruction manual of the instrument for details on how to use the power statistics/CCDF function.
2. Set resolution/measurement bandwidth $\geq$ OBW of the signal, or $\geq$ signal's occupied bandwidth.
3. Set the number of counts to a value that stabilizes the measured CCDF curve.
4. Set the measurement interval as follows:
 - a) For continuous transmissions, set to $[10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$ or 1 ms.
 - b) For burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize. Set the measurement interval to a time that is less than or equal to the burst duration.
 - c) If there are multiple carriers (i.e., multiple emission signals with specific associated necessary bandwidths) in a single antenna port, the peak power for that port shall be determined for each individual carrier by disabling the other carriers while measuring the required carrier, then the total peak power is calculated from the sum of the individual carrier peak powers.
5. Record the maximum PAPR level associated with a probability of 0.1 %.



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5.3 Test Results

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

- LTE

Band	Mode	Frequency (MHz)	PAR (dB)
2 (1.4 MHz)	QPSK	1 850.7	4.85
		1 880.0	4.62
		1 909.3	4.87
2 (3 MHz)	QPSK	1 851.5	4.92
		1 880.0	4.71
		1 908.5	4.84
2 (5 MHz)	QPSK	1 852.5	4.59
		1 880.0	4.68
		1 907.5	4.86
2 (10 MHz)	QPSK	1 855.0	4.92
		1 880.0	4.63
		1 905.0	4.81
2 (15 MHz)	QPSK	1 857.5	4.67
		1 880.0	4.26
		1 902.5	4.23
2 (20 MHz)	QPSK	1 860.0	4.46
		1 880.0	4.20
		1 900.0	4.35

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Band	Mode	Frequency (MHz)	PAR (dB)
4 (1.4 MHz)	QPSK	1 710.7	5.07
		1 732.5	4.86
		1 754.3	5.25
4 (3 MHz)	QPSK	1 711.5	5.08
		1 732.5	4.87
		1 753.5	5.25
4 (5 MHz)	QPSK	1 712.5	5.14
		1 732.5	4.86
		1 752.5	5.26
4 (10 MHz)	QPSK	1 715.0	5.14
		1 732.5	4.78
		1 750.0	4.98
4 (15 MHz)	QPSK	1 717.5	5.07
		1 732.5	4.64
		1 747.5	4.99
4 (20 MHz)	QPSK	1 720.0	4.72
		1 732.5	4.49
		1 745.0	4.64

Band	Mode	Frequency (MHz)	PAR (dB)
5 (1.4 MHz)	QPSK	824.7	5.37
		836.5	5.30
		848.3	5.62
5 (3 MHz)	QPSK	825.5	5.28
		836.5	5.30
		847.5	5.41
5 (5 MHz)	QPSK	826.5	5.28
		836.5	5.37
		846.5	5.43
5 (10 MHz)	QPSK	829.0	5.26
		836.5	5.30
		844.0	5.23

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Band	Mode	Frequency (MHz)	PAR (dB)
12 (1.4 MHz)	QPSK	699.7	5.11
		707.5	5.29
		715.3	5.14
12 (3 MHz)	QPSK	700.5	5.03
		707.5	5.19
		714.5	5.09
12 (5 MHz)	QPSK	701.5	5.11
		707.5	5.24
		713.5	5.17
12 (10 MHz)	QPSK	704.0	5.09
		707.5	5.15
		711.0	5.14

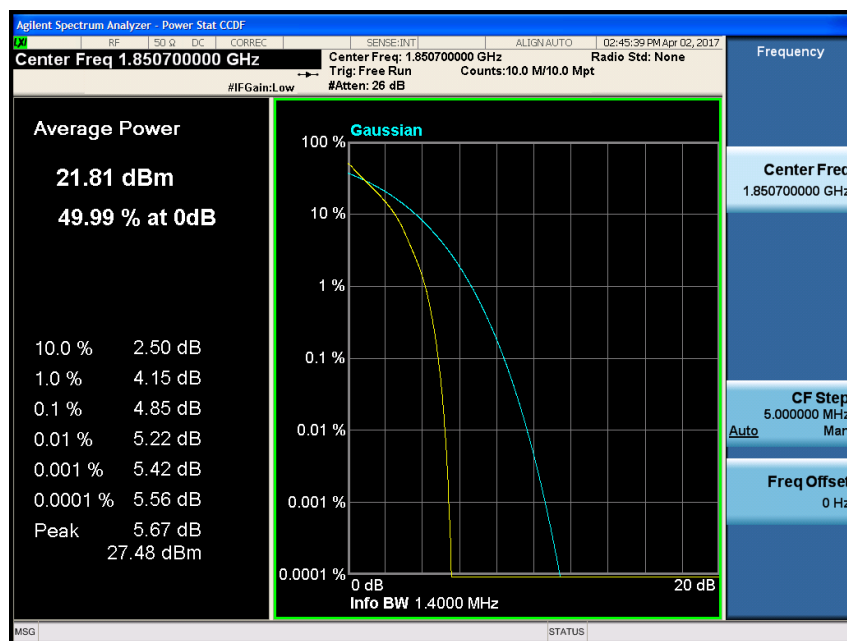
Band	Mode	Frequency (MHz)	PAR (dB)
13 (5 MHz)	QPSK	779.5	5.15
		782.0	5.06
		784.5	5.49
13 (10 MHz)	QPSK	-	-
		782.0	5.05
		-	-

Band	Mode	Frequency (MHz)	PAR (dB)
17 (5 MHz)	QPSK	706.5	5.21
		710.0	5.13
		713.5	5.08
17 (10 MHz)	QPSK	709.0	5.11
		710.0	5.11
		711.0	5.08

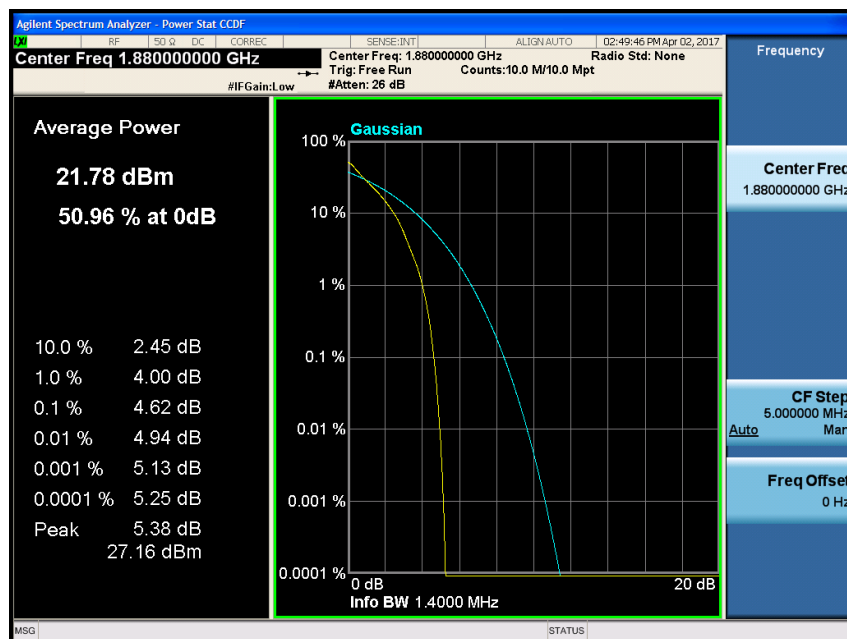
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LTE band 2 (1.4 MHz - QPSK)

Low Channel

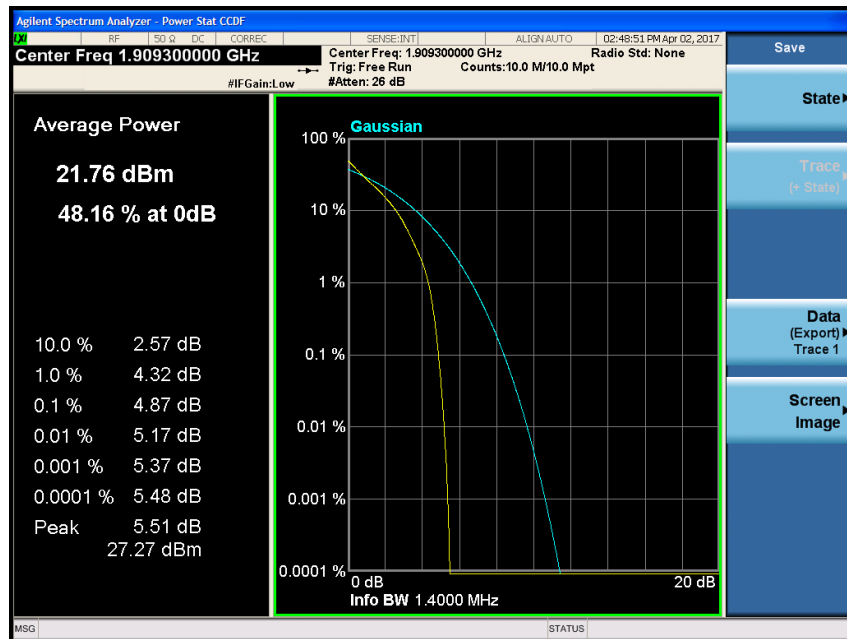


Middle Channel



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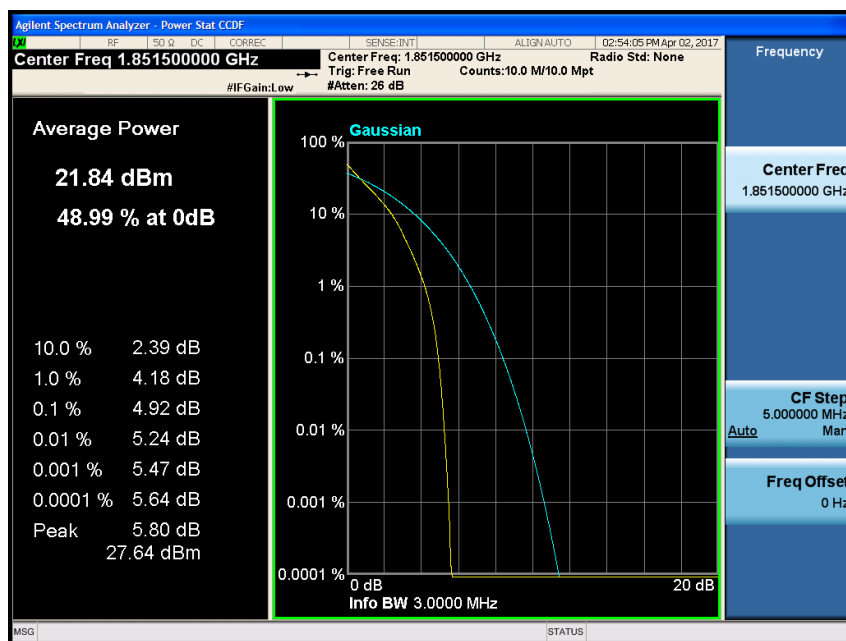
High Channel



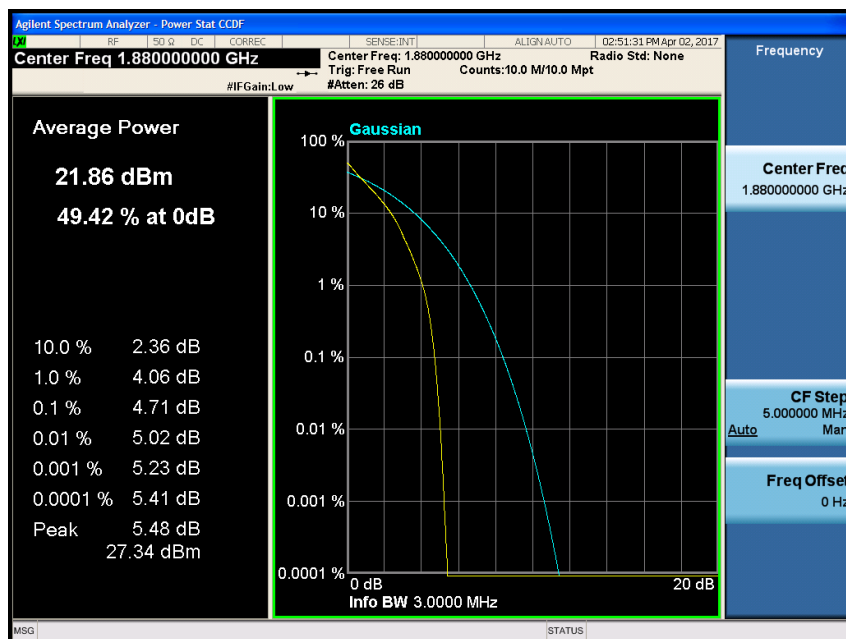
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LTE band 2 (3 MHz - QPSK)

Low Channel

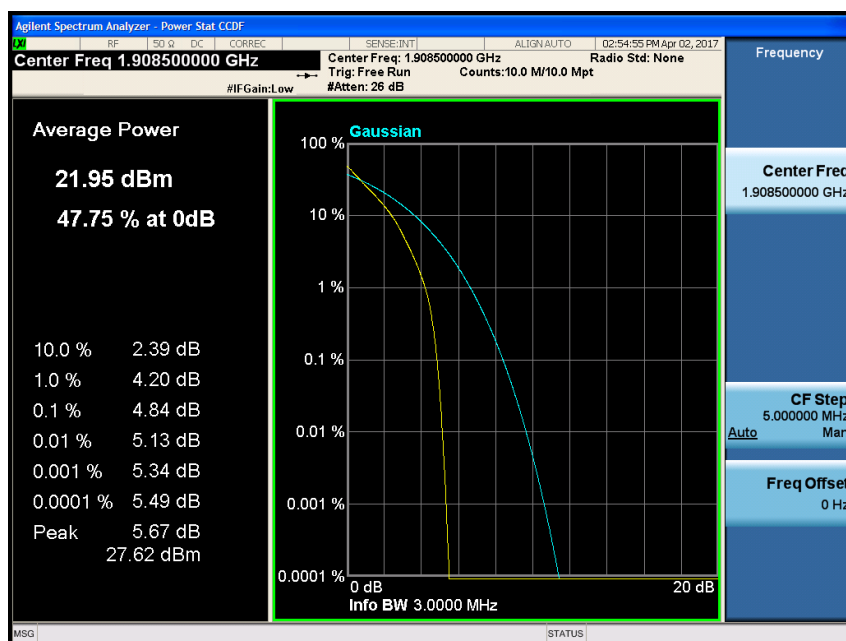


Middle Channel



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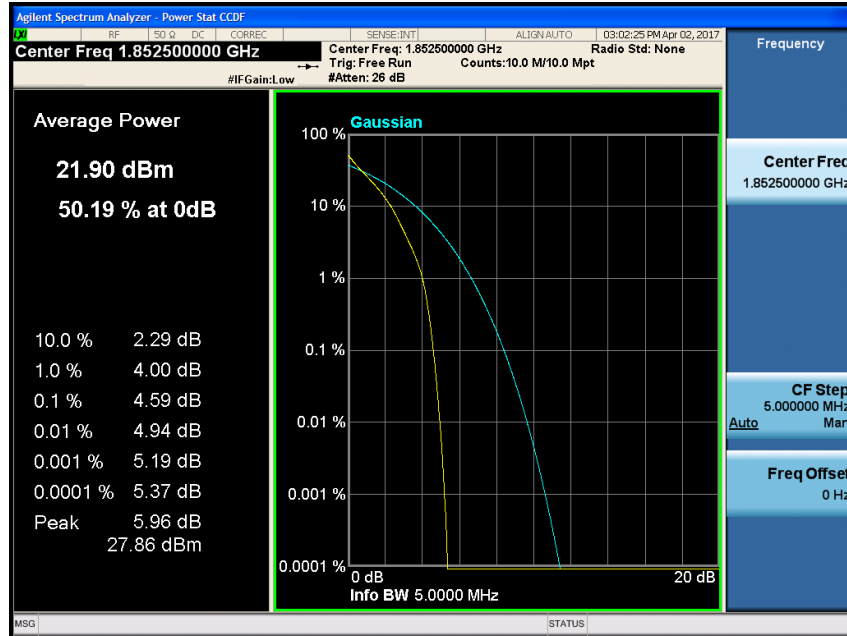
High Channel



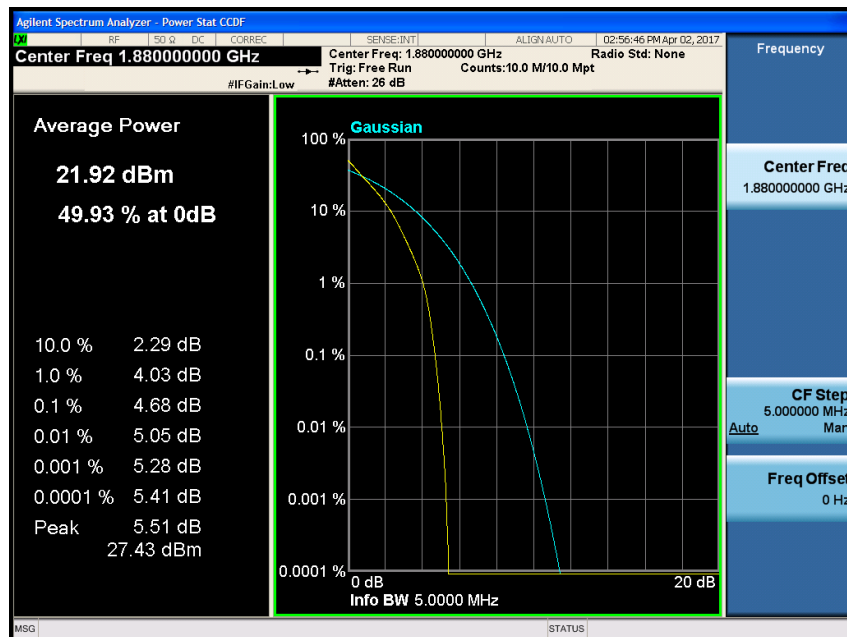
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LTE band 2 (5 MHz - QPSK)

Low Channel

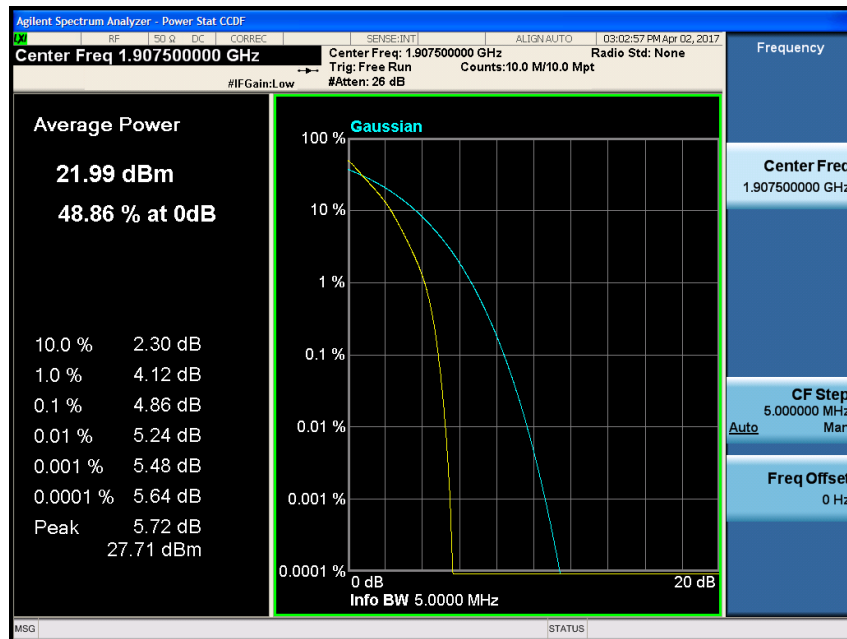


Middle Channel



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High Channel



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SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

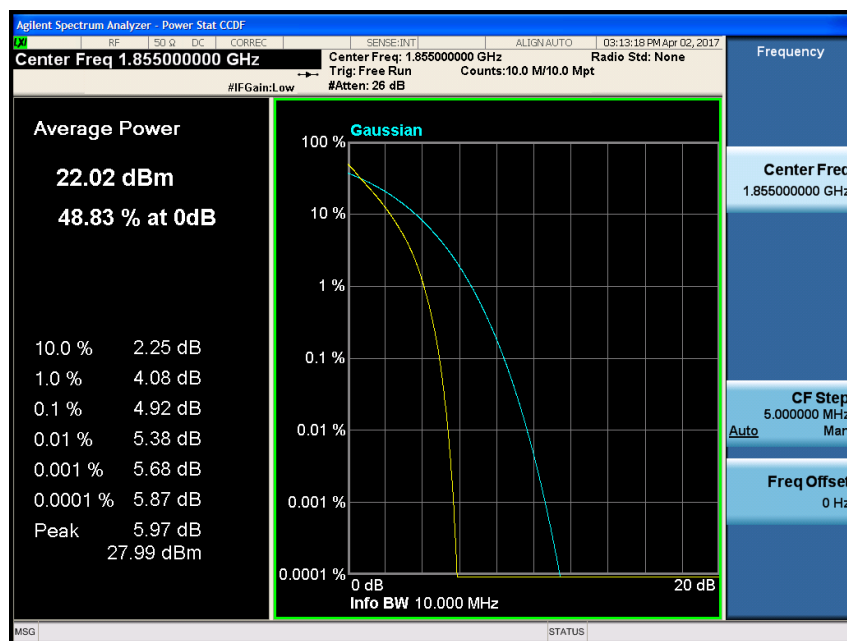
RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

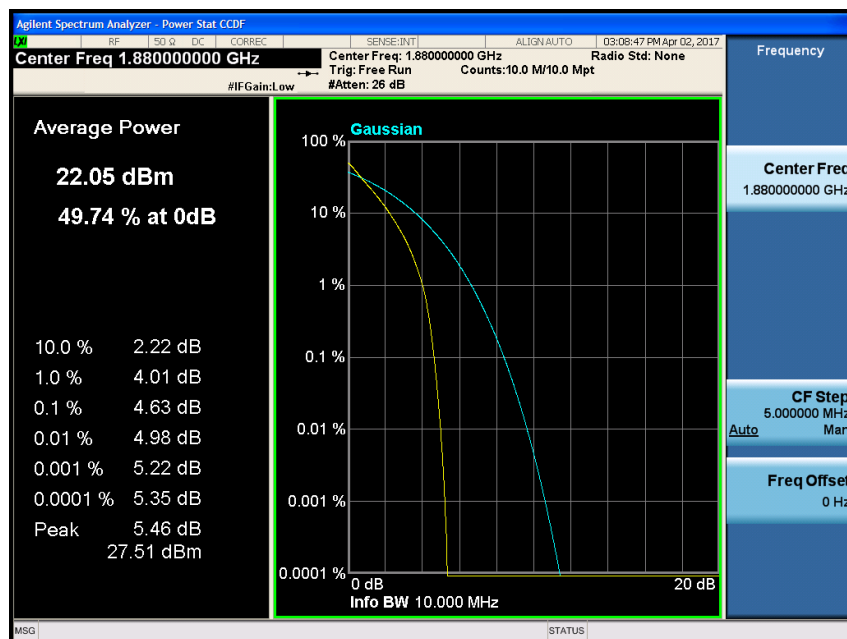
A4(210 mm x 297 mm)

LTE band 2 (10 MHz - QPSK)

Low Channel

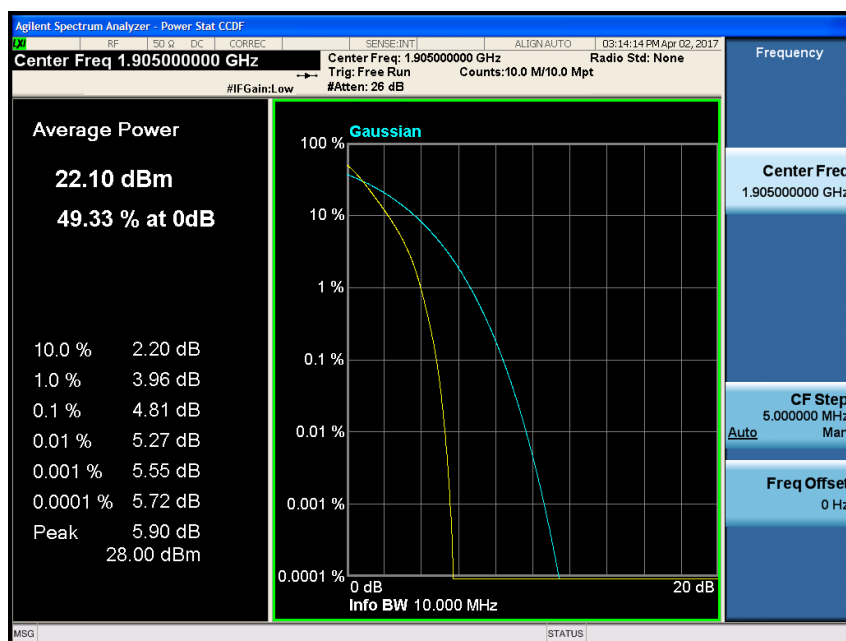


Middle Channel



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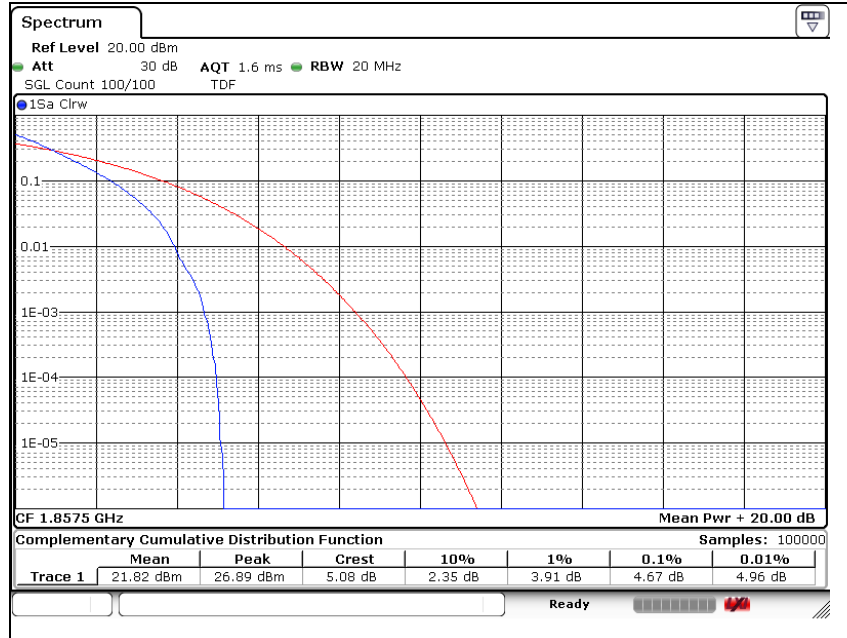
High Channel



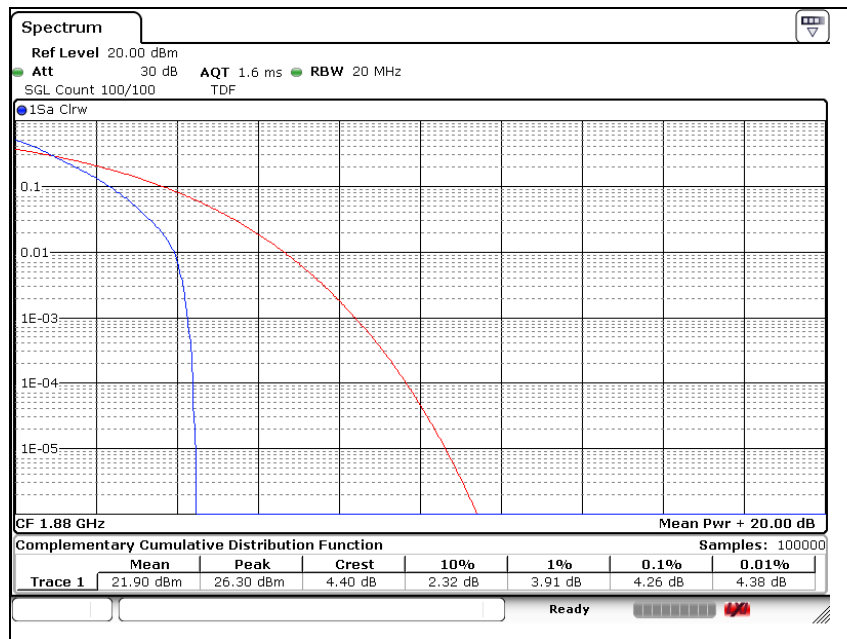
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LTE band 2 (15 MHz - QPSK)

Low Channel

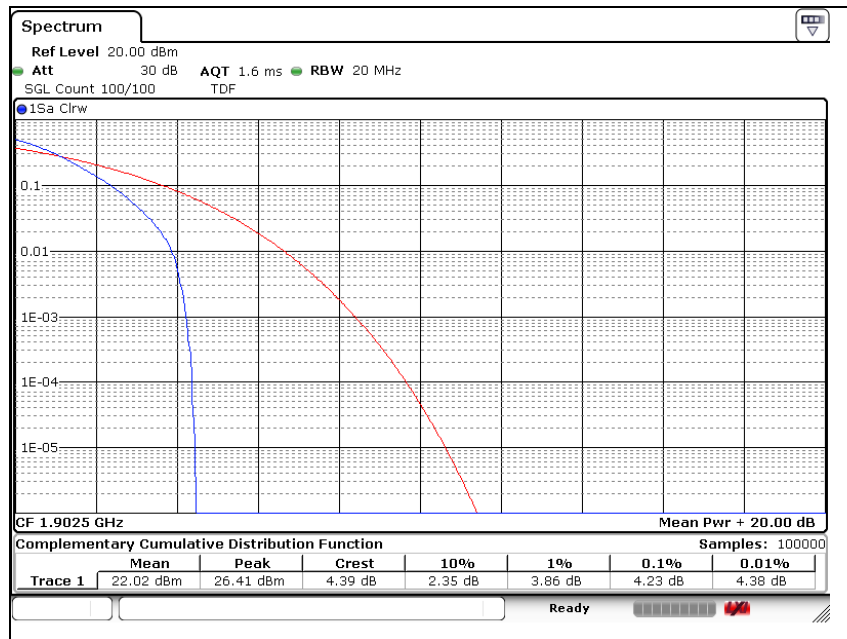


Middle Channel



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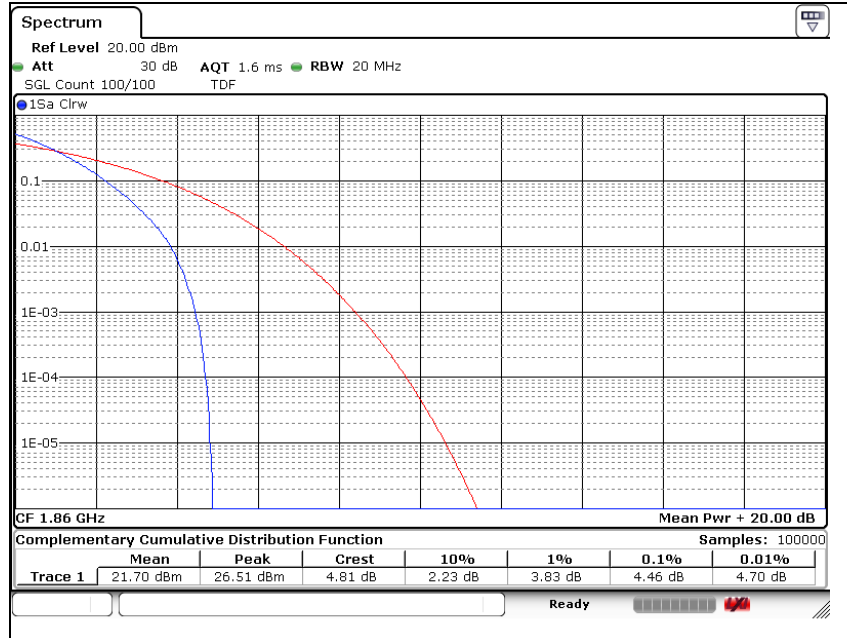
High Channel



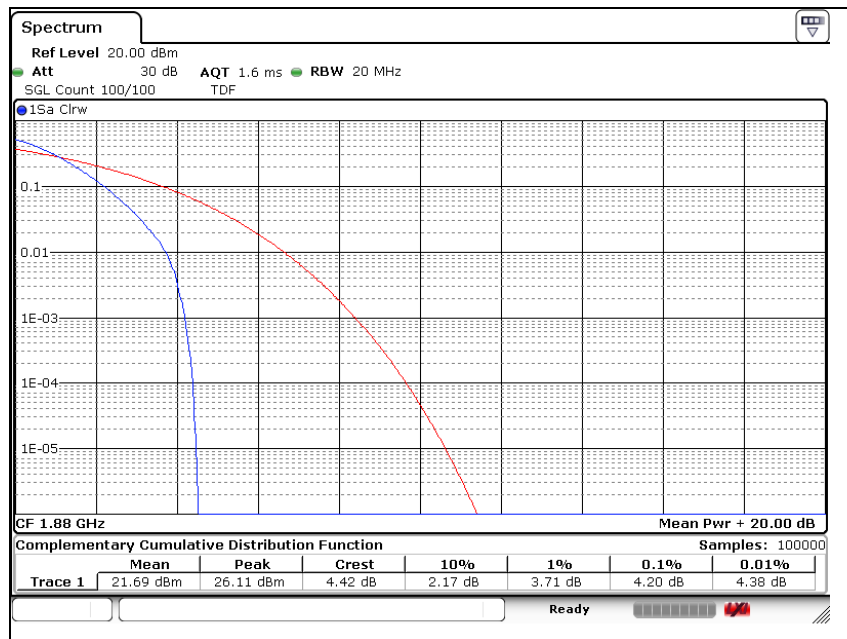
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LTE band 2 (20 MHz - QPSK)

Low Channel

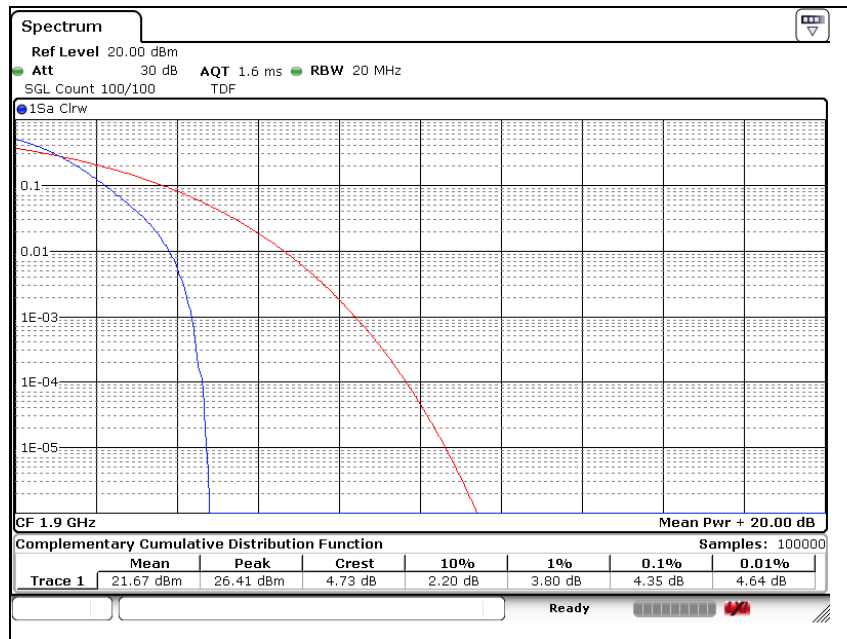


Middle Channel



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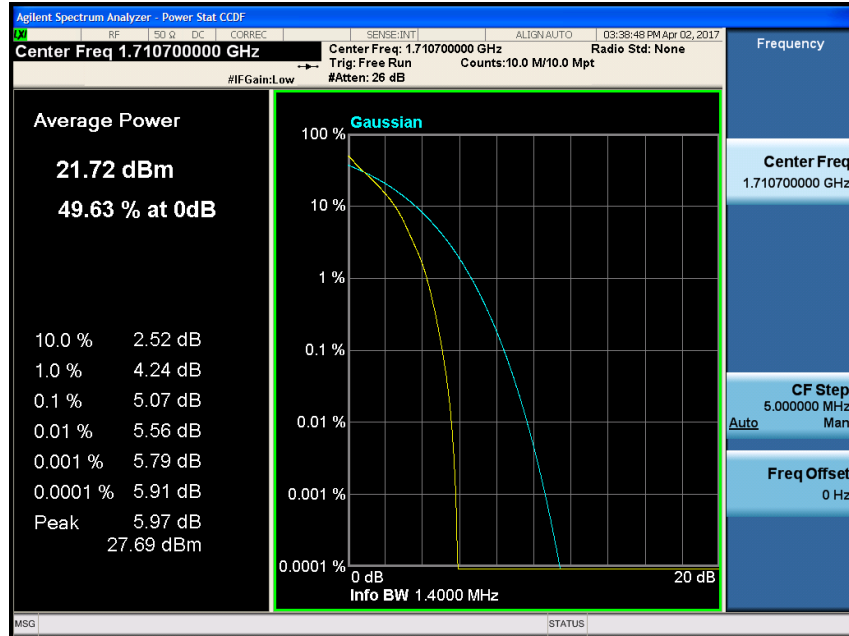
High Channel



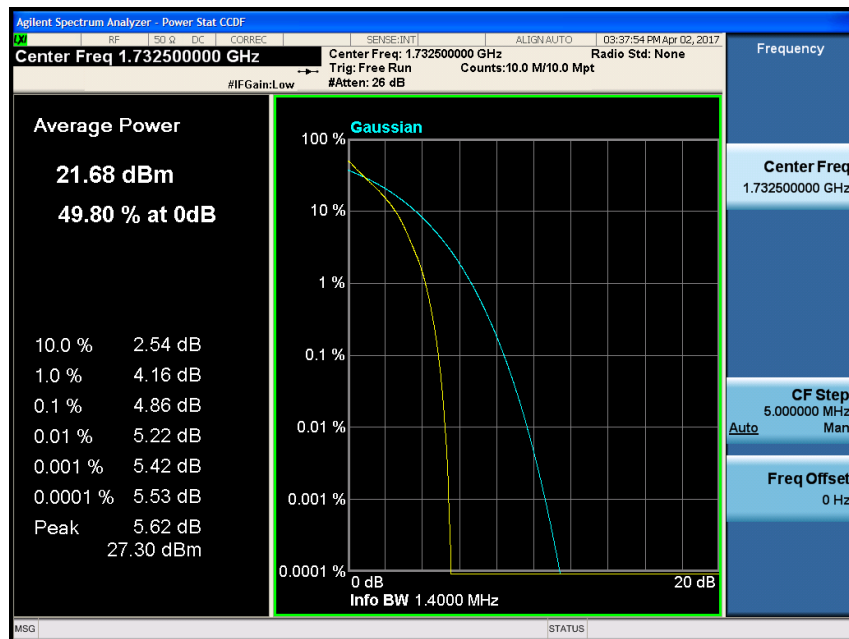
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LTE band 4 (1.4 MHz - QPSK)

Low Channel

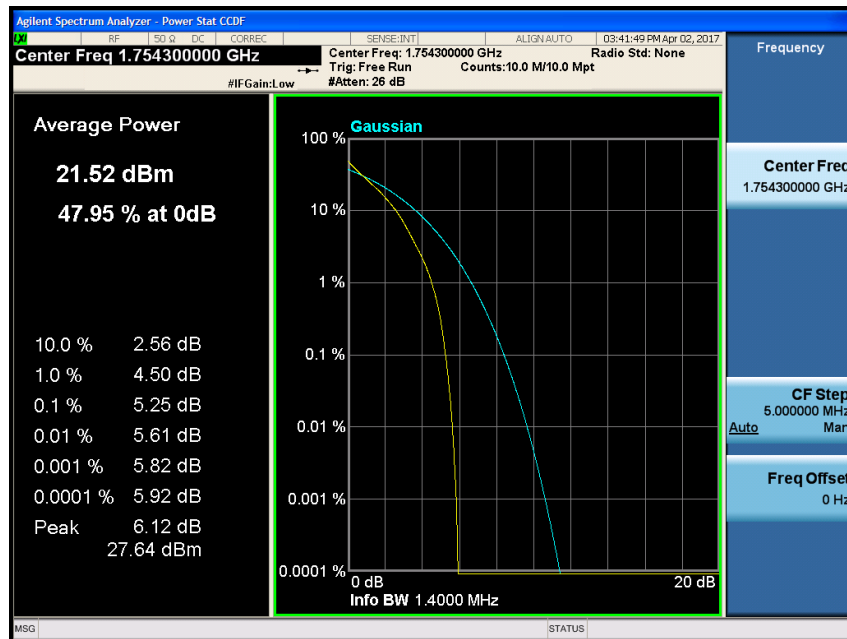


Middle Channel



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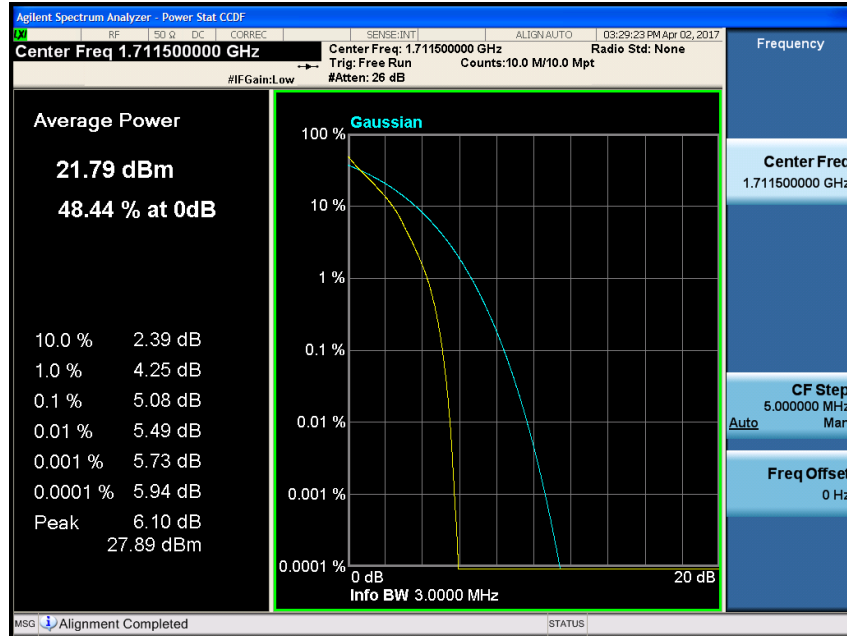
High Channel



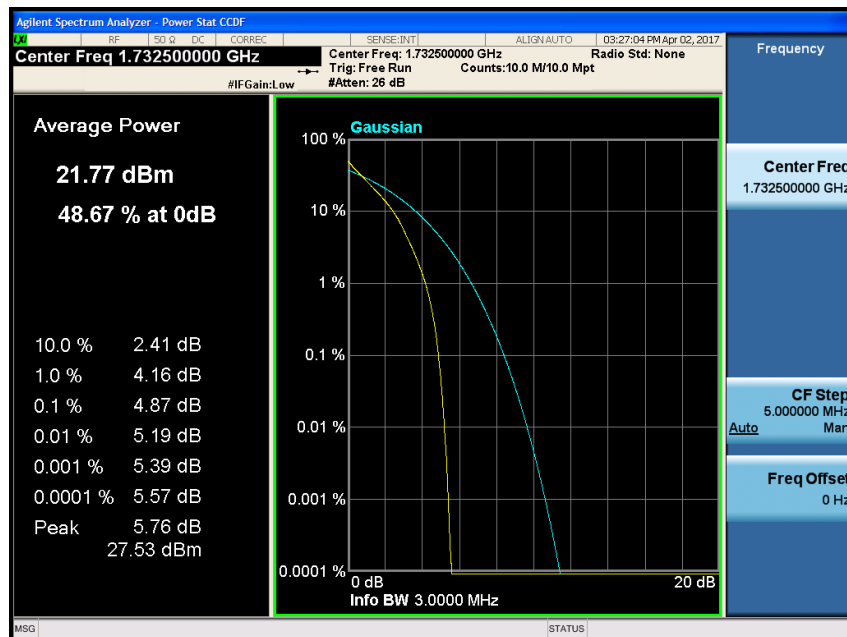
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LTE band 4 (3 MHz - QPSK)

Low Channel



Middle Channel



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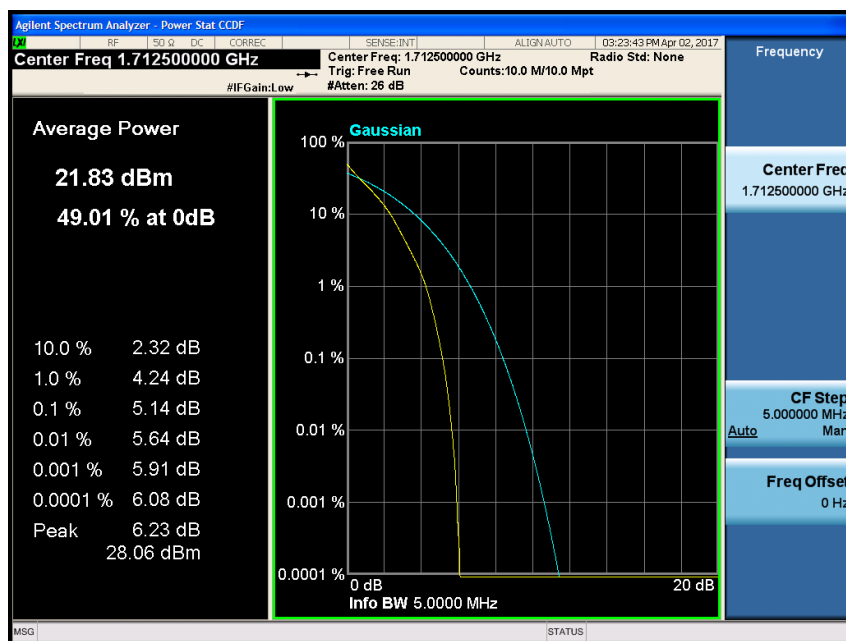
High Channel



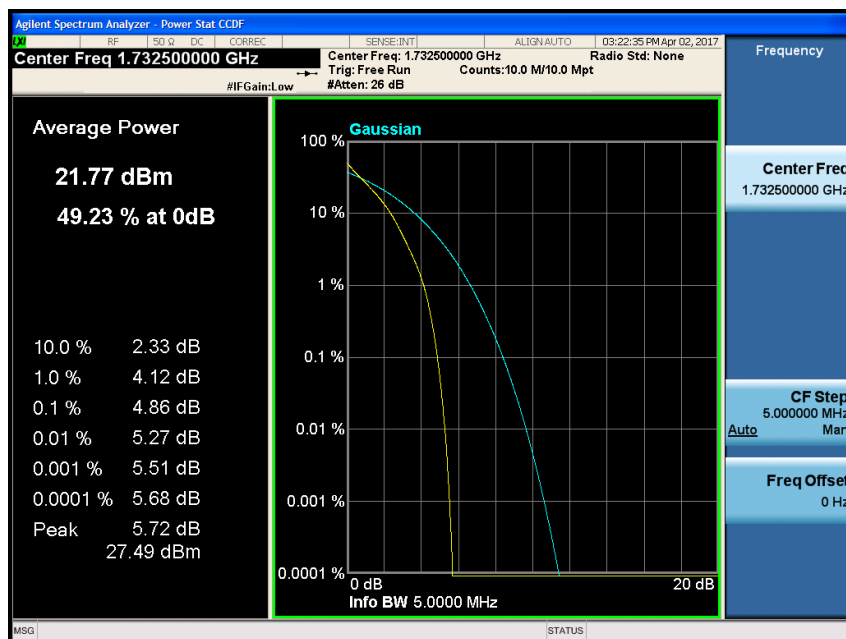
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LTE band 4 (5 MHz - QPSK)

Low Channel

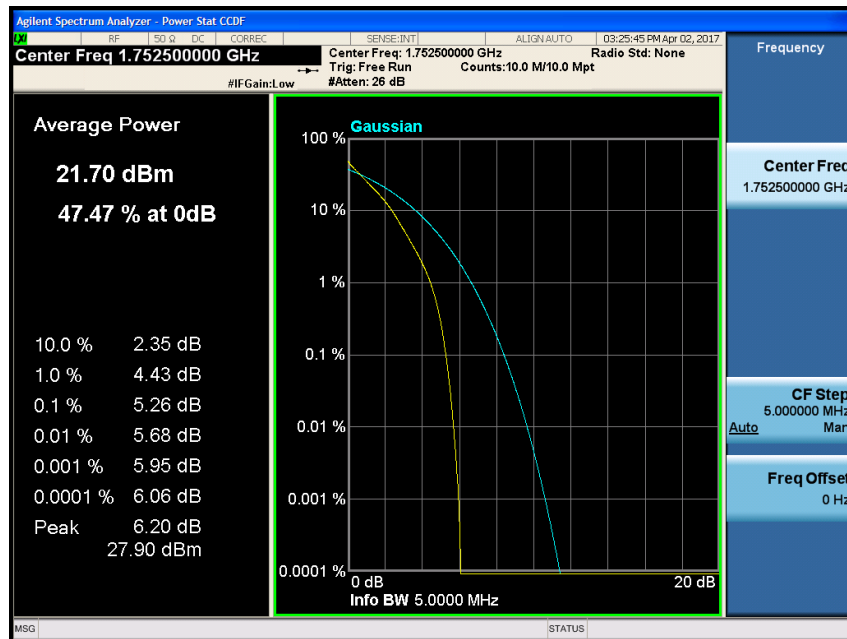


Middle Channel



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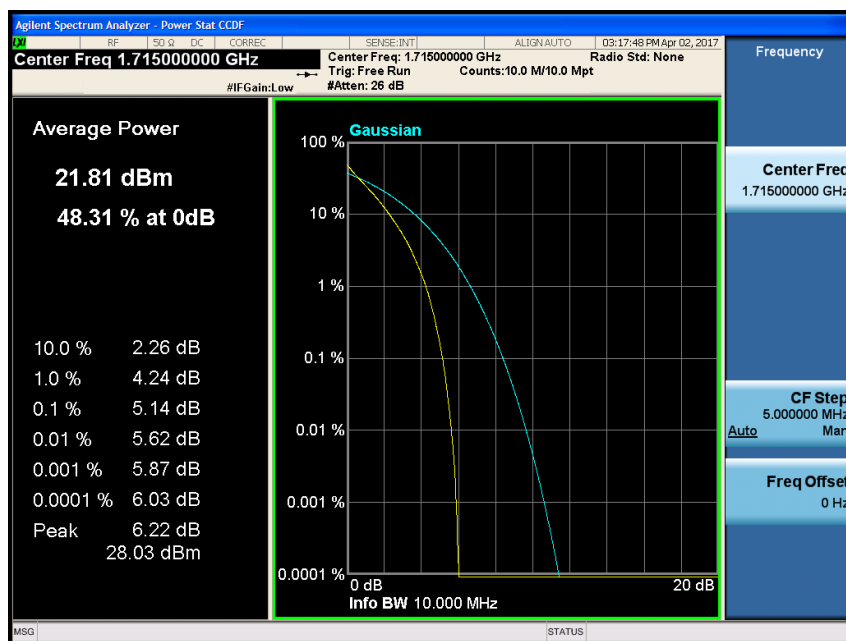
High Channel



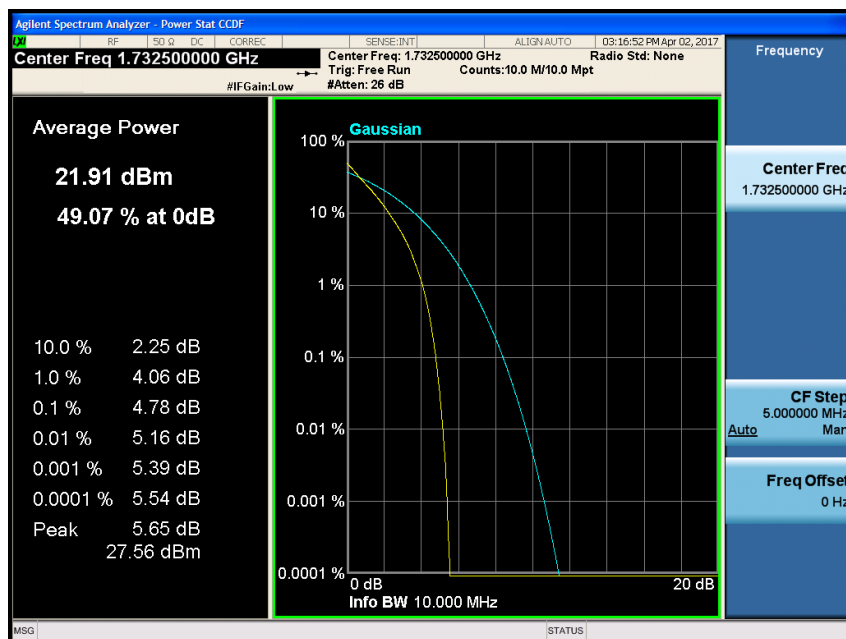
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LTE band 4 (10 MHz - QPSK)

Low Channel

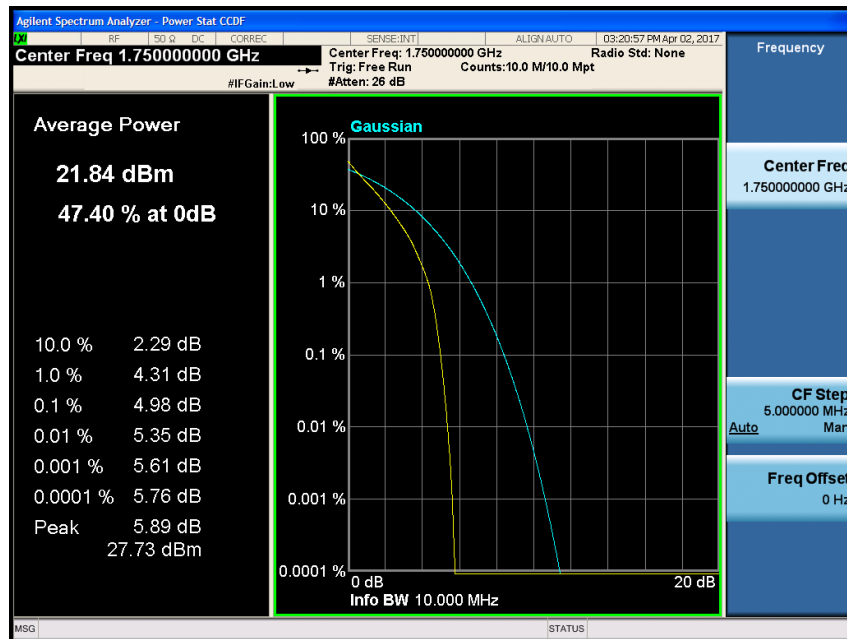


Middle Channel



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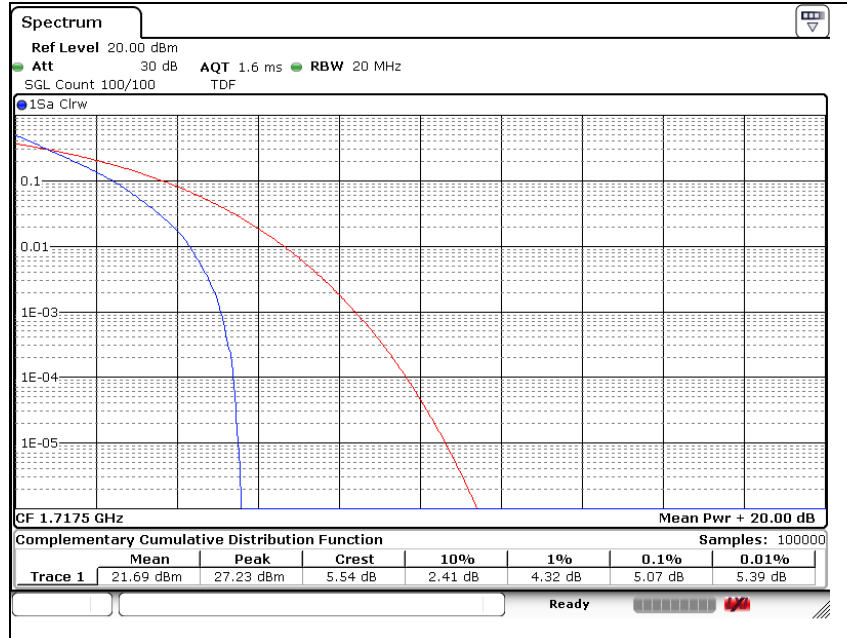
High Channel



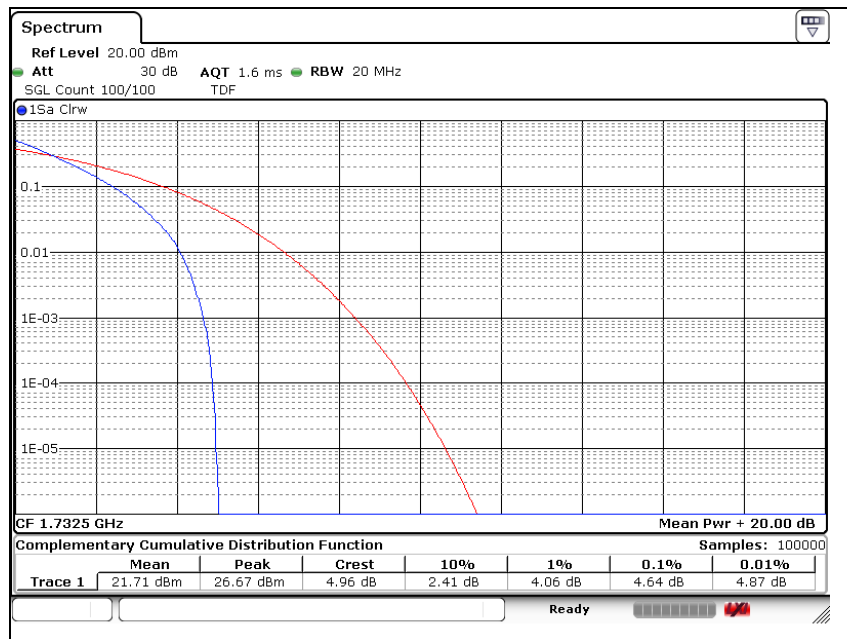
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LTE band 4 (15 MHz - QPSK)

Low Channel

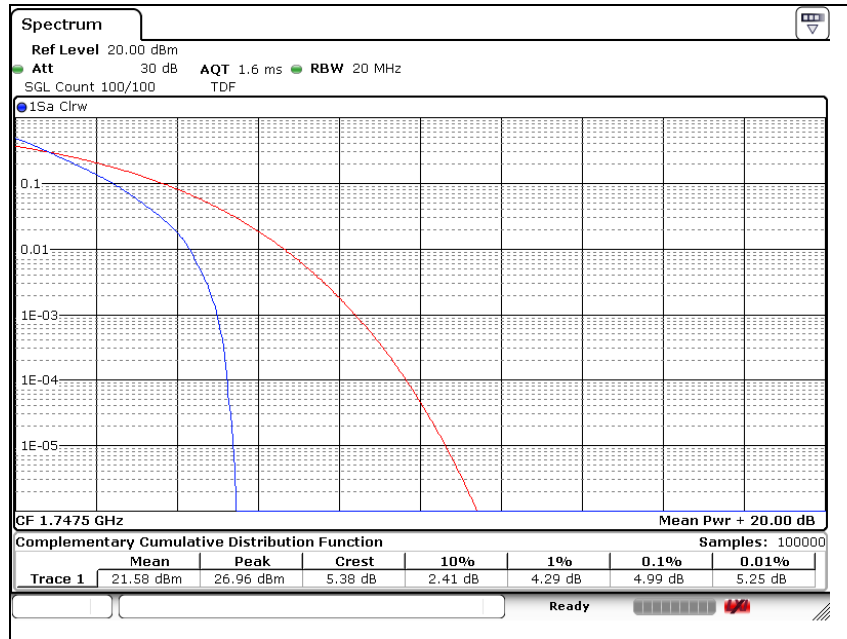


Middle Channel



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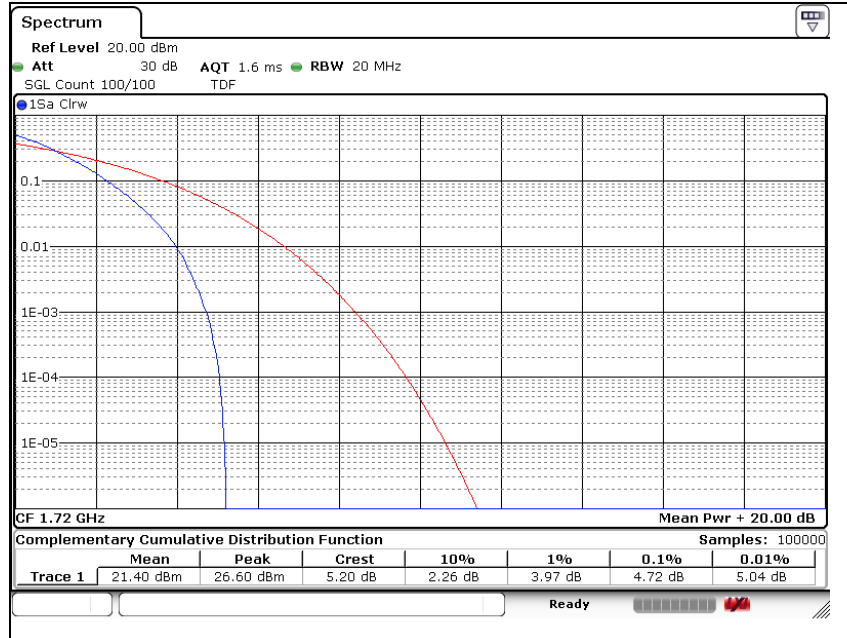
High Channel



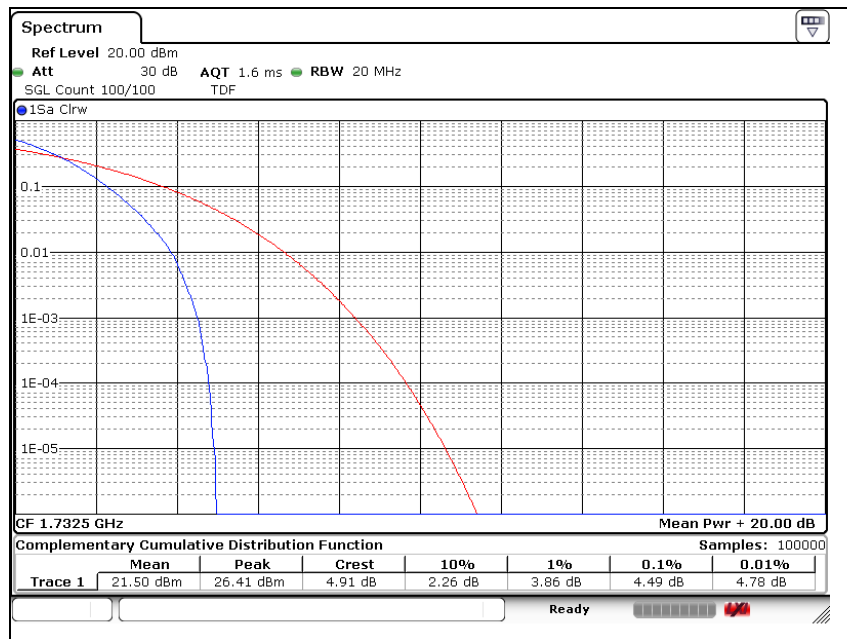
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LTE band 4 (20 MHz - QPSK)

Low Channel

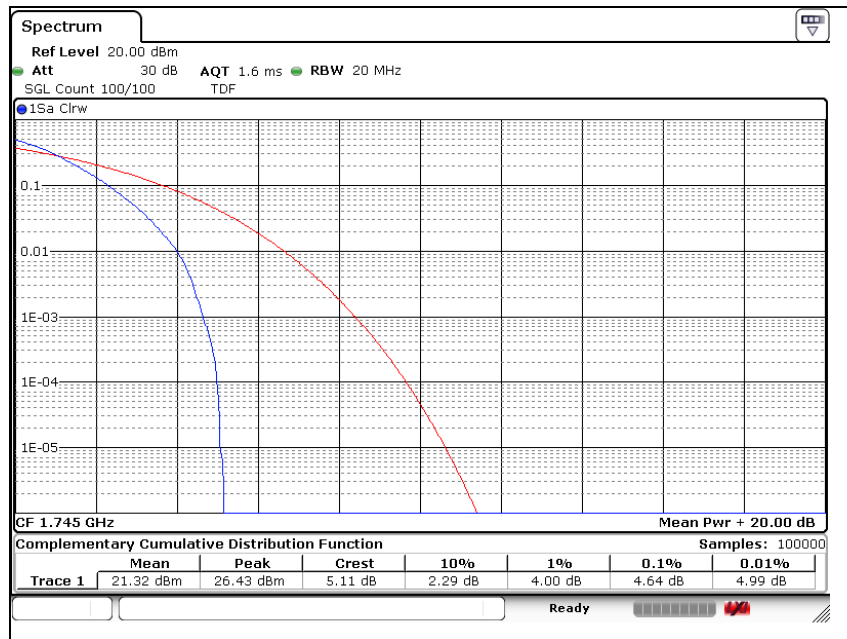


Middle Channel



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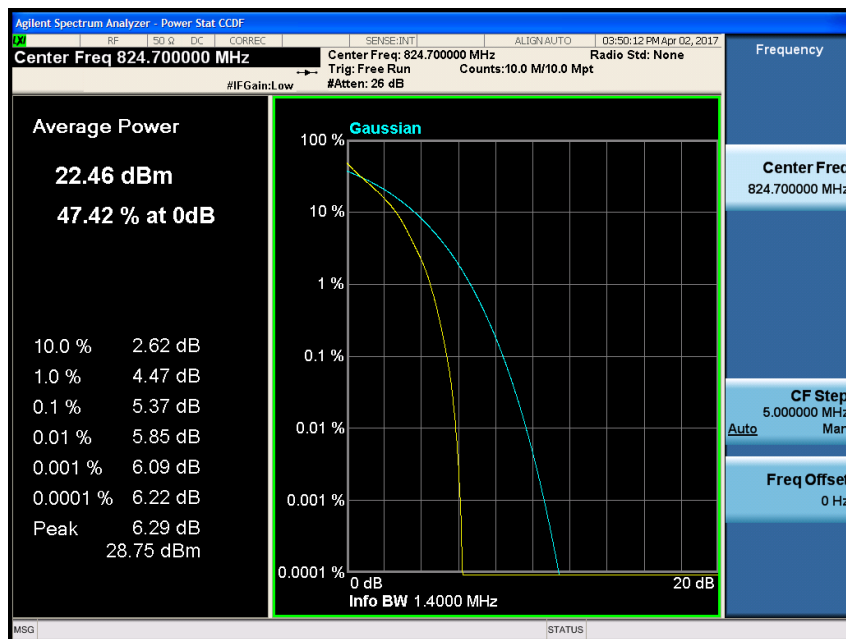
High Channel



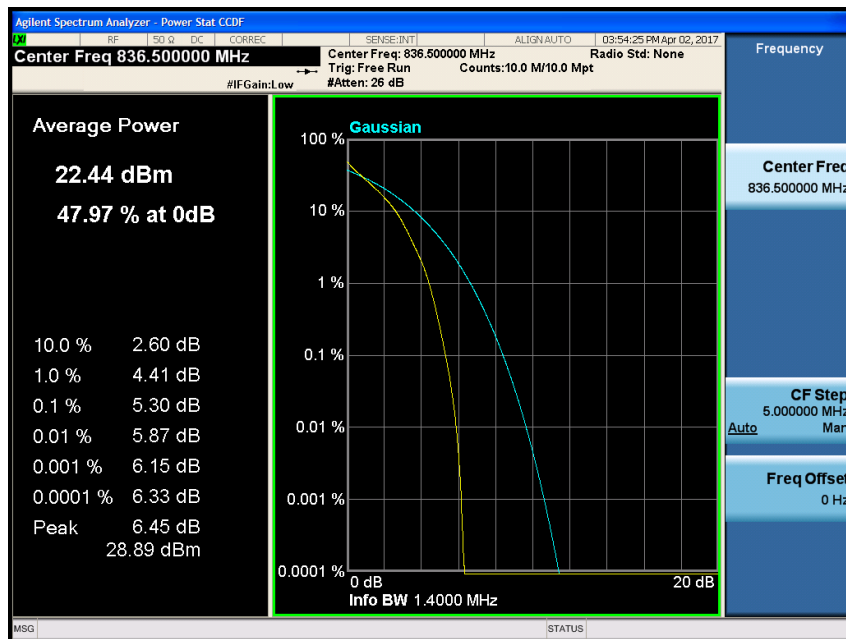
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LTE band 5 (1.4 MHz - QPSK)

Low Channel



Middle Channel



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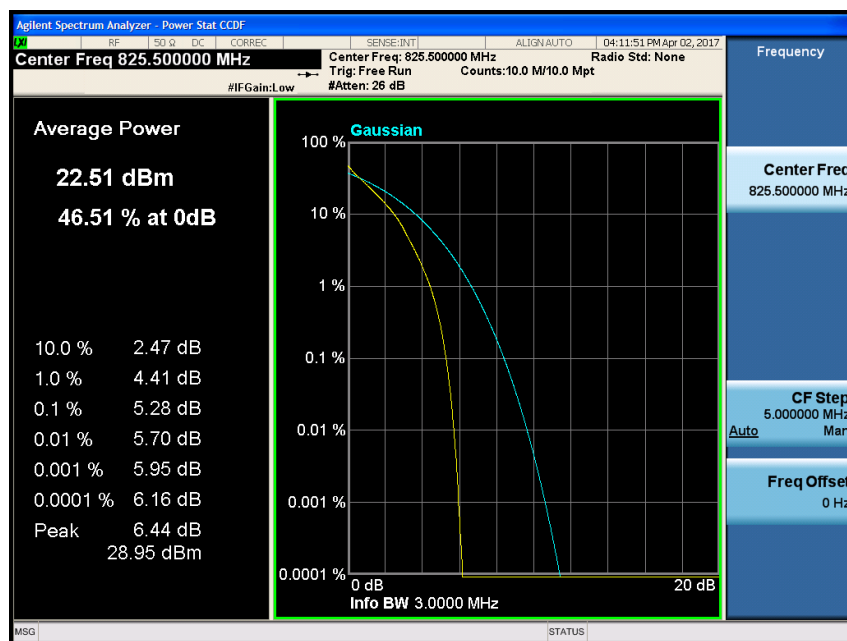
High Channel



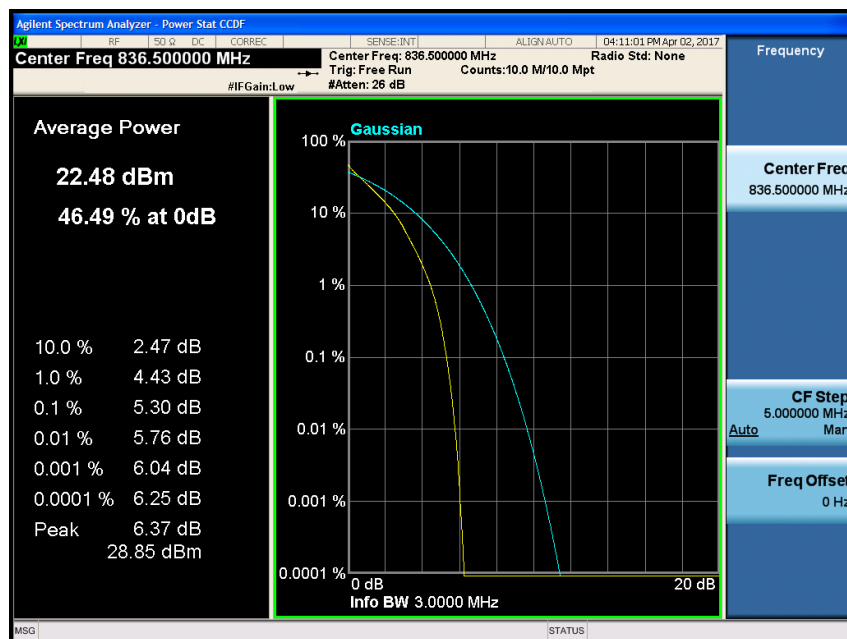
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LTE band 5 (3 MHz - QPSK)

Low Channel



Middle Channel



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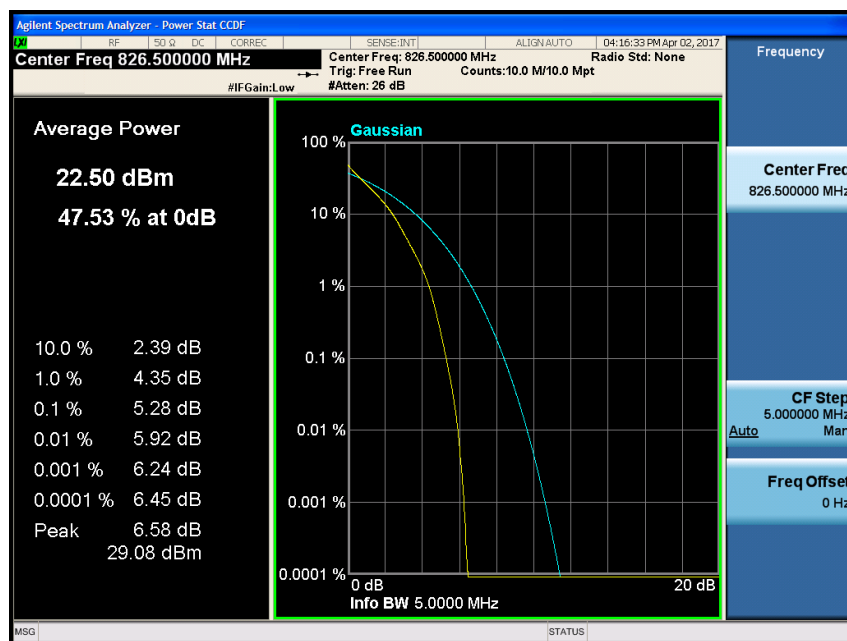
High Channel



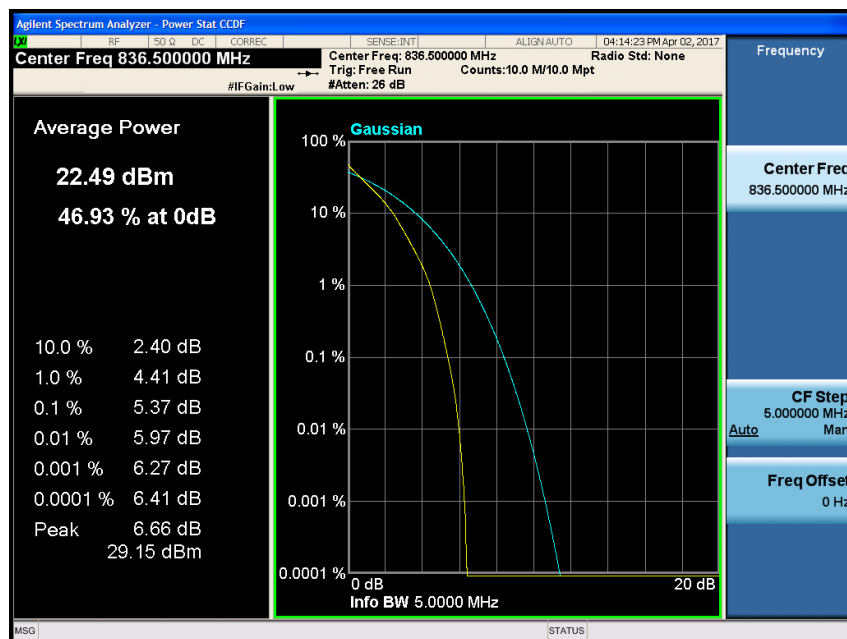
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LTE band 5 (5 MHz - QPSK)

Low Channel

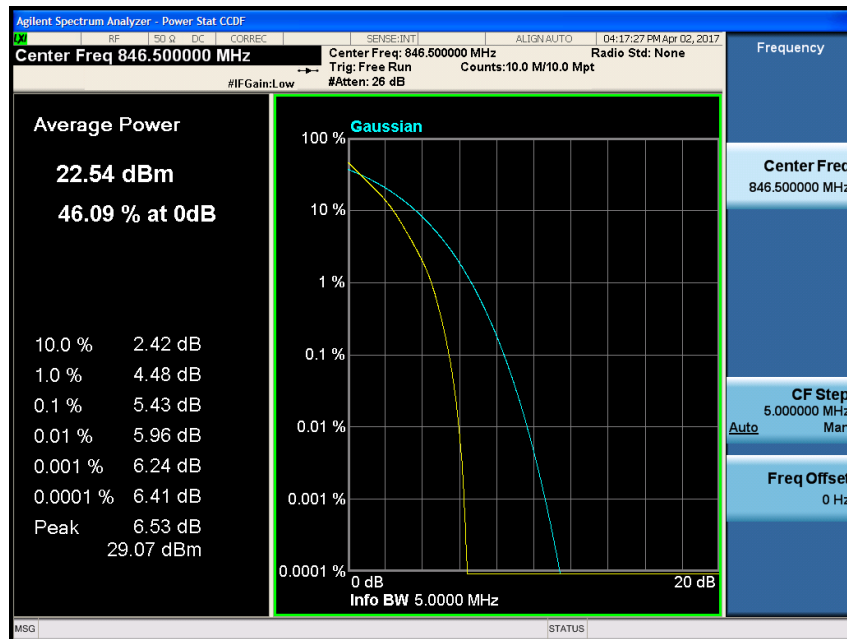


Middle Channel



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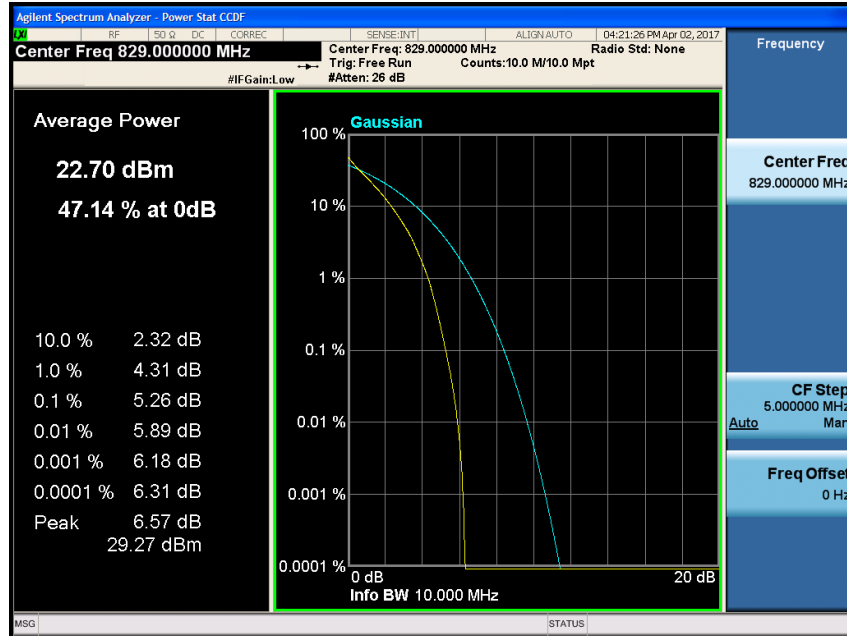
High Channel



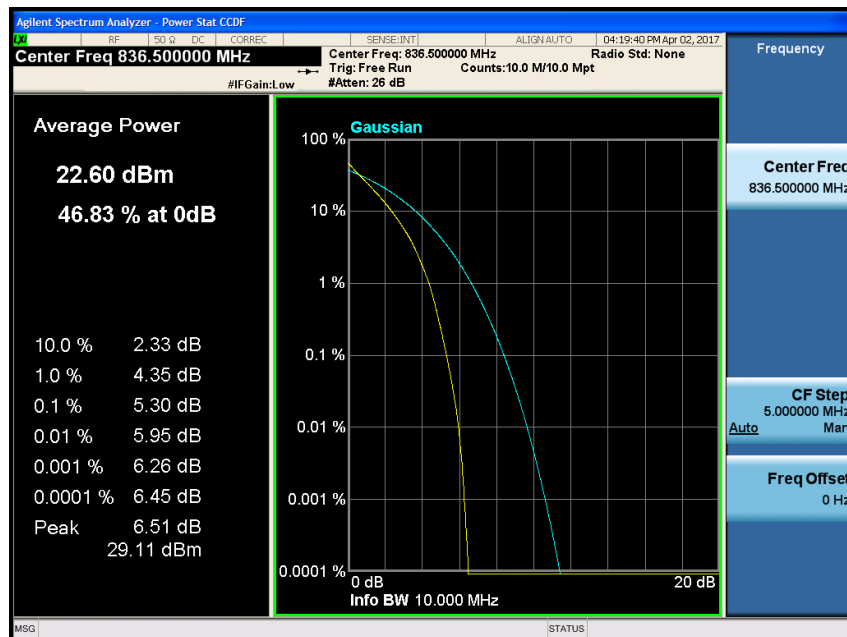
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LTE band 5 (10 MHz - QPSK)

Low Channel



Middle Channel



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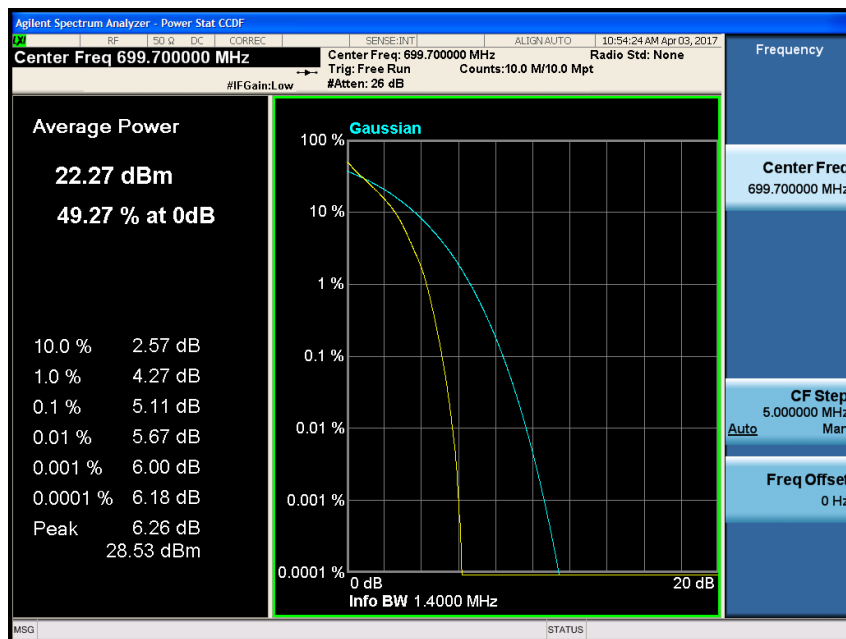
High Channel



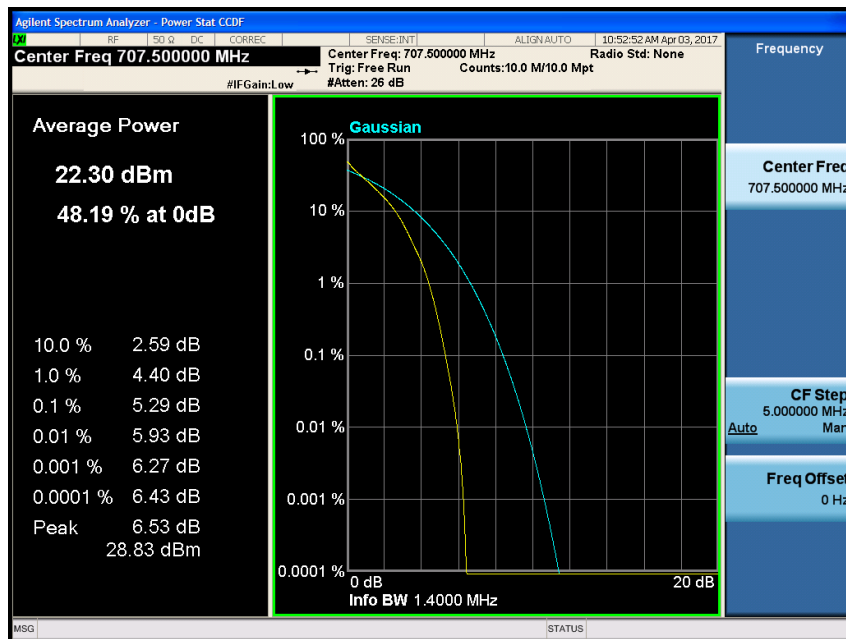
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LTE band 12 (1.4 MHz - QPSK)

Low Channel

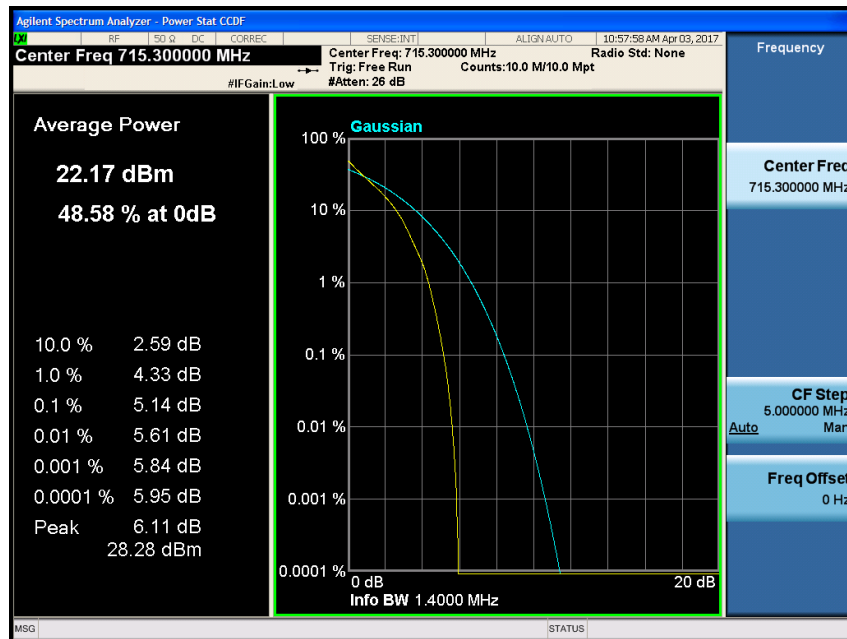


Middle Channel



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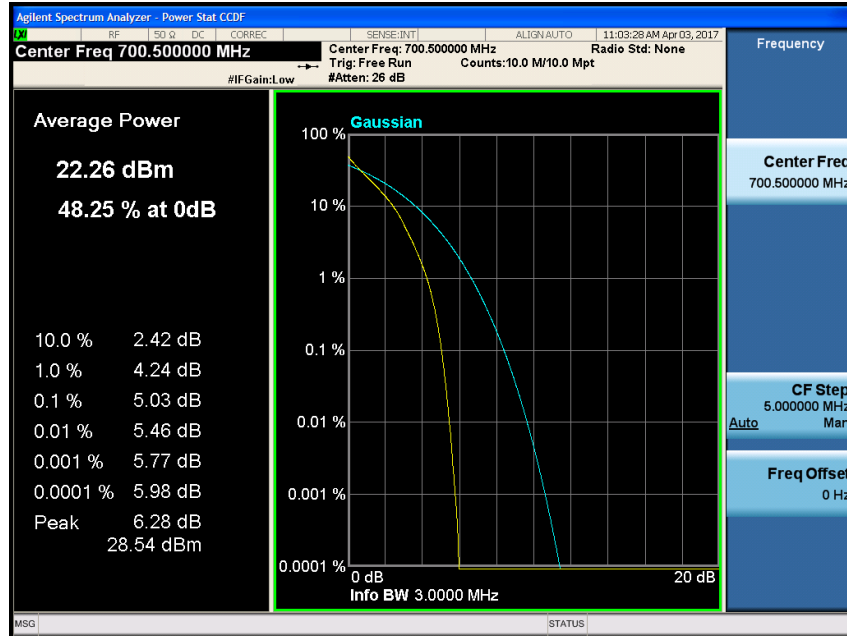
High Channel



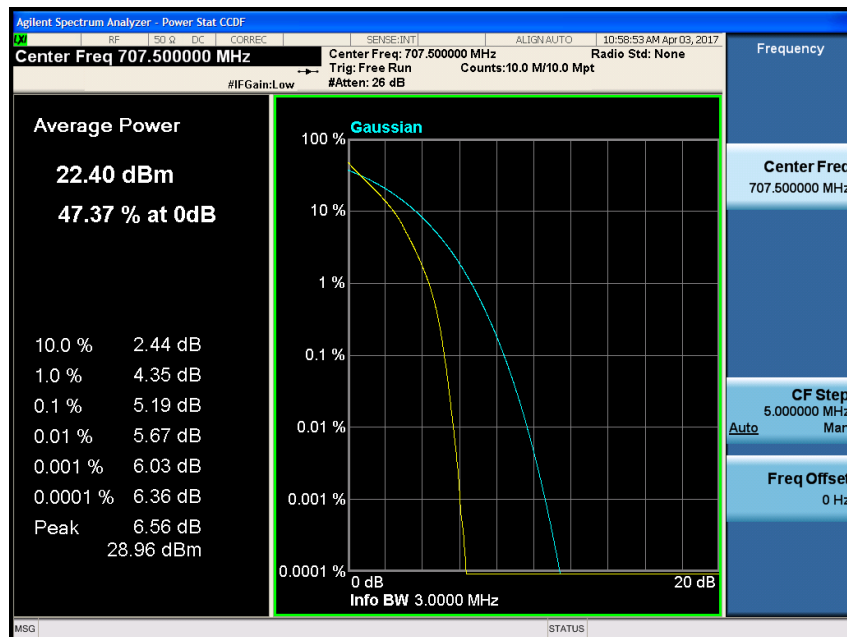
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

LTE band 12 (3 MHz - QPSK)

Low Channel

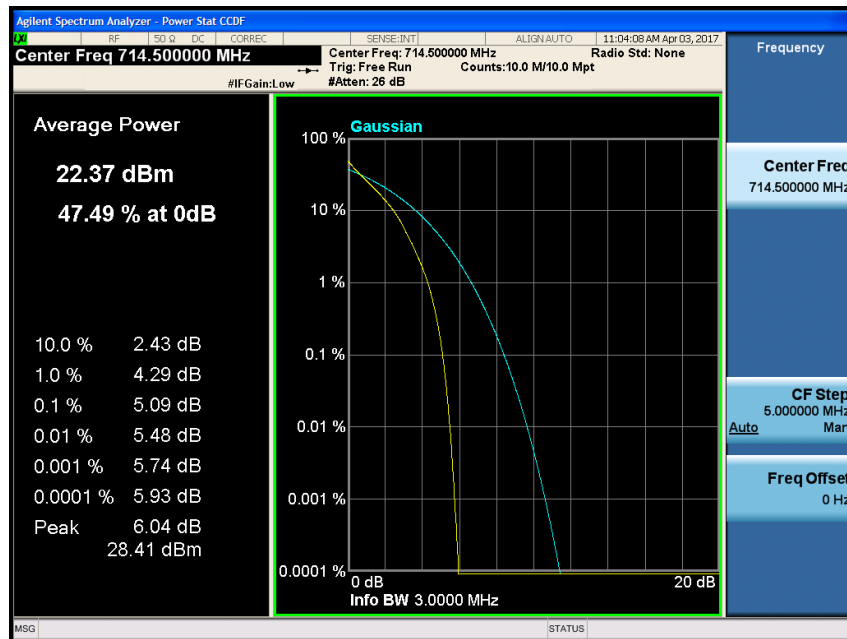


Middle Channel



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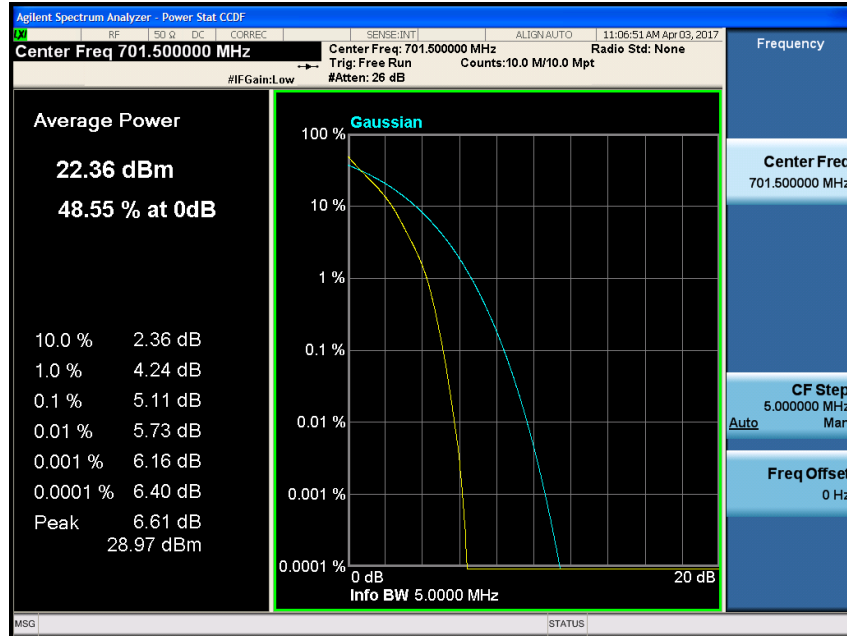
High Channel



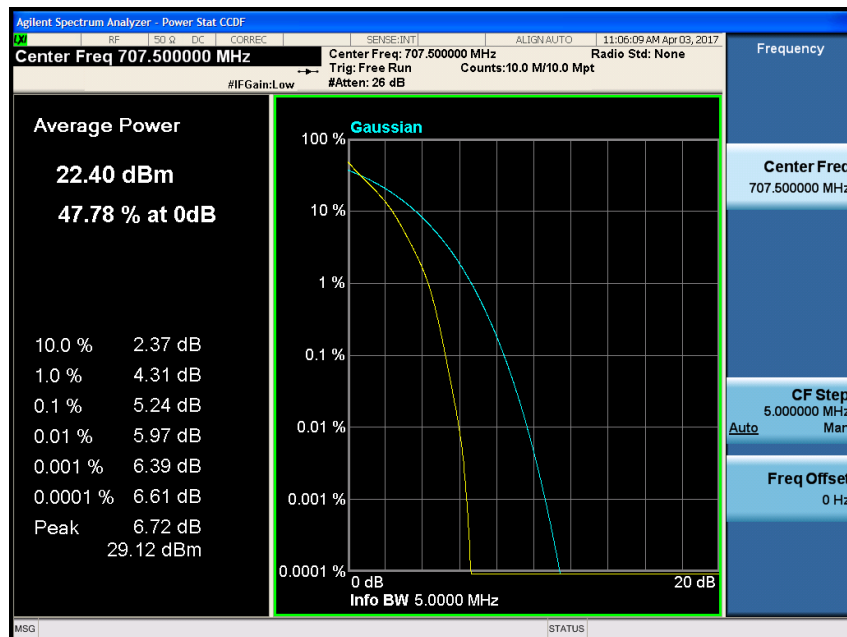
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LTE band 12 (5 MHz - QPSK)

Low Channel

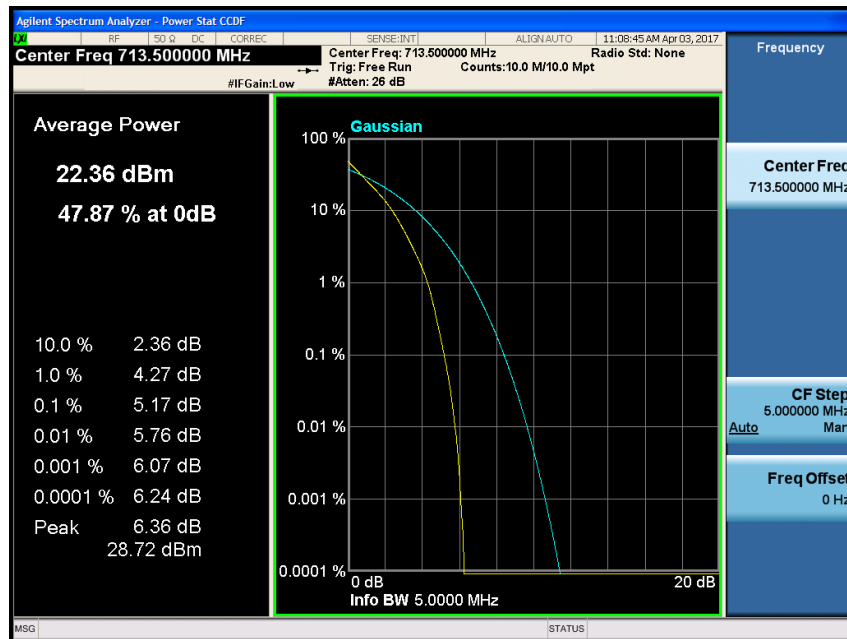


Middle Channel



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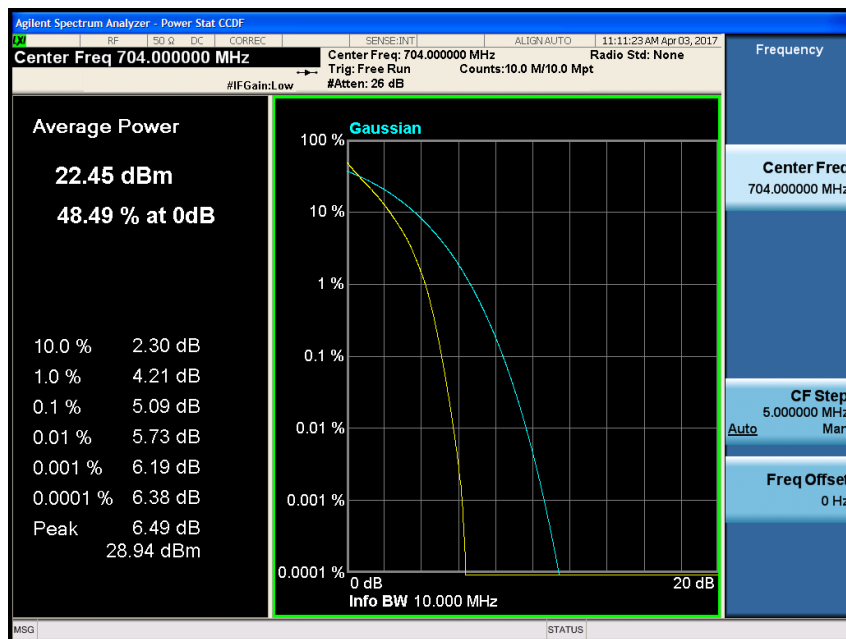
High Channel



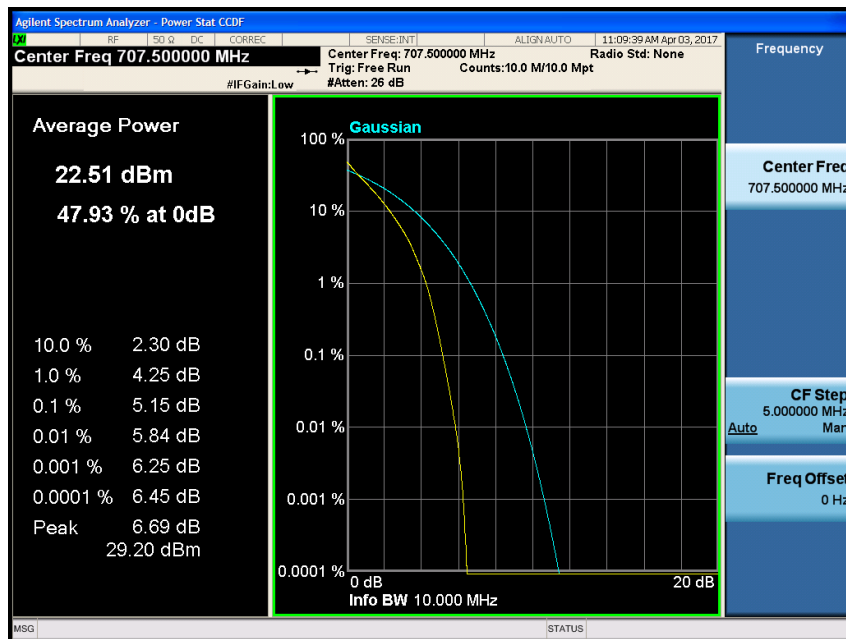
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

LTE band 12 (10 MHz - QPSK)

Low Channel

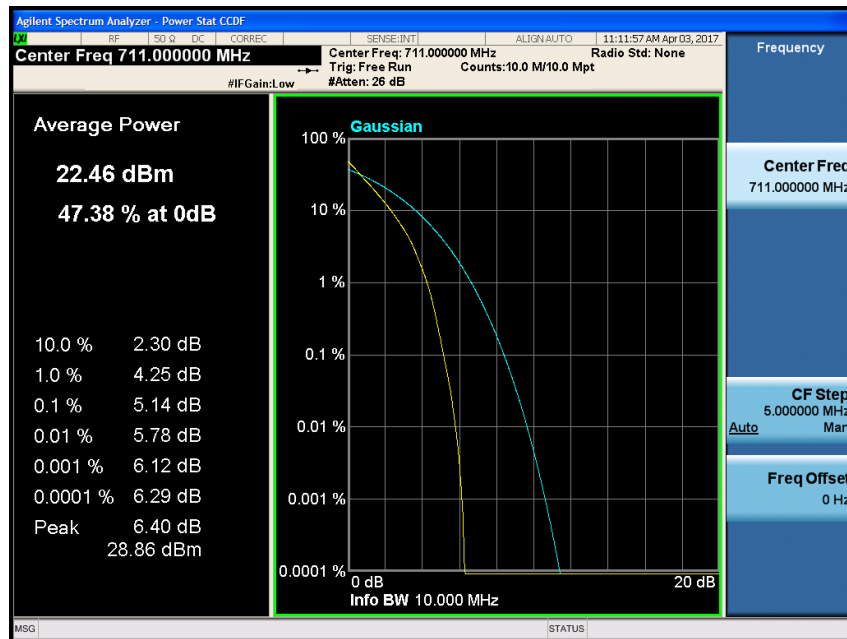


Middle Channel



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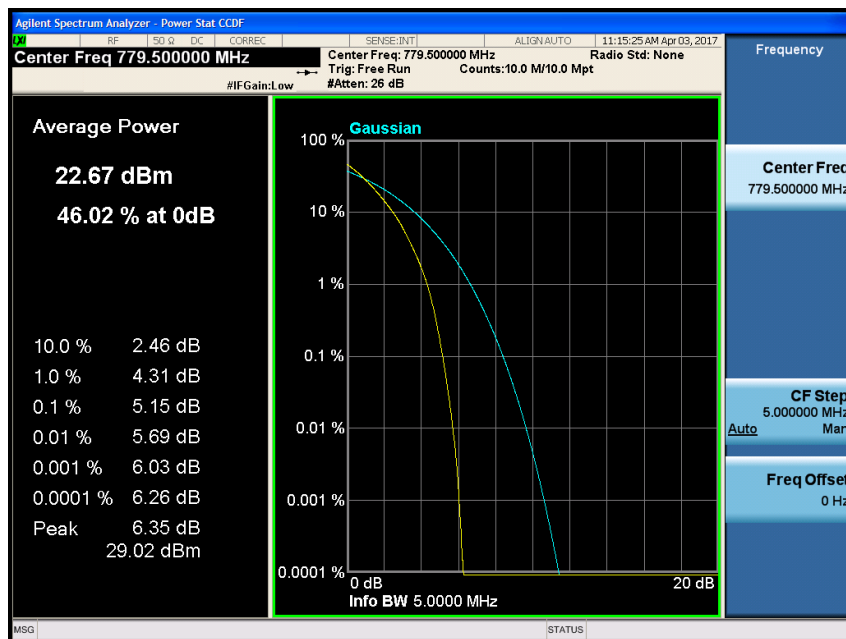
High Channel



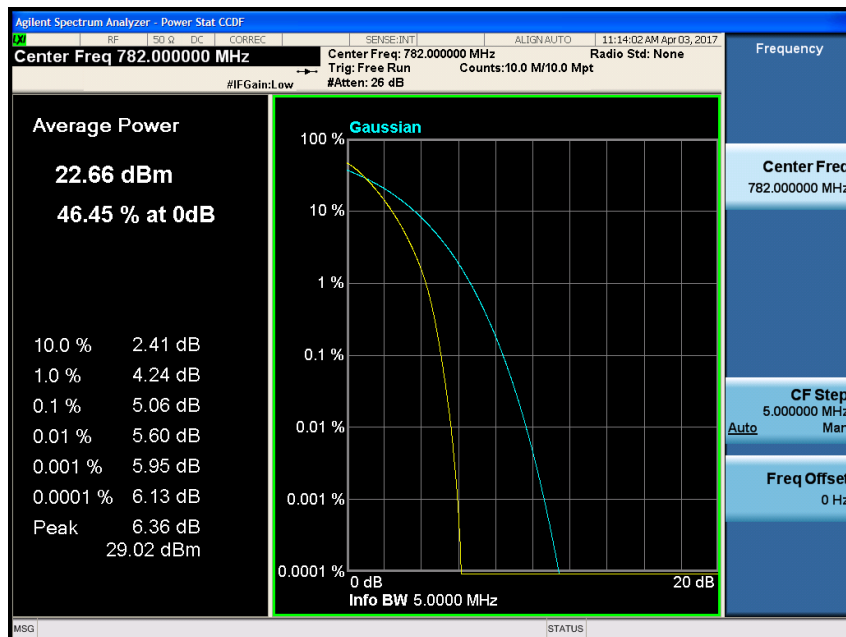
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

LTE band 13 (5 MHz - QPSK)

Low Channel

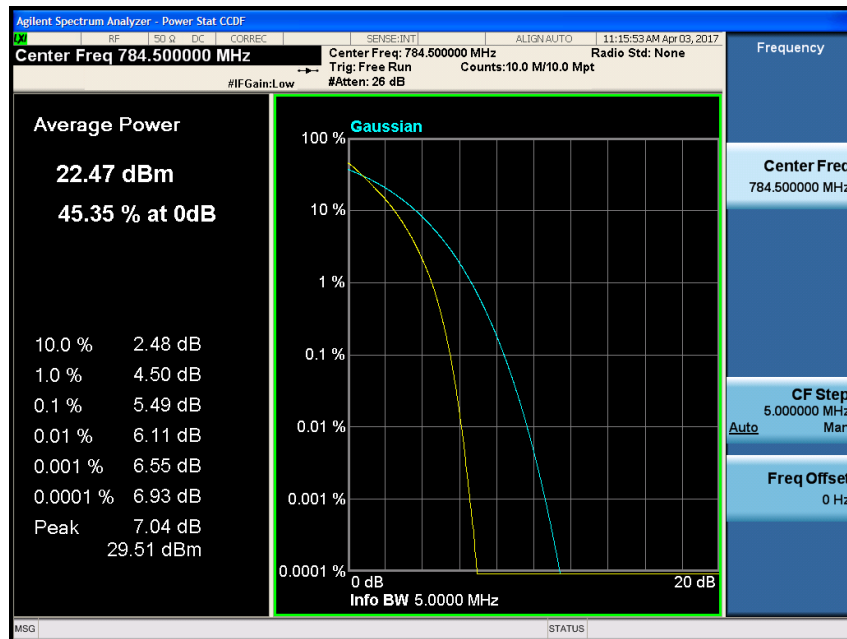


Middle Channel



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

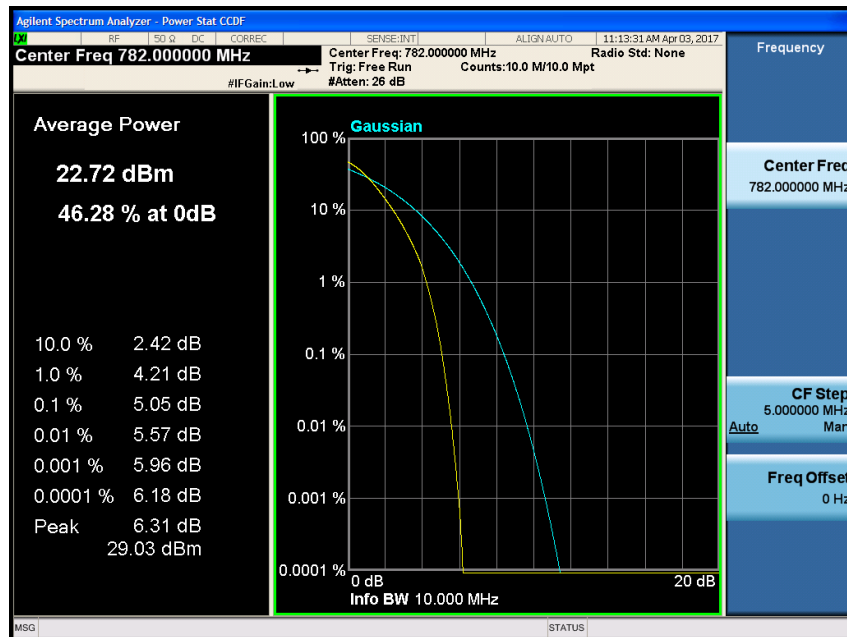
High Channel



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LTE band 13 (10 MHz - QPSK)

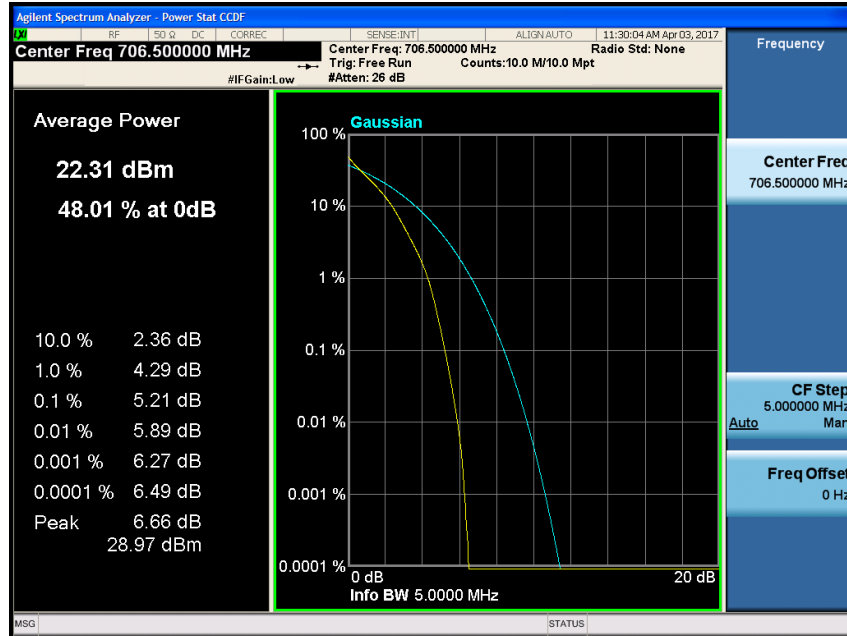
Middle Channel



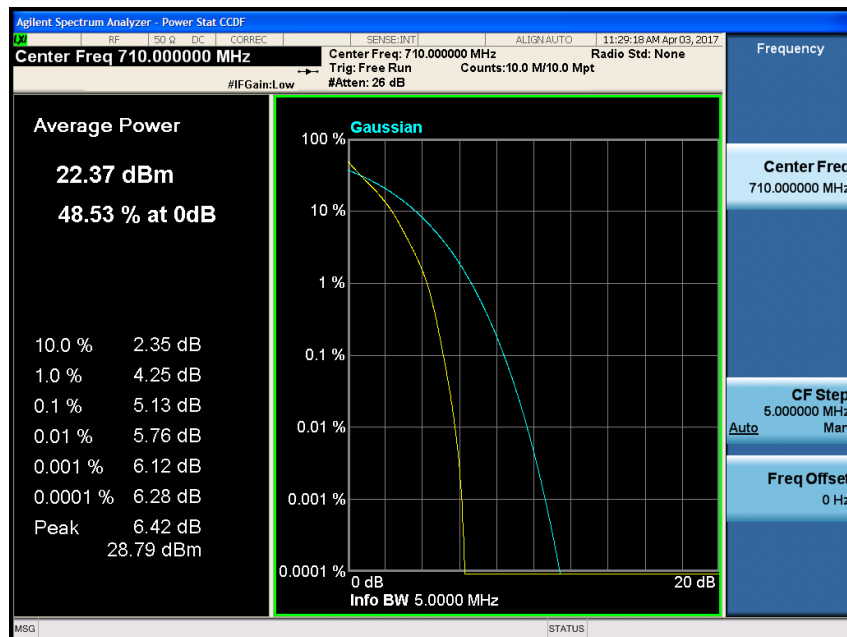
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

LTE band 17 (5 MHz - QPSK)

Low Channel

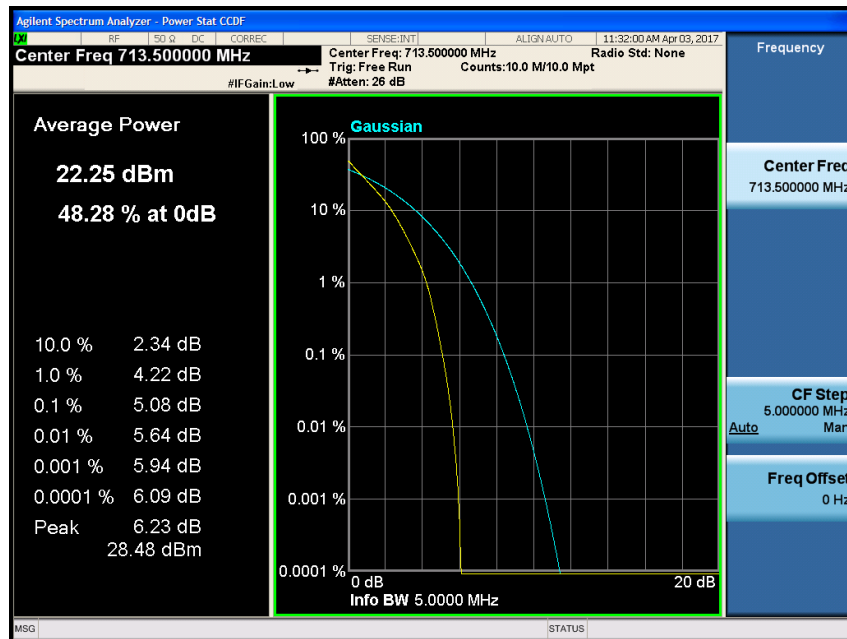


Middle Channel



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

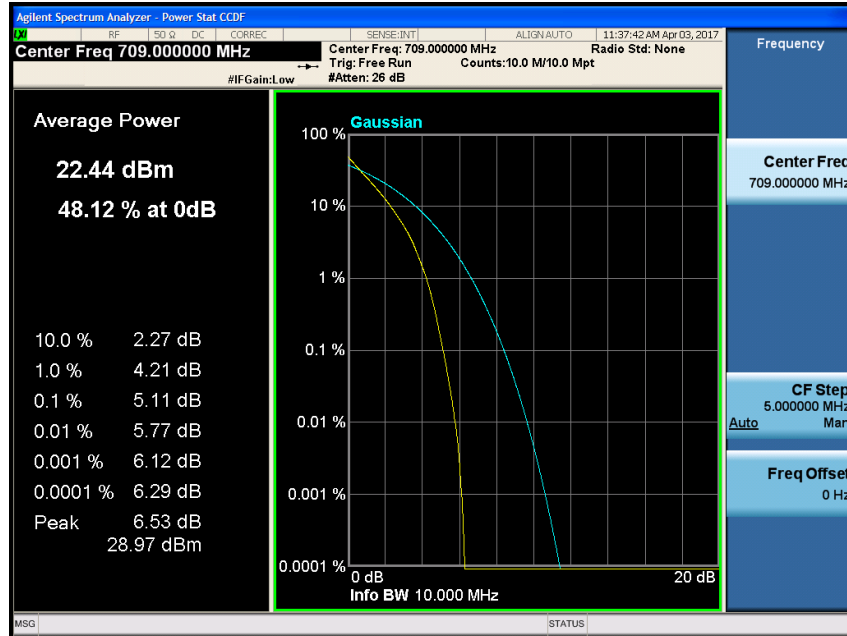
High Channel



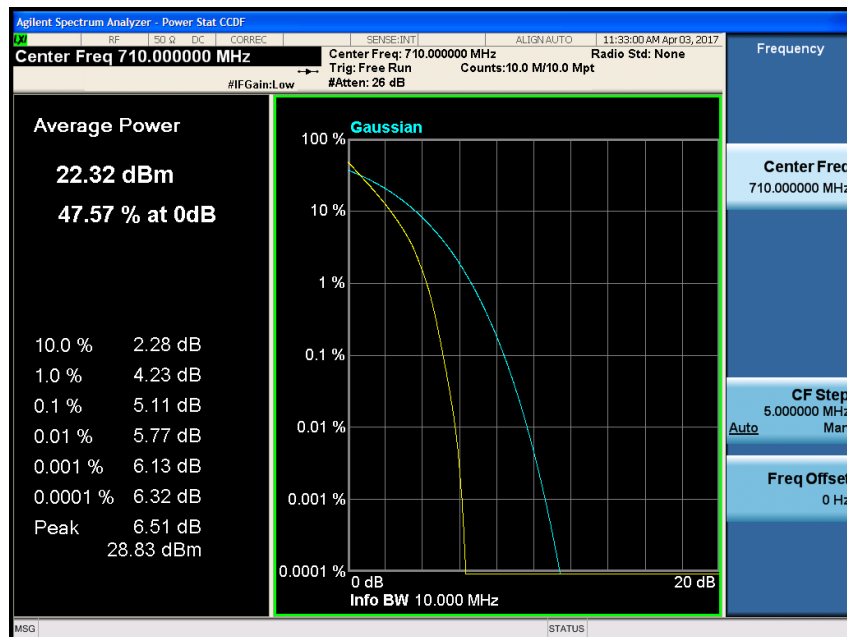
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

LTE band 17 (10 MHz - QPSK)

Low Channel

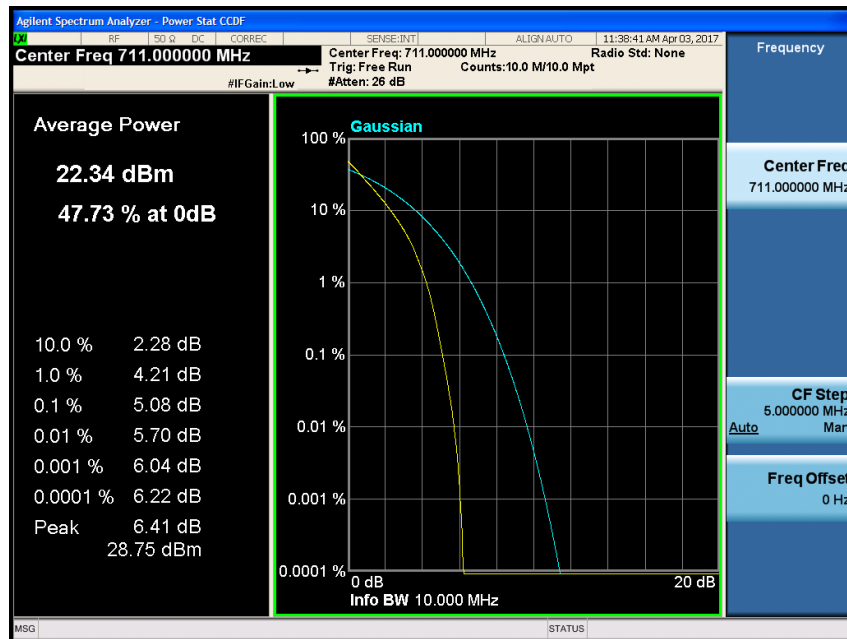


Middle Channel



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High Channel



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6. Spurious Emissions at Antenna Terminal

6.1. Limit

FCC

- §22.917(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.

- §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.

- §27.53(c)(2), on any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P)$ dB.

- §27.53(g), the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P)$ dB.

- §27.53(h)(1), for operations in the 1 695-1 710 MHz, 1 710-1 755 MHz, 1 755-1 780 MHz, 1 915-1 920 MHz, 1 995-2 000 MHz, 2 000-2 020 MHz, 2 110-2 155 MHz, 2 155-2 180 MHz, and 2 180-2 200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10} (P)$ dB.

IC

- RSS-130 Issue 1

4.6.1, the power of any unwanted emissions in any 100 kHz bandwidth on any frequency outside the frequency range(s) within which the equipment is designed to operate shall be attenuated below the transmitter power, P (dB W), by at least $43 + 10 \log_{10} p$ (watts), dB. However, in the 100 kHz band immediately outside the equipment's operating frequency range, a resolution bandwidth of 30 kHz may be employed.

4.6.2, In addition to the limit outlined in Section 4.6.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

(a) The power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dB W), by at least:

- (i) $76 + 10 \log_{10} p$ (watts), dB, for base and fixed equipment, and
- (ii) $65 + 10 \log_{10} p$ (watts), dB, for mobile and portable equipment.

(b) The e.i.r.p. in the band 1 559-1 610 MHz shall not exceed -70 dB W/MHz for wideband signal and -80 dB W for discrete emission with bandwidth less than 700 Hz.

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- RSS-132 Issue 3

5.5, Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

(i) In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1 % of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dB W) by at least $43 + 10 \log_{10} p$ (watts).

(ii) After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dB W) by at least $43 + 10 \log_{10} p$ (watts). If the measurement is performed using 1 % of the occupied bandwidth, power integration over 100 kHz is required.

- RSS-133 Issue 6

6.5, Equipment shall comply with the limits in (i) and (ii) below.

(i) In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1 % of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dB W) by at least $43 + 10 \log_{10} p$ (watts).

(ii) After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dB W) by at least $43 + 10 \log_{10} p$ (watts). If the measurement is performed using 1 % of the emission bandwidth, power integration over 1.0 MHz is required.

- RSS-139 Issue 3

6.6, (i) In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block,² which can contain the equipment's occupied bandwidth, the emission power per any 1 % of the emission bandwidth shall be attenuated below the transmitter output power P (in dB W) by at least $43 + 10 \log_{10} p$ (watts) dB.

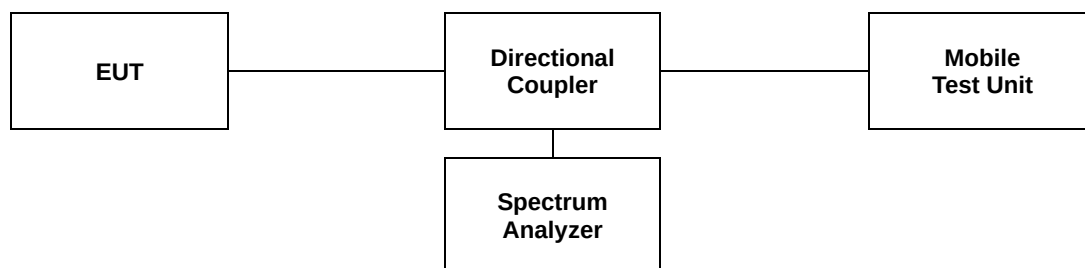
(ii) After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dB W) by at least $43 + 10 \log_{10} p$ (watts) dB.

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6.2. Test Procedure

The test follows section 6.0 of FCC KDB Publication 971168 D01 v03.

1. Start frequency was set to 30 MHz and stop frequency was set to at least 10* the fundamental frequency.
2. Detector = Peak.
3. Trace mode = Max hold.
4. Sweep time = Auto couple.
5. The trace was allowed to stabilize.
6. Please see notes below for RBW and VBW settings.
7. For plots showing conducted spurious emissions from 30 MHz to 20 GHz, all path loss of wide frequency range was investigated and compensated to spectrum analyzer as correction factor.



Notes;

Compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater for frequencies less than 1 GHz and frequencies greater than 1 GHz. However, 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. The emission bandwidth is defined as the width of the signal between two point, 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.

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SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

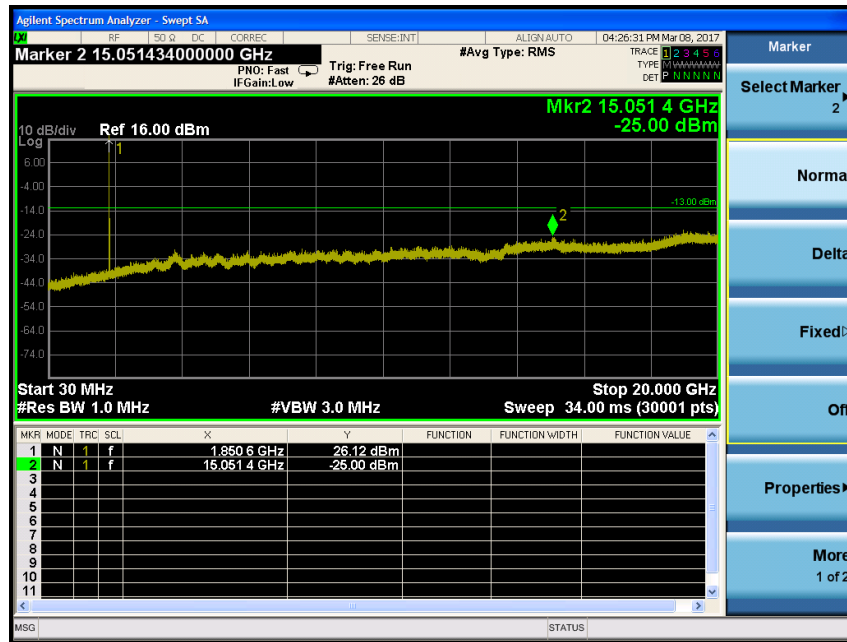
6.3. Test Results

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

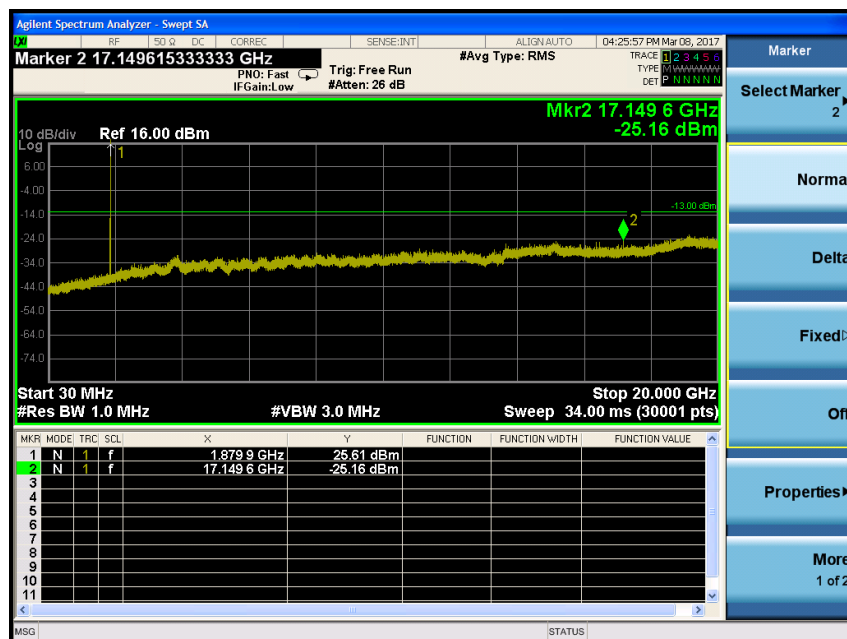
Please refer to the following plots.

LTE band 2 (1.4 MHz - QPSK)

Low Channel

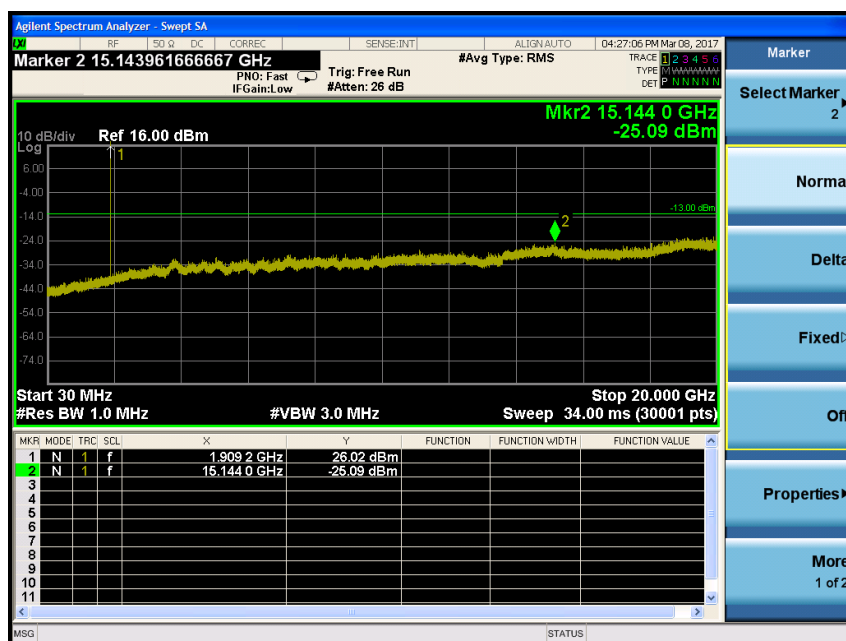


Middle Channel



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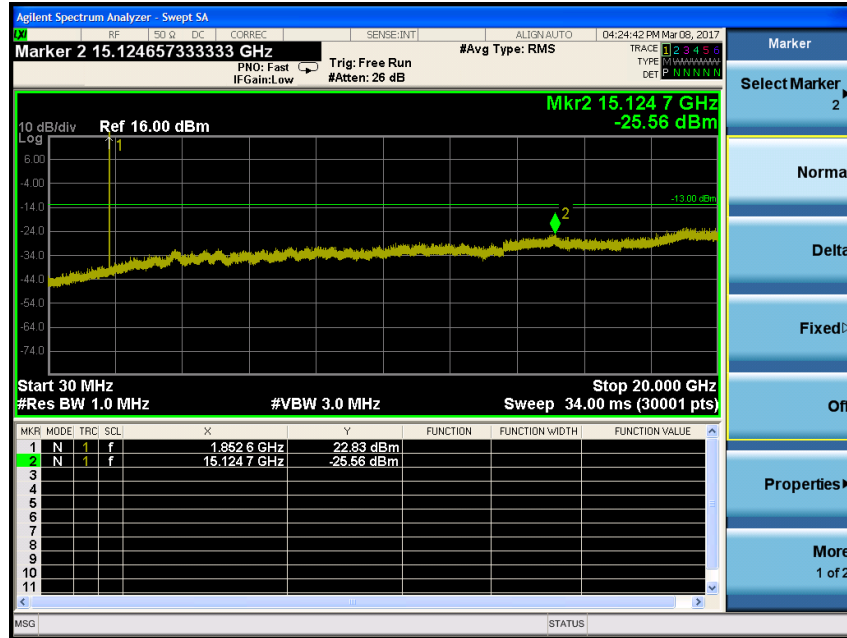
High Channel



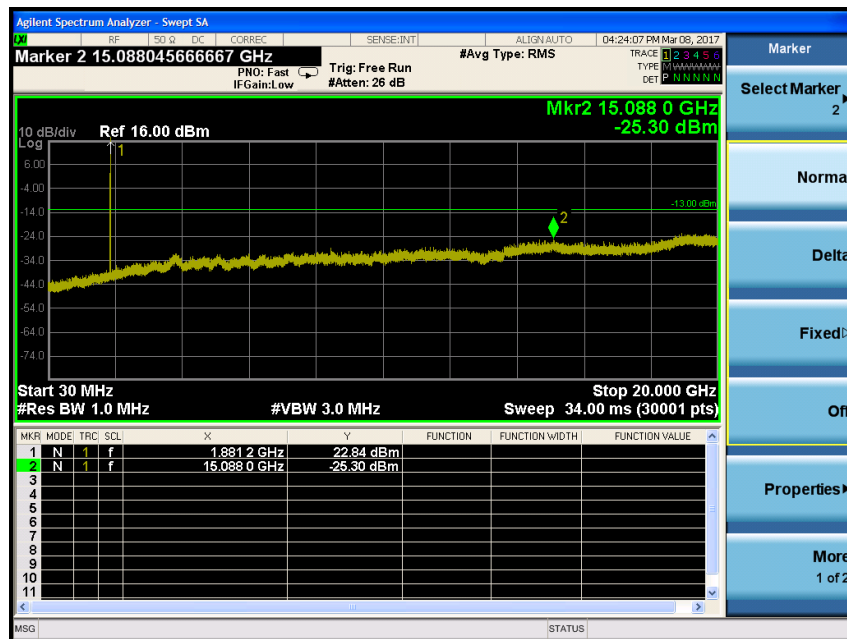
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LTE band 2 (3 MHz - QPSK)

Low Channel

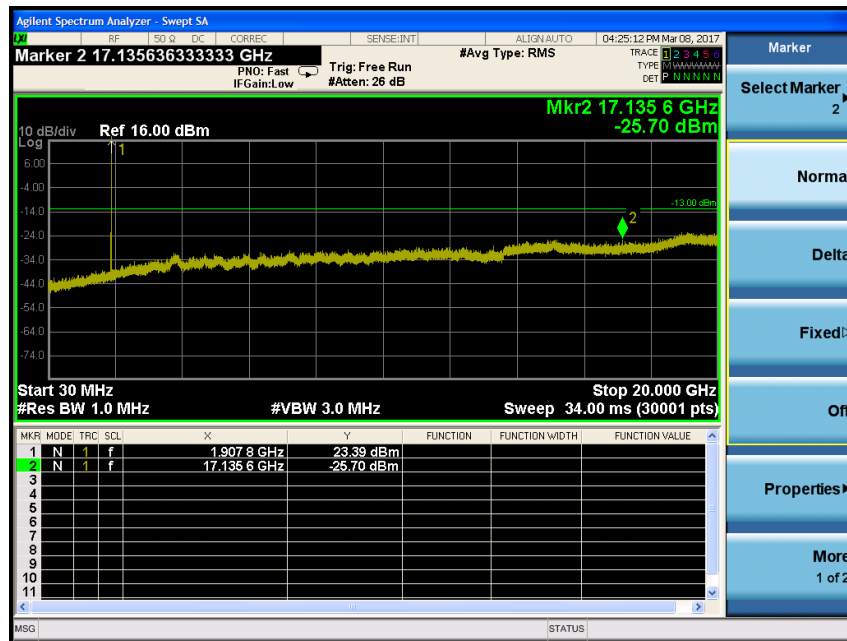


Middle Channel



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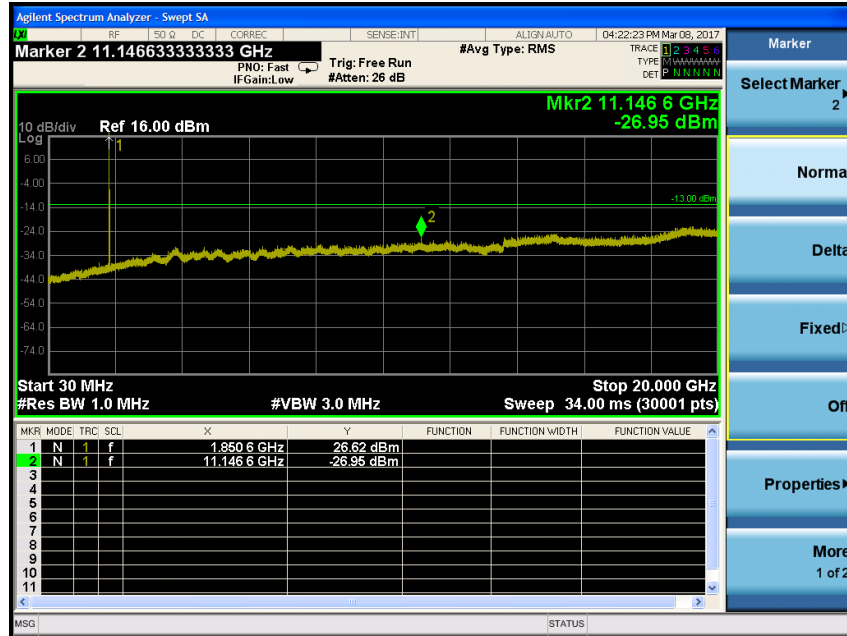
High Channel



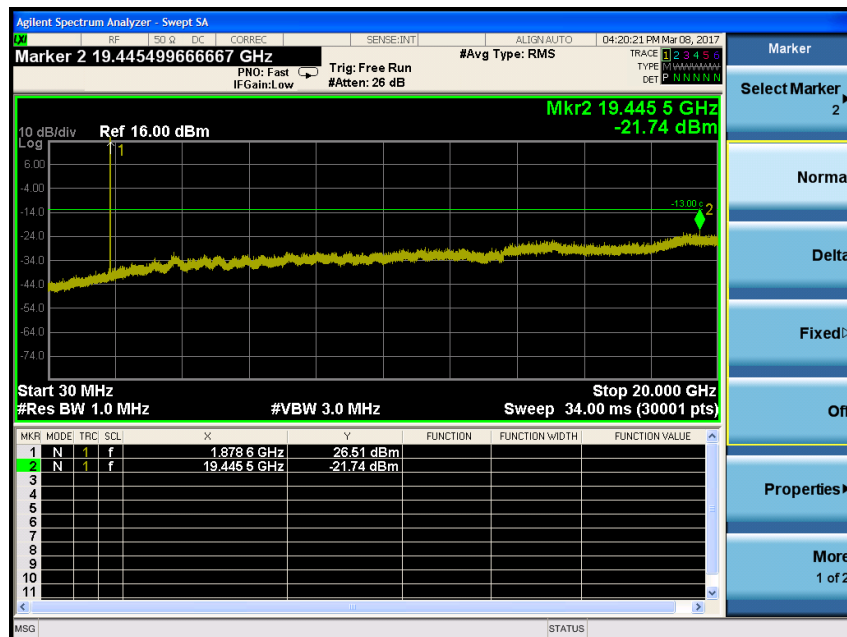
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LTE band 2 (5 MHz - QPSK)

Low Channel

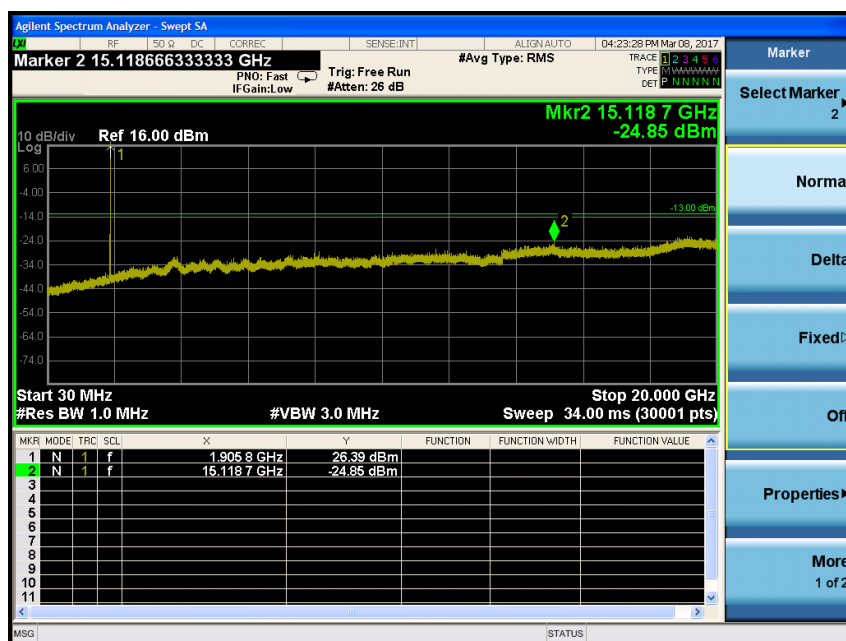


Middle Channel



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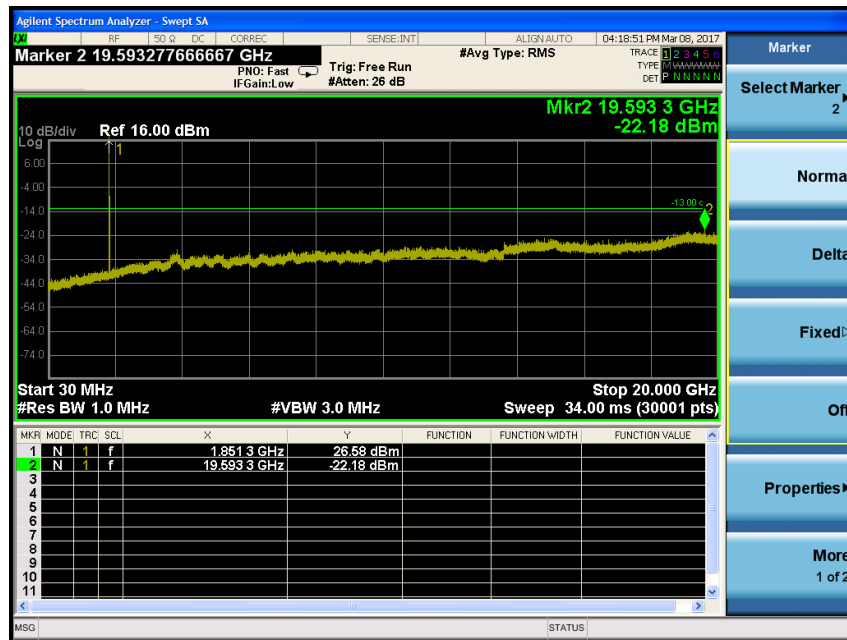
High Channel



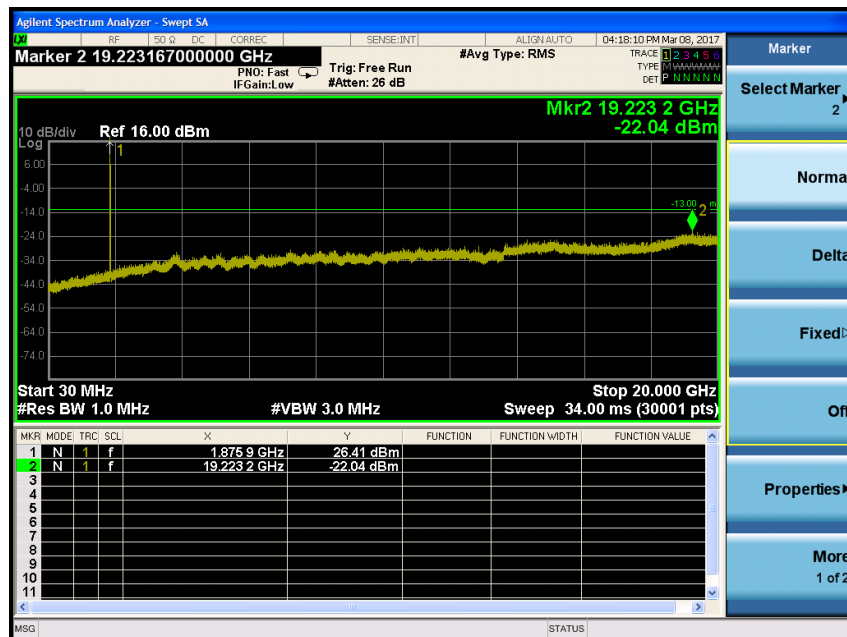
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LTE band 2 (10 MHz - QPSK)

Low Channel

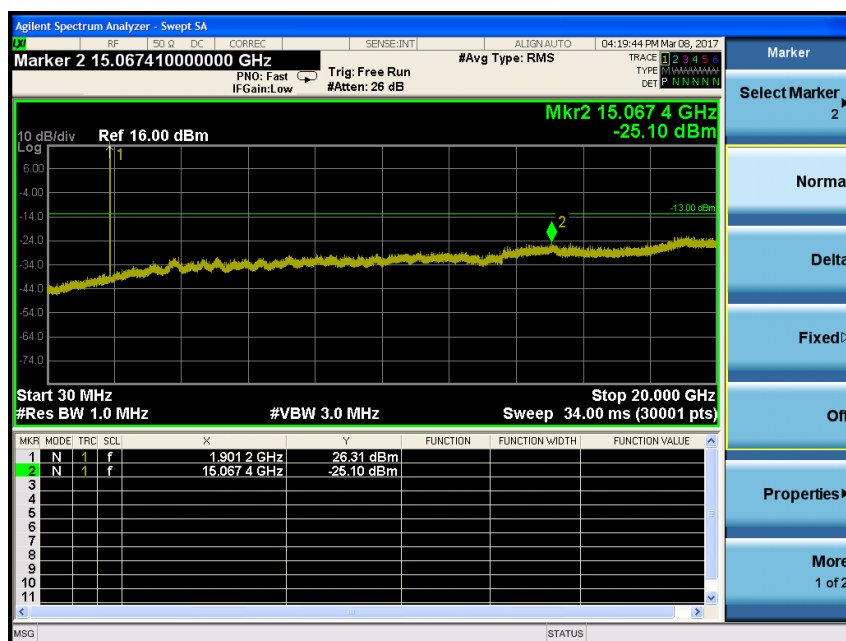


Middle Channel



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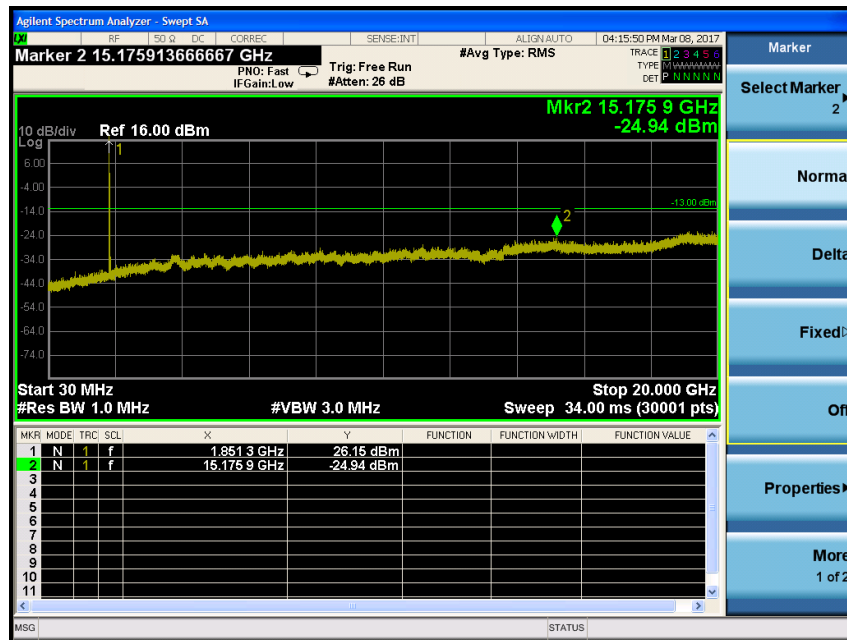
High Channel



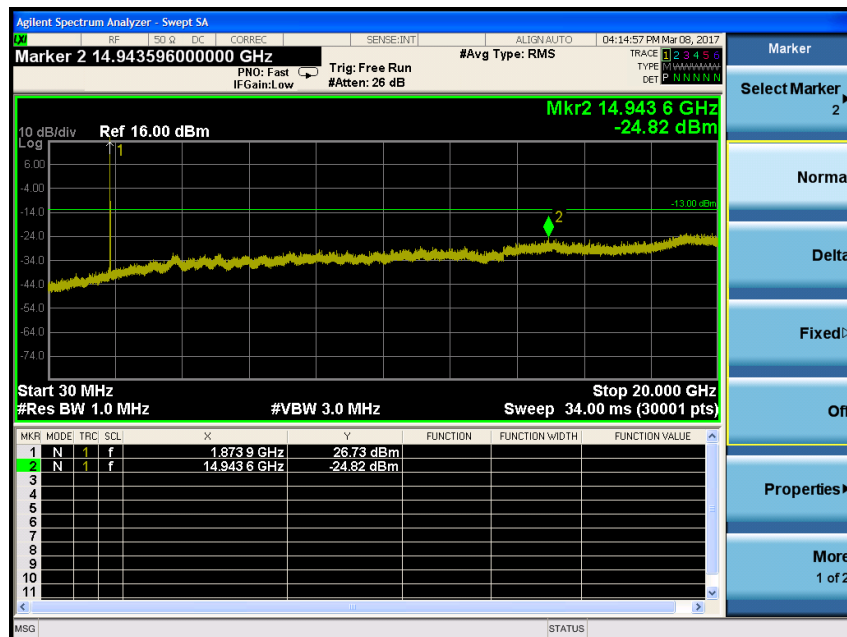
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LTE band 2 (15 MHz - QPSK)

Low Channel

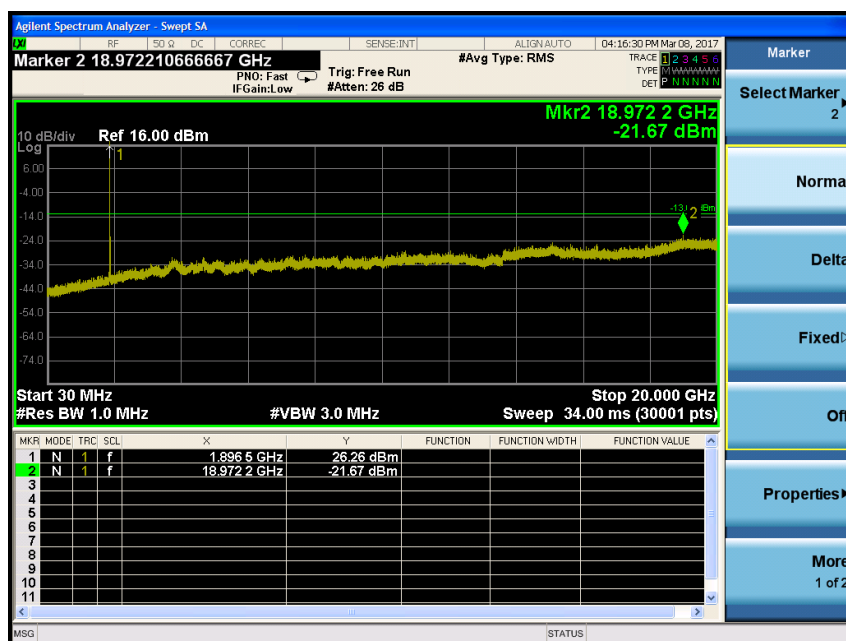


Middle Channel



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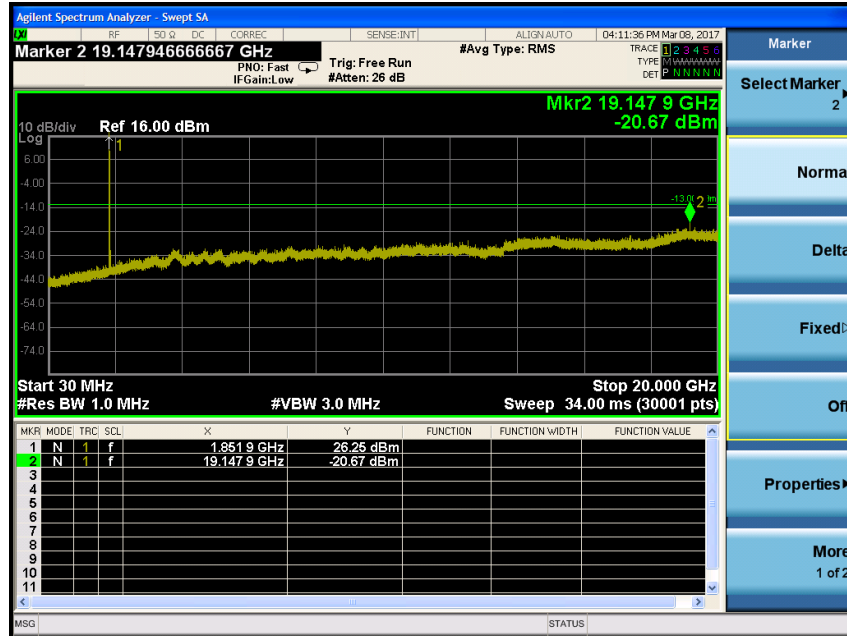
High Channel



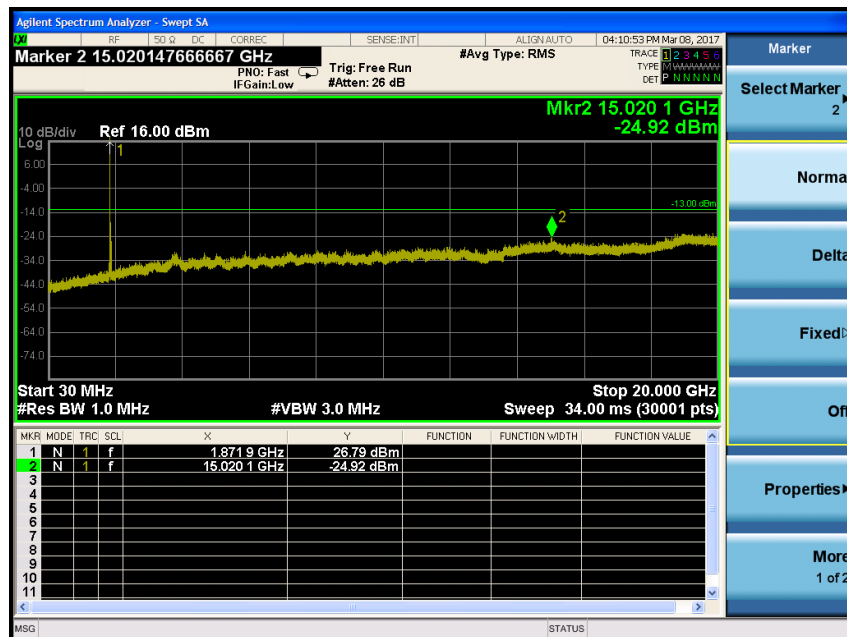
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LTE band 2 (20 MHz - QPSK)

Low Channel

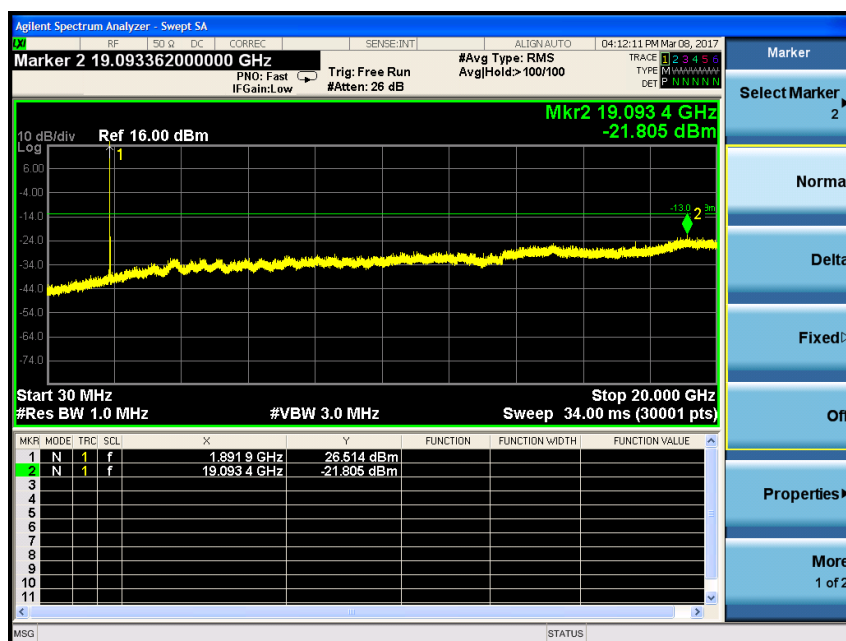


Middle Channel



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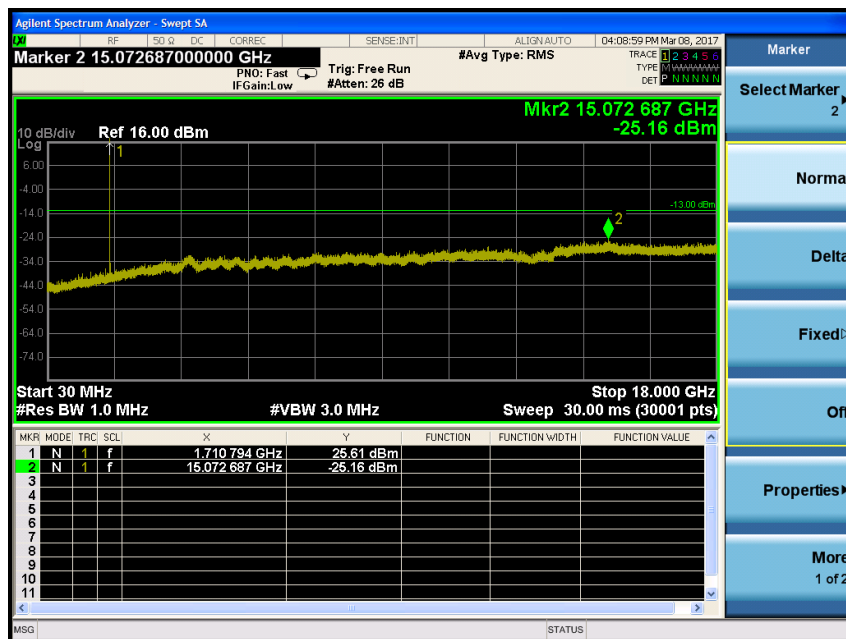
High Channel



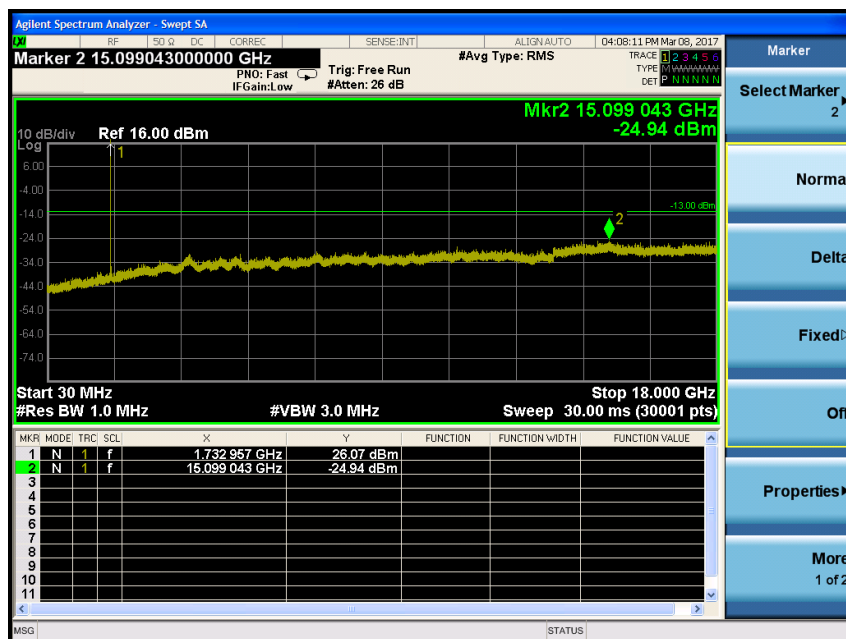
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LTE band 4 (1.4 MHz - QPSK)

Low Channel

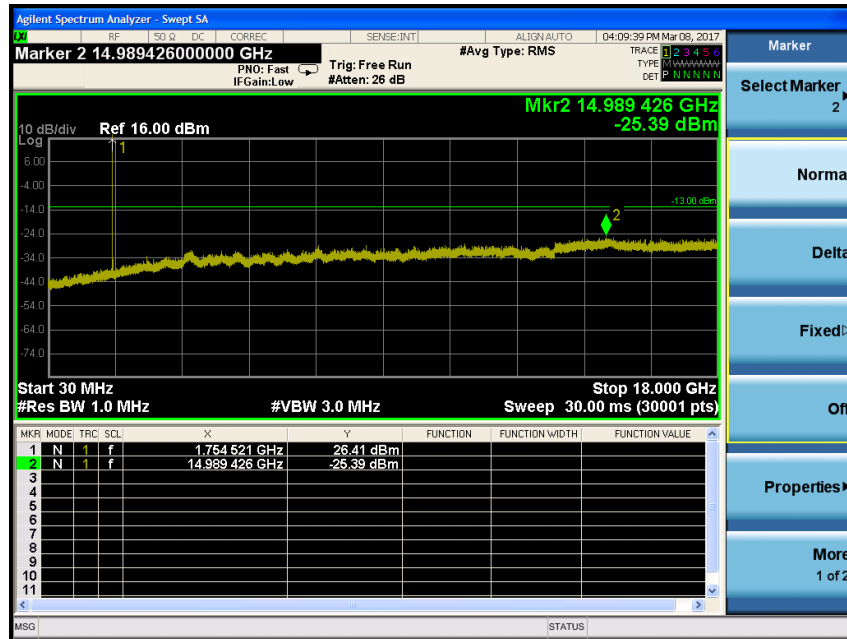


Middle Channel



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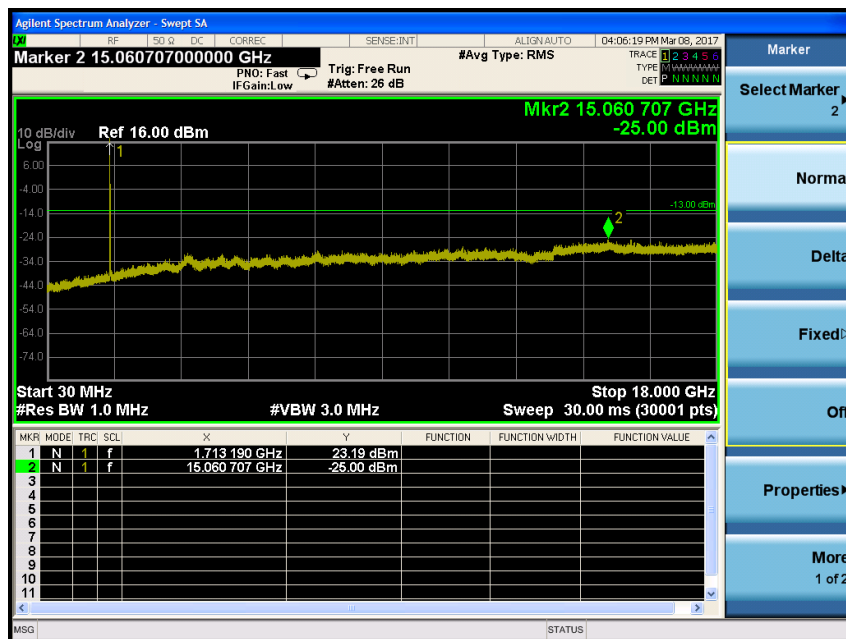
High Channel



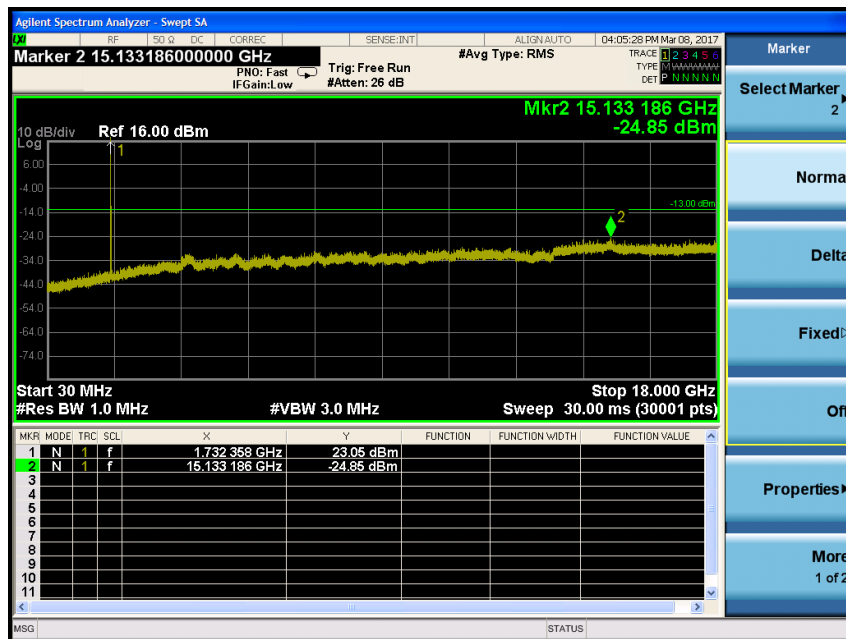
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LTE band 4 (3 MHz - QPSK)

Low Channel

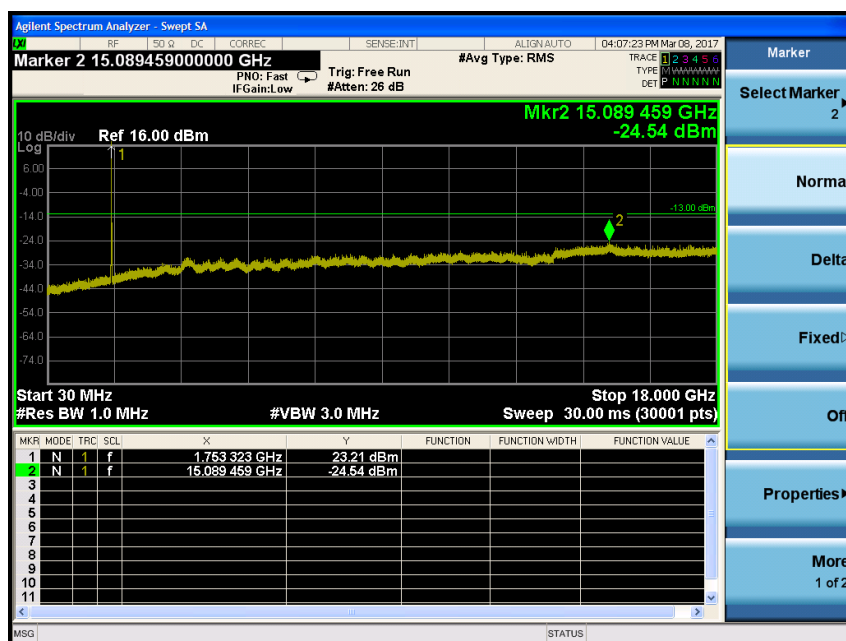


Middle Channel



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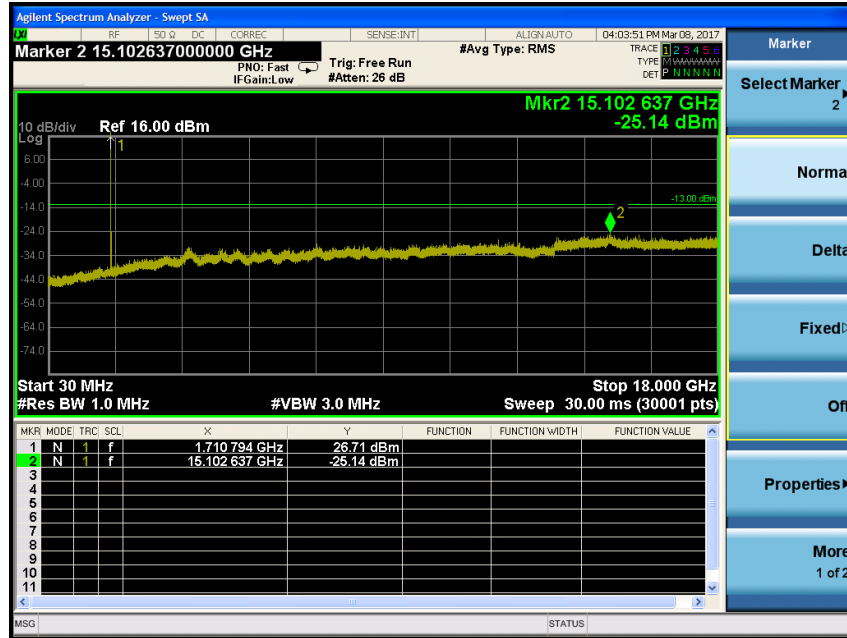
High Channel



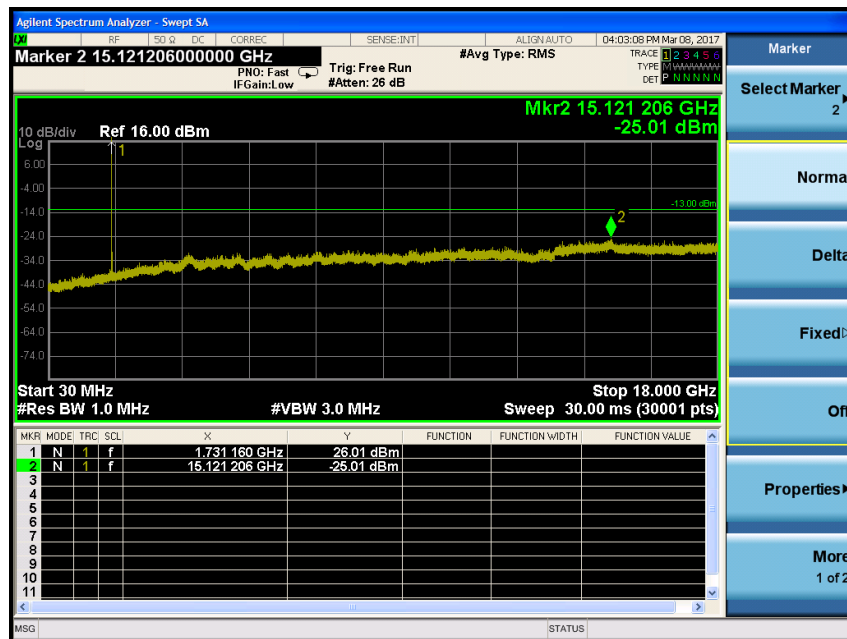
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LTE band 4 (5 MHz - QPSK)

Low Channel



Middle Channel



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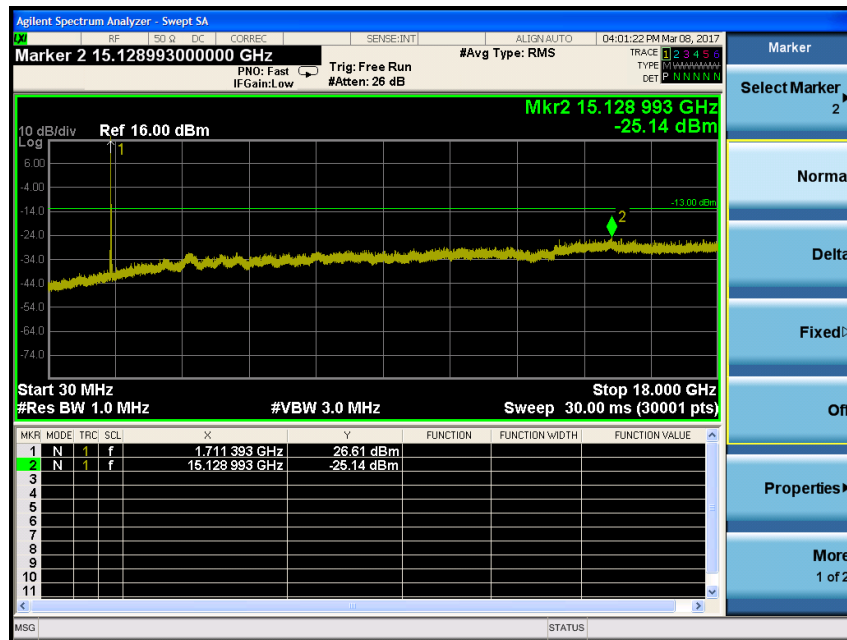
High Channel



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LTE band 4 (10 MHz - QPSK)

Low Channel

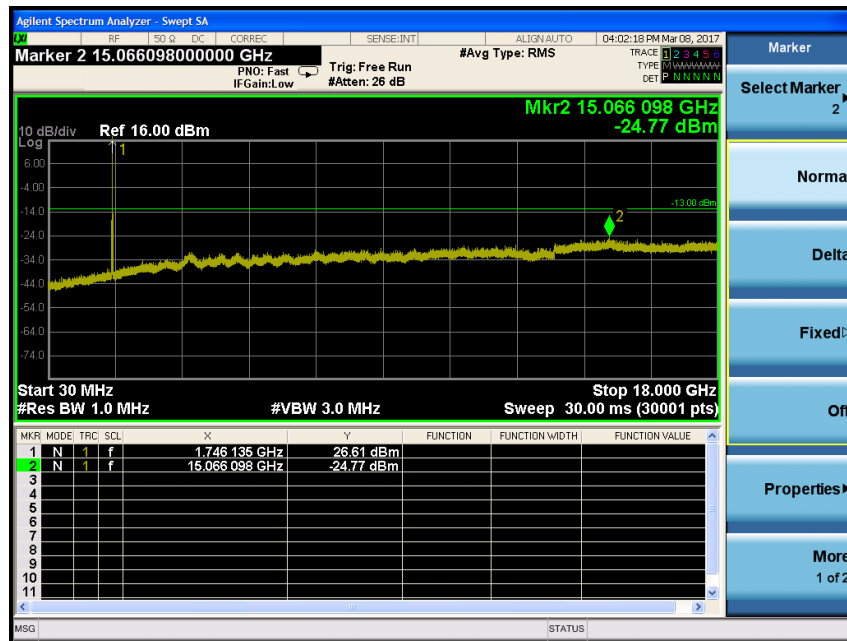


Middle Channel



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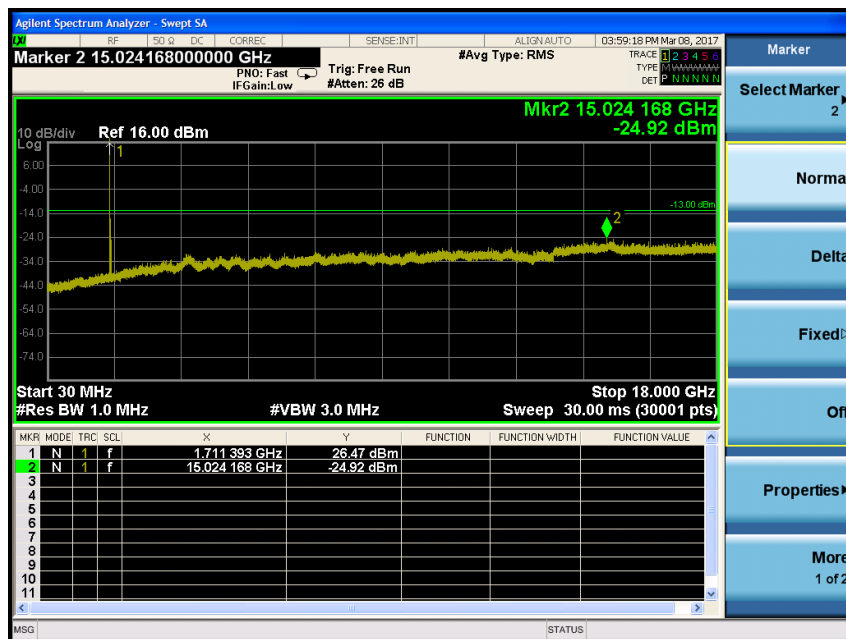
High Channel



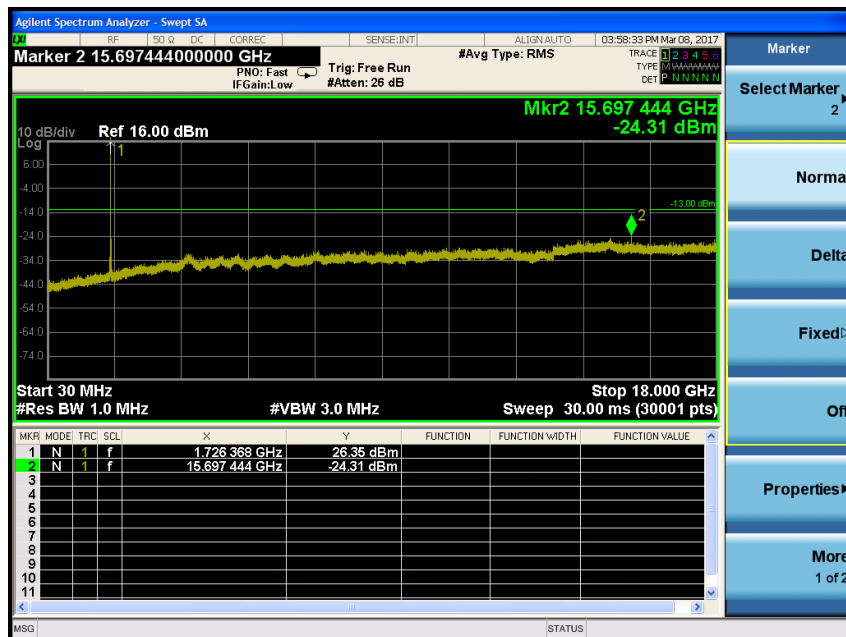
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LTE band 4 (15 MHz - QPSK)

Low Channel

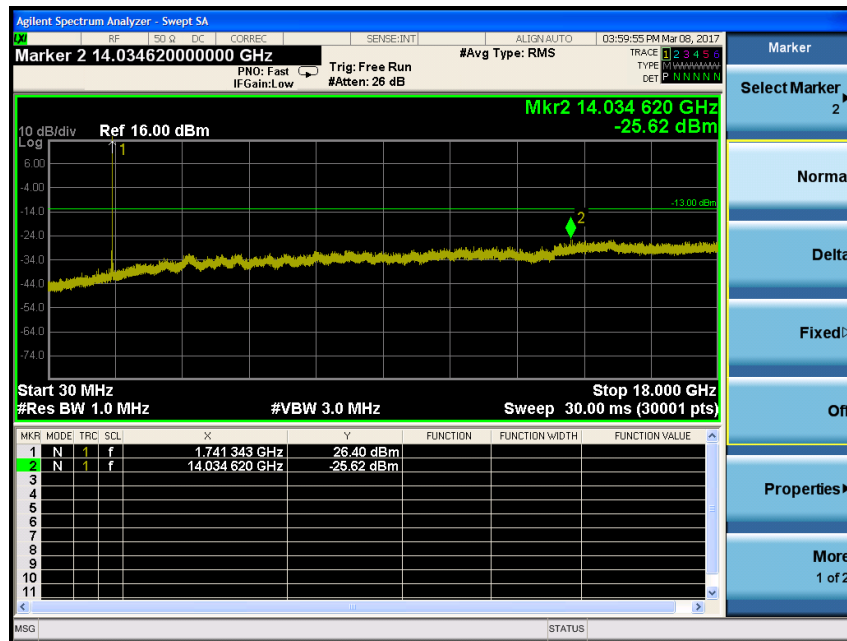


Middle Channel



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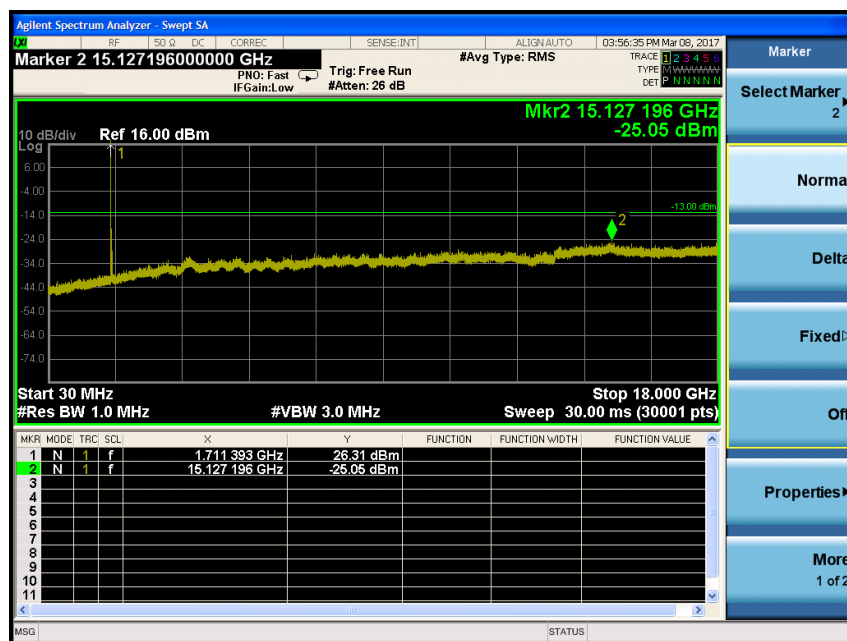
High Channel



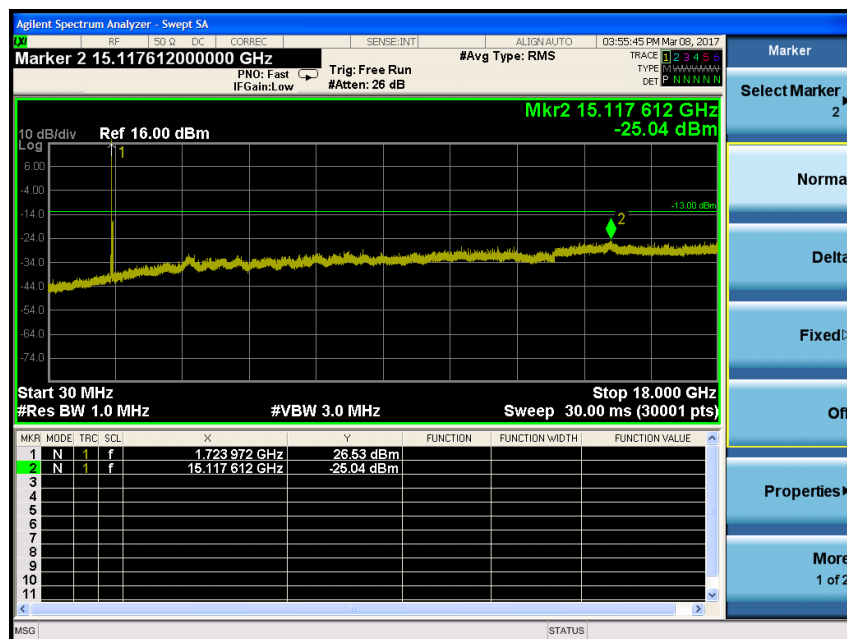
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LTE band 4 (20 MHz - QPSK)

Low Channel

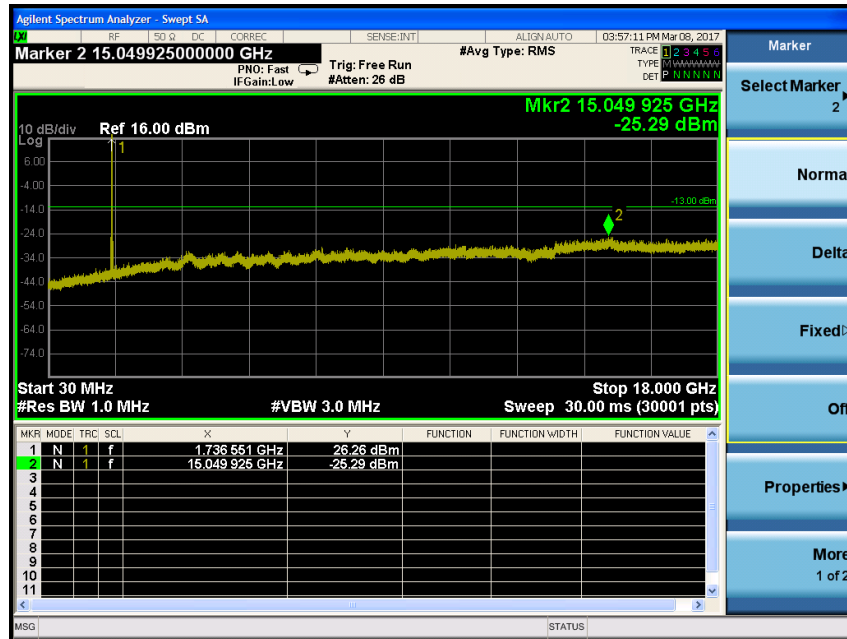


Middle Channel



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High Channel



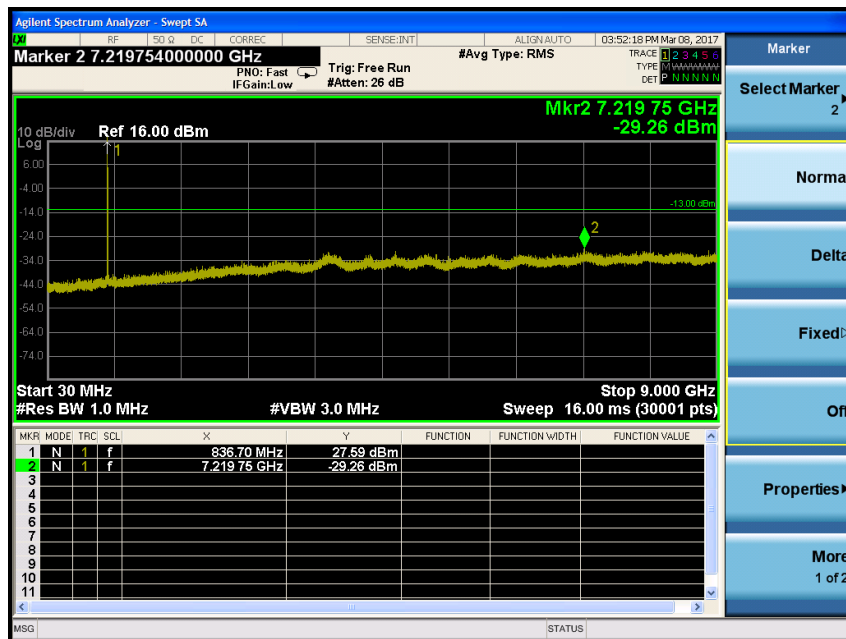
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LTE band 5 (1.4 MHz - QPSK)

Low Channel

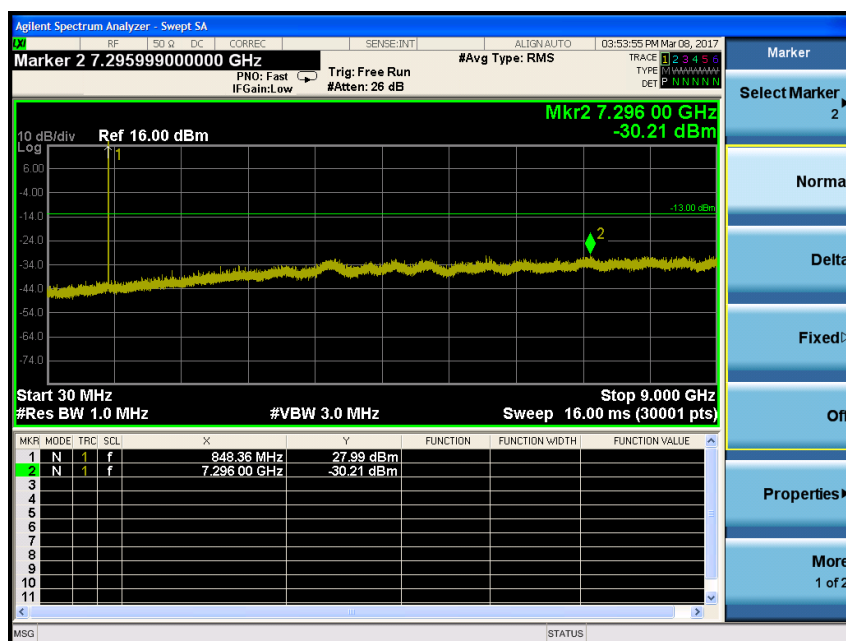


Middle Channel



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High Channel



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