Zacta

# TEST REPORT

Report number : JPD-TR-17243-0
Issue date : December 29, 2017

The device, as described herewith, was tested pursuant to applicable test procedure and complies with the requirements of;

## FCC Part 24 Subpart E

The test results are traceable to the international or national standards.

| | | |
|---|---|---|
| Applicant | : | KYOCERA Corporation |
| Equipment under test (EUT) | : | Mobile Phone |
| Model number | : | YKFA21 |
| FCC ID | : | JOYYKFA21 |

| | | |
|---|---|---|
| Date of test | : | November 29, 30, 2017<br>December 6, 7, 8, 14, 15, 16, 18, 22, 2017 |
| Test place | : | TÜV SÜD Zacta Ltd. Yonezawa Testing Center<br>5-4149-7, Hachimanpara, Yonezawa-shi,<br>Yamagata, 992-1128 Japan<br>Phone: +81-238-28-2881 Fax: +81-238-28-2888 |
| Test results | : | Complied |

The results in this report are applicable only to the equipment tested.
This report shall not be re-produced except in full without the written approval of TÜV SÜD Zacta Ltd.
This test report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, ILAC-MRA, or any agency of the federal government.

Tested by : Tadahiro Seino Chiaki Kanno
Tadahiro Seino Chiaki Kanno

Approved by : Hiroaki Suzuki
Hiroaki Suzuki
Lab Manager of RF Lab

NVLAP TESTING
NVLAP LAB CODE 200306-0

ilac-MRA

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# 1. Summary of Test

## 1.1 Purpose of test

It is the original test in order to verify conformance to FCC Part 24 Subpart E.

## 1.2 Standards

CFR47 FCC Part 24 Subpart E

### 1.2.1 Test Methods

KDB 971168 D01 Power Meas License Digital Systems v02r02
ANSI/TIA/EIA-603-D-2010

### 1.2.2 Deviation from standards

None

## 1.3 List of applied test to the EUT

| Test items Section | Test items | Condition | Result |
|---|---|---|---|
| 2.1046 | Conducted Output Power | Conducted | PASS Note 1 |
| 24.232(c) | Effective Radiated Power<br>Equivalent Isotropic Radiated Power | Radiated | PASS |
| 24.232(d) | Peak to Average Ratio | Conducted | PASS |
| 24.238(a)<br>2.1049 | Occupied Bandwidth | Conducted | PASS |
| 24.238(a)<br>2.1051 | Band Edge Spurious and Harmonic at Antenna Terminal | Conducted | PASS |
| 24.238(a)<br>2.1053 | Radiated emissions and<br>Harmonic Emissions | Radiated | PASS |
| 24.235<br>2.1055 | Frequency Stability | Conducted | PASS |

Note 1: Refer to RF Exposure Report (Test Report_SAR)

### 1.3.1 Test set up

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## 1.4 Modification to the EUT by laboratory

None

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# 2. Equipment Under Test

## 2.1 General Description of equipment

EUT is the Mobile Phone.

## 2.2 EUT information

| | | |
|---|---|---|
| Applicant | : | KYOCERA Corporation<br>Yokohama Office 2-1-1 Kagahara, Tsuzuki-ku Yokohama-shi, Kanagawa, Japan<br>Phone: +81-45-943-6253 Fax: +81-45-943-6314 |
| Equipment under test | : | Mobile Phone |
| Trade name | : | Kyocera |
| Model number | : | YKFA21 |
| Serial number | : | N/A |
| EUT condition | : | Pre-Production |
| Power ratings | : | Battery: DC 3.8V |
| Size | : | (W) 71.5mm × (D) 8.4mm × (H) 145.0mm |
| Environment | : | Indoor and Outdoor use |
| Terminal limitation | : | -20˚C to 60˚C |
| RF Specification<br>Frequency of Operation | : | Up Link<br>GSM1900: 1850.2-1909.8MHz<br>WCDMA Band II: 1852.4-1907.6MHz<br>LTE Band II: 1850.0-1910.0MHz<br>Down Link<br>GSM1900: 1930.2-1989.8MHz<br>WCDMA Band II: 1932.4-1987.6MHz<br>LTE Band II: 1930.0-1990.0MHz |
| Modulation type | : | GSM1900: GMSK<br>WCDMA Band II: QPSK, 16QAM<br>LTE Band II: QPSK, 16QAM |
| Emission designator | : | GSM1900: 244KGXW<br>WCDMA Band II: 4M13F9W<br>LTE Band II:<br>BW 1.4M QPSK: 1M10G7D, 16QAM: 1M10W7D<br>BW 3M QPSK: 2M71G7D, 16QAM: 2M72W7D<br>BW 5M QPSK: 4M53G7D, 16QAM: 4M50W7D<br>BW 10M QPSK: 8M94G7D, 16QAM: 8M97W7D<br>BW 15M QPSK: 13M5G7D, 16QAM: 13M4W7D<br>BW 20M QPSK: 17M9G7D, 16QAM: 18M0W7D |
| Equivalent Isotropic Radiated Power (E.I.R.P) | : | GSM1900: 1.230W (30.9dBm)<br>WCDMA Band II: 0.135W (21.3dBm)<br>LTE Band II: 0.309W (24.9dBm) |

Antenna type : Internal antenna

Antenna gain : GSM1900: -2.5dBi
WCDMA Band II: -2.5dBi
LTE Band II: -2.5dBi

## 2.3 Variation of the family model(s)

Not applicable

## 2.4 Description of Test mode

The EUT had been tested under operating condition.
There are three channels have been tested as following:

| Band | Modulation | Bandwidth [MHz] | Channel | Frequency [MHz] |
|---|---|---|---|---|
| GSM1900 | GMSK | - | 512, 661, 810 | 1850.2, 1880.0, 1909.8 |
| WCDMA Band II | QPSK | - | 9262, 9400, 9538 | 1852.4, 1880.0, 1907.6 |
| | 16QAM | - | 9262, 9400, 9538 | 1852.4, 1880.0, 1907.6 |
| LTE Band II | QPSK | 1.4 | 18607, 18900, 19193 | 1850.7, 1880.0, 1909.3 |
| | | 3 | 18615, 18900, 19185 | 1851.5, 1880.0, 1908.5 |
| | | 5 | 18625, 18900, 19175 | 1852.5, 1880.0, 1907.5 |
| | | 10 | 18650, 18900, 19150 | 1855.0, 1880.0, 1905.0 |
| | | 15 | 18675, 18900, 19125 | 1857.5, 1880.0, 1902.5 |
| | | 20 | 18700, 18900, 19100 | 1860.0, 1880.0, 1900.0 |
| | 16QAM | 1.4 | 18607, 18900, 19193 | 1850.7, 1880.0, 1909.3 |
| | | 3 | 18615, 18900, 19185 | 1851.5, 1880.0, 1908.5 |
| | | 5 | 18625, 18900, 19175 | 1852.5, 1880.0, 1907.5 |
| | | 10 | 18650, 18900, 19150 | 1855.0, 1880.0, 1905.0 |
| | | 15 | 18675, 18900, 19125 | 1857.5, 1880.0, 1902.5 |
| | | 20 | 18700, 18900, 19100 | 1860.0, 1880.0, 1900.0 |

The field strength of spurious emissions was measured at each position of all three axis X, Y and Z to compare the level, and the maximum noise.
The worst emission was found in X axis (All Bands) and the worst case recorded.

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# 3. Configuration of equipment

## 3.1 Equipment(s) used

| No. | Equipment | Company | Model No. | Serial No. | FCC ID / DoC | Comment |
|---|---|---|---|---|---|---|
| 1 | Mobile Phone | KYOCERA | YKFA21 | N/A | JOYYKFA21 | EUT |

## 3.2 System configuration

1. Mobile Phone
   (EUT)

Note1: Numbers assigned to equipment or cables on this diagram correspond to the list in “3.1 Equipment(s) used”.

# 4. Equivalent Isotropic Radiated Power

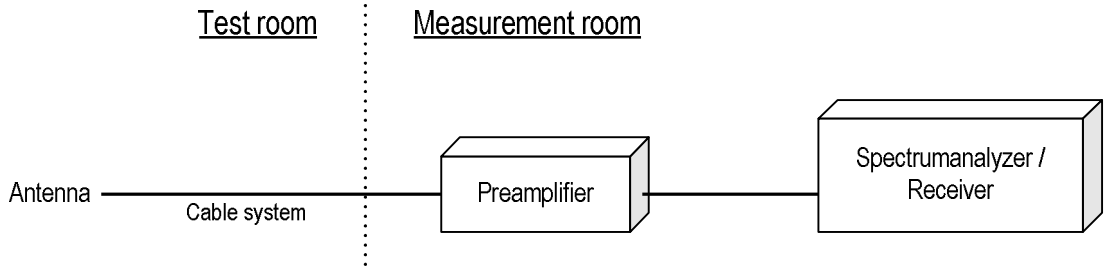
## 4.1 Measurement procedure [FCC 24.232(c)]

<Step 1>
The EUT and support equipment are placed on a 1 meter x 1 meter surface, 0.8 meter height styrene foam table. Radiated emission measurements are performed at 3 meter distance with the broadband antenna (double ridged guide antenna). The antenna is positioned both the horizontal and vertical planes of polarization and height is varied 1 to 4 meters and stopped at height producing the maximum emission.
The bandwidth of the spectrum analyzer is set to 1MHz. The turntable is rotated by 360 degrees and stopped at azimuth of producing the maximum emission.

<Step 2>
The substitution antenna is replaced by the transmitter antenna (EUT).
The frequency of the signal generator is adjusted to the measurement frequency.
Level of the signal generator is adjusted to the level that is obtained from step 1, and record the emission level of signal generator.

The spectrum analyzer is set to;
a) Span = 1.5 times the OBW
b) RBW = 1-5% of the expected OBW, not to exceed 1MHz
c) VBW ≥ 3 x RBW
d) Number of sweep points ≥ 2 x span / RBW
e) Sweep time = auto-couple
f) Detector = RMS (power averaging)
g) If the EUT can be configured to transmit continuously (i.e., burst duty cycle ≥ 98%), then set the trigger to free run.
h) If the EUT cannot be configured to transmit continuously (i.e., burst duty cycle < 98 %), then use a sweep trigger with the level set to enable triggering only on full power bursts and configure the EUT to transmit at full power for the entire duration of each sweep. Ensure that the sweep time is less than or equal to the transmission burst duration.
i) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
j) Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function, with the band limits set equal to the OBW band edges. If the instrument does not have a band power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

- Test configuration



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### 4.2 Calculation method

Result(EIRP) = Ant. Input - Cable loss + Antenna Gain
Margin = Limit – Result (EIRP)

Example:
Limit @ 1880MHz : 33.0dBm
Ant. Input = 19.3dBm Cable loss = 1.1dB Ant. Gain = 8.3dBi
Result = 19.3 - 1.1 + 8.3 = 26.5dBm
Margin = 33.0 - 26.5 = 6.5dB

### 4.3 Limit

2 W (33dBm)

### 4.4 Test data

| | | | | | |
|---|---|---|---|---|---|
| Date | : | December 6, 2017 | | | |
| Temperature | : | 23.5 [˚C] | | | |
| Humidity | : | 20.8 [%] | Test engineer | : | |
| Test place | : | 3m Semi-anechoic chamber | | | Tadahiro Seino |

| | | | | | |
|---|---|---|---|---|---|
| Date | : | December 7, 2017 | | | |
| Temperature | : | 23.3 [˚C] | | | |
| Humidity | : | 40.5 [%] | Test engineer | : | |
| Test place | : | 3m Semi-anechoic chamber | | | Tadahiro Seino |

| | | | | | |
|---|---|---|---|---|---|
| Date | : | December 16, 2017 | | | |
| Temperature | : | 20.6 [˚C] | | | |
| Humidity | : | 24.0 [%] | Test engineer | : | |
| Test place | : | 3m Semi-anechoic chamber | | | Tadahiro Seino |

| | | | | | |
|---|---|---|---|---|---|
| Date | : | December 22, 2017 | | | |
| Temperature | : | 20.4 [˚C] | | | |
| Humidity | : | 22.5 [%] | Test engineer | : | |
| Test place | : | 3m Semi-anechoic chamber | | | Tadahiro Seino |

**[GSM1900]**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1850.2 | -31.6 | 20.5 | 1.1 | 8.1 | 27.4 | 33.0 | 5.6 |
| H | 1880.0 | -31.1 | 21.7 | 1.1 | 8.0 | 28.6 | 33.0 | 4.4 |
| H | 1909.8 | -30.1 | 24.1 | 1.2 | 8.0 | 30.9 | 33.0 | 2.1 |

**[WCDMA Band II]**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1852.4 | -30.9 | 12.4 | 1.1 | 8.1 | 19.3 | 33.0 | 13.7 |
| H | 1880.0 | -29.8 | 13.9 | 1.1 | 8.0 | 20.7 | 33.0 | 12.3 |
| H | 1907.6 | -30.1 | 14.5 | 1.2 | 7.9 | 21.3 | 33.0 | 11.7 |

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## [LTE Band II]

### QPSK, BW 1.4MHz

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1850.7 | -29.0 | 14.0 | 1.1 | 8.1 | 20.9 | 33.0 | 12.1 |
| H | 1880.0 | -27.5 | 16.1 | 1.1 | 8.0 | 22.9 | 33.0 | 10.1 |
| H | 1909.3 | -26.5 | 18.1 | 1.2 | 8.0 | 24.9 | 33.0 | 8.1 |

### 16QAM, BW 1.4MHz

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1850.2 | -30.2 | 12.7 | 1.1 | 8.1 | 19.7 | 33.0 | 13.3 |
| H | 1880.0 | -28.1 | 15.5 | 1.1 | 8.0 | 22.3 | 33.0 | 10.7 |
| H | 1909.3 | -26.9 | 17.4 | 1.2 | 8.0 | 24.2 | 33.0 | 8.8 |

### QPSK, BW 3MHz

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1851.5 | -29.3 | 14.0 | 1.1 | 8.1 | 20.9 | 33.0 | 12.1 |
| H | 1880.0 | -28.5 | 15.4 | 1.1 | 8.0 | 22.2 | 33.0 | 10.8 |
| H | 1908.5 | -27.1 | 17.7 | 1.2 | 7.9 | 24.5 | 33.0 | 8.5 |

### 16QAM, BW 3MHz

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1851.5 | -30.3 | 13.0 | 1.1 | 8.1 | 19.9 | 33.0 | 13.1 |
| H | 1880.0 | -29.0 | 14.9 | 1.1 | 8.0 | 21.7 | 33.0 | 11.3 |
| H | 1908.5 | -28.0 | 16.9 | 1.2 | 7.9 | 23.7 | 33.0 | 9.3 |

### QPSK, BW 5MHz

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1852.5 | -29.1 | 14.4 | 1.1 | 8.1 | 21.3 | 33.0 | 11.7 |
| H | 1880.0 | -28.0 | 15.9 | 1.1 | 8.0 | 22.7 | 33.0 | 10.3 |
| H | 1907.5 | -26.9 | 17.9 | 1.2 | 7.9 | 24.7 | 33.0 | 8.3 |

### 16QAM, BW 5MHz

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1852.5 | -30.0 | 13.5 | 1.1 | 8.1 | 20.4 | 33.0 | 12.6 |
| H | 1880.0 | -28.8 | 15.1 | 1.1 | 8.0 | 21.9 | 33.0 | 11.1 |
| H | 1907.5 | -27.7 | 17.0 | 1.2 | 7.9 | 23.8 | 33.0 | 9.2 |

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**QPSK, BW 10MHz**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1855.0 | -28.6 | 15.4 | 1.1 | 8.0 | 22.3 | 33.0 | 10.7 |
| H | 1880.0 | -27.2 | 16.7 | 1.1 | 8.0 | 23.5 | 33.0 | 9.5 |
| H | 1905.0 | -27.0 | 17.3 | 1.2 | 7.9 | 24.1 | 33.0 | 8.9 |

**16QAM, BW 10MHz**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1855.0 | -29.0 | 14.9 | 1.1 | 8.0 | 21.8 | 33.0 | 11.2 |
| H | 1880.0 | -28.1 | 15.8 | 1.1 | 8.0 | 22.6 | 33.0 | 10.4 |
| H | 1905.0 | -27.8 | 16.6 | 1.2 | 7.9 | 23.4 | 33.0 | 9.6 |

**QPSK, BW 15MHz**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1857.5 | -28.9 | 15.4 | 1.1 | 8.0 | 22.3 | 33.0 | 10.7 |
| H | 1880.0 | -27.4 | 16.5 | 1.1 | 8.0 | 23.3 | 33.0 | 9.7 |
| H | 1902.5 | -26.8 | 16.9 | 1.2 | 7.9 | 23.7 | 33.0 | 9.3 |

**16QAM, BW 15MHz**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1857.5 | -29.8 | 14.5 | 1.1 | 8.0 | 21.4 | 33.0 | 11.6 |
| H | 1880.0 | -28.3 | 15.6 | 1.1 | 8.0 | 22.4 | 33.0 | 10.6 |
| H | 1902.5 | -27.9 | 16.0 | 1.2 | 7.9 | 22.8 | 33.0 | 10.2 |

**QPSK, BW 20MHz**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1860.0 | -28.9 | 15.7 | 1.1 | 8.0 | 22.6 | 33.0 | 10.4 |
| H | 1880.0 | -27.7 | 16.2 | 1.1 | 8.0 | 23.0 | 33.0 | 10.0 |
| H | 1900.0 | -26.9 | 16.7 | 1.2 | 7.9 | 23.4 | 33.0 | 9.6 |

**16QAM, BW 20MHz**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 1860.0 | -29.8 | 14.8 | 1.1 | 8.0 | 21.7 | 33.0 | 11.3 |
| H | 1880.0 | -28.9 | 15.1 | 1.1 | 8.0 | 21.9 | 33.0 | 11.1 |
| H | 1900.0 | -27.9 | 15.7 | 1.2 | 7.9 | 22.4 | 33.0 | 10.6 |

# 5. Peak to Average Ratio

## 5.1 Measurement procedure [FCC 24.232(d)]

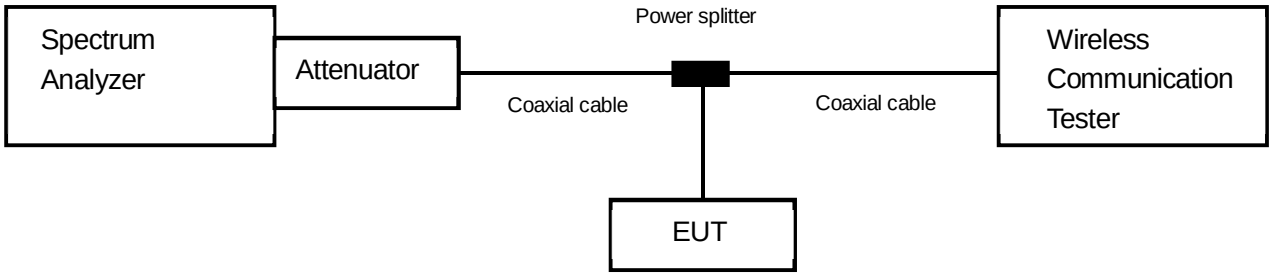
The peak to average ratio was measured with a spectrum analyzer connected to the antenna terminal.

The spectrum analyzer is set to;

[GSM1900]
a) Span = 5MHz
b) RBW = 1MHz
c) VBW ≥ 3 x RBW
d) Detector = Peak / Average
e) Sweep time = auto-couple
f) Trace mode=Max hold

[WCDMA Band II, LTE Band II]
a) Power Stat CCDF mode
b) Set resolution / measurement bandwidth ≥ signal's occupied bandwidth.
c) Set the number of counts to a value that stabilizes the measured CCDF curve.
d) Set the measurement interval as follows:
1) For continuous transmissions, set to 1ms.
2) 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 duration.
e) Record the maximum PAPR level associated with a probability of 0.1%.

- Test configuration




## 5.2 Limit

13dB or less

## 5.3 Measurement result

Date : November 29, 2017
Temperature : 24.0 [˚C]
Humidity : 34.1 [%] Test engineer :
Test place : Shielded room No.4 Chiaki Kanno

Date : November 30, 2017
Temperature : 22.1 [˚C]
Humidity : 36.3 [%] Test engineer :
Test place : Shielded room No.4 Chiaki Kanno

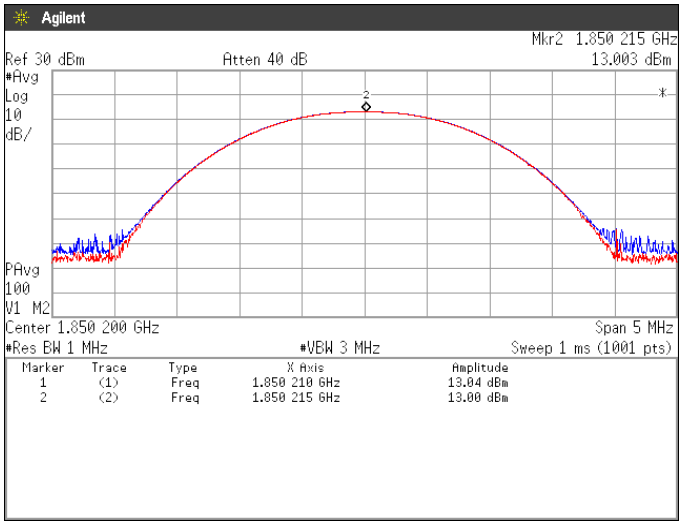
| Band | Channel | Frequency [MHz] | Peak to Average Power Ratio [dB] | Limit [dB] |
|---|---|---|---|---|
| GSM1900 | 512 | 1850.2 | 0.04 | 13.0 |
| | 661 | 1880.0 | 0.02 | |
| | 810 | 1909.8 | 0.03 | |
| WCDMA Band II | 9262 | 1852.4 | 3.26 | 13.0 |
| | 9400 | 1880.0 | 3.28 | |
| | 9538 | 1907.6 | 3.30 | |

| Band | Channel | Frequency [MHz] | Modulation | Bandwidth [MHz] | RB | Peak to Average Power Ratio [dB] | Limit [dB] |
|---|---|---|---|---|---|---|---|
| LTE Band II | 18900 | 1880.0 | QPSK | 1.4 | 6-0 | 5.31 | 13.0 |
| | | | | 3 | 15-0 | 5.38 | |
| | | | | 5 | 25-0 | 5.29 | |
| | | | | 10 | 50-0 | 4.69 | |
| | | | | 15 | 75-0 | 5.84 | |
| | | | | 20 | 100-0 | 6.57 | |
| | | | 16QAM | 1.4 | 6-0 | 6.19 | |
| | | | | 3 | 15-0 | 6.37 | |
| | | | | 5 | 25-0 | 6.18 | |
| | | | | 10 | 50-0 | 6.23 | |
| | | | | 15 | 75-0 | 6.92 | |
| | | | | 20 | 100-0 | 7.37 | |

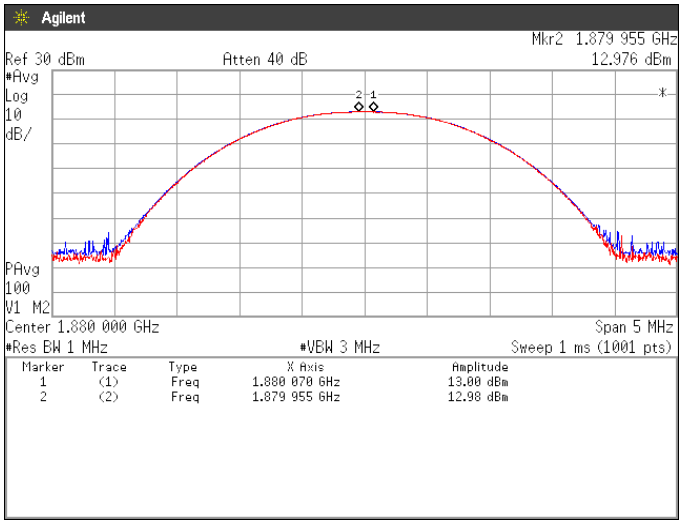
## 5.4 Trace data

### [GSM1900]

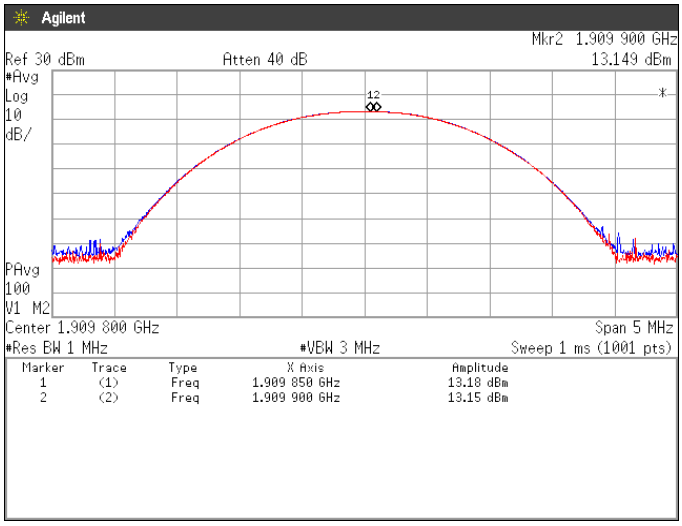
#### Channel: 512




#### Channel: 661

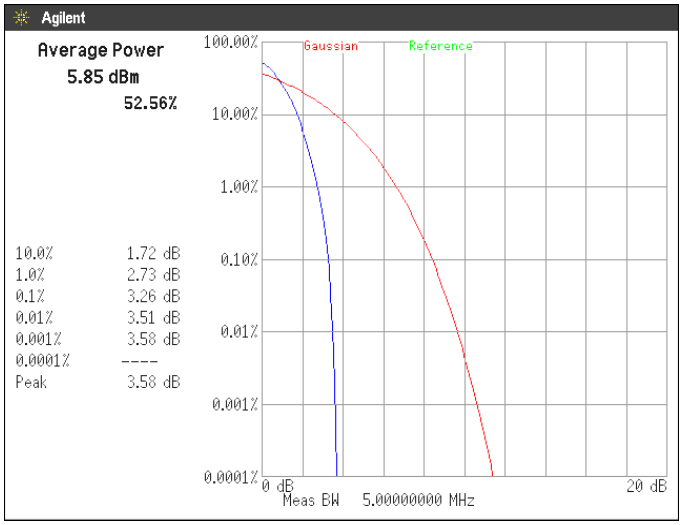



#### Channel: 810

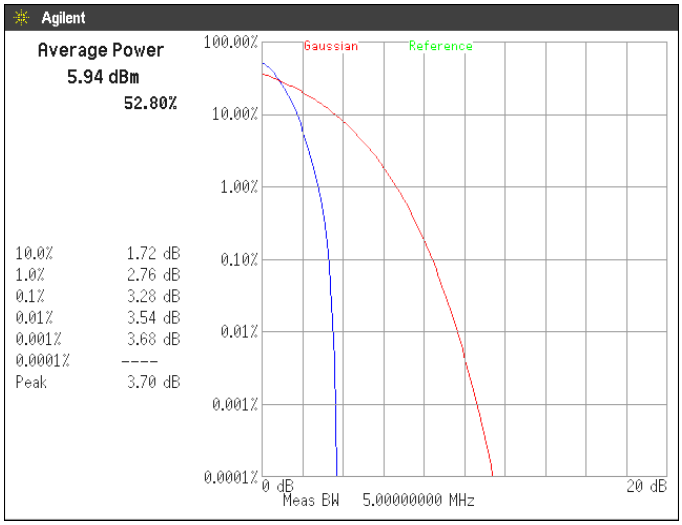


## [WCDMA Band II]

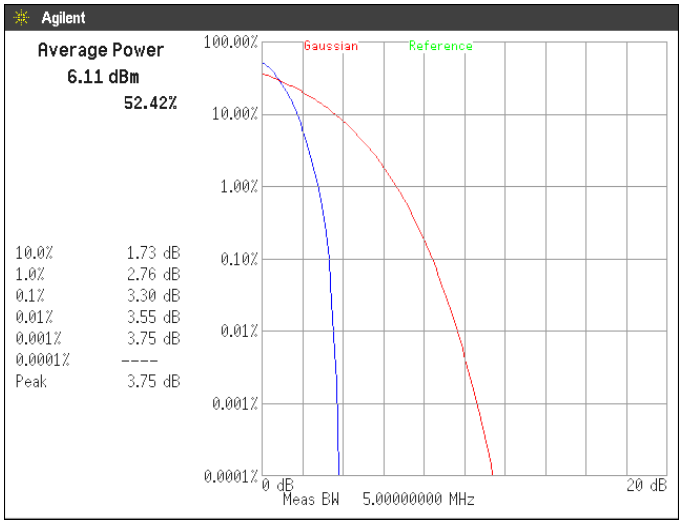
### Channel: 9262




### Channel: 9400



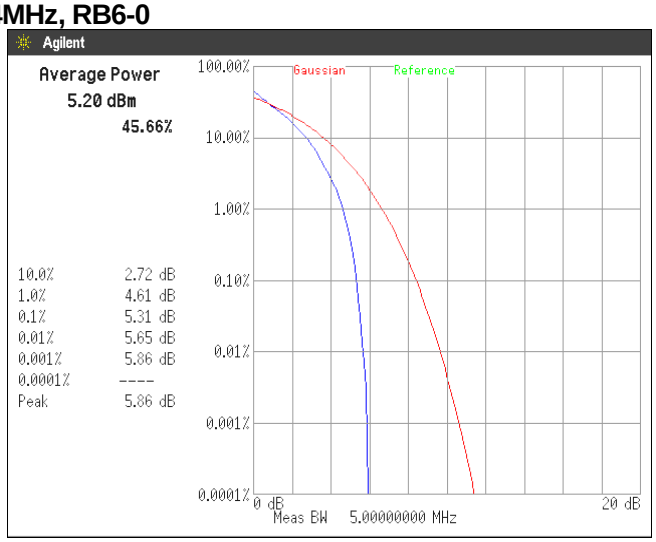

### Channel: 9538



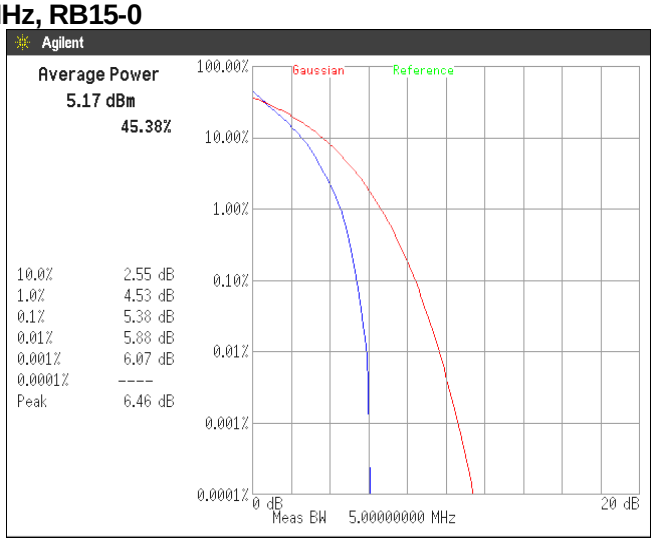
## [LTE Band II]

### Channel: 18900

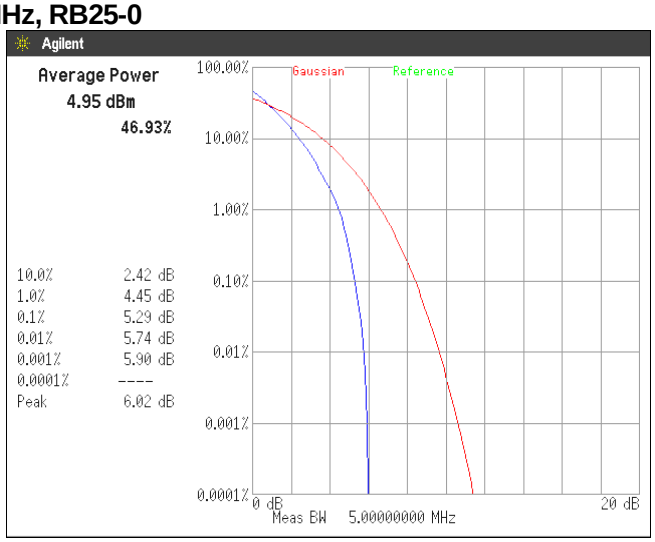
### QPSK, BW 1.4MHz, RB6-0



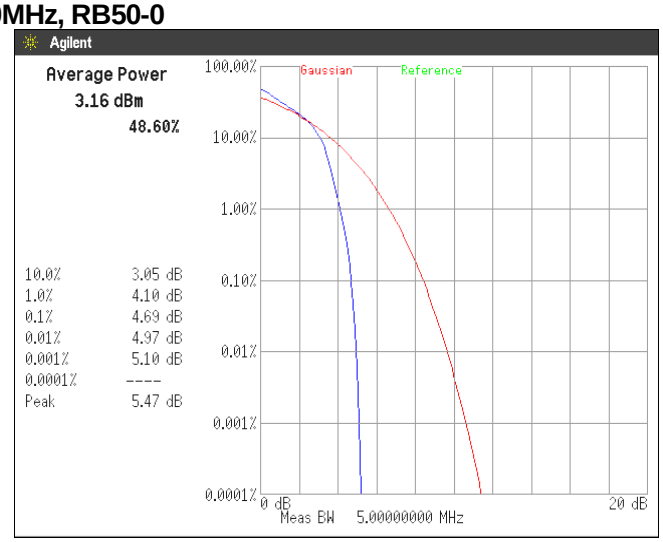

### QPSK, BW 3MHz, RB15-0



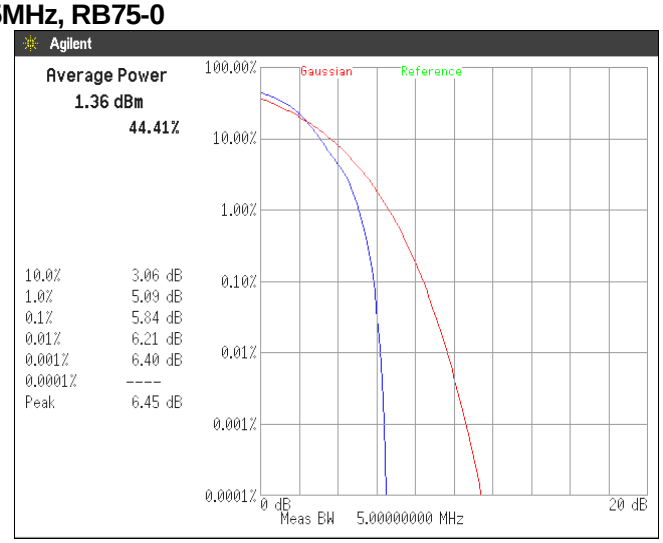

### QPSK, BW 5MHz, RB25-0



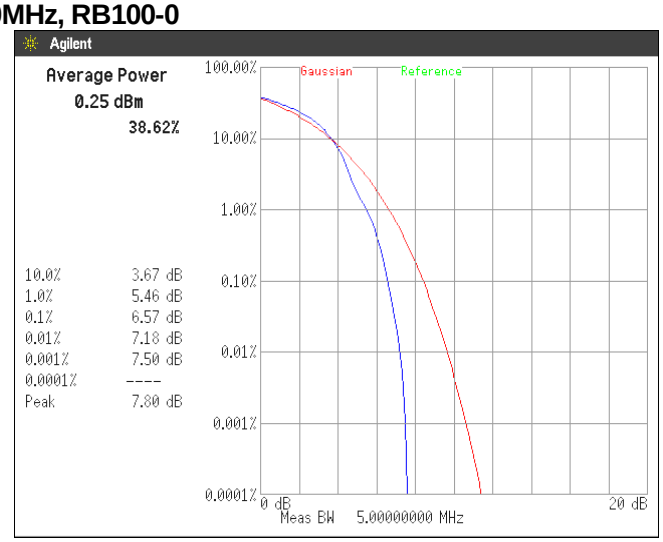
## Channel: 18900
## QPSK, BW 10MHz, RB50-0



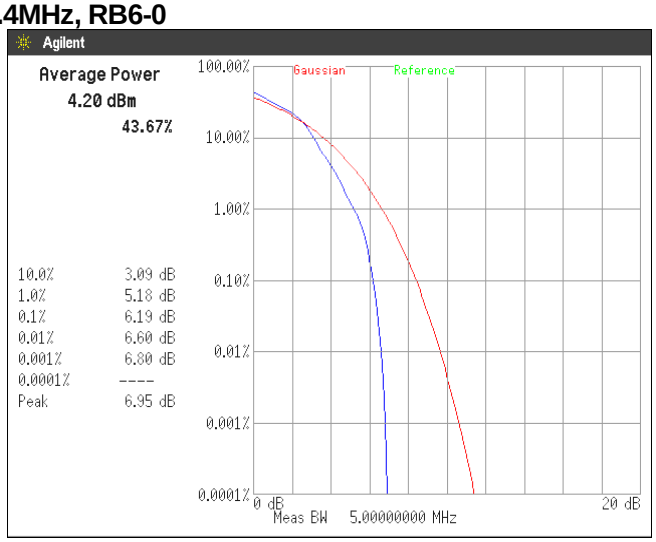

## QPSK, BW 15MHz, RB75-0



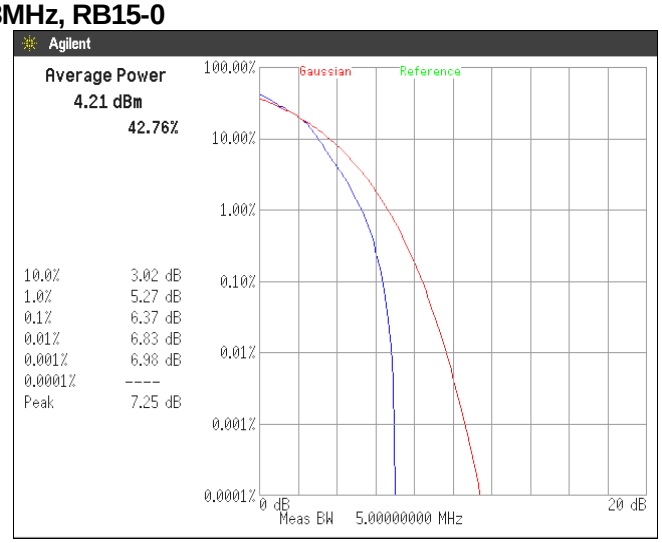

## QPSK, BW 20MHz, RB100-0



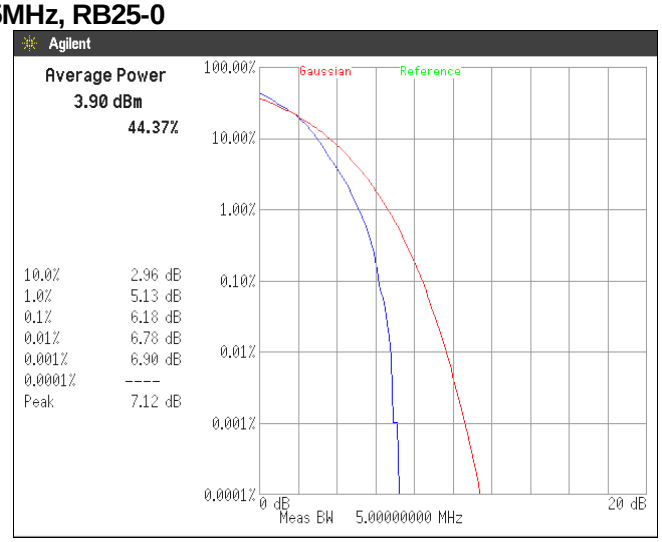
## Channel: 18900
## 16QAM, BW 1.4MHz, RB6-0



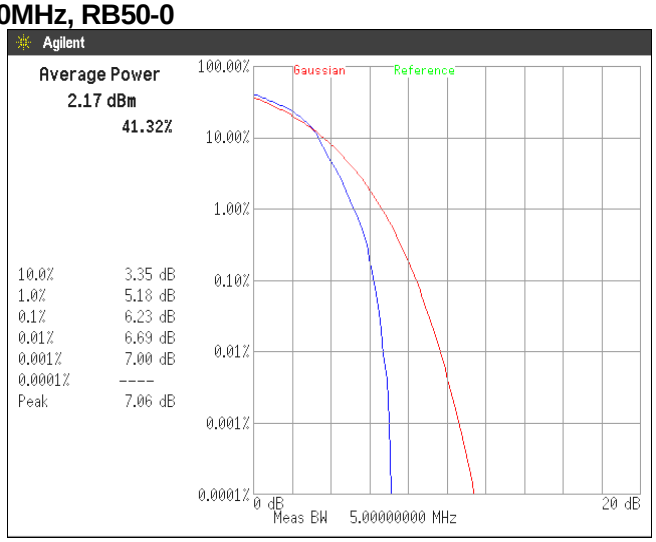

## 16QAM, BW 3MHz, RB15-0



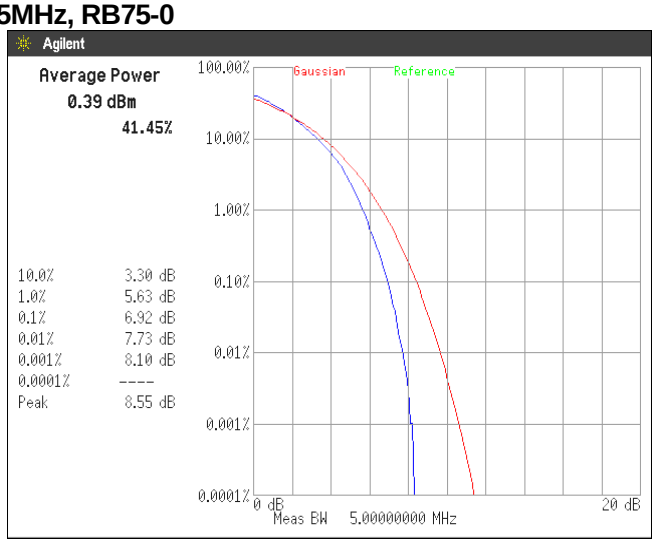

## 16QAM, BW 5MHz, RB25-0



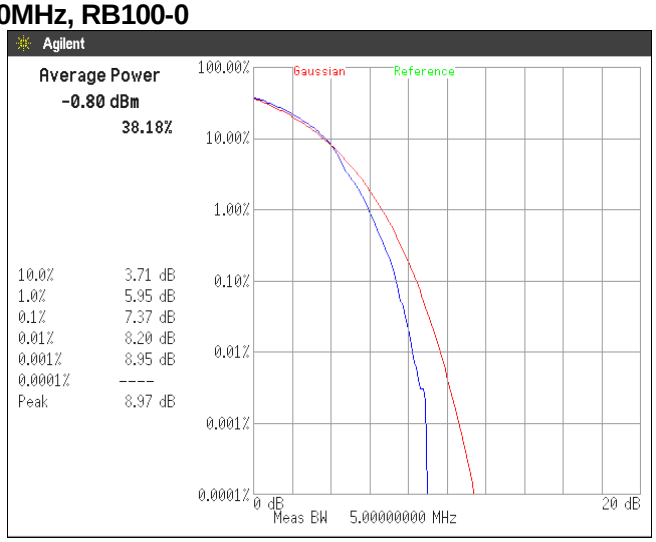
## Channel: 18900
## 16QAM, BW 10MHz, RB50-0




## 16QAM, BW 15MHz, RB75-0




## 16QAM, BW 20MHz, RB100-0



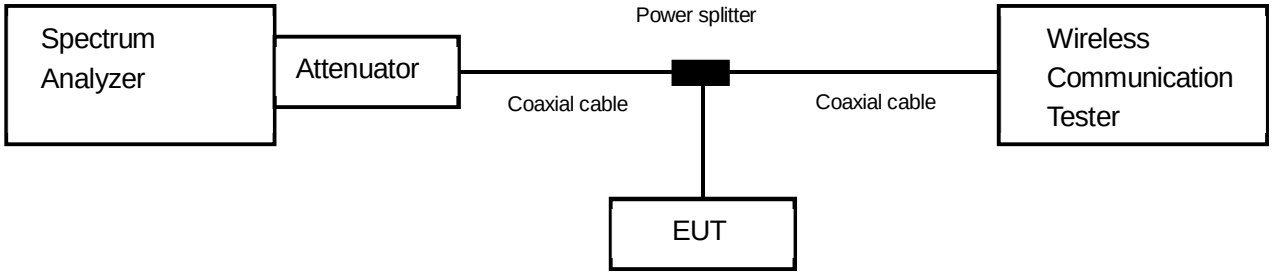
# 6. Occupied Bandwidth

## 6.1 Measurement procedure [FCC 24.238(a), 2.1049]

The Occupied bandwidth was measured with a spectrum analyzer connected to the antenna terminal.

The spectrum analyzer is set to;
a) RBW = 1-5% of the expected OBW & VBW ≥ 3 x RBW
b) Detector = Peak
c) Trace mode = Max hold
d) Sweep time = auto-couple

- Test configuration




## 6.2 Limit

None

## 6.3 Measurement result

| | | | | | |
|---|---|---|---|---|---|
| Date | : | November 29, 2017 | | | |
| Temperature | : | 24.0 [˚C] | | | |
| Humidity | : | 34.1 [%] | Test engineer | : | |
| Test place | : | Shielded room No.4 | | | Chiaki Kanno |

| | | | | | |
|---|---|---|---|---|---|
| Date | : | November 30, 2017 | | | |
| Temperature | : | 22.1 [˚C] | | | |
| Humidity | : | 36.3 [%] | Test engineer | : | |
| Test place | : | Shielded room No.4 | | | Chiaki Kanno |

| Band | Channel | Frequency [MHz] | Test Result [kHz] |
|---|---|---|---|
| GSM1900 | 512 | 1850.2 | 244.3406 |
| | 661 | 1880.0 | 244.2760 |
| | 810 | 1909.8 | 242.6947 |

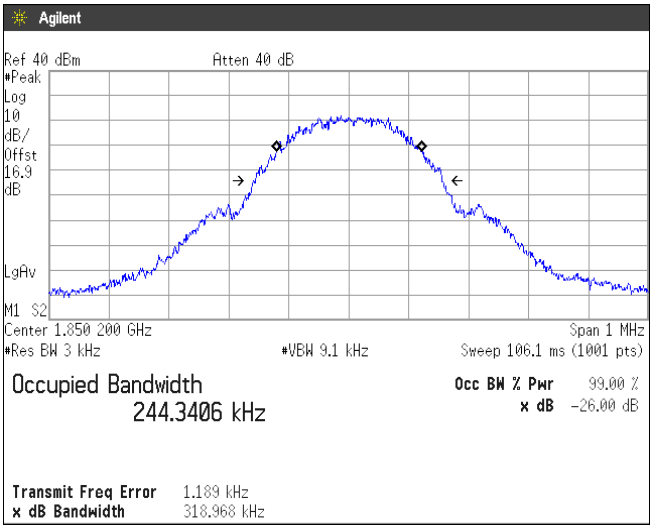
| Band | Channel | Frequency [MHz] | Test Result [MHz] |
|---|---|---|---|
| WCDMA Band II | 9262 | 1852.4 | 4.1198 |
| | 9400 | 1880.0 | 4.1237 |
| | 9538 | 1907.6 | 4.1261 |

| Band | Channel | Frequency [MHz] | Bandwidth [MHz] | Modulation | RB | Test Result [MHz] |
|---|---|---|---|---|---|---|
| LTE Band II | 18900 | 1880.0 | 1.4 | QPSK | 3-1 | 0.6150 |
| | | | | | 6-0 | 1.0973 |
| | | | | 16QAM | 3-1 | 0.6232 |
| | | | | | 6-0 | 1.1011 |
| | | | 3 | QPSK | 8-4 | 1.5300 |
| | | | | | 15-0 | 2.7071 |
| | | | | 16QAM | 8-4 | 1.5404 |
| | | | | | 15-0 | 2.7208 |
| | | | 5 | QPSK | 12-7 | 2.3759 |
| | | | | | 25-0 | 4.5333 |
| | | | | 16QAM | 12-7 | 2.3312 |
| | | | | | 25-0 | 4.5028 |
| | | | 10 | QPSK | 25-12 | 4.6609 |
| | | | | | 50-0 | 8.9367 |
| | | | | 16QAM | 25-12 | 4.7599 |
| | | | | | 50-0 | 8.9667 |
| | | | 15 | QPSK | 36-20 | 6.8117 |
| | | | | | 75-0 | 13.4581 |
| | | | | 16QAM | 36-20 | 6.7790 |
| | | | | | 75-0 | 13.4172 |
| | | | 20 | QPSK | 50-24 | 9.2611 |
| | | | | | 100-0 | 17.8847 |
| | | | | 16QAM | 50-24 | 9.2411 |
| | | | | | 100-0 | 17.9674 |

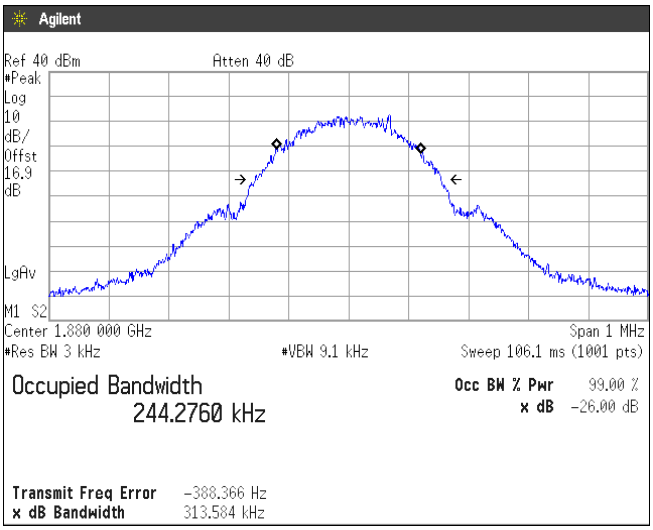
## 6.4 Trace data

### [GSM1900]

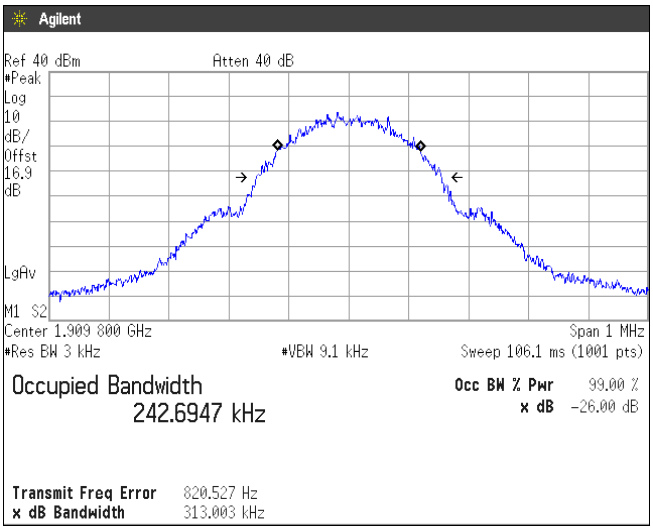
#### Channel: 512




#### Channel: 661

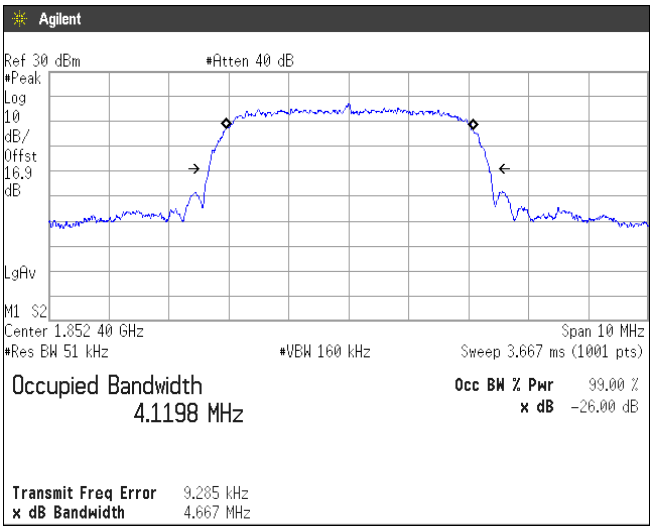



#### Channel: 810

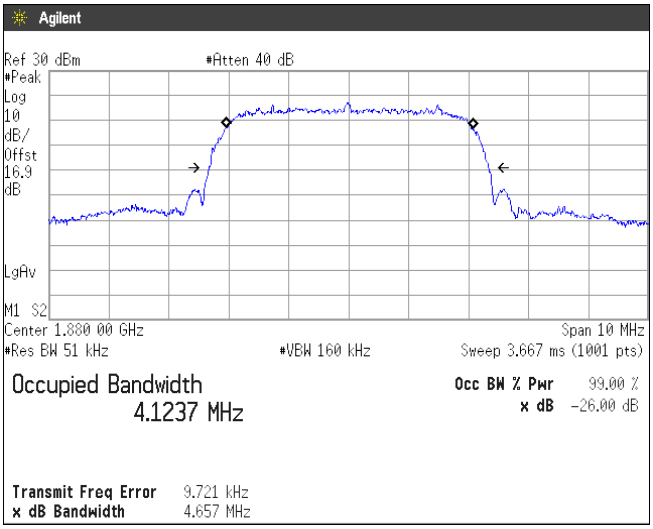


## [WCDMA Band II]

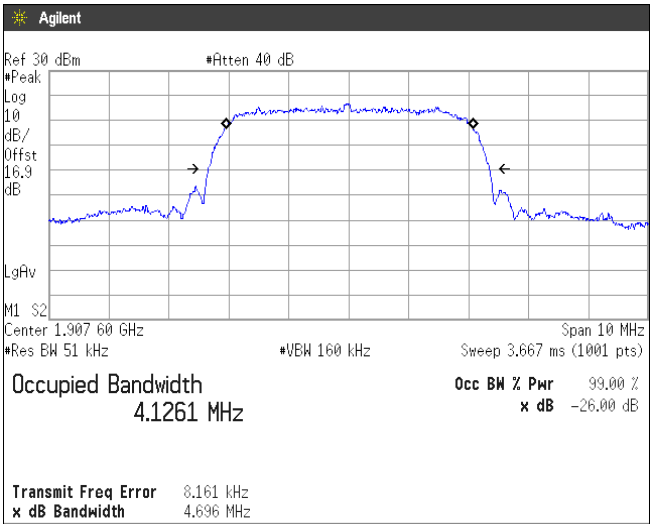
### Channel: 9262




### Channel: 9400




### Channel: 9538

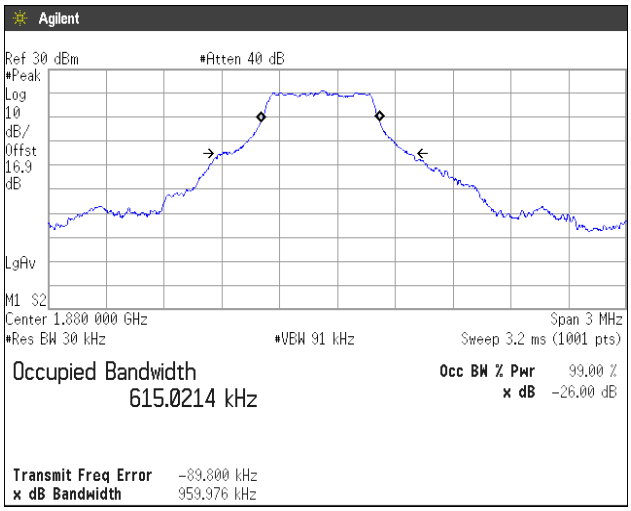


Zacta

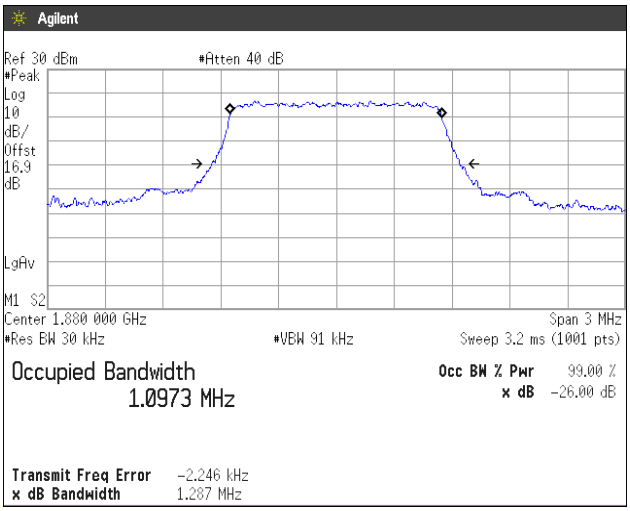
**[LTE Band II]**
**Channel: 18900**

## QPSK, BW 1.4MHz

### RB3-1

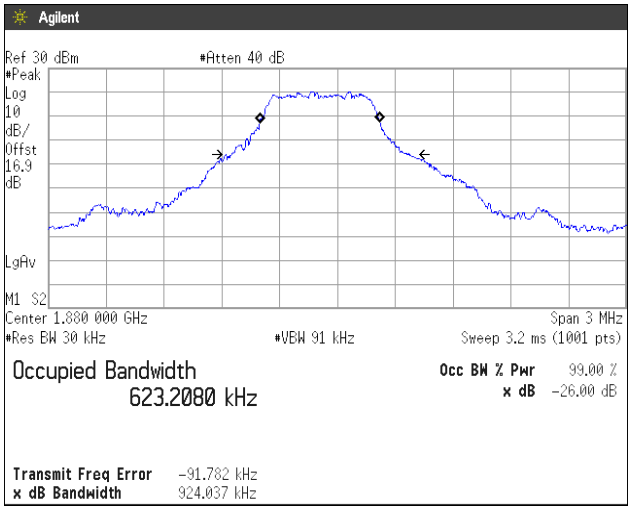



### RB6-0

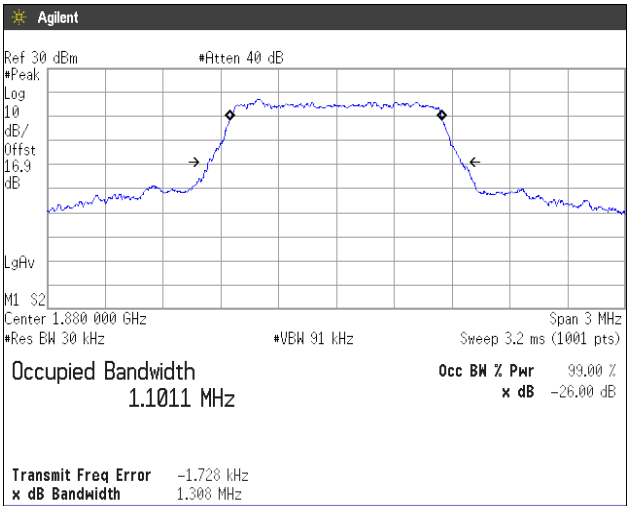



## 16QAM, BW 1.4MHz

### RB3-1

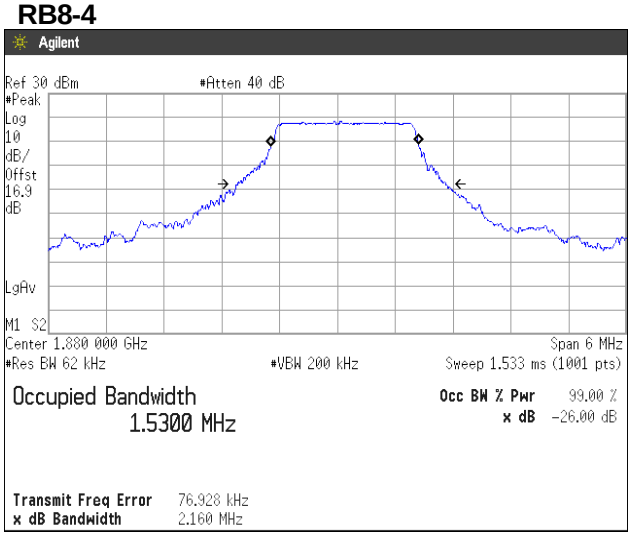



### RB6-0

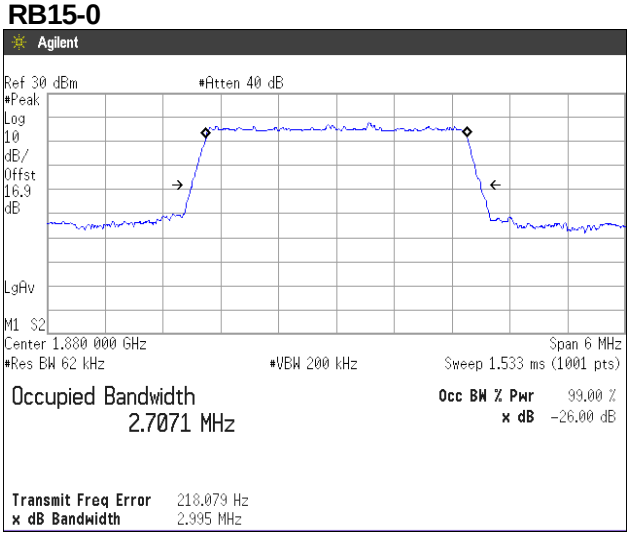


## QPSK, BW 3MHz

### RB8-4

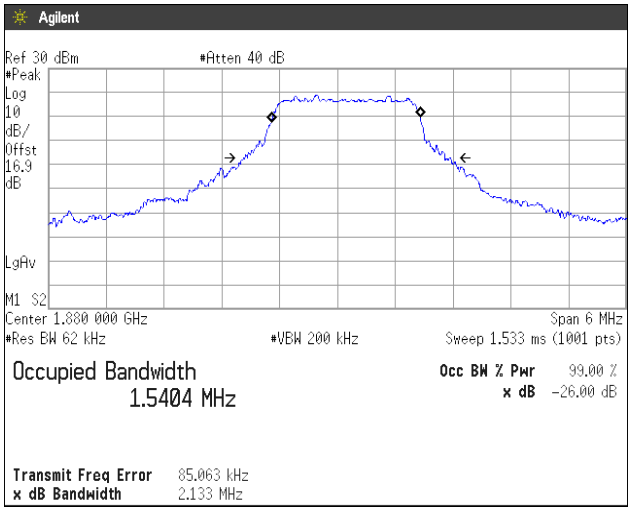



### RB15-0

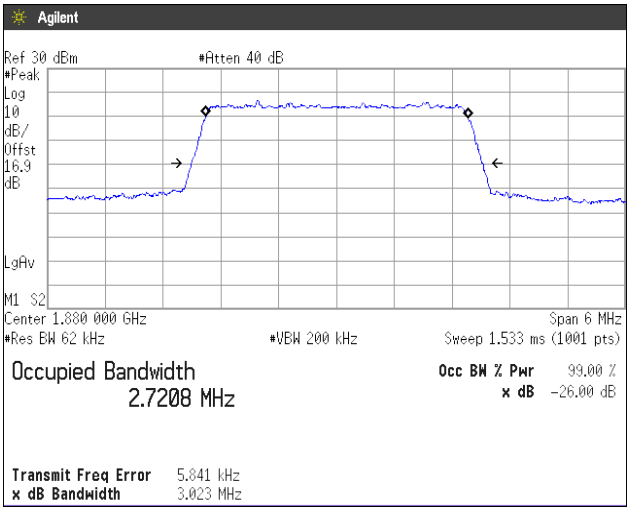



## 16QAM, BW 3MHz

### RB8-4

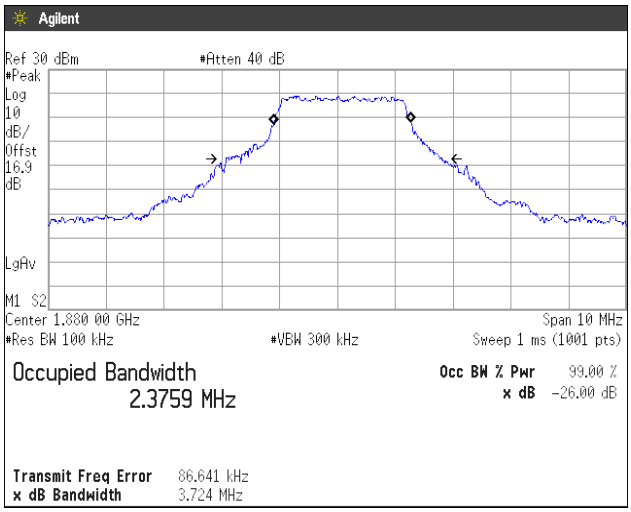



### RB15-0

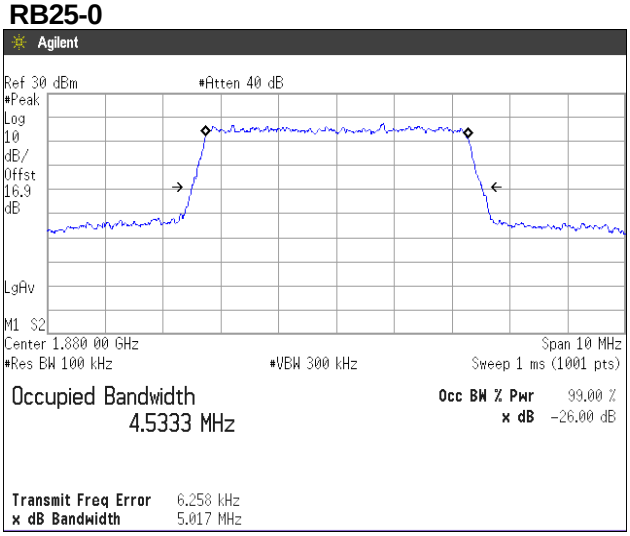


## QPSK, BW 5MHz

### RB12-7

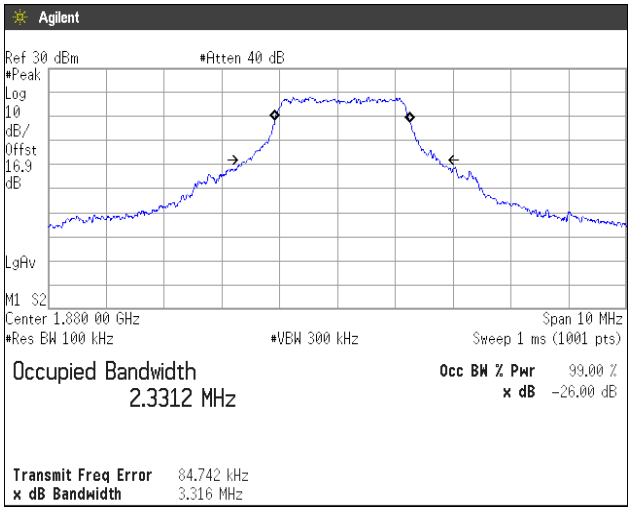



### RB25-0

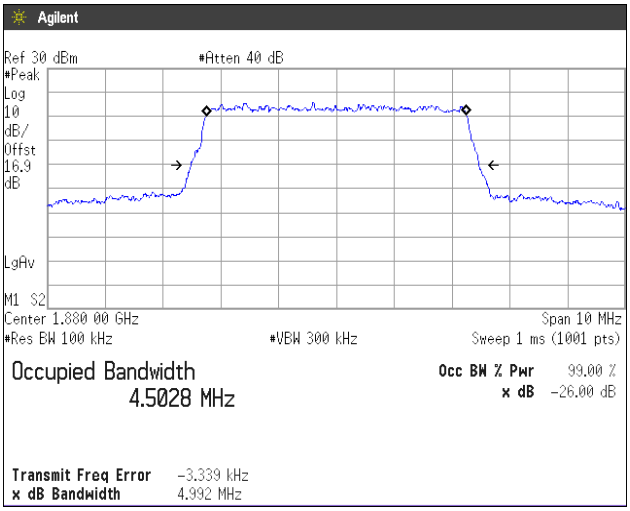



## 16QAM, BW 5MHz

### RB12-7

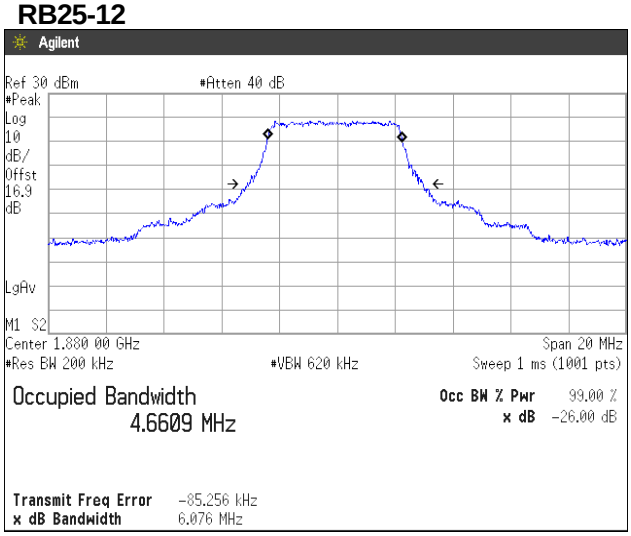



### RB25-0

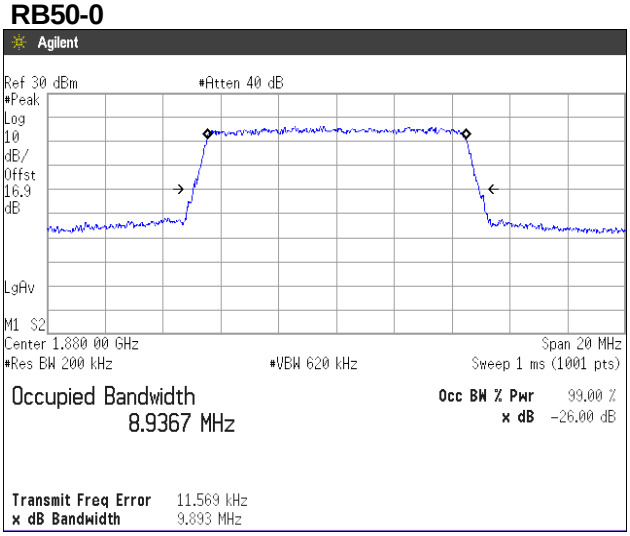


## QPSK, BW 10MHz

### RB25-12

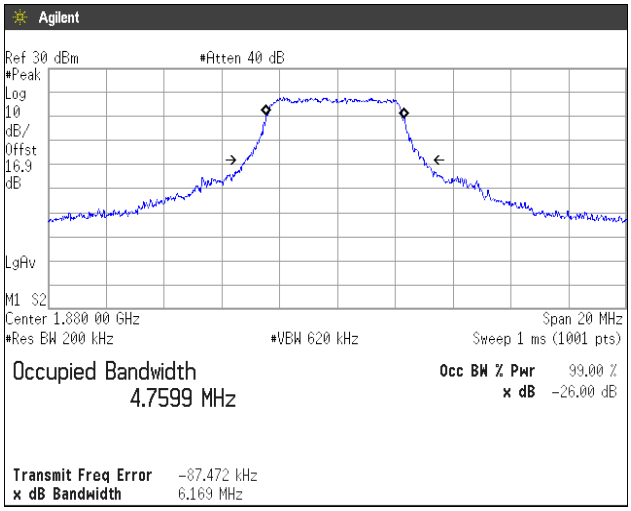



### RB50-0

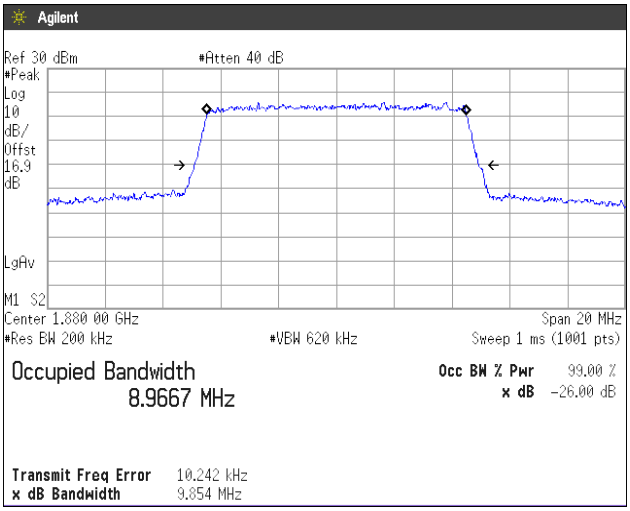



## 16QAM, BW 10MHz

### RB25-12

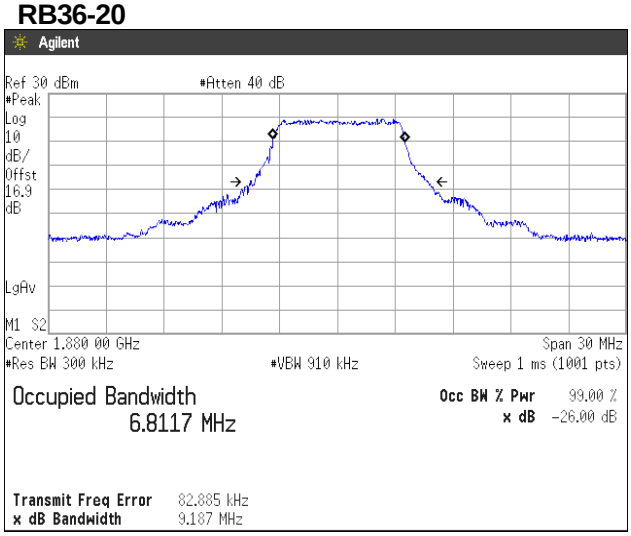



### RB50-0

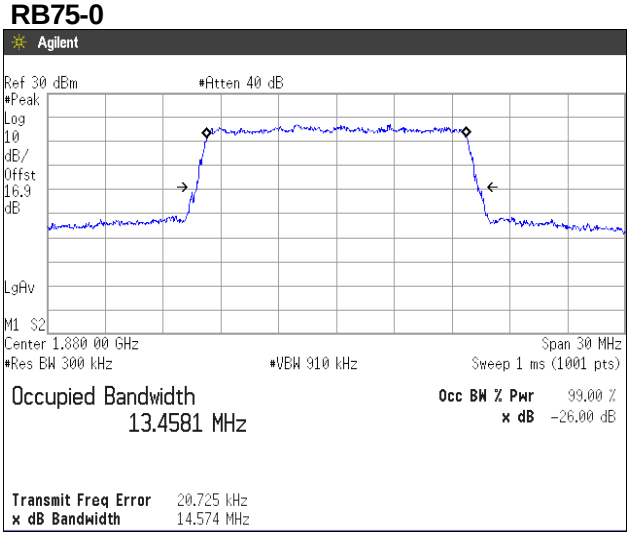


## QPSK, BW 15MHz

### RB36-20

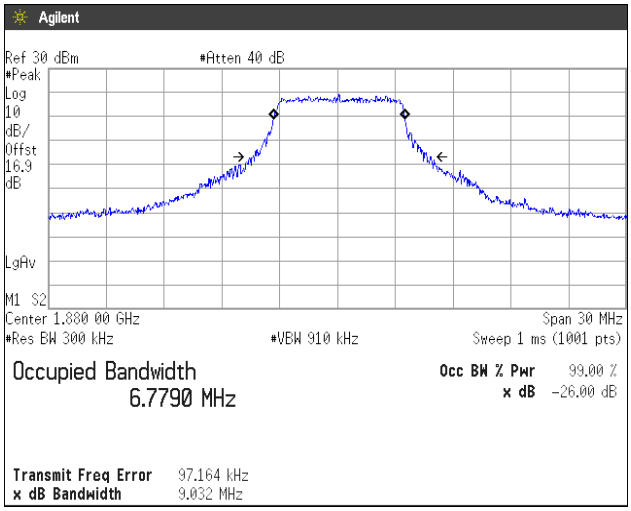



### RB75-0

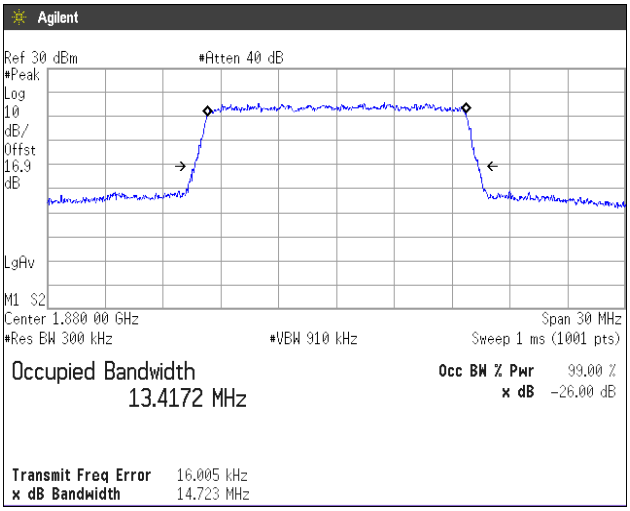



## 16QAM, BW 15MHz

### RB36-20

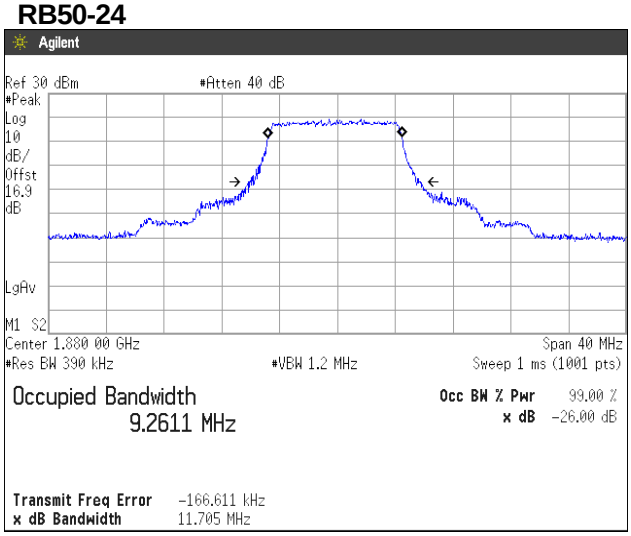



### RB75-0

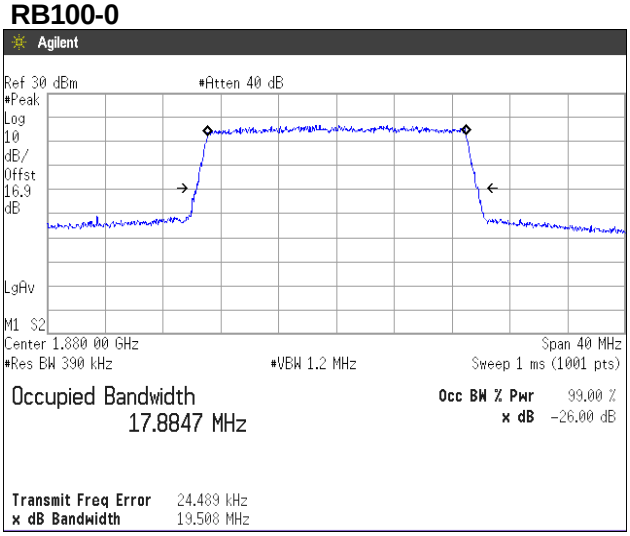


## QPSK, BW 20MHz

### RB50-24

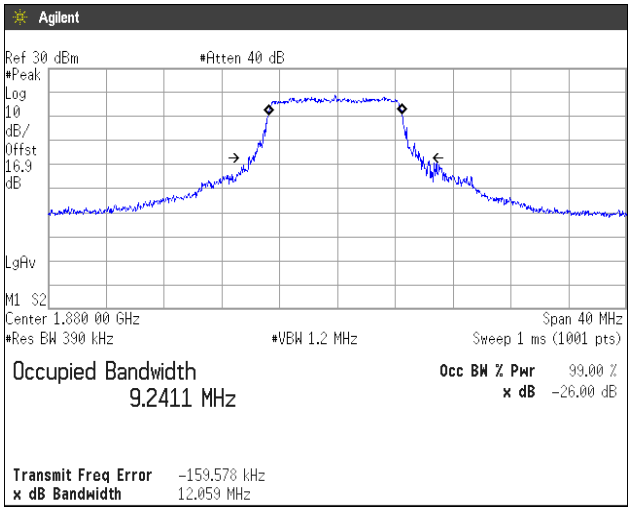



### RB100-0

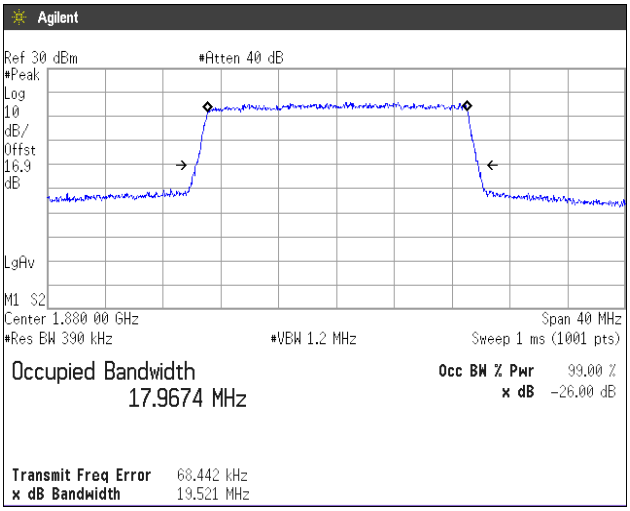



## 16QAM, BW 20MHz

### RB50-24




### RB100-0



# 7. Band Edge Spurious and Harmonic at Antenna Terminals

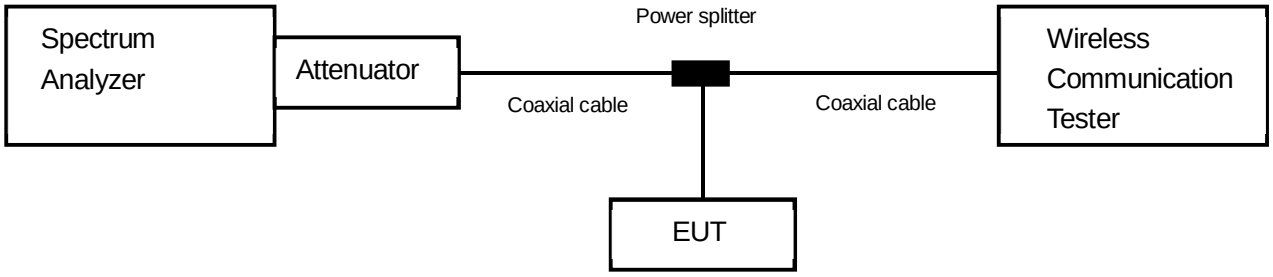
## 7.1 Measurement procedure [FCC 24.238(a), 2.1051]

The band edge spurious and harmonic was measured with a spectrum analyzer connected to the antenna terminal.

The spectrum analyzer is set to;
<Band Edge>
a) Span was set large enough so as to capture all out of band emissions near the band edge
b) RBW ≥ 1% of the emission bandwidth or 2% of the emission bandwidth
c) VBW ≥ 3 x RBW
d) Detector = RMS
e) Trace mode = Max hold
f) Sweep time = auto-couple
g) Number of sweep point ≥ 2 x span / RBW

<Spurious Emissions>
a) RBW = 1MHz & VBW ≥ 3 x RBW
b) Detector = Peak
c) Trace mode = Max hold
d) Sweep time = auto-couple
e) Number of sweep point ≥ 2 x span / RBW

- Test configuration




## 7.2 Limit

-13dBm or less

## 7.3 Measurement result

Date : November 29, 2017
Temperature : 24.0 [˚C]
Humidity : 34.1 [%] Test engineer :
Test place : Shielded room No.4 Chiaki Kanno

Date : November 30, 2017
Temperature : 22.1 [˚C]
Humidity : 36.3 [%] Test engineer :
Test place : Shielded room No.4 Chiaki Kanno

| Band | Channel | Frequency [MHz] | Limit [dB] | Results | |
|---|---|---|---|---|---|
| GSM1900 | 512 | 1850.2 | -13.0 | See the trace data | PASS |
| | 810 | 1909.8 | -13.0 | See the trace data | PASS |
| WCDMA Band II | 9262 | 1852.4 | -13.0 | See the trace data | PASS |
| | 9538 | 1907.6 | -13.0 | See the trace data | PASS |

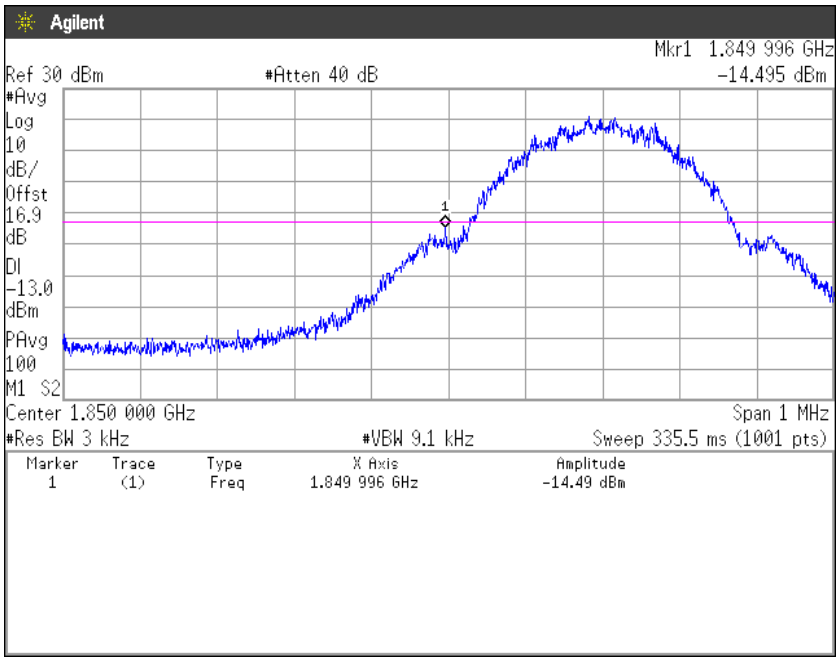
| Band | Modulation | Bandwidth [MHz] | Limit [dB] | Results | |
|---|---|---|---|---|---|
| LTE Band II | QPSK | 1.4 | -13.0 | See the trace data | PASS |
| | | 3 | -13.0 | See the trace data | PASS |
| | | 5 | -13.0 | See the trace data | PASS |
| | | 10 | -13.0 | See the trace data | PASS |
| | | 15 | -13.0 | See the trace data | PASS |
| | | 20 | -13.0 | See the trace data | PASS |
| | 16QAM | 1.4 | -13.0 | See the trace data | PASS |
| | | 3 | -13.0 | See the trace data | PASS |
| | | 5 | -13.0 | See the trace data | PASS |
| | | 10 | -13.0 | See the trace data | PASS |
| | | 15 | -13.0 | See the trace data | PASS |
| | | 20 | -13.0 | See the trace data | PASS |

## 7.4 Trace data

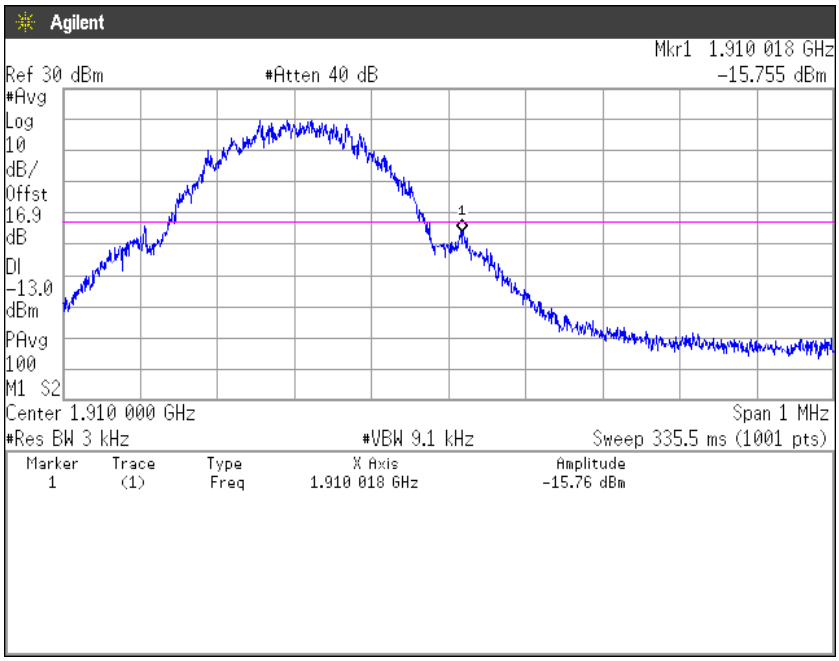
[GSM1900]

(Band Edge)

### Channel: 512



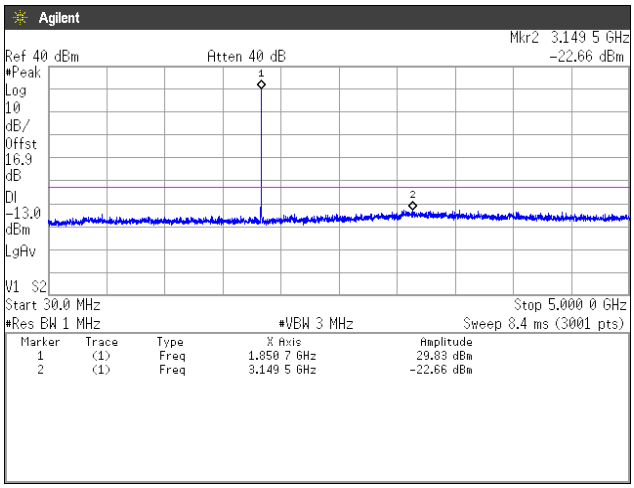

### Channel: 810



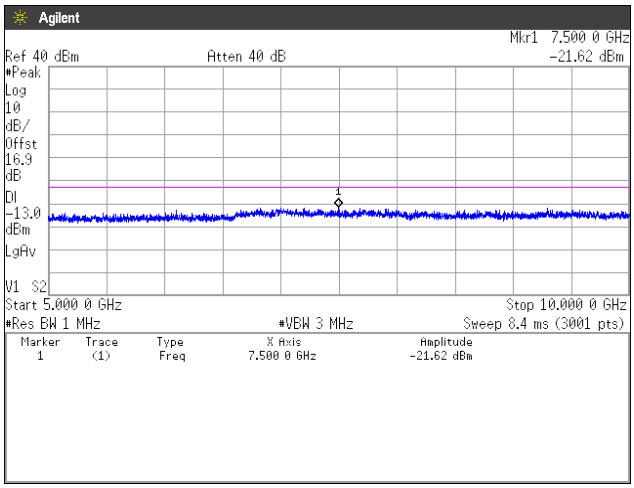
**(Spurious Emissions)**
**Note: Conducted spurious test was measured in the worst case of conducted output power.**

**Channel: 512**

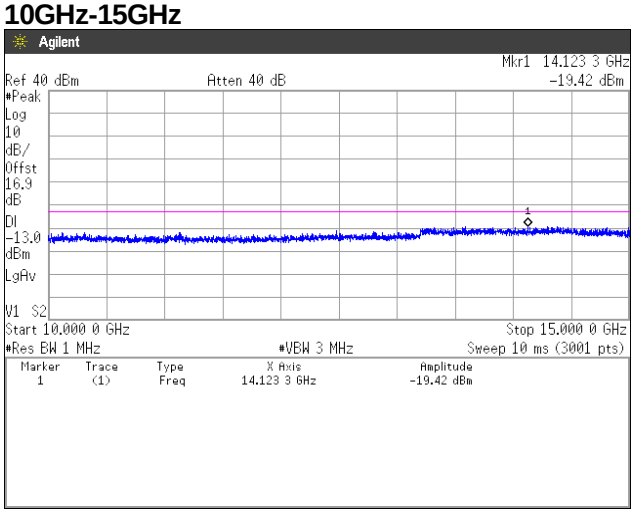
**30MHz-5GHz**



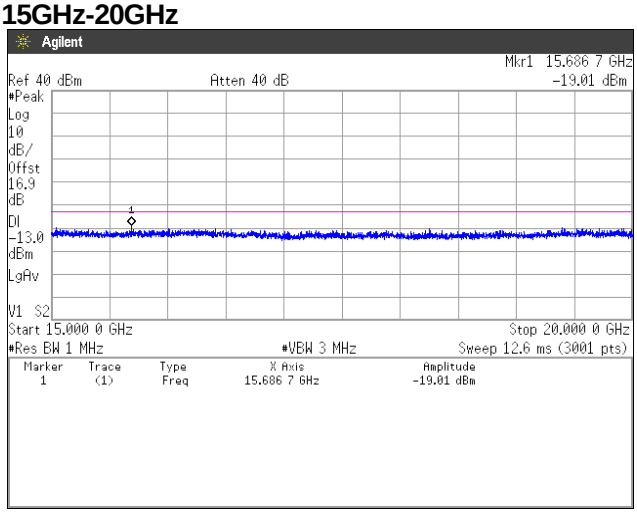

**5GHz-10GHz**




**10GHz-15GHz**

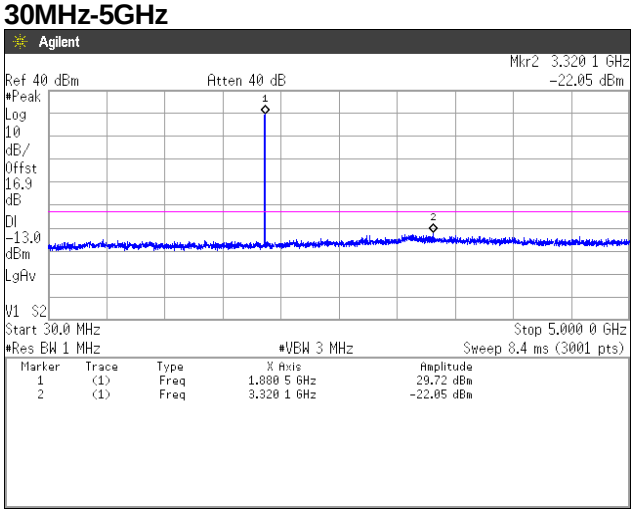



**15GHz-20GHz**

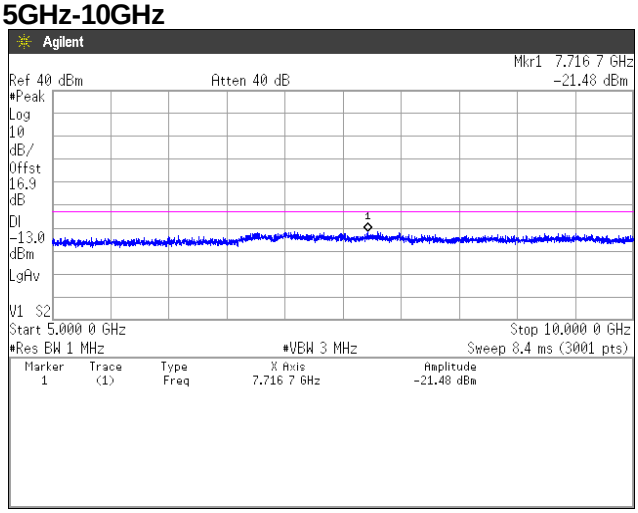


## Channel: 661

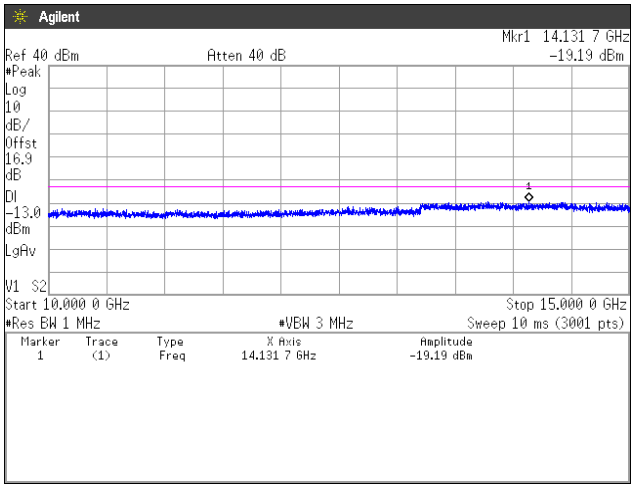
### 30MHz-5GHz



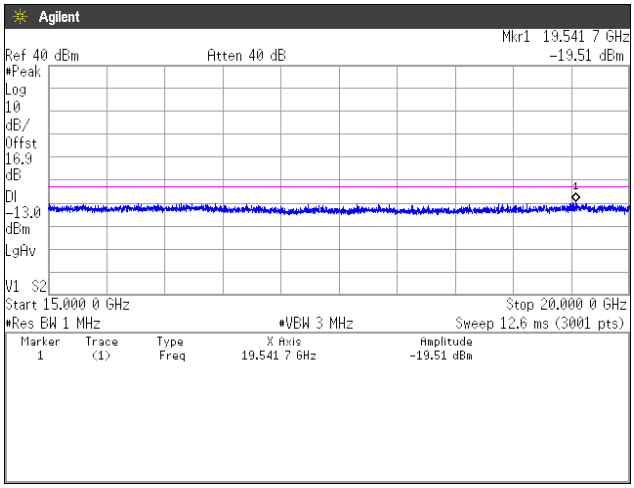

### 5GHz-10GHz




### 10GHz-15GHz

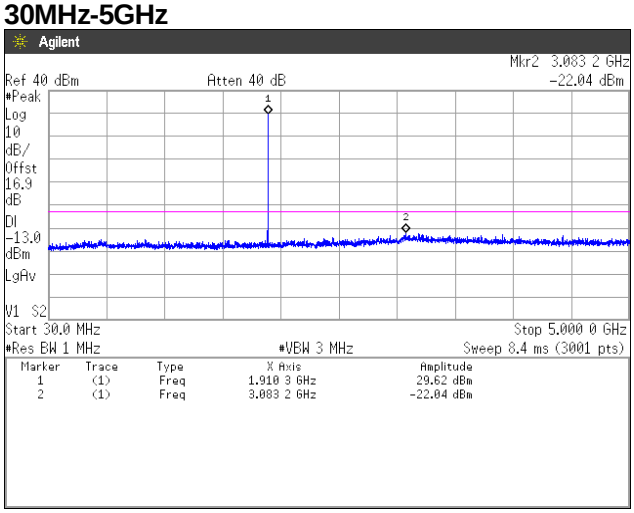



### 15GHz-20GHz

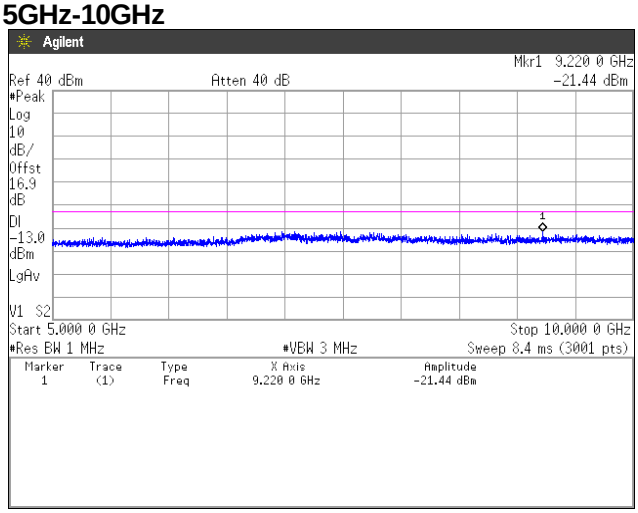


## Channel: 810

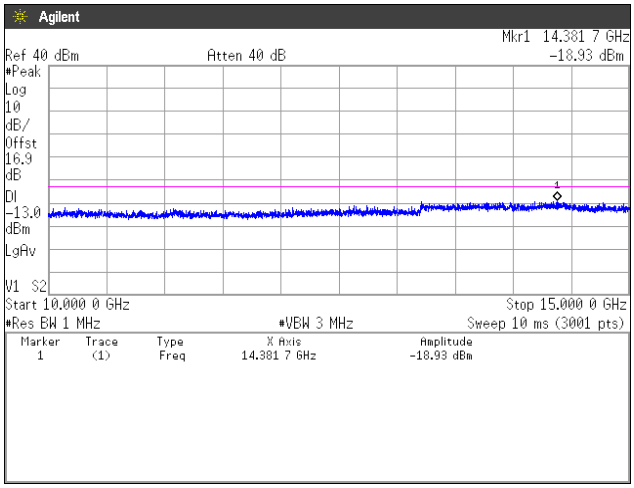
### 30MHz-5GHz



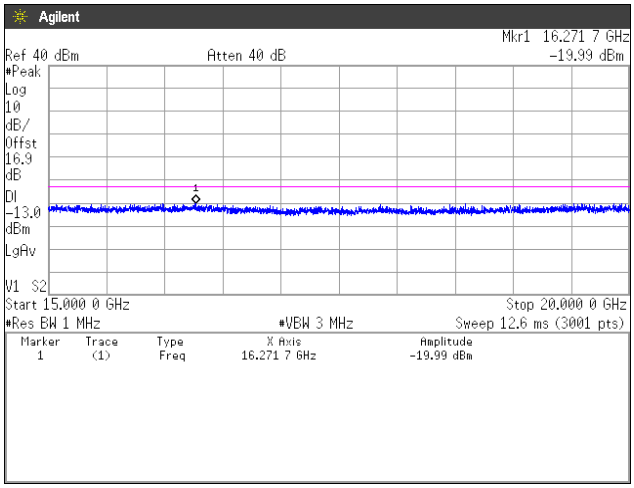

### 5GHz-10GHz




### 10GHz-15GHz

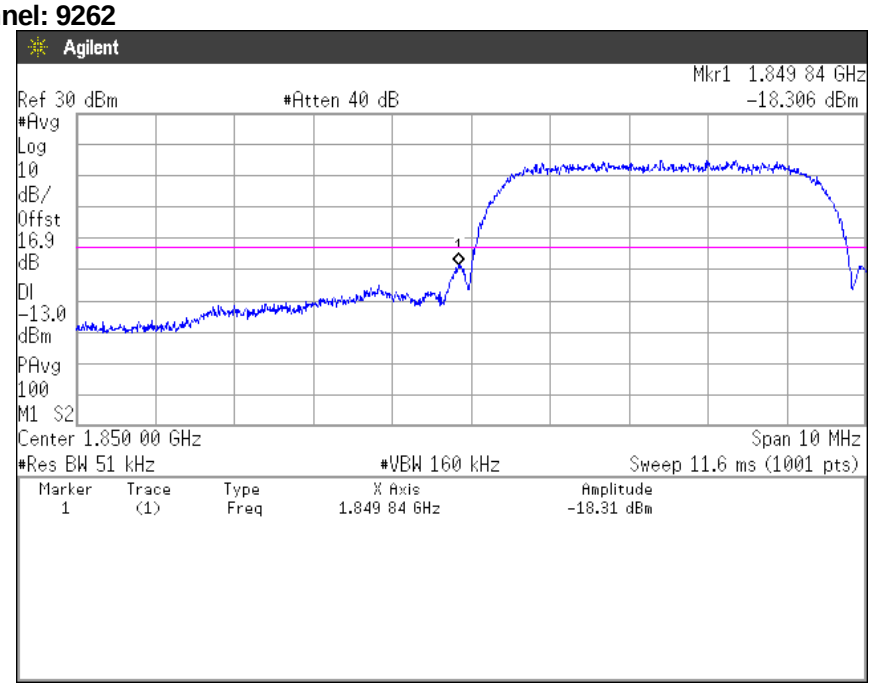


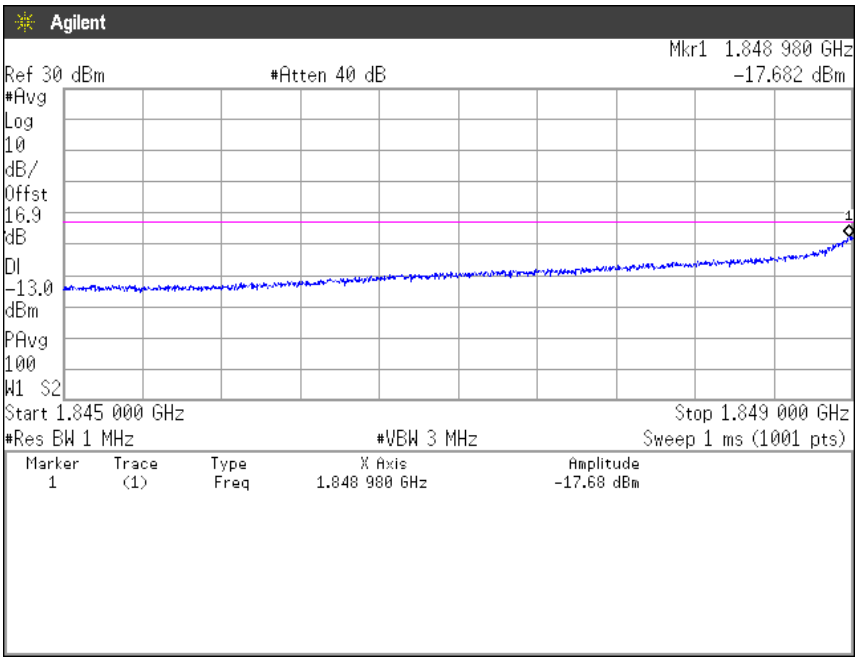

### 15GHz-20GHz



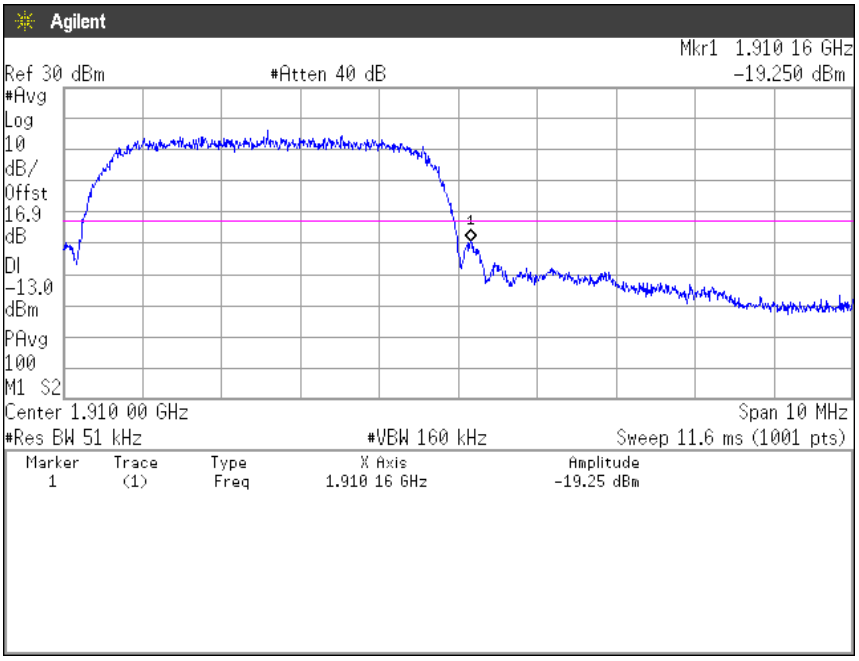
**[WCDMA Band II]**
**(Band Edge)**

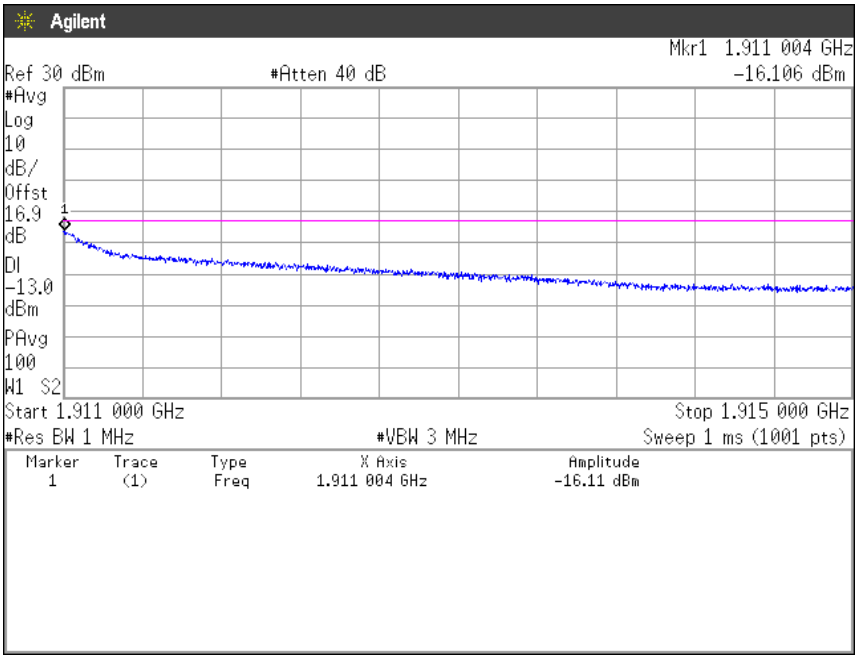
**Channel: 9262**



## Channel: 9538

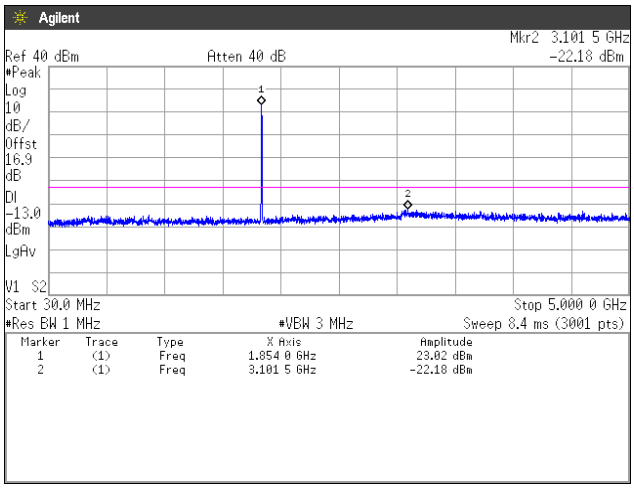


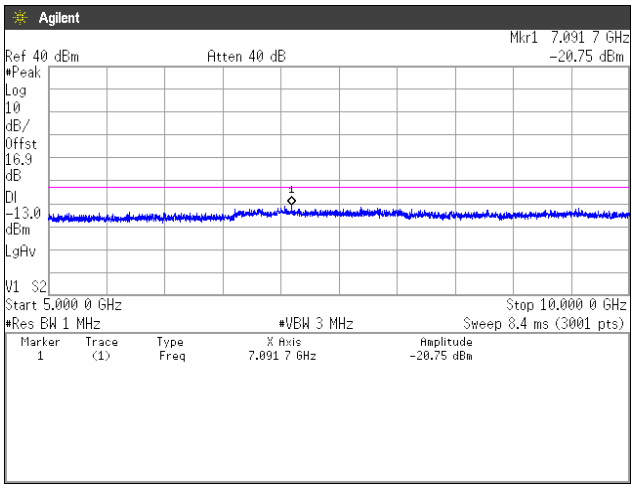
**(Spurious Emissions)**
**Note: Conducted spurious test was measured in the worst case of conducted output power.**

**Channel: 9262**

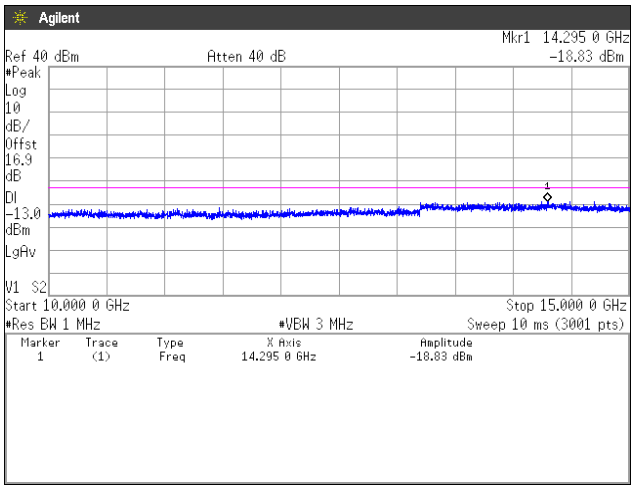
**30MHz-5GHz**



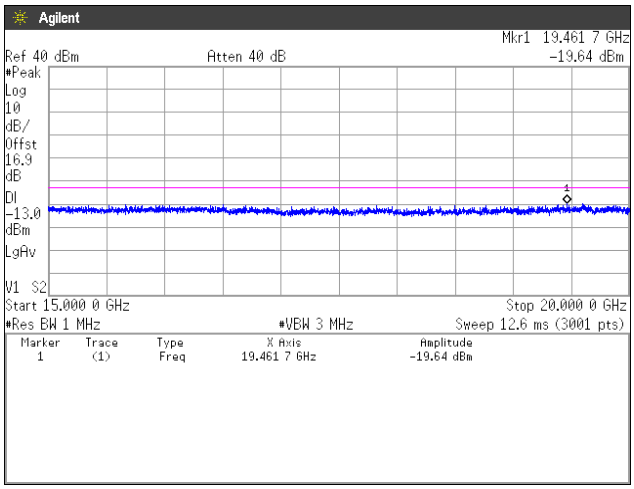

**5GHz-10GHz**




**10GHz-15GHz**

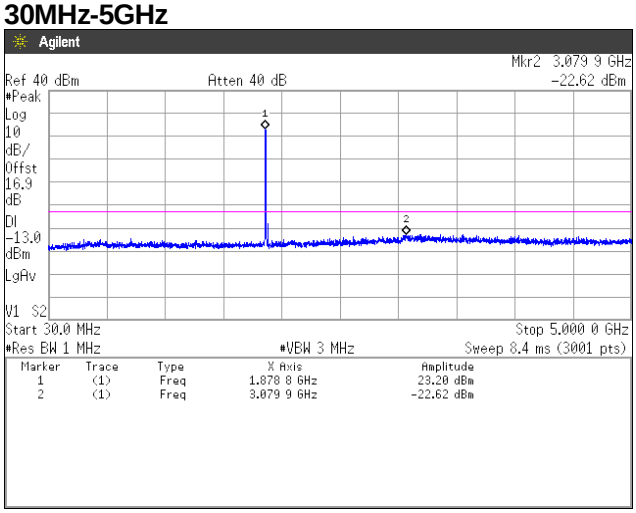



**15GHz-20GHz**

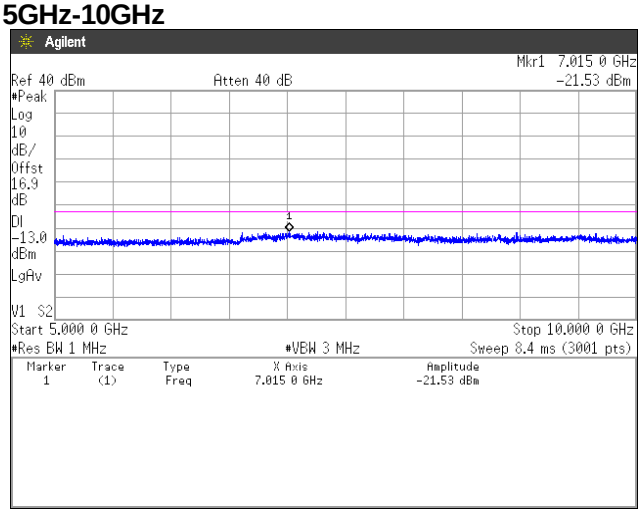


## Channel: 9400

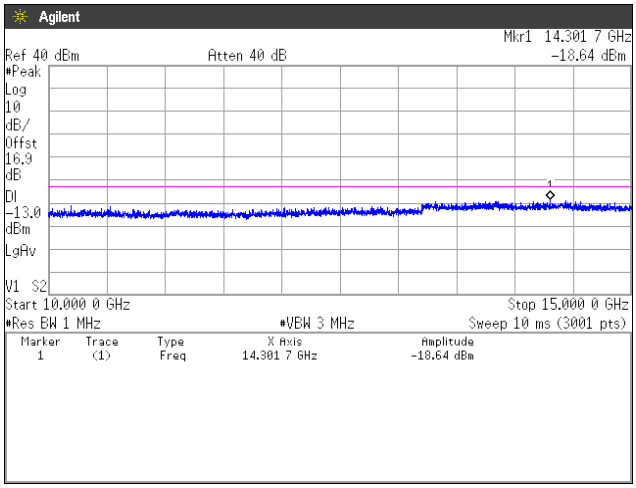
### 30MHz-5GHz



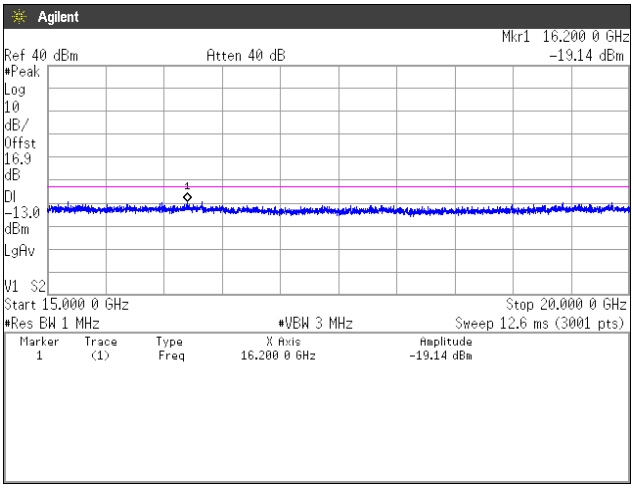

### 5GHz-10GHz




### 10GHz-15GHz

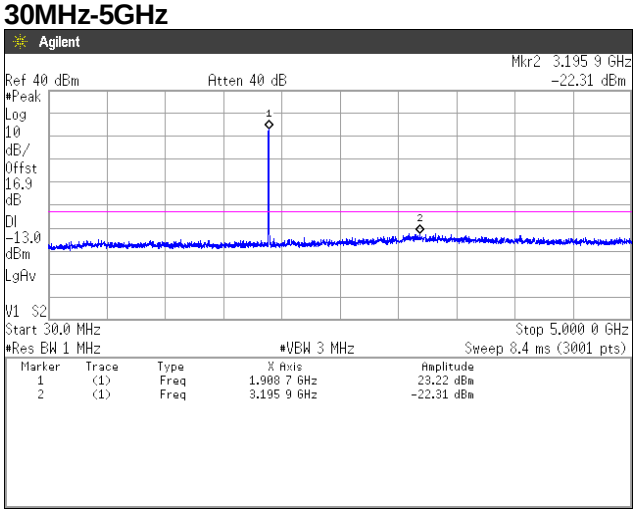



### 15GHz-20GHz

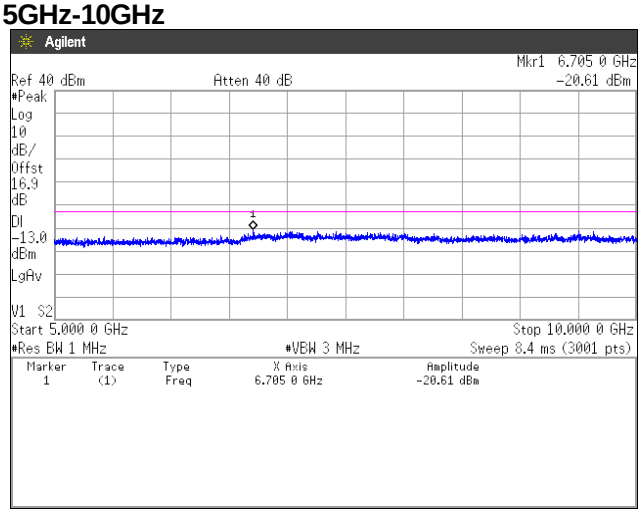


## Channel: 9538

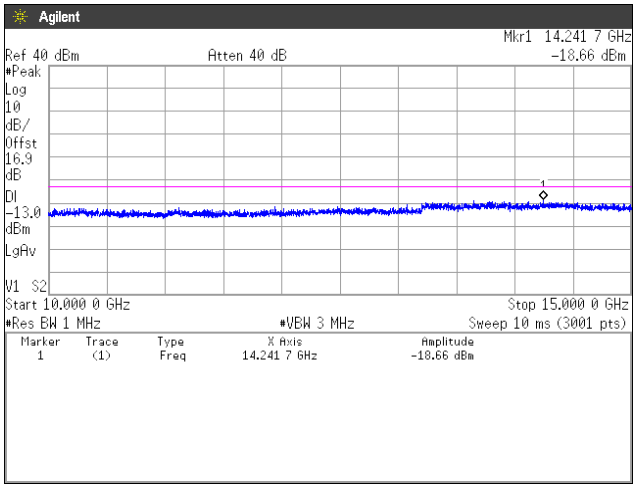
### 30MHz-5GHz



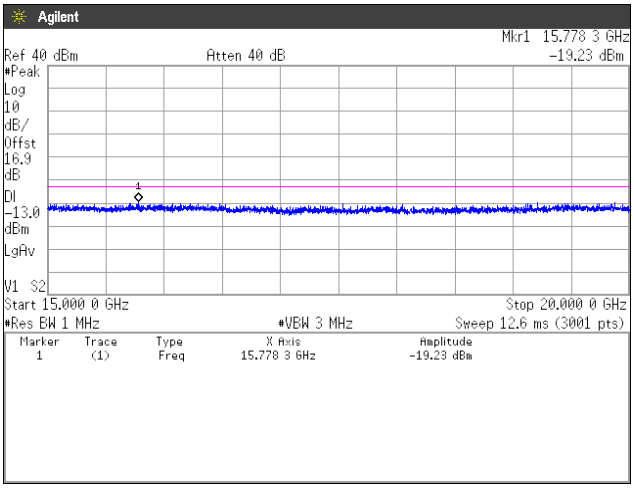

### 5GHz-10GHz



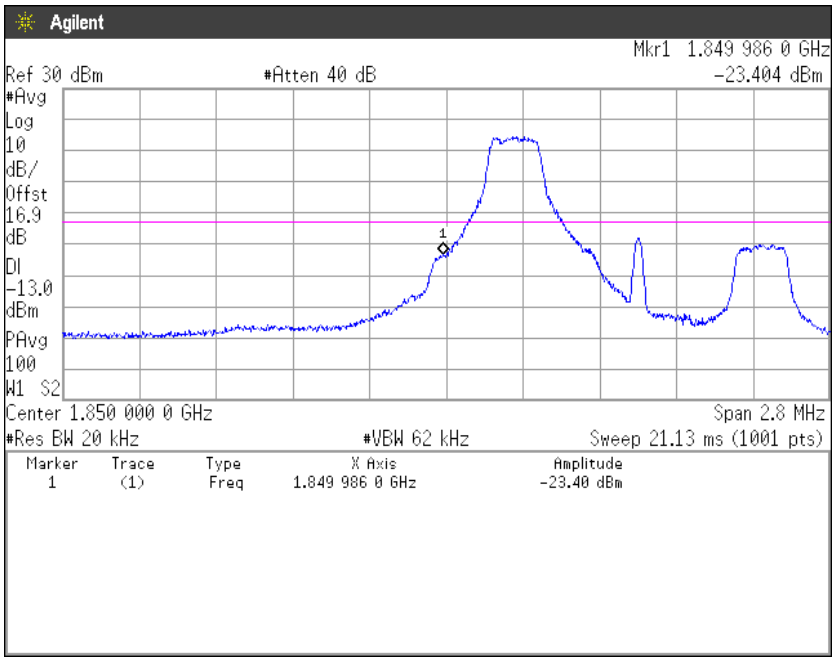

### 10GHz-15GHz



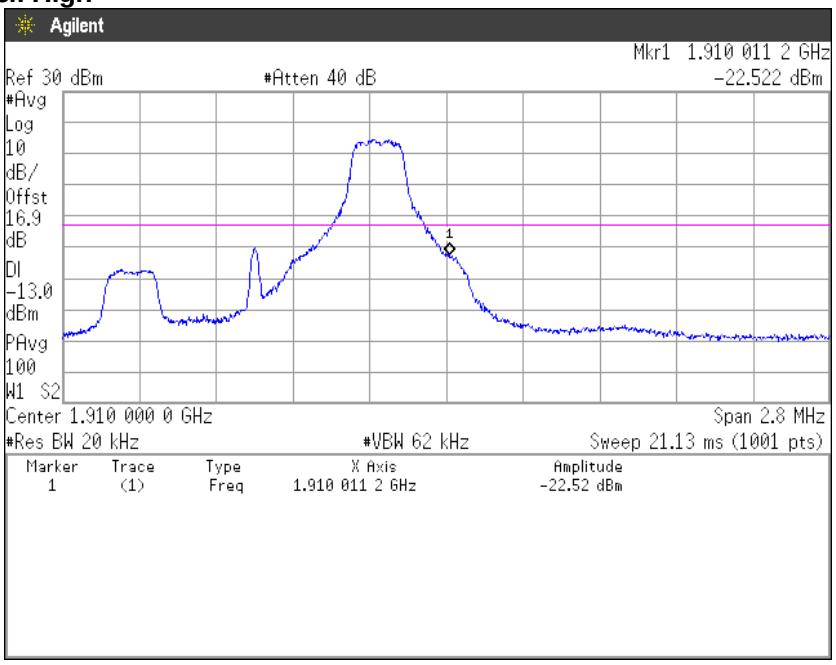

### 15GHz-20GHz



**[LTE Band II]**
**(Band Edge)**
**QPSK, BW 1.4MHz, RB1-0**
**Channel: Low**




**QPSK, BW 1.4MHz, RB1-5**
**Channel: High**



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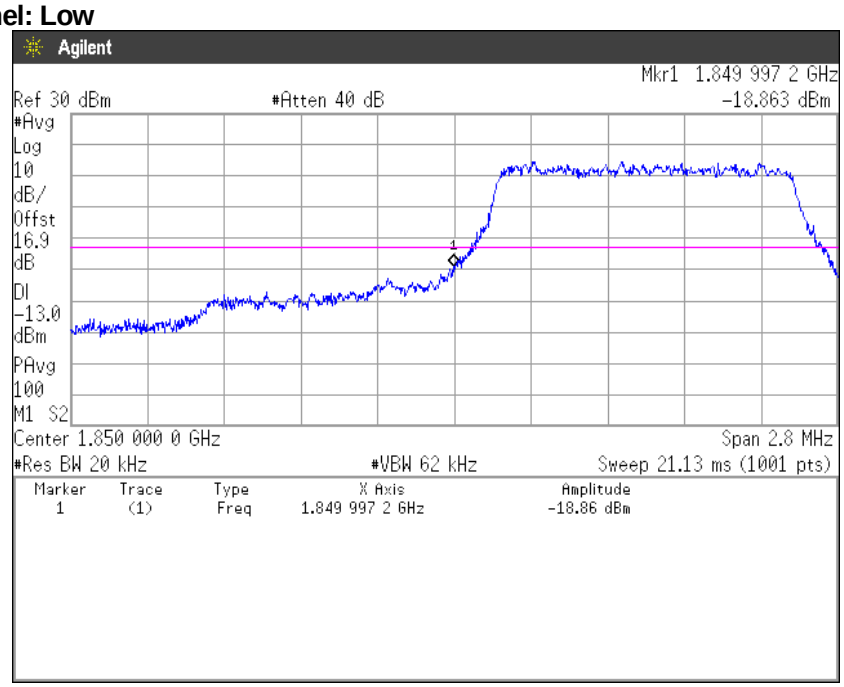
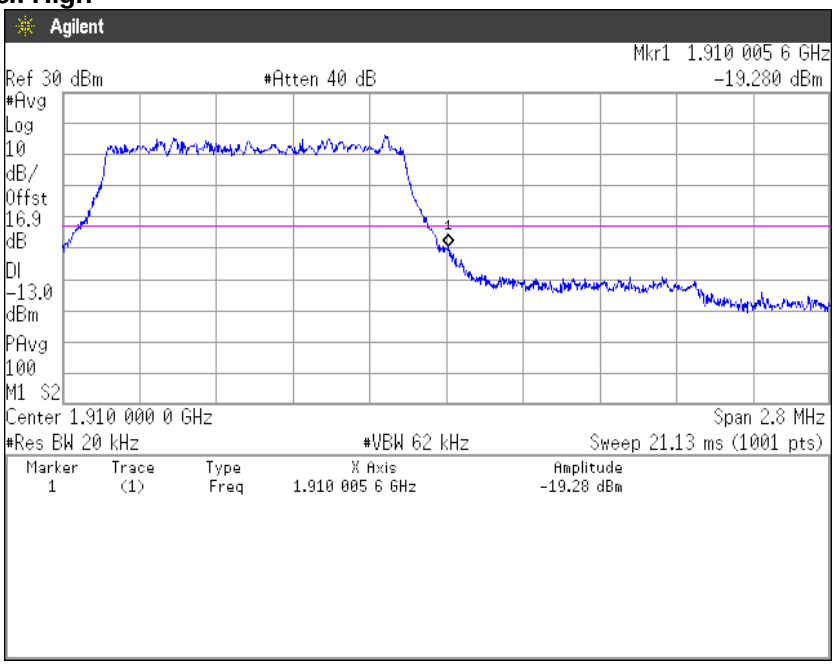
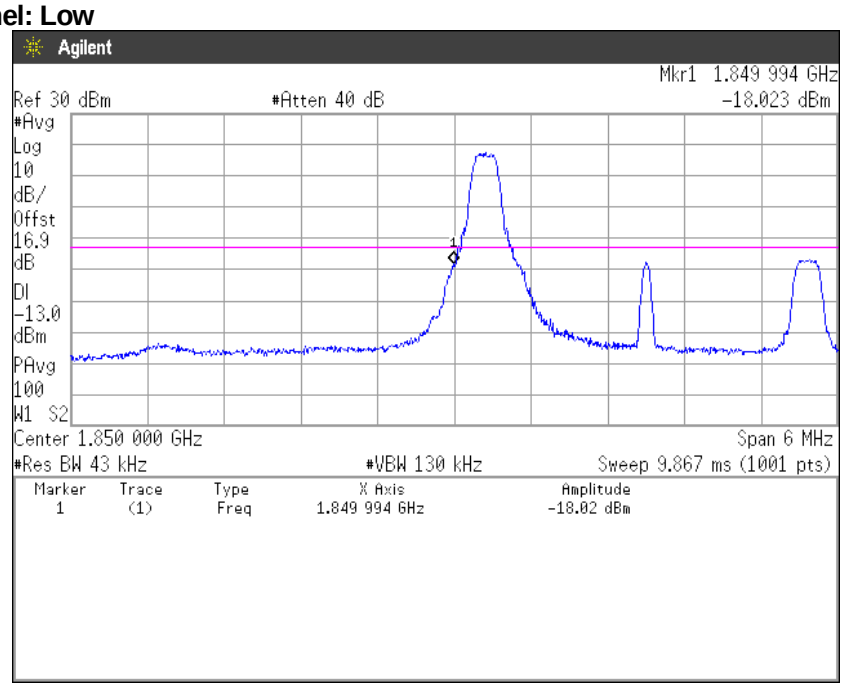
**QPSK, BW 1.4MHz, RB6-0**
**Channel: Low**



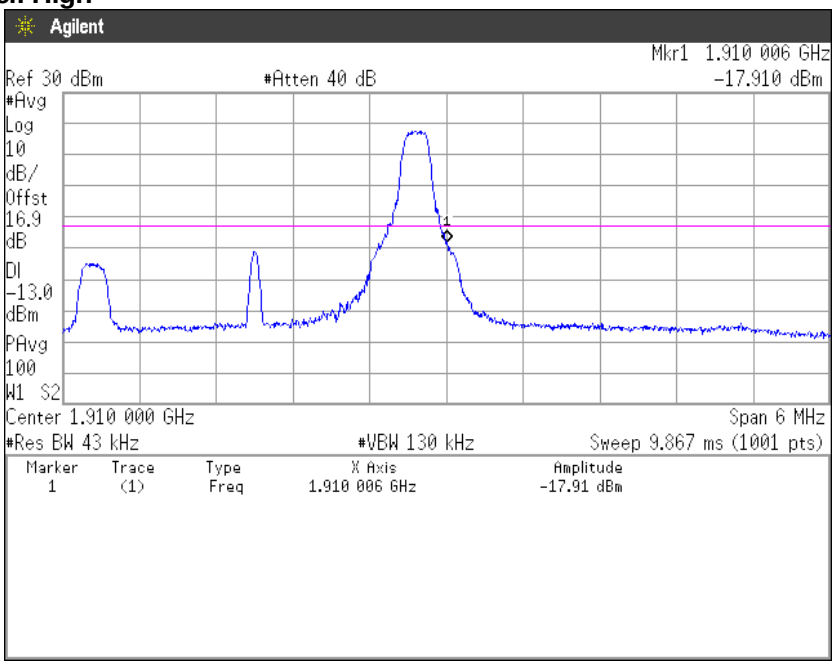

**QPSK, BW 1.4MHz, RB6-0**
**Channel: High**



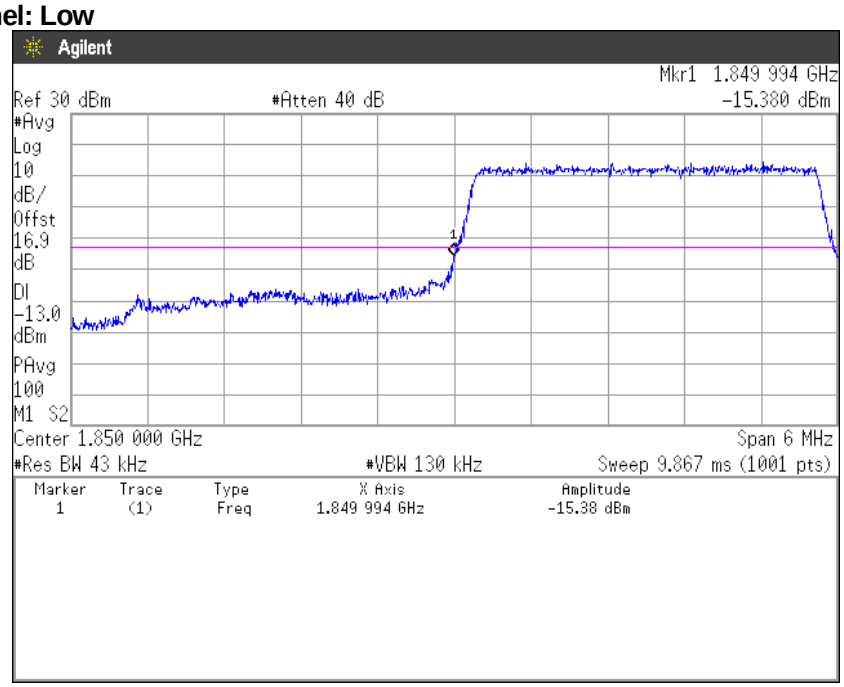
## QPSK, BW 3MHz, RB1-0
### Channel: Low



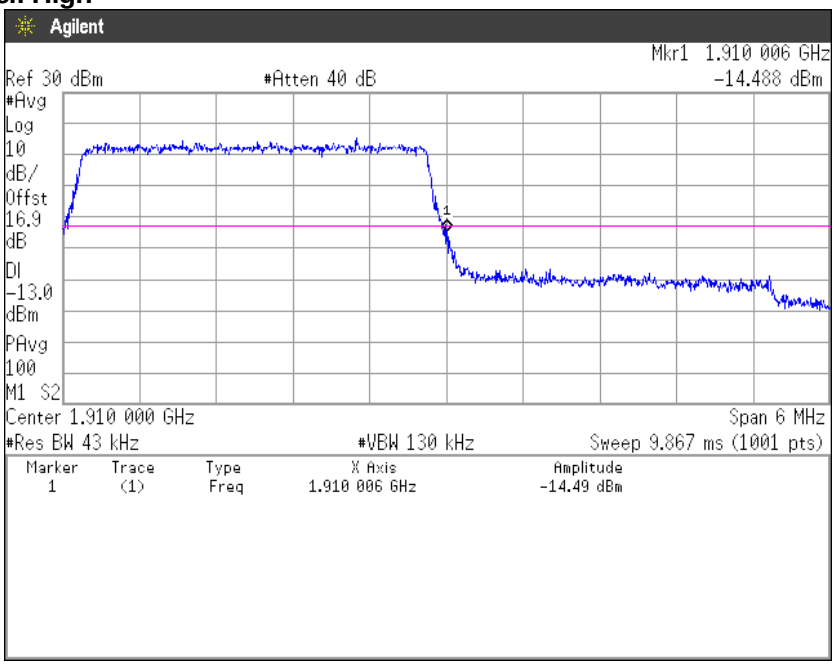

## QPSK, BW 3MHz, RB1-14
### Channel: High



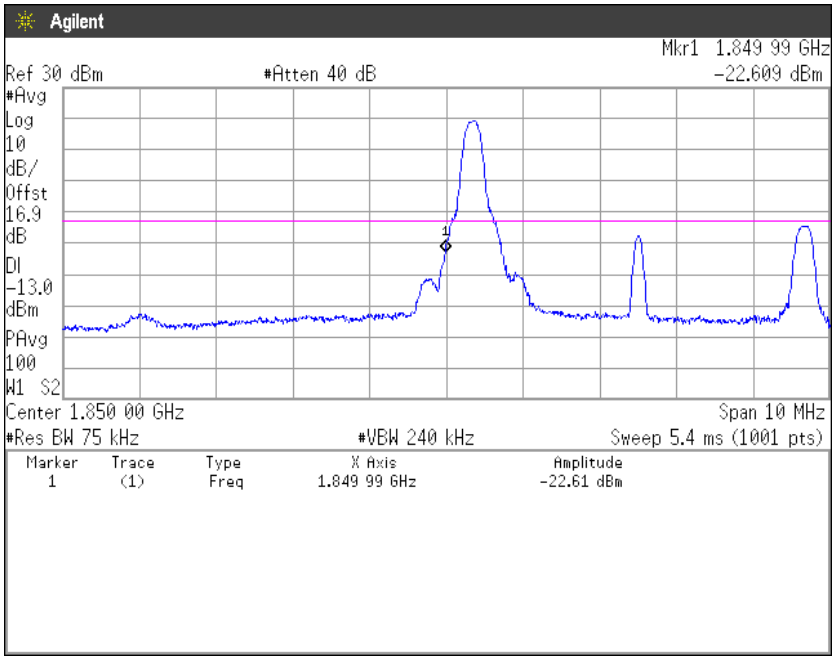
## QPSK, BW 3MHz, RB15-0
### Channel: Low



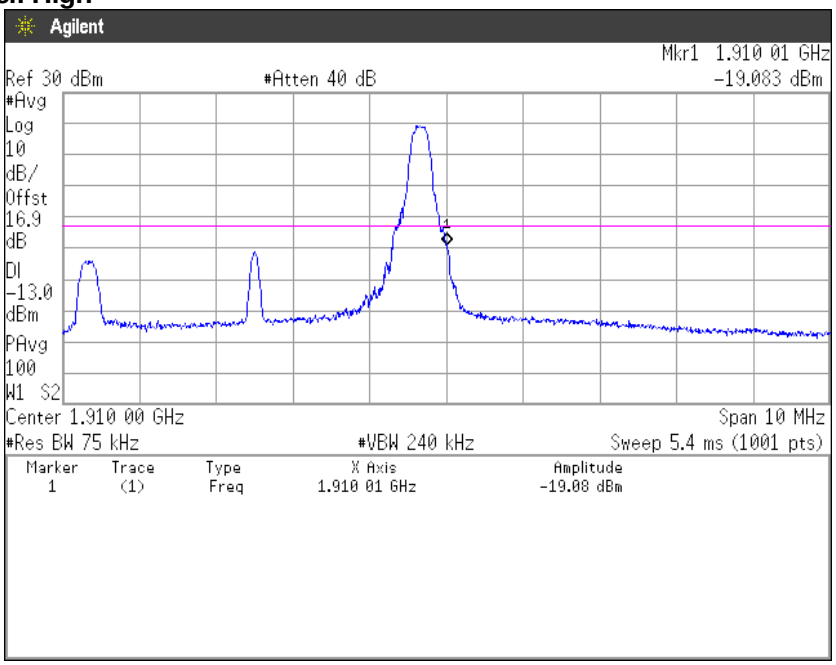

## QPSK, BW 3MHz, RB15-0
### Channel: High



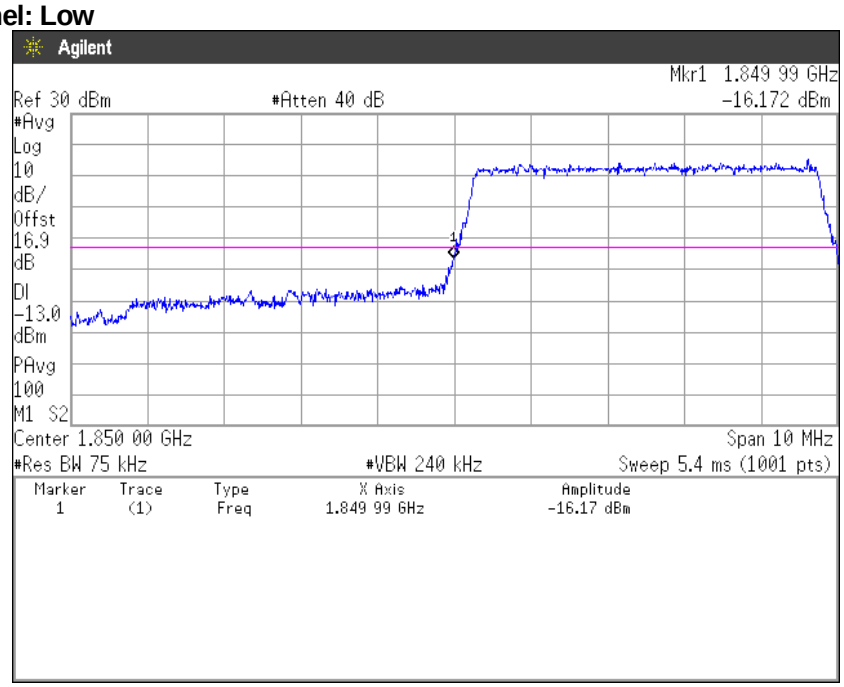
**QPSK, BW 5MHz, RB1-0**
**Channel: Low**



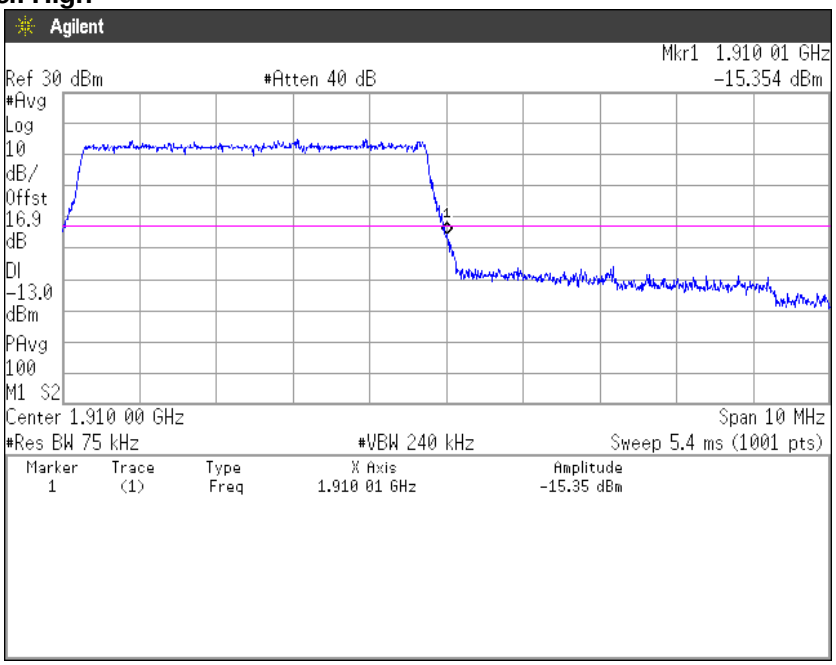

**QPSK, BW 5MHz, RB1-24**
**Channel: High**



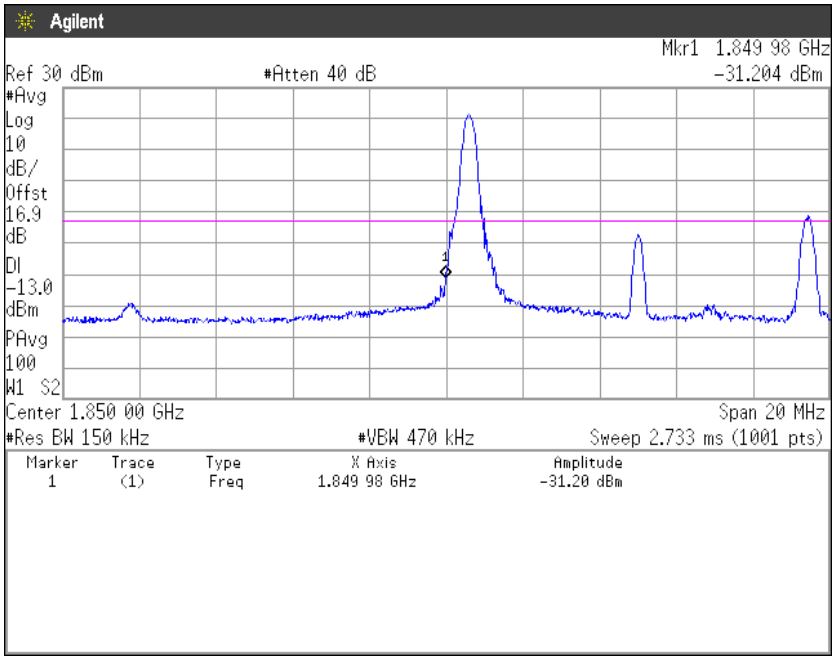
**QPSK, BW 5MHz, RB25-0**
**Channel: Low**



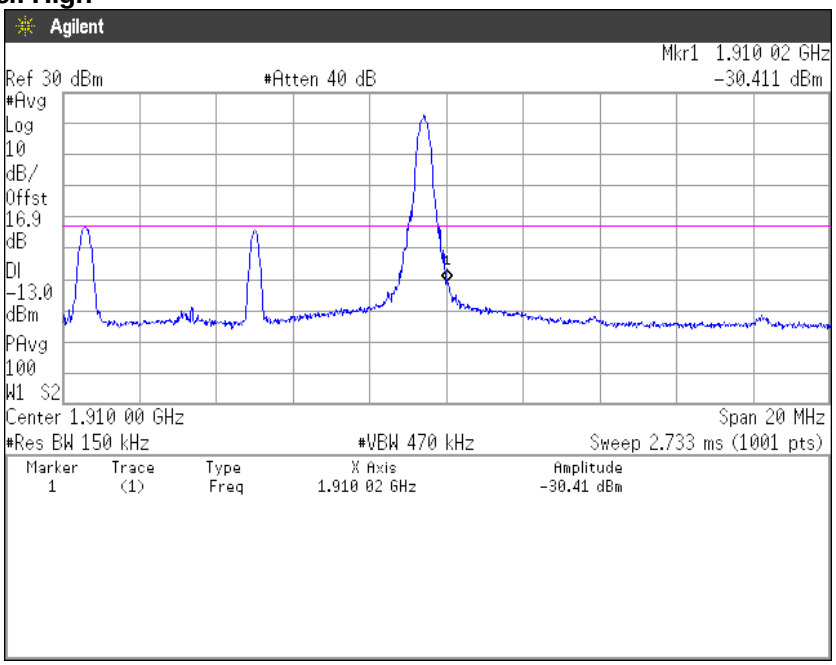

**QPSK, BW 5MHz, RB25-0**
**Channel: High**



**QPSK, BW 10MHz, RB1-0**
**Channel: Low**




**QPSK, BW 10MHz, RB1-49**
**Channel: High**



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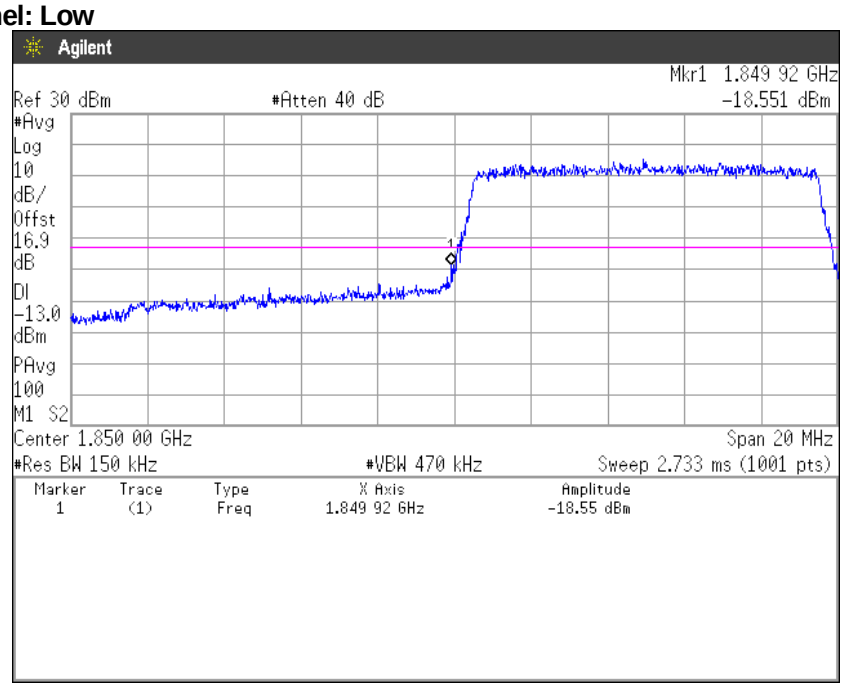
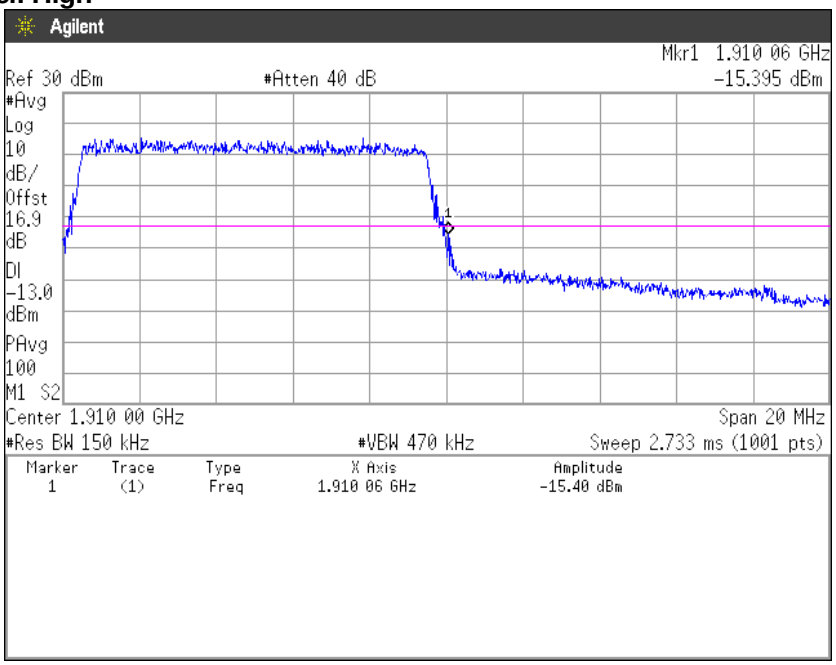
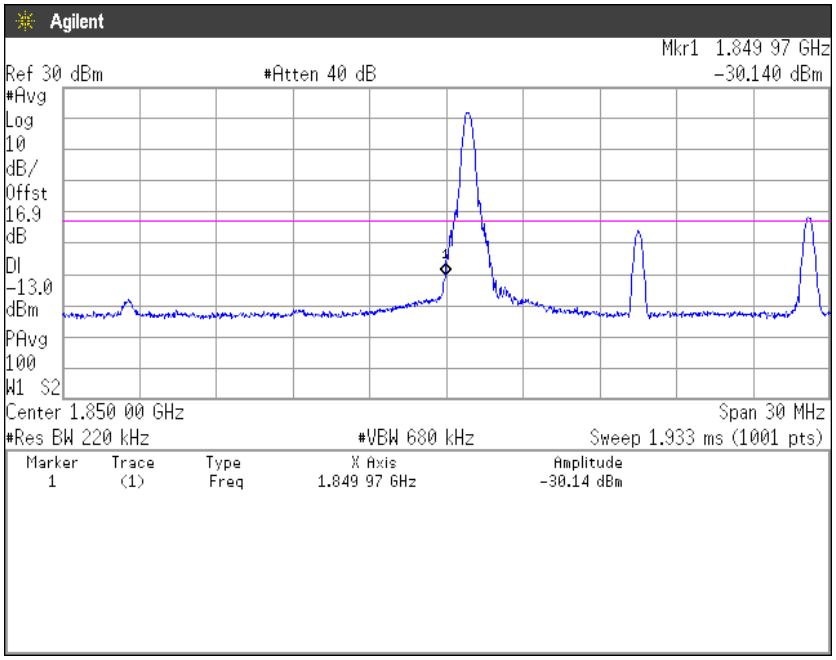
**QPSK, BW 10MHz, RB50-0**
**Channel: Low**



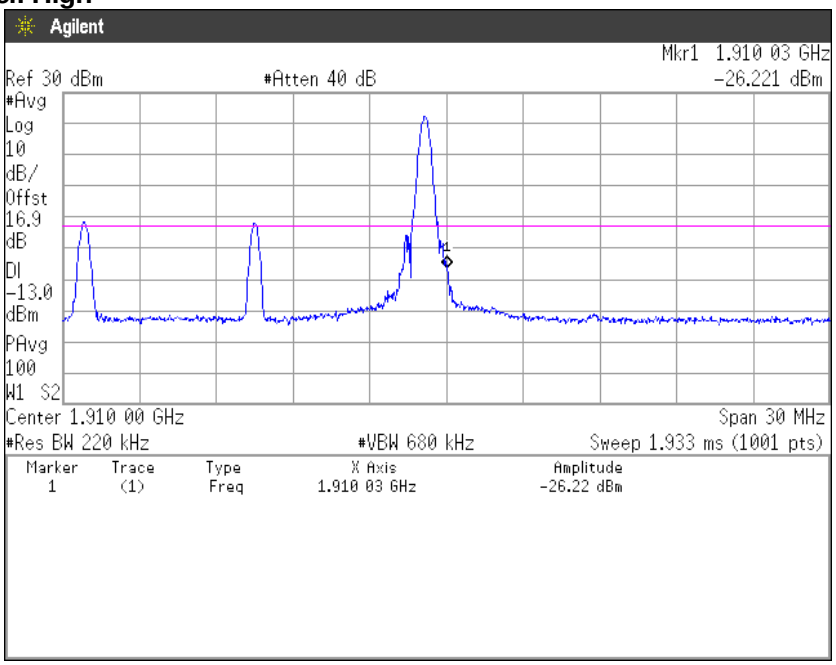

**QPSK, BW 10MHz, RB50-0**
**Channel: High**



**QPSK, BW 15MHz, RB1-0**
**Channel: Low**

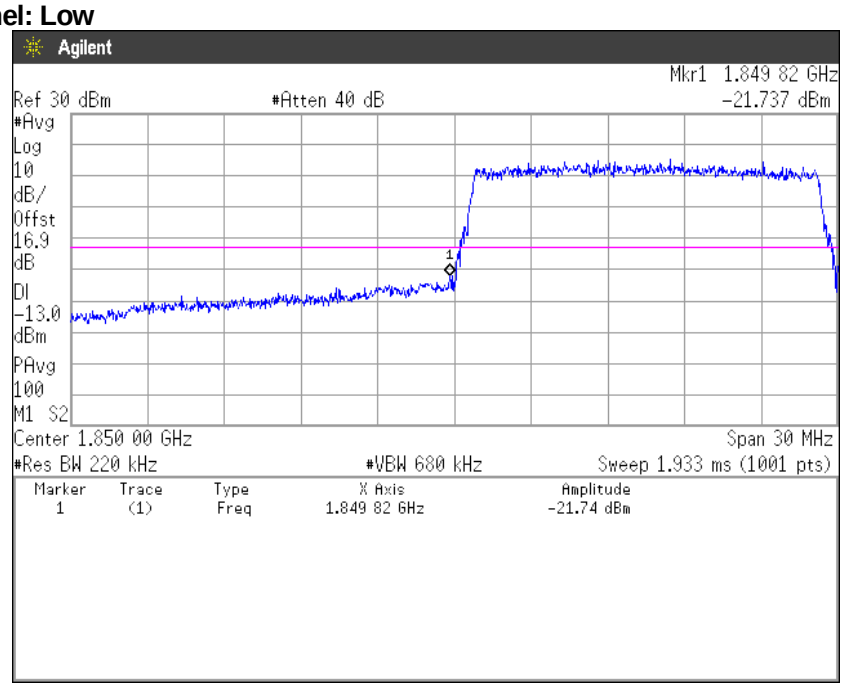



**QPSK, BW 15MHz, RB1-74**
**Channel: High**

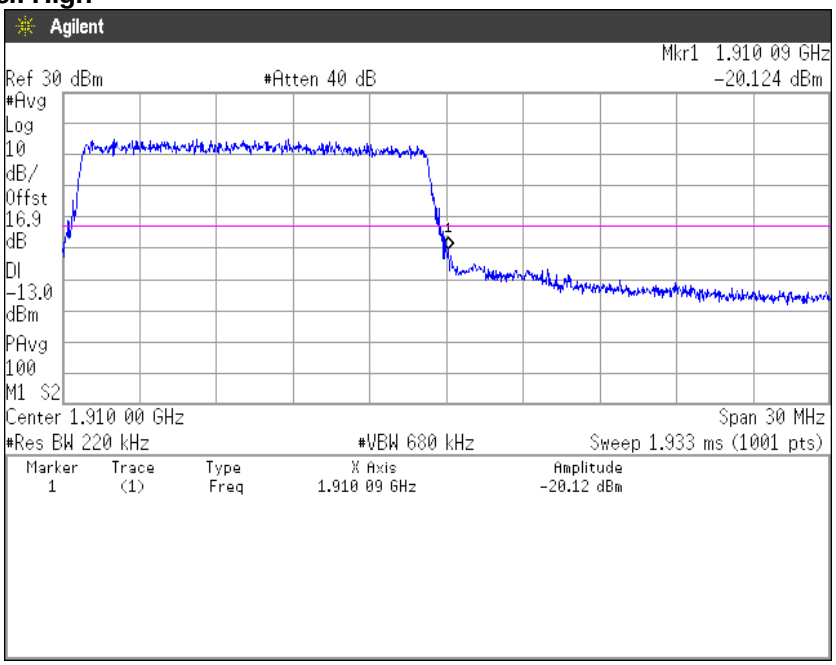


Zacta

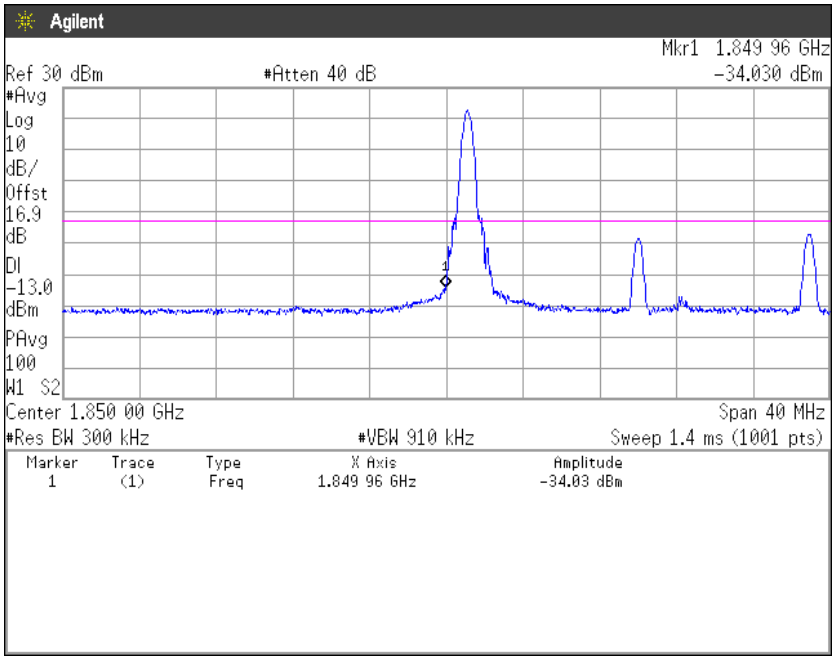
**QPSK, BW 15MHz, RB75-0**
**Channel: Low**



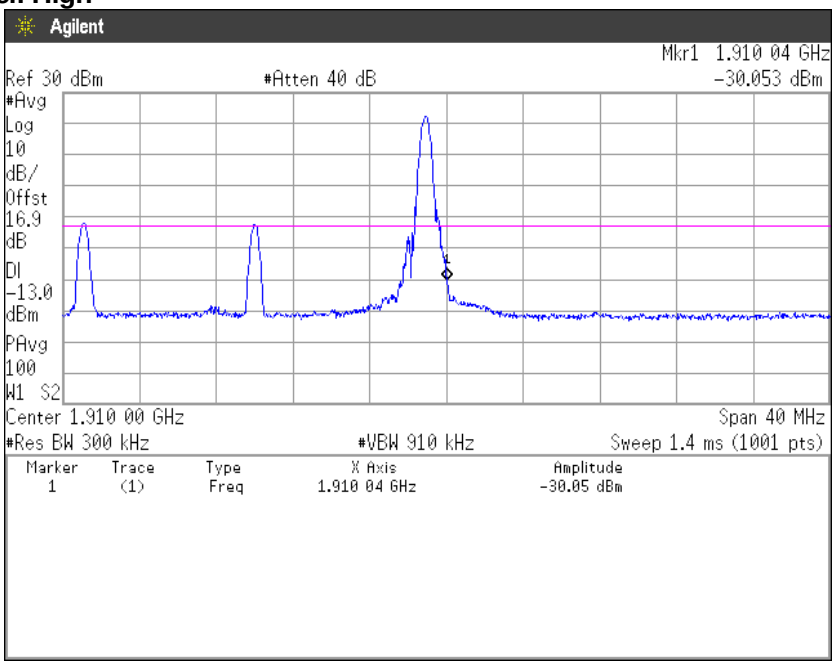

**QPSK, BW 15MHz, RB75-0**
**Channel: High**



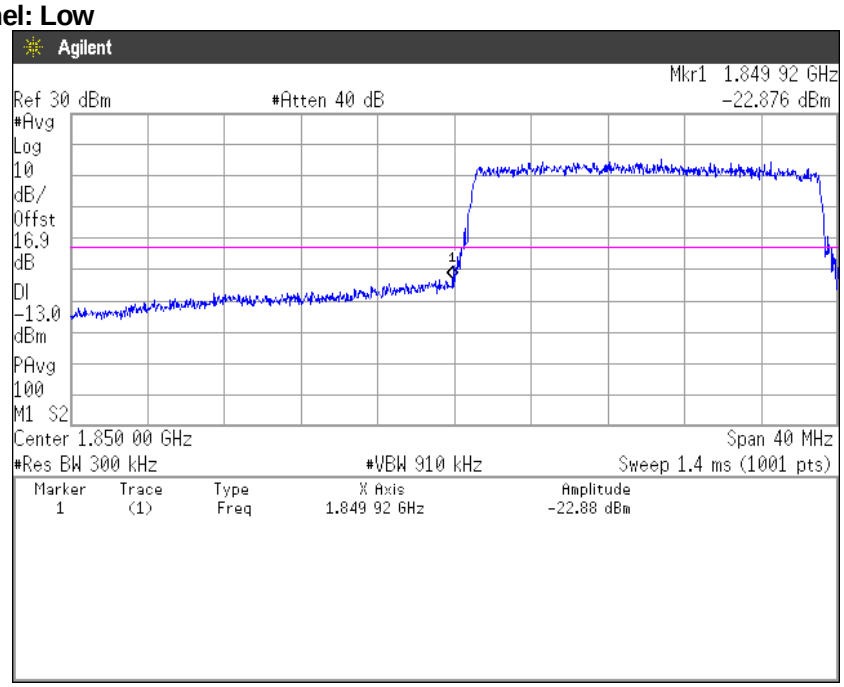
## QPSK, BW 20MHz, RB1-0
### Channel: Low



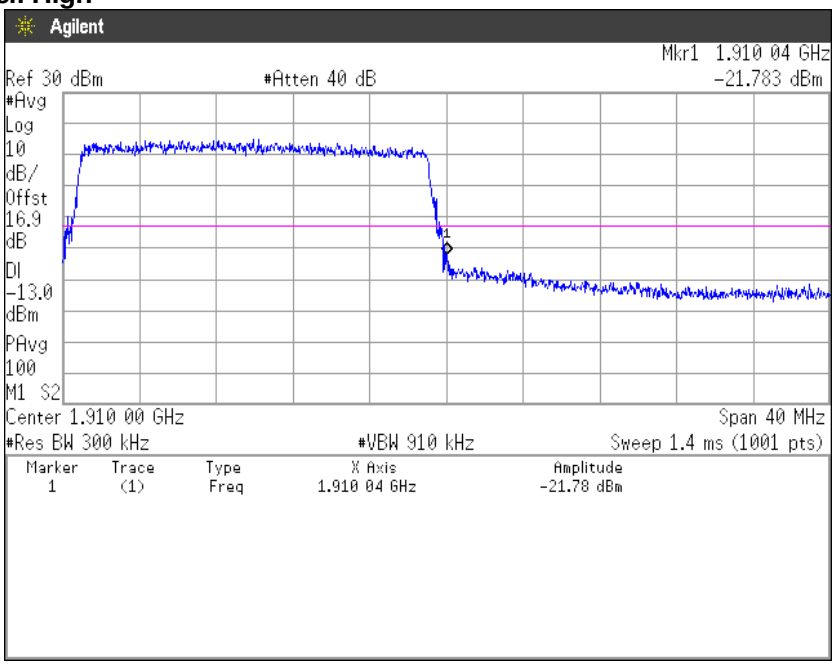

## QPSK, BW 20MHz, RB1-99
### Channel: High



## QPSK, BW 20MHz, RB100-0
### Channel: Low




## QPSK, BW 20MHz, RB100-0
### Channel: High



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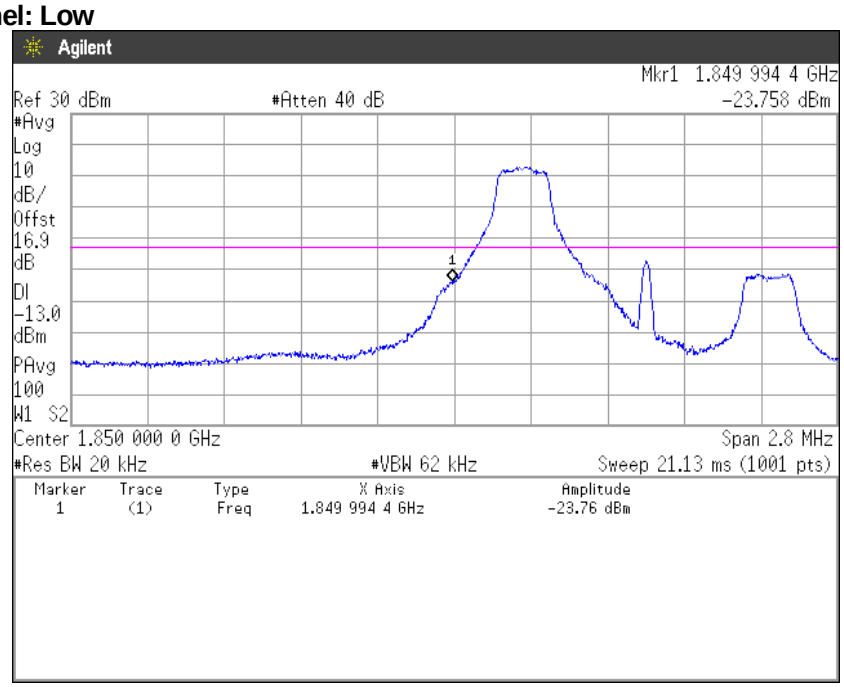
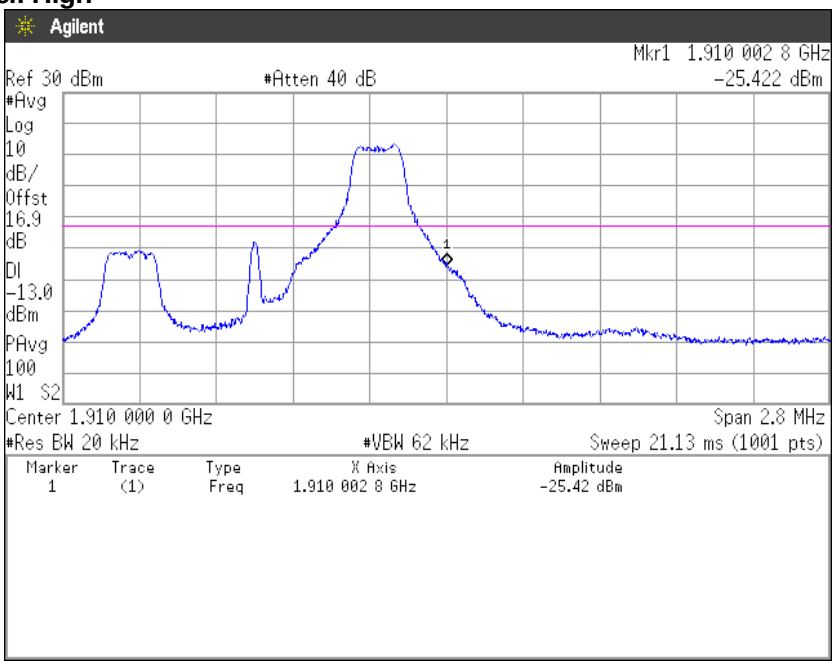
**16QAM, BW 1.4MHz, RB1-0**

**Channel: Low**



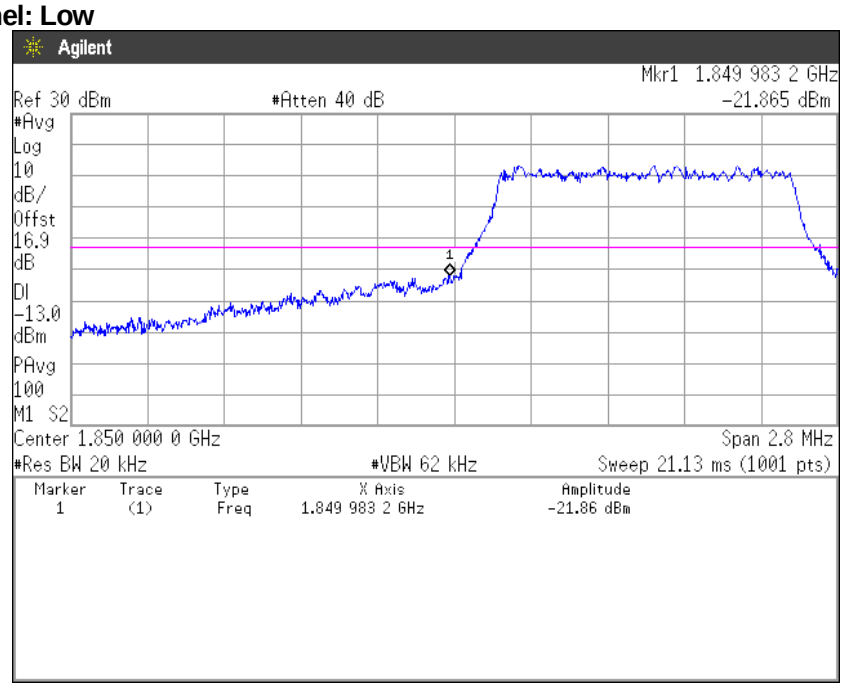

**16QAM, BW 1.4MHz, RB1-5**

**Channel: High**

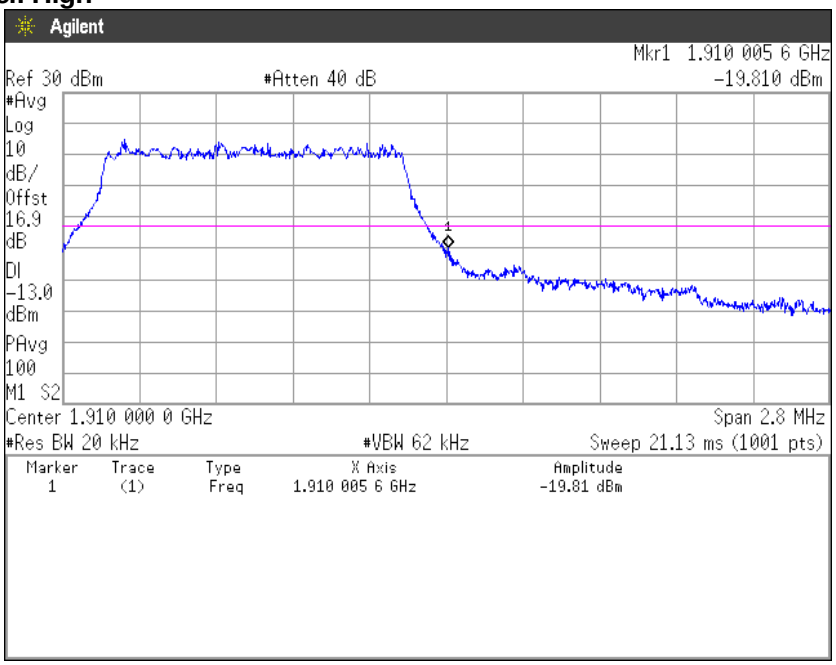


Zacta

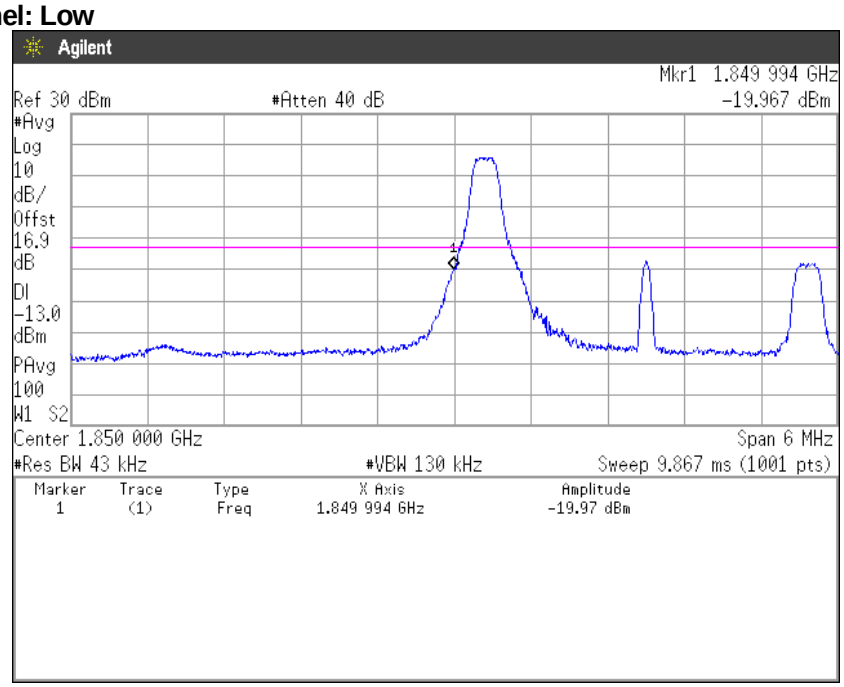
**16QAM, BW 1.4MHz, RB6-0**
**Channel: Low**



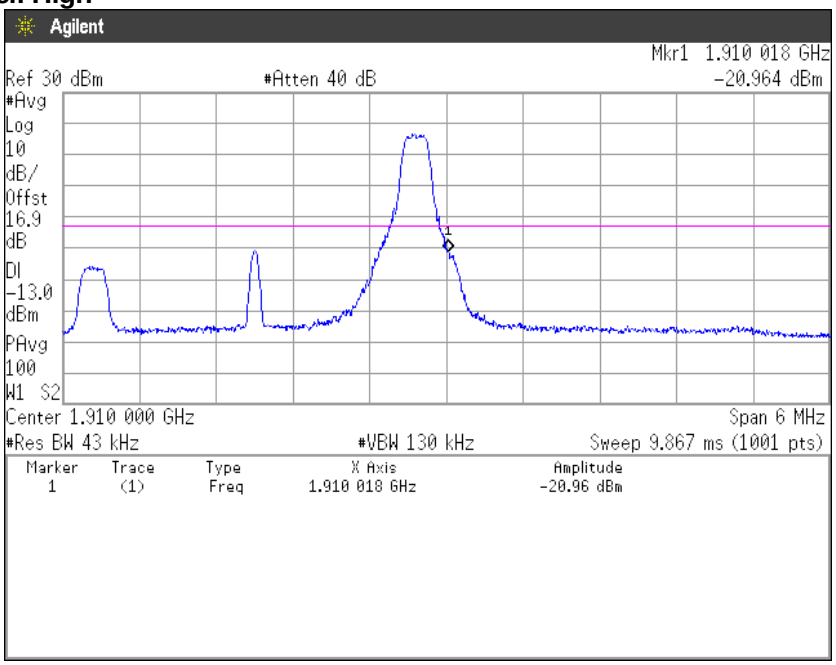

**16QAM, BW 1.4MHz, RB6-0**
**Channel: High**



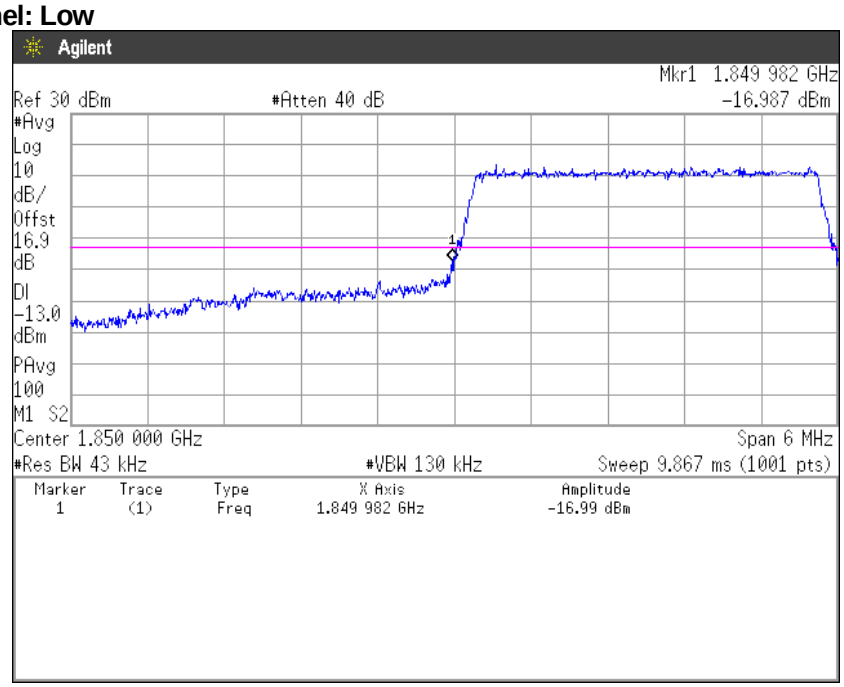
## 16QAM, BW 3MHz, RB1-0
### Channel: Low



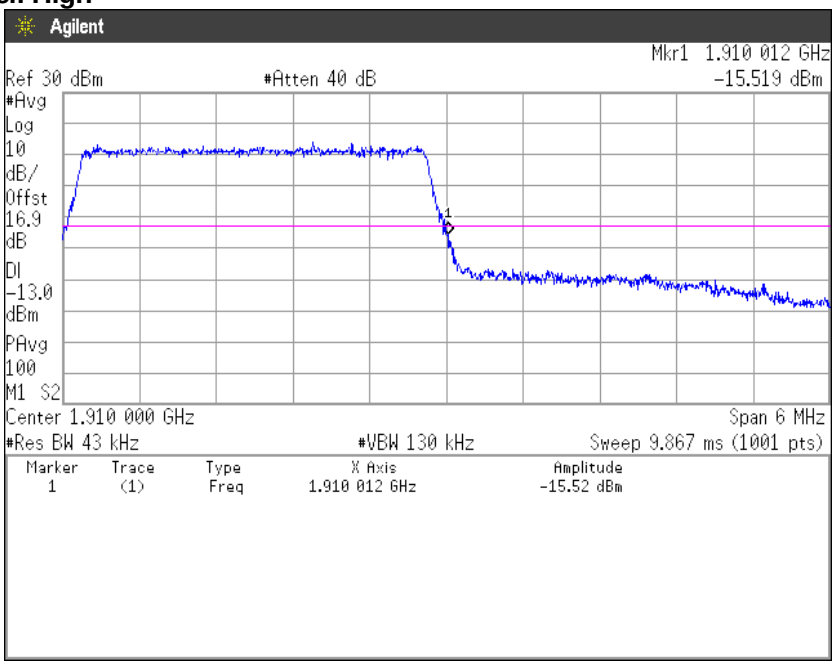

## 16QAM, BW 3MHz, RB1-14
### Channel: High



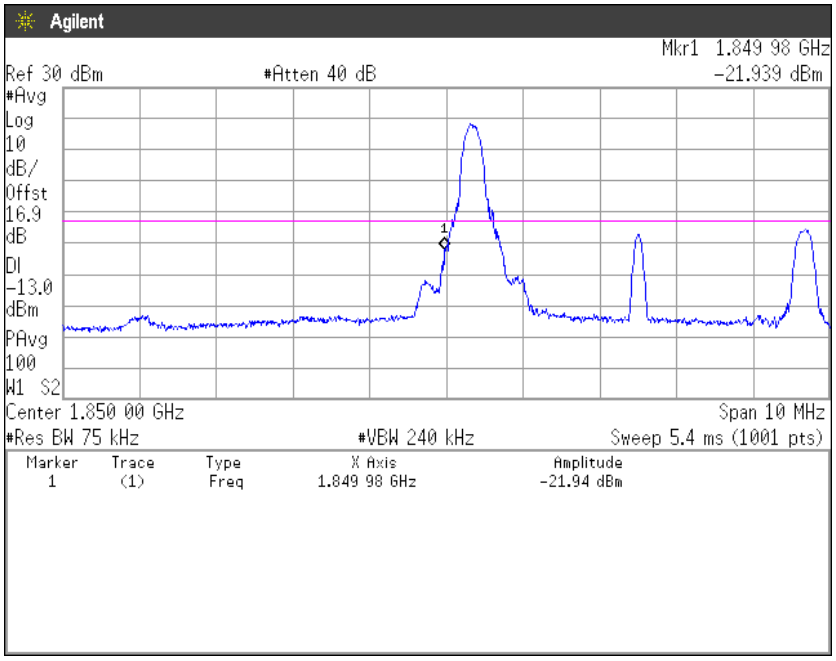
## 16QAM, BW 3MHz, RB15-0
### Channel: Low



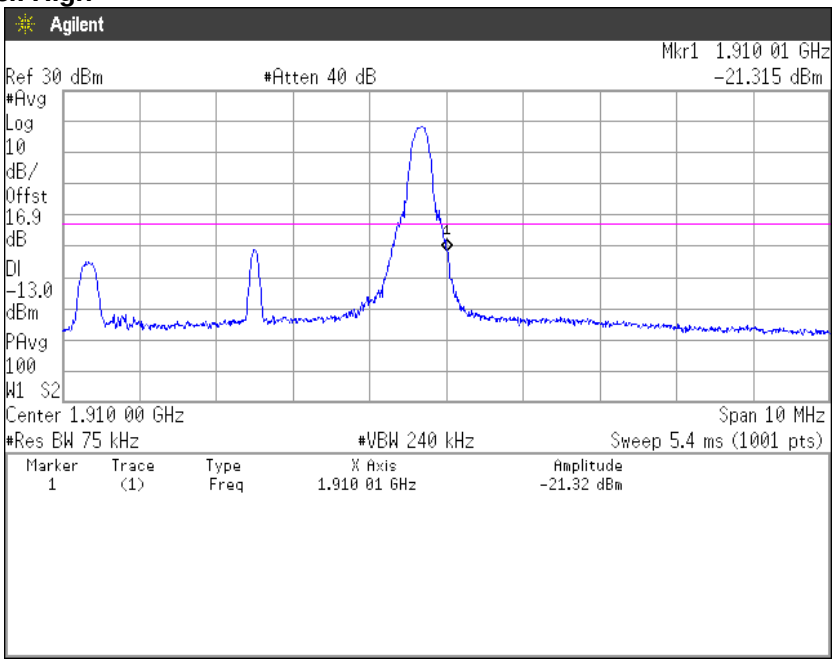

## 16QAM, BW 3MHz, RB15-0
### Channel: High



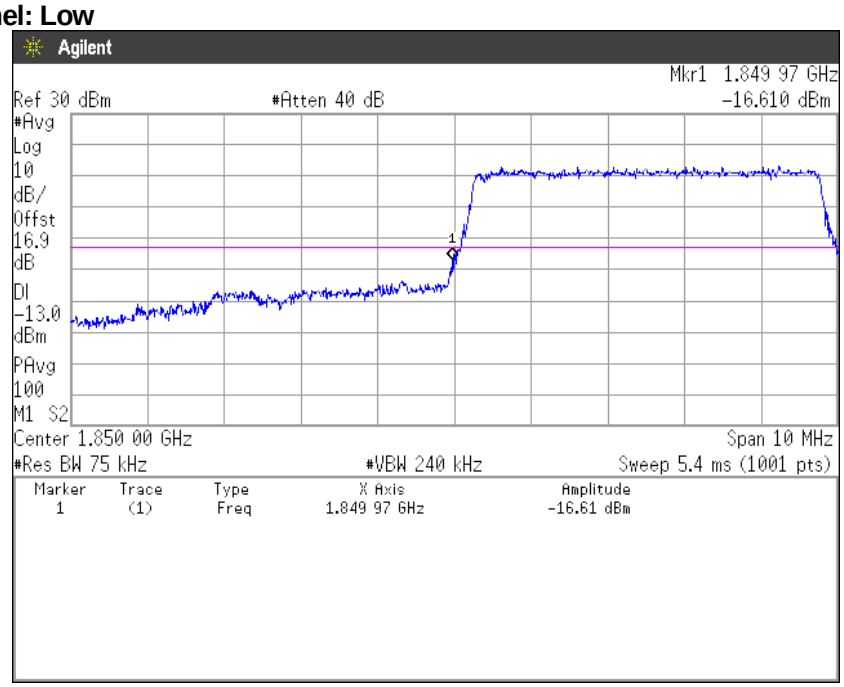
## 16QAM, BW 5MHz, RB1-0
### Channel: Low



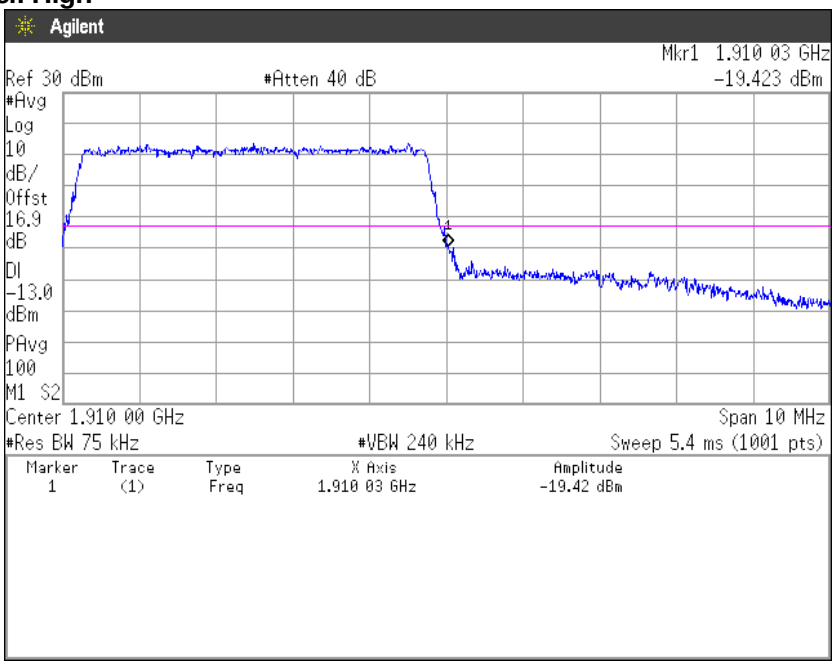

## 16QAM, BW 5MHz, RB1-24
### Channel: High



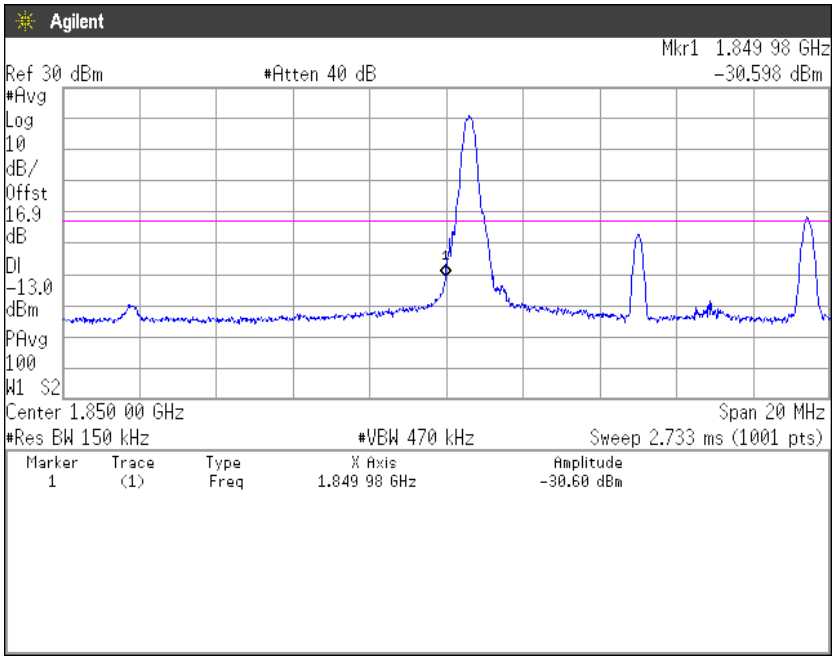
## 16QAM, BW 5MHz, RB25-0
### Channel: Low



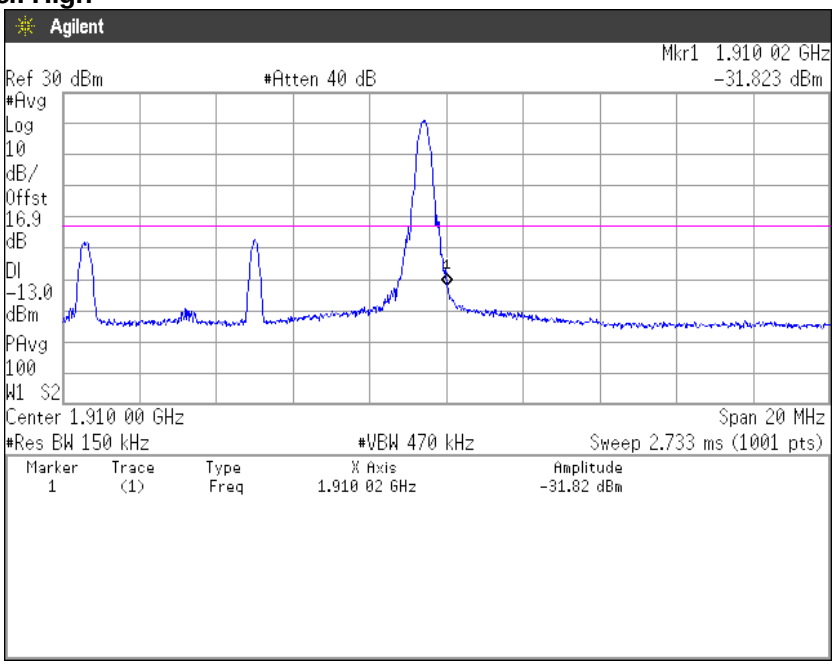

## 16QAM, BW 5MHz, RB25-0
### Channel: High



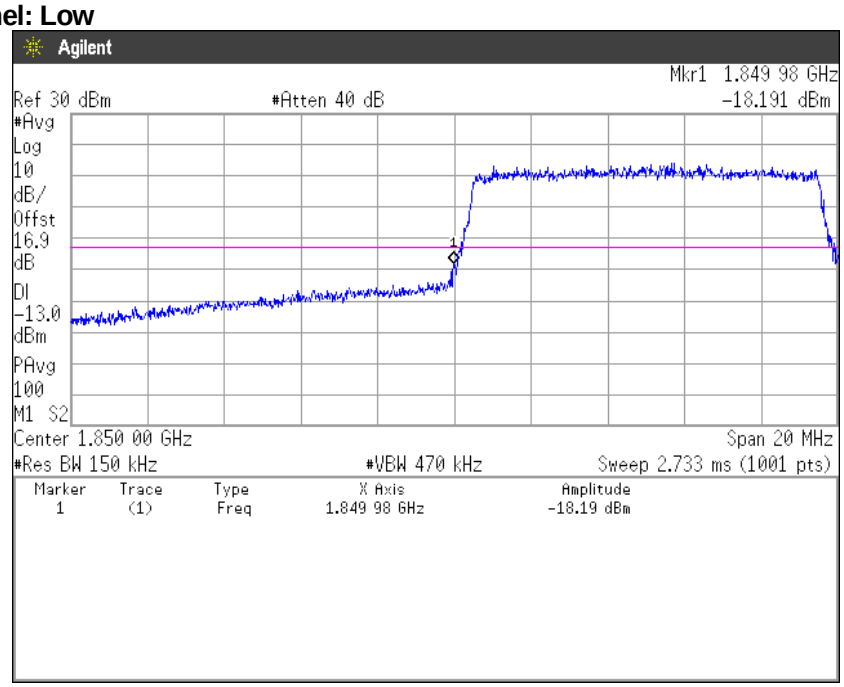
## 16QAM, BW 10MHz, RB1-0
### Channel: Low



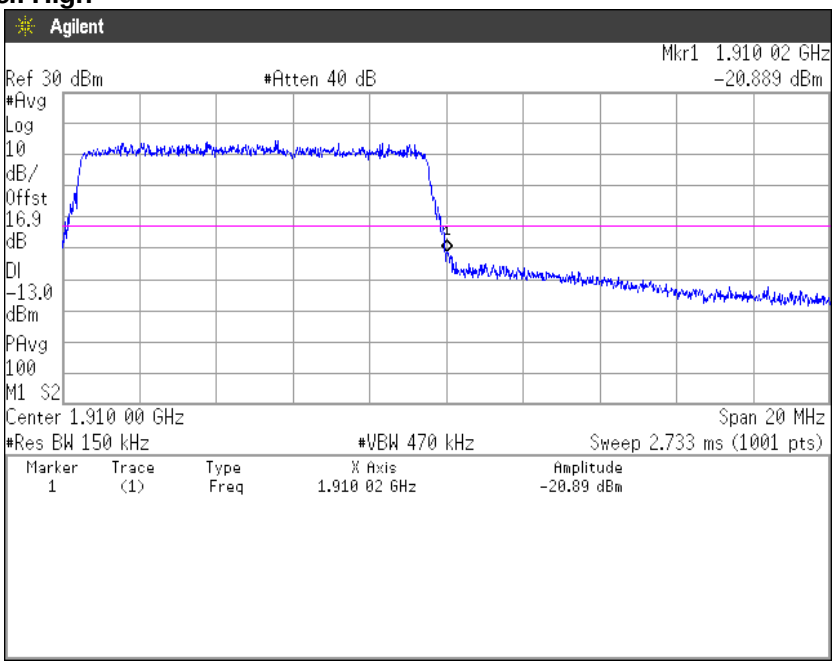

## 16QAM, BW 10MHz, RB1-49
### Channel: High



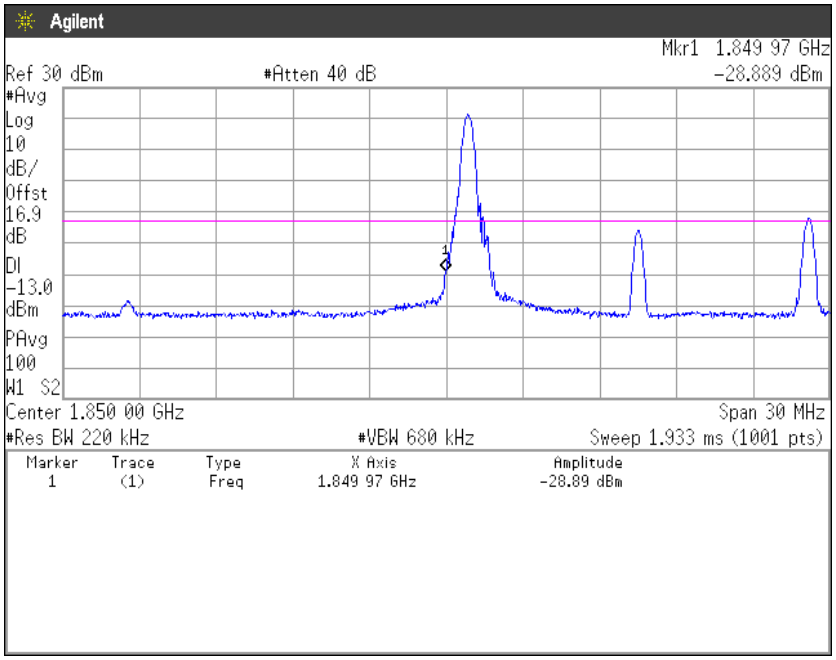
## 16QAM, BW 10MHz, RB50-0
### Channel: Low



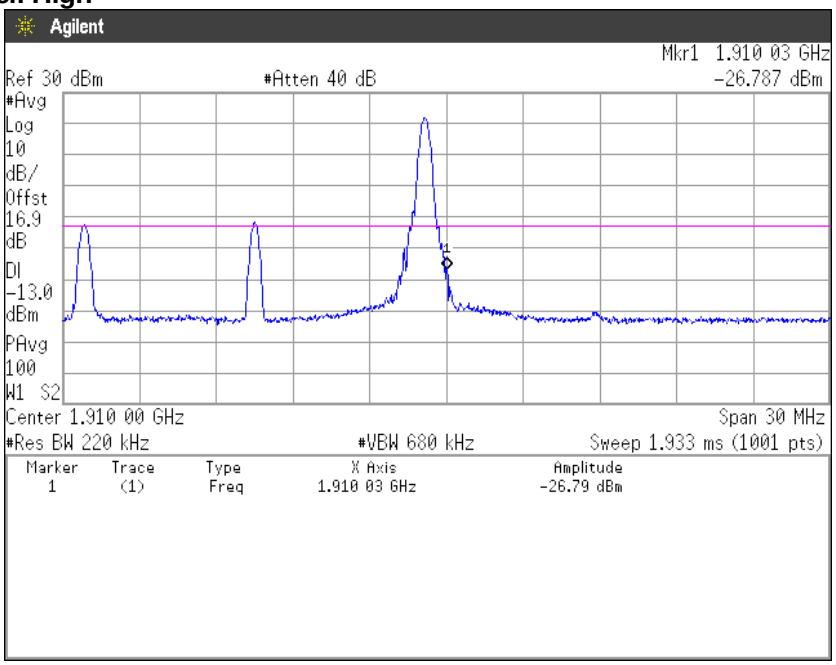

## 16QAM, BW 10MHz, RB50-0
### Channel: High



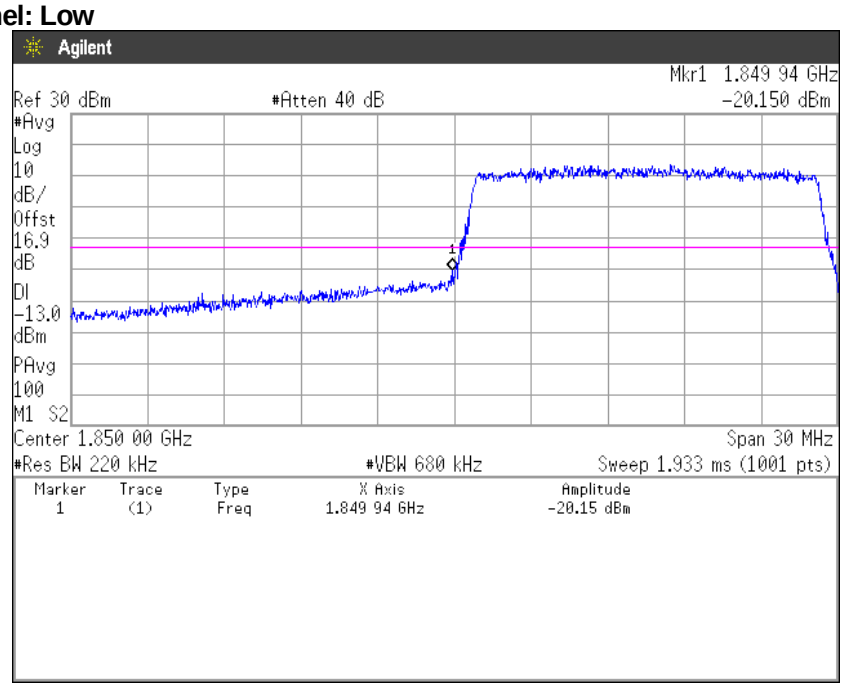
## 16QAM, BW 15MHz, RB1-0
### Channel: Low



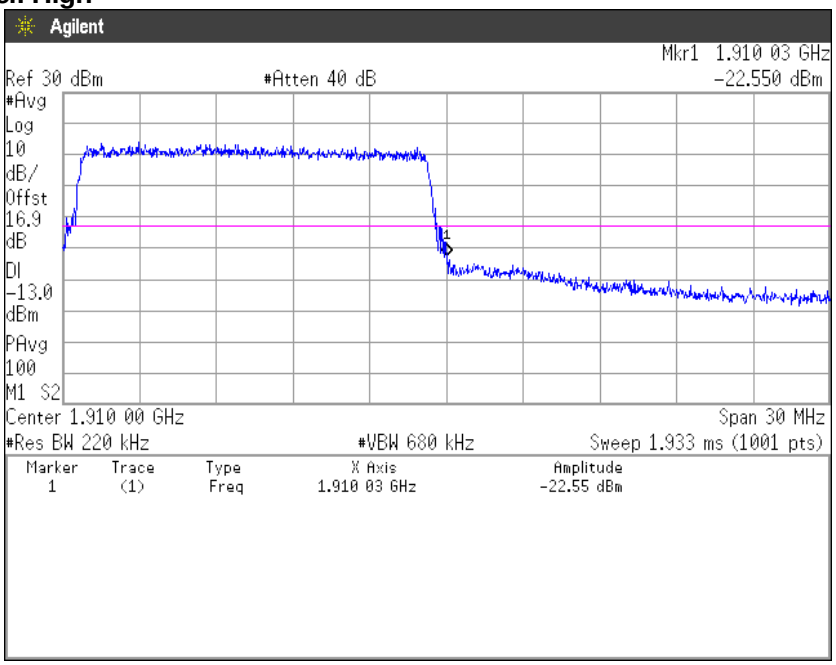

## 16QAM, BW 15MHz, RB1-74
### Channel: High



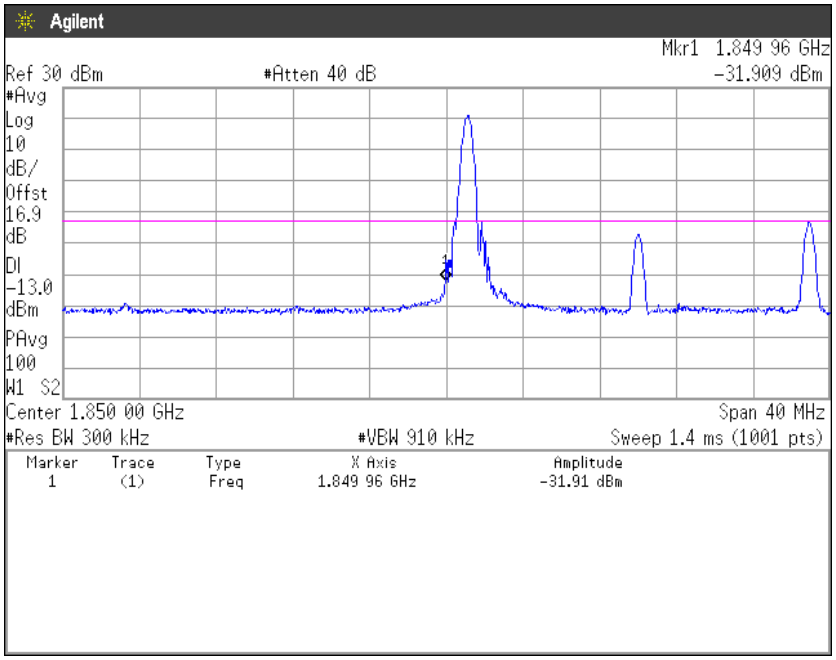
## 16QAM, BW 15MHz, RB75-0
### Channel: Low



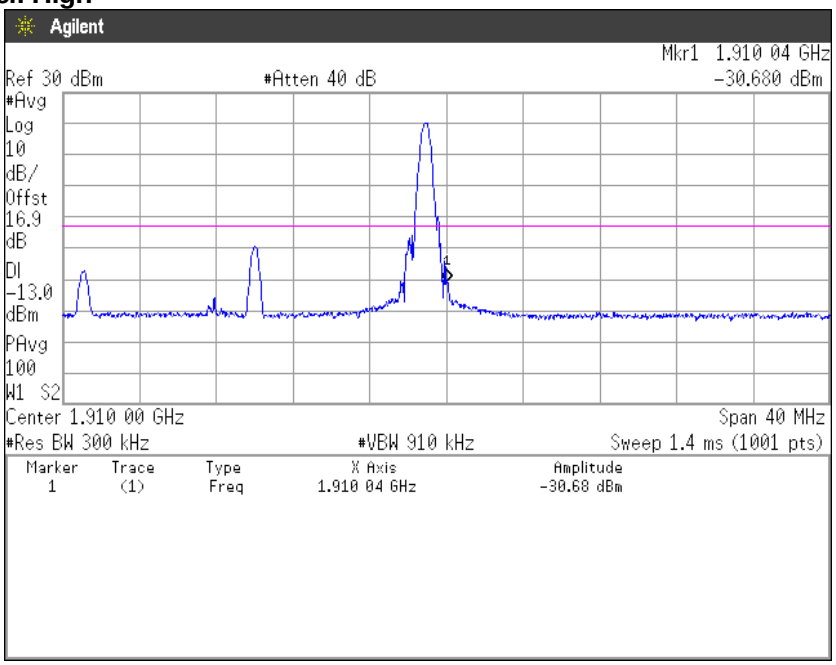

## 16QAM, BW 15MHz, RB75-0
### Channel: High



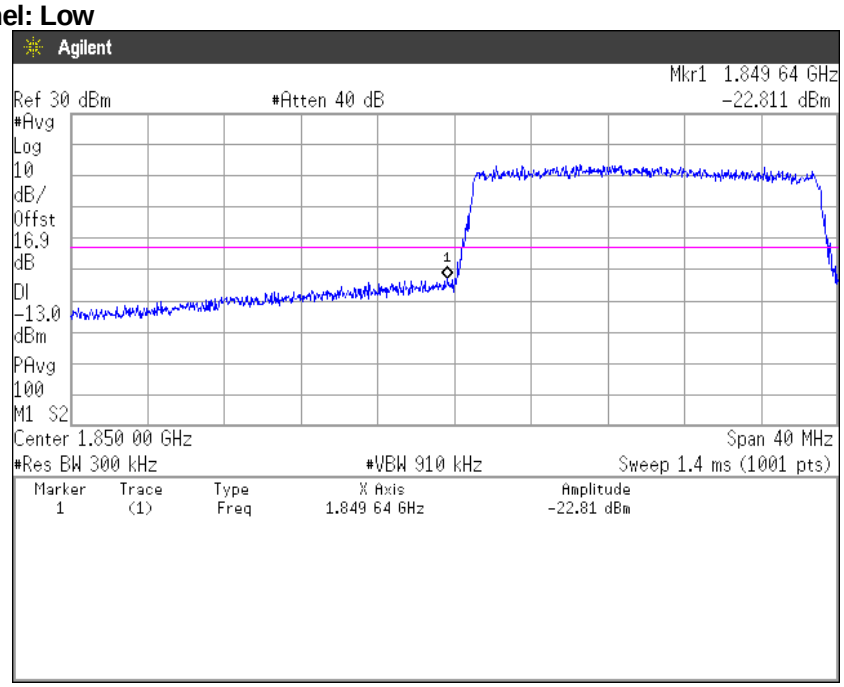
## 16QAM, BW 20MHz, RB1-0
### Channel: Low



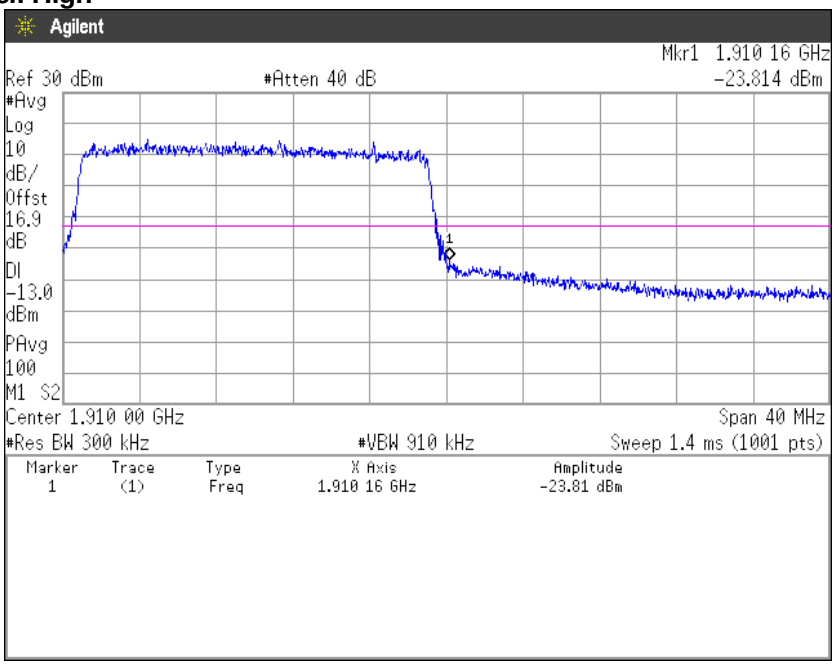

## 16QAM, BW 20MHz, RB1-99
### Channel: High



## 16QAM, BW 20MHz, RB100-0
### Channel: Low



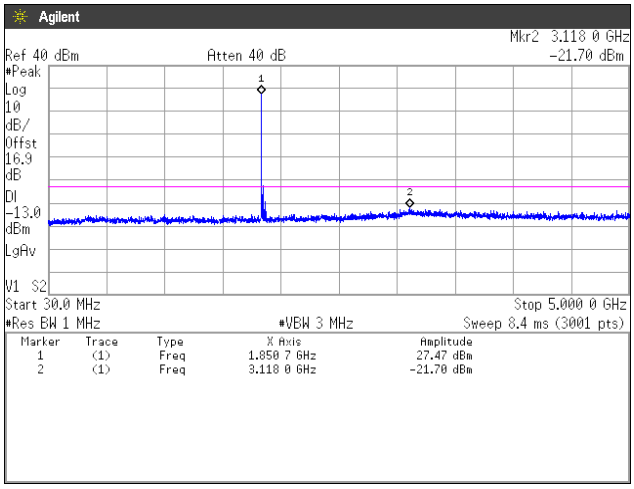

## 16QAM, BW 20MHz, RB100-0
### Channel: High



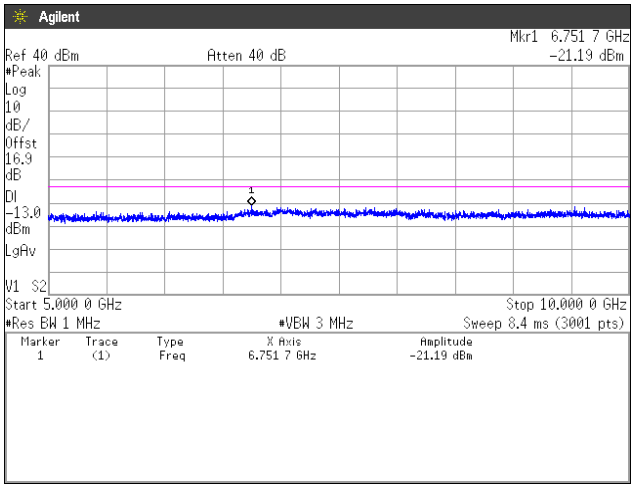
**(Spurious Emissions)**
**Note: Conducted spurious test was measured in the worst case of conducted output power.**

**QPSK, BW 20MHz**
**Channel: 18700**

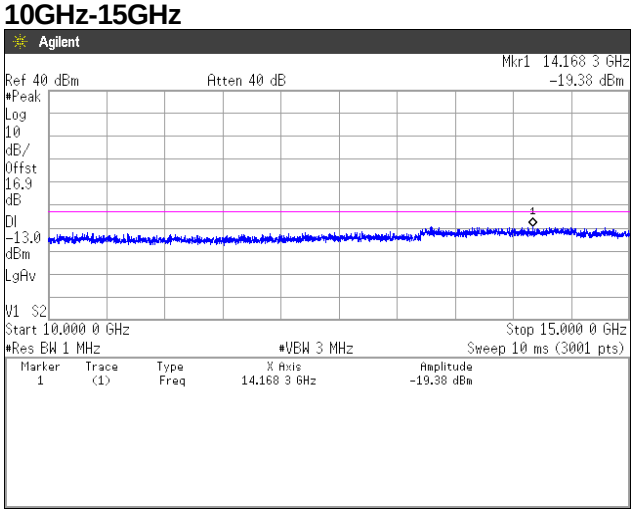
**30MHz-5GHz**



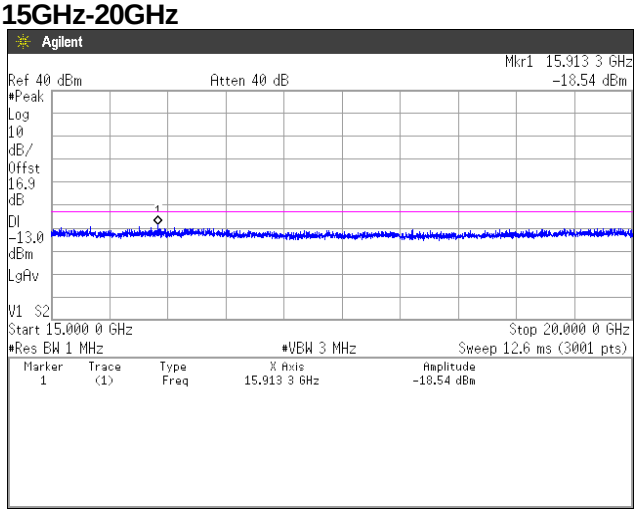

**5GHz-10GHz**




**10GHz-15GHz**

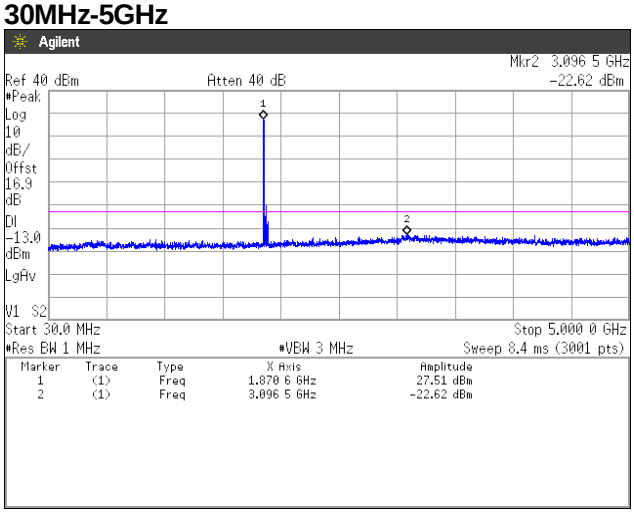



**15GHz-20GHz**

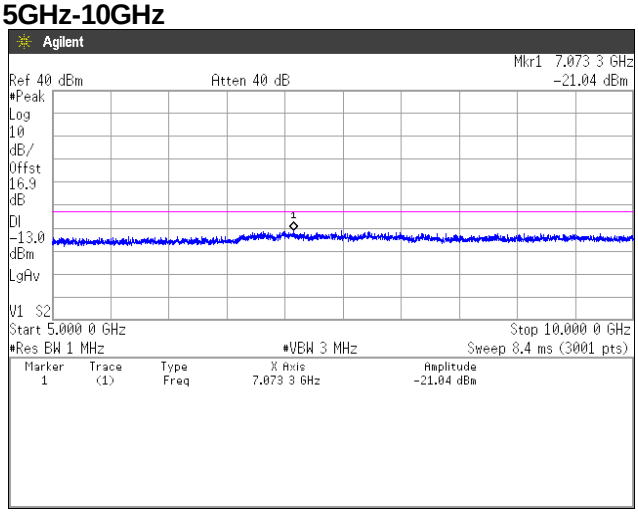


## Channel: 18900

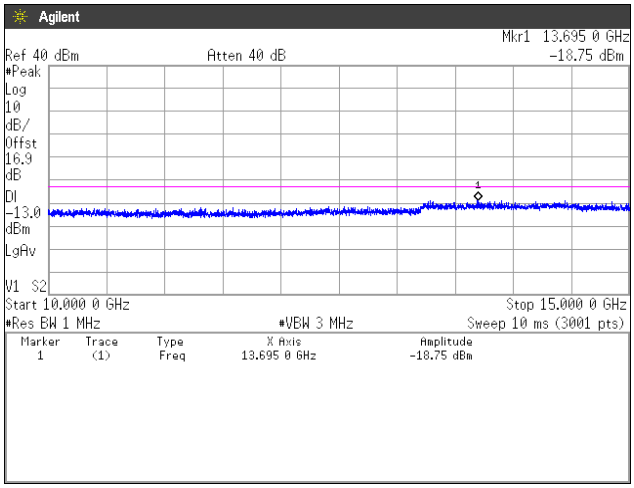
### 30MHz-5GHz



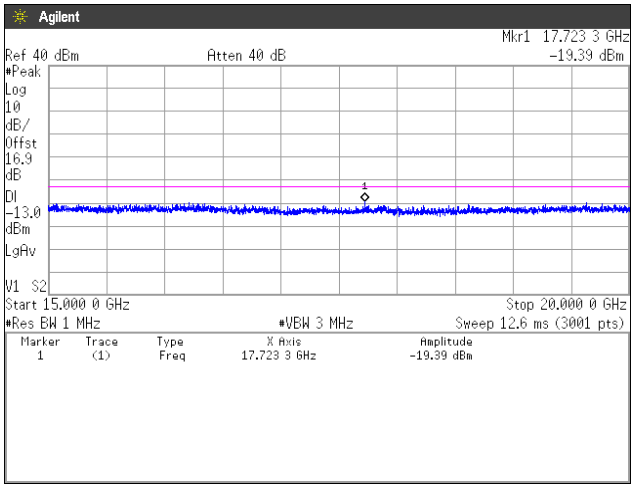

### 5GHz-10GHz




### 10GHz-15GHz

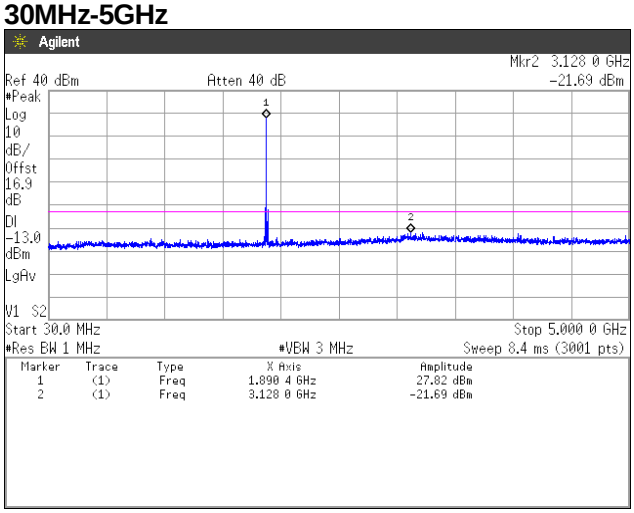



### 15GHz-20GHz

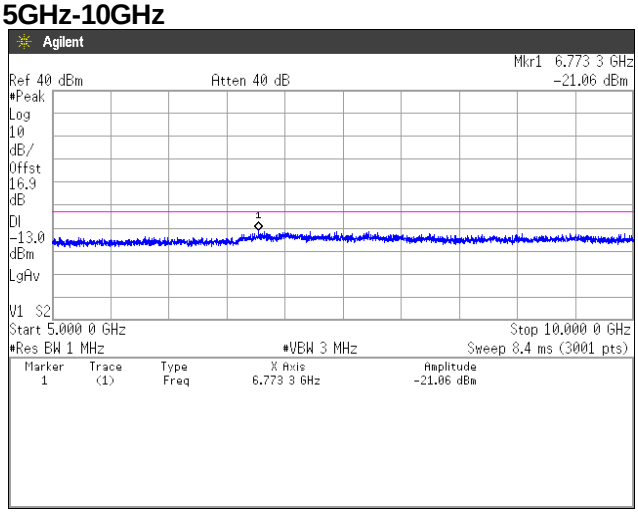


## Channel: 19100

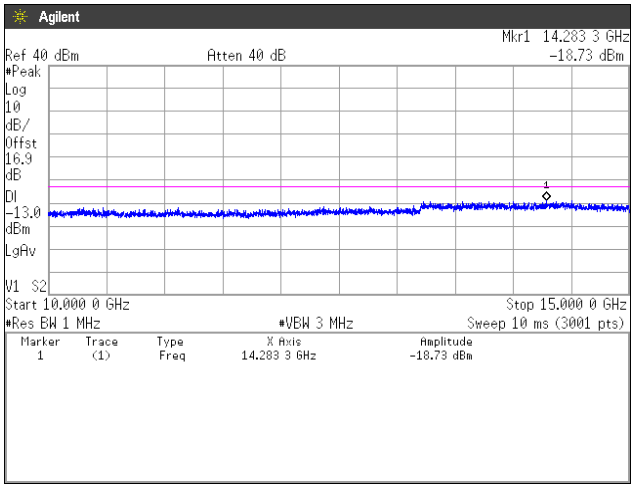
### 30MHz-5GHz



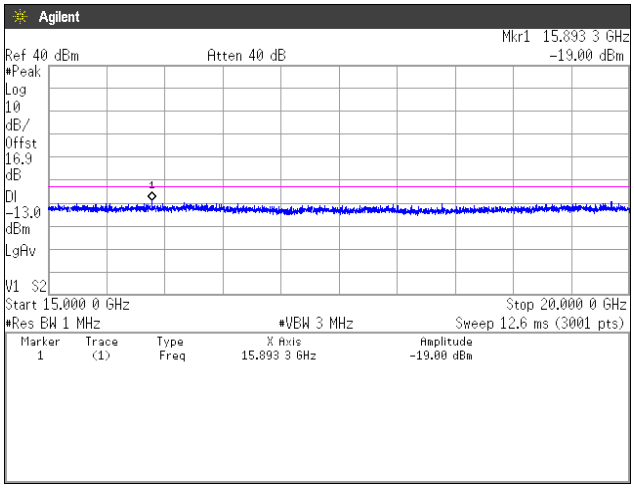

### 5GHz-10GHz




### 10GHz-15GHz




### 15GHz-20GHz



# 8. Radiated Emissions and Harmonic Emissions

## 8.1 Measurement procedure [FCC 24.238(a), 2.1053]

<Step 1>

The EUT and support equipment are placed on a 1 meter x 1 meter surface, 0.8 meter height styrene foam table. Radiated emission measurements are performed at 3 meter distance with the broadband antenna (Biconical antenna, Log periodic antenna and double ridged guide antenna). The antenna is positioned both the horizontal and vertical planes of polarization and height is varied 1 to 4 meters and stopped at height producing the maximum emission.

The bandwidth of the spectrum analyzer is set to 1MHz. The turntable is rotated by 360 degrees and stopped at azimuth of producing the maximum emission. The frequency is investigated up to 20GHz.

<Step 2>

The substitution antenna is replaced by the transmitter antenna (EUT).

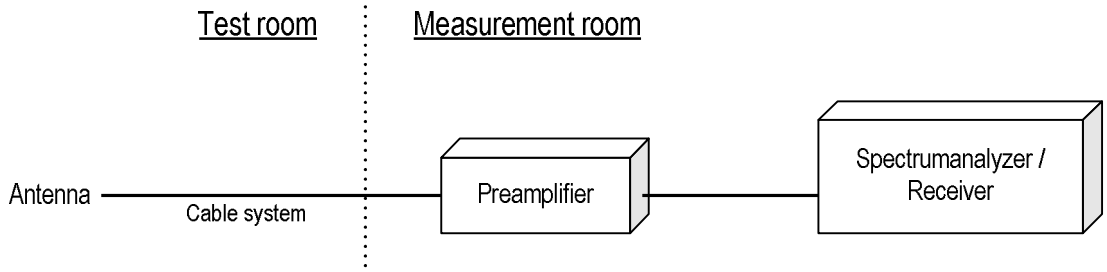
The frequency of the signal generator is adjusted to the measurement frequency.

Level of the signal generator is adjusted to the level that is obtained from step 1, and record the emission level of signal generator.

The spectrum analyzer is set to;

a) RBW = 100kHz for below 1GHz and 1MHz for above 1GHz / VBW ≥ 3 x RBW
b) Detector = Peak
c) Trace mode = Max hold
d) Sweep time = auto-couple

- Test configuration



## 8.2 Calculation method

Result = Ant. Input - Cable loss + Antenna Gain
Margin = Limit – Result (EIRP)

Example:
Limit @ 3700.4MHz : -13.0dBm
Ant. Input = -55.6dBm Cable loss = 1.6dB Ant. Gain = 9.2dBi
Result = -55.6 - 1.6 + 9.2 = -49.3dBm
Margin = -13.0 - (-49.3) = 36.3dB

## 8.3 Limit

-13dBm or less

## 8.4 Test data

| | | | | | |
|---|---|---|---|---|---|
| Date | : | December 6, 2017 | | | |
| Temperature | : | 23.5 [˚C] | | | |
| Humidity | : | 20.8 [%] | Test engineer | : | |
| Test place | : | 3m Semi-anechoic chamber | | | Tadahiro Seino |

| | | | | | |
|---|---|---|---|---|---|
| Date | : | December 8, 2017 | | | |
| Temperature | : | 21.6 [˚C] | | | |
| Humidity | : | 21.6 [%] | Test engineer | : | |
| Test place | : | 3m Semi-anechoic chamber | | | Tadahiro Seino |

| | | | | | |
|---|---|---|---|---|---|
| Date | : | December 14, 2017 | | | |
| Temperature | : | 20.2 [˚C] | | | |
| Humidity | : | 21.8 [%] | Test engineer | : | |
| Test place | : | 3m Semi-anechoic chamber | | | Tadahiro Seino |

| | | | | | |
|---|---|---|---|---|---|
| Date | : | December 15, 2017 | | | |
| Temperature | : | 20.5 [˚C] | | | |
| Humidity | : | 22.1 [%] | Test engineer | : | |
| Test place | : | 3m Semi-anechoic chamber | | | Tadahiro Seino |

| | | | | | |
|---|---|---|---|---|---|
| Date | : | December 16, 2017 | | | |
| Temperature | : | 20.6 [˚C] | | | |
| Humidity | : | 24.0 [%] | Test engineer | : | |
| Test place | : | 3m Semi-anechoic chamber | | | Tadahiro Seino |

| | | | | | |
|---|---|---|---|---|---|
| Date | : | December 18, 2017 | | | |
| Temperature | : | 20.2 [˚C] | | | |
| Humidity | : | 24.7 [%] | Test engineer | : | |
| Test place | : | 3m Semi-anechoic chamber | | | Tadahiro Seino |

Zacta

**[GSM1900]**
**Channel: 512**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3700.4 | -55.4 | -57.7 | 1.6 | 8.8 | -50.5 | -13.0 | 37.5 |

**Channel: 661**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -55.8 | -59.9 | 1.6 | 8.7 | -52.9 | -13.0 | 39.9 |

**Channel: 810**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3819.6 | -55.6 | -58.5 | 1.7 | 8.7 | -51.5 | -13.0 | 38.5 |

**[WCDMA Band II]**
**Channel: 9262**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3704.8 | -54.9 | -57.0 | 1.6 | 8.8 | -49.8 | -13.0 | 36.8 |

**Channel: 9400**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -55.5 | -58.2 | 1.6 | 8.7 | -51.2 | -13.0 | 38.2 |

**Channel: 9538**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBi] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3815.2 | -55.1 | -58.0 | 1.6 | 8.7 | -51.0 | -13.0 | 38.0 |

**[LTE Band II]**
**QPSK, BW 1.4MHz**
**Channel: 18607**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3701.4 | -54.2 | -54.2 | 1.6 | 8.8 | -47.0 | -13.0 | 34.0 |

**Channel: 18900**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -53.2 | -51.5 | 1.6 | 8.7 | -44.5 | -13.0 | 31.5 |

**Channel: 19193**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3818.6 | -54.5 | -53.3 | 1.7 | 8.7 | -46.3 | -13.0 | 33.3 |

**16QAM, BW 1.4MHz**
**Channel: 18607**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3701.4 | -54.2 | -53.8 | 1.6 | 8.8 | -46.6 | -13.0 | 33.6 |

**Channel: 18900**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -53.1 | -51.0 | 1.6 | 8.7 | -44.0 | -13.0 | 31.0 |

**Channel: 19193**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3818.6 | -54.4 | -53.0 | 1.7 | 8.7 | -46.0 | -13.0 | 33.0 |

**QPSK, BW 3MHz**
**Channel: 18615**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3703.0 | -54.1 | -54.0 | 1.6 | 8.8 | -46.8 | -13.0 | 33.8 |

**Channel: 18900**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -54.2 | -53.8 | 1.6 | 8.7 | -46.8 | -13.0 | 33.8 |

**Channel: 19185**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3817.0 | -54.5 | -54.5 | 1.7 | 8.7 | -47.5 | -13.0 | 34.5 |

**16QAM, BW 3MHz**
**Channel: 18615**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3703.0 | -53.8 | -53.1 | 1.6 | 8.8 | -45.9 | -13.0 | 32.9 |

**Channel: 18900**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -53.6 | -53.6 | 1.6 | 8.7 | -46.6 | -13.0 | 33.6 |

**Channel: 19185**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3817.0 | -54.4 | -55.1 | 1.7 | 8.7 | -48.1 | -13.0 | 35.1 |

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**QPSK, BW 5MHz**
**Channel: 18625**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3705.0 | -54.0 | -53.5 | 1.6 | 8.8 | -46.3 | -13.0 | 33.3 |

**Channel: 18900**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -53.5 | -52.5 | 1.6 | 8.7 | -45.5 | -13.0 | 32.5 |

**Channel: 19175**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3815.0 | -54.4 | -55.6 | 1.6 | 8.7 | -48.6 | -13.0 | 35.6 |

**16QAM, BW 5MHz**
**Channel: 18625**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3705.0 | -54.1 | -54.0 | 1.6 | 8.8 | -46.8 | -13.0 | 33.8 |

**Channel: 18900**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -52.9 | -50.7 | 1.6 | 8.7 | -43.7 | -13.0 | 30.7 |

**Channel: 19175**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3815.0 | -54.4 | -55.6 | 1.6 | 8.7 | -48.6 | -13.0 | 35.6 |

Zacta

**QPSK, BW 10MHz**
**Channel: 18650**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3710.0 | -53.3 | -52.9 | 1.6 | 8.8 | -45.7 | -13.0 | 32.7 |

**Channel: 18900**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -53.5 | -52.1 | 1.6 | 8.7 | -45.1 | -13.0 | 32.1 |

**Channel: 19150**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3810.0 | -54.1 | -54.9 | 1.6 | 8.7 | -47.9 | -13.0 | 34.9 |

**16QAM, BW 10MHz**
**Channel: 18650**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3710.0 | -52.3 | -48.4 | 1.6 | 8.8 | -41.2 | -13.0 | 28.2 |

**Channel: 18900**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -53.7 | -52.4 | 1.6 | 8.7 | -45.4 | -13.0 | 32.4 |

**Channel: 19150**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3810.0 | -54.0 | -53.8 | 1.6 | 8.7 | -46.8 | -13.0 | 33.8 |

Zacta

**QPSK, BW 15MHz**
**Channel: 18675**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3715.0 | -52.1 | -48.5 | 1.6 | 8.8 | -41.4 | -13.0 | 28.4 |

**Channel: 18900**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -53.6 | -52.4 | 1.6 | 8.7 | -45.4 | -13.0 | 32.4 |

**Channel: 19125**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3805.0 | -54.5 | -55.2 | 1.6 | 8.6 | -48.2 | -13.0 | 35.2 |

**16QAM, BW 15MHz**
**Channel: 18675**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3715.0 | -52.6 | -49.0 | 1.6 | 8.8 | -41.9 | -13.0 | 28.9 |

**Channel: 18900**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -53.8 | -53.0 | 1.6 | 8.7 | -46.0 | -13.0 | 33.0 |

**Channel: 19125**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3805.0 | -54.8 | -56.5 | 1.6 | 8.6 | -49.5 | -13.0 | 36.5 |

Zacta

**QPSK, BW 20MHz**
**Channel: 18700**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3720.0 | -54.1 | -53.4 | 1.6 | 8.8 | -46.3 | -13.0 | 33.3 |

**Channel: 18900**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -53.2 | -51.6 | 1.6 | 8.7 | -44.6 | -13.0 | 31.6 |

**Channel: 19100**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3800.0 | -54.8 | -56.6 | 1.6 | 8.6 | -49.6 | -13.0 | 36.6 |

**16QAM, BW 20MHz**
**Channel: 18700**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3720.0 | -53.1 | -51.2 | 1.6 | 11.0 | -41.9 | -13.0 | 28.9 |

**Channel: 18900**

| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3760.0 | -53.7 | -51.8 | 1.6 | 10.9 | -42.6 | -13.0 | 29.6 |

**Channel: 19100**

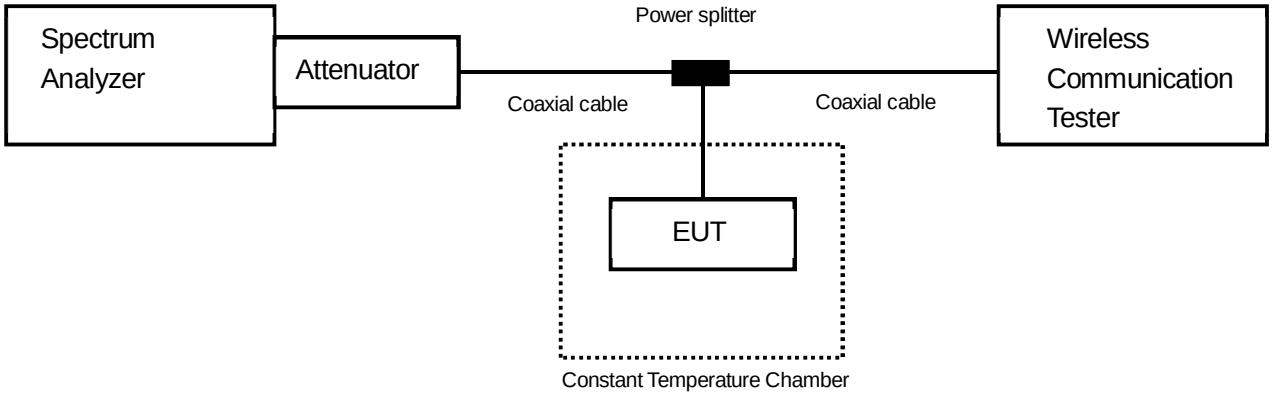
| H/V | Frequency [MHz] | S.A Reading [dBm] | Ant. Input [dBm] | Cable loss [dB] | Ant.Gain [dBd] | Result [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| H | 3800.0 | -54.7 | -56.5 | 1.6 | 10.8 | -47.3 | -13.0 | 34.3 |

# 9. Frequency Stability

## 9.1 Measurement procedure [FCC 24.235, 2.1055]

The EUT was placed of an inside of an constant temperature chamber as the temperature in the chamber was varied between -30˚C and +50˚C. The temperature was incremented by 10˚C intervals and the unit was allowed to stabilize at each measurement. The frequency drift was measured with the normal Temperature and voltage tolerance and it is presented as the ppm unit.

- Test configuration




## 9.2 Limit

±2.5ppm

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### 9.3 Measurement result

Date : November 29, 2017
Temperature : 24.0 [˚C]
Humidity : 34.1 [%] Test engineer :
Test place : Shielded room No.4 Chiaki Kanno

**[GSM1900]**
**Channel: 661**

| Limit: ±0.00025% = ±2.5ppm | | | | | |
|---|---|---|---|---|---|
| **Power Supply [V]** | **Temperature [ºC]** | **Measurements Frequency [Hz]** | **Frequency Tolerance [ppm]** | **Limit [ppm]** | **Result** |
| 3.80 | 25(Ref.) | 1,879,999,971 | 0.00000 | ±2.5 | Pass |
| | 50 | 1,879,999,973 | 0.00100 | ±2.5 | Pass |
| | 40 | 1,879,999,969 | -0.00096 | ±2.5 | Pass |
| | 30 | 1,879,999,972 | 0.00062 | ±2.5 | Pass |
| | 20 | 1,879,999,970 | -0.00013 | ±2.5 | Pass |
| | 10 | 1,879,999,976 | 0.00303 | ±2.5 | Pass |
| | 0 | 1,879,999,974 | 0.00193 | ±2.5 | Pass |
| | -10 | 1,879,999,970 | -0.00039 | ±2.5 | Pass |
| | -20 | 1,879,999,964 | -0.00352 | ±2.5 | Pass |
| | -30 | 1,879,999,960 | -0.00551 | ±2.5 | Pass |
| 3.42 | 25 | 1,879,999,968 | -0.00123 | ±2.5 | Pass |
| 4.18 | 25 | 1,879,999,967 | -0.00194 | ±2.5 | Pass |

**[WCDMA Band II]**
**Channel: 9400**

| Limit: ±0.00025% = ±2.5ppm | | | | | |
|---|---|---|---|---|---|
| **Power Supply [V]** | **Temperature [ºC]** | **Measurements Frequency [Hz]** | **Frequency Tolerance [ppm]** | **Limit [ppm]** | **Result** |
| 3.80 | 25(Ref.) | 1,879,999,996 | 0.00000 | ±2.5 | Pass |
| | 50 | 1,879,999,995 | -0.00051 | ±2.5 | Pass |
| | 40 | 1,879,999,996 | 0.00012 | ±2.5 | Pass |
| | 30 | 1,879,999,995 | -0.00014 | ±2.5 | Pass |
| | 20 | 1,880,000,005 | 0.00513 | ±2.5 | Pass |
| | 10 | 1,879,999,995 | -0.00046 | ±2.5 | Pass |
| | 0 | 1,879,999,996 | -0.00009 | ±2.5 | Pass |
| | -10 | 1,880,000,005 | 0.00470 | ±2.5 | Pass |
| | -20 | 1,879,999,995 | -0.00020 | ±2.5 | Pass |
| | -30 | 1,880,000,005 | 0.00476 | ±2.5 | Pass |
| 3.42 | 25 | 1,879,999,996 | -0.00006 | ±2.5 | Pass |
| 4.18 | 25 | 1,879,999,995 | -0.00020 | ±2.5 | Pass |

**[LTE Band II]**
**QPSK, BW 20MHz**
**Channel: 18900**

| Limit: ±0.00025% = ±2.5ppm | | | | | |
|---|---|---|---|---|---|
| **Power Supply [V]** | **Temperature [ºC]** | **Measurements Frequency [Hz]** | **Frequency Tolerance [ppm]** | **Limit [ppm]** | **Result** |
| 3.80 | 25(Ref.) | 1,879,999,992 | 0.00000 | ±2.5 | Pass |
| | 50 | 1,879,999,991 | -0.00051 | ±2.5 | Pass |
| | 40 | 1,879,999,992 | 0.00008 | ±2.5 | Pass |
| | 30 | 1,879,999,992 | -0.00029 | ±2.5 | Pass |
| | 20 | 1,879,999,992 | -0.00017 | ±2.5 | Pass |
| | 10 | 1,879,999,993 | 0.00028 | ±2.5 | Pass |
| | 0 | 1,879,999,993 | 0.00036 | ±2.5 | Pass |
| | -10 | 1,879,999,993 | 0.00038 | ±2.5 | Pass |
| | -20 | 1,879,999,989 | -0.00146 | ±2.5 | Pass |
| | -30 | 1,879,999,992 | 0.00013 | ±2.5 | Pass |
| 3.42 | 25 | 1,879,999,990 | -0.00125 | ±2.5 | Pass |
| 4.18 | 25 | 1,879,999,991 | -0.00061 | ±2.5 | Pass |

Calculation;

Frequency Tolerance (ppm) = Measurements Frequency (Hz) – Reference Frequency (Hz) / Reference Frequency (Hz) x 1000000

## *10. Uncertainty of measurement*

Expanded uncertainties stated are calculated with a coverage Factor k=2.
Please note that these results are not taken into account when measurement uncertainty considerations contained in ETSI TR 100 028-0011 determining compliance or non-compliance with test result.

| Test item | Measurement uncertainty |
|---|---|
| Conducted emission, AMN (9kHz – 150kHz) | ±3.8dB |
| Conducted emission, AMN (150kHz – 30MHz) | ±3.3dB |
| Radiated emission (9kHz – 30MHz) | ±3.0dB |
| Radiated emission (30MHz – 1000MHz) | ±4.7dB |
| Radiated emission (1GHz – 6GHz) | ±4.9dB |
| Radiated emission (6GHz – 18GHz) | ±5.2dB |
| Radiated emission (18GHz – 40GHz) | ±5.8dB |

# 11. Laboratory Information

**1. Location**

Name: Yonezawa Testing Center
Address: 5-4149-7, Hachimanpara, Yonezawa-shi, Yamagata, 992-1128 Japan
Phone: +81-238-28-2881
Fax: +81-238-28-2888

**2. Accreditation and Registration**

1) VLAC
Accreditation No.: VLAC-013

2) NVLAP
LAB CODE: 200306-0

3) BSMI
Laboratory Code: SL2-IN-E-6018, SL2-A1-E-6018

4) Industry Canada

| Site number | Facility | Expiration date |
|---|---|---|
| 4224A-4 | 3m Semi-anechoic chamber | 2020-11-27 |
| 4224A-5 | 10m Semi-anechoic chamber No.1 | 2020-11-27 |
| 4224A-6 | 10m Semi-anechoic chamber No.2 | 2019-12-14 |

5) VCCI Council

| Registration number | Expiration date |
|---|---|
| A-0166 | 2019-07-03 |

# *Appendix A. Test equipment*

## Antenna port conducted test

| Equipment | Company | Model No. | Serial No. | Cal. Due | Cal. Date |
|---|---|---|---|---|---|
| Spectrum analyzer | Agilent Technologies | E4440A | US44302655 | Jun. 30, 2018 | Jun. 28, 2017 |
| Attenuator | Weinschel | 56-10 | J4993 | Nov. 30, 2017 | Nov. 1, 2016 |
| | | | | Dec. 31, 2018 | Dec. 4, 2017 |
| Microwave cable | HUBER+SUHNER | SUCOFLEX 104 | 199119/4 | Feb. 28, 2018 | Feb. 2, 2017 |
| Power divider | ANRITSU | K240B | 1301239 | Jul. 31, 2018 | Jul. 21, 2017 |
| Wideband Radio Frequency Tester | ROHDE&SCHWARZ | CMW500 | 126079 | Oct. 31, 2018 | Oct. 13, 2017 |
| Temperature and humidity chamber | ESPEC | PL1KP | 14007261 | Jan. 31, 2018 | Jan. 20, 2017 |

## Radiated emission

| Equipment | Company | Model No. | Serial No. | Cal. Due | Cal. Date |
|---|---|---|---|---|---|
| EMI Receiver | ROHDE&SCHWARZ | ESCI | 100765 | Sep. 30, 2018 | Sep. 13, 2017 |
| Spectrum analyzer | Agilent Technologies | E4447A | MY46180188 | Mar. 31, 2018 | Mar. 15, 2017 |
| Spectrum analyzer | Agilent Technologies | E4440A | US40420937 | Oct. 31, 2018 | Oct. 19, 2017 |
| Preamplifier | ANRITSU | MH648A | M96057 | Feb. 28, 2018 | Feb. 1, 2017 |
| Biconical antenna | Schwarzbeck | VHA9103/BBA9106 | 2155 | Jul. 31, 2018 | Jul. 18, 2017 |
| Log periodic antenna | Schwarzbeck | UHALP9108A | 0560 | Jul. 31, 2018 | Jul. 18, 2017 |
| Attenuator | TME | CFA-01NPJ-6 | N/A(S275) | Feb. 28, 2018 | Feb. 3, 2017 |
| Attenuator | TME | CFA-01NPJ-3 | N/A(S272) | Feb. 28, 2018 | Feb. 2, 2017 |
| Preamplifier | TSJ | MLA-100M18-B02-40 | 1929118 | Feb. 28, 2018 | Feb. 3, 2017 |
| Attenuator | AEROFLEX | 26A-10 | 081217-08 | May 31, 2018 | May 24, 2017 |
| Double ridged guide antenna | ETS LINDGREN | 3117 | 00052315 | Feb. 28, 2018 | Feb. 23, 2017 |
| Attenuator | Agilent Technologies | 8491B | MY39268633 | Feb. 28, 2018 | Feb. 2, 2017 |
| Double ridged guide antenna | A.H.Systems Inc. | SAS-574 | 469 | Aug. 31, 2018 | Aug. 8, 2017 |
| Preamplifier | TSJ | MLA-1840-B03-35 | 1240332 | Aug. 31, 2018 | Aug. 8, 2017 |
| Band rejection filter | Micro-Tronics | BRC50720 | 014 | Nov. 30, 2017 | Nov. 1, 2016 |
| | | | | Dec. 31, 2018 | Dec. 5, 2017 |
| High Pass Filter | Wainwright | WHKX2.8/18G-6SS | 1 | Jul. 31, 2018 | Jul. 20, 2017 |
| Signal generator | ROHDE&SCHWARZ | SMB100A | 177525 | Jun. 30, 2018 | Jun. 12, 2017 |
| RF power amplifier | R&K | CGA020M602-2633R | B40240 | May 31, 2018 | May 26, 2017 |
| Microwave cable | HUBER+SUHNER | SUCOFELX102/2m | 31648 | Mar. 31, 2018 | Mar. 13, 2017 |
| Dipole antenna | Schwarzbeck | VHAP | 1021 | Aug. 31, 2018 | Aug. 2, 2017 |
| Dipole antenna | Schwarzbeck | UHAP | 993 | Aug. 31, 2018 | Aug. 2, 2017 |
| Double ridged guide antenna | EMCO | 3115 | 00058532 | Dec. 31, 2017 | Dec. 6, 2016 |
| Wideband Radio Frequency Tester | ROHDE&SCHWARZ | CMW500 | 126079 | Oct. 31, 2018 | Oct. 13, 2017 |
| Microwave cable | HUBER+SUHNER | SUCOFLEX104/9m | MY30037/4 | Feb. 28, 2018 | Feb. 3, 2017 |
| | | SUCOFLEX104/1m | my24610/4 | Feb. 28, 2018 | Feb. 3, 2017 |
| | | SUCOFLEX104/8m | SN MY30031/4 | Feb. 28, 2018 | Feb. 2, 2017 |
| | | SUCOFLEX104 | MY32976/4 | Dec. 31, 2017 | Dec. 2, 2016 |
| | | SUCOFLEX104/1.5m | MY19309/4 | Feb. 28, 2018 | Feb. 3, 2017 |
| | | SUCOFLEX104/7m | 41625/6 | Feb. 28, 2018 | Feb. 3, 2017 |
| PC | DELL | DIMENSION E521 | 75465BX | N/A | N/A |
| Software | TOYO Corporation | EP5/RE-AJ | 0611193/V5.6.0 | N/A | N/A |
| Absorber | RIKEN | PFP30 | N/A | N/A | N/A |
| 3m Semi an-echoic Chamber | TOKIN | N/A | N/A(9002-NSA) | May 31, 2018 | May 30, 2017 |
| 3m Semi an-echoic Chamber | TOKIN | N/A | N/A(9002-SVSWR) | May 31, 2018 | May 31, 2017 |

*: The calibrations of the above equipment are traceable to NIST or equivalent standards of the reference organizations.