

## CERTIFICATION TEST REPORT

Report Number: 2013 06236241 FCCR1

Project Number: Q10239539

Nex Number: 236241

Applicant: BROADCAST MICROWAVE SERVICES  
12367 CROSTHWAITE CIRCLEDock 10  
Poway, CA 92069

Equipment Under Test (EUT): TRANSMITTER

Model: HELI-CODER 4

FCC ID: CNVHC4-2

In Accordance With: FCC Part 74, Subpart F  
TELEVISION BROADCAST AUXILIARY STATIONS

Tested By: Nemko USA Inc.  
2210 Faraday Avenue, Suite 150  
Carlsbad, CA 92008

Authorized By:   
Alex Chang, EMC/RF Test Engineer

Date: FEBRUARY 20, 2014

Total Number of Pages: 146

|                        |                                 |                                                                                               |             |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-------------|
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## Section 1. Summary of Test Results

### 1.1 General

All measurements are traceable to national standards

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 74; Subpart F. Radiated tests were conducted in accordance with ANSI C63.4-2003. Radiated emissions are made in the 10m Semi-anechoic chamber. A description of the test facility is on file with the FCC and IC.

The assessment summary is as follows:

|                              |              |
|------------------------------|--------------|
| Apparatus Assessed:          | Transmitter  |
| Model:                       | Heli-Coder 4 |
| Specification:               | FCC Part 74  |
| Date Received in Laboratory: | May 17, 2013 |
| Compliance Status:           | Complies     |
| Exclusions:                  | None         |
| Non-compliances:             | None         |

|                        |                                 |                                                                                               |          |
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## 1.2 Report Release History

| Revision | Date              | Comments                                                                                                        |
|----------|-------------------|-----------------------------------------------------------------------------------------------------------------|
| -        | June 5, 2013      | Prepared By: Alex Chang                                                                                         |
| -        | June 5, 2013      | Initial Release: Alan Laudani                                                                                   |
| 1        | FEBRUARY 20, 2014 | Revised BW, E-masks, Spurious and Power by D. Light, Added Modulation Characteristics; re-release: Alan Laudani |

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025.

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Alan Laudani  
Senior RF/EMC Engineer  
Test Report Verificator

|                        |                                 |                                                                                               |          |
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### 1.3 Description of Test Site

The test site is located at 2210 Faraday Ave., Suite 150, Carlsbad, CA 92008. Radiated emissions measurements are performed in the 10 meter Semi-Anechoic chamber, which conforms to the volumetric normalized site attenuation (VNSA) for three and ten-meter measurements. The chamber also conforms to the SVSWR compliance requirements for 1-18 GHz measurements. The VNSA and SVSWR meet the technical requirements, as set, in the CISPR 16 and ANSI C63.4 documents. Facility test areas for conducted emissions and immunity testing also meet the construction and characteristics, as required by CISPR 16 and ANSI C63.4 documents.

Emissions measurements are performed using TILE software. Version 4.0.A.7 for radiated and version 3.4.K.24 for conducted.

### 1.4 Facility Accreditation and Authorization

Nemko USA, Inc. is accredited through National Voluntary Laboratory Accreditation Program.



NVLAP LAB CODE 200116-0

| Organization                      | Registration and Recognition numbers |
|-----------------------------------|--------------------------------------|
| Federal Communications Commission | US5058                               |
| Industry Canada                   | 2040B-3                              |

### 1.5 Equipment Under Test

The assessment summary is as follows:

| DEVICE            | MANUFACTURER<br>MODEL #<br>SERIAL #                                   | POWER CABLE |
|-------------------|-----------------------------------------------------------------------|-------------|
| EUT - Transmitter | Broadcast Microwave Services<br>Model: Heli-Coder 4<br>Serial #: ENG1 |             |

|                        |                                 |                                                                                               |          |
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## Section 2. Test Results

### 2.1 Summary Of Test Data

Part 74

2025 MHz to 2110 MHz

2450 MHz to 2483 MHz

| Name Of Test                            | Para. No. | Part 74   | Result   |
|-----------------------------------------|-----------|-----------|----------|
| RF Power Output                         | 2.1046    | 74.636    | Complies |
| Modulation Characteristics              | 2.1047    |           | Complies |
| Occupies Bandwidth                      | 2.1049    | 74.637(g) | Complies |
| Spurious Emissions at Antenna Terminals | 2.1051    |           | Complies |
| Field Strength of Spurious Emissions    | 2.1053    |           | Complies |
| Frequency Stability                     | 2.1055    | 74.661    | Complies |

### 2.2 Test Conditions

Indoor

Temperature: 22-24 °C

Humidity: 45-48 %

|                        |                                 |                                                                                               |          |
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## 2.3 Modulation Characteristics

|                                     |                             |
|-------------------------------------|-----------------------------|
| Test Performed By: CLIENT STATEMENT | Date of Test: Feb. 20, 2014 |
|-------------------------------------|-----------------------------|

Para. No.: 2.1047

### Modulation Characteristics:

The HC4 uses the DVB-T standard (EN 300 744) for the broadcast transmission of digital terrestrial video. The DVB-T standard utilizes coded orthogonal frequency-division multiplexing modulation, from here on abbreviated as COFDM, consisting of 1705 individual subcarriers (aka "2K" mode) capable of QPSK, 16QAM, or 64QAM modulation schemes. Each of the modulation schemes, also known as constellation types, share the same maximum symbol amplitude. The subcarrier spacing and symbol rate are dependent on the modulation bandwidth setting; configurable between 6, 7, and 8MHz OBW. The chart below provides the subcarrier spacing and unpadded symbol duration per subcarrier for the available modulation bandwidth settings. Increases in the order of the modulation scheme from QPSK to 16QAM to 64QAM provide an increase in the number of data bits-per-symbol (2, 4, and 6 bits-per-symbol respectively), providing an increased end-to-end data rate (up to 31Mbps) at the expense of signal robustness. The modulation bandwidth and modulation scheme are user selectable settings.

The 8MHz BW setting is regarded as the most severe operating case due to the greatest occupied bandwidth and the highest symbol rate (shortest symbol duration).

| 2K-mode DVB-T Characteristics (All constellation types) |                      |                           |                      |                       |
|---------------------------------------------------------|----------------------|---------------------------|----------------------|-----------------------|
| Mod BW Setting (MHz)                                    | Sub-carrier Quantity | Sub-carrier Spacing (kHz) | Symbol Duration (uS) | Anticipated OBW (MHz) |
| 8                                                       | 1705                 | 4.464                     | 224.01               | 7.606                 |
| 7                                                       | 1705                 | 3.906                     | 256.02               | 6.655                 |
| 6                                                       | 1705                 | 3.348                     | 298.69               | 5.704                 |

The DVB-T standard is published as EN 300 744, *Framing structure, channel coding and modulation for digital terrestrial television* and is available from the European Telecommunications Standards Institute (ETSI) website at <http://www.etsi.org>

|                        |                                 |                                                                                               |          |
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## 2.4 RF Power Output

Para. No.: 2.1046

|                               |                            |
|-------------------------------|----------------------------|
| Test Performed By: Alex Chang | Date of Test: Feb. 4, 2014 |
|-------------------------------|----------------------------|

Minimum Standard: Para. No. 74.636

| Frequency band (MHz) | Maximum allowable transmitter power | Maximum allowable EIRP |              |
|----------------------|-------------------------------------|------------------------|--------------|
|                      | Mobile (W)                          | Fixed (dBW)            | Mobile (dBW) |
| 2,025 to 2,110       | 12.0                                | +45                    | +35          |
| 2,450 to 2,483.5     | 12.0                                | +45                    | +35          |

Test Results:

Measurement Data:  
Averaging Power Meter  
40 dB Attenuator

Antennas:  
BMA-6-OA 5.5 dBi gain  
GCA-11 11 dBi gain

Measured per eCFR T47 §2.1046(a)  
Method guidance from FCC OET 971168-D01 §5.0  
Limitations defined in eCFR T47 §74.636(a)

All power measurements are performed using a thermocouple-type RF power sensor capable of accurate RMS measurements up to 18GHz. A power attenuator is placed between the EUT output and power meter to reduce the signal strength to a safe input level for the power sensor. The attenuation offset and sensor calibration factor are supplied to the power meter in order to provide accurate scaled measurements. The cascaded attenuator and power sensor provide a nominal 50 ohm broadband load for the EUT.

The EUT is a multicarrier digital-modulation transmitter where the measured power represents the combined (summed) RMS power for all carriers within the nominal transmit channel. Output power data was recorded at multiple carrier frequencies within the governed frequency bands for all combinations of modulation bandwidth (6, 7, 8MHz) and constellation types (QPSK, 16QAM, 64QAM).

For a nominal 10W (+40dBm) transmitter, antenna gains up to 25dBi are compliant with the +35dBW EIRP limit for mobile applications within the authorized 2025-2110MHz and 2450-2483.5MHz bands. All antennas supplied by the applicant for use with the EUT have nominal gains of 5.5dBi and 11dBi and therefore meet the maximum allowable EIRP limit.

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## Test Data:

| Freq<br>MHz | BW<br>MHz | Modulation | Power<br>dBm | Power<br>dBW | Freq<br>MHz | BW<br>MHz | Modulation | Power<br>dBm | Power<br>dBW | Freq<br>MHz | BW<br>MHz | Modulation | Power<br>dBm | Power<br>dBW |
|-------------|-----------|------------|--------------|--------------|-------------|-----------|------------|--------------|--------------|-------------|-----------|------------|--------------|--------------|
| 2031        | 8         | QPSK       | 39.9         | 9.9          | 2031        | 8         | 16QAM      | 39.9         | 9.9          | 2031        | 8         | 64QAM      | 39.9         | 9.9          |
| 2067        | 8         | QPSK       | 40.1         | 10.1         | 2067        | 8         | 16QAM      | 40.0         | 10.0         | 2067        | 8         | 64QAM      | 40.1         | 10.1         |
| 2104        | 8         | QPSK       | 39.7         | 9.7          | 2104        | 8         | 16QAM      | 39.7         | 9.7          | 2104        | 8         | 64QAM      | 39.7         | 9.7          |
| 2456        | 8         | QPSK       | 39.9         | 9.9          | 2456        | 8         | 16QAM      | 39.9         | 9.9          | 2456        | 8         | 64QAM      | 40.0         | 10.0         |
| 2467        | 8         | QPSK       | 39.9         | 9.9          | 2467        | 8         | 16QAM      | 39.9         | 9.9          | 2467        | 8         | 64QAM      | 39.9         | 9.9          |
| 2477        | 8         | QPSK       | 39.8         | 9.8          | 2477        | 8         | 16QAM      | 39.8         | 9.8          | 2477        | 8         | 64QAM      | 39.8         | 9.8          |
| 2031        | 7         | QPSK       | 39.9         | 9.9          | 2031        | 7         | 16QAM      | 40.0         | 10.0         | 2031        | 7         | 64QAM      | 40.0         | 10.0         |
| 2067        | 7         | QPSK       | 39.9         | 9.9          | 2067        | 7         | 16QAM      | 40.0         | 10.0         | 2067        | 7         | 64QAM      | 40.0         | 10.0         |
| 2104        | 7         | QPSK       | 39.6         | 9.6          | 2104        | 7         | 16QAM      | 39.7         | 9.7          | 2104        | 7         | 64QAM      | 39.7         | 9.7          |
| 2456        | 7         | QPSK       | 40.0         | 10.0         | 2456        | 7         | 16QAM      | 40.0         | 10.0         | 2456        | 7         | 64QAM      | 40.0         | 10.0         |
| 2467        | 7         | QPSK       | 39.8         | 9.8          | 2467        | 7         | 16QAM      | 39.8         | 9.8          | 2467        | 7         | 64QAM      | 39.9         | 9.9          |
| 2477        | 7         | QPSK       | 39.8         | 9.8          | 2477        | 7         | 16QAM      | 39.8         | 9.8          | 2477        | 7         | 64QAM      | 39.8         | 9.8          |
| 2031        | 6         | QPSK       | 40.0         | 10.0         | 2031        | 6         | 16QAM      | 40.0         | 10.0         | 2031        | 6         | 64QAM      | 40.1         | 10.1         |
| 2067        | 6         | QPSK       | 40.0         | 10.0         | 2067        | 6         | 16QAM      | 40.0         | 10.0         | 2067        | 6         | 64QAM      | 40.1         | 10.1         |
| 2104        | 6         | QPSK       | 39.7         | 9.7          | 2104        | 6         | 16QAM      | 39.7         | 9.7          | 2104        | 6         | 64QAM      | 39.8         | 9.8          |
| 2456        | 6         | QPSK       | 40.0         | 10.0         | 2456        | 6         | 16QAM      | 40.0         | 10.0         | 2456        | 6         | 64QAM      | 40.1         | 10.1         |
| 2467        | 6         | QPSK       | 39.9         | 9.9          | 2467        | 6         | 16QAM      | 39.9         | 9.9          | 2467        | 6         | 64QAM      | 39.9         | 9.9          |
| 2477        | 6         | QPSK       | 39.8         | 9.8          | 2477        | 6         | 16QAM      | 39.9         | 9.9          | 2477        | 6         | 64QAM      | 39.9         | 9.9          |

|                        |                                 |                                                                                               |             |
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## 2.5 Occupied Bandwidth

Para. No.: 2.1049

|                               |                            |
|-------------------------------|----------------------------|
| Test Performed By: A. Laudani | Date of Test: Feb. 4, 2014 |
|-------------------------------|----------------------------|

Minimum Standard: 74.637

Test Results: Complies

Test Data: See attached graph(s).

Measured per eCFR T47 §2.1049(h)  
Method guidance provided by FCC OET 971168-D01 §4.2  
Limitations defined in eCFR T47 §74.637(g)

All occupied power bandwidth (OBW or OPB) measurements are performed using a spectrum analyzer. A power attenuator is placed between the EUT output and spectrum analyzer to reduce the signal strength to a safe input level for the spectrum analyzer. A reference level offset, equivalent to the external attenuation and cable loss, is supplied to the spectrum analyzer to provide accurate scaled measurements.

The measured occupied bandwidth represents the signal bandwidth in which 99% of the total transmitted power resides. OBW data was recorded at multiple carrier frequencies within the governed frequency range for all combinations of modulation bandwidth (6, 7, 8MHz) and constellation types (QPSK, 16QAM, 64QAM).

|                        |                                 |                                                                                               |           |
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#### LOW BAND

| Frequency | Modulation Bandwidth | Bandwidth (MHz) |
|-----------|----------------------|-----------------|
| 2031 MHz  | 8 MHz QPSK           | 7.6             |
|           | 8 MHz 16QAM          | 7.6             |
|           | 8 MHz 64QAM          | 7.6             |
|           | 7 MHz QPSK           | 6.6             |
|           | 7 MHz 16QAM          | 6.7             |
|           | 7 MHz 64QAM          | 6.6             |
|           | 6 MHz QPSK           | 5.7             |
|           | 6 MHz 16QAM          | 5.7             |
|           | 6 MHz 64 QAM         | 5.7             |
| 2067 MHz  | 8 MHz QPSK           | 7.6             |
|           | 8 MHz 16QAM          | 7.6             |
|           | 8 MHz 64QAM          | 7.6             |
|           | 7 MHz QPSK           | 6.7             |
|           | 7 MHz 16QAM          | 6.7             |
|           | 7 MHz 64QAM          | 6.7             |
|           | 6 MHz QPSK           | 5.7             |
|           | 6 MHz 16QAM          | 5.7             |
|           | 6 MHz 64 QAM         | 5.7             |
| 2104 MHz  | 8 MHz QPSK           | 7.6             |
|           | 8 MHz 16QAM          | 7.6             |
|           | 8 MHz 64QAM          | 7.6             |
|           | 7 MHz QPSK           | 6.7             |
|           | 7 MHz 16QAM          | 6.7             |
|           | 7 MHz 64QAM          | 6.7             |
|           | 6 MHz QPSK           | 5.7             |
|           | 6 MHz 16QAM          | 5.7             |
|           | 6 MHz 64 QAM         | 5.7             |

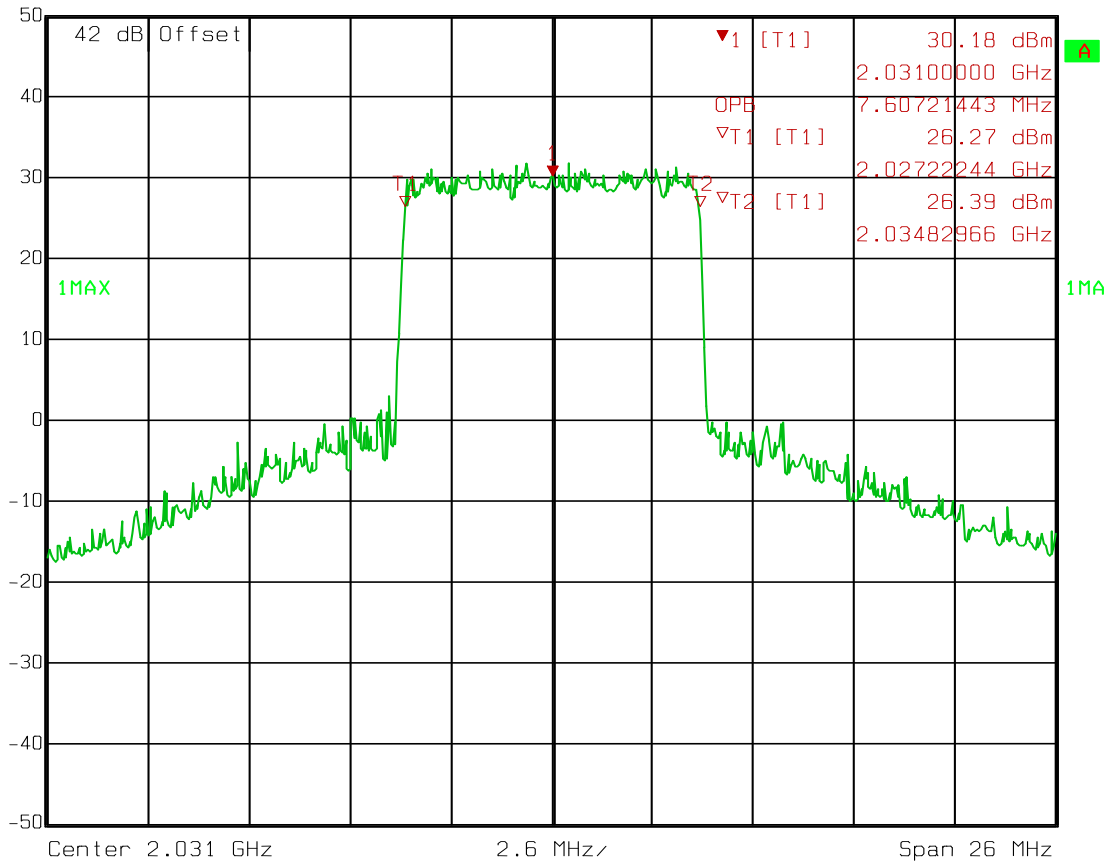
|                        |                                 |                                                                                               |           |
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# Low Channel 8 MHz QPSK



Marker 1 [T1] RBW 100 kHz RF Att 30 dB  
 Ref Lvl 30.18 dBm VBW 300 kHz  
 50 dBm 2.03100000 GHz SWT 6.5 ms Unit dBm



Date: 04.FEB.2014 09:41:41

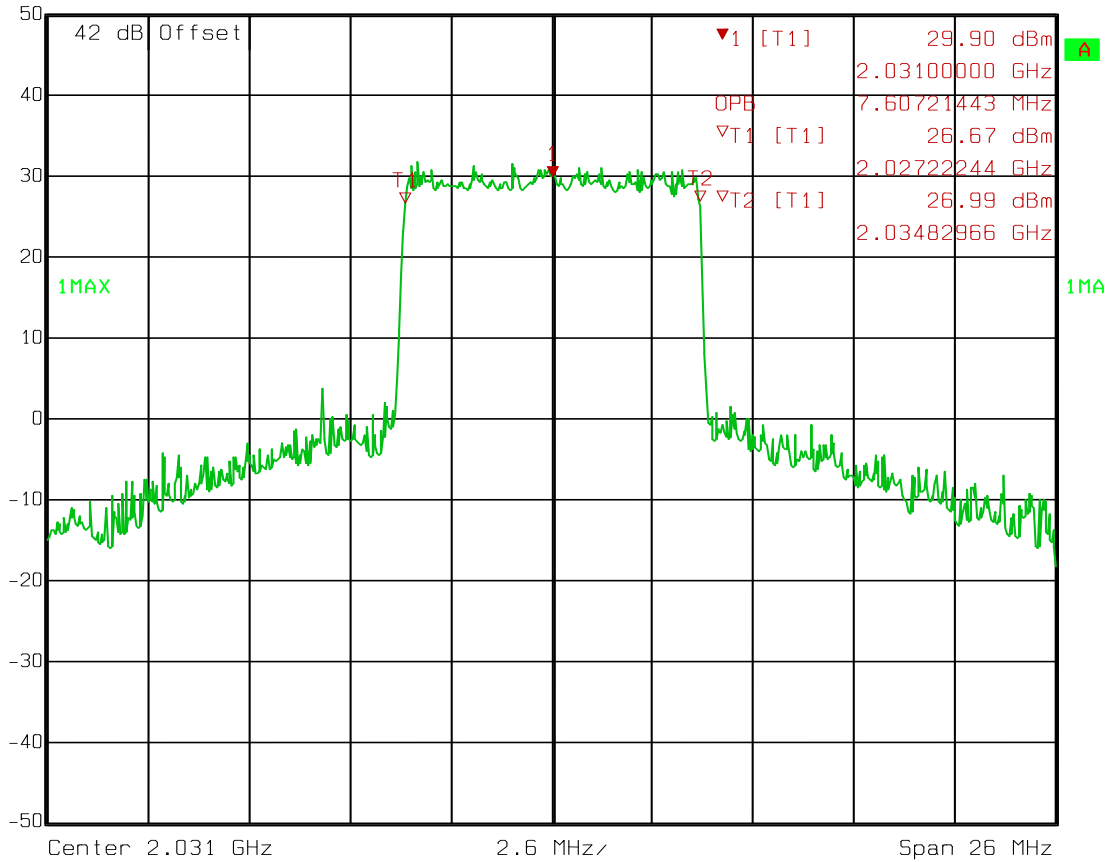
|                        |                                 |                                                                                               |           |
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# Low Channel 8 MHz 16QAM



Marker 1 [T1] RBW 100 kHz RF Att 30 dB  
 Ref Lvl 29.90 dBm VBW 300 kHz  
 50 dBm 2.03100000 GHz SWT 6.5 ms Unit dBm

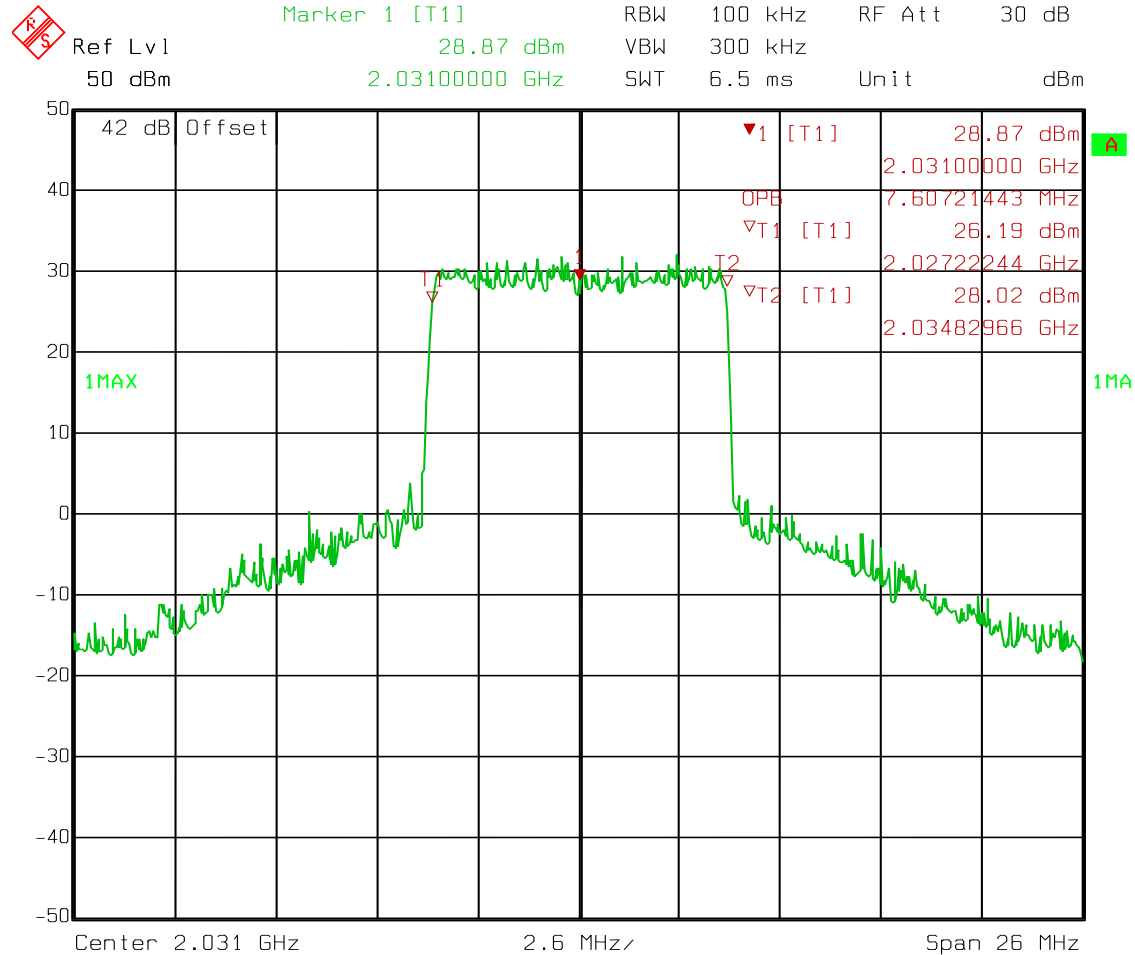


Date: 04.FEB.2014 09:42:01

|                        |                                 |                                                                                               |           |
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# Low Channel 8 MHz 64QAM



Date: 04.FEB.2014 09:42:26

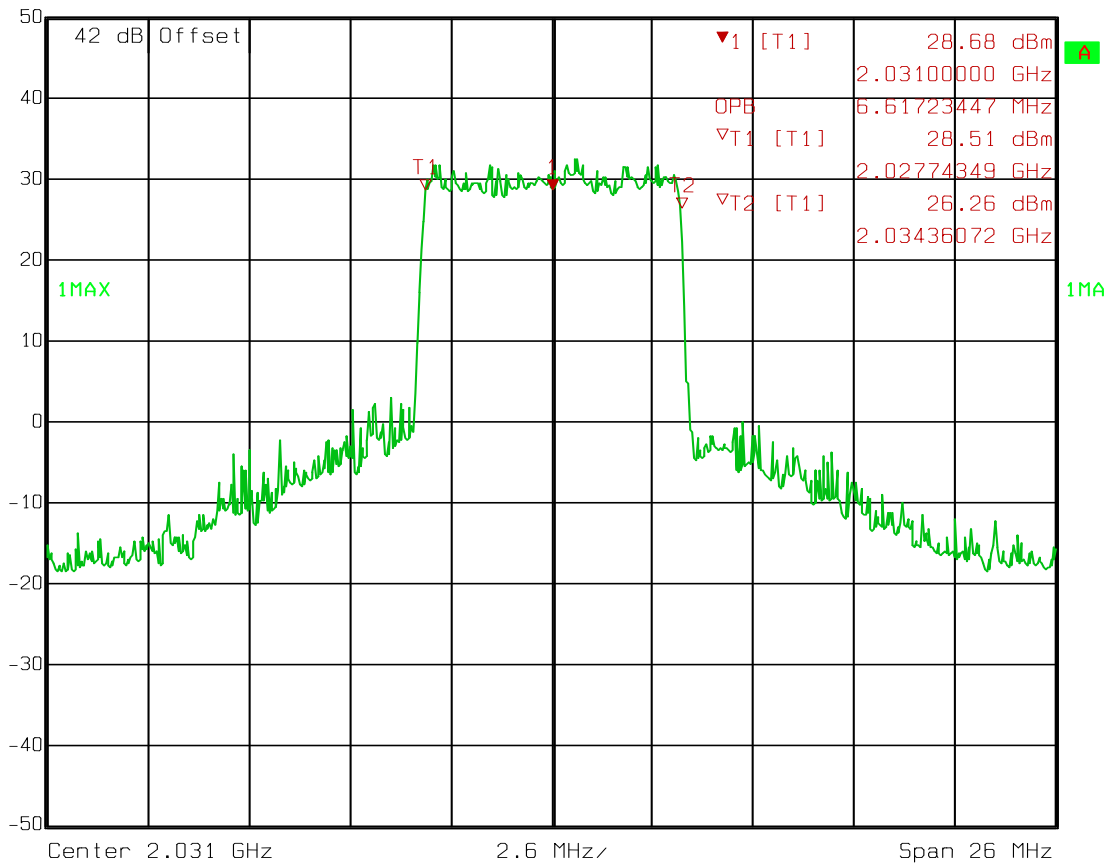
|                        |                                 |                                                                                               |           |
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# Low Channel 7 MHz QPSK



Marker 1 [T1] RBW 100 kHz RF Att 30 dB  
 Ref Lvl 28.68 dBm VBW 300 kHz  
 50 dBm 2.03100000 GHz SWT 6.5 ms Unit dBm

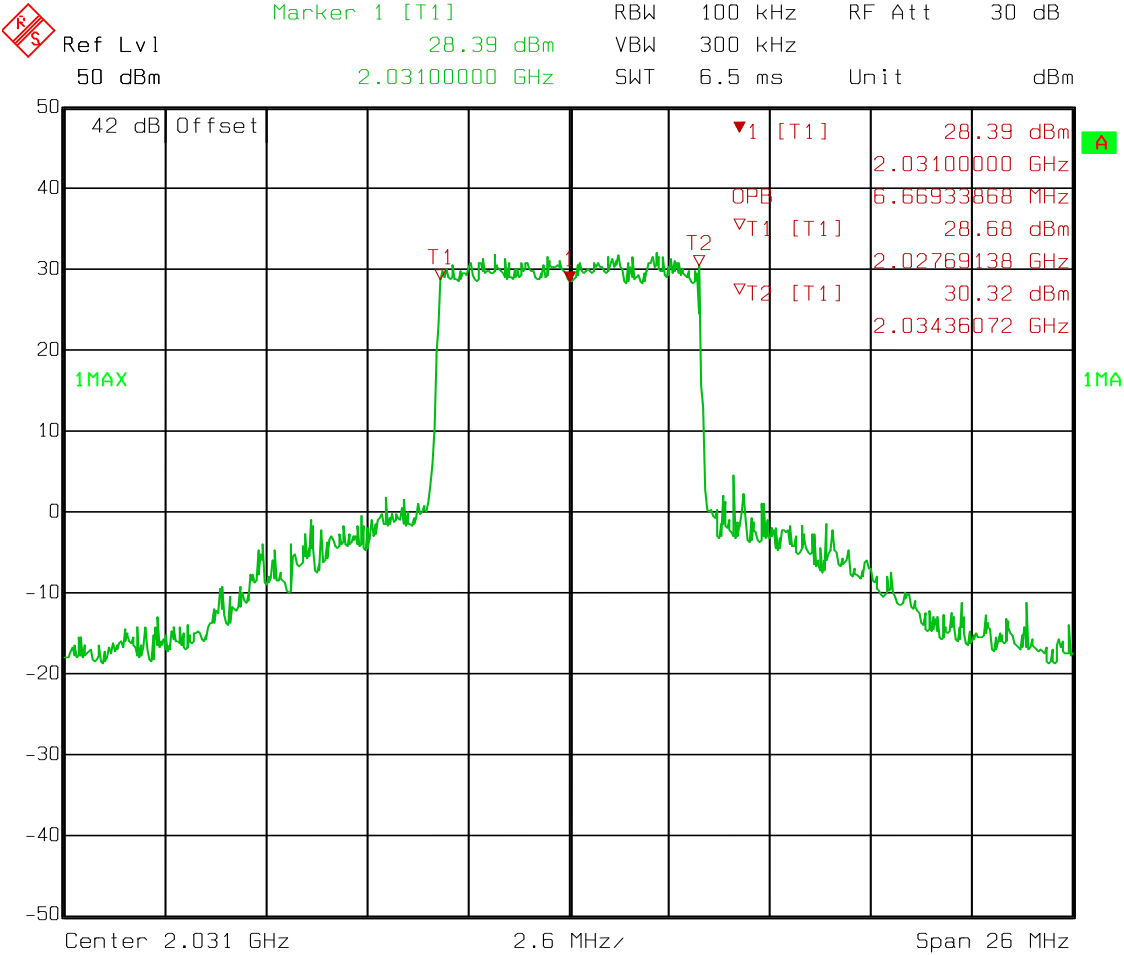


Date: 04.FEB.2014 09:42:52

|                        |                                 |                                                                                               |           |
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Low Channel 7 MHz 16QAM



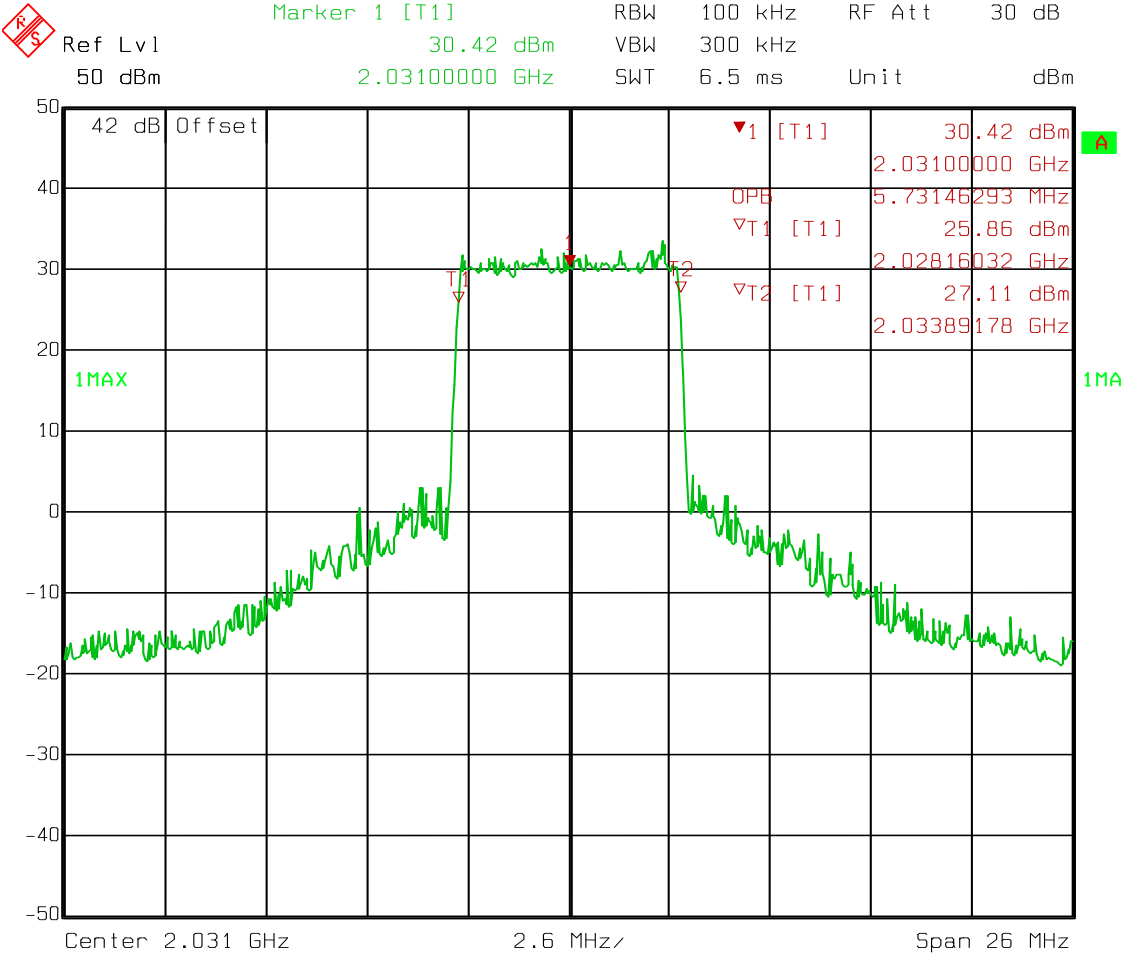
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 18 of 146 |

FCC ID: CNVHC4-2

Low Channel 6 MHz QPSK

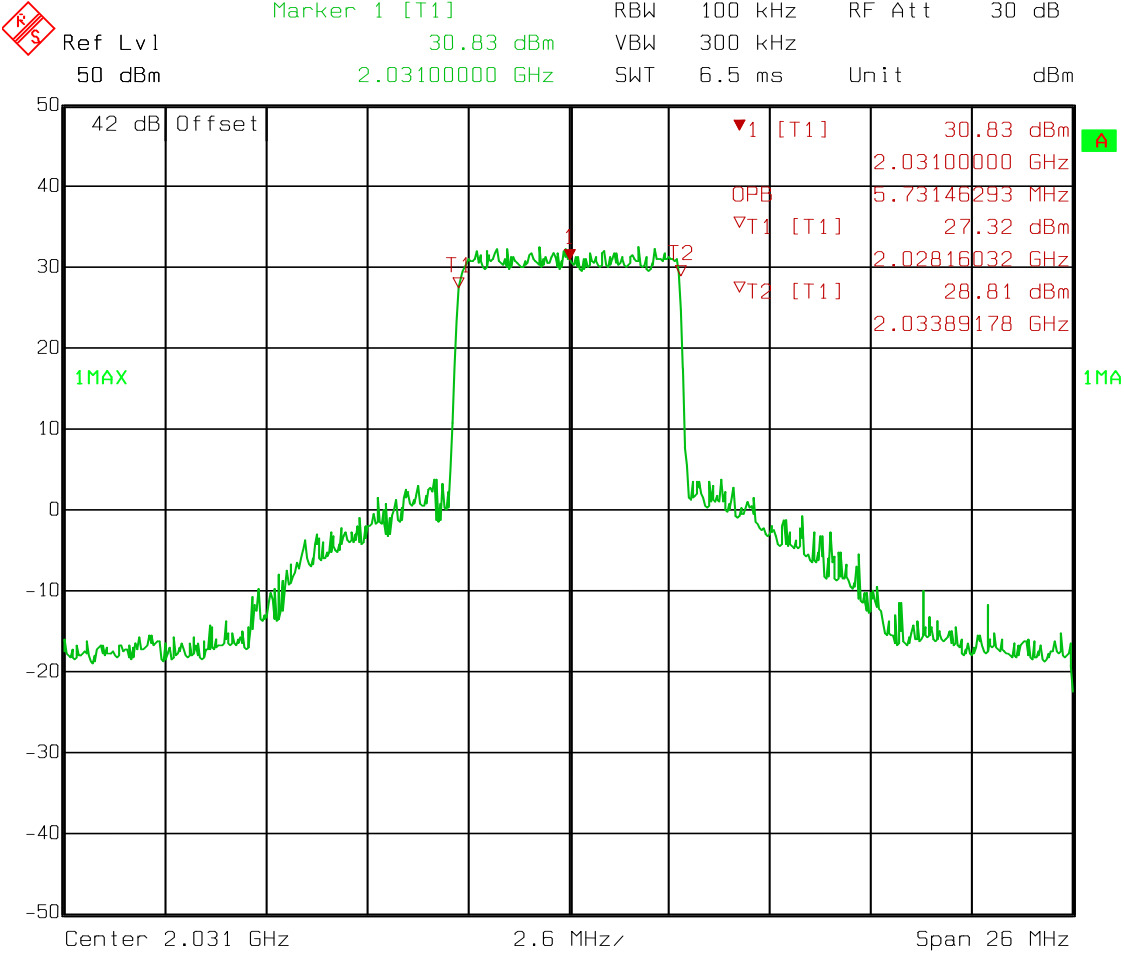


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Low Channel 6 MHz 16QAM

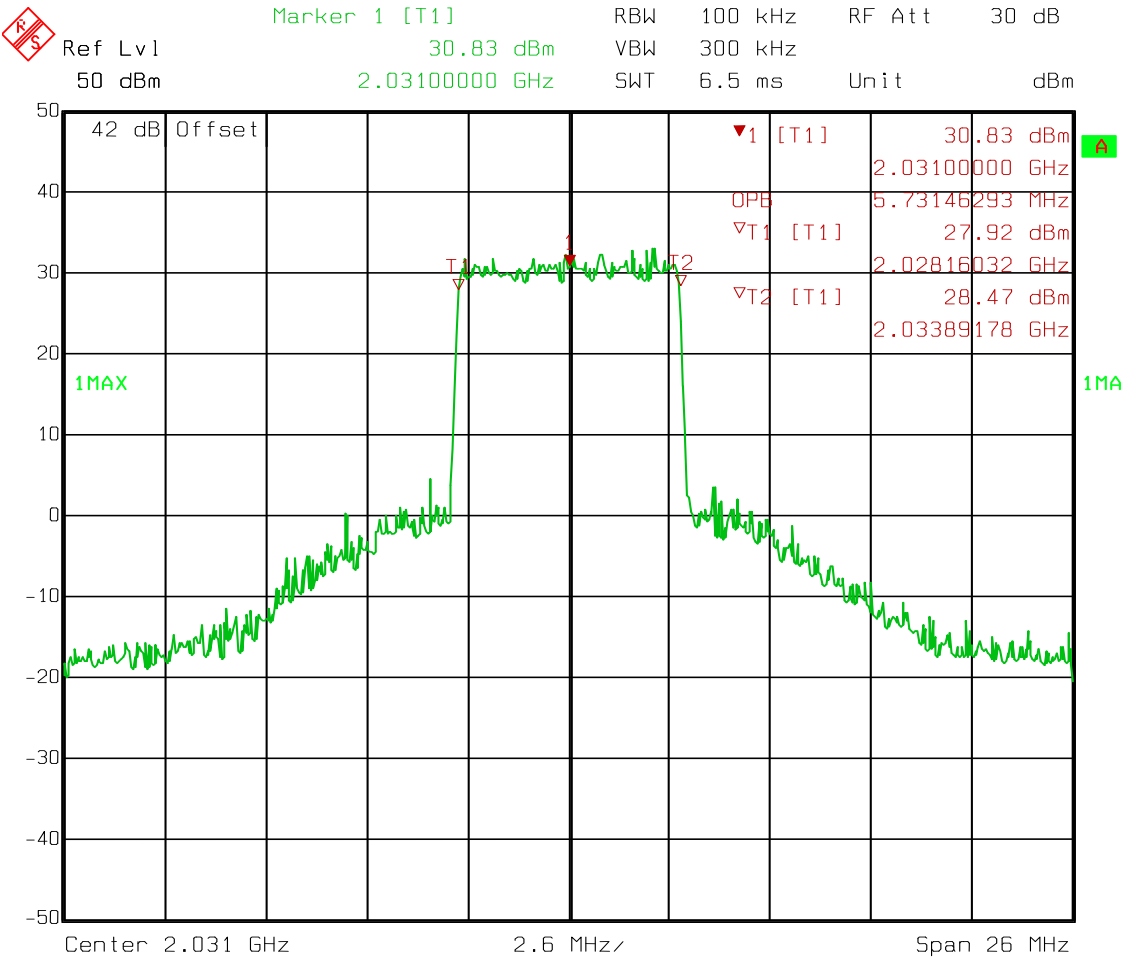


Date: 04.FEB.2014 09:45:03

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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 20 of 146 |

FCC ID: CNVHC4-2

Low Channel 6 MHz 64 QAM

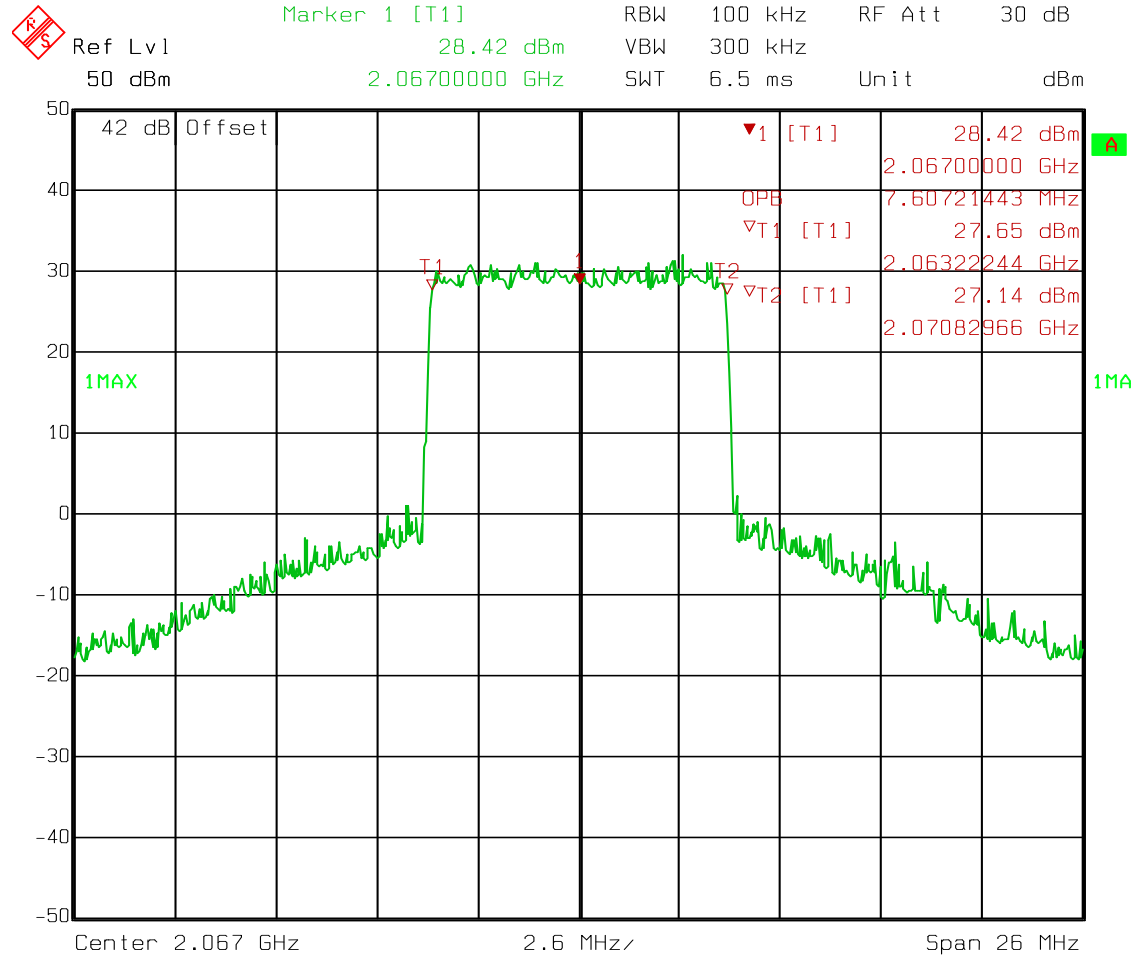


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

# Mid Channel 8 MHz QPSK

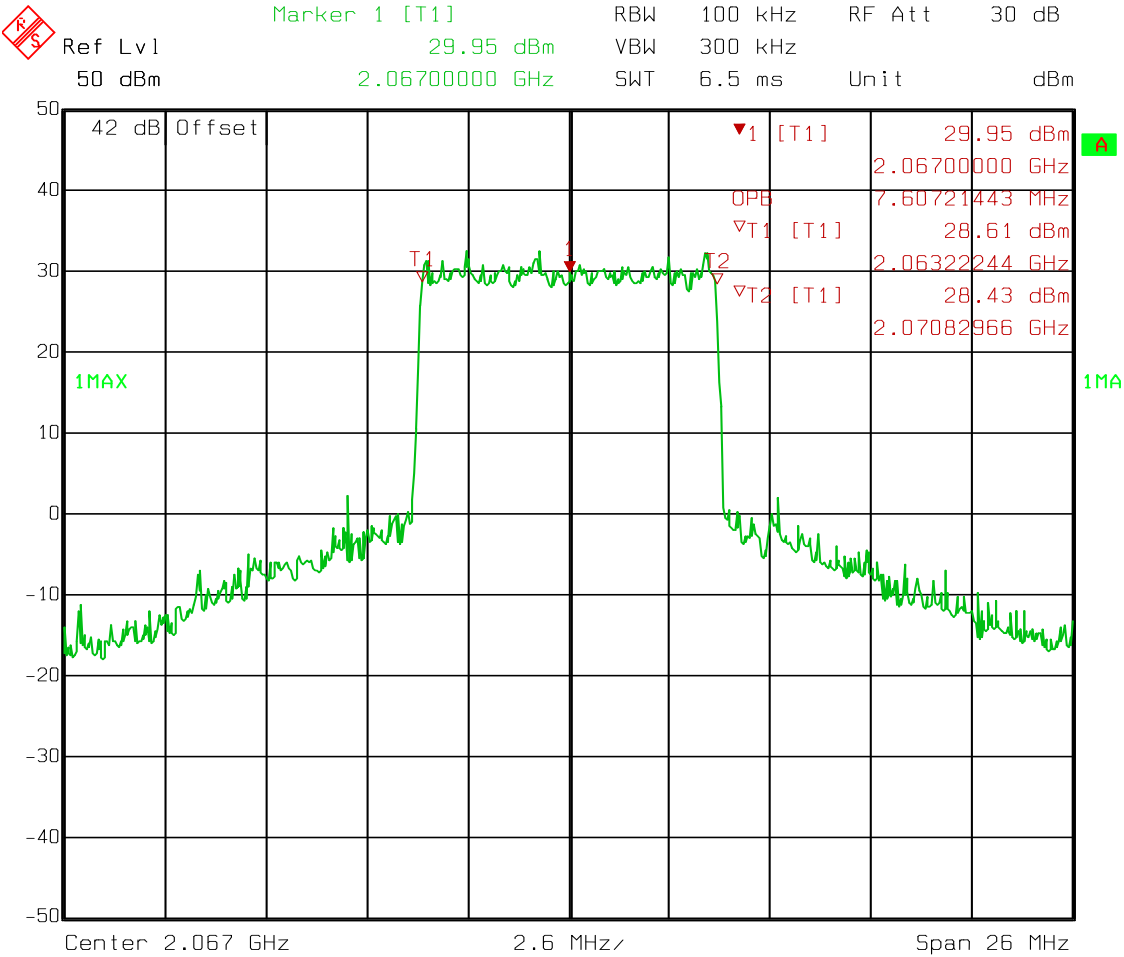


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Mid Channel 8 MHz 16QAM



Date: 04.FEB.2014 09:47:08

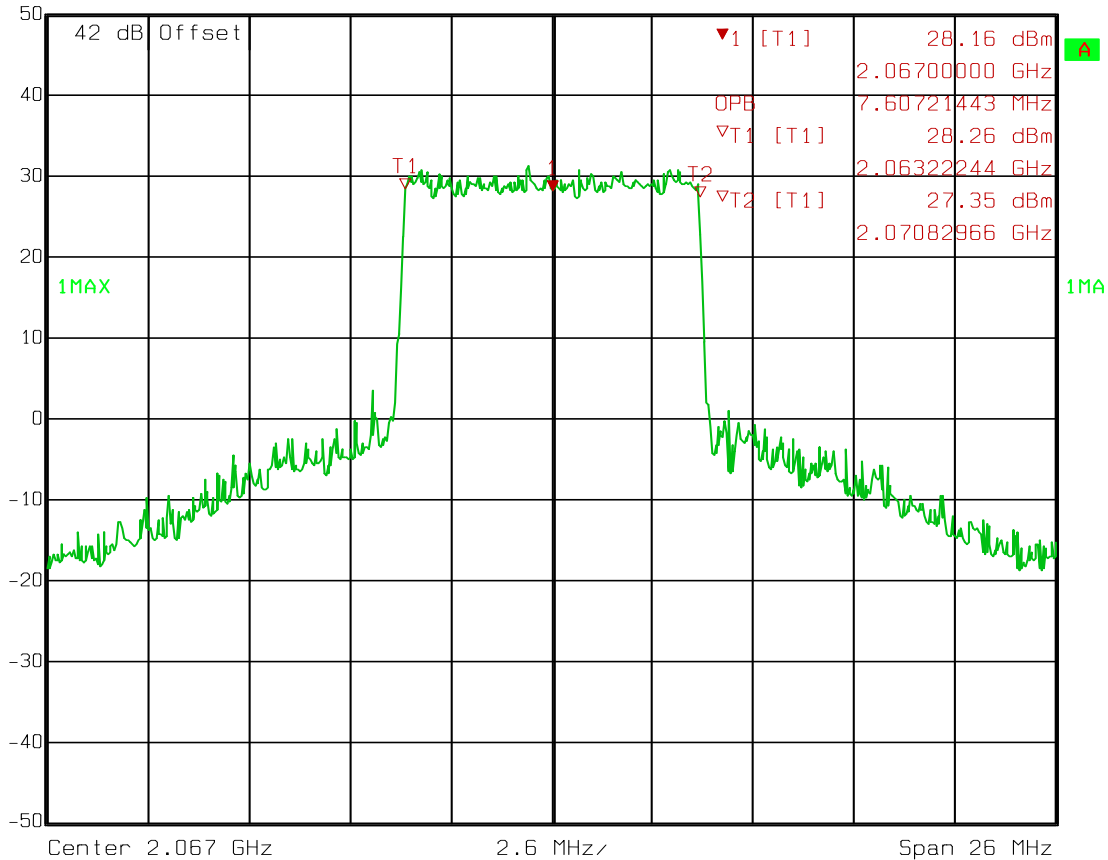
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FCC ID: CNVHC4-2

# Mid Channel 8 MHz 64 QAM



Marker 1 [T1] RBW 100 kHz RF Att 30 dB  
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 50 dBm 2.06700000 GHz SWT 6.5 ms Unit dBm



Date: 04.FEB.2014 09:47:30

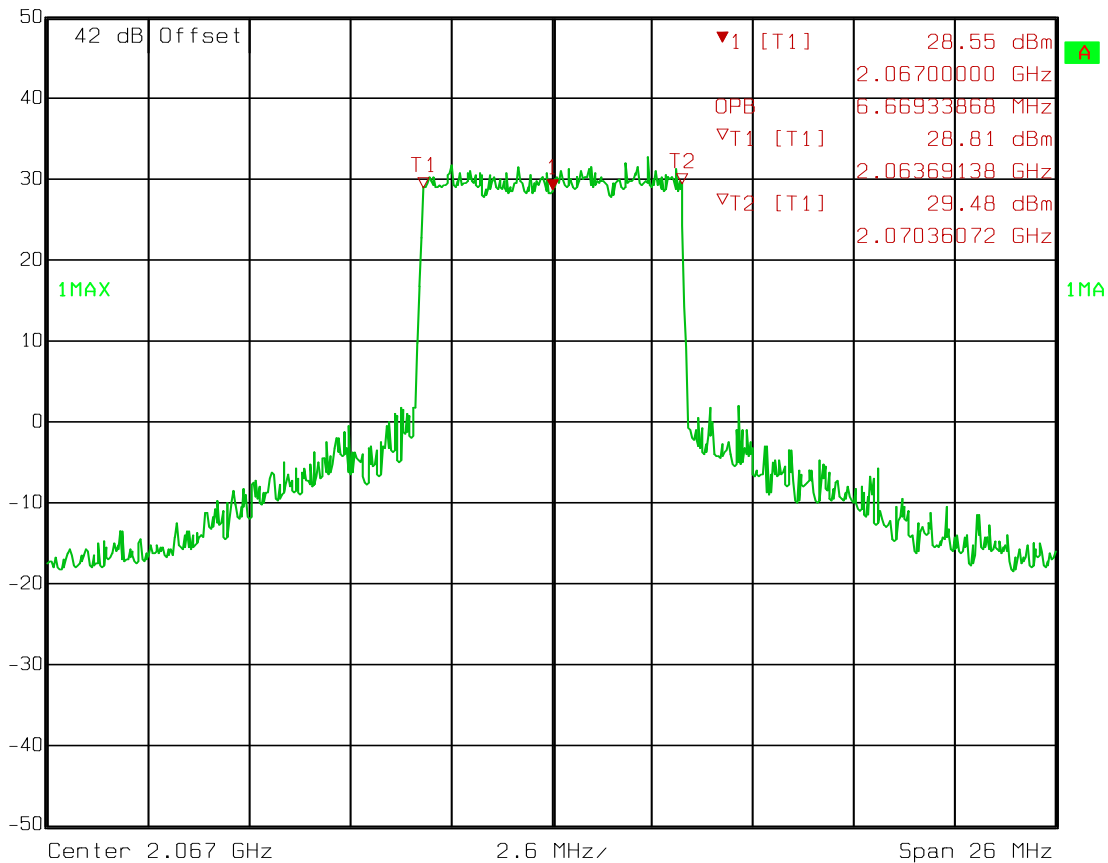
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FCC ID: CNVHC4-2

# Mid Channel 7 MHz QPSK



Marker 1 [T1] RBW 100 kHz RF Att 30 dB  
 Ref Lvl 28.55 dBm VBW 300 kHz  
 50 dBm 2.06700000 GHz SWT 6.5 ms Unit dBm

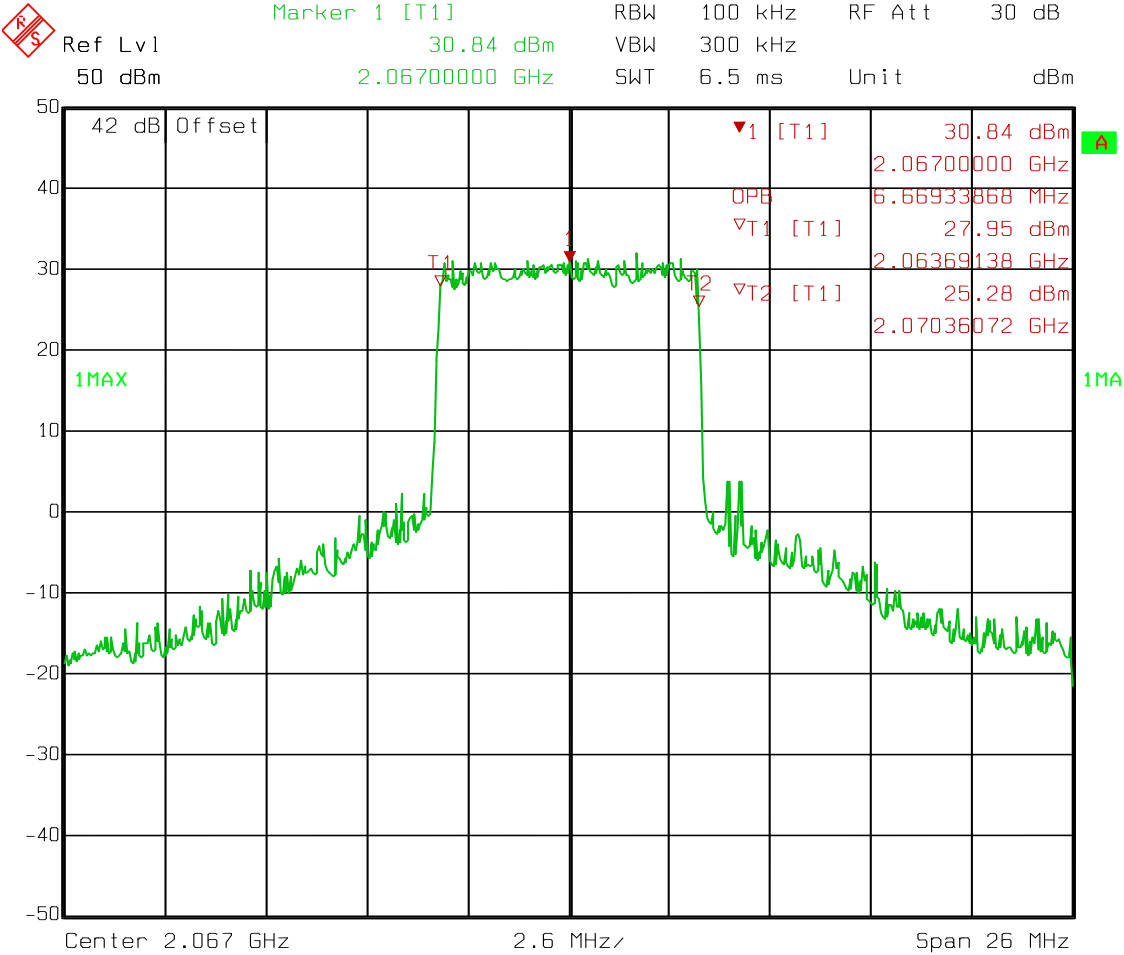


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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |           |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Mid Channel 7 MHz 16QAM

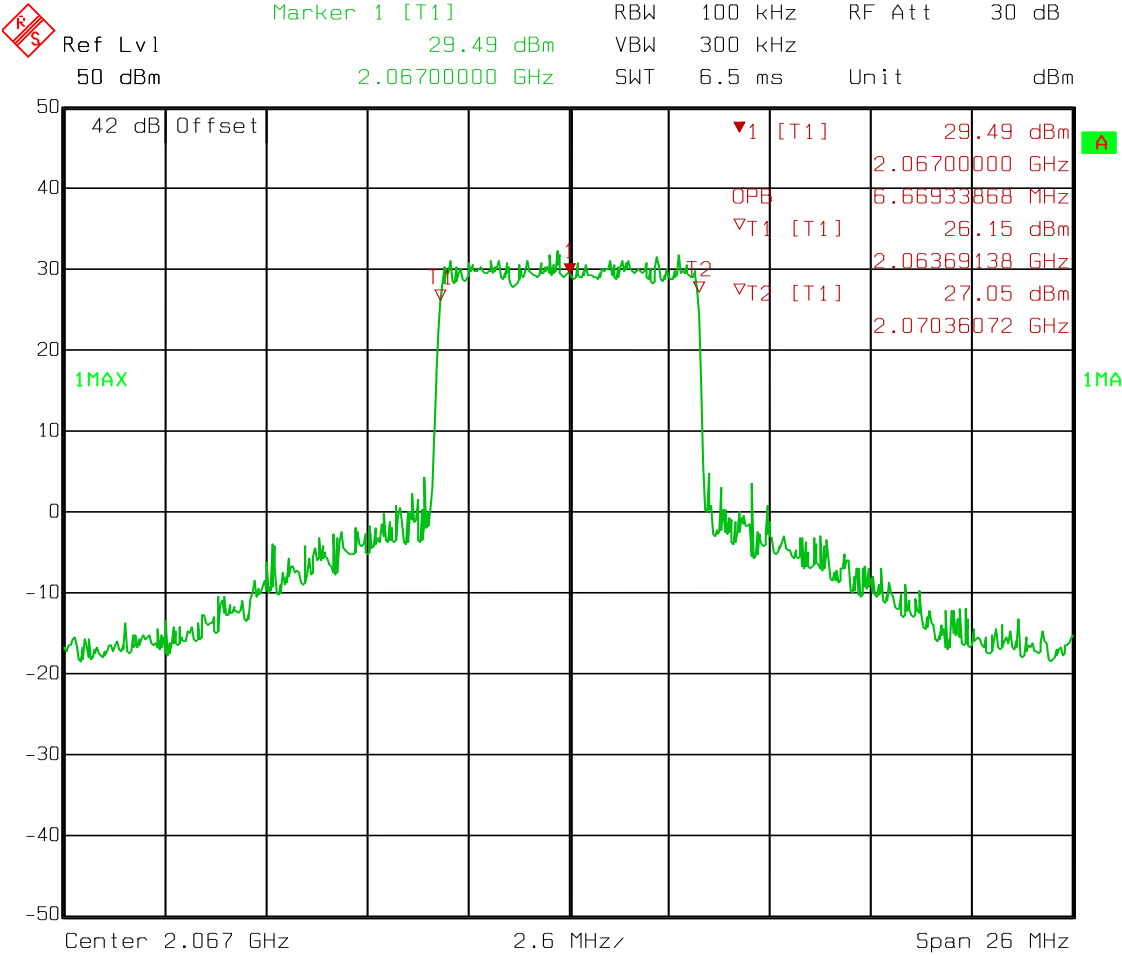


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Mid Channel 7 MHz 64QAM

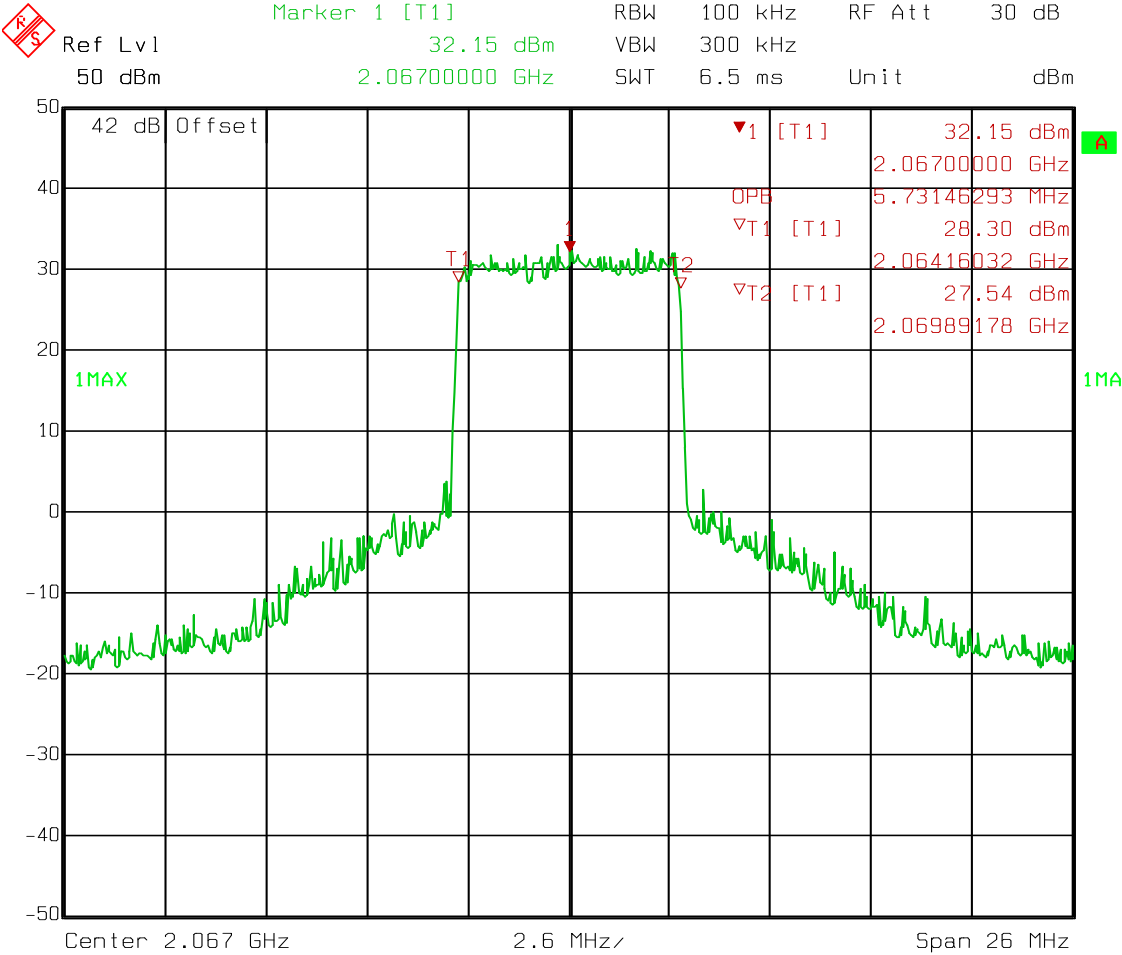


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Mid Channel 6 MHz QPSK

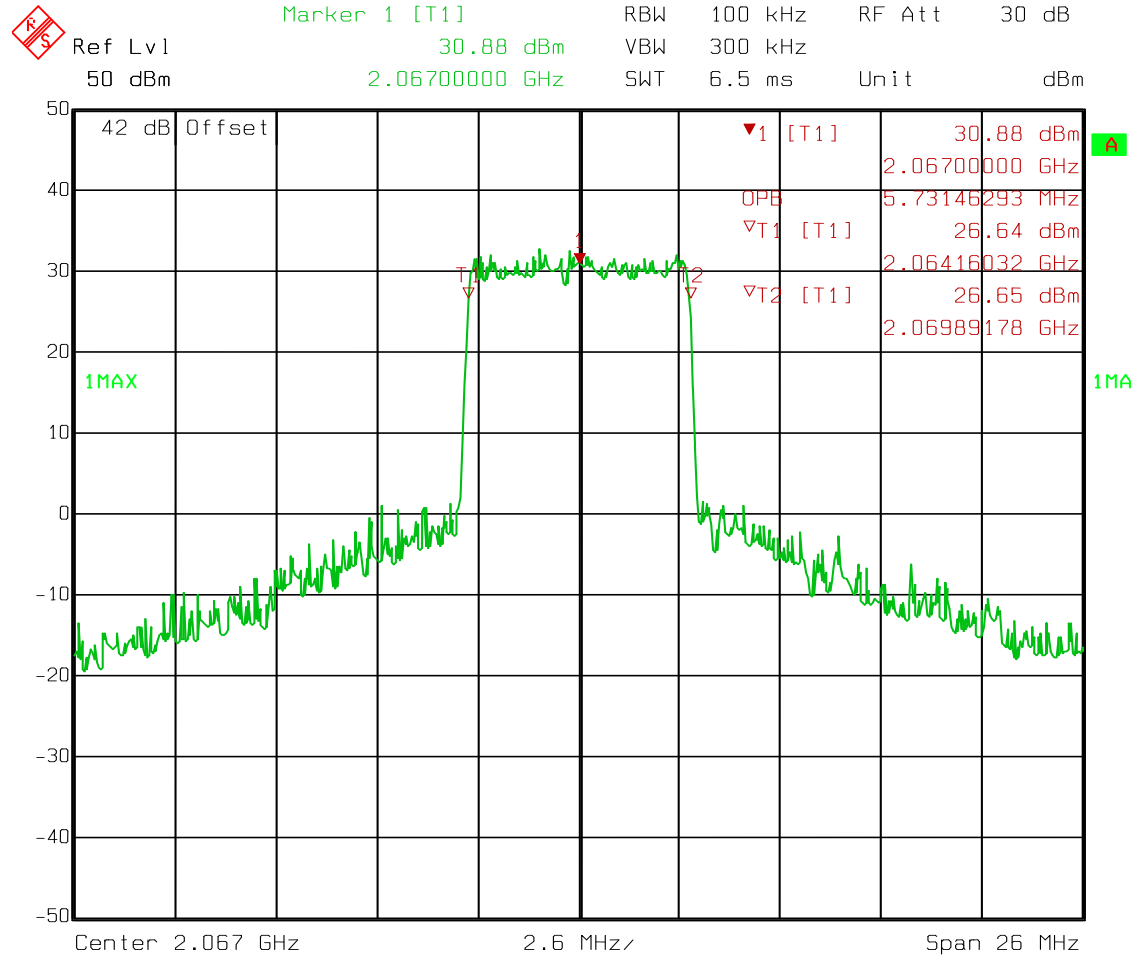


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

# Mid Channel 6 MHz 16QAM

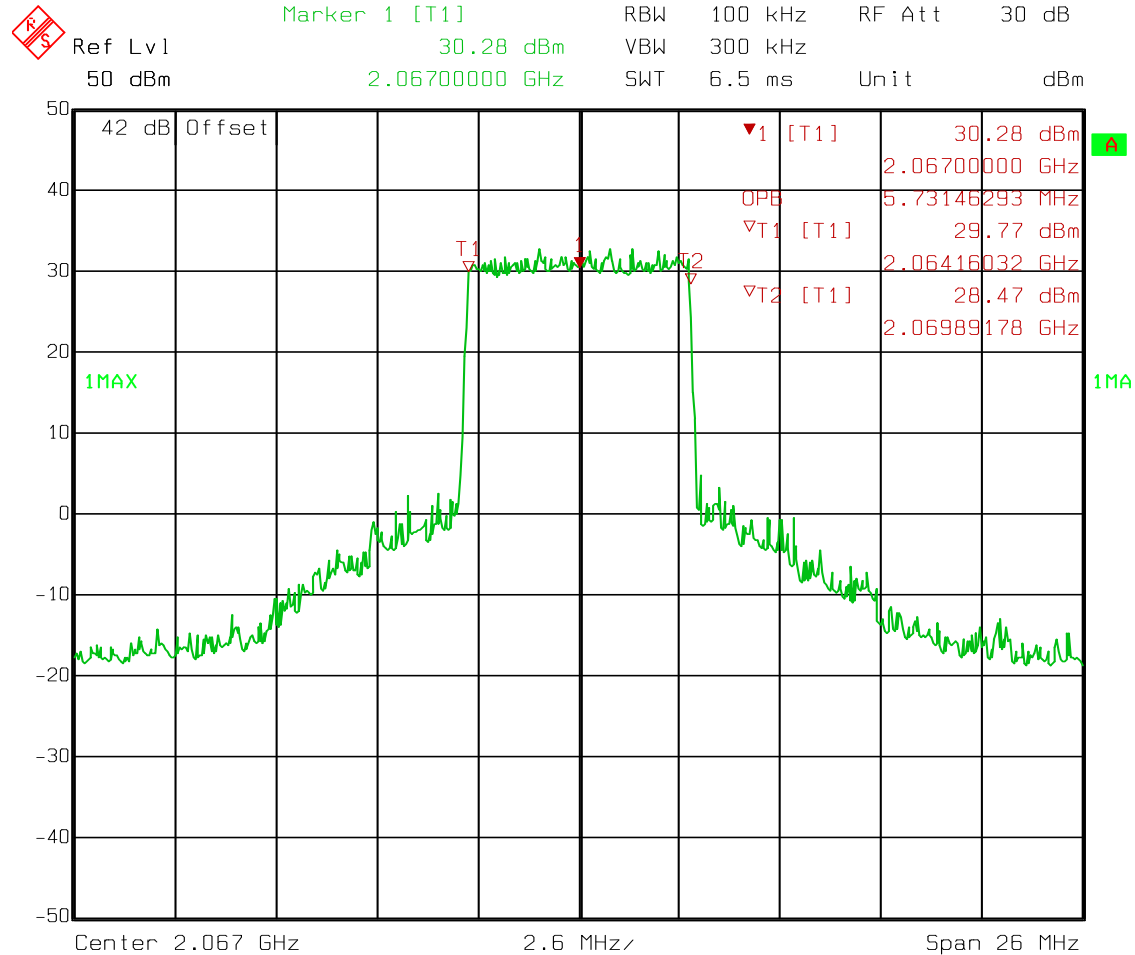


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FCC ID: CNVHC4-2

# Mid Channel 6 MHz 64QAM

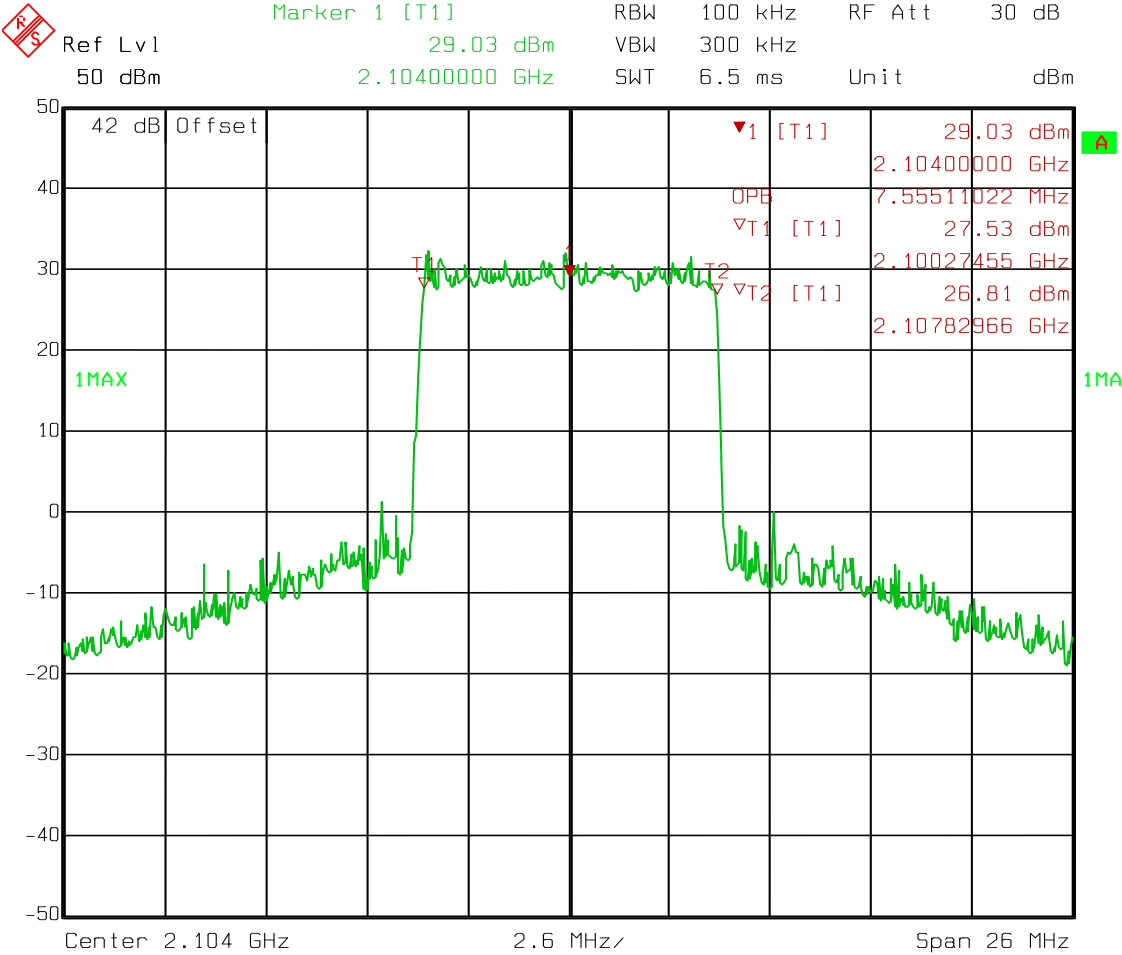


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FCC ID: CNVHC4-2

Upper Channel 8 MHz QPSK

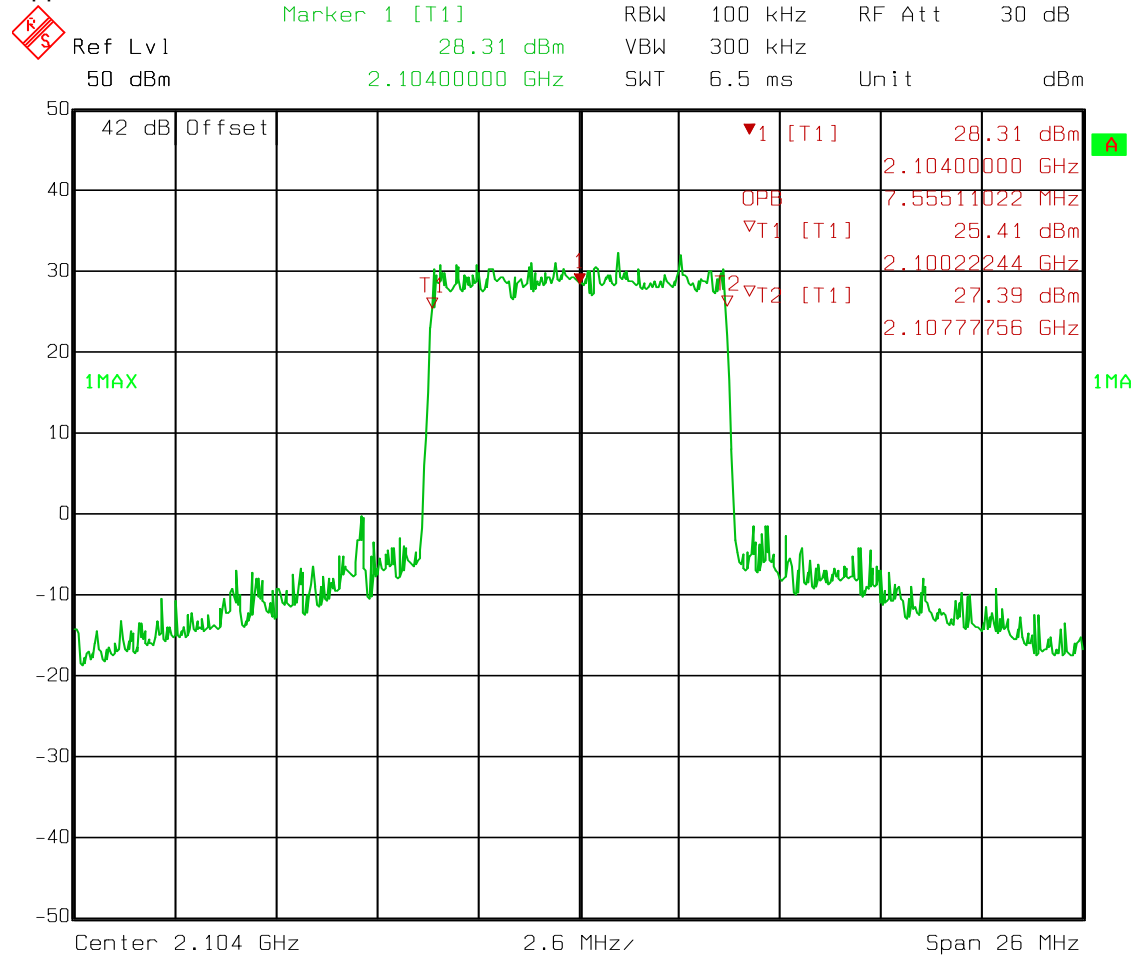


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FCC ID: CNVHC4-2

# Upper Channel 8 MHz 16QAM

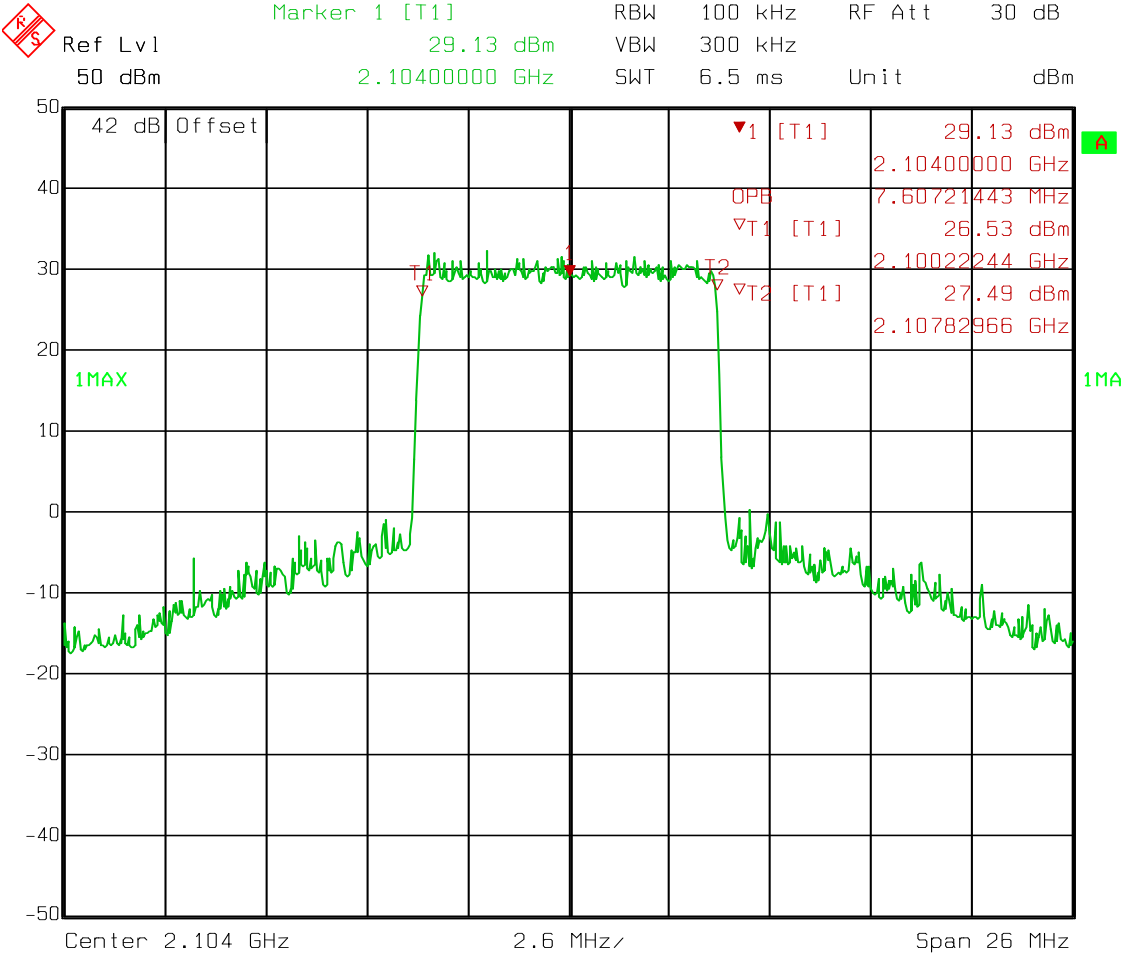


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FCC ID: CNVHC4-2

Upper Channel 8 MHz 64QAM

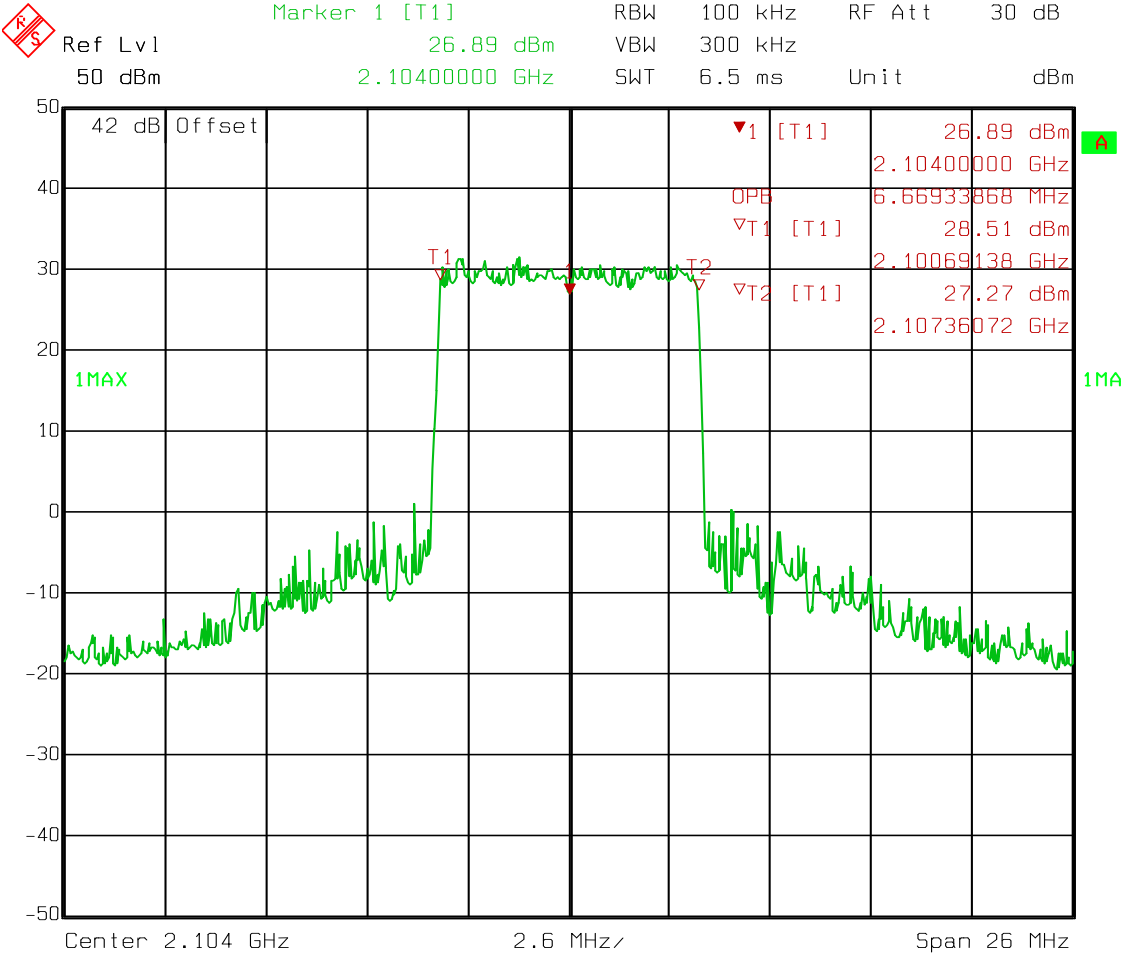


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Upper Channel 7 MHz QPSK

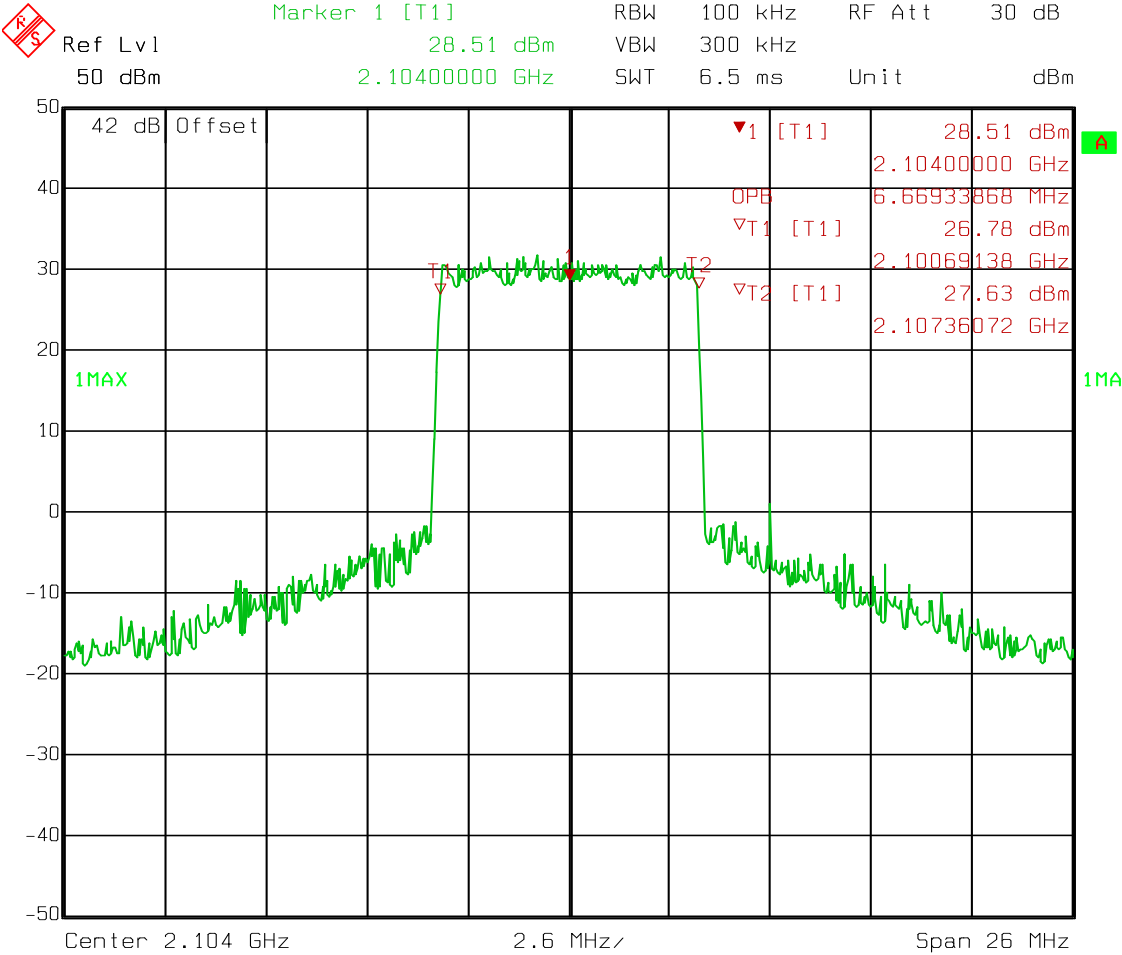


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Upper Channel 7 MHz 16QAM

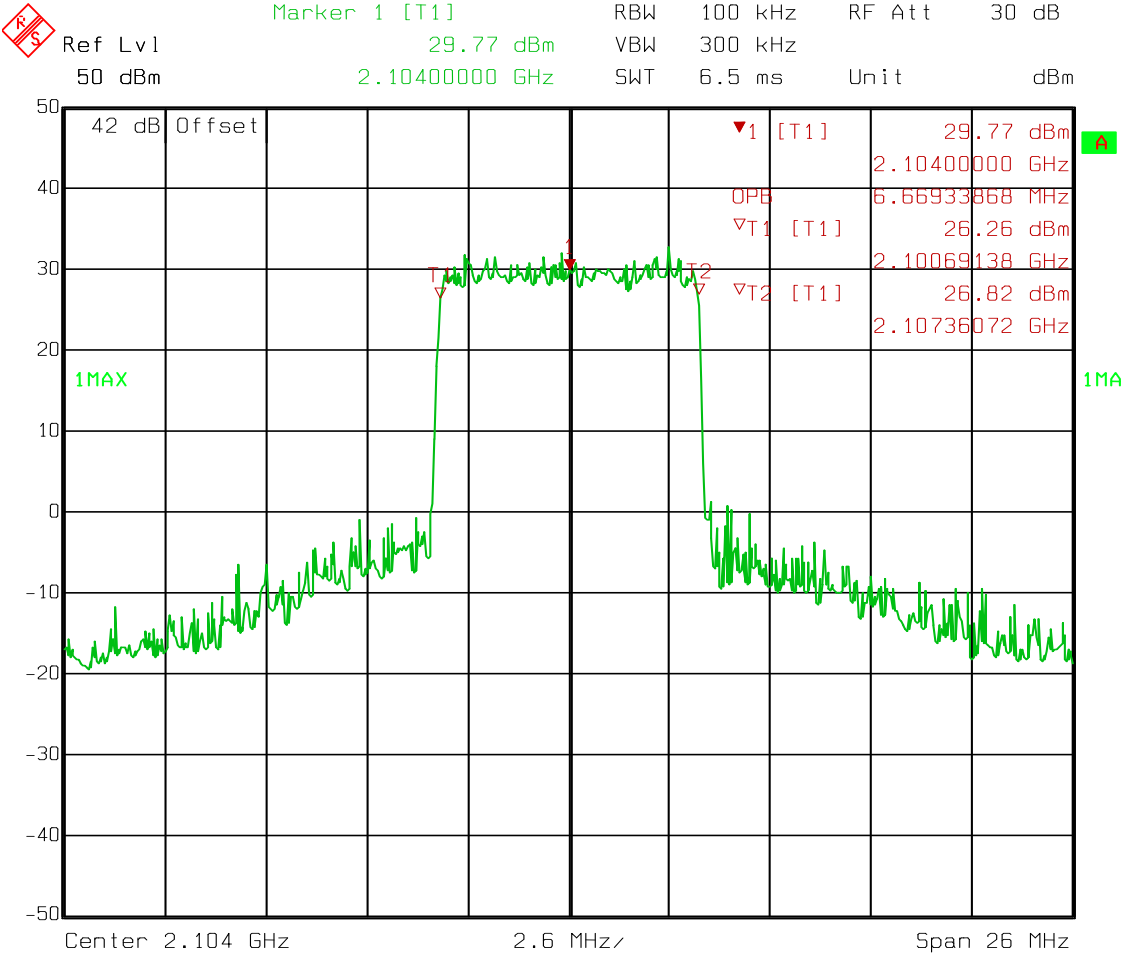


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FCC ID: CNVHC4-2

Upper Channel 7 MHz 64QAM

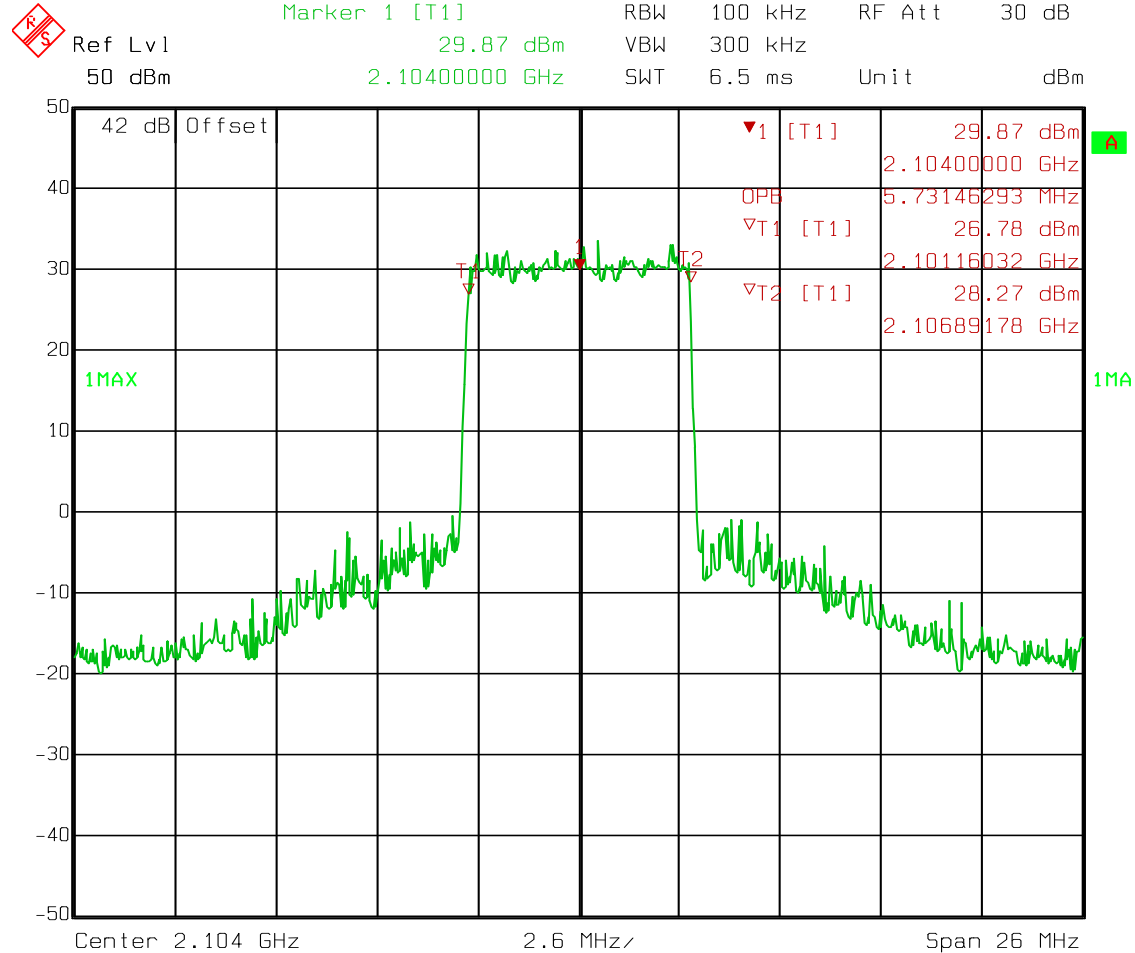


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

# Upper Channel 6 MHz QPSK

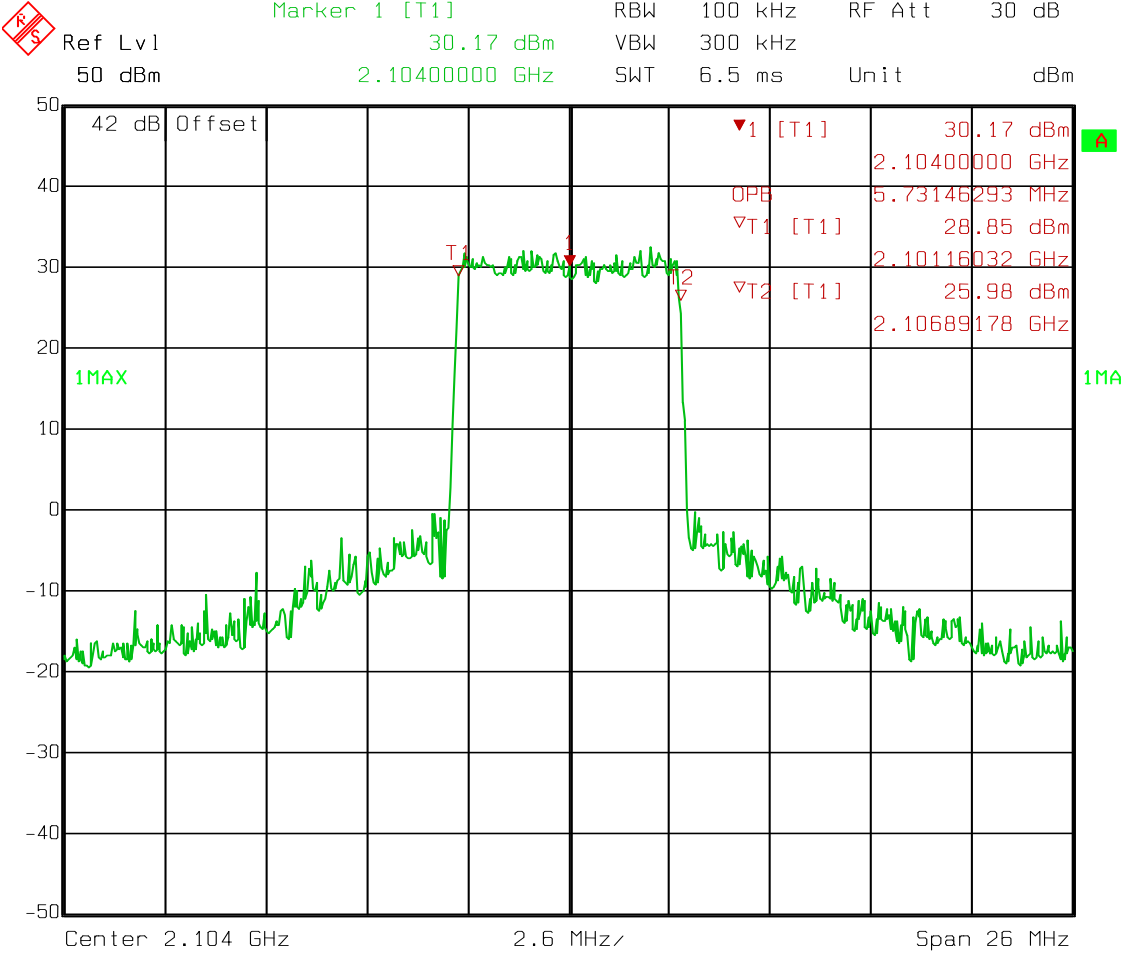


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FCC ID: CNVHC4-2

Upper Channel 6 MHz 16QAM

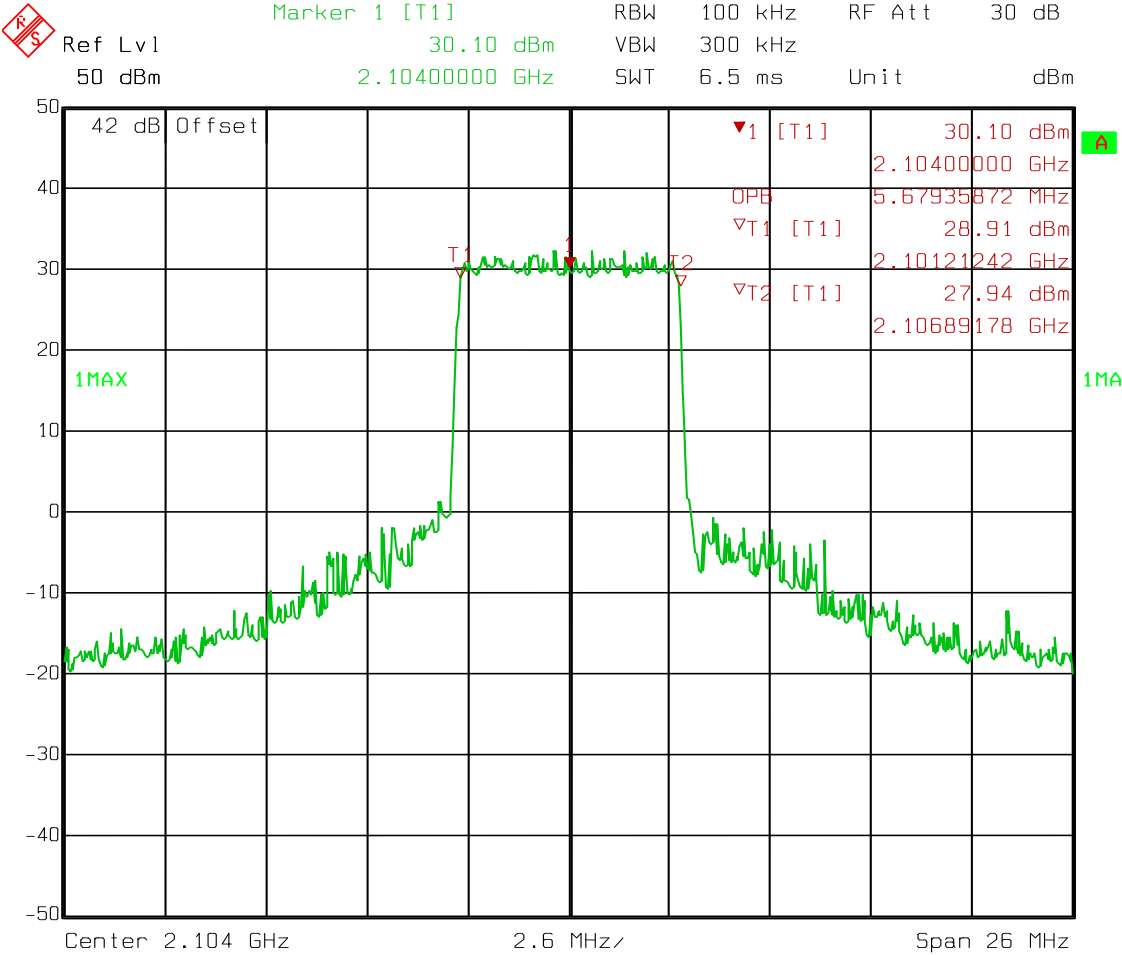


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FCC ID: CNVHC4-2

Upper Channel 6 MHz 64QAM



Date: 04.FEB.2014 09:55:11

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FCC ID: CNVHC4-2

# HIGH BAND

| Frequency | Modulation Bandwidth | Bandwidth (MHz) |
|-----------|----------------------|-----------------|
| 2456 MHz  | 8 MHz QPSK           | 7.6             |
|           | 8 MHz 16QAM          | 7.6             |
|           | 8 MHz 64QAM          | 7.6             |
|           | 7 MHz QPSK           | 6.7             |
|           | 7 MHz 16QAM          | 6.7             |
|           | 7 MHz 64QAM          | 6.7             |
|           | 6 MHz QPSK           | 5.7             |
|           | 6 MHz 16QAM          | 5.7             |
|           | 6 MHz 64 QAM         | 5.7             |
| 2467 MHz  | 8 MHz QPSK           | 7.6             |
|           | 8 MHz 16QAM          | 7.6             |
|           | 8 MHz 64QAM          | 7.9             |
|           | 7 MHz QPSK           | 6.7             |
|           | 7 MHz 16QAM          | 6.7             |
|           | 7 MHz 64QAM          | 6.7             |
|           | 6 MHz QPSK           | 5.7             |
|           | 6 MHz 16QAM          | 5.7             |
|           | 6 MHz 64 QAM         | 5.7             |
| 2477 MHz  | 8 MHz QPSK           | 7.6             |
|           | 8 MHz 16QAM          | 7.6             |
|           | 8 MHz 64QAM          | 7.6             |
|           | 7 MHz QPSK           | 6.7             |
|           | 7 MHz 16QAM          | 6.6             |
|           | 7 MHz 64QAM          | 6.7             |
|           | 6 MHz QPSK           | 5.7             |
|           | 6 MHz 16QAM          | 5.7             |
|           | 6 MHz 64 QAM         | 5.7             |

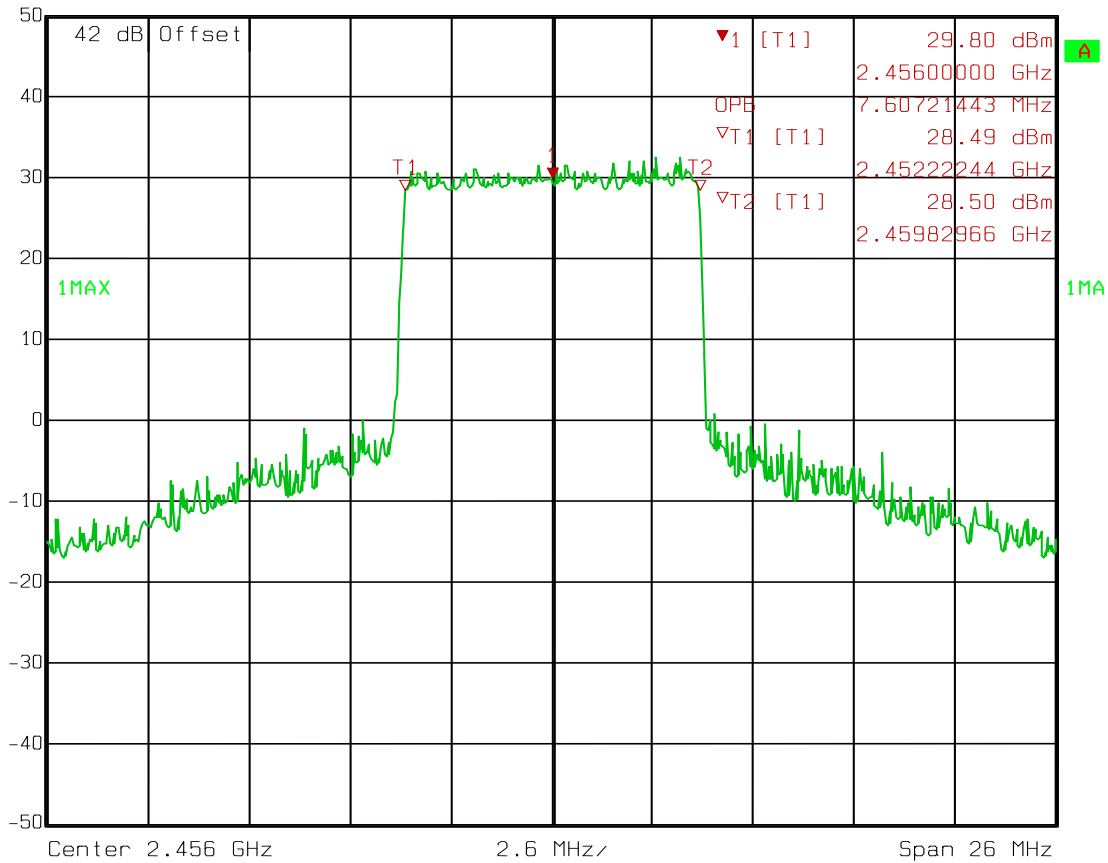
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

# Low Channel 8 MHz QPSK



Marker 1 [T1] RBW 100 kHz RF Att 30 dB  
 Ref Lvl 29.80 dBm VBW 300 kHz  
 50 dBm 2.45600000 GHz SWT 6.5 ms Unit dBm



Date: 04.FEB.2014 09:58:58

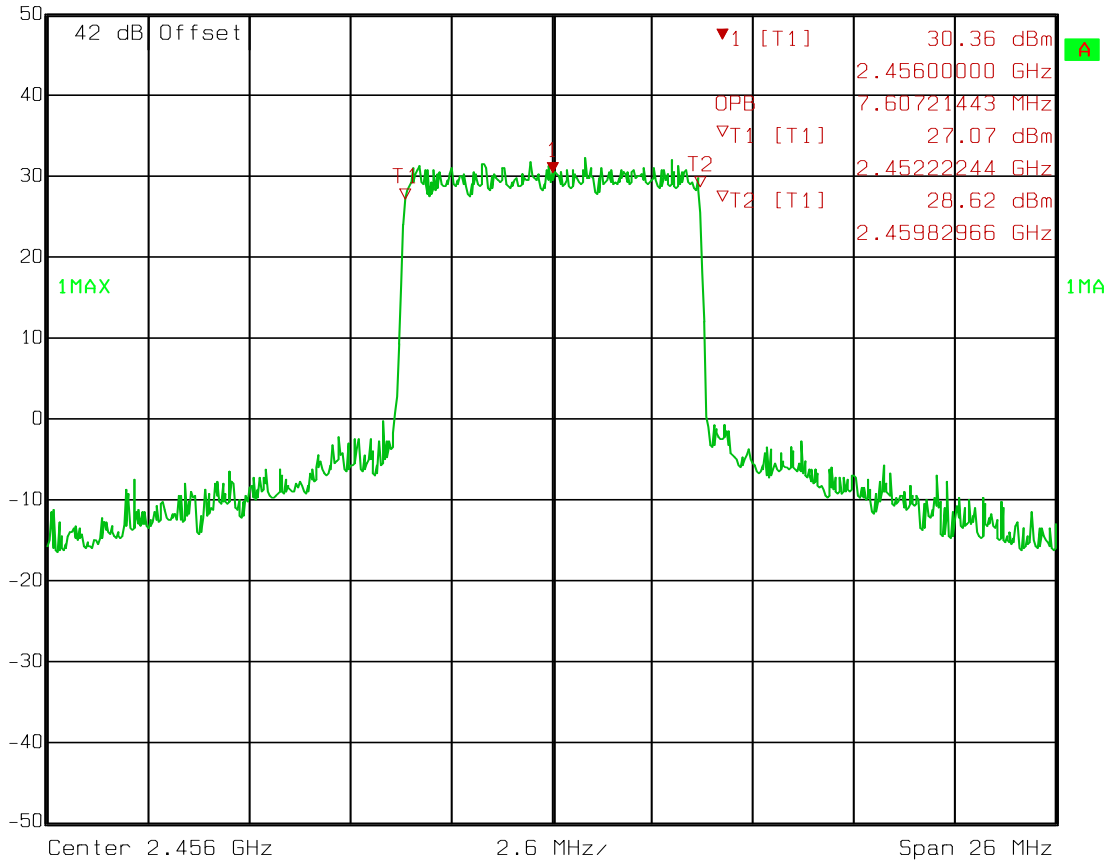
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FCC ID: CNVHC4-2

# Low Channel 8 MHz 16QAM



Marker 1 [T1] RBW 100 kHz RF Att 30 dB  
 Ref Lvl 30.36 dBm VBW 300 kHz  
 50 dBm 2.45600000 GHz SWT 6.5 ms Unit dBm

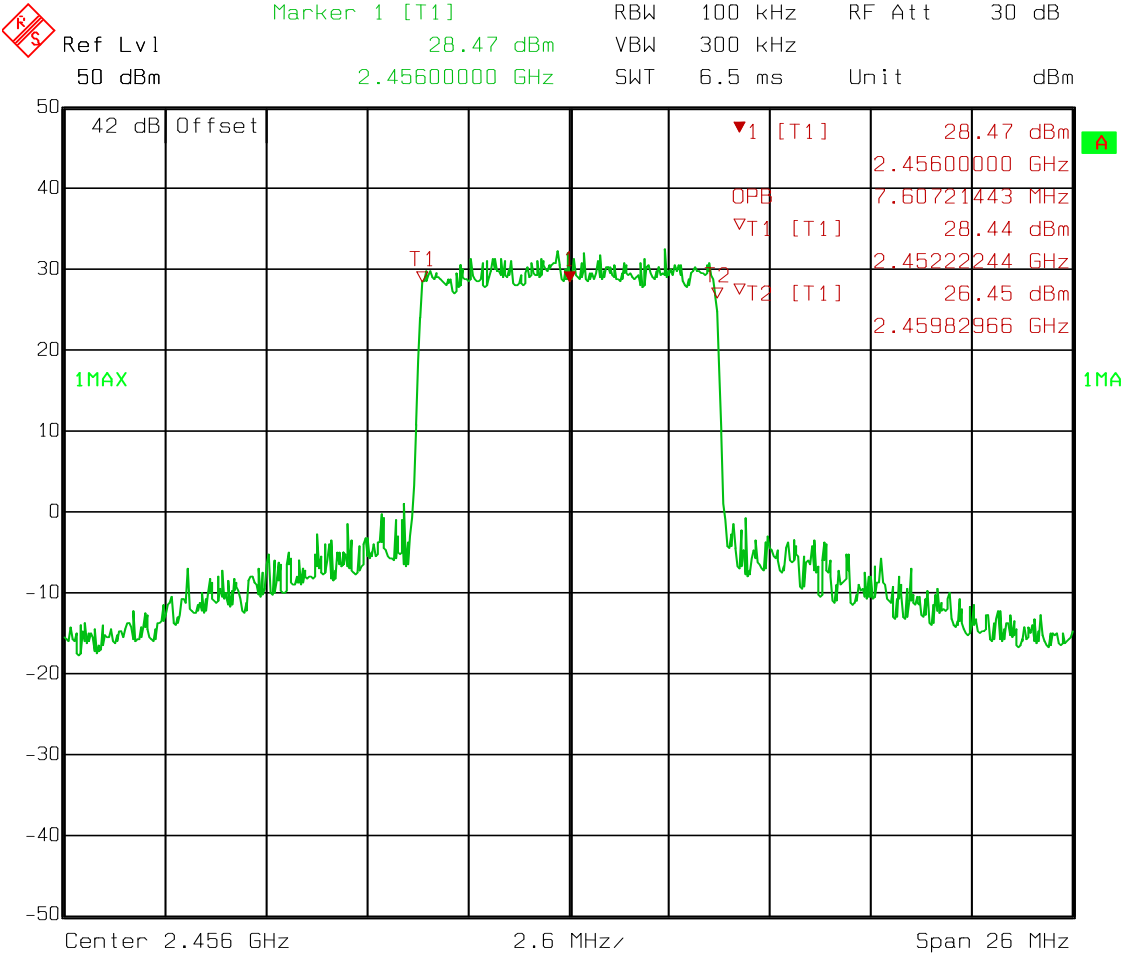


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FCC ID: CNVHC4-2

Low Channel 8 MHz 64QAM



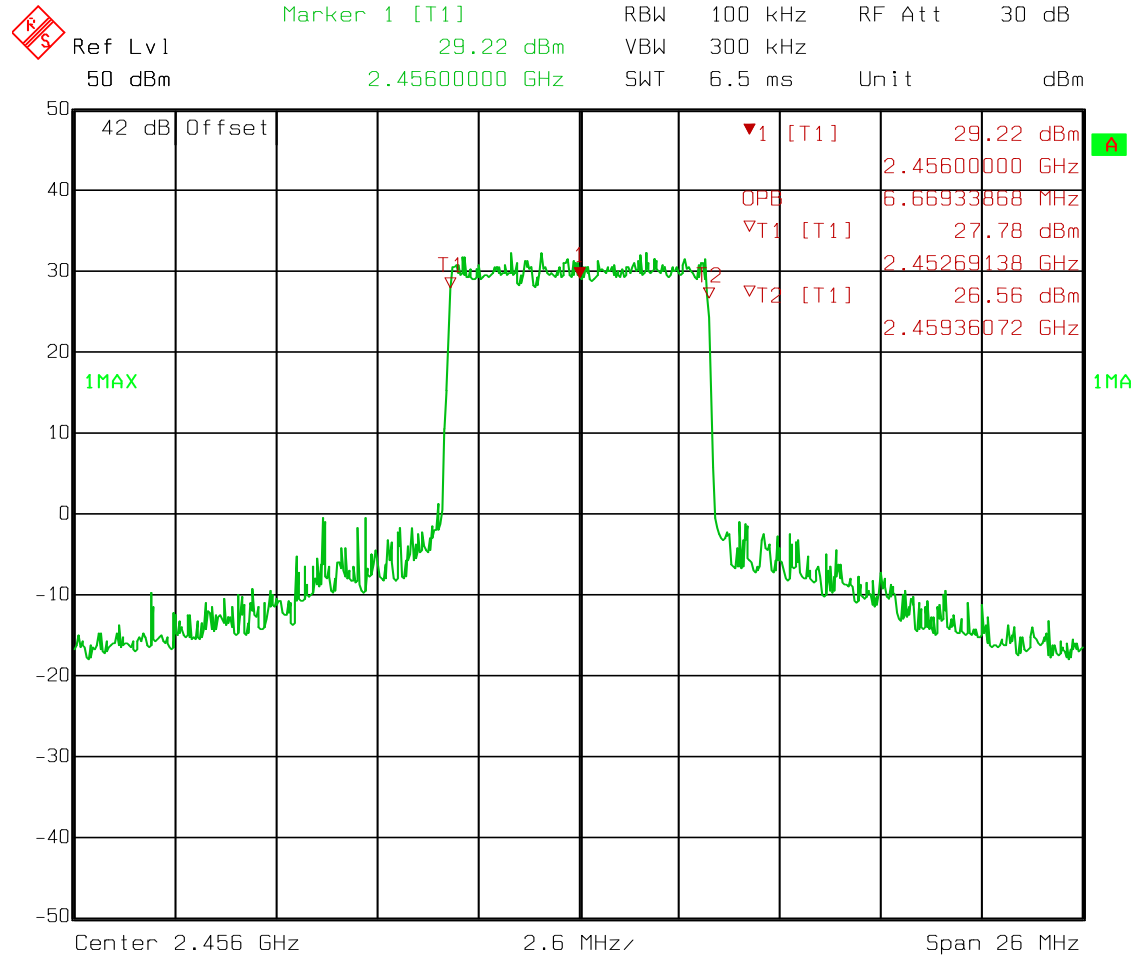
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FCC ID: CNVHC4-2

# Low Channel 7 MHz 16QAM



Date: 04.FEB.2014 10:00:52





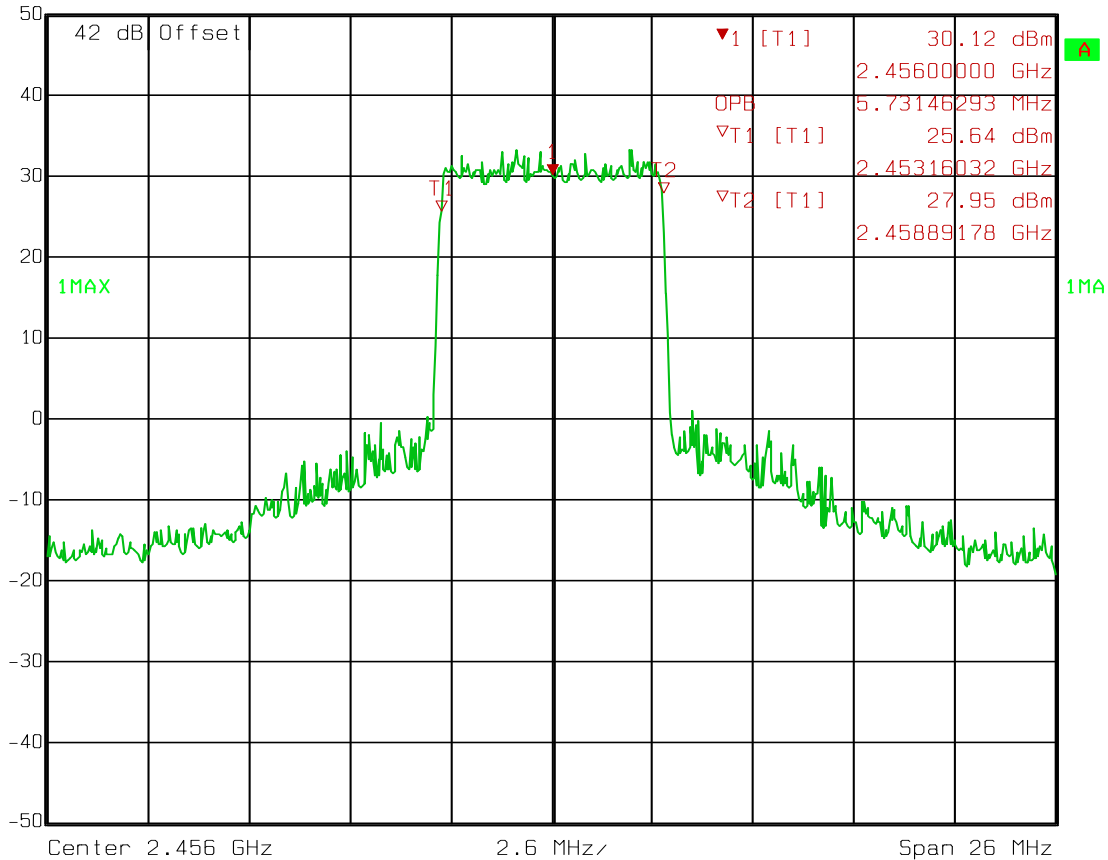
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FCC ID: CNVHC4-2

# Low Channel 6 MHz 16QAM



Marker 1 [T1] RBW 100 kHz RF Att 30 dB  
 Ref Lvl 30.12 dBm VBW 300 kHz  
 50 dBm 2.45600000 GHz SWT 6.5 ms Unit dBm

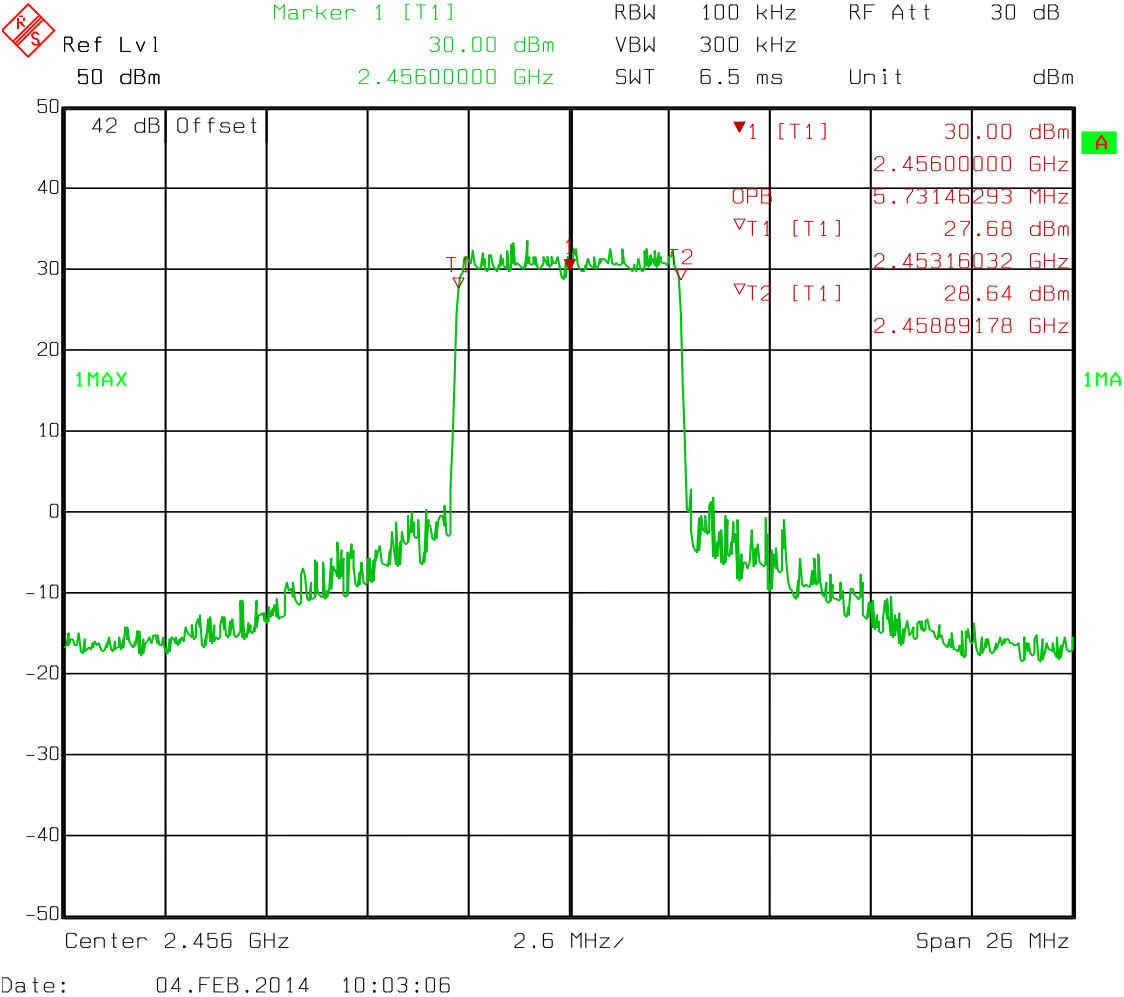


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|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-----------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 48 of 146 |

FCC ID: CNVHC4-2

Low Channel 6 MHz 64 QAM

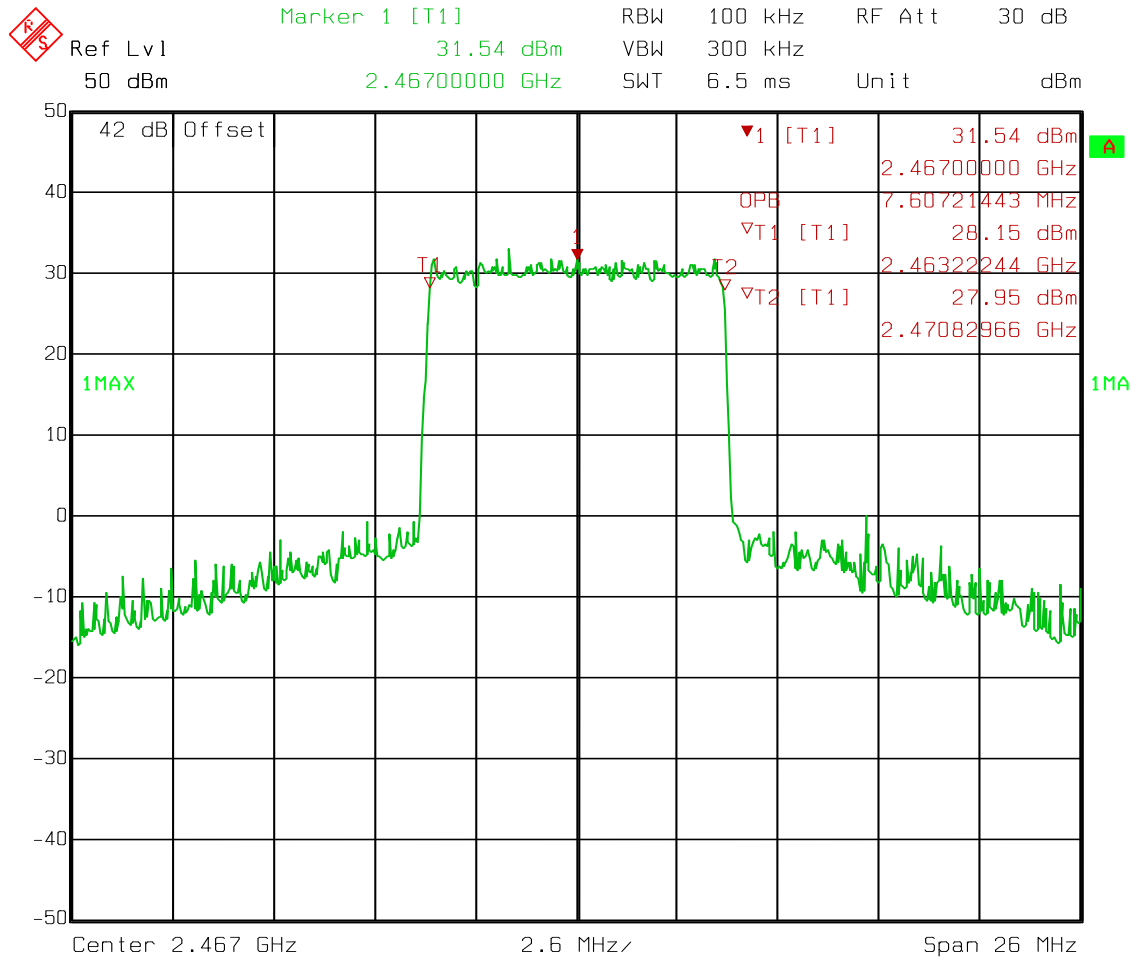




|                        |                                 |                                                                                               |           |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-----------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 50 of 146 |

FCC ID: CNVHC4-2

Mid Channel 8 MHz

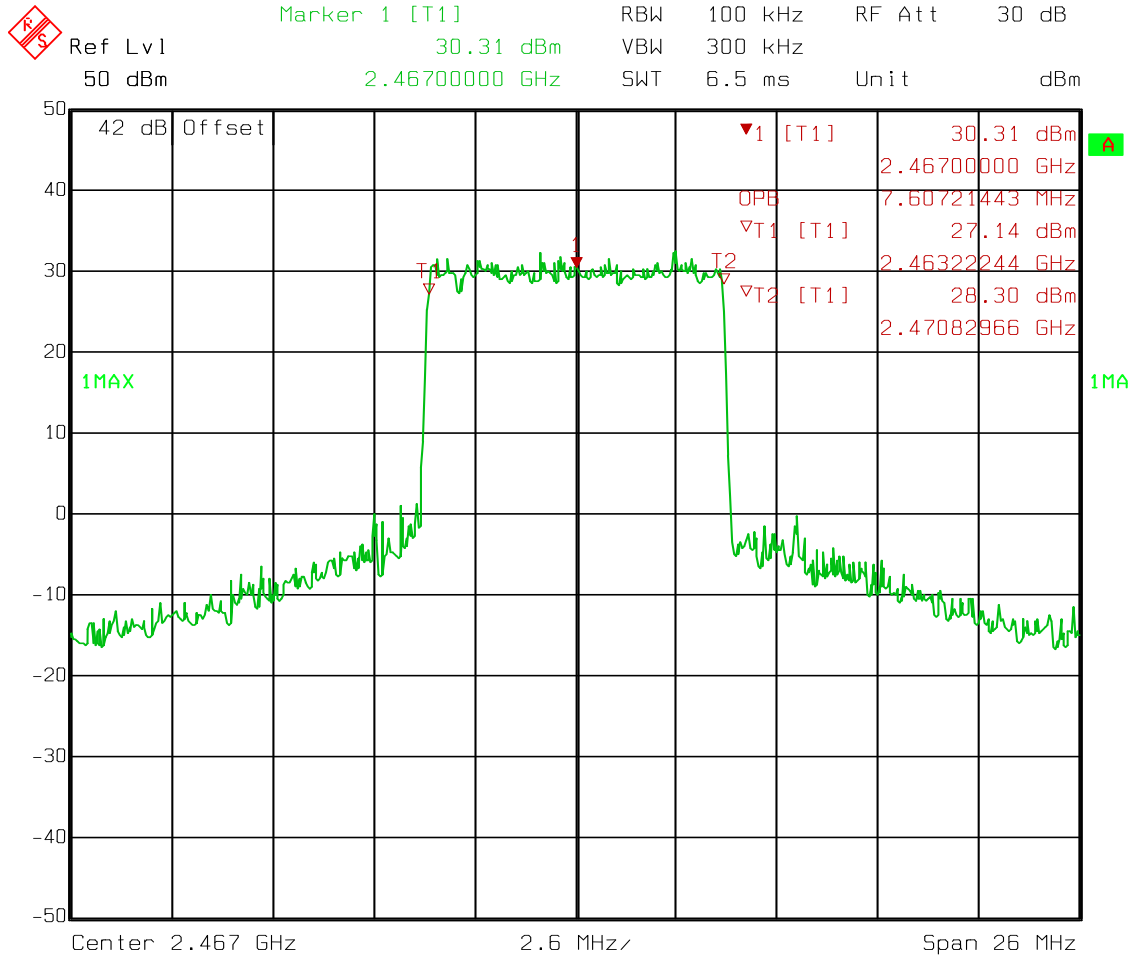


16QAM Date: 04.FEB.2014 10:04:45

|                        |                                 |                                                                                               |           |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-----------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Mid Channel 8 MHz 64

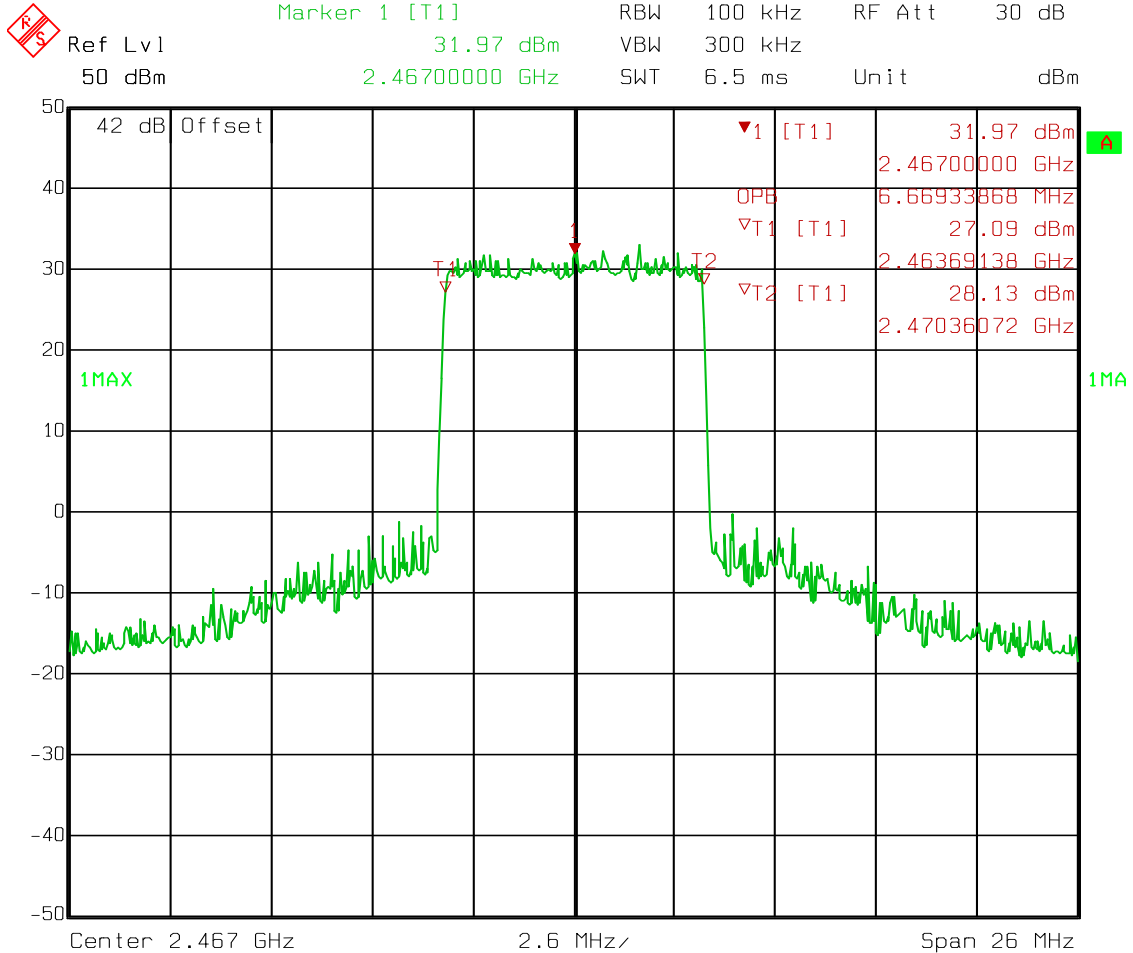


QAM Date: 04.FEB.2014 10:05:14

|                        |                                 |                                                                                               |           |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-----------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

# Mid Channel 7 MHz

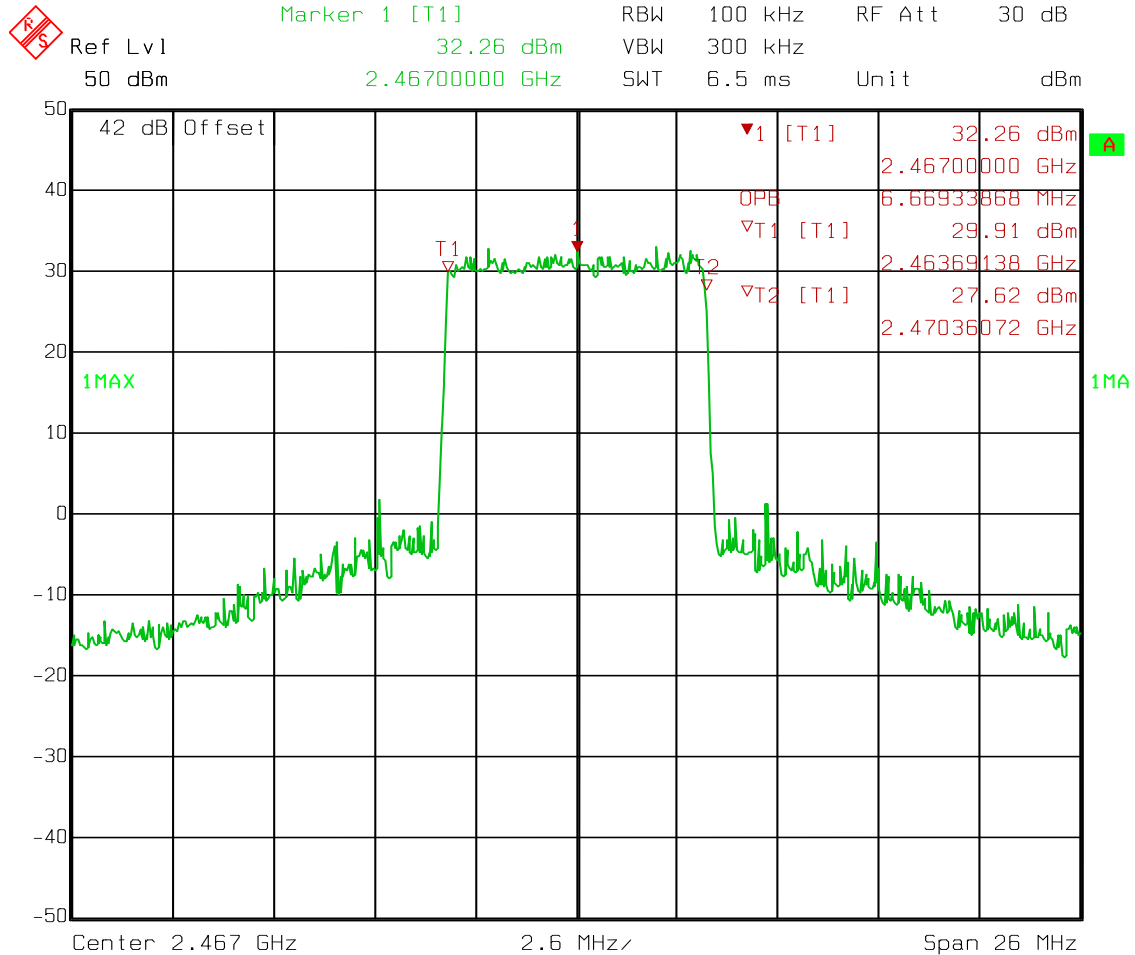


QPSK Date: 04.FEB.2014 10:05:45

|                        |                                 |                                                                                               |           |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-----------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

# Mid Channel 7 MHz

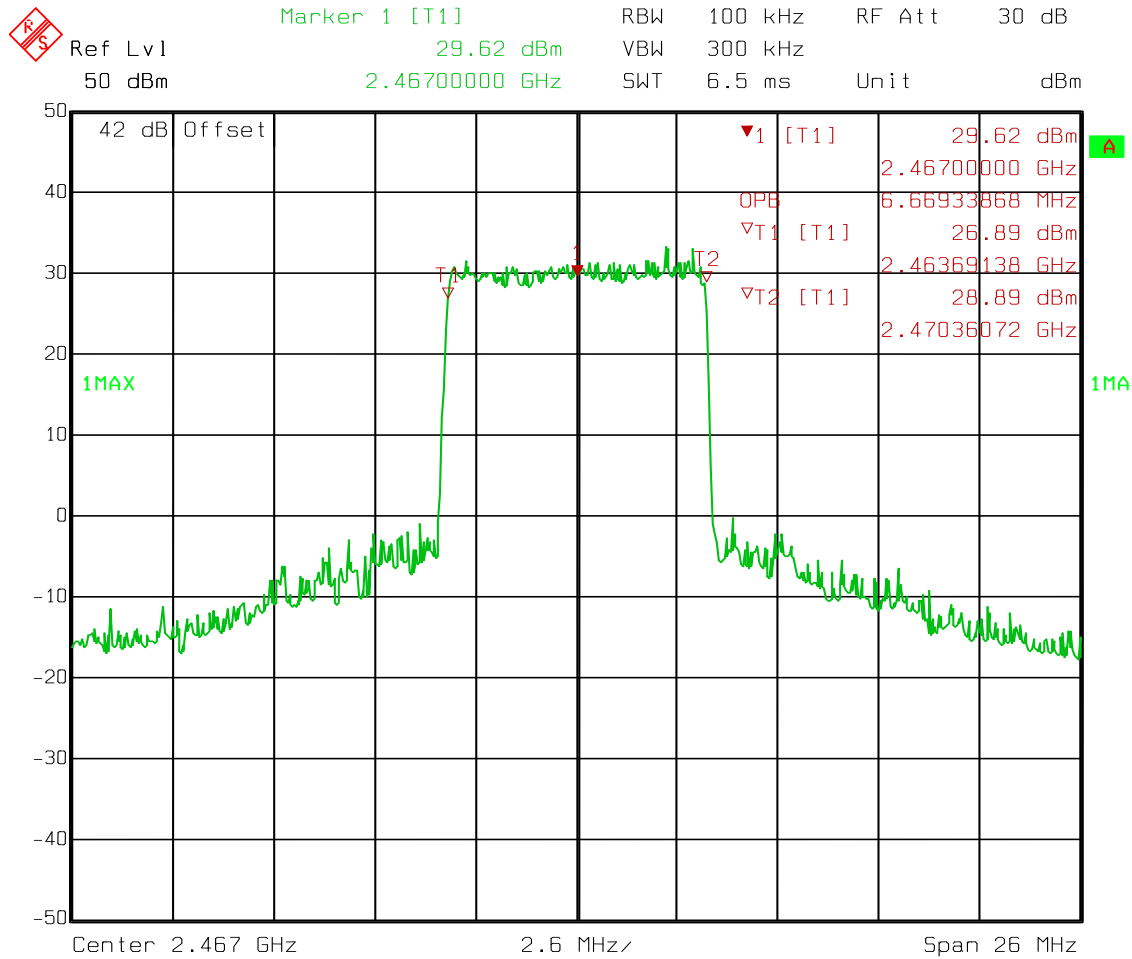


16QAM Date: 04.FEB.2014 10:06:51

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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 54 of 146 |

FCC ID: CNVHC4-2

Mid Channel 7 MHz

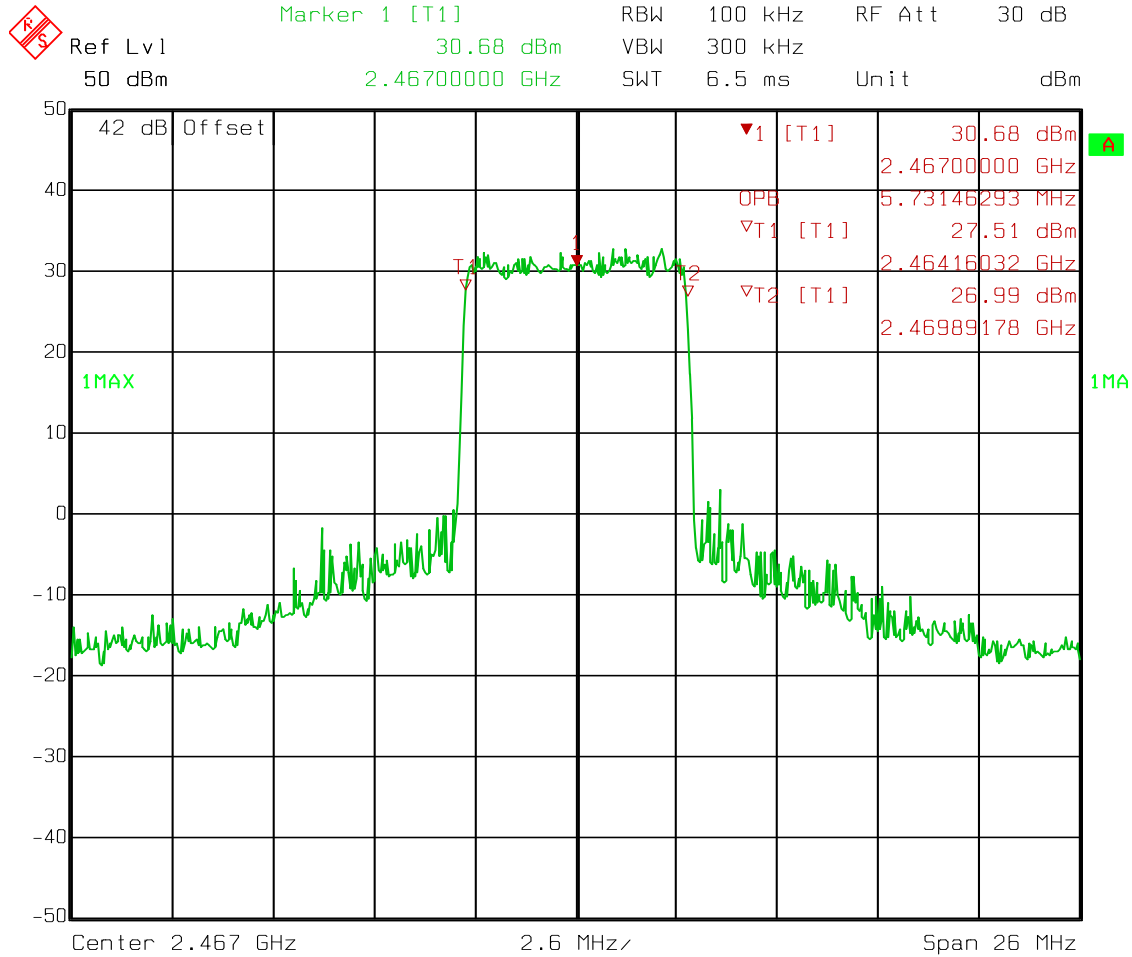


64QAM Date: 04.FEB.2014 10:07:32

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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Mid Channel 6 MHz

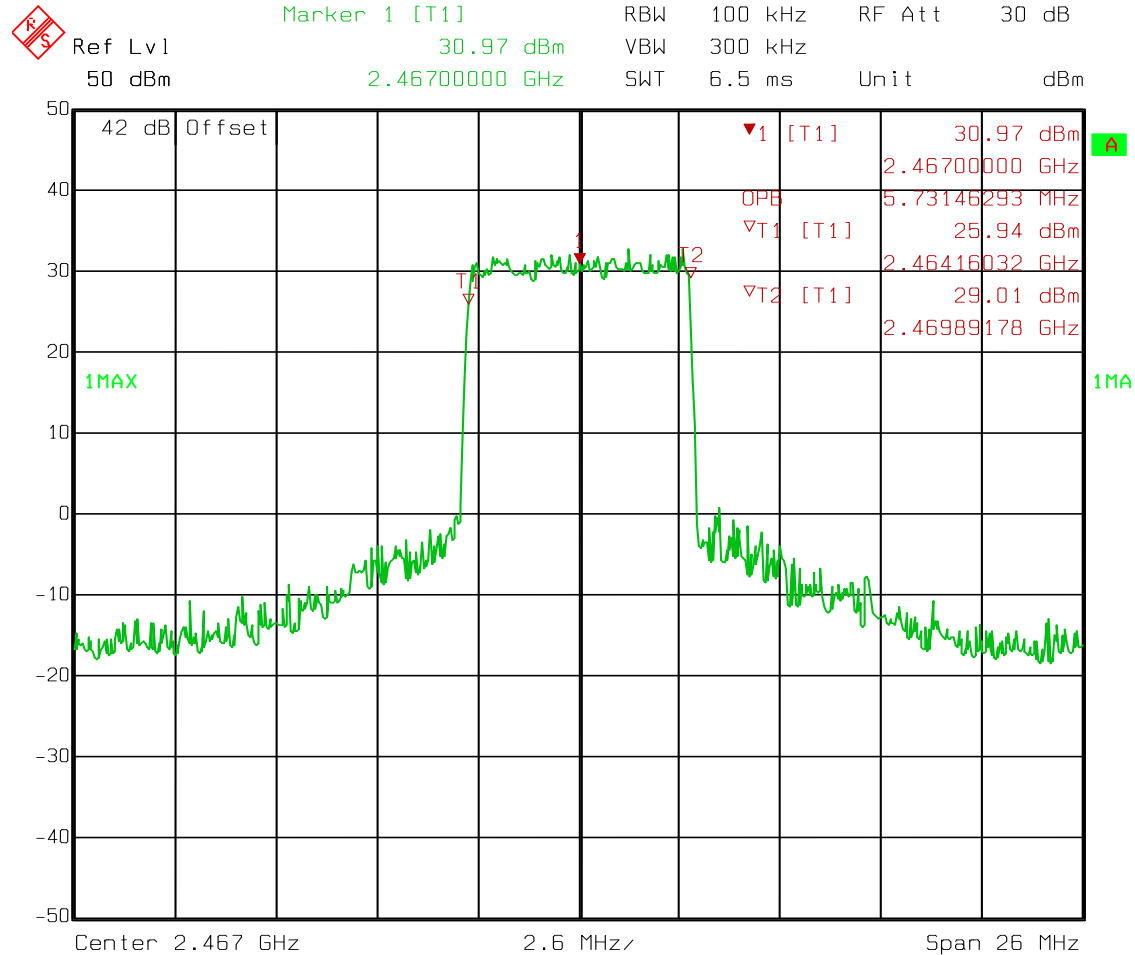


QPSK Date: 04.FEB.2014 10:08:05

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|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-----------|
| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |           |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 56 of 146 |

FCC ID: CNVHC4-2

# Mid Channel 6 MHz 16QAM

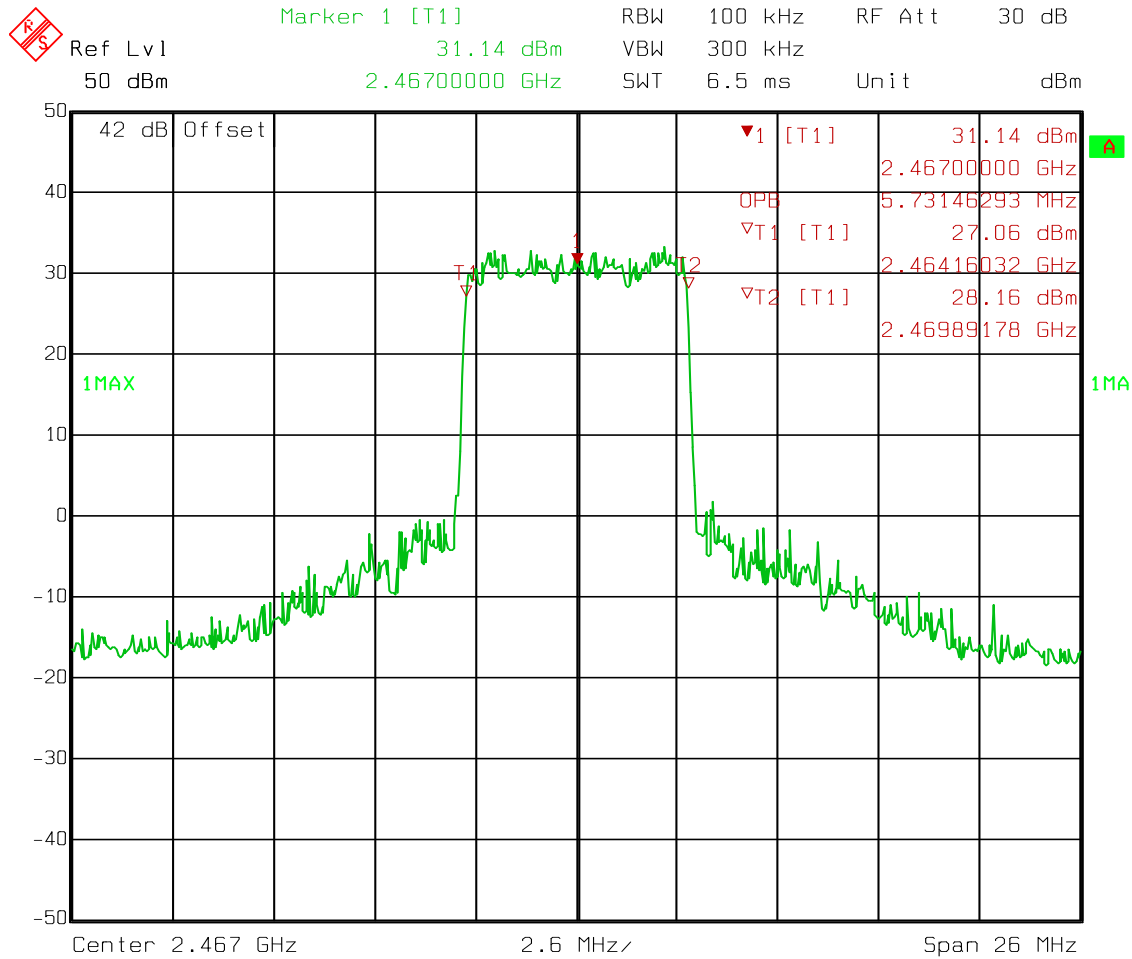


Date: 04.FEB.2014 10:09:14

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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Mid Channel 6 MHz

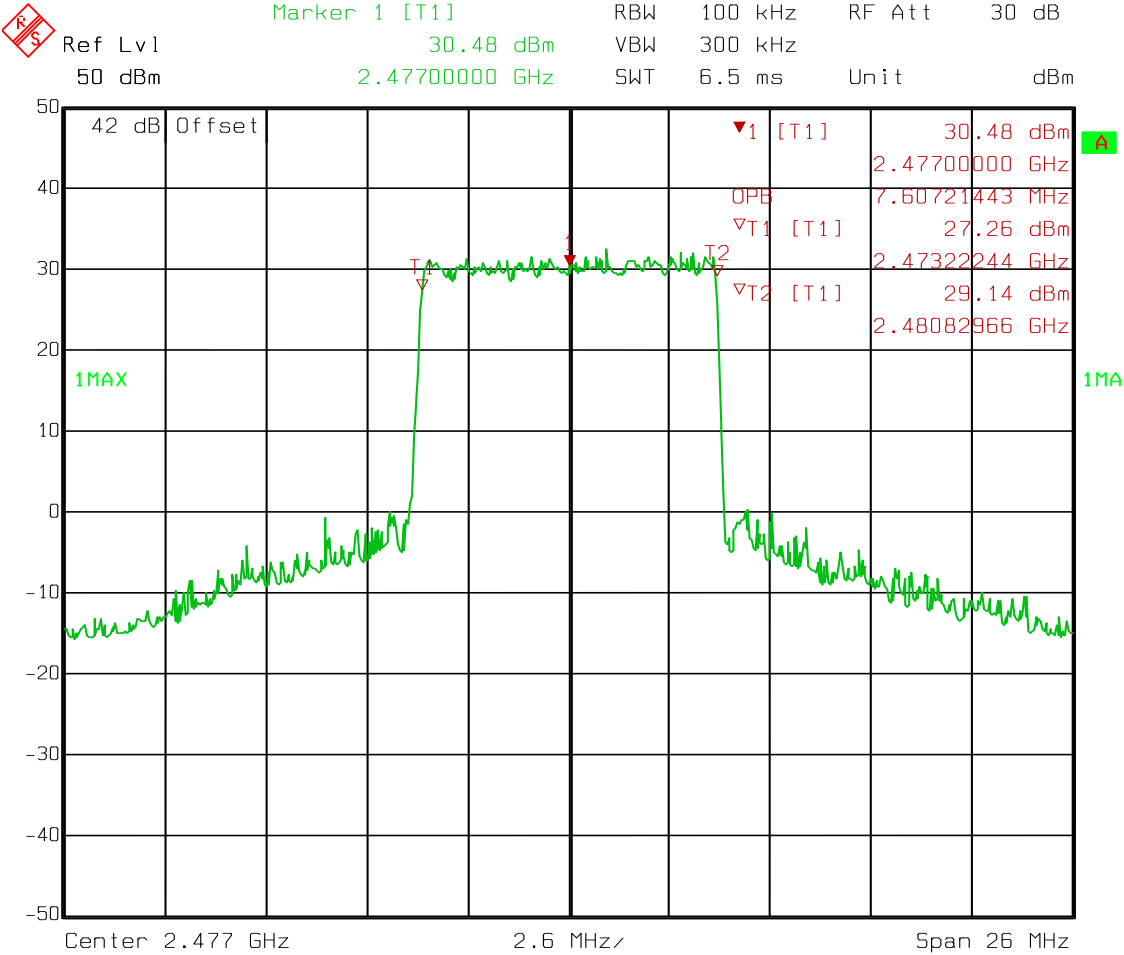


64QAM Date: 04.FEB.2014 10:09:48

|                        |                                 |                                                                                               |           |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-----------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 58 of 146 |

FCC ID: CNVHC4-2

Upper Channel 8 MHz QPSK

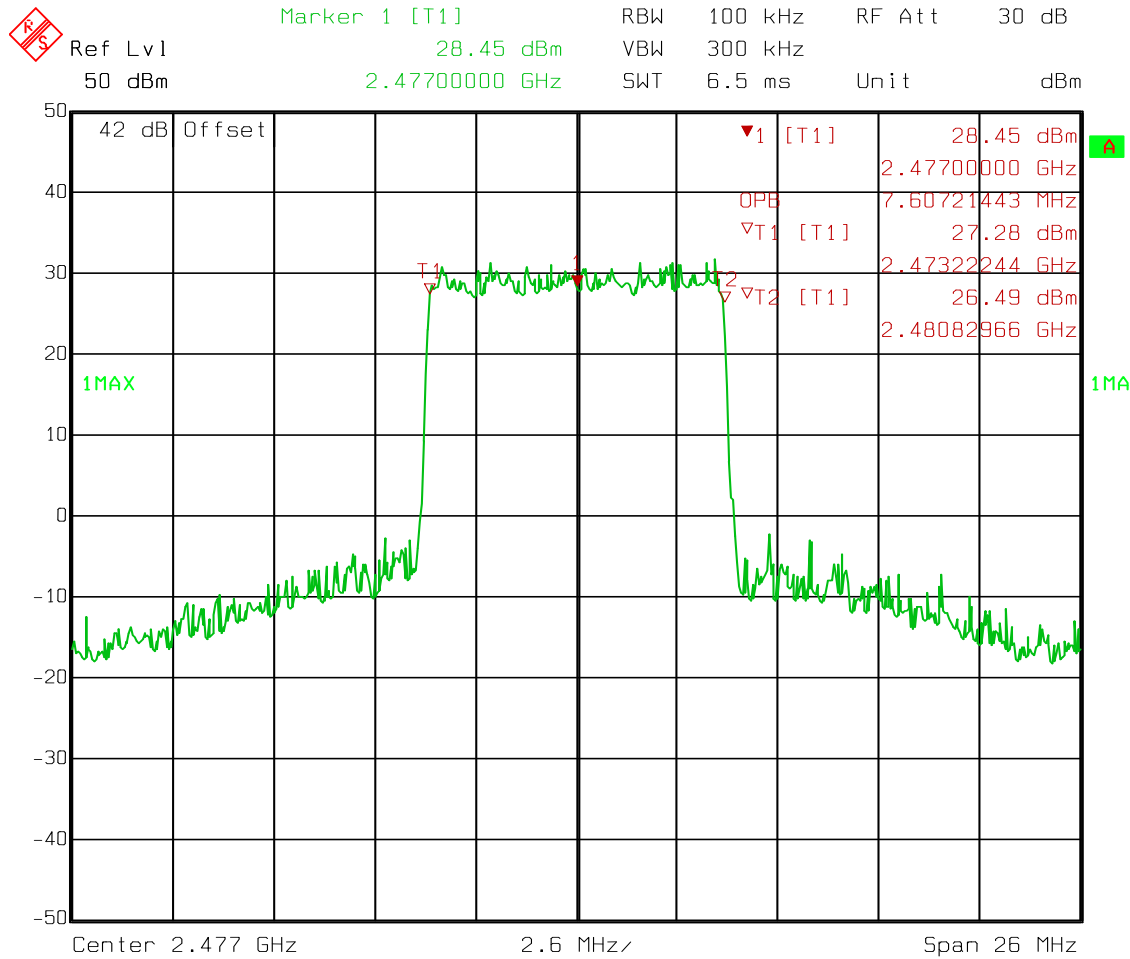


Date: 04.FEB.2014 10:11:23

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|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-----------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 59 of 146 |

FCC ID: CNVHC4-2

Upper Channel 8 MHz

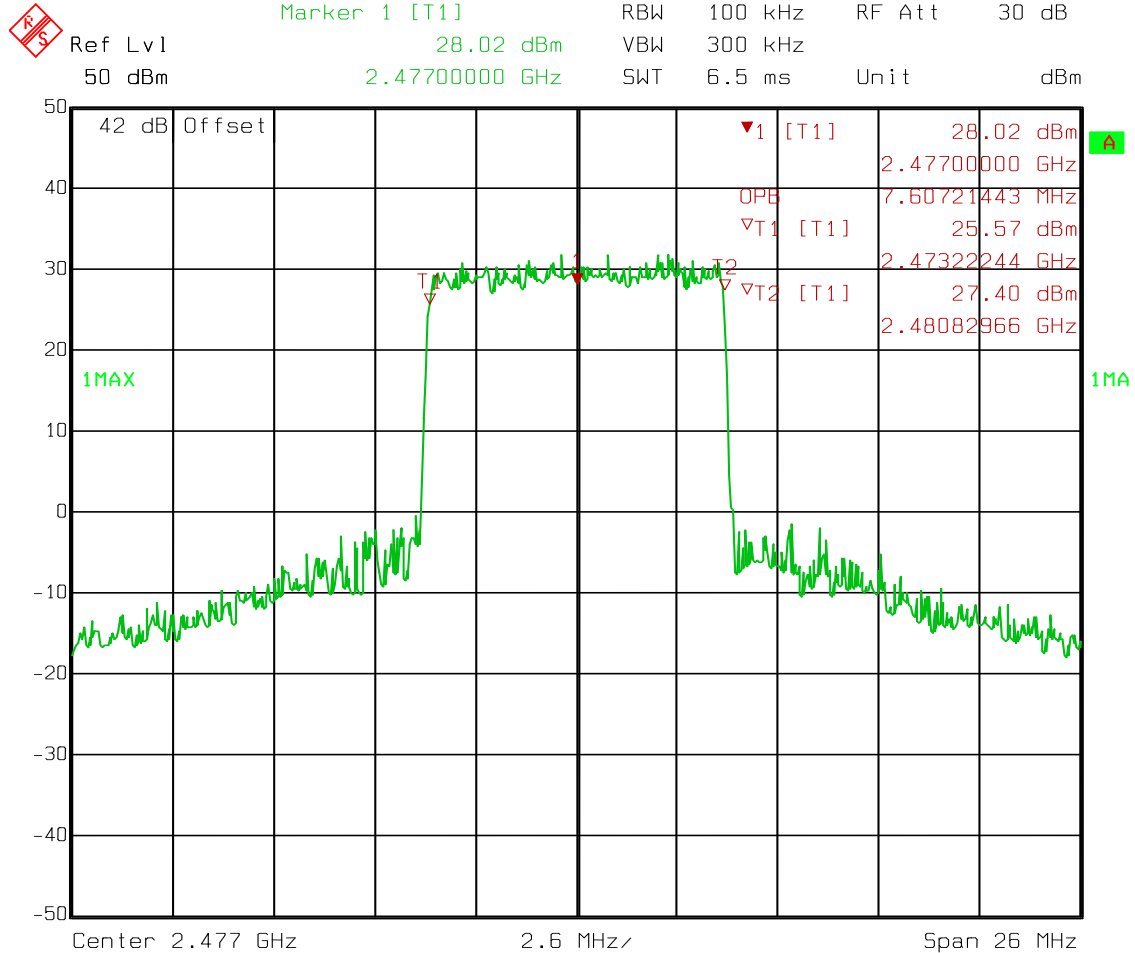


16QAM Date: 04.FEB.2014 10:11:48

|                        |                                 |                                                                                               |           |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-----------|
| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |           |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Upper Channel 8 MHz

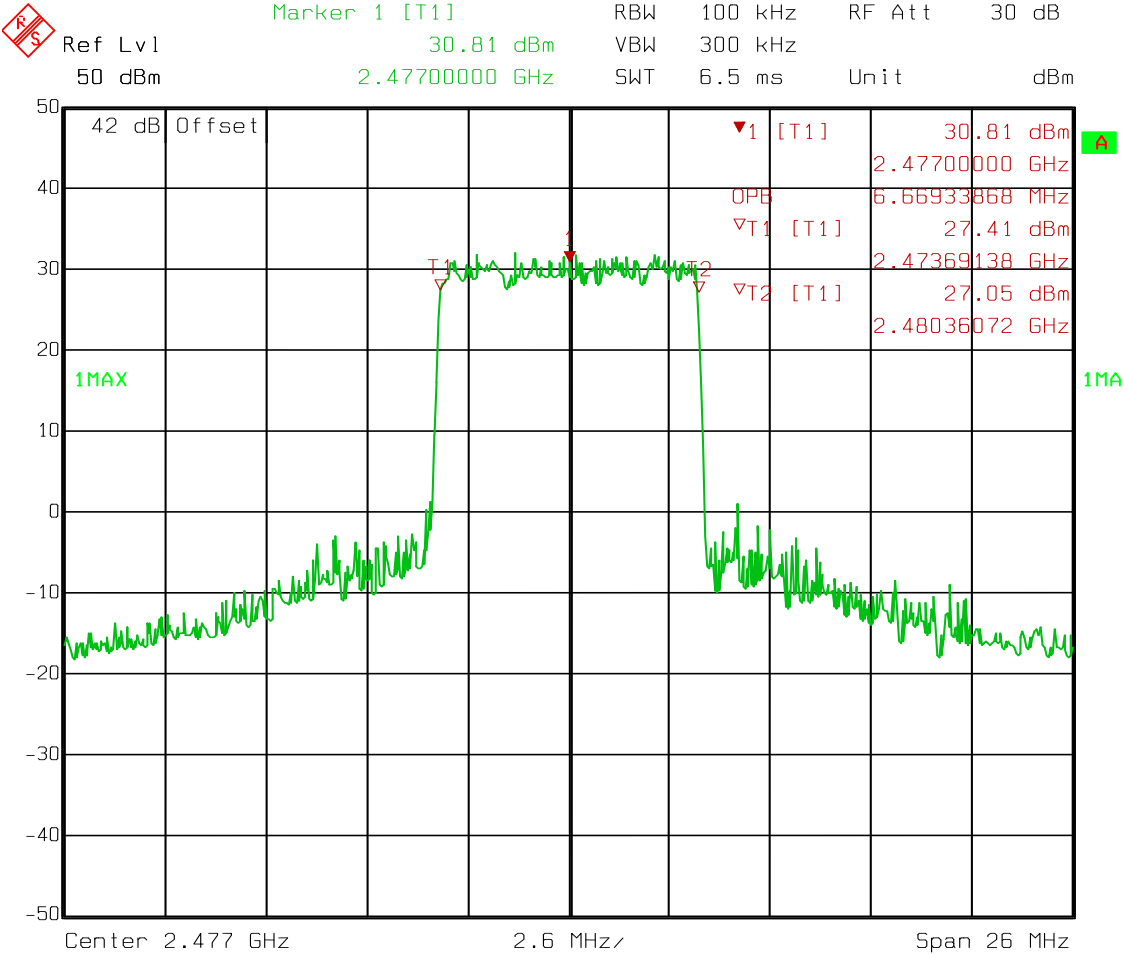


64QAM Date: 04.FEB.2014 10:12:25

|                        |                                 |                                                                                               |           |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-----------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Upper Channel 7 MHz QPSK

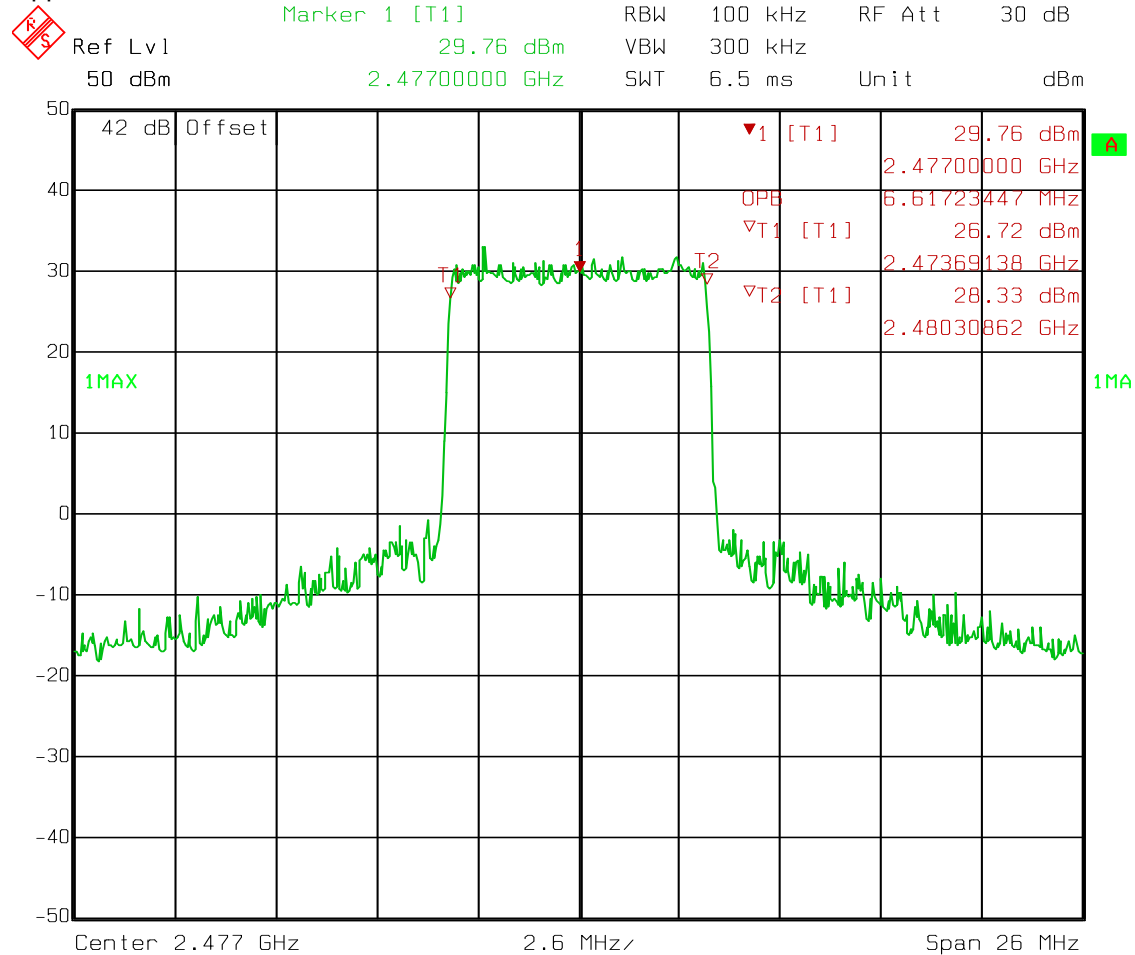


Date: 04.FEB.2014 10:12:55

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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

# Upper Channel 7 MHz 16QAM



Date: 04.FEB.2014 10:13:23

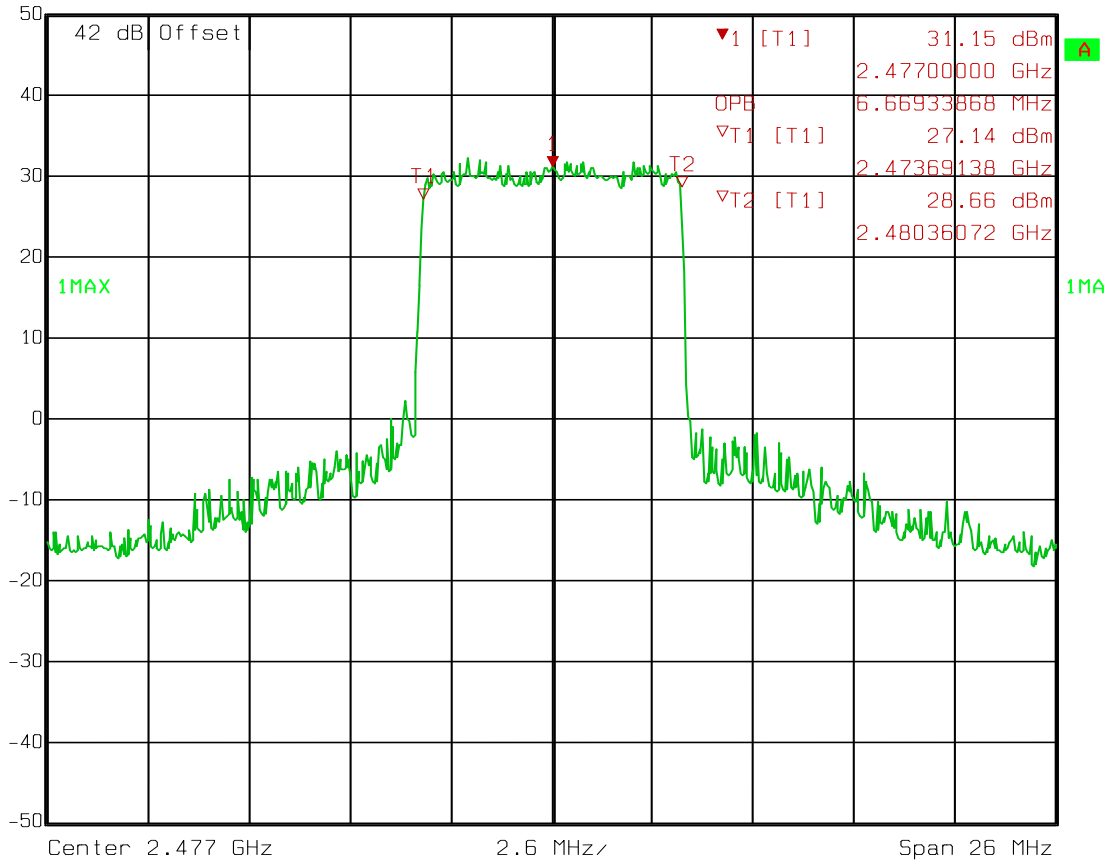
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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |           |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

# Upper Channel 7 MHz 64QAM



Marker 1 [T1] RBW 100 kHz RF Att 30 dB  
Ref Lvl 31.15 dBm VBW 300 kHz  
50 dBm 2.47700000 GHz SWT 6.5 ms Unit dBm

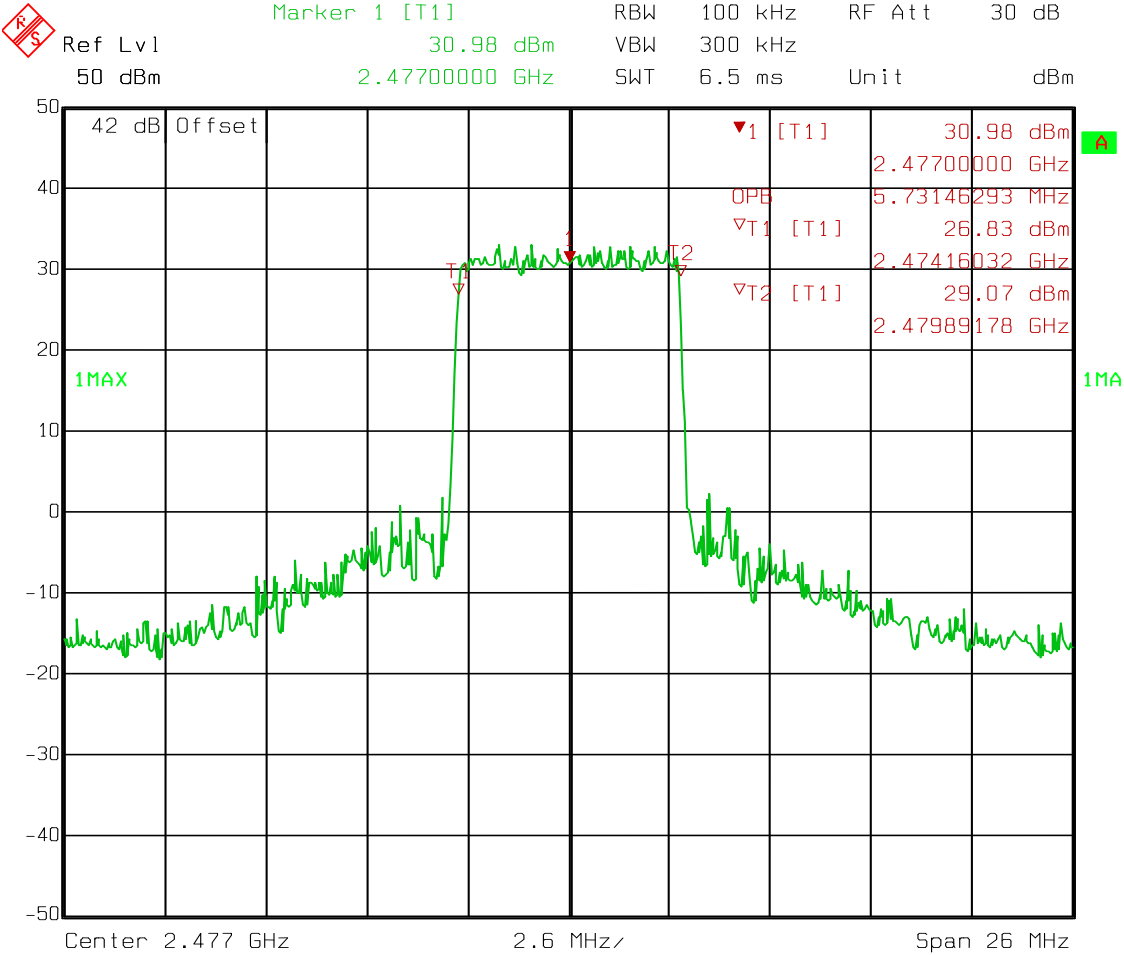


Date: 04.FEB.2014 10:13:46

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|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-----------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Upper Channel 6 MHz QPSK



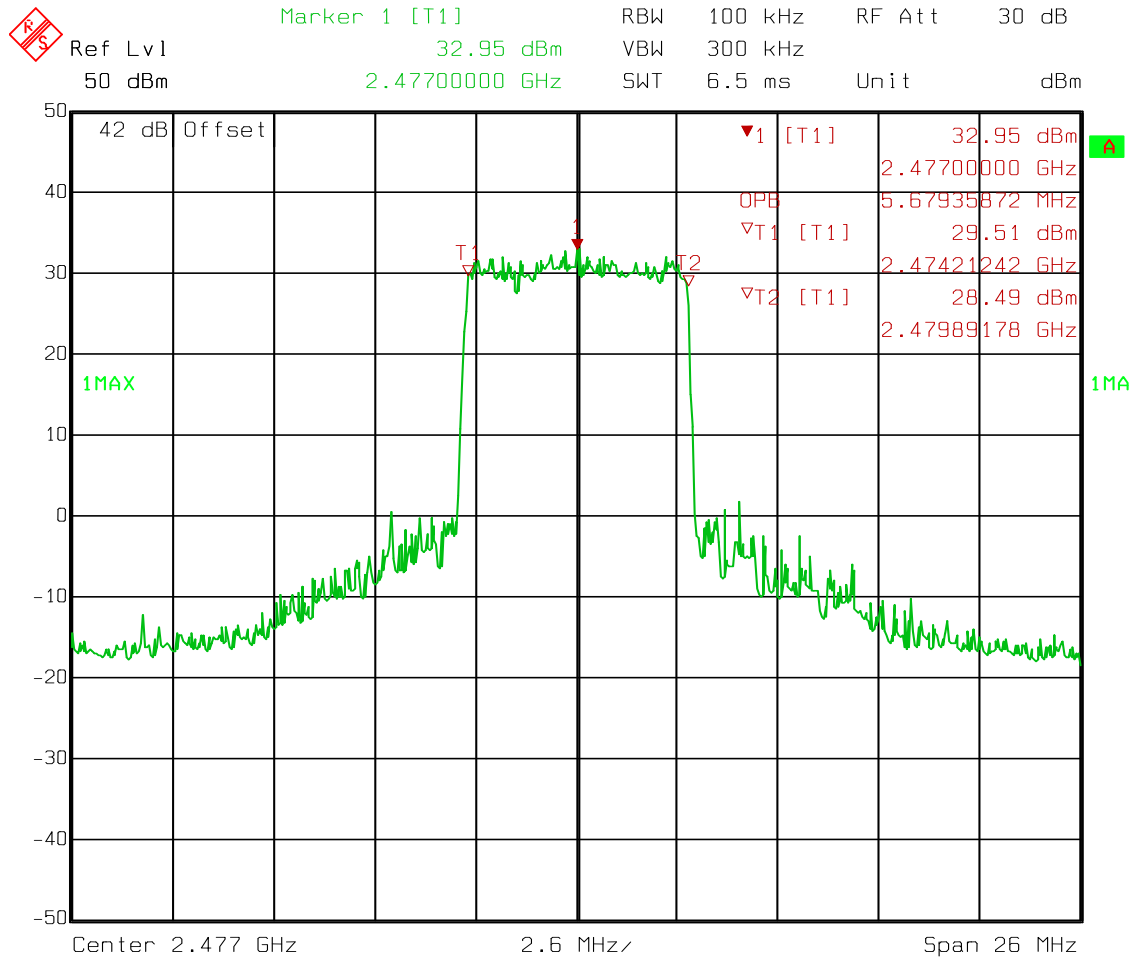
Date: 04.FEB.2014 10:14:21



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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Upper Channel 6 MHz



64QAM Date: 04.FEB.2014 10:15:08

|                        |                                 |                                                                                               |           |
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

## 2.6 Spurious Emissions At Antenna Terminals

Para. No.: 2.1051

|                               |                            |
|-------------------------------|----------------------------|
| Test Performed By: Alex Chang | Date of Test: Feb. 4, 2014 |
|-------------------------------|----------------------------|

Minimum Standard: Para. No. 74.637

Test Results: Complies  
Conducted Spurious:  
Max Hold, Peak, Limit -13 dBm

Test Data: See attached graphs.

### Spurious Emissions (Greater than $\pm 250\%$ of Authorized Bandwidth):

Measured per eCFR T47 §2.1051 & §2.1057(a)  
Method guidance provided by FCC 971168-D01 §6.0  
Limitations defined in eCFR §74.637(a)(2)(i) and (a)(2)(iii)  
Rules pertain to digital modulation types where operating frequency is below 15GHz.

All spurious emission measurements are performed using a spectrum analyzer capable of measurements up to the 10<sup>th</sup> harmonic of the EUT (25GHz). A power attenuator is placed between the EUT output and spectrum analyzer to reduce the signal strength to a safe input level for the spectrum analyzer. A reference level offset, equivalent to the external attenuation and cable loss, is supplied to the spectrum analyzer in order to provide accurate scaled measurements.

An emission limit line corresponding to the emission limit outside of  $\pm 250\%$  of the authorized channel bandwidth has been overlaid on the spectral display for easy identification of non-compliant spurs. The emission limit defined in §74.637(a)(2)(iii) for a 4kHz RBW is given as follows:

**Attenuation:  $A(\text{dB}) = 43 + 10 \cdot \log_{10}(\text{PMEAN in watts})$**

Where: PMEAN = 10W

$A(\text{dB})$  = attenuation required for emissions relative to PMEAN.

**Limit (in 4kHz RBW) =  $\text{PMEAN}(\text{dBm}) - A(\text{dB}) = 40\text{dBm} - 53\text{dB} = -13\text{dBm}$**

To decrease measurement sweep time, all wide-band emission measurements are taken at a 1MHz resolution bandwidth (RBW) setting and verified according to the 4kHz RBW limit line. Spurs meeting the 4kHz RBW limit when measured in a 1MHz RBW setting by definition meet the 4kHz limit when measured in a 4kHz RBW setting and are compliant.

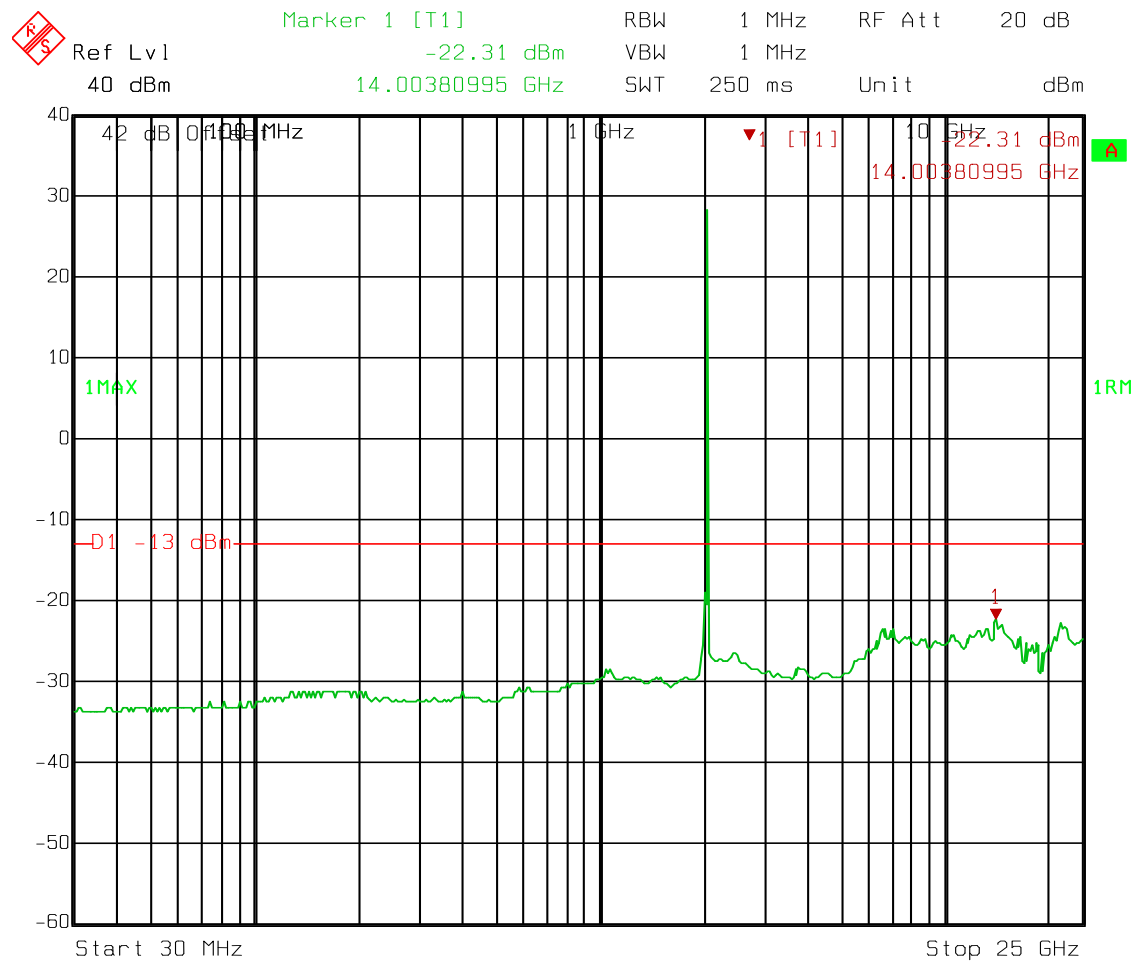
All spurious emission plots provided are measured with the modulation configured for the maximum rated conditions; 8MHz bandwidth per §2.1049(h). Changes in modulation bandwidth and constellation type show no observable change to the spurious emissions. Spurious data plots are provided for multiple carrier frequencies within the governed frequency range for all constellation types (QPSK, 16QAM, 64QAM).

|                        |                                 |                                                                                               |           |
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

## Low Band Spurious

Low Channel 8MHz QPSK

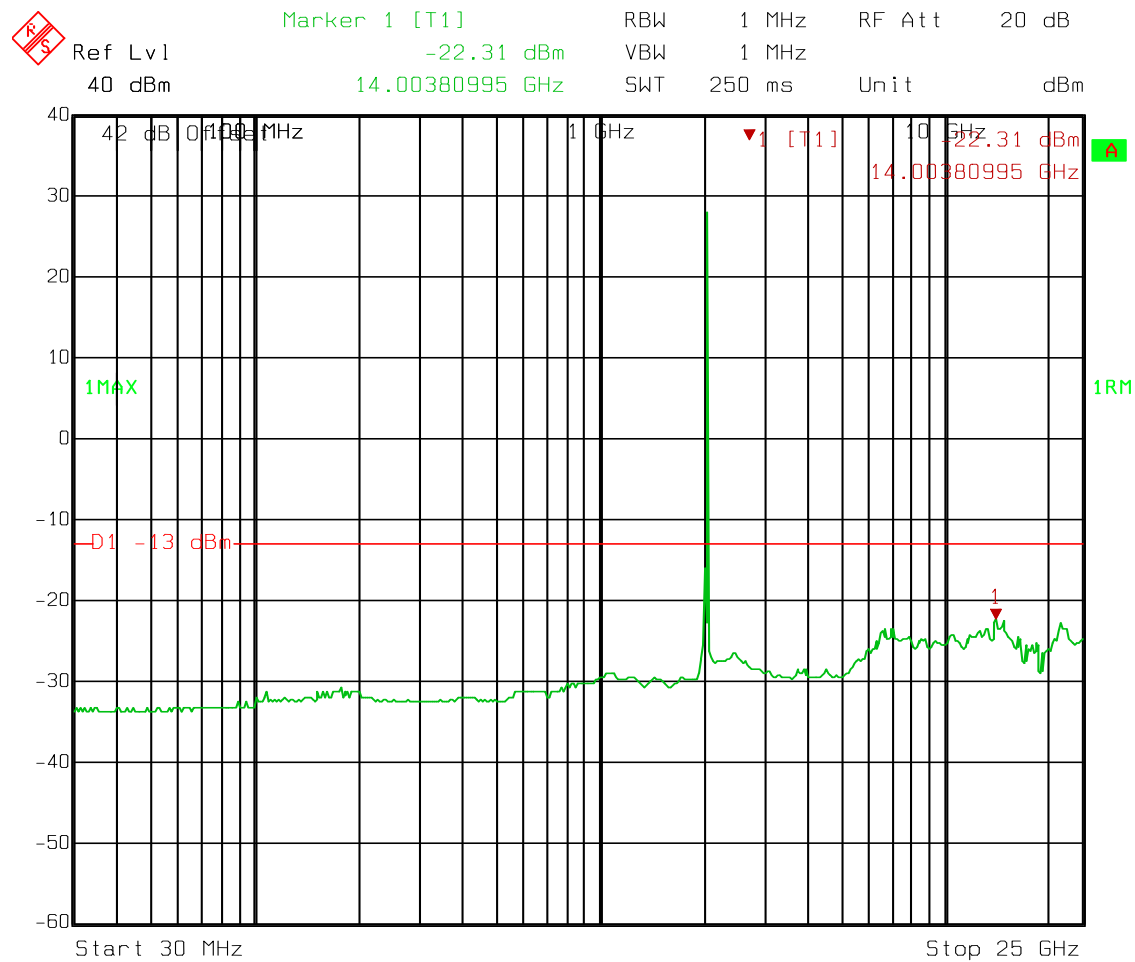


Date: 04.FEB.2014 10:36:14

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|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-----------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 69 of 146 |

FCC ID: CNVHC4-2

# Low Channel 8 MHz 16QAM

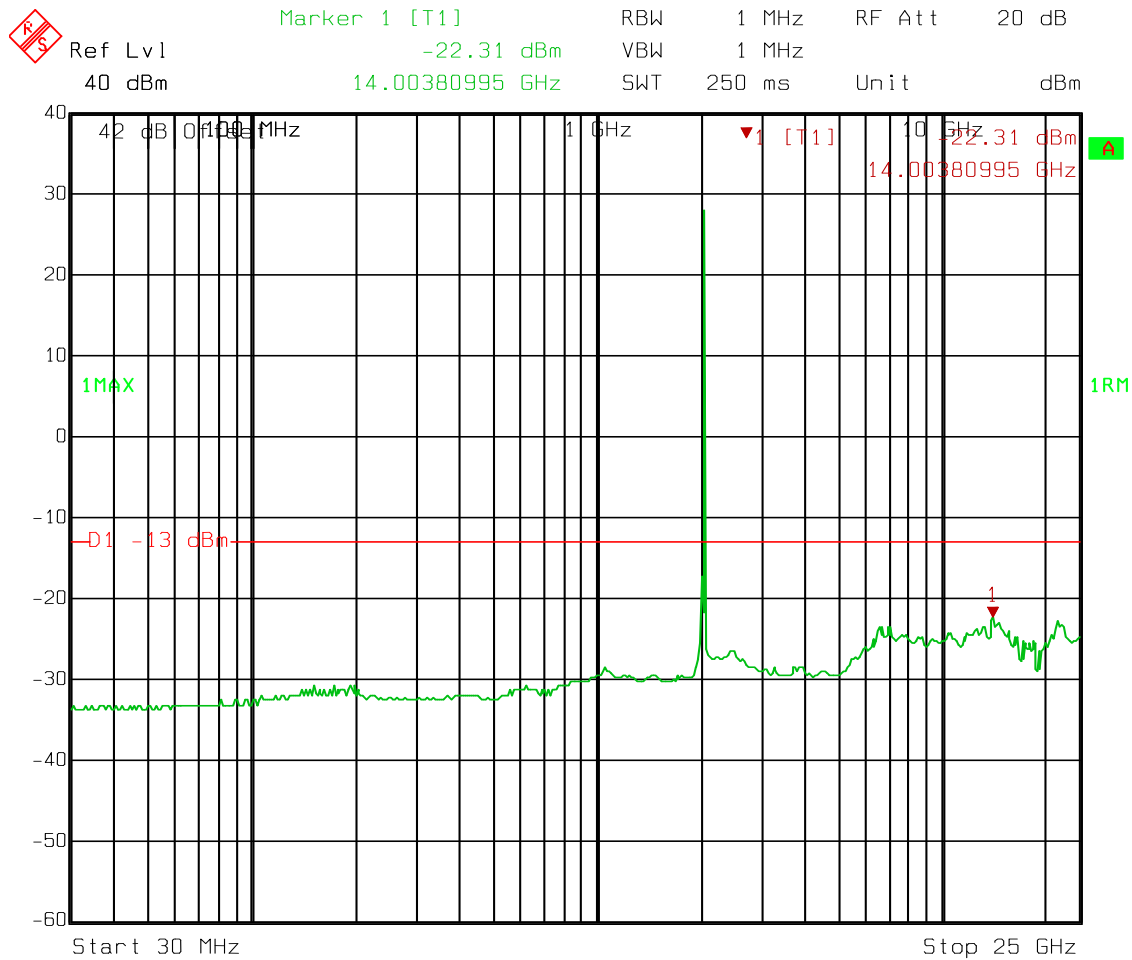


Date: 04.FEB.2014 10:36:55

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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 70 of 146 |

FCC ID: CNVHC4-2

# Low Channel 8 MHz 64QAM

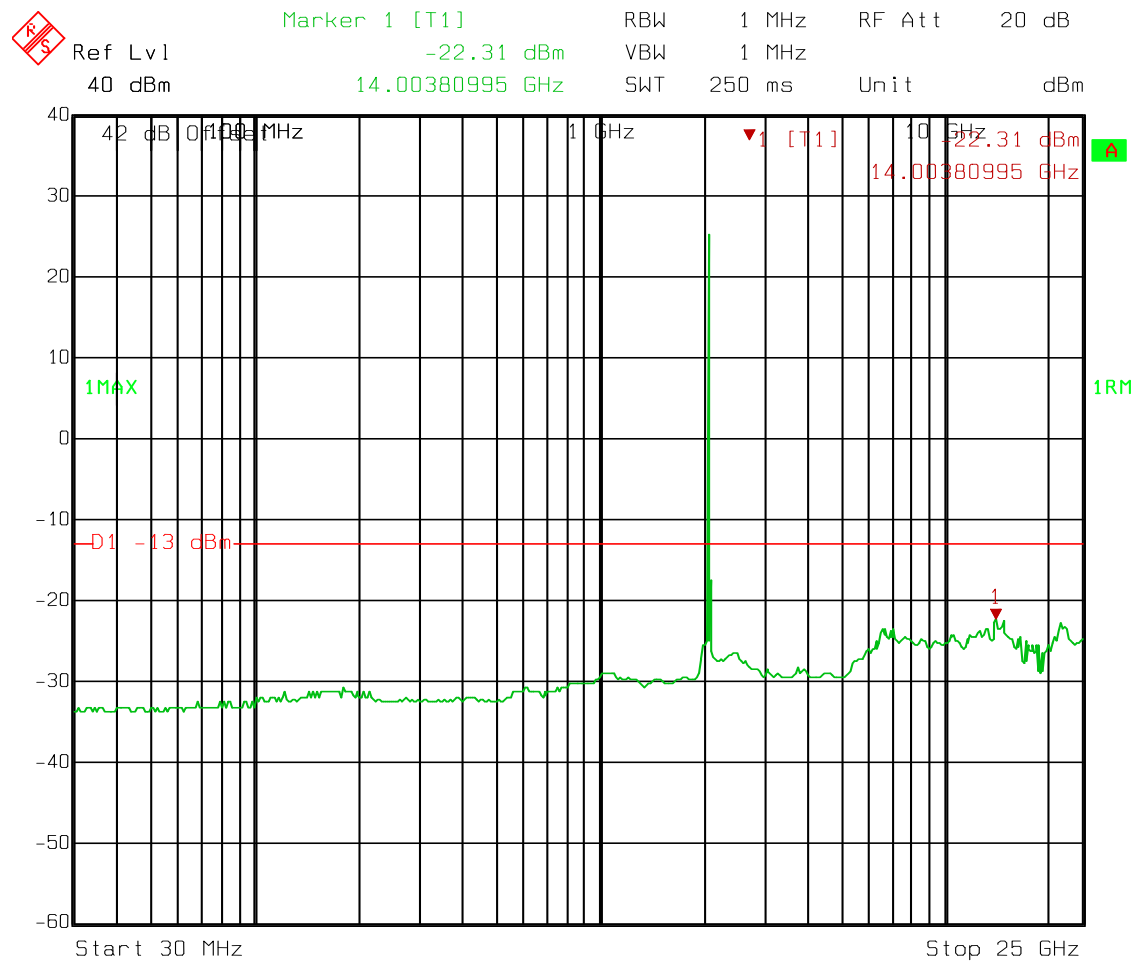


Date: 04.FEB.2014 10:37:36

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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 71 of 146 |

FCC ID: CNVHC4-2

# Mid Channel 8 MHz QPSK

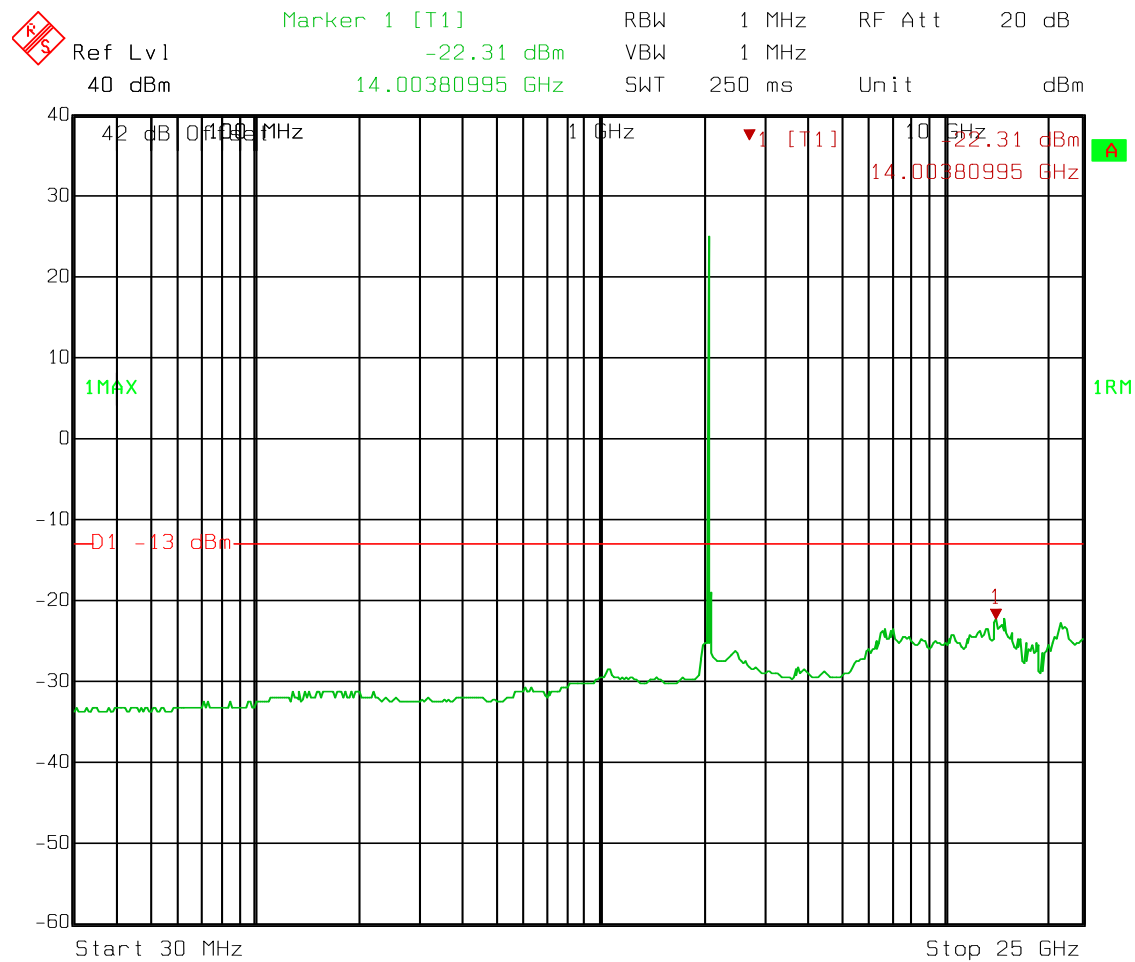


Date: 04.FEB.2014 10:38:08

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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

# Mid Channel 8 MHz 16QAM

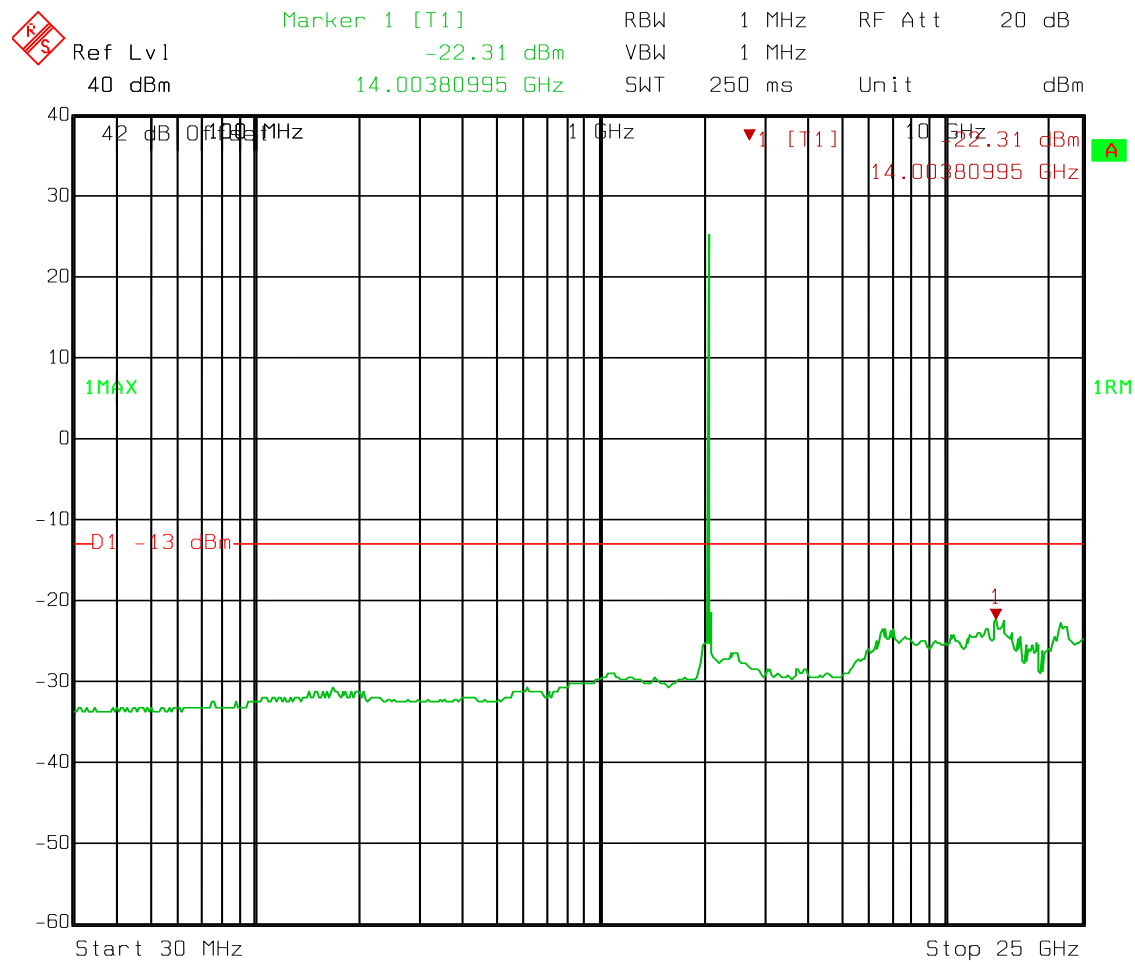


Date: 04.FEB.2014 10:38:46

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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |           |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 73 of 146 |

FCC ID: CNVHC4-2

# Mid Channel 8 MHz 64QAM

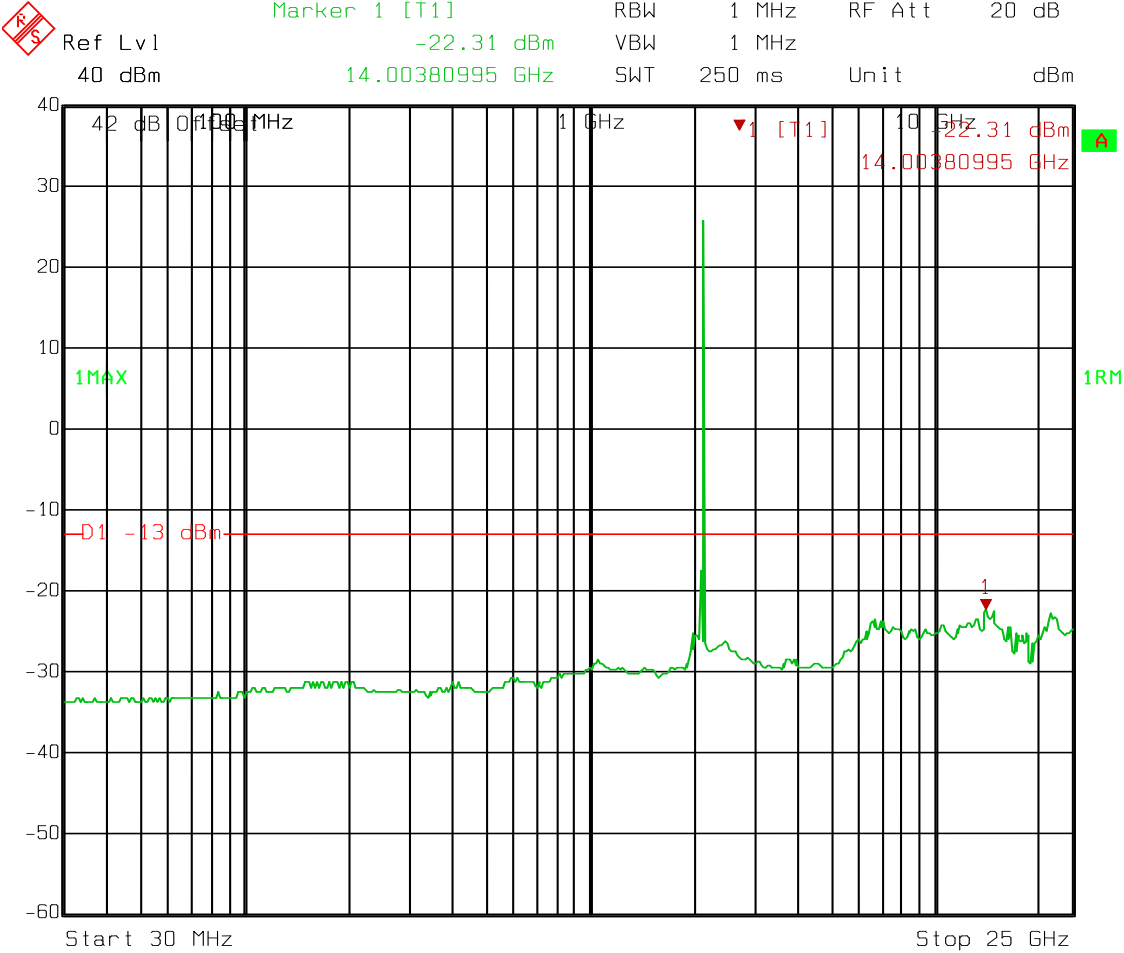


Date: 04.FEB.2014 10:39:16

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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |           |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Upper Channel 8 MHz QPSK



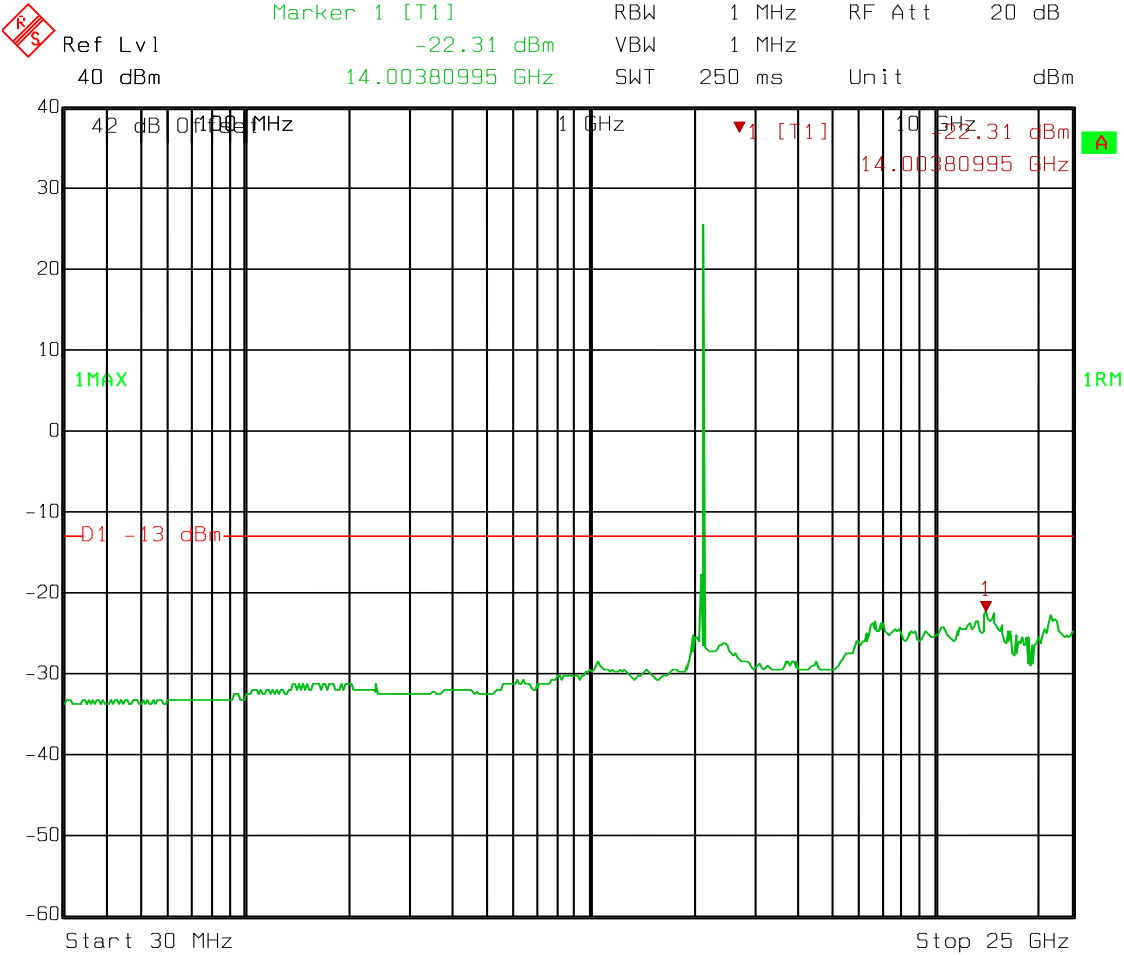
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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |           |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 76 of 146 |

FCC ID: CNVHC4-2

Upper Channel 8 MHz 64QAM



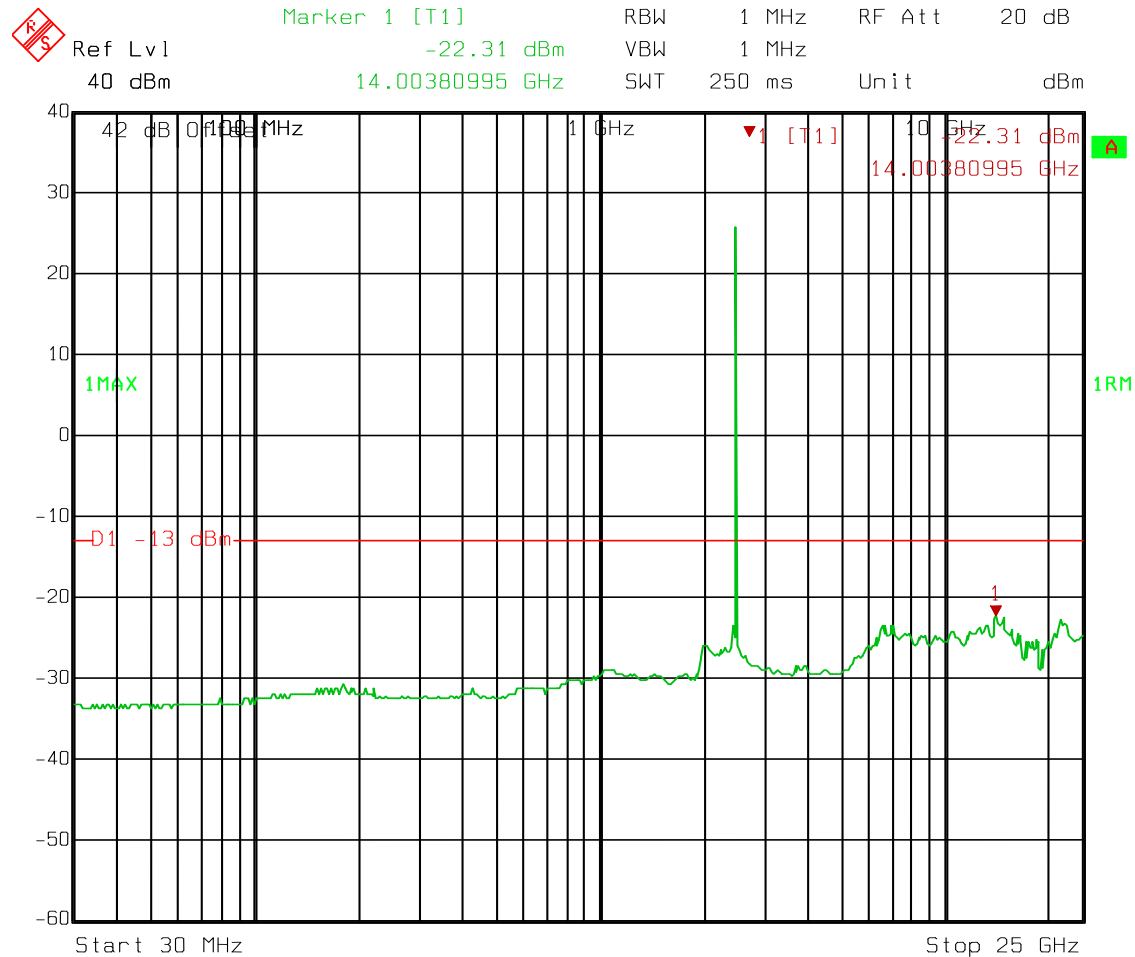
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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |           |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

## High Band Spurious

Low Channel 8MHz QPSK

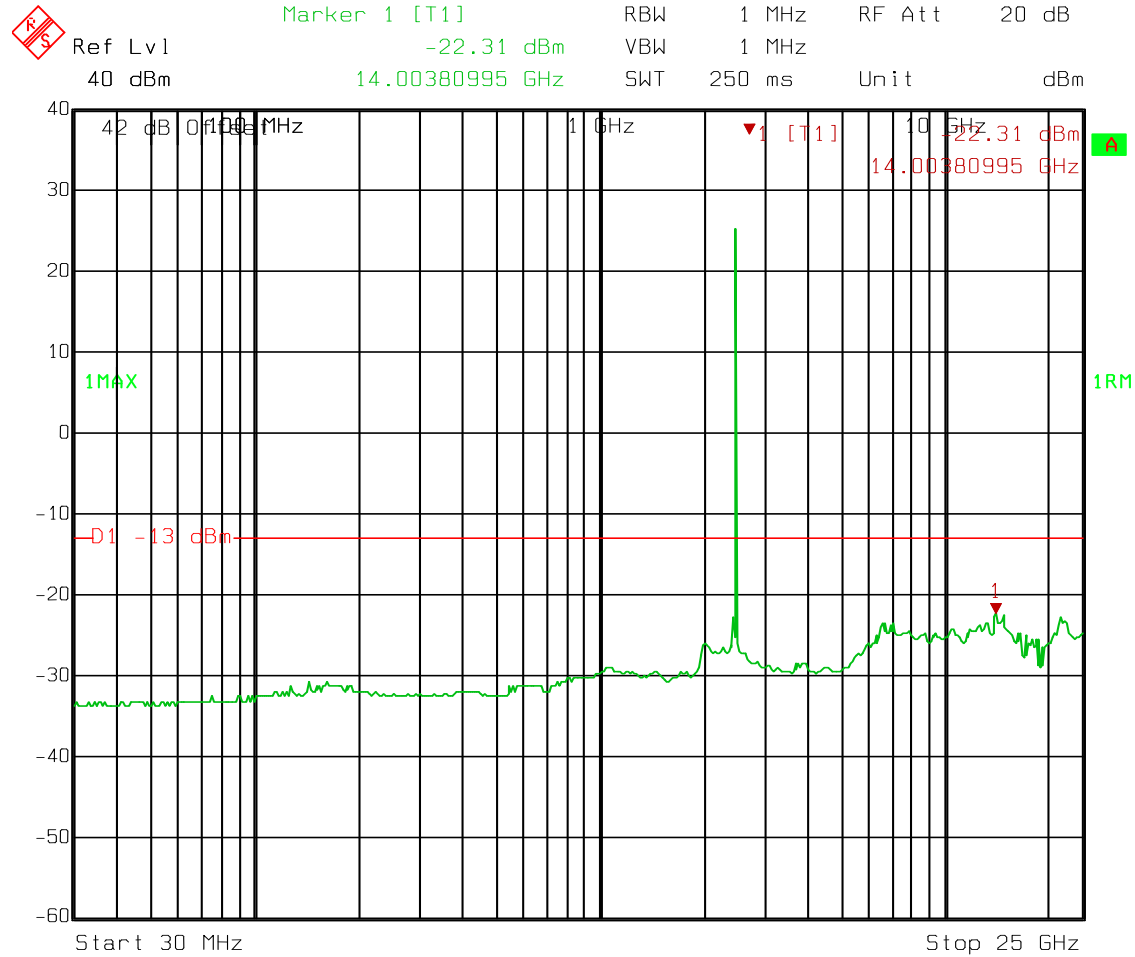


Date: 04.FEB.2014 10:43:17

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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

# Low Channel 8 MHz 16QAM

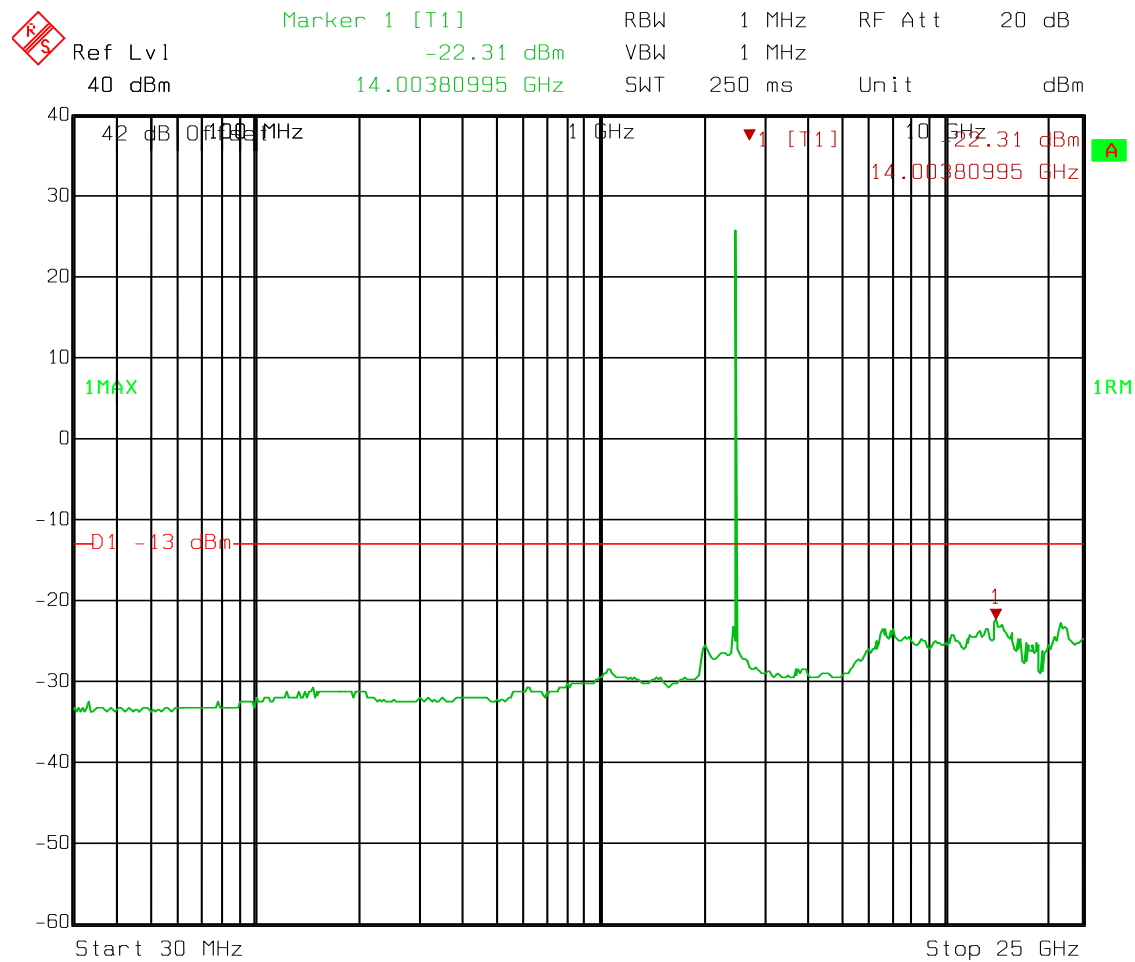


Date: 04.FEB.2014 10:43:40

|                        |                                 |                                                                                               |           |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|-----------|
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FCC ID: CNVHC4-2

# Low Channel 8 MHz 64QAM

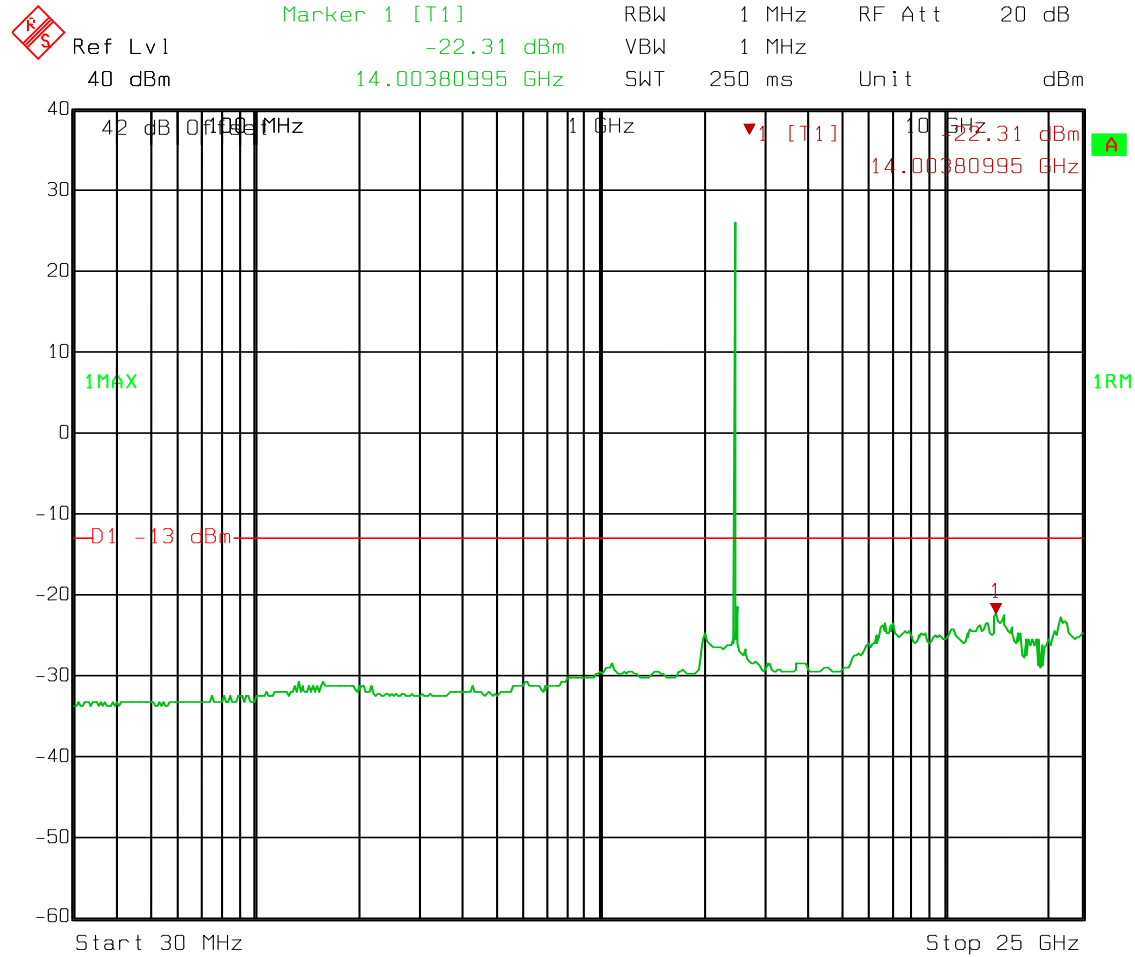


Date: 04.FEB.2014 10:44:12

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FCC ID: CNVHC4-2

# Mid Channel 8 MHz QPSK

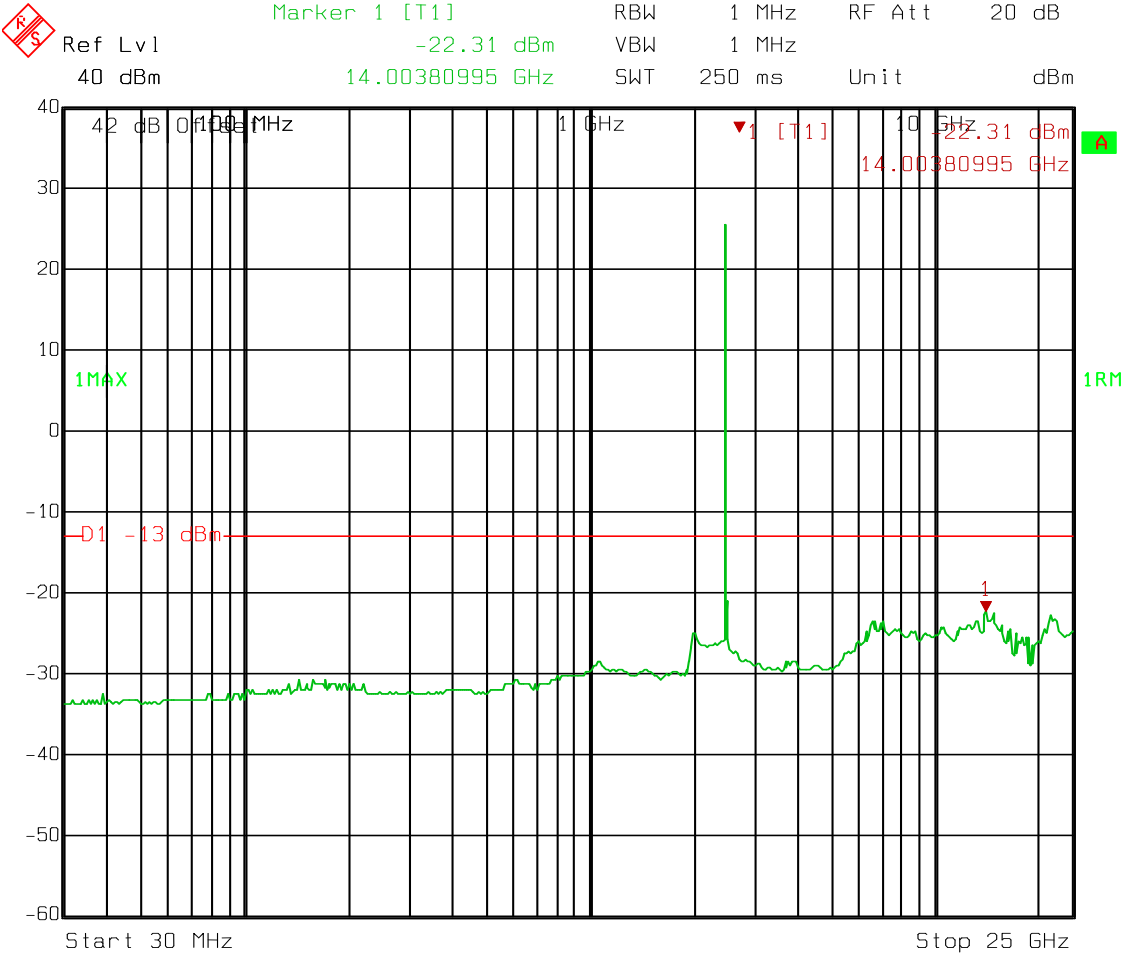


Date: 04.FEB.2014 10:46:32

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FCC ID: CNVHC4-2

Mid Channel 8 MHz 16QAM

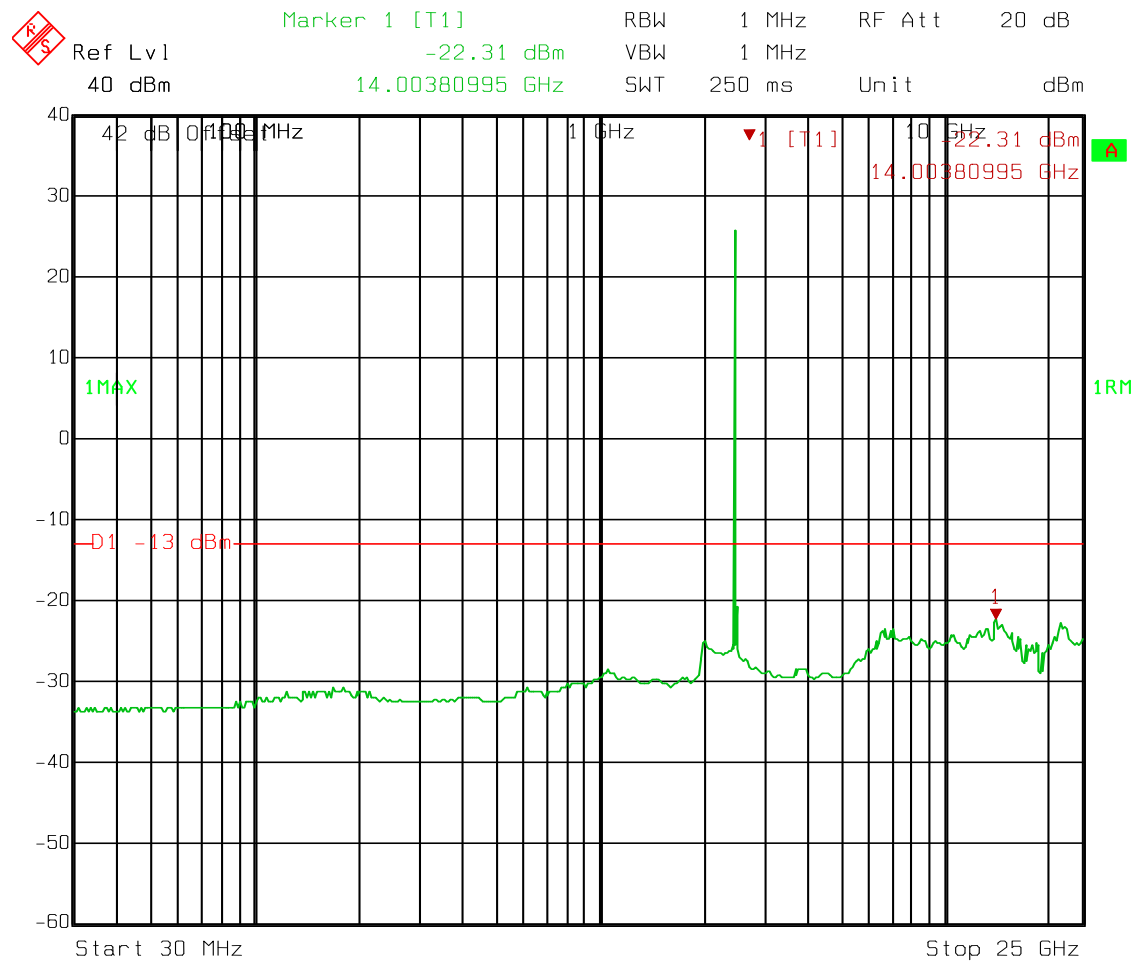


Date: 04.FEB.2014 10:47:12

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FCC ID: CNVHC4-2

# Mid Channel 8 MHz 64QAM

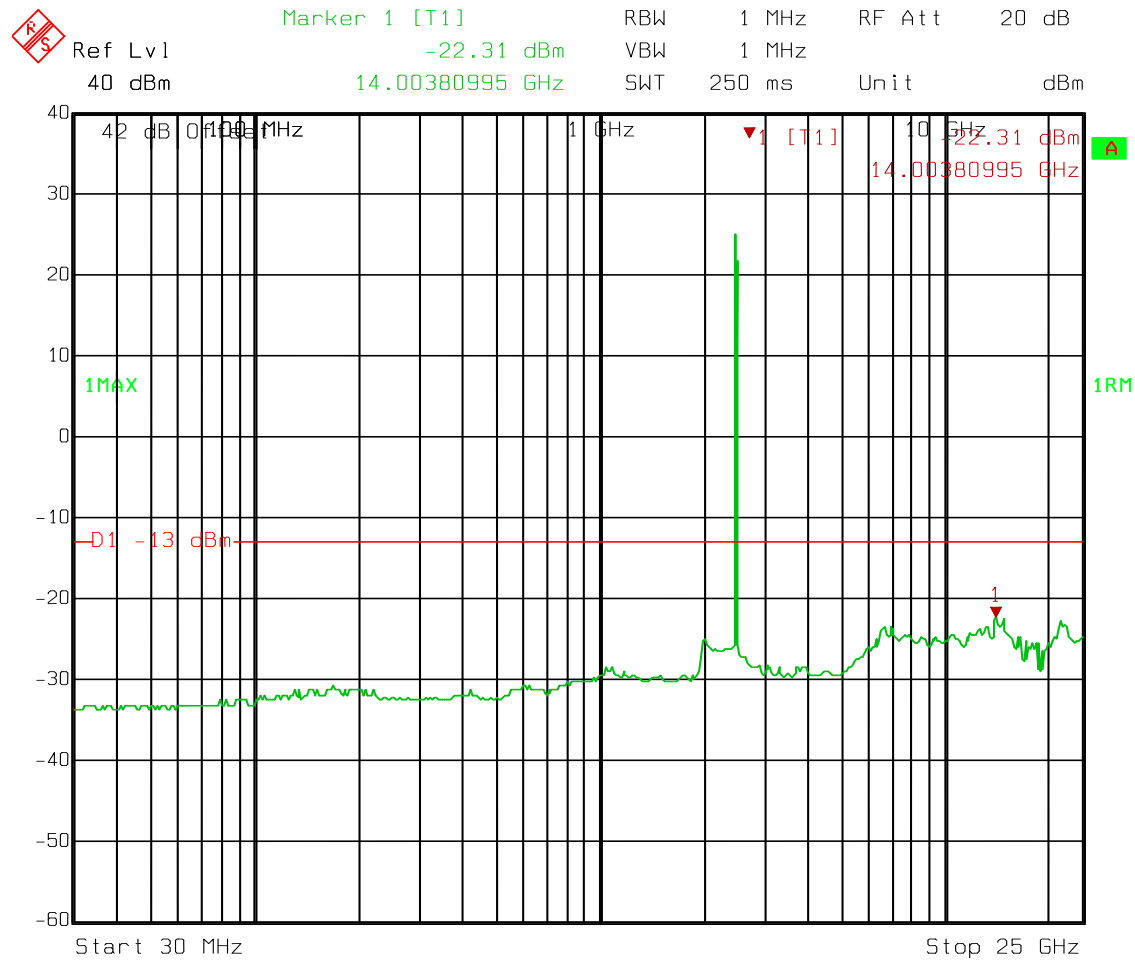


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FCC ID: CNVHC4-2

# Upper Channel 8 MHz QPSK

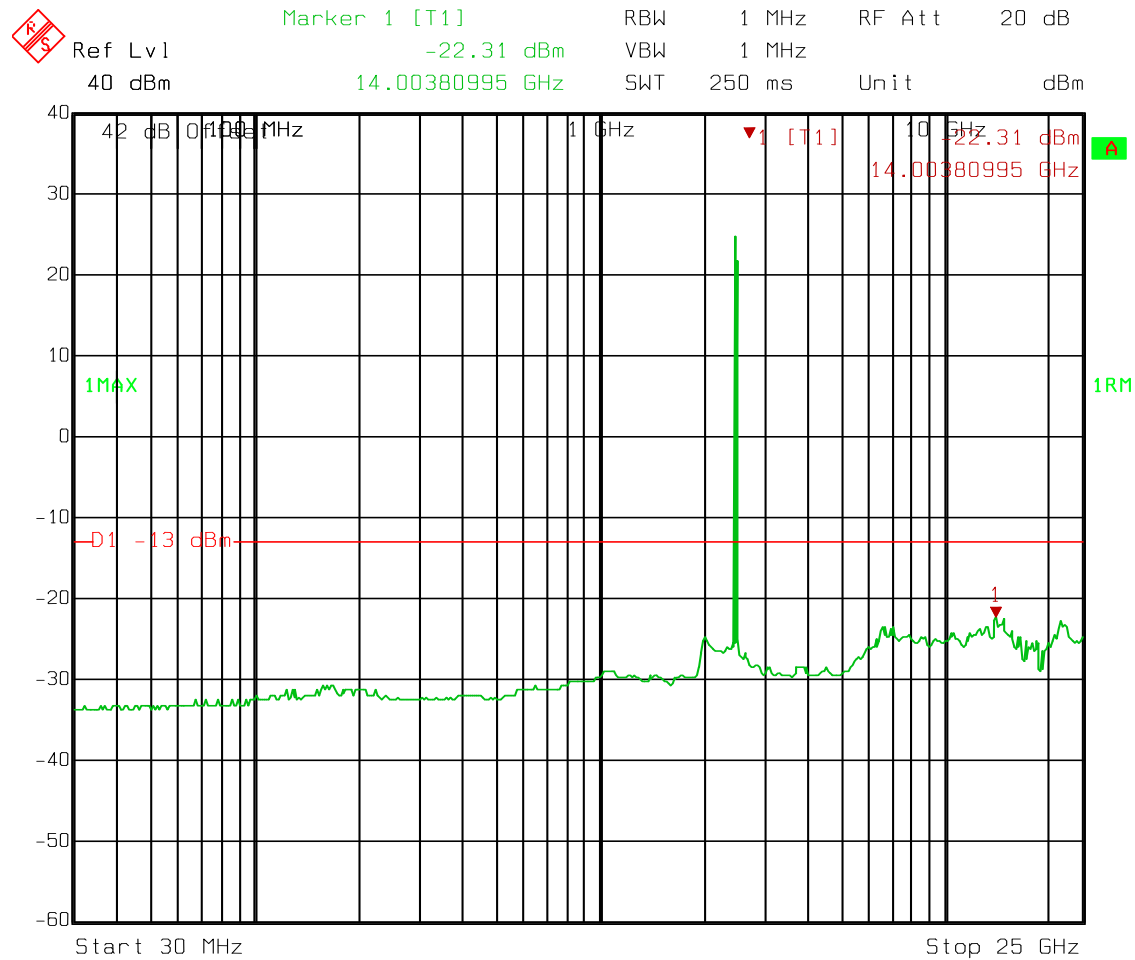


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

Upper Channel 8 MHz 16 QAM

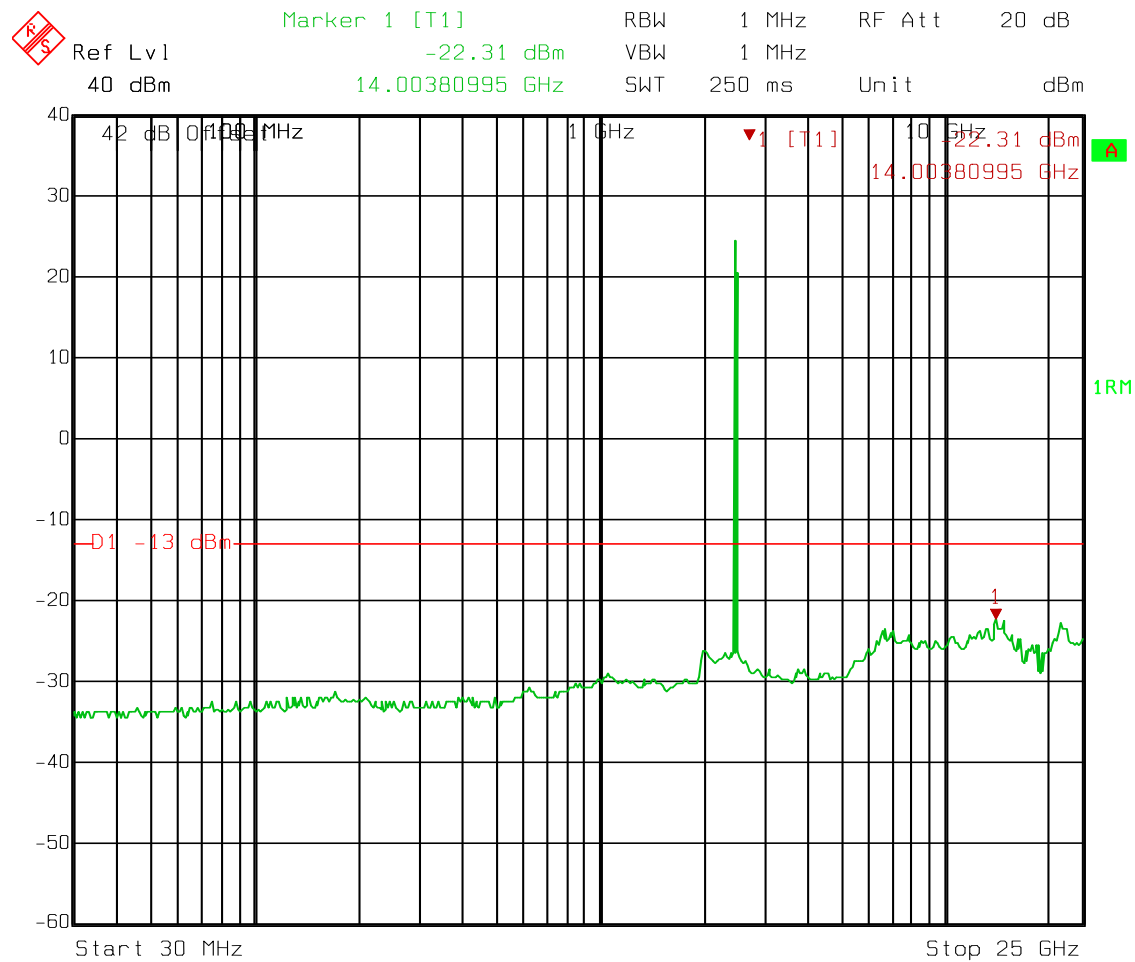


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FCC ID: CNVHC4-2

# Upper Channel 8 MHz 64QAM



Date: 04.FEB.2014 10:48:58

|                        |                                 |                                                                                               |             |
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| <b>DATE</b>            | <b>DOCUMENT NAME</b>            | <b>DOCUMENT #</b>                                                                             | <b>PAGE</b> |
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## 2.7 Emission Masks

(a) The mean power of emissions shall be attenuated below the mean transmitter power (PMEAN ) in accordance with the following schedule:

(1) When using frequency modulation:

(i) On any frequency removed from the assigned (center) frequency by more than 50% up to and including 100% of the authorized bandwidth: At least 25 dB in any 100 kHz reference bandwidth (BREF );

(ii) On any frequency removed from the assigned (center) frequency by more than 100% up to and including 250% of the authorized bandwidth: At least 35 dB in any 100 kHz reference bandwidth;

(iii) On any frequency removed from the assigned (center) frequency by more than 250% of the authorized bandwidth: At least  $43 + 10 \log_{10}(\text{PMEAN in watts})$  dB, or 80 dB, whichever is the lesser attenuation, in any 100 kHz reference bandwidth.

|                               |                            |
|-------------------------------|----------------------------|
| Test Performed By: A. Laudani | Date of Test: Feb. 4, 2014 |
|-------------------------------|----------------------------|

Peak Hold, RMS detector. Reference level set to channel power.

### Emission Masks (Within $\pm 250\%$ of Authorized Bandwidth):

Measured per eCFR T47 §74.637(a)(2);

Limitations defined in eCFR T47 §74.637(a)(2)

A 12MHz authorized channel bandwidth emission mask corresponding to the emission limit defined in §74.637(a)(2)(i) has been overlaid on the spectral display. To decrease sweep time and minimize the dynamic range required by the spectrum analyzer, all measurements are taken at a 100kHz resolution bandwidth (RBW) setting. To compensate for the change in RBW, the mask limit equation (given for a 4kHz RBW) has been updated to the following:

$$\text{Attenuation A(dB)} = 35 + 0.8*(G-50) + 10\log(BW) - 10\log(RBW/4\text{kHz})$$

Where: RBW = 100kHz, BW = 12MHz, G = % of BW removed from the carrier

A(dB) = attenuation required for emissions relative to PMEAN.

The 12MHz authorized channel bandwidth pertains to the allotted channel size specified for use with the Broadcast Auxiliary Service (BAS) after January 7, 2004 as defined in §74.602(a)(3)(i) and §74.602(a)(3)(iii). For the 2450-2483.5MHz band, the authorized channel size increases to 17MHz as defined in the §74.602(a) frequency assignment table. The wider 17MHz authorized bandwidth is not required and therefore the 2450-2483.5MHz frequency band will be certified to the same 12MHz authorized channel bandwidth specified in the 2025-2110MHz band.

The emission mask is calculated as the following:

| 10W Emission Mask for 12MHz Channel (100kHz RBW) |             |            |
|--------------------------------------------------|-------------|------------|
| Frequency Offset                                 | Attenuation | Mask Limit |
| $\pm 0.000$ MHz                                  | 0.00 dB     | 40.0 dBm   |
| $\pm 6.000$ MHz                                  | 0.00 dB     | 40.0 dBm   |
| $\pm 6.000$ MHz                                  | 36.02 dB*   | 3.98 dBm*  |
| $\pm 6.636$ MHz                                  | 36.02 dB*   | 3.98 dBm*  |
| $\pm 11.132$ MHz                                 | 66.00 dB    | -26.0 dBm  |
| $\pm 30.000$ MHz                                 | 66.00 dB    | -26.0 dBm  |

\*Values represent minimum attenuation value required outside of authorized BW.

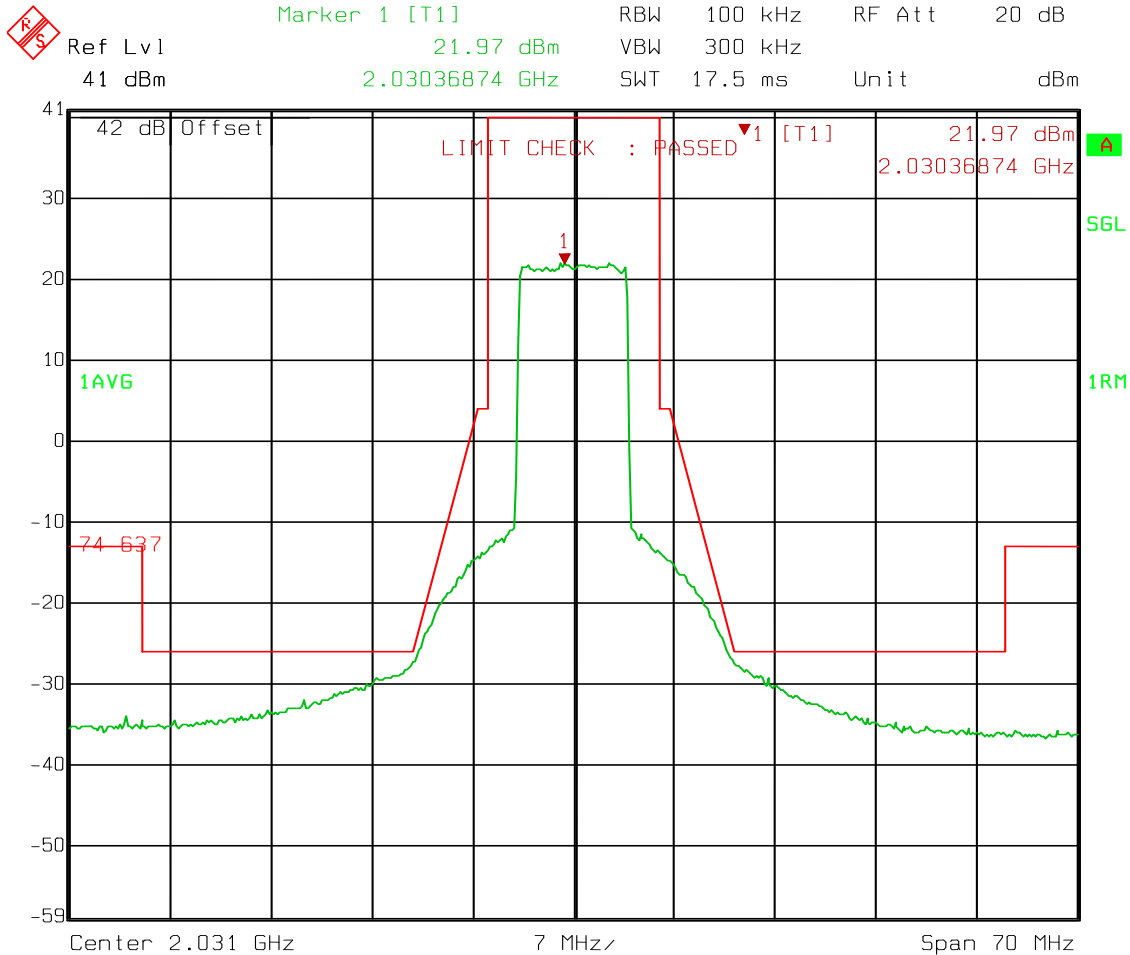
Emission plots are provided for all combinations of main carrier frequency, modulation bandwidth, and constellation type.

|                        |                                 |                                                                                               |           |
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FCC ID: CNVHC4-2

## LOW Band

Low Channel 8 MHz 16 QAM

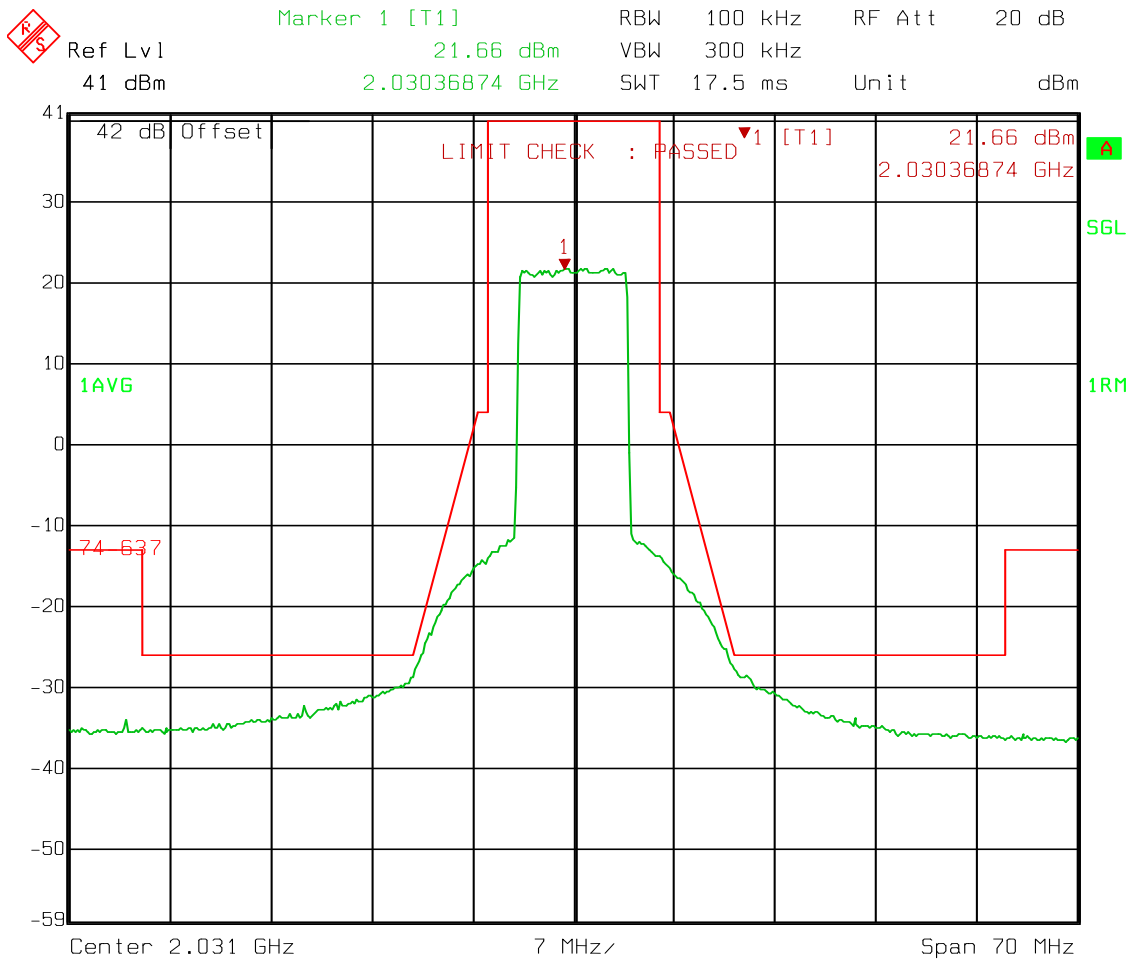


Date: 04.FEB.2014 08:34:50

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FCC ID: CNVHC4-2

# Low Channel 8 MHz QPSK

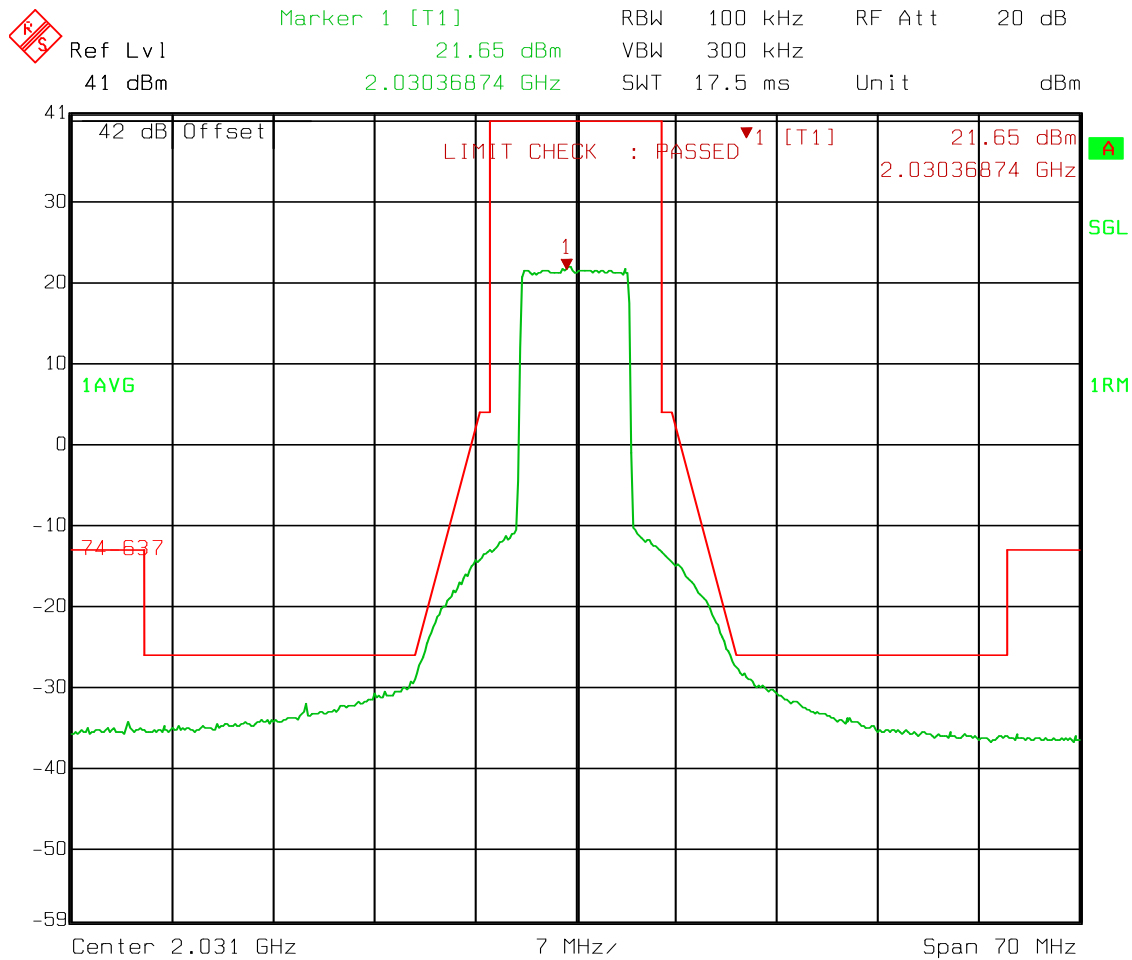


Date: 04.FEB.2014 08:36:07

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FCC ID: CNVHC4-2

# Low Channel 8 MHz 64QAM



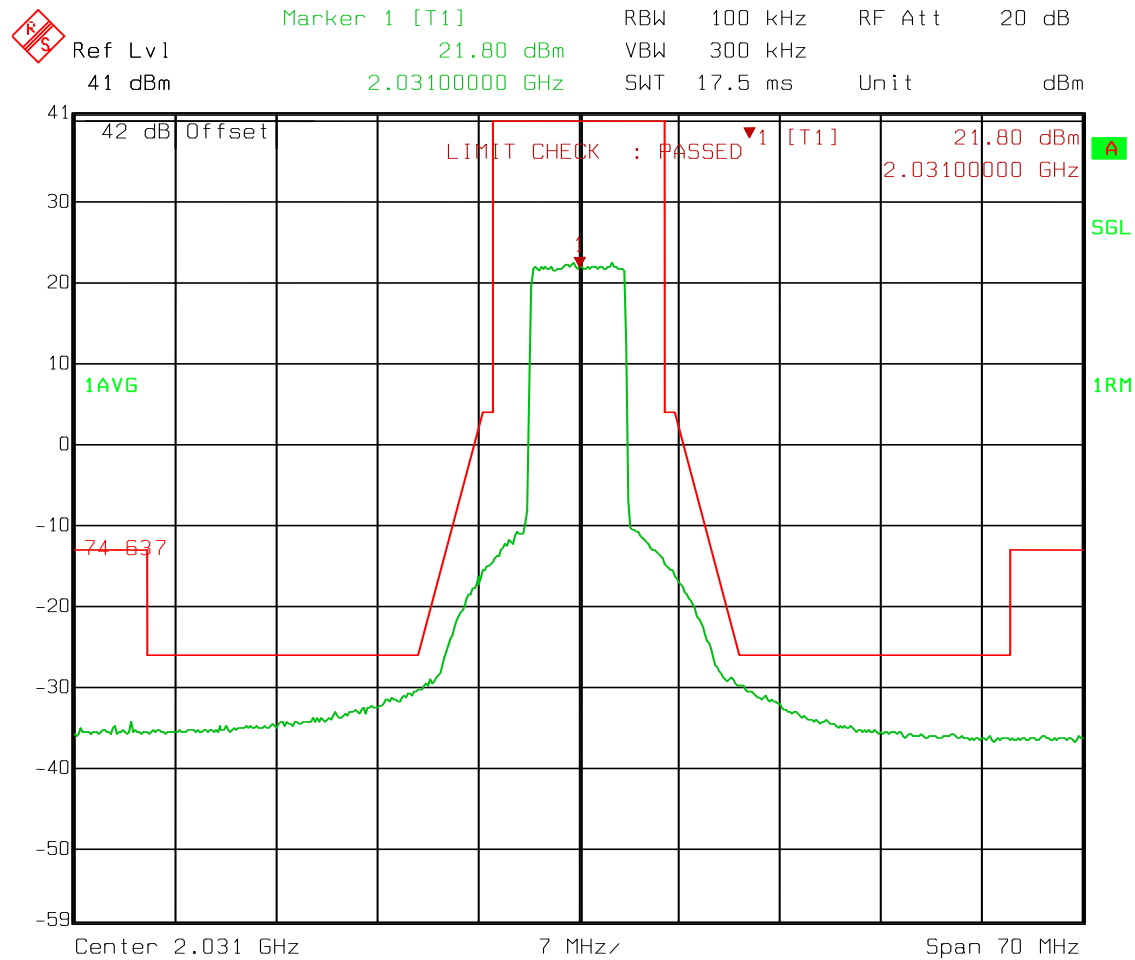
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

# Low Channel 7 MHz 16QAM

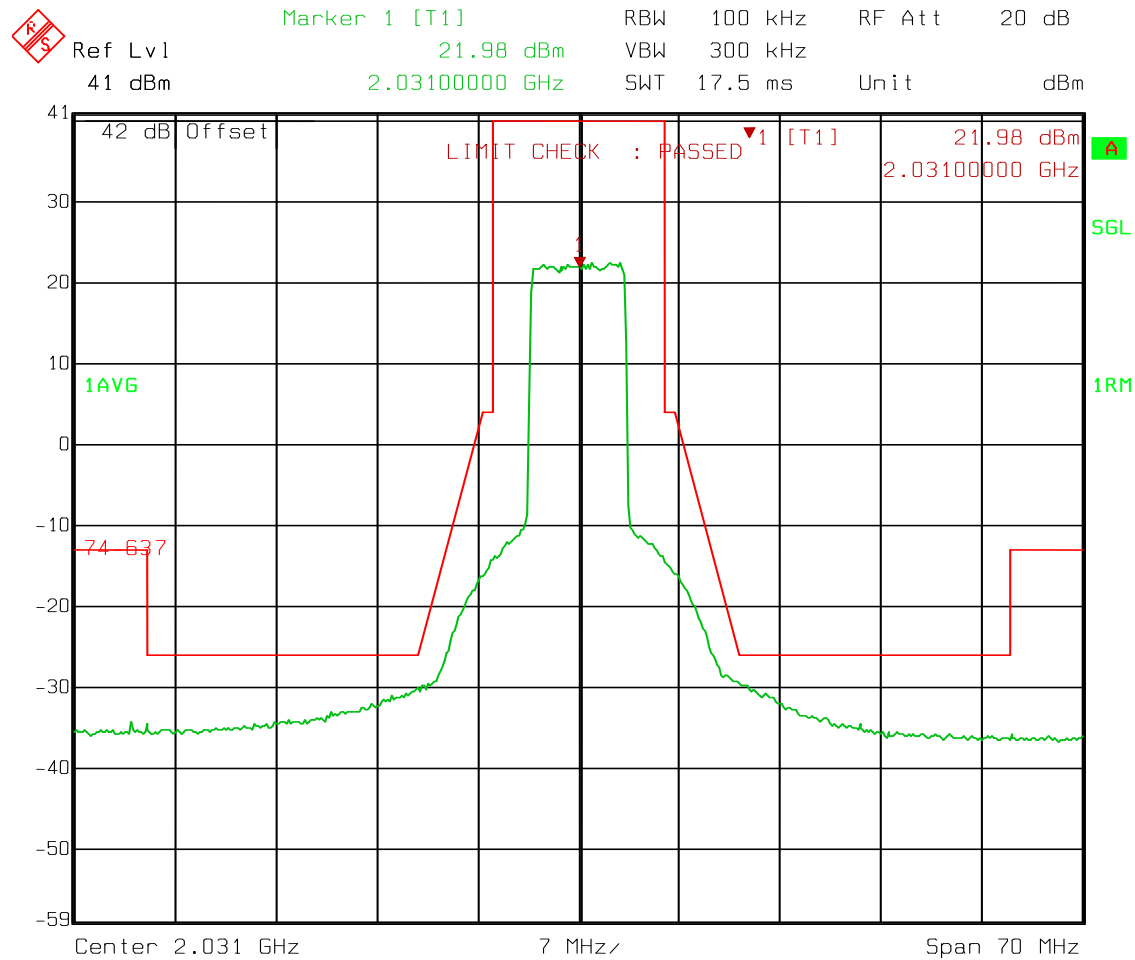


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

# Low Channel 7 MHz 64QAM

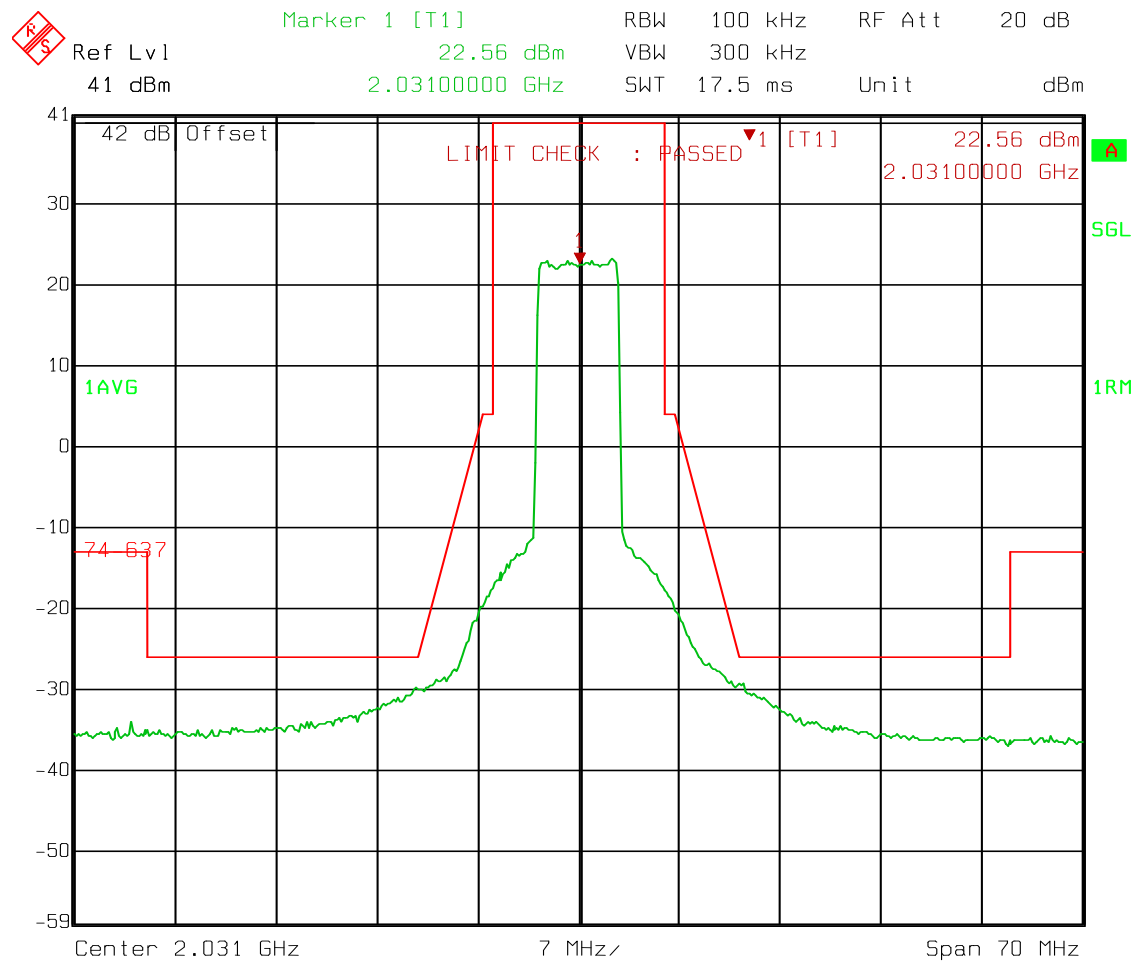


Date: 04.FEB.2014 08:38:29

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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE      |
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FCC ID: CNVHC4-2

# Low Channel 6 MHz QPSK

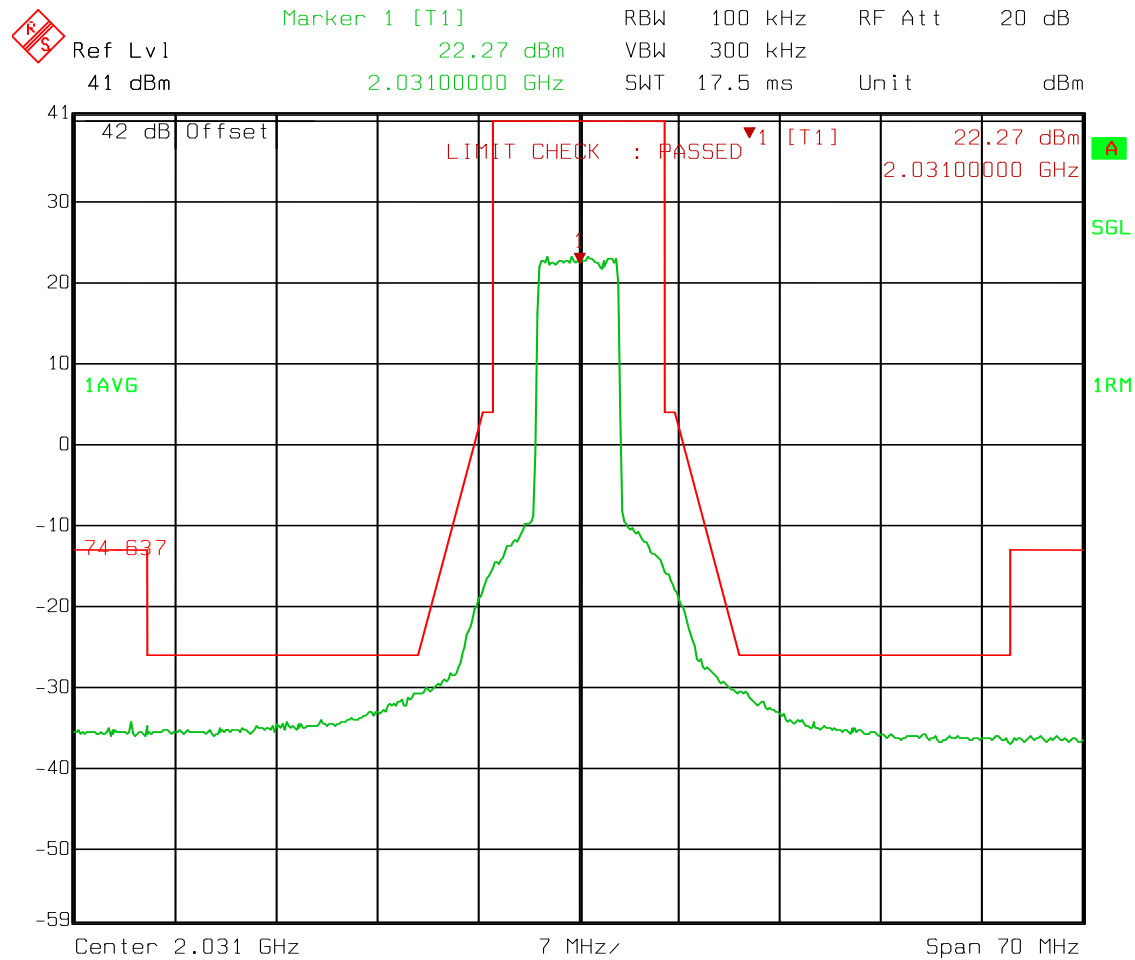


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FCC ID: CNVHC4-2

# Low Channel 6 MHz 16QAM

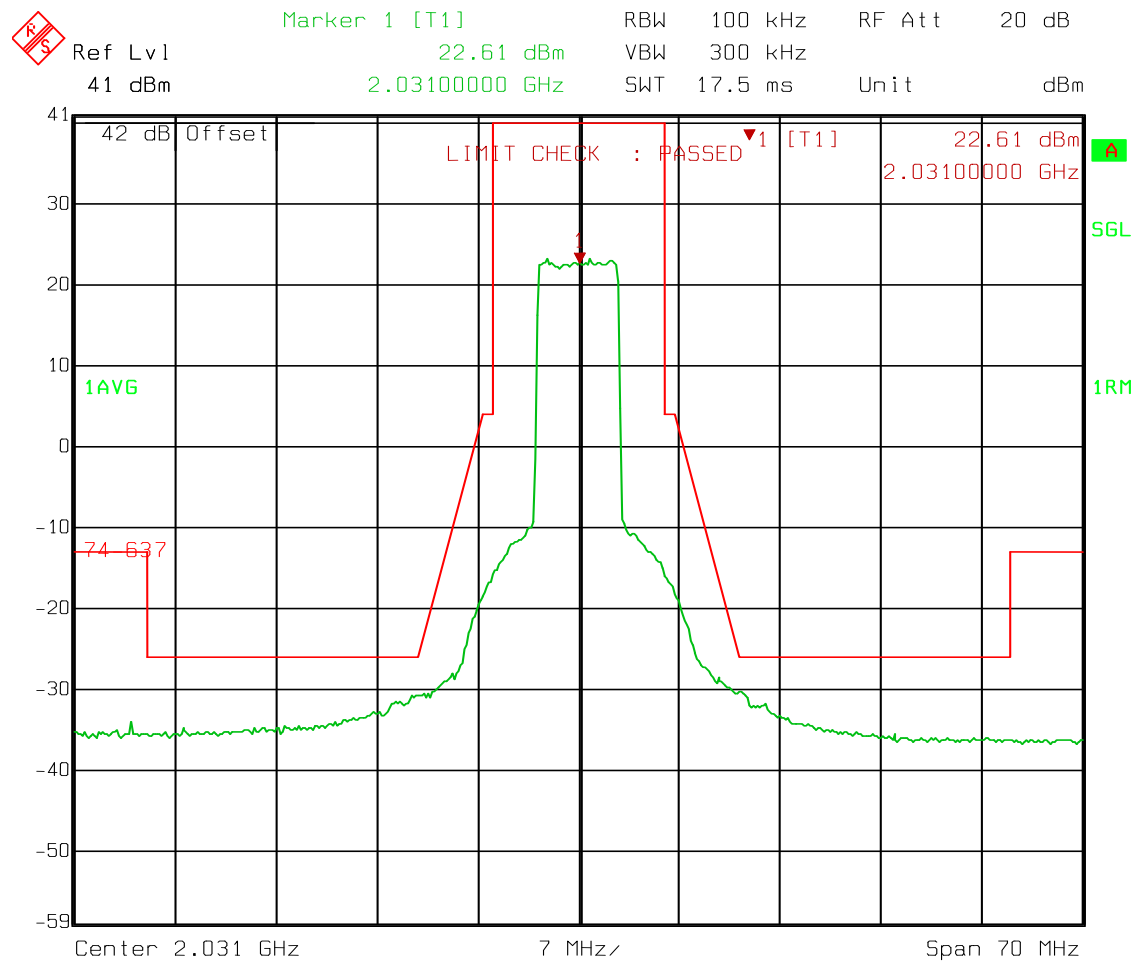


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# Low Channel 6 MHz 64 QAM

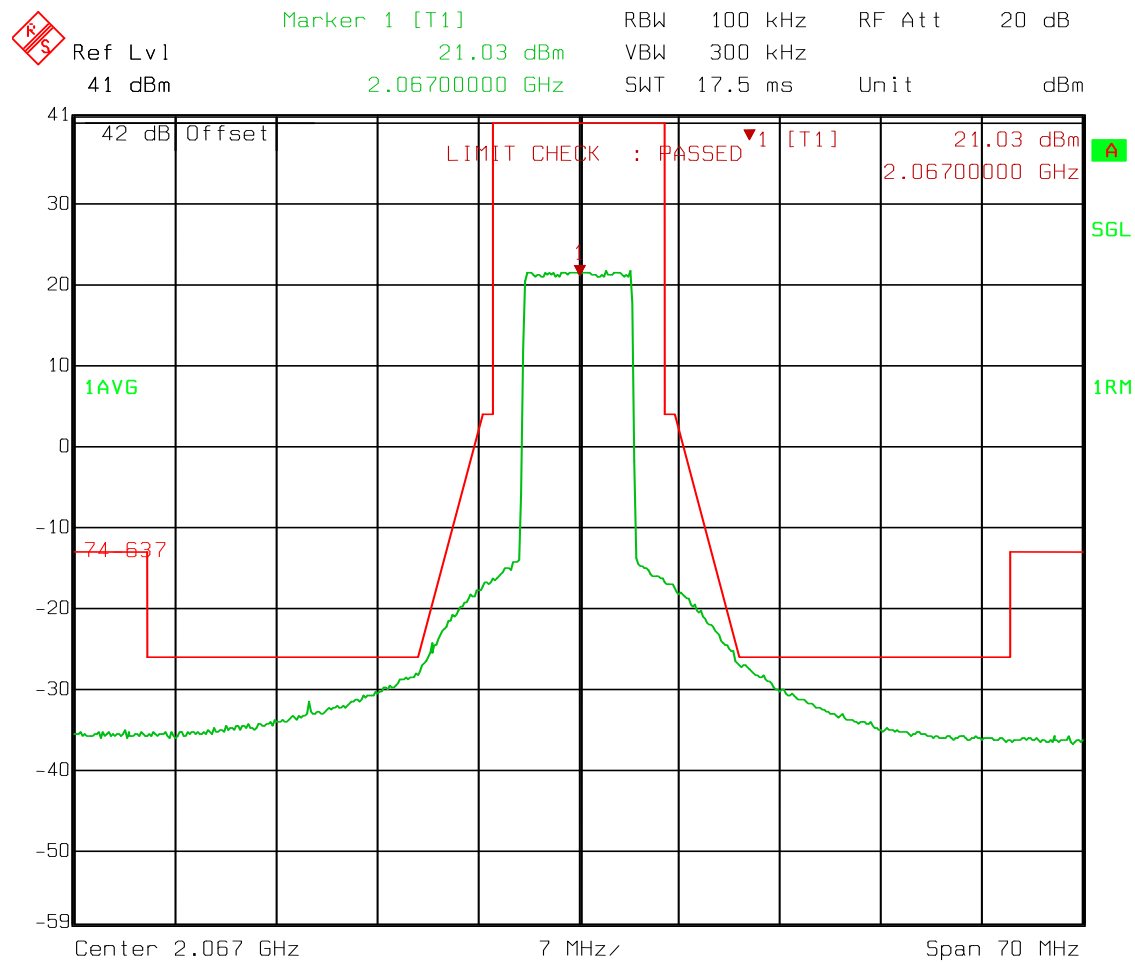


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# Mid Channel 8 MHz QPSK

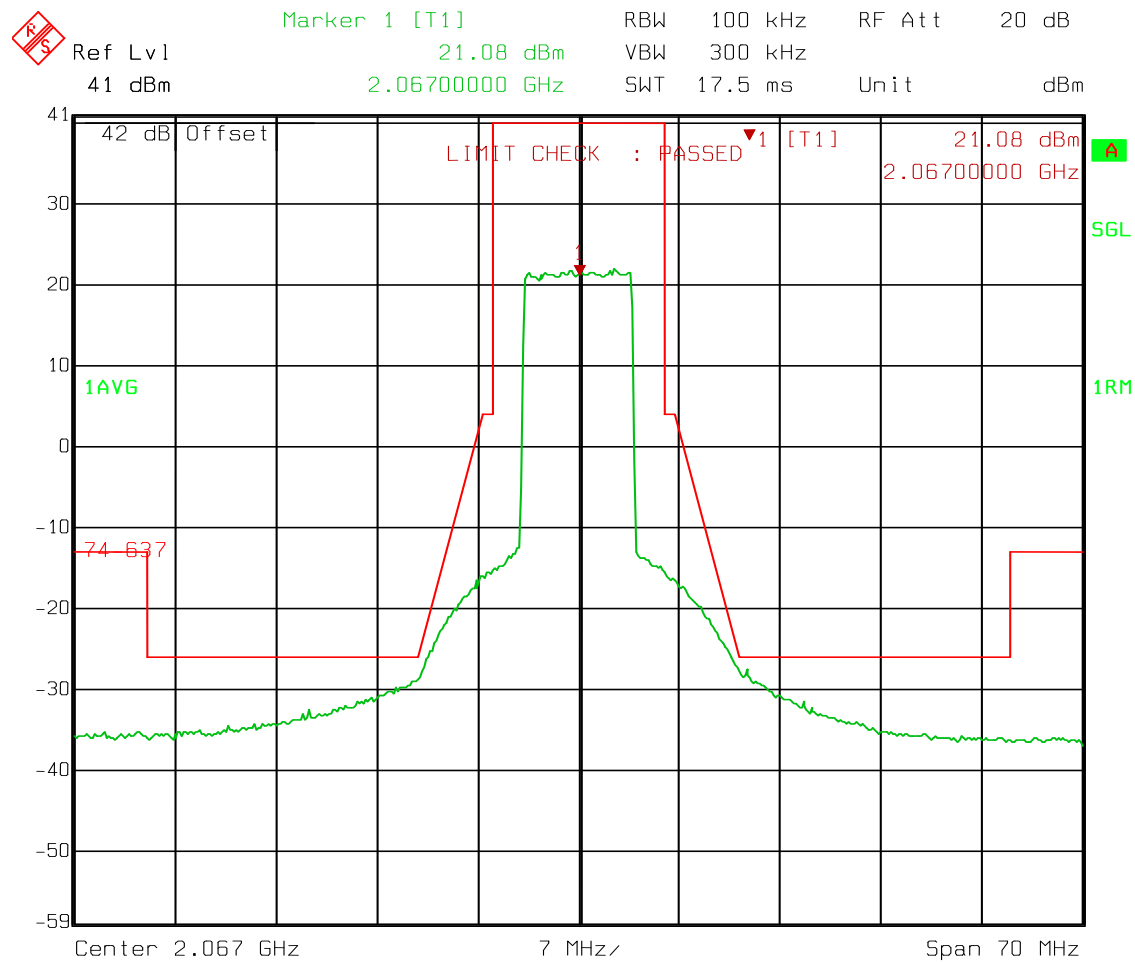


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Mid Channel 8 MHz 16QAM

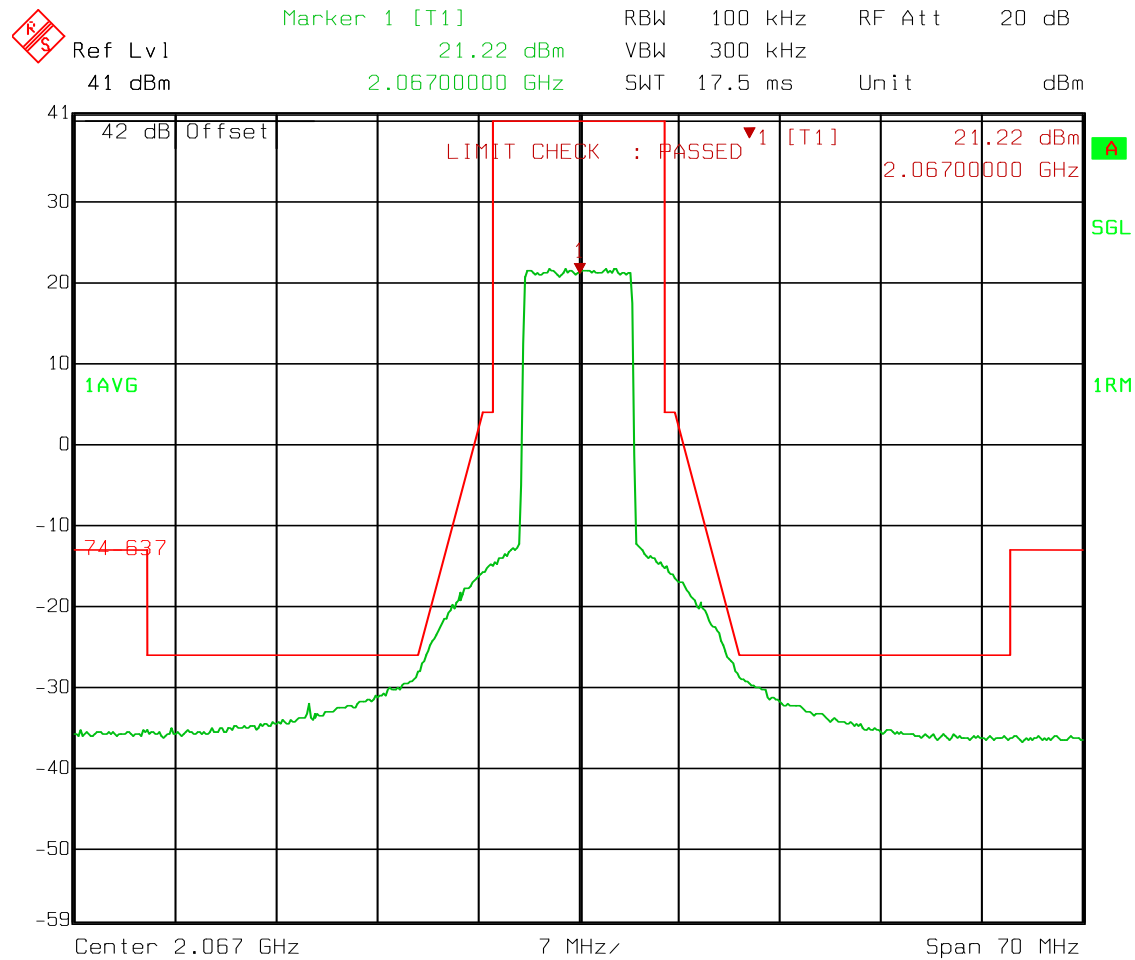


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Mid Channel 8 MHz 64 QAM

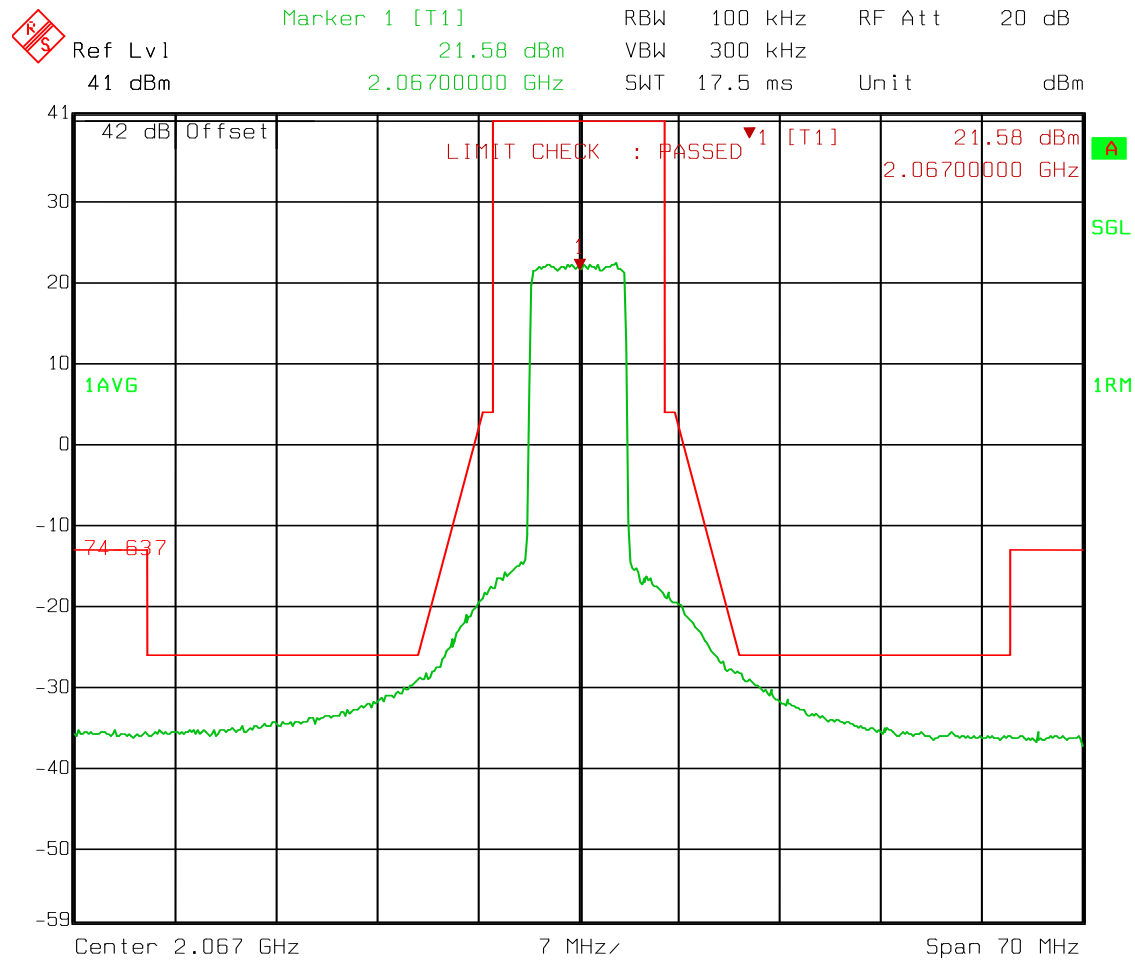


Date: 04.FEB.2014 08:42:08

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FCC ID: CNVHC4-2

# Mid Channel 7 MHz QPSK

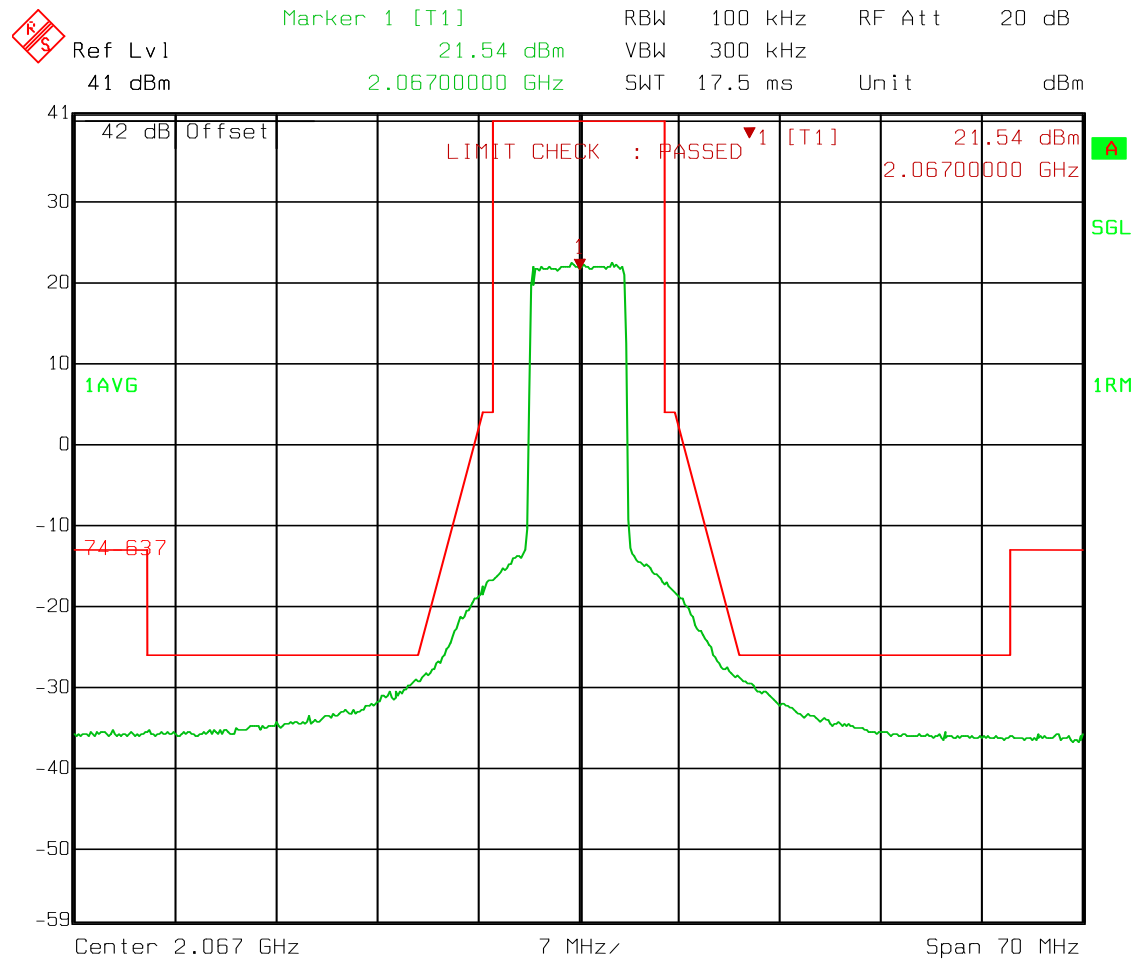


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# Mid Channel 7 MHz 16QAM

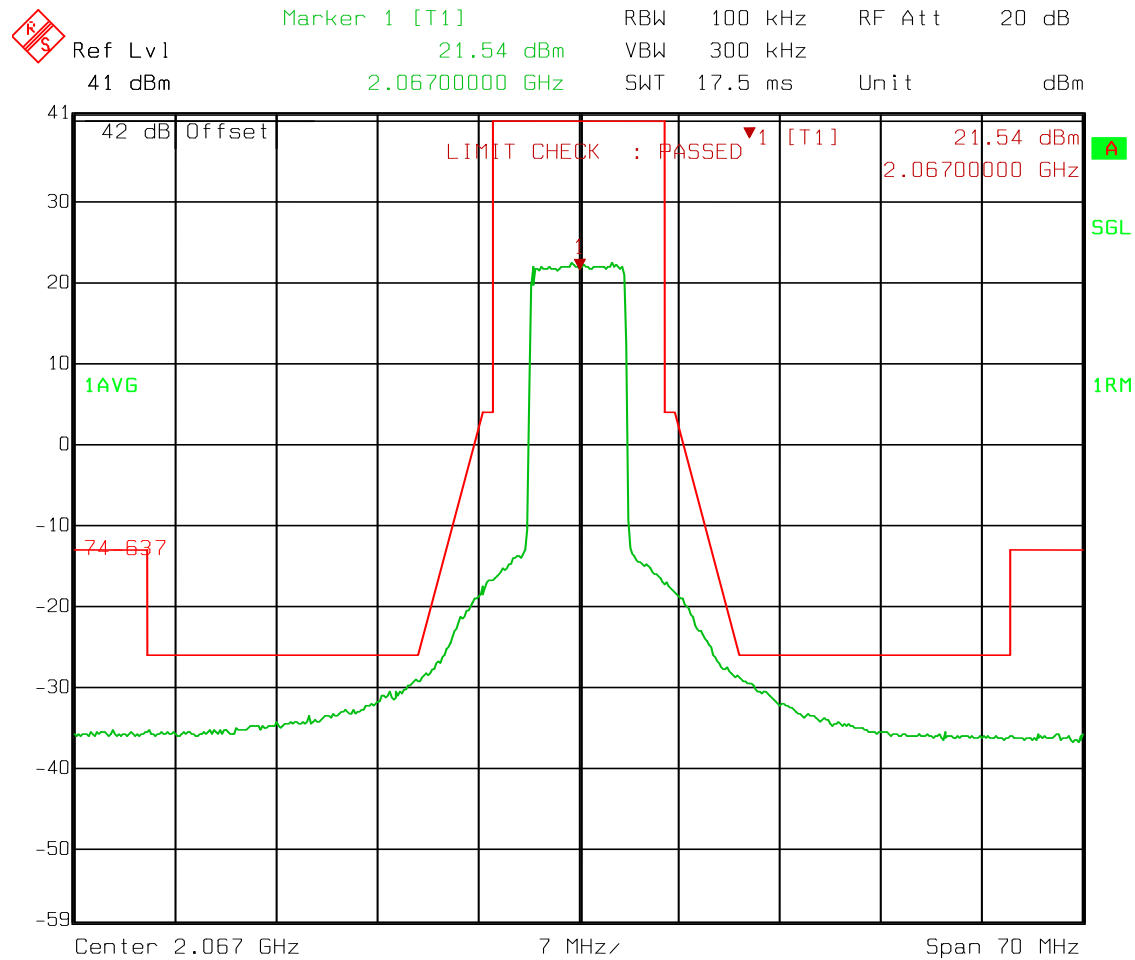


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# Mid Channel 7 MHz 64QAM

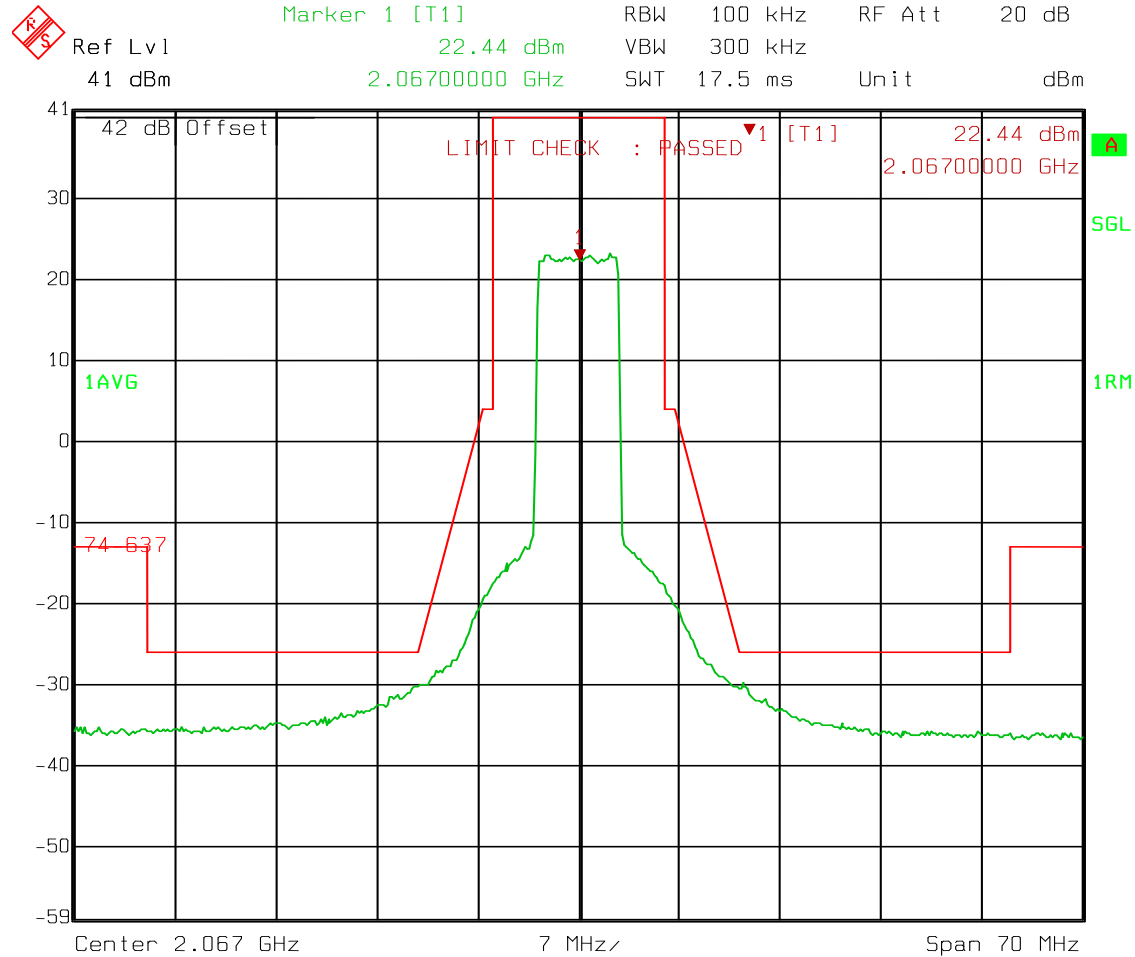


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# Mid Channel 6 MHz QPSK

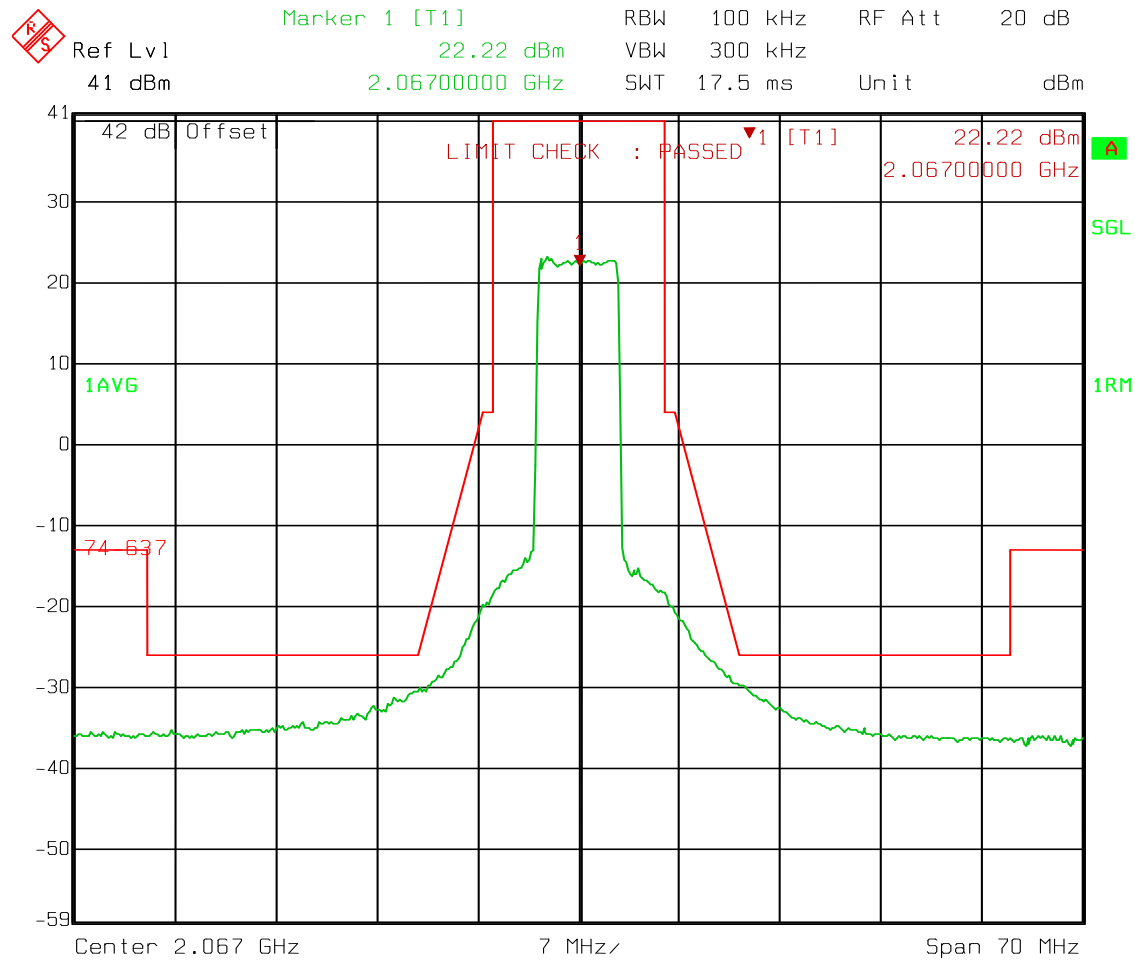


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# Mid Channel 6 MHz 16QAM

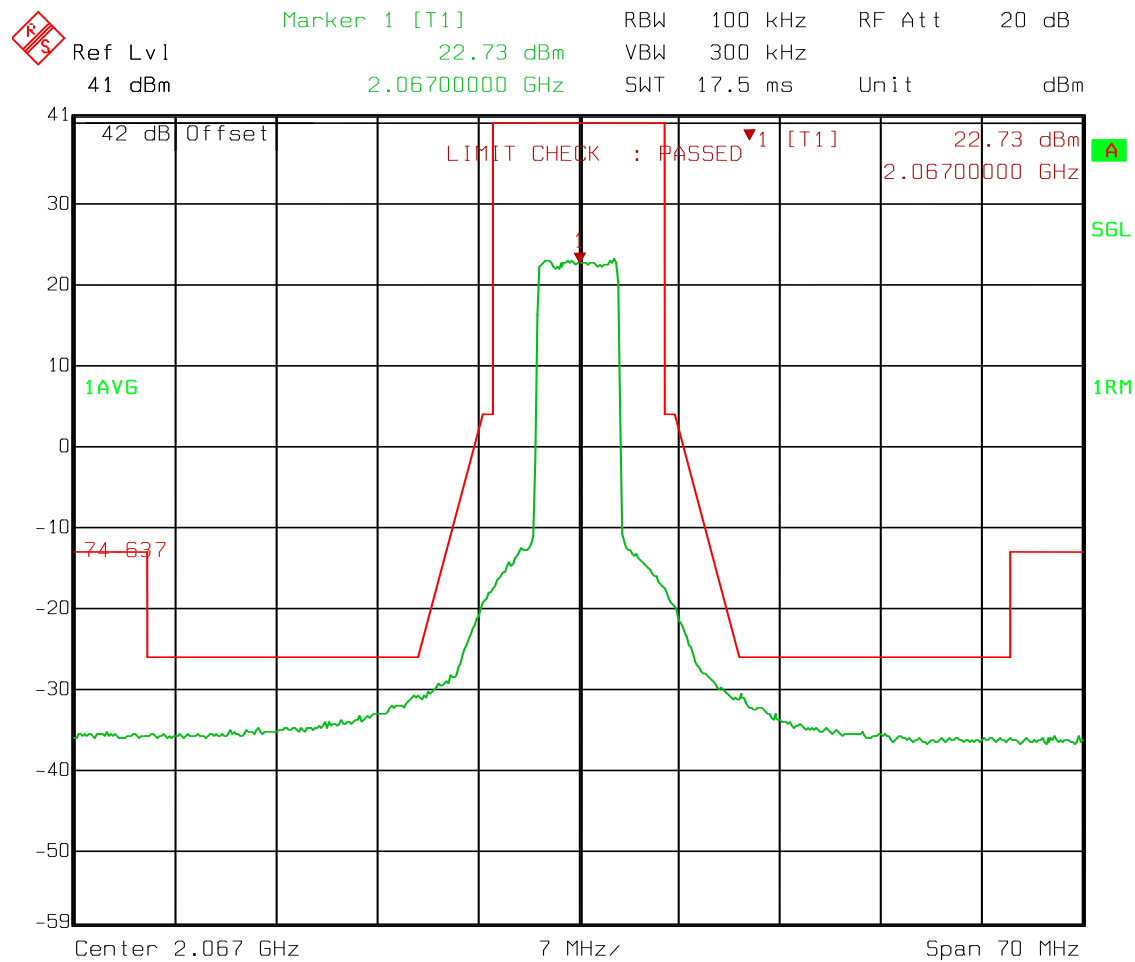


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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# Mid Channel 6 MHz 64QAM

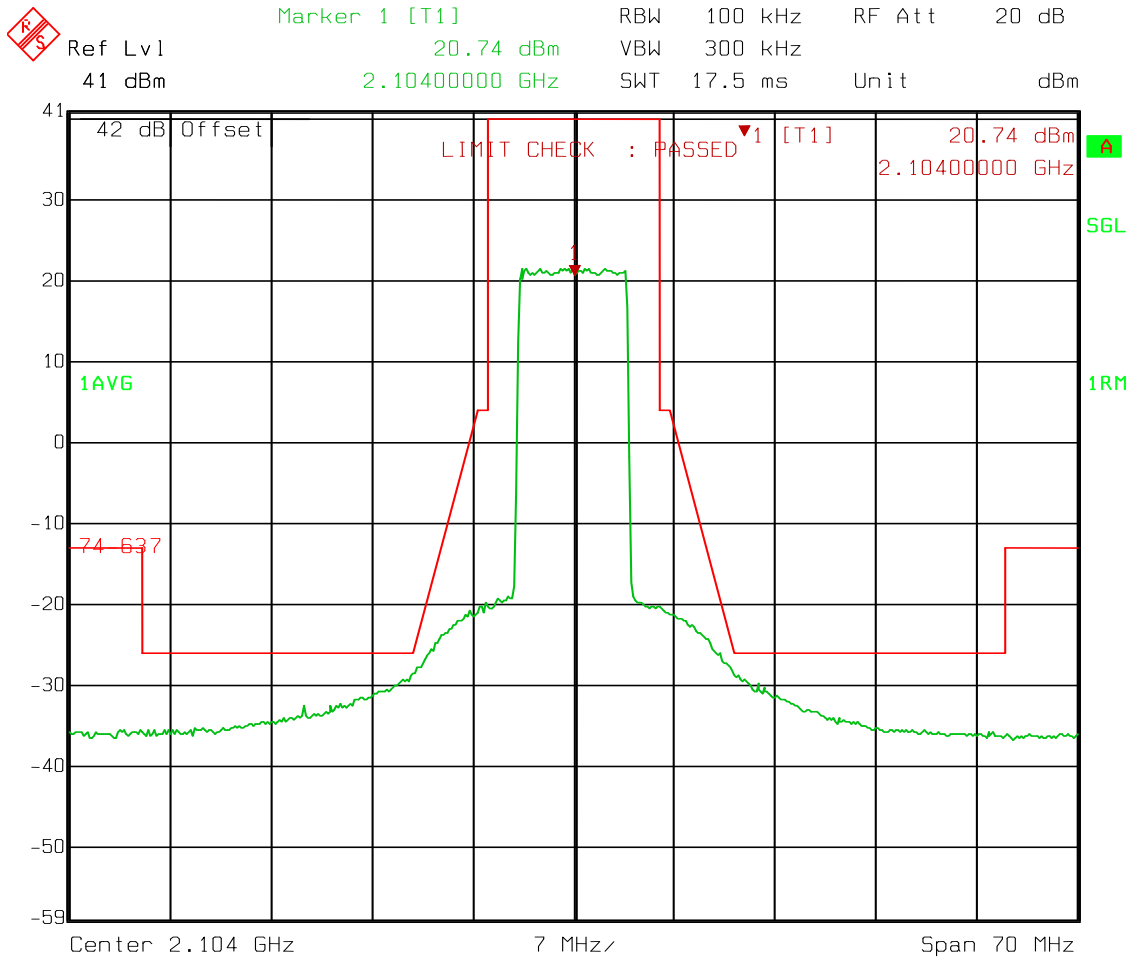


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# Upper Channel 8 MHz QPSK

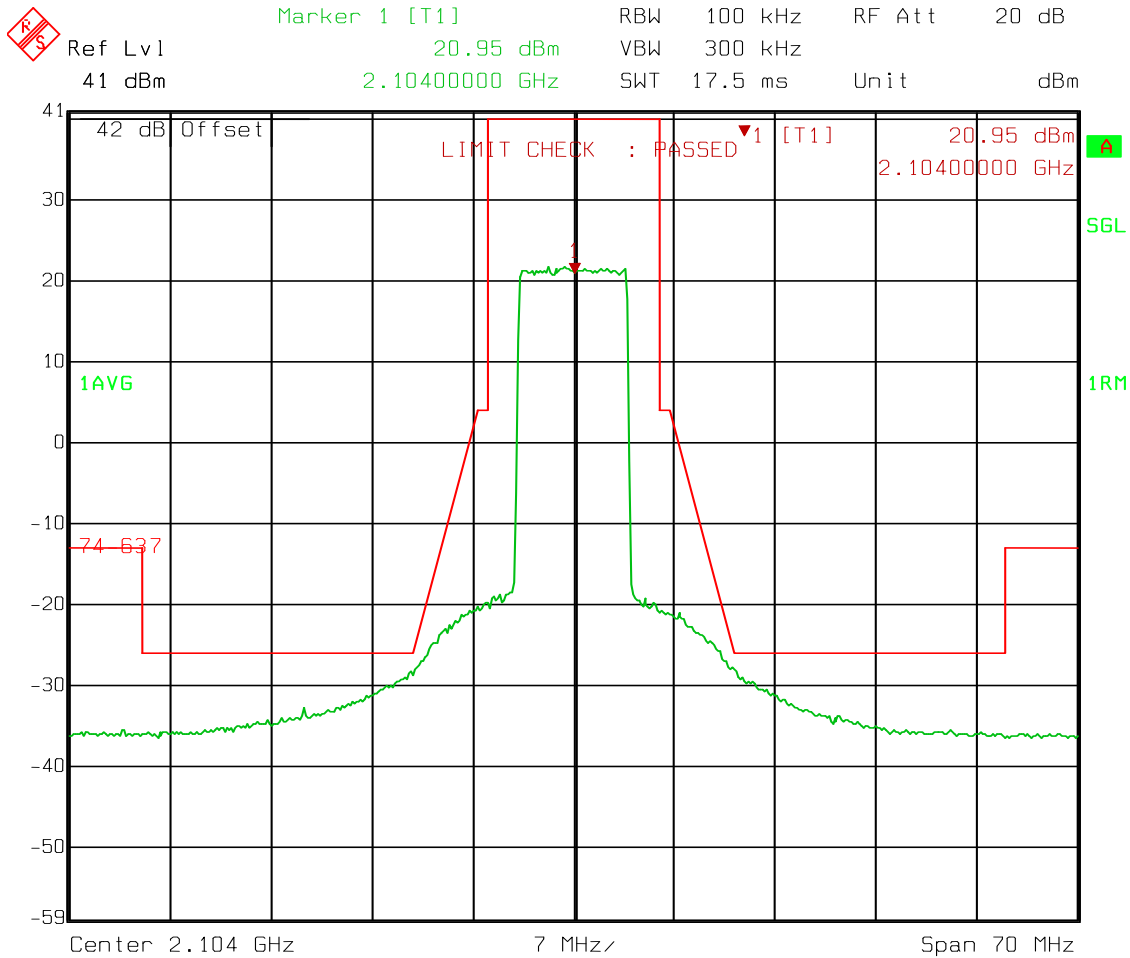


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# Upper Channel 8 MHz 16QAM

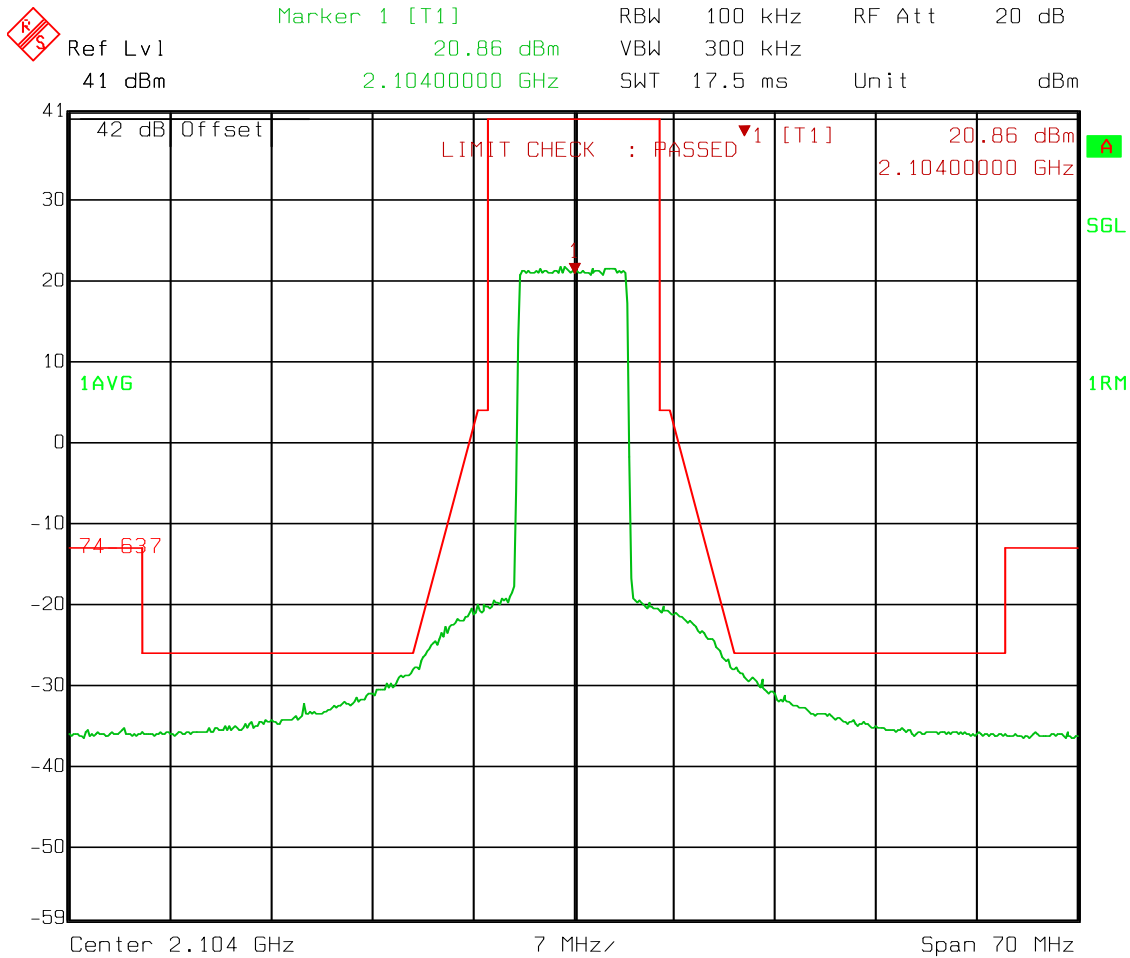


Date: 04.FEB.2014 09:00:10

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|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|------------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Upper Channel 8 MHz 64QAM

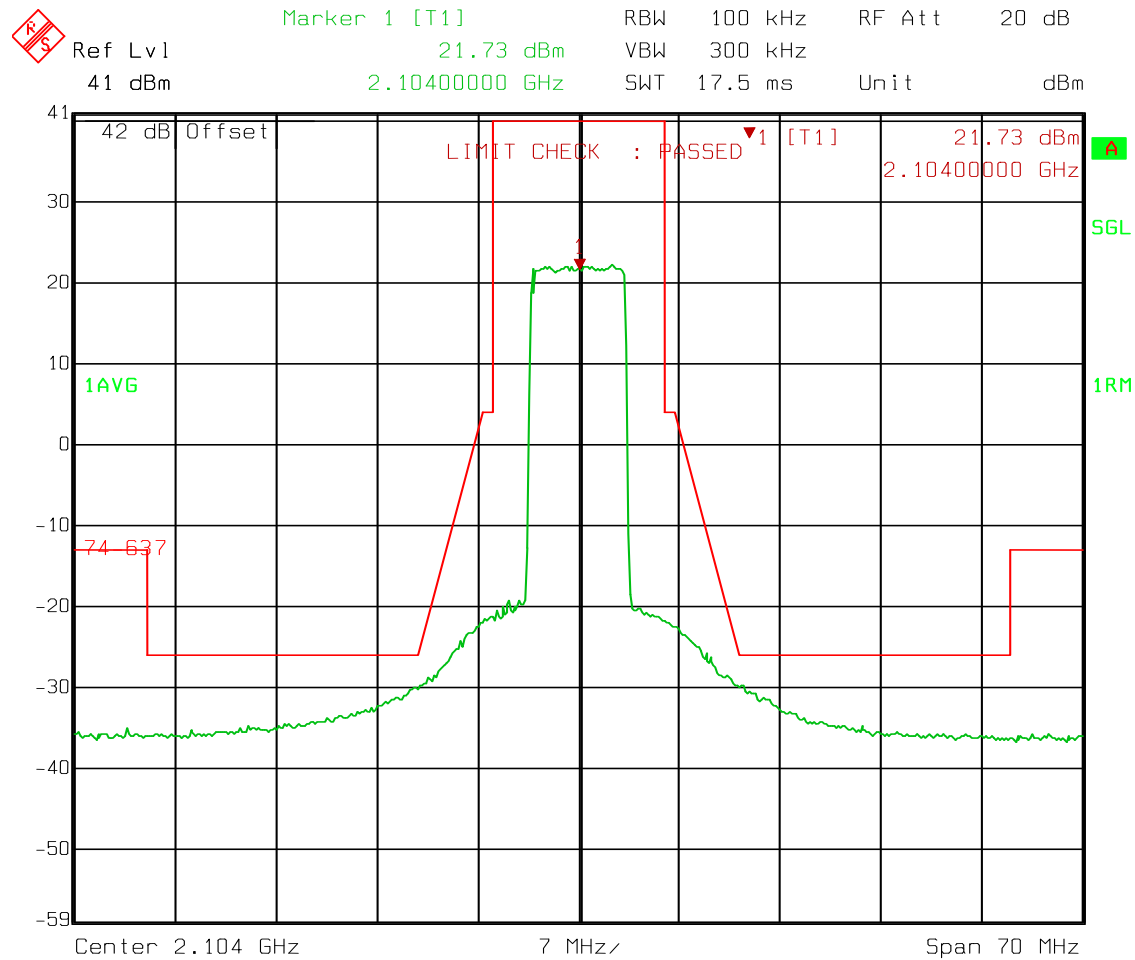


Date: 04.FEB.2014 09:00:55

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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Upper Channel 7 MHz QPSK



Date: 04.FEB.2014 09:01:35

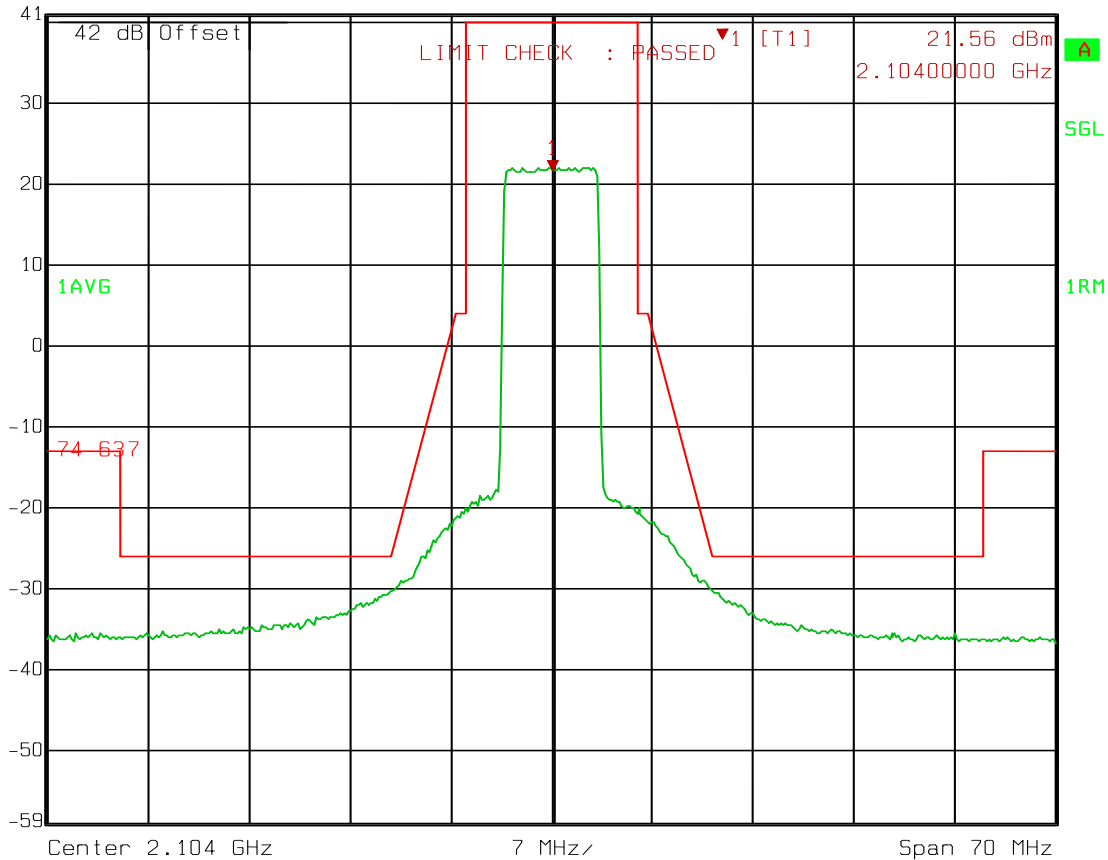
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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Upper Channel 7 MHz 16QAM



Marker 1 [T1] RBW 100 kHz RF Att 20 dB  
Ref Lvl 21.56 dBm VBW 300 kHz  
41 dBm 2.10400000 GHz SWT 17.5 ms Unit dBm

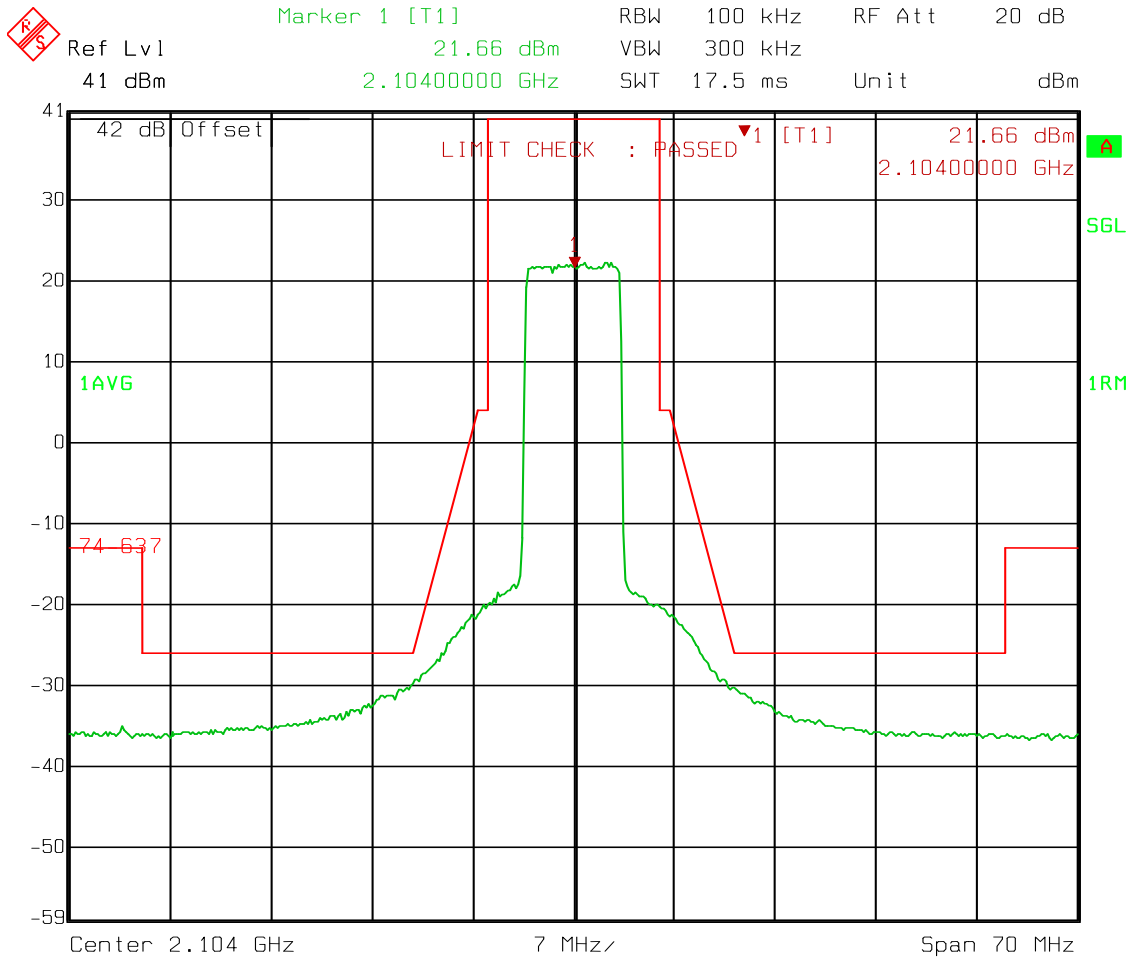


Date: 04.FEB.2014 09:02:09

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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 110 of 146 |

FCC ID: CNVHC4-2

# Upper Channel 7 MHz 64QAM

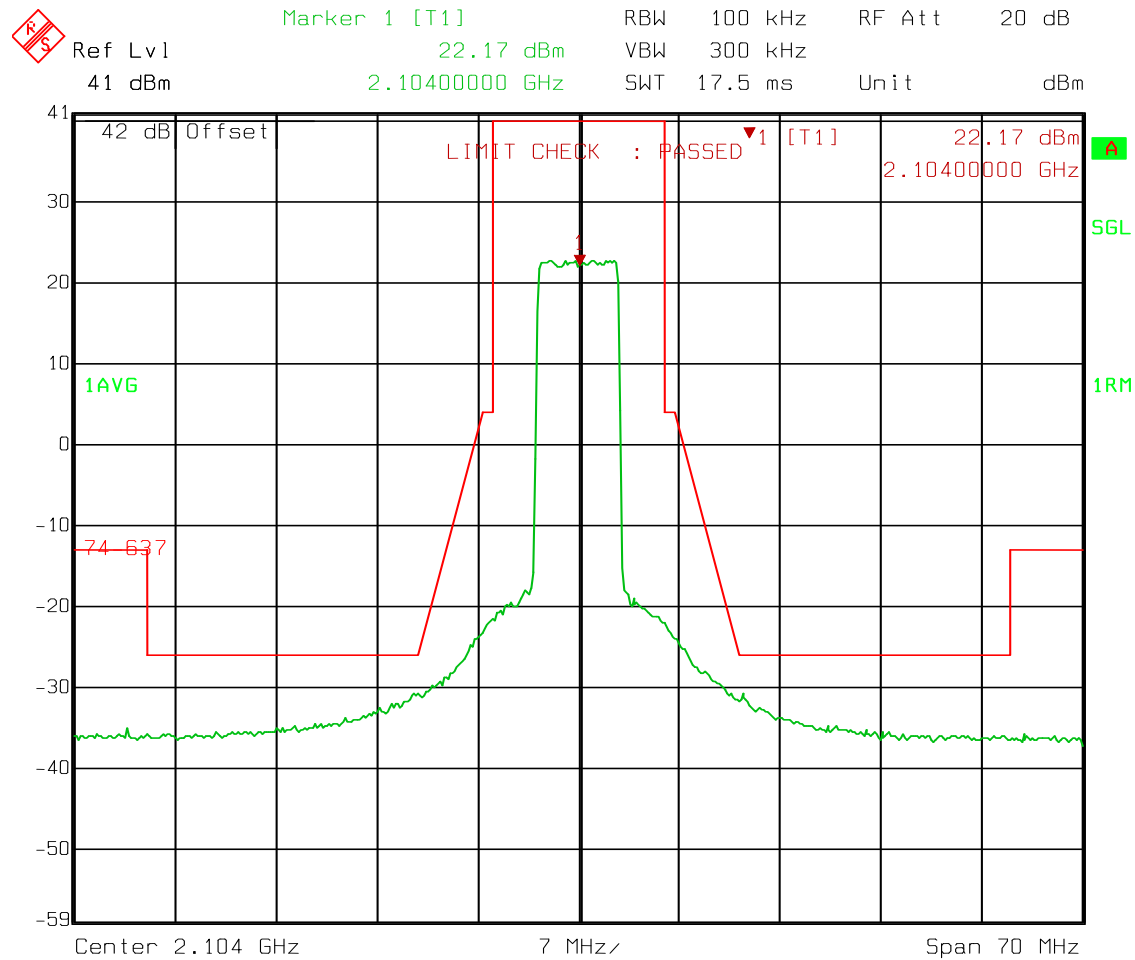


Date: 04.FEB.2014 09:02:42

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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Upper Channel 6 MHz QPSK

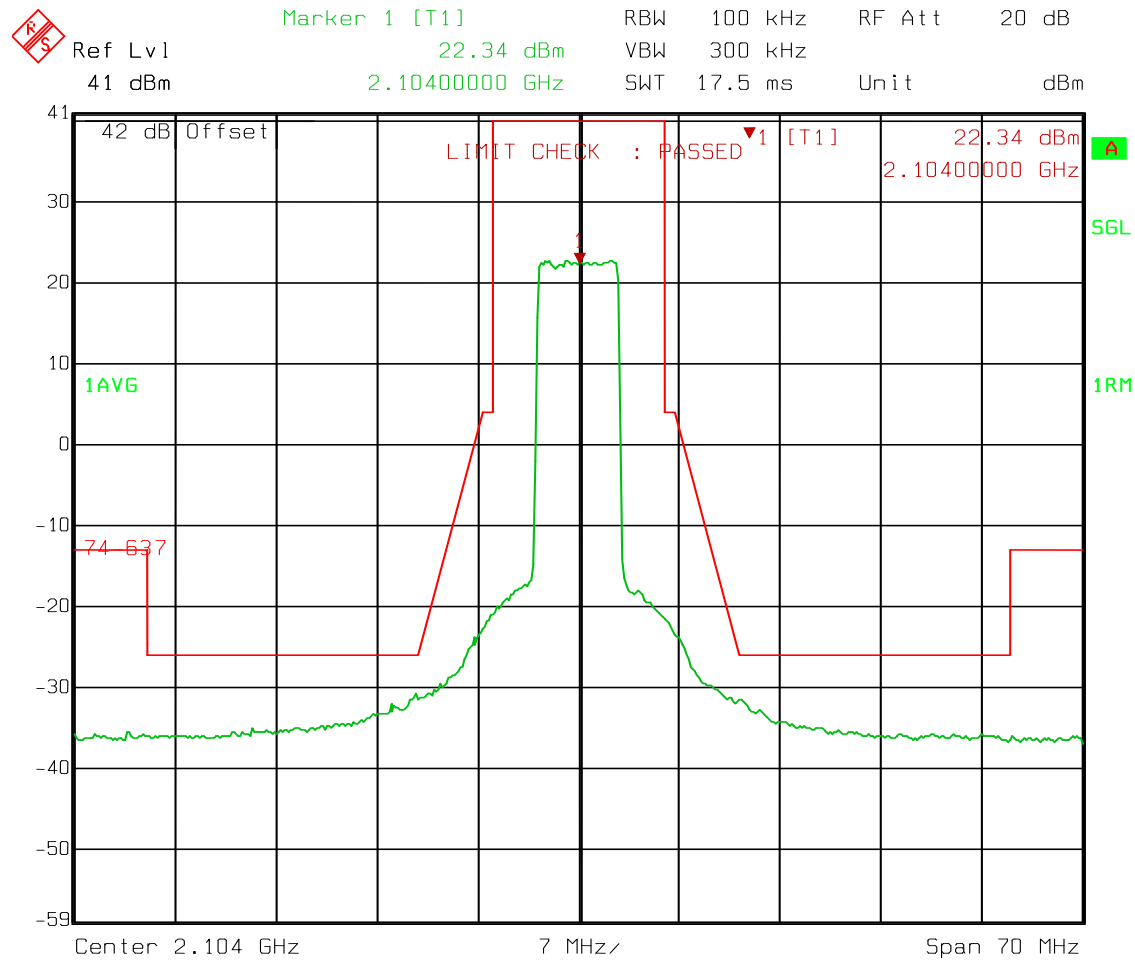


Date: 04.FEB.2014 09:03:16

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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

## Upper Channel 6 MHz 16QAM

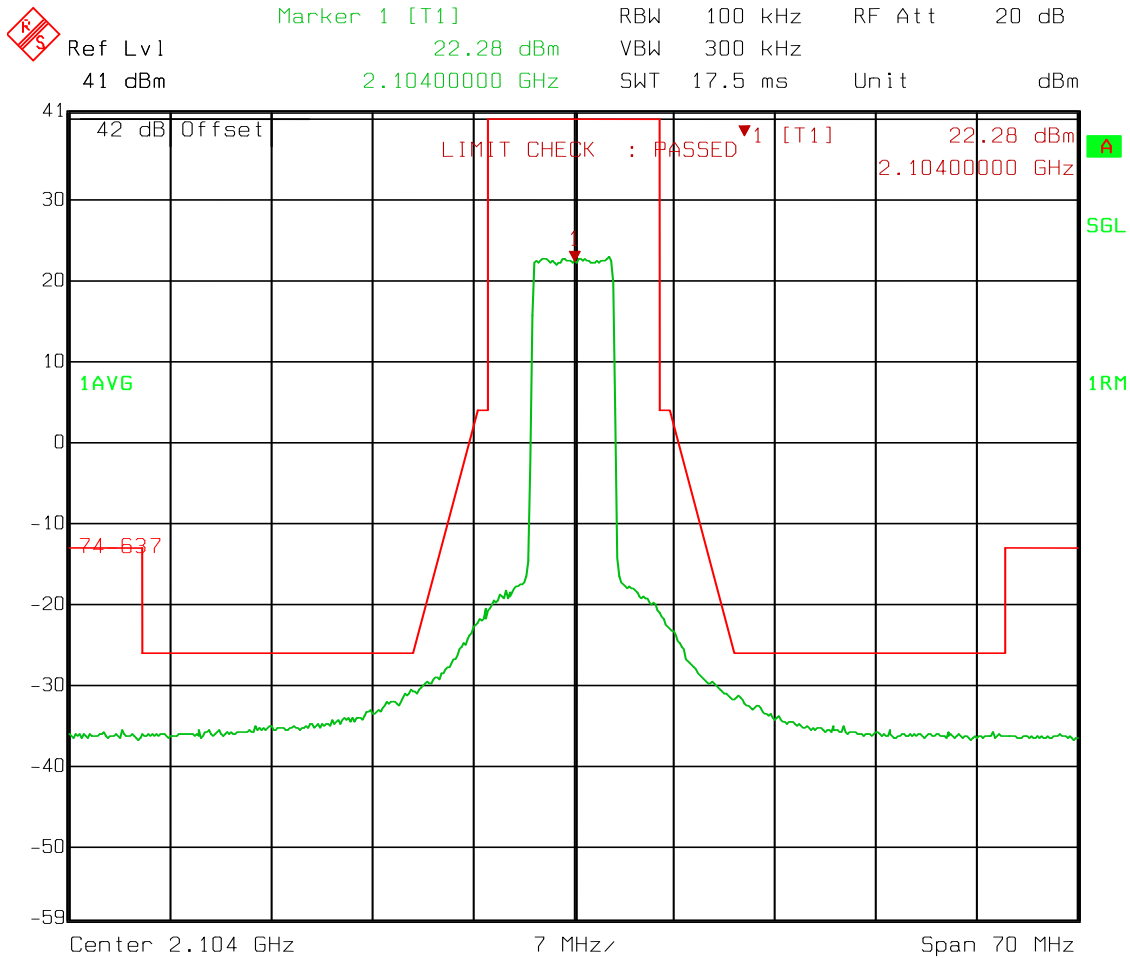


Date: 04.FEB.2014 09:03:47

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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Upper Channel 6 MHz 64QAM



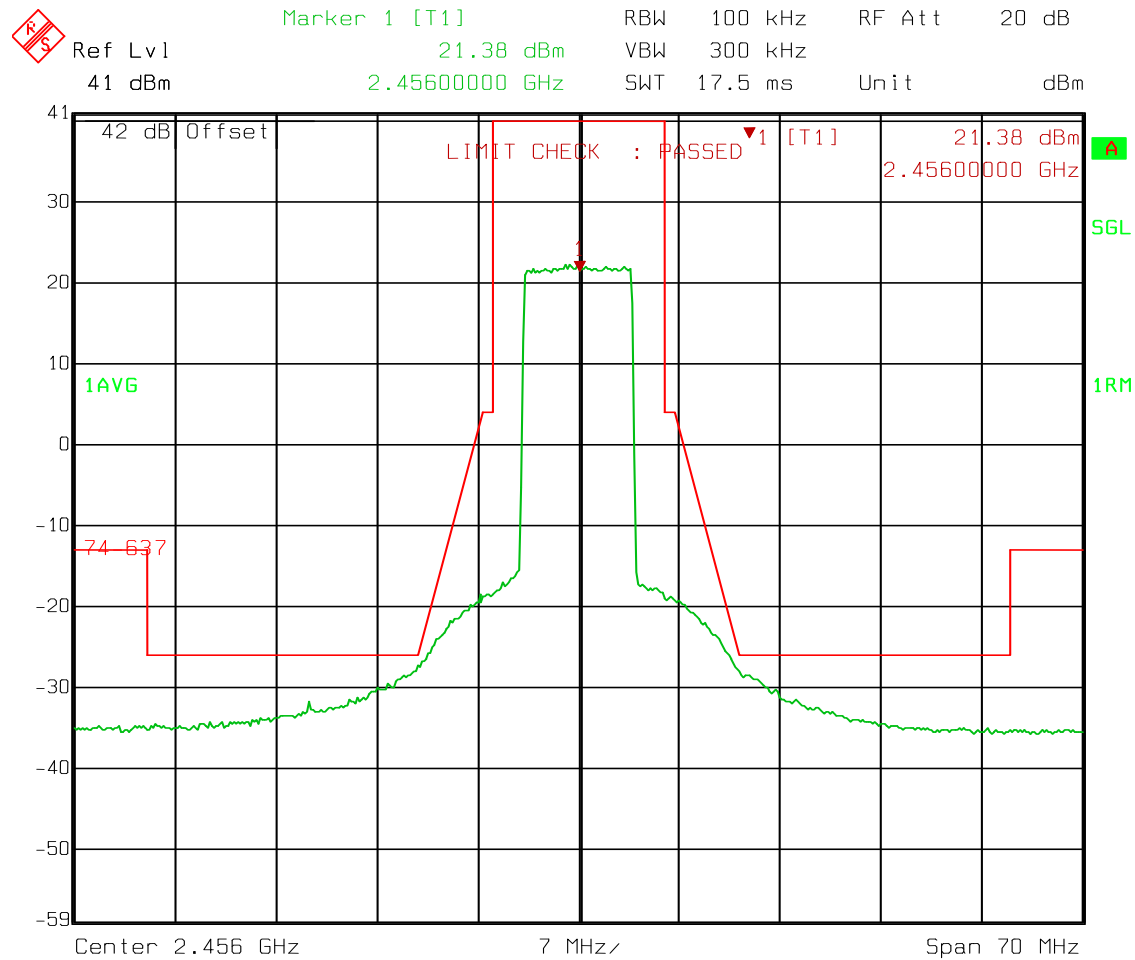
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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# HIGH Band

Low Channel 8 MHz 16 QAM



Date: 04.FEB.2014 09:09:40

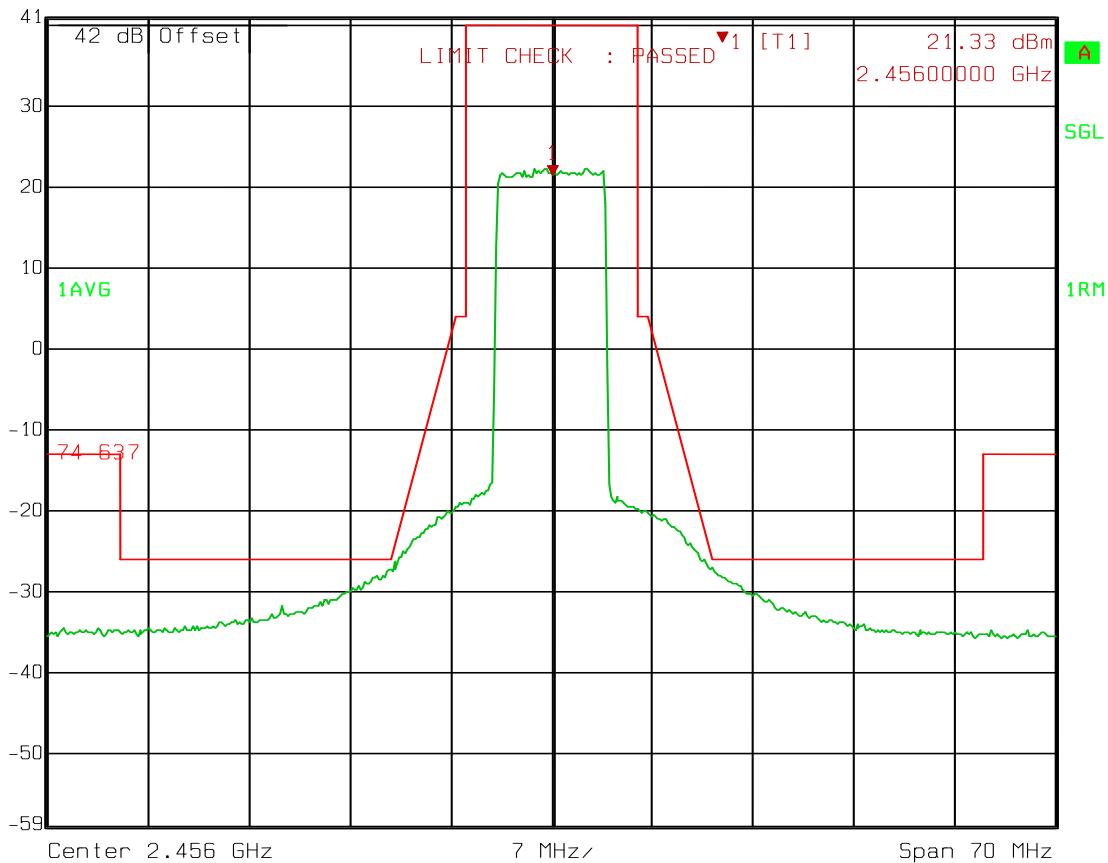
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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Low Channel 8 MHz QPSK



Marker 1 [T1] RBW 100 kHz RF Att 20 dB  
 Ref Lvl 21.33 dBm VBW 300 kHz  
 41 dBm 2.45600000 GHz SWT 17.5 ms Unit dBm



Date: 04.FEB.2014 09:09:12

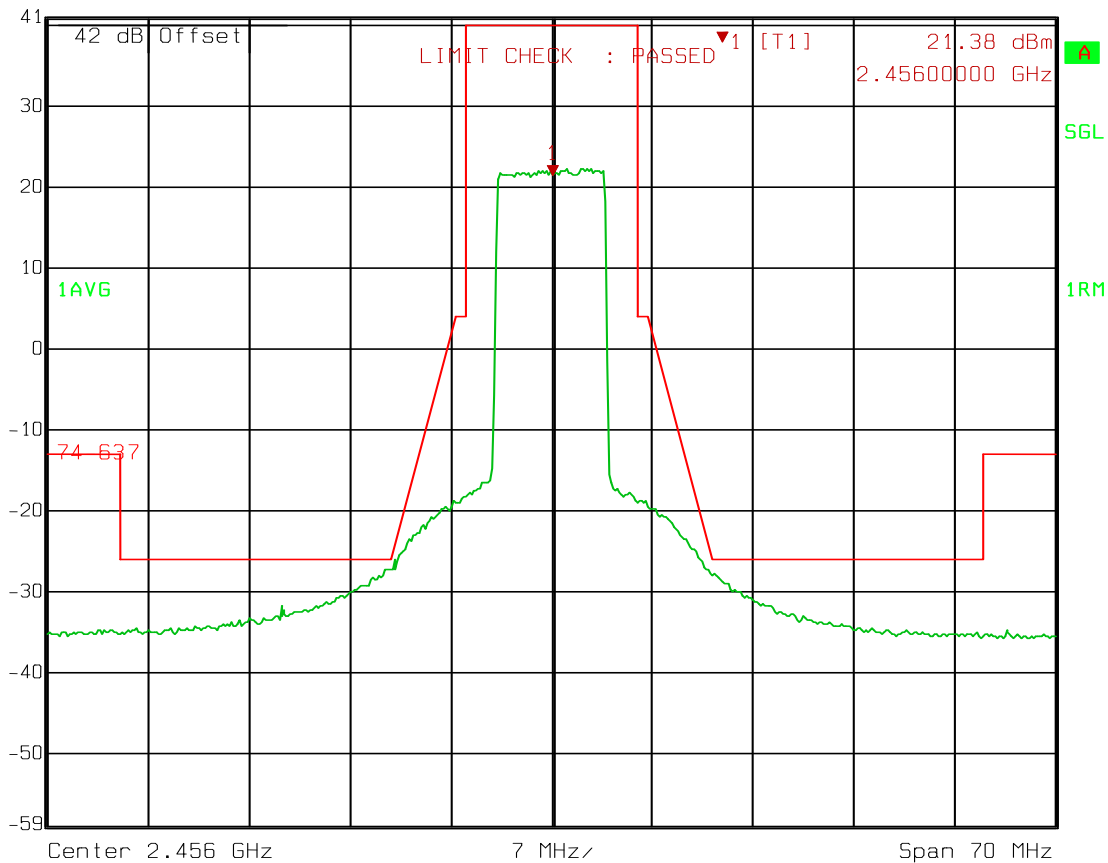
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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Low Channel 8 MHz 64QAM



Marker 1 [T1] RBW 100 kHz RF Att 20 dB  
 Ref Lvl 21.38 dBm VBW 300 kHz  
 41 dBm 2.45600000 GHz SWT 17.5 ms Unit dBm



Date: 04.FEB.2014 09:10:07

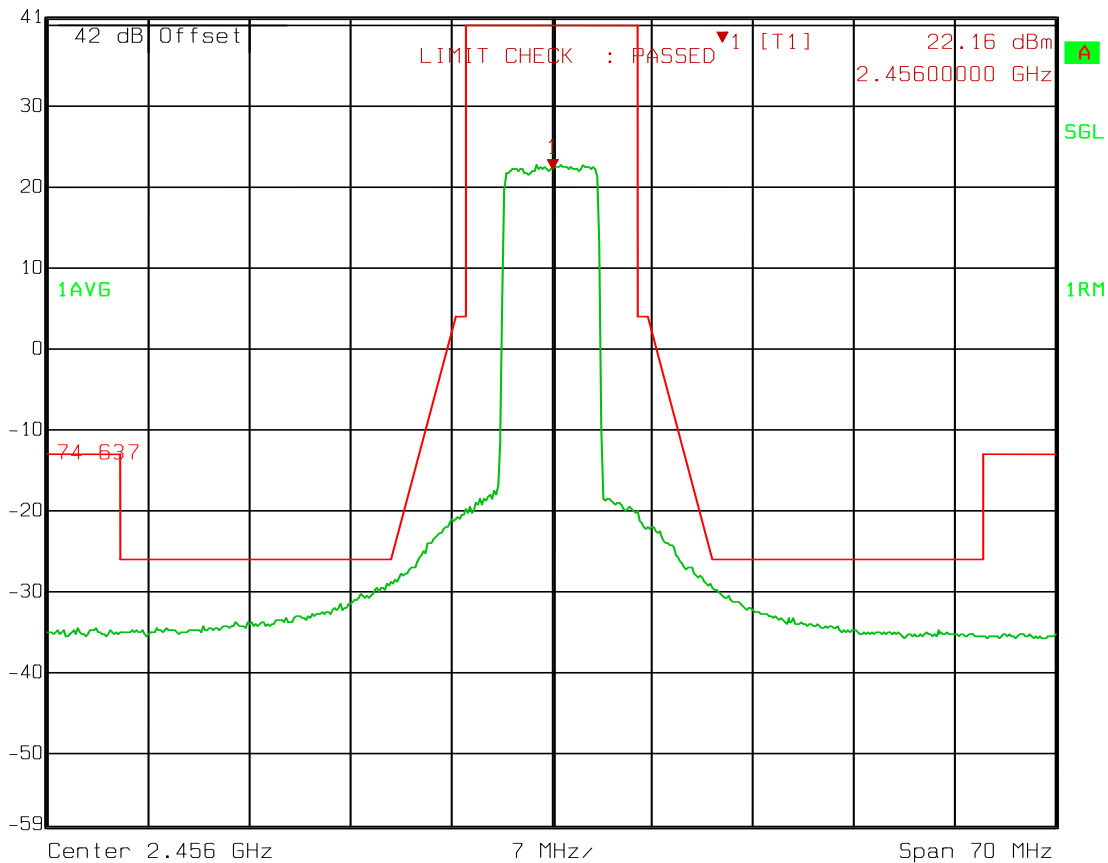
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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Low Channel 7 MHz QPSK



Marker 1 [T1] RBW 100 kHz RF Att 20 dB  
 Ref Lvl 22.16 dBm VBW 300 kHz  
 41 dBm 2.45600000 GHz SWT 17.5 ms Unit dBm

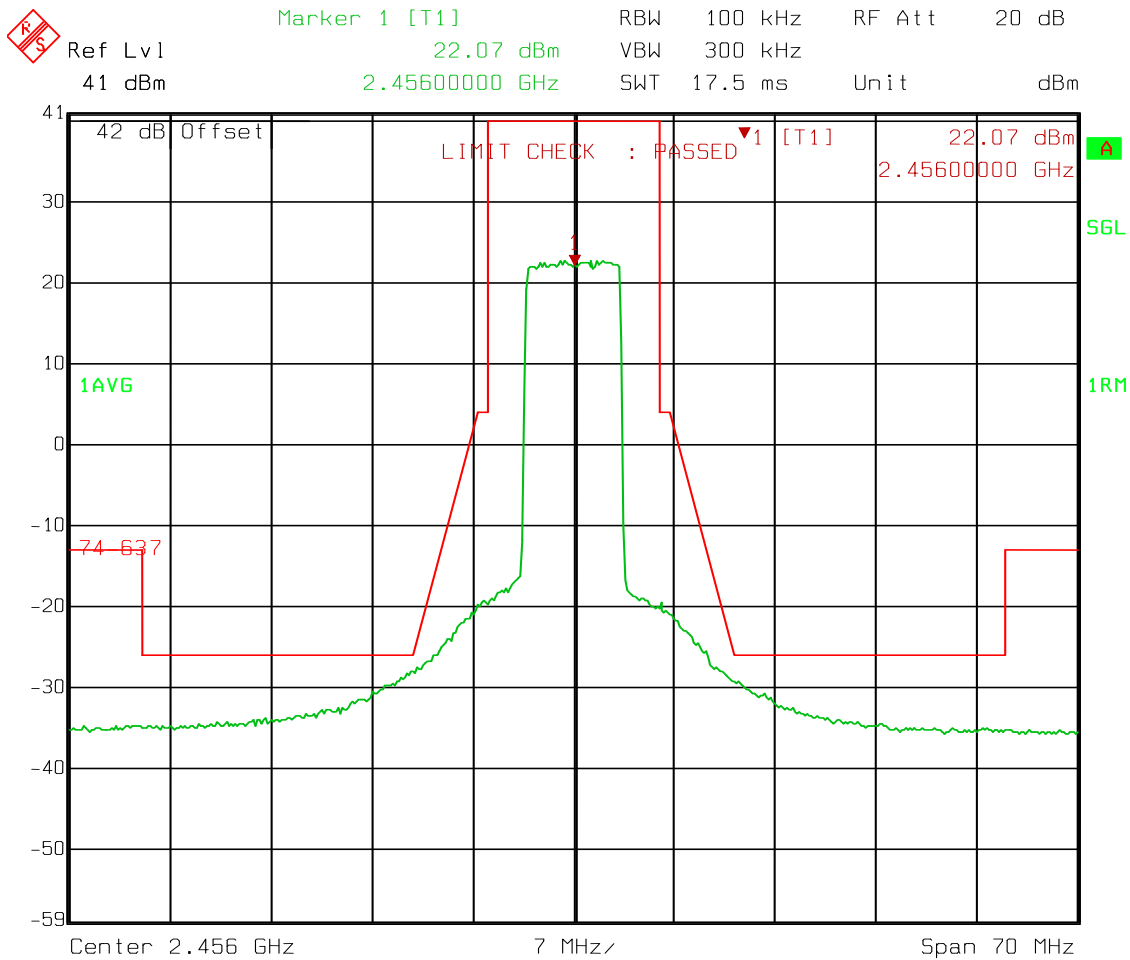


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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Low Channel 7 MHz 16QAM



Date: 04.FEB.2014 09:25:47

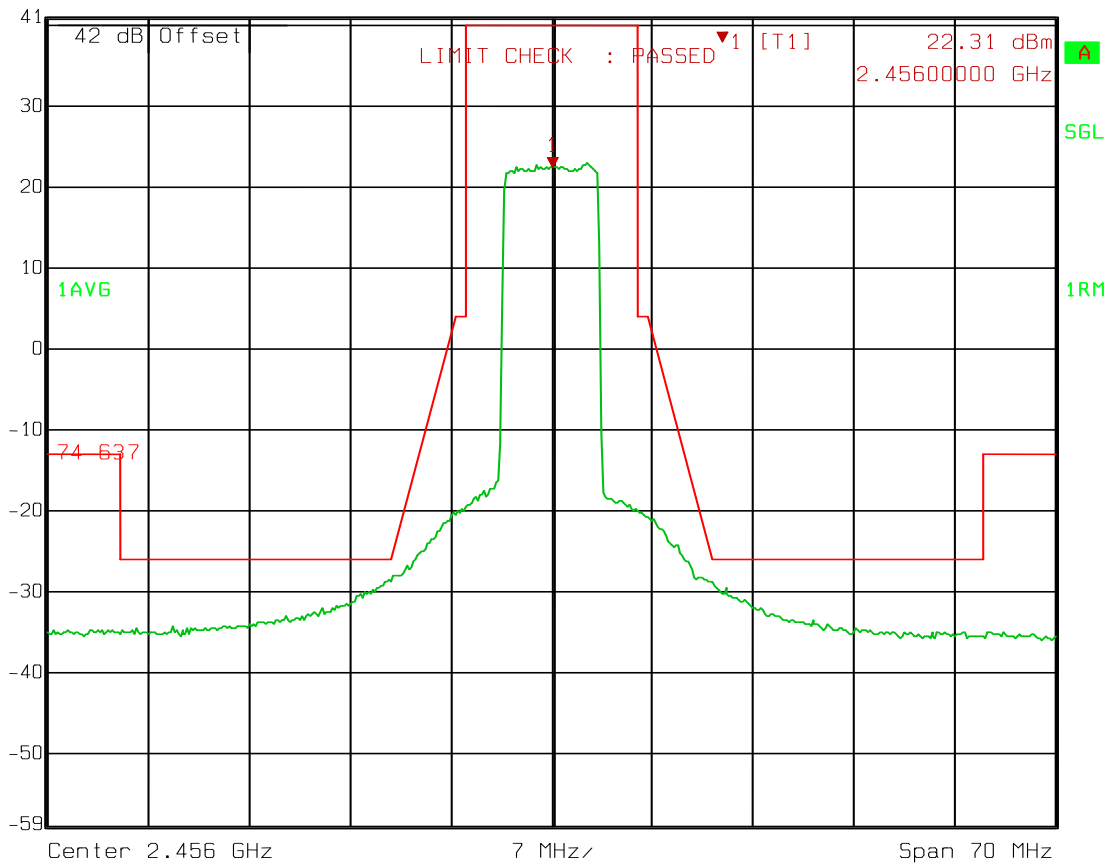
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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Low Channel 7 MHz 64QAM



Marker 1 [T1] RBW 100 kHz RF Att 20 dB  
 Ref Lvl 22.31 dBm VBW 300 kHz  
 41 dBm 2.45600000 GHz SWT 17.5 ms Unit dBm



Date: 04.FEB.2014 09:10:57

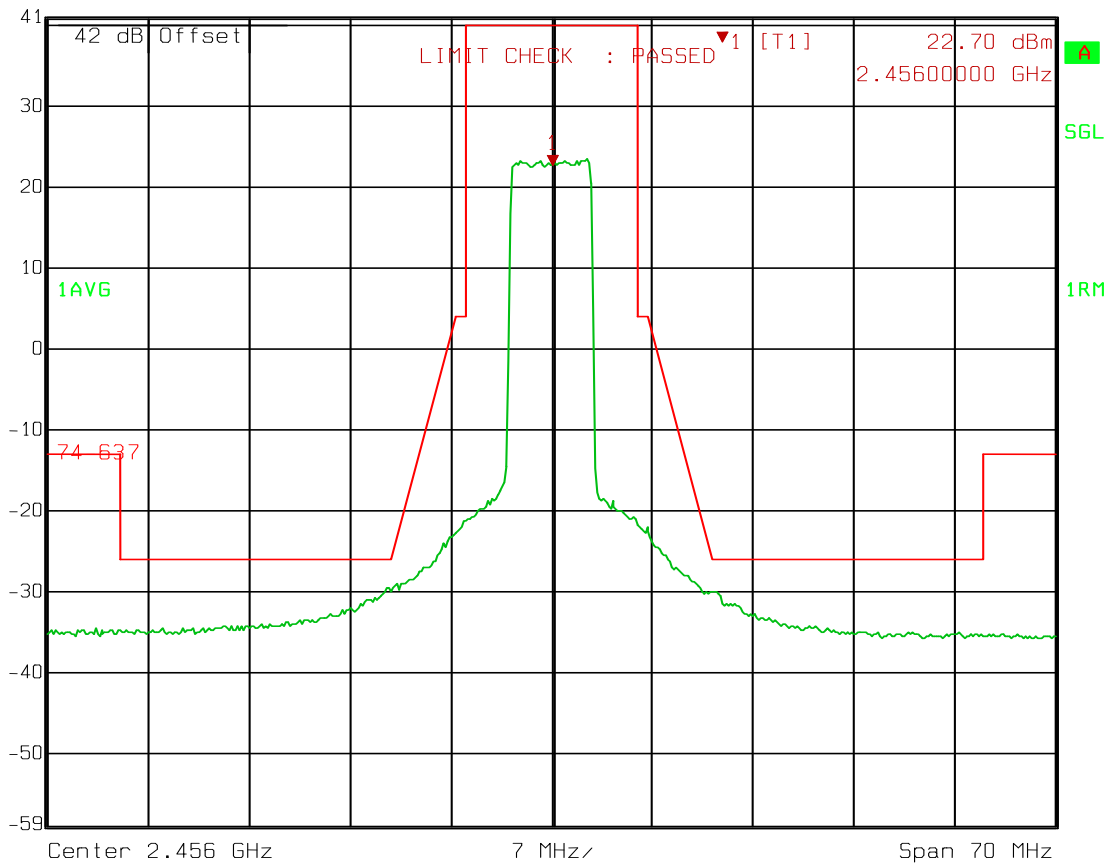
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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Low Channel 6 MHz QPSK



Marker 1 [T1] RBW 100 kHz RF Att 20 dB  
 Ref Lvl 22.70 dBm VBW 300 kHz  
 41 dBm 2.45600000 GHz SWT 17.5 ms Unit dBm

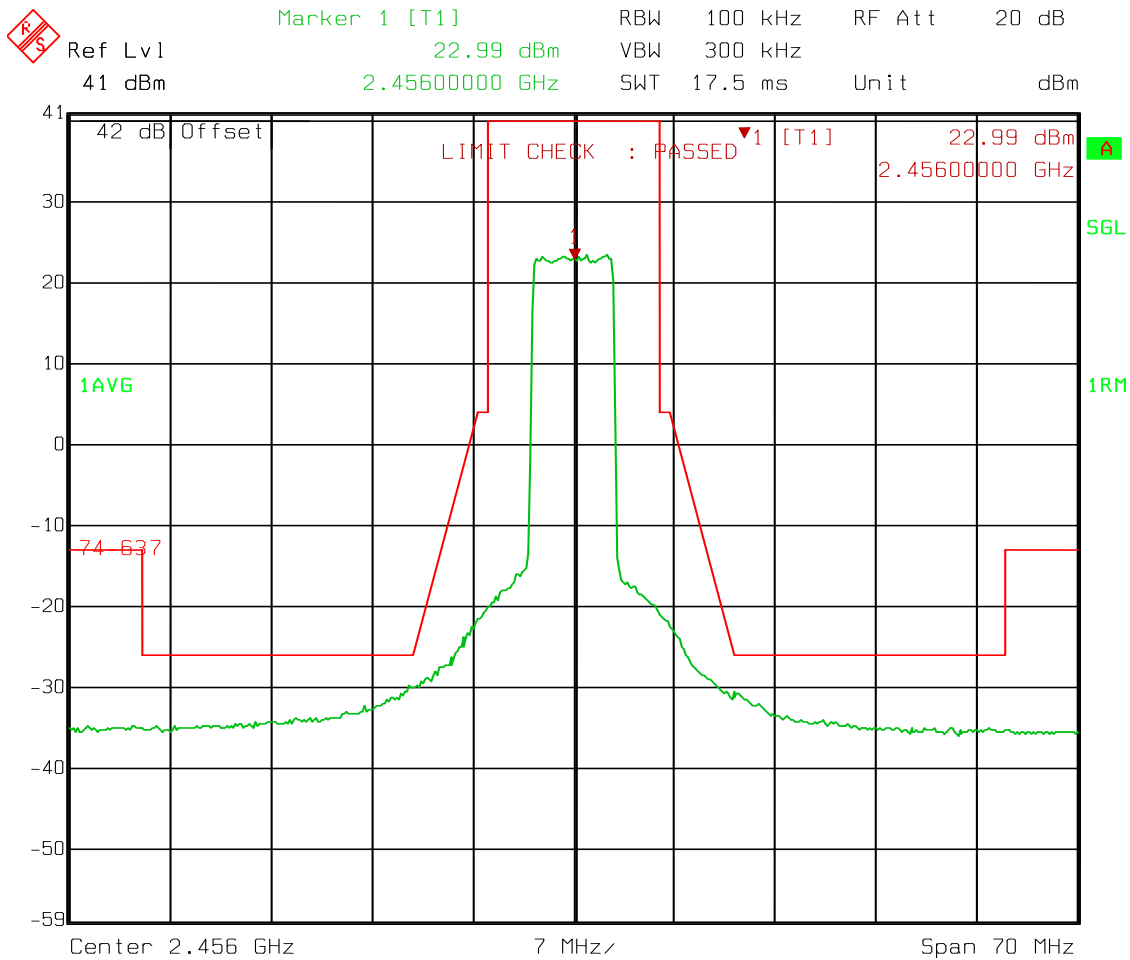


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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Low Channel 6 MHz 16QAM



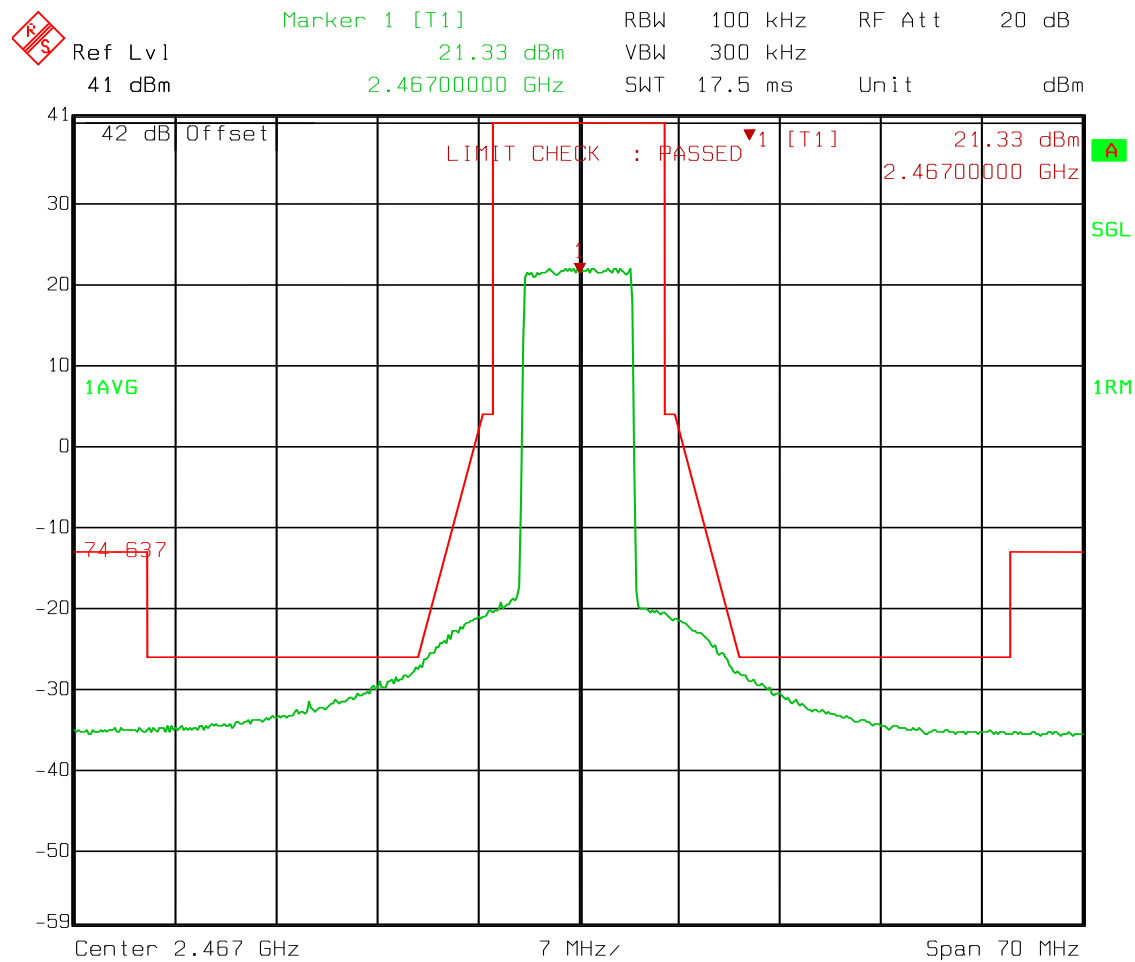
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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 123 of 146 |

FCC ID: CNVHC4-2

# Mid Channel 8 MHz QPSK

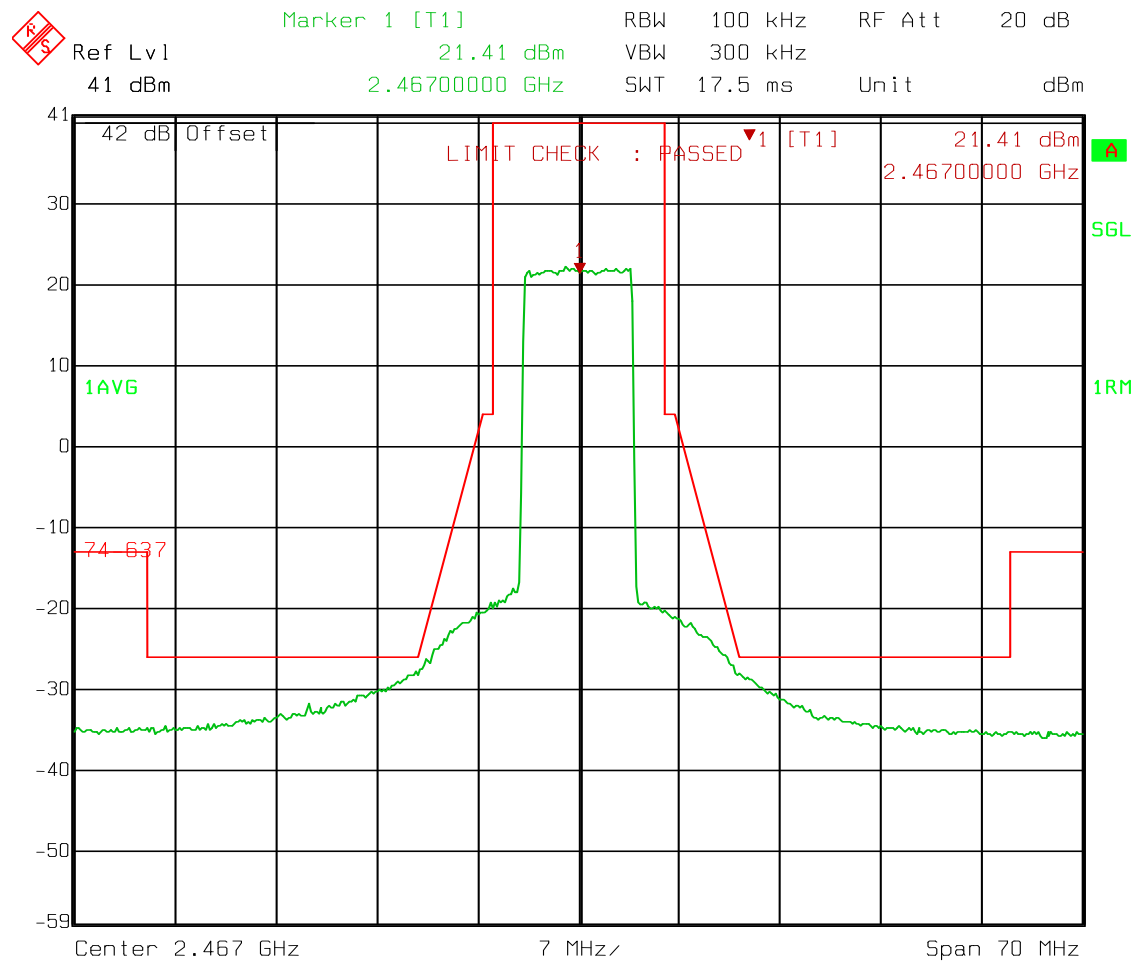


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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

Mid Channel 8 MHz 16QAM



Date: 04.FEB.2014 09:16:13

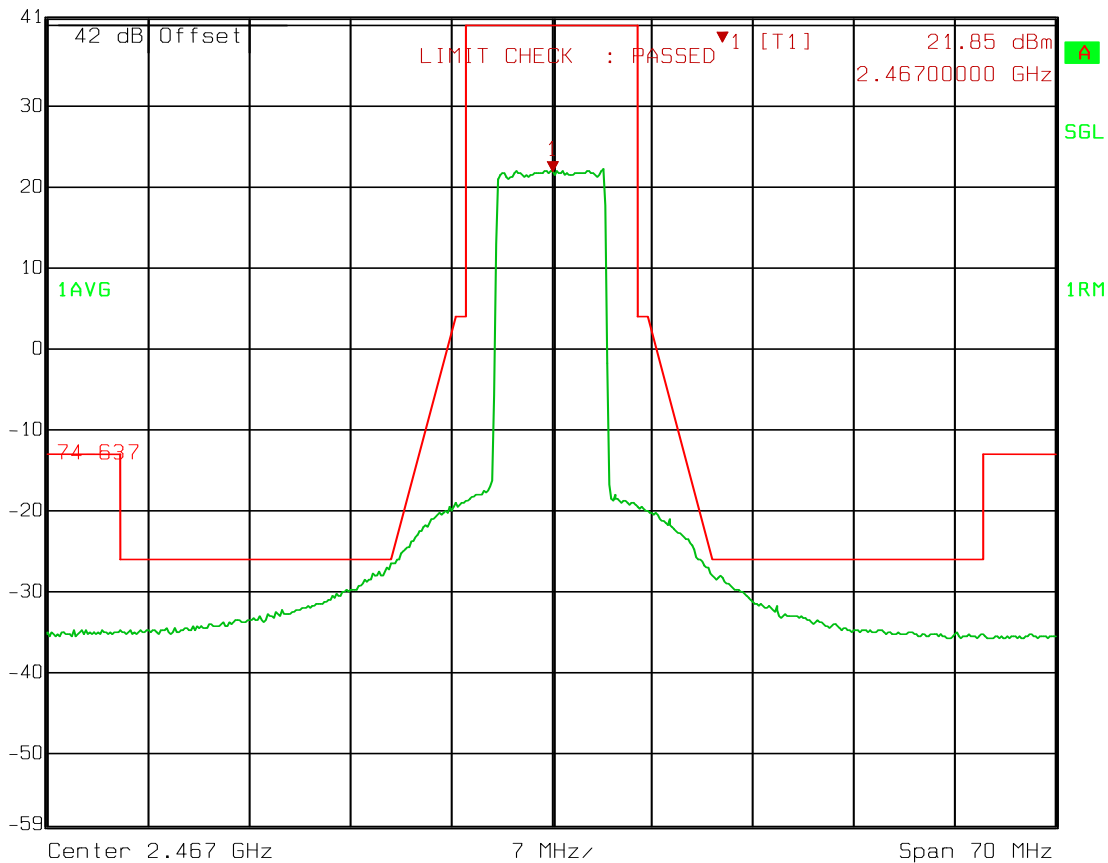
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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Mid Channel 8 MHz 64 QAM



Marker 1 [T1] RBW 100 kHz RF Att 20 dB  
 Ref Lvl 21.85 dBm VBW 300 kHz  
 41 dBm 2.46700000 GHz SWT 17.5 ms Unit dBm

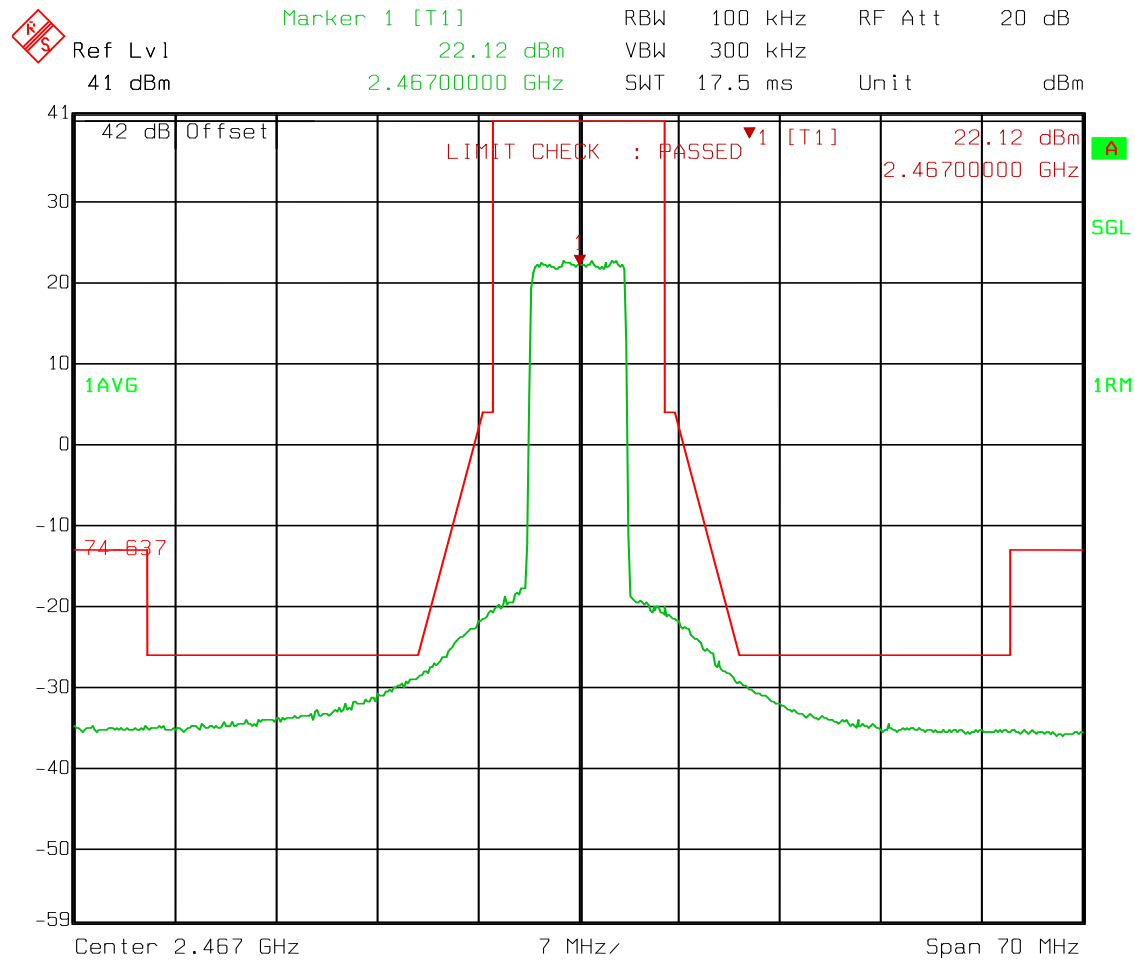


Date: 04.FEB.2014 09:16:40

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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Mid Channel 7 MHz QPSK

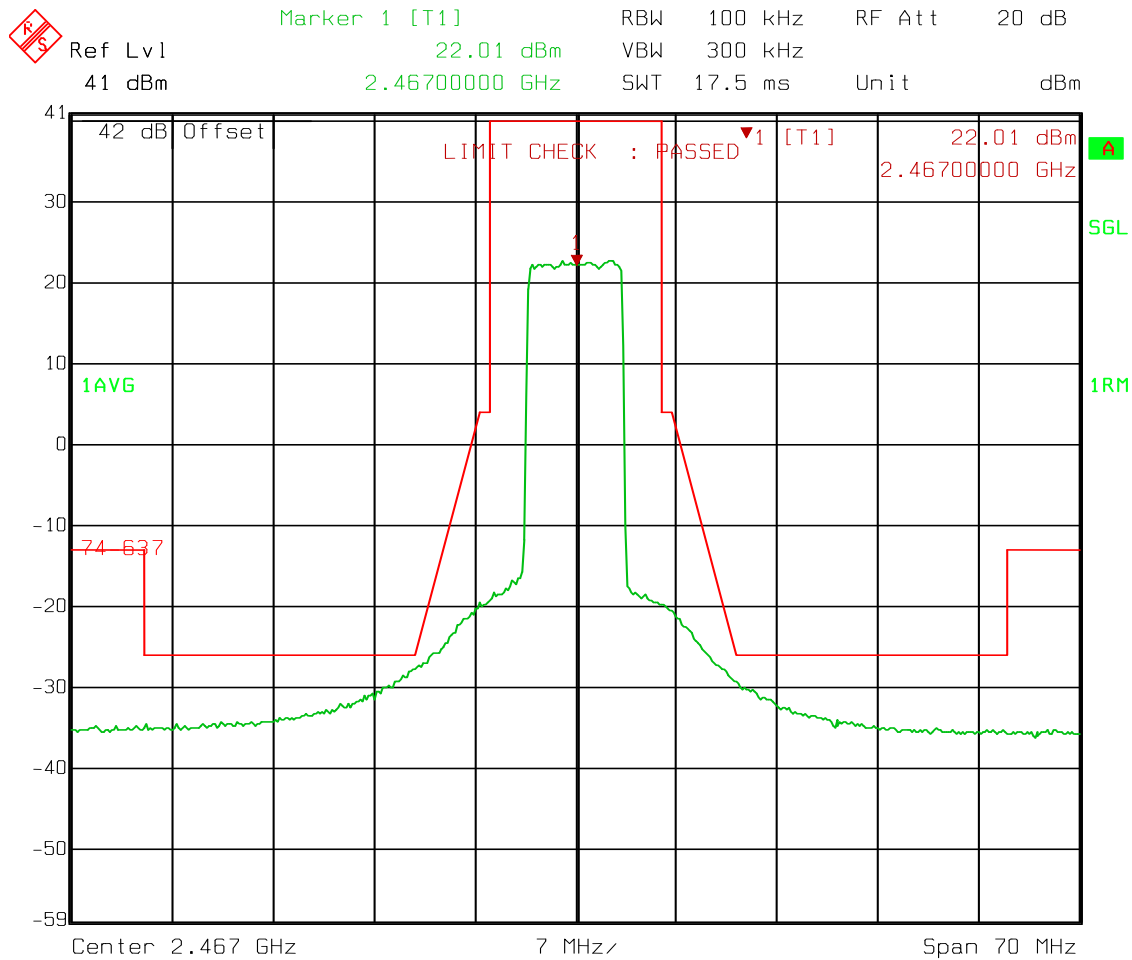


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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Mid Channel 7 MHz 16QAM

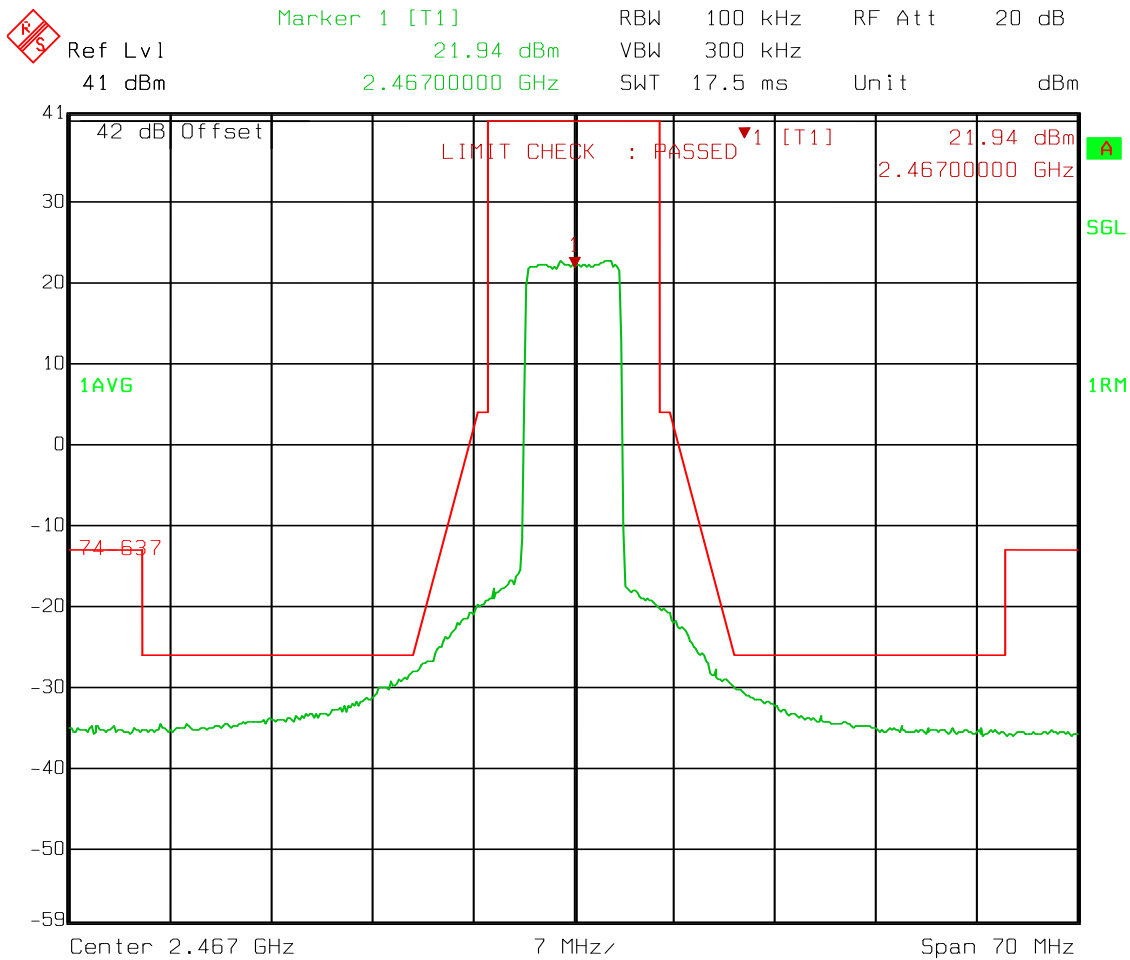


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 128 of 146 |

FCC ID: CNVHC4-2

# Mid Channel 7 MHz 64QAM

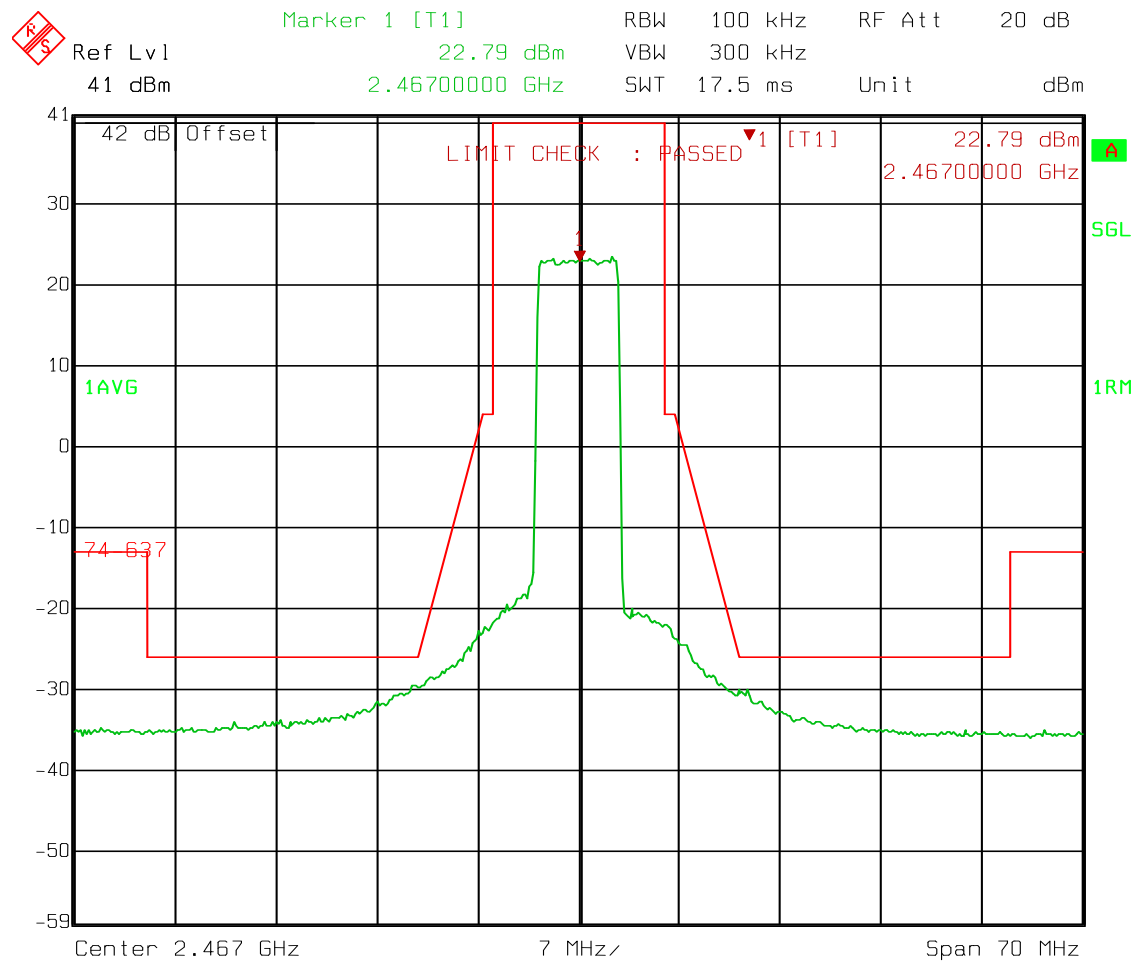


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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 129 of 146 |

FCC ID: CNVHC4-2

# Mid Channel 6 MHz QPSK

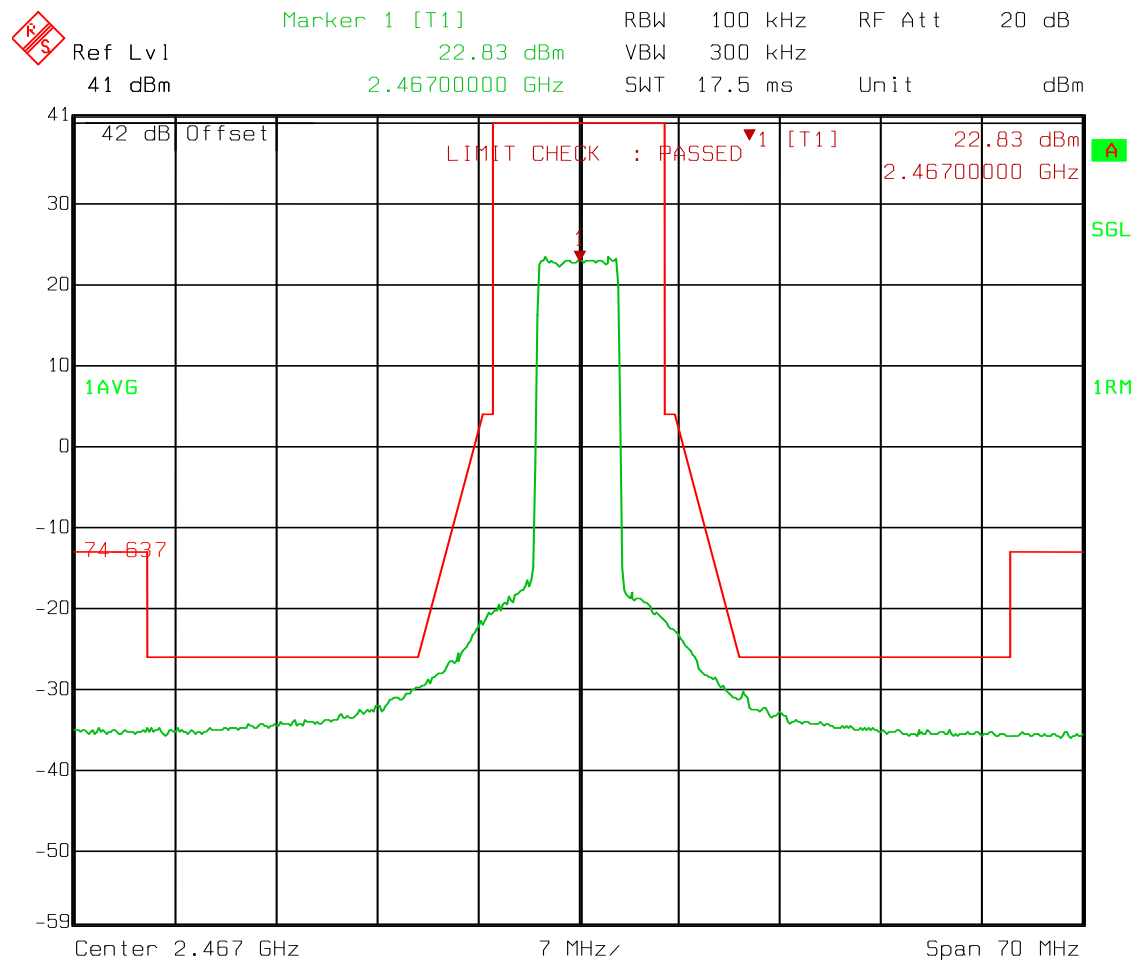


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| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
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FCC ID: CNVHC4-2

# Mid Channel 6 MHz 16QAM

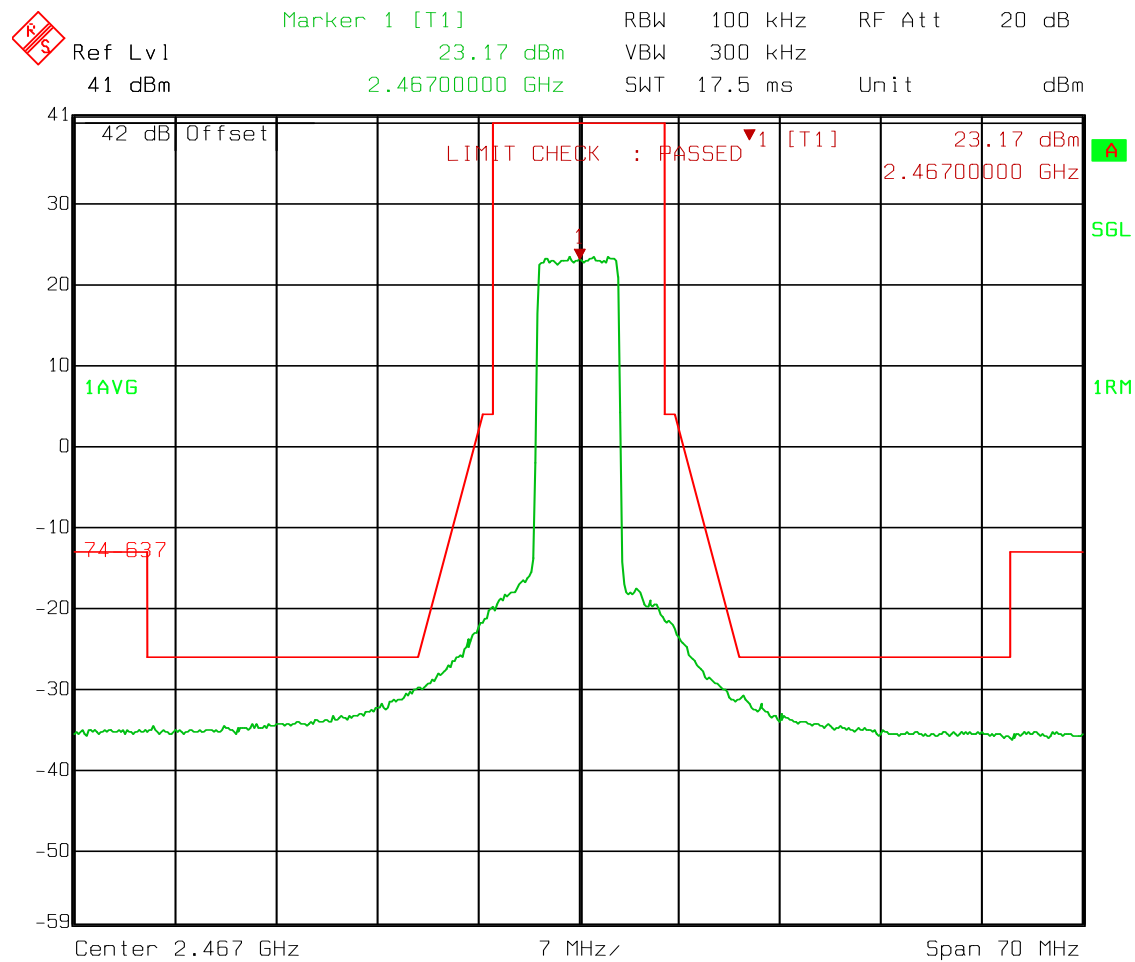


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FCC ID: CNVHC4-2

# Mid Channel 6 MHz 64QAM

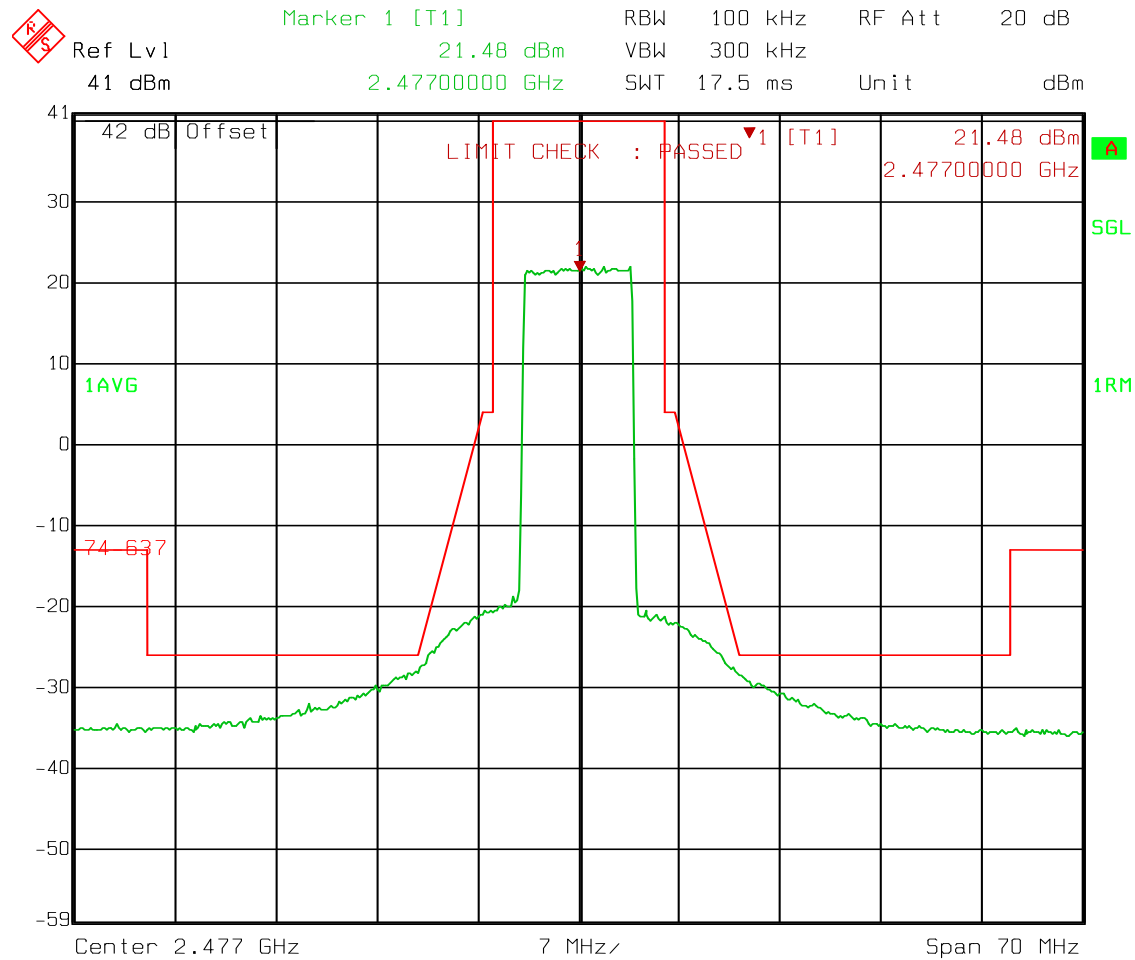


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Upper Channel 8 MHz QPSK



Date: 04.FEB.2014 09:20:08

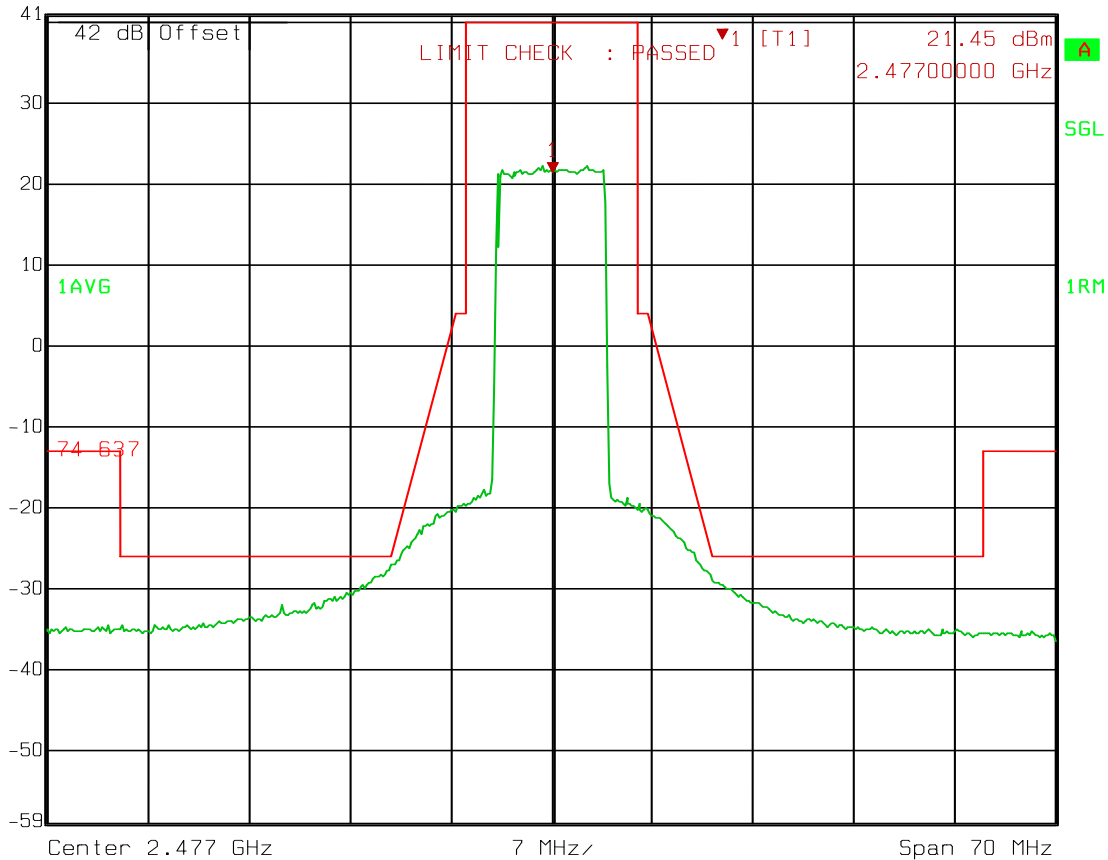
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FCC ID: CNVHC4-2

# Upper Channel 8 MHz 16QAM



Marker 1 [T1] RBW 100 kHz RF Att 20 dB  
 Ref Lvl 21.45 dBm VBW 300 kHz  
 41 dBm 2.47700000 GHz SWT 17.5 ms Unit dBm

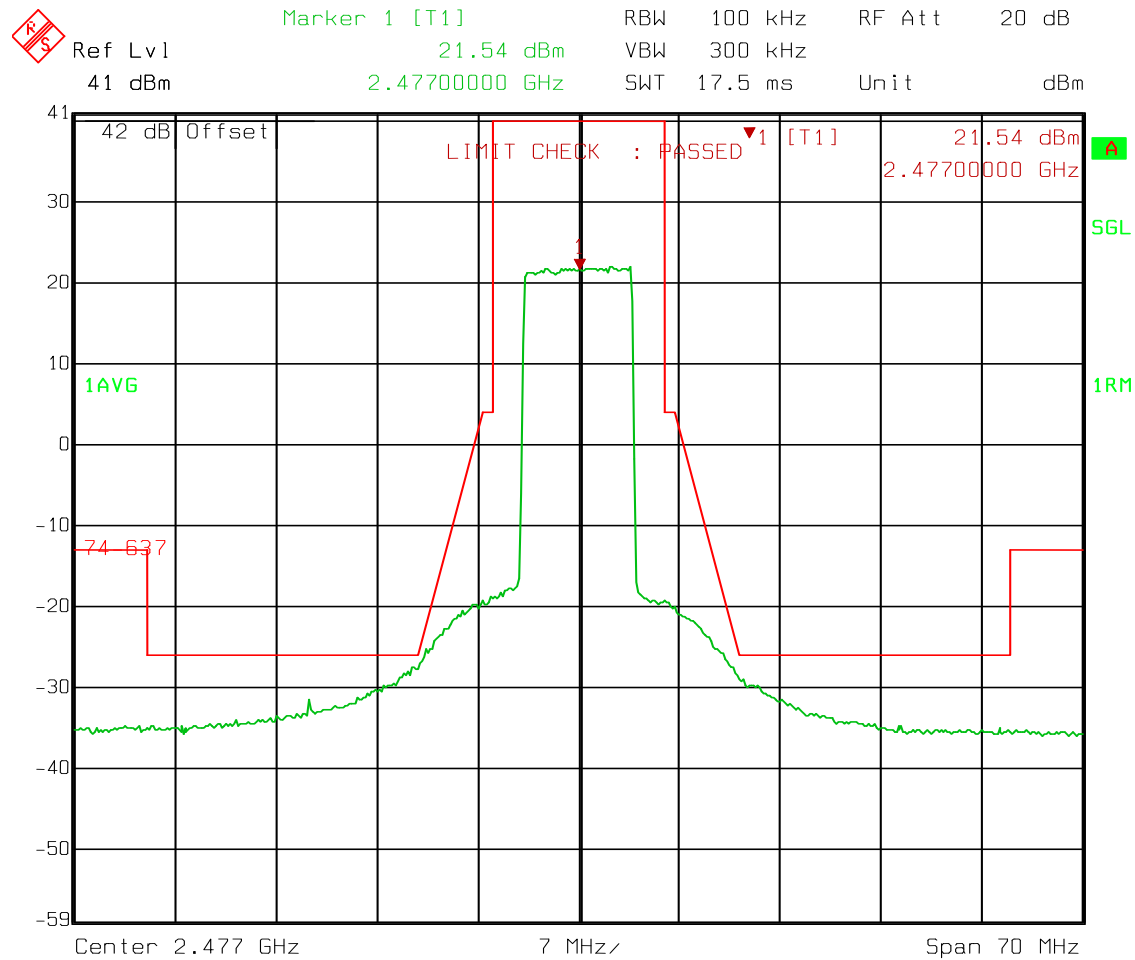


Date: 04.FEB.2014 09:20:33

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FCC ID: CNVHC4-2

# Upper Channel 8 MHz 64QAM



Date: 04.FEB.2014 09:20:59

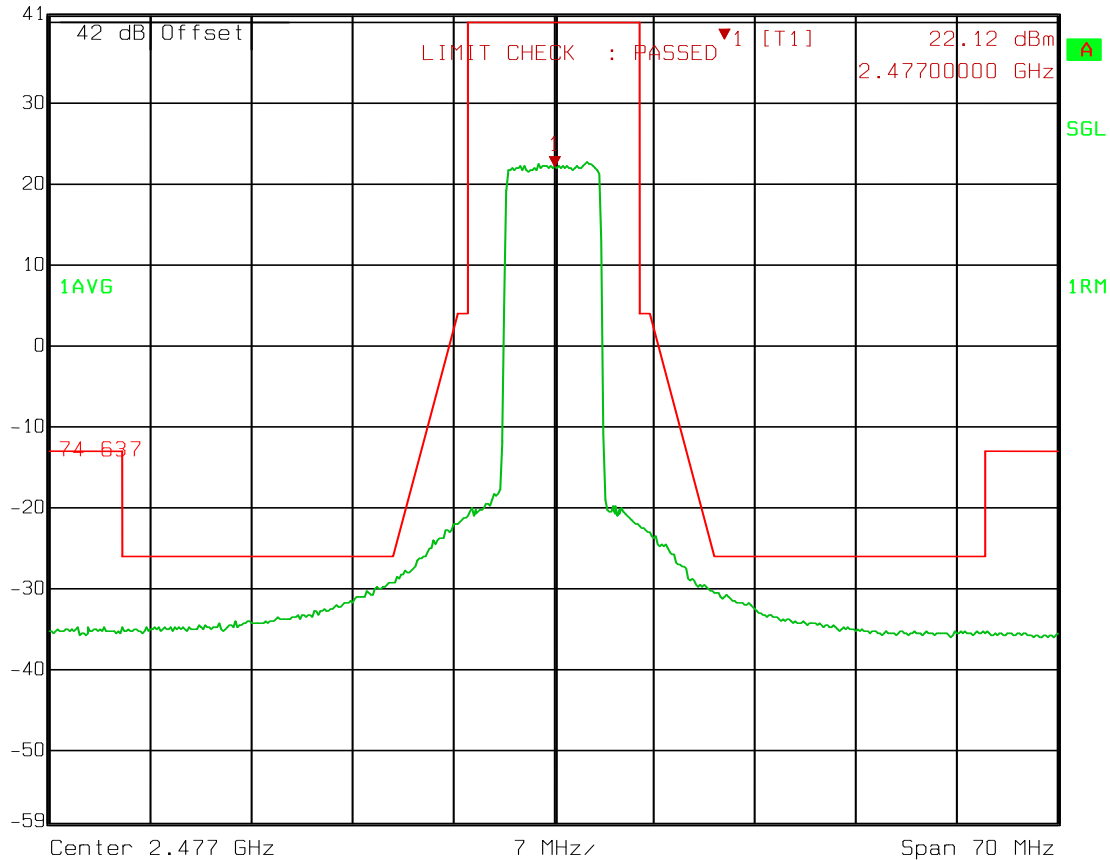
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Upper Channel 7 MHz QPSK



Marker 1 [T1] RBW 100 kHz RF Att 20 dB  
 Ref Lvl 22.12 dBm VBW 300 kHz  
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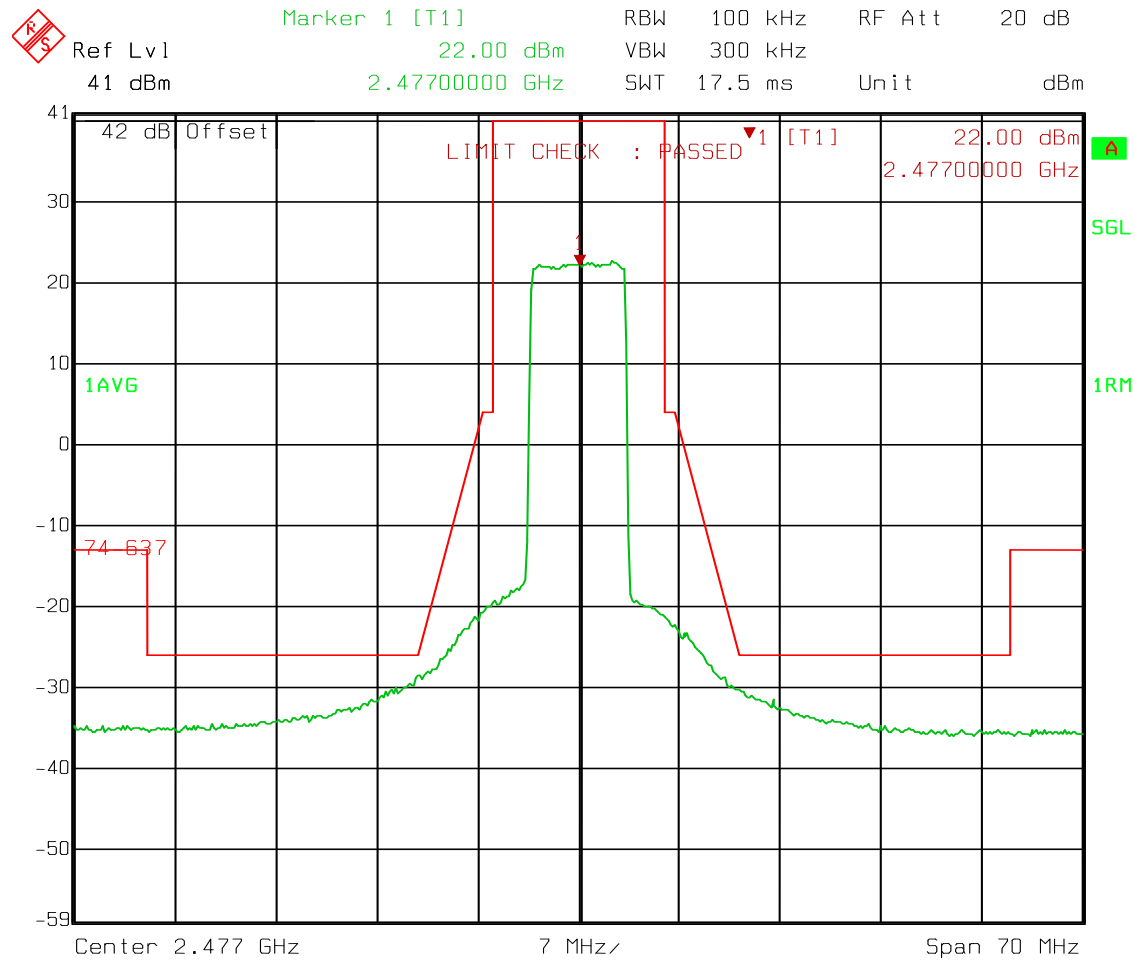


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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Upper Channel 7 MHz 16QAM

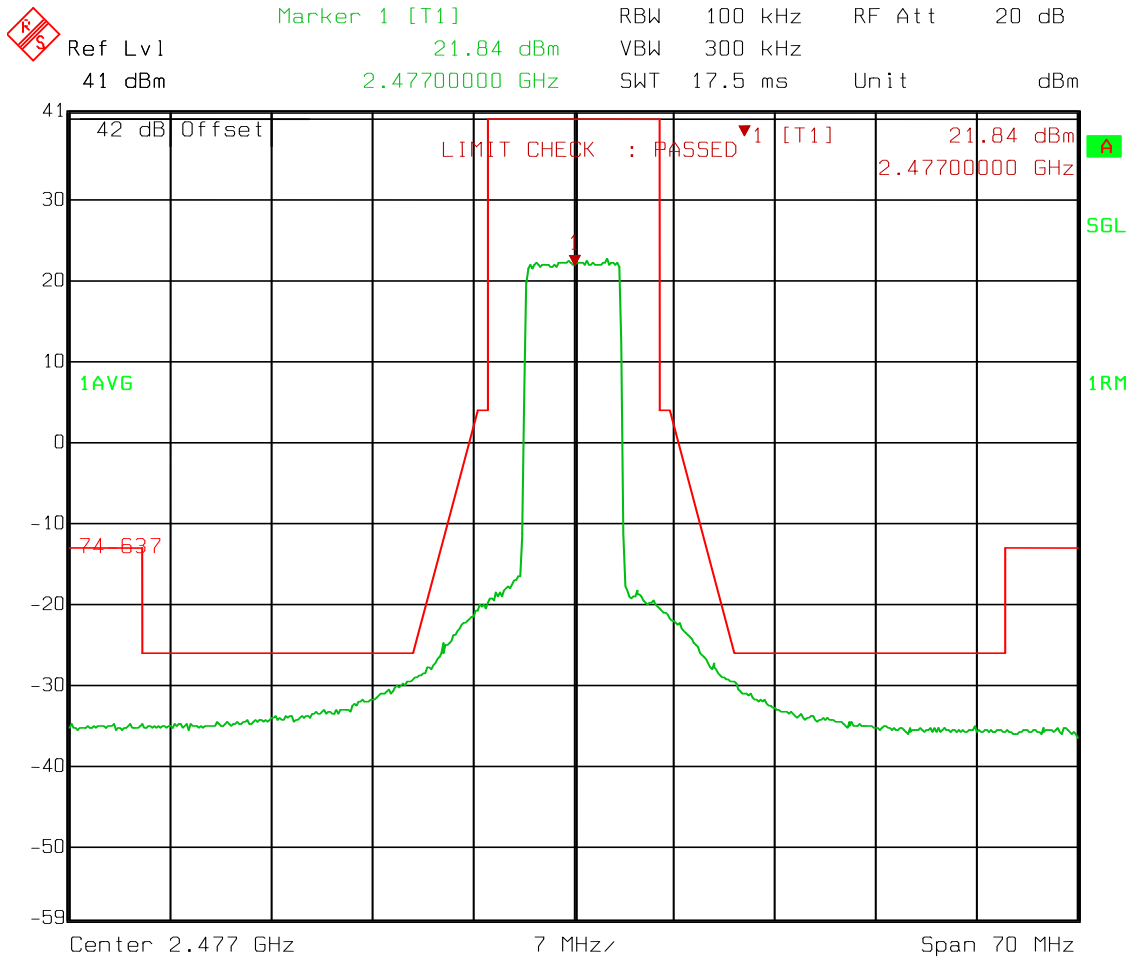


Date: 04.FEB.2014 09:21:50

|                        |                                 |                                                                                               |            |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|------------|
| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 137 of 146 |

FCC ID: CNVHC4-2

# Upper Channel 7 MHz 64QAM

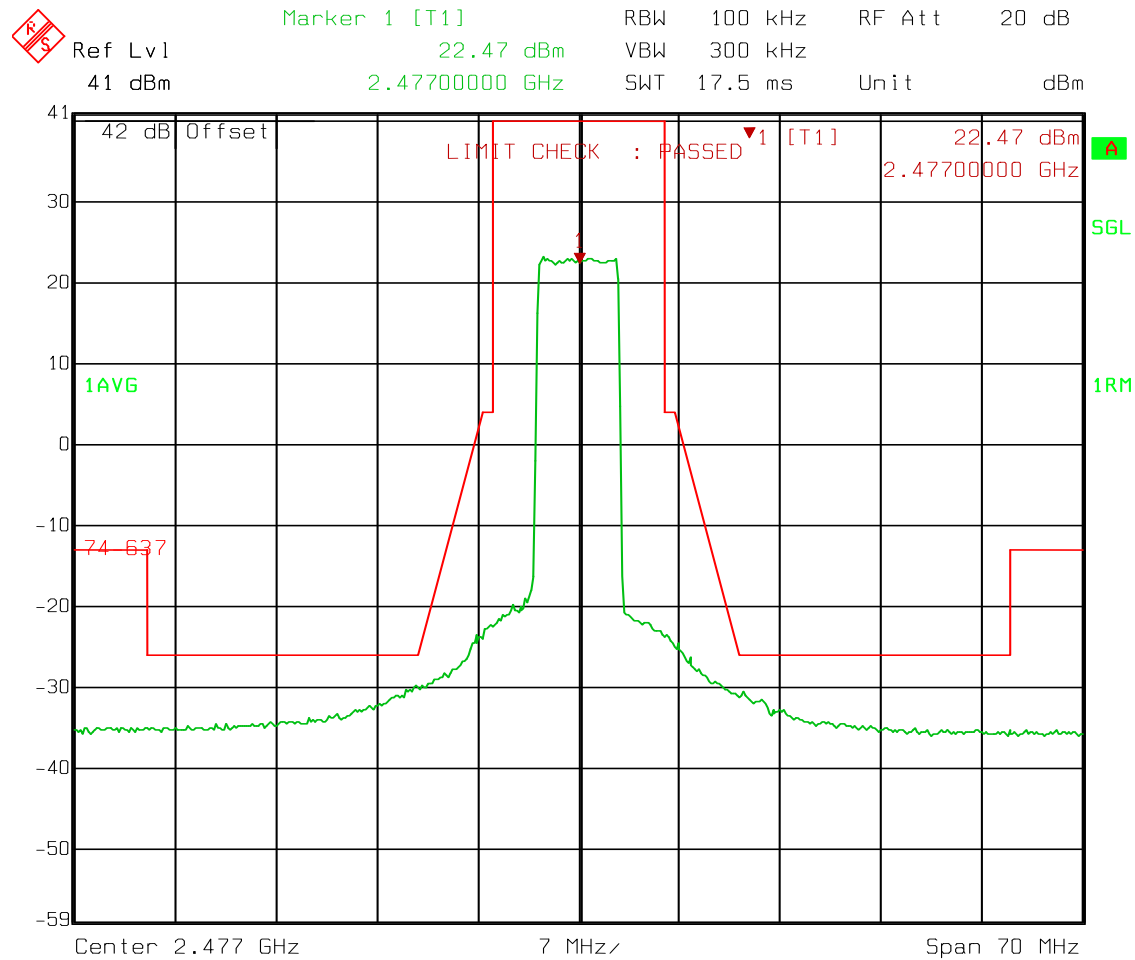


Date: 04.FEB.2014 09:22:13

|                        |                                 |                                                                                               |            |
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

## Upper Channel 6 MHz QPSK

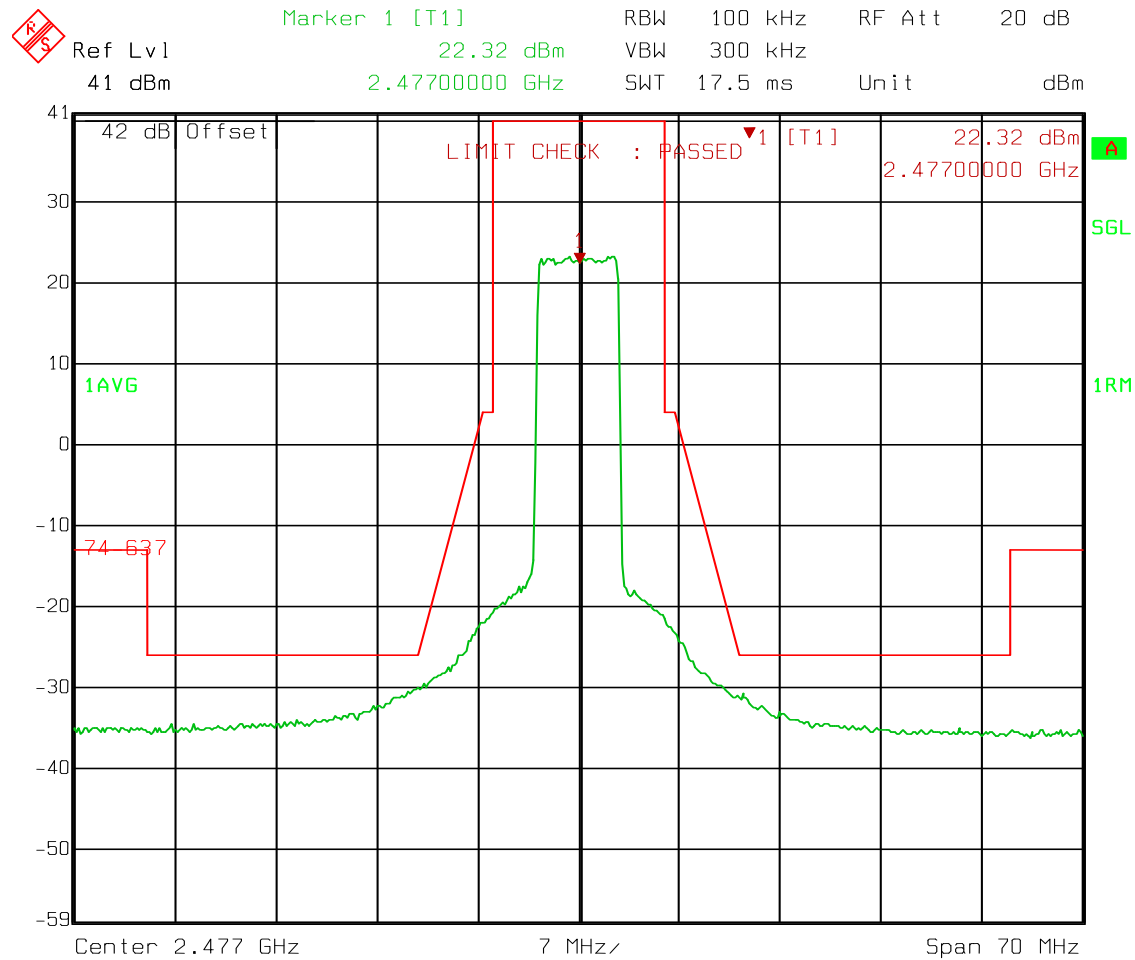


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|                        |                                 |                                                                                               |            |
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Upper Channel 6 MHz 16QAM



Date: 04.FEB.2014 09:23:09

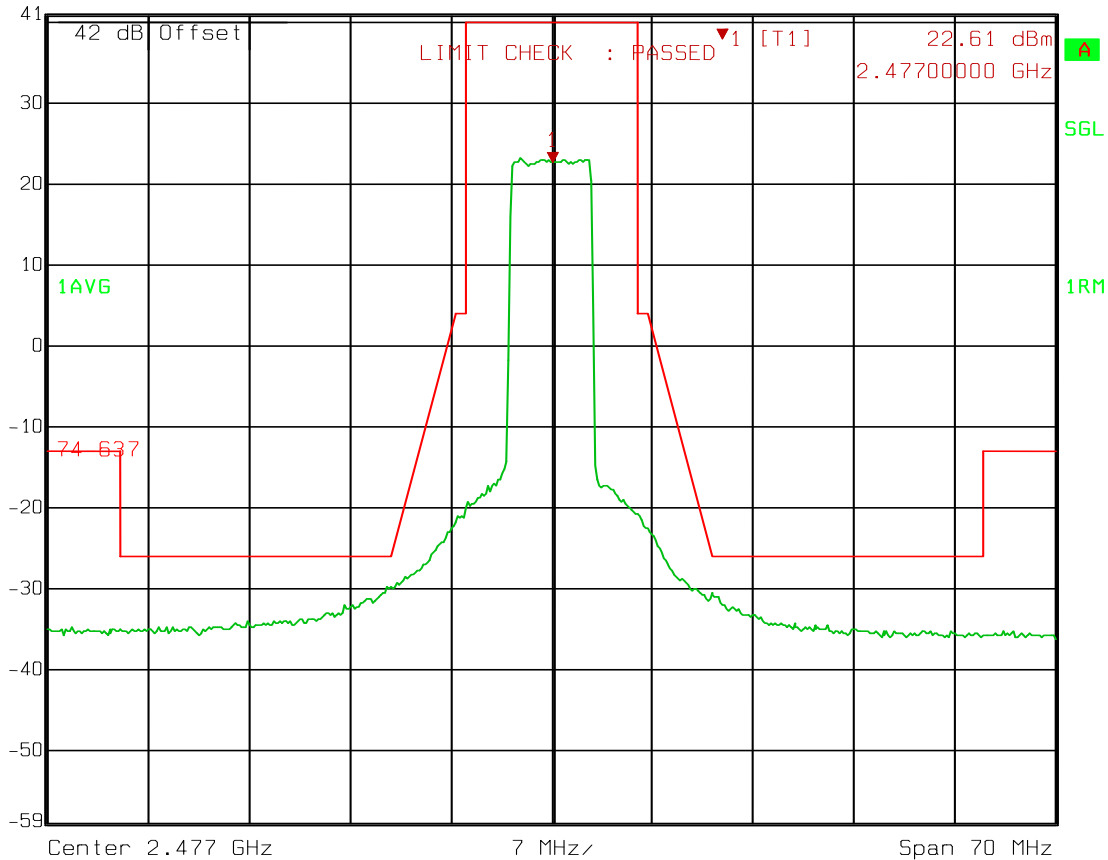
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|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|------------|
| <b>Nemko USA, Inc.</b> |                                 | 2210 Faraday Avenue, Suite 150, Carlsbad, CA 92008<br>Phone (760) 444-3500 Fax (760) 444-3005 |            |
| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

# Upper Channel 6 MHz 64QAM



Marker 1 [T1] RBW 100 kHz RF Att 20 dB  
Ref Lvl 22.61 dBm VBW 300 kHz  
41 dBm 2.47700000 GHz SWT 17.5 ms Unit dBm



Date: 04.FEB.2014 09:23:36

|                        |                                 |                                                                                               |            |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|------------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

## 2.8 Frequency Stability

Para. No.: 2.1055

|                               |                            |
|-------------------------------|----------------------------|
| Test Performed By: Alex Chang | Date of Test: May 17, 2013 |
|-------------------------------|----------------------------|

Minimum Standard: Para. No. 74.661

| Frequency band<br>(MHz) | Frequency tolerance (%) |
|-------------------------|-------------------------|
| 2,025 to 2,110          | 0.005                   |
| 2,450 to 2,483.5        | 0.001*                  |

\* 10 ppm

Measurement Data: Test Frequency: 2106 MHz  
Test Voltage: 28.0 VDC

Test Results: Table next page

|                        |                                 |                                                                                               |            |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|------------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
| Feb. 20, 2014          | Heli-Coder 4 -- FCC Test Report | 2013 06236241 FCCR1                                                                           | 142 of 146 |

FCC ID: CNVHC4-2

Modulation: CW.

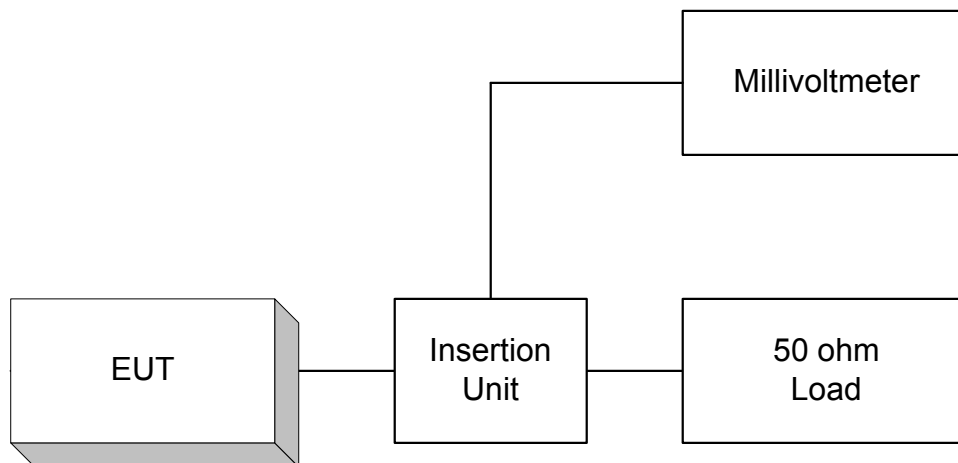
|                                         |                        |  |                           |  |                   |
|-----------------------------------------|------------------------|--|---------------------------|--|-------------------|
| Part 2.1055 (-30°C to +50°C)            |                        |  |                           |  |                   |
| Spectrum Analyzer @ 3KHz RBW, 100HZ VBW |                        |  |                           |  |                   |
| 100000 Hz, Limit                        |                        |  |                           |  |                   |
| Max                                     | 0.0 Hz (>Set freq.)    |  | Monitored Frequency:      |  | 2.106000000 GHz   |
| Min                                     | 7244.0 Hz (<Set freq.) |  | *Red are negative numbers |  |                   |
| 85% of Vnom                             |                        |  | Vnom=28VDC                |  | 115% of Vnom      |
| Temp.Set Point                          | Frequency Δ (GHz)      |  | Frequency Δ (GHz)         |  | Frequency Δ (GHz) |
| Temp.Actual                             | Difference (GHz)       |  | Difference (GHz)          |  | Difference (GHz)  |
| -30                                     | 2.105999269            |  | 2.105999269               |  | 2.105999760       |
| -29.9                                   | 0.000000731            |  | 0.000000731               |  | 0.000000240       |
| -20                                     | 2.105999770            |  | 2.105999770               |  | 2.105999770       |
| -20                                     | 0.000000230            |  | 0.000000230               |  | 0.000000230       |
| -10                                     | 2.105998267            |  | 2.105998267               |  | 2.105998267       |
| -9.9                                    | 0.000001733            |  | 0.000001733               |  | 0.000001733       |
| 0                                       | 2.105995261            |  | 2.105995762               |  | 2.105995762       |
| -0.1                                    | 0.000004739            |  | 0.000004238               |  | 0.000004238       |
| 10                                      | 2.105993257            |  | 2.105993257               |  | 2.105993257       |
| 10.1                                    | 0.000006743            |  | 0.000006743               |  | 0.000006743       |
| 20                                      | 2.105999688            |  | 2.105999688               |  | 2.105999688       |
| 19.8                                    | 0.000000312            |  | 0.000000312               |  | 0.000000312       |
| 30                                      | 2.105998998            |  | 2.105998998               |  | 2.105998998       |
| 30                                      | 0.000001002            |  | 0.000001002               |  | 0.000001002       |
| 40                                      | 2.105998998            |  | 2.105998998               |  | 2.105998998       |
| 40                                      | 0.000001002            |  | 0.000001002               |  | 0.000001002       |
| 50                                      | 2.105992756            |  | 2.105992756               |  | 2.105992756       |
| 49.9                                    | 0.000007244            |  | 0.000007244               |  | 0.000007244       |

|                        |                                 |                                                                                               |            |
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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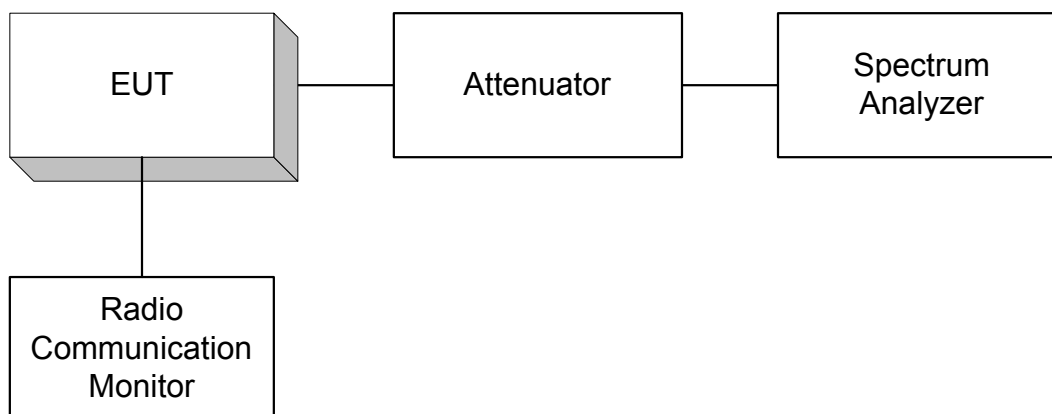
FCC ID: CNVHC4-2

### Section 3. Block Diagrams

Para. No. 2.1046 - R.F. Power Output



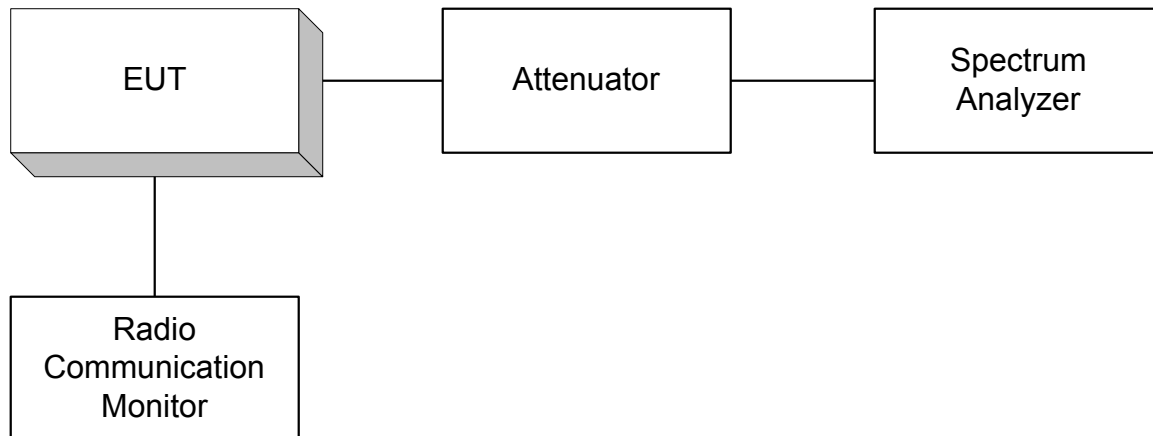
Para. No. 2.1049 - Occupied Bandwidth



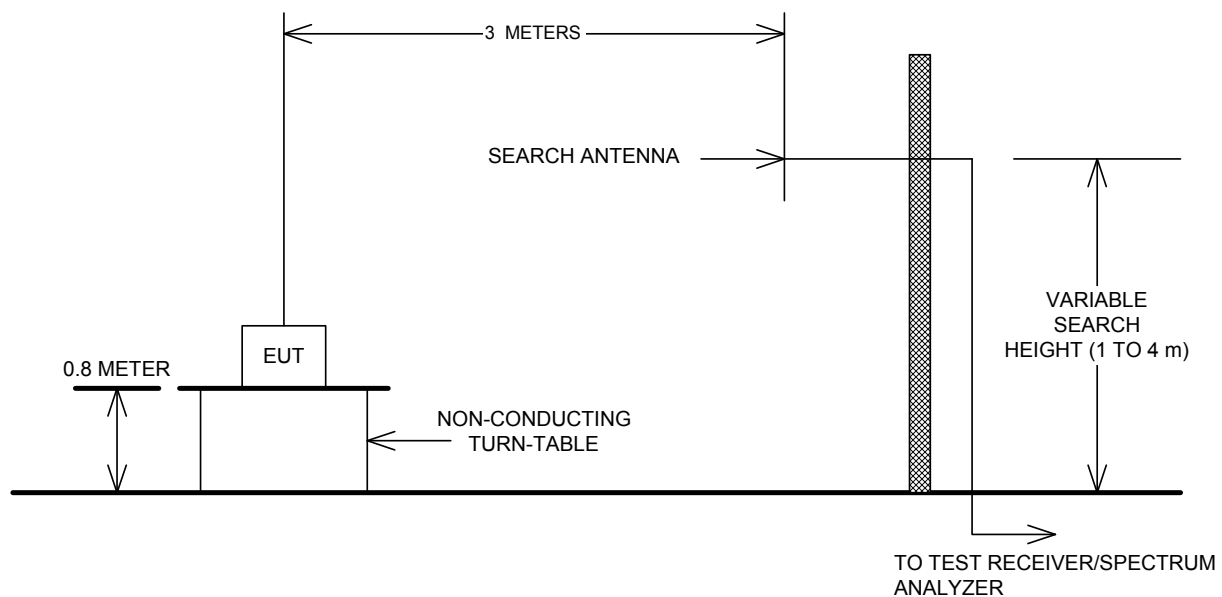
|                        |                                 |                                                                                               |            |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|------------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

#### Para. No. 2.1051 - Spurious Emissions at Antenna Terminals



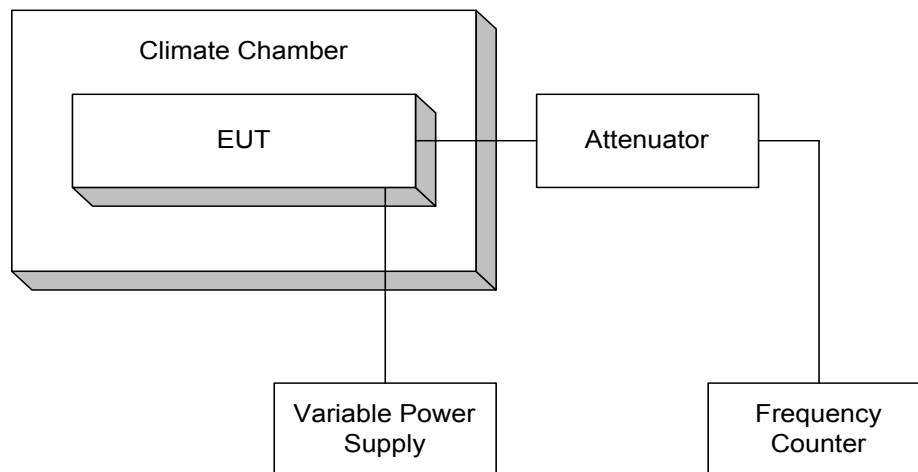
#### Para. No. 2.1053 - Field Strength of Spurious Radiation



|                        |                                 |                                                                                               |            |
|------------------------|---------------------------------|-----------------------------------------------------------------------------------------------|------------|
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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# Para. No. 2.1055 - Frequency Stability



|                        |                                 |                                                                                               |            |
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| DATE                   | DOCUMENT NAME                   | DOCUMENT #                                                                                    | PAGE       |
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FCC ID: CNVHC4-2

## Section 4. Test Equipment List

| Asset No. | Description           | Manufacturer        | Model Number     | Serial Number | Last Cal.   | Cal due     |
|-----------|-----------------------|---------------------|------------------|---------------|-------------|-------------|
| 815       | Multimeter            | Fluke               | 111              | 78130066      | 20-Sep-2012 | 20-Sep-2013 |
| 835       | Spectrum Analyzer     | Rohde & Schwarz     | RHDFSEK          | 829058/005    | 06-Sep-2012 | 06-Sep-2013 |
| 836       | Signal Generator      | Agilent             | E8254A           | US41140229    | 09-Mar-2013 | 09-Mar-2014 |
| 911       | Spectrum Analyzer     | Agilent             | E4440A           | US41421266    | 15-Oct-2012 | 15-Oct-2013 |
| 941       | Power Meter           | Agilent             | E4418B           | MY40510887    | 30-Aug-2012 | 30-Aug-2013 |
| 942       | Power Sensor          | Hewlett Packard     | 8481A            | US37296058    | 30-Aug-2012 | 30-Aug-2013 |
| NA        | Attenuator*           | Aeroflex            | 73-40-34         | QS636         |             |             |
| N149      | Environmental Chamber | Cincinnati Sub-Zero | ZPHS-32-2-2-H/AC | ZP0552665     | 16-Apr-2013 | 16-Apr-2014 |
| N157      | DC Power Supply       | Kikusui             | PAD 110-10L      | NA            | Not Cal'd   | Not Cal'd.  |

\*Path loss verified with 835 and 836.

Revision 1 Equipment for testing done Feb. 4, 2014

| Asset No. | Description       | Manufacturer     | Model Number | Serial Number | Last Cal.   | Cal due     |
|-----------|-------------------|------------------|--------------|---------------|-------------|-------------|
| 1036      | Spectrum Analyzer | Rohde & Schwartz | FSEK30       | 830844/006    | 15-Jul-2013 | 15-Jul-2015 |
| NA        | Attenuator*       | Aeroflex         | 73-40-34     | QS636         |             |             |