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# TEST REPORT

## 4RF SR+ SQ215M141 Point to Multi-point Digital Radio

*tested to the*

## Code of Federal Regulations (CFR) 47

## Part 90 –Private Land Mobile Services

*for*

## 4RF Limited

This Test Report is issued with the authority of:

**Andrew Cutler - General Manager**

IANZ ACCREDITED LABORATORY

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

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# 1. COMPLIANCE STATEMENT

The **4RF SR+ SQ215M141 Point to Multi-point Digital Radio** complies with the limits defined in 47 CFR Part 90 and 47 CFR Part 2 when tested in-accordance with the test methods described in 47 CFR Part 2, ANSI C63.4, 2002 and ANSI / TIA-603-C, 2004.

# 2. RESULT SUMMARY

The results of testing carried out in March, April, July and August 2014 are summarised below.

| Clause | Description | Result |
|---|---|---|
| 90.203 | Certification required | Noted |
| 2.1046<br>90.259 (a) | RF power output<br>Power and antenna height limits | Noted<br>Noted |
| 2.1049<br>2.202<br><br>90.207<br>90.209<br>90.210 | Occupied bandwidth<br>Bandwidths<br><br>Types of emissions<br>Bandwidth limitations<br>Emission masks | Noted<br>Noted<br><br>Complies<br>Complies<br>Complies |
| 2.1051 | Spurious emissions at antenna terminals | Complies |
| 2.1053 | Field strength of spurious radiation | Complies |
| 2.1055<br>90.213 | Frequency stability<br>Frequency stability | Noted<br>Complies |
| 1.1310 | Radio frequency exposure limits | Complies |

# 3. ATTESTATION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification with the following conditions:

**The client selected the test sample.**

**The report relates only to the sample tested.**

**This report does not contain corrections or erasures.**

Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

All compliance statements have been made with respect of the specification limit with no reference to the measurement uncertainty.

In addition this equipment has been tested in accordance with the requirements contained in the appropriate Commission regulations.

To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Commission standards and demonstrate that the equipment complies with the appropriate standards.

I further certify that the necessary measurements were made by EMC Technologies NZ Ltd, 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand.

Andrew Cutler
General Manager
EMC Technologies NZ Ltd

# 4. CLIENT INFORMATION

**Company Name** 4RF Limited

**Address** 26 Glover Street
Ngauranga
Wellington

**Country** New Zealand

**Contact** Mr Paul Young

# 5. TEST SAMPLE DESCRIPTION

**Brand Name** Aprisa SR+

**Model Number** SQ215M141

**Product** Point to Multi Point Digital Radio

**Manufacturer** 4RF Limited

**Manufactured in** New Zealand

**Designed in** New Zealand

**Serial Numbers** -

**FCC ID** UIPSQ215M141

The sample tested has the following specifications:

**Rated Transmitter Output Power**

5.0 Watts (37.0 dBm)

**Transmitter FCC frequency range**

Part 90: 216 - 217 MHz, 217 - 220 MHz and 220 – 222 MHz

**Test frequencies**

| Channel | Frequency (MHz) | Power (Watts) | Spacing (kHz) |
|---|---|---|---|
| 1 | 216.575 | 5.0 | 12.5, 25.0 & 50.0 |
| 2 | 217.575 | 2.0 | 12.5, 25.0 & 50.0 |
| 3 | 219.575 | 2.0 | 12.5, 25.0 & 50.0 |
| 4 | 221.000 | 5.0 | 15.0 |

**Modes of operation**

G1D and D1D emissions designators have been applied when the transmitter uses 12.5, 15.0, 25.0 and 50 kHz channel spacing.

G1D emission designator is applied when QPSK modulation is utilised

D1D emission designator is applied when 16QAM and 64QAM modulation is utilised

**Power Supply**

The equipment is powered using an external DC supply.

**Standard Temperature and Humidity**

| | |
|---|---|
| Temperature: | +15°C to + 30°C maintained. |
| Relative Humidity: | 20% to 75% observed. |

**Standard Test Power Source**

| | |
|---|---|
| Nominal Voltage: | 13.8 V dc. |
| Standard Test Voltage: | 13.8 V dc. |

**Extreme Temperature**

| | |
|---|---|
| High Temperature: | + 50°C maintained. |
| Low Temperature: | - 30°C maintained. |

**Extreme Test Voltages**

| | |
|---|---|
| High Voltage: | 30.0 Vdc |
| Low Voltage: | 10.0 Vdc |

# 6. TEST RESULTS

**RF power output**

Measurements were carried out at the RF output terminals of the transmitter using a 30 dB power attenuator and a 50 Ω dummy load.

Measurements were carried out when the transmitter was not being modulated.

Testing was carried out at 5 watts (37 dBm) for the band 216 – 217 MHz.

| Frequency (MHz) | Voltage (Vdc) | Rated (dBm) | Measured (dBm) |
|---|---|---|---|
| 216.575 | 10.0 | 37.0 | 36.5 |
| 216.575 | 13.8 | 37.0 | 36.5 |
| 216.575 | 30.0 | 37.0 | 36.5 |

Testing was carried out at 2 watts (33 dBm) for the band 217 – 220 MHz

| Frequency (MHz) | Voltage (Vdc) | Rated (dBm) | Measured (dBm) |
|---|---|---|---|
| 217.575 | 10.0 | 33.0 | 32.9 |
| 217.575 | 13.8 | 33.0 | 32.9 |
| 217.575 | 30.0 | 33.0 | 32.9 |

Testing was carried out at 5 watts (37 dBm) for the band 220 – 220 MHz.

| Frequency (MHz) | Voltage (Vdc) | Rated (dBm) | Measured (dBm) |
|---|---|---|---|
| 221.000 | 10.0 | 37.0 | 36.4 |
| 221.000 | 13.8 | 37.0 | 36.4 |
| 221.000 | 30.0 | 37.0 | 36.4 |

**Limit:**
90.259 (a) (4) In the 217-220 MHz band, the maximum transmitter output power is 2 watts.

The maximum antenna height above average terrain (HAAT) is 152 m (500 feet).

**Result:** Complies
**Measurement Uncertainty**: ± 0.5 dB

**Part 90.207 – Emission types:**

The following emission types are used:

- G1D digital data when QPSK modulation is utilised

- D1D digital data when 16QAM or 64QAM modulation is utilised

**Part 90.209 – Bandwidth limitations (216 – 217 and 217 – 220 MHz bands):**

The authorised bandwidth is taken to be the necessary bandwidth.

Measurements have been made to verify the declared bandwidth.

The occupied bandwidth has been measured and compared against the occupied bandwidth declared by the client.

Measurements have been made of each modulation type using a spectrum analyser operating in peak hold mode and a 30 dB attenuator.

Initially power measurements are made using a resolution bandwidth of 120 kHz.

This level is used as a reference level on the spectrum analyser.

The resolution bandwidth is then changed to 100 Hz and the reference level minus 23 dB (99%) absolute bandwidth points determined.

**Nominal Frequency:** 217.575 MHz

| Emission | Channel (kHz) | Measured (kHz) | Authorised Bandwidth (kHz) |
|---|---|---|---|
| **QPSK** | 12.5 | 10.750 | 11.25 |
| **16QAM** | 12.5 | 10.350 | 11.25 |
| **64QAM** | 12.5 | 9.975 | 11.25 |
| | | | |
| **QPSK** | 25.0 | 17.750 | 20.0 |
| **16QAM** | 25.0 | 17.300 | 20.0 |
| **64QAM** | 25.0 | 16.750 | 20.0 |
| | | | |
| **QPSK** | 50.0 | 39.000 | 45.0 |
| **16QAM** | 50.0 | 39.000 | 45.0 |
| **64QAM** | 50.0 | 38.625 | 45.0 |

**Result:** Complies.

**Part 90.209 – Bandwidth limitations (220 – 222 MHz band):**

The authorised bandwidth is taken to be the necessary bandwidth.

Measurements have been made to verify the declared bandwidth.

The occupied bandwidth has been measured and compared against the occupied bandwidth declared by the client.

90.733 (e) allows three (3) contiguous channels to form channels greater than 5 kHz.

Measurements have been made of each modulation type using a spectrum analyser operating in peak hold mode and a 30 dB attenuator.

Initially power measurements are made using a resolution bandwidth of 120 kHz.

This level is used as a reference level on the spectrum analyser.

The resolution bandwidth is then changed to 100 Hz and the reference level minus 23 dB (99%) absolute bandwidth points determined.

**Nominal Frequency:** 221.000 MHz

| Emission | Channel Spacing (kHz) | Measured (kHz) | Authorised Bandwidth (kHz) |
|---|---|---|---|
| **QPSK** | 15.0 | 11.750 | 12.0 |
| **16QAM** | 15.0 | 11.600 | 12.0 |
| **64QAM** | 15.0 | 11.150 | 12.0 |

**Result:** Complies.

**Spectrum Masks (216 – 217 and 217 – 220 MHz bands).**

Part 90.210 states all equipment operating in other bands equipment designed to operate with a must meet the requirements of Emission Mask B or C, as applicable.

Mask B has been applied as the transmitter has an audio low pass filter.

The transmitter can operate in the band 217-220 MHz using an authorised bandwidth of 11.25 kHz and channel spacing of 12.5 kHz and an authorised bandwidth of 20 kHz and a channel spacing of 25 kHz.

Measurements have been made of each modulation type using a spectrum analyser operating in peak hold mode and a 30 dB attenuator.

Initially power measurements are made using a resolution bandwidth of 120 kHz.

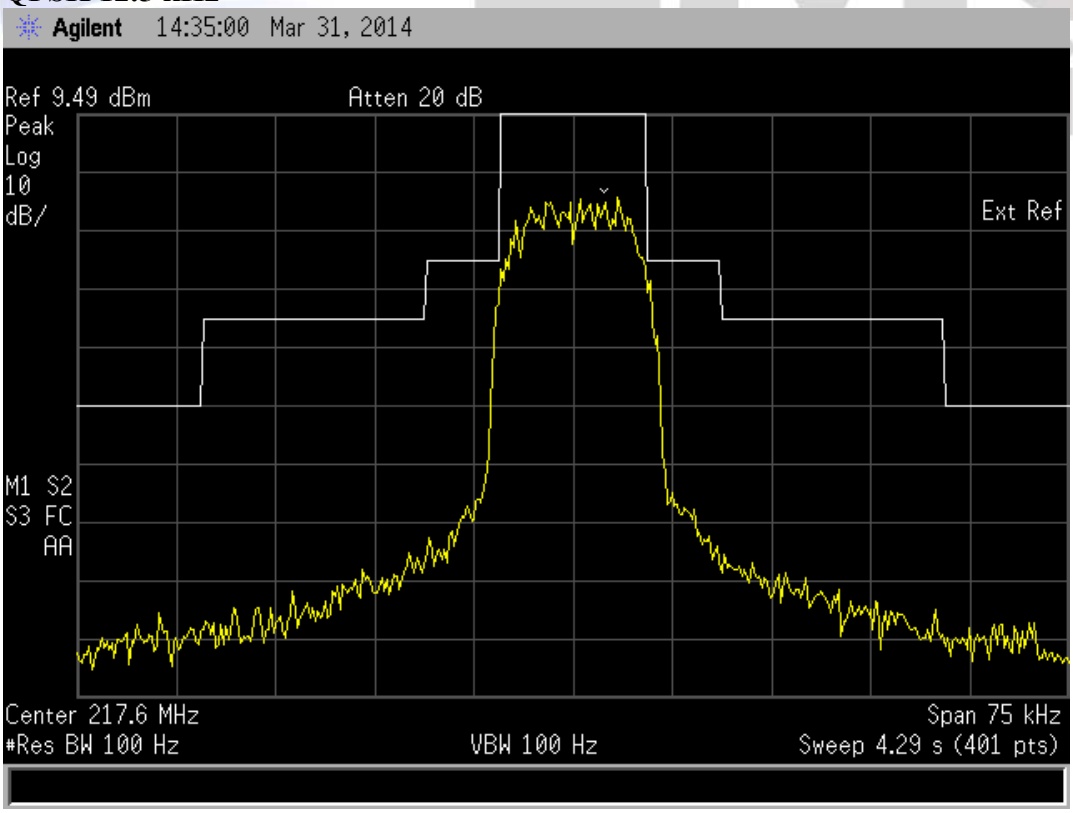
This level is used as a reference level on the spectrum analyser.

The resolution bandwidth is then changed and the reference level minus 23 dB (99%) absolute bandwidth points determined.

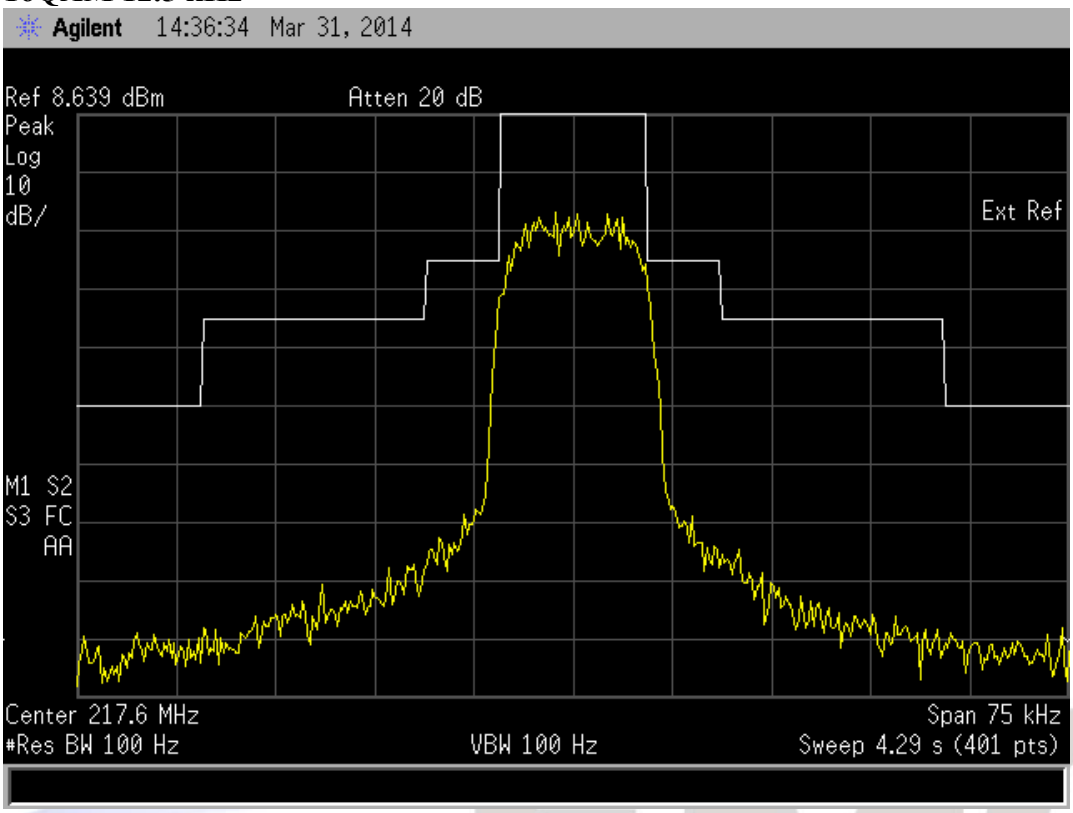
Measurements were made with the spectrum analyser operating in peak hold centred on the allocated frequency.

**Nominal Frequency:** 217.575 MHz

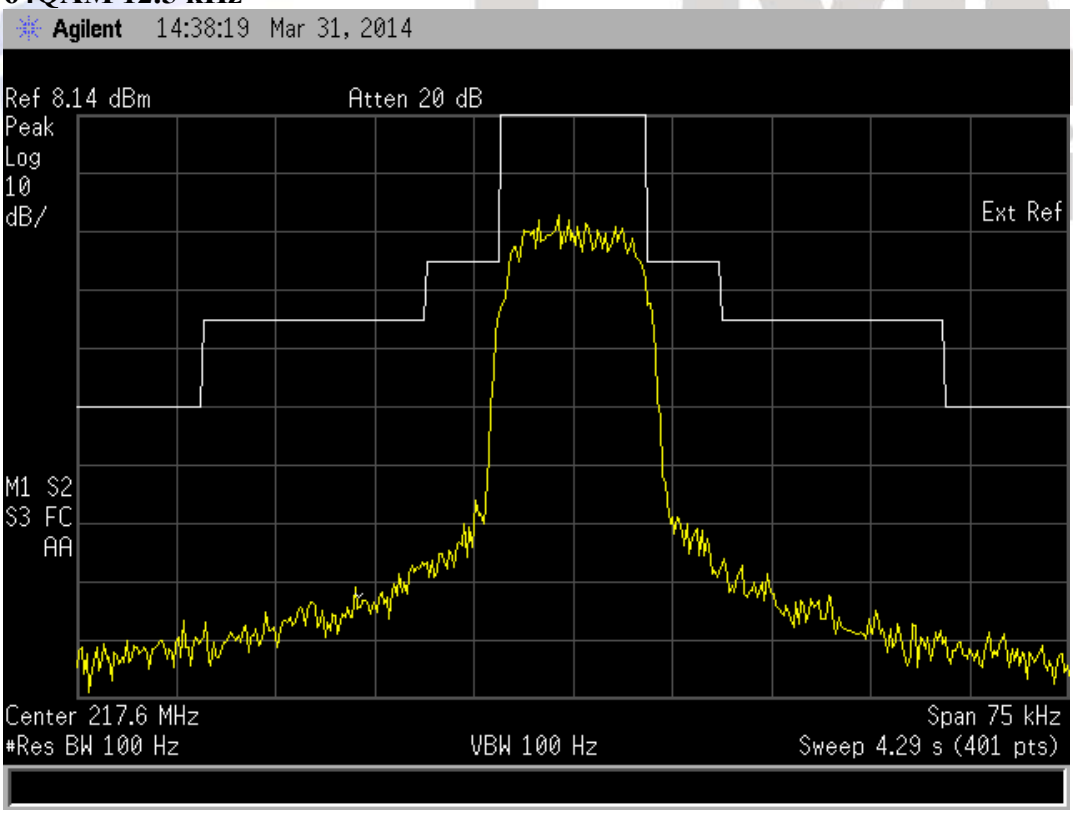
**QPSK 12.5 kHz**



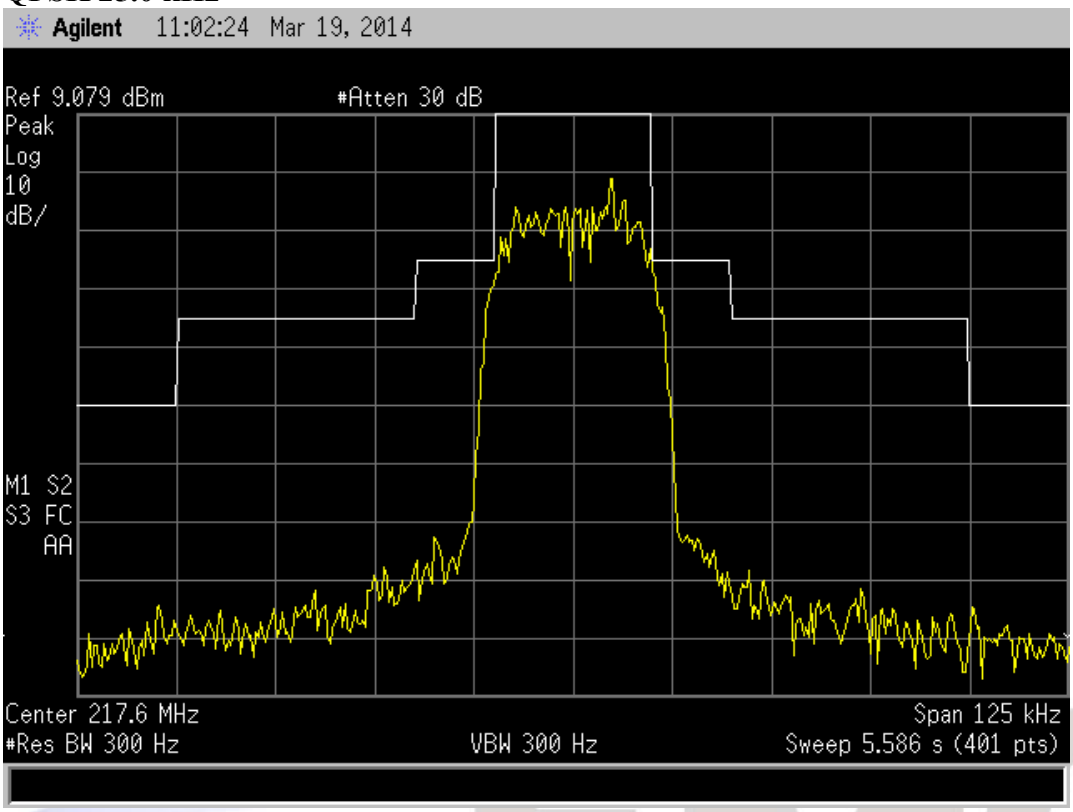
## 16QAM 12.5 kHz



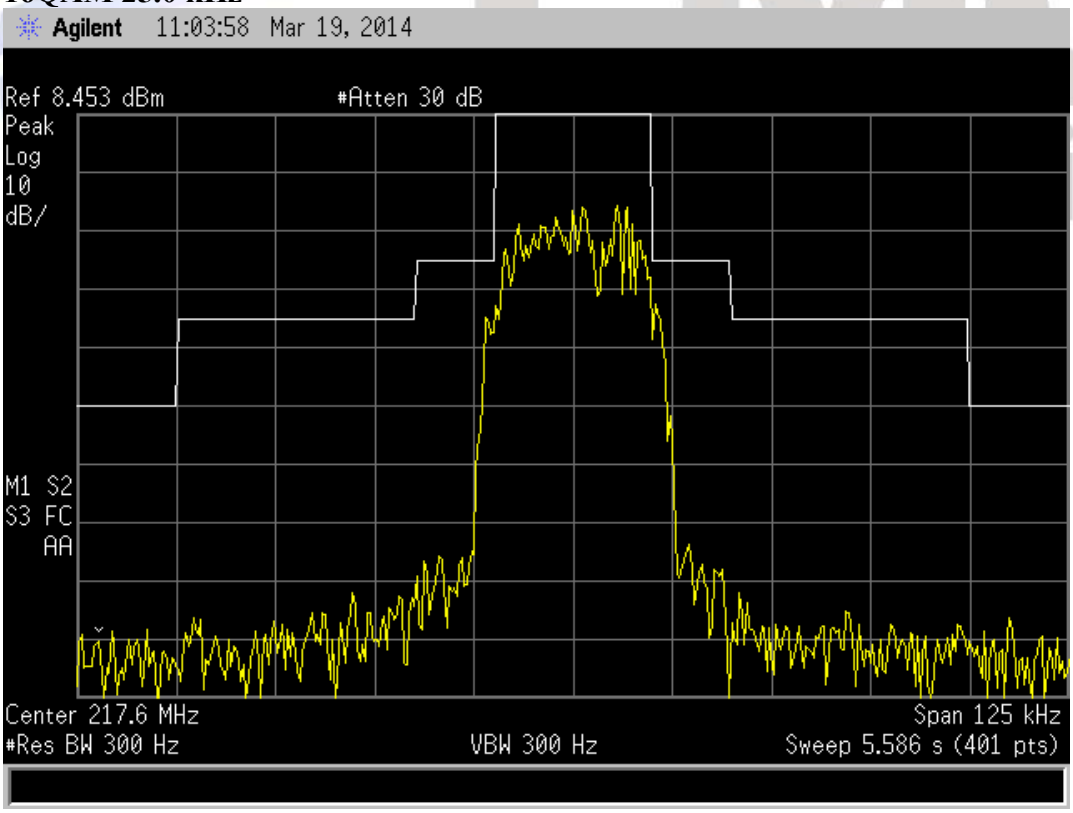

## 64QAM 12.5 kHz



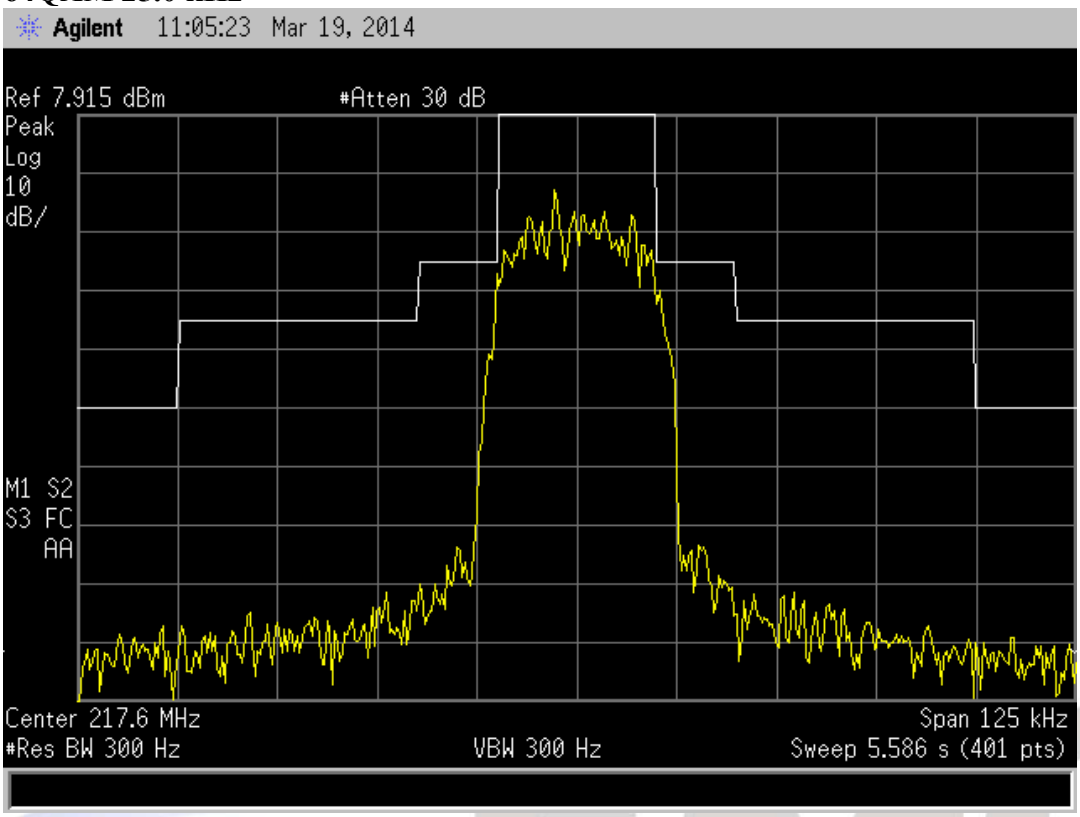
## QPSK 25.0 kHz



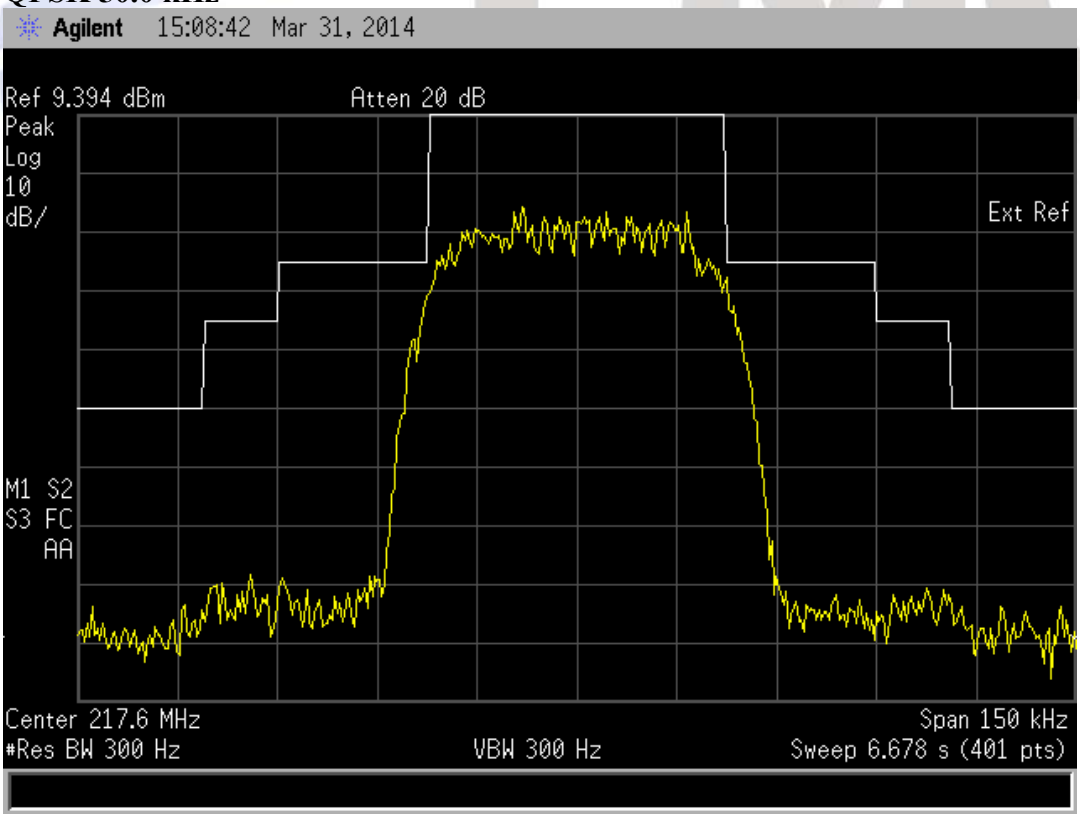

## 16QAM 25.0 kHz



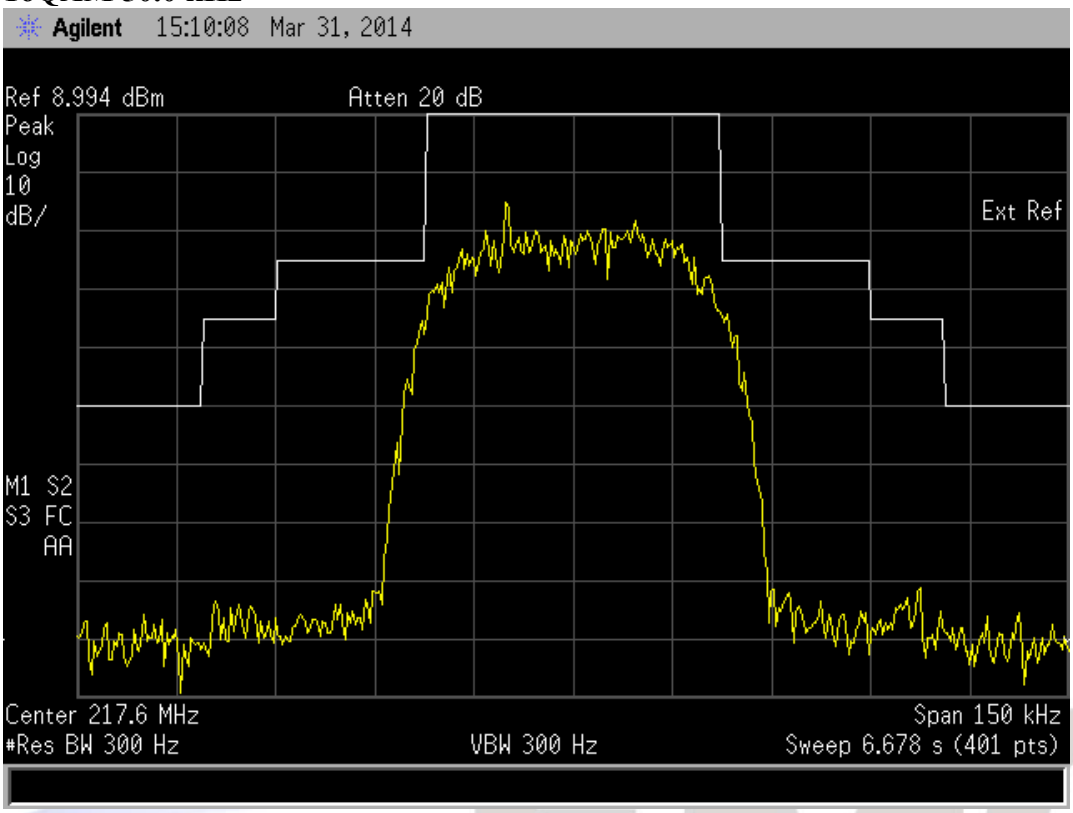
## 64QAM 25.0 kHz



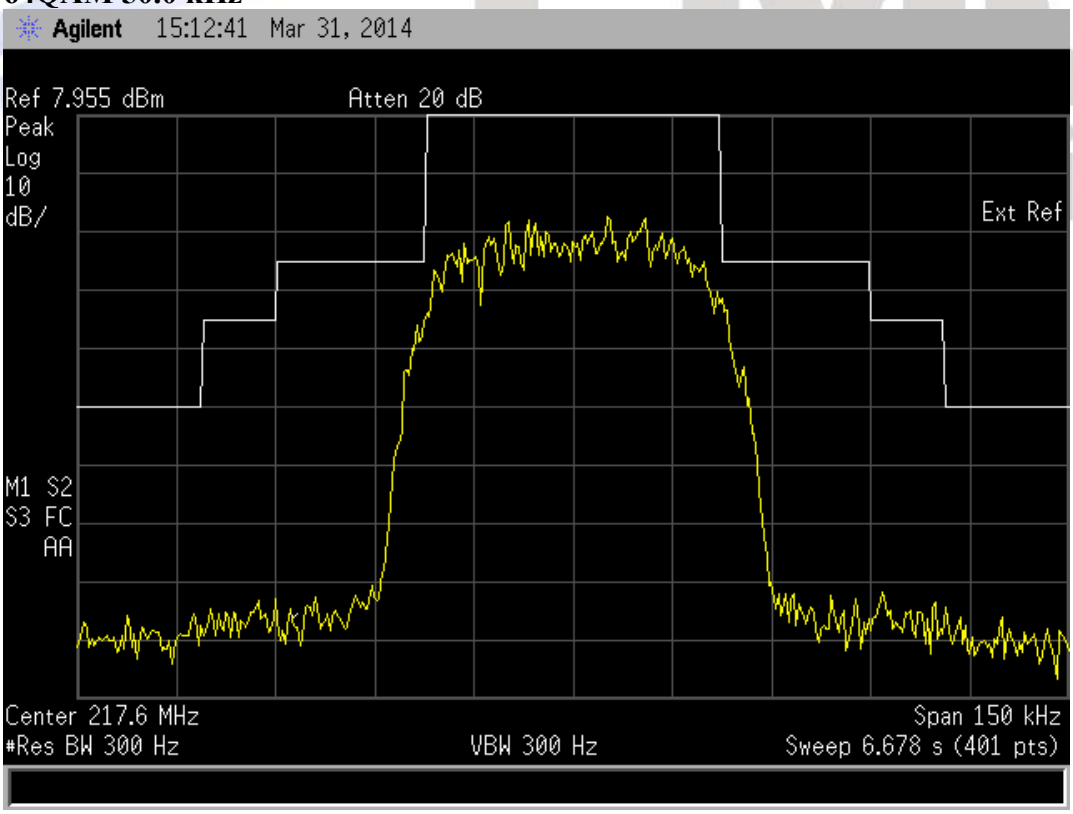

## QPSK 50.0 kHz



**16QAM 50.0 kHz**




**64QAM 50.0 kHz**




**Result:** Complies

**Spectrum Masks (220 – 222 MHz band).**

Part 90.210 states equipment designed to operate in the 220-222 MHz band must meet the requirements of Emission Mask F.

Mask F has been applied as the transmitter has an audio low pass filter.

The transmitter can operate in the band 220-222 MHz using an authorised bandwidth of 4.0 kHz and channel spacing of 5 kHz.

Part 90.733 (e) states: In combining authorized, contiguous channels (including channels derived from multiple authorizations) to form channels wider than 5 kHz, the emission limits in §90.210(f) must be met only at the outermost edges of the contiguous channels.

Transmitters shall be tested to confirm compliance with this requirement with the transmission located as close to the band edges as permitted by the design of the transmitter.

The frequency stability requirements in §90.213 shall apply only to the outermost of the contiguous channels authorized to the licensee.

However, the frequency stability employed for transmissions operating inside the outermost contiguous channels must be such that the emission limits in §90.210(f) are met over the temperature and voltage variations.

Measurements have been made when operating on 221.000 MHz with the supply voltage at 10.0, 13.8 and 30.0 Vdc.

Measurements have been made at ambient temperatures and extreme temperatures of +50.0°C and -30°C.

Measurements have been made of each modulation type using a spectrum analyser operating in peak hold mode and a 30 dB attenuator.

Initially power measurements are made using a resolution bandwidth of 120 kHz.

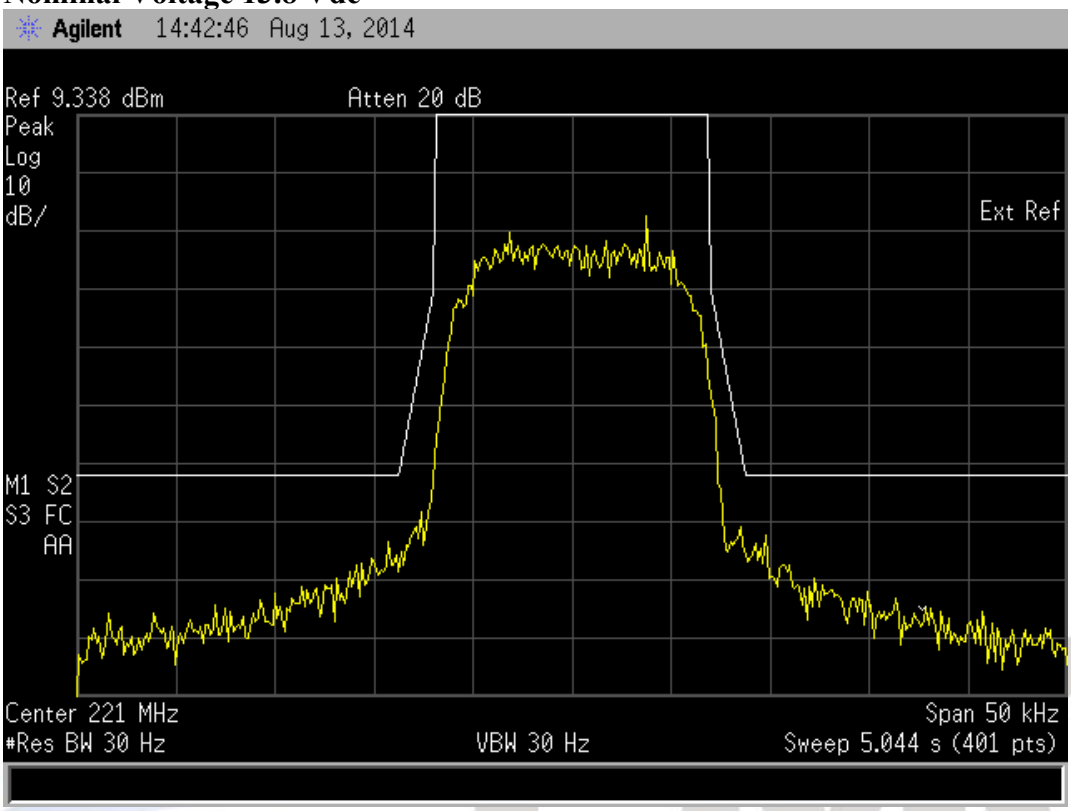
This level is used as a reference level on the spectrum analyser.

Measurements were made with the spectrum analyser operating in peak hold centred on the allocated frequency.

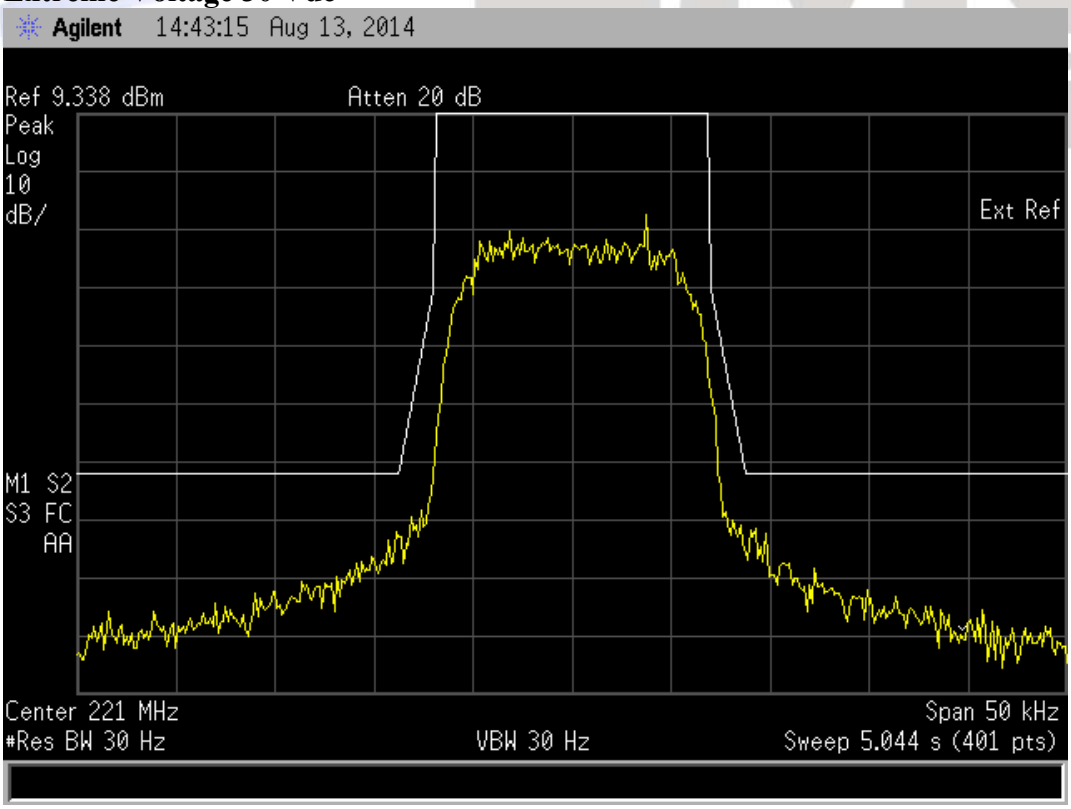
**Result:** Complies

QPSK at ambient temperature +25°C

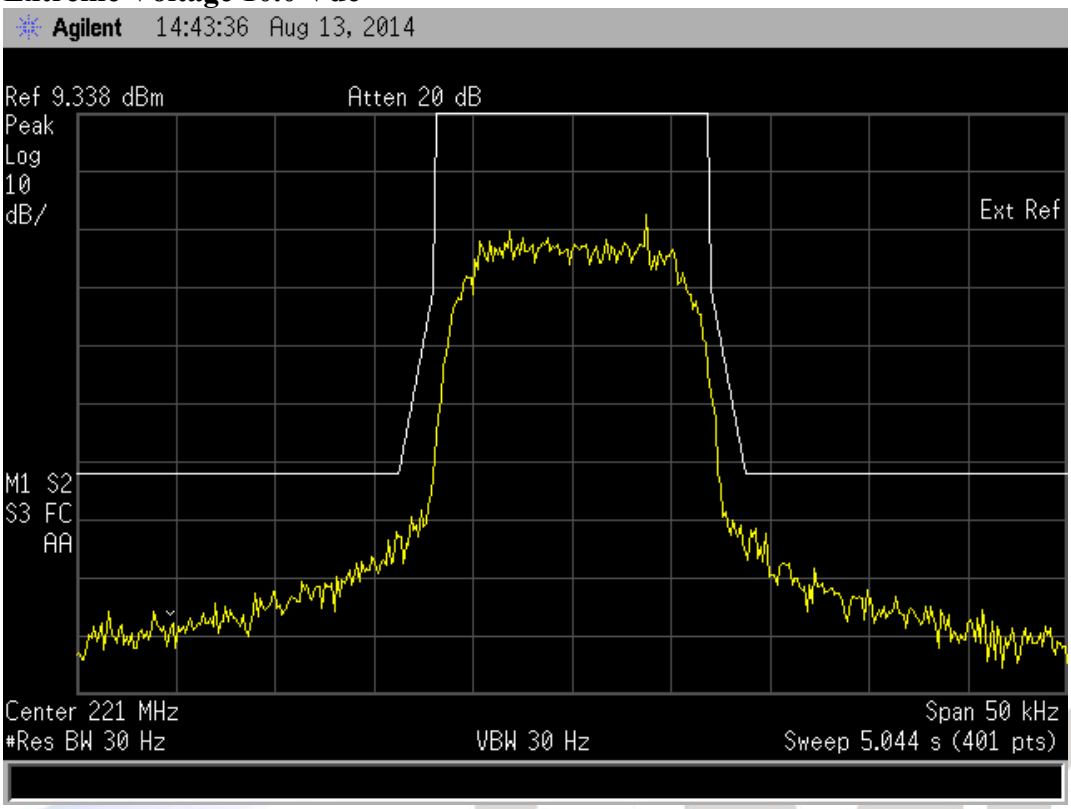
**Nominal Voltage 13.8 Vdc**




**Extreme Voltage 30 Vdc**

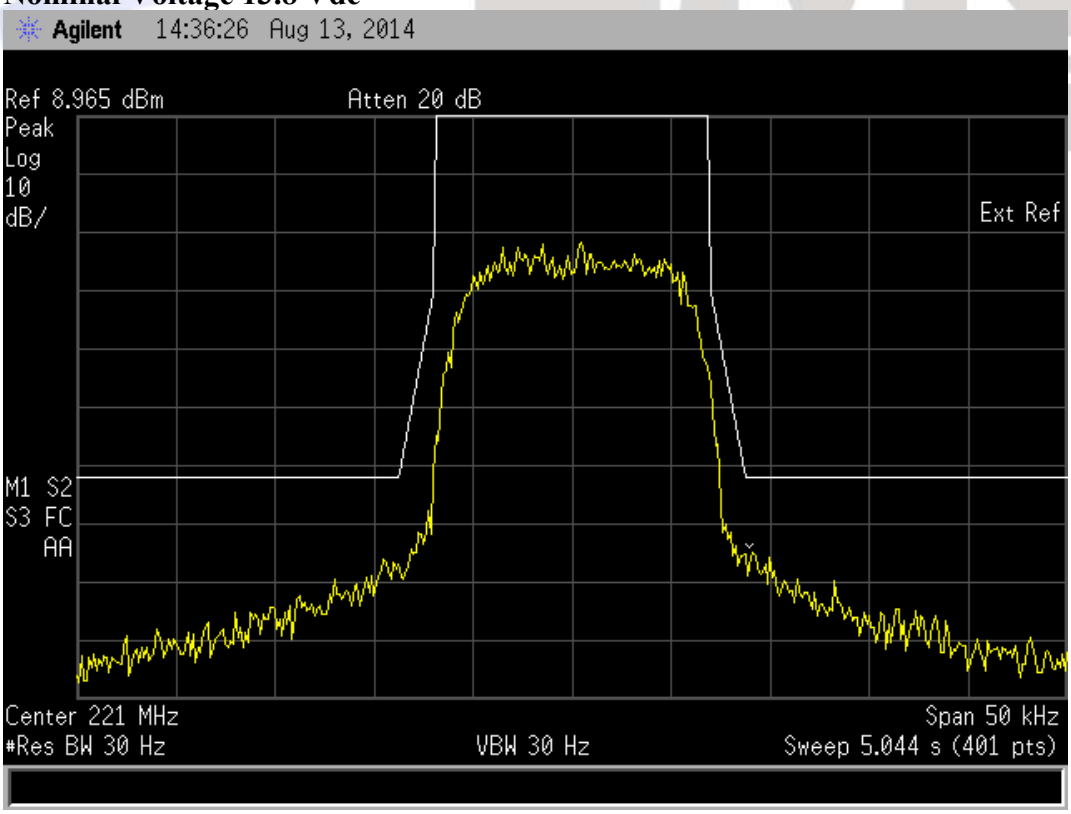


**Extreme Voltage 10.0 Vdc**

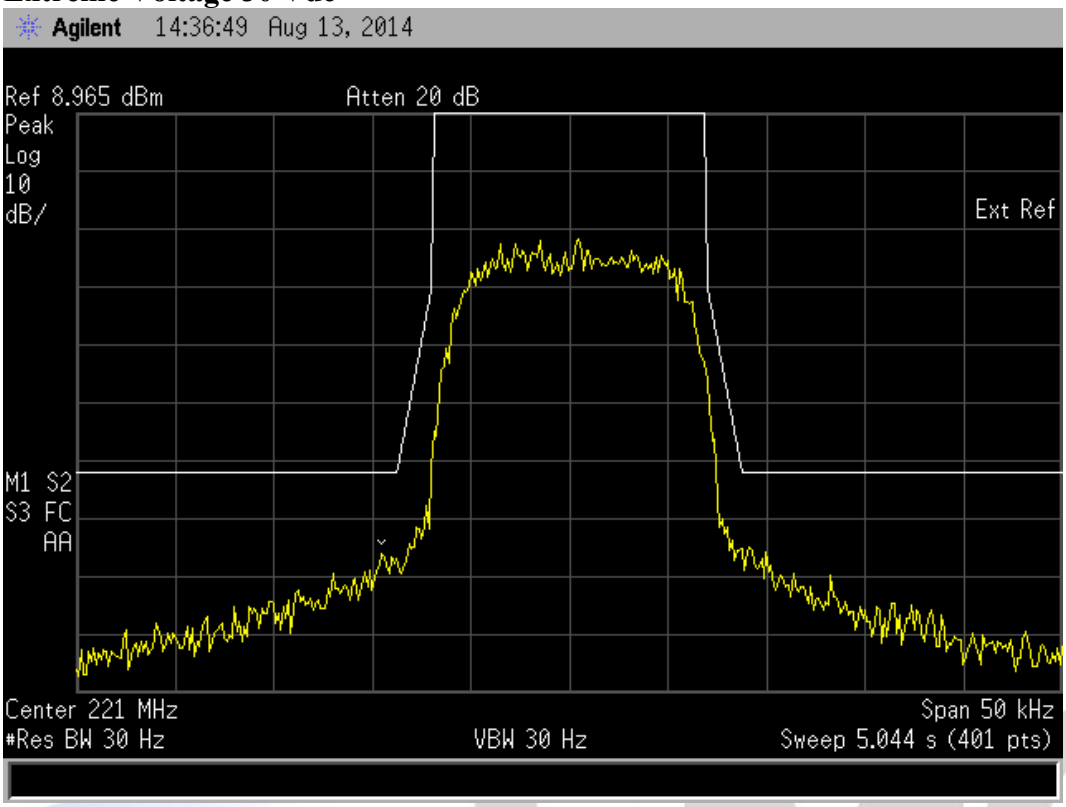



16QAM at ambient temperature +25°C

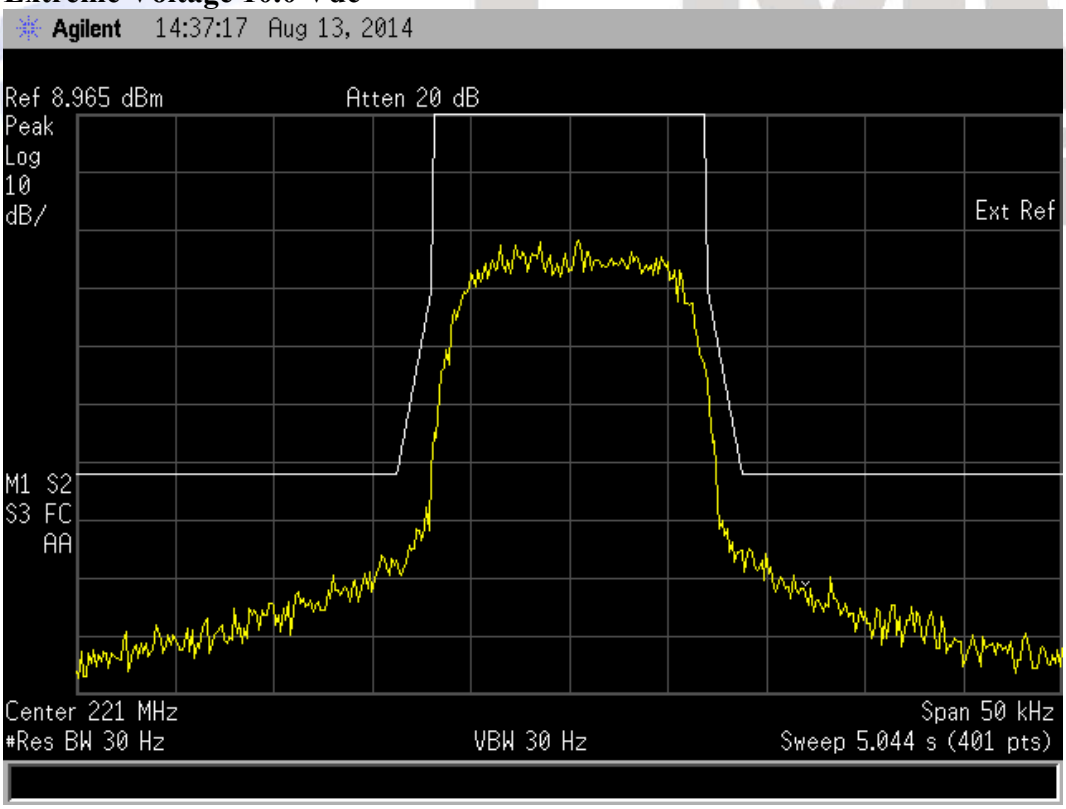
**Nominal Voltage 13.8 Vdc**



## Extreme Voltage 30 Vdc

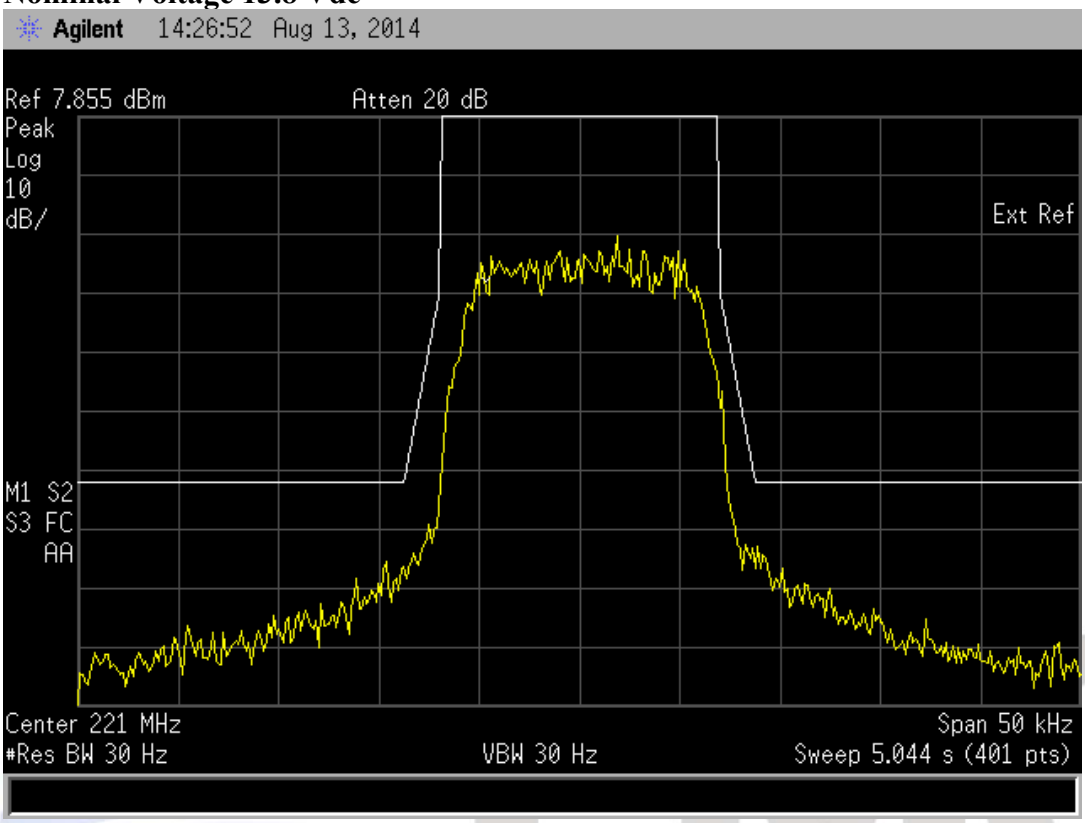



## Extreme Voltage 10.0 Vdc

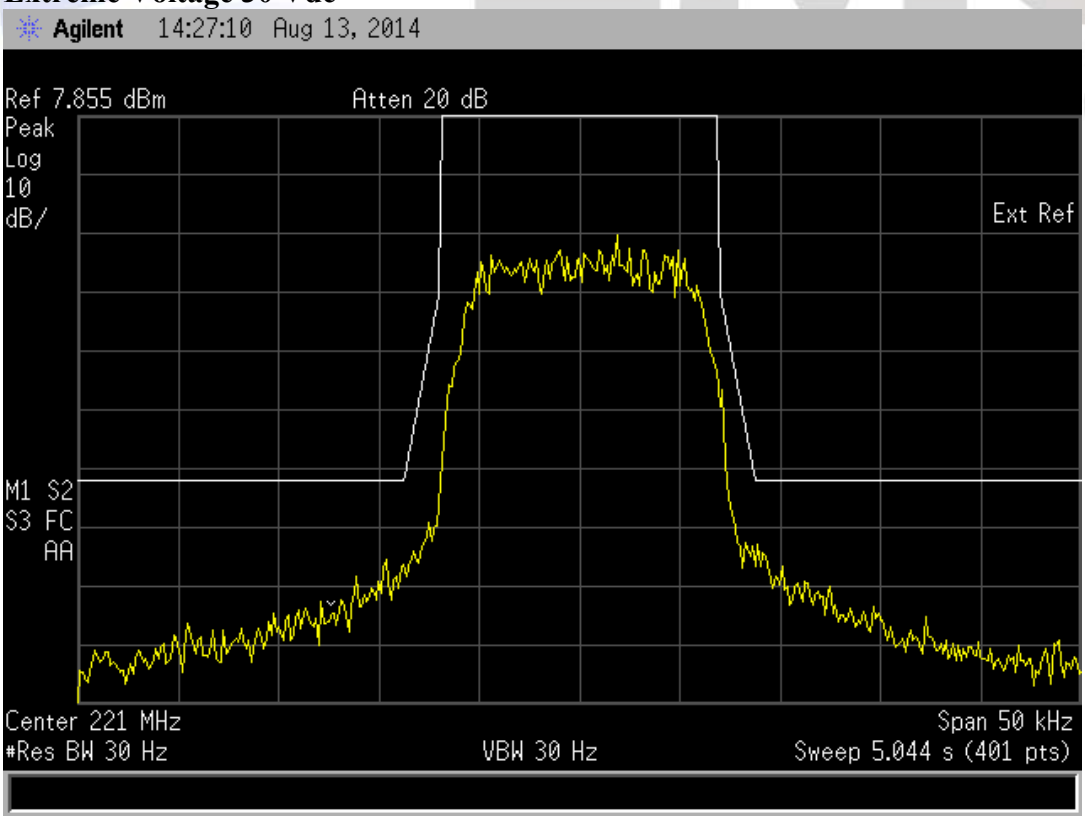


64QAM at ambient temperature +25°C

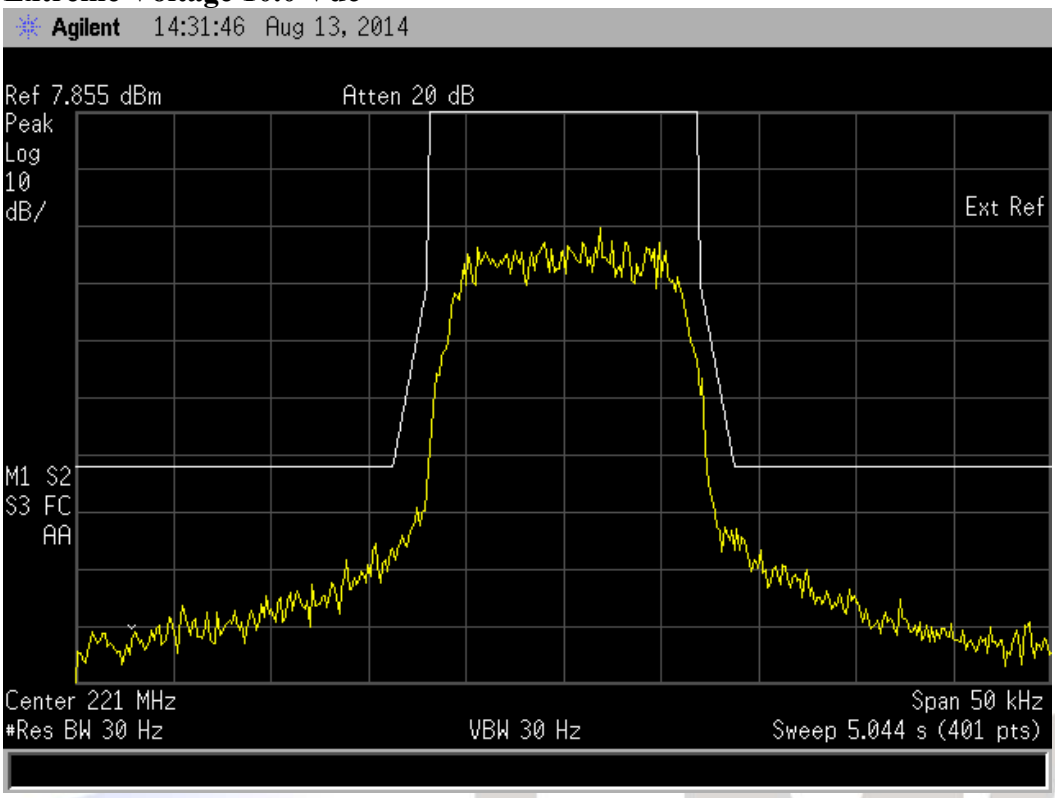
**Nominal Voltage 13.8 Vdc**




**Extreme Voltage 30 Vdc**

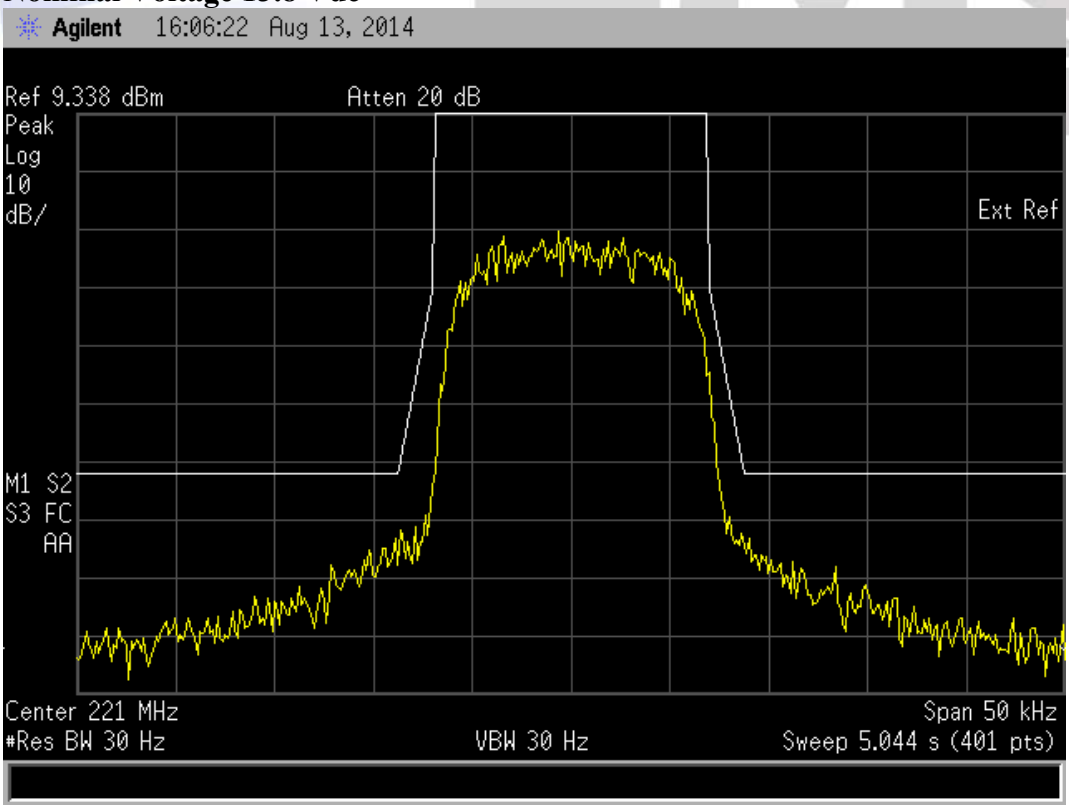


**Extreme Voltage 10.0 Vdc**

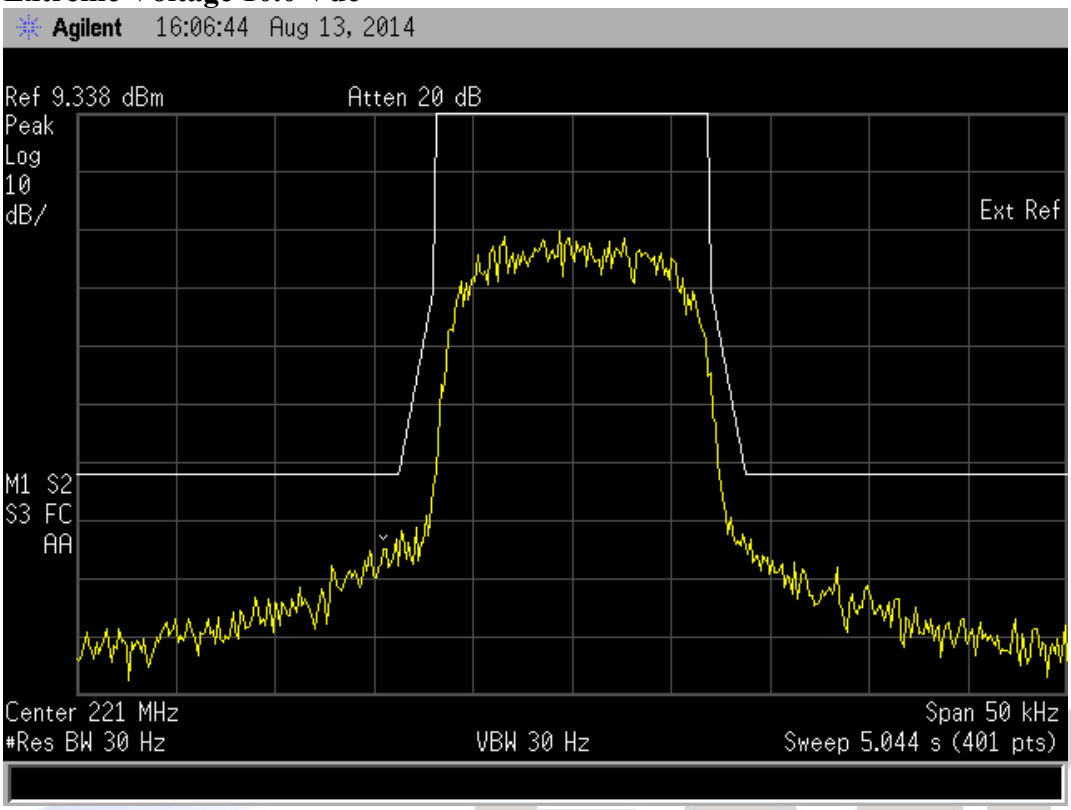



QPSK at extreme temperature +50°C

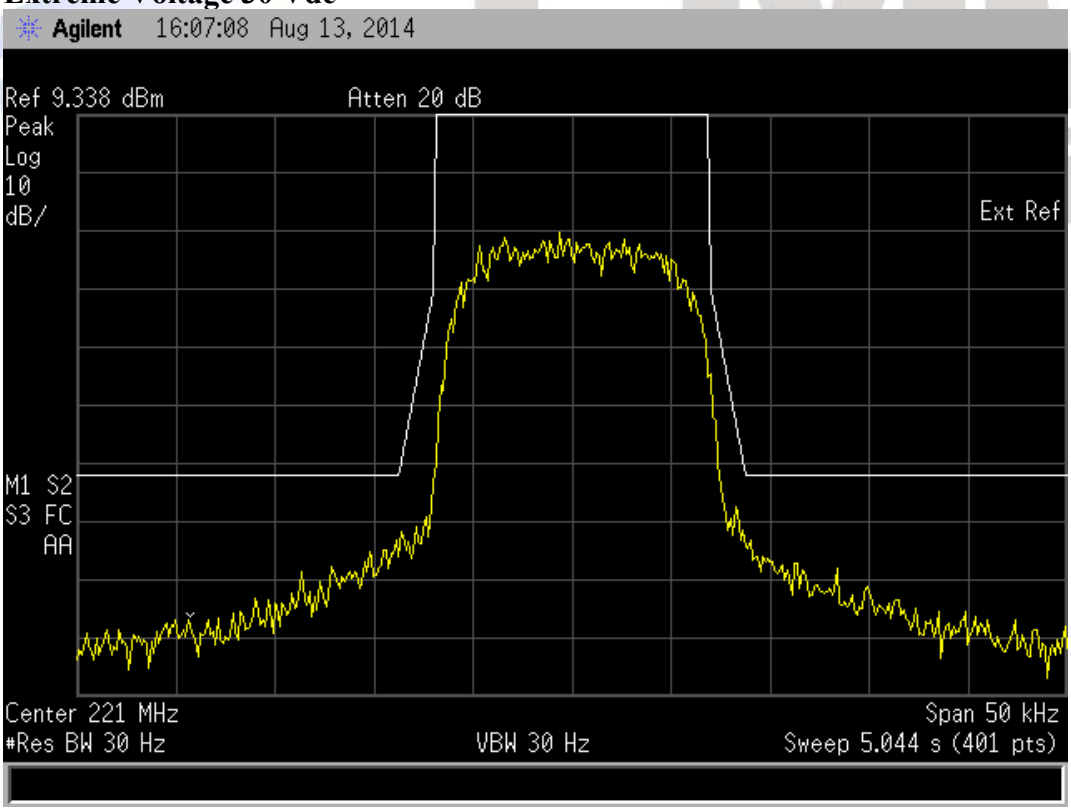
**Nominal Voltage 13.8 Vdc**



## Extreme Voltage 10.0 Vdc

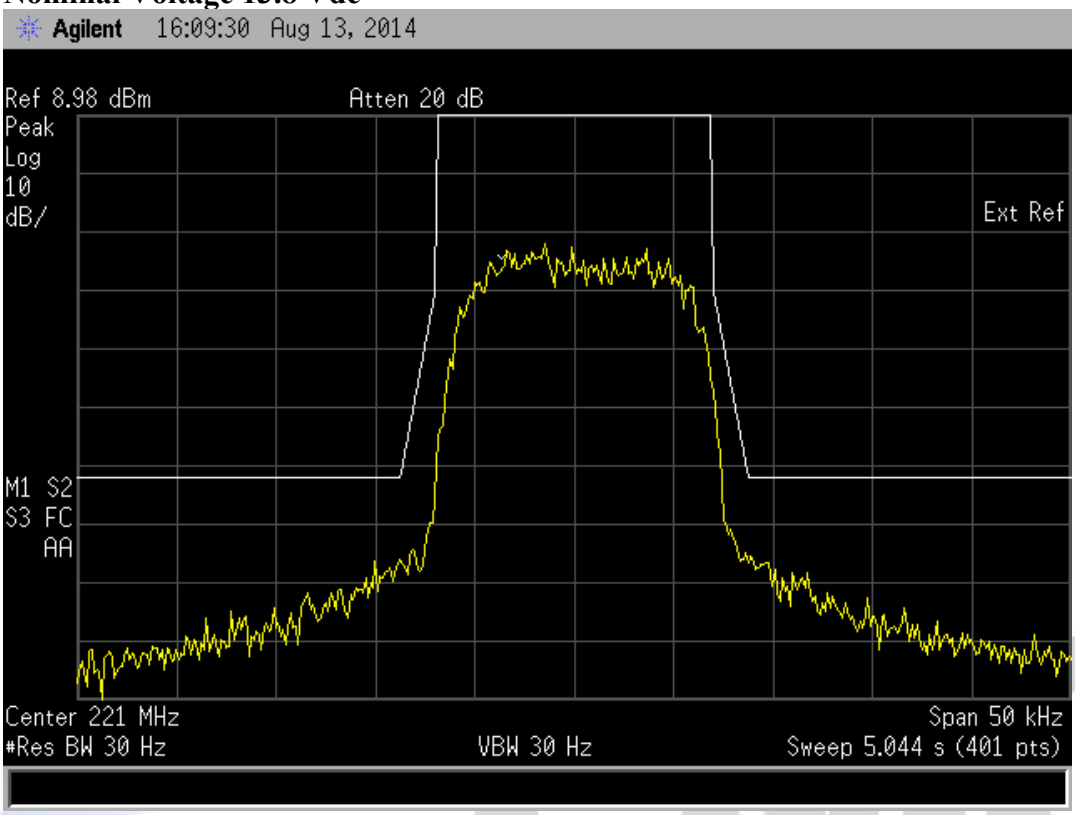



## Extreme Voltage 30 Vdc

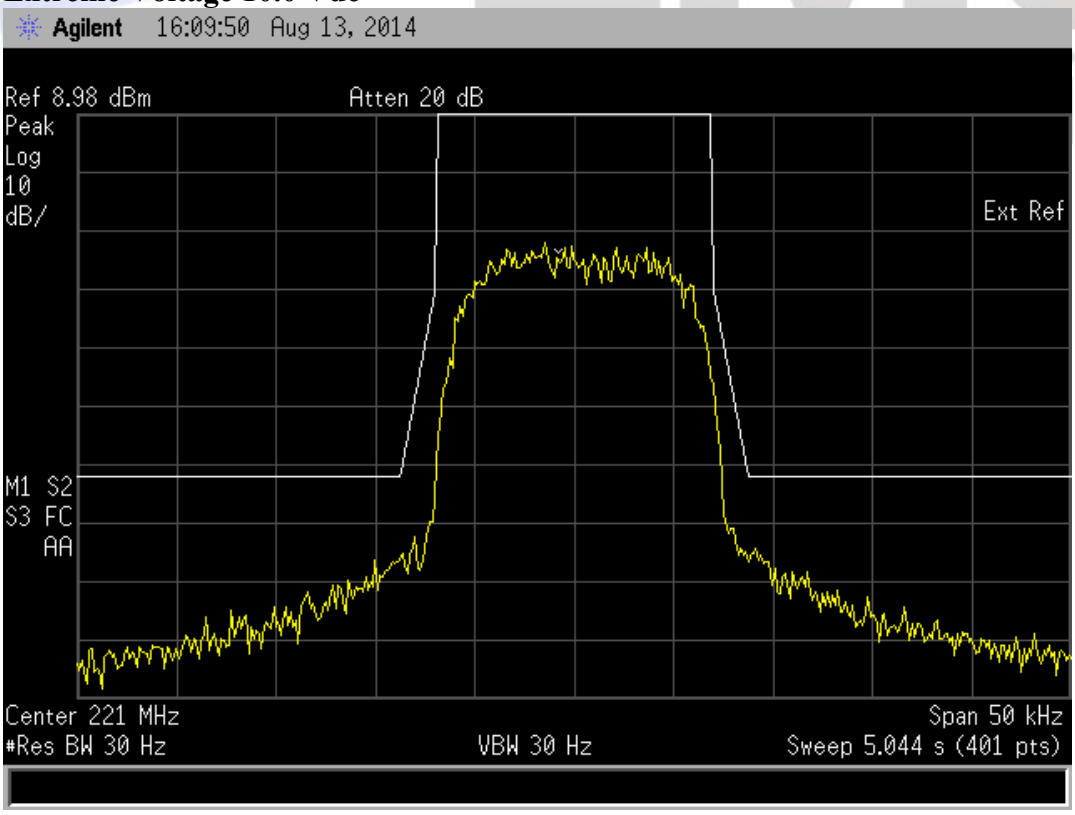


16QAM at extreme temperature +50°C

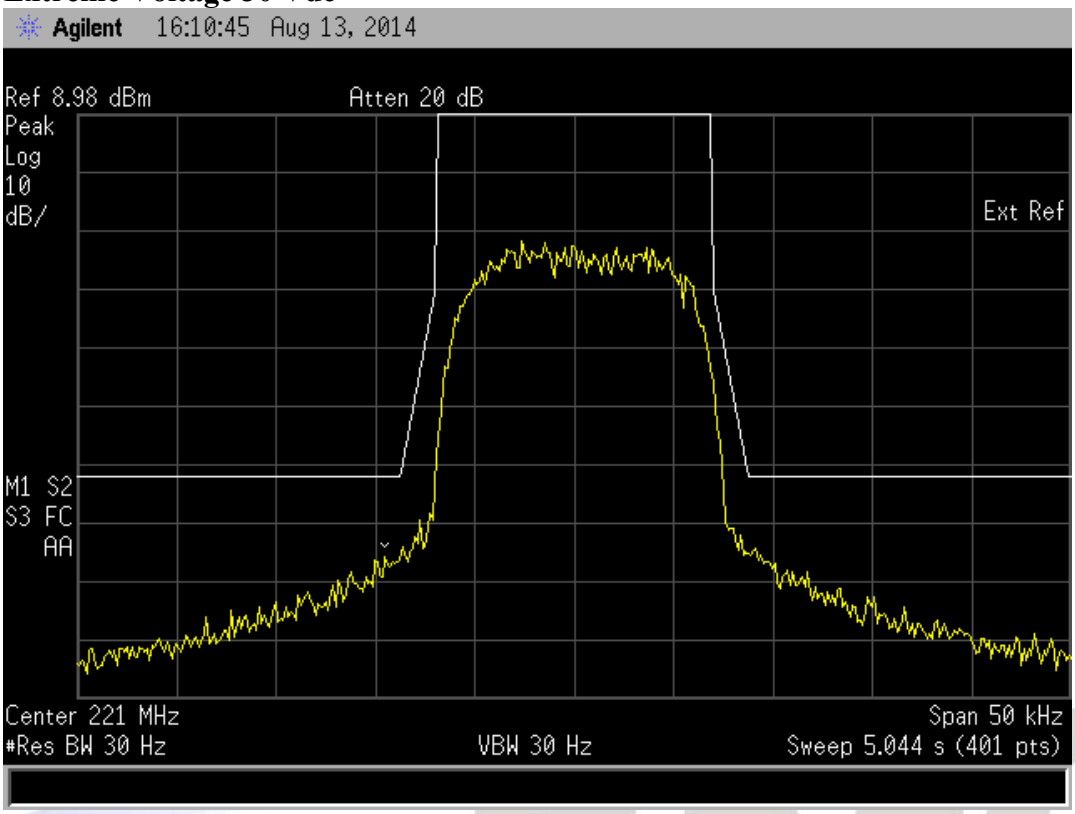
**Nominal Voltage 13.8 Vdc**




**Extreme Voltage 10.0 Vdc**

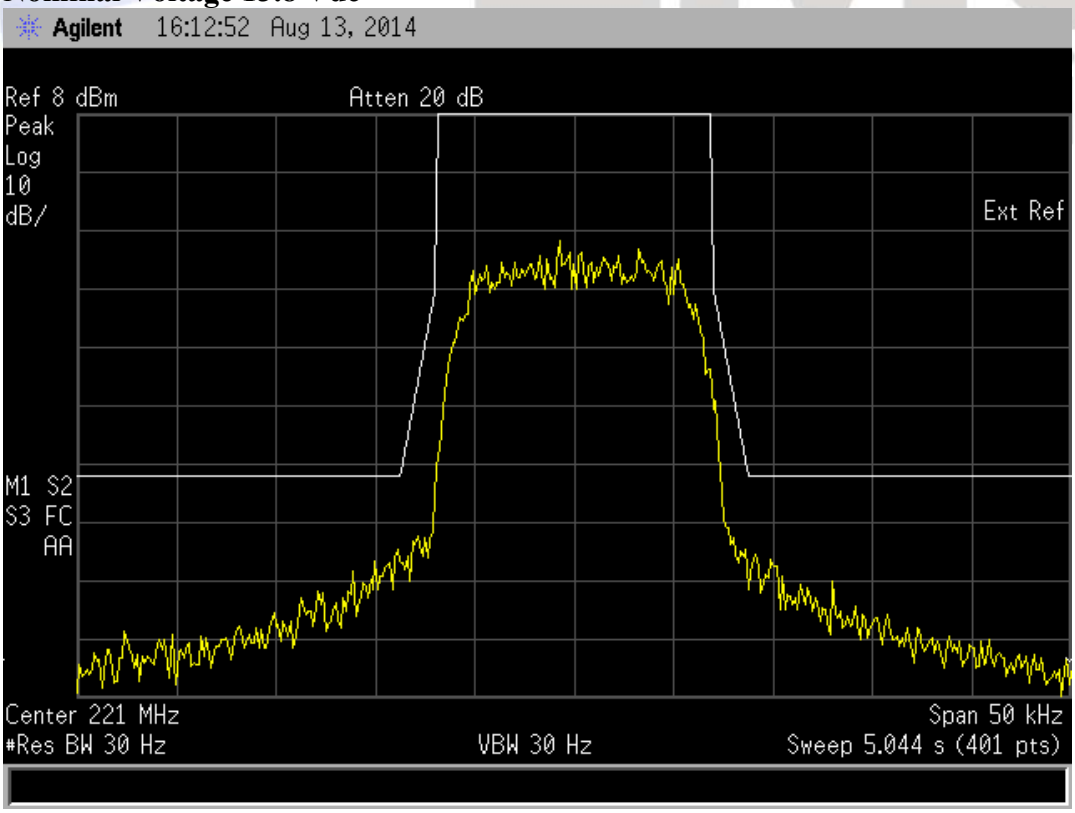


**Extreme Voltage 30 Vdc**

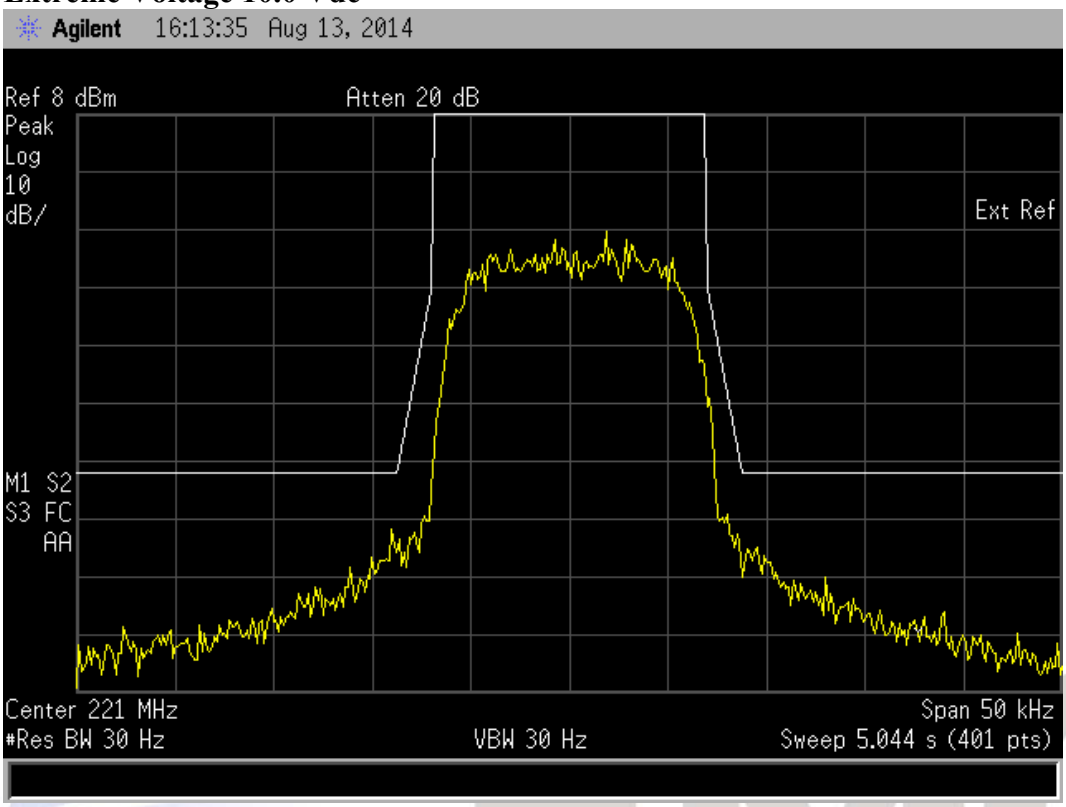



64QAM at extreme temperature +50°C

**Nominal Voltage 13.8 Vdc**



## Extreme Voltage 10.0 Vdc

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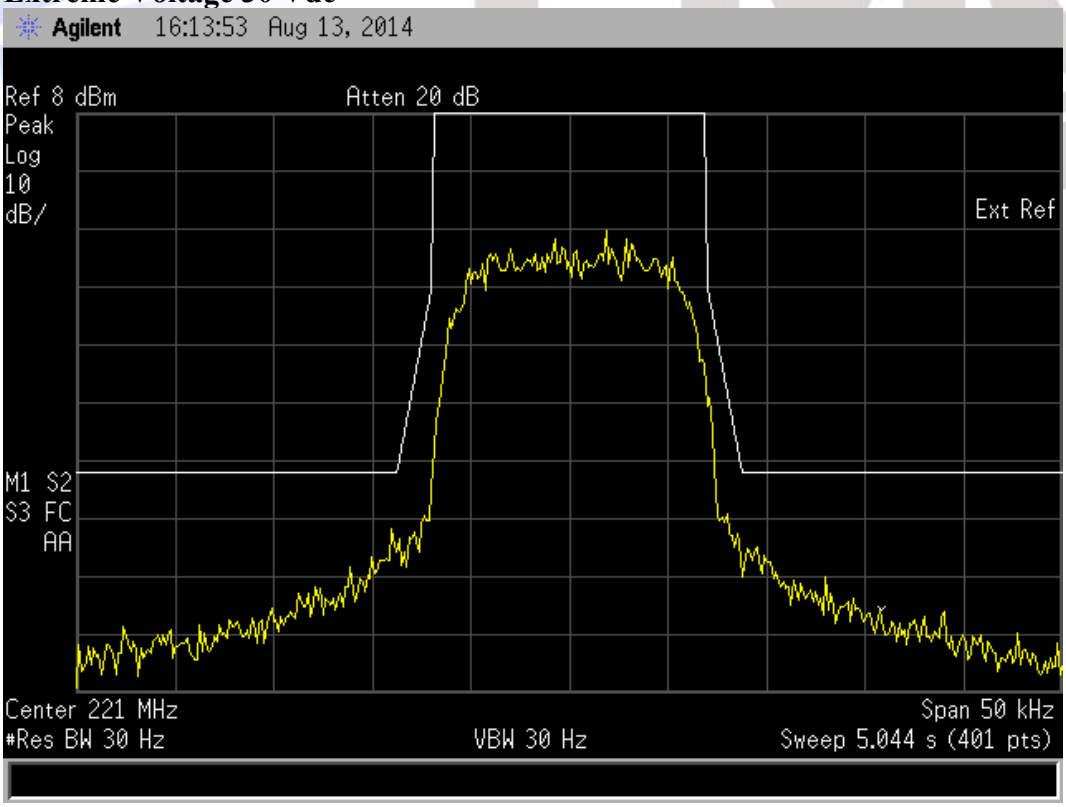
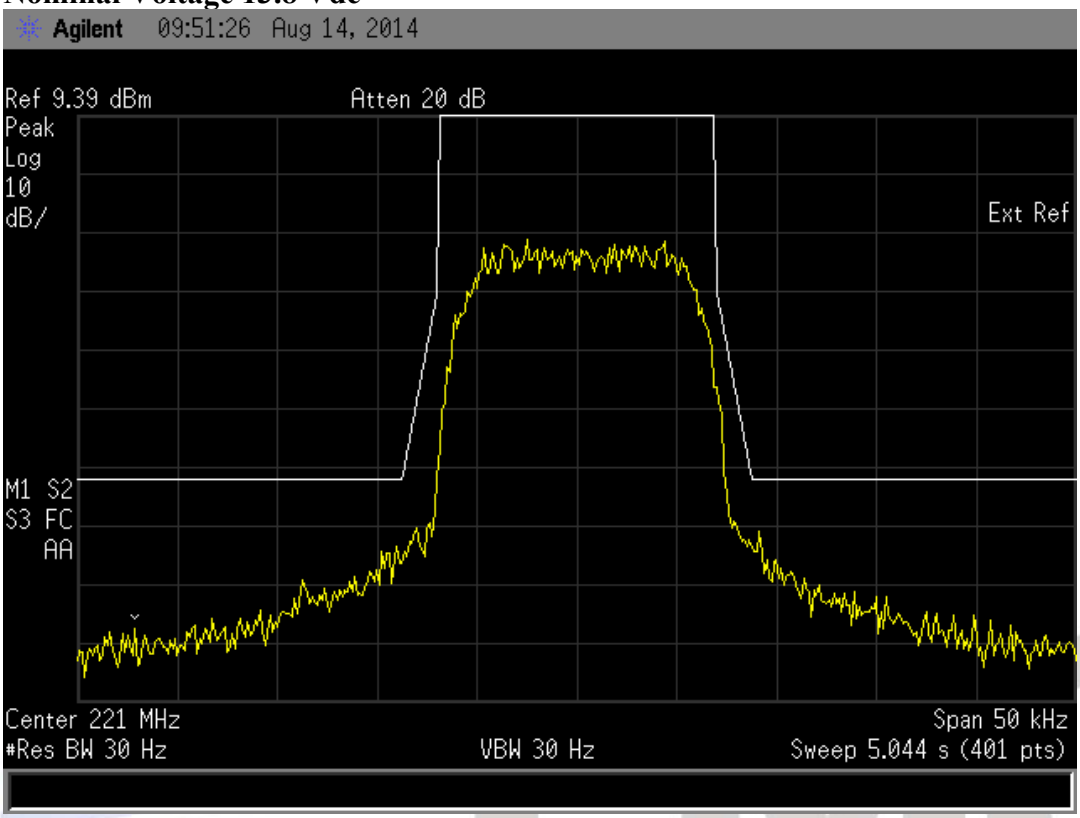
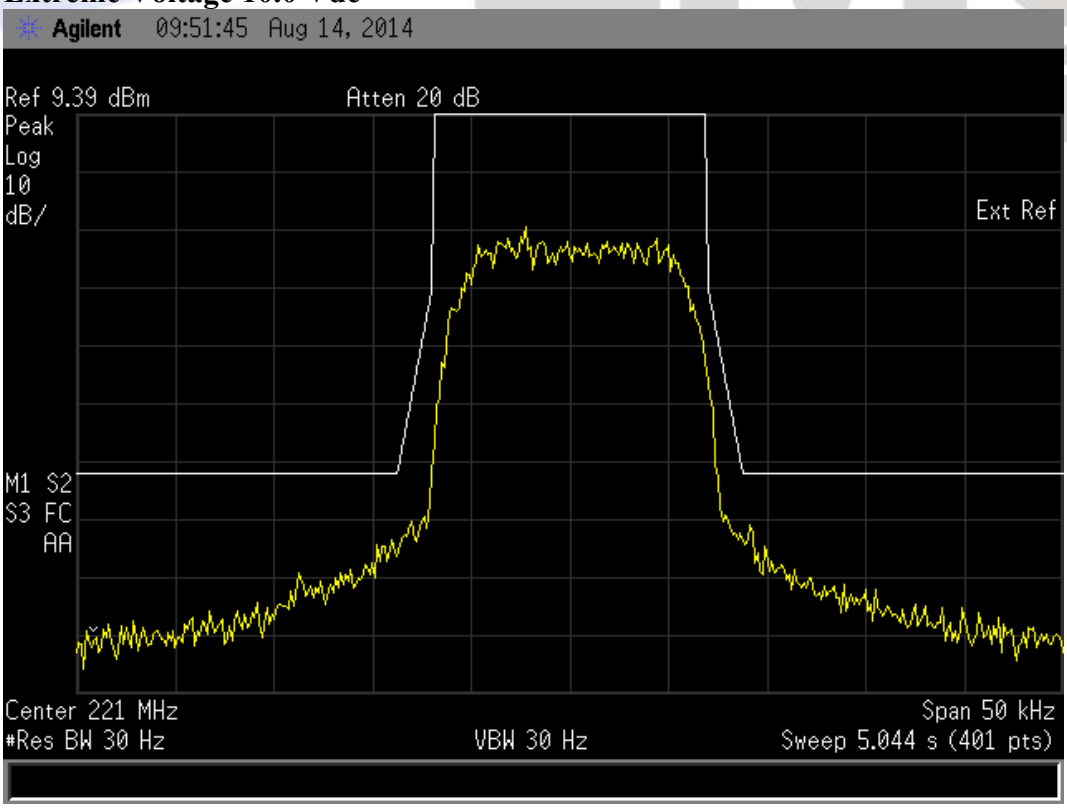


QPSK at extreme temperature -30°C

**Nominal Voltage 13.8 Vdc**




**Extreme Voltage 10.0 Vdc**



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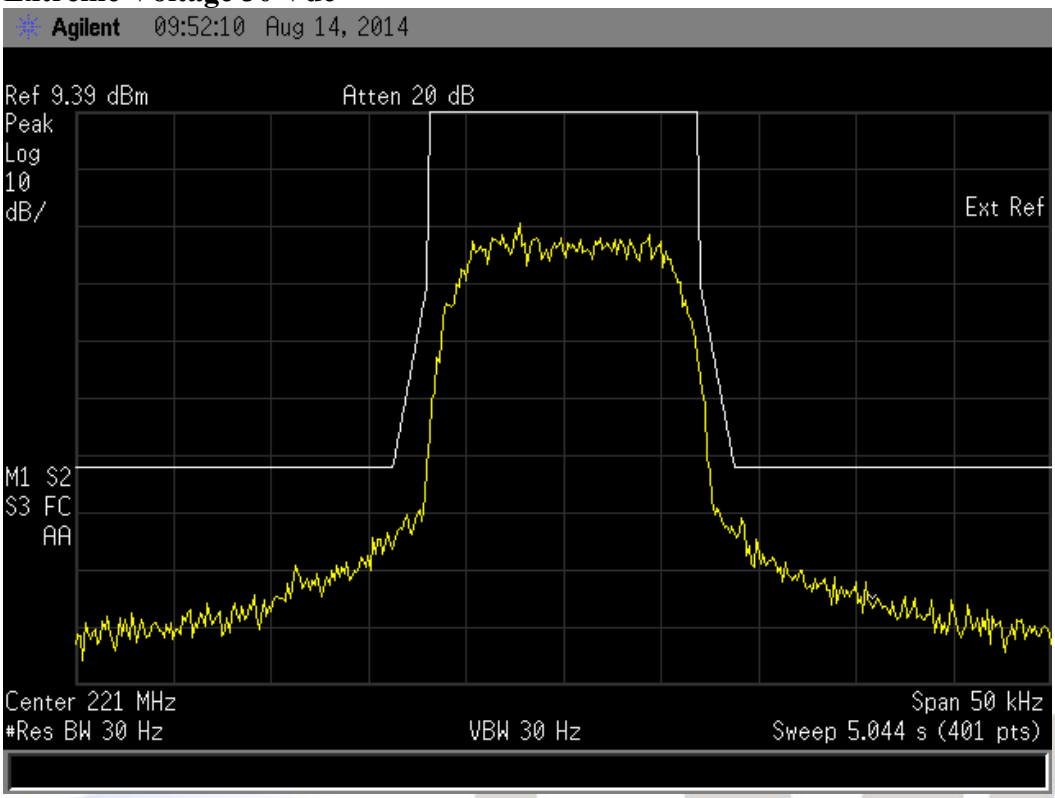
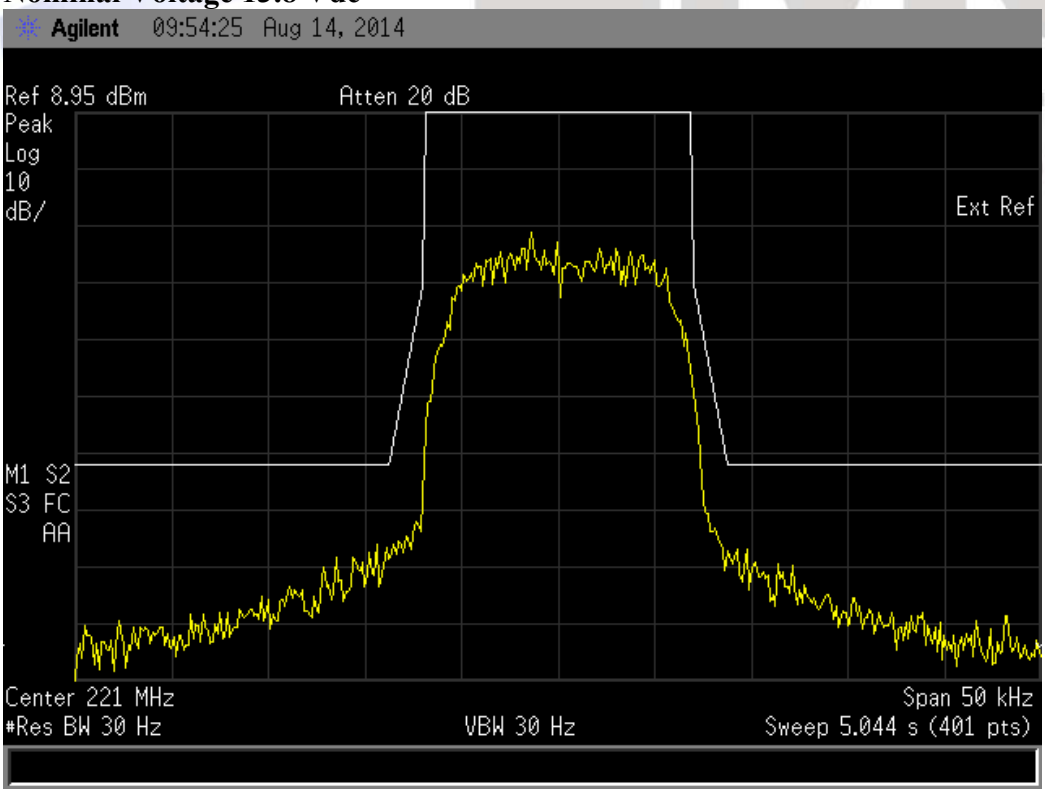
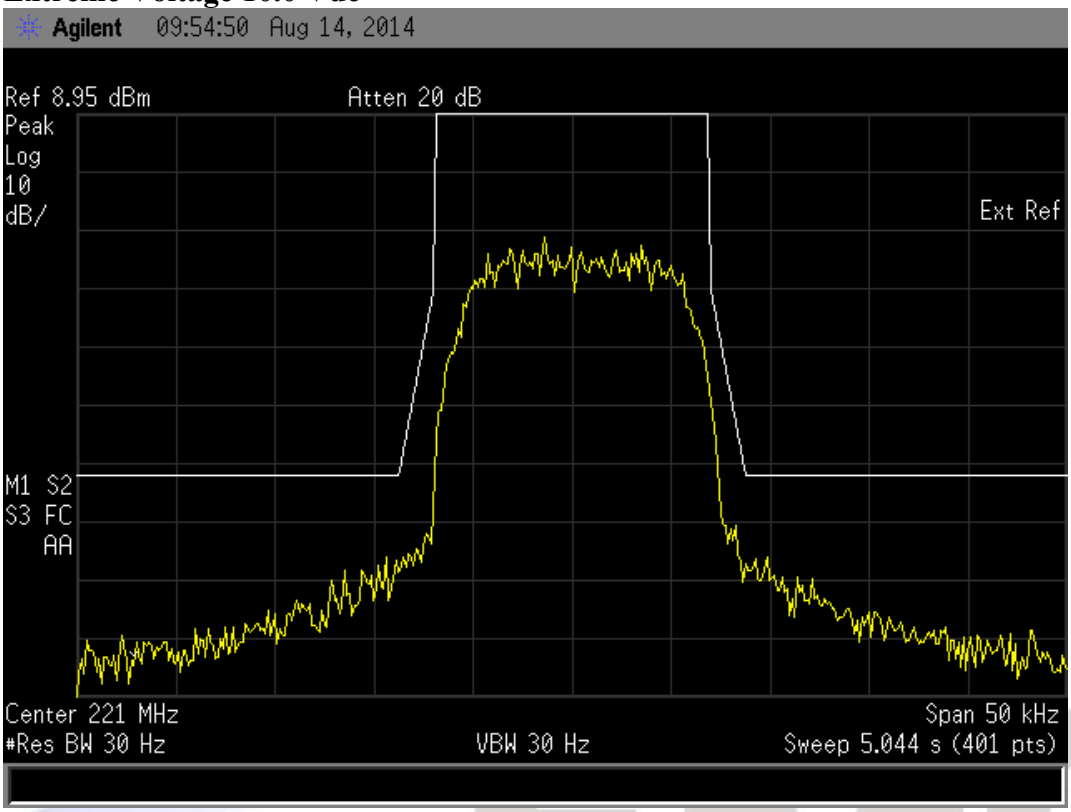



16QAM at extreme temperature -30°C

**Nominal Voltage 13.8 Vdc**



## Extreme Voltage 10.0 Vdc

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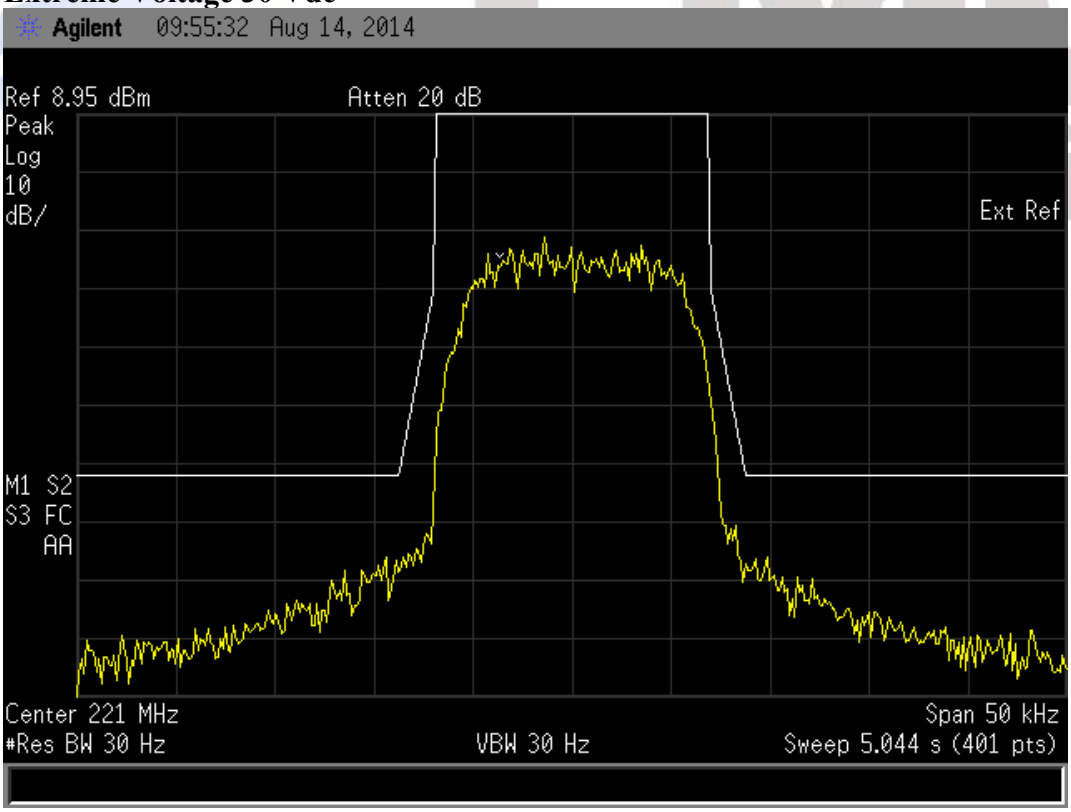
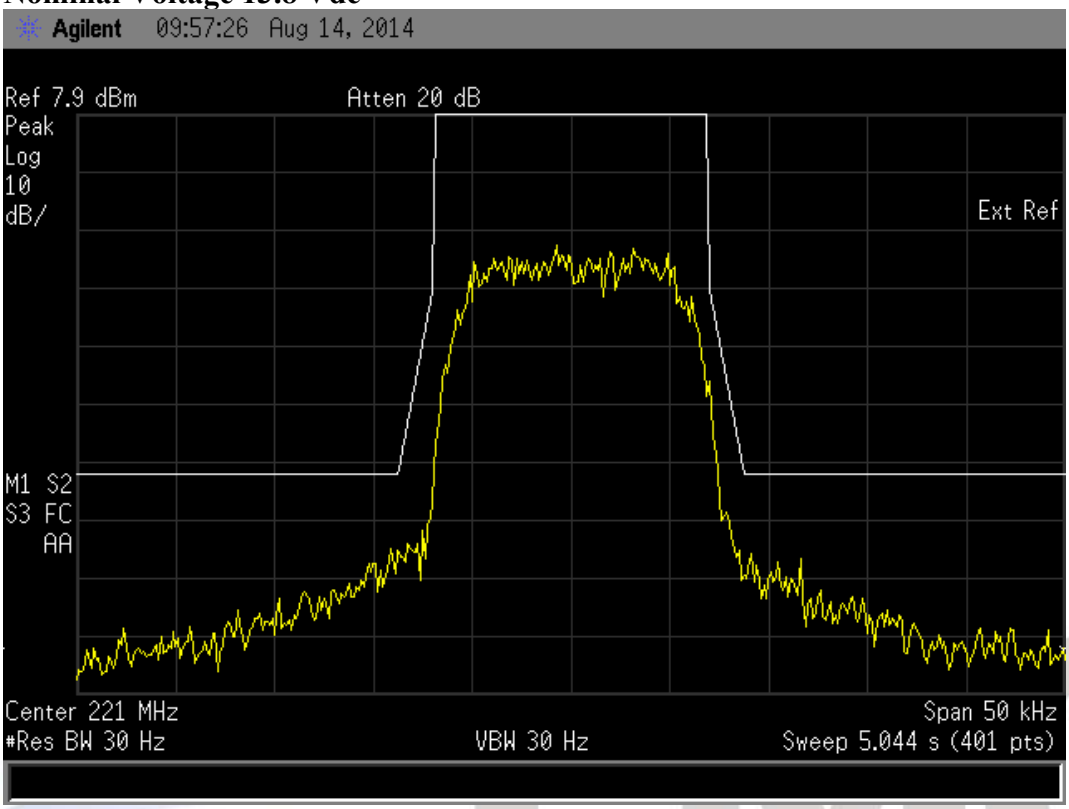
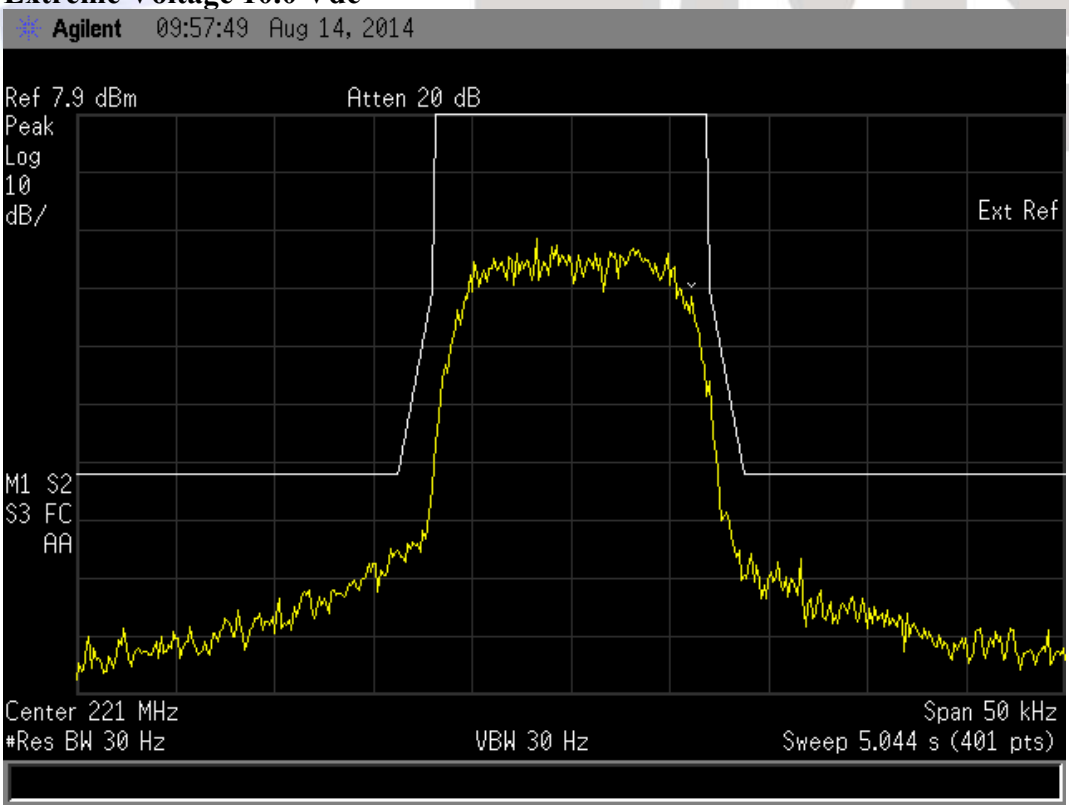


64QAM at extreme temperature -30°C

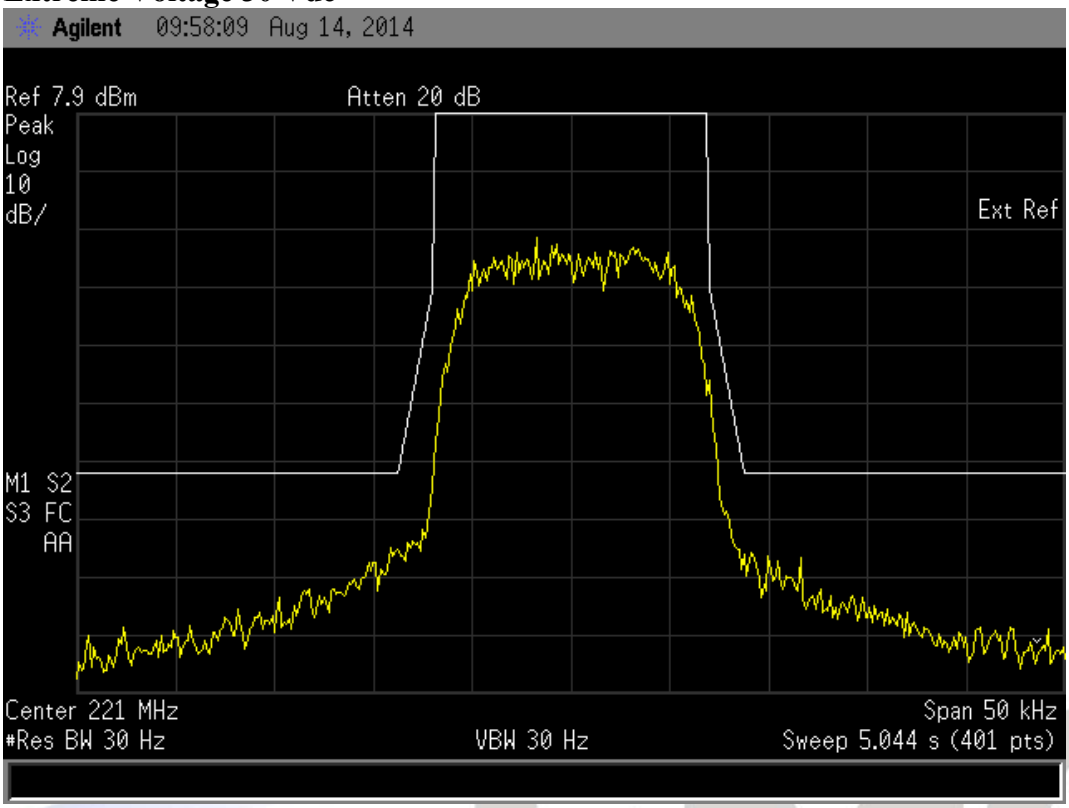
**Nominal Voltage 13.8 Vdc**




**Extreme Voltage 10.0 Vdc**



## Extreme Voltage 30 Vdc



**Transmitter spurious emissions at the antenna terminals (216 – 217 and 217 – 220 MHz bands).**

**Nominal Frequency:** 216.575 MHz

| Spurious emission (MHz) | Emission level (dBm) | Limit (dBm) |
|---|---|---|
| 433.150 | -31.1 | -13.0 |
| 649.725 | < -70.0 | -13.0 |
| 866.300 | < -70.0 | -13.0 |
| 1082.875 | < -70.0 | -13.0 |
| 1299.450 | < -70.0 | -13.0 |
| 1516.025 | < -70.0 | -13.0 |
| 1732.600 | < -70.0 | -13.0 |
| 1949.175 | < -70.0 | -13.0 |
| 2165.750 | < -70.0 | -13.0 |

**Nominal Frequency:** 217.575 MHz

| Spurious emission (MHz) | Emission level (dBm) | Limit (dBm) |
|---|---|---|
| 435.150 | -31.4 | -13.0 |
| 652.725 | < -70.0 | -13.0 |
| 870.300 | < -70.0 | -13.0 |
| 1087.875 | < -70.0 | -13.0 |
| 1305.450 | < -70.0 | -13.0 |
| 1523.025 | < -70.0 | -13.0 |
| 1740.600 | < -70.0 | -13.0 |
| 1958.175 | < -70.0 | -13.0 |
| 2175.750 | < -70.0 | -13.0 |

**Nominal Frequency:** 219.575 MHz

| Spurious emission (MHz) | Emission level (dBm) | Limit (dBm) |
|---|---|---|
| 439.150 | -33.6 | -13.0 |
| 658.725 | < -70.0 | -13.0 |
| 878.300 | < -70.0 | -13.0 |
| 1097.875 | < -70.0 | -13.0 |
| 1317.450 | < -70.0 | -13.0 |
| 1537.025 | < -70.0 | -13.0 |
| 1756.600 | < -70.0 | -13.0 |
| 1976.175 | < -70.0 | -13.0 |
| 2195.750 | < -70.0 | -13.0 |

**Limit:**

Applied mask B, on any frequency removed from the centre of the authorised bandwidth by a displacement frequency of more than 12.5 kHz shall be attenuated by at least 43 + 10 log (P).

A rated power of 2.0 watts (33.0 dBm) and of 5.0 watts (37.0 dBm) gives a limit of –13 dBm.

The spectrum has been investigated up to the 10th harmonic of the transmitter.

Part 2.1051 states that emissions greater than 20 dB below the limit need not be specified.

Part 2.1057 states that the spectrum should be investigated up to the 10th harmonic if the transmitter operates below 10 GHz.

**Result:** Complies.
**Measurement Uncertainty**: ± 3.3 dB

**Transmitter spurious emissions at the antenna terminals (220 – 222 MHz band)**

**Nominal Frequency:** 221.000 MHz

| Spurious emission (MHz) | Emission level (dBm) | Limit (dBm) |
|---|---|---|
| 442.000 | -31.9 | -25.0 |
| 663.000 | < -70.0 | -25.0 |
| 884.000 | < -70.0 | -25.0 |
| 1105.000 | < -70.0 | -25.0 |
| 1326.000 | < -70.0 | -25.0 |
| 1547.000 | < -70.0 | -25.0 |
| 1768.000 | < -70.0 | -25.0 |
| 1989.000 | < -70.0 | -25.0 |
| 2210.000 | < -70.0 | -25.0 |

**Limit:**

Applied mask F, on any frequency removed from the centre of the authorised bandwidth by a displacement frequency of more than 11.25 kHz shall be attenuated by at least 55 + 10 log (P).

A rated power of 5.0 watts (37.0 dBm) gives a limit of –25 dBm.

The spectrum has been investigated up to the 10th harmonic of the transmitter.

Part 2.1051 states that emissions greater than 20 dB below the limit need not be specified.

Part 2.1057 states that the spectrum should be investigated up to the 10th harmonic if the transmitter operates below 10 GHz.

**Result:** Complies.
**Measurement Uncertainty**: ± 3.3 dB

**Field strength of the transmitter spurious emissions (216 – 222 MHz)**

**Nominal Frequency:** 216.075 MHz

| Frequency (MHz) | Level (dBµV/m) | Level (dBm) | Limit (dBm) | Polarity | Margin (dB) |
|---|---|---|---|---|---|
| 433.1500 | 27.8 | -69.6 | -20.0 | Vertical | 49.6 |
| 433.1500 | 27.6 | -69.8 | -20.0 | Horizontal | 49.8 |
| 649.7250 | 31.8 | -65.6 | -20.0 | Vertical | 45.6 |
| 649.7250 | 31.7 | -65.7 | -20.0 | Horizontal | 45.7 |
| 866.3000 | 35.4 | -62.0 | -20.0 | Vertical | 42.0 |
| 866.3000 | 35.4 | -62.0 | -20.0 | Horizontal | 42.0 |
| 1082.8750 | 44.4 | -53.0 | -20.0 | Vertical | 33.0 |
| 1082.8750 | 45.2 | -52.2 | -20.0 | Horizontal | 32.2 |
| 1299.4500 | 46.7 | -50.7 | -20.0 | Vertical | 30.7 |
| 1299.4500 | 47.3 | -50.1 | -20.0 | Horizontal | 30.1 |
| 1516.0250 | 49.0 | -48.4 | -20.0 | Vertical | 28.4 |
| 1516.0250 | 48.8 | -48.6 | -20.0 | Horizontal | 28.6 |
| 1732.6000 | 51.4 | -46.0 | -20.0 | Vertical | 26.0 |
| 1732.6000 | 49.6 | -47.8 | -20.0 | Horizontal | 27.8 |
| 1949.1750 | 53.6 | -43.8 | -20.0 | Vertical | 23.8 |
| 1949.1750 | 53.0 | -44.4 | -20.0 | Horizontal | 24.4 |
| 2165.7500 | 55.7 | -41.7 | -20.0 | Vertical | 21.7 |
| 2165.7500 | 55.0 | -42.4 | -20.0 | Horizontal | 22.4 |

**Nominal Frequency:** 217.575 MHz

| Frequency (MHz) | Level (dBµV/m) | Level (dBm) | Limit (dBm) | Polarity | Margin (dB) |
|---|---|---|---|---|---|
| 435.1500 | 27.8 | -69.6 | -20.0 | Vertical | 49.6 |
| 435.1500 | 27.6 | -69.8 | -20.0 | Horizontal | 49.8 |
| 652.7250 | 31.8 | -65.6 | -20.0 | Vertical | 45.6 |
| 652.7250 | 31.7 | -65.7 | -20.0 | Horizontal | 45.7 |
| 870.3000 | 35.4 | -62.0 | -20.0 | Vertical | 42.0 |
| 870.3000 | 35.4 | -62.0 | -20.0 | Horizontal | 42.0 |
| 1087.8750 | 44.4 | -53.0 | -20.0 | Vertical | 33.0 |
| 1087.8750 | 45.2 | -52.2 | -20.0 | Horizontal | 32.2 |
| 1305.4500 | 46.7 | -50.7 | -20.0 | Vertical | 30.7 |
| 1305.4500 | 47.3 | -50.1 | -20.0 | Horizontal | 30.1 |
| 1523.0250 | 49.0 | -48.4 | -20.0 | Vertical | 28.4 |
| 1523.0250 | 48.8 | -48.6 | -20.0 | Horizontal | 28.6 |
| 1740.6000 | 51.4 | -46.0 | -20.0 | Vertical | 26.0 |
| 1740.6000 | 49.6 | -47.8 | -20.0 | Horizontal | 27.8 |
| 1958.1750 | 53.6 | -43.8 | -20.0 | Vertical | 23.8 |
| 1958.1750 | 53.0 | -44.4 | -20.0 | Horizontal | 24.4 |
| 2175.7500 | 55.7 | -41.7 | -20.0 | Vertical | 21.7 |
| 2175.7500 | 55.0 | -42.4 | -20.0 | Horizontal | 22.4 |

**Nominal Frequency:** 219.575 MHz

| Frequency (MHz) | Level (dBµV/m) | Level (dBm) | Limit (dBm) | Polarity | Margin (dB) |
|---|---|---|---|---|---|
| 439.1500 | 27.8 | -69.6 | -20.0 | Vertical | 49.6 |
| 439.1500 | 27.6 | -69.8 | -20.0 | Horizontal | 49.8 |
| 658.7250 | 31.8 | -65.6 | -20.0 | Vertical | 45.6 |
| 658.7250 | 31.7 | -65.7 | -20.0 | Horizontal | 45.7 |
| 878.3000 | 35.4 | -62.0 | -20.0 | Vertical | 42.0 |
| 878.3000 | 35.4 | -62.0 | -20.0 | Horizontal | 42.0 |
| 1097.8750 | 44.4 | -53.0 | -20.0 | Vertical | 33.0 |
| 1097.8750 | 45.3 | -52.1 | -20.0 | Horizontal | 32.1 |
| 1317.4500 | 46.7 | -50.7 | -20.0 | Vertical | 30.7 |
| 1317.4500 | 46.9 | -50.5 | -20.0 | Horizontal | 30.5 |
| 1537.0250 | 49.0 | -48.4 | -20.0 | Vertical | 28.4 |
| 1537.0250 | 48.5 | -48.9 | -20.0 | Horizontal | 28.9 |
| 1756.6000 | 51.4 | -46.0 | -20.0 | Vertical | 26.0 |
| 1756.6000 | 49.6 | -47.8 | -20.0 | Horizontal | 27.8 |
| 1976.1750 | 53.6 | -43.8 | -20.0 | Vertical | 23.8 |
| 1976.1750 | 53.0 | -44.4 | -20.0 | Horizontal | 24.4 |
| 2195.7500 | 55.7 | -41.7 | -20.0 | Vertical | 21.7 |
| 2195.7500 | 55.1 | -42.3 | -20.0 | Horizontal | 22.3 |

In transmit mode the transmitter was tested while transmitting continuously while attached to a dummy load.

Device was tested on an open area test site at a distance of 3 metres.

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Driving Creek, Orere Point, Auckland. Details of this site have been filed with the Commission, Registration Number: 90838, which was last updated in July 2013

**Limit:**

All spurious emissions are to be attenuated by at least 50 + 10 log (P).

The rated power of 2 watts (33.0 dBm) and 5.0 watts (37.0 dBm) gives a limit of –20 dBm.

No measurements were made above the 10$^{th}$ harmonic.

**Result:** Complies.
**Measurement Uncertainty**: ± 4.1 dB

**Frequency Stability (216 – 217 and 217 – 220 MHz band)**

Frequency stability measurements were between - 30°C and + 50°C in 10°C increments.

At each temperature the transmitter was given a period of 30 minutes to stabilise.

The transmitter was then turned on and the frequency error measured after a period of 1 minute.

**Nominal Frequency:** 217.575 MHz

**Frequency Error (Hz)**

| Temperature (°C) | Voltage (10.8 Vdc) | Voltage (13.8 Vdc) | Voltage (15.6 Vdc) |
|---|---|---|---|
| **+50** | -13.0 | -10.0 | -12.0 |
| **+40** | -18.0 | -18.0 | -19.0 |
| **+30** | -12.0 | -15.0 | -15.0 |
| **+20** | +10.0 | +11.0 | +13.0 |
| **+10** | +12.0 | +14.0 | +14.0 |
| **0** | +18.0 | +18.0 | +21.0 |
| **-10** | -15.0 | -15.0 | -17.0 |
| **-20** | -38.0 | -38.0 | -42.0 |
| **-30** | -44.0 | -48.0 | -53.0 |

**Limit:**
Part 90.213 states that mobile station transmitters operating between 216 – 220 fixed base stations are required to have a frequency tolerance of 1.0 ppm.

The Part 90 frequency stability requirement has been applied to this transmitter.

This transmitter was tested on 217.575 MHz.

1.0 ppm = 1.0 x = 217.5 Hz.

A worst case error of -53 Hz or 0.24 ppm was observed.

**Result:** Complies.
**Measurement Uncertainty:** ± 30 Hz.

**Exposure of humans to RF fields**

As per Section 1.1310 mobile transmitters are required to be operated in a manner that ensures the public is not exposed to RF energy levels in accordance with OST/OET Bulletin Number 65.

Calculations have been made using the General Public Exposure limits.

Minimum safe distances have been calculated below.

Power density, $mW/cm^2 = E^2/3770$

- General Public / Uncontrolled exposure limit will be 0.2 $mW/cm^2$ or 27.5 V/m.

The minimum distance from the antenna at which the MPE is met is calculated from the equation relating field strength in V/m, transmit power in watts, transmit antenna gain, transmitter duty cycle and separation distance in metres:

E, V/m = (√ (30 * P * G * DC)) / d

In the band the 216 – 217 MHz a transmitter power (P) of 5 watts was measured on 216.575 MHz

In the band 217 – 220 MHz a transmitter power (P) of 2 watts was measured on 217.575 MHz.

In the band the 220 – 222 MHz a transmitter power (P) of 5 watts was measured on 221.000 MHz

The client has declared a duty (DC) of 100% (1)

**General Public / Uncontrolled**

216 – 217 MHz band (216.575 MHz) at 5 watts
220 – 222 MHz band (221.000 MHz) at 5 watts

d = √ (30 * 5 * 20 * 1) / 27.5
d = 1.99 metres or 199 cm

217 – 220 MHz (217.575 MHz) at 2 watts

d = √ (30 * 2 * 20 * 1) / 27.5
d = 1.26 metres or 126 cm

**Result:** Complies if the above safe distance is defined in the user manual for this equipment.

# 7. TEST EQUIPMENT USED

| Instrument | Manufacturer | Model | Serial # | Asset | Cal Due | Interval |
|---|---|---|---|---|---|---|
| Aerial Controller | EMCO | 1090 | 9112-1062 | 3710 | N/a | N/a |
| Aerial Mast | EMCO | 1070-1 | 9203-1661 | 3708 | N/a | N/a |
| Turntable | EMCO | 1080-1-2.1 | 9109-1578 | 3709 | N/a | N/a |
| VHF Balun | Schwarzbeck | VHA9103 | - | 3603 | 12/01/2015 | 1 year |
| Biconical Antenna | Schwarzbeck | BBA 9106 | - | 3612 | 12/01/2015 | 1 year |
| Log Periodic | Schwarzbeck | VUSLP 91111 | 9111-228 | 3785 | 12/01/2015 | 1 year |
| Horn Antenna | EMCO | 3115 | 9511-4629 | E1526 | 04/06/2017 | 1 year |
| Receiver | Rohde & Schwarz | ESIB-40 | 100171 | EMC4003 | 29/01/2015 | 1 year |
| Modulation Analyzer | Rohde & Schwarz | FMA | 837807/020 | E1552 | 15/01/2015 | 1 year |
| Oscilloscope | Tektronics | 745A | B010643 | E1569 | 15/01/2015 | 1 year |
| Power Attenuator | Weinschel | 49-20-43 | GC104 | E1308 | N/a | N/a |
| Power Supply | Hewlett Packard | 6032A | 2743A-02859 | E1069 | N/a | N/a |
| Signal Generator | Rohde & Schwarz | SMHU | 838923/028 | E1493 | 22/01/2015 | 1 year |
| Spectrum Analyzer | Hewlett Packard | E7405A | US39150142 | RFS 3776 | 07/07/2015 | 1 year |
| Thermal chamber | Contherm | M180F | 86025 | E1129 | 01/01/2015 | 1 year |
| Thermometer | DSIR | RT200 | 035 | E1049 | 01/01/2015 | 1 year |

All test equipment was within calibration at the time of testing.

# 8. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies NZ Ltd registration with the Federal Communications Commission as a listed facility, Registration Number: 90838, which was updated in July 2013 and then June 2014.

All testing has been carried out in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to ISO/IEC 17025.

All measurement equipment has been calibrated in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to ISO/IEC 17025.

International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with various accreditation bodies in a number of economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.

# 9. PHOTOGRAPHS

External photos of the device tested



Labels

Radiated emissions test set up photos