HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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# TEST REPORT

**ACCORDING TO: FCC 47CFR part 96**

**FOR:**

## Airspan Networks Inc.
## LTE Base Station Radio
## Model: AirHarmony 4200 3550-3700MHz (B48)
## FCC ID:PIDAH4200A

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# 1 Applicant information

| | |
|---|---|
| **Client name:** | Airspan Networks Inc. |
| **Address:** | 777 Yamato, Road Suite 310 Boca Raton, FL 33431, USA |
| **Telephone:** | +1 561 893 8670 |
| **Fax:** | +1 561 893 8671 |
| **E-mail:** | zlevi@airspan.com |
| **Contact name:** | Mr. Zion Levi |

# 2 Equipment under test attributes

| | |
|---|---|
| **Product name:** | LTE Base Station Radio |
| **Product type:** | Transceiver |
| **Model(s):** | AirHarmony 4200 3550-3700MHz (B48) |
| **Serial number:** | D5EF25CED5BC |
| **Hardware version:** | C2 |
| **Software release:** | SR 16.00 |
| **Receipt date** | 05-Jun-19 |

# 3 Manufacturer information

| | |
|---|---|
| **Manufacturer name:** | Airspan Networks Inc. |
| **Address:** | 777 Yamato, Road Suite 310 Boca Raton, FL 33431, USA |
| **Telephone:** | +1 561 893 8670 |
| **Fax:** | +1 561 893 8671 |
| **E-Mail:** | zlevi@airspan.com |
| **Contact name:** | Mr. Zion Levi |

# 4 Test details

| | |
|---|---|
| **Project ID:** | 33454 |
| **Location:** | Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel |
| **Test started:** | 18-Jun-19 |
| **Test completed:** | 24-Jun-19 |
| **Test specification(s):** | FCC 47CFR part 96 |

# 5 Tests summary

| Test | Status |
|---|---|
| **Transmitter characteristics** | |
| Section 96.41(b), Maximum EIRP and maximum power spectral density | Pass |
| Section 96.41(g), Peak-to- average power ratio | Pass* |
| Section 2.1049, Occupied bandwidth | Pass* |
| Section 96.41(e), Emission mask | Pass** |
| Section 96.41(e)(2), Radiated spurious emissions | Pass* |
| Section 96.41(e)(3), Conducted spurious emissions | Pass** |
| Section 2.1055, Frequency stability | Pass* |

The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

* Accoording to “KDB 484596 D01 Referencing Test Data v01” the results were re-used from FCC ID:PIDAH4200, test report AIRRAD_FCC.31875_rev2. The explanation of differencies between FCC ID:PIDAH4200 and FCC ID:PIDAH4200A provided as an exhibit in Application for certification.
** The spot check at mid frequency was conducted, the results were not worse that the original ones, so sufficient evidence of the similarity provided.

This test report supersedes the previously issued test report identified by Doc ID: AIRRAD_FCC.33454

| | Name and Title | Date | Signature |
|---|---|---|---|
| **Tested by:** | Mr. S. Samokha, test engineer | June 24, 2019 | |
| **Reviewed by:** | Mrs. M. Cherniavsky, certification engineer | July 1, 2019 | |
| **Approved by:** | Mr. M. Nikishin, EMC and Radio group manager | July 3, 2019 | |

# 6 EUT description

## 6.1 General information

The EUT, Mobile Digital station, AirHarmony 4200 3550-3700MHz (B48), is part of a LTE broadband fixed cellular wireless access system. The system provides a radio link between an end-user (a subscriber) and a network to give high-speed data access. The AirHarmony's transceiver/receiver (Up to 64 QAM modulation, data rate up to 95 Mbps) equipped with a 18 dBi external antenna. Advanced Antenna Techniques 2x2 MIMO are supported. The maximum RF output power (not including antenna gain) is 32 dBm for 18 dBi and it can be reduced by software.
The AirHarmony is installed outdoors. The Subscriber transmits and receives traffic to and from the base station respectively. The transceiver provides subscribers with "always-on" Internet, high speed data only, or data and voice (VoIP) services and is configured with a unique base station reference number, preventing the LTE UE from relocating to another subscriber premises without authorization.
**Note**: The AH4200 equipment defined as Category B CBSD (Citizens Broadband Radio Service Device). The transmitter output signal are completely uncorrelated, antennas 1/2 is one sector and antennas 3/4 is another sector. The sectors are not working on the same frequency, each sector has the different frequency.

## 6.2 Ports and lines

| Port type | Port description | Connected from | Connected to | Qty. | Cable type | Cable length, m |
|---|---|---|---|---|---|---|
| Power | DC power | EUT | AC/DC adapter | 1 | Unshielded | 20 |
| Signal | Ethernet | EUT | Laptop | 1 | Shielded | 20 |
| Signal* | Serial* | Not connected | Not connected | 1 | NA | NA |

*for maintenance only

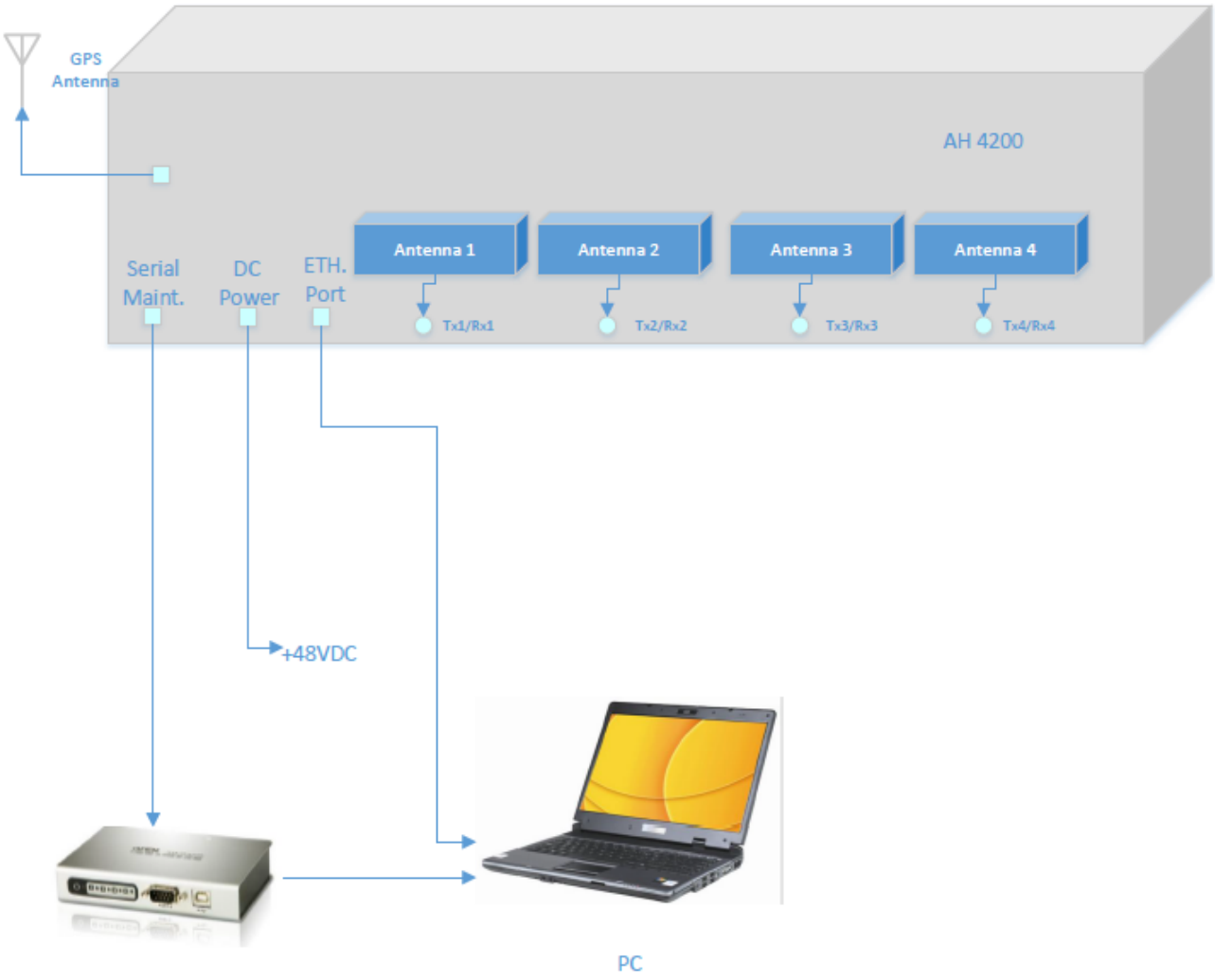
## 6.3 Support and test equipment

| Description | Manufacturer | Model number | Serial number |
|---|---|---|---|
| Laptop | Dell | E7450 | 8TYRP32 |
| USB to RS-232 convertor | ATEN | UC2324 | NA |
| AC/DC adapter | DVE | DSA-96PFB-12 1 120750 | P/N DSA-96PFB-12 1 120750-W25 |

## 6.4 Changes made in the EUT

No changes were implemented in the EUT during testing.

## 6.5 Test configuration



## 6.6 Transmitter characteristics

| Type of equipment | |
|---|---|
| V | Stand-alone (Equipment with or without its own control provisions) |
| | Combined equipment (Equipment where the radio part is fully integrated within another type of equipment) |
| | Plug-in card (Equipment intended for a variety of host systems) |

| Intended use | | Condition of use |
|---|---|---|
| V | fixed | Always at a distance more than 2 m from all people |
| | mobile | Always at a distance more than 20 cm from all people |
| | portable | May operate at a distance closer than 20 cm to human body |

| | |
|---|---|
| **Assigned frequency range** | 3550.0 – 3700.0 MHz |
| **Operating frequency (full bands)** | 3555.0 – 3695.0 MHz |
| **RF channel spacing** | 10 MHz, 20 MHz |
| **Maximum rated output power** | At transmitter 50 Ω RF output connector (per port) 32 dBm |

| **Is transmitter output power variable?** | | | | |
|---|---|---|---|---|
| | No | | | |
| V | Yes | | continuous variable | |
| | | V | stepped variable with step size | 0.25 dB |
| | | | minimum RF power | -30 dBm |
| | | | maximum RF power at antenna connector | dBm |

| Antenna connection | | | | |
|---|---|---|---|---|
| unique coupling | V standard connector | Integral | V | with temporary RF connector |
| | | | | without temporary RF connector |

| Antenna/s technical characteristics | | | |
|---|---|---|---|
| Type | Manufacturer | Model number | Gain |
| External | ALPHA Wireless Ltd. | AW3089 | 18 dBi |

| Transmitter aggregate data rate/s, Mbps | | | |
|---|---|---|---|
| Transmitter 26dBc power bandwidth | Type of modulation | | |
| | QPSK | 16QAM | 64QAM |
| 10 MHz | 10.7 | 22.7 | 47.3 |
| 20 MHz | 23.4 | 45.4 | 95 |

| | |
|---|---|
| **Type of multiplexing** | TDD |
| **Modulating test signal (baseband)** | PRBS |
| **Maximum transmitter duty cycle in normal use** | 0.74 |

| Transmitter power source | | | | | |
|---|---|---|---|---|---|
| | | **Nominal rated voltage** | | Battery type | |
| V | DC | **Nominal rated voltage** | 48 VDC | | |
| | AC mains | **Nominal rated voltage** | | Frequency | |

| | | | |
|---|---|---|---|
| **Common power source for transmitter and receiver** | **V** | yes | no |

| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

# 7 Transmitter tests according to 47CFR part 96

## 7.1 Maximum EIRP and maximum power spectral density test

### 7.1.1 General

This test was performed to measure the peak spectral power density at the transmitter RF antenna connector. Specification test limits are given in Table 7.1.1.

**Table 7.1.1 Peak output power limits**

| Assigned frequency range, MHz | ERP | |
|---|---|---|
| | W/10 MHz | dBm/10 MHz |
| 3550 - 3700 | 17.0 | 47.0 |

**Table 7.1.2 Peak spectral power density limits**

| Assigned frequency range, MHz | Measurement bandwidth, MHz | Peak spectral power density, dBm |
|---|---|---|
| 3550 - 3700 | 1.0 | 37.0 |

### 7.1.2 Test procedure

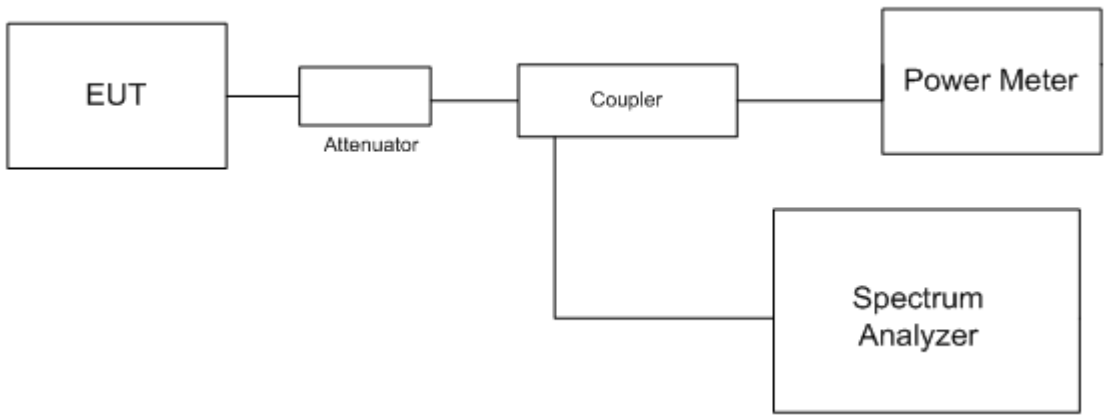
**7.1.2.1** The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

**7.1.2.2** The EUT was adjusted to produce maximum available to end user RF output power.

**7.1.2.3** The peak output power was measured with power meter as provided in Table 7.1.3.

**7.1.2.4** Spectrum analyzer was set in average mode, sufficient number of sweeps was allowed for trace stabilization and peak spectral power density was measured as provided in Table 7.1.4 and the associated plots.

**Figure 7.1.1 Peak output power and spectral power density test setup**



| **Test specification:** | **Section 96.41(e), Emission mask** | | |
|---|---|---|---|
| **Test procedure:** | Section 96.41(e)(3) | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 19-Jun-19 | | |
| **Temperature:** 24 ºC | **Relative Humidity:** 52 % | **Air Pressure:** 1010 hPa | **Power:** 48 VDC |
| **Remarks:** | | | |

**Table 7.1.3 Maximum EIRP test results**

ASSIGNED FREQUENCY RANGE: 3550.0 – 3700.0 MHz
DETECTOR USED: Average (gated)
ANTENNA GAIN 18 dBi

CHANNEL SPACING: 10 MHz

| Frequency, MHz | RF Output power | | | | Total EIRP, dBm* | EIRP, dBm/10MHz** | Limit, dBm/ 10 MHz | Margin, dB*** | Verdict |
|---|---|---|---|---|---|---|---|---|---|
| | Chain RF#1, dBm | Chain RF#2, dBm | Chain RF#3, dBm | Chain RF#4, dBm | | | | | |
| **Modulation QPSK** | | | | | | | | | |
| 3555.0 | 28.50 | 28.80 | 28.36 | 28.66 | 46.80 | 46.80 | 47.0 | -0.2 | Pass |
| 3625.0 | 28.00 | 28.50 | 28.49 | 28.80 | 46.80 | 46.80 | 47.0 | -0.2 | Pass |
| 3695.0 | 28.52 | 28.48 | 28.99 | 28.00 | 46.99 | 46.99 | 47.0 | -0.01 | Pass |
| **Modulation 16QAM** | | | | | | | | | |
| 3555.0 | 28.40 | 28.97 | 28.80 | 28.85 | 46.97 | 46.97 | 47.0 | -0.03 | Pass |
| 3625.0 | 28.00 | 28.55 | 28.49 | 28.75 | 46.75 | 46.75 | 47.0 | -0.25 | Pass |
| 3695.0 | 28.70 | 28.48 | 28.30 | 28.70 | 46.70 | 46.70 | 47.0 | -0.3 | Pass |
| **Modulation 64QAM** | | | | | | | | | |
| 3555.0 | 28.65 | 28.90 | 28.80 | 28.60 | 46.90 | 46.90 | 47.0 | -0.1 | Pass |
| 3625.0 | 28.45 | 28.45 | 28.30 | 28.60 | 46.60 | 46.60 | 47.0 | -0.4 | Pass |
| 3695.0 | 28.92 | 28.83 | 28.75 | 28.55 | 46.92 | 46.92 | 47.0 | -0.08 | Pass |

* - Total EIRP = Max SA reading (Chains #1&2and #3&4) + Antenna gain
** - EIRP dBm/10MHz = Total EIRP, dBm + 10*log[10 MHz/OBW(MHz)
*** - Margin = EIRP, dBm/10MHz – specification limit.

CHANNEL SPACING: 20 MHz

| Frequency, MHz | RF Output power | | | | Total EIRP, dBm* | EIRP dBm/10MHz** | Limit, dBm/ 10 MHz | Margin, dB | Verdict |
|---|---|---|---|---|---|---|---|---|---|
| | Chain RF#1, dBm | Chain RF#2, dBm | Chain RF#3, dBm | Chain RF#4, dBm | | | | | |
| | **Modulation QPSK** | | | | | | | | |
| 3560.0 | 32.00 | 31.75 | 31.80 | 32.00 | 50.00 | 47.00 | 47.00 | 0 | Pass |
| 3625.0 | 31.97 | 31.30 | 32.00 | 31.95 | 50.00 | 47.00 | 47.00 | 0 | Pass |
| 3690.0 | 31.40 | 31.70 | 31.70 | 31.60 | 49.70 | 46.70 | 47.00 | -0.30 | Pass |
| | **Modulation 16QAM** | | | | | | | | |
| 3560.0 | 31.95 | 31.80 | 32.00 | 31.95 | 50.00 | 47.00 | 47.00 | 0 | Pass |
| 3625.0 | 31.98 | 31.40 | 32.00 | 32.00 | 50.00 | 47.00 | 47.00 | 0 | Pass |
| 3690.0 | 31.50 | 31.82 | 31.90 | 31.60 | 49.90 | 46.90 | 47.00 | -0.10 | Pass |
| | **Modulation 64QAM** | | | | | | | | |
| 3560.0 | 32.00 | 31.88 | 32.00 | 32.00 | 50.00 | 47.00 | 47.00 | 0 | Pass |
| 3625.0 | 32.00 | 31.35 | 31.83 | 31.99 | 50.00 | 47.00 | 47.00 | 0 | Pass |
| 3690.0 | 31.60 | 31.82 | 31.97 | 31.66 | 49.97 | 46.97 | 47.00 | -0.03 | Pass |

* - Total EIRP = Max SA reading (Chains #1&2and #3&4) + Antenna gain
** - EIRP dBm/10MHz = Total EIRP, dBm + 10*log[10 MHz/OBW(MHz)
*** - Margin = EIRP, dBm/10MHz – specification limit.

| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

**Table 7.1.4 Peak spectral power density test results**

ASSIGNED FREQUENCY RANGE: 3550.0 – 3700.0 MHz
DETECTOR USED: Average (gated)
VIDEO BANDWIDTH: ≥ Resolution bandwidth
NUMBER OF CHAINS: 2

| Frequency, MHz | RF Output power | | | | Total PSD*, dBm | Limit, dBm/10 MHz | Margin, dB | Verdict |
|---|---|---|---|---|---|---|---|---|
| | Chain RF#1, dBm | Chain RF#2, dBm | Chain RF#3, dBm | Chain RF#4, dBm | | | | |
| **Channel Spacing 10 MHz** | | | | | | | | |
| **Modulation QPSK** | | | | | | | | |
| 3555.0 | 19.74 | 20.22 | 19.66 | 20.18 | 23.22 | 37 | -13.78 | Pass |
| 3625.0 | 19.14 | 19.64 | 19.67 | 19.88 | 22.88 | 37 | -14.12 | Pass |
| 3695.0 | 19.54 | 19.43 | 20.25 | 19.11 | 23.25 | 37 | -13.75 | Pass |
| **Modulation 16QAM** | | | | | | | | |
| 3555.0 | 19.61 | 20.32 | 19.82 | 20.23 | 23.32 | 37 | -13.68 | Pass |
| 3625.0 | 19.10 | 19.75 | 19.12 | 19.31 | 22.75 | 37 | -14.25 | Pass |
| 3695.0 | 19.77 | 20.10 | 19.47 | 19.98 | 23.10 | 37 | -13.90 | Pass |
| **Modulation 64QAM** | | | | | | | | |
| 3555.0 | 20.17 | 20.07 | 20.14 | 20.05 | 23.17 | 37 | -13.83 | Pass |
| 3625.0 | 19.60 | 19.88 | 19.14 | 19.95 | 22.95 | 37 | -14.05 | Pass |
| 3695.0 | 20.42 | 19.98 | 20.42 | 19.65 | 23.42 | 37 | -13.58 | Pass |
| **Channel Spacing 20 MHz** | | | | | | | | |
| **Modulation QPSK** | | | | | | | | |
| 3560.0 | 20.57 | 20.21 | 20.29 | 20.78 | 23.78 | 37 | -13.22 | Pass |
| 3625.0 | 19.87 | 19.37 | 20.35 | 20.39 | 23.39 | 37 | -13.61 | Pass |
| 3690.0 | 20.37 | 20.15 | 20.64 | 20.11 | 23.64 | 37 | -13.36 | Pass |
| **Modulation 16QAM** | | | | | | | | |
| 3560.0 | 20.51 | 20.73 | 20.98 | 20.69 | 23.98 | 37 | -13.02 | Pass |
| 3625.0 | 20.31 | 19.76 | 20.47 | 20.43 | 23.47 | 37 | -13.53 | Pass |
| 3690.0 | 20.10 | 20.15 | 20.49 | 19.93 | 23.49 | 37 | -13.51 | Pass |
| **Modulation 64QAM** | | | | | | | | |
| 3560.0 | 19.74 | 20.21 | 20.80 | 20.48 | 23.80 | 37 | -13.20 | Pass |
| 3625.0 | 20.53 | 19.94 | 20.27 | 19.92 | 23.53 | 37 | -13.47 | Pass |
| 3690.0 | 20.10 | 20.26 | 20.39 | 20.13 | 23.39 | 37 | -13.61 | Pass |

* - Total PSD = Max SA reading (Chains #1&2 or chains #3&4) + 10*log(N) = Max SA reading +3 dB
** - Margin = Total PSD, dBm – specification limit.

**Reference numbers of test equipment used**

| HL 3301 | HL 3302 | HL 4366 | HL 5409 | HL 5376 | |
|---|---|---|---|---|---|

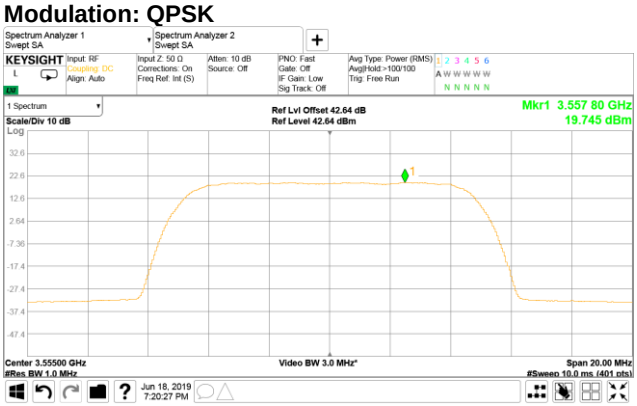
Full description is given in Appendix A.

| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

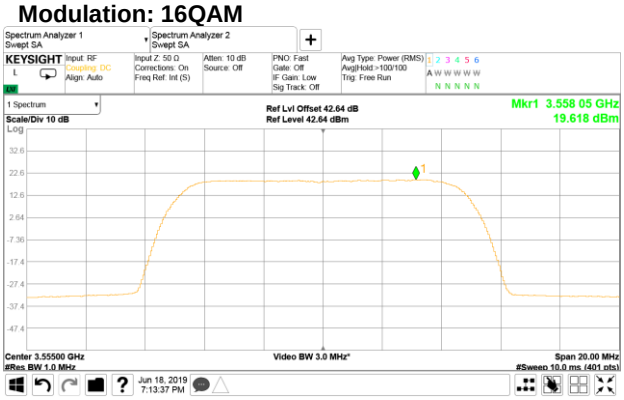
**Plot 7.1.1 Peak spectral power density at low frequency**

CHANNEL SPACING: 10 MHz
ANTENNA CHAIN: 1

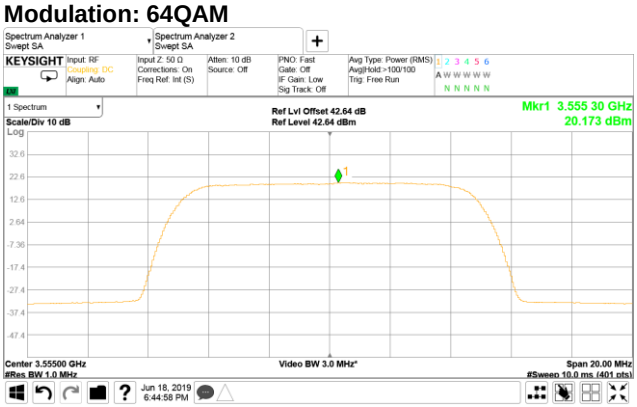
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**



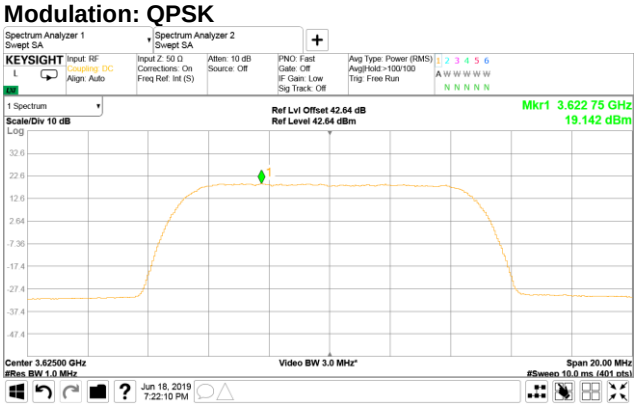

Spectrum Offset = Attenuator + Coupler loss + DC factor = 30+10+2.64 = 42.64 (dB)

| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

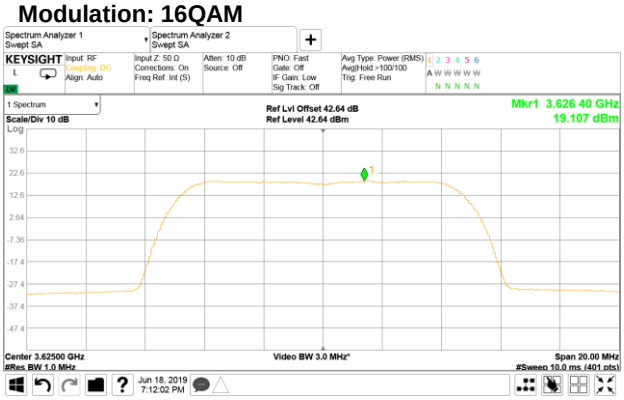
**Plot 7.1.2 Peak spectral power density at mid frequency**

CHANNEL SPACING: 10 MHz
ANTENNA CHAIN: 1

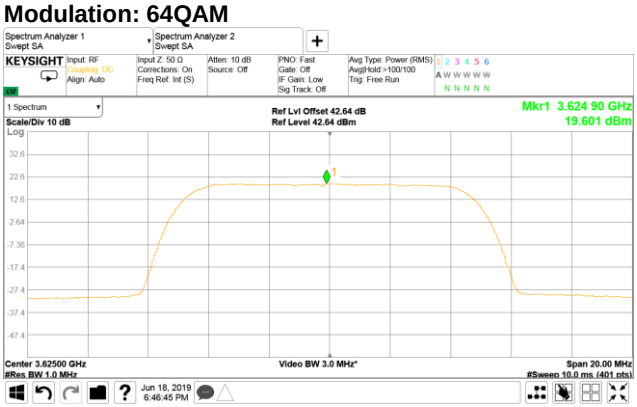
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**



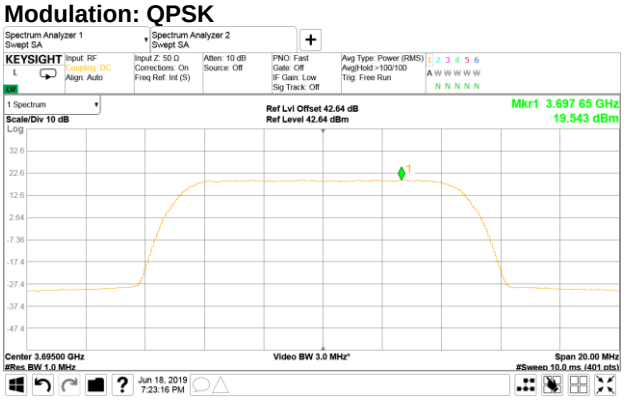

Spectrum Offset = Attenuator + Coupler loss + DC factor = 30+10+2.64 = 42.64 (dB)

| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

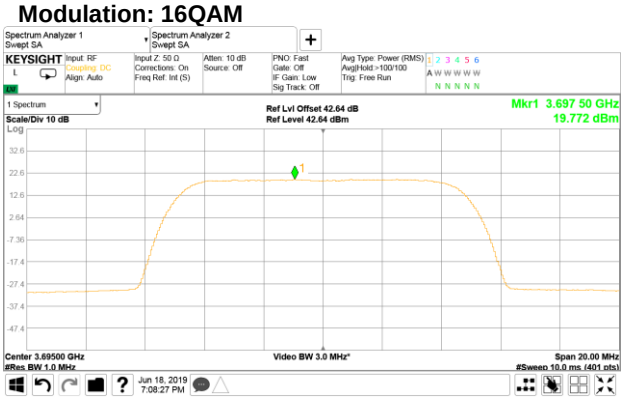
**Plot 7.1.3 Peak spectral power density at high frequency**

HANNEL SPACING: 10 MHz
ANTENNA CHAIN: 1

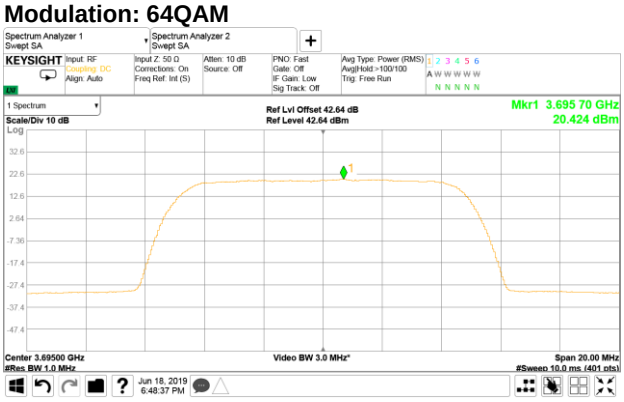
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**



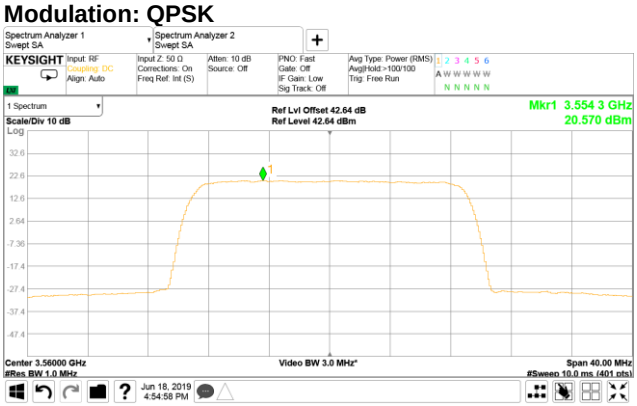

Spectrum Offset = Attenuator + Coupler loss + DC factor = 30+10+2.64 = 42.64 (dB)

| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

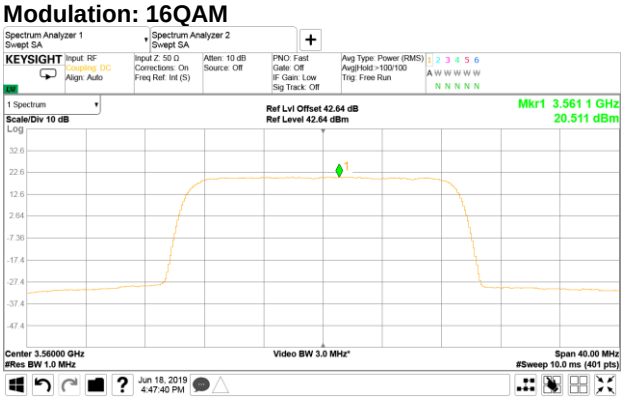
**Plot 7.1.4 Peak spectral power density at low frequency**

CHANNEL SPACING: 20 MHz
ANTENNA CHAIN: 1

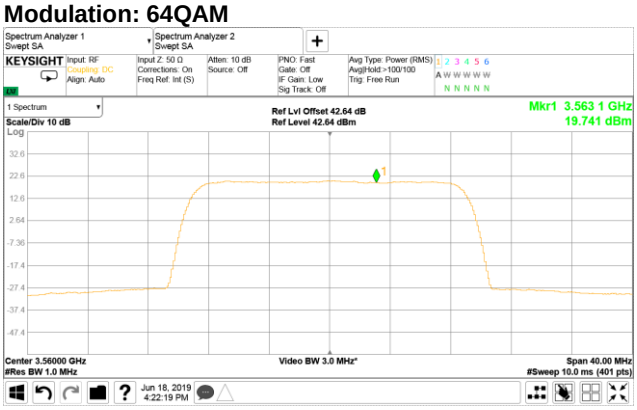
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

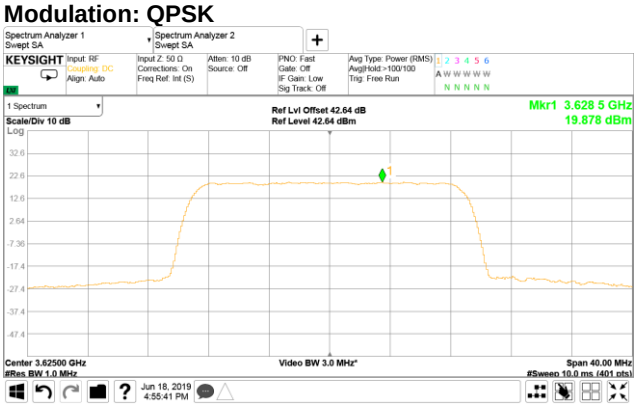


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

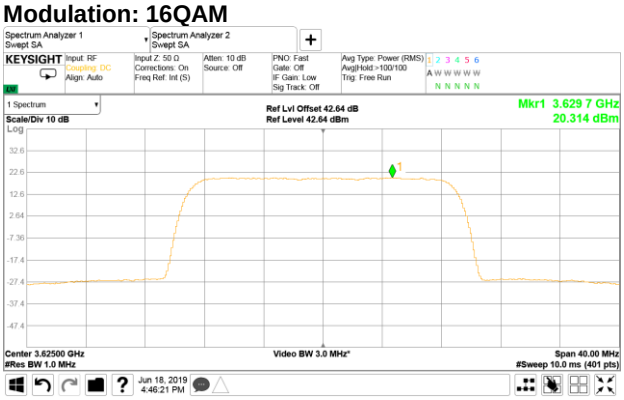
**Plot 7.1.5 Peak spectral power density at mid frequency**

CHANNEL SPACING: 20 MHz
ANTENNA CHAIN: 1

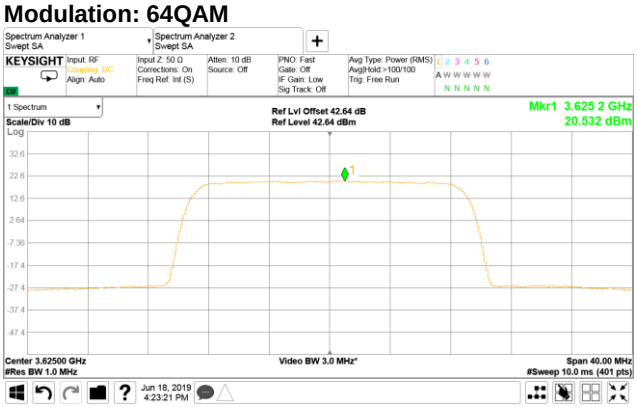
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

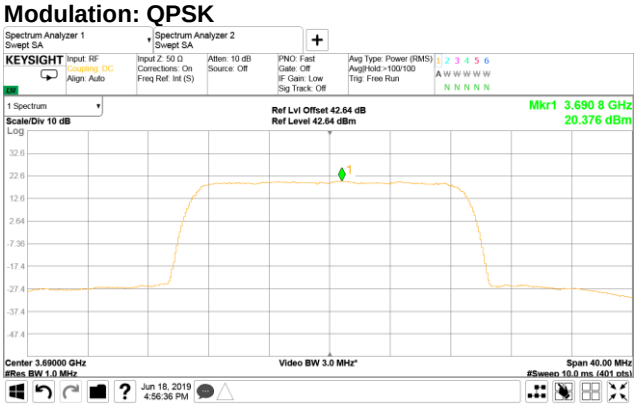


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

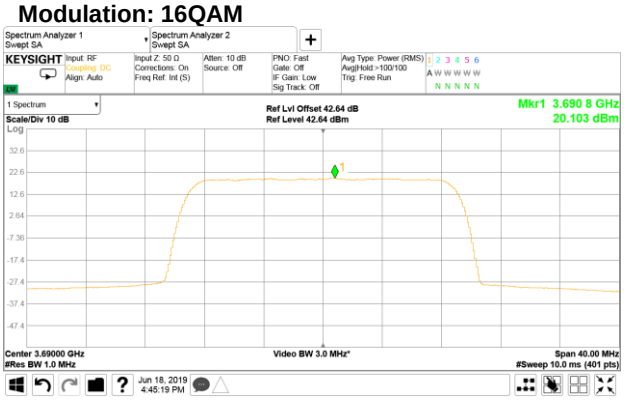
**Plot 7.1.6 Peak spectral power density at high frequency**

CHANNEL SPACING: 20 MHz
ANTENNA CHAIN: 1

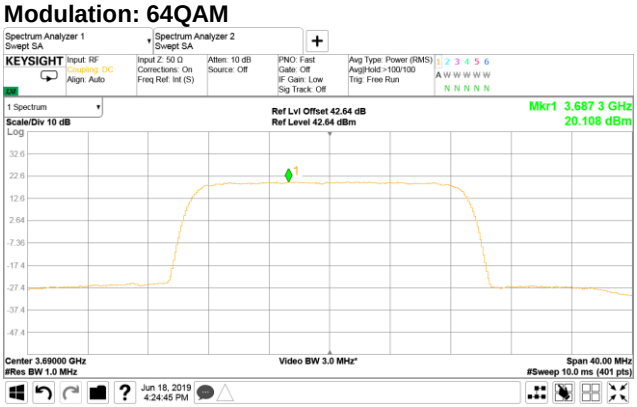
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

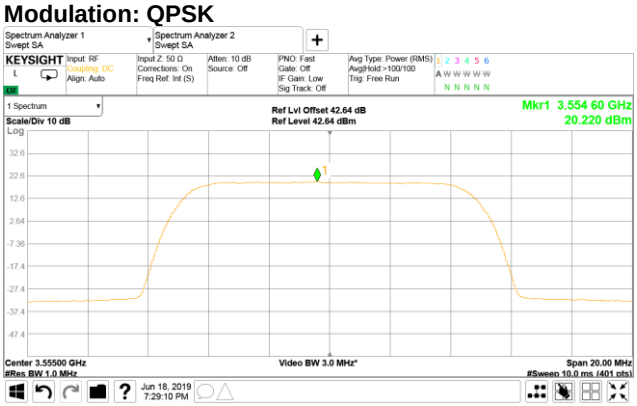


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

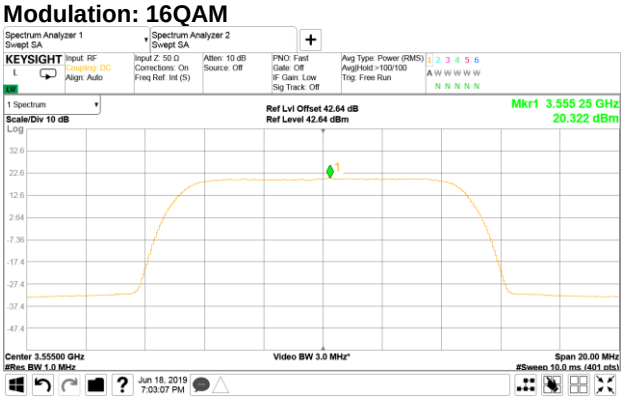
**Plot 7.1.7 Peak spectral power density at low frequency**

CHANNEL SPACING: 10 MHz
ANTENNA CHAIN: 2

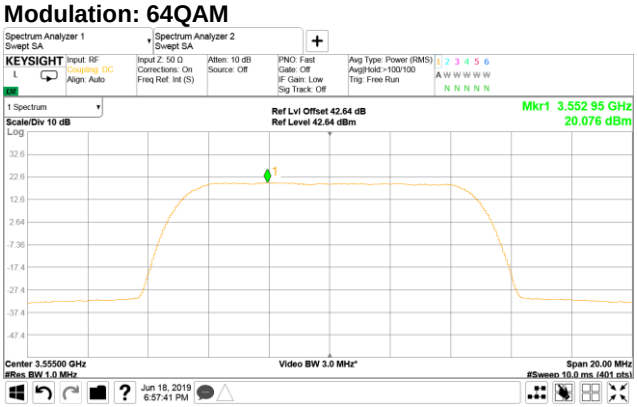
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

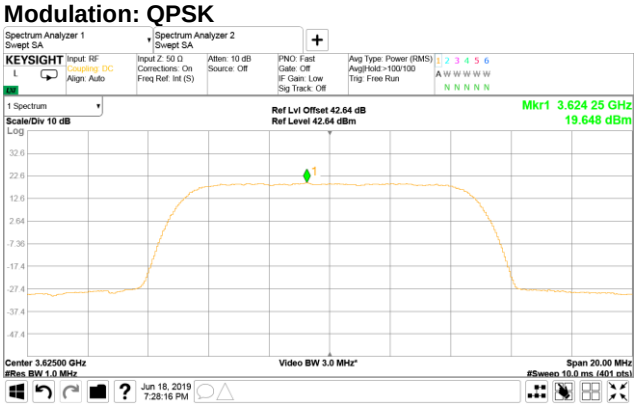


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

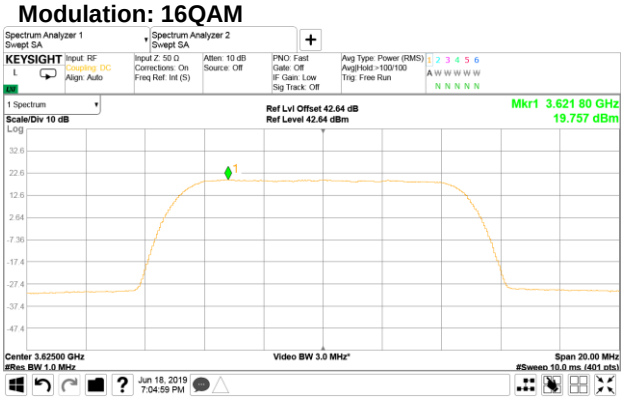
**Plot 7.1.8 Peak spectral power density at mid frequency**

CHANNEL SPACING: 10 MHz
ANTENNA CHAIN: 2

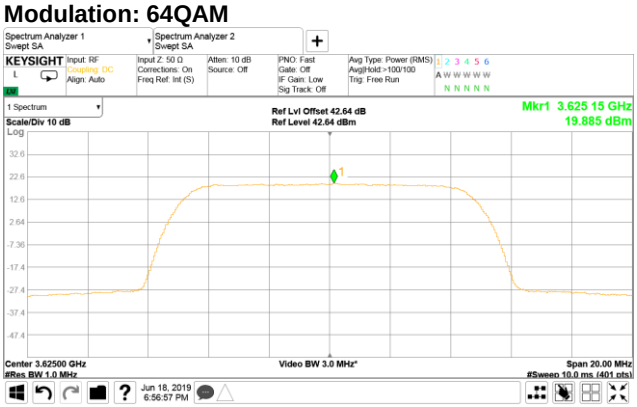
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

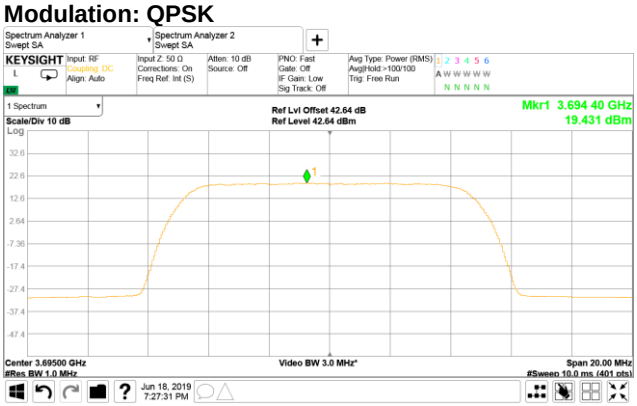


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

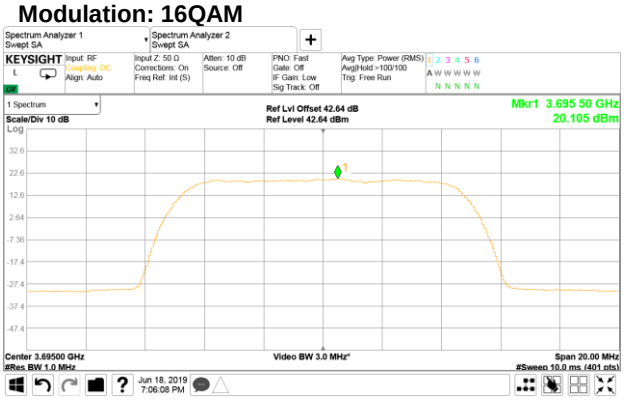
**Plot 7.1.9 Peak spectral power density at high frequency**

HANNEL SPACING: 10 MHz
ANTENNA CHAIN: 2

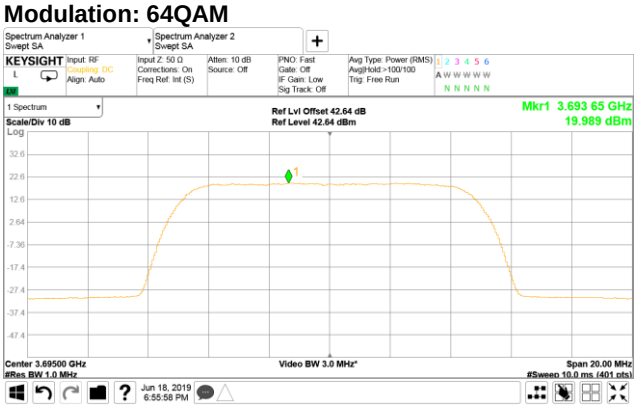
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

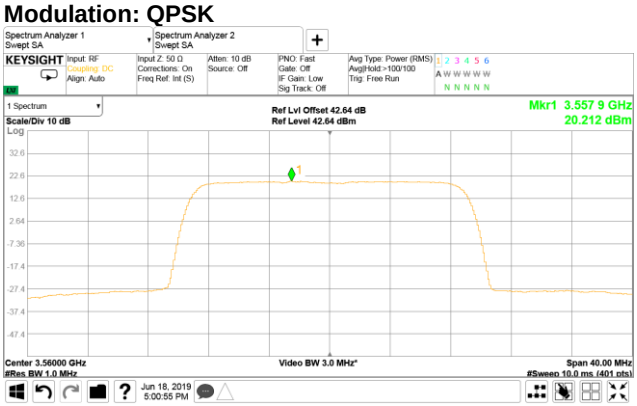


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

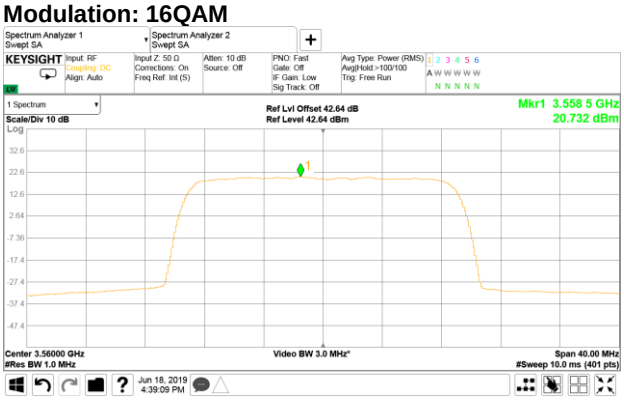
**Plot 7.1.10 Peak spectral power density at low frequency**

CHANNEL SPACING: 20 MHz
ANTENNA CHAIN: 2

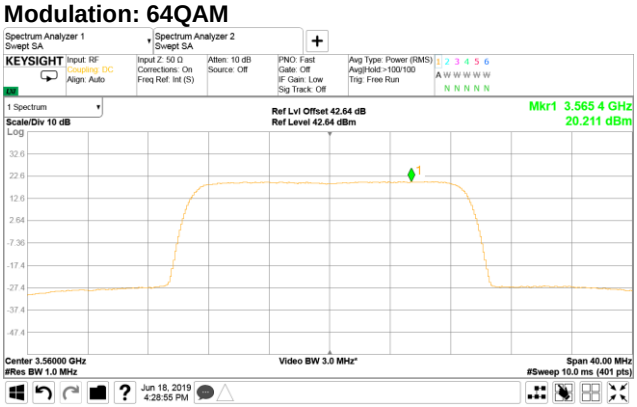
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

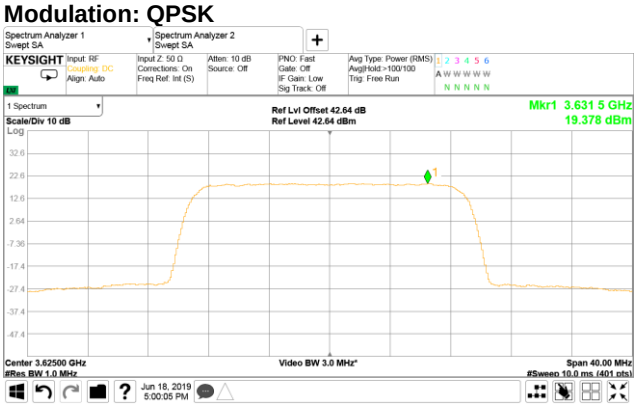


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

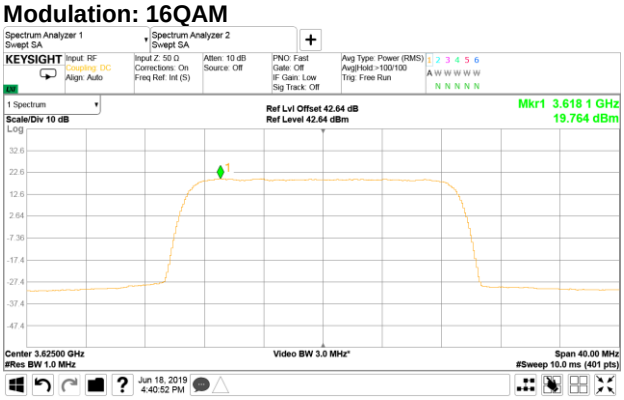
**Plot 7.1.11 Peak spectral power density at mid frequency**

CHANNEL SPACING: 20 MHz
ANTENNA CHAIN: 2

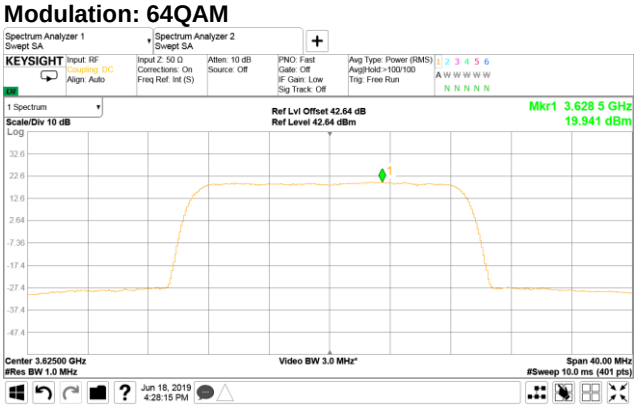
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

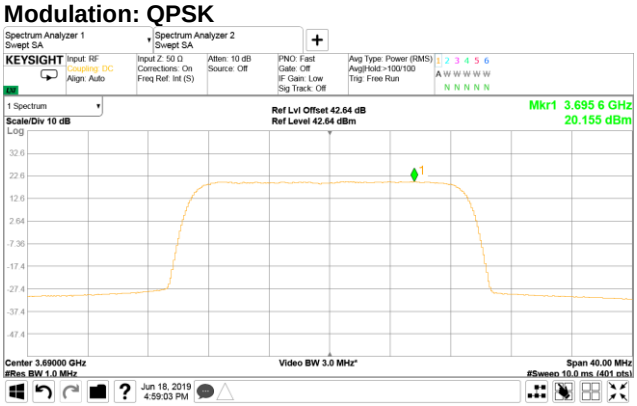


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

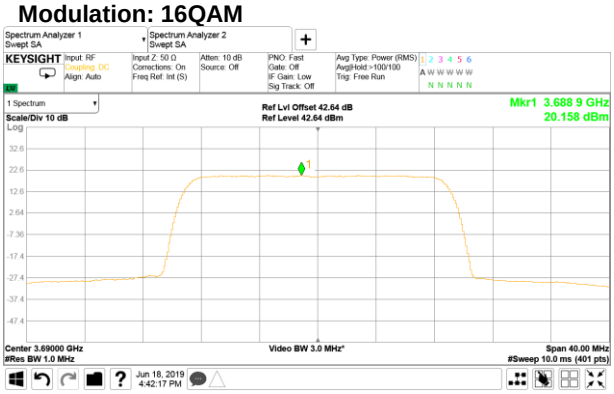
**Plot 7.1.12 Peak spectral power density at high frequency**

CHANNEL SPACING: 20 MHz
ANTENNA CHAIN: 2

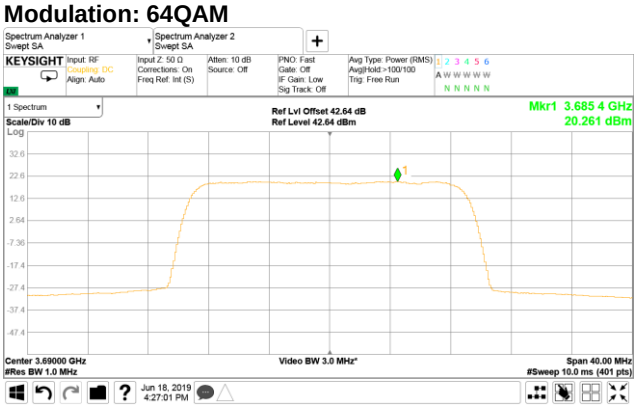
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

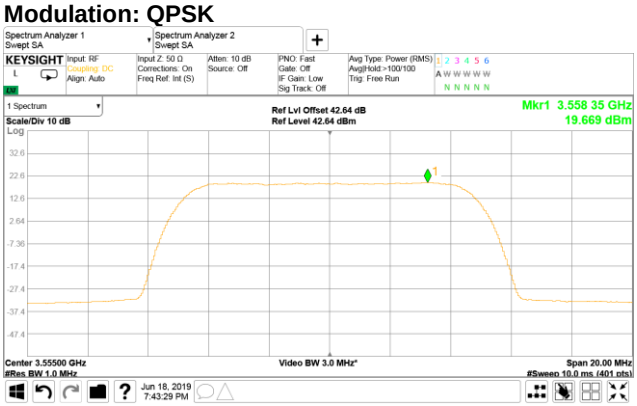


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

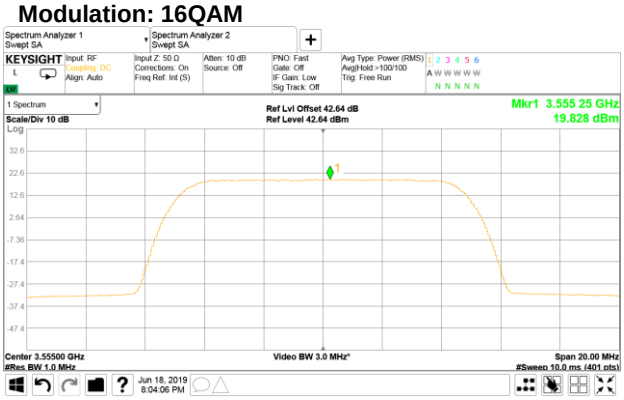
**Plot 7.1.13 Peak spectral power density at low frequency**

CHANNEL SPACING: 10 MHz
ANTENNA CHAIN: 3

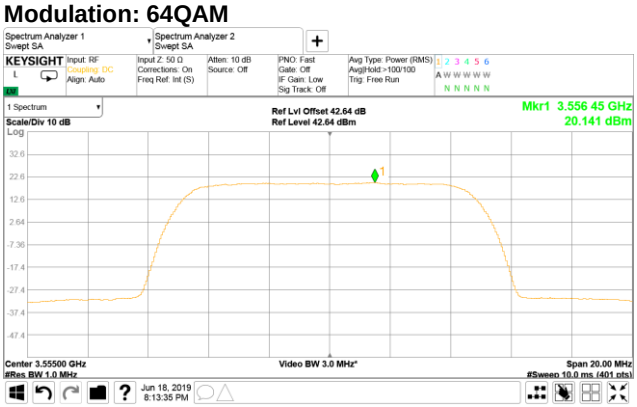
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

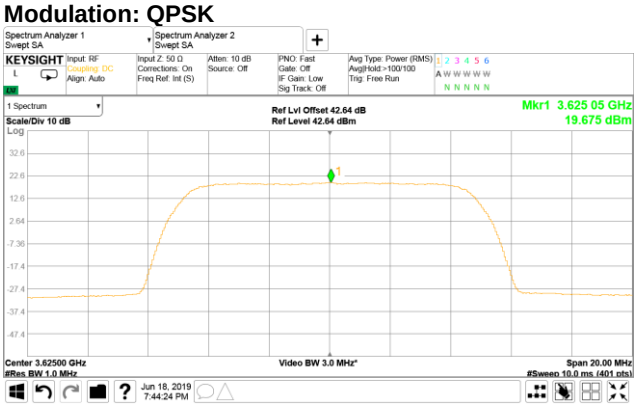


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

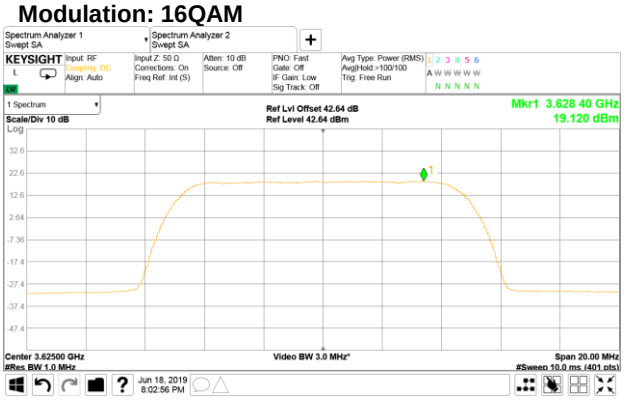
**Plot 7.1.14 Peak spectral power density at mid frequency**

CHANNEL SPACING: 10 MHz
ANTENNA CHAIN: 3

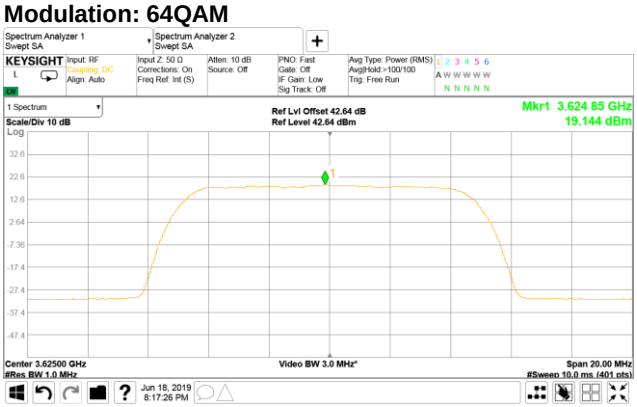
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

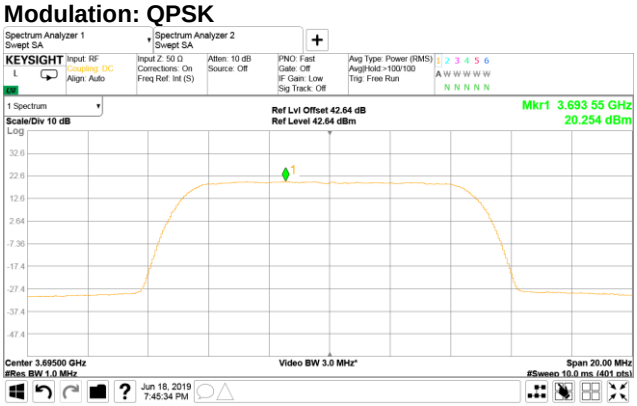


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

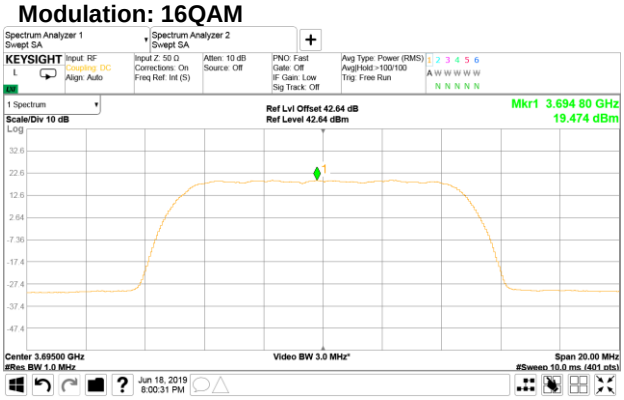
**Plot 7.1.15 Peak spectral power density at high frequency**

HANNEL SPACING: 10 MHz
ANTENNA CHAIN: 3

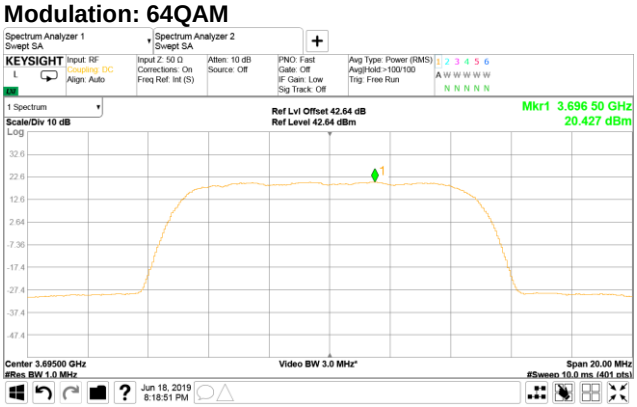
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

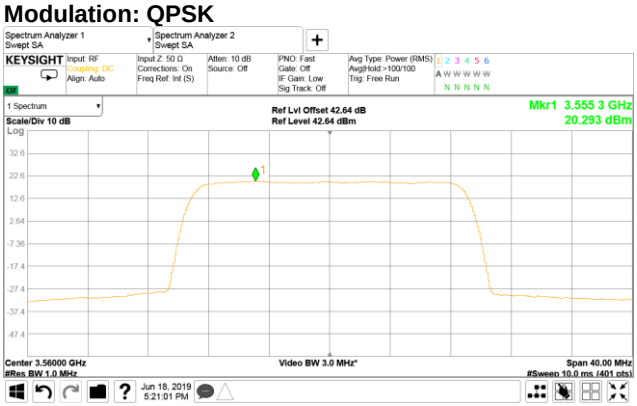


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

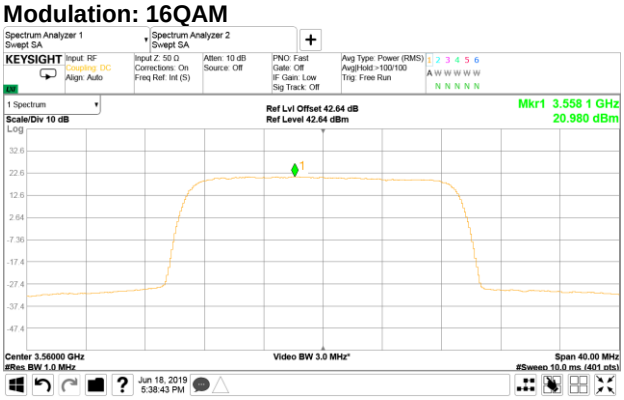
**Plot 7.1.16 Peak spectral power density at low frequency**

CHANNEL SPACING: 20 MHz
ANTENNA CHAIN: 3

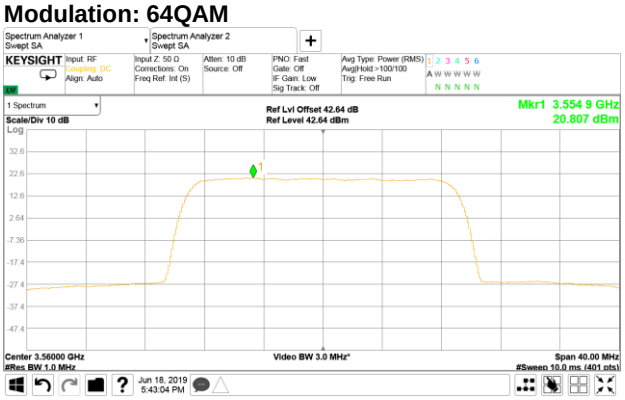
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

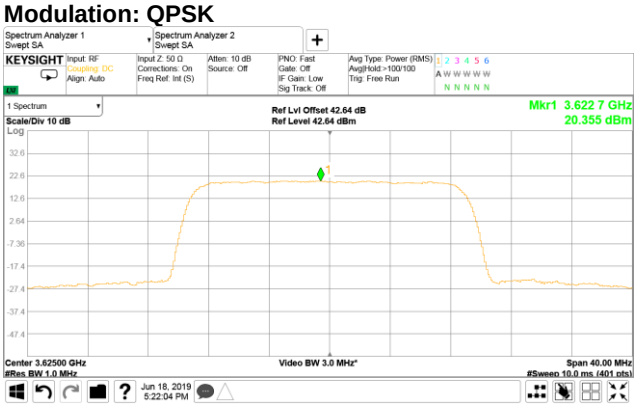


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

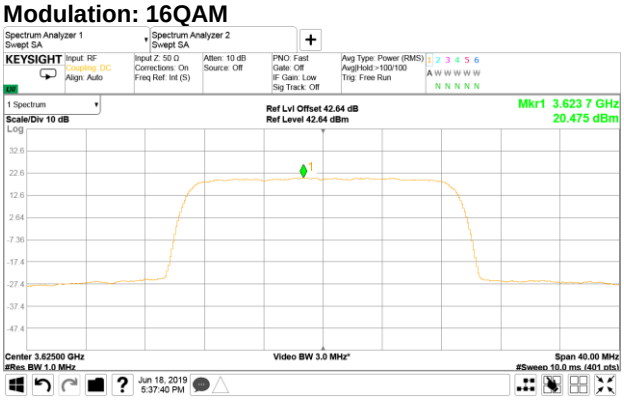
**Plot 7.1.17 Peak spectral power density at mid frequency**

CHANNEL SPACING: 20 MHz
ANTENNA CHAIN: 3

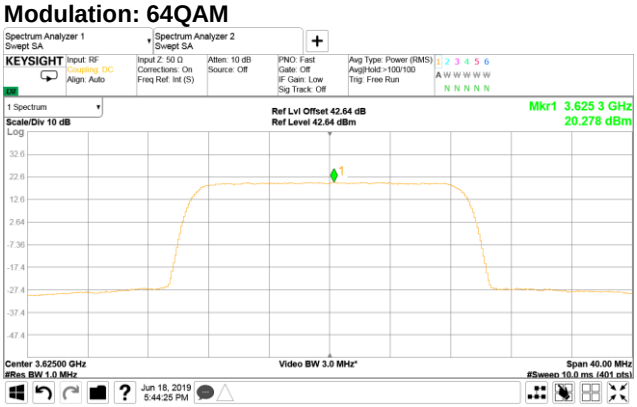
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

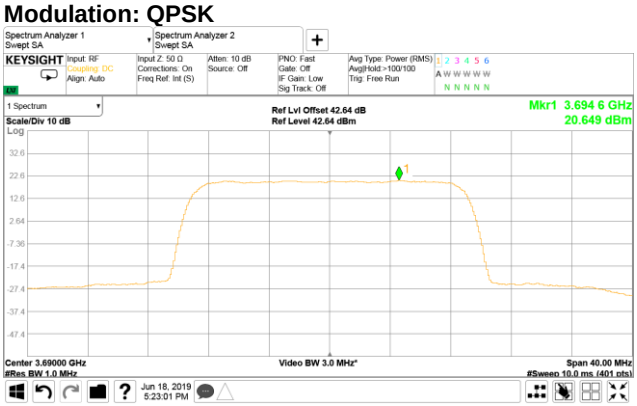


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

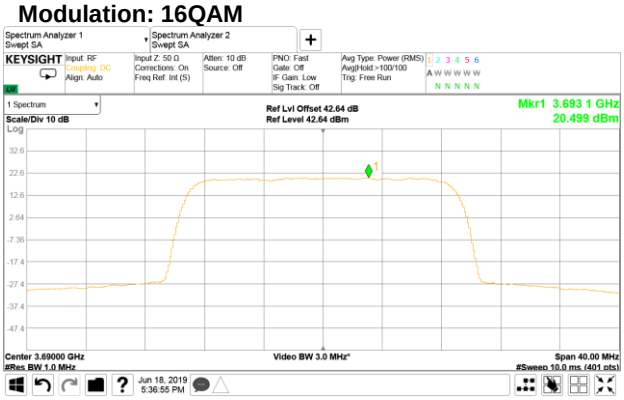
**Plot 7.1.18 Peak spectral power density at high frequency**

CHANNEL SPACING: 20 MHz
ANTENNA CHAIN: 3

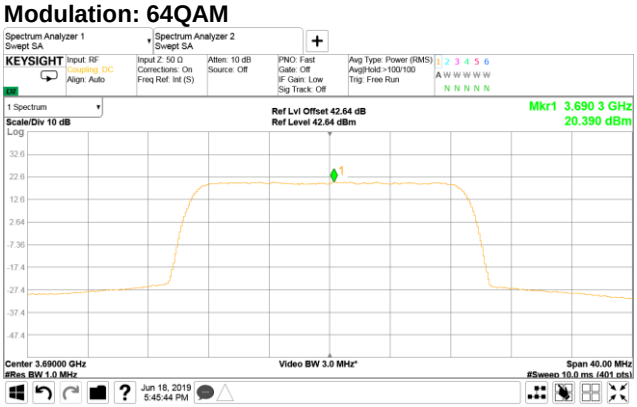
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

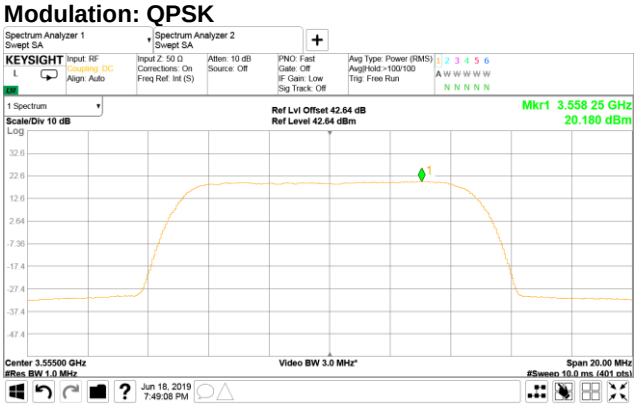


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

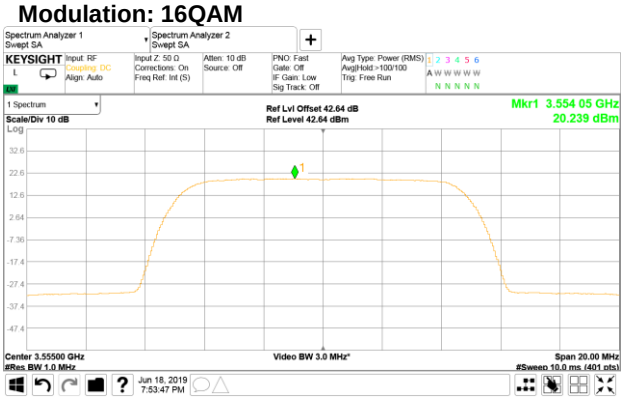
**Plot 7.1.19 Peak spectral power density at low frequency**

CHANNEL SPACING: 10 MHz
ANTENNA CHAIN: 4

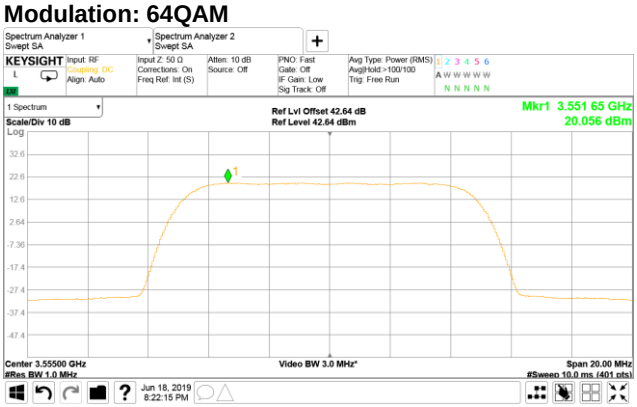
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

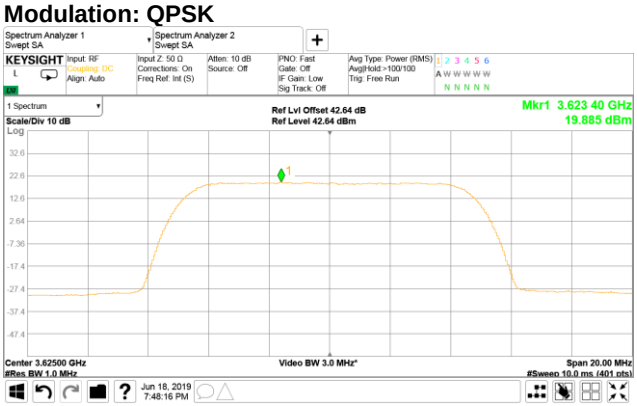


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

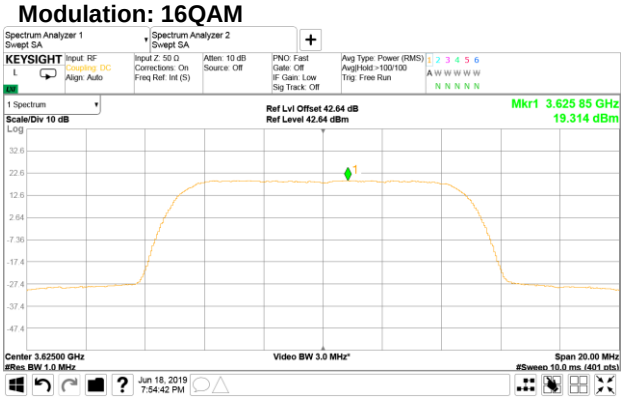
**Plot 7.1.20 Peak spectral power density at mid frequency**

CHANNEL SPACING: 10 MHz
ANTENNA CHAIN: 4

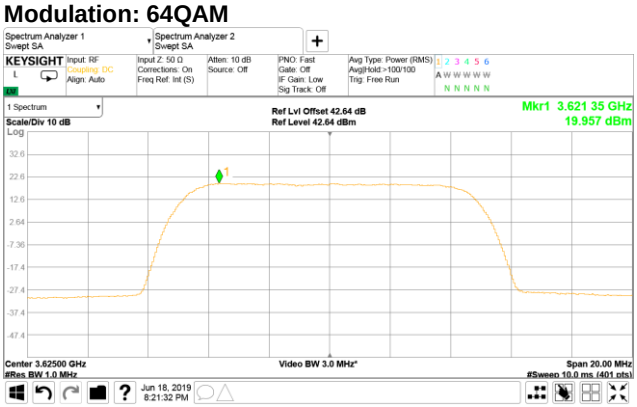
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

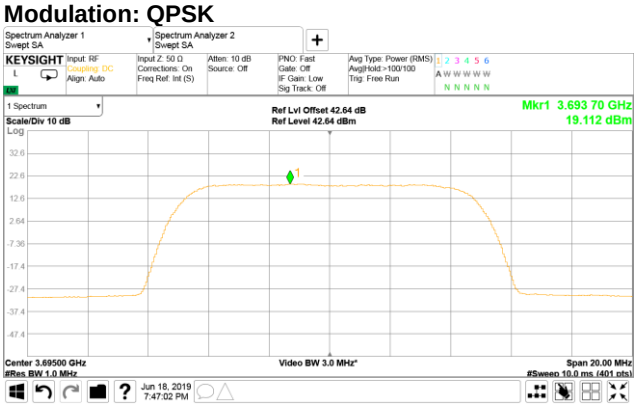


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

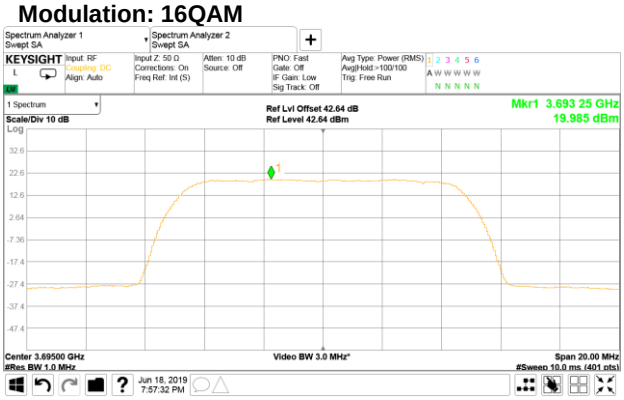
**Plot 7.1.21 Peak spectral power density at high frequency**

HANNEL SPACING: 10 MHz
ANTENNA CHAIN: 4

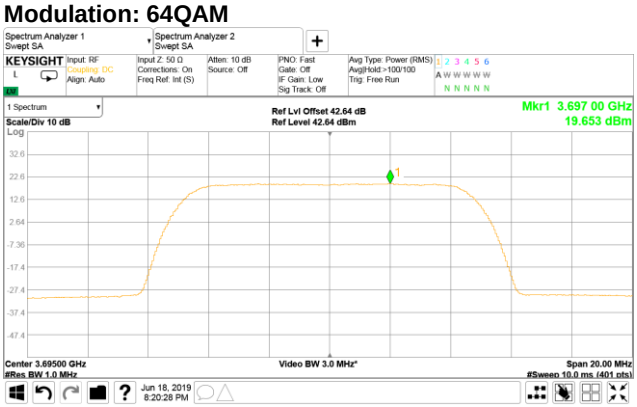
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

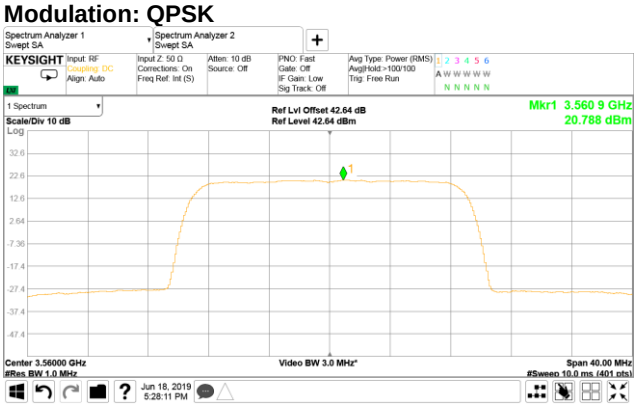


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

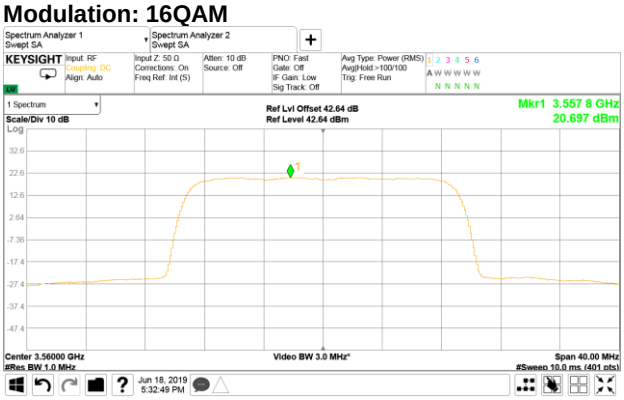
**Plot 7.1.22 Peak spectral power density at low frequency**

CHANNEL SPACING: 20 MHz
ANTENNA CHAIN: 4

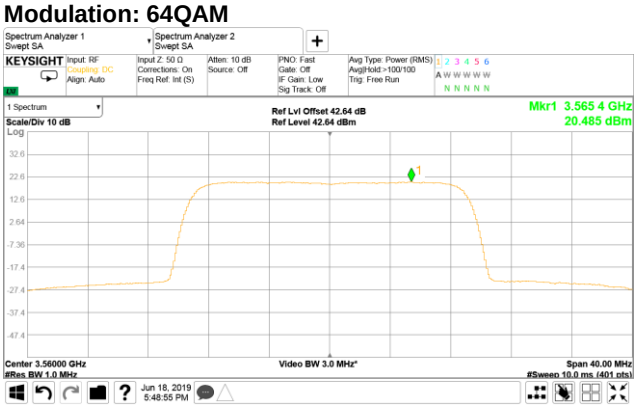
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

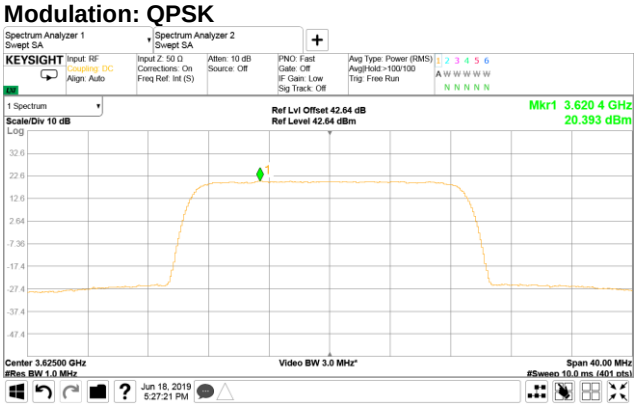


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

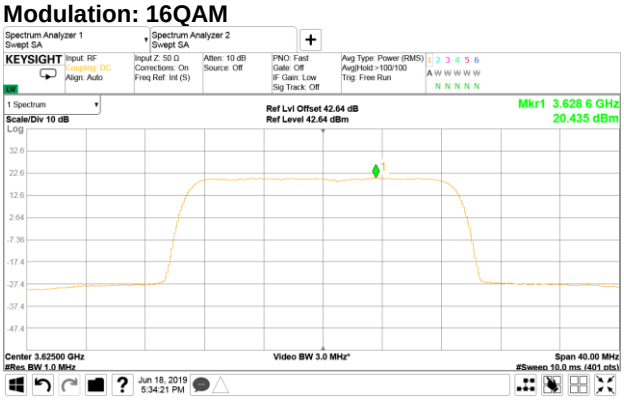
**Plot 7.1.23 Peak spectral power density at mid frequency**

CHANNEL SPACING: 20 MHz
ANTENNA CHAIN: 4

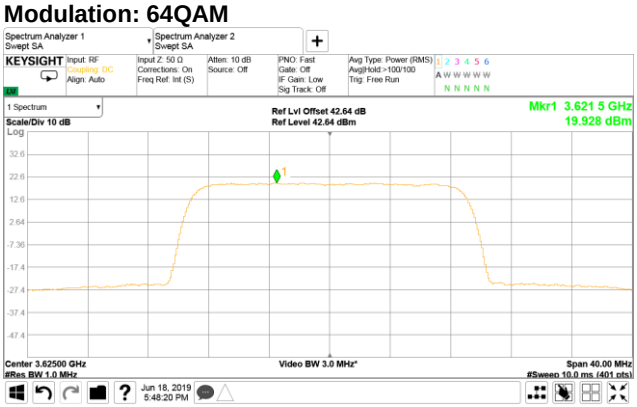
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**

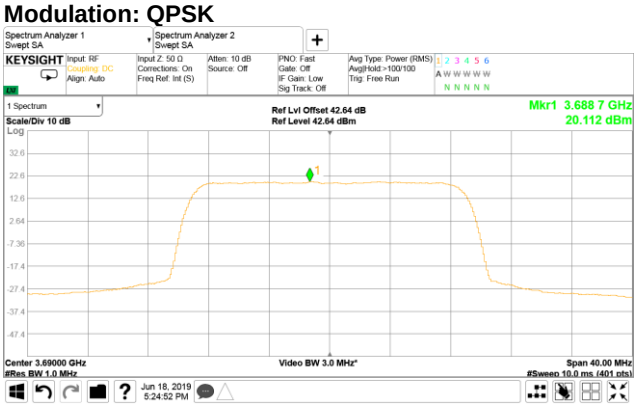


| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

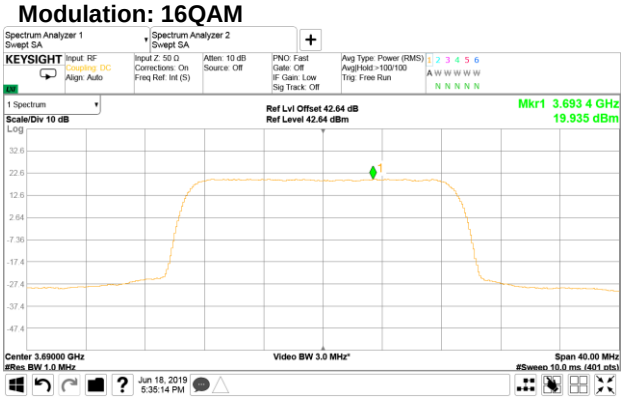
**Plot 7.1.24 Peak spectral power density at high frequency**

CHANNEL SPACING: 20 MHz
ANTENNA CHAIN: 4

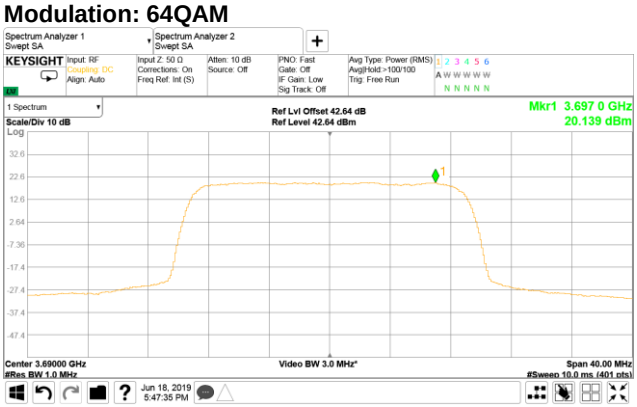
**Modulation: QPSK**




**Modulation: 16QAM**




**Modulation: 64QAM**



| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

## 7.2 Emission mask test

### 7.2.1 General

This test was performed to measure emission mask at RF antenna connector. Specification test limits are given in Table 7.2.1.

**Table 7.2.1 Emission mask limits**

| Frequency displacement from frequency block | Limit*, dBm/MHz | RBW, kHz |
|---|---|---|
| **Channel Spacing 10 MHz** | | |
| 0 – 1 MHz | - 13 | 100 |
| 0 – 10 MHz | - 13 | 1000 |
| 10 – 20 MHz | - 25 | 1000 |
| Above 3530 MHz and below 3720 MHz | - 25 | 1000 |
| Below 3530 MHz and above 3720 MHz | - 40 | 1000 |
| **Channel Spacing 20 MHz** | | |
| 0 – 1 MHz | - 13 | 200 |
| 0 – 10 MHz | - 13 | 1000 |
| 10 – 20 MHz | - 25 | 1000 |
| Above 3530 MHz and below 3720 MHz | - 25 | 1000 |
| Below 3530 MHz and above 3720 MHz | - 40 | 1000 |

* - Limit at each antenna connector (amount of antennas N = 2)

.

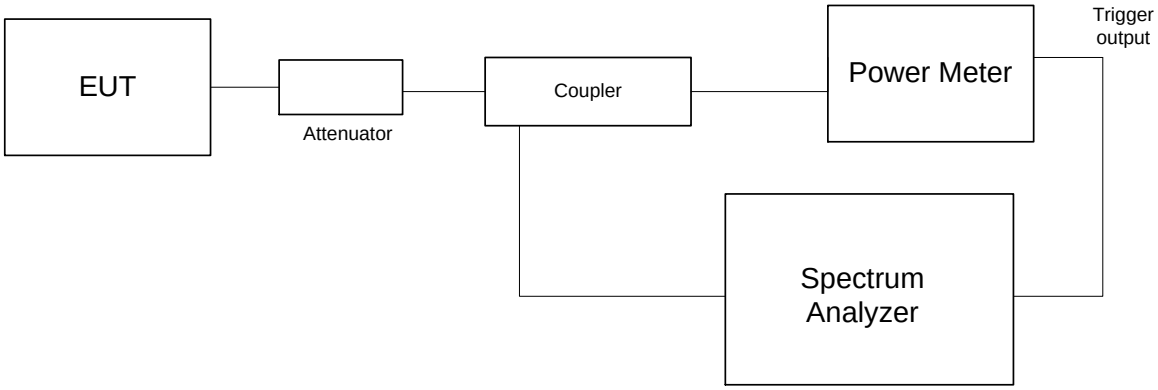
### 7.2.2 Test procedure

**7.2.2.1** The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

**7.2.2.2** The emission mask was measured with spectrum analyzer as provided in Table 7.2.2, Table 7.2.3 and the the associated plots.

| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

**Figure 7.2.1 Emission mask test setup**



| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

**Table 7.2.2 Emission mask test results, CS=10 MHz**

| Modulation | Carrier frequency, MHz | Frequency displacement from EA frequency block | Test result, dBm/MHz | Limit*, dBm/MHz | Verdict |
|---|---|---|---|---|---|
| QPSK | Mid | Within 0 to 10 MHz | -27.08 | -16.0 | Pass |
| | | Greater than 10 MHz | -37.54 | -28.0 | Pass |
| 16QAM | Mid | Within 0 to 10 MHz | -25.96 | -16.0 | Pass |
| | | Greater than 10 MHz | -36.98 | -28.0 | Pass |
| 64QAM | Mid | Within 0 to 10 MHz | -24.36 | -16.0 | Pass |
| | | Greater than 10 MHz | -37.60 | -28.0 | Pass |

*The limit was reduced by 10*log(N), where N=2 – is number of antennas.

**Table 7.2.3 Emission mask test results, CS=20 MHz**

| Modulation | Carrier frequency, MHz | Frequency displacement from EA frequency block | Test result dBm/MHz | Limit* dBm/MHz | Verdict |
|---|---|---|---|---|---|
| QPSK | Mid | Within 0 to 10 MHz | -28.90 | -16.0 | Pass |
| | | Greater than 10 MHz | -34.11 | -28.0 | Pass |
| 16QAM | Mid | Within 0 to 10 MHz | -28.02 | -16.0 | Pass |
| | | Greater than 10 MHz | -33.81 | -28.0 | Pass |
| 64QAM | Mid | Within 0 to 10 MHz | -25.30 | -16.0 | Pass |
| | | Greater than 10 MHz | -31.25 | -28.0 | Pass |

*The limit was reduced by 10*log(N), where N=2 – is number of antennas.

**Reference numbers of test equipment used**

| | | | | | |
|---|---|---|---|---|---|
| HL 5376 | HL 5409 | | | | |

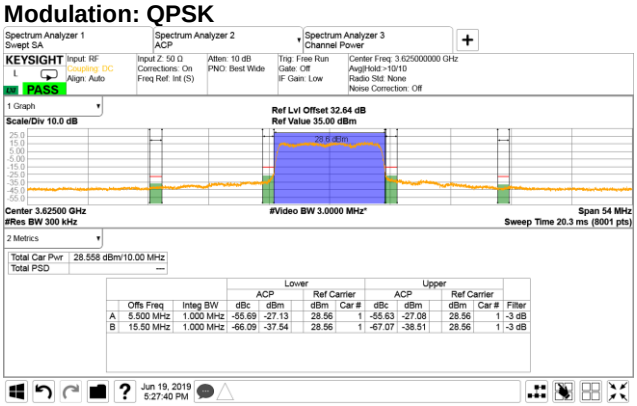
Full description is given in Appendix A.

| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

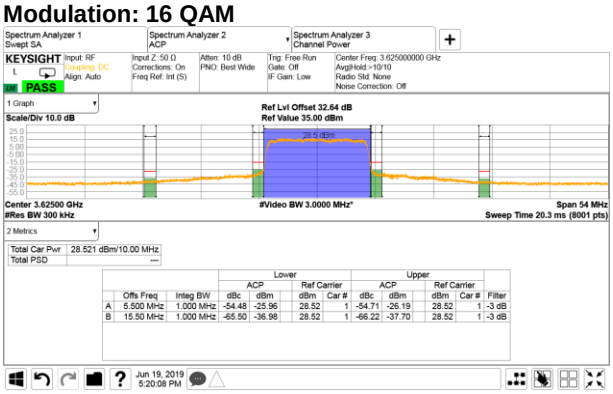
**Plot 7.2.1 Emission outside the fundamental test results at mid carrier frequency**

CHANNEL SPACING: 10 MHz
ANTENNA CHAIN: 4

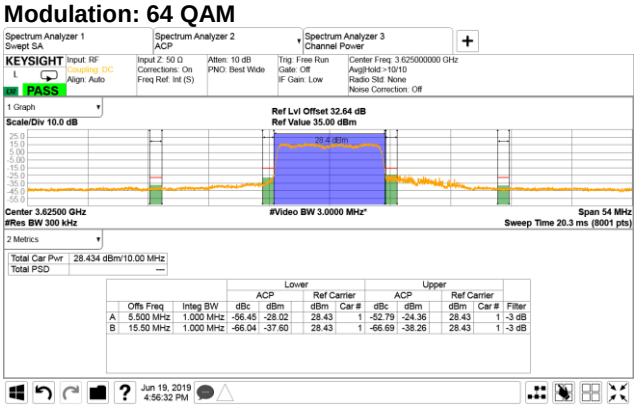
**Modulation: QPSK**




**Modulation: 16 QAM**




**Modulation: 64 QAM**



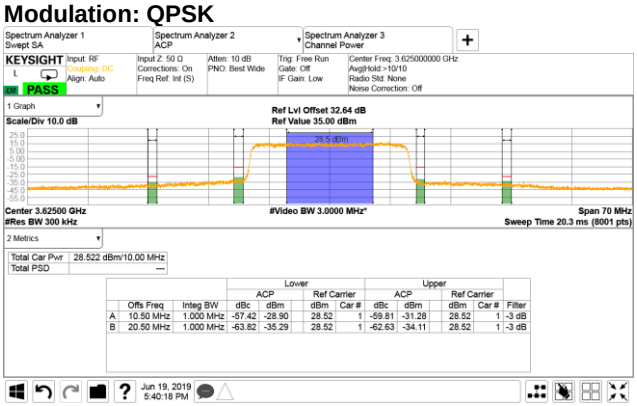

Spectrum Offset = Attenuator + DC factor = 30 + 2.64 = 32.64 dB

| Test specification: | Section 96.41(e), Emission mask | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 52 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

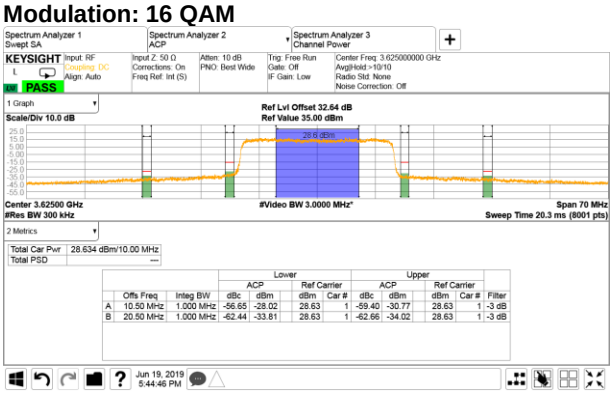
**Plot 7.2.2 Emission outside the fundamental test results at mid carrier frequency**

CHANNEL SPACING: 20 MHz
ANTENNA CHAIN: 4

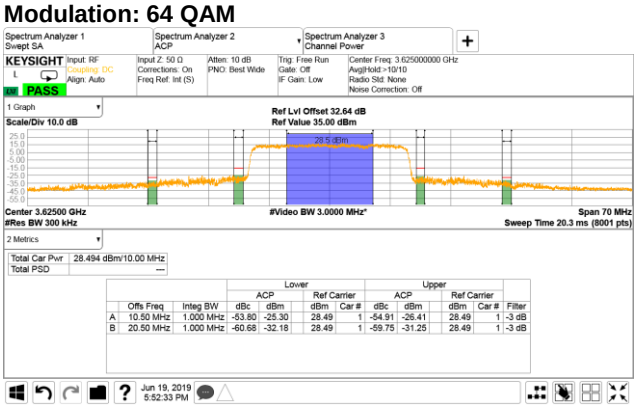
**Modulation: QPSK**




**Modulation: 16 QAM**




**Modulation: 64 QAM**




Spectrum Offset = Attenuator + DC factor = 30 + 2.64 = 32.64 dB

| Test specification: | Section 96.41(e)(3), Conducted spurious emissions | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 54 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

## 7.3 Spurious emissions at RF antenna connector test

### 7.3.1 General

This test was performed to measure spurious emissions at RF antenna connector. Specification test limits are given in Table 7.3.1.

**Table 7.3.1 Spurious emission limits**

| Frequency offset from channel band edge, MHz | Attenuation below carrier, dBc | ERP of spurious, dBm |
|---|---|---|
| 0 – 10 | NA | -13.0 |
| 10 – 20 | NA | -25.0 |
| More than 20 | NA | -40.0 |

* - spurious emission limits do not apply to the in band emission within ± 250 % of the authorized bandwidth from the carrier; investigated in course of emission mask testing
** - P is transmitter output power in Watts

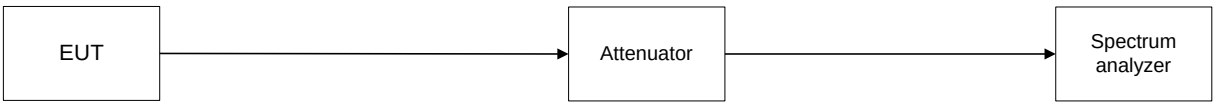
### 7.3.2 Test procedure

**7.3.2.1** The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.

**7.3.2.2** The EUT was adjusted to produce maximum available for end user RF output power.

**7.3.2.3** The spurious emission was measured with spectrum analyzer as provided in Table 7.3.2 and associated plots.

**Figure 7.3.1 Spurious emission test setup**



| Test specification: | Section 96.41(e)(3), Conducted spurious emissions | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 54 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

**Table 7.3.2 Spurious emission test results**

ASSIGNED FREQUENCY RANGE: 3550 - 3700 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 – 37000 MHz
DETECTOR USED: Peak
VIDEO BANDWIDTH: ≥ Resolution bandwidth
MODULATION: QPSK
MODULATING SIGNAL: PRBS
CHANNEL SPACING: 10 MHz
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

| Frequency, MHz | SA reading, dBm | Attenuator, dB | Cable loss, dB | RBW, kHz | Spurious emission, dBm | Attenuation below carrier, dBc | Limit, dBc | Margin, dB* | Verdict |
|---|---|---|---|---|---|---|---|---|---|
| **Low carrier frequency 3555 MHz** | | | | | | | | | |
| No emissions were found | | | | | | | | | Pass |
| **Mid carrier frequency 3625 MHz** | | | | | | | | | |
| No emissions were found | | | | | | | | | Pass |
| **High carrier frequency 3695 MHz** | | | | | | | | | |
| No emissions were found | | | | | | | | | Pass |

*****- Margin = Spurious emission – specification limit.

Note: in 0.009-18000 MHz range the offset 31.6 dB included: attenuator 30 dB, cables loss 1.6 dB
in 18-37 GHz range the offset 32.9 dB included: attenuator 30 dB, cables loss 2.9 dB

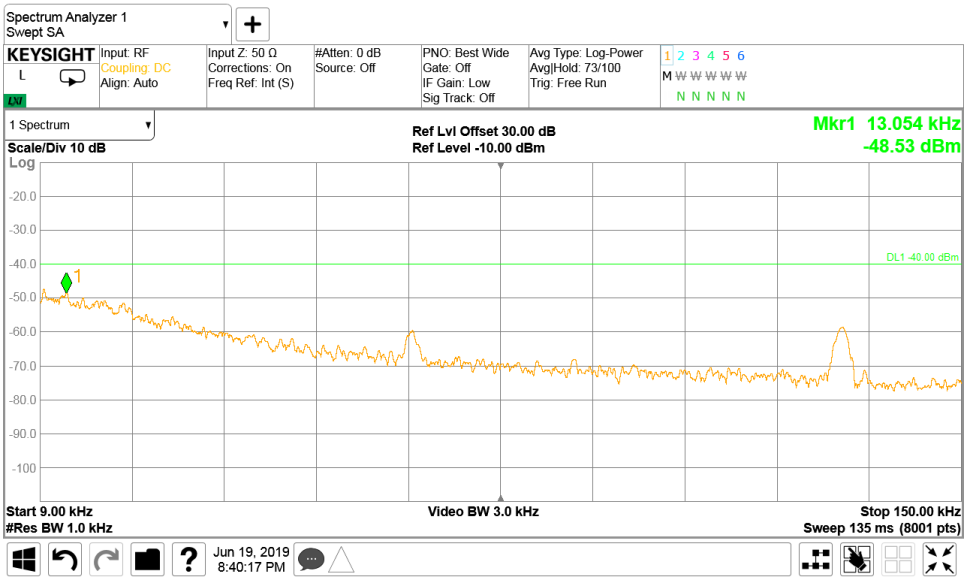
**Reference numbers of test equipment used**

| | | | | | |
|---|---|---|---|---|---|
| HL 4355 | HL 3818 | HL 3903 | HL 3434 | HL 4366 | HL 5286 |
| HL 3287 | HL 4342 | HL 5174 | HL 5175 | | |

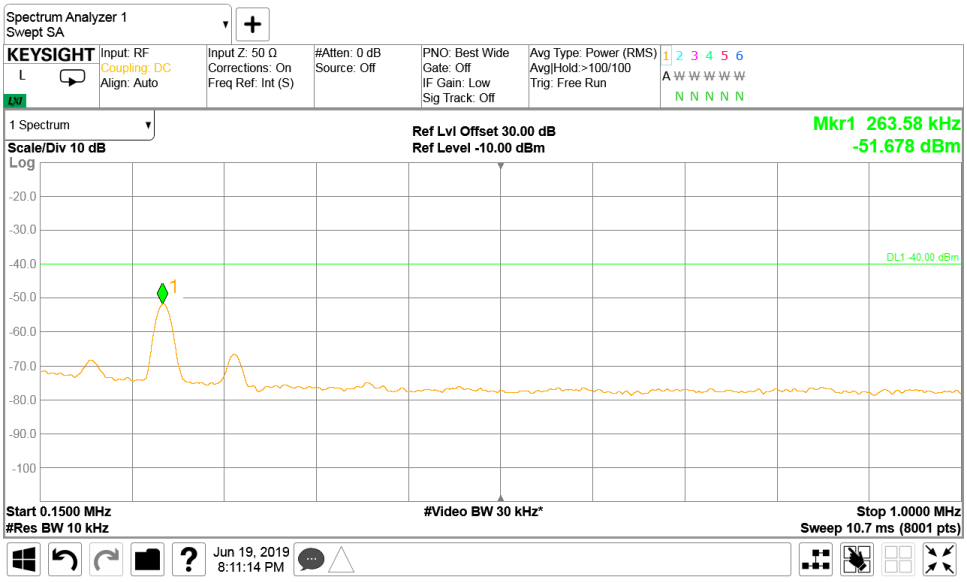
Full description is given in Appendix A.

| Test specification: | Section 96.41(e)(3), Conducted spurious emissions | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 54 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

**Plot 7.3.1 Spurious emission measurements in 9 - 150 kHz range at mid carrier frequency**

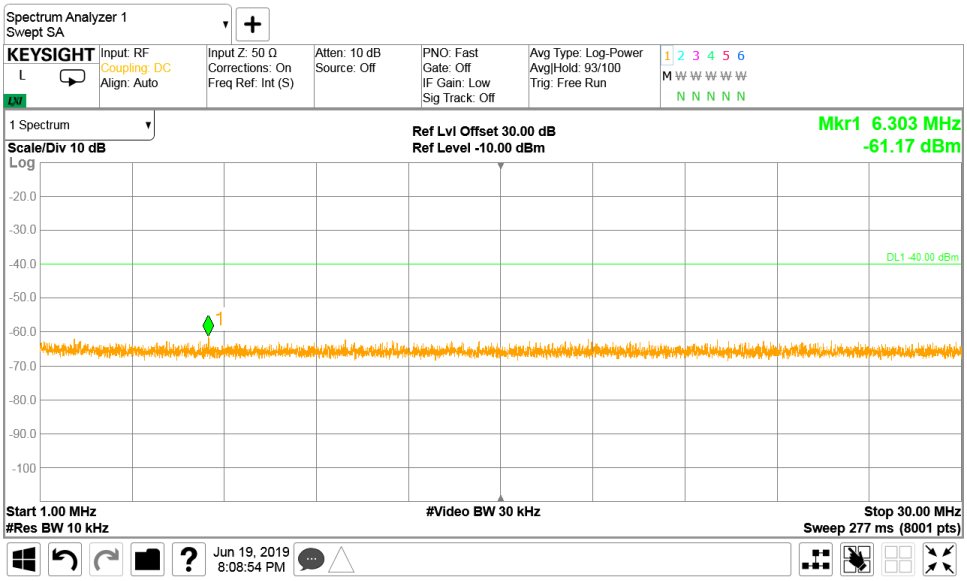



**Plot 7.3.2 Spurious emission measurements in 0.15 – 1 MHz range at mid carrier frequency**

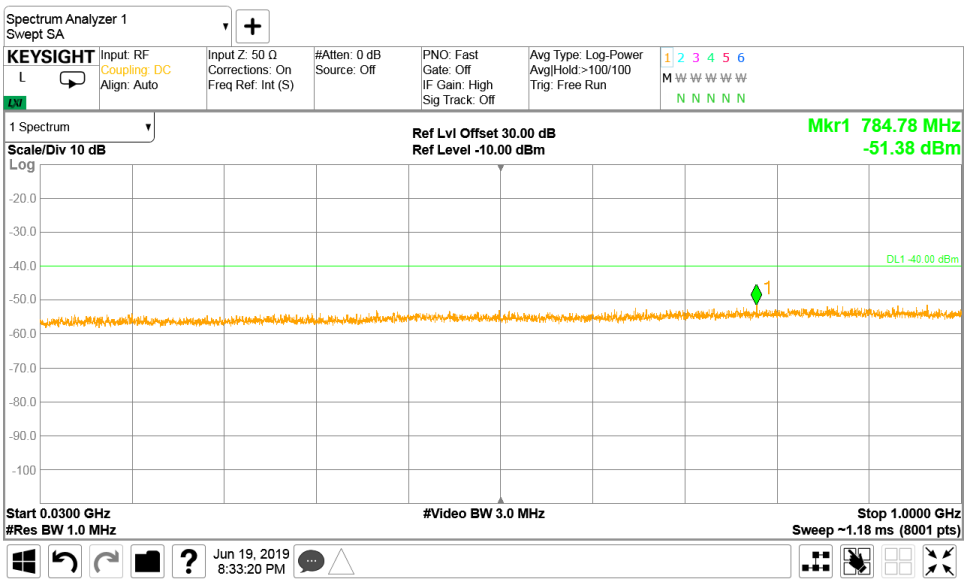


| Test specification: | Section 96.41(e)(3), Conducted spurious emissions | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 54 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

**Plot 7.3.3 Spurious emission measurements in 1- 30.0 MHz range at mid carrier frequency**

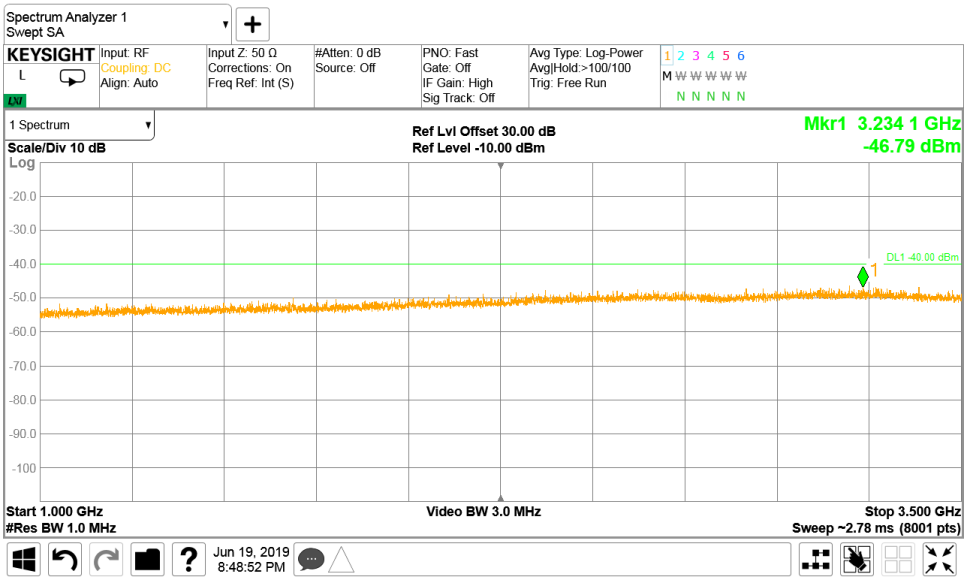



**Plot 7.3.4 Spurious emission measurements in 30.0 - 1000 MHz range at mid carrier frequency**

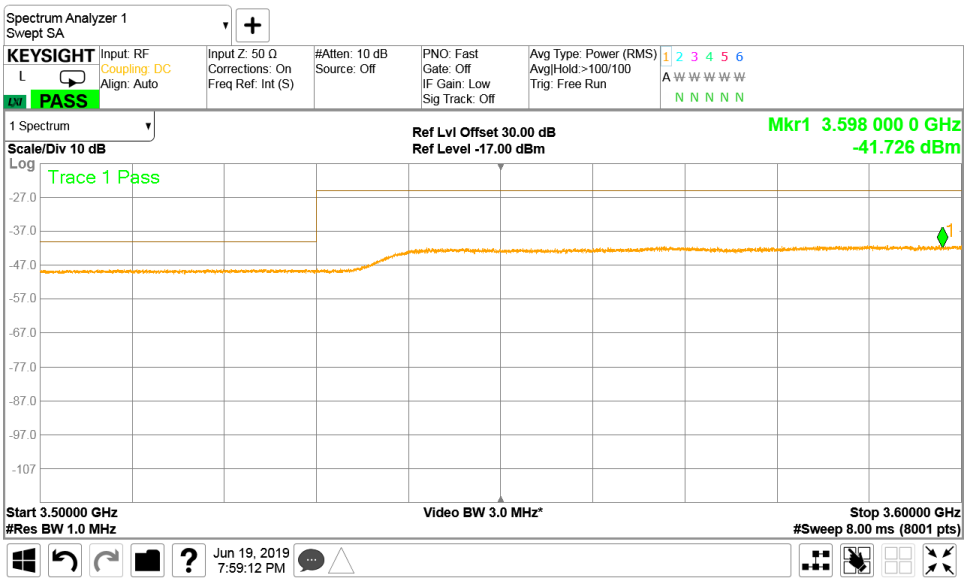


| Test specification: | Section 96.41(e)(3), Conducted spurious emissions | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 54 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

**Plot 7.3.5 Spurious emission measurements in 1000 - 3500 MHz at mid carrier frequency**

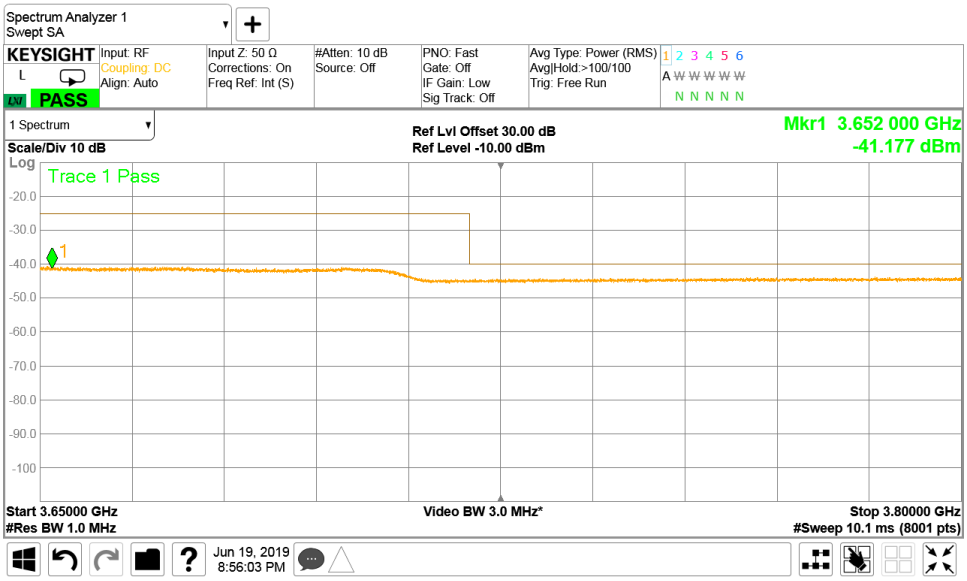



**Plot 7.3.6 Spurious emission measurements in 3500 - 3600 MHz at mid carrier frequency**

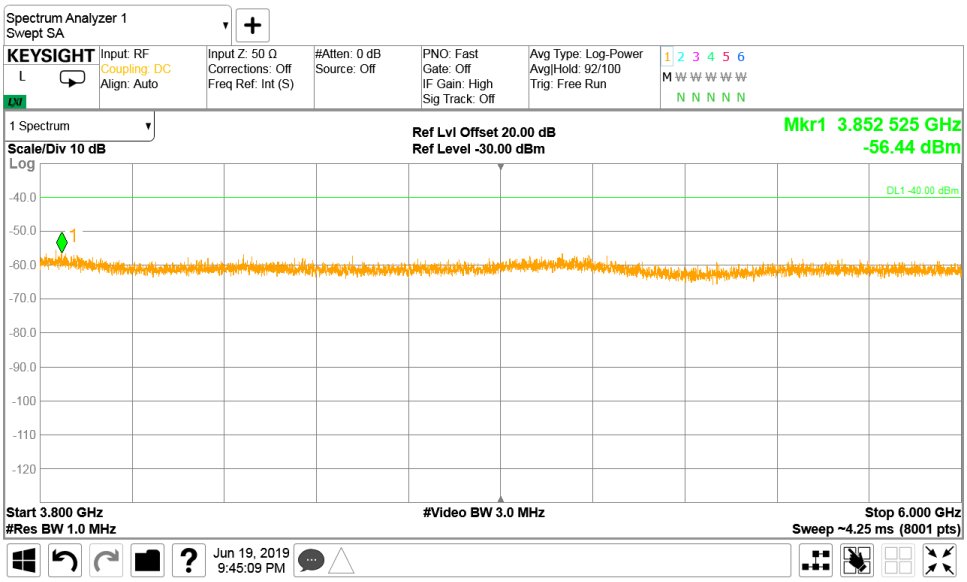


| Test specification: | Section 96.41(e)(3), Conducted spurious emissions | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 54 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

**Plot 7.3.7 Spurious emission measurements in 3650 - 3800 MHz range at mid carrier frequency**

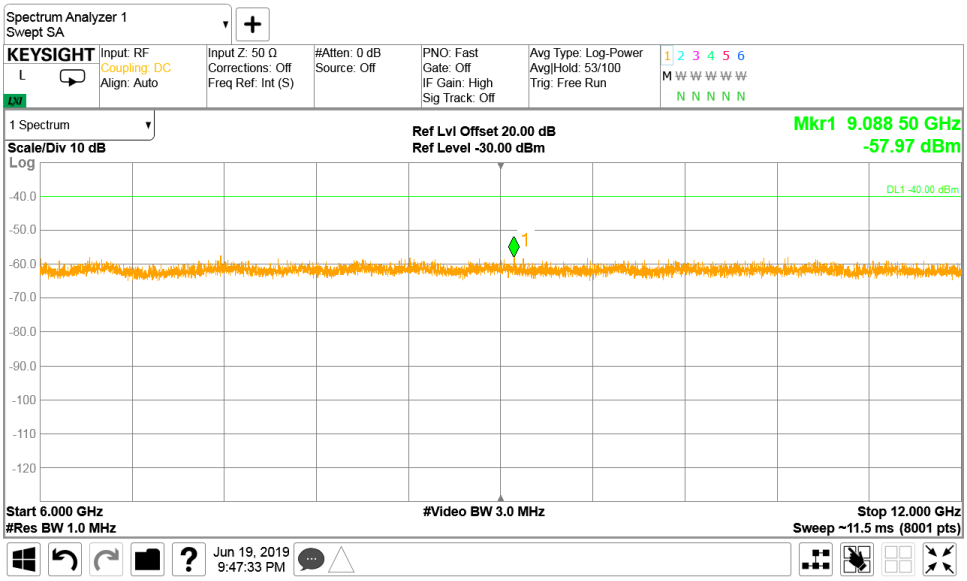



**Plot 7.3.8 Spurious emission measurements in 3800 - 6000 MHz at mid carrier frequency**

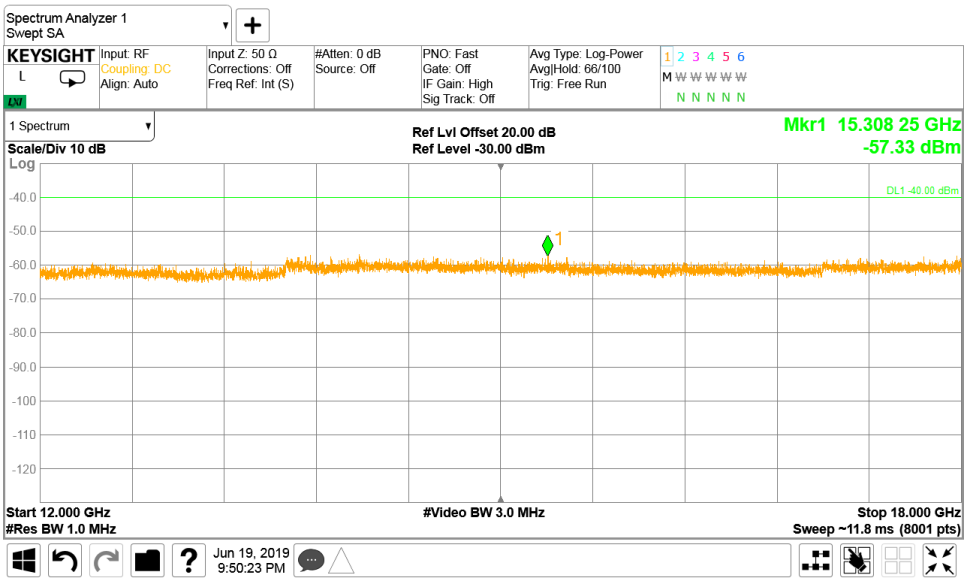


| Test specification: | Section 96.41(e)(3), Conducted spurious emissions | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 54 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

**Plot 7.3.9 Spurious emission measurements in 6000 - 12000 MHz at mid carrier frequency**

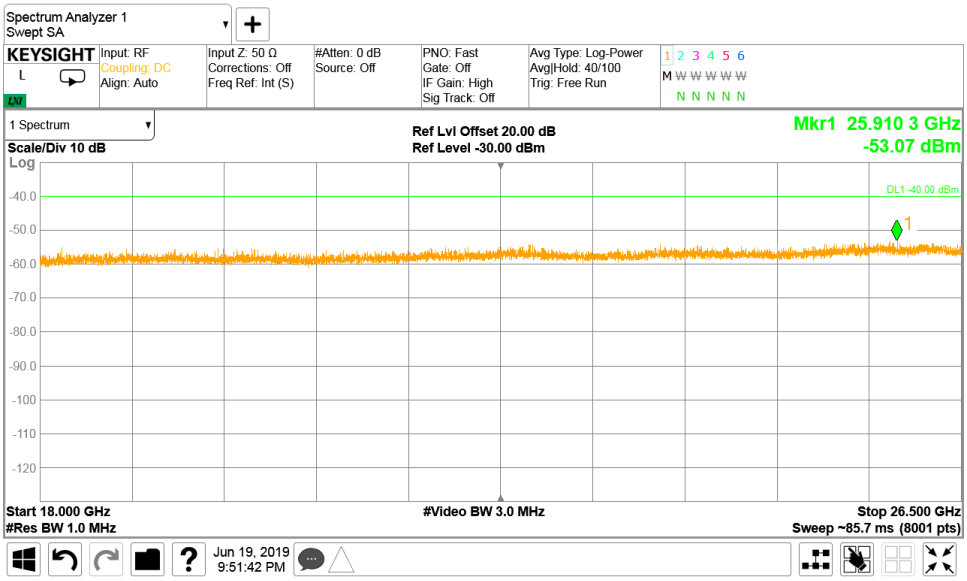



**Plot 7.3.10 Spurious emission measurements in 12000 - 18000 MHz at mid carrier frequency**

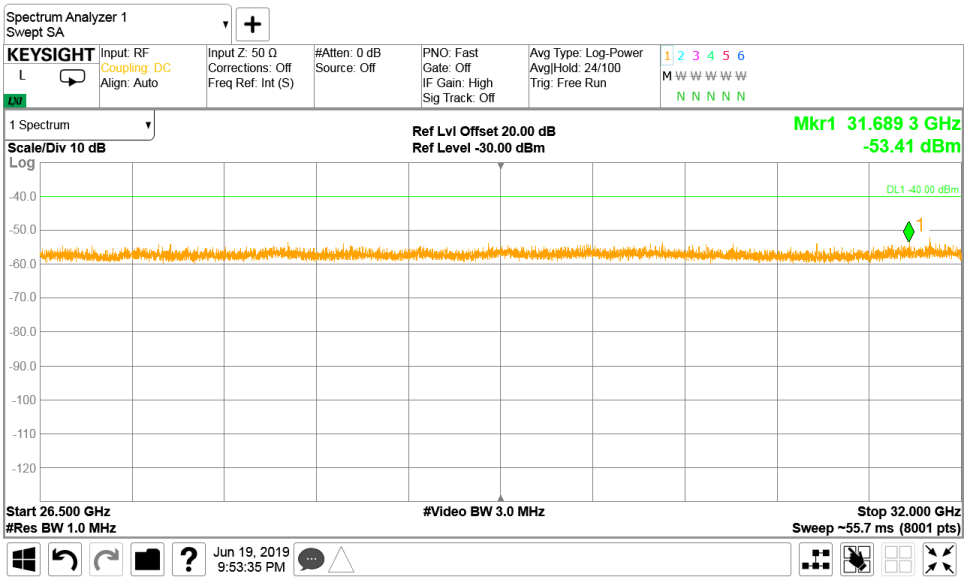


| Test specification: | Section 96.41(e)(3), Conducted spurious emissions | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 54 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

**Plot 7.3.11 Spurious emission measurements in 18000 - 26500 MHz at mid carrier frequency**

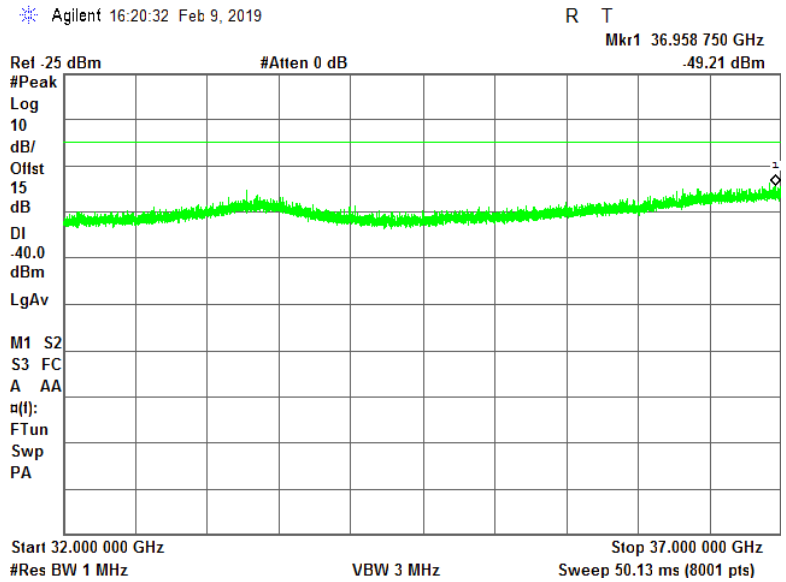



**Plot 7.3.12 Spurious emission measurements in 26500 - 32000 MHz at mid carrier frequency**



| Test specification: | Section 96.41(e)(3), Conducted spurious emissions | | |
|---|---|---|---|
| Test procedure: | Section 96.41(e)(3) | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 19-Jun-19 | | |
| Temperature: 24 ºC | Relative Humidity: 54 % | Air Pressure: 1010 hPa | Power: 48 VDC |
| Remarks: | | | |

**Plot 7.3.13 Spurious emission measurements in 32000 - 37000 MHz at mid carrier frequency**



# 8 APPENDIX A Test equipment and ancillaries used for tests

| HL No | Description | Manufacturer | Model | Ser. No. | Last Cal./ Check | Due Cal./ Check |
|---|---|---|---|---|---|---|
| 3287 | Low pass filter, DC-3.0 GHz | Unknown | NA | 3287 | 05-Jun-19 | 05-Jun-20 |
| 3301 | Power Meter, P-series, 50 MHz to 40 GHz | Agilent Technologies | N1911A | MY45101057 | 28-Apr-19 | 28-Apr-20 |
| 3302 | Power sensor, P-Series, 50 MHz to 40 GHz, -35/30 to 20 dBm | Agilent Technologies | N1922A | MY45240586 | 28-Apr-19 | 28-Apr-20 |
| 3434 | Test Cable , DC-18 GHz, 1.5 m, SMA - SMA | Mini-Circuits | CBL-5FT-SMSM+ | 25683 | 15-Apr-19 | 15-Apr-20 |
| 3818 | PSA Series Spectrum Analyzer, 3 Hz- 44 GHz | Agilent Technologies | E4446A | MY48250288 | 24-Apr-19 | 24-Apr-20 |
| 3903 | Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA | Huber-Suhner | SUCOFLEX 102A | 1226/2A | 07-Apr-19 | 07-Apr-20 |
| 4342 | High Pass Filter, 50 Ohm, 10.6 to 26.5 GHz,SMA-M / SMA-FM | RLC Electronics | F-5738A | 8425 | 05-Jun-19 | 05-Jun-20 |
| 4355 | Signal and Spectrum Analyzer, 9 kHz to 7 GHz | Rohde & Schwarz | FSV 7 | 101630 | 28-Jun-19 | 28-Jun-20 |
| 4366 | Directional coupler, 1 GHz to 18 GHz, 10 dB, SMA Female | Tiger Micro-Electronics Institute | TGD-A1101-10 | 01e-JSDE805-007 | 21-May-18 | 21-May-20 |
| 5174 | Medium Power Fixed Coaxial Attenuator DC to 40 GHz, 10 dB, 5 W | API Weinschel, Inc | 75A-10-12 | TD854 | 07-Apr-19 | 07-Apr-20 |
| 5175 | Medium Power Fixed Coaxial Attenuator DC to 40 GHz, 20 dB, 5 W | API Weinschel, Inc | 75A-20-12 | TE289 | 07-Apr-19 | 07-Apr-20 |
| 5286 | Band Pass Filter, 50 Ohm, 4.4 to 18 GHz, SMA/M-SMA/F | A-INFOMW | WBLB-T-HP-4.4-18-S | J10800000305 | 05-Jun-19 | 05-Jun-20 |
| 5376 | EXA Signal Analyzer, 10 Hz - 32 GHz | Keysight Technologies | N9010B | MY57470404 | 18-Mar-19 | 18-Mar-20 |
| 5409 | RF cable, 40 GHz, SMA-SMA, 2 m | Huber-Suhner | SF102EA/11SK/11SK/2000MM | 503973/2EA | 19-Aug-18 | 19-Aug-19 |

# 9 APPENDIX B Measurement uncertainties

**Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements**

| Test description | Expanded uncertainty |
|---|---|
| **Transmitter tests** | |
| Carrier power conducted at antenna connector | ± 1.7 dB |
| Carrier power radiated (substitution method) | ± 4.5 dB |
| Occupied bandwidth | ±8% |
| Conducted emissions at RF antenna connector | 9 kHz to 2.9 GHz: ± 2.6 dB<br>2.9 GHz to 6.46 GHz: ± 3.5 dB<br>6.46 GHz to 13.2 GHz: ± 4.3 dB<br>13.2 GHz to 22.0 GHz: ± 5.0 dB<br>22.0 GHz to 26.8 GHz: ± 5.5 dB<br>26.8 GHz to 40.0 GHz: ± 4.8 dB |
| Spurious emissions radiated 30 MHz – 40 GHz (substitution method) | ± 4.5 dB |
| Frequency error | 30 – 300 MHz: ± 50.5 Hz (1.68 ppm)<br>300 – 1000 MHz: ± 168 Hz (0.56 ppm) |
| Transient frequency behaviour | 187 Hz<br>± 13.9 % |
| Duty cycle, timing (Tx ON / OFF) and average factor measurements | ± 1.0 % |

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.

Hermon Laboratories calibrates its reference and transfer standards by calibration laboratories accredited to ISO/IEC 17025 by a mutually recognized Accreditation Body or by a recognized national metrology institute. All reference and transfer standards used in the calibration system are traceable to national or international standards.

In-house calibration of all test and measurement equipment is performed on a regular basis according to Hermon Laboratories calibration procedures, manufacturer calibration/verification procedures or procedures defined in the relevant standards. The Hermon Laboratories test and measurement equipment is calibrated within the tolerances specified by the manufacturers and/or by the relevant standards.

# 10 APPENDIX C Test facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, Radio, Safety, Environmental and Telecommunication testing facility.
Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for relevant parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; Recognized by Innovation, Science and Economic Development Canada for wireless and terminal testing (ISED), ISED #2186A, CAB identifier is IL1001; Certified by VCCI, Japan (the registration numbers are R-10808 for OATS, R-1082 for anechoic chamber, G-10869 for RE measurements above 1 GHz, C-10845 for conducted emissions site and T-11606 for conducted emissions at telecommunication ports).
The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing, environmental simulation and calibration (for exact scope please refer to Certificate No. 839.01, 839.03 and 839.04).

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website: www.hermonlabs.com

Person for contact: Mr. Michael Nikishin, EMC&Radio group manager

# 11 APPENDIX D Specification references

| | |
|---|---|
| FCC 47CFR part 96: 2018 | Citizens Broaband Radio Service |
| FCC 47CFR part 1: 2018 | Practice and procedure |
| FCC 47CFR part 2: 2018 | Frequency allocations and radio treaty matters; general rules and regulations |
| ANSI C63.26:2015 | American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services |
| ANSI C63.2: 1996 | American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications. |
| ANSI C63.4: 2014 | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. |
| KDB 971168 D01 v03r01 | Measurement Guidance for Certification of Licensed Digital Transmitters |
| KDB 940660 D01 v01 | Certification and Test Procedures for Citizens Broadband Radio Service Devices Authorized under Part 96 |
| KDB 662911 D01 v02r01 | Emissions Testing of Transmitters with Multiple Outputs in the Same Band |
| KDB 662911 D02 v01 | MIMO with Cross-Polarized Antenna |

# 12 APPENDIX E Test equipment correction factors

**Cable loss**
**Microwave Cable Assembly, Huber-Suhner, 40 GHz, 1.5 m, SMA-SMA, S/N 1226/2A**
**HL 3903**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|---|---|
| 10 | -0.02 | 9500 | 1.84 | 21000 | 2.98 |
| 100 | 0.15 | 10000 | 1.86 | 22000 | 3.07 |
| 500 | 0.38 | 10500 | 1.93 | 23000 | 3.13 |
| 1000 | 0.56 | 11000 | 1.99 | 24000 | 3.21 |
| 1500 | 0.69 | 11500 | 2.04 | 25000 | 3.26 |
| 2000 | 0.82 | 12000 | 2.10 | 26000 | 3.48 |
| 2500 | 0.90 | 12500 | 2.15 | 27000 | 3.44 |
| 3000 | 0.98 | 13000 | 2.21 | 28000 | 3.53 |
| 3500 | 1.06 | 13500 | 2.25 | 29000 | 3.59 |
| 4000 | 1.11 | 14000 | 2.29 | 30000 | 3.66 |
| 4500 | 1.17 | 14500 | 2.34 | 31000 | 3.70 |
| 5000 | 1.24 | 15000 | 2.36 | 32000 | 3.79 |
| 5500 | 1.32 | 15500 | 2.40 | 33000 | 3.88 |
| 6000 | 1.40 | 16000 | 2.45 | 34000 | 3.94 |
| 6500 | 1.50 | 16500 | 2.48 | 35000 | 3.91 |
| 7000 | 1.56 | 17000 | 2.56 | 36000 | 4.05 |
| 7500 | 1.62 | 17500 | 2.58 | 37000 | 4.22 |
| 8000 | 1.68 | 18000 | 2.60 | 38000 | 4.25 |
| 8500 | 1.74 | 19000 | 2.84 | 39000 | 4.27 |
| 9000 | 1.78 | 20000 | 2.88 | 40000 | 4.33 |

**Cable loss**
**RF Cable, Huber-Suhner, 40 GHz, 2 m, ,**
**SF102EA/11SK/11SK/2000MM, S/N 503973/2EA**
**HL 5409**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|
| 100 | 0.26 | 20500 | 3.75 |
| 200 | 0.36 | 21000 | 3.80 |
| 300 | 0.45 | 21500 | 3.85 |
| 500 | 0.58 | 22000 | 3.90 |
| 1000 | 0.82 | 22500 | 3.95 |
| 1500 | 0.99 | 23000 | 4.00 |
| 2000 | 1.15 | 23500 | 4.04 |
| 2500 | 1.28 | 24000 | 4.09 |
| 3000 | 1.40 | 24500 | 4.13 |
| 3500 | 1.51 | 25000 | 4.19 |
| 4000 | 1.61 | 25500 | 4.25 |
| 4500 | 1.71 | 26000 | 4.30 |
| 5000 | 1.80 | 26500 | 4.37 |
| 5500 | 1.89 | 27000 | 4.45 |
| 6000 | 1.98 | 27500 | 4.47 |
| 6500 | 2.06 | 28000 | 4.45 |
| 7000 | 2.14 | 28500 | 4.49 |
| 7500 | 2.22 | 29000 | 4.57 |
| 8000 | 2.29 | 29500 | 4.60 |
| 8500 | 2.36 | 30000 | 4.59 |
| 9000 | 2.43 | 30500 | 4.63 |
| 9500 | 2.50 | 31000 | 4.68 |
| 10000 | 2.58 | 31500 | 4.74 |
| 10500 | 2.63 | 32000 | 4.81 |
| 11000 | 2.70 | 32500 | 4.89 |
| 11500 | 2.76 | 33000 | 4.89 |
| 12000 | 2.82 | 33500 | 4.92 |
| 12500 | 2.87 | 34000 | 4.94 |
| 13000 | 2.94 | 34500 | 4.99 |
| 13500 | 3.00 | 35000 | 5.07 |
| 14000 | 3.06 | 35500 | 5.12 |
| 14500 | 3.11 | 36000 | 5.14 |
| 15000 | 3.17 | 36500 | 5.22 |
| 15500 | 3.23 | 37000 | 5.28 |
| 16000 | 3.29 | 37500 | 5.30 |
| 16500 | 3.35 | 38000 | 5.39 |
| 17000 | 3.41 | 38500 | 5.48 |
| 17500 | 3.47 | 39000 | 5.44 |
| 18000 | 3.51 | 39500 | 5.45 |
| 18500 | 3.56 | 40000 | 5.51 |
| 19000 | 3.60 | | |
| 19500 | 3.66 | | |
| 20000 | 3.71 | | |

# 13 APPENDIX F Abbreviations and acronyms

| | |
|---|---|
| A | ampere |
| AC | alternating current |
| A/m | ampere per meter |
| AM | amplitude modulation |
| AVRG | average (detector) |
| BB | broad band |
| cm | centimeter |
| dB | decibel |
| dBm | decibel referred to one milliwatt |
| dB(μV) | decibel referred to one microvolt |
| dB(μV/m) | decibel referred to one microvolt per meter |
| dB(μA) | decibel referred to one microampere |
| dBΩ | decibel referred to one Ohm |
| DC | direct current |
| EIRP | equivalent isotropically radiated power |
| ERP | effective radiated power |
| EUT | equipment under test |
| F | frequency |
| GHz | gigahertz |
| GND | ground |
| H | height |
| HL | Hermon laboratories |
| Hz | hertz |
| ITE | information technology equipment |
| k | kilo |
| kHz | kilohertz |
| LISN | line impedance stabilization network |
| LO | local oscillator |
| m | meter |
| MHz | megahertz |
| min | minute |
| mm | millimeter |
| ms | millisecond |
| μs | microsecond |
| NA | not applicable |
| NB | narrow band |
| NT | not tested |
| OATS | open area test site |
| Ω | Ohm |
| QP | quasi-peak |
| PM | pulse modulation |
| PS | power supply |
| RE | radiated emission |
| RF | radio frequency |
| rms | root mean square |
| Rx | receive |
| s | second |
| T | temperature |
| Tx | transmit |
| V | volt |
| VA | volt-ampere |

END OF DOCUMENT