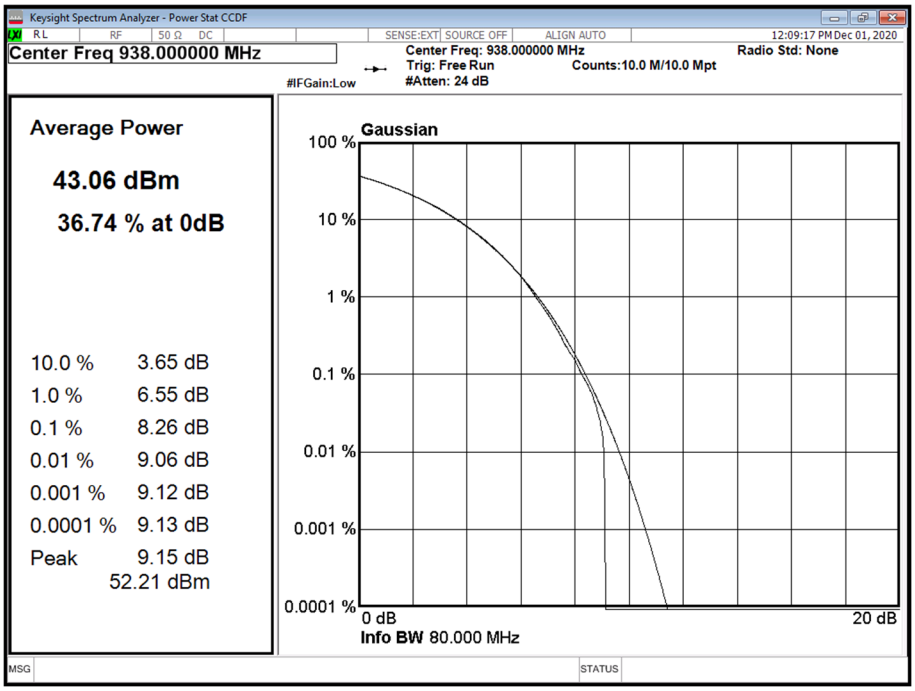
Configuration A2

Maximum Output Power 43 dBm

| Antenna | LTE-Modulation | LTE Carrier Bandwidth | Peak to Average Ratio (PAR) / Output Power | | |
|---|---|---|---|---|---|
| | | | Channel Position M | | |
| | | | PAR (dB) | Average Power | |
| | | | | dBm | dBm/MHz |
| B | 16QAM | 1.4 MHz | 8.26 | 43.11 | 42.69 |

Antenna B - LTE-Modulation 16QAM - LTE Carrier Bandwidth 1.4 MHz - Channel Position M

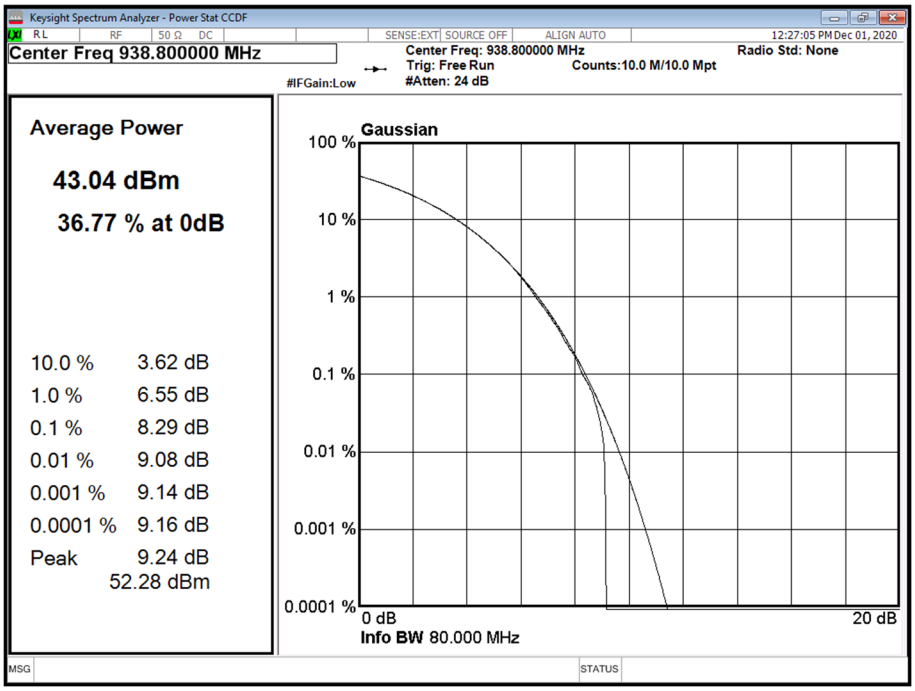


Configuration A2

Maximum Output Power 43 dBm

| Antenna | LTE-Modulation | LTE Carrier Bandwidth | Peak to Average Ratio (PAR) / Output Power | | |
|---|---|---|---|---|---|
| | | | Channel Position T | | |
| | | | PAR (dB) | Average Power | |
| | | | | dBm | dBm/MHz |
| B | 16QAM | 1.4 MHz | 8.29 | 43.08 | 42.65 |

Antenna B - LTE-Modulation 16QAM - LTE Carrier Bandwidth 1.4 MHz - Channel Position T

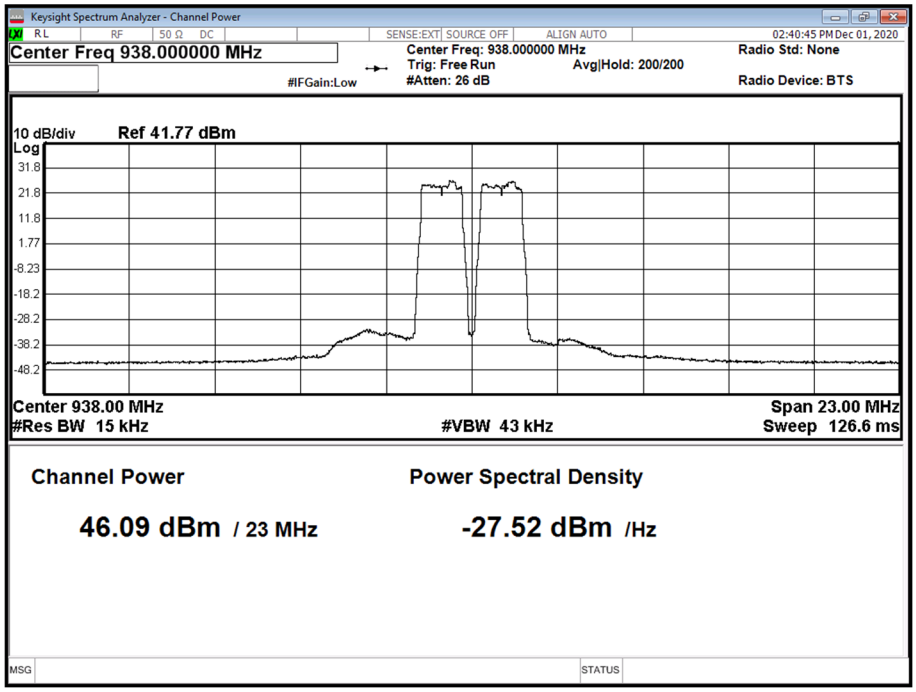


Configuration A3

Maximum Output Power 46 dBm

| Antenna | LTE-Modulation | LTE Carrier Bandwidth | Peak to Average Ratio (PAR) / Output Power | | |
|---|---|---|---|---|---|
| | | | Channel Position M | | |
| | | | PAR (dB) | Average Power | |
| | | | | dBm | dBm/MHz |
| B | 16QAM | 1.4 MHz + 1.4MHz | - | 46.09 | 42.41 |

Antenna B - LTE-Modulation 16QAM - LTE Carrier Bandwidth 1.4 MHz + 1.4 MHz - Channel Position M

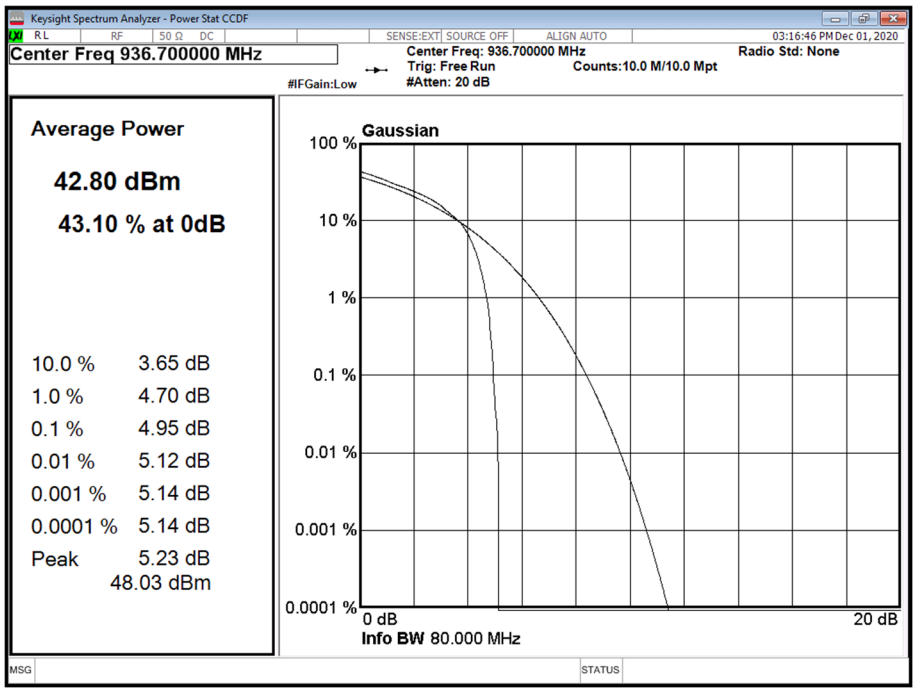


Configuration A4

Maximum Output Power 43 dBm

| Antenna | NB-IoT SA Modulation | NB-IoT SA Carrier Bandwidth | Peak to Average Ratio (PAR) / Output Power | | |
|---|---|---|---|---|---|
| | | | Channel Position B | | |
| | | | PAR (dB) | Average Power | |
| | | | | dBm | dBm/MHz |
| B | QPSK | 400 kHz | 4.95 | 42.79 | 43.34 |

Antenna B - NB-IoT SA Modulation QPSK - NB-IoT SA Carrier Bandwidth 400 kHz - Channel Position B

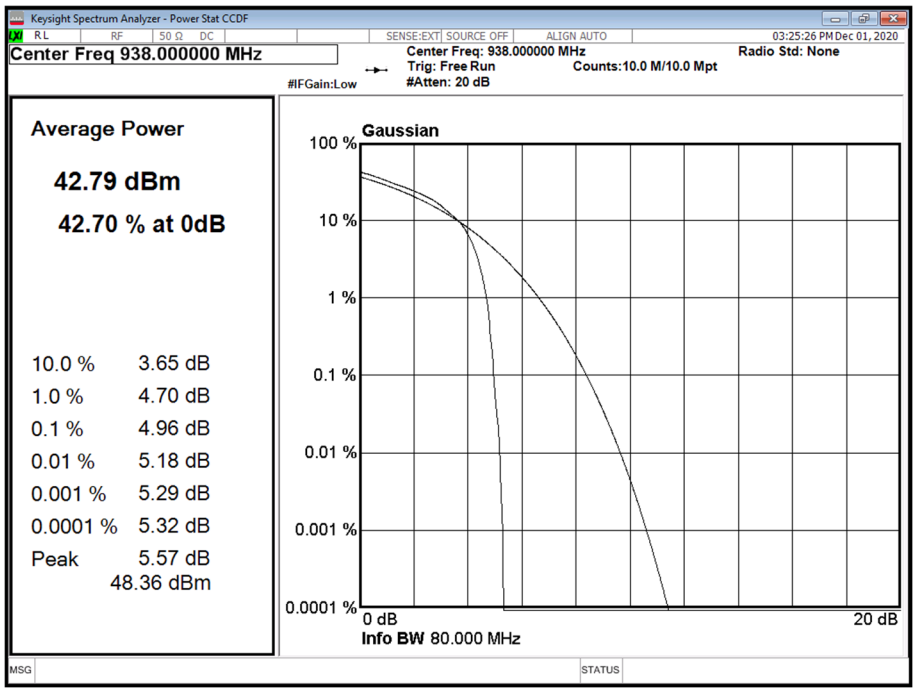


Configuration A4

Maximum Output Power 43 dBm

| Antenna | NB-IoT SA Modulation | NB-IoT SA Carrier Bandwidth | Peak to Average Ratio (PAR) / Output Power | | |
|---|---|---|---|---|---|
| | | | Channel Position M | | |
| | | | PAR (dB) | Average Power | |
| | | | | dBm | dBm/MHz |
| B | QPSK | 400 kHz | 4.96 | 42.80 | 43.30 |

Antenna B - NB-IoT SA Modulation QPSK - NB-IoT SA Carrier Bandwidth 400 kHz - Channel Position M

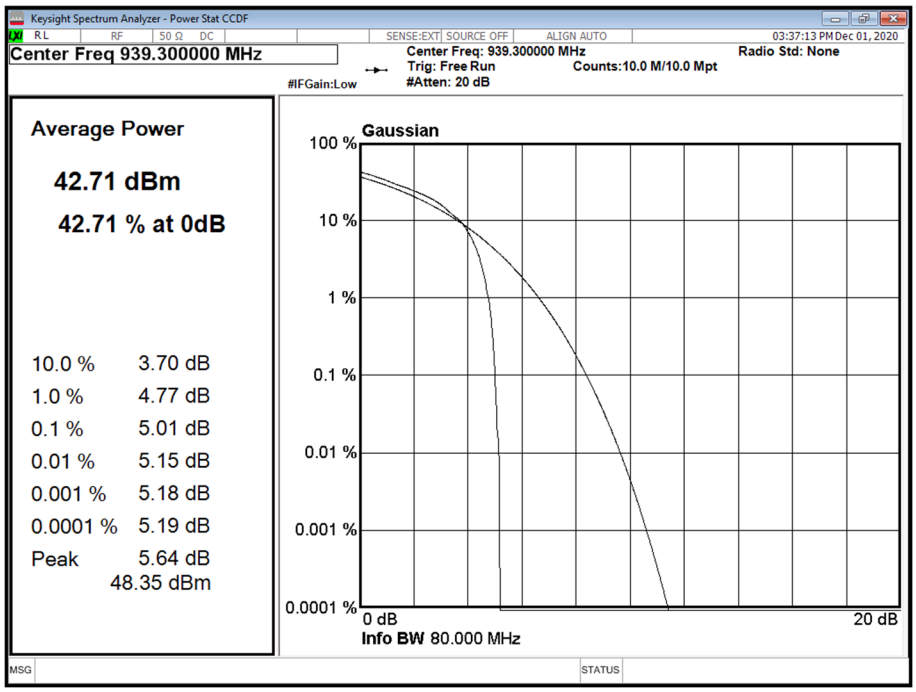


Configuration A4

Maximum Output Power 43 dBm

| Antenna | NB-IoT SA Modulation | NB-IoT SA Carrier Bandwidth | Peak to Average Ratio (PAR) / Output Power | | |
|---|---|---|---|---|---|
| | | | Channel Position T | | |
| | | | PAR (dB) | Average Power | |
| | | | | dBm | dBm/MHz |
| B | QPSK | 400 kHz | 5.01 | 42.76 | 43.14 |

Antenna B - NB-IoT SA Modulation QPSK - NB-IoT SA Carrier Bandwidth 400 kHz - Channel Position T




| Measurement | Limit |
|---|---|
| PSD<br>for antenna height of ≤ 304m height above average terrain | ≤ 400 Watts/Megahertz |
| PAR | ≤ 13dB |

## 2.4 TRANSMITTER SPURIOUS EMISSIONS

### 2.4.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1051
FCC CFR Part 27, Clause 27.53 (h)
FCC-20-67A1, FCC CFR Part 27, Subpart P, Clause 27.1509

### 2.4.2 Date of Test and Modification State

01 and 07 December 2020 - Modification State 0

### 2.4.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.4.4 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 20.7-22.2°C |
| Relative Humidity | 35.6 - 36.0% |

### 2.4.5 Test Method

All measurements were made in accordance with FCC KDB 971168 D01, Clause 6.

Each antenna port has been declared as being equivalent, therefore measurements were made on one antenna port only. To account for this, the limit was tightened by 10 * Log(N), where N is equal to the number of MIMO antenna ports.

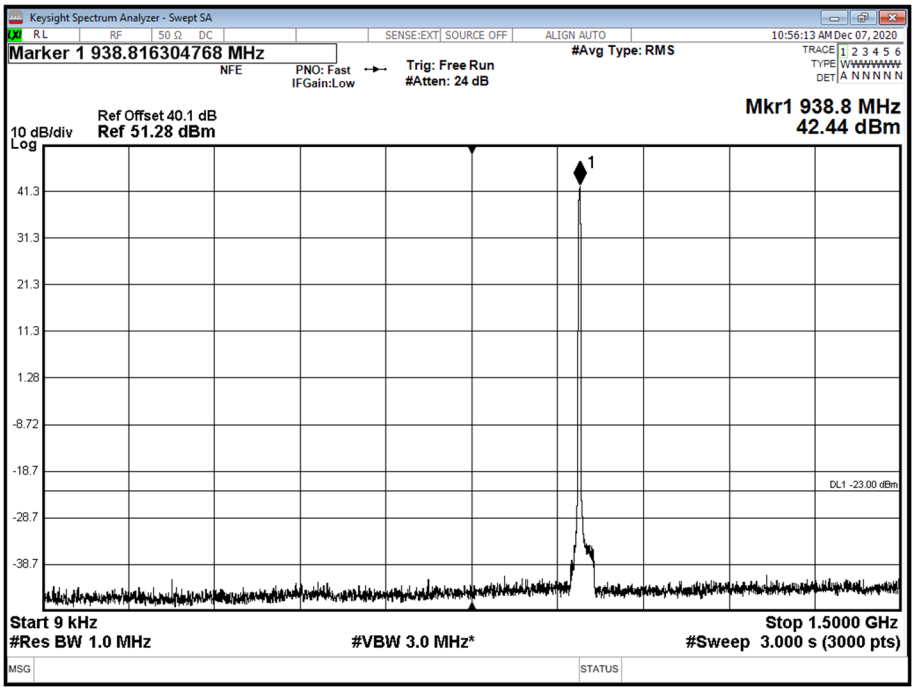
For single port, the limit was calculated as being -20 dBm - 10 * Log (2) = -23 dBm.

### 2.4.6 Test Results

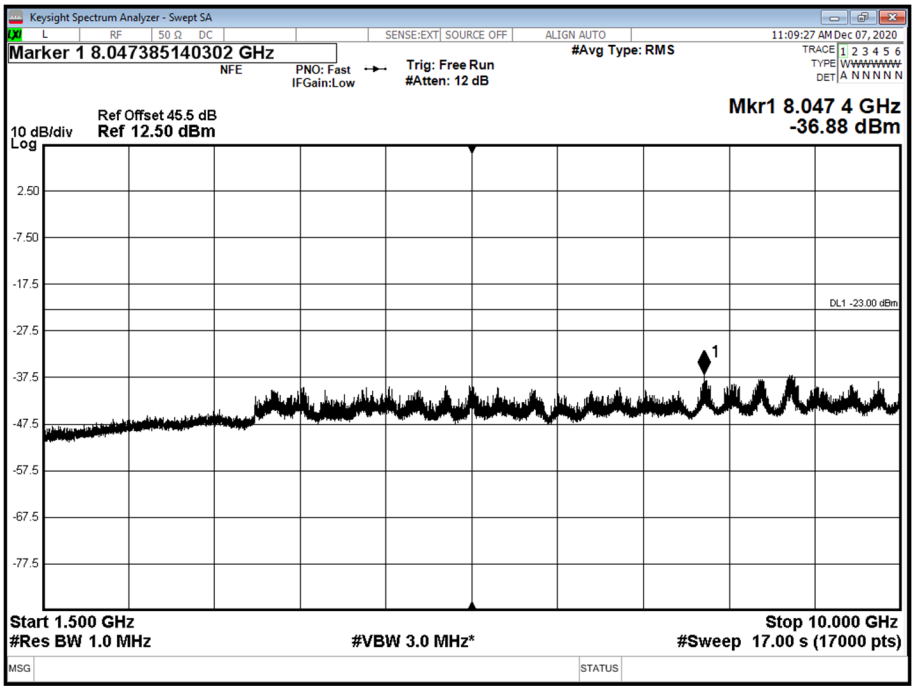
Configuration A1

Maximum Output Power 46 dBm

Antenna B - LTE + NB-IoT IB Modulation QPSK - LTE + NB-IoT IB Carrier Bandwidth 3.0 MHz + NB-IoT IB - Channel Position M - Band 1 - Range 0.009 to 1500 MHz



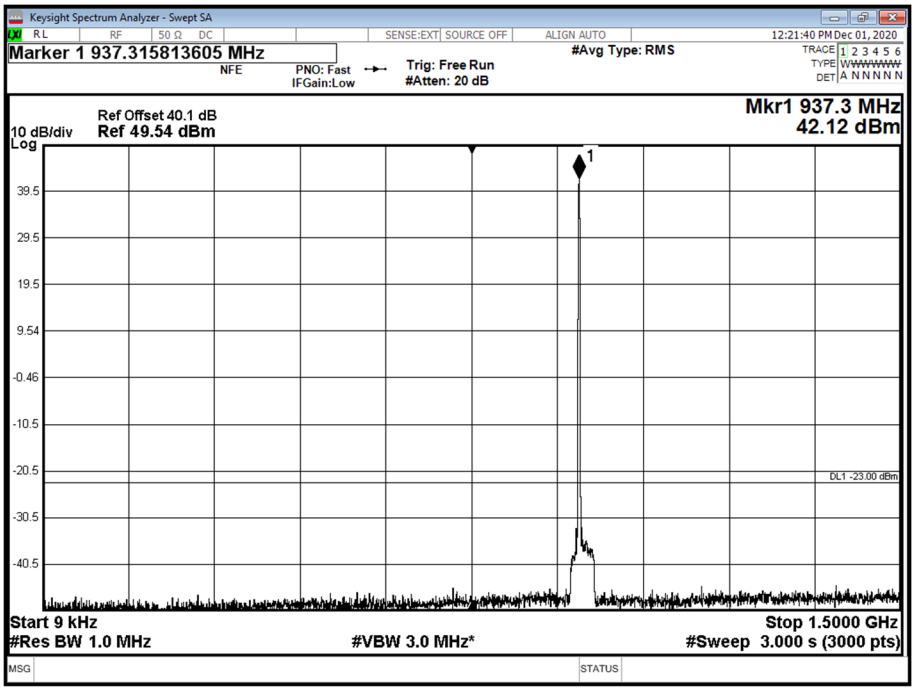

Antenna B - LTE + NB-IoT IB Modulation QPSK - LTE + NB-IoT IB Carrier Bandwidth 3.0 MHz + NB-IoT IB - Channel Position M - Band 2 - Range 1500 to 10000 MHz



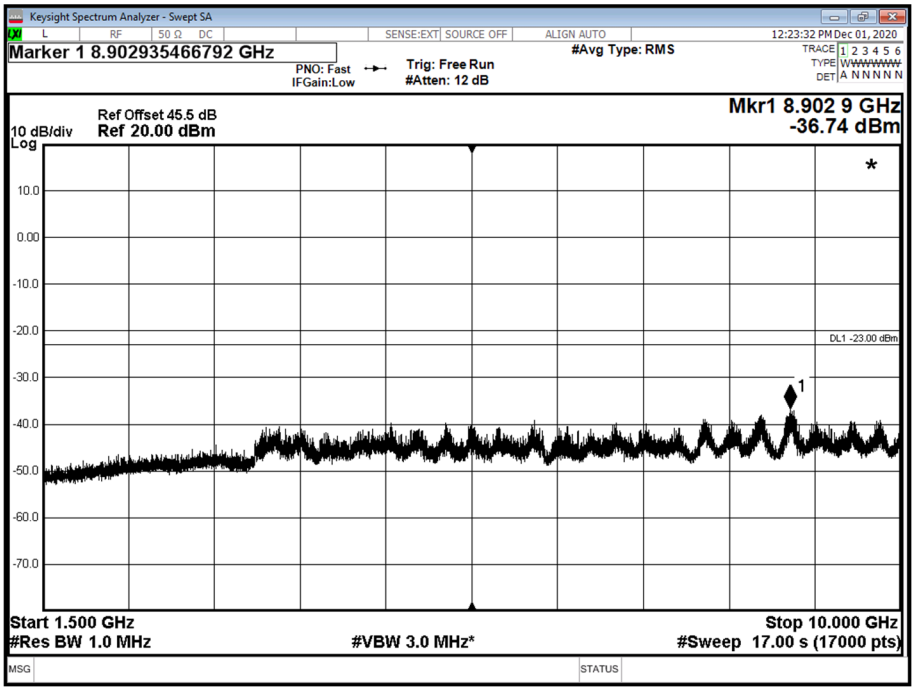
Configuration A2

Maximum Output Power 43 dBm

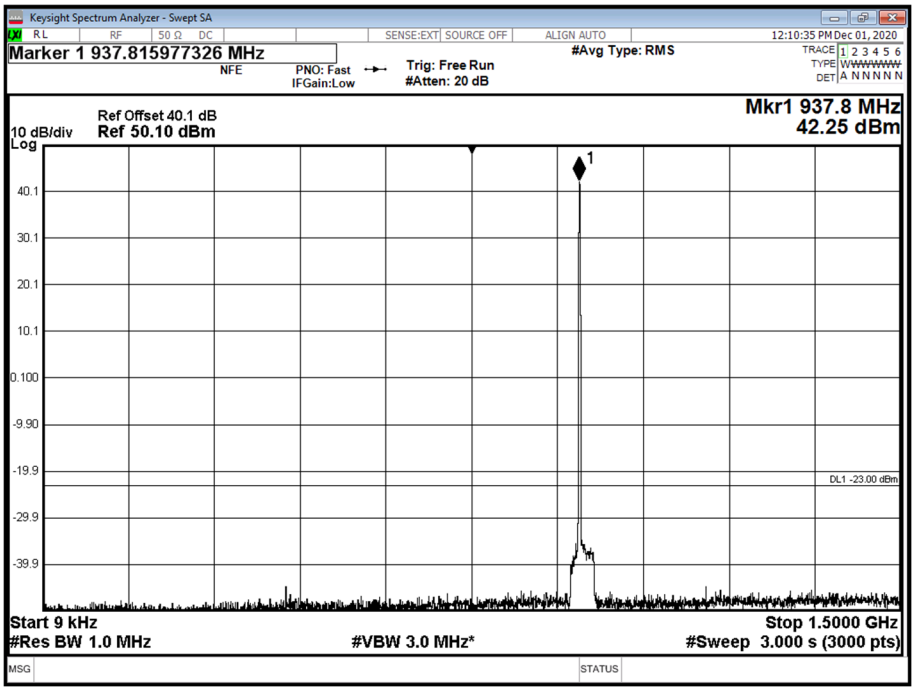
Antenna B - LTE-Modulation 16QAM - LTE Carrier Bandwidth 1.4 MHz - Channel Position B - Band 1 - Range 0.009 to 1500 MHz



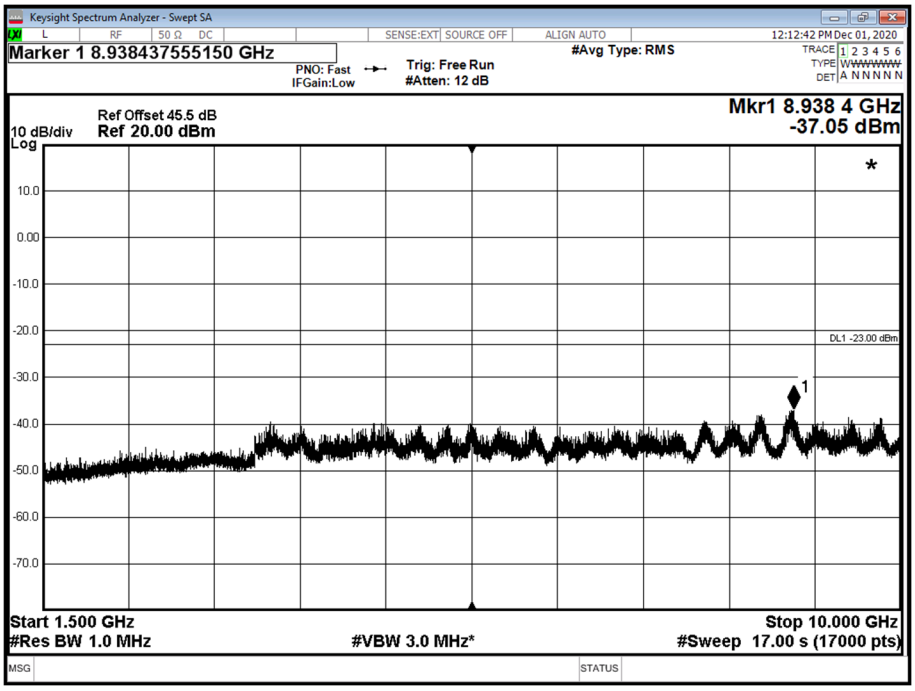

Antenna B - LTE-Modulation 16QAM - LTE Carrier Bandwidth 1.4 MHz - Channel Position B - Band 2 - Range 1500 to 10000 MHz



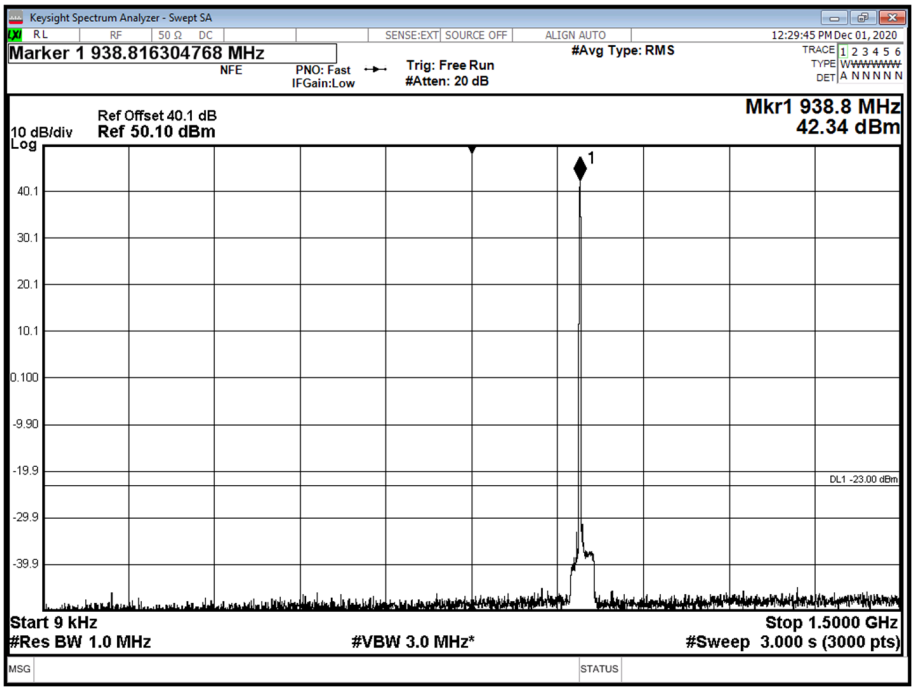
Antenna B - LTE-Modulation 16QAM - LTE Carrier Bandwidth 1.4 MHz - Channel Position M - Band 1 - Range 0.009 to 1500 MHz



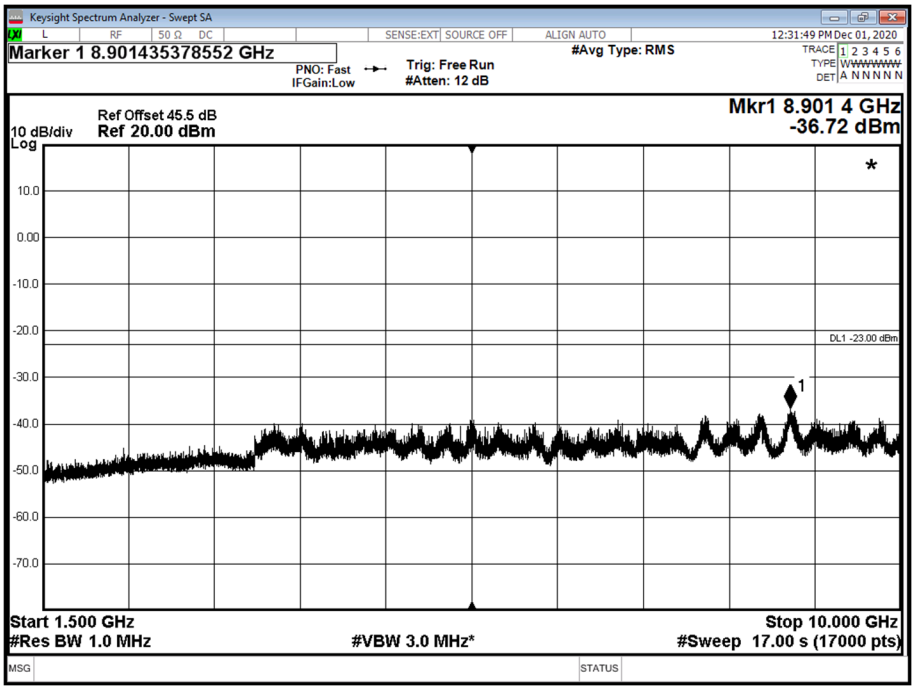

Antenna B - LTE-Modulation 16QAM - LTE Carrier Bandwidth 1.4 MHz - Channel Position M - Band 2 - Range 1500 to 10000 MHz



Antenna B - LTE-Modulation 16QAM - LTE Carrier Bandwidth 1.4 MHz - Channel Position T - Band 1 - Range 0.009 to 1500 MHz



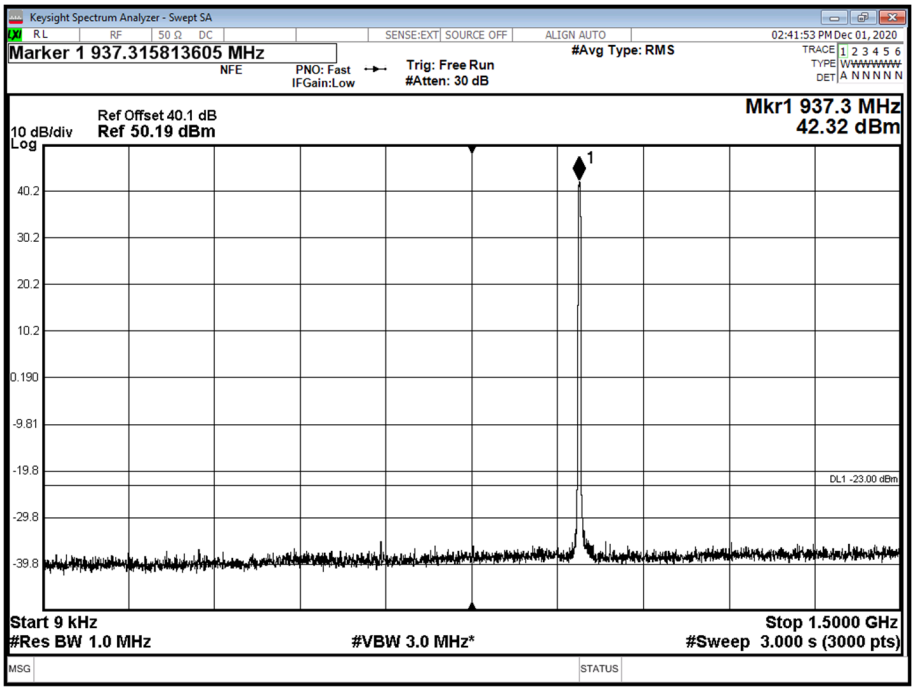

Antenna B - LTE-Modulation 16QAM - LTE Carrier Bandwidth 1.4 MHz - Channel Position T - Band 2 - Range 1500 to 10000 MHz



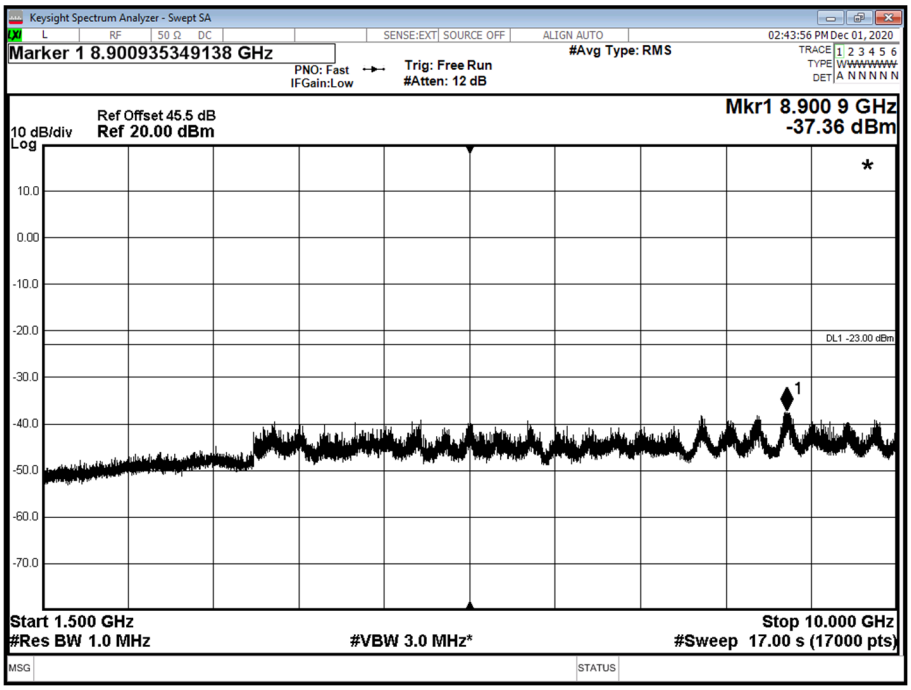
Configuration A3

Maximum Output Power 46 dBm

Antenna B - LTE-Modulation 16QAM - LTE Carrier Bandwidth 1.4 MHz +1.4 MHz - Channel Position M - Band 1 - Range 0.009 to 1500 MHz



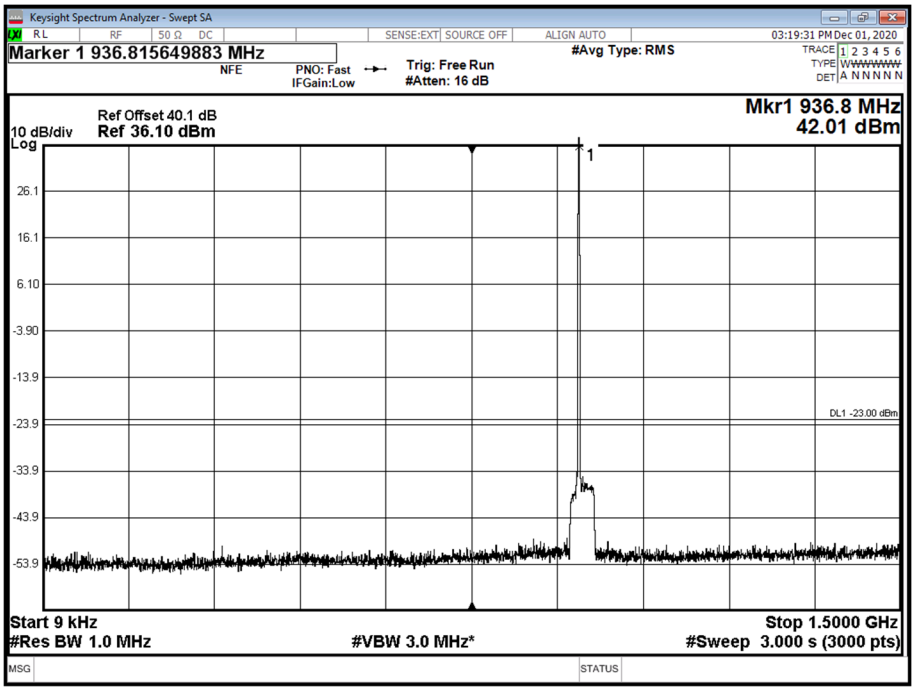

Antenna B - LTE-Modulation 16QAM - LTE Carrier Bandwidth 1.4 MHz +1.4 MHz - Channel Position M - Band 2 - Range 1500 to 10000 MHz



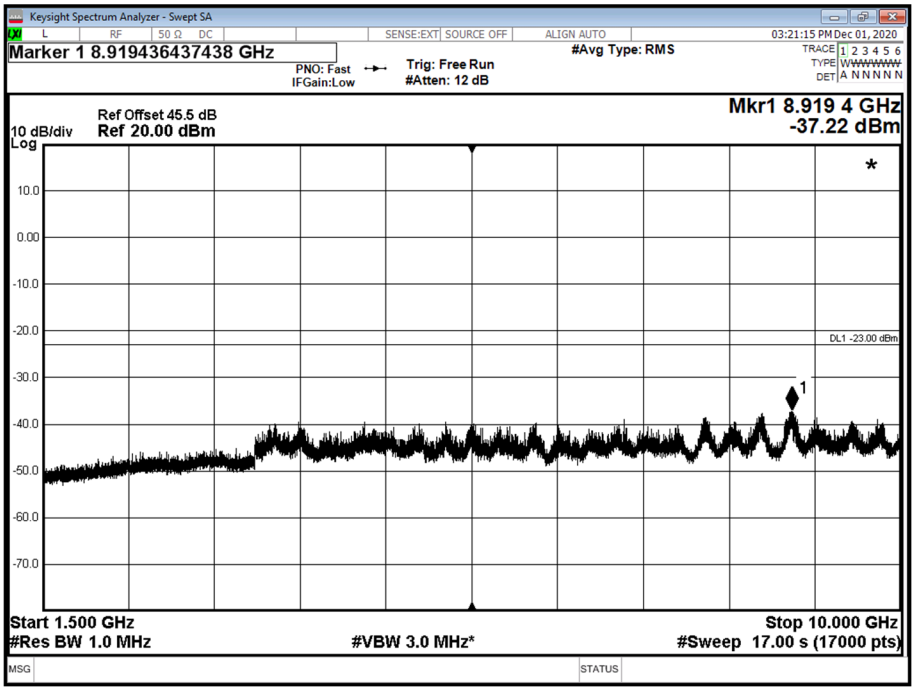
Configuration A4

Maximum Output Power 43 dBm

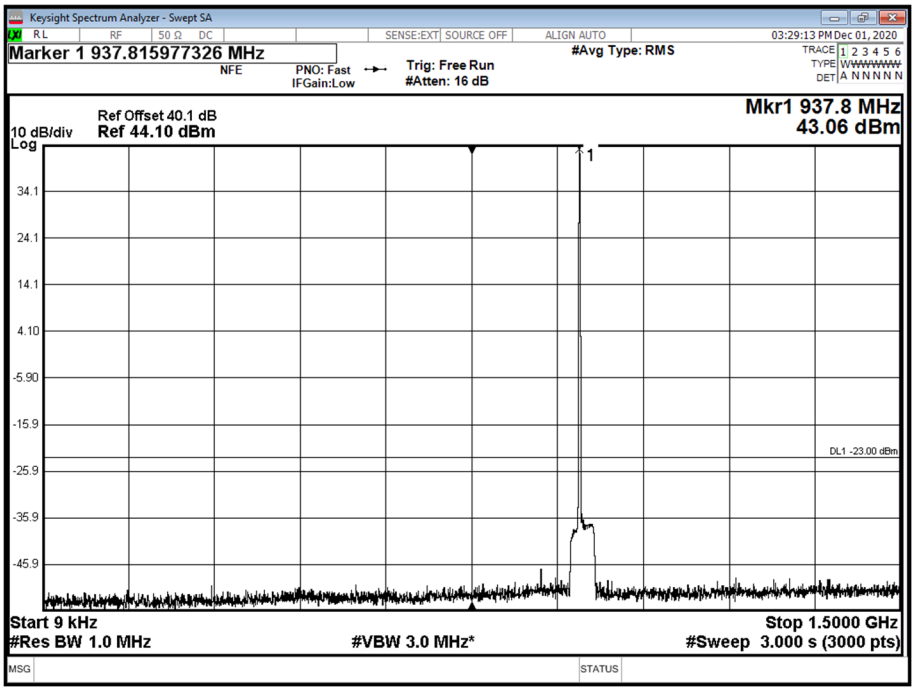
Antenna B - NB-IoT SA Modulation QPSK - NB-IoT SA Carrier Bandwidth 400 kHz - Channel Position B - Band 1 - Range 0.009 to 1500 MHz



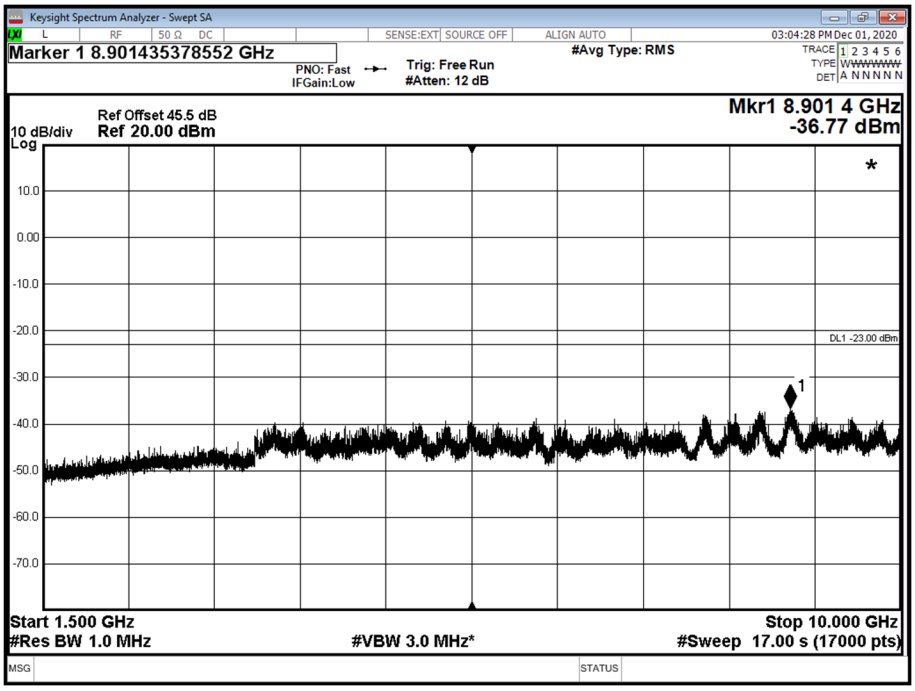

Antenna B - NB-IoT SA Modulation QPSK - NB-IoT SA Carrier Bandwidth 400 kHz - Channel Position B - Band 2 - Range 1500 to 10000 MHz



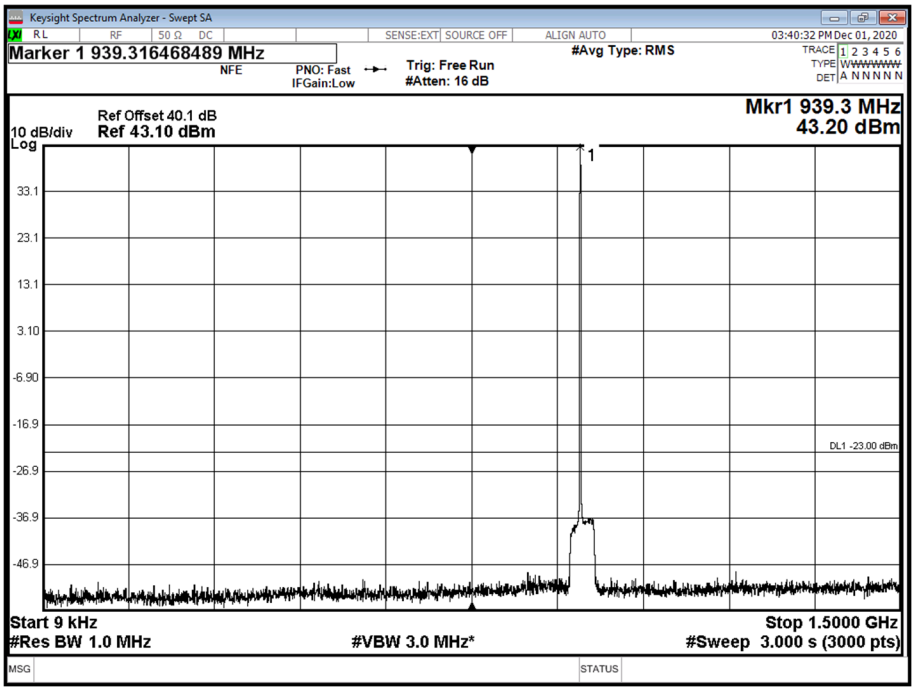
Antenna B - NB-IoT SA Modulation QPSK - NB-IoT SA Carrier Bandwidth 400 kHz - Channel Position M - Band 1 - Range 0.009 to 1500 MHz



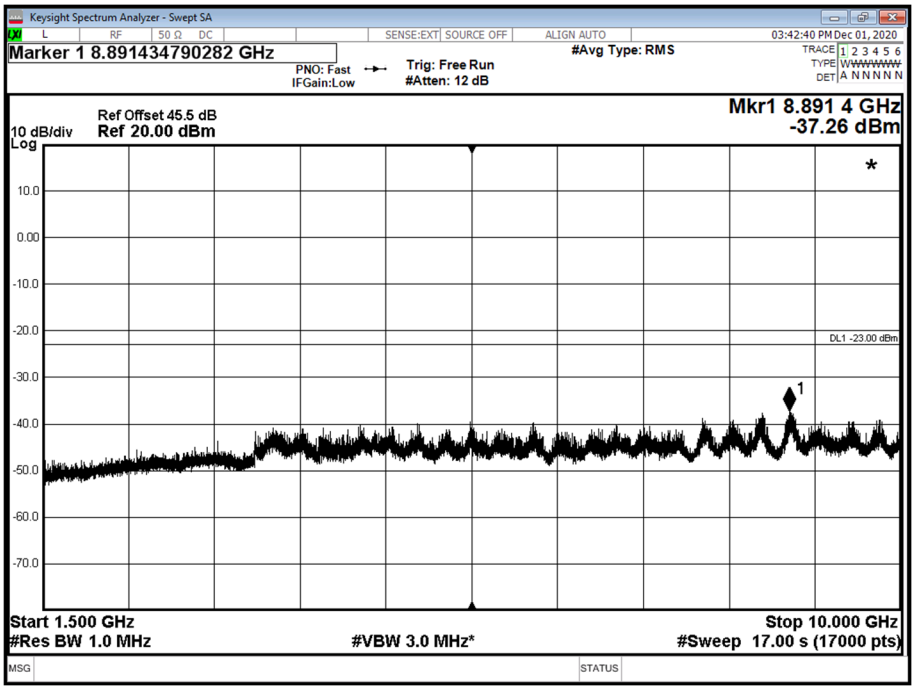

Antenna B - NB-IoT SA Modulation QPSK - NB-IoT SA Carrier Bandwidth 400 kHz - Channel Position M - Band 2 - Range 1500 to 10000 MHz



Antenna B - NB-IoT SA Modulation QPSK - NB-IoT SA Carrier Bandwidth 400 kHz - Channel Position T - Band 1 - Range 0.009 to 1500 MHz




Antenna B - NB-IoT SA Modulation QPSK - NB-IoT SA Carrier Bandwidth 400 kHz - Channel Position T - Band 2 - Range 1500 to 10000 MHz




| | |
|---|---|
| For 900 MHz broadband operations in the 936.5-939.5 MHz band, by at least 50 + 10 log (P) dB | Limit |
| | -23dBm |

## 2.5 RADIATED EMISSIONS

### 2.5.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1053
FCC CFR Part 27, Clause 27.53 (h)
FCC-20-67A1, FCC CFR Part 27, Subpart P, Clause 27.1509

### 2.5.2 Date of Test and Modification State

08 December 2020 - Modification State 0

### 2.5.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.5.4 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 23.8°C |
| Relative Humidity | 26.8% |

### 2.5.5 Test Method

The test was performed in accordance with ANSI C63.26 Clause 5. The EUT was configured as defined in ANSI C63.26, clause 5.5.2.3.2.

As a result of the conducted measurements that were performed on the EUT, it was established that LTE 16QAM 3 MHz was the bandwidth configuration which gave the highest output power and therefore deemed to be worst case operating mode for Single Carrier.

The EUT was setup at a height of 0.8 m above the reference ground plane for measurements below 1 GHz. Above 1 GHz, the EUT was placed at a height of 1.5 m.
A preliminary profile of the Spurious Radiated Emissions was obtained up to the 10th harmonic by operating the EUT on a remotely controlled turntable within a semi-anechoic chamber.

Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The profiling produced a list of the worst-case emissions together with the EUT azimuth and antenna polarisation.

Prescans and final measurements were performed using the direct field strength method. The final measurement detector used is Peak with a Max Hold trace.
The Regulatory limit of -13dBm / MHz has been converted to a field strength limit in accordance with ANSI C63.26 clause 5.2.7 equation c). This is the limit line shown on the plots. Testing was performed at a measurement distance of 3 m.

Example calculation
E (dBuV/m) = EIRP (dBm) - 20log(d) + 104.8 where (d) is the measurement distance.
E (dBuV/m) = -13 - 20log(3) + 104.8
E (dBuV/m) = 82.26

EUT Port/Cable Identification

| Port | Max Cable Length specified | Usage | Type | Screened |
|---|---|---|---|---|
| Configuration and Mode: DC Powered - Transmitters Idle | | | | |
| AC Power | 0.8 m | Power | 115 V 60 Hz AC Mains Power | No |
| DC Power | 1m | Power | -48 V DC | No |
| Fan Alarm | 15m | Signal | RPM 513 2350/15000 | Yes |
| ALD | 3m | Signal | 1/TSR 484 21/3000 | Yes |
| RET en | - | RET | ATM200-A20 | Yes |

### 2.5.6 Test Results

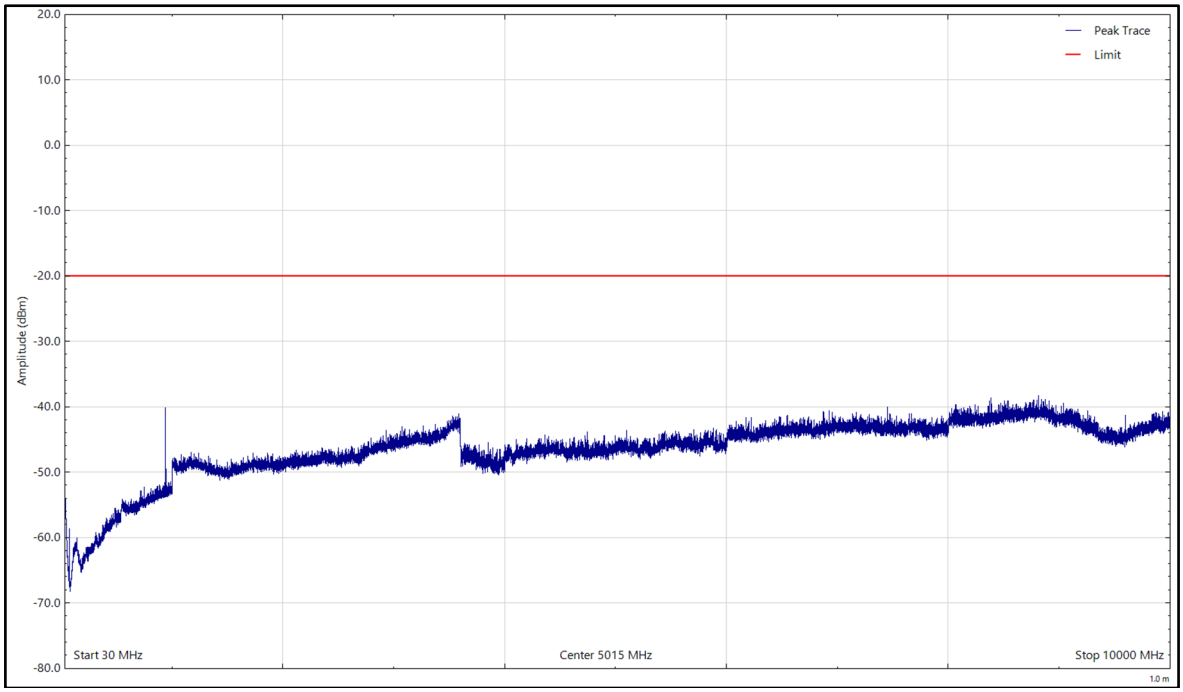
Configuration A2

Maximum Output Power 43 dBm, LTE- M - 1 Carrier - 3.0MHz, 938.00 MHz, 30 MHz to 10 GHz

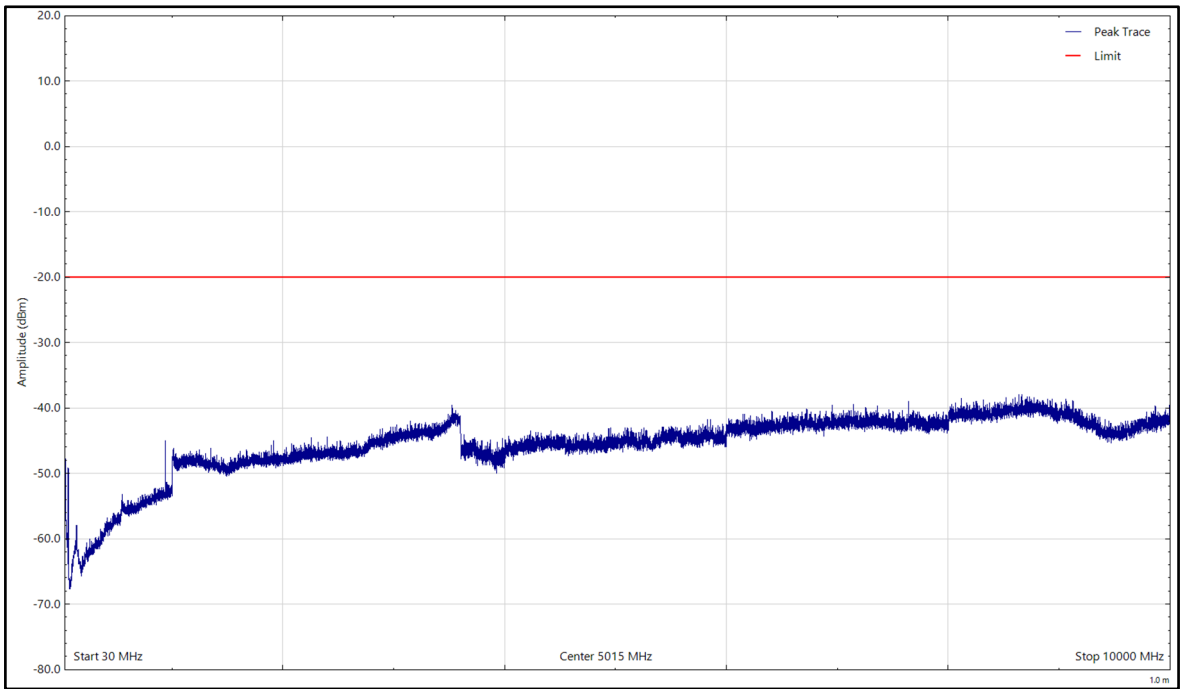
| Frequency (MHz) | Level (dBm) | Limit (dBm) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation |
|---|---|---|---|---|---|---|---|
| * | | | | | | | |

*No emissions found within 6 dB of the limit.

LTE-M - 1 Carrier - 3.0MHz, 938.00 MHz, 30 MHz to 10 GHz, Horizontal (Peak)



LTE-M - 1 Carrier - 3.0MHz, 938.00 MHz, 30 MHz to 10 GHz, Vertical (Peak)



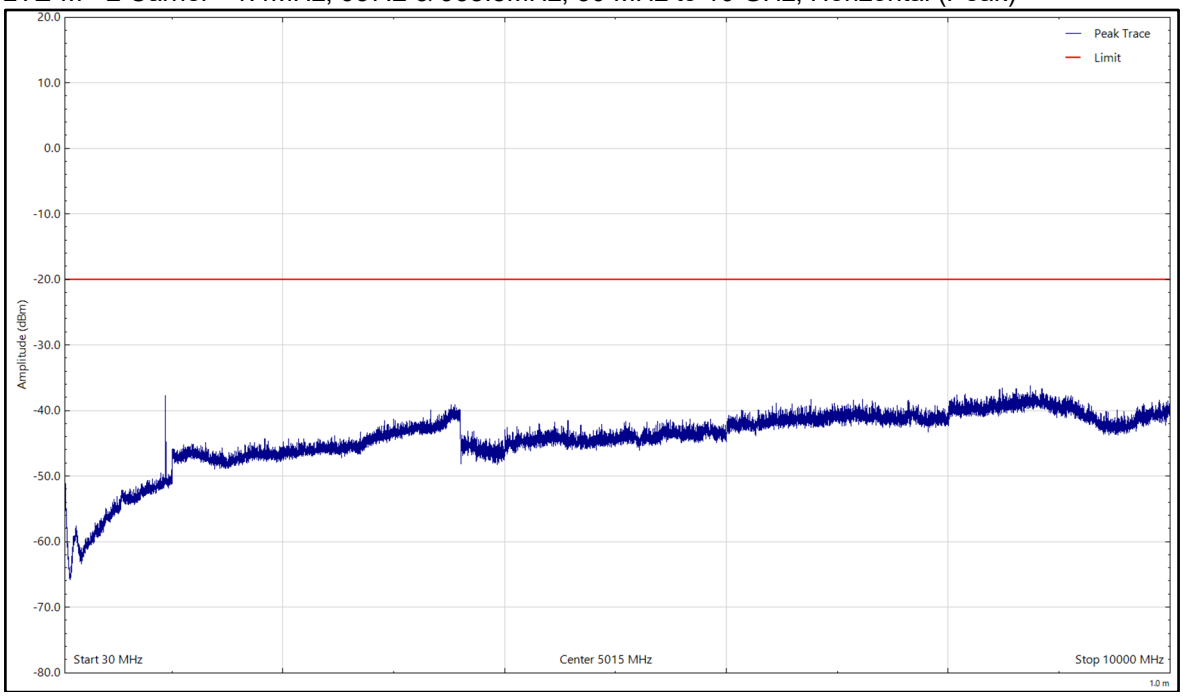
Configuration A3

Maximum Output Power 46 dBm - LTE-M - 2 Carrier - 1.4MHz, 937.2&938.8MHz, 30 MHz to 10 GHz

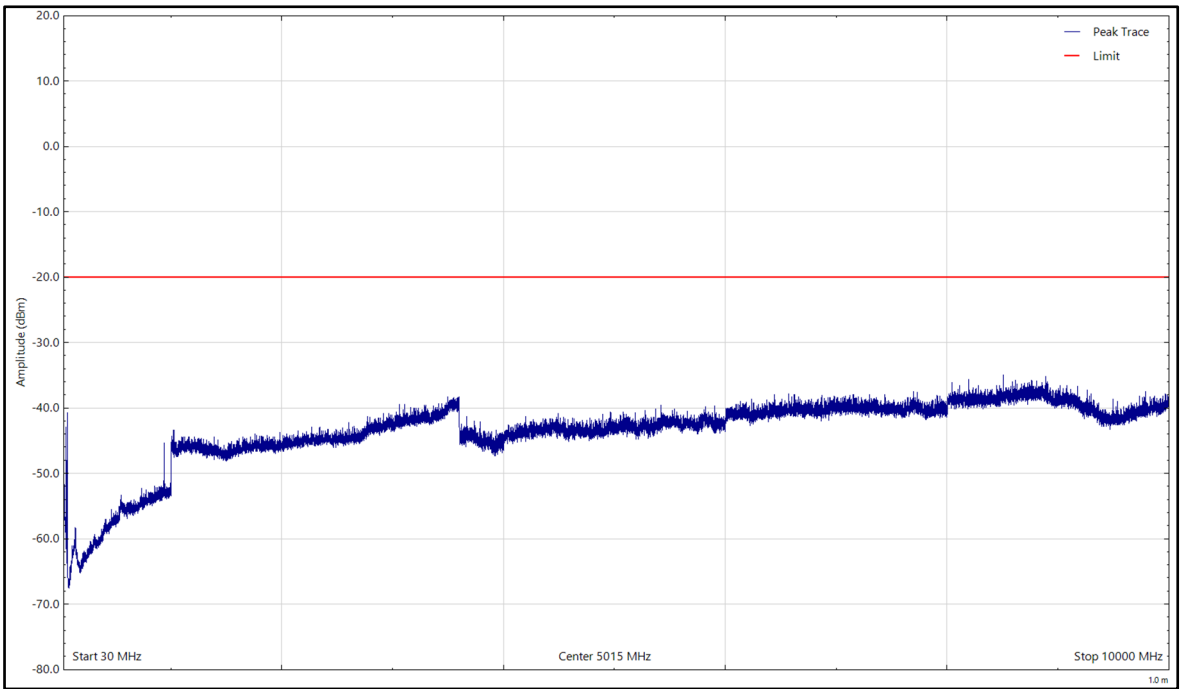
| Frequency (MHz) | Level (dBm) | Limit (dBm) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation |
|---|---|---|---|---|---|---|---|
| * | | | | | | | |

*No emissions found within 6 dB of the limit.

LTE-M - 2 Carrier - 1.4MHz, 937.2 & 938.8MHz, 30 MHz to 10 GHz, Horizontal (Peak)



LTE-M - 2 Carrier - 1.4MHz, 937.2&938.8MHz, 30 MHz to 10 GHz, Vertical (Peak)




| | |
|---|---|
| Limit<br>For 900 MHz broadband operations | The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) in watts by at least the following amounts: |
| 897.5-900.5 MHz band | by at least 43 + 10 log (P) dB. |
| 936.5-939.5 MHz band, | by at least 50 + 10 log (P) dB. |

## 2.6 FREQUENCY STABILITY

### 2.6.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1055
FCC CFR Part 27, Clause 27.54

### 2.6.2 Date of Test and Modification State

07 December 2020 - Modification State 0

### 2.6.3 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.6.4 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 20.7°C |
| Relative Humidity | 27.4% |

### 2.6.5 Test Method

All measurements were made in accordance with FCC KDB 971168 D01, Clause 9 and ANSI C63.26 Clause 5.6.

### 2.6.6 Test Results

Configuration A1

Maximum Output Power 46 dBm

| Temperature | Voltage | Frequency Error (Hz) |
|---|---|---|
| | | Channel Position M |
| -30°C | -48.0 V DC | -0.95 |
| -20°C | -48.0 V DC | -1.02 |
| -10°C | -48.0 V DC | -0.90 |
| 0°C | -48.0 V DC | -0.99 |
| +10°C | -48.0 V DC | -1.02 |
| +20°C | -40.5 V DC | -1.16 |
| +20°C | -48.0 V DC | -1.20 |
| +20°C | -57.5 V DC | -1.20 |
| +30°C | -48.0 V DC | -1.13 |
| +40°C | -48.0 V DC | -1.07 |
| +50°C | -48.0 V DC | -1.09 |

| | |
|---|---|
| Limit | The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation. |

## SECTION 3

## TEST EQUIPMENT USED

## 3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

| Instrument | Manufacturer | Type No. | TE No. | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| Maximum Peak Output Power and Peak to Average Ratio - Conducted | | | | | |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB-40 | 5480 | 12 | 18-Mar-2021 |
| Power Supply | Rohde & Schwarz | HMP4040 | 4954 | - | O/P MON |
| Multimeter | Fluke | 79 | 3057 | 12 | 21-Aug-2021 |
| Attenuator 10dB 100W | Weinschel | 48-10-43 | 4867 | 12 | 23-Jul-2021 |
| Attenuator 30dB 100W | Weinschel | 48-30-43-LIM | 5135 | 12 | 23-Jul-2021 |
| PXA Signal Analyser | Keysight | N9030A | 4653 | 12 | 10-Feb-2021 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 17-May-2021 |
| Rubidium Standard | Rohde & Schwarz | XSRM | 1316 | 6 | 17-May-2021 |
| Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 11-Dec-2020 |
| Calibration Kit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 11-Dec-2020 |
| Occupied Bandwidth | | | | | |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB-40 | 5480 | 12 | 18-Mar-2021 |
| Power Supply | Rohde & Schwarz | HMP4040 | 4954 | - | O/P MON |
| Multimeter | Fluke | 79 | 3057 | 12 | 21-Aug-2021 |
| Attenuator 10dB 100W | Weinschel | 48-10-43 | 4867 | 12 | 23-Jul-2021 |
| Attenuator 30dB 100W | Weinschel | 48-30-43-LIM | 5135 | 12 | 23-Jul-2021 |
| PXA Signal Analyser | Keysight | N9030A | 4653 | 12 | 10-Feb-2021 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 17-May-2021 |
| Rubidium Standard | Rohde & Schwarz | XSRM | 1316 | 6 | 17-May-2021 |
| Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 11-Dec-2020 |
| Calibration Kit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 11-Dec-2020 |
| Band Edge | | | | | |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB-40 | 5480 | 12 | 18-Mar-2021 |
| Power Supply | Rohde & Schwarz | HMP4040 | 4954 | - | O/P MON |
| Multimeter | Fluke | 79 | 3057 | 12 | 21-Aug-2021 |
| Attenuator 10dB 100W | Weinschel | 48-10-43 | 4867 | 12 | 23-Jul-2021 |
| Attenuator 30dB 100W | Weinschel | 48-30-43-LIM | 5135 | 12 | 23-Jul-2021 |
| PXA Signal Analyser | Keysight | N9030A | 4653 | 12 | 10-Feb-2021 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 17-May-2021 |
| Rubidium Standard | Rohde & Schwarz | XSRM | 1316 | 6 | 17-May-2021 |
| Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 11-Dec-2020 |
| Calibration Kit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 11-Dec-2020 |
| Transmitter Spurious Emissions | | | | | |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB-40 | 5480 | 12 | 18-Mar-2021 |
| Power Supply | Rohde & Schwarz | HMP4040 | 4954 | - | O/P MON |
| Multimeter | Fluke | 79 | 3057 | 12 | 21-Aug-2021 |

| Instrument | Manufacturer | Type No. | TE No. | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| Attenuator 10dB 100W | Weinschel | 48-10-43 | 4867 | 12 | 23-Jul-2021 |
| Attenuator 30dB 100W | Weinschel | 48-30-43-LIM | 5135 | 12 | 23-Jul-2021 |
| PXA Signal Analyser | Keysight | N9030A | 4653 | 12 | 10-Feb-2021 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 17-May-2021 |
| Rubidium Standard | Rohde & Schwarz | XSRM | 1316 | 6 | 17-May-2021 |
| Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 11-Dec-2020 |
| Calibration Kit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 11-Dec-2020 |
| HPF 1.5GHz | Wainwright | WHKX12-1290-1500-18000-80SS | 4961 | 12 | 25-Mar-2021 |
| Frequency Stability | | | | | |
| Hygrometer | Rotronic | A1 | 2138 | 12 | 01-Jul-2021 |
| Power Supply | Rohde & Schwarz | HMP4040 | 4954 | - | O/P MON |
| Multimeter | Fluke | 79 | 3057 | 12 | 21-Aug-2021 |
| Attenuator 10dB 100W | Weinschel | 48-10-43 | 4867 | 12 | 23-Jul-2021 |
| Attenuator 30dB 100W | Weinschel | 48-30-43-LIM | 5135 | 12 | 23-Jul-2021 |
| PXA Signal Analyser | Keysight | N9030A | 4654 | 12 | 06-Nov-2021 |
| Frequency Standard | Symmetricom | 8040C | 3490 | 12 | 27-May-2021 |
| Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 11-Dec-2020 |
| Calibration Kit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 11-Dec-2020 |
| Environmental Chamber | ACS | DY110TC | 5589 | - | O/P MON |
| Thermometer | Digitron | T208 | 2831 | 12 | 19-Dec-2020 |
| Radiated Emissions | | | | | |
| Antenna with permanent attenuator (Bilog) | Schaffner | CBL6143 | 287 | 24 | 14-Oct-2022 |
| Power Supply Unit | Farnell | TSV-70 | 2043 | 12 | O/P Mon |
| Multimeter | Fluke | 79 Series II | 3057 | 12 | 21-Aug-2021 |
| EMI Test Receiver | Rohde & Schwarz | ESU40 | 3506 | 12 | 03-Jan-2021 |
| EmX Emissions Software | TUV SUD | V2.0.1<br>V.V2.0.1 | 5125 | 0 | Software |
| 3.5 mm 2m Cable | Junkosha | MWX221-02000DMS | 5428 | 12 | 15-Oct-2021 |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB-40 | 5481 | 12 | 18-Mar-2021 |
| 8m N Type Cable | Junkosha | MWX221-08000NMSNMS/B | 5519 | 12 | 24-Mar-2021 |
| Broadband Horn Antenna (1-10 GHz) | Schwarzbeck | BBHA 9120 B | 5611 | 12 | 22-Sep-2021 |
| 3m Semi Anechoic Chamber | MVG | EMC-3 | 5621 | 36 | 11-Aug-2023 |

N/A – Not Applicable
O/P Mon – Output Monitored with Calibrated Equipment

## 3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

| Test Discipline | Frequency / Parameter | | MU |
|---|---|---|---|
| Conducted Maximum Peak Output Power | 30 MHz to 20 GHz Amplitude | | ± 0.8908 dB |
| Conducted Emissions | 30 MHz to 20 GHz Amplitude | | ± 2.5445 dB |
| Frequency Stability | 30 MHz to 2 GHz | | ± 5.0 Hz |
| Occupied Bandwidth | Up to 20 MHz Bandwidth | 5 MHz Bandwidth | ± 11547 Hz |
| | | 10 MHz Bandwidth | ± 23094 Hz |
| | | 15 MHz Bandwidth | ± 34641 Hz |
| | | 20 MHz Bandwidth | ± 46188 Hz |
| Band Edge | 30 MHz to 20 GHz Amplitude | | ± 0.8908dB |

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2007, clause 4.4.3 and 4.5.1.

## SECTION 5

## ACCREDITATION, DISCLAIMERS AND COPYRIGHT

## 4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

# ANNEX A

# MODULE LIST

| Configuration A1-A4 | | | |
|---|---|---|---|
| Product | Product No | R-State | Serial No |
| Radio 2212 B8 | KRC161 650/1 | R5H | E238996984 |
| Software Version: | CXP9013268/15 | Revision: | R85BS |