

## FCC/ISED Test Report

**Prepared for:** Connections Design, LLC

**Address:** 405 N Jefferson Ave  
Springfield, MO 65806, USA

**Product:** ECRI

**Test Report No:** R230404-20-E1

**Approved by:**



Mahendra Karthik Vepuri, NCE  
EMC Test Engineer,  
iNARTE Certified EMC Engineer #EMC-041453-E

**DATE:** June 29, 2023

**Total Pages:** 41

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|                |                         |     |   |
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## REVISION PAGE

| Rev. No. | Date         | Description                                                      |
|----------|--------------|------------------------------------------------------------------|
| 0        | 29 June 2023 | Issued by KVepuri<br>Reviewed by KVepuri<br>Prepared by ESchmidt |



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## 1.0 SUMMARY OF TEST RESULTS

The worst-case measurements were reported in this report. Summary of test results presented in this report correspond to the following section:

### FCC Part 15.247

The EUT has been tested according to the following specifications:

- (1) US Code of Federal Regulations, Title 47, Part 15
- (2) ISSED RSS-Gen, Issue 5
- (3) ISSED RSS-247, Issue 2

| APPLIED STANDARDS AND REGULATIONS                                                                                            |                                |                                             |
|------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------------------------|
| Standard Section                                                                                                             | Test Type                      | Result                                      |
| FCC Part 15.35<br>RSS Gen, Issue 5, Section 6.10                                                                             | Duty Cycle                     | Pass                                        |
| FCC Part 15.247(b)(3)<br>RSS-247 Issue 2 Section 5.4(d)                                                                      | Peak output power              | Pass                                        |
| FCC Part 15.247(a)(2)<br>RSS-247 Issue 2 Section 5.2(a)                                                                      | Bandwidth                      | Pass                                        |
| FCC Part 15.209<br>RSS-Gen Issue 5, Section 7.3                                                                              | Receiver Radiated Emissions    | Pass                                        |
| FCC Part 15.209 (restricted bands), 15.247 (unrestricted)<br>RSS-247 Issue 2 Section 5.5, RSS-Gen Issue 5, Section 8.9, 8.10 | Transmitter Radiated Emissions | Pass                                        |
| FCC Part 15.247(e)<br>RSS-247 Issue 2 Section 5.2(b)                                                                         | Power Spectral Density         | Pass                                        |
| FCC Part 15.209, 15.247(d)<br>RSS-247 Issue 2 Section 5.5                                                                    | Band Edge Measurement          | Pass                                        |
| FCC Part 15.207<br>RSS-Gen Issue 5, Section 8.8                                                                              | Conducted Emissions            | Not Applicable –<br>EUT is battery powered. |



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## 2.0 EUT DESCRIPTION

### 2.1 EQUIPMENT UNDER TEST

#### Summary and Operating Condition:

|                        |                                                                                                                                                                                                                   |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EUT                    | ECRI                                                                                                                                                                                                              |
| Model                  | ECRI-A01                                                                                                                                                                                                          |
| IC                     | 30310-ECRIA01                                                                                                                                                                                                     |
| FCC ID                 | 2BARY-ECRIA01                                                                                                                                                                                                     |
| EUT Received           | 14 June 2023                                                                                                                                                                                                      |
| EUT Tested             | 14 June 2023- 15 June 2023                                                                                                                                                                                        |
| Serial No.             | 011158 (NCEE assigned SN)                                                                                                                                                                                         |
| Operating Band         | 2400 – 2483.5 MHz                                                                                                                                                                                                 |
| Device Type            | <input checked="" type="checkbox"/> GMSK <input type="checkbox"/> GFSK <input type="checkbox"/> BT BR <input type="checkbox"/> BT EDR 2MB <input type="checkbox"/> BT EDR 3MB<br><input type="checkbox"/> 802.11x |
| Power Supply / Voltage | Powered by 12VDC Marine Battery                                                                                                                                                                                   |

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual.

### 2.2 DESCRIPTION OF TEST MODES

The operating range of the EUT is dependent on the device type found in section 2.1:

GMSK Transmissions:

| Channel | Frequency |
|---------|-----------|
| Low     | 2402 MHz  |
| Mid     | 2440 MHz  |
| High    | 2480 MHz  |

These are the only representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequency and designations.

### 2.3 DESCRIPTION OF SUPPORT UNITS

None

|                                                                                  |                |                         |     |   |
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### 3.0 LABORATORY AND GENERAL TEST DESCRIPTION

#### 3.1 LABORATORY DESCRIPTION

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)  
 4740 Discovery Drive  
 Lincoln, NE 68521  
 A2LA Certificate Number: 1953.01  
 FCC Accredited Test Site Designation No: US1060  
 Industry Canada Test Site Registration No: 4294A  
 NCC CAB Identification No: US0177

Environmental conditions varied slightly throughout the tests:

Relative humidity of  $35 \pm 4\%$

Temperature of  $22 \pm 3^\circ$  Celsius



#### 3.2 TEST PERSONNEL

| No. | PERSONNEL      | TITLE           | ROLE               |
|-----|----------------|-----------------|--------------------|
| 1   | Fox Lane       | Test Engineer   | Testing            |
| 2   | Karthik Vepuri | Test Engineer   | Review and Report  |
| 3   | Ethan Schmidt  | Test Technician | Testing and Report |

**Notes:** All personnel are permanent staff members of NCEE Labs. No testing or review was sub-contracted or performed by sub-contracted personnel.



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### 3.3 TEST EQUIPMENT

| DESCRIPTION AND MANUFACTURER                              | MODEL NO.                      | SERIAL NO.           | LAST CALIBRATION DATE | CALIBRATION DUE DATE |
|-----------------------------------------------------------|--------------------------------|----------------------|-----------------------|----------------------|
| Keysight MXE Signal Analyzer (26.5GHz)**                  | N9038A                         | MY56400083           | July 19, 2022         | July 19, 2024        |
| SunAR RF Motion                                           | JB1                            | A082918-1            | July 26, 2022         | July 26, 2023        |
| ETS EMCO Red Horn Antenna                                 | 3115                           | 00218655             | July 21, 2022         | July 21, 2023        |
| 8447F POT H64 Preamplifier*                               | 8447F POT H64                  | 3113AD4667           | March 21, 2022        | March 21, 2024       |
| Rohde & Schwarz Preamplifier*                             | TS-PR18                        | 3545700803           | August 22, 2022       | August 22, 2024      |
| Trilithic High Pass Filter*                               | 6HC330                         | 23042                | March 21, 2022        | March 21, 2024       |
| ETS – Lindgren- VSWR on 10m Chamber***                    | 10m Semi-anechoic chamber-VSWR | 4740 Discovery Drive | July 30, 2020         | July 30, 2023        |
| NCEE Labs-NSA on 10m Chamber*                             | 10m Semi-anechoic chamber-NSA  | NCEE-001             | May 25, 2022          | May 25, 2024         |
| TDK Emissions Lab Software                                | V11.25                         | 700307               | NA                    | NA                   |
| RF Cable (preamplifier to antenna)*                       | MFR-57500                      | 90-195-040           | August 22, 2022       | August 22, 2024      |
| RF Cable (antenna to 10m chamber bulkhead)*               | FSCM 64639                     | 01E3872              | September 24, 2021    | September 24, 2023   |
| RF Cable (10m chamber bulkhead to control room bulkhead)* | FSCM 64639                     | 01E3864              | September 24, 2021    | September 24, 2023   |
| RF Cable (control room bulkhead to test receiver)*        | FSCM 64639                     | 01F1206              | September 24, 2021    | September 24, 2023   |
| N connector bulkhead (10m chamber)*                       | PE9128                         | NCEEBH1              | September 24, 2021    | September 24, 2023   |
| N connector bulkhead (control room)*                      | PE9128                         | NCEEBH2              | September 24, 2021    | September 24, 2023   |

\*Internal Characterization

\*\*2 Year Cal Cycle

\*\*\*3 Year Cal Cycle

**Notes:**

All equipment is owned by NCEE Labs and stored permanently at NCEE Labs facilities.

|                                                                                  |                |                         |     |   |
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### 3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMENTS

Measurement type presented in this report (Please see the checked box below):

#### Conducted – N/A

The conducted measurements were performed by connecting the output of the transmitter directly into a spectrum analyzer using an impedance matched cable and connector soldered to the EUT in place of the antenna. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in the Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

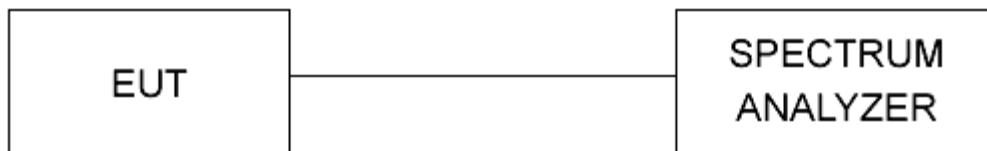


Figure 1 - Bandwidth Measurements Test Setup

#### Radiated ☒

All the radiated measurements were taken at a distance of 3m from the EUT. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in the Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

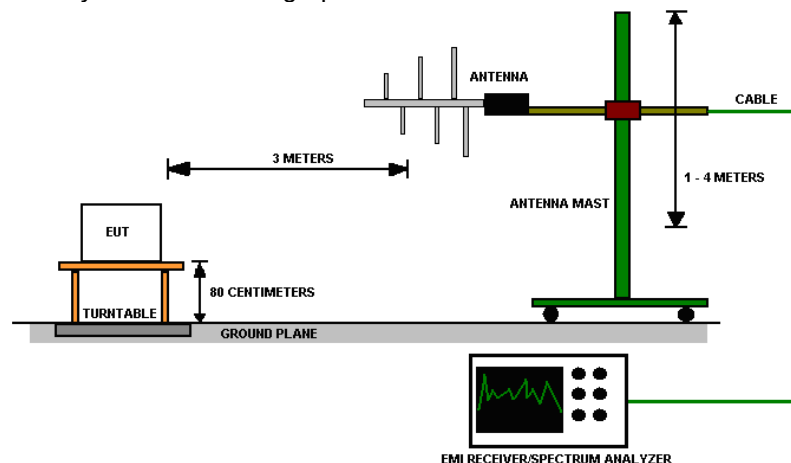


Figure 2 - Radiated Emissions Test Setup



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**4.0 RESULTS****DTS Radiated Radio Measurements**

| CHANNEL                                                  | Mode | Occupied Bandwidth (kHz) | 6 dB Bandwidth (kHz) | PEAK OUTPUT POWER (dBm)                             | PEAK OUTPUT POWER (mW) | PSD (dBm) | Result |
|----------------------------------------------------------|------|--------------------------|----------------------|-----------------------------------------------------|------------------------|-----------|--------|
| Low                                                      | GMSK | 1922.50                  | 1212.00              | 7.917                                               | 6.190                  | 1.626     | PASS   |
| Mid                                                      | GMSK | 1927.00                  | 1210.00              | 6.623                                               | 4.595                  | 0.233     | PASS   |
| High                                                     | GMSK | 1932.30                  | 1209.00              | 5.555                                               | 3.593                  | -0.851    | PASS   |
| Occupied Bandwidth = N/A; 6 dB Bandwidth Limit = 500 kHz |      |                          |                      | Peak Output Power Limit = 30 dBm; PSD Limit = 8 dBm |                        |           |        |

**Radiated Unrestricted Band-Edge**

| CHANNEL | Mode | Band edge /Measurement Frequency (MHz) | Relative Highest out of band level (dBuV) | Relative Fundamental (dBuV) | Delta (dB) | Min Delta (dB) | Result |
|---------|------|----------------------------------------|-------------------------------------------|-----------------------------|------------|----------------|--------|
| Low     | GMSK | 2400.00                                | 9.208                                     | 60.529                      | 51.321     | 20.00          | PASS   |
| High    | GMSK | 2483.50                                | -2.030                                    | 57.413                      | 59.443     | 20.00          | PASS   |

**Radiated Peak Restricted Band-Edge**

| CHANNEL | Mode | Band edge /Measurement Frequency (MHz) | Highest out of band level (dBuV/m @ 3m) | Detector | Limit (dBuV/m @ 3m) | Margin (dB) | Result |
|---------|------|----------------------------------------|-----------------------------------------|----------|---------------------|-------------|--------|
| Low     | GMSK | 2390.00                                | 51.092                                  | Peak     | 73.98               | 22.888      | PASS   |
| High    | GMSK | 2483.50                                | 54.672                                  | Peak     | 73.98               | 19.308      | PASS   |

\*Limit shown is the peak limit taken from FCC Part 15.209

**Radiated Average Restricted Band-Edge**

| CHANNEL | Mode | Band edge /Measurement Frequency (MHz) | Highest out of band level (dBuV/m @ 3m) | Detector | Limit (dBuV/m @ 3m) | Margin (dB) | Result |
|---------|------|----------------------------------------|-----------------------------------------|----------|---------------------|-------------|--------|
| Low     | GMSK | 2390.00                                | 41.729                                  | Peak     | 53.98               | 12.251      | PASS   |
| High    | GMSK | 2483.50                                | 44.506                                  | Peak     | 53.98               | 9.474       | PASS   |

\*Limit shown is the peak limit taken from FCC Part 15.209

\*Note that all the power related measurements contain the corrections including EIRP conversion from 3m.

Example of Conversion:

Correction with EIRP = 8.83 (Cable loss) + 27.66 (Transducer) + 107 (dBm-dBuV) - 95.23 (EIRP conversion from 3m)  
= 48.26 dB (for High Channel)

This value is used as reference level offset to get the corrected value of 5.55 dBm



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#### 4.1 OUTPUT POWER

**Test Method:** All measurements were performed using the section 11.9.2.2.2 from ANSI C63.10.

**Limits of power measurements:**

**For FCC Part 15.247 Device:**

The maximum allowed output power is 30 dBm.

**Test procedures:**

Details can be found in section 3.4 of this report.

**Deviations from test standard:**

No deviation.

**Test setup:**

Details can be found in section 3.4 of this report.

**EUT operating conditions:**

Details can be found in section 2.1 of this report.

**Test results:**

**Pass**

Comments:

1. All the output power plots can be found in the Appendix C.
2. All the measurements were found to be compliant.
3. Tabulated data is listed in section 4.0.



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## 4.2 BANDWIDTH

**Test Method:** All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

### Limits of bandwidth measurements:

#### For FCC Part 15.247 Device:

The 99% occupied bandwidth is for informational purpose only. The 6dB bandwidth of the signal must be greater than 500 kHz.

#### Test procedures:

Details can be found in section 3.4 of this report.

#### Deviations from test standard:

No deviation.

#### Test setup:

Test setup details can be found in section 3.4 of this report.

#### EUT operating conditions:

Details can be found in section 2.1 of this report.

#### Test results:

### Pass

Comments:

1. All the bandwidth plots can be found in the Appendix C.
2. All the measurements were found to be compliant.
3. Tabulated data is listed in section 4.0.



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#### 4.3 DUTY CYCLE

**Test Method:** Test software utilized >98% duty cycle and all tests were run with >98% duty cycle. Duty cycle correction was not applied to any of the measurements.

#### 4.4 RADIATED EMISSIONS

**Test Method:** ANSI C63.10-2013, Section 6.5, 6.6

**Limits for radiated emissions measurements:**

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

| FREQUENCIES<br>(MHz) | FIELD STRENGTH<br>( $\mu$ V/m) | MEASUREMENT<br>DISTANCE (m) |
|----------------------|--------------------------------|-----------------------------|
| 0.009-0.490          | 2400/F(kHz)                    | 300                         |
| 0.490-1.705          | 24000/F(kHz)                   | 30                          |
| 1.705-30.0           | 30                             | 3                           |
| 30-88                | 100                            | 3                           |
| 88-216               | 150                            | 3                           |
| 216-960              | 200                            | 3                           |
| Above 960            | 500                            | 3                           |

**NOTE:**

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dB $\mu$ V/m) = 20 \* log \* Emission level ( $\mu$ V/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.
4. The EUT was tested for spurious emissions while running off of battery power and external USB power. The worse-case emissions were produced while running off of USB power, so results from this mode are presented.

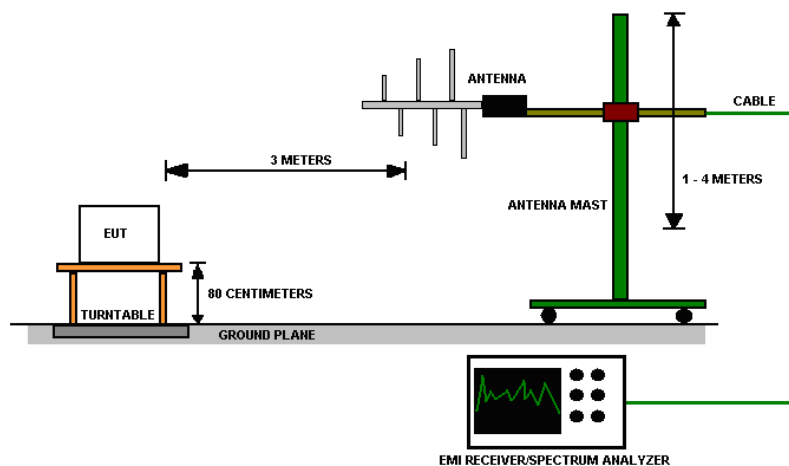


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**Test procedures:**

- a. The EUT was placed on the top of a rotating table above the ground plane in a 10-meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements from 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.
- d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.
- e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise, the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- g. The EUT was maximized in all 3 orthogonal positions. The results are presented for the axis that had the highest emissions.

### Test setup:



**Figure 3 - Radiated Emissions Test Setup**

### NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.
2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz. A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

### Deviations from test standard:

No deviation.

### EUT operating conditions

Details can be found in section 2.1 of this report.



|                |                         |     |   |
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Test results:

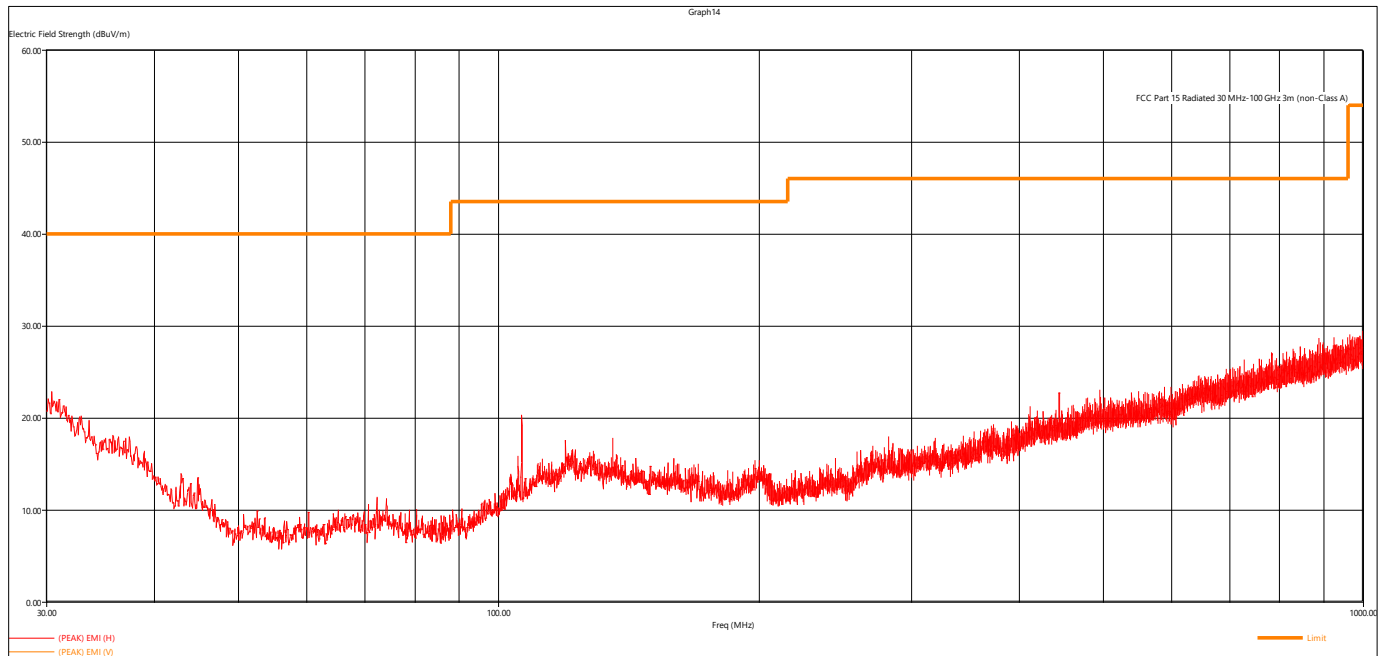


Figure 4 - Radiated Emissions Plot, Receive, Horizontal

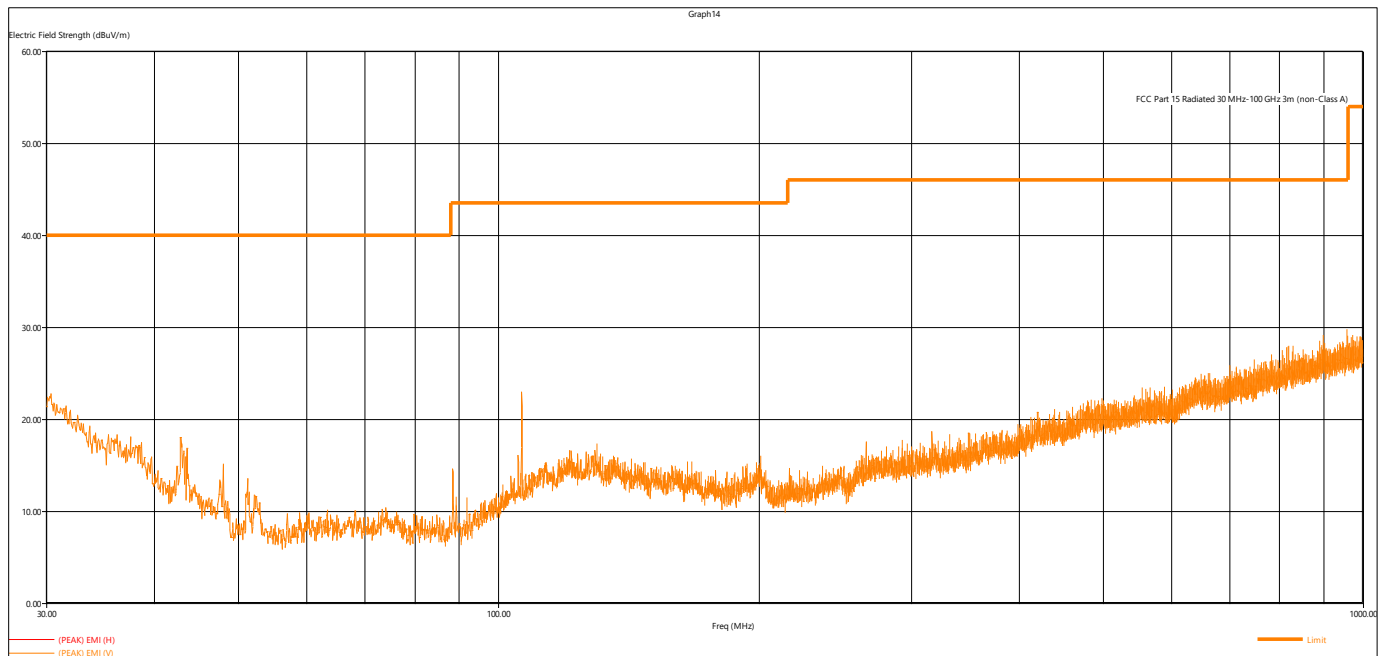
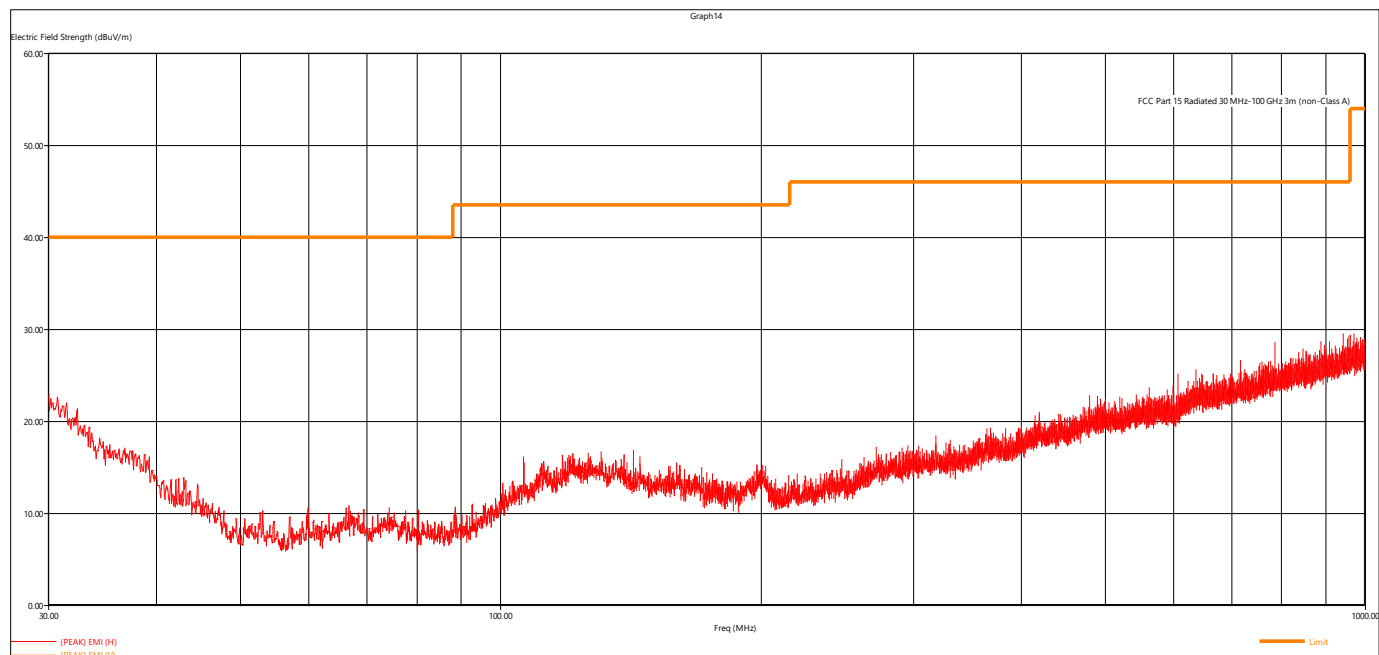
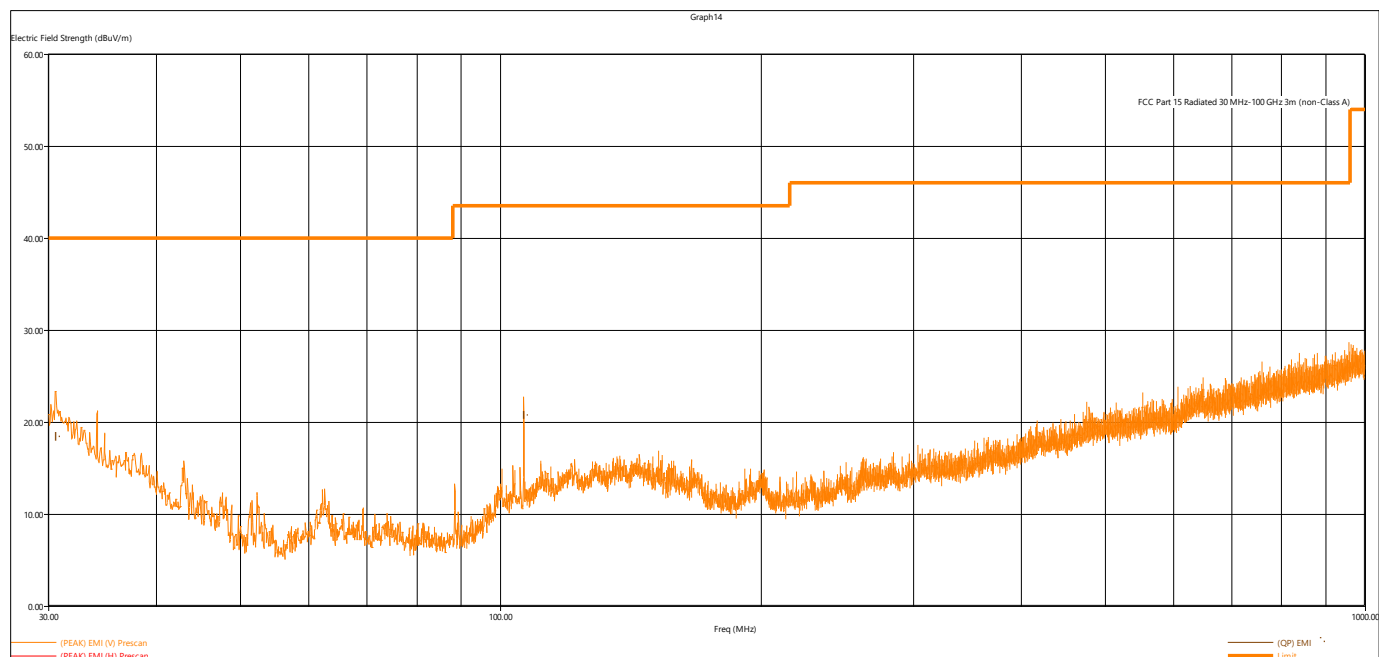


Figure 5 - Radiated Emissions Plot, Receive, Vertical



**Figure 6 - Radiated Emissions Plot, GMSK, Horizontal**



**Figure 7 - Radiated Emissions Plot, GMSK, Vertical**



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**REMARKS:**

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value - Emission level

| Quasi-Peak Measurements, GMSK |              |              |        |        |        |     |         |            |
|-------------------------------|--------------|--------------|--------|--------|--------|-----|---------|------------|
| Frequency                     | Level        | Limit        | Margin | Height | Angle  | Pol | Channel | Modulation |
| MHz                           | dB $\mu$ V/m | dB $\mu$ V/m | dB     | cm.    | deg.   |     |         |            |
| 30.491520                     | 18.34        | 40.00        | 21.66  | 398.00 | 112.00 | V   | Low     | GMSK       |
| 106.284720                    | 20.67        | 43.52        | 22.85  | 106.00 | 343.00 | V   | Low     | GMSK       |

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the plot and table above.  
All other measurements were found to be at least 6 dB below the limit.



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**Peak Measurements, GMSK**

| Frequency    | Level        | Limit        | Margin | Height | Angle  | Pol | Channel | Modulation |
|--------------|--------------|--------------|--------|--------|--------|-----|---------|------------|
| MHz          | dB $\mu$ V/m | dB $\mu$ V/m | dB     | cm.    | deg.   |     |         |            |
| 2401.308000  | 103.11       | NA           | NA     | 250.00 | 90.00  | H   | Low     | GMSK       |
| 2440.444000  | 101.96       | NA           | NA     | 211.00 | 323.00 | H   | Mid     | GMSK       |
| 2480.470000  | 100.32       | NA           | NA     | 276.00 | 109.00 | H   | High    | GMSK       |
| 7207.518000  | 56.86        | 73.98        | 17.12  | 467.00 | 10.00  | V   | Low     | GMSK       |
| 12006.566000 | 57.67        | 73.98        | 16.31  | 379.00 | 38.00  | V   | Low     | GMSK       |
| 7321.492000  | 55.76        | 73.98        | 18.22  | 358.00 | 198.00 | V   | Mid     | GMSK       |
| 12196.606000 | 58.45        | 73.98        | 15.53  | 380.00 | 36.00  | V   | Mid     | GMSK       |
| 7441.244000  | 54.86        | 73.98        | 19.12  | 380.00 | 30.00  | V   | High    | GMSK       |
| 12402.278000 | 61.44        | 73.98        | 12.54  | 364.00 | 37.00  | V   | High    | GMSK       |

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the plot above.

All other measurements were found to be at least 6 dB below the limit.

**Average Measurements, GMSK**

| Frequency    | Level        | Limit        | Margin | Height | Angle  | Pol | Channel | Modulation |
|--------------|--------------|--------------|--------|--------|--------|-----|---------|------------|
| MHz          | dB $\mu$ V/m | dB $\mu$ V/m | dB     | cm.    | deg.   |     |         |            |
| 2401.308000  | 96.70        | NA           | NA     | 250.00 | 90.00  | H   | Low     | GMSK       |
| 2440.444000  | 96.08        | NA           | NA     | 211.00 | 323.00 | H   | Mid     | GMSK       |
| 2480.470000  | 94.24        | NA           | NA     | 276.00 | 109.00 | H   | High    | GMSK       |
| 7207.518000  | 45.37        | 53.98        | 8.61   | 467.00 | 10.00  | V   | Low     | GMSK       |
| 12006.566000 | 44.88        | 53.98        | 9.10   | 379.00 | 38.00  | V   | Low     | GMSK       |
| 7321.492000  | 43.72        | 53.98        | 10.26  | 358.00 | 198.00 | V   | Mid     | GMSK       |
| 12196.606000 | 45.96        | 53.98        | 8.02   | 380.00 | 36.00  | V   | Mid     | GMSK       |
| 7441.244000  | 43.61        | 53.98        | 10.37  | 380.00 | 30.00  | V   | High    | GMSK       |
| 12402.278000 | 50.71        | 53.98        | 3.27   | 364.00 | 37.00  | V   | High    | GMSK       |

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the table above.

All other measurements were found to be at least 6 dB below the limit.



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#### 4.5 BAND EDGES

**Test Method:**

All the radio measurements were performed using the sections from ANSI C63.10, Section 11.12.2.5.2. Details about the section used can be found in the spectrum analyzer titles on the graph.

**Limits of band-edge measurements:****For FCC Part 15.247 Device:**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

**Test procedures:**

The highest emissions level beyond the band-edge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209. More details can be found in section 3.4 of this report.

**Deviations from test standard:**

No deviation.

**Test setup:**

Test setup details can be found in section 3.4 of this report.

**EUT operating conditions:**

Details can be found in section 2.1 of this report.



|                |                         |     |   |
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**Test results:**

**Pass**

Comments:

1. All the band edge plots can be found in the Appendix C.
2. If the device falls under FCC Part 15.247 (Details can be found in summary of test results), compliance is shown in the unrestricted band edges by showing minimum delta of 20 dB between peak and the band edge.
3. The restricted band edge compliance is shown by comparing to the general limit defined in Part 15.209.
4. Tabulated data is listed in section 4.0.



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## 4.6 POWER SPECTRAL DENSITY

### Test Method:

All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

### Limits of power measurements:

#### For FCC Part 15.247 Device:

The maximum PSD allowed is 8 dBm.

### Test procedures:

Details can be found in section 3.4 of this report.

### Deviations from test standard:

No deviation.

### Test setup:

Details can be found in section 3.4 of this report.

### EUT operating conditions:

Details can be found in section 2.1 of this report.

### Test results:

## Pass

#### Comments:

1. All the Power Spectral Density (PSD) plots can be found in the Appendix C.
2. All the measurements were found to be compliant.
3. Tabulated data is listed in section 4.0.

|                                                                                  |                |                         |     |   |
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## APPENDIX A: SAMPLE CALCULATION

### Field Strength Calculation

The field strength is calculated by adding the Antenna Factor, Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF - (-CF + AG) + AV$$

FS = Field Strength  
 RA = Receiver Amplitude  
 AF = Antenna Factor  
 CF = Cable Attenuation Factor  
 AG = Amplifier Gain  
 AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dB $\mu$ V is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dB $\mu$ V/m.

$$FS = 55 + 12 - (-1.1 + 20) + 0 = 48.1 \text{ dB}\mu\text{V/m}$$

The 48.1 dB $\mu$ V/m value can be mathematically converted to its corresponding level in  $\mu$ V/m.

Level in  $\mu$ V/m = Common Antilogarithm [(48.1 dB $\mu$ V/m)/20] = 254.1  $\mu$ V/m

AV is calculated by taking the  $20 \cdot \log(T_{on}/100)$  where  $T_{on}$  is the maximum transmission time in any 100ms window.

### EIRP Calculations

In cases where direct antenna port measurement is not possible or would be inaccurate, output power is measured in EIRP. The maximum field strength is measured at a specified distance and the EIRP is calculated using the following equation;

$$EIRP \text{ (Watts)} = [Field \text{ Strength (V/m)} \times antenna \text{ distance (m)}]^2 / 30$$

$$Power \text{ (watts)} = 10^{[Power \text{ (dBm)}/10]} / 1000$$

$$Voltage \text{ (dB}\mu\text{V)} = Power \text{ (dBm)} + 107 \text{ (for } 50\Omega \text{ measurement systems)}$$

$$Field \text{ Strength (V/m)} = 10^{[Field \text{ Strength (dB}\mu\text{V/m)} / 20]} / 10^6$$

$$Gain = 1 \text{ (numeric gain for isotropic radiator)}$$

$$Conversion \text{ from } 3m \text{ field strength to EIRP (d=3):}$$

$$EIRP = [FS(V/m) \times d^2]/30 = FS [0.3] \quad \text{for } d = 3$$

$$EIRP(dBm) = FS(dB\mu V/m) - 10(\log 10^9) + 10\log[0.3] = FS(dB\mu V/m) - 95.23$$

$10\log(10^9)$  is the conversion from micro to milli.



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## APPENDIX B – MEASUREMENT UNCERTAINTY

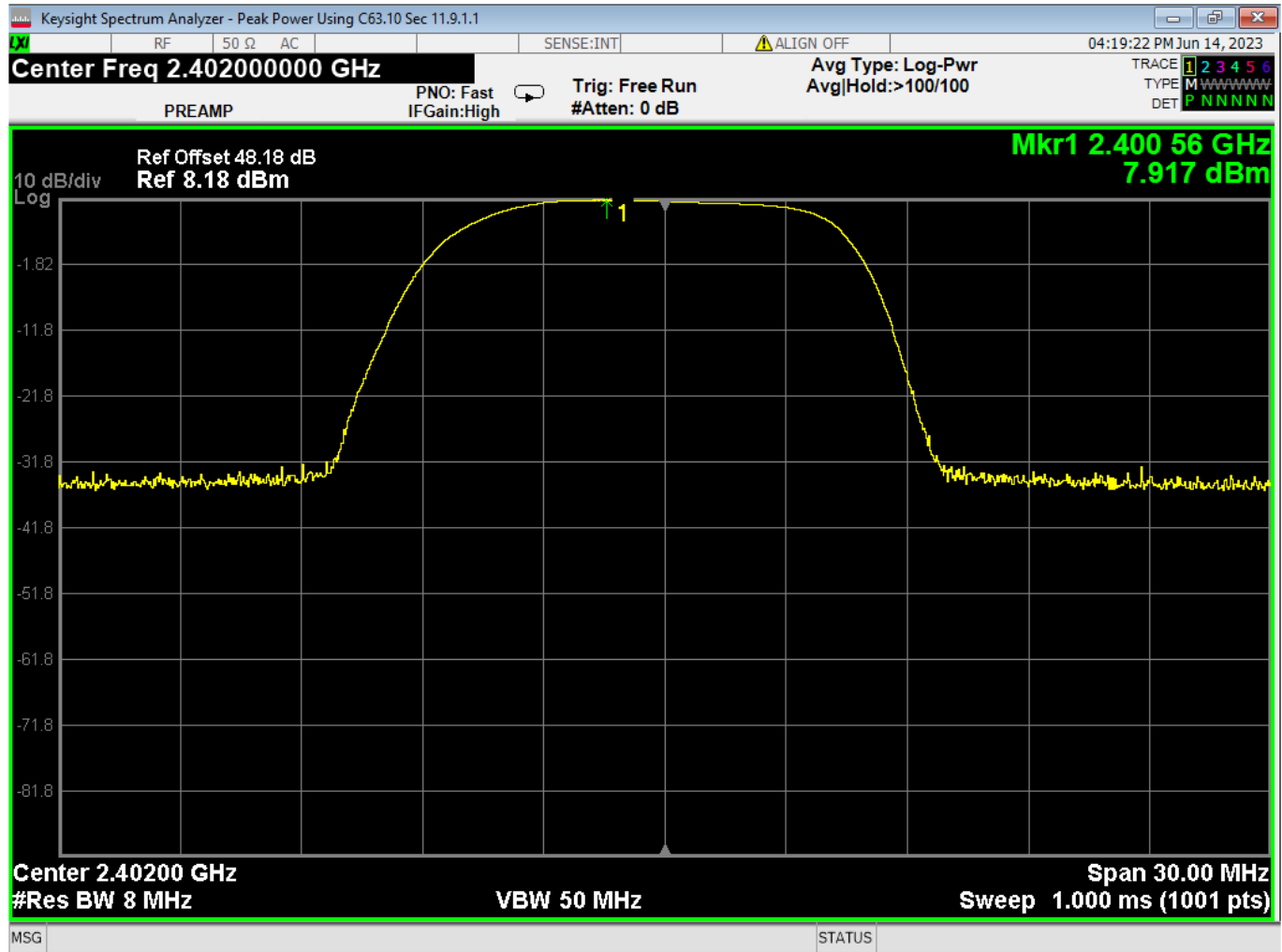
Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

| Test                        | Frequency Range | Uncertainty Value (dB) |
|-----------------------------|-----------------|------------------------|
| Radiated Emissions, 3m      | 30MHz - 1GHz    | ±4.31                  |
| Radiated Emissions, 3m      | 1GHz - 18GHz    | ±5.08                  |
| Emissions limits, conducted | 30MHz – 18GHz   | ±3.03                  |

Expanded uncertainty values are calculated to a confidence level of 95%.

|                                                                                  |                |                         |     |   |
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## APPENDIX C – GRAPHS AND TABLES



### 01 Peak Power, Low Channel, GMSK

\*Note that the measurement contains the corrections including EIRP conversion from 3m test distance.

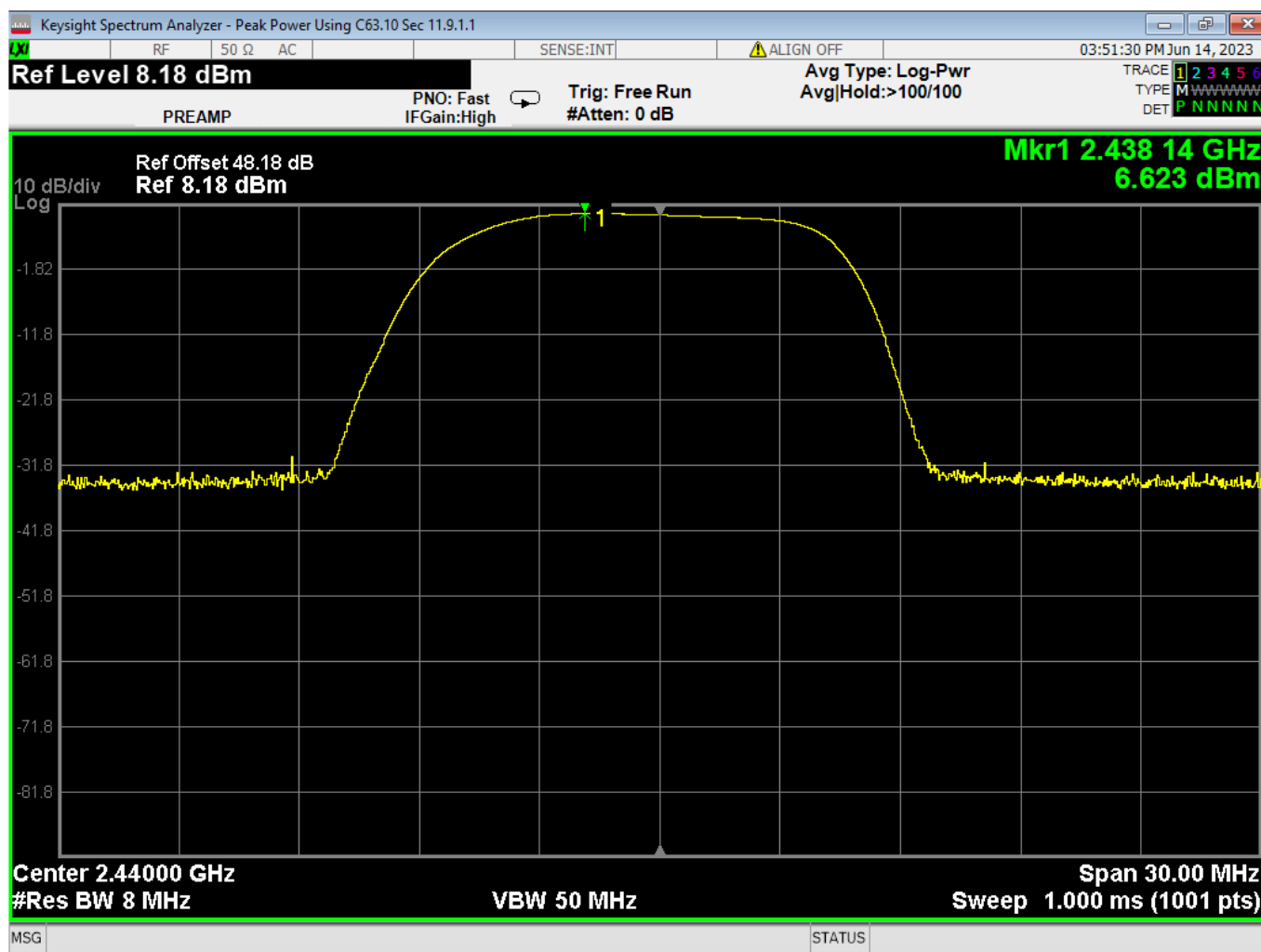


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**02 Peak Power, Mid Channel, GMSK**

\*Note that the measurement contains the corrections including EIRP conversion from 3m test distance.

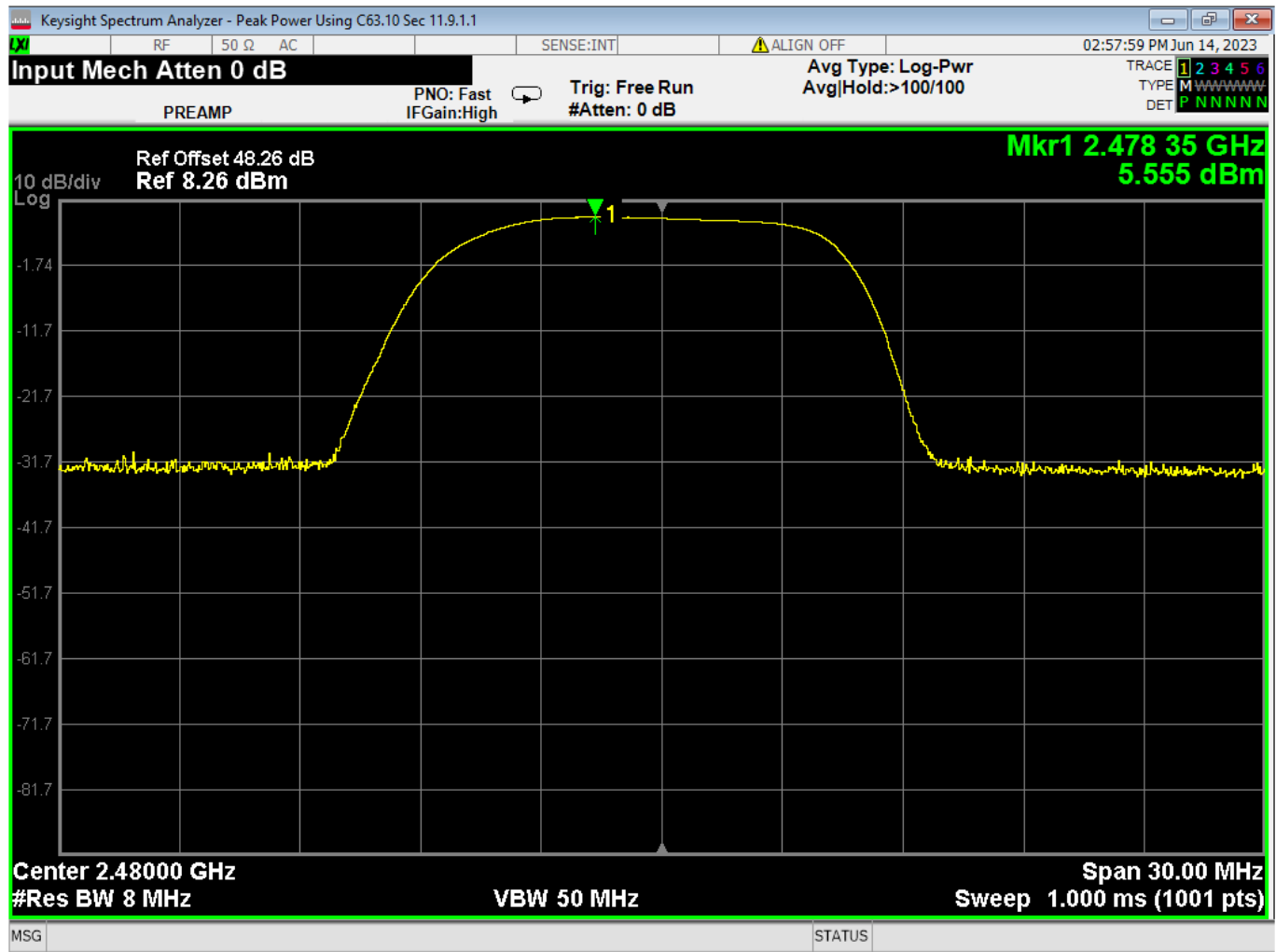


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**03 Peak Power, High Channel, GMSK**

\*Note that the measurement contains the corrections including EIRP conversion from 3m test distance.

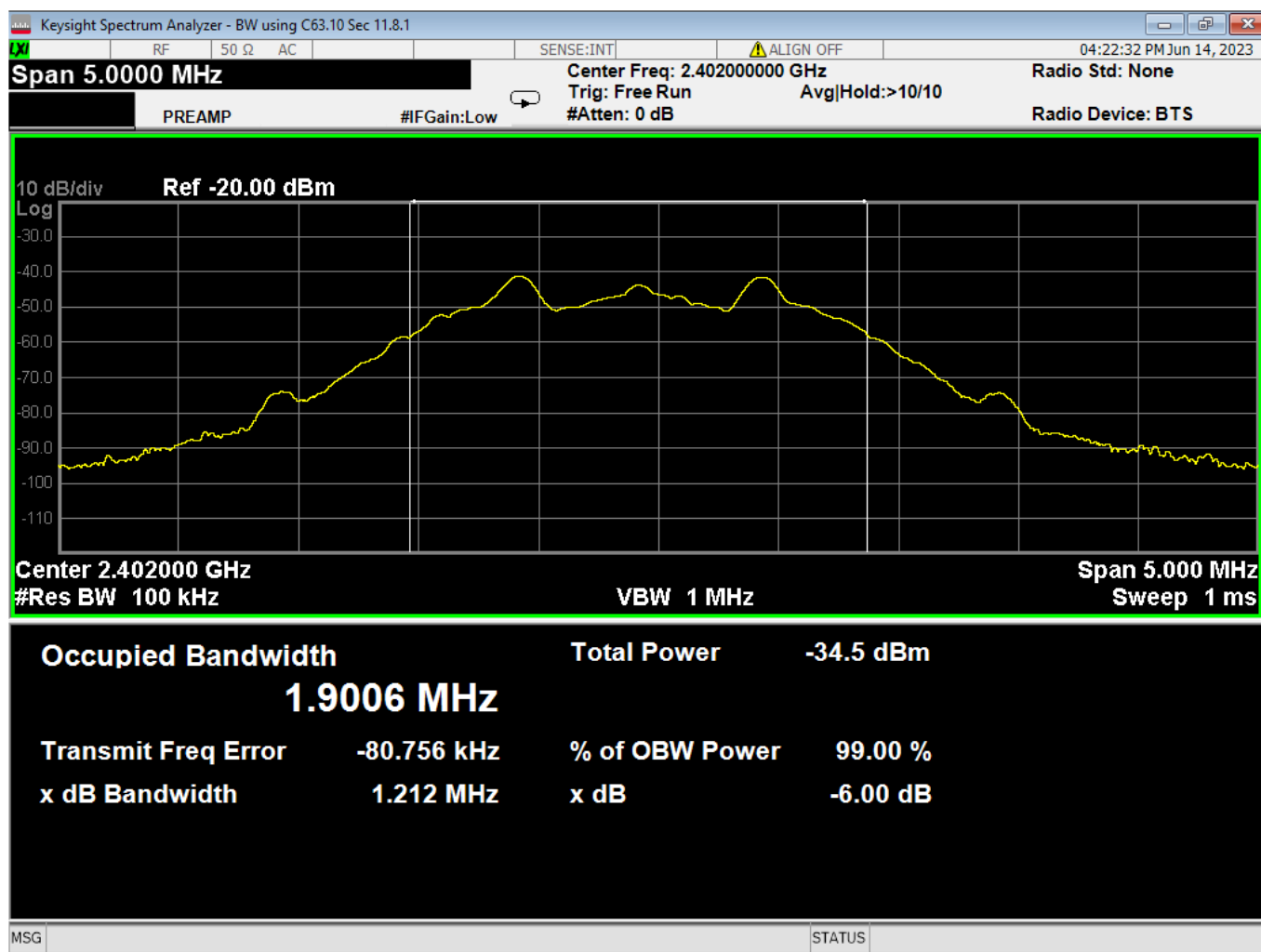


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04 6dB Bandwidth, Low Channel, GMSK

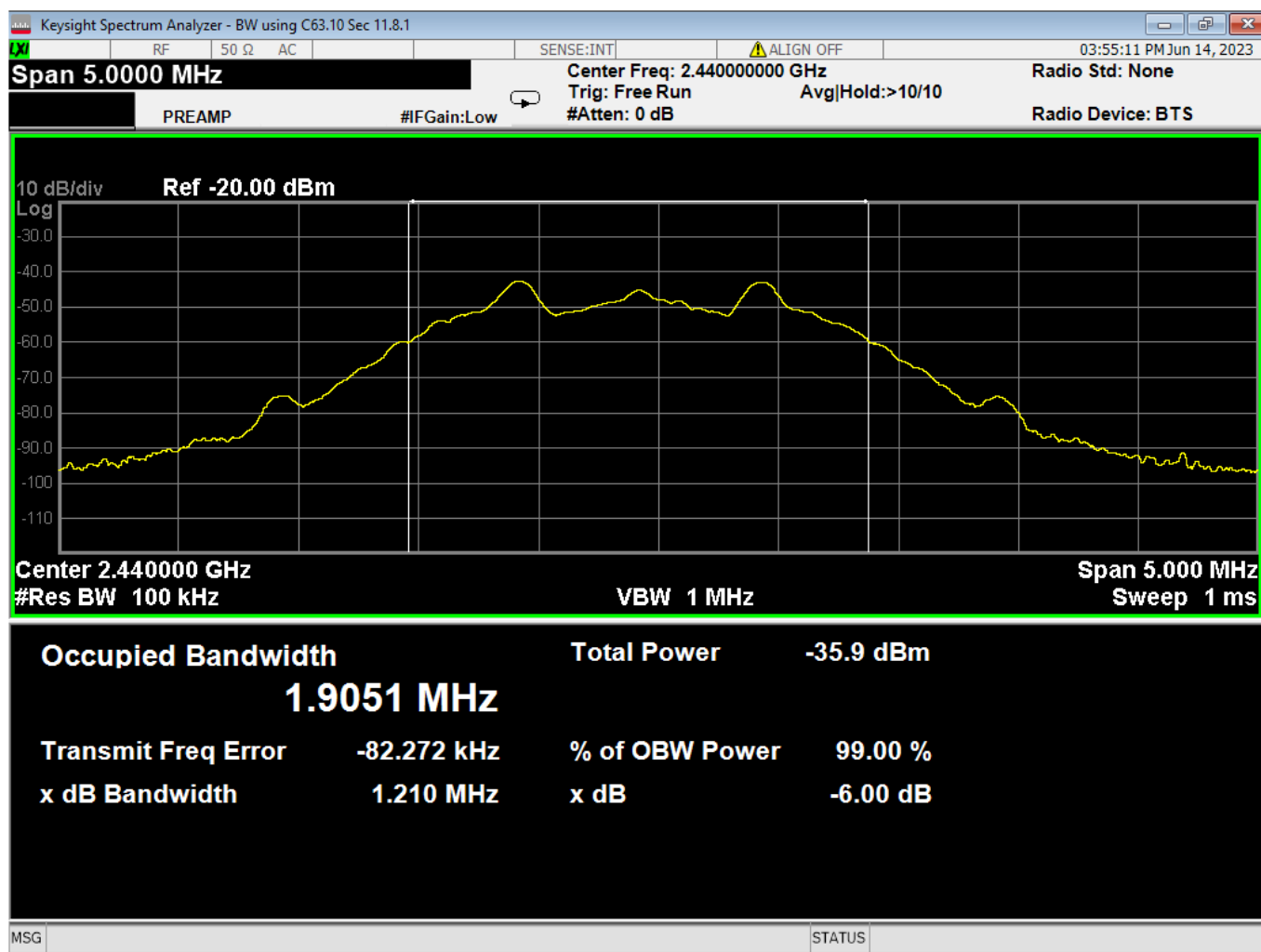


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05 6dB Bandwidth, Mid Channel, GMSK

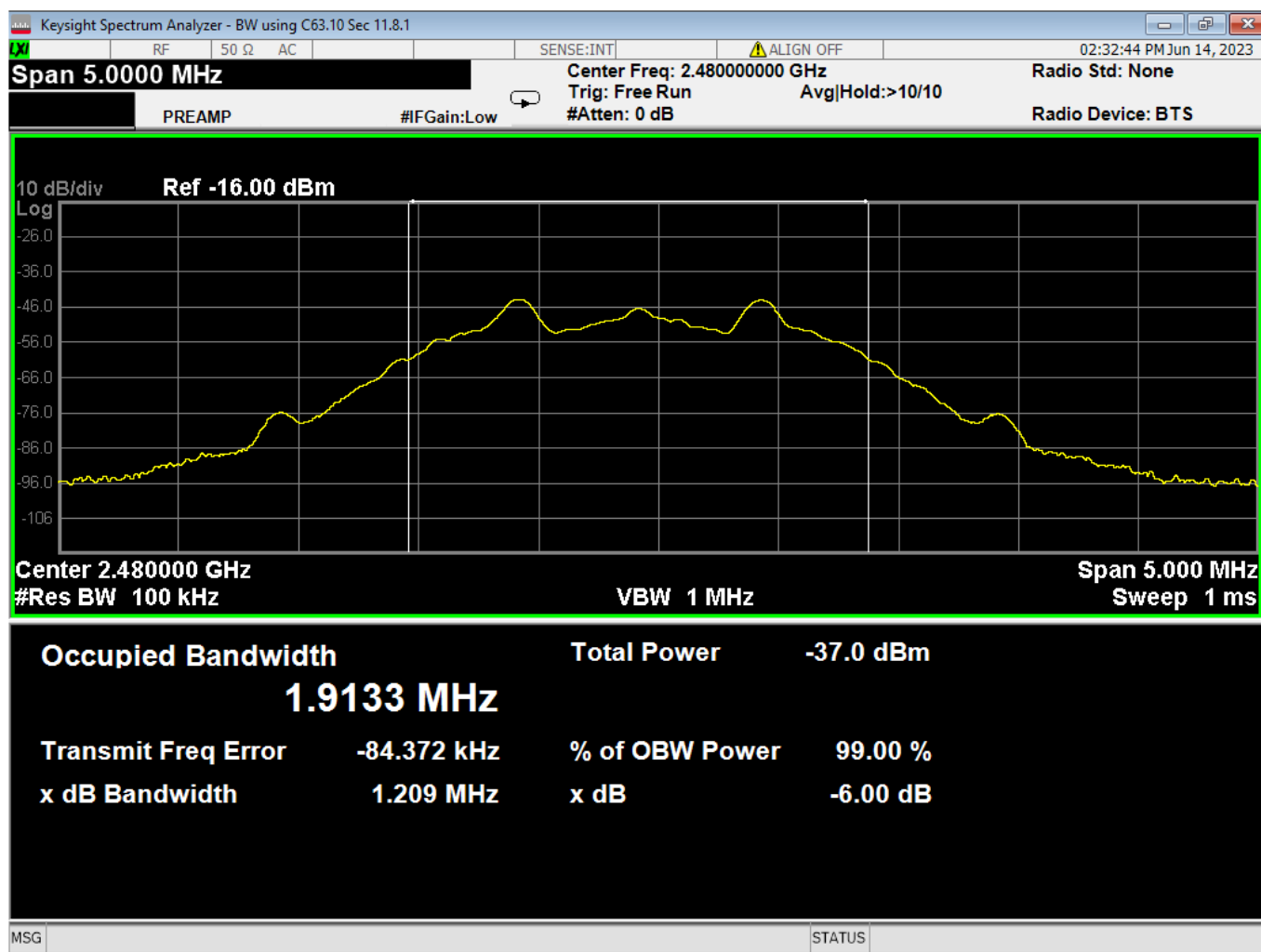


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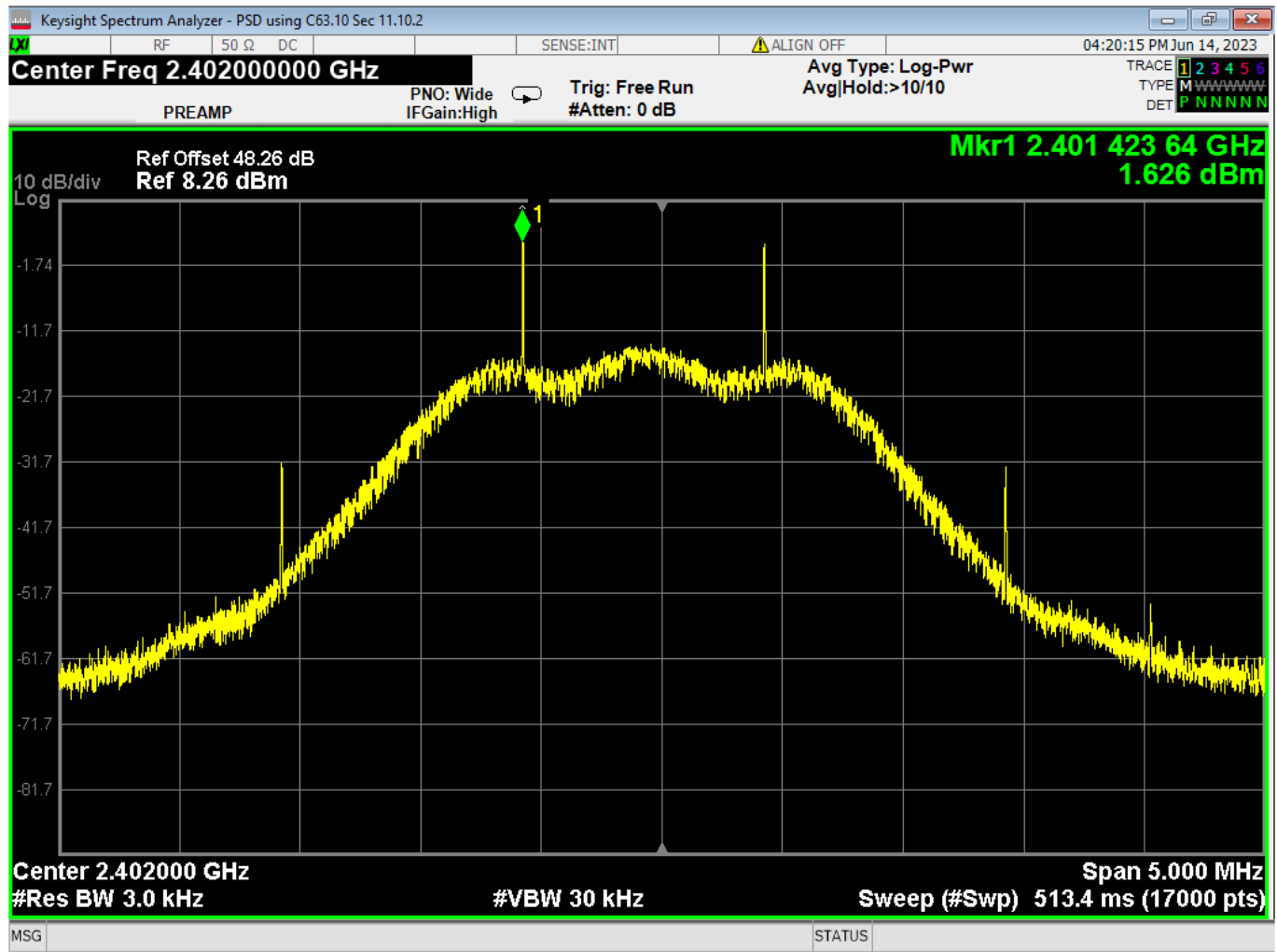
0

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06 6dB Bandwidth, High Channel, GMSK

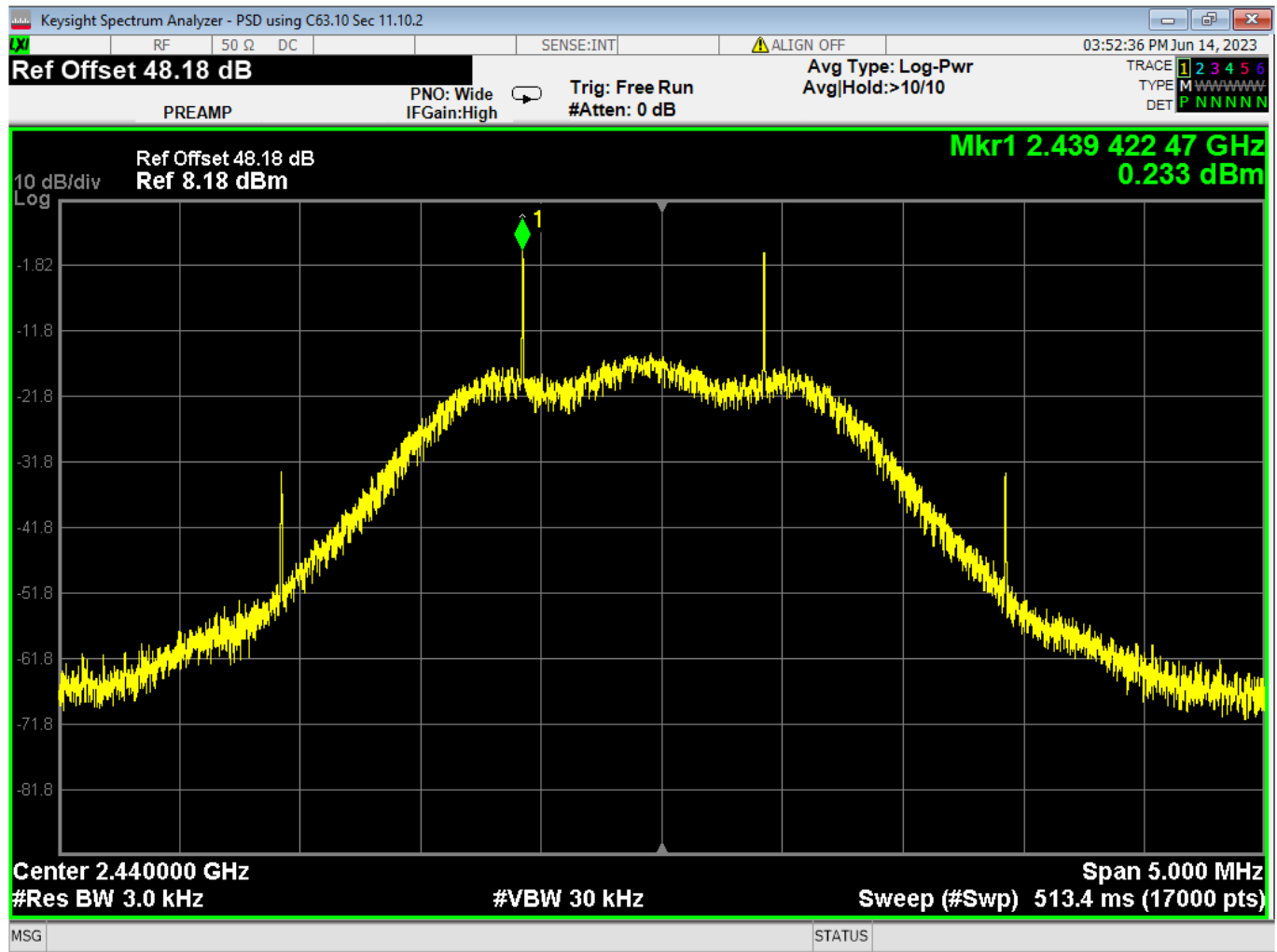
|                                                                                  |                |                         |     |   |
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#### 07 PSD, Low Channel, GMSK

\*Note that the measurement contains the corrections including EIRP conversion from 3m test distance.

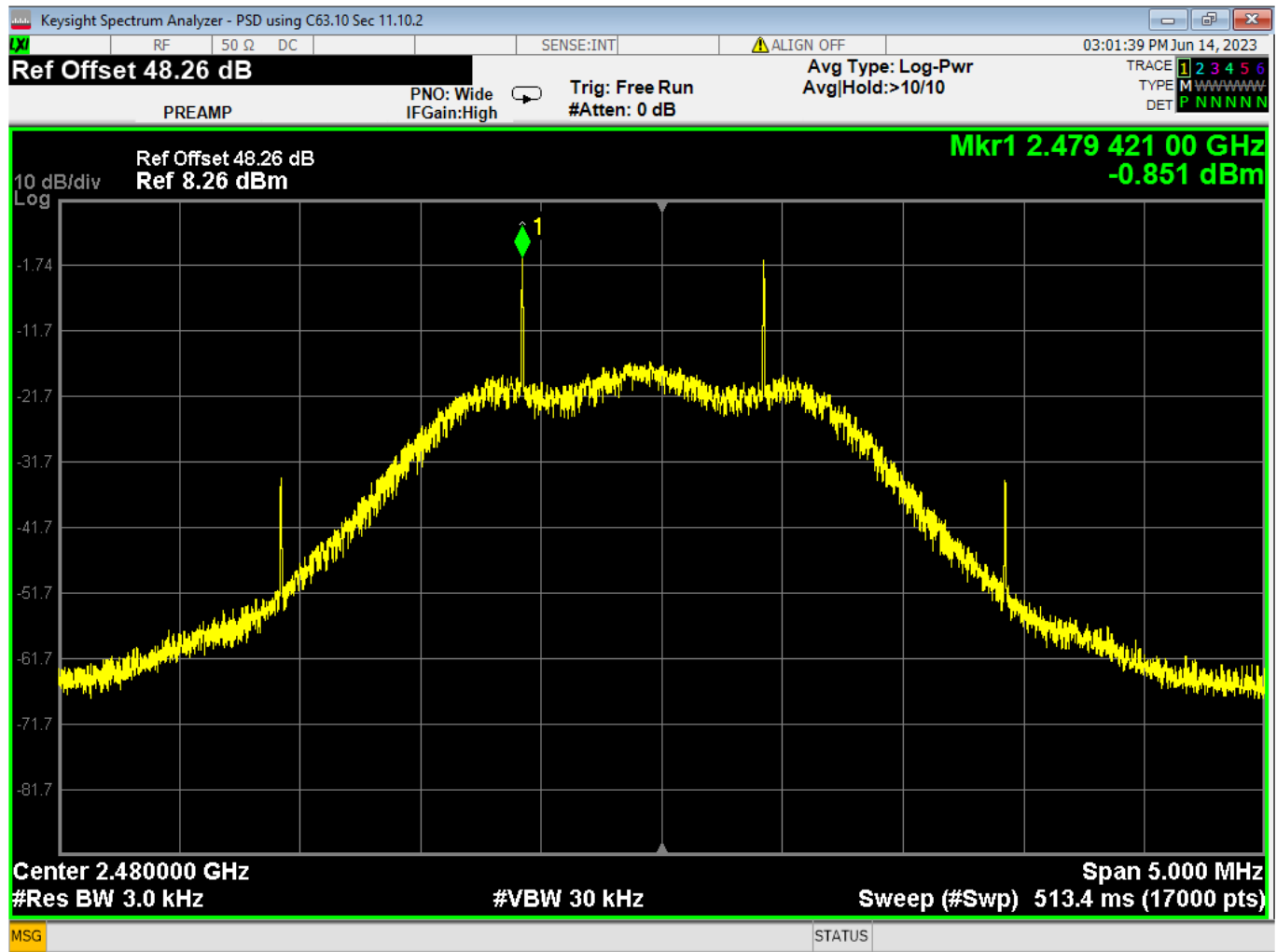
|                                                                                  |                |                         |     |   |
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08 PSD, Mid Channel, GMSK

\*Note that the measurement contains the corrections including EIRP conversion from 3m test distance.

|                                                                                  |                |                         |     |   |
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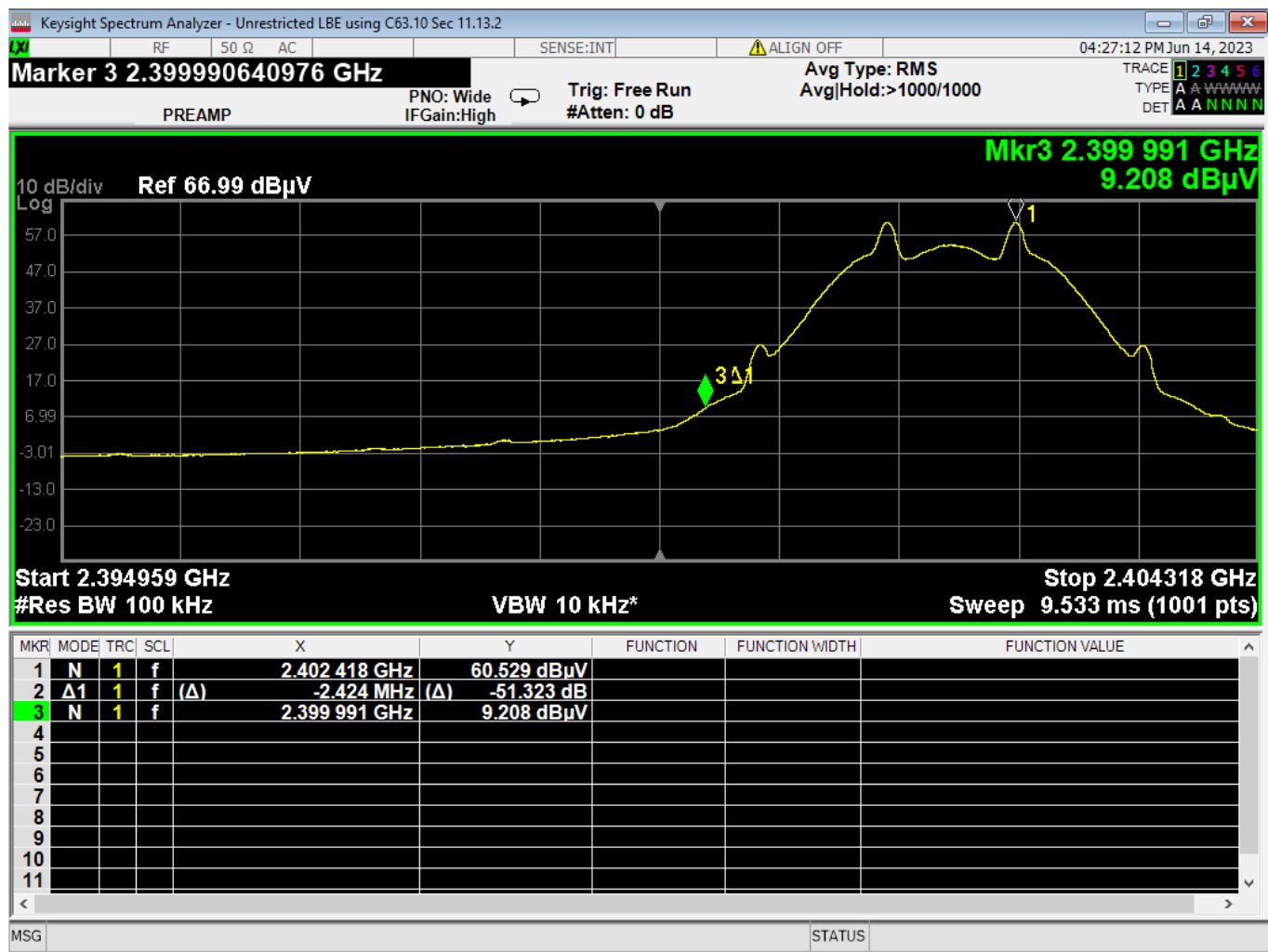


#### 09 PSD, High Channel, GMSK

\*Note that the measurement contains the corrections including EIRP conversion from 3m test distance.



|                |                         |     |   |
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10 LBE Unrestricted, GMSK

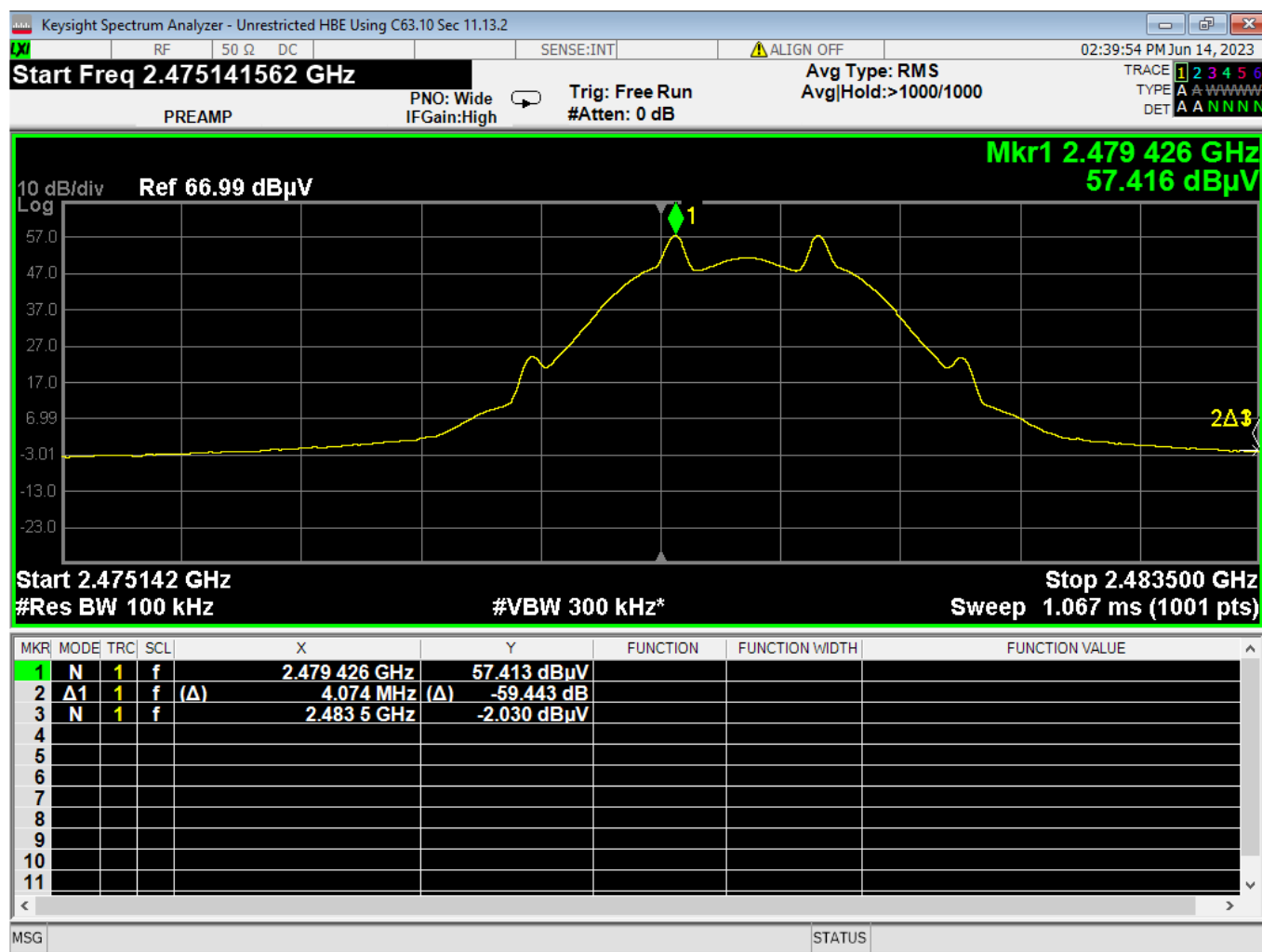


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11 HBE Unrestricted, GMSK

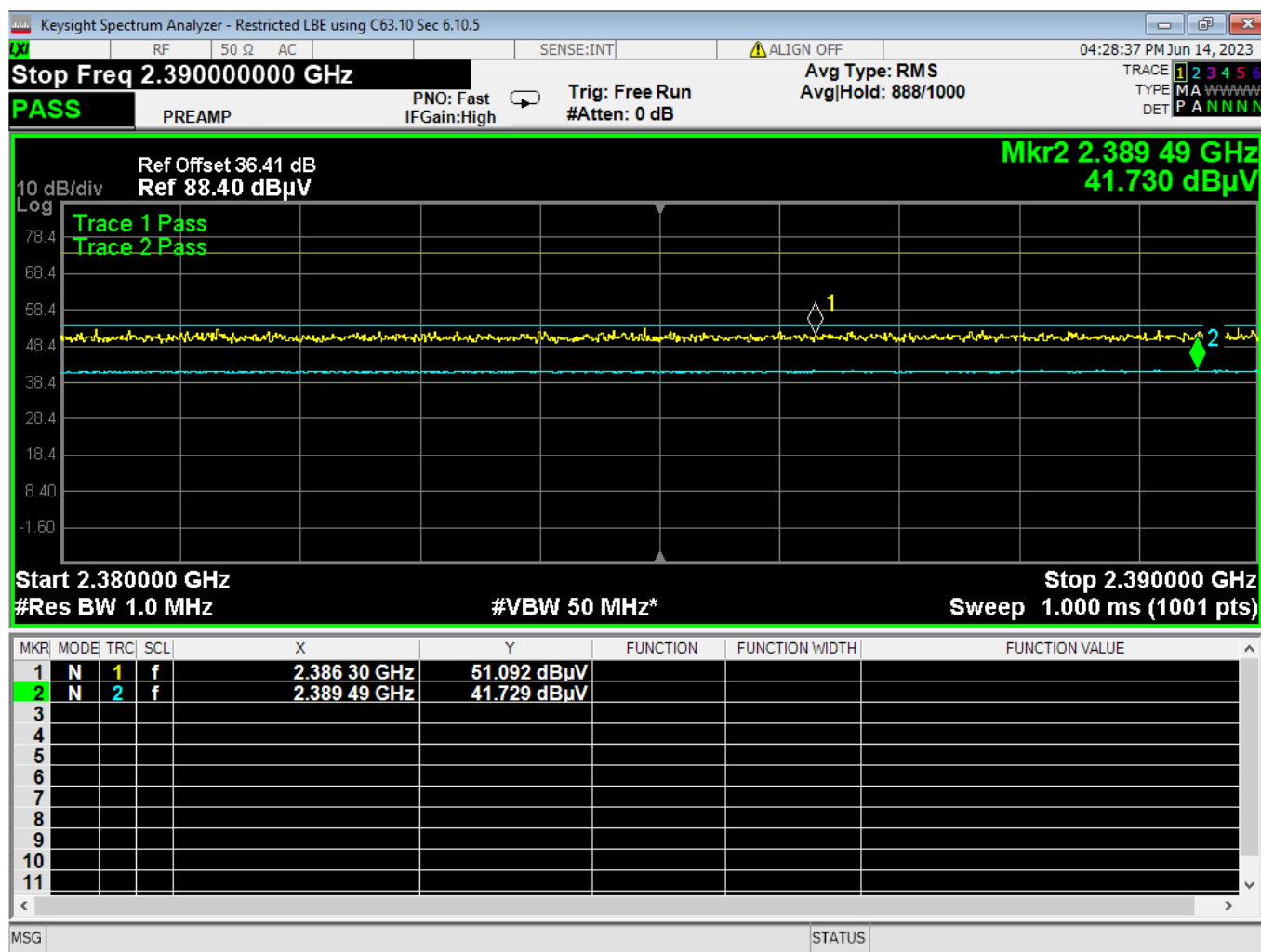


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**12 LBE Restricted, GMSK**

\*Note that the measurement contains the corrections including EIRP conversion from 3m test distance.

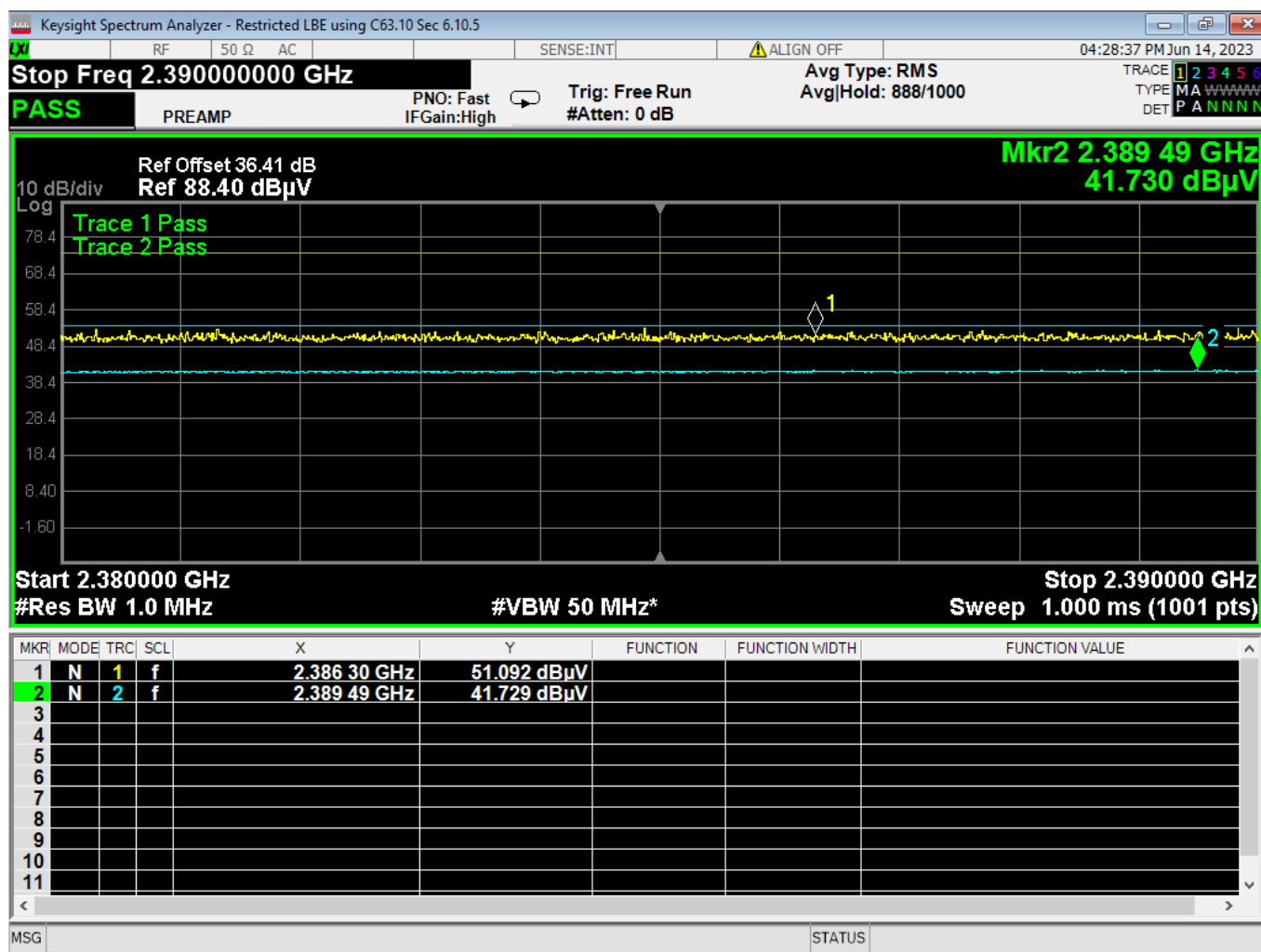


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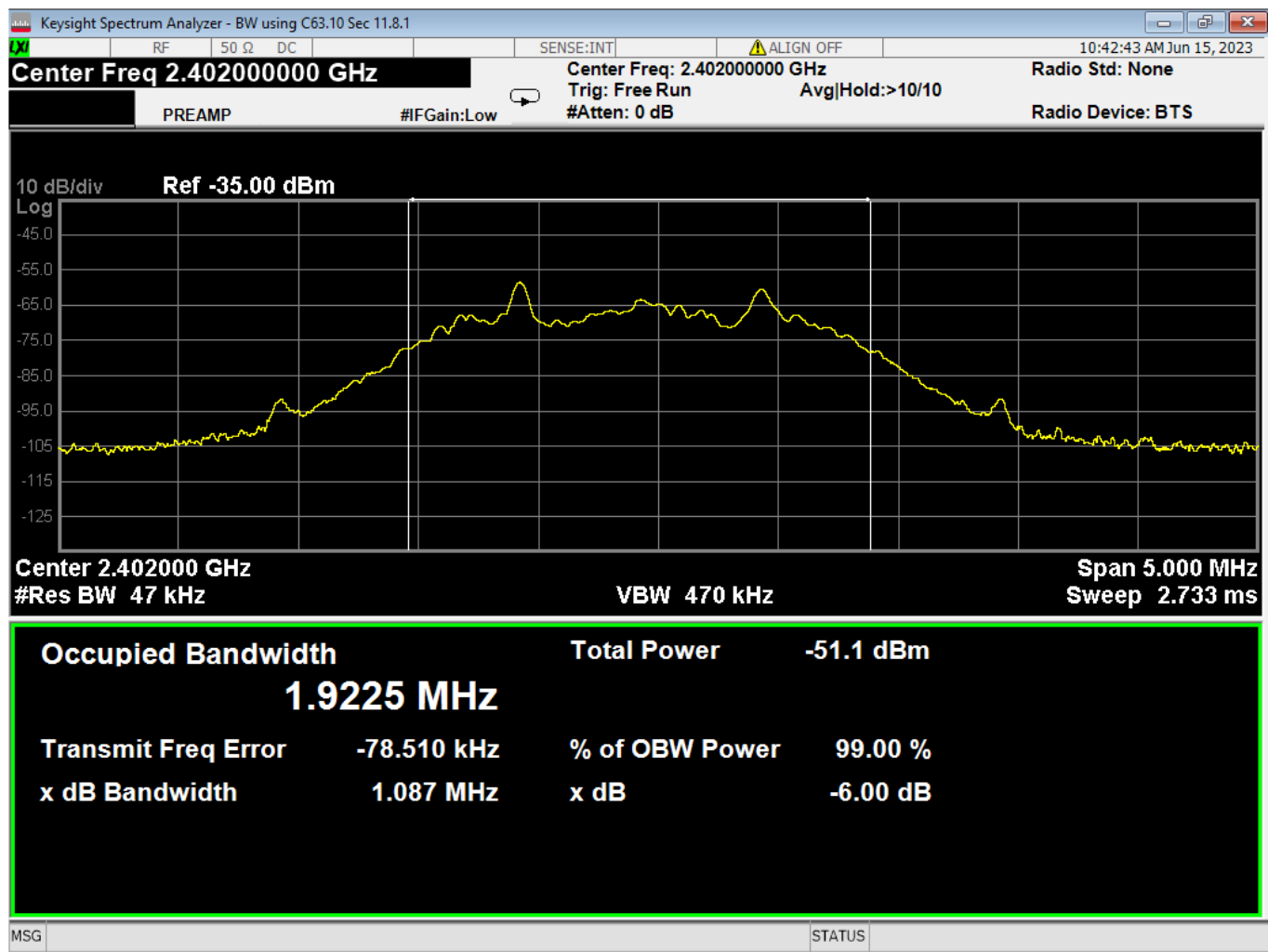
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**13 HBE Restricted, GMSK**

\*Note that the measurement contains the corrections including EIRP conversion from 3m test distance.



|                |                         |     |   |
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27 Occupied Bandwidth, Low Channel, GMSK

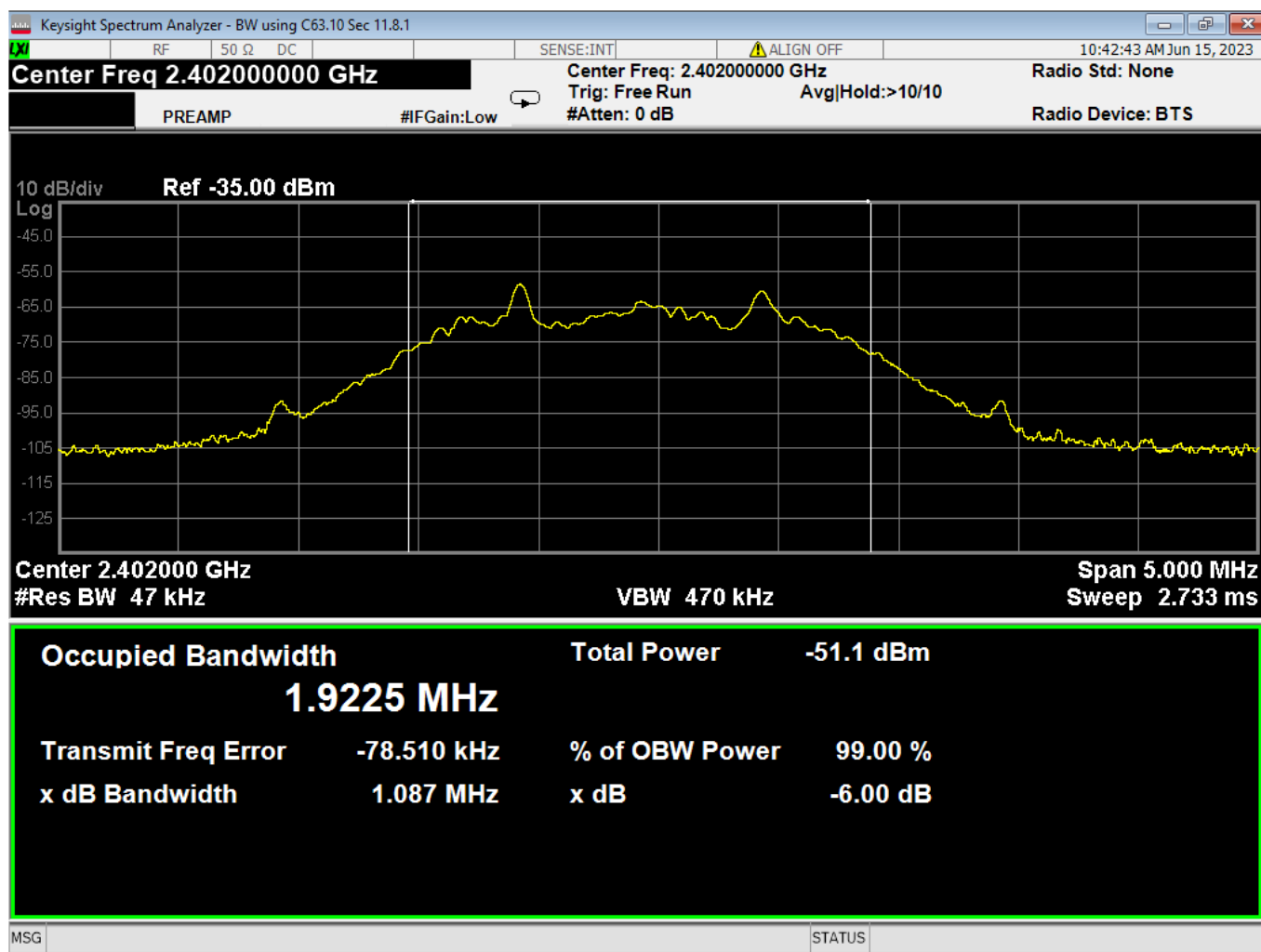


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28 Occupied Bandwidth, Mid Channel, GMSK

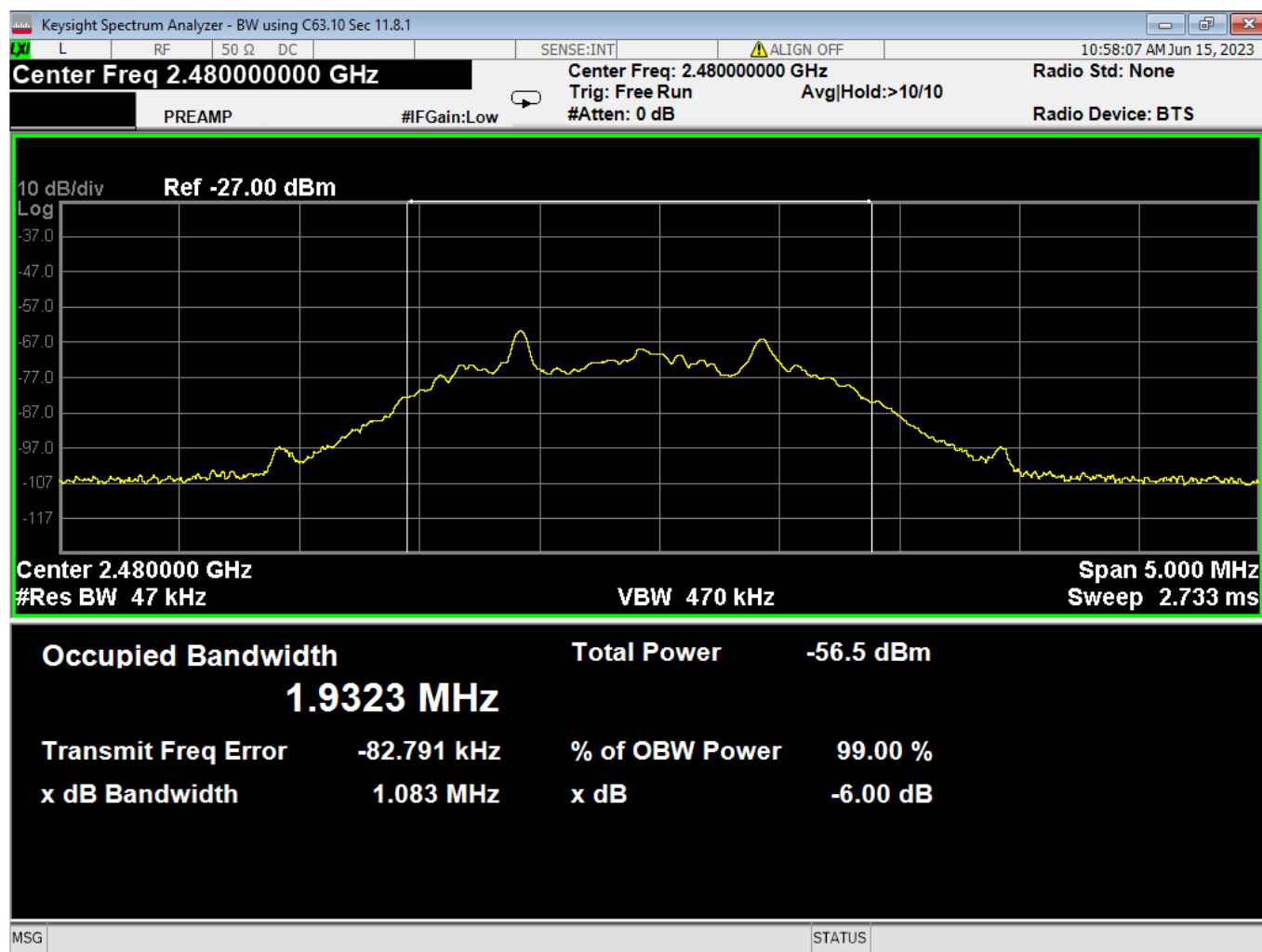


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29 Occupied Bandwidth, High Channel, GMSK



|                |                         |     |   |
|----------------|-------------------------|-----|---|
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