



# FCC RADIO TEST REPORT

|            |                                                                                                  |
|------------|--------------------------------------------------------------------------------------------------|
| Applicant  | : Measurement Specialties (China), Ltd.                                                          |
| Address    | : No. 26 Langshan Road Shenzhen High-Tech Park (North)<br>Nanshan District Shenzhen 518057 China |
| Equipment  | : Wireless Pressure Sensor                                                                       |
| Model No.  | : 6XX1N-XX-X-XX (X is variable. For more details refer to model naming rule.)                    |
| Trade Name | : TE Connectivity                                                                                |
| FCC ID     | : 2A85PA6XX1N                                                                                    |
| Standard   | : FCC part 15 Subpart C § 15.247                                                                 |

## I HEREBY CERTIFY THAT :

The sample was received on Mar. 23, 2023 and the testing was completed on Apr. 07, 2023 at CerpPASS Technology Corp. The test result refers exclusively to the test presented test model / sample. Without written approval of CerpPASS Technology Corp., the test report shall not be reproduced except in full.

Approved by:

Leevin Li /Supervisor



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## History of this test report

### History of this test report

| Version No. | Report No   | Date          | Description   |
|-------------|-------------|---------------|---------------|
| Rev.01      | DEFM2211182 | Apr. 14, 2023 | Initial Issue |



## 1. Summary of Test Procedure and Test Results

### 1.1 Applicable Standards

ANSI C63.10:2013

FCC Rules and Regulations Part 15 Subpart C §15.247

| FCC Rule                                                                                                                                                                                                                                                                                                                                                                                     | Description of Test                    | Result |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|--------|
| 15.203                                                                                                                                                                                                                                                                                                                                                                                       | Antenna Requirement                    | PASS   |
| 15.207                                                                                                                                                                                                                                                                                                                                                                                       | AC Power Line Conducted Emission       | N/A    |
| 15.209<br>15.205                                                                                                                                                                                                                                                                                                                                                                             | Radiated Spurious Emission             | PASS   |
| 15.247(a)(1)                                                                                                                                                                                                                                                                                                                                                                                 | Channel Carrier Frequencies Separation | PASS   |
| 15.247(d)                                                                                                                                                                                                                                                                                                                                                                                    | Conducted Spurious Emission            | PASS   |
| 15.247(a)(1)                                                                                                                                                                                                                                                                                                                                                                                 | 20dB Bandwidth Measurement             | PASS   |
| 15.247(a)(1)                                                                                                                                                                                                                                                                                                                                                                                 | Dwell Time                             | PASS   |
| 15.247(b)                                                                                                                                                                                                                                                                                                                                                                                    | Number of Hopping Channels             | PASS   |
| 15.247(b)                                                                                                                                                                                                                                                                                                                                                                                    | Maximum Peak Output Power              | PASS   |
| 15.247(f)                                                                                                                                                                                                                                                                                                                                                                                    | Power Spectral Density                 | PASS   |
| 15.247(d)                                                                                                                                                                                                                                                                                                                                                                                    | Band Edges Measurement Data            | PASS   |
| Note: Deviations    Yes <input type="checkbox"/> No <input checked="" type="checkbox"/><br>N/A denotes test is not applicable in this Test Report.<br>*The lab has reduced the uncertainty risk factor from test equipment,<br>environment and staff technicians which according to the standard on contract.<br>Therefore, the test result will only be determined by standard requirement. |                                        |        |



## 2. Test Configuration of Equipment under Test

### 2.1 Feature of Equipment under Test

|                           |                                                                                                                                                                                                                                                                                                            |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment                 | Wireless Pressure Sensor                                                                                                                                                                                                                                                                                   |
| Model Name                | 6XX1N-XX-X-XX (X is variable. For more details refer to model naming rule.)                                                                                                                                                                                                                                |
| Model Description         | All the models are electrical identical including the same and hardware design (RF Chip, Hardware, Schematics), same mechanical structure and design (including product enclosure, materials, etc.), the only difference is the model name and software.<br>Model 6911N-EX-A-F5 was chosen for final test. |
| Operation Frequency Range | 902MHz~928MHz                                                                                                                                                                                                                                                                                              |
| Center Frequency Range    | 125KHz:902.3MHz~914.9MHz                                                                                                                                                                                                                                                                                   |
| Modulation Type           | LoRa, Hybrid System                                                                                                                                                                                                                                                                                        |
| Antenna Gain.             | 0.68dBi                                                                                                                                                                                                                                                                                                    |
| Antenna Type              | monopole Antenna                                                                                                                                                                                                                                                                                           |
| Operating Voltage         | From battery:3.6Vdc                                                                                                                                                                                                                                                                                        |
| Working Temperature       | -30°C to +75°C                                                                                                                                                                                                                                                                                             |
| FVIN                      | 65X1N Series: SW_65XX_HCC512B<br>69X1N Series: SW_69XX_HCC512B                                                                                                                                                                                                                                             |

Note: For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.



## Product Model Naming Rules for 6XX1N-XX-X-XX

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |               |      |              |          |            |       |          |             |   |               |      |   |        |           |            |                |         |      |             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------|------|--------------|----------|------------|-------|----------|-------------|---|---------------|------|---|--------|-----------|------------|----------------|---------|------|-------------|
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          | X             |      | X            |          | 1          |       | N        |             | - | X             | X    | - | X      |           | -          | X              |         | X    |             |
| SENSOR TYPE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          | COMMUNICATION |      | PRESSURE REF |          | TECHNOLOGY |       | PLATFORM |             |   | CERTIFICATION |      |   | REGION |           |            | PRESSURE RANGE |         | PORT |             |
| Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Product  | Code          | Type | Code         | Type     | Code       | Type  | Code     | Type        |   | Code          | Type |   | Code   | Type      |            | Code           | BAR STD | Code | Type        |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Pressure | 5             | BLE5 | 1            | Absolute | 1          | Ultra | N        | Initial IOT |   | NX            | None |   | A      | 915MHz US |            | C              | 007B    | 2    | 1/4-19 BSPP |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |               |      |              |          |            |       |          |             | E | 868MHz EU     |      | E | 020B   |           |            |                |         |      |             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |               |      |              |          |            |       |          |             |   |               |      | F | 035B   | 5         | 1/4-18 NPT |                |         |      |             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |               |      |              |          |            |       |          |             |   |               |      | H | 350B   |           |            |                |         |      |             |
| <div>Note:<br/>1) Disabled Lora by software (software due to disable LoRa, not any RF parameter change. RF Chip, Hardware, Schematics still are the same)<br/>2) The circuit design and layout between of all model numbers are the same.<br/>3)The Region code depends on Communication code, e.g: if Communication code is "5", the region code should be "B"; if Communication code is "9", the region code can be "A" or "E"<br/>4) For this application is only for Region code "A" or "B".</div> |          |               |      |              |          |            |       |          |             |   |               |      |   |        |           |            |                |         |      |             |



## 2.2 Carrier Frequency of Channels

125KHz (SF10/SF09/SF08/SF07)

| Channel    | Frequency (MHz) | Channel    | Frequency (MHz) | Channel | Frequency (MHz) | Channel    | Frequency (MHz) |
|------------|-----------------|------------|-----------------|---------|-----------------|------------|-----------------|
| <b>*00</b> | <b>902.3</b>    | 17         | 905.7           | 34      | 909.1           | 51         | 912.5           |
| 01         | 902.5           | 18         | 905.9           | 35      | 909.3           | 52         | 912.7           |
| 02         | 902.7           | 19         | 906.1           | 36      | 909.5           | 53         | 912.9           |
| 03         | 902.9           | 20         | 906.3           | 37      | 909.7           | 54         | 913.1           |
| 04         | 903.1           | 21         | 906.5           | 38      | 909.9           | 55         | 913.3           |
| 05         | 903.3           | 22         | 906.7           | 39      | 910.1           | 56         | 913.5           |
| 06         | 903.5           | 23         | 906.9           | 40      | 910.3           | 57         | 913.7           |
| 07         | 903.7           | 24         | 907.1           | 41      | 910.5           | 58         | 913.9           |
| 08         | 903.9           | 25         | 907.3           | 42      | 910.7           | 59         | 914.1           |
| 09         | 904.1           | 26         | 907.5           | 43      | 910.9           | 60         | 914.3           |
| 10         | 904.3           | 27         | 907.7           | 44      | 911.1           | 61         | 914.5           |
| 11         | 904.5           | 28         | 907.9           | 45      | 911.3           | 62         | 914.7           |
| 12         | 904.7           | 29         | 908.1           | 46      | 911.5           | <b>*63</b> | <b>914.9</b>    |
| 13         | 904.9           | 30         | 908.3           | 47      | 911.7           | ---        | ---             |
| 14         | 905.1           | <b>*31</b> | <b>908.5</b>    | 48      | 911.9           |            |                 |
| 15         | 905.3           | 32         | 908.7           | 49      | 912.1           |            |                 |
| 16         | 905.5           | 33         | 908.9           | 50      | 912.3           |            |                 |

Note: Channels remarked \* are selected to perform test.

## 2.3 Test Mode and Test Software

- During testing, the interface cables and equipment positions were varied according to ANSI C63.10.
- The complete test system included Notebook, Dongle and EUT for RF test.
- Run the test software "Nrf Connect for Desktop.exe (Ver.: 3.12.0.0)" under Win 10 System was executed to transmit and receive data via Lora.
- The following test modes were performed for the test:

| Radiation Emissions (Below 1GHz)                                                       |                                          |
|----------------------------------------------------------------------------------------|------------------------------------------|
| Test Mode                                                                              | Operating Description                    |
| 1                                                                                      | Lora(125KHz) for SF10 with 6911N-EX-A-F5 |
| 2                                                                                      | Lora(125KHz) for SF09 with 6911N-EX-A-F5 |
| 3                                                                                      | Lora(125KHz) for SF08 with 6911N-EX-A-F5 |
| 4                                                                                      | Lora(125KHz) for SF07 with 6911N-EX-A-F5 |
| caused "Test Mode 1" generated the worst case, they were reported as the final data.   |                                          |
| Radiation Emissions (1GHz ~ 10GHz)                                                     |                                          |
| Test Mode                                                                              | Operating Description                    |
| 1                                                                                      | Lora(125KHz) for SF10 with 6911N-EX-A-F5 |
| 2                                                                                      | Lora(125KHz) for SF09 with 6911N-EX-A-F5 |
| 3                                                                                      | Lora(125KHz) for SF08 with 6911N-EX-A-F5 |
| 4                                                                                      | Lora(125KHz) for SF07 with 6911N-EX-A-F5 |
| caused "Test Mode 1,4" generated the worst case, they were reported as the final data. |                                          |



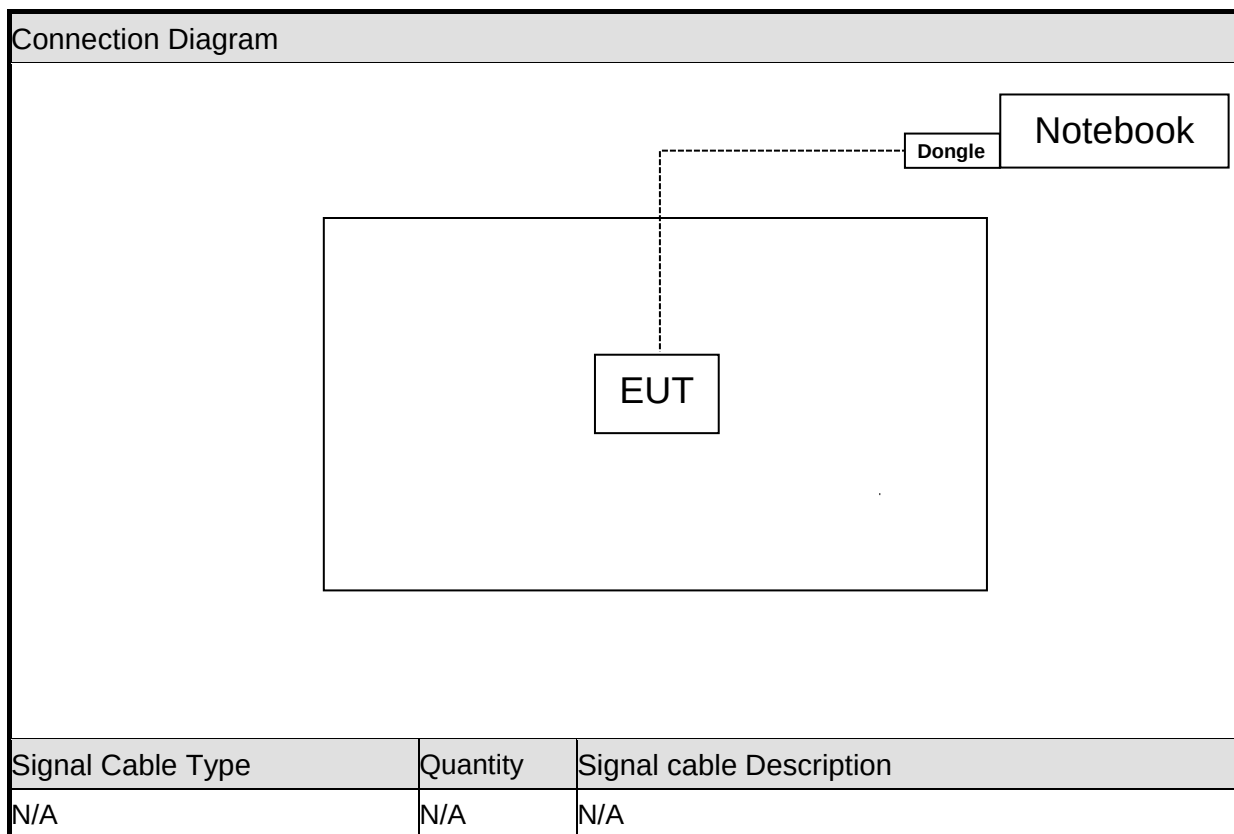


## 2.4 Power Parameter Value of the test software

| Mode         | Frequency (MHz) | Power Setting |
|--------------|-----------------|---------------|
| Lora(125KHz) | 902.3           | 8             |
|              | 908.5           | 8             |
|              | 914.9           | 8             |

## 2.5 Description of Test System

| Product    | Manufacturer | Model No.         | Power Cord         |
|------------|--------------|-------------------|--------------------|
| 1 Notebook | DELL         | Dell Optiplex 380 | Non-Shielded, 1.8m |
| 2 Dongle   | NORDIC       | nRF52840-Dongle   | N/A                |





## 2.6 General Information of Test

|                               |                                                                                                                                                                                                                |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Site                     | <b>CerpPASS Technology Corporation(CerpPASS Laboratory)</b><br>Address: Room 102, No. 5, Xing'an Road, Chang'an Town,<br>Dongguan City, Guangdong Province<br>Tel: +86-769-8547-1212<br>Fax: +86-769-8547-1912 |
| FCC Designation No.:          | CN1288                                                                                                                                                                                                         |
| Frequency Range Investigated: | Conducted: from 150kHz to 30 MHz<br>Radiation: from 30 MHz to 10,000MHz                                                                                                                                        |
| Test Distance:                | The test distance of radiated emission from antenna to EUT is 3 M.                                                                                                                                             |

| Test Item          | Test Site  | Test period           | Environmental Conditions | Tested By  |
|--------------------|------------|-----------------------|--------------------------|------------|
| Radiated Emissions | 3M01-DG    | 2023/04/03~2023/04/04 | 22~24℃ / 48~50%          | Amos Zhang |
| RF Conducted       | RFCON01-DG | 2023/04/06~2023/04/07 | 23~25℃ / 45~ 47%         | Amos Zhang |

## 2.7 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)).

| Measurement Item                         | Uncertainty |
|------------------------------------------|-------------|
| AC Power Line Conduction(150K~30MHz)     | ±2.60dB     |
| Radiated Spurious Emission(9KHz~30MHz)   | ±4.99dB     |
| Radiated Spurious Emission(30MHz~1GHz)   | ±4.39dB     |
| Radiated Spurious Emission(1GHz~18GHz)   | ±5.36dB     |
| Radiated Spurious Emission(18GHz~40GHz)  | ±5.43dB     |
| 6dB Bandwidth&20dB Bandwidth             | ±4.4%       |
| Occupied Bandwidth                       | ±4.4%       |
| Peak Output Power(Conducted Power Meter) | ±0.57 dB    |
| Power Spectral Density                   | ±1.01 dB    |
| Dwell Time / Deactivation Time           | ±1.1%       |



### 3. Test Equipment and Ancillaries Used for Tests

| Radiated Emissions          |               |           |            |                  |            |
|-----------------------------|---------------|-----------|------------|------------------|------------|
| Test Site                   | 3M01-DG       |           |            |                  |            |
| Instrument                  | Manufacturer  | Model No. | Serial No. | Calibration Date | Valid Date |
| EMI Test Receiver           | R&S           | ESCI      | 100565     | 2022.05.07       | 2023.05.06 |
| Amplifier                   | EMCI          | EMC330    | 980082     | 2022.05.07       | 2023.05.06 |
| Loop Antenna                | R&S           | HFH2-Z2   | 100150     | 2022.05.11       | 2024.05.10 |
| Bilog Antenna               | Sunol Science | JB6       | A111218    | 2023.01.12       | 2025.01.11 |
| Preamplifier                | Agilent       | 8449B     | 3008A02342 | 2023.01.06       | 2024.01.05 |
| Preamplifier                | COM-POWER     | PA-840    | 711885     | 2022.05.07       | 2023.05.06 |
| Broad-Band Horn Antenna     | Schwarzbeck   | BBHA9120D | 9120D-619  | 2022.05.22       | 2024.05.21 |
| Standard Gain Horn Antenna  | TRC           | HA-2640   | 18050      | 2022.05.09       | 2024.05.08 |
| Standard Gain Horn Antenna  | TRC           | HA-1726   | 18051      | 2022.05.09       | 2024.05.08 |
| FSQ Signal Analyzer         | R&S           | FSQ40     | 200012     | 2022.05.07       | 2023.05.06 |
| Temperature/ Humidity Meter | GEMLEAD       | STH200A   | N/A        | 2022.08.05       | 2023.08.04 |

| RF Conducted                |              |           |            |                  |            |
|-----------------------------|--------------|-----------|------------|------------------|------------|
| Test Site                   | RFCON01-DG   |           |            |                  |            |
| Instrument                  | Manufacturer | Model No. | Serial No. | Calibration Date | Valid Date |
| MXA Signal Analyzer         | KEYSIGHT     | N9020A    | US46220290 | 2022.05.07       | 2023.05.06 |
| EXA Signal Analyzer         | KEYSIGHT     | N9010A    | MY53400169 | 2022.05.07       | 2023.05.06 |
| ESG VECTOR SIGNAL GENERATOR | Agilent      | E4438C    | MY45092582 | 2022.05.07       | 2023.05.06 |
| MXG VECTOR SIGNAL GENERATOR | Agilent      | N5182B    | MY53050127 | 2022.05.07       | 2023.05.06 |
| USB Wideband Power Sensor   | Boonton      | 55006     | 9778       | 2023.01.06       | 2024.01.05 |
| Temperature/ Humidity Meter | mingle       | ETH529    | N/A        | 2023.01.06       | 2024.01.05 |



## 4. Antenna Requirements

### 4.1 Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

### 4.2 Antenna Construction and Directional Gain

|              |                  |
|--------------|------------------|
| Antenna Type | monopole Antenna |
| Antenna Gain | 0.68dBi          |



## 5. Test of Conducted Emission

### 5.1 Test Limit

Conducted Emissions were measured from 150 kHz to 30 MHz with a bandwidth of 9 KHz on the 120 VAC power and return leads of the EUT according to the methods defined in ANSI C63.10-2013. The EUT was placed on a nonmetallic stand in a shielded room 0.8 meters above the ground plane as shown in section 6.2.2. The interface cables and equipment positioning were varied within limits of reasonable applications to determine the position produced maximum conducted emissions

| Frequency<br>(MHz) | Quasi Peak<br>(dB $\mu$ V) | Average<br>(dB $\mu$ V) |
|--------------------|----------------------------|-------------------------|
| 0.15 – 0.5         | 66-56*                     | 56-46*                  |
| 0.5 – 5.0          | 56                         | 46                      |
| 5.0 – 30.0         | 60                         | 50                      |

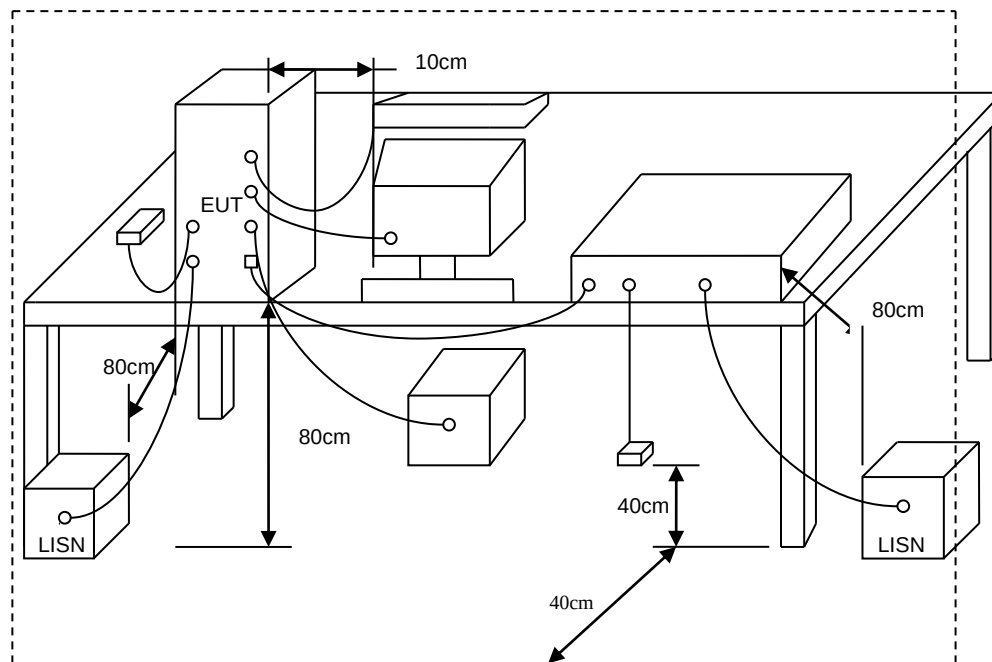
\*Decreases with the logarithm of the frequency.

### 5.2 Test Procedures

- The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- Connect EUT to the power mains through a line impedance stabilization network (LISN).
- All the support units are connecting to the other LISN.
- The LISN provides 50 ohm coupling impedance for the measuring instrument.
- The FCC states that a 50 ohm, 50 micro-Henry LISN should be used.
- Both sides of AC line were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.



### 5.3 Typical Test Setup



### 5.4 Test Result and Data

Not applicable, since the EUT supplied by battery.



## 6. Test of Spurious Emission (Radiated)

### 6.1 Test Limit

In any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. If the transmitter measurement is based on the maximum conducted output power, the attenuation required under this paragraph shall be 30dB instead of 20dB. In addition, radiated emissions which fall in section 15.205(a) the restricted bands must also comply with the radiated emission limit specified in section 15.209(a).

| Frequency (MHz) | Field Strength (microvolt/meter) | Measurement Distance (meters) |
|-----------------|----------------------------------|-------------------------------|
| 0.009 ~ 0.490   | 2400/F(kHz)                      | 300                           |
| 0.490 ~ 1.705   | 24000/F(kHz)                     | 30                            |
| 1.705 ~ 30.0    | 30                               | 30                            |
| 30 ~ 88         | 100                              | 3                             |
| 88 ~ 216        | 150                              | 3                             |
| 216 ~ 960       | 200                              | 3                             |
| Above 960       | 500                              | 3                             |

### 6.2 Test Procedures

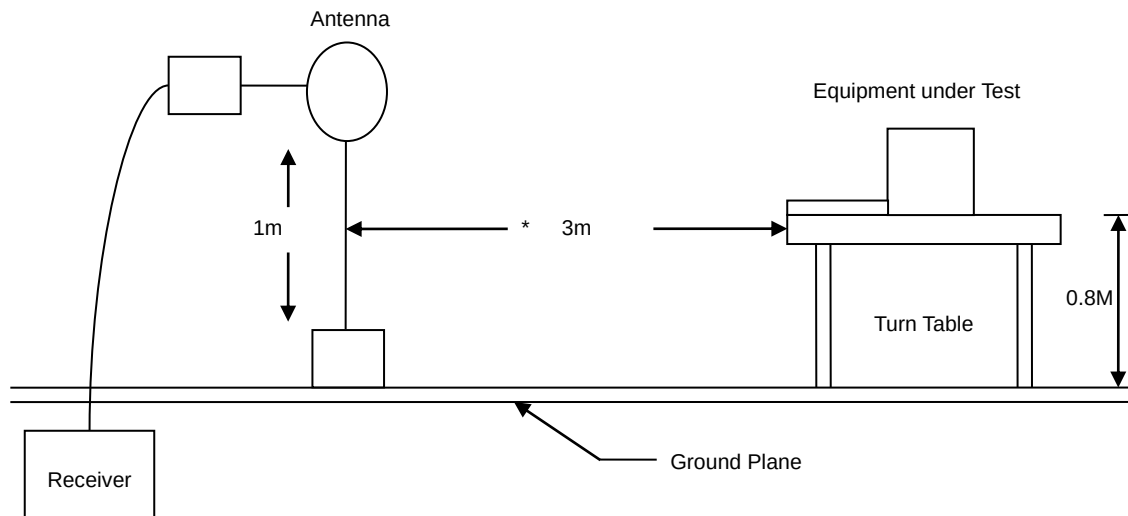
- The EUT was placed on a rotatable table top 0.8 meter above ground.
- The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
- The table was rotated 360 degrees to determine the position of the highest radiation.
- The antenna is a broadband antenna and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.
- For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 M to 4 M) and turn table (from 0 degree to 360 degrees) to find the maximum reading.
- Set the test-receiver system to Peak or CISPR quasi-peak Detect Function and specified bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method and reported.
- For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
- "Cone of radiation" has been considered to be 3dB bandwidth of the measurement antenna.

Note: The supporting fixture shall permit orientation of the EUT in each of three orthogonal axis positions such that emissions from the EUT are maximized. (X AXIS is the worst.)

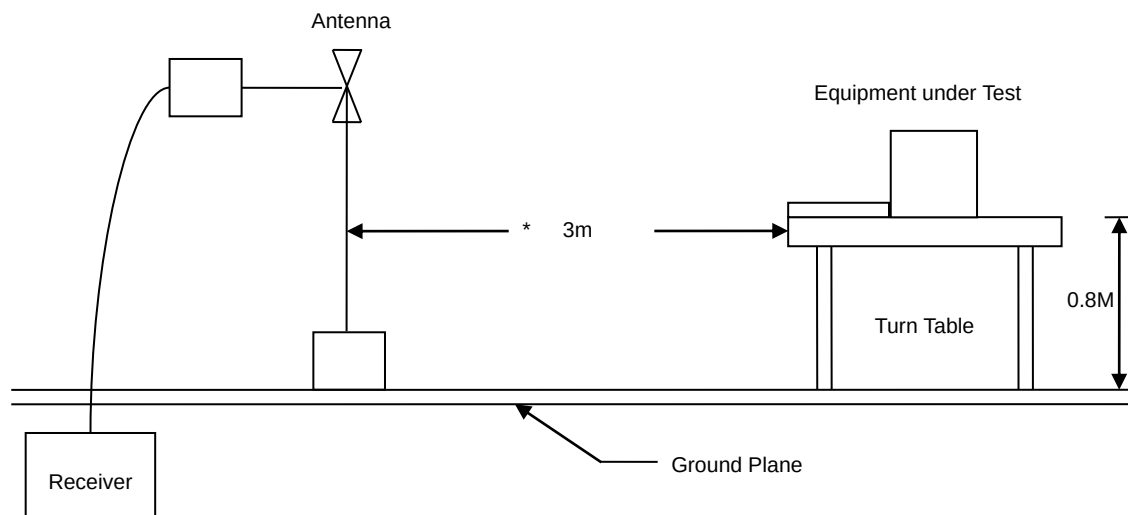


### 6.3 Typical Test Setup

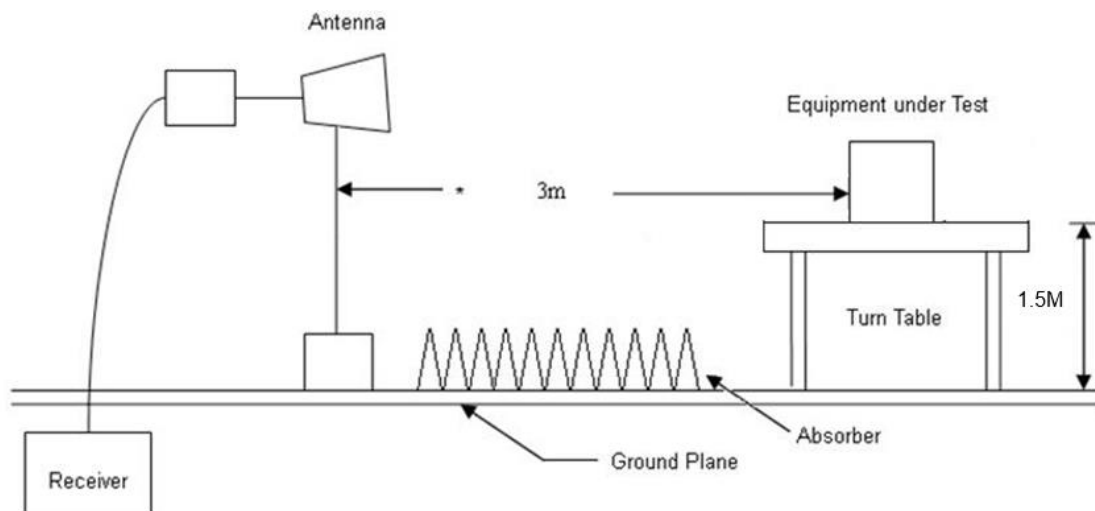
Below 30MHz test setup



30MHz- 1GHz Test Setup



Above 1GHz Test Setup



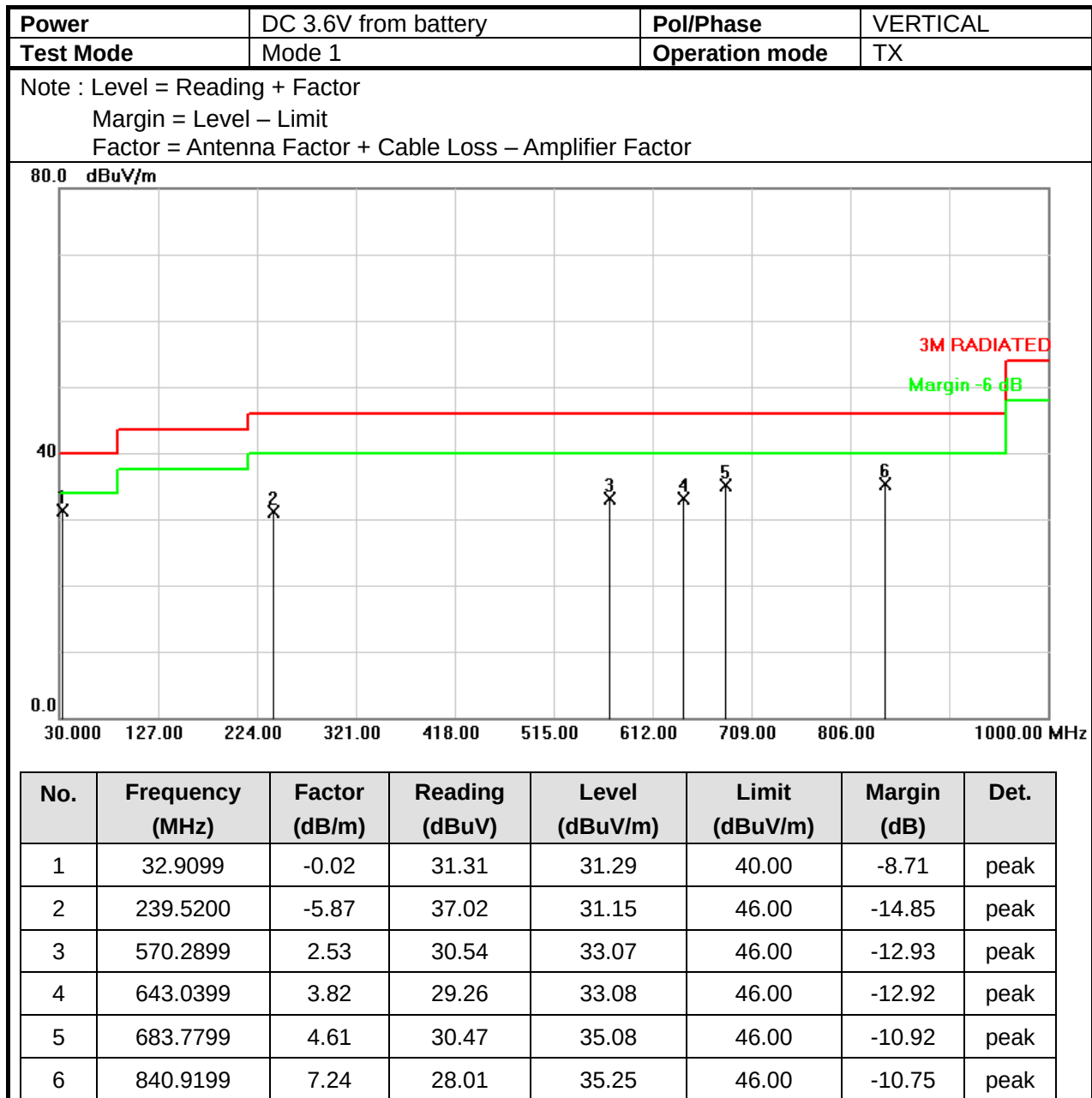


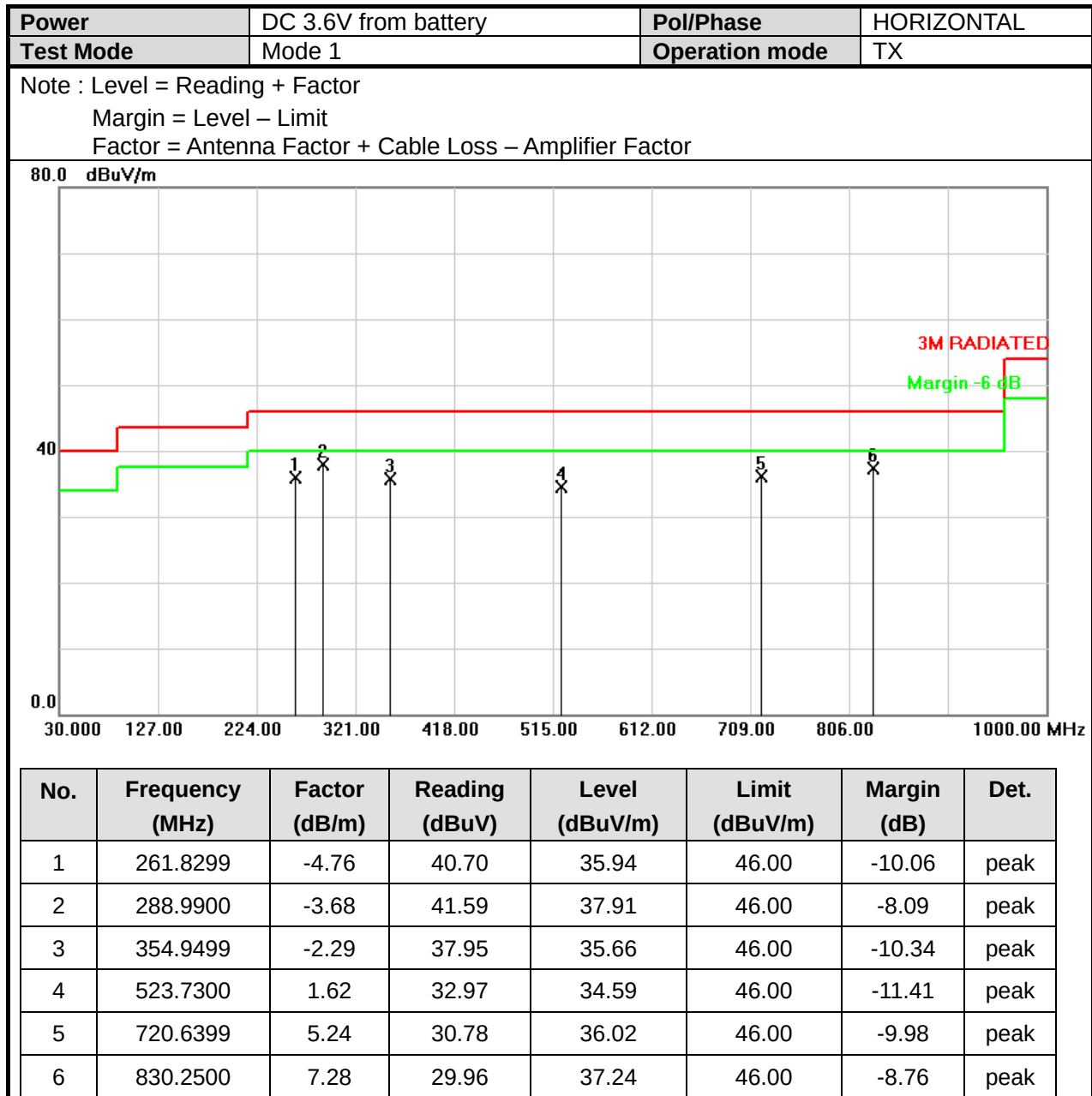


## 6.4 Test Result and Data (9kHz ~ 30MHz)

The 9kHz - 30MHz spurious emission is under limit 20dB more.

## 6.5 Test Result and Data (30MHz ~ 1GHz)







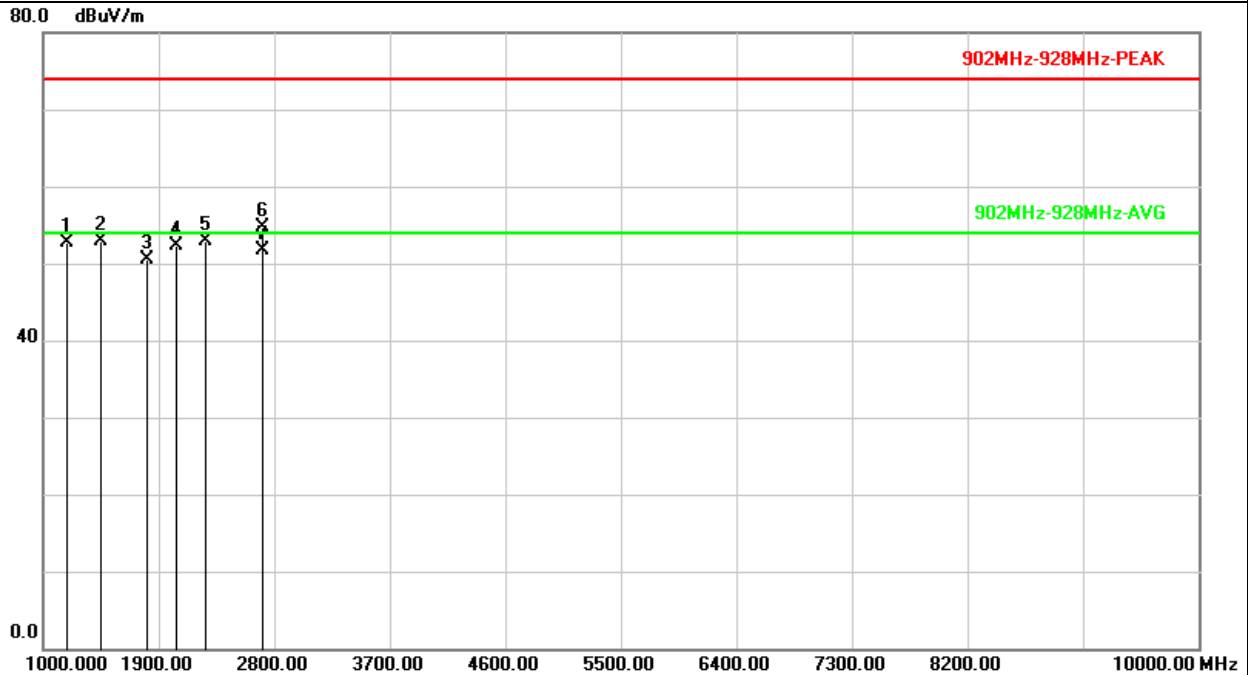
## 6.6 Test Result and Data (1GHz ~ 10GHz)

|           |                      |                |          |
|-----------|----------------------|----------------|----------|
| Power     | DC 3.6V from battery | Pol/Phase      | VERTICAL |
| Test Mode | Mode 1, 902.3MHz     | Operation mode | TX       |

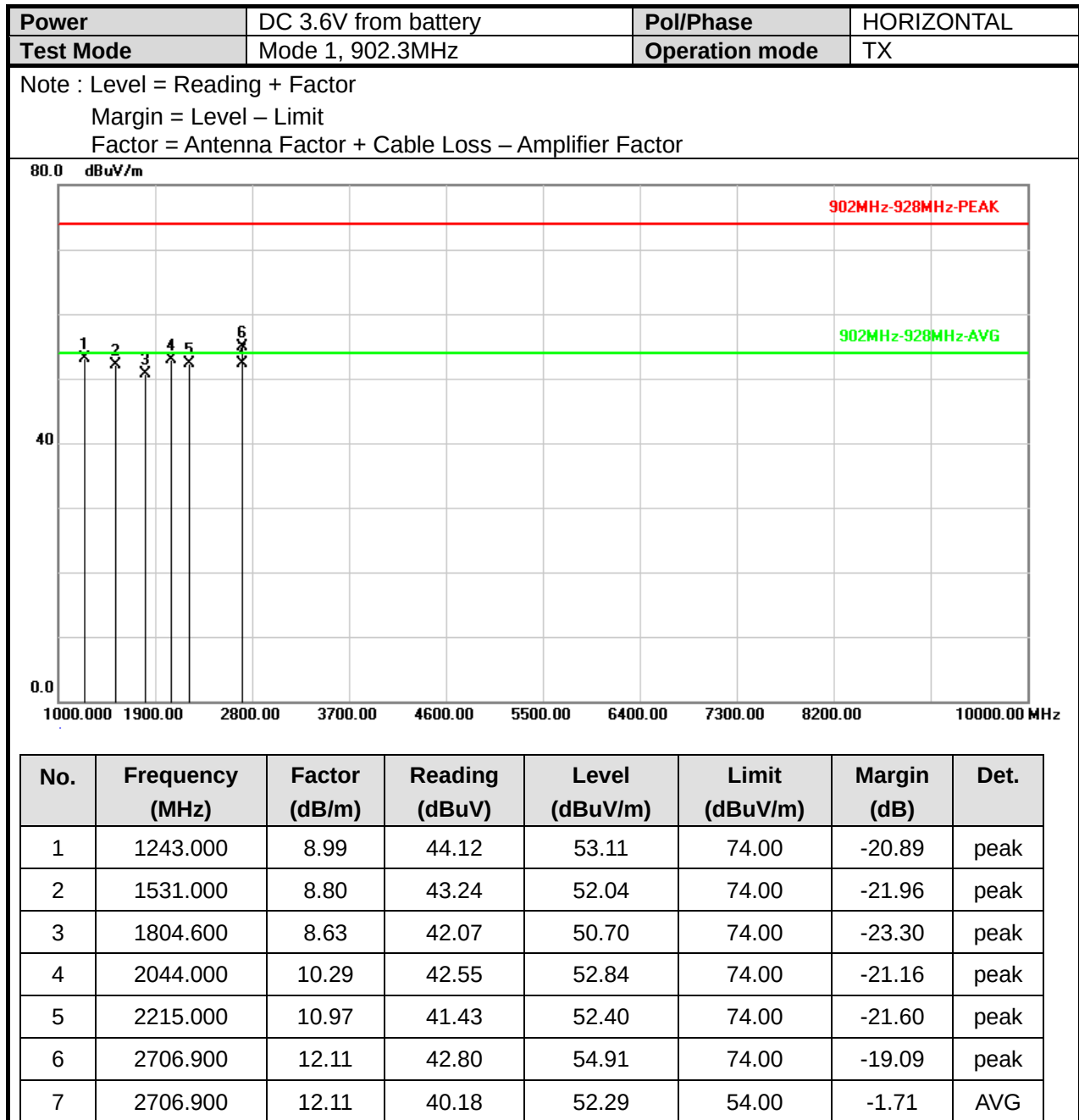
Note : Level = Reading + Factor

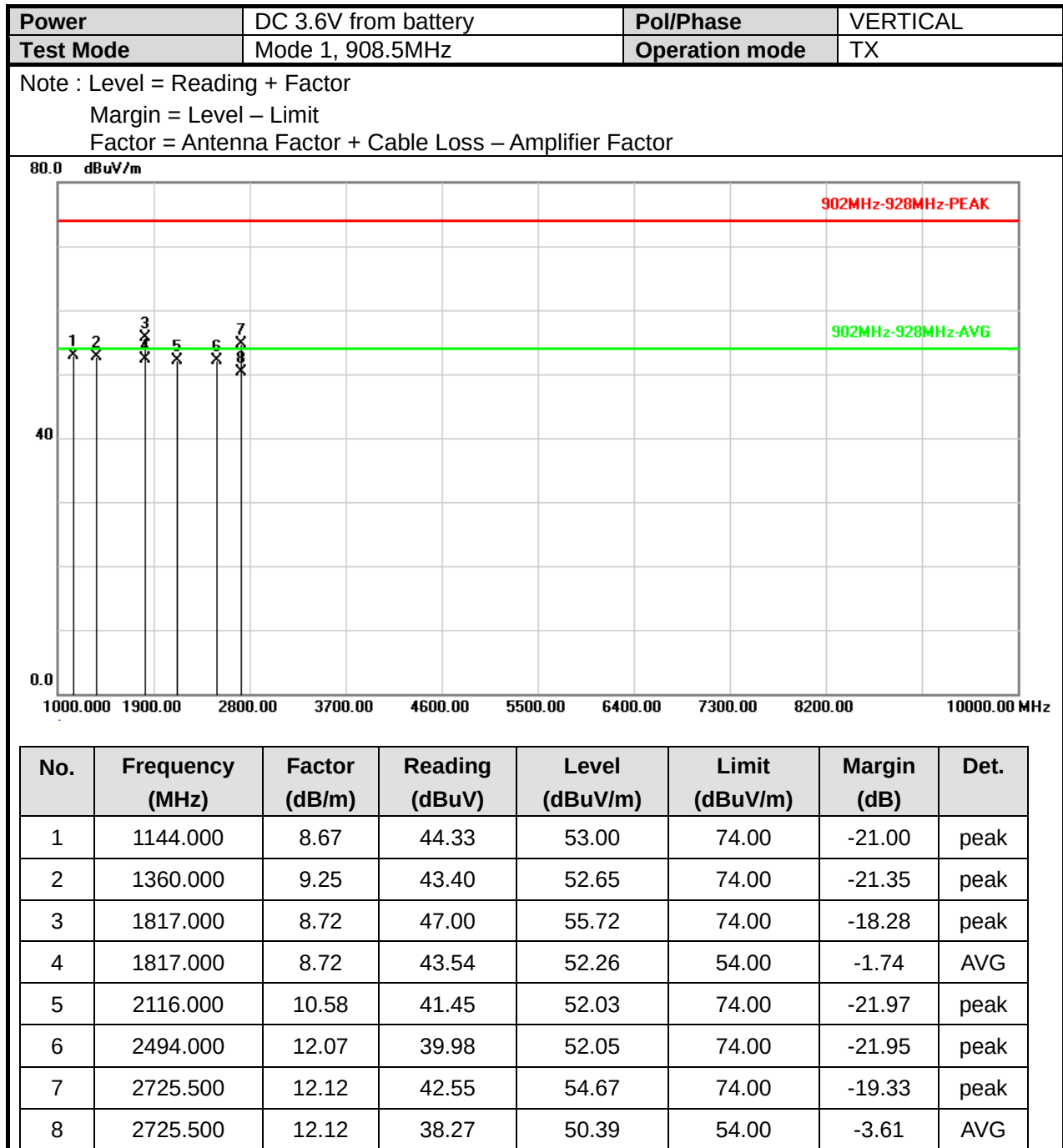
Margin = Level – Limit

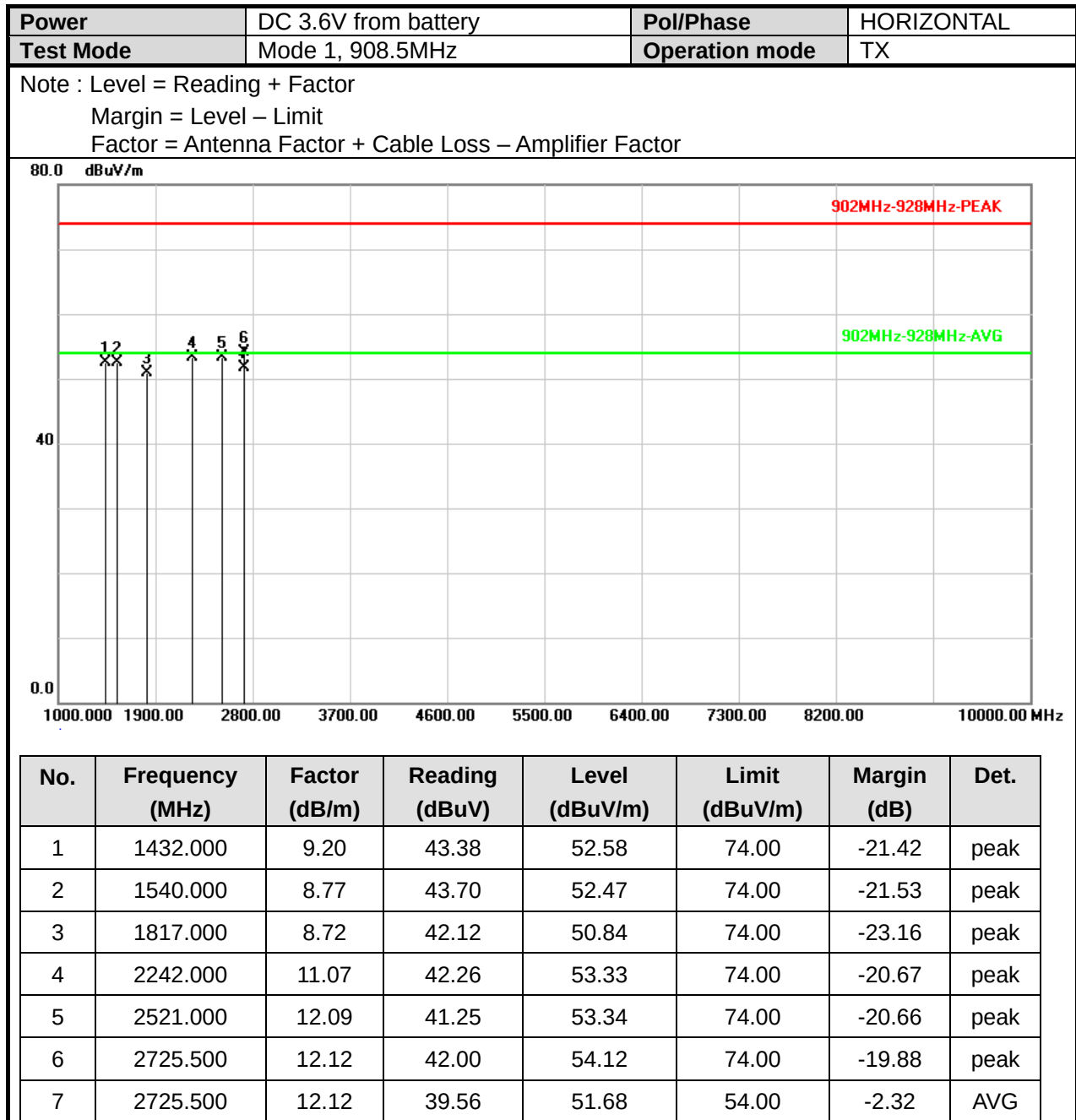
Factor = Antenna Factor + Cable Loss – Amplifier Factor

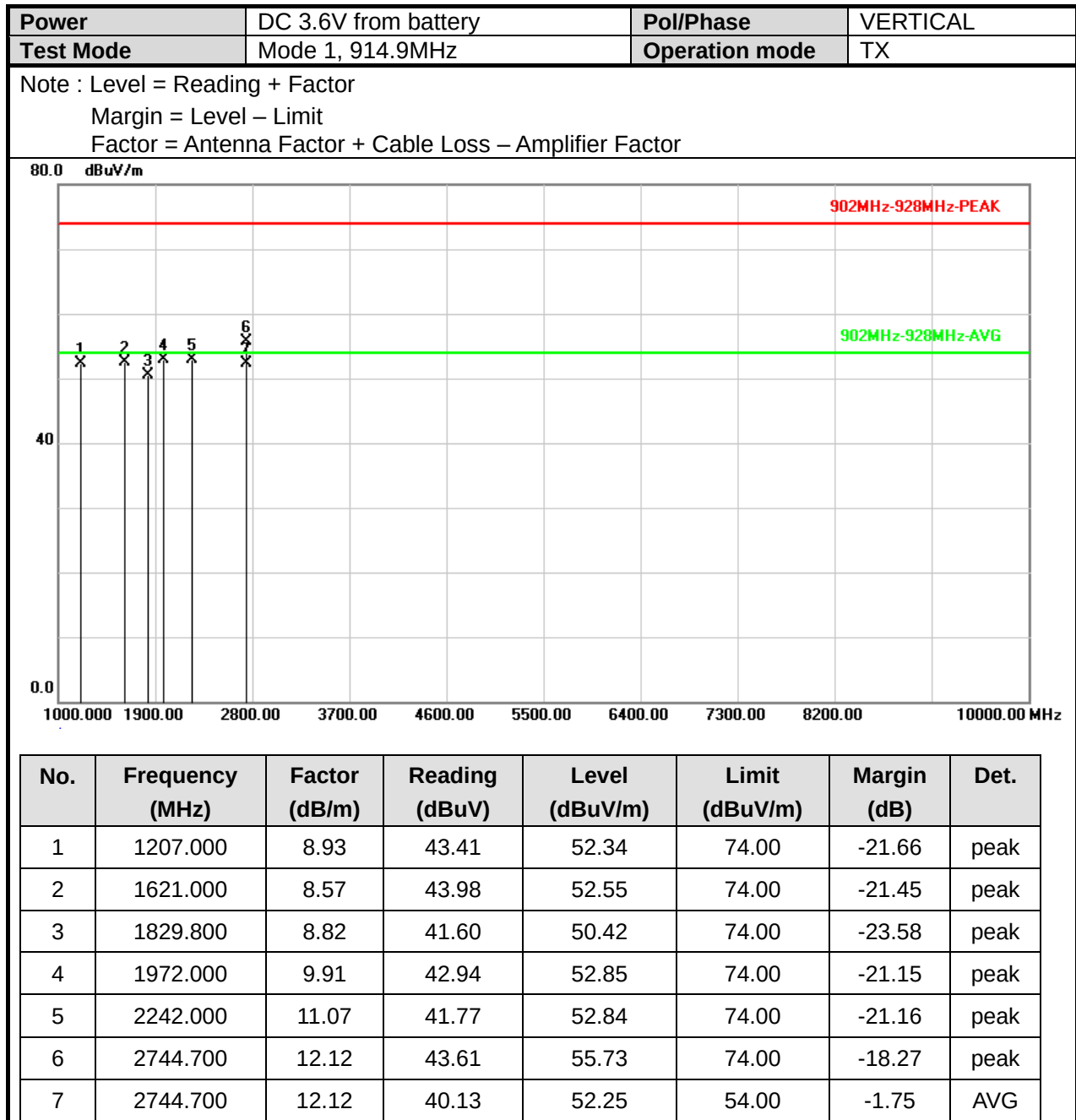


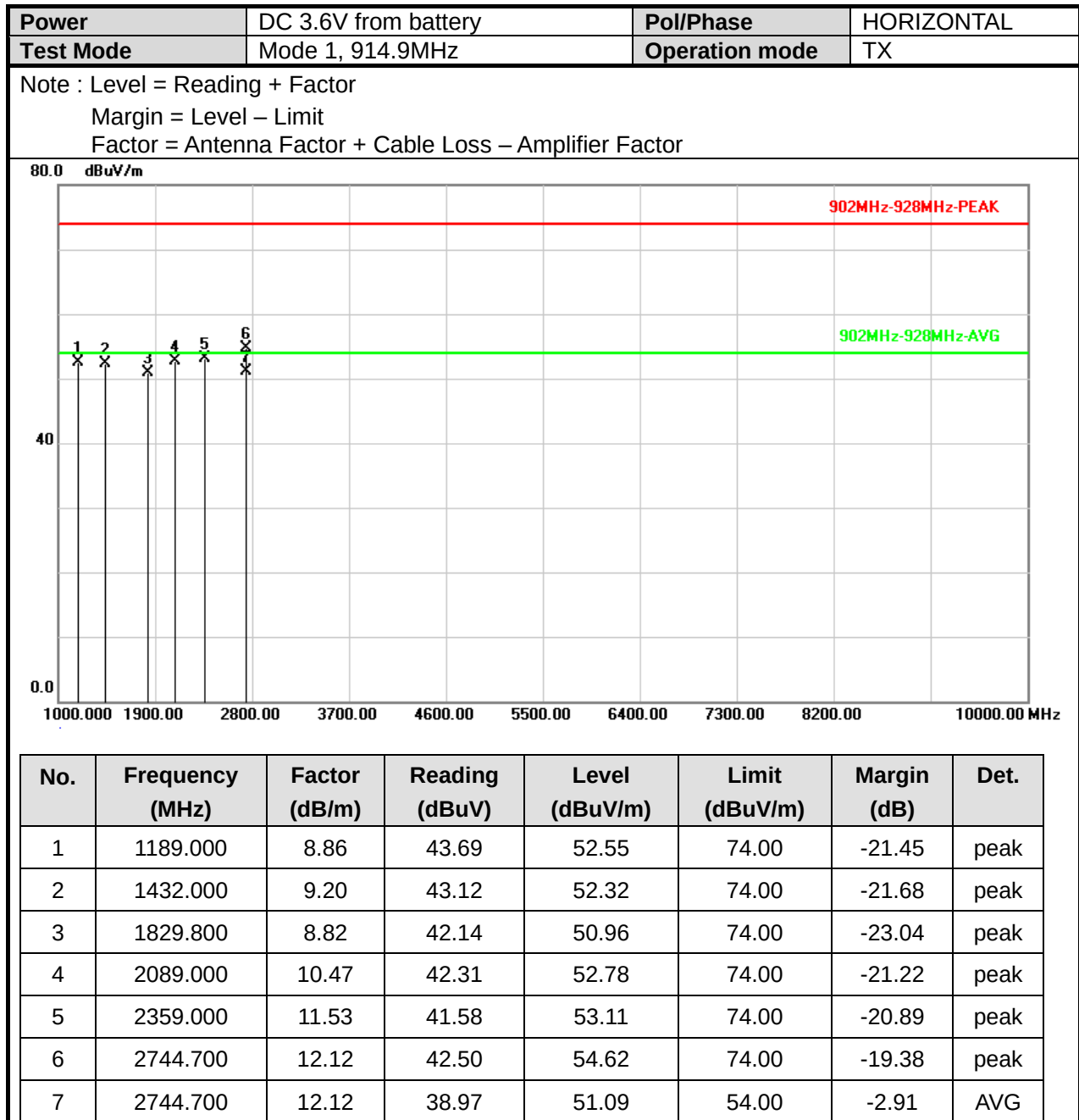
| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Det. |
|-----|-----------------|---------------|----------------|----------------|----------------|-------------|------|
| 1   | 1180.000        | 8.82          | 43.98          | 52.80          | 74.00          | -21.20      | peak |
| 2   | 1450.000        | 9.12          | 43.73          | 52.85          | 74.00          | -21.15      | peak |
| 3   | 1804.600        | 8.63          | 41.88          | 50.51          | 74.00          | -23.49      | peak |
| 4   | 2035.000        | 10.26         | 41.97          | 52.23          | 74.00          | -21.77      | peak |
| 5   | 2269.000        | 11.19         | 41.80          | 52.99          | 74.00          | -21.01      | peak |
| 6   | 2706.900        | 12.11         | 42.60          | 54.71          | 74.00          | -19.29      | peak |
| 7   | 2706.900        | 12.11         | 39.51          | 51.62          | 54.00          | -2.38       | AVG  |



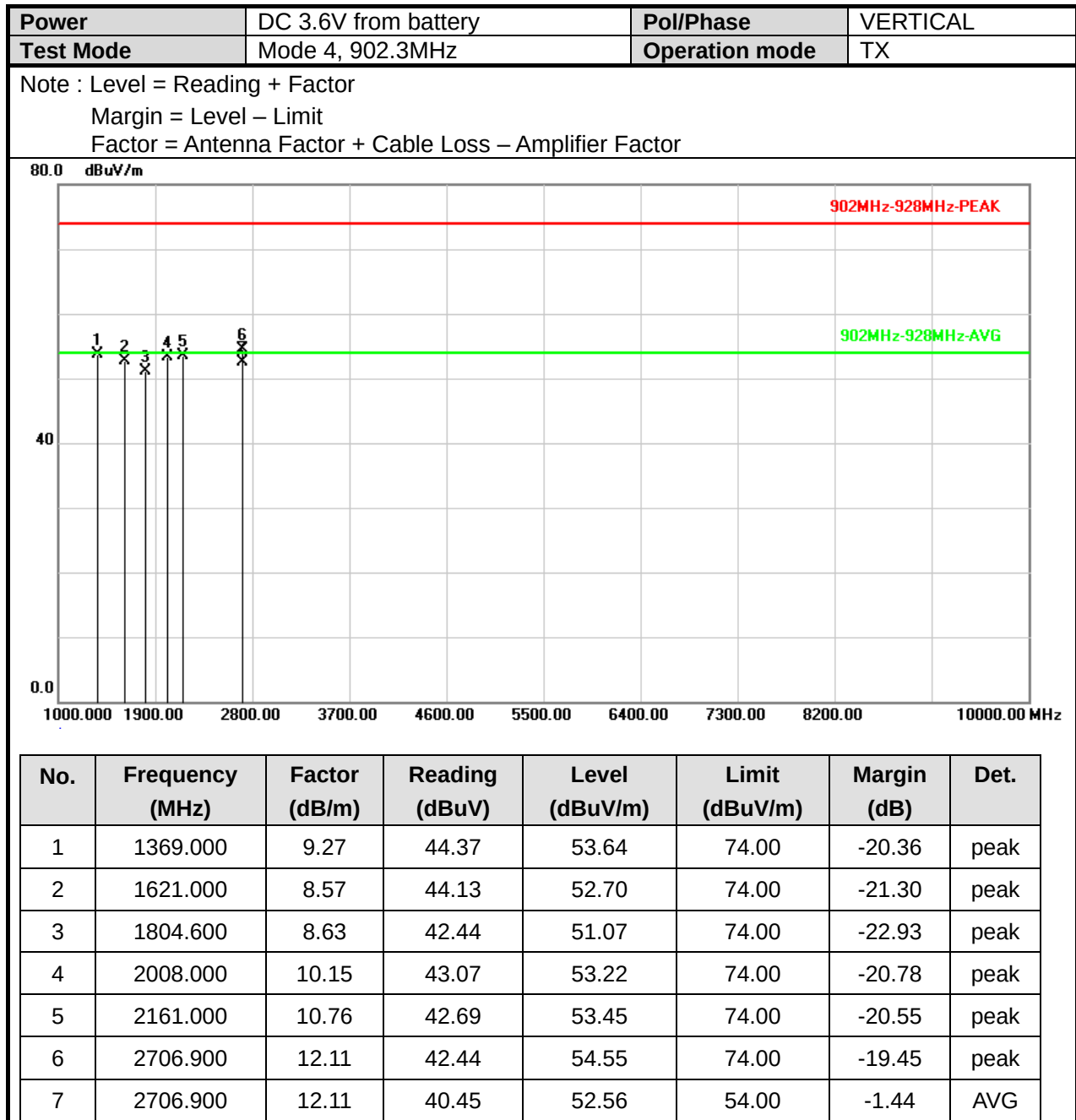


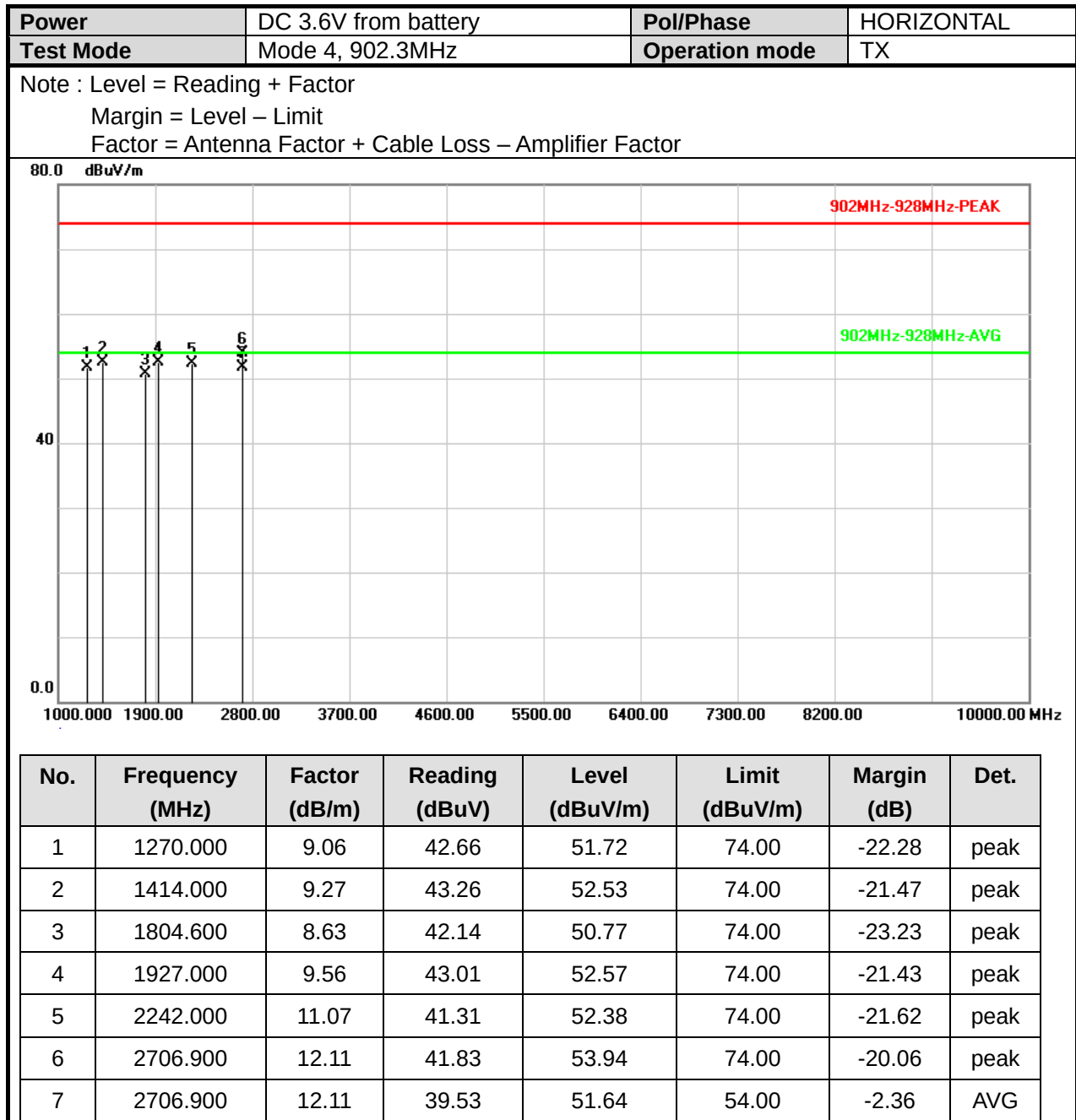


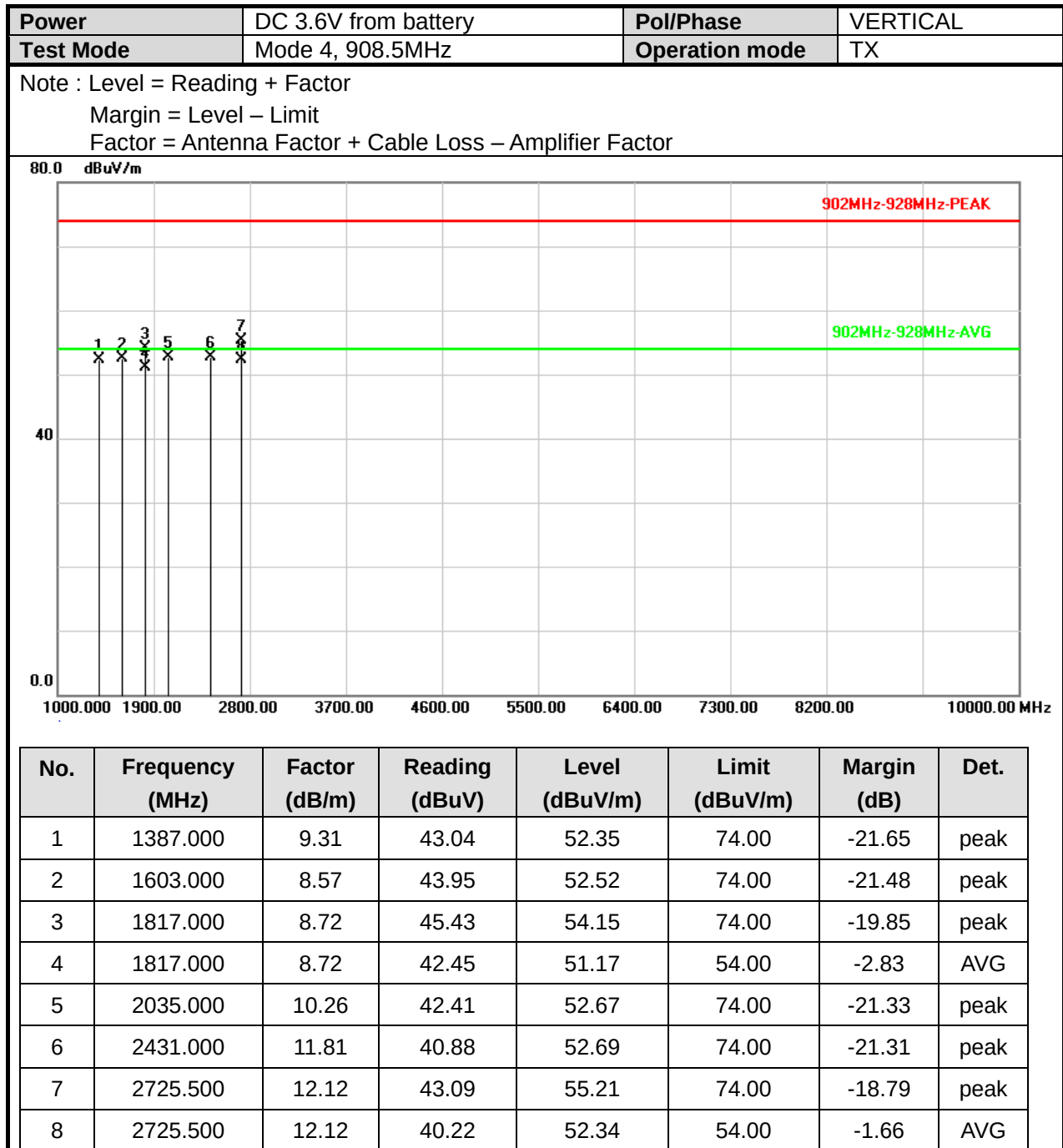


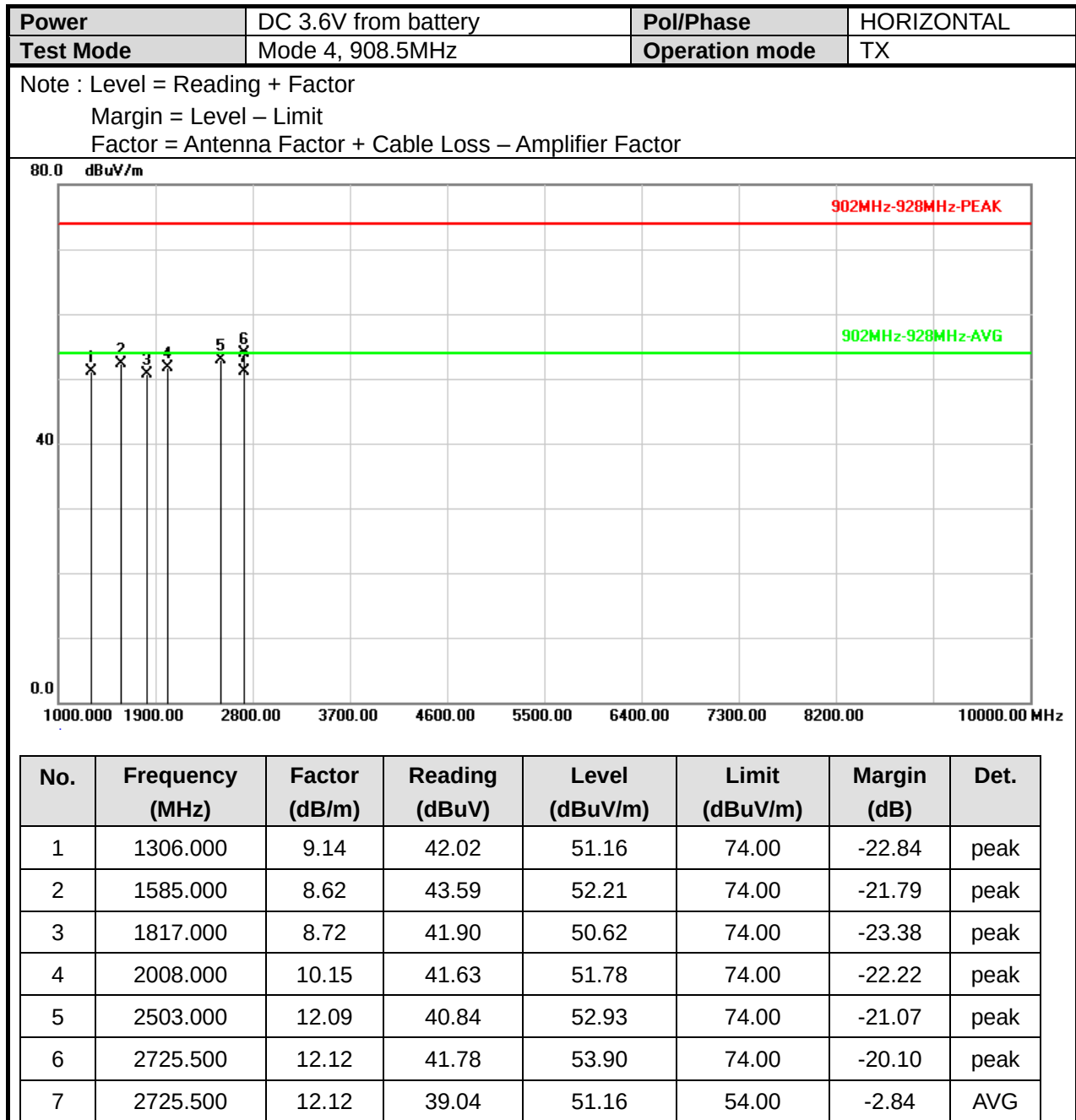


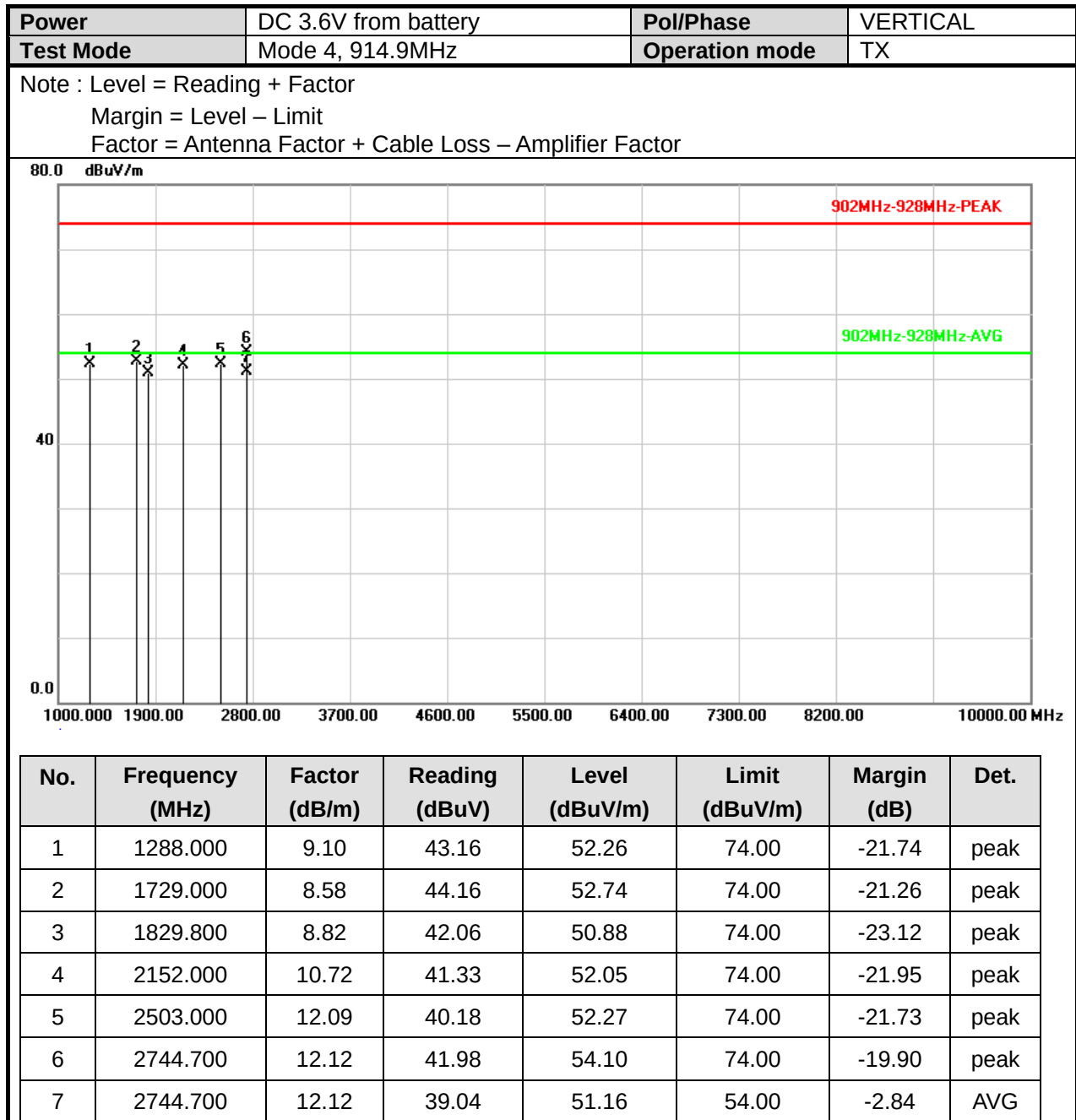


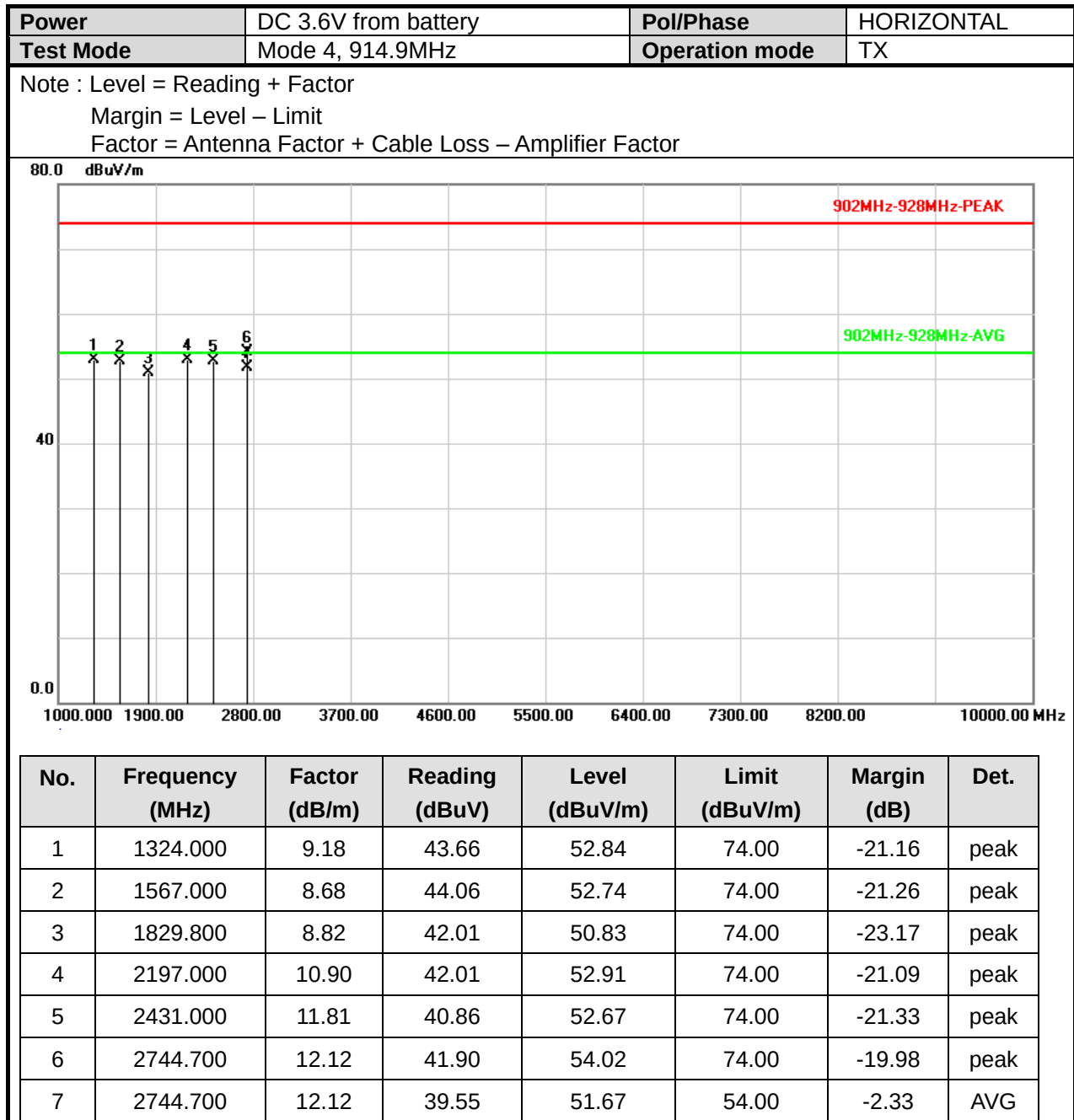












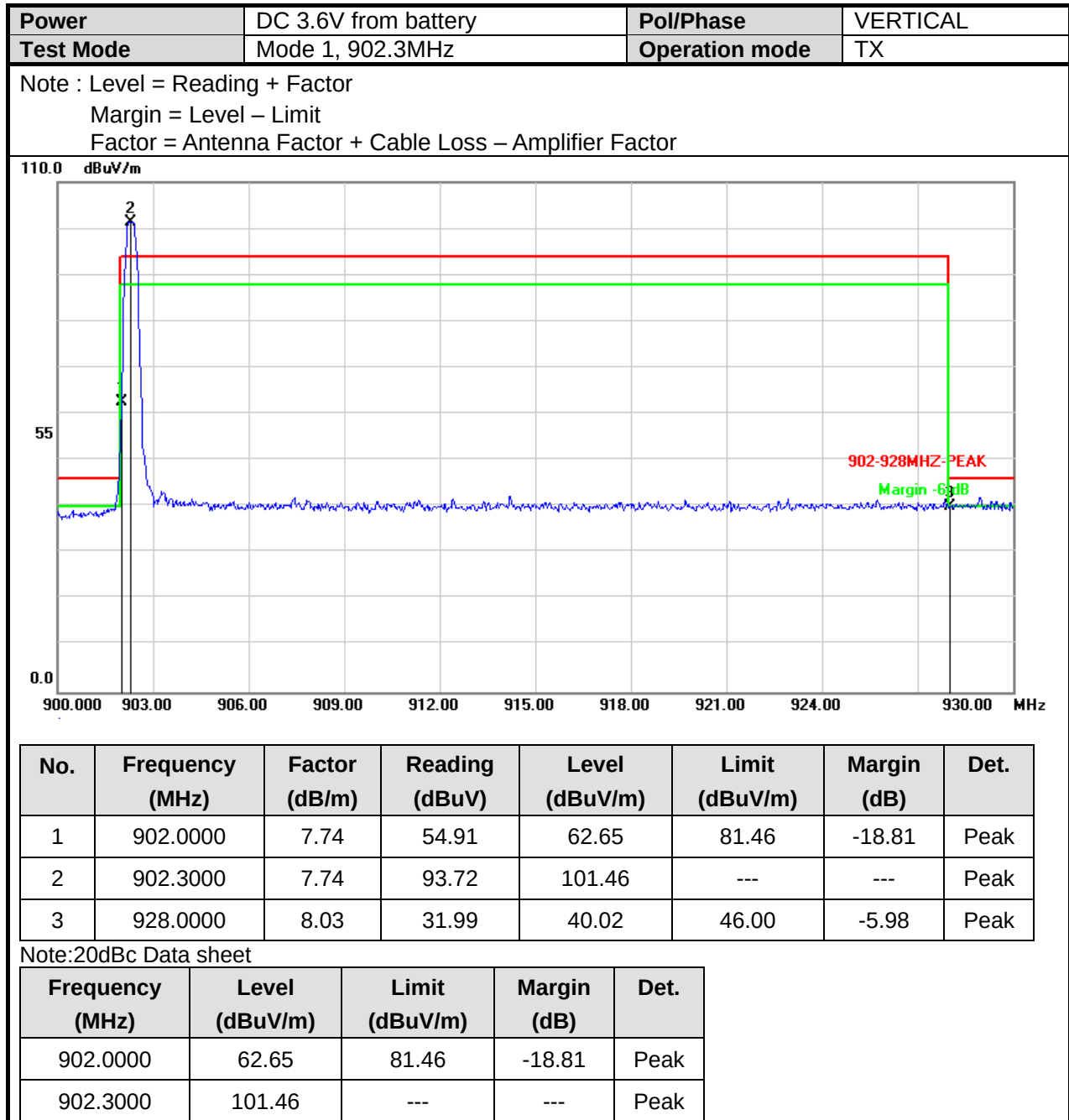


## 6.7 Restricted Bands of Operation

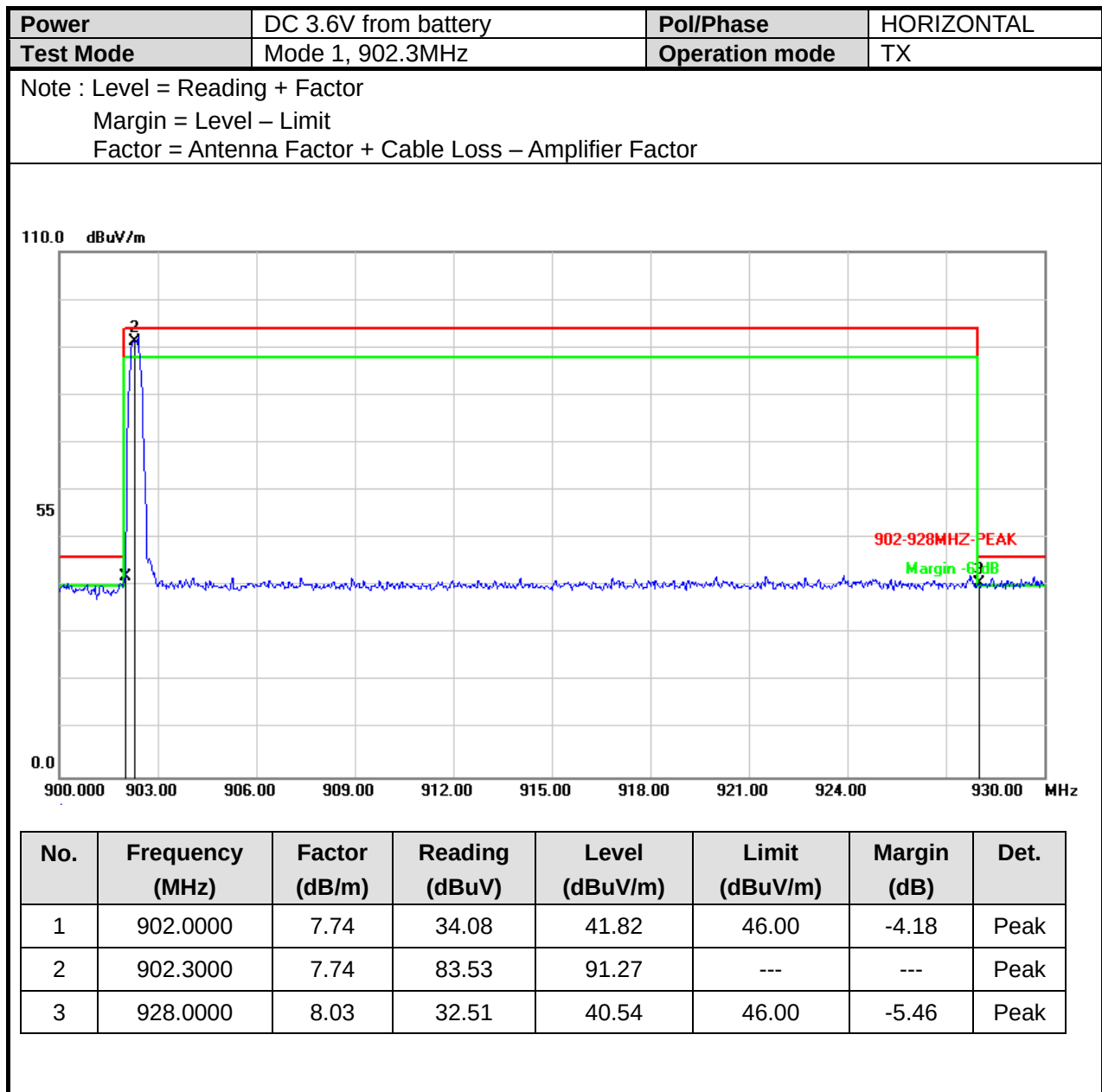
Only spurious emissions are permitted in any of the frequency bands listed below:

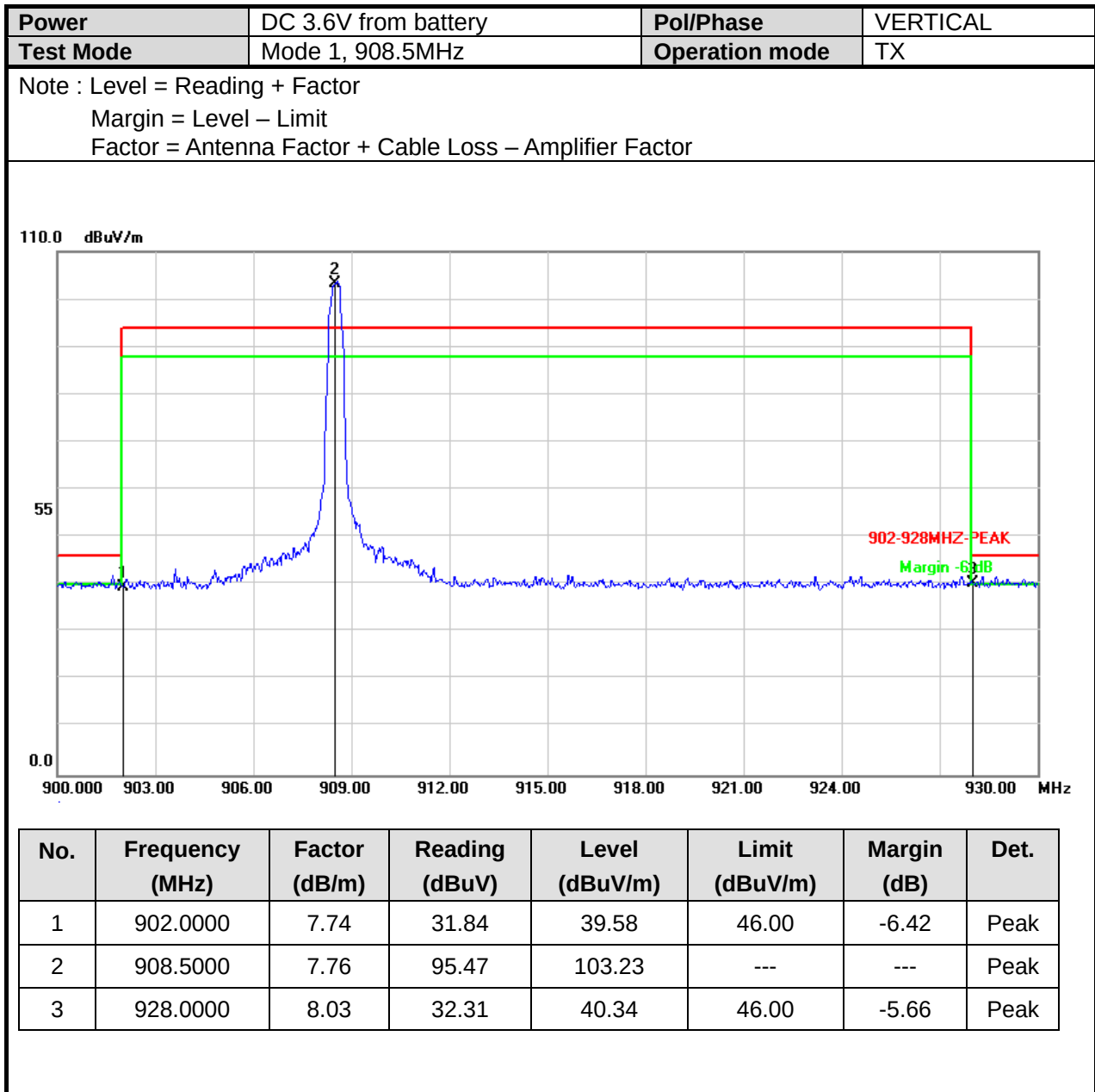
| MHz                 | MHz                   | MHz             | GHz             |
|---------------------|-----------------------|-----------------|-----------------|
| 0.09000 – 0.11000   | 16.42000 – 16.42300   | 399.9 – 410.0   | 4.500 – 5.250   |
| 0.49500 – 0.505**   | 16.69475 – 16.69525   | 608.0 – 614.0   | 5.350 – 5.460   |
| 2.17350 – 2.19050   | 16.80425 – 16.80475   | 960.0 – 1240.0  | 7.250 – 7.750   |
| 4.12500 – 4.12800   | 25.50000 – 25.67000   | 1300.0 – 1427.0 | 8.025 – 8.500   |
| 4.17725 – 4.17775   | 37.50000 – 38.25000   | 1435.0 – 1626.5 | 9.000 – 9.200   |
| 4.20725 – 4.20775   | 73.00000 – 74.60000   | 1645.5 – 1646.5 | 9.300 – 9.500   |
| 6.21500 – 6.21800   | 74.80000 – 75.20000   | 1660.0 – 1710.0 | 10.600 – 12.700 |
| 6.26775 – 6.26825   | 108.00000 – 121.94000 | 1718.8 – 1722.2 | 13.250 – 13.400 |
| 6.31175 – 6.31225   | 123.00000 – 138.00000 | 2200.0 – 2300.0 | 14.470 – 14.500 |
| 8.29100 – 8.29400   | 149.90000 – 150.05000 | 2310.0 – 2390.0 | 15.350 – 16.200 |
| 8.36200 – 8.36600   | 156.52475 – 156.52525 | 2483.5 – 2500.0 | 17.700 – 21.400 |
| 8.37625 – 8.38675   | 156.70000 – 156.90000 | 2655.0 – 2900.0 | 22.010 – 23.120 |
| 8.41425 – 8.41475   | 162.01250 – 167.17000 | 3260.0 – 3267.0 | 23.600 – 24.000 |
| 12.29000 – 12.29300 | 167.72000 – 173.20000 | 3332.0 – 3339.0 | 31.200 – 31.800 |
| 12.51975 – 12.52025 | 240.00000 – 285.00000 | 3345.8 – 3358.0 | 36.430 – 36.500 |
| 12.57675 – 12.57725 | 322.00000 – 335.40000 | 3600.0 – 4400.0 | Above 38.6      |
| 13.36000 – 13.41000 |                       |                 |                 |

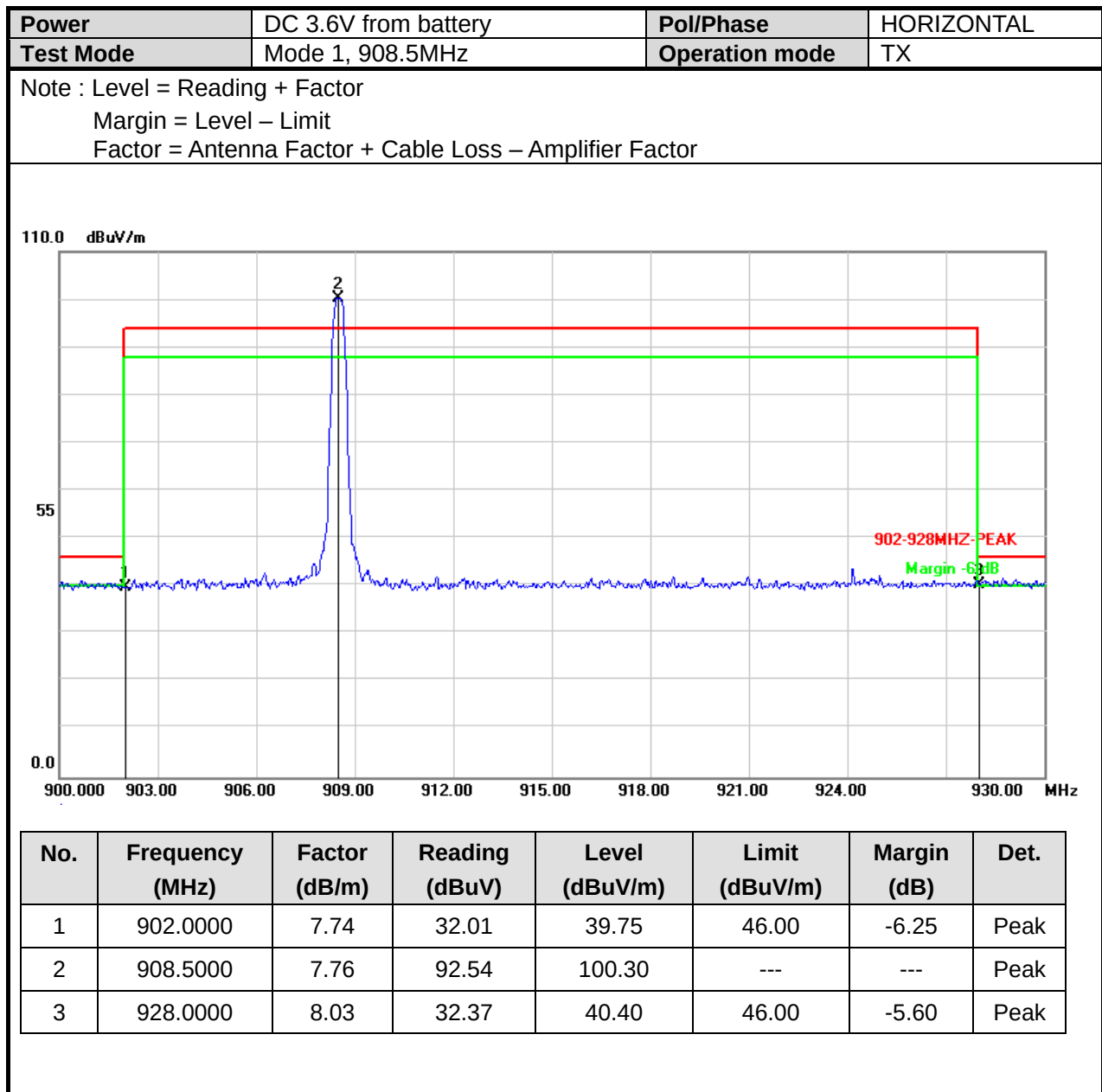
\*\* : Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

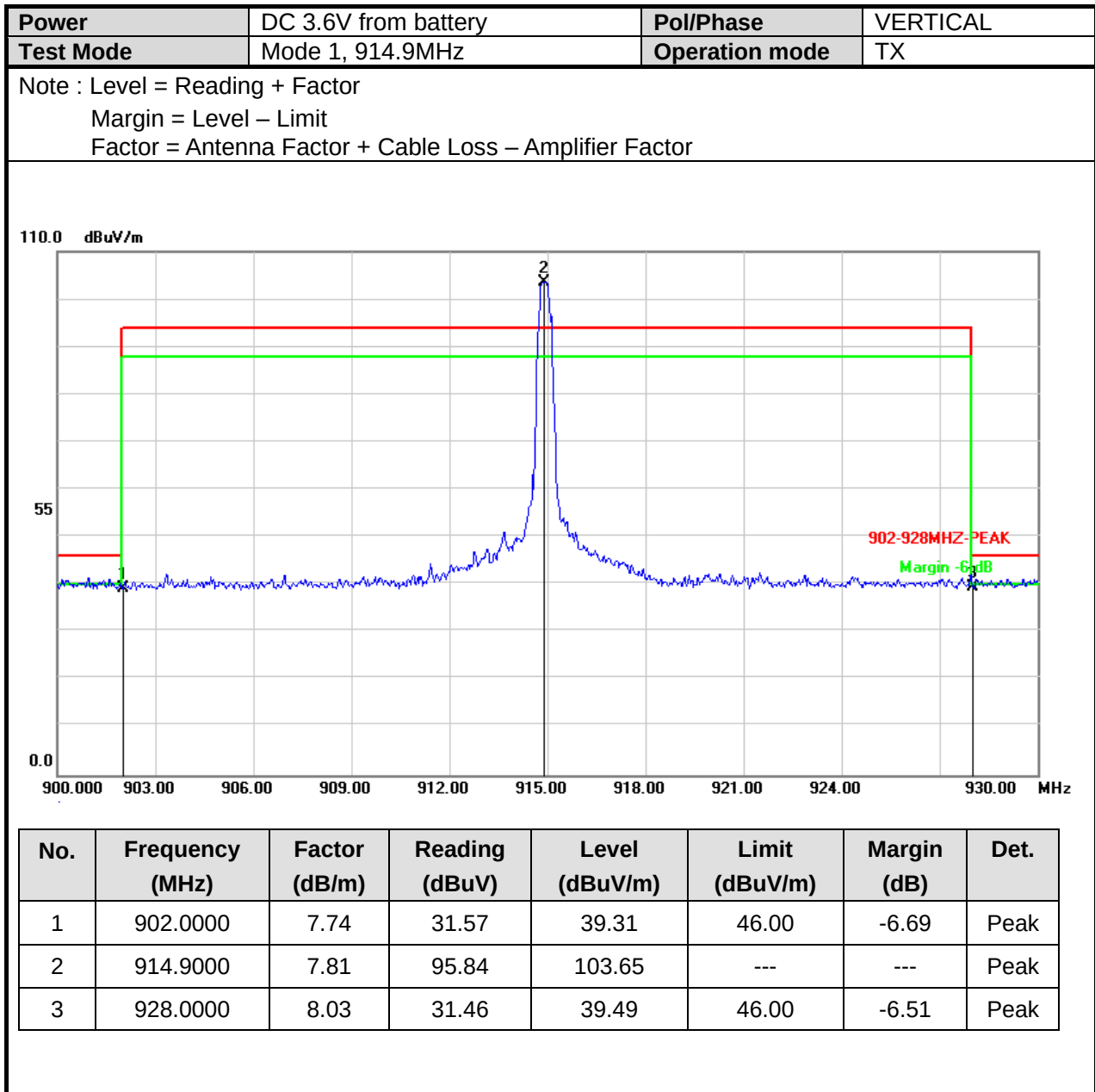


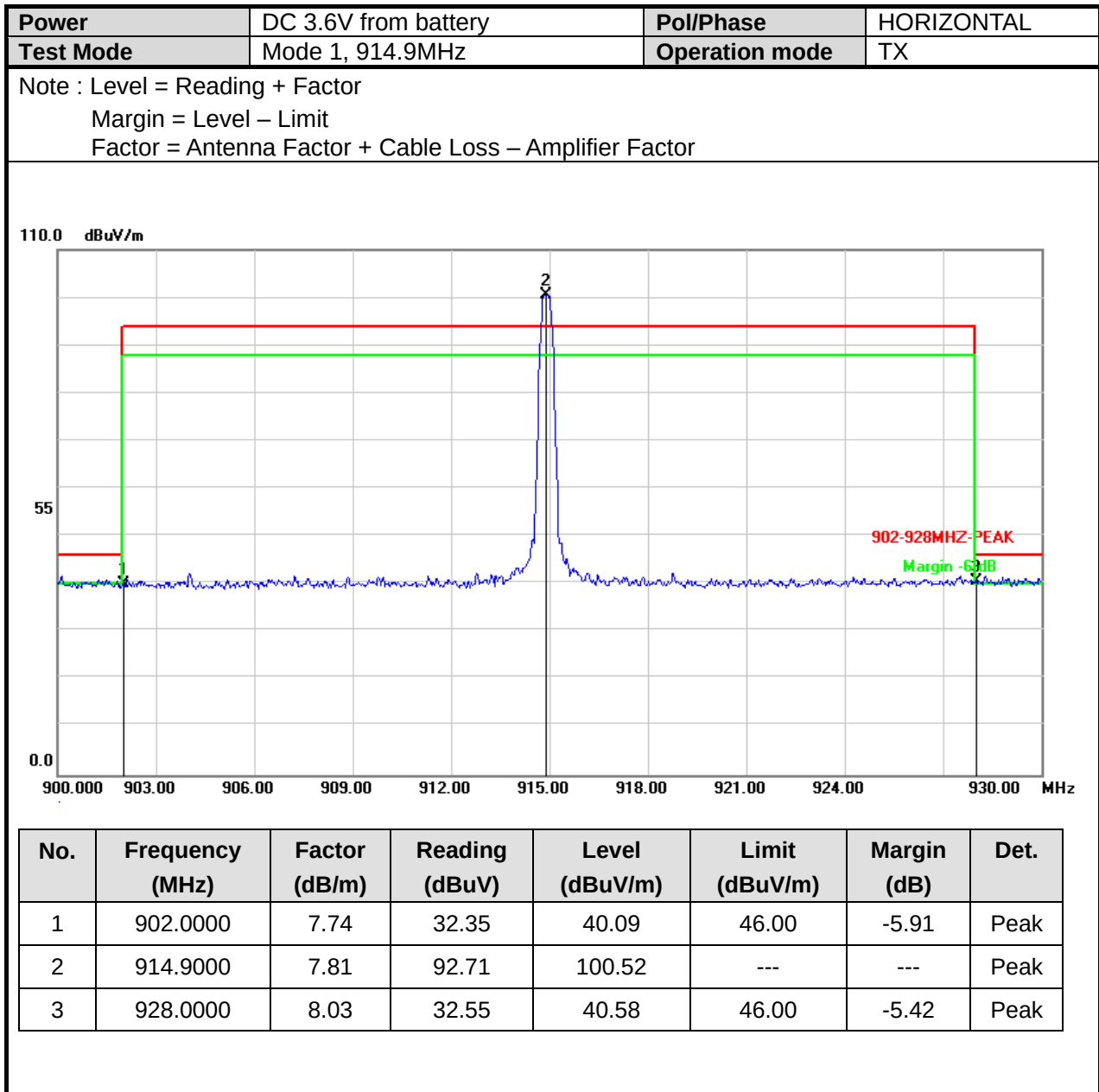


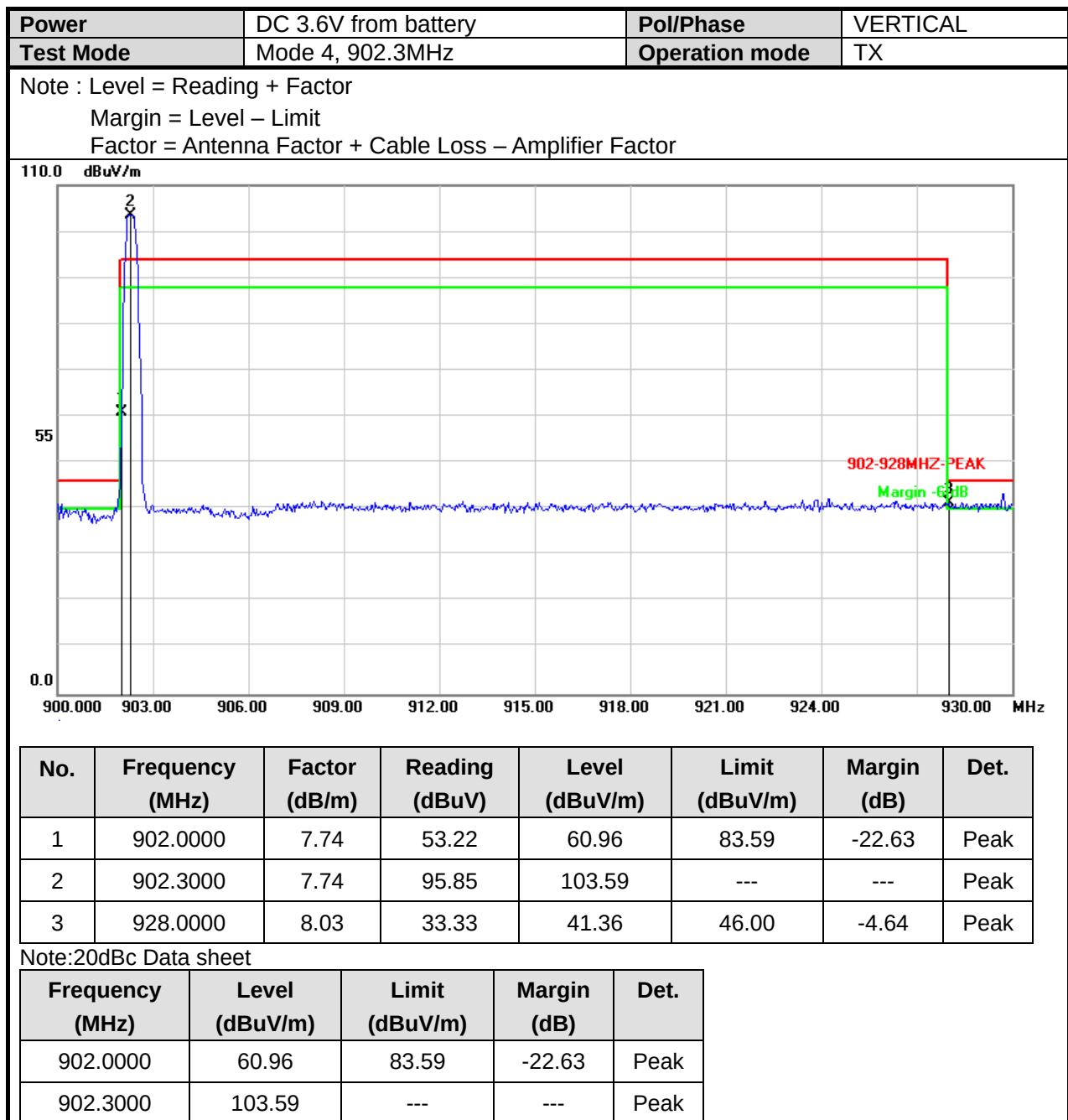


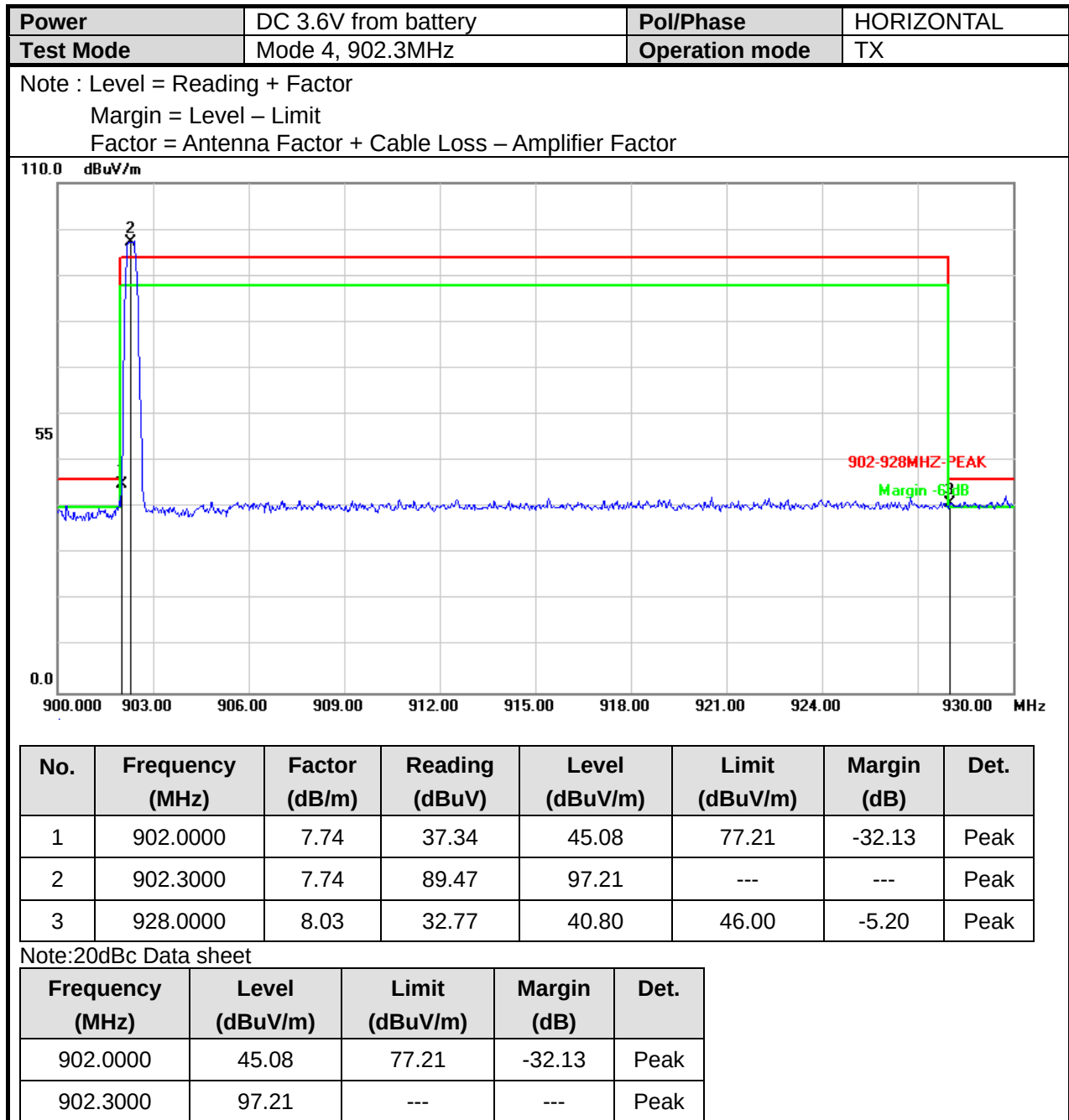


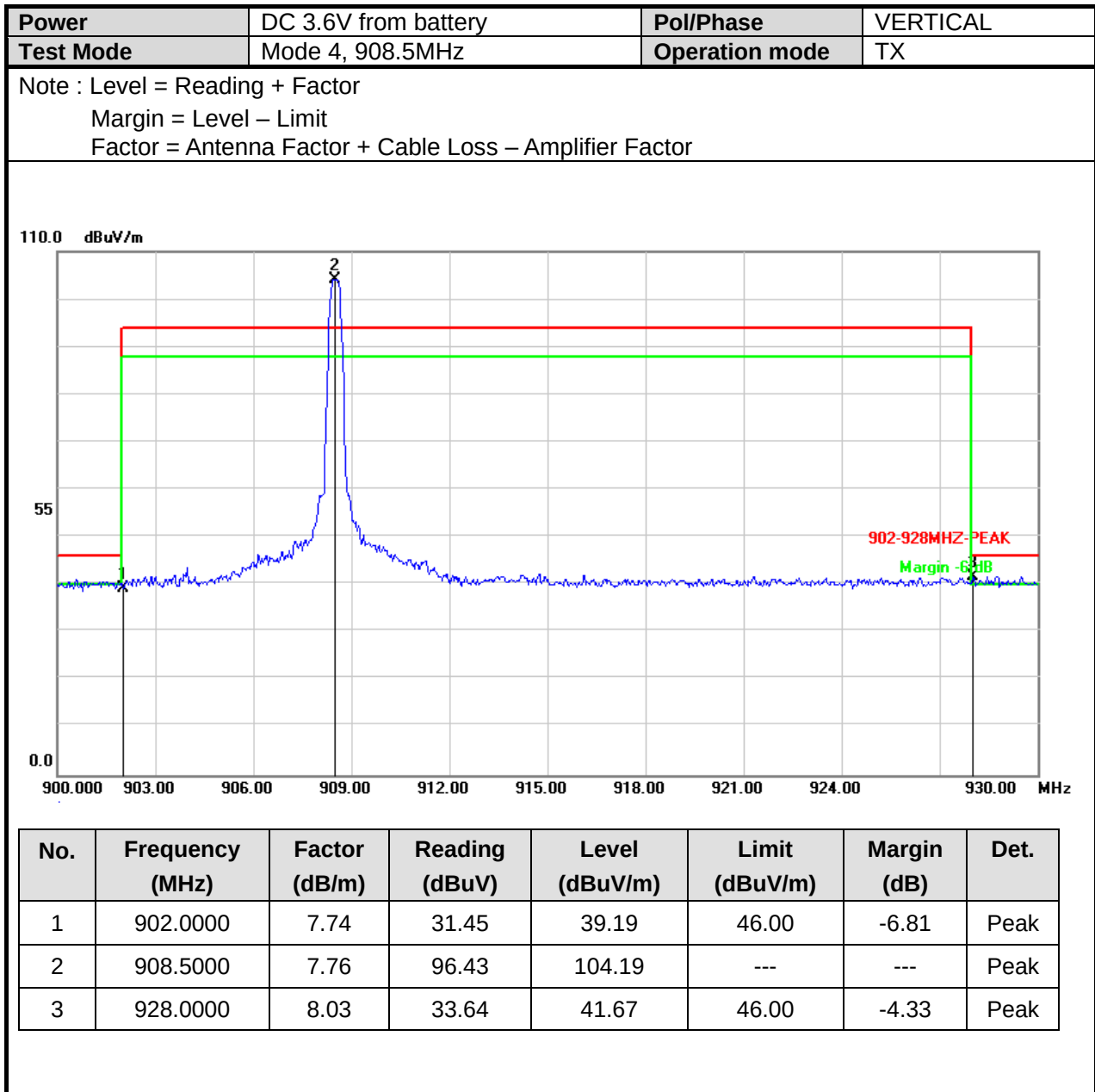




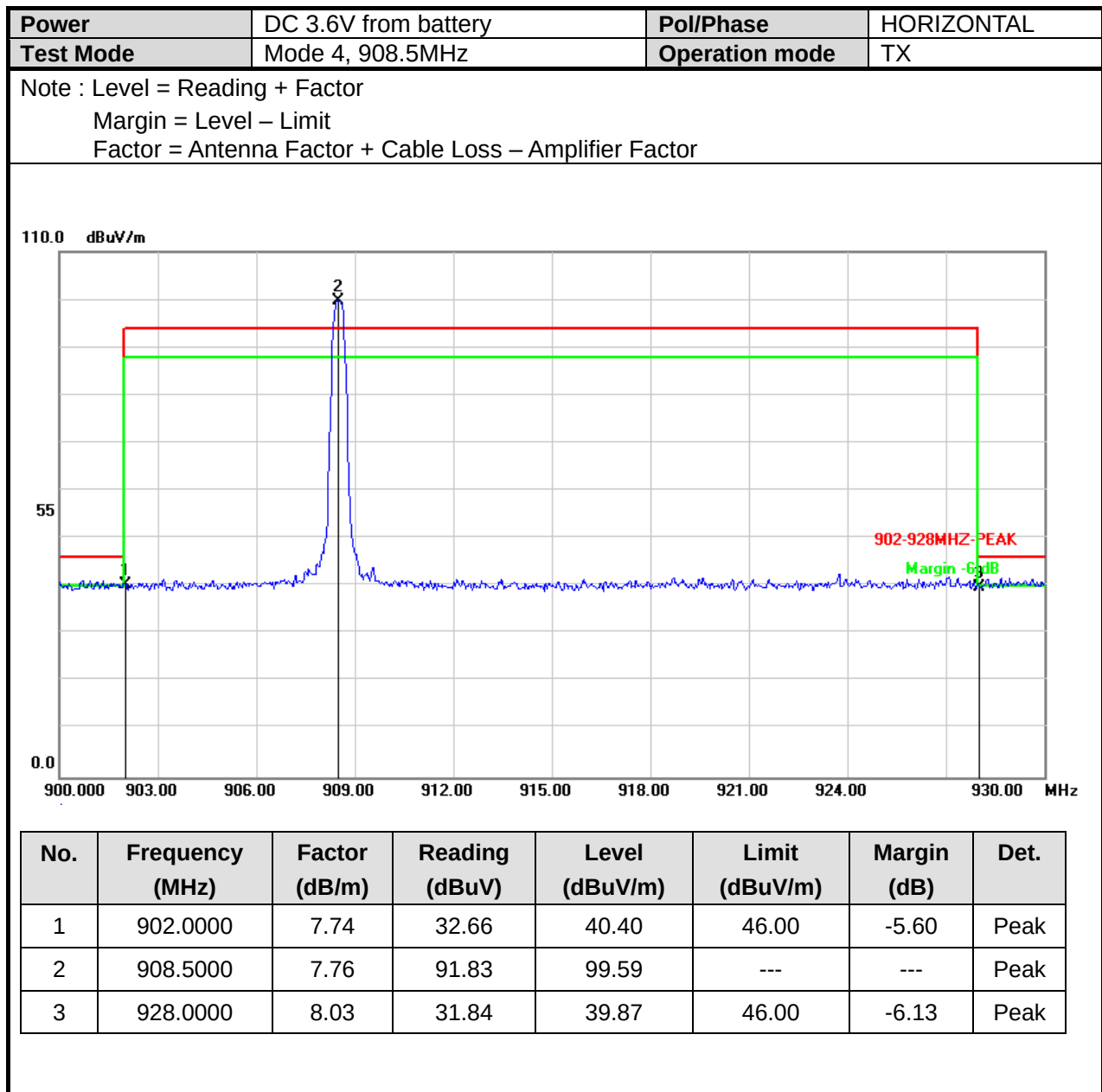


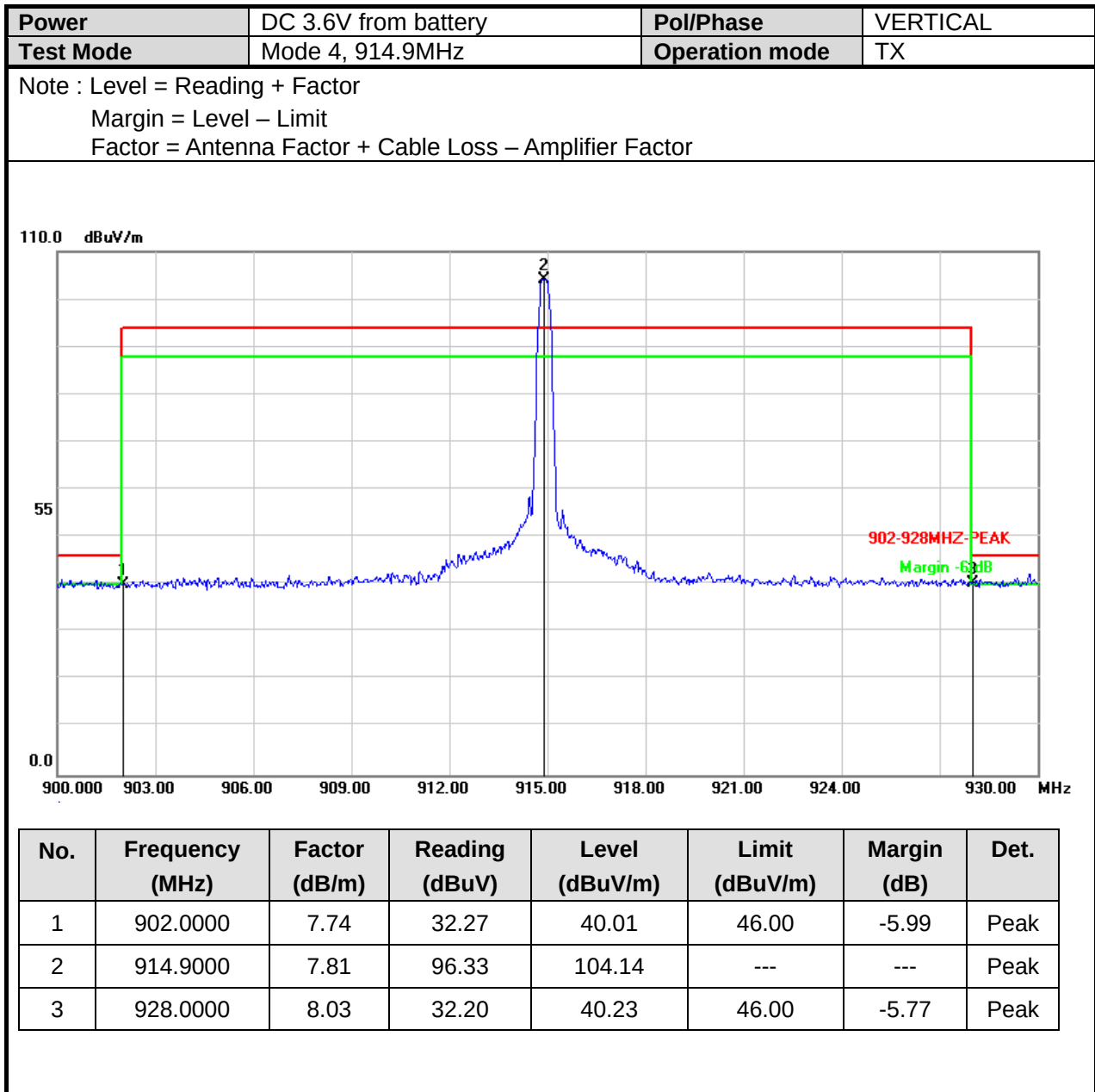


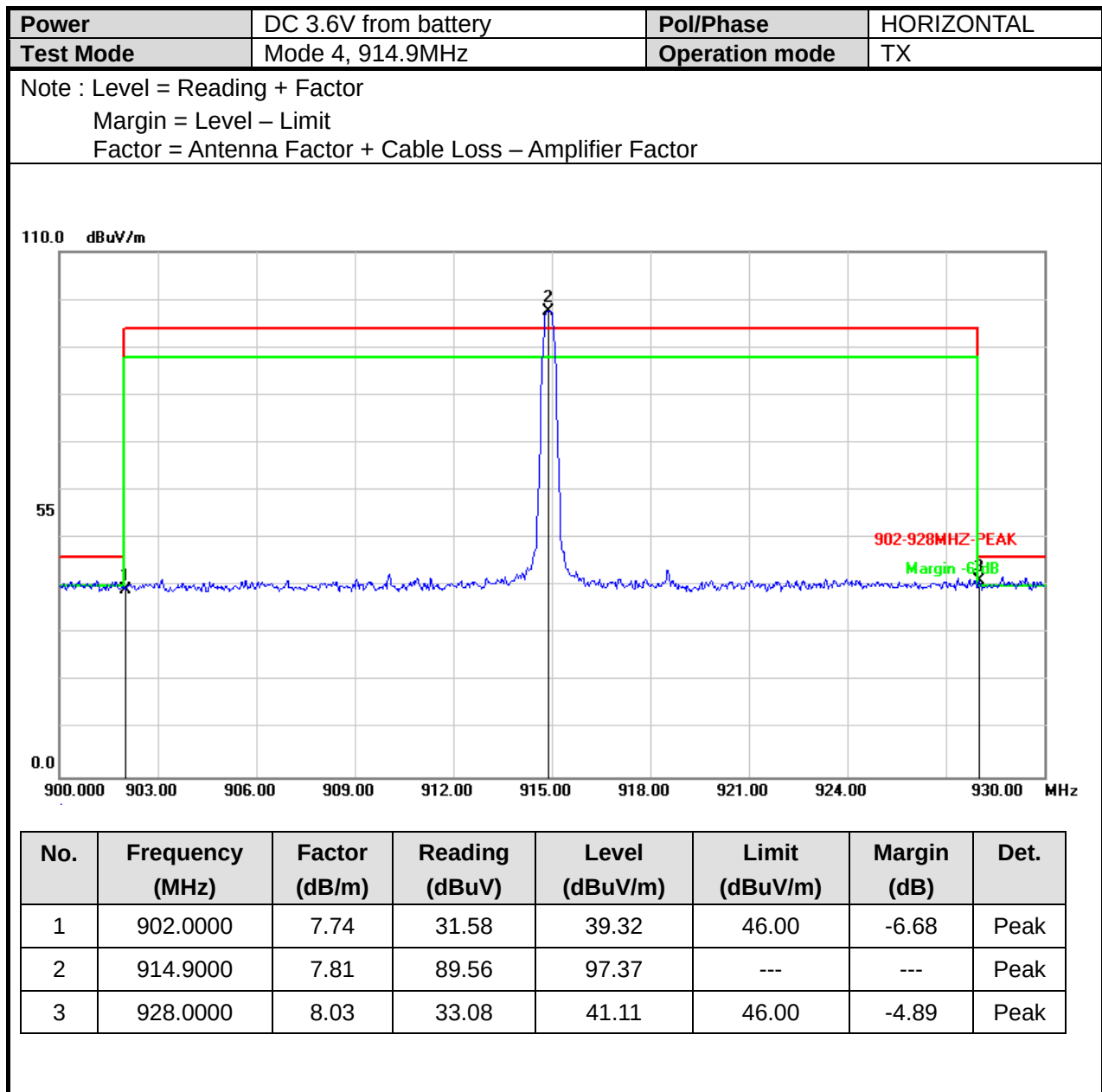














## 7. Test of Spurious Emission (Conducted)

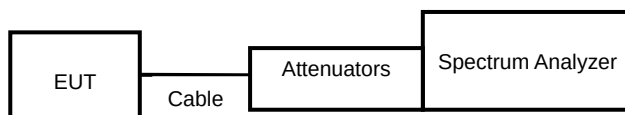
### 7.1 Test Limit

Below  $-20\text{dB}$  of the highest emission level of operating band (In 100 kHz Resolution Bandwidth)

### 7.2 Test Procedure

- The transmitter output was connected to the spectrum analyzer via a low loss cable.
- Set RBW of spectrum analyzer to 100 KHz and VBW of spectrum analyzer to 300 KHz with convenient frequency span including 100 KHz bandwidth from band edge.
- Peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20dB relative to the maximum measured in-band peak PSD level.
- The band edges was measured and recorded.

### 7.3 Test Setup Layout

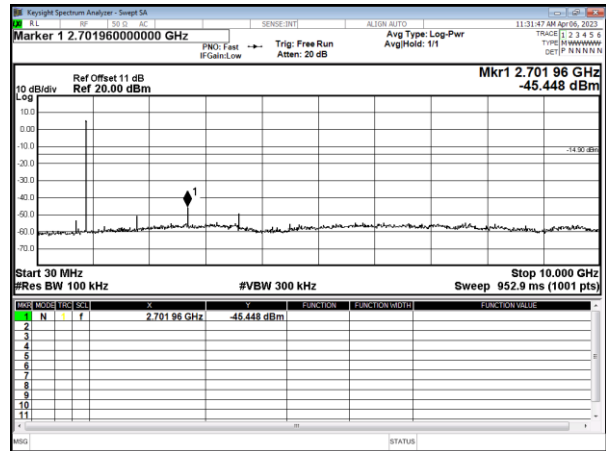
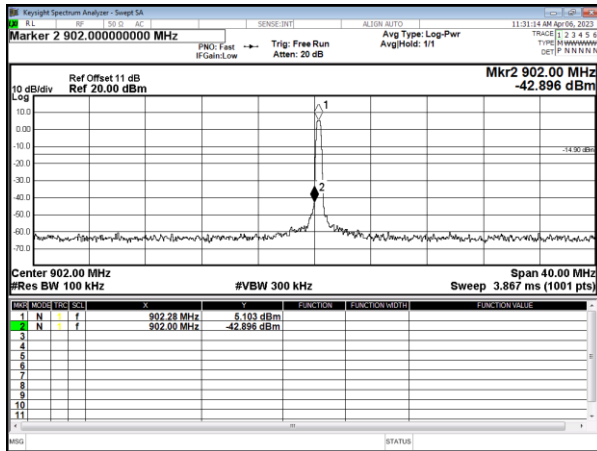


### 7.4 Test Result and Data

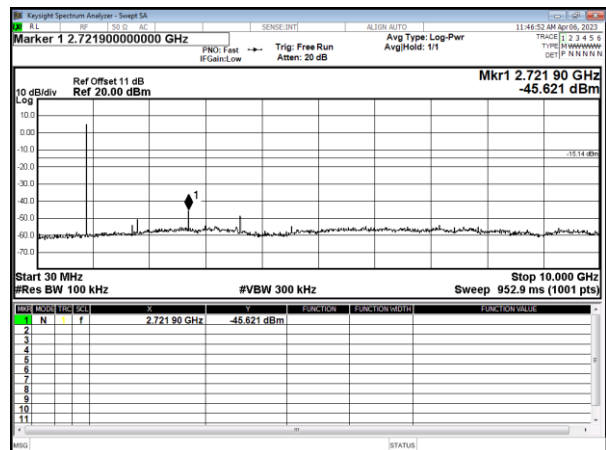
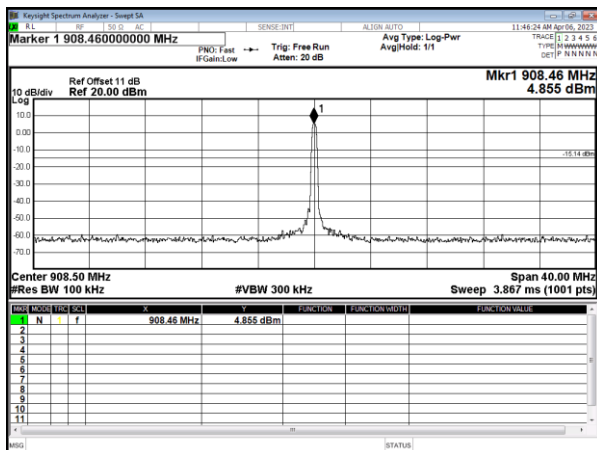
Note: Test plots refer to the following pages.



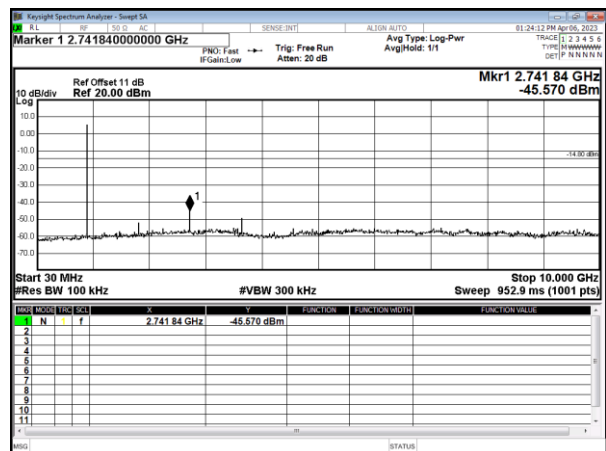
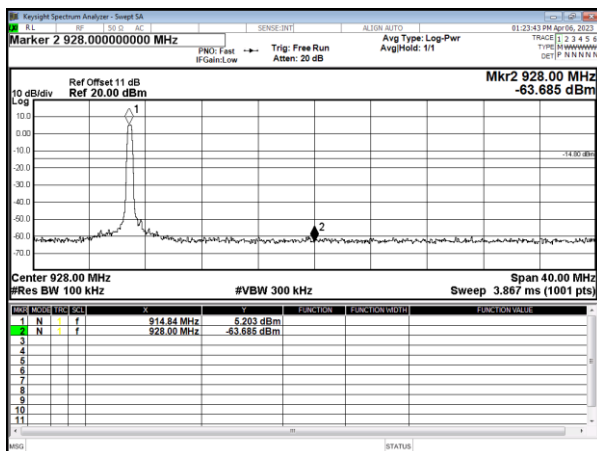
Lora 125KHz  
SF07-902.3MHz

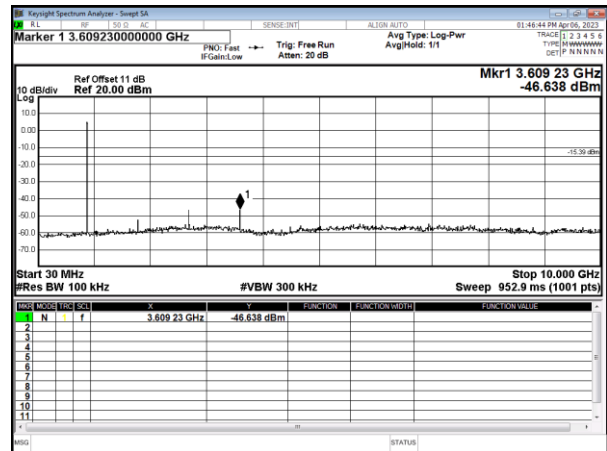
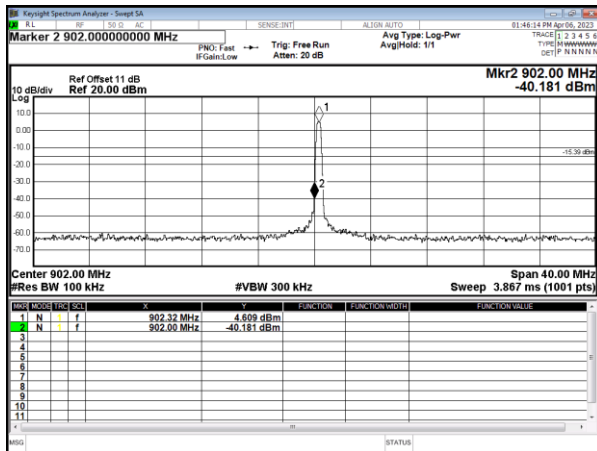
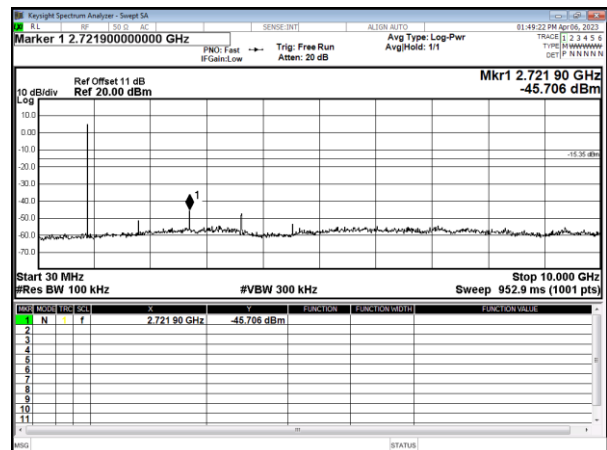
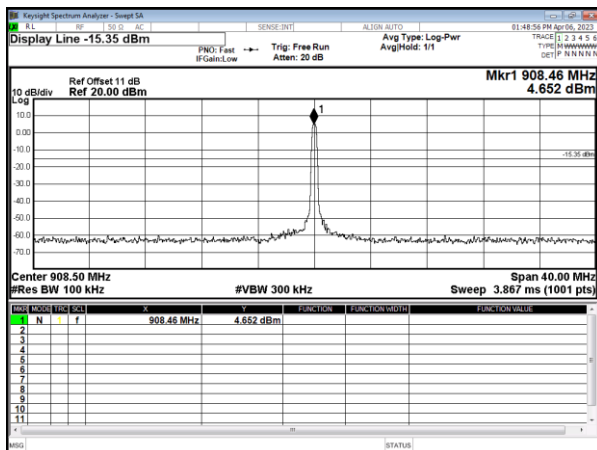
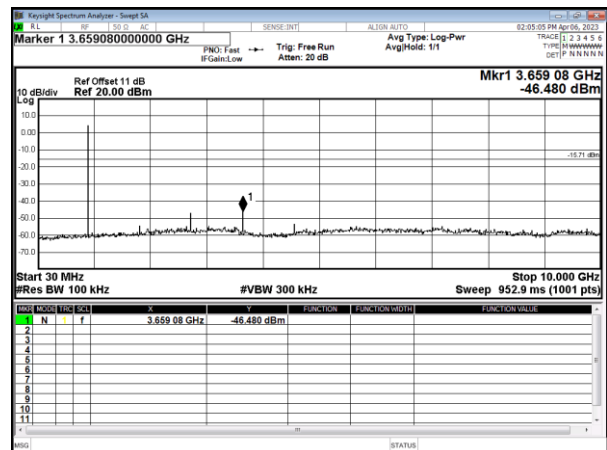
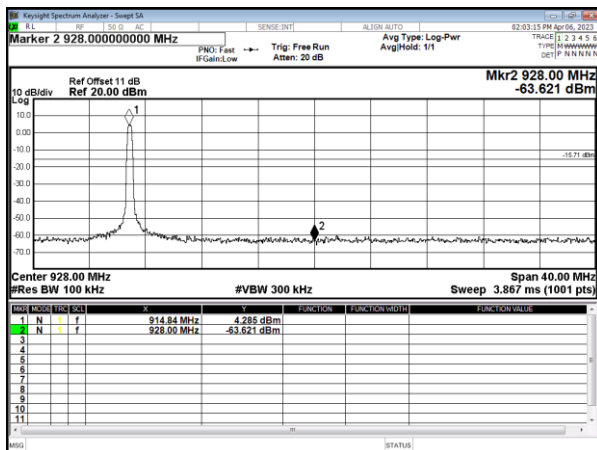


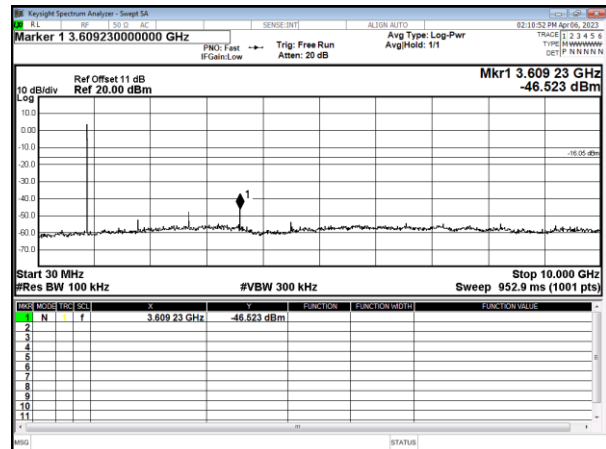
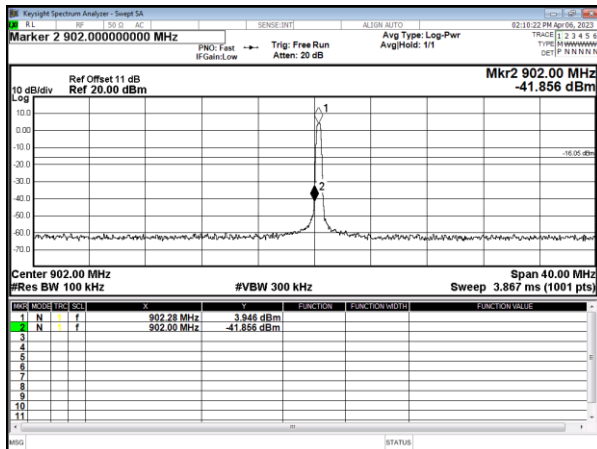
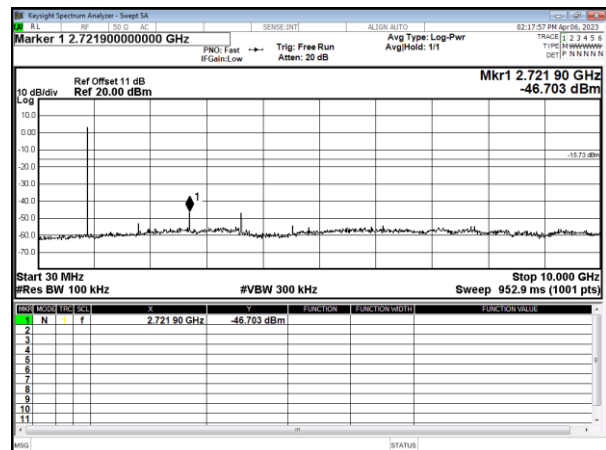
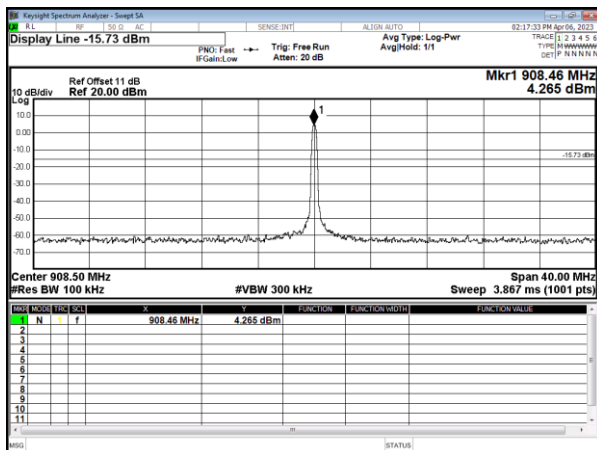
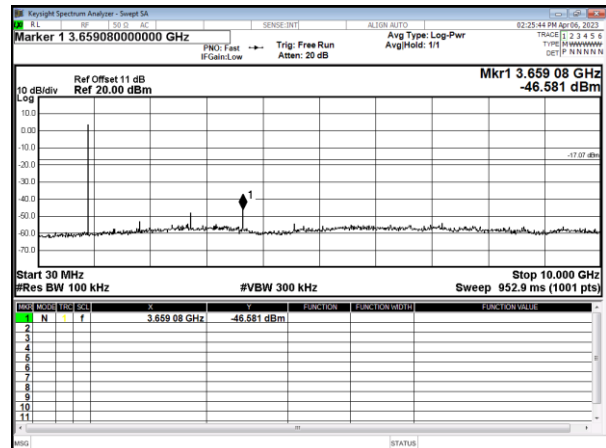
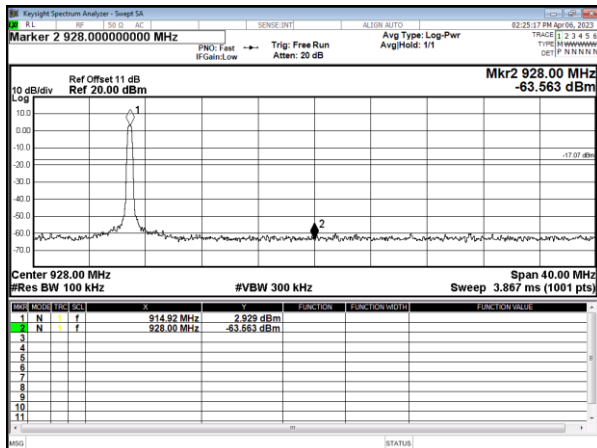
Lora 125KHz  
SF07-908.5MHz



Lora 125KHz  
SF07-914.9MHz

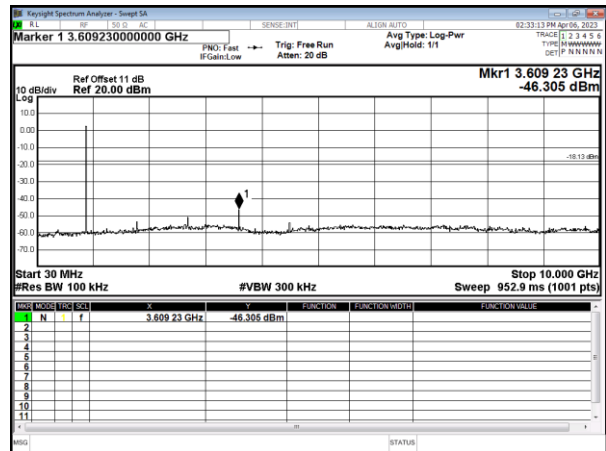
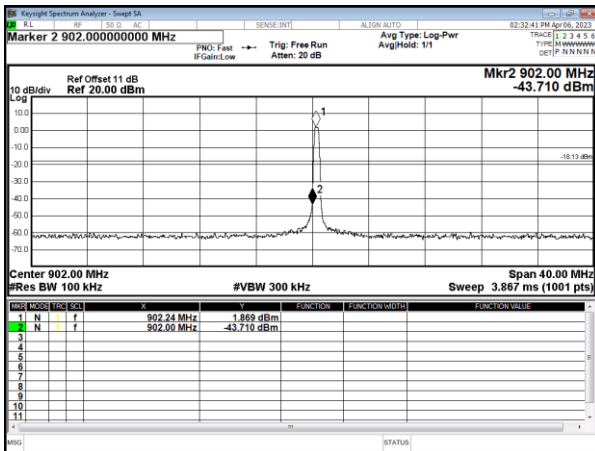


Lora 125KHz  
SF08-902.3MHzLora 125KHz  
SF08-908.5MHzLora 125KHz  
SF08-914.9MHz

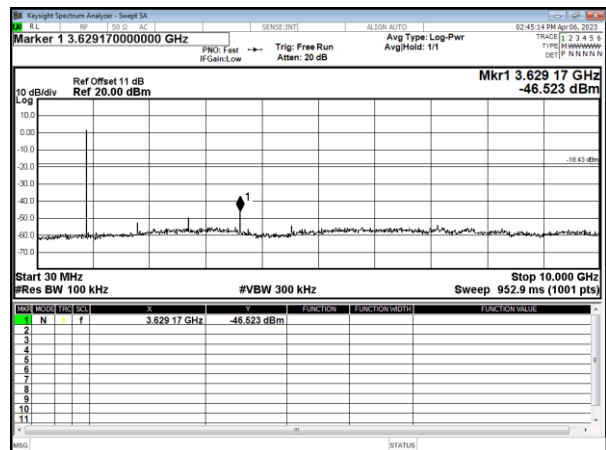
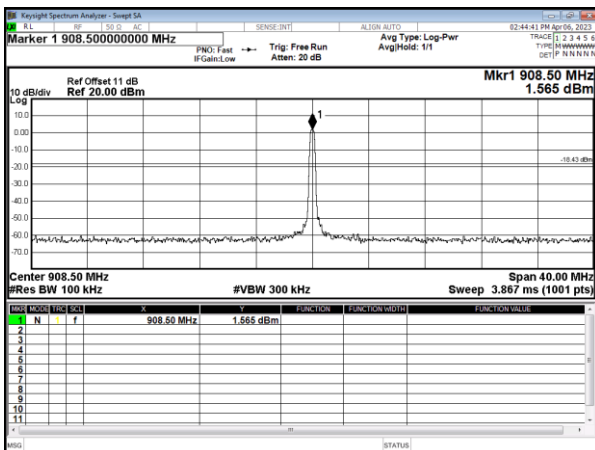
Lora 125KHz  
SF09-902.3MHzLora 125KHz  
SF09-908.5MHzLora 125KHz  
SF09-914.9MHz



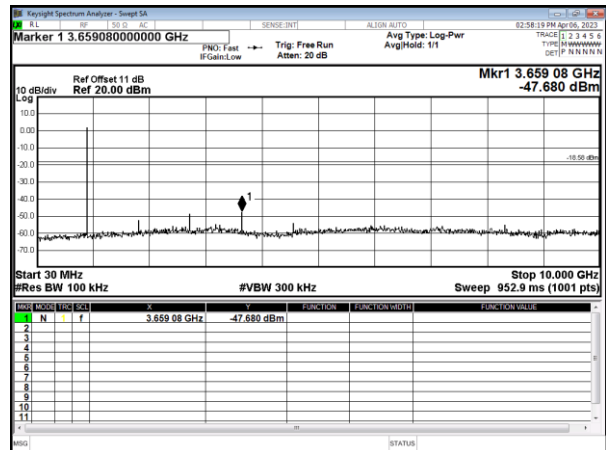
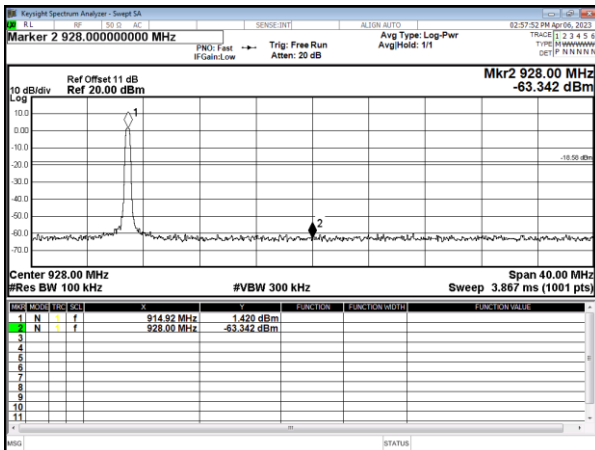
Lora 125KHz  
SF10-902.3MHz



Lora 125KHz  
SF10-908.5MHz



Lora 125KHz  
SF10-914.9MHz







## 8. On Time, Duty Cycle and Measurement methods

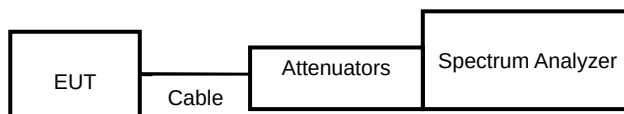
### 8.1 Test Limit

None; for reporting purposes only.

### 8.2 Test Procedure

Zero-Span Spectrum Analyzer Method.

### 8.3 Test Setup Layout

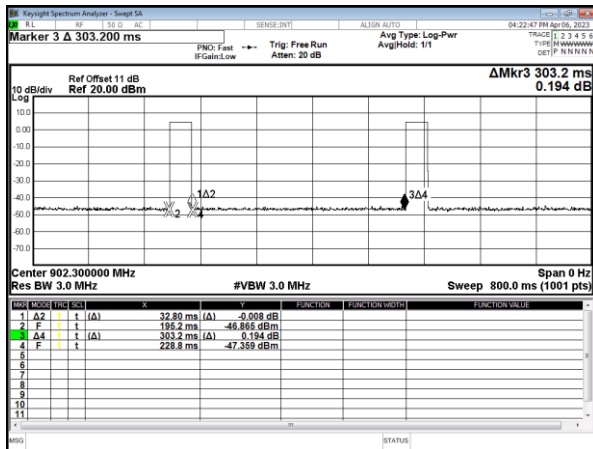


### 8.4 Test Result and Data

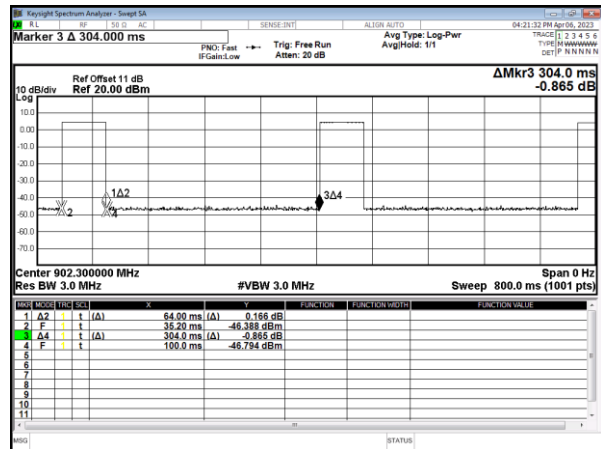
| Modulation Type    | On Time (msec) | Period Time (msec) | Duty Cycle (%) |
|--------------------|----------------|--------------------|----------------|
| Lora 125KHz (SF07) | 32.80          | 336.00             | 9.76%          |
| Lora 125KHz (SF08) | 64.00          | 368.00             | 17.39%         |
| Lora 125KHz (SF09) | 125.60         | 428.00             | 29.35%         |
| Lora 125KHz (SF10) | 252.80         | 555.20             | 45.53%         |



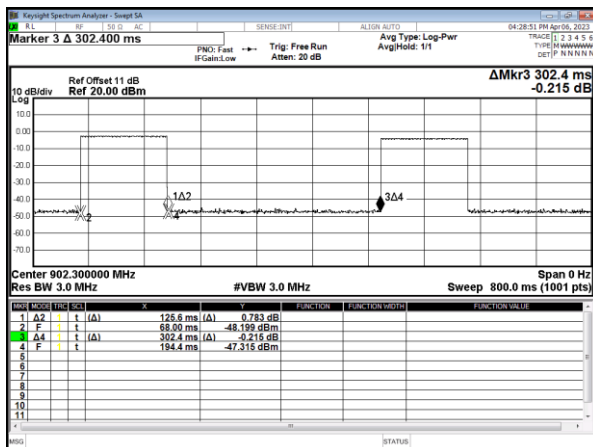
Lora 125KHz (SF07)



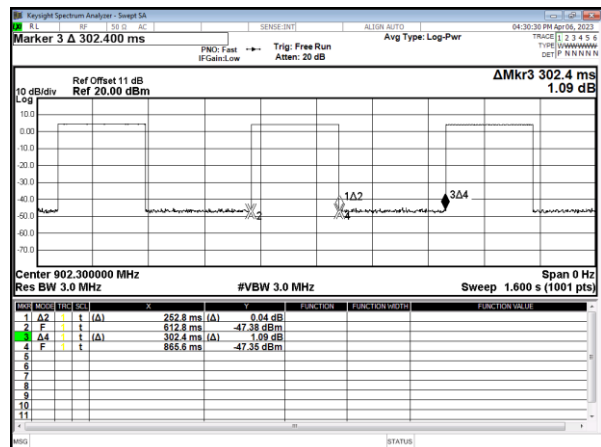
Lora 125KHz (SF08)



Lora 125KHz (SF09)



Lora 125KHz (SF10)





## 9. 20dB Bandwidth Measurement Data

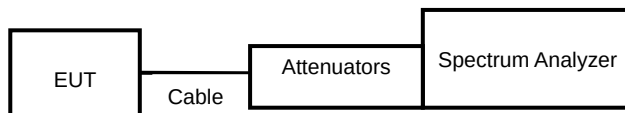
### 9.1 Test Limit

For reference data.

### 9.2 Test Procedures

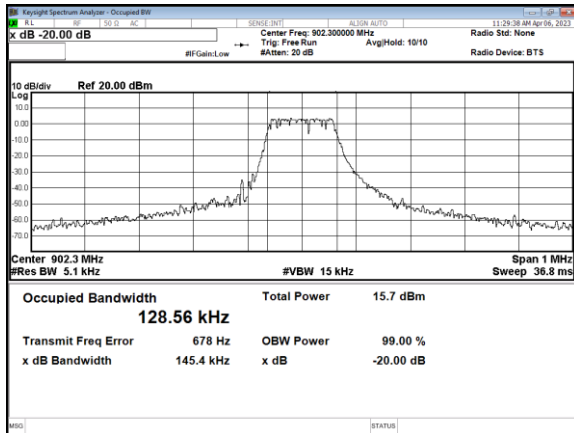
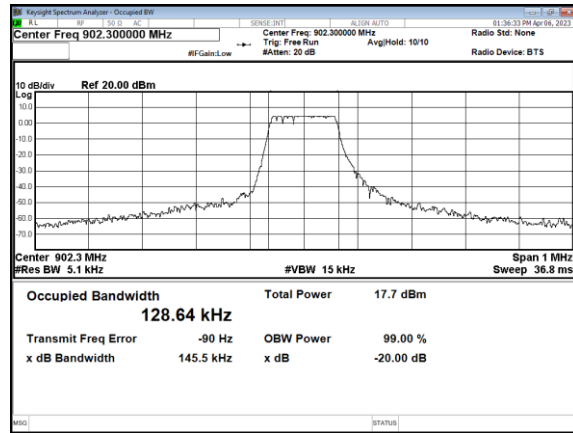
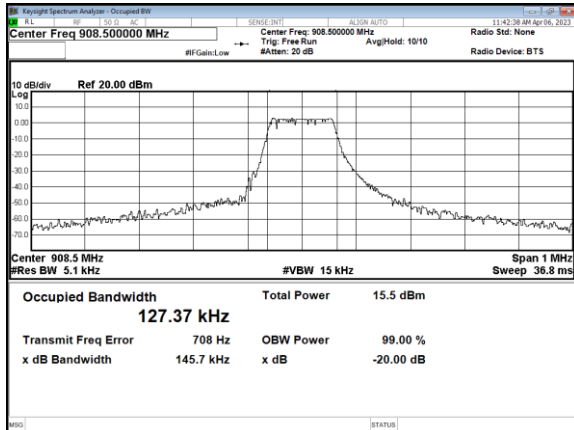
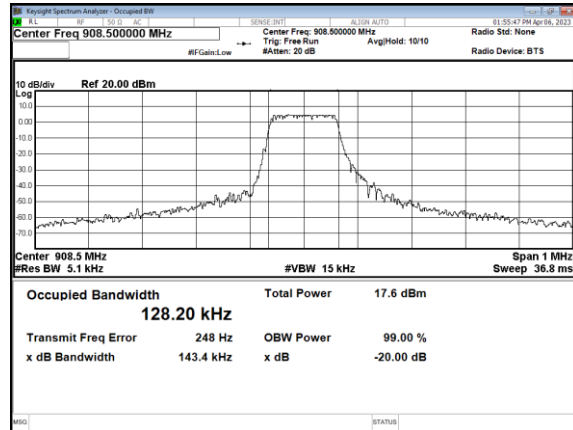
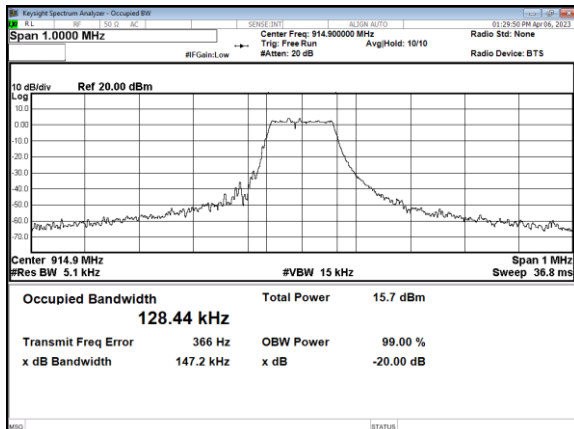
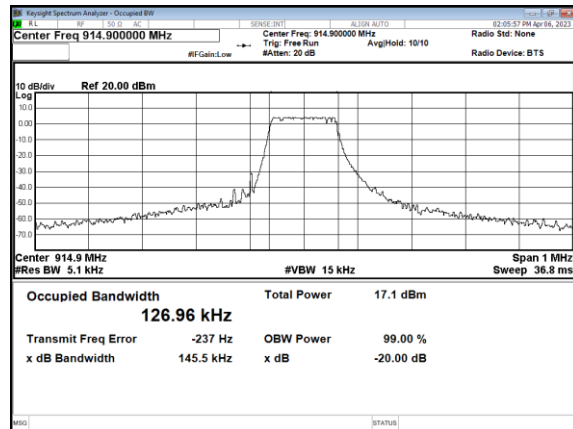
- The transmitter output was connected to the spectrum analyzer.
- Set RBW of spectrum analyzer to 1~5% of the 20dB bandwidth and VBW to approximately three time RBW.
- The 20 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB.

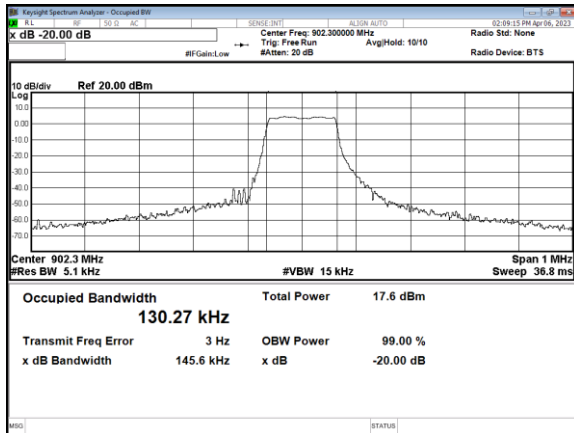
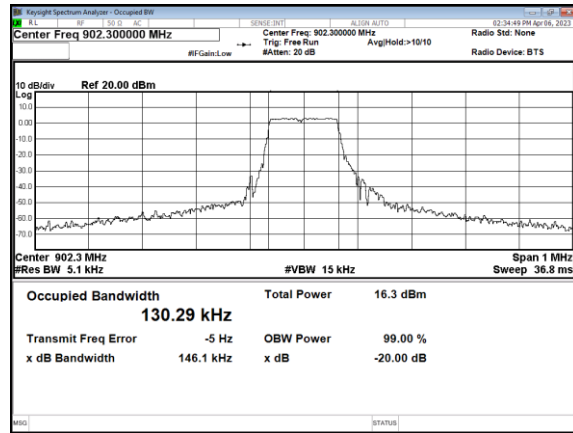
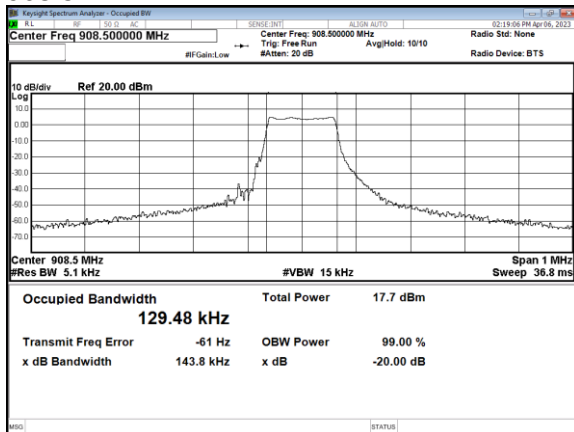
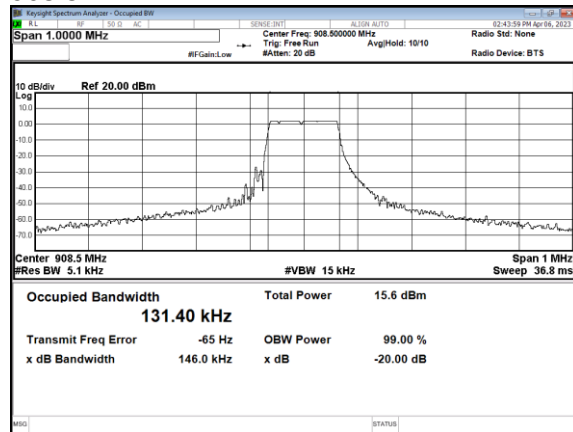
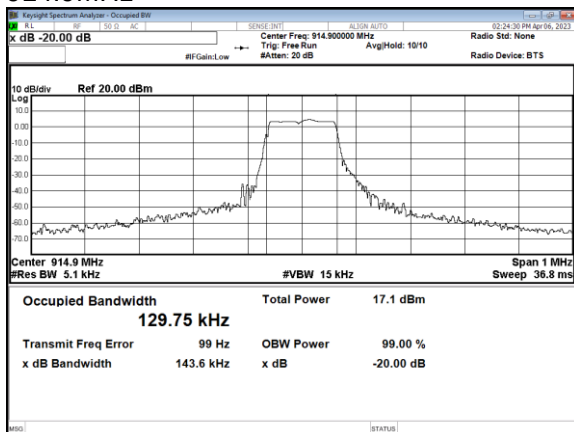
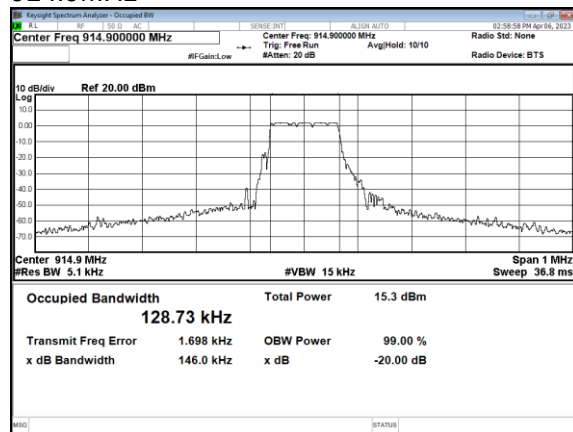
### 9.3 Test Setup Layout



### 9.4 Test Result and Data

| Modulation Type    | Frequency (MHz) | 20dB Bandwidth (KHz) |
|--------------------|-----------------|----------------------|
| Lora 125KHz (SF07) | 902.3           | 145.40               |
|                    | 908.5           | 145.70               |
|                    | 914.9           | 147.20               |
| Lora 125KHz (SF08) | 902.3           | 145.50               |
|                    | 908.5           | 143.40               |
|                    | 914.9           | 145.50               |
| Lora 125KHz (SF09) | 902.3           | 145.60               |
|                    | 908.5           | 143.80               |
|                    | 914.9           | 143.60               |
| Lora 125KHz (SF10) | 902.3           | 146.10               |
|                    | 908.5           | 146.00               |
|                    | 914.9           | 146.00               |

Lora 125KHz(SF07)  
902.3MHzLora 125KHz(SF08)  
902.3MHzLora 125KHz(SF07)  
908.5MHzLora 125KHz(SF08)  
908.5MHzLora 125KHz(SF07)  
914.9MHzLora 125KHz(SF08)  
914.9MHz

Lora 125KHz(SF09)  
902.3MHzLora 125KHz(SF10)  
902.3MHzLora 125KHz(SF09)  
908.5MHzLora 125KHz(SF10)  
908.5MHzLora 125KHz(SF09)  
914.9MHzLora 125KHz(SF10)  
914.9MHz



## 10. Frequencies Separation

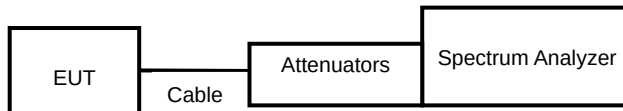
### 10.1 Test Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

### 10.2 Test Procedures

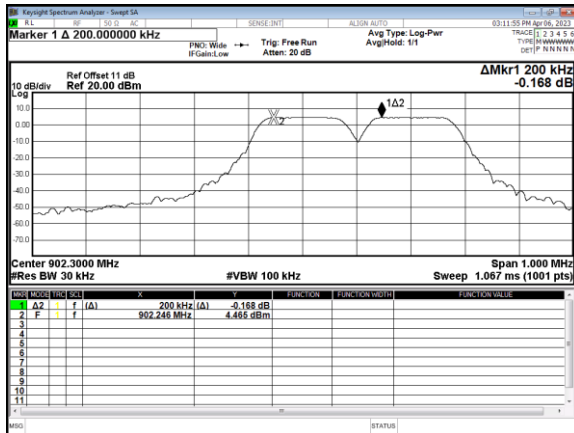
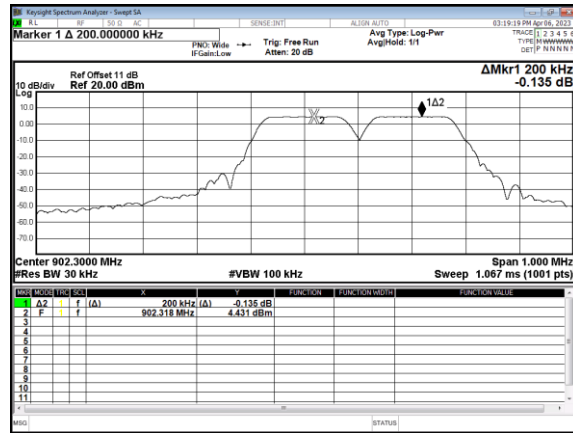
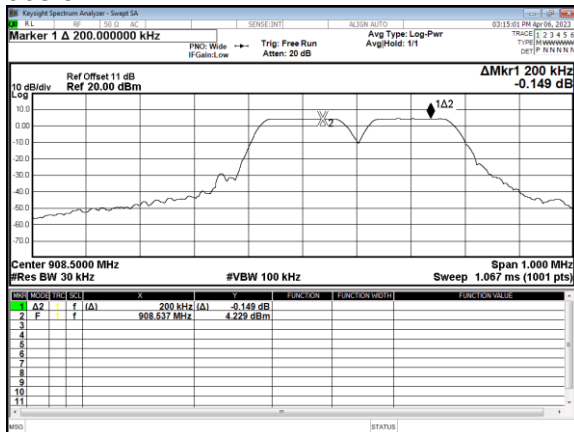
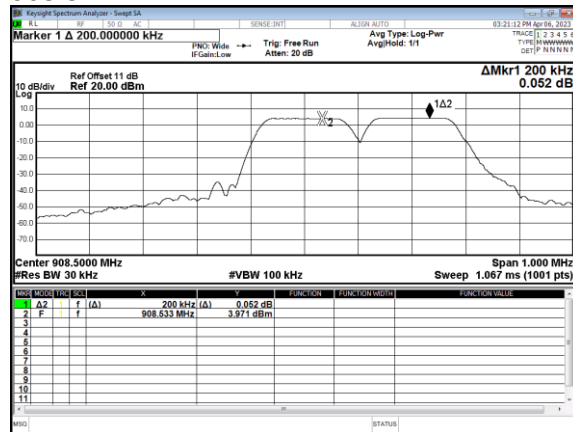
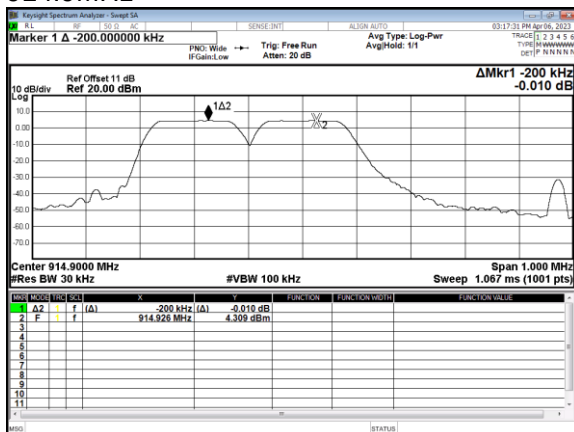
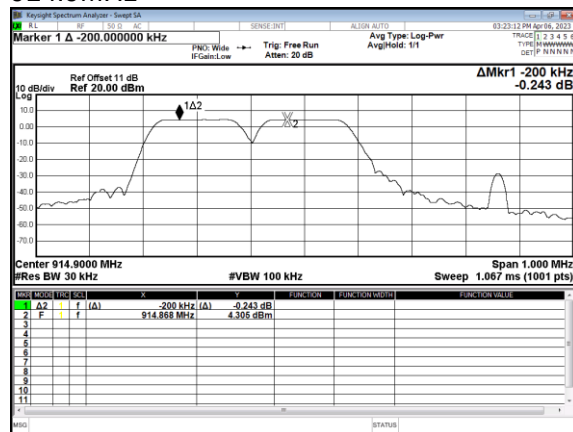
- The transmitter output was connected to the spectrum analyzer.
- Set RBW of spectrum analyzer to 30 KHz and VBW to 100 KHz.
- By using the MaxHold function record the separation of two adjacent channels.
- Measure the frequency difference of these two adjacent channels.

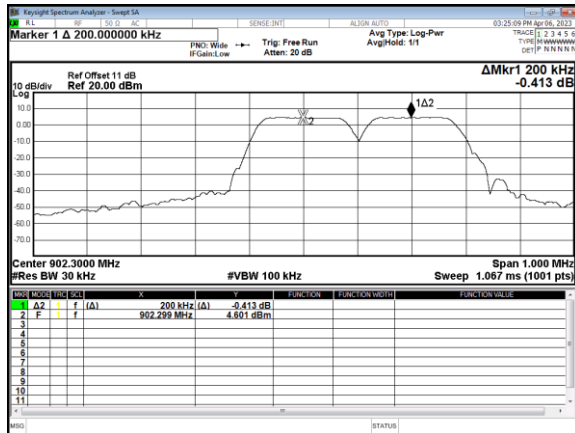
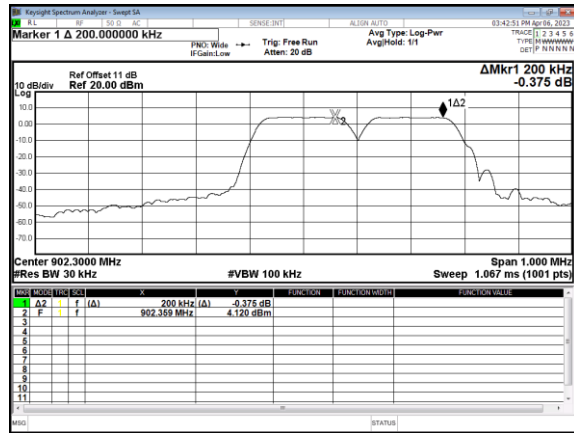
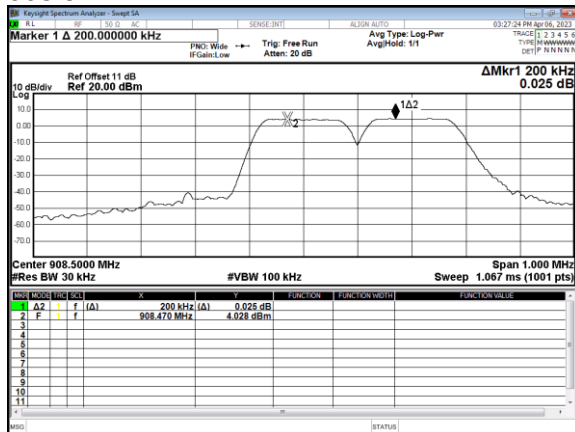
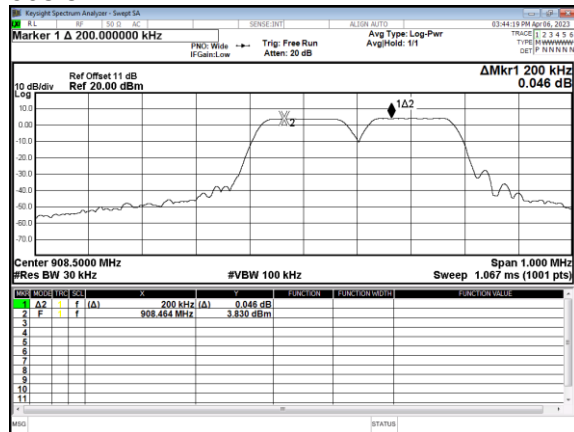
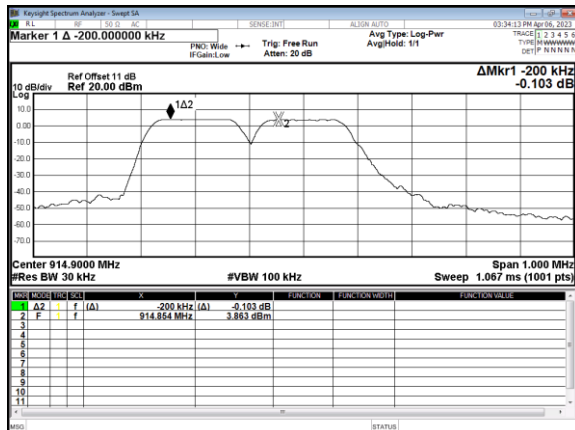
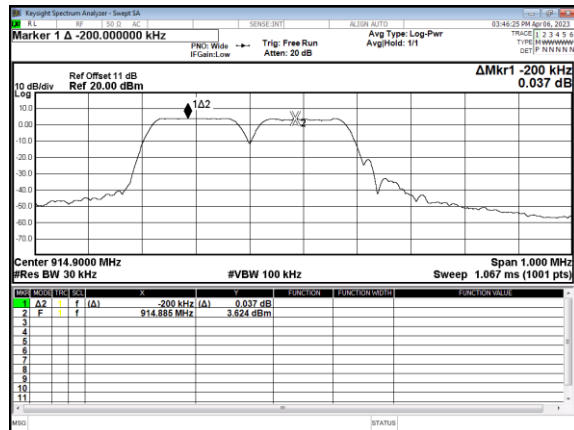
### 10.3 Test Setup Layout



### 10.4 Test Result and Data

| Modulation Type    | Frequency (MHz) | Channel Separation (KHz) | Limit (KHz) |
|--------------------|-----------------|--------------------------|-------------|
| Lora 125KHz (SF07) | 902.3           | 200                      | 146.70      |
|                    | 908.5           | 200                      | 146.60      |
|                    | 914.9           | 200                      | 147.20      |
| Lora 125KHz (SF08) | 902.3           | 200                      | 144.10      |
|                    | 908.5           | 200                      | 145.10      |
|                    | 914.9           | 200                      | 145.40      |
| Lora 125KHz (SF09) | 902.3           | 200                      | 149.10      |
|                    | 908.5           | 200                      | 144.40      |
|                    | 914.9           | 200                      | 145.30      |
| Lora 125KHz (SF10) | 902.3           | 200                      | 145.50      |
|                    | 908.5           | 200                      | 146.10      |
|                    | 914.9           | 200                      | 145.90      |

Lora 125KHz(SF07)  
902.3MHzLora 125KHz(SF08)  
902.3MHzLora 125KHz(SF07)  
908.5MHzLora 125KHz(SF08)  
908.5MHzLora 125KHz(SF07)  
914.9MHzLora 125KHz(SF08)  
914.9MHz

Lora 125KHz(SF09)  
902.3MHzLora 125KHz(SF10)  
902.3MHzLora 125KHz(SF09)  
908.5MHzLora 125KHz(SF10)  
908.5MHzLora 125KHz(SF09)  
914.9MHzLora 125KHz(SF10)  
914.9MHz





## 11. Dwell Time on each channel

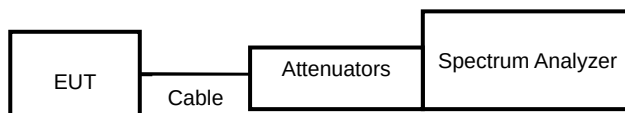
### 11.1 Test Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

### 11.2 Test Procedures

1. The transmitter output was connected to the spectrum analyzer.
2. Adjust the center frequency to measure frequency, then set zero span mode.
2. Set RBW of spectrum analyzer to 100KHz and VBW to 300KHz.
4. Measure the time duration of one transmission on the measured frequency.

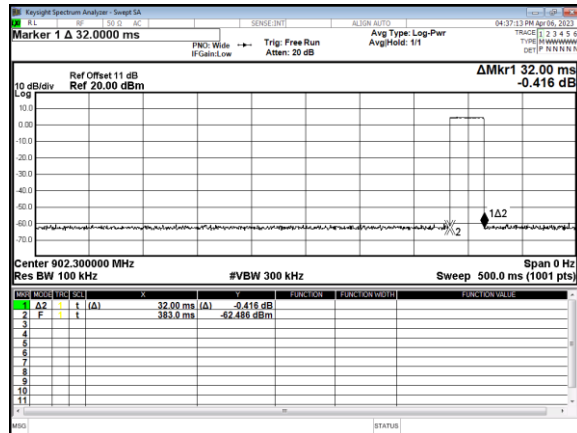
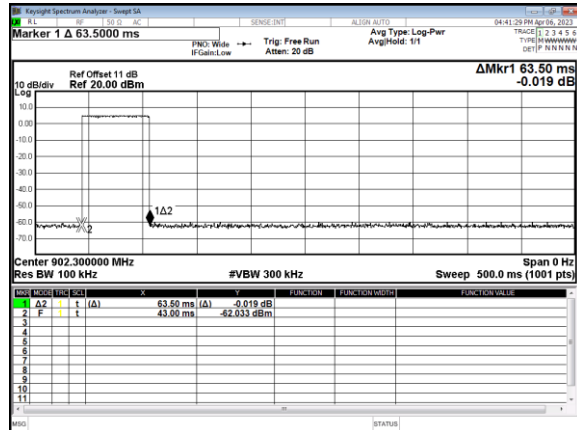
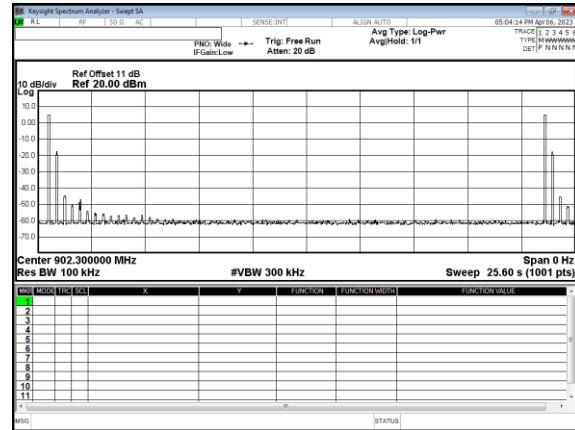
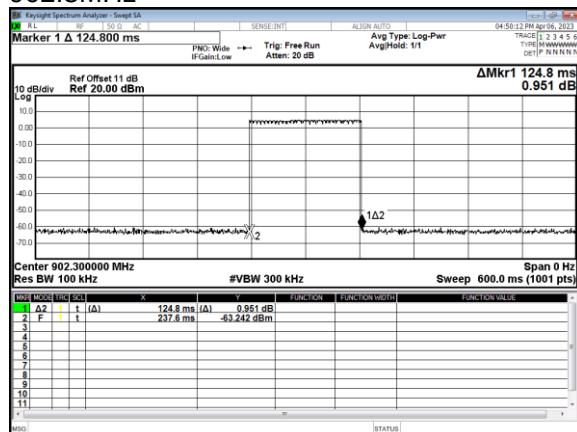
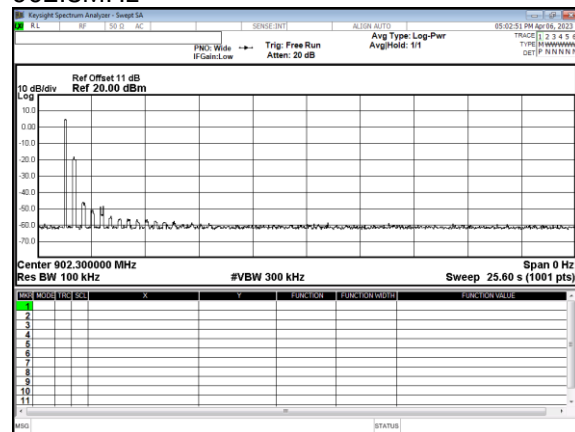
### 11.3 Test Setup Layout



### 11.4 Test Result and Data

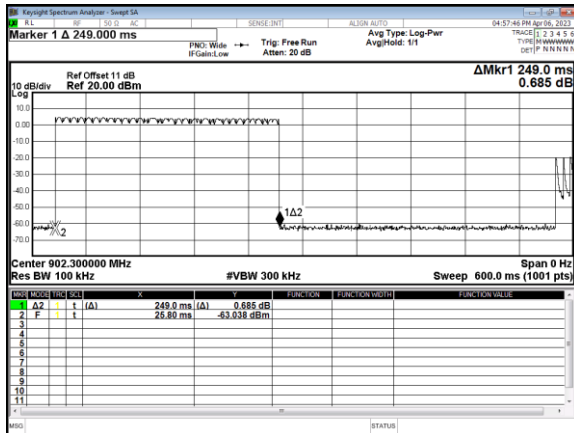
Test Period = 0.4 (second/ channel) x 64 Channel = 25.6 sec

| Modulation Type    | Length of transmission time (ms) | Number of transmission in a 25.6 (64 Hopping*0.4) | Dwell Time (ms) | Limit (ms) |
|--------------------|----------------------------------|---------------------------------------------------|-----------------|------------|
| Lora 125KHz (SF07) | 32                               | 2.00                                              | 64.00           | 400        |
| Lora 125KHz (SF08) | 63.5                             | 2.00                                              | 127.00          | 400        |
| Lora 125KHz (SF09) | 124.8                            | 1.00                                              | 124.80          | 400        |
| Lora 125KHz (SF10) | 249                              | 1.00                                              | 249.00          | 400        |

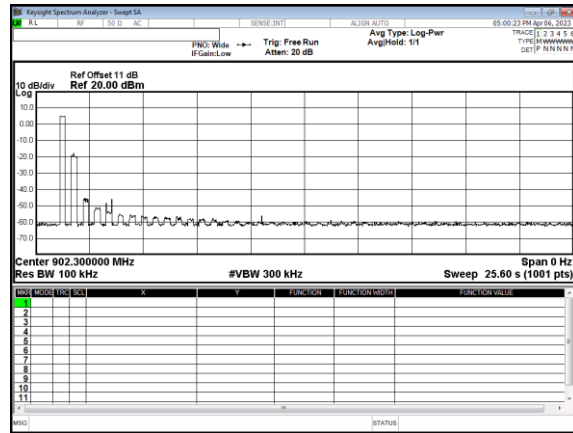
Lora 125KHz(SF07)  
902.3MHzLora 125KHz(SF07)  
902.3MHzLora 125KHz(SF08)  
902.3MHzLora 125KHz(SF08)  
902.3MHzLora 125KHz(SF09)  
902.3MHzLora 125KHz(SF09)  
902.3MHz



Lora 125KHz(SF10)  
902.3MHz



Lora 125KHz(SF10)  
902.3MHz





## 12. Number of Hopping Channels

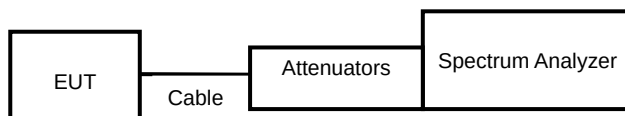
### 12.1 Test Limit

No limit.

### 12.2 Test Procedures

- The transmitter output was connected to the spectrum analyzer.
- Set RBW of spectrum analyzer to 300 KHz and VBW to 300 KHz.
- Set the MaxHold function, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been record.

### 12.3 Test Setup Layout

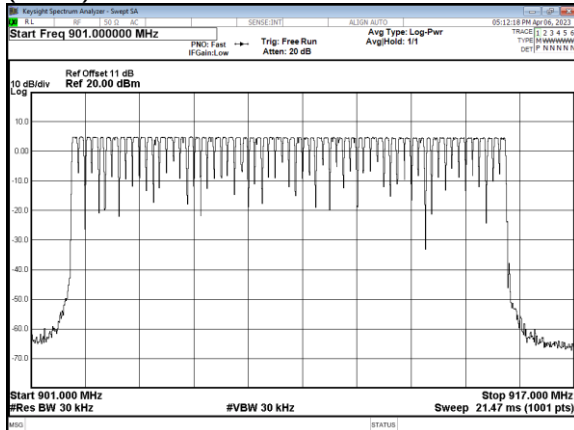


### 12.4 Test Result and Data

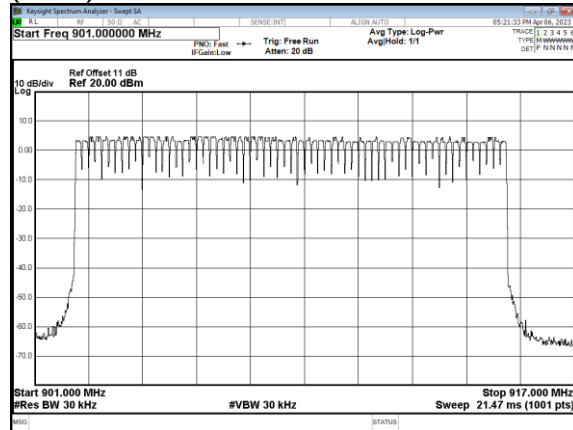
| Modulation Type    | Hopping Channels |
|--------------------|------------------|
| Lora 125KHz (SF07) | 64               |
| Lora 125KHz (SF08) | 64               |
| Lora 125KHz (SF09) | 64               |
| Lora 125KHz (SF10) | 64               |



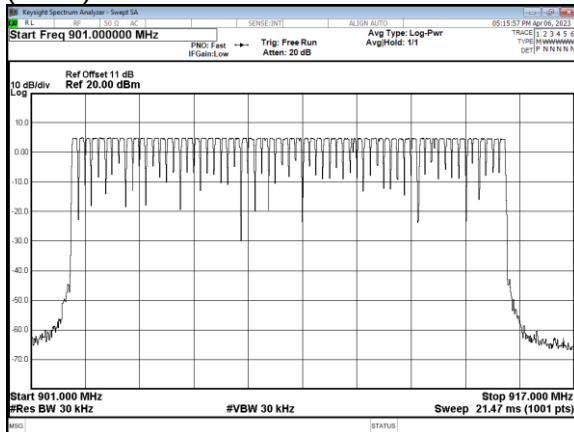
Lora 125KHz  
(SF07)



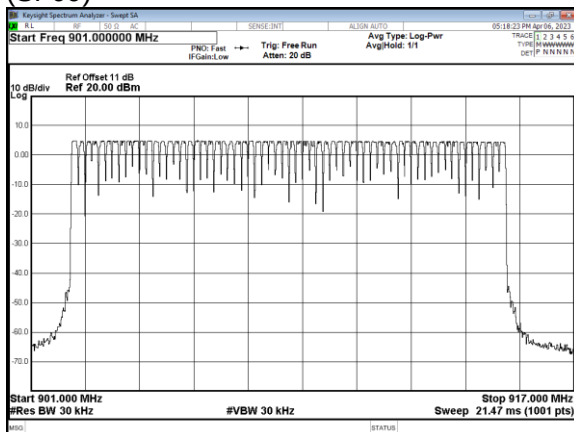
Lora 125KHz  
(SF10)



Lora 125KHz  
(SF08)



Lora 125KHz  
(SF09)





## 13. Maximum Peak Output Power

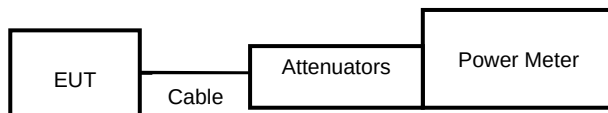
### 13.1 Test Limit

The Maximum Peak Output Power Measurement is 30dBm.

### 13.2 Test Procedures

The antenna port (RF output) of the EUT was connected to the input (RF input) of a power meter. Power was read directly from the meter and cable loss connection was added to the reading to obtain power at the EUT antenna terminal. The EUT Output Power was set to maximum to produce the worse case test result.

### 13.3 Test Setup Layout



### 13.4 Test Result and Data

| Modulation Type    | Frequency (MHz) | Power Output (dBm) | Peak Power Output (mW) |
|--------------------|-----------------|--------------------|------------------------|
| Lora 125KHz (SF07) | 902.3           | 5.842              | 3.839                  |
|                    | 908.5           | 5.134              | 3.261                  |
|                    | 914.9           | 4.778              | 3.005                  |
| Lora 125KHz (SF08) | 902.3           | 4.543              | 2.846                  |
|                    | 908.5           | 4.514              | 2.827                  |
|                    | 914.9           | 4.314              | 2.700                  |
| Lora 125KHz (SF09) | 902.3           | 4.539              | 2.844                  |
|                    | 908.5           | 4.456              | 2.790                  |
|                    | 914.9           | 2.858              | 1.931                  |
| Lora 125KHz (SF10) | 902.3           | 1.715              | 1.484                  |
|                    | 908.5           | 3.956              | 2.487                  |
|                    | 914.9           | 1.713              | 1.484                  |



Hopping on

| Modulation Type    | Power Output (dBm) | Peak Power Output (mW) |
|--------------------|--------------------|------------------------|
| Lora 125KHz (SF07) | 4.461              | 2.793                  |
| Lora 125KHz (SF08) | 4.204              | 2.633                  |
| Lora 125KHz (SF09) | 4.352              | 2.724                  |
| Lora 125KHz (SF10) | 4.175              | 2.615                  |



## 14. Power Spectral Density

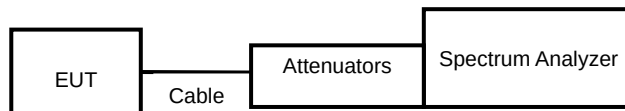
### 14.1 Test Limit

The Maximum of Power Spectral Density Measurement is 8dBm.

### 14.2 Test Procedures

- The transmitter output was connected to spectrum analyzer.
- The spectrum analyzer's resolution bandwidth were set at 3KHz RBW and 10KHz VBW as that of the fundamental frequency. Set the sweep time=auto couple.
- The power spectral density was measured and recorded.

### 14.3 Test Setup Layout

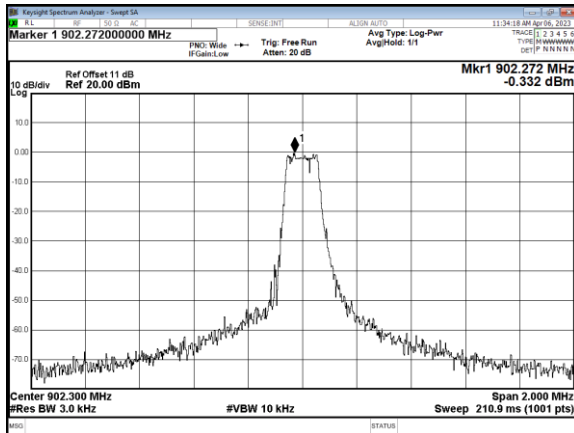
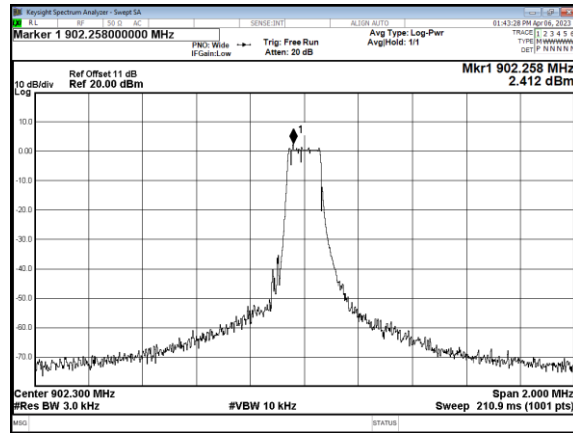
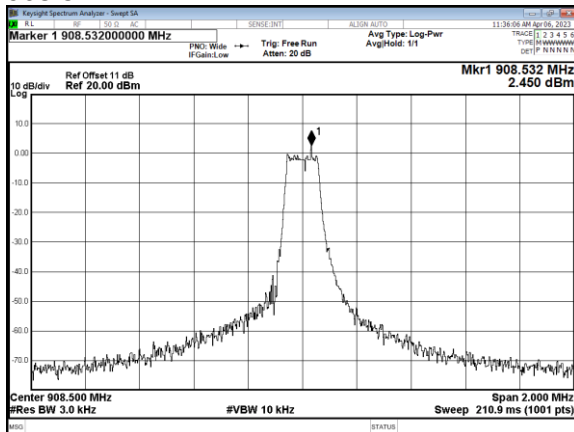
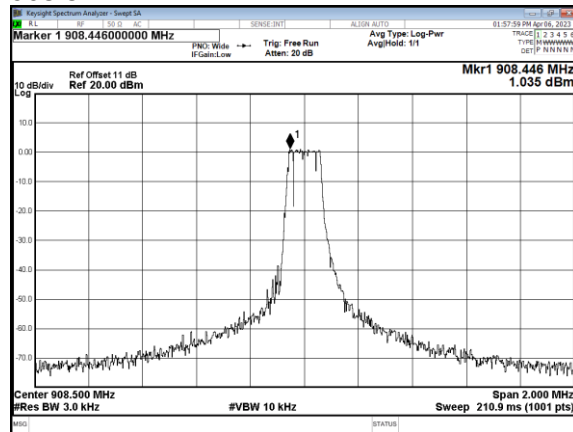
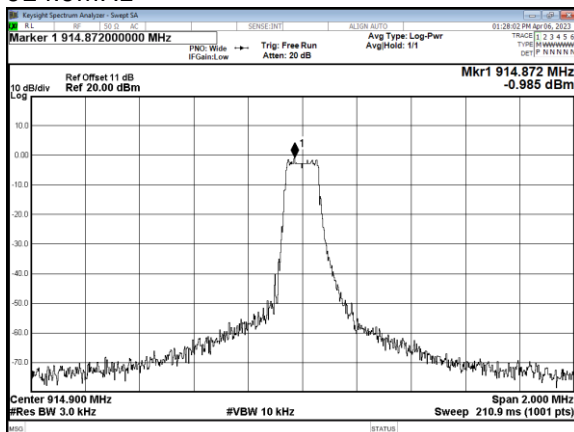
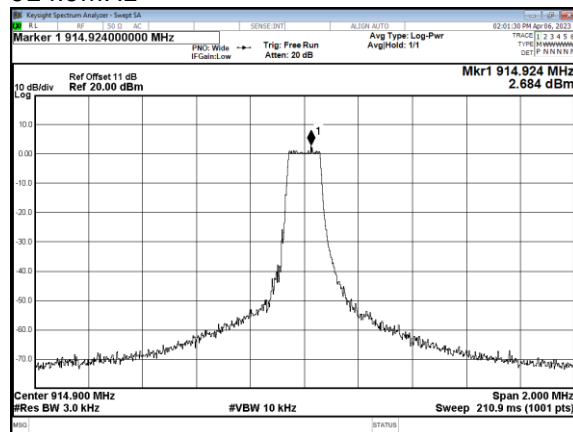


### 14.4 Test Result and Data

| Modulation Type    | Frequency (MHz) | Maximum Power Density of 3 kHz Bandwidth (dBm) | Limit (dBm) |
|--------------------|-----------------|------------------------------------------------|-------------|
| Lora 125KHz (SF07) | 902.3           | -0.332                                         | 8.00        |
|                    | 908.5           | 2.45                                           | 8.00        |
|                    | 914.9           | -0.985                                         | 8.00        |
| Lora 125KHz (SF08) | 902.3           | 2.412                                          | 8.00        |
|                    | 908.5           | 1.035                                          | 8.00        |
|                    | 914.9           | 2.684                                          | 8.00        |
| Lora 125KHz (SF09) | 902.3           | 3.284                                          | 8.00        |
|                    | 908.5           | 3.264                                          | 8.00        |
|                    | 914.9           | 2.992                                          | 8.00        |
| Lora 125KHz (SF10) | 902.3           | 4.136                                          | 8.00        |
|                    | 908.5           | 1.912                                          | 8.00        |
|                    | 914.9           | 4.111                                          | 8.00        |

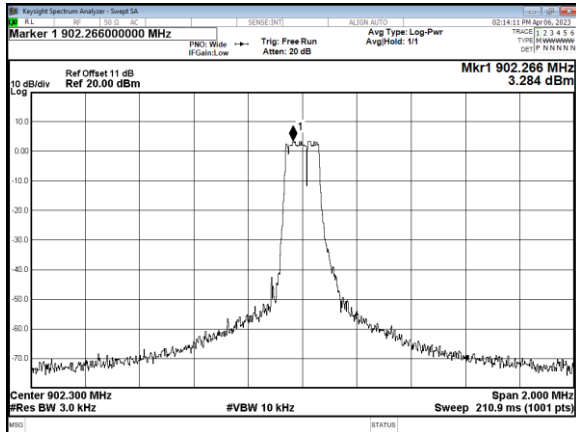
Note: Test plots refer to the following pages.



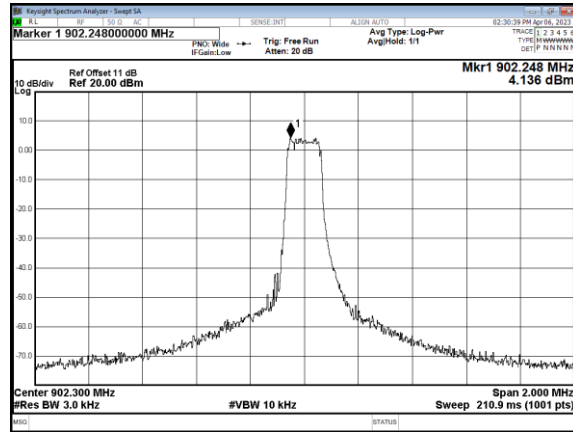
Lora 125KHz(SF07)  
902.3MHzLora 125KHz(SF08)  
902.3MHzLora 125KHz(SF07)  
908.5MHzLora 125KHz(SF08)  
908.5MHzLora 125KHz(SF07)  
914.9MHzLora 125KHz(SF08)  
914.9MHz



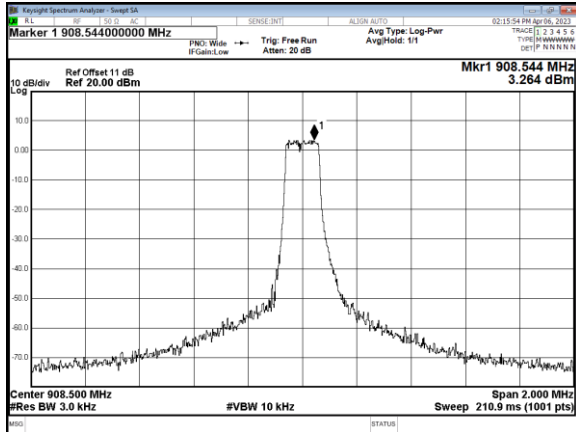
Lora 125KHz(SF09)  
902.3MHz



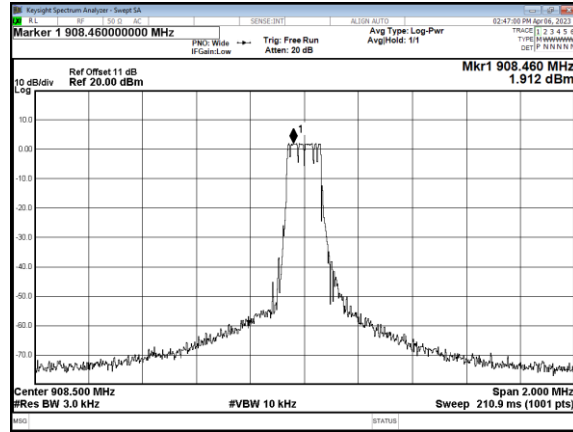
Lora 125KHz(SF10)  
902.3MHz



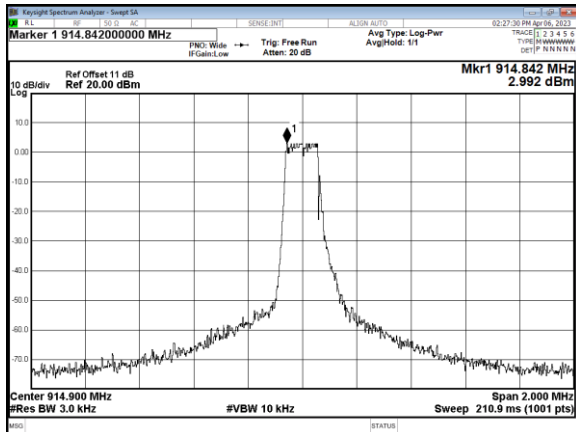
Lora 125KHz(SF09)  
908.5MHz



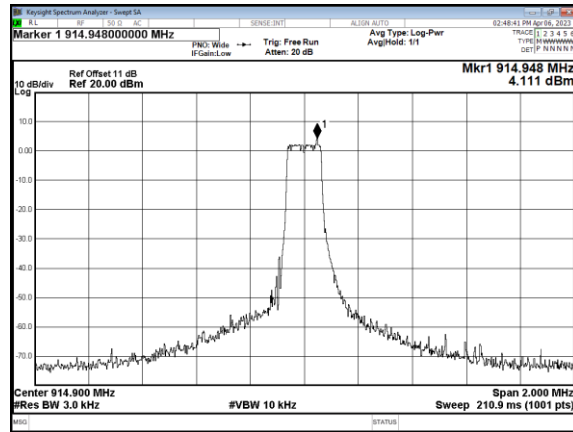
Lora 125KHz(SF10)  
908.5MHz



Lora 125KHz(SF09)  
914.9MHz



Lora 125KHz(SF10)  
914.9MHz



----- End of the report -----