

Test data, continued

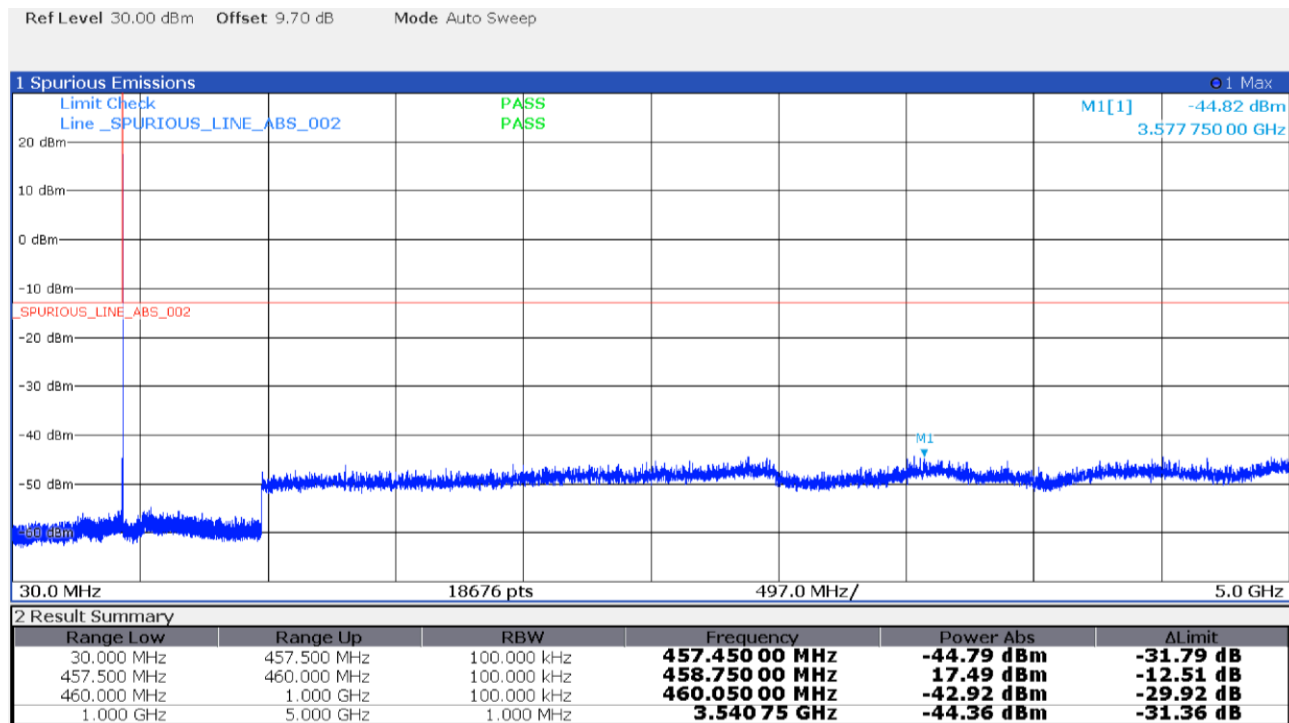


Figure 8.6-2: Conducted spurious emissions, up link

## 8.7 Spurious emissions radiated measurements

### 8.7.1 References, definitions and limits

#### FCC §90.210(b)

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

- (1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
- (2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
- (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least  $43 + 10 \log (P)$  dB.

#### FCC §90.219(e)

- (3) Spurious emissions from a signal booster must not exceed -13 dBm within any 100 kHz measurement bandwidth.

### 8.7.2 Test summary

|           |             |           |              |
|-----------|-------------|-----------|--------------|
| Verdict   | Pass        |           |              |
| Tested by | P. Barbieri | Test date | July 9, 2022 |

### 8.7.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.  
 Testing was performed with RF ports terminated with 50 Ohm load.  
 In the graphics below, no radiated spurious emission found and the limit is exceeded only by the carrier.

Spectrum analyser settings:

|                       |                         |
|-----------------------|-------------------------|
| Resolution bandwidth: | 100 kHz and 1 MHz       |
| Video bandwidth:      | VBW $\geq 3 \times$ RBW |
| Detector mode:        | Peak                    |
| Trace mode:           | Max Hold                |

Input signal frequency

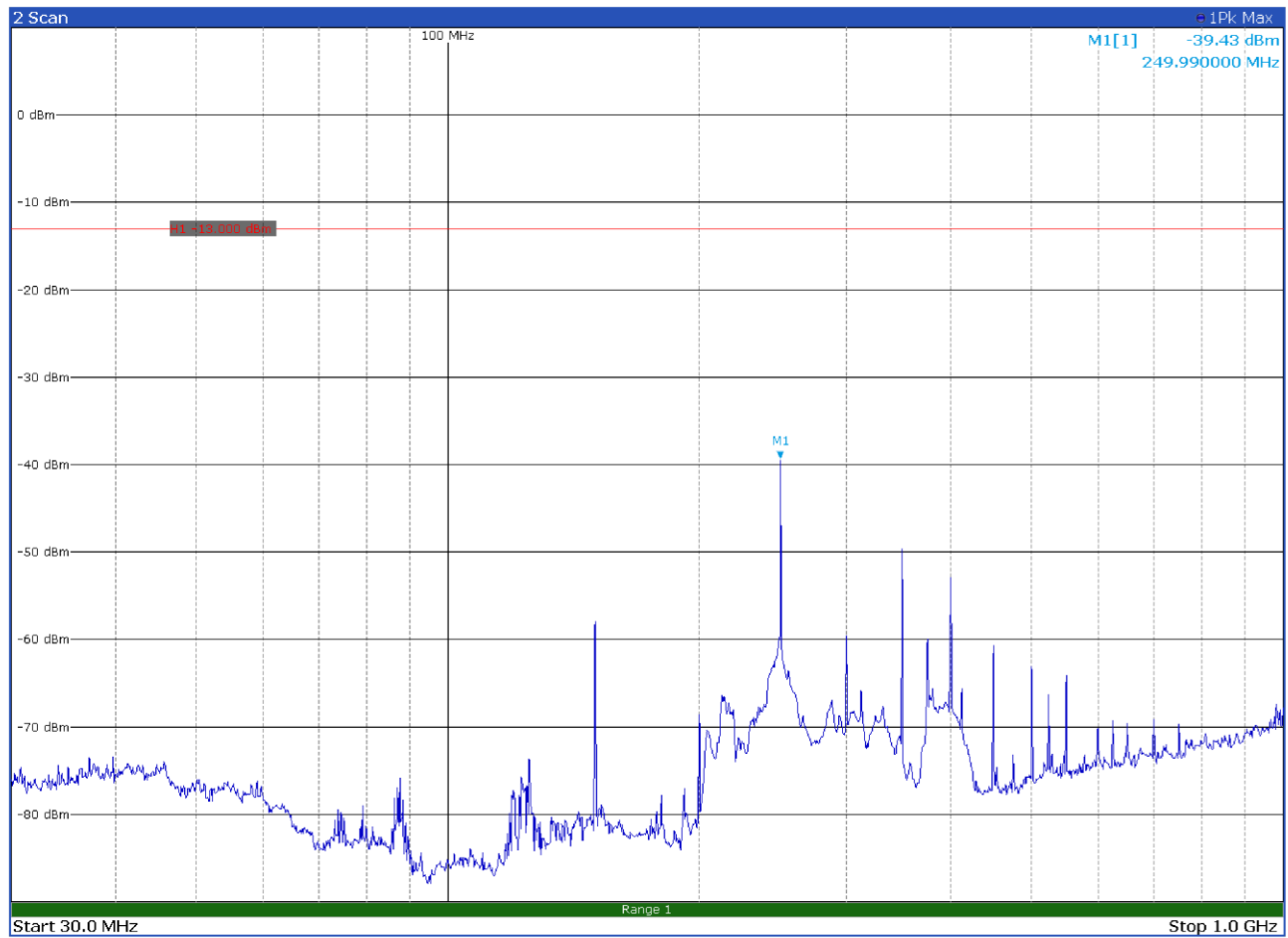
|           |            |
|-----------|------------|
| Down link | 453.75 MHz |
| Up link   | 458.75 MHz |

### 8.7.4 Test equipment used

| Equipment                   | Manufacturer                | Model no.                 | Asset no.     |
|-----------------------------|-----------------------------|---------------------------|---------------|
| EMI Receiver                | Rohde & Schwarz             | ESW44                     | 101620        |
| RF Vector Signal Generator  | Rohde & Schwarz             | SMBV100A                  | 263254        |
| Antenna Trilog 25MHz - 8GHz | Schwarzbeck Mess-Elektronik | VULB9162                  | 9162-025      |
| Antenna 1 - 18 GHz          | Schwarzbeck Mess-Elektronik | STLP9148                  | STLP 9148-152 |
| Broadband Amplifier         | Schwarzbeck Mess-Elektronik | BBV9718C                  | 00121         |
| Controller                  | Maturo                      | FCU3.0                    | 10041         |
| Tilt antenna mast           | Maturo                      | TAM4.0-E                  | 10042         |
| Turntable                   | Maturo                      | TT4.0-5T                  | 2.527         |
| Semi-anechoic chamber       | Nemko S.p.a.                | 10m semi-anechoic chamber | 530           |

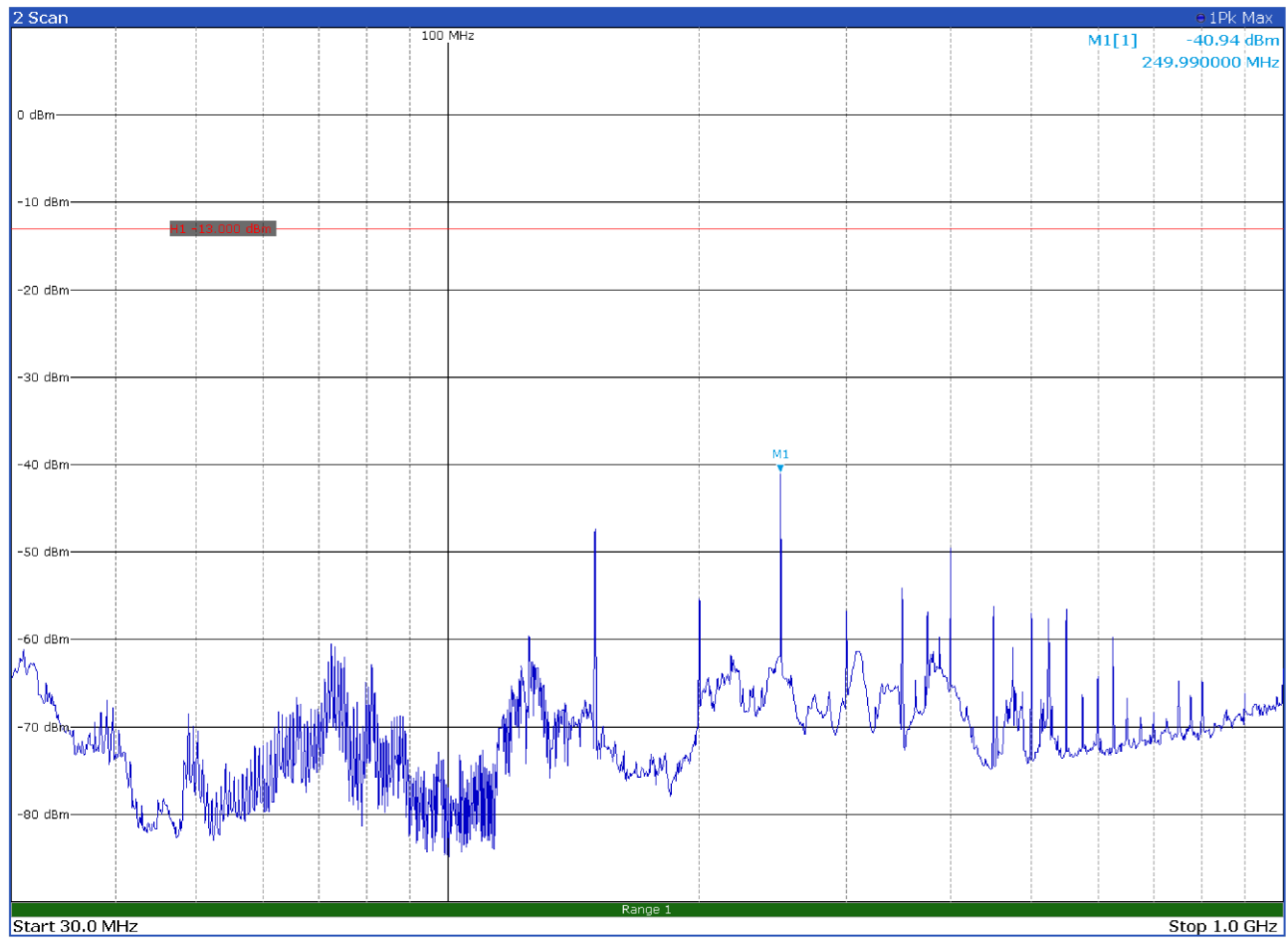
Notes:      NCR - no calibration required, VOU - verify on use

## 8.7.5 Test data



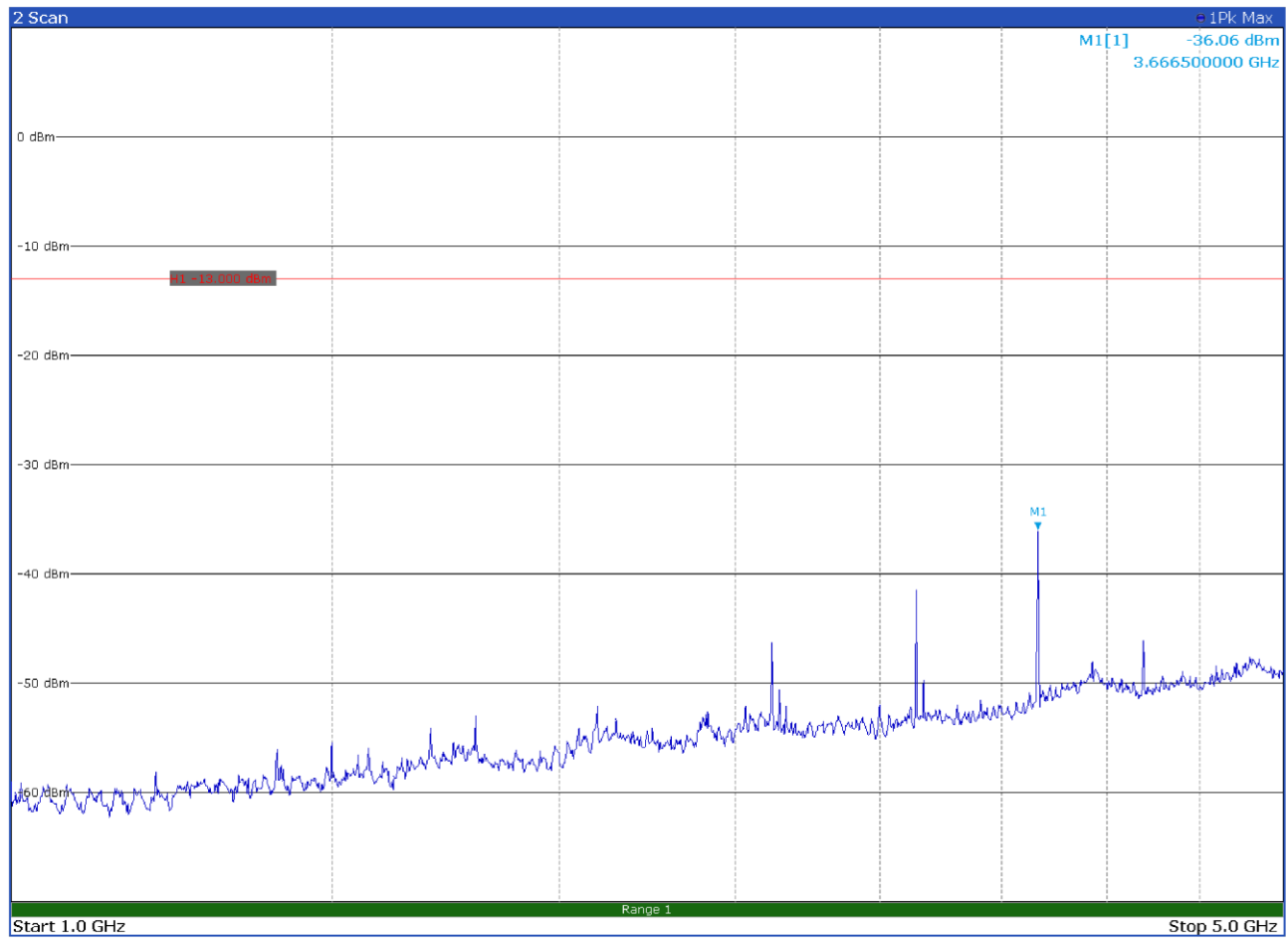
**Figure 8.7-1:** Radiated spurious emissions below 1 GHz with antenna in horizontal polarization – down link

Test data, continued



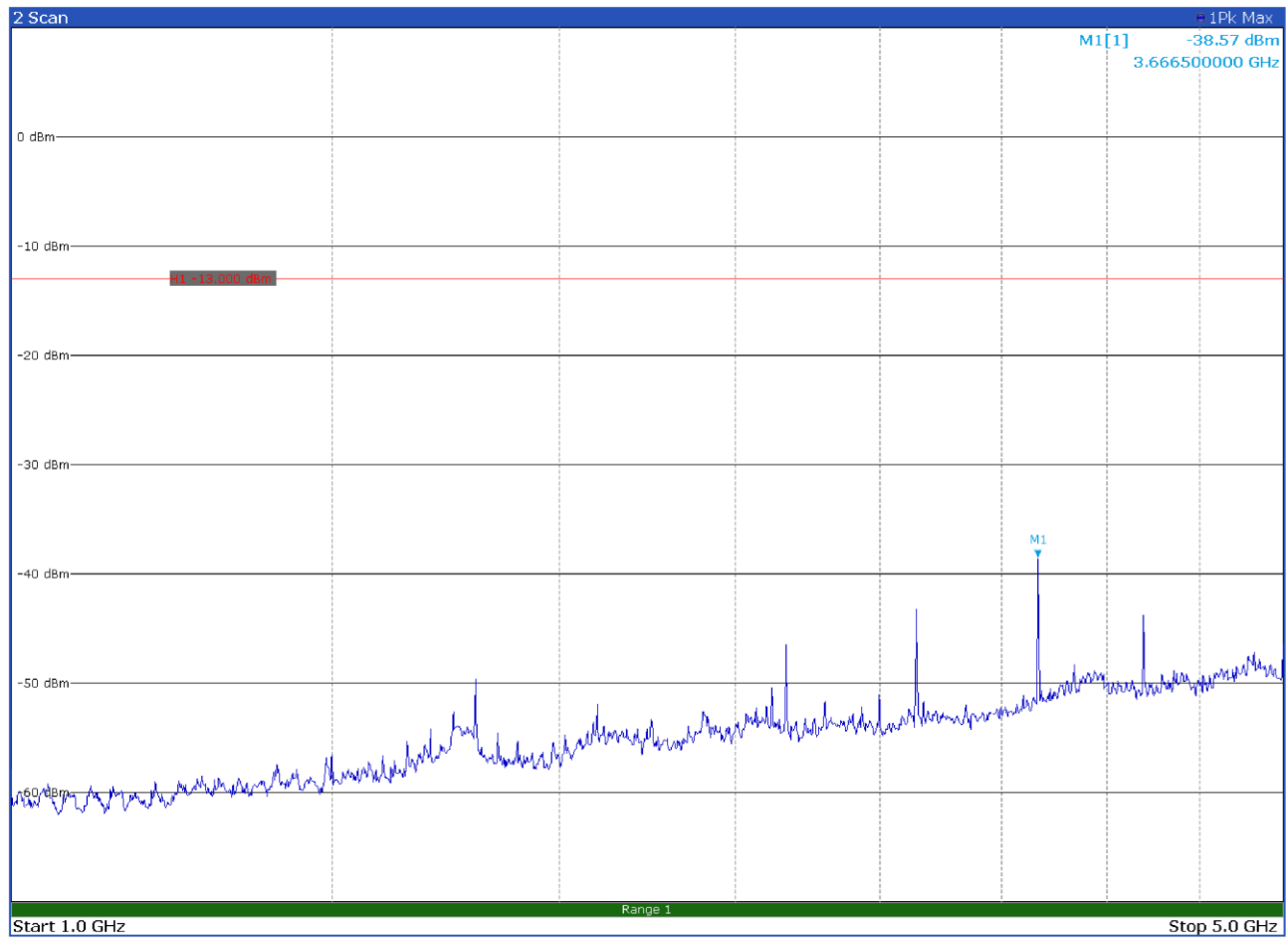
**Figure 8.7-2:** Radiated spurious emissions below 1 GHz with antenna in vertical polarization – down link

Test data, continued



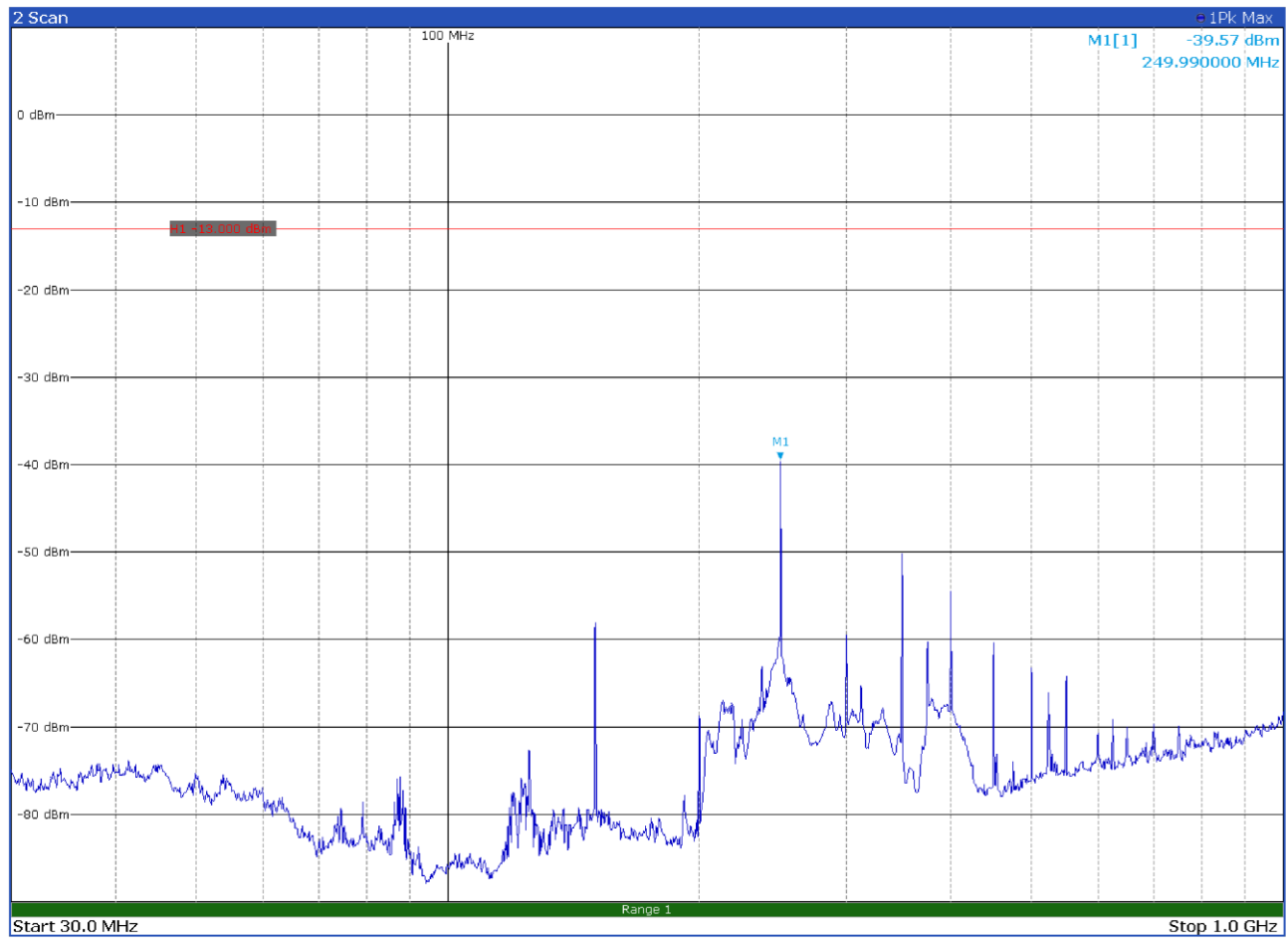
**Figure 8.7-3:** Radiated spurious emissions above 1 GHz with antenna in horizontal polarization – down link

Test data, continued



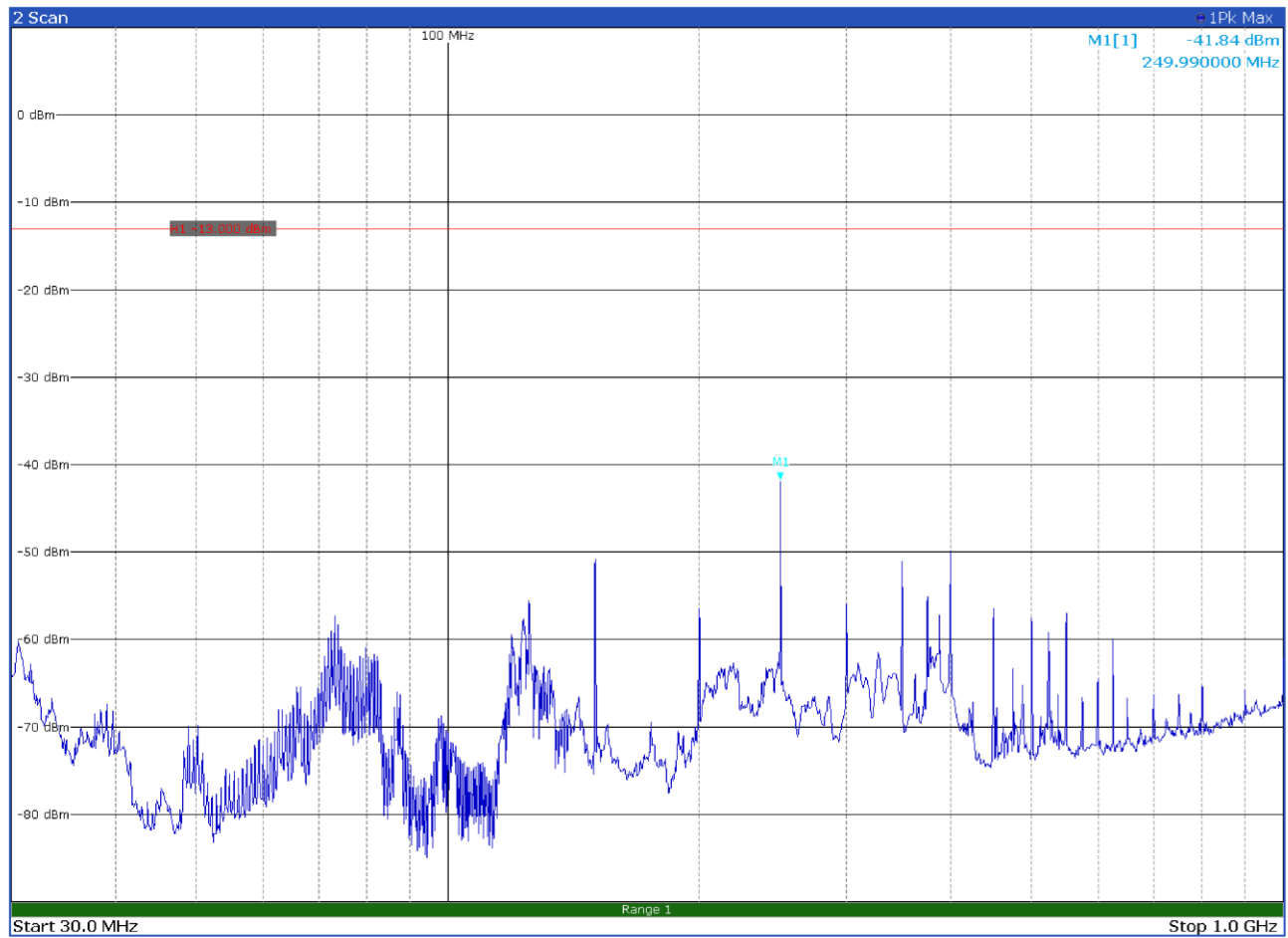
**Figure 8.7-4:** Radiated spurious emissions above 1 GHz with antenna in vertical polarization – down link

Test data, continued



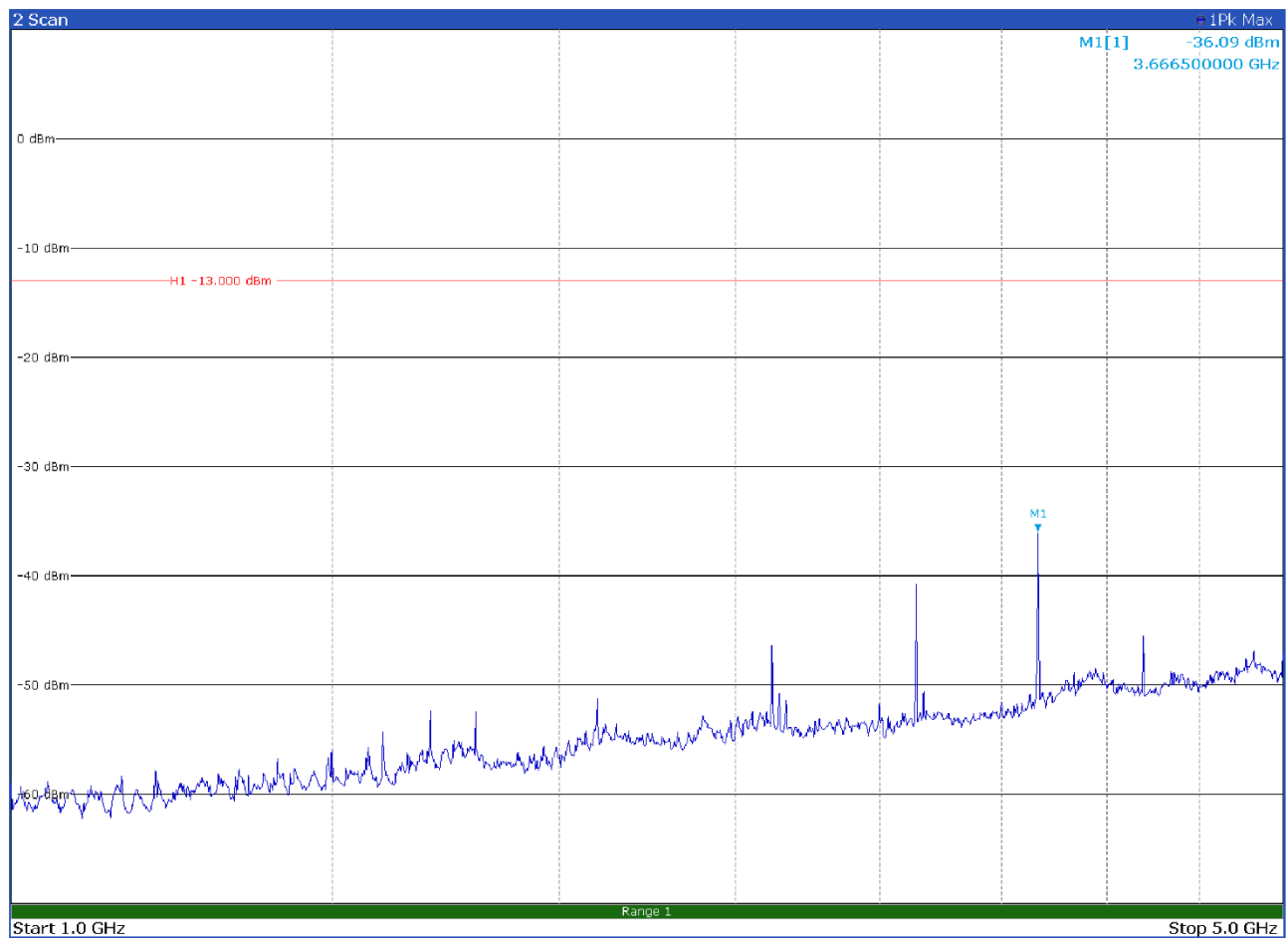
**Figure 8.7-5:** Radiated spurious emissions below 1 GHz with antenna in horizontal polarization – up link

Test data, continued



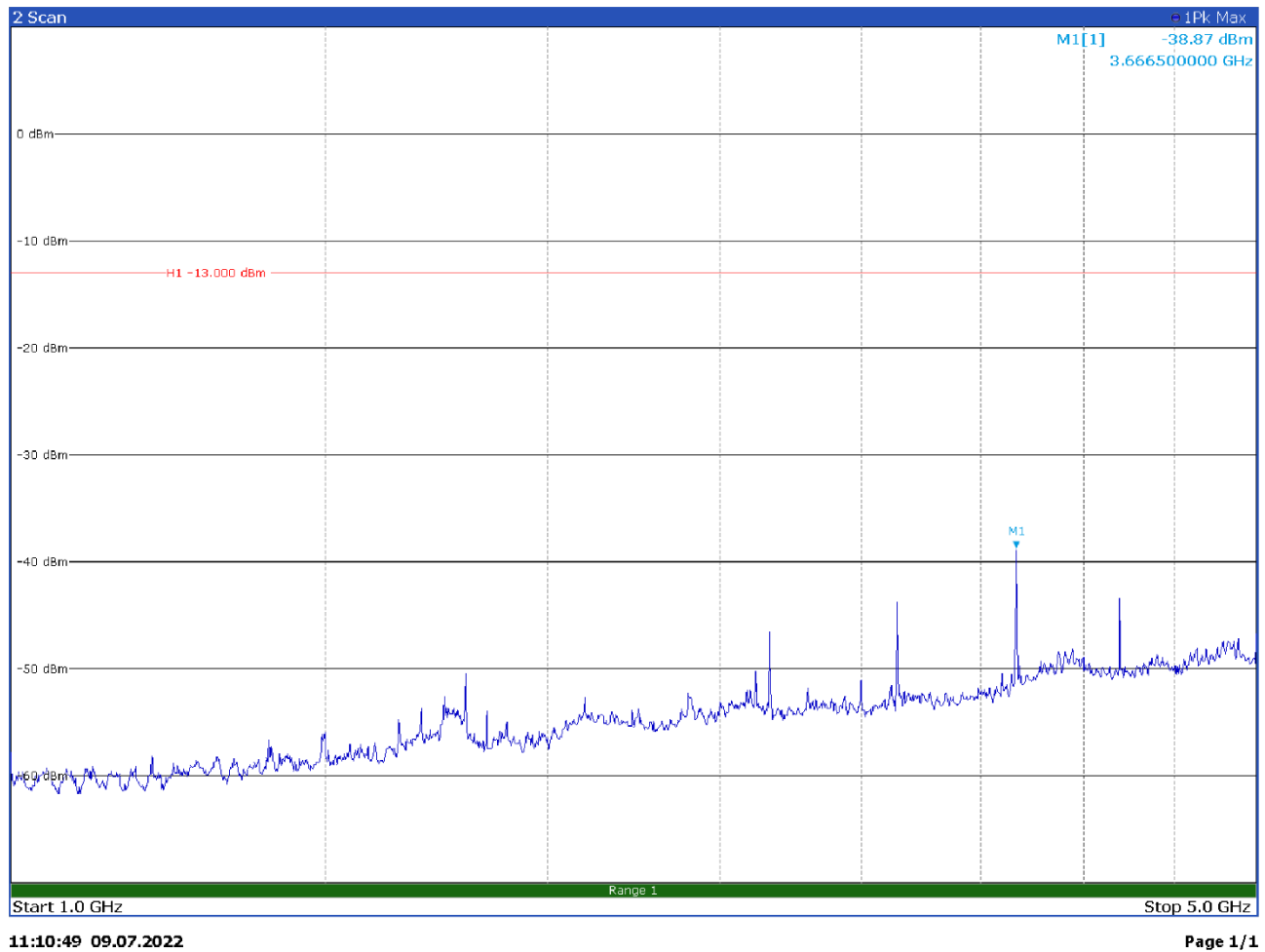
**Figure 8.7-6:** Radiated spurious emissions below 1 GHz with antenna in vertical polarization – up link

Test data, continued



**Figure 8.7-7:** Radiated spurious emissions above 1 GHz with antenna in horizontal polarization – up link

Test data, continued



**Figure 8.7-8:** Radiated spurious emissions above 1 GHz with antenna in vertical polarization – up link

## 8.8 Frequency stability measurements

### 8.8.1 References, definitions and limits

#### FCC § 90.213(a)

- (a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

| Frequency range (MHz) | Fixed and base stations | Mobile stations           |                              |
|-----------------------|-------------------------|---------------------------|------------------------------|
|                       |                         | Over 2 watts output power | 2 watts or less output power |
| 421-512               | <sup>7 11 14</sup> 2.5  | <sup>8 5</sup>            | <sup>8 5</sup>               |

<sup>7</sup> In the 421-512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.

<sup>8</sup> In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

<sup>11</sup> Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 2.5 ppm in the 421-512 MHz band.

<sup>14</sup> Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

### 8.8.2 Test summary

|           |             |           |               |
|-----------|-------------|-----------|---------------|
| Verdict   | Pass        |           |               |
| Tested by | P. Barbieri | Test date | July 11, 2022 |

### 8.8.3 Observations, settings and special notes

Test performed with a CW input signal.

Input signal frequency

|           |            |
|-----------|------------|
| Down link | 453.75 MHz |
| Up link   | 458.75 MHz |

### 8.8.4 Test equipment used

| Equipment                  | Manufacturer    | Model no. | Asset no.  |
|----------------------------|-----------------|-----------|------------|
| EMI Receiver               | Rohde & Schwarz | ESU8      | 100202     |
| RF Vector Signal Generator | Rohde & Schwarz | SMBV100A  | 263254     |
| Climatic chamber           | Espec           | ARS-1100  | 4100000067 |

Notes: NCR - no calibration required, VOU - verify on use

## 8.8.5 Test data

**Table 8.8-1:** Transmitter frequency stability results for down link

| Test conditions      | Frequency, Hz | Drift, Hz | Drift, ppm | Limit ±ppm | Margin, ±ppm |
|----------------------|---------------|-----------|------------|------------|--------------|
| +50 °C, Nominal      | 453749905     | 0         | 0          | 2.5        | 2.5          |
| +40 °C, Nominal      | 453749905     | 0         | 0          | 2.5        | 2.5          |
| +30 °C, Nominal      | 453749905     | 0         | 0          | 2.5        | 2.5          |
| +20 °C, -15% voltage | 453749905     | 0         | 0          | 2.5        | 2.5          |
| +20 °C, Nominal      | 453749905     | Reference | Reference  | Reference  | Reference    |
| +20 °C, +15% voltage | 453749905     | 0         | 0          | 2.5        | 2.5          |
| +10 °C, Nominal      | 453749905     | 0         | 0          | 2.5        | 2.5          |
| 0 °C, Nominal        | 453749905     | 0         | 0          | 2.5        | 2.5          |
| -10 °C, Nominal      | 453749905     | 0         | 0          | 2.5        | 2.5          |
| -20 °C, Nominal      | 453749905     | 0         | 0          | 2.5        | 2.5          |
| -30 °C, Nominal      | 453749905     | 0         | 0          | 2.5        | 2.5          |

**Table 8.8-2:** Transmitter frequency stability results for up link

| Test conditions      | Frequency, Hz | Drift, Hz | Drift, ppm | Limit ±ppm | Margin, ±ppm |
|----------------------|---------------|-----------|------------|------------|--------------|
| +50 °C, Nominal      | 458749901     | 0         | 0          | 2.5        | 2.5          |
| +40 °C, Nominal      | 458749901     | 0         | 0          | 2.5        | 2.5          |
| +30 °C, Nominal      | 458749901     | 0         | 0          | 2.5        | 2.5          |
| +20 °C, -15% voltage | 458749901     | 0         | 0          | 2.5        | 2.5          |
| +20 °C, Nominal      | 458749901     | Reference | Reference  | Reference  | Reference    |
| +20 °C, +15% voltage | 458749901     | 0         | 0          | 2.5        | 2.5          |
| +10 °C, Nominal      | 458749901     | 0         | 0          | 2.5        | 2.5          |
| 0 °C, Nominal        | 458749901     | 0         | 0          | 2.5        | 2.5          |
| -10 °C, Nominal      | 458749901     | 0         | 0          | 2.5        | 2.5          |
| -20 °C, Nominal      | 458749901     | 0         | 0          | 2.5        | 2.5          |
| -30 °C, Nominal      | 458749901     | 0         | 0          | 2.5        | 2.5          |

## 8.9 Noise figure measurements

### 8.9.1 References, definitions and limits

#### FCC § 90.219(e)(2)

(2) The noise figure of a signal booster must not exceed 9 dB in either direction.

### 8.9.2 Test summary

|           |             |           |               |
|-----------|-------------|-----------|---------------|
| Verdict   | Pass        |           |               |
| Tested by | P. Barbieri | Test date | July 13, 2022 |

### 8.9.3 Observations, settings and special notes

A noise figure analyzer and an excess noise ratio (ENR) calibrated noise source have been used to perform this test.

#### Input signal frequency

|           |            |
|-----------|------------|
| Down link | 453.75 MHz |
| Up link   | 458.75 MHz |

### 8.9.4 Test equipment used

| Equipment         | Manufacturer    | Model no. | Asset no. |
|-------------------|-----------------|-----------|-----------|
| Spectrum Analyzer | Rohde & Schwarz | FSW43     | 101767    |
| Noise generator   | Rohde & Schwarz | FS-SNS26  | 112614    |

Notes: NCR - no calibration required, VOUE - verify on use

### 8.9.5 Test data

**Table 8.9-1: Noise figure results**

| Antenna port | Frequency, MHz | Noise figure, dB | Limit, dB | Margin, dB |
|--------------|----------------|------------------|-----------|------------|
| Down link    | 453.75         | 3.8              | 9.0       | -5.2       |
| Up link      | 458.75         | 3.8              | 9.0       | -5.2       |

Test data, continued

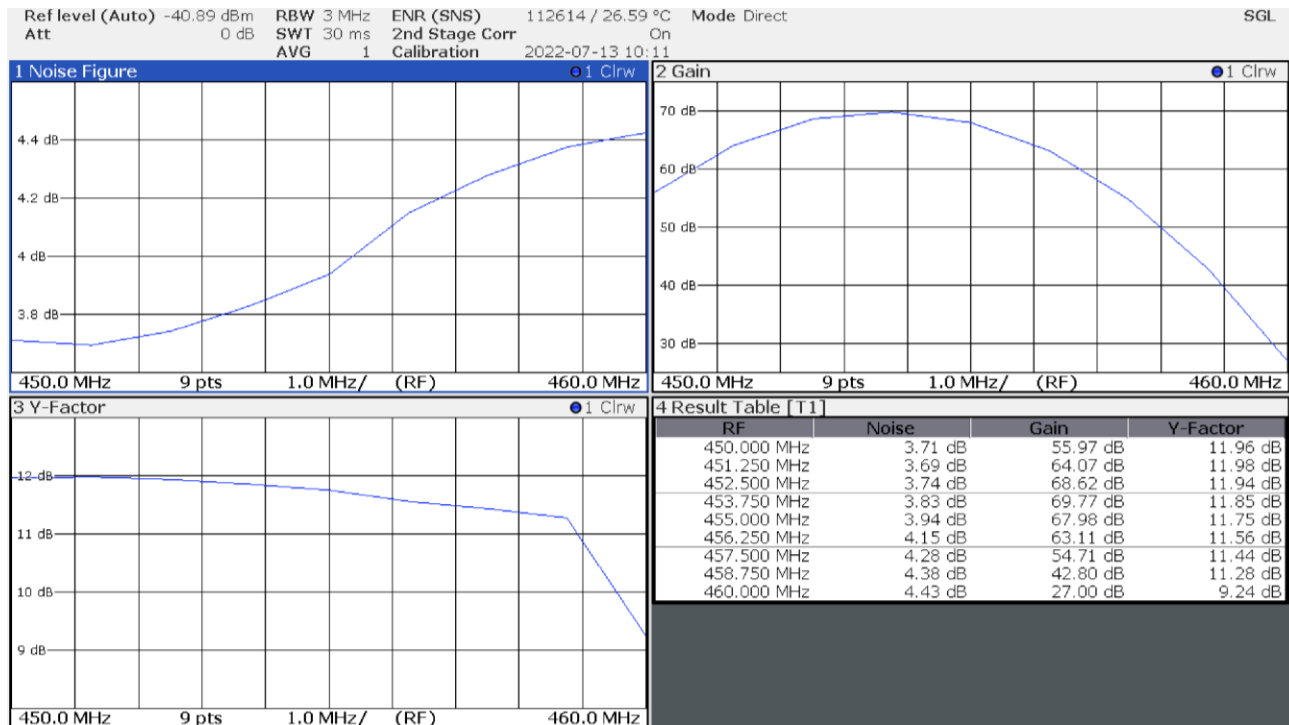


Figure 8.9-1: Noise figure for down link

Test data, continued

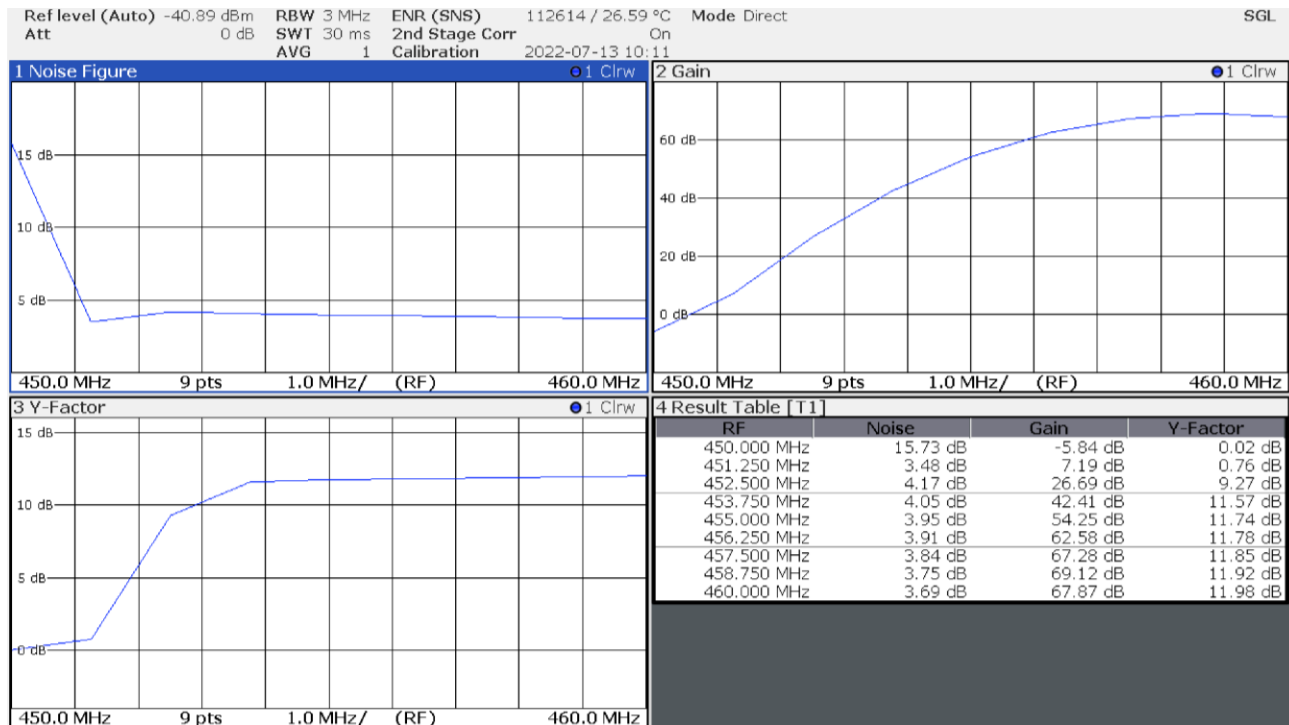
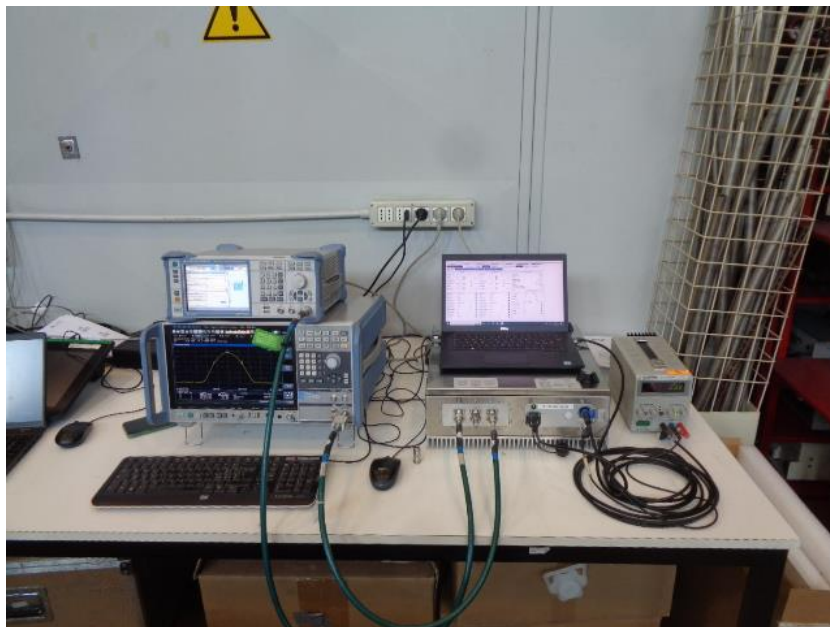


Figure 8.9-2: Noise figure for up link

## Section 9 EUT photos

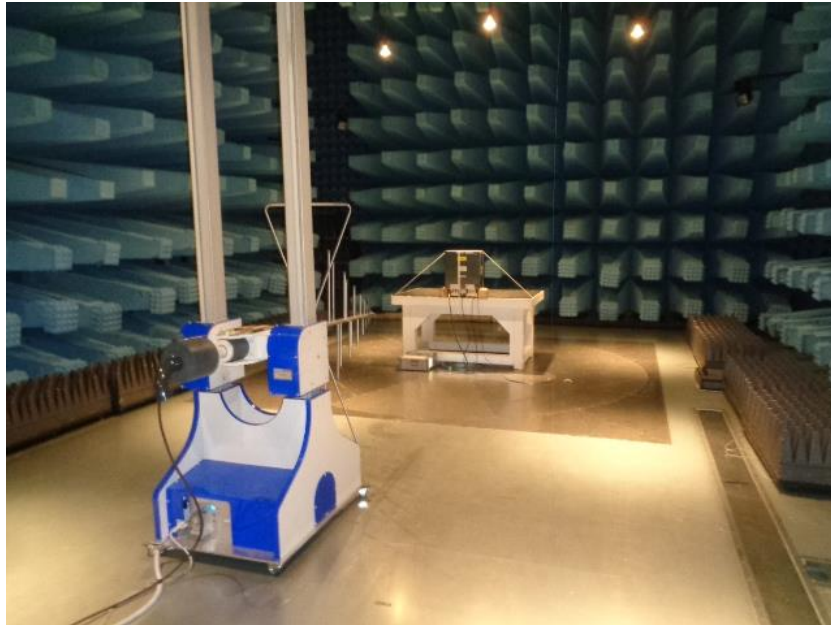
### 9.1 Set-up photos



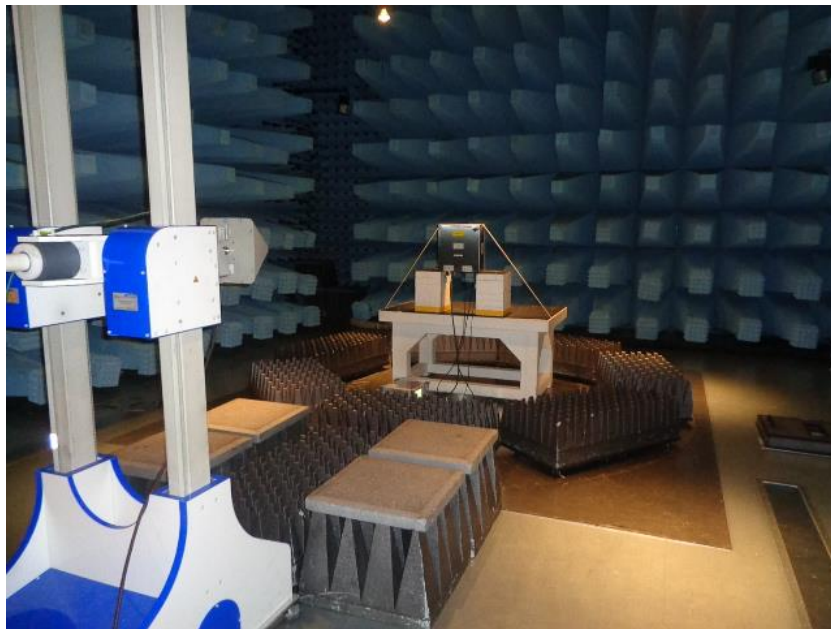
**Figure 9.1-1:** Antenna port testing set-up



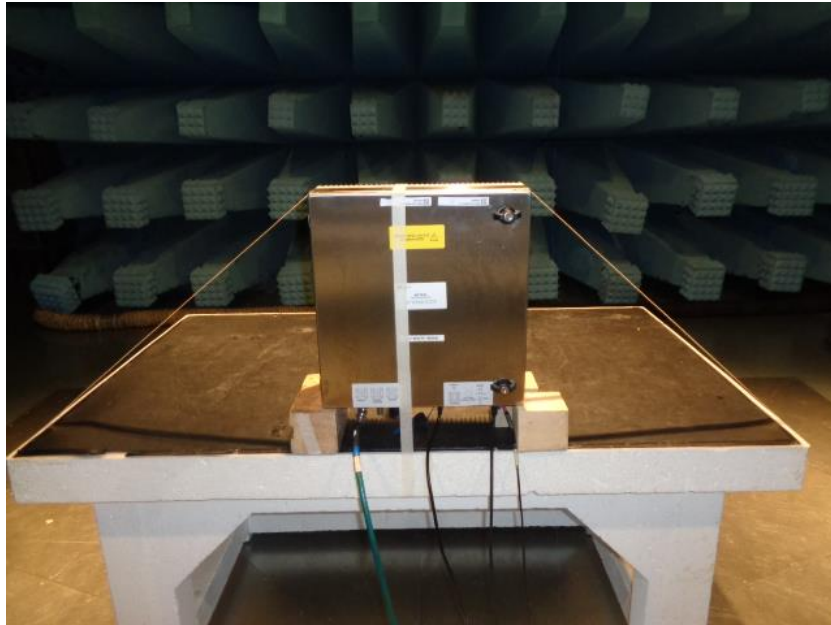
**Figure 9.1-2:** Antenna port testing set-up in climatic chamber



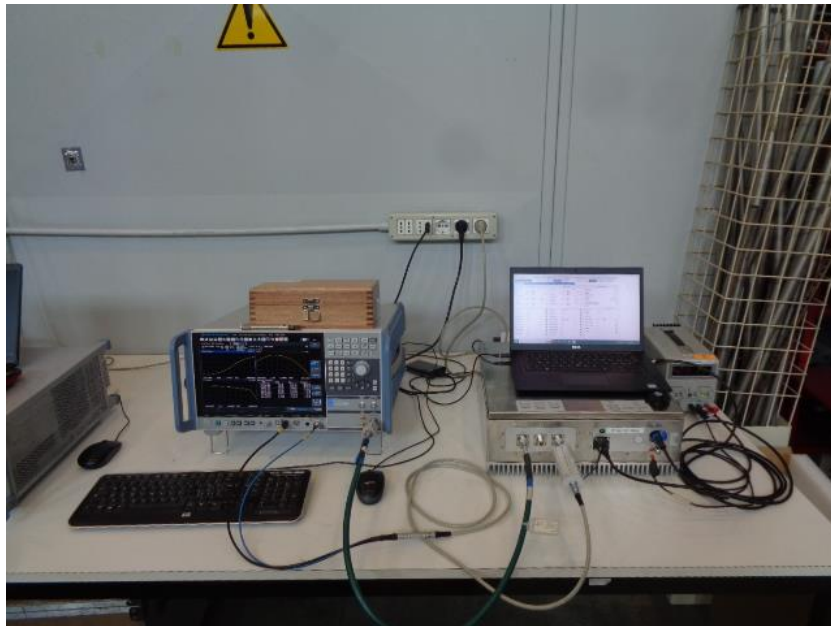
**Figure 9.1-3:** Radiated emissions set-up for frequencies below 1 GHz



**Figure 9.1-4:** Radiated emissions set-up for frequencies above 1 GHz



**Figure 9.1-5:** Radiated emissions EUT set-up



**Figure 9.1-6:** Noise figure testing set-up

## 9.2 External photos

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**Figure 9.2-1:** EUT photo – external view



**Figure 9.2-2:** EUT photo – external view



*Figure 9.2-3: EUT photo – connector side*



*Figure 9.2-4: EUT photo – internal view*

**End of the test report**