# *Test Report No. 7312311921*

***Applicant*: Talgil Computing and Control LTD**

***Equipment Under Test:***

***STM32WLE5***

***Model:*** ***RF-MODULE-G5P***

***FCC ID:*** ***2AC2T-RF-MODULE-G5P***

***Issued by:***
***The Standards Institution of Israel***
***Industry Division***
***Electrical & Electronics Laboratory***
***EMC Branch***

ilac-MRA

ANAB
ANSI National Accreditation Board
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ISO/IEC 17025
TESTING LABORATORY
Certificate Number: AT-1359

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| | |
|---|---|
| **Applicant:** | Talgil Computing and Control LTD |
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| **Sample for test selected by:** | The customer |
| **The date of test:** | May 2023 |

| | |
|---|---|
| **Description of Equipment under Test (EUT):** | STM32WLE5 |
| **Model:** | RF-MODULE-G5P |
| **Software version:** | RTU_RF_G5P_ECO_ONE_V1.2 |
| **Hardware version:** | TL0387 |
| **Manufactured by:** | Talgil Computing and Control LTD |

***Reference Documents:***

❖ CFR 47 FCC (2020) Rules and Regulations: Part 15. Radio frequency devices, Subpart C: Intentional radiators. Section 15.247: Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz

***Test Results*** The EUT was found to be in compliance with the following standard:

CFR 47 Part 15 Subpart C
sections: 15.203, 15.205, 15.207, 15.209 and 15.247.

| | |
|---|---|
| This Test Report contains 34 pages and may be used only in its entirety. | This Test Report applies only to the specimen tested and may not be applied to other specimens of the same product. |

***Table of Contents***

# 1. Summary of Test Results

| Transmitter characteristic | Ref. Section |
|---|---|
| 6dB and occupied bandwidth | 15.247 (a) (2) |
| Maximum peak conducted output power | 15.247 (b) (3) |
| Power spectral density | 15.247 (e) |
| Radiated emission in restricted and non-restricted bands | 15.247 (d), 15.209, 15.205 |
| Band-edge compliance of RF conducted emission | 15.247 (d) |
| AC power line conducted emission measurements | N/A |
| Antenna requirement | 15. 203 |

Name: Eng. Yuri Rozenberg
Position: Head of Branch

Electrical & Electronics Laboratory
8 January 2024

Tested by: Alexander Konkov
Position: Testing Technician

# 2. EUT Description

**Note:** All information in this section was provided by the customer.

## *2.1. General description:*

The "RF-MODULE-G5P" is based on STMicroelectronics SoC (System on Chip) wireless STM32WLE5 microcontroller patented LoRa (Long Range) digital modulation technique. The "RF-MODULE-G5P" is used as plug-in RF module in remote terminal unit (RTU) for irrigation and fertilizer application in agriculture. RF module is used one from seventeen RF channels in USA in the frequency range 902-928MHz.

**The test data contained in this report pertains only to the emissions due to the EUT's RF transmitter**.

In the beginning, the STM32WLE5 controller makes the initialization of the RF transceiver by internal serial SPI channel. On this stage, the STM32WLE5 controller defines all main RF parameters: frequency channel, modulation, baud rate, output power etc. After initialization the RF transceiver goes to sleep mode with very low power consumption (few hundreds nanoampers).

If necessary, the STM32WLE5 controller changes "sleep" to receive mode. In this case, it sends command "receive" to transceiver by internal SPI channel. If the RF part of STM32WLE5 receives relevant RF message, then it generates interrupt to STM32WLE5 controller and the controller reads binary data message from receiver data buffer by internal SPI channel during one millisecond.

If necessary, the controller changes "sleep" to transmit mode. In this case, it fills transmitter data buffer and sends command "transmit" to transceiver STM32WLE5 by SPI internal channel.

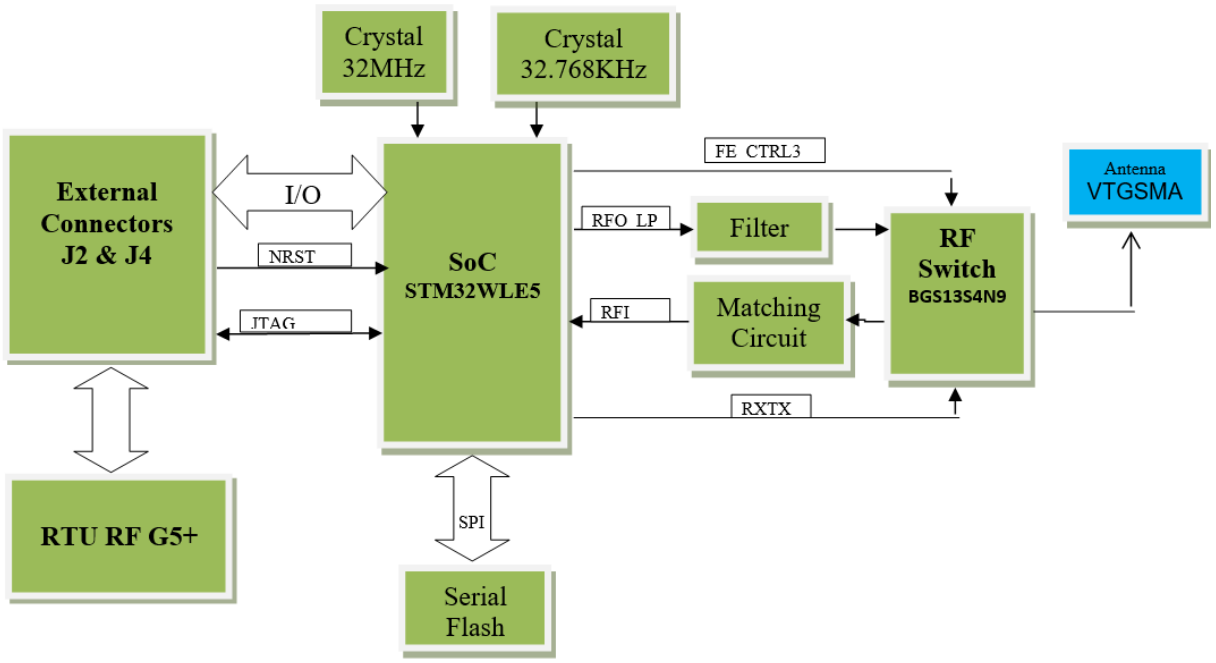



**Figure 1. Block diagram**


**Figure 2. STM32WLE5**

## *2.2. Transmitter description:*

| **Type of equipment** |
|---|
| Combined equipment (Equipment where the radio part is fully integrated within another type of equipment) |

| | |
|---|---|
| **Technologies** | LoRa (Long Range) |

| | | |
|---|---|---|
| **Assigned frequency range** | from 902 MHz to 928 MHz | |
| **Operating frequency range** | from 903 MHz to 927 MHz (RF transceiver) | |
| **RF channel spacing** | 0.6 MHz (RF transceiver) | |
| **Maximum rated output power** | Effective radiated power (for equipment with no RF connector) | 12.88 dBm = 19.4089 mW |
| Declare temperature range: | -10°C --- 55°C | |

| **Antenna information** |
|---|
| 860-930MHz Stubby Rubber Antenna |
| **Manufacturer:** Shanghai Saintenna Wireless Technology Co. Ltd. |
| **Antenna gain:** 2.28 dBi |

| **Transmitter 99% power bandwidth** | |
|---|---|
| **Type of modulation** | LoRa |
| **Modulating test signal (baseband)** | LoRa |

| **Transmitter power source** |
|---|
| Nominal rated voltage 6 VDC |
| Type of battery Alkaline |

## *2.3. Test setup:*

The EUT was tested per the guidance ANSI C63.10: 2020.
The test setup is shown in Figures 3 - 5. EUT gets 6 VDC power from battery.

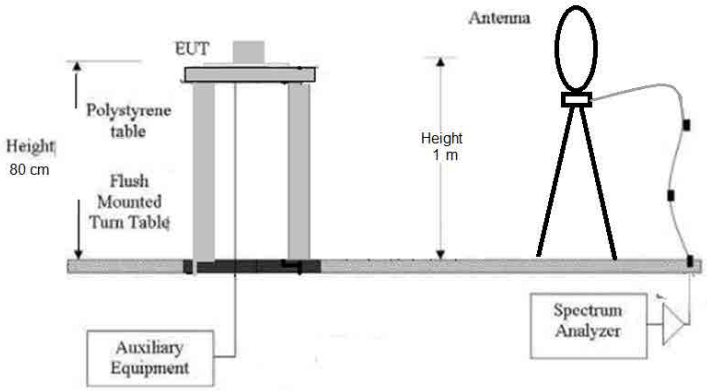



**Figure 3. RE test setup for 9kHz – 30 MHz.**

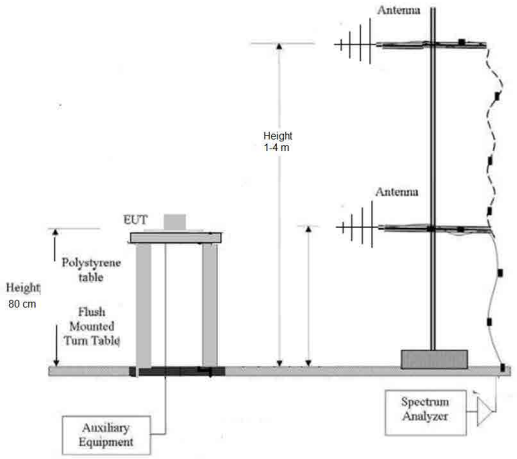



**Figure 4. RE test setup lower 1 GHz.**

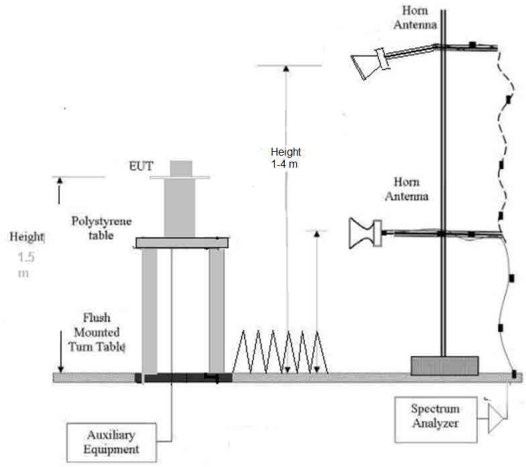



**Figure 5. RE test setup above 1 GHz.**

## *2.4. System test configuration:*

**Table 1. RF channels / frequencies**

| Channel | Channel central frequency [MHz] |
|---|---|
| 1 | 903.0 |
| 2 | 904.5 |
| 3 | 906.0 |
| 4 | 907.5 |
| 5 | 909.0 |
| 6 | 910.5 |
| 7 | 912.0 |
| 8 | 913.5 |
| 9 | 915.0 |
| 10 | 916.5 |
| 11 | 918.0 |
| 12 | 919.5 |
| 13 | 921.0 |
| 14 | 922.5 |
| 15 | 924.0 |
| 16 | 925.5 |
| 17 | 927.0 |

## 3. Test specification, methods and procedures

| | |
|---|---|
| ❖ CFR 47 FCC | Rules and Regulations: Part 15. Radio frequency devices, Subpart C: Intentional radiators (2020) |
| ❖ ANSI C63.4:2014 | American National Standard for Method of Measurement of Radio Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range 9 kHz to 40 GHz. |
| ❖ ANSI C63.10: 2020 | American National Standard for Testing of Unlicensed Wireless Devices |

## 4. Testing Facility:

Laboratory Name: Standards Institution of Israel (SII)
Test site location: 42 Haim Levanon st., Tel-Aviv Israel
Laboratory Accreditation: ANAB: AT-1359

## 5. Measurement uncertainty

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error.
The laboratory calibrates its standards by a third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements.

| Test description | Calculated uncertainty $U_{LAB}$ |
|---|---|
| **Conducted measurements** | |
| Frequency error | 37.6 Hz |
| Spurious emission | ± 2.98 dB |
| **Radiated measurements** | |
| Electric field strength in a SAR at 3 m distance<br>30 MHz – 1.0 GHz | ±4.32 dB |
| Electric field strength in a FAR at 3 m distance<br>1.0 GHz – 18 GHz | ± 4.47 |
| **Substitution measurements** | |
| In a FAR at 3 m distance<br>1.0 GHz – 18 GHz | ± 3.41 dB |

# 6. Transmitter characteristics - test results

## *6.1. 6dB and Occupied Bandwidth*

### *Limits & methods:*

| | | | |
|---|---|---|---|
| **FCC requirements** | 15.247(a)(2) | | |
| **Test procedure** | ANSI 63.10 --- 11.8 DTS bandwidth<br>Conducted Measurement | | |
| **Operating mode** | Tx continuous, Hight Mid and Low | | |
| Ambient Temperature 23$^0$C | Relative Humidity 50% | Air Pressure 1009hPa | |

### *Limit:*

The minimum 6dB bandwidth shall be at least 500 kHz.

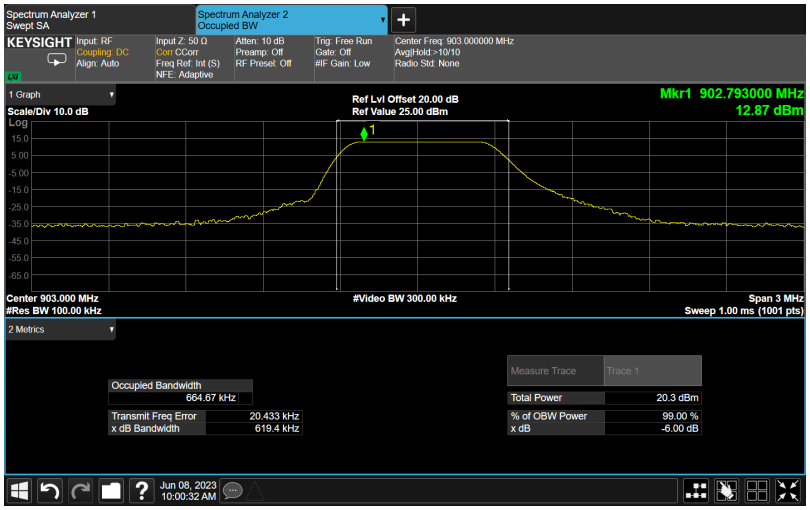
### *Test procedure*

The measurements were performed in constant transmission mode of operation for carrier (channel) frequency at bottom, middle and at the top of 902 MHz to 928 MHz frequency band and maximum transmitting data rate.

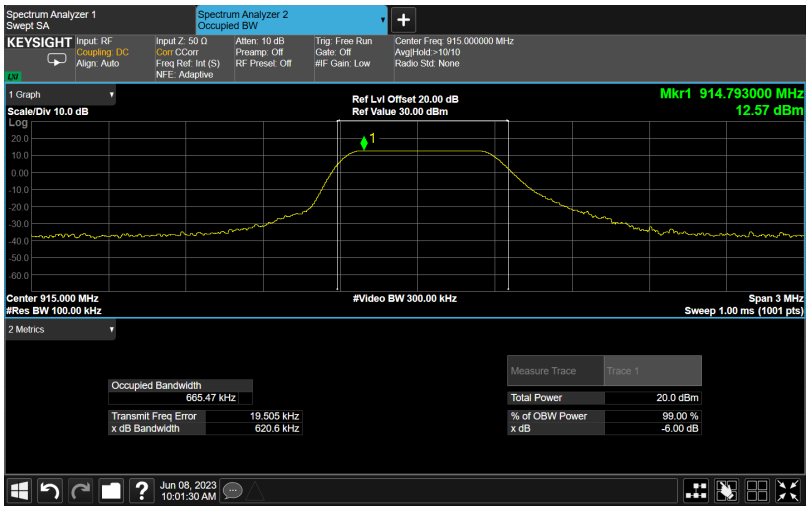
### *Results:*

**Table 2. 6dB Bandwidth & Occupied Bandwidth Results**

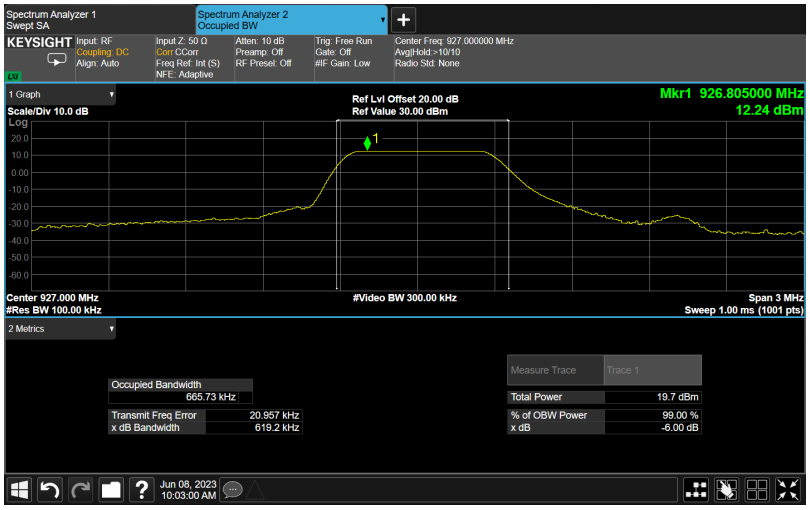
| Frequency MHz | 6dB Bandwidth kHz | Limit kHz | Verdict | Ref. Plot |
|---|---|---|---|---|
| 903 | 619.4 | 500 | Pass | 1 |
| 915 | 620.6 | 500 | Pass | 2 |
| 925 | 619.2 | 500 | Pass | 3 |




**Plot 1**




**Plot 2**




**Plot 3**

## *6.2. Maximum Peak Conducted Output Power*

### *Limits & methods:*

| | | | |
|---|---|---|---|
| **FCC requirements** | 15.247(b)(3) | | |
| **Test procedure** | ANSI 63.10 11.9.1.1 RBW ≥ DTS bandwidth<br>Conducted Measurement | | |
| **Operating mode** | Tx continuous, Hight Mid and Low | | |
| Ambient Temperature 23$^0$C | Relative Humidity 50% | Air Pressure | 1009hPa |

### *Limit*

The maximum peak conducted output power shall not exceed 1 watt.

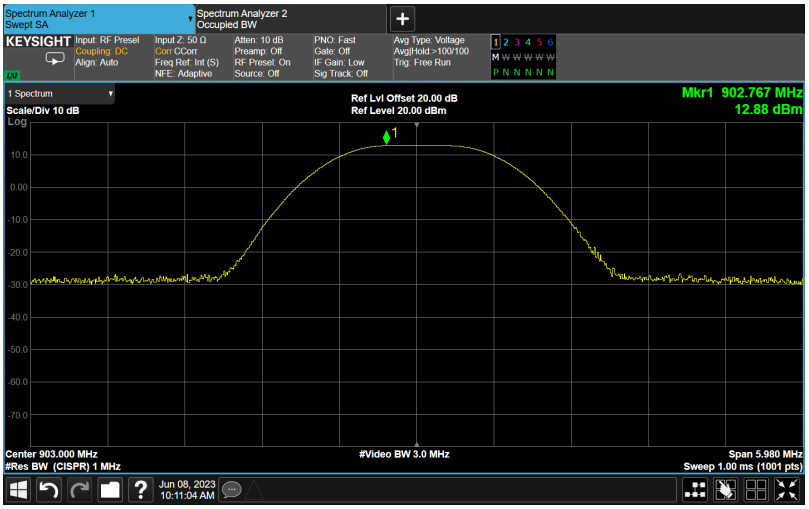
### *Test procedure*

The measurements were performed in constant transmission mode of operation for carrier (channel) frequency at bottom, middle and at the top of 902 MHz to 928 MHz frequency band and maximum transmitting data rate.

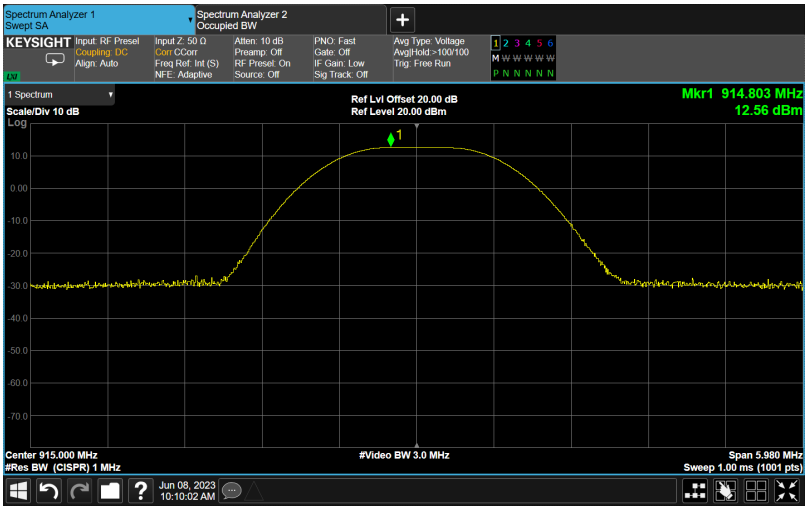
### *Results:*

**Table 3. Maximum Peak Conducted Output Power Results**

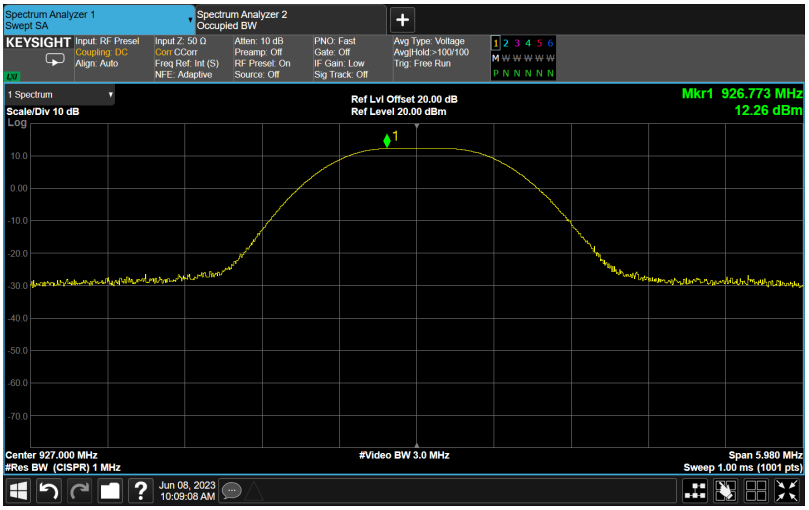
| Freq. MHz | Mesure dBm | Calculated mWatt | Limit Watt | Verdict | Plot |
|---|---|---|---|---|---|
| 903 | 12.88 | 19.32 | 1 | Pass | 4 |
| 915 | 12.56 | 18.04 | 1 | Pass | 5 |
| 927 | 12.26 | 16.83 | 1 | Pass | 6 |




**Plot 4**




**Plot 5**




**Plot 6**

## *6.3. Power Spectral Density*

### *Limits & methods:*

| | | | |
|---|---|---|---|
| **FCC requirements** | 15.247(e) | | |
| **Test procedure** | ANSI 63.10 11.10.3 Method AVGPSD-1<br>Conducted Measurement | | |
| **Operating mode** | Tx continuous, Hight Mid and Low | | |
| Ambient Temperature 23$^0$C | Relative Humidity 50% | Air Pressure | 1009hPa |

### *Limit*

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

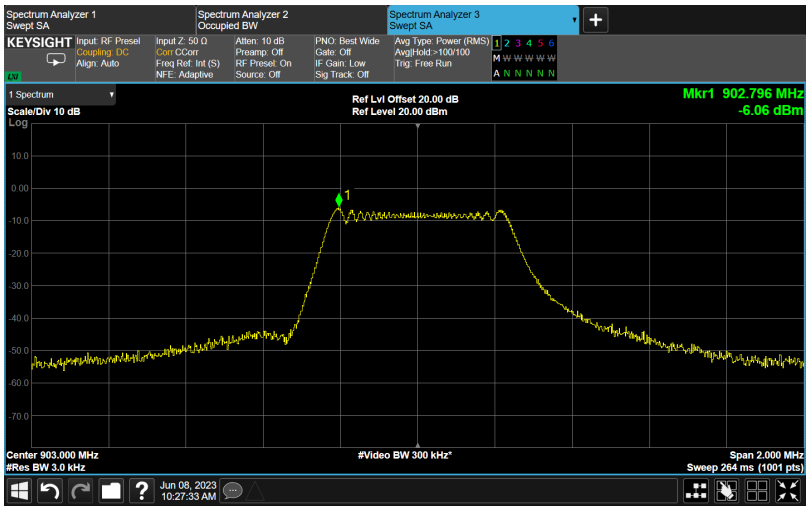
### *Test procedure*

The measurements were performed in constant transmission mode of operation for carrier (channel) frequency at bottom, middle and at the top of 902 MHz to 928 MHz frequency band and maximum transmitting data rate.

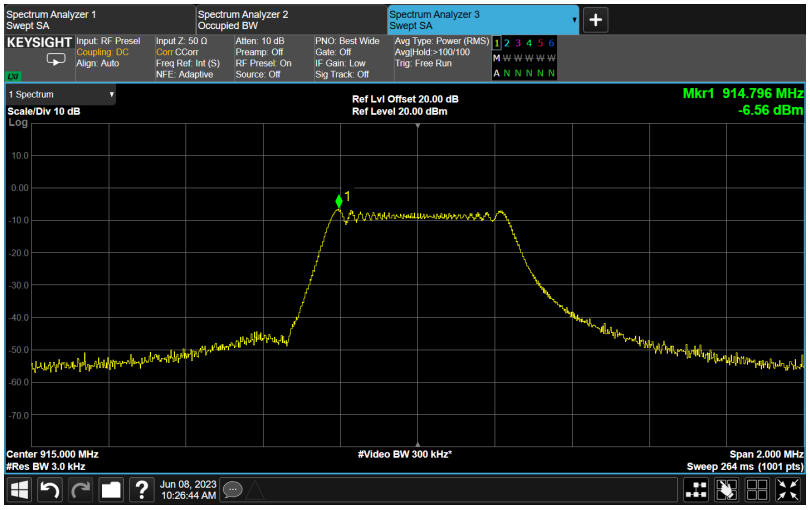
### *Results:*

**Table 4. Power Spectral Densiry Test Results**

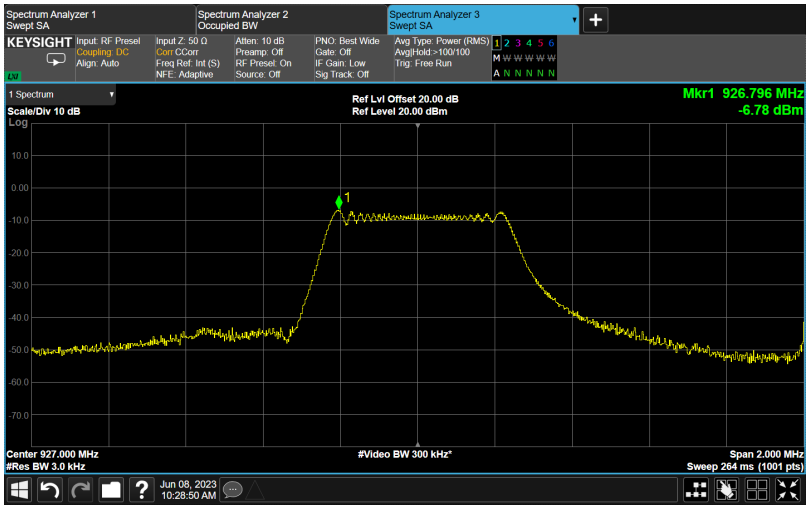
| Freq. MHz | Measure dBm/3kHz | Limit dBm/3kHz | Verdict | Plot |
|---|---|---|---|---|
| 903 | -6.06 | 8 | Pass | 7 |
| 915 | -6.56 | 8 | Pass | 8 |
| 927 | -6.78 | 8 | Pass | 9 |




**Plot 7**




**Plot 8**




**Plot 9**

## *6.4. Radiated Emissions in Restricted and non-Restricted bands*

### *Limits & methods:*

| | | | |
|---|---|---|---|
| **FCC requirements** | 15.247(d), 15.209, 15.205 | | |
| **Test procedure** | ANSI 63.10 Sections 6.5, 6.6, 11.11, 11.12<br>Radiated Measurement | | |
| **Operating mode** | Tx continuous, Hight Mid and Low | | |
| Ambient Temperature 23$^0$C | Relative Humidity 49% | Air Pressure | 1009hPa |

### *Limit*

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.
Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see below)

| FREQUENCIES (MHz) | FIELD STRENGTH (microvolts/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 |

### *Test procedure*

The frequency spectrum was investigated from the lowest radio frequency signal generated in the equipment and up to ten harmonics. The measurements were performed in constant transmission mode of operation for carrier (channel) frequency at bottom, middle and at the top of 902 MHz to 928 MHz frequency band and maximum transmitting data rate.

***Results:***

**Range: 9 kHz-30 MHz**
Not found disturbance emission plot 10, plot 18, plot 25.

**Range: 30 MHz – 40 GHz:**

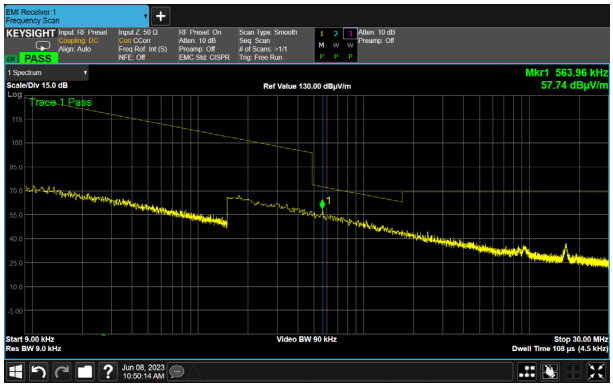
**Table 5. CH1 903 MHz – LoRa digital modulation - Results**

| Frequency MHz | Meas Freq. MHz | Pk Det. dbuV/m | QPk Det. dbuV/m | Limit Pk dbuV/m | Limit QPk dbuV/m | Verdict | Ref. Plot |
|---|---|---|---|---|---|---|---|
| CH 1 903 | 521.12 | 42.755 | 37.779 | - | 90.36 | Pass | 11-15 |
| | 870.77 | 44.511 | 39.579 | - | 90.36 | Pass | 11-15 |
| | 893.68 | 45.741 | 41.275 | - | 90.36 | Pass | 11-15 |
| | 897.52 | 47.124 | 41.548 | - | 90.36 | Pass | 11-15 |
| | 898.12 | 53.148 | 47.268 | - | 90.36 | Pass | 11-15 |
| | 898.96 | 57.451 | 51.300 | - | 90.36 | Pass | 11-15 |
| | 899.62 | 58.894 | 53.347 | - | 90.36 | Pass | 11-15 |
| | 900.47 | 61.078 | 55.937 | - | 90.36 | Pass | 11-15 |
| | 901.24 | 61.657 | 57.276 | - | 90.36 | Pass | 11-15 |
| | 912.46 | 45.504 | 41.296 | - | 90.36 | Pass | 11-15 |
| | 935.14 | 45.150 | 40.935 | - | 90.36 | Pass | 11-15 |
| | | | AVG Det. dbuV/m | | Limit AVG Det. dbuV/m | | |
| | 1806 | 47.554 | 36.518 | 90.36 | - | Pass | 16 |
| | 2709.5 | 53.675 | 42.189 | 74* | 54* | Pass | 16 |
| | 4514.5 | 53.996 | 41.271 | 74* | 54* | Pass | 16 |
| | 5419 | 56.448 | 43.602 | 74* | 54* | Pass | 16 |
| | 8256 | 57.15 | 48.60 | 74* | 54* | Pass | 17 |

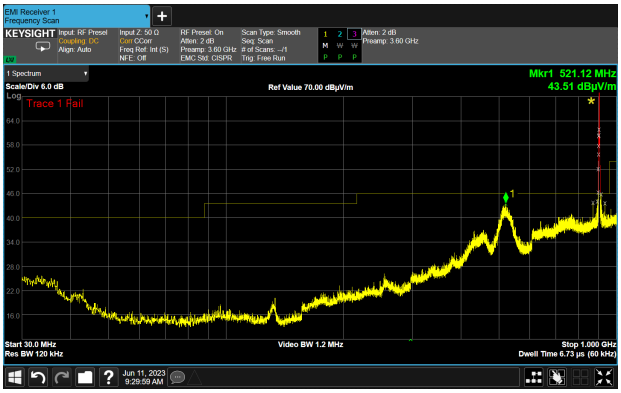
Note:
* Restricted bands § 15.205, must also comply with the radiated emission limits specified in § 15.209(a).

The radio frequency power that is produced by the intentional radiator (Not Restricted bands) shall be at least 20 dB below P(dbuV/m).

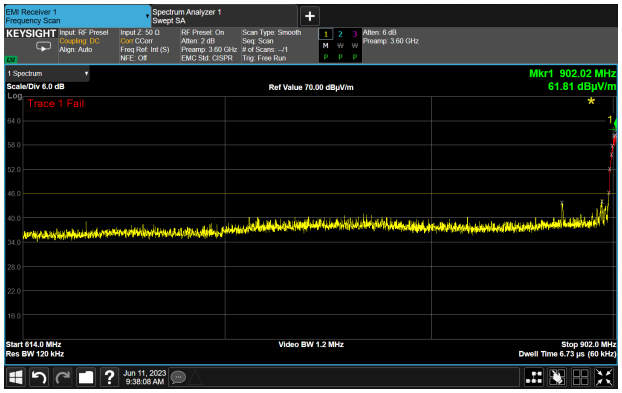
P(dbuV/m) = P(Conducted) + Antenna Gain + 95.2 = 110.36 dbuV/m
Limit = P(dbuV/m) – 20 dB = 90.36 dbuV/m



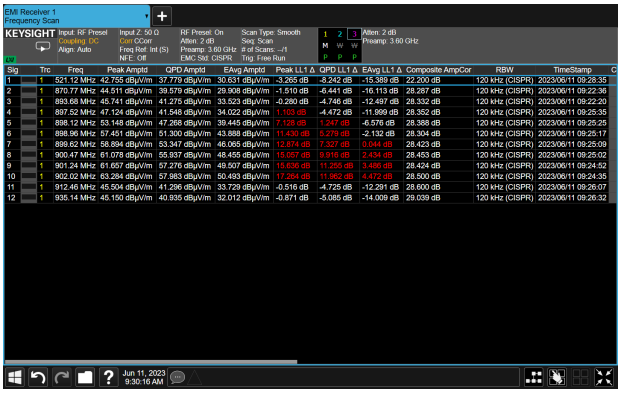

**Plot 10**




**Plot 11**

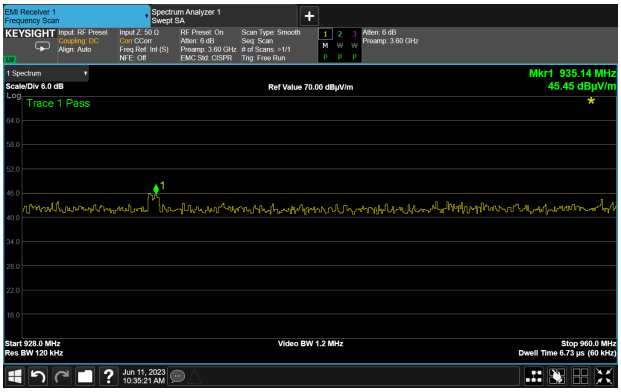



**Plot 12**



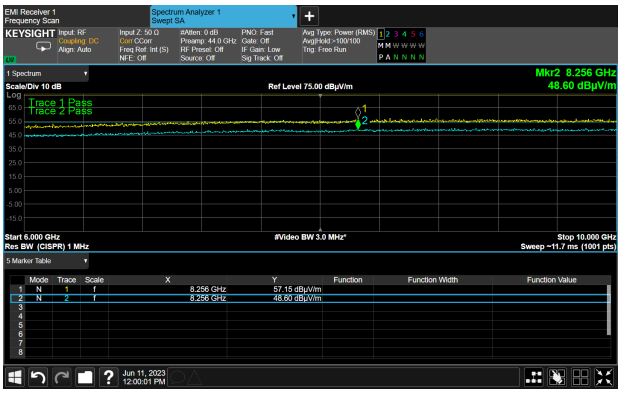

**Plot 13**


**Plot 14**




**Plot 15**


**Plot 16**




**Plot 17**

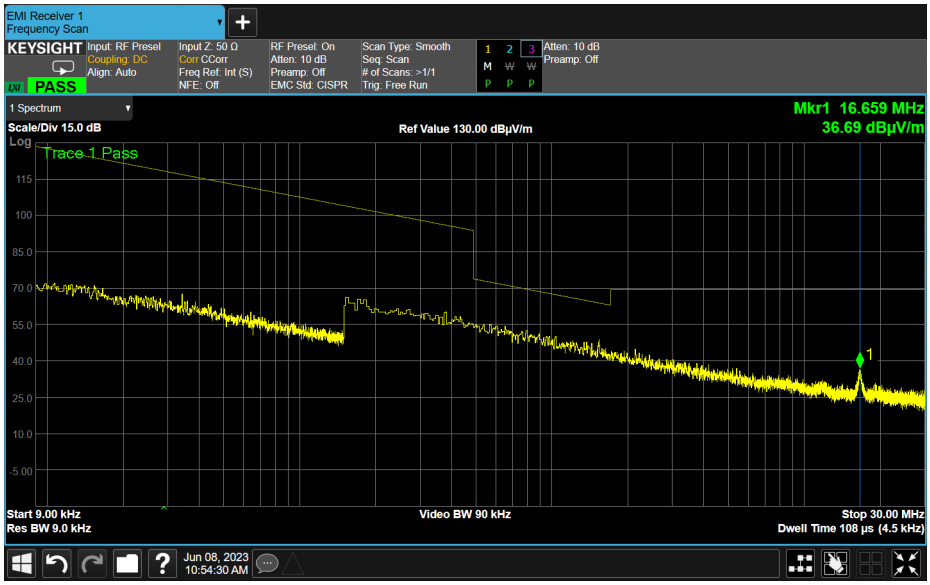
**Table 6. CH9 915 MHz – LoRa digital modulation - Results**

| Frequency MHz | Meas Freq. MHz | Pk Det. dbuV/m | QPk Det. dbuV/m | Limit Pk dbuV/m | Limit QPk dbuV/m | Verdict | Ref. Plot |
|---|---|---|---|---|---|---|---|
| CH 9 915 | 521.84 | 42.371 | 37.311 | - | 90.04 | Pass | 19-22 |
| | 882.94 | 43.196 | 37.724 | - | 90.04 | Pass | 19-22 |
| | 902.86 | 44.360 | 39.474 | - | 90.04 | Pass | 19-22 |
| | 904.60 | 43.372 | 38.716 | - | 90.04 | Pass | 19-22 |
| | 905.32 | 46.007 | 41.105 | - | 90.04 | Pass | 19-22 |
| | 927.47 | 45.513 | 40.758 | - | 90.04 | Pass | 19-22 |
| | 930.04 | 43.183 | 38.135 | - | 90.04 | Pass | 19-22 |
| | 946.84 | 44.721 | 39.829 | - | 90.04 | Pass | 19-22 |
| | | | AVG Det. dbuV/m | | Limit AVG Det. dbuV/m | | |
| | 1829.5 | 46.774 | 34.08 | 90.04 | - | Pass | 23 |
| | 2745.0 | 50.609 | 38.573 | 74* | 54* | Pass | 23 |
| | 4574.0 | 53.529 | 41.282 | 74* | 54* | Pass | 23 |
| | 5489.5 | 55.864 | 43.603 | 90.04 | - | Pass | 23 |
| | 9912 | 57.70 | 49.26 | 90.04 | - | Pass | 24 |

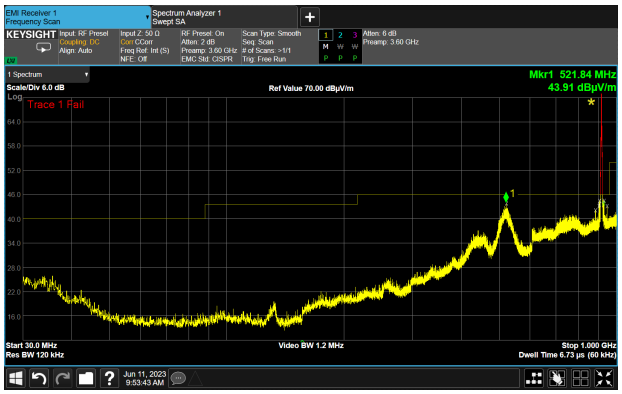
Note:
* Restricted bands § 15.205, must also comply with the radiated emission limits specified in § 15.209(a).

The radio frequency power that is produced by the intentional radiator (Not Restricted bands) shall be at least 20 dB below P(dbuV/m).

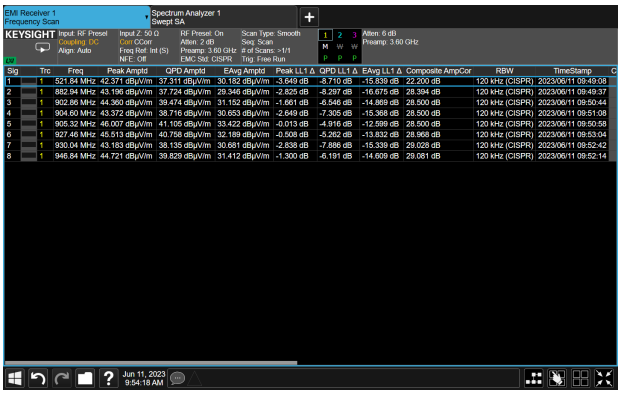
P(dbuV/m) = P(Conducted) + Antenna Gain + 95.2 = 110.04 dbuV/m
Limit = P(dbuV/m) – 20 dB = 90.04 dbuV/m



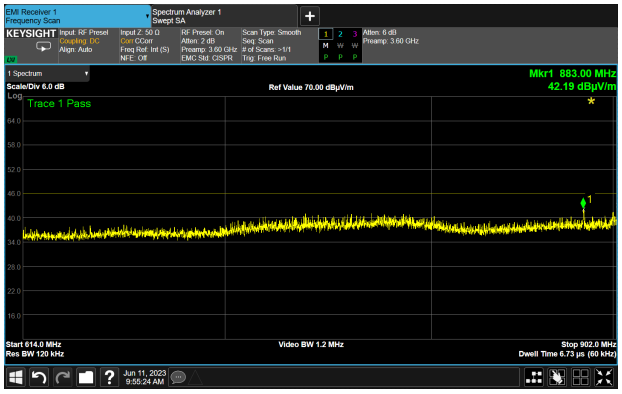

**Plot 18**




**Plot 19**



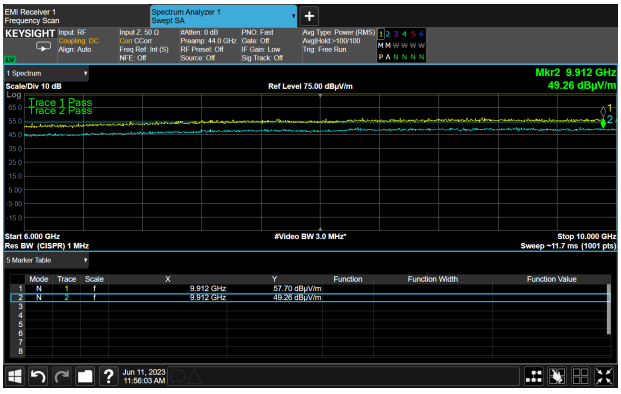
**Plot 20**




**Plot 21**


**Plot 22**


**Plot 23**




**Plot 24**

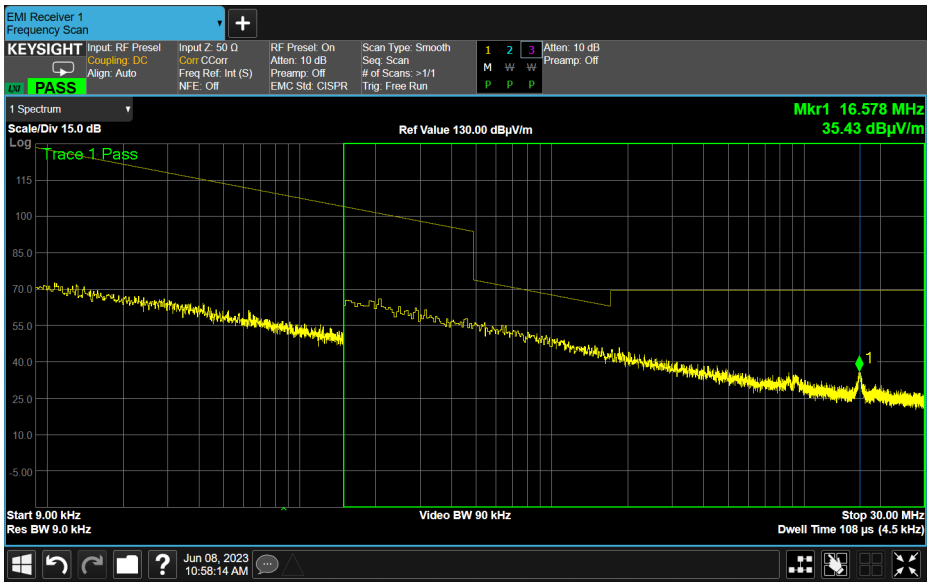
**Table 7. CH17 927 MHz – LoRa digital modulation - Results**

| Frequency MHz | Meas Freq. MHz | Pk Det. dbuV/m | QPk Det. dbuV/m | Limit Pk dbuV/m | Limit QPk dbuV/m | Verdict | Ref. Plot |
|---|---|---|---|---|---|---|---|
| CH 17 927 | 513.20 | 52.067 | 47.033 | - | 89.74 | Pass | 26-29 |
| | 520.33 | 52.629 | 47.239 | - | 89.74 | Pass | 26-29 |
| | 894.82 | 58.718 | 53.448 | - | 89.74 | Pass | 26-29 |
| | 928.48 | 62.748 | 56.482 | - | 89.74 | Pass | 26-29 |
| | 928.90 | 61.236 | 55.819 | - | 89.74 | Pass | 26-29 |
| | 929.32 | 59.562 | 53.985 | - | 89.74 | Pass | 26-29 |
| | 929.92 | 57.796 | 52.192 | - | 89.74 | Pass | 26-29 |
| | 930.82 | 54.196 | 48.494 | - | 89.74 | Pass | 26-29 |
| | 931.36 | 51.182 | 45.704 | - | 89.74 | Pass | 26-29 |
| | 931.65 | 48.775 | 43.782 | - | 89.74 | Pass | 26-29 |
| | 933.64 | 44.227 | 38.884 | - | 89.74 | Pass | 26-29 |
| | 934.36 | 46.083 | 39.396 | - | 89.74 | Pass | 26-29 |
| | 935.19 | 44.792 | 38.742 | - | 89.74 | Pass | 26-29 |
| | 936.22 | 45.435 | 39.498 | - | 89.74 | Pass | 26-29 |
| | 937.96 | 45.195 | 39.019 | - | 89.74 | Pass | 26-29 |
| | 939.28 | 44.343 | 39.220 | - | 89.74 | Pass | 26-29 |
| | 959.08 | 43.941 | 38.663 | - | 89.74 | Pass | 26-29 |
| | 959.32 | 43.720 | 38.386 | - | 89.74 | Pass | 26-29 |
| | | | AVG Det. dbuV/m | | Limit AVG Det. dbuV/m | | |
| | 1857.5 | 46.573 | 33.148 | 89.74 | - | Pass | 30 |
| | 2781.5 | 49.223 | 36.346 | 74* | 54* | Pass | 30 |
| | 3148.0 | 51.542 | 37.821 | 89.74 | - | Pass | 30 |
| | 5562.5 | 57.821 | 44.852 | 89.74 | - | Pass | 30 |
| | 8000 | 55.95 | 47.88 | 89.74 | - | Pass | 31 |

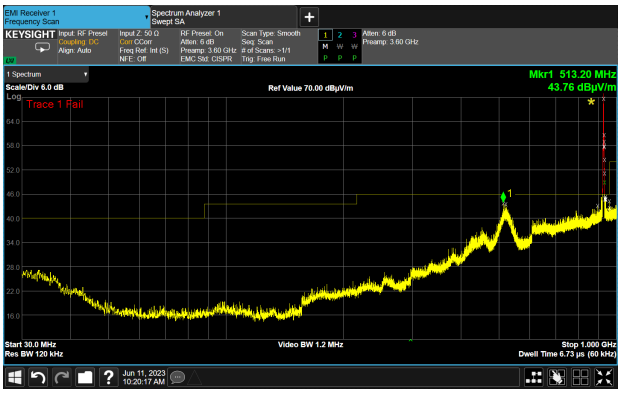
Note:
* Restricted bands § 15.205, must also comply with the radiated emission limits specified in § 15.209(a).

The radio frequency power that is produced by the intentional radiator (Not Restricted bands) shall be at least 20 dB below P(dbuV/m)

P(dbuV/m) = P(Conducted) + Antenna Gain + 95.2 = 109.74 dbuV/m
Limit = P(dbuV/m) – 20 dB = 89.74 dbuV/m

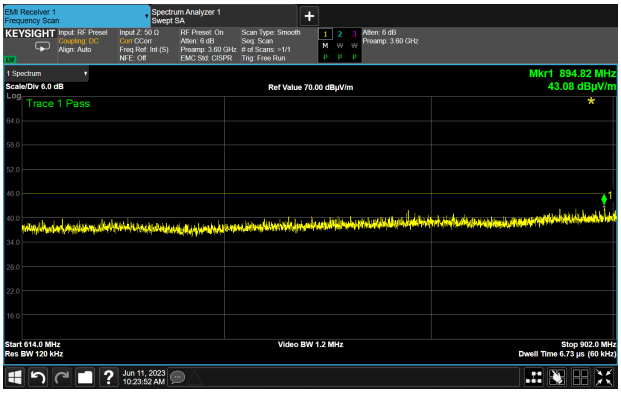

EMI Receiver 1
Frequency Scan
KEYSIGHT
Input: RF Presel
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corr CCorr
Freq Ref: Int (S)
NFE: Off
RF Presel: On
Atten: 10 dB
Preamp: Off
EMC Std: CISPR
Scan Type: Smooth
Seq: Scan
# of Scans: >1/1
Trig: Free Run
Atten: 10 dB
Preamp: Off
PASS
1 Spectrum
Mkr1 16.578 MHz
35.43 dBµV/m
Scale/Div 15.0 dB
Ref Value 130.00 dBµV/m
Log
Trace 1 Pass
115
100
85.0
70.0
55.0
40.0
25.0
10.0
-5.00
Start 9.00 kHz
Res BW 9.0 kHz
Video BW 90 kHz
Stop 30.00 MHz
Dwell Time 108 µs (4.5 kHz)
Jun 08, 2023
10:58:14 AM

**Plot 25**




Plot 26

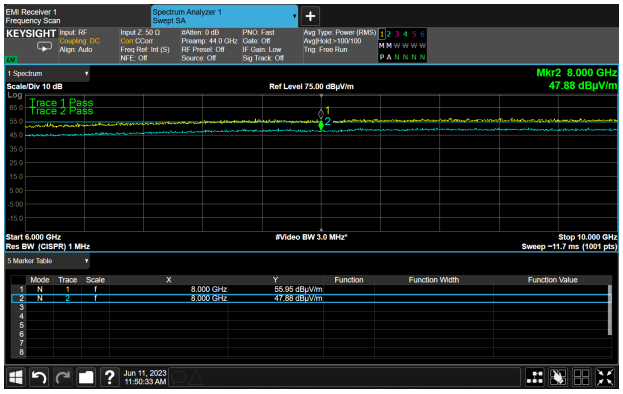

Plot 27




Plot 28


Plot 29


Plot 30




Plot 31

## *6.5. Band-edge measurements*

### *Limits & methods:*

| | | | |
|---|---|---|---|
| **FCC requirements** | 15.247(d) | | |
| **Test procedure** | ANSI 63.10 Section 11.13<br>Radiated Measurement | | |
| **Operating mode** | Tx continuous, Hight and Low | | |
| Ambient Temperature 23$^0$C | Relative Humidity 49% | Air Pressure | 1009hPa |

### *Limit*

In any 100 kHz bandwidth outside the frequency band the radio frequency power shall be at least 20 dB below that in the 100 kHz bandwidth within the band

### *Results:*

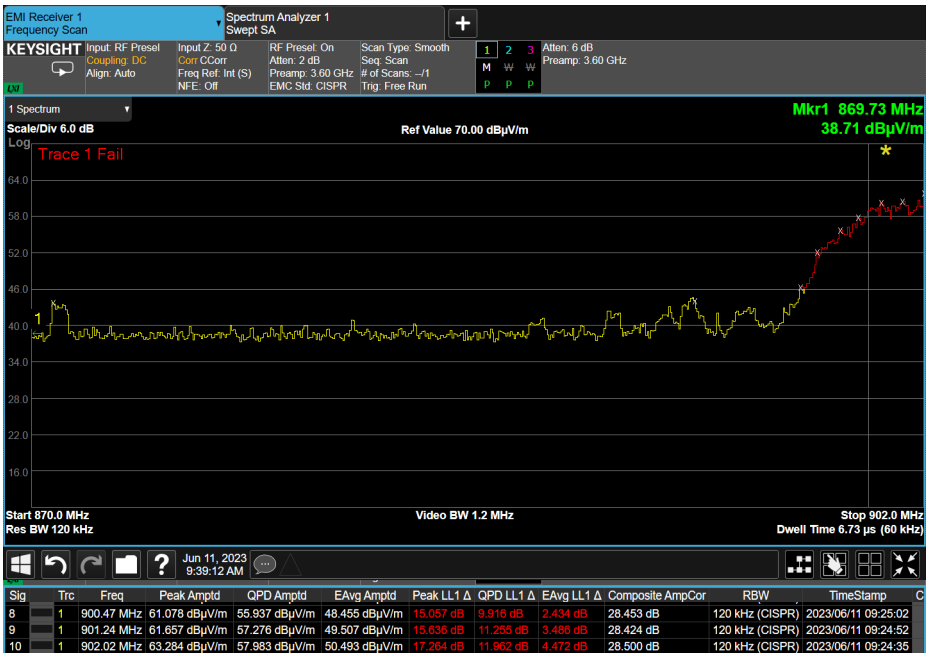
**Table 8. Band-edge Results**

| Channel | Freq MHz | Peak, dBµV/m | Limit 20dBc dBµV/m | Verdict | Plot |
|---|---|---|---|---|---|
| CH 1<br>903 MHz | 902.02 | 63.284 | 90.36 | Pass | 32 |
| CH 17<br>927 MHz | 928.00 | 69.663 | 89.74 | Pass | 33 |

**Note:**
The radio frequency power that is produced by the intentional radiator shall be at least 20 dB below P(dbuV/m).

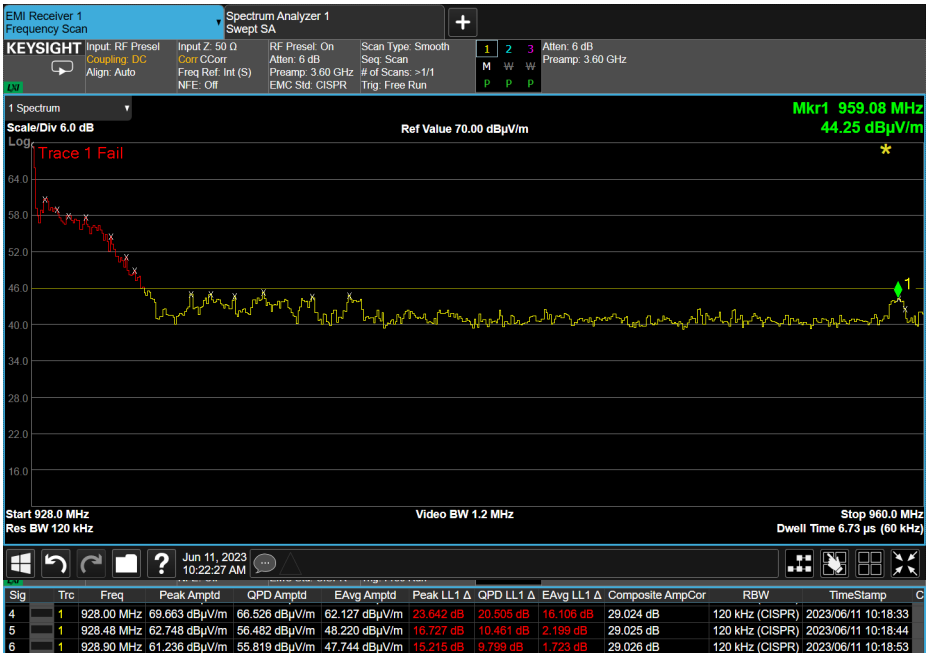
**CH 1:**
Antenna gain: 2.28 dBi
P(Conducted) = 12.88 dBm
P(dbuV/m) = P(Conducted) + Antenna Gain + 95.2 = 110.36 dbuV/m
**Limit** = P(dbuV/m) – 20 dB = 90.36 dbuV/m

**CH 17:**
Antenna gain: 2.28 dBi
P(Conducted) = 12.26 dBm
P(dbuV/m) = P(Conducted) + Antenna Gain + 95.2 = 109.74 dbuV/m
**Limit** = P(dbuV/m) – 20 dB = 89.74 dbuV/m




| Sig | Trc | Freq | Peak Ampld | QPD Ampld | EAvg Ampld | Peak LL1 Δ | QPD LL1 Δ | EAvg LL1 Δ | Composite AmpCor | RBW | TimeStamp |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 1 | 900.47 MHz | 61.078 dBµV/m | 55.937 dBµV/m | 48.455 dBµV/m | 15.057 dB | 9.916 dB | 2.434 dB | 28.453 dB | 120 kHz (CISPR) | 2023/06/11 09:25:02 |
| 9 | 1 | 901.24 MHz | 61.657 dBµV/m | 57.276 dBµV/m | 49.507 dBµV/m | 15.636 dB | 11.255 dB | 3.486 dB | 28.424 dB | 120 kHz (CISPR) | 2023/06/11 09:24:52 |
| 10 | 1 | 902.02 MHz | 63.284 dBµV/m | 57.983 dBµV/m | 50.493 dBµV/m | 17.264 dB | 11.962 dB | 4.472 dB | 28.500 dB | 120 kHz (CISPR) | 2023/06/11 09:24:35 |

**Plot 32**




| Sig | Trc | Freq | Peak Ampld | QPD Ampld | EAvg Ampld | Peak LL1 Δ | QPD LL1 Δ | EAvg LL1 Δ | Composite AmpCor | RBW | TimeStamp |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 1 | 928.00 MHz | 69.663 dBµV/m | 66.526 dBµV/m | 62.127 dBµV/m | 23.642 dB | 20.505 dB | 16.106 dB | 29.024 dB | 120 kHz (CISPR) | 2023/06/11 10:18:33 |
| 5 | 1 | 928.48 MHz | 62.748 dBµV/m | 56.482 dBµV/m | 48.220 dBµV/m | 16.727 dB | 10.461 dB | 2.199 dB | 29.025 dB | 120 kHz (CISPR) | 2023/06/11 10:18:44 |
| 6 | 1 | 928.90 MHz | 61.236 dBµV/m | 55.819 dBµV/m | 47.744 dBµV/m | 15.215 dB | 9.799 dB | 1.723 dB | 29.026 dB | 120 kHz (CISPR) | 2023/06/11 10:18:53 |

**Plot 33**

# 7. Antenna requirements

**Excerpt from §15.203 of the FCC Rules/Regulations**:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

The antenna of the device is **-** inside case box and the antenna is connected using an SMA connector, the antenna is inside the box and in order to change it you need to open the box.

Conclusion: The unit complies with the requirement of §15.203.

**Figure 6. Antenna**

# 8. Appendix 1: Test equipment used

All measurements equipment is on SII calibration schedule with a recalibration interval not exceeding one year.

| Instrument | Manufacturer | Model | SII No. | Last calibration date | Next calibration date |
|---|---|---|---|---|---|
| EMI RECEIVER-MXE 3Hz-44GHz | Keysight | N9038B | 6505208 | 09/22 | 09/23 |
| Biconilog Antenna 30 – 6000 MHz | ETS Lindgren | 3142D | 146490 | 10/21 | 10/23 |
| Double Ridged Waveguide Antenna 1-18 GHz | ETS Lindgren | 3115 | 0143138 | 07/21 | 07/23 |
| Semi Anechoic Chamber | ETS-Lindgren | RFSD-F/A-100 | 5002 | N/A | N/A |
| Multi-Device Positioning Controller | ETS-Lindgren | 2090 | 5002 | N/A | N/A |
| Antenna Tower | ETS-Lindgren | 2175 | 5002 | N/A | N/A |
| Boresight Antenna Tower | ETS-Lindgren | 2171B | 5002 | N/A | N/A |
| Turntable | ETS-Lindgren | 2188 | 5002 | N/A | N/A |
| Attenuator | HASCO, INC | HA18N5W-20 | 6502991 | 03/23 | 03/25 |
| Cable Sets 9 kHz-18GHz (7mtr LLEF 142) | - | - | - | 02/23 | 02/24 |
| Cable Sets 9 kHz-6GHz RE Cbl Set (Horn Ant) | - | - | - | 02/23 | 02/24 |
| Cable Up to 18 GHz | SUCOFLEX | 104PE | 21323 | 02/23 | 02/24 |

# 9. Appendix 2: Antenna Factor and Cable Loss

**Cable Loss (SAC, frequency range: 30 MHz-1.0 GHz)**

| No. | Frequency (MHz) | Attenuation (dB) | Frequency (MHz) | Attenuation (dB) | Frequency (MHz) | Attenuation (dB) |
|---|---|---|---|---|---|---|
| 1 | 28.71 | 0.4 | 97.21 | 1.0 | 329.17 | 1.7 |
| 2 | 30.14 | 0.4 | 102.07 | 1.0 | 345.63 | 1.8 |
| 3 | 31.65 | 0.5 | 107.17 | 1.0 | 362.91 | 1.8 |
| 4 | 33.23 | 0.5 | 112.53 | 1.0 | 381.06 | 1.8 |
| 5 | 34.89 | 0.5 | 118.15 | 1.0 | 400.11 | 1.9 |
| 6 | 36.64 | 0.5 | 124.06 | 1.1 | 420.12 | 2.0 |
| 7 | 38.47 | 0.5 | 130.27 | 1.1 | 441.12 | 2.0 |
| 8 | 40.39 | 0.6 | 136.78 | 1.1 | 463.18 | 2.1 |
| 9 | 42.41 | 0.6 | 143.62 | 1.1 | 486.34 | 2.1 |
| 10 | 44.53 | 0.6 | 150.80 | 1.1 | 510.66 | 2.2 |
| 11 | 46.76 | 0.6 | 158.34 | 1.1 | 536.19 | 2.2 |
| 12 | 49.10 | 0.6 | 166.26 | 1.1 | 563.00 | 2.4 |
| 13 | 51.55 | 0.6 | 174.57 | 1.2 | 591.15 | 2.4 |
| 14 | 54.13 | 0.7 | 183.30 | 1.2 | 620.70 | 2.5 |
| 15 | 56.83 | 0.7 | 192.46 | 1.3 | 651.74 | 2.6 |
| 16 | 59.68 | 0.7 | 202.08 | 1.3 | 684.33 | 2.6 |
| 17 | 62.66 | 0.7 | 212.19 | 1.3 | 718.54 | 2.8 |
| 18 | 65.79 | 0.8 | 222.80 | 1.4 | 754.47 | 2.9 |
| 19 | 69.08 | 0.8 | 233.94 | 1.4 | 792.19 | 2.9 |
| 20 | 72.54 | 0.8 | 245.63 | 1.4 | 831.80 | 3.0 |
| 21 | 76.16 | 0.8 | 257.92 | 1.5 | 873.39 | 3.2 |
| 22 | 79.97 | 0.9 | 270.81 | 1.5 | 917.06 | 3.2 |
| 23 | 83.97 | 0.9 | 284.35 | 1.5 | 962.92 | 3.3 |
| 24 | 88.17 | 0.9 | 298.57 | 1.6 | 1011.06 | 3.4 |
| 25 | 92.58 | 0.9 | 313.50 | 1.6 | -- | -- |

## Cable Loss (SAC, frequency range: 1.0 GHz – 6.0 GHz)

| No. | Frequency (MHz) | Attenuation (dB) | Frequency (MHz) | Attenuation (dB) | Frequency (MHz) | Attenuation (dB) |
|---|---|---|---|---|---|---|
| 1 | 962.92 | 3.3 | 1815.72 | 5.0 | 3423.81 | 7.2 |
| 2 | 1011.06 | 3.4 | 1906.51 | 5.1 | 3595.00 | 6.8 |
| 3 | 1061.61 | 3.4 | 2001.83 | 5.2 | 3774.75 | 7.0 |
| 4 | 1114.70 | 3.5 | 2101.92 | 5.3 | 3963.49 | 7.1 |
| 5 | 1170.43 | 3.7 | 2207.02 | 5.4 | 4161.67 | 7.6 |
| 6 | 1228.95 | 3.9 | 2317.37 | 5.5 | 4369.75 | 7.7 |
| 7 | 1290.4 | 3.9 | 2433.24 | 5.6 | 4588.24 | 7.7 |
| 8 | 1354.92 | 4.0 | 2554.90 | 5.9 | 4817.65 | 7.8 |
| 9 | 1422.67 | 4.2 | 2682.65 | 5.8 | 5058.53 | 8.1 |
| 10 | 1493.80 | 4.6 | 2816.78 | 5.8 | 5311.46 | 8.4 |
| 11 | 1568.49 | 4.7 | 2957.62 | 6.3 | 5577.03 | 8.6 |
| 12 | 1646.91 | 4.8 | 3105.50 | 6.2 | 5855.88 | 9.1 |
| 13 | 1729.26 | 4.9 | 3260.77 | 6.7 | 6000.00 | 9.3 |

## Antenna Magnetic Factor
## For Antenna Loop ETS LINDGREN Model 6507, SII S/N 00144641, 0.009 MHz to 30 MHz

| No. | f / MHz | AF/ dBuA/m | f / MHz | AF/ dBuA/m |
|---|---|---|---|---|
| 1 | 0.009 | -21.2 | 1.00 | -33.7 |
| 2 | 0.01 | -22.1 | 2.00 | -33.6 |
| 3 | 0.02 | -27.7 | 3.00 | -33.7 |
| 4 | 0.05 | -32.1 | 4.00 | -34.0 |
| 5 | 0.075 | -33.0 | 5.00 | -34.3 |
| 6 | 0.10 | -33.3 | 10.00 | -35.2 |
| 7 | 0.15 | -33.5 | 15.00 | -35.8 |
| 8 | 0.25 | -33.7 | 20.00 | -36.1 |
| 9 | 0.50 | -33.8 | 25.00 | -36.6 |
| 10 | 0.75 | -33.8 | 30.00 | -37.0 |

## Antenna Factor

**Biconilog Antenna, Model Number: 3142D S/N: 00146488 SII No. 6503046**
**Frequency range: 30 MHz – 2.0 GHz**
**3 m distance**

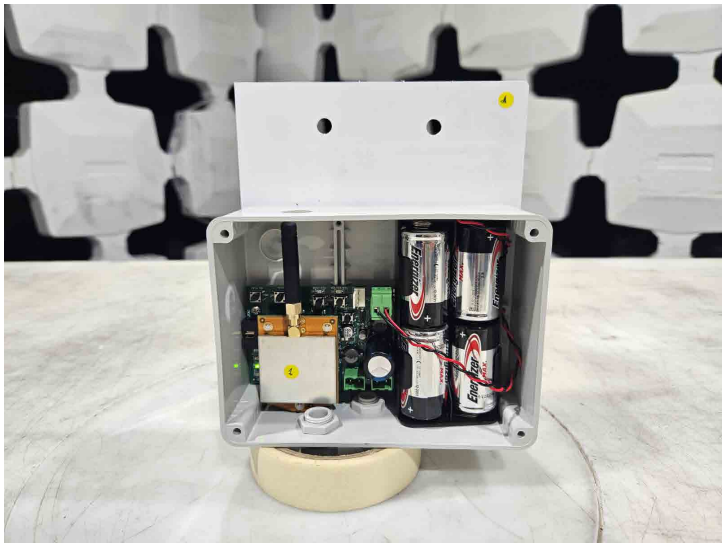
| No. | f / MHz | ACF / dB/m | f / MHz | AF / dB/m |
|---|---|---|---|---|
| 1 | 30 | 22.7 | 200 | 16.7 |
| 2 | 35 | 20.4 | 250 | 18.0 |
| 3 | 40 | 17.8 | 300 | 19.8 |
| 4 | 45 | 15.7 | 400 | 22.7 |
| 5 | 50 | 14.2 | 500 | 25.8 |
| 6 | 60 | 13.0 | 600 | 27.4 |
| 7 | 70 | 13.0 | 700 | 28.4 |
| 8 | 80 | 12.4 | 800 | 30.0 |
| 9 | 90 | 13.3 | 900 | 31.3 |
| 10 | 100 | 14.2 | 1000 | 32.8 |
| 11 | 120 | 13.3 | 1250 | 35.8 |
| 12 | 140 | 13.3 | 1500 | 42.9 |
| 13 | 160 | 14.6 | 1750 | 36.1 |
| 14 | 180 | 16.3 | 2000 | 34.6 |

**Double Ridged Waveguide Antenna Model Number: 3115 S/N 0143138**
**Frequency range: 1.0 GHz – 18.0 GHz**
**3m distance**

| No. | f / MHz | AF / dB/m | f / MHz | AF / dB/m | f / MHz | AF / dB/m |
|---|---|---|---|---|---|---|
| 1 | 1000 | 23.6 | 7000 | 36.7 | 13000 | 39.7 |
| 2 | 1500 | 25.6 | 7500 | 37.3 | 13500 | 40.3 |
| 3 | 2000 | 28.2 | 8000 | 37.0 | 14000 | 41.0 |
| 4 | 2500 | 27.8 | 8500 | 37.6 | 14500 | 41.0 |
| 5 | 3000 | 29.3 | 9000 | 37.8 | 15000 | 39.6 |
| 6 | 3500 | 30.7 | 9500 | 38.0 | 15500 | 38.8 |
| 7 | 4000 | 31.8 | 10000 | 38.3 | 16000 | 39.1 |
| 8 | 4500 | 32.1 | 10500 | 38.6 | 16500 | 40.0 |
| 9 | 5000 | 32.9 | 11000 | 38.6 | 17000 | 40.9 |
| 10 | 5500 | 32.9 | 11500 | 38.9 | 17500 | 42.3 |
| 11 | 6000 | 34.0 | 12000 | 38.8 | 18000 | 42.5 |
| 12 | 6500 | 35.3 | 12500 | 38.9 | -- | -- |

## 10. Appendix 3: Test illustrations

**Picture 1**
**Radiated spurious emission test setup.**



**Picture 2**
**Radiated spurious emission test setup ( continuation).**

**Picture 3**
**Conducted spurious emission test setup.**

**END OF THE DOCUMENT**