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|---|---|
| **Test Report num** | 24E11202-1a |
| **Quotation** | Q24-1704-2 |
| **Prepared For** | Nordic ID Oy |
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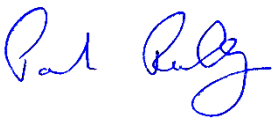
| **Tested By** | Joy Dalayap |
| **Test Report By** | Michael Kirby |
| **FCC Test Firm Designation** | IE0002 |
| **ISED Cab Identifier** | IE0001 |
| **Date** | 25th Sept 2024 |
| **EUT Description** | RFID module |
| **FCC ID** | SCC NUR30W1 |
| **IC ID** | 5137A-NUR30W1 |
| **Authorised by** | **Paul Reilly** |
| **Authorised Signature:** |  |

**TEST SUMMARY**

The equipment complies with the requirements according to the following standards.

| 15.-247 Section | RSS-247 Section | TEST PARAMETERS | Test Result |
|---|---|---|---|
| 15.247(a) | 5.1(a) | 20dB bandwidth of hopping Channel | Pass |
| 15.247(a) | 5.1(b) | Hopping Frequency Separation | Pass |
| 1.247(a) | 5.1(c) | Number of Hopping Channels | Pass |
| 15.247(a) | 5.1(c) | Average Time of Occupancy | Pass |
| 15.247(b) | 5.4 | Output power | Pass |
| 15.247(d) | 5.5 | Conducted Spurious Emissions | Pass |
| | RSS Gen 6.7 | 99% bandwidth | Pass |
| 15.205 15.209 | RSS Gen 8.9 and 8.10 | Radiated Spurious Emissions for restricted bands | Pass |
| 15.207 | RSS Gen 8.8 | Conducted Emissions on the mains | Pass |

RSS 247 Issue 3 Aug 2023
RSS-Gen Issue 5 Apr 2018 + Amd1 Mar 2019 + Amd2 Feb 2021

# Contents



**Please refer to report "24E11202-1a Nordic ID NUR3-0W1 FCCIC Part 2 of 2 Appendix"**

**for Appendices D, E,F,G**

# 1 EUT Description

| | |
|---|---|
| **Type:** | RFID module |
| **Type of radio:** | Stand-alone |
| **Transmitter Type:** | RFID FHSS |
| **Operating Frequency Range(s):** | 902.75-927.25 MHz |
| **Number of Channels:** | 50 |
| **Channel Separation:** | 500KHz |
| **PMN** | NUR3-0W1 |
| **HVIN** | NUR3-0W1 |
| **FVIN** | v15.5c |
| **Antenna:** | External antenna model 813-S0<br>External antenna model SA0408 |
| **External Antenna Gain Max:** | 813-S0 +4dBi<br>SA0408 -4dBi |
| **External Antenna Impedance** | 813-S0 50ohms<br>SA0408 50ohms |
| **External Antenna Description** | S0 Patch Antenna<br>SA0408 UHF RFID antenna |
| **Test Standards** | 15.247 RSS-247 |
| **Test Methodology:** | Measurements performed according to the procedures in ANSI C63.10-2013 |

The EUT was an RFID module using frequency hopping in the 902-928MHz frequency band.

**Software used to control the EUT**

Test software (NUR RD tester version 2.0.5.2) from Nordic ID, running on a standard Windows laptop (Lenovo X230) was used control the EUT during test.
This application is downloadable from Nordic ID for the purposes of testing the EUT radio interface.

## 1.1 EUT Operation

**Operating Conditions during Test:**

The EUT (RFID module)Sample 001 was fitted to a host pcb to allow powering and control of the module.

The same EUT was used for all tests.
The EUT was operated in test mode where the channel and modulation were set via USB connection to the control laptop.
The settings were 100mW for power level and continuous transmit modulated mode.
The host pcb was powered from a bench power supply Kenwood PR36-3 s/n 4100013 for all tests (except conducted emissions on the mains).

Conducted measurements were performed on the EUT with the analyser connected to the host external antenna port (Ant1) .
Radiated measurements were repeated with 2 different external antennas fitted on port Ant1

a) Nordic ID Oy, part num NPG00001 SN K240905287 model 813-S0
b) Nordic ID Oy, part num ANS00004 SN K204000600 model SA0408

**Environmental conditions**

| | Temperature | Relative Humidity |
|---|---|---|
| **Test** | °C | % |
| Radiated Emissions <1GHz | 21 | 52 |
| Radiated Emissions >1GHz | 23 | 55 |
| Conducted Emissions | 22 | 53 |
| Conducted Emissions on Mains | 21 | 42 |

## 1.2 Modifications

No modifications were required in order to pass the test specifications.

## 1.3 Date of Test

The tests were carried out on 17th, 18th, 19th , 20th , 25th Sept 2024.

## 1.4 Description of Test modes

**Channel List**

| Channel | Freq MHz |
|---|---|
| Low Ch 0 | 902.75 |
| Mid Ch 24 | 914.75 |
| High Ch 49 | 927.25 |

## 1.5 Description of Test methods

Tests were performed manually, and no special test software was used.
Preliminary tests were carried out and this report contains the worst-case results.

# 2 Emissions Measurements

## 2.1 Conducted Emissions Measurements

Radio Conducted measurements were carried out on the EUT as per section 1.1 above.

All results were measured as conducted on the antenna port except radiated spurious emissions.

## 2.2 Radiated Emissions Measurements

The EUT was centred on a motorized turntable, which allows 360-degree rotation.
Emissions below 1GHz were measured using an antenna positioned at a distance of 3 metres from the EUT (as measured from the closest point of the EUT). The radiated emissions were maximised by configuring the EUT, by rotating the EUT, and by raising and lowering the antenna from 1 to 4 metres. In this case the resolution bandwidth was 100kHz. A bi-conical antenna was used for frequencies below 300MHz, and a log periodic antenna was used for the 300MHz to 1GHz frequency range
Emissions in the 1GHz-3.6GHz range were measured using a horn antenna located at 3 metres distance from the EUT in a fully anechoic chamber. The radiated emissions were maximised by configuring the EUT and by rotating the EUT and by raising and lowering the antenna from 1 to 4 metres. In this case the resolution bandwidth was 1MHz and video bandwidth was 3MHz. for peak measurements. The Video bandwidth was changed to 10Hz for Average measurements (as per ANSI 63.10 2013 Section 4.1.4.2.3)
Emissions above 3.6GHz were measured using a horn antenna located at 3 metre distance from the EUT in a fully anechoic chamber. The radiated emissions were maximised by configuring the EUT and by rotating the EUT. In this case the resolution bandwidth was 1MHz and video bandwidth was 3MHz. for peak measurements. The Video bandwidth was changed to 10Hz for Average measurements (as per ANSI 63.10 2013 Section 4.1.4.2.3).

# 3 Conducted Measurements on the Antenna port

## 3.1 Bandwidth

### 3.1.1 20dB bandwidth

**Requirement FCC 15.247(a) IC RSS-247 5.1a**

*The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.*

As per Ansi63.10 Section 7.8.7

Test Method

A reference level is established by first using a resolution bandwidth that exceeds the signal bandwidth.

The resolution bandwidth is then reduced to 1% of the estimated emission bandwidth and the video bandwidth is set to 3 times the resolution bandwidth. The markers are now moved to the -20 dB points ( from the previously established reference level) on either side of centre frequency

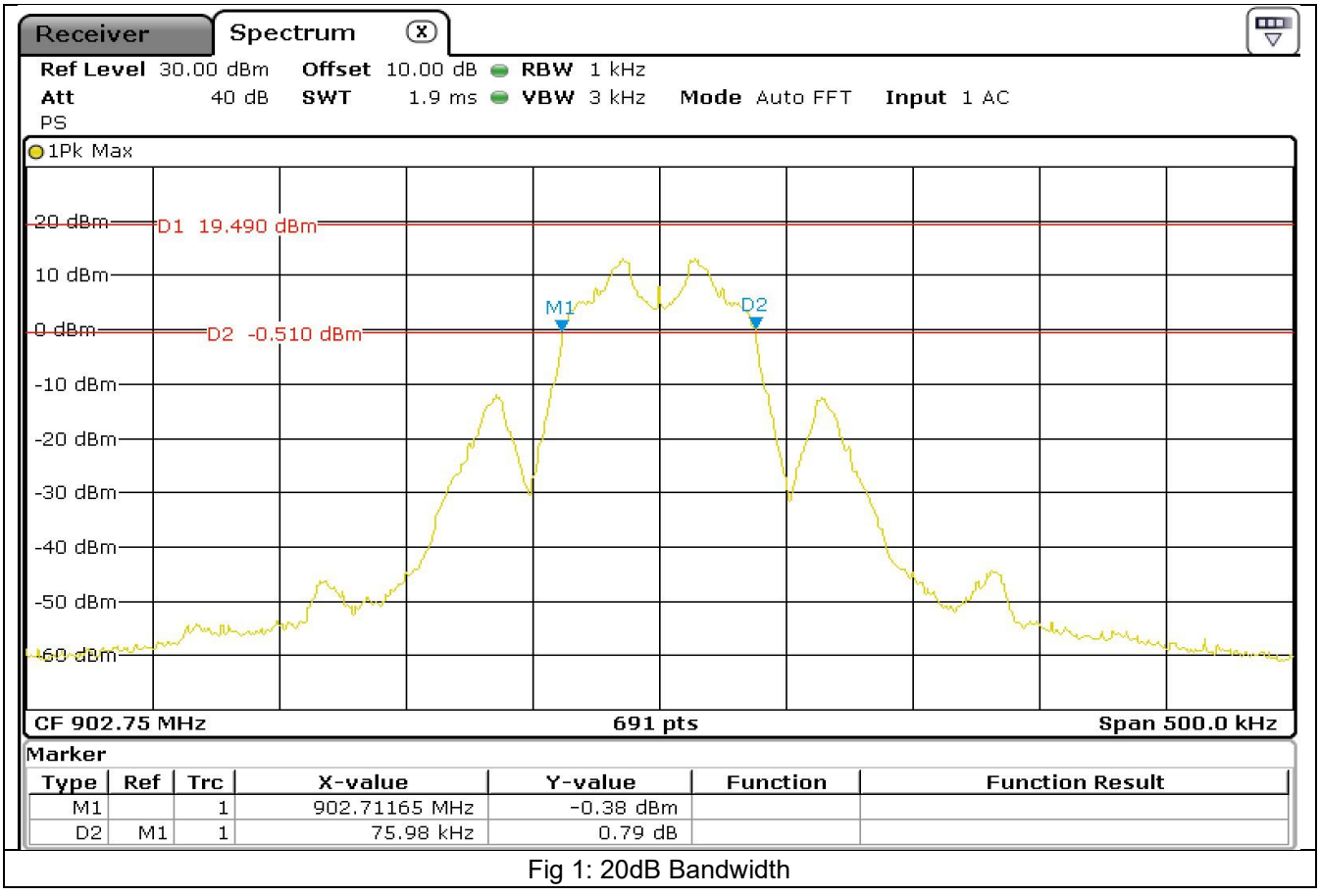



Fig 1: 20dB Bandwidth

| Channel | Frequency | 20dB Bandwidth | 20dB Bandwidth Limit |
|---|---|---|---|
| | MHz | **KHz** | **KHz** |
| Low | 902.75 | 75.98 | 500 |
| Mid | 914.75 | 75.98 | 500 |
| High | 927.25 | 75.98 | 500 |

**Test Result: Pass**

### 3.1.2 99% bandwidth

Test Method
As per Ansi 63.10 Section 6.9.3

**Ansi 63.10 Section 6.9.3 Occupied bandwidth—power bandwidth (99%) measurement procedure**

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwidth:

a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.

c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

d) Step a) through step c) might require iteration to adjust within the specified range.

e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.

f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.

h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

TEST PROCEDURE
The test was performed as a conducted measurement.

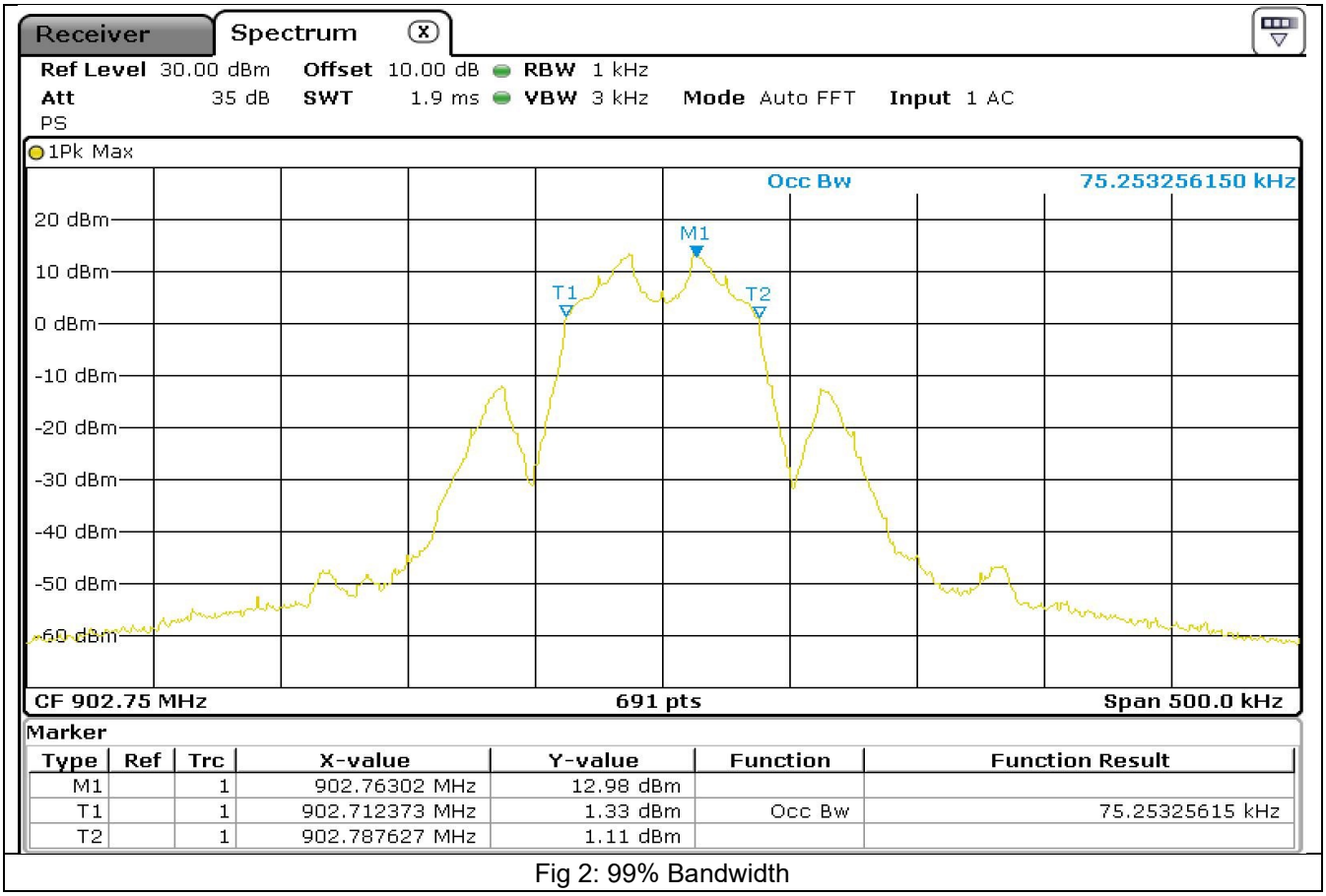



Fig 2: 99% Bandwidth

Bandwidth Result

| Channel | Frequency | 99% Bandwidth |
|---|---|---|
| | MHz | KHz |
| Low | 902.75 | 75.253 |
| Mid | 914.75 | 75.253 |
| High | 927.25 | 75.253 |

**Test Result: Pass**

## 3.2 Output power Conducted

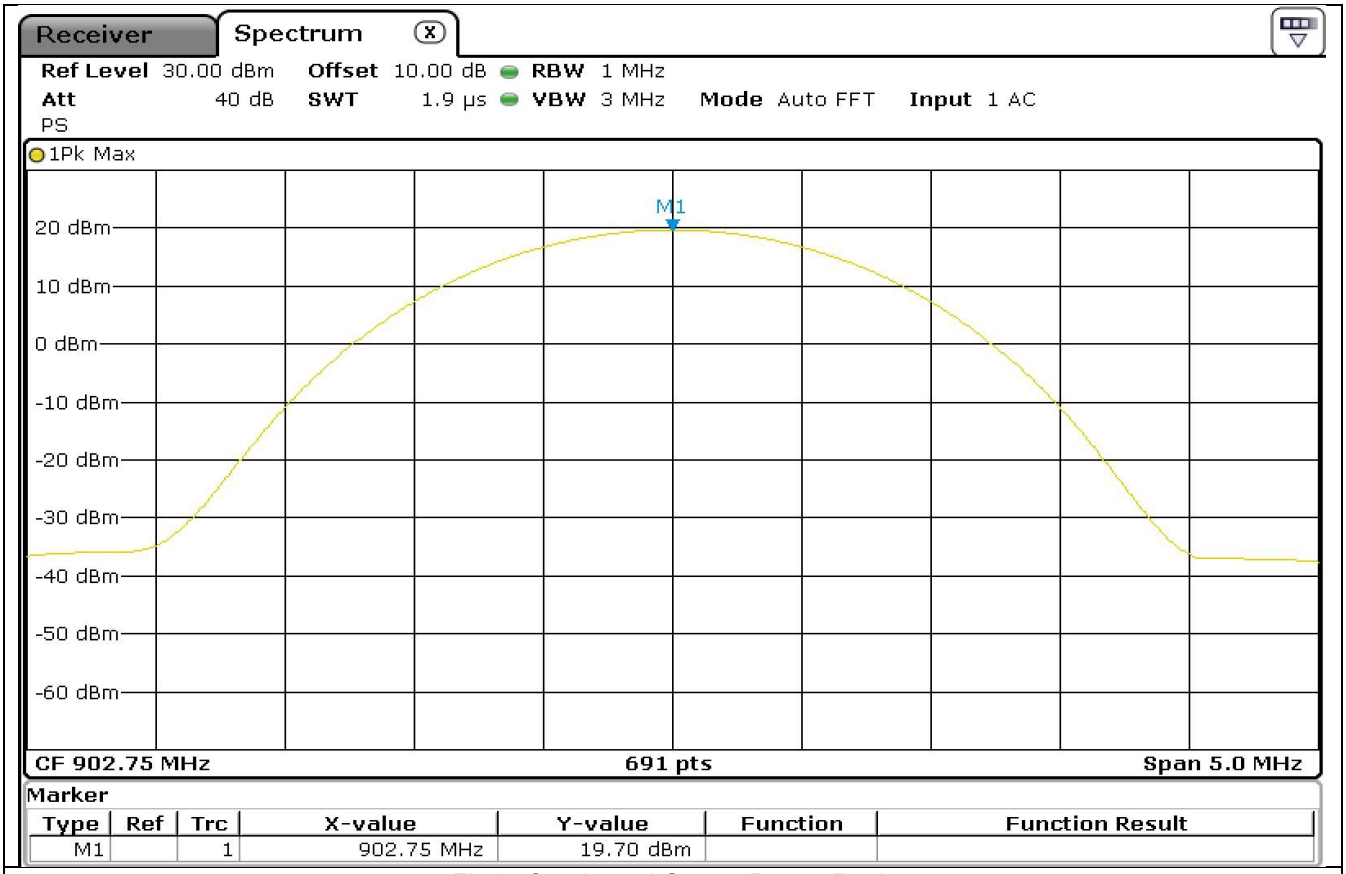



Fig 3: Conducted Output Power Peak

| Frequency | Conducted Peak | Limit | Margin |
|---|---|---|---|
| MHz | dBm | dBm | dB |
| 902.75 | 19.7 | 30 | 10.3 |
| 914.75 | 20.02 | 30 | 9.98 |
| 927.25 | 19.81 | 30 | 10.19 |

**Limit**

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels

**Test Result: Pass**

## 3.3 Frequency Hopping Characteristics

Limit
For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

### 3.3.1 Frequency hopping range number of hopping Channels

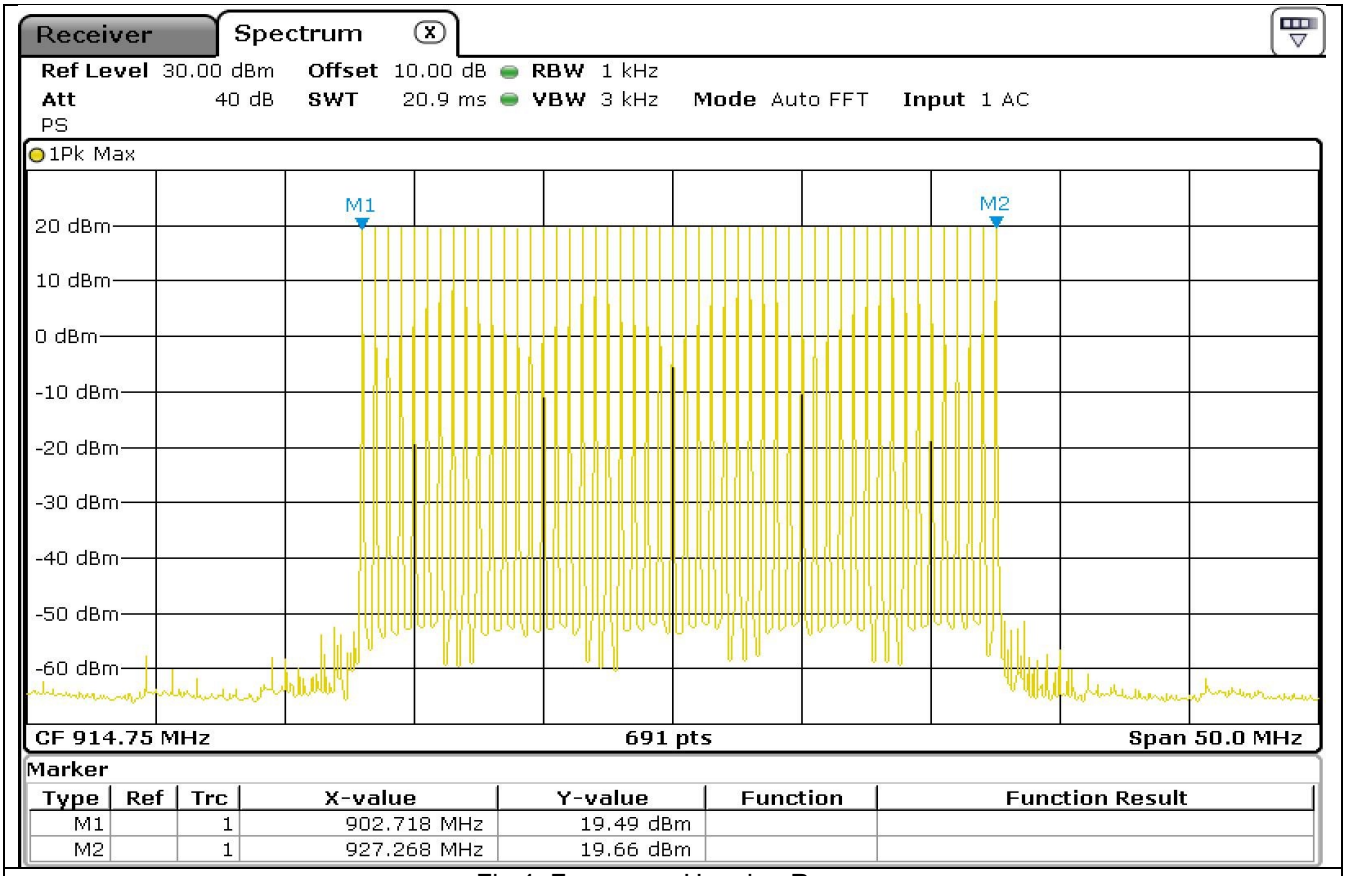


Fig 4: Frequency Hopping Range

Lowest channel 902.75MHz
Highest channel 927.25MHz

Number of hopping channels = 50

Limit: Min 50 hopping channels if the bandwidth is less than 250KHz.

**Test Result: Pass**

### 3.3.2 Frequency hopping channel separation

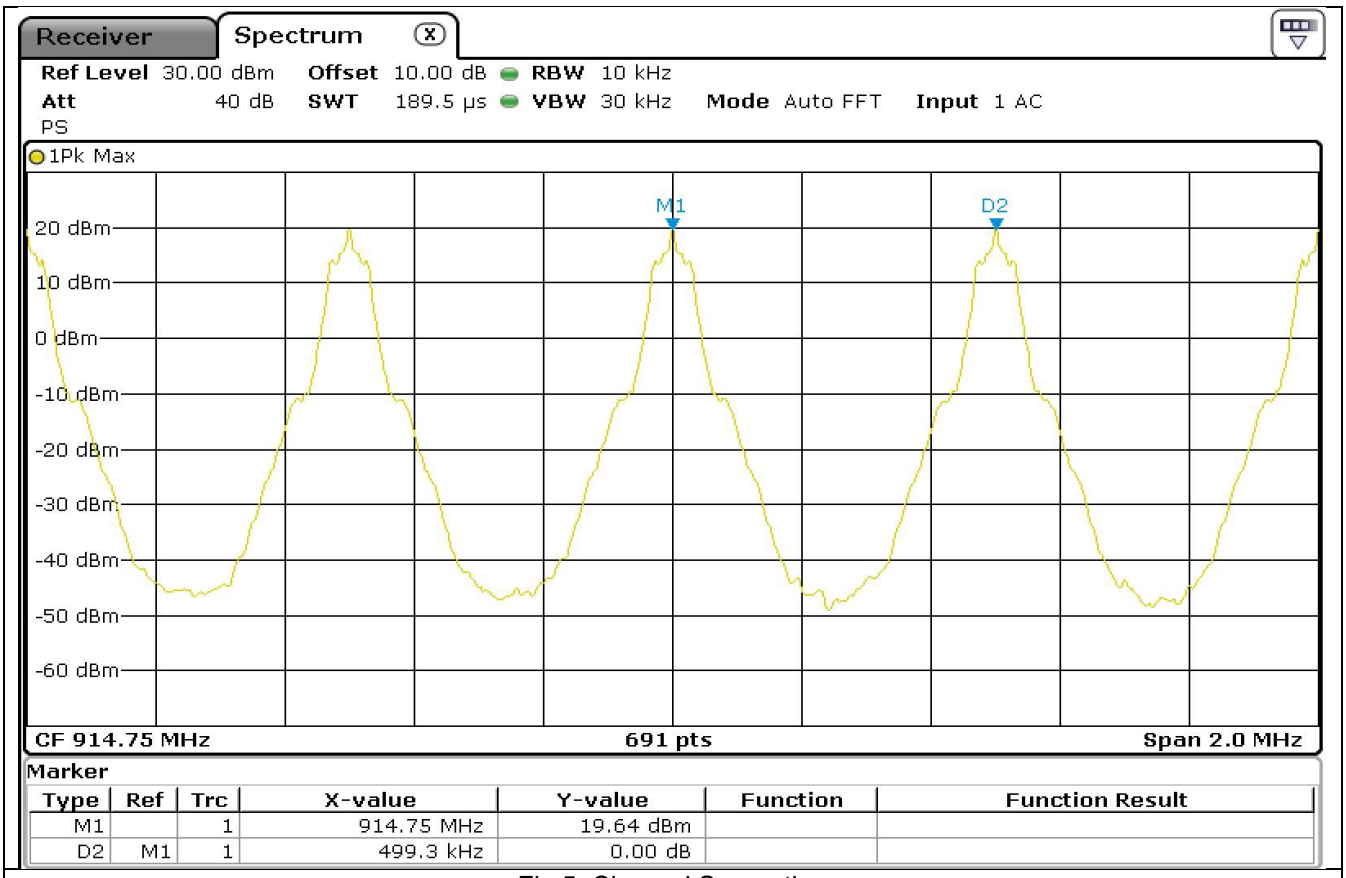



Fig 5: Channel Separation

Channel separation = 499.3KHz

### 3.3.3 Frequency hopping average time of channel occupancy

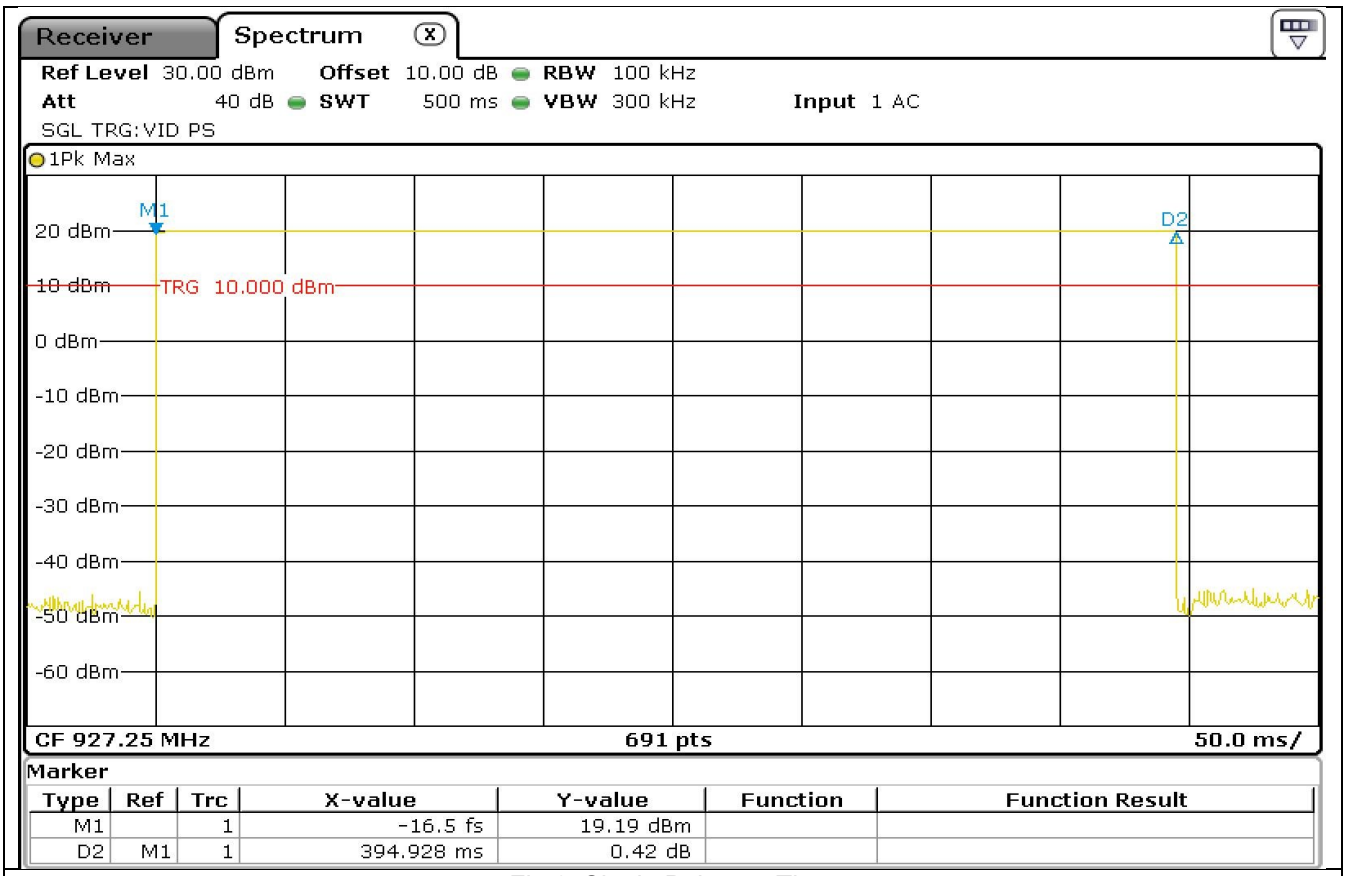



Fig 6: Single Pulse on Time

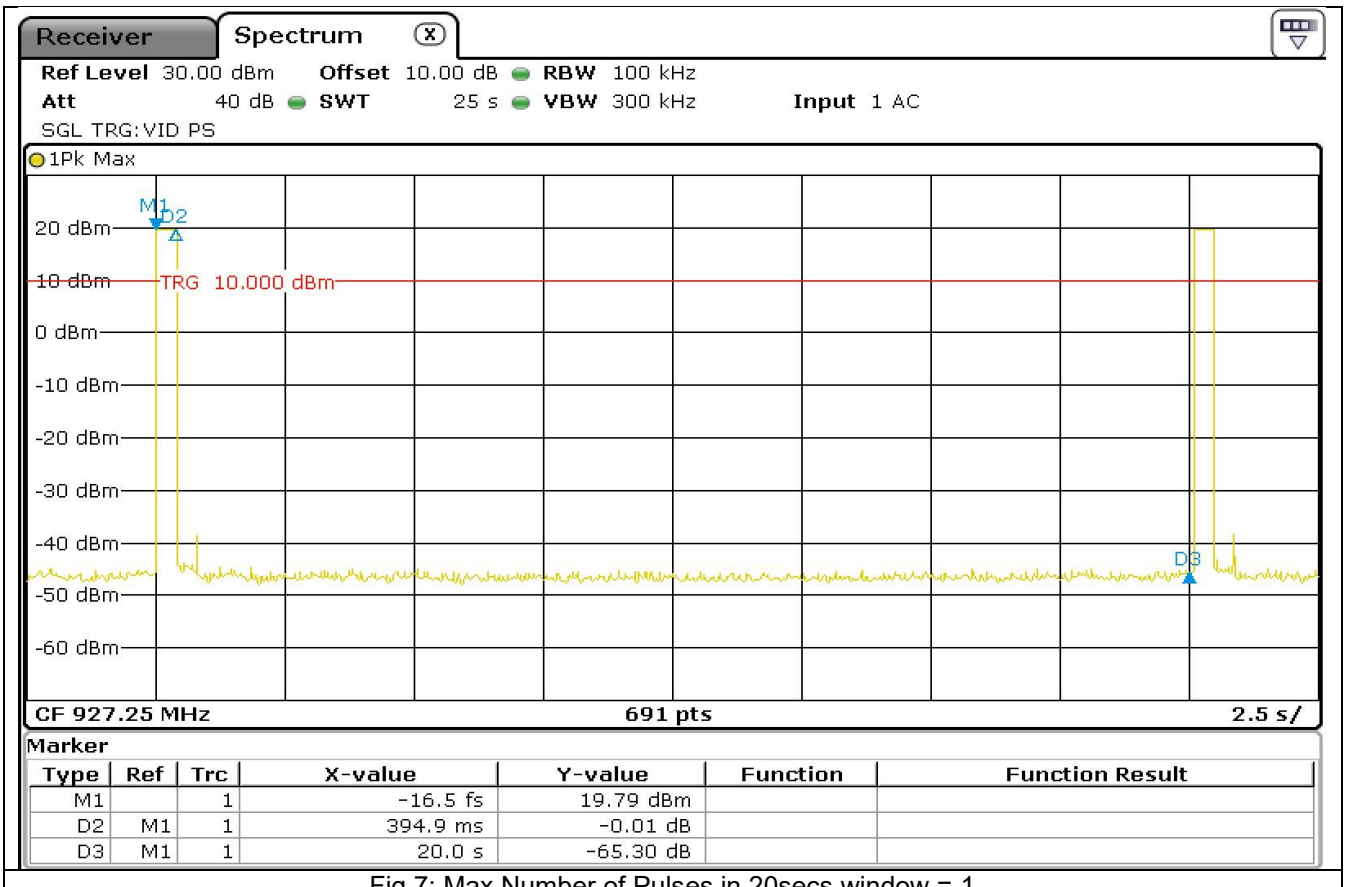



Fig 7: Max Number of Pulses in 20secs window = 1

Calculation
Single pulse on time = 394.928mS
Max Num of pulses in 20sec window = 1
Max on time in 20secs window =1* 0.394928 secs < 0.4 secs limit

**Test Result: Pass**

## 3.4 Conducted Spurious Emissions

### 3.4.1 Conducted Spurious Emissions (100KHz bandwidth)

| Frequency | 100KHz RBW | dBc Limit Min | Margin | Result |
|---|---|---|---|---|
| MHz | dBm | dB | dB | P/F |
| 902.75 | 19.77 | 20 | - | - |
| 1805.5 | -44.4 | 20 | 44.17 | Pass |
| 2708.2 | -83.7 | 20 | 83.47 | Pass |
| 3611 | -66.1 | 20 | 65.87 | Pass |

**Results for Conducted Emission for Low Channel (902.75MHz)**

| Frequency | 100KHz RBW | dBc Limit Min | Margin | Result |
|---|---|---|---|---|
| MHz | dBm | dB | dB | P/F |
| 914.75 | 19.8 | 20 | - | - |
| 1829.5 | -43.1 | 20 | 42.9 | Pass |
| 2744.2 | -82.1 | 20 | 81.9 | Pass |
| 3659 | -67.59 | 20 | 67.39 | Pass |

**Results for Conducted Emission for Middle Channel (914.75MHz)**

| Frequency | 100KHz RBW | dBc Limit Min | Margin | Result |
|---|---|---|---|---|
| MHz | dBm | dB | dB | P/F |
| 927.25 | 19.82 | 20 | - | - |
| 1854.5 | -42 | 20 | 41.82 | Pass |
| 2781.7 | -88.2 | 20 | 88.02 | Pass |
| 3709 | -64.27 | 20 | 64.09 | Pass |

**Results for Conducted Emission for High Channel (927.25MHz)**

Refer to Appendix A for Scans

**Test Result: Pass**

### 3.4.2 Conducted Emissions Band Edge

Refer to Appendix B for Scans

**Test Result: Pass**

# 4 Radiated Emissions

## 4.1 Radiated Spurious Emissions with External Antenna S0

### 4.1.1 Radiated Spurious Emission for 902.75MHz

| Frequency | Reading Peak | EUT Orientation | Antenna Polarity | Antenna Factor | Preamp Gain | Cable loss | Final Field Strength Peak | Average Limit | Margin for Peak v Average Limit +20dB | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | dBuV/m | | V/H | dB | dB | dB | dBuV/m | dBuV/m | dB | P/F |
| 2.708 | 13.7 | O1 | Vertical | 29.1 | 0 | 5.1 | 47.9 | 54.0 | 26.1 | Pass |
| 3.611 | 44.6 | O1 | Vertical | 31.7 | 38.2 | 5.8 | 43.9 | 54.0 | 30.1 | Pass |
| 4.514 | 44.7 | O1 | Vertical | 32.6 | 39.1 | 7.5 | 45.7 | 54.0 | 28.3 | Pass |
| 5.417 | 44.9 | O1 | Vertical | 34.3 | 39.2 | 8.2 | 48.2 | 54.0 | 25.8 | Pass |
| 8.125 | 46.5 | O1 | Vertical | 36.7 | 41.1 | 10.9 | 53.0 | 54.0 | 21.0 | Pass |
| 9.028 | 44.5 | O1 | Vertical | 37.8 | 38.9 | 10.2 | 53.6 | 54.0 | 20.4 | Pass |
| 2.708 | 13.8 | O3 | Horizontal | 29.1 | 0 | 5.1 | 48.0 | 54.0 | 26.0 | Pass |
| 3.611 | 44.5 | O3 | Horizontal | 31.7 | 38.2 | 5.8 | 43.8 | 54.0 | 30.2 | Pass |
| 4.514 | 45.6 | O3 | Horizontal | 32.6 | 39.1 | 7.5 | 46.6 | 54.0 | 27.4 | Pass |
| 5.417 | 44.6 | O3 | Horizontal | 34.3 | 39.2 | 8.2 | 47.9 | 54.0 | 26.1 | Pass |
| 8.125 | 46.1 | O3 | Horizontal | 36.7 | 41.1 | 10.9 | 52.6 | 54.0 | 21.4 | Pass |
| 9.028 | 44.1 | O3 | Horizontal | 37.8 | 38.9 | 10.2 | 53.2 | 54.0 | 20.8 | Pass |

**Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)**
**Calculation Example 47.9 = 13.7 + 29.1 - 0 + 5.1**

## Test Result: Pass

### 4.1.2 Radiated Spurious Emission for 914.75MHz

| Frequency | Reading Peak | EUT Orientation | Antenna Polarity | Antenna Factor | Preamp Gain | Cable loss | Final Field Strength Peak | Average Limit | Margin for Peak v Average Limit +20dB | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | dBuV/m | | V/H | dB | dB | dB | dBuV/m | dBuV/m | dB | P/F |
| 2.744 | 13.9 | O1 | Vertical | 29.1 | 0 | 5.1 | 48.1 | 54.0 | 25.9 | Pass |
| 3.659 | 44.9 | O1 | Vertical | 31.8 | 38.3 | 6 | 44.4 | 54.0 | 29.6 | Pass |
| 4.574 | 45.1 | O1 | Vertical | 32.7 | 39.7 | 8.1 | 46.2 | 54.0 | 27.8 | Pass |
| 7.318 | 45.3 | O1 | Vertical | 36.4 | 40.6 | 10.1 | 51.2 | 54.0 | 22.8 | Pass |
| 8.233 | 45.4 | O1 | Vertical | 36.8 | 40.9 | 11 | 52.3 | 54.0 | 21.7 | Pass |
| 9.148 | 44.0 | O1 | Vertical | 37.8 | 38.8 | 10.1 | 53.1 | 54.0 | 20.9 | Pass |
| 2.744 | 13.9 | O1 | Horizontal | 29.1 | 0 | 5.1 | 48.1 | 54.0 | 25.9 | Pass |
| 3.659 | 45.8 | O1 | Horizontal | 31.8 | 38.3 | 6 | 45.3 | 54.0 | 28.7 | Pass |
| 4.574 | 45.3 | O1 | Horizontal | 32.7 | 39.7 | 8.1 | 46.4 | 54.0 | 27.6 | Pass |
| 7.318 | 45.1 | O1 | Horizontal | 36.4 | 40.6 | 10.1 | 51.0 | 54.0 | 23.0 | Pass |
| 8.233 | 45.4 | O1 | Horizontal | 36.8 | 40.9 | 11 | 52.3 | 54.0 | 21.7 | Pass |
| 9.148 | 43.9 | O1 | Horizontal | 37.8 | 38.8 | 10.1 | 53.0 | 54.0 | 21.0 | Pass |

**Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)**
**Calculation Example44.7 = 44.4 = 44.9 + 31.8 - 38.3 + 6**

## Test Result: Pass

### 4.1.3 Radiated Spurious Emission for 927.25MHz

| Frequency | Reading Peak | EUT Orientation | Antenna Polarity | Antenna Factor | Preamp Gain | Cable loss | Final Field Strength Peak | Average Limit | Margin for Peak v Average Limit +20dB | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | dBuV/m | | V/H | dB | dB | dB | dBuV/m | dBuV/m | dB | P/F |
| 2.782 | 13.5 | O1 | Vertical | 29.3 | 0 | 5.3 | 48.1 | 54.0 | 25.9 | Pass |
| 3.709 | 46.1 | O1 | Vertical | 32.1 | 38.3 | 6 | 45.9 | 54.0 | 28.1 | Pass |
| 4.636 | 46.4 | O1 | Vertical | 32.6 | 39.7 | 8.1 | 47.4 | 54.0 | 26.6 | Pass |
| 7.418 | 45.7 | O1 | Vertical | 36.6 | 40.8 | 10.4 | 51.9 | 54.0 | 22.1 | Pass |
| 8.345 | 45.7 | O1 | Vertical | 37.2 | 40.7 | 10.9 | 53.1 | 54.0 | 20.9 | Pass |
| 2.782 | 13.6 | O1 | Vertical | 29.3 | 0 | 5.3 | 48.2 | 54.0 | 25.8 | Pass |
| 3.709 | 46.2 | O1 | Horizontal | 32.1 | 38.3 | 6 | 46.0 | 54.0 | 28.0 | Pass |
| 4.636 | 45.3 | O1 | Horizontal | 32.6 | 39.7 | 8.1 | 46.3 | 54.0 | 27.7 | Pass |
| 7.418 | 45.3 | O1 | Horizontal | 36.6 | 40.8 | 10.4 | 51.5 | 54.0 | 22.5 | Pass |
| 8.345 | 45.2 | O1 | Horizontal | 37.2 | 40.7 | 10.9 | 52.6 | 54.0 | 21.4 | Pass |

**Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)**
Calculation Example **48.1 = 13.5 + 29.3 - 0 + 5.3**

Refer to Appendix C for Scans

## Test Result: Pass

## 4.2 Radiated Spurious Emissions with External Antenna SA0408

### 4.2.1 Radiated Spurious Emission for 902.75MHz

| Frequency | Reading Peak | EUT Orientation | Antenna Polarity | Antenna Factor | Preamp Gain | Cable loss | Final Field Strength Peak | Average Limit | Margin for Peak v Average Limit +20dB | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | dBuV/m | | V/H | dB | dB | dB | dBuV/m | dBuV/m | dB | P/F |
| 2.708 | 28.5 | O1 | Vertical | 29.1 | 0 | 5.1 | 62.7 | 54.0 | 11.3 | Pass |
| 3.611 | 44.0 | O1 | Vertical | 31.7 | 38.2 | 5.8 | 43.3 | 54.0 | 30.7 | Pass |
| 4.514 | 45.5 | O1 | Vertical | 32.6 | 39.1 | 7.5 | 46.5 | 54.0 | 27.5 | Pass |
| 5.417 | 43.9 | O1 | Vertical | 34.3 | 39.2 | 8.2 | 47.2 | 54.0 | 26.8 | Pass |
| 8.125 | 46.0 | O1 | Vertical | 36.7 | 41.1 | 10.9 | 52.5 | 54.0 | 21.5 | Pass |
| 9.028 | 44.9 | O1 | Vertical | 37.8 | 38.9 | 10.2 | 54.0 | 54.0 | 20.0 | Pass |
| 2.708 | 13.8 | O3 | Horizontal | 29.1 | 0 | 5.1 | 48.0 | 54.0 | 26.0 | Pass |
| 3.611 | 43.6 | O3 | Horizontal | 31.7 | 38.2 | 5.8 | 42.9 | 54.0 | 31.1 | Pass |
| 4.514 | 45.0 | O3 | Horizontal | 32.6 | 39.1 | 7.5 | 46.0 | 54.0 | 28.0 | Pass |
| 5.417 | 43.7 | O3 | Horizontal | 34.3 | 39.2 | 8.2 | 47.0 | 54.0 | 27.0 | Pass |
| 8.125 | 46.1 | O3 | Horizontal | 36.7 | 41.1 | 10.9 | 52.6 | 54.0 | 21.4 | Pass |
| 9.028 | 44.7 | O3 | Horizontal | 37.8 | 38.9 | 10.2 | 53.8 | 54.0 | 20.2 | Pass |

**Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)**
Calculation Example **62.7 = 28.5 + 29.1 - 0 + 5.1**

| Frequency | Reading Average | EUT Orientation | Antenna Polarity | Antenna Factor | Preamp Gain | Cable loss | Final Field Strength Average | Average Limit | Margin | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | dBuV/m | | V/H | dB | dB | dB | dBuV/m | dBuV/m | dB | P/F |
| 2.708 | 0.8 | O1 | Vertical | 29.1 | 0 | 5.1 | 35.0 | 54.0 | 19.0 | Pass |
| 9.028 | 34.3 | O1 | Vertical | 37.8 | 38.9 | 10.2 | 43.4 | 54.0 | 10.6 | Pass |
| 9.028 | 33.6 | O3 | Horizontal | 37.8 | 38.9 | 10.2 | 42.7 | 54.0 | 11.2 | Pass |

**Final Field Strength Average (dBuV/m) =Reading Average (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)**
Calculation Example **35 = 0.8 + 29.1 - 0 + 5.1**

Refer to Appendix D for Scans

## Test Result: Pass

### 4.2.2 Radiated Spurious Emission for 914.75MHz

| Frequency | Reading Peak | EUT Orientation | Antenna Polarity | Antenna Factor | Preamp Gain | Cable loss | Final Field Strength Peak | Average Limit | Margin for Peak v Average Limit +20dB | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | dBuV/m | | V/H | dB | dB | dB | dBuV/m | dBuV/m | dB | P/F |
| 2.744 | 13.9 | O1 | Vertical | 29.1 | 0 | 5.1 | 48.1 | 54.0 | 25.9 | Pass |
| 3.659 | 45.3 | O1 | Vertical | 31.8 | 38.3 | 6 | 44.8 | 54.0 | 29.2 | Pass |
| 4.574 | 44.2 | O1 | Vertical | 32.7 | 39.7 | 8.1 | 45.3 | 54.0 | 28.7 | Pass |
| 7.318 | 46.2 | O1 | Vertical | 36.4 | 40.6 | 10.1 | 52.1 | 54.0 | 21.9 | Pass |
| 8.233 | 46.6 | O1 | Vertical | 36.8 | 40.9 | 11 | 53.5 | 54.0 | 20.5 | Pass |
| 9.148 | 44.9 | O1 | Vertical | 37.8 | 38.8 | 10.1 | 54.0 | 54.0 | 20.0 | Pass |
| 2.744 | 14.1 | O3 | Horizontal | 29.1 | 0 | 5.1 | 48.3 | 54.0 | 25.7 | Pass |
| 3.659 | 45.5 | O3 | Horizontal | 31.8 | 38.3 | 6 | 45.0 | 54.0 | 29.0 | Pass |
| 4.574 | 44.4 | O3 | Horizontal | 32.7 | 39.7 | 8.1 | 45.5 | 54.0 | 28.5 | Pass |
| 7.318 | 46.2 | O3 | Horizontal | 36.4 | 40.6 | 10.1 | 52.1 | 54.0 | 21.9 | Pass |
| 8.233 | 45.4 | O3 | Horizontal | 36.8 | 40.9 | 11 | 52.3 | 54.0 | 21.7 | Pass |
| 9.148 | 44.2 | O3 | Horizontal | 37.8 | 38.8 | 10.1 | 53.3 | 54.0 | 20.7 | Pass |

**Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)**
**Calculation Example 44.8 = 45.3 + 31.8 - 38.3 + 6**

| Frequency | Reading Average | EUT Orientation | Antenna Polarity | Antenna Factor | Preamp Gain | Cable loss | Final Field Strength Average | Average Limit | Margin | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | dBuV/m | | V/H | dB | dB | dB | dBuV/m | dBuV/m | dB | P/F |
| 9.148 | 34.2 | O1 | Vertical | 37.8 | 38.8 | 10.1 | 43.3 | 54.0 | 10.7 | Pass |

**Final Field Strength Average (dBuV/m) =Reading Average (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)**
Calculation Example **43.3 = 34.2 + 37.8 - 38.8 + 10.1**

Refer to Appendix D for Scans

## Test Result: Pass

### 4.2.3 Radiated Spurious Emission for 927.25MHz

| Frequency | Reading Peak | EUT Orientation | Antenna Polarity | Antenna Factor | Preamp Gain | Cable loss | Final Field Strength Peak | Average Limit | Margin for Peak v Average Limit +20dB | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | dBuV/m | | V/H | dB | dB | dB | dBuV/m | dBuV/m | dB | P/F |
| 2.782 | 14.0 | O1 | Vertical | 29.3 | 0 | 5.3 | 48.6 | 54.0 | 25.4 | Pass |
| 3.709 | 44.9 | O1 | Vertical | 32.1 | 38.3 | 6 | 44.7 | 54.0 | 29.3 | Pass |
| 4.636 | 44.0 | O1 | Vertical | 32.6 | 39.7 | 8.1 | 45.0 | 54.0 | 29.0 | Pass |
| 7.418 | 45.1 | O1 | Vertical | 36.6 | 40.8 | 10.4 | 51.3 | 54.0 | 22.7 | Pass |
| 8.345 | 44.8 | O1 | Vertical | 37.2 | 40.7 | 10.9 | 52.2 | 54.0 | 21.8 | Pass |
| 2.782 | 14.1 | O3 | Vertical | 29.3 | 0 | 5.3 | 48.7 | 54.0 | 25.3 | Pass |
| 3.709 | 46.1 | O3 | Horizontal | 32.1 | 38.3 | 6 | 45.9 | 54.0 | 28.1 | Pass |
| 4.636 | 46.0 | O3 | Horizontal | 32.6 | 39.7 | 8.1 | 47.0 | 54.0 | 27.0 | Pass |
| 7.418 | 45.2 | O3 | Horizontal | 36.6 | 40.8 | 10.4 | 51.4 | 54.0 | 22.6 | Pass |
| 8.345 | 45.4 | O3 | Horizontal | 37.2 | 40.7 | 10.9 | 52.8 | 54.0 | 21.2 | Pass |

**Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)**
Calculation Example **62.7 = 28.5 + 29.1 - 0 + 5.1**

Refer to Appendix D for Scans

## Test Result: Pass

## 4.3 Output Power Radiated

### 4.3.1 S0 Antenna

| Frequency | Reading Peak | EUT Orientation | Antenna Polarity | Antenna Factor | Preamp Gain | Cable loss | Final Field Strength Peak | Transmitted Power | Limit | Margin | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MHz | dBuV/m | | V/H | dB | dB | dB | dBuV/m | dBm | dBm | dB | P/F |
| 902.750 | 94.6 | O1 | Vertical | 23.5 | 0 | 5.3 | 123.4 | 28.2 | 36.0 | 7.8 | Pass |
| 902.750 | 96.1 | O1 | Horizontal | 23.5 | 0 | 5.3 | 124.9 | 29.7 | 36.0 | 6.3 | Pass |
| 914.750 | 93.7 | O1 | Vertical | 23.5 | 0 | 5.4 | 122.6 | 27.4 | 36.0 | 8.60 | Pass |
| 914.750 | 95.2 | O1 | Horizontal | 23.5 | 0 | 5.4 | 124.1 | 28.9 | 36.0 | 7.10 | Pass |
| 927.250 | 92.0 | O1 | Vertical | 23.7 | 0 | 5.5 | 121.2 | 26.0 | 36.0 | 10.00 | Pass |
| 927.250 | 94.5 | O1 | Horizontal | 23.7 | 0 | 5.5 | 123.7 | 28.5 | 36.0 | 7.50 | Pass |

**Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)**
**Calculation Example 123.4 = 94.6 + 23.5 - 0 + 5.3**

**Transmitted power (dBm) = Final Field Strength Peak (dBuV/m) -95.2 dB**
Calculation Example **28.2 = 123.4 - 95.2**

## Test Result: Pass

### 4.3.2 SA0408 Antenna

| Frequency | Reading Peak | EUT Orientation | Antenna Polarity | Antenna Factor | Preamp Gain | Cable loss | Final Field Strength Peak | Transmitted Power | Limit | Margin | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MHz | dBuV/m | | V/H | dB | dB | dB | dBuV/m | dBm | dBm | dB | P/F |
| 902.750 | 85.3 | O1 | Vertical | 23.5 | 0 | 5.3 | 114.1 | 18.9 | 36.0 | 17.1 | Pass |
| 902.750 | 84.6 | O3 | Horizontal | 23.5 | 0 | 5.3 | 113.4 | 18.2 | 36.0 | 17.8 | Pass |
| 914.750 | 88.3 | O1 | Vertical | 23.5 | 0 | 5.4 | 117.2 | 22.0 | 36.0 | 14.00 | Pass |
| 914.750 | 87.7 | O3 | Horizontal | 23.5 | 0 | 5.4 | 116.6 | 21.4 | 36.0 | 14.60 | Pass |
| 927.250 | 89.8 | O1 | Vertical | 23.7 | 0 | 5.5 | 119.0 | 23.8 | 36.0 | 12.20 | Pass |
| 927.250 | 88.5 | O3 | Horizontal | 23.7 | 0 | 5.5 | 117.7 | 22.5 | 36.0 | 13.50 | Pass |

**Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)**
**Calculation Example 114.1 = 85.3 + 23.5 - 0 + 5.3**

**Transmitted power (dBm) = Final Field Strength Peak (dBuV/m) -95.2 dB**
Calculation Example **18.9 = 114.1 - 95.2**

## Test Result: Pass

## 5 Conducted Emissions on the mains

Conducted Emissions on the mains test was performed on the EUT transmit mode, which was powered from the LISN through a mains to DC adapter Qualcomm model Q183

| Detector | Frequency | Reading | Margin | Phase |
|---|---|---|---|---|
| QP/ Ave | MHz | dBuV | dB | L/N |
| Quasi-Peak | 0.1523 | 50.46 | -15.48 | Live |
| Average | 0.1680 | 36.23 | -19.26 | Live |
| Average | 0.1950 | 33.14 | -21.57 | Live |
| Average | 0.5258 | 28.60 | -17.4 | Live |
| Average | 3.154 | 24.84 | -21.16 | Live |
| Quasi-Peak | 3.647 | 30.68 | -25.32 | Live |

| Detector | Frequency | Reading | Margin | Phase |
|---|---|---|---|---|
| QP/ Ave | MHz | dBuV | dB | L/N |
| Quasi-Peak | 0.1523 | 51.35 | -14.59 | Neutral |
| Average | 0.1680 | 35.95 | -19.54 | Neutral |
| Average | 0.1950 | 32.71 | -22 | Neutral |
| Average | 0.5258 | 25.54 | -20.46 | Neutral |
| Average | 3.1538 | 18.62 | -27.38 | Neutral |
| Quasi-Peak | 3.6465 | 24.14 | -31.86 | Neutral |

Ref Appendix E for scans

**Test Result: Pass**

# 6 List of Test Equipment

| Instrument | Manufacturer | Model | Serial Num | CEI Ref | Cal Date | Cal Interval Months |
|---|---|---|---|---|---|---|
| Microwave Preamplifier | Hewlett Packard | 83017A | 3123A00175 | 805 | 29-Sep-23 | 12 |
| Spectrum Analyser 30Hz-40GHz | Rohde & Schwarz | FSP40 | 100053 | 850 | 08-Dec-21 | 36 |
| Test Receiver 3.6GHz | Rohde & Schwarz | ESR | 1316.3003k03-101625-s | 869 | 23-May-23 | 36 |
| Antenna Horn | EMCO | 3115 | 2363 | 1100 | 19-Feb-23 | 36 |
| Fully Anechoic Chamber | CEI | FAR 3M | 906 | 906 | 11-May-23 | 36 |
| Anechoic Chamber | CEI | SAR 10M | 845 | 845 | 10-Sep-22 | 36 |
| Antenna Biconical | Schwarzbeck | VHBB 9124 | 9124 667 | 871 | 04-Oct-21 | 36 |
| Antenna Log Periodic | AH Systems | SAS200/510 | 1001 | 784 | 14-Nov-22 | 36 |
| Cable 20m | | | | 1213 | 02-Aug-24 | 12 |
| Cable purple Ktype 1.8m | | | | 917 | 02-Aug-24 | 12 |
| Cable HF Ktype 1.5m | | | | 705 | 02-Aug-24 | 12 |
| LISN | Rohde & Schwarz | ESH3-Z5 | 825460/003 | 604 | 22-Feb-23 | 36 |

## 7 Measurement Uncertainties

| Measurement | Uncertainty |
|---|---|
| Radio Frequency | +/- $5x10^{-7}$ |
| Maximum Frequency Deviation | +/- 1.7 % |
| Conducted Emissions | +/- 1 dB |
| Radiated Emission 30MHz-100MHz | +/- 5.3 dB |
| Radiated Emission 100MHz-300MHz | +/- 4.7 dB |
| Radiated Emission 300MHz-1GHz | +/- 3.9 dB |
| Radiated Emission 1GHz-40GHz | +/- 3.8 dB |
| Modulation bandwidth | +/- $5x10^{-7}$ |
| Duty Cycle | +/- 5 % |
| Power supply | ±0.1 VDC |
| Temperature | ±0.2 °C |
| Frequency | ±0.01 ppm |

The measurement uncertainties stated were calculated with a k=2 for a confidence level of over 95% as per ETS TR100 028.

# Appendix A: Conducted Measurements Spurious Emissions

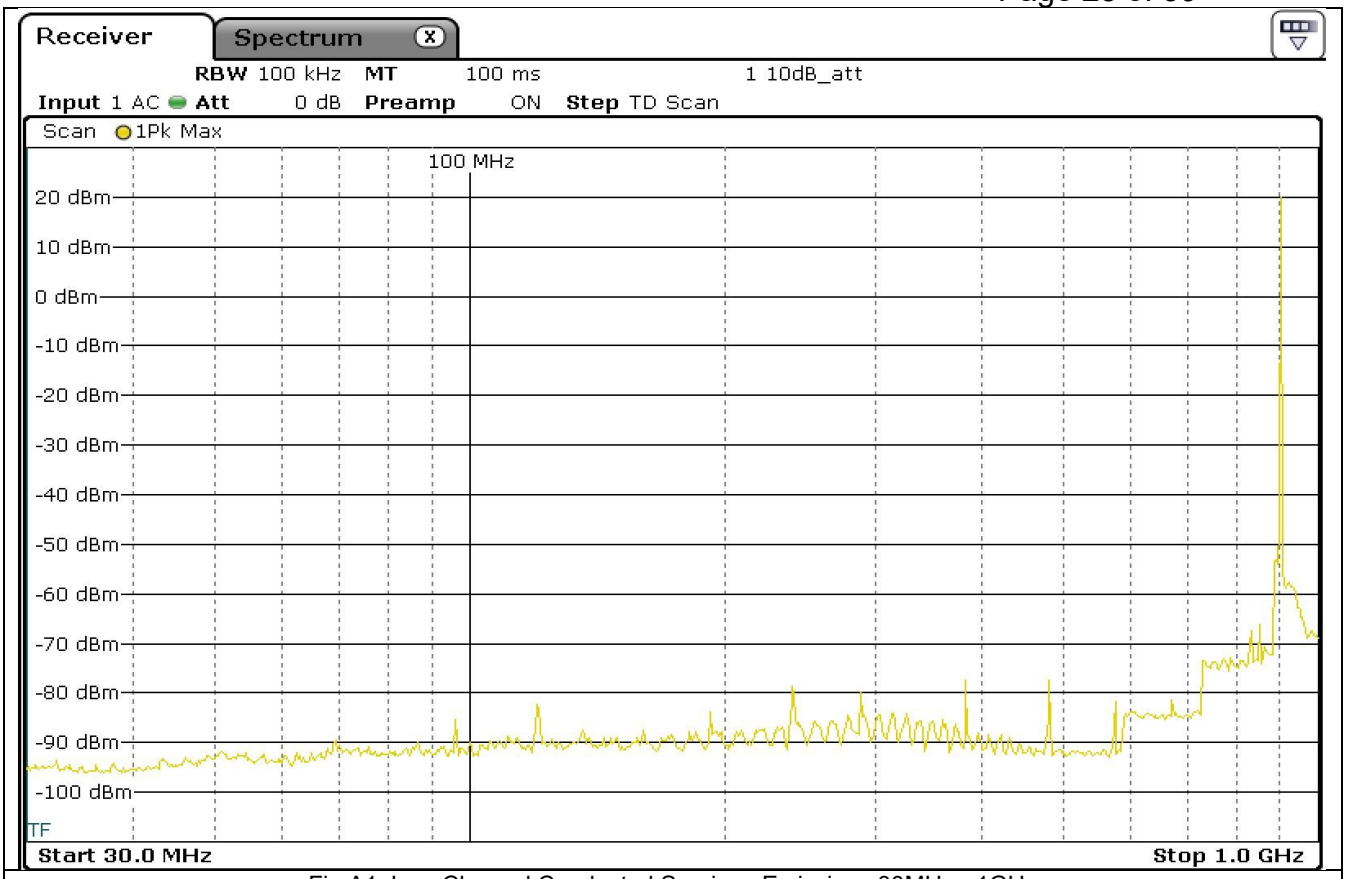



Fig A1: Low Channel Conducted Spurious Emissions 30MHz - 1GHz

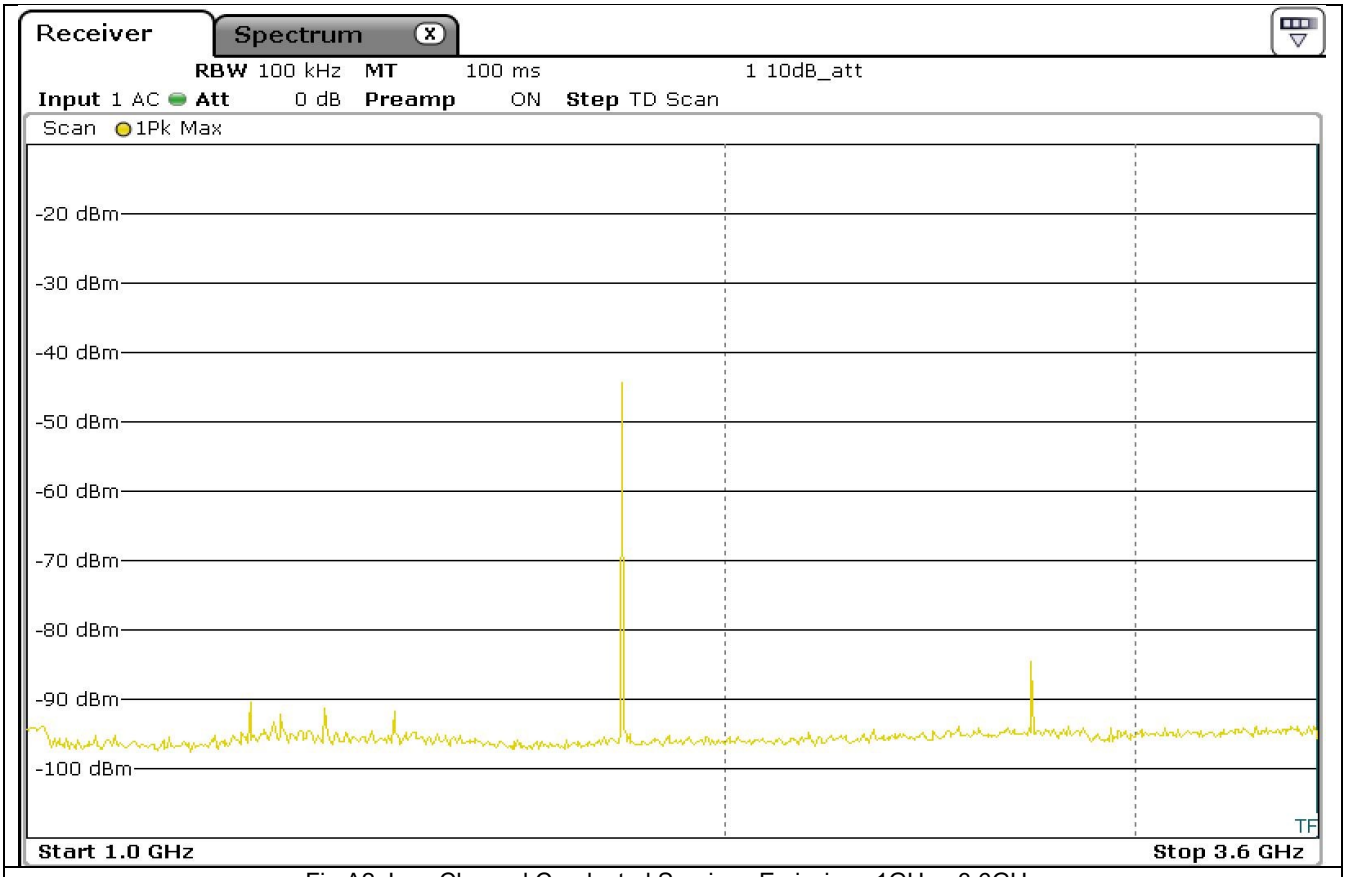
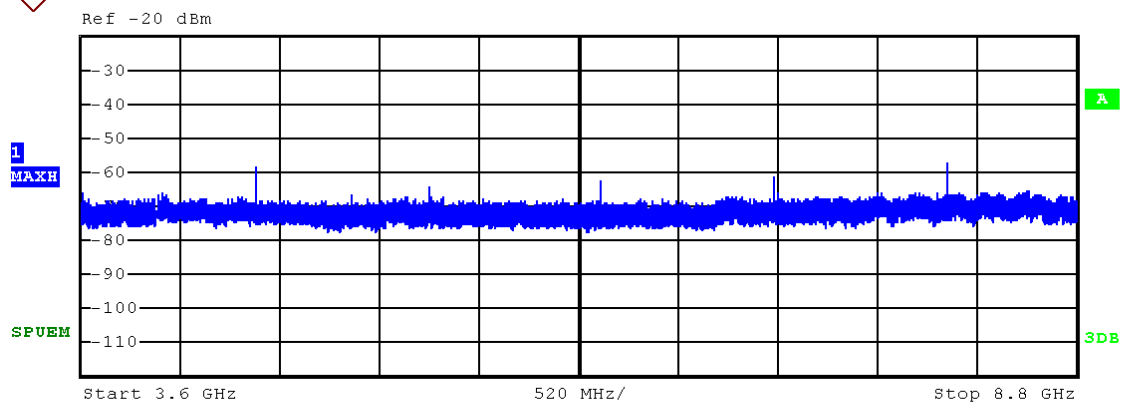
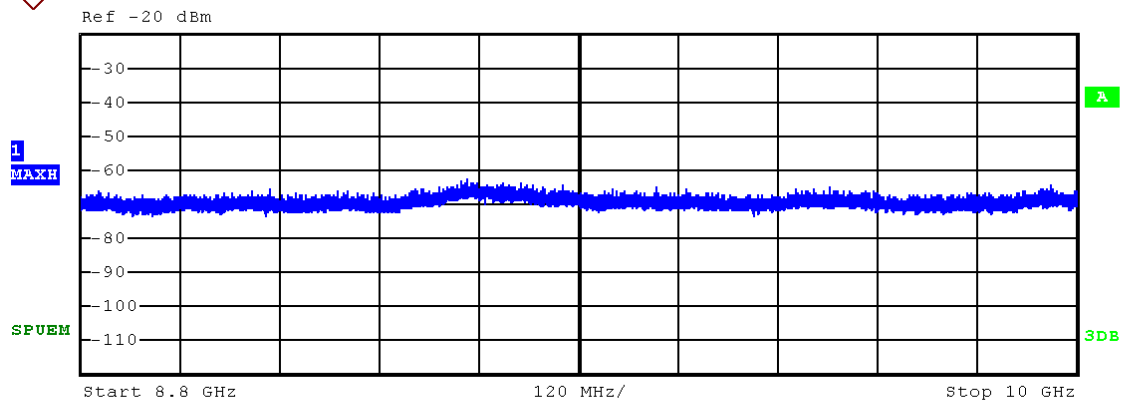



Fig A2: Low Channel Conducted Spurious Emissions 1GHz - 3.6GHz




| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | ΔLimit [dB] |
|---|---|---|---|---|---|
| 3.600 G | 4.000 G | 100.00 k | 3.610950 G | -66.11 | -200.00 |
| 4.000 G | 4.800 G | 100.00 k | 4.513800 G | -58.28 | -200.00 |
| 4.800 G | 5.200 G | 100.00 k | 5.013900 G | -66.78 | -200.00 |
| 5.200 G | 5.600 G | 100.00 k | 5.416500 G | -64.33 | -200.00 |
| 5.600 G | 6.000 G | 100.00 k | 5.699550 G | -67.63 | -200.00 |
| 6.000 G | 6.400 G | 100.00 k | 6.319300 G | -62.31 | -200.00 |
| 6.400 G | 6.800 G | 100.00 k | 6.639350 G | -67.41 | -200.00 |
| 6.800 G | 7.200 G | 100.00 k | 7.024000 G | -66.80 | -200.00 |
| 7.200 G | 7.600 G | 100.00 k | 7.222000 G | -61.23 | -200.00 |
| 7.600 G | 8.000 G | 100.00 k | 7.778100 G | -65.62 | -200.00 |
| 8.000 G | 8.400 G | 100.00 k | 8.124750 G | -57.20 | -200.00 |
| 8.400 G | 8.800 G | 100.00 k | 8.555150 G | -65.10 | -200.00 |

Fig A3: Low Channel Conducted Spurious Emissions 3.6GHz -8.8GHz




| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | ΔLimit [dB] |
|---|---|---|---|---|---|
| 8.800 G | 9.200 G | 100.00 k | 9.027500 G | -65.08 | -200.00 |
| 9.200 G | 9.600 G | 100.00 k | 9.264750 G | -62.58 | -200.00 |
| 9.600 G | 10.000 G | 100.00 k | 9.968800 G | -64.41 | -200.00 |

Fig A4: Low Channel Conducted Spurious Emissions 8.8GHz -10GHz

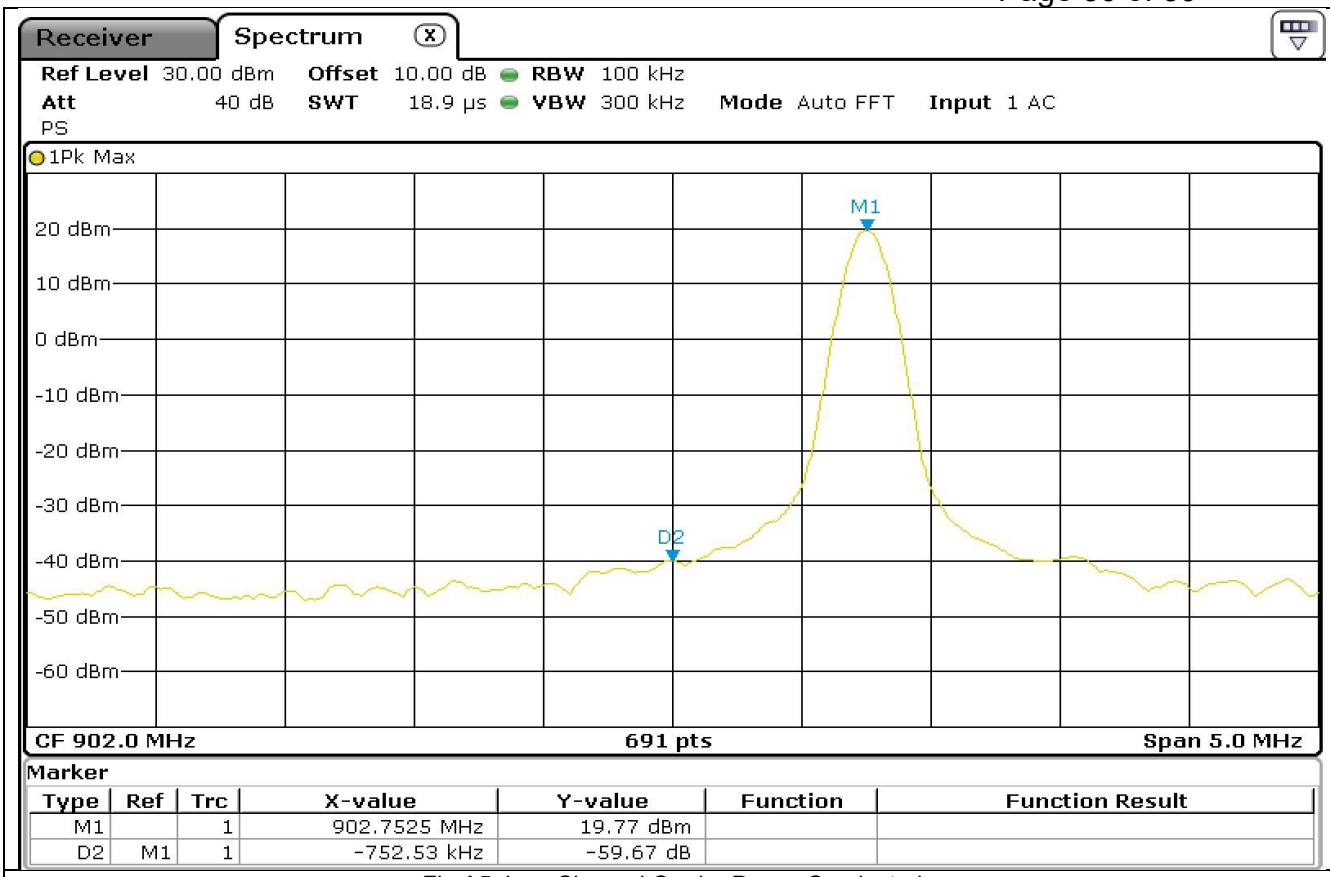



Fig A5: Low Channel Carrier Power Conducted

# Appendix B: Conducted Tests for Band Edges

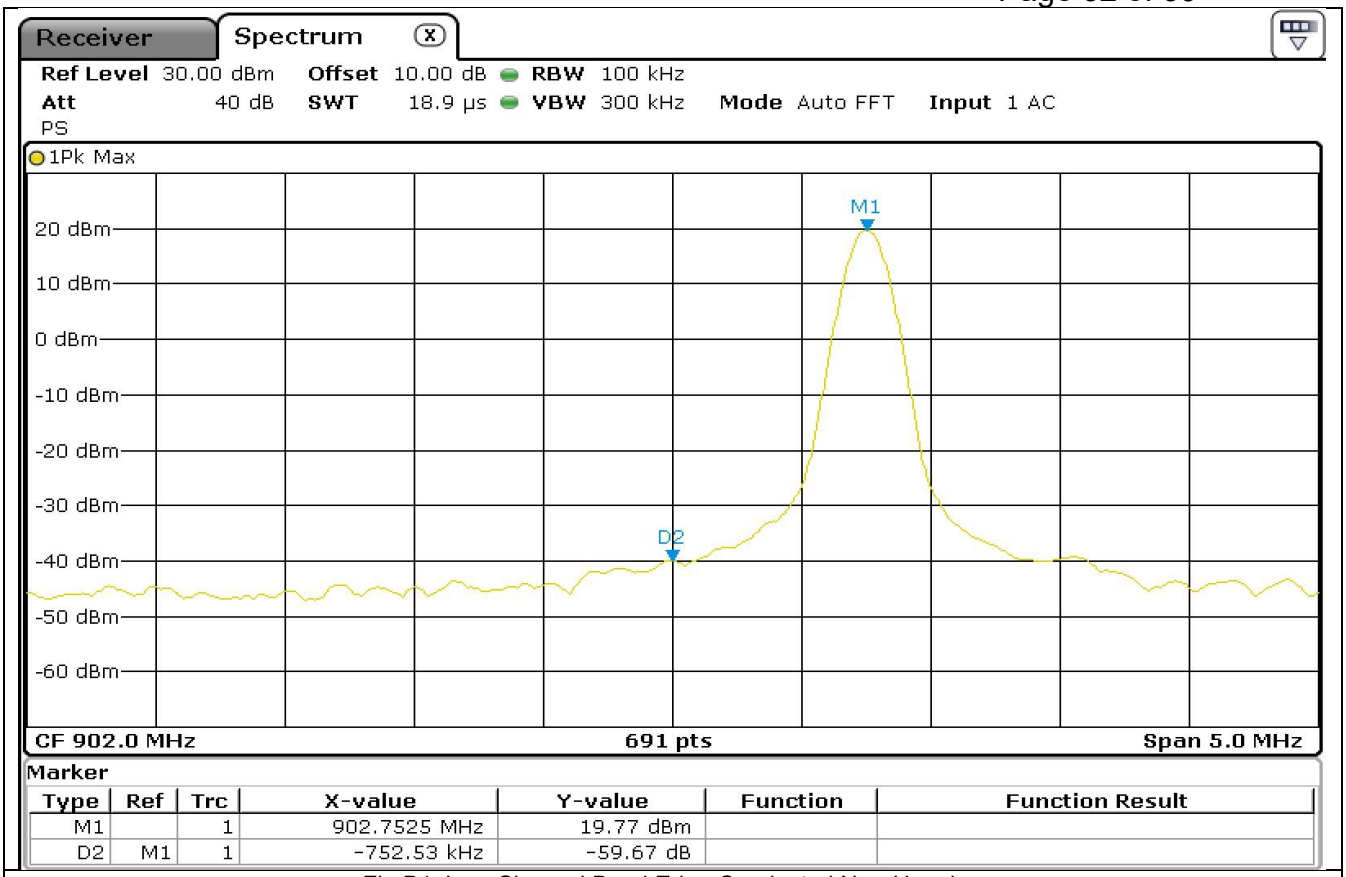



Fig B1: Low Channel Band Edge Conducted Non-Hopping

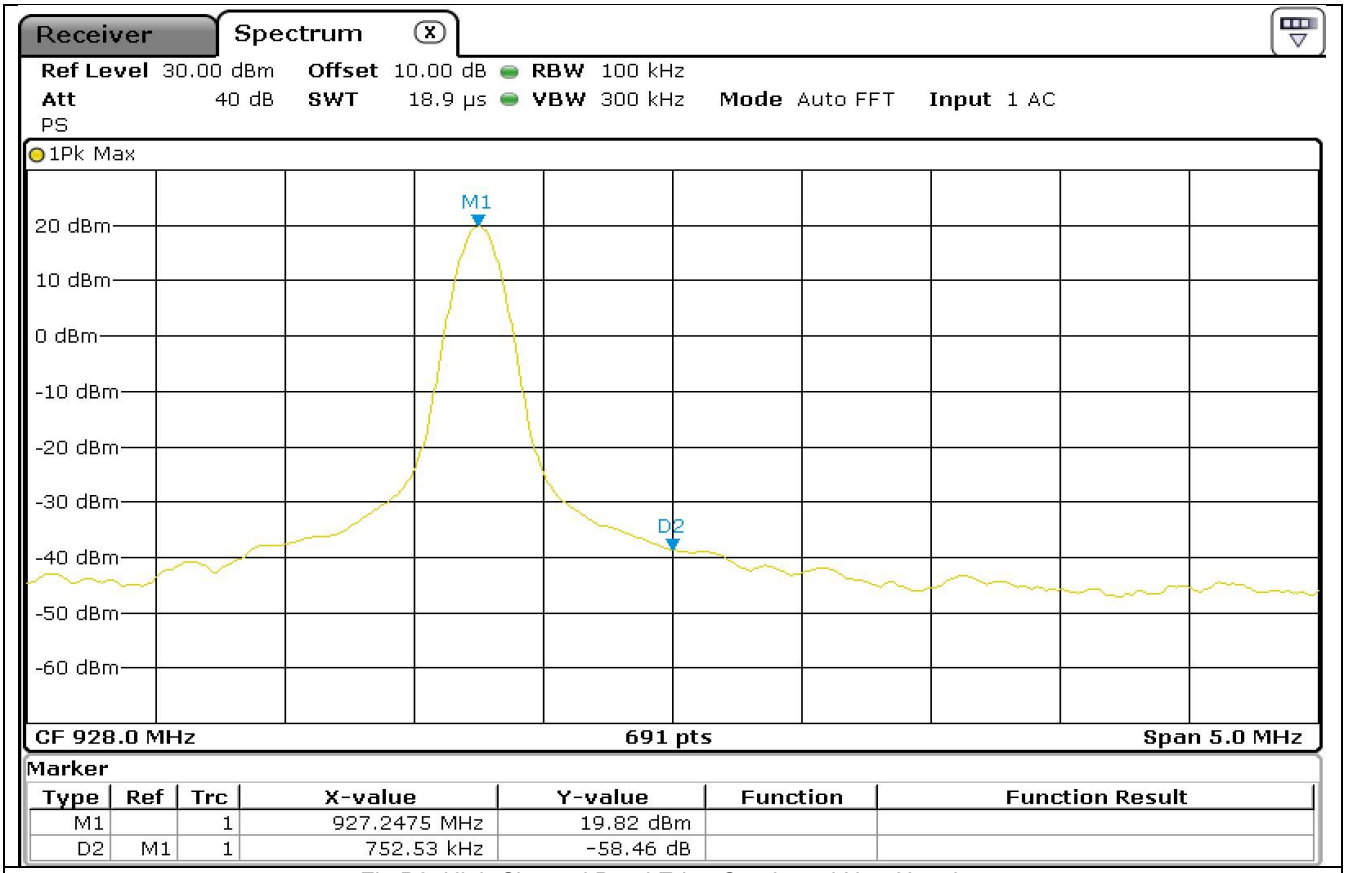



Fig B2: High Channel Band Edge Conducted Non-Hopping

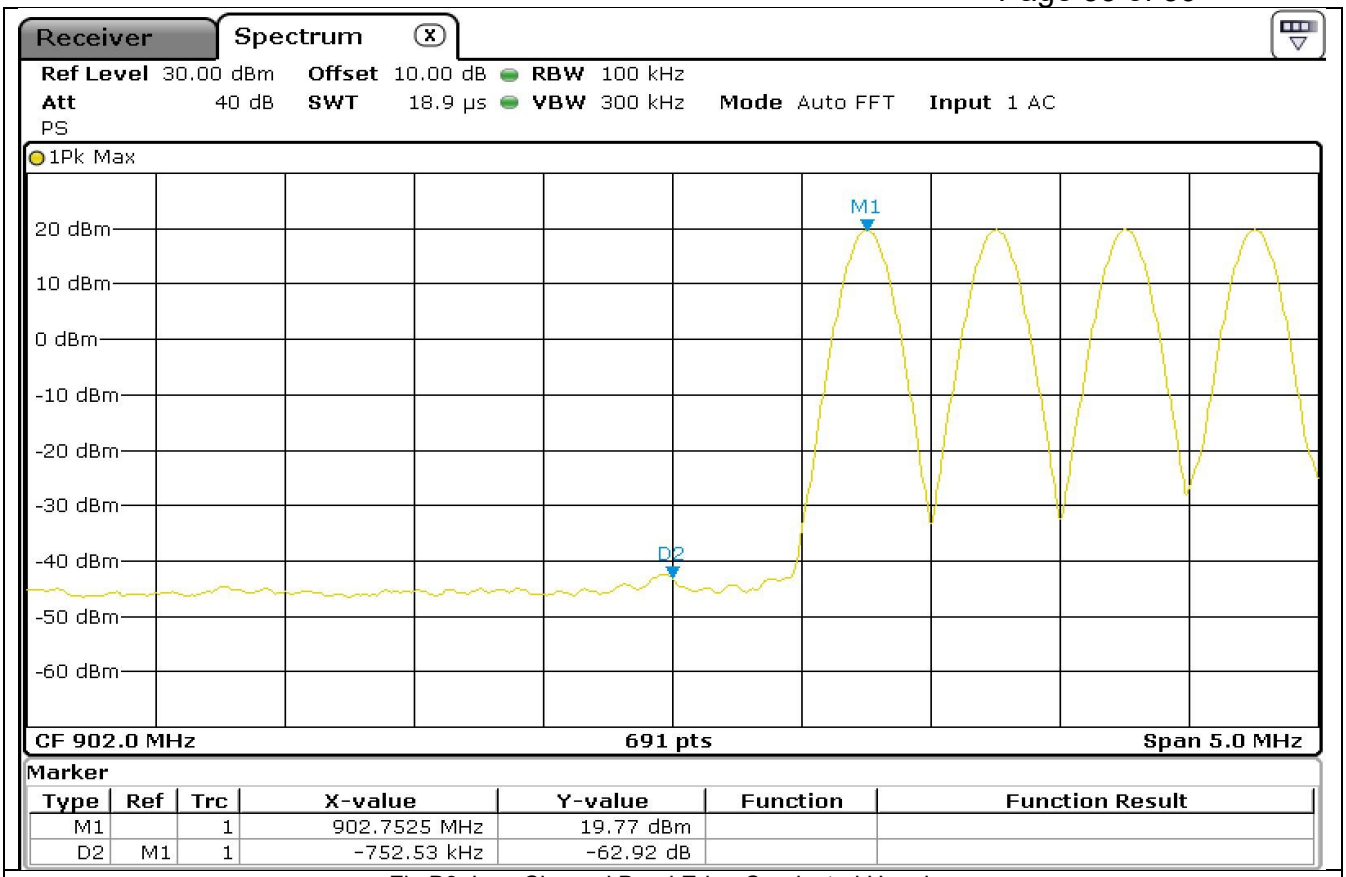



Fig B3: Low Channel Band Edge Conducted Hopping

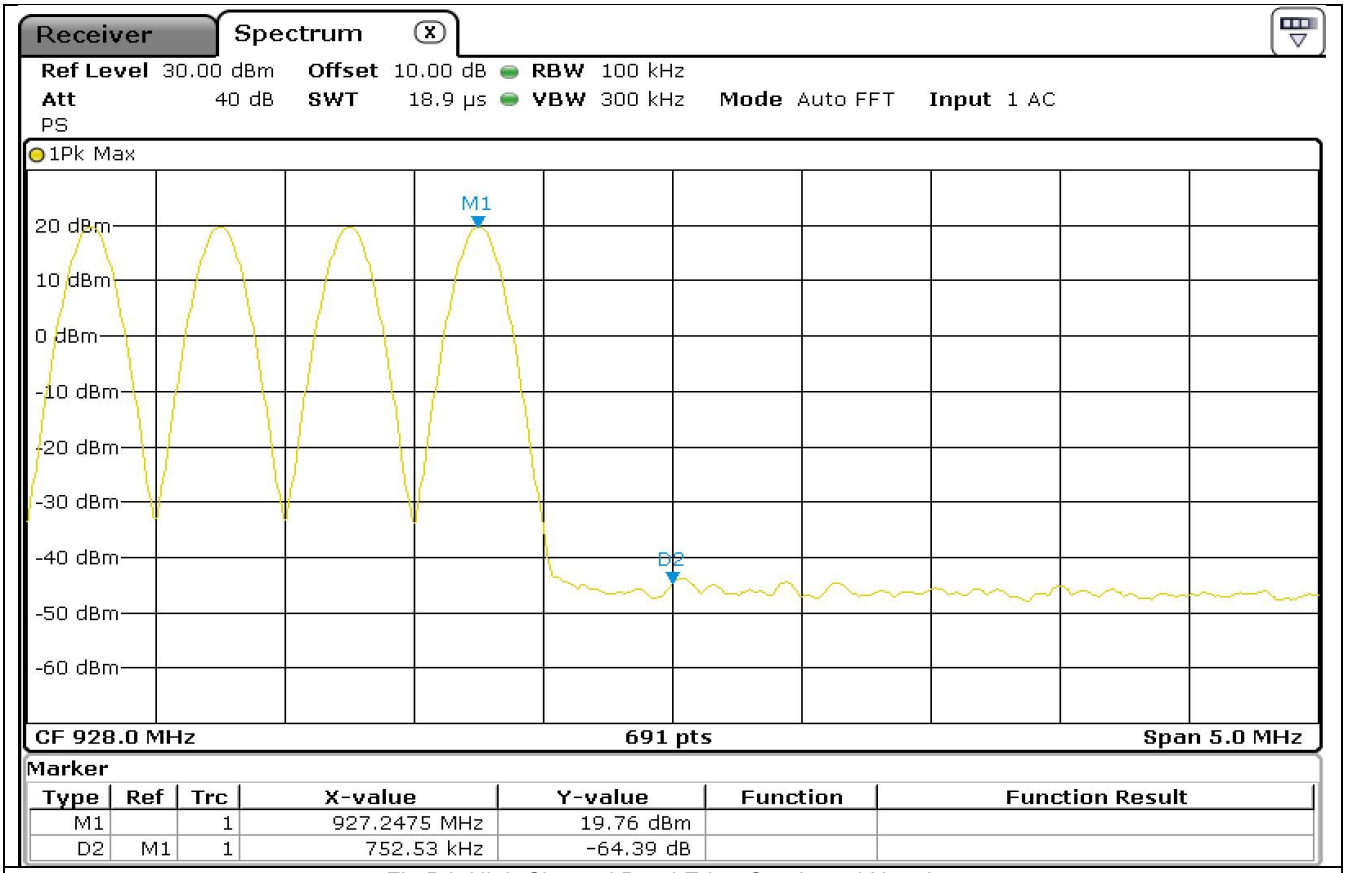



Fig B4: High Channel Band Edge Conducted Hopping

## Appendix C: Radiated Spurious Emissions with External Antenna S0

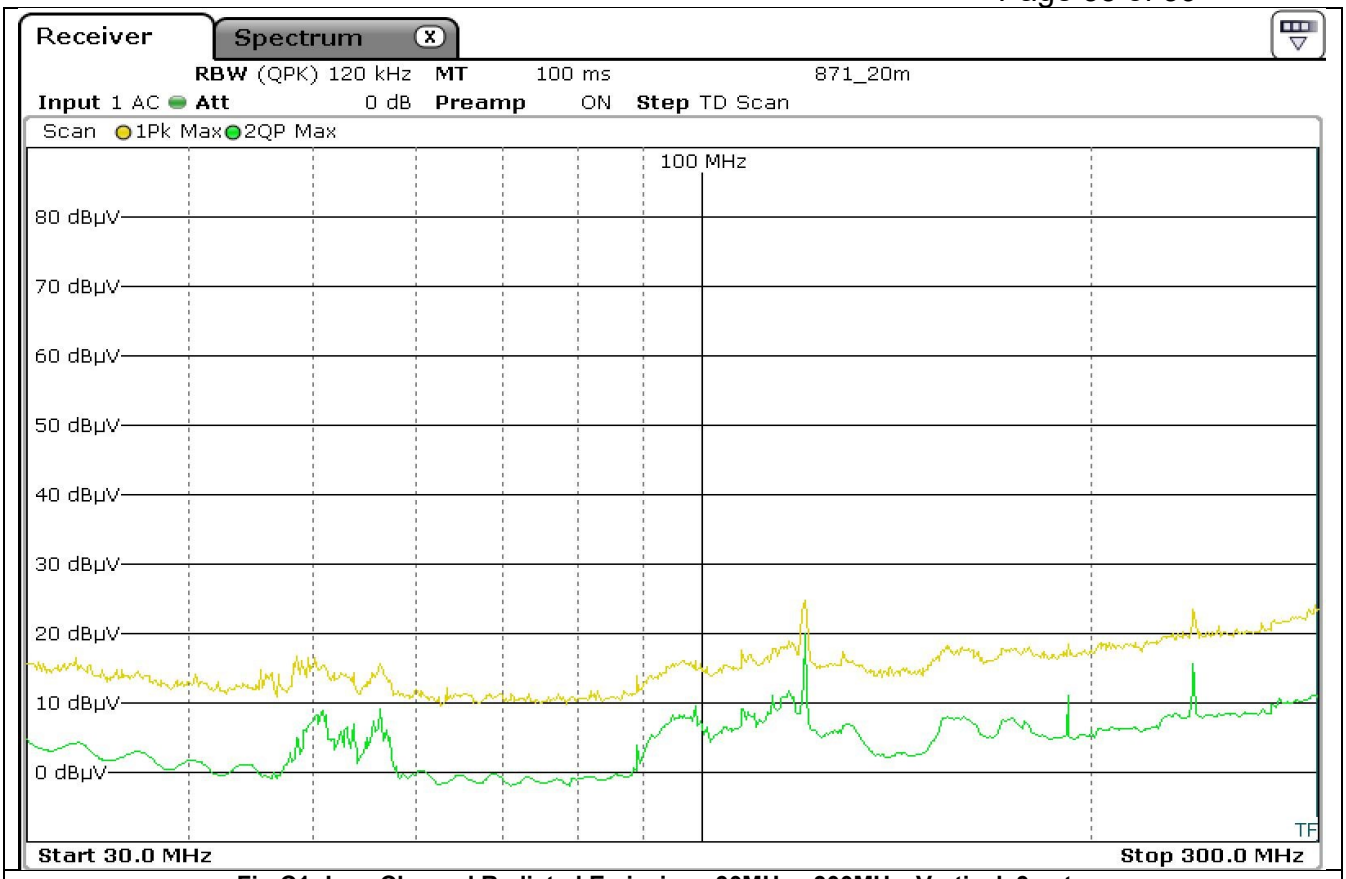



**Fig C1: Low Channel Radiated Emissions 30MHz - 300MHz, Vertical, 3metres**

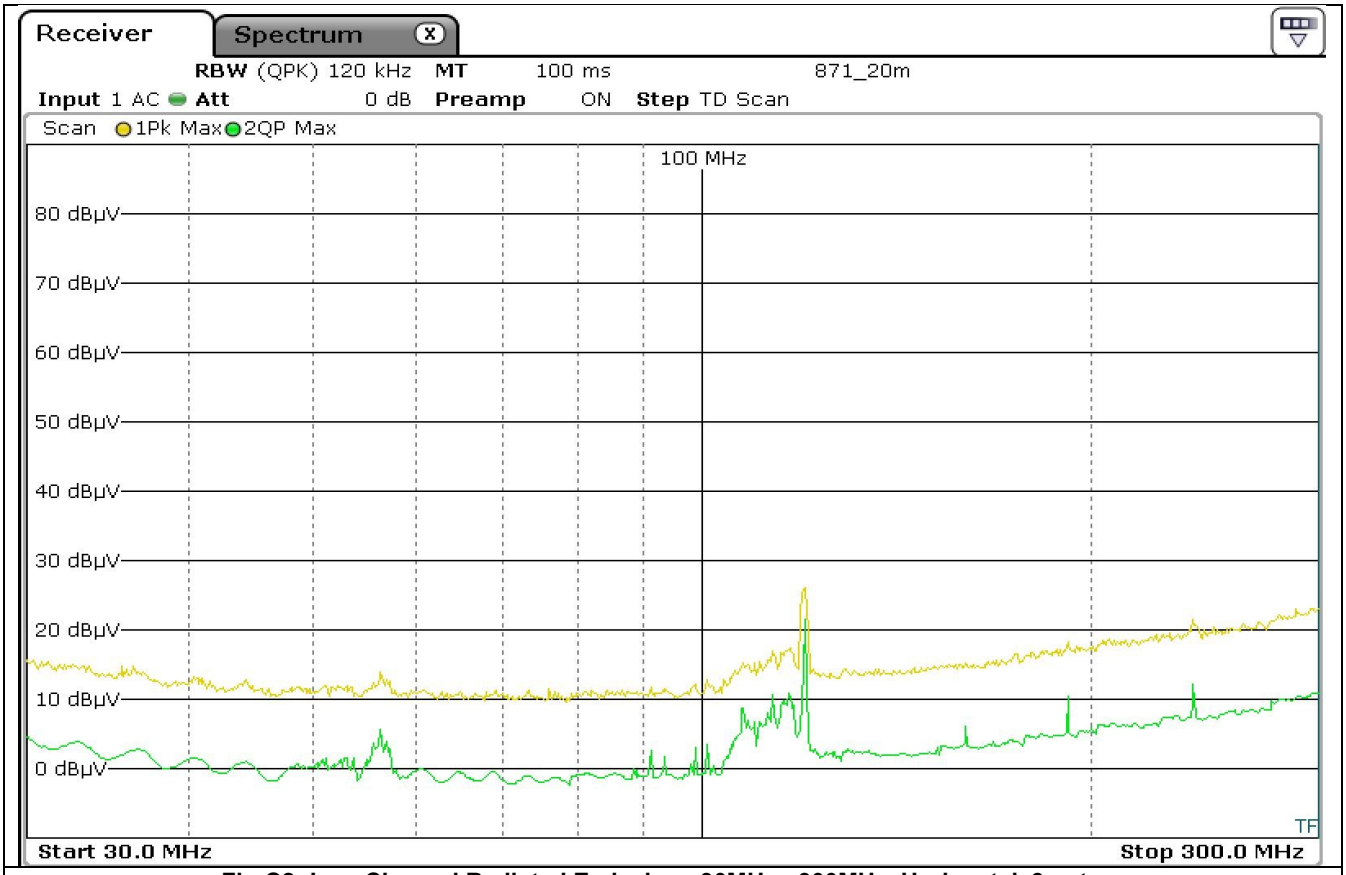



**Fig C2: Low Channel Radiated Emissions 30MHz - 300MHz, Horizontal, 3metres**

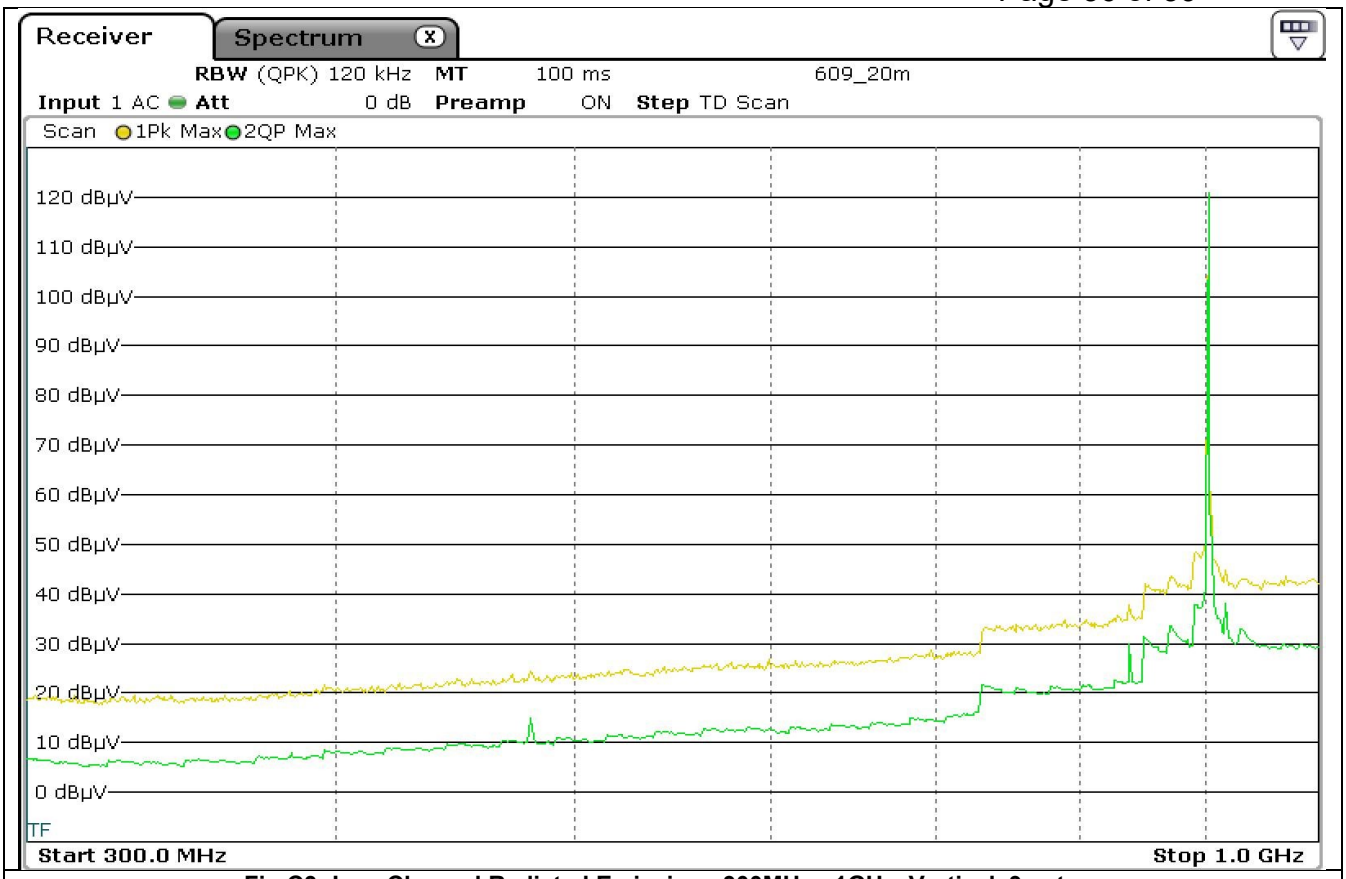



**Fig C3: Low Channel Radiated Emissions 300MHz - 1GHz, Vertical, 3metres**

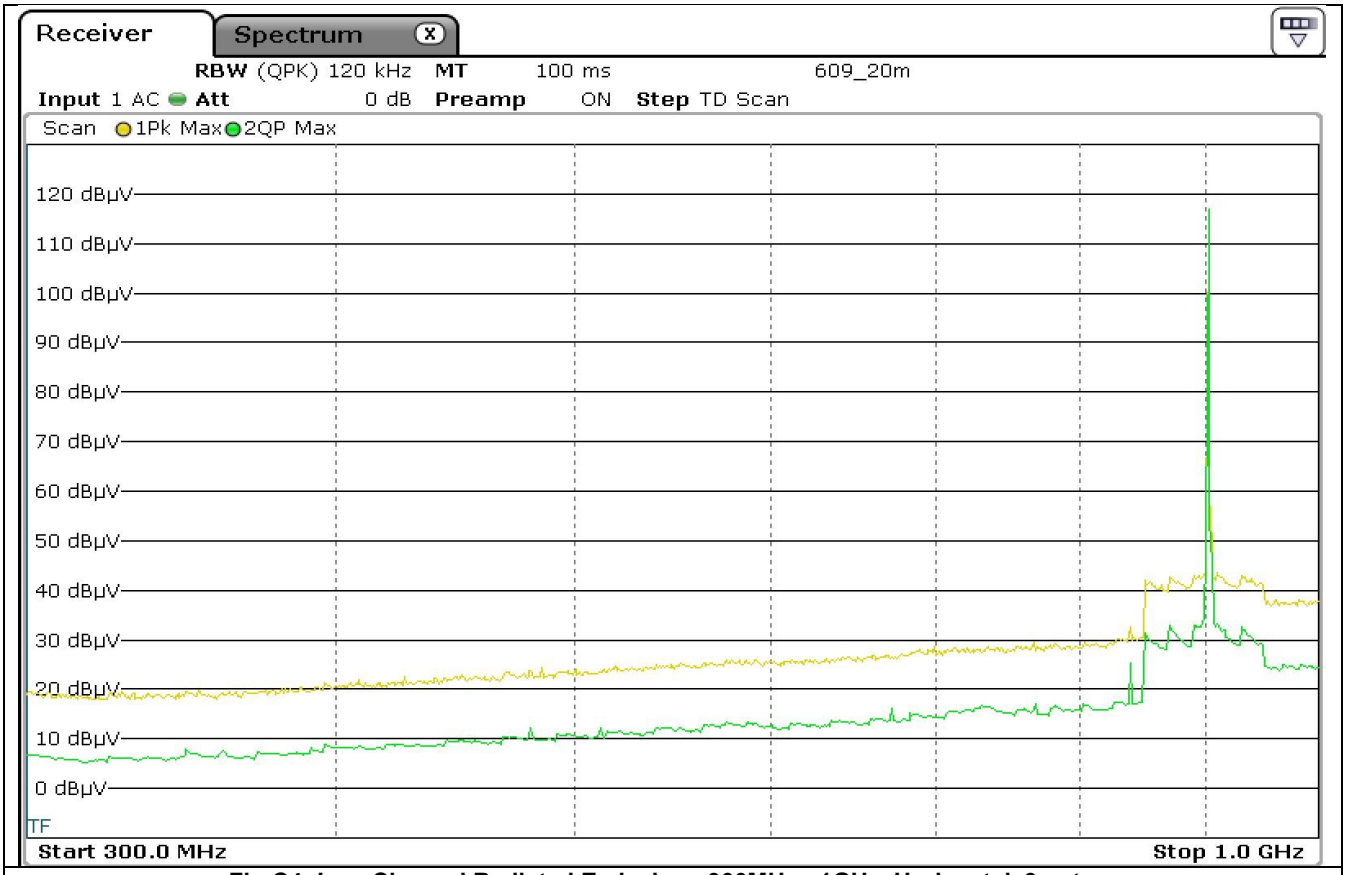



**Fig C4: Low Channel Radiated Emissions 300MHz - 1GHz, Horizontal, 3metres**

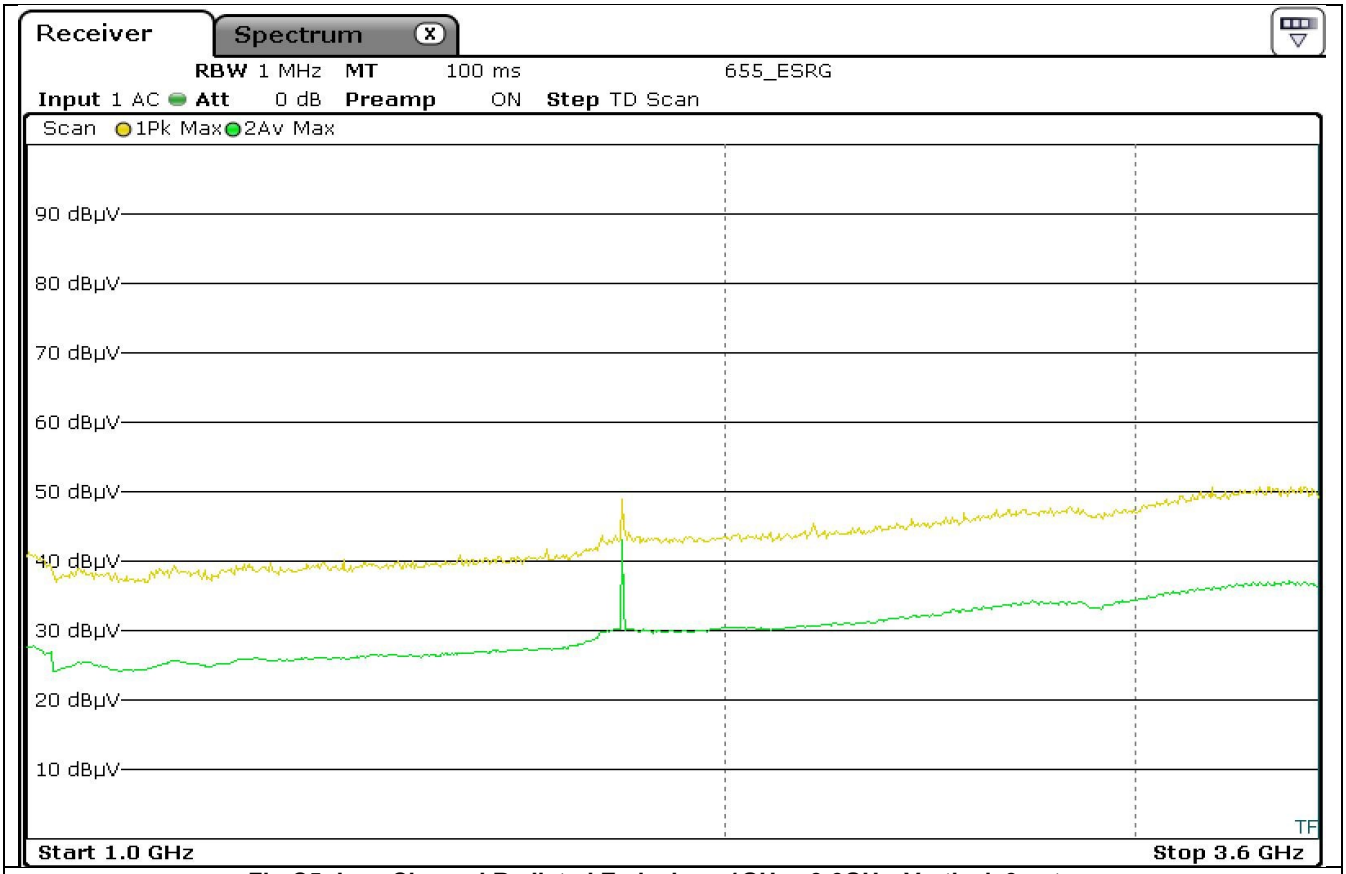



**Fig C5: Low Channel Radiated Emissions 1GHz - 3.6GHz, Vertical, 3metres**

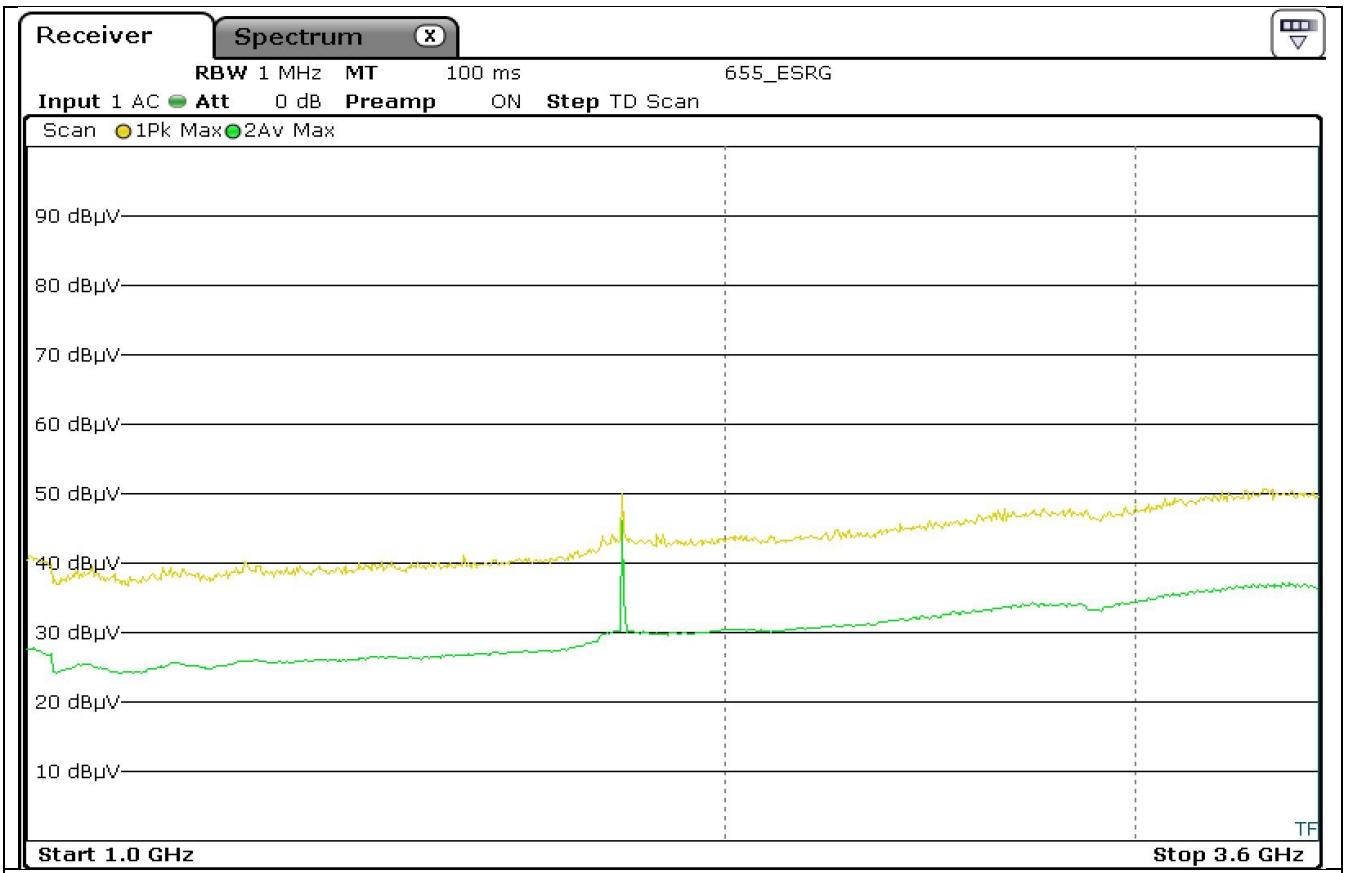
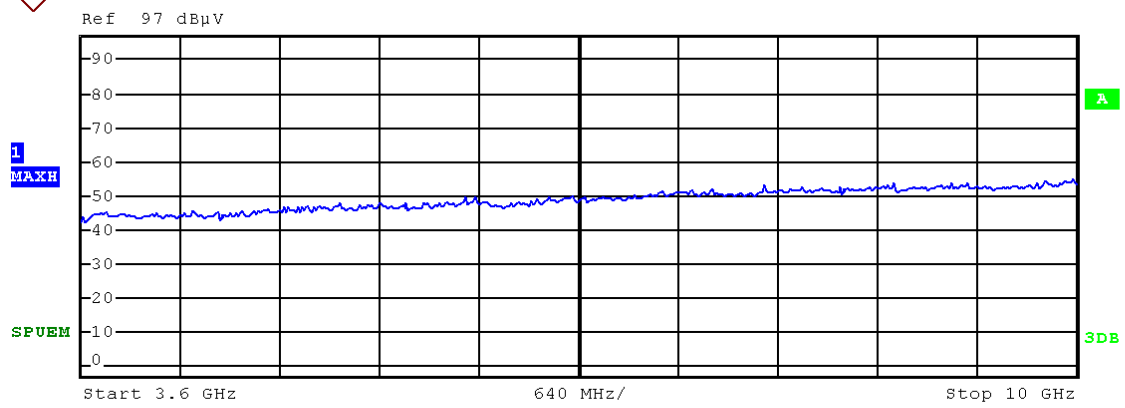
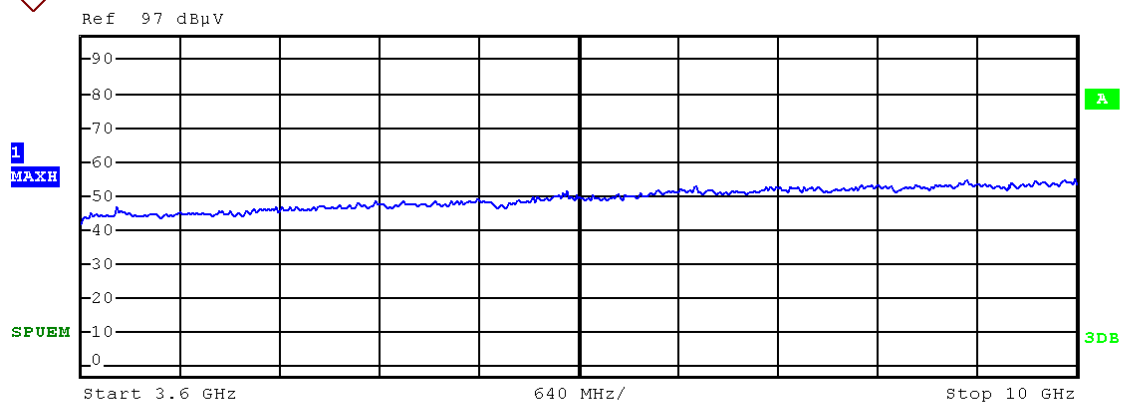



**Fig C6: Low Channel Radiated Emissions 1GHz - 3.6GHz, Horizontal, 3metres**




| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | ΔLimit [dB] |
|---|---|---|---|---|---|
| 3.600 G | 4.500 G | 1.00 M | 4.319662 G | -60.94 | -200.00 |
| 4.500 G | 5.400 G | 1.00 M | 5.267812 G | -58.57 | -200.00 |
| 5.400 G | 6.300 G | 1.00 M | 6.071962 G | -56.97 | -200.00 |
| 6.300 G | 7.200 G | 1.00 M | 7.160287 G | -56.77 | -200.00 |
| 7.200 G | 8.100 G | 1.00 M | 7.995262 G | -53.80 | -200.00 |
| 8.100 G | 9.000 G | 1.00 M | 8.825288 G | -53.22 | -200.00 |
| 9.000 G | 9.900 G | 1.00 M | 9.792900 G | -52.18 | -200.00 |
| 9.900 G | 10.000 G | 1.00 M | 9.978050 G | -51.89 | -200.00 |

**Fig C7: Low Channel Radiated Emissions 3.6GHz - 10GHz, Vertical, 3metre**




| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | ΔLimit [dB] |
|---|---|---|---|---|---|
| 3.600 G | 4.500 G | 1.00 M | 3.824212 G | -60.16 | -200.00 |
| 4.500 G | 5.400 G | 1.00 M | 5.383913 G | -58.92 | -200.00 |
| 5.400 G | 6.300 G | 1.00 M | 6.149700 G | -57.74 | -200.00 |
| 6.300 G | 7.200 G | 1.00 M | 6.725587 G | -55.49 | -200.00 |
| 7.200 G | 8.100 G | 1.00 M | 7.997850 G | -53.93 | -200.00 |
| 8.100 G | 9.000 G | 1.00 M | 8.678025 G | -53.51 | -200.00 |
| 9.000 G | 9.900 G | 1.00 M | 9.289575 G | -52.48 | -200.00 |
| 9.900 G | 10.000 G | 1.00 M | 9.984188 G | -52.10 | -200.00 |

**Fig C8: Low Channel Radiated Emissions 3.6GHz - 10GHz, Horizontal, 3metre**

**Please refer to report “24E11202-1a Nordic ID NUR3-0W1 FCCIC Part2 of 2 Appendix “**

**for Appendices D, E,F,G**