

# LABORATORY TEST REPORT

## RADIO PERFORMANCE MEASUREMENTS

for the

TBDH5G BASE STATION Transceiver

Tested in accordance with:

FCC 47 CFR Parts 22, 74 and 90

RSS-119 Issue 12  
RSS-Gen Issue 4

Report Revision: 2

Issue Date: 01-June-2016

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\_\_\_\_\_  
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\_\_\_\_\_  
Laboratory Technical Manager



OATS FCC LISTING REGISTRATION: 837095  
OATS IC LISTING REGISTRATION: SITE# 737A-1

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation.

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## REVISION

| Date         | Revision | Comments                           |
|--------------|----------|------------------------------------|
| 16-May-2016  | 1        | Initial test report                |
| 01-June-2016 | 2        | Added FCC 47 CFR Part 74 to report |

## INTRODUCTION

Type approval testing of the TBDH5G, 40 Watt, BASE STATION transceiver in order to demonstrate compliance with FCC 47 Parts 22, 74 & 90, and RSS-119 Issue 12 & RSS-Gen Issue 4. This radio supports analogue, digital FFSK, Digital Mobile Radio (DMR) modulations.

Type Approval Testing of the TBDH5G  
Serial number 18236735  
Frequency range 400 → 470 MHz

in accordance with:

FCC 47 CFR Parts 22, 74 and 90  
RSS-119 Issue 12 & RSS-Gen Issue 4

### REPORT PREPARED FOR

Tait Ltd  
245 Wooldridge Road  
Harewood  
Christchurch 8051  
New Zealand

### DESCRIPTION OF SAMPLE

Manufacturer Tait Limited  
Equipment: BASE STATION Transceiver  
Type: TBDH5G  
Product Code: TB7310-H5B0-0000-00AE-10  
Serial Number(s): 18236735  
Quantity: 1

| Modulation                 |                                              | Channel Spacing | Speech Channels | Symbol Rate (symbols/sec) | Data Rate (bps) |
|----------------------------|----------------------------------------------|-----------------|-----------------|---------------------------|-----------------|
| Analogue FM                |                                              | 12.5 kHz        | 1               | -                         | -               |
| FFSK                       | Fast Frequency Shift Keying                  | 12.5 kHz        | -               | 1200                      | 1200            |
| Digital Mobile Radio (DMR) | 4 Level FSK (2 slot TDMA) (ETSI TS102 361-1) | 12.5 kHz        | 2               | 4800                      | 9600            |

### HARDWARE & SOFTWARE

| Module          | Product Code   | Serial Number | Firmware Version | Hardware Version |
|-----------------|----------------|---------------|------------------|------------------|
| Reciter         | T01-01403-SAZZ | 18236681      | dmr-2.15.00.0006 | 1                |
| Power Amplifier | T01-01405-SAZZ | 18236684      |                  | 0.01             |
| Front Panel     | T01-01410-AAAA | 2887992       | 1.08.00.0002     | 0.01             |

### TEST CONDITIONS

All testing was performed between 02 → 12-May-2016, and under the following conditions:

Ambient temperature: 15°C → 30°C  
Relative Humidity: 20% → 75%  
Standard Test Voltage 13.8 V<sub>DC</sub>

## STATEMENT OF COMPLIANCE

We, TELTEST LABORATORIES of 558 Wairakei Road, Christchurch, New Zealand, declare under our sole responsibility that the product:

Equipment: BASE STATION Transceiver  
Type: TBDH5G  
Product Code: TB7310-H5B0-0000-00AE-10  
Serial Number(s): 18236735  
Quantity: 1

to which this declaration relates, is in conformity with the following standards:

FCC 47 CFR Parts 22, 74 and 90

RSS-119 Issue 12 & RSS-Gen Issue 4

**Signature:** \_\_\_\_\_

Mike James  
Technical Manager

**Date:** \_\_\_\_\_

## MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS

### MODULATION TYPES:

|     |                               |                  |          |
|-----|-------------------------------|------------------|----------|
| F3E | Analogue Frequency Modulation |                  |          |
| F2D | Fast Frequency Shift Keying   | 1200 symbols/sec | 1200 bps |
| FXD | Digital Data                  | 4800 symbols/sec | 9600 bps |
| FXW | Digital Voice / Data          | 4800 symbols/sec | 9600 bps |

CHANNEL SPACINGS: 12.5 kHz

### EMISSION DESIGNATORS:

|                   |         |
|-------------------|---------|
| FM Voice          | 11K0F3E |
| FFSK              | 7K60F2D |
| Digital Voice DMR | 7K60FXW |
| Digital Data DMR  | 7K60FXD |
| FM                | 11K0F3E |

### CALCULATIONS

Equation:  $B_n = 2M + 2Dk$

(M is highest modulating frequency; D is peak allowable deviation; k is a constant of 1 for FM)

#### Analogue Voice 12.5 kHz Bandwidth

Necessary bandwidth

M = 3.0 kHz

D = 2.5 kHz

$$B_n = (2 \times 3.0) + (2 \times 2.5) \times 1 \\ = 11.0 \text{ kHz}$$

Emission Designator

**11K0F3E**

F3E represents an FM voice transmission

#### Fast Frequency Shift Keying (FFSK – 1200 bps) 12.5 kHz Channel Spacing

Necessary bandwidth

M = 1.8 kHz

D = 2.0 kHz

$$B_n = (2 \times 1.8) + (2 \times 2.0) \times 1 \\ = 7.6 \text{ kHz}$$

Emission Designator

**7K60F2D**

F2D represents a FM data transmission with the use of a modulating sub carrier

#### Digital Voice 12.5 kHz Bandwidth DMR

99% bandwidth

= 7.6 kHz

FXW represents a FM Time Division Multiple Access (TDMA) combination of data and telephony

Emission Designator

**7K60FXW**

#### Digital Data 12.5 kHz Bandwidth DMR

99% bandwidth

= 7.6 kHz

FXD represents FM Time Division Multiple Access (TDMA) data only

Emission Designator

**7K60FXD**

## TEST RESULTS

### TRANSMITTER OUTPUT POWER (CONDUCTED)

SPECIFICATION: FCC 47 CFR 2.1046  
RSS-119 5.4

GUIDE: TIA-102.CAAA-C 2.2.1

#### MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up.
2. The coaxial attenuator has an impedance of 50 Ohms.
3. The unmodulated output power was measured with an RF Power meter.

#### MEASUREMENT RESULTS:

Manufacturer's Rated Output Power:

Switchable: 40 W and 2 W

| Nominal 40 W                   | 406.2 MHz | 418.1 MHz | 429.9 MHz | 450.1 MHz | 459.9MHz | 469.9MHz |
|--------------------------------|-----------|-----------|-----------|-----------|----------|----------|
| Measured                       | 41.7      | 40.3      | 40.4      | 40.3      | 42.0     | 40.7     |
| Variation (%)                  | 4.1       | 0.8       | 1.1       | 0.8       | 5.0      | 1.7      |
| Variation (dB)                 | 0.2       | 0.0       | 0.0       | 0.0       | 0.2      | 0.1      |
| Nominal 2 W                    | 406.2 MHz | 418.1 MHz | 429.9 MHz | 450.1 MHz | 459.9MHz | 469.9MHz |
| Measured                       | 2.0       | 1.9       | 1.9       | 1.9       | 1.9      | 1.9      |
| Variation (%)                  | -2.2      | -5.3      | -3.8      | -3.9      | -3.3     | -5.1     |
| Variation (dB)                 | -0.1      | -0.2      | -0.2      | -0.2      | -0.1     | -0.2     |
| Measurement Uncertainty 0.6 dB |           |           |           |           |          |          |

#### LIMIT CLAUSES:

##### FCC 47 CFR 90.205 (s)

The output power shall not exceed by more than 20%... the manufacturer's rated output power for the particular transmitter specifically listed on the authorization.

##### RSS-119 5.4

The output power shall be within  $\pm 1.0$  dB of the manufacturer's rated power.

## TRANSMITTER AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS

SPECIFICATION: FCC 47 CFR 2.1047 (a)

GUIDE: TIA/EIA-603D 2.2.6

### MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up.
2. An audio input tone of 1000 Hz was applied with the level set to obtain 20% of maximum deviation. This was used as the 0 dB reference point.
3. The AF was varied while the audio level was held constant.
4. The response in dB relative to 1000 Hz was measured.

### MEASUREMENT RESULTS:

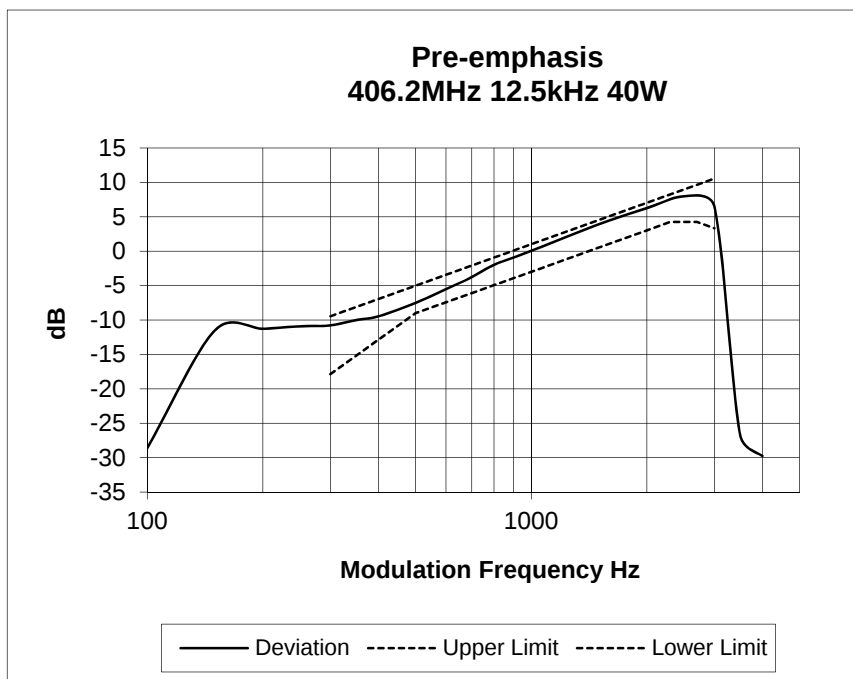
See the plots on the following pages for 12.5 kHz channel spacing tested at 40 W transmit power.

LIMIT CLAUSE: TIA/EIA-603D 3.2.6

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 406.2 MHz

12.5 kHz Channel Spacing

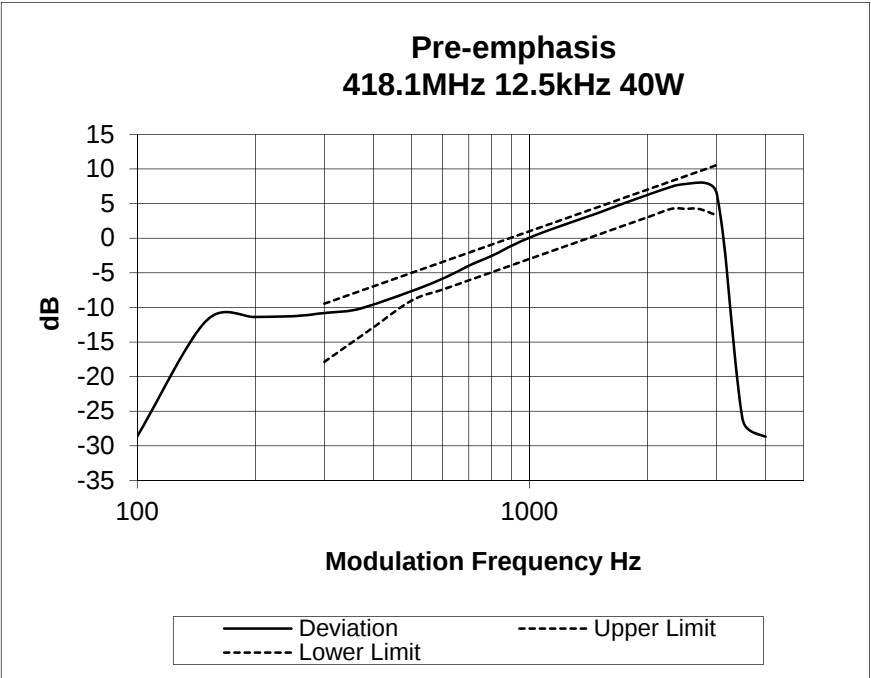


Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 418.1 MHz

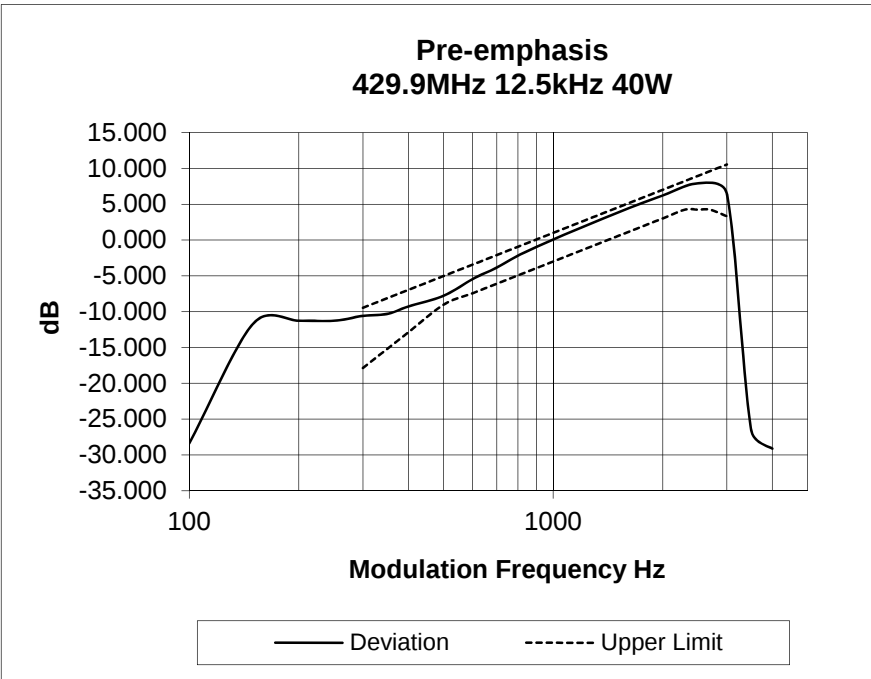
12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 429.9 MHz

12.5 kHz Channel Spacing

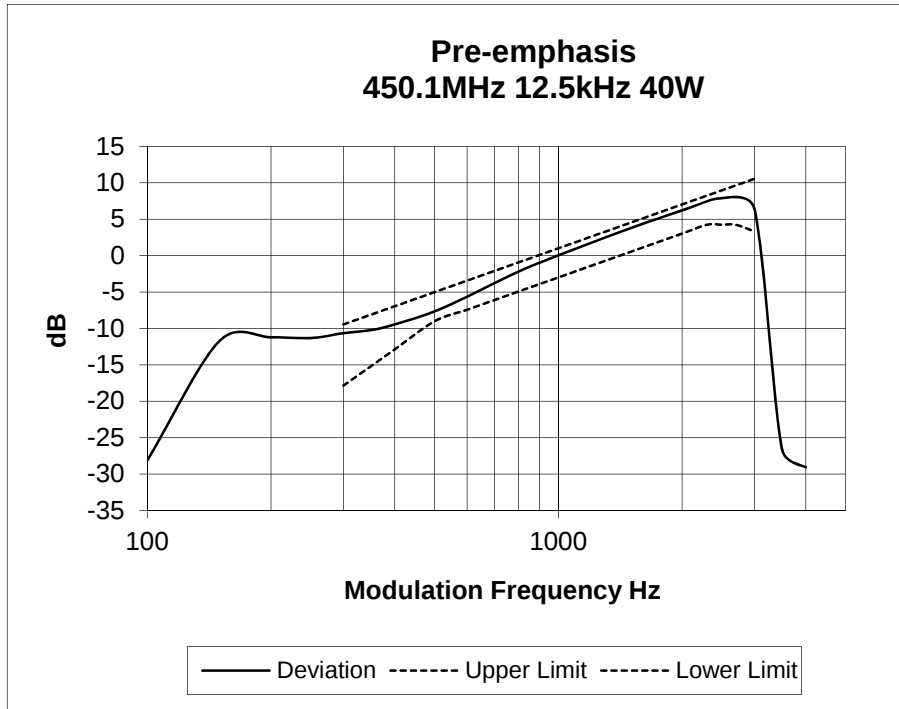


### Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 450.1 MHz

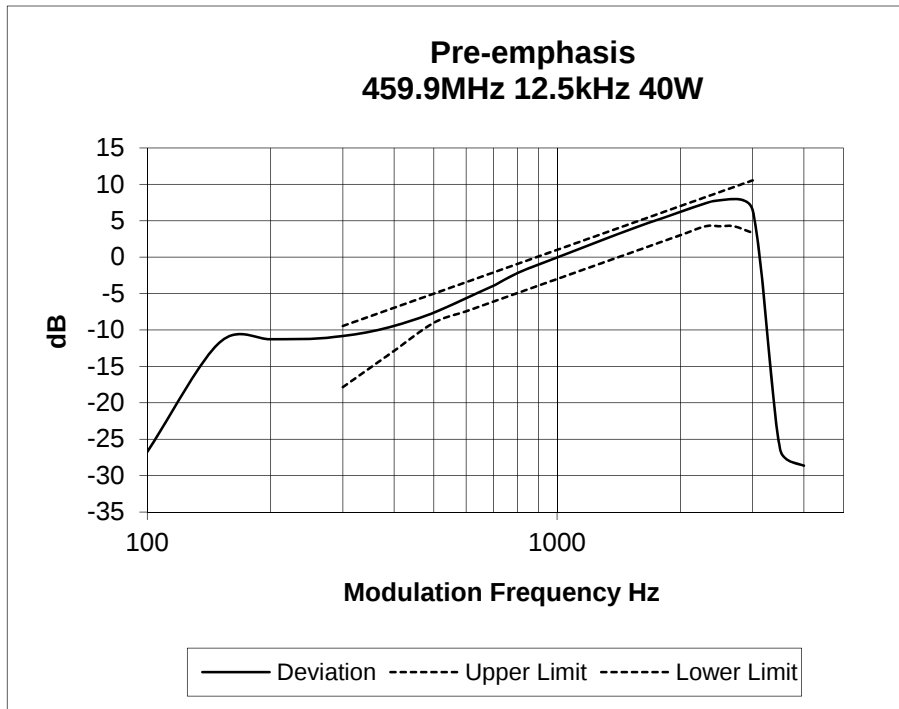
12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 459.9MHz

12.5 kHz Channel Spacing

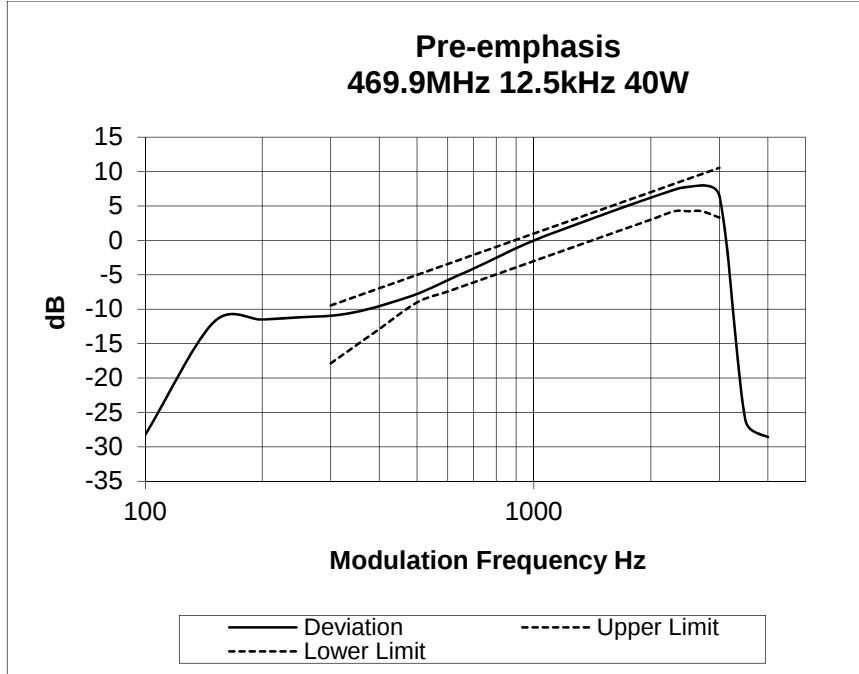


## Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 469.9 MHz

12.5 kHz Channel Spacing



## TRANSMITTER MODULATION LIMITING

SPECIFICATION: FCC 47 CFR 2.1047 (b)

GUIDE: TIA/EIA-603D 2.2.3

### MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up.
2. The modulation response was measured at three audio frequencies while varying the input level.
3. Measurements were made for both Positive and Negative Deviation.

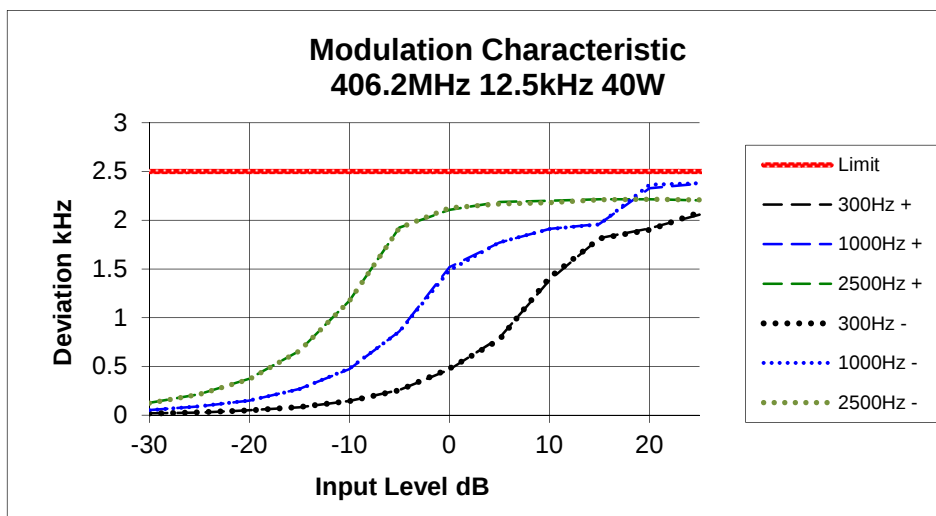
### MEASUREMENT RESULTS:

See the plots on the following pages for 12.5 kHz channel spacing.

LIMIT CLAUSE: TIA/EIA-603D 1.3.4.4

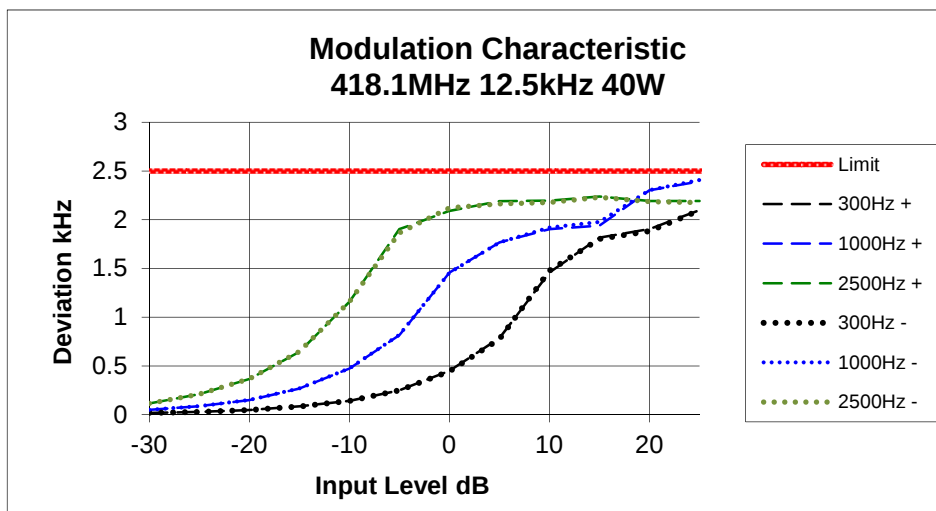
Tx FREQUENCY: 406.2 MHz

12.5 kHz Channel Spacing



Tx FREQUENCY: 418.1 MHz

12.5 kHz Channel Spacing

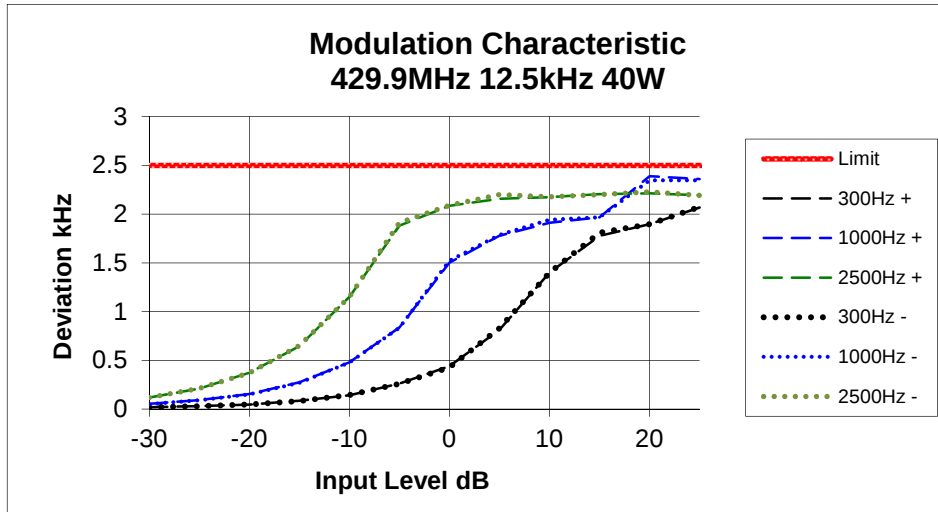


### Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

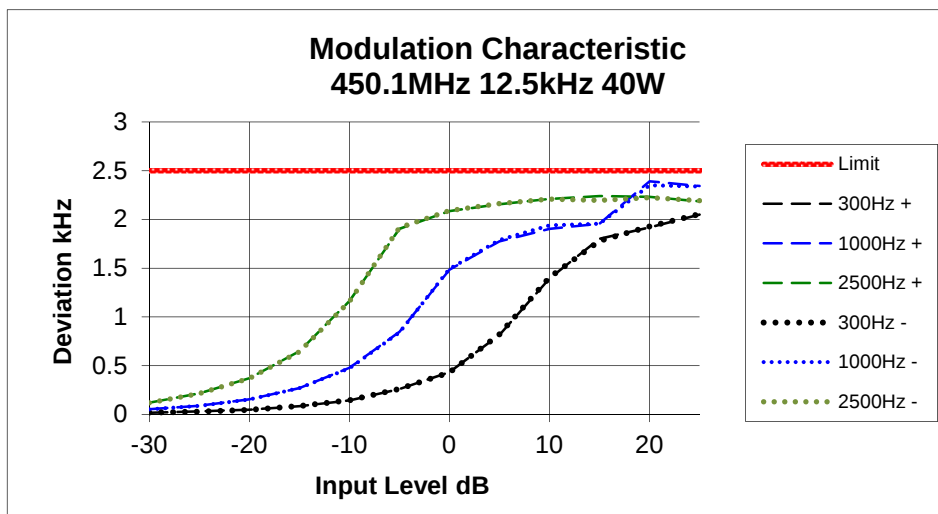
Tx FREQUENCY: 429.9 MHz

12.5 kHz Channel Spacing



Tx FREQUENCY: 450.1 MHz

12.5 kHz Channel Spacing

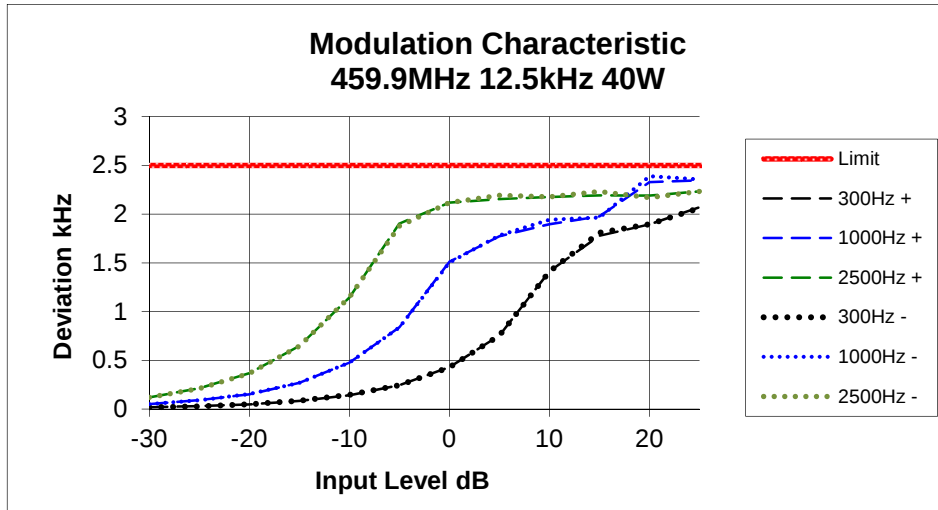


### Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

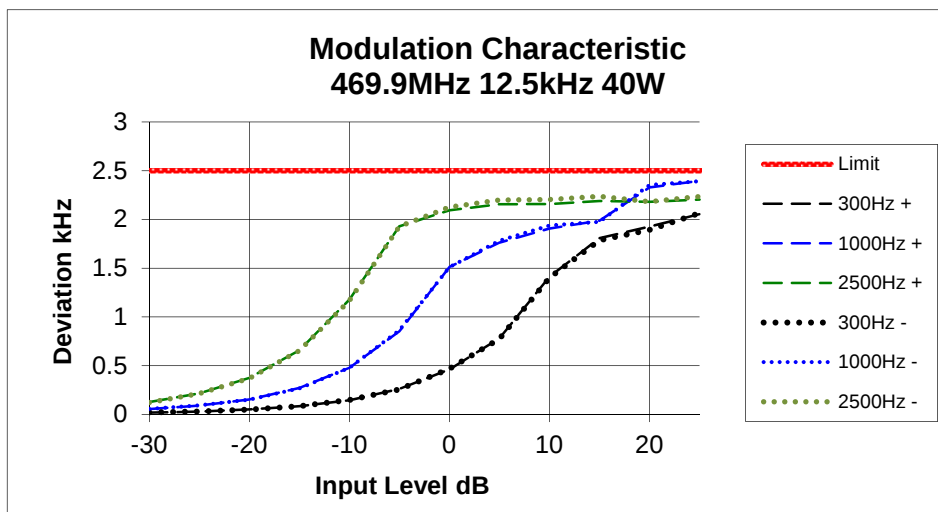
Tx FREQUENCY: 459.9MHz

12.5 kHz Channel Spacing



Tx FREQUENCY: 469.9 MHz

12.5 kHz Channel Spacing



## TRANSMITTER OCCUPIED BANDWIDTH AND SPECTRUM MASKS

SPECIFICATION: FCC 47 CFR 2.1049 (c) RSS-119 5.5

GUIDE: TIA/EIA-603D 2.2.11 (Analog)  
TIA-102.CAAA-C 2.2.5 (Digital)

### MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment Set up.  
The EUT was modulated with an internally generated pseudo random bit sequence at the appropriate Baud rates.
2. The Occupied Bandwidth was measured on the Spectrum Analyser, with bandwidth settings as follows.  
Emission Mask D – Resolution Bandwidth = 100 Hz, Video Bandwidth = 1 kHz

### MEASUREMENT RESULTS:

See the plots on the following pages for 12.5 kHz & 25.0 kHz channel spacings.

LIMIT CLAUSE: FCC 47 CFR 90.210 RSS-119 5.5

### EMISSION MASKS

Emission Mask D 12.5 kHz Channel Spacing Analog, FFSK, Digital Voice/Data

### DATA SPEED

FFSK 12.5 kHz Channel Spacing 1200 bps  
Digital Voice/Data 12.5 kHz Channel Spacing 9600 bps

## Occupied Bandwidth and Spectrum Masks

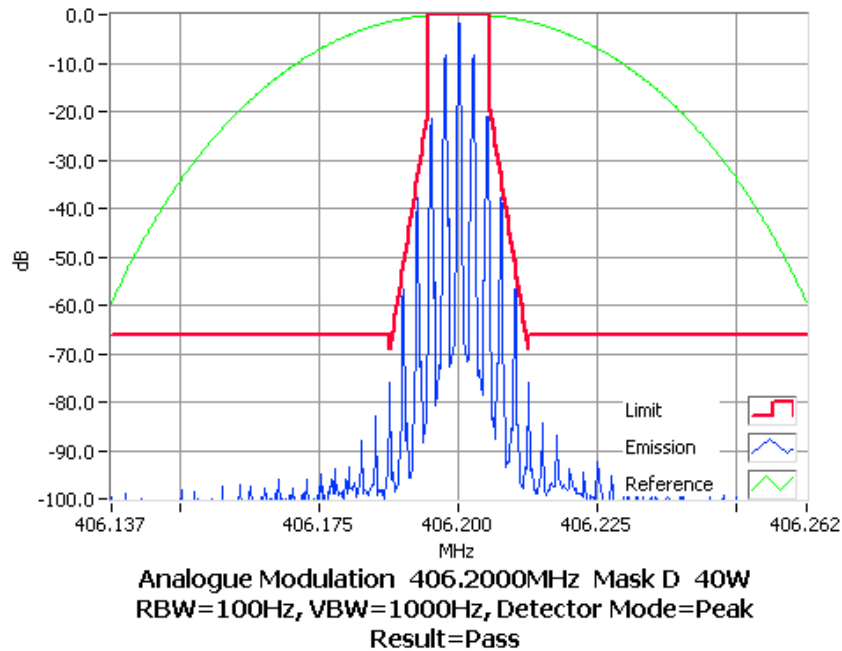
Analog

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

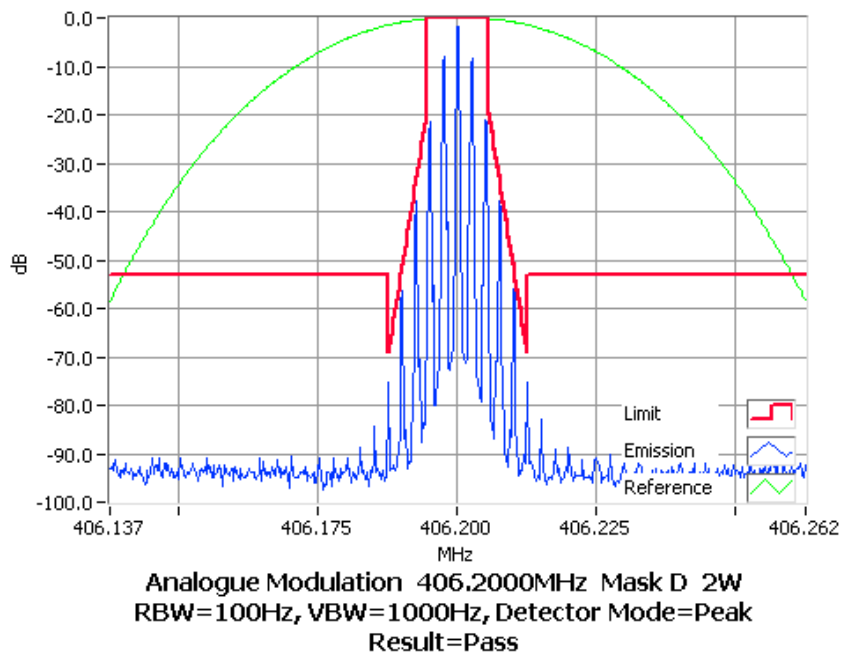
Tx FREQUENCY: 406.2 MHz 40 W

12.5 kHz Channel Spacing



Tx FREQUENCY: 406.2 MHz 2 W

12.5 kHz Channel Spacing



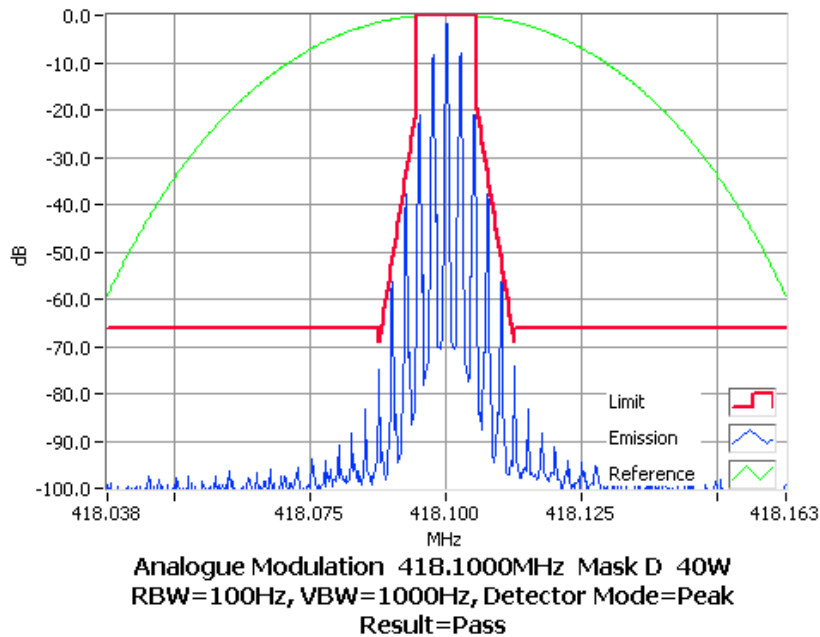
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

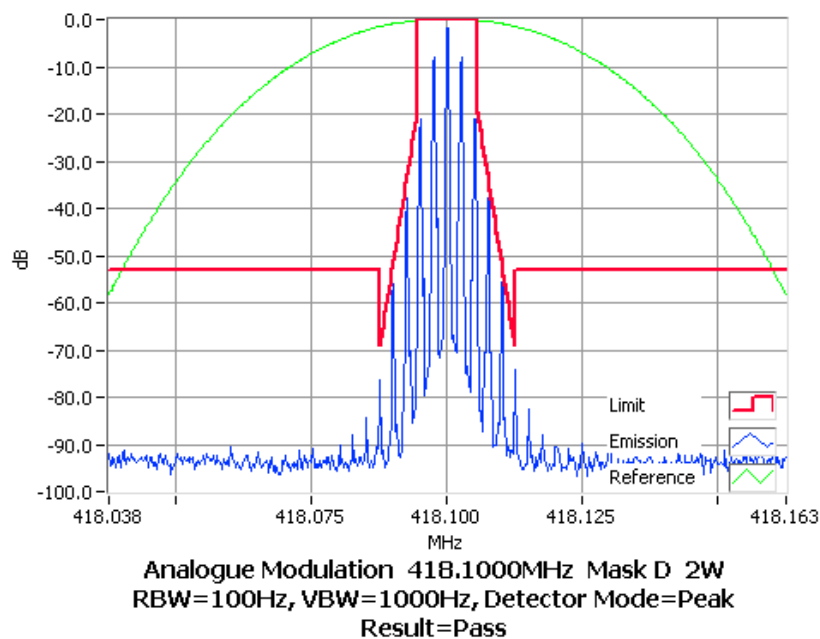
Tx FREQUENCY: 418.1 MHz 40 W

12.5 kHz Channel Spacing



Tx FREQUENCY: 418.1 MHz 2 W

12.5 kHz Channel Spacing



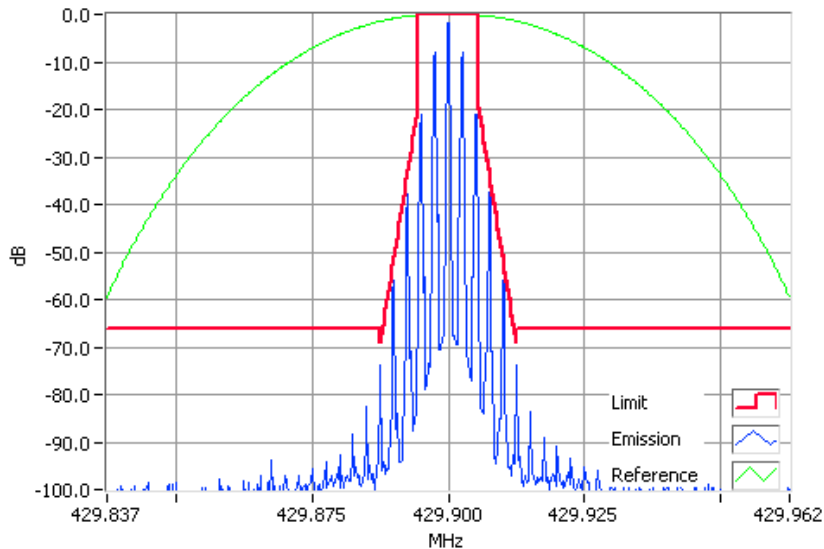
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

Tx FREQUENCY: 429.9 MHz 40 W

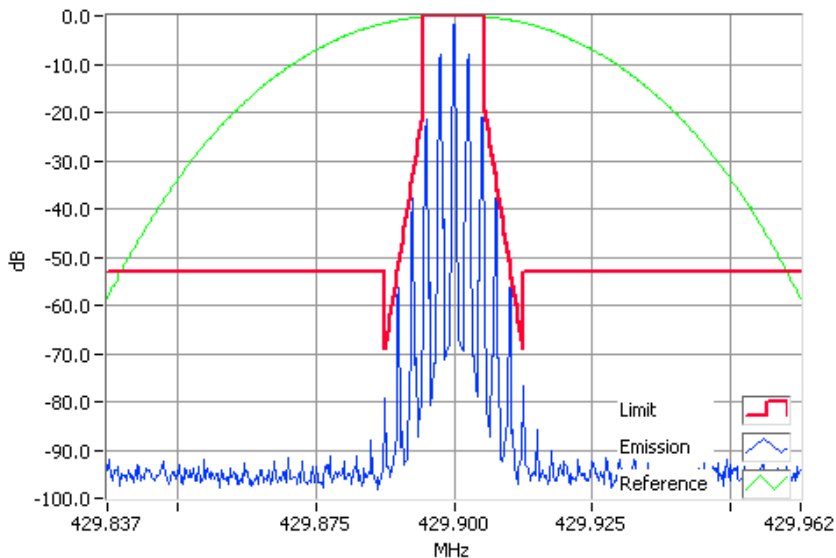
12.5 kHz Channel Spacing



Analogue Modulation 429.9000MHz Mask D 40W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 429.9 MHz 2 W

12.5 kHz Channel Spacing



Analogue Modulation 429.9000MHz Mask D 2W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

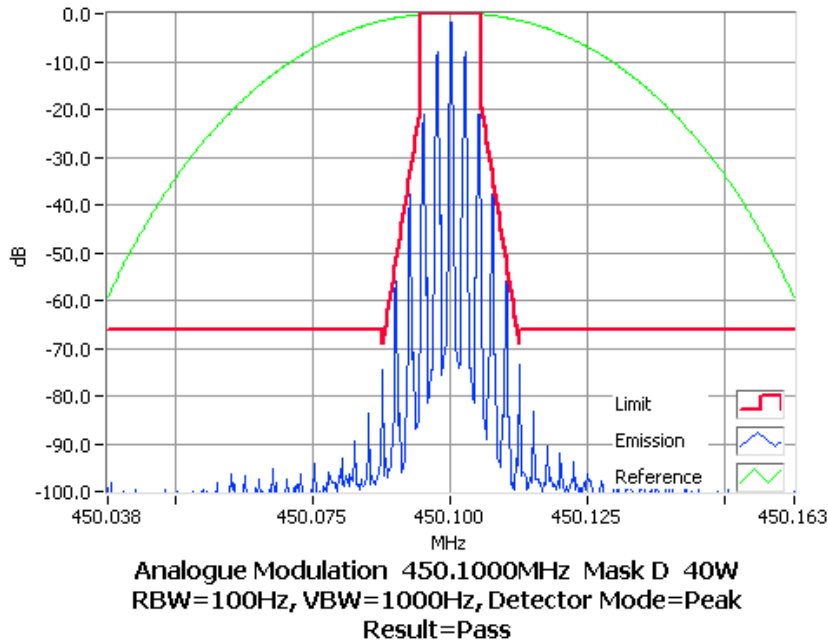
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

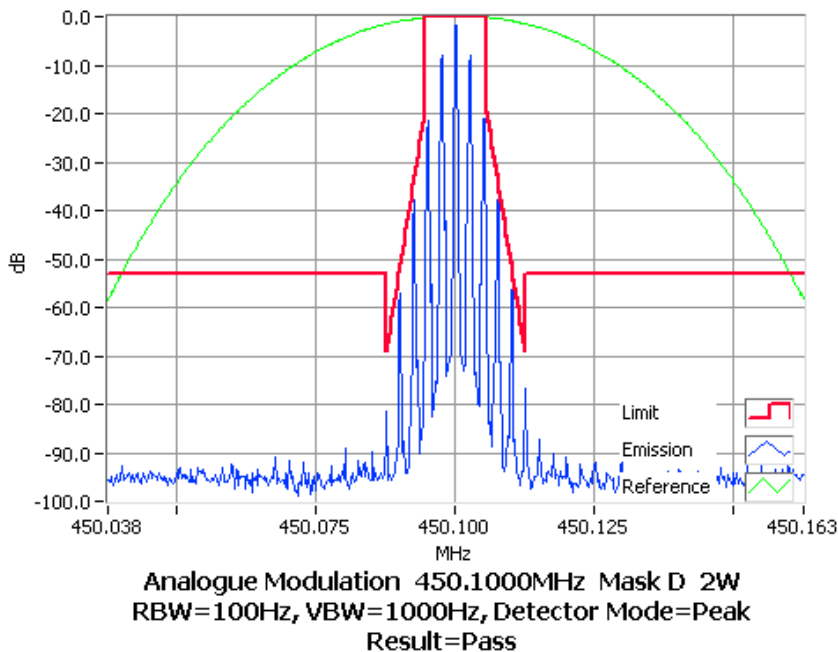
Tx FREQUENCY: 450.1 MHz 40 W

12.5 kHz Channel Spacing



Tx FREQUENCY: 450.1 MHz 2 W

12.5 kHz Channel Spacing



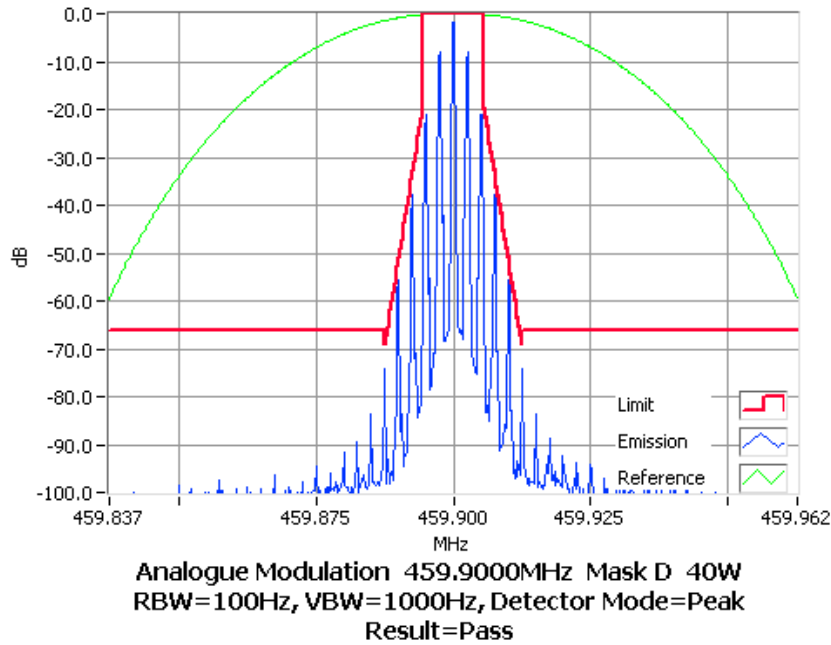
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

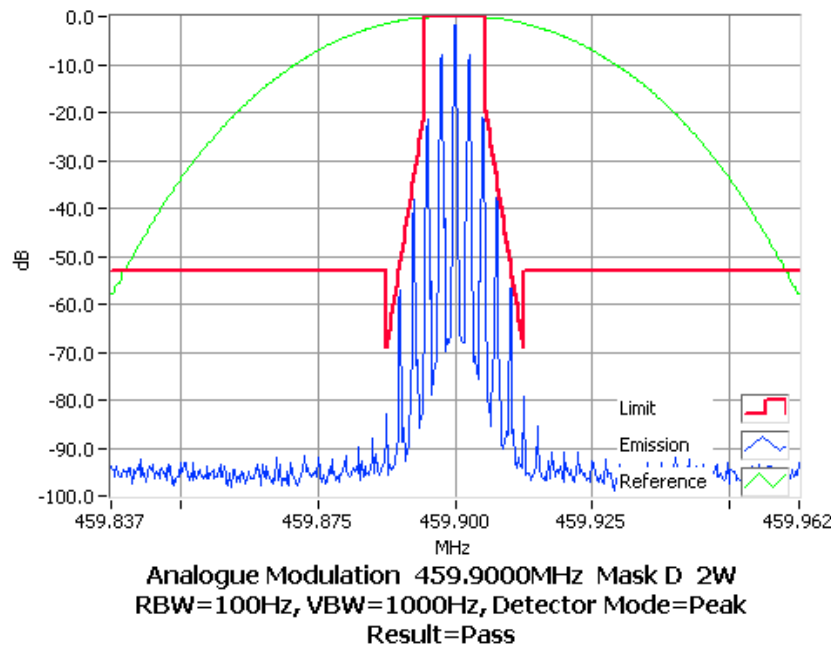
Tx FREQUENCY: 459.9 MHz 40 W

12.5 kHz Channel Spacing



Tx FREQUENCY: 459.9 MHz 2 W

12.5 kHz Channel Spacing



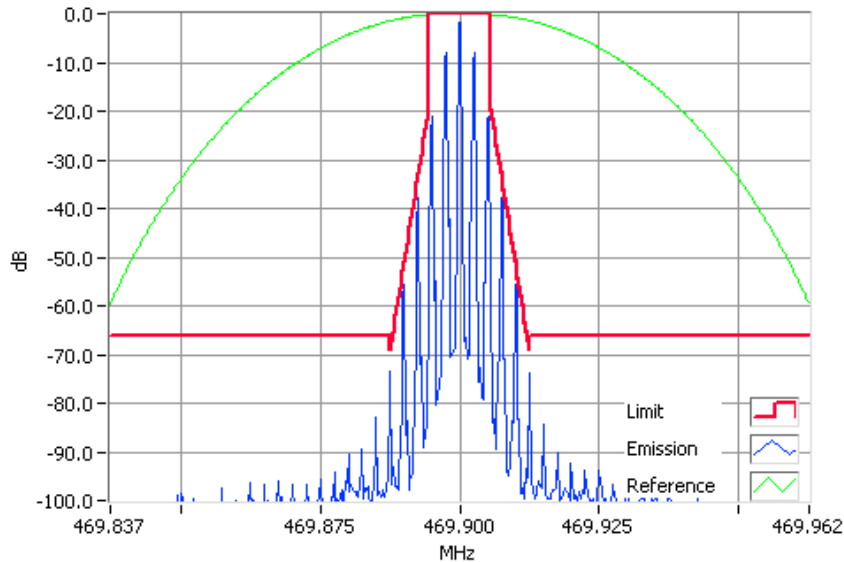
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

Tx FREQUENCY: 469.9 MHz 40 W

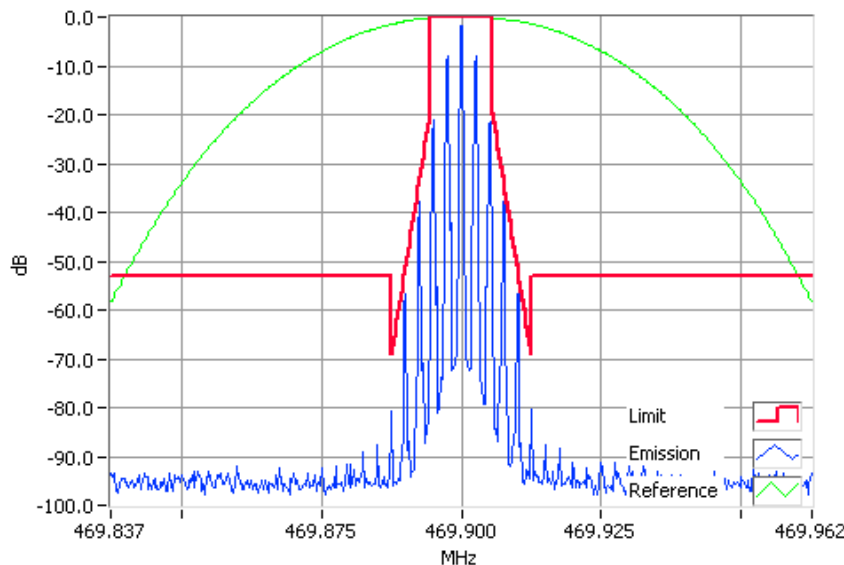
12.5 kHz Channel Spacing



Analogue Modulation 469.9000MHz Mask D 40W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 469.9 MHz 2 W

12.5 kHz Channel Spacing



Analogue Modulation 469.9000MHz Mask D 2W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

## Occupied Bandwidth and Spectrum Masks

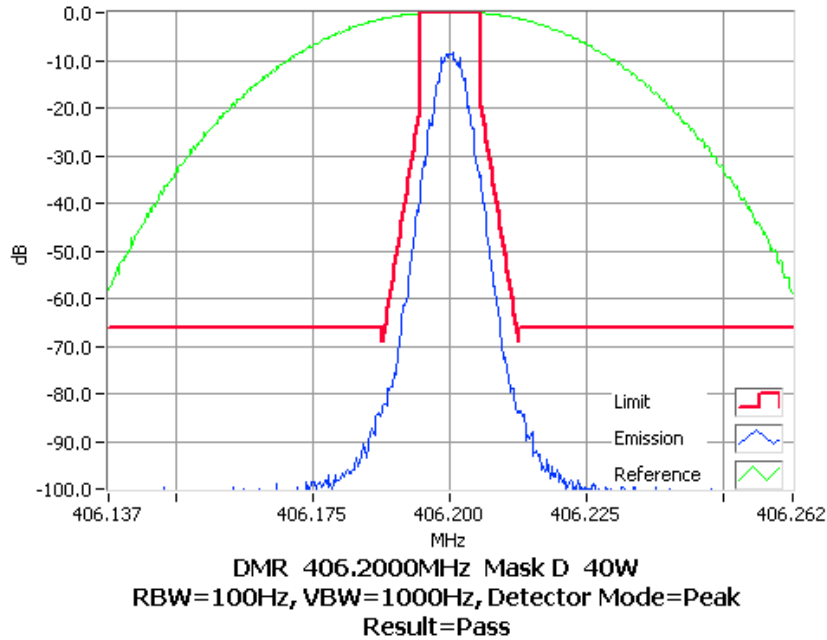
DMR

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

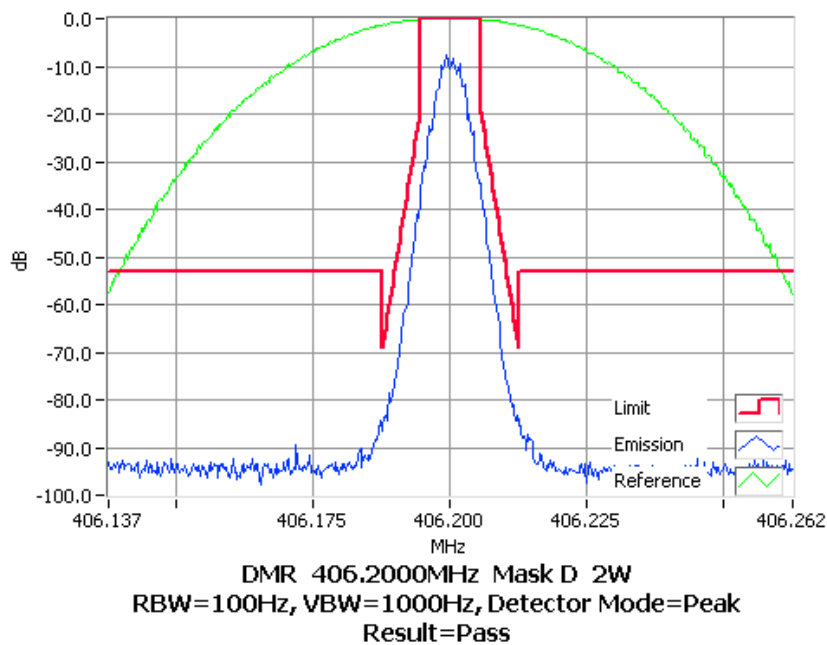
Tx FREQUENCY: 406.2 MHz 40 W

12.5 kHz Channel Spacing



Tx FREQUENCY: 406.2 MHz 2 W

12.5 kHz Channel Spacing



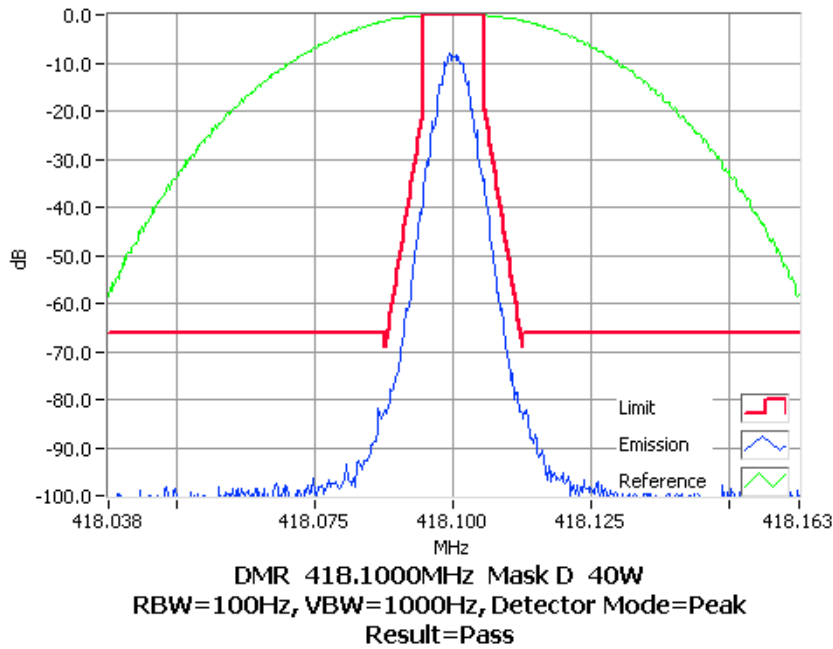
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

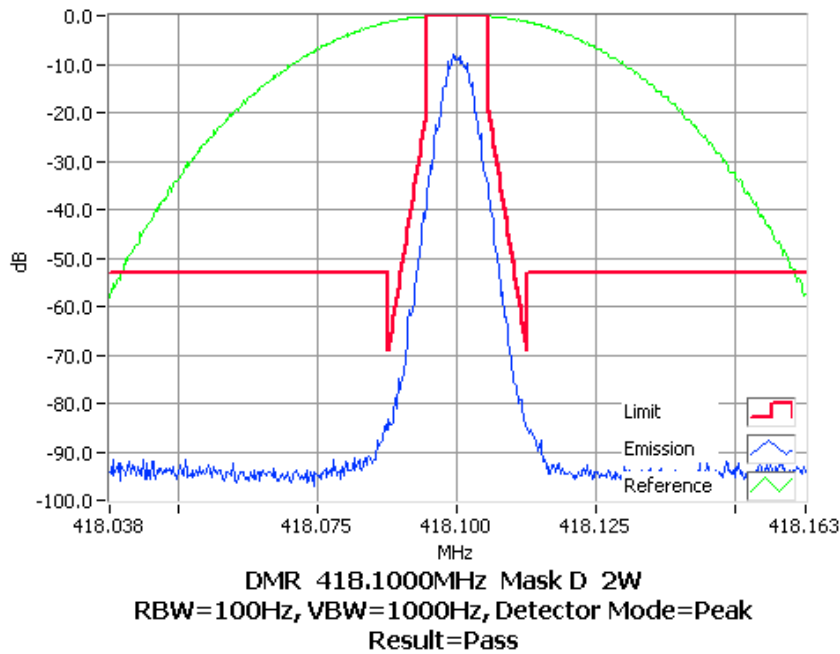
Tx FREQUENCY: 418.1 MHz 40 W

12.5 kHz Channel Spacing



Tx FREQUENCY: 418.1 MHz 2 W

12.5 kHz Channel Spacing



## Occupied Bandwidth and Spectrum Masks

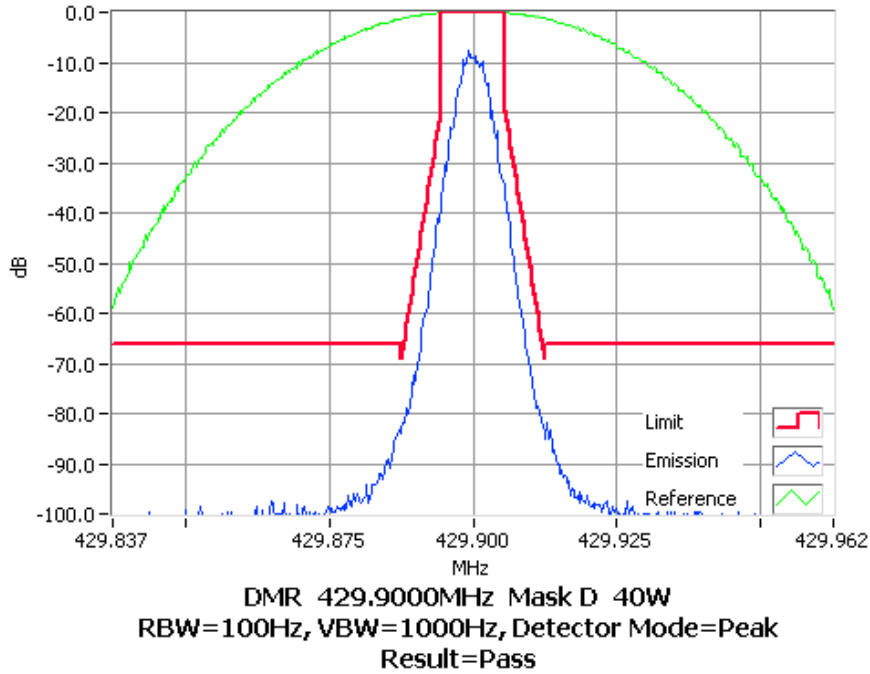
SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

Tx FREQUENCY: 429.9 MHz

40 W

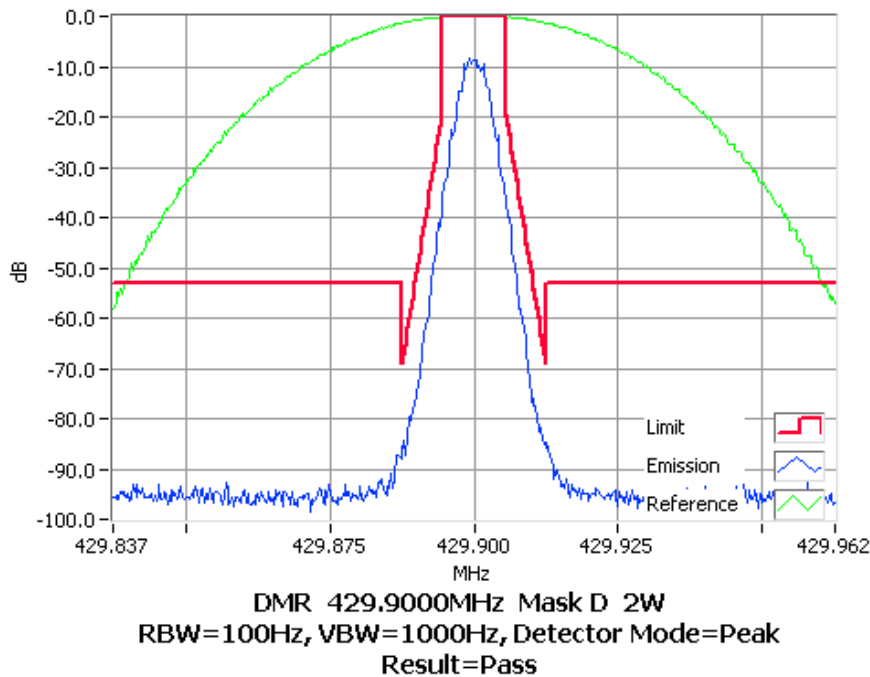
12.5 kHz Channel Spacing



Tx FREQUENCY: 429.9 MHz

2 W

12.5 kHz Channel Spacing



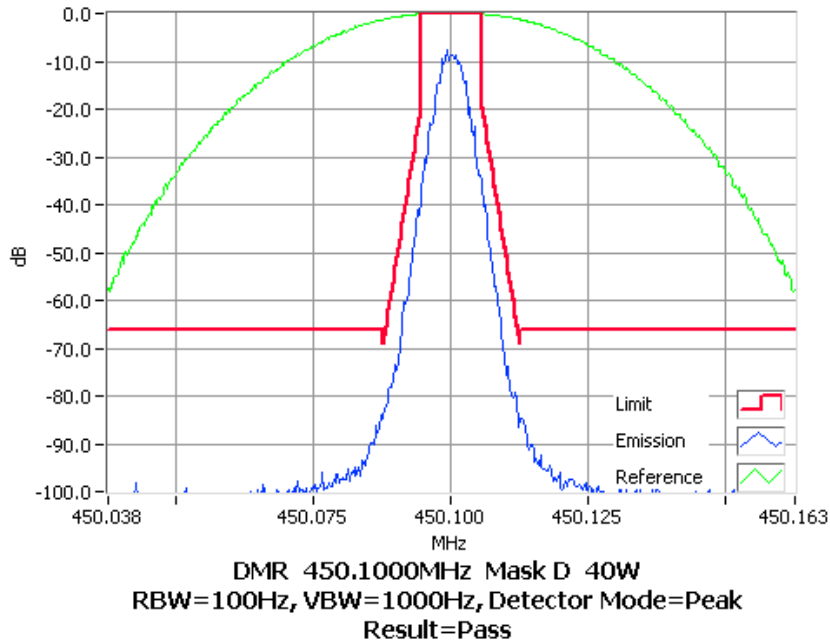
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

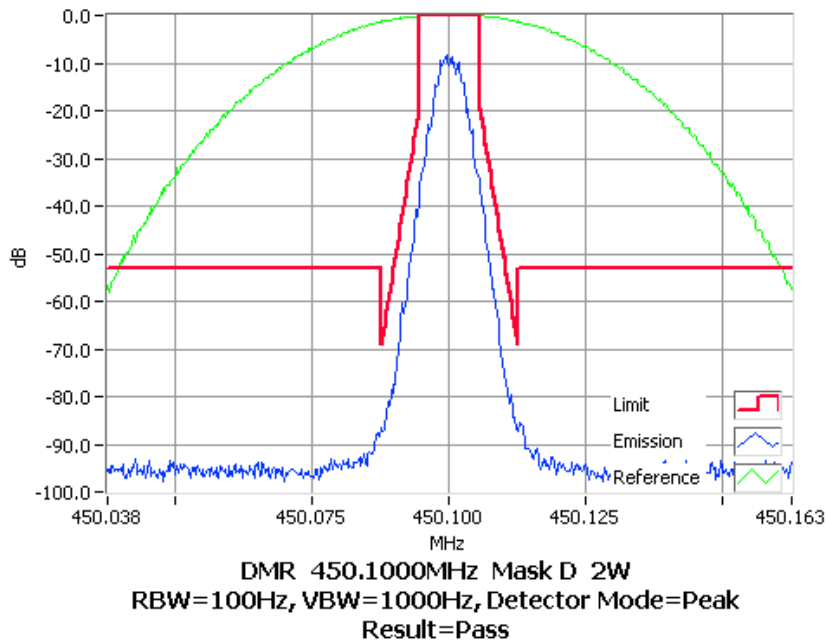
Tx FREQUENCY: 450.1 MHz 40 W

12.5 kHz Channel Spacing



Tx FREQUENCY: 450.1 MHz 2 W

12.5 kHz Channel Spacing



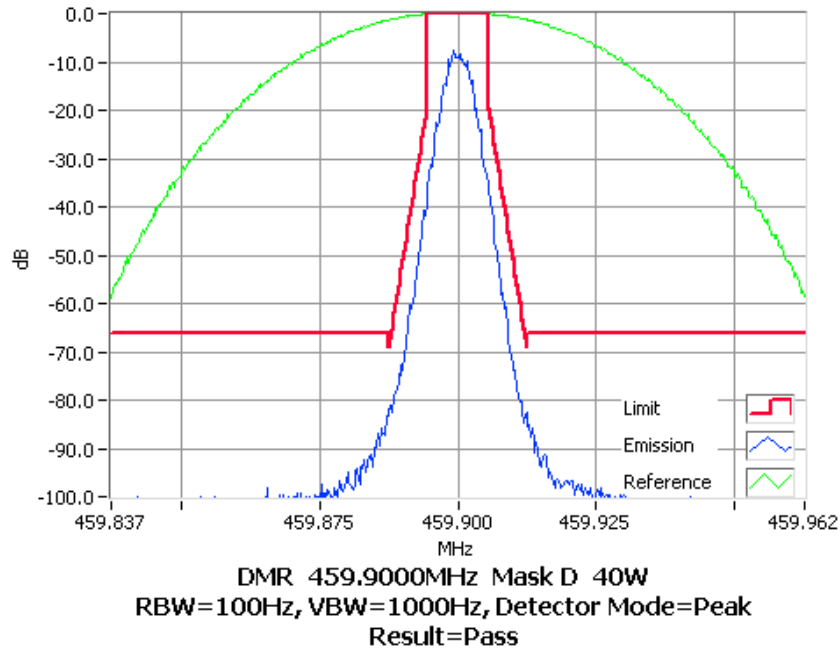
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

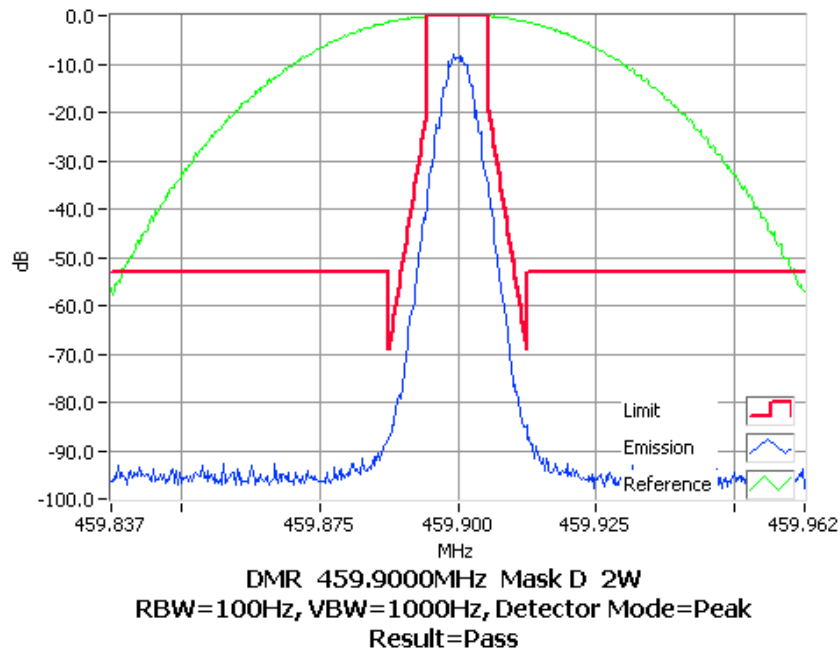
Tx FREQUENCY: 459.9 MHz 40 W

12.5 kHz Channel Spacing



Tx FREQUENCY: 459.9 MHz 2 W

12.5 kHz Channel Spacing



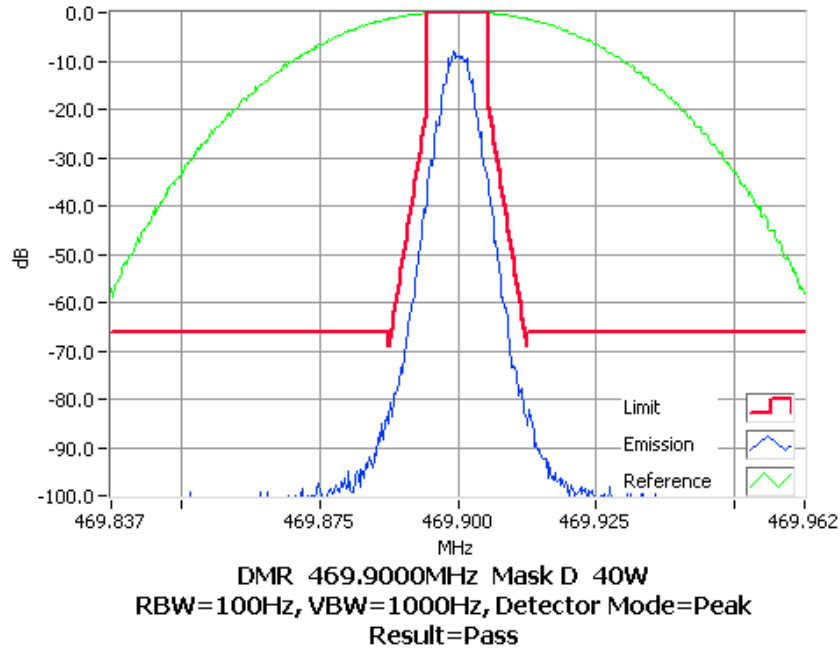
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

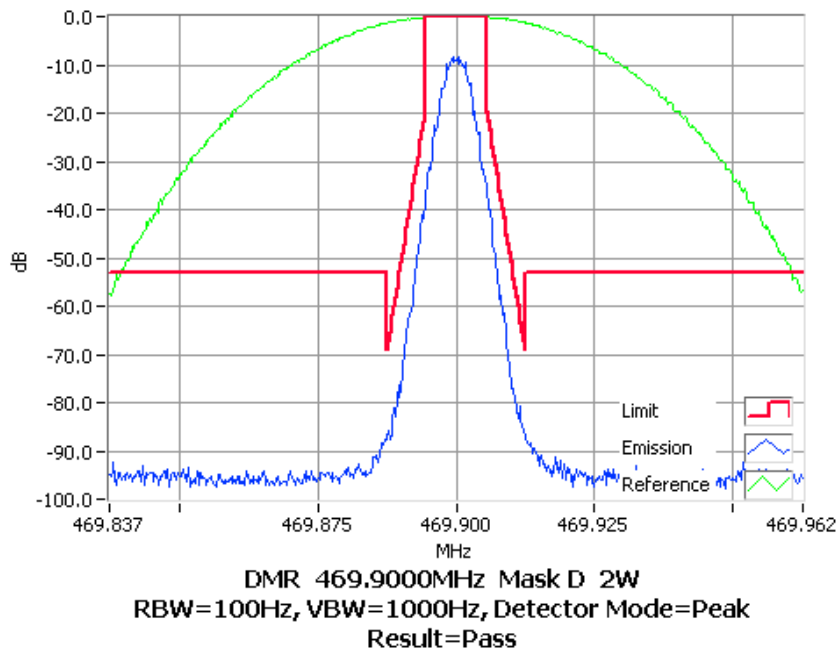
Tx FREQUENCY: 469.9 MHz 40 W

12.5 kHz Channel Spacing



Tx FREQUENCY: 469.9 MHz 2 W

12.5 kHz Channel Spacing



## Occupied Bandwidth and Spectrum Masks

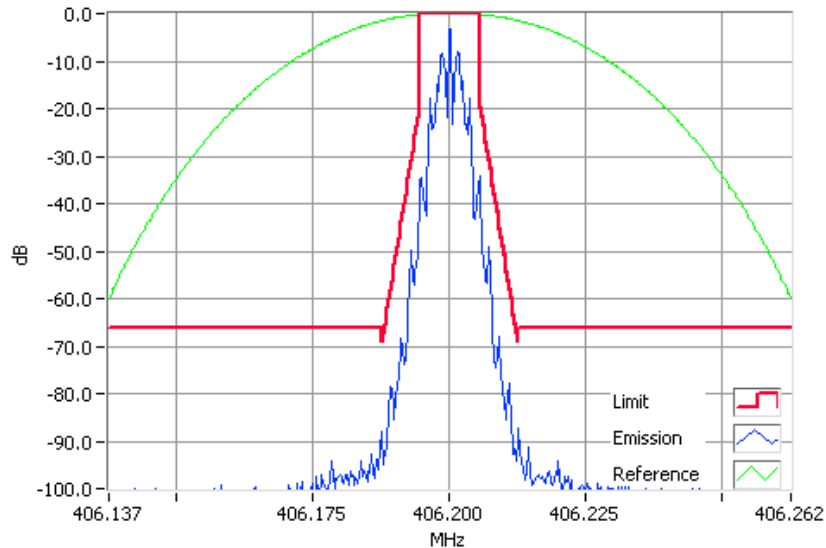
FFSK

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

Tx FREQUENCY: 406.2 MHz 40 W

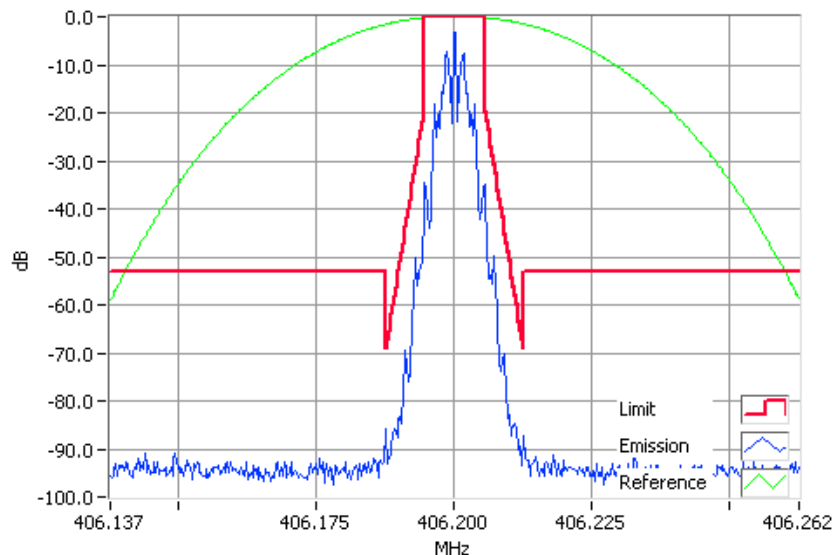
12.5 kHz Channel Spacing



FFSK 406.2000MHz Mask D 40W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 406.2 MHz 2 W

12.5 kHz Channel Spacing



FFSK 406.2000MHz Mask D 2W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

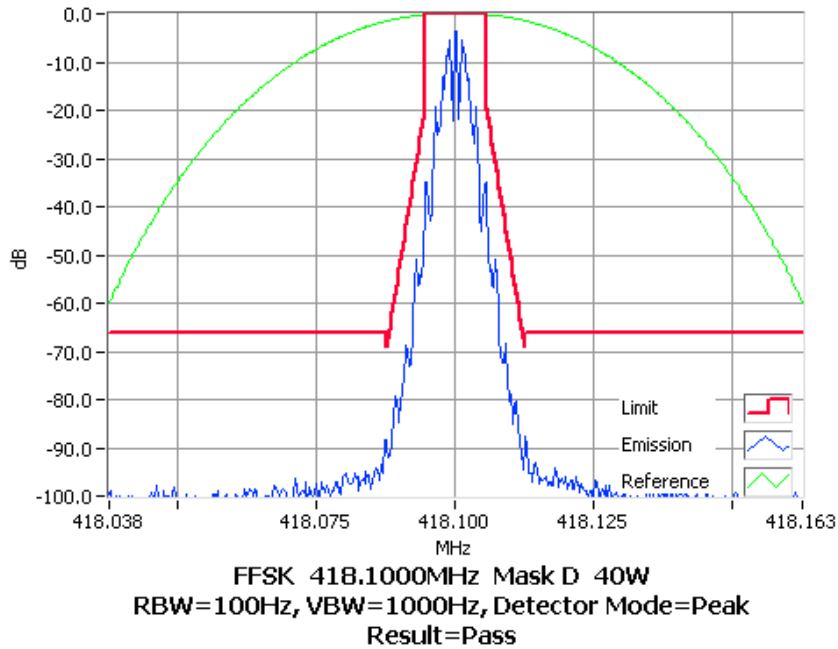
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

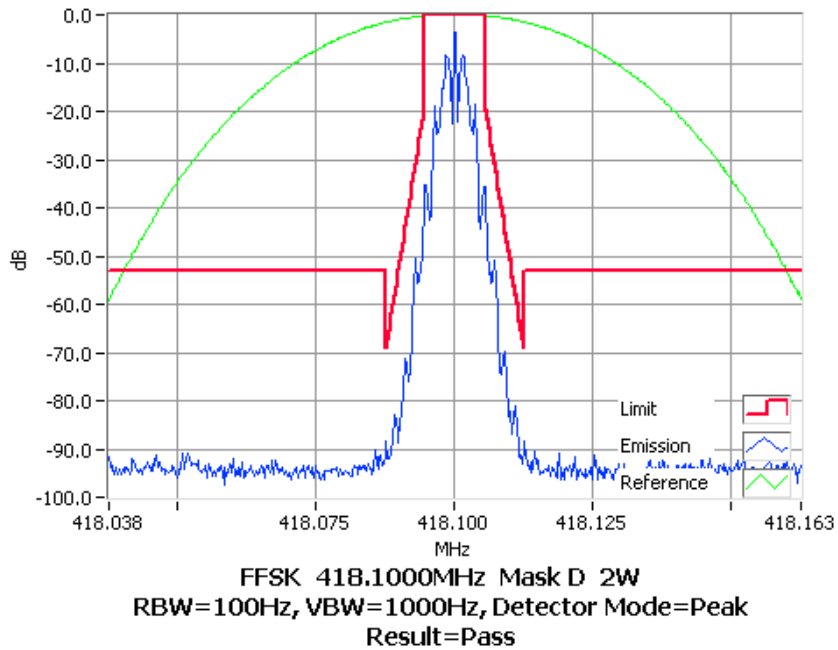
Tx FREQUENCY: 418.1 MHz 40 W

12.5 kHz Channel Spacing



Tx FREQUENCY: 418.1 MHz 2 W

12.5 kHz Channel Spacing



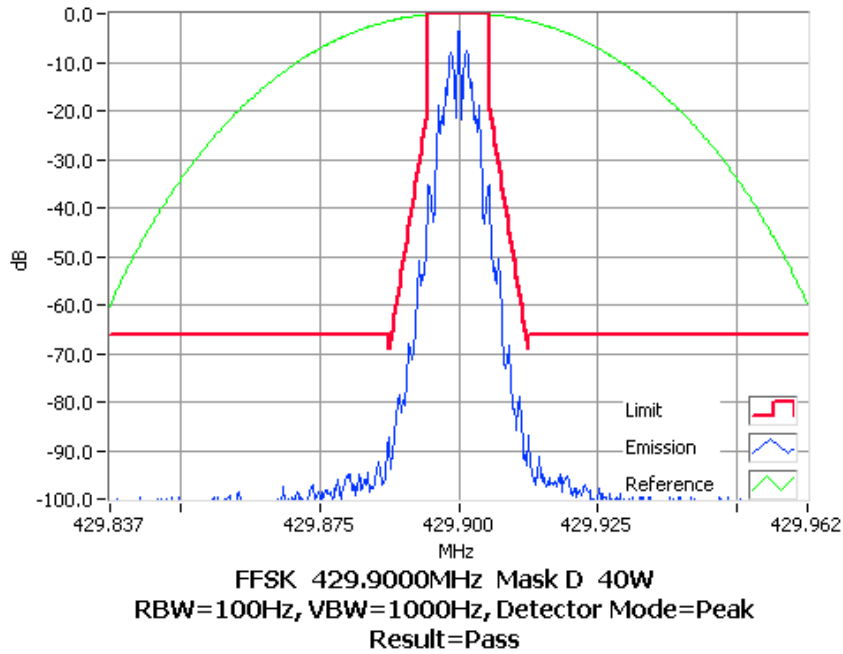
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

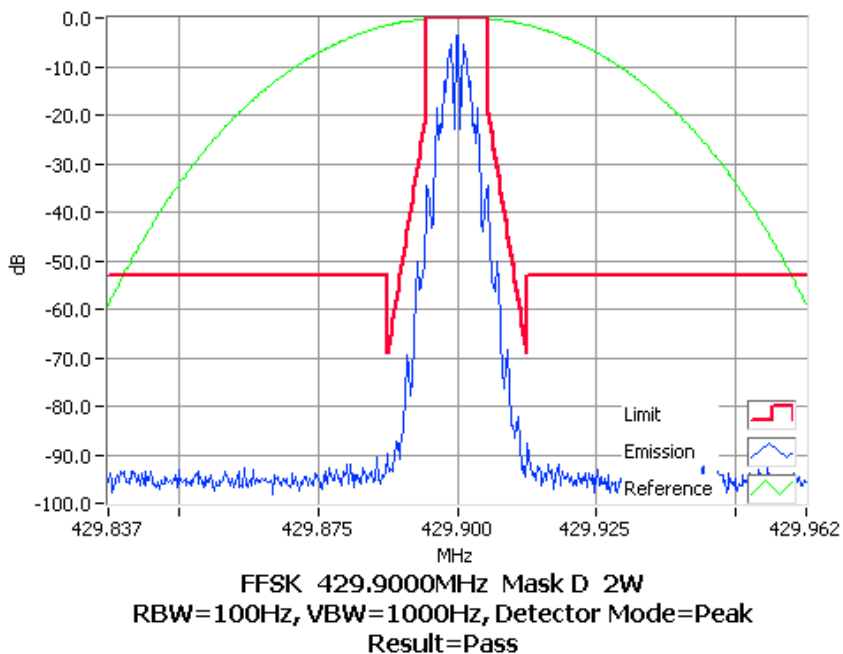
Tx FREQUENCY: 429.9 MHz 40 W

12.5 kHz Channel Spacing



Tx FREQUENCY: 429.9 MHz 2 W

12.5 kHz Channel Spacing



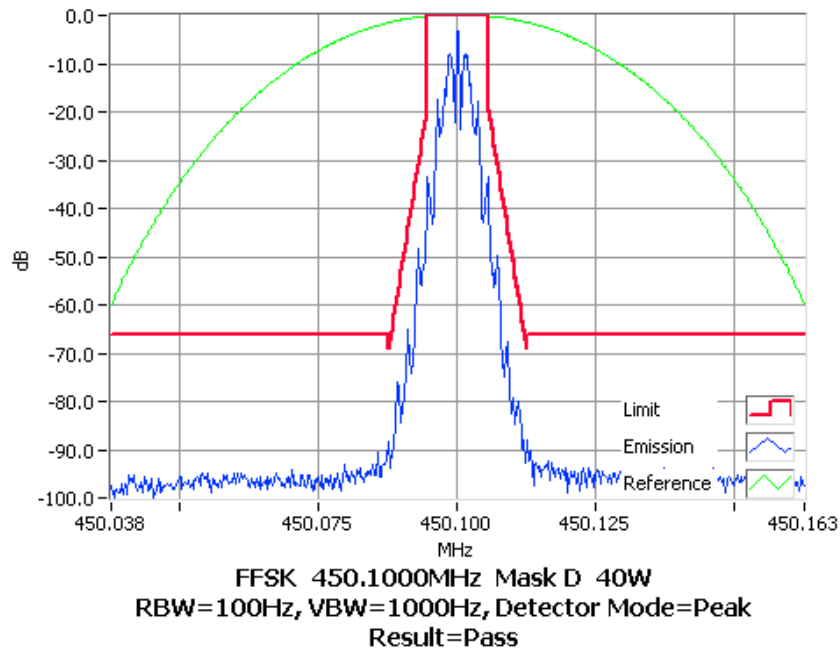
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

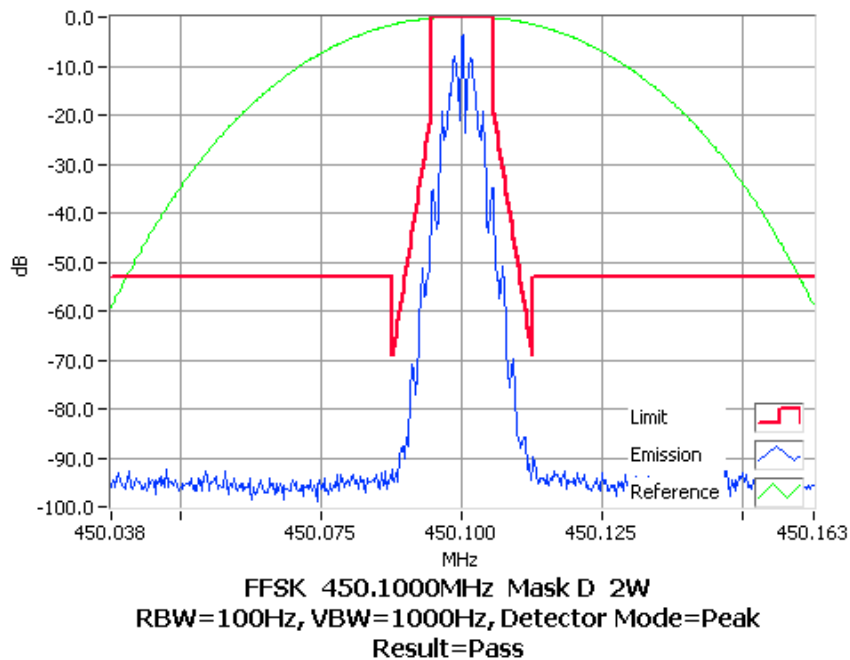
Tx FREQUENCY: 450.1 MHz 40 W

12.5 kHz Channel Spacing



Tx FREQUENCY: 450.1 MHz 2 W

12.5 kHz Channel Spacing



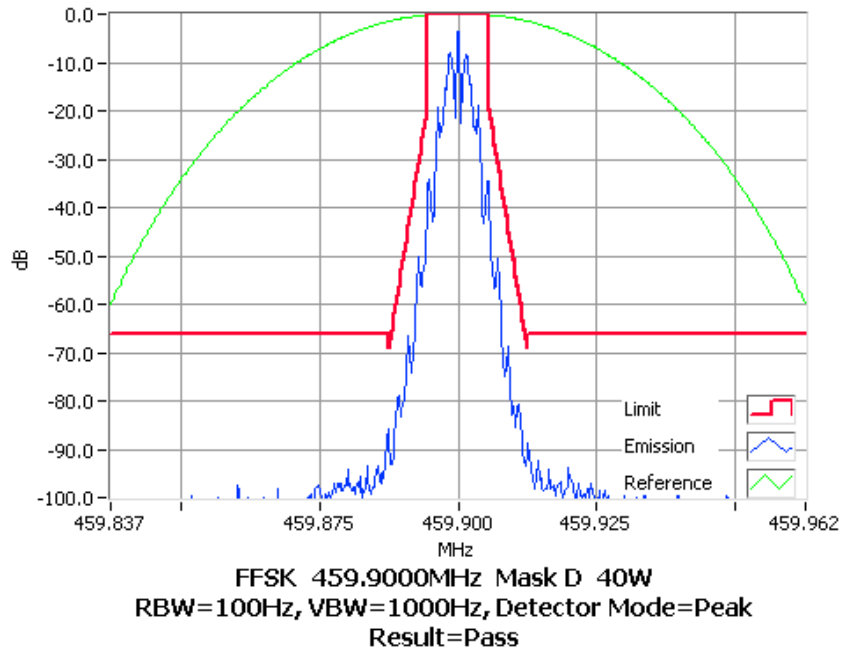
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

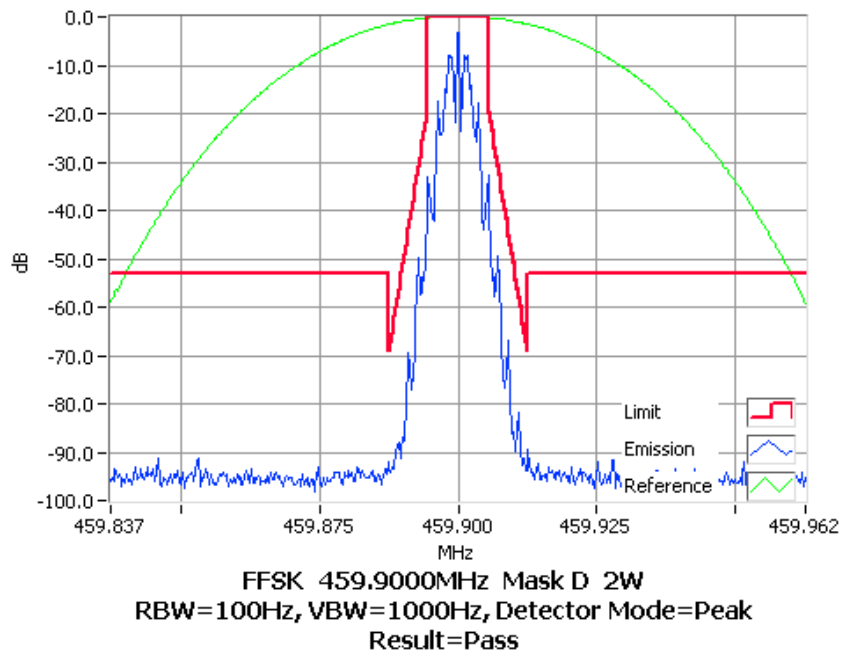
Tx FREQUENCY: 459.9 MHz 40 W

12.5 kHz Channel Spacing



Tx FREQUENCY: 459.9 MHz 2 W

12.5 kHz Channel Spacing



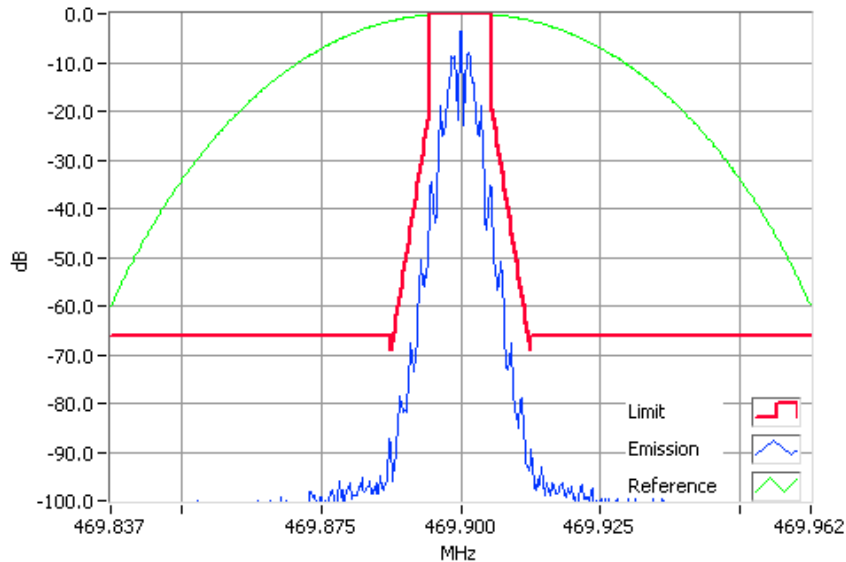
## Occupied Bandwidth and Spectrum Masks

SPECIFICATION: FCC CFR 2.1049 (c)

RSS-119 5.5

Tx FREQUENCY: 469.9 MHz 40 W

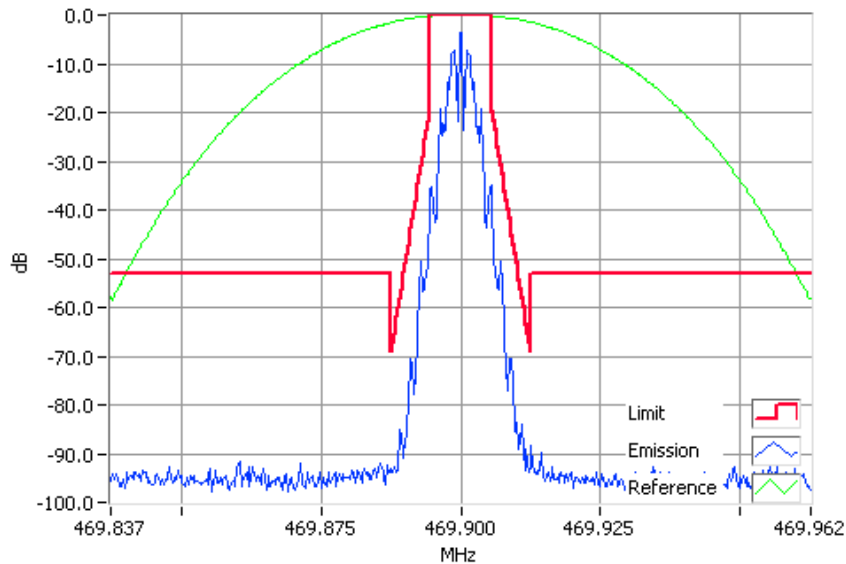
12.5 kHz Channel Spacing



FFSK 469.9000MHz Mask D 40W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 469.9 MHz 2 W

12.5 kHz Channel Spacing



FFSK 469.9000MHz Mask D 2W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

## TRANSMITTER SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATIONS: FCC 47 CFR 2.1051

RSS-119 5.8

GUIDE: TIA-102.CAAA-C 2.2.7

### MEASUREMENT PROCEDURE:

1. Refer Annex A for equipment set up.
2. The frequency range examined was from the lowest frequency generated within the EUT, to a frequency higher than the 10<sup>th</sup> Harmonic: 100 kHz to Fc-BW  
Fc+ BW to 10Fc GHz
3. A Pre-scan is performed with a resolution bandwidth of 1 kHz, and a video bandwidth of 3 kHz. If any emissions are found to be within 20 dB of the limit a second measurement is made with the carrier modulated, and a resolution bandwidth of 10 kHz, and a video bandwidth of 30 kHz.

Spurious emissions which were attenuated by more than 20 dB below the limit were not recorded.

A photograph of the test set-up is included below.

### MEASUREMENT RESULTS:

See the tables and plots on the following pages for 12.5 kHz channel spacings.

LIMIT CLAUSES: FCC 47 CFR 90.210

RSS-119 5.8

Photo: Conducted Emissions Test Setup



# Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051

RSS-119 5.8

Tx FREQUENCY: 406.2 MHz

12.5 kHz Channel Spacing

406.2 MHz @ 40 W

Emission Mask D

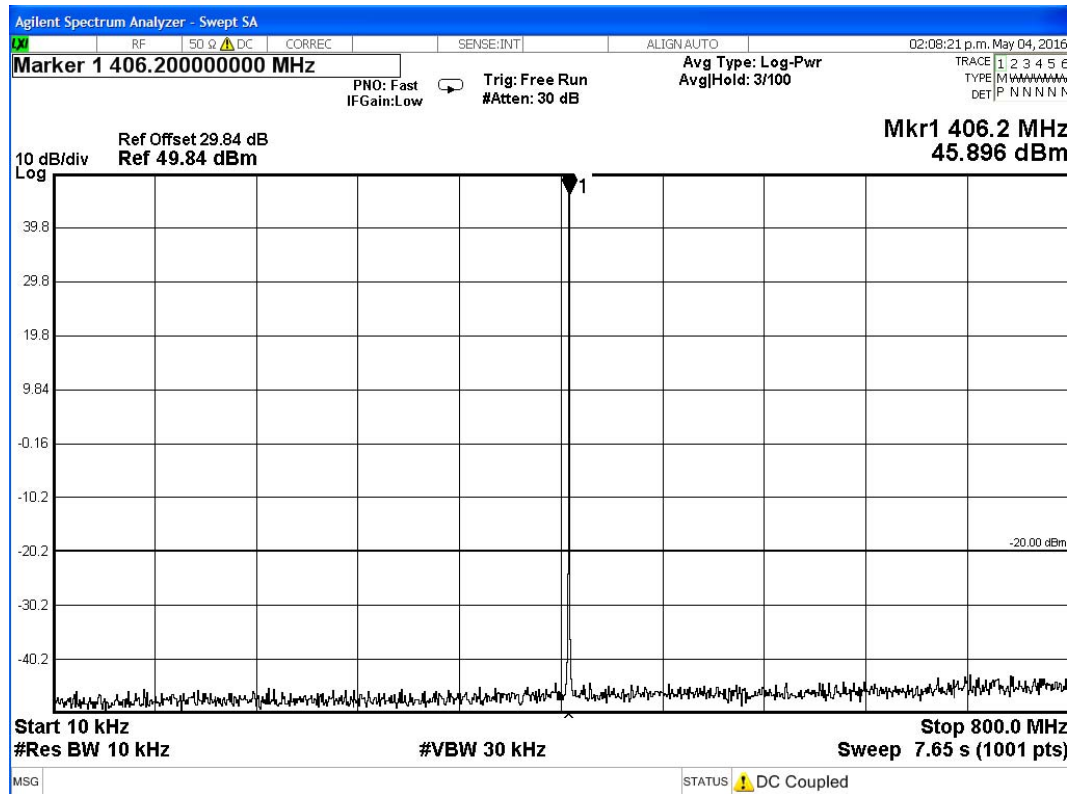
| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| ~                        | ~           | ~           |

12.5 kHz Channel Spacing

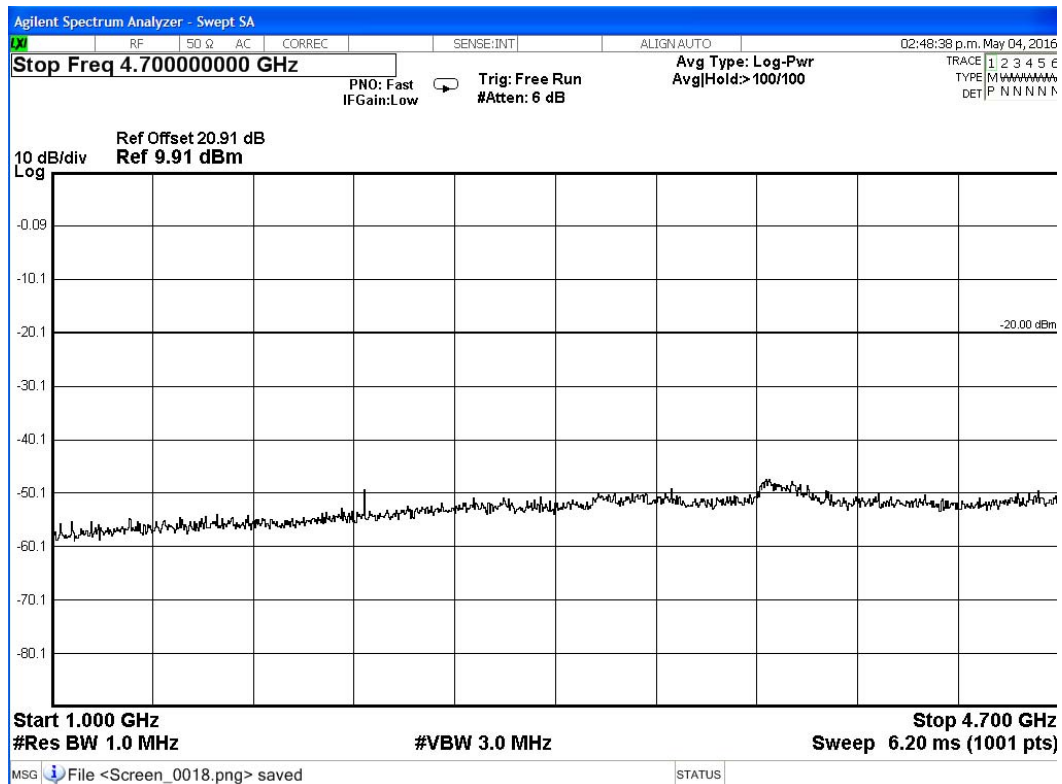
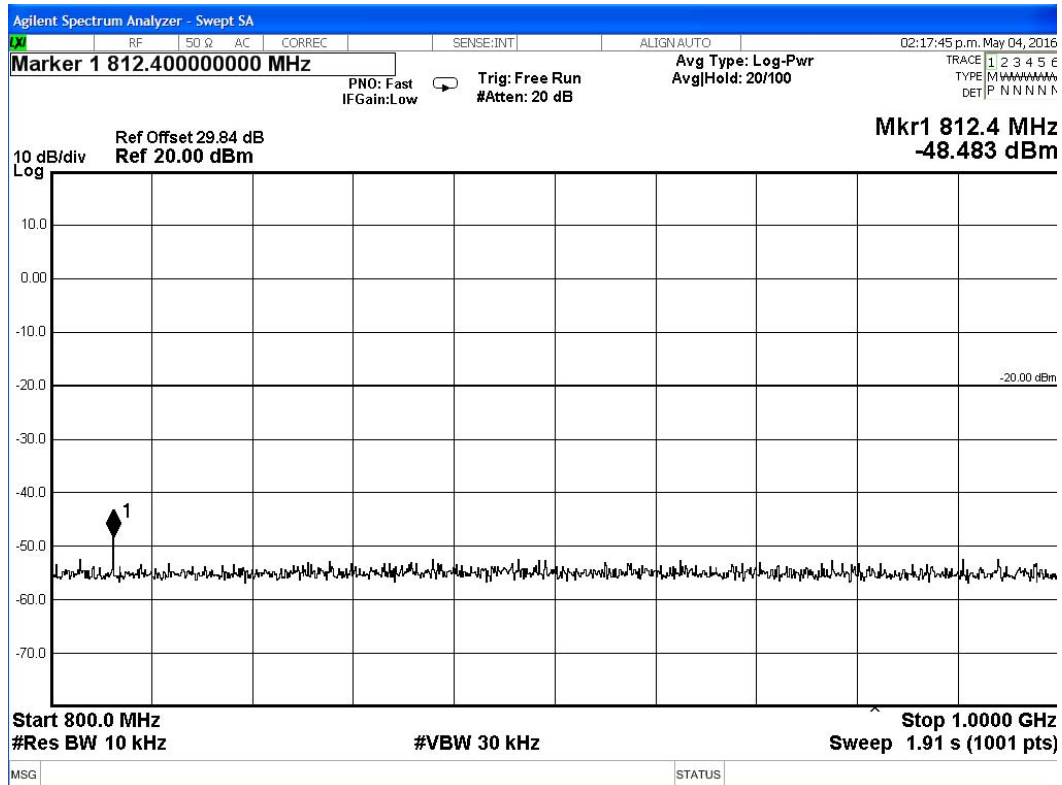
406.2 MHz @ 2 W

Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |



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# Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051

RSS-119 5.8

12.5 kHz Channel Spacing

418.1 MHz @ 40 W

Emission Mask D

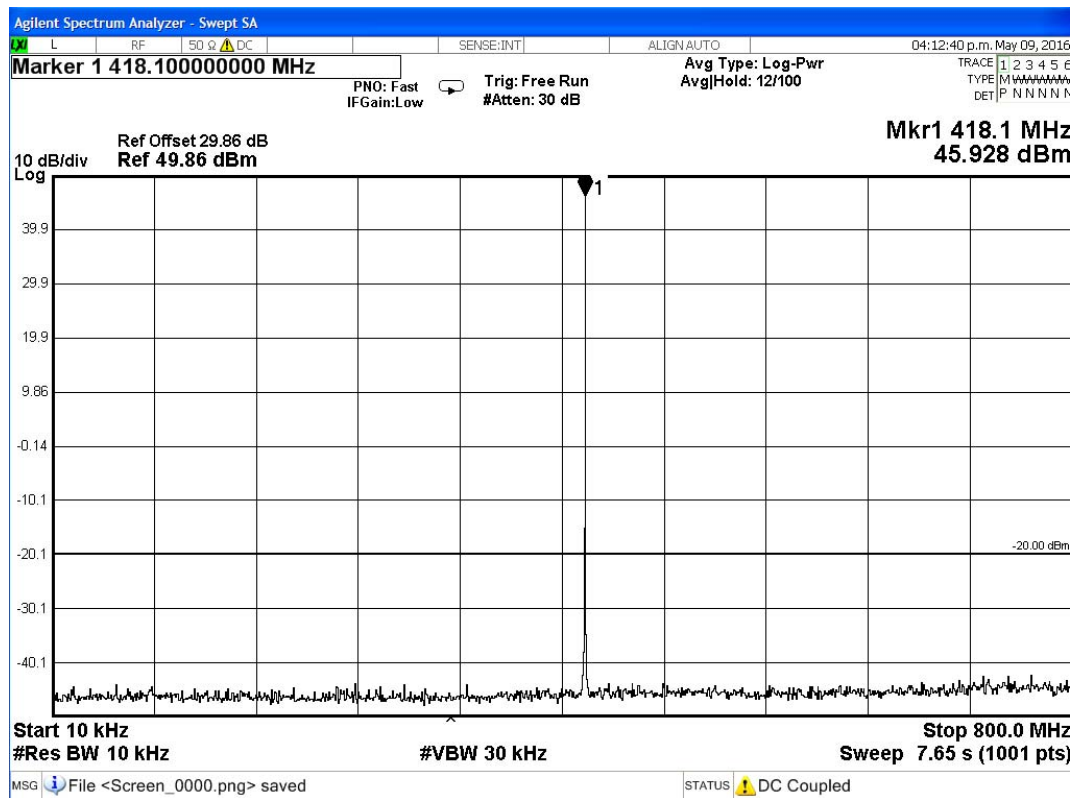
| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| ~                        | ~           | ~           |

12.5 kHz Channel Spacing

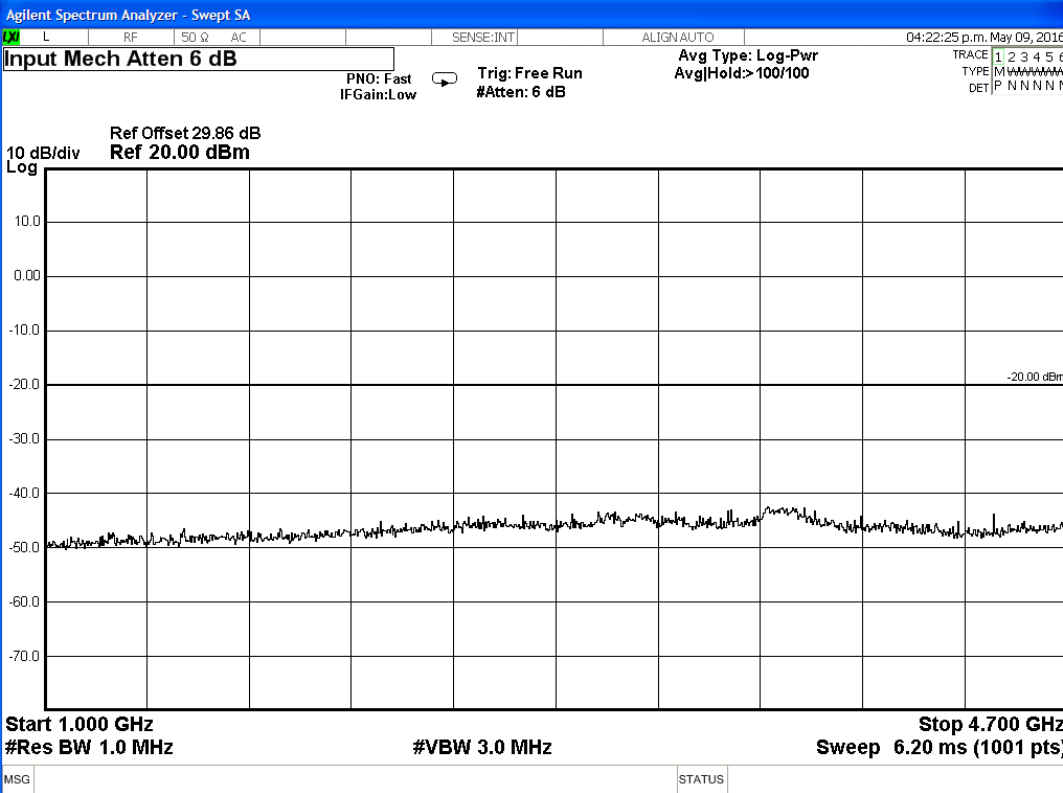
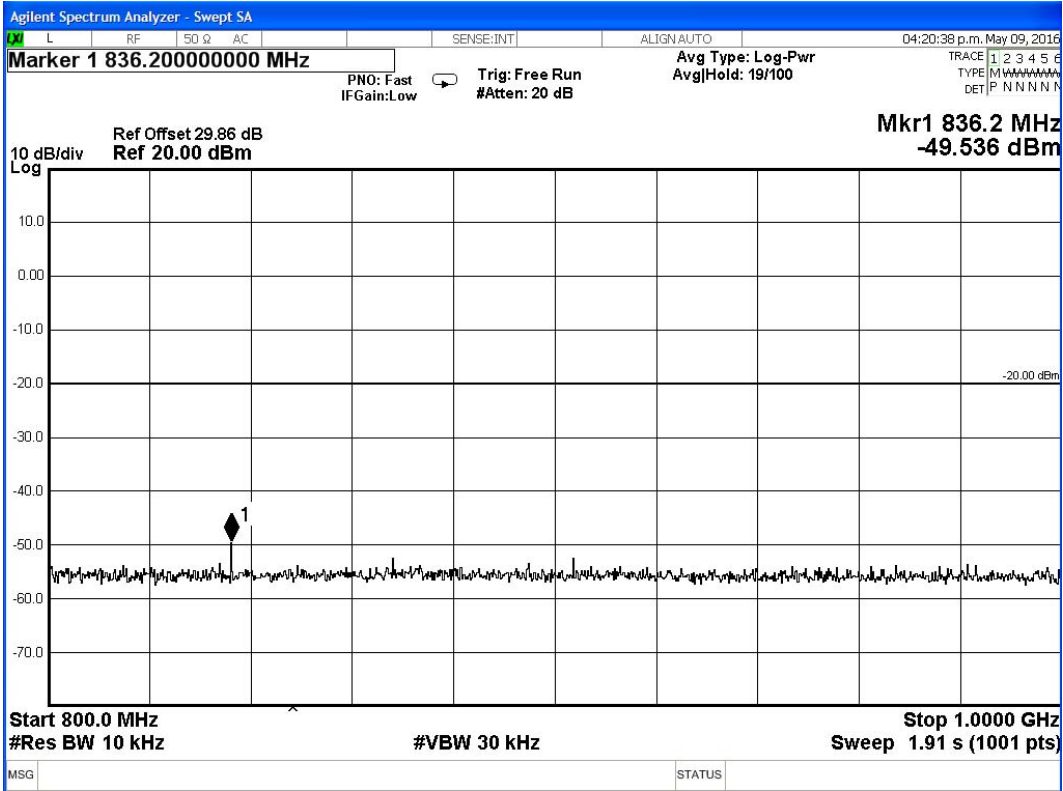
418.1 MHz @ 2 W

Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |



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## Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051

RSS-119 5.8

12.5 kHz Channel Spacing

429.9 MHz @ 40 W

Emission Mask D

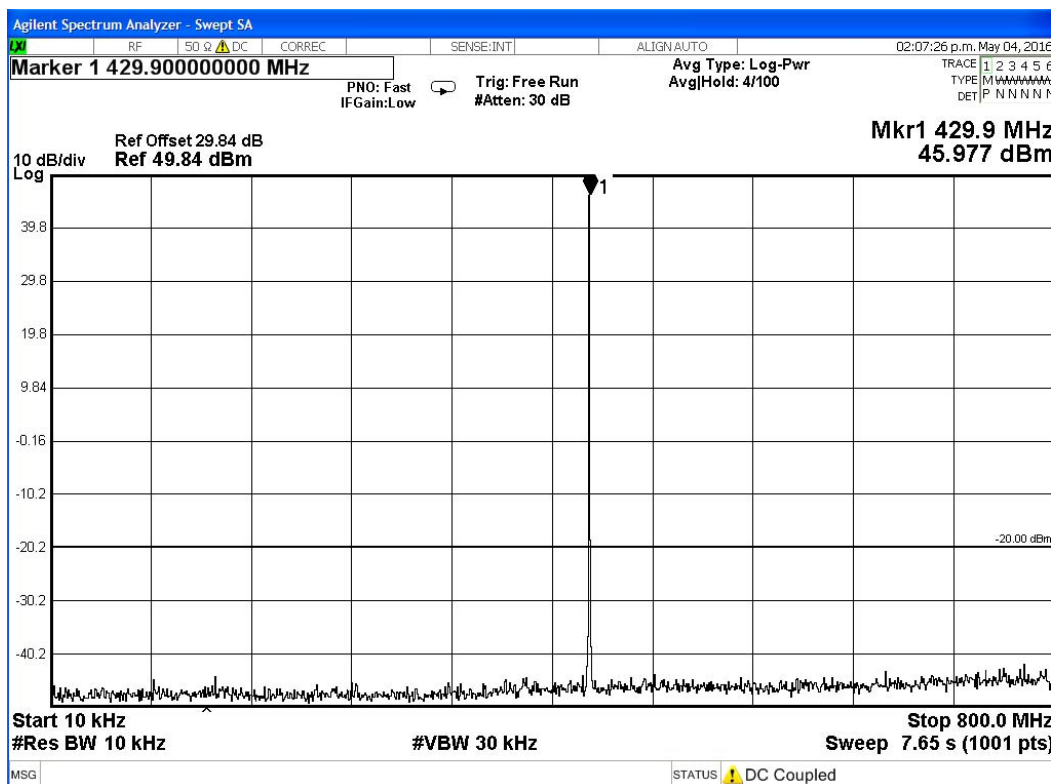
| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| ~                        | ~           | ~           |

12.5 kHz Channel Spacing

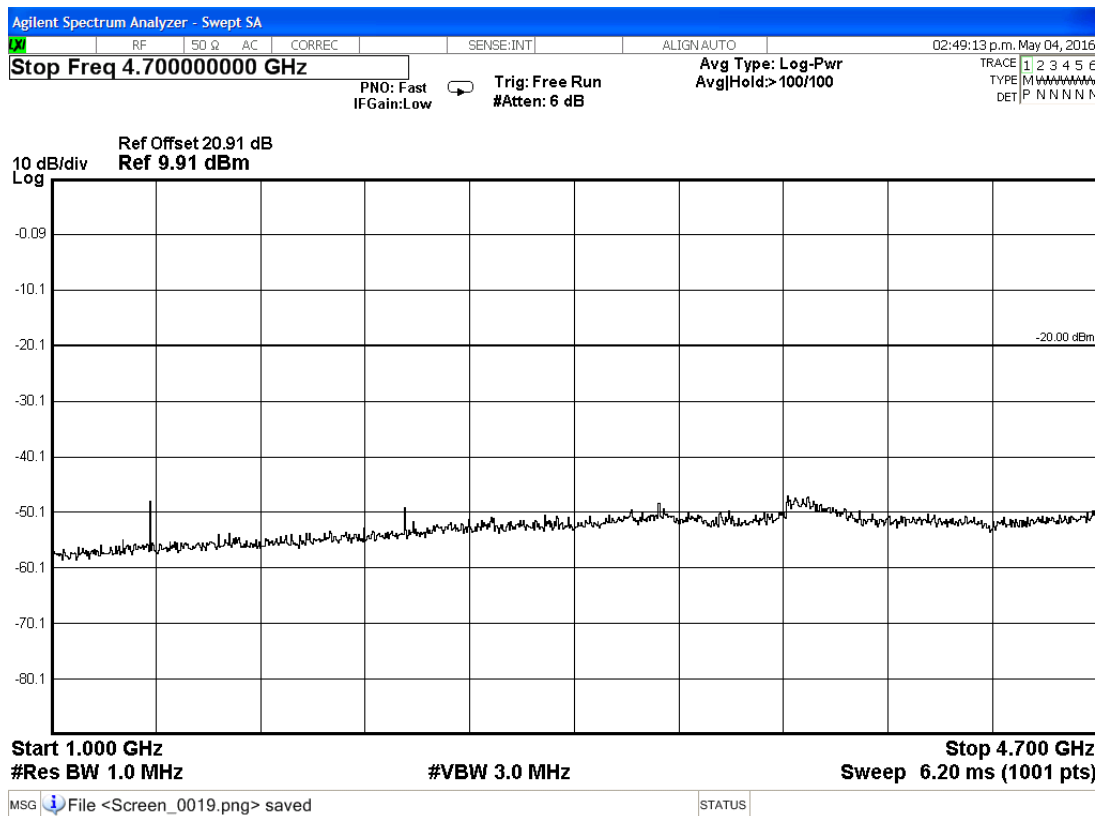
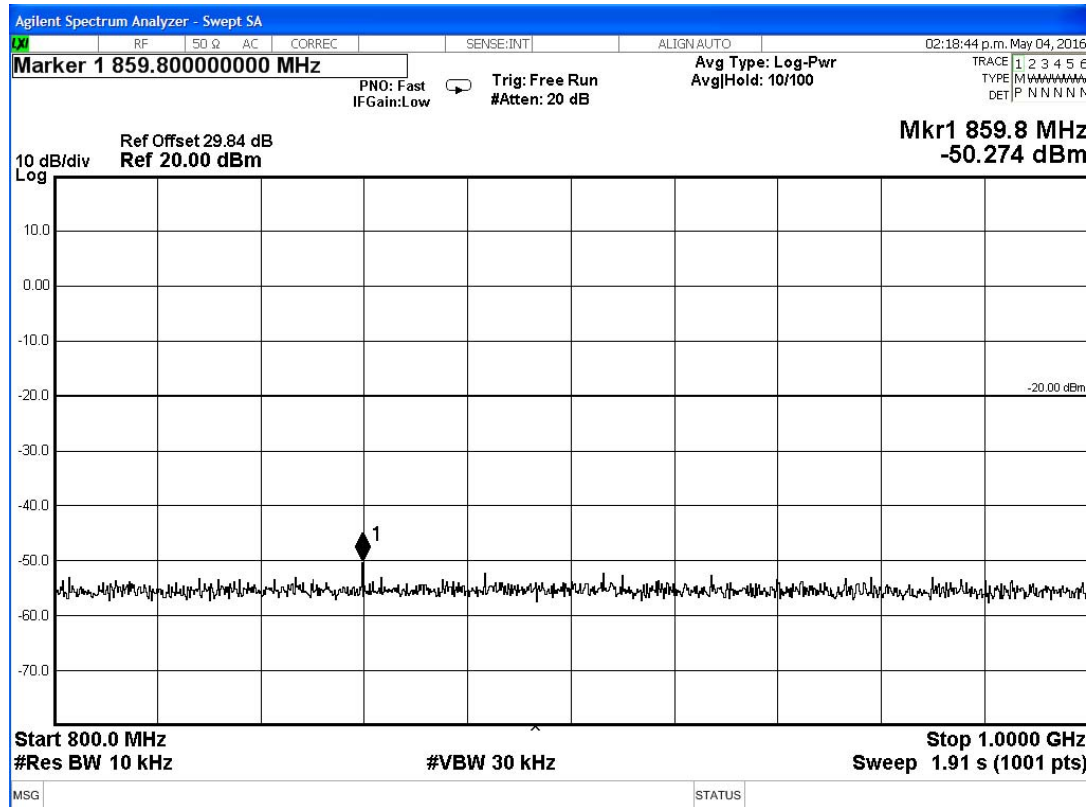
429.9 MHz @ 2 W

Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |



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Spurious Emissions (Tx Conducted)

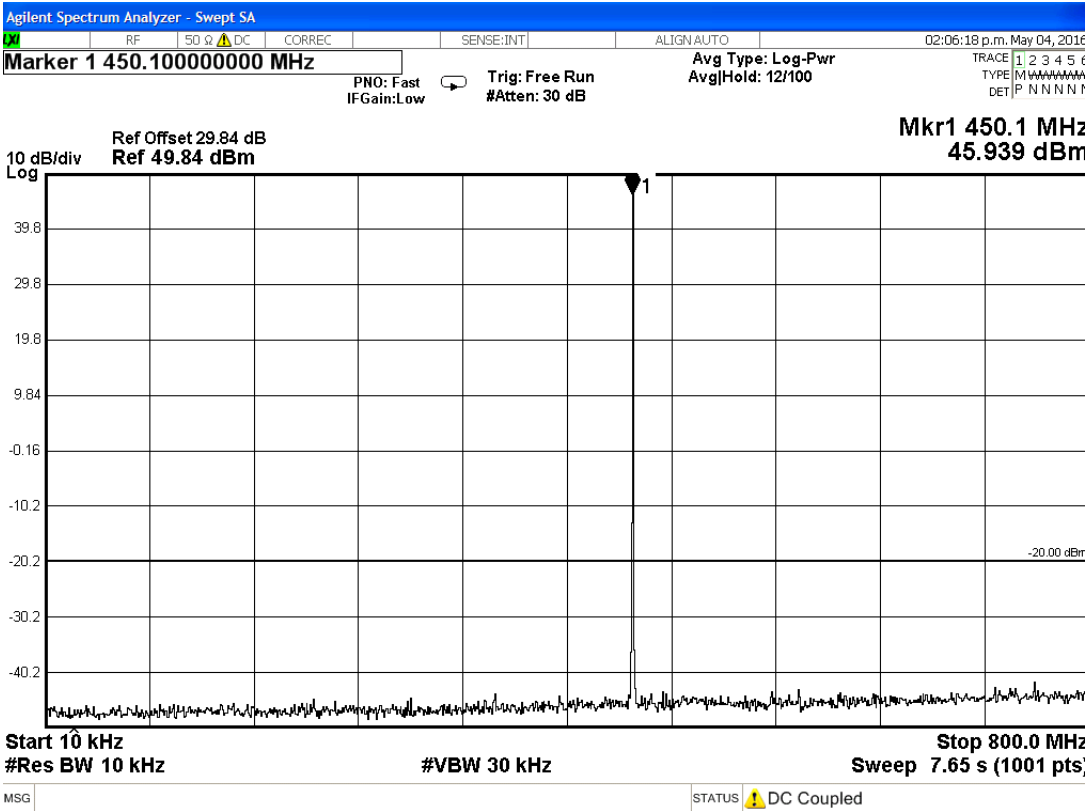
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

12.5 kHz Channel Spacing 450.1 MHz @ 40 W Emission Mask D

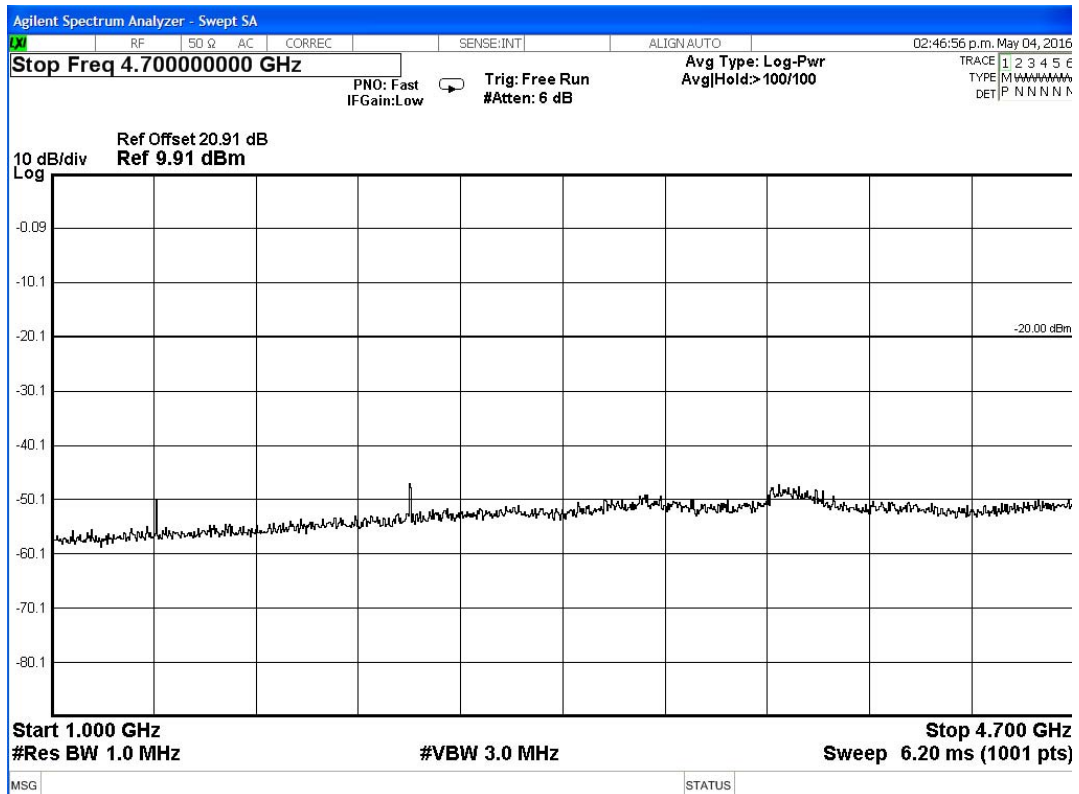
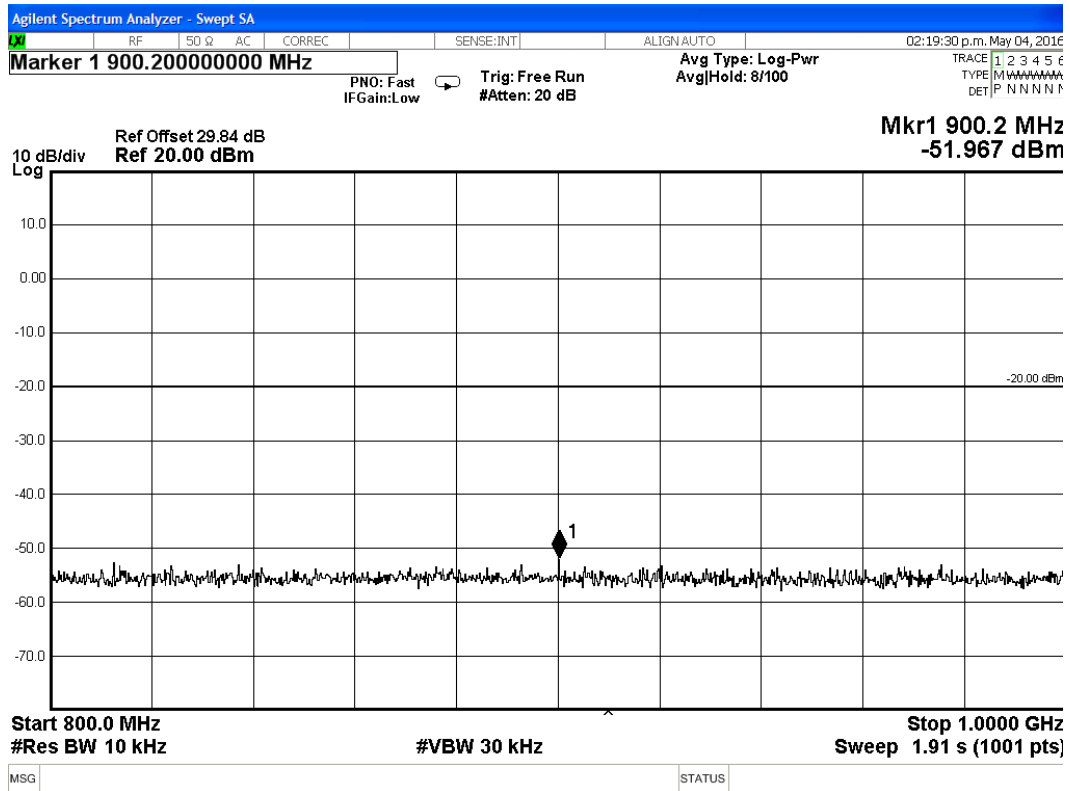
| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| ~                        | ~           | ~           |

12.5 kHz Channel Spacing 450.1 MHz @ 2 W Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |



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Spurious Emissions (Tx Conducted)

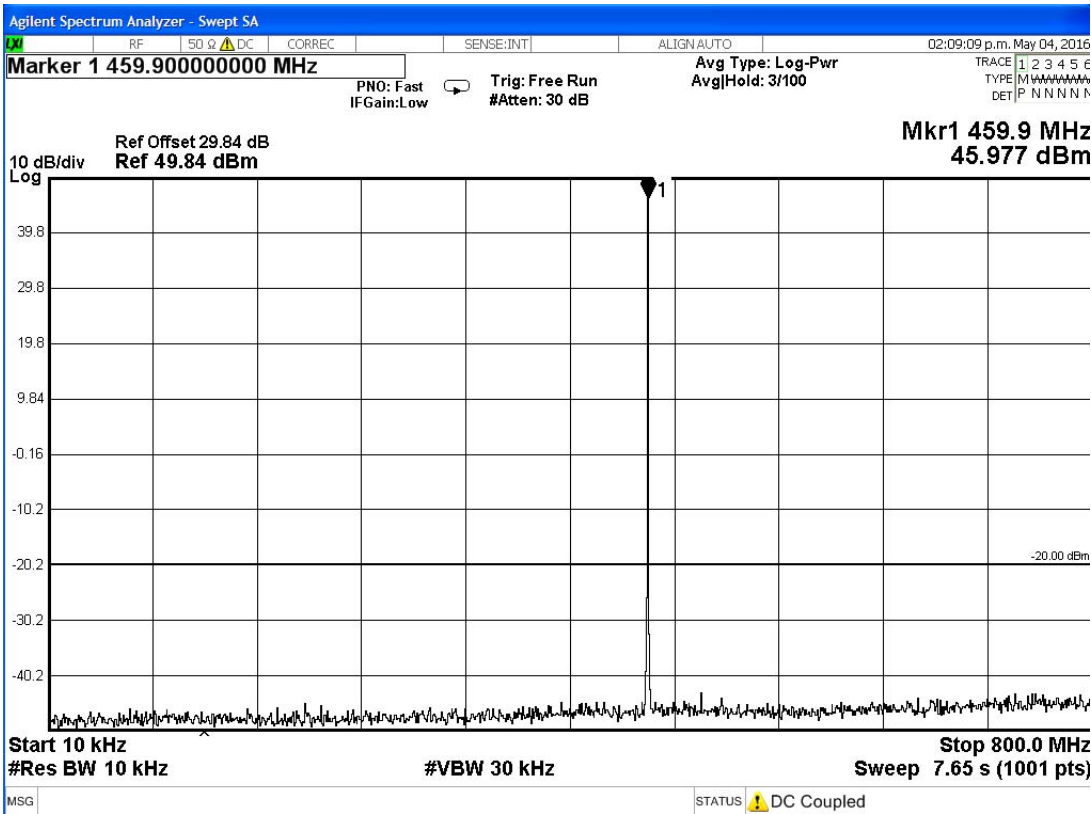
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

12.5 kHz Channel Spacing 459.9 MHz @ 40 W Emission Mask D

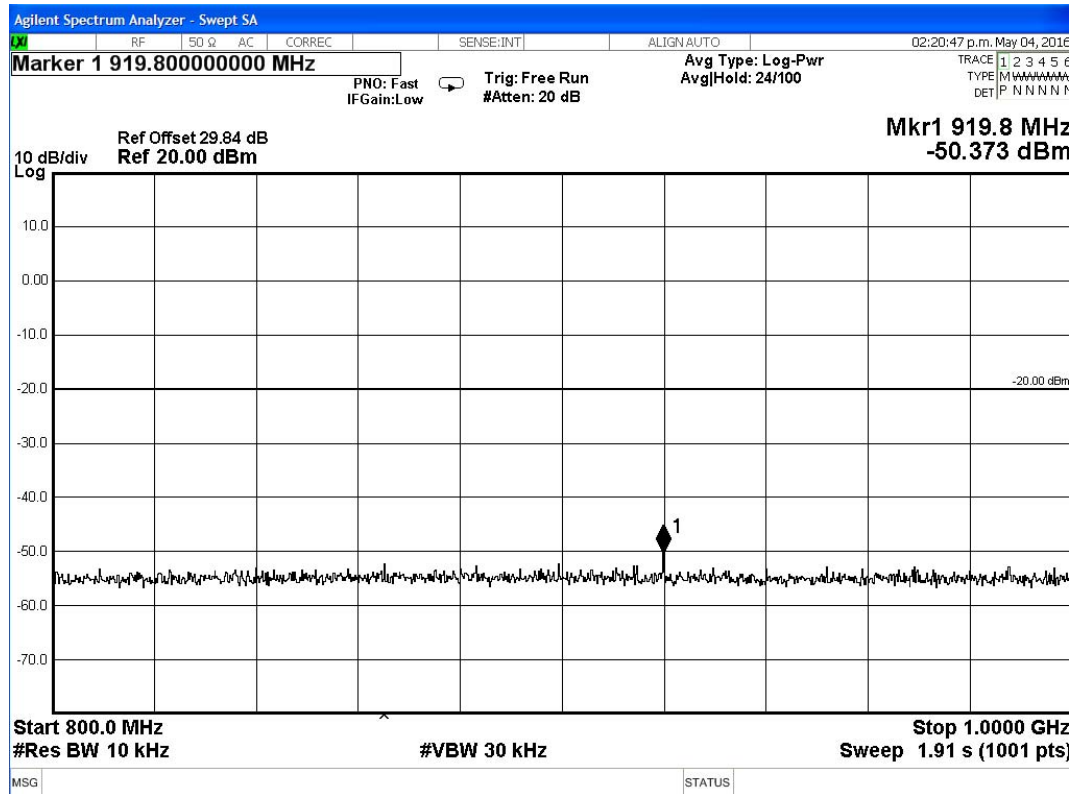
| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| ~                        | ~           | ~           |

12.5 kHz Channel Spacing 459.9 MHz @ 2 W Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |



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Spurious Emissions (Tx Conducted)

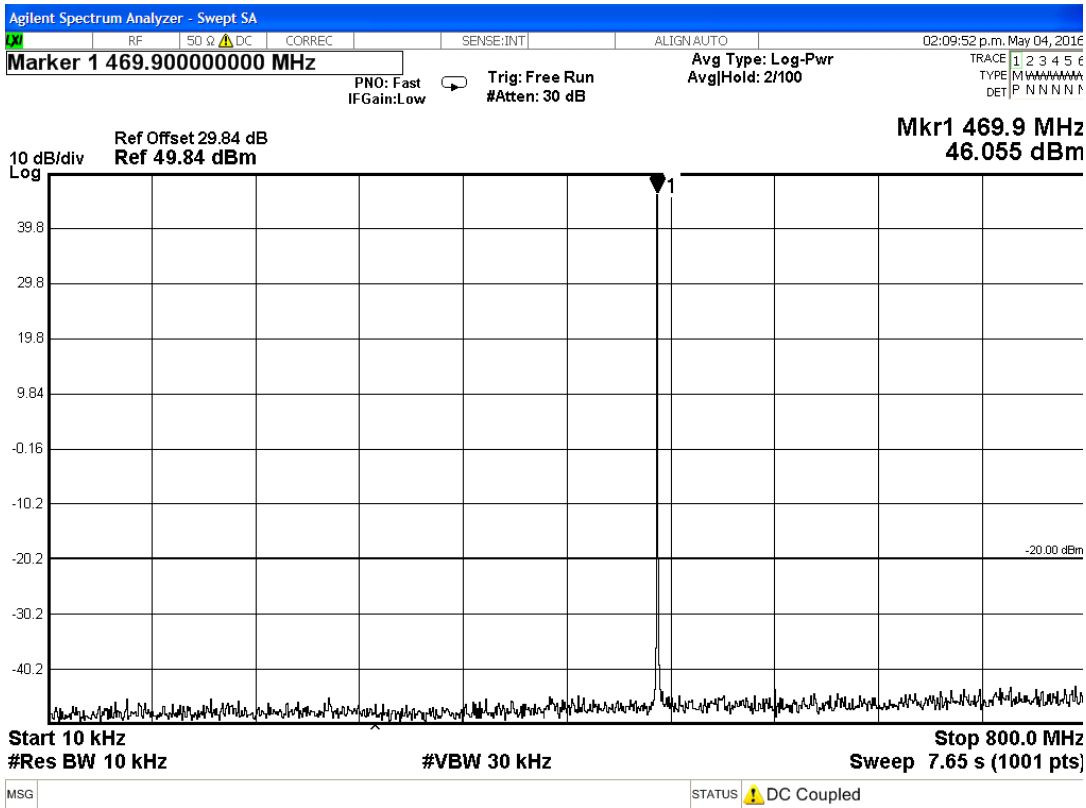
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

12.5 kHz Channel Spacing 469.9 MHz @ 40 W Emission Mask D

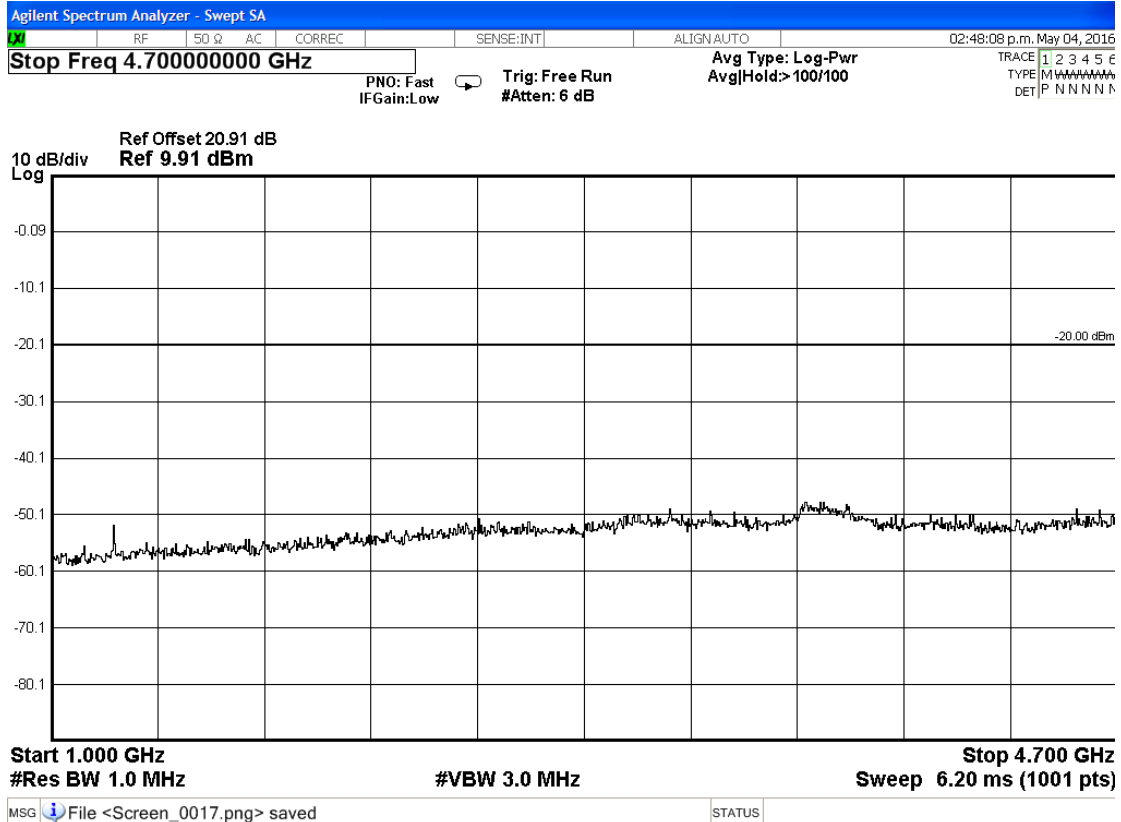
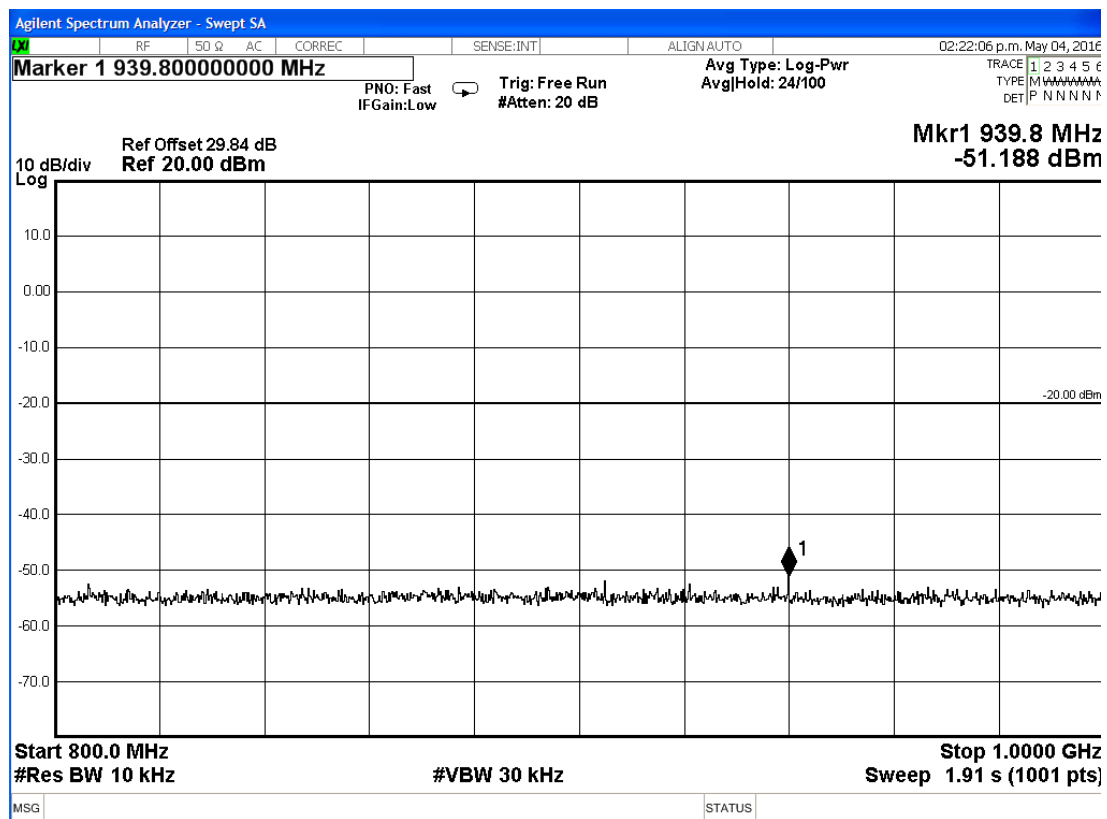
| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| ~                        | ~           | ~           |

12.5 kHz Channel Spacing 469.9 MHz @ 2 W Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |



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Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

LIMITS: FCC 47 CFR 90.210 RSS-119 5.8

| Carrier Output Power | Emission Mask D<br>12.5 kHz Channel Spacing<br>$50 + 10 \log_{10} (P_{\text{Watts}})$ |     |
|----------------------|---------------------------------------------------------------------------------------|-----|
|                      | -20 dBm                                                                               | dBc |
| 40 W                 | -20 dBm                                                                               | dBc |
| 2 W                  | -20 dBm                                                                               | dBc |

## TRANSMITTER SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC 47 CFR 2.1053

GUIDE: TIA-102.CAAA-C 2.2.6

### MEASUREMENT PROCEDURE:

#### Initial Scan:

1. The EUT is placed in the S-Line TEM cell and emissions are measured from 30 MHz to 800 MHz. Any emission within 20 dB of the limit is then re-tested on the OATS.
2. The EUT is placed in the reverberation chamber and emissions are measured from 800 MHz to the upper frequency required. Any emission within 20 dB of the limit is then re-tested on the OATS.
3. The harmonics emissions up to the 6<sup>th</sup> harmonic of the fundamental frequency are measured on the OATS

#### OATS Measurement:

1. The EUT is placed on a wooden turntable at a distance of three metres from the test antenna. The output terminal is connected to an RF dummy load.
2. The test antenna is raised from 1 m to 4 m to obtain a maximum reading; the turntable is then rotated through 360° to obtain the maximum response of each spurious emission. Valid emissions are determined by switching the EUT on and off.
3. The EUT is then replaced by a signal generator and substitution antenna to make measurements by the substitution method.

### MEASUREMENT RESULTS:

See the tables on the following pages

LIMIT CLAUSE: FCC 47 CFR 90.210

### Spurious Emissions (Tx Radiated)

SPECIFICATION: FCC CFR 2.1053

Tx FREQUENCY: 406.2 MHz

12.5 kHz Channel Spacing

406.2 MHz @ 40 W

Emission Mask D

| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| ~                        | ~           | ~           |
|                          |             |             |

12.5 kHz Channel Spacing

406.2 MHz @ 2 W

Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
|                                                                           |             |             |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |

Tx FREQUENCY: 418.1 MHz

12.5 kHz Channel Spacing

418.1 MHz @ 40 W

Emission Mask D

| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| ~                        | ~           | ~           |
|                          |             |             |

12.5 kHz Channel Spacing

418.1 MHz @ 2 W

Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
|                                                                           |             |             |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |

Tx FREQUENCY: 429.9 MHz

12.5 kHz Channel Spacing

429.9 MHz @ 40 W

Emission Mask D

| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| ~                        | ~           | ~           |
|                          |             |             |

12.5 kHz Channel Spacing

429.9 MHz @ 2 W

Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
|                                                                           |             |             |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |

Tx FREQUENCY: 450.1 MHz

12.5 kHz Channel Spacing

450.1 MHz @ 40 W

Emission Mask D

| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| ~                        | ~           | ~           |
|                          |             |             |

12.5 kHz Channel Spacing

450.1 MHz @ 2 W

Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
|                                                                           |             |             |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |

Tx FREQUENCY: 459.9 MHz

12.5 kHz Channel Spacing 459.9 MHz @ 40 W Emission Mask D

| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| ~                        | ~           | ~           |
|                          |             |             |

12.5 kHz Channel Spacing 459.9 MHz @ 2 W Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
|                                                                           |             |             |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |

Tx FREQUENCY: 469.9 MHz

12.5 kHz Channel Spacing 469.9 MHz @ 40 W Emission Mask D

| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| ~                        | ~           | ~           |
|                          |             |             |

12.5 kHz Channel Spacing 469.9 MHz @ 2 W Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
|                                                                           |             |             |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |

LIMITS: FCC CFR 2.1053

| Carrier Output Power | Emission Mask D<br>12.5 kHz Channel Spacing<br>$50 + 10 \log_{10}(P_{\text{Watts}})$ |     |
|----------------------|--------------------------------------------------------------------------------------|-----|
| 40 W                 | -20 dBm                                                                              | dBc |
| 2 W                  | -20 dBm                                                                              | dBc |

Tx Radiated Emissions - Continued

Open Area Test Site Results:

12.5 kHz Channel Spacing

450.1 MHz @ 40 W

Emission Mask D

| Harmonics<br>Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|---------------------------------------|-------------|-------------|
| 900.200000                            | -48.42      | -94.42      |
| 1350.300000                           | -55.93      | -101.93     |
| 1800.400000                           | -66.86      | -112.86     |
| 2250.500000                           | -77.13      | -123.13     |
| 2700.600000                           | -67.42      | -113.42     |
|                                       |             |             |

Photo: OATS Setup



## TRANSIENT FREQUENCY BEHAVIOR

SPECIFICATION: FCC 47 CFR 90.214

RSS-119 5.9

GUIDE: TIA-102.CAAA-C 2.2.18

### MEASUREMENT PROCEDURE:

1. Refer Annex A for equipment set up.
2. Measurements and plots were made following the TIA procedure.

### MEASUREMENT RESULTS:

See the tables and plots on the following pages for 12.5 kHz channel spacings.

LIMIT CLAUSES: FCC 47 CFR 90.214

RSS-119 5.9

## Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

RSS-119 5.9

Tx FREQUENCY: 406.2 MHz

40 W

12.5 kHz Channel Spacing

406.2 MHz @ 40 W Tx

| TRANSIENT RESPONSE PERIOD | CARRIER PEAK VARIATION FROM NORMAL |               |
|---------------------------|------------------------------------|---------------|
|                           | Key ON (kHz)                       | Key OFF (kHz) |
| t1                        | -0.6                               | N/A           |
| t2                        | -0.5                               | N/A           |
| t3                        | N/A                                | 0.2           |

|                                                                                                                     |     |                          |
|---------------------------------------------------------------------------------------------------------------------|-----|--------------------------|
| Confirm that during periods t1 and t3 the frequency difference does not exceed the value of one channel separation. | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |
| Confirm that during the period t2 the frequency difference does not exceed half a channel separation.               | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |
| Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.         | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |

LIMIT: FCC 47 CFR 90.214

| TRANSIENT PERIODS | FREQUENCY RANGE   |                   |
|-------------------|-------------------|-------------------|
|                   | 150 MHz – 174 MHz | 421 MHz – 512 MHz |
| t1 (ms)           | 5 ms              | 10 ms             |
| t2 (ms)           | 20 ms             | 25 ms             |
| t3 (ms)           | 5 ms              | 10 ms             |

LIMIT: RSS-119 5.9

| Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels |                              |                 |                 |
|--------------------------------------------------------------------------------------|------------------------------|-----------------|-----------------|
| TRANSIENT PERIODS                                                                    | Maximum Frequency Difference | FREQUENCY RANGE |                 |
|                                                                                      |                              | 138 – 174 MHz   | 406.1 – 470 MHz |
| t1 (ms)                                                                              | ± 12.5 kHz                   | 5 ms            | 10 ms           |
| t2 (ms)                                                                              | ± 6.25 kHz                   | 20 ms           | 25 ms           |
| t3 (ms)                                                                              | ± 12.5 kHz                   | 5 ms            | 10 ms           |

Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

### Transient Frequency Behaviour

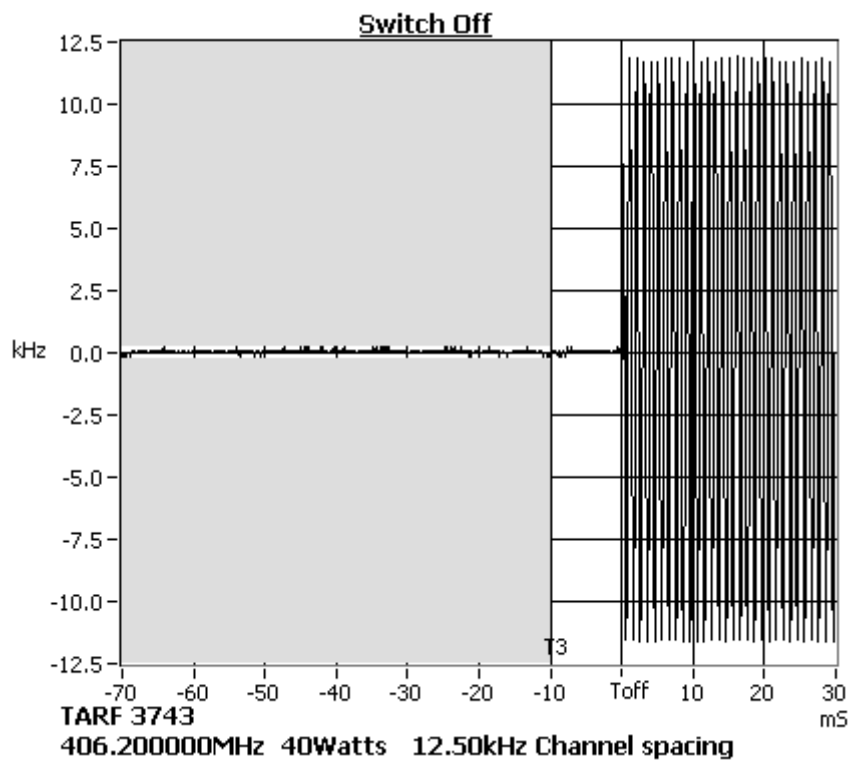
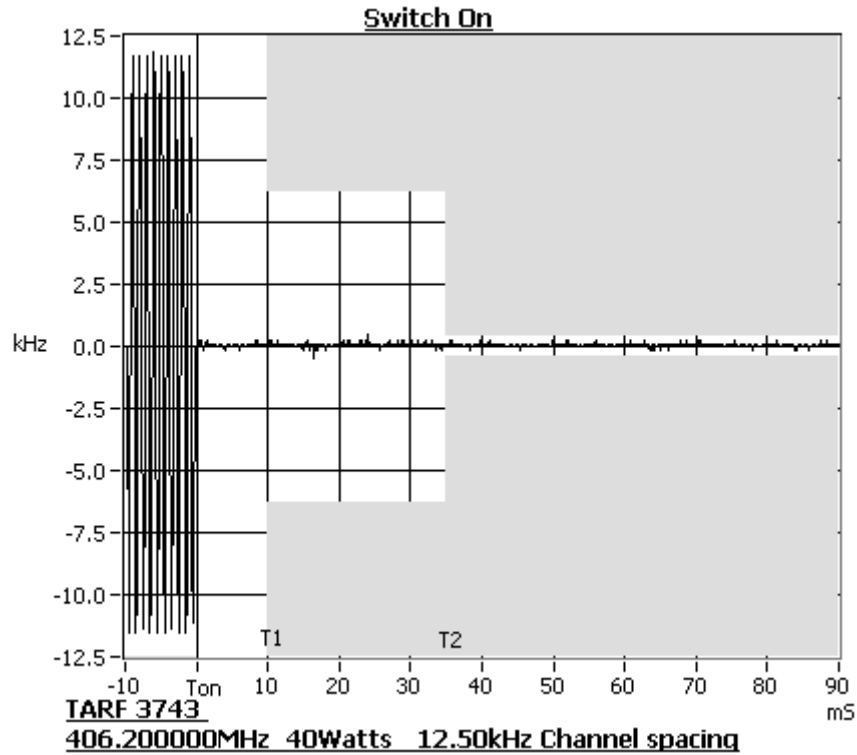
SPECIFICATION: FCC 47 CFR 90.214

RSS-119 5.9

Tx FREQUENCY: 406.2 MHz

40 W

12.5 kHz Channel Spacing



## Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 418.1 MHz 40 W 12.5 kHz Channel Spacing

418.1 MHz @ 40 W Tx

| TRANSIENT RESPONSE PERIOD | CARRIER PEAK VARIATION FROM NORMAL |               |
|---------------------------|------------------------------------|---------------|
|                           | Key ON (kHz)                       | Key OFF (kHz) |
| t1                        | 0.4                                | N/A           |
| t2                        | 0.3                                | N/A           |
| t3                        | N/A                                | -0.5          |

|                                                                                                                     |     |                          |
|---------------------------------------------------------------------------------------------------------------------|-----|--------------------------|
| Confirm that during periods t1 and t3 the frequency difference does not exceed the value of one channel separation. | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |
| Confirm that during the period t2 the frequency difference does not exceed half a channel separation.               | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |
| Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.         | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |

LIMIT: FCC 47 CFR 90.214

| TRANSIENT PERIODS | FREQUENCY RANGE   |                   |
|-------------------|-------------------|-------------------|
|                   | 150 MHz – 174 MHz | 421 MHz – 512 MHz |
| t1 (ms)           | 5 ms              | 10 ms             |
| t2 (ms)           | 20 ms             | 25 ms             |
| t3 (ms)           | 5 ms              | 10 ms             |

LIMIT: RSS-119 5.9

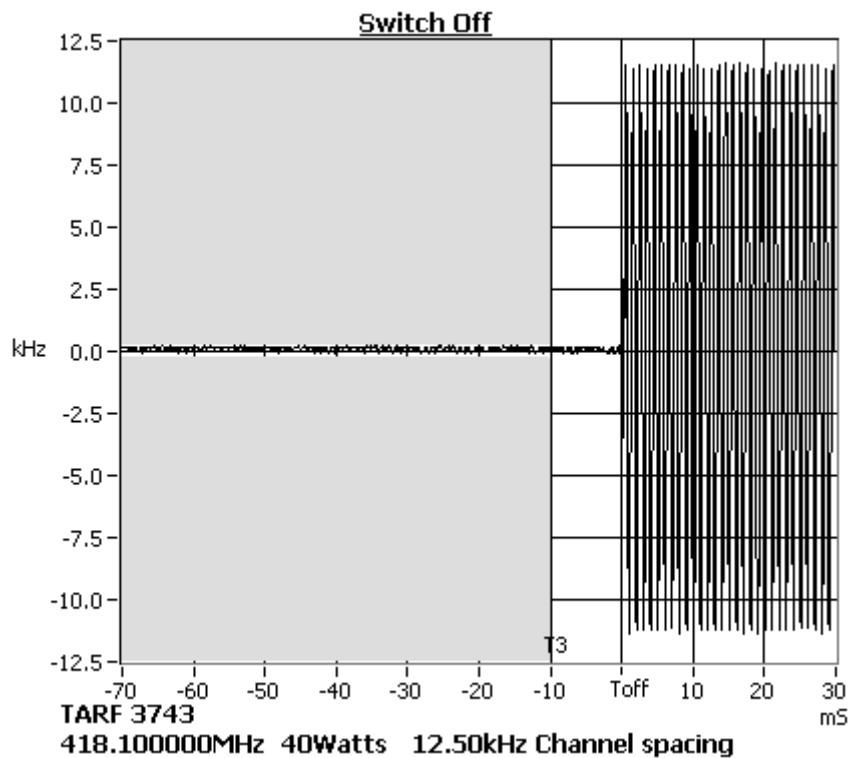
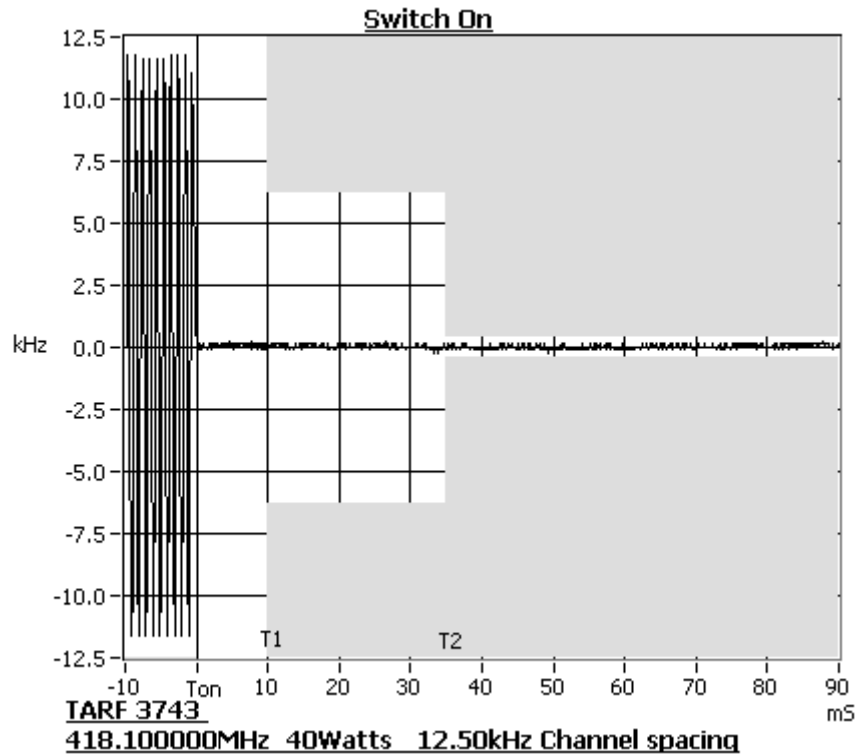
| Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels |                              |                 |                 |
|--------------------------------------------------------------------------------------|------------------------------|-----------------|-----------------|
| TRANSIENT PERIODS                                                                    | Maximum Frequency Difference | FREQUENCY RANGE |                 |
|                                                                                      |                              | 138 – 174 MHz   | 406.1 – 470 MHz |
| t1 (ms)                                                                              | ± 12.5 kHz                   | 5 ms            | 10 ms           |
| t2 (ms)                                                                              | ± 6.25 kHz                   | 20 ms           | 25 ms           |
| t3 (ms)                                                                              | ± 12.5 kHz                   | 5 ms            | 10 ms           |

Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

### Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 418.1 MHz 40 W 12.5 kHz Channel Spacing



### Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 429.9 MHz 40 W 12.5 kHz Channel Spacing

429.9 MHz @ 40 W Tx

| TRANSIENT RESPONSE PERIOD | CARRIER PEAK VARIATION FROM NORMAL |               |
|---------------------------|------------------------------------|---------------|
|                           | Key ON (kHz)                       | Key OFF (kHz) |
| t1                        | 0.2                                | N/A           |
| t2                        | 0.2                                | N/A           |
| t3                        | N/A                                | 0.4           |

|                                                                                                                     |     |                          |
|---------------------------------------------------------------------------------------------------------------------|-----|--------------------------|
| Confirm that during periods t1 and t3 the frequency difference does not exceed the value of one channel separation. | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |
| Confirm that during the period t2 the frequency difference does not exceed half a channel separation.               | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |
| Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.         | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |

LIMIT: FCC 47 CFR 90.214

| TRANSIENT PERIODS | FREQUENCY RANGE   |                   |
|-------------------|-------------------|-------------------|
|                   | 150 MHz – 174 MHz | 421 MHz – 512 MHz |
| t1 (ms)           | 5 ms              | 10 ms             |
| t2 (ms)           | 20 ms             | 25 ms             |
| t3 (ms)           | 5 ms              | 10 ms             |

LIMIT: RSS-119 5.9

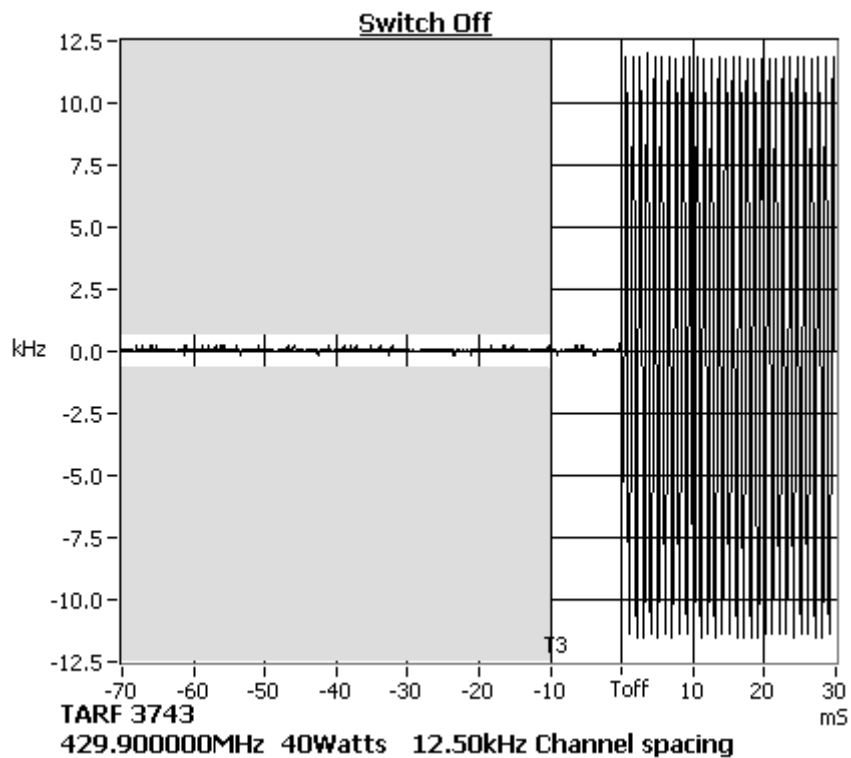
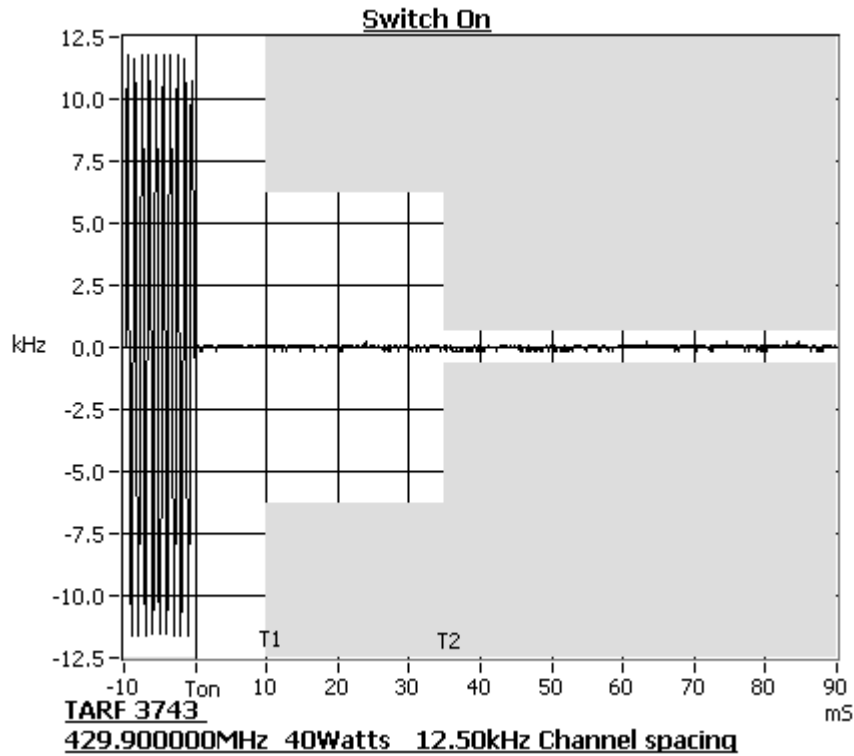
| Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels |                              |                 |                 |
|--------------------------------------------------------------------------------------|------------------------------|-----------------|-----------------|
| TRANSIENT PERIODS                                                                    | Maximum Frequency Difference | FREQUENCY RANGE |                 |
|                                                                                      |                              | 138 – 174 MHz   | 406.1 – 470 MHz |
| t1 (ms)                                                                              | ± 12.5 kHz                   | 5 ms            | 10 ms           |
| t2 (ms)                                                                              | ± 6.25 kHz                   | 20 ms           | 25 ms           |
| t3 (ms)                                                                              | ± 12.5 kHz                   | 5 ms            | 10 ms           |

Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

### Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 429.9 MHz      40 W      12.5 kHz Channel Spacing



## Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 450.1 MHz 40 W 12.5 kHz Channel Spacing

450.1 MHz @ 40 W Tx

| TRANSIENT RESPONSE PERIOD | CARRIER PEAK VARIATION FROM NORMAL |               |
|---------------------------|------------------------------------|---------------|
|                           | Key ON (kHz)                       | Key OFF (kHz) |
| t1                        | -0.4                               | N/A           |
| t2                        | -0.3                               | N/A           |
| t3                        | N/A                                | 0.2           |

|                                                                                                                     |     |                          |
|---------------------------------------------------------------------------------------------------------------------|-----|--------------------------|
| Confirm that during periods t1 and t3 the frequency difference does not exceed the value of one channel separation. | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |
| Confirm that during the period t2 the frequency difference does not exceed half a channel separation.               | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |
| Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.         | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |

LIMIT: FCC 47 CFR 90.214

| TRANSIENT PERIODS | FREQUENCY RANGE   |                   |
|-------------------|-------------------|-------------------|
|                   | 150 MHz – 174 MHz | 421 MHz – 512 MHz |
| t1 (ms)           | 5 ms              | 10 ms             |
| t2 (ms)           | 20 ms             | 25 ms             |
| t3 (ms)           | 5 ms              | 10 ms             |

LIMIT: RSS-119 5.9

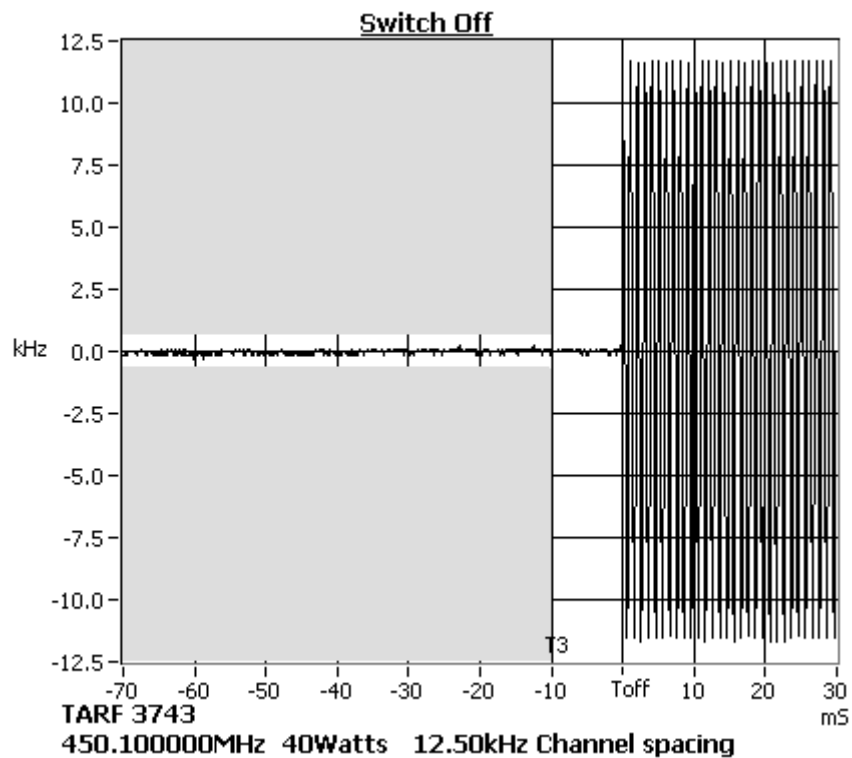
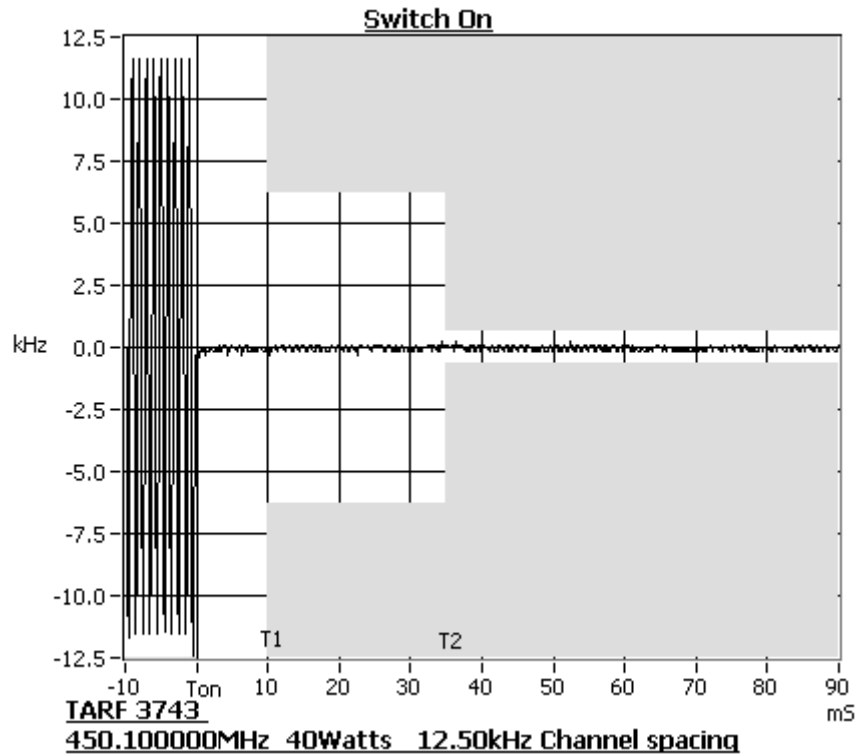
| Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels |                              |                 |                 |
|--------------------------------------------------------------------------------------|------------------------------|-----------------|-----------------|
| TRANSIENT PERIODS                                                                    | Maximum Frequency Difference | FREQUENCY RANGE |                 |
|                                                                                      |                              | 138 – 174 MHz   | 406.1 – 470 MHz |
| t1 (ms)                                                                              | ± 12.5 kHz                   | 5 ms            | 10 ms           |
| t2 (ms)                                                                              | ± 6.25 kHz                   | 20 ms           | 25 ms           |
| t3 (ms)                                                                              | ± 12.5 kHz                   | 5 ms            | 10 ms           |

Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

### Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 450.1 MHz      40 W      12.5 kHz Channel Spacing



### Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 459.9 MHz 40 W 12.5 kHz Channel Spacing

459.9 MHz @ 40 W Tx

| TRANSIENT RESPONSE PERIOD | CARRIER PEAK VARIATION FROM NORMAL |               |
|---------------------------|------------------------------------|---------------|
|                           | Key ON (kHz)                       | Key OFF (kHz) |
| t1                        | 0.4                                | N/A           |
| t2                        | -0.2                               | N/A           |
| t3                        | N/A                                | 0.7           |

|                                                                                                                     |     |                          |
|---------------------------------------------------------------------------------------------------------------------|-----|--------------------------|
| Confirm that during periods t1 and t3 the frequency difference does not exceed the value of one channel separation. | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |
| Confirm that during the period t2 the frequency difference does not exceed half a channel separation.               | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |
| Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.         | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |

LIMIT: FCC 47 CFR 90.214

| TRANSIENT PERIODS | FREQUENCY RANGE   |                   |
|-------------------|-------------------|-------------------|
|                   | 150 MHz – 174 MHz | 421 MHz – 512 MHz |
| t1 (ms)           | 5 ms              | 10 ms             |
| t2 (ms)           | 20 ms             | 25 ms             |
| t3 (ms)           | 5 ms              | 10 ms             |

LIMIT: RSS-119 5.9

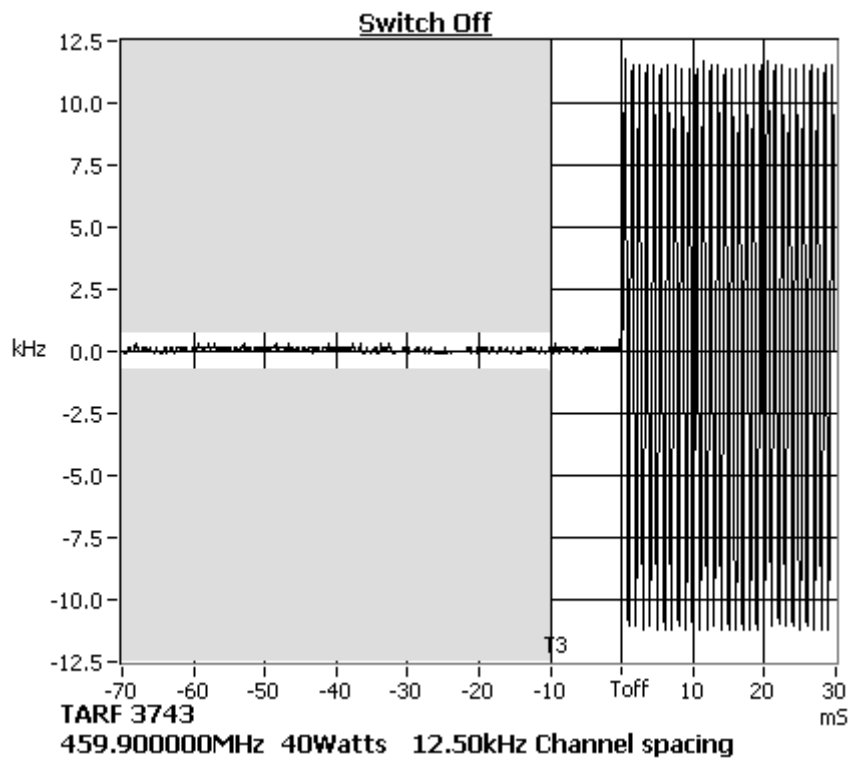
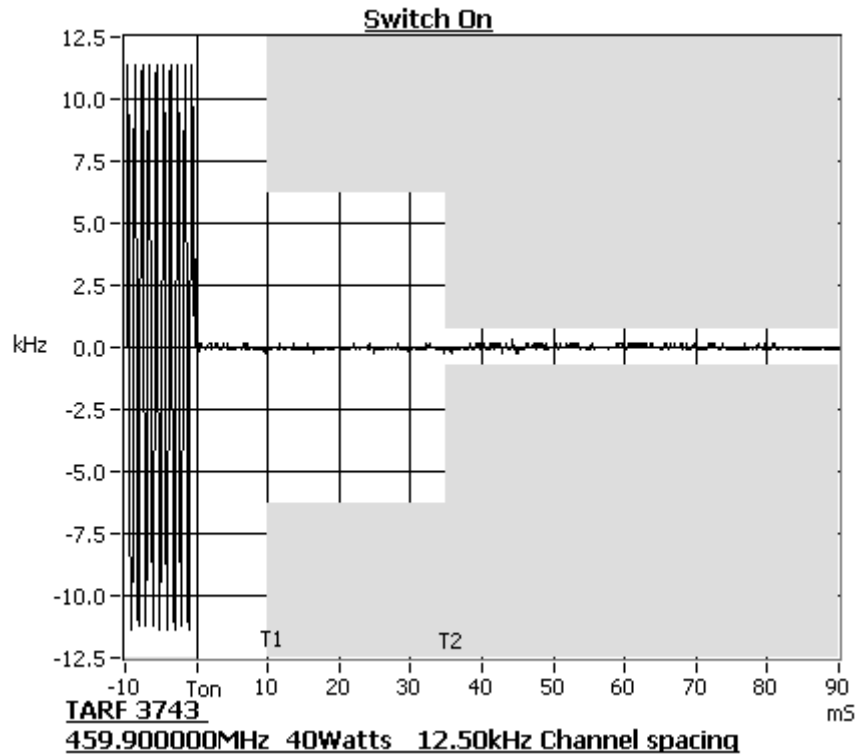
| Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels |                              |                 |                 |
|--------------------------------------------------------------------------------------|------------------------------|-----------------|-----------------|
| TRANSIENT PERIODS                                                                    | Maximum Frequency Difference | FREQUENCY RANGE |                 |
|                                                                                      |                              | 138 – 174 MHz   | 406.1 – 470 MHz |
| t1 (ms)                                                                              | ± 12.5 kHz                   | 5 ms            | 10 ms           |
| t2 (ms)                                                                              | ± 6.25 kHz                   | 20 ms           | 25 ms           |
| t3 (ms)                                                                              | ± 12.5 kHz                   | 5 ms            | 10 ms           |

Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

### Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 459.9 MHz      40 W      12.5 kHz Channel Spacing



### Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 469.9 MHz 40 W 12.5 kHz Channel Spacing

469.9 MHz @ 40 W Tx

| TRANSIENT RESPONSE PERIOD | CARRIER PEAK VARIATION FROM NORMAL |               |
|---------------------------|------------------------------------|---------------|
|                           | Key ON (kHz)                       | Key OFF (kHz) |
| t1                        | -0.4                               | N/A           |
| t2                        | -0.2                               | N/A           |
| t3                        | N/A                                | 0.7           |

|                                                                                                                     |     |                          |
|---------------------------------------------------------------------------------------------------------------------|-----|--------------------------|
| Confirm that during periods t1 and t3 the frequency difference does not exceed the value of one channel separation. | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |
| Confirm that during the period t2 the frequency difference does not exceed half a channel separation.               | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |
| Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.         | YES | NO                       |
|                                                                                                                     | ✓   | <input type="checkbox"/> |

LIMIT: FCC 47 CFR 90.214

| TRANSIENT PERIODS | FREQUENCY RANGE   |                   |
|-------------------|-------------------|-------------------|
|                   | 150 MHz – 174 MHz | 421 MHz – 512 MHz |
| t1 (ms)           | 5 ms              | 10 ms             |
| t2 (ms)           | 20 ms             | 25 ms             |
| t3 (ms)           | 5 ms              | 10 ms             |

LIMIT: RSS-119 5.9

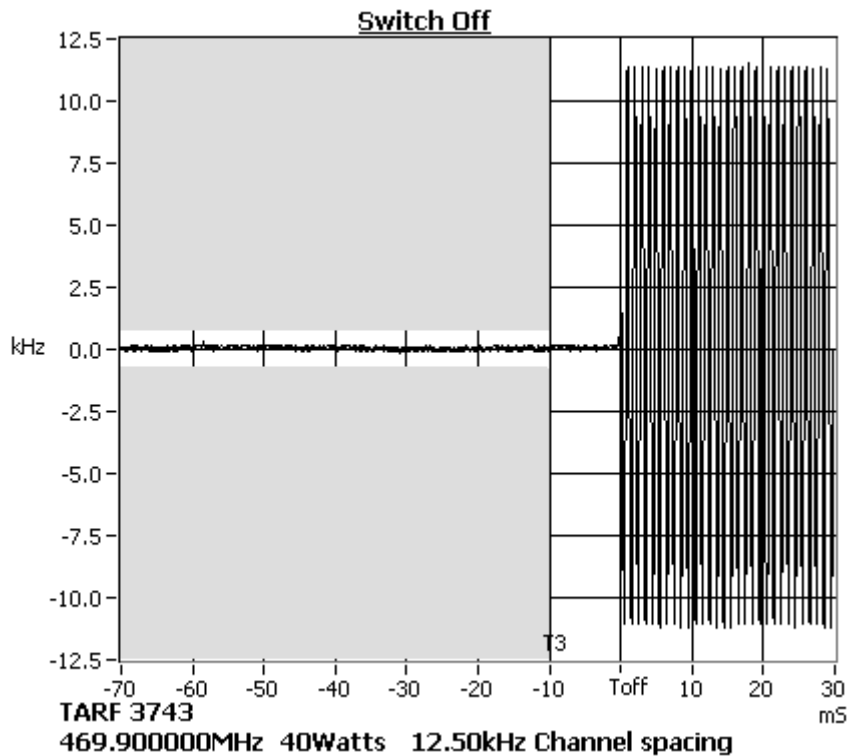
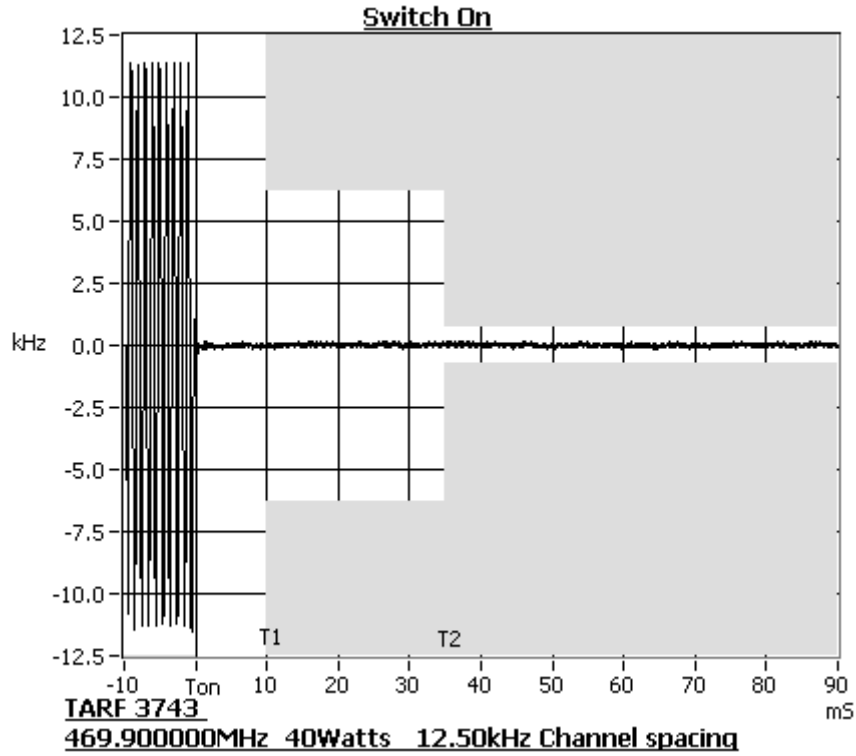
| Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels |                              |                 |                 |
|--------------------------------------------------------------------------------------|------------------------------|-----------------|-----------------|
| TRANSIENT PERIODS                                                                    | Maximum Frequency Difference | FREQUENCY RANGE |                 |
|                                                                                      |                              | 138 – 174 MHz   | 406.1 – 470 MHz |
| t1 (ms)                                                                              | ± 12.5 kHz                   | 5 ms            | 10 ms           |
| t2 (ms)                                                                              | ± 6.25 kHz                   | 20 ms           | 25 ms           |
| t3 (ms)                                                                              | ± 12.5 kHz                   | 5 ms            | 10 ms           |

Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

### Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 469.9 MHz      40 W      12.5 kHz Channel Spacing



## TRANSMITTER FREQUENCY STABILITY - TEMPERATURE

SPECIFICATION: FCC 47 CFR 2.1055 (a) (1)

RSS-119 5.3

GUIDE: TIA-102.CAAA-C 2.2.2

### MEASUREMENT PROCEDURE:

1. Refer Annex A for equipment set up.
2. The EUT was tested for frequency error from  $-30^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  in  $10^{\circ}\text{C}$  increments
3. The frequency error was recorded in parts per million (ppm).

### MEASUREMENT RESULTS:

See the plots on the following pages for 12.5 kHz & 25.0 kHz channel spacings.

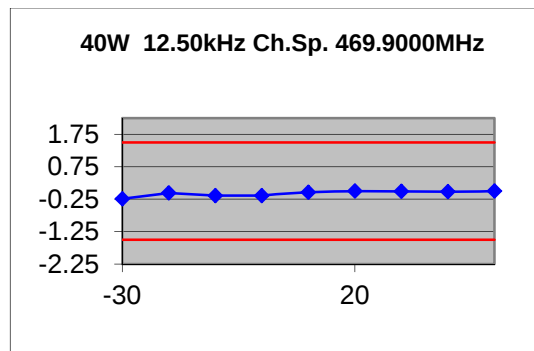
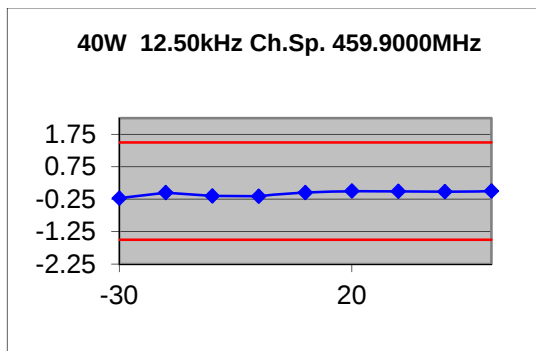
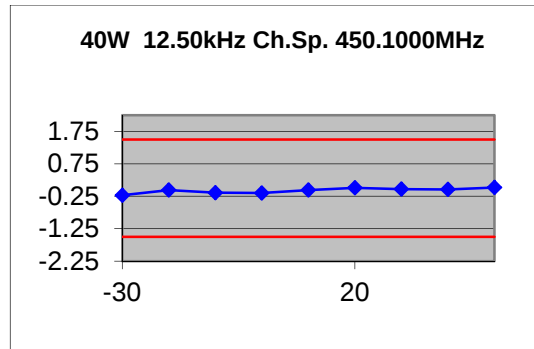
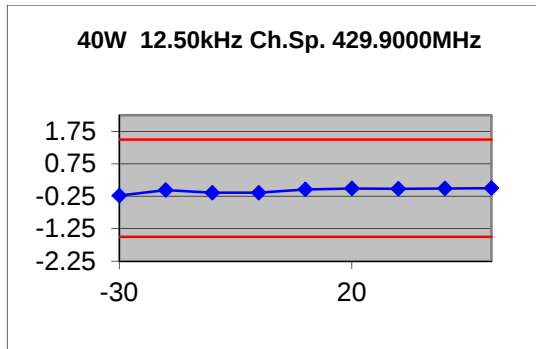
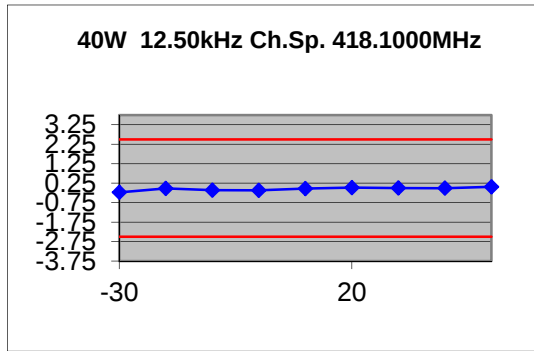
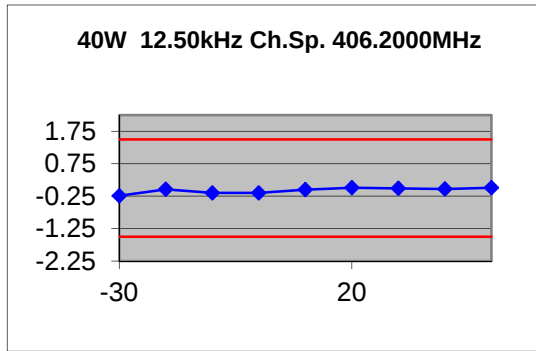
| °C  | 406.2000MHz |       | 418.1000MHz |       | 429.9000MHz |       | 450.1000MHz |       | 459.9000MHz |       | 469.9000MHz |       |
|-----|-------------|-------|-------------|-------|-------------|-------|-------------|-------|-------------|-------|-------------|-------|
|     | Hz          | ppm   | Hz          | ppm   | Hz          | ppm   | Hz          | ppm   | Hz          | ppm   | Hz          | ppm   |
| -30 | -96         | -0.24 | -93         | -0.22 | -100        | -0.23 | -101        | -0.22 | -103        | -0.22 | -112        | -0.24 |
| -20 | -18         | -0.04 | -10         | -0.02 | -27         | -0.06 | -27         | -0.06 | -21         | -0.05 | -26         | -0.06 |
| -10 | -62         | -0.15 | -44         | -0.11 | -59         | -0.14 | -62         | -0.14 | -70         | -0.15 | -64         | -0.14 |
| 0   | -62         | -0.15 | -50         | -0.12 | -62         | -0.14 | -69         | -0.15 | -72         | -0.16 | -66         | -0.14 |
| 10  | -19         | -0.05 | -14         | -0.03 | -19         | -0.04 | -26         | -0.06 | -22         | -0.05 | -20         | -0.04 |
| 20  | 5           | 0.01  | 7           | 0.02  | -3          | -0.01 | 4           | 0.01  | 0           | 0     | -1          | 0     |
| 30  | -3          | -0.01 | 0           | 0     | -8          | -0.02 | -13         | -0.03 | -5          | -0.01 | -6          | -0.01 |
| 40  | -13         | -0.03 | -3          | -0.01 | -6          | -0.01 | -17         | -0.04 | -10         | -0.02 | -11         | -0.02 |
| 50  | 5           | 0.01  | 26          | 0.06  | -1          | 0     | 7           | 0.02  | 1           | 0     | 2           | 0     |

LIMIT: FCC 47 CFR 90.213

RSS-119 5.3

| Channel Spacing (kHz) | Frequency Error (ppm) |
|-----------------------|-----------------------|
| 12.5                  | 2.5                   |
| 25.0                  | 5.0                   |

### Transmitter Frequency Stability - Temperature



## TRANSMITTER FREQUENCY STABILITY - VOLTAGE

SPECIFICATION: FCC 47 CFR 2.1055 (d) (1)

RSS-119 5.3

GUIDE: TIA-102.CAAA-C 2.2.2

### MEASUREMENT PROCEDURE:

1. Refer Annex A for equipment set up.
2. The EUT was tested for frequency error at an input voltage to the radio of 85% to 115%.
3. The frequency error was recorded in parts per million (ppm).

### MEASUREMENT RESULTS:

40W

| Voltage              | FREQUENCY ERROR (ppm) for 12.5 kHz |           |           |
|----------------------|------------------------------------|-----------|-----------|
|                      | 406.2 MHz                          | 418.1 MHz | 429.9 MHz |
| 13.8V <sub>DC</sub>  | 0.01                               | -0.02     | 0.01      |
| 11.7V <sub>DC</sub>  | 0.00                               | -0.03     | 0.00      |
| 15.9 V <sub>DC</sub> | -0.01                              | -0.01     | 0.02      |
| Max Frequency ppm    | 0.01                               | -0.03     | 0.02      |

40W

| Voltage              | FREQUENCY ERROR (ppm) for 12.5 kHz |           |           |
|----------------------|------------------------------------|-----------|-----------|
|                      | 450.1 MHz                          | 459.9 MHz | 469.9 MHz |
| 13.8V <sub>DC</sub>  | -0.01                              | 0.00      | -0.01     |
| 11.7V <sub>DC</sub>  | 0.00                               | -0.02     | -0.03     |
| 15.9 V <sub>DC</sub> | 0.00                               | -0.02     | -0.01     |
| Max Frequency ppm    | -0.01                              | -0.02     | -0.03     |

LIMIT CLAUSES: FCC 47 CFR 90.213

RSS-119 5.3

| Channel Spacing (kHz) | Frequency Error (ppm) |
|-----------------------|-----------------------|
| 12.5                  | 5.0                   |

## RECEIVER SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: RSS-119 5.11

GUIDE: TIA-102.CAAA-C 2.1.2

### MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up diagram.
2. The frequency range examined was from 30 MHz to 3 times highest tunable frequency.
3. Spurious emissions which were attenuated more than 20 dB below the limit were not recorded.

| 406.2 MHz Receive (Receiver Input Port)           |            |             |
|---------------------------------------------------|------------|-------------|
| Emission Frequency (MHz)                          | Level (nW) | Level (dBm) |
| ~                                                 | ~          | ~           |
| No emissions were detected within 20 dB of Limit. |            |             |

| 418.1 MHz Receive (Receiver Input Port)           |            |             |
|---------------------------------------------------|------------|-------------|
| Emission Frequency (MHz)                          | Level (nW) | Level (dBm) |
| ~                                                 | ~          | ~           |
| No emissions were detected within 20 dB of Limit. |            |             |

| 429.9 MHz Receive (Receiver Input Port)           |            |             |
|---------------------------------------------------|------------|-------------|
| Emission Frequency (MHz)                          | Level (nW) | Level (dBm) |
| ~                                                 | ~          | ~           |
| No emissions were detected within 20 dB of Limit. |            |             |

## RECEIVER SPURIOUS EMISSIONS (CONDUCTED)

| 450.1 MHz Receive (Receiver Input Port)           |            |             |
|---------------------------------------------------|------------|-------------|
| Emission Frequency (MHz)                          | Level (nW) | Level (dBm) |
| ~                                                 | ~          | ~           |
| No emissions were detected within 20 dB of Limit. |            |             |

| 459.9 MHz Receive (Receiver Input Port)           |            |             |
|---------------------------------------------------|------------|-------------|
| Emission Frequency (MHz)                          | Level (nW) | Level (dBm) |
| ~                                                 | ~          | ~           |
| No emissions were detected within 20 dB of Limit. |            |             |

| 469.9 MHz Receive (Receiver Input Port)           |            |             |
|---------------------------------------------------|------------|-------------|
| Emission Frequency (MHz)                          | Level (nW) | Level (dBm) |
| ~                                                 | ~          | ~           |
| No emissions were detected within 20 dB of Limit. |            |             |

### LIMIT CLAUSE: RSS-Gen 6(b)

| LIMIT | 30 → 1000 MHz | 2 nW | - 57 dBm |
|-------|---------------|------|----------|
|       | > 1000 MHz    | 5 nW | - 53 dBm |

## TRANSMITTER STANDBY SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: RSS-119 5.11

GUIDE: TIA-102.CAAA-C 2.1.2

### MEASUREMENT PROCEDURE:

4. Refer Annex A for Equipment set up diagram.
5. The frequency range examined was from 30 MHz to 3 times highest tunable frequency.
6. Spurious emissions which were attenuated more than 20 dB below the limit were not recorded.

| 406.2 MHz Transmitter Standby (Transmitter RF Output Port) |            |             |
|------------------------------------------------------------|------------|-------------|
| Emission Frequency (MHz)                                   | Level (nW) | Level (dBm) |
| ~                                                          | ~          | ~           |
| No emissions were detected within 20 dB of Limit.          |            |             |

| 418.1 MHz Transmitter Standby (Transmitter RF Output Port) |            |             |
|------------------------------------------------------------|------------|-------------|
| Emission Frequency (MHz)                                   | Level (nW) | Level (dBm) |
| ~                                                          | ~          | ~           |
| No emissions were detected within 20 dB of Limit.          |            |             |

| 429.9 MHz Transmitter Standby (Transmitter RF Output Port) |            |             |
|------------------------------------------------------------|------------|-------------|
| Emission Frequency (MHz)                                   | Level (nW) | Level (dBm) |
| ~                                                          | ~          | ~           |
| No emissions were detected within 20 dB of Limit.          |            |             |

## TRANSMITTER STANDBY SPURIOUS EMISSIONS (CONDUCTED)

| 450.1 MHz Transmitter Standby (Transmitter RF Output Port) |            |             |
|------------------------------------------------------------|------------|-------------|
| Emission Frequency (MHz)                                   | Level (nW) | Level (dBm) |
| ~                                                          | ~          | ~           |
| No emissions were detected within 20 dB of Limit.          |            |             |

| 459.9 MHz Transmitter Standby (Transmitter RF Output Port) |            |             |
|------------------------------------------------------------|------------|-------------|
| Emission Frequency (MHz)                                   | Level (nW) | Level (dBm) |
| ~                                                          | ~          | ~           |
| No emissions were detected within 20 dB of Limit.          |            |             |

| 469.9 MHz Transmitter Standby (Transmitter RF Output Port) |            |             |
|------------------------------------------------------------|------------|-------------|
| Emission Frequency (MHz)                                   | Level (nW) | Level (dBm) |
| ~                                                          | ~          | ~           |
| No emissions were detected within 20 dB of Limit.          |            |             |

### LIMIT CLAUSE: RSS-Gen 6(b)

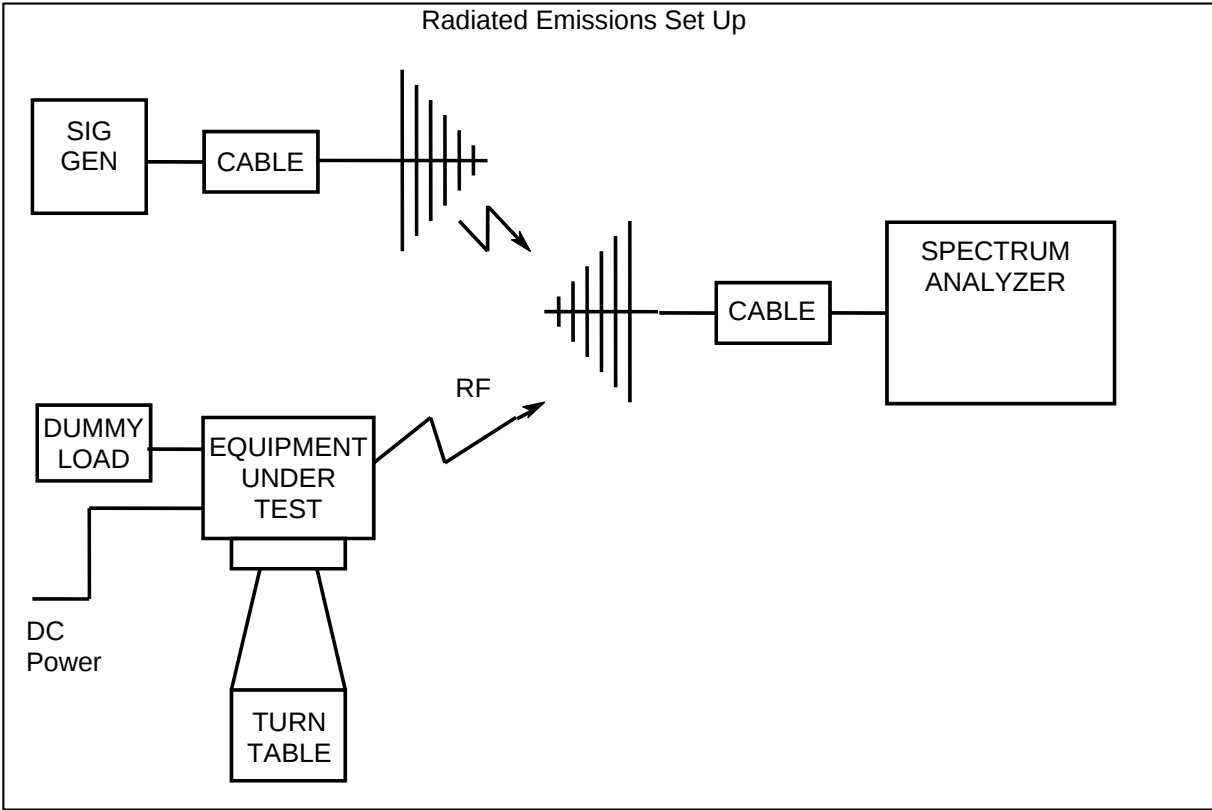
| LIMIT | 30 → 1000 MHz | 2 nW | - 57 dBm |
|-------|---------------|------|----------|
|       | > 1000 MHz    | 5 nW | - 53 dBm |

## TEST EQUIPMENT LIST

| Equipment Type             | Information                                | Manufacturer    | Model No           | Serial No#    | Tait ID | Cal Due   |
|----------------------------|--------------------------------------------|-----------------|--------------------|---------------|---------|-----------|
| Signal Generator           | Analog 3.2GHz                              | Hewlett Packard | HP8648C            | 3443U00543    | E3558   | 16-Oct-16 |
| Environ. Chamber           | Chest                                      | Contherm        | Chest              | E3397         | E3397   | 1-Aug-17  |
| Power Supply               | TREVA2 60V/25A                             | Agilent         | N5767A             | US09F4901H    | E4656   | 18-Oct-17 |
| Antenna                    | Reference Dipoles                          | Emco            | 3121C DB1          | 9510-1164     | E3559   | 14-Apr-19 |
| Antenna                    | 18GHz DRG                                  | Emco            | DRG3115            | 9512-4638     | E3560   | 29-Apr-19 |
| Antenna                    | 18GHz DRG                                  | Emco            | DRG3115            | 2084          | E3076   | 29-Apr-19 |
| Spectrum Analyser          | 26.5GHz                                    | Agilent         | PXA N9030A         | MY49432161    | E4907   | 6-Jul-16  |
| RF Chamber                 | S-LINE TEM CELL                            | Rohde & Schwarz | 1089.9296.02       | 338232/003    | E3636   | 29-Sep-16 |
| Filter Notch               |                                            | Tait            |                    | N/A           | -       |           |
| RF Attenuator              | 10dB 150W                                  | Weinschel       | 57-10-34           | LB590         | E3674   | 18-Oct-16 |
| RF Attenuator              | 10dB 50W                                   | Weinschel       | 24-10-34           | AZ0401        | E3388   | 18-Oct-16 |
| RF Attenuator              | 20dB 50W                                   | Weinschel       | 24-20-44           | AW1266        | E3562   | 15-Oct-16 |
| RF Load                    | 150W                                       | Bird            | 8166               | 524           | E3625   |           |
| Coax Cable                 | 3m Blue                                    | Suhner          | Sucoflex 104A      | 44611/4A      | E4620   | 18-Oct-16 |
| Oscilloscope               | 400MHz                                     | Tektronics      | TDS380             | B017095       | E3782   | 13-Oct-17 |
| Modulation Analyser        | TREVA2                                     | Hewlett Packard | HP8901B (Opt 002)  | 3704A05837    | E3786   | 20-Oct-16 |
| Signal Generator           | TREVA2 Analog 3.3GHz                       | Rohde & Schwarz | SML03 1090.3000.13 | 100597        | E4050   | 18-Oct-16 |
| RF Combiner                | TREVA2                                     | Minicircuits    | ZFSC-4-1           | -             | E4084   |           |
| ISN                        | CISPR22 2006                               | TESEQ           | ISN T800           | 27956         | E4658   | 29-Nov-15 |
| OATS                       | Antenna Tower                              | Electrometrics  | EM-4720-2          | 112           | E4447   |           |
| OATS                       | Controller                                 | Electrometrics  | EM-4700            | 119           | E4445   |           |
| OATS                       | Turntable                                  | Electrometrics  | EM-4704A           | 105           | E4446   |           |
| RF Attenuator              | 30dB 350W                                  | Weinschel       | 67-30-33           | BR0531        | E4280   | 18-Oct-16 |
| Coax Cable                 | 2m Black                                   | Suhner          | RG214HF/Nm/Nm/2000 | TeltestBlack5 | E4850   | 16-Oct-16 |
| Coax Cable                 | 2m Black                                   | Suhner          | RG214HF/Nm/Nm/2000 | TeltestBlack6 | E4849   | 16-Oct-16 |
| Power Meter                | TREVA2 Power Head for HP8901               | Hewlett Packard | HP11722A           | 2716A02037    | 1575    | 20-Oct-16 |
| Antenna                    | Collapsible Biconical and Balun            | Schwarzbeck     | FBAB 9177,VHA 9103 | 9104-2459     | E4616   | 5-Aug-16  |
| LISN                       |                                            | Schwarzbeck     | NNBM 8125          | 8125-1127     | E4618   | 19-Oct-16 |
| LISN                       |                                            | Schwarzbeck     | NNBM 8125          | 8125-1505     | E4654   | 19-Oct-16 |
| TREVA 2                    |                                            | Teltest         | -                  | 2             | -       | 5-May-17  |
| Coax Cable                 | 2.5m Blue                                  | Suhner          | Sucoflex 104A      | 33449/4PEA    | E4997   | 18-Oct-16 |
| RF Chamber                 | Reverb - 0.5 - 18GHz Reverberation Chamber | Teseq           | RVC XS             | 29765         | E4855   |           |
| Antenna                    | Reverb - 1-18GHz DRG                       | Schwarzbeck     | BBHA 9120 D        | 9120D-885     | E4857   |           |
| Temp & Humidity datalogger |                                            | Hobo            | U21-011            | 10134276      | E4981   | 14-Aug-16 |
| OATS                       | FCC Listing Registration                   |                 |                    | 837095        |         | 12-May-16 |
| Coax Cable                 | OATS Turntable Cable 2                     | Intelcom        | RG215              | OATS3         | E4995   | 20-Oct-16 |

NOTE: Items without calibration dates are calibrated immediately before use, or set using calibrated instruments.

ANNEX A – TEST SETUP DETAILS



All other testing is performed using the Teltest Radio **EVA**luation system (TREVA), which is configured as shown below. The Spectrum Analyser is connected to the EUT via the attenuator network for Conducted Emissions testing, and Occupied Bandwidth.

