

# LABORATORY TEST REPORT

## RADIO PERFORMANCE MEASUREMENTS

for the

TBCHHB BASE STATION Transceiver

Tested in accordance with:

FCC 47 CFR Parts 22 and 90

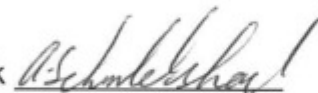
RSS-119 Issue 12  
RSS-Gen Issue 4

Report Revision: 1

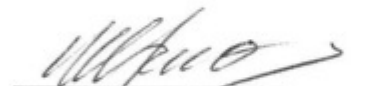
Issue Date: 29 March 2018

PREPARED BY:

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Test Technician

CHECKED & APPROVED BY: M. C. James

  
Laboratory Technical Manager



**IANZ**  
ACCREDITED LABORATORY

FCC REGISTRATION: 838288  
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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FCC ID: CASTBCHHB  
IC : 737A-TBCHHB

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Report Revision: 1  
Issue Date: 29 March 2018

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## REVISION

| Date          | Revision | Comments            |
|---------------|----------|---------------------|
| 29 March 2018 | 1        | Initial test report |
|               |          |                     |

## INTRODUCTION

Type approval testing of the TBCHHB, 100 Watt, BASE STATION transceiver in order to demonstrate compliance with FCC 47 Parts 22 & 90, and RSS-119 Issue 12 & RSS-Gen Issue 4. This radio supports analogue, APCO P25 phase-1 and APCO P25 phase-2 modulations.

### REPORT PREPARED FOR

Tait Limited  
245 Wooldridge Road  
Harewood  
Christchurch 8051  
New Zealand

### DESCRIPTION OF SAMPLE

Manufacturer: Tait Limited  
Equipment: BASE STATION Transceiver  
Type Code: TBCHHB  
Serial Number(s): 18272769  
Frequency range: 378 → 420 MHz  
Transmit Power: 100 W

| Modulation                                   |                                | Channel Spacing | Speech Channels | Symbol Rate (symbols/sec) | Data Rate (bps) |
|----------------------------------------------|--------------------------------|-----------------|-----------------|---------------------------|-----------------|
| Analogue FM                                  |                                | 12.5 kHz        | 1               | -                         | -               |
| APCO P25 Phase 1                             | C4FM (TIA 102)                 | 12.5 kHz        | 1               | 4800                      | 9600            |
| APCO P25 Phase 1 Linear Simulcast Modulation | CQPSK (TIA 102)                | 12.5 kHz        | 1               | 4800                      | 9600            |
| APCO P25 Phase 2                             | H-DQPSK(2 slot TDMA) (TIA 102) | 12.5 kHz        | 2               | 6000                      | 12000           |

### HARDWARE & SOFTWARE

Quantity: 1

| Description            | Product Code   | Serial Number | Firmware Version | Hardware Version |
|------------------------|----------------|---------------|------------------|------------------|
| Reciter<br>378-420 MHz | T01-01103-JAAA | 18272328      | p25-2.40.00.0003 | 01.00            |
| Power Amplifier        | T01-01121-JBAA | 18272421      | 1.09.00.0002     | 6                |
| Power Management Unit  | TBA30A0-0100   | 18272432      | 0316             | 01.00            |
| Front Panel            | T01-01110-AACA | 18272831      | 1.09.00.0002     | 00.04            |

### TEST CONDITIONS

All testing was performed between 12 → 29 March 2018, and under the following conditions:

Ambient temperature: 15°C → 30°C  
Relative Humidity: 20% → 75%  
Standard Test Voltage 120 V<sub>AC</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 Code: TBCHHB  
Serial Number(s): 18272769  
Quantity: 1

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

FCC 47 CFR Parts 22 and 90

RSS-119 Issue 12 & RSS-Gen Issue 4

Signature: 

M. C. James  
Laboratory Technical Manager

Date: 11 April 2018

## MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS

### MODULATION TYPES:

|     |                                                       |           |
|-----|-------------------------------------------------------|-----------|
| F3E | Analogue Frequency Modulation (FM)                    |           |
| F1E | P25 phase 1 Digital Voice                             | 9600 bps  |
| F1D | P25 phase 1 Digital Data                              | 9600 bps  |
| F7W | P25 phase 1 Digital Voice/Data                        | 9600 bps  |
| D1W | P25 Phase 1 Linear Simulcast Modulation Digital Voice | 9600 bps  |
| F7W | P25 phase 2 Digital Voice / Data                      | 12000 bps |

CHANNEL SPACING: 12.5 kHz

### EMISSION DESIGNATORS:

|                                    | 12.5 kHz |
|------------------------------------|----------|
| Analog FM                          | 11K0F3E  |
| Digital Voice P25 phase 1          | 8K10F1E  |
| Digital Data P25 phase 1           | 8K10F1D  |
| Digital Voice/Data phase 1         | 8K10F7W  |
| Digital Voice P25 phase 1 LSM      | 8K70D1W  |
| Digital Voice/Data P25 phase 1 LSM | 8K70D7W  |
| Digital Voice/Data P25 phase 2     | 9K80D7W  |

### 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

### APCO P25 Phase 1:

Digital Voice / Data (C4FM - 4 level frequency shift keying)

Digital Voice/data transmissions use a 4 level frequency shift keying modulation scheme.

The necessary bandwidth has been measured using the 99% energy rule, and in accordance with FCC KDB 971168 D01 and RSS-Gen 4.6.1.

Digital Voice 12.5 kHz Channel Spacing

99% bandwidth

= 8.1 kHz

Emission Designator

**8K10F1E**

F1E represents a digital FM voice transmission

Digital Data 12.5 kHz Channel Spacing

99% bandwidth

= 8.1 kHz

Emission Designator

**8K10F1D**

F1D represents a digital FM data transmission

Digital Voice and Data 12.5 kHz Channel Spacing

99% bandwidth

= 8.1 kHz

Emission Designator

**8K10F7W**

F7W represents a digital FM transmission containing both voice and data.

### Linear Simulcast Modulation (LSM):

Digital Voice/data transmissions use a CQPSK modulation scheme.  
The necessary bandwidth has been measured using the 99% energy rule, and in accordance with FCC KDB 971168 D01 and RSS-Gen 4.6.1.

#### CQPSK Digital Data 12.5 kHz Bandwidth

99% bandwidth  
= 8.7 kHz

Emission Designator

**8K70D1W**

D1W represents a single channel containing quantized or digital information combining two modulation modes simultaneously (amplitude + angle) for a voice transmission.

#### CQPSK Digital Data 12.5 kHz Bandwidth

99% bandwidth  
= 8.7 kHz

Emission Designator

**8K70D7W**

D7W represents a single channel containing quantized or digital information combining two modulation modes simultaneously (amplitude + angle) for a transmission containing both voice and data.

### APCO P25 Phase 2:

Digital Voice/data transmissions use a differential phase shift keying modulation scheme.  
The necessary bandwidth has been measured using the 99% energy rule, and in accordance with FCC KDB 971168 D01 and RSS-Gen 4.6.1.

#### H-DQPSK Digital Data 12.5 kHz Bandwidth

99% bandwidth  
= 9.8 kHz

Emission Designator

**9K80D7W**

D7W represents two or more channels containing quantized or digital information combining of two modulation modes simultaneously (amplitude + angle) for a transmission containing both voice and data.

## TEST RESULTS

### TRANSMITTER OUTPUT POWER (CONDUCTED)

SPECIFICATION: FCC 47 CFR 2.1046  
RSS-119 5.4

GUIDE: TIA/EIA-603D 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: 100 W and 10 W

| Nominal 100 W           | Measured | Variation (%) | Variation (dB) |
|-------------------------|----------|---------------|----------------|
| 406.1 MHz               | 92.5     | -7.5          | -0.3           |
| 413.1 MHz               | 93.8     | -6.2          | -0.3           |
| 419.9 MHz               | 92.2     | -7.8          | -0.4           |
| Measurement Uncertainty |          | ± 0.6 dB      |                |

Transmitter Output Power (Conducted) - continued

| Nominal 10 W            | Measured | Variation (%) | Variation (dB) |
|-------------------------|----------|---------------|----------------|
| 406.1 MHz               | 9.3      | -7.0          | -0.3           |
| 413.1 MHz               | 9.3      | -6.9          | -0.3           |
| 419.9 MHz               | 9.3      | -7.1          | -0.3           |
| Measurement Uncertainty |          | $\pm 0.6$ 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 100 W transmit power.

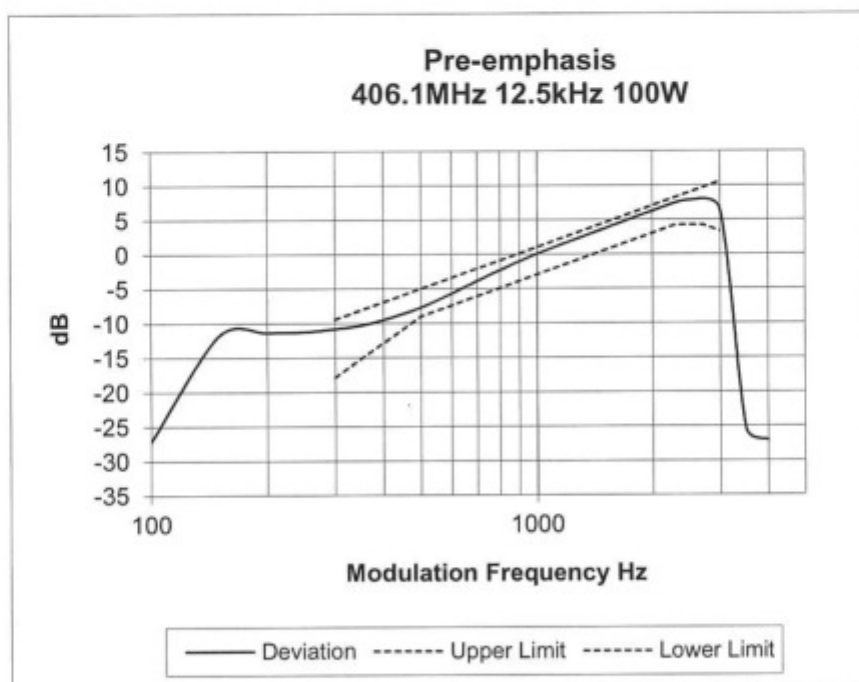
LIMIT CLAUSE: TIA/EIA-603D 3.2.6

MEASUREMENT UNCERTAINTY:  $\pm 1.5$  %

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 406.1 MHz

12.5 kHz Channel Spacing

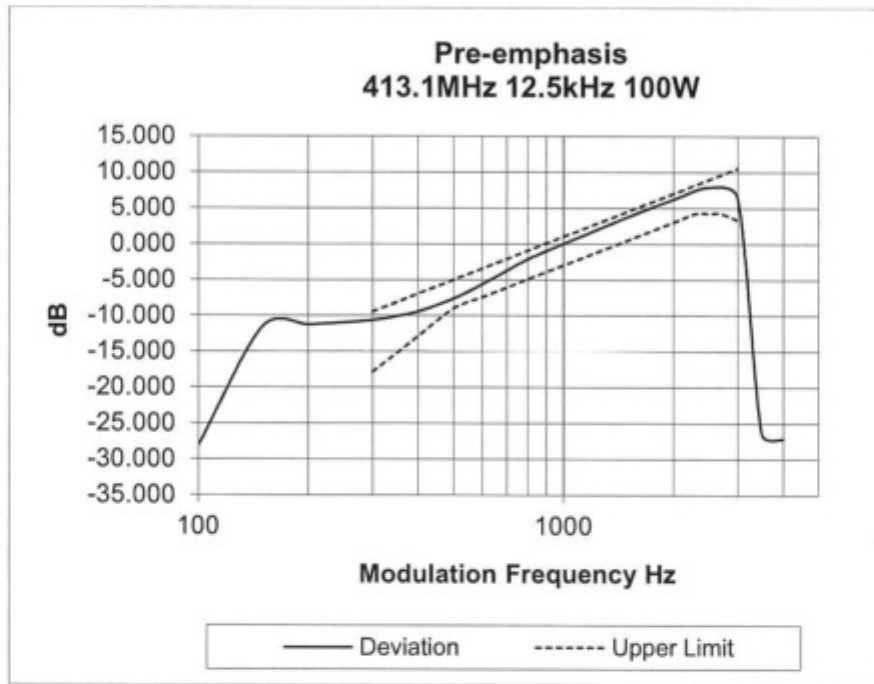


### Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 413.1 MHz

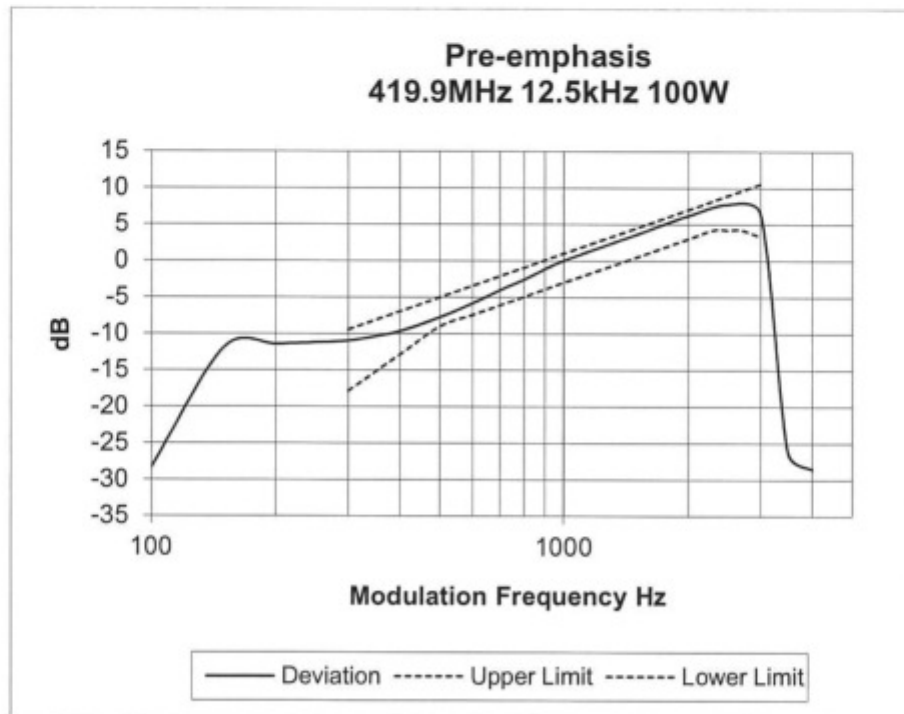
12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 419.9 MHz

12.5 kHz Channel Spacing



## Transmitter Audio Frequency Response – Pre-emphasis

### 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:

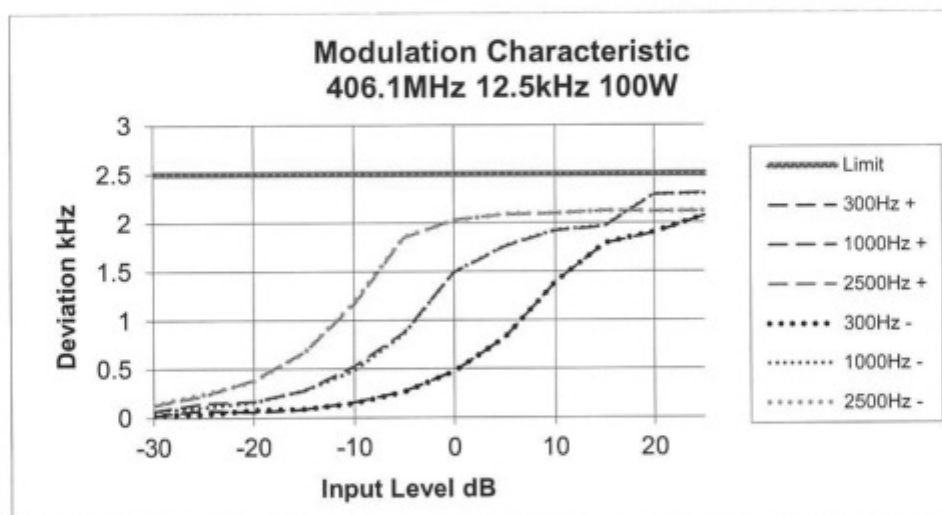
See the plots on the following pages for 12.5 kHz channel spacing.

LIMIT CLAUSE: TIA/EIA-603D 1.3.4.4

MEASUREMENT UNCERTAINTY:  $\pm 1.5\%$

Tx FREQUENCY: 406.1 MHz

12.5 kHz Channel Spacing

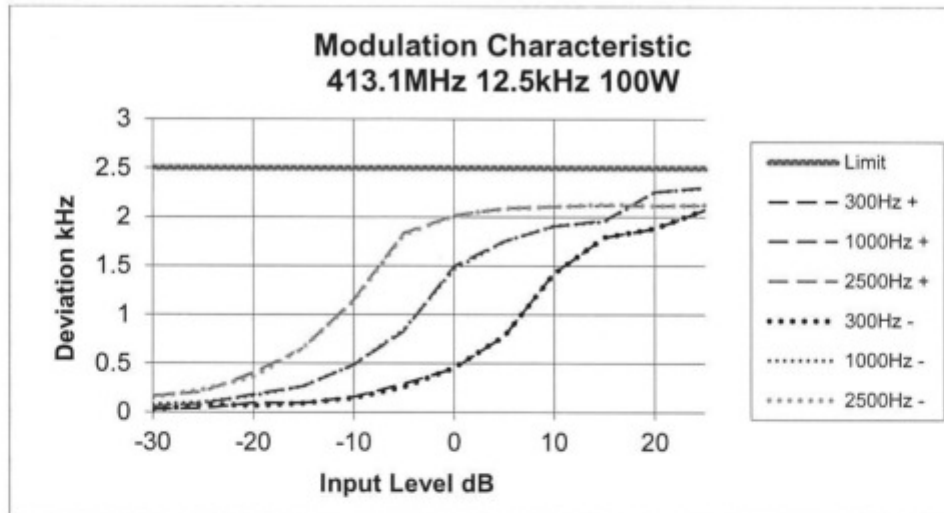


### Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 413.1 MHz

12.5 kHz Channel Spacing

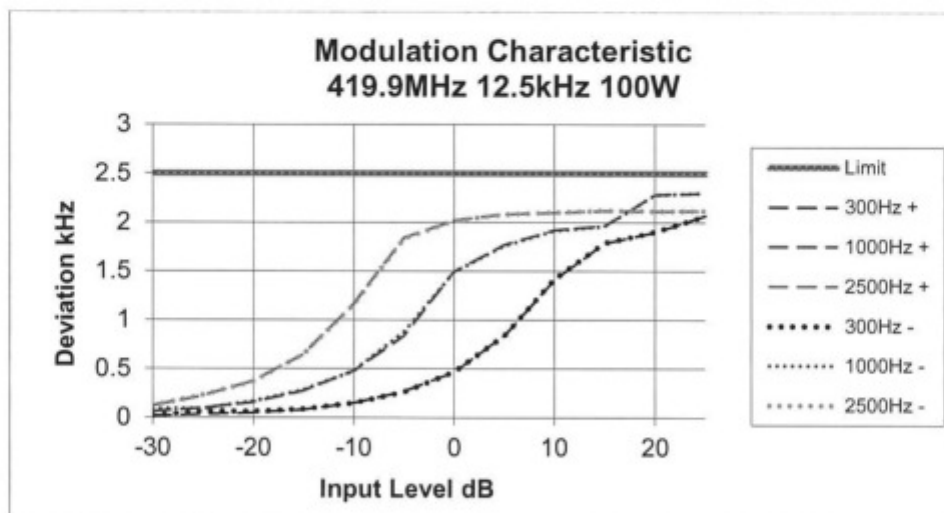


### Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 419.9 MHz

12.5 kHz Channel Spacing



Transmitter Modulation Limiting

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.
2. For analog measurements: The EUT was modulated by a 2500 Hz tone at an input level 16 dB above a level that produced 50% deviation. The input level was established at the frequency of maximum response of the audio modulating circuit.  
For Data measurements: The EUT was modulated with an internally generated pseudo random bit sequence at the appropriate Baud rates.
3. 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 channel spacing.

MEASUREMENT UNCERTAINTY 95%  $\pm 0.65\text{dB}$

LIMIT CLAUSE: FCC 47 CFR 90.210 RSS-119 5.5

EMISSION MASKS

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

DATA SPEED

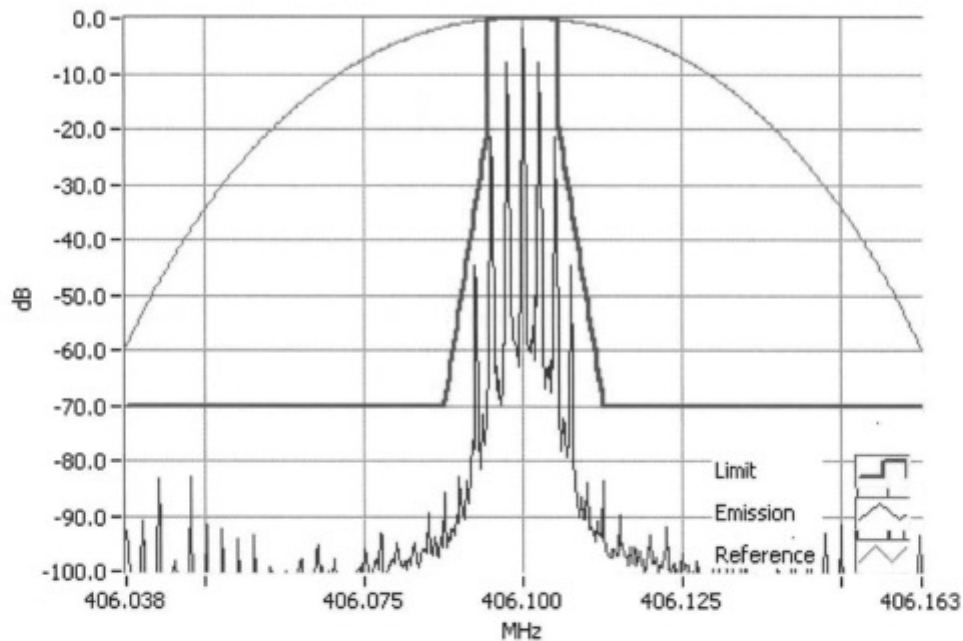
Digital Voice/Data 12.5 kHz Channel Spacing 9600 bps & 12000 bps

## Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

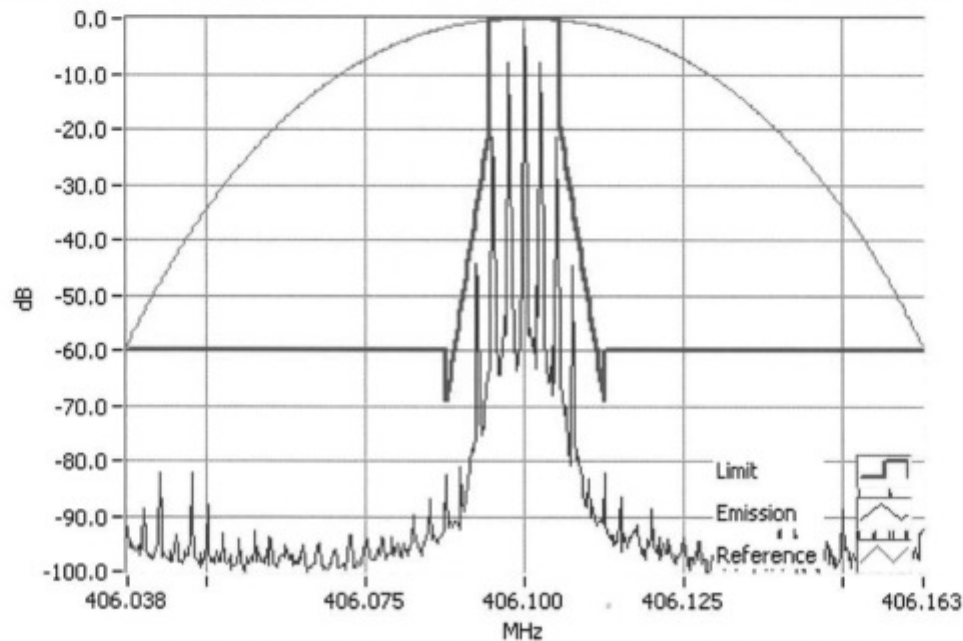
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 406.1 MHz 100 W 12.5 kHz Channel Spacing



Analogue Modulation 406.1000MHz Mask D 100W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 406.1 MHz 10 W 12.5 kHz Channel Spacing



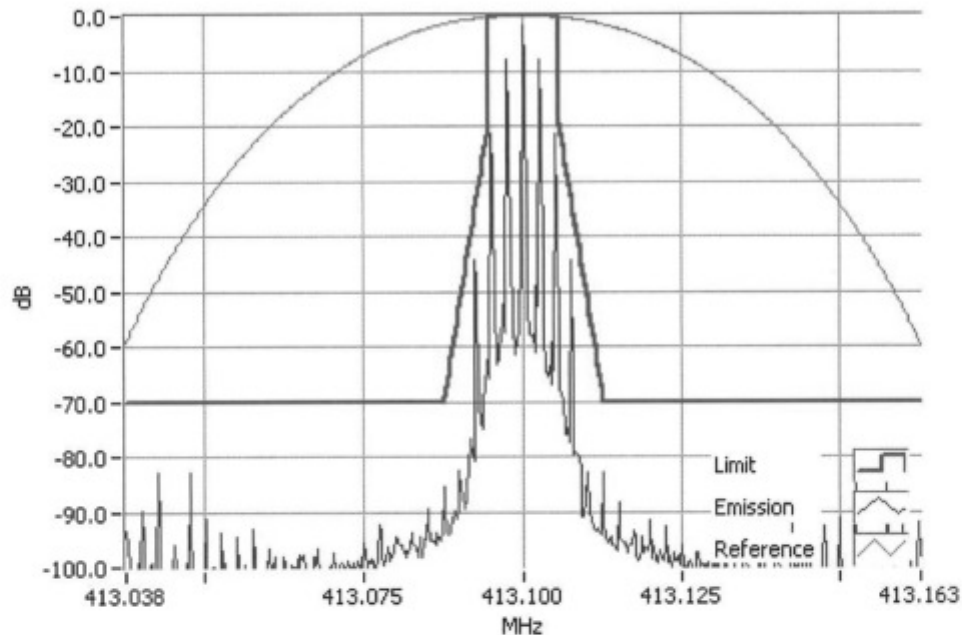
Analogue Modulation 406.1000MHz Mask D 10W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

## Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

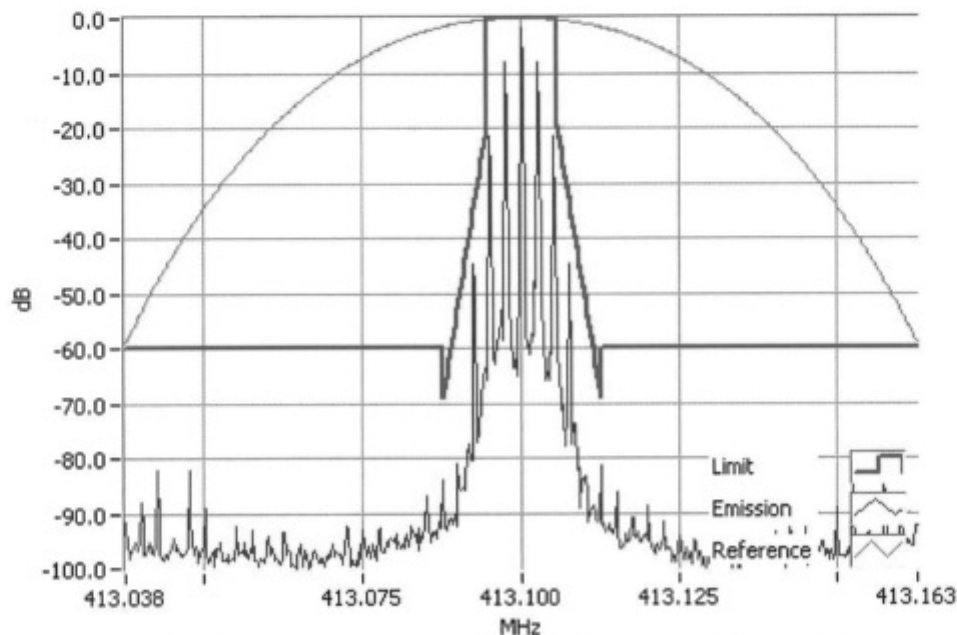
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 413.1 MHz 100 W 12.5 kHz Channel Spacing



Analogue Modulation 413.1000MHz Mask D 100W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 413.1 MHz 10 W 12.5 kHz Channel Spacing



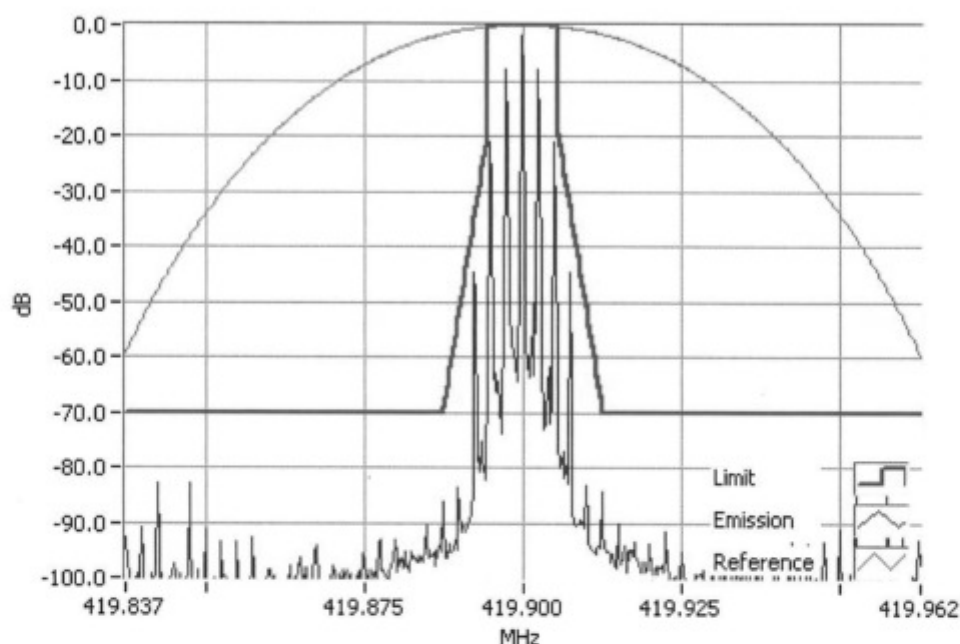
Analogue Modulation 413.1000MHz Mask D 10W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

## Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

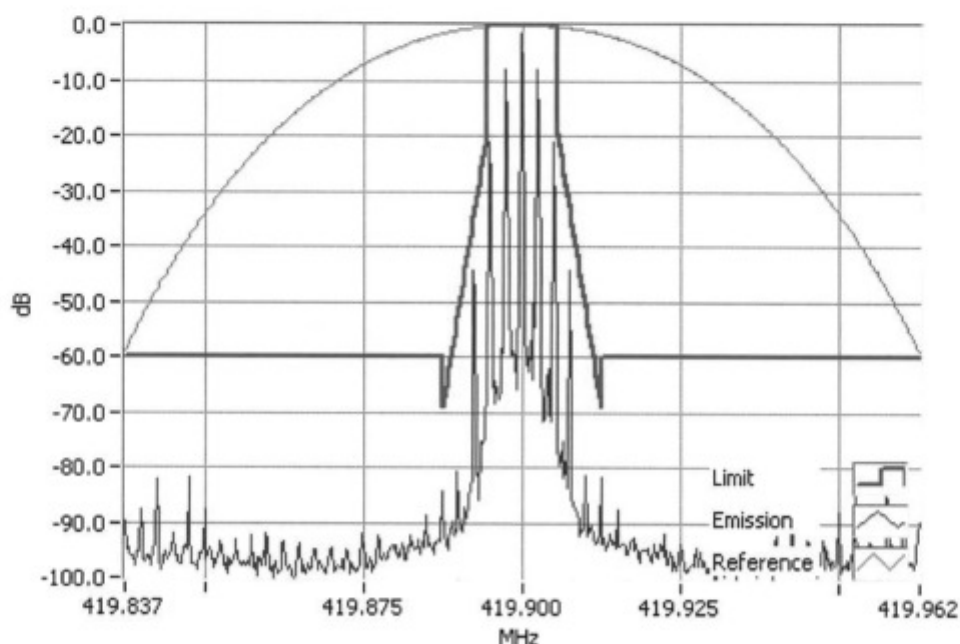
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 419.9 MHz 100 W 12.5 kHz Channel Spacing



Analogue Modulation 419.9000MHz Mask D 100W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 419.9 MHz 10 W 12.5 kHz Channel Spacing



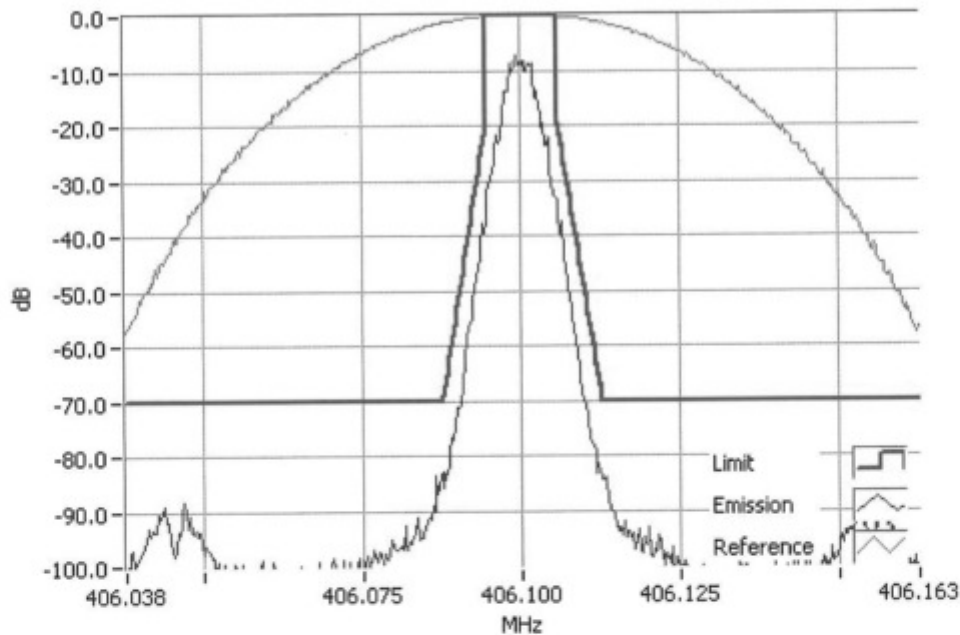
Analogue Modulation 419.9000MHz Mask D 10W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

## Occupied Bandwidth and Spectrum Masks

APCO P25 phase-1 C4FM

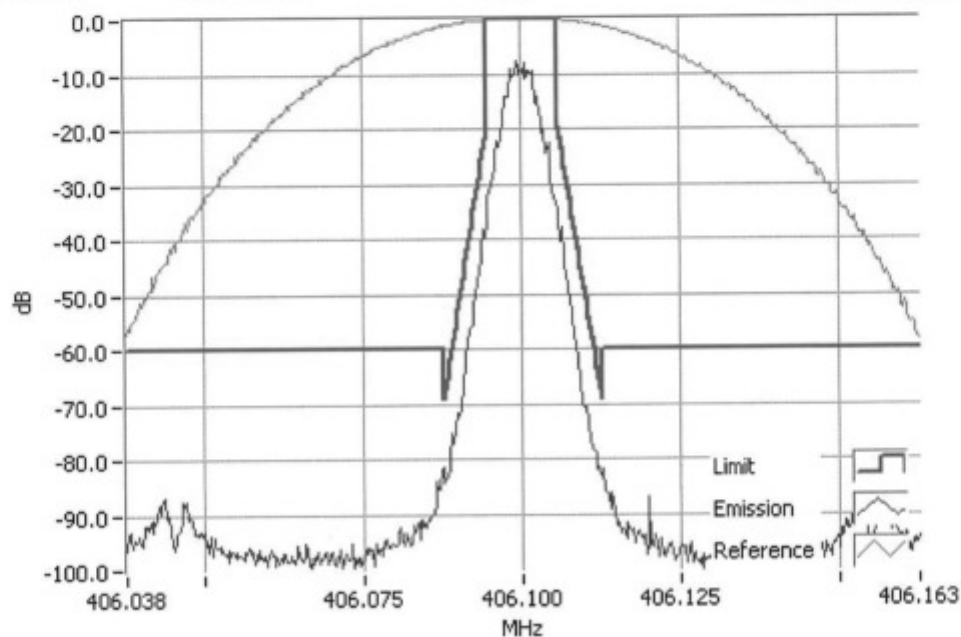
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 406.1 MHz 100 W 12.5 kHz Channel Spacing



P25 Ph1 C4FM 406.1000MHz Mask D 100W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 406.1 MHz 10 W 12.5 kHz Channel Spacing



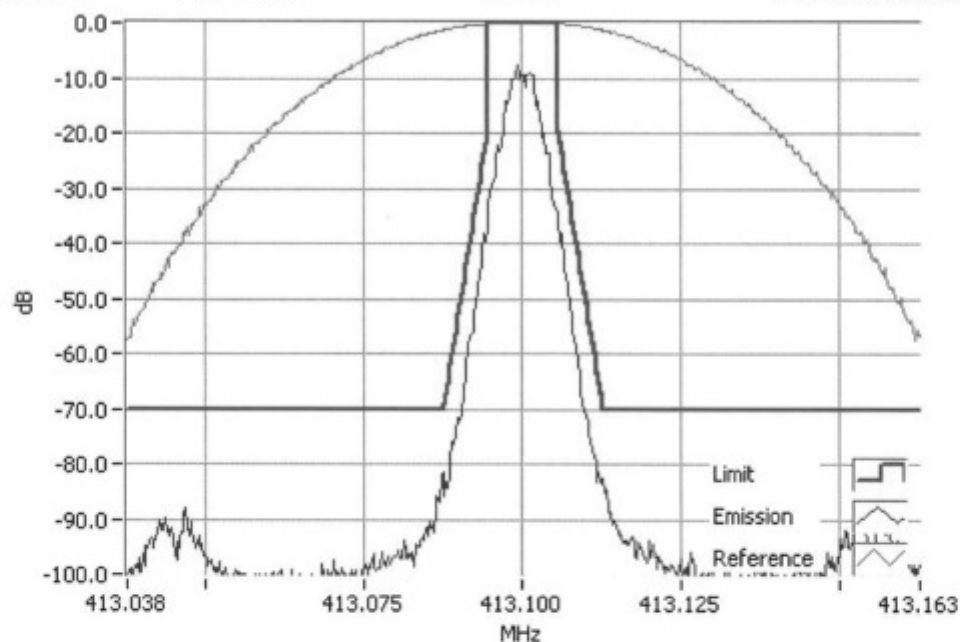
P25 Ph1 C4FM 406.1000MHz Mask D 10W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

## Occupied Bandwidth and Spectrum Masks

APCO P25 phase-1 C4FM

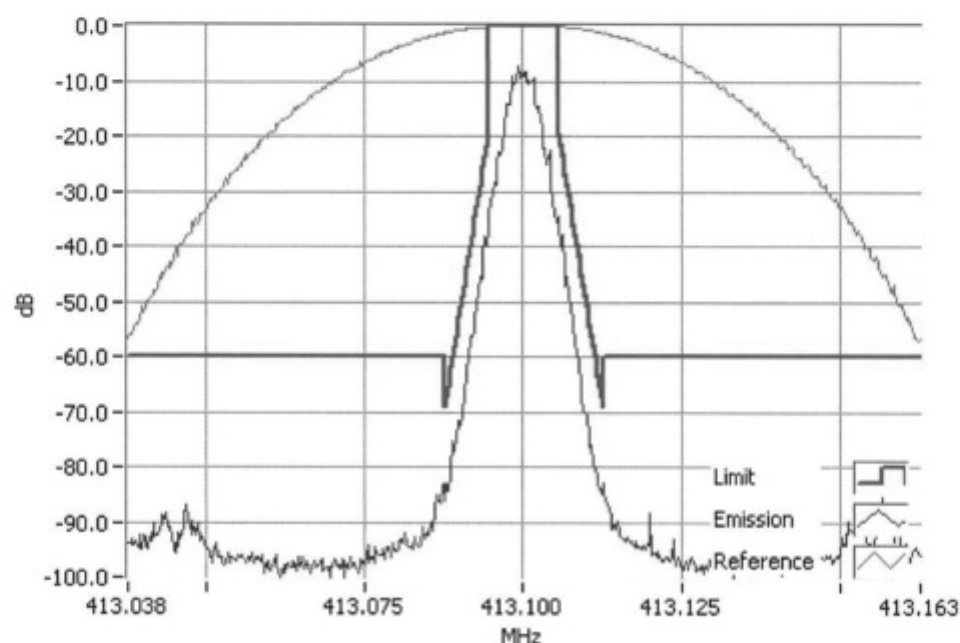
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 413.1 MHz 100 W 12.5 kHz Channel Spacing



P25 Ph1 C4FM 413.1000MHz Mask D 100W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 413.1 MHz 10 W 12.5 kHz Channel Spacing



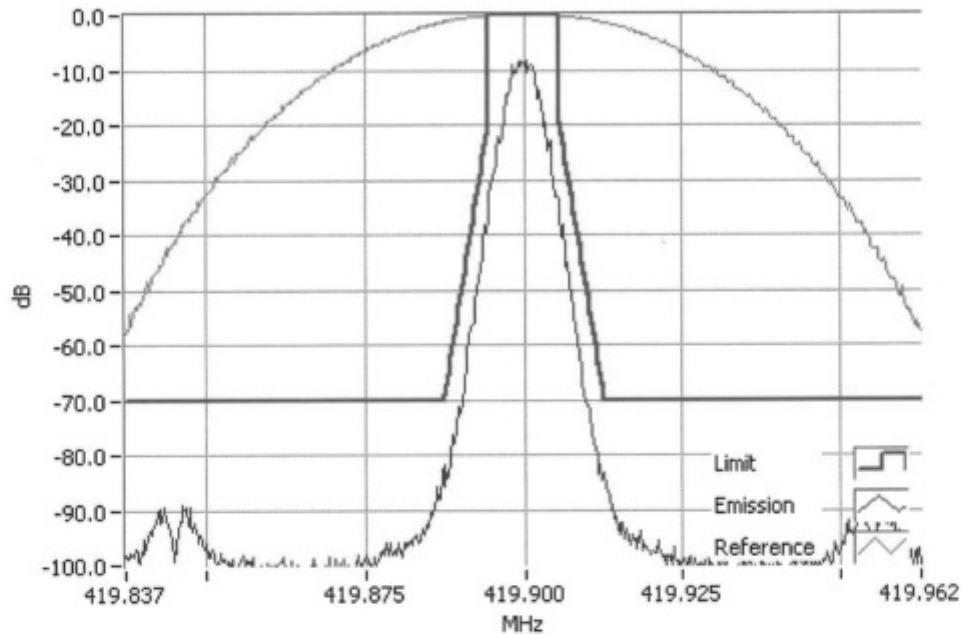
P25 Ph1 C4FM 413.1000MHz Mask D 10W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

## Occupied Bandwidth and Spectrum Masks

APCO P25 phase-1 C4FM

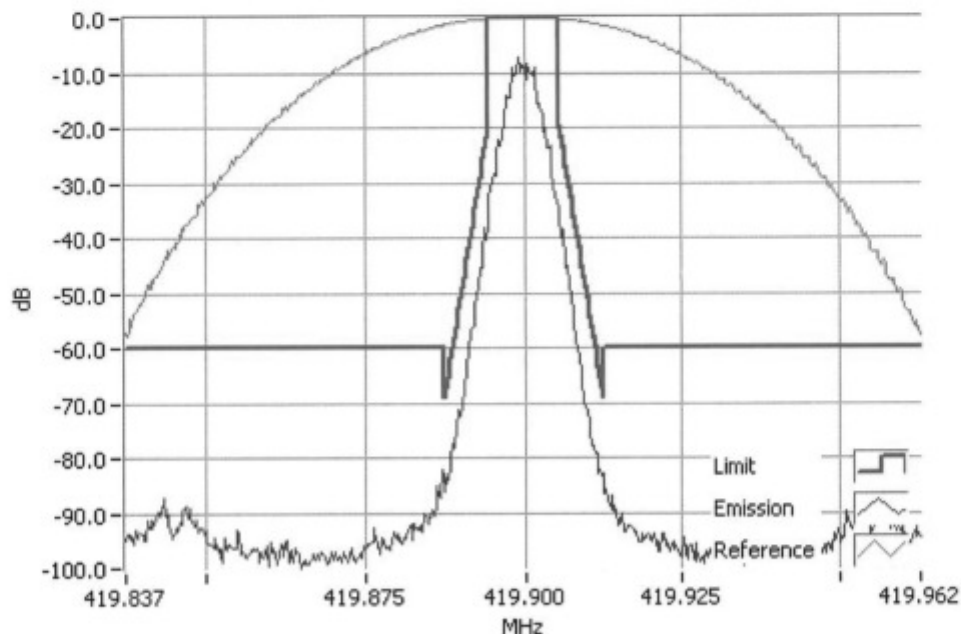
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 419.9 MHz 100 W 12.5 kHz Channel Spacing



P25 Ph1 C4FM 419.9000MHz Mask D 100W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 419.9 MHz 10 W 12.5 kHz Channel Spacing



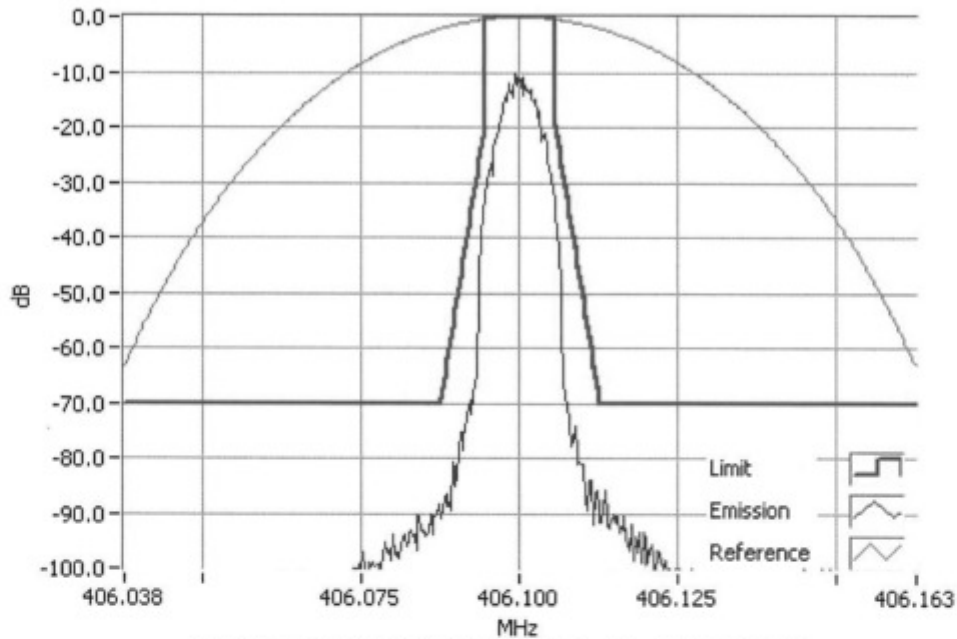
P25 Ph1 C4FM 419.9000MHz Mask D 10W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

## Occupied Bandwidth and Spectrum Masks

APCO P25 phase-1 LSM

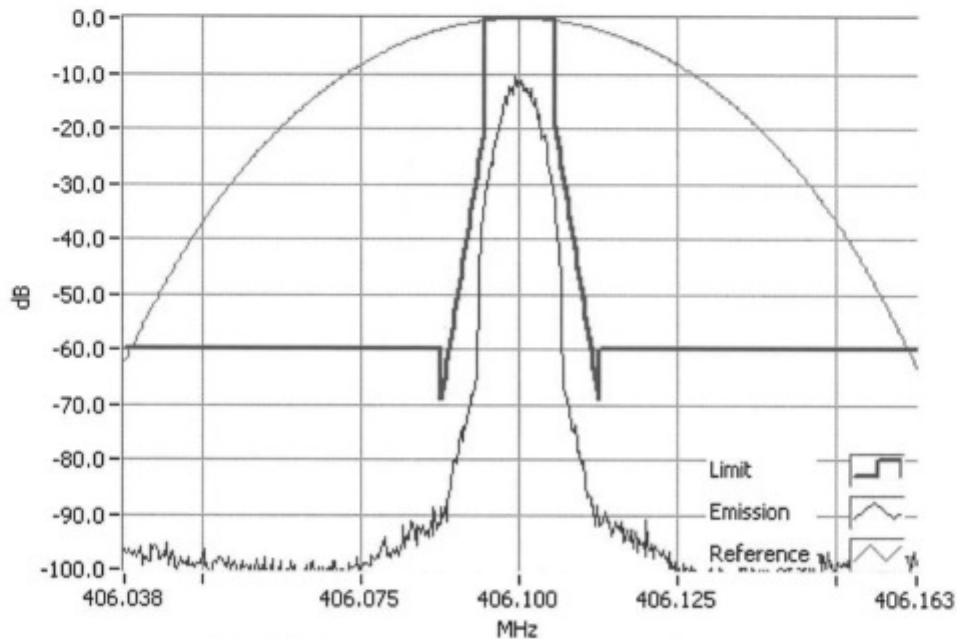
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 406.1 MHz 100 W 12.5 kHz Channel Spacing



P25 Ph1 LSM 406.1000MHz Mask D 100W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 406.1 MHz 10 W 12.5 kHz Channel Spacing



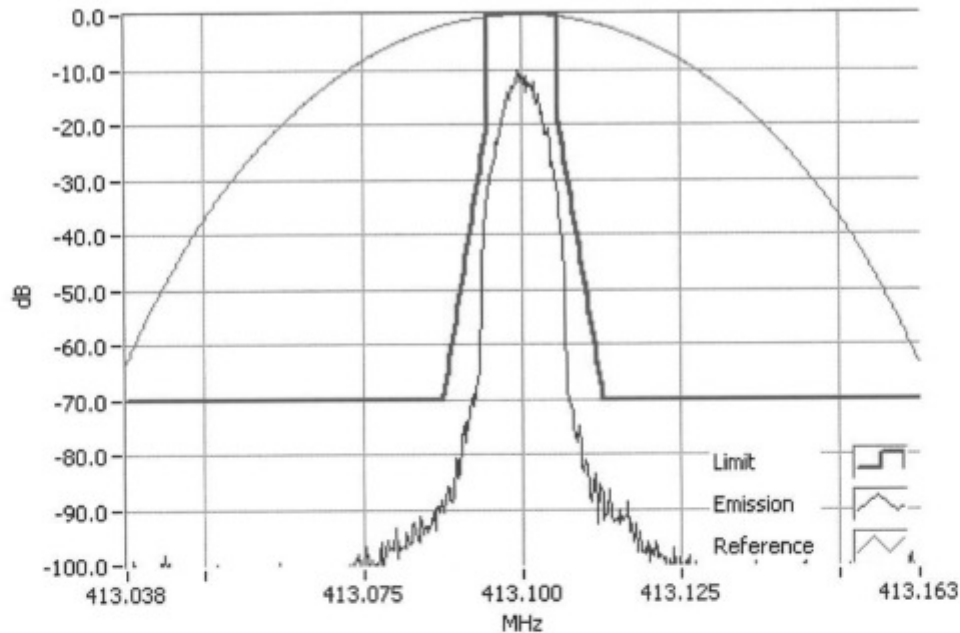
P25 Ph1 LSM 406.1000MHz Mask D 10W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

## Occupied Bandwidth and Spectrum Masks

APCO P25 phase-1 LSM

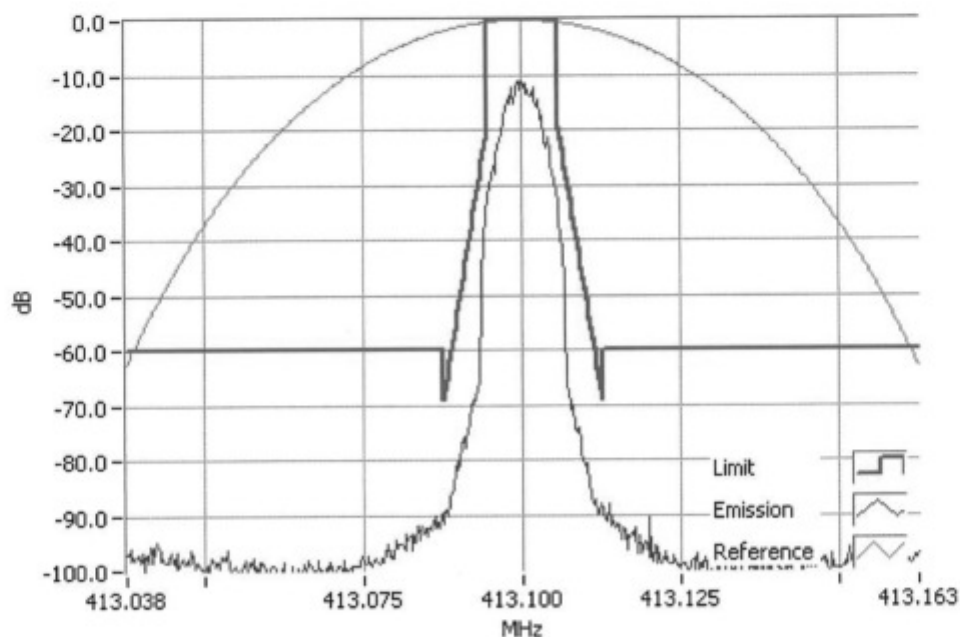
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 413.1 MHz 100 W 12.5 kHz Channel Spacing



P25 Ph1 LSM 413.1000MHz Mask D 100W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 413.1 MHz 10 W 12.5 kHz Channel Spacing



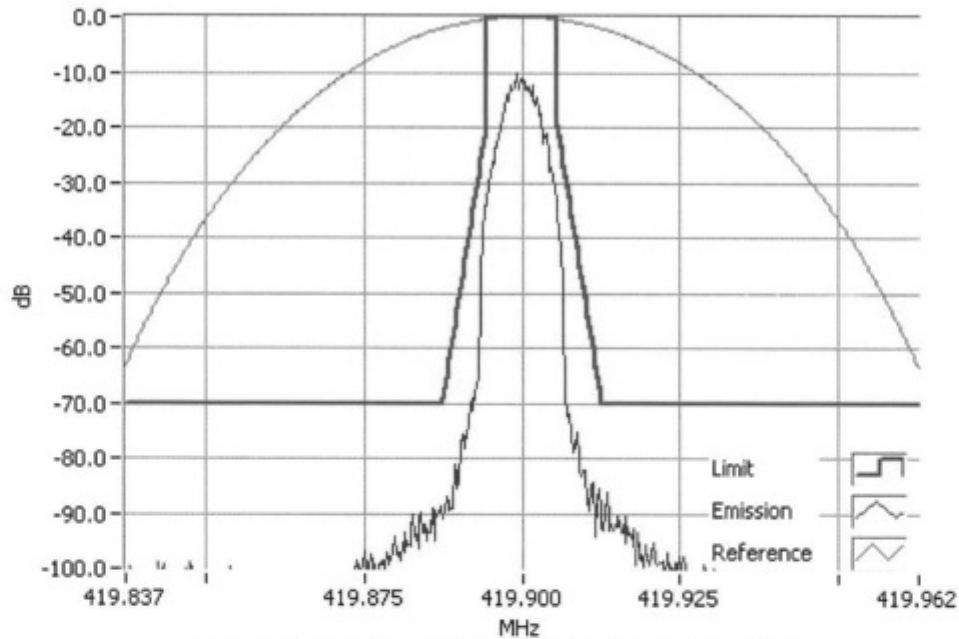
P25 Ph1 LSM 413.1000MHz Mask D 10W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

## Occupied Bandwidth and Spectrum Masks

APCO P25 phase-1 LSM

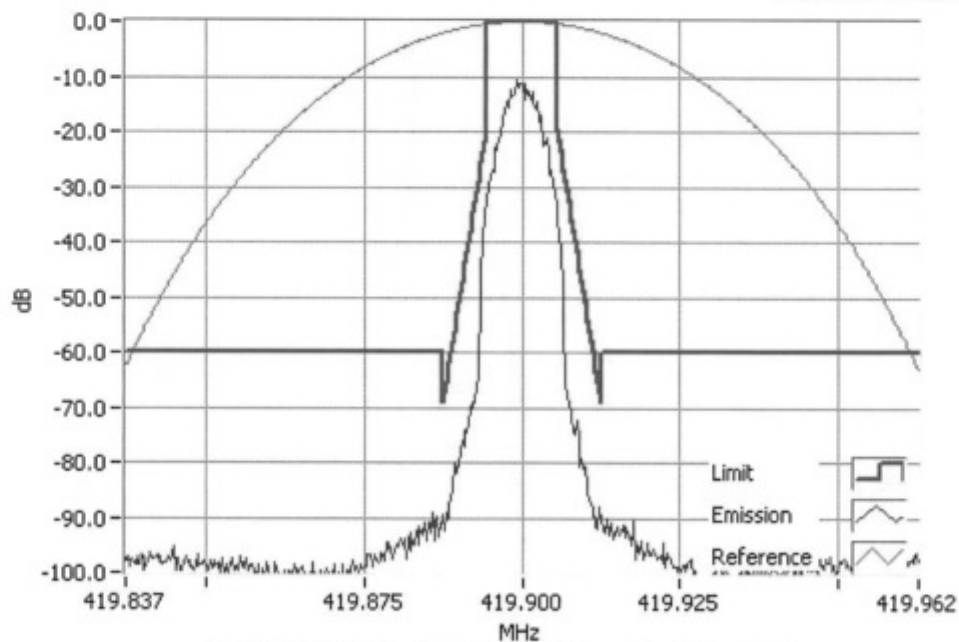
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 419.1 MHz 100 W 12.5 kHz Channel Spacing



P25 Ph1 LSM 419.9000MHz Mask D 100W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 419.1 MHz 10 W 12.5 kHz Channel Spacing



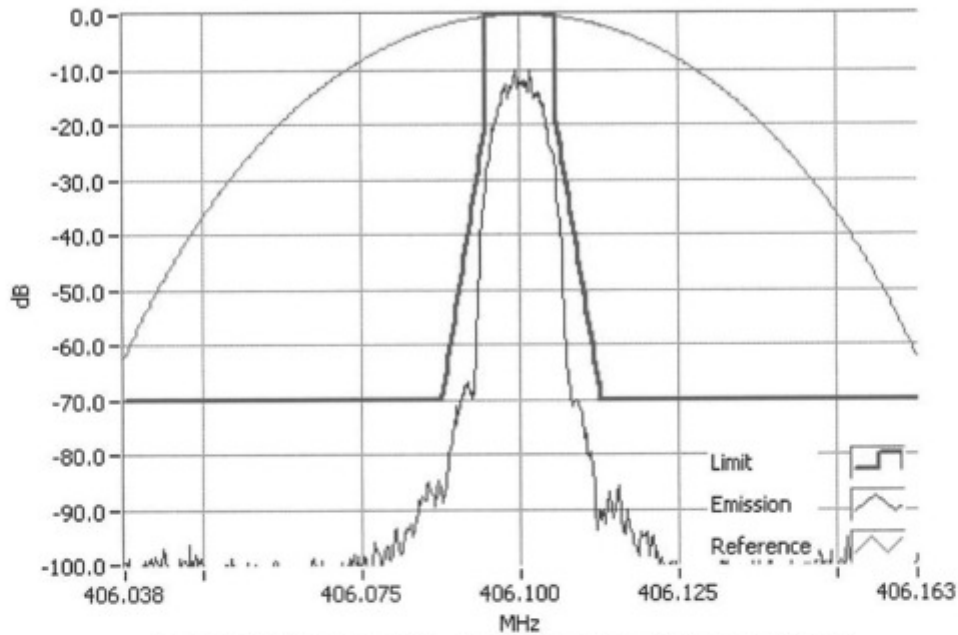
P25 Ph1 LSM 419.9000MHz Mask D 10W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

## Occupied Bandwidth and Spectrum Masks

APCO P25 phase-2

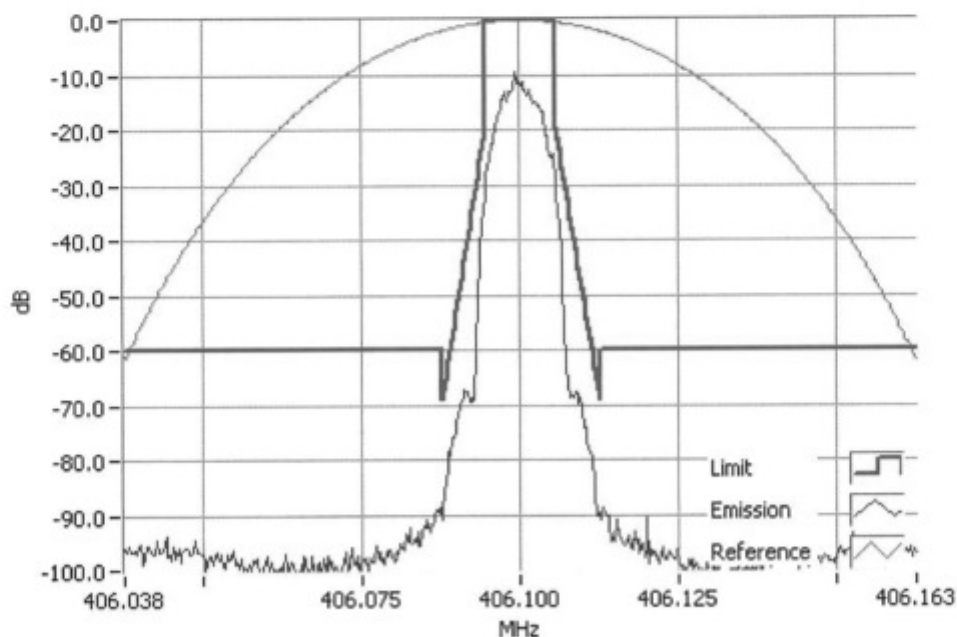
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 406.1 MHz 100 W 12.5 kHz Channel Spacing



P25 Ph11 H-DQPSK 406.1000MHz Mask D 100W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 406.1 MHz 10 W 12.5 kHz Channel Spacing



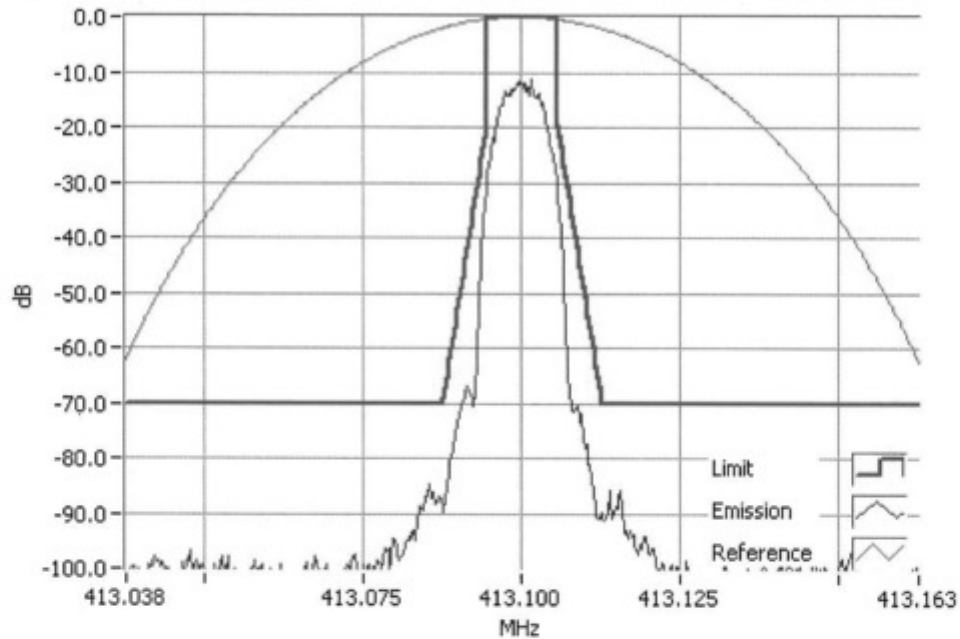
P25 Ph11 H-DQPSK 406.1000MHz Mask D 10W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

## Occupied Bandwidth and Spectrum Masks

APCO P25 phase-2

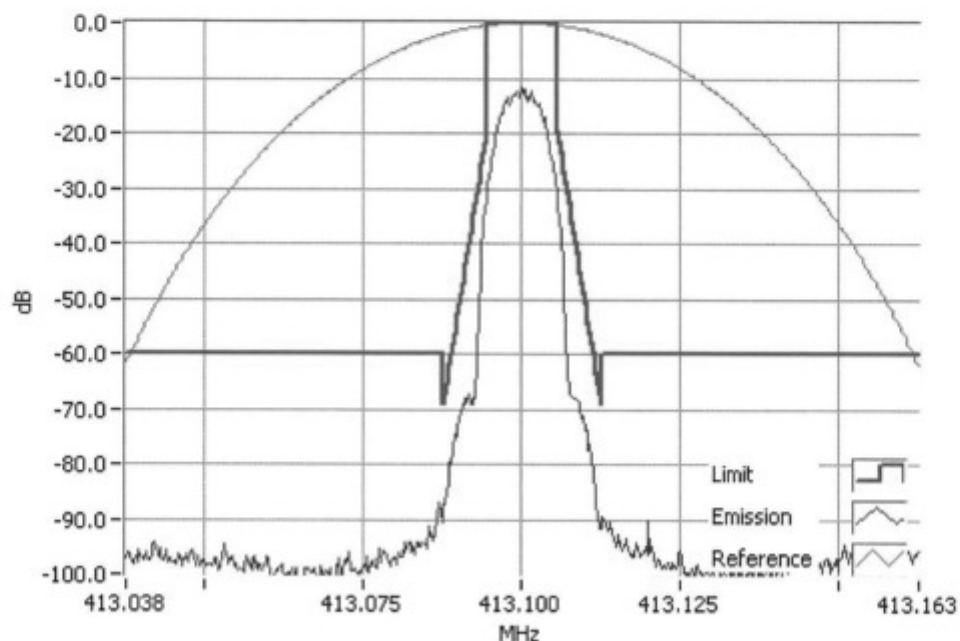
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 413.1 MHz 100 W 12.5 kHz Channel Spacing



P25 Ph11 H-DQPSK 413.1000MHz Mask D 100W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 413.1 MHz 10 W 12.5 kHz Channel Spacing



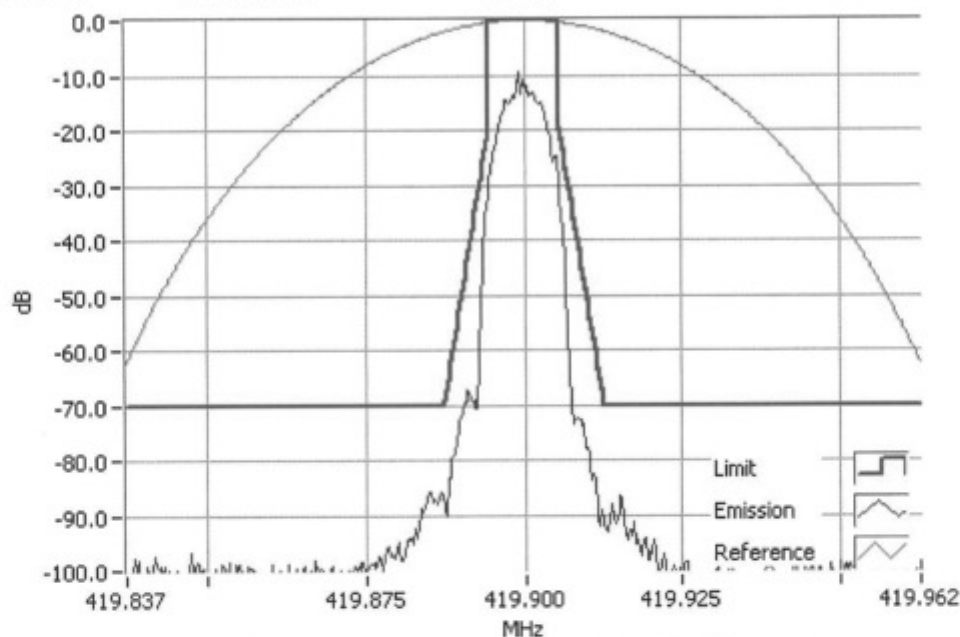
P25 Ph11 H-DQPSK 413.1000MHz Mask D 10W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

## Occupied Bandwidth and Spectrum Masks

APCO P25 phase-2

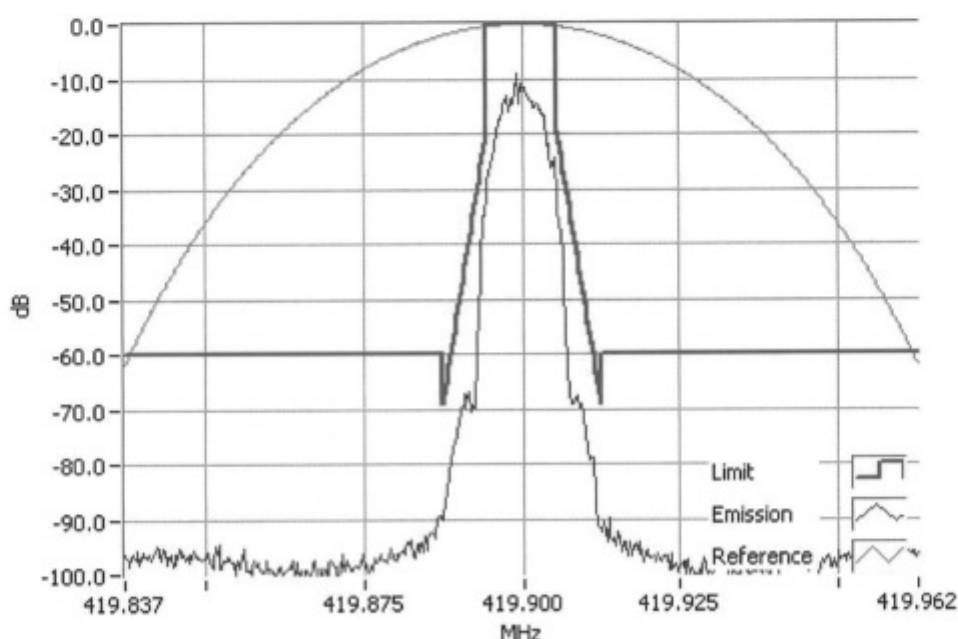
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 419.9 MHz 100 W 12.5 kHz Channel Spacing



P25 Ph11 H-DQPSK 419.9000MHz Mask D 100W  
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak  
Result=Pass

Tx FREQUENCY: 419.9 MHz 10 W 12.5 kHz Channel Spacing



P25 Ph11 H-DQPSK 419.9000MHz Mask D 10W  
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/EIA-603D 2.2.13

### 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.

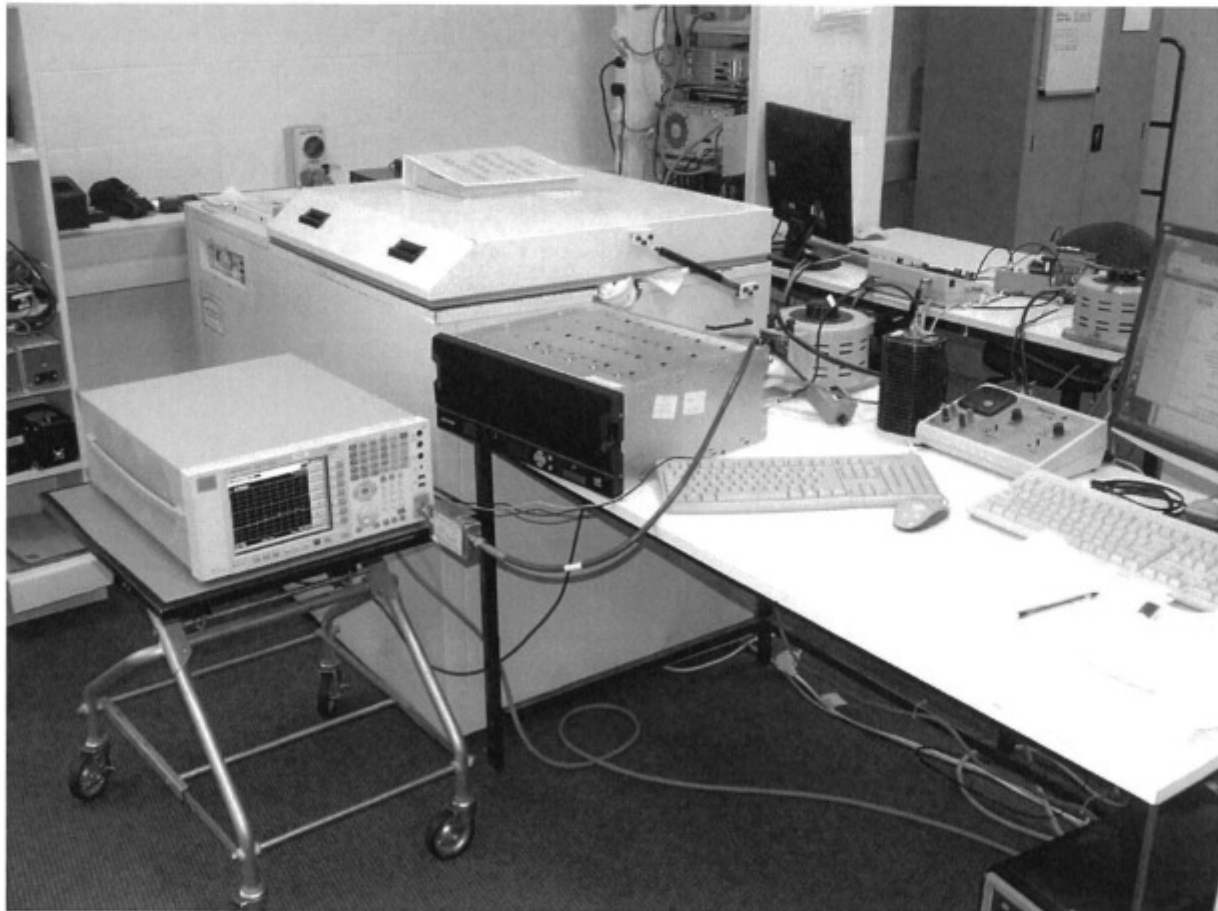
### MEASUREMENT RESULTS:

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

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

12.5 kHz Channel Spacing

406.1 MHz @ 100 W

Emission Mask D

| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| 2842.6996                | -34.3       | 84.3        |
| ~                        | ~           | ~           |

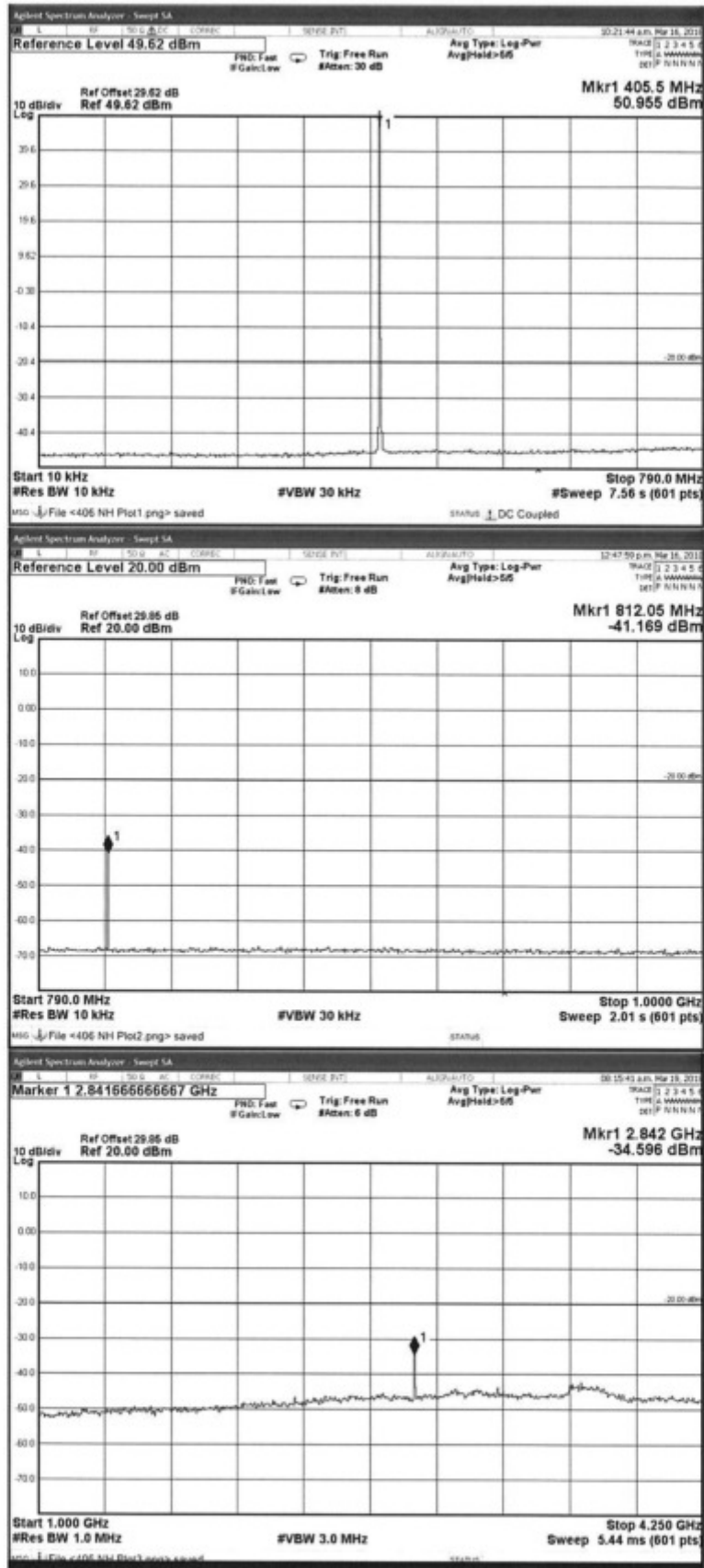
12.5 kHz Channel Spacing

406.1 MHz @ 10 W

Emission Mask D

| Emission Frequency (MHz)                                                        | Level (dBm)        | Level (dBc) |
|---------------------------------------------------------------------------------|--------------------|-------------|
| ~                                                                               | ~                  | ~           |
| Measurement Uncertainty:                                                        | ≤2.75 GHz ± 3.0 dB |             |
| No other emissions were detected at a level greater than 20 dB below the limit. |                    |             |

TELTEST Laboratories  
Tait Ltd  
Report Number 3870



### Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051

RSS-119 5.8

12.5 kHz Channel Spacing

413.1 MHz @ 100 W

Emission Mask D

| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| 2891.6995                | -34.4       | 84.4        |
| ~                        | ~           | ~           |

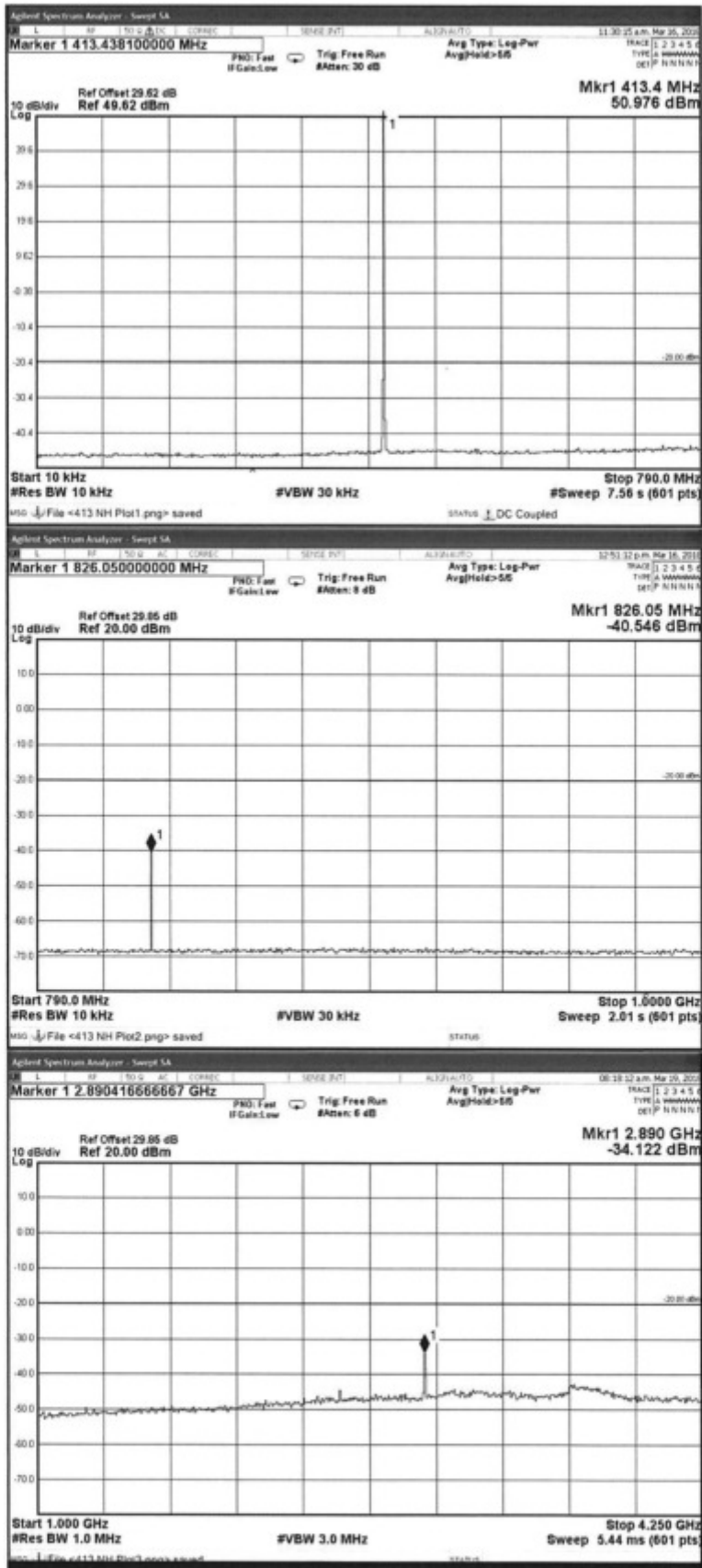
12.5 kHz Channel Spacing

413.1 MHz @ 10 W

Emission Mask D

| Emission Frequency (MHz)                                                        | Level (dBm)        | Level (dBc) |
|---------------------------------------------------------------------------------|--------------------|-------------|
| ~                                                                               | ~                  | ~           |
| Measurement Uncertainty:                                                        | ≤2.75 GHz ± 3.0 dB |             |
| No other emissions were detected at a level greater than 20 dB below the limit. |                    |             |

TELTEST Laboratories  
Tait Ltd  
Report Number 3870



Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051

RSS-119 5.8

12.5 kHz Channel Spacing

419.9 MHz @ 100 W

Emission Mask D

| Emission Frequency (MHz) | Level (dBm) | Level (dBc) |
|--------------------------|-------------|-------------|
| 2939.2995                | -34.4       | 84.4        |
| ~                        | ~           | ~           |

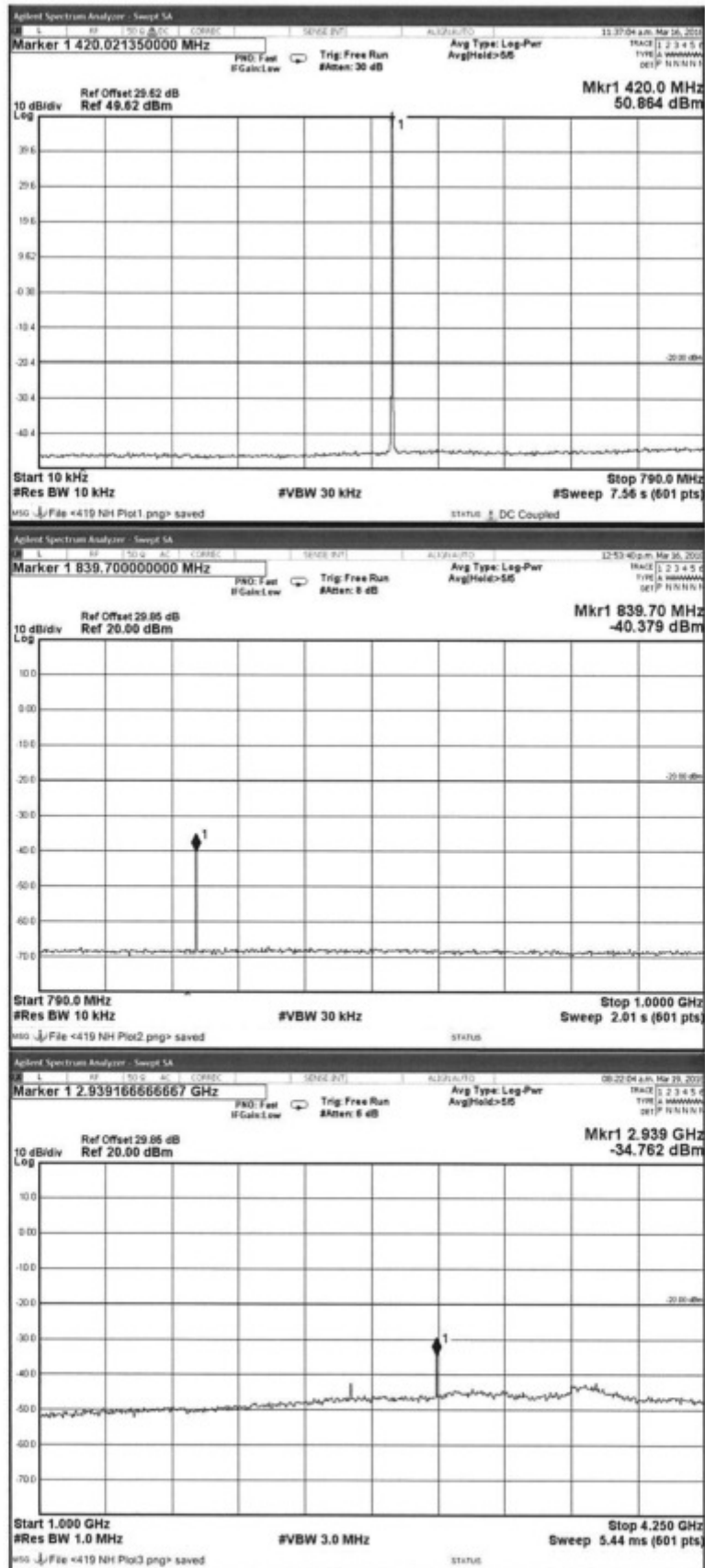
12.5 kHz Channel Spacing

419.9 MHz @ 10 W

Emission Mask D

| Emission Frequency (MHz)                                                        | Level (dBm)        | Level (dBc) |
|---------------------------------------------------------------------------------|--------------------|-------------|
| ~                                                                               | ~                  | ~           |
| Measurement Uncertainty:                                                        | ≤2.75 GHz ± 3.0 dB |             |
| No other emissions were detected at a level greater than 20 dB below the limit. |                    |             |

TELTEST Laboratories  
Tait Ltd  
Report Number 3870



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                                                                               | -70 dBc |
| 100 W                | -20 dBm                                                                               | -70 dBc |
| 10 W                 | -20 dBm                                                                               | -60 dBc |

## TRANSMITTER SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC 47 CFR 2.1053

GUIDE: TIA/EIA-603D 2.2.12

### 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) - Continued

SPECIFICATION: FCC CFR 2.1053

12.5 kHz Channel Spacing      406.1 MHz @ 100 W      Emission Mask D

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

12.5 kHz Channel Spacing      406.1 MHz @ 10 W      Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
|                                                                           |             |             |
| Measurement Uncertainty                                                   | ± 4.6 dB    |             |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |

12.5 kHz Channel Spacing      413.1 MHz @ 100 W      Emission Mask D

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

12.5 kHz Channel Spacing      413.1 MHz @ 10 W      Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
|                                                                           |             |             |
| Measurement Uncertainty                                                   | ± 4.6 dB    |             |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |

12.5 kHz Channel Spacing      419.9 MHz @ 100 W      Emission Mask D

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

12.5 kHz Channel Spacing      419.9 MHz @ 10 W      Emission Mask D

| Emission Frequency (MHz)                                                  | Level (dBm) | Level (dBc) |
|---------------------------------------------------------------------------|-------------|-------------|
| ~                                                                         | ~           | ~           |
|                                                                           |             |             |
| Measurement Uncertainty                                                   | ± 4.6 dB    |             |
| No emissions were detected at a level greater than 20 dB below the limit. |             |             |

Spurious Emissions (Tx Radiated) - Continued

LIMITS: FCC CFR 2.1053

| Carrier Output Power | Emission Mask D<br>12.5 kHz Channel Spacing<br>$50 + 10 \log_{10}(P_{\text{Watts}})$ |        |
|----------------------|--------------------------------------------------------------------------------------|--------|
| 100 W                | -20 dBm                                                                              | 70 dBc |
| 10 W                 | -20 dBm                                                                              | 60 dBc |

Open Area Test Site Results:

12.5 kHz Channel Spacing

419.9 MHz @ 100 W

Emission Mask D

| Harmonics<br>Emission Frequency (MHz) | Level (dBm)  | Level (dBc) |
|---------------------------------------|--------------|-------------|
| 839.800000                            | -59.54       | -109.54     |
| 1259.700000                           | -66.36       | -116.36     |
| 1679.600000                           | -55.88       | -105.88     |
| 2099.500000                           | -75.98       | -125.98     |
| 2519.400000                           | -69.33       | -119.33     |
| 2939.300000                           | -65.03       | -115.03     |
| Measurement Uncertainty               | $\pm 4.6$ dB |             |

Sample  
Calculation

| Sample Calculation       | Measurement           |               |                           |                    |                                | Result |         |
|--------------------------|-----------------------|---------------|---------------------------|--------------------|--------------------------------|--------|---------|
|                          | Reference             | Substitution  |                           |                    |                                |        |         |
| Emission Frequency (MHz) | Reference Level (dBm) | Sig-gen Level | Cable and Attenuator Gain | Antenna Gain (dBd) | Path and Boresight corrections | dBm    | nW      |
| 839.800000               | -92.19                | -42.84        | -16.47                    | -0.35              | 0.12                           | -59.54 | 1.11174 |
|                          |                       | A             | B                         | C                  | D                              | E      |         |

Result (E) = A+B+C+D

Photo: OATS Setup



## TRANSIENT FREQUENCY BEHAVIOR

SPECIFICATION: FCC 47 CFR 90.214

RSS-119 5.9

GUIDE: TIA/EIA-603D 2.2.19

### MEASUREMENT PROCEDURE:

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

### MEASUREMENT RESULTS:

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

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: 406.1 MHz 100 W 12.5 kHz Channel Spacing

406.1 MHz @ 100 W Tx

| TRANSIENT RESPONSE PERIOD | CARRIER PEAK VARIATION FROM NORMAL |               |
|---------------------------|------------------------------------|---------------|
|                           | Key ON (kHz)                       | Key OFF (kHz) |
| t1                        | -0.8                               | N/A           |
| t2                        | -0.6                               | N/A           |
| t3                        | N/A                                | 0.8           |

|                                                                                                                     |     |                          |
|---------------------------------------------------------------------------------------------------------------------|-----|--------------------------|
| 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"/> |

Measurement Uncertainty: Frequency  $\pm 130$  Hz; Time  $\pm 0.2\%$

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)                                                                              | $\pm 12.5$ kHz               | 5 ms            | 10 ms           |
| t2 (ms)                                                                              | $\pm 6.25$ kHz               | 20 ms           | 25 ms           |
| t3 (ms)                                                                              | $\pm 12.5$ 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

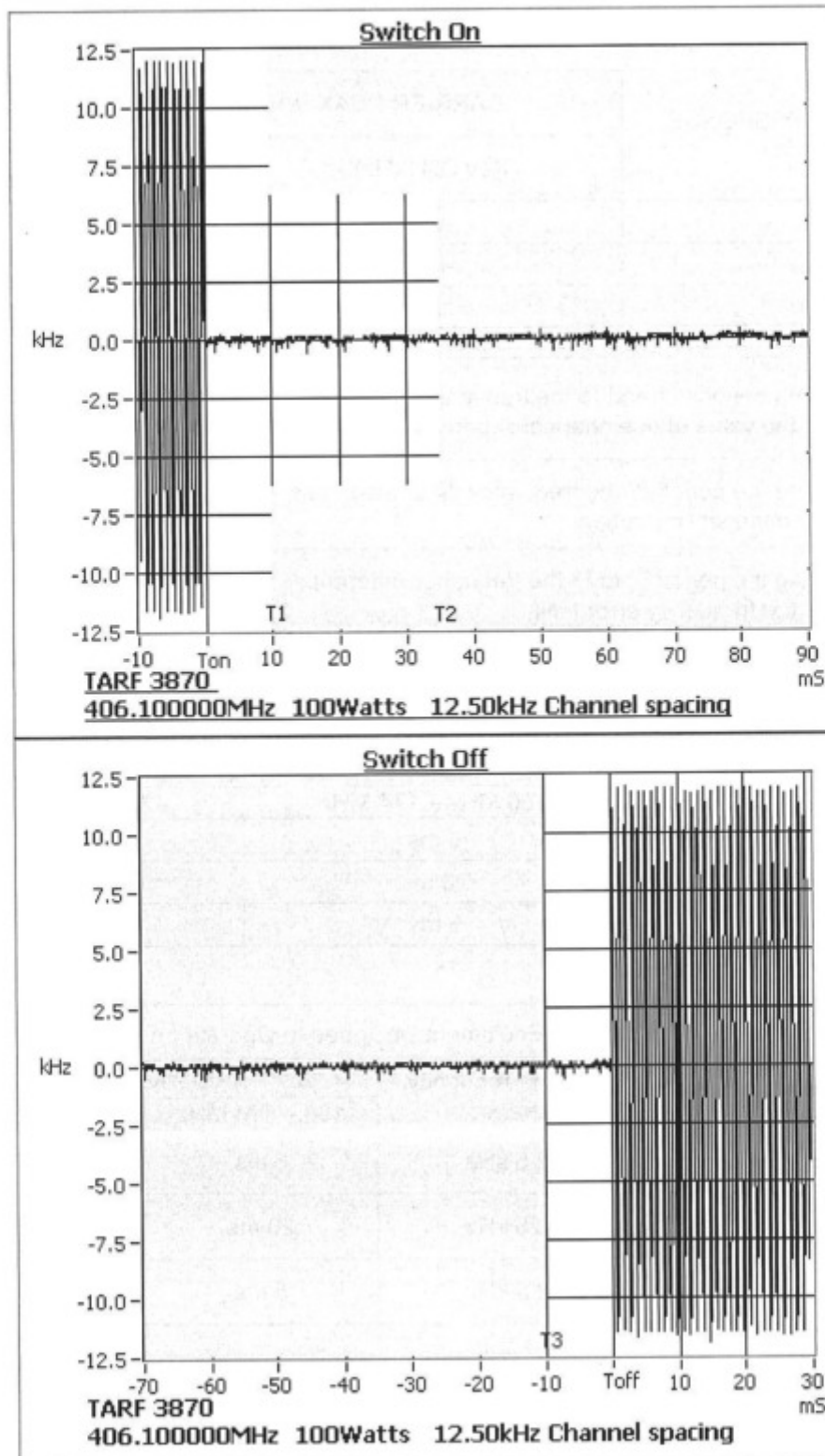
SPECIFICATION: FCC 47 CFR 90.214

RSS-119 5.9

Tx FREQUENCY: 406.1 MHz

100 W

12.5 kHz Channel Spacing



## Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 413.1 MHz 100 W 12.5 kHz Channel Spacing

413.1 MHz @ 100 W Tx

| TRANSIENT RESPONSE PERIOD | CARRIER PEAK VARIATION FROM NORMAL |               |
|---------------------------|------------------------------------|---------------|
|                           | Key ON (kHz)                       | Key OFF (kHz) |
| t1                        | -0.7                               | N/A           |
| t2                        | -0.4                               | N/A           |
| t3                        | N/A                                | -0.6          |

|                                                                                                                     |     |                          |
|---------------------------------------------------------------------------------------------------------------------|-----|--------------------------|
| 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"/> |

Measurement Uncertainty: Frequency  $\pm$  130 Hz; Time  $\pm$  0.2%

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

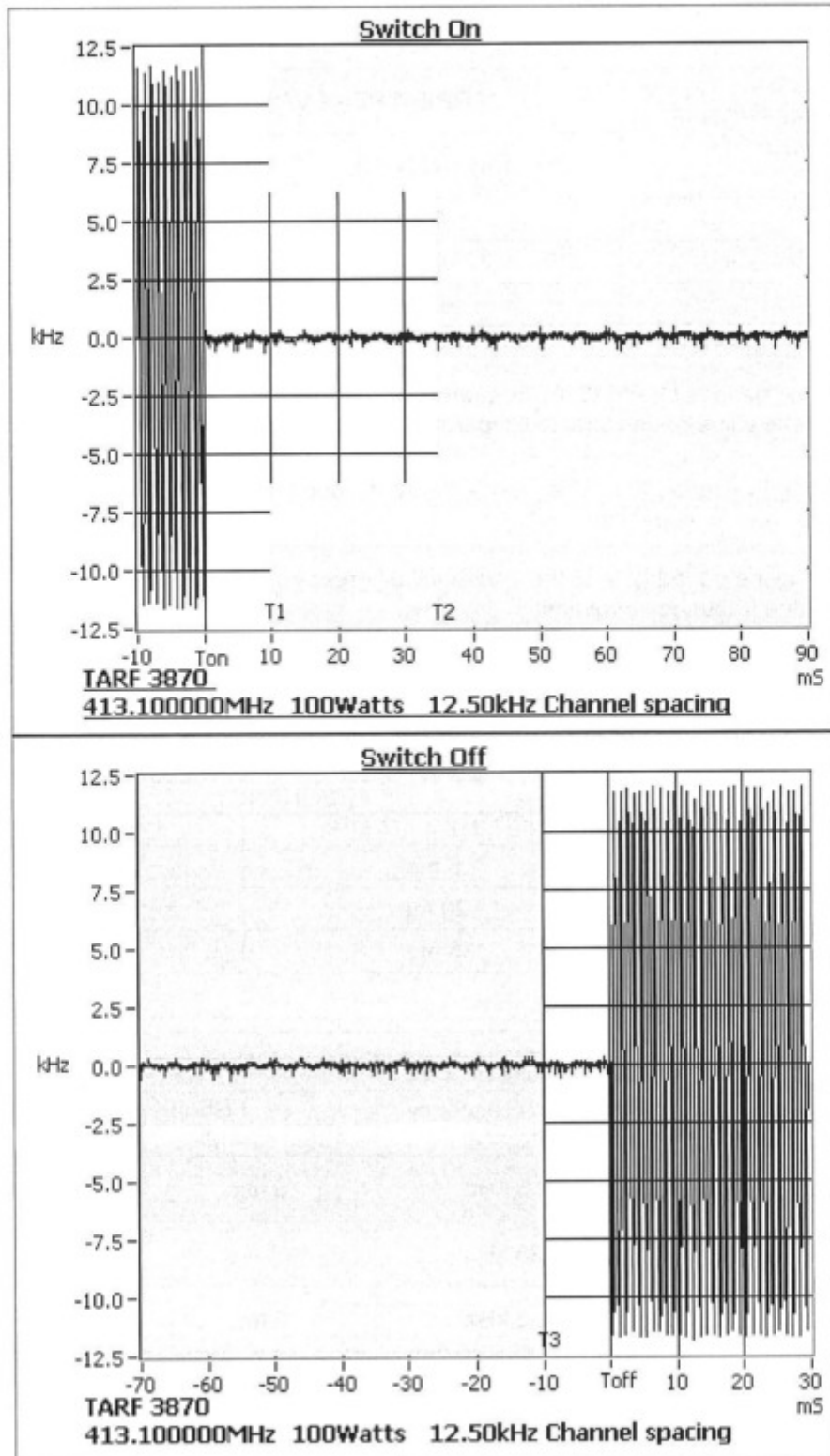
| Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels |                              |                 |                 |
|--------------------------------------------------------------------------------------|------------------------------|-----------------|-----------------|
| TRANSIENT PERIODS                                                                    | Maximum Frequency Difference | FREQUENCY RANGE |                 |
|                                                                                      |                              | 138 – 174 MHz   | 406.1 – 470 MHz |
| t1 (ms)                                                                              | $\pm$ 12.5 kHz               | 5 ms            | 10 ms           |
| t2 (ms)                                                                              | $\pm$ 6.25 kHz               | 20 ms           | 25 ms           |
| t3 (ms)                                                                              | $\pm$ 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: 413.1 MHz      100 W      12.5 kHz Channel Spacing



## Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

RSS-119 5.9

Tx FREQUENCY: 419.9 MHz

100 W

12.5 kHz Channel Spacing

419.9 MHz @ 100 W Tx

| TRANSIENT RESPONSE PERIOD | CARRIER PEAK VARIATION FROM NORMAL |               |
|---------------------------|------------------------------------|---------------|
|                           | Key ON (kHz)                       | Key OFF (kHz) |
| t1                        | 1.1                                | N/A           |
| t2                        | -0.7                               | 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"/> |

Measurement Uncertainty: Frequency  $\pm 130$  Hz; Time  $\pm 0.2\%$

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)                                                                              | $\pm 12.5$ kHz               | 5 ms            | 10 ms           |
| t2 (ms)                                                                              | $\pm 6.25$ kHz               | 20 ms           | 25 ms           |
| t3 (ms)                                                                              | $\pm 12.5$ kHz               | 5 ms            | 10 ms           |

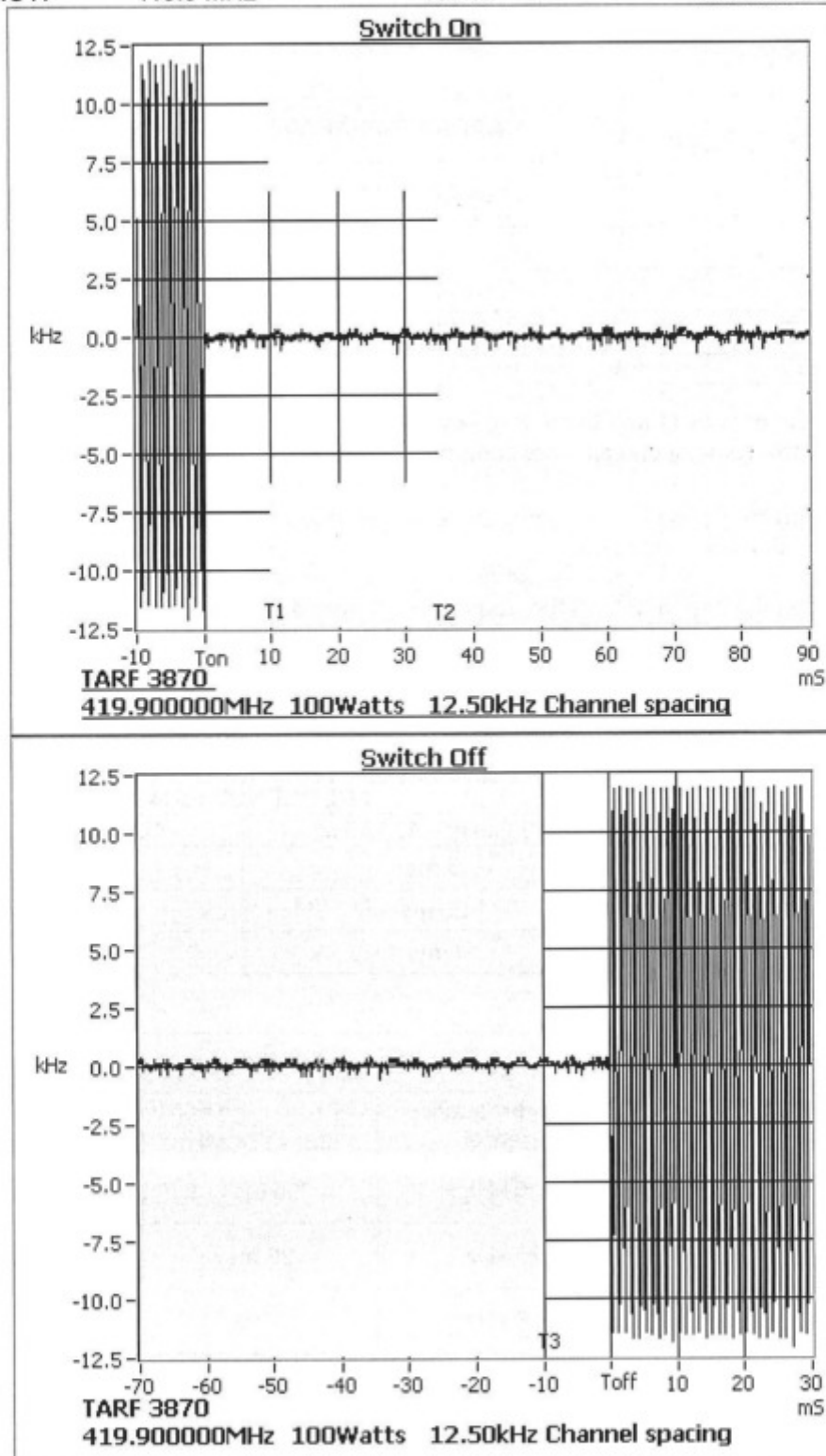
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

## Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

RSS-119 5.9

Tx FREQUENCY: 419.9 MHz 100 W 12.5 kHz Channel Spacing



Measurement Uncertainty: Frequency  $\pm 130$  Hz; Time  $\pm 0.2\%$

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)                                                                              | $\pm 12.5$ kHz               | 5 ms            | 10 ms           |
| t2 (ms)                                                                              | $\pm 6.25$ kHz               | 20 ms           | 25 ms           |
| t3 (ms)                                                                              | $\pm 12.5$ 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

### TRANSMITTER FREQUENCY STABILITY - TEMPERATURE

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

RSS-119 5.3

GUIDE: TIA/EIA-603D 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 channel spacing.

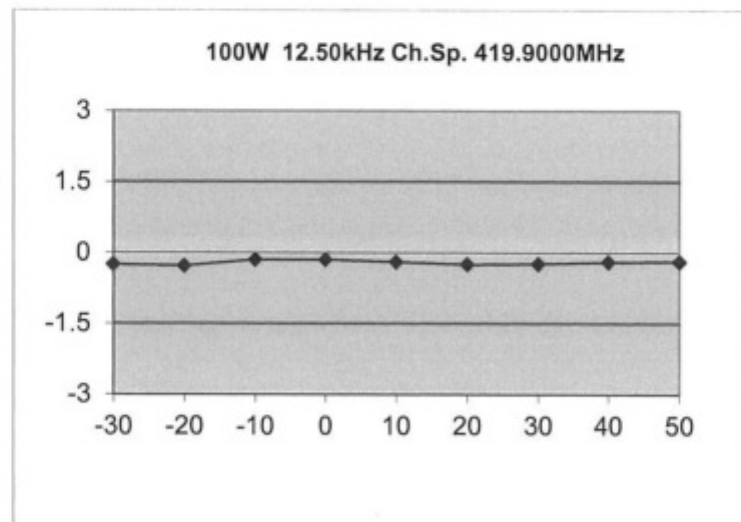
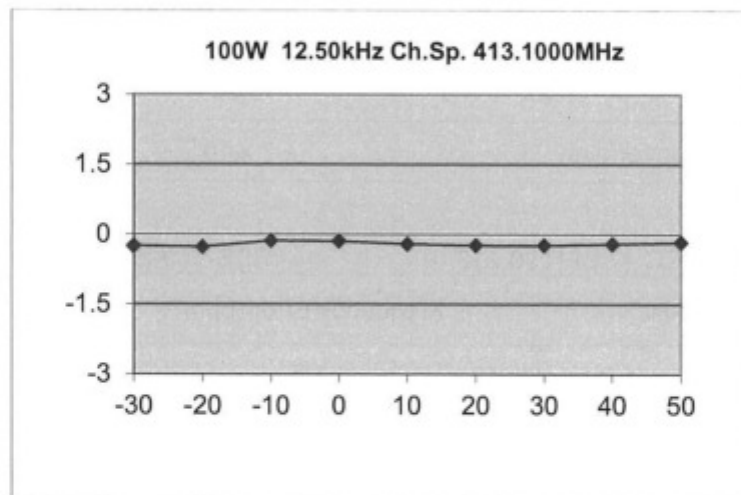
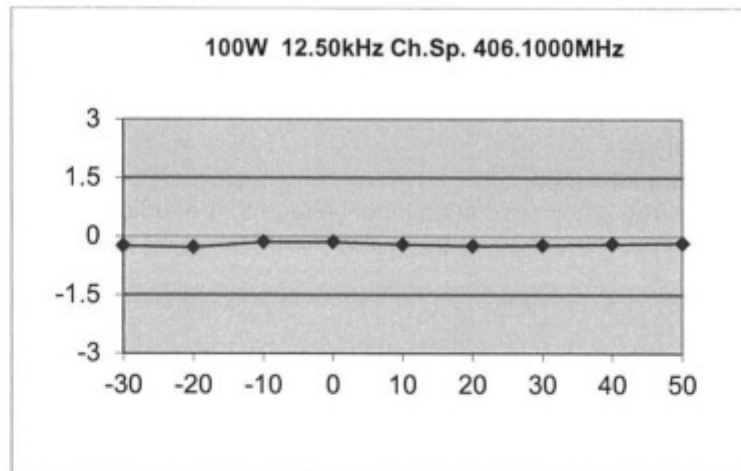
| Temperature ( $^{\circ}\text{C}$ ) | Error (ppm)            |           |           |
|------------------------------------|------------------------|-----------|-----------|
|                                    | 406.1 MHz              | 413.1 MHz | 419.9 MHz |
| -30                                | -0.25                  | -0.25     | -0.25     |
| -20                                | -0.28                  | -0.27     | -0.28     |
| -10                                | -0.15                  | -0.14     | -0.15     |
| 0                                  | -0.15                  | -0.15     | -0.15     |
| 10                                 | -0.21                  | -0.21     | -0.2      |
| 20                                 | -0.25                  | -0.24     | -0.25     |
| 30                                 | -0.23                  | -0.24     | -0.24     |
| 40                                 | -0.2                   | -0.21     | -0.2      |
| 50                                 | -0.18                  | -0.18     | -0.19     |
| Measurement Uncertainty            | $\pm 7 \times 10^{-8}$ |           |           |

LIMIT: FCC 47 CFR 90.213

RSS-119 5.3

| Channel Spacing (kHz) | Frequency Error (ppm) |
|-----------------------|-----------------------|
| 12.5                  | 1.5                   |

### Transmitter Frequency Stability - Temperature



## TRANSMITTER FREQUENCY STABILITY - VOLTAGE

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

RSS-119 5.3

GUIDE: TIA/EIA-603D 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 85% to 115%.
3. The frequency error was recorded in parts per million (ppm).

MEASUREMENT RESULTS:  $\pm 7 \times 10^{-8}$

|                         | FREQUENCY ERROR (ppm) for 12.5 kHz |                        |                     |
|-------------------------|------------------------------------|------------------------|---------------------|
|                         | 120 V <sub>AC</sub>                | 102 V <sub>AC</sub>    | 138 V <sub>AC</sub> |
| 406.1 MHz               | -0.21                              | -0.21                  | -0.21               |
| 413.1 MHz               | -0.22                              | -0.21                  | -0.21               |
| 419.9 MHz               | -0.22                              | -0.22                  | -0.21               |
| Measurement Uncertainty |                                    | $\pm 7 \times 10^{-8}$ |                     |

LIMIT CLAUSES: FCC 47 CFR 90.213 RSS-119 5.3

| Channel Spacing (kHz) | Frequency Error (ppm) |
|-----------------------|-----------------------|
| 12.5                  | 1.5                   |

## RECEIVER SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: RSS-119 5.11

GUIDE: TIA/EIA-603D 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                                 |                    |             |
|---------------------------------------------------|--------------------|-------------|
| Emission Frequency (MHz)                          | Level (nW)         | Level (dBm) |
| ~                                                 | ~                  | ~           |
|                                                   |                    |             |
| Measurement Uncertainty                           | ≤2.75 GHz ± 3.0 dB |             |
| No emissions were detected within 20 dB of Limit. |                    |             |

| 413.2 MHz Receive                                 |                    |             |
|---------------------------------------------------|--------------------|-------------|
| Emission Frequency (MHz)                          | Level (nW)         | Level (dBm) |
| ~                                                 | ~                  | ~           |
|                                                   |                    |             |
| Measurement Uncertainty                           | ≤2.75 GHz ± 3.0 dB |             |
| No emissions were detected within 20 dB of Limit. |                    |             |

| 419.8 MHz Receive                                 |                    |             |
|---------------------------------------------------|--------------------|-------------|
| Emission Frequency (MHz)                          | Level (nW)         | Level (dBm) |
| ~                                                 | ~                  | ~           |
|                                                   |                    |             |
| Measurement Uncertainty                           | ≤2.75 GHz ± 3.0 dB |             |
| No emissions were detected within 20 dB of Limit. |                    |             |

### Receiver Spurious Emissions (Conducted) – Continued

LIMIT CLAUSE: RSS-Gen 6(b)

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

## TEST EQUIPMENT LIST

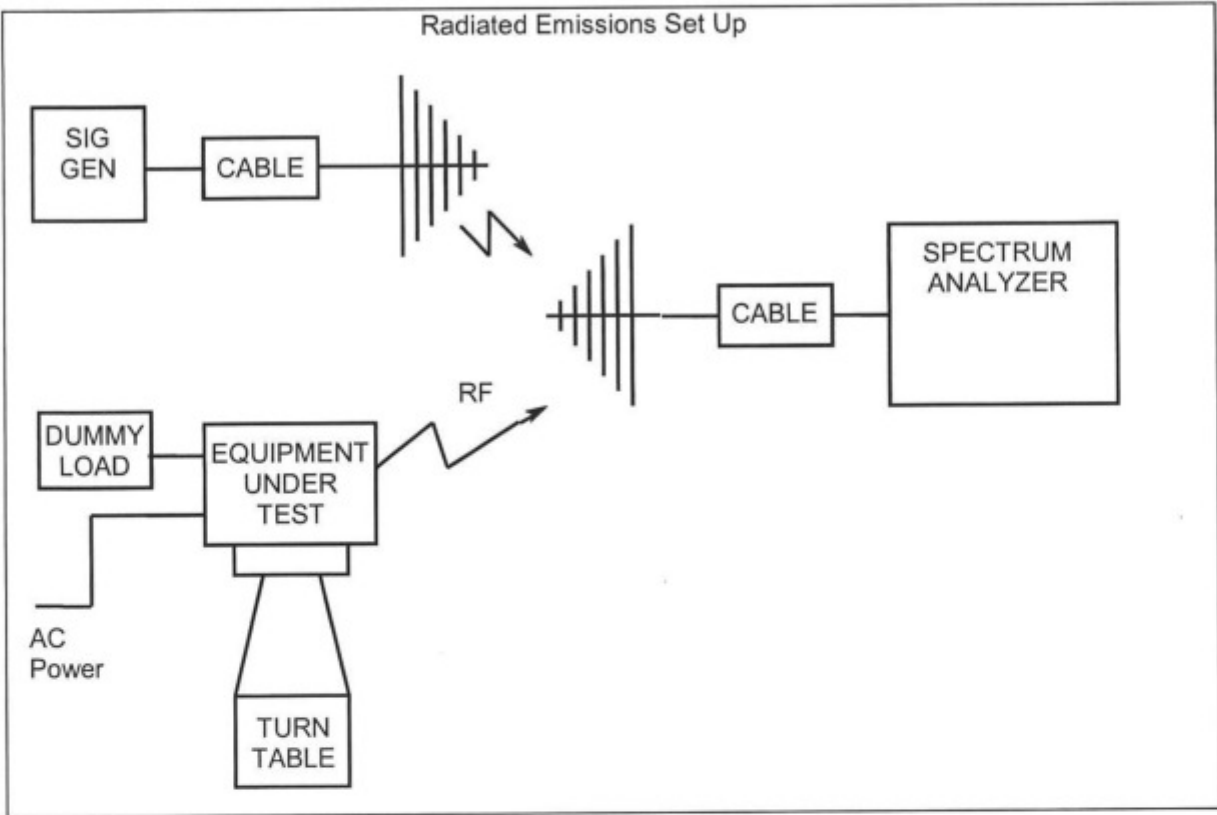
| Equipment Type    | Information                                    | Manufacturer    | Model No           | Serial No#    | Tait ID | Cal Due   |
|-------------------|------------------------------------------------|-----------------|--------------------|---------------|---------|-----------|
| Signal Generator  | Analog 1GHz                                    | Hewlett Packard | HP8648A            | 3430U00344    | E3579   | 25-Sep-18 |
| Signal Generator  | Analog 4GHz                                    | Agilent         | E4422B             | GB40050320    | E3788   | 28-Sep-18 |
| Antenna           | Reference Dipoles                              | Emco            | 3121C DB1          | 9510-1164     | E3559   | 14-Apr-19 |
| Antenna           | 18GHz DRG                                      | Emco            | DRG3115            | 9512-4638     | E3560   | 15-May-20 |
| Antenna           | 18GHz DRG                                      | Emco            | DRG3115            | 2084          | E3076   |           |
| Spectrum Analyser | 26.5GHz                                        | Agilent         | PXA N9030A         | MY49432161    | E4907   | 18-Oct-18 |
| Transient Limiter | 9kHz to 200MHz                                 | Agilent         | 11947A             | 3107A03657    | E4982   | 29-Sep-18 |
| RF Attenuator     | 20dB 50W                                       | Weinschel       | 24-20-44           | AW1266        | E3562   | 20-Dec-18 |
| RF Attenuator     | 20dB 25W                                       | Weinschel       | 33-20-33           | BD5871        | E3673   | 20-Dec-18 |
| RF Load           | 150W                                           | Bird            | 8166               | 524           | E3625   | 20-Dec-18 |
| Coax Cable        | 2m Black                                       | Suhner          | RG214HF/Nm/Nm/2000 | TeltestBlack2 | E4623   | 20-Dec-18 |
| Spectrum Analyser | 13.2GHz                                        | Hewlett Packard | HP8562E            | 3821A00779    | E3715   | 2-Oct-18  |
| LISN              |                                                | Emco            | 3825/2             | 9204-1961     | E3040   | 4-Oct-18  |
| Oscilloscope      | 400MHz                                         | Tektronics      | TDS380             | B017095       | E3782   | 29-Sep-19 |
| Signal Generator  | TREVA2 Analog 3.3GHz                           | Rohde & Schwarz | SML03 1090.3000.13 | 100597        | E4050   | 10-Oct-18 |
| Spectrum Analyser | 13.2GHz                                        | Agilent         | E4445A             | MY42510072    | E4139   | 15-Oct-18 |
| Coax Cable        | OATS Turntable Cable 1                         | Intelcom        | RG214              | OATS1         | E4621   | 1-Jan-19  |
| Coax Cable        | OATS Tower Cable                               | Intelcom        | RG214              | OATS2         | E4622   | 1-Jan-19  |
| OATS              | Antenna Tower                                  | Electrometrics  | EM-4720-2          | 112           | E4447   |           |
| OATS              | Controller                                     | Electrometrics  | EM-4700            | 119           | E4445   |           |
| OATS              | Turntable                                      | Electrometrics  | EM-4704A           | 105           | E4446   |           |
| Coax Cable        | 2m Black                                       | Suhner          | RG214HF/Nm/Nm/2000 | TeltestBlack6 | E4849   | 20-Dec-18 |
| Coax Cable        | Reverb - 4.5m Multiflex 141                    | TeltestBlue6    | MF 141             | TeltestBlue6  | E4843   | 20-Dec-18 |
| Coax Cable        | Reverb - 2m Multiflex 141                      | TeltestBlue5    | MF 141             | TeltestBlue5  | E4844   | 20-Dec-18 |
| Coax Cable        | Reverb - 2m Multiflex 141                      | TeltestBlue4    | MF 141             | TeltestBlue4  | E4845   | 20-Dec-18 |
| Coax Cable        | Reverb - 1m Multiflex 141                      | TeltestBlue2    | MF 141             | TeltestBlue2  | E4847   | 20-Dec-18 |
| Coax Cable        | Reverb - 1m Multiflex 141                      | TeltestBlue1    | MF 141             | TeltestBlue1  | E4848   | 20-Dec-18 |
| Power Meter       | Reverb - USB interface for NRT Z44             | Rohde & Schwarz | NRT Z5             | 100586        | E4852   |           |
| Power Meter       | Reverb - 0.2 - 4GHz directional power meter    | Rohde & Schwarz | NRT Z44            | 105151        | E4853   | 11-Oct-18 |
| RF Chamber        | Reverb - Stirrer controller for reverb chamber | Teseq           | Stirrer Controller | 29765.1       | E4854   |           |
| 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   |           |
| Antenna           | Reverb - 1-18GHz DRG                           | Schwarzbeck     | BBHA 9120 D        | 9120D-884     | E4858   |           |

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|                  |                           |          |             |            |       |           |
|------------------|---------------------------|----------|-------------|------------|-------|-----------|
| RF Amplifier     | Pre-amplifier             | Agilent  | 87405C      | MY47010688 | E4941 | 9-Oct-18  |
| Power Supply     | 60V/25A                   | Agilent  | N5767A      | 3111A05573 | E4979 | 10-Oct-18 |
| Coax Cable       | OATS Turntable<br>Cable 2 | Intelcom | RG215       | OATS3      | E4995 | 1-Jan-19  |
| Signal Generator | Digital 4GHz              | Agilent  | E4437B      | US39260389 | E4764 | 30-Sep-19 |
| Testware         | Reverb Emissions          |          | 28 May 2015 | -          | -     |           |
|                  |                           |          |             |            |       |           |

\* 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 **EVAL**uation 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.

