

# LABORATORY TEST REPORT

## RADIO PERFORMANCE MEASUREMENTS

for the  
TPDC0A Handportable Transceiver

Tested in accordance with:

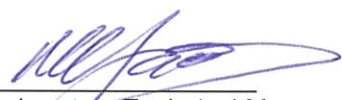
FCC 47 CFR Part 90

Report Revision: 1  
Issue Date: 20 April 2018

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CHECKED & APPROVED BY: M. C. James

  
Laboratory Technical Manager



FCC REGISTRATION: 838288

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

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## REVISION

| Date          | Revision | Comments            |
|---------------|----------|---------------------|
| 20 April 2018 | 1        | Initial test report |
|               |          |                     |

## INTRODUCTION

Type approval testing of the TPDC0A, 5 Watt, Handportable transceiver in order to demonstrate compliance with FCC 47 Part 90 for 173.2-173.4 MHz. This is a Class 2 permissive change to extend the frequency range of this product. The previous FCC Grant for this product is FCCID: CASTPDC0A 220-222 MHz to CFR part 90 (test report Timco 1425AUT17), and a previous class 2 permissive change added 217-220 MHz to part 80 (test report Timco 1977UT17).

This radio supports analogue, digital FFSK and Digital Mobile Radio (DMR) modulations.

### REPORT PREPARED FOR

Tait Ltd  
245 Wooldridge Road  
Harewood  
Christchurch 8051  
New Zealand

### DESCRIPTION OF SAMPLE

Manufacturer: Tait Limited  
Equipment: Handportable Transceiver  
Type: TPDC0A  
Product Code: T03-00043-CJDB  
Serial Number(s): 25905515  
Frequency range: 173 → 225 MHz  
Transmit Power: 5 W

| 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            |
|                            |                                              | 12.5 kHz        | -               | 2400                      | 2400            |
| Digital Mobile Radio (DMR) | 4 Level FSK (2 slot TDMA) (ETSI TS102 361-1) | 12.5 kHz        | 2               | 4800                      | 9600            |

### HARDWARE & SOFTWARE

Quantity: 1

|                   |                              |
|-------------------|------------------------------|
|                   | Analogue, FFSK and DMR tests |
| Hardware ID       | TPDB1X-C000_0007             |
| Boot Code         | QPD1B_S00_3.01.03.0001       |
| DSP               | QPD1A_E00_2.17.07.0086       |
| Radio Application | QPD1F_E00_2.17.07.0086       |
| Firmware Package  | QI93P_E00_2.17.07.0086       |
| FPGA Image        | QPD1G_S01_1.12.00.0003       |

### TEST CONDITIONS

All testing was performed between 16 → 19 April 2018, and under the following conditions:

Ambient temperature: 15°C → 30°C  
Relative Humidity: 20% → 75%  
Standard Test Voltage 7.5 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: Handportable Transceiver  
Type: TPDC0A  
Product Code: T03-00043-CJDB  
Serial Number(s): 25905515  
Quantity: 1

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

FCC 47 CFR Part 90

**Signature:**



M. C. James  
Laboratory Technical Manager

**Date:**



## MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS

### MODULATION TYPES:

|     |                                    |                       |
|-----|------------------------------------|-----------------------|
| F3E | Analogue Frequency Modulation (FM) |                       |
| F2D | FFSK                               | 1200 bps and 2400 bps |
| FXW | DMR Digital Voice                  | 9600 bps              |
| FXD | DMR Digital Data                   | 9600 bps              |

CHANNEL SPACINGS: 12.5 kHz

### EMISSION DESIGNATORS:

|                    |          |
|--------------------|----------|
|                    | 12.5 kHz |
| Analog FM          | 11K0F3E  |
| FFSK Data 1200 bps | 6K60F2D  |
| FFSK Data 2400 bps | 7K80F2D  |
| Digital Voice DMR  | 7K60FXW  |
| Digital Data DMR   | 7K60FXD  |

### CALCULATIONS

Equation:  $B_n = 2M + 2Dk$

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

Analog 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 Bandwidth

Necessary bandwidth

M = 1.8 kHz

D = 1.5 kHz (60% of peak deviation)

$$B_n = (2 \times 1.8) + (2 \times 1.5) \times 1$$

$$= 6.6 \text{ kHz}$$

Emission Designator

**6K60F2D**

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

Fast Frequency Shift Keying (FFSK – 2400 bps) 12.5 kHz Bandwidth

Necessary bandwidth

M = 2.4 kHz

D = 1.5 kHz (60% of peak deviation)

$$B_n = (2 \times 2.4) + (2 \times 1.5) \times 1$$

$$= 7.8 \text{ kHz}$$

Emission Designator

**7K80F2D**

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

Emission Designator

**7K60FXW**

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

Digital Data 12.5 kHz Bandwidth DMR

99% bandwidth

= 7.6 kHz

Emission Designator

**7K60FXD**

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

## TEST RESULTS

### TRANSMITTER OUTPUT POWER (CONDUCTED)

SPECIFICATION: FCC 47 CFR 2.1046

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: 5 W and 1 W

|               |           |
|---------------|-----------|
| Nominal 5 W   | 173.3 MHz |
| Measured      | 5.2       |
| Variation (%) | 4.6       |

|                         |              |
|-------------------------|--------------|
| Nominal 1 W             | 173.3 MHz    |
| Measured                | 1.0          |
| Variation (%)           | 0.4          |
| Measurement Uncertainty | $\pm 0.6$ dB |

#### LIMIT CLAUSE:

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.

## 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:

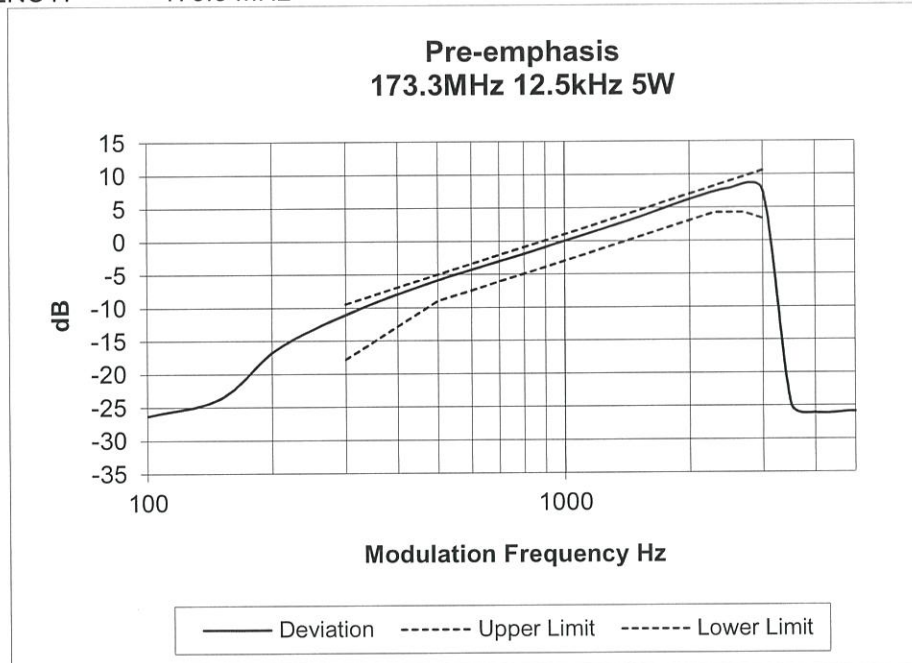
See the plot below for 12.5 kHz channel spacing tested at 5 W transmit power.

LIMIT CLAUSE: TIA/EIA-603D 3.2.6

MEASUREMENT UNCERTAINTY:  $\pm 1.5\%$

Tx FREQUENCY: 173.3 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:

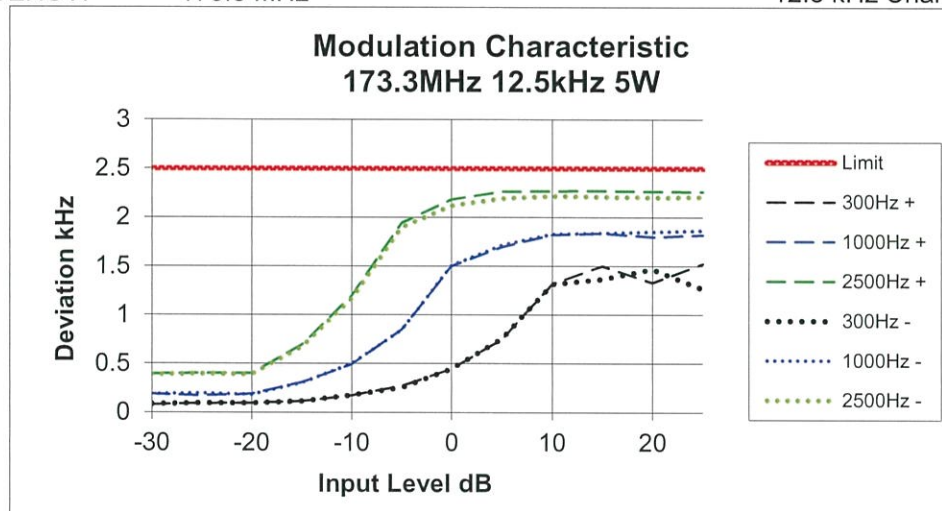
See the plot below for 12.5 kHz channel spacing.

LIMIT CLAUSE: TIA/EIA-603D 1.3.4.4

MEASUREMENT UNCERTAINTY:  $\pm 1.5\%$

Tx FREQUENCY: 173.3 MHz

12.5 kHz Channel Spacing



## TRANSMITTER OCCUPIED BANDWIDTH AND SPECTRUM MASKS

SPECIFICATION: FCC 47 CFR 2.1049 (c)

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

### EMISSION MASKS

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

### DATA SPEED

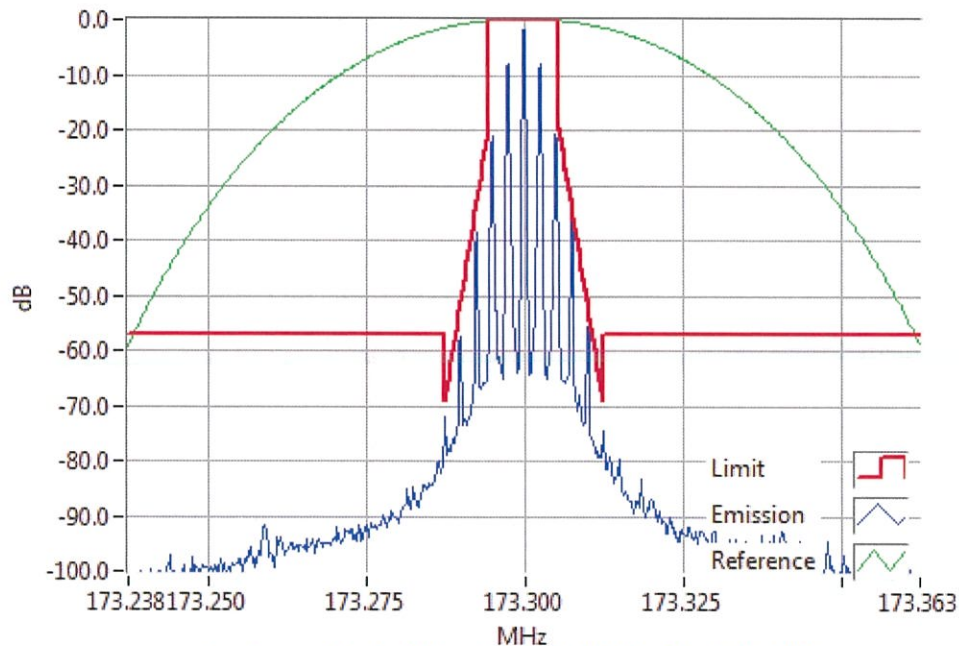
|                    |                          |                     |
|--------------------|--------------------------|---------------------|
| Digital Voice/Data | 12.5 kHz Channel Spacing | 9600 bps            |
| FFSK               | 12.5 kHz Channel Spacing | 1200 bps & 2400 bps |

## Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

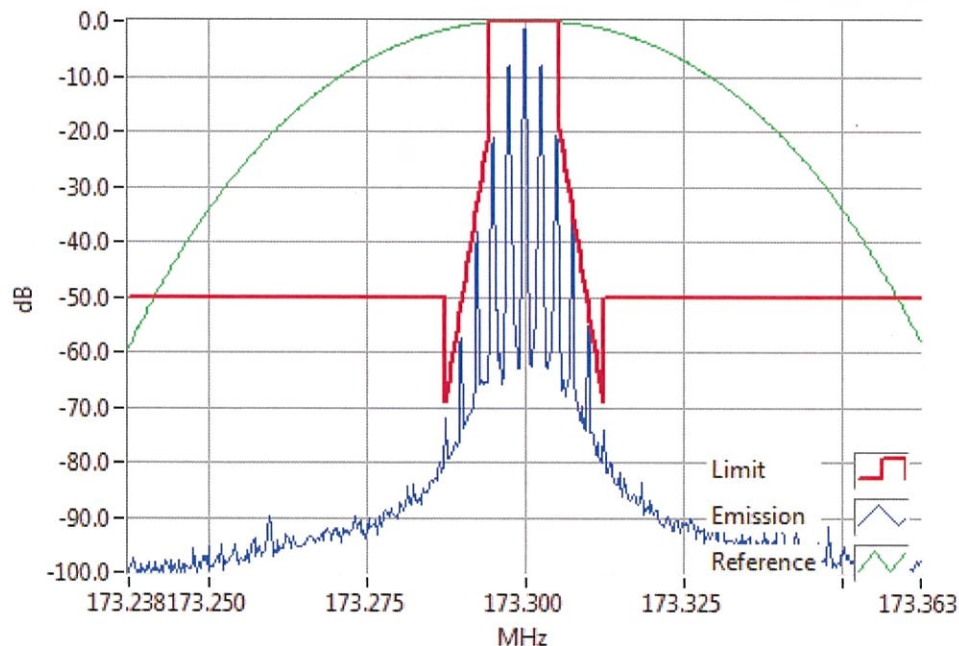
SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 173.3 MHz 5 W 12.5 kHz Channel Spacing



**Analogue Modulation 173.3000MHz Mask D 5W**  
**RBW=100Hz, VBW=1000Hz, Detector Mode=Peak**  
**Result=Pass**

Tx FREQUENCY: 173.3 MHz 1 W 12.5 kHz Channel Spacing



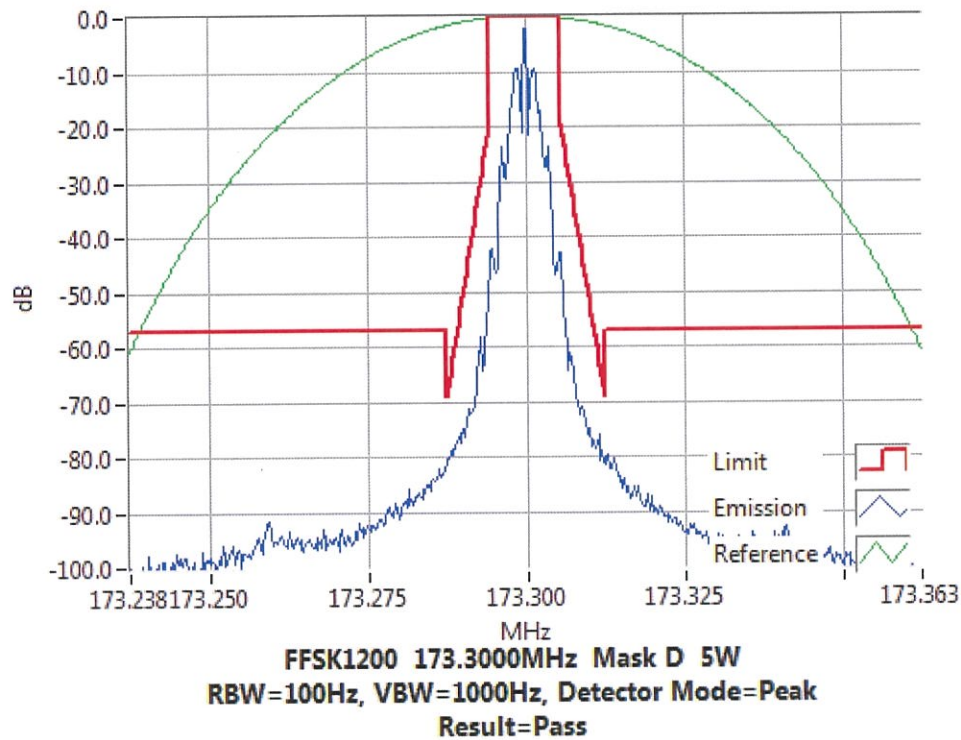
**Analogue Modulation 173.3000MHz Mask D 1W**  
**RBW=100Hz, VBW=1000Hz, Detector Mode=Peak**  
**Result=Pass**

## Occupied Bandwidth and Spectrum Masks

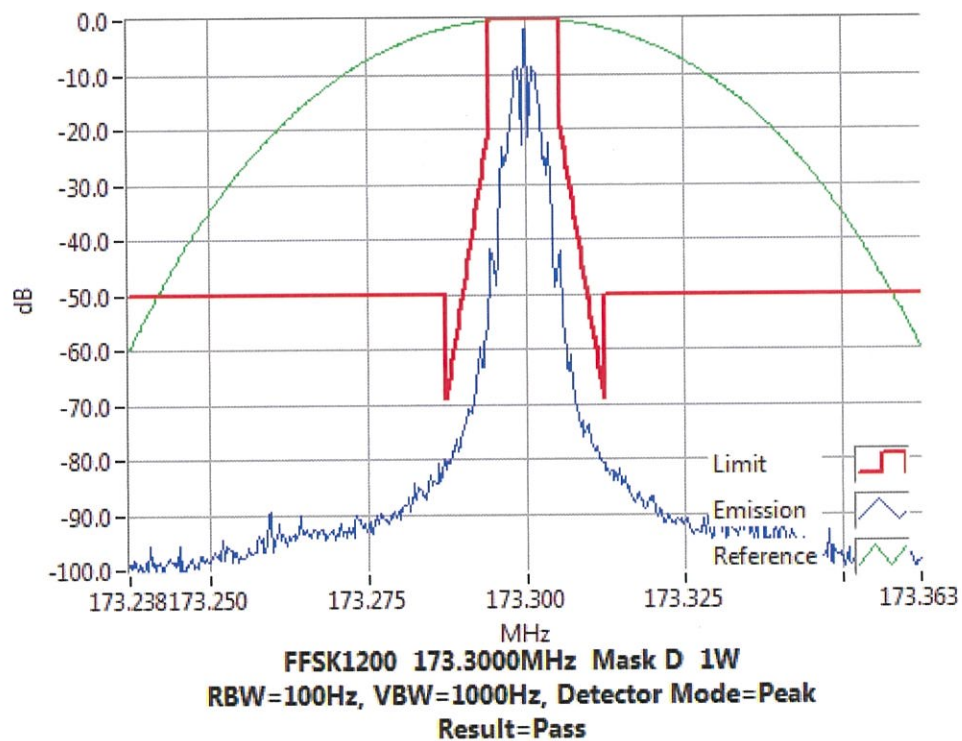
FFSK 1200 bps

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 173.3 MHz 5 W 12.5 kHz Channel Spacing



Tx FREQUENCY: 173.3 MHz 1 W 12.5 kHz Channel Spacing

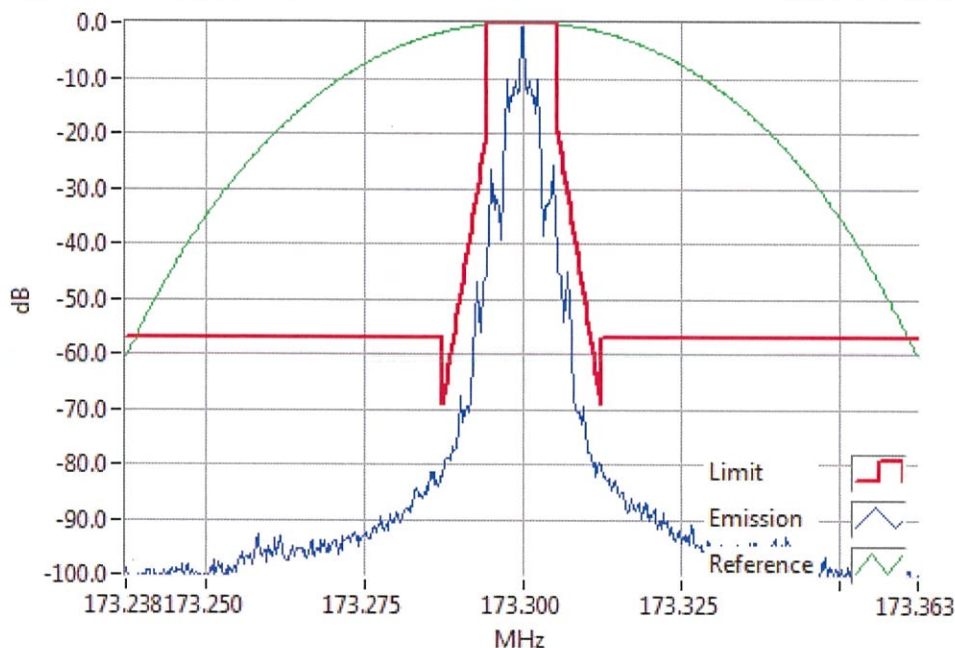


## Occupied Bandwidth and Spectrum Masks

FFSK 2400 bps

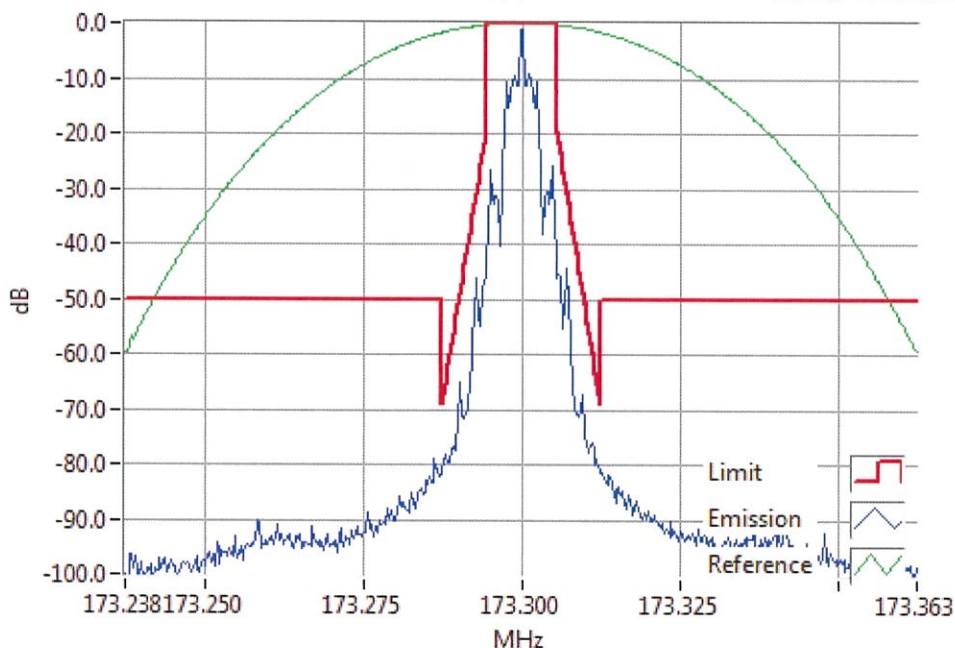
SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 173.3 MHz 5 W 12.5 kHz Channel Spacing



**FFSK2400 173.3000MHz Mask D 5W**  
**RBW=100Hz, VBW=1000Hz, Detector Mode=Peak**  
**Result=Pass**

Tx FREQUENCY: 173.3 MHz 1 W 12.5 kHz Channel Spacing



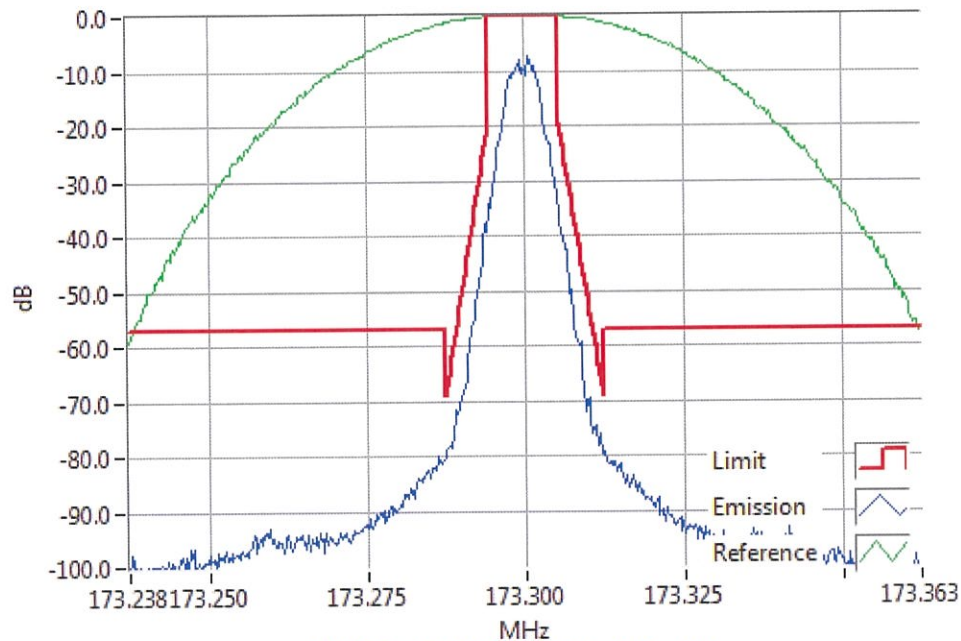
**FFSK2400 173.3000MHz Mask D 1W**  
**RBW=100Hz, VBW=1000Hz, Detector Mode=Peak**  
**Result=Pass**

## Occupied Bandwidth and Spectrum Masks

DMR

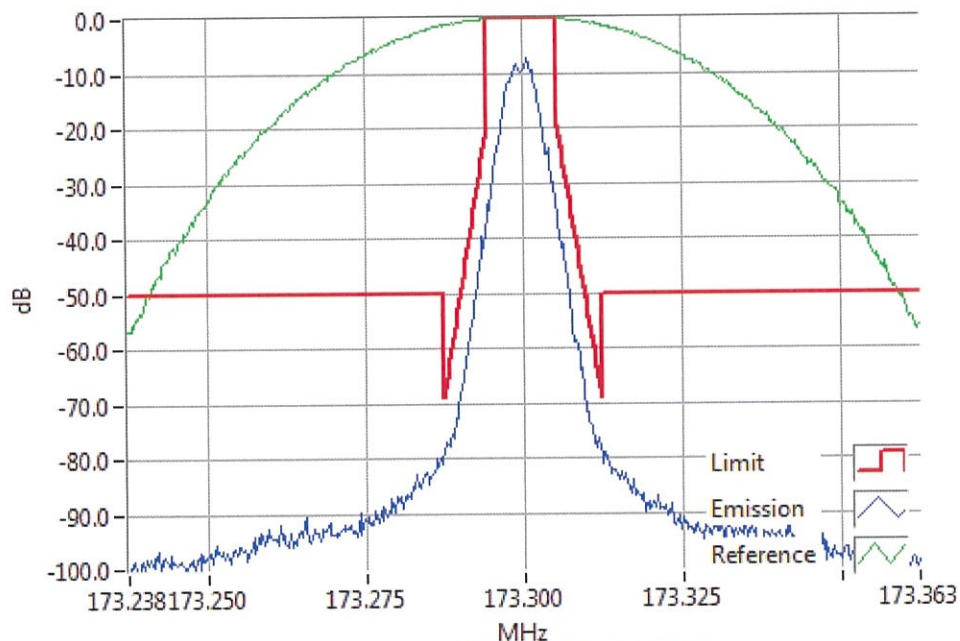
SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 173.3 MHz 5 W 12.5 kHz Channel Spacing



**DMR 173.3000MHz Mask D 5W**  
**RBW=100Hz, VBW=1000Hz, Detector Mode=Peak**  
**Result=Pass**

Tx FREQUENCY: 173.3 MHz 1 W 12.5 kHz Channel Spacing



**DMR 173.3000MHz Mask D 1W**  
**RBW=100Hz, VBW=1000Hz, Detector Mode=Peak**  
**Result=Pass**

## TRANSMITTER SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATIONS: FCC 47 CFR 2.1051

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.

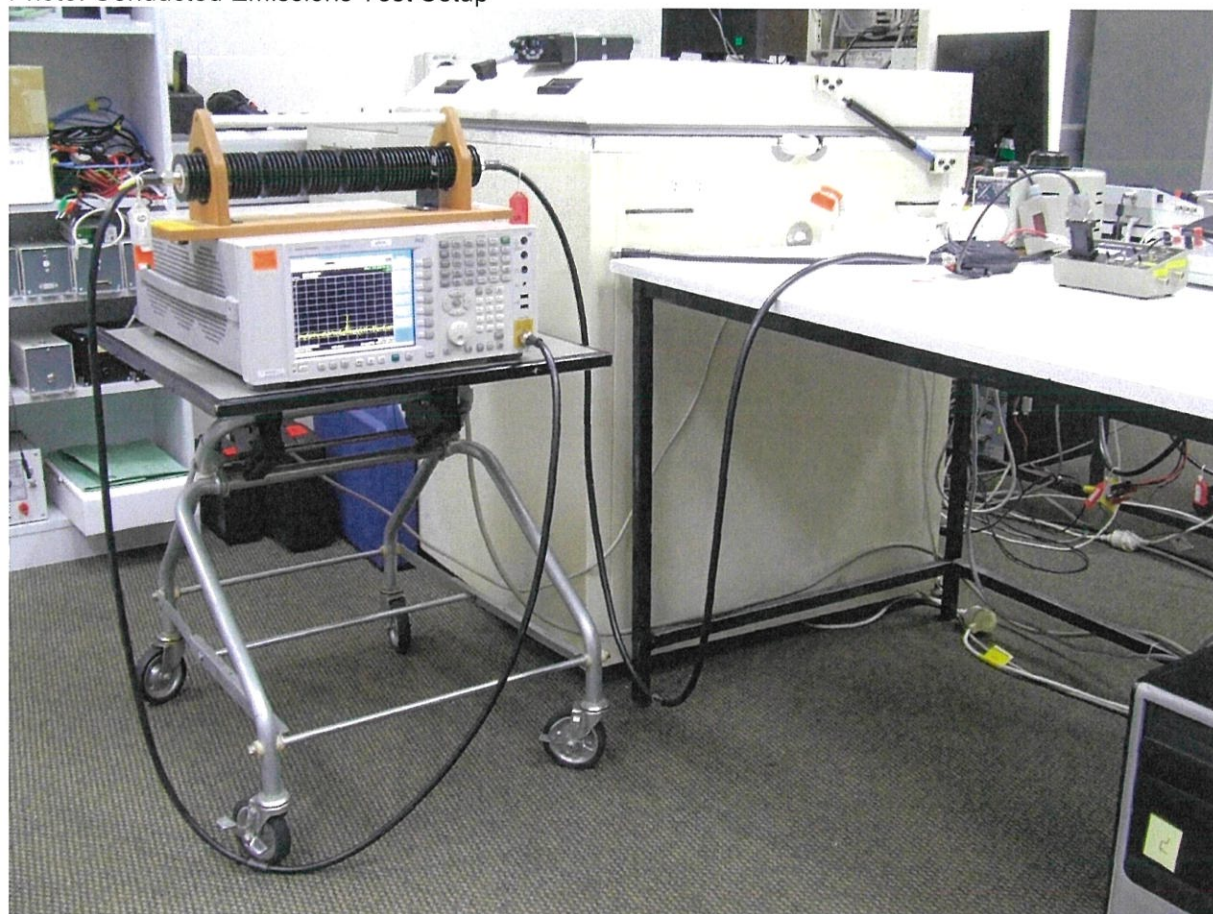
A photograph of the test set-up is included below.

### MEASUREMENT RESULTS:

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

LIMIT CLAUSE: FCC 47 CFR 90.210

Photo: Conducted Emissions Test Setup



Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051

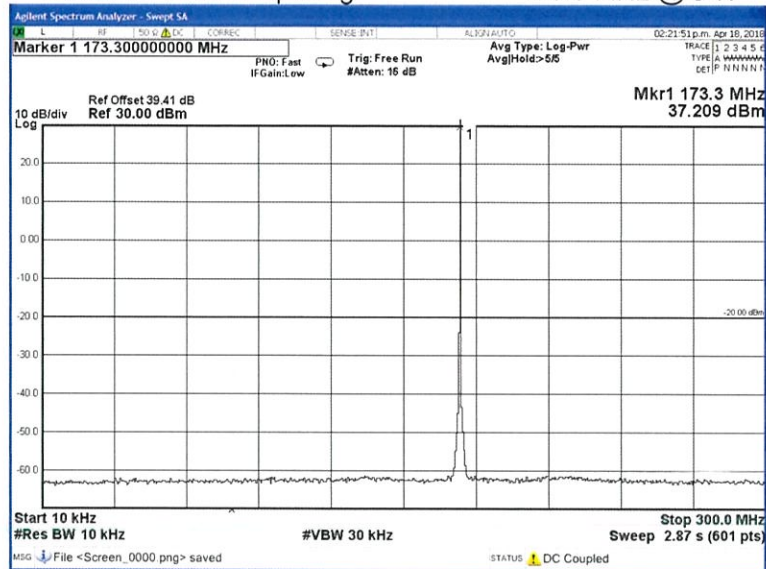
12.5 kHz Channel Spacing      173.3 MHz @ 5 W      Emission Mask D

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

12.5 kHz Channel Spacing      173.3 MHz @ 1 W      Emission Mask D

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

Spurious Emissions (Tx Conducted)  
12.5 kHz Channel Spacing 173.3 MHz @ 5 W



Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051

LIMITS: FCC 47 CFR 90.210

| Carrier Output Power | Emission Mask D<br>12.5 kHz Channel Spacing<br>$50 + 10 \log_{10} (P_{\text{Watts}})$ |         |
|----------------------|---------------------------------------------------------------------------------------|---------|
|                      | -20 dBm                                                                               | -57 dBc |
| 5 W                  | -20 dBm                                                                               | -57 dBc |
| 1 W                  | -20 dBm                                                                               | -50 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 page

LIMIT CLAUSE: FCC 47 CFR 90.210

## Spurious Emissions (Tx Radiated)

SPECIFICATION: FCC CFR 2.1053

12.5 kHz Channel Spacing      173.3 MHz @ 5 W      Emission Mask D

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

12.5 kHz Channel Spacing      173.3 MHz @ 1 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. |             |             |

LIMITS: FCC CFR 2.1053

| Carrier Output Power | Emission Mask D<br>12.5 kHz Channel Spacing<br>$50 + 10 \log_{10} (P_{\text{Watts}})$ |         |
|----------------------|---------------------------------------------------------------------------------------|---------|
| 5 W                  | -20 dBm                                                                               | -57 dBc |
| 1 W                  | -20 dBm                                                                               | -50 dBc |

## Tx Radiated Emissions - Continued

### Open Area Test Site Results:

12.5 kHz Channel Spacing

173.3 MHz @ 5 W

Emission Mask D

| Harmonics<br>Emission Frequency (MHz) | Level (dBm)  | Level (dBc) |
|---------------------------------------|--------------|-------------|
| 346.6                                 | -67.03       | -104.03     |
| 519.9                                 | -65.14       | -102.14     |
| 693.2                                 | -59.40       | -96.40      |
| 866.5                                 | -71.33       | -108.33     |
| 1039.8                                | -72.89       | -109.89     |
| 1213.1                                | -72.17       | -109.17     |
| Measurement Uncertainty               | $\pm 4.6$ dB |             |

| 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   |
| 346.6                    | -91.26                | -53.20        | -14.16                    | -0.35              | 0.68                           | -67.03 | 0.20 |
|                          |                       | A             | B                         | C                  | D                              | E      |      |
| Result (E) = A+B+C+D     |                       |               |                           |                    |                                |        |      |

Photo: OATS Setup



## TRANSIENT FREQUENCY BEHAVIOR

SPECIFICATION: FCC 47 CFR 90.214

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 CLAUSE: FCC 47 CFR 90.214

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 173.3 MHz 5 W 12.5 kHz Channel Spacing

173.3 MHz @ 5 W Tx

| TRANSIENT RESPONSE PERIOD | CARRIER PEAK VARIATION FROM NORMAL |               |
|---------------------------|------------------------------------|---------------|
|                           | Key ON (kHz)                       | Key OFF (kHz) |
| t1                        | -0.4                               | 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             |