

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

PREPARED BY: L. M. White


Test Technician

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.

This document must not be reproduced except in full, without the written permission of the Compliance Laboratory Manager

TELTEST Laboratories (A Division of Tait Communications)
PO Box 1645, 558 Wairakei Road, Christchurch, New Zealand.

Telephone: 64 3 358 3399
FAX: 64 3 359 4632

TABLE OF CONTENTS

REVISION.....	3
INTRODUCTION	4
STATEMENT OF COMPLIANCE.....	5
MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS	6
TEST RESULTS	7
TRANSMITTER OUTPUT POWER (CONDUCTED).....	7
TRANSMITTER AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS	8
TRANSMITTER MODULATION LIMITING.....	9
TRANSMITTER OCCUPIED BANDWIDTH AND SPECTRUM MASKS	10
TRANSMITTER SPURIOUS EMISSIONS (CONDUCTED)	15
TRANSMITTER SPURIOUS EMISSIONS (RADIATED).....	19
TRANSIENT FREQUENCY BEHAVIOR	22
TRANSMITTER FREQUENCY STABILITY - TEMPERATURE	24
TRANSMITTER FREQUENCY STABILITY - VOLTAGE.....	25
TEST EQUIPMENT LIST	26
ANNEX A – TEST SETUP DETAILS	28

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_{DC}

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:

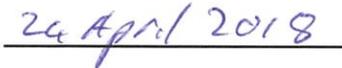
FCC 47 CFR Part 90

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

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

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	± 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:

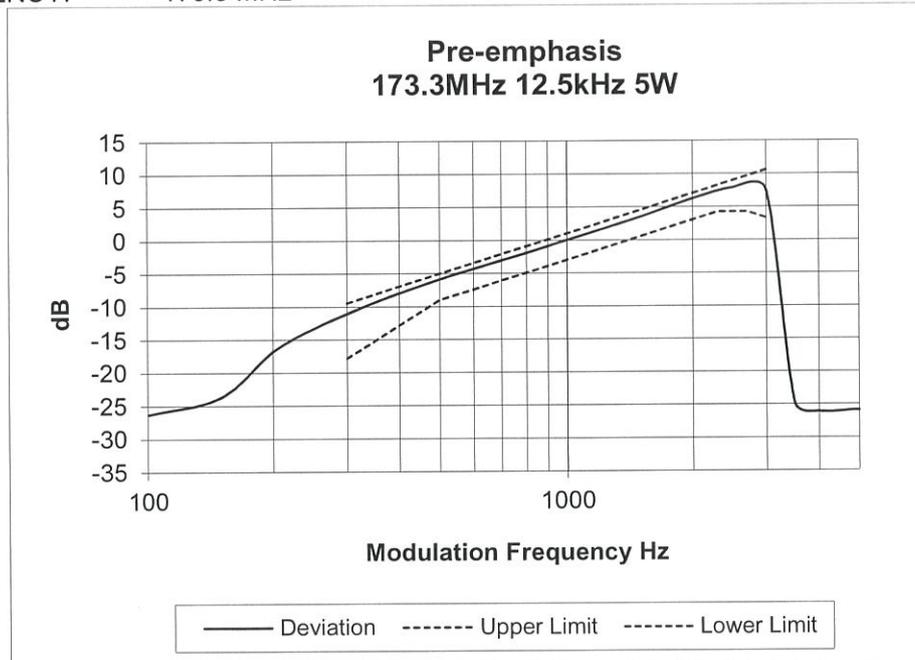
See the plot below for 12.5 kHz channel spacing tested at 5 W transmit power.

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:

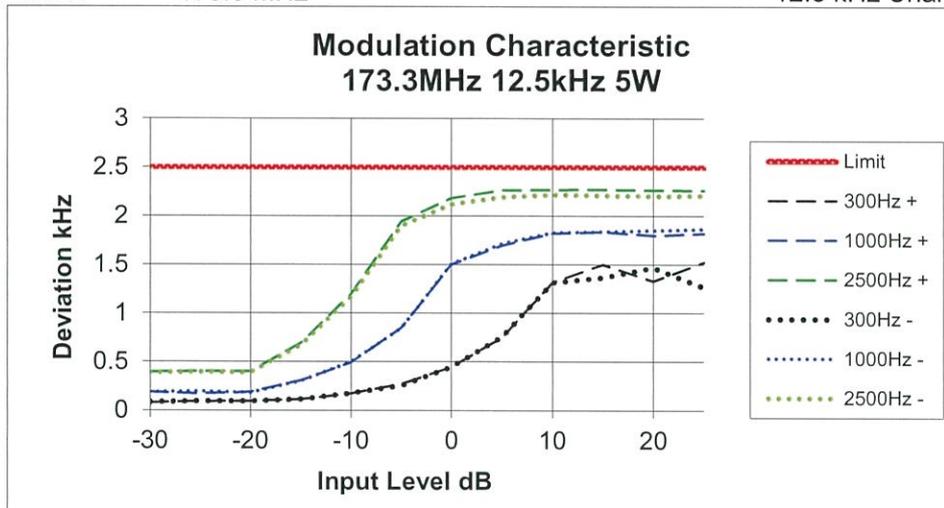
See the plot below for 12.5 kHz channel spacing.

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

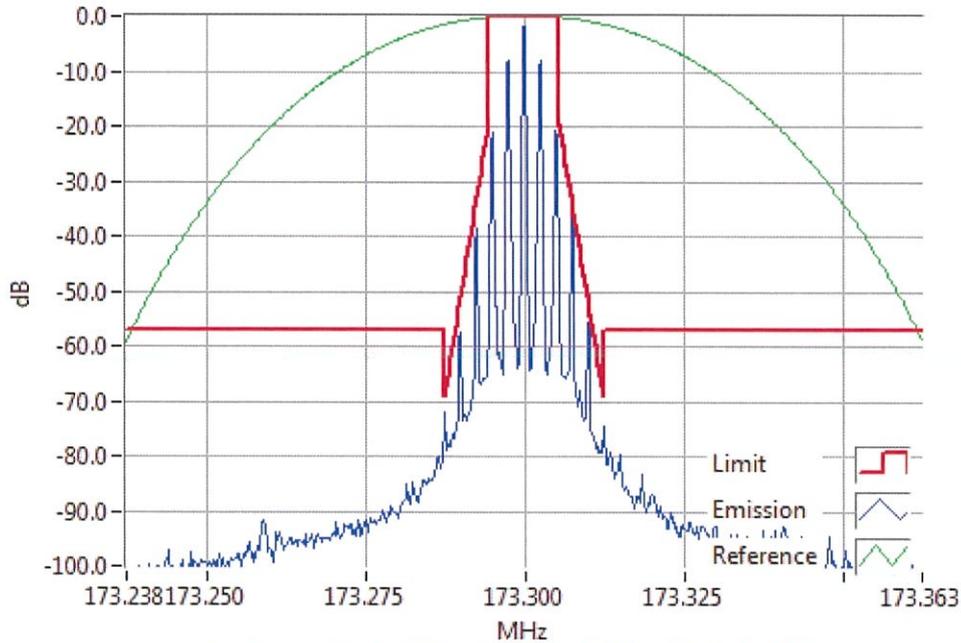
Digital Voice/Data 12.5 kHz Channel Spacing 9600 bps
FFSK 12.5 kHz Channel Spacing 1200 bps & 2400 bps

Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

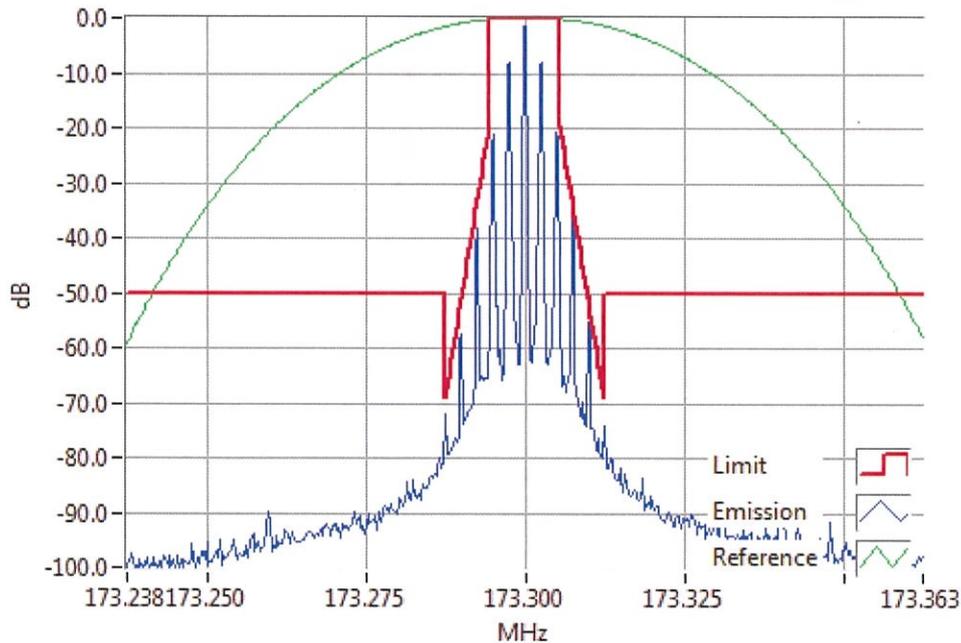
SPECIFICATION: FCC CFR 2.1049 (c)

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



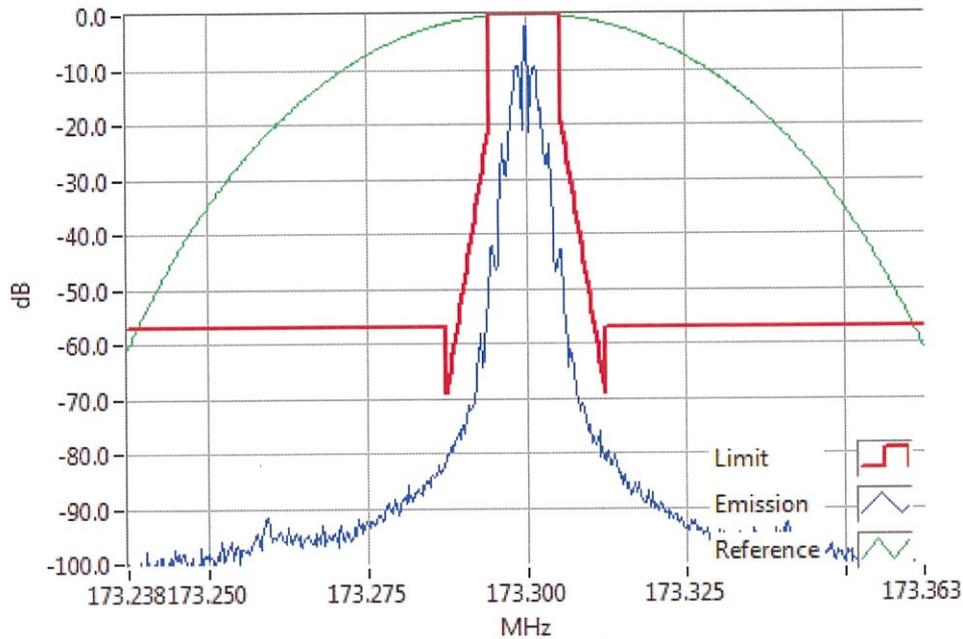
Analogue Modulation 173.3000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 1200 bps

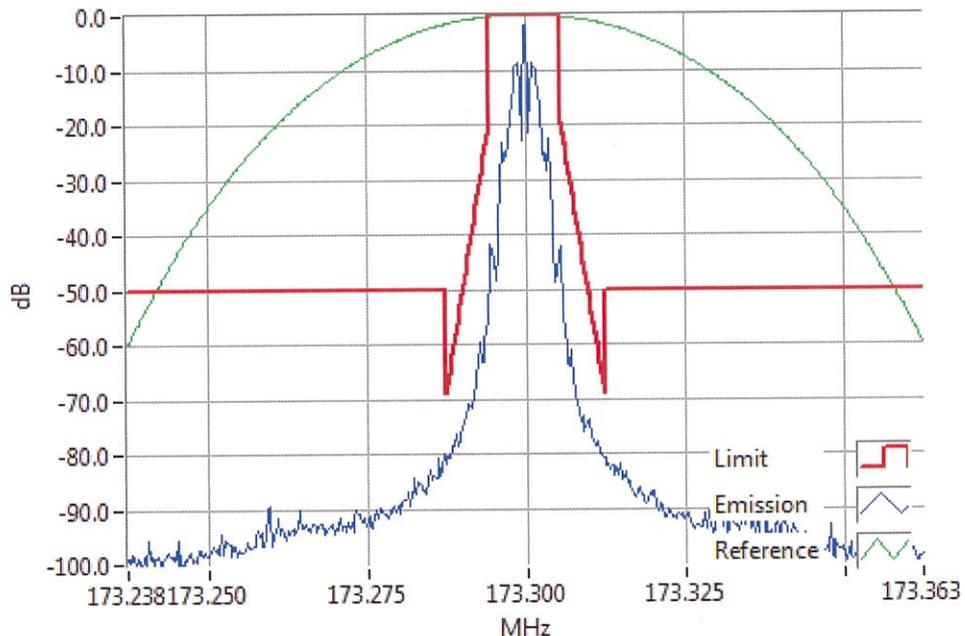
SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 173.3 MHz 5 W 12.5 kHz Channel Spacing



FFSK1200 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



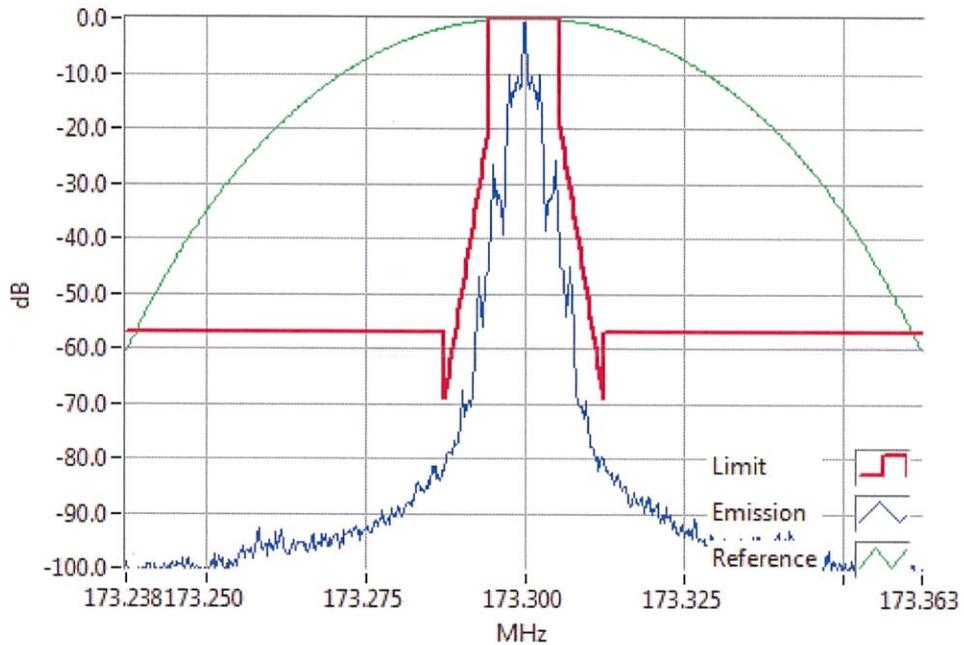
FFSK1200 173.3000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 2400 bps

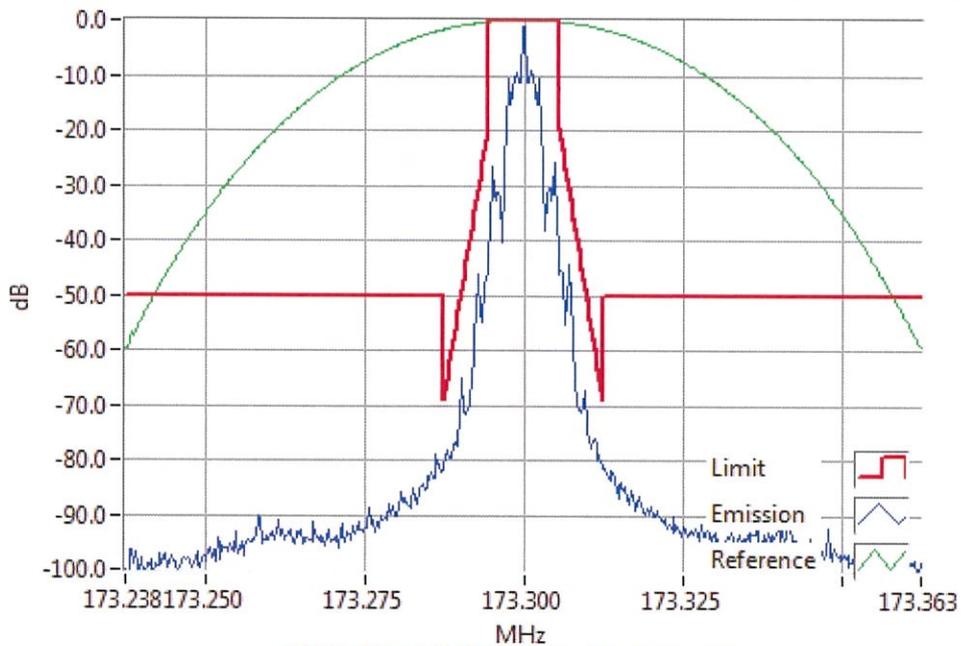
SPECIFICATION: FCC CFR 2.1049 (c)

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



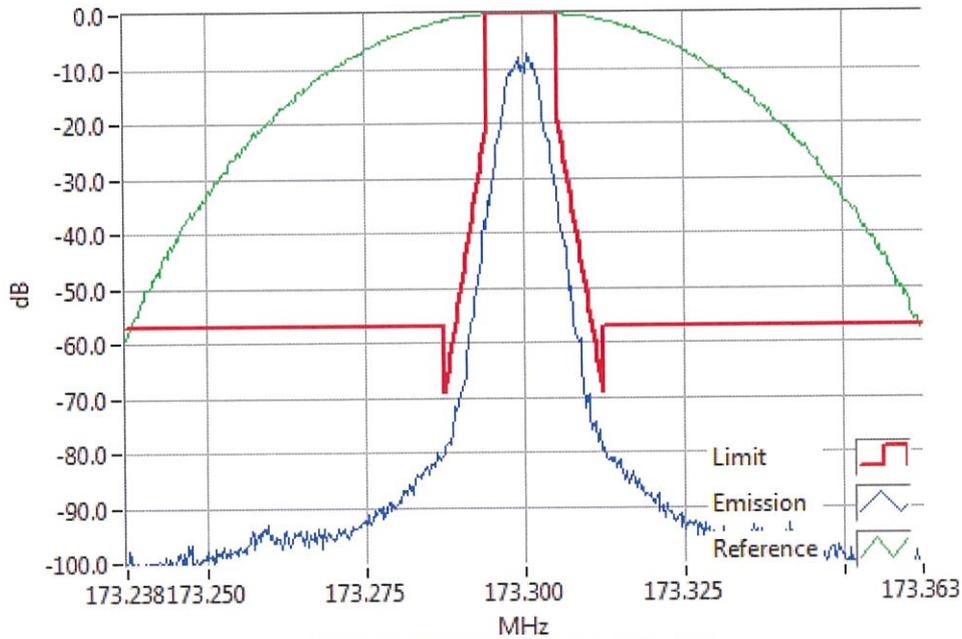
FFSK2400 173.3000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

DMR

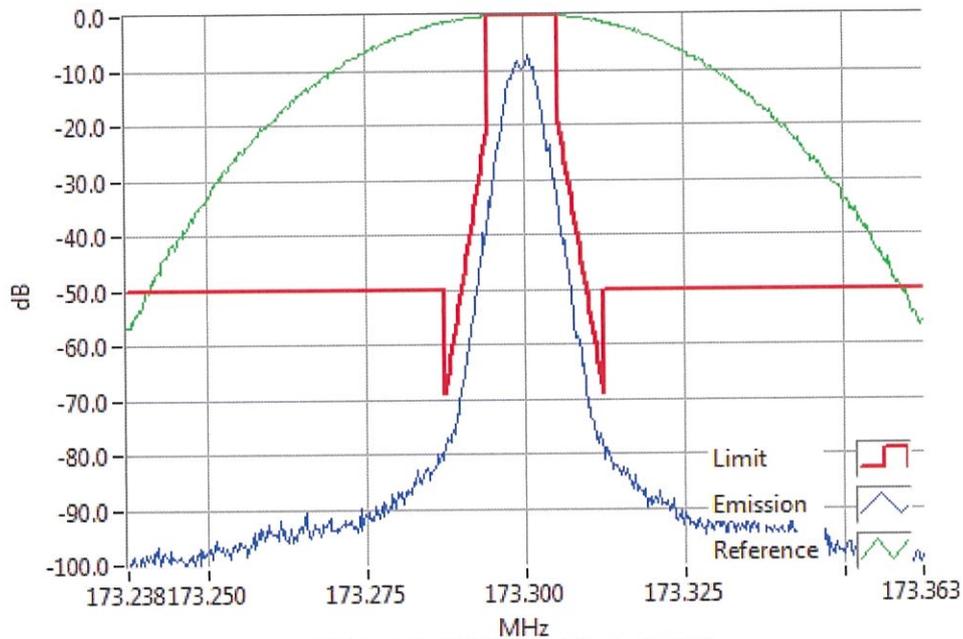
SPECIFICATION: FCC CFR 2.1049 (c)

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 10th 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.

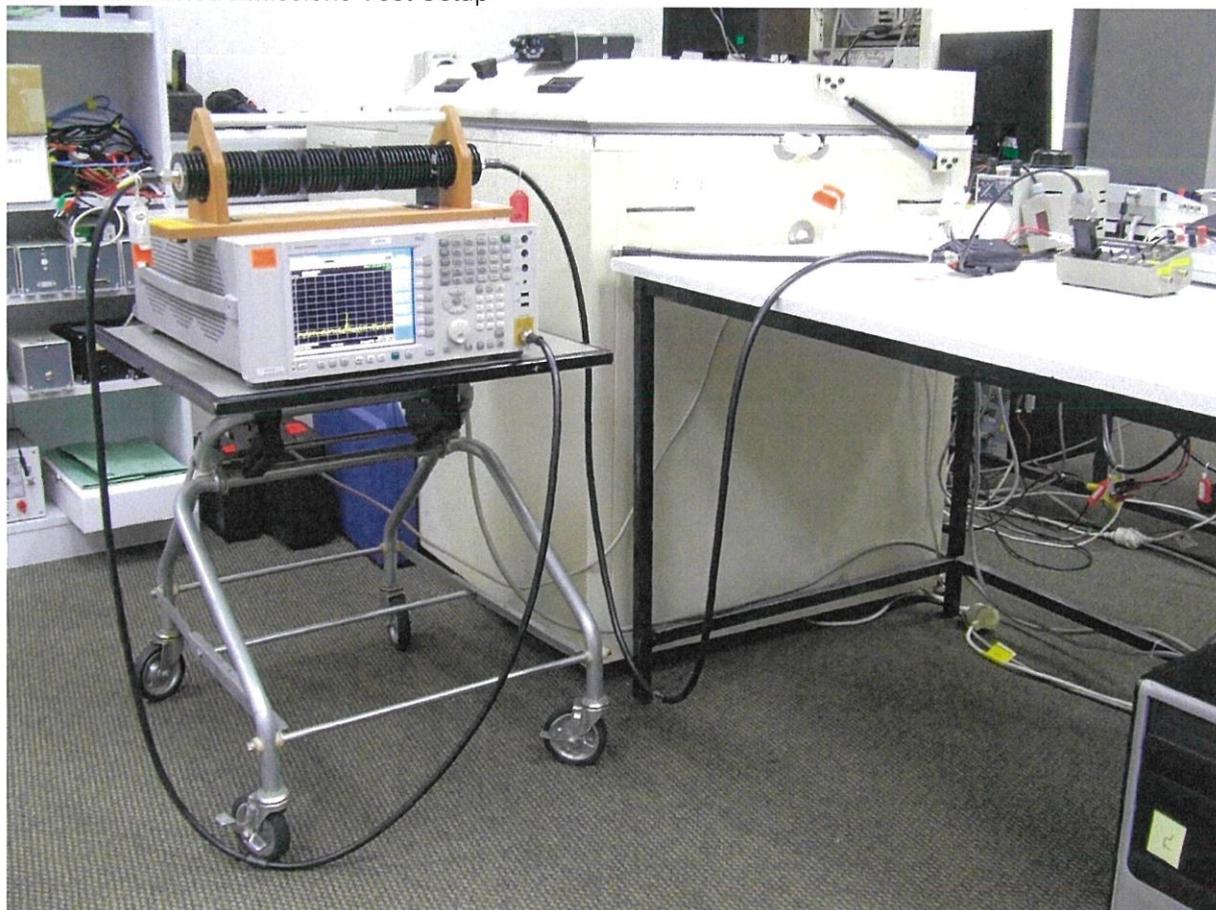
A photograph of the test set-up is included below.

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

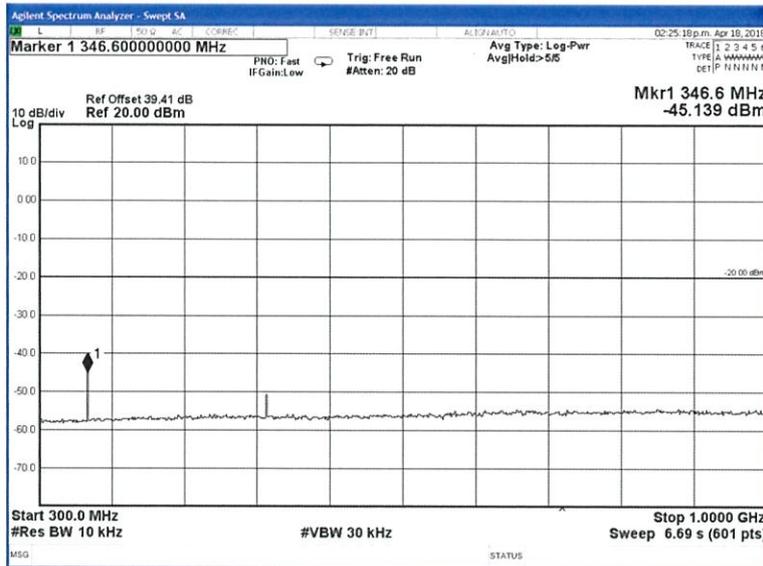
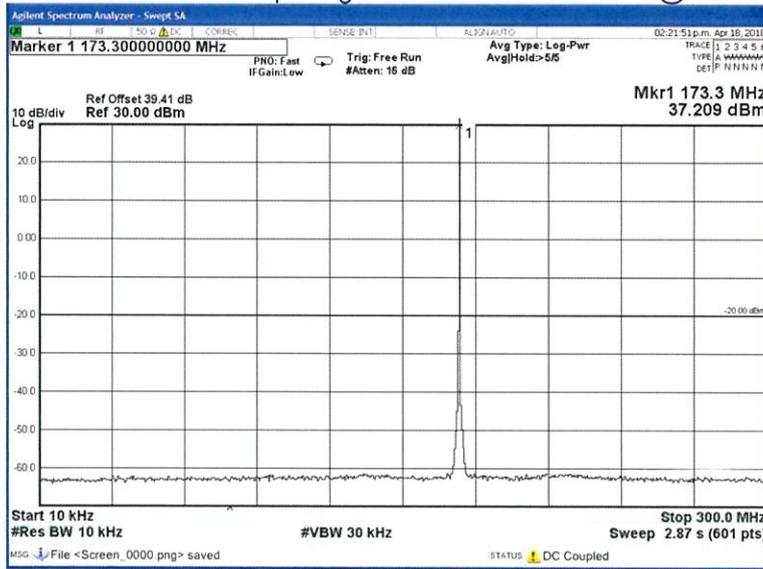
12.5 kHz Channel Spacing 173.3 MHz @ 5 W Emission Mask D

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 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{\text{Watts}})$	
	5 W	-20 dBm
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 6th 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 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{\text{Watts}})$	
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 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	± 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 ± 130 Hz; Time ± 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