TELTEST Laboratories
Tait International Ltd
Report Number 4064

LABORATORY TEST REPORT

RADIO PERFORMANCE MEASUREMENTS

for the

TDAC0A Data Terminal Transceiver

Tested in accordance with:

FCC 47 CFR Parts 22 and 90

Report Revision:	1	
Issue Date:	14 February 2020	
PREPARED BY:	L. M. White	Test Technician
CHECKED & APPROVED BY:	M. C. James	Laboratory Technical Manager

FCC Registration: 838288

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TABLE OF CONTENTS

REVISION

Date	Revision	Comments
14 February 2020	1	Initial test report

INTRODUCTION

Type approval testing of the TDAC0A, 25 Watt, Data Terminal transceiver in order to demonstrate compliance with FCC 47 Parts 22 & 90. This radio supports Digital Mobile Radio (DMR) modulation.

REPORT PREPARED FOR
Tait International Ltd
245 Wooldridge Road
Harewood
Christchurch 8051
New Zealand

DESCRIPTION OF SAMPLE

Manufacturer	Tait International Limited
Equipment:	Data Terminal Transceiver
Type:	TDAC0A
Product Code:	T04-00002-CEAA
Serial Number(s):	29057751
Frequency range	174 → 225 MHz
Transmit Power	25 W

Modulation		Channel Spacing	Speech Channels	Symbol Rate (symbols/sec)	Data Rate (bps)
Digital Mobile Radio (DMR)	4 Level FSK (2 slot TDMA) (ETSI TS102 361-1)	12.5 kHz	2	4800	9600

HARDWARE & SOFTWARE
Quantity: 1

Hardware ID	TMBB22-C000_0002
Boot Code	QMB2B_S00_3.05.06.0001
DSP	QMB2A_E00_2.18.05.0064
Radio Application	QMB2F_E00_2.18.05.0064
Firmware Package	QI93M_E00_2.18.05.0064
FPGA Image	QMB2G_S00_1.12.04.0001

TEST CONDITIONS
All testing was performed between 23 January → 13 February 2020, and under the following conditions:

Ambient temperature:	15°C → 30°C
Relative Humidity:	20% → 75%
Standard Test Voltage	24 V_{DC}

TEST REQUIREMENTS AND RESULT SUMMARY

FCC Specification	Test Name	Test Methods	Result
FCC 47 CFR 2.1046	Transmitter Output Power (Conducted)	ANSI C63.26 5.2.4.2	Pass
FCC 47 CFR 2.1047 (a)	Transmitter Audio Frequency Response – Pre-emphasis	ANSI C63.26 5.3.3.2	N/A 1
FCC 47 CFR 2.1047 (b)	Transmitter Modulation Limiting	ANSI C63.26 5.3.2	N/A 1
FCC 47 CFR 2.1049 (c)	Transmitter Occupied (99%) Bandwidth	ANSI C63.26 5.4.4	Pass
FCC 47 CFR 90.210	Transmitter Spectrum Masks	TIA-603-E 2.2.11	Pass
FCC 47 CFR 90.543	Adjacent Channel Power Ratio	ANSI C63.26 6.5.2.4	N/A 2
FCC 47 CFR 2.1051	Transmitter Spurious Emissions (Conducted)	ANSI C63.26 5.7	Pass
FCC 47 CFR 2.1053	Transmitter Spurious Emissions (Radiated)	ANSI C63.26 5.5	Pass
FCC CFR 90.543	Transmitter Radiated Emissions in the GNSS Band	ANSI C63.26 6.5.2.7.3	N/A 2
No specification	Transmitter Conducted Emissions in the GNSS Band	ANSI C63.26 6.5.2.7.4	N/A 2
FCC 47 CFR 90.214	Transient Frequency Behaviour	ANSI C63.26 6.5.2.2	Pass
FCC 47 CFR 90.214	Transmitter Frequency Stability - Temperature	ANSI C63.26 5.6.4	Pass
FCC 47 CFR 2.1055 (d) (1)	Transmitter Frequency Stability - Voltage	ANSI C63.26 5.6.5	Pass
FCC 47CFR 15.111	Receiver Spurious Emissions (Conducted)	TIA-603E 2.1.2	Pass 1

Comments:
N/A 1: Only required where the EUT is capable of Analogue modulation
N/A 2: Only required where the EUT transmits in the 768-776 or 798-806 MHz band (ISED), or 769-775 or 799-805 MHz band (FCC).
Pass 1: Results are found in TELTEST Report 4064a.

STATEMENT OF COMPLIANCE

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

Equipment:	Data Terminal Transceiver
Type:	TDAC0A
Product Code:	T04-00002-CEAA
Serial Number(s):	29057751
Quantity:	1

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

FCC 47 CFR Parts 22 and 90

Signature: _____

M. C. James
Laboratory Technical Manager

Date: 3 March 2020

CHANNEL TABLE

Label	Channel Number	Receive Frequency	Transmit Frequency	Power	Bandwidth
173 NH	1	173.3	173.3	25 watts	12.5 kHz
173 NL	2	173.3	173.3	1 watt	12.5 kHz
216 NH	3	216.5	216.5	25 watts	12.5 kHz
216 NL	4	216.5	216.5	1 watt	12.5 kHz
221 NH	5	221.5	221.5	25 watts	12.5 kHz
221 NL	6	221.5	221.5	1 watt	12.5 kHz

Programming Application Name	**Version**
DMR and P25 Terminals Programming Application	2.106.1.74 Alpha

MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS

MODULATION TYPES:

FXW	DMR Digital Voice	9600 bps
FXD	DMR Digital Data	9600 bps

CHANNEL SPACING: 12.5 kHz

EMISSION DESIGNATORS:

	12.5 kHz
Digital Voice DMR	7K60FXW
Digital Data DMR	7K60FXD

CALCULATIONS

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.

EXAMPLE CALCULATION:

Power in dBm =	Measured power (dBm) + attenuator and cable loss (dB)
Chan 1 power (dBm) =	13.48 dBm +30.49 dB
=	43.97dBm
Power in Watts =	(10^(43.97dBm)/10)/1000
=	25.0W

MEASUREMENT RESULTS:

Manufacturer's Rated Output Power: Switchable: 25 W and 1 W

Nominal 25 W	173.3 MHz	216.5 MHz	221.5 MHz
Measured	25.0	25.8	26.3
Variation (%)	-0.1	3.4	5.2
Variation (dB)	0.0	0.1	0.2
Nominal 1 W	173.3 MHz	216.5 MHz	221.5 MHz
Measured	0.9	0.9	0.9
Variation (%)	-5.3	-8.1	-7.8
Variation (dB)	-0.2	-0.4	-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 OCCUPIED (99%) BANDWIDTH

SPECIFICATION: FCC 47 CFR 2.1049 (c)

GUIDE: ANSI C63.26 5.4.4

MEASUREMENT PROCEDURE:
1. Refer Annex A for Equipment Set up.
2. 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.
   Resolution Bandwidth = 100 Hz, Video Bandwidth = 300 Hz

MEASUREMENT RESULTS:

		Bandwidths (kHz)
Channel Spacing (MHz)	Channel Spacing (kHz)	DMR
173.3 MHz	12.5	7.55
216.5 MHz	12.5	7.53
221.5 MHz	12.5	7.50
Limit Authorized Bandwidth 47 CFR 90.209		11.25
Necessary BW used in emission designator		7.6
Result		Pass

TRANSMITTER SPECTRUM MASKS

SPECIFICATION: FCC 47 CFR 2.1049 (c)

GUIDE: TIA-102.CAAA-C 2.2.5 (Digital)

MEASUREMENT PROCEDURE:

4. Refer Annex A for Equipment Set up.
5. For Data measurements: The EUT was modulated with an internally generated pseudo random bit sequence at the appropriate Baud rates.
6. 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
   Emission Mask B, and F – Resolution bandwidth = 300 Hz, Video Bandwidth = 3 kHz

Please note: frequencies in the 216-220 MHz band are to be tested with emission mask found in part 80.211 (f). This mask is the same as Mask B found in Part 90.210

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

MEASUREMENT UNCERTAINTY 95% ±0.65dB

LIMIT CLAUSE: FCC 47 CFR 90.210

EMISSION MASKS

Emission Mask D, B, F	12.5 kHz Channel Spacing	Digital Voice/Data

DATA SPEED

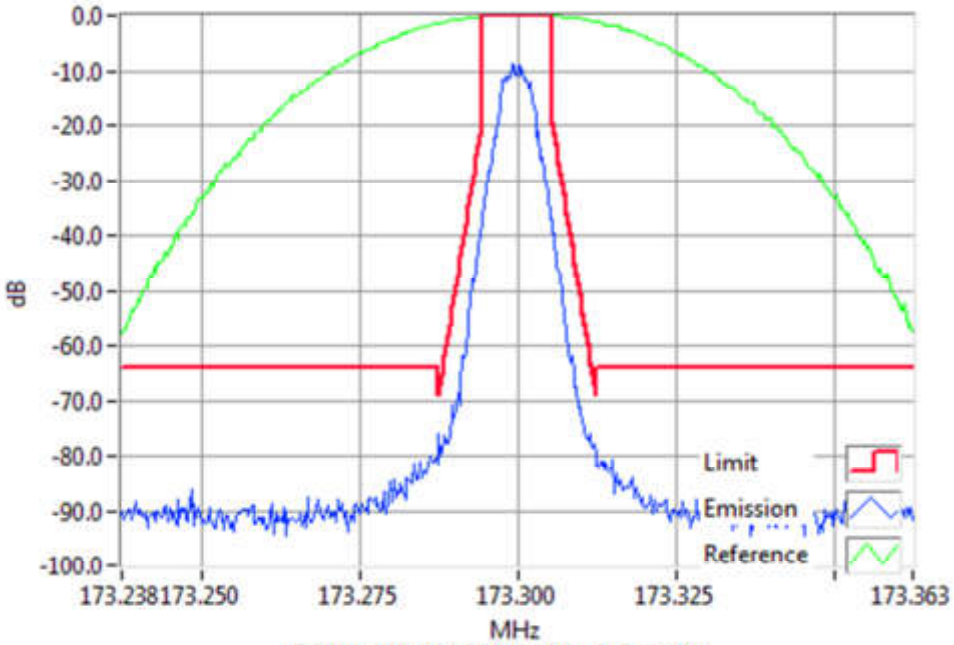
Digital Voice/Data	12.5 kHz Channel Spacing	9600 bps

Transmitter Spectrum Masks

DMR

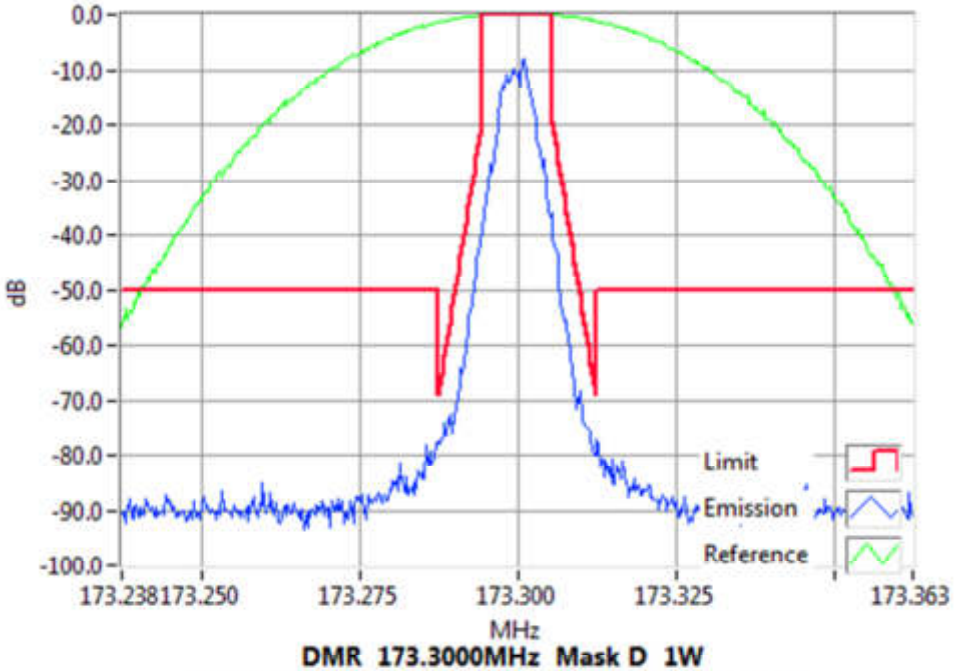
SPECIFICATION: FCC 47 CFR 2.1049 (c)

Tx FREQUENCY: 173.3 MHz 25 W 12.5 kHz Channel Spacing



DMR 173.3000MHz Mask D 25W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 173.3 MHz 1 W 12.5 kHz Channel Spacing



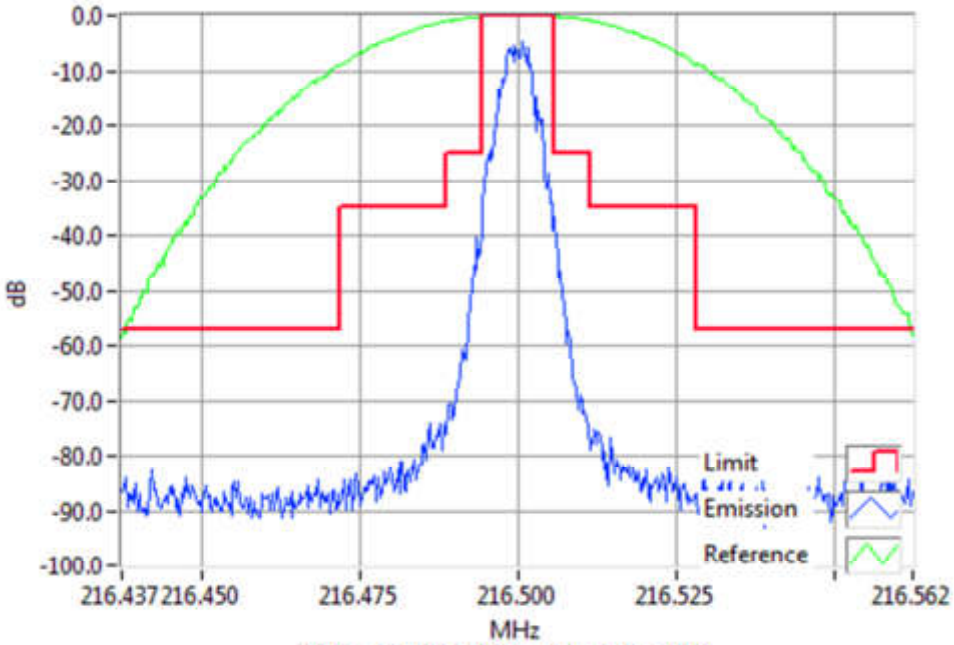
DMR 173.3000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Transmitter Spectrum Masks

DMR

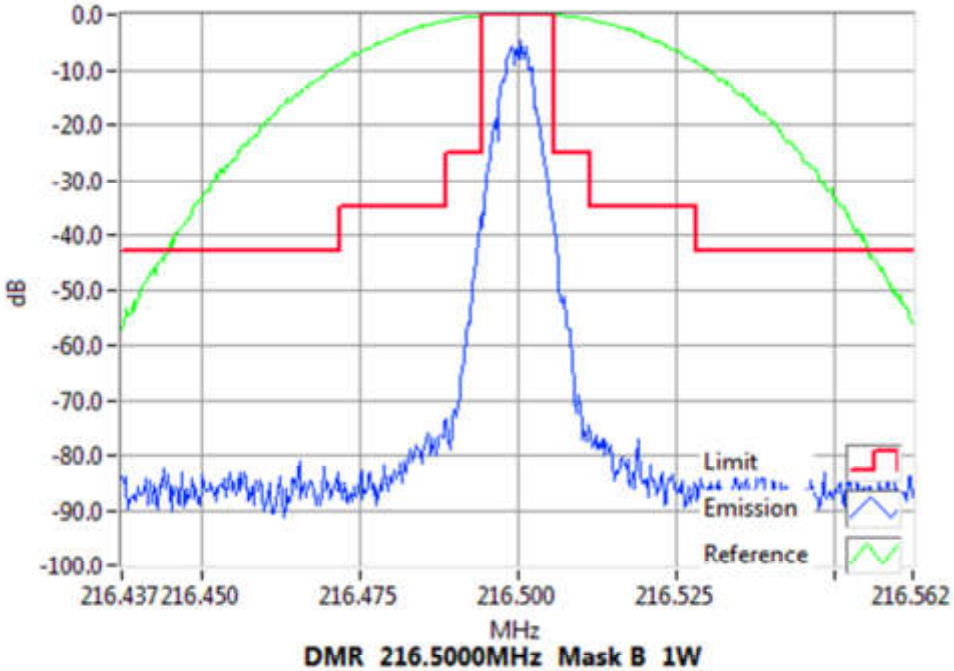
SPECIFICATION: FCC 47 CFR 2.1049 (c)

Tx FREQUENCY: 216.5 MHz 25 W 12.5 kHz Channel Spacing



DMR 216.5000MHz Mask B 25W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 216.5 MHz 1 W 12.5 kHz Channel Spacing



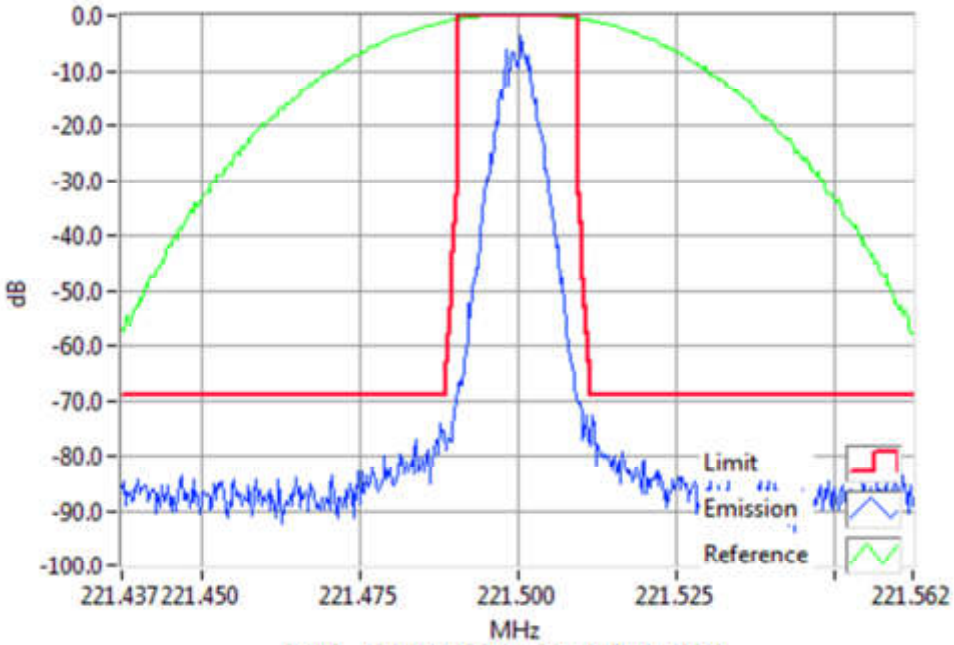
DMR 216.5000MHz Mask B 1W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Transmitter Spectrum Masks

DMR

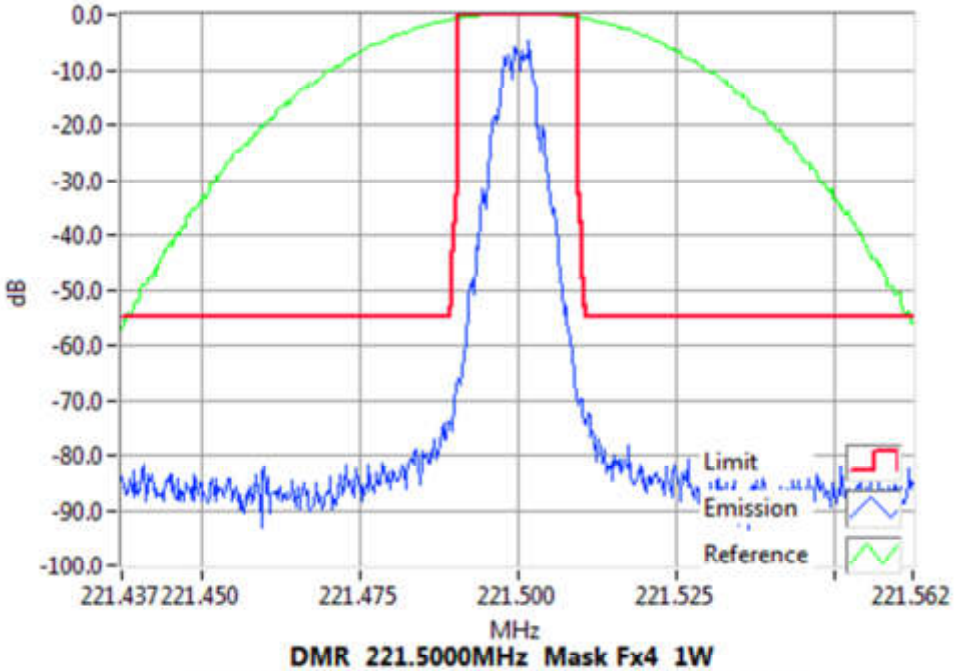
SPECIFICATION: FCC 47 CFR 2.1049 (c)

Tx FREQUENCY: 221.5 MHz 25 W 12.5 kHz Channel Spacing



DMR 221.5000MHz Mask Fx4 25W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 221.5 MHz 1 W 12.5 kHz Channel Spacing



DMR 221.5000MHz Mask Fx4 1W
RBW=300Hz, VBW=3000Hz, 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 (1.8 or 2.25 GHz)
3. The EUT was set to transmit high or low power, modulated with DMR Modulation. A scan is performed with a resolution bandwidth of 100 kHz and a video bandwidth of 300 kHz for frequencies up to 1 GHz, and a resolution bandwidth of 1 MHz and a video bandwidth of 3 MHz for frequencies above 1 GHz. A filter was used for frequencies just below the second harmonic to 1.8 or 2.25 GHz.
4. For each frequency range the spectrum analyser was loaded with the appropriate calibration figures to compensate for the cables, attenuator and filter losses, allowing the emission levels to be read directly with no further calculation.
   The calibrations are loaded as an overall reference level offset plus a set of correction factors for the required frequency band.

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

Example of attenuation correction:

30dB 350W CK9178	31.94	
2m Black4	0.22	
2m Black6	0.23	
Total Attenuation @ 173.3 MHz	32.39	Sum of component attenuation (a)
Amplitude offset	32.39	(b)
Correction @ 173.3 MHz	-0.01	(a-b)

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 47 CFR 2.1051

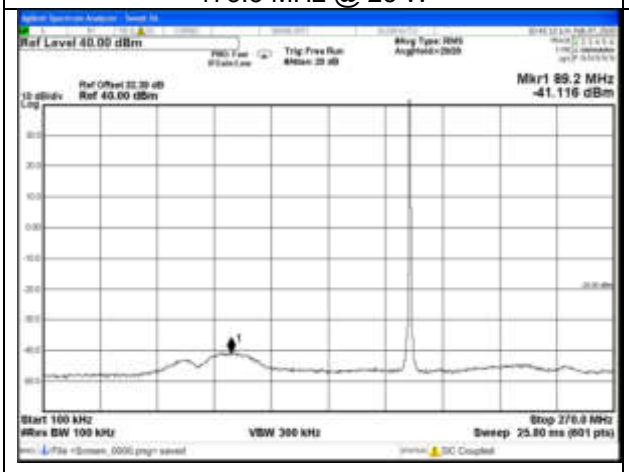
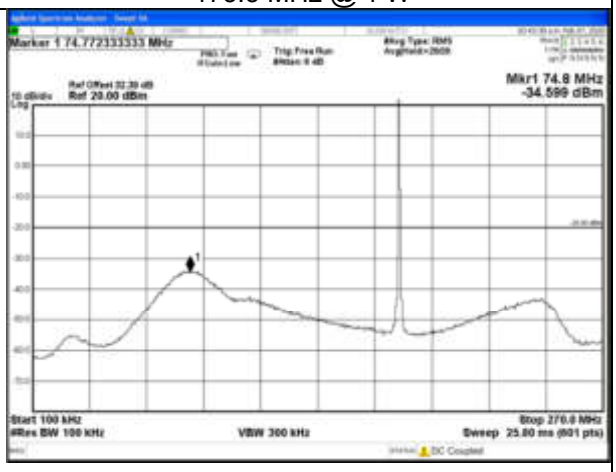
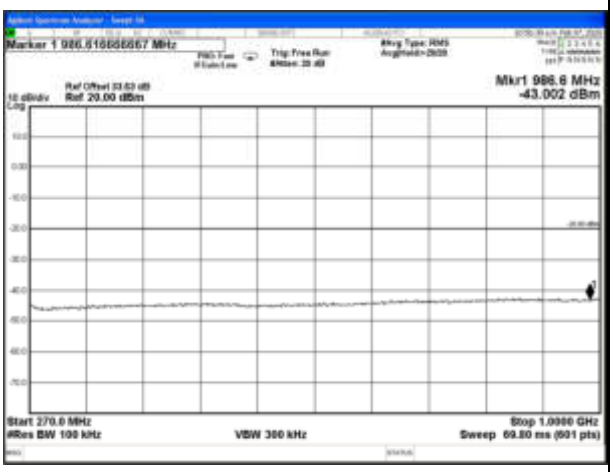
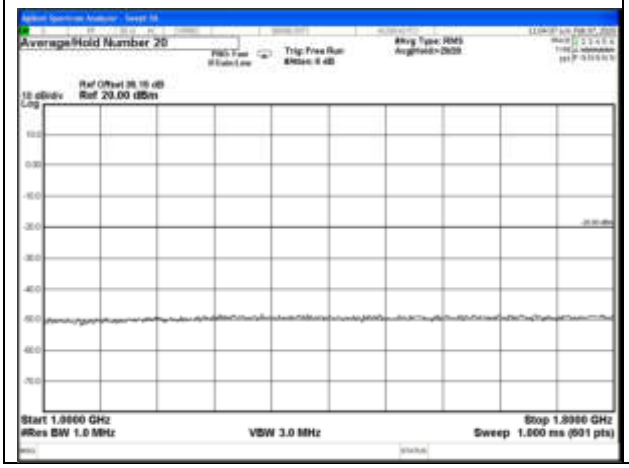
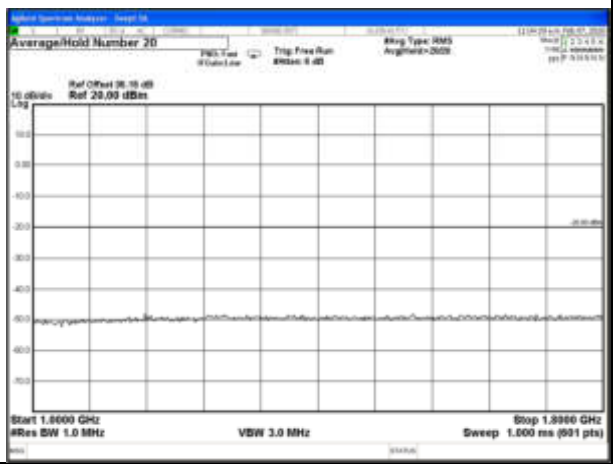
12.5 kHz Channel Spacing 173.3 MHz @ 25 W Emission Mask D

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)
74.8	-34.6	-64.6
~	~	~
Measurement Uncertainty:	≤12.75 GHz ± 3.0 dB	
No other emissions were detected at a level greater than 20 dB below the limit.		

Spurious Emissions (Tx Conducted)

173.3 MHz @ 25 W	173.3 MHz @ 1 W
	
	
	

Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC 47 CFR 2.1051

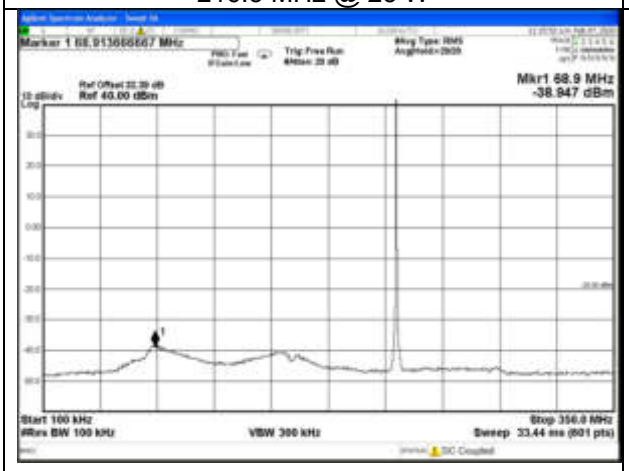
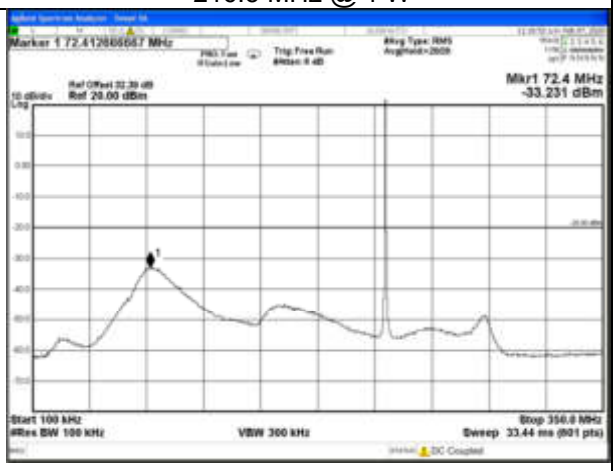
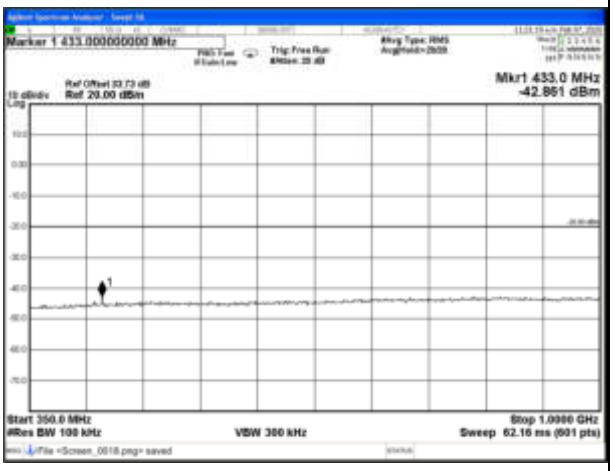
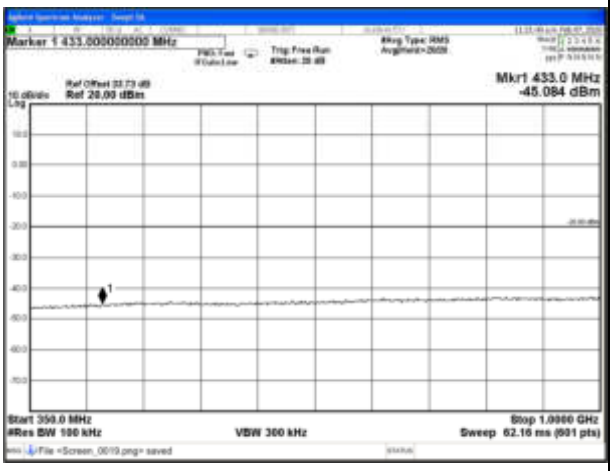
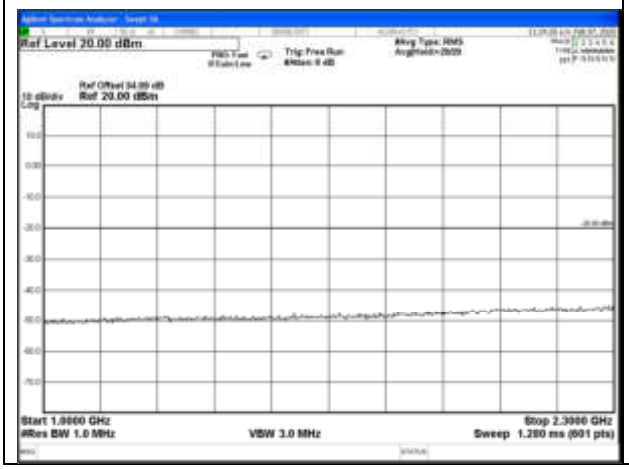
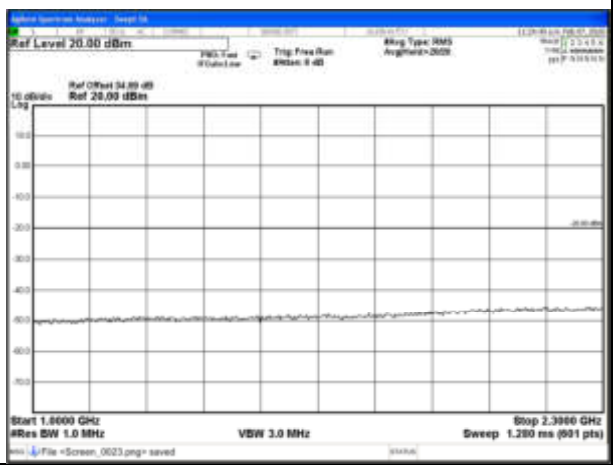
12.5 kHz Channel Spacing 216.5 MHz @ 25 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
68.9	-39.0	-83.0
~	~	~

12.5 kHz Channel Spacing 216.5 MHz @ 1 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
72.4	-33.2	-63.2
~	~	~
Measurement Uncertainty:	≤12.75 GHz ± 3.0 dB	
No other emissions were detected at a level greater than 20 dB below the limit.		

Spurious Emissions (Tx Conducted)

216.5 MHz @ 25 W	216.5 MHz @ 1 W
	
	
	

Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC 47 CFR 2.1051

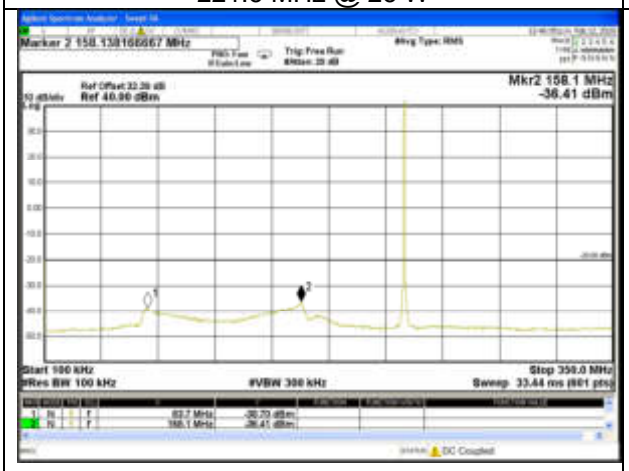
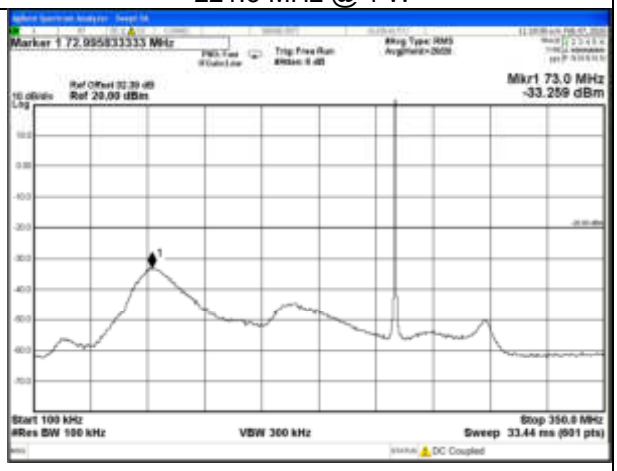
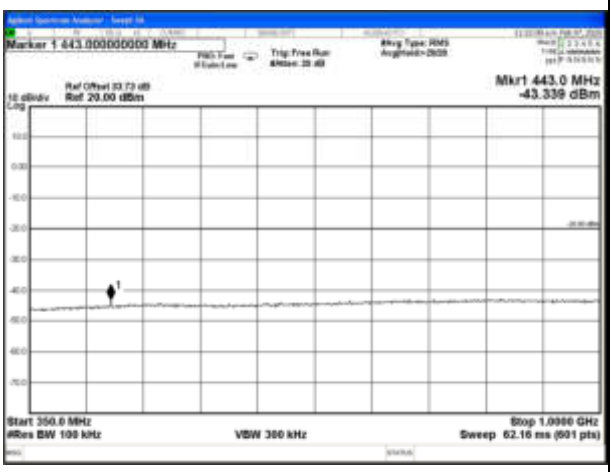
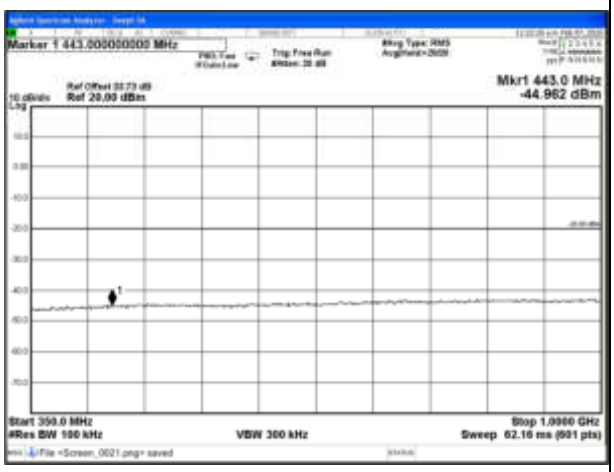
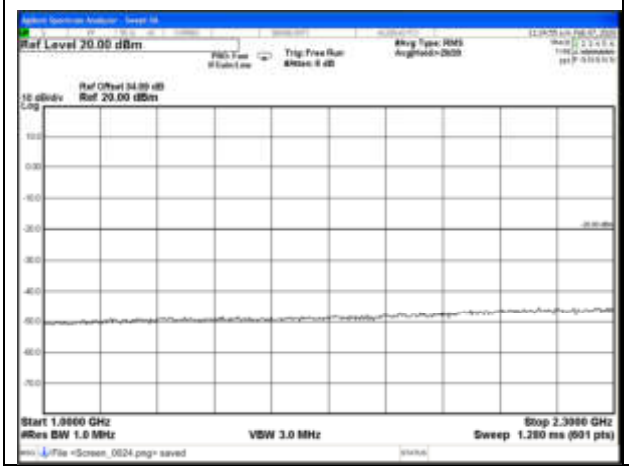
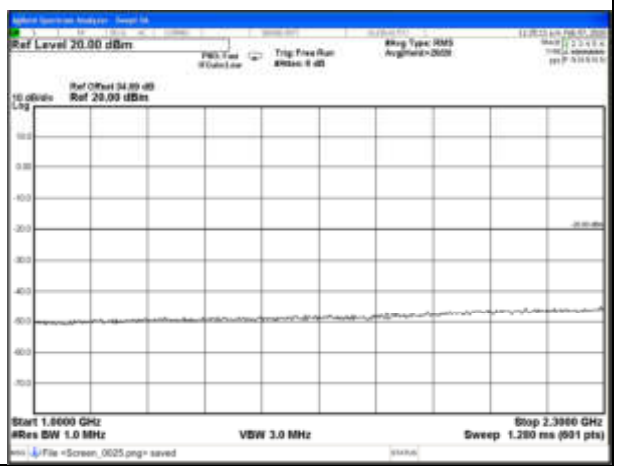
12.5 kHz Channel Spacing 221.5 MHz @ 25 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
63.7	-38.7	-82.7
158.1	-36.4	-80.4
~	~	~

12.5 kHz Channel Spacing 221.5 MHz @ 1 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
73.0	-33.3	-63.3
~	~	~
Measurement Uncertainty:	≤12.75 GHz ± 3.0 dB	
No other emissions were detected at a level greater than 20 dB below the limit.		

Spurious Emissions (Tx Conducted)

221.5 MHz @ 25 W	221.5 MHz @ 1 W
	
	
	

Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC 47 CFR 2.1051

LIMITS: FCC 47 CFR 90.210

Carrier Output Power	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
25 W	-20 dBm	-64 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^{th} 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^{o} to obtain the maximum response of each spurious emission. Valid emissions are determined by switching the EUT on and off.
3. The EUT is then replaced by a signal generator and substitution antenna to make measurements by the substitution method.

MEASUREMENT RESULTS:
See the tables on the following pages

LIMIT CLAUSE: FCC 47 CFR 90.210

Spurious Emissions (Tx Radiated)

SPECIFICATION: FCC 47 CFR 2.1053

12.5 kHz Channel Spacing 173.3 MHz @ 25 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.		

12.5 kHz Channel Spacing 216.5 MHz @ 25 W Emission Mask D

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

12.5 kHz Channel Spacing 216.5 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.		

12.5 kHz Channel Spacing 221.5 MHz @ 25 W Emission Mask D

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

12.5 kHz Channel Spacing 221.5 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.		

Spurious Emissions (Tx Radiated)

LIMITS: FCC 47 CFR 2.1053

Carrier Output Power	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
25 W	-20 dBm	-64 dBc
1 W	-20 dBm	-50 dBc

Tx Radiated Emissions - Continued

Open Area Test Site Results:

12.5 kHz Channel Spacing | 216.5 MHz @ 25 W | Emission Mask B

Harmonics Emission Frequency (MHz)	Level (dBm)	Level (dBc)
433.0	-92.61	-136.61
649.5	-66.07	-110.07
866.0	-68.01	-112.01
1082.5	-74.23	-118.23
1299.0	-71.15	-115.15
1515.5	-78.62	-122.62
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
433.0	-116.78	-77.20	-14.86	-0.19	-0.36	-92.61	0.00055
		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 table below and plots on the following pages for 12.5 kHz channel spacing.

LIMIT CLAUSE: FCC 47 CFR 90.214

Tx FREQUENCY: 173.3 MHz 25 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	0.6	N/A
t2	-0.3	N/A
t3	N/A	-0.6

	YES	NO
Confirm that during periods t1 and t3 the frequency difference does not exceed the value of one channel separation.	✓	☐
Confirm that during the period t2 the frequency difference does not exceed half a channel separation.	✓	☐
Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.	✓	☐

Measurement Uncertainty: Frequency ± 130 Hz; Time ± 0.2%

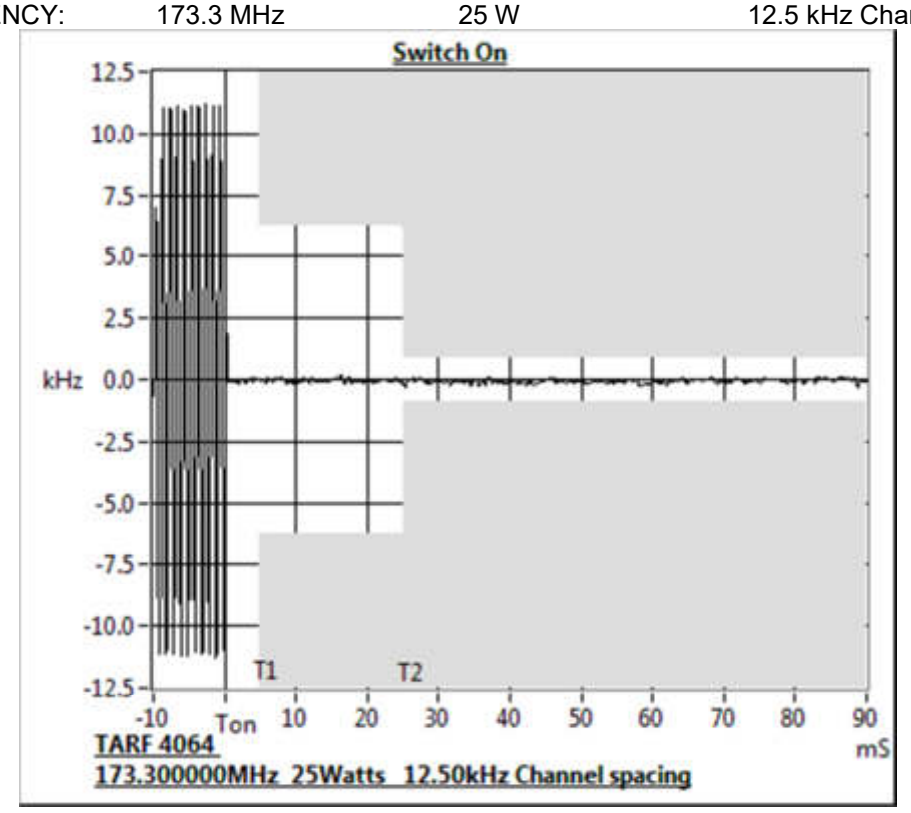
LIMIT: FCC 47 CFR 90.214

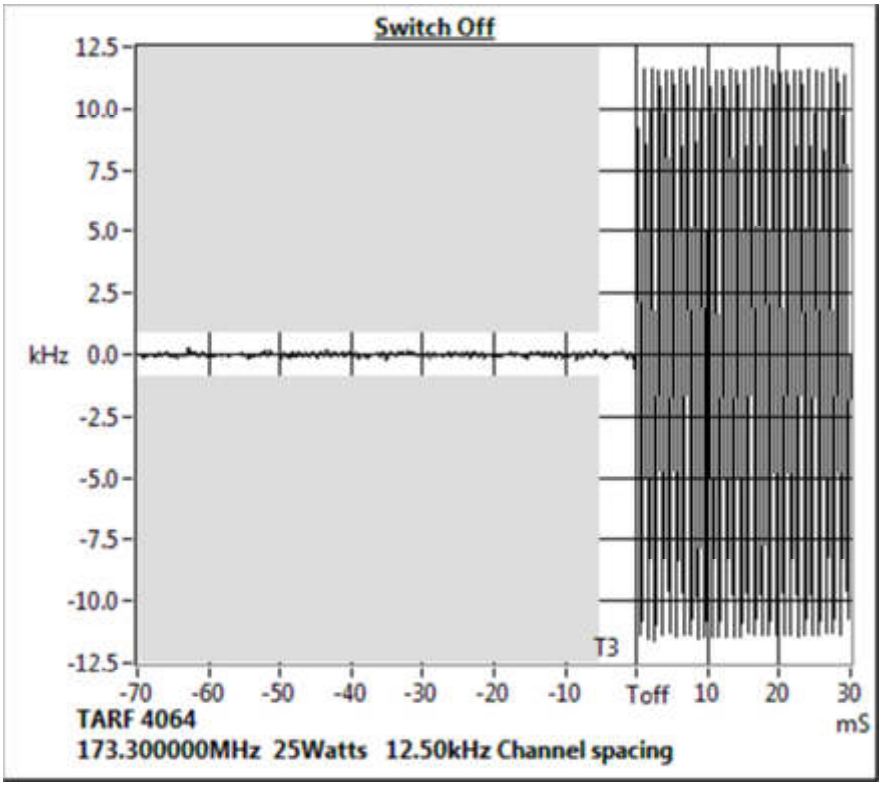
TRANSIENT PERIODS	FREQUENCY RANGE	
	150 MHz – 174 MHz	421 MHz – 512 MHz
t1 (ms)	5 ms	10 ms
t2 (ms)	20 ms	25 ms
t3 (ms)	5 ms	10 ms

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 173.3 MHz 25 W 12.5 kHz Channel Spacing





TRANSMITTER FREQUENCY STABILITY - TEMPERATURE

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

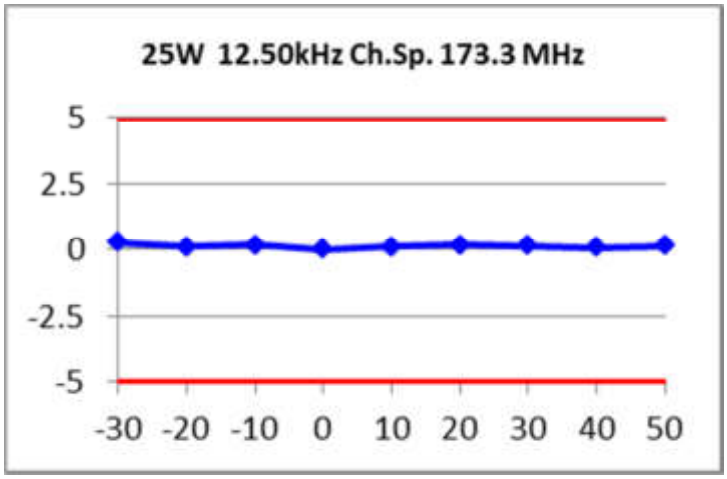
GUIDE: TIA/EIA-603D 2.2.2

MEASUREMENT PROCEDURE:
1. Refer Annex A for equipment set up.
2. The EUT was tested for frequency error from –30° C to +50° C in 10° 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.

173.3 MHz

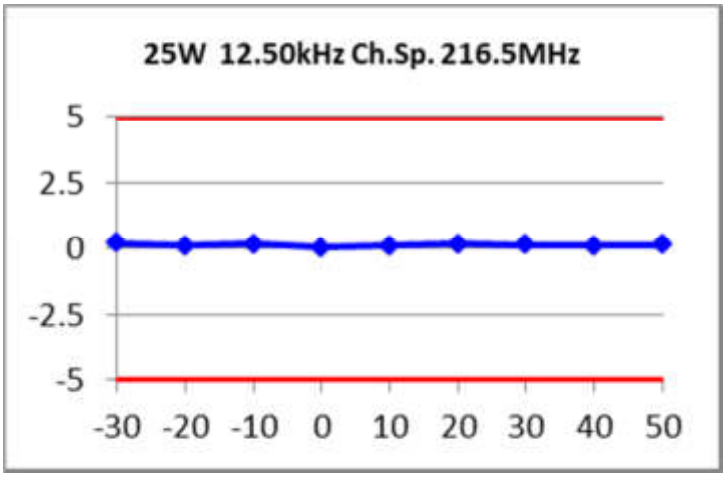
Temperature (ºC)	Frequency (Hz)	Error (ppm)
-30	43	0.25
-20	19	0.11
-10	27	0.16
0	0	0.00
10	18	0.10
20	29	0.17
30	21	0.12
40	12	0.07
50	21	0.12
Measurement Uncertainty	± 7 x 10^{-8}	



Transmitter Frequency Stability – Temperature

216.5 MHz

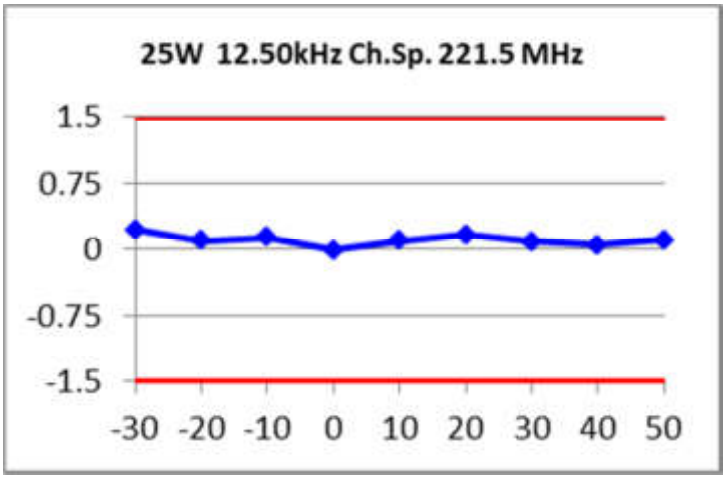
Temperature (ºC)	Frequency (Hz)	Error (ppm)
-30	42	0.19
-20	21	0.1
-10	35	0.16
0	7	0.03
10	18	0.08
20	37	0.17
30	29	0.13
40	18	0.08
50	25	0.12
Measurement Uncertainty	± 7 x 10^{-8}	



Transmitter Frequency Stability – Temperature

221.5 MHz

Temperature (ºC)	Frequency (Hz)	Error (ppm)
-30	49	0.22
-20	23	0.10
-10	31	0.14
0	-2	-0.01
10	23	0.10
20	36	0.16
30	21	0.09
40	12	0.05
50	25	0.11
Measurement Uncertainty	± 7 x 10^{-8}	



LIMIT CLAUSE: FCC 47 CFR 90.213

Channel Frequency	Frequency Error (ppm)
150 - 174 MHz	5.0
220 - 222 MHz	1.5

TRANSMITTER FREQUENCY STABILITY - VOLTAGE

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

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 as specified by the manufacturer.
3. The frequency error was recorded in parts per million (ppm).

MEASUREMENT RESULTS:

Voltage	FREQUENCY ERROR (ppm) for 12.5 kHz		
	173.3 MHz	216.5 MHz	221.5 MHz
24 V_{DC}	0.08	0.07	0.05
9 V_{DC}	0.09	0.09	0.05
36 V_{DC}	0.09	0.09	0.05
Measurement Uncertainty		± 7 x 10^{-8}	

LIMIT CLAUSE: FCC 47 CFR 90.213

Channel Frequency	Frequency Error (ppm)
150 - 174 MHz	5.0
220 - 222 MHz	1.5

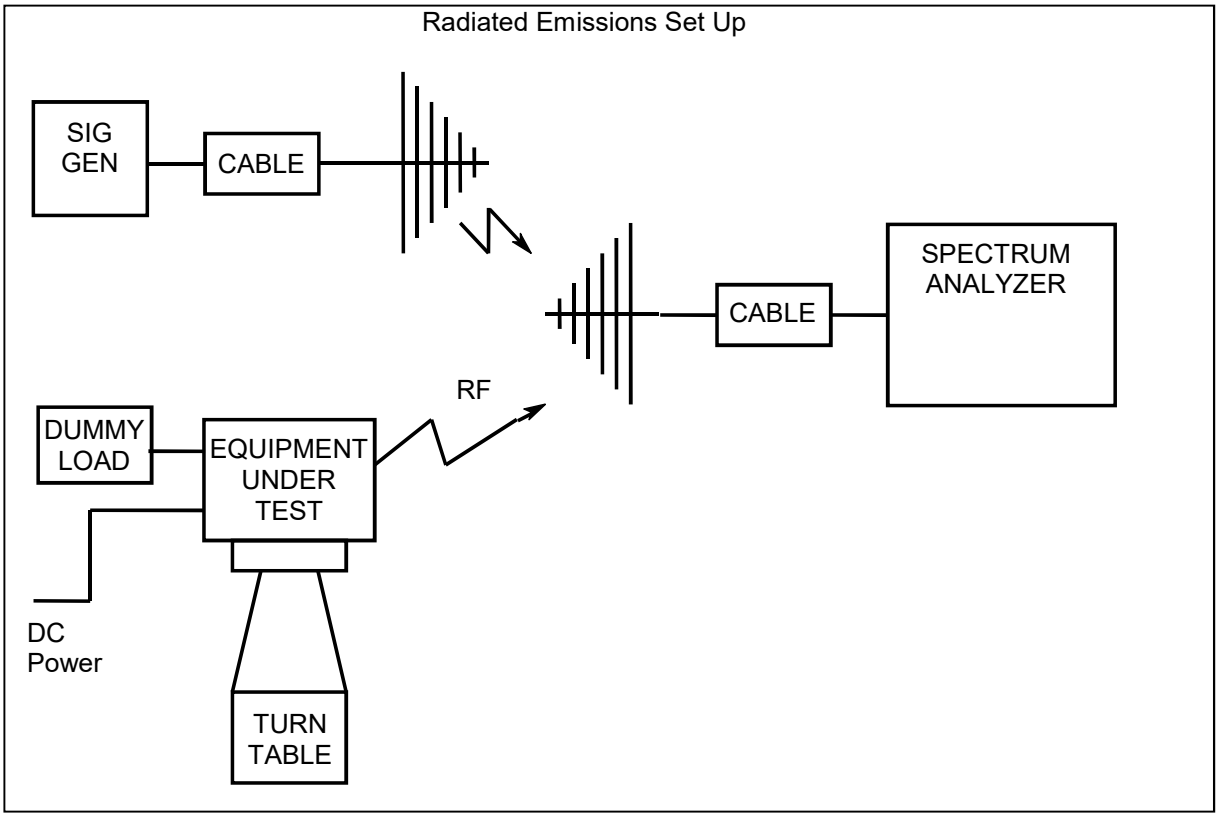
TEST EQUIPMENT LIST

Equipment Type	Information	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
Antenna	18GHz DRG	Emco	DRG3115	2084	E3076	
Antenna	Reference Dipoles	Emco	3121C DB1	9510-1164	E3559	14-May-22
Antenna	18GHz DRG	Emco	DRG3115	9512-4638	E3560	15-May-20
Antenna	Log Periodic	Schwarzbeck	VUSLP	9111-219	E4617	
Antenna	Reverb - 1-18GHz DRG	Schwarzbeck	BBHA 9120 D	9120D-885	E4857	
Antenna	Reverb - 1-18GHz DRG	Schwarzbeck	BBHA 9120 D	9120D-884	E4858	
Coax Cable	OATS Turntable Cable 1	Intelcom	RG214	OATS1	E4621	28-Oct-20
Coax Cable	OATS Tower Cable	Intelcom	RG214	OATS2	E4622	28-Oct-20
Coax Cable	2m Black	Suhner	RG214HF/Nm/ Nm/2000	TeltestBlack2	E4623	23-Oct-20
Coax Cable	2m Black	Suhner	RG214HF/Nm/ Nm/2000	TeltestBlack3	E4624	23-Oct-20
Coax Cable	Reverb - 4.5m Multiflex 141	TeltestBlue6	MF 141	TeltestBlue6	E4843	24-Oct-20
Coax Cable	Reverb - 2m Multiflex 141	TeltestBlue5	MF 141	TeltestBlue5	E4844	24-Oct-20
Coax Cable	Reverb - 2m Multiflex 141	TeltestBlue4	MF 141	TeltestBlue4	E4845	24-Oct-20
Coax Cable	Reverb - 1m Multiflex 141	TeltestBlue3	MF 141	TeltestBlue3	E4846	24-Oct-20
Coax Cable	Reverb - 1m Multiflex 141	TeltestBlue1	MF 141	TeltestBlue1	E4848	24-Oct-20
Coax Cable	OATS Turntable Cable 2	Intelcom	RG215	OATS3	E4995	28-Oct-20
Coax Cable	2.5m Blue	Suhner	Sucoflex 104A	33449/4PEA	E4997	23-Oct-20
Coax Cable	2m Black	Suhner	RG214HF/Nm/ Nm/2000	TeltestBlack8	E5005	28-Oct-20
Coax Cable	3m Blue	Suhner	Sucoflex 126EA	503429/126EA	E5015	23-Oct-20
Environ. Chamber	Chest	Contherm	Chest	E3397	E3397	28-Nov-24
Environ. Chamber	Chest	Contherm	Chest	E3397	E3397	29-Nov-20
Filter High Pass/ Notch	135 to 175MHz	Tait		N/A	E3382	3-Nov-20
Filter High Pass/ Notch	175 to 220MHz	Tait		N/A	E3383	3-Nov-20
Modulation Analyser	TREVA2	Hewlett Packard	HP8901B (Opt 002)	3704A05837	E3786	4-Oct-20
OATS	Controller	Electrometrics	EM-4700	119	E4445	
OATS	Turntable	Electrometrics	EM-4704A	105	E4446	
OATS	Antenna Tower	Electrometrics	EM-4720-2	112	E4447	
OATS	NSA	Tait				18-Jun-20
Oscilloscope	400MHz	Tektronics	TDS380	B017095	E3782	28-Sep-21
Power Meter	TREVA2 Power Head for HP8901	Hewlett Packard	HP11722A	2716A02037	1575	4-Oct-20
Power Supply	60V/50A/1000W	Hewlett Packard	HP6012B	2524A00616	E3712	30-Sep-21
Power Supply	TREVA2 60V/25A	Agilent	N5767A	US09F4901H	E4656	3-Oct-21
Power Supply	60V/25A	Agilent	N5767A	3111A05573	E4979	2-Oct-20
RF Amplifier	+21.7 dB 1GHz	Tait	ZFL-1000LN	E3660	E3360	30-Apr-20
RF Amplifier	Pre-amplifier	Agilent	87405C	MY47010688	E4941	14-Oct-20
RF Attenuator	10dB 50W	Weinschel	24-10-34	AZ0401	E3388	24-Oct-20
RF Attenuator	TREVA2 20dB 150W	Weinschel	40-20-33	CJ405	E3733	23-Oct-20
RF Attenuator	33dB 350W	Weinschel	67-30-33 & BW-N3W5+	CK9178	E5023	15-Jul-20

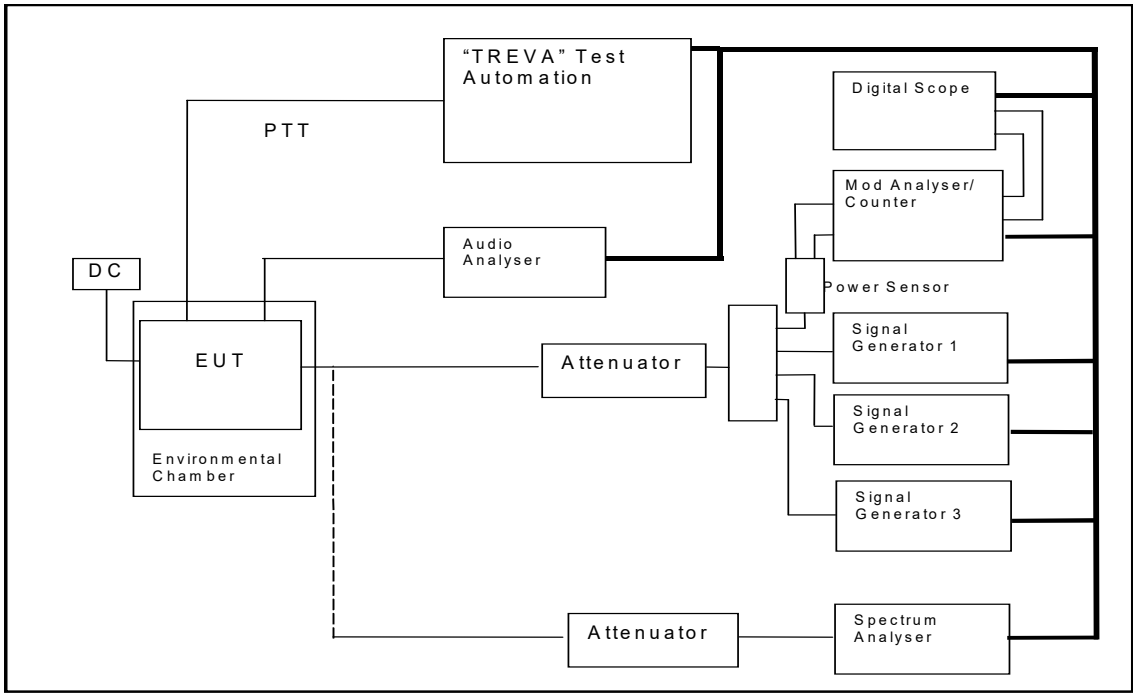
Equipment Type	Information	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
RF Attenuator	10dB 50W	Weinschel	24-10-34	BC3293	E4364	23-Oct-20
RF Attenuator	TREVA2 3dB	Weinschel	Model 1	BL9950	E4080	23-Oct-20
RF Attenuator	3dB 0.5W	Weinschel	Model 1	CH6857	E5012	23-Oct-20
RF Chamber	S-LINE TEM CELL	Rohde & Schwarz	1089.9296.02	338232/003	E3636	12-Sep-20
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	
RF Combiner	TREVA2	Minicircuits	ZFSC-4-1	-	E4084	
RF Load	50W	Weinschel	F1426	BF0487	E3675	22-Oct-20
Signal Generator	Analog 4GHz	Agilent	E4422B	GB40050320	E3788	10-Oct-20
Signal Generator	TREVA2 Analog 3.3GHz	Rohde & Schwarz	SML03 1090.3000.13	100597	E4050	9-Oct-20
Signal Generator	Digital 3GHz	Agilent	E4438C	MY45093154	E4600	3-Oct-20
Spectrum Analyser	13.2GHz	Agilent	E4445A	MY42510072	E4139	19-Jul-20
Spectrum Analyser	26.5GHz	Agilent	PXA N9030A	MY49432161	E4907	27-Oct-20
Temp & Humidity datalogger		Hobo	U21-011	10134275	E4980	5-May-20
TREVA 2		Teltest	-	2	-	7-May-20
Testware	Frequency Vs Temperature		April 2018	-	-	
Testware	Radiated Emissions		April 2018	-	-	
Testware	Sideband Spectrum		February 2017	-	-	
Testware	S-Line Radiated Emissions		April 2018	-	-	
Testware	Reverb Emissions		May 2019	-	-	
Testware	TREVA		January 2020	-	-	
Testware	Spec An Correction Loader		June 2019	-	-	

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 **T**eltest **R**adio **EVA**luation system (TREVA), which is configured as shown below. The Spectrum Analyser is connected to the EUT via the attenuator network for Conducted Emissions testing, and Occupied Bandwidth.



END OF REPORT