

LABORATORY TEST REPORT

RADIO PERFORMANCE MEASUREMENTS

for the

TBCH1B Basestation Transceiver

Tested in accordance with:

FCC 47 CFR Part 90

RSS-119 Issue 11
RSS-Gen Issue 3

Report Revision: 1
Issue Date: 23 January 2014

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Laboratory Technical Manager



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

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

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FCC ID: CASTBCH1B
IC: 737A-TBCH1B

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Report Revision: 1
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REVISION

Date	Revision	Comments
23 January 2014	1	Initial test report

INTRODUCTION

This report covers the requirements of FCC 47 Part 90, and RSS-119 Issue 11 & RSS-Gen Issue 3.

REASON FOR REPORT					
The TB9400 H1 100 W is a new addition to the Tait Communications Ltd product line capable of digital P25 phase-1 and P25 phase-2 modulations:					
Modulation		Channel Spacing	Speech Channels	Symbol Rate (symbols/sec)	Data Rate (bps)
APCO P25 Phase 1	C4FM (TIA 102)	12.5 kHz	1	4800	9600
APCO P25 Phase 1	LSM	12.5 kHz	1	4800	9600
APCO P25 Phase 2	H-DQPSK	12.5 kHz	2	6000	12000
APCO P25 Phase 2	H-D8PSK	12.5 kHz	2	4000	12000

Type Approval Testing of the Frequency range TBCH1B
400 → 440 MHz

in accordance with:
FCC 47 CFR Part 90
RSS-119 Issue 11 & RSS-Gen Issue 3

REPORT PREPARED FOR
Tait Communications
PO Box 1645
558 Wairakei Road
Christchurch
New Zealand

DESCRIPTION OF SAMPLE
Manufacturer Tait Limited
Equipment: Basestation Transceiver
Type: TBCH1B

The TBCH1B Basestation Transceiver consists of:

Functional Description	Product Designation Code	Serial Number
Reciter	T01-01103-KAAA	18195183
Power Amplifier	T01-01121-KBAA	18195194
Power Management Unit	TBA30A0-0100	18194239
Front Panel	T01-01110-AAAA	18195218
Subrack	T01-01101-DAAA	18195206

HARDWARE & SOFTWARE Details:

<i>Functional Description</i>	<i>Firmware Version</i>	<i>Hardware Version</i>
Reciter	P25-1.30.00.0006	00.11
Power Amplifier	1.06.00.0001	0006
Power Management Unit	0316	00.03
Front Panel	1.06.00.0001	00.04

TEST CONDITIONS

All testing was performed between 9 → 23 January 2014, and under the following conditions:

Ambient temperature: 15°C → 30°C

Relative Humidity: 20% → 75%

Standard Test Voltage 120 V_{AC}

STATEMENT OF COMPLIANCE

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

Equipment: Basestation Transceiver
Type: TBCH1B
Quantity: 1

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

FCC 47 CFR Part 90

RSS-119 Issue 11 & RSS-Gen Issue 3

Signature: _____

Mike James
Technical Manager

Date: _____

MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS

MODULATION TYPES:

APCO P25 Phase 1

F1E	C4FM	4800 symbols/sec	9600 bps
F1D	C4FM	4800 symbols/sec	9600 bps
D1W	LSM	4800 symbols/sec	9600 bps
D7W	LSM	4800 symbols/sec	9600 bps

APCO P25 Phase 2

D7W	H-DQPSK	6000 symbols/sec	12000 bps
D7W	H-D8PSK	4000 symbols/sec	12000 bps

CHANNEL SPACINGS: 12.5 kHz

EMISSION DESIGNATORS:

P25 Phase 1 Digital Voice	8K10F1E
P25 Phase 1 Digital Data	8K10F1D
LSM	8K70D1W
LSM	8K70D7W
P25 Phase 2 H-DQPSK	9K80D7W
P25 Phase 2 H-D8PSK	6K80D7W

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 TIA/102 CAAB 2.2.5.2 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

8K10F7E

F7E represents two or more channels containing quantized or digital voice information

Digital Data 12.5 kHz Channel Spacing

99% bandwidth
= 8.1 kHz

Emission Designator

8K10F1D

F1D represents an digital FM data transmission

8K10F7D

F7D represents two or more channels containing quantized or digital information

Linear Simulcast Modulation (LSM):

Digital Voice/data transmissions use a 4 level frequency shift keying modulation scheme. The necessary bandwidth as been measured using the 99% energy rule, and in accordance with TIA/102 CAAB 2.2.5.2 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 data or telephony

8K70D7W

D7W represents two or more channels containing quantized or digital information combining two modulation modes simultaneously (amplitude + angle) for a data/telephony combination.

APCO P25 Phase II:

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 data/telephony combination.

H-D8PSK Digital Data 12.5 kHz Bandwidth

99% bandwidth
= 6.8 kHz

Emission Designator
6K80D7W

D7W represents two or more channels containing quantized or digital information combining of two modulation modes simultaneously (amplitude + angle) for a data/telephony combination.

TEST RESULTS

TRANSMITTER OUTPUT POWER (CONDUCTED)

SPECIFICATION: FCC 47 CFR 2.1046
RSS-119 5.4

GUIDE: TIA-102.CAAA-C 2.2.1

MEASUREMENT PROCEDURE:

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

MEASUREMENT RESULTS:

Manufacturer's Rated Output Power:

Switchable: 100 W and 10 W

Nominal 100	406.2 MHz	418.1 MHz	429.9 MHz
Measured	98.1	95.1	97.6
Variation (%)	-1.9	-4.9	-2.4
Variation (dB)	-0.1	-0.2	-0.1
Nominal 10	406.2 MHz	418.1 MHz	429.9 MHz
Measured	9.8	9.8	9.4
Variation (%)	-2.0	-2.1	-5.8
Variation (dB)	-0.1	-0.1	-0.3
Measurement Uncertainty		± 0.6 dB	

LIMIT CLAUSES:

FCC 47 CFR 90.205 (s)

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

RSS-119 5.4

The output power shall be within ±1.0 dB of the manufacturer's rated power.

TRANSMITTER OCCUPIED BANDWIDTH AND SPECTRUM MASKS

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

GUIDE: TIA-102.CAAA-C 2.2.5

MEASUREMENT PROCEDURE:

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

MEASUREMENT RESULTS:

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

LIMIT CLAUSE: FCC 47 CFR 90.210 RSS-119 5.5

EMISSION MASKS

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

DATA SPEED

Digital Voice/Data 12.5 kHz Channel Spacing 9600 bps (P25 Phase I)
Digital Voice/Data 12.5 kHz Channel Spacing 12000 bps (P25 Phase II)

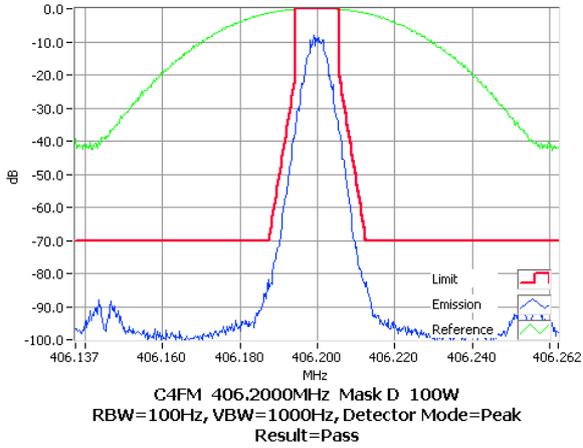
Occupied Bandwidth and Spectrum Masks

P25 Phase 1 C4FM
SPECIFICATION:

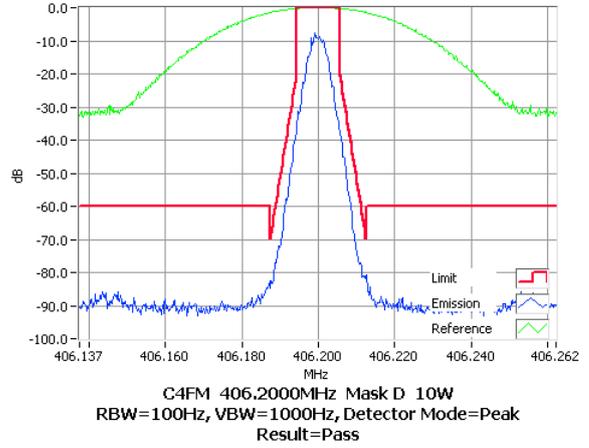
FCC CFR 2.1049 (c)

RSS-119 5.5

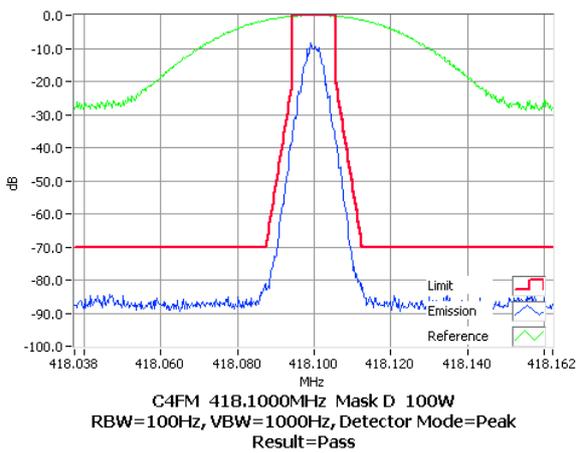
Tx Freq: 406.2 MHz, 100 W, 12.5 kHz Chan Spacing



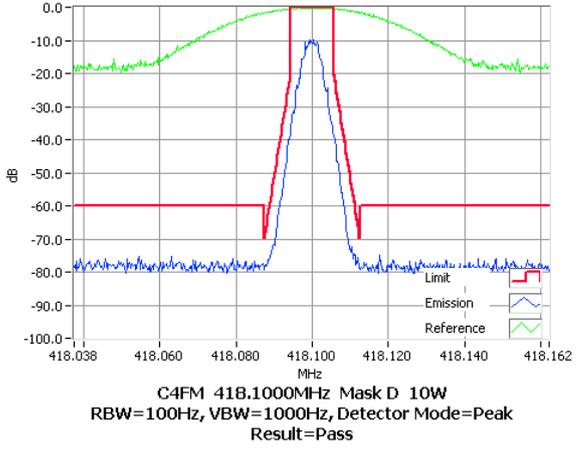
Tx Freq: 406.2 MHz, 10 W, 12.5 kHz Chan Spacing



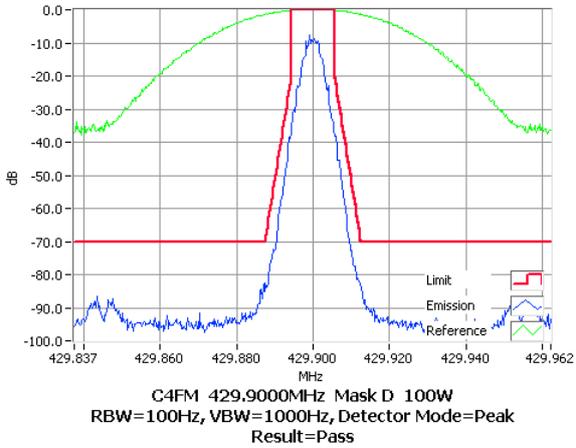
Tx Freq: 418.1 MHz, 100 W, 12.5 kHz Chan Spacing



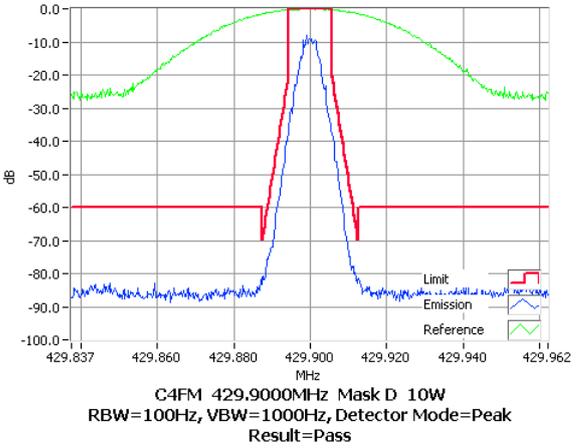
Tx Freq: 418.1 MHz, 10 W, 12.5 kHz Chan Spacing



Tx Freq: 429.9 MHz, 100 W, 12.5 kHz Chan Spacing



Tx Freq: 429.9 MHz, 10 W, 12.5 kHz Chan Spacing



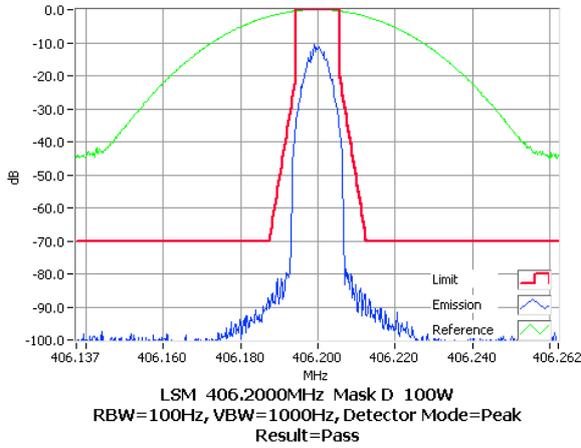
Occupied Bandwidth and Spectrum Masks

P25 Phase 1 LSM
SPECIFICATION:

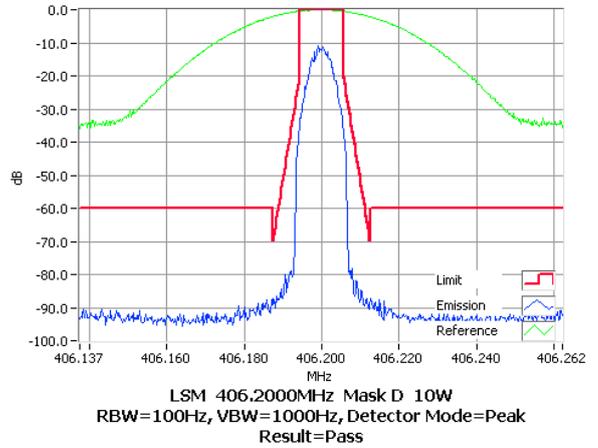
FCC CFR 2.1049 (c)

RSS-119 5.5

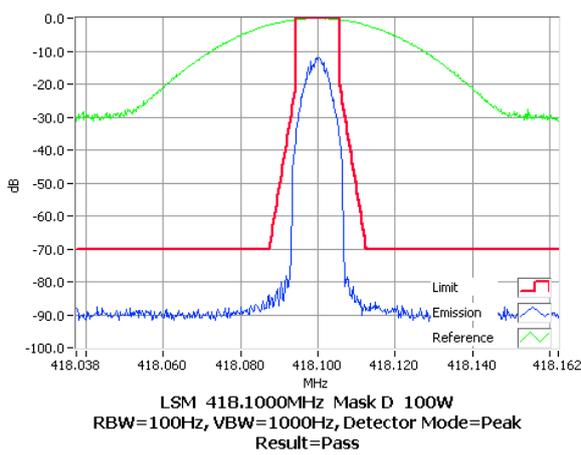
Tx Freq: 406.2 MHz, 100 W, 12.5 kHz Chan Spacing



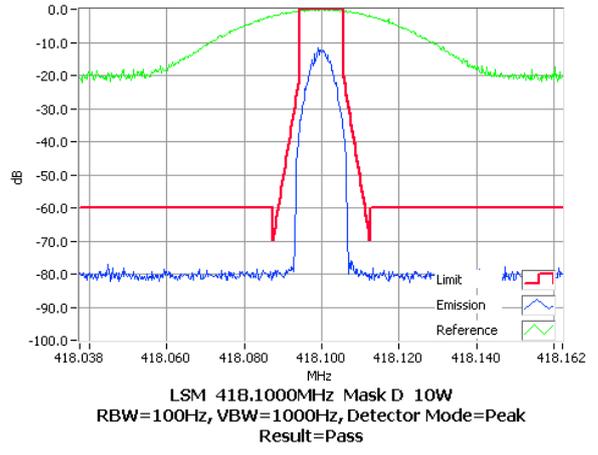
Tx Freq: 406.2 MHz, 10 W, 12.5 kHz Chan Spacing



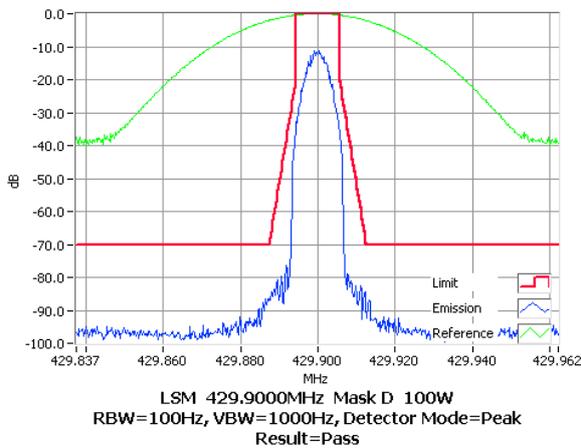
Tx Freq: 418.1 MHz, 100 W, 12.5 kHz Chan Spacing



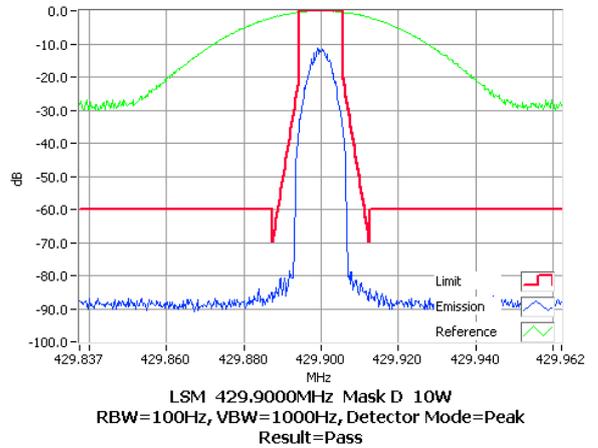
Tx Freq: 418.1 MHz, 10 W, 12.5 kHz Chan Spacing



Tx Freq: 429.9 MHz, 100 W, 12.5 kHz Chan Spacing



Tx Freq: 429.9 MHz, 10 W, 12.5 kHz Chan Spacing



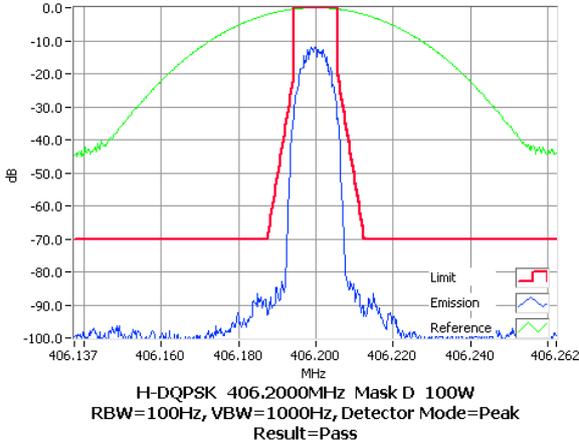
Occupied Bandwidth and Spectrum Masks

P25 Phase 2 H-DQPSK
SPECIFICATION:

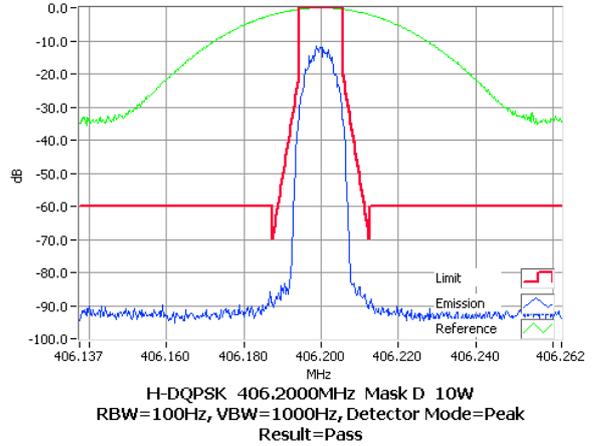
FCC CFR 2.1049 (c)

RSS-119 5.5

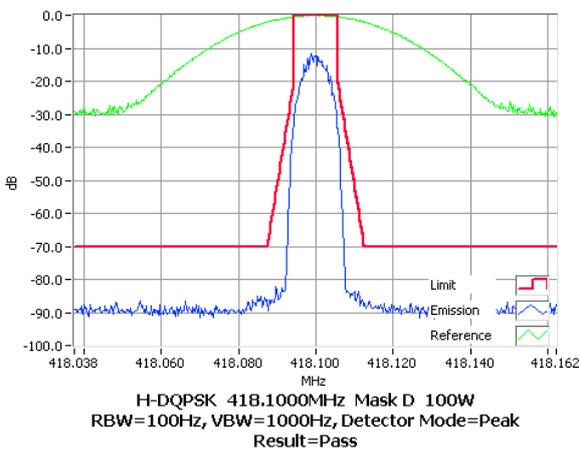
Tx Freq: 406.2 MHz, 100 W, 12.5 kHz Chan Spacing



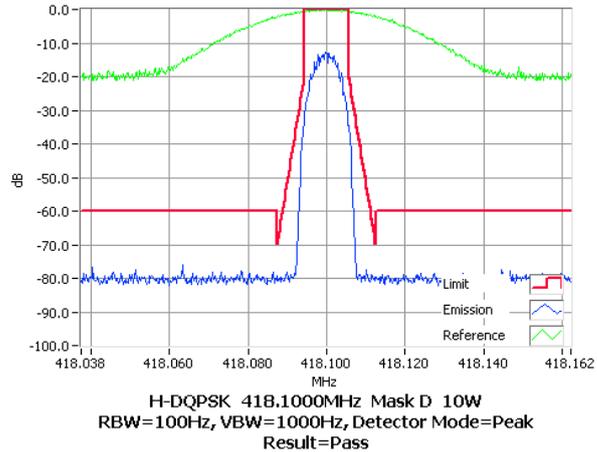
Tx Freq: 406.2 MHz, 10 W, 12.5 kHz Chan Spacing



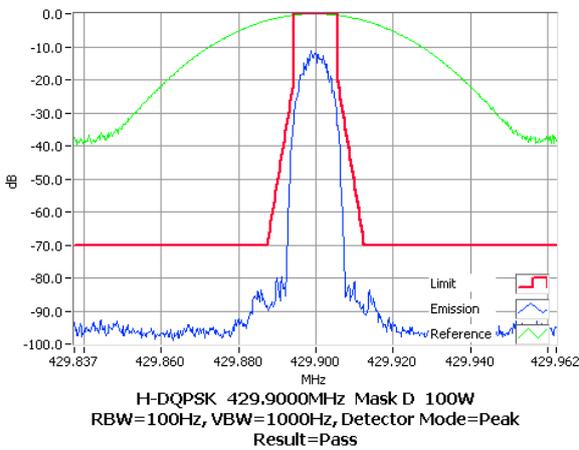
Tx Freq: 418.1 MHz, 100 W, 12.5 kHz Chan Spacing



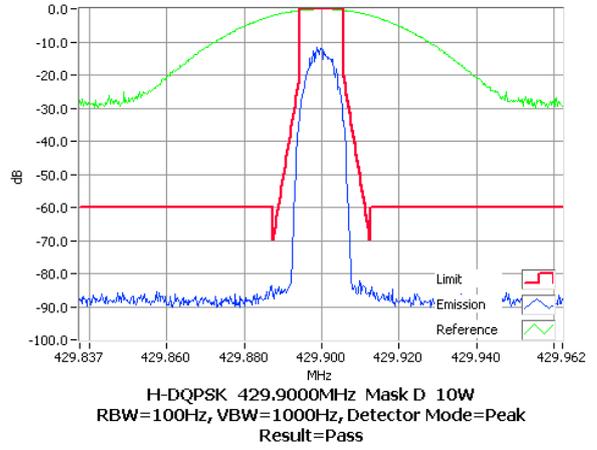
Tx Freq: 418.1 MHz, 10 W, 12.5 kHz Chan Spacing



Tx Freq: 429.9 MHz, 100 W, 12.5 kHz Chan Spacing



Tx Freq: 429.9 MHz, 10 W, 12.5 kHz Chan Spacing



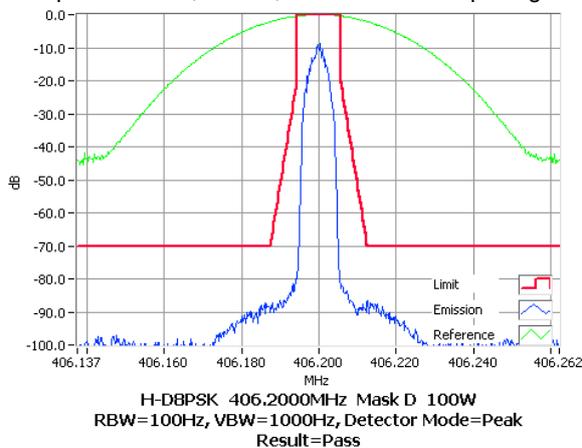
Occupied Bandwidth and Spectrum Masks

P25 Phase 2 H-D8PSK
SPECIFICATION:

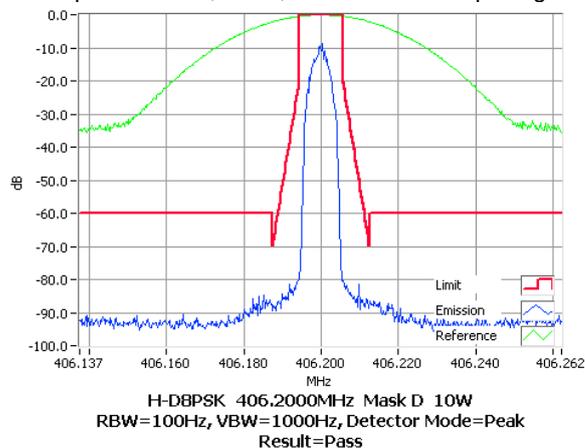
FCC CFR 2.1049 (c)

RSS-119 5.5

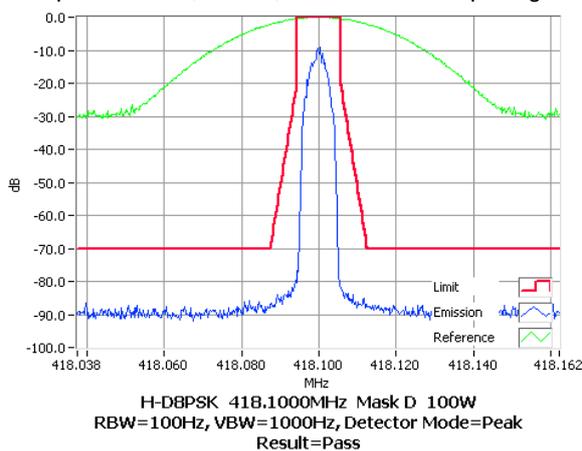
Tx Freq: 406.2 MHz, 100 W, 12.5 kHz Chan Spacing



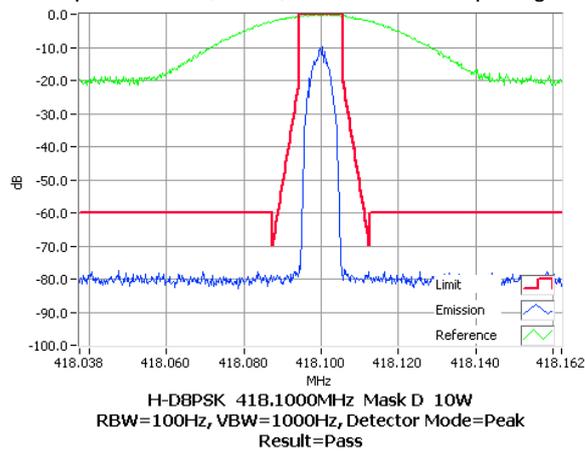
Tx Freq: 406.2 MHz, 10 W, 12.5 kHz Chan Spacing



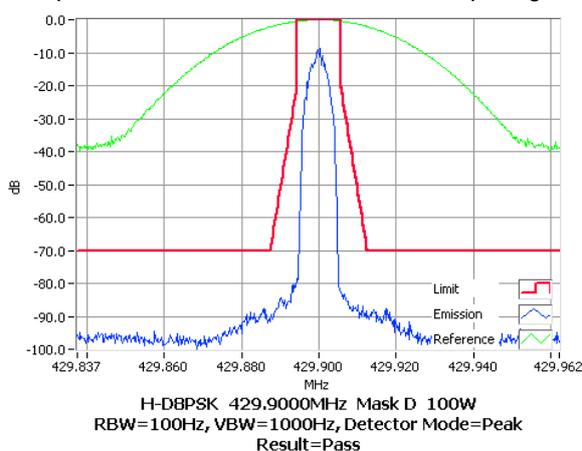
Tx Freq: 418.1 MHz, 100 W, 12.5 kHz Chan Spacing



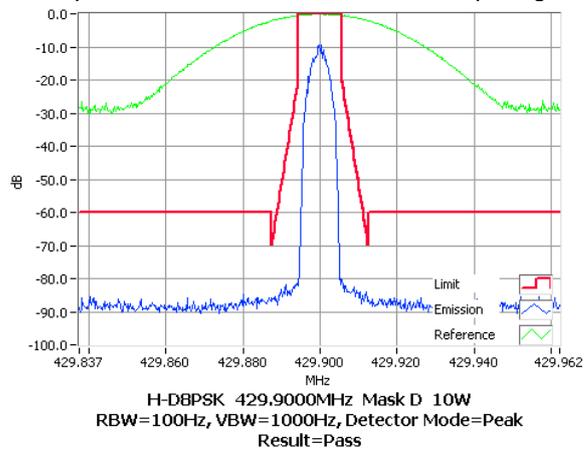
Tx Freq: 418.1 MHz, 10 W, 12.5 kHz Chan Spacing



Tx Freq: 429.9 MHz, 100 W, 12.5 kHz Chan Spacing



Tx Freq: 429.9 MHz, 10 W, 12.5 kHz Chan Spacing



TRANSMITTER SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATIONS: FCC 47 CFR 2.1051

RSS-119 5.8

GUIDE: TIA-102.CAAA-C 2.2.7

MEASUREMENT PROCEDURE:

1. Refer Annex A for equipment set up.
2. The frequency range examined was from the lowest frequency generated within the EUT, to a frequency higher than the 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.

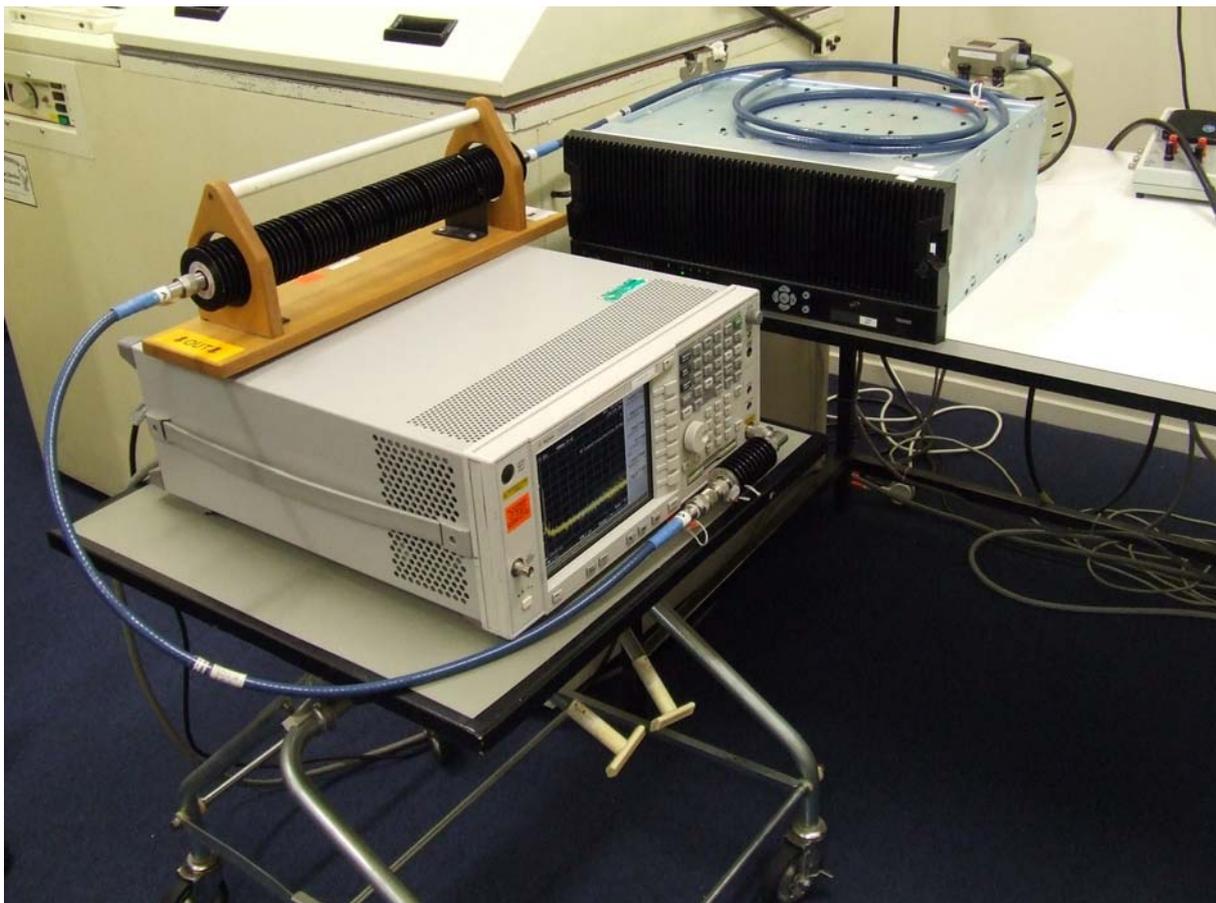
MEASUREMENT RESULTS:

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

LIMIT CLAUSES: FCC 47 CFR 90.210

RSS-119 5.8

Photo: Conducted Emissions Test Setup



Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051

RSS-119 5.8

Tx FREQUENCY: 406.2 MHz

12.5 kHz Channel Spacing

406.2 MHz @ 100 W

Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
2843.4	-37.8	-87.8
No other emissions were detected at a level greater than 20 dB below the limit.		

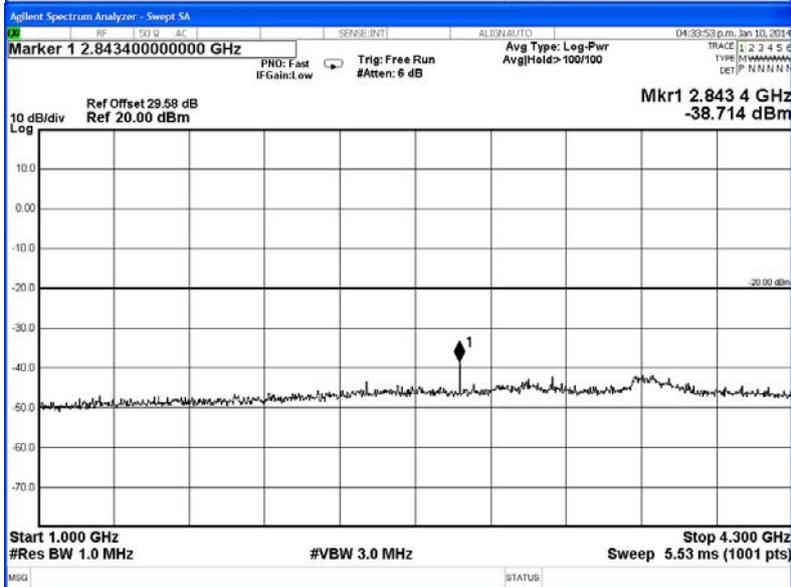
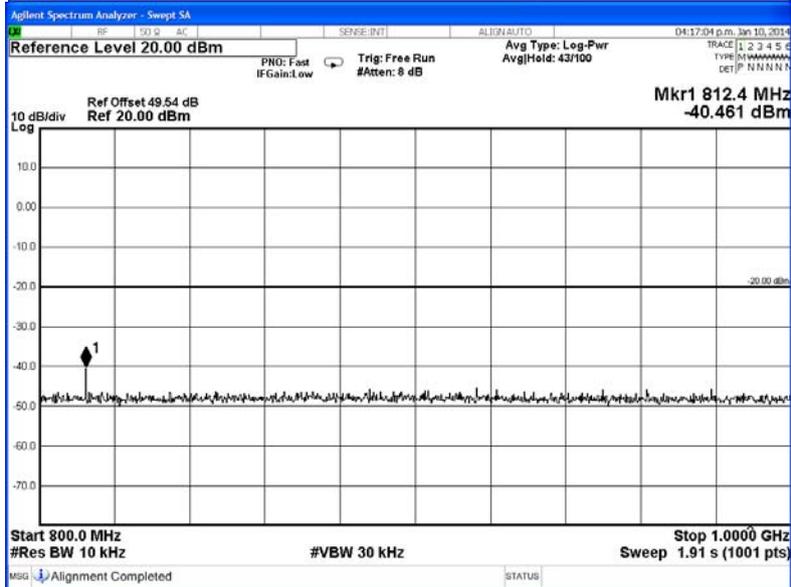
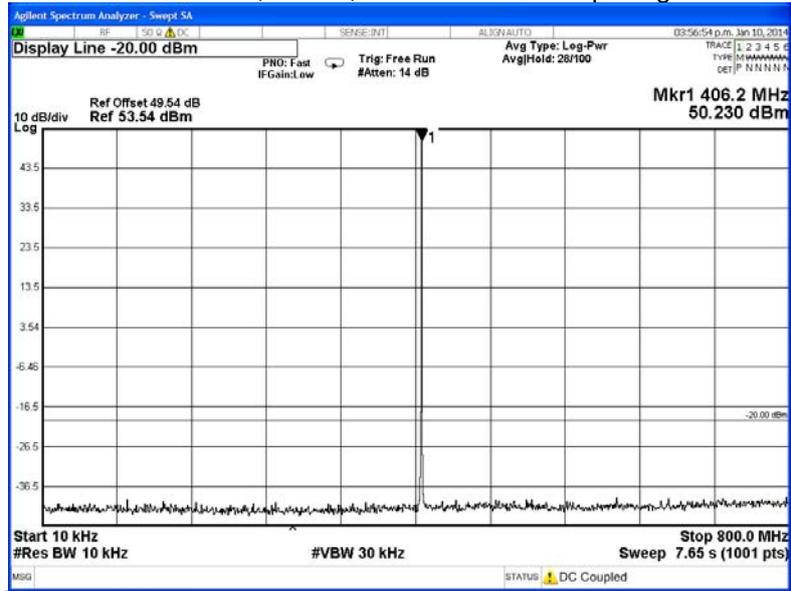
12.5 kHz Channel Spacing

406.2 MHz @ 10 W

Emission Mask D

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

Spurious Emissions (Tx Conducted)
406.2 MHz, 100 W, 12.5 kHz channel spacing



Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051

RSS-119 5.8

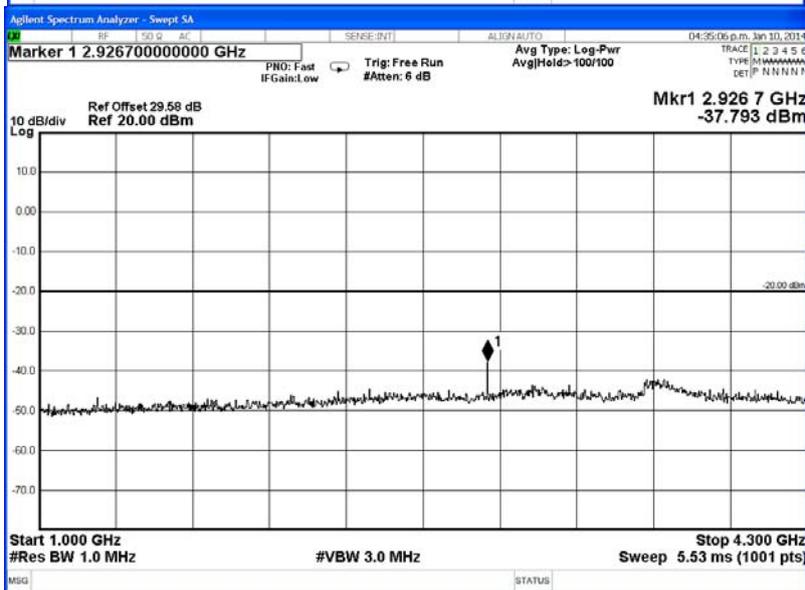
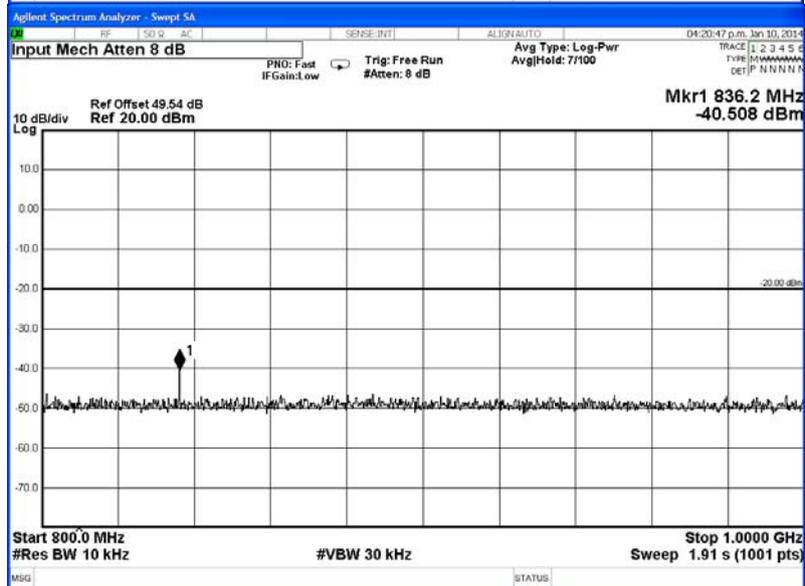
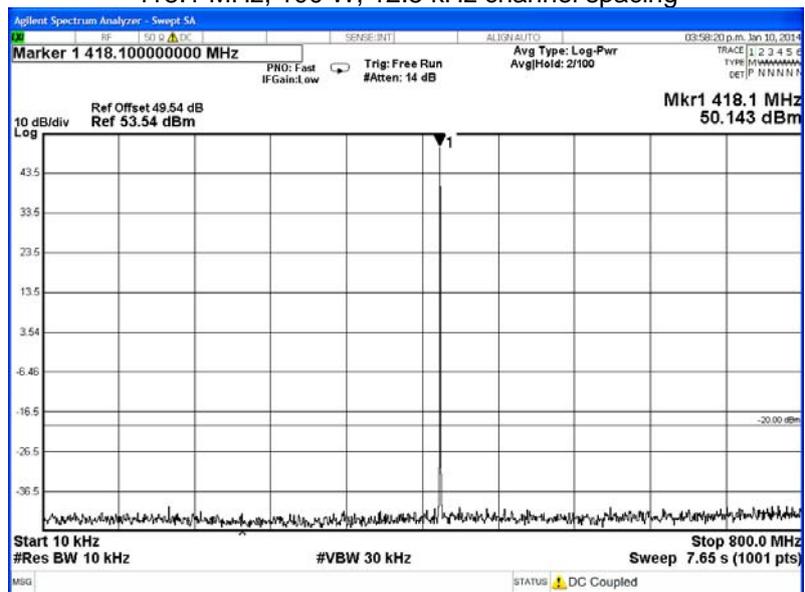
12.5 kHz Channel Spacing 418.1 MHz @ 100 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
2926.7	-34.7	-84.7
No other emissions were detected at a level greater than 20 dB below the limit.		

12.5 kHz Channel Spacing 418.1 MHz @ 10 W Emission Mask D

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

Spurious Emissions (Tx Conducted)
418.1 MHz, 100 W, 12.5 kHz channel spacing



Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051

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12.5 kHz Channel Spacing

429.9 MHz @ 100 W

Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
3009.3	-32.7	-82.7
No other emissions were detected at a level greater than 20 dB below the limit.		

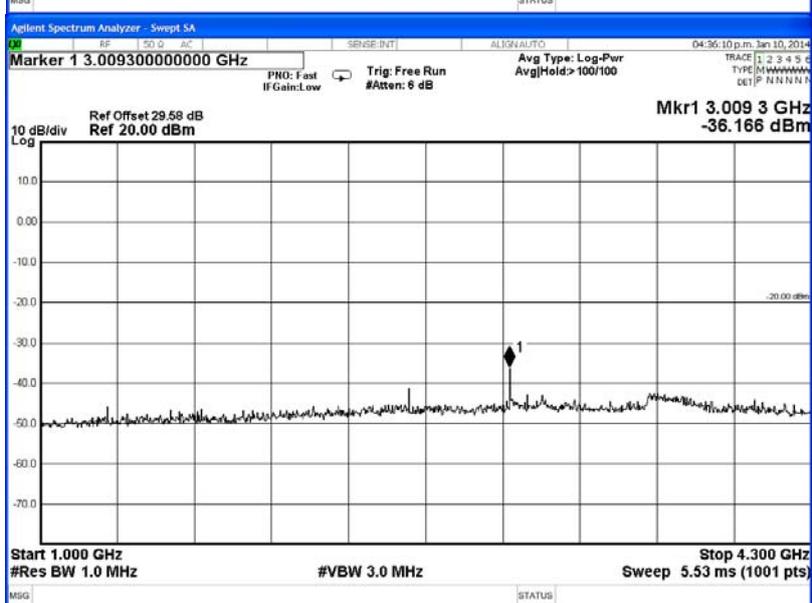
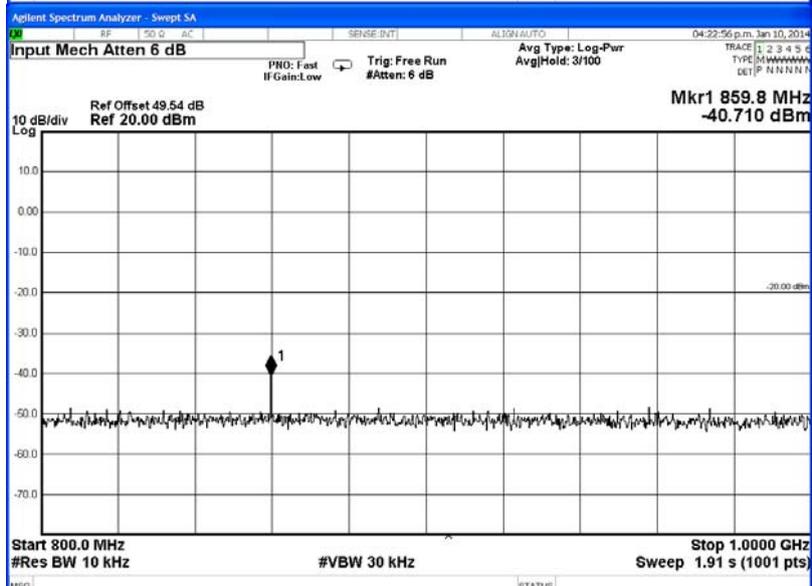
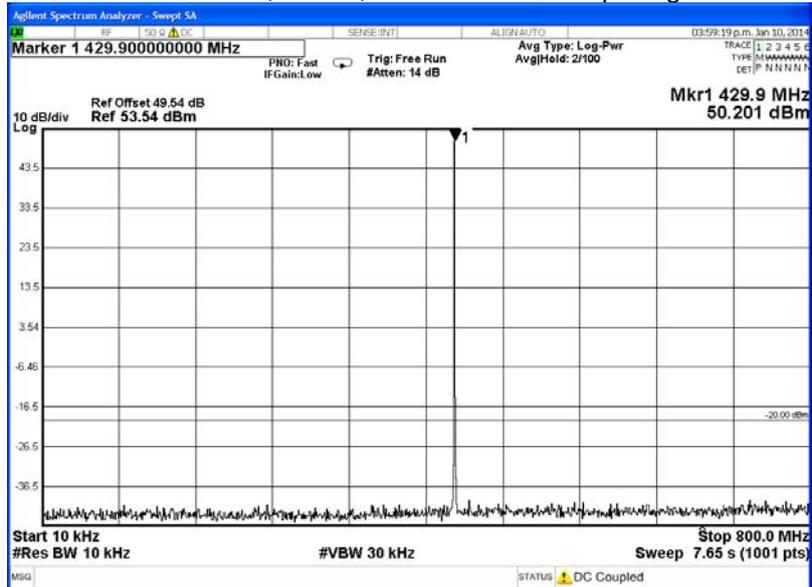
12.5 kHz Channel Spacing

429.9 MHz @ 10 W

Emission Mask D

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

Spurious Emissions (Tx Conducted)
429.9 MHz, 100 W, 12.5 kHz channel spacing



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 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{\text{Watts}})$	
	100 W	-20 dBm
10 W	-20 dBm	-60 dBc

TRANSMITTER SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC 47 CFR 2.1053

GUIDE: TIA-102.CAAA-C 2.2.6

MEASUREMENT PROCEDURE:

Initial Scan:

1. The EUT is placed in the S-Line TEM cell and emissions are measured from 30 MHz to 1000 MHz. Any emission within 20 dB of the limit is then re-tested on the OATS along with measurements from 1000 MHz to the 10th harmonic of the fundamental frequency.
2. The EUT is placed in the reverberation chamber and emissions are measured from 1000 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 pages

LIMIT CLAUSE: FCC 47 CFR 90.210

Spurious Emissions (Tx Radiated)

SPECIFICATION: FCC CFR 2.1053

Tx FREQUENCY: 406.2 MHz

12.5 kHz Channel Spacing 406.2 MHz @ 100 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
No emissions were detected at a level greater than 10 dB below the limit.		

12.5 kHz Channel Spacing 406.2 MHz @ 10 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
No emissions were detected at a level greater than 10 dB below the limit.		

12.5 kHz Channel Spacing 418.1 MHz @ 100 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
No emissions were detected at a level greater than 10 dB below the limit.		

12.5 kHz Channel Spacing 418.1 MHz @ 10 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
No emissions were detected at a level greater than 10 dB below the limit.		

12.5 kHz Channel Spacing 429.9 MHz @ 100 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
No emissions were detected at a level greater than 10 dB below the limit.		

12.5 kHz Channel Spacing 429.9 MHz @ 10 W Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
No emissions were detected at a level greater than 10 dB below the limit.		

Tx Radiated Emissions - Continued

LIMITS: FCC CFR 2.1053

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

Open Area Test Site Results:

12.5 kHz Channel Spacing 418.1 MHz @ 100 W Emission Mask D

Harmonics Emission Frequency (MHz)	Level (dBm)	Level (dBc)
836.2	-62.80	-112.80
1254.3	-45.66	-95.66
1672.4	-44.41	-94.41
2090.5	-62.66	-112.66
2508.6	-59.28	-109.28
2926.7	-59.49	-109.49

Photo: OATS Setup



TRANSIENT FREQUENCY BEHAVIOR

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

GUIDE: TIA-102.CAAA-C 2.2.18

MEASUREMENT PROCEDURE:

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

MEASUREMENT RESULTS:

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

LIMIT CLAUSES: FCC 47 CFR 90.214 RSS-119 5.9

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

RSS-119 5.9

Tx FREQUENCY: 406.2 MHz

100 W

12.5 kHz Channel Spacing

406.2 MHz @ 100 W Tx

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	-0.4	N/A
t2	0.3	N/A
t3	N/A	0.6
t2 → t3 ppm	0.00	
ERROR LIMIT (t2 → t3) ppm	1.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

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

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

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

RSS-119 5.9

Tx FREQUENCY: 418.1 MHz

100 W

12.5 kHz Channel Spacing

418.1 MHz @ 100 W Tx

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	0.5	N/A
t2	0.3	N/A
t3	N/A	0.5
t2 → t3 ppm	0.01	
ERROR LIMIT (t2 → t3) ppm	1.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

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

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

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

RSS-119 5.9

Tx FREQUENCY: 429.9 MHz

100 W

12.5 kHz Channel Spacing

429.9 MHz @ 100 W Tx

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	0.4	N/A
t2	-0.3	N/A
t3	N/A	0.3
t2 → t3 ppm	0.02	
ERROR LIMIT (t2 → t3) ppm	1.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

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

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

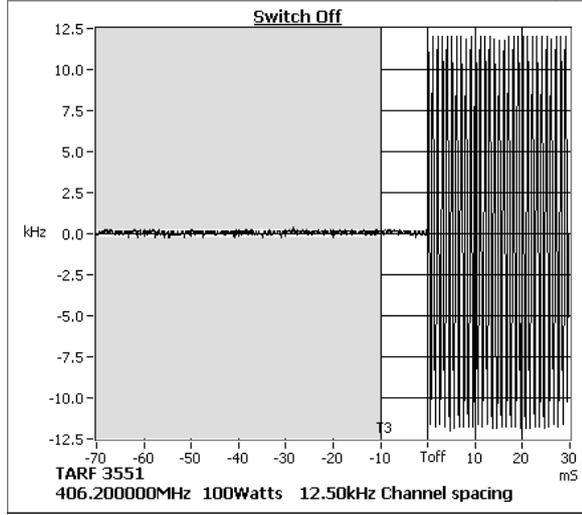
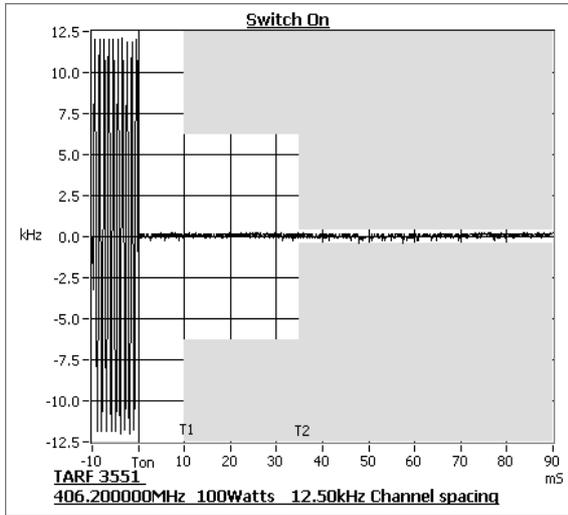
Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

RSS-119 5.9

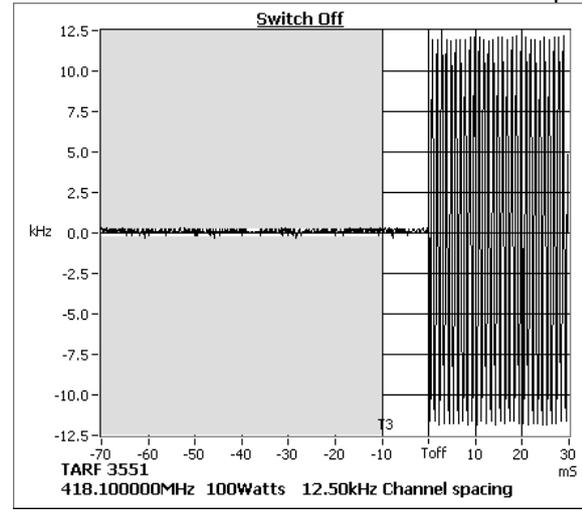
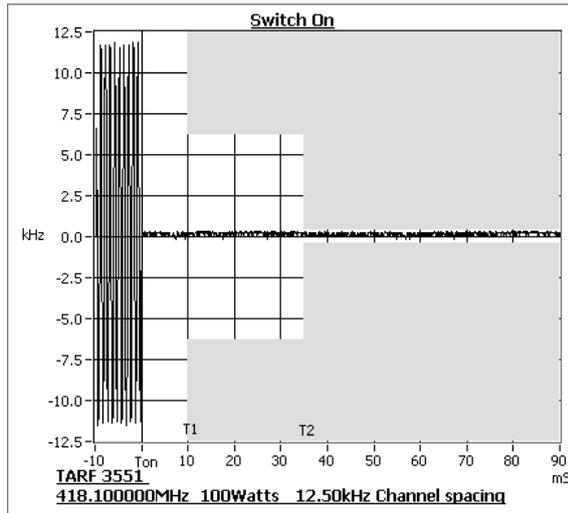
Tx FREQUENCY: 406.2 MHz

100 W 12.5 kHz Channel Spacing



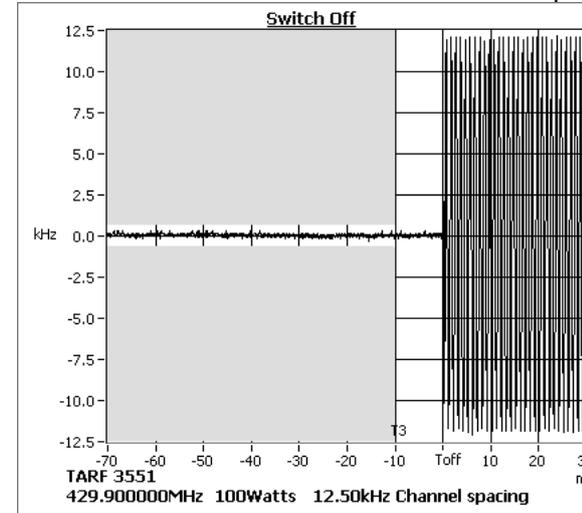
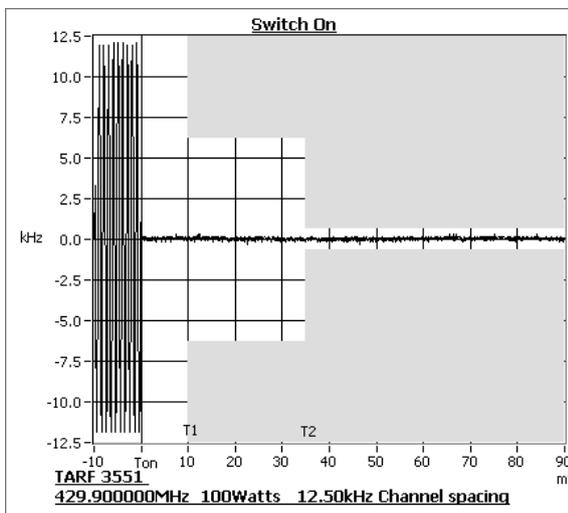
Tx FREQUENCY: 418.1 MHz

100 W 12.5 kHz Channel Spacing



Tx FREQUENCY: 429.9 MHz

100 W 12.5 kHz Channel Spacing



TRANSMITTER FREQUENCY STABILITY - TEMPERATURE

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

RSS-119 5.3

GUIDE: TIA-102.CAAA-C 2.2.2

MEASUREMENT PROCEDURE:

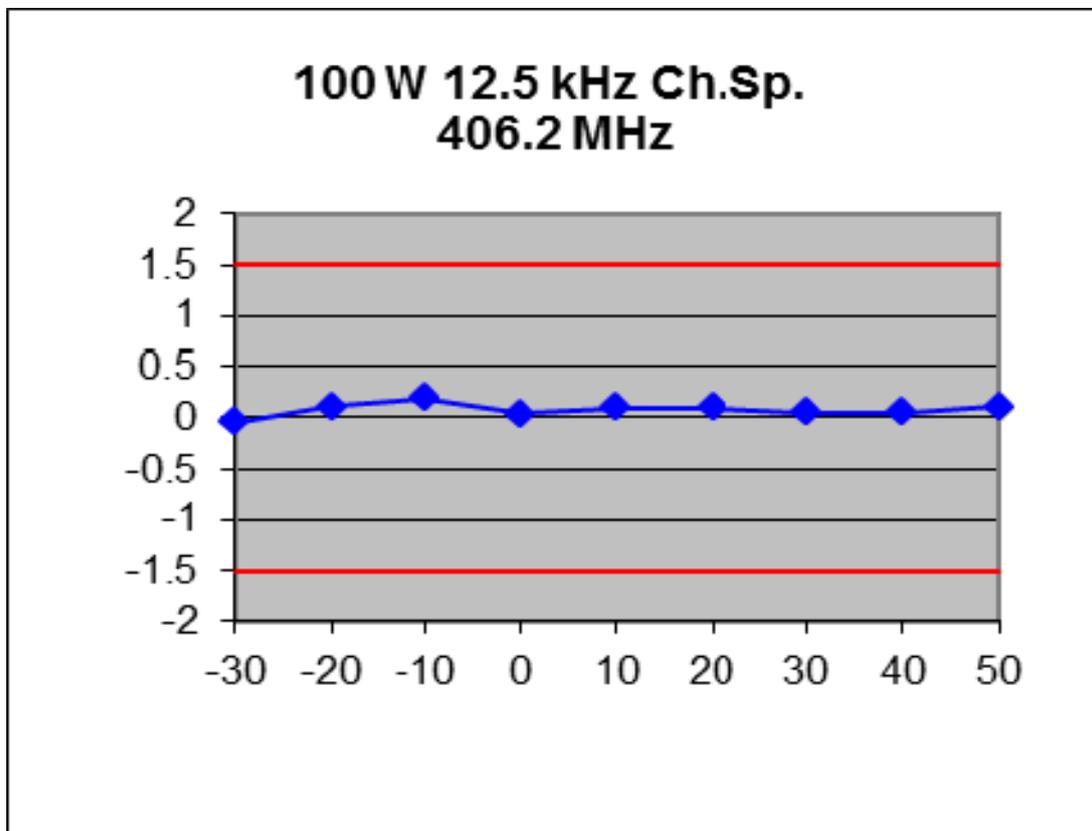
1. Refer Annex A for equipment set up.
2. The EUT was tested for frequency error from -30°C to $+50^{\circ}\text{C}$ in 10°C increments
3. The frequency error was recorded in parts per million (ppm).

MEASUREMENT RESULTS:

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

406.2 MHz

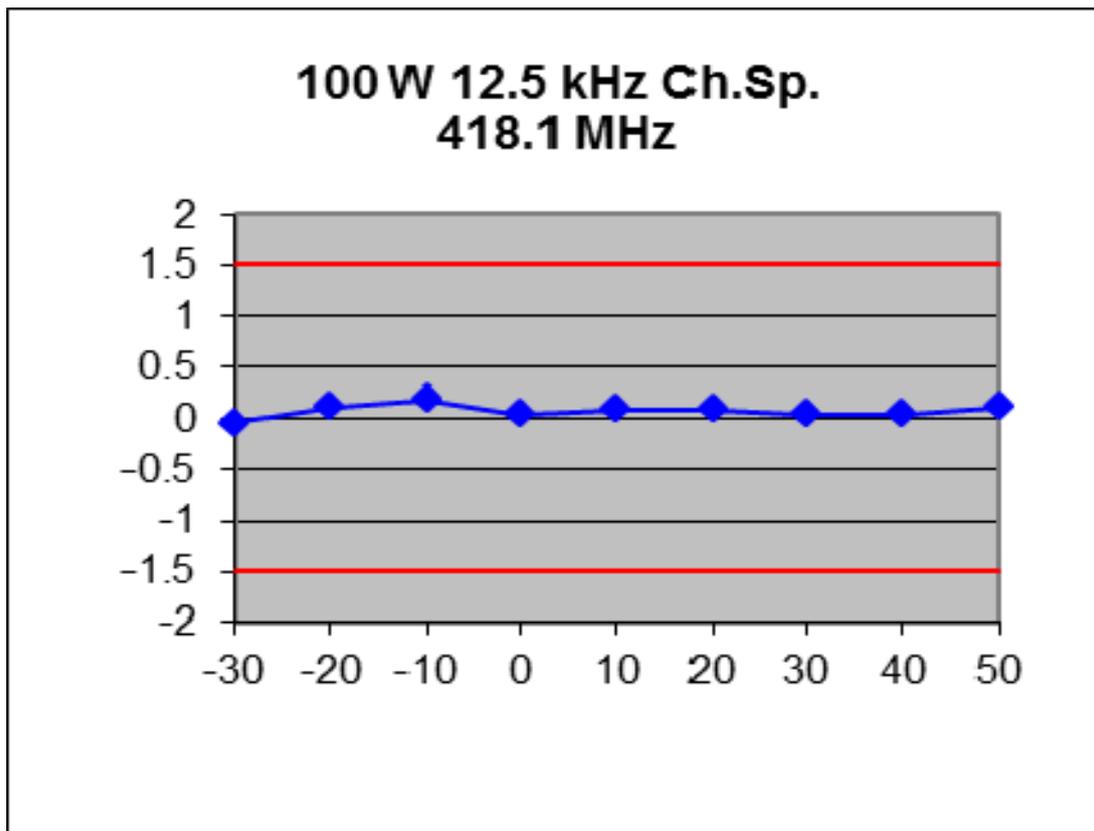
Temperature ($^{\circ}\text{C}$)	Frequency Error (Hz)	Frequency Error (ppm)
-30	-20	-0.05
-20	46	0.11
-10	76	0.19
0	14	0.03
10	36	0.09
20	37	0.09
30	17	0.04
40	17	0.04
50	45	0.11



Transmitter Frequency Stability - Temperature

418.1 MHz

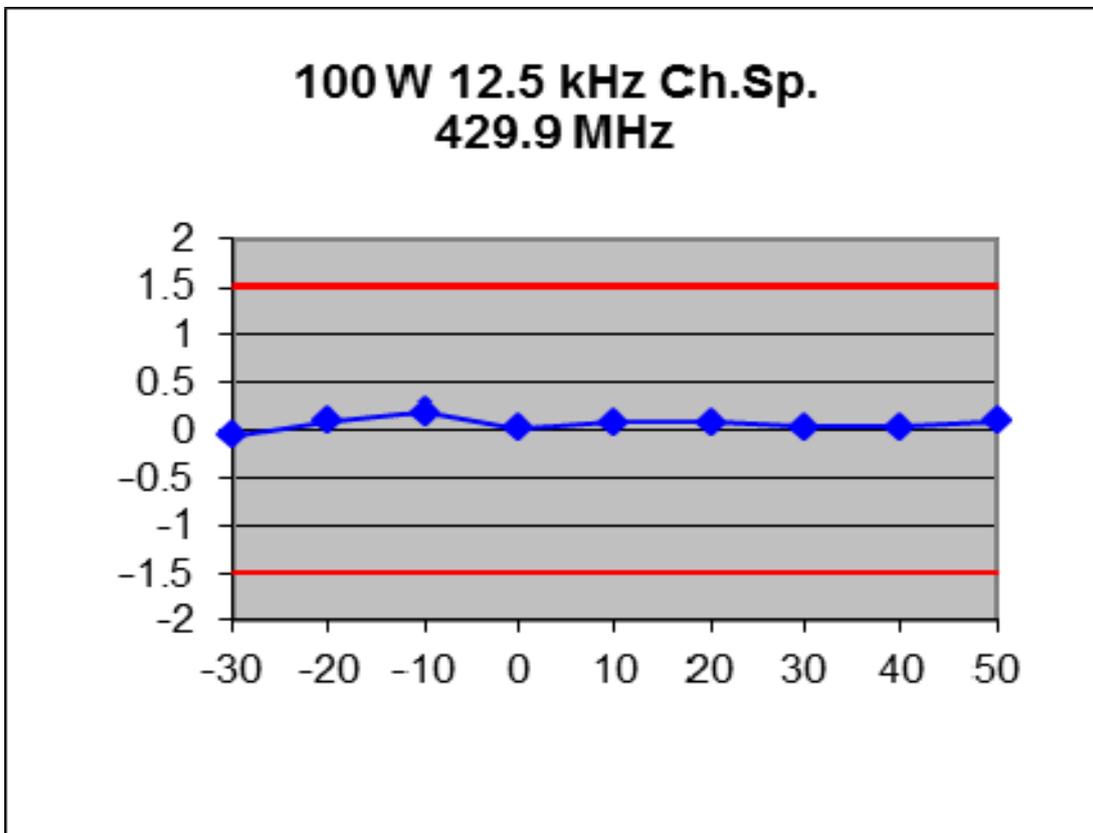
Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	-18	-0.04
-20	48	0.11
-10	80	0.19
0	15	0.04
10	36	0.09
20	38	0.09
30	18	0.04
40	17	0.04
50	49	0.12



Transmitter Frequency Stability - Temperature

429.9 MHz

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	-20	-0.05
-20	49	0.11
-10	81	0.19
0	14	0.03
10	38	0.09
20	40	0.09
30	19	0.04
40	18	0.04
50	49	0.11



LIMIT: FCC 47 CFR 90.213 RSS-119 5.3

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

TRANSMITTER FREQUENCY STABILITY - VOLTAGE

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

RSS-119 5.3

GUIDE: TIA-102.CAAA-C 2.2.2

MEASUREMENT PROCEDURE:

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

MEASUREMENT RESULTS:

Voltage	FREQUENCY ERROR (ppm) for 12.5 kHz		
	406.2 MHz	418.1 MHz	429.9 MHz
120 V _{DC}	0.00	0.01	0.02
102 V _{DC}	0.00	0.01	0.02
138 V _{DC}	0.00	0.01	0.02

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-102.CAAA-C 2.1.2

MEASUREMENT PROCEDURE:

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

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

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

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

LIMIT CLAUSE: RSS-Gen 6(b)

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

TRANSMITTER STANDBY SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: RSS-119 5.11

GUIDE: TIA-102.CAAA-C 2.1.2

MEASUREMENT PROCEDURE:

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

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

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

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

LIMIT CLAUSE: RSS-Gen 6(b)

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

TEST EQUIPMENT LIST

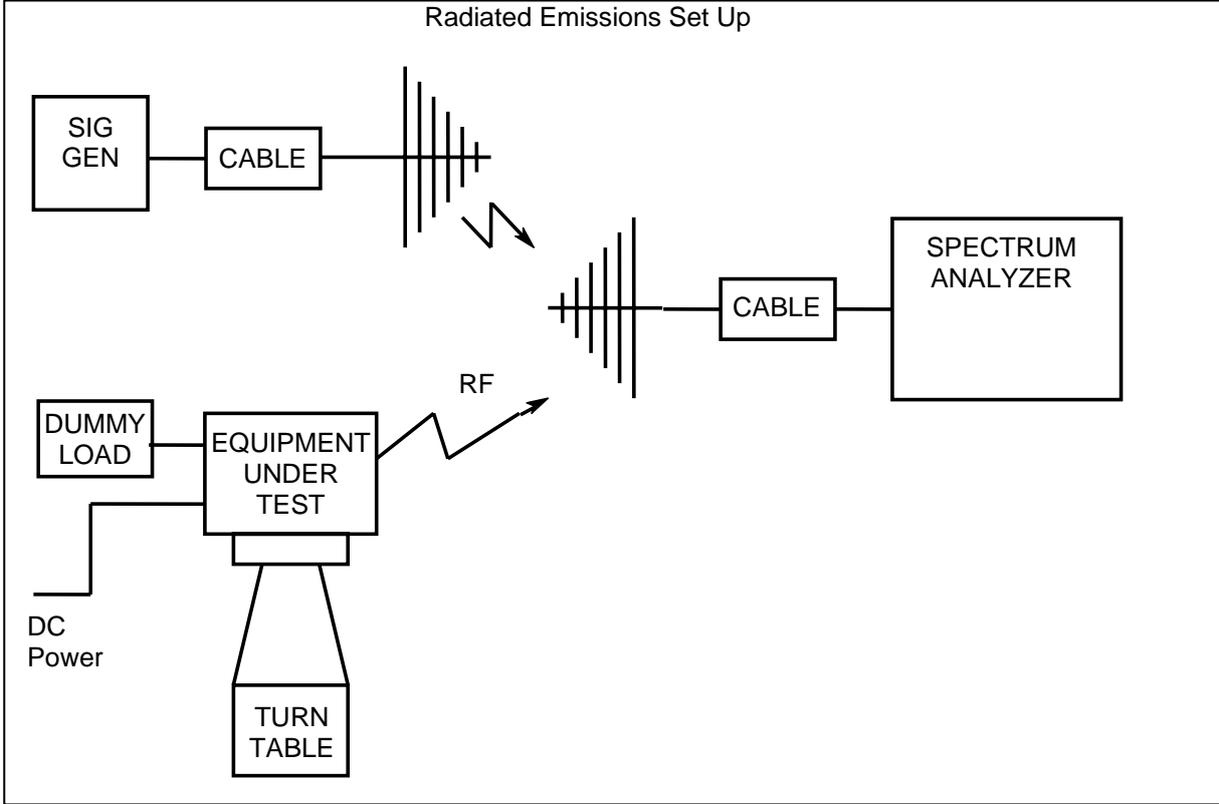
Equipment Type	Information	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
AC Voltmeter		Tait		2		8-Aug-14
Antenna	Reference Dipoles	Emco	3121C DB1	9510-1164	E3559	30-Jan-16
Antenna	Reverb - 1-18GHz DRG	Schwarzbeck	BBHA 9120 D	9120D-885	E4857	
Antenna	Reverb - 1-18GHz DRG	Schwarzbeck	BBHA 9120 D	9120D-884	E4858	
Antenna	18GHz DRG	Emco	DRG3115	9512-4638	E3560	6-Mar-16
Antenna	18GHz DRG	Emco	DRG3115	2084	E3076	6-Mar-16
Antenna	Log Periodic	Schwarzbeck	VUSLP	9111-219	E4147	
Antenna	Collapsible Biconical and Balun	Schwarzbeck	FBAB 9177,VHA 9103	9104-2459	E4616	5-Aug-16
Coax Cable	1m Blue	Suhner	Sucoflex 104A	44610/4A	E4619	16-Oct-14
Coax Cable	3m Blue	Suhner	Sucoflex 104A	44611/4A	E4620	16-Oct-14
Coax Cable	OATS Tower Cable	Intelcom	RG214	OATS1	E4621	13-Oct-14
Coax Cable	OATS Turntable Cable	Intelcom	RG215	OATS2	E4622	13-Oct-14
Coax Cable	Reverb - 2m Multiflex 141	TeltestBlue5	MF 141	TeltestBlue5	E4844	16-Oct-14
Coax Cable	Reverb - 1m Multiflex 141	TeltestBlue3	MF 141	TeltestBlue3	E4846	17-Oct-14
Coax Cable	Reverb - 1m Multiflex 141	TeltestBlue2	MF 141	TeltestBlue2	E4847	17-Oct-14
Environ. Chamber	Chest	Contherm	Chest	E3397	E3397	5-Aug-14
Field Strength Meter	10kHz 9.25GHz RF Field Probe	NARDA	EP601	401WX01247	E4856	21-Apr-16
LISN		Emco	3825/2	9204-1961	E3040	19-Oct-14
Modulation Analyser	TREVA2	Hewlett Packard	HP8901B (Opt 002)	3704A05837	E3786	19-Oct-14
Multimeter		Fluke	77	35069359	E3237	16-Oct-14
OATS	NSA	Tait				15-Apr-14
OATS	Antenna Tower	Electrometrics	EM-4720-2	112	E4447	
OATS	Controller	Electrometrics	EM-4700	119	E4445	
OATS	Turntable	Electrometrics	EM-4704A	105	E4446	
Oscilloscope	400MHz	Tektronics	TDS380	B017095	E3782	16-Oct-14
Power Meter	TREVA2 Power Head for HP8901	Hewlett Packard	HP11722A	2716A02037	1575	21-Oct-14
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	17-Oct-14
Power Supply	AC Variac	Yamabishi	S-260-5	TX-533	E1737	
RF Amplifier	+21.7 dB 1GHz	Tait	ZFL-1000LN	E3660	E3360	16-Jan-15
RF Amplifier	Pre-amplifier	Agilent	87405C	MY47010688	E4941	18-Oct-14
RF Attenuator	20dB 50W	Weinschel	24-20-44	AW1266	E3562	17-Oct-14
RF Attenuator	20dB 25W	Weinschel	33-20-33	BD5871	E3673	18-Oct-14
RF Attenuator	TREVA2 20dB 150W	Weinschel	40-20-33	CJ405	E3733	21-Oct-14
RF Attenuator	30dB 350W	Weinschel	67-30-33	BR0531	E4280	18-Oct-14
RF Attenuator	TREVA2 3dB	Weinschel	Model 1	BL9950	E4080	
RF Chamber	S-LINE TEM CELL	Rohde & Schwarz	1089.9296.02	338232/003	E3636	31-Aug-15
RF Chamber	Reverb - Stirrer controller for reverb chamber	Teseq	Stirrer Controller	29765.1	E4854	

TELTEST Laboratories
Tait Ltd
Report Number 3551

RF Chamber	Reverb - 0.5 - 18GHz Reverberation Chamber	Teseq	RVC XS	29765	E4855	
RF Combiner	TREVA2	Minicircuits	ZFSC-4-1	-	E4084	
RF Load	150W	Bird	8166	524	E3625	23-Oct-14
RF Load	2W	MCL	NTRM-50	954214	E3576	16-Jan-15
RF Load	2W	MCL	NTRM-50	02		16-Jan-15
Signal Generator	Analog 4GHz	Agilent	E4422B	GB40050320	E3788	8-May-14
Spectrum Analyser	26.5GHz	Agilent	PXA N9030A	MY49432161	E4907	30-Mar-14
Spectrum Analyser	13.2GHz	Hewlett Packard	HP8562E	3821A00779	E3715	18-Oct-14
Spectrum Analyser	13.2GHz	Agilent	E4445A	MY42510072	E4139	21-Nov-14
Temp & Humidity datalogger		Hobo	U21-011	10134275	E4980	8-Apr-14

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

ANNEX A – TEST SETUP DETAILS



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

