

# LABORATORY TEST REPORT

## RADIO PERFORMANCE MEASUREMENTS

for the

TBCH2B Base Station Transceiver

Tested in accordance with:

FCC 47 CFR Part 90

RSS-119 Issue 11  
RSS-Gen Issue 3

Report Revision:

1

Issue Date:

21 July 2014

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\_\_\_\_\_  
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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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## REVISION

Date	Revision	Comments
21 July 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 H2 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 TBCH2B  
Frequency range 440 → 480 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: TBCH2B

The TBCH2B Basestation Transceiver consists of:

<i>Module</i>	<i>Product Code</i>	<i>Serial Number</i>	<i>Firmware Version</i>	<i>Hardware Version</i>
Reciter	T01-01103-LAAA	18200037	P25-1.30.00.0007	00.11
Power Amplifier	T01-01121-LBAA	18199462	1.06.00.0001	0006
Power Management Unit	TBA30A0-0100	18195930	0316	0001
Front Panel	T01-01110-AAAA	18200463	1.06.00.0001	00.04

### TEST CONDITIONS

All testing was performed between 24 June → 4 July 2014, and under the following conditions:

Ambient temperature: 15°C → 30°C  
Relative Humidity: 20% → 75%  
Standard Test Voltage 120 V<sub>AC</sub>

## STATEMENT OF COMPLIANCE

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

Equipment:            Basestation Transceiver  
Type:                 TBCH2B  
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 FCC KDB 971168 D01 and RSS-Gen 4.6.1.

#### Digital Voice 12.5 kHz Channel Spacing

99% bandwidth	Emission Designator
≤ 8.1 kHz	8K10F1E
	F1E represents a digital FM voice transmission

#### Digital Data 12.5 kHz Channel Spacing

99% bandwidth	Emission Designator
≤ 8.1 kHz	8K10F1D
	F1D represents a digital FM data transmission

## Linear Simulcast Modulation (LSM):

Digital Voice/data transmissions use a 4 level frequency shift keying modulation scheme. The necessary bandwidth has been measured using the 99% energy rule, and in accordance with FCC KDB 971168 D01 and RSS-Gen 4.6.1.

### 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 W	450.1 MHz	459.9 MHz	469.9 MHz
Measured	92.2	94.0	97.8
Variation (%)	-7.8	-6.0	-2.2
Variation (dB)	-0.4	-0.3	-0.1
Nominal 10 W	450.1 MHz	459.9 MHz	469.9 MHz
Measured	9.1	9.5	9.9
Variation (%)	-8.8	-4.9	-1.5
Variation (dB)	-0.4	-0.2	-0.1
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)

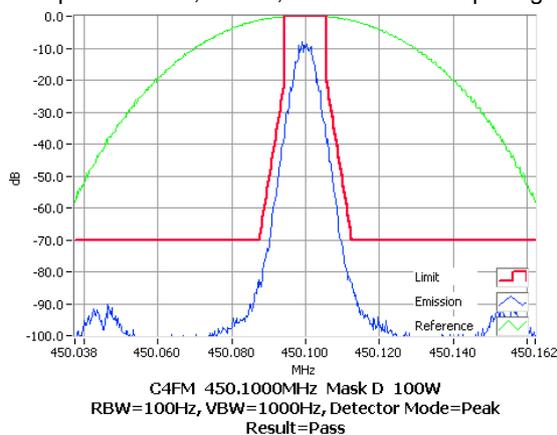
### Occupied Bandwidth and Spectrum Masks

**P25 Phase 1 C4FM**  
SPECIFICATION:

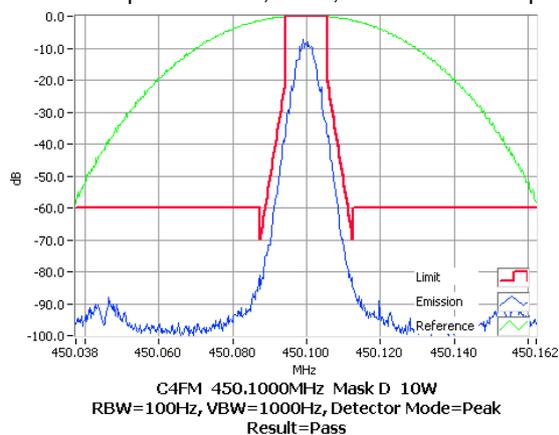
FCC CFR 2.1049 (c)

RSS-119 5.5

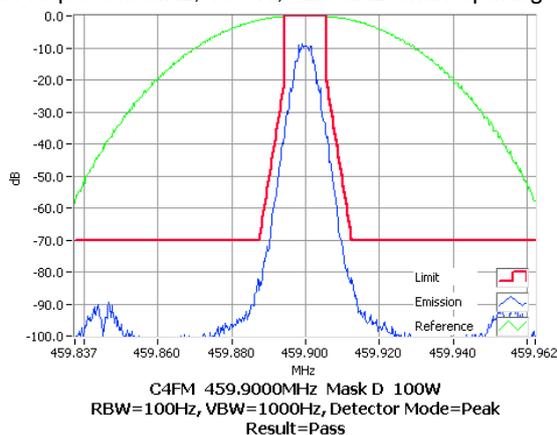
Tx Freq: 450.1 MHz, 100 W, 12.5 kHz Chan Spacing



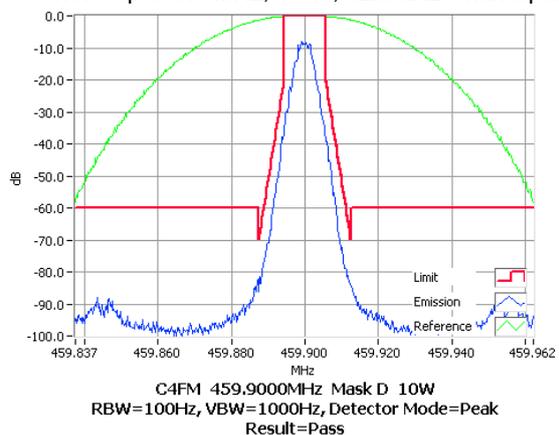
Tx Freq: 450.1 MHz, 10 W, 12.5 kHz Chan Spacing



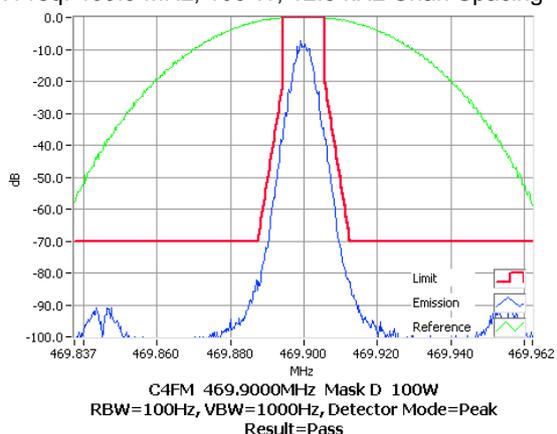
Tx Freq: 459.9 MHz, 100 W, 12.5 kHz Chan Spacing



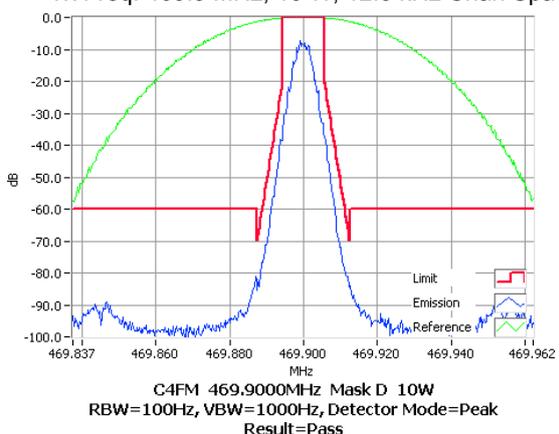
Tx Freq: 459.9 MHz, 10 W, 12.5 kHz Chan Spacing



Tx Freq: 469.9 MHz, 100 W, 12.5 kHz Chan Spacing



Tx Freq: 469.9 MHz, 10 W, 12.5 kHz Chan Spacing



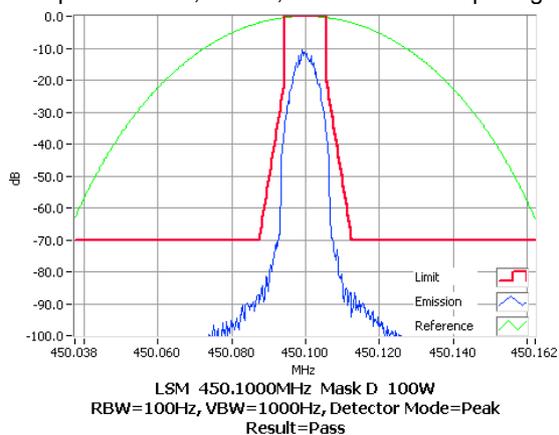
### Occupied Bandwidth and Spectrum Masks

**P25 Phase 1 LSM**  
SPECIFICATION:

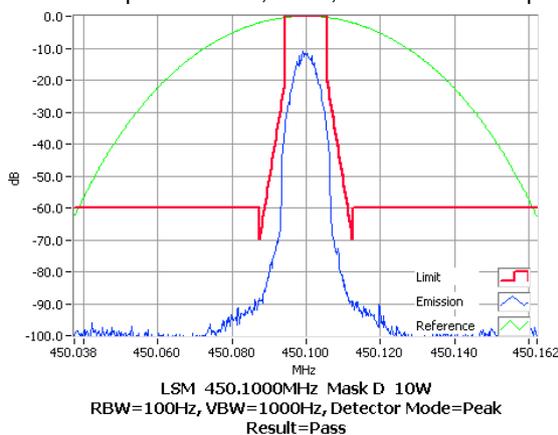
FCC CFR 2.1049 (c)

RSS-119 5.5

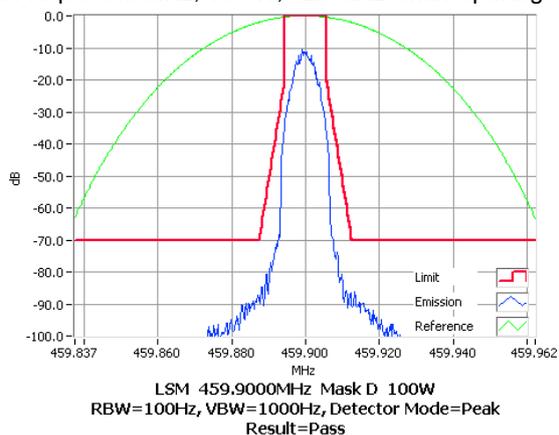
Tx Freq: 450.1 MHz, 100 W, 12.5 kHz Chan Spacing



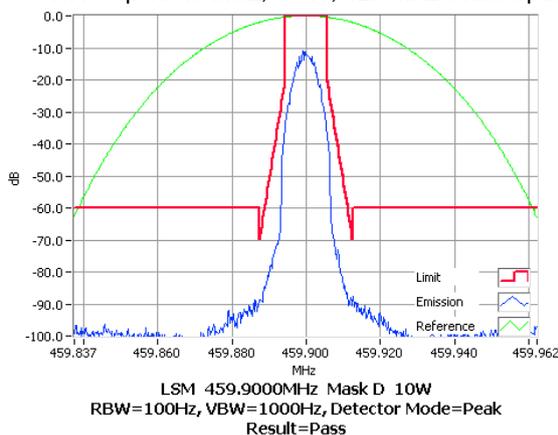
Tx Freq: 450.1 MHz, 10 W, 12.5 kHz Chan Spacing



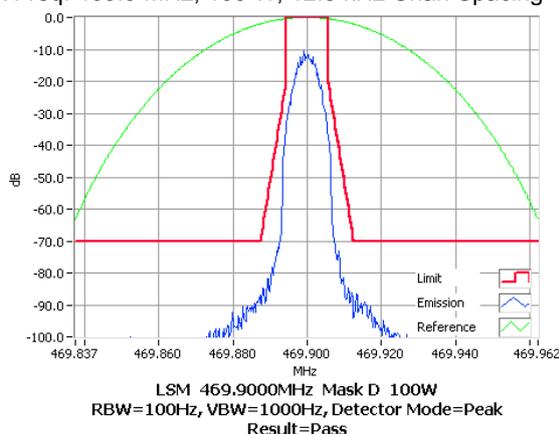
Tx Freq: 459.9 MHz, 100 W, 12.5 kHz Chan Spacing



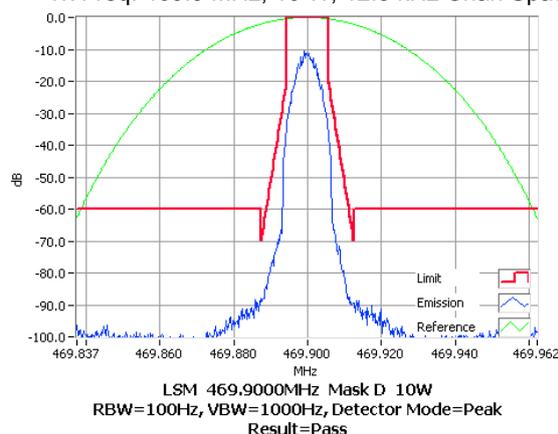
Tx Freq: 459.9 MHz, 10 W, 12.5 kHz Chan Spacing



Tx Freq: 469.9 MHz, 100 W, 12.5 kHz Chan Spacing



Tx Freq: 469.9 MHz, 10 W, 12.5 kHz Chan Spacing



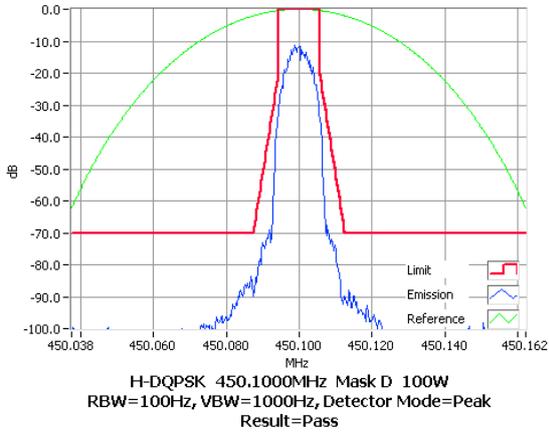
### Occupied Bandwidth and Spectrum Masks

**P25 Phase 2 H-DQPSK**  
SPECIFICATION:

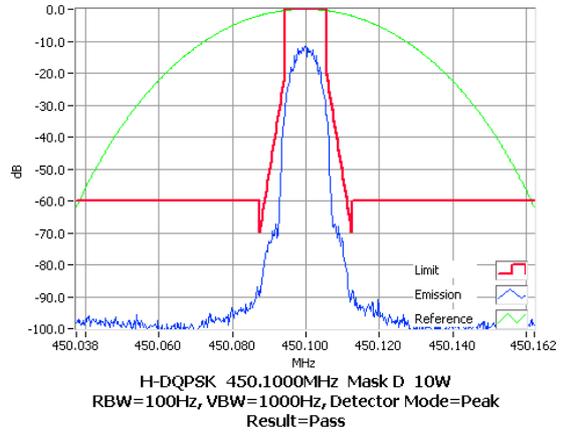
FCC CFR 2.1049 (c)

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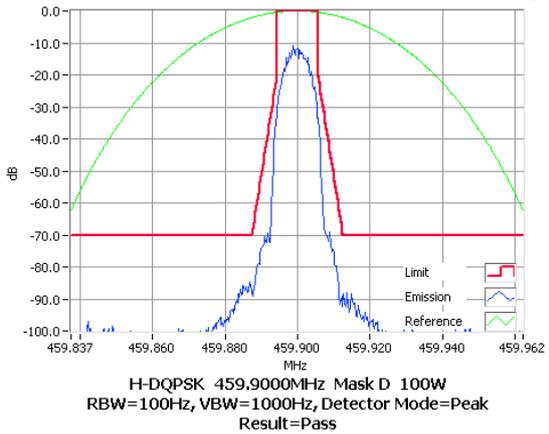
Tx Freq: 450.1 MHz, 100 W, 12.5 kHz Chan Spacing



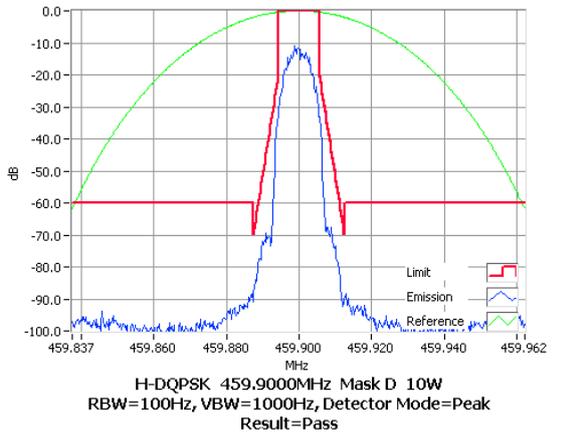
Tx Freq: 450.1 MHz, 10 W, 12.5 kHz Chan Spacing



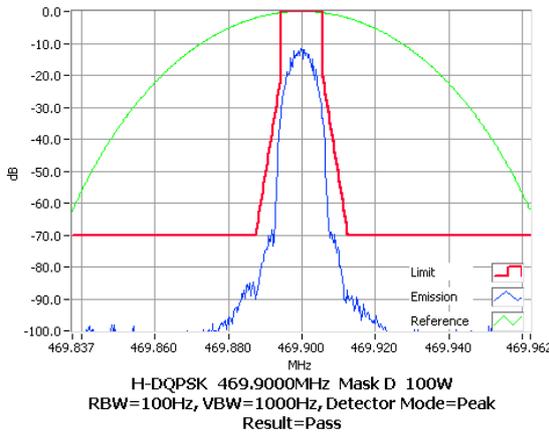
Tx Freq: 459.9 MHz, 100 W, 12.5 kHz Chan Spacing



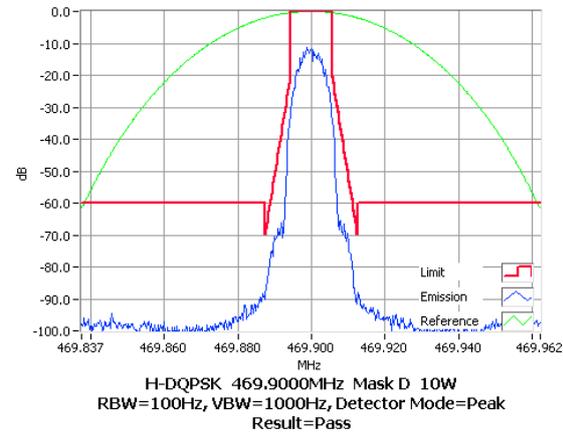
Tx Freq: 459.9 MHz, 10 W, 12.5 kHz Chan Spacing



Tx Freq: 469.9 MHz, 100 W, 12.5 kHz Chan Spacing



Tx Freq: 469.9 MHz, 10 W, 12.5 kHz Chan Spacing



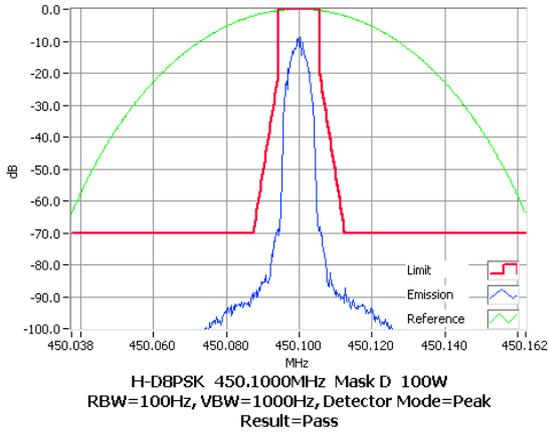
### Occupied Bandwidth and Spectrum Masks

**P25 Phase 2 H-D8PSK**  
SPECIFICATION:

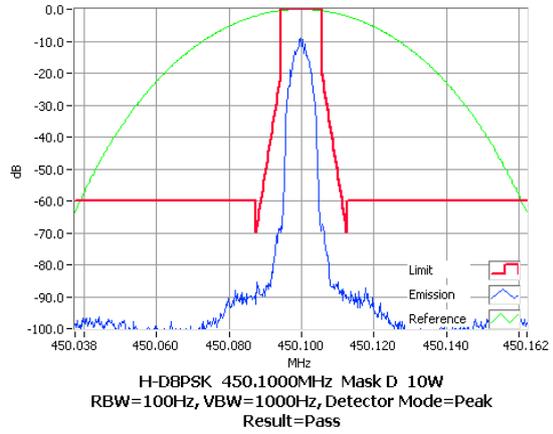
FCC CFR 2.1049 (c)

RSS-119 5.5

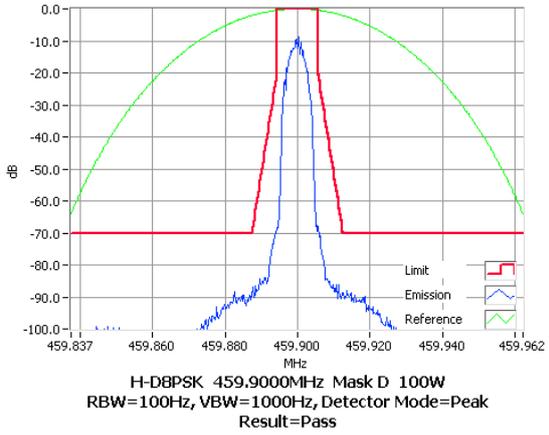
Tx Freq: 450.1 MHz, 100 W, 12.5 kHz Chan Spacing



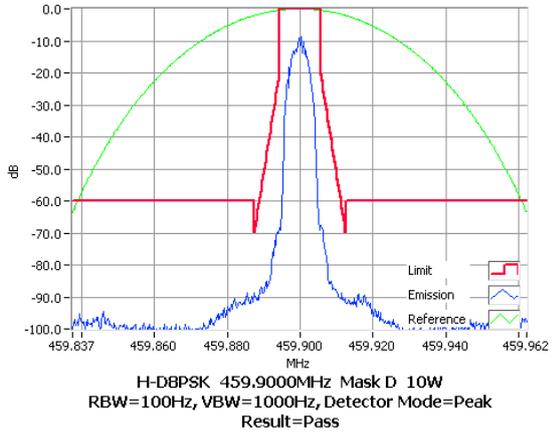
Tx Freq: 450.1 MHz, 10 W, 12.5 kHz Chan Spacing



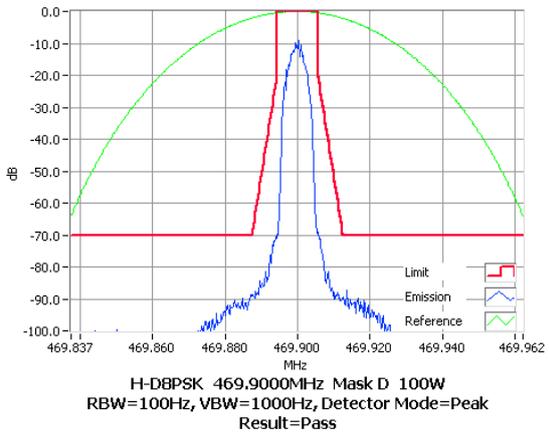
Tx Freq: 459.9 MHz, 100 W, 12.5 kHz Chan Spacing



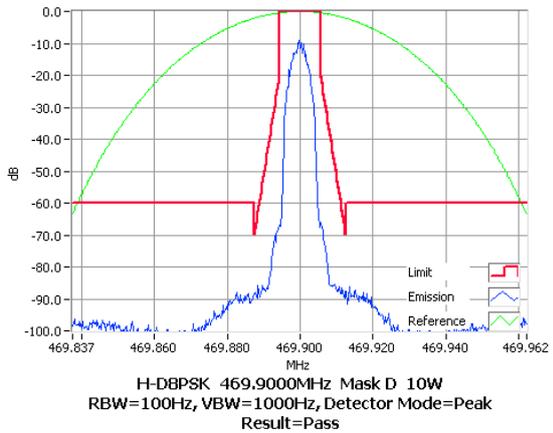
Tx Freq: 459.9 MHz, 10 W, 12.5 kHz Chan Spacing



Tx Freq: 469.9 MHz, 100 W, 12.5 kHz Chan Spacing



Tx Freq: 469.9 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 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.

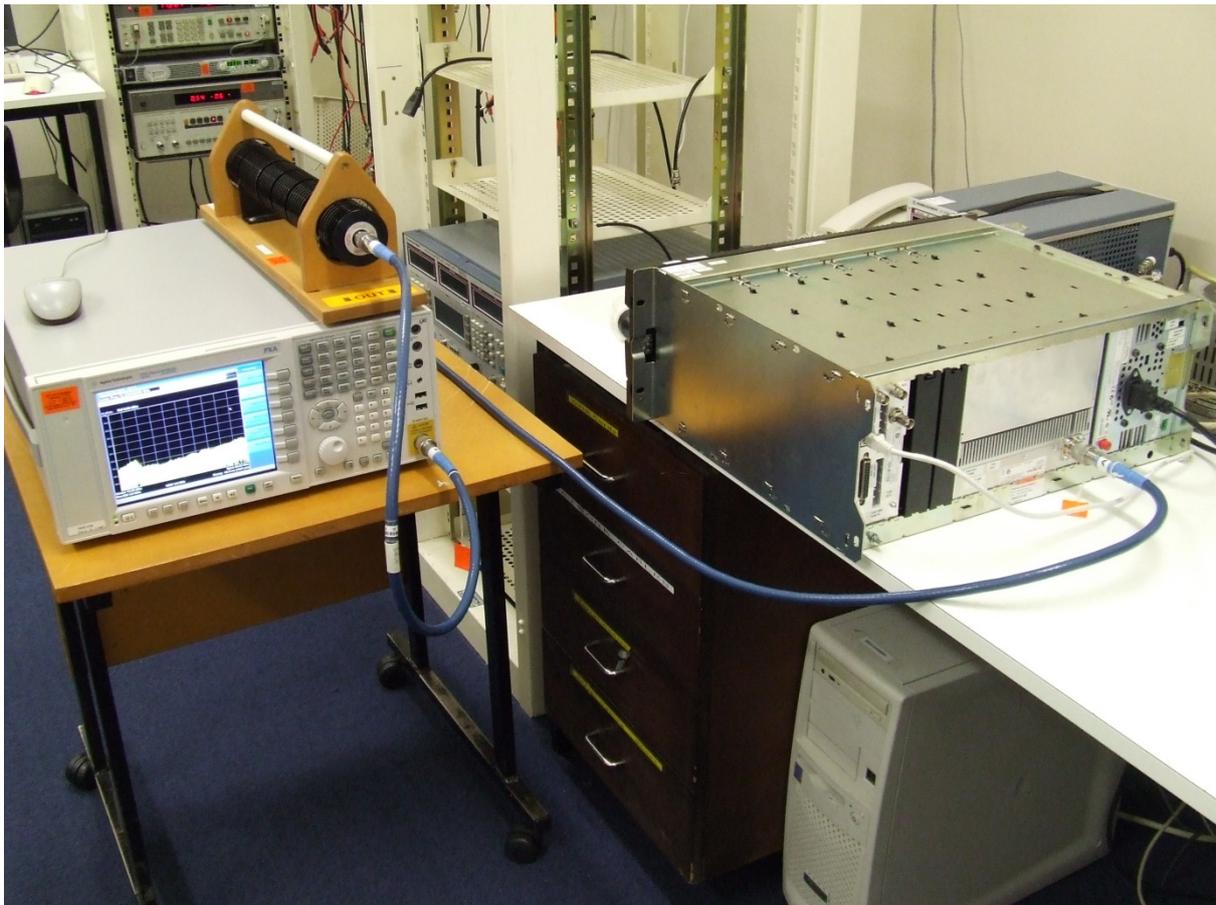
### MEASUREMENT RESULTS:

See the tables and plots on the following pages for 12.5 kHz channel 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: 450.1 MHz

12.5 kHz Channel Spacing

450.1 MHz @ 100 W

Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
2700.6001	-36.5	-86.5
3150.7002	-36.9	-86.9
~	~	~
No other emissions were detected at a level greater than 20 dB below the limit.		

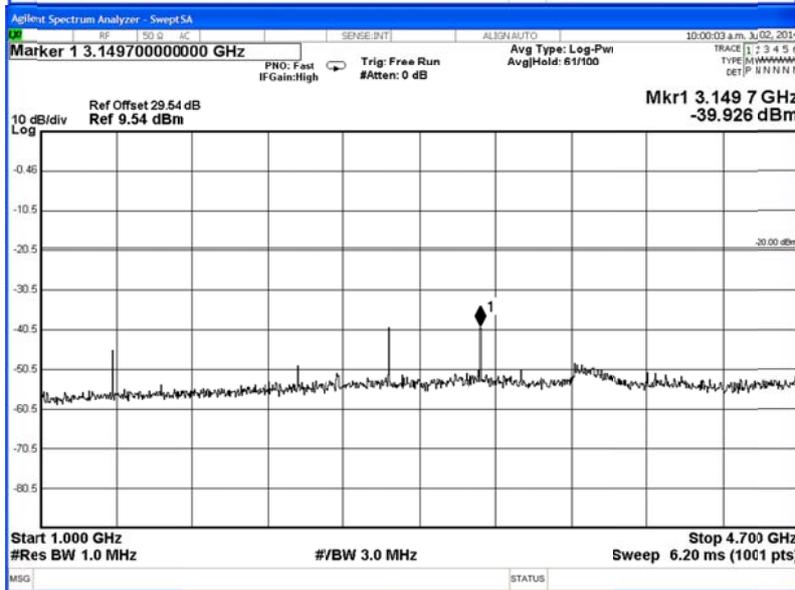
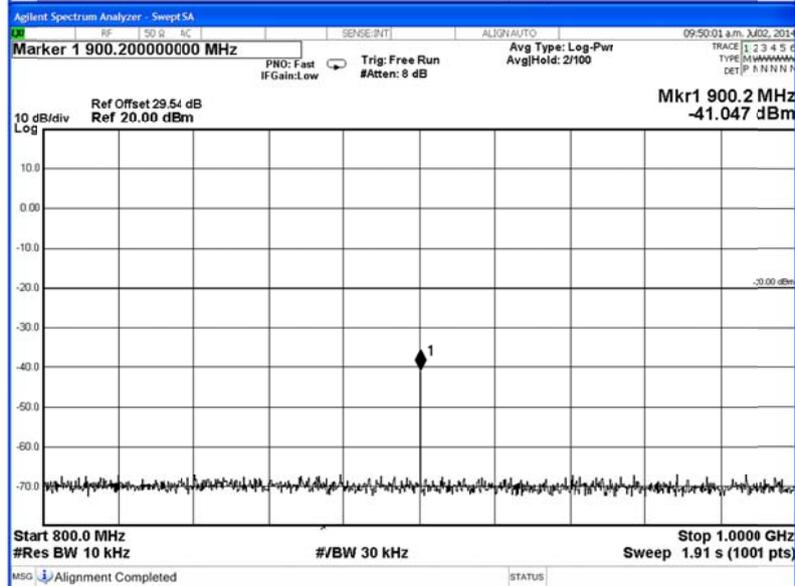
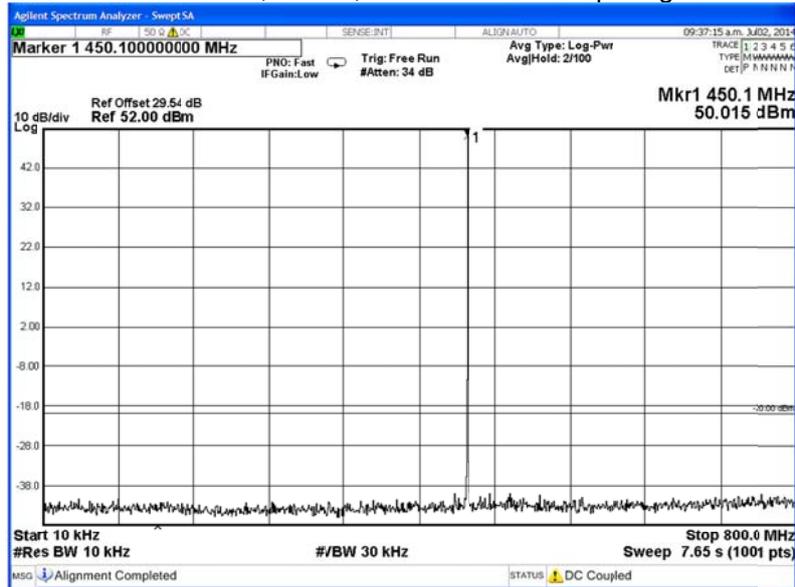
12.5 kHz Channel Spacing

450.1 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)  
450.1 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

459.9 MHz @ 100 W

Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
919.8000	-39.2	-89.2
2759.4001	-36.6	-86.6
3219.3002	-39.4	-89.4
~	~	~
No other emissions were detected at a level greater than 20 dB below the limit.		

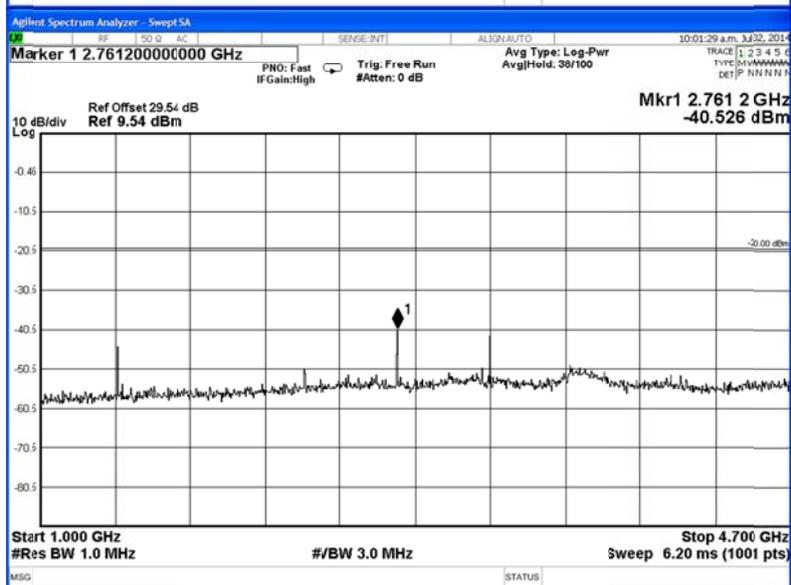
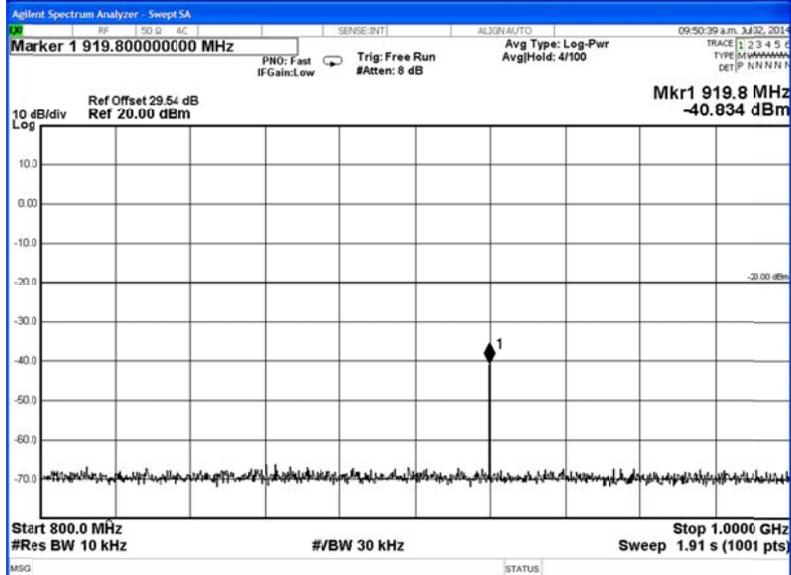
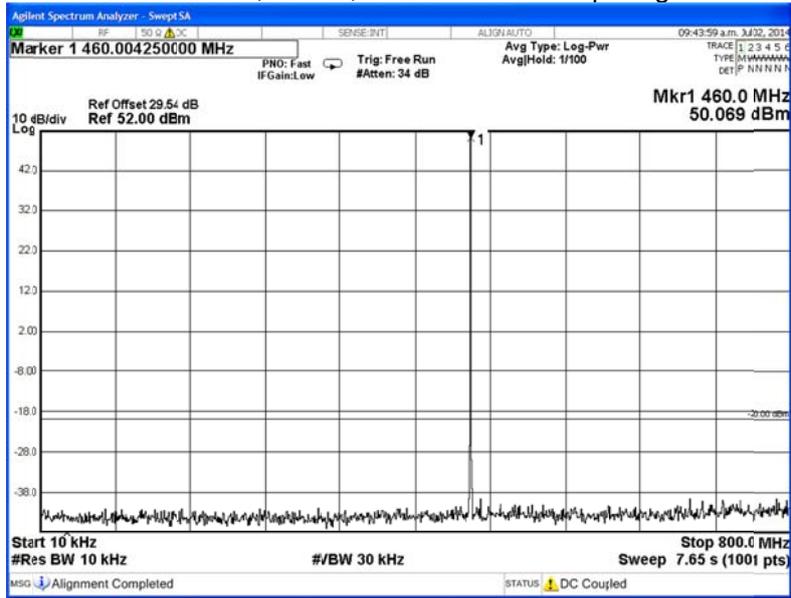
12.5 kHz Channel Spacing

459.9 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)  
459.9 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

469.9 MHz @ 100 W

Emission Mask D

Emission Frequency (MHz)	Level (dBm)	Level (dBc)
939.8000	-39.4	-89.4
2819.4001	-35.7	-85.7
~	~	~
No other emissions were detected at a level greater than 20 dB below the limit.		

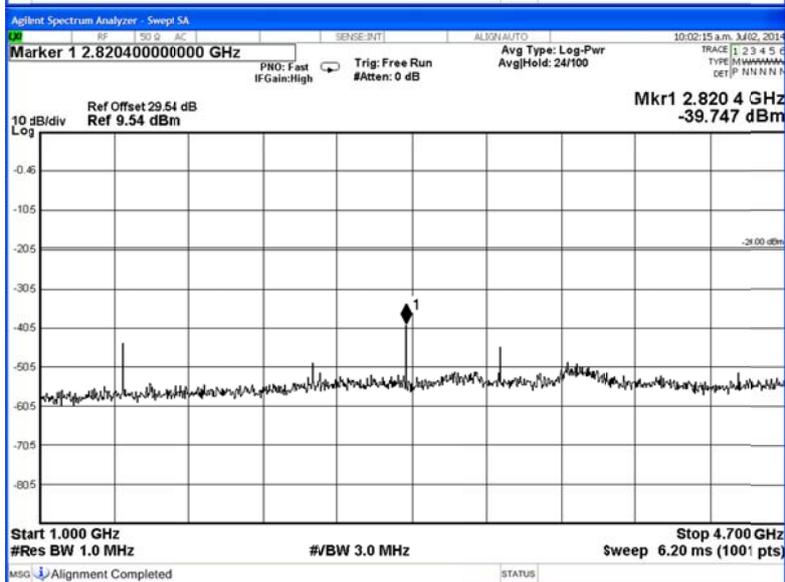
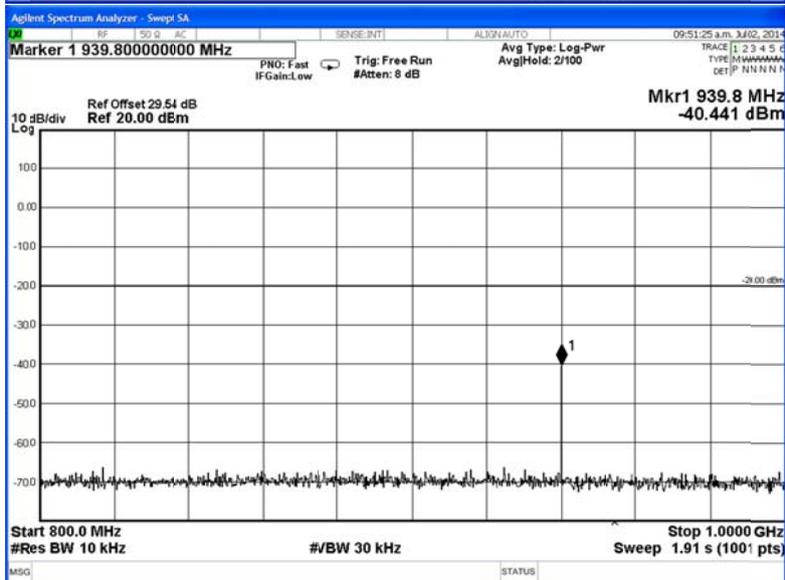
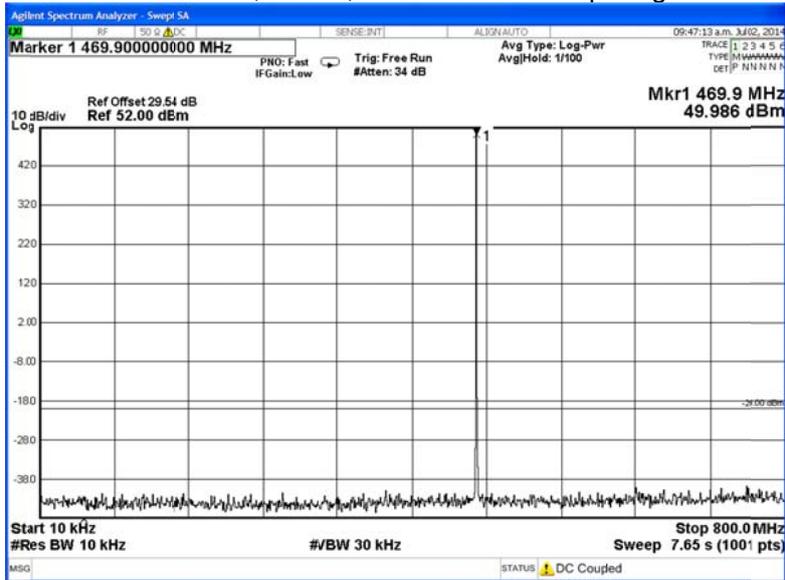
12.5 kHz Channel Spacing

469.9 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)  
469.9 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 10<sup>th</sup> 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 6<sup>th</sup> harmonic of the fundamental frequency are measured on the OATS

#### OATS Measurement:

1. The EUT is placed on a wooden turntable at a distance of three metres from the test antenna. The output terminal is connected to an RF dummy load.
2. The test antenna is raised from 1 m to 4 m to obtain a maximum reading; the turntable is then rotated through 360° to obtain the maximum response of each spurious emission. Valid emissions are determined by switching the EUT on and off.
3. The EUT is then replaced by a signal generator and substitution antenna to make measurements by the substitution method.

### MEASUREMENT RESULTS:

See the tables on the following pages

LIMIT CLAUSE: FCC 47 CFR 90.210

Spurious Emissions (Tx Radiated)

SPECIFICATION: FCC CFR 2.1053

Tx FREQUENCY: 450.1 MHz

12.5 kHz Channel Spacing                      450.1 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                      450.1 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                      459.9 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                      459.9 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.		

12.5 kHz Channel Spacing                      469.9 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                      469.9 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 $50 + 10 \log_{10}(P_{\text{Watts}})$	
100 W	-20 dBm	-70 dBc
10 W	-20 dBm	-60 dBc

Open Area Test Site Results:

12.5 kHz Channel Spacing                      459.9 MHz @ 100 W                      Emission Mask D

Harmonics Emission Frequency (MHz)	Level (dBm)	Level (dBc)
919.8	-64.5	-114.5
1379.7	-64.2	-114.2
1839.6	-48.9	-98.9
2299.5	-72.6	-122.6
2759.4	-48.2	-98.2
3219.3	-57.7	-107.7

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: 450.1 MHz

100 W

12.5 kHz Channel Spacing

450.1 MHz @ 100 W Tx

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	-0.4	N/A
t2	0.2	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 checked="" type="checkbox"/>	<input type="checkbox"/>
Confirm that during the period t2 the frequency difference does not exceed half a channel separation.	YES	NO
	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.	YES	NO
	<input checked="" type="checkbox"/>	<input type="checkbox"/>

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: 459.9 MHz

100 W

12.5 kHz Channel Spacing

459.9 MHz @ 100 W Tx

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	-0.7	N/A
t2	0.3	N/A
t3	N/A	-0.5

Confirm that during periods t1 and t3 the frequency difference does not exceed the value of one channel separation.	YES	NO
	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Confirm that during the period t2 the frequency difference does not exceed half a channel separation.	YES	NO
	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.	YES	NO
	<input checked="" type="checkbox"/>	<input type="checkbox"/>

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: 469.9 MHz

100 W

12.5 kHz Channel Spacing

469.9 MHz @ 100 W Tx

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	0.8	N/A
t2	0.3	N/A
t3	N/A	0.3

Confirm that during periods t1 and t3 the frequency difference does not exceed the value of one channel separation.	YES	NO
	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Confirm that during the period t2 the frequency difference does not exceed half a channel separation.	YES	NO
	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.	YES	NO
	<input checked="" type="checkbox"/>	<input type="checkbox"/>

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

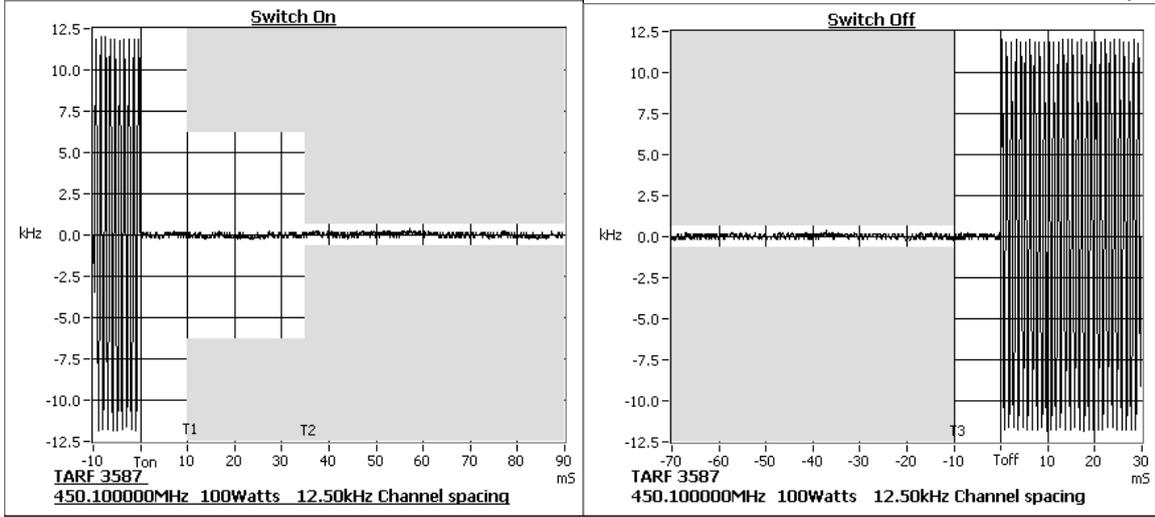
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

### Transient Frequency Behaviour

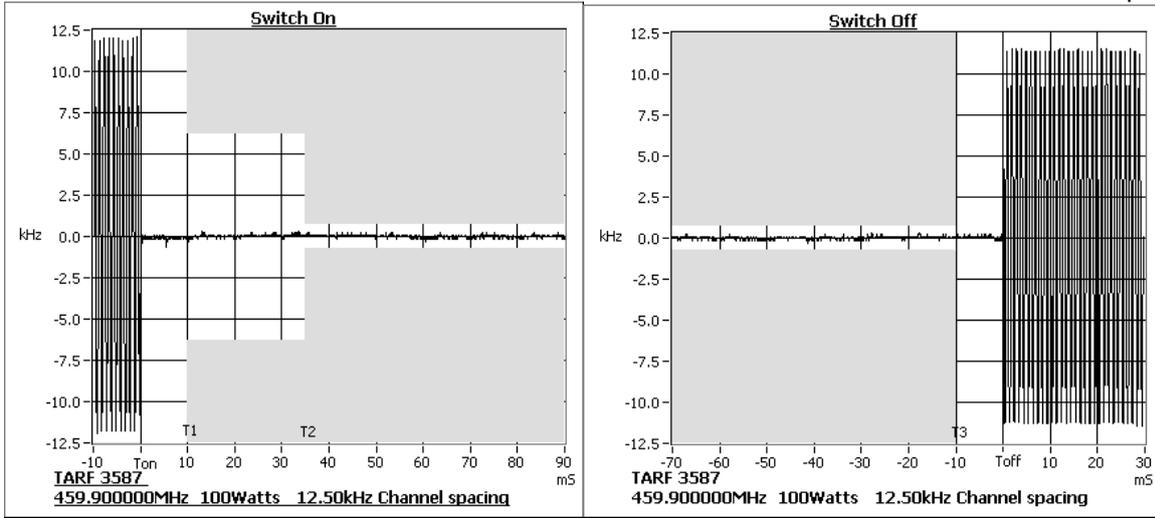
SPECIFICATION: FCC 47 CFR 90.214

RSS-119 5.9

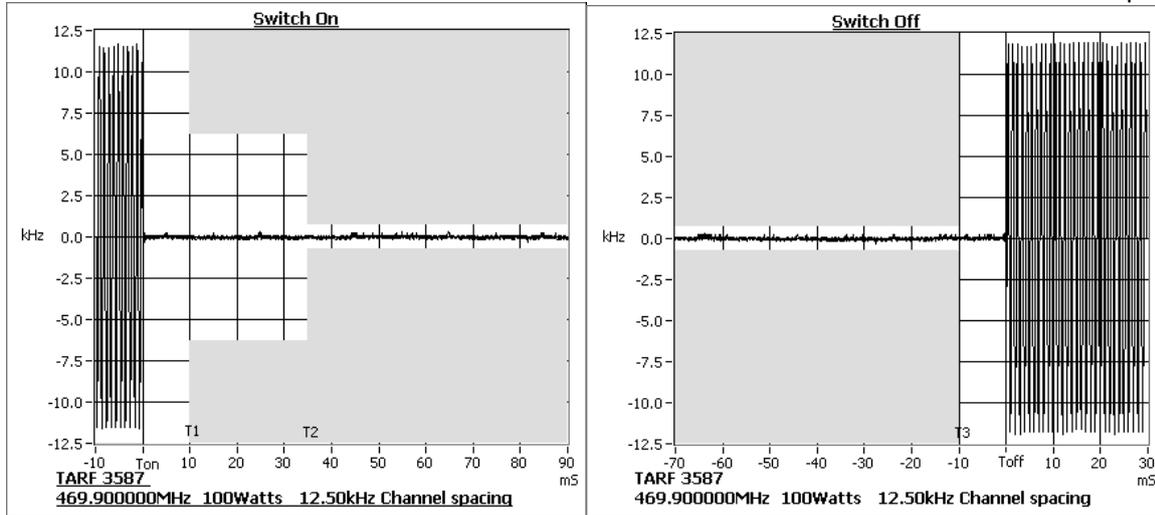
Tx FREQUENCY: 450.1 MHz 100 W 12.5 kHz Channel Spacing



Tx FREQUENCY: 459.9 MHz 100 W 12.5 kHz Channel Spacing



Tx FREQUENCY: 469.9 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° C in 10° C increments
3. The frequency error was recorded in parts per million (ppm).

MEASUREMENT RESULTS:

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

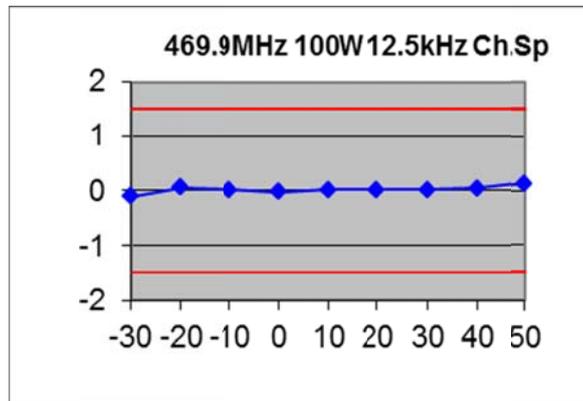
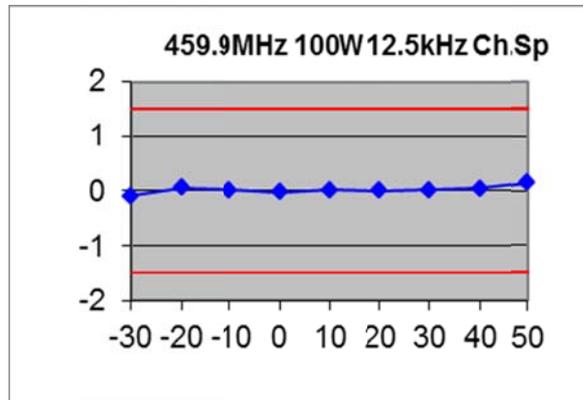
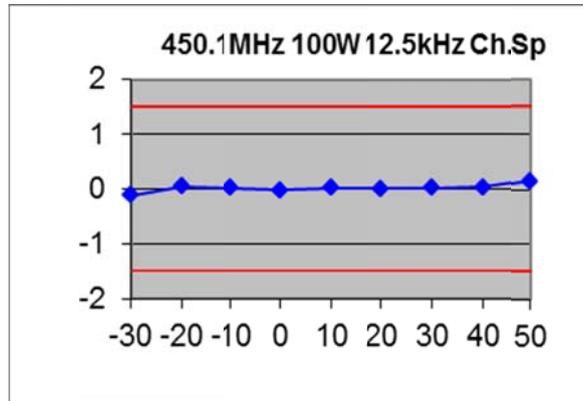
Temperature (°C)	Frequency Error (ppm)		
	450.1 MHz	459.9 MHz	469.9 MHz
-30	-0.12	-0.10	-0.11
-20	0.04	0.05	0.05
-10	0.02	0.02	0.02
0	-0.02	-0.02	-0.02
10	0.01	0.02	0.01
20	0.00	0.00	0.01
30	0.02	0.02	0.02
40	0.03	0.04	0.04
50	0.16	0.16	0.15

LIMIT: FCC 47 CFR 90.213

RSS-119 5.3

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

Transmitter Frequency Stability - Temperature



TRANSMITTER FREQUENCY STABILITY - VOLTAGE

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

RSS-119 5.3

GUIDE: TIA-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		
	450.1 MHz	459.9 MHz	469.9 MHz
120 V <sub>DC</sub>	-0.06	-0.05	-0.04
102 V <sub>DC</sub>	-0.06	-0.05	-0.03
138 V <sub>DC</sub>	-0.05	-0.05	-0.03

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.

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

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

469.9 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

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.

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

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

469.9 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

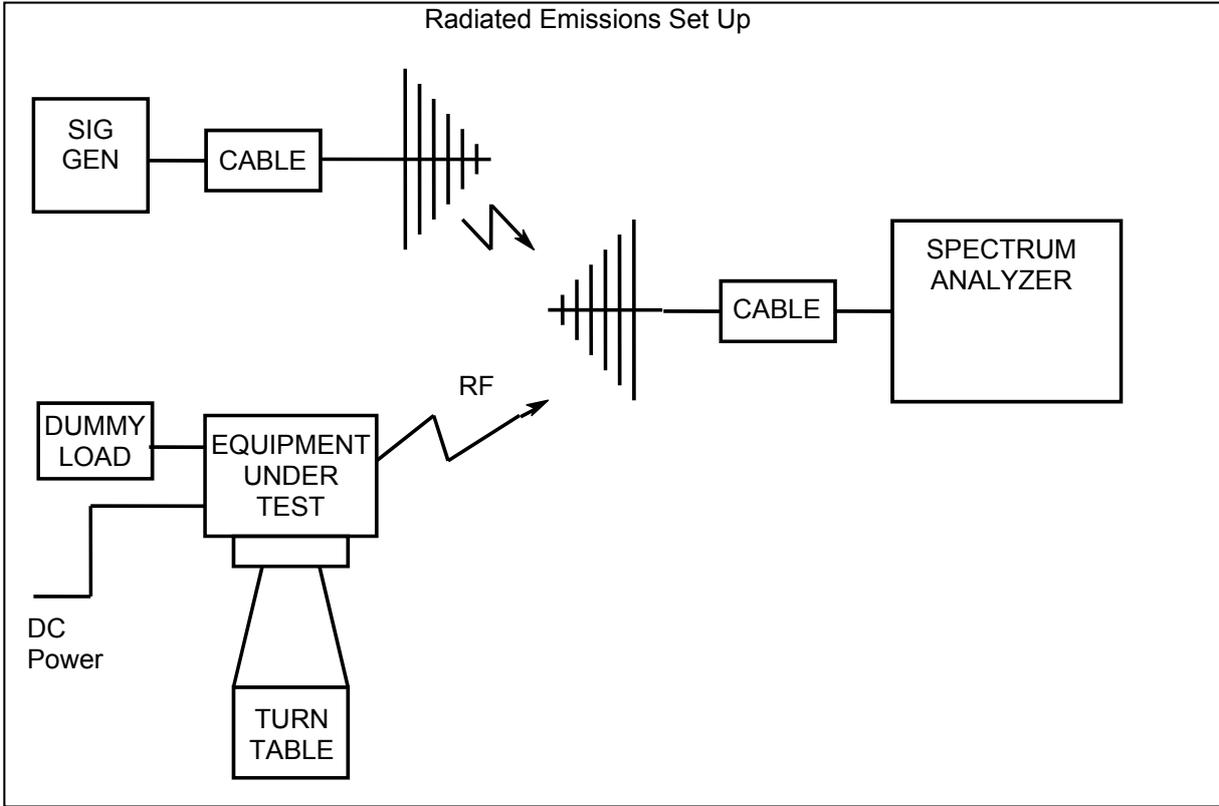
Equipment Type	Information	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
AC Voltmeter		Tait		1		8-Aug-14
Antenna	Reference Dipoles	Emco	3121C DB1	9510-1164	E3559	30-Jan-16
Antenna	18GHz DRG	Emco	DRG3115	9512-4638	E3560	6-Mar-16
Antenna	18GHz DRG	Emco	DRG3115	2084	E3076	6-Mar-16
Antenna	Log Periodic	Schwarzbeck	VUSLP	9111-219	E4147	
Antenna	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	1m Blue	Suhner	Sucoflex 104A	44610/4A	E4619	16-Oct-14
Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack2	E4623	15-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	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack5	E4850	15-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	Upright	Contherm	5400 RHSLT.M	1416	E4051	2-Aug-15
Field Strength Meter	10kHz 9.25GHz RF Field Probe	NARDA	EP601	401WX01247	E4856	21-Apr-16
ISN		Rohde & Schwarz	ENY41	100136	E4277	
LISN		Emco	3825/2	9204-1961	E3040	19-Oct-14
Modulation Analyser	TREVA1	Hewlett Packard	HP8901B (Opt 002)	2441A00393	E3073	19-Oct-14
Multimeter		Fluke	77	35069359	E3237	16-Oct-14
OATS	NSA	Tait				4-Jun-15
OATS	Antenna Tower	Electrometrics	EM-4720-2	112	E4447	
OATS	Controller	Electrometrics	EM-4700	119	E4445	
OATS	Turntable	Electrometrics	EM-4704A	105	E4446	
Oscilloscope	100MHz Digital	Tektronics	TDS340	B013611	E3585	16-Oct-14
Power Meter	TREVA1 Power Head for HP8901	Hewlett Packard	HP11722A	3111A05573	E7054	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	30dB 250W	Weinschel	45-30-34	JW663	E3386	18-Oct-14
RF Attenuator	TREVA1 20dB 150W	Weinschel	40-20-33	QT968	E4842	17-Oct-14
RF Attenuator	10dB 50W	Weinschel	24-10-34	AZ0401	E3388	17-Oct-14
RF Attenuator	20dB 50W	Weinschel	24-20-44	AW1266	E3562	17-Oct-14
RF Attenuator	TREVA1 3dB	Weinschel	Model 1	BL9958	E4081	
RF Chamber	S-LINE TEM CELL	Rohde & Schwarz	1089.9296.02	338232/003	E3636	31-Aug-15

TELTEST Laboratories  
Tait Ltd  
Report Number 3587

Equipment Type	Information	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
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	TREVA1	Minicircuits	ZFSC-4-1	-	E4083	
RF Load	150W	Bird	8166	524	E3625	23-Oct-14
RF Load	2W	MCL	NTRM-50	951215	E3574	16-Jan-15
RF Load	2W	MCL	NTRM-50	954214	E3576	16-Jan-15
Signal Generator	Analog 4GHz	Agilent	E4422B	GB40050320	E3788	20-Oct-14
Spectrum Analyser	26.5GHz	Agilent	PXA N9030A	MY49432161	E4907	6-Jul-16
Spectrum Analyser	13.2GHz	Agilent	E4445A	MY42510072	E4139	21-Nov-14
Temp & Humidity datalogger		Hobo	U21-011	10134275	E4980	30-Jun-15
Temp & Humidity datalogger		Hobo	U21-011	10134276	E4981	30-Jun-15
TREVA 1		Teltest	-	1	-	21-Oct-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 **EVAL**uation system (TREVA), which is configured as shown below. The Spectrum Analyser is connected to the EUT via the attenuator network for Conducted Emissions testing, and Occupied Bandwidth.

