

LABORATORY TEST REPORT

RADIO PERFORMANCE MEASUREMENTS

for the

TPDB1A Handportable Transceiver

Tested in accordance with:

FCC 47 CFR Parts 22, 74 and 90

RSS-119 Issue 11

RSS-Gen Issue 3

Report Revision: 1

Issue Date: 11-January-2013

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Test Technician

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Laboratory Manager



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REVISION

Date	Revision	Comments
11-January-2013	1	Initial test report

INTRODUCTION

This report demonstrates that the TPDB1A handportable transceiver complies with FCC 47 Parts 22, 74 & 90, and RSS-119 Issue 11 & RSS-Gen Issue 3. This radio supports analog, digital FFSK, P25 phase-1, P25 phase-2, and Digital Mobile Radio modulations:					
Modulation		Channel Spacing	Speech Channels	Symbol Rate (symbols/sec)	Data Rate (bps)
Analogue FM		12.5 kHz	1	-	-
FFSK	Fast Frequency Shift Keying	12.5 kHz	-	1200	1200
		12.5 kHz	-	2400	2400
Digital Mobile Radio (DMR)	4 Level FSK (2 slot TDMA) (ETSI TS102 361-1)	12.5 kHz	2	4800	9600
APCO P25 Phase 1	C4FM (TIA 102)	12.5 kHz	1	4800	9600
APCO P25 Phase 2	H-CPM (2 slot TDMA) (TIA 102)	12.5 kHz	2	6000	12000

Type Approval Testing of the T03-00043-BJDG
Serial number 25385974
Frequency range 136 → 174 MHz

in accordance with:
FCC 47 CFR Parts 22, 74 and 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: Handportable Transceiver
Type: TPDB1A
Product Code: T03-00043-BJDG
Serial Number(s): 25385974
Quantity: 1

HARDWARE & SOFTWARE

	DMR	P25 phase 1
Hardware ID	TPDB1X-B100_0006	TPDB1X-B100_0006
Boot Code	QPD1B_S00_2.18.00.0003	QPD1B_S00_2.18.00.0003
DSP	QPD1A_E01ML_0.14.00.0382	QPD1A_A01ML_0.08.00.0382
Radio Application	QPD1F_E00ML_0.14.00.0382	QPD1F_A00ML_0.08.00.0382
FPGA Image	QPD1G_D07_0.56.00.0001	QPD1G_D07_0.56.00.0001

	P25 phase 2
Hardware ID	TPDB1X-B100_0006
Boot Code	QPD1B_S00_3.00.01.0003
DSP	QPD1A_E00ML_1.01.00.1029.SMEC
Radio Application	QPD1F_E00_0.14.00.0001
FPGA Image	QPD1G_S00_1.00.02.0001_P2.a

TEST CONDITIONS

All testing was performed between 26th September → 6th October 2012, and 11 January 2013 and under the following conditions:

Ambient temperature: 15°C → 30°C
Relative Humidity: 20% → 75%
Standard Test Voltage 7.5 V_{DC}

DECLARATION OF CONFORMITY

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

Equipment: Handportable Transceiver
Type: TPDB1A
Product Code: T03-00043-BJDG
Serial Number(s): 25385974
Quantity: 1

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

FCC 47 CFR Parts 22, 74 and 90

RSS-119 Issue 11 & RSS-Gen Issue 3

Signature : _____

S.A. Crompton
Compliance Laboratory Manager

Date : _____

MODULATION TYPES, NECESSARY BANDWIDTH, and EMISSION DESIGNATORS

MODULATION TYPES:

F3E	Analog FM		
F2D	FFSK	1200 bps	2400 bps
FXD	Digital	9600 bps	
FXW	Digital Voice / Data	9600 bps	
F1W	Digital Voice / Data	12000 bps	

CHANNEL SPACINGS: 12.5 kHz

EMISSION DESIGNATORS:

Analog FM	11K0F3E			
FFSK Data 1200bps	6K60F2D			
FFSK Data 2400bps	7K80F2D			
Digital Voice / Data	8K10F1E	8K10F7E	8K10F7D	8K10F1D
	8K10F1W			
Digital Voice/Data	7K60FXW	7K60FXD		

CALCULATIONS

Equation: $B_n = 2M + 2Dk$

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

Analogue Voice 12.5 kHz Bandwidth

Necessary bandwidth

M = 3.0 kHz

D = 2.5 kHz

$$B_n = (2 \times 3.0) + (2 \times 2.5) \times 1$$

$$= 11.0 \text{ kHz}$$

Emission Designator

11K0F3E

F3E represents an FM voice transmission

Fast Frequency Shift Keying (FFSK – 1200 bps) 12.5 kHz Bandwidth

Necessary bandwidth

M = 1.8 kHz

D = 1.5 kHz (60% of peak deviation)

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

$$= 6.6 \text{ kHz}$$

Emission Designator

6K60F2D

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

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

Necessary bandwidth

M = 2.4 kHz

D = 1.5 kHz (60% of peak deviation)

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

$$= 7.8 \text{ kHz}$$

Emission Designator

7K80F2D

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

Emission Designators - Continued

Digital Voice / Data C4FM 4800 bps

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/EIA 102 CAAB 2.2.5.2

Digital Voice 12.5 kHz Bandwidth P25 phase 1

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 Voice 12.5 kHz Bandwidth P25 phase 2

99% bandwidth
= 8.1 kHz

Emission Designator

8K10F1W

F1W represents a single FM telephony channel

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 P25 phase 1

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

Digital Data 12.5 kHz Bandwidth P25 phase 2

99% bandwidth
= 8.1 kHz

Emission Designator

8K10F1W

F1W represents digital FM data transmission

Digital Data 12.5 kHz Bandwidth DMR

99% bandwidth
= 7.6 kHz

Emission Designator

7K60FXD

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

TEST RESULTS

TRANSMITTER OUTPUT POWER (CONDUCTED)

SPECIFICATION: FCC 47 CFR 2.1046
RSS-119 5.4

GUIDE: TIA/EIA-603D 2.2.1

MEASUREMENT PROCEDURE:

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

MEASUREMENT RESULTS:

Manufacturer's Rated Output Power: Switchable: 5 W and 1 W

Nominal 5 W	138.1 MHz	152.1 MHz	153.1 MHz	158.1 MHz	173.1 MHz
Measured	4.89	5.10	5.06	4.92	4.96
Variation (%)	-2.14	2.02	1.17	-1.50	-0.80
Variation (dB)	-0.1	0.1	0.1	-0.1	0.0
Nominal 1 W	138.1 MHz	152.1 MHz	153.1 MHz	158.1 MHz	173.1 MHz
Measured	0.96	1.00	1.00	0.97	0.99
Variation (%)	-3.82	-0.32	0.49	-2.74	-0.73
Variation (dB)	-0.2	0.0	0.0	-0.1	0.0
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 AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS

SPECIFICATION: FCC 47 CFR 2.1047 (a)

GUIDE: TIA/EIA-603D 2.2.6

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up.
2. An audio input tone of 1000Hz was applied with the level set to obtain 20% of maximum deviation. This was used as the 0dB reference point.
3. The AF was varied while the audio level was held constant.
4. The response in dB relative to 1000Hz was measured.

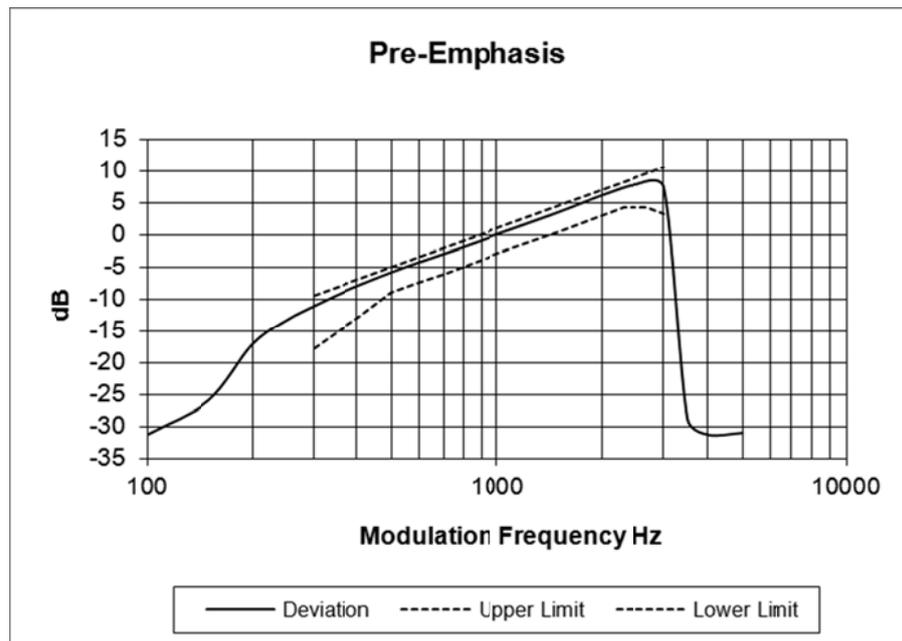
MEASUREMENT RESULTS:

See the plots on the following pages for 12.5 kHz channel spacing tested at 5 W transmit power.

LIMIT CLAUSE: TIA/EIA-603D 3.2.6

SPECIFICATION: FCC CFR 2.1047 (a)

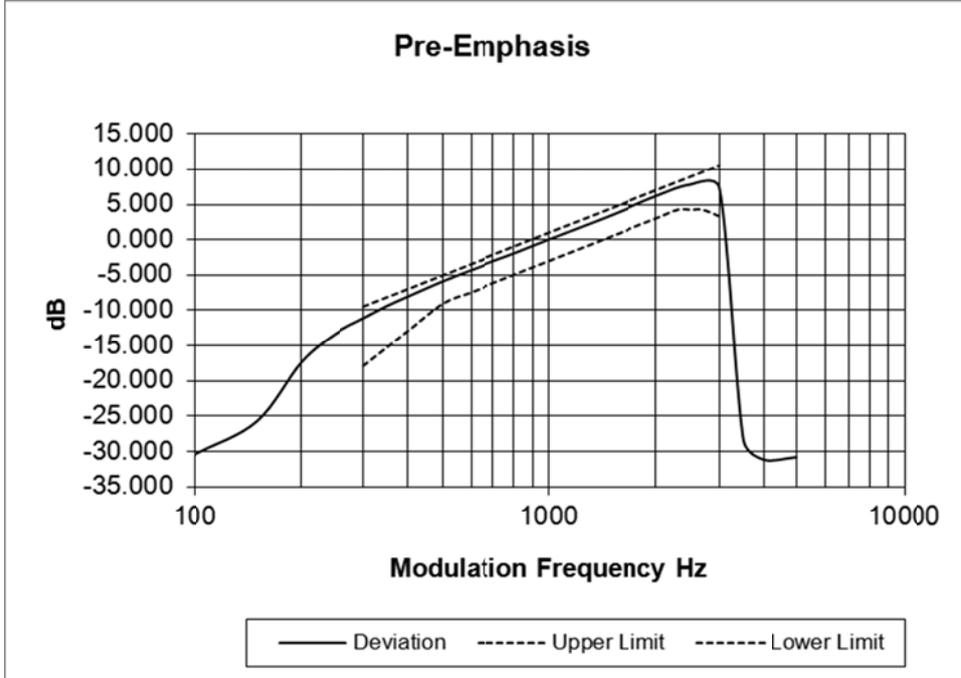
Tx FREQUENCY: 138.1 MHz 12.5 kHz Channel Spacing



Transmitter Audio Frequency Response – Pre-emphasis

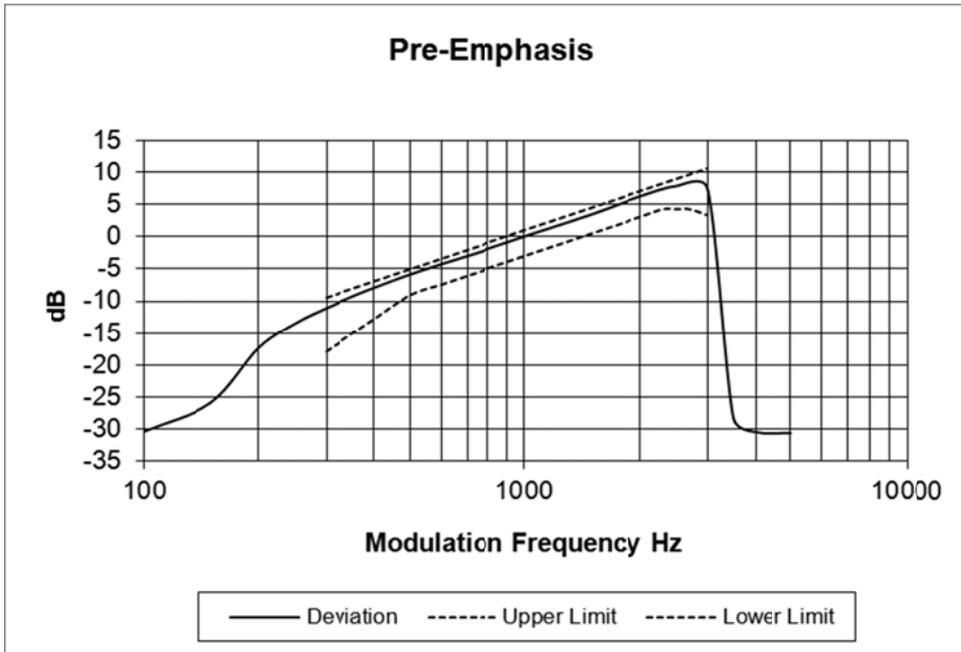
SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 152.1 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

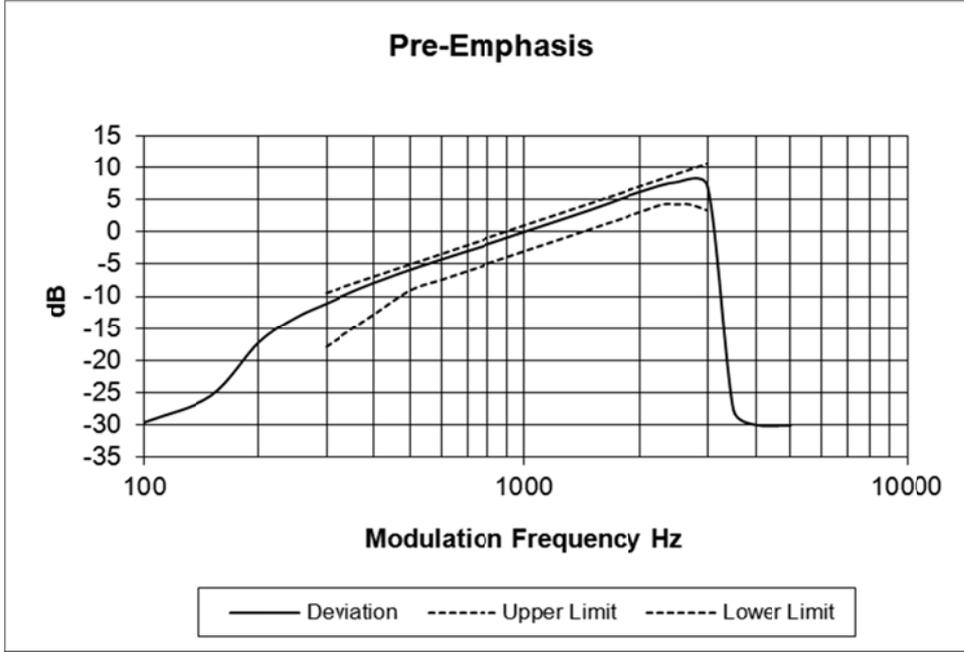
Tx FREQUENCY: 153.1 MHz 12.5 kHz Channel Spacing



Transmitter Audio Frequency Response – Pre-emphasis

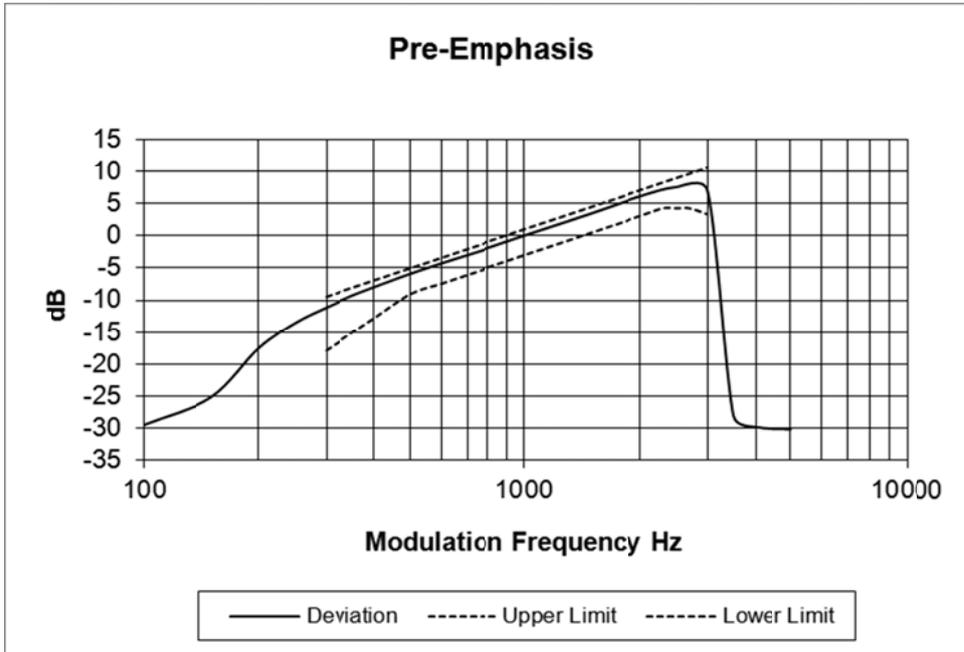
SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 158.1 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 173.1 MHz 12.5 kHz Channel Spacing



TRANSMITTER MODULATION LIMITING

SPECIFICATION: FCC 47 CFR 2.1047 (b)

GUIDE: TIA/EIA-603D 2.2.3

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up.
2. The modulation response was measured at three audio frequencies while varying the input level.
3. Measurements were made for both Positive and Negative Deviation.

MEASUREMENT RESULTS:

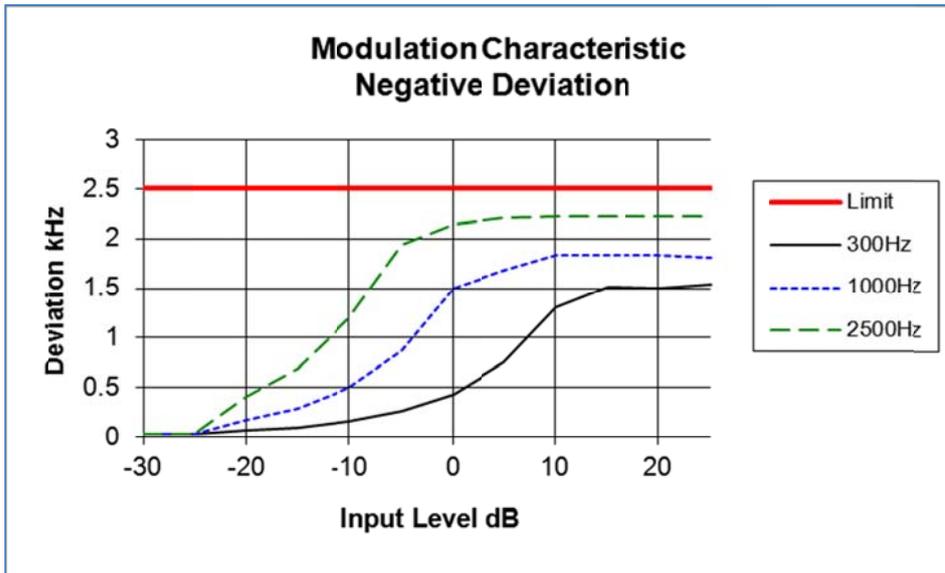
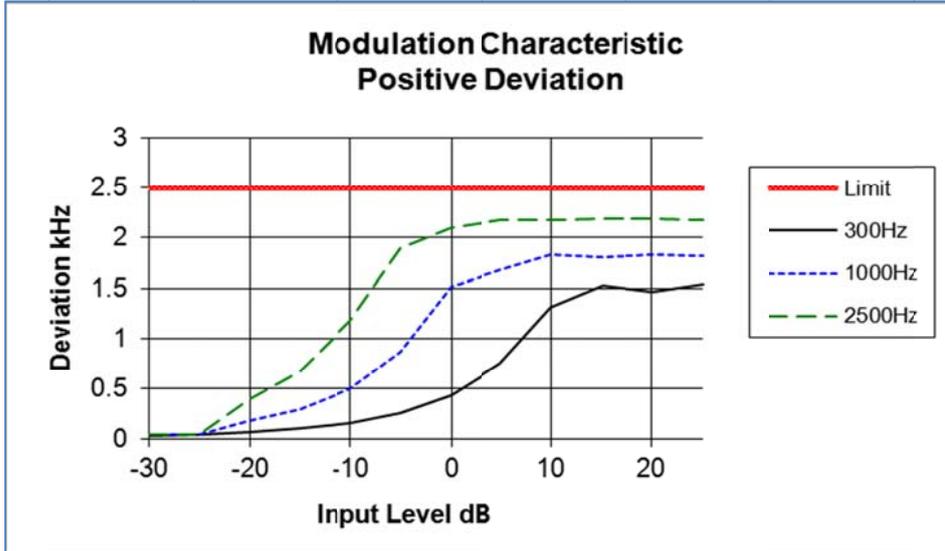
See the plots on the following pages for 12.5 kHz channel spacing.

LIMIT CLAUSE: TIA/EIA-603D 1.3.4.4

Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

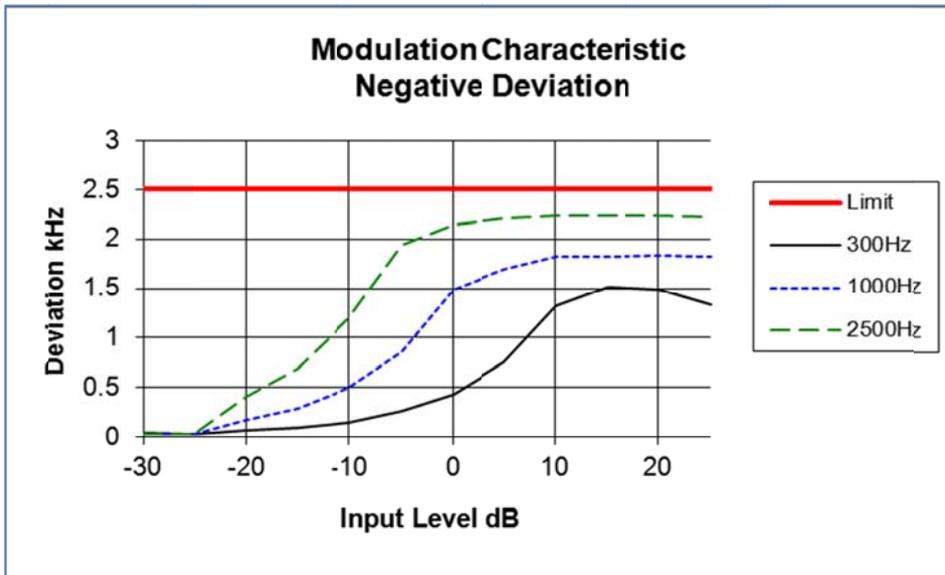
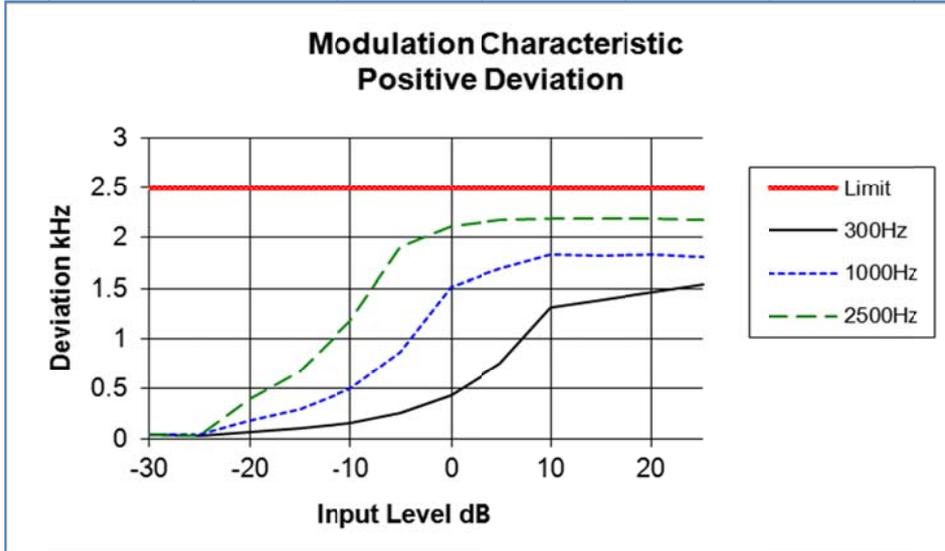
Tx FREQUENCY: 138.1 MHz 12.5 kHz Channel Spacing



Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

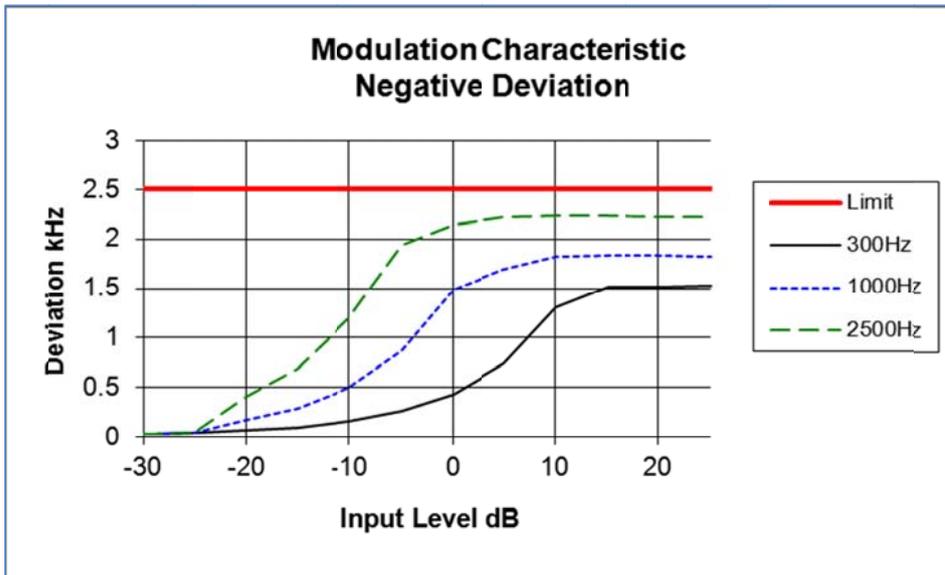
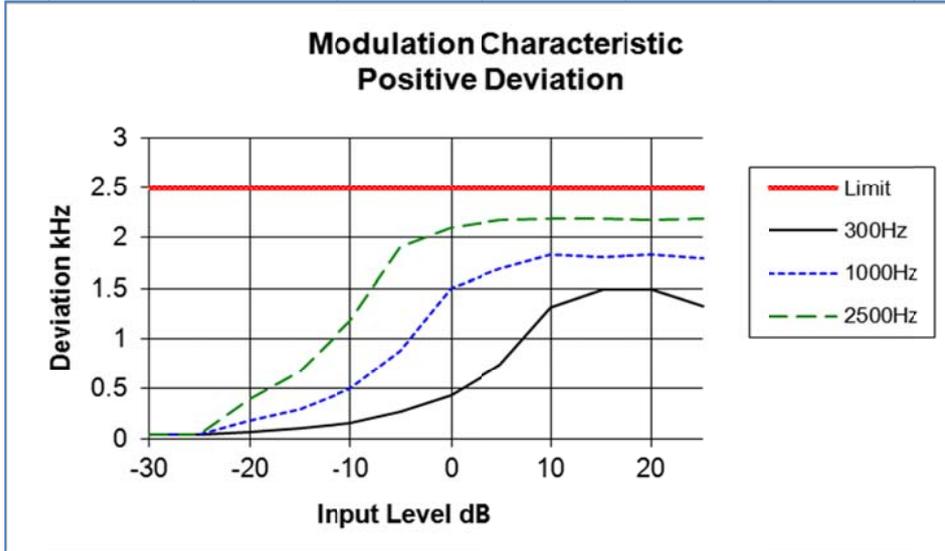
Tx FREQUENCY: 152.1 MHz 12.5 kHz Channel Spacing



Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

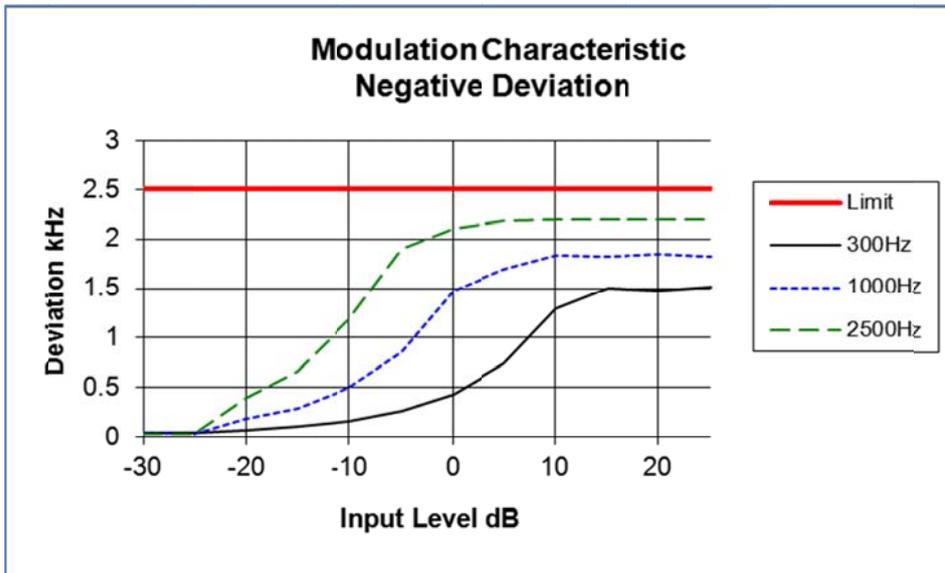
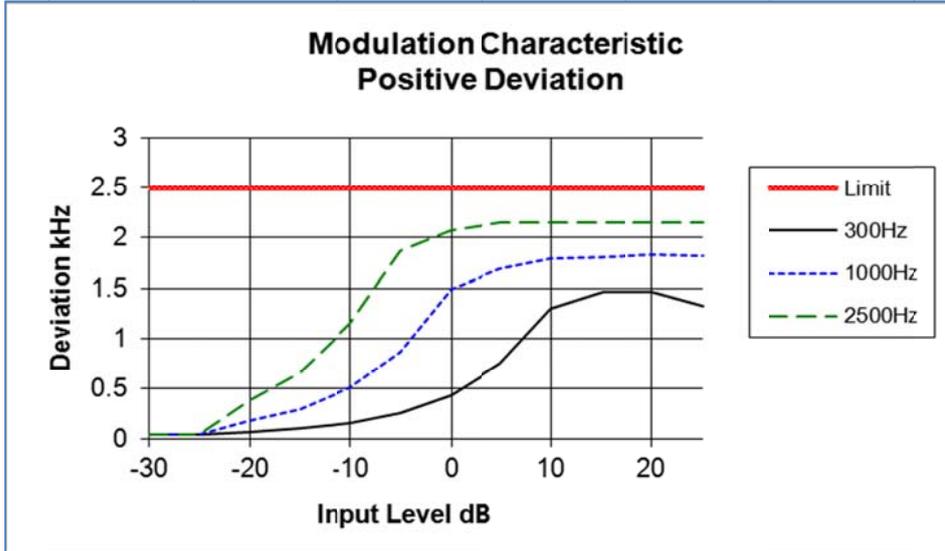
Tx FREQUENCY: 153.1 MHz 12.5 kHz Channel Spacing



Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

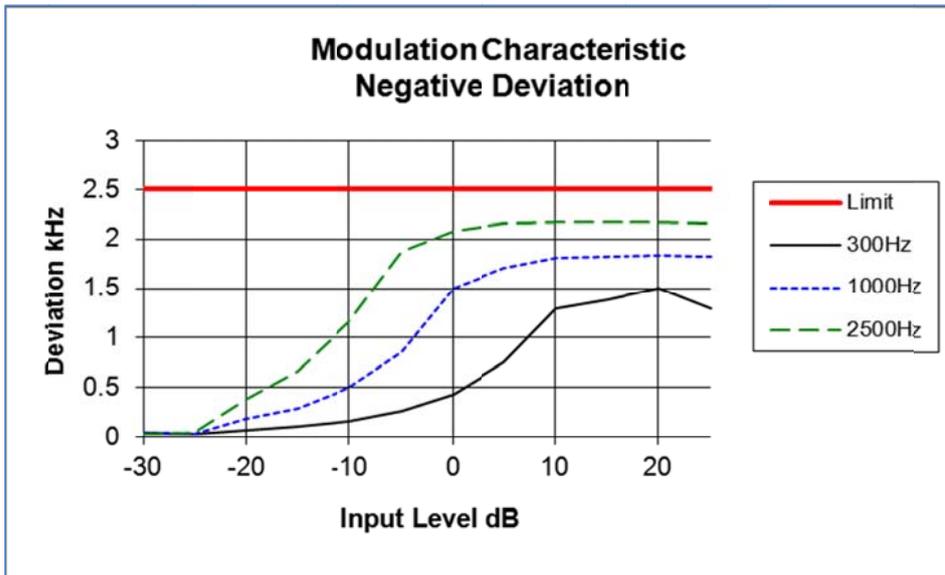
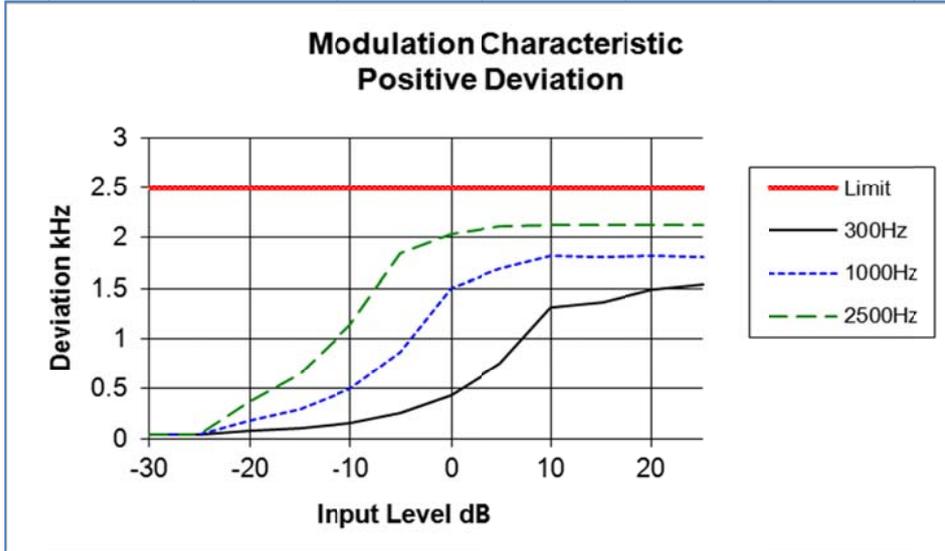
Tx FREQUENCY: 158.1 MHz 12.5 kHz Channel Spacing



Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 173.1 MHz 12.5 kHz Channel Spacing



OCCUPIED BANDWIDTH AND SPECTRUM MASKS

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

GUIDE: TIA/EIA-603D 2.2.11

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment Set up.
2. For analog measurements: The EUT was modulated by a 2500 Hz tone at an input level 16dB above a level that produced 50% deviation. The input level was established at the frequency of maximum response of the audio modulating circuit.
For Data measurements: The EUT was modulated with an internally generated pseudo random bit sequence at the appropriate Baud rates.
3. The Occupied Bandwidth was measured on the Spectrum Analyser, with bandwidth settings as follows.

Emission Mask D – Resolution Bandwidth = 100 Hz, Video Bandwidth = 1 kHz

MEASUREMENT RESULTS:

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

LIMIT CLAUSE: FCC 47 CFR 90.210 RSS-119 5.5

EMISSION MASKS

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

DATA SPEED

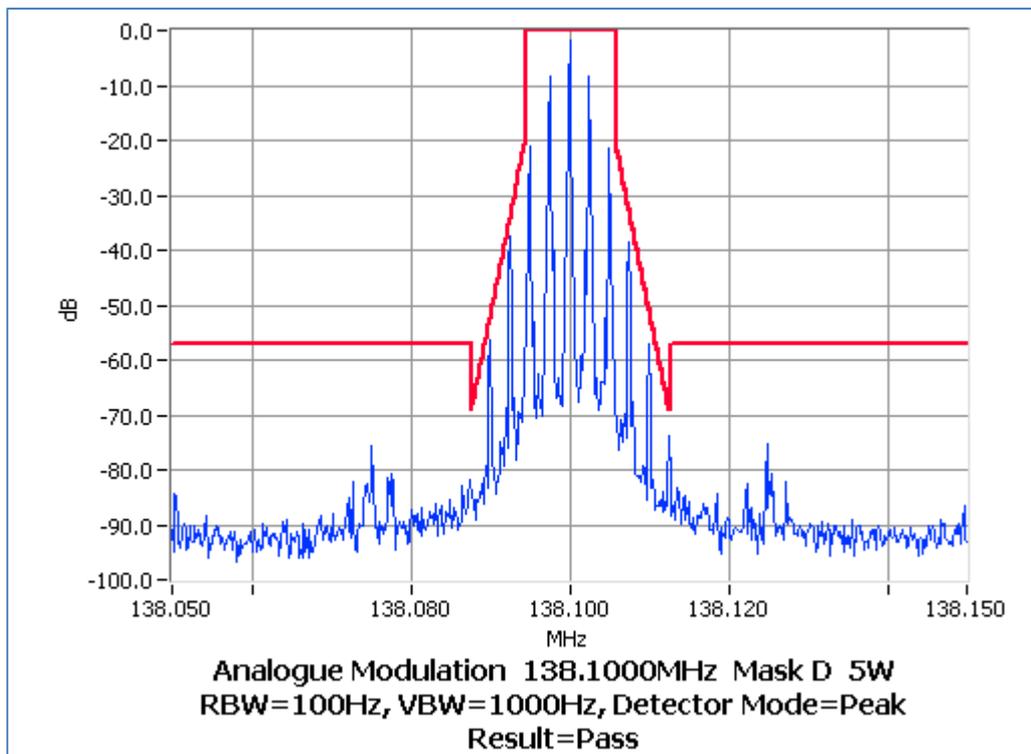
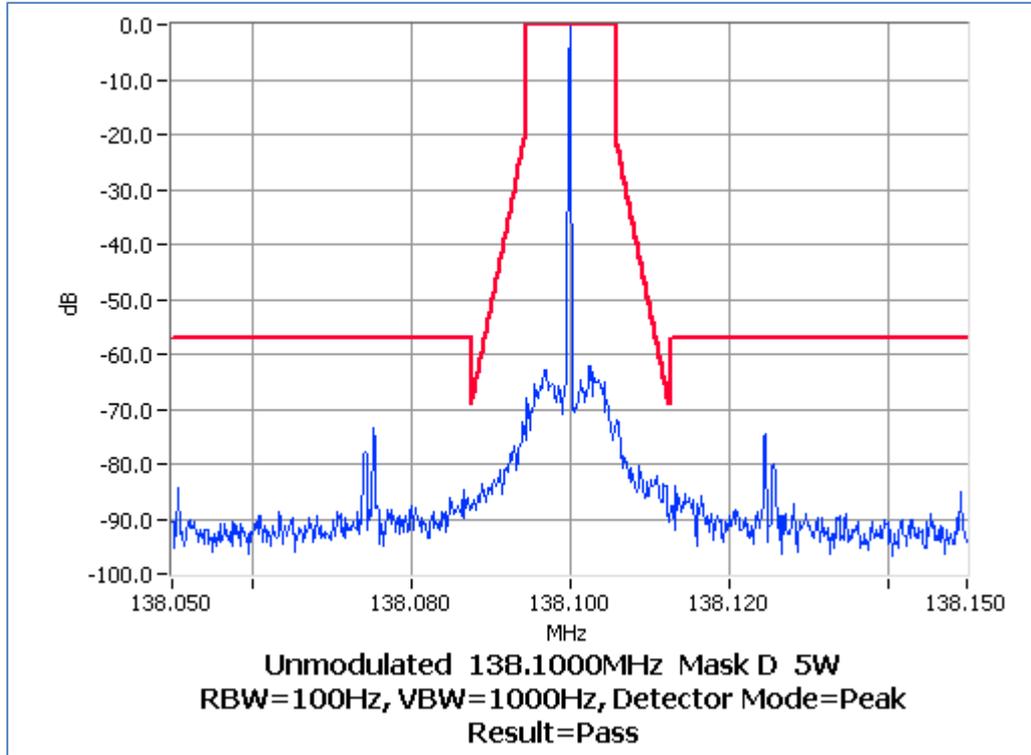
Digital Voice/Data 12.5 kHz Channel Spacing 9600 bps & 12000 bps
FFSK 12.5 kHz Channel Spacing 1200 bps & 2400 bps

Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

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

Tx FREQUENCY: 138.1 MHz 5 W 12.5 kHz Channel Spacing

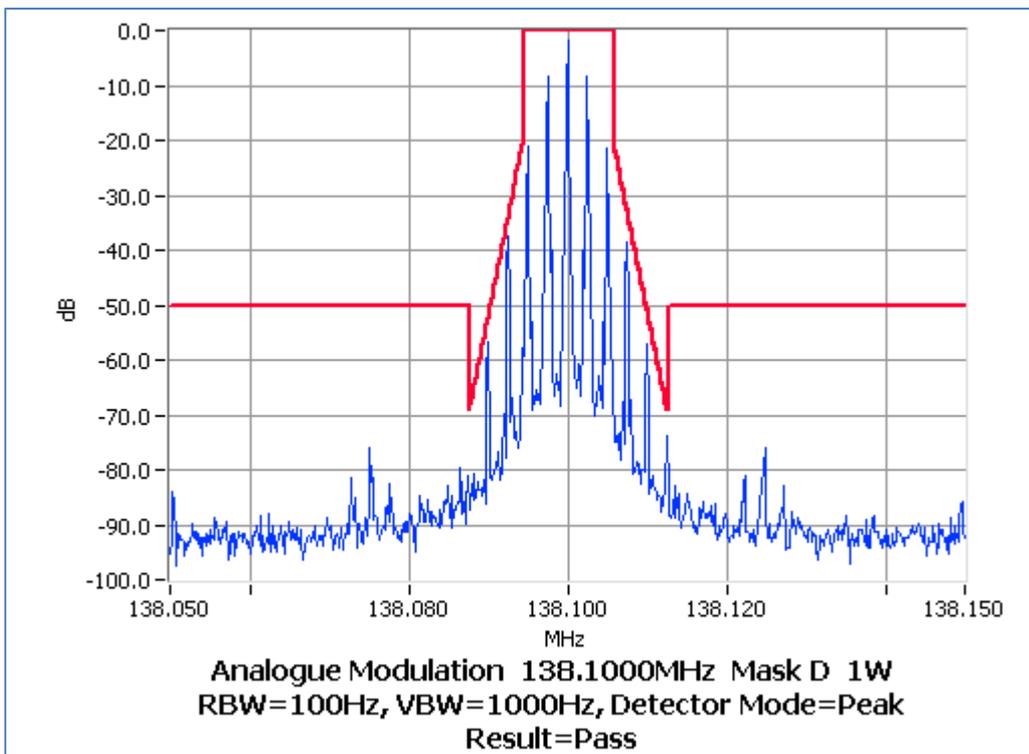
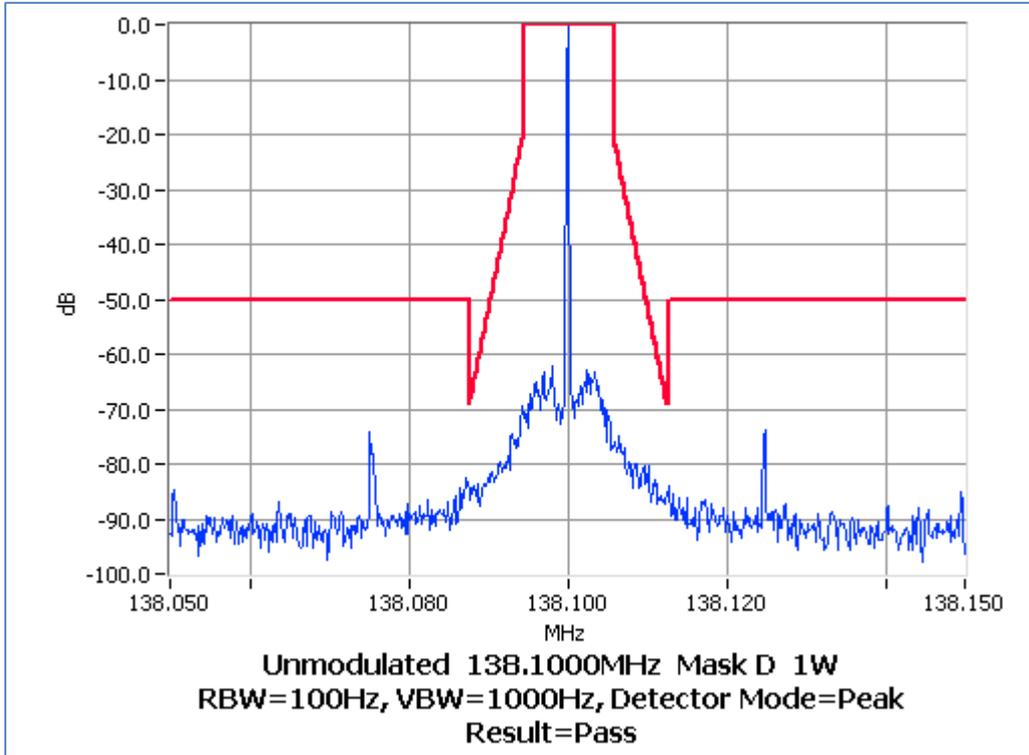


Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

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

Tx FREQUENCY: 138.1 MHz 1 W 12.5 kHz Channel Spacing

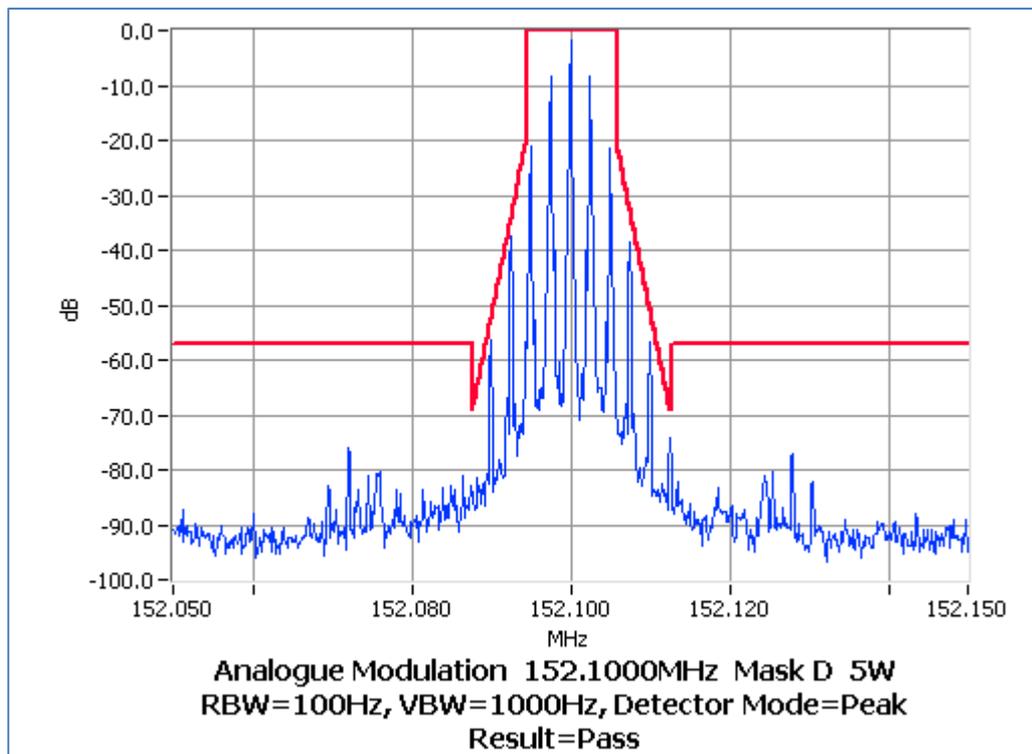
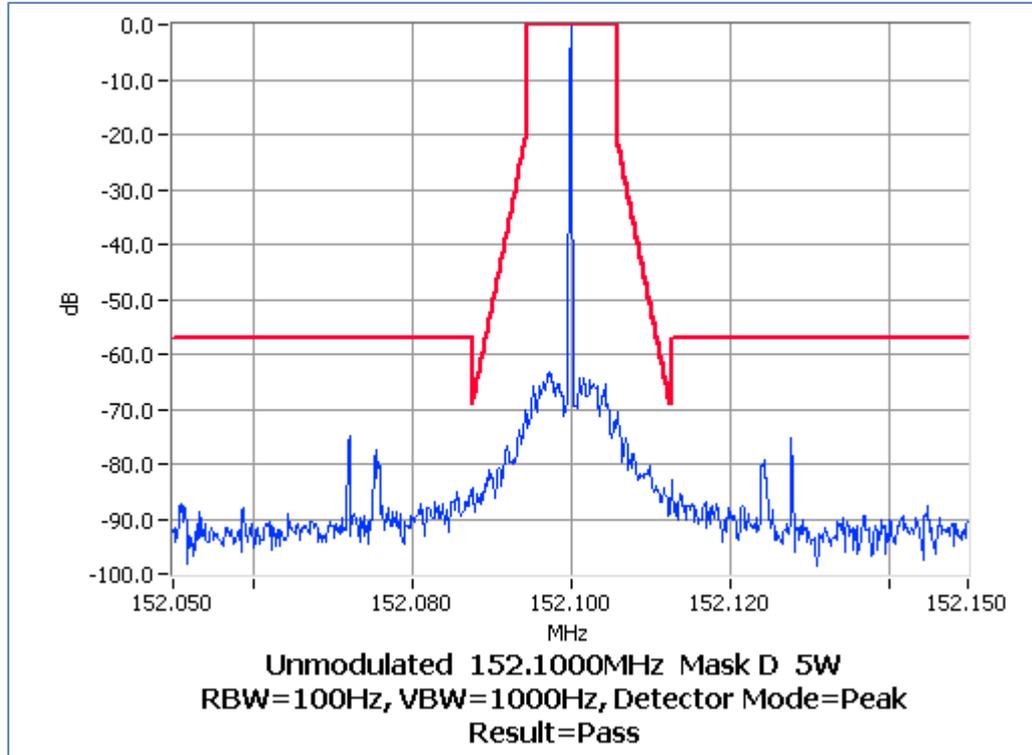


Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

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

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing

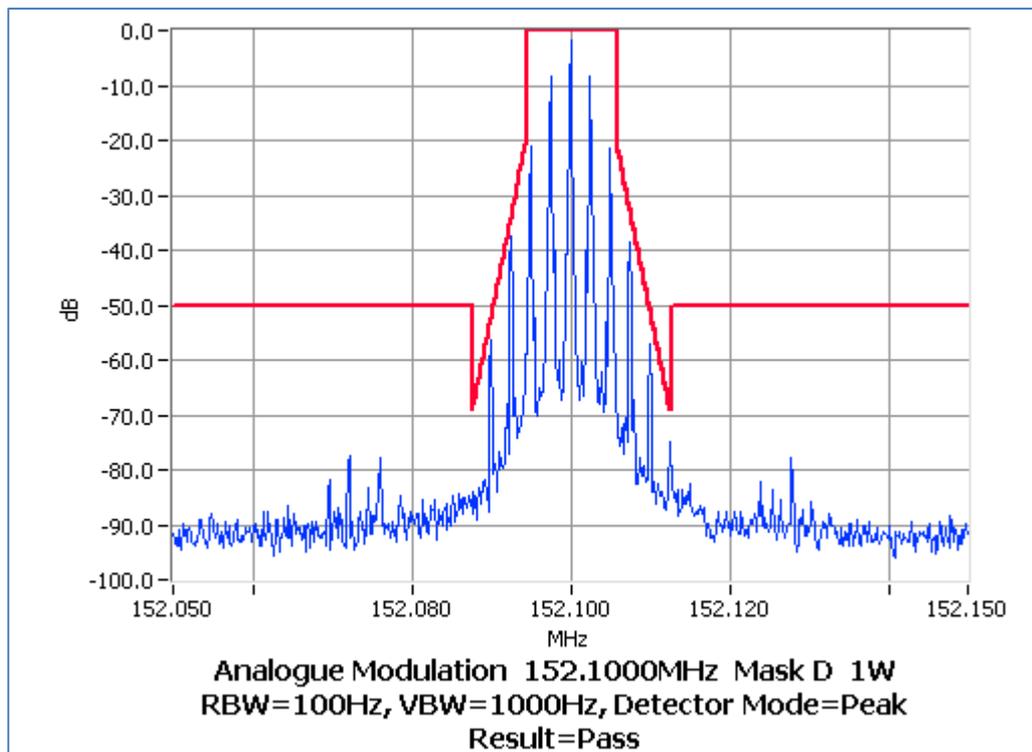
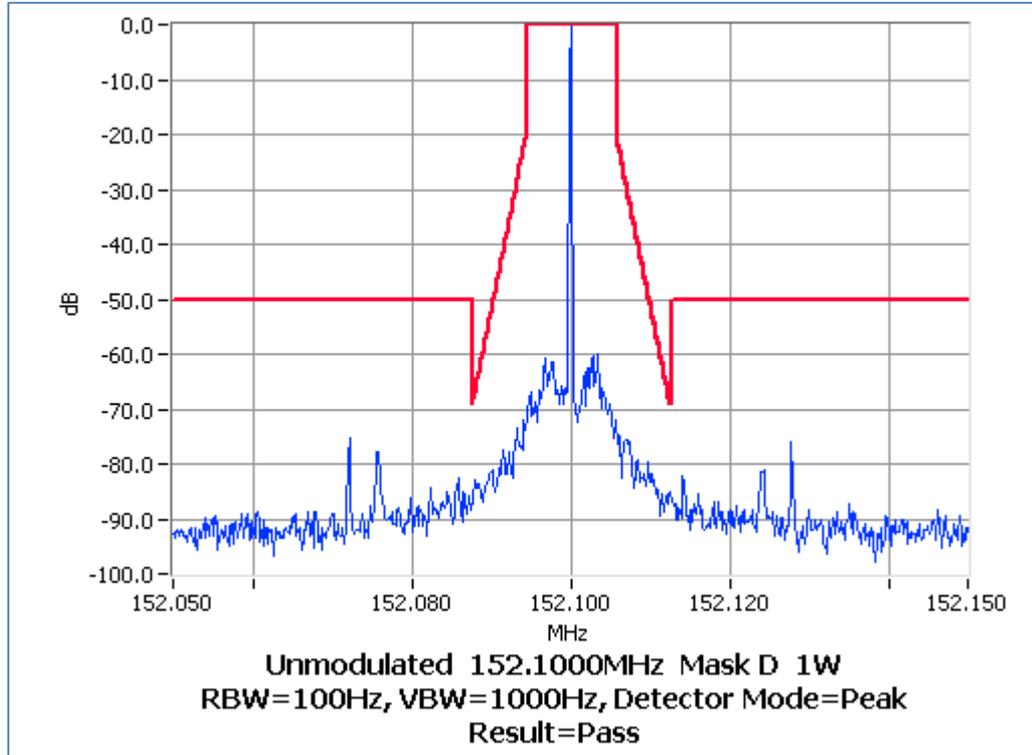


Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

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

Tx FREQUENCY: 152.1 MHz 1 W 12.5 kHz Channel Spacing

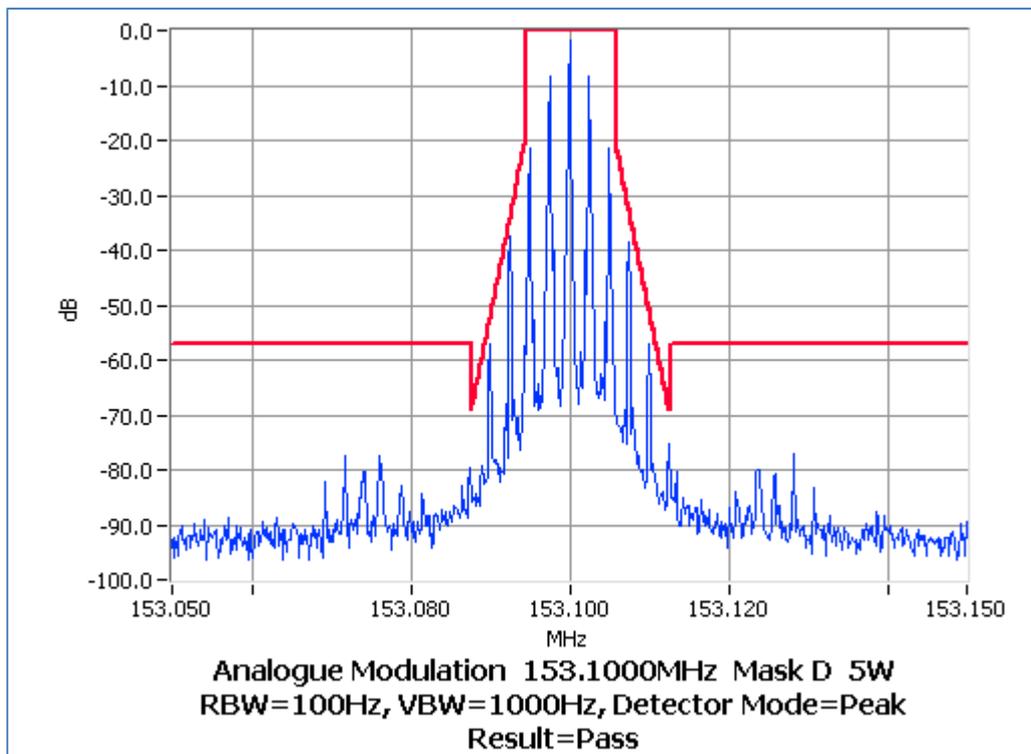
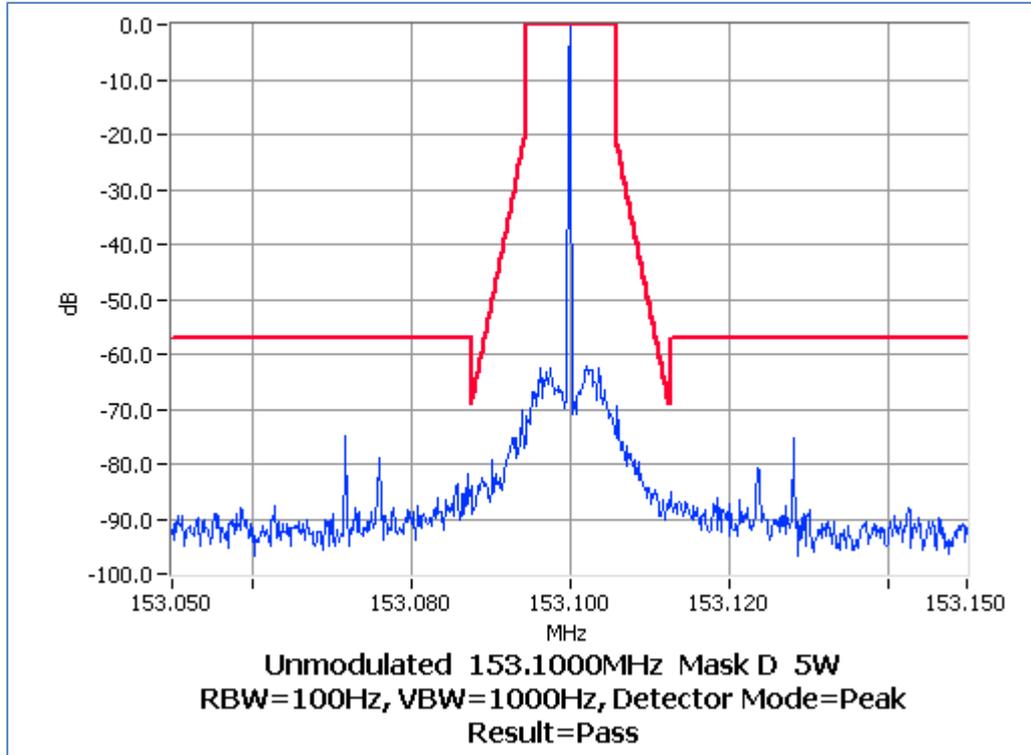


Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

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

Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing

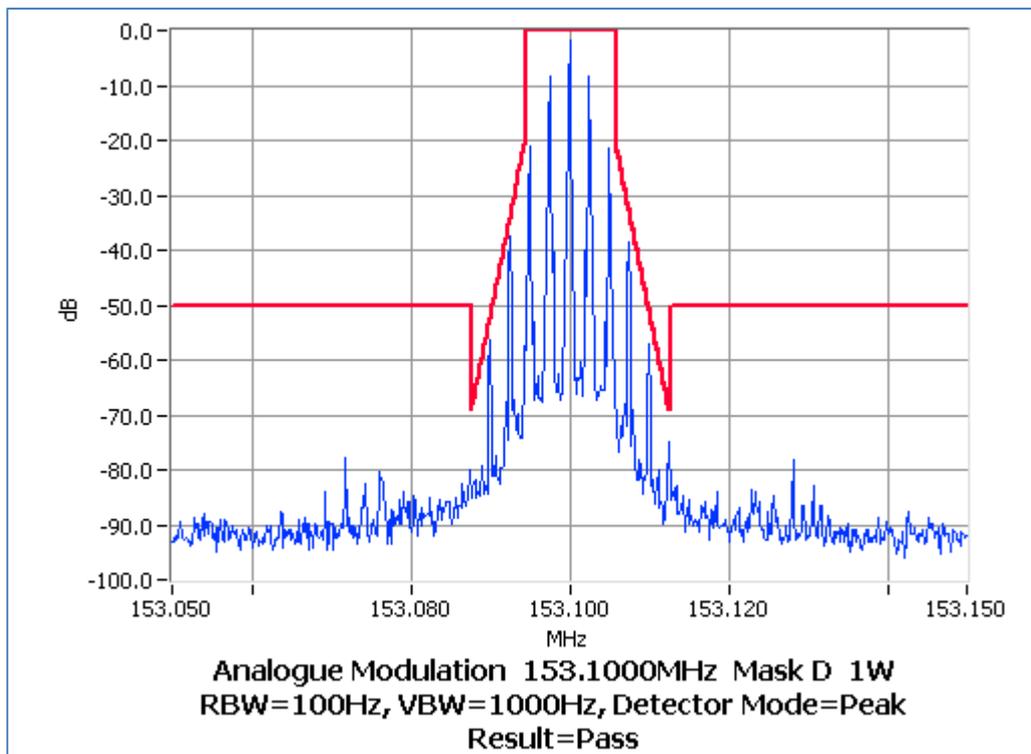
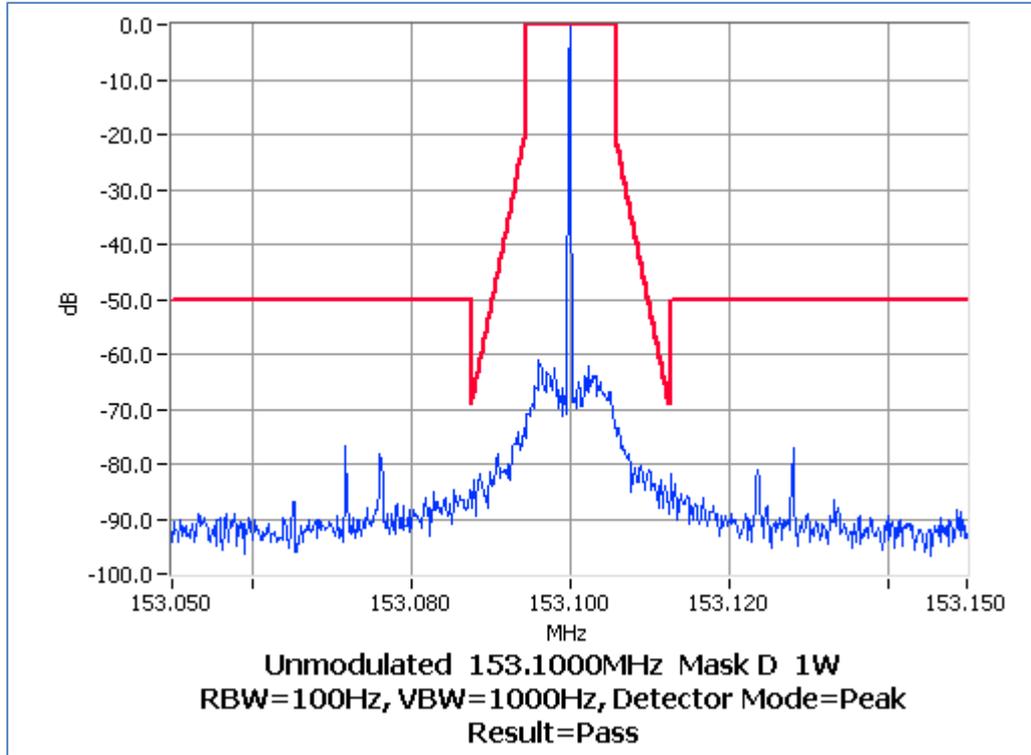


Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

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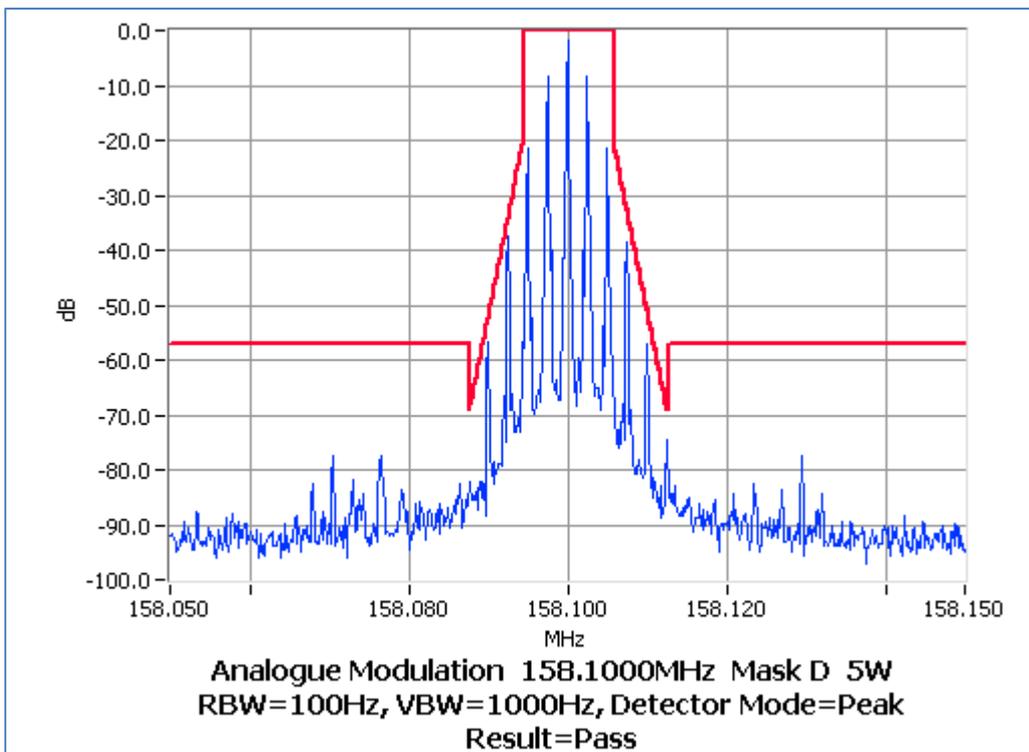
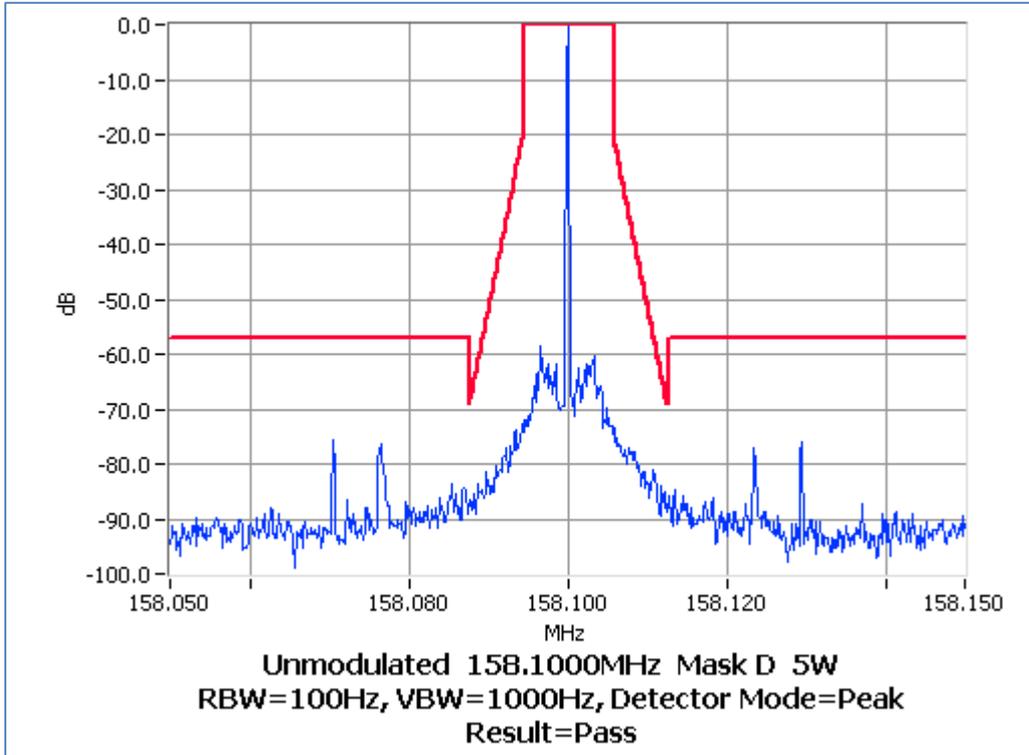


Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

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

Tx FREQUENCY: 158.1 MHz 5 W 12.5 kHz Channel Spacing

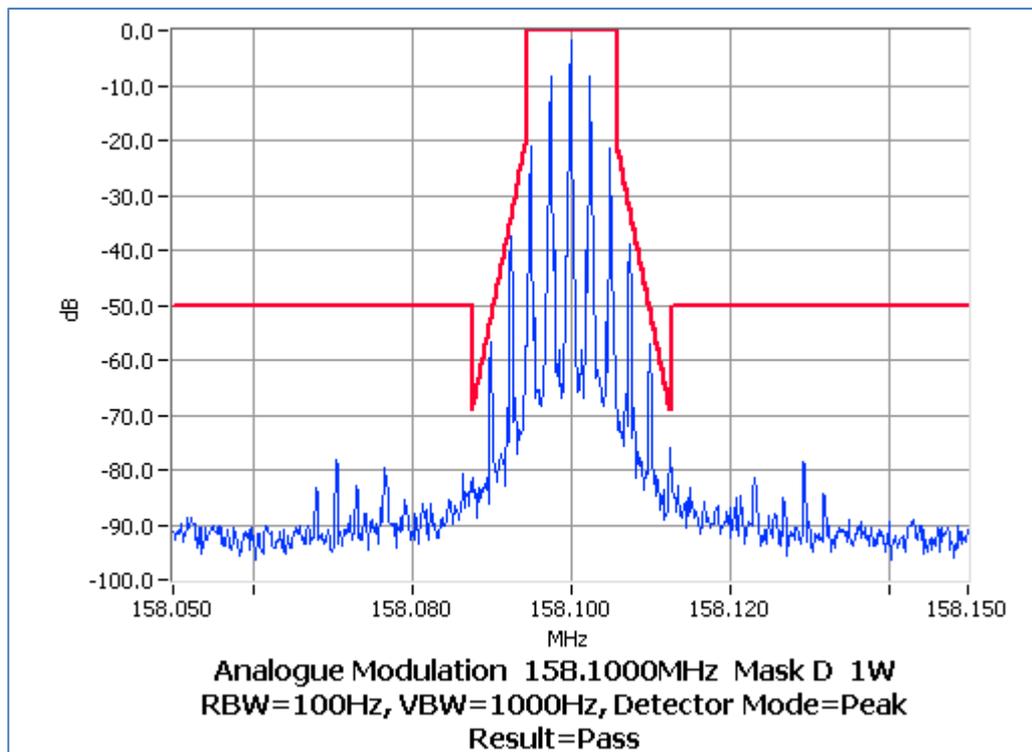
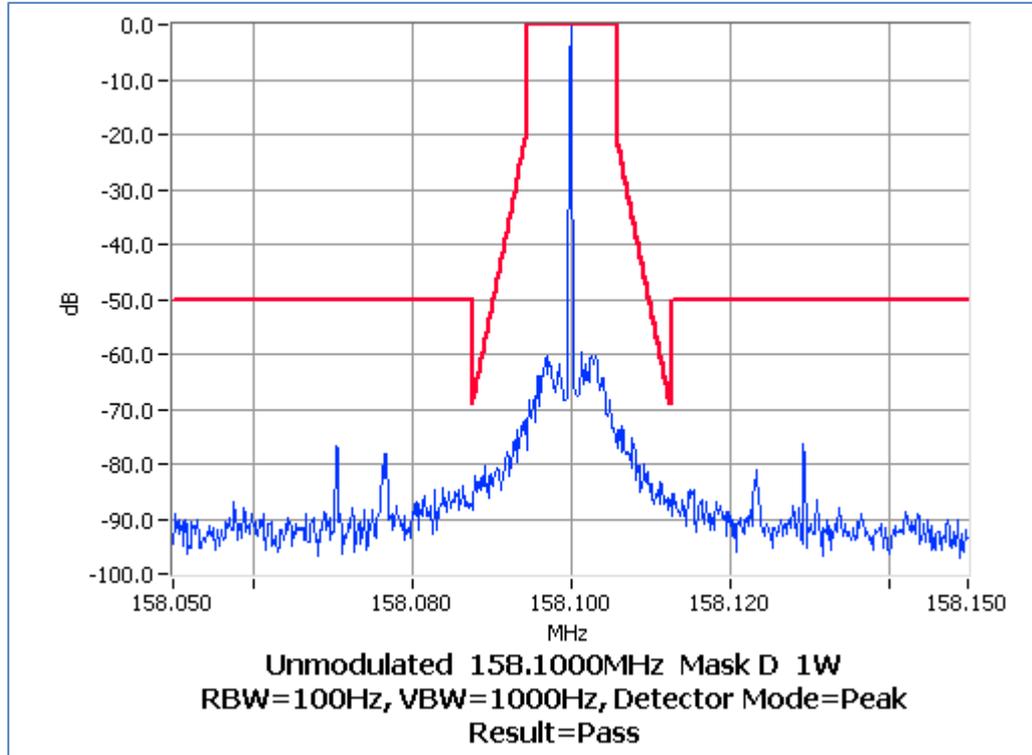


Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

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

Tx FREQUENCY: 158.1 MHz 1 W 12.5 kHz Channel Spacing

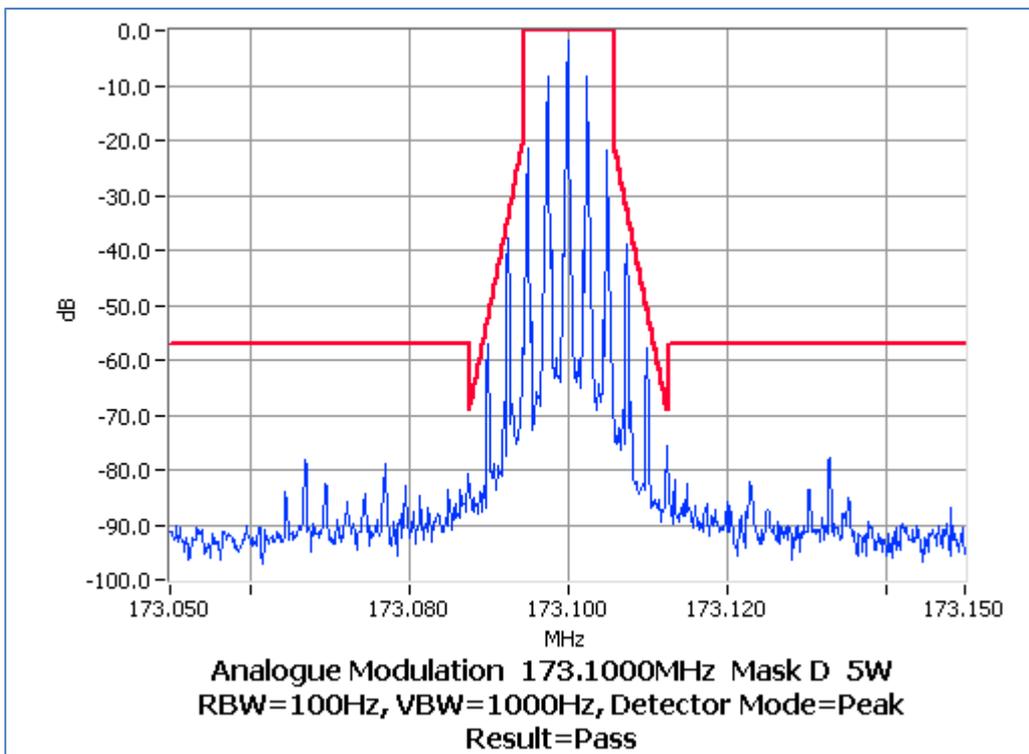
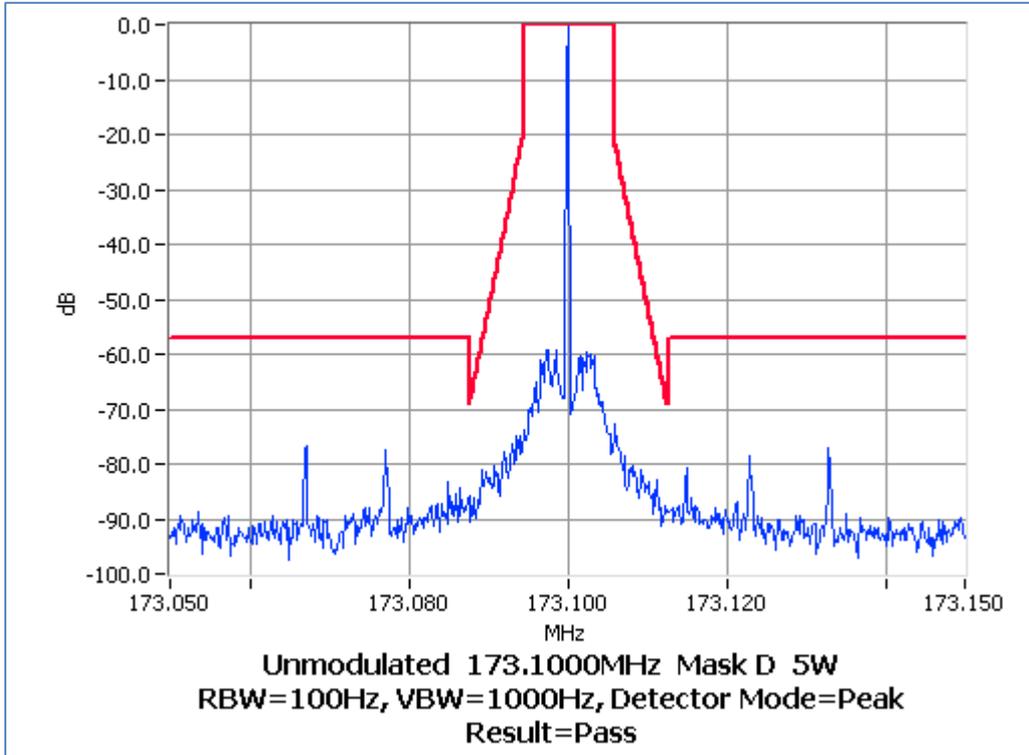


Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

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

Tx FREQUENCY: 173.1 MHz 5 W 12.5 kHz Channel Spacing

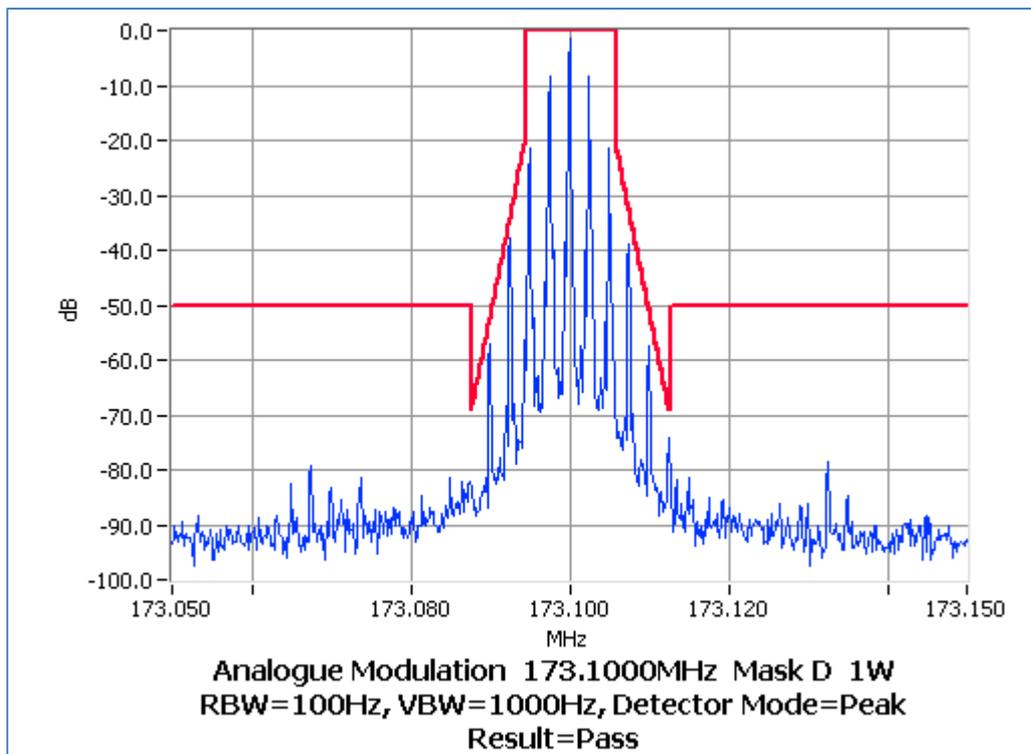
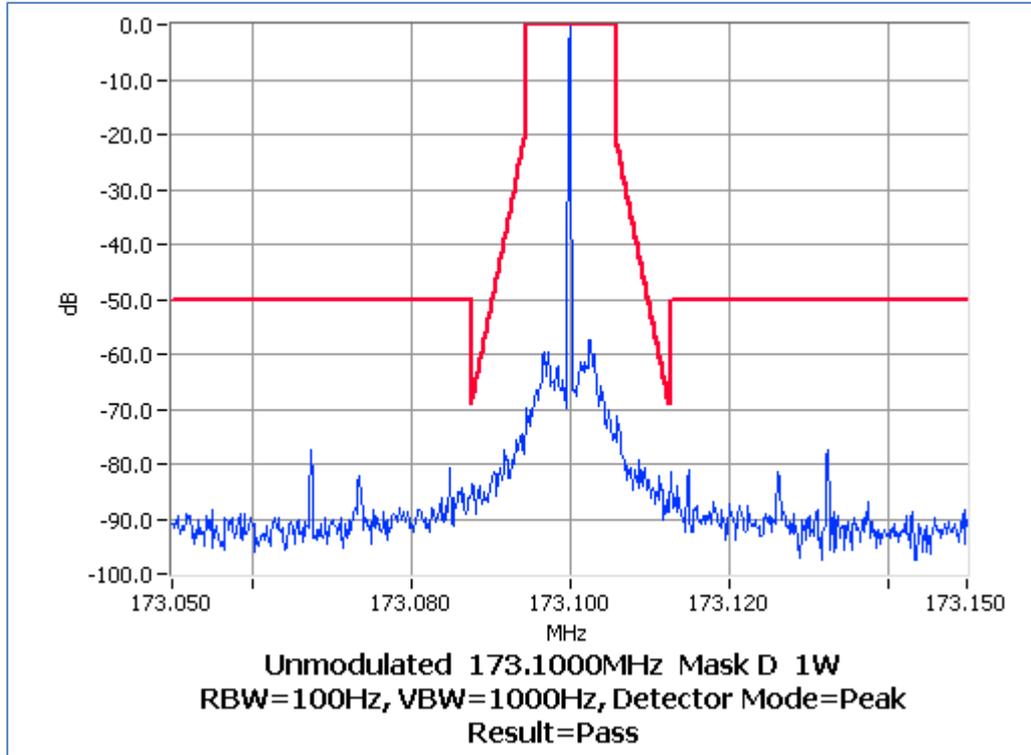


Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

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

Tx FREQUENCY: 173.1 MHz 1 W 12.5 kHz Channel Spacing

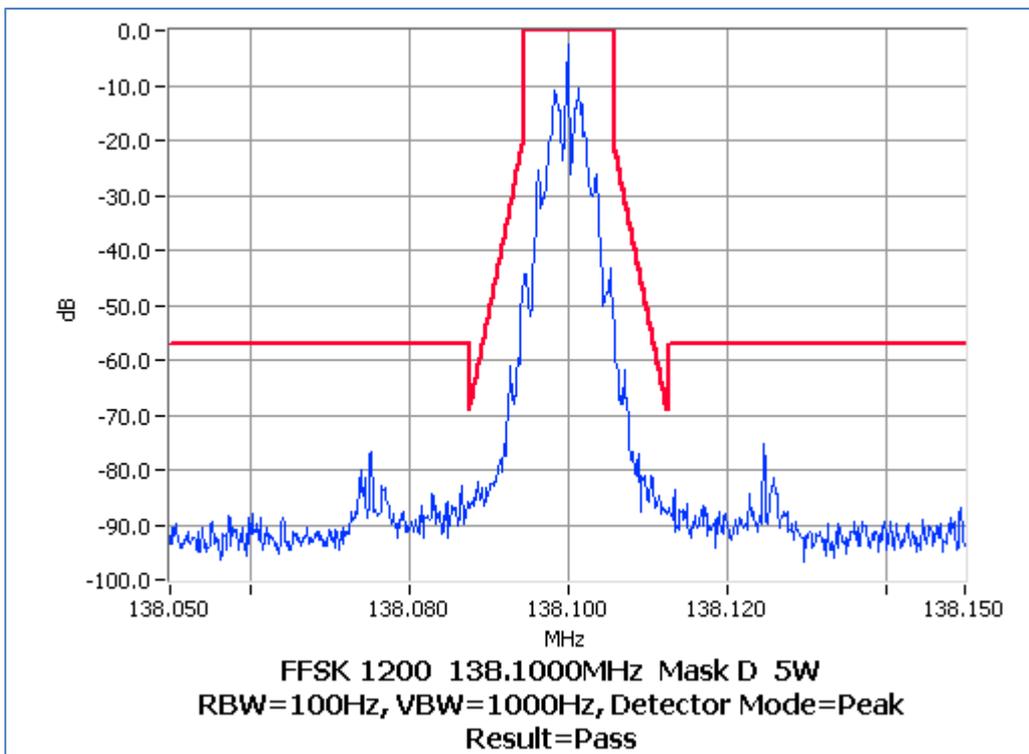
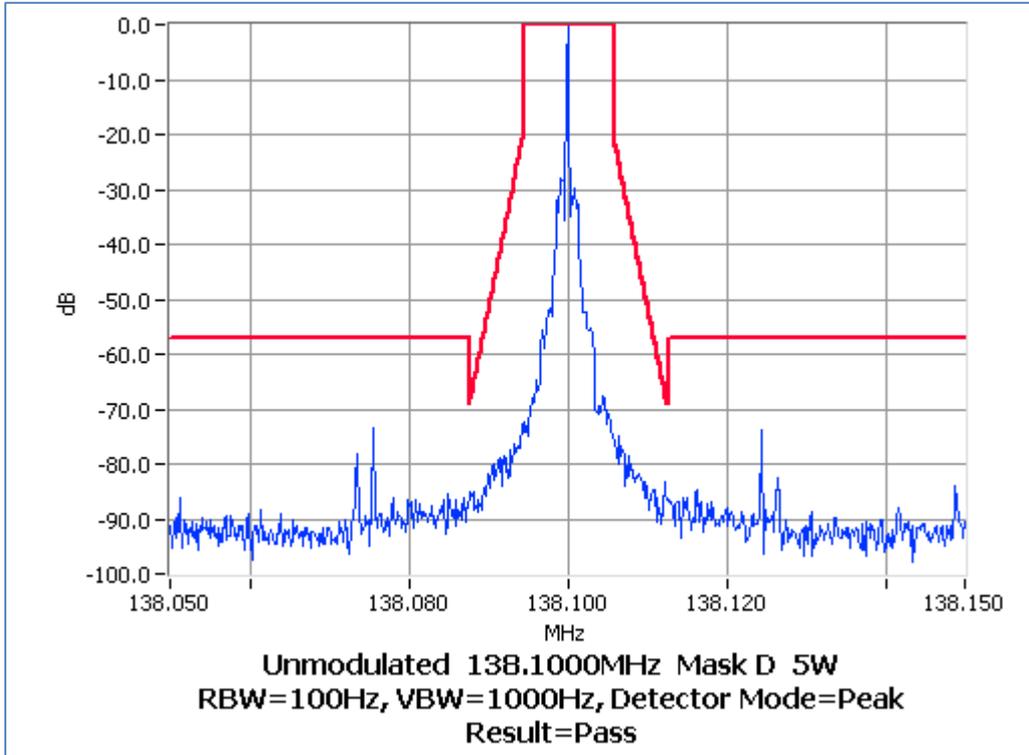


Occupied Bandwidth and Spectrum Masks

FFSK – 1200 bps

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

Tx FREQUENCY: 138.1 MHz 5 W 12.5 kHz Channel Spacing

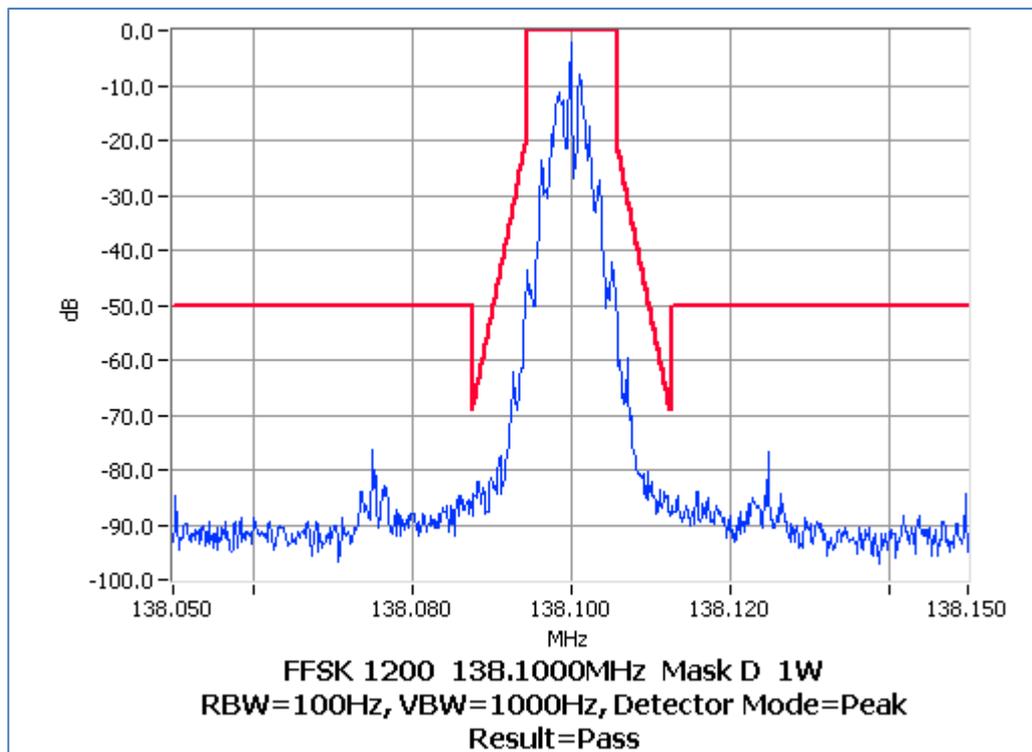
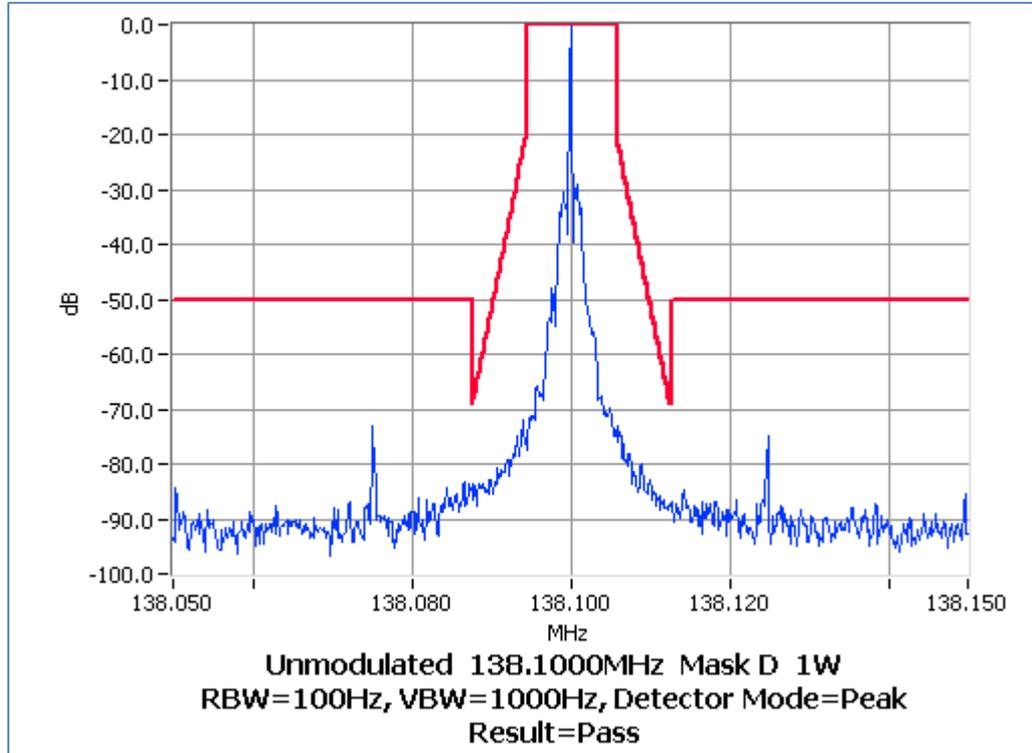


Occupied Bandwidth and Spectrum Masks

FFSK – 1200 bps

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

Tx FREQUENCY: 138.1 MHz 1 W 12.5 kHz Channel Spacing

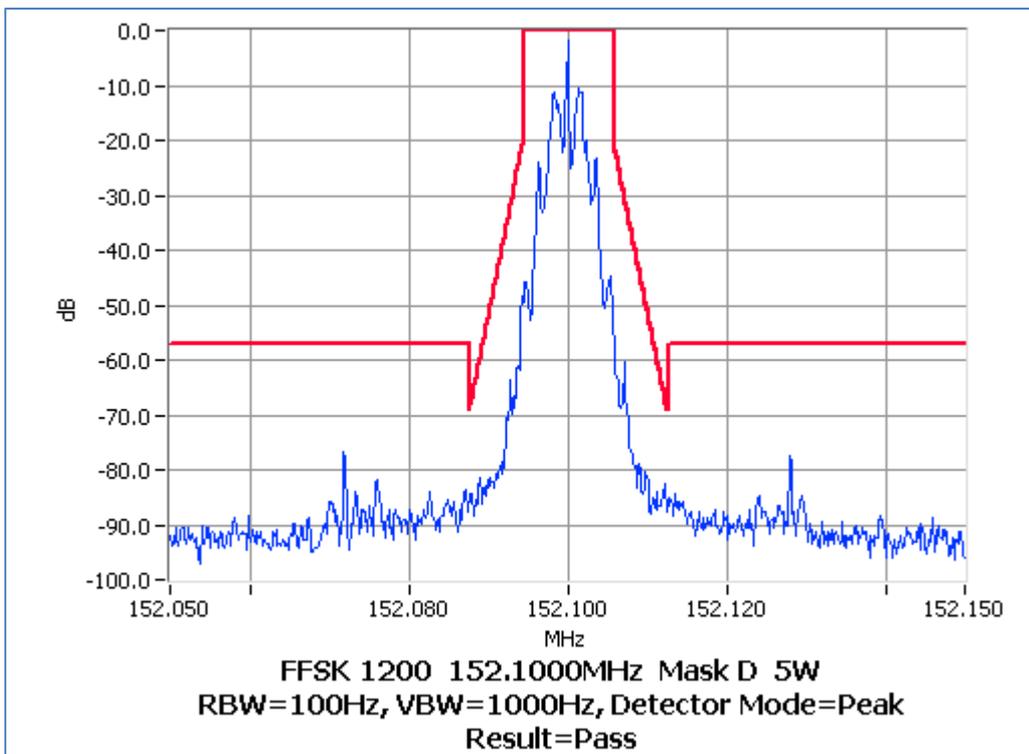
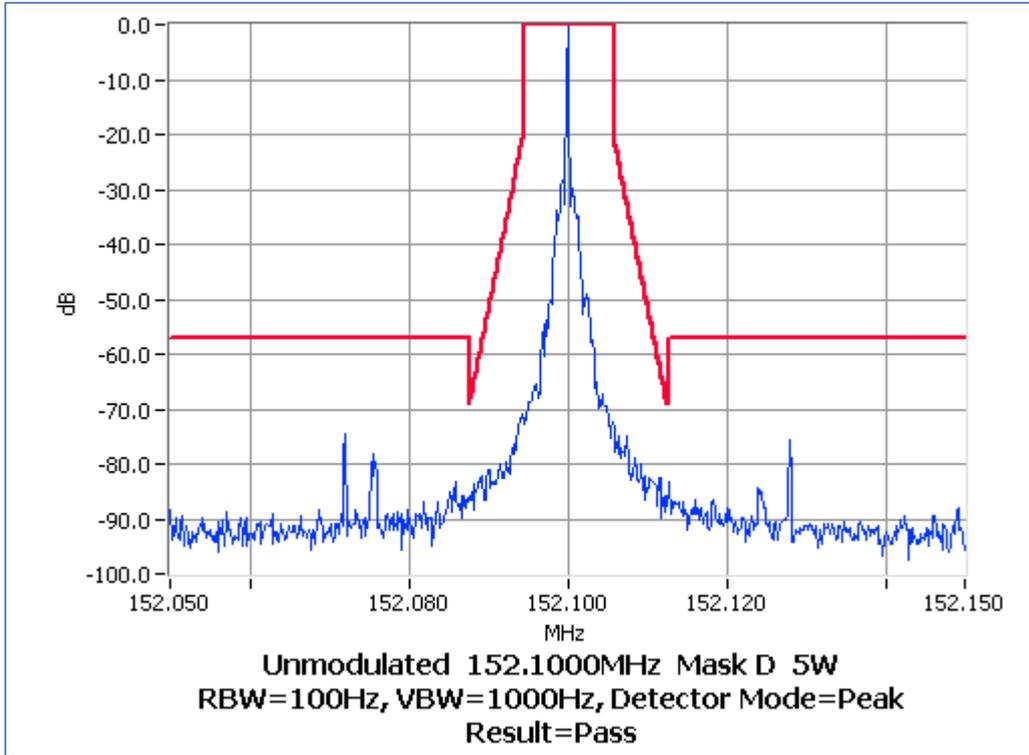


Occupied Bandwidth and Spectrum Masks

FFSK – 1200 bps

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

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing

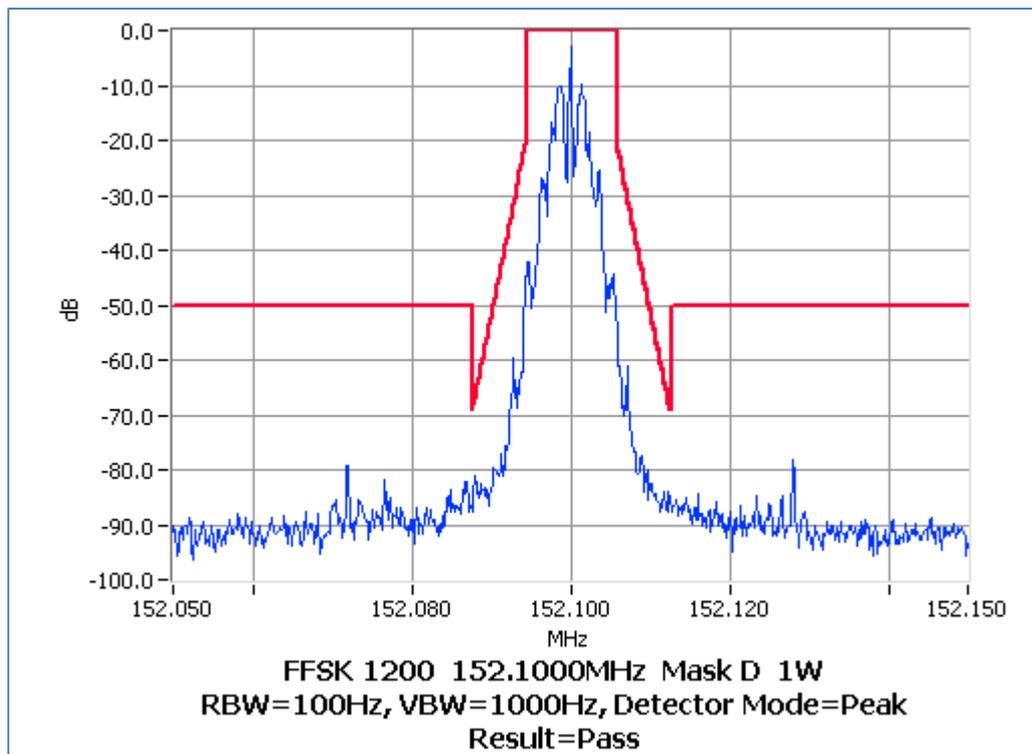
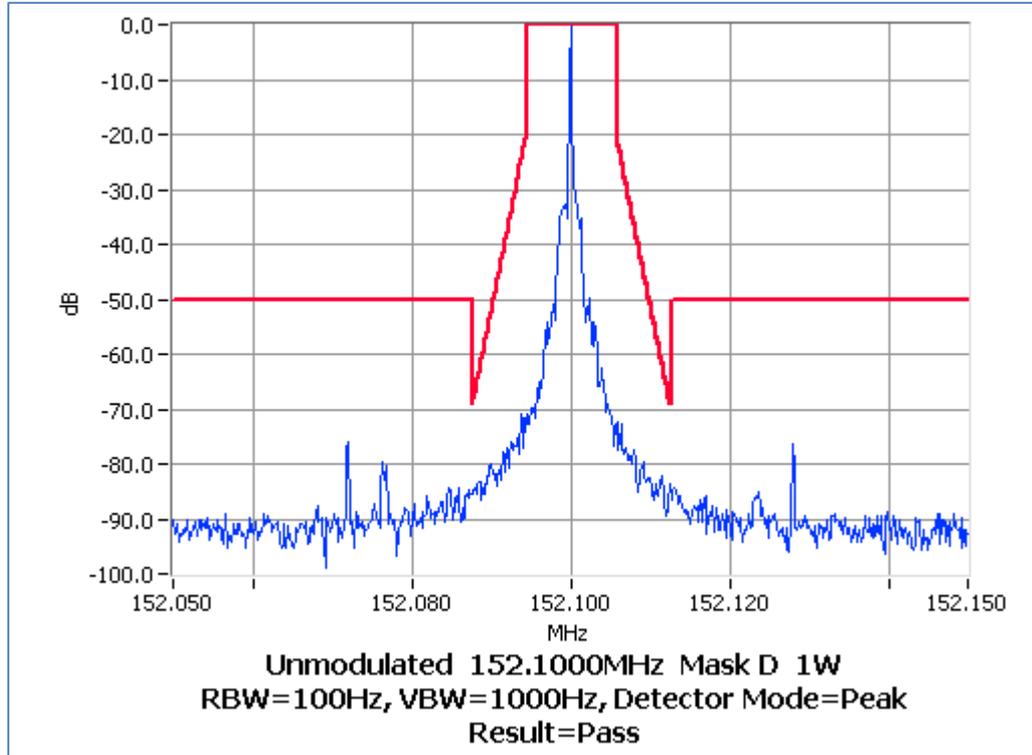


Occupied Bandwidth and Spectrum Masks

FFSK – 1200 bps

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

Tx FREQUENCY: 152.1 MHz 1 W 12.5 kHz Channel Spacing

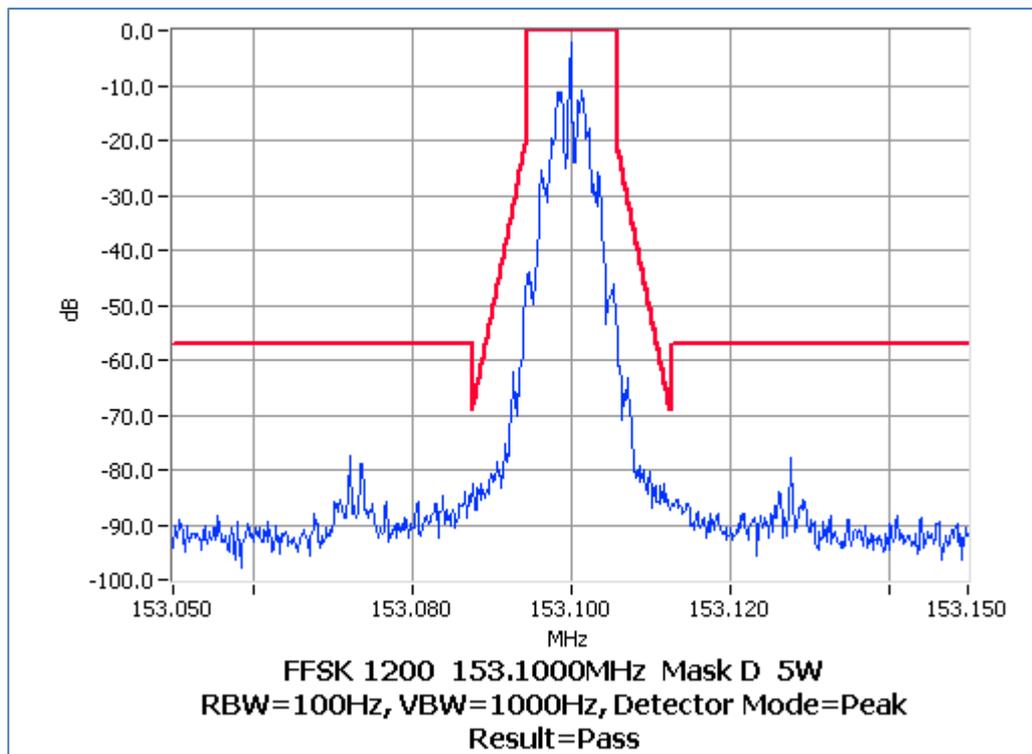
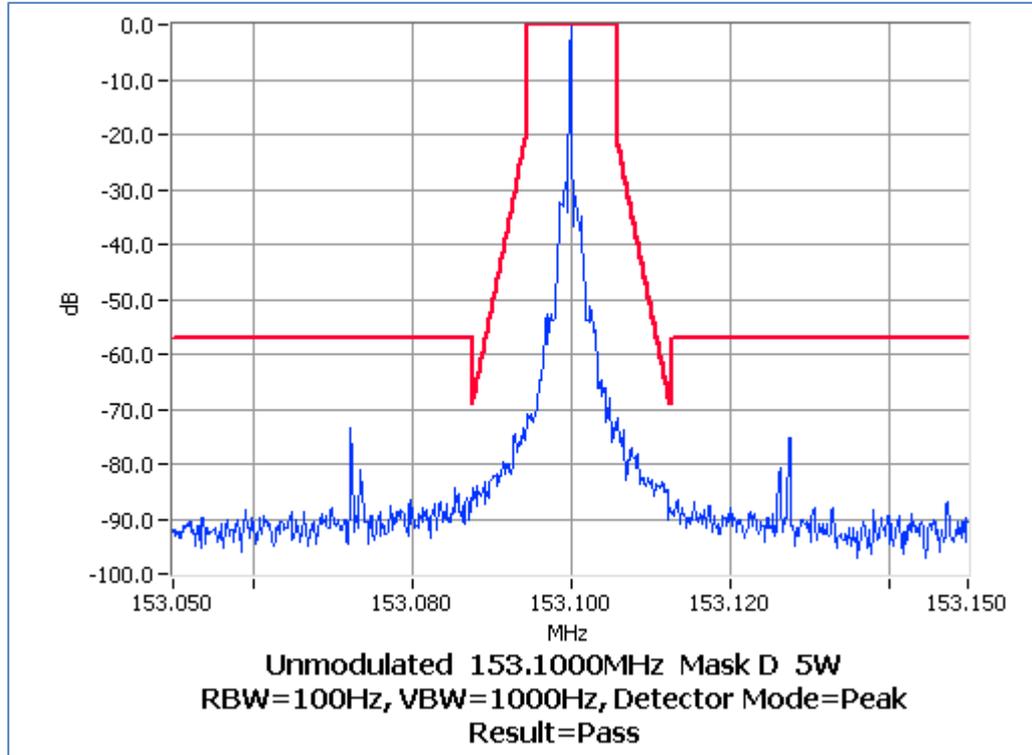


Occupied Bandwidth and Spectrum Masks

FFSK – 1200 bps

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

Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing

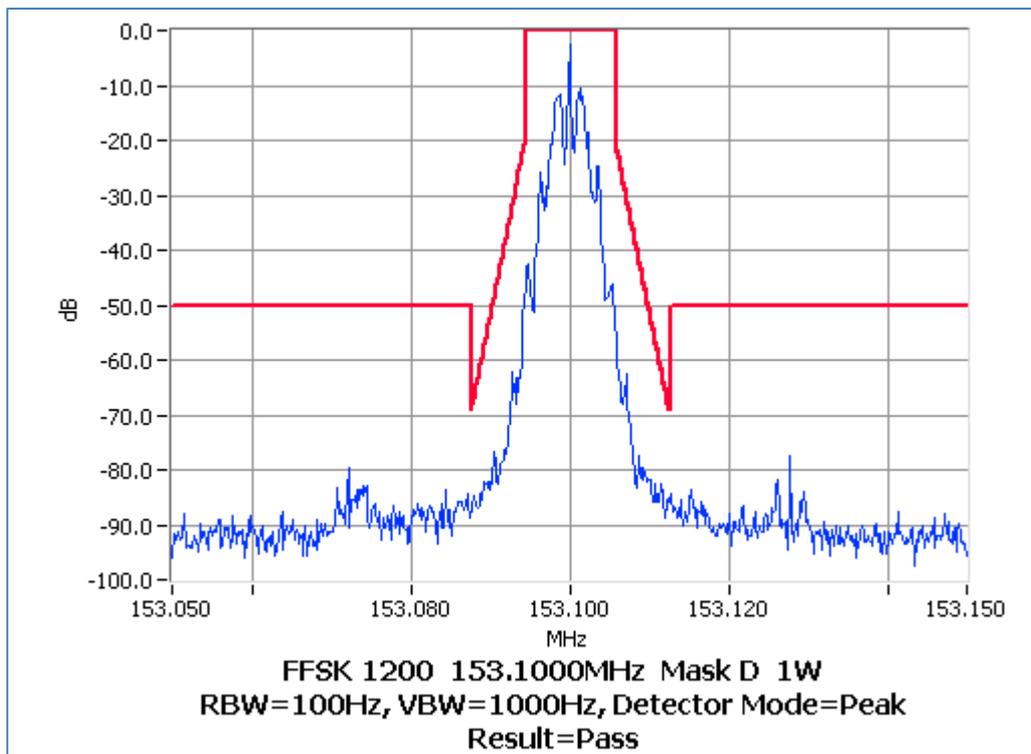
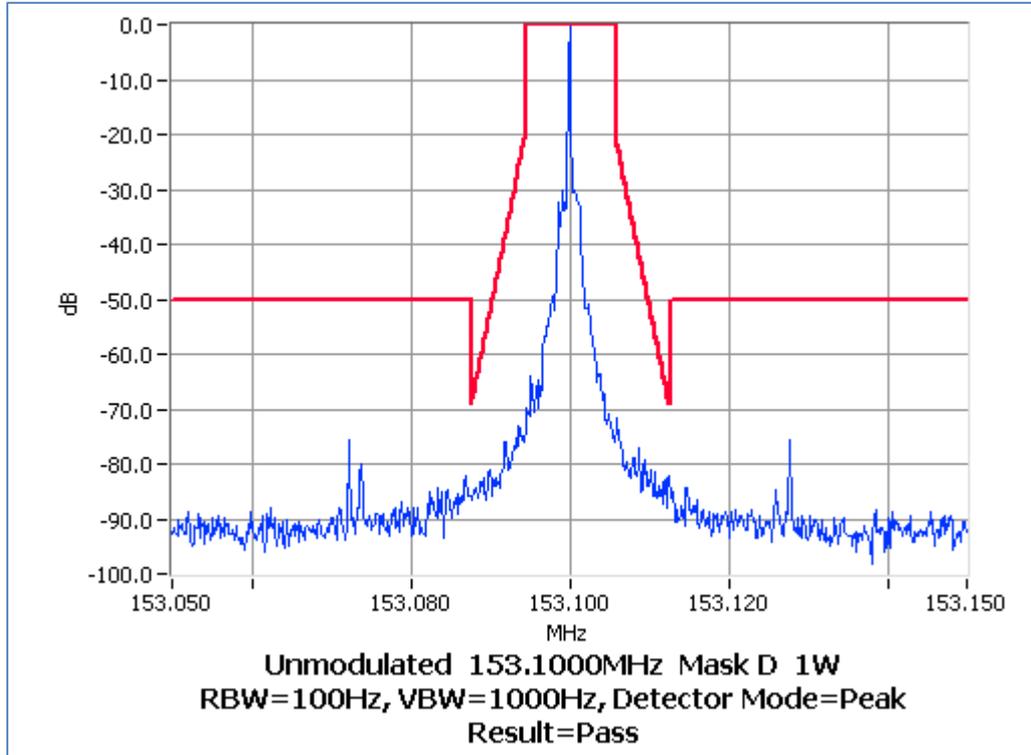


Occupied Bandwidth and Spectrum Masks

FFSK – 1200 bps

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

Tx FREQUENCY: 153.1 MHz 1 W 12.5 kHz Channel Spacing

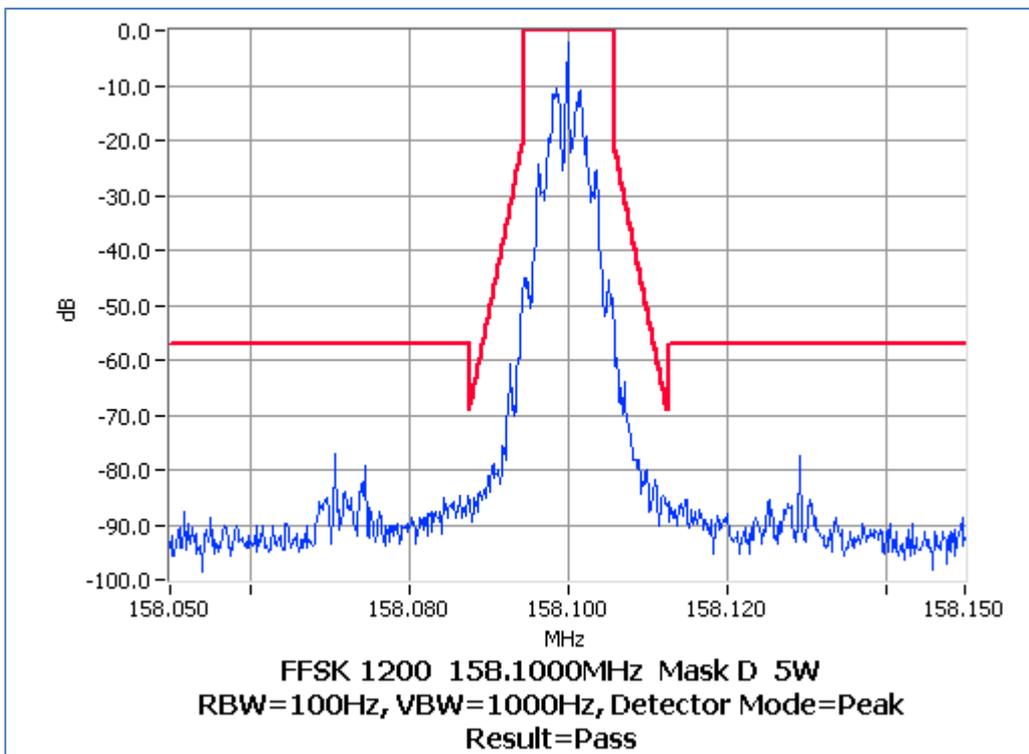
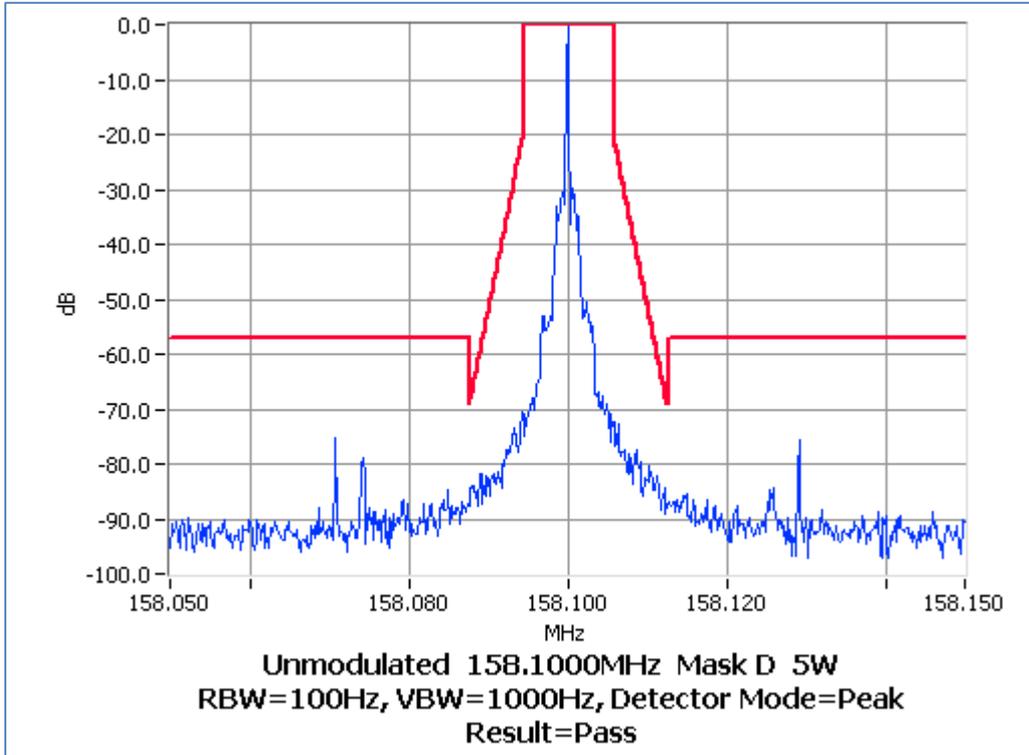


Occupied Bandwidth and Spectrum Masks

FFSK – 1200 bps

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

Tx FREQUENCY: 158.1 MHz 5 W 12.5 kHz Channel Spacing

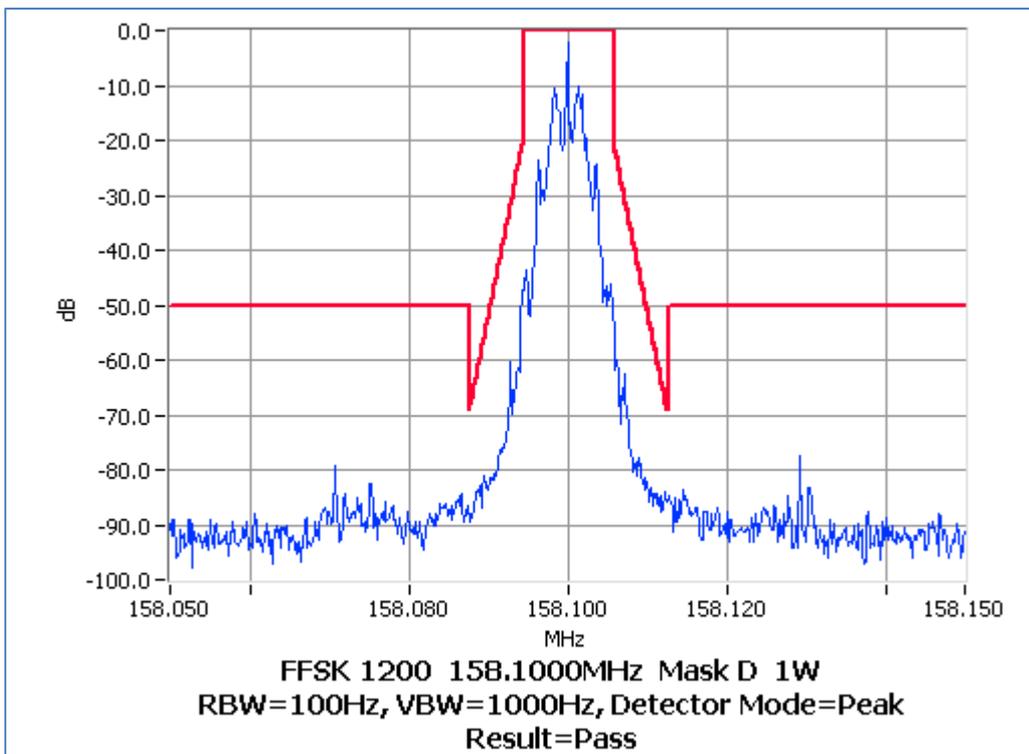
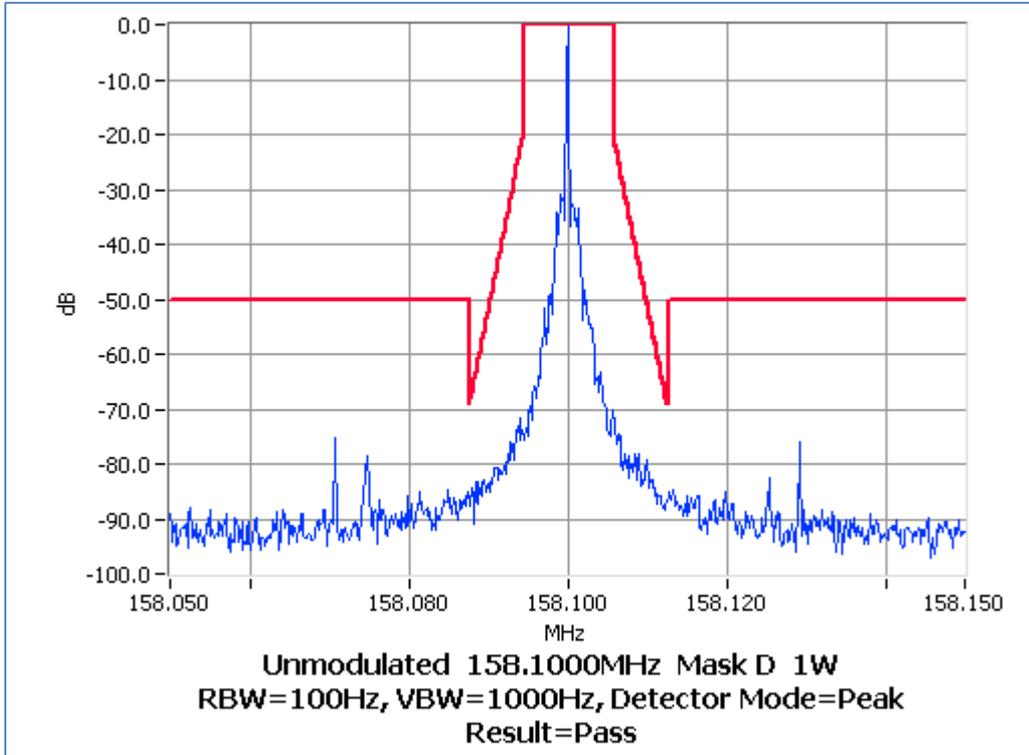


Occupied Bandwidth and Spectrum Masks

FFSK – 1200 bps

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

Tx FREQUENCY: 158.1 MHz 1 W 12.5 kHz Channel Spacing

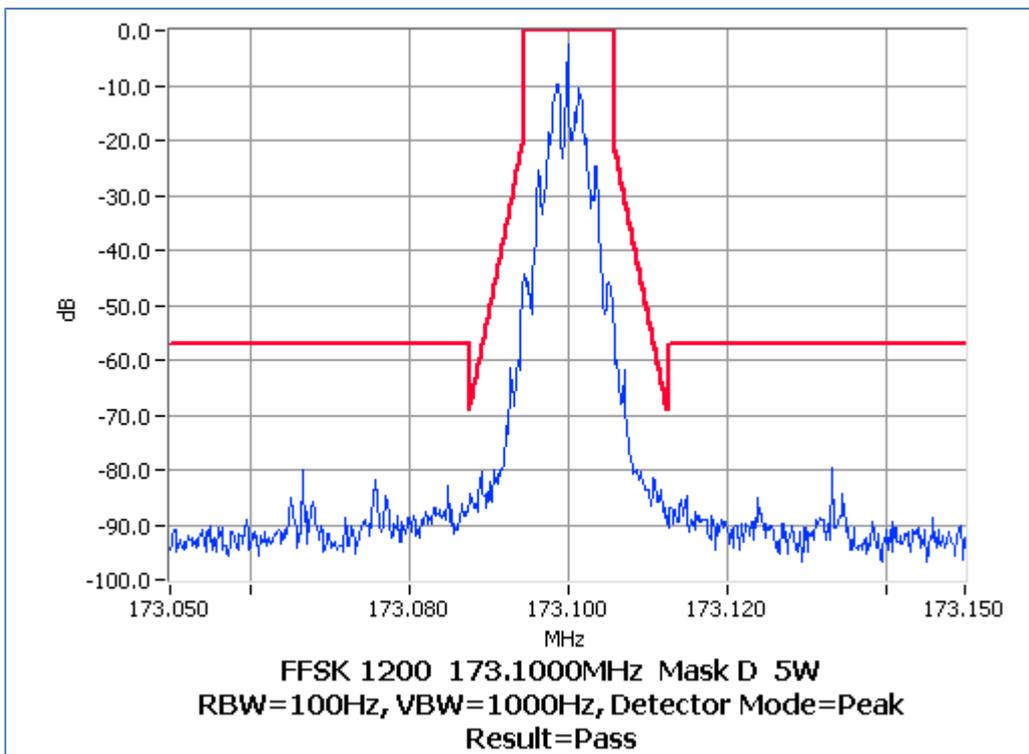
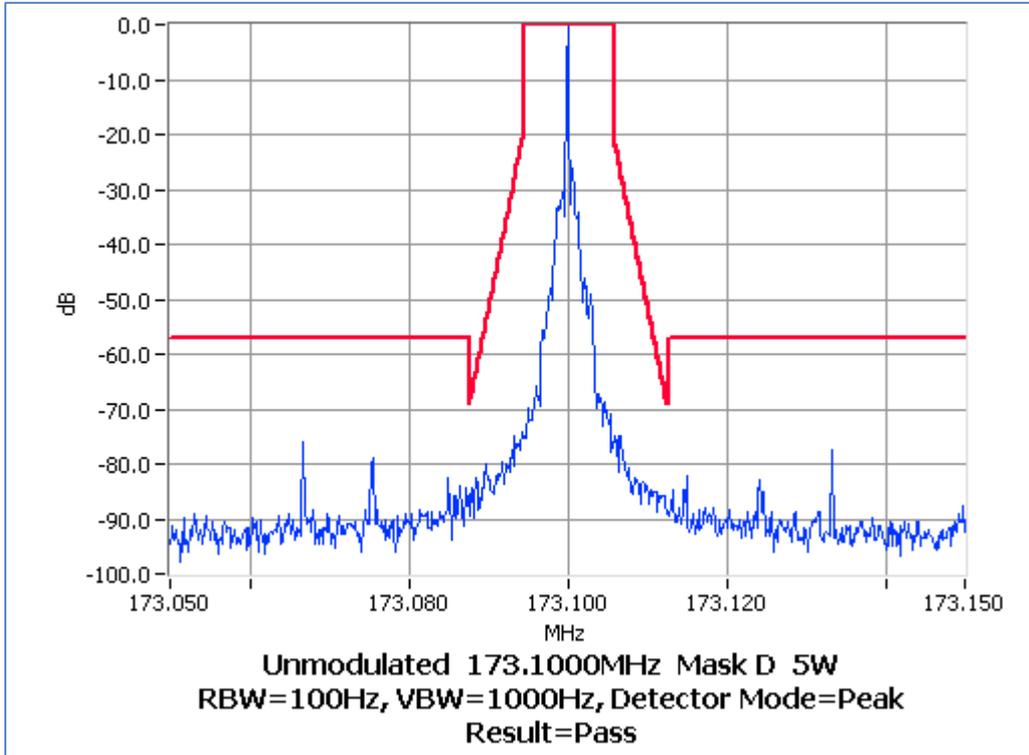


Occupied Bandwidth and Spectrum Masks

FFSK – 1200 bps

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

Tx FREQUENCY: 173.1 MHz 5 W 12.5 kHz Channel Spacing

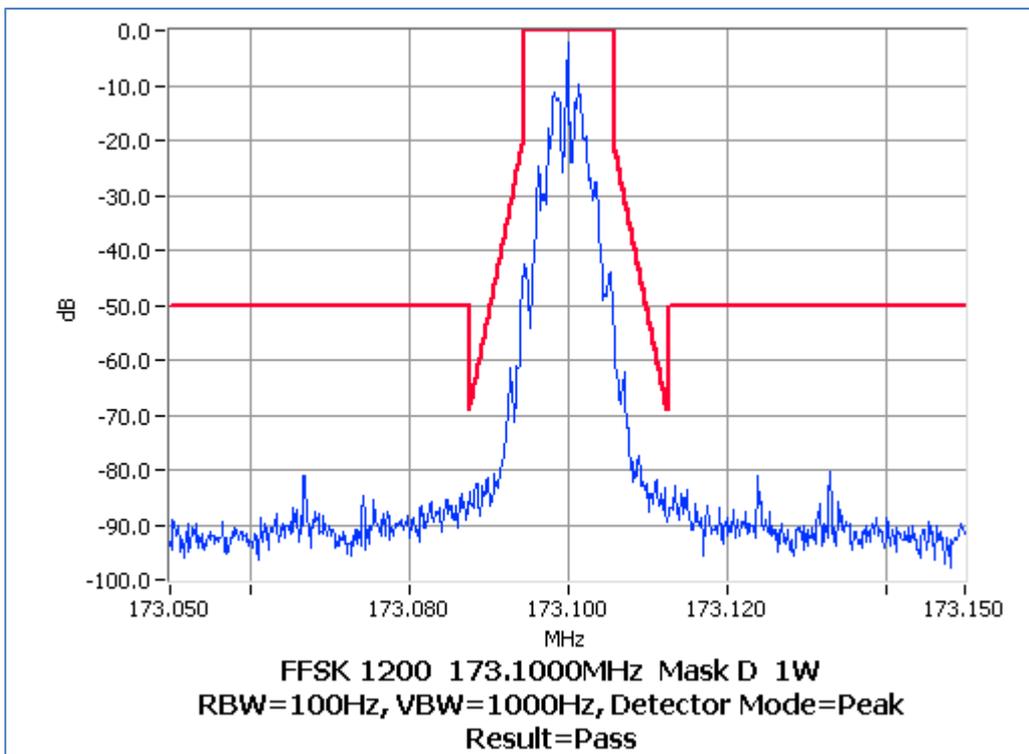
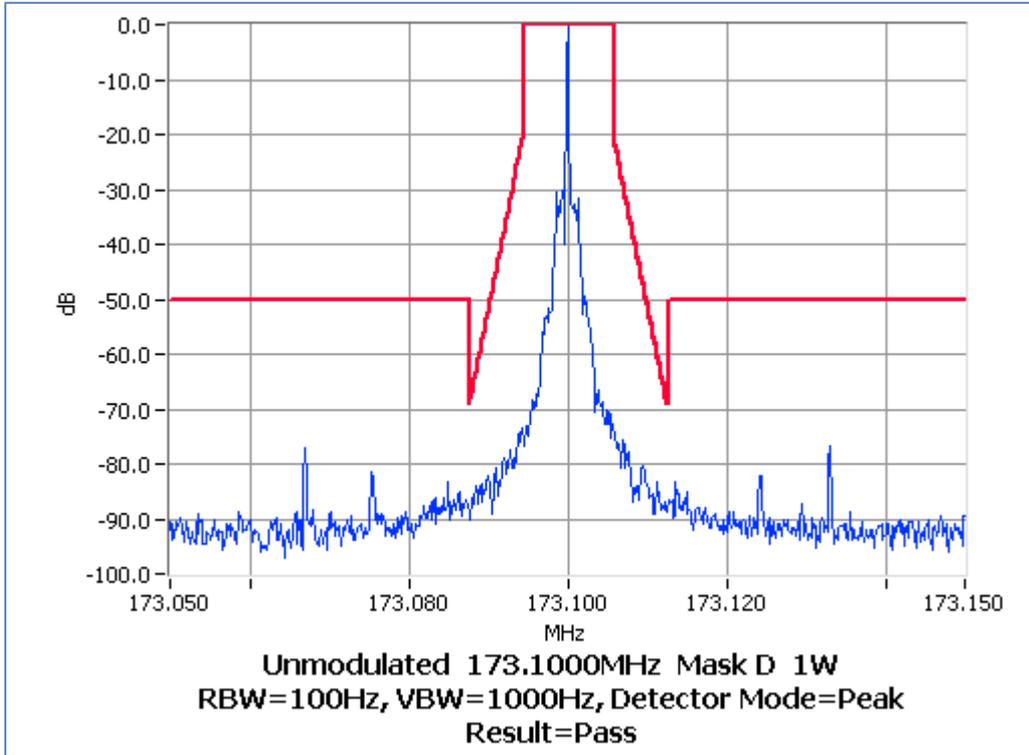


Occupied Bandwidth and Spectrum Masks

FFSK – 1200 bps

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

Tx FREQUENCY: 173.1 MHz 1 W 12.5 kHz Channel Spacing

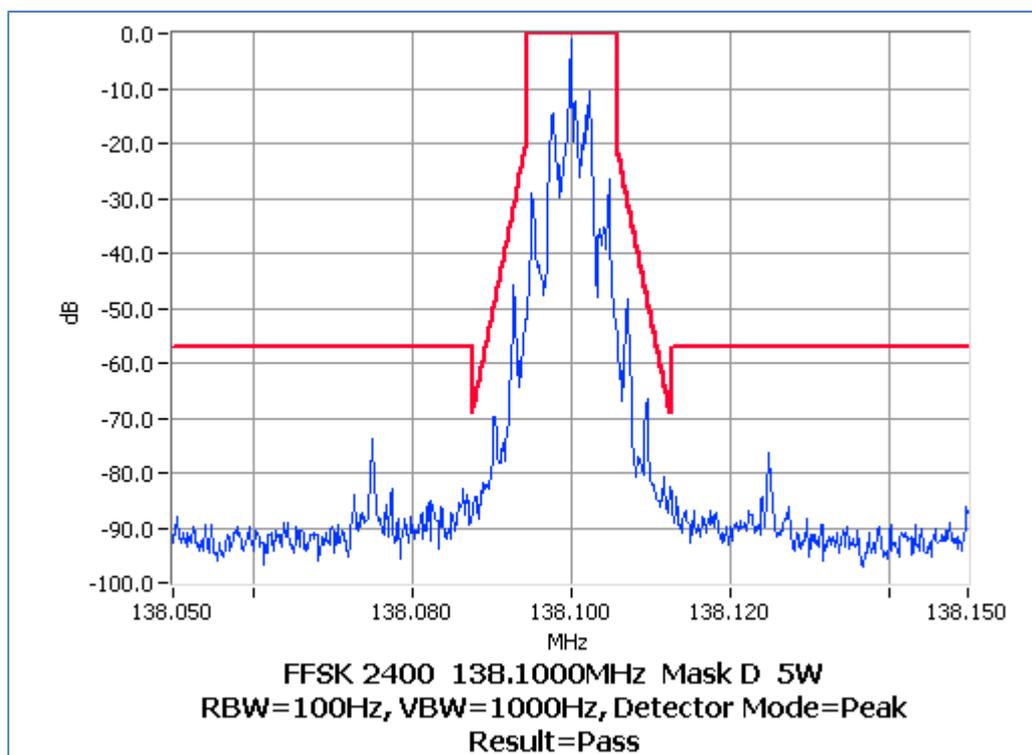
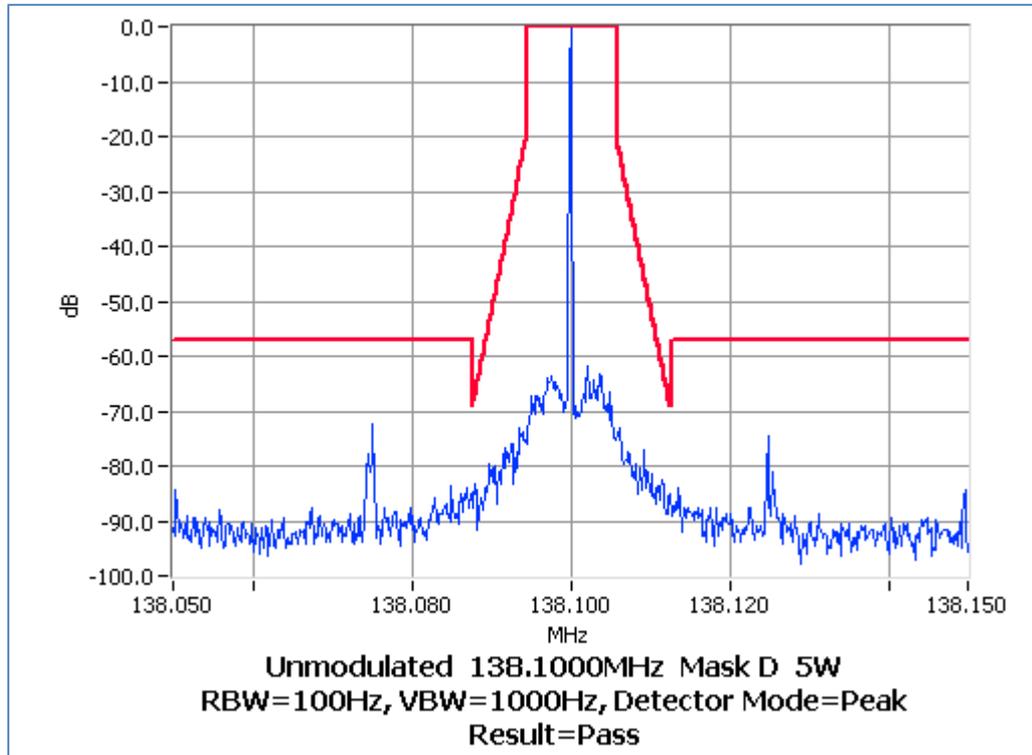


Occupied Bandwidth and Spectrum Masks

FFSK – 2400 bps

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

Tx FREQUENCY: 138.1 MHz 5 W 12.5 kHz Channel Spacing

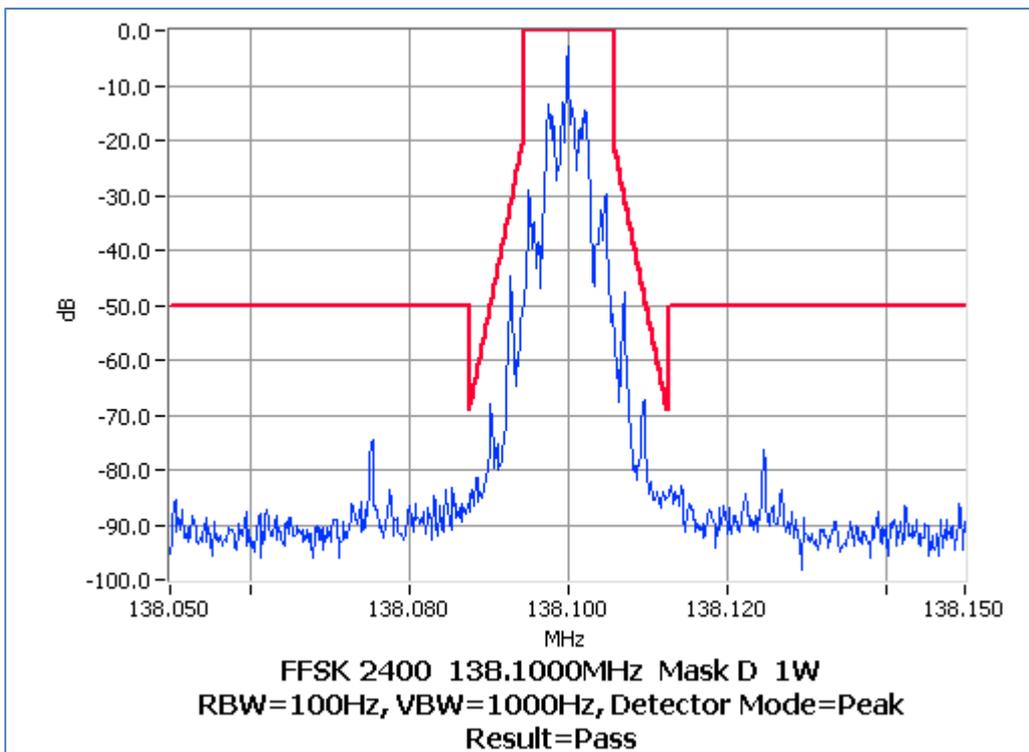
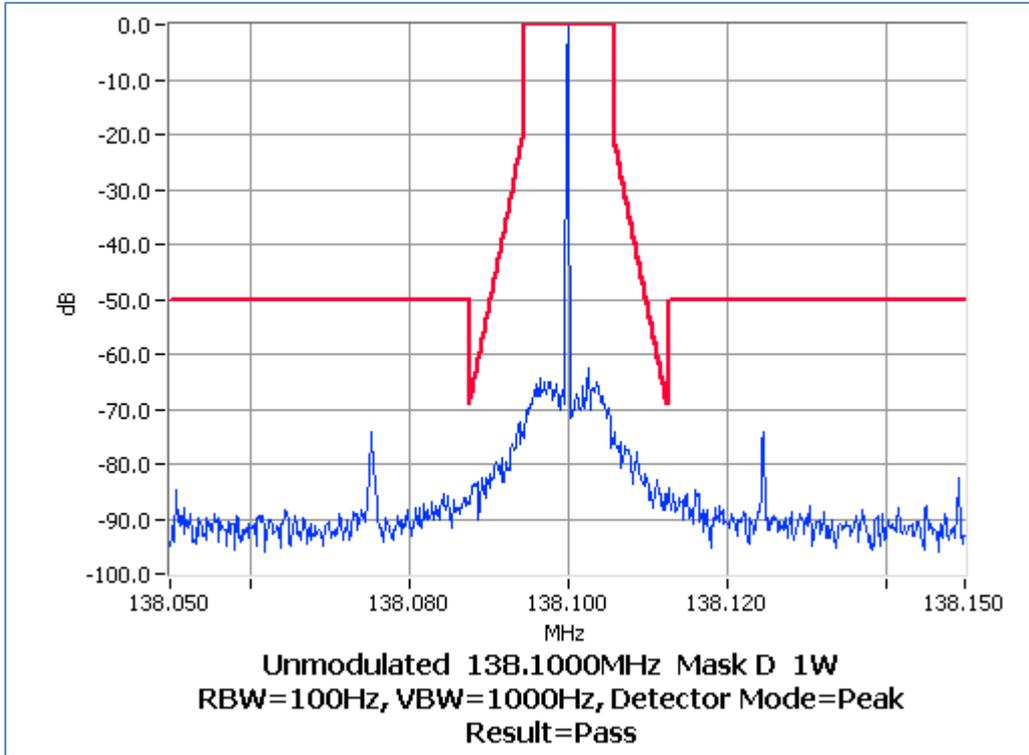


Occupied Bandwidth and Spectrum Masks

FFSK – 2400 bps

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

Tx FREQUENCY: 138.1 MHz 1 W 12.5 kHz Channel Spacing

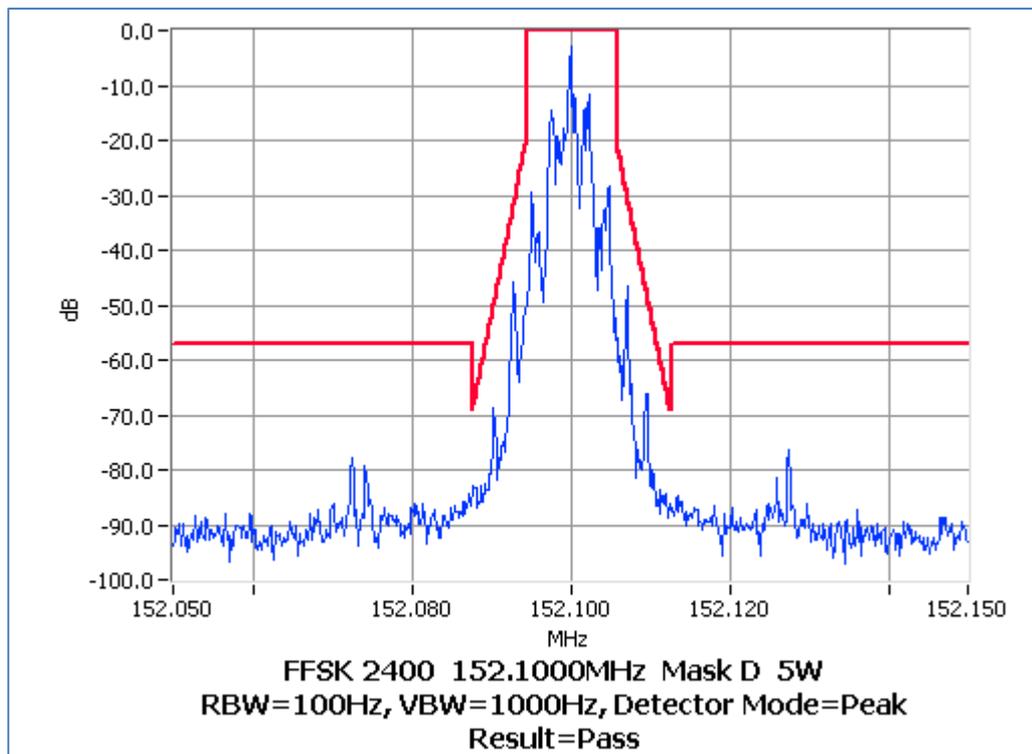
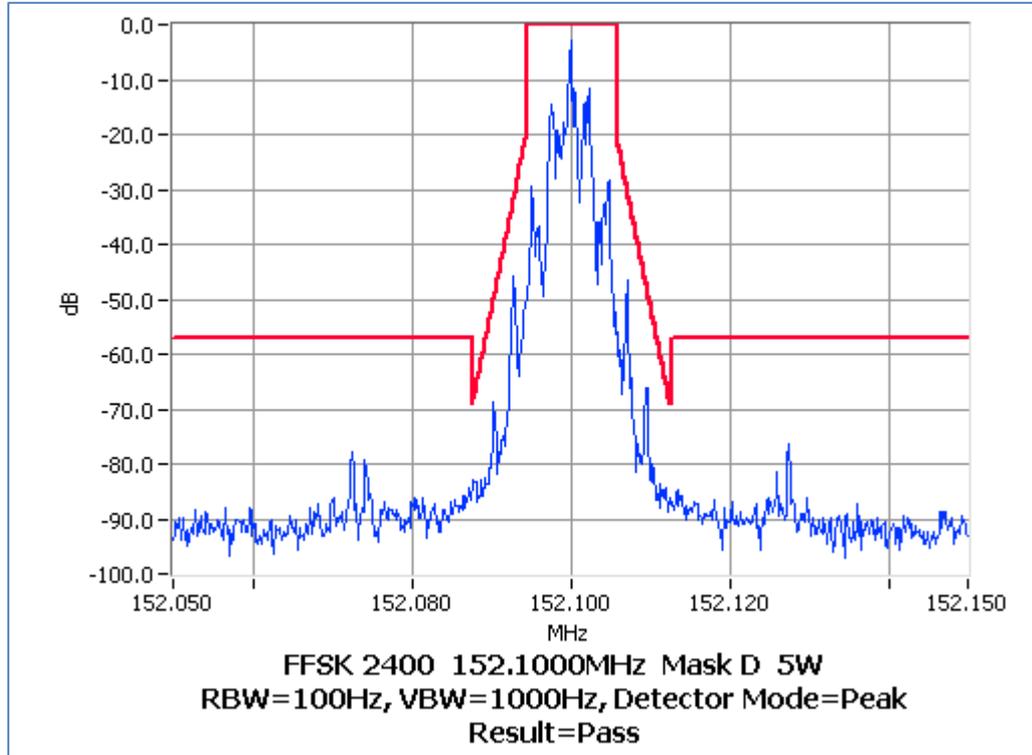


Occupied Bandwidth and Spectrum Masks

FFSK – 2400 bps

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

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing

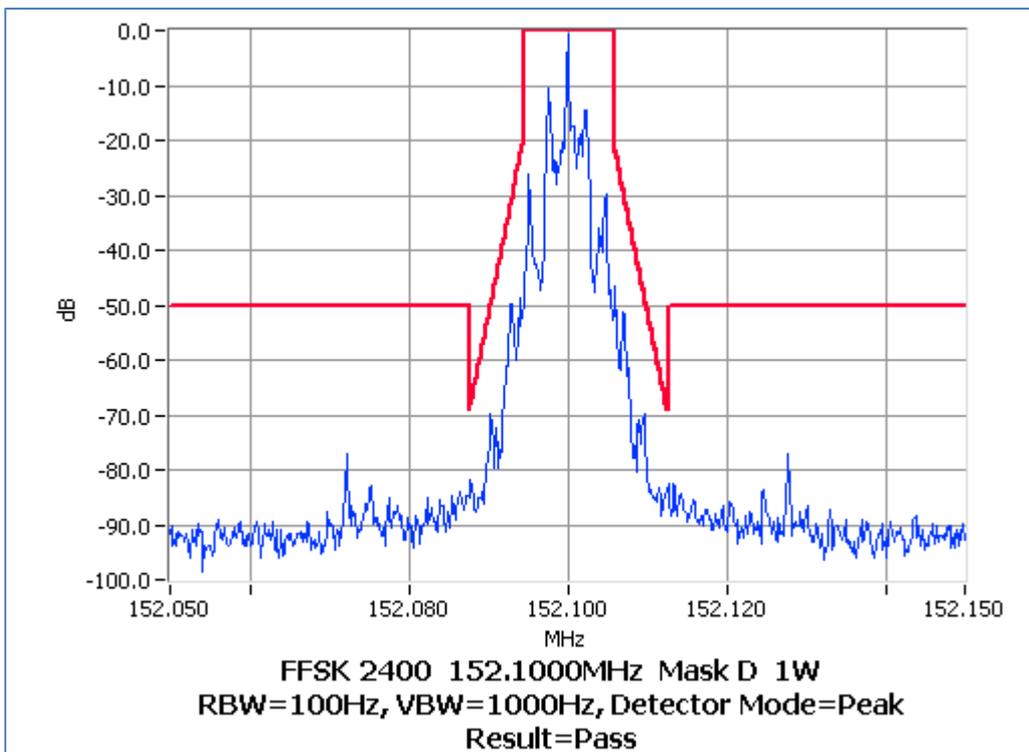
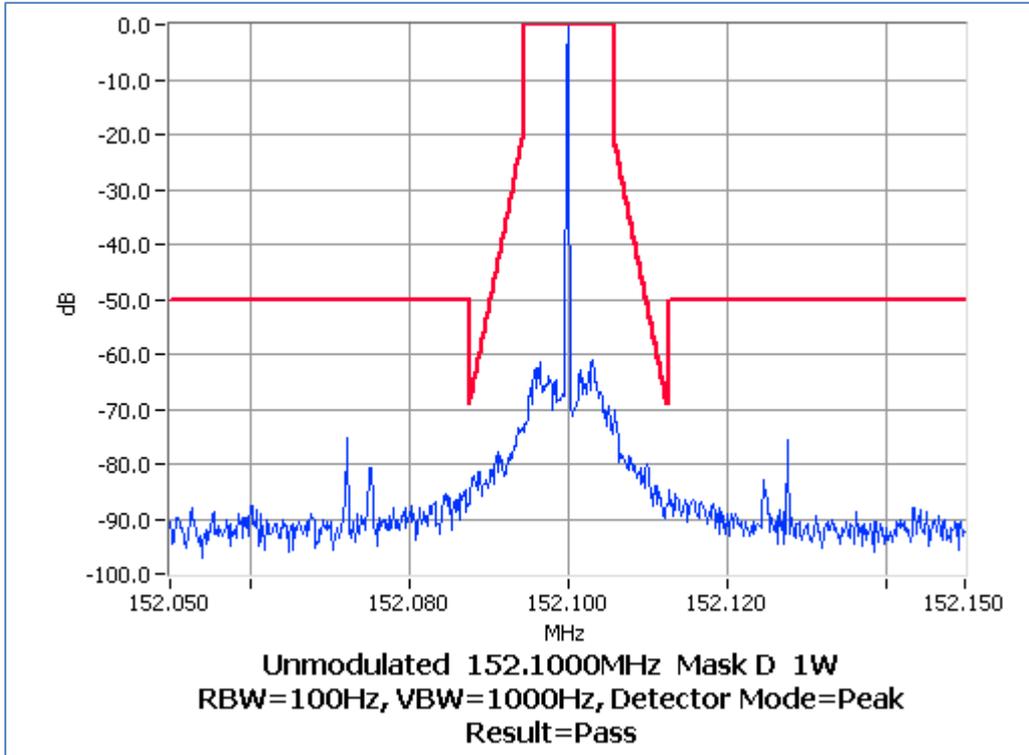


Occupied Bandwidth and Spectrum Masks

FFSK – 2400 bps

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

Tx FREQUENCY: 152.1 MHz 1 W 12.5 kHz Channel Spacing

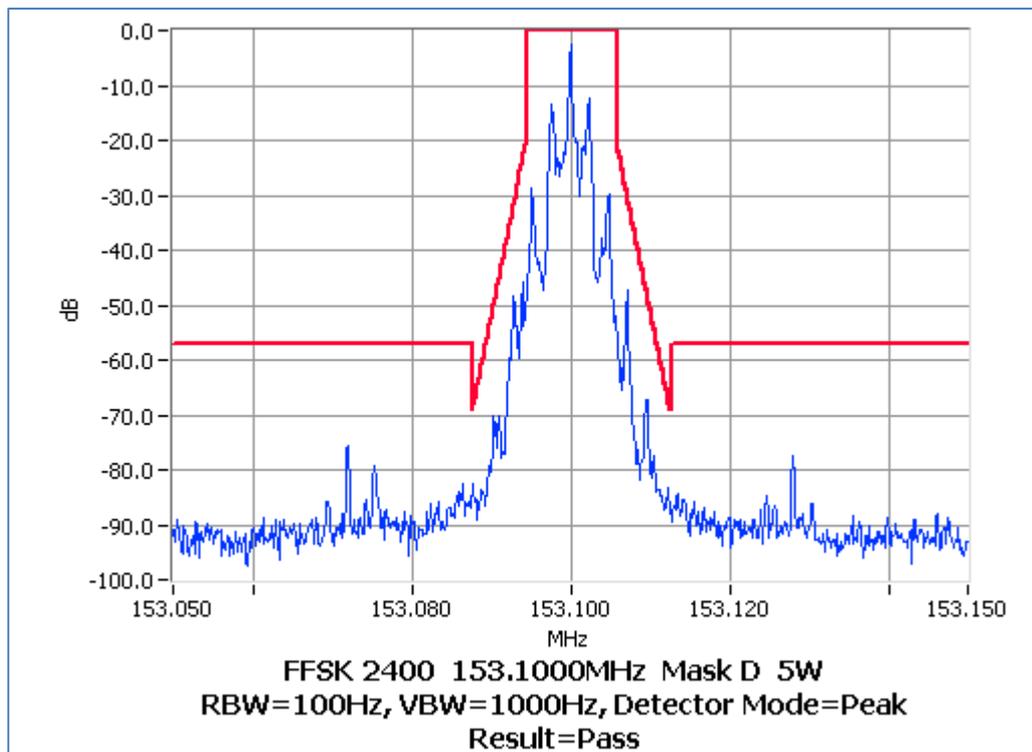
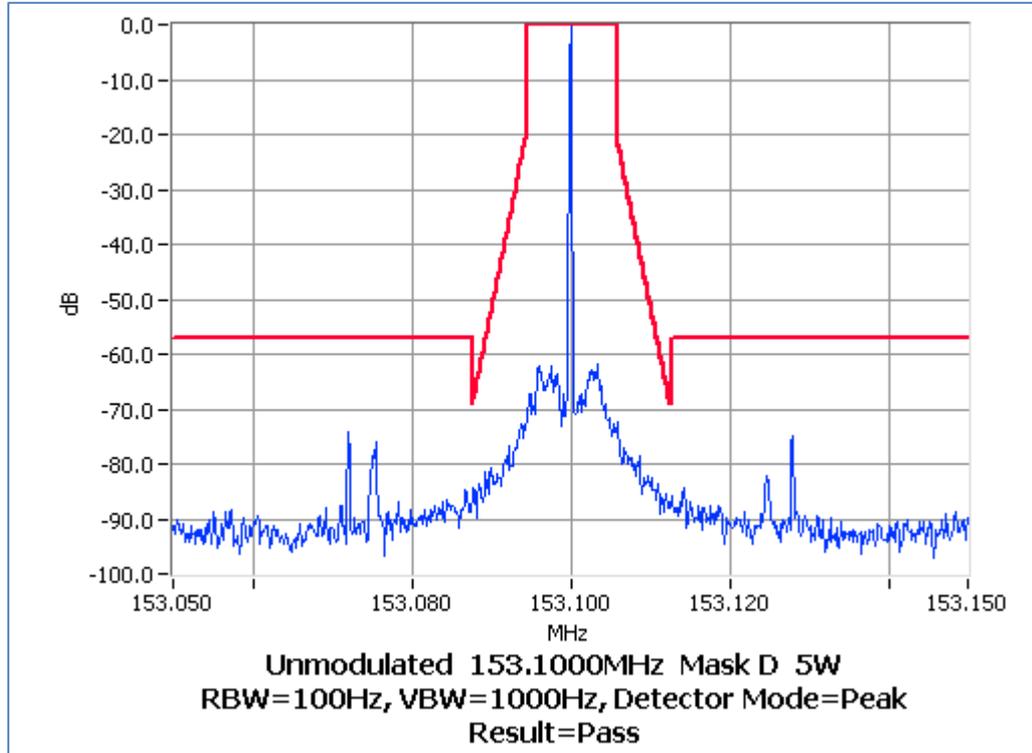


Occupied Bandwidth and Spectrum Masks

FFSK – 2400 bps

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

Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing

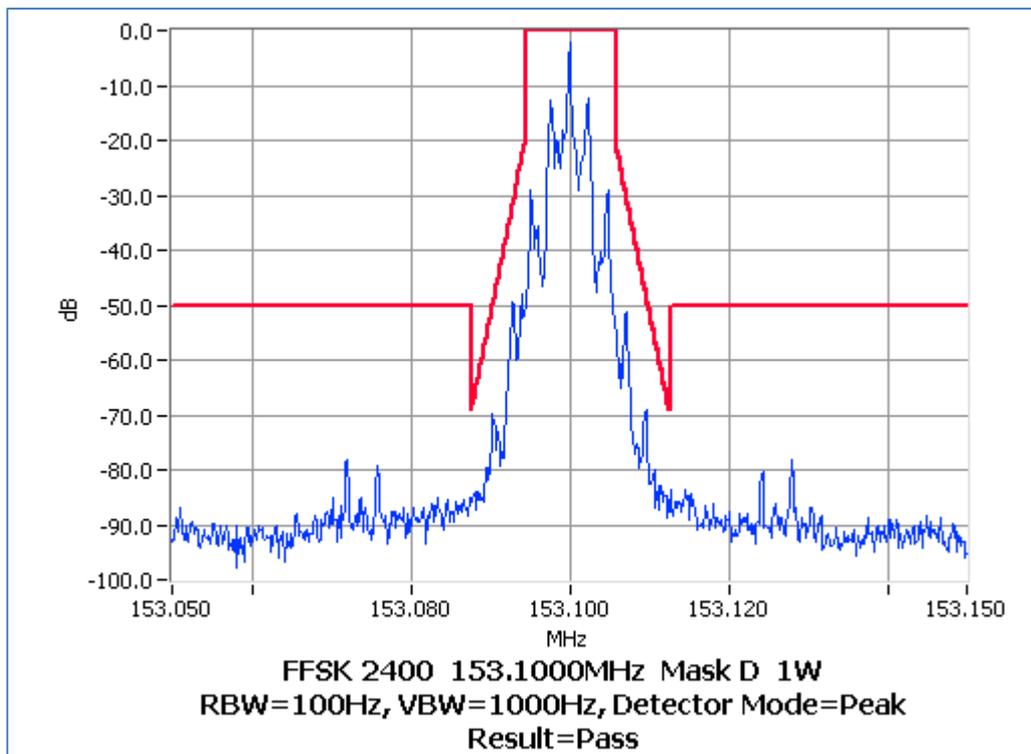
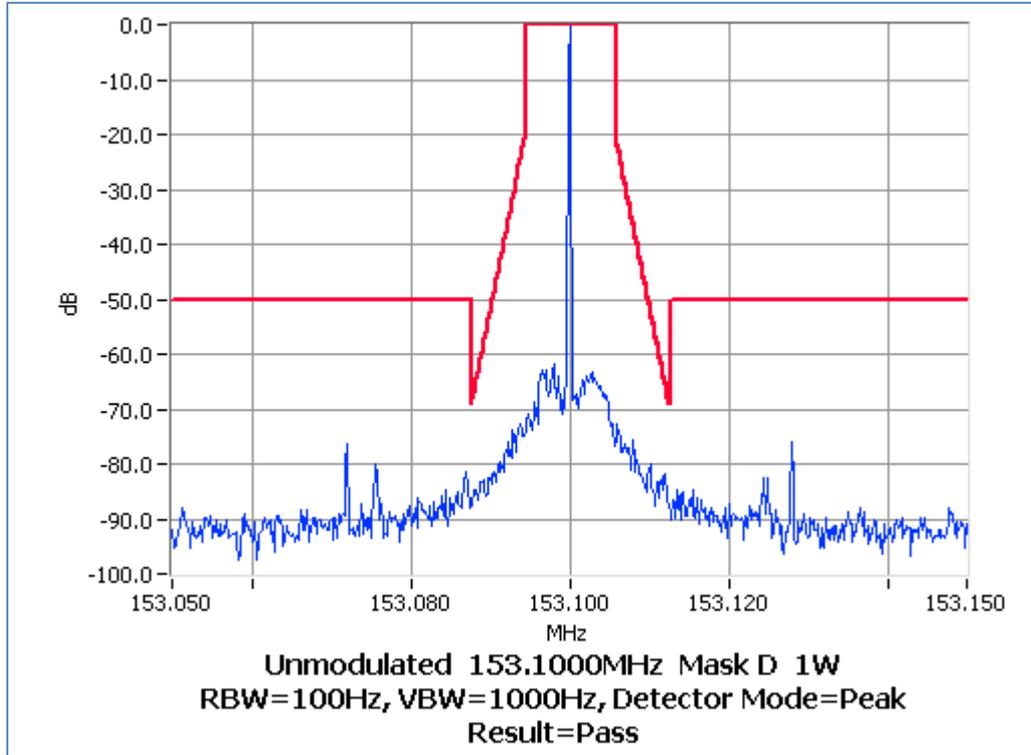


Occupied Bandwidth and Spectrum Masks

FFSK – 2400 bps

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

Tx FREQUENCY: 153.1 MHz 1 W 12.5 kHz Channel Spacing

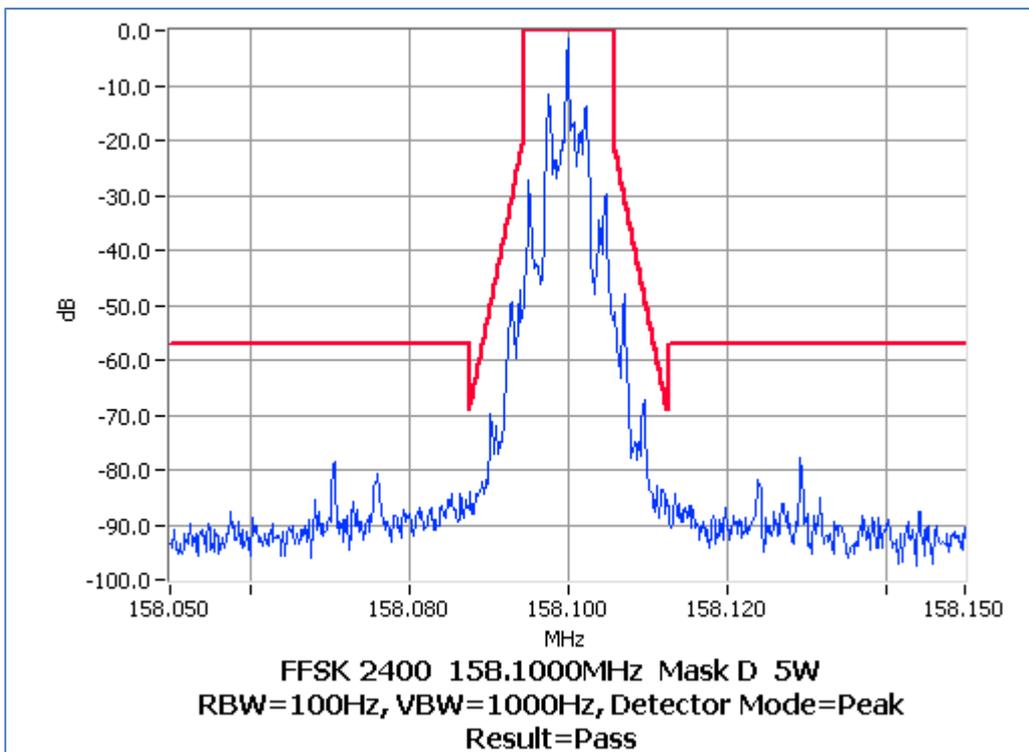
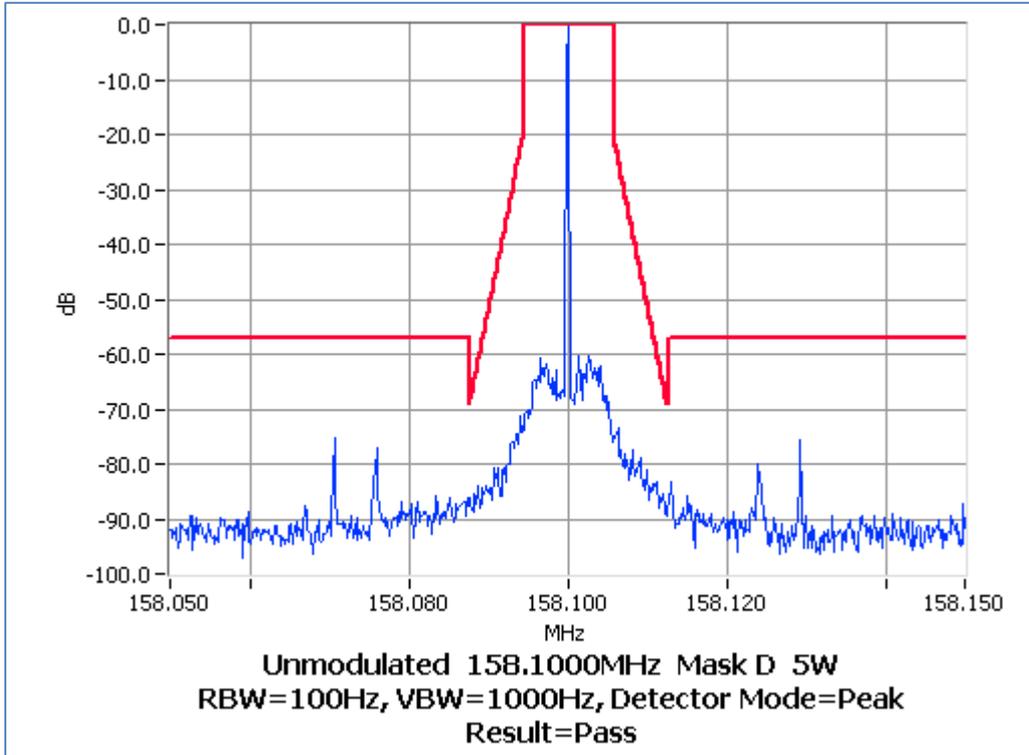


Occupied Bandwidth and Spectrum Masks

FFSK – 2400 bps

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

Tx FREQUENCY: 158.1 MHz 5 W 12.5 kHz Channel Spacing

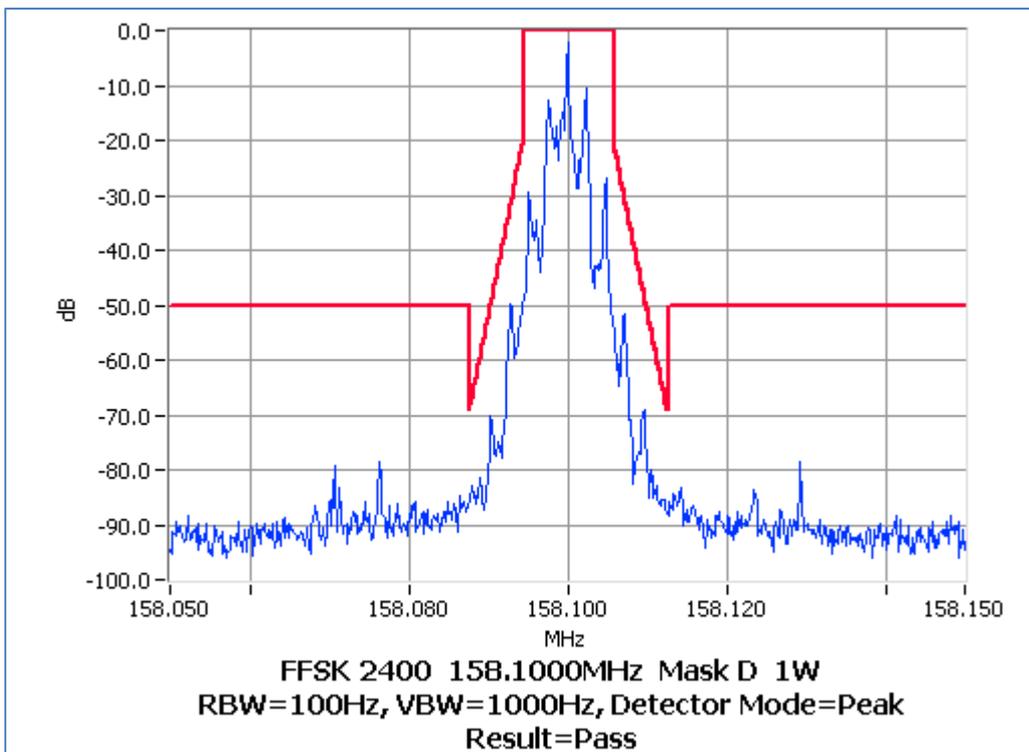
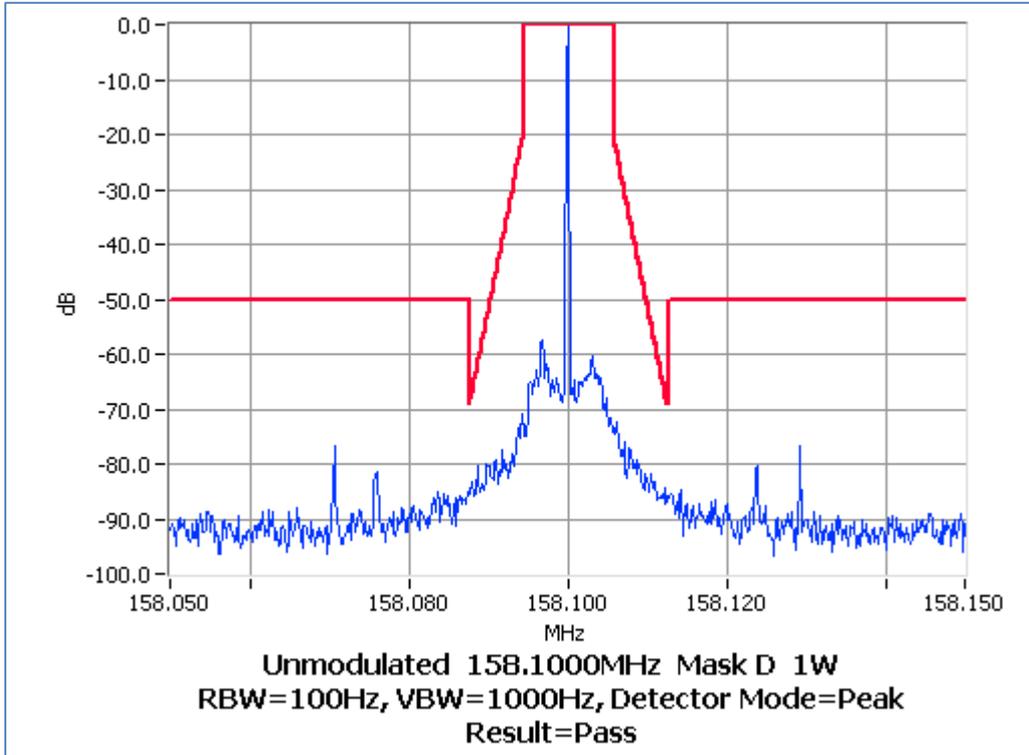


Occupied Bandwidth and Spectrum Masks

FFSK – 2400 bps

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

Tx FREQUENCY: 158.1 MHz 1 W 12.5 kHz Channel Spacing

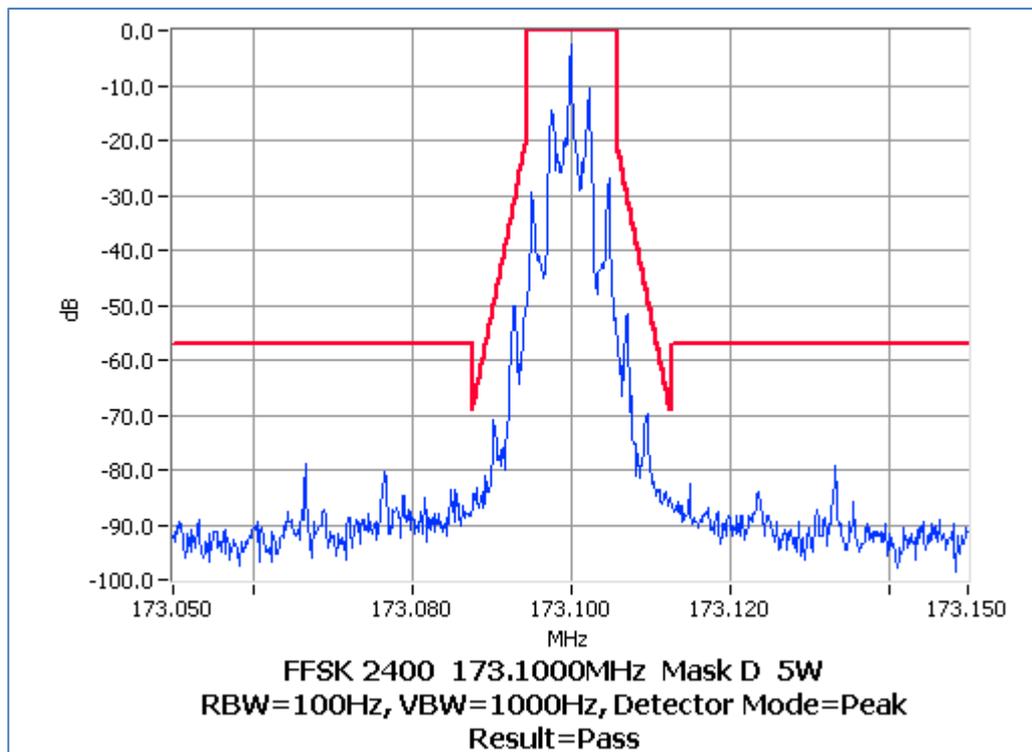
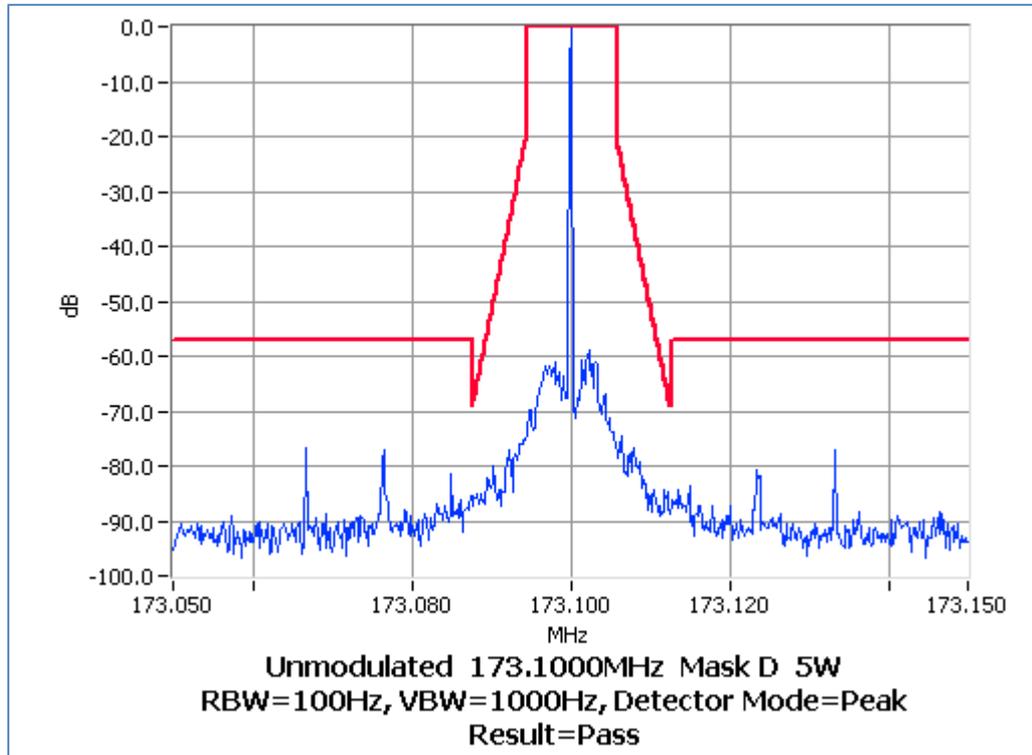


Occupied Bandwidth and Spectrum Masks

FFSK – 2400 bps

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

Tx FREQUENCY: 173.1 MHz 5 W 12.5 kHz Channel Spacing

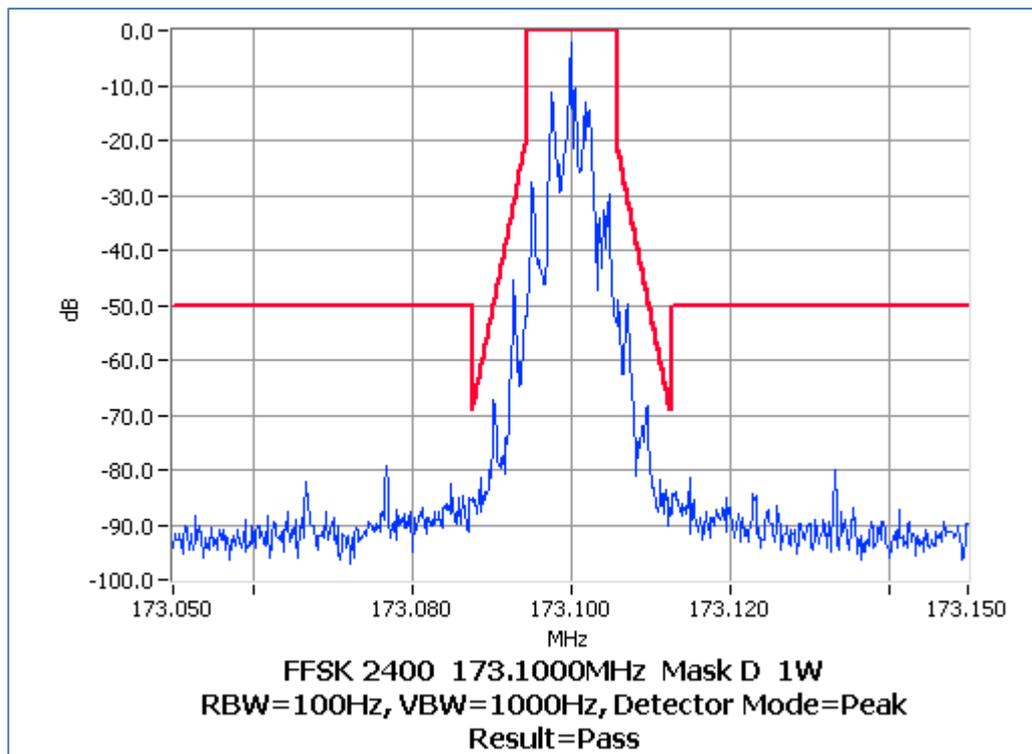
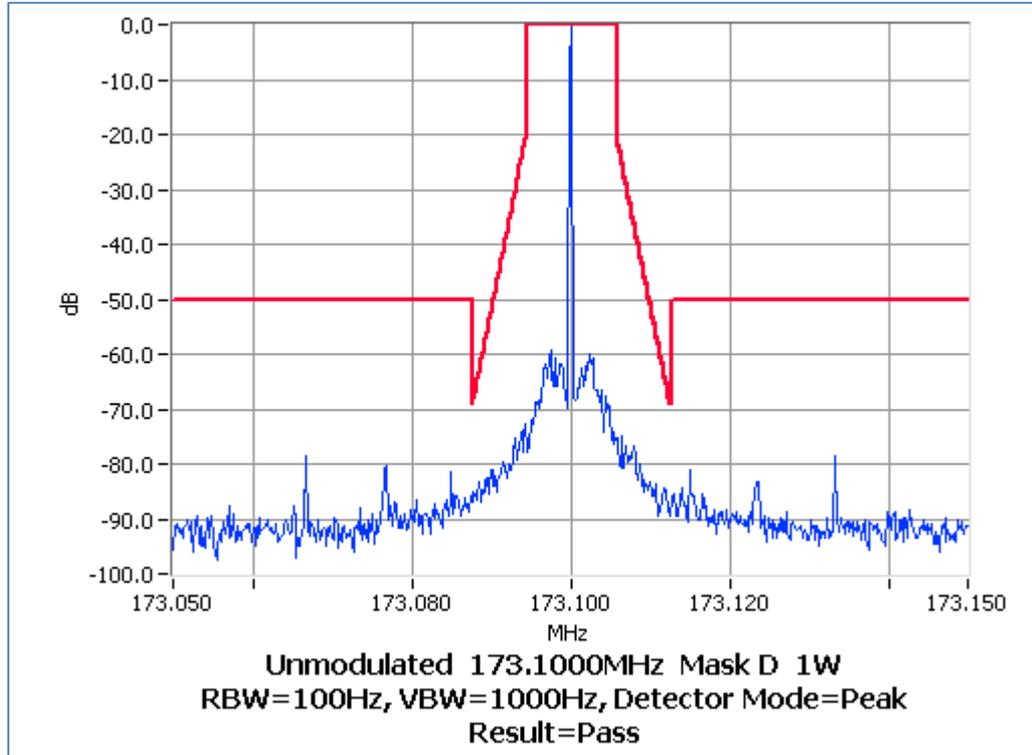


Occupied Bandwidth and Spectrum Masks

FFSK – 2400 bps

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

Tx FREQUENCY: 173.1 MHz 1 W 12.5 kHz Channel Spacing

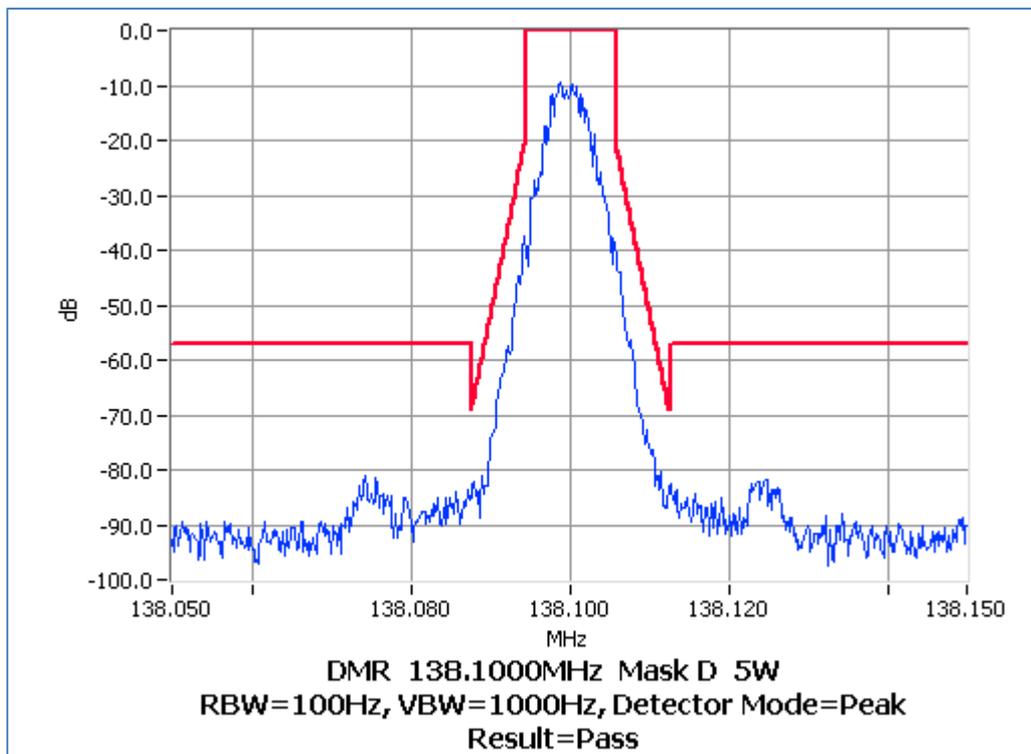
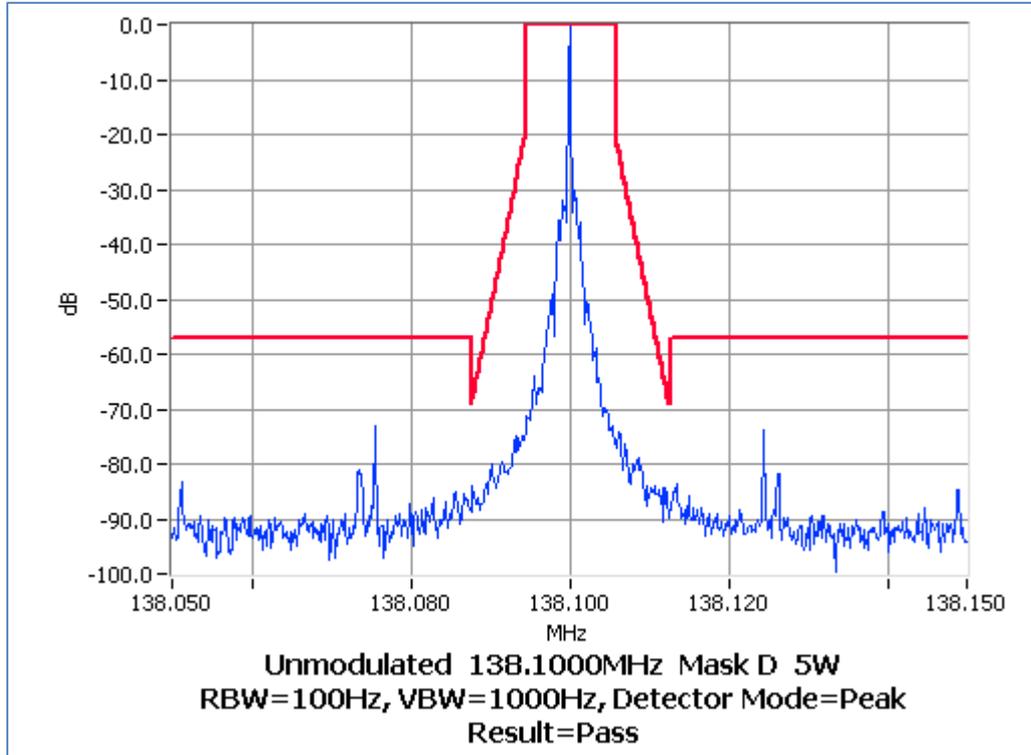


Occupied Bandwidth and Spectrum Masks

DMR

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

Tx FREQUENCY: 138.1 MHz 5 W 12.5 kHz Channel Spacing

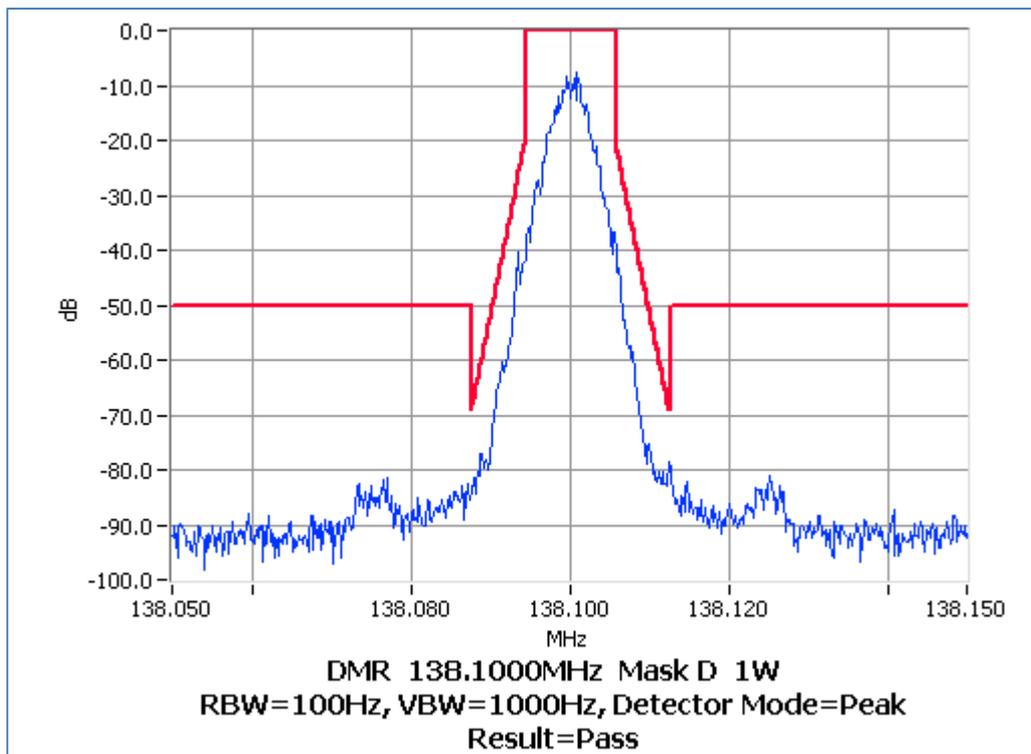
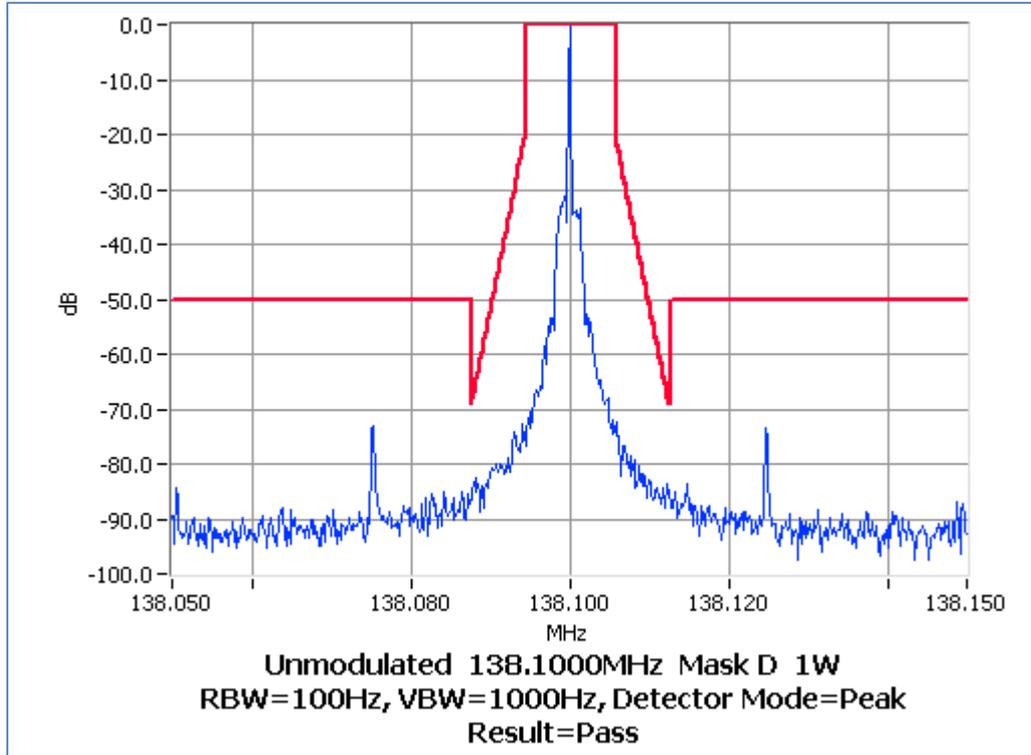


Occupied Bandwidth and Spectrum Masks

DMR

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

Tx FREQUENCY: 138.1 MHz 1 W 12.5 kHz Channel Spacing

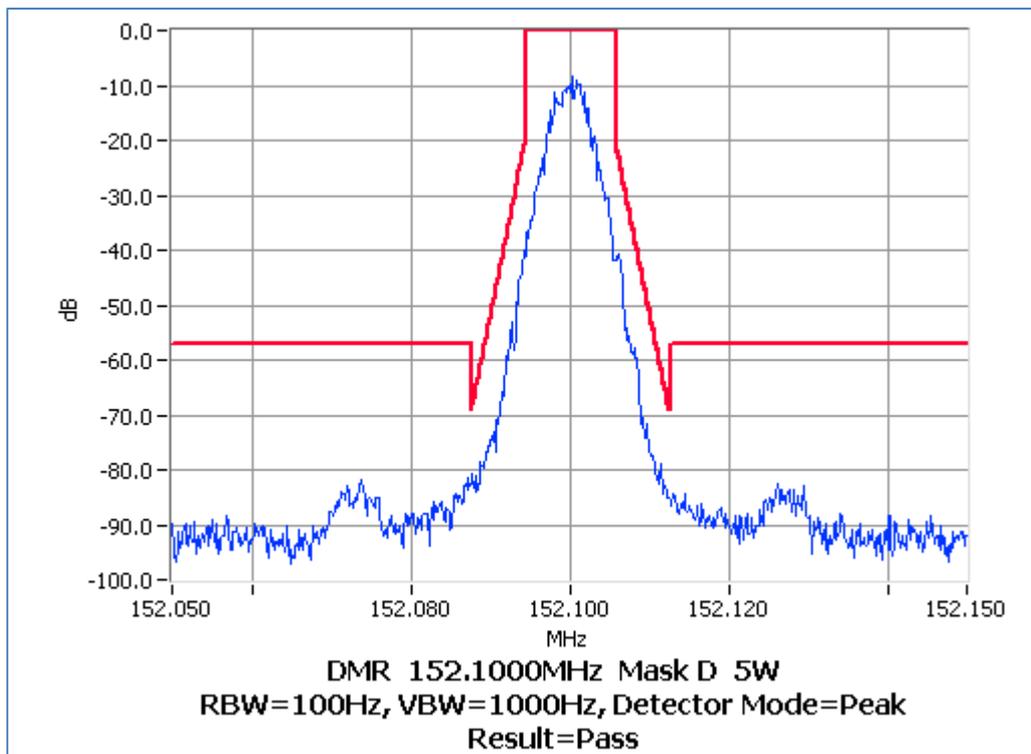
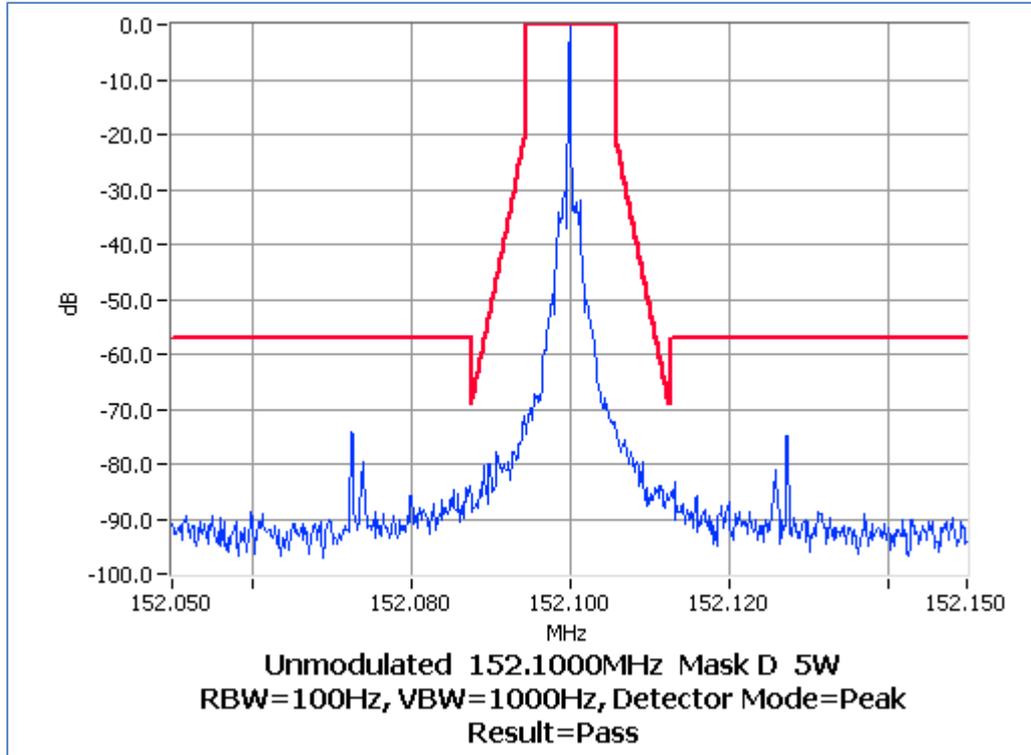


Occupied Bandwidth and Spectrum Masks

DMR

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

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing

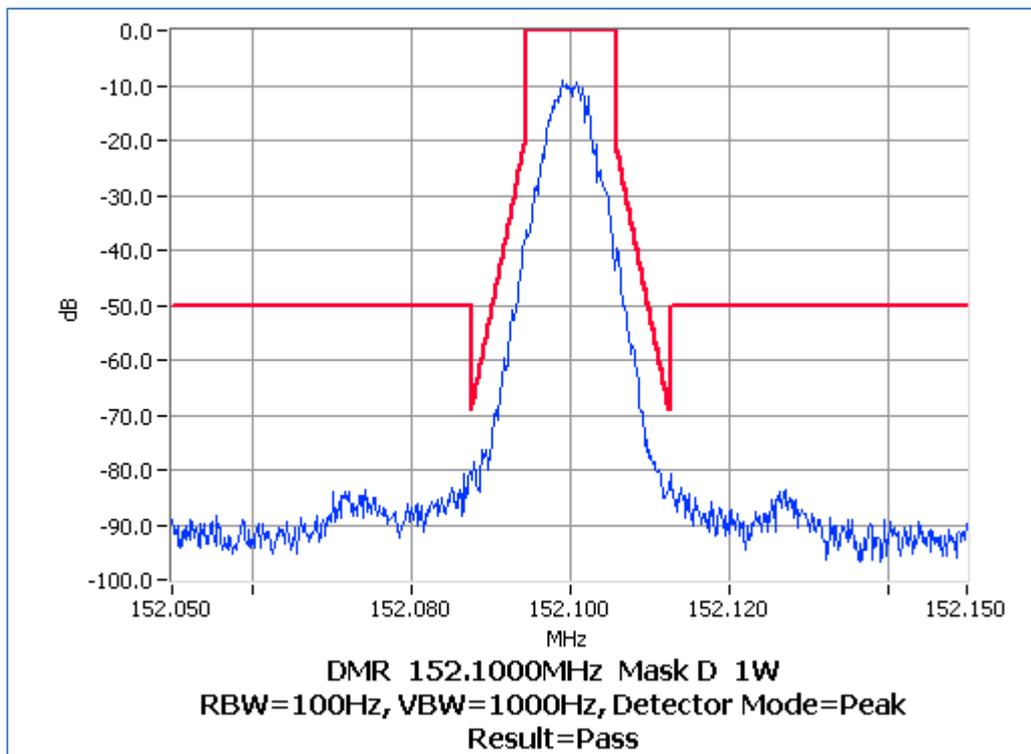
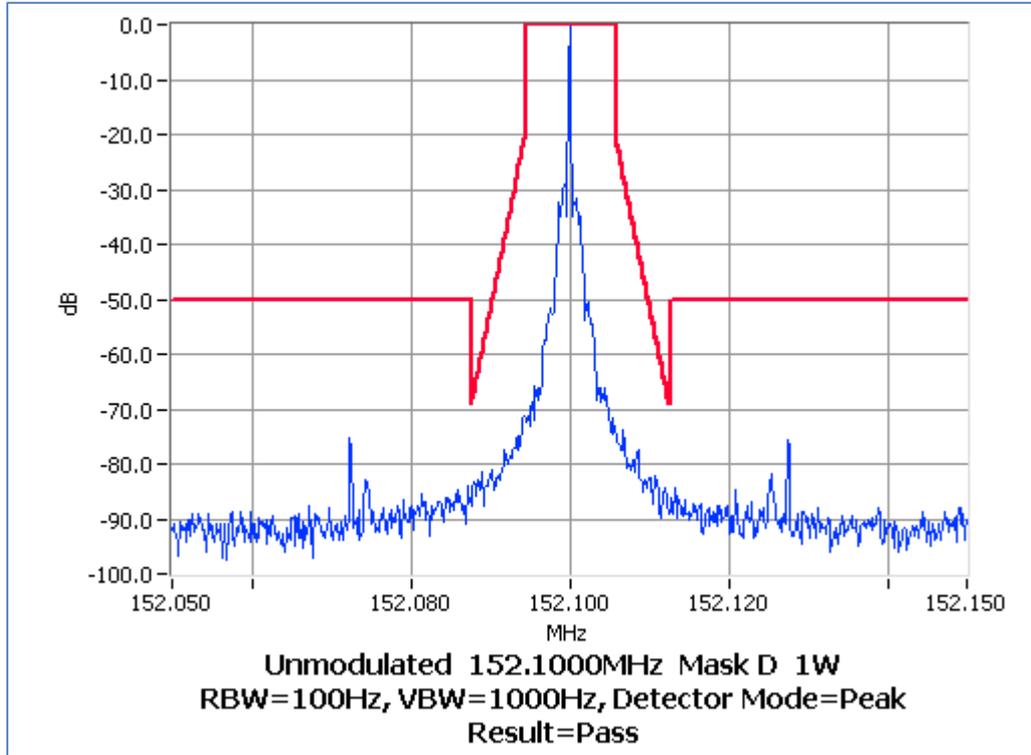


Occupied Bandwidth and Spectrum Masks

DMR

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

Tx FREQUENCY: 152.1 MHz 1 W 12.5 kHz Channel Spacing

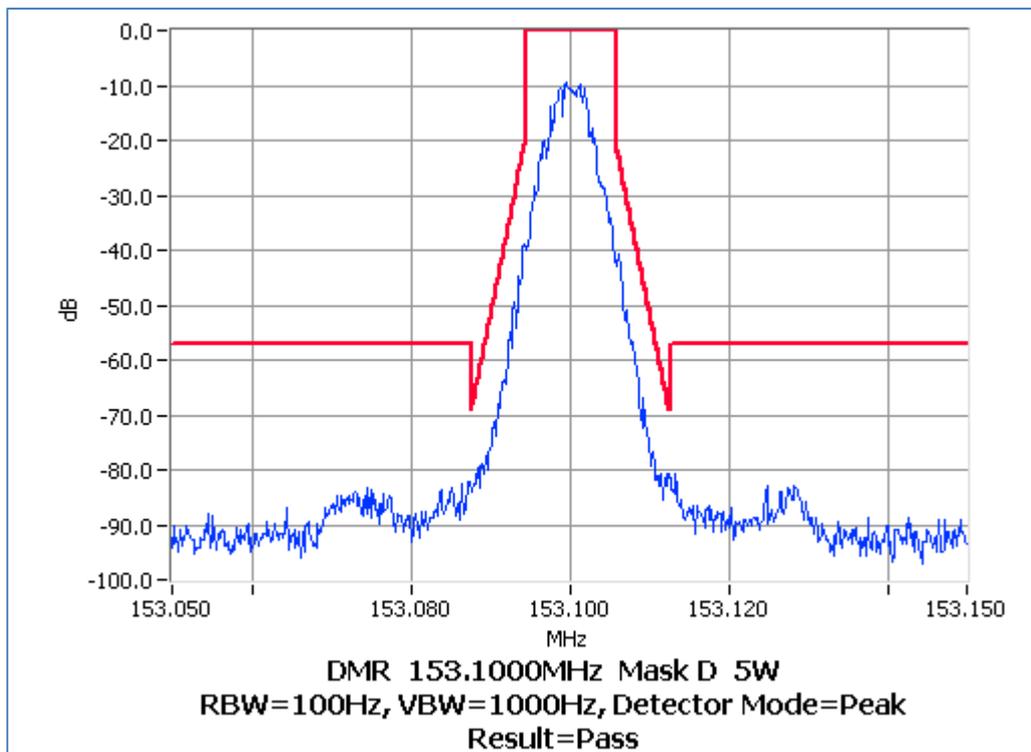
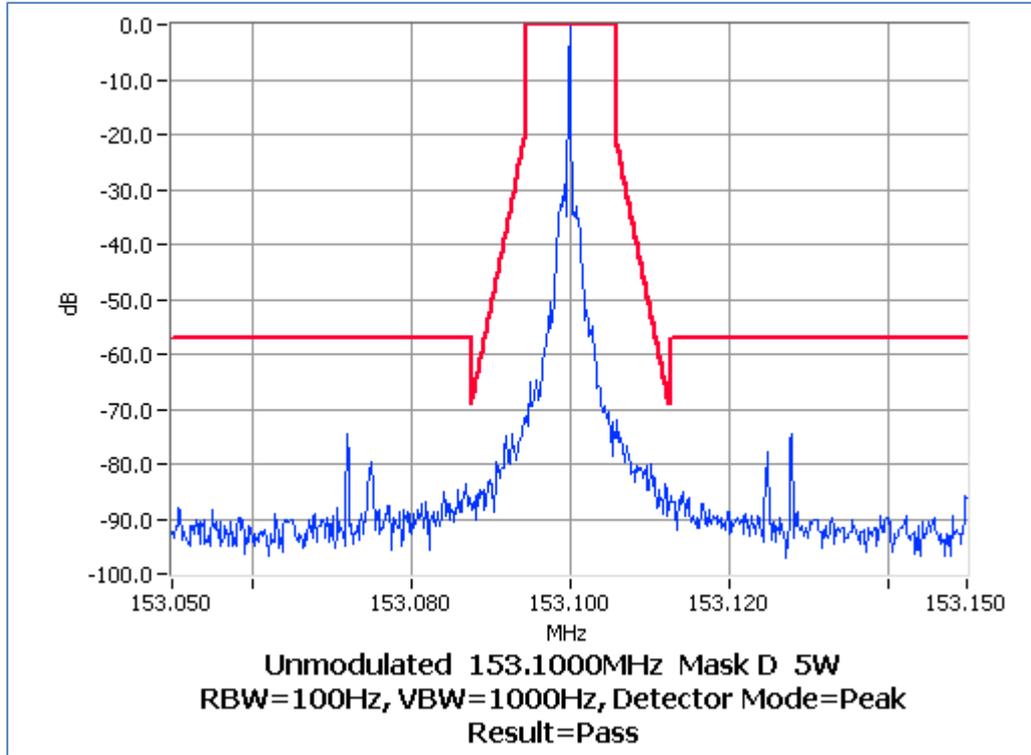


Occupied Bandwidth and Spectrum Masks

DMR

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

Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing

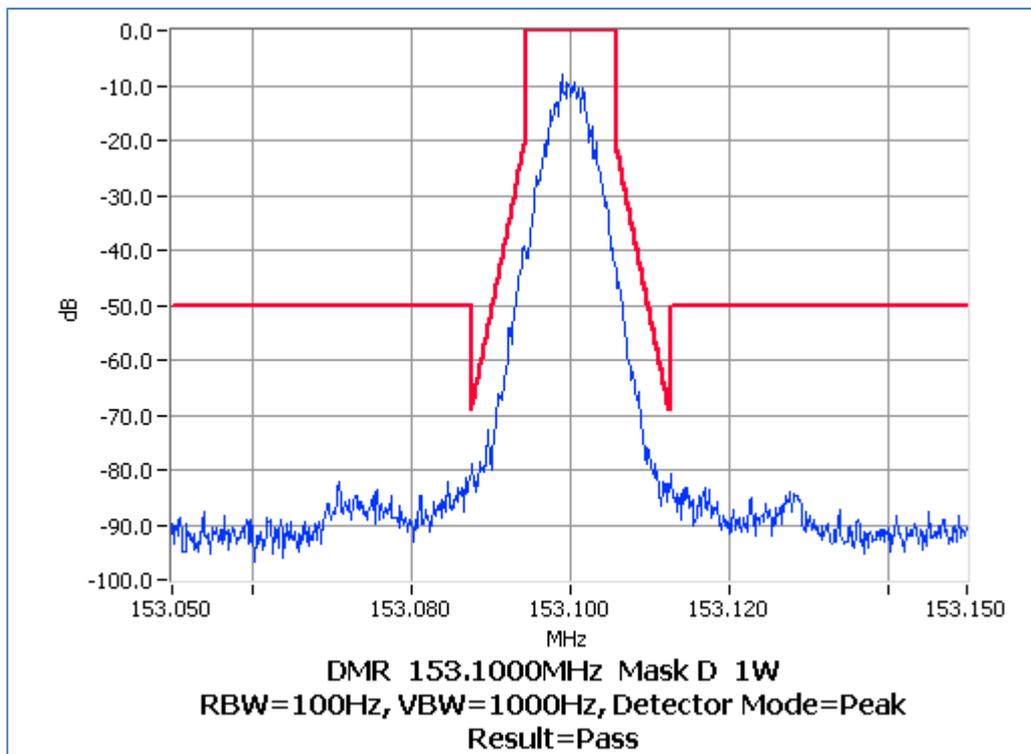
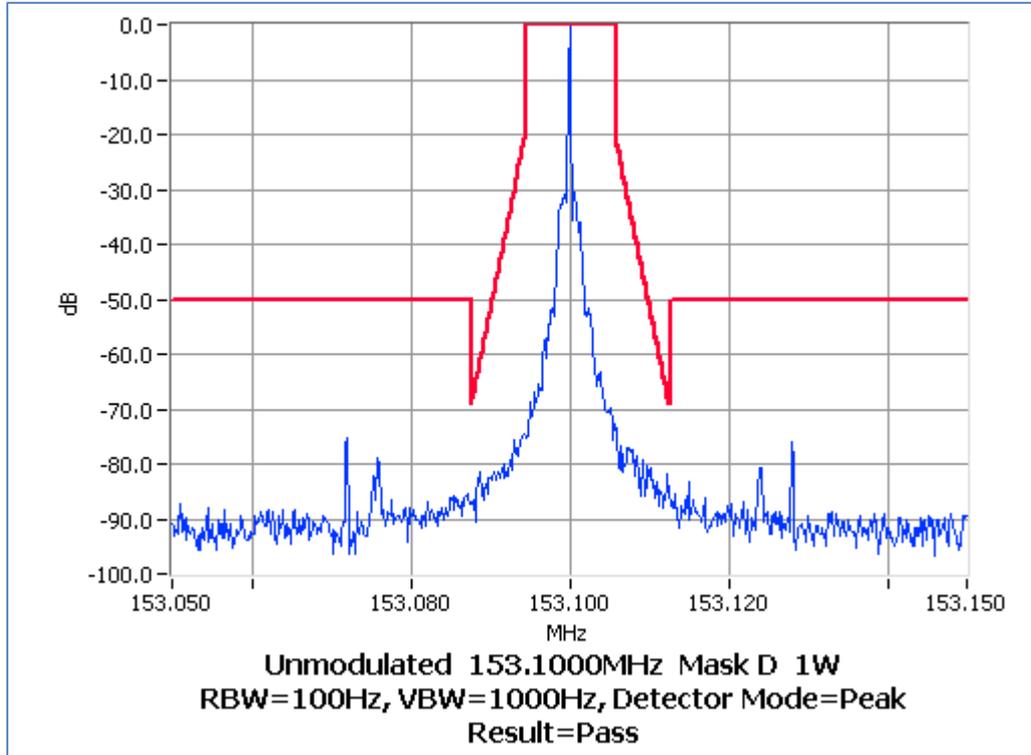


Occupied Bandwidth and Spectrum Masks

DMR

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

Tx FREQUENCY: 153.1 MHz 1 W 12.5 kHz Channel Spacing

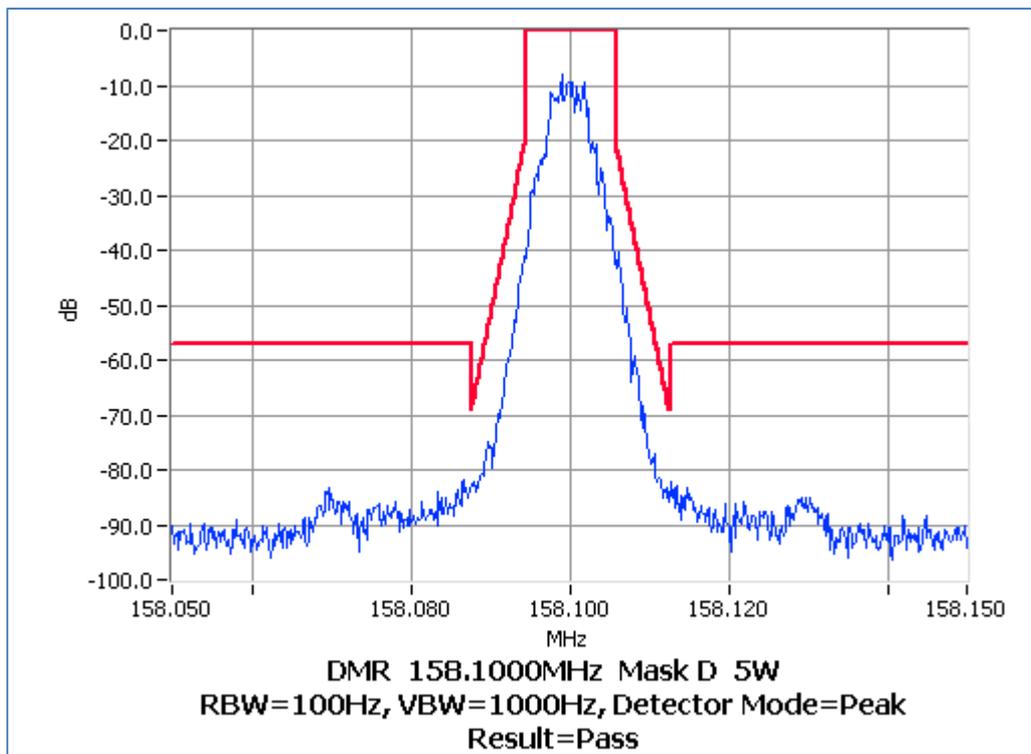
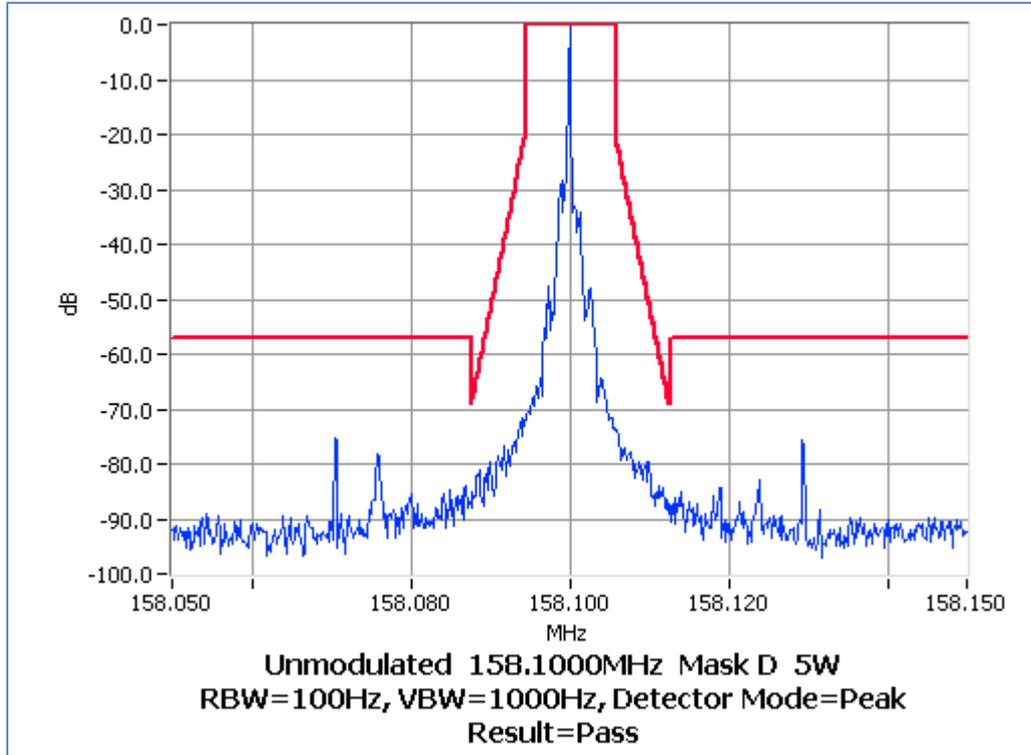


Occupied Bandwidth and Spectrum Masks

DMR

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

Tx FREQUENCY: 158.1 MHz 5 W 12.5 kHz Channel Spacing

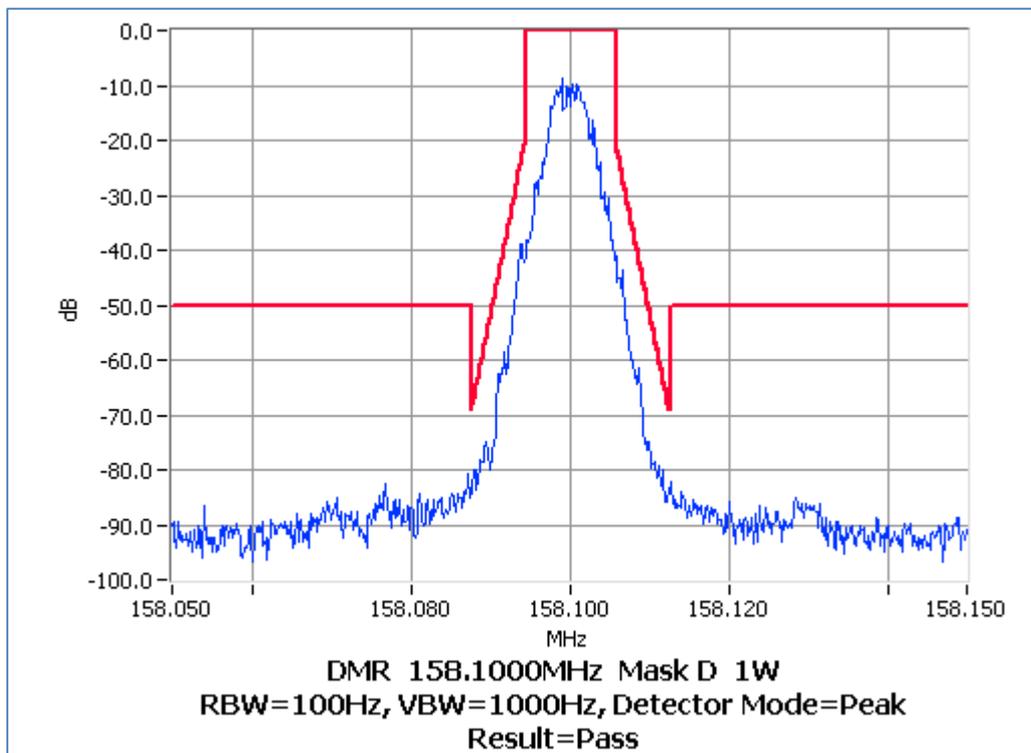
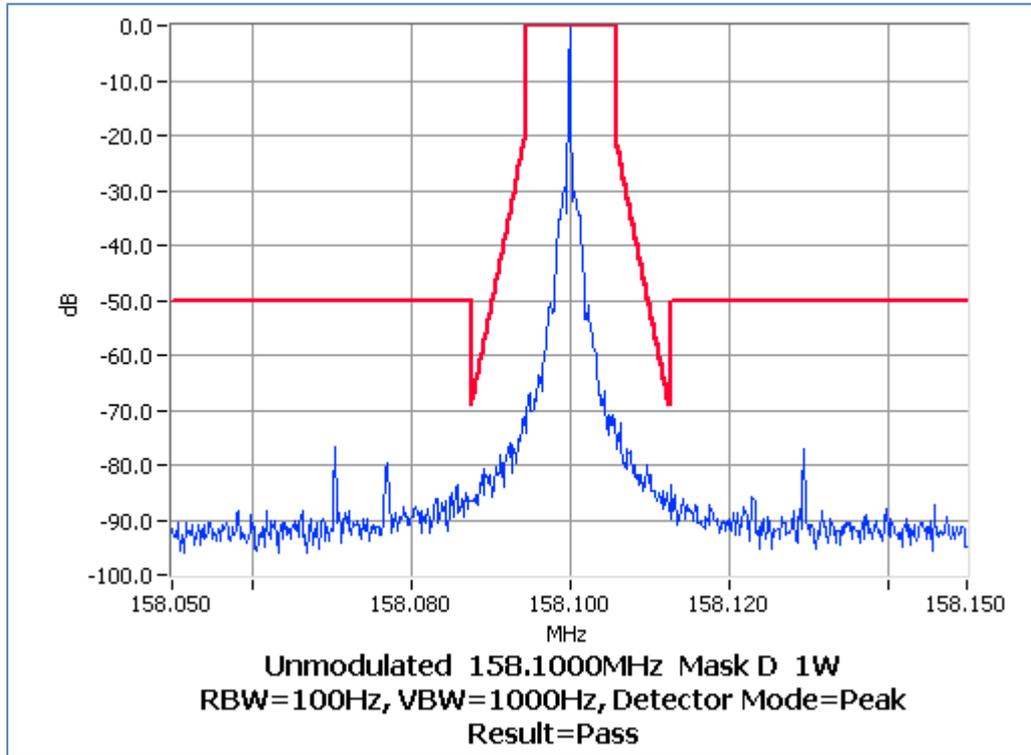


Occupied Bandwidth and Spectrum Masks

DMR

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

Tx FREQUENCY: 158.1 MHz 1 W 12.5 kHz Channel Spacing

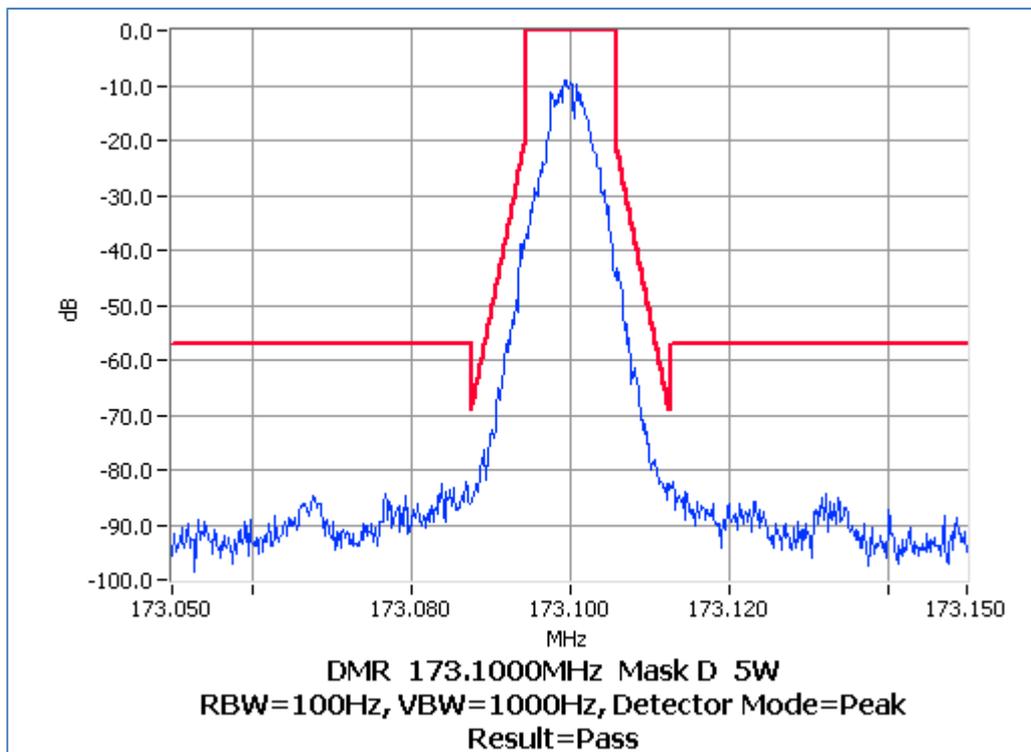
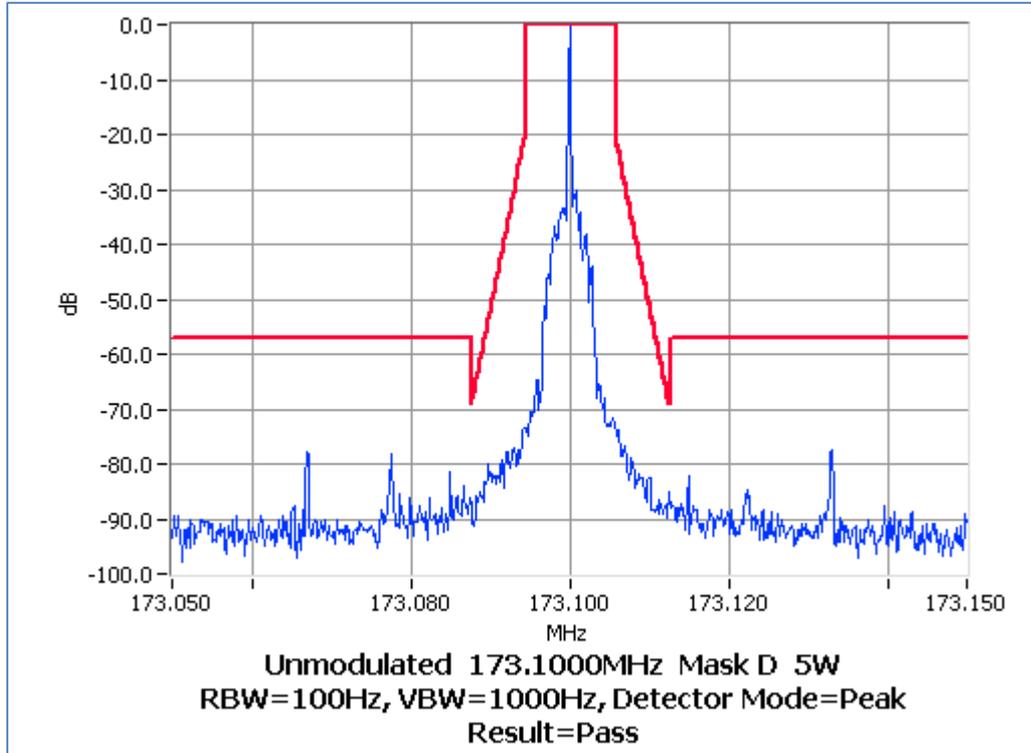


Occupied Bandwidth and Spectrum Masks

DMR

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

Tx FREQUENCY: 173.1 MHz 5 W 12.5 kHz Channel Spacing

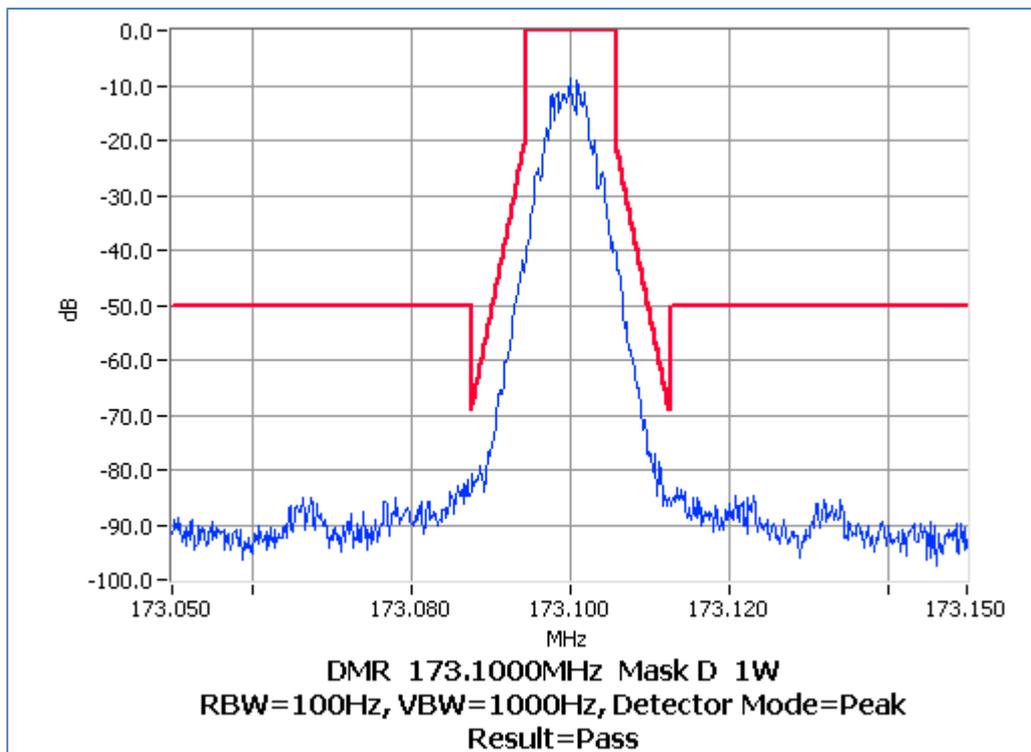
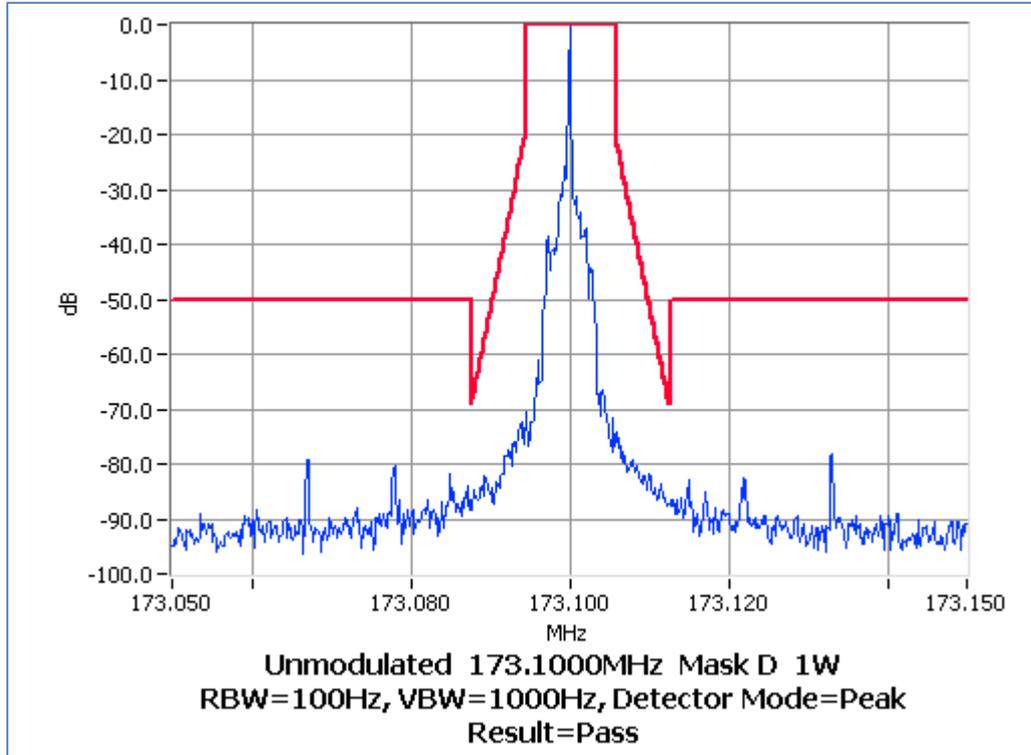


Occupied Bandwidth and Spectrum Masks

DMR

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

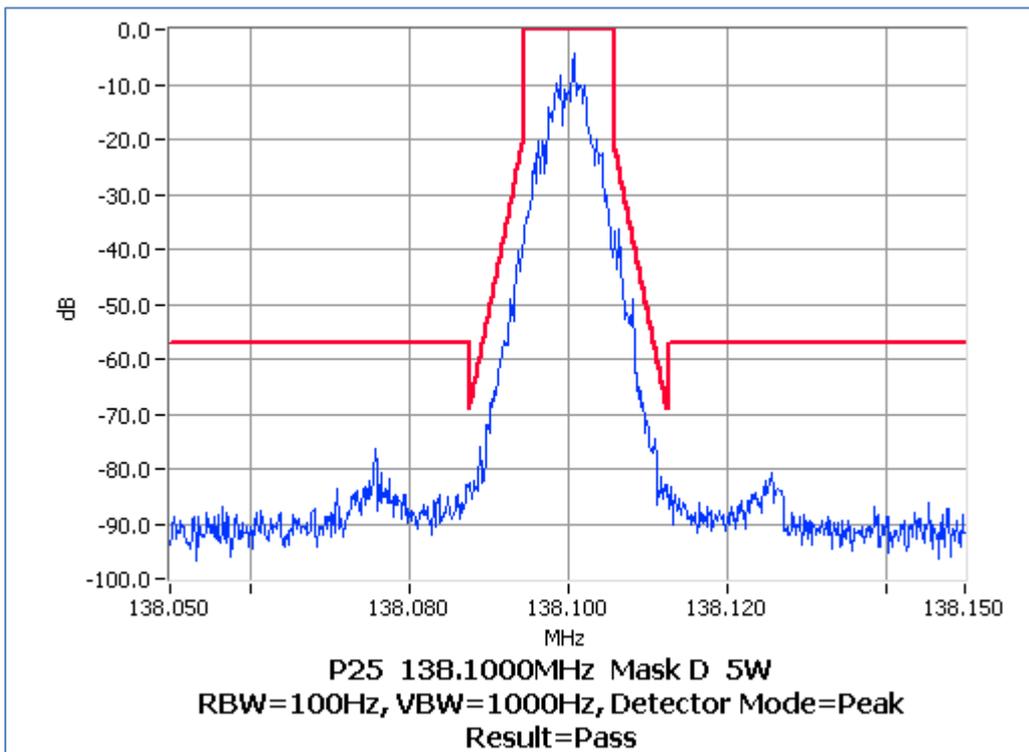
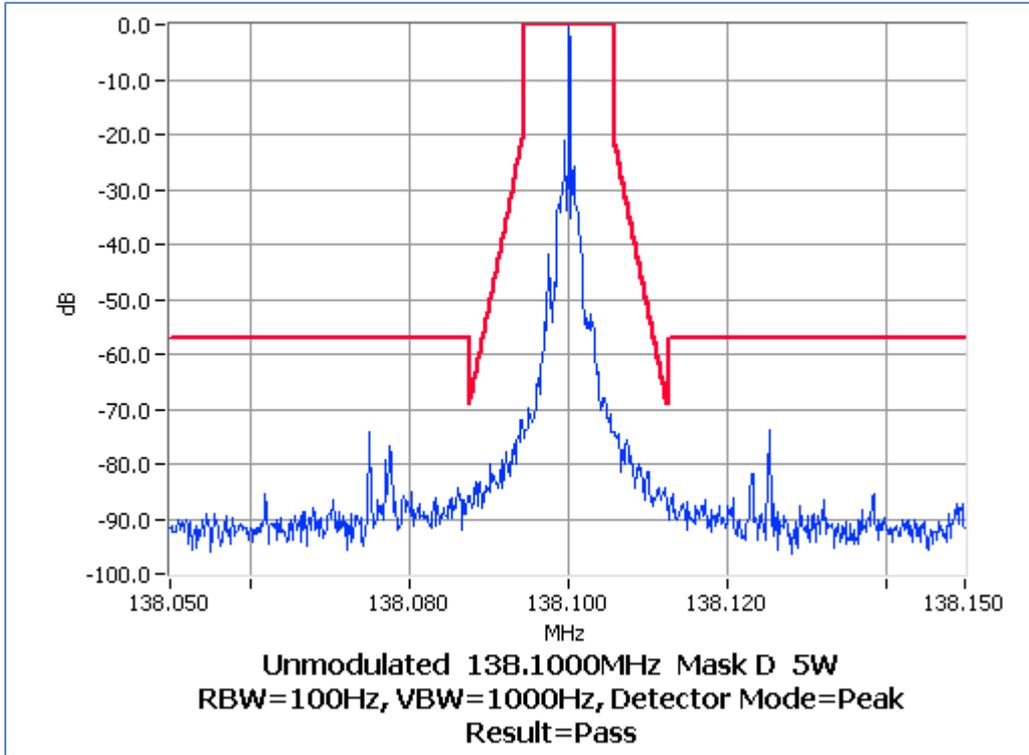
Tx FREQUENCY: 173.1 MHz 1 W 12.5 kHz Channel Spacing



Occupied Bandwidth and Spectrum Masks

P25

SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5
Tx FREQUENCY: 138.1 MHz 5 W 12.5 kHz Channel Spacing

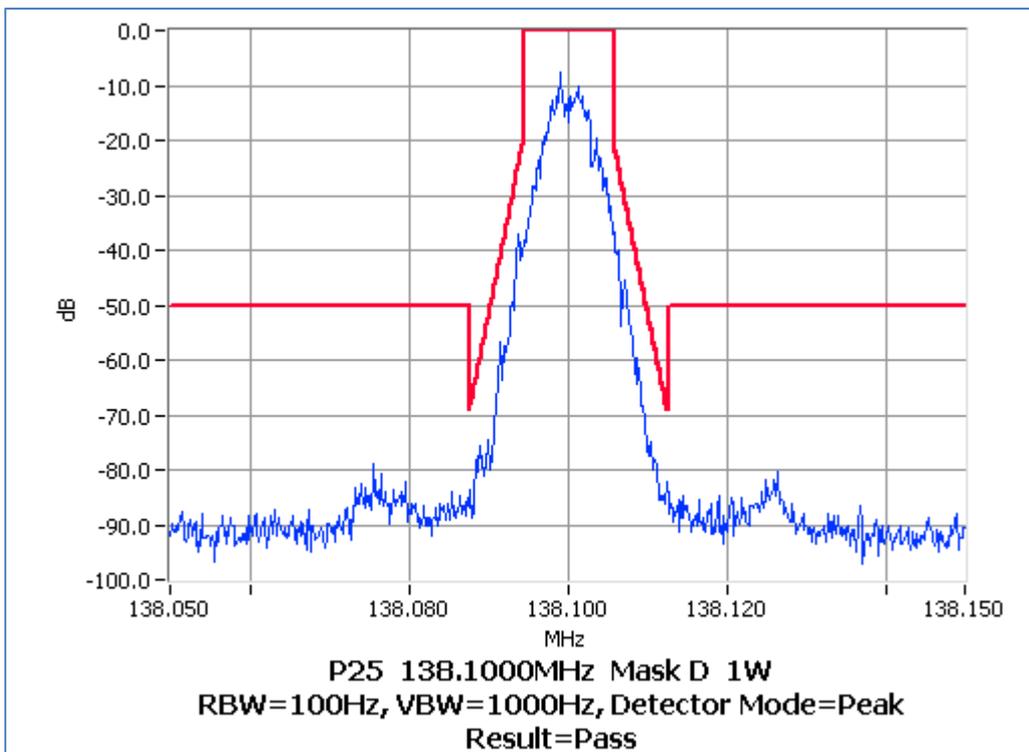
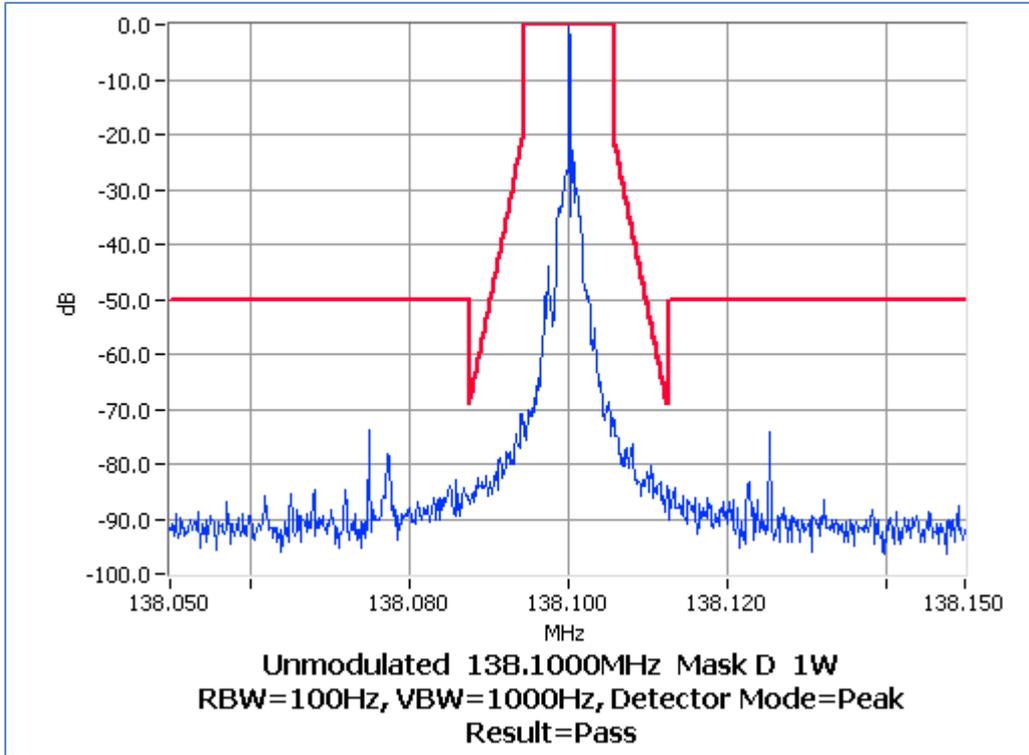


Occupied Bandwidth and Spectrum Masks

P25

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

Tx FREQUENCY: 138.1 MHz 1 W 12.5 kHz Channel Spacing

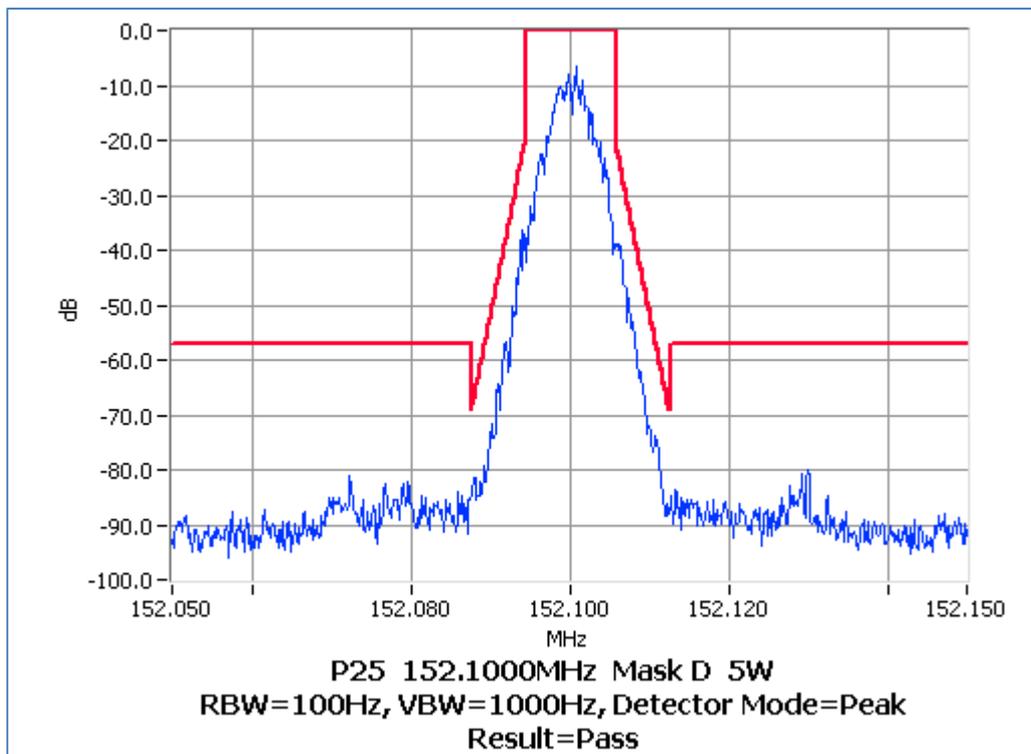
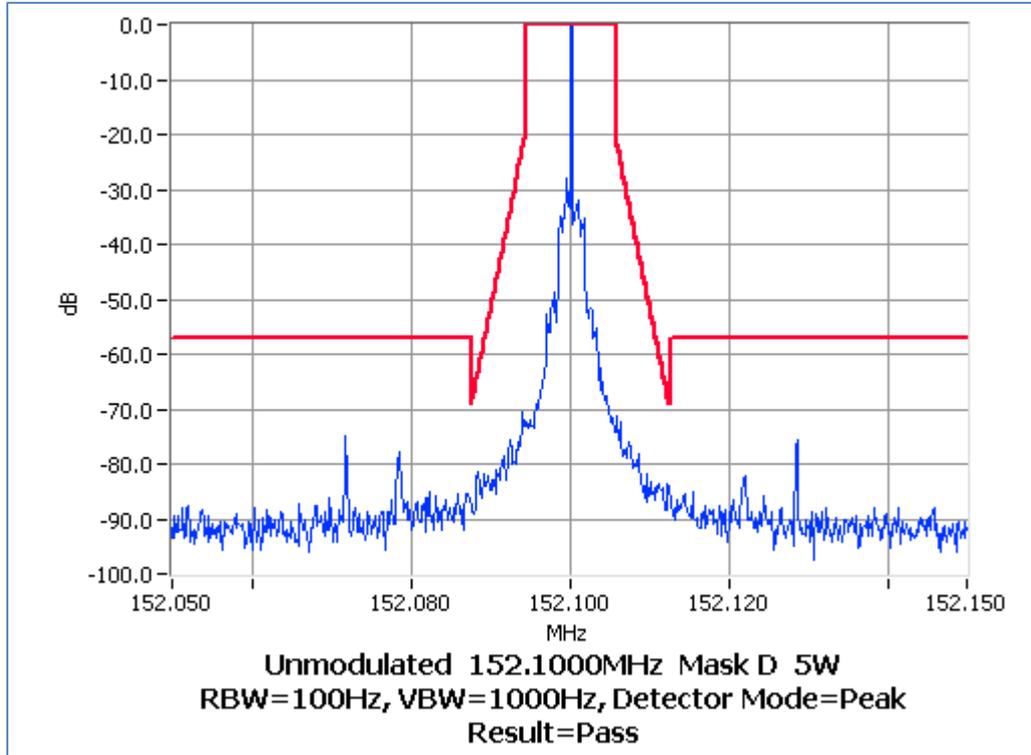


Occupied Bandwidth and Spectrum Masks

P25

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

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing

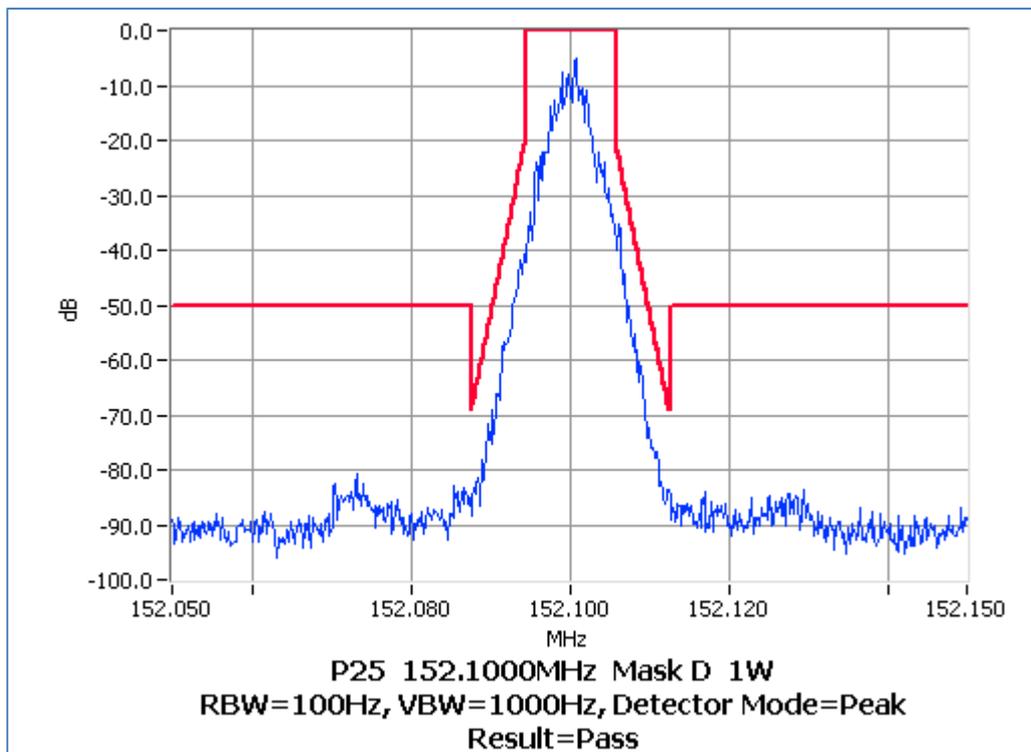
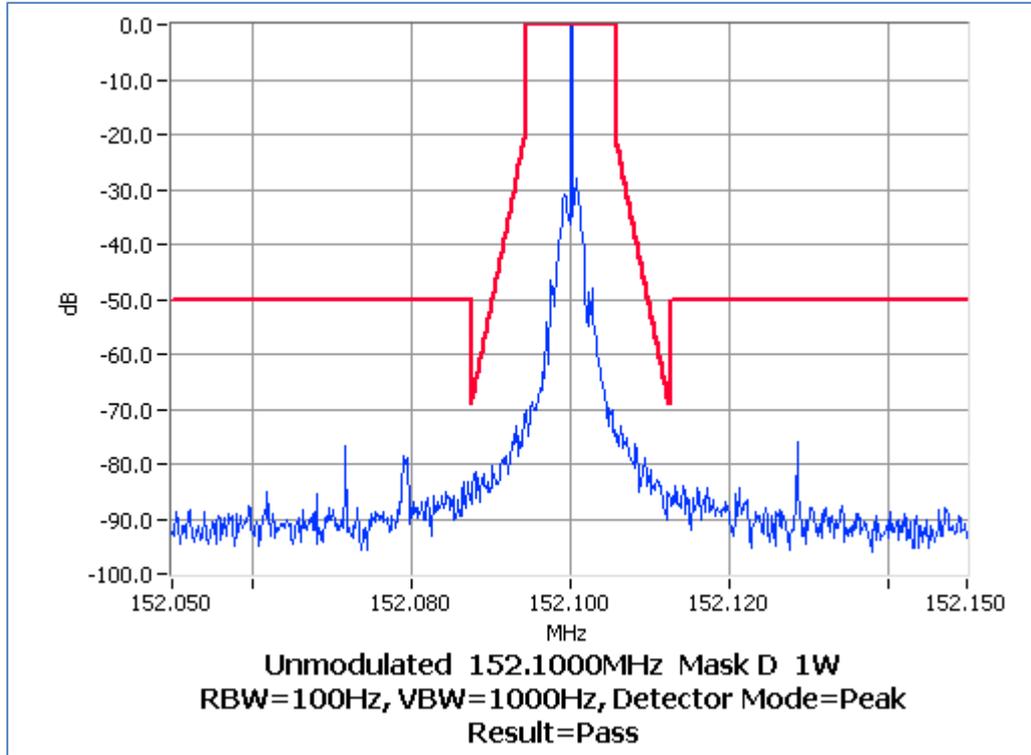


Occupied Bandwidth and Spectrum Masks

P25

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

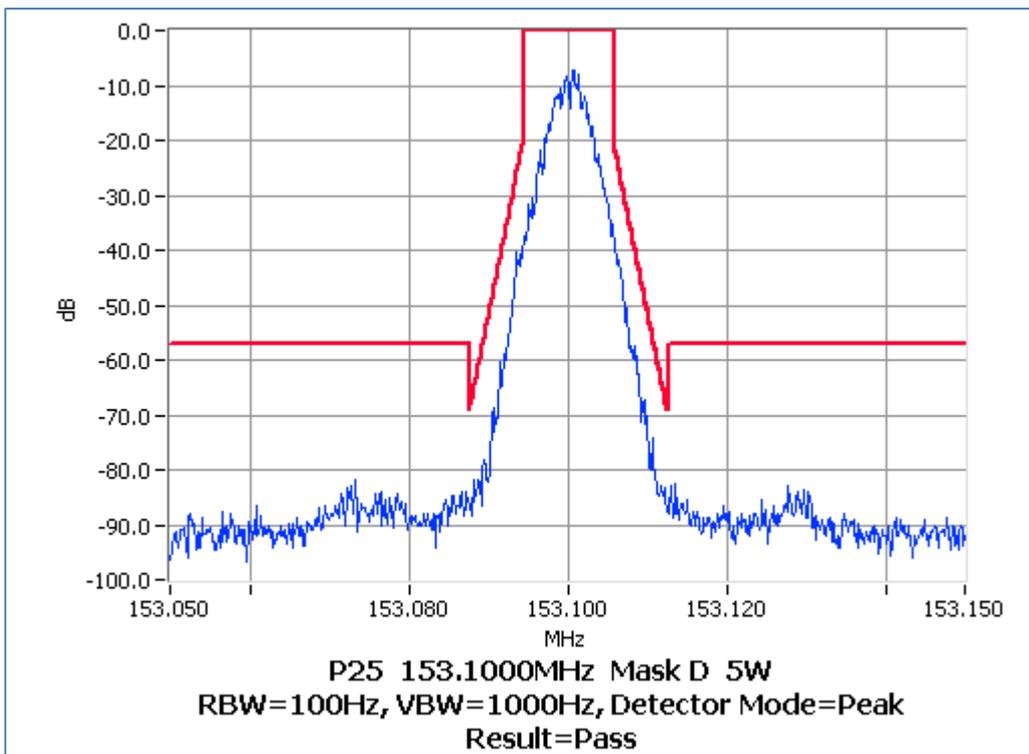
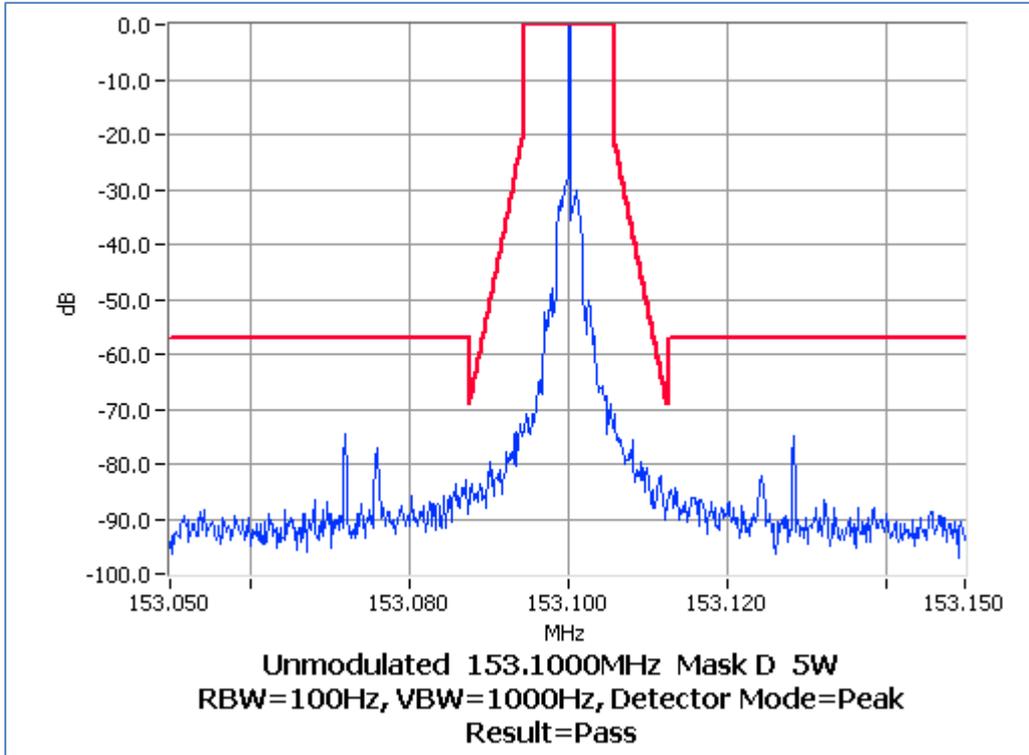
Tx FREQUENCY: 152.1 MHz 1 W 12.5 kHz Channel Spacing



Occupied Bandwidth and Spectrum Masks

P25

SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5
Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing

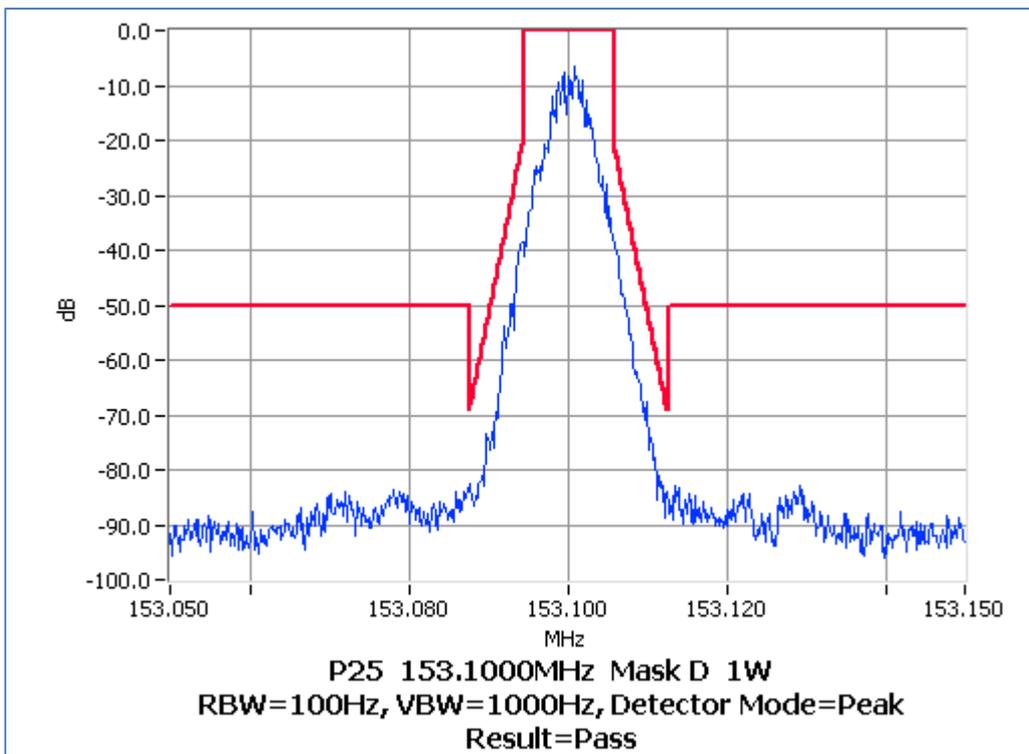
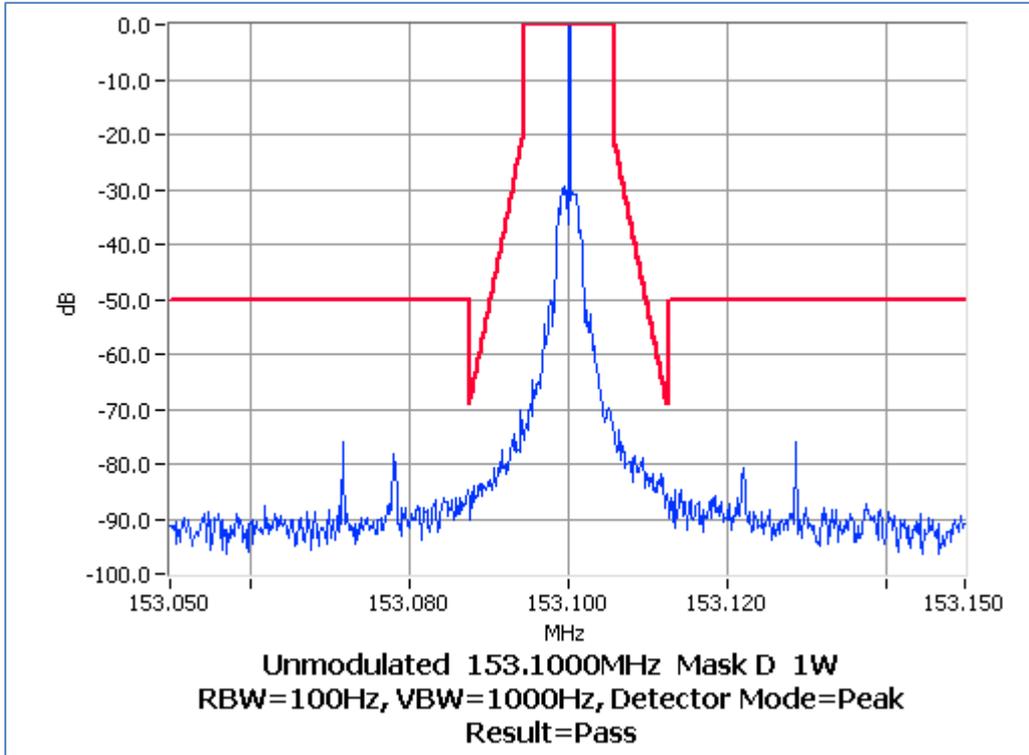


Occupied Bandwidth and Spectrum Masks

P25

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

Tx FREQUENCY: 153.1 MHz 1 W 12.5 kHz Channel Spacing

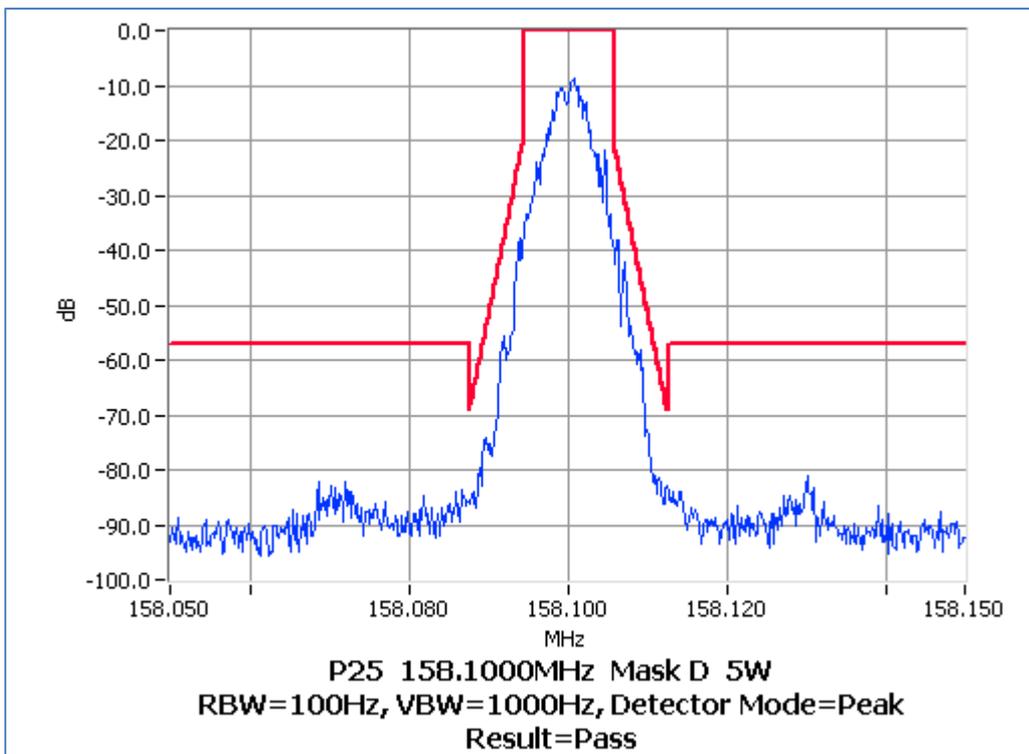
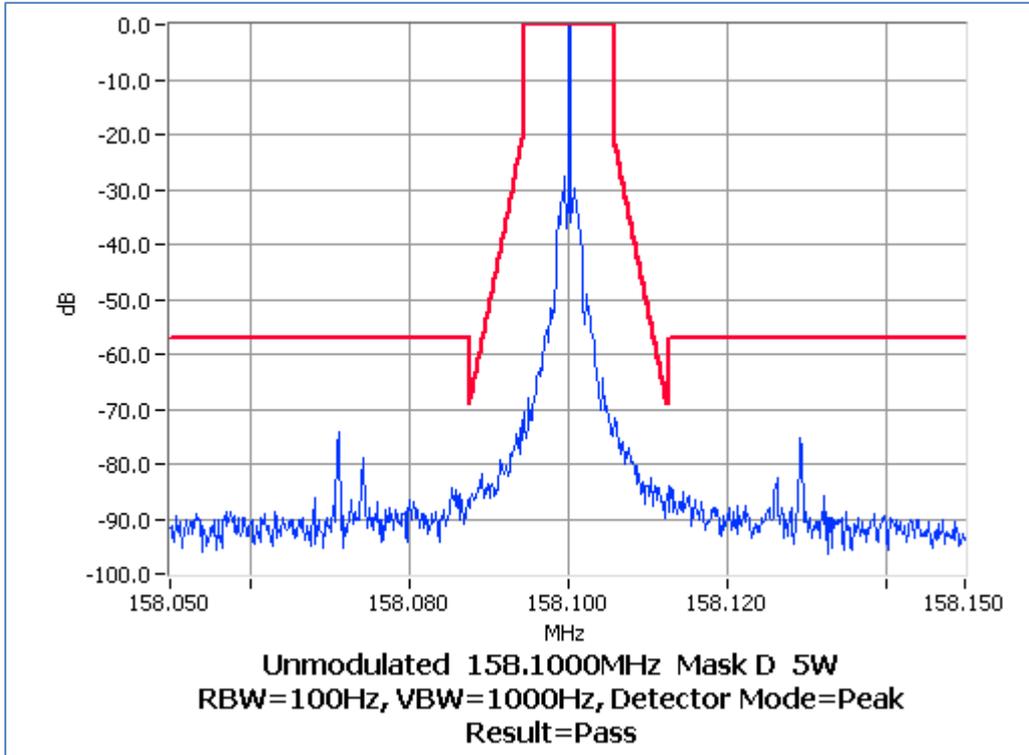


Occupied Bandwidth and Spectrum Masks

P25

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

Tx FREQUENCY: 158.1 MHz 5 W 12.5 kHz Channel Spacing

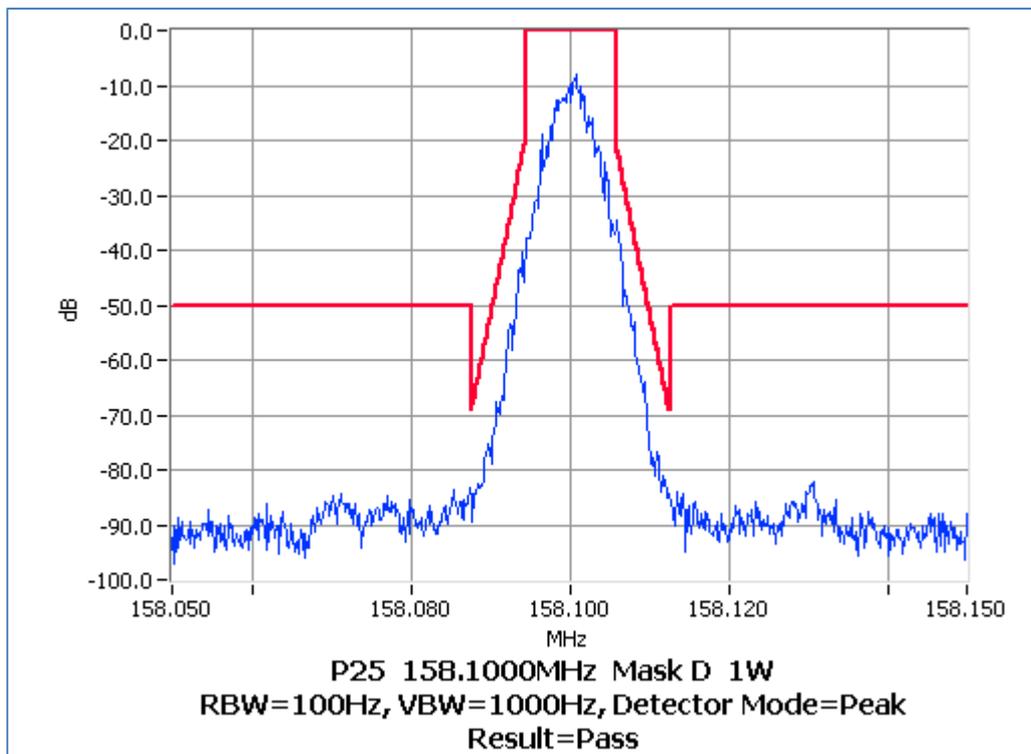
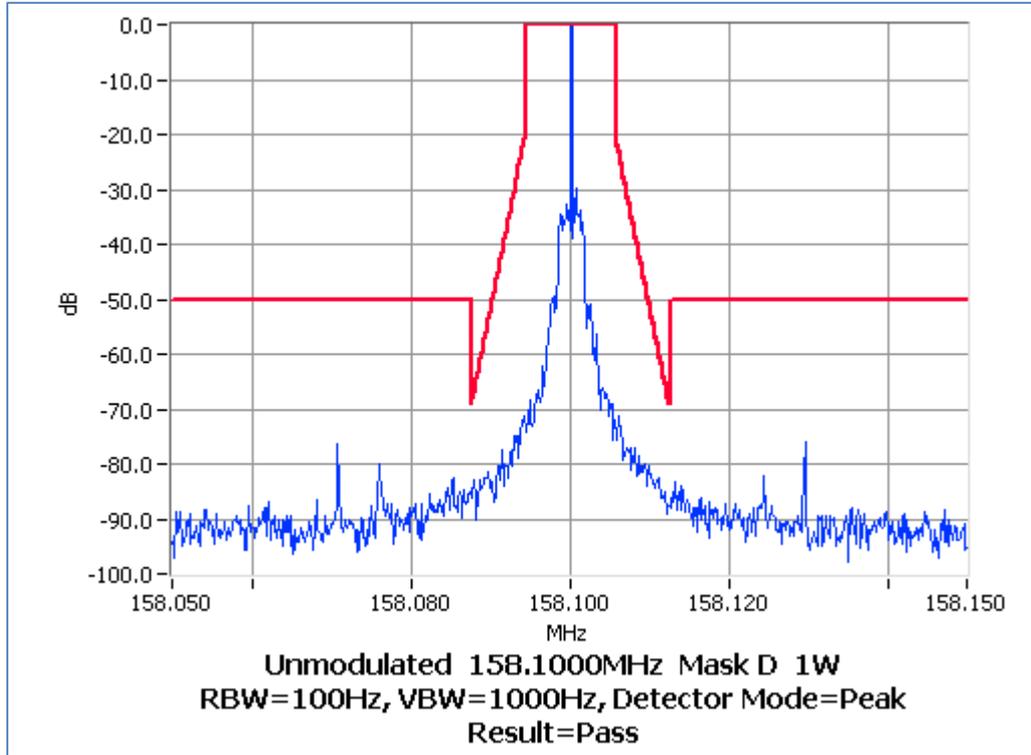


Occupied Bandwidth and Spectrum Masks

P25

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

Tx FREQUENCY: 158.1 MHz 1 W 12.5 kHz Channel Spacing

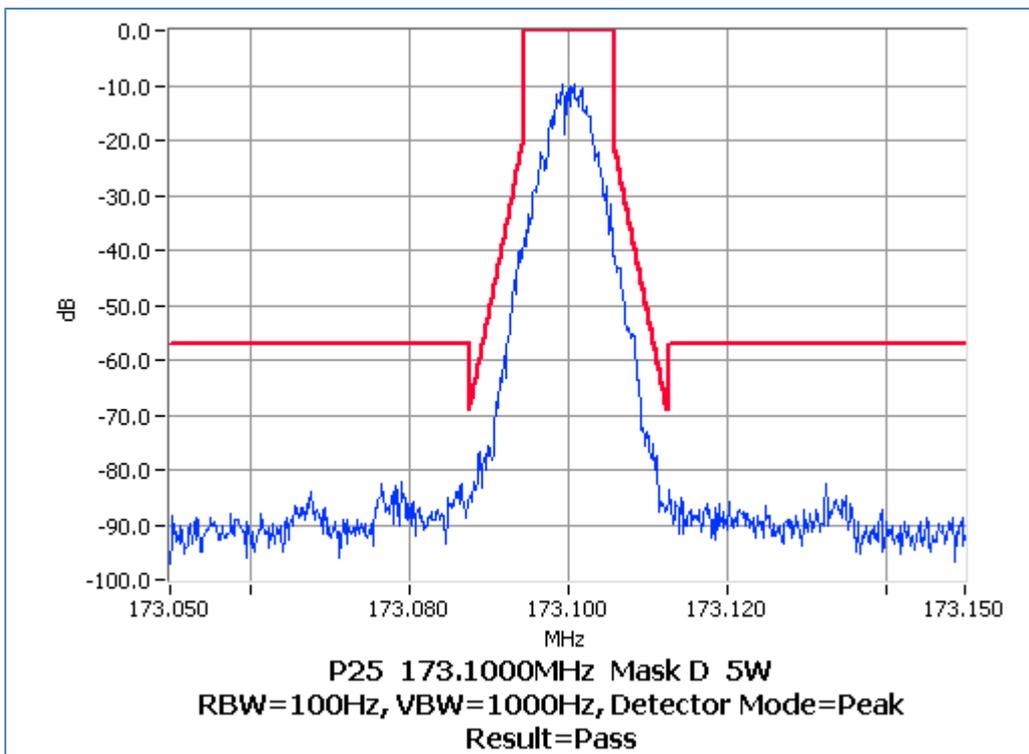
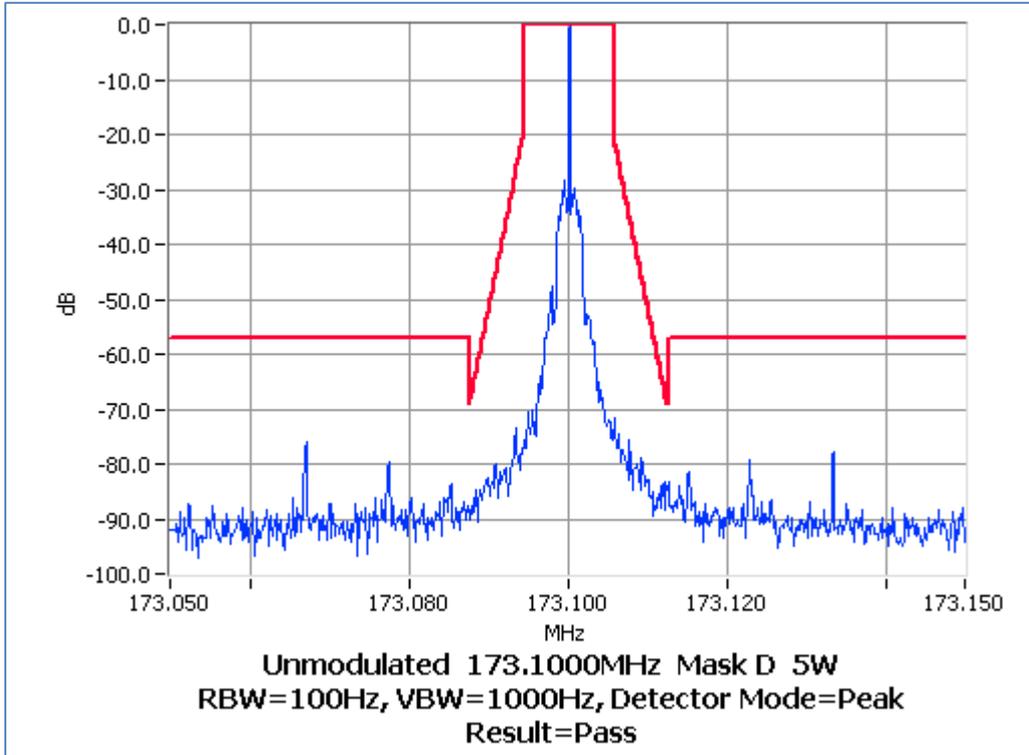


Occupied Bandwidth and Spectrum Masks

P25

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

Tx FREQUENCY: 173.1 MHz 5 W 12.5 kHz Channel Spacing

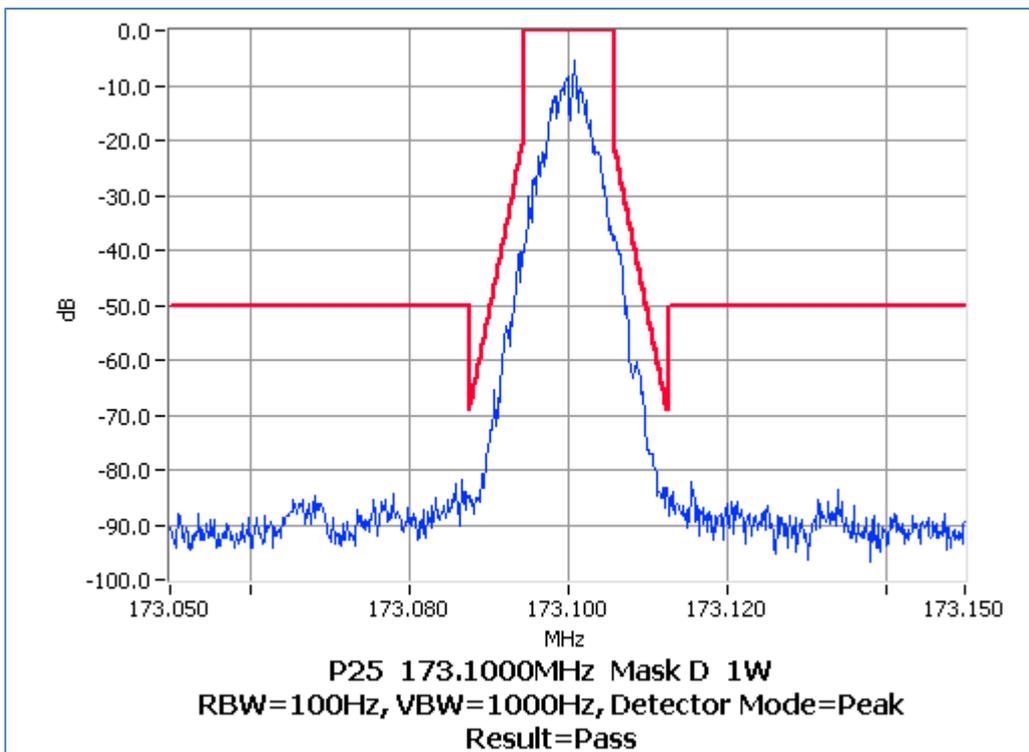
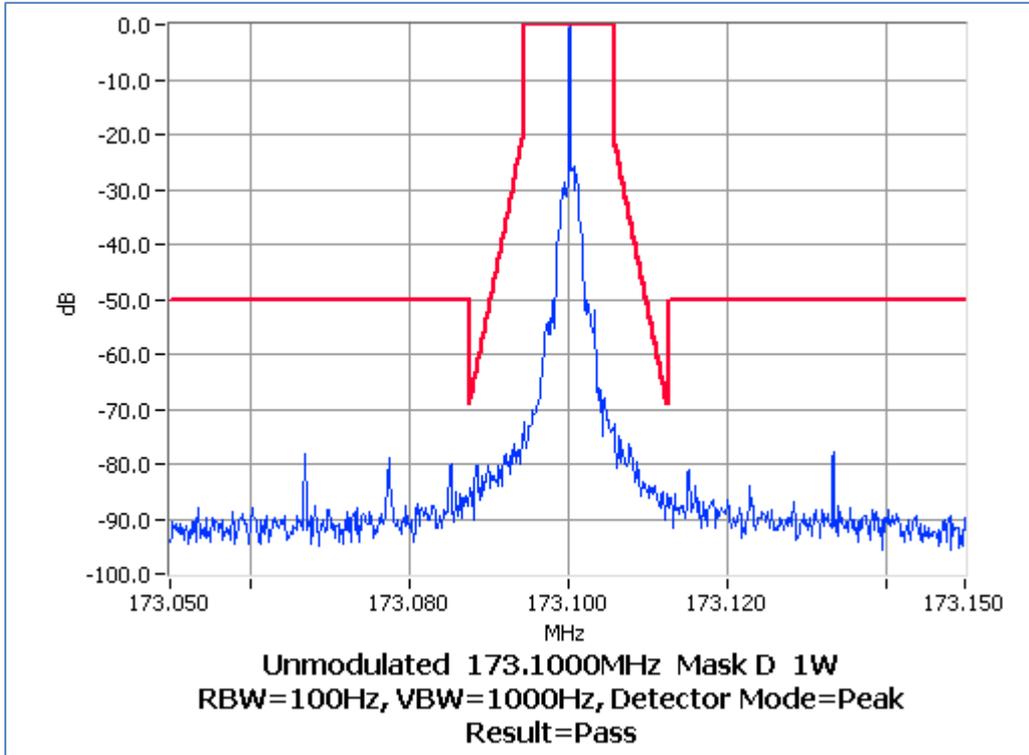


Occupied Bandwidth and Spectrum Masks

P25

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

Tx FREQUENCY: 173.1 MHz 1 W 12.5 kHz Channel Spacing

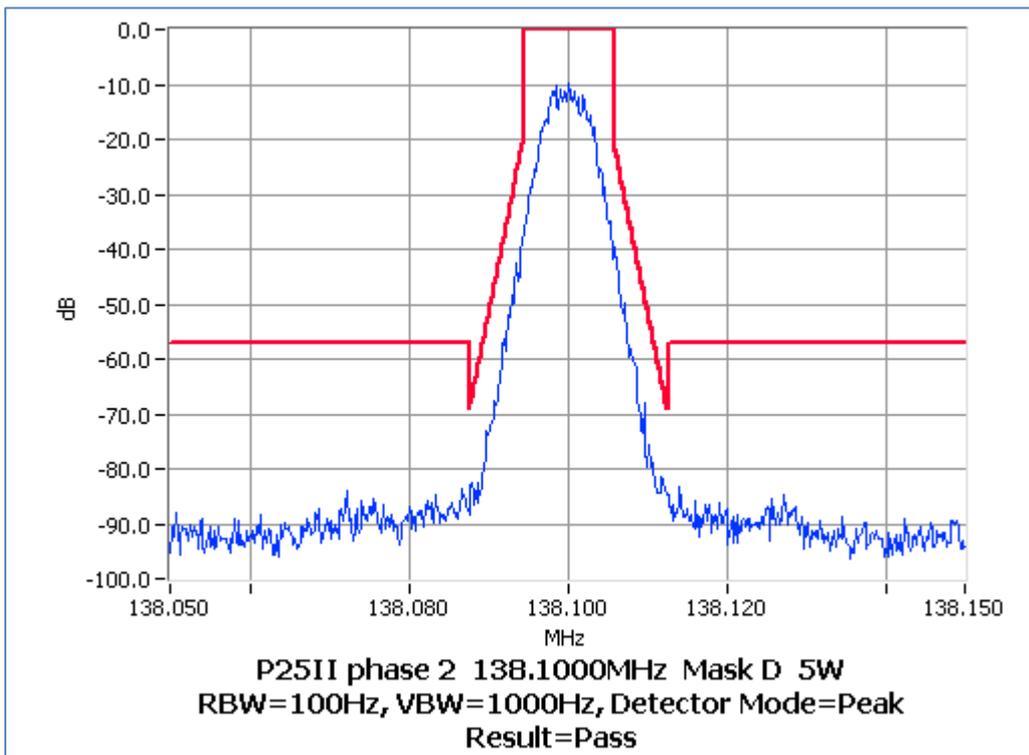
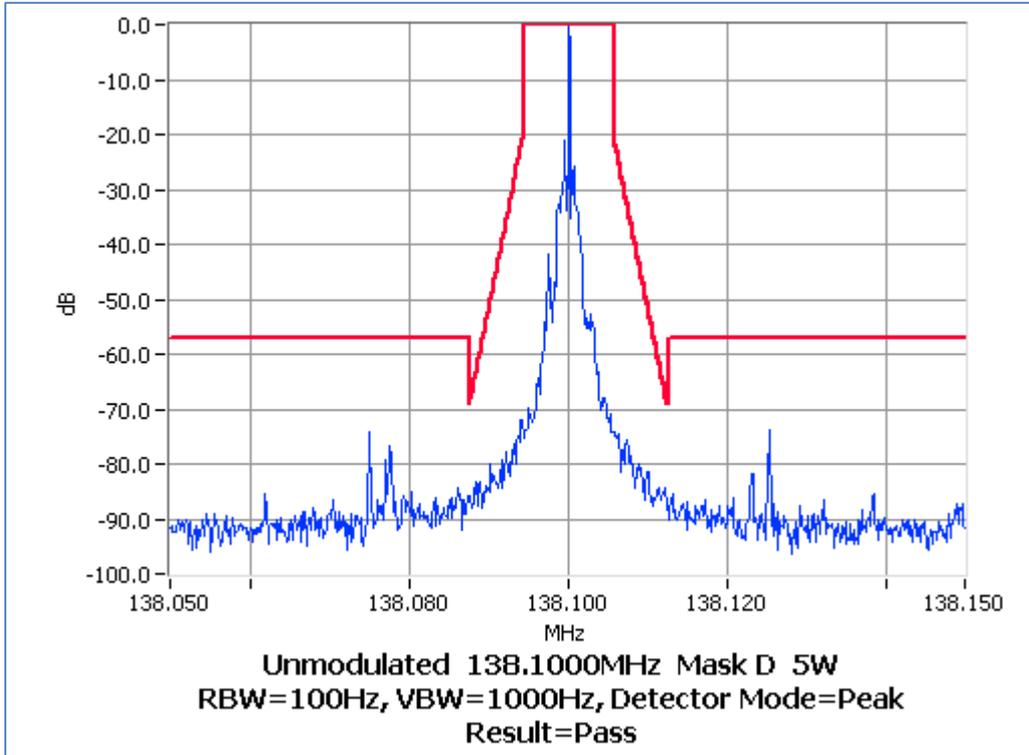


Occupied Bandwidth and Spectrum Masks

P25 Phase 2

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

Tx FREQUENCY: 138.1 MHz 5 W 12.5 kHz Channel Spacing

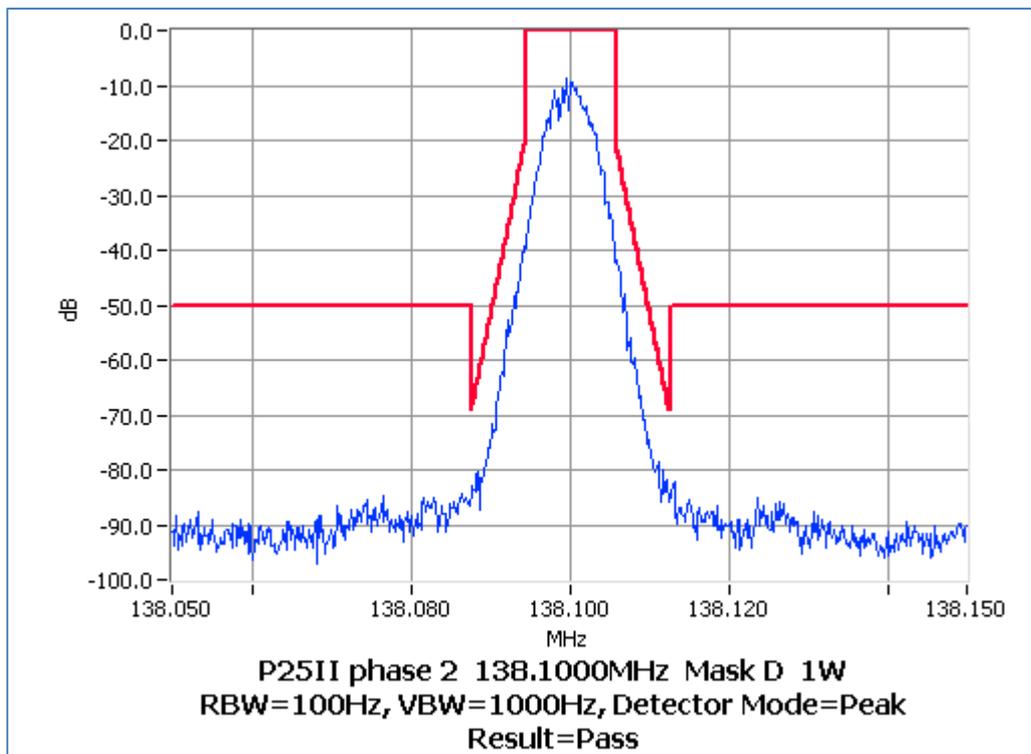
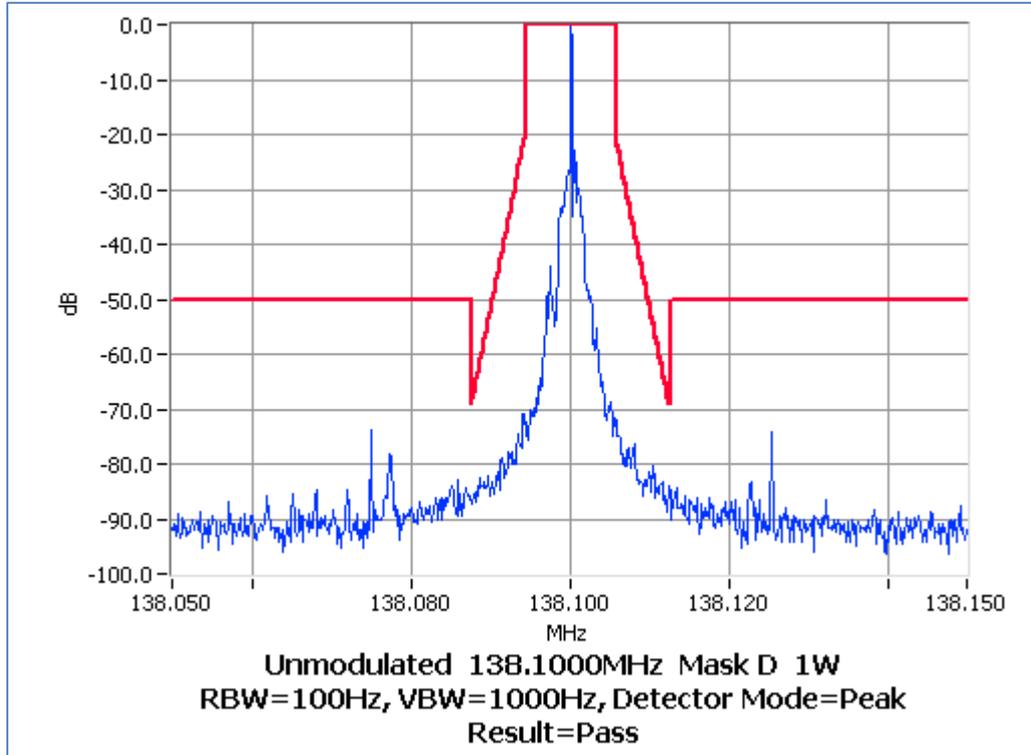


Occupied Bandwidth and Spectrum Masks

P25 Phase 2

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

Tx FREQUENCY: 138.1 MHz 1 W 12.5 kHz Channel Spacing

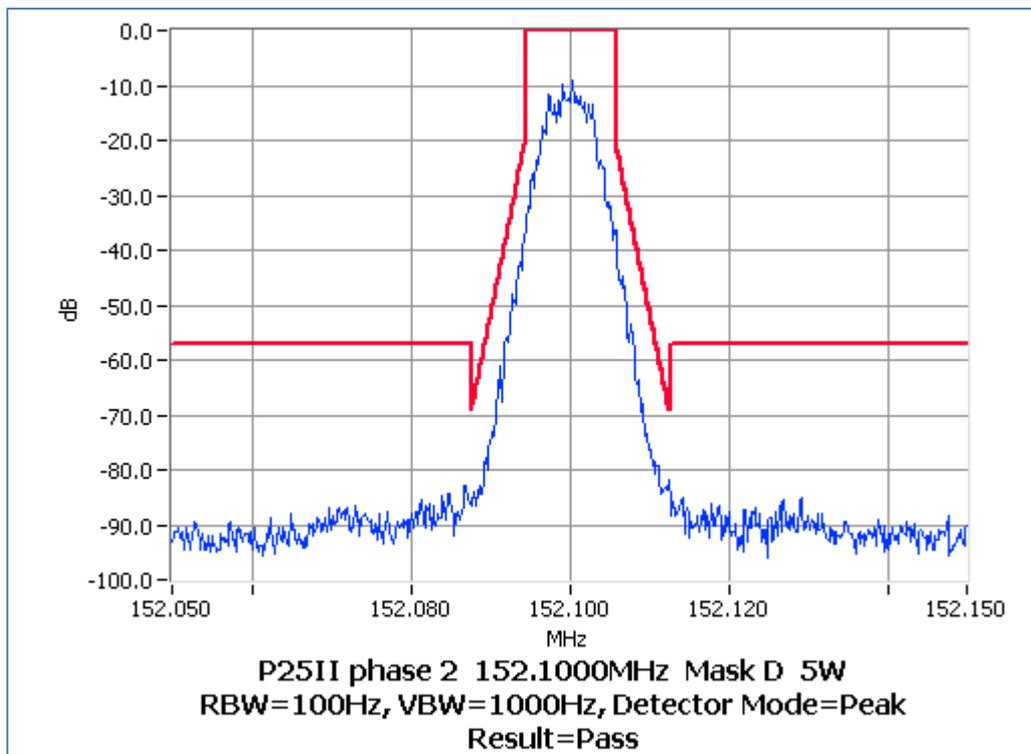
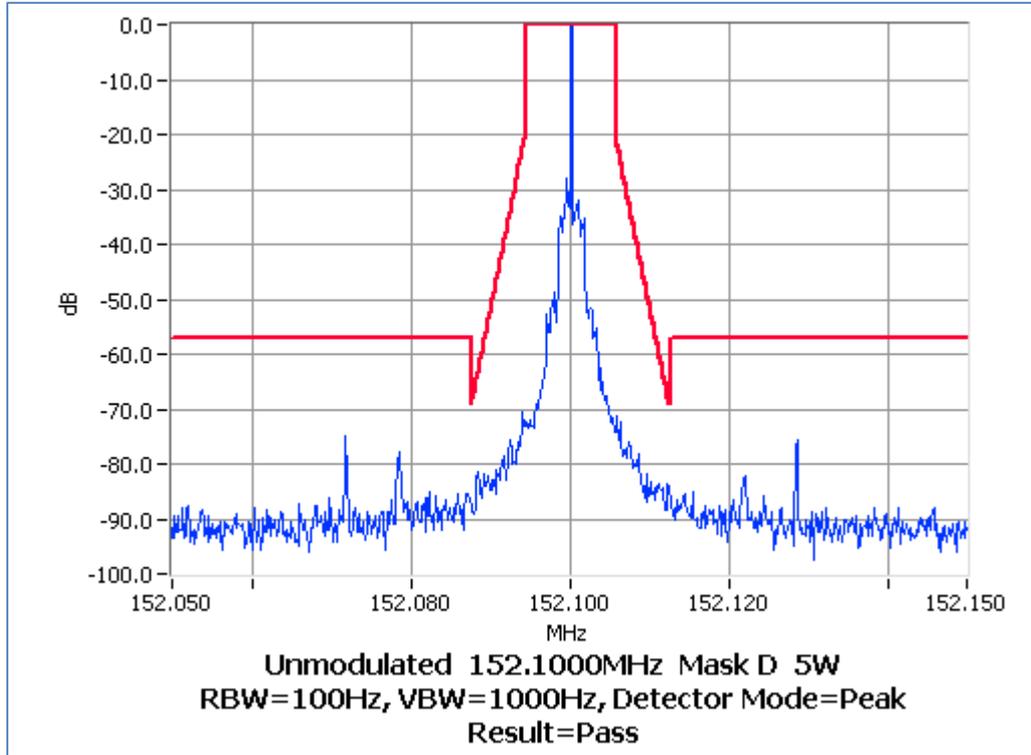


Occupied Bandwidth and Spectrum Masks

P25 Phase 2

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

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing

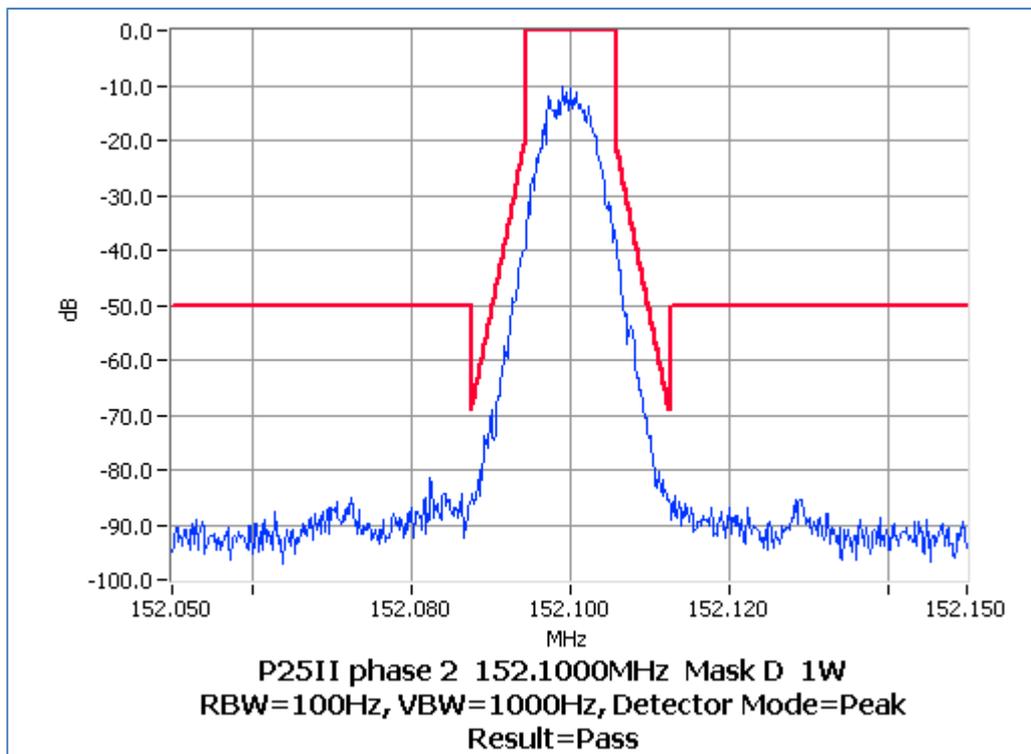
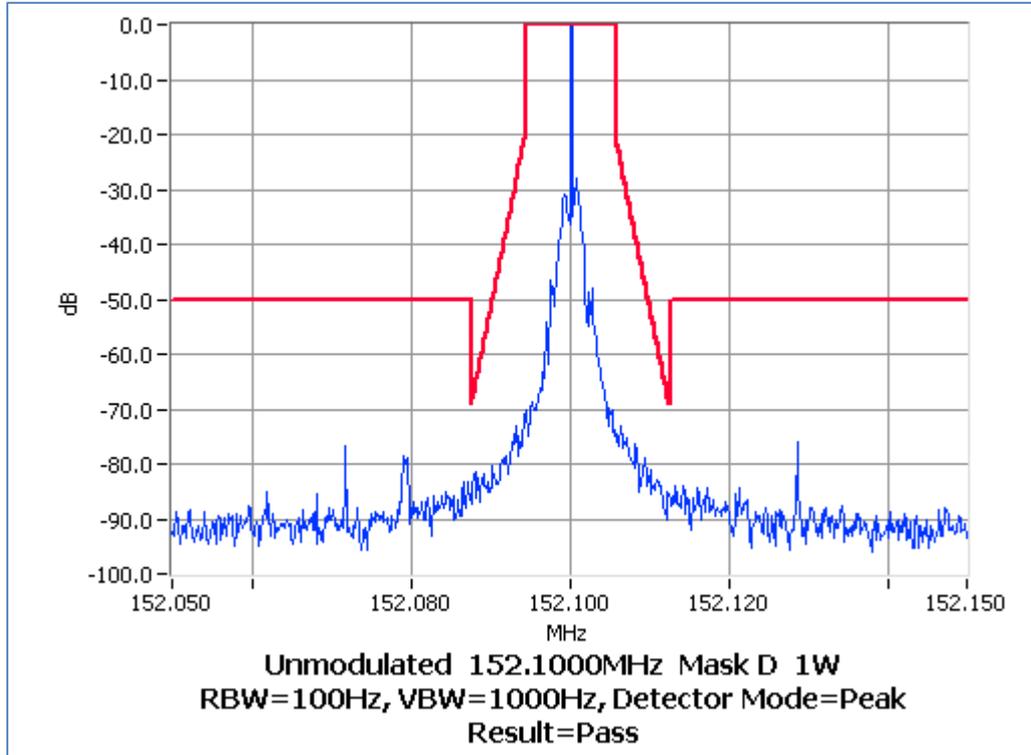


Occupied Bandwidth and Spectrum Masks

P25 Phase 2

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

Tx FREQUENCY: 152.1 MHz 1 W 12.5 kHz Channel Spacing

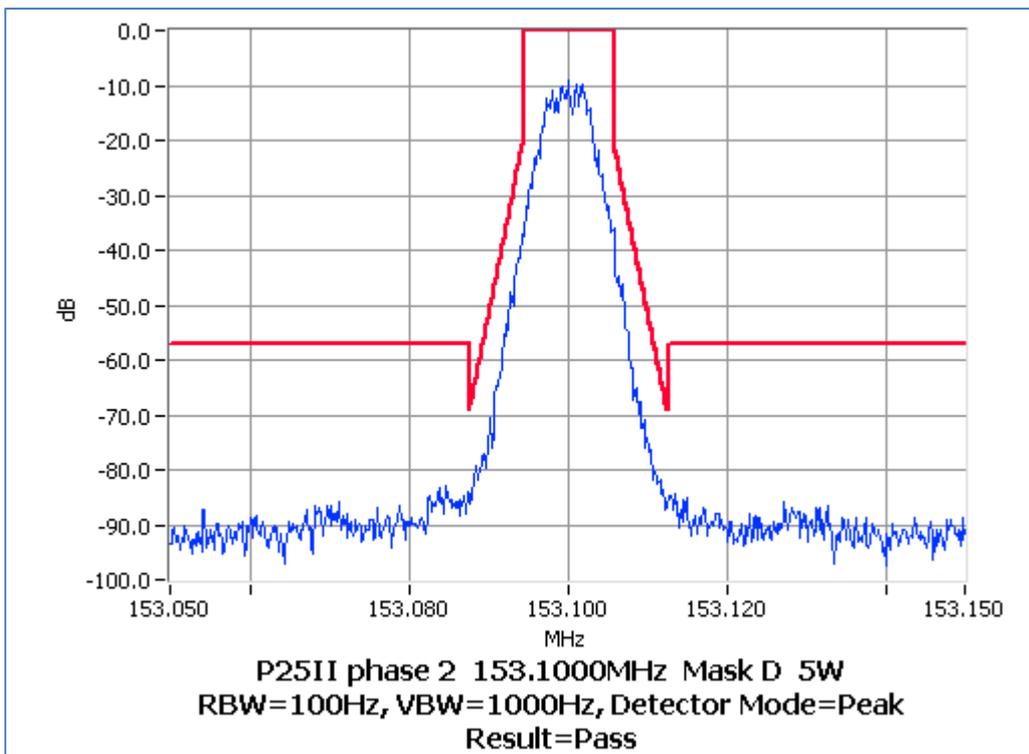
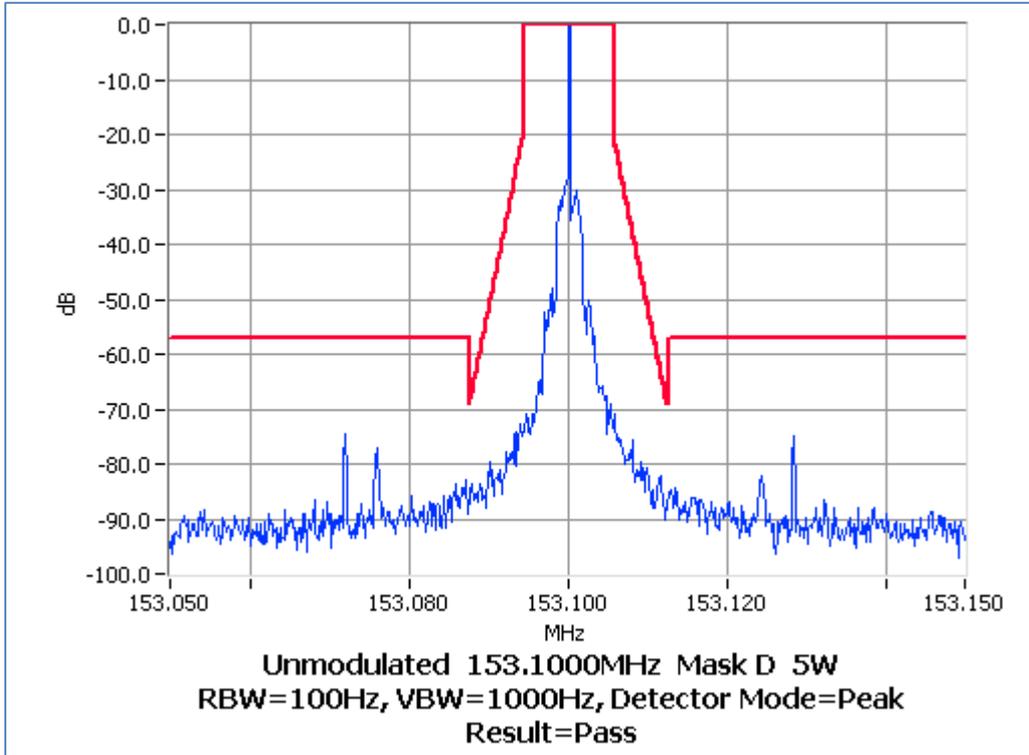


Occupied Bandwidth and Spectrum Masks

P25 Phase 2

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

Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing

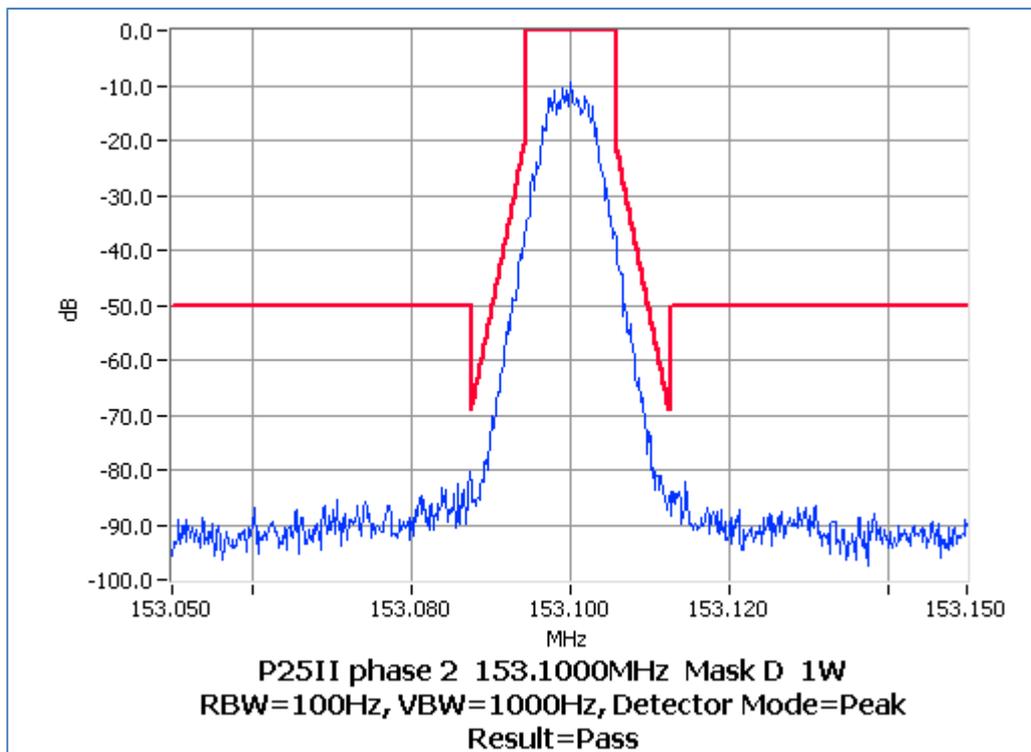
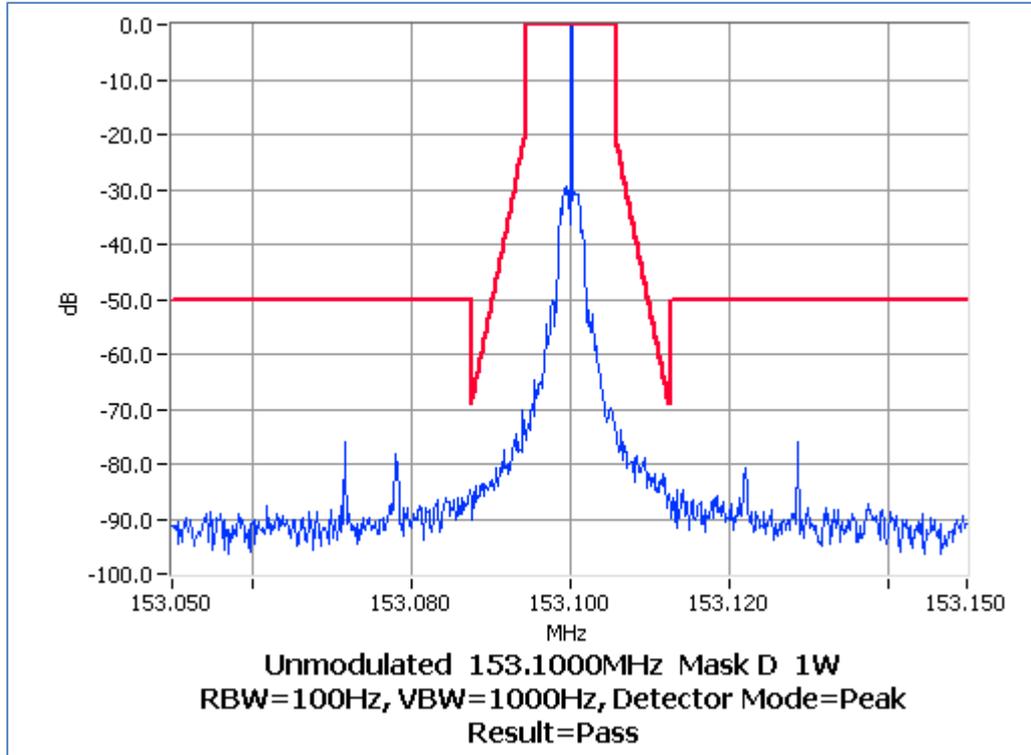


Occupied Bandwidth and Spectrum Masks

P25 Phase 2

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

Tx FREQUENCY: 153.1 MHz 1 W 12.5 kHz Channel Spacing

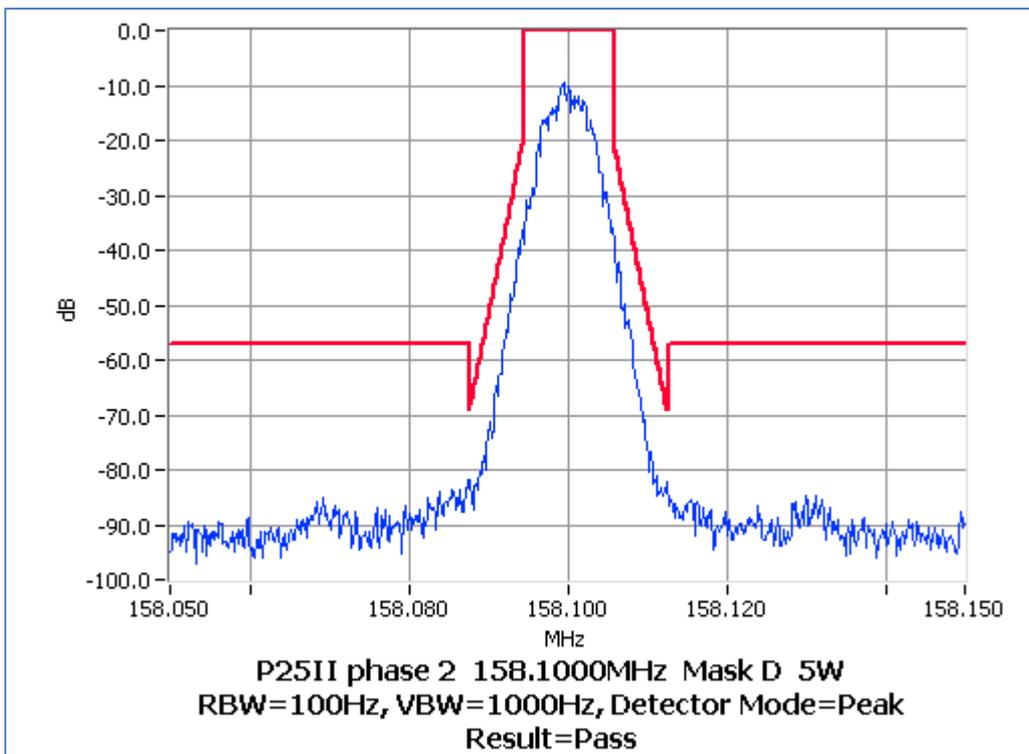
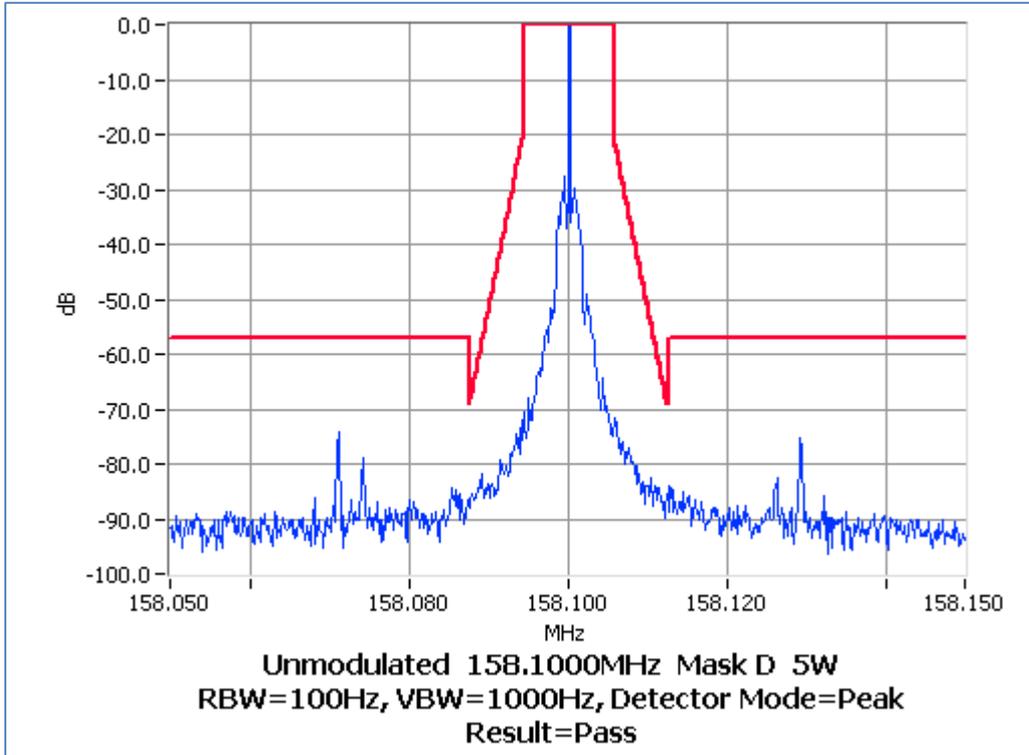


Occupied Bandwidth and Spectrum Masks

P25 Phase 2

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

Tx FREQUENCY: 158.1 MHz 5 W 12.5 kHz Channel Spacing

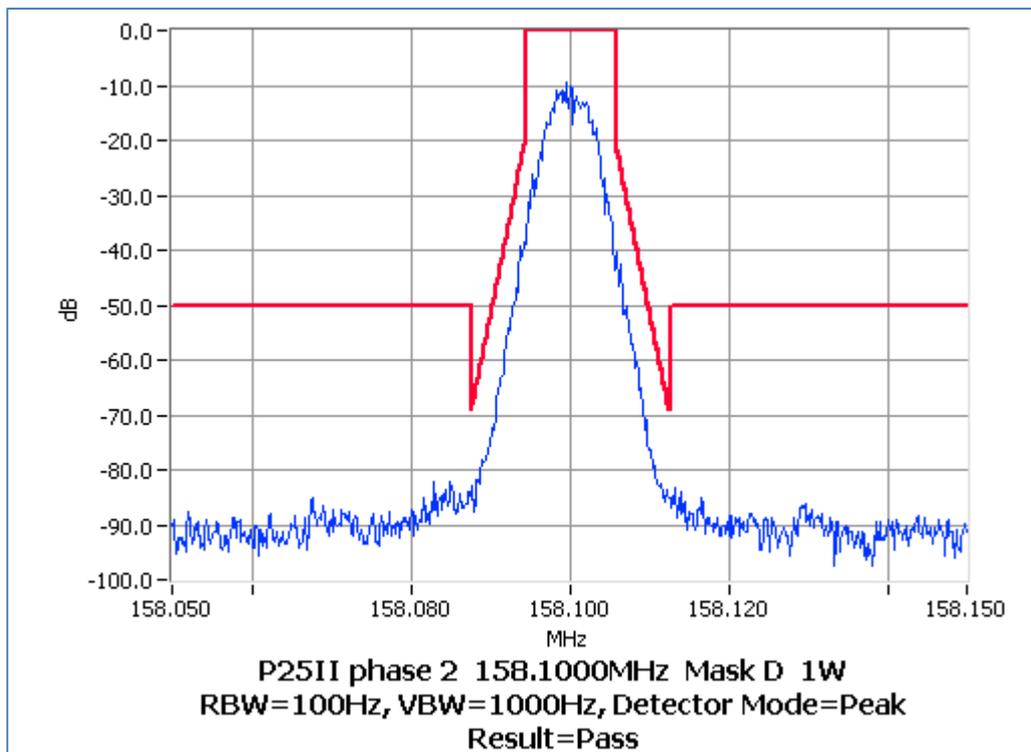
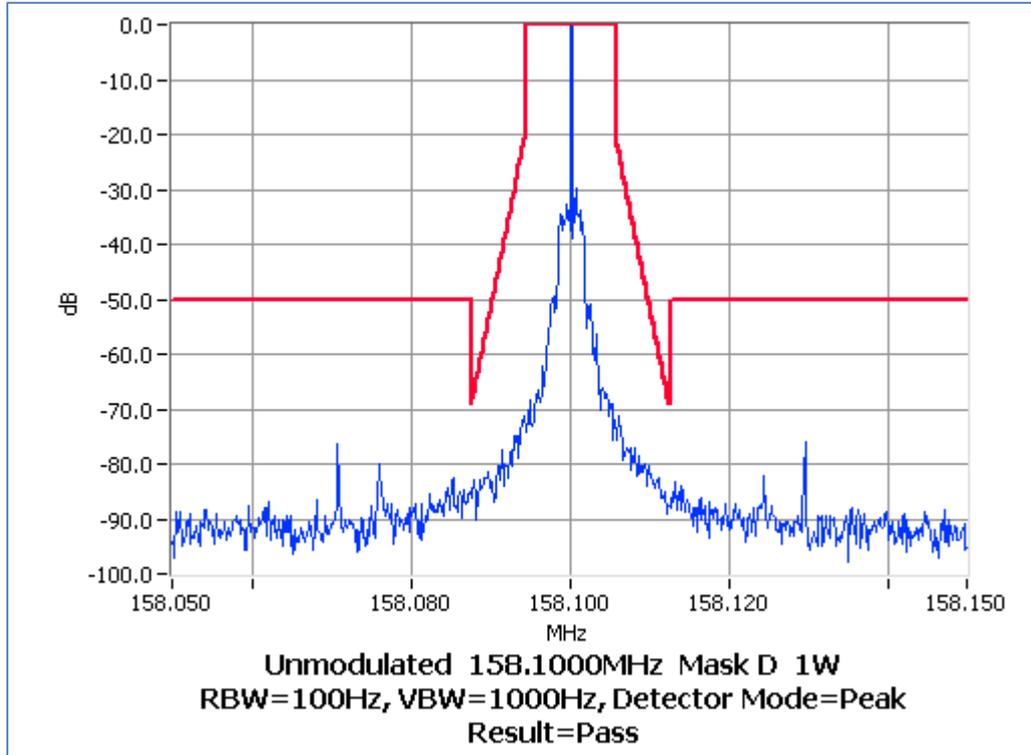


Occupied Bandwidth and Spectrum Masks

P25 Phase 2

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

Tx FREQUENCY: 158.1 MHz 1 W 12.5 kHz Channel Spacing

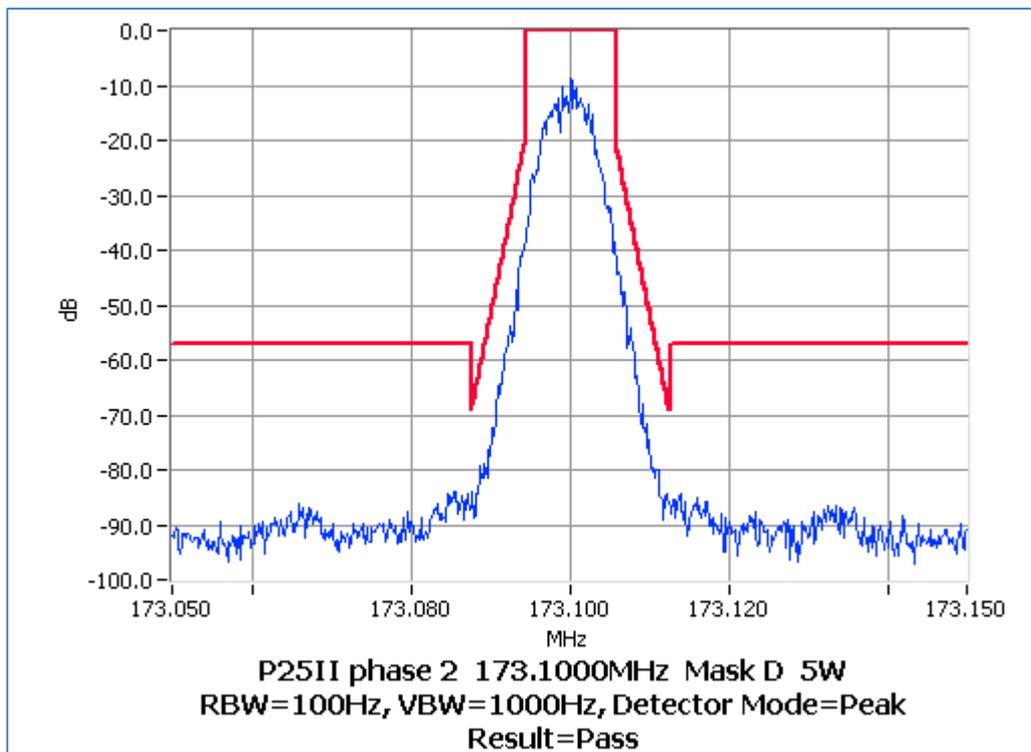
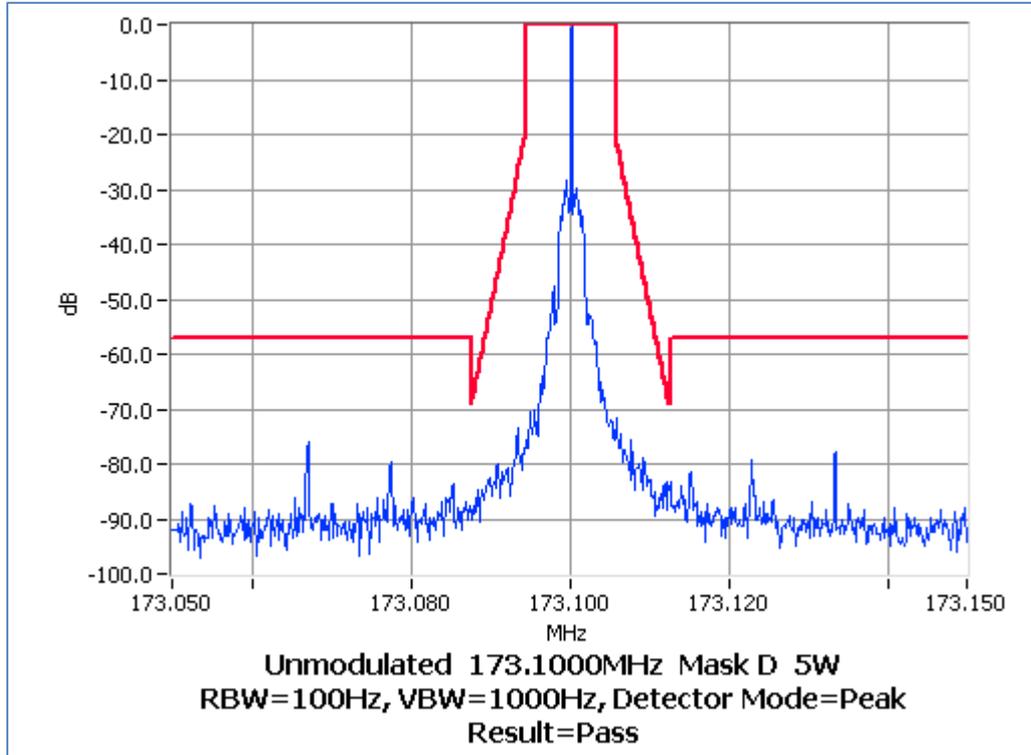


Occupied Bandwidth and Spectrum Masks

P25 Phase 2

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

Tx FREQUENCY: 173.1 MHz 5 W 12.5 kHz Channel Spacing

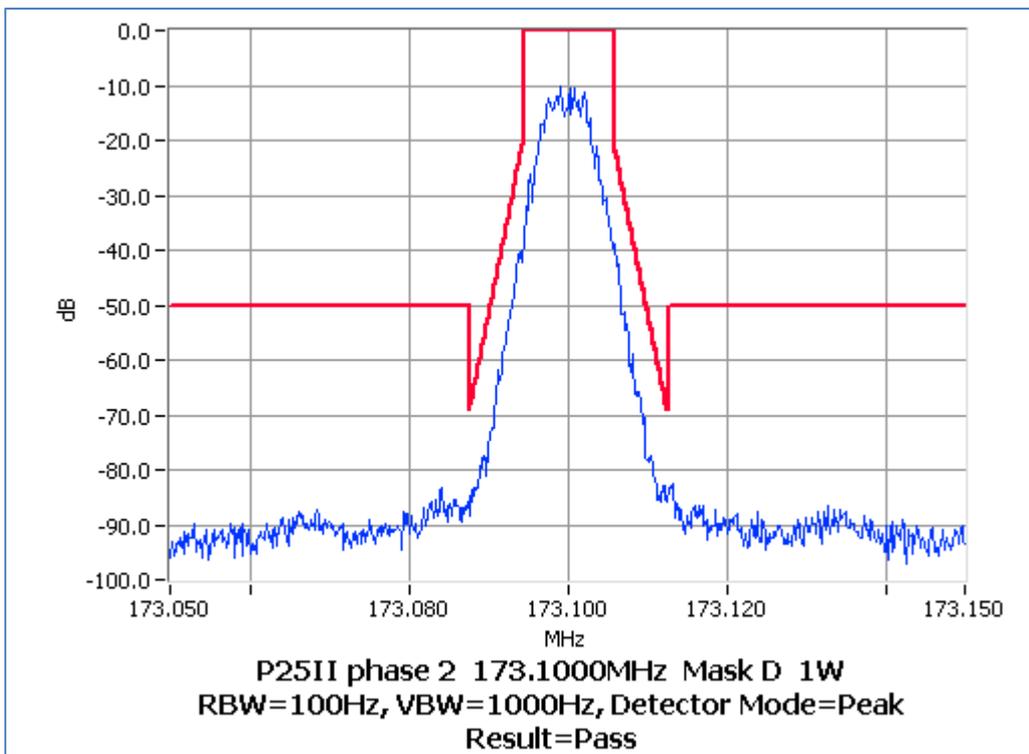
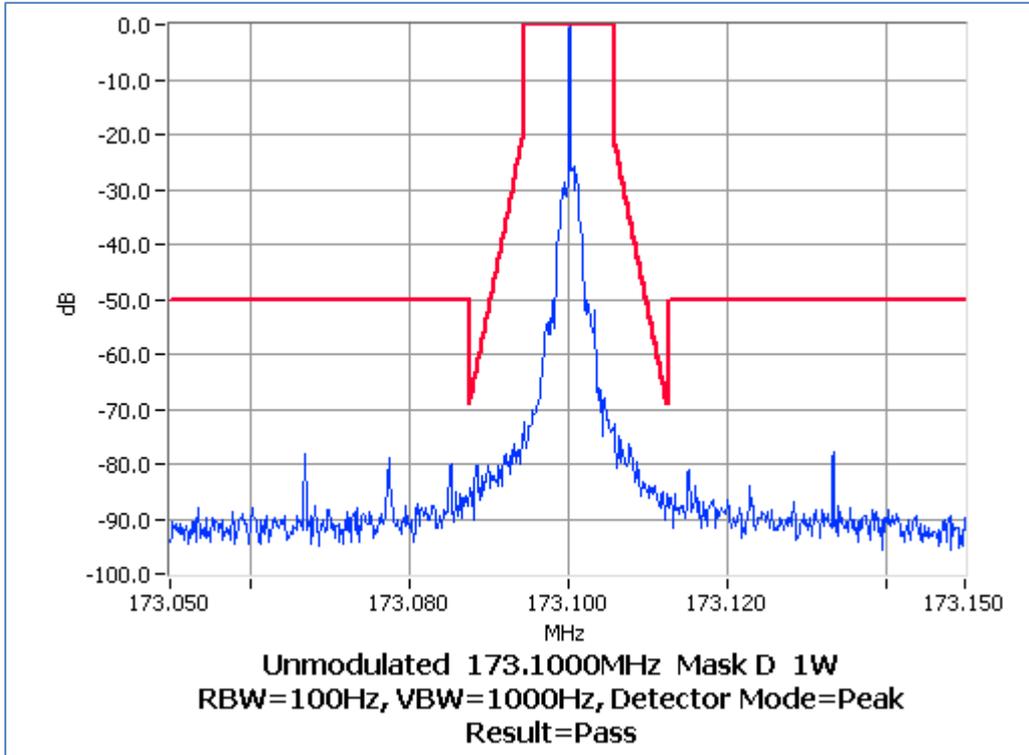


Occupied Bandwidth and Spectrum Masks

P25 Phase 2

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

Tx FREQUENCY: 173.1 MHz 1 W 12.5 kHz Channel Spacing



SPURIOUS EMISSIONS (Tx CONDUCTED)

SPECIFICATIONS: FCC 47 CFR 2.1051 RSS-119 5.8

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: 100kHz 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 20dB 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.

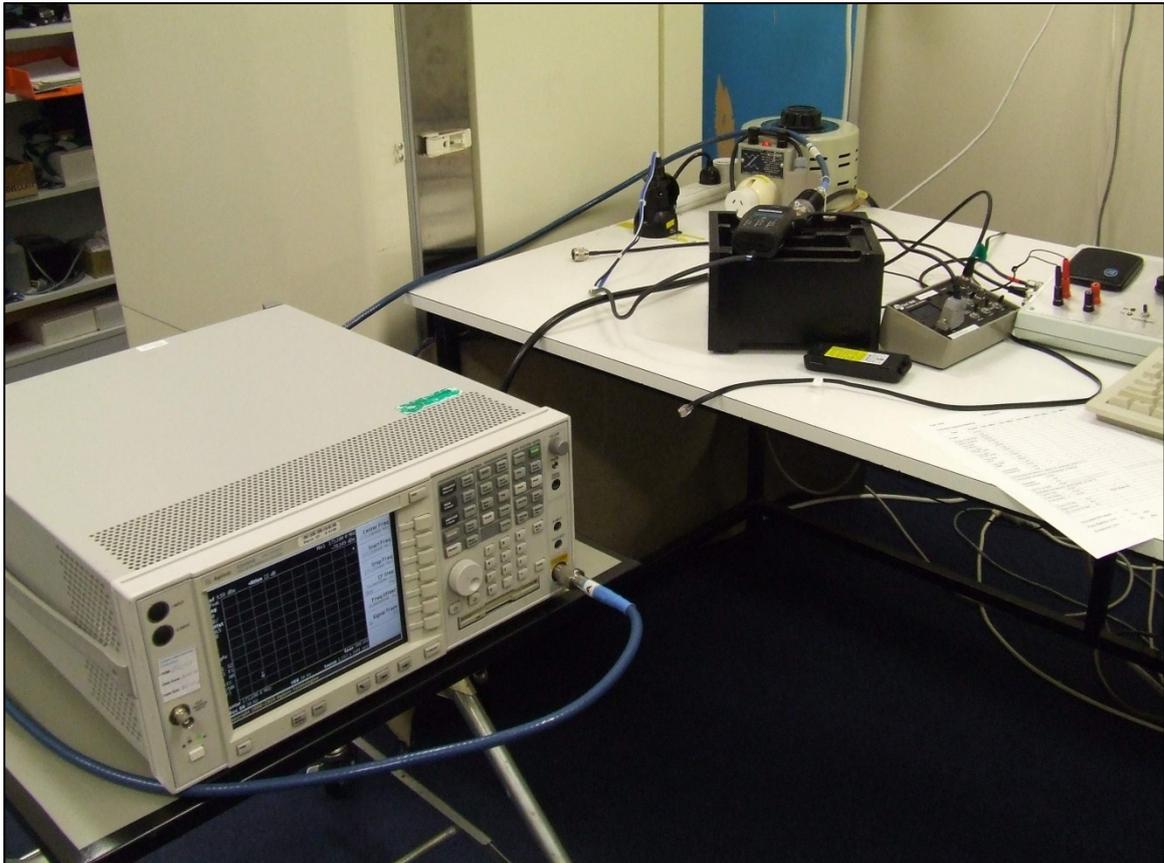
MEASUREMENT RESULTS:

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

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

LIMIT CLAUSES: FCC 47 CFR 90.210 RSS-119 5.8

Photo: Conducted Emissions Test Setup

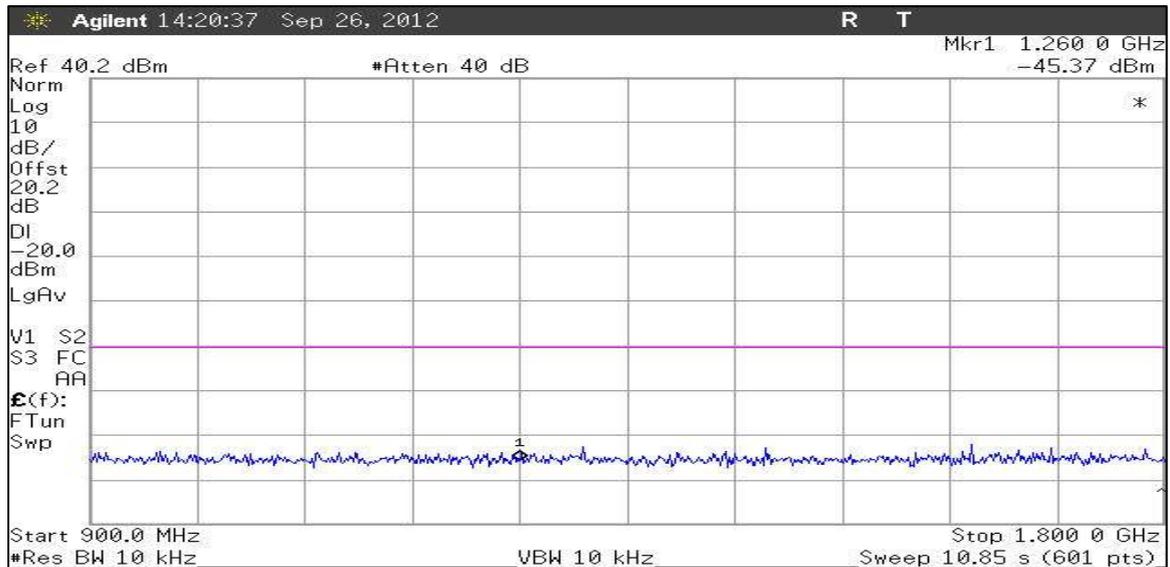
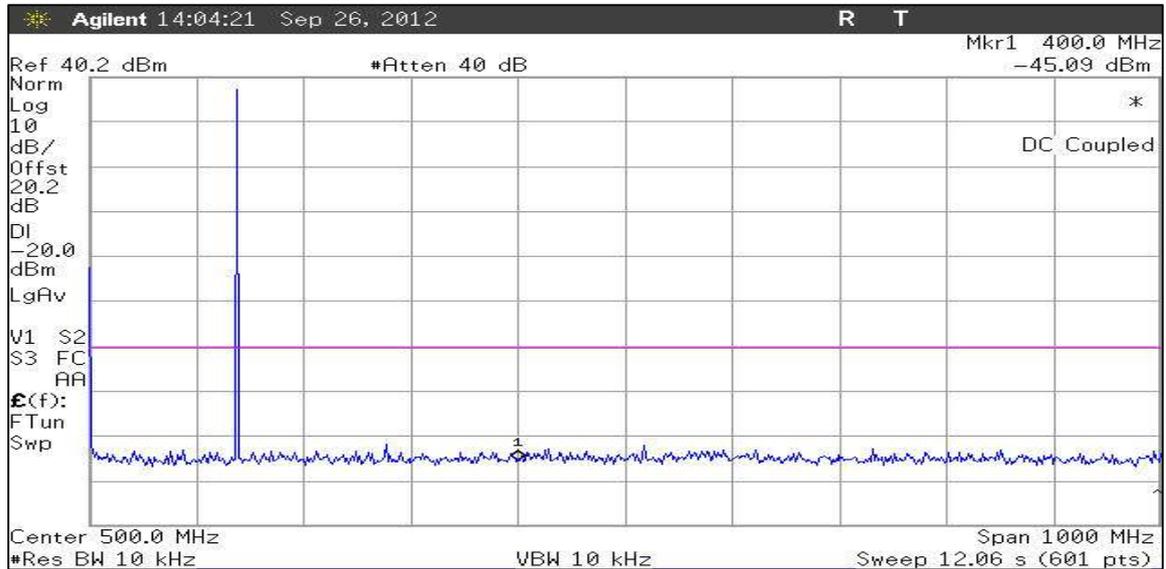


Tx Conducted Emissions - Continued

SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

12.5 kHz Channel Spacing		138.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)		Level (dBc)
138.0755	-38.0		-75.0
12.5 kHz Channel Spacing		138.1 MHz @ 1 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)		Level (dBc)
~	~		~
No other emissions were detected at a level greater than 20 dB below the limit.			

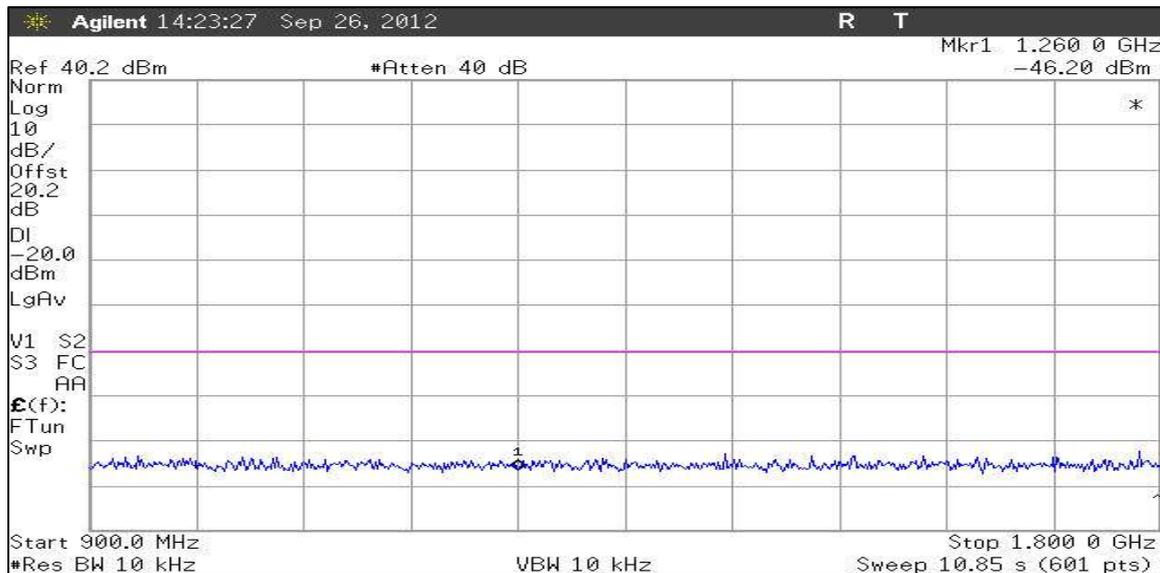
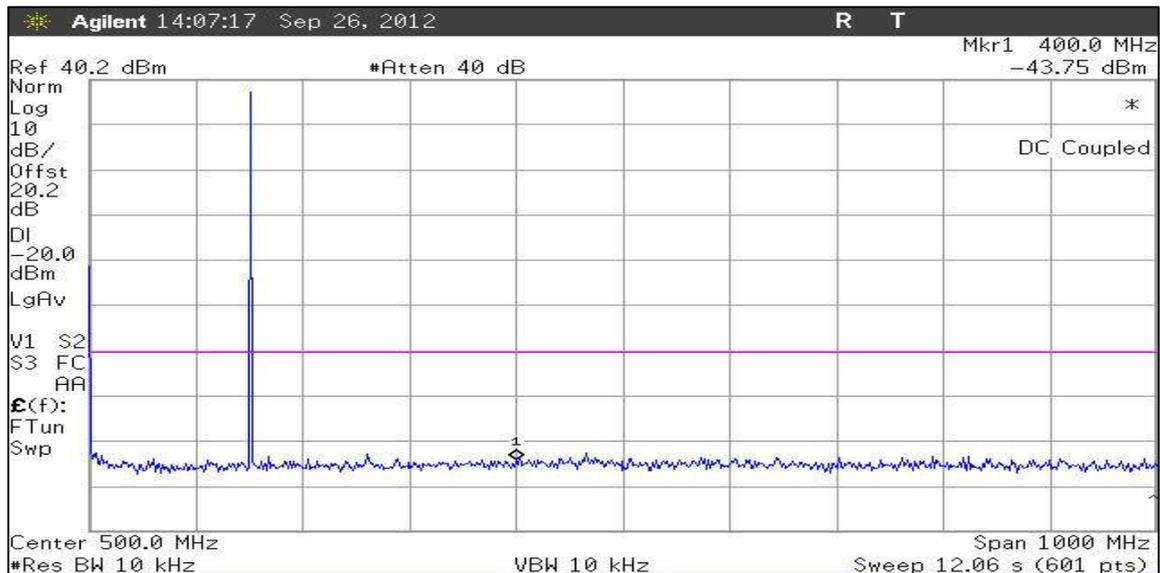
138.1 MHz @ 5 W



Tx Conducted Emissions - Continued

12.5 kHz Channel Spacing		152.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)	
152.0721	-38.8	-75.8	
152.1270	-39.8	-76.8	
12.5 kHz Channel Spacing		152.1 MHz @ 1 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)	
~	~	~	
No other emissions were detected at a level greater than 20 dB below the limit.			

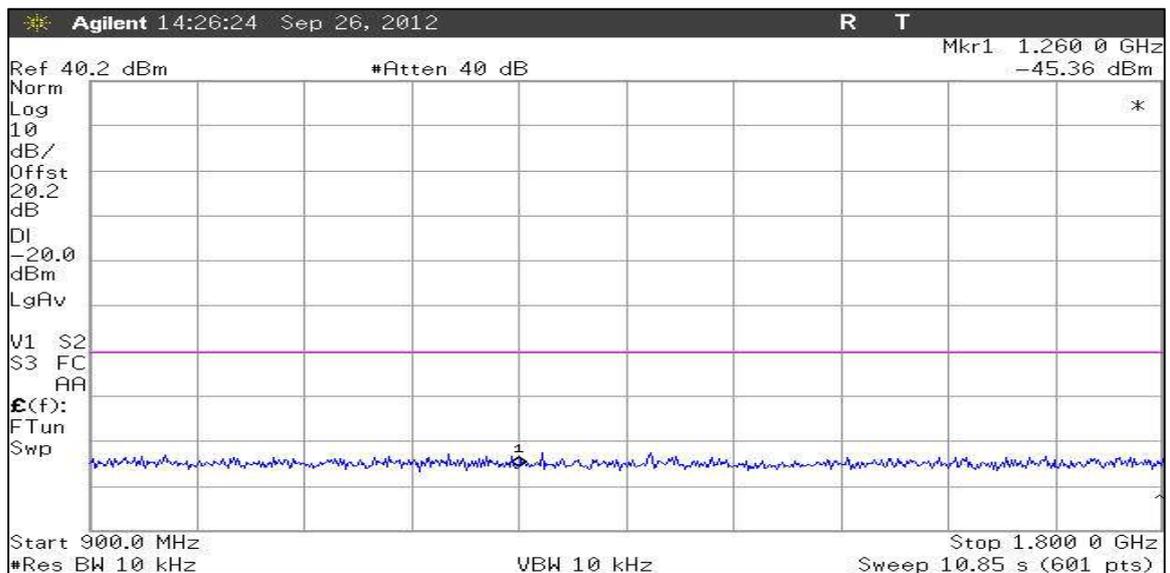
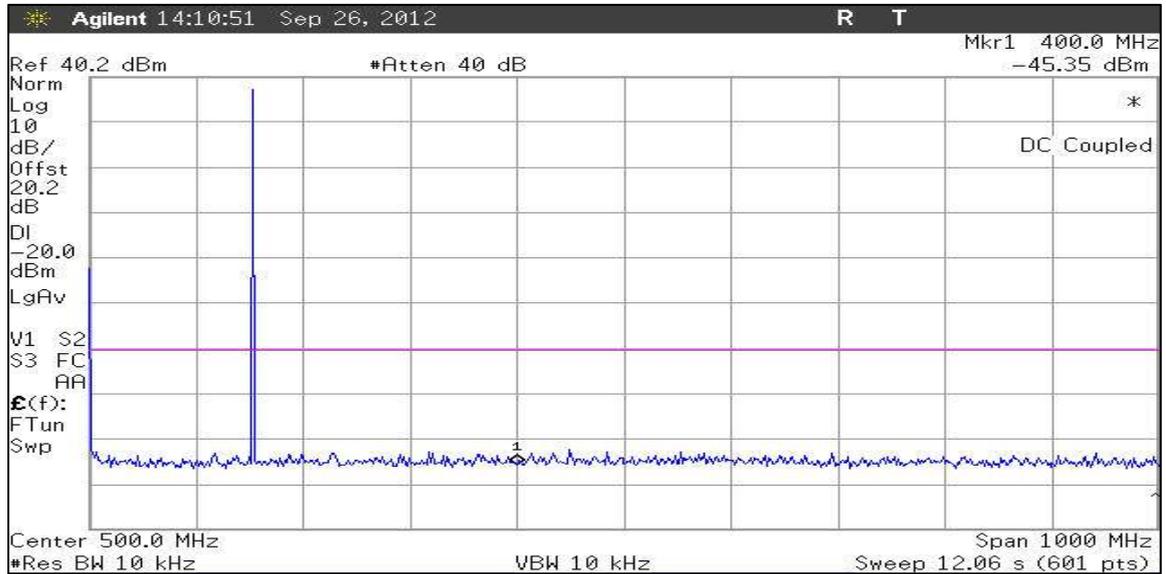
152.1 MHz @ 5 W



Tx Conducted Emissions - Continued

12.5 kHz Channel Spacing		153.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)		Level (dBc)
153.0713	-38.7		-75.7
12.5 kHz Channel Spacing		153.1 MHz @ 1 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)		Level (dBc)
~	~		~
No other emissions were detected at a level greater than 20 dB below the limit.			

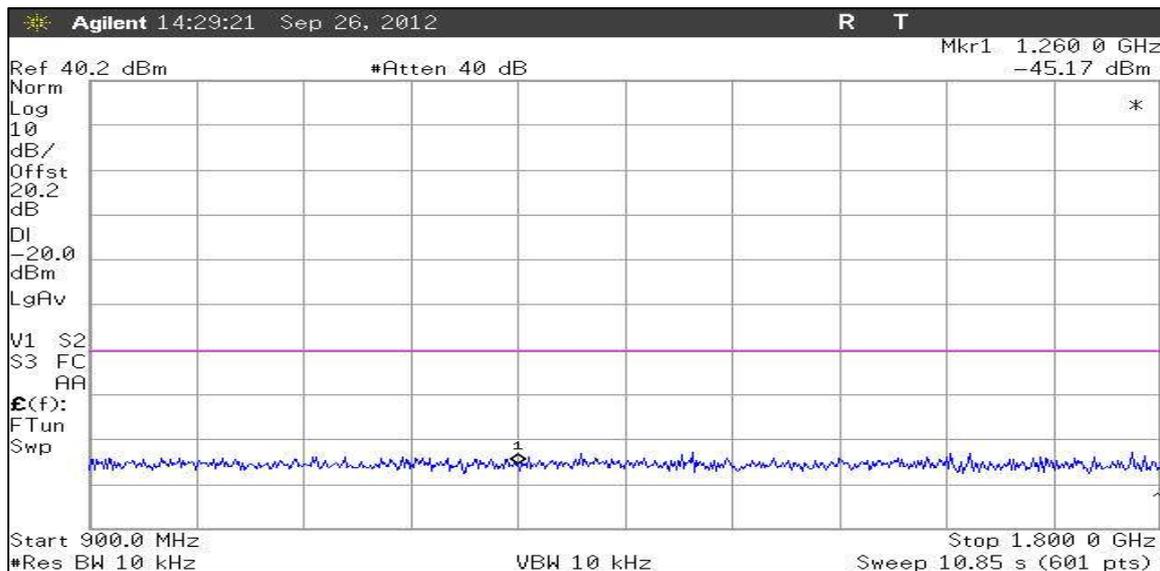
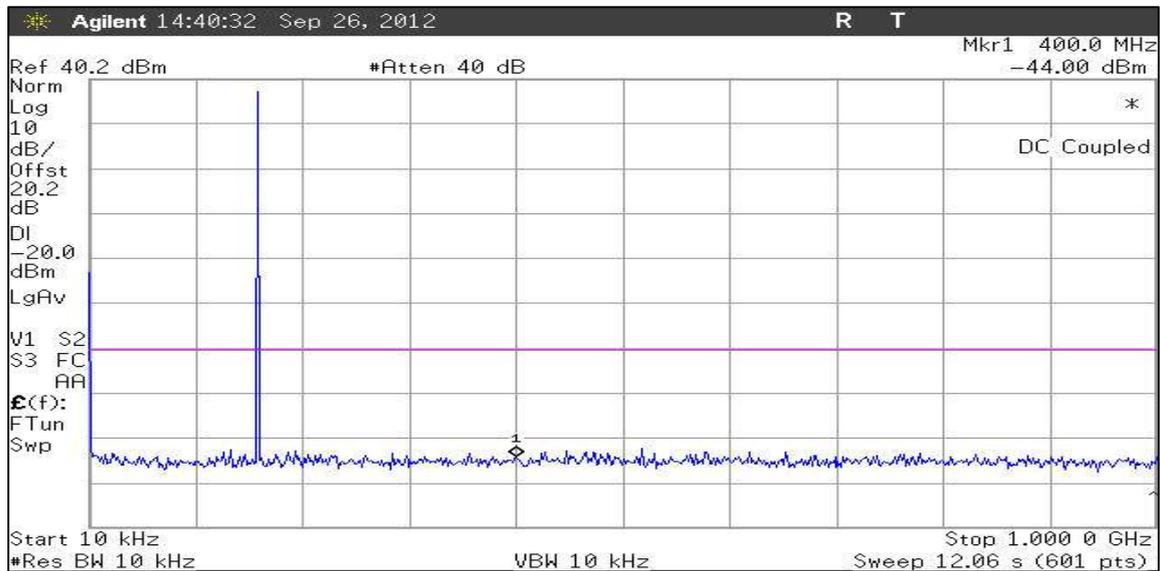
153.1 MHz @ 5 W



Tx Conducted Emissions - Continued

12.5 kHz Channel Spacing		158.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)	
158.0705	-39.9	-76.9	
158.1287	-39.7	-76.7	
12.5 kHz Channel Spacing		158.1 MHz @ 1 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)	
~	~	~	
No other emissions were detected at a level greater than 20 dB below the limit.			

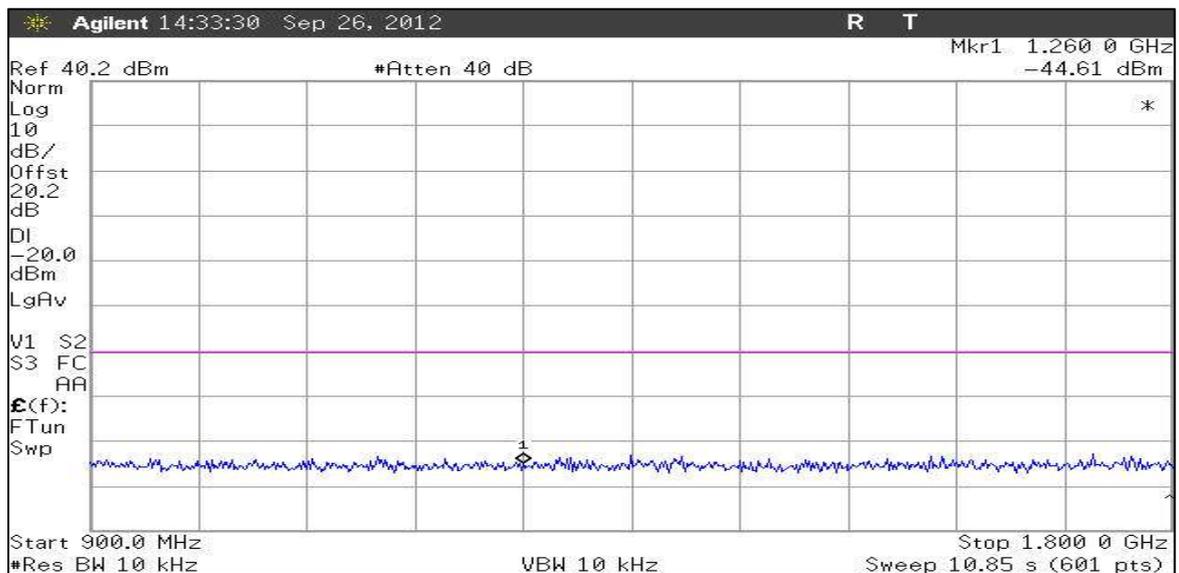
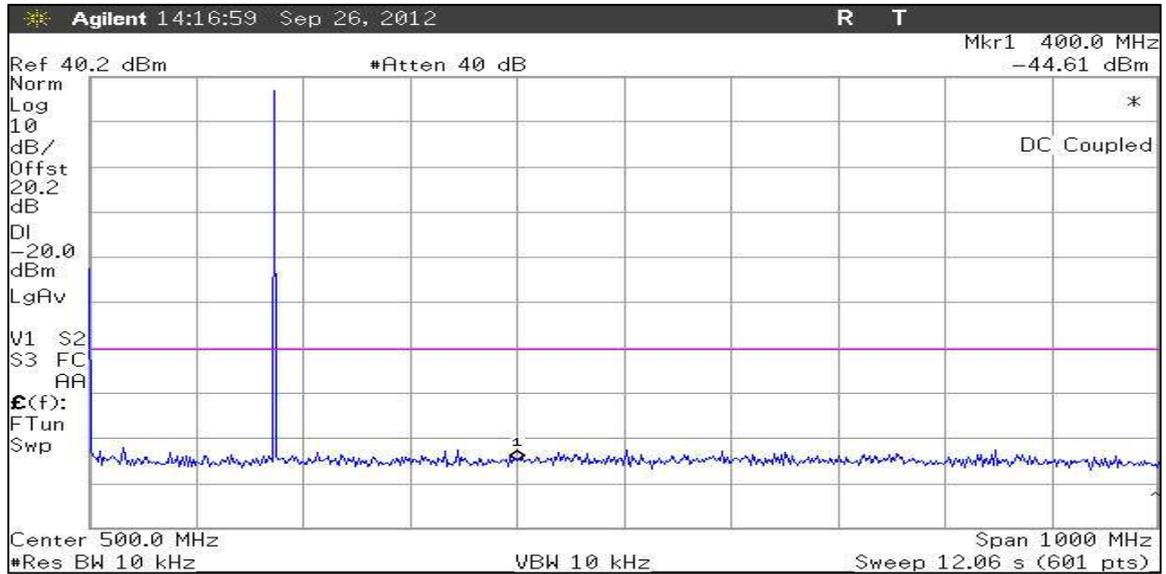
158.1 MHz @ 5 W



Tx Conducted Emissions - Continued

12.5 kHz Channel Spacing		173.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)		Level (dBc)
~	~		~
12.5 kHz Channel Spacing		173.1 MHz @ 1 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.			

173.1 MHz @ 5 W



Tx Conducted Emissions – Continued

LIMITS: FCC 47 CFR 90.210 RSS-119 5.8

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

SPURIOUS EMISSIONS (Tx 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 30MHz to 1000MHz. Any emission within 10dB of the limit is then re-tested on the OATS along with measurements from 1000MHz to the 10th harmonic of the fundamental frequency.
2. The EUT is then placed on a wooden turntable at a distance of 0.5 metres from the test antenna and emissions are measured from 1000MHz to the upper frequency required. Any emission within 10 dB of the limit is then re-tested on the OATS.
3. The harmonics emissions upto 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 meters from the test antenna. The output terminal is connected to an RF dummy load.
2. The test antenna is raised from 1m to 4m 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

Tx Radiated Emissions - Continued

12.5 kHz Channel Spacing		138.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)		Level (dBc)
~	~		~
12.5 kHz Channel Spacing		138.1 MHz @ 1 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		152.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)		Level (dBc)
~	~		~
12.5 kHz Channel Spacing		152.1 MHz @ 1 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		153.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)		Level (dBc)
~	~		~
12.5 kHz Channel Spacing		153.1 MHz @ 1 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

12.5 kHz Channel Spacing		158.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)		Level (dBc)
~	~		~
12.5 kHz Channel Spacing		158.1 MHz @ 1 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		173.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)		Level (dBc)
~	~		~
12.5 kHz Channel Spacing		173.1 MHz @ 1 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.			

LIMITS: FCC CFR 2.1053

Carrier Output Power Watts	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{\text{Watts}})$	
5 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	158.1 MHz @ 5 W	Emission Mask D
Harmonics Emission Frequency (MHz)	Level (dBm)	Level (dBc)
316.2	-52.1	-89.1
474.3	-64.3	-101.3
632.4	-71.9	-108.9
790.5	-59.1	-96.1
948.6	-52.0	-89.0
1106.7	-70.2	-107.2

Photo: OATS Setup



TRANSIENT FREQUENCY BEHAVIOR

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

GUIDE: TIA/EIA-603D 2.2.19

MEASUREMENT PROCEDURE:

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

MEASUREMENT RESULTS:

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

LIMIT CLAUSES: FCC 47 CFR 90.214 RSS-119 5.9

Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 138.1 MHz 5 W 12.5 kHz Channel Spacing

FREQUENCY	138.1 MHz @ 5 W Tx	
TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	0.4	N/A
t2	-0.2	N/A
t3	N/A	-0.4
t2 → t3 ppm	2.3	
ERROR LIMIT (t2 → t3) ppm	5.0	

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 – 174 MHz	FREQUENCY RANGE 421 – 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

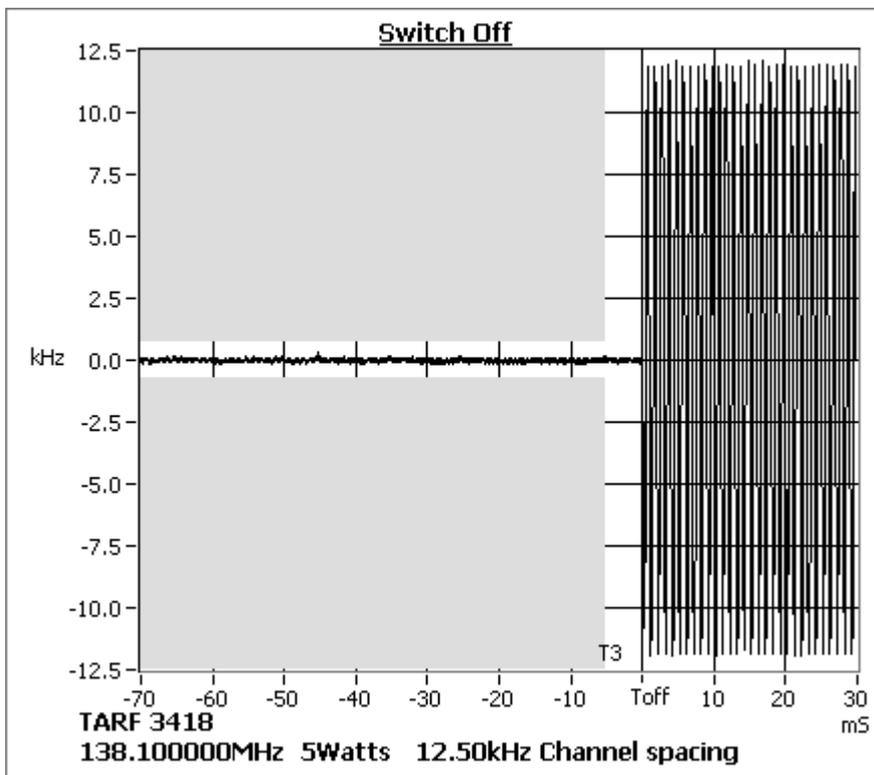
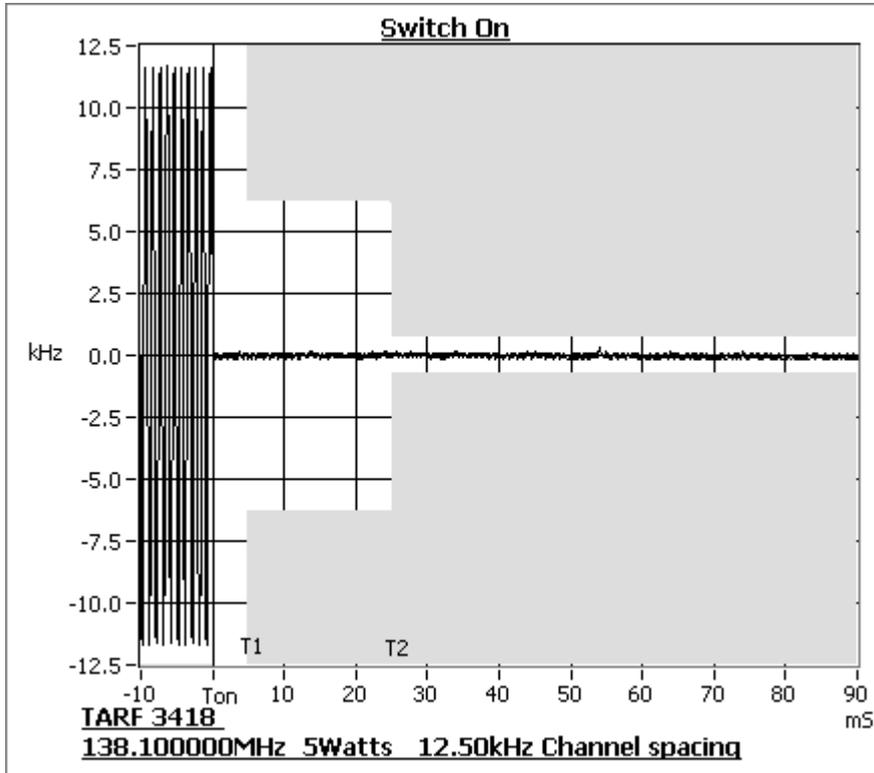
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

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 Behavior

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 138.1 MHz 5 W 12.5 kHz Channel Spacing



Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing

FREQUENCY	152.1 MHz @ 5 W Tx	
TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	0.9	N/A
t2	-0.3	N/A
t3	N/A	0.2
t2 → t3 ppm	4.1	
ERROR LIMIT (t2 → t3) ppm	5.0	

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 – 174 MHz	FREQUENCY RANGE 421 – 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

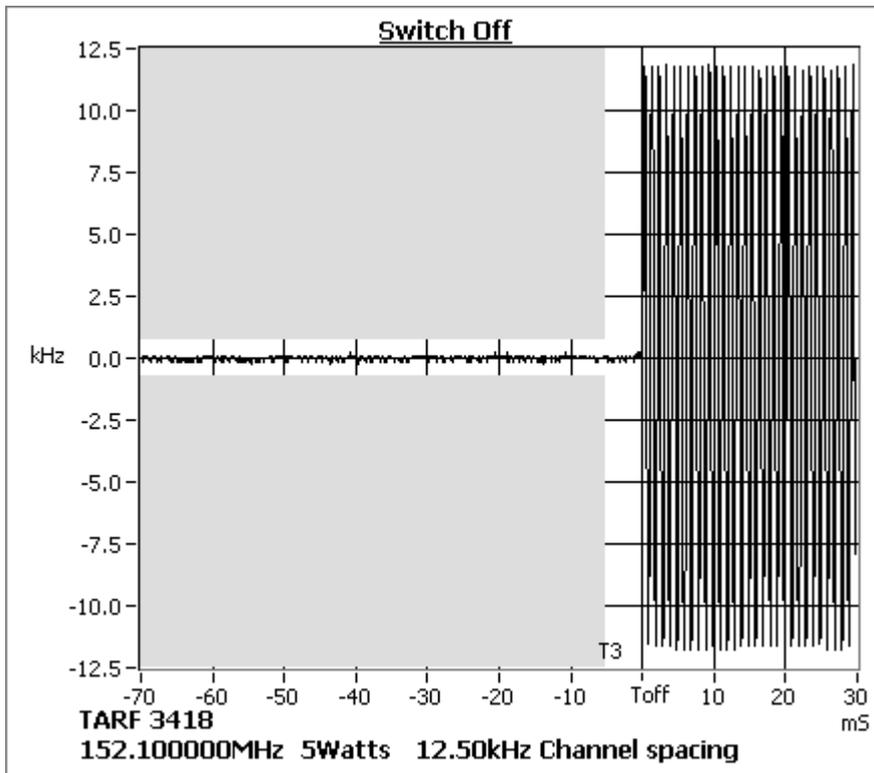
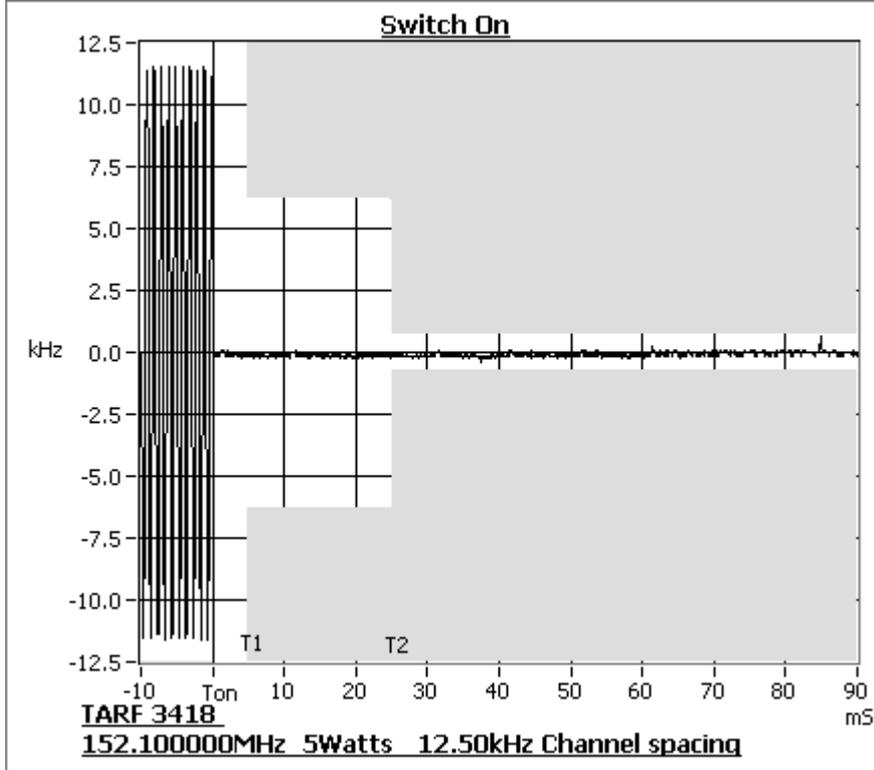
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

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 Behavior

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing



Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing

FREQUENCY	153.1 MHz @ 5 W Tx	
TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	-2.5	N/A
t2	0.3	N/A
t3	N/A	-0.5
t2 → t3 ppm	1.7	
ERROR LIMIT (t2 → t3) ppm	5.0	

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 – 174 MHz	FREQUENCY RANGE 421 – 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

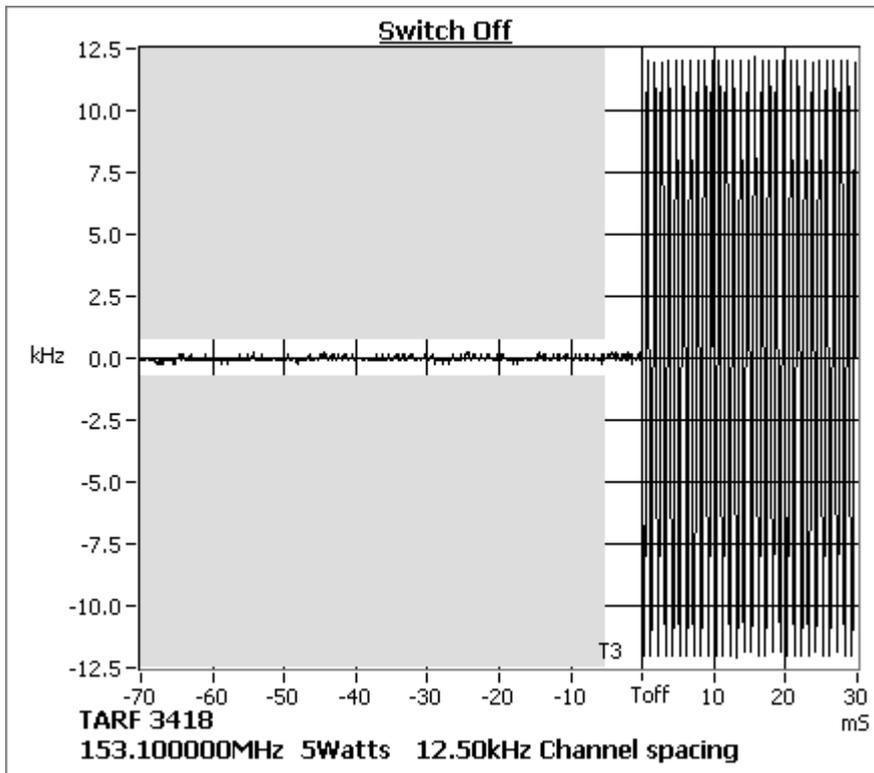
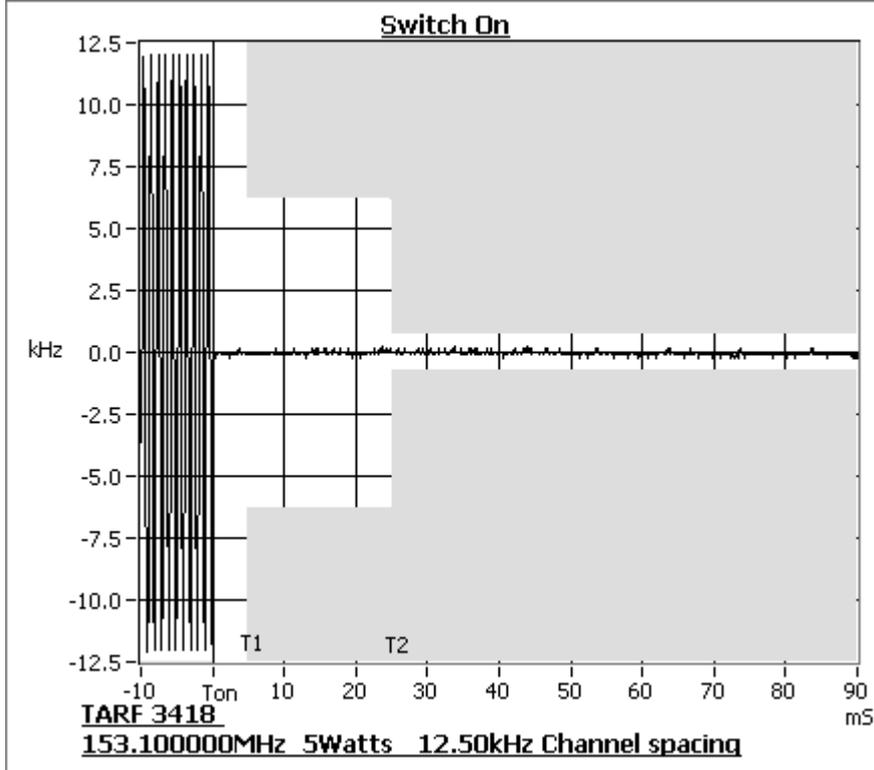
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

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 Behavior

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing



Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 158.1 MHz 5 W 12.5 kHz Channel Spacing

FREQUENCY	158.1 MHz @ 5 W Tx	
TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	0.4	N/A
t2	-0.2	N/A
t3	N/A	0.3
t2 → t3 ppm	-2.2	
ERROR LIMIT (t2 → t3) ppm	5.0	

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 – 174 MHz	FREQUENCY RANGE 421 – 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

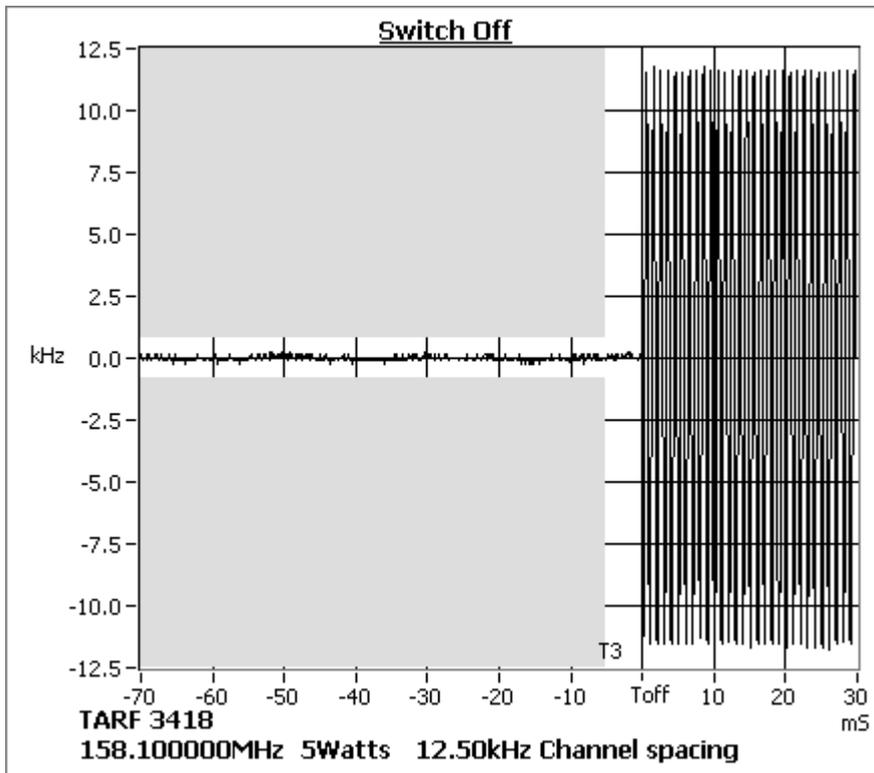
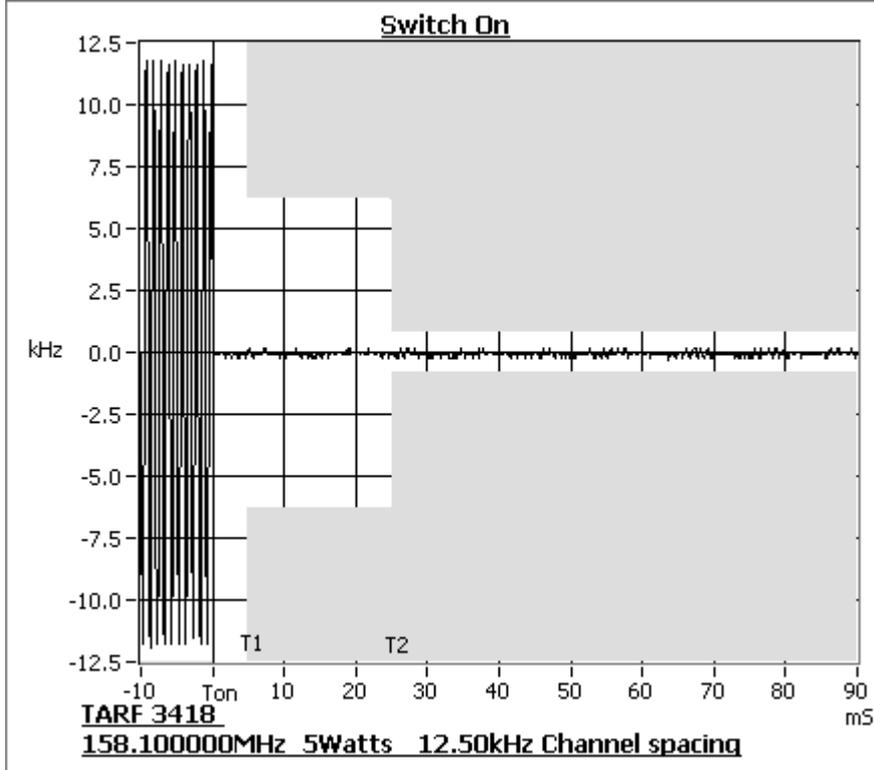
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

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 Behavior

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 158.1 MHz 5 W 12.5 kHz Channel Spacing



Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 173.1 MHz 5 W 12.5 kHz Channel Spacing

FREQUENCY	173.1 MHz @ 5 W Tx	
TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	1.7	N/A
t2	-0.3	N/A
t3	N/A	0.2
t2 → t3 ppm	1.8	
ERROR LIMIT (t2 → t3) ppm	5.0	

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 – 174 MHz	FREQUENCY RANGE 421 – 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

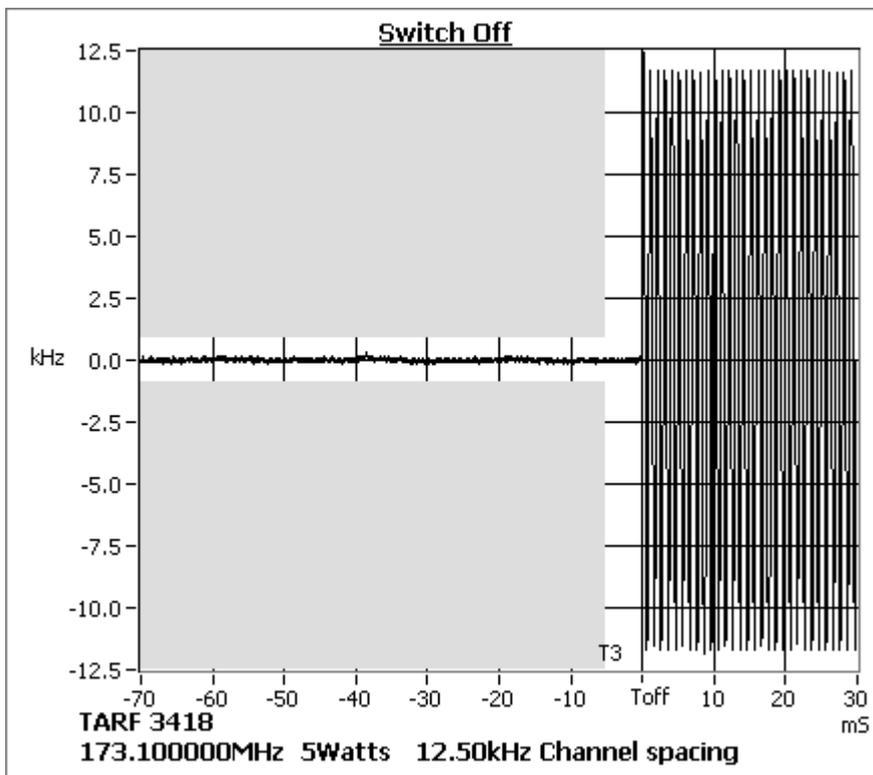
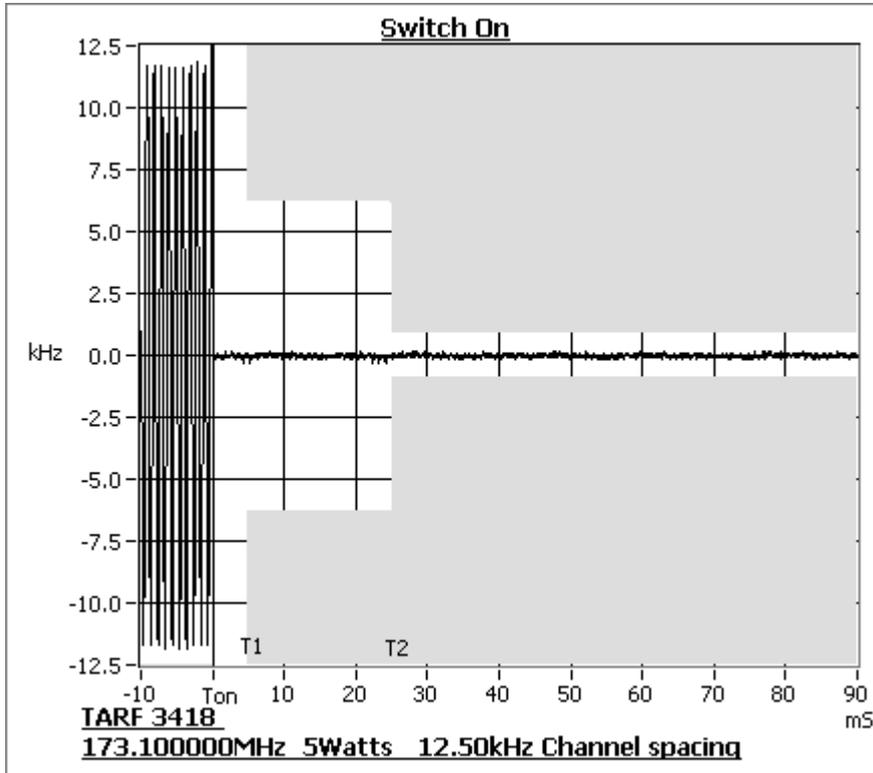
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

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 Behavior

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 173.1 MHz 5 W 12.5 kHz Channel Spacing



TRANSMITTER FREQUENCY STABILITY - TEMPERATURE

SPECIFICATION: FCC 47 CFR 2.1055 (a) (1) RSS-119 5.3

GUIDE: TIA/EIA-603D 2.2.2

MEASUREMENT PROCEDURE:

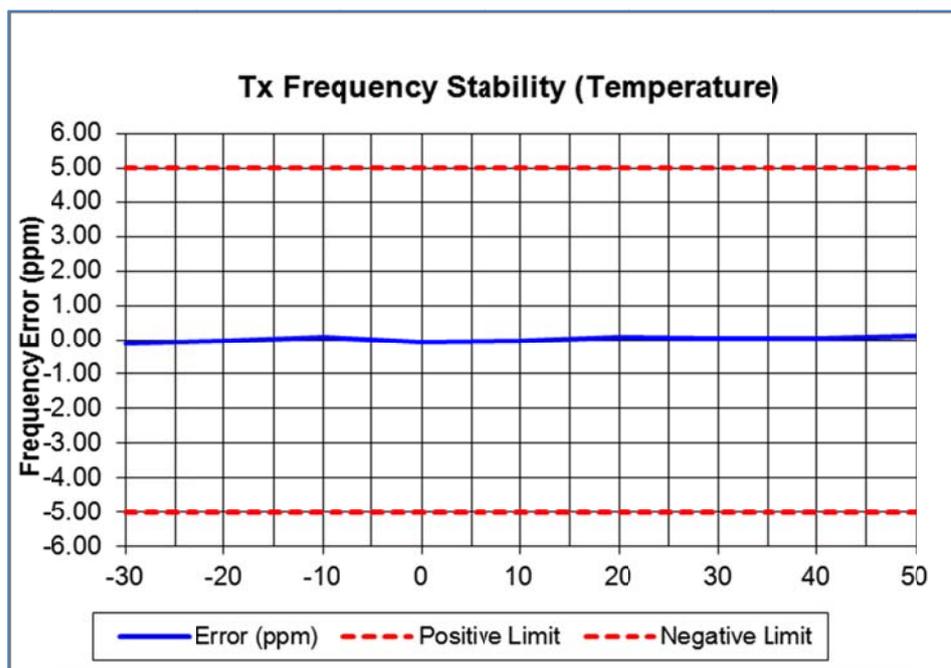
1. Refer Annex A for equipment set up.
2. The EUT was tested for frequency error from -30°C to $+50^{\circ}\text{C}$ in 10°C increments
3. The frequency error was recorded in parts per million (ppm).

MEASUREMENT RESULTS:

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

138.1 MHz

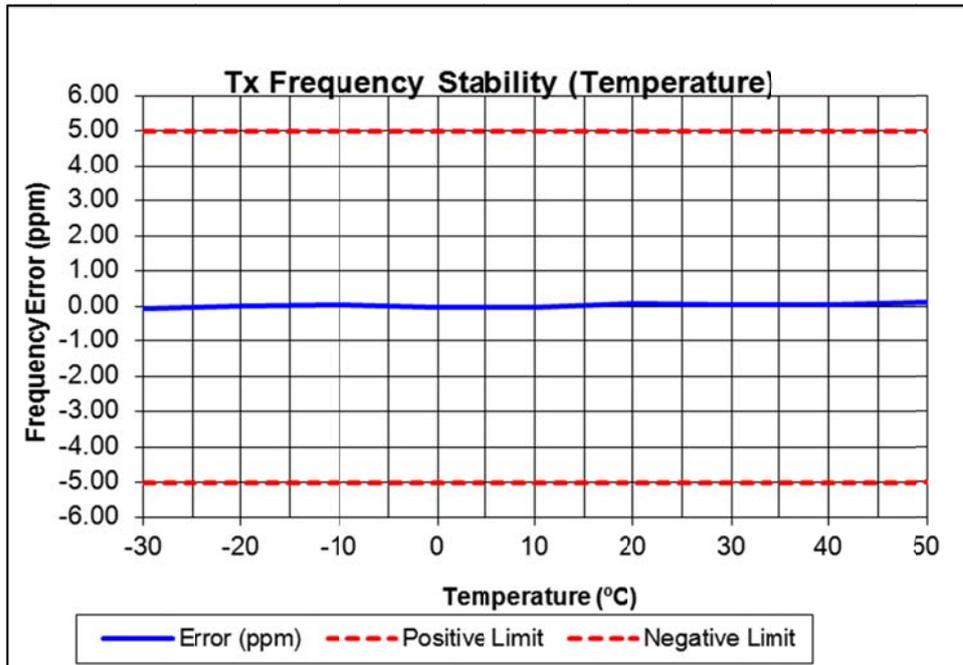
Temperature ($^{\circ}\text{C}$)	Frequency (MHz)	Error (ppm)
50	138.100016	0.12
40	138.100006	0.04
30	138.100006	0.04
20	138.100009	0.07
10	138.099994	-0.04
0	138.099991	-0.07
-10	138.100009	0.07
-20	138.099996	-0.03
-30	138.099987	-0.09



Transmitter Frequency Stability - Temperature

152.1 MHz

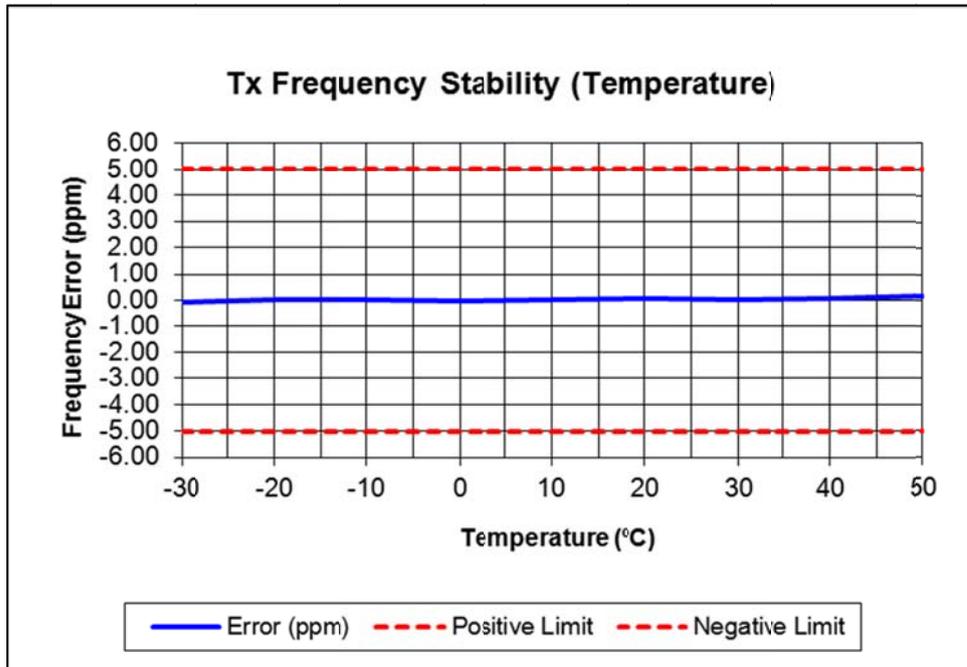
Temperature (°C)	Frequency (MHz)	Error (ppm)
50	152.100019	0.12
40	152.100007	0.05
30	152.100008	0.05
20	152.100012	0.08
10	152.099997	-0.02
0	152.099993	-0.05
-10	152.100006	0.04
-20	152.099999	-0.01
-30	152.099991	-0.06



Transmitter Frequency Stability - Temperature

153.1 MHz

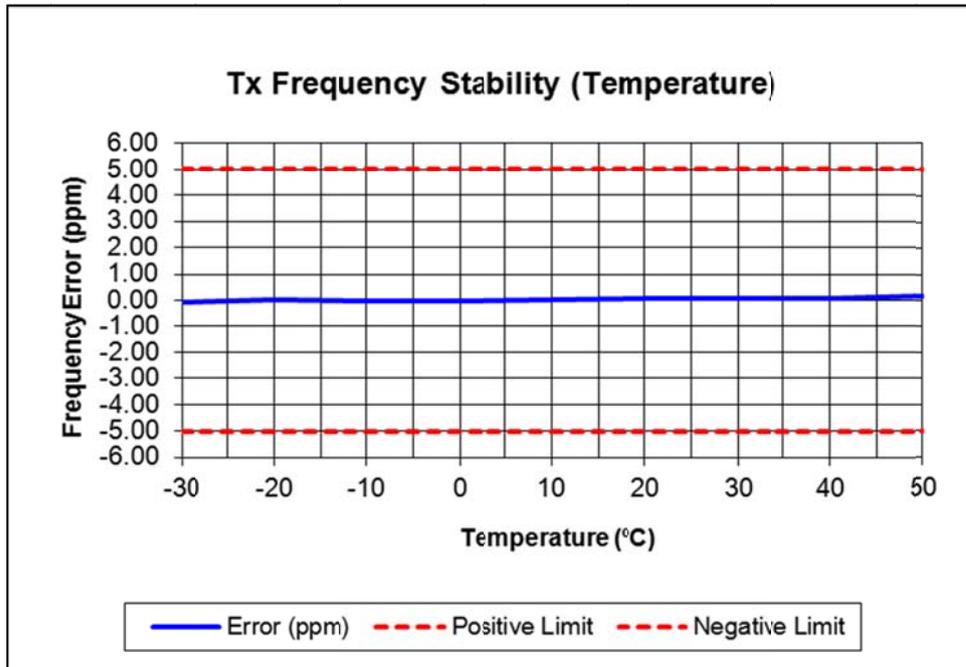
Temperature (°C)	Frequency (MHz)	Error (ppm)
50	153.100023	0.15
40	153.100011	0.07
30	153.100007	0.05
20	153.100012	0.08
10	153.100001	0.01
0	153.099994	-0.04
-10	153.100003	0.02
-20	153.100002	0.01
-30	153.099991	-0.06



Transmitter Frequency Stability - Temperature

158.1 MHz

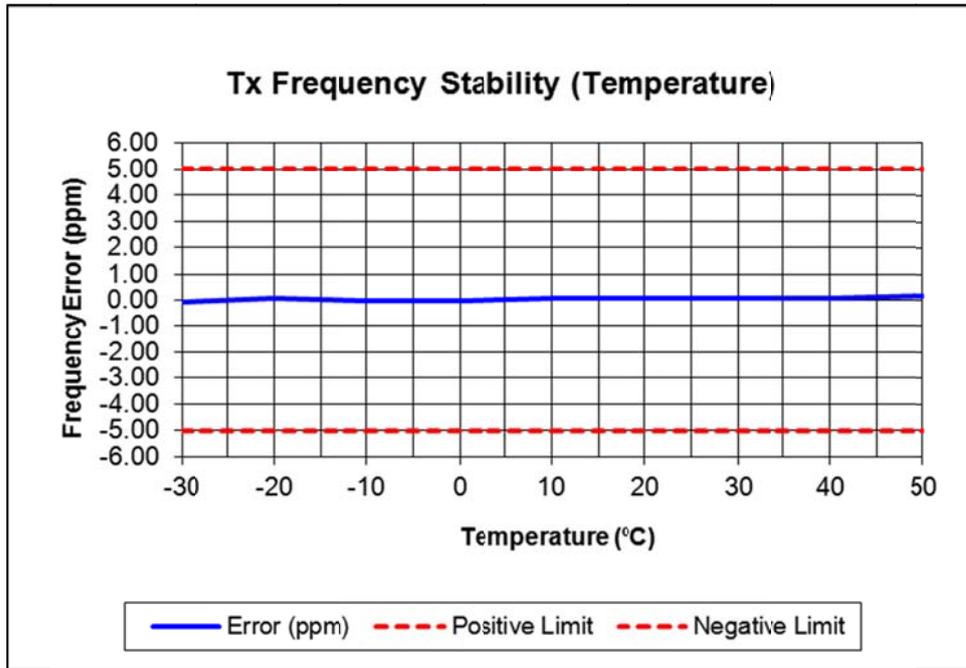
Temperature (°C)	Frequency (MHz)	Error (ppm)
50	158.100026	0.16
40	158.100013	0.08
30	158.100008	0.05
20	158.100013	0.08
10	158.100003	0.02
0	158.099994	-0.04
-10	158.099998	-0.01
-20	158.100006	0.04
-30	158.099989	-0.07



Transmitter Frequency Stability - Temperature

173.1 MHz

Temperature (°C)	Frequency (MHz)	Error (ppm)
50	173.100031	0.18
40	173.100016	0.09
30	173.100009	0.05
20	173.100016	0.09
10	173.100009	0.05
0	173.099998	-0.01
-10	173.099993	-0.04
-20	173.100011	0.06
-30	173.099988	-0.07



LIMIT: FCC 47 CFR 90.213

RSS-119 5.3

Channel Spacing (kHz)	Frequency Error (ppm)
12.5	5.0

TRANSMITTER FREQUENCY STABILITY - VOLTAGE

SPECIFICATION: FCC 47 CFR 2.1055 (d) (1) RSS-119 5.3

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 of nominal and battery endpoint.
3. The frequency error was recorded in parts per million (ppm).

MEASUREMENT RESULTS:

Voltage	FREQUENCY ERROR (ppm) for 12.5 kHz				
	138.1 MHz	152.1 MHz	153.1 MHz	158.1 MHz	173.1 MHz
7.5 V _{DC}	-0.05	0.00	0.01	-0.01	0.01
6.375 V _{DC}	-0.04	0.01	0.01	0.01	-0.01

LIMIT CLAUSES: FCC 47 CFR 90.213 RSS-119 5.3

Channel Spacing (kHz)	Frequency Error (ppm)
12.5	5.0

SPURIOUS EMISSIONS – Rx CONDUCTED

SPECIFICATION: RSS-119 5.11

GUIDE: TIA/EIA-603D 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 20dB below the limit were not recorded.

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

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

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

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

Spurious Emissions – Rx Conducted

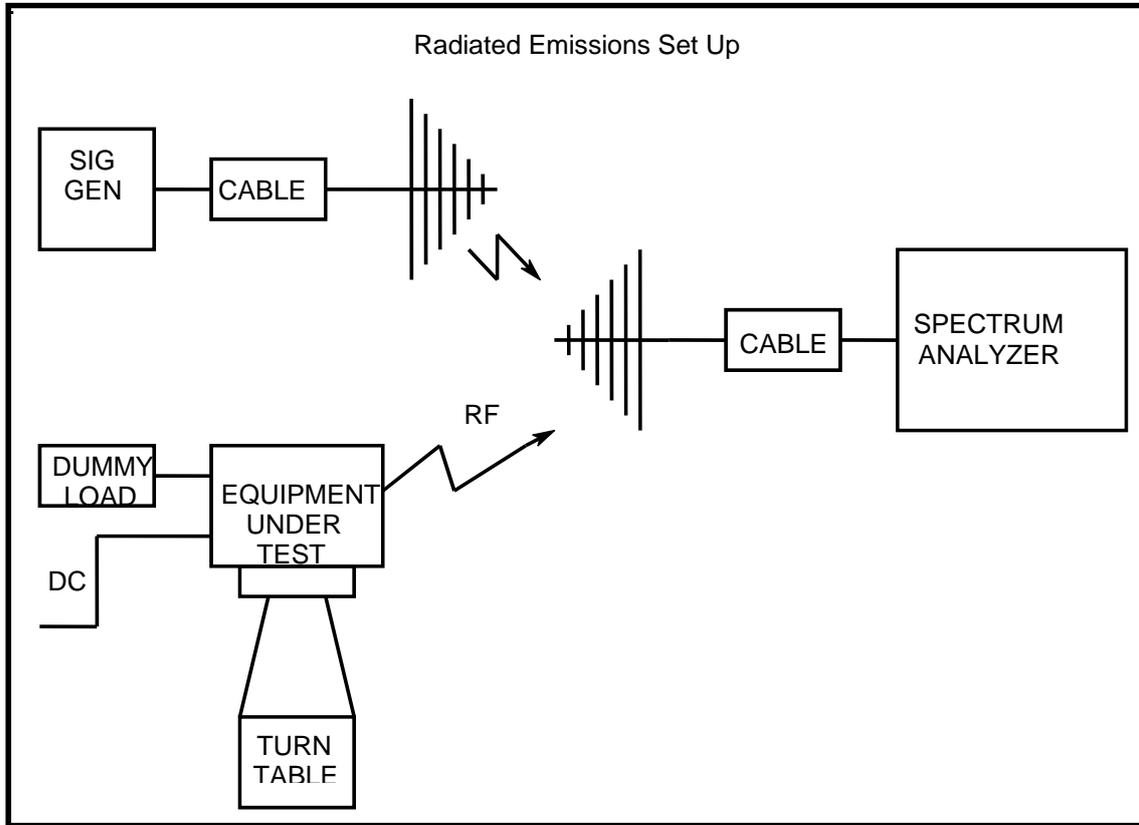
173.1 MHz Receive		
Emission Frequency (MHz)	Level (nW)	Level (dBm)
~	~	~
No emissions were detected within 20 dB of Limit.		

LIMIT CLAUSE:	RSS-Gen	6(b)	
LIMIT	30 → 1000 MHz	2 nW	- 57 dBm
	> 1000 MHz	5 nW	- 53 dBm

TEST EQUIPMENT LIST

No#	Equipment	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
3	Signal Generator	Agilent	E4422B	GB40050320	E3788	15-Oct-13
11	Modulation Analyser	Hewlett Packard	HP8901B (Opt 002)	2441A00393	E3073	18-Oct-13
13	Audio Analyser	Hewlett Packard	HP8903A	2308A02597	E3074	10-Oct-13
20	Power Supply	Hewlett Packard	HP6032A	2441A00412	E3075	17-Oct-13
22	Oscilloscope	Tektronics	TDS340	B013611	E3585	10-Oct-13
40	Reference Dipoles	Emco	3121C DB1	9510-1164	E3559	9-Dec-12
43	Horn Antenna	Emco	DRG3115	2084	E3076	5-Jan-13
44	Spectrum Analyser	Agilent	PXA N9030A	MY49432161	E4907	30-Mar-14
46	S-LINE TEM CELL	Rohde & Schwarz	1089.9296.02	338232/003	E3636	31-Aug-15
52	Amplifier +21.7 dB	Tait	ZFL-1000LN	E3660	E3360	2-Dec-12
64	RF Attenuator 50W	Weinschel	24-10-34	AZ0401	E3388	13-Oct-13
65	RF Attenuator 50W	Weinschel	24-20-44	AW1266	E3562	13-Oct-13
66	RF Attenuator 25W	Weinschel	33-20-33	BD5871	E3673	13-Oct-13
67	RF Attenuator 150W Treva	Weinschel	40-20-33	CJ405	E3733	12-Oct-13
72	RF Load 50W	Weinschel	F1426	AE2490	E3624	13-Oct-13
82	1m Coax Cable	Suhner	Sucoflex 104A	44610/4A	E4619	12-Oct-13
83	2m Coax (Black2)	Suhner	RG214HF/Nm/Nm/2000	Black2	E4623	12-Oct-13
84	2m Coax (Black3)	Suhner	RG214HF/Nm/Nm/2000	Black3	E4624	13-Oct-13
85	3m Coax Cable	Suhner	Sucoflex 104A	44611/4A	E4620	13-Oct-13
86	2m Coax (Black4)	Suhner	RG214HF/Nm/Nm/2000	Black4	E4653	13-Oct-13
88	Spectrum Analyser	Hewlett Packard	HP8562E	3821A00779	E3715	17-Oct-13
115	Environ. Chamber	Contherm	5400 RHSLT.M	1416	E4051	2-Aug-15
120	RF Splitter Combiner	Minicircuits	ZFSC-4-1	-	E4083	-
123	Spectrum Analyser	Agilent	E4445A	MY42510072	E4139	21-Nov-14
126	OATS NSA	Tait				31-Aug-13
127	OATS Tower Cable	Intelcom	RG214	OATS1	E4621	15-Oct-13
128	OATS Turntable Cable	Intelcom	RG215	OATS2	E4622	15-Oct-13
129	Antenna Tower	Electrometrics	EM-4720-2	112	E4447	-
130	Controller	Electrometrics	EM-4700	119	E4445	-
131	Turntable	Electrometrics	EM-4704A	105	E4446	-
149	Log Periodic Antenna	Schwarzbeck	VUSLP	9111-219	E4617	-

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.

