TELTEST Laboratories
Tait Ltd
Report Number 3535

LABORATORY TEST REPORT

RADIO PERFORMANCE MEASUREMENTS

for the

TBCB1A Base Station 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: 08 November 2013

PREPARED BY: Robin Kidson _____
Test Technician

CHECKED & APPROVED BY: M.C. James _____
Laboratory Technical Manager

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

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

TABLE OF CONTENTS

REVISION

Date	Revision	Comments
08/11/2013	1	Initial test report

INTRODUCTION

This report covers the requirements of FCC 47 Parts 22, 74 & 90, and RSS-119 Issue 11 & RSS-Gen Issue 3.

REASON FOR REPORT
The TB9400 B1 50 W is a new addition to the Tait Communications Ltd product line capable of APCO Phase I C4FM and LSM modulation as well as APCO Phase II modulation.

Type Approval Testing of the TBCB1A
Frequency range 148 → 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: Base Station Transceiver
Type: TBCB1A

The TBCB1A Base Station Transceiver consisting of:

FUNCTIONAL DESCRIPTION	**PRODUCT DESIGNATION CODE**	**SERIAL NUMBER (S)**
Reciter	T01-01103-DAAA	18188040
Power Amplifier	T01-01121-DAAA	18188126
Power Management Unit	TBA30A0-0100	18187044
Front Panel	T01-01110-BAAA	18188451
Subrack	T01-01101-FAAA	18188131

HARDWARE & SOFTWARE Details:

FUNCTIONAL DESCRIPTION	FIRMWARE VERSION	HARDWARE VERSION
Reciter	p25-1.25.00.0006	00.11
Power Amplifier	1.05.00.0001	0006
Power Management Unit	0316	00.03
Front Panel	1.05.00.0001	00.04

TEST CONDITIONS
All testing was performed between 10 October → 04 November 2013, and under the following conditions:
Ambient temperature: $15^{o}C \rightarrow 30^{o}C$
Relative Humidity: 20% → 75%
Standard Test Voltage $120\ V_{AC}$

STATEMENT OF COMPLIANCE

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

Equipment: Base Station Transceiver
Type: TBCB1A
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: _____

Mike James
Technical Manager

Date: _____

MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS

MODULATION TYPES Phase I:

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

MODULATION TYPES FOR APCO PHASE II:

D7W	H-DQPSK	6000 symbols/sec	12000 bps
D7W	H-D8PSK	6000 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 as been measured using the 99% energy rule, and in accordance with TIA/102 CAAB 2.2.5.2 and RSS-Gen 4.6.1.

Digital Voice 12.5 kHz Channel Spacing

99% bandwidth	Emission Designator
= 8.1 kHz	8K10F1E F1E represents a digital FM voice transmission 8K10F7E F7E represents two or more channels containing quantized or digital voice information

Digital Data 12.5 kHz Channel Spacing

99% bandwidth	Emission Designator
= 8.1 kHz	8K10F1D F1D represents an digital FM data transmission 8K10F7D F7D represents two or more channels containing quantized or digital information

Linear Simulcast Modulation (LSM):

Digital Voice/data transmissions use a 4 level frequency shift keying modulation scheme.
The necessary bandwidth as been measured using the 99% energy rule, and in accordance with TIA/102 CAAB 2.2.5.2 and RSS-Gen 4.6.1.

QPSK Digital Data 12.5 kHz Bandwidth

99% bandwidth	Emission Designator
= 8.7 kHz	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	Emission Designator
= 9.8 kHz	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	Emission Designator
= 6.8 kHz	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: 50 W and 5 W

Nominal 50	148.1 MHz	149.8 MHz	152.1 MHz	153.1 MHz	161.1 MHz	173.1 MHz
Measured	46.6	47.4	46.9	46.9	46.4	48.0
Variation (%)	-6.9	-5.2	-6.2	-6.3	-7.1	-4.0
Variation (dB)	-0.3	-0.2	-0.3	-0.3	-0.3	-0.2
Nominal 5	148.1 MHz	149.8 MHz	152.1 MHz	153.1 MHz	161.1 MHz	173.1 MHz
Measured	4.7	4.7	4.7	4.7	4.7	4.8
Variation (%)	-6.0	-6.4	-5.5	-5.7	-5.4	-3.4
Variation (dB)	-0.3	-0.3	-0.2	-0.3	-0.2	-0.2
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

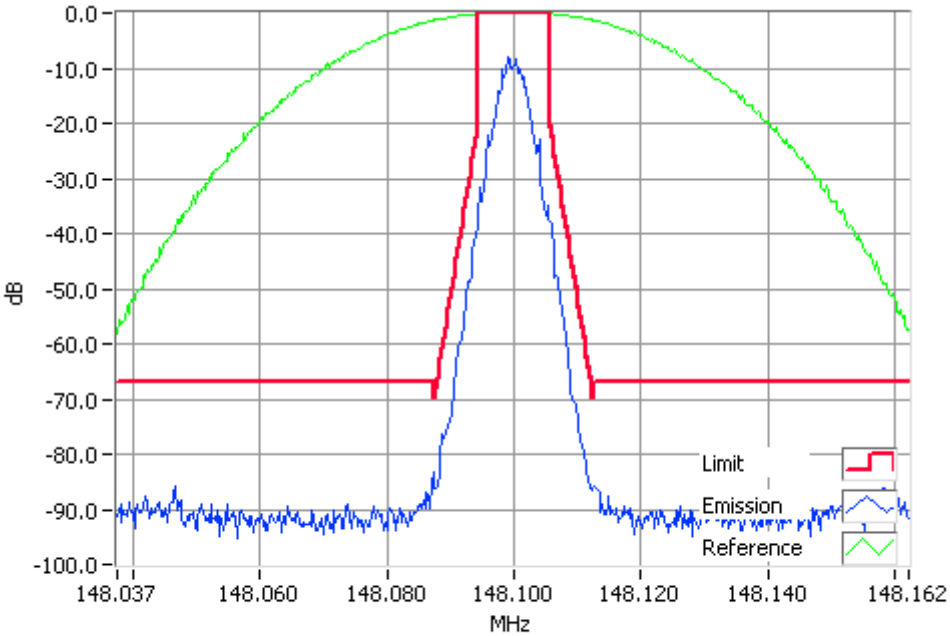
MEASUREMENT RESULTS:
See the plots on the following pages for 12.5 kHz & 25.0 kHz channel spacings.

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

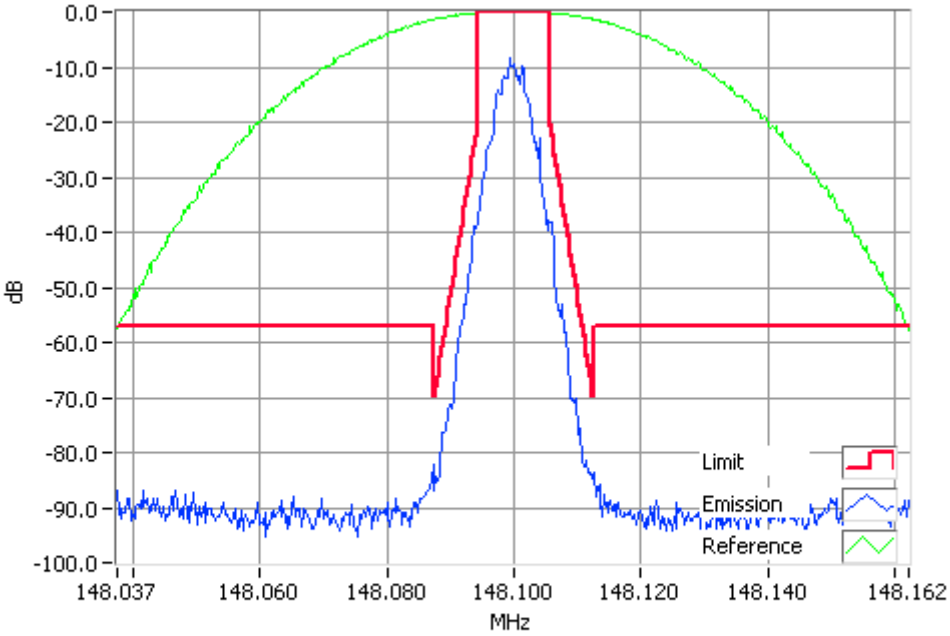
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 148.1 MHz 50 W 12.5 kHz Channel Spacing



C4FM 148.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 148.1 MHz 5 W 12.5 kHz Channel Spacing

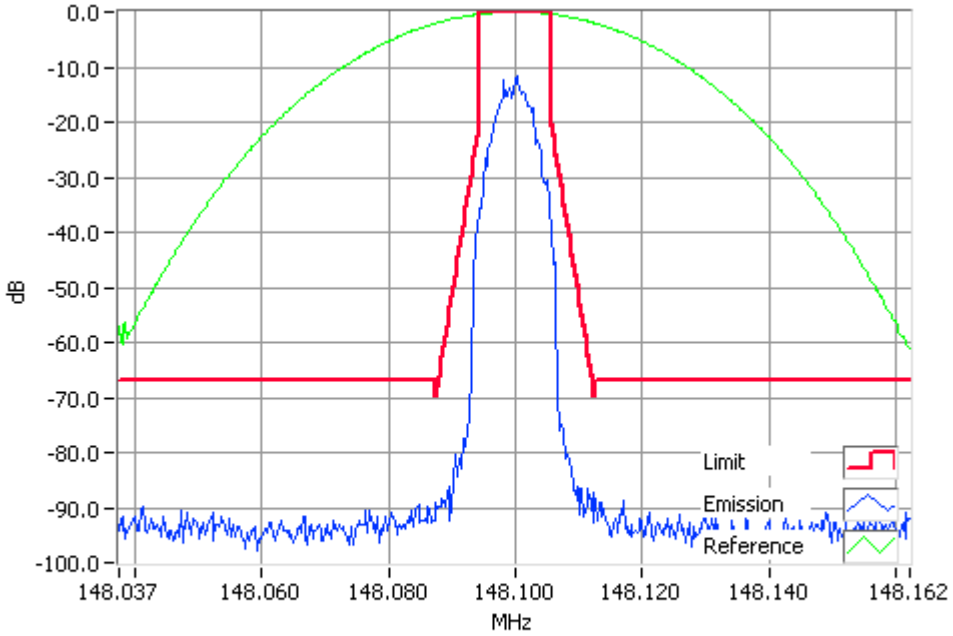


C4FM 148.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

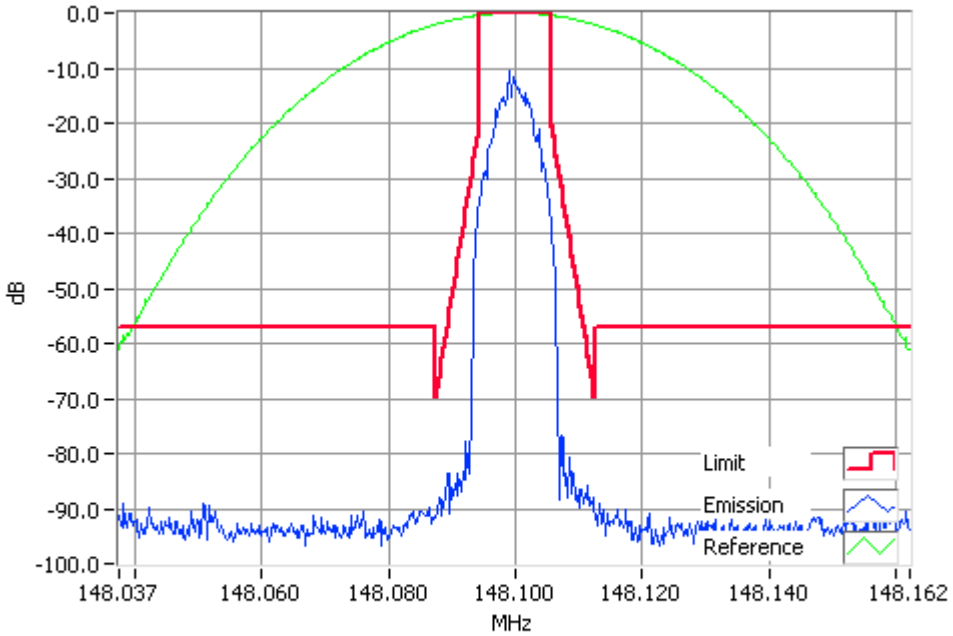
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 148.1 MHz 50 W 12.5 kHz Channel Spacing



LSM 148.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 148.1 MHz 5 W 12.5 kHz Channel Spacing

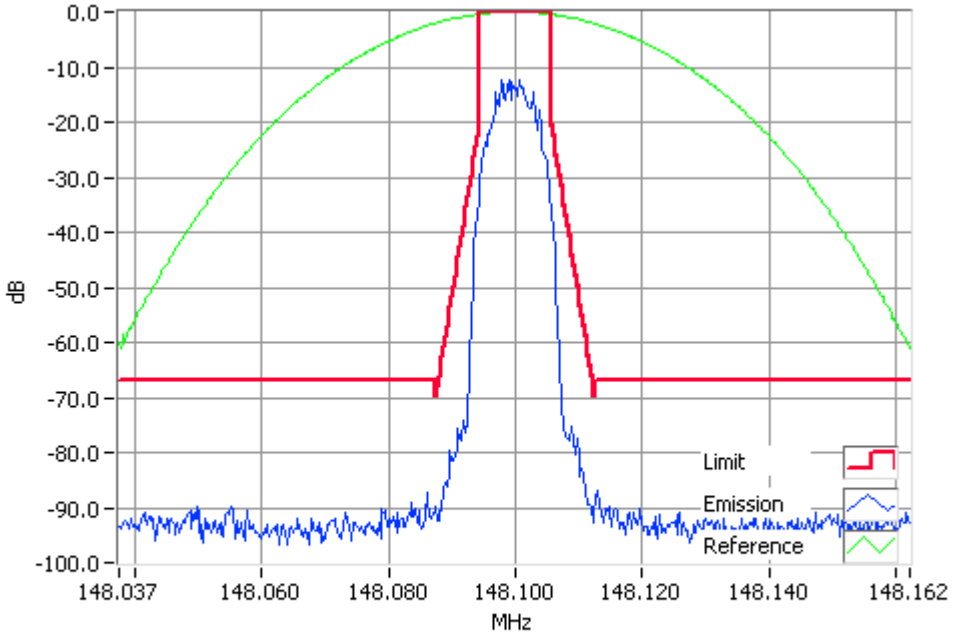


LSM 148.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

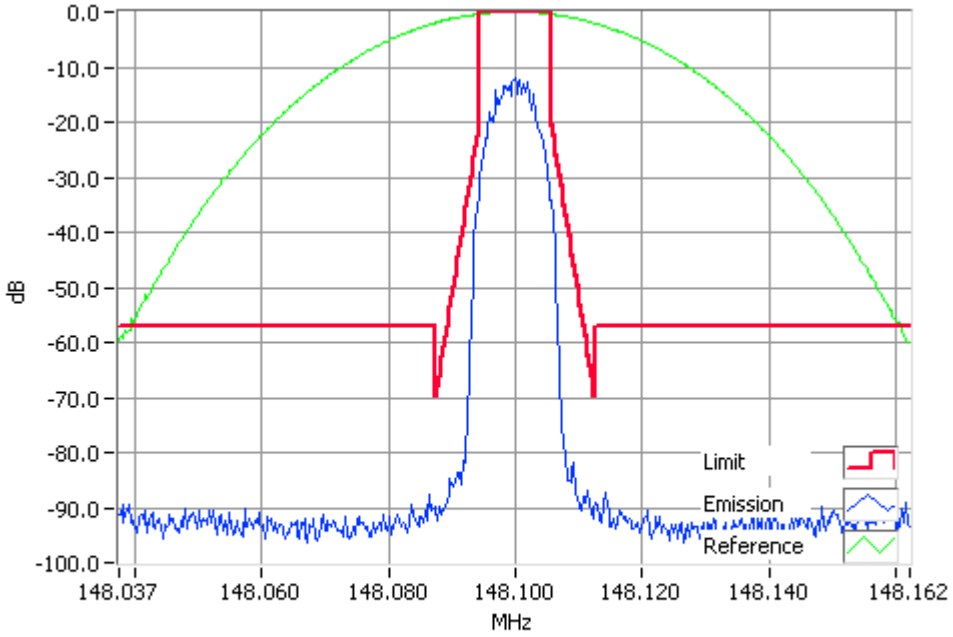
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 148.1 MHz 50 W 12.5 kHz Channel Spacing



H-DQPSK 148.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 148.1 MHz 5 W 12.5 kHz Channel Spacing

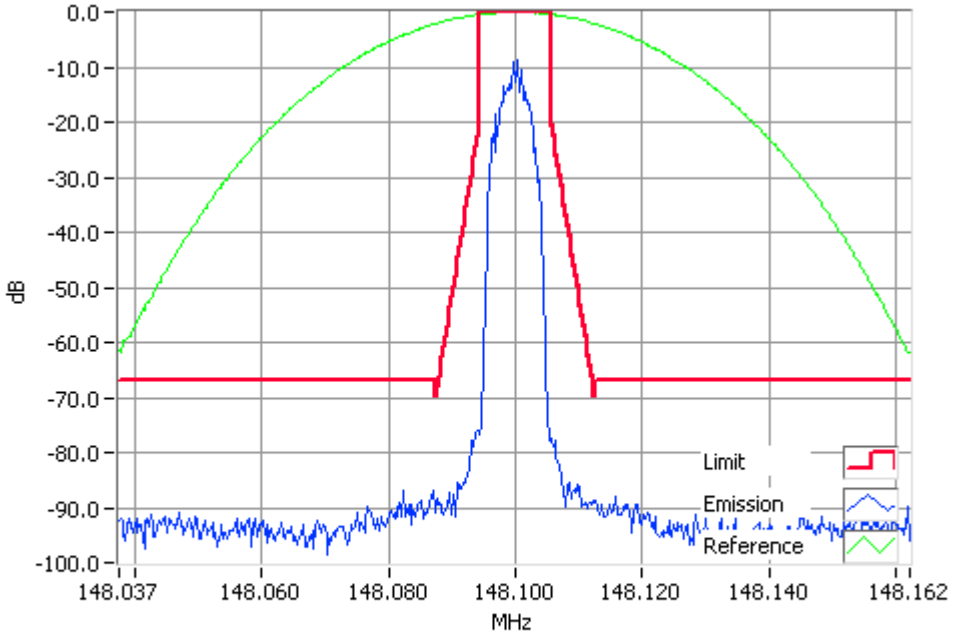


H-DQPSK 148.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

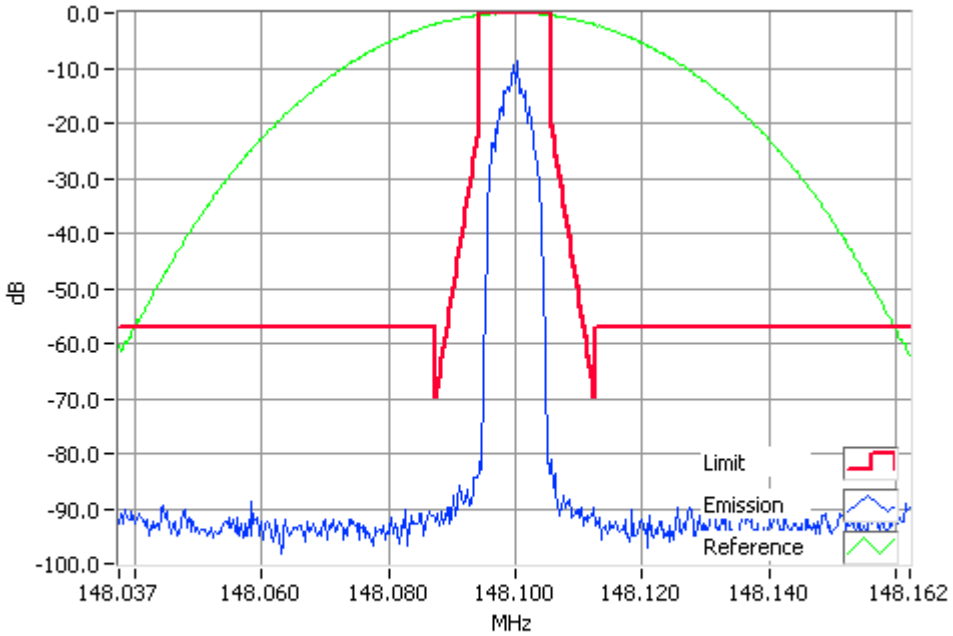
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 148.1 MHz 50 W 12.5 kHz Channel Spacing



H-D8PSK 148.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 148.1 MHz 5 W 12.5 kHz Channel Spacing

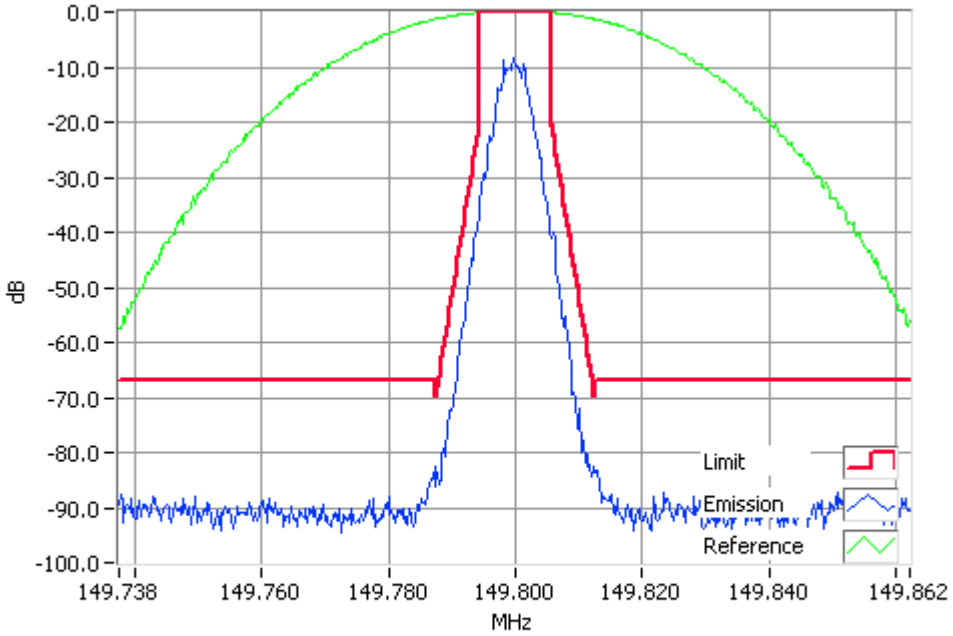


H-D8PSK 148.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

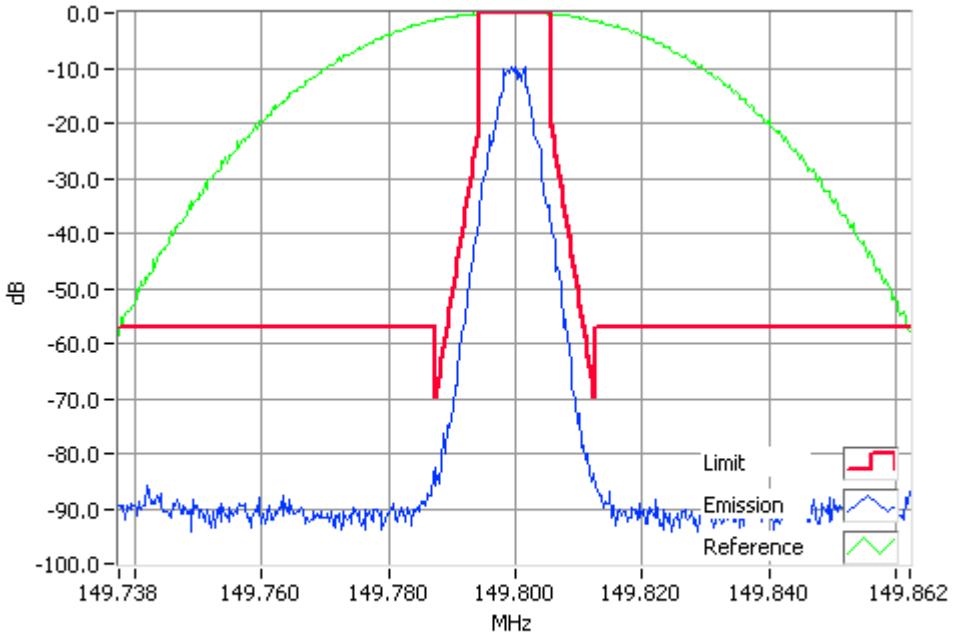
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 149.8 MHz 50 W 12.5 kHz Channel Spacing



C4FM 149.8000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 149.8 MHz 5 W 12.5 kHz Channel Spacing

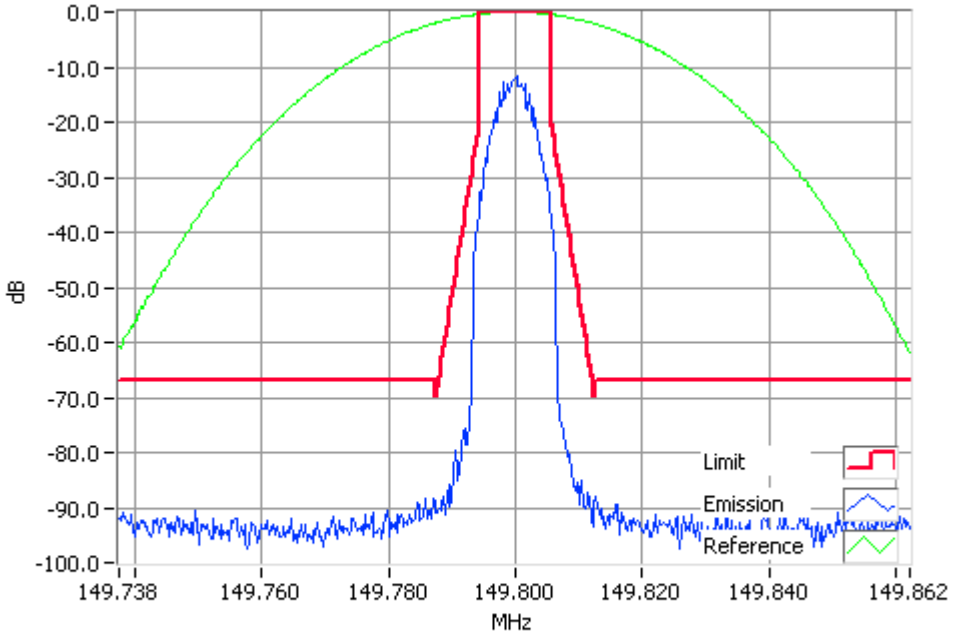


C4FM 149.8000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

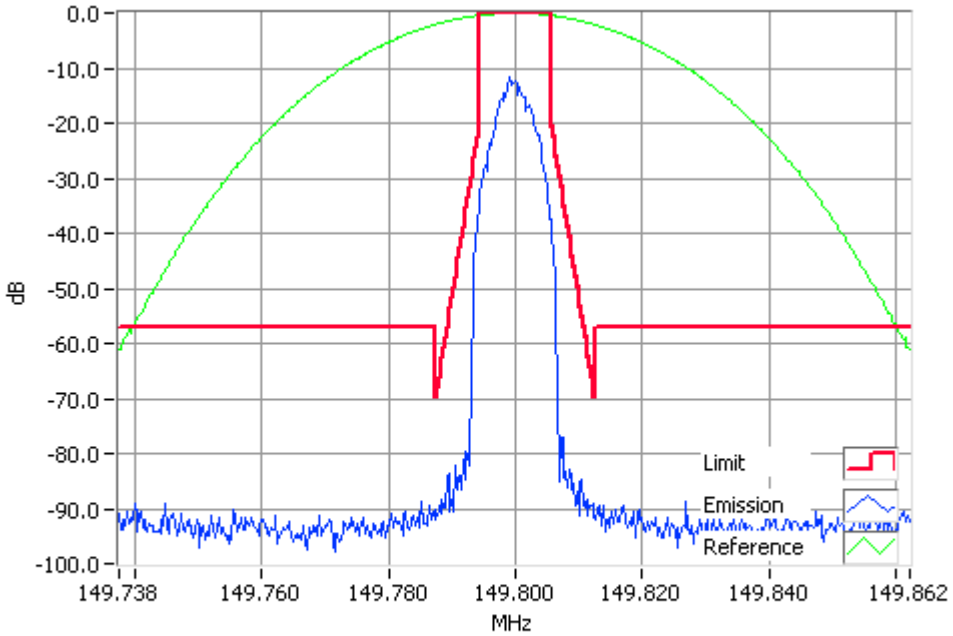
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 149.8 MHz 50 W 12.5 kHz Channel Spacing



LSM 149.8000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 149.8 MHz 5 W 12.5 kHz Channel Spacing

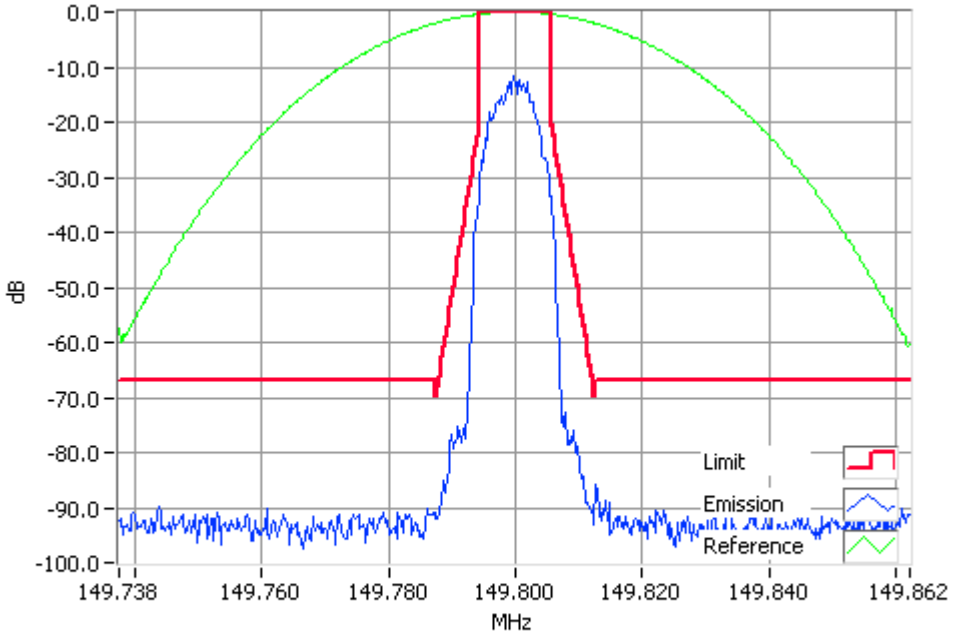


LSM 149.8000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

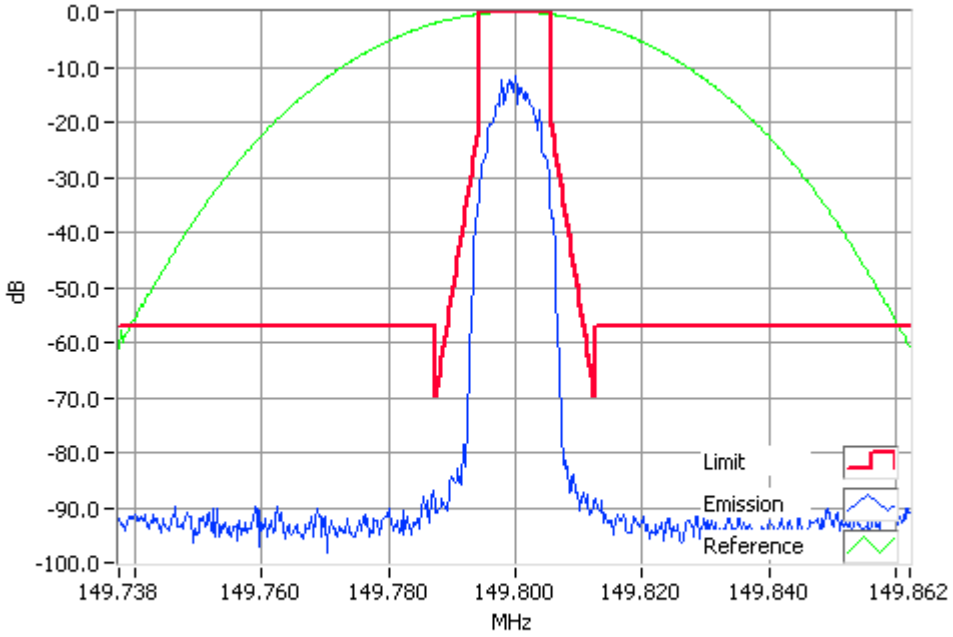
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 149.8 MHz 50 W 12.5 kHz Channel Spacing



H-DQPSK 149.8000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 149.8 MHz 5 W 12.5 kHz Channel Spacing

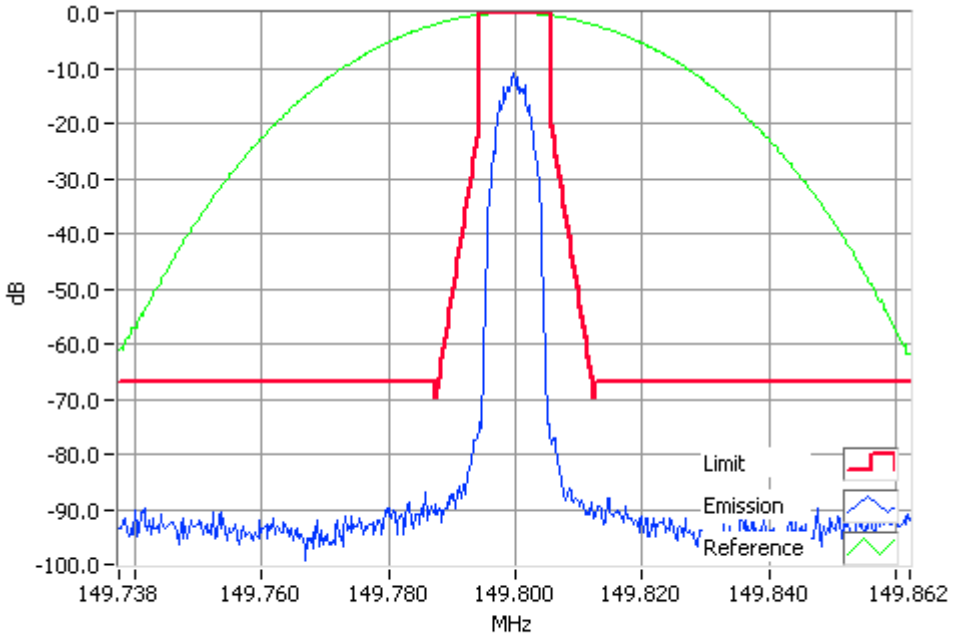


H-DQPSK 149.8000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

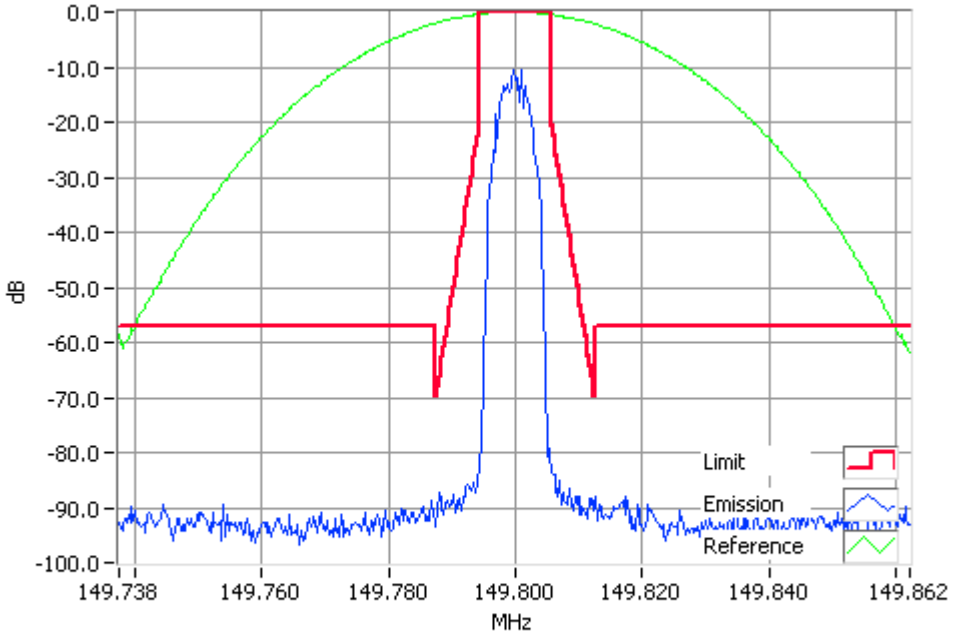
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 149.8 MHz 50 W 12.5 kHz Channel Spacing



H-D8PSK 149.8000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 149.8 MHz 5 W 12.5 kHz Channel Spacing

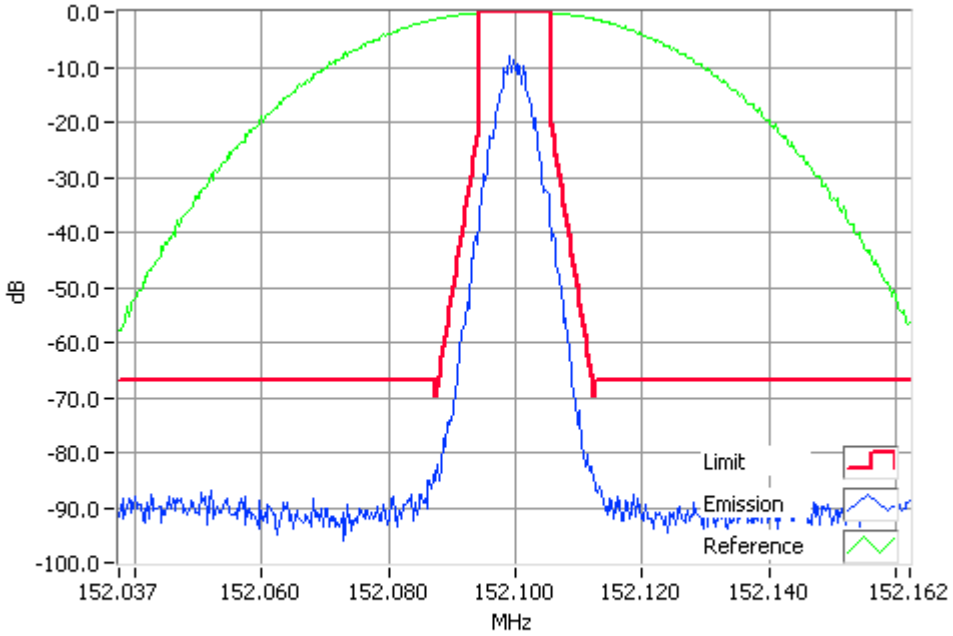


H-D8PSK 149.8000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

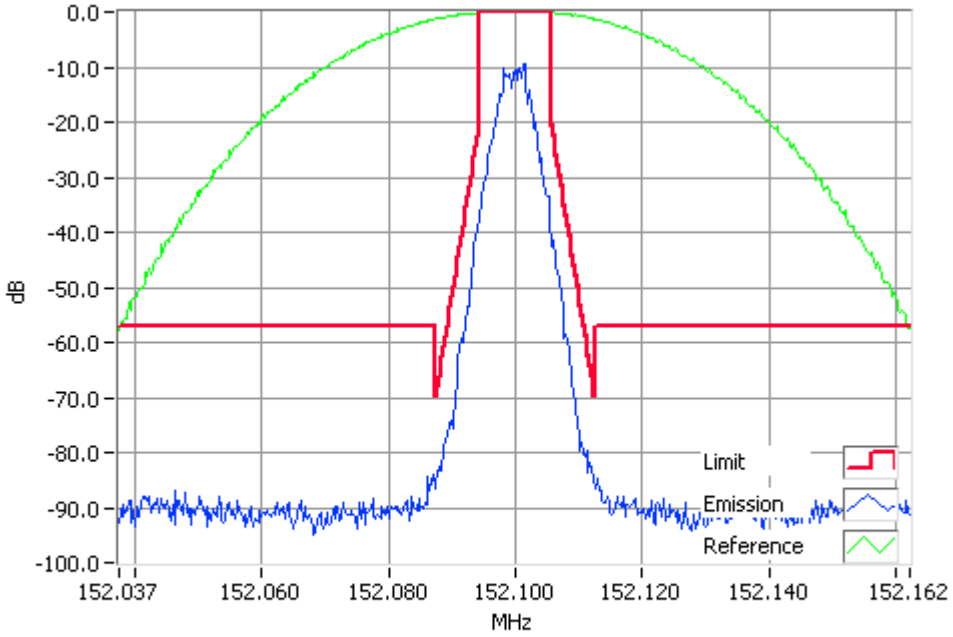
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 152.1 MHz 50 W 12.5 kHz Channel Spacing



C4FM 152.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing

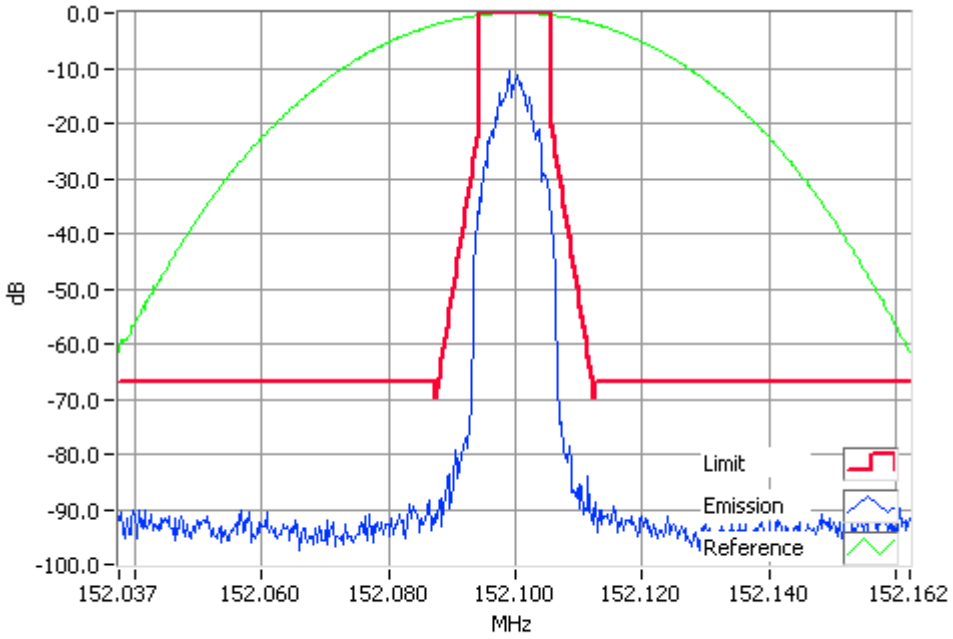


C4FM 152.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

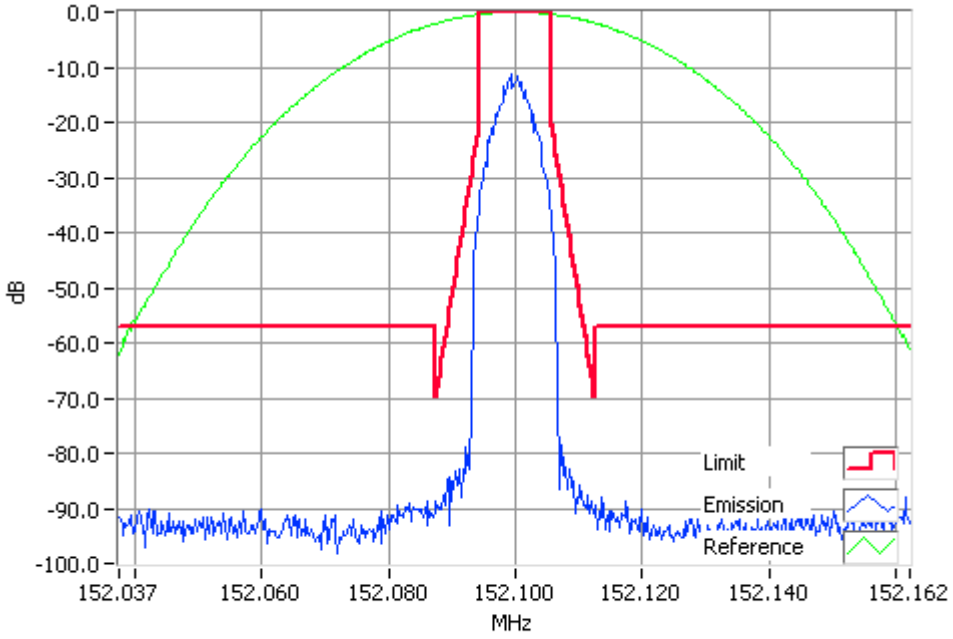
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 152.1 MHz 50 W 12.5 kHz Channel Spacing



LSM 152.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing

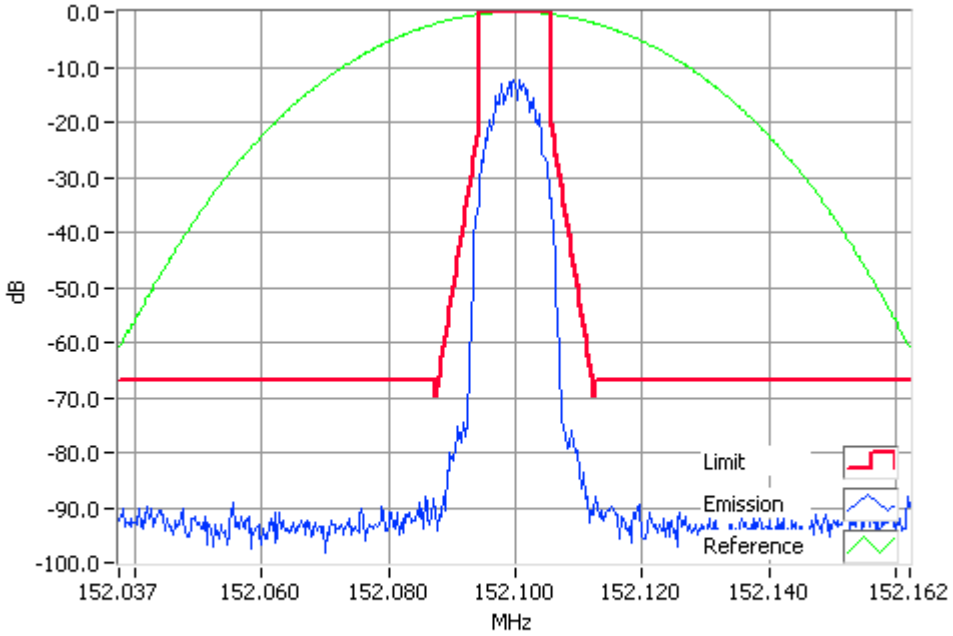


LSM 152.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

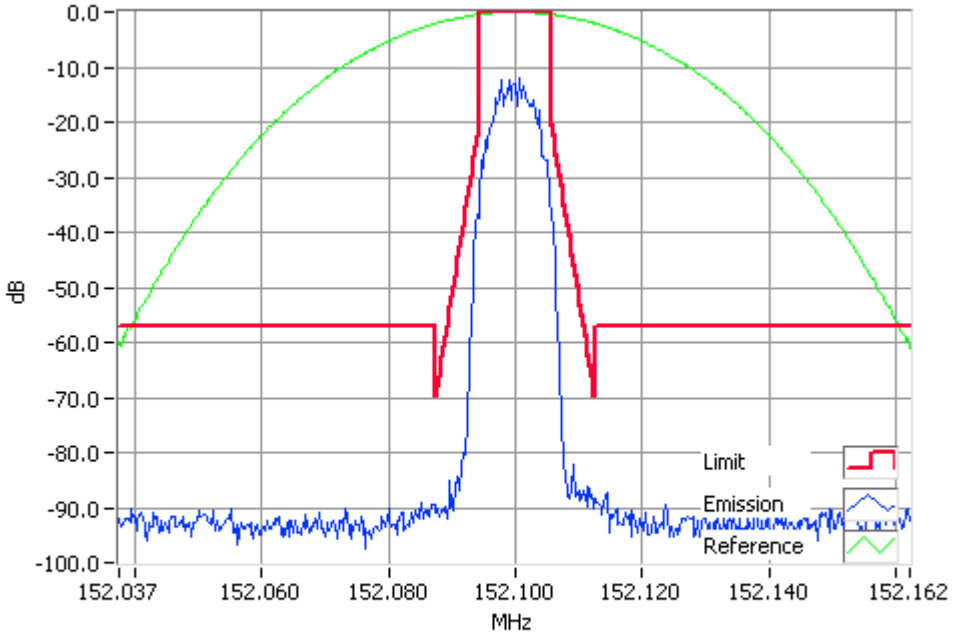
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 152.1 MHz 50 W 12.5 kHz Channel Spacing



H-DQPSK 152.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing

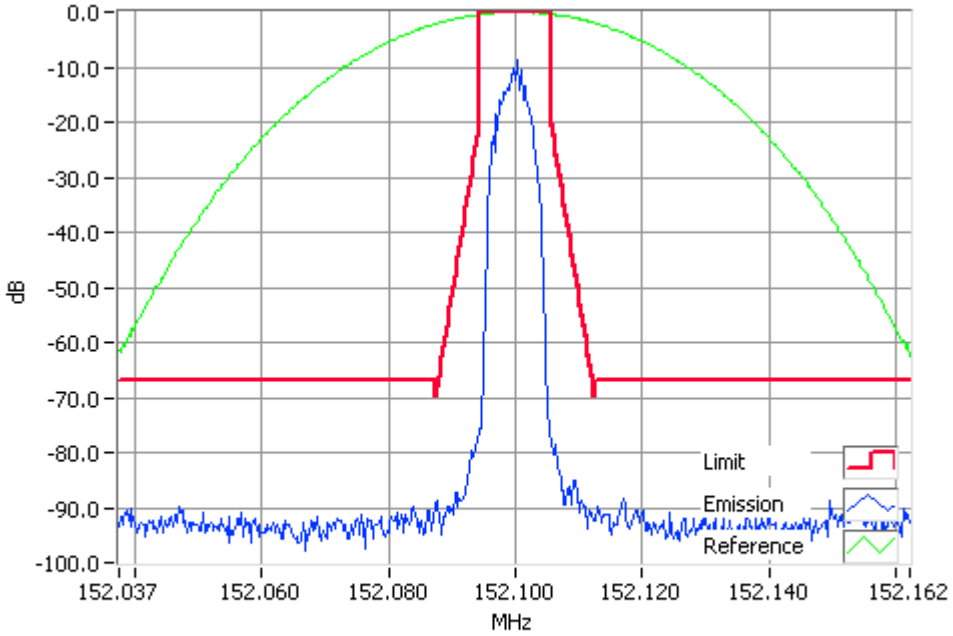


H-DQPSK 152.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

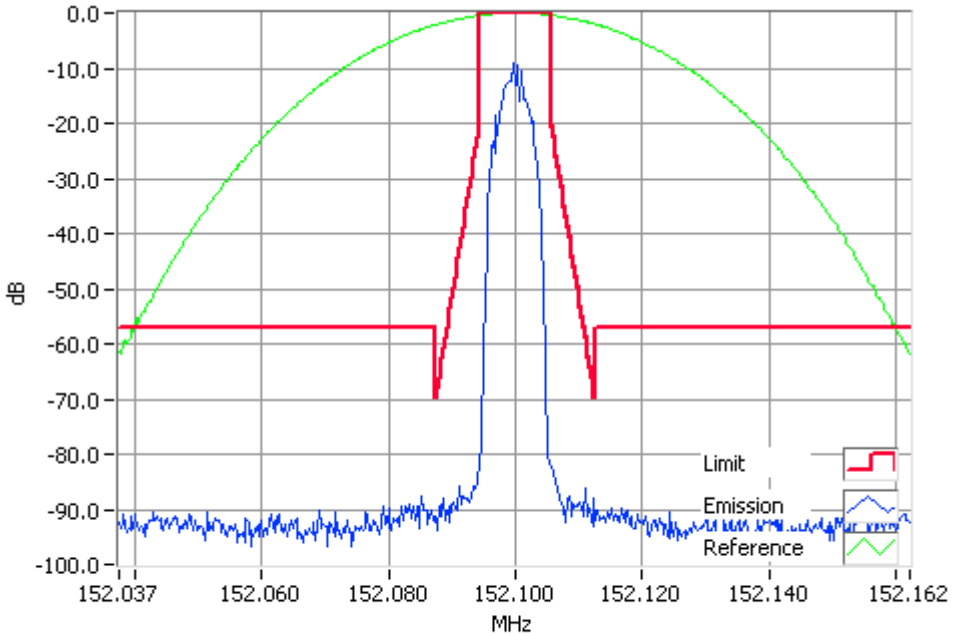
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 152.1 MHz 50 W 12.5 kHz Channel Spacing



H-D8PSK 152.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing

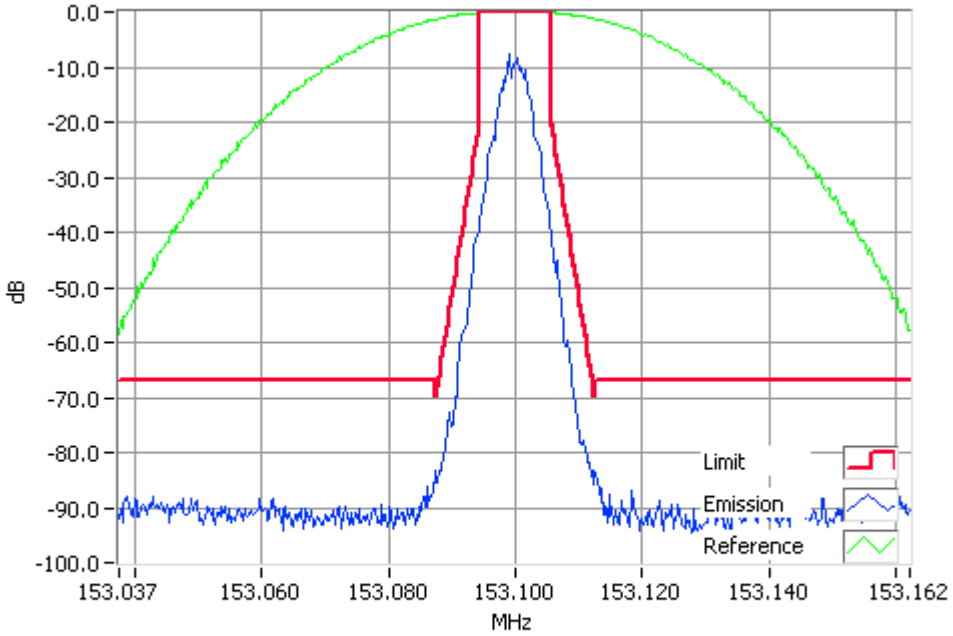


H-D8PSK 152.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

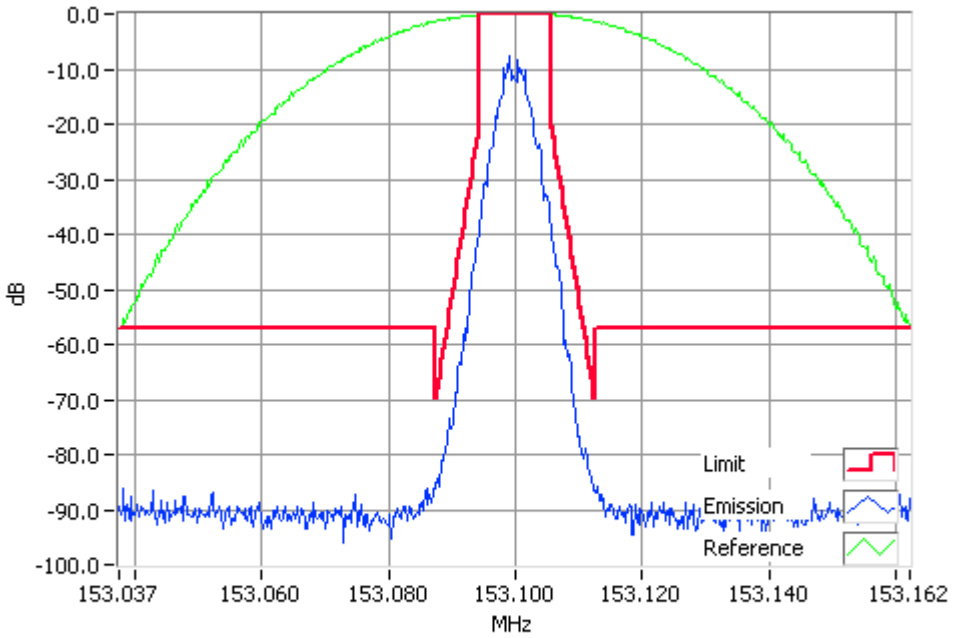
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 153.1 MHz 50 W 12.5 kHz Channel Spacing



C4FM 153.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing

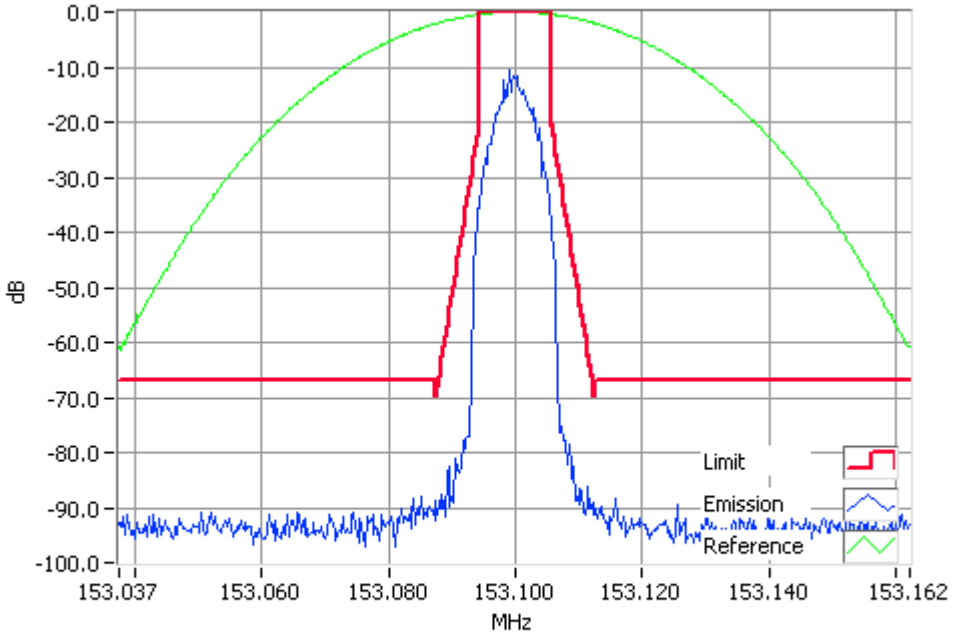


C4FM 153.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

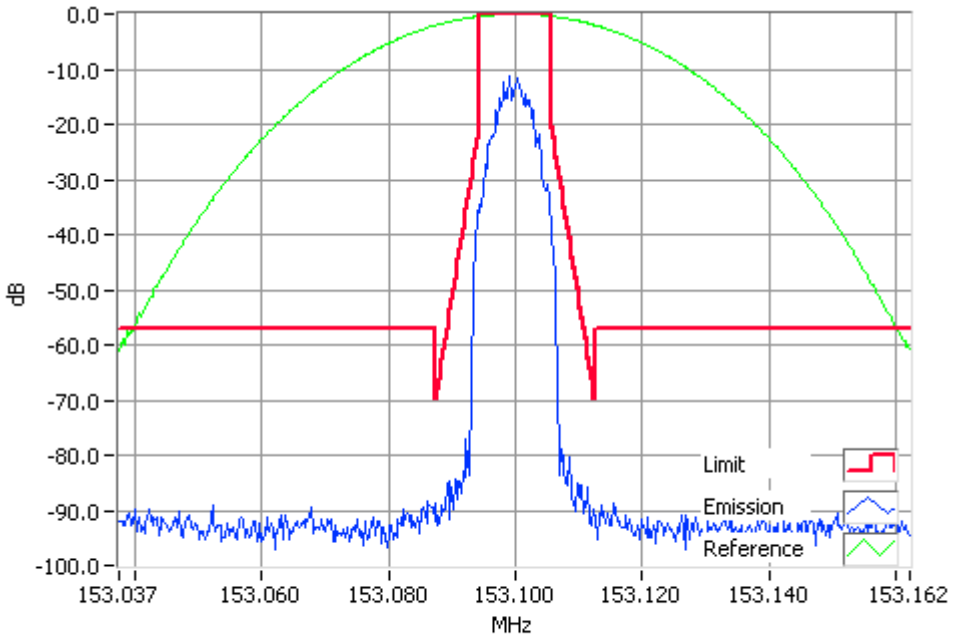
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 153.1 MHz 50 W 12.5 kHz Channel Spacing



LSM 153.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing

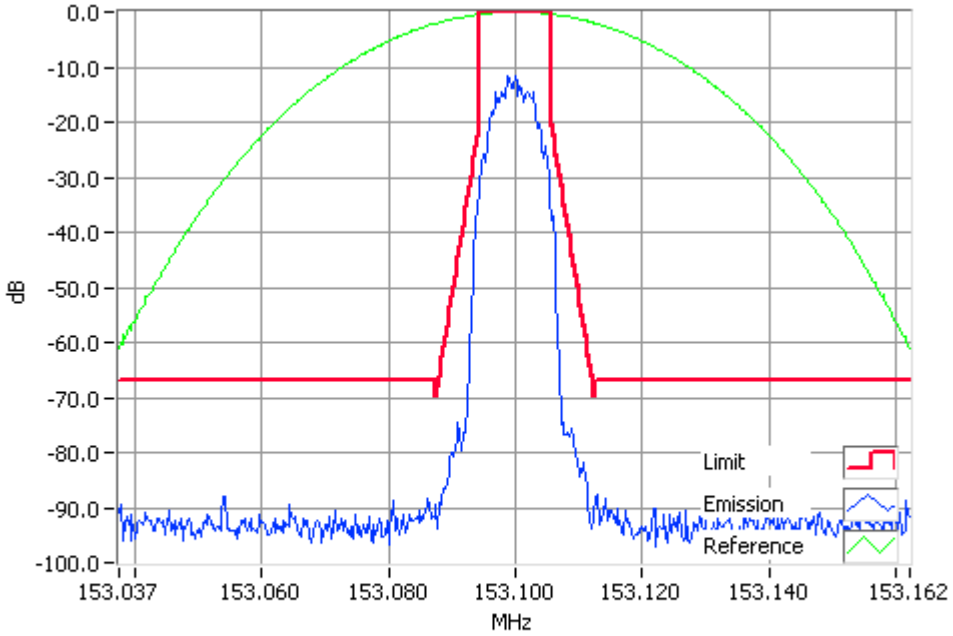


LSM 153.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

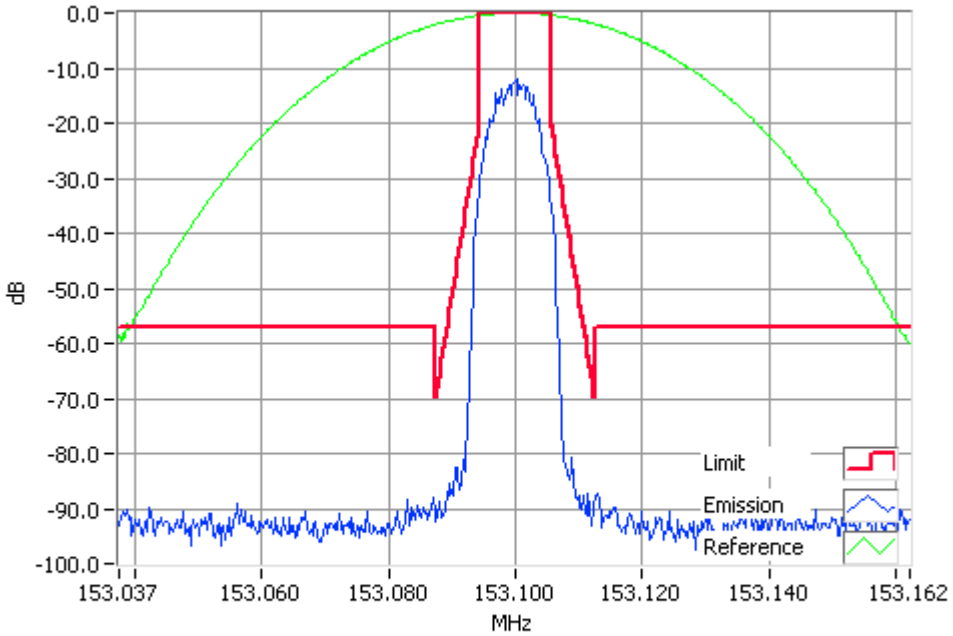
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 153.1 MHz 50 W 12.5 kHz Channel Spacing



H-DQPSK 153.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing

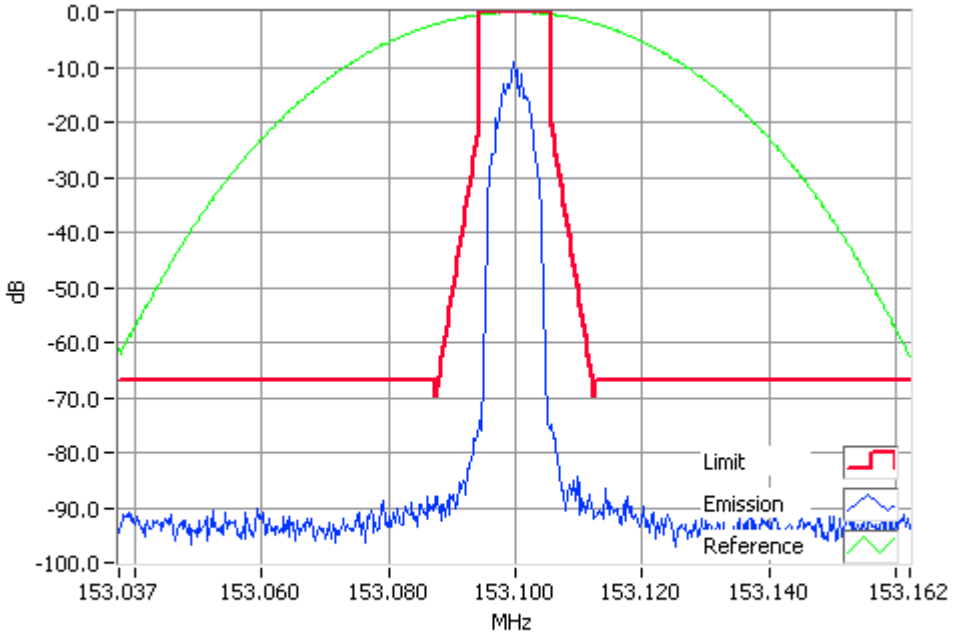


H-DQPSK 153.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

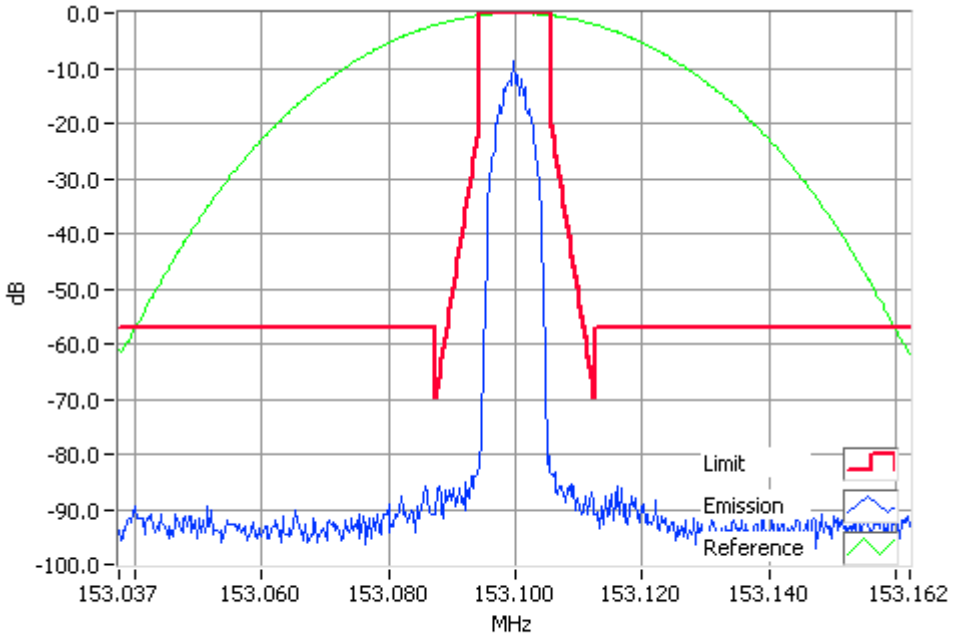
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 153.1 MHz 50 W 12.5 kHz Channel Spacing



H-D8PSK 153.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing

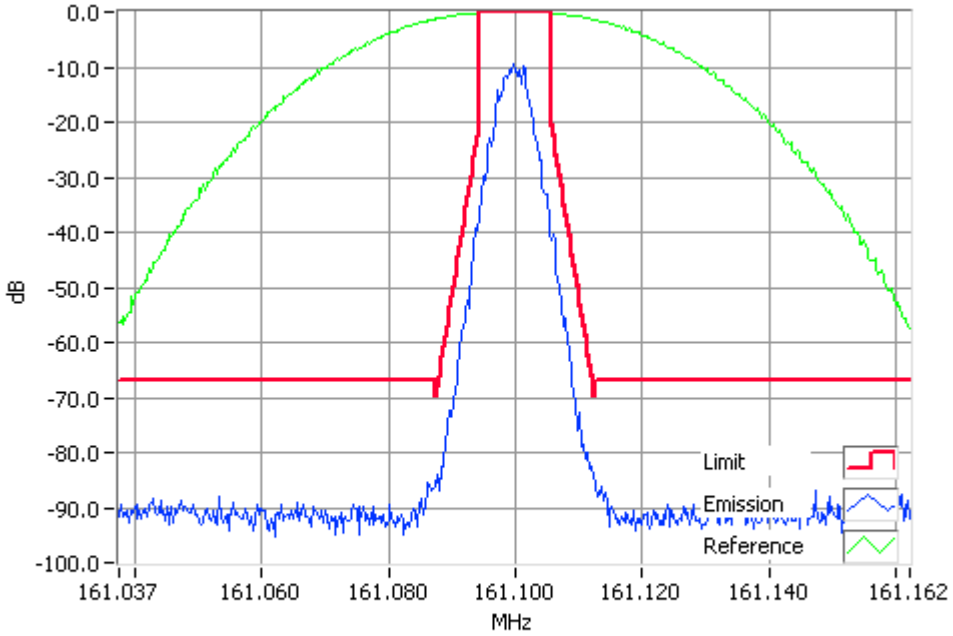


H-D8PSK 153.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

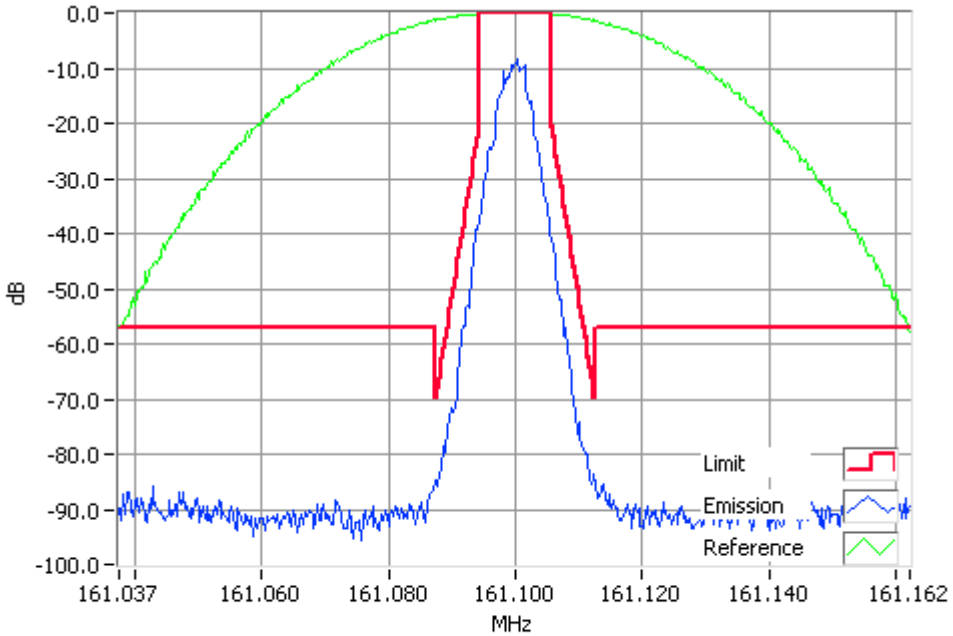
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 161.1 MHz 50 W 12.5 kHz Channel Spacing



C4FM 161.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 161.1 MHz 5 W 12.5 kHz Channel Spacing

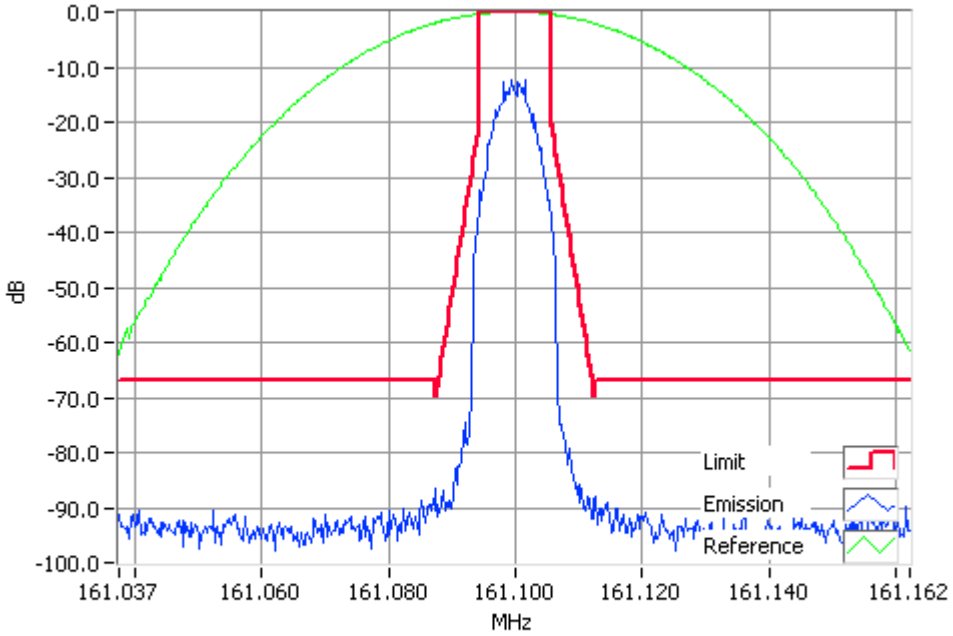


C4FM 161.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

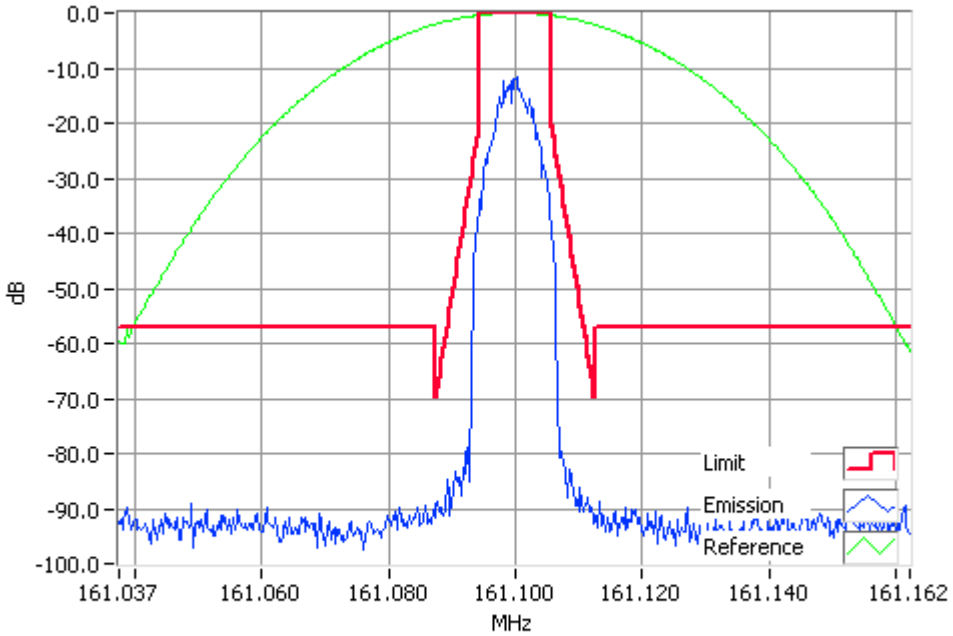
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 161.1 MHz 50 W 12.5 kHz Channel Spacing



LSM 161.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 161.1 MHz 5 W 12.5 kHz Channel Spacing

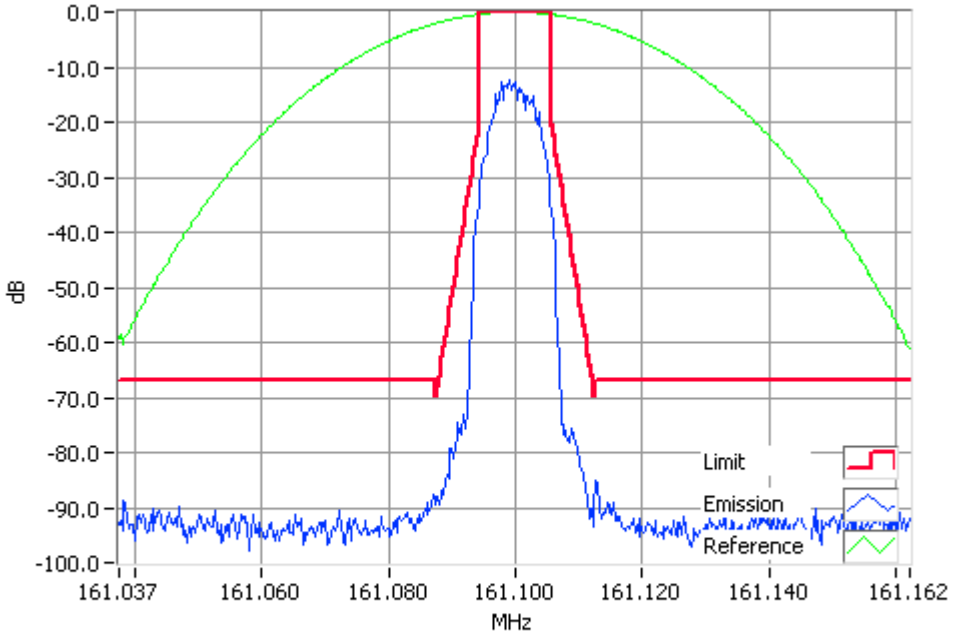


LSM 161.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

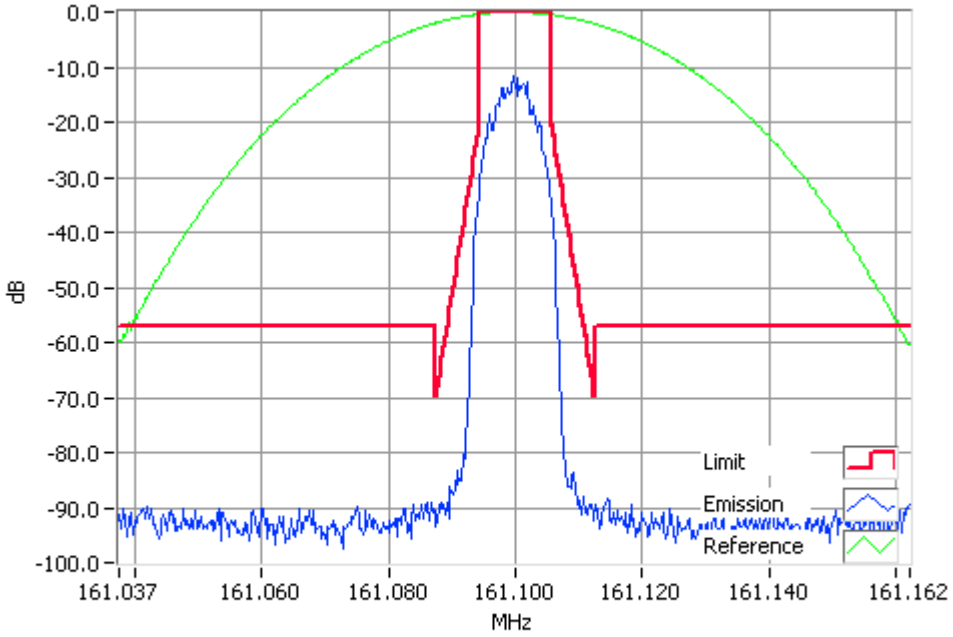
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 161.1 MHz 50 W 12.5 kHz Channel Spacing



H-DQPSK 161.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 161.1 MHz 5 W 12.5 kHz Channel Spacing

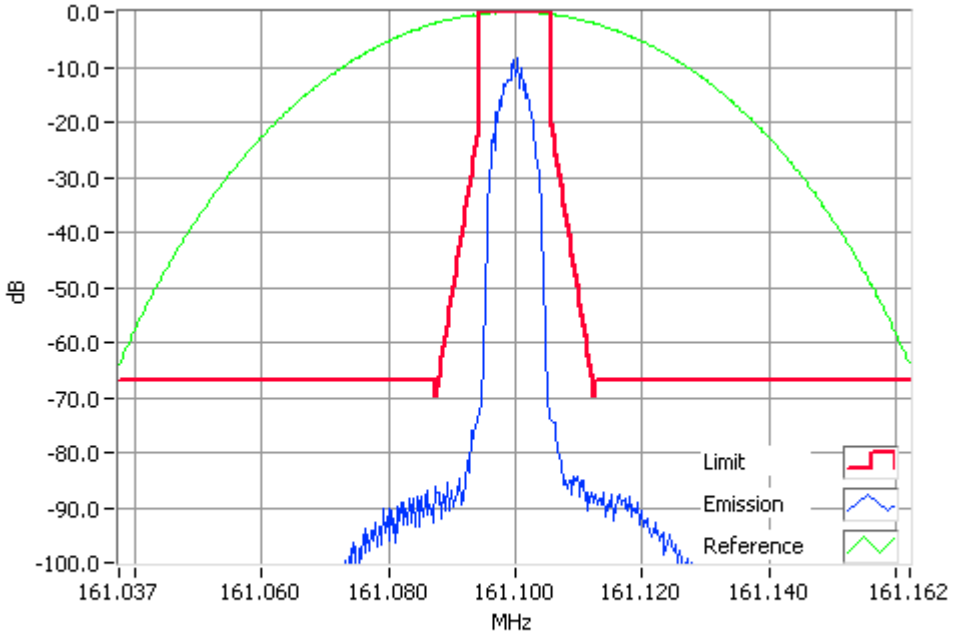


H-DQPSK 161.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

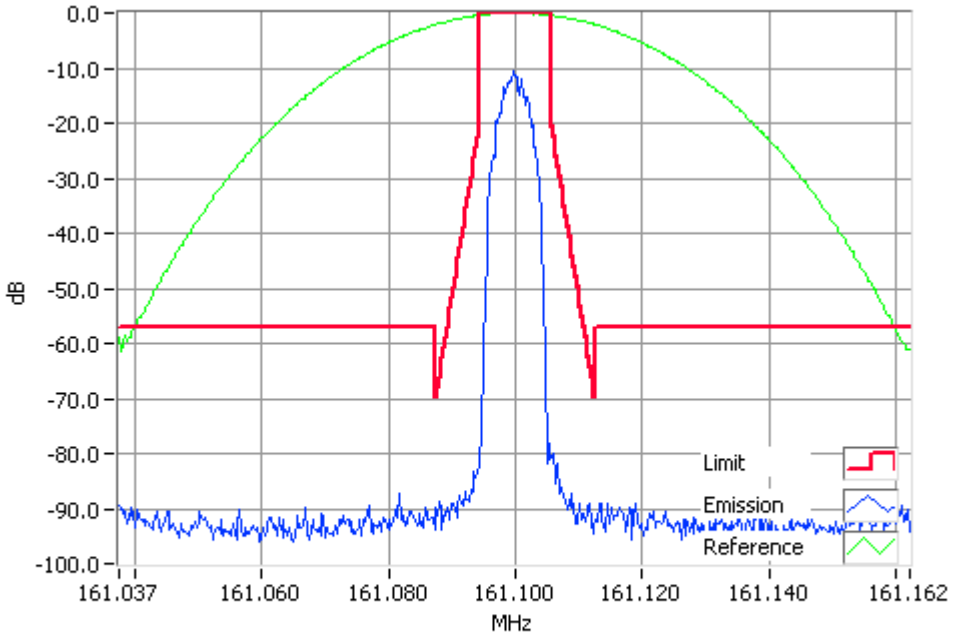
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 161.1 MHz 50 W 12.5 kHz Channel Spacing



H-D8PSK 161.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 161.1 MHz 5 W 12.5 kHz Channel Spacing

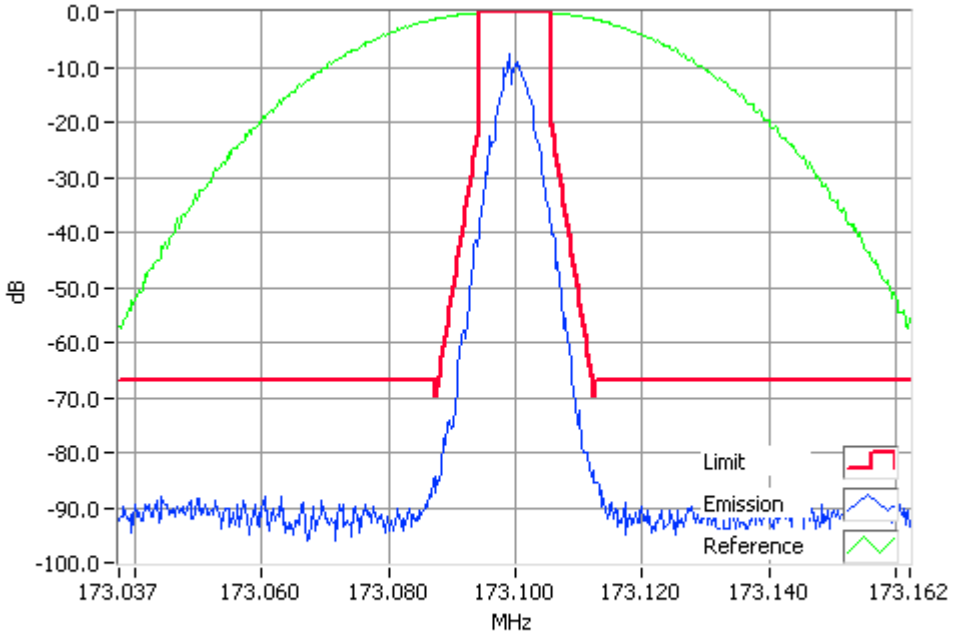


H-D8PSK 161.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

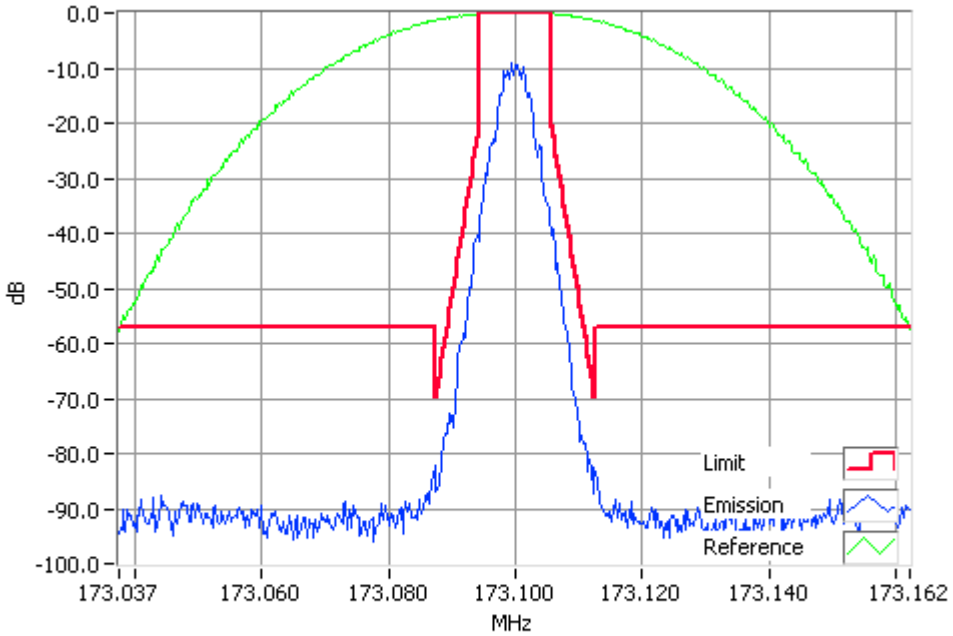
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 173.1 MHz 50 W 12.5 kHz Channel Spacing



C4FM 173.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 173.1 MHz 5 W 12.5 kHz Channel Spacing

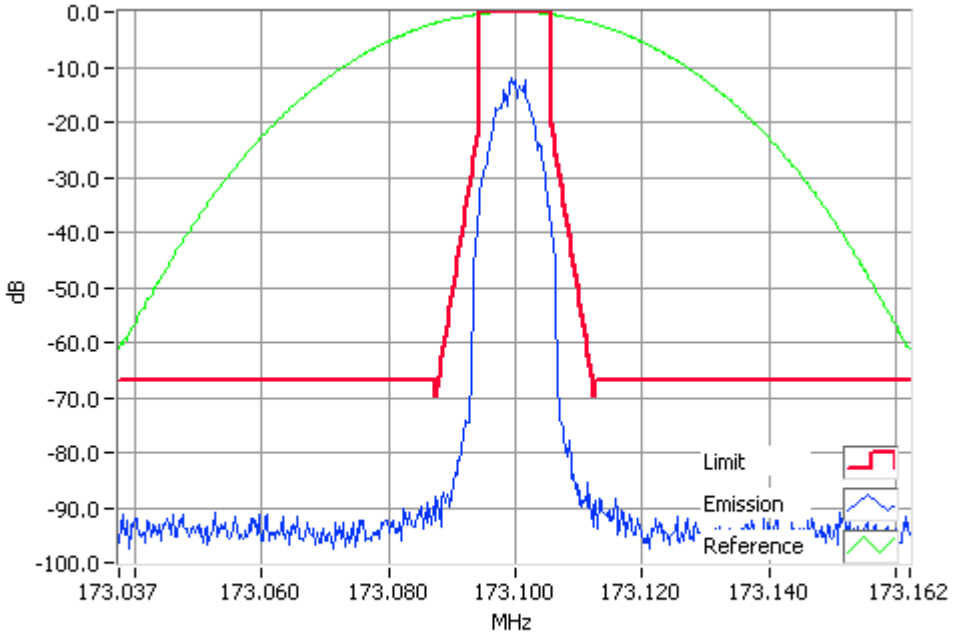


C4FM 173.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

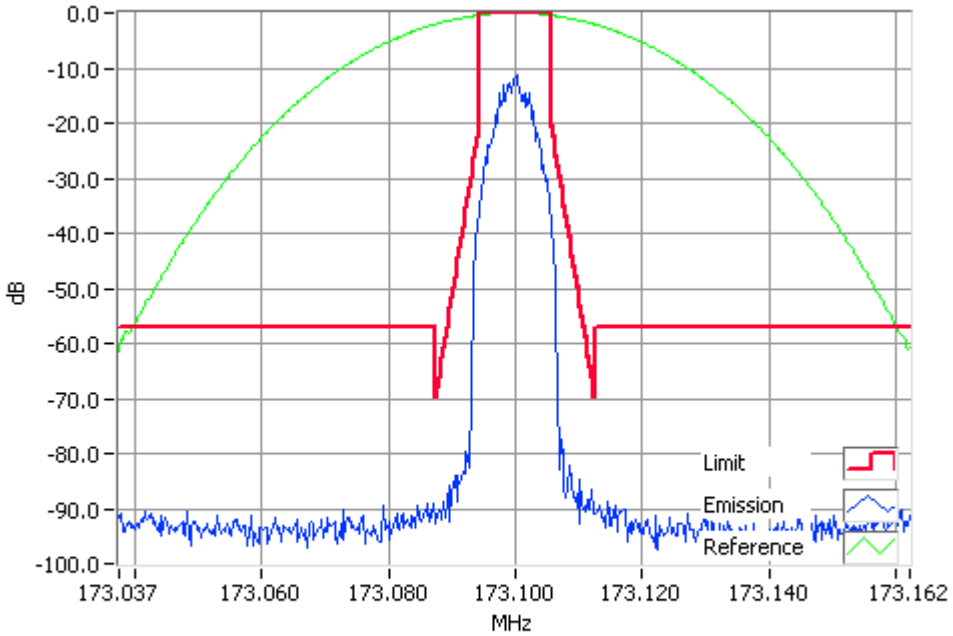
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 173.1 MHz 50 W 12.5 kHz Channel Spacing



LSM 173.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 173.1 MHz 5 W 12.5 kHz Channel Spacing

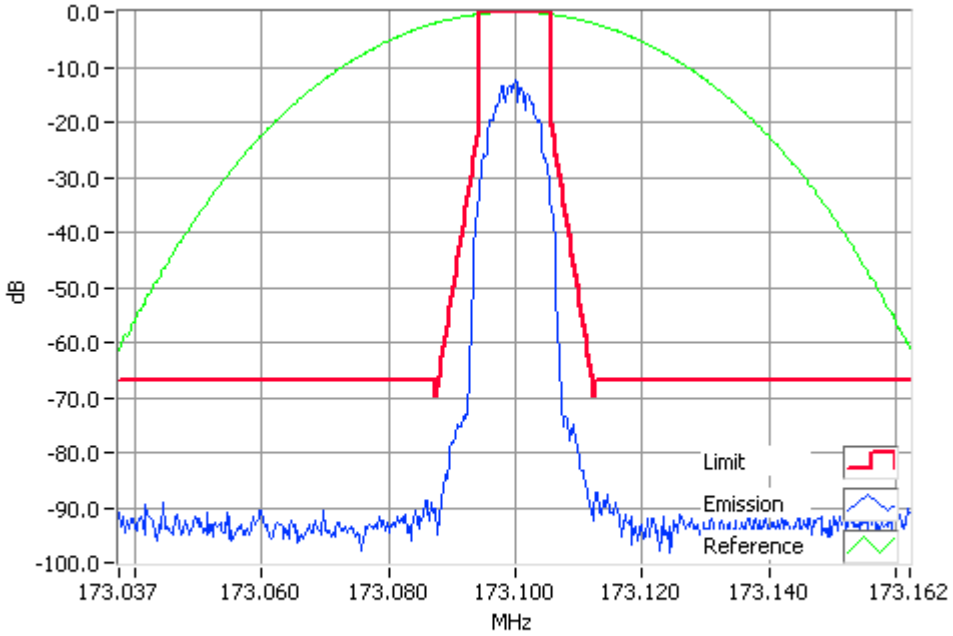


LSM 173.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

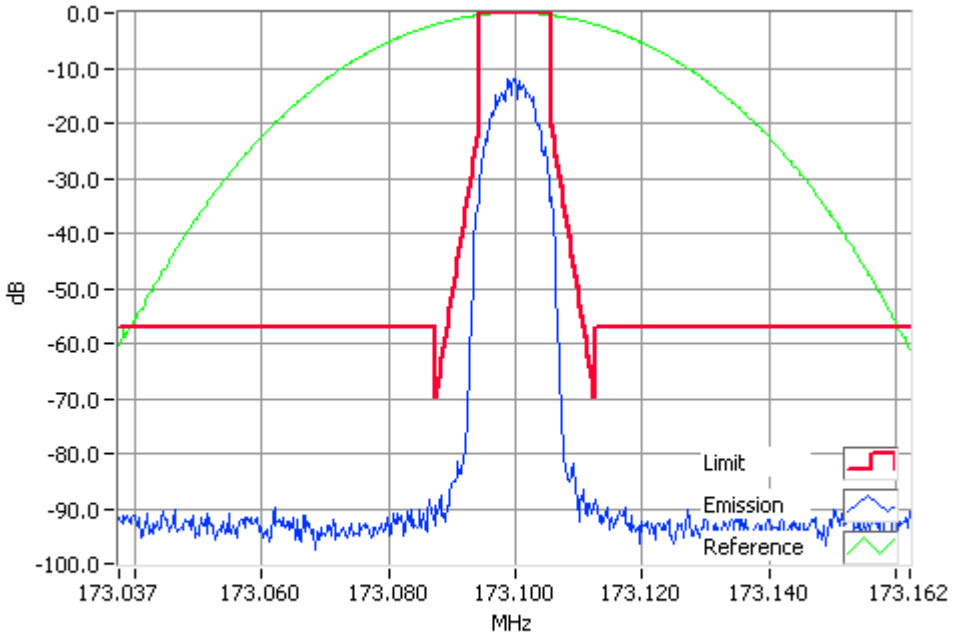
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 173.1 MHz 50 W 12.5 kHz Channel Spacing



H-DQPSK 173.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 173.1 MHz 5 W 12.5 kHz Channel Spacing

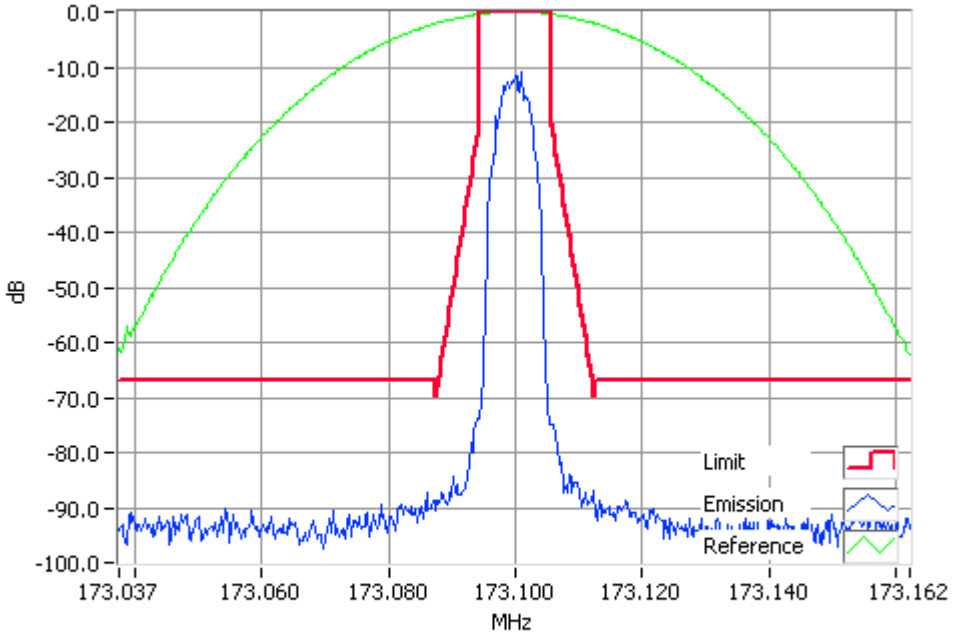


H-DQPSK 173.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

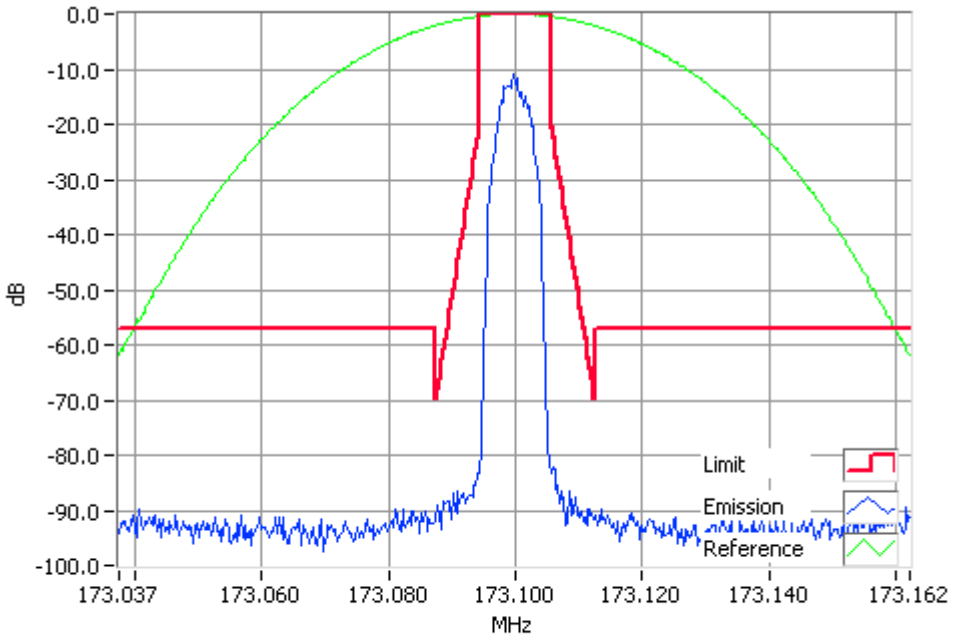
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 173.1 MHz 50 W 12.5 kHz Channel Spacing



H-D8PSK 173.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 173.1 MHz 5 W 12.5 kHz Channel Spacing



H-D8PSK 173.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

TRANSMITTER SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATIONS: FCC 47 CFR 2.1051 RSS-119 5.8

GUIDE: TIA-102.CAAA-C 2.2.7

MEASUREMENT PROCEDURE:

1. Refer Annex A for equipment set up.
2. The frequency range examined was from the lowest frequency generated within the EUT, to a frequency higher than the 10th Harmonic: 100 kHz to Fc-BW
   Fc+ BW to 10Fc GHz
3. A Pre-scan is performed with a resolution bandwidth of 1 kHz, and a video bandwidth of 3 kHz. If any emissions are found to be within 20 dB of the limit a second measurement is made with the carrier modulated, and a resolution bandwidth of 10 kHz, and a video bandwidth of 30 kHz.

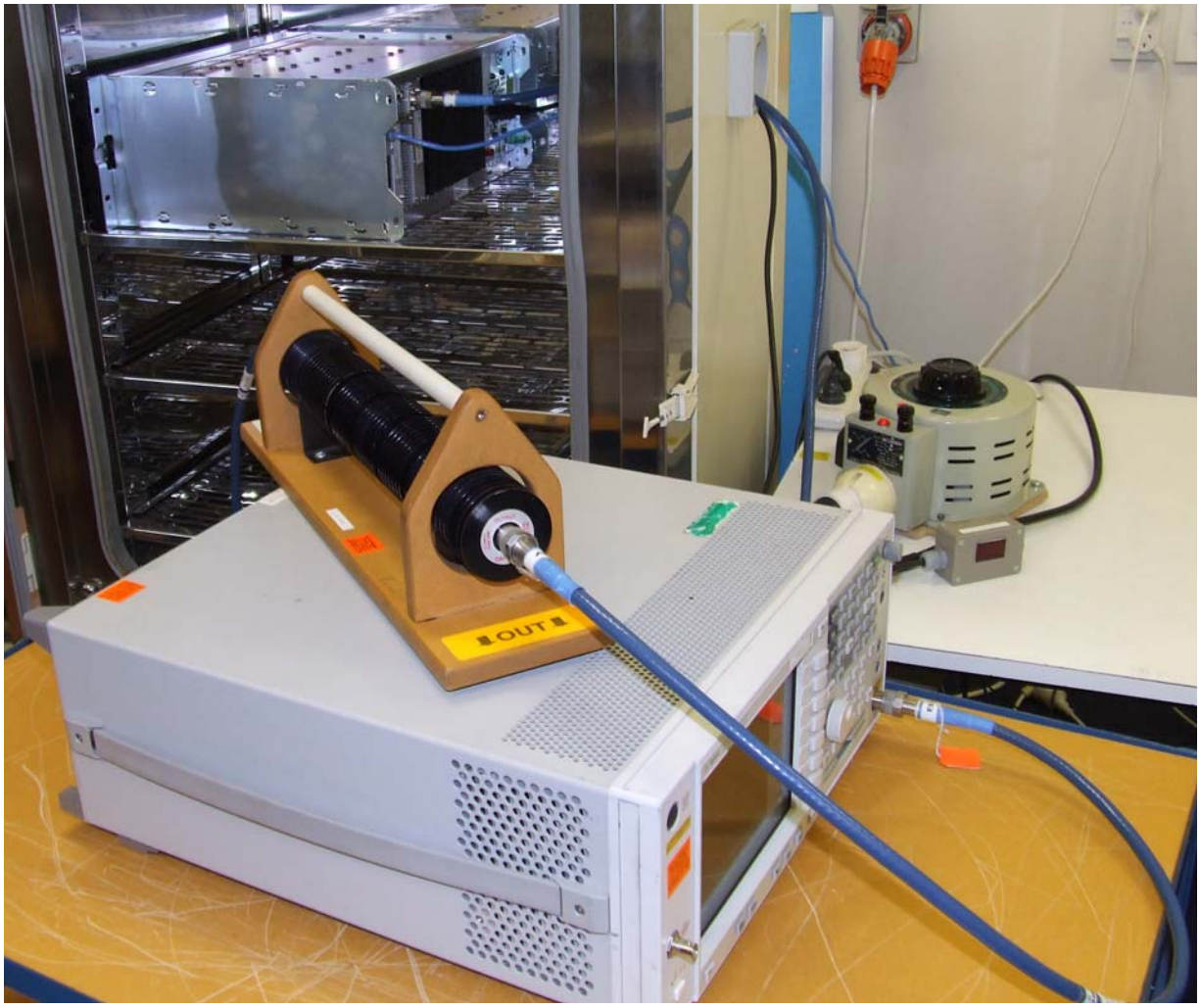
Spurious emissions which were attenuated by more than 20 dB below the limit were not recorded.

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

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

LIMIT CLAUSES: FCC 47 CFR 90.210 RSS-119 5.8

Photo: Conducted Emissions Test Setup



Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

12.5 kHz Channel Spacing	148.1 MHz @ 50 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
~	~	~
12.5 kHz Channel Spacing	148.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
~	~	~
12.5 kHz Channel Spacing	149.8 MHz @ 50 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
~	~	~
12.5 kHz Channel Spacing	149.8 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
~	~	~
12.5 kHz Channel Spacing	152.1 MHz @ 50 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
152.2518	-36.1	83.1
~	~	~
12.5 kHz Channel Spacing	152.1 MHz @ 5 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.		

Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

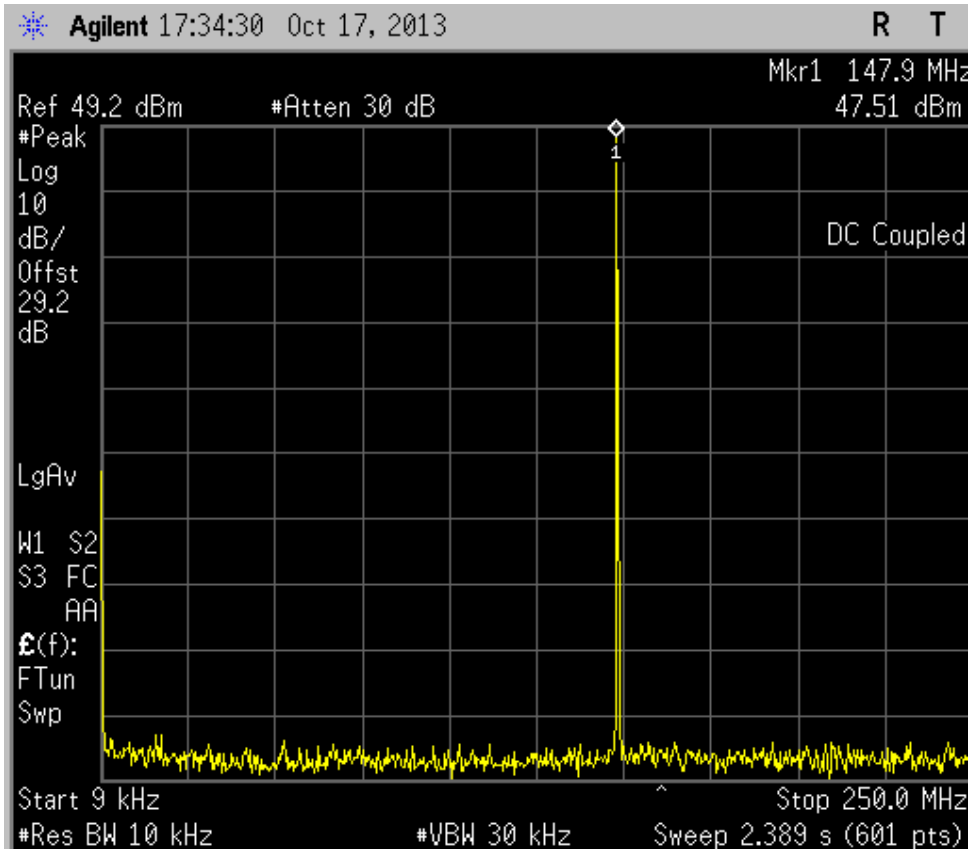
12.5 kHz Channel Spacing	153.1 MHz @ 50 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
153.2485	-38.0	-85.0
~	~	~
12.5 kHz Channel Spacing	153.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
~	~	~
12.5 kHz Channel Spacing	161.1 MHz @ 50 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
161.2468	-33.0	-80.0
~	~	~
12.5 kHz Channel Spacing	161.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
~	~	~
12.5 kHz Channel Spacing	173.1 MHz @ 50 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
~	~	~
12.5 kHz Channel Spacing	173.1 MHz @ 5 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.		

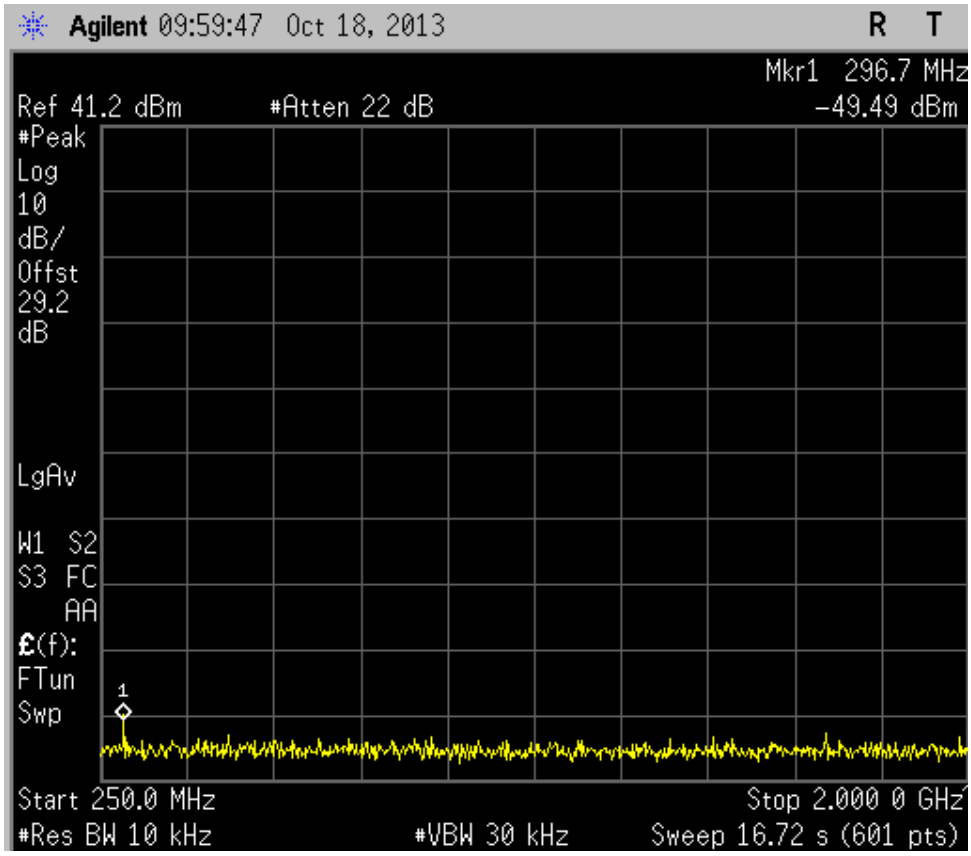
LIMITS: FCC 47 CFR 90.210 RSS-119 5.8

Carrier Output Power	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
50 W	-20 dBm	-67 dBc
5 W	-20 dBm	-57 dBc

Spurious Emissions (Tx Conducted)

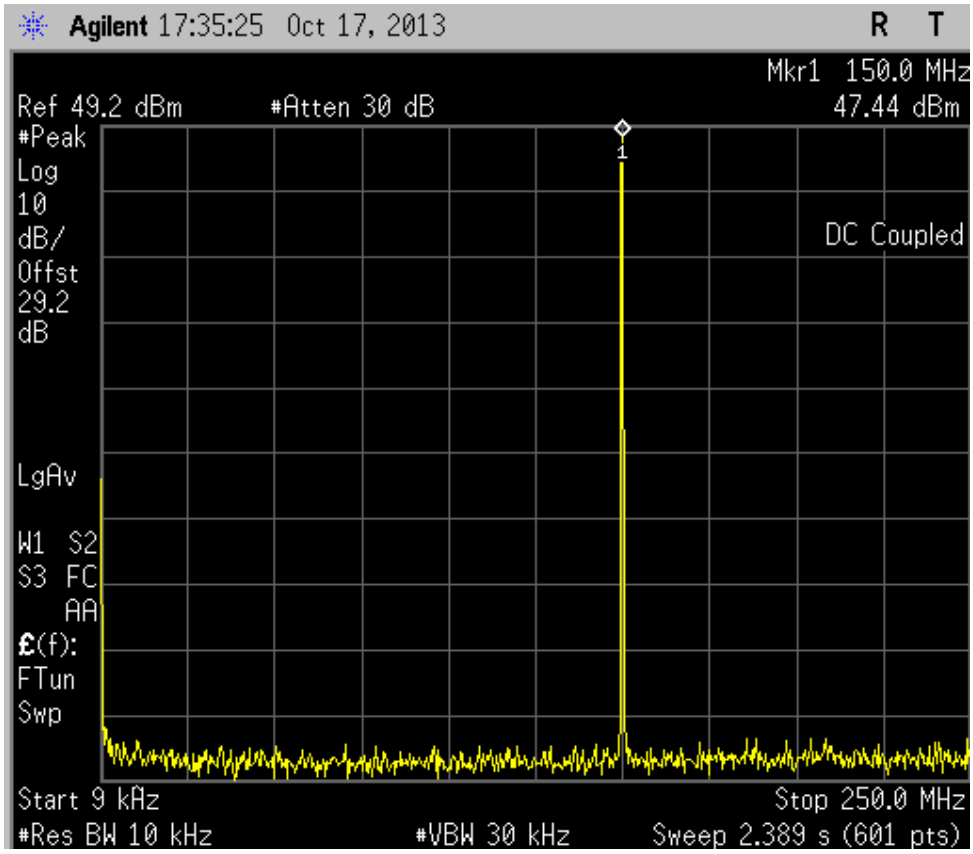
148.1 MHz @ 50 W Plots:

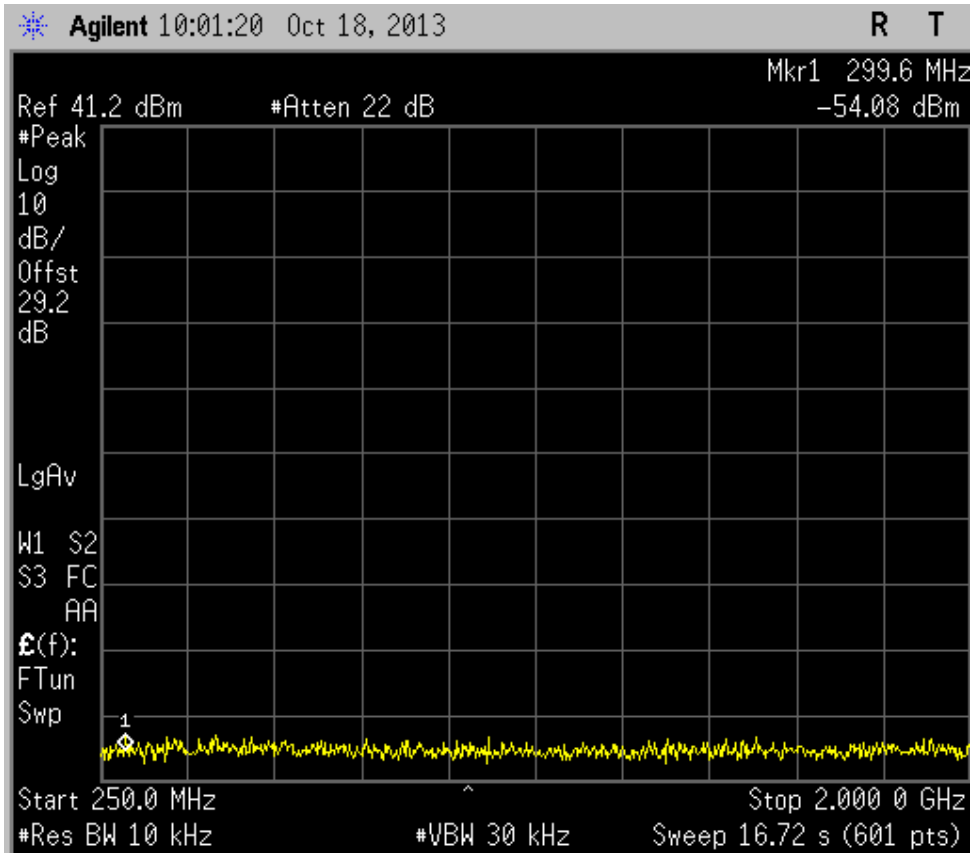




Spurious Emissions (Tx Conducted)

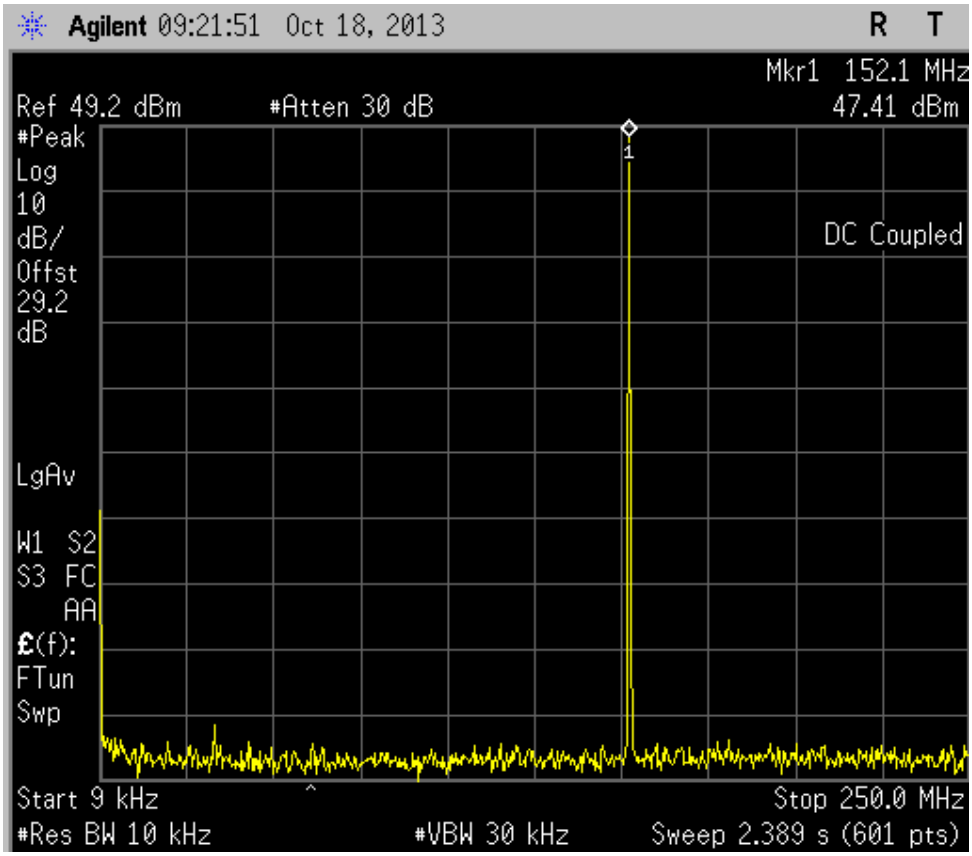
149.8 MHz @ 50 W Plots:

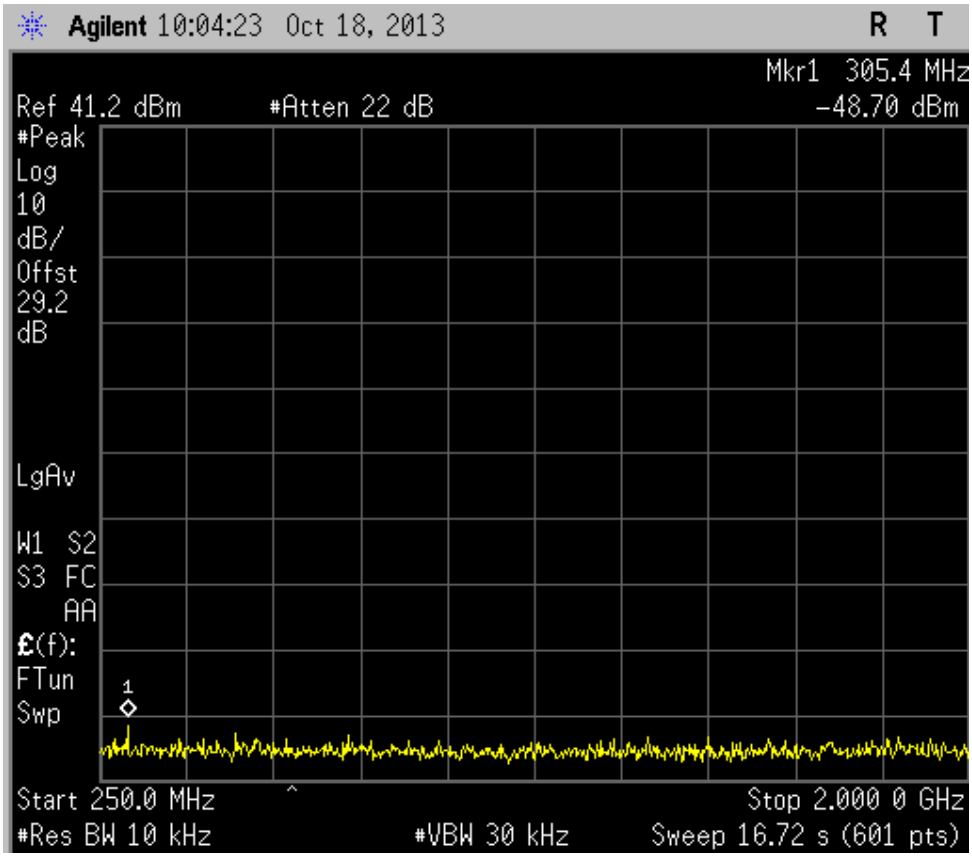




Spurious Emissions (Tx Conducted)

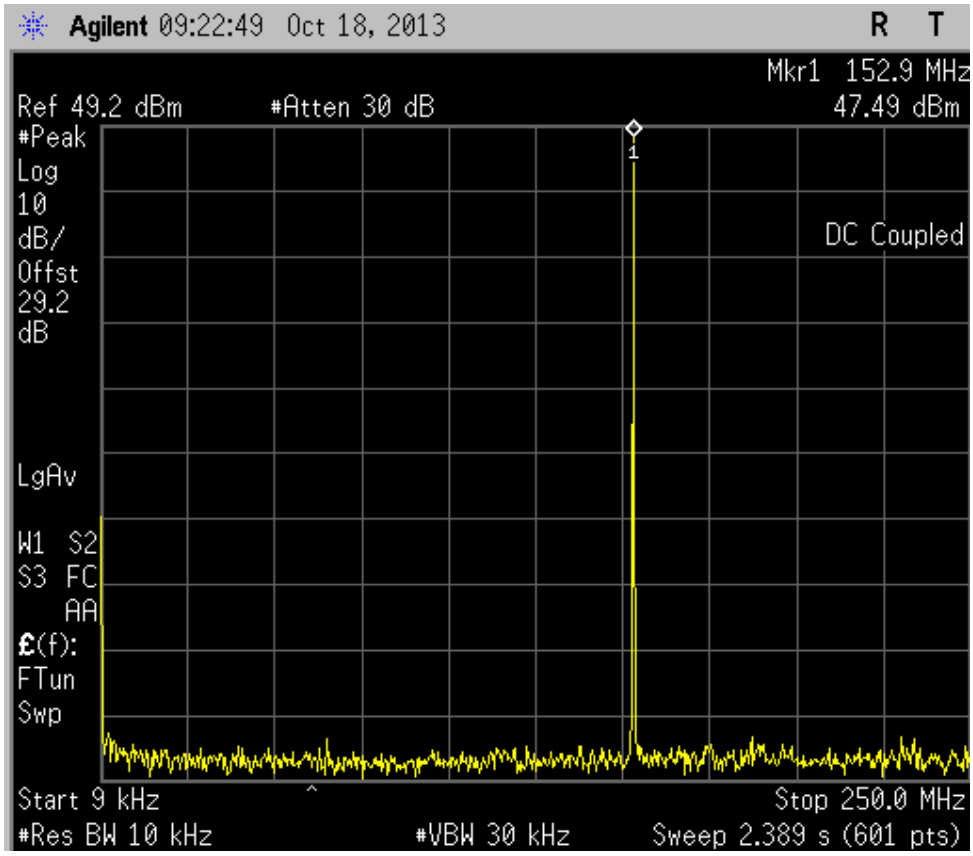
152.1 MHz @ 50 W Plots:

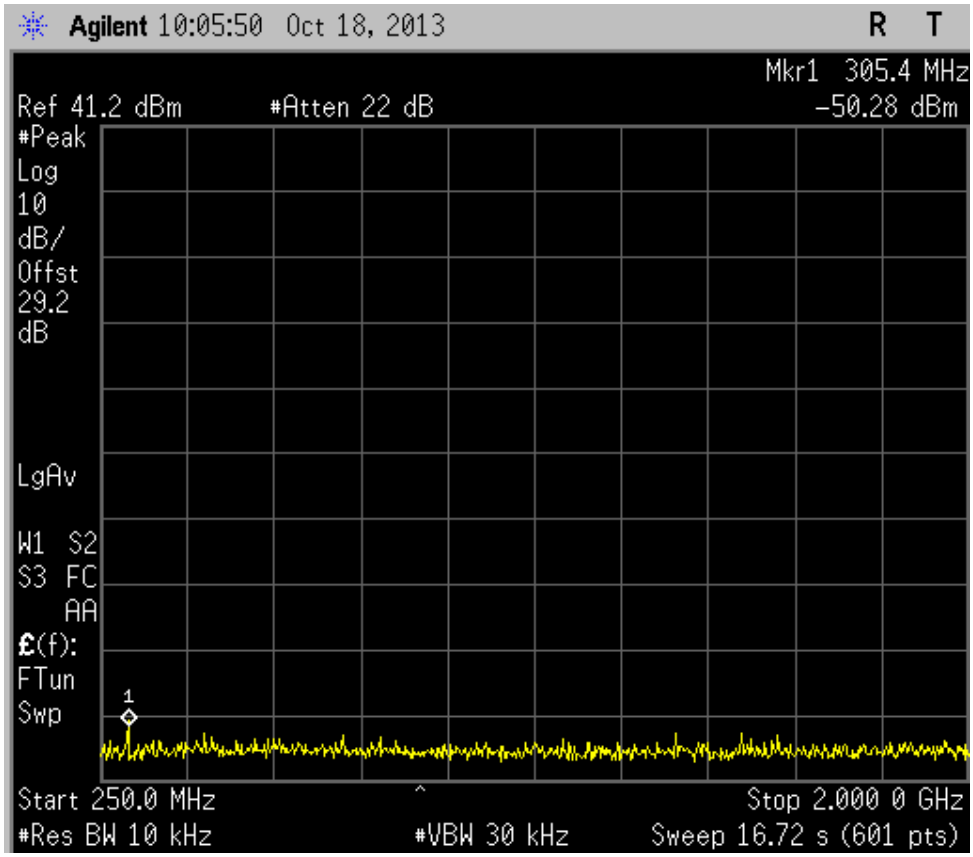




Spurious Emissions (Tx Conducted)

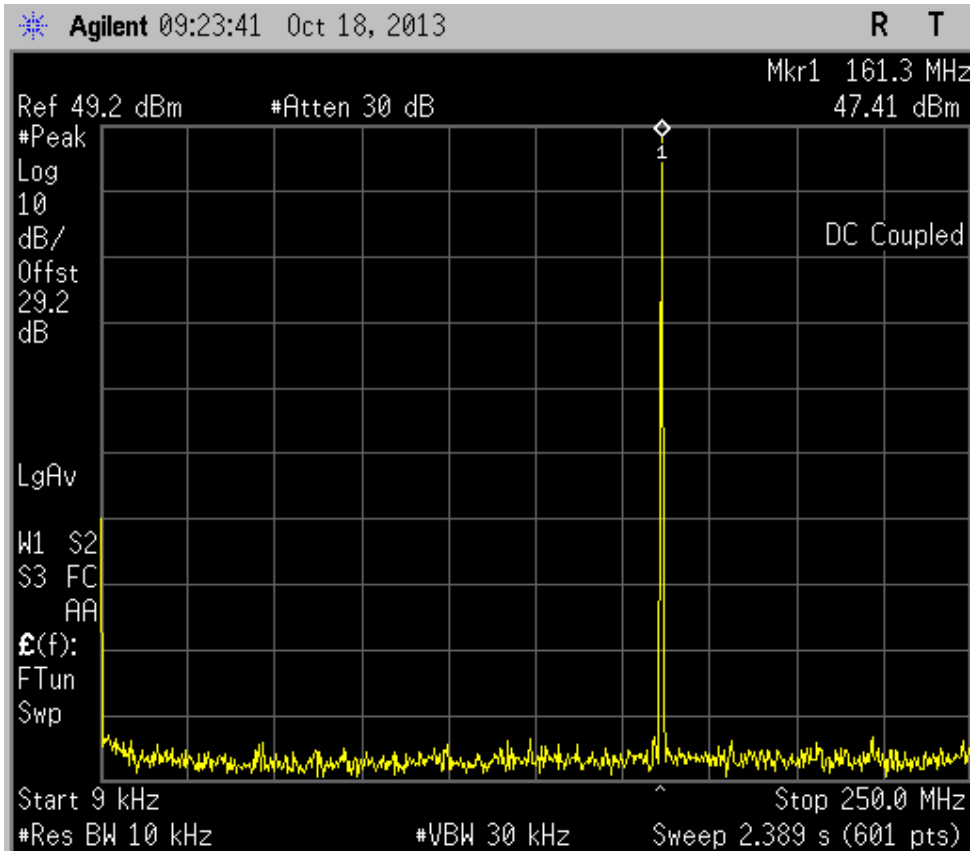
153.1 MHz @ 50 W Plots:

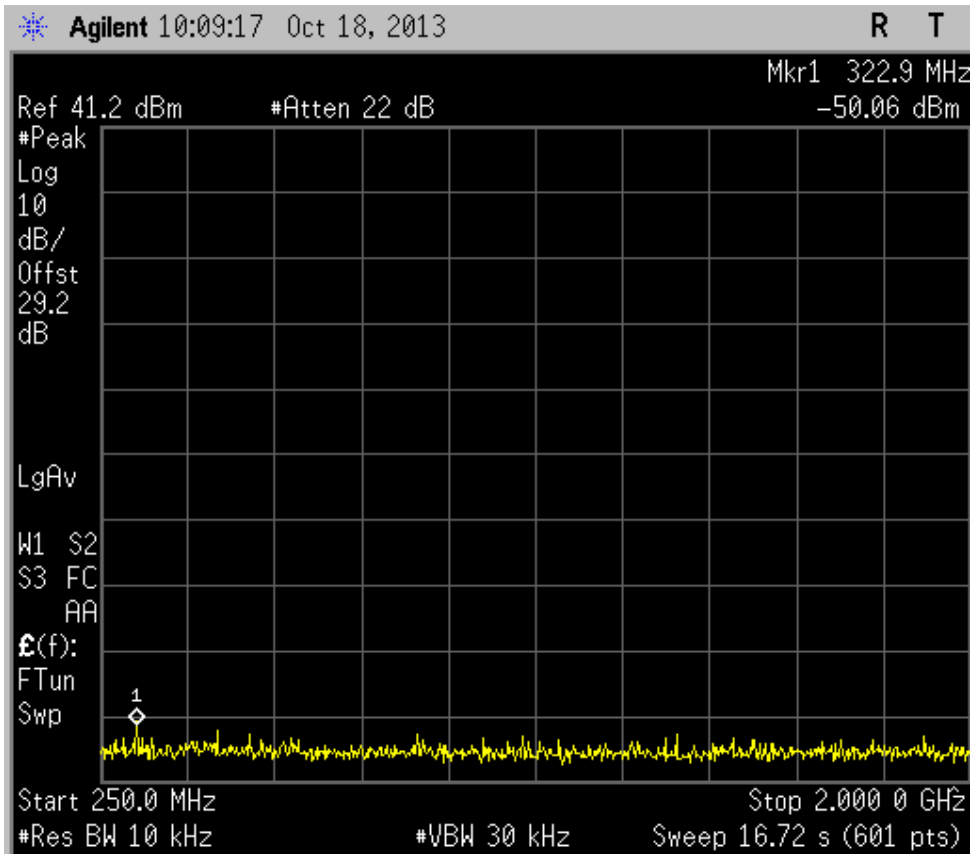




Spurious Emissions (Tx Conducted)

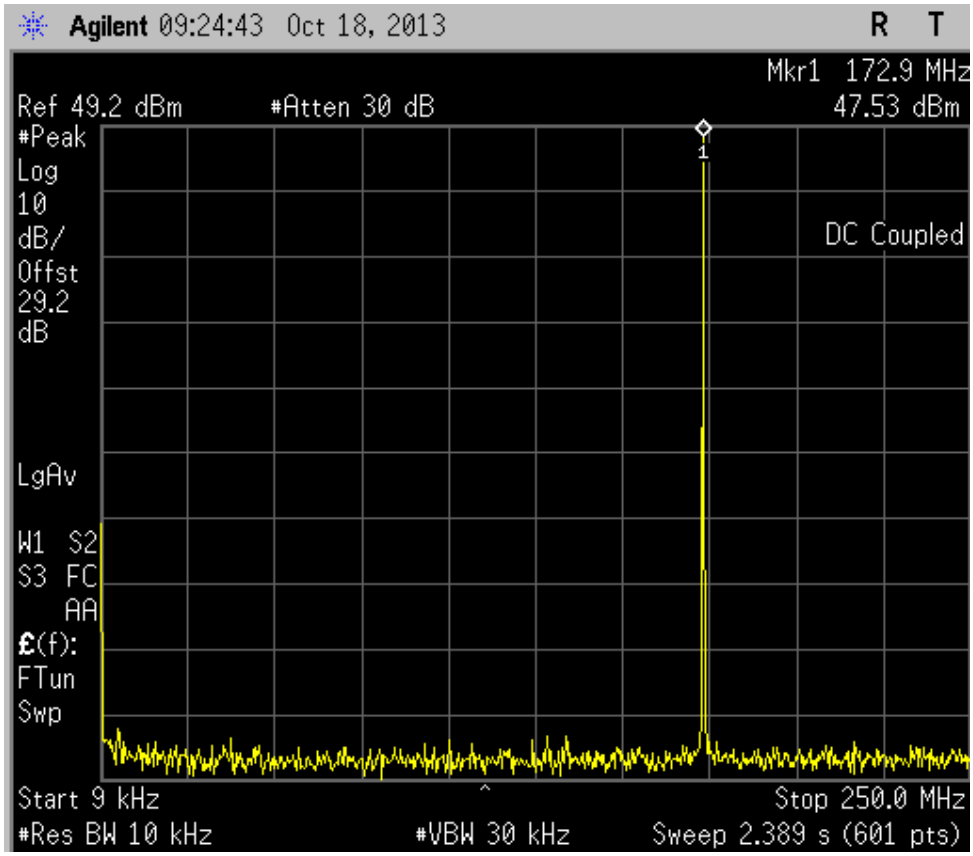
161.1 MHz @ 50 W Plots:

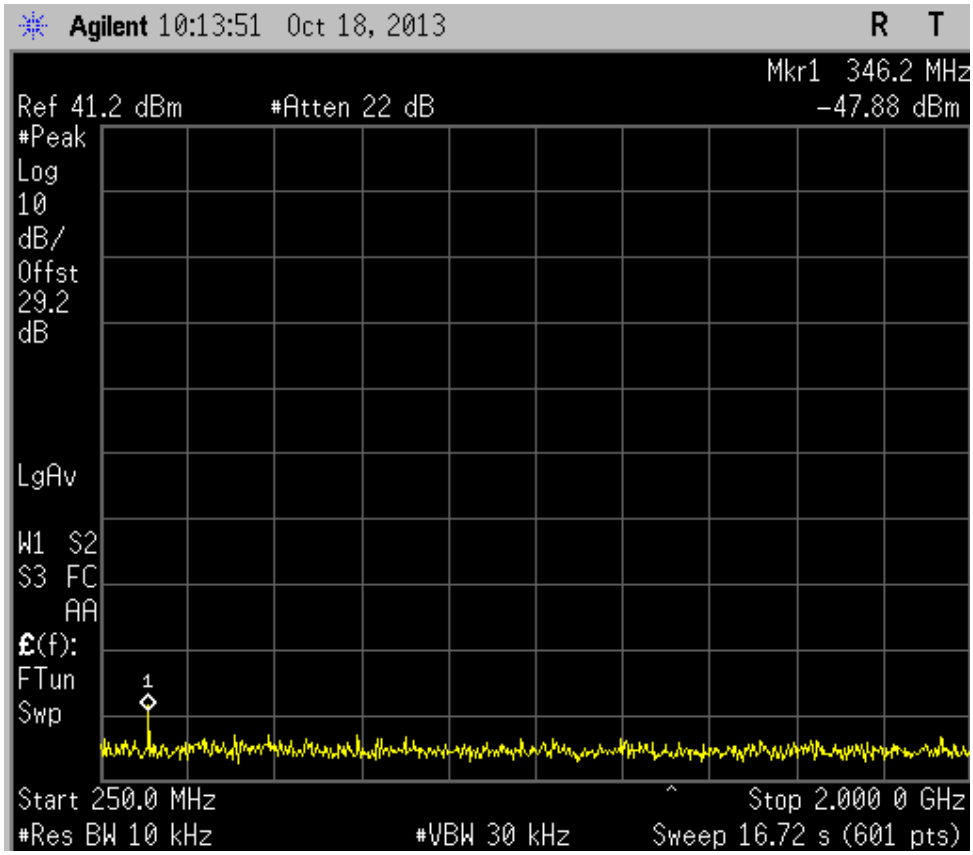




Spurious Emissions (Tx Conducted)

173.1 MHz @ 50 W Plots:





TRANSMITTER SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC 47 CFR 2.1053

GUIDE: TIA-102.CAAA-C 2.2.6

MEASUREMENT PROCEDURE:
Initial Scan:

1. The EUT is placed in the S-Line TEM cell and emissions are measured from 30 MHz to 1000 MHz. Any emission within 20 dB of the limit is then re-tested on the OATS along with measurements from 1000 MHz to the 10th harmonic of the fundamental frequency.
2. The EUT is placed in the reverberation chamber and emissions are measured from 1000 MHz to the upper frequency required. Any emission within 20 dB of the limit is then re-tested on the OATS.
3. The harmonics emissions up to the 6th harmonic of the fundamental frequency are measured on the OATS

OATS Measurement:

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

MEASUREMENT RESULTS:
See the tables on the following pages

LIMIT CLAUSE: FCC 47 CFR 90.210

Spurious Emissions (Tx Radiated)

SPECIFICATION: FCC CFR 2.1053

12.5 kHz Channel Spacing	148.1 MHz @ 50 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
12.5 kHz Channel Spacing	148.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
12.5 kHz Channel Spacing	149.8 MHz @ 50 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
12.5 kHz Channel Spacing	149.8 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
12.5 kHz Channel Spacing	152.1 MHz @ 50 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
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	153.1 MHz @ 50 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
12.5 kHz Channel Spacing	153.1 MHz @ 5 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.		
Measurement Uncertainty	± 4.6 dB	

Spurious Emissions (Tx Radiated)

SPECIFICATION: FCC CFR 2.1053

12.5 kHz Channel Spacing	161.1 MHz @ 50 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
12.5 kHz Channel Spacing	161.1 MHz @ 5 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
12.5 kHz Channel Spacing	173.1 MHz @ 50 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
12.5 kHz Channel Spacing	173.1 MHz @ 5 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.		
Measurement Uncertainty	± 4.6 dB	

LIMITS: FCC CFR 2.1053

Carrier Output Power	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
50 W	-20 dBm	-67 dBc
5 W	-20 dBm	-57 dBc

Tx Radiated Emissions - Continued

Open Area Test Site Results:

12.5 kHz Channel Spacing | 161.1 MHz @ 50 W | Emission Mask D

Harmonics Emission Frequency (MHz)	Level (dBm)	Level (dBc)
322.2	-74.1	-111.1
483.3	-77.8	-114.8
644.4	-64.5	-101.5
805.5	-38.8	-75.8
966.6	-61.7	-98.7
1127.7	-77.4	-114.4
No emissions were detected at a level greater than 10 dB below the limit.		
Measurement Uncertainty	± 4.6 dB	

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: 148.1 MHz 50 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	0.5	N/A
t2	-0.2	N/A
t3	N/A	-0.2
t2 → t3 ppm	1.7	
ERROR LIMIT (t2 → t3) ppm	2.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

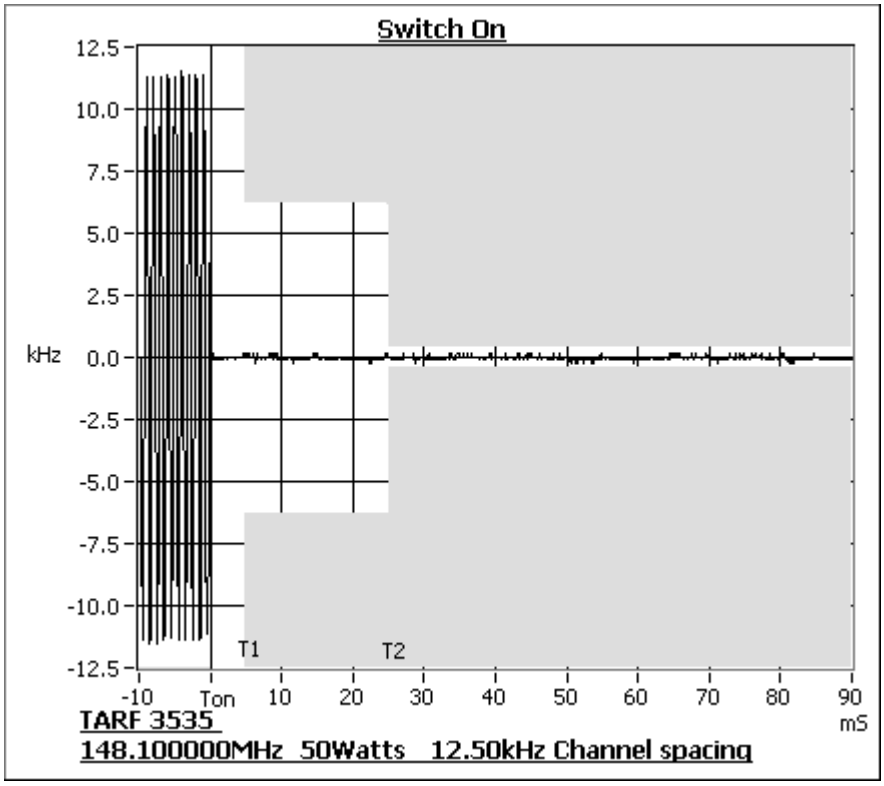
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

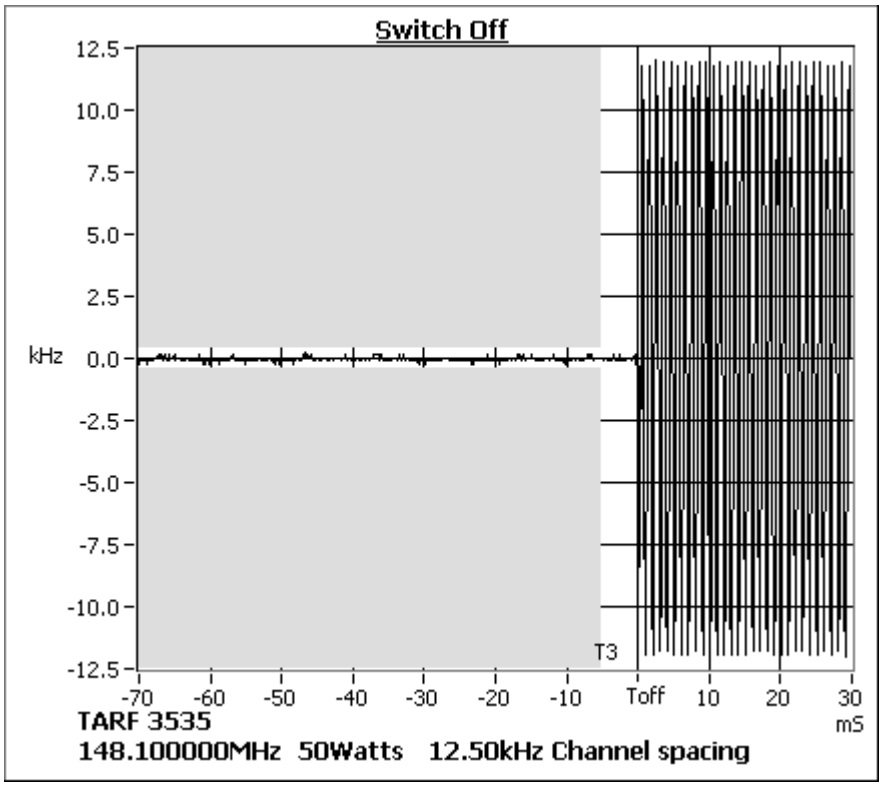
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 148.1 MHz 50 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 149.8 MHz 50 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	-0.3	N/A
t2	-0.9	N/A
t3	N/A	0.3
t2 → t3 ppm	2.0	
ERROR LIMIT (t2 → t3) ppm	2.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

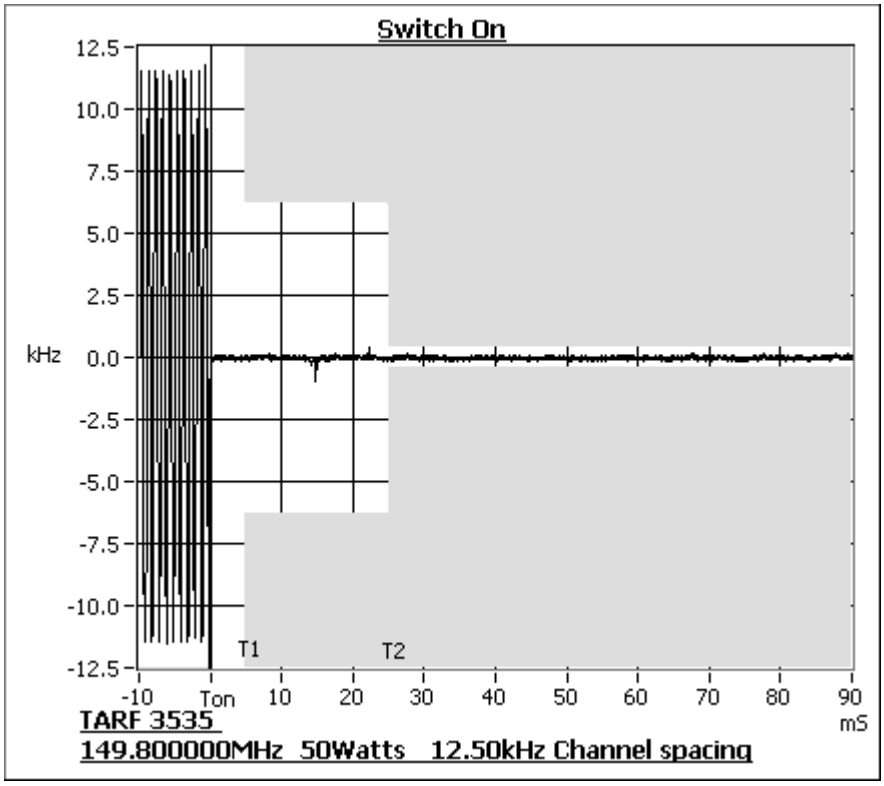
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

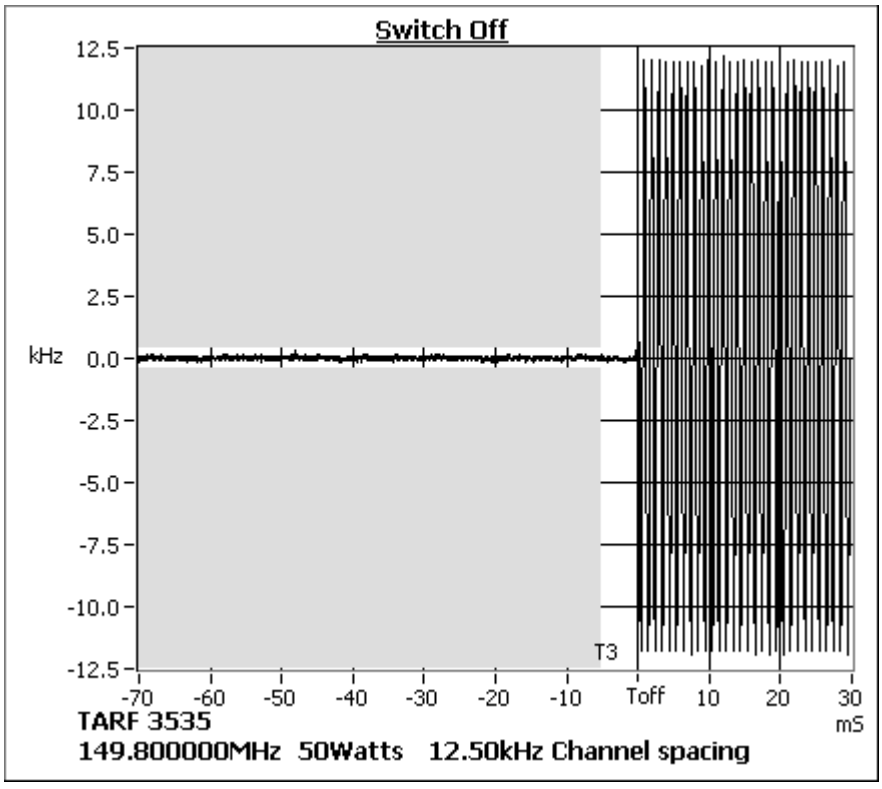
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 149.8 MHz 50 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 152.1 MHz 50 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	-0.1	N/A
t2	0.2	N/A
t3	N/A	-0.5
t2 → t3 ppm	-1.8	
ERROR LIMIT (t2 → t3) ppm	2.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

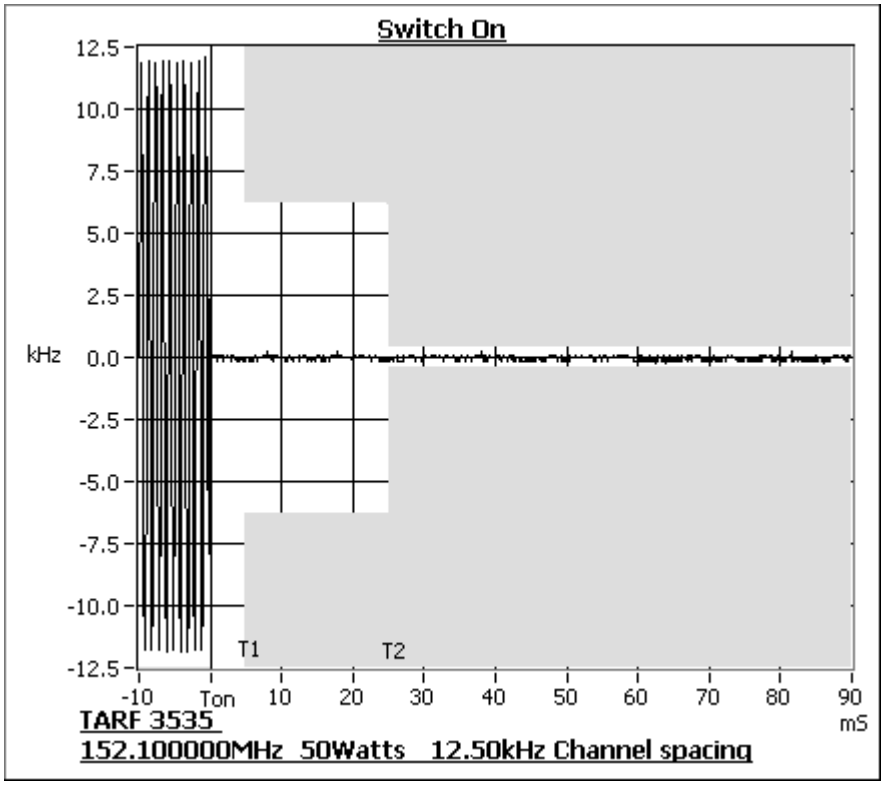
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

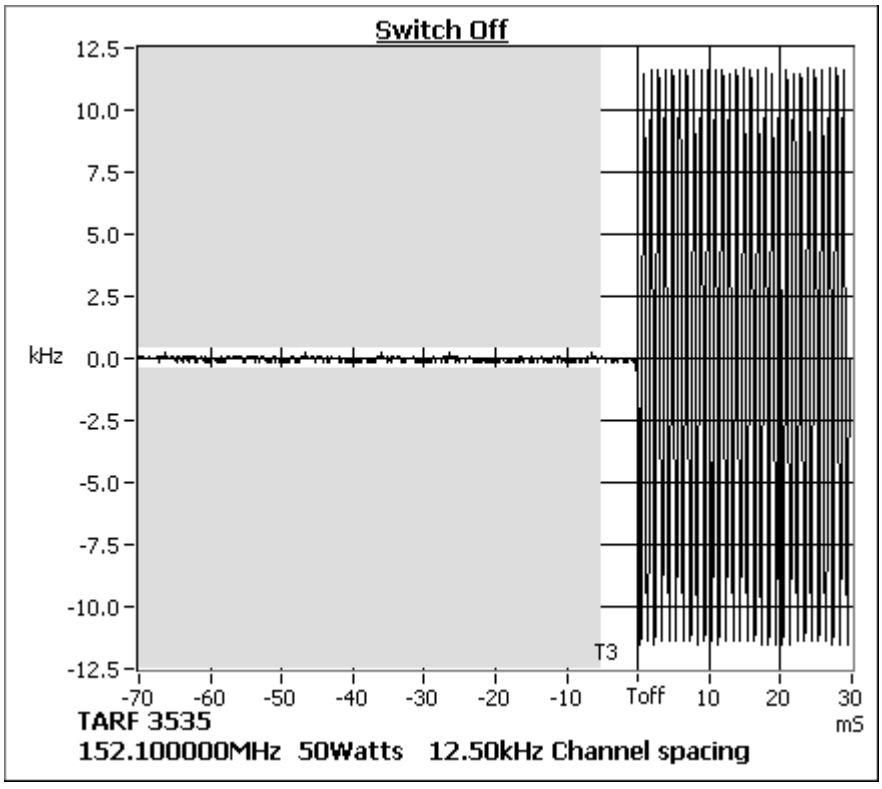
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 152.1 MHz 50 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 153.1 MHz 50 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	1.3	N/A
t2	-0.4	N/A
t3	N/A	0.5
t2 → t3 ppm	-1.8	
ERROR LIMIT (t2 → t3) ppm	2.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

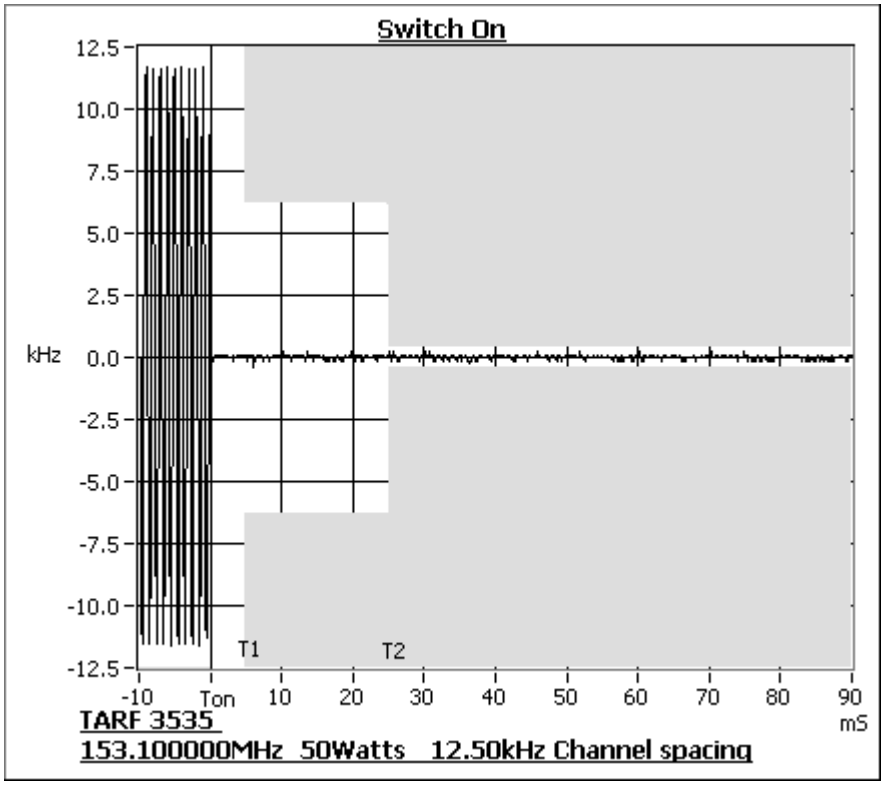
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

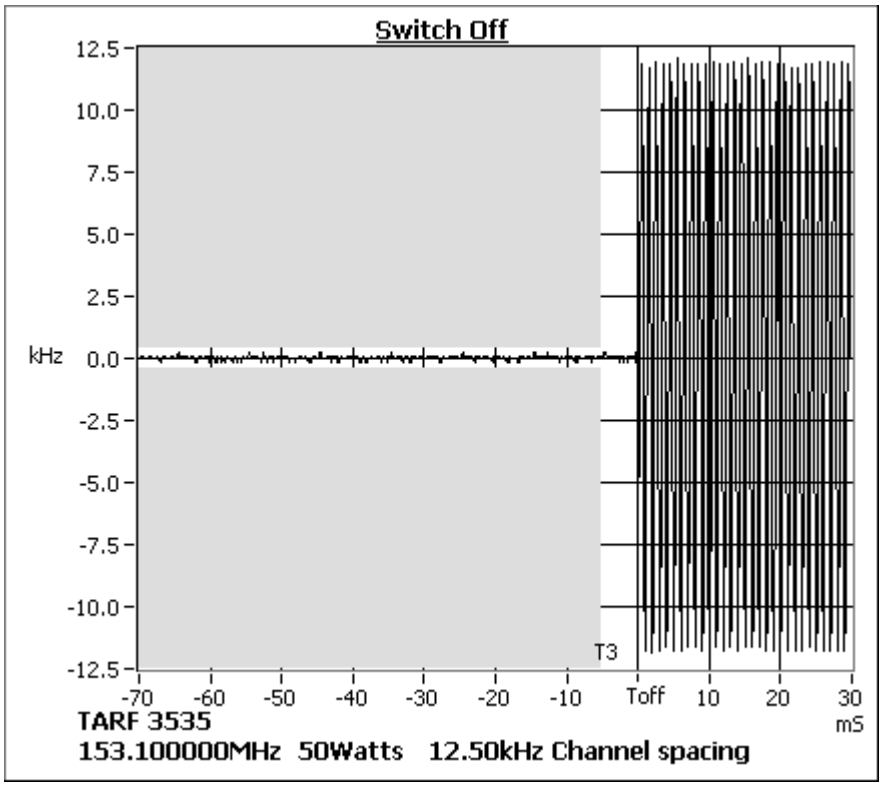
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 153.1 MHz 50 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 161.1 MHz 50 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	-0.2	N/A
t2	-0.2	N/A
t3	N/A	0.3
t2 → t3 ppm	1.8	
ERROR LIMIT (t2 → t3) ppm	2.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

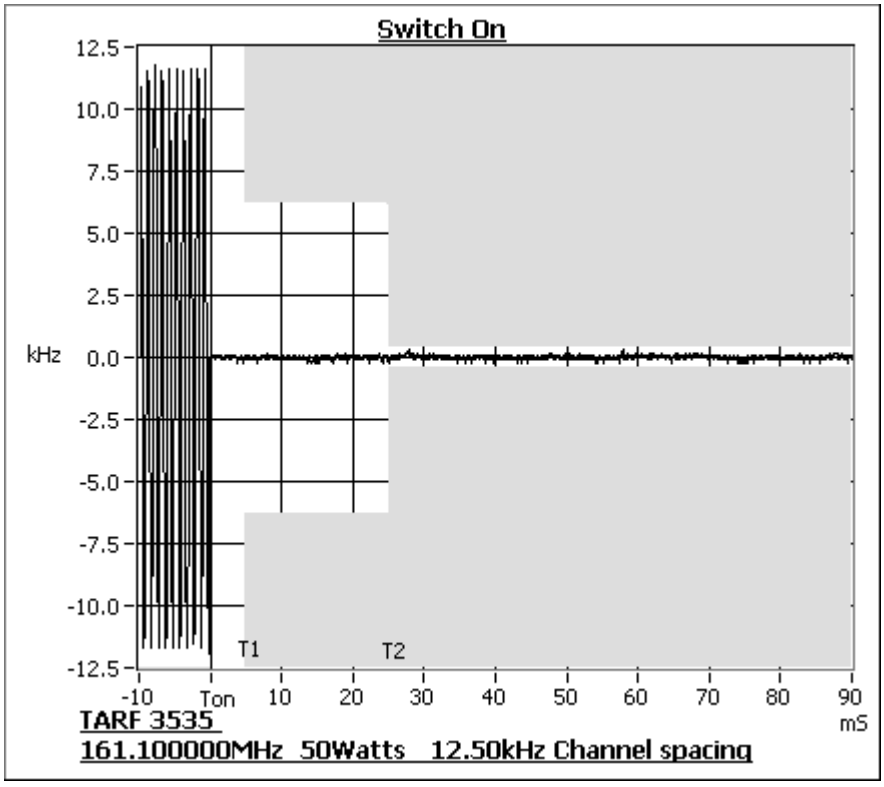
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

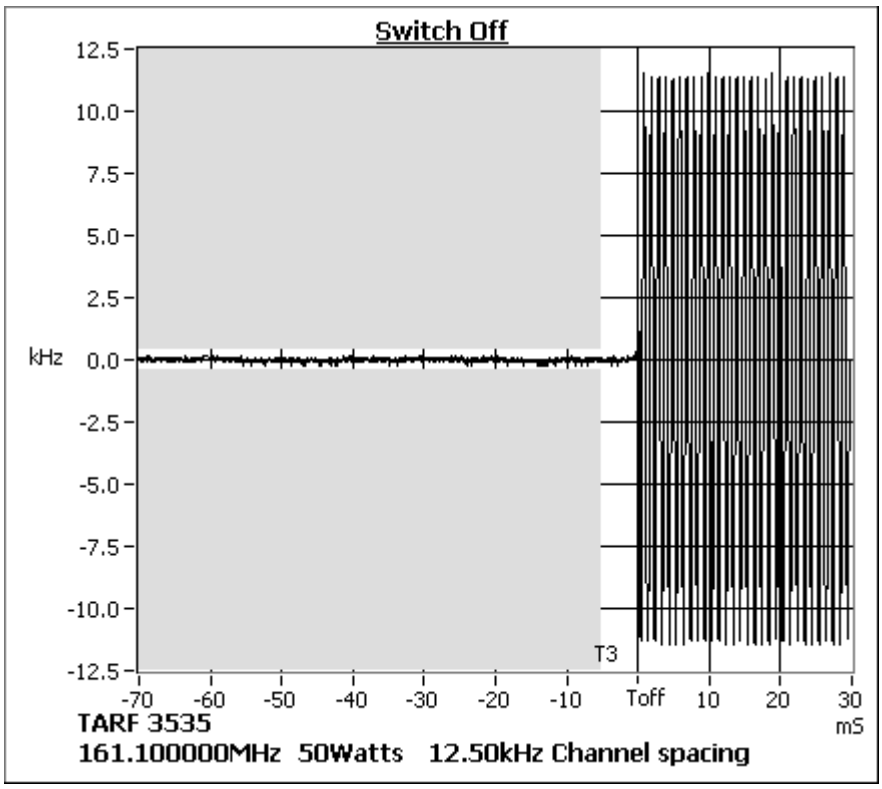
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 161.1 MHz 50 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 173.1 MHz 50 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	0.3	N/A
t2	-0.3	N/A
t3	N/A	-0.5
t2 → t3 ppm	1.7	
ERROR LIMIT (t2 → t3) ppm	2.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

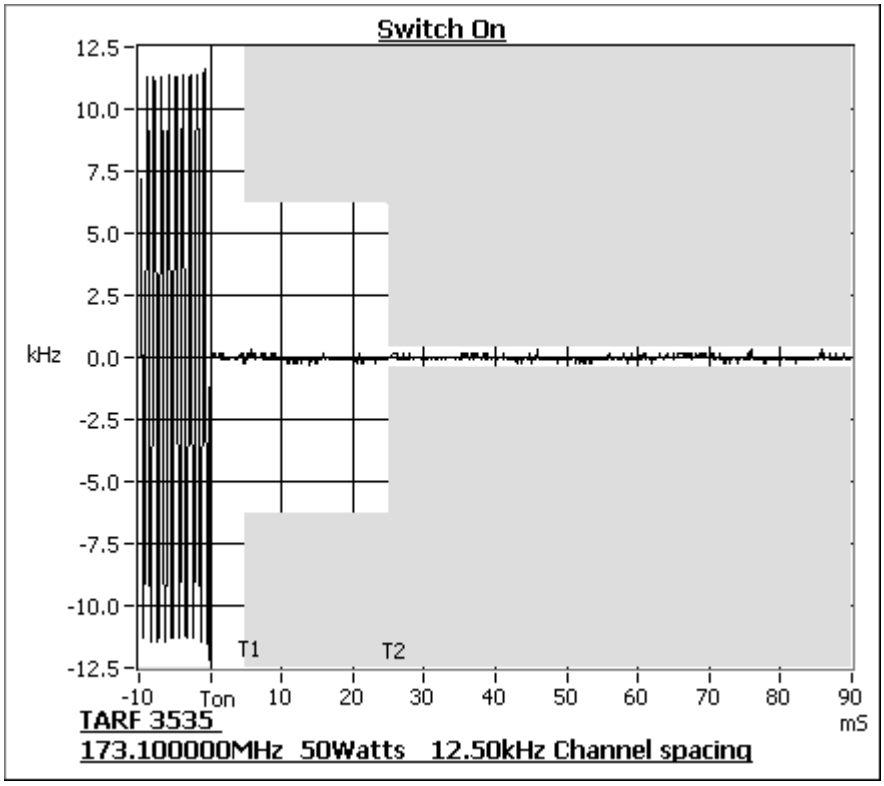
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

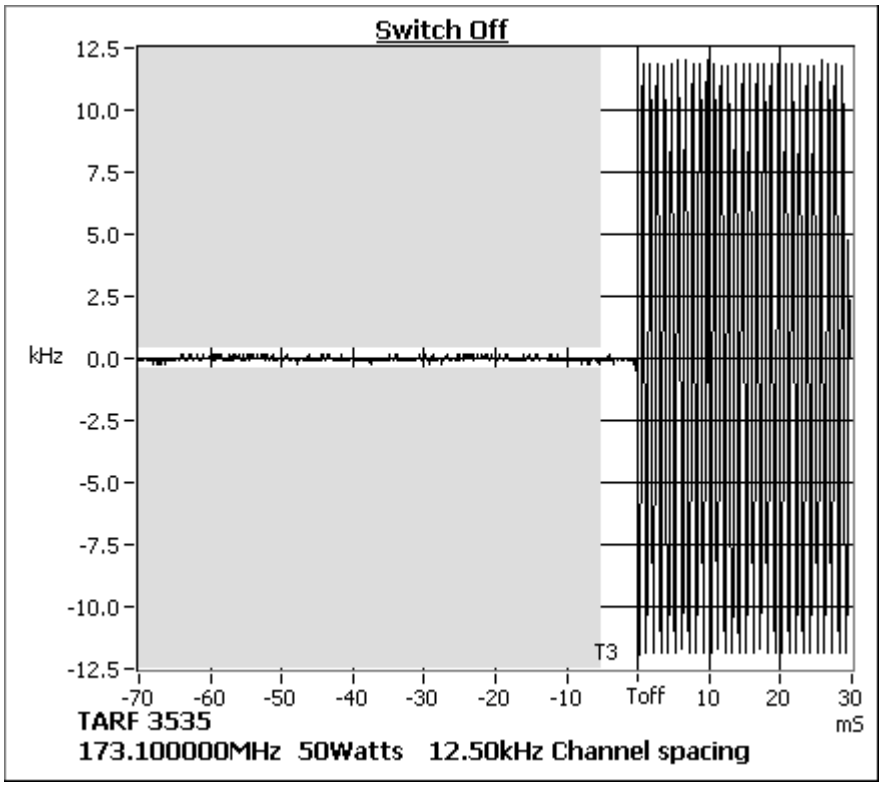
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 173.1 MHz 50 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 148.1 MHz 5 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	-0.3	N/A
t2	-0.3	N/A
t3	N/A	-0.5
t2 → t3 ppm	2.4	
ERROR LIMIT t2 → t3 (ppm)	2.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

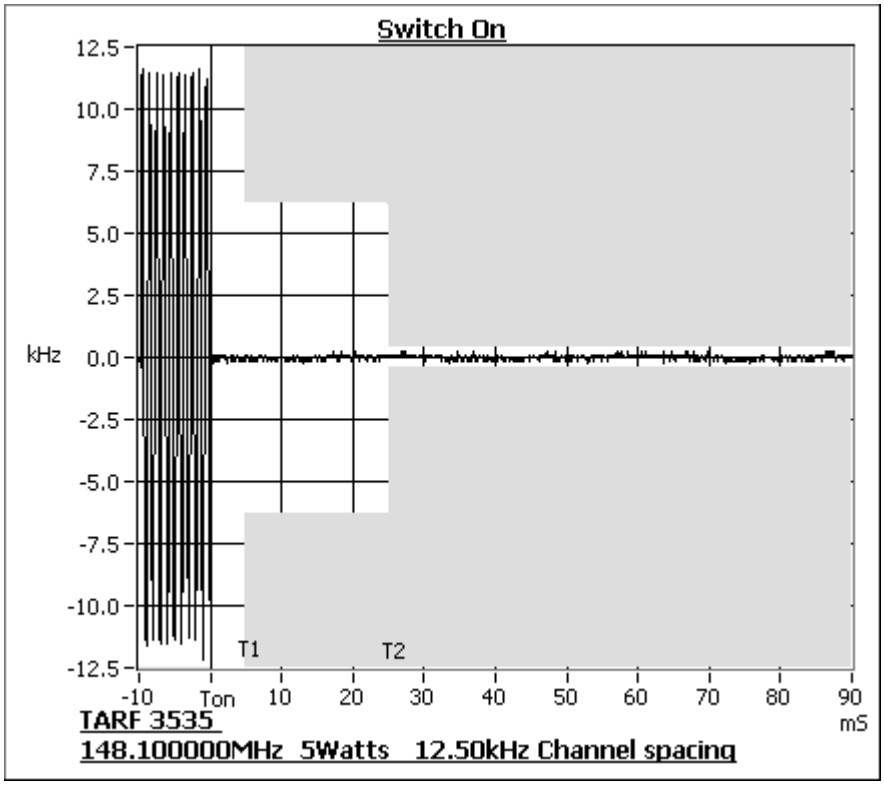
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

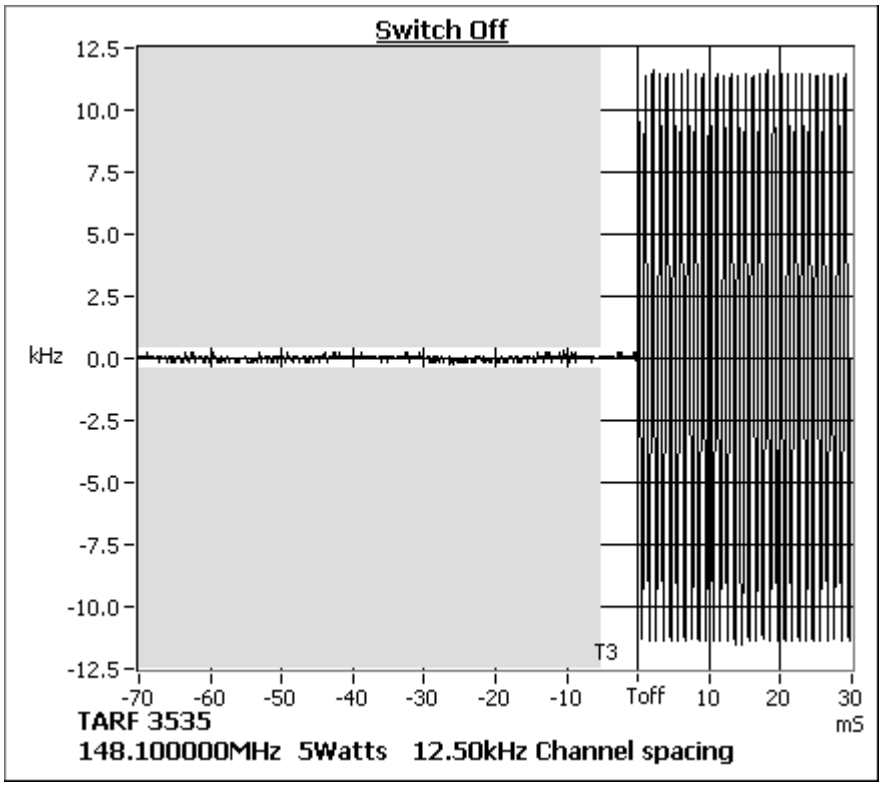
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 148.1 MHz 5 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 149.8 MHz 5 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	-0.3	N/A
t2	0.3	N/A
t3	N/A	0.3
t2 → t3 ppm	1.9	
ERROR LIMIT t2 → t3 (ppm)	2.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

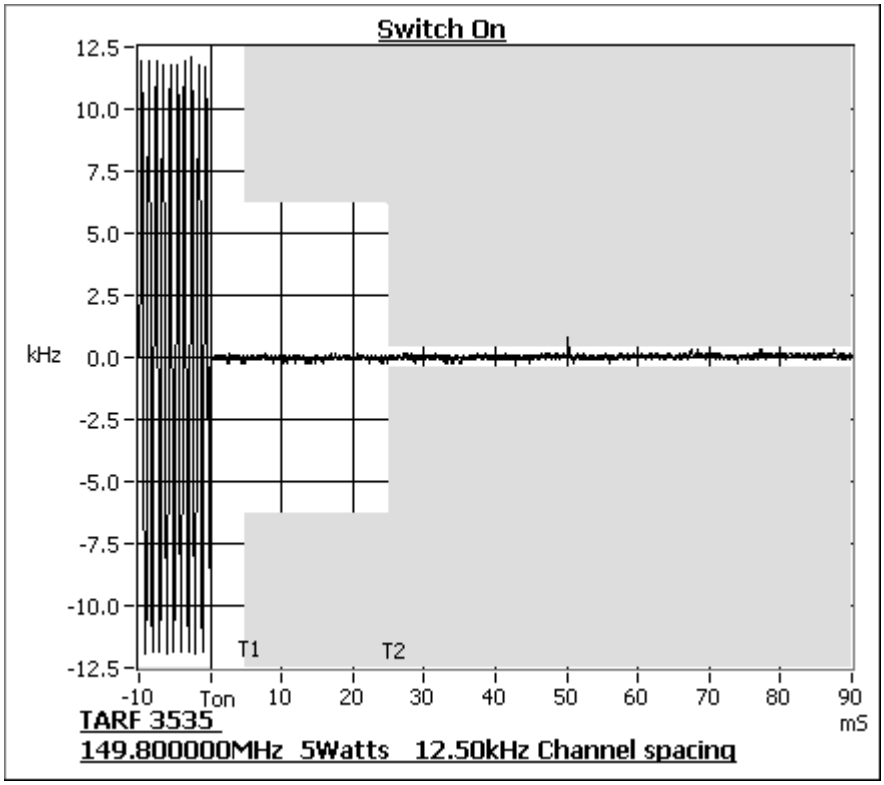
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

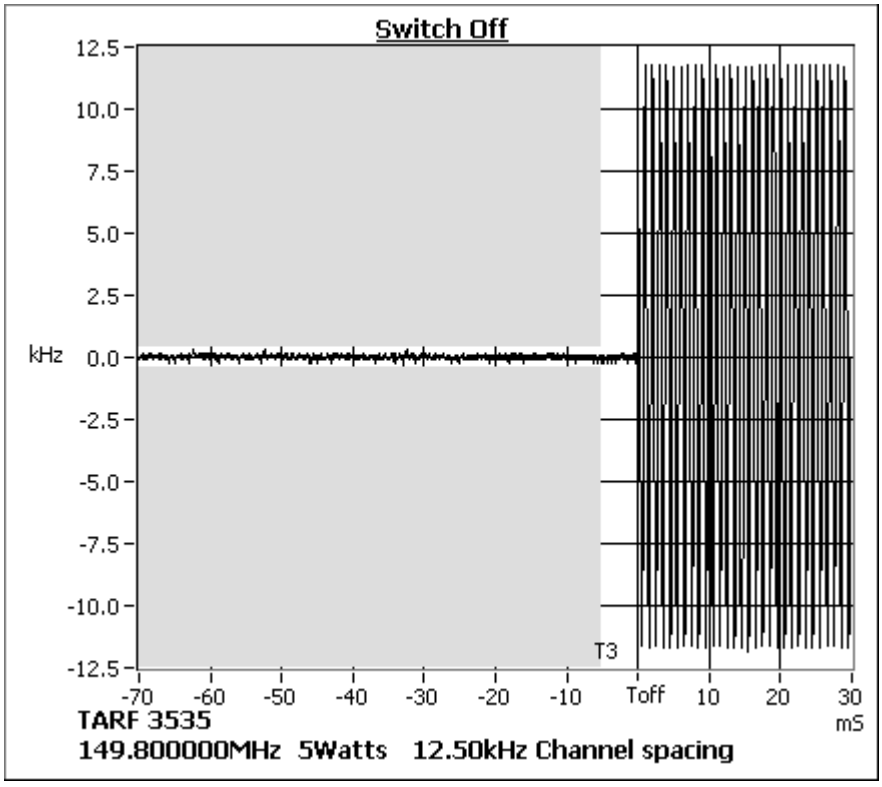
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 149.8 MHz 5 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	-0.3	N/A
t2	-0.2	N/A
t3	N/A	0.2
t2 → t3 ppm	-1.9	
ERROR LIMIT t2 → t3 (ppm)	2.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

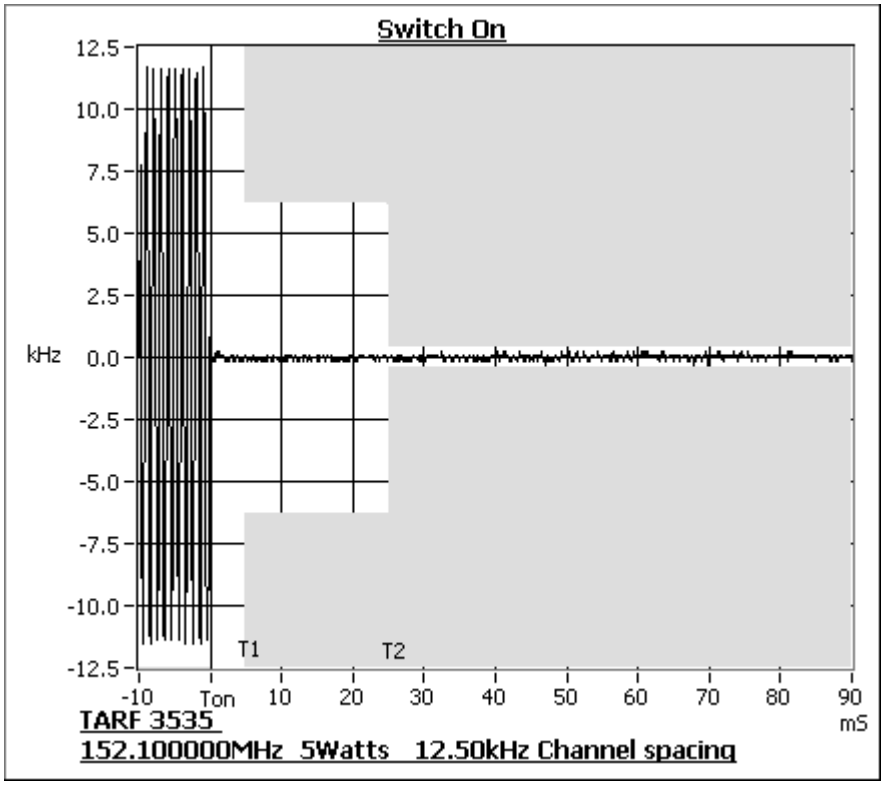
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

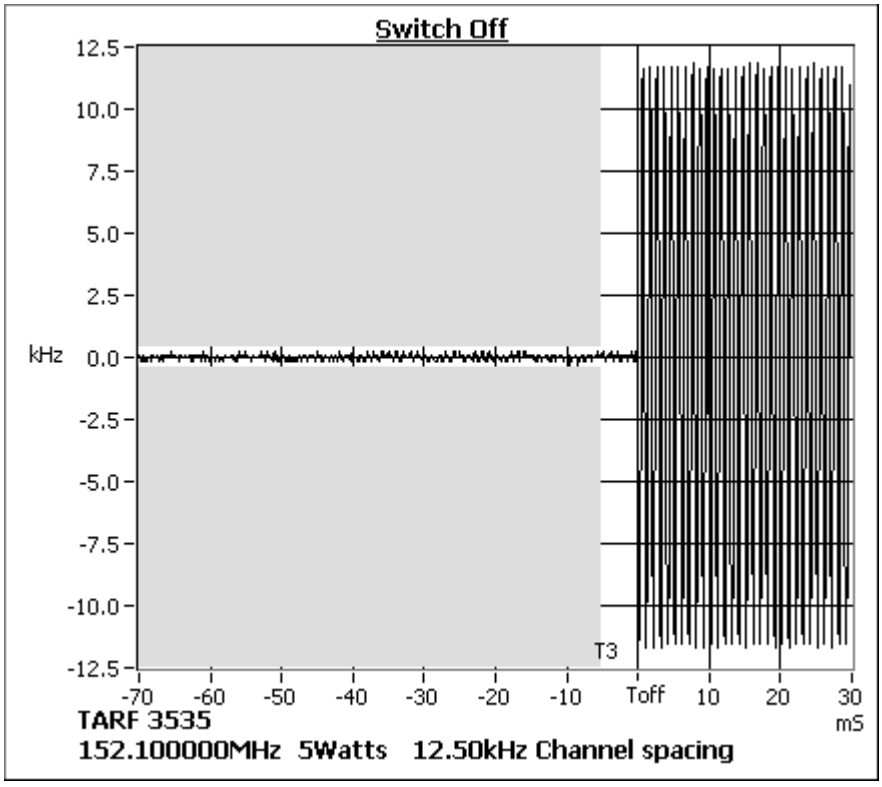
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 152.1 MHz 5 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	0.3	N/A
t2	-0.3	N/A
t3	N/A	-0.3
t2 → t3 ppm	2.1	
ERROR LIMIT t2 → t3 (ppm)	2.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

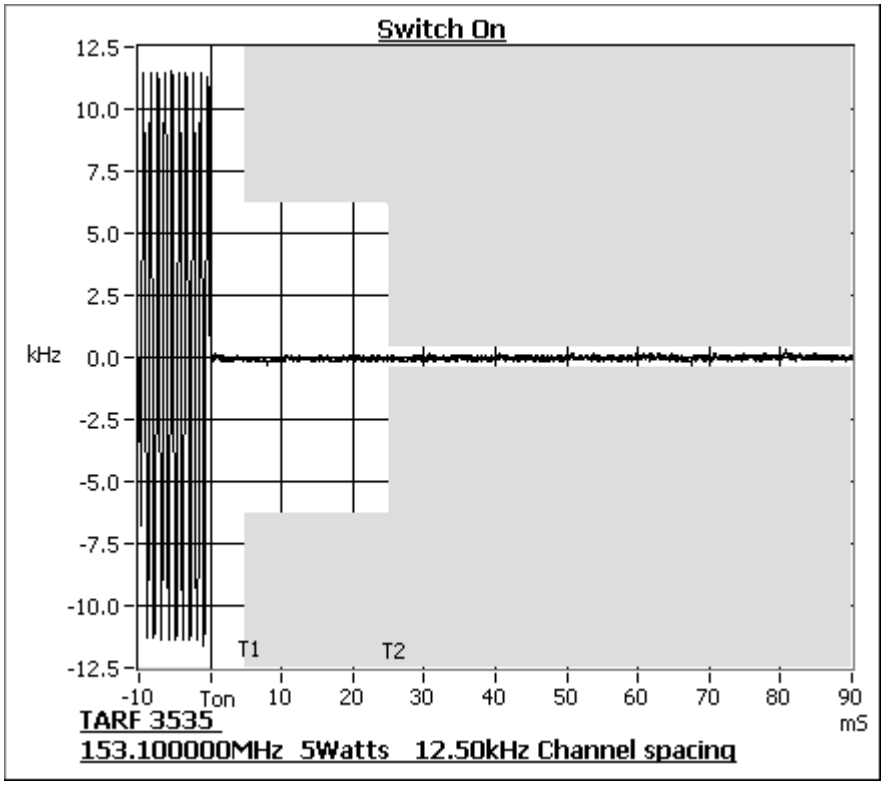
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

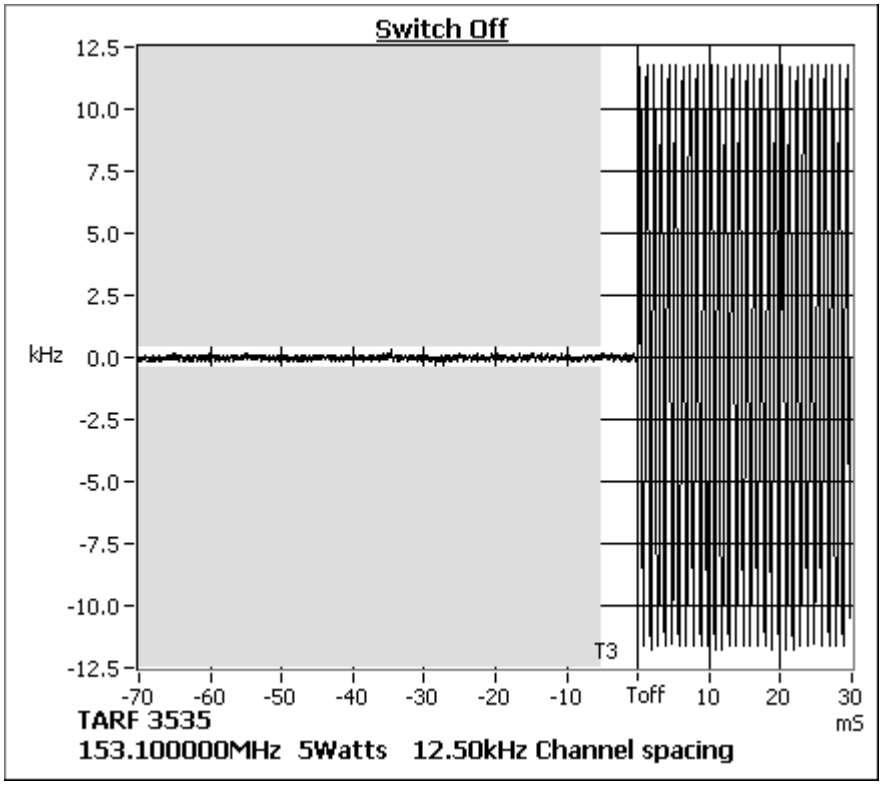
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 153.1 MHz 5 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 161.1 MHz 5 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	0.5	N/A
t2	0.3	N/A
t3	N/A	0.6
t2 → t3 ppm	1.6	
ERROR LIMIT t2 → t3 (ppm)	2.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

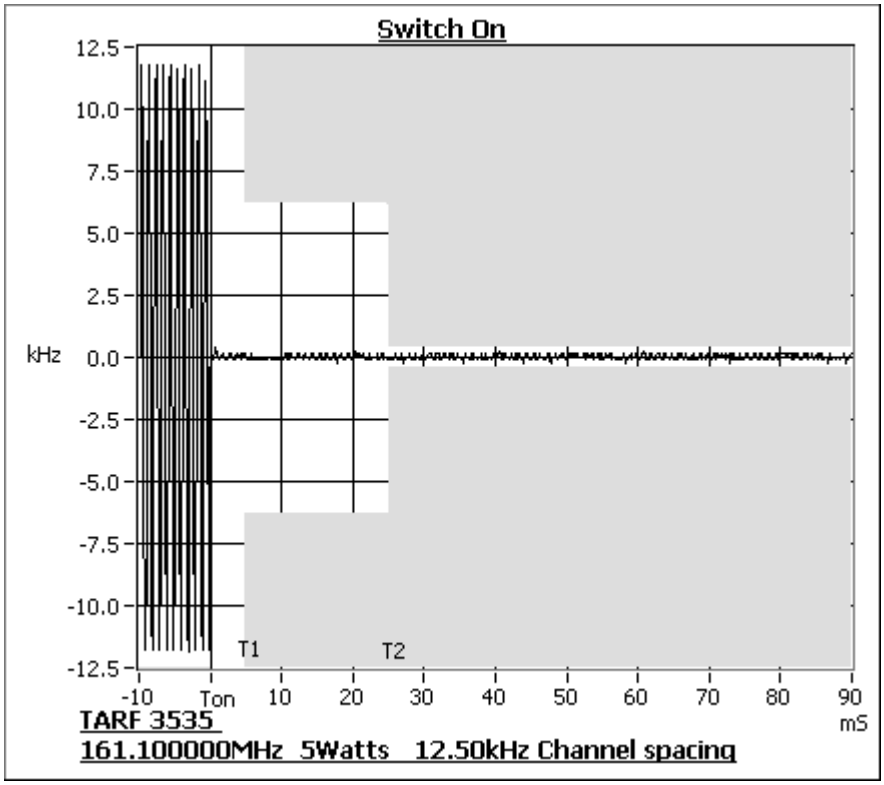
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

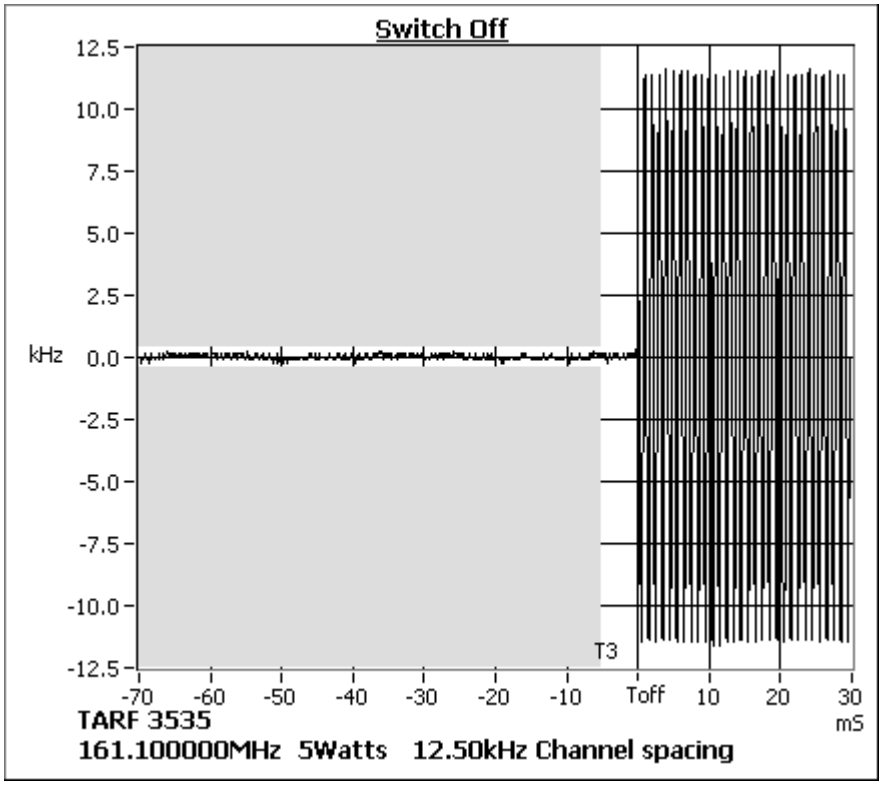
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 161.1 MHz 5 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 173.1 MHz 5 W 12.5 kHz Channel Spacing

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	1.6	N/A
t2	0.4	N/A
t3	N/A	-0.2
t2 → t3 ppm	1.5	
ERROR LIMIT t2 → t3 (ppm)	2.5	

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

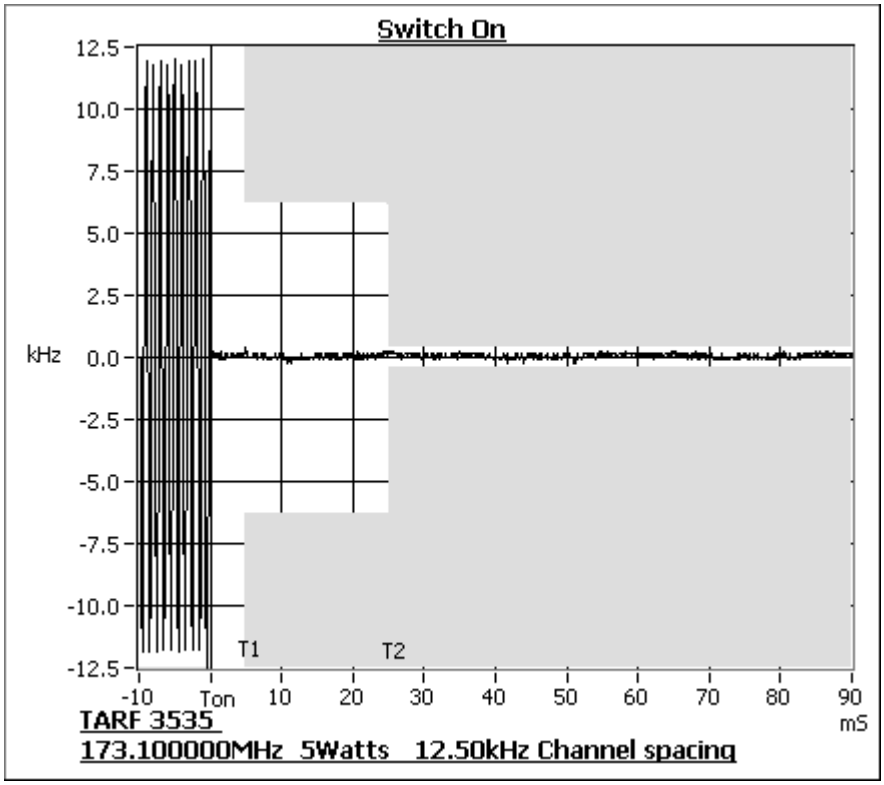
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

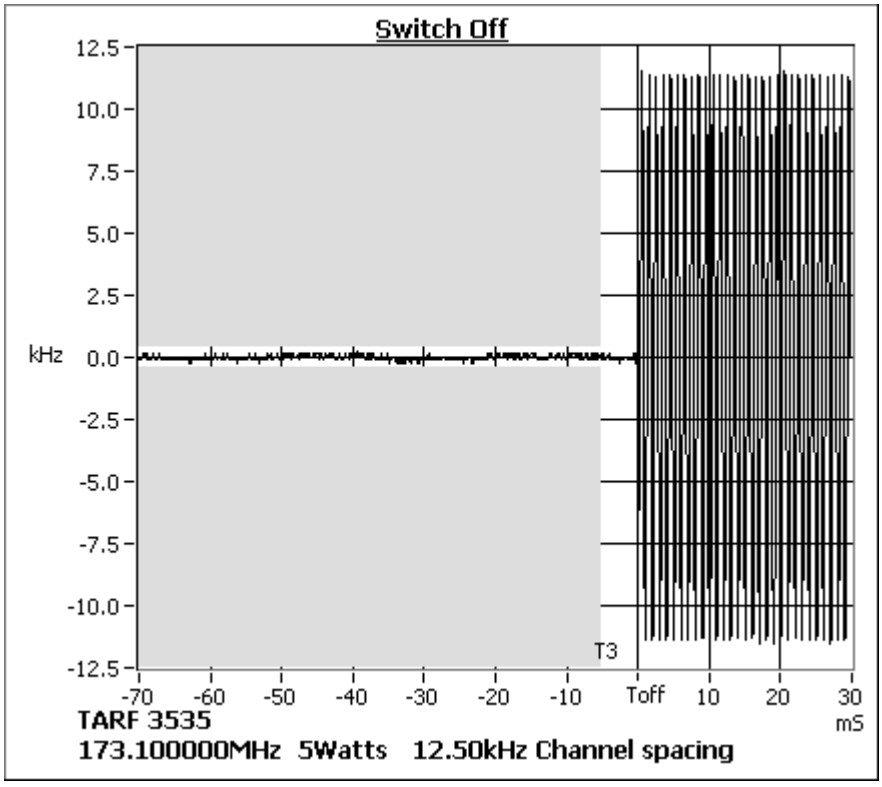
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

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-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 pages for 12.5 kHz & 25.0 kHz channel spacings.

148.1 MHz

Temperature (ºC)	Frequency (MHz)	Error (ppm)
50	148.099996	0.0
40	148.099997	0.0
30	148.099998	0.0
20	148.100001	0.0
10	148.099996	0.0
0	148.099989	-0.1
-10	148.099994	0.0
-20	148.099994	0.0
-30	148.099973	-0.2

149.8 MHz

Temperature (ºC)	Frequency (MHz)	Error (ppm)
50	149.799996	0.0
40	149.799997	0.0
30	149.799997	0.0
20	149.800000	0.0
10	149.799996	0.0
0	149.799989	-0.1
-10	149.799994	0.0
-20	149.799994	0.0
-30	149.799972	-0.2

Transmitter Frequency Stability - Temperature

152.1 MHz

Temperature (ºC)	Frequency (MHz)	Error (ppm)
50	152.099997	0.0
40	152.099997	0.0
30	152.099997	0.0
20	152.100001	0.0
10	152.099997	0.0
0	152.099990	-0.1
-10	152.099994	0.0
-20	152.099993	0.0
-30	152.099971	-0.2

153.1 MHz

Temperature (ºC)	Frequency (MHz)	Error (ppm)
50	153.099996	0.0
40	153.099997	0.0
30	153.099998	0.0
20	153.100000	0.0
10	153.099997	0.0
0	153.099990	-0.1
-10	153.099993	0.0
-20	153.099995	0.0
-30	153.099971	-0.2

Transmitter Frequency Stability - Temperature

161.1 MHz

Temperature (ºC)	Frequency (MHz)	Error (ppm)
50	161.099996	0.0
40	161.099998	0.0
30	161.099997	0.0
20	161.100001	0.0
10	161.099995	0.0
0	161.099989	-0.1
-10	161.099993	0.0
-20	161.099993	0.0
-30	161.099968	-0.2

173.1 MHz

Temperature (ºC)	Frequency (MHz)	Error (ppm)
50	173.099997	0.0
40	173.099995	0.0
30	173.099998	0.0
20	173.100000	0.0
10	173.099998	0.0
0	173.099989	-0.1
-10	173.099992	0.0
-20	173.099994	0.0
-30	173.099970	-0.2

LIMIT: FCC 47 CFR 90.213 RSS-119 5.3

Channel Spacing (kHz)	Frequency Error (ppm)
12.5	2.5
25.0	5.0

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					
	148.1 MHz	149.8 MHz	152.1 MHz	153.1 MHz	161.1 MHz	173.1 MHz
120 V_{AC}	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
102 V_{AC}	-0.01	-0.01	0.00	-0.01	-0.01	-0.01
138 V_{AC}	-0.01	-0.01	-0.01	-0.01	0.00	-0.01

LIMIT CLAUSES: FCC 47 CFR 90.213 RSS-119 5.3

Channel Spacing (kHz)	Frequency Error (ppm)
12.5	5.0
25.0	5.0

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.

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

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

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

RECEIVER SPURIOUS EMISSIONS (CONDUCTED)

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

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

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

LIMIT CLAUSE: RSS-Gen 6(b)

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

TRANSMITTER STANDBY SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: RSS-119 5.11

GUIDE: TIA-102.CAAA-C 2.1.2

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

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

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

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

TRANSMITTER STANDBY SPURIOUS EMISSIONS (CONDUCTED)

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

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

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

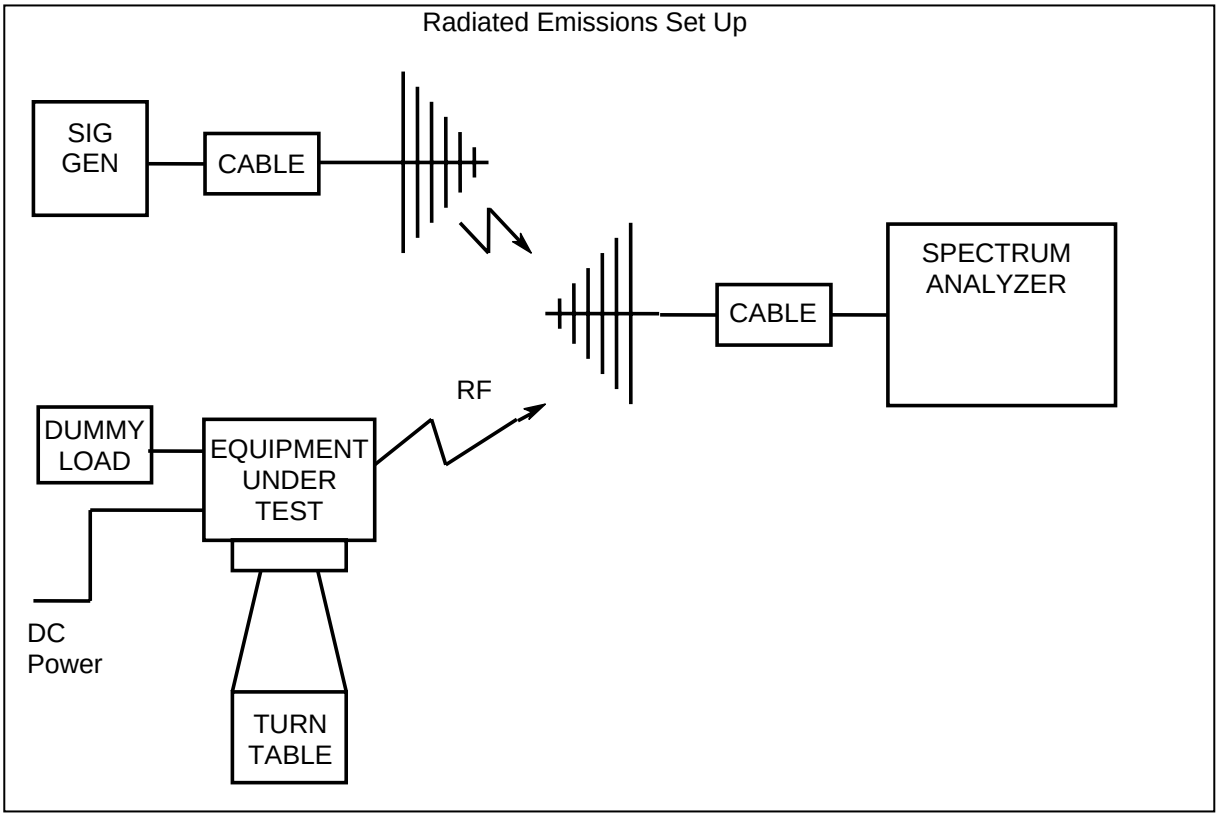
LIMIT CLAUSE: RSS-Gen 6(b)

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

TEST EQUIPMENT LIST

No#	Equipment Type	Information	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
8	Modulation Analyser	TREVA1	Hewlett Packard	HP8901B (Opt 002)	2441A00393	E3073	19-Oct-14
16	Oscilloscope	100MHz Digital	Tektronics	TDS340	B013611	E3585	16-Oct-14
27	Power Supply	AC Variac	Yamabishi	S-260-5	TX-533	E1737	
31	Antenna	18GHz DRG	Emco	DRG3115	9512-4638	E3560	6-Mar-16
32	Antenna	18GHz DRG	Emco	DRG3115	2084	E3076	6-Mar-16
35	RF Chamber	S-LINE TEM CELL	Rohde & Schwarz	1089.9296.02	338232/003	E3636	31-Aug-15
38	RF Amplifier	+21.7 dB 1GHz	Tait	ZFL-1000LN	E3660	E3360	18-Dec-13
45	RF Attenuator	TREVA1 20dB 150W	Weinschel	40-20-33	QT968	E4842	17-Oct-14
49	RF Attenuator	20dB 50W	Weinschel	24-20-44	AW1266	E3562	17-Oct-14
52	RF Load	150W	Bird	8166	524	E3625	23-Oct-14
56	RF Load	2W	MCL	NTRM-50	951215	E3574	18-Dec-13
60	Coax Cable	1m Blue	Suhner	Sucoflex 104A	44610/4A	E4619	16-Oct-14
61	Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack2	E4623	15-Oct-14
62	Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack3	E4624	15-Oct-14
63	Coax Cable	3m Blue	Suhner	Sucoflex 104A	44611/4A	E4620	16-Oct-14
91	Signal Generator	Digital 4GHz	Agilent	E4433B	US38440446	E4147	18-Oct-14
94	Environ. Chamber	Upright	Contherm	5400 RHSLT.M	1416	E4051	2-Aug-15
95	Environ. Chamber	Upright	Contherm	5400 RHSLT.M	1416	E4051	5-Aug-14
96	Power Meter	TREVA1 Power Head for HP8901	Hewlett Packard	HP11722A	3111A05573	E7054	21-Oct-14
98	RF Attenuator	TREVA1 3dB	Weinschel	Model 1	BL9958	E4081	
100	RF Combiner	TREVA1	Minicircuits	ZFSC-4-1	-	E4083	
103	Spectrum Analyser	13.2GHz	Agilent	E4445A	MY42510072	E4139	21-Nov-14
107	Coax Cable	OATS Tower Cable	Intelcom	RG214	OATS1	E4621	13-Oct-14
108	Coax Cable	OATS Turntable Cable	Intelcom	RG215	OATS2	E4622	13-Oct-14
109	OATS	Antenna Tower	Electrometrics	EM-4720-2	112	E4447	
110	OATS	Controller	Electrometrics	EM-4700	119	E4445	
111	OATS	Turntable	Electrometrics	EM-4704A	105	E4446	
115	RF Attenuator	30dB 350W	Weinschel	67-30-33	BR0531	E4280	18-Oct-14
117	Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack5	E4850	15-Oct-14
118	Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack6	E4849	16-Oct-14
128	Antenna	Log Periodic	Schwarzbeck	VUSLP	9111-219	E4147	
134	Coax Cable	Reverb - 4.5m Multiflex 141	TeltestBlue6	MF 141	TeltestBlue6	E4843	16-Oct-14
135	Coax Cable	Reverb - 2m Multiflex 141	TeltestBlue5	MF 141	TeltestBlue5	E4844	16-Oct-14
136	Coax Cable	Reverb - 2m Multiflex 141	TeltestBlue4	MF 141	TeltestBlue4	E4845	15-Oct-14
137	Coax Cable	Reverb - 1m Multiflex 141	TeltestBlue3	MF 141	TeltestBlue3	E4846	17-Oct-14
138	Coax Cable	Reverb - 1m Multiflex 141	TeltestBlue2	MF 141	TeltestBlue2	E4847	17-Oct-14
139	Coax Cable	Reverb - 1m Multiflex 141	TeltestBlue1	MF 141	TeltestBlue1	E4848	17-Oct-14
143	Power Meter	Reverb - USB interface for NRT Z44	Rohde & Schwarz	NRT Z5	100586	E4852	
144	Power Meter	Reverb - 0.2 - 4GHz directional power meter	Rohde & Schwarz	NRT Z44	105151	E4853	17-Oct-14
145	RF Chamber	Reverb - Stirrer controller for reverb chamber	Teseq	Stirrer Controller	29765.1	E4854	
146	RF Chamber	Reverb - 0.5 - 18GHz Reverberation Chamber	Teseq	RVC XS	29765	E4855	
148	Antenna	Reverb - 1-18GHz DRG	Schwarzbeck	BBHA 9120 D	9120D-885	E4857	
149	Antenna	Reverb - 1-18GHz DRG	Schwarzbeck	BBHA 9120 D	9120D-884	E4858	
150	RF Amplifier	Pre-amplifier	Agilent	87405C	MY47010688	E4941	18-Oct-14

ANNEX A – TEST SETUP DETAILS



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