TELTEST Laboratories
Tait Ltd
Report Number 3732

LABORATORY TEST REPORT

RADIO PERFORMANCE MEASUREMENTS

for the

TPDHBB Handportable Transceiver

Tested in accordance with:

FCC 47 CFR Parts 22, 74 and 90

RSS-119 Issue 12
RSS-Gen Issue 4

Report Revision: 1

Issue Date: 13-April-2016

PREPARED BY: L. M. White _____
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.

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REVISION

Date	Revision	Comments
13-April-2016	1	Initial test report

INTRODUCTION

Type approval testing of the TPDHBB, 4 Watt, Handportable transceiver in order to demonstrate compliance with FCC 47 Parts 22, 74 & 90, and RSS-119 Issue 12 & RSS-Gen Issue 4. This radio supports analogue, digital FFSK, Digital Mobile Radio (DMR), APCO P25 phase-1 and APCO P25 phase-2 modulations.

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

DESCRIPTION OF SAMPLE

Manufacturer	Tait Limited
Equipment:	Handportable Transceiver
Type:	TPDHBB
Product Code:	T03-22112-GBDA (USA labelling) T03-22512-GBDA (Canada labelling)
Serial Number(s):	25755841
Frequency range	380 → 470 MHz
Transmit Power	4 W

The unit tested was a pre-production unit and was missing a part of the conformal coating that would normally cover the whole board for safety purposes. This was judged to be in an area that was unlikely to affect the rf performance of the radio.

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

HARDWARE & SOFTWARE
Quantity: 1

	Analogue, FFSK and P25 tests	DMR tests
Hardware ID	TPDB1X-HB02_0006	TPDB1X-HB02_0006
Boot Code	QPD1B_S00_3.01.03.0001	QPD1B_S00_3.01.03.0001
DSP	QPD1A_A02_2.06.00.0011	QPD1A_E00_2.08.00.0073
Radio Application	QPD1F_A00_2.06.00.0011	QPD1F_E00_2.08.00.0073
FPGA Image	QPD1G_S00_1.09.00.0003	QPD1G_S00_1.09.00.0003

TEST CONDITIONS
All testing was performed between 8 → 12 April 2016, and under the following conditions:
Ambient temperature: $15^{o}C$ → $30^{o}C$
Relative Humidity: 20% → 75%
Standard Test Voltage 7.5 V_{DC}

STATEMENT OF COMPLIANCE

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

Equipment:	Handportable Transceiver
Type:	TPDHBB
Product Code:	T03-22112-GBDA (USA labelling) T03-22512-GBDA (Canada labelling)
Serial Number(s):	25755841
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 12 & RSS-Gen Issue 4

Signature: _____

M. C. James
Laboratory Technical Manager

Date: _____

MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS

MODULATION TYPES:

F3E	Analogue Frequency Modulation (FM)	
F2D	FFSK	1200 bps and 2400 bps
FXW	DMR Digital Voice	9600 bps
FXD	DMR Digital Data	9600 bps
F1E, F7E	P25 phase 1 Digital Voice	9600 bps
F1D, F7D	P25 phase 1 Digital Data	9600 bps
F1W	P25 phase 2 Digital Voice / Data	12000 bps

CHANNEL SPACING: 12.5 kHz

EMISSION DESIGNATORS:

	12.5 kHz
Analog FM	11K0F3E
FFSK Data 1200 bps	6K60F2D
FFSK Data 2400 bps	7K80F2D
Digital Voice DMR	7K60FXW
Digital Data DMR	7K60FXD
Digital Voice P25 phase 1	8K10F1E
Digital Data P25 phase 1	8K10F1D
Digital Voice P25 phase 2	8K10F1W
Digital Data P25 phase 2	8K10F1W

CALCULATIONS

Equation: Bn = 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
Bn = (2x3.0) + (2x2.5) x 1
= 11.0 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)
Bn = (2 x 1.8) + (2 x 1.5) x 1
= 6.6 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)
Bn = (2 x 2.4) + (2 x 1.5) x 1
= 7.8 kHz

Emission Designator
7K80F2D
F2D represents a FM data transmission with the use of a modulating sub carrier

Emission Designators – Continued

Digital Voice 12.5 kHz Bandwidth DMR

99% bandwidth	Emission Designator
= 7.6 kHz	**7K60FXW**

FXW represents a FM Time Division Multiple Access (TDMA) combination of data and telephony

Digital Data 12.5 kHz Bandwidth DMR

99% bandwidth	Emission Designator
= 7.6 kHz	**7K60FXD**

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

Digital Voice 12.5 kHz Bandwidth P25 phase 1

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

Digital Data 12.5 kHz Bandwidth P25 phase 1

99% bandwidth	Emission Designator
= 8.1 kHz	**8K10F1D**
	F1D represents an digital FM data transmission

Digital Voice 12.5 kHz Bandwidth P25 phase 2

99% bandwidth	Emission Designator
= 8.1 kHz	**8K10F1W**
	F1W represents a single FM telephony channel

Digital Data 12.5 kHz Bandwidth P25 phase 2

99% bandwidth	Emission Designator
= 8.1 kHz	**8K10F1W**
	F1W represents digital FM data transmission

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: 4 W and 1 W

Nominal 4 W	Measured	Variation (%)	Variation (dB)
406.2 MHz	3.6	-10.2	-0.5
418.1 MHz	3.6	-10.1	-0.5
429.9 MHz	3.5	-13.0	-0.6
450.1 MHz	3.6	-10.6	-0.5
459.9 MHz	3.5	-13.4	-0.6
469.9 MHz	3.4	-15.1	-0.7
Measurement Uncertainty		± 0.6 dB	

Transmitter Output Power (Conducted) - continued

Nominal 1 W	Measured	Variation (%)	Variation (dB)
406.2 MHz	0.8	-15.5	-0.7
418.1 MHz	0.9	-13.5	-0.6
429.9 MHz	0.8	-19.7	-1.0
450.1 MHz	0.8	-16.7	-0.8
459.9 MHz	0.8	-18.0	-0.9
469.9 MHz	0.8	-19.3	-0.9
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 1000 Hz was applied with the level set to obtain 20% of maximum deviation. This was used as the 0 dB reference point.
3. The AF was varied while the audio level was held constant.
4. The response in dB relative to 1000 Hz was measured.

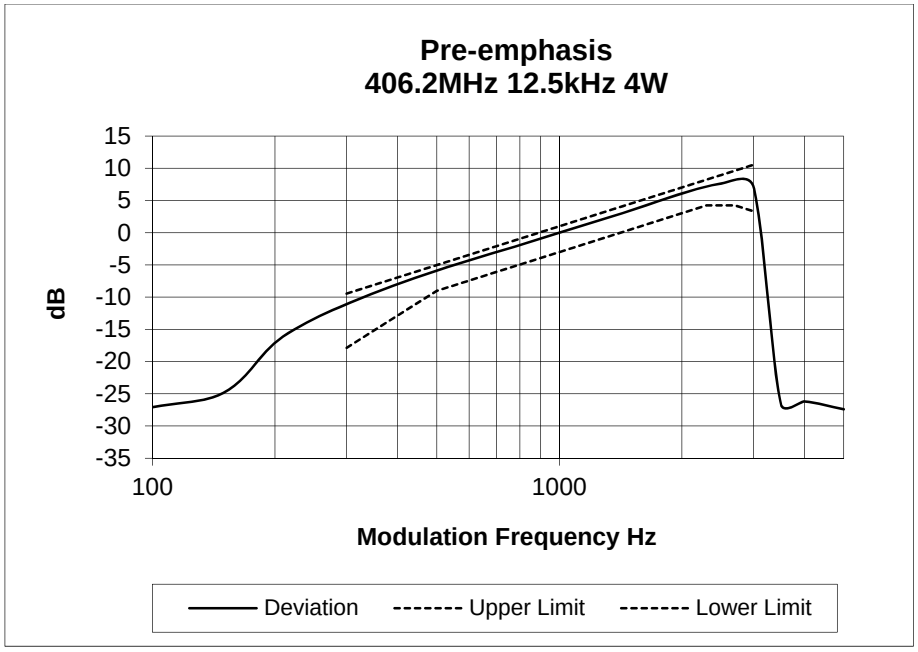
MEASUREMENT RESULTS:
See the plots on the following pages for 12.5 kHz channel spacing tested at 4 W transmit power.

Transmitter Audio Frequency Response – Pre-emphasis

LIMIT CLAUSE: TIA/EIA-603D 3.2.6

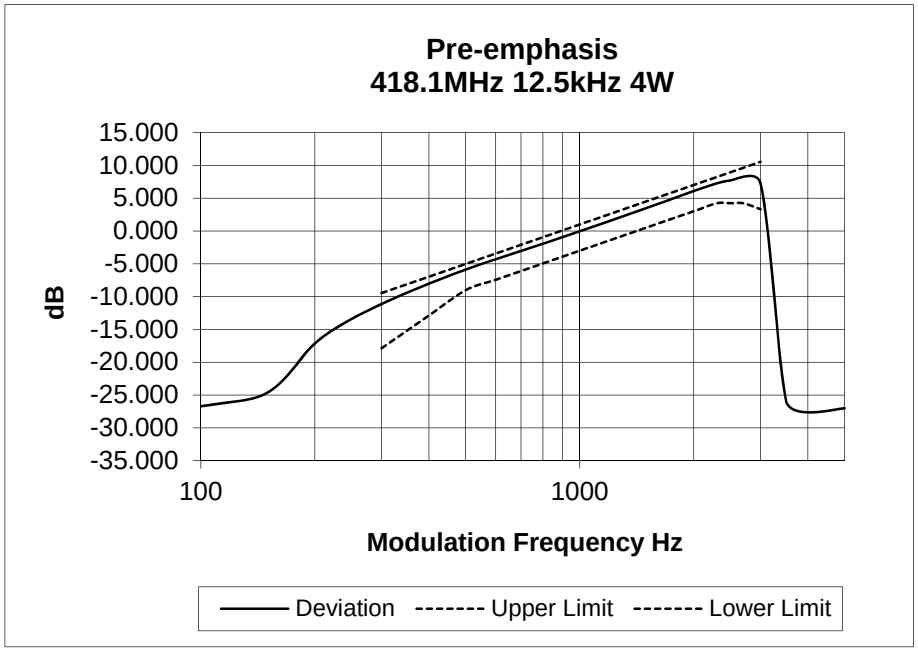
SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 406.2 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

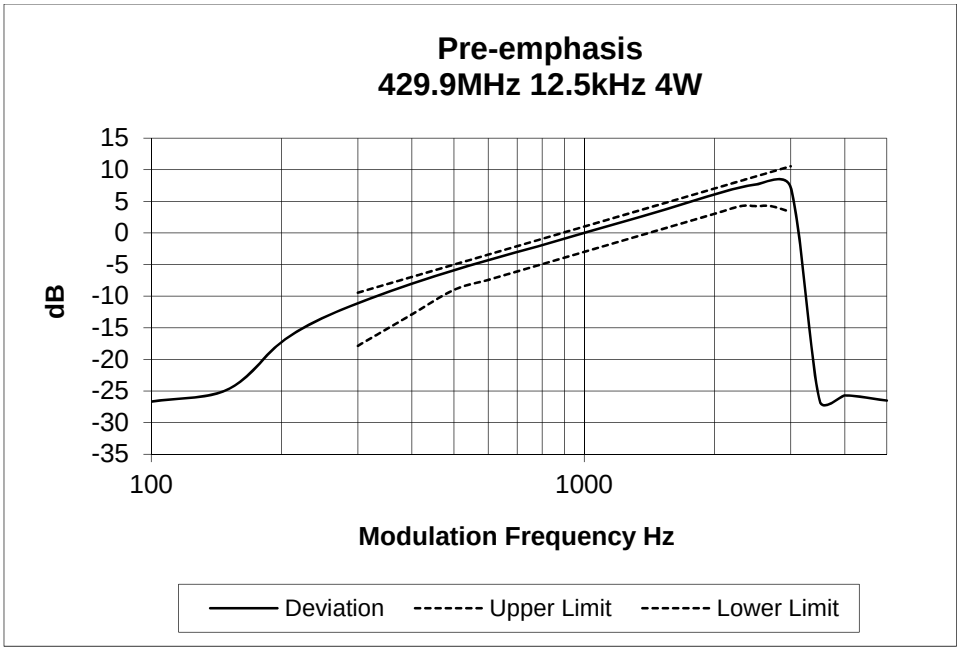
Tx FREQUENCY: 418.1 MHz 12.5 kHz Channel Spacing



Transmitter Audio Frequency Response – Pre-emphasis

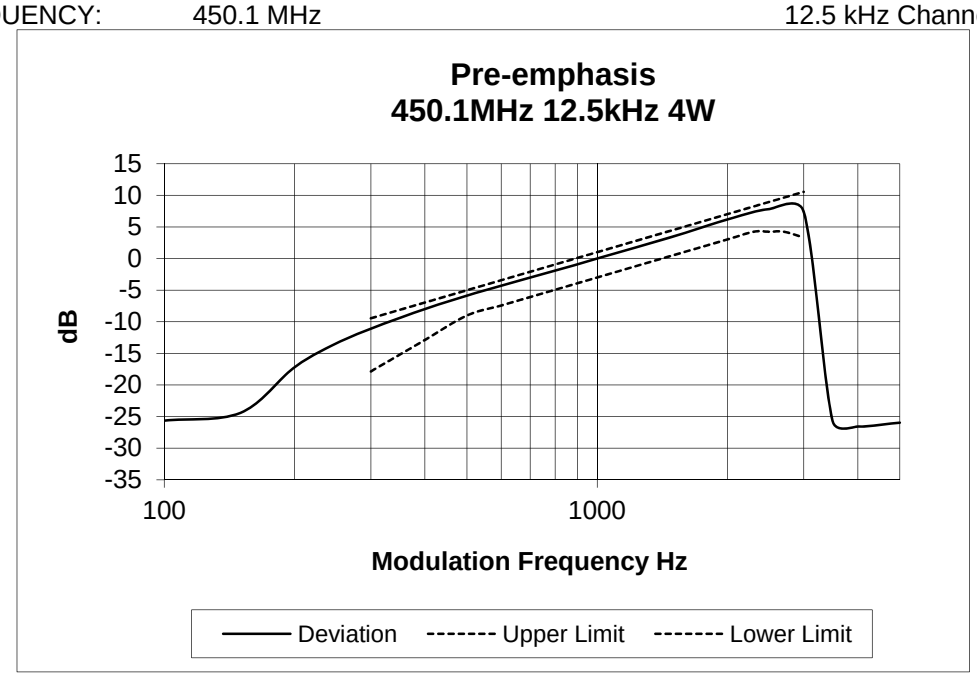
SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 429.9 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

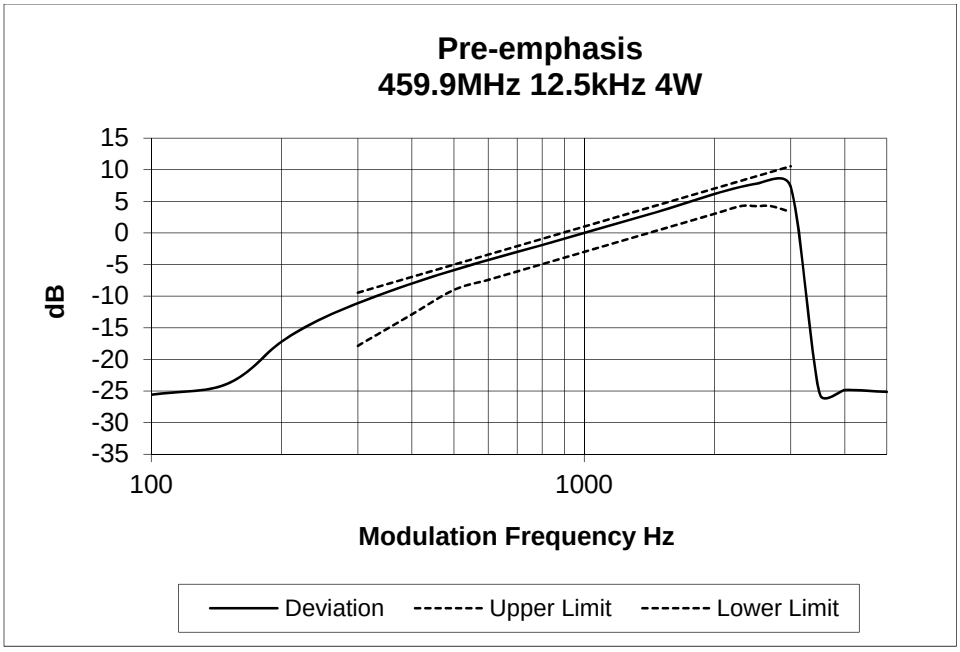
Tx FREQUENCY: 450.1 MHz 12.5 kHz Channel Spacing



Transmitter Audio Frequency Response – Pre-emphasis

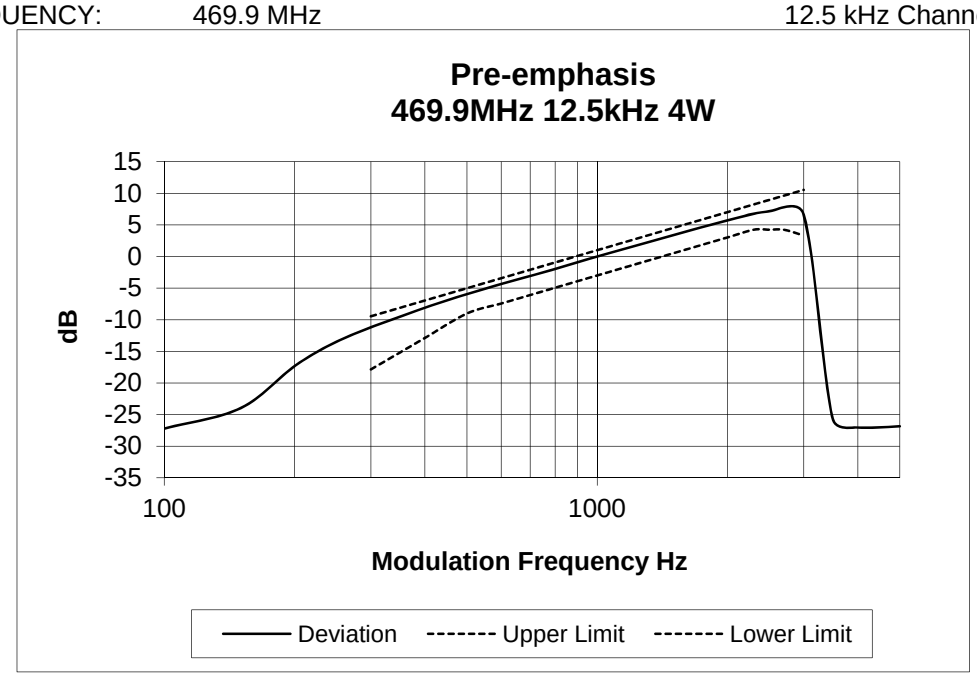
SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 459.9 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 469.9 MHz 12.5 kHz Channel Spacing



TRANSMITTER MODULATION LIMITING

SPECIFICATION: FCC 47 CFR 2.1047 (b)

GUIDE: TIA/EIA-603D 2.2.3

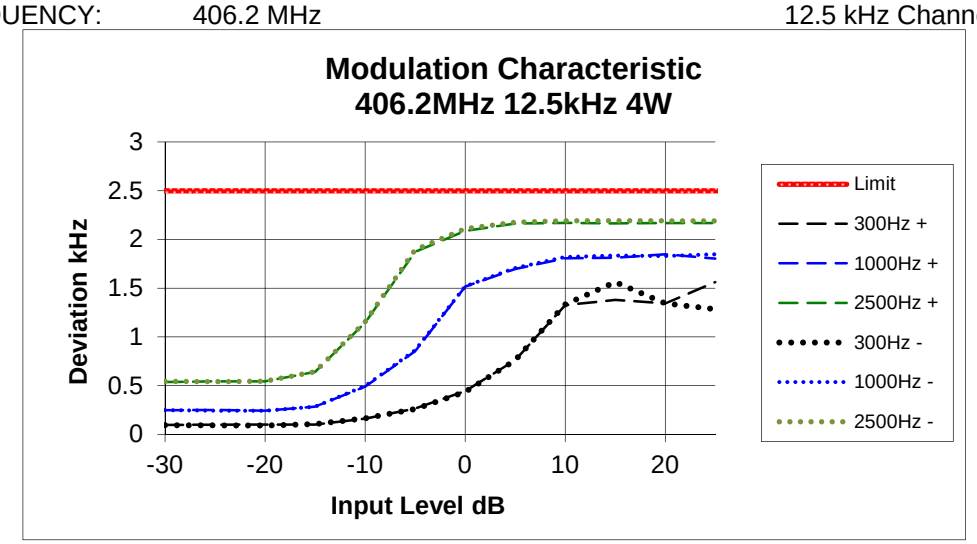
MEASUREMENT PROCEDURE:
1. Refer Annex A for Equipment set up.
2. The modulation response was measured at three audio frequencies while varying the input level.
3. Measurements were made for both Positive and Negative Deviation.

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

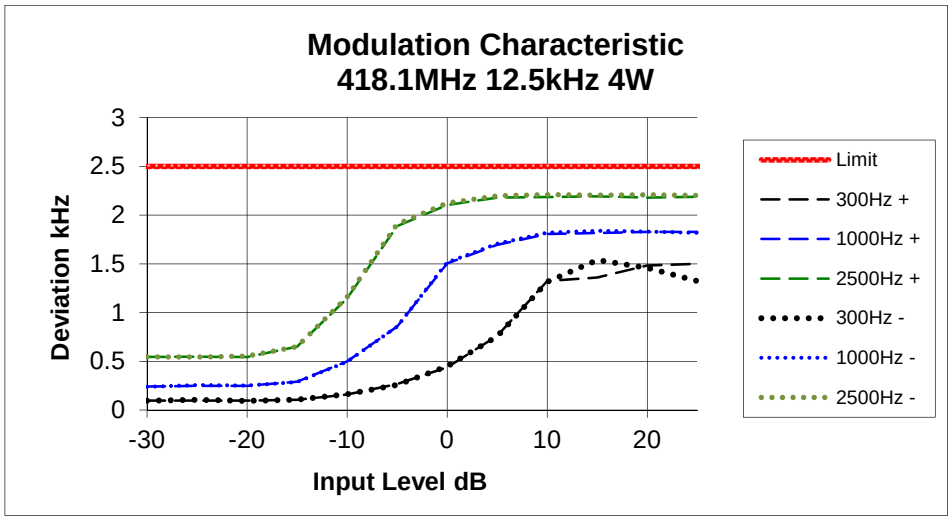
Transmitter Modulation Limiting

LIMIT CLAUSE: TIA/EIA-603D 1.3.4.4
SPECIFICATION: FCC CFR 2.1047 (b)

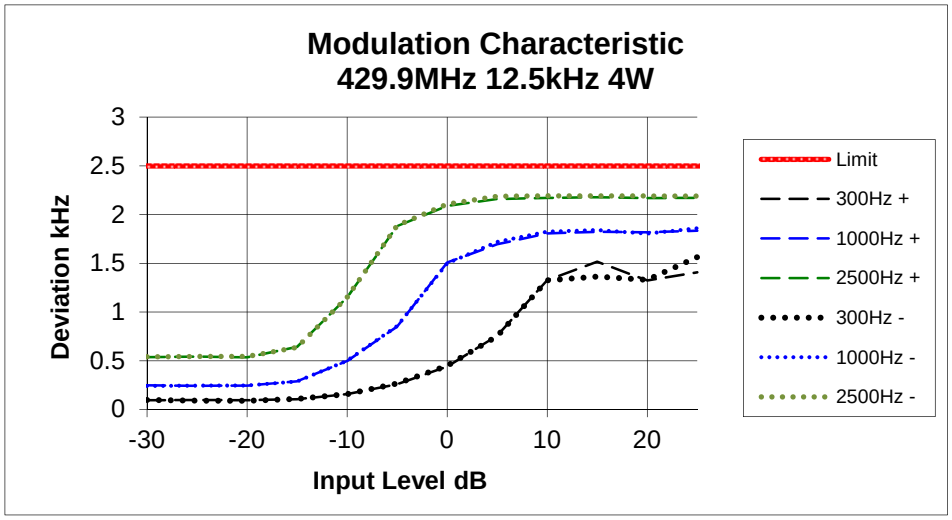
Tx FREQUENCY: 406.2 MHz 12.5 kHz Channel Spacing



Tx FREQUENCY: 418.1 MHz 12.5 kHz Channel Spacing

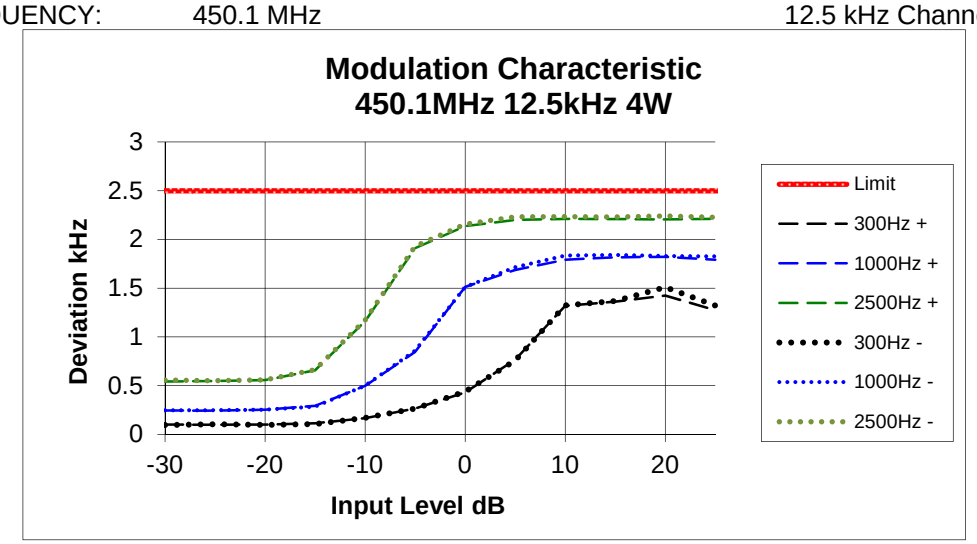


Tx FREQUENCY: 429.9 MHz 12.5 kHz Channel Spacing

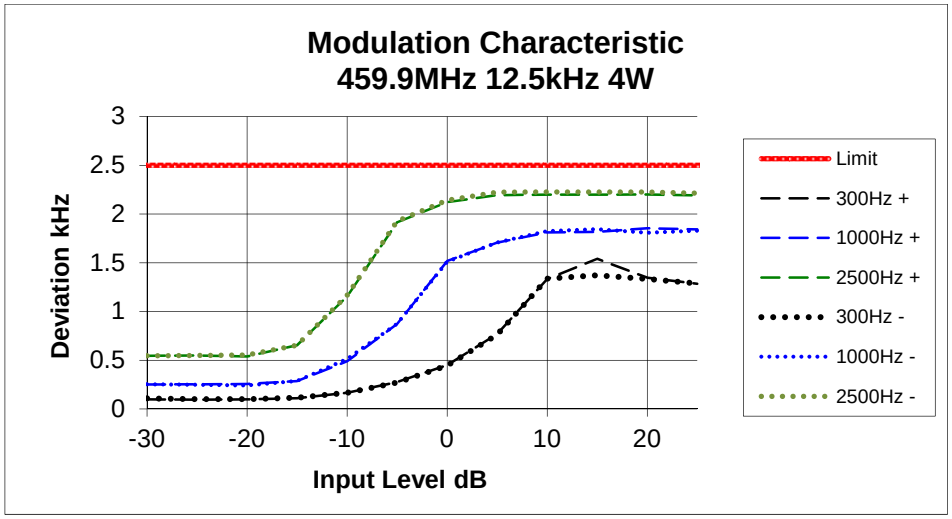


Transmitter Modulation Limiting

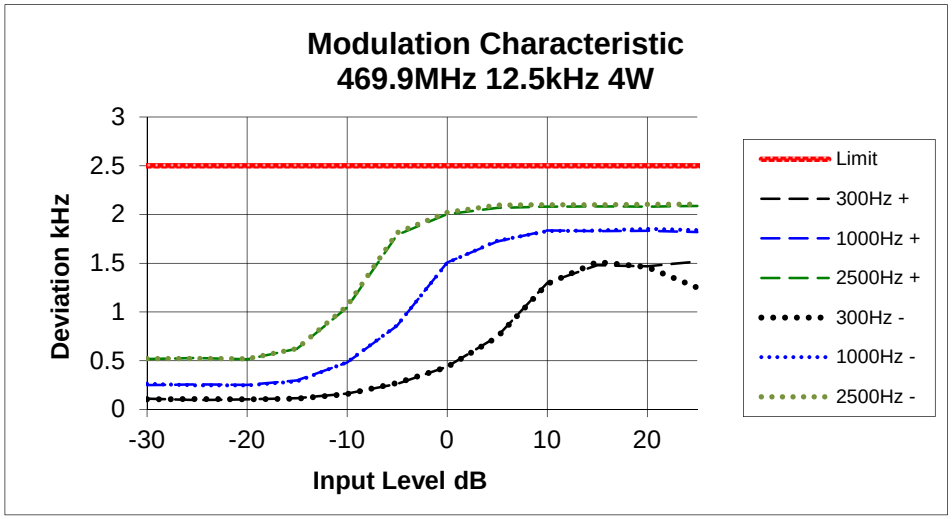
Tx FREQUENCY: 450.1 MHz 12.5 kHz Channel Spacing



Tx FREQUENCY: 459.9 MHz 12.5 kHz Channel Spacing



Tx FREQUENCY: 469.9 MHz 12.5 kHz Channel Spacing



TRANSMITTER OCCUPIED BANDWIDTH AND SPECTRUM MASKS

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

GUIDE: TIA/EIA-603D 2.2.11 (Analog)
TIA-102.CAAA-C 2.2.5 (Digital)

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 16 dB 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.

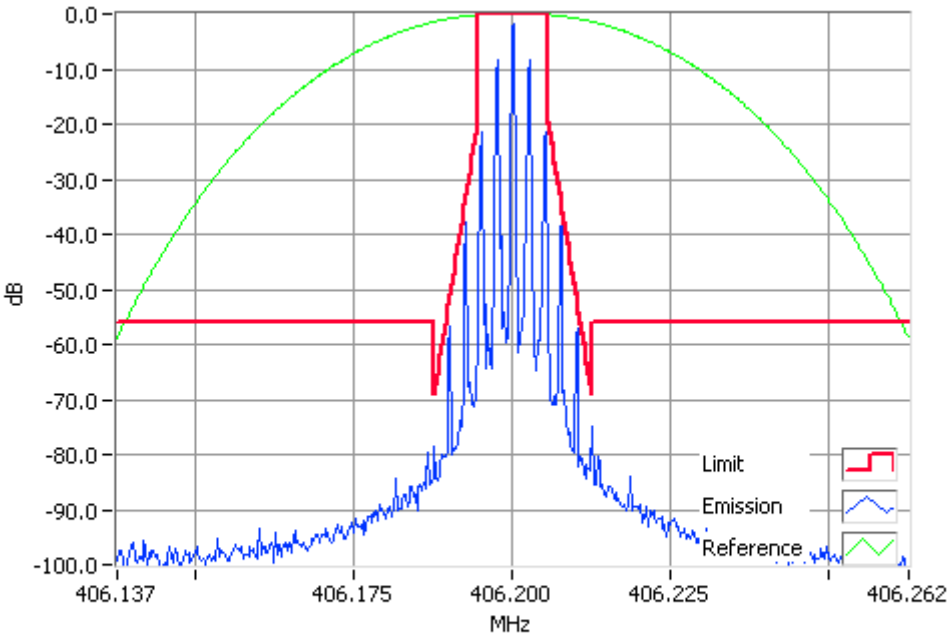
LIMIT CLAUSE:	FCC 47 CFR 90.210	RSS-119 5.5
EMISSION MASKS		
Emission Mask D	12.5 kHz Channel Spacing	Analog, FFSK, Digital Voice/data
DATA SPEED		
Digital Voice/Data	12.5 kHz Channel Spacing	9600 bps & 12000 bps
FFSK	12.5 kHz Channel Spacing	1200 bps & 2400 bps

Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

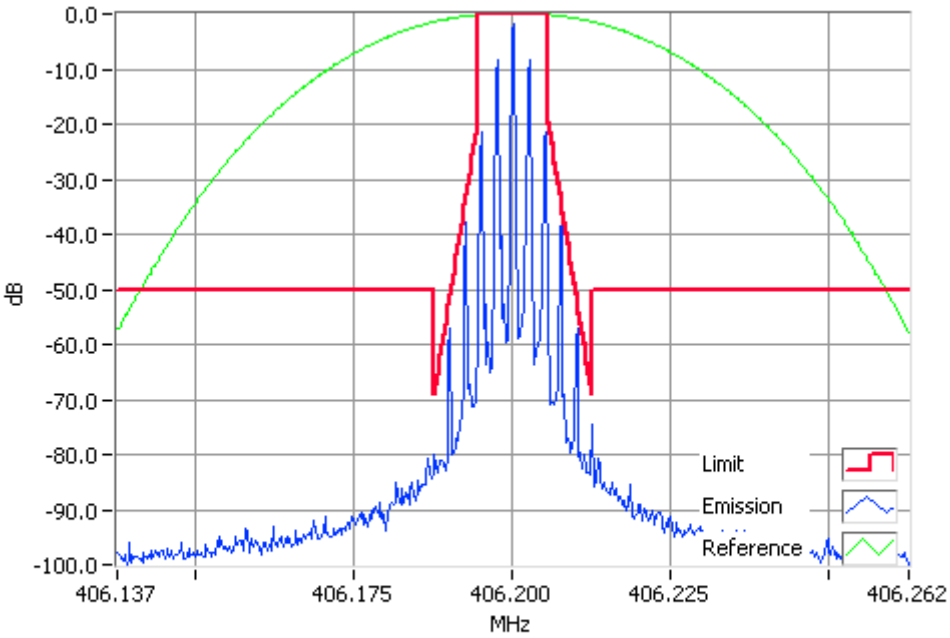
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 406.2 MHz 4 W 12.5 kHz Channel Spacing



Analogue Modulation 406.2000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 406.2 MHz 1 W 12.5 kHz Channel Spacing



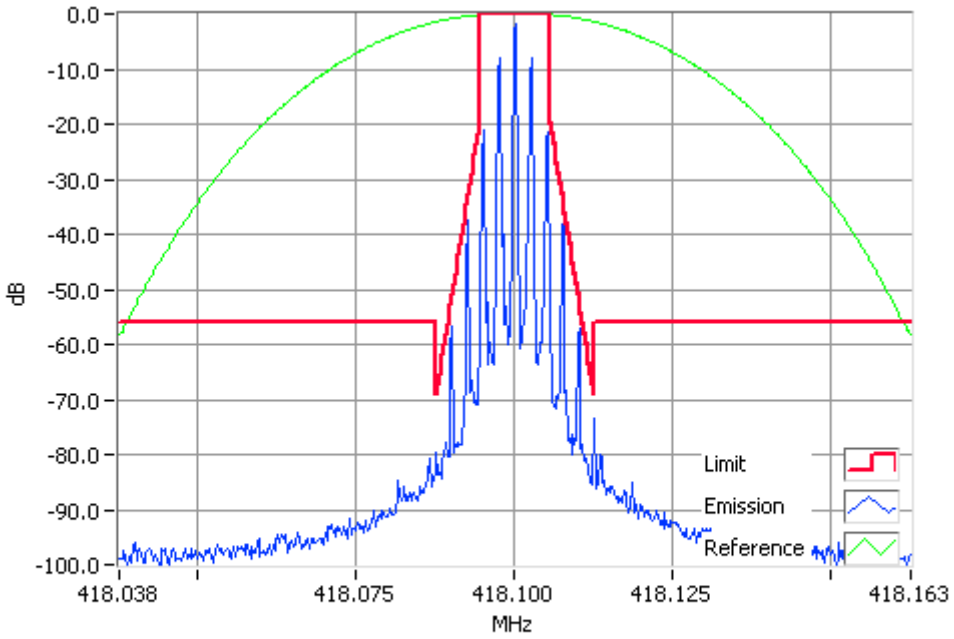
Analogue Modulation 406.2000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

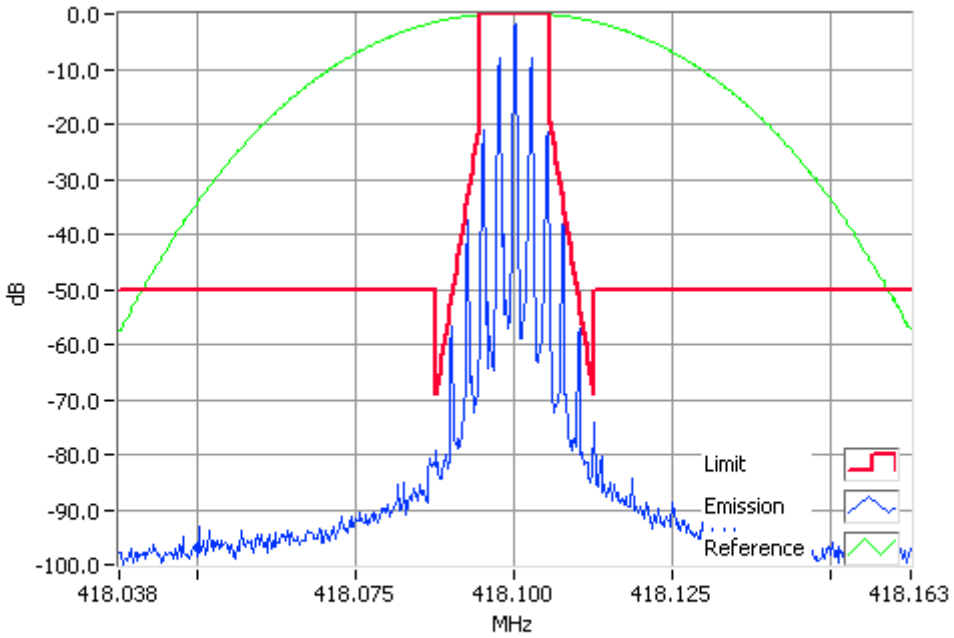
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 418.1 MHz 4 W 12.5 kHz Channel Spacing



Analogue Modulation 418.1000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 418.1 MHz 1 W 12.5 kHz Channel Spacing



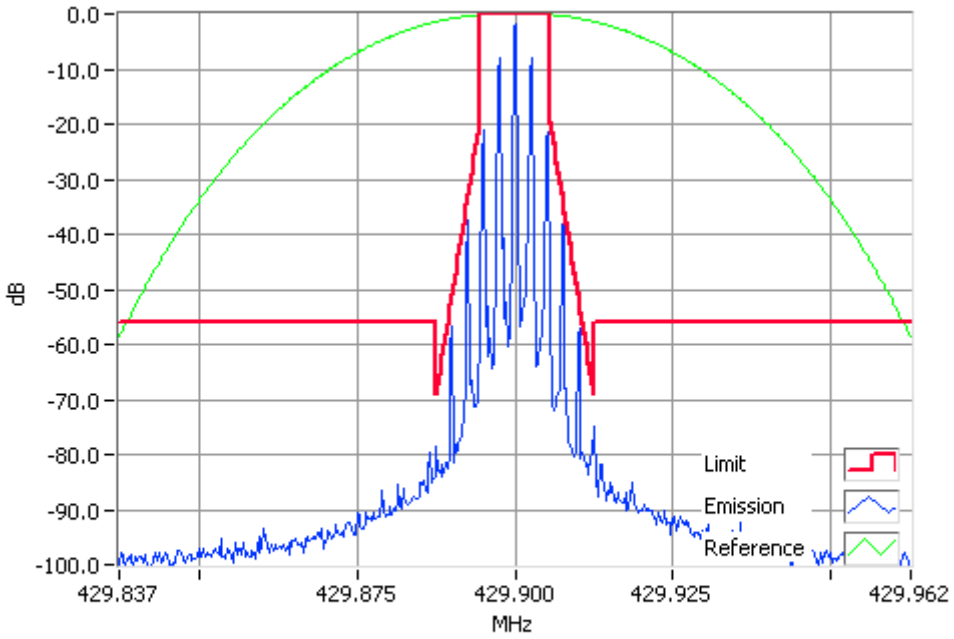
Analogue Modulation 418.1000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

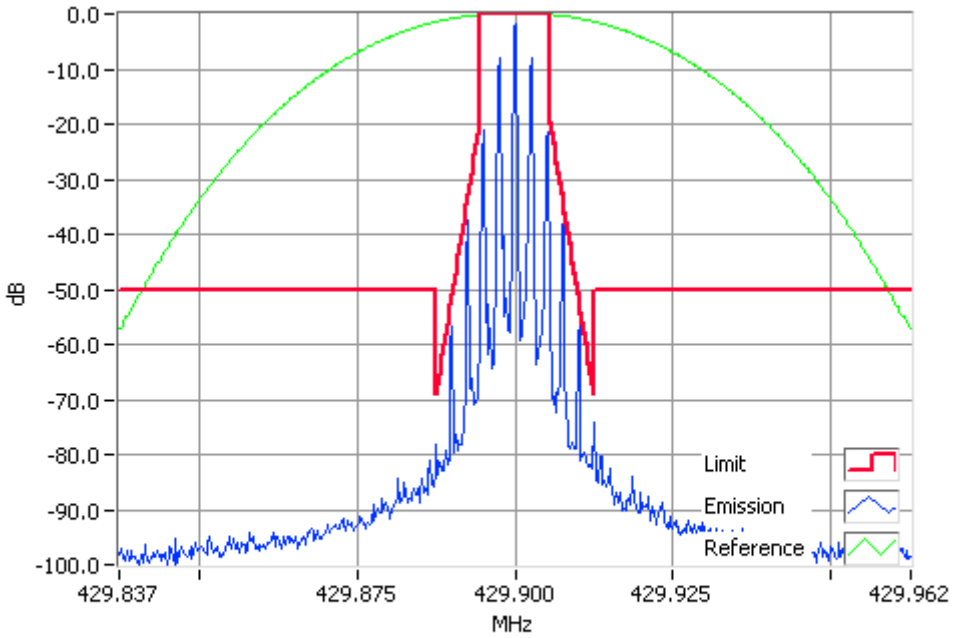
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 429.9 MHz 4 W 12.5 kHz Channel Spacing



Analogue Modulation 429.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 429.9 MHz 1 W 12.5 kHz Channel Spacing



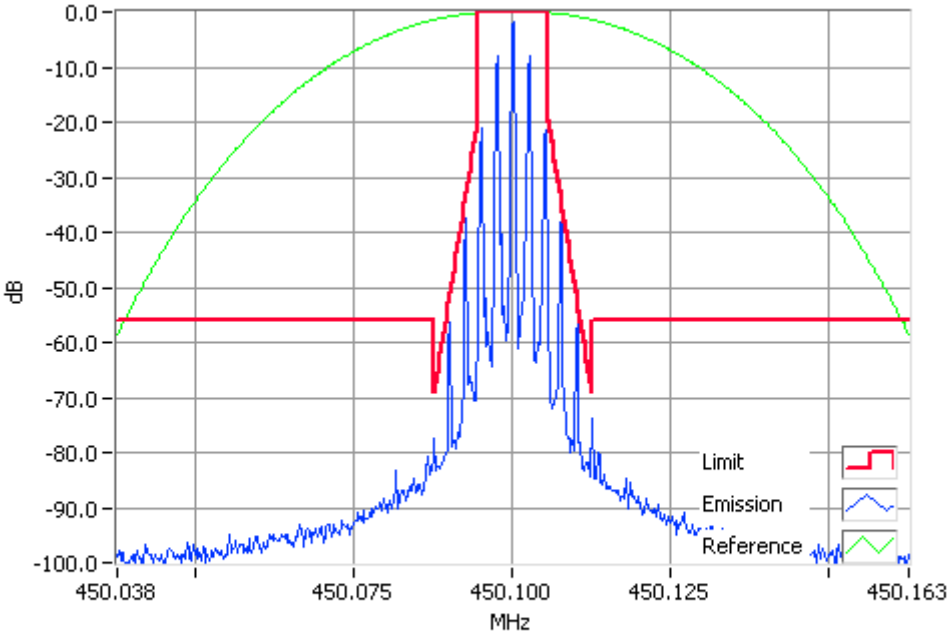
Analogue Modulation 429.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

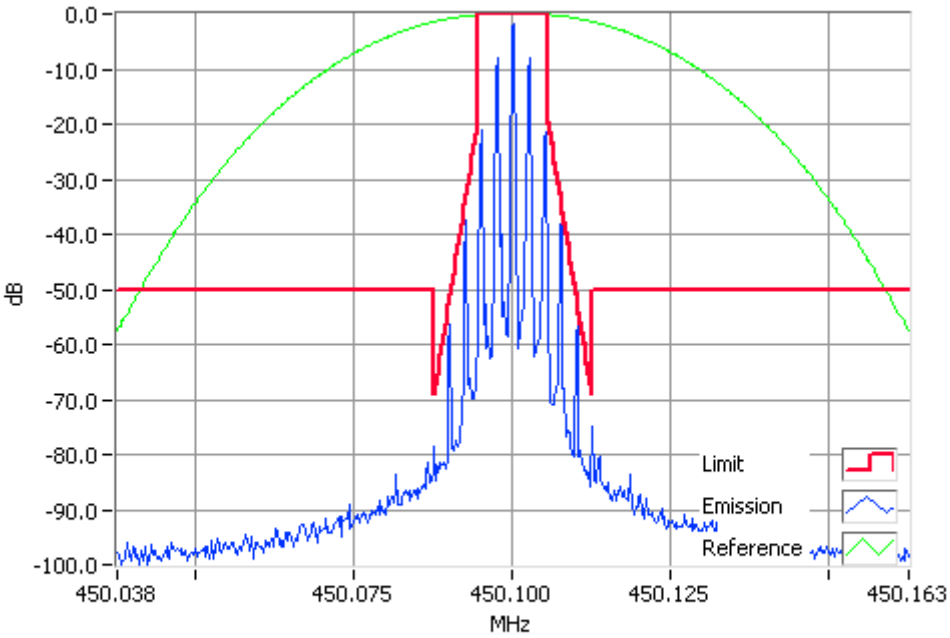
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 450.1 MHz 4 W 12.5 kHz Channel Spacing



Analogue Modulation 450.1000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 450.1 MHz 1 W 12.5 kHz Channel Spacing



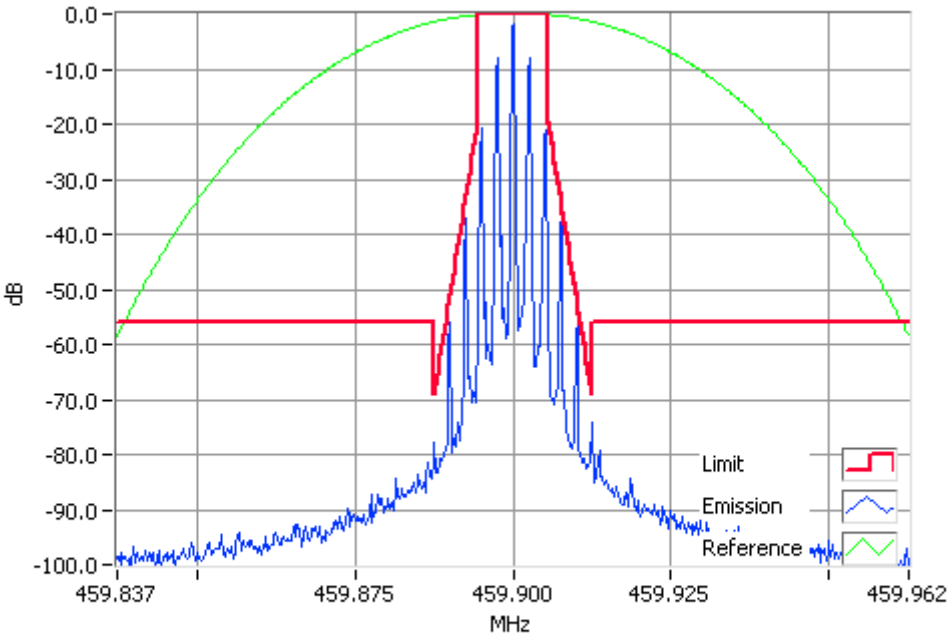
Analogue Modulation 450.1000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

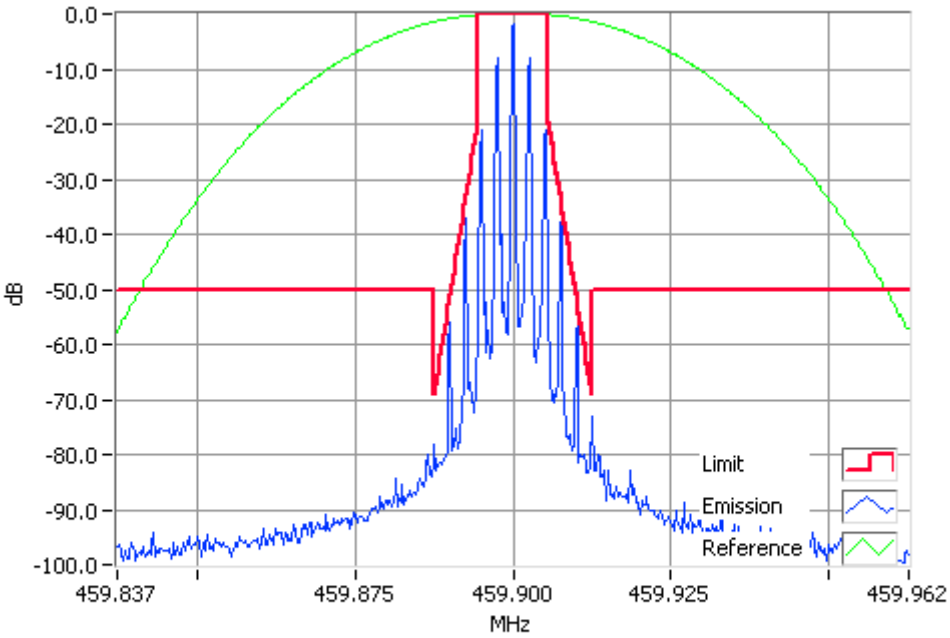
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 459.9 MHz 4 W 12.5 kHz Channel Spacing



Analogue Modulation 459.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 459.9 MHz 1 W 12.5 kHz Channel Spacing



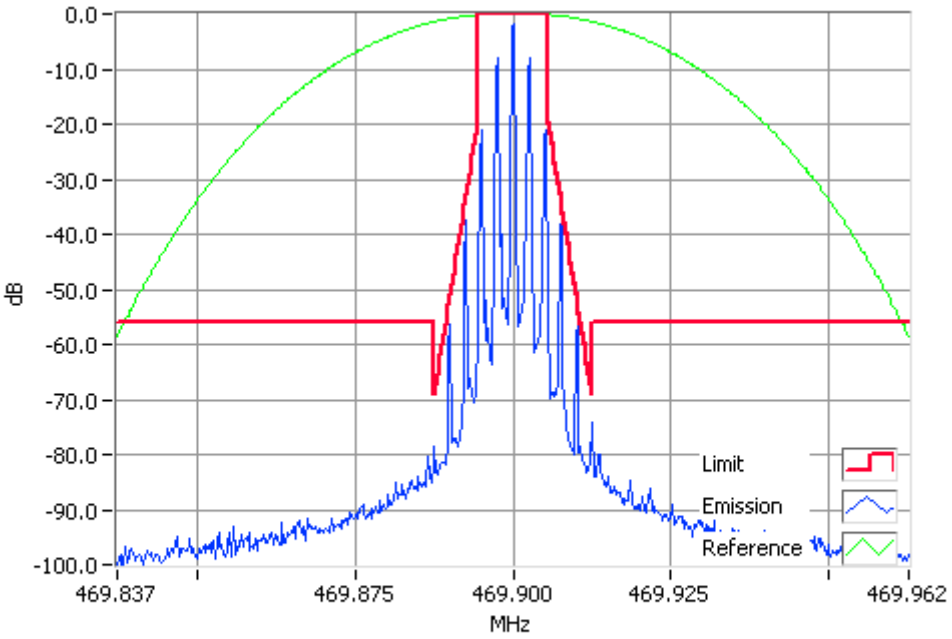
Analogue Modulation 459.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

ANALOG VOICE

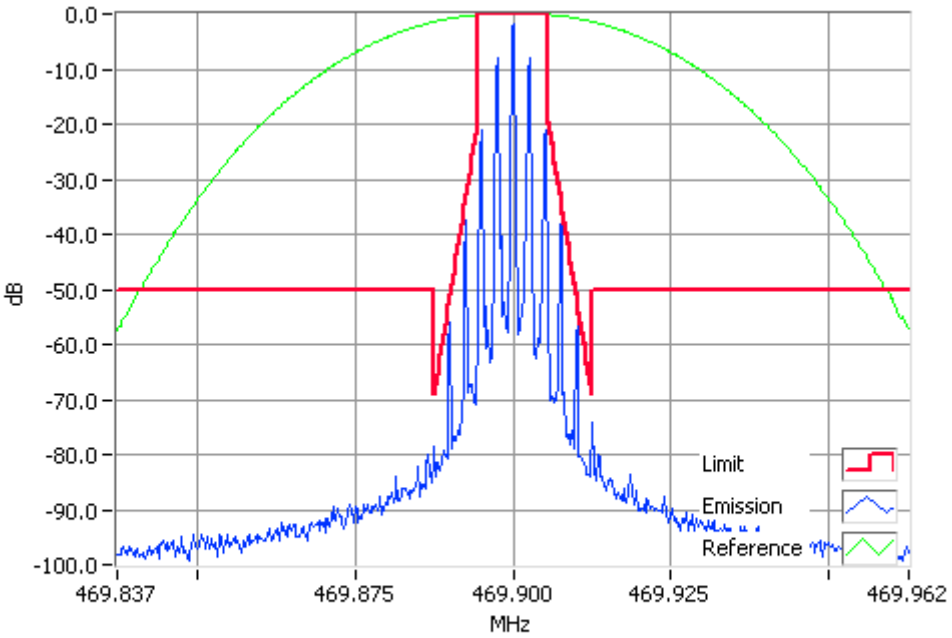
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 469.9 MHz 4 W 12.5 kHz Channel Spacing



Analogue Modulation 469.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 469.9 MHz 1 W 12.5 kHz Channel Spacing



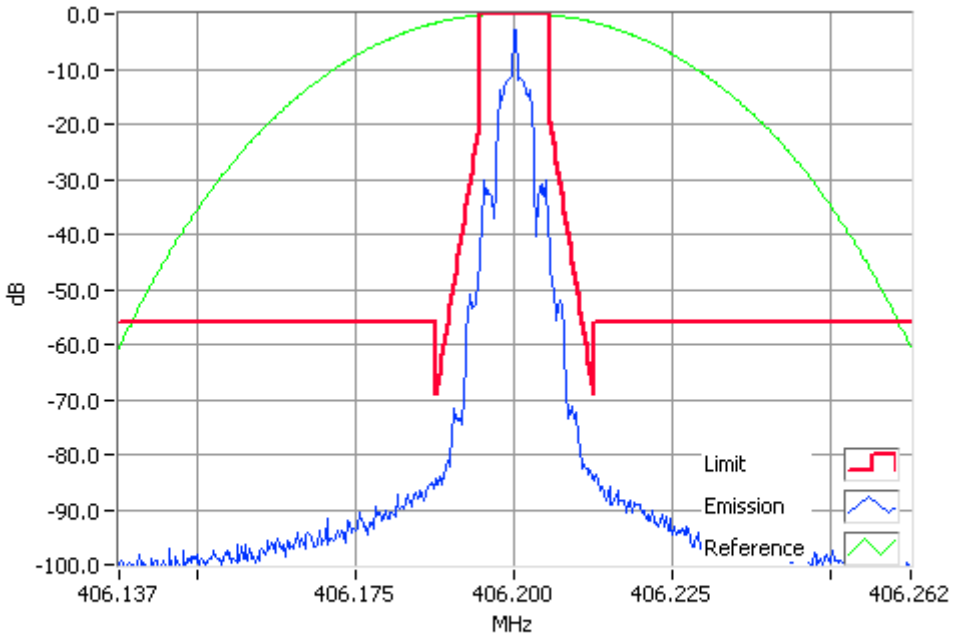
Analogue Modulation 469.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 1200 bps

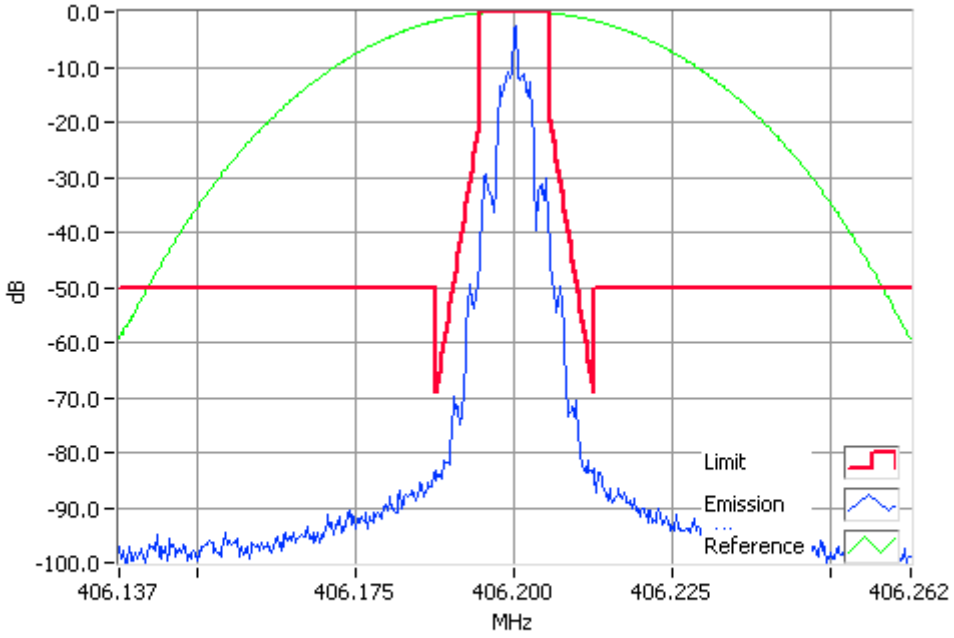
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 406.2 MHz 4 W 12.5 kHz Channel Spacing



FFSK1200 406.2000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 406.2 MHz 1 W 12.5 kHz Channel Spacing



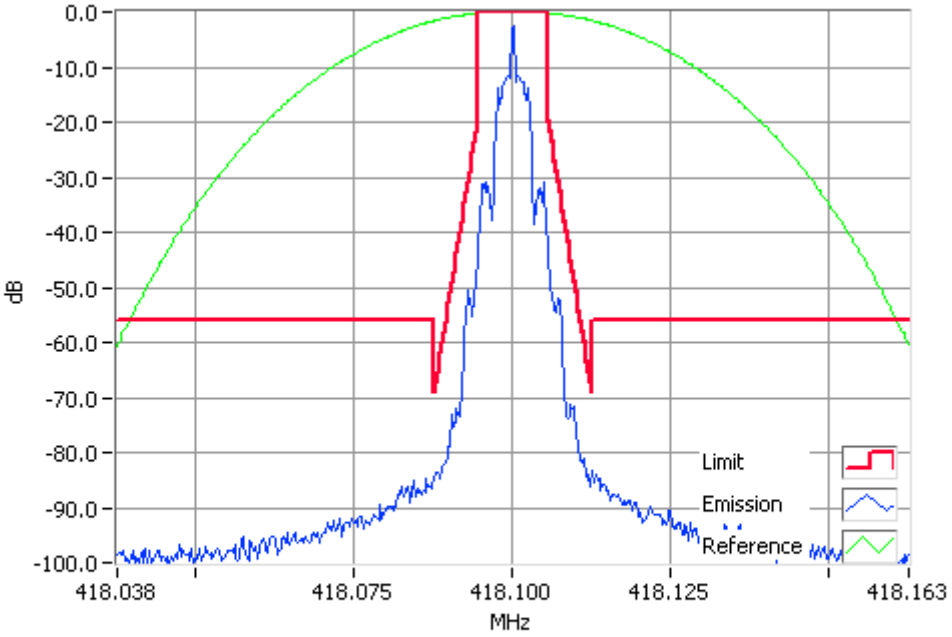
FFSK1200 406.2000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 1200 bps

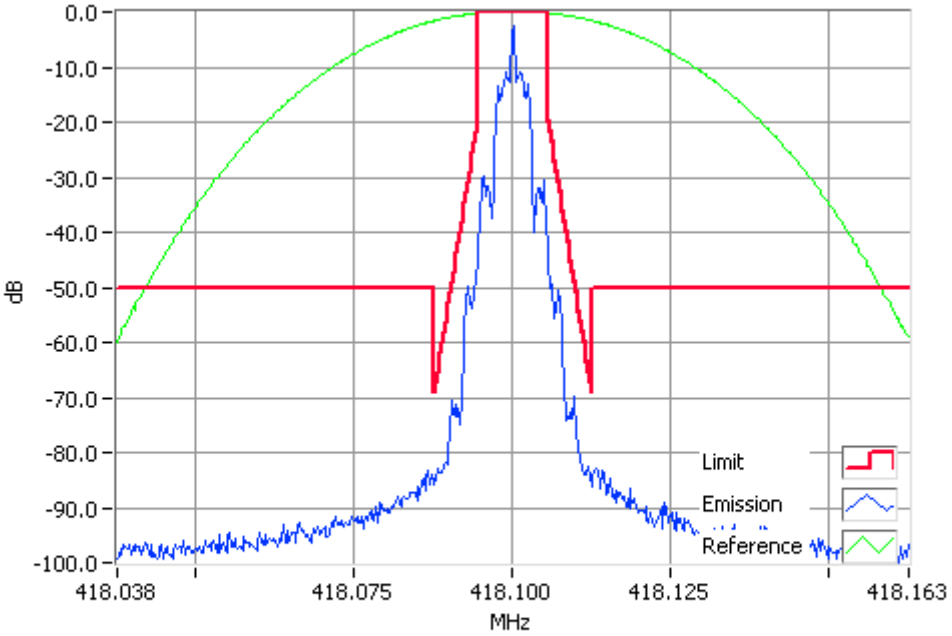
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 418.1 MHz 4 W 12.5 kHz Channel Spacing



FFSK1200 418.1000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 418.1 MHz 1 W 12.5 kHz Channel Spacing



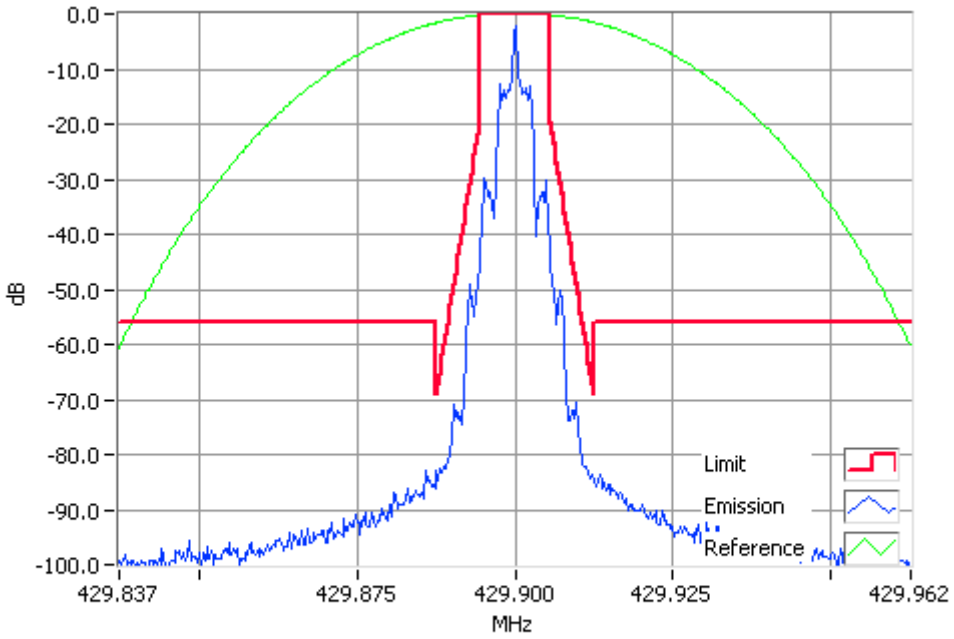
FFSK1200 418.1000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 1200 bps

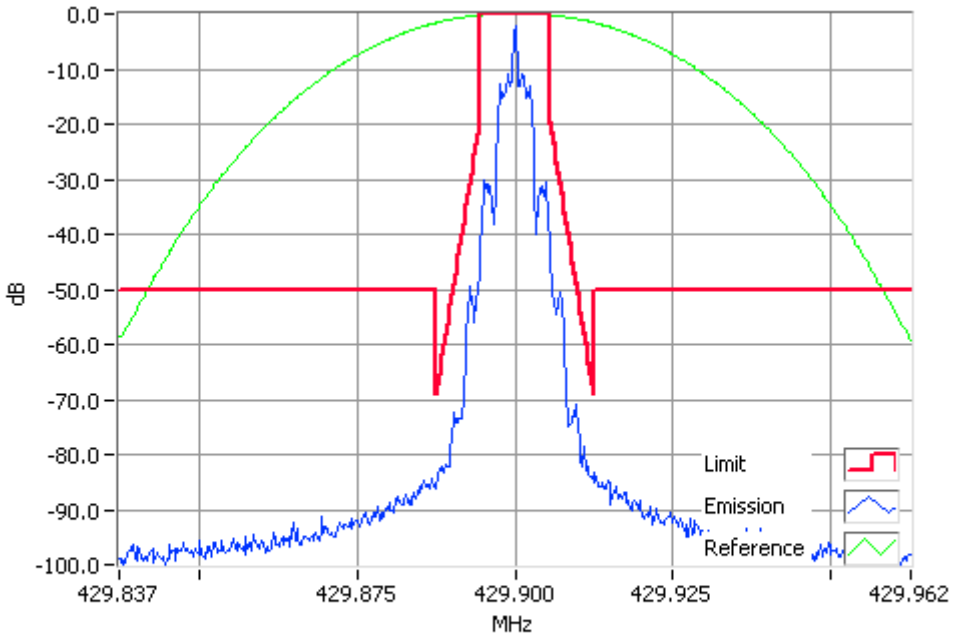
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 429.9 MHz 4 W 12.5 kHz Channel Spacing



FFSK1200 429.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 429.9 MHz 1 W 12.5 kHz Channel Spacing



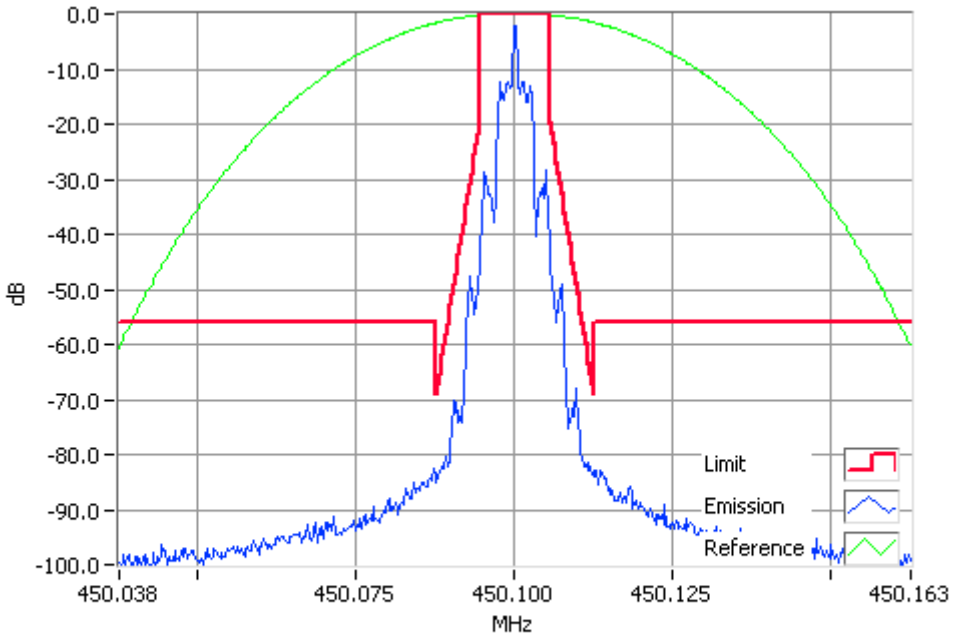
FFSK1200 429.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 1200 bps

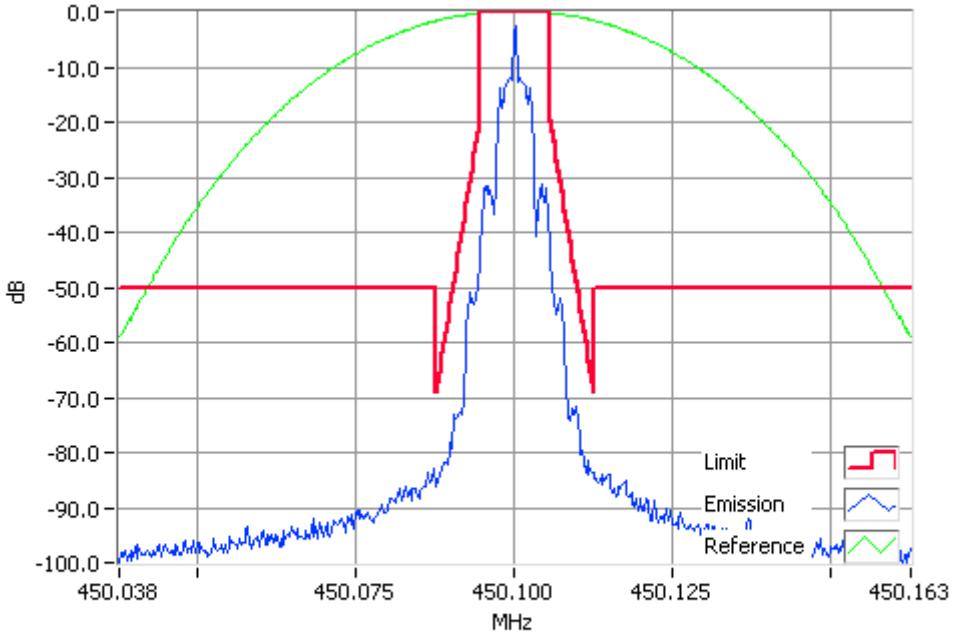
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 450.1 MHz 4 W 12.5 kHz Channel Spacing



FFSK1200 450.1000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 450.1 MHz 1 W 12.5 kHz Channel Spacing



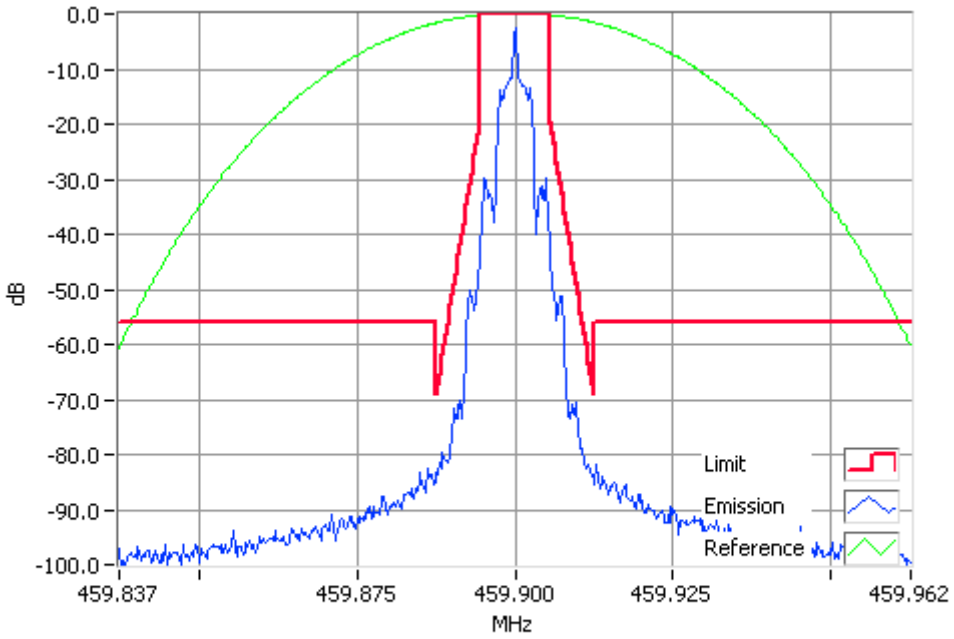
FFSK1200 450.1000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 1200 bps

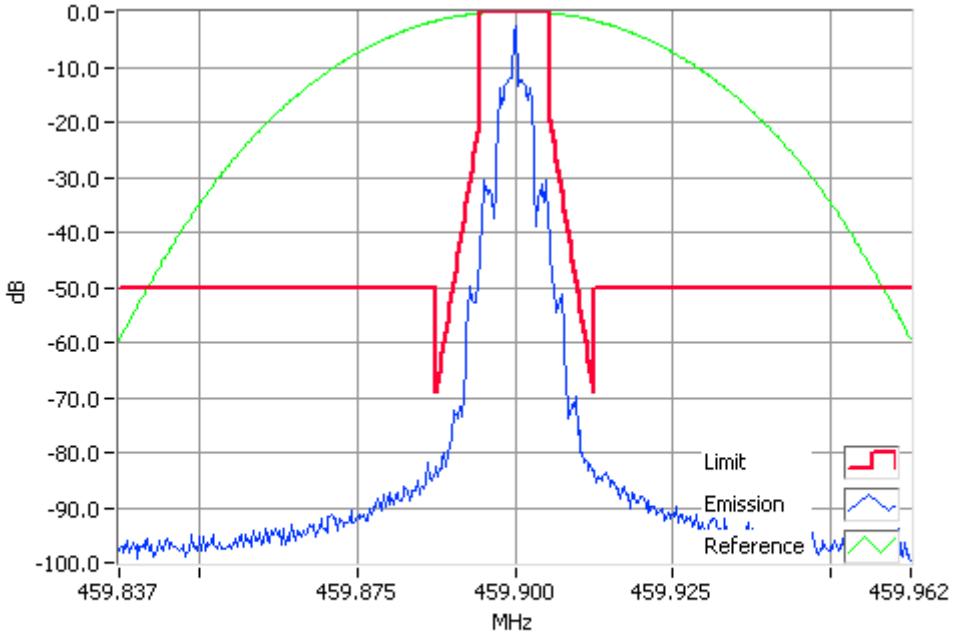
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 459.9 MHz 4 W 12.5 kHz Channel Spacing



FFSK1200 459.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 459.9 MHz 1 W 12.5 kHz Channel Spacing



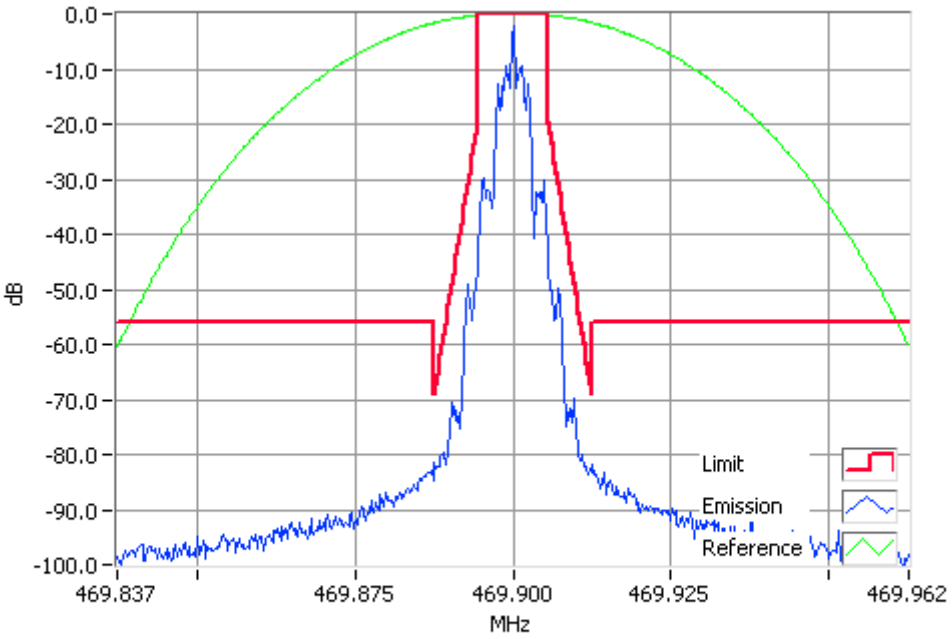
FFSK1200 459.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 1200 bps

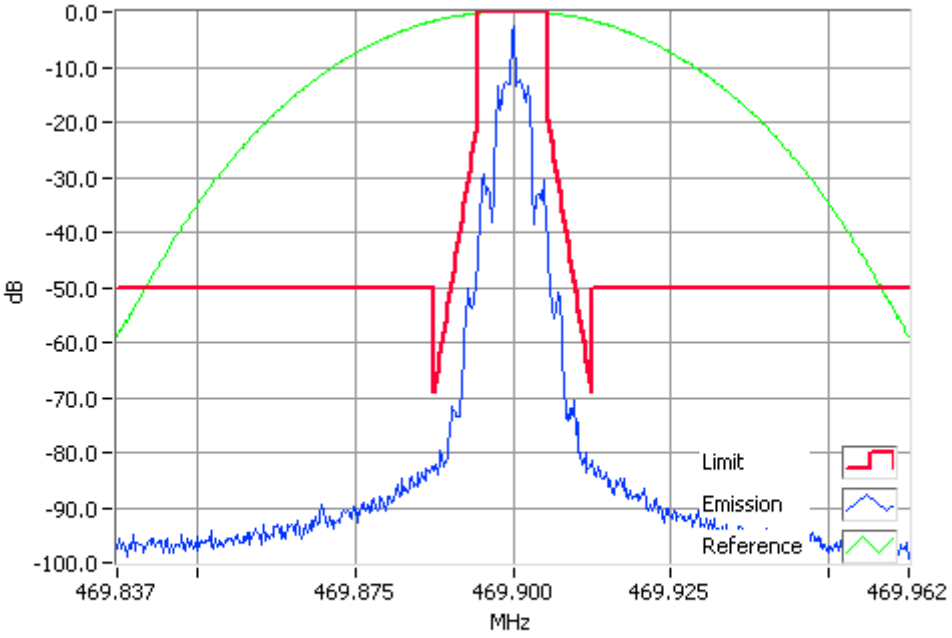
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 469.9 MHz 4 W 12.5 kHz Channel Spacing



FFSK1200 469.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 469.9 MHz 1 W 12.5 kHz Channel Spacing



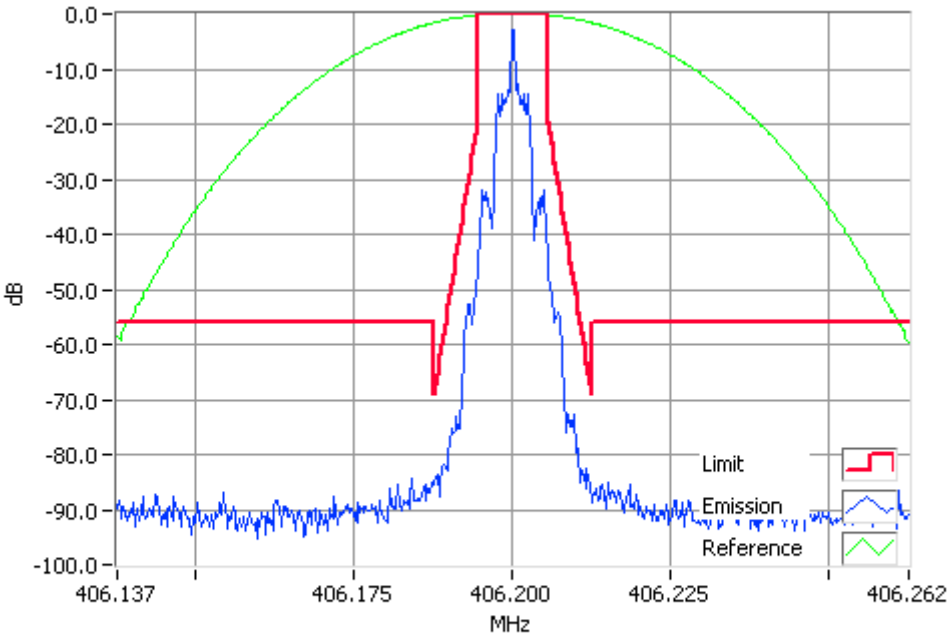
FFSK1200 469.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 2400 bps

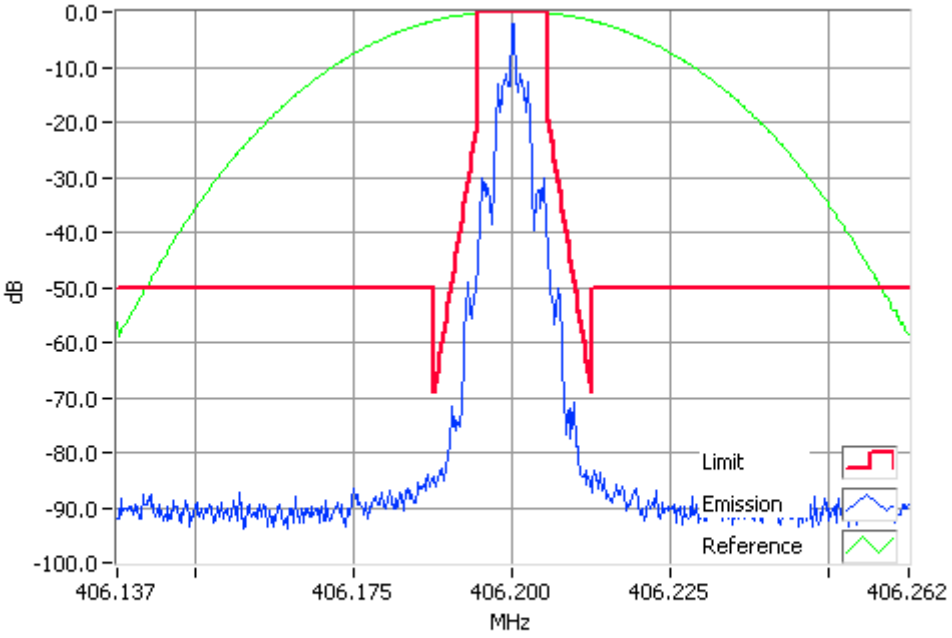
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 406.2 MHz 4 W 12.5 kHz Channel Spacing



FFSK2400 406.2000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 406.2 MHz 1 W 12.5 kHz Channel Spacing



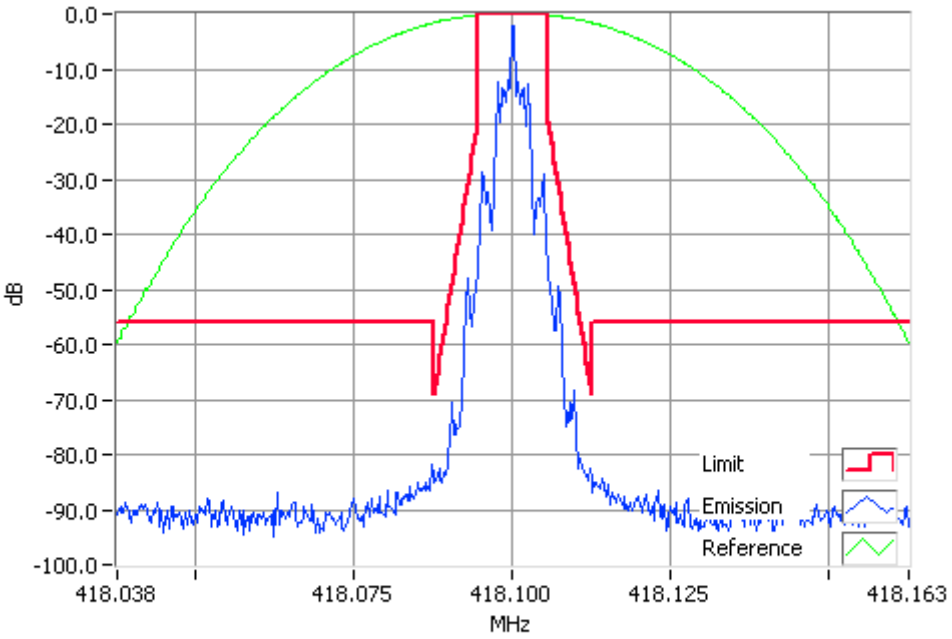
FFSK2400 406.2000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 2400 bps

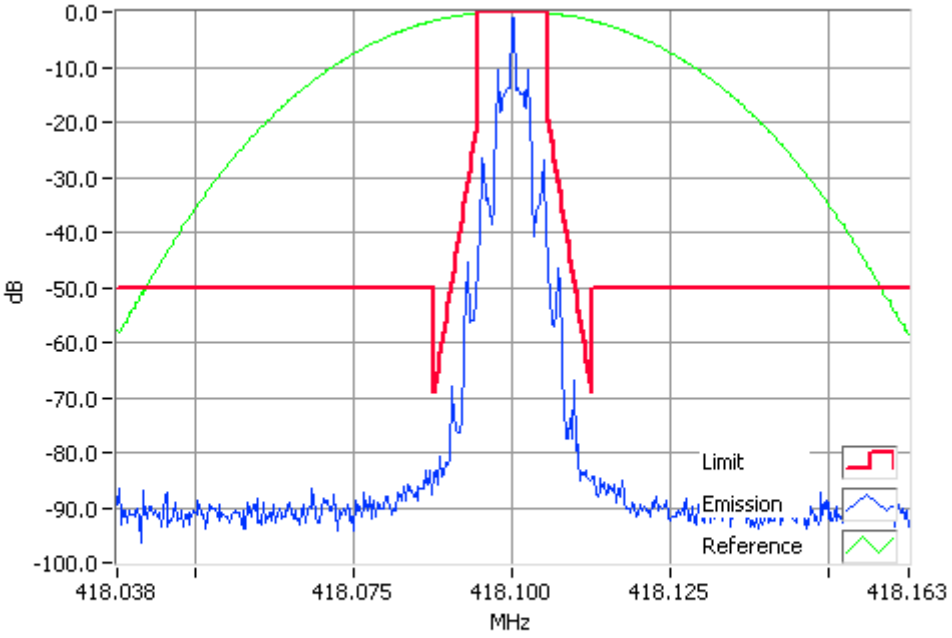
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 418.1 MHz 4 W 12.5 kHz Channel Spacing



FFSK2400 418.1000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 418.1 MHz 1 W 12.5 kHz Channel Spacing



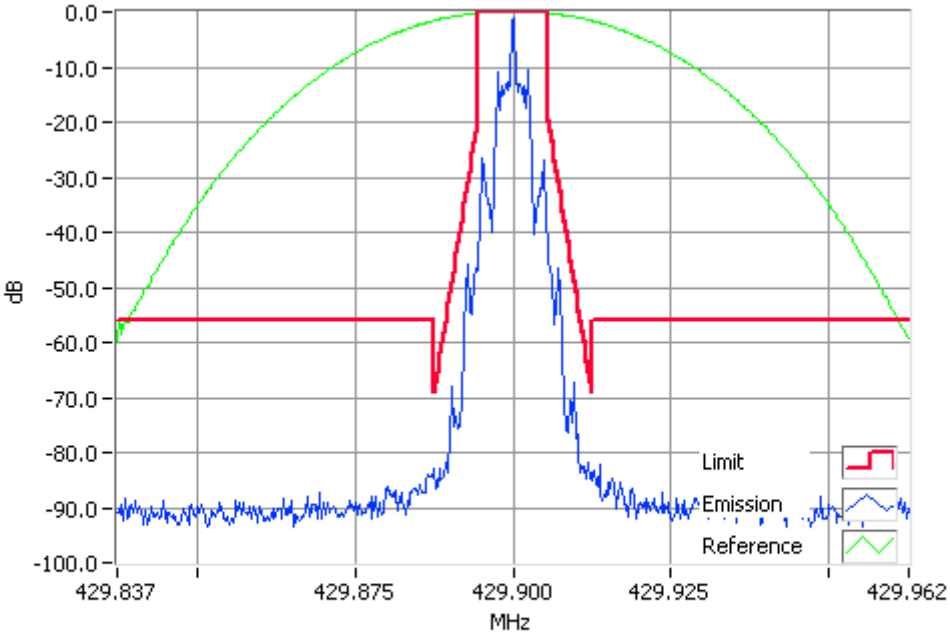
FFSK2400 418.1000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 2400 bps

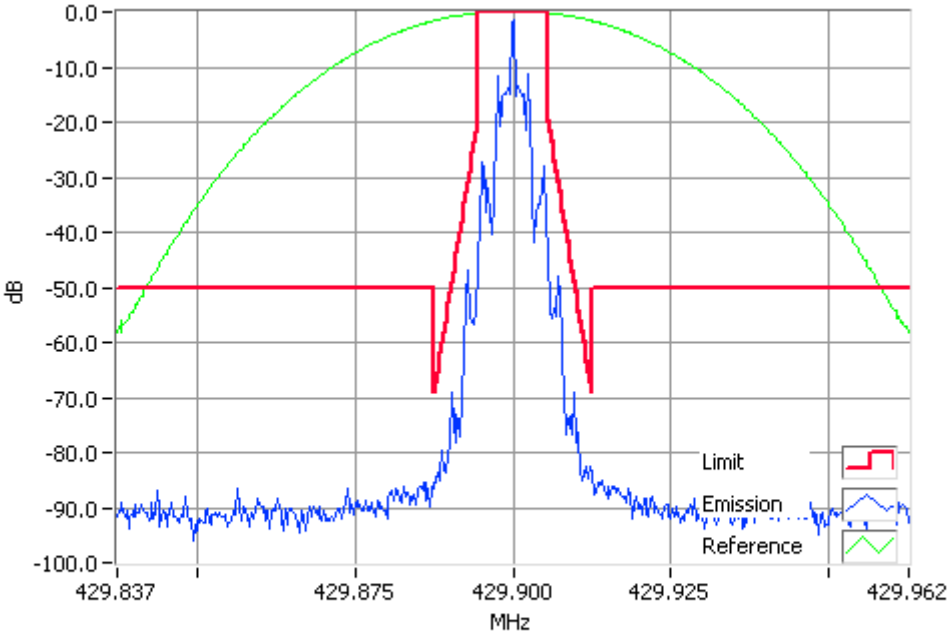
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 429.9 MHz 4 W 12.5 kHz Channel Spacing



FFSK2400 429.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 429.9 MHz 1 W 12.5 kHz Channel Spacing



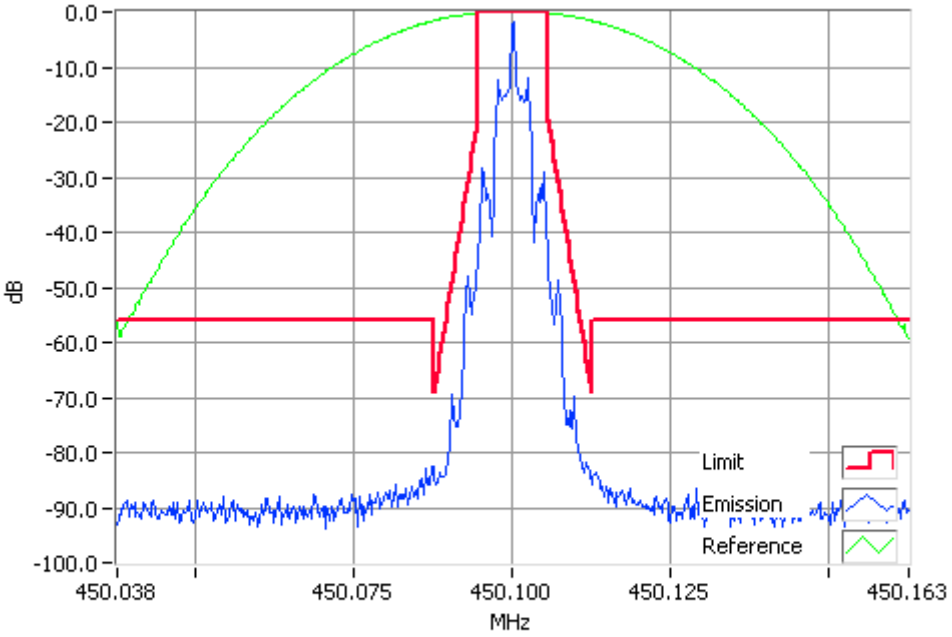
FFSK2400 429.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 2400 bps

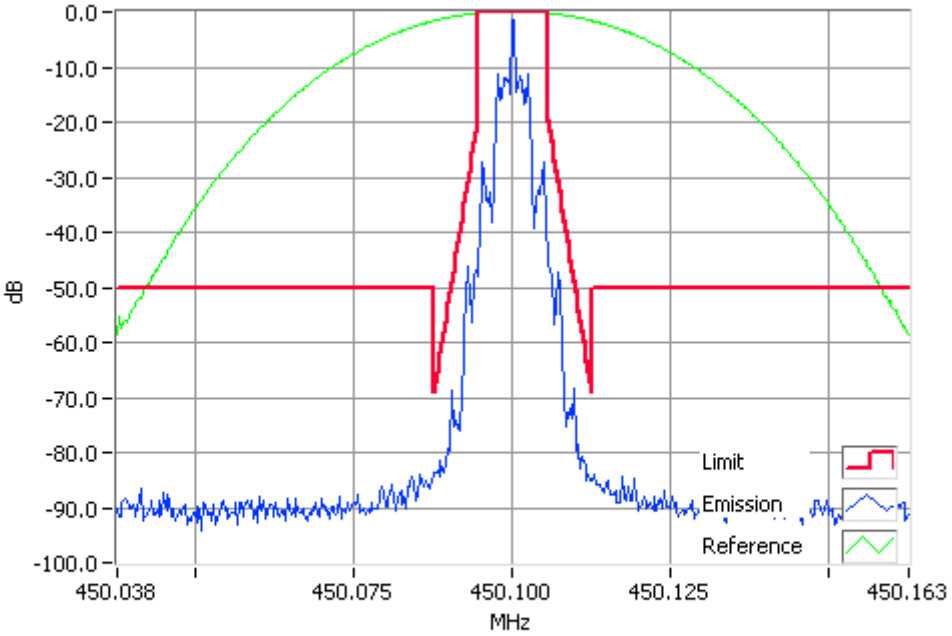
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 450.1 MHz 4 W 12.5 kHz Channel Spacing



FFSK2400 450.1000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 450.1 MHz 1 W 12.5 kHz Channel Spacing



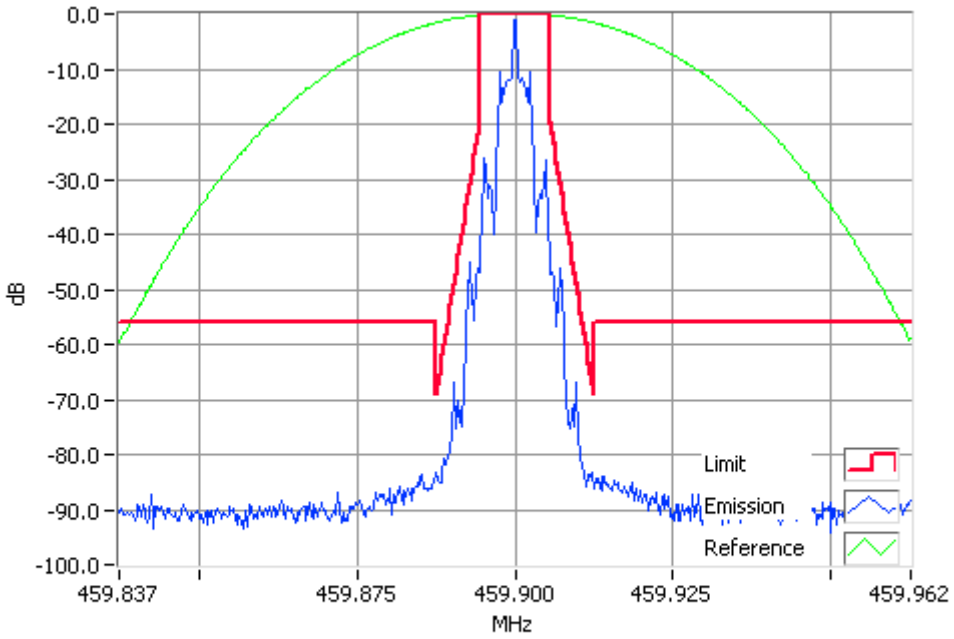
FFSK2400 450.1000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 2400 bps

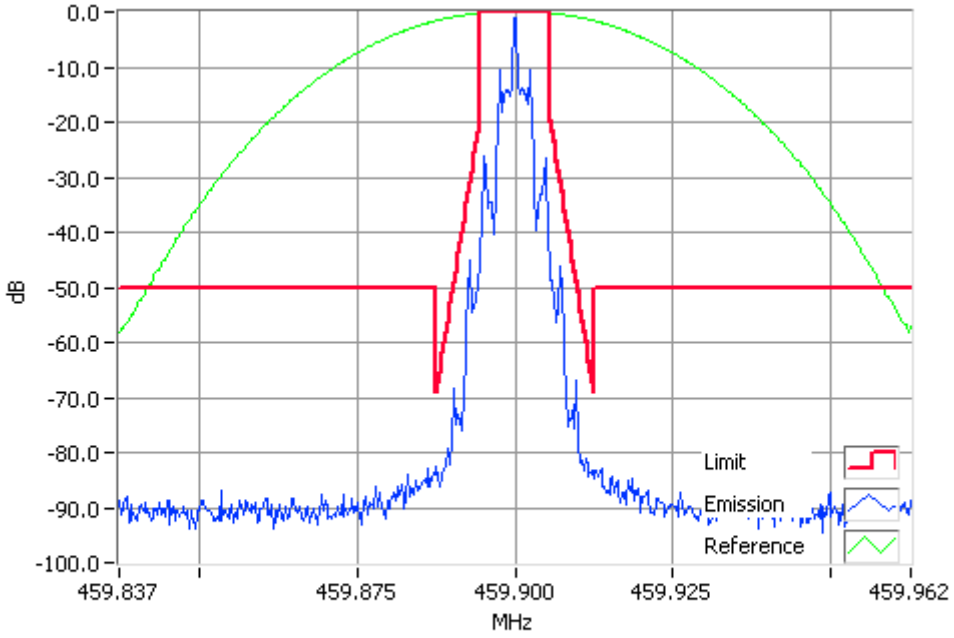
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 459.9 MHz 4 W 12.5 kHz Channel Spacing



FFSK2400 459.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 459.9 MHz 1 W 12.5 kHz Channel Spacing



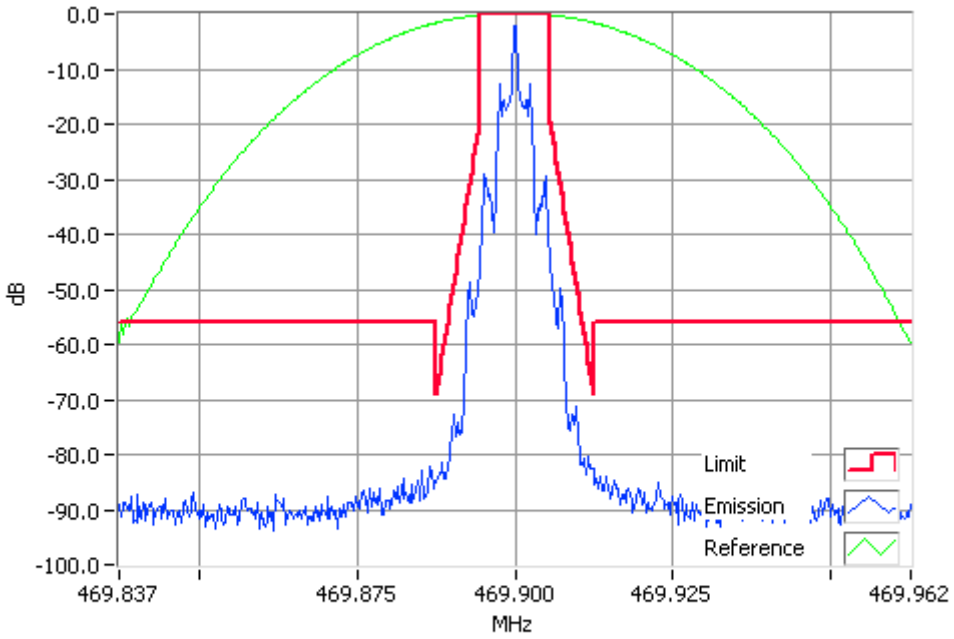
FFSK2400 459.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK 2400 bps

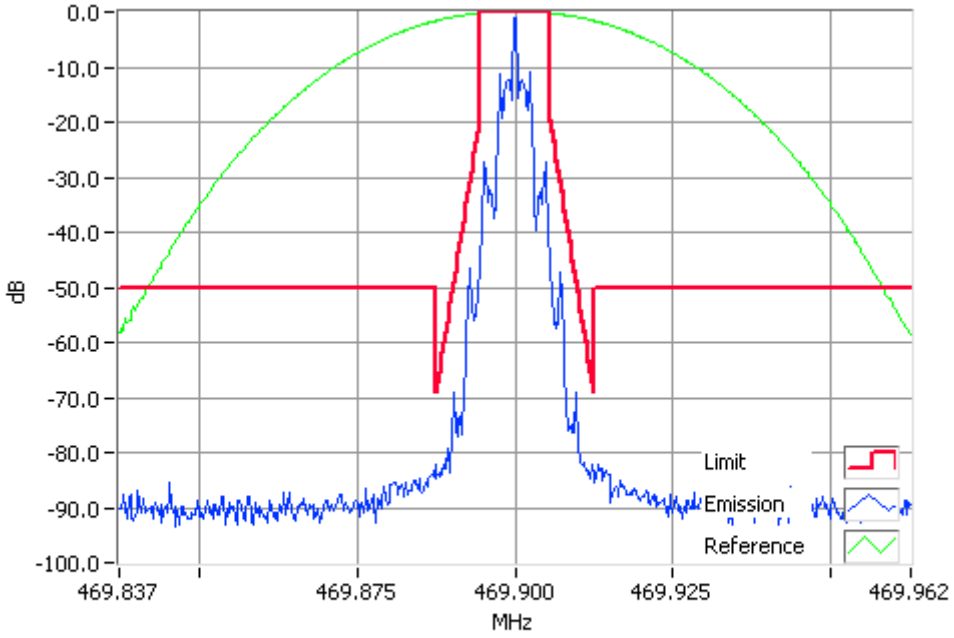
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 469.9 MHz 4 W 12.5 kHz Channel Spacing



FFSK2400 469.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 469.9 MHz 1 W 12.5 kHz Channel Spacing



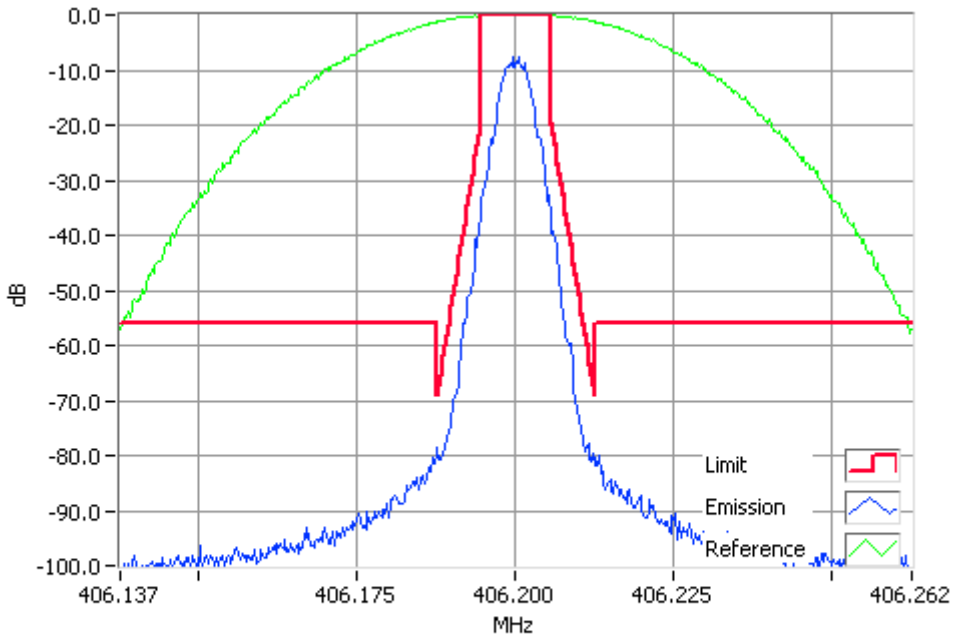
FFSK2400 469.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

DMR

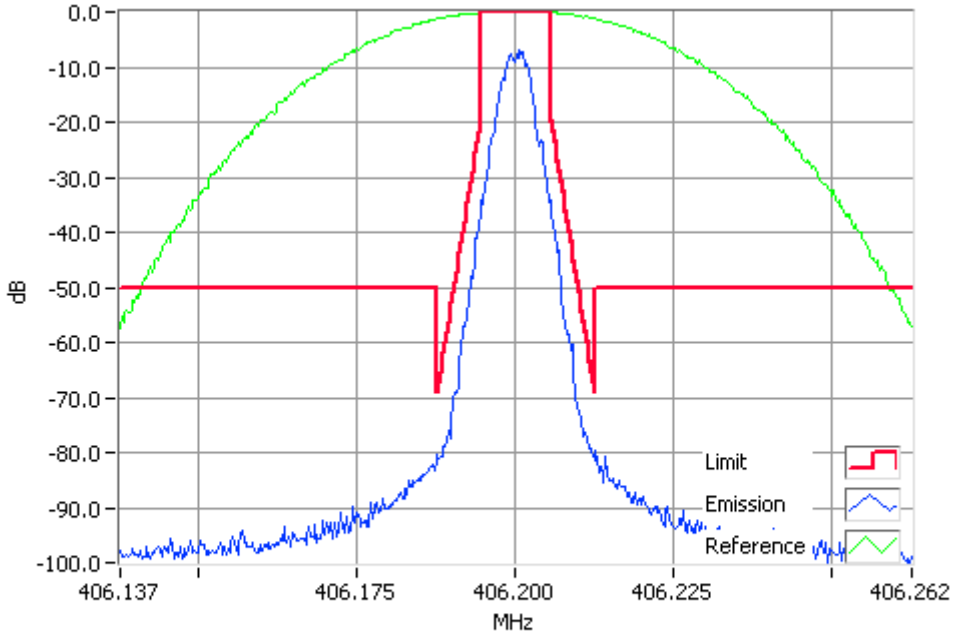
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 406.2 MHz 4 W 12.5 kHz Channel Spacing



DMR 406.2000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 406.2 MHz 1 W 12.5 kHz Channel Spacing



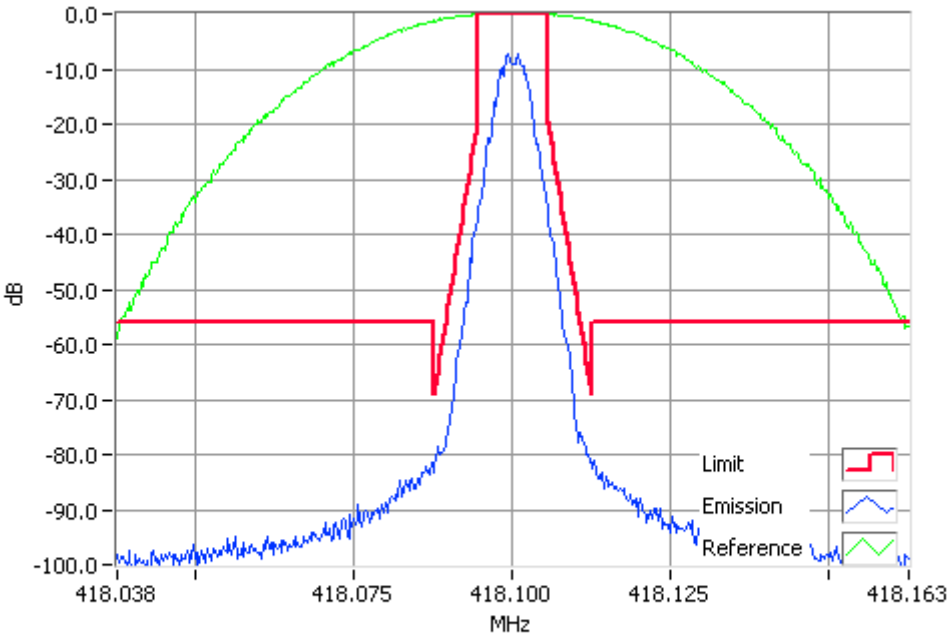
DMR 406.2000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

DMR

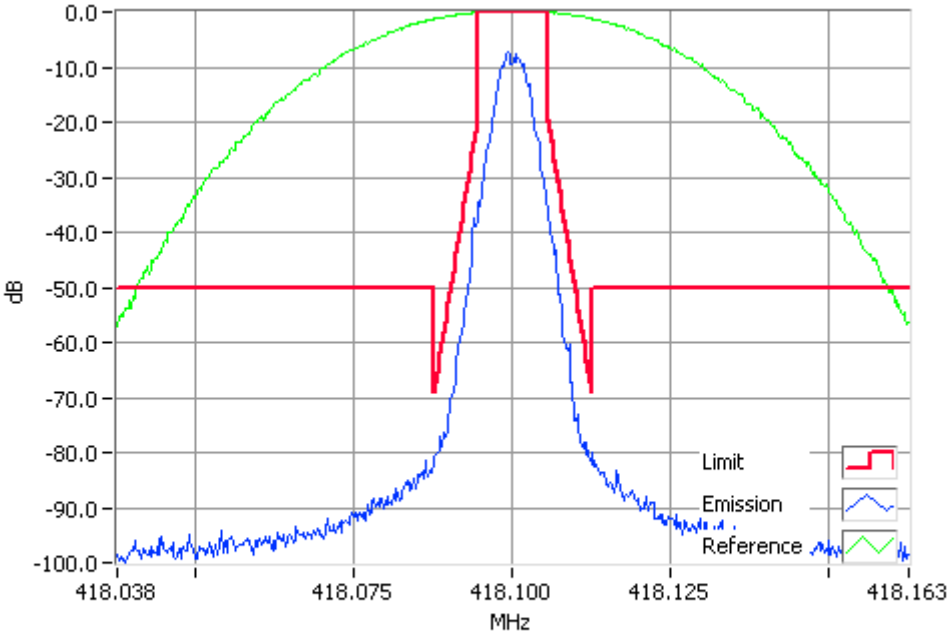
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 418.1 MHz 4 W 12.5 kHz Channel Spacing



DMR 418.1000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 418.1 MHz 1 W 12.5 kHz Channel Spacing



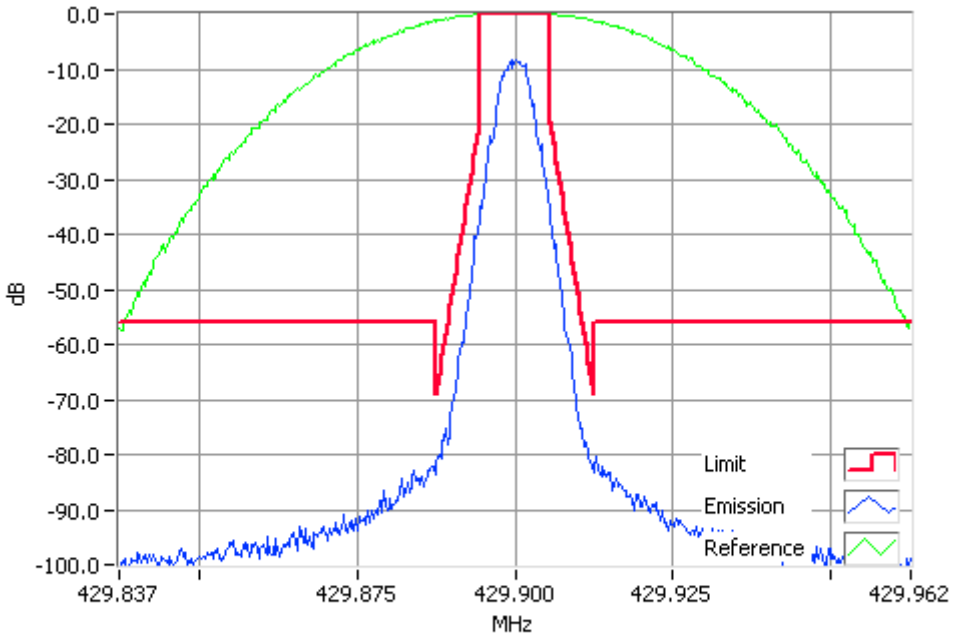
DMR 418.1000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

DMR

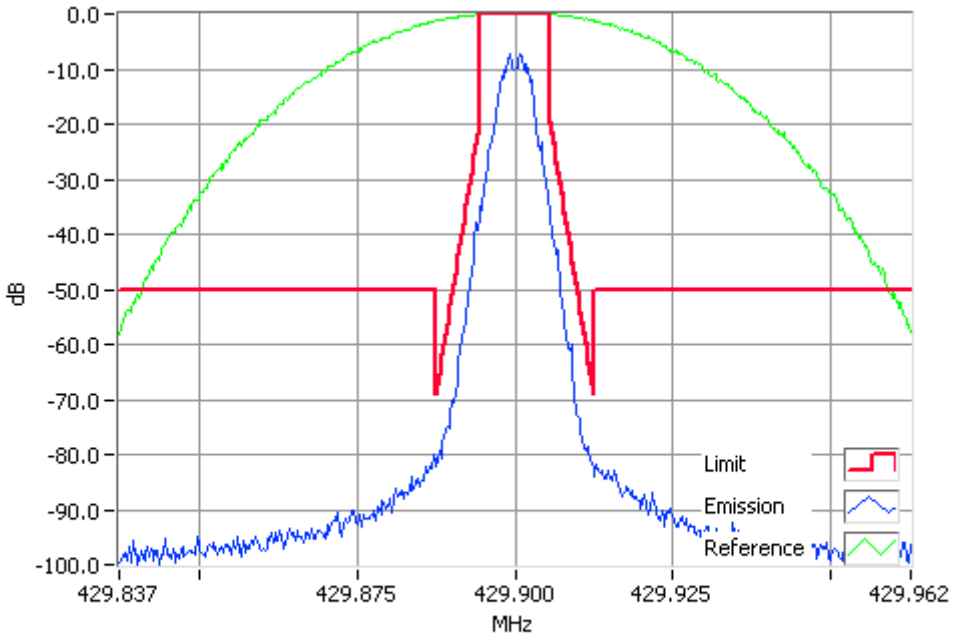
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 429.9 MHz 4 W 12.5 kHz Channel Spacing



DMR 429.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 429.9 MHz 1 W 12.5 kHz Channel Spacing



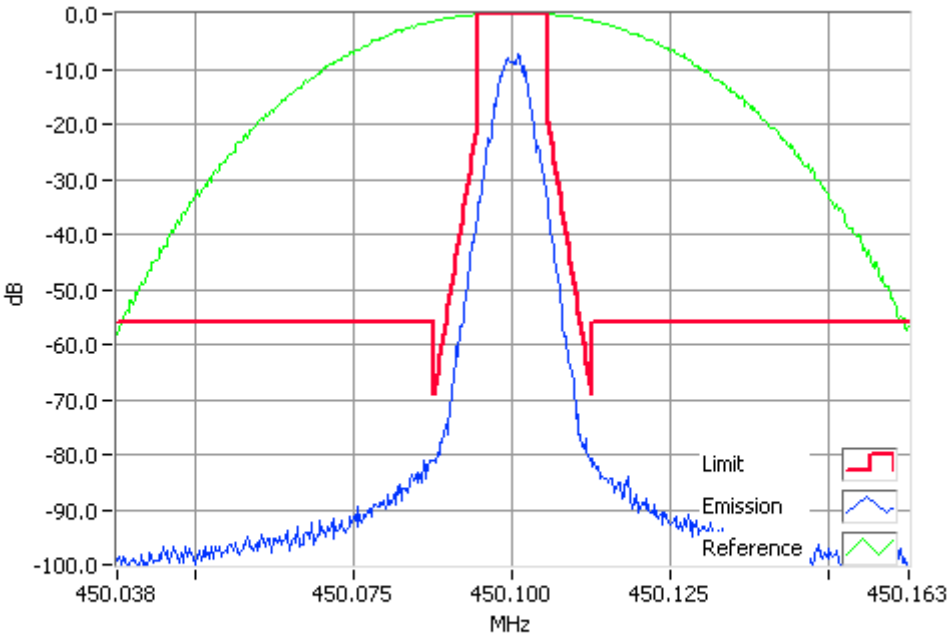
DMR 429.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

DMR

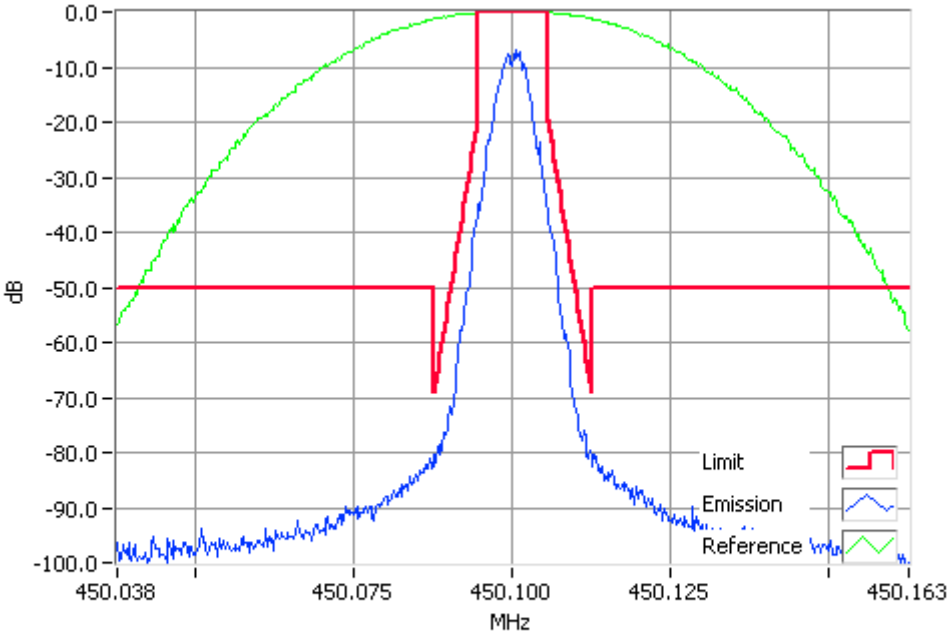
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 450.1 MHz 4 W 12.5 kHz Channel Spacing



DMR 450.1000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 450.1 MHz 1 W 12.5 kHz Channel Spacing



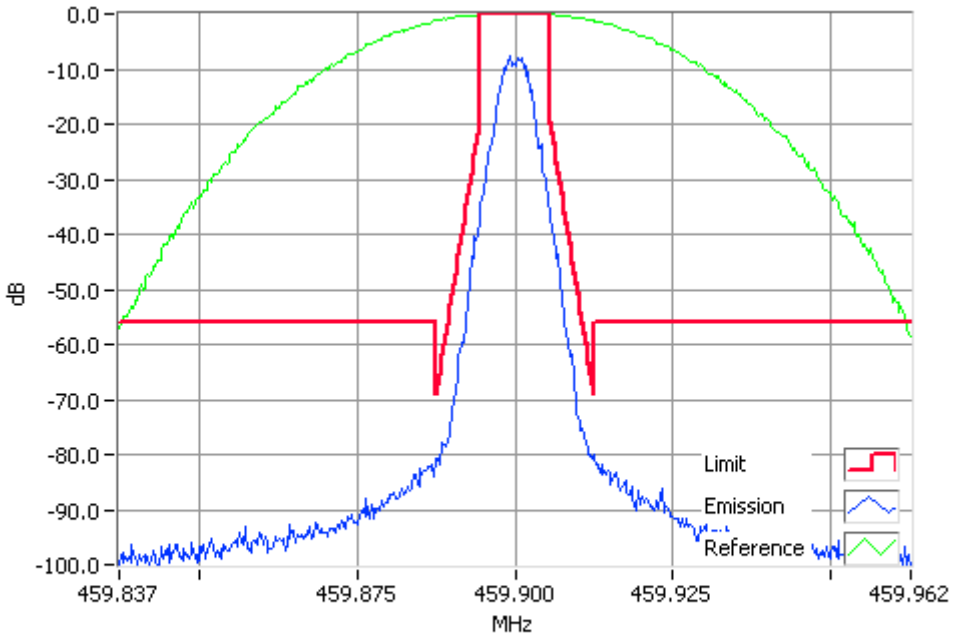
DMR 450.1000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

DMR

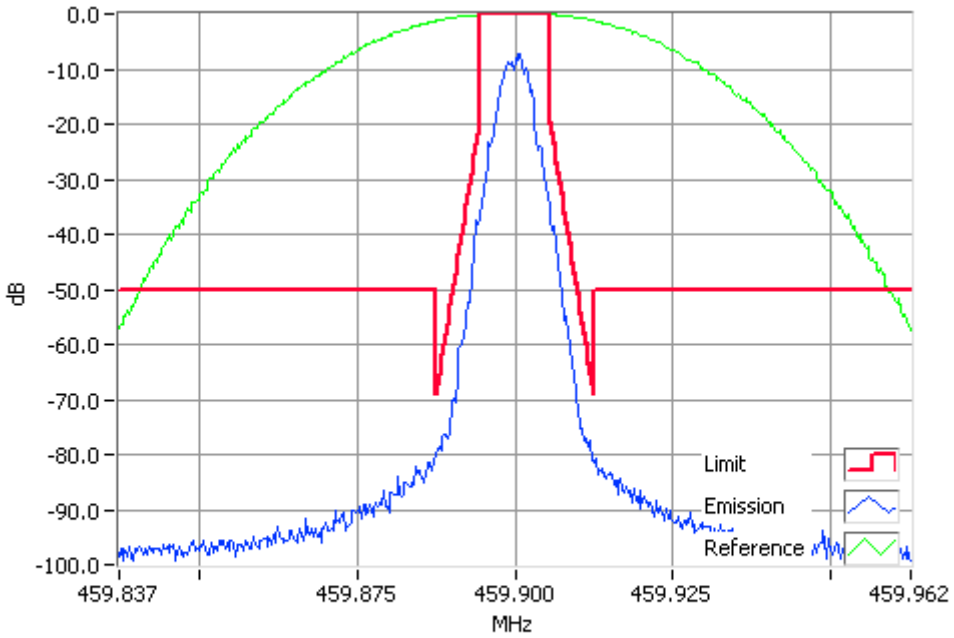
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 459.9 MHz 4 W 12.5 kHz Channel Spacing



DMR 459.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 459.9 MHz 1 W 12.5 kHz Channel Spacing



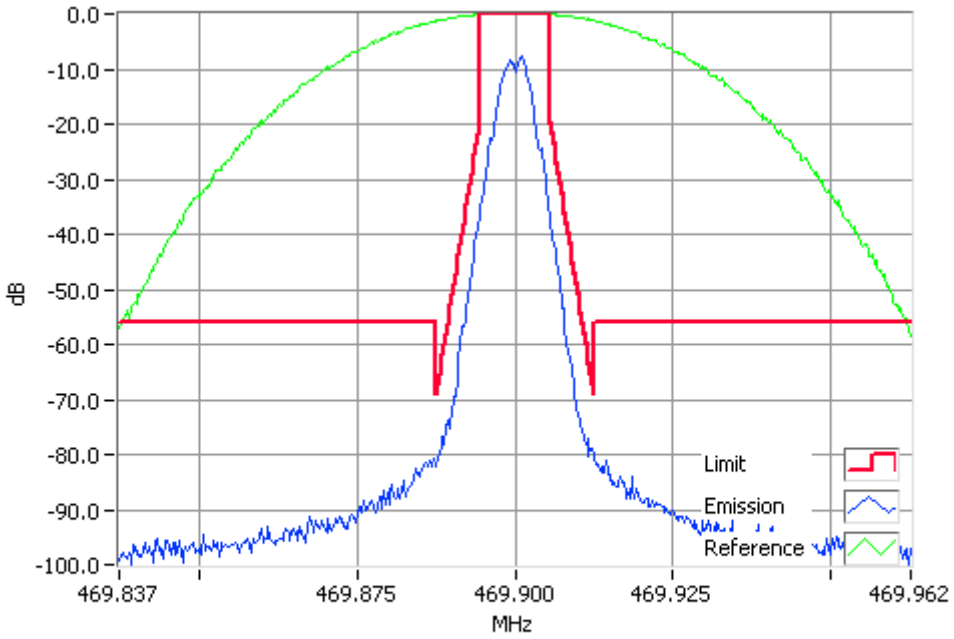
DMR 459.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

DMR

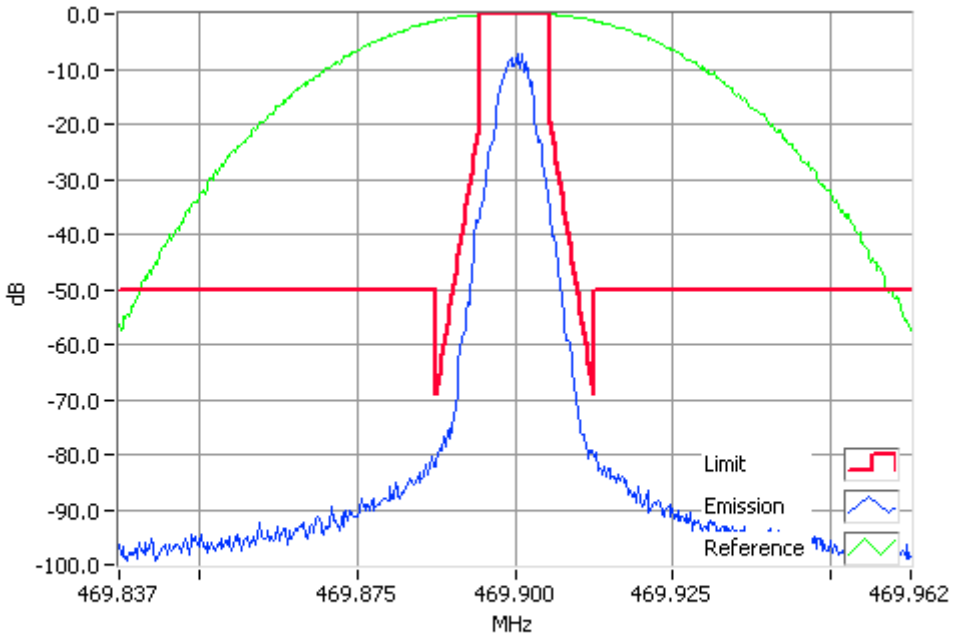
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 469.9 MHz 4 W 12.5 kHz Channel Spacing



DMR 469.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 469.9 MHz 1 W 12.5 kHz Channel Spacing



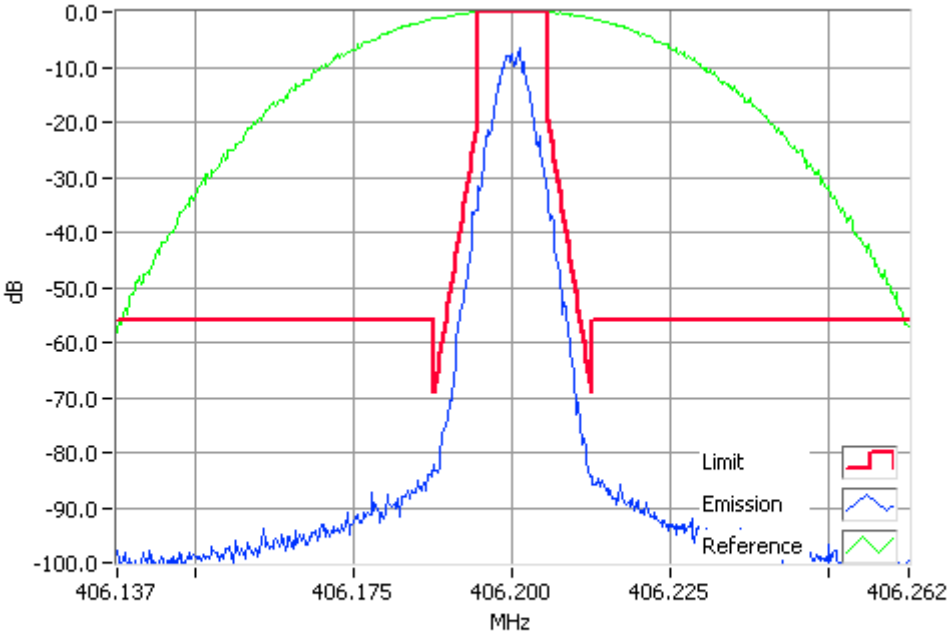
DMR 469.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

APCO P25 phase-1

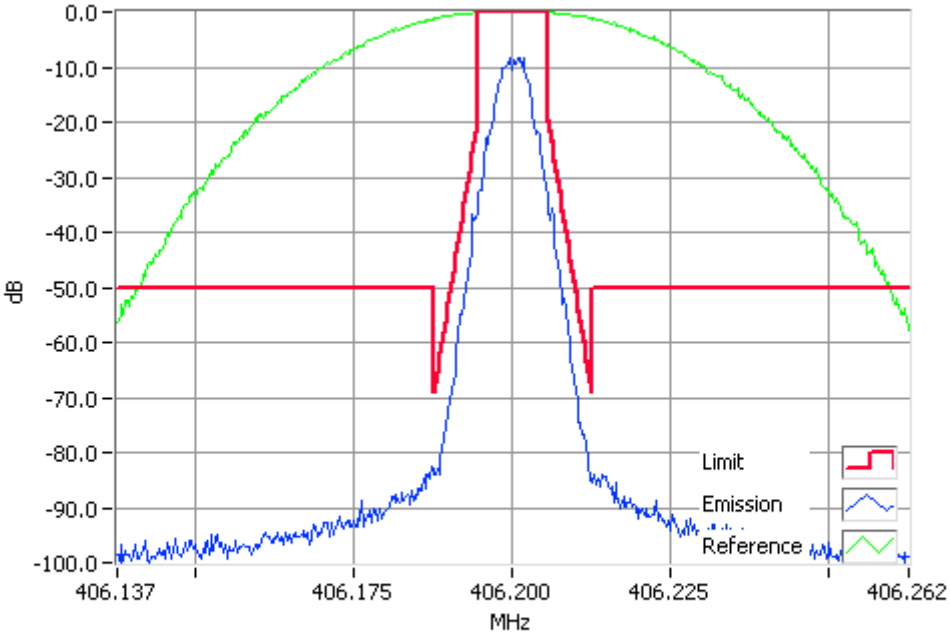
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 406.2 MHz 4 W 12.5 kHz Channel Spacing



P25I 406.2000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 406.2 MHz 1 W 12.5 kHz Channel Spacing



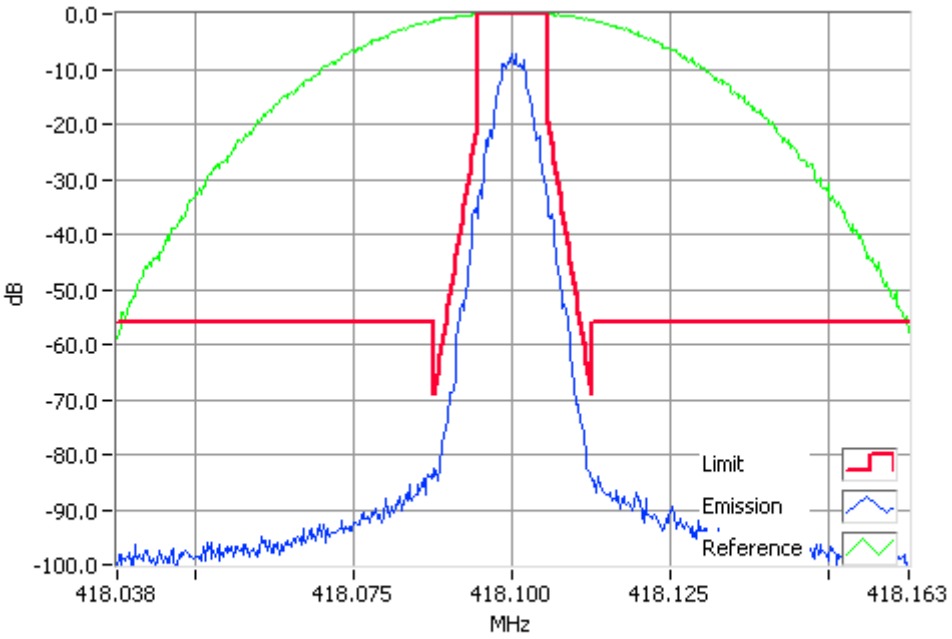
P25I 406.2000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

APCO P25 phase-1

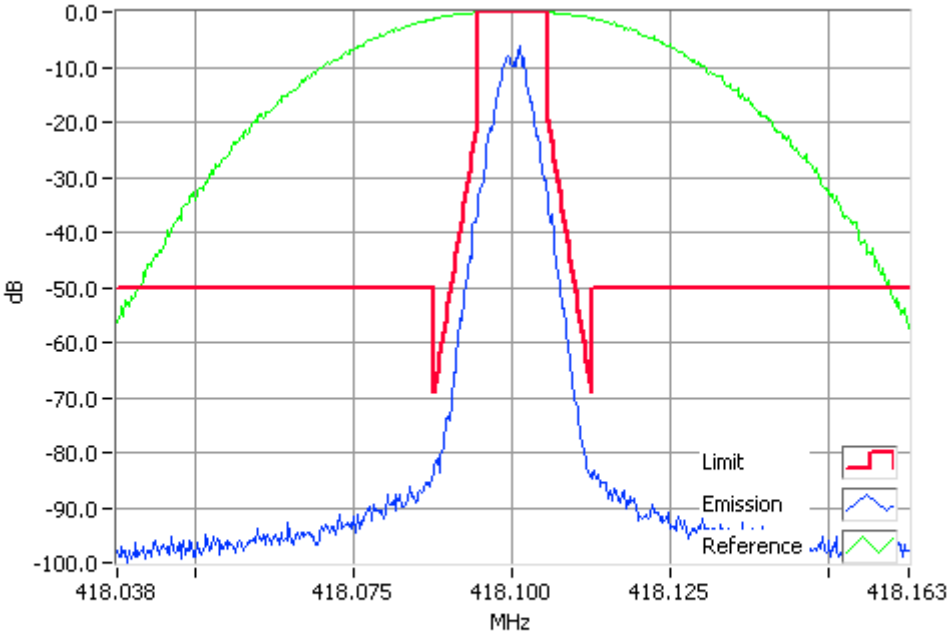
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 418.1 MHz 4 W 12.5 kHz Channel Spacing



P25I 418.1000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 418.1 MHz 1 W 12.5 kHz Channel Spacing



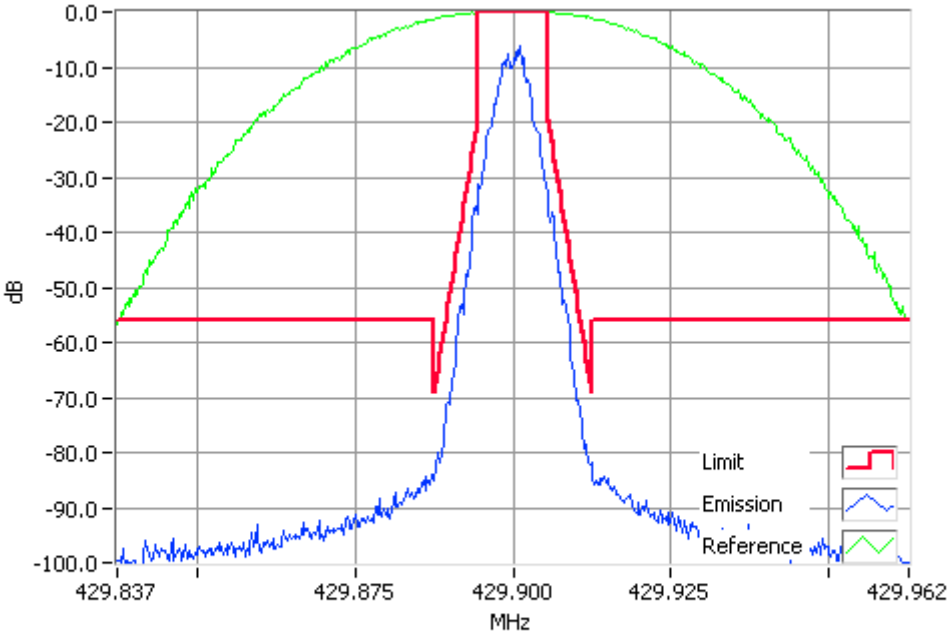
P25I 418.1000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

APCO P25 phase-1

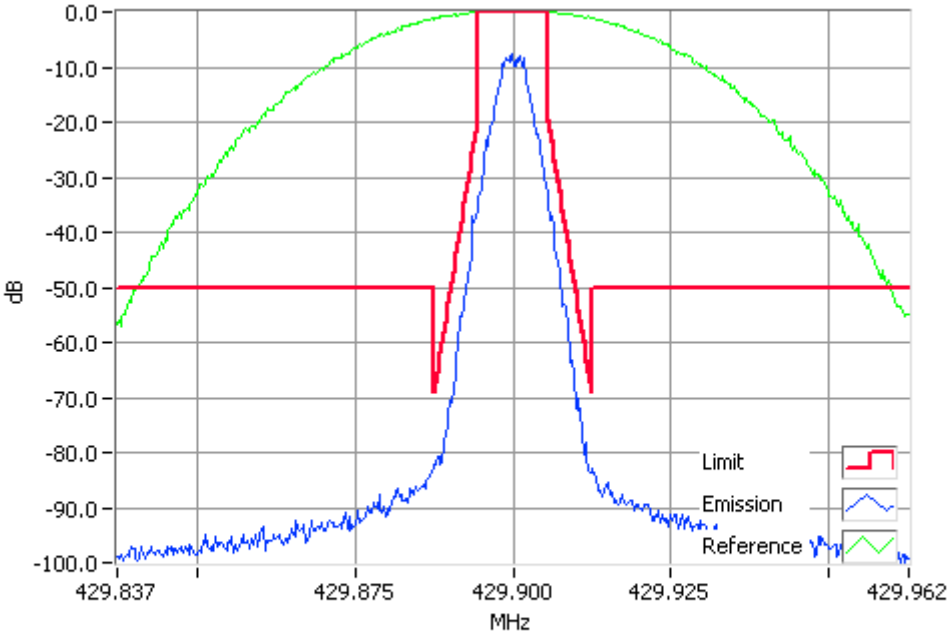
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 429.9 MHz 4 W 12.5 kHz Channel Spacing



P25I 429.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 429.9 MHz 1 W 12.5 kHz Channel Spacing



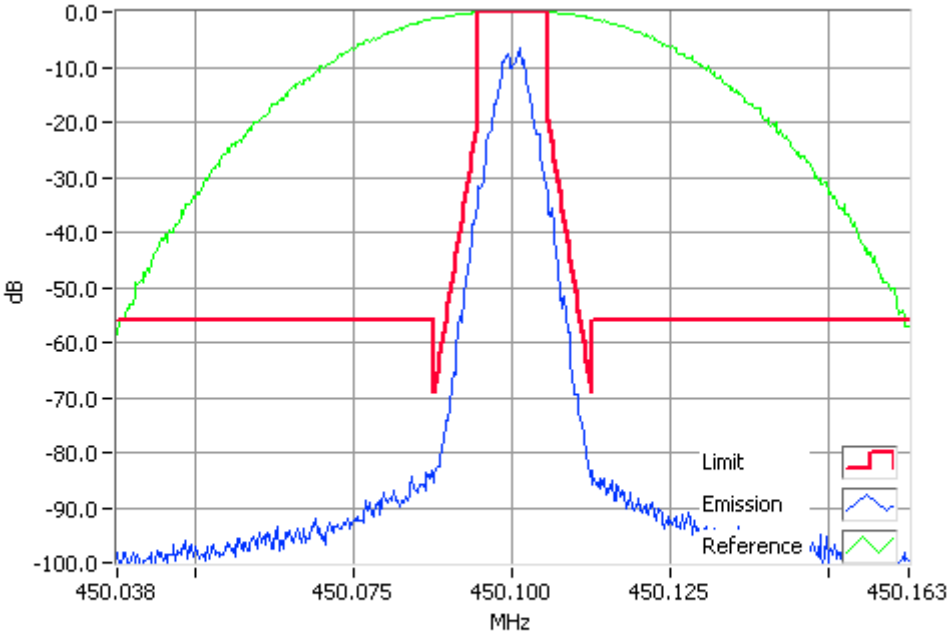
P25I 429.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

APCO P25 phase-1

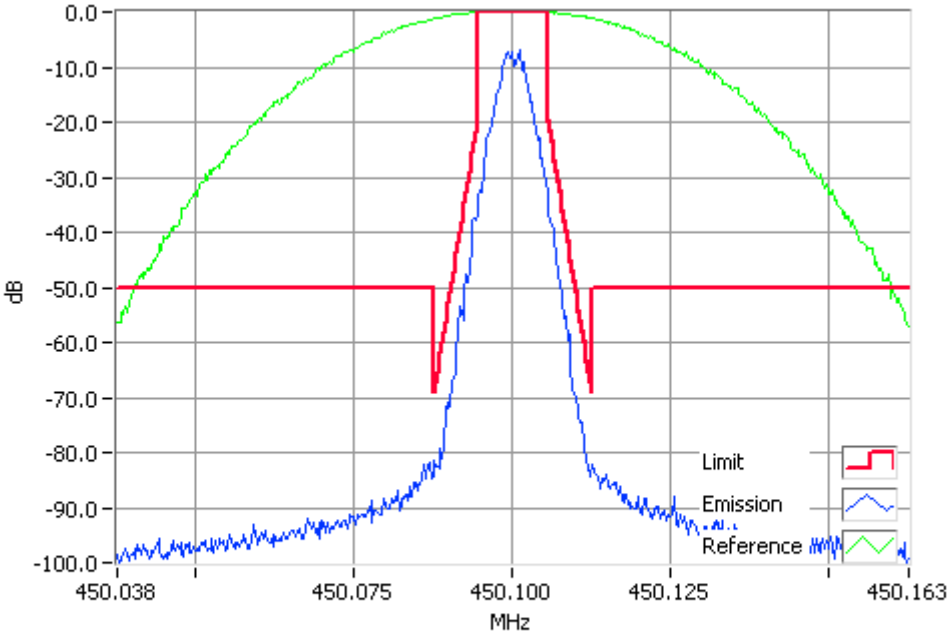
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 450.1 MHz 4 W 12.5 kHz Channel Spacing



P25I 450.1000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 450.1 MHz 1 W 12.5 kHz Channel Spacing



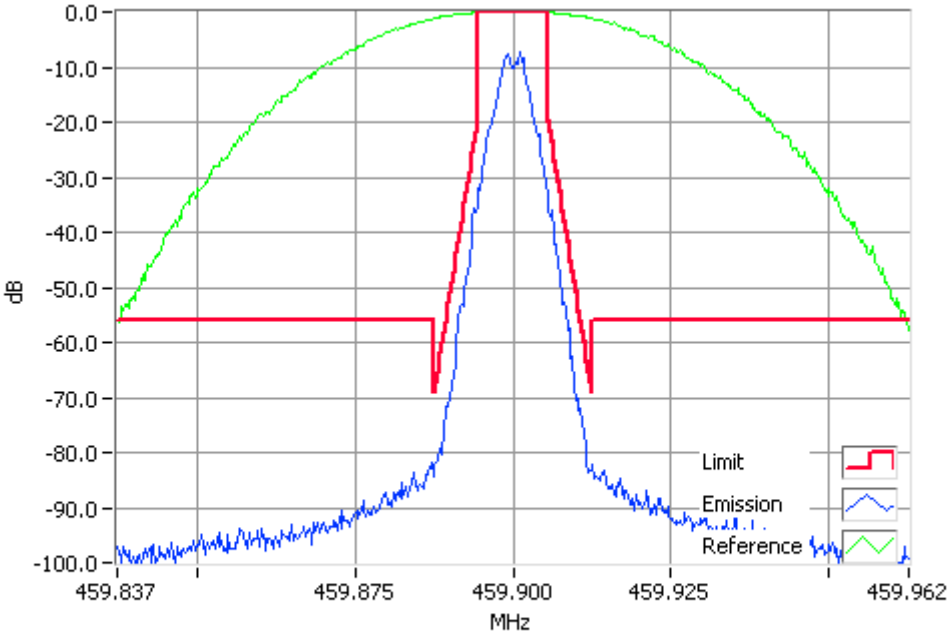
P25I 450.1000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

APCO P25 phase-1

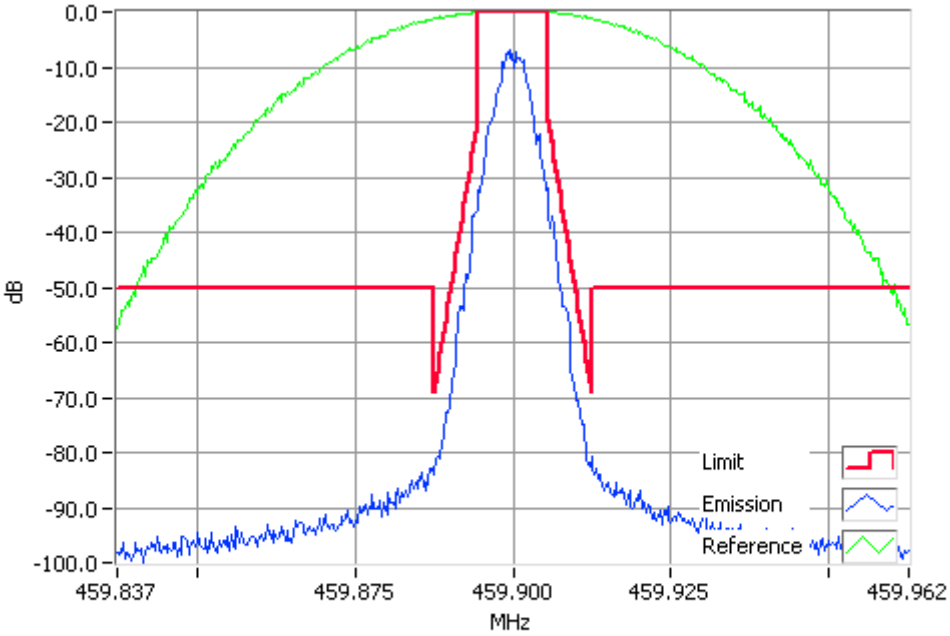
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 459.9 MHz 4 W 12.5 kHz Channel Spacing



P25I 459.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 459.9 MHz 1 W 12.5 kHz Channel Spacing



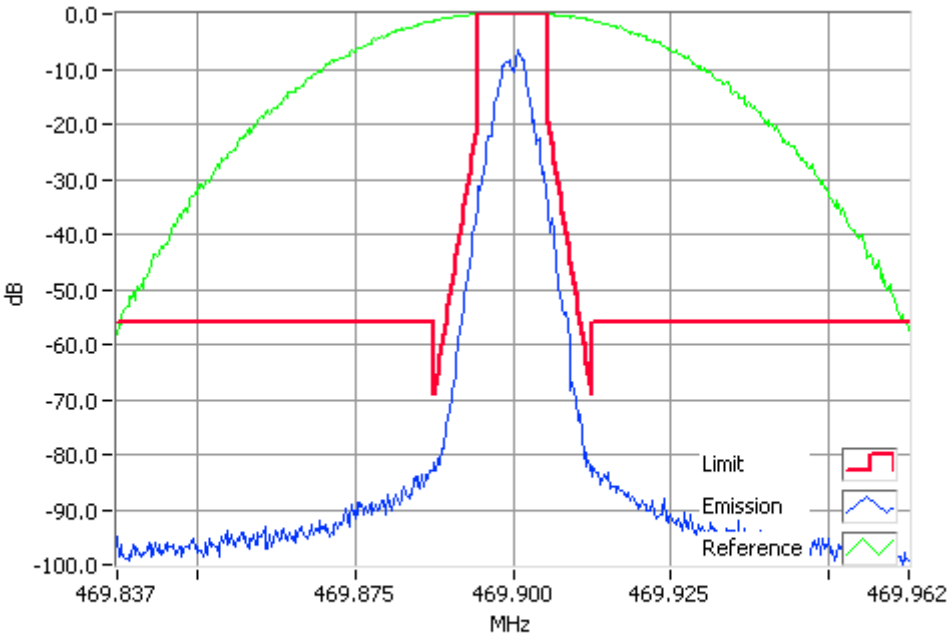
P25I 459.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

APCO P25 phase-1

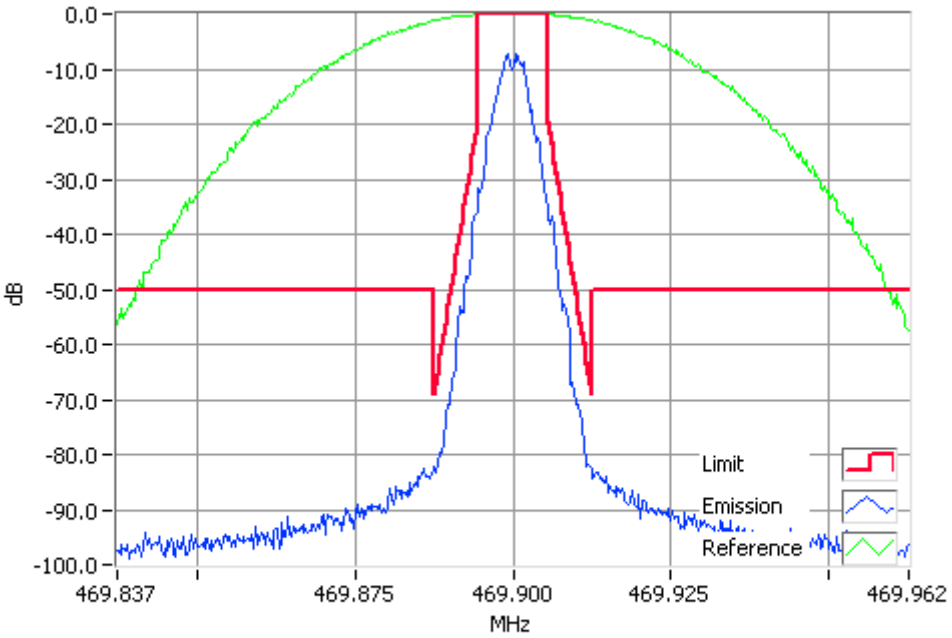
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 469.9 MHz 4 W 12.5 kHz Channel Spacing



P25I 469.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 469.9 MHz 1 W 12.5 kHz Channel Spacing



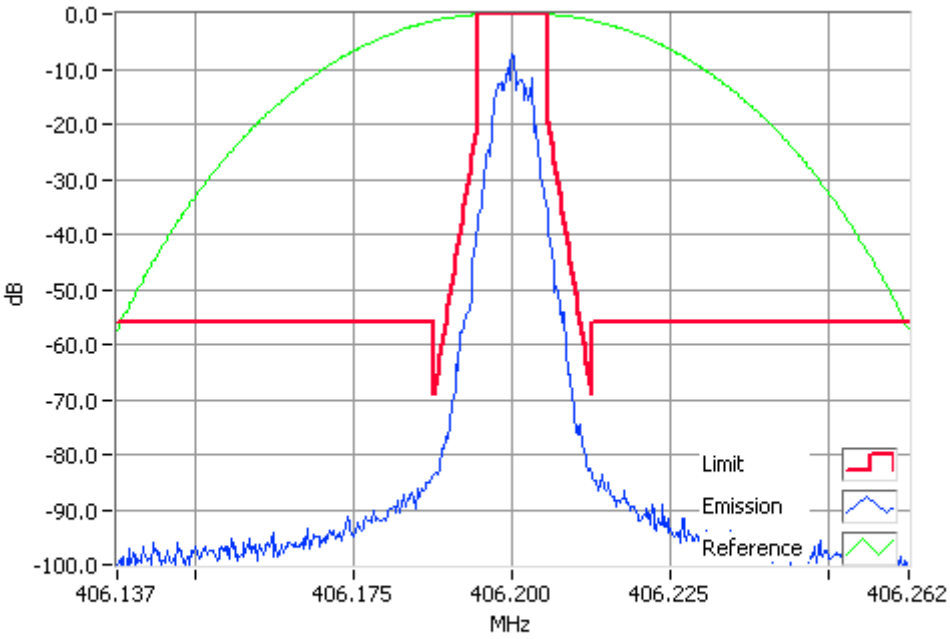
P25I 469.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

APCO P25 phase-2

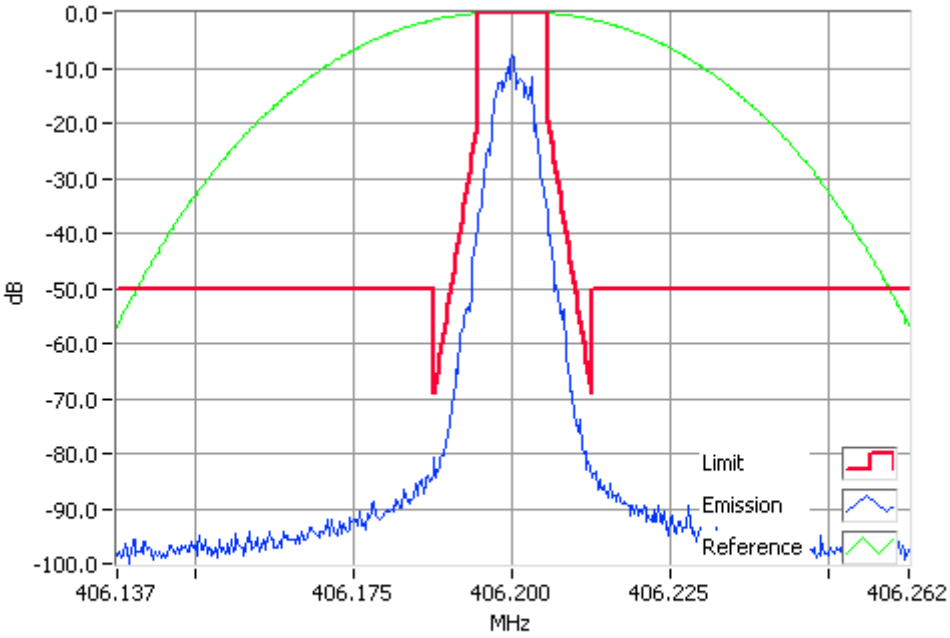
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 406.2 MHz 4 W 12.5 kHz Channel Spacing



P25II 406.2000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 406.2 MHz 1 W 12.5 kHz Channel Spacing



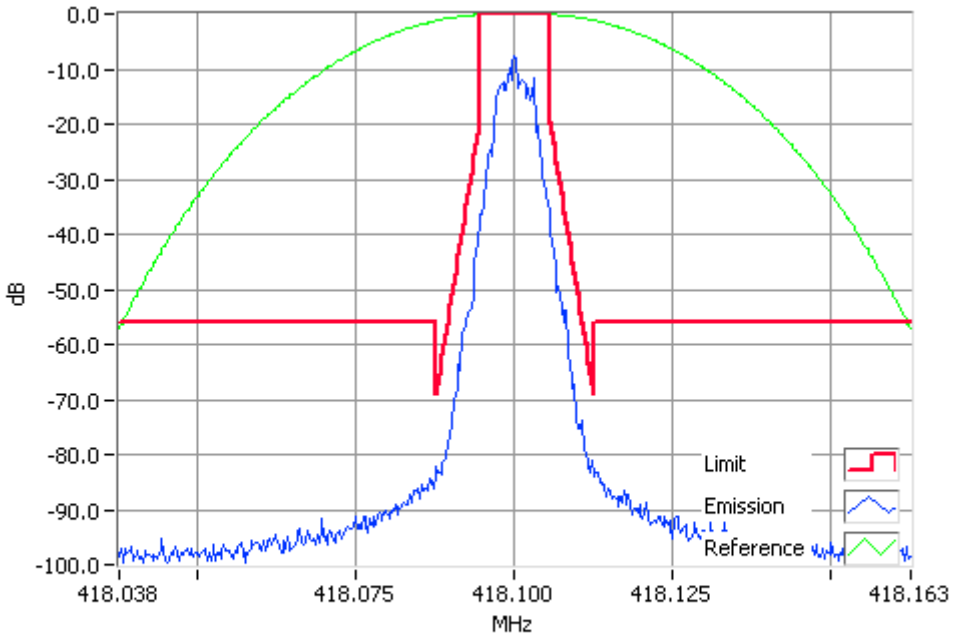
P25II 406.2000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

APCO P25 phase-2

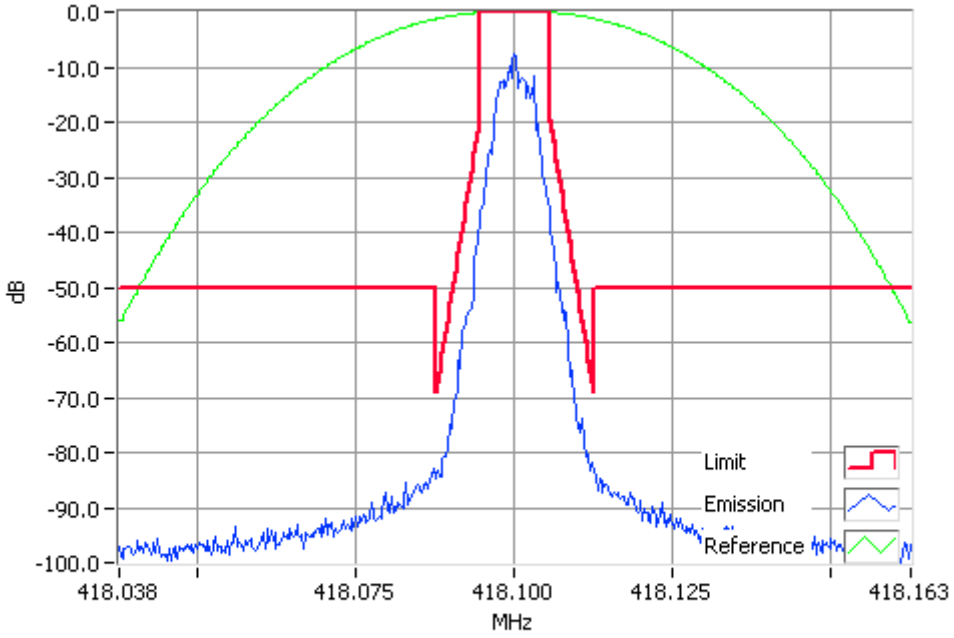
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 418.1 MHz 4 W 12.5 kHz Channel Spacing



P25II 418.1000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 418.1 MHz 1 W 12.5 kHz Channel Spacing



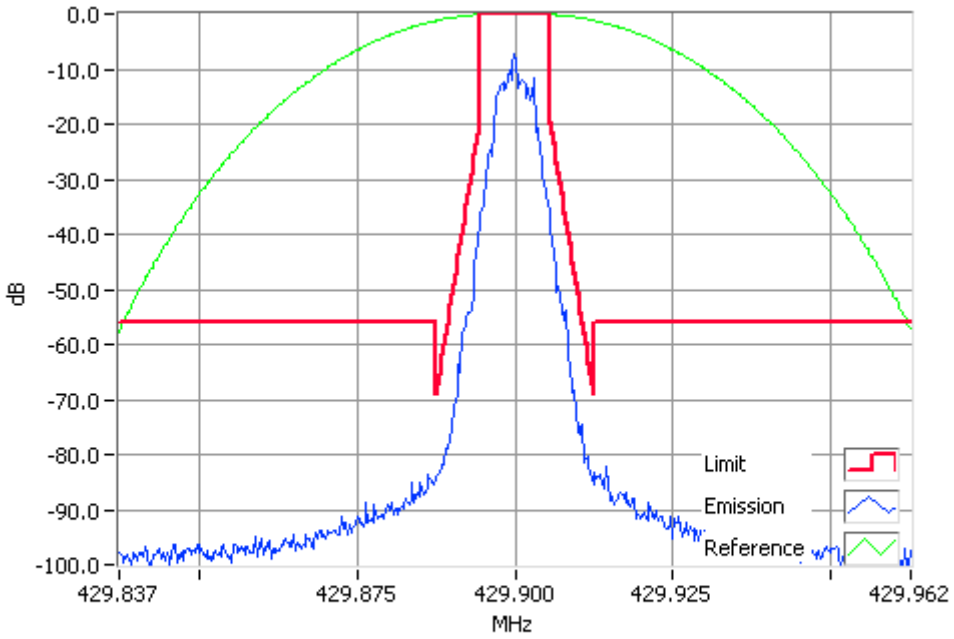
P25II 418.1000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

APCO P25 phase-2

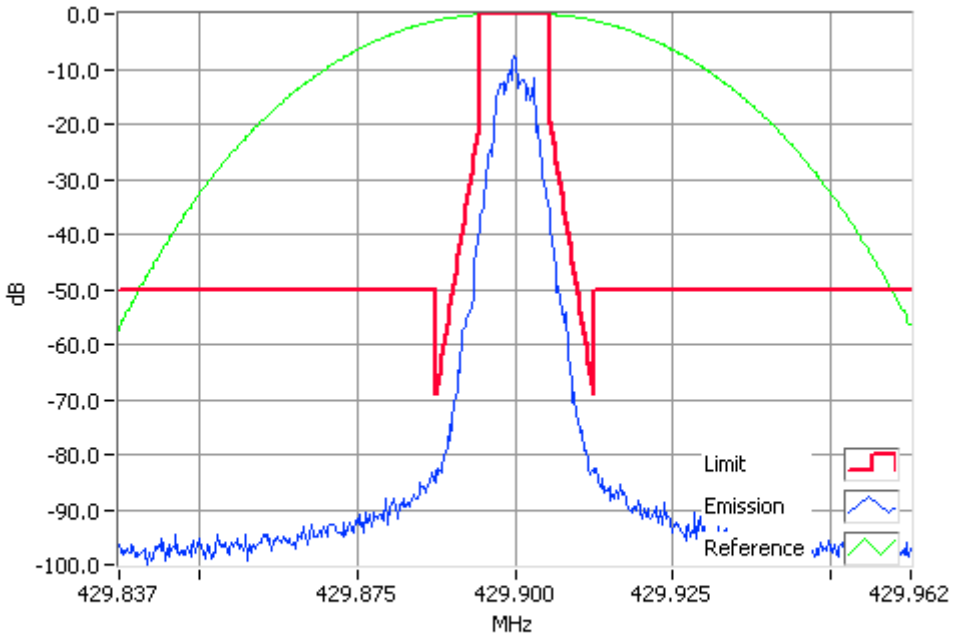
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 429.9 MHz 4 W 12.5 kHz Channel Spacing



P25II 429.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 429.9 MHz 1 W 12.5 kHz Channel Spacing



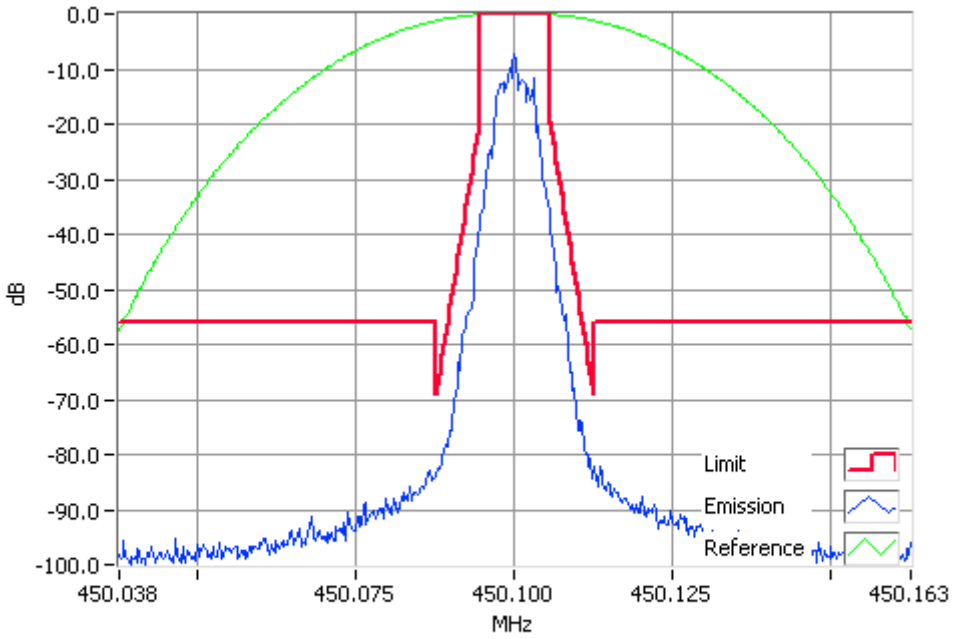
P25II 429.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

APCO P25 phase-2

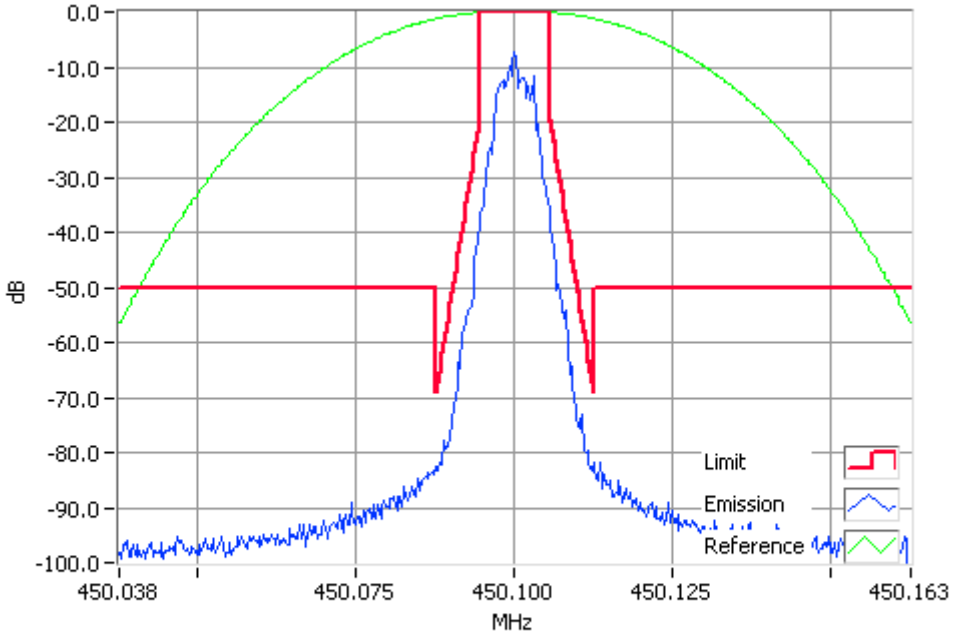
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 450.1 MHz 4 W 12.5 kHz Channel Spacing



P25II 450.1000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 450.1 MHz 1 W 12.5 kHz Channel Spacing



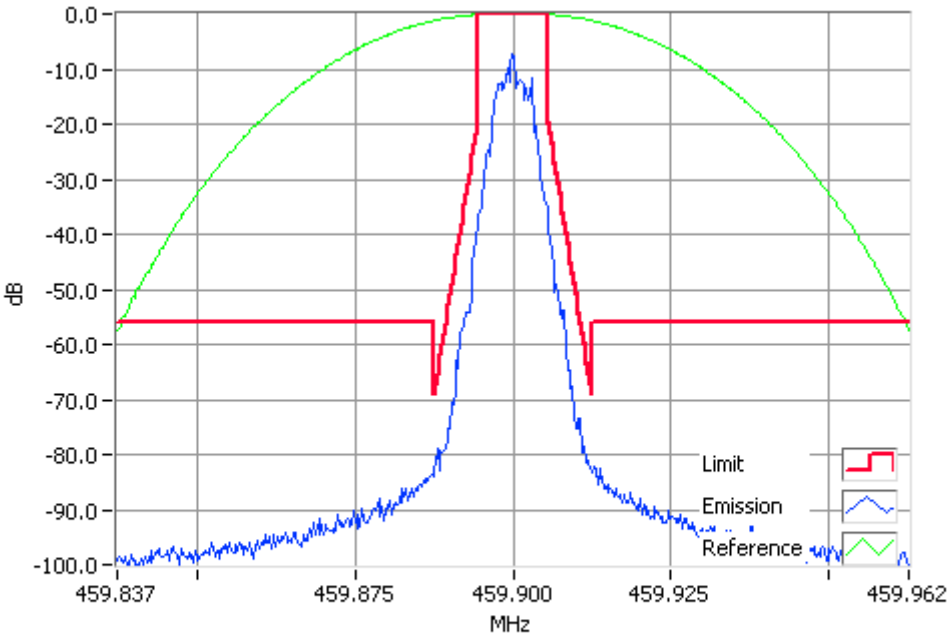
P25II 450.1000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

APCO P25 phase-2

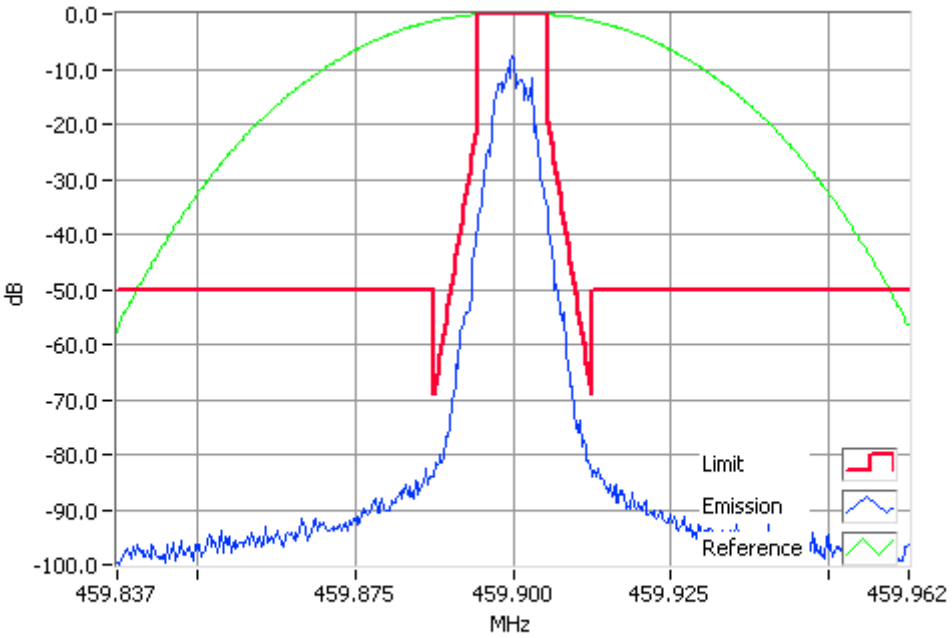
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 459.9 MHz 4 W 12.5 kHz Channel Spacing



P25II 459.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 459.9 MHz 1 W 12.5 kHz Channel Spacing



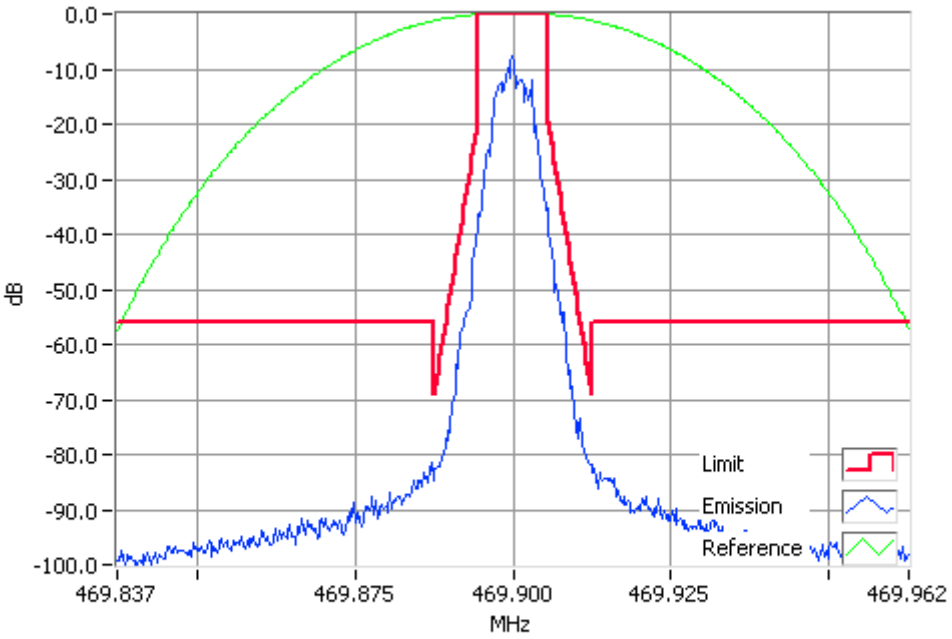
P25II 459.9000MHz Mask D 1W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

APCO P25 phase-2

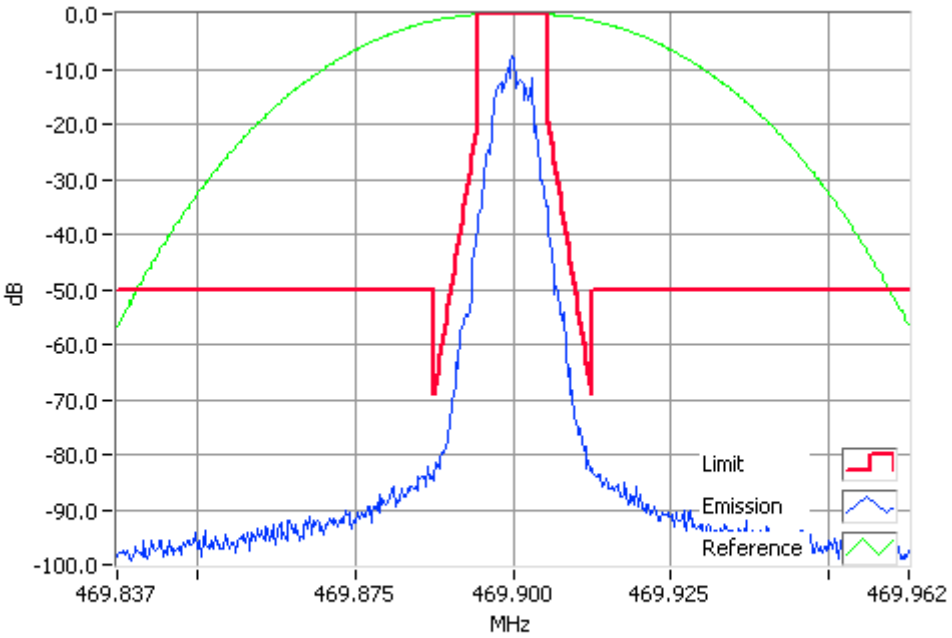
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 469.9 MHz 4 W 12.5 kHz Channel Spacing



P25II 469.9000MHz Mask D 4W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 469.9 MHz 1 W 12.5 kHz Channel Spacing



P25II 469.9000MHz Mask D 1W
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/EIA-603D 2.2.13

MEASUREMENT PROCEDURE:

1. Refer Annex A for equipment set up.
2. The frequency range examined was from the lowest frequency generated within the EUT, to a frequency higher than the 10th Harmonic: 100 kHz to Fc-BW
   Fc+ BW to 10Fc 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.

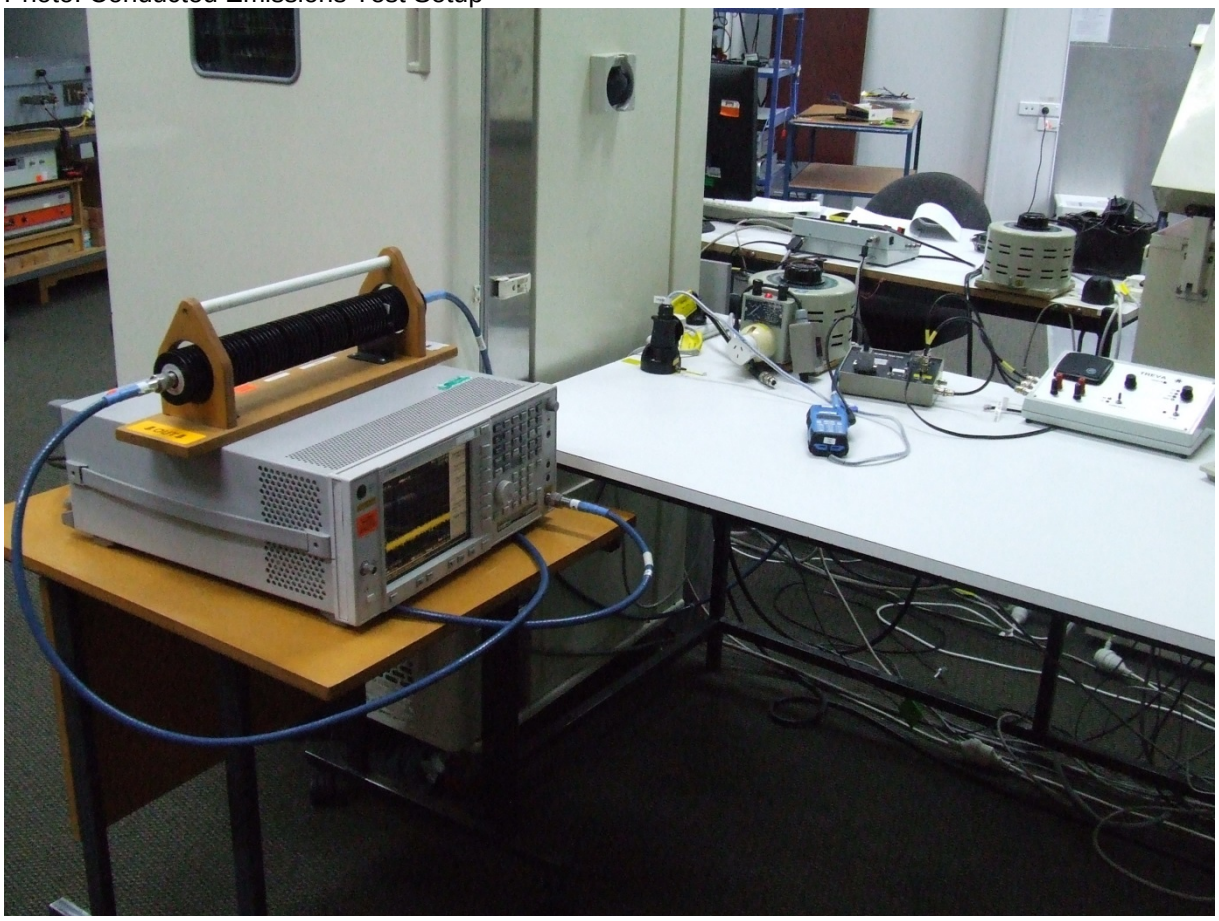
Spurious emissions which were attenuated by more than 20 dB below the limit were not recorded.

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 spacing.

LIMIT CLAUSES: FCC 47 CFR 90.210 RSS-119 5.8

Photo: Conducted Emissions Test Setup



Spurious Emissions (Tx Conducted)

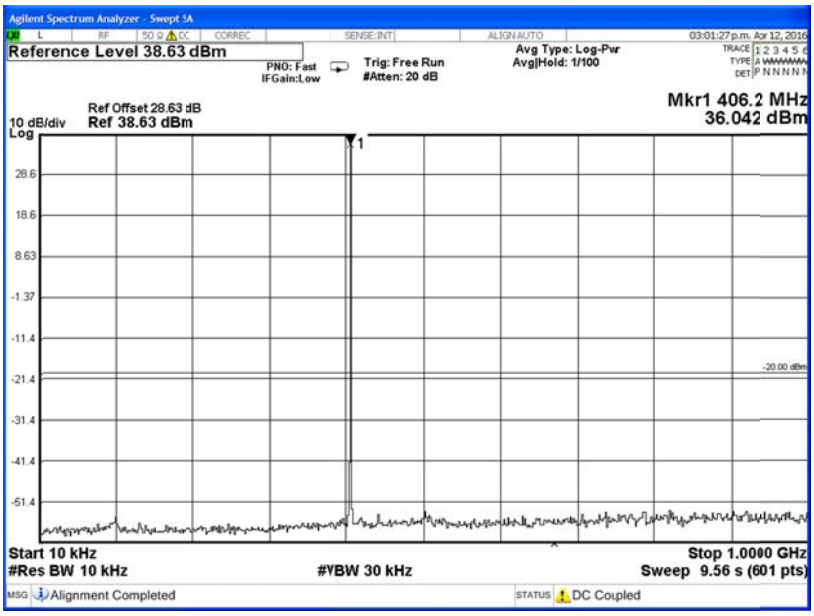
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

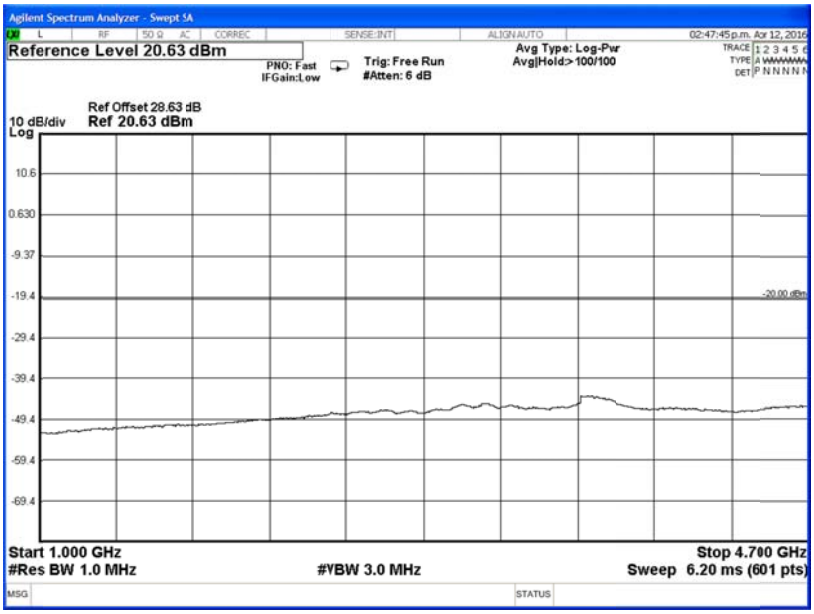
12.5 kHz Channel Spacing 406.2 MHz @ 4 W Emission Mask D

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

12.5 kHz Channel Spacing 406.2 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.		





Spurious Emissions (Tx Conducted)

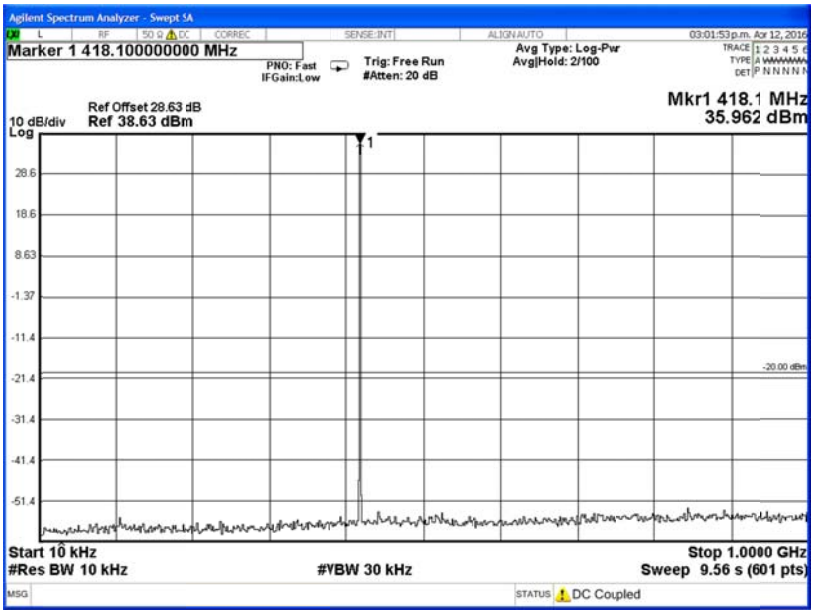
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

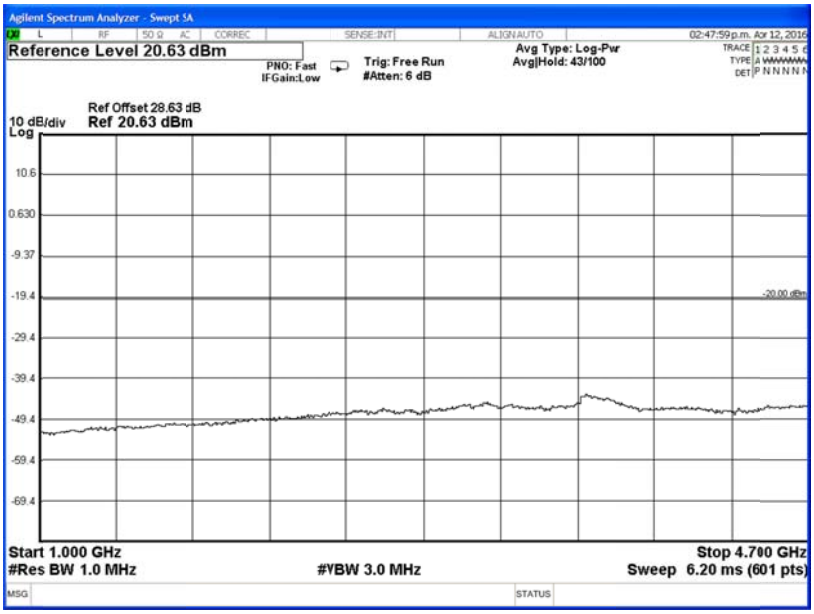
12.5 kHz Channel Spacing 418.1 MHz @ 4 W Emission Mask D

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

12.5 kHz Channel Spacing 418.1 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.		





Spurious Emissions (Tx Conducted)

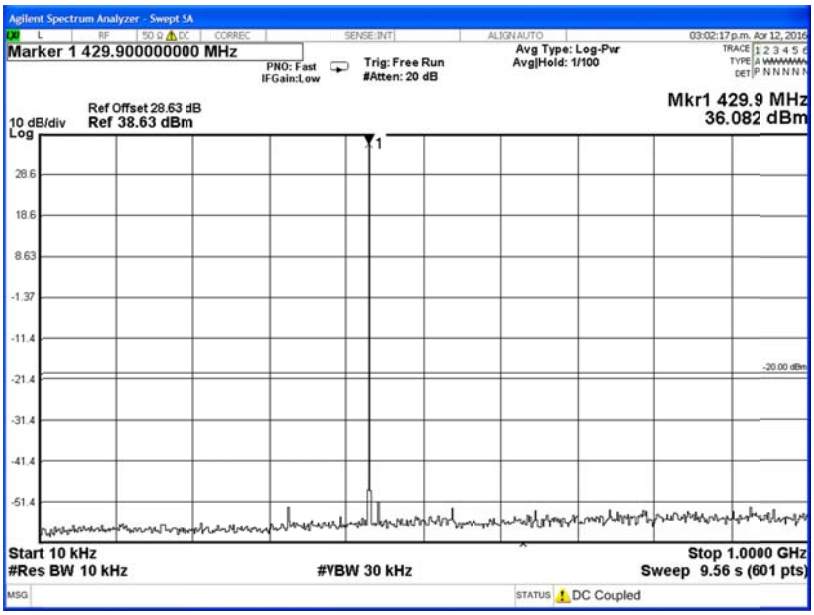
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

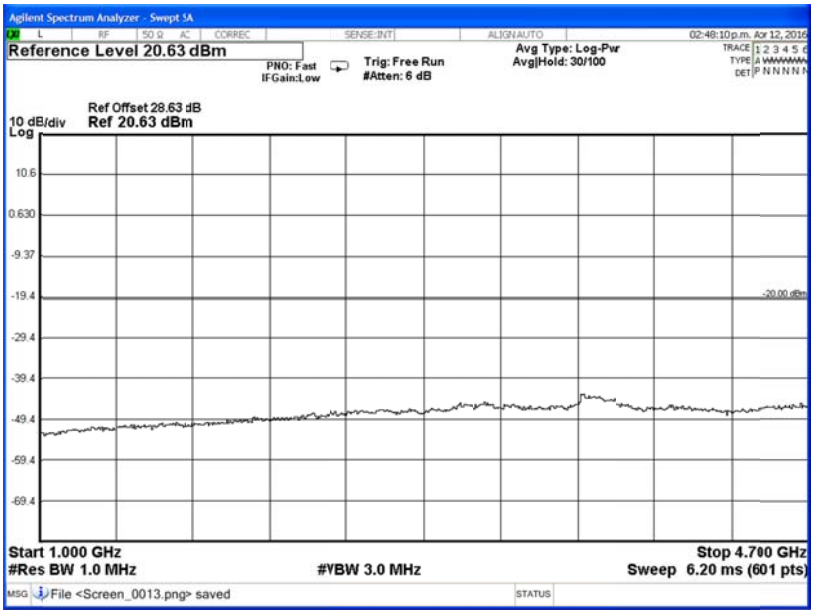
12.5 kHz Channel Spacing 429.9 MHz @ 4 W Emission Mask D

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

12.5 kHz Channel Spacing 429.9 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.		





Spurious Emissions (Tx Conducted)

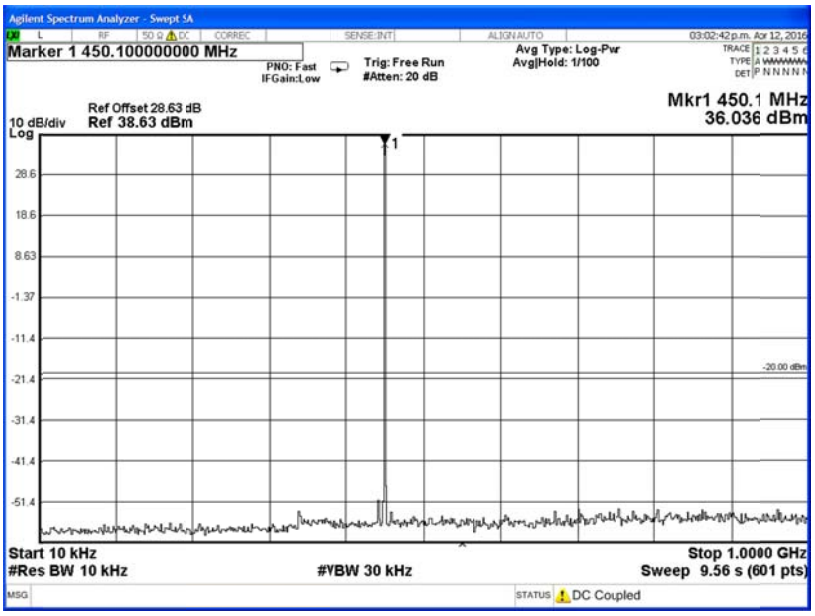
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

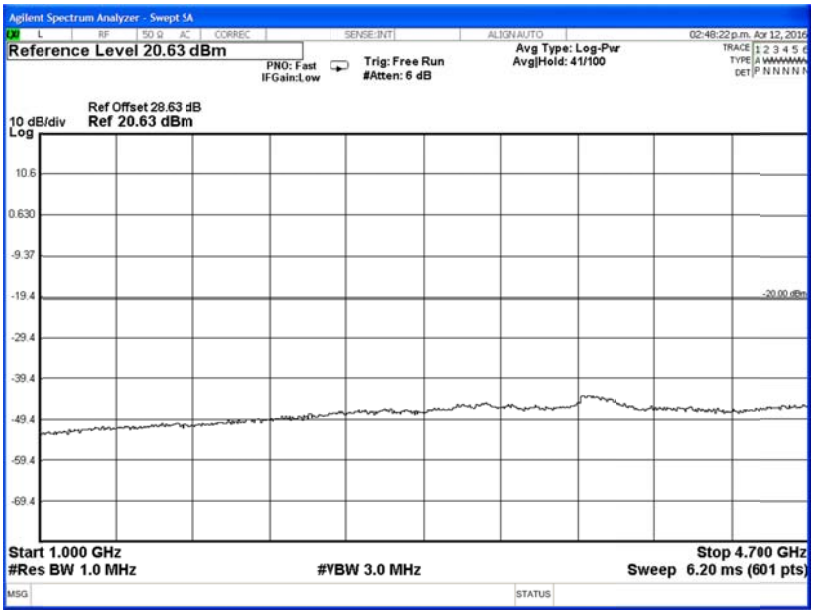
12.5 kHz Channel Spacing 450.1 MHz @ 4 W Emission Mask D

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

12.5 kHz Channel Spacing 450.1 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.		





Spurious Emissions (Tx Conducted)

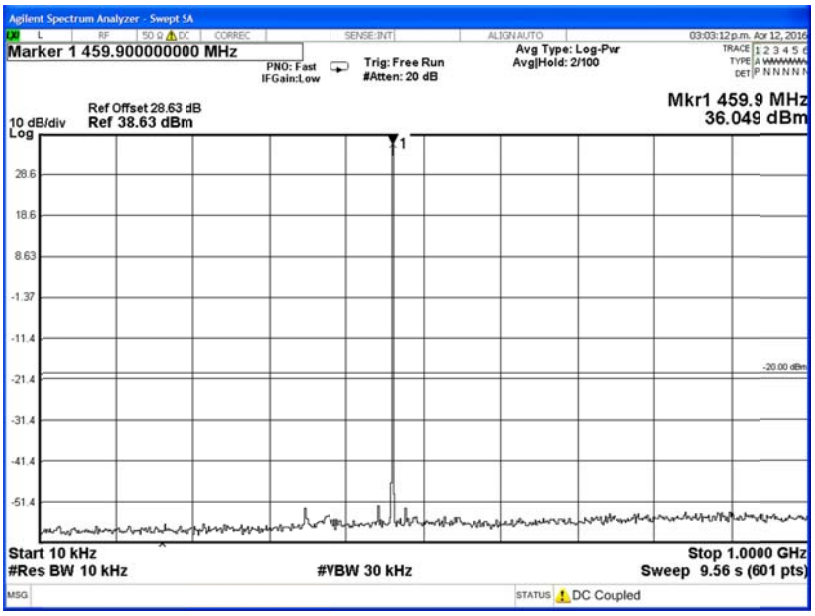
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

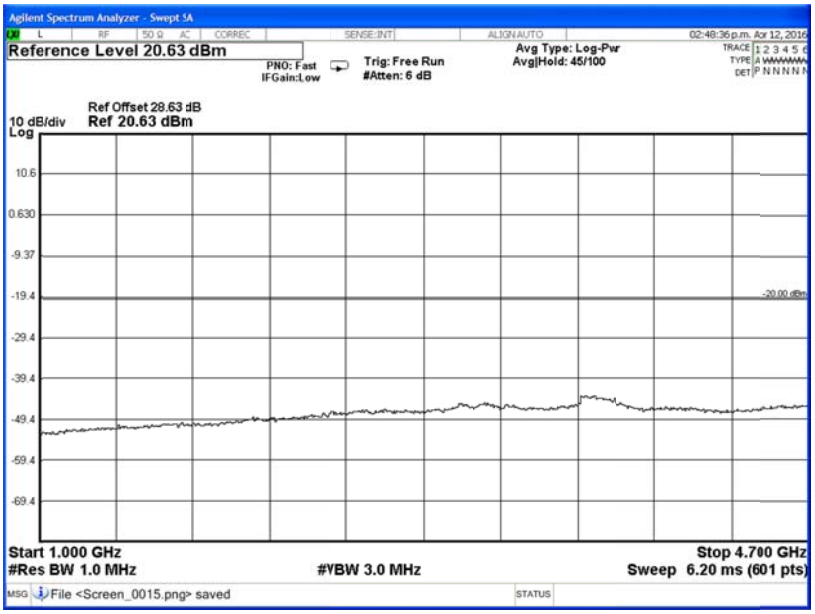
12.5 kHz Channel Spacing 459.9 MHz @ 4 W Emission Mask D

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

12.5 kHz Channel Spacing 459.9 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.		





Spurious Emissions (Tx Conducted)

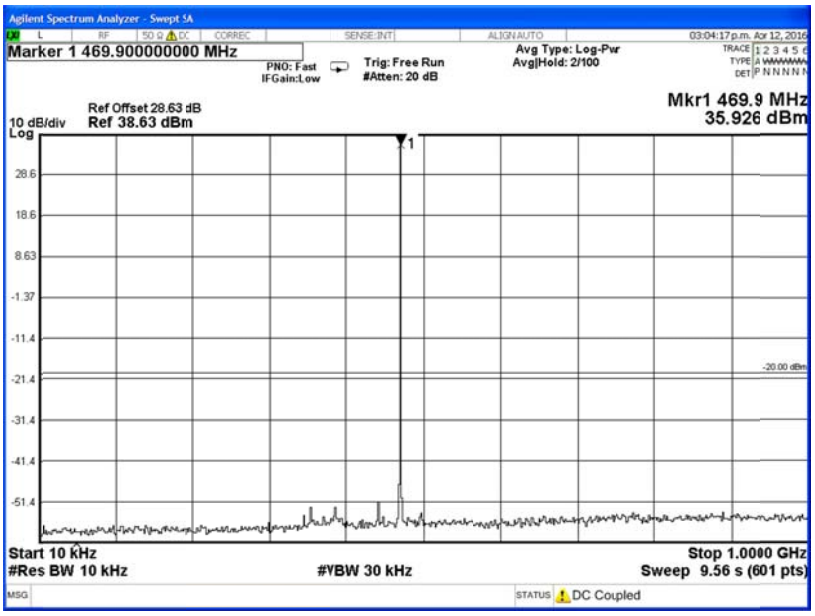
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

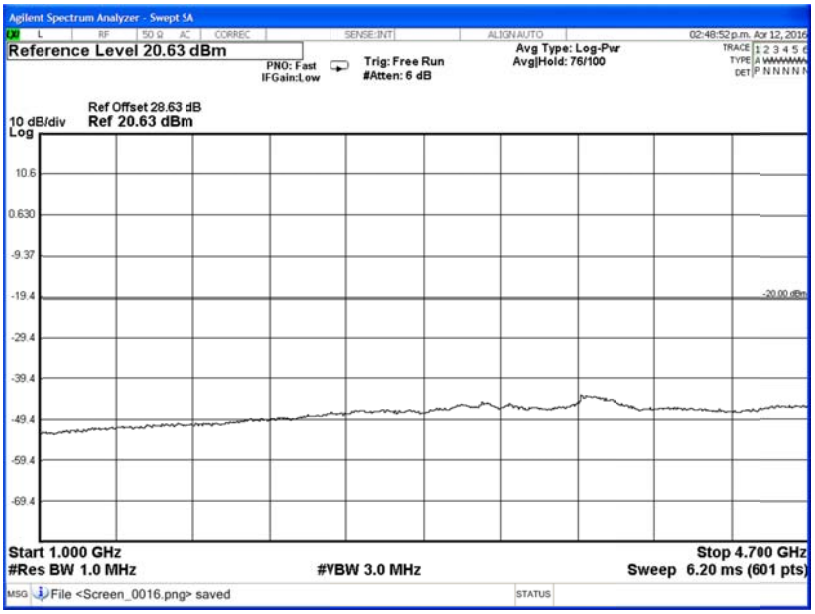
12.5 kHz Channel Spacing 469.9 MHz @ 4 W Emission Mask D

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

12.5 kHz Channel Spacing 469.9 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.		





Spurious Emissions (Tx Conducted)

SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

LIMITS: FCC 47 CFR 90.210 RSS-119 5.8

Carrier Output Power	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
4 W	-20 dBm	-56 dBc
1 W	-20 dBm	-50 dBc

TRANSMITTER SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC 47 CFR 2.1053

GUIDE: TIA/EIA-603D 2.2.12

MEASUREMENT PROCEDURE:
Initial Scan:

1. The EUT is placed in the S-Line TEM cell and emissions are measured from 30 MHz to 800 MHz. Any emission within 20 dB of the limit is then re-tested on the OATS.
2. The EUT is placed in the reverberation chamber and emissions are measured from 800 MHz to the upper frequency required. Any emission within 20 dB of the limit is then re-tested on the OATS.
3. The harmonics emissions up to the 6^{th} harmonic of the fundamental frequency are measured on the OATS

OATS Measurement:

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

MEASUREMENT RESULTS:
See the tables on the following pages

LIMIT CLAUSE: FCC 47 CFR 90.210

Spurious Emissions (Tx Radiated) - Continued

SPECIFICATION: FCC CFR 2.1053

12.5 kHz Channel Spacing 406.2 MHz @ 4 W Emission Mask D

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

12.5 kHz Channel Spacing 406.2 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.		

12.5 kHz Channel Spacing 418.1 MHz @ 4 W Emission Mask D

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

12.5 kHz Channel Spacing 418.1 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.		

12.5 kHz Channel Spacing 429.9 MHz @ 4 W Emission Mask D

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

12.5 kHz Channel Spacing 429.9 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.		

Spurious Emissions (Tx Radiated) - Continued

12.5 kHz Channel Spacing 450.1 MHz @ 4 W Emission Mask D

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

12.5 kHz Channel Spacing 450.1 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.		

12.5 kHz Channel Spacing 459.9 MHz @ 4 W Emission Mask D

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

12.5 kHz Channel Spacing 459.9 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.		

12.5 kHz Channel Spacing 469.9 MHz @ 4 W Emission Mask D

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

12.5 kHz Channel Spacing 469.9 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.		

Spurious Emissions (Tx Radiated) - Continued

LIMITS: FCC CFR 2.1053

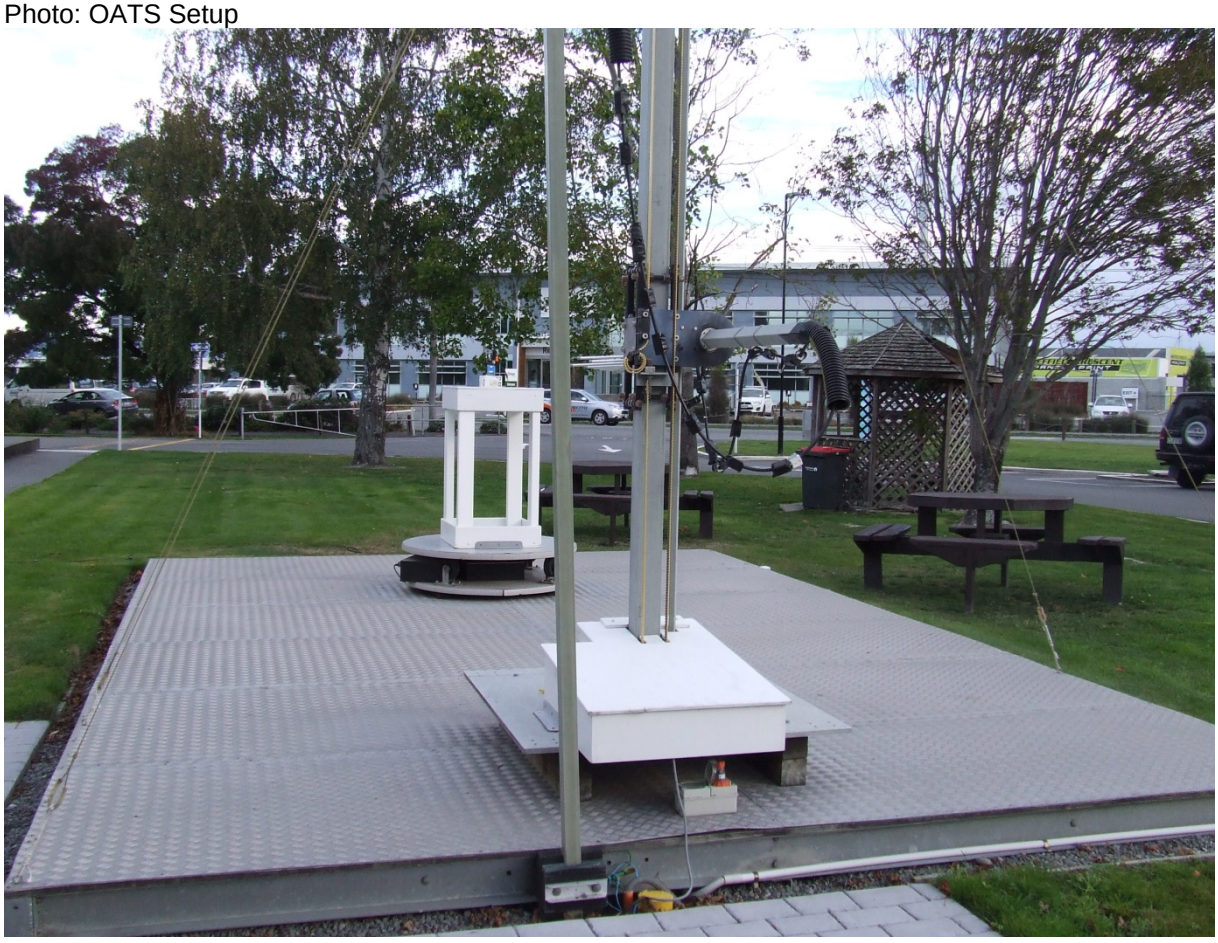
Carrier Output Power	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
4 W	-20 dBm	-56 dBc
1 W	-20 dBm	-50 dBc

Open Area Test Site Results:

12.5 kHz Channel Spacing 429.9 MHz @ 4 W Emission Mask D

Harmonics Emission Frequency (MHz)	Level (dBm)	Level (dBc)
859.8	-50.4	-86.4
1289.7	-60.0	-96.0
1719.6	-66.6	-102.6
2149.5	-53.9	-89.9
2579.4	-63.2	-99.2
3009.3	-70.0	-106.0

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 Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 406.2 MHz 4 W 12.5 kHz Channel Spacing

406.2 MHz @ 4 W Tx

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	-0.3	N/A
t2	0.7	N/A
t3	N/A	-0.4

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

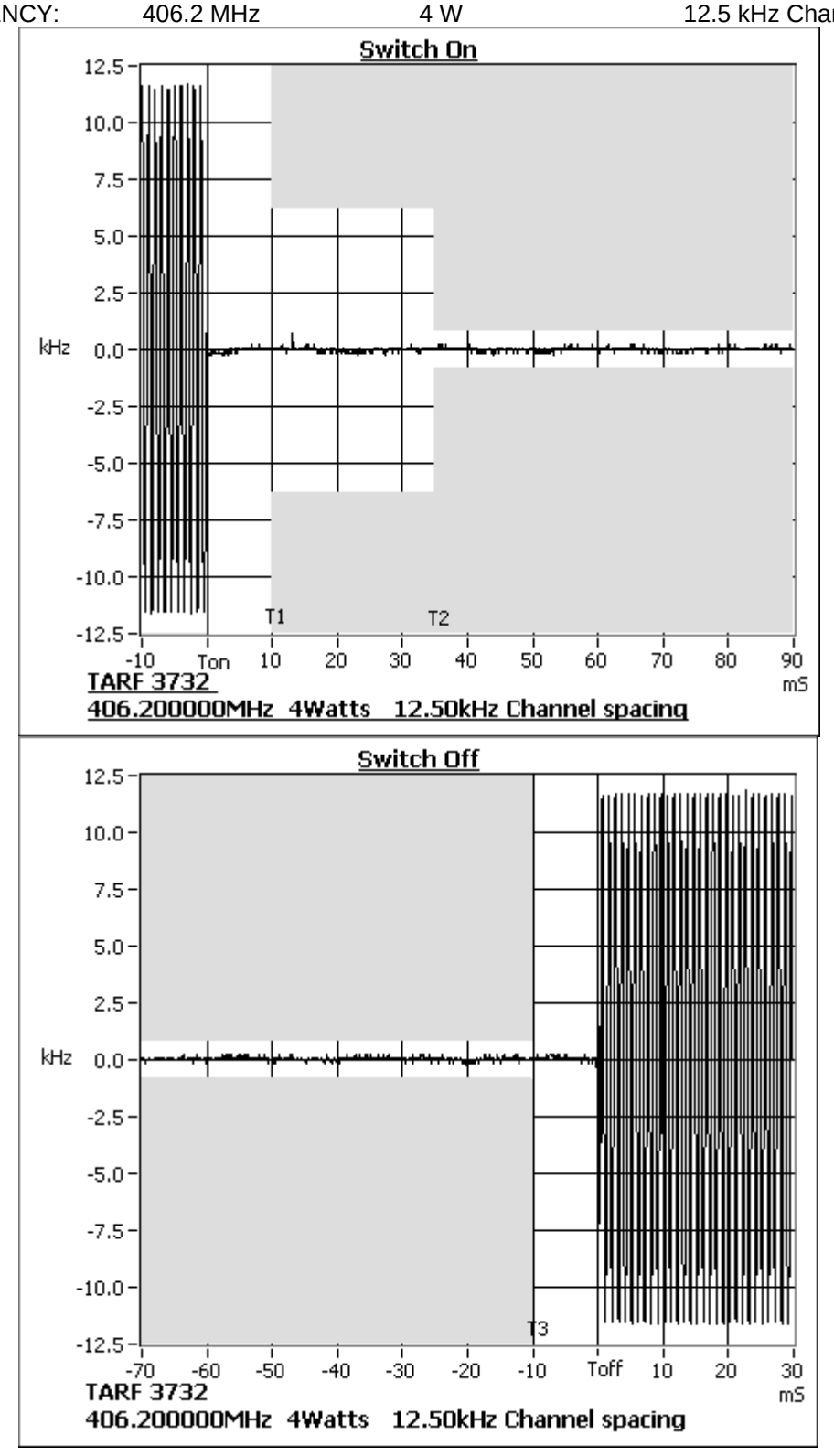
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

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

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 406.2 MHz 4 W 12.5 kHz Channel Spacing



Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 418.1 MHz 4 W 12.5 kHz Channel Spacing

418.1 MHz @ 4 W Tx

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

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

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

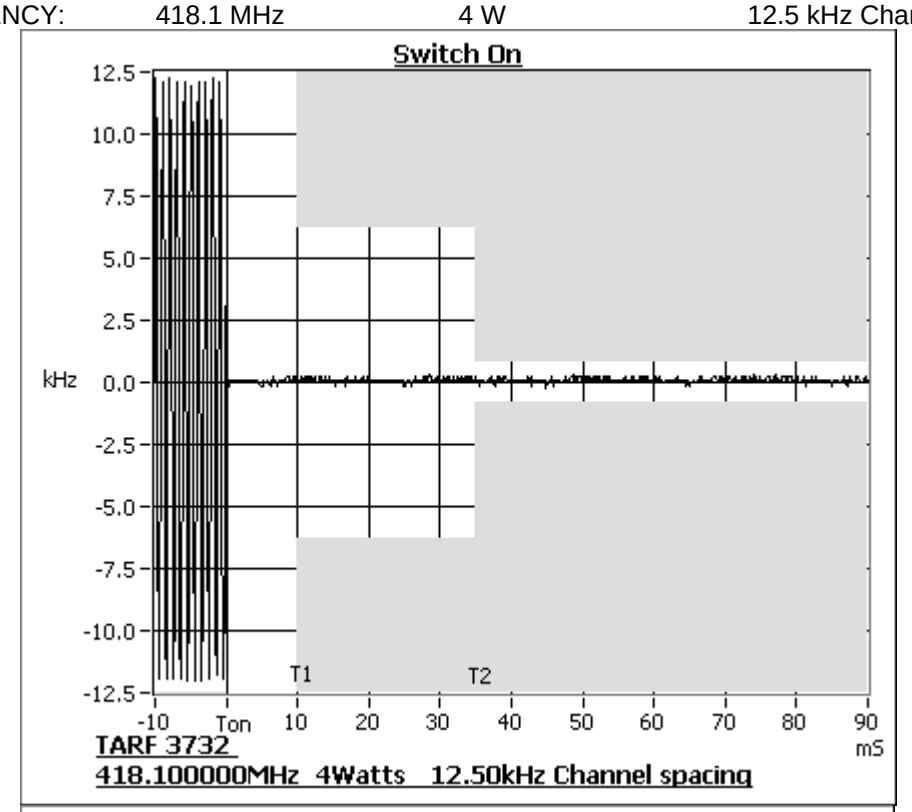
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

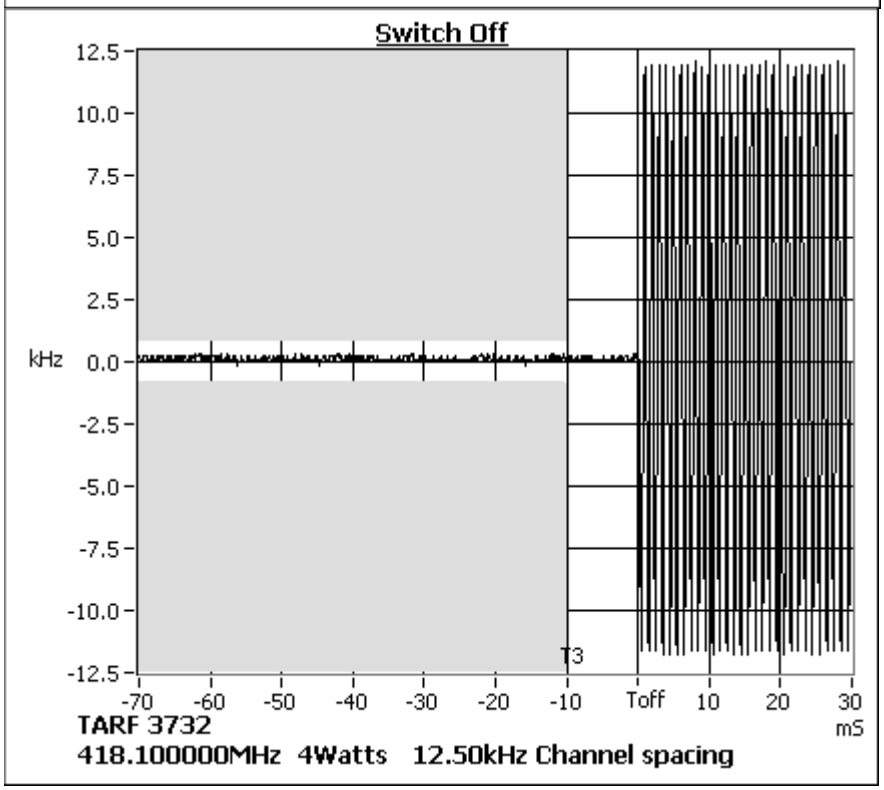
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 418.1 MHz 4 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 429.9 MHz 4 W 12.5 kHz Channel Spacing

429.9 MHz @ 4 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	0.4

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

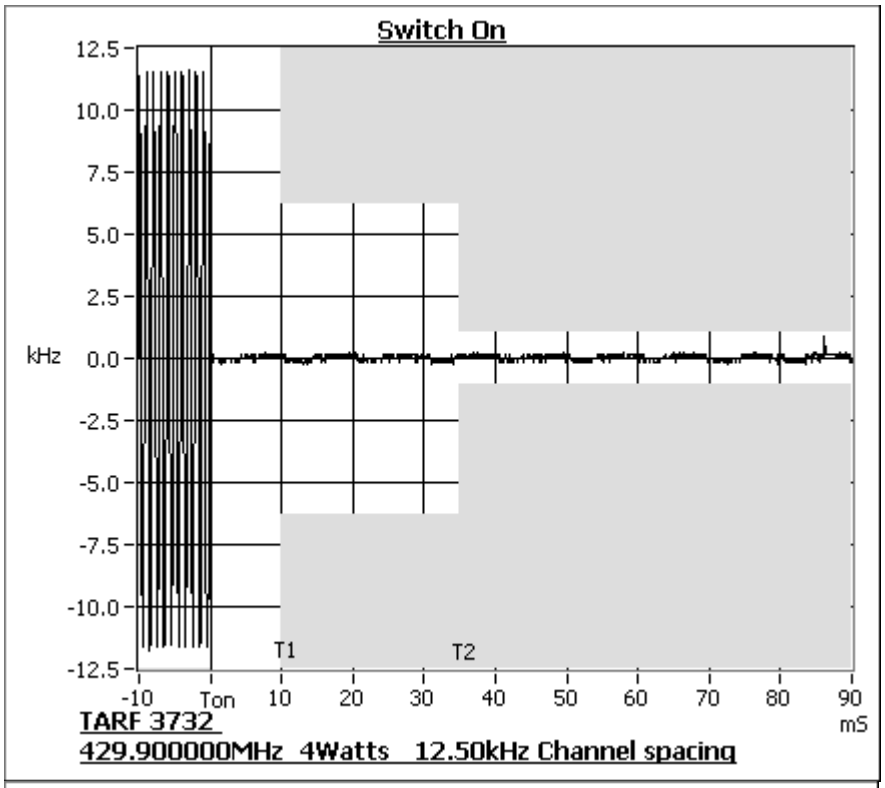
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

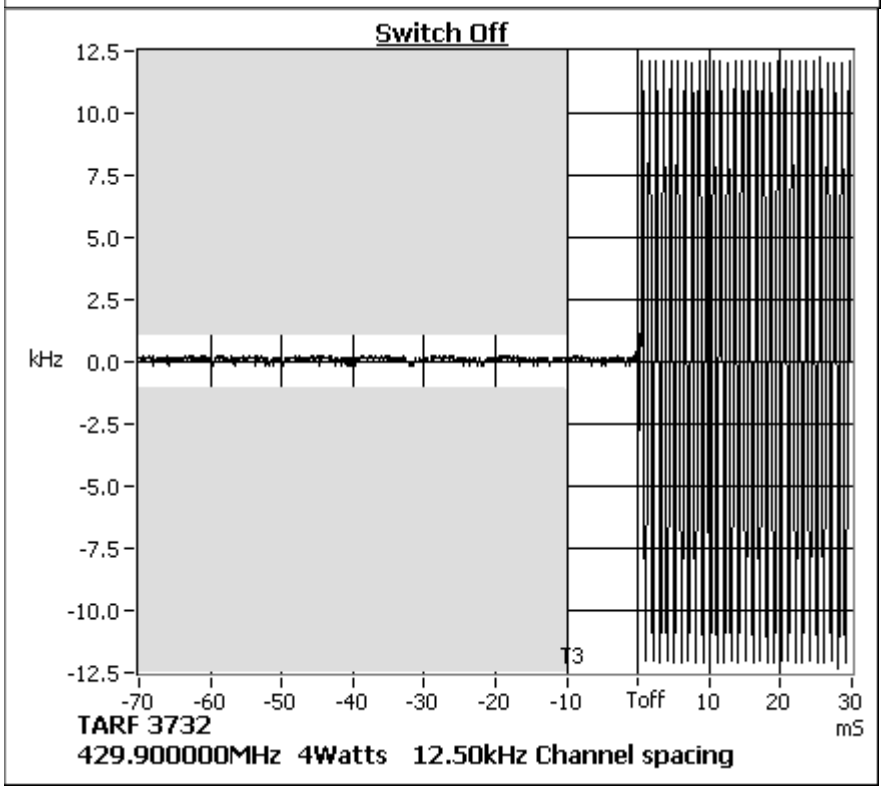
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 429.9 MHz 4 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 450.1 MHz 4 W 12.5 kHz Channel Spacing

450.1 MHz @ 4 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	0.5

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

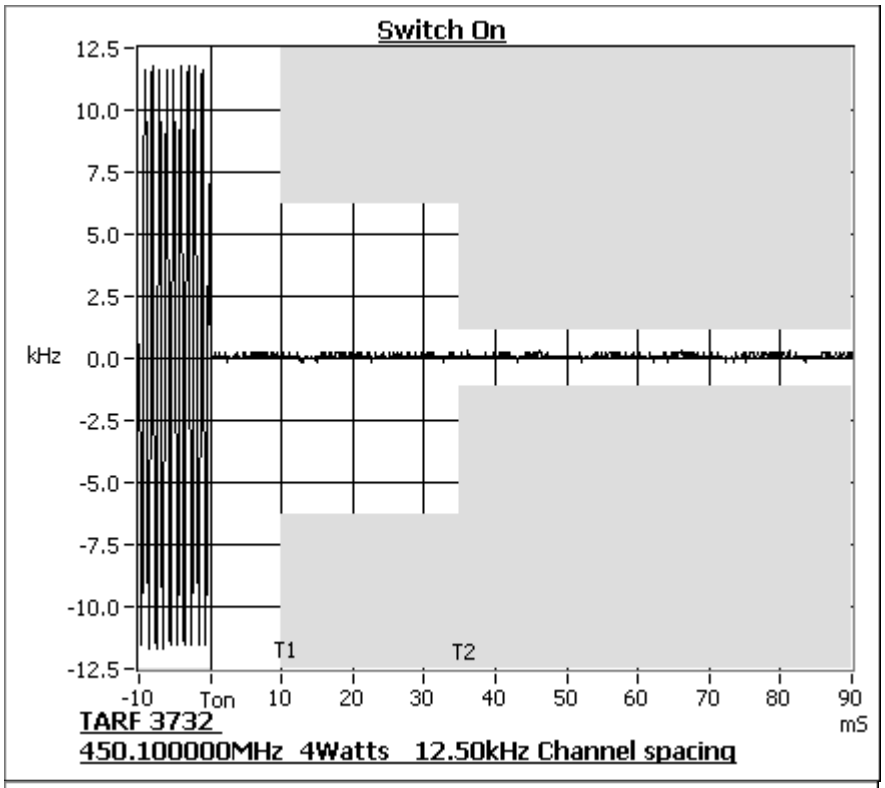
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

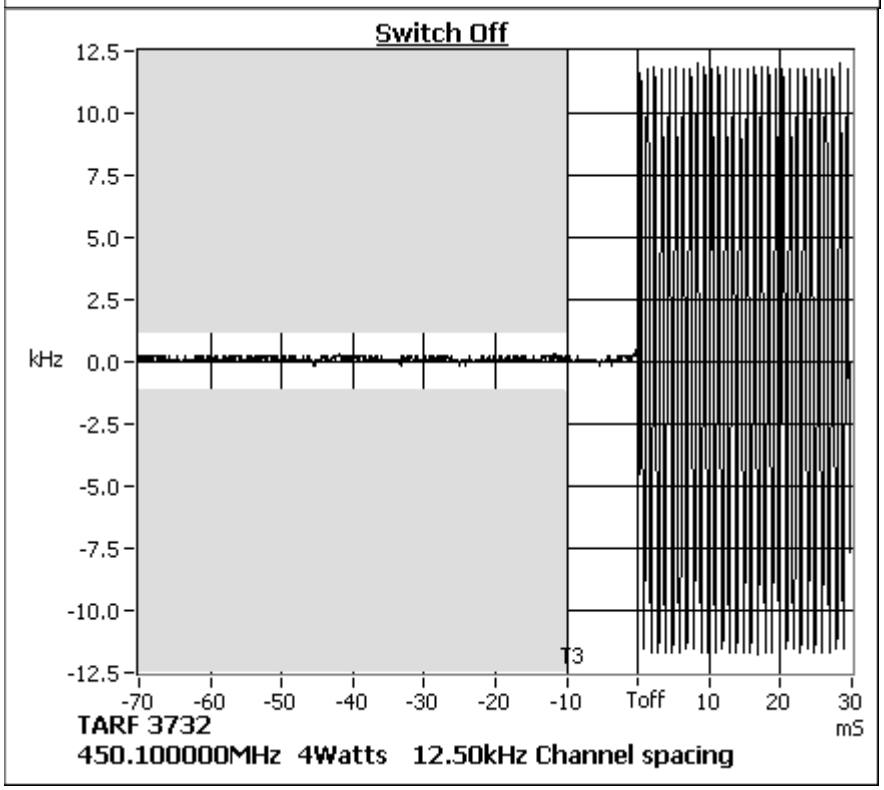
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 450.1 MHz 4 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 459.9 MHz 4 W 12.5 kHz Channel Spacing

459.9 MHz @ 4 W Tx

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	-0.4

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

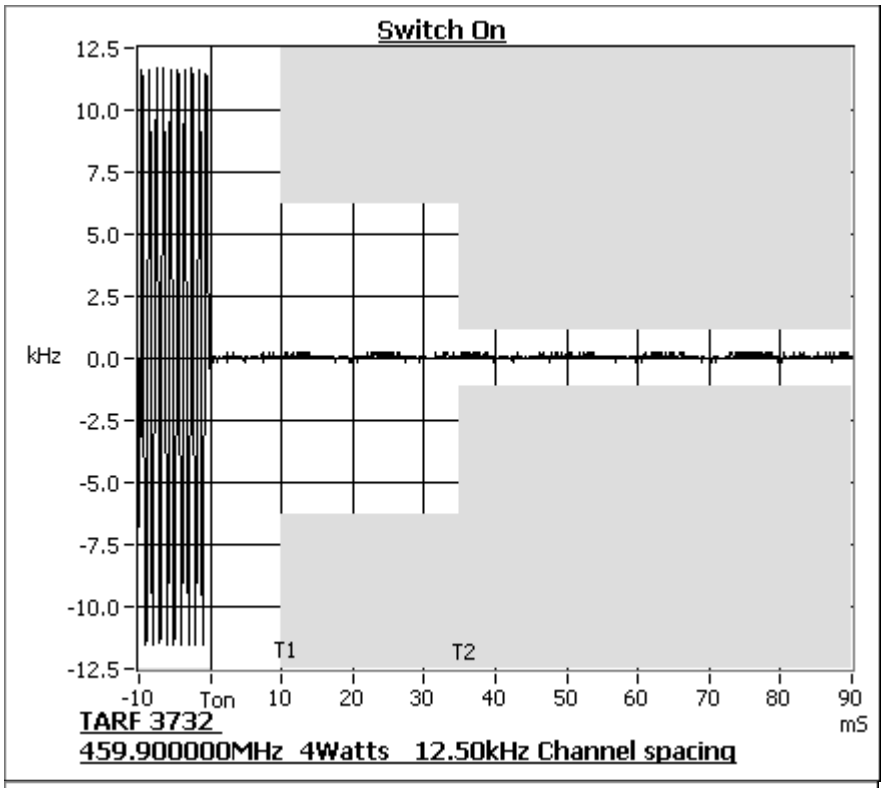
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

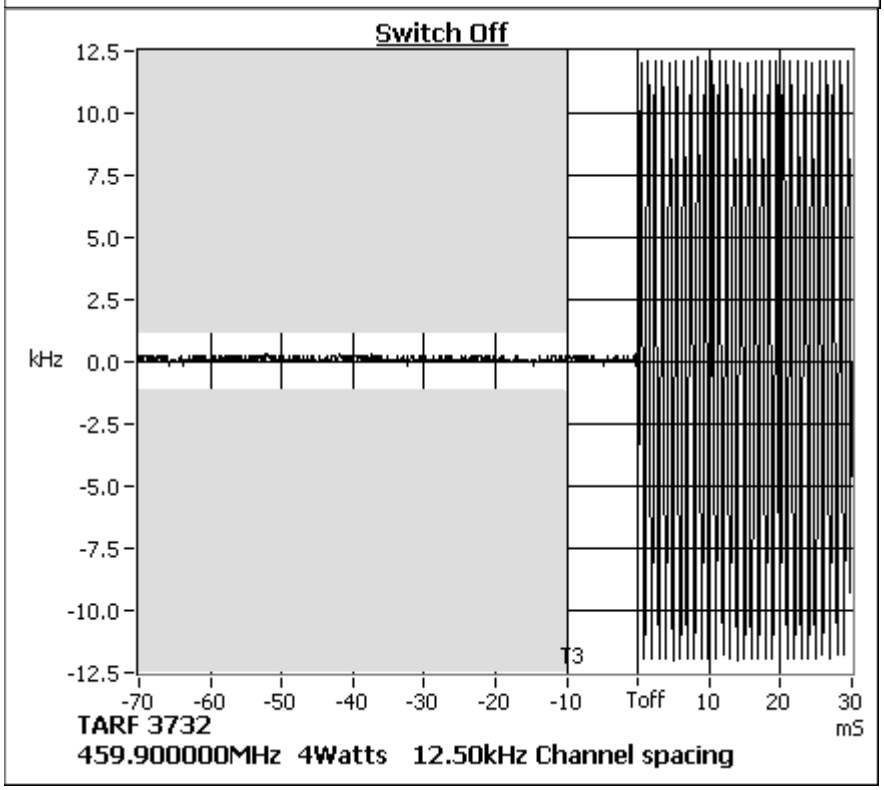
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 459.9 MHz 4 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 469.9 MHz 4 W 12.5 kHz Channel Spacing

469.9 MHz @ 4 W Tx

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	0.4

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

LIMIT: FCC 47 CFR 90.214

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

LIMIT: RSS-119 5.9

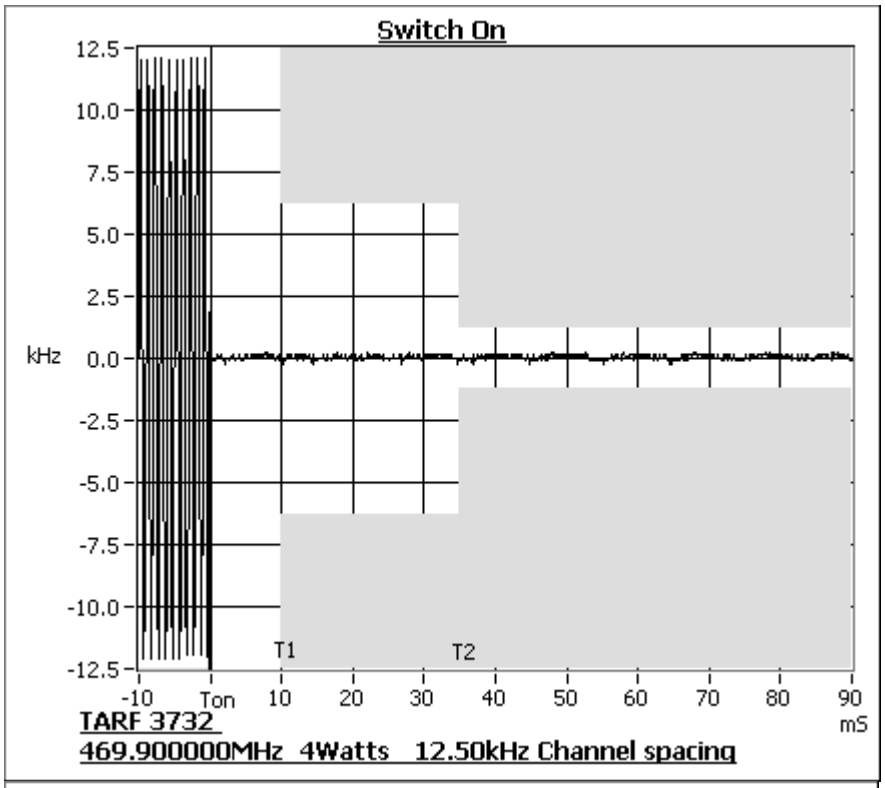
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

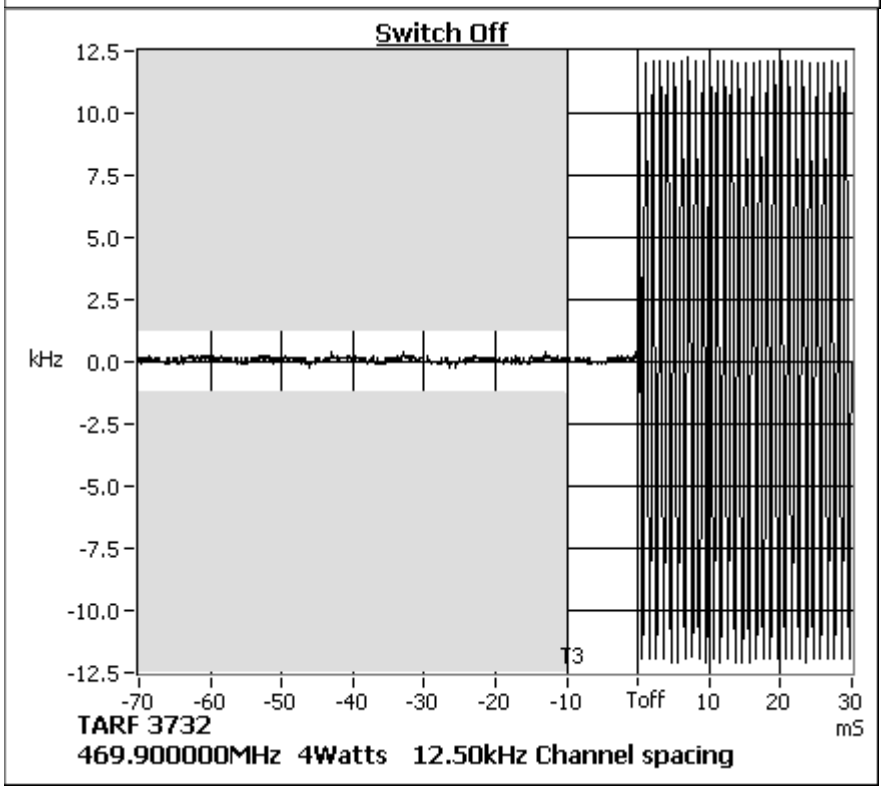
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 469.9 MHz 4 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° C in 10° C increments
3. The frequency error was recorded in parts per million (ppm).

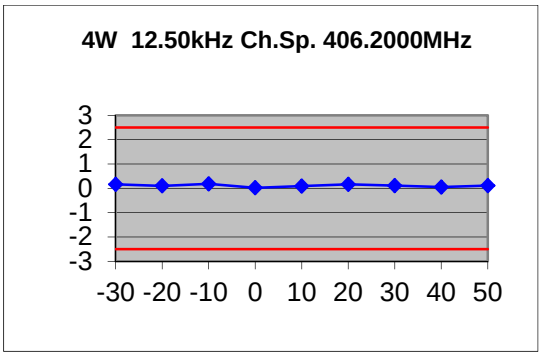
MEASUREMENT RESULTS:
See the plots on the following pages for 12.5 kHz channel spacing.

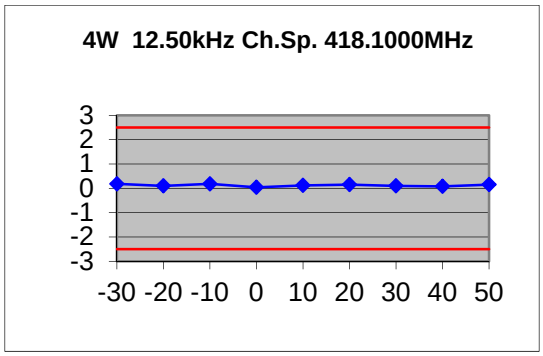
	Error (ppm)					
Temperature (ºC)	406.2 MHz	418.1 MHz	429.9 MHz	450.1 MHz	459.9 MHz	469.9 MHz
-30	0.16	0.18	0.15	0.14	0.14	0.12
-20	0.1	0.1	0.13	0.15	0.16	0.17
-10	0.18	0.18	0.16	0.15	0.15	0.13
0	0.02	0.04	0.05	0.05	0.05	0.08
10	0.09	0.12	0.13	0.13	0.15	0.17
20	0.16	0.15	0.16	0.16	0.15	0.14
30	0.11	0.1	0.11	0.11	0.1	0.1
40	0.05	0.08	0.08	0.08	0.09	0.11
50	0.11	0.15	0.15	0.15	0.17	0.19

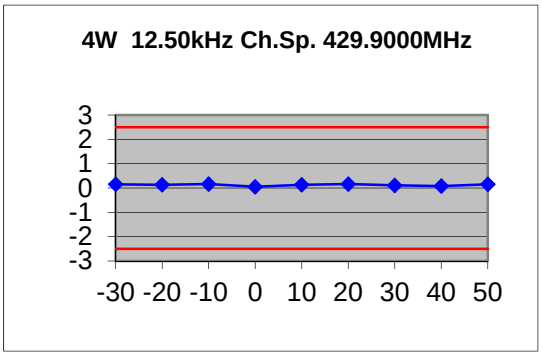
LIMIT: FCC 47 CFR 90.213 RSS-119 5.3

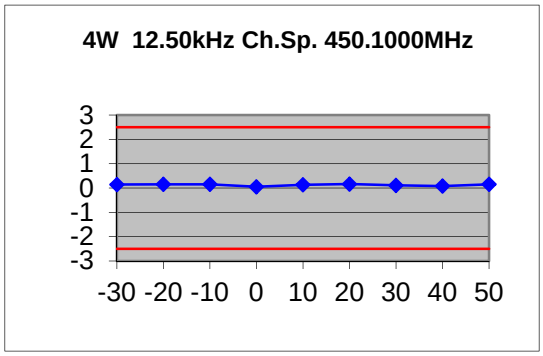
Channel Spacing (kHz)	Frequency Error (ppm)
12.5	2.5

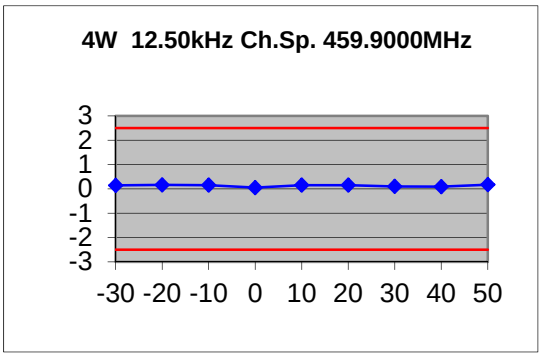
Transmitter Frequency Stability – Temperature

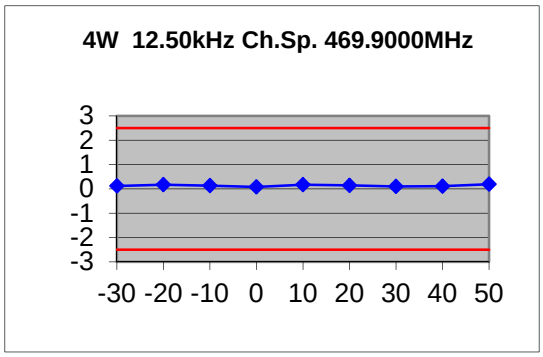












TRANSMITTER FREQUENCY STABILITY - VOLTAGE

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 battery voltage and battery end point.
3. The frequency error was recorded in parts per million (ppm).

MEASUREMENT RESULTS:

	FREQUENCY ERROR (ppm) for 12.5 kHz	
	7.5 V_{DC}	6.375 V_{DC}
406.2 MHz	-0.06	-0.04
418.1 MHz	-0.03	-0.03
429.9 MHz	-0.01	-0.01
450.1 MHz	-0.01	-0.02
459.9 MHz	0.01	-0.01
469.9 MHz	0.00	0.01

LIMIT CLAUSES: FCC 47 CFR 90.213 RSS-119 5.3

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

RECEIVER SPURIOUS EMISSIONS (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 20 dB below the limit were not recorded.

406.2 MHz Receive		
Emission Frequency (MHz)	Level (nW)	Level (dBm)
361.1000	0.076	-71.2
~	~	~
No other emissions were detected within 20 dB of Limit.		

418.1 MHz Receive		
Emission Frequency (MHz)	Level (nW)	Level (dBm)
373.0000	0.060	-72.2
~	~	~
No other emissions were detected within 20 dB of Limit.		

429.9 MHz Receive		
Emission Frequency (MHz)	Level (nW)	Level (dBm)
384.8000	0.048	-73.2
~	~	~
No other emissions were detected within 20 dB of Limit.		

450.1 MHz Receive		
Emission Frequency (MHz)	Level (nW)	Level (dBm)
405.0000	0.030	-75.2
~	~	~
No other emissions were detected within 20 dB of Limit.		

Receiver Spurious Emissions (Conducted) – Continued

459.9 MHz Receive		
Emission Frequency (MHz)	Level (nW)	Level (dBm)
414.8000	0.026	-75.9
~	~	~
No other emissions were detected within 20 dB of Limit.		

469.9 MHz Receive		
Emission Frequency (MHz)	Level (nW)	Level (dBm)
424.8000	0.022	-76.6
~	~	~
No other emissions were detected within 20 dB of Limit.		

LIMIT CLAUSE: RSS-Gen 6(b)

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

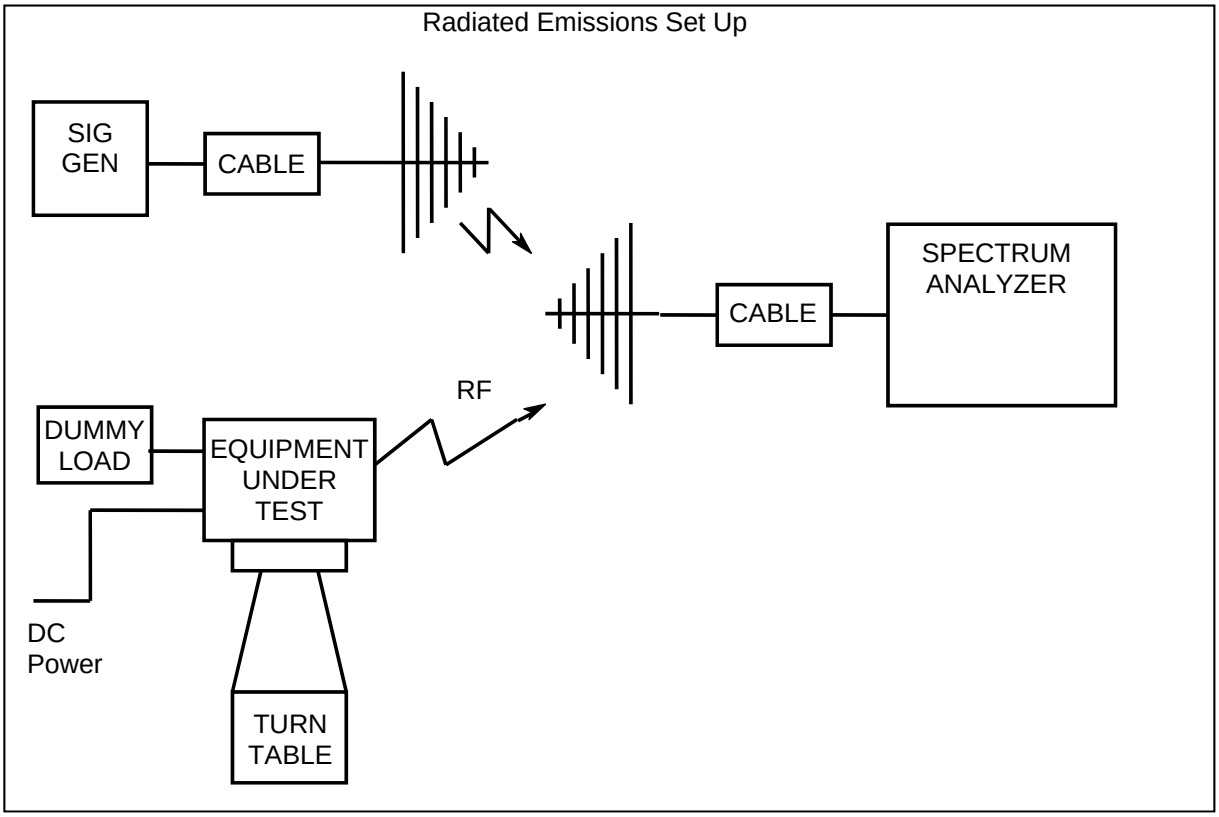
TEST EQUIPMENT LIST

Equipment Type	Information	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
Antenna	18GHz DRG	Emco	DRG3115	9512-4638	E3560	6-May-16
Antenna	Log Periodic	Schwarzbeck	VUSLP	9111-219	E4617	
Antenna	Reverb - 1-18GHz DRG	Schwarzbeck	BBHA 9120 D	9120D-885	E4857	
Antenna	Reverb - 1-18GHz DRG	Schwarzbeck	BBHA 9120 D	9120D-884	E4858	
Antenna	Precision Dipole 300 to 1000MHz	Schwarzbeck	UHAP	1041	E4975	
Audio Analyser	TREVA1	Hewlett Packard	HP8903A	2437A04625	E4986	21-Oct-16
Coax Cable	2m Black	Suhner	RG214HF/Nm/ Nm/2000	TeltestBlack2	E4623	18-Oct-16
Coax Cable	2m Black	Suhner	RG214HF/Nm/ Nm/2000	TeltestBlack3	E4624	18-Oct-16
Coax Cable	3m Blue	Suhner	Sucoflex 104A	44611/4A	E4620	18-Oct-16
Coax Cable	OATS Turntable Cable 1	Intelcom	RG214	OATS1	E4621	20-Oct-16
Coax Cable	OATS Tower Cable	Intelcom	RG214	OATS2	E4622	20-Oct-16
Coax Cable	Reverb - 4.5m Multiflex 141	TeltestBlue6	MF 141	TeltestBlue6	E4843	20-Oct-16
Coax Cable	Reverb - 2m Multiflex 141	TeltestBlue5	MF 141	TeltestBlue5	E4844	20-Oct-16
Coax Cable	Reverb - 2m Multiflex 141	TeltestBlue4	MF 141	TeltestBlue4	E4845	20-Oct-16
Coax Cable	Reverb - 1m Multiflex 141	TeltestBlue3	MF 141	TeltestBlue3	E4846	20-Oct-16
Coax Cable	Reverb - 1m Multiflex 141	TeltestBlue2	MF 141	TeltestBlue2	E4847	20-Oct-16
Coax Cable	2.5m Blue	Suhner	Sucoflex 104A	33449/4PEA	E4997	18-Oct-16
Coax Cable	OATS Turntable Cable 2	Intelcom	RG215	OATS3	E4995	20-Oct-16
Environ. Chamber	Upright	Contherm	5400 RHSLT.M	1416	E4051	1-Aug-17
Modulation Analyser	TREVA1	Hewlett Packard	HP8901B (Opt 002)	2441A00393	E3073	21-Oct-16
OATS	NSA	Tait				9-Jun-16
OATS	Antenna Tower	Electrometrics	EM-4720-2	112	E4447	
OATS	Controller	Electrometrics	EM-4700	119	E4445	
OATS	Turntable	Electrometrics	EM-4704A	105	E4446	
OATS	FCC Listing Registration			837095		12-May-16
Oscilloscope	100MHz Digital	Tektronics	TDS340	B013611	E3585	13-Oct-17
Power Meter	TREVA1 Power Head for HP8901	Hewlett Packard	HP11722A	3111A05573	E7054	21-Oct-16
Power Supply	TREVA1	Hewlett Packard	HP6032A	2441A00412	E3075	13-Oct-17
RF Amplifier	+21.7 dB 1GHz	Tait	ZFL-1000LN	E3660	E3360	17-Jan-17
RF Amplifier	Pre-amplifier	Agilent	87405C	MY47010688	E4941	20-Oct-16
RF Attenuator	20dB 25W	Weinschel	33-20-33	BD5871	E3673	15-Oct-16
RF Attenuator	30dB 350W	Weinschel	67-30-33	BR0531	E4280	18-Oct-16
RF Attenuator	TREVA1 3dB	Weinschel	Model 1	BL9958	E4081	
RF Attenuator	20dB 150W	Weinschel	40-20-23	MF817	E4082	19-Oct-16
RF Chamber	S-LINE TEM CELL	Rohde & Schwarz	1089.9296.02	338232/003	E3636	29-Sep-16
RF Chamber	Reverb - Stirrer controller for reverb chamber	Teseq	Stirrer Controller	29765.1	E4854	
RF Chamber	Reverb - 0.5 - 18GHz Reverberation Chamber	Teseq	RVC XS	29765	E4855	
RF Combiner	TREVA1	Minicircuits	ZFSC-4-1	-	E4083	
RF Load	50W	Weinschel	F1426	BF0487	E3675	19-Oct-16

Signal Generator	Analog 4GHz	Agilent	E4422B	GB40050320	E3788	18-Oct-16
Signal Generator	Analog 3.2GHz	Hewlett Packard	HP8648C	3443U00543	E3558	16-Oct-16
Signal Generator	TREVA1 Analog 3.2GHz	Agilent	E8663D	MY50420224	E4908	16-Oct-16
Spectrum Analyser	26.5GHz	Agilent	PXA N9030A	MY49432161	E4907	6-Jul-16
Spectrum Analyser	13.2GHz	Agilent	E4445A	MY42510072	E4139	22-Oct-16
Temp & Humidity datalogger		Hobo	U21-011	10134276	E4981	14-Aug-16

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

ANNEX A – TEST SETUP DETAILS



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