TELTEST Laboratories
Tait Ltd
Report Number 3743

LABORATORY TEST REPORT

RADIO PERFORMANCE MEASUREMENTS

for the

TBDH5G BASE STATION Transceiver

Tested in accordance with:

FCC 47 CFR Parts 22, 74 and 90

RSS-119 Issue 12
RSS-Gen Issue 4

Report Revision: 2

Issue Date: 01-June-2016

PREPARED BY: Aaron Fan _____
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
16-May-2016	1	Initial test report
01-June-2016	2	Added FCC 47 CFR Part 74 to report

INTRODUCTION

Type approval testing of the TBDH5G, 40 Watt, BASE STATION 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) modulations.

Type Approval Testing of the TBDH5G
Serial number 18236735
Frequency range 400 → 470 MHz

in accordance with:
FCC 47 CFR Parts 22, 74 and 90
RSS-119 Issue 12 & RSS-Gen Issue 4

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

DESCRIPTION OF SAMPLE
Manufacturer Tait Limited
Equipment: BASE STATION Transceiver
Type: TBDH5G
Product Code: TB7310-H5B0-0000-00AE-10
Serial Number(s): 18236735
Quantity: 1

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
Digital Mobile Radio (DMR)	4 Level FSK (2 slot TDMA) (ETSI TS102 361-1)	12.5 kHz	2	4800	9600

HARDWARE & SOFTWARE

Module	*Product Code*	*Serial Number*	*Firmware Version*	*Hardware Version*
Reciter	T01-01403-SAZZ	18236681	dmr-2.15.00.0006	1
Power Amplifier	T01-01405-SAZZ	18236684		0.01
Front Panel	T01-01410-AAAA	2887992	1.08.00.0002	0.01

TEST CONDITIONS
All testing was performed between 02 → 12-May-2016, and under the following conditions:
Ambient temperature: 15°C → 30°C
Relative Humidity: 20% → 75%
Standard Test Voltage 13.8 V_{DC}

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:	TBDH5G
Product Code:	TB7310-H5B0-0000-00AE-10
Serial Number(s):	18236735
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: _____

Mike James
Technical Manager

Date: _____

MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS

MODULATION TYPES:

F3E	Analogue Frequency Modulation		
F2D	Fast Frequency Shift Keying	1200 symbols/sec	1200 bps
FXD	Digital Data	4800 symbols/sec	9600 bps
FXW	Digital Voice / Data	4800 symbols/sec	9600 bps

CHANNEL SPACINGS: 12.5 kHz

EMISSION DESIGNATORS:

FM Voice	11K0F3E
FFSK	7K60F2D
Digital Voice DMR	7K60FXW
Digital Data DMR	7K60FXD
FM	11K0F3E

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 Channel Spacing

Necessary bandwidth
M = 1.8 kHz
D = 2.0 kHz
Bn = (2 x 1.8) + (2 x 2.0) x 1
= 7.6 kHz

Emission Designator
7K60F2D
F2D represents a FM data transmission with the use of a modulating sub carrier

Digital Voice 12.5 kHz Bandwidth DMR

99% bandwidth
= 7.6 kHz

Emission Designator
7K60FXW
FXW represents a FM Time Division Multiple Access (TDMA) combination of data and telephony

Digital Data 12.5 kHz Bandwidth DMR

99% bandwidth
= 7.6 kHz

Emission Designator
7K60FXD
FXD represents FM Time Division Multiple Access (TDMA) data only

TEST RESULTS

TRANSMITTER OUTPUT POWER (CONDUCTED)

SPECIFICATION: FCC 47 CFR 2.1046
RSS-119 5.4

GUIDE: TIA-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: 40 W and 2 W

Nominal 40 W	406.2 MHz	418.1 MHz	429.9 MHz	450.1 MHz	459.9MHz	469.9MHz
Measured	41.7	40.3	40.4	40.3	42.0	40.7
Variation (%)	4.1	0.8	1.1	0.8	5.0	1.7
Variation (dB)	0.2	0.0	0.0	0.0	0.2	0.1
Nominal 2 W	406.2 MHz	418.1 MHz	429.9 MHz	450.1 MHz	459.9MHz	469.9MHz
Measured	2.0	1.9	1.9	1.9	1.9	1.9
Variation (%)	-2.2	-5.3	-3.8	-3.9	-3.3	-5.1
Variation (dB)	-0.1	-0.2	-0.2	-0.2	-0.1	-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 AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS

SPECIFICATION: FCC 47 CFR 2.1047 (a)

GUIDE: TIA/EIA-603D 2.2.6

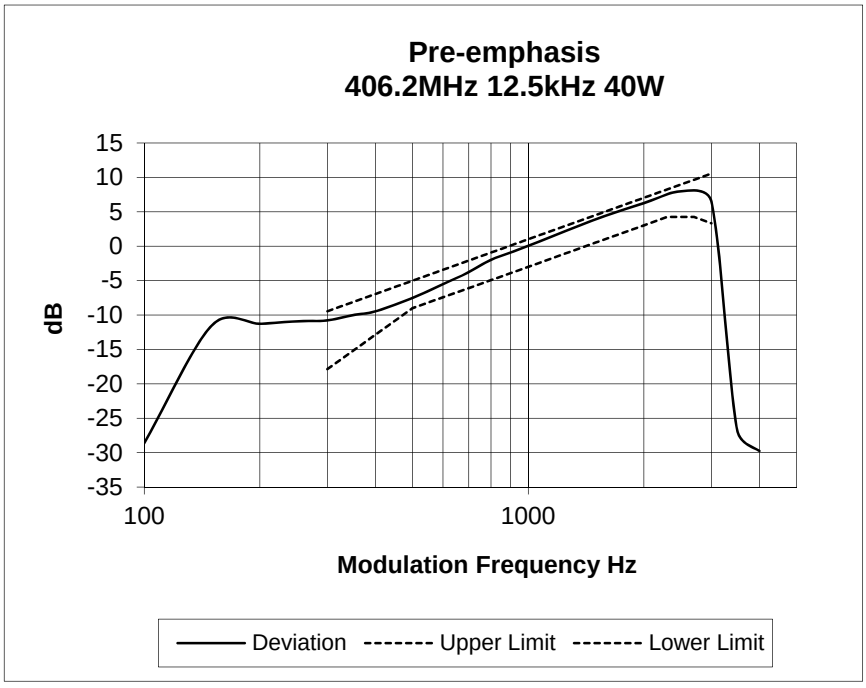
MEASUREMENT PROCEDURE:
1. Refer Annex A for Equipment set up.
2. An audio input tone of 1000 Hz was applied with the level set to obtain 20% of maximum deviation. This was used as the 0 dB reference point.
3. The AF was varied while the audio level was held constant.
4. The response in dB relative to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

MEASUREMENT RESULTS:
See the plots on the following pages for 12.5 kHz channel spacing tested at 40 W transmit power.

LIMIT CLAUSE: TIA/EIA-603D 3.2.6

SPECIFICATION: FCC CFR 2.1047 (a)

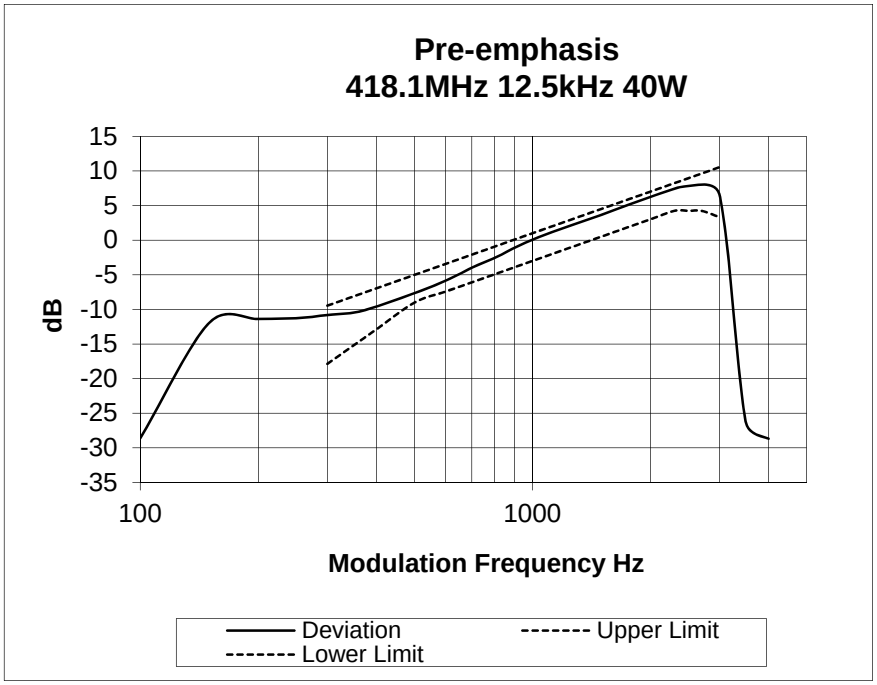
Tx FREQUENCY: 406.2 MHz 12.5 kHz Channel Spacing



Transmitter Audio Frequency Response – Pre-emphasis

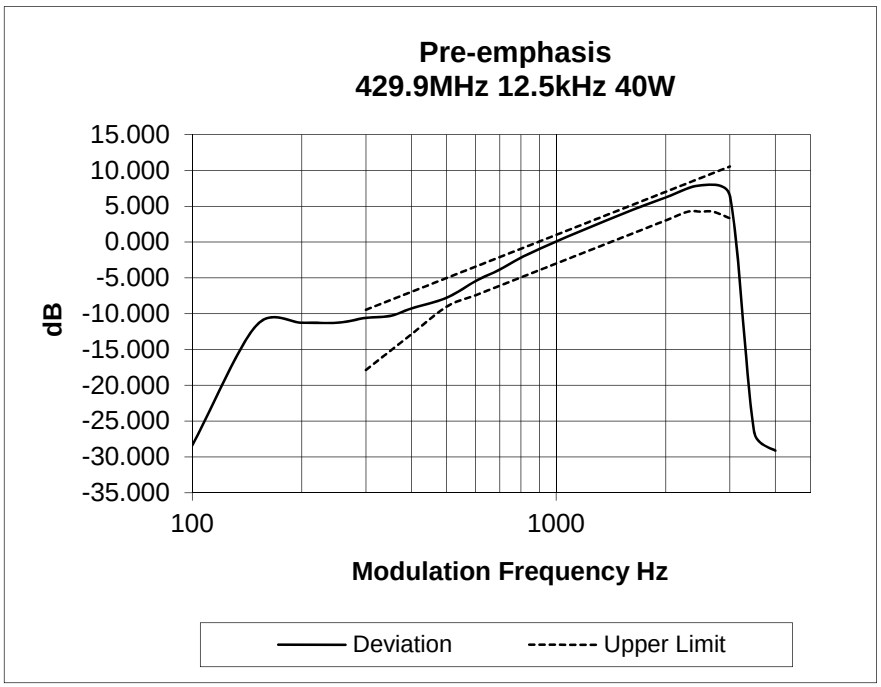
SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 418.1 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

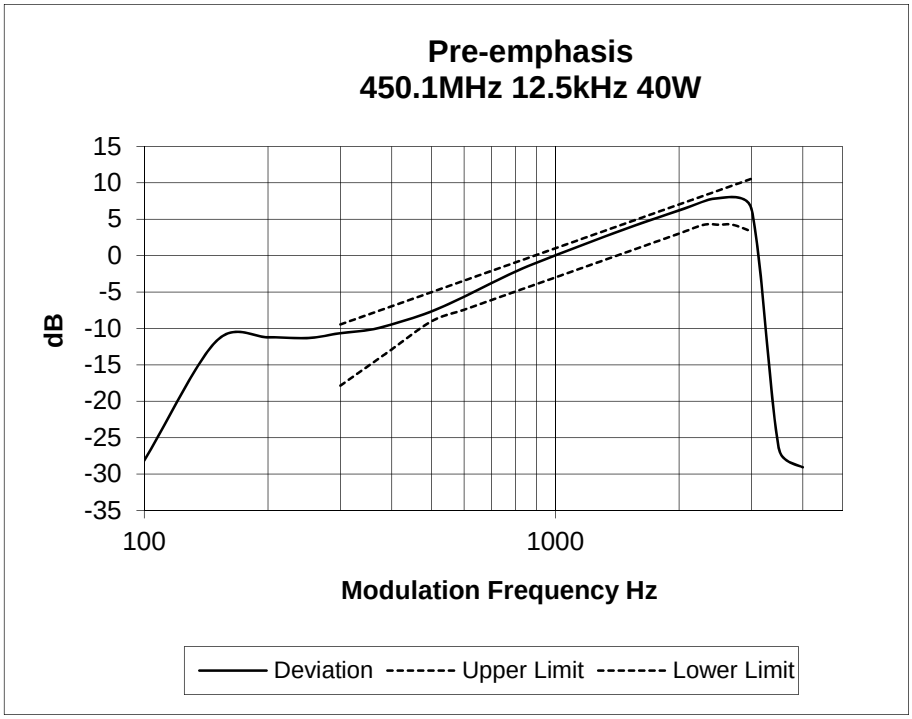
Tx FREQUENCY: 429.9 MHz 12.5 kHz Channel Spacing



Transmitter Audio Frequency Response – Pre-emphasis

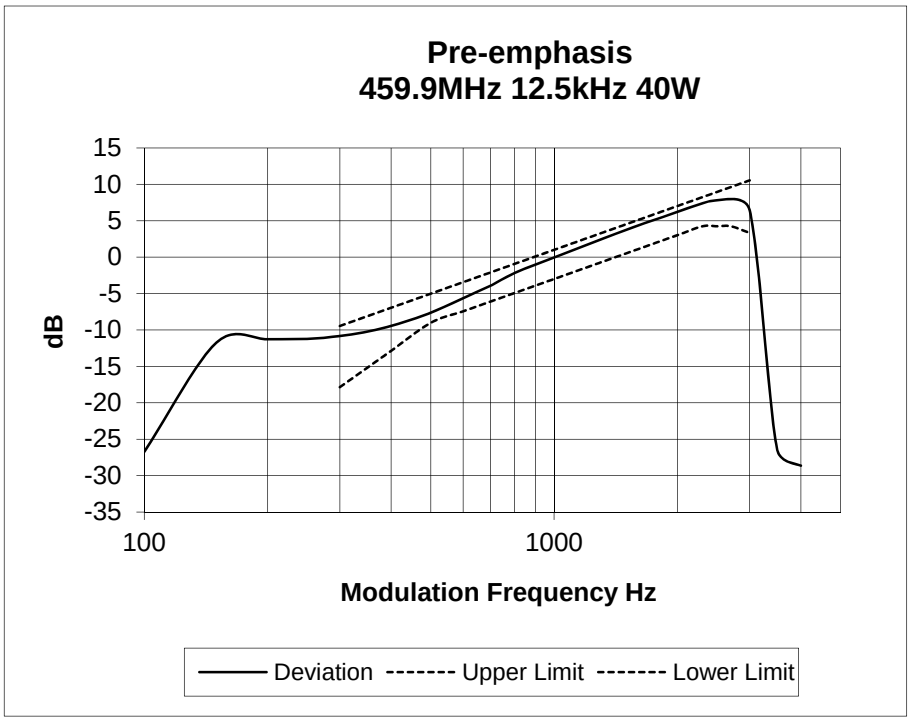
SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 450.1 MHz 12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

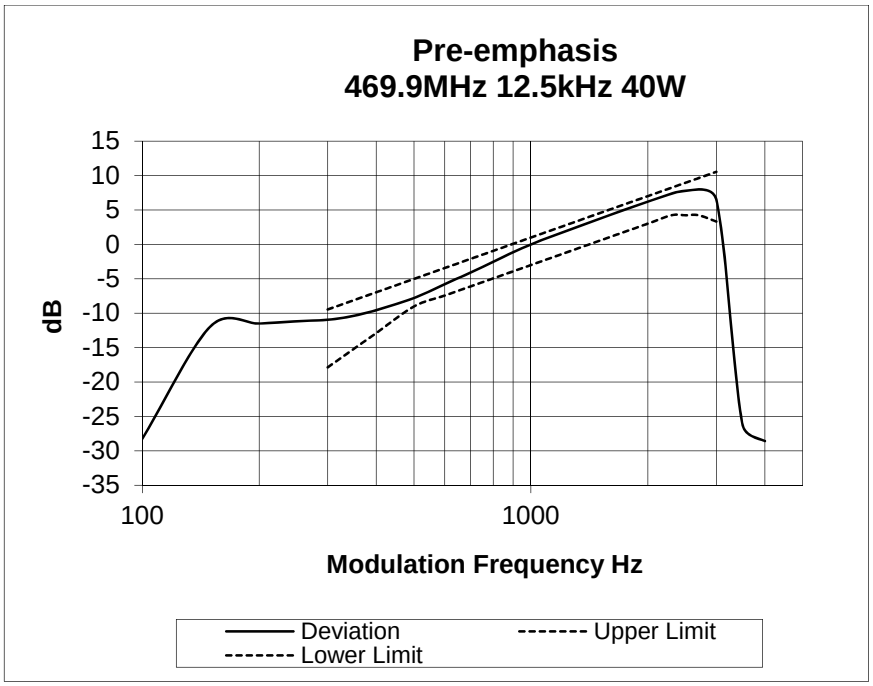
Tx FREQUENCY: 459.9MHz 12.5 kHz Channel Spacing



Transmitter Audio Frequency Response – Pre-emphasis

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)

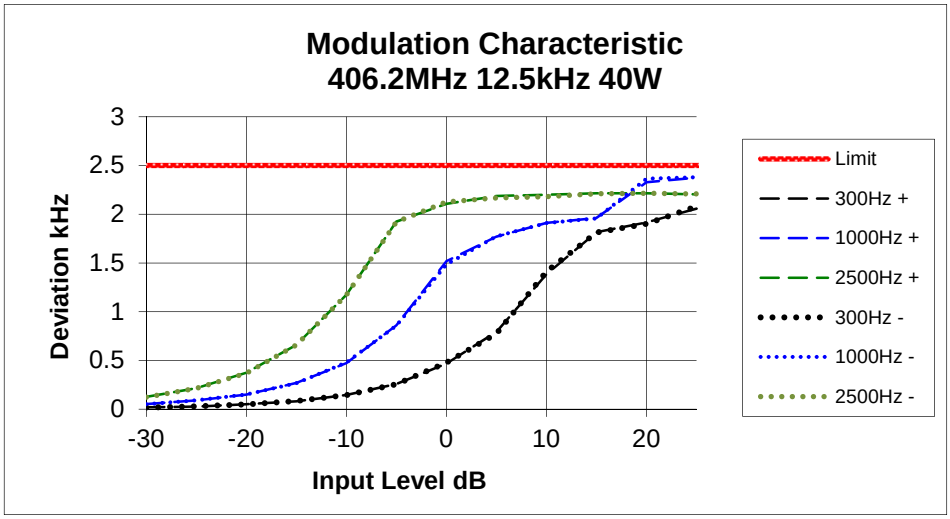
GUIDE: TIA/EIA-603D 2.2.3

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.

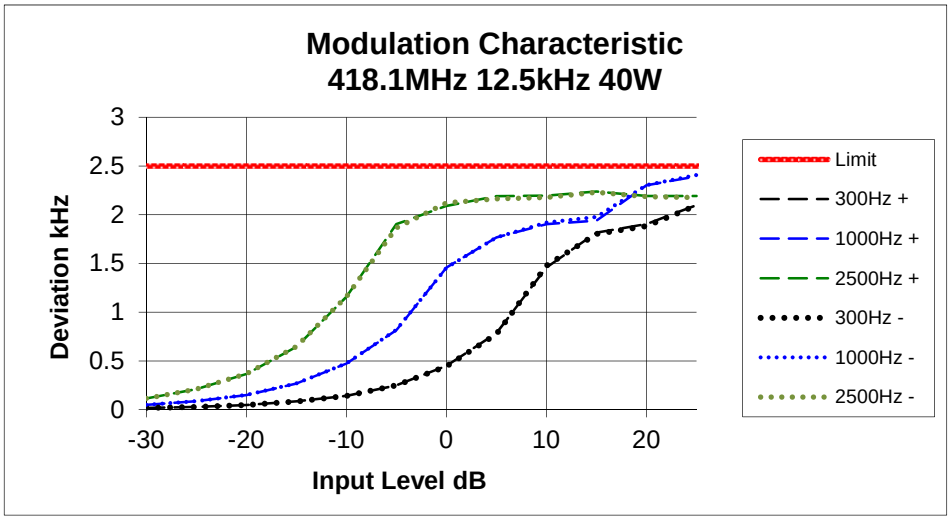
MEASUREMENT RESULTS:
See the plots on the following pages for 12.5 kHz channel spacing.

LIMIT CLAUSE: TIA/EIA-603D 1.3.4.4

Tx FREQUENCY: 406.2 MHz 12.5 kHz Channel Spacing



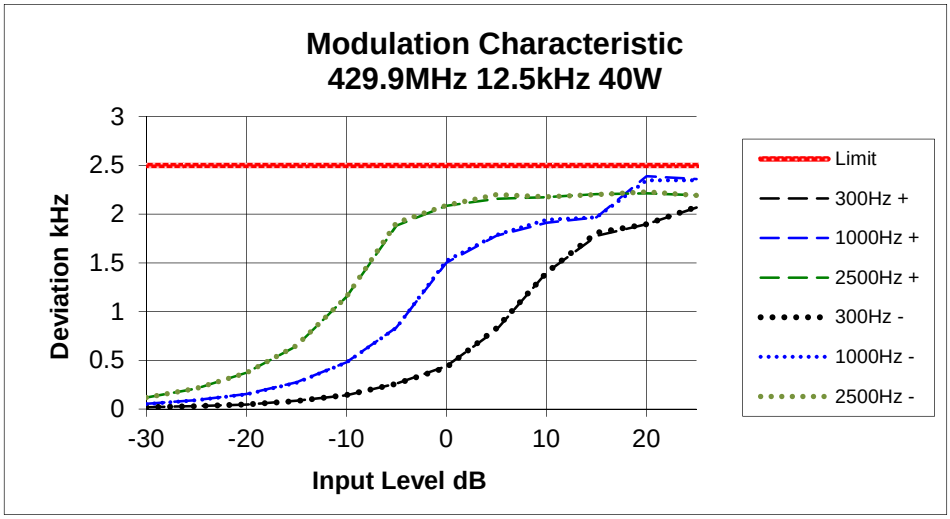
Tx FREQUENCY: 418.1 MHz 12.5 kHz Channel Spacing



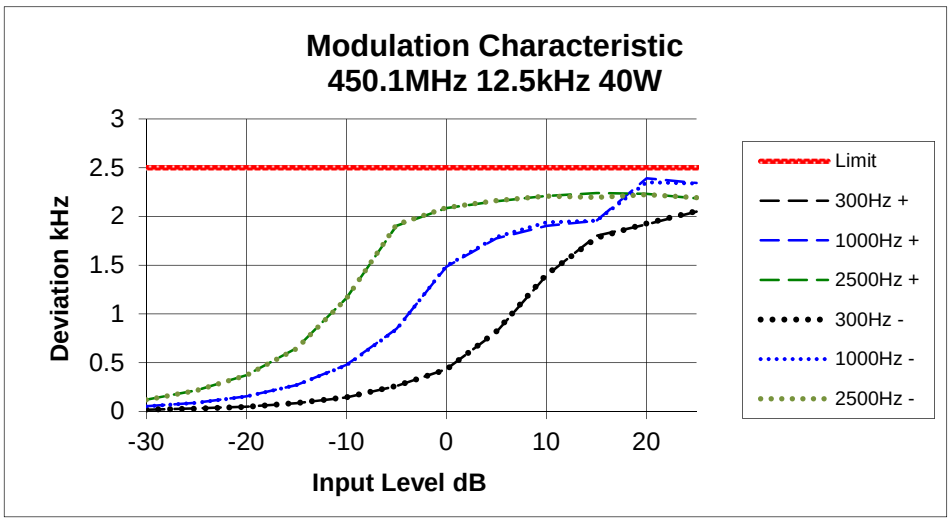
Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 429.9 MHz 12.5 kHz Channel Spacing



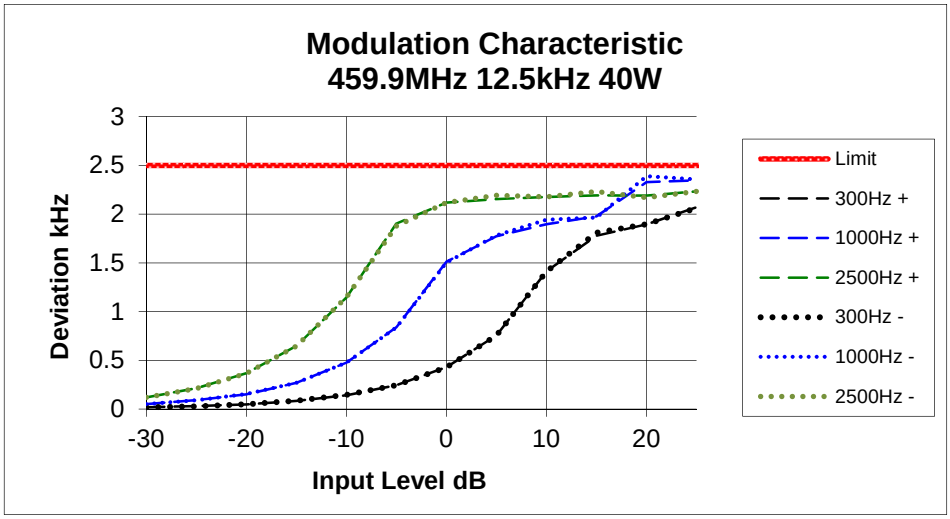
Tx FREQUENCY: 450.1 MHz 12.5 kHz Channel Spacing



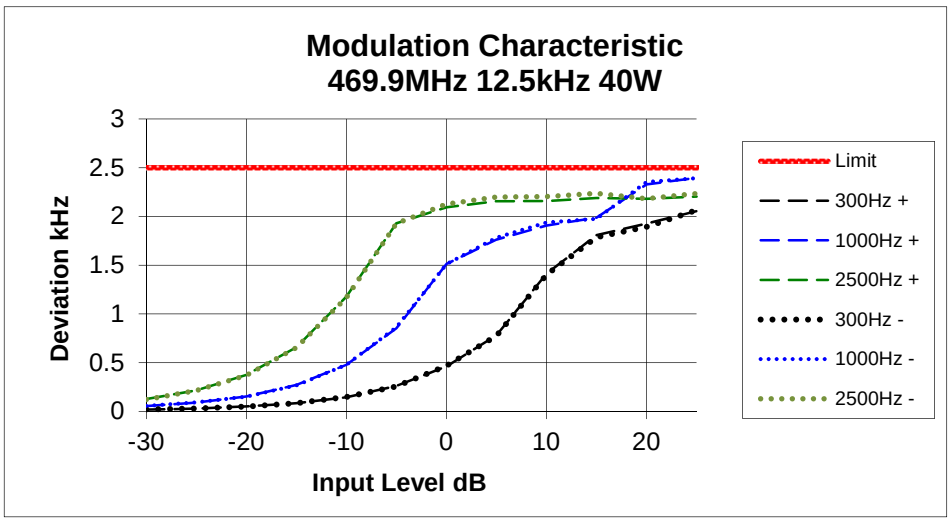
Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 459.9MHz 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.
   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.

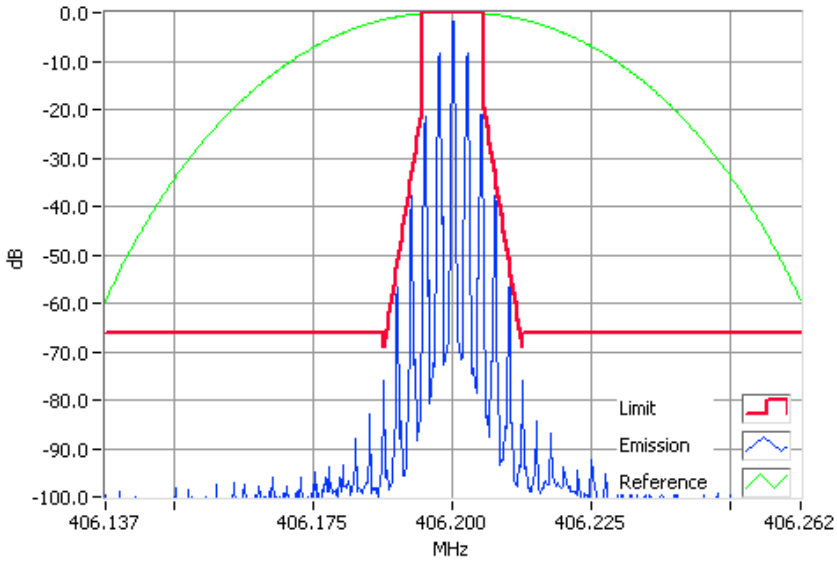
LIMIT CLAUSE:	FCC 47 CFR 90.210	RSS-119 5.5
EMISSION MASKS		
Emission Mask D	12.5 kHz Channel Spacing	Analog, FFSK, Digital Voice/Data
DATA SPEED		
FFSK	12.5 kHz Channel Spacing	1200 bps
Digital Voice/Data	12.5 kHz Channel Spacing	9600 bps

Occupied Bandwidth and Spectrum Masks

Analog

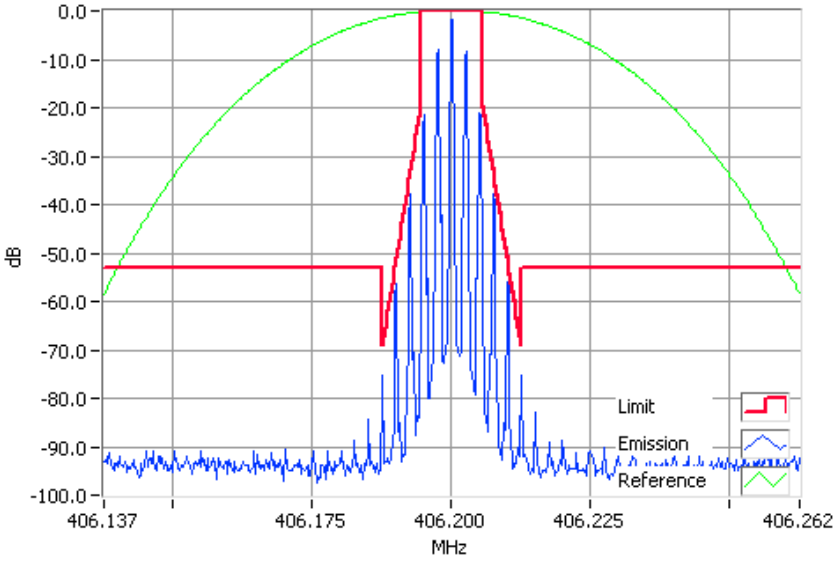
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 406.2 MHz 40 W 12.5 kHz Channel Spacing



Analogue Modulation 406.2000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 406.2 MHz 2 W 12.5 kHz Channel Spacing

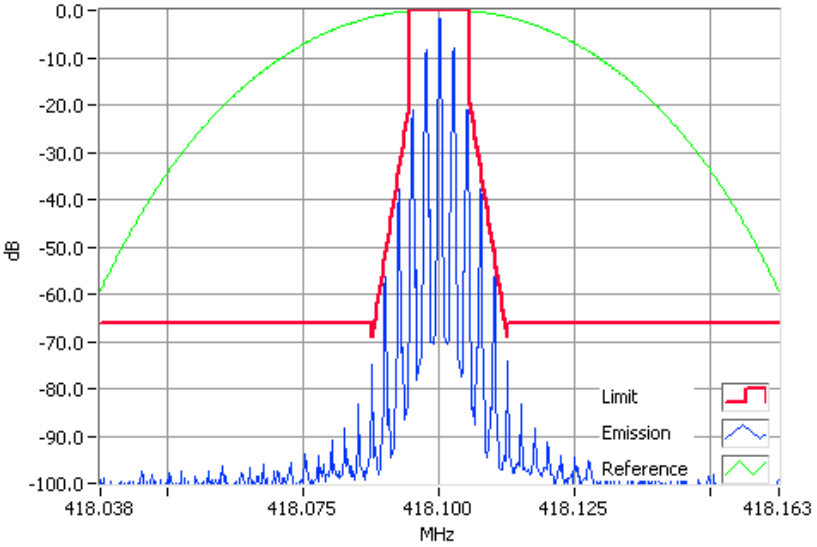


Analogue Modulation 406.2000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

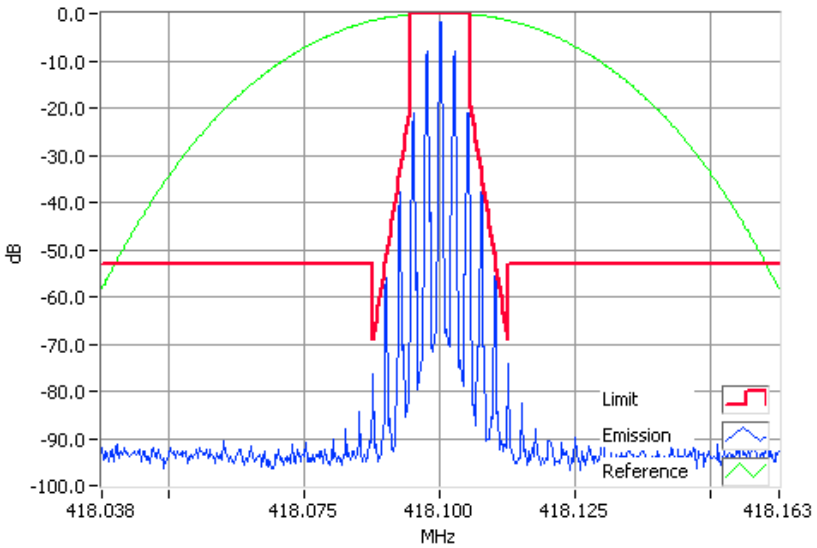
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 418.1 MHz 40 W 12.5 kHz Channel Spacing



Analogue Modulation 418.1000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 418.1 MHz 2 W 12.5 kHz Channel Spacing

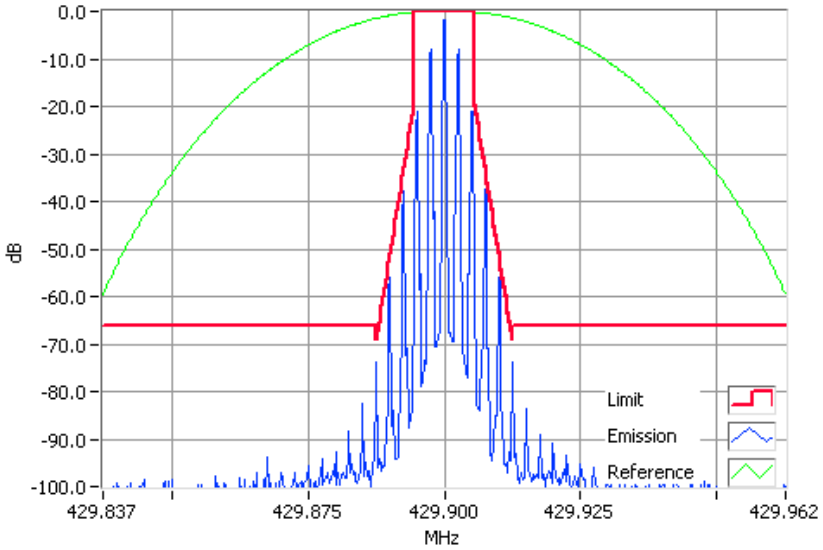


Analogue Modulation 418.1000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

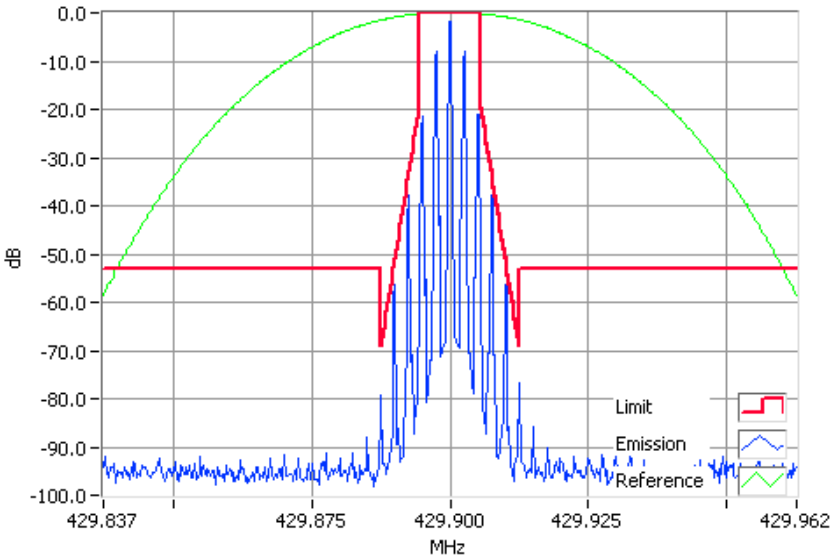
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 429.9 MHz 40 W 12.5 kHz Channel Spacing



Analogue Modulation 429.9000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 429.9 MHz 2 W 12.5 kHz Channel Spacing

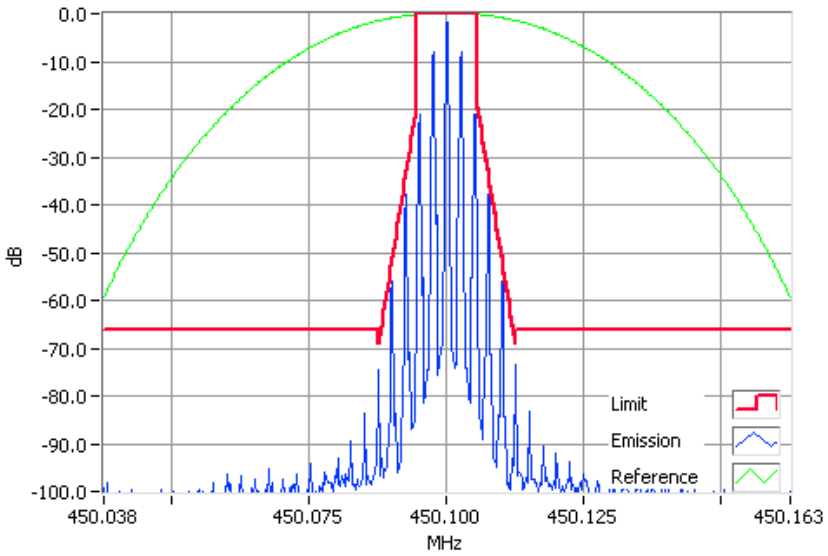


Analogue Modulation 429.9000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

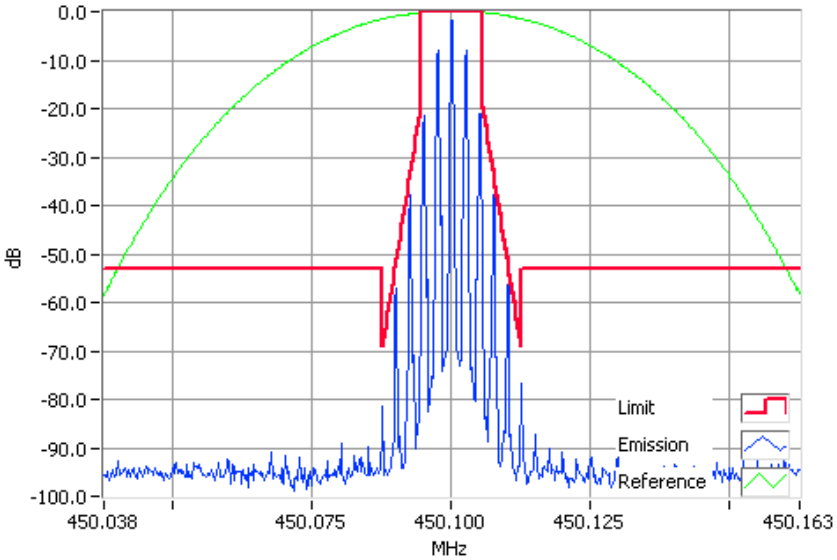
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 450.1 MHz 40 W 12.5 kHz Channel Spacing



Analogue Modulation 450.1000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 450.1 MHz 2 W 12.5 kHz Channel Spacing

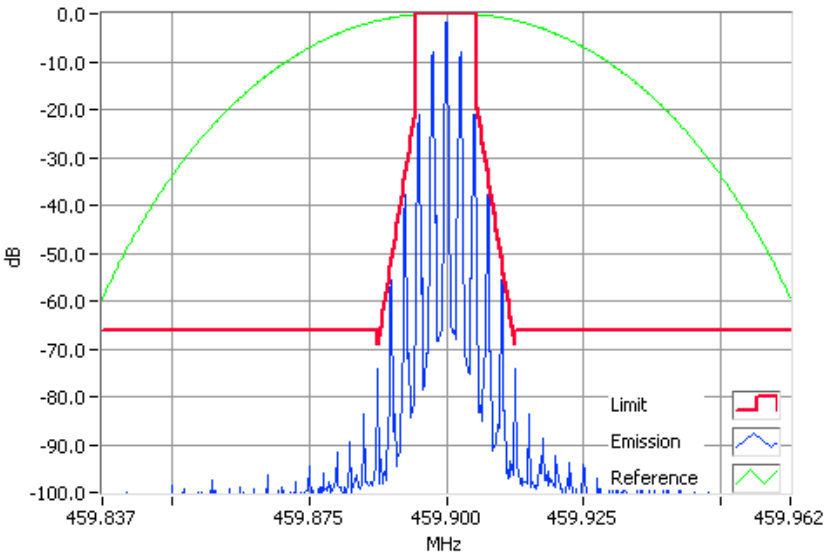


Analogue Modulation 450.1000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

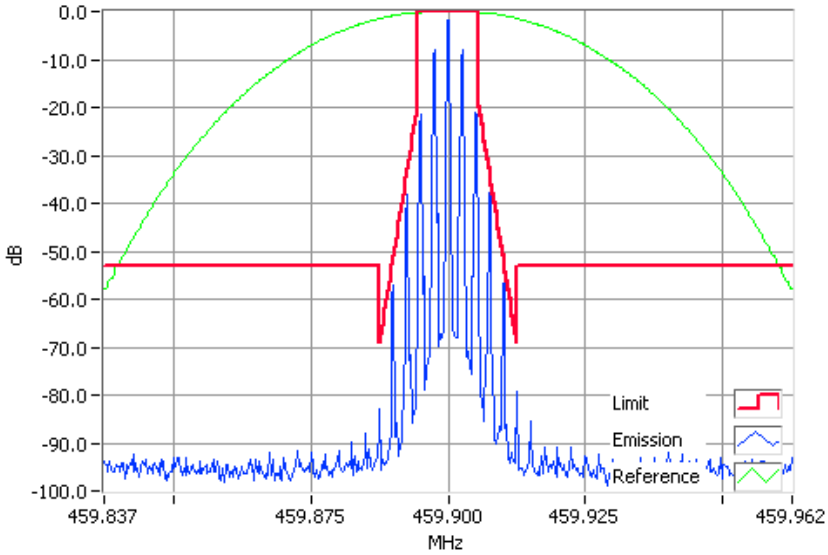
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 459.9 MHz 40 W 12.5 kHz Channel Spacing



Analogue Modulation 459.9000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 459.9 MHz 2 W 12.5 kHz Channel Spacing

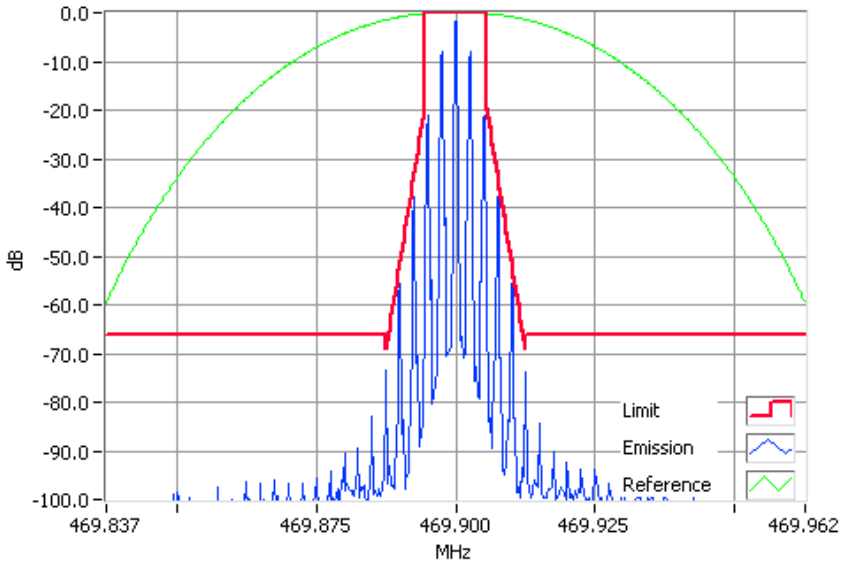


Analogue Modulation 459.9000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

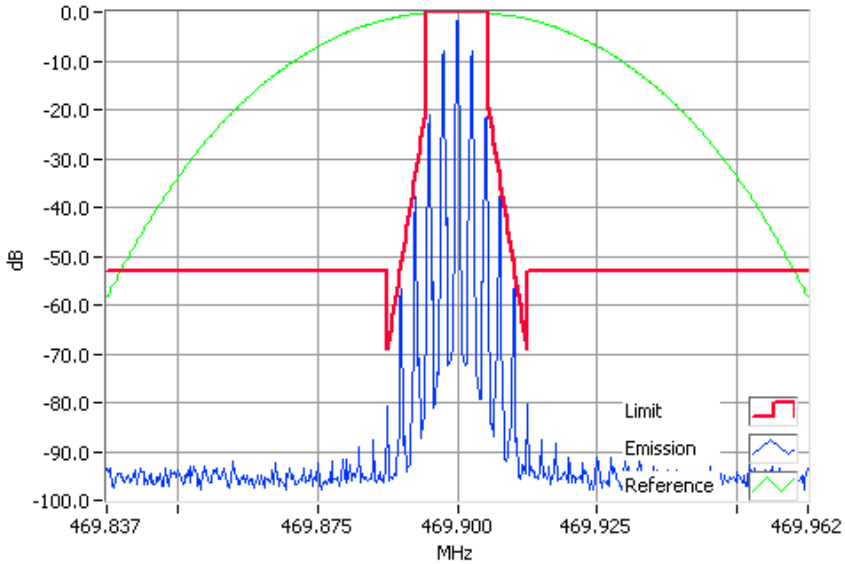
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 469.9 MHz 40 W 12.5 kHz Channel Spacing



Analogue Modulation 469.9000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 469.9 MHz 2 W 12.5 kHz Channel Spacing



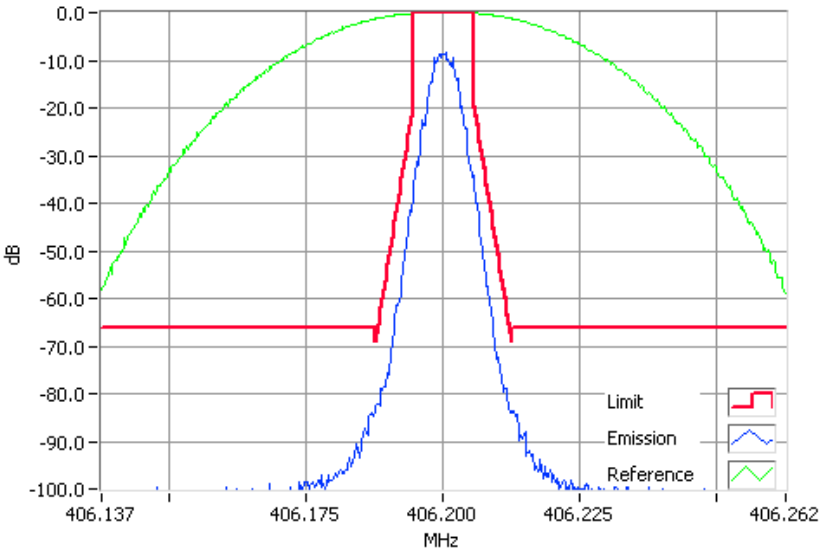
Analogue Modulation 469.9000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

DMR

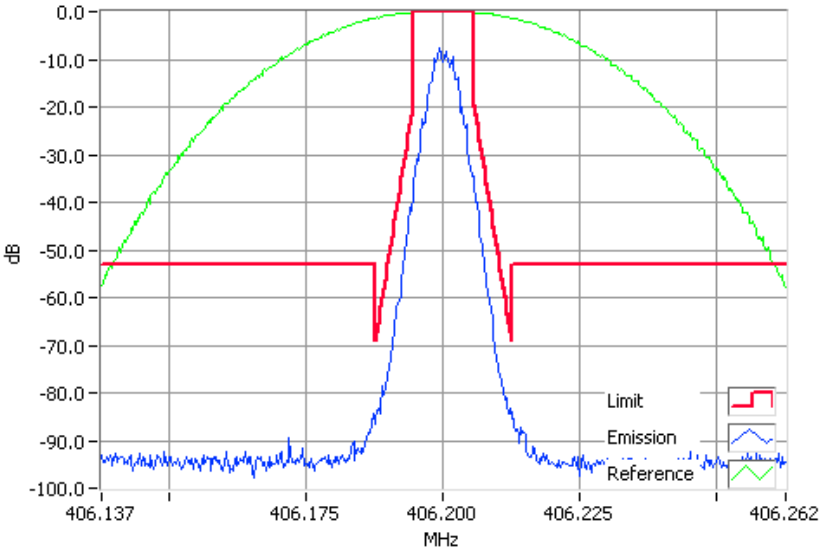
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 406.2 MHz 40 W 12.5 kHz Channel Spacing



DMR 406.2000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 406.2 MHz 2 W 12.5 kHz Channel Spacing

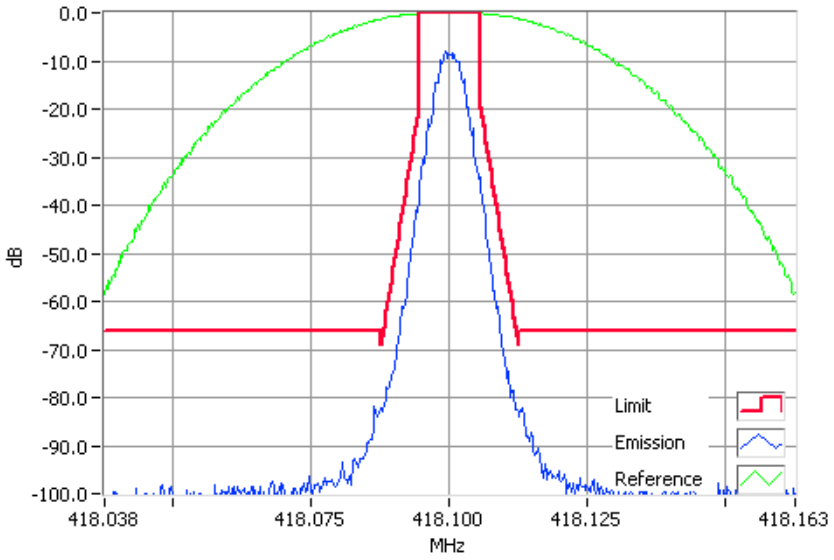


DMR 406.2000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

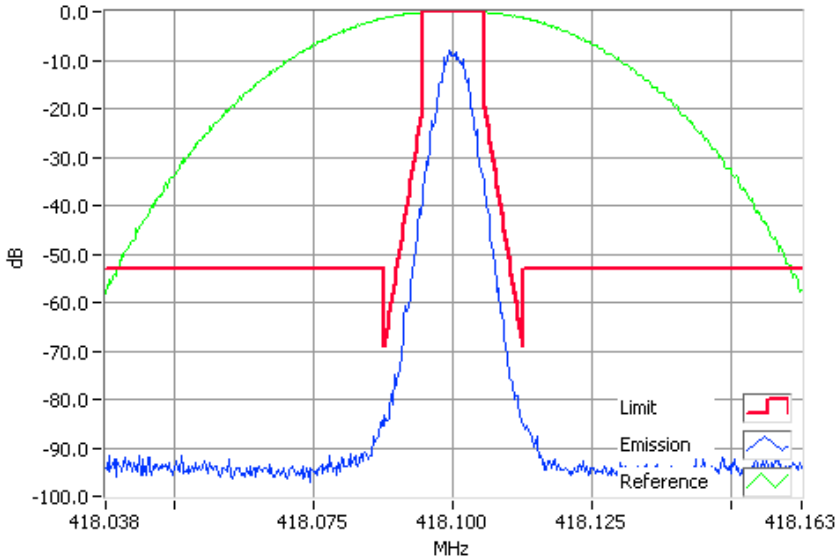
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 418.1 MHz 40 W 12.5 kHz Channel Spacing



DMR 418.1000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 418.1 MHz 2 W 12.5 kHz Channel Spacing

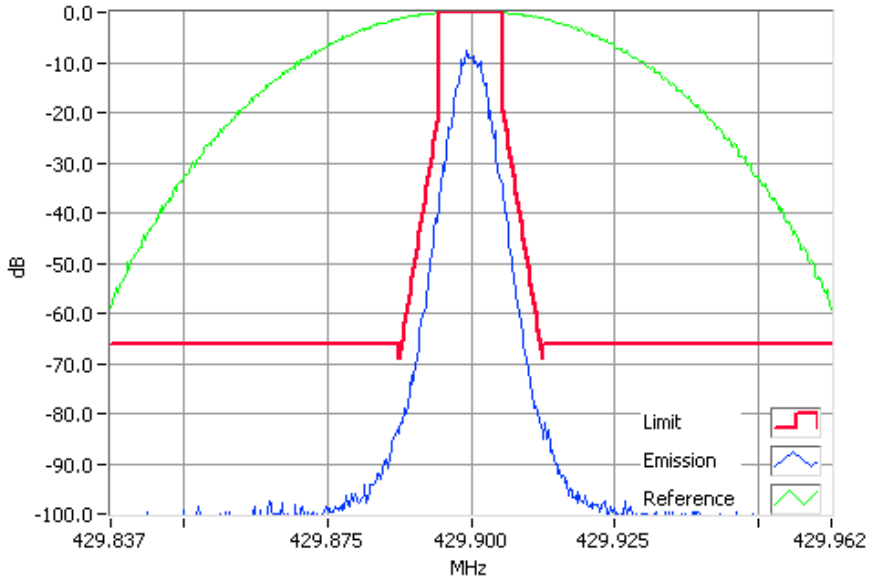


DMR 418.1000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

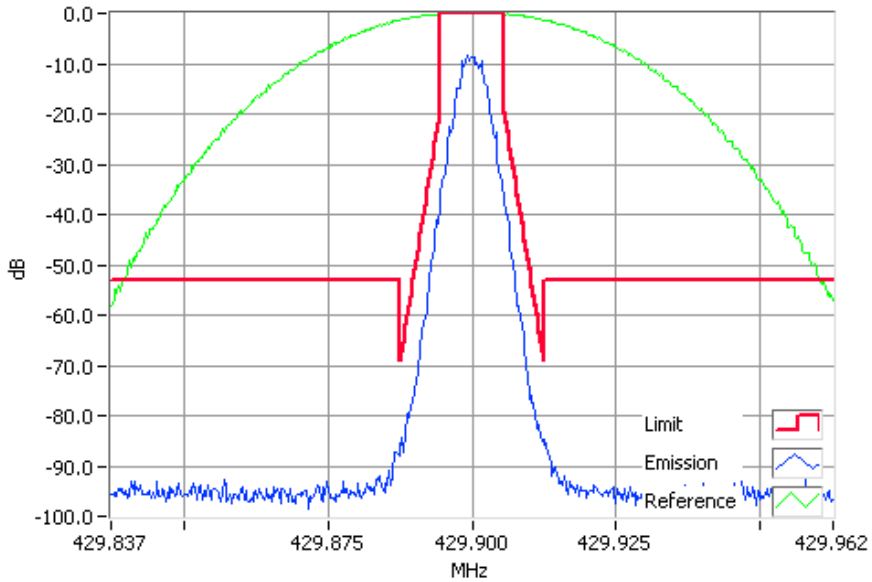
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 429.9 MHz 40 W 12.5 kHz Channel Spacing



DMR 429.9000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 429.9 MHz 2 W 12.5 kHz Channel Spacing

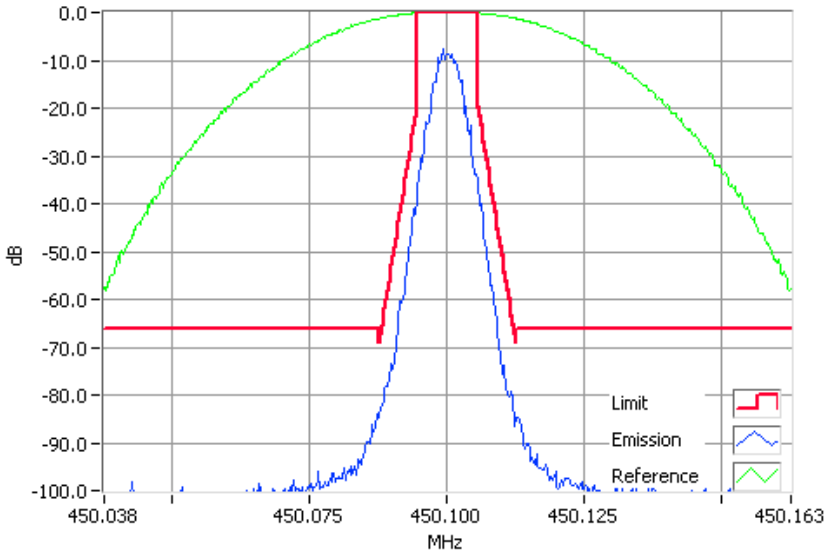


DMR 429.9000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

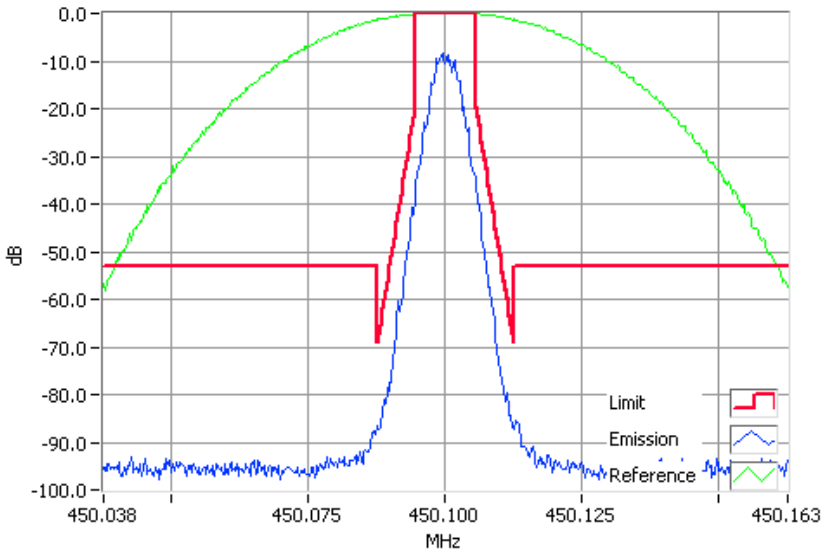
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 450.1 MHz 40 W 12.5 kHz Channel Spacing



DMR 450.1000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 450.1 MHz 2 W 12.5 kHz Channel Spacing

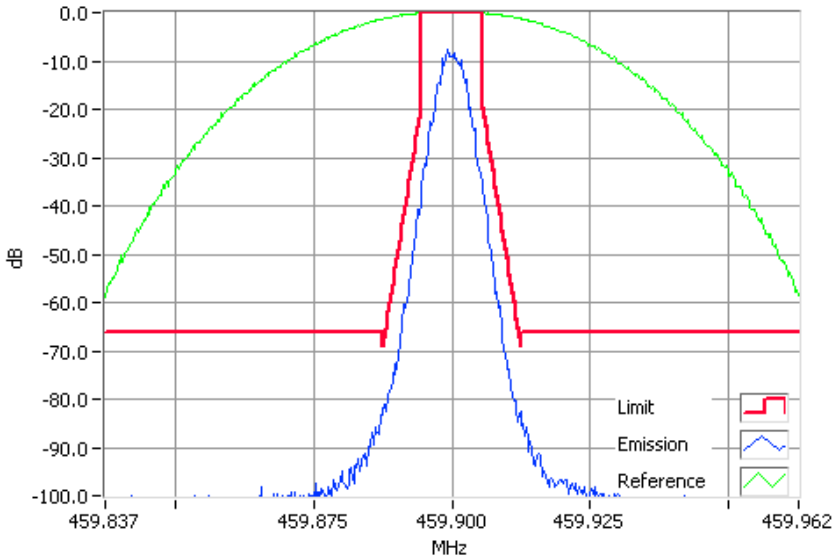


DMR 450.1000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

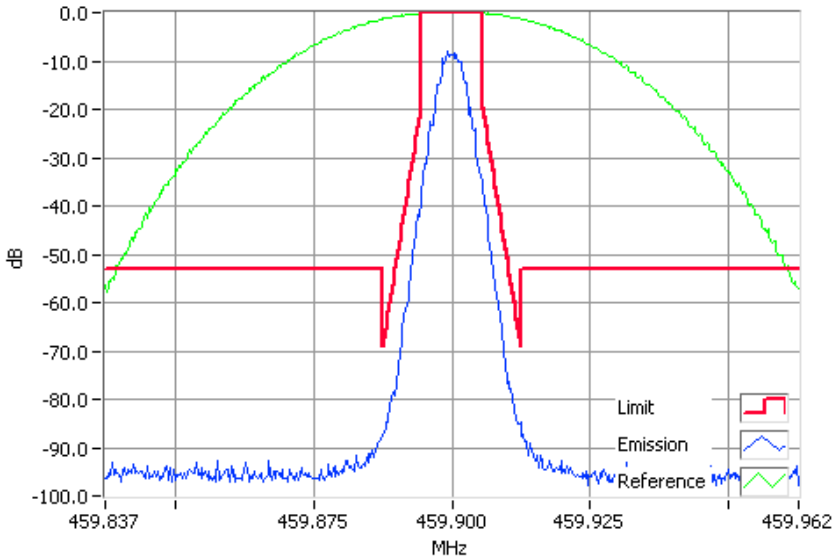
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 459.9 MHz 40 W 12.5 kHz Channel Spacing



DMR 459.9000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 459.9 MHz 2 W 12.5 kHz Channel Spacing

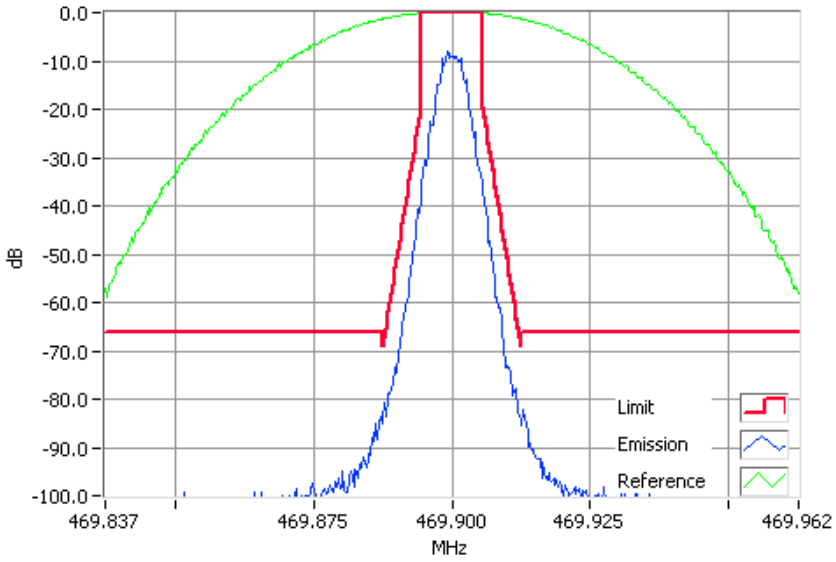


DMR 459.9000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

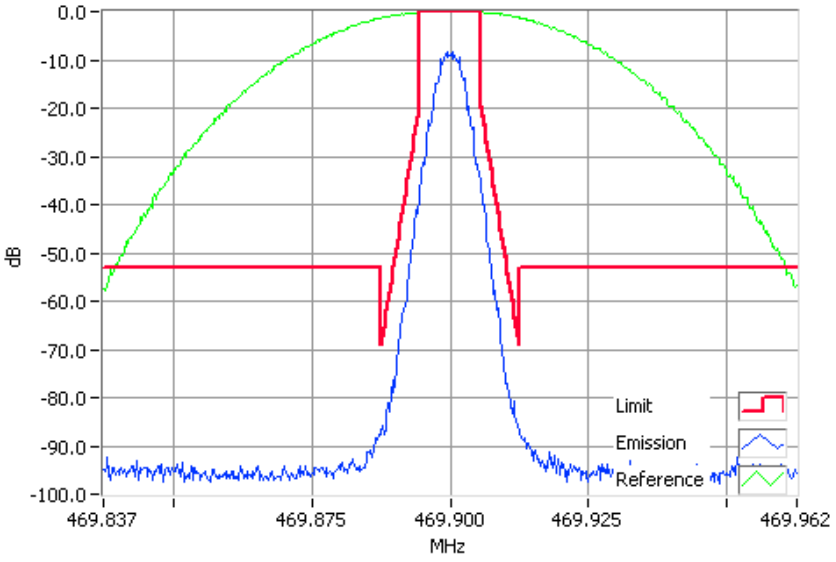
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 469.9 MHz 40 W 12.5 kHz Channel Spacing



DMR 469.9000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 469.9 MHz 2 W 12.5 kHz Channel Spacing



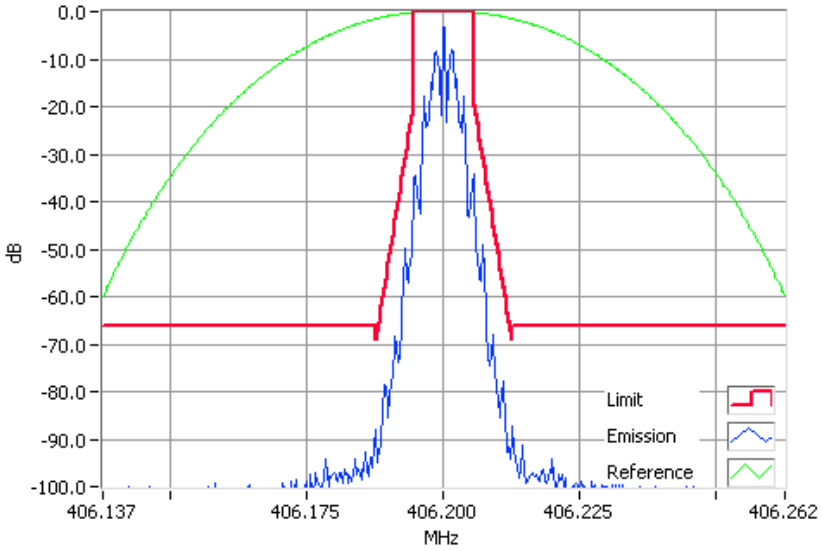
DMR 469.9000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

FFSK

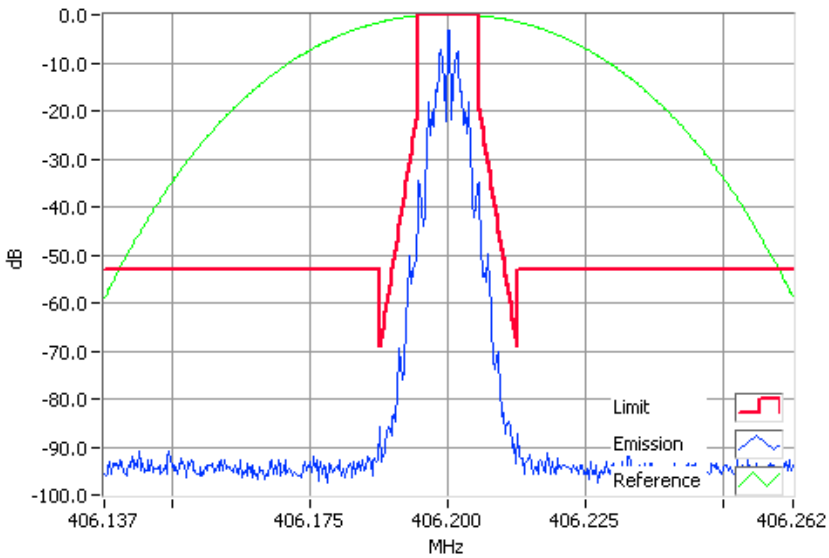
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 406.2 MHz 40 W 12.5 kHz Channel Spacing



FFSK 406.2000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 406.2 MHz 2 W 12.5 kHz Channel Spacing

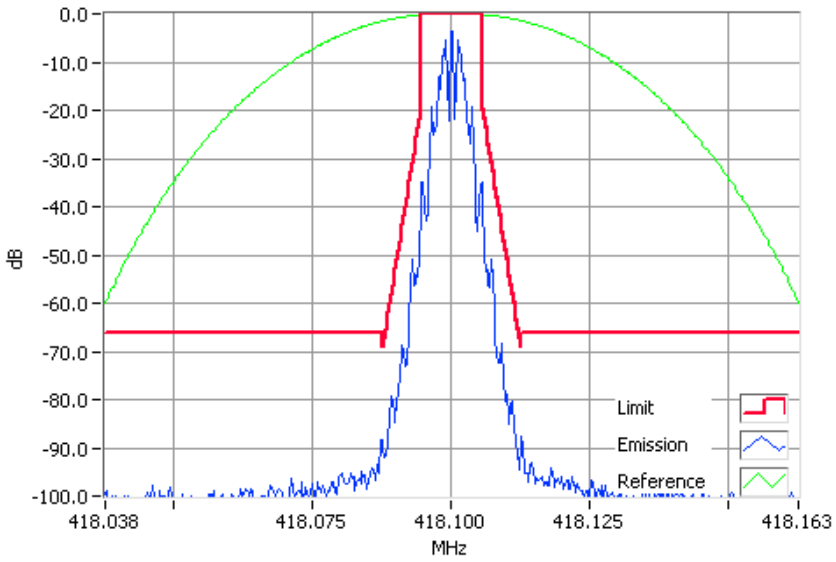


FFSK 406.2000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

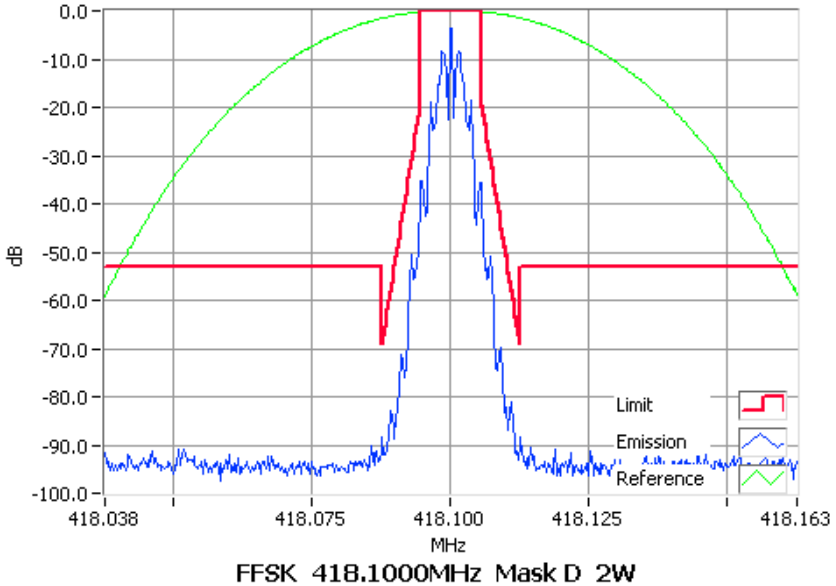
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 418.1 MHz 40 W 12.5 kHz Channel Spacing



FFSK 418.1000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 418.1 MHz 2 W 12.5 kHz Channel Spacing

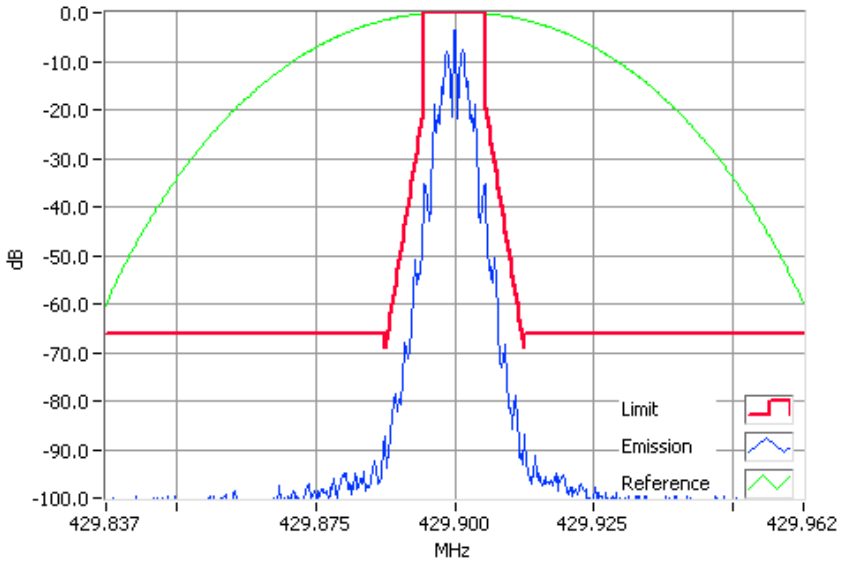


FFSK 418.1000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

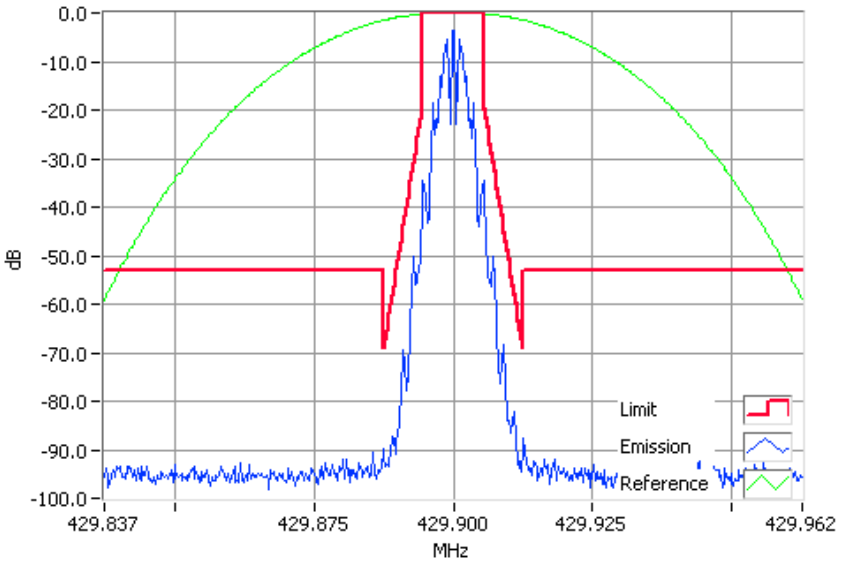
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 429.9 MHz 40 W 12.5 kHz Channel Spacing



FFSK 429.9000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 429.9 MHz 2 W 12.5 kHz Channel Spacing

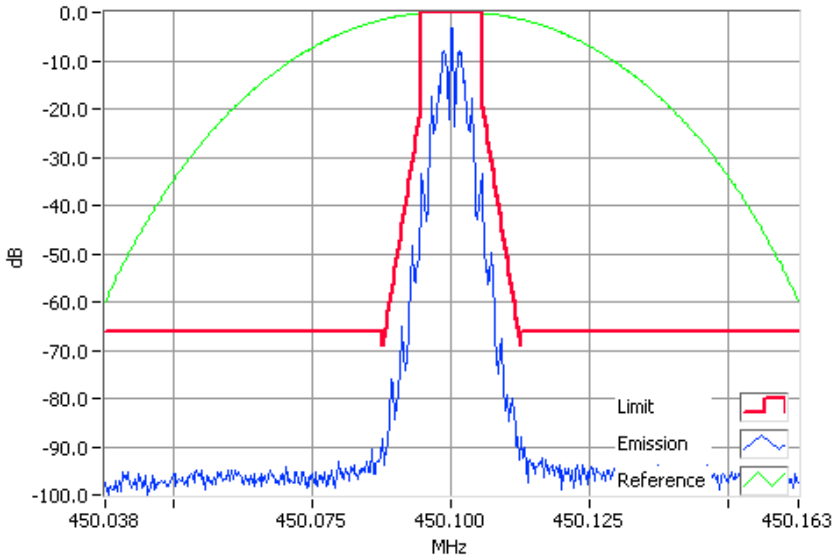


FFSK 429.9000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

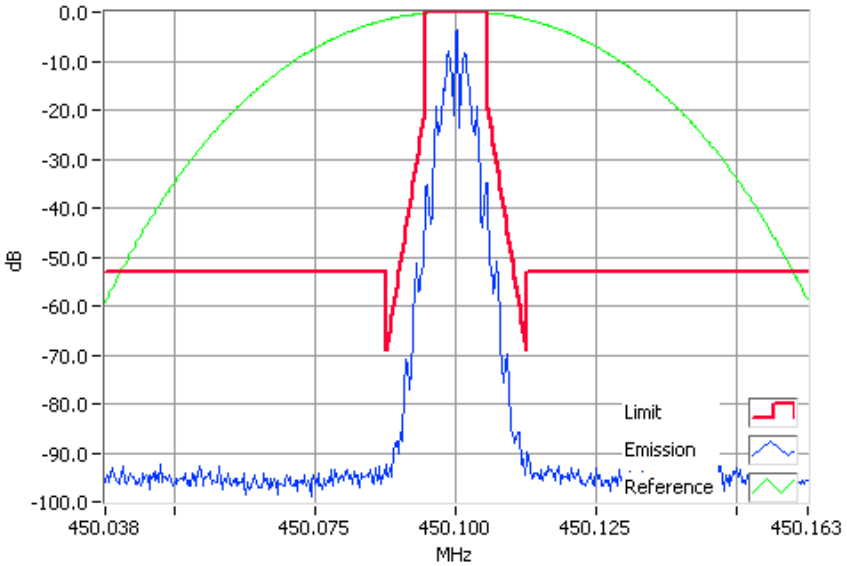
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 450.1 MHz 40 W 12.5 kHz Channel Spacing



FFSK 450.1000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 450.1 MHz 2 W 12.5 kHz Channel Spacing

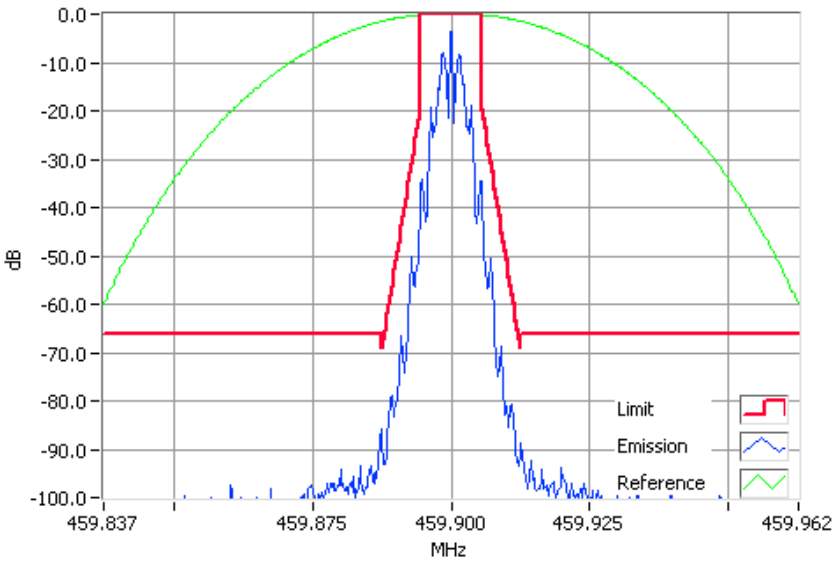


FFSK 450.1000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

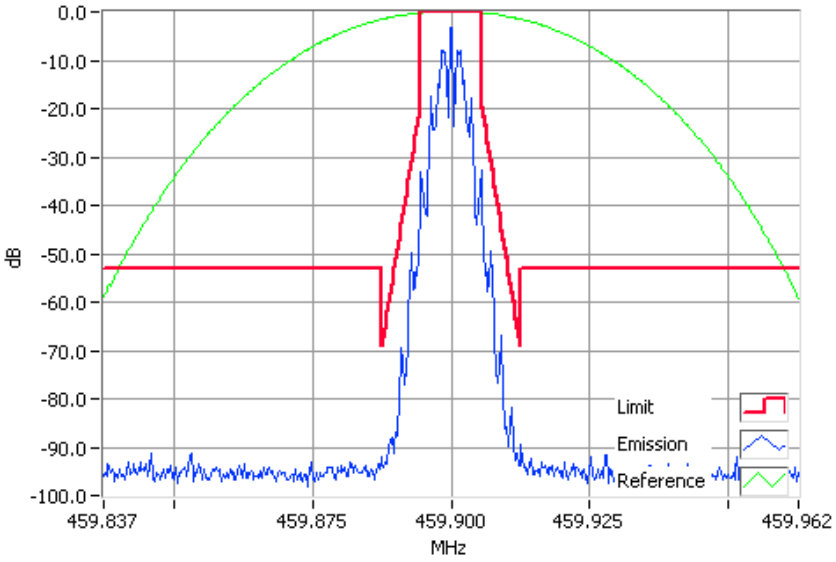
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 459.9 MHz 40 W 12.5 kHz Channel Spacing



FFSK 459.9000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 459.9 MHz 2 W 12.5 kHz Channel Spacing

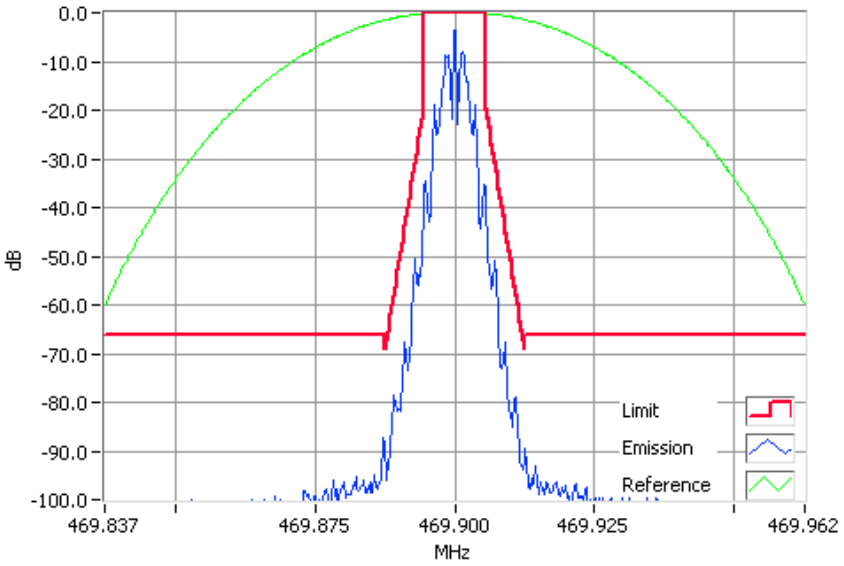


FFSK 459.9000MHz Mask D 2W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

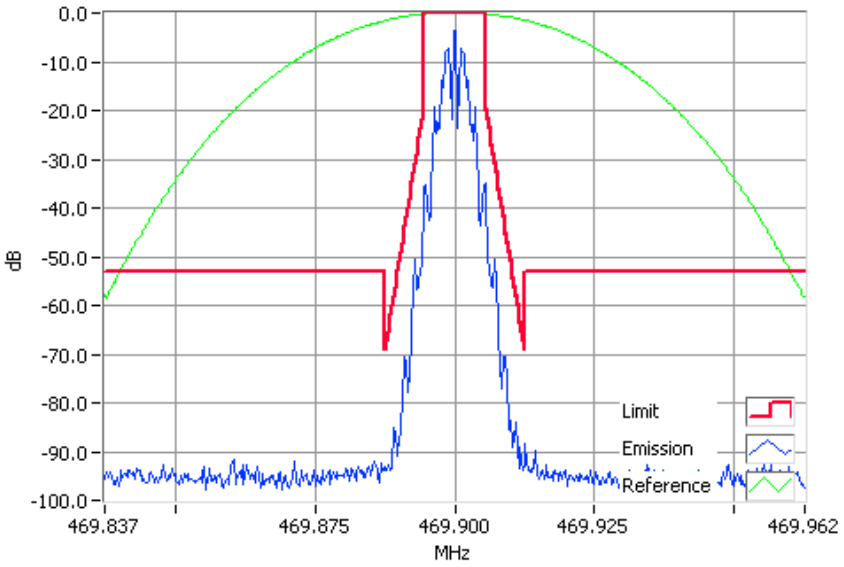
SPECIFICATION: FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY: 469.9 MHz 40 W 12.5 kHz Channel Spacing



FFSK 469.9000MHz Mask D 40W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 469.9 MHz 2 W 12.5 kHz Channel Spacing



FFSK 469.9000MHz Mask D 2W
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

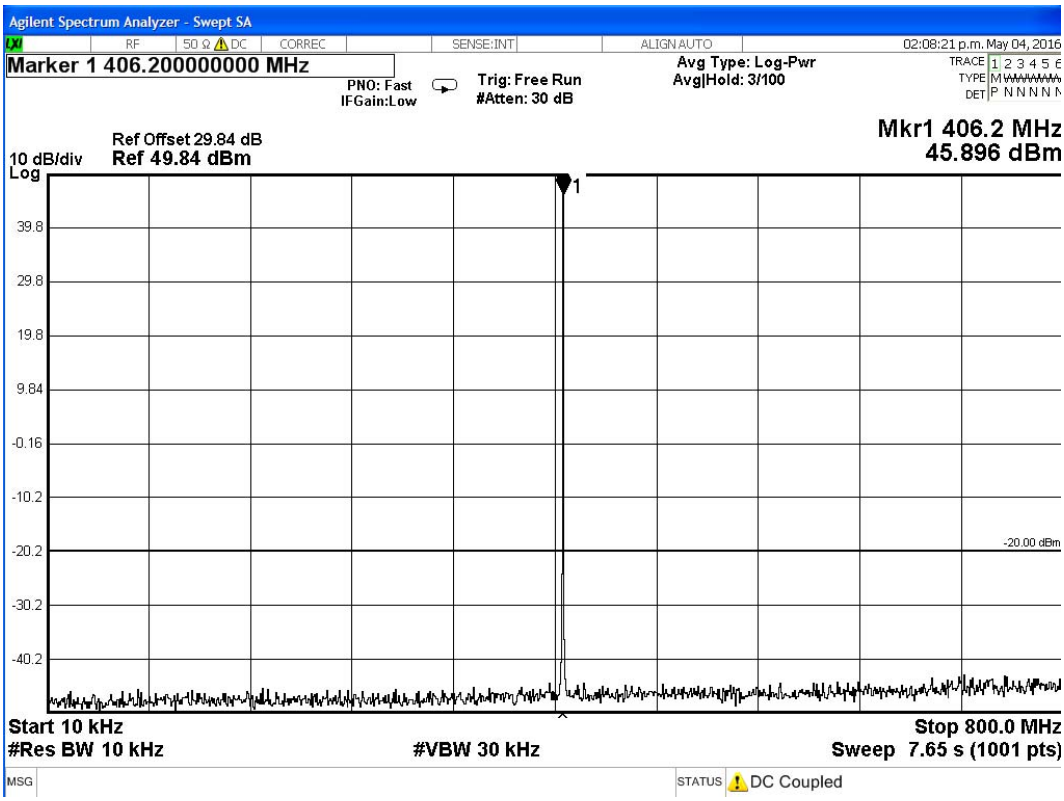
Tx FREQUENCY: 406.2 MHz

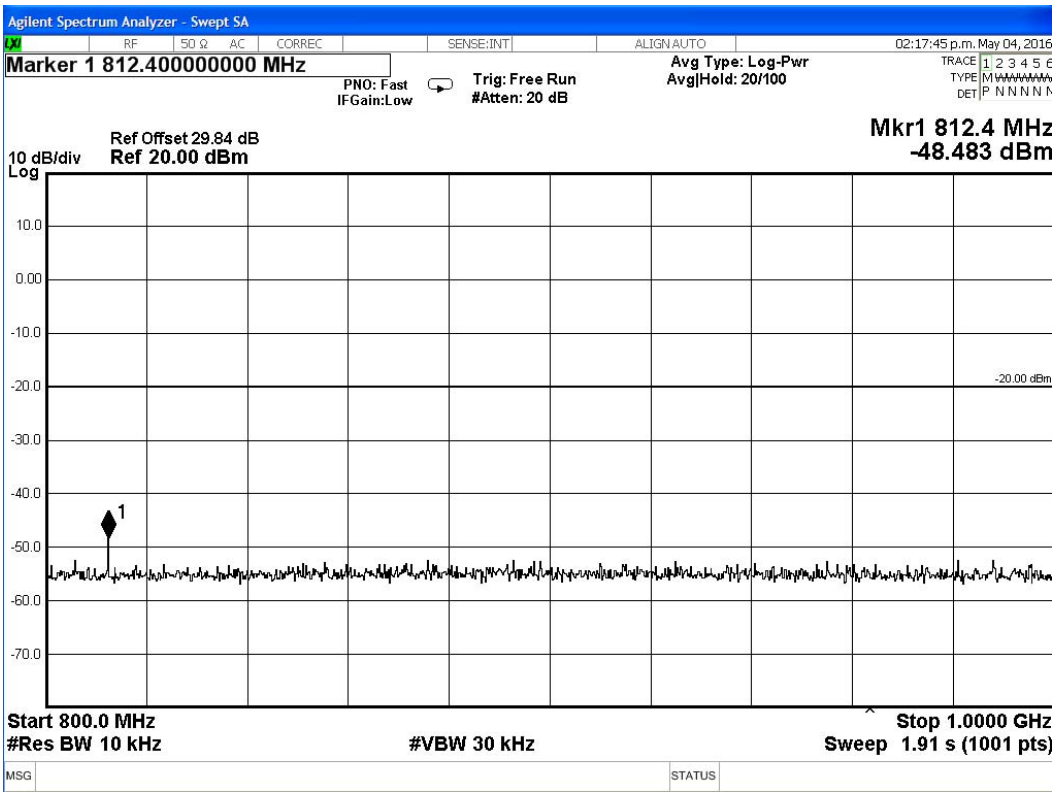
12.5 kHz Channel Spacing 406.2 MHz @ 40 W Emission Mask D

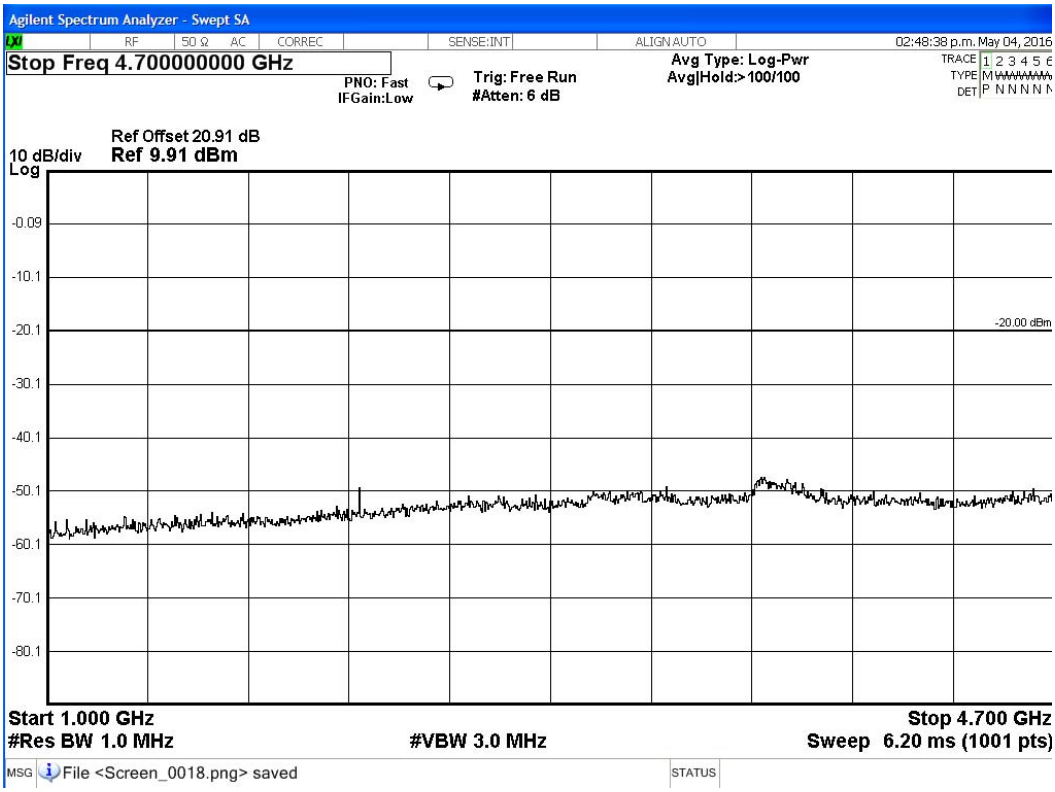
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing 406.2 MHz @ 2 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.		




Agilent Spectrum Analyzer - Swept SA
RF
50 Ω AC
CORREC
SENSE:INT
ALIGN AUTO
02:17:45 p.m. May 04, 2016
Marker 1 812.400000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 20/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 29.84 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 812.4 MHz
-48.483 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-20.00 dBm
1
Start 800.0 MHz
#Res BW 10 kHz
#VBW 30 kHz
Stop 1.0000 GHz
Sweep 1.91 s (1001 pts)
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
RF
50 Ω AC
CORREC
SENSE:INT
ALIGN AUTO
02:48:38 p.m. May 04, 2016
Stop Freq 4.700000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 6 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 20.91 dB
10 dB/div
Log
Ref 9.91 dBm
-0.09
-10.1
-20.1
-30.1
-40.1
-50.1
-60.1
-70.1
-80.1
-20.00 dBm
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 4.700 GHz
Sweep 6.20 ms (1001 pts)
MSG
File <Screen_0018.png> saved
STATUS

Spurious Emissions (Tx Conducted)

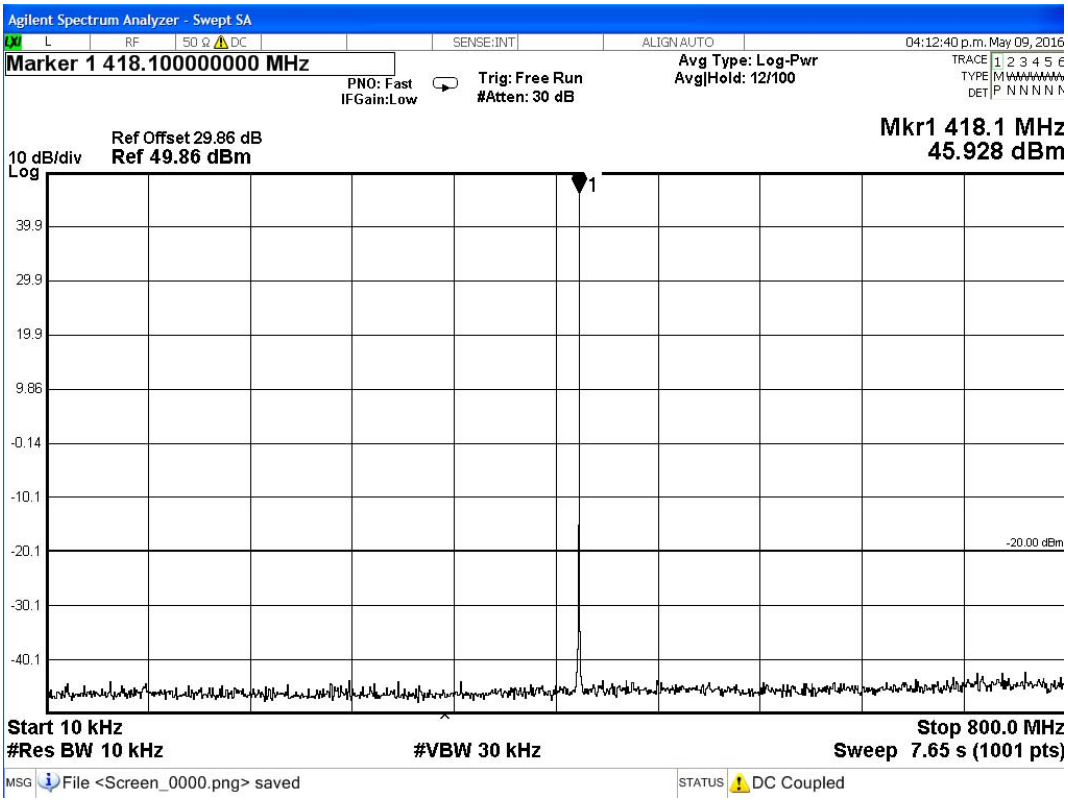
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

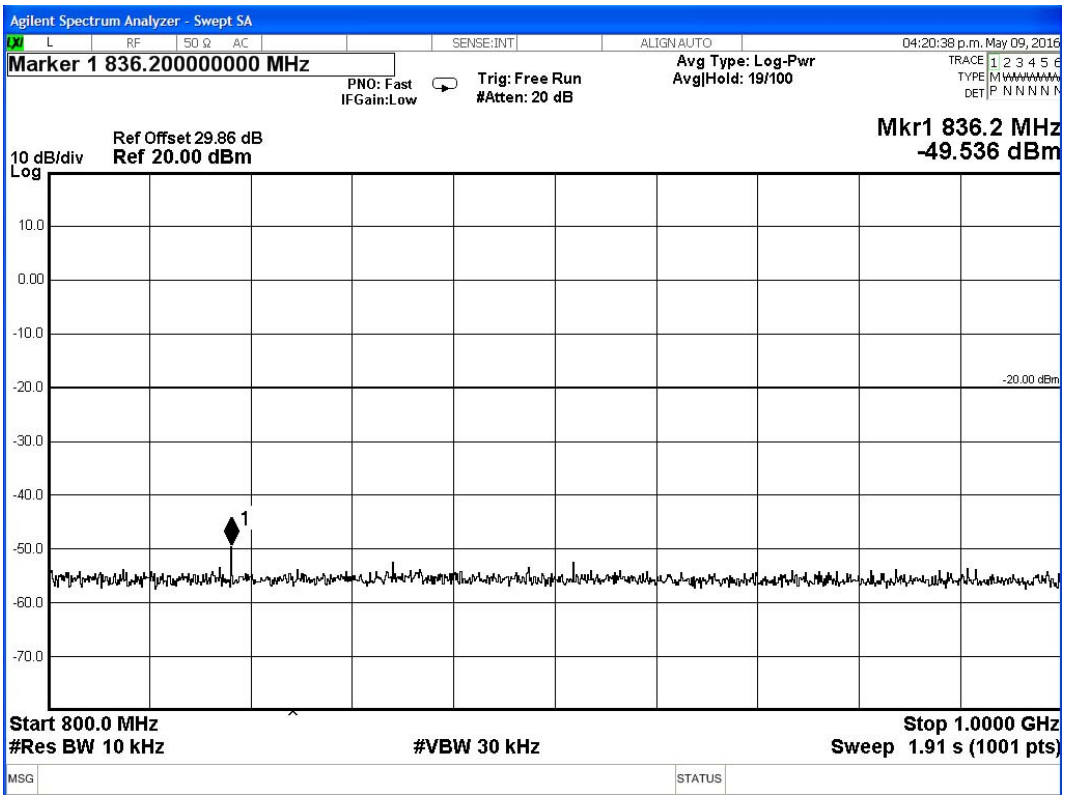
12.5 kHz Channel Spacing 418.1 MHz @ 40 W Emission Mask D

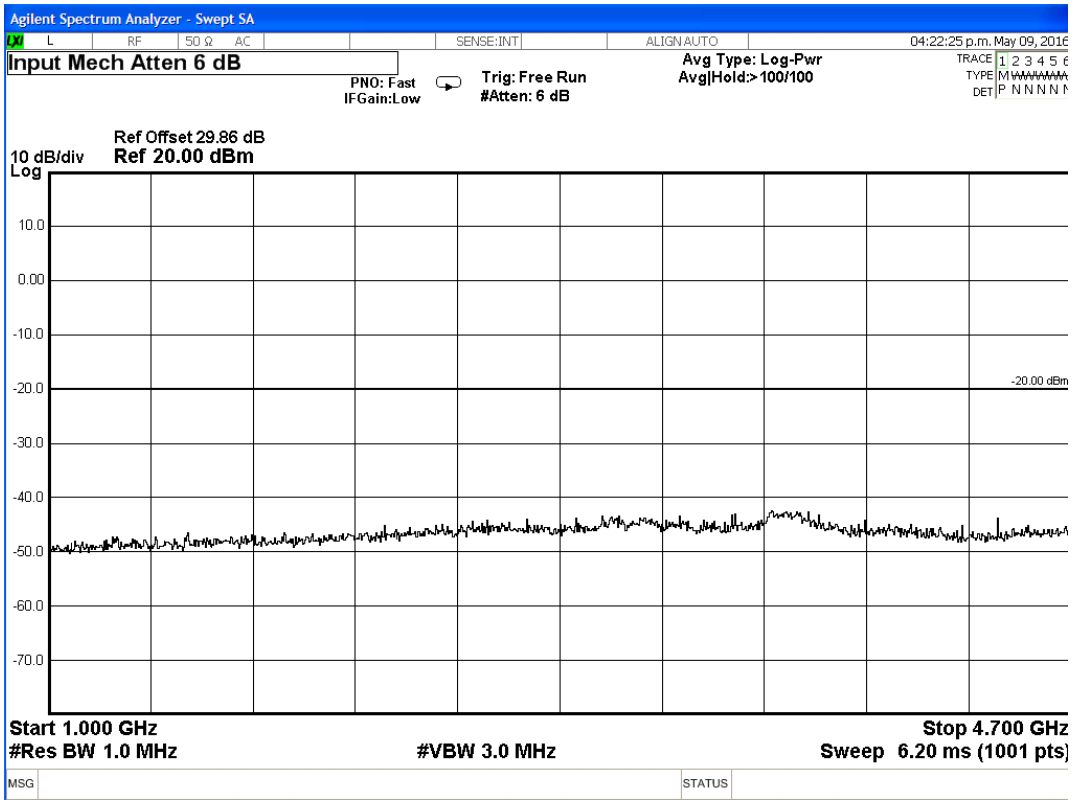
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing 418.1 MHz @ 2 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.		




Agilent Spectrum Analyzer - Swept SA
Marker 1 836.200000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 19/100
04:20:38 p.m. May 09, 2016
Ref Offset 29.86 dB
10 dB/div
Ref 20.00 dBm
Mkr1 836.2 MHz
-49.536 dBm
-20.00 dBm
Start 800.0 MHz
#Res BW 10 kHz
#VBW 30 kHz
Stop 1.0000 GHz
Sweep 1.91 s (1001 pts)


Agilent Spectrum Analyzer - Swept SA
Input Mech Atten 6 dB
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 6 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
04:22:25 p.m. May 09, 2016
Ref Offset 29.86 dB
10 dB/div
Ref 20.00 dBm
-20.00 dBm
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 4.700 GHz
Sweep 6.20 ms (1001 pts)

Spurious Emissions (Tx Conducted)

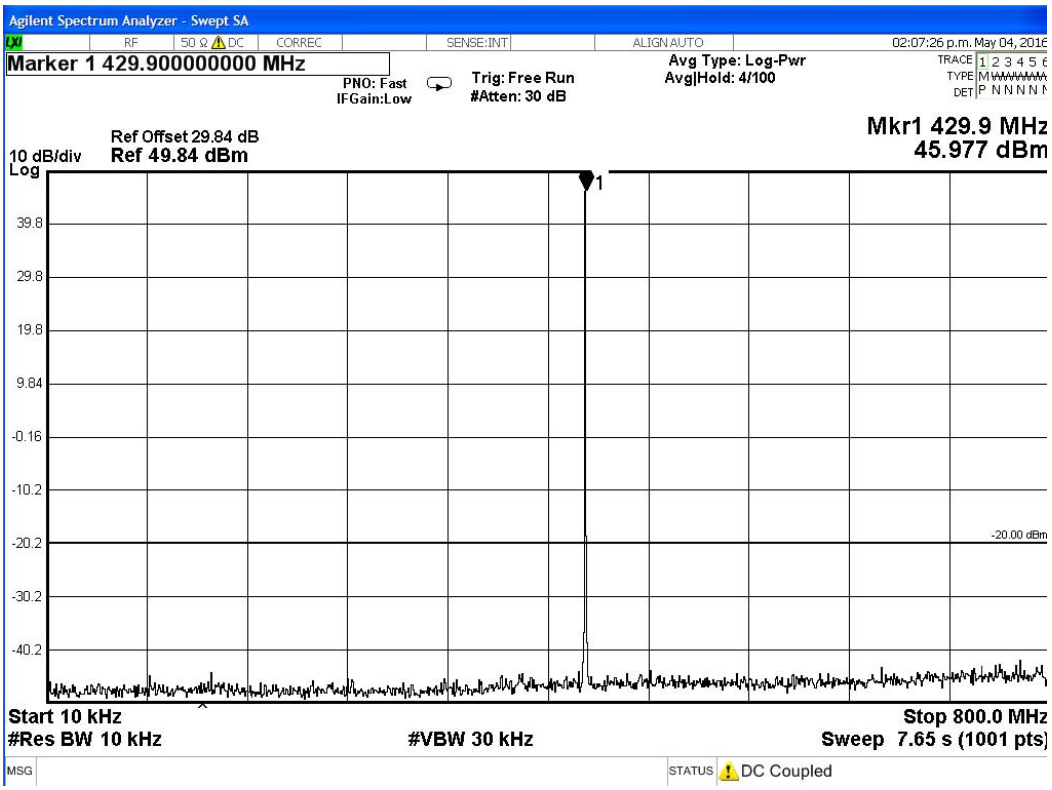
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

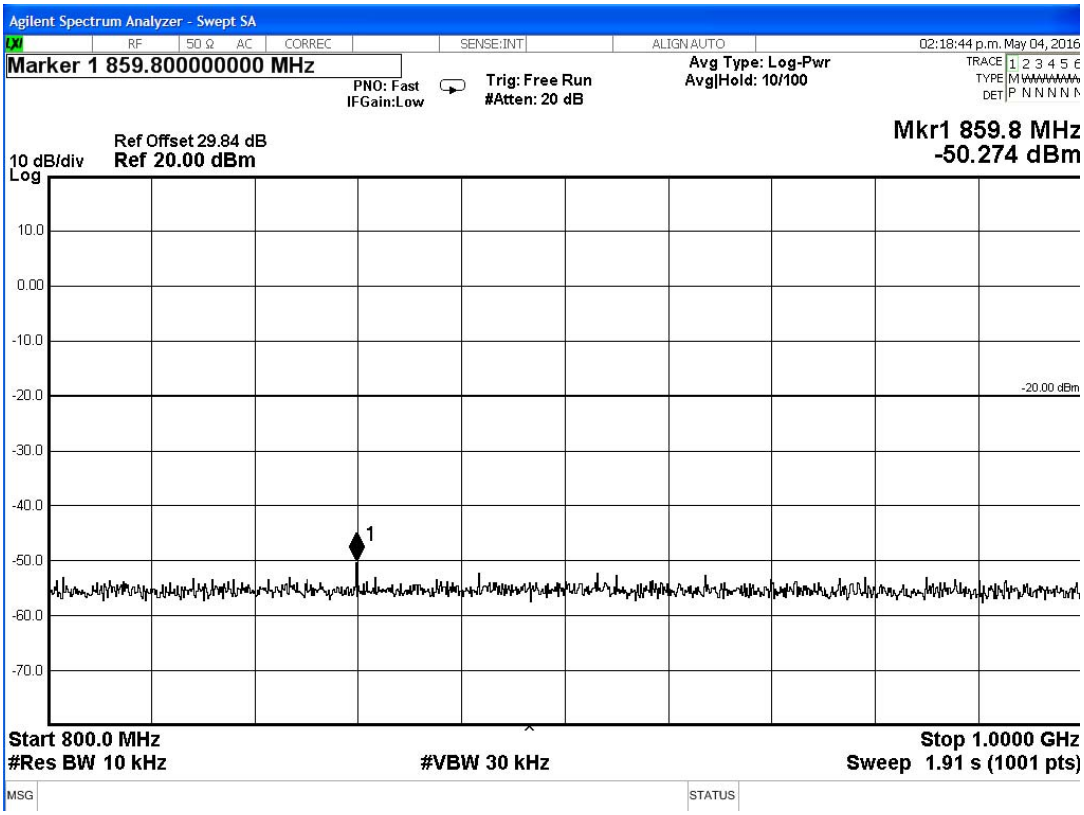
12.5 kHz Channel Spacing 429.9 MHz @ 40 W Emission Mask D

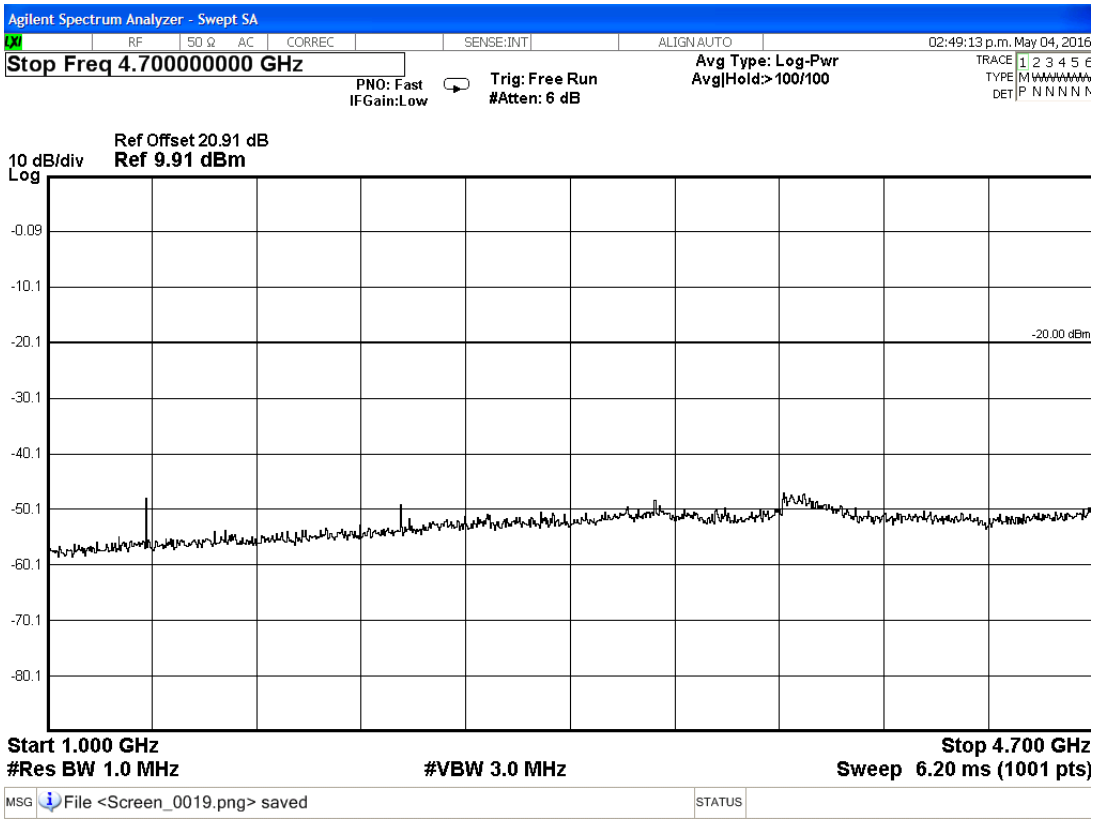
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing 429.9 MHz @ 2 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.		




Agilent Spectrum Analyzer - Swept SA
RF
50 Ω AC
CORREC
SENSE:INT
ALIGN AUTO
02:18:44 p.m. May 04, 2016
Marker 1 859.800000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 10/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Mkr1 859.8 MHz
-50.274 dBm
Ref Offset 29.84 dB
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-20.00 dBm
1
Start 800.0 MHz
#Res BW 10 kHz
#VBW 30 kHz
Stop 1.0000 GHz
Sweep 1.91 s (1001 pts)
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
RF
50 Ω AC
CORREC
SENSE:INT
ALIGN AUTO
02:49:13 p.m. May 04, 2016
Stop Freq 4.700000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 6 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 20.91 dB
10 dB/div
Log
Ref 9.91 dBm
-0.09
-10.1
-20.1
-30.1
-40.1
-50.1
-60.1
-70.1
-80.1
-20.00 dBm
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 4.700 GHz
Sweep 6.20 ms (1001 pts)
MSG
File <Screen_0019.png> saved
STATUS

Spurious Emissions (Tx Conducted)

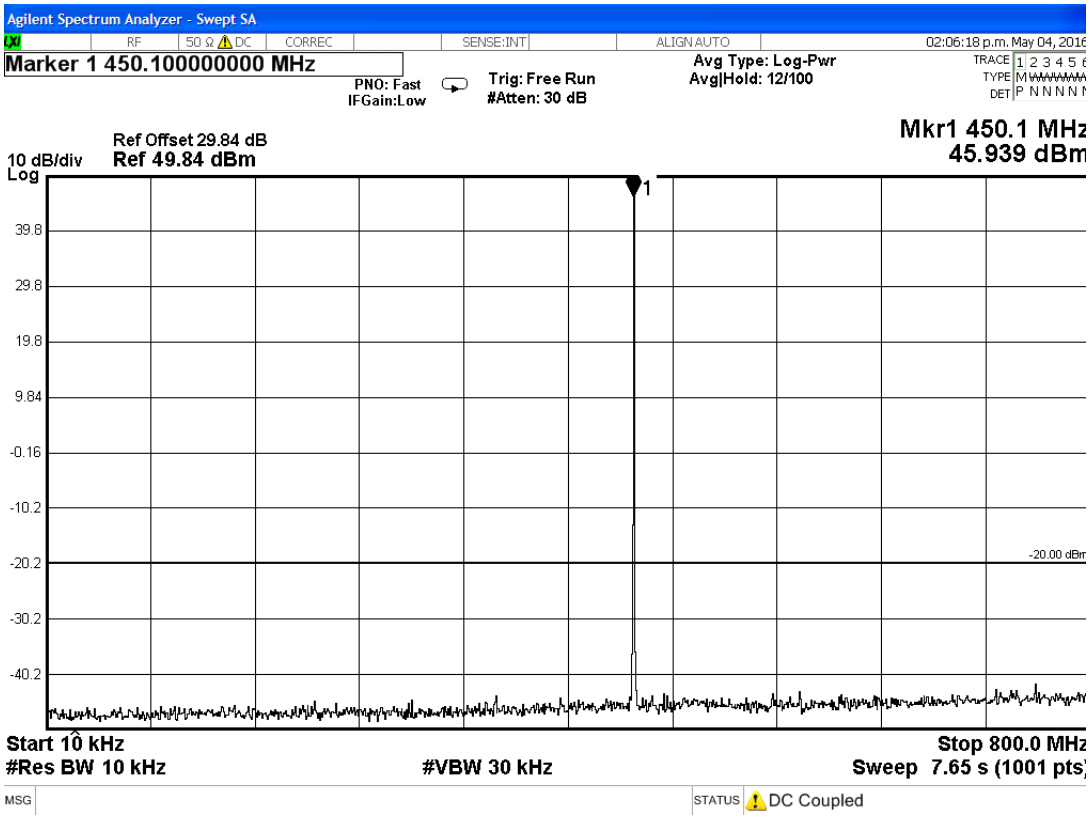
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

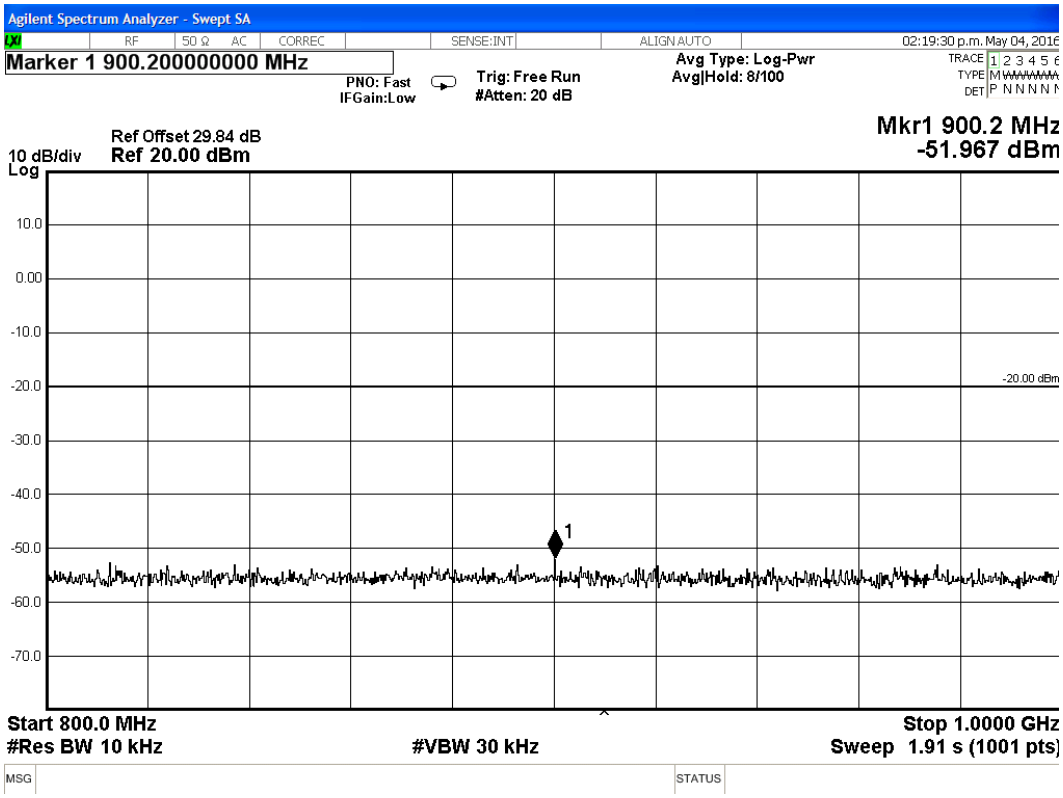
12.5 kHz Channel Spacing 450.1 MHz @ 40 W Emission Mask D

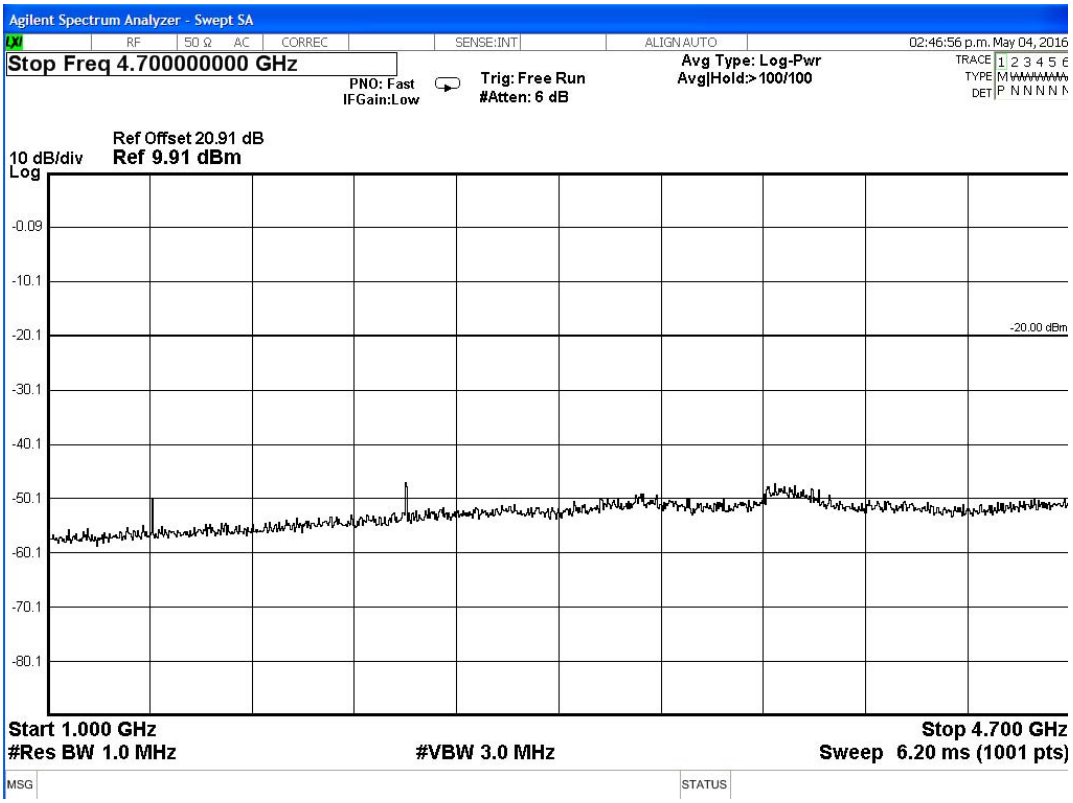
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing 450.1 MHz @ 2 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.		




Agilent Spectrum Analyzer - Swept SA
RF
50 Ω AC
CORREC
SENSE:INT
ALIGN AUTO
02:19:30 p.m. May 04, 2016
Marker 1 900.200000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 8/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 29.84 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 900.2 MHz
-51.967 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-20.00 dBm
1
Start 800.0 MHz
#Res BW 10 kHz
#VBW 30 kHz
Stop 1.0000 GHz
Sweep 1.91 s (1001 pts)
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
RF
50 Ω AC
CORREC
SENSE:INT
ALIGN AUTO
02:46:56 p.m. May 04, 2016
Stop Freq 4.700000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 6 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 20.91 dB
10 dB/div
Log
Ref 9.91 dBm
-0.09
-10.1
-20.1
-30.1
-40.1
-50.1
-60.1
-70.1
-80.1
-20.00 dBm
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 4.700 GHz
Sweep 6.20 ms (1001 pts)
MSG
STATUS

Spurious Emissions (Tx Conducted)

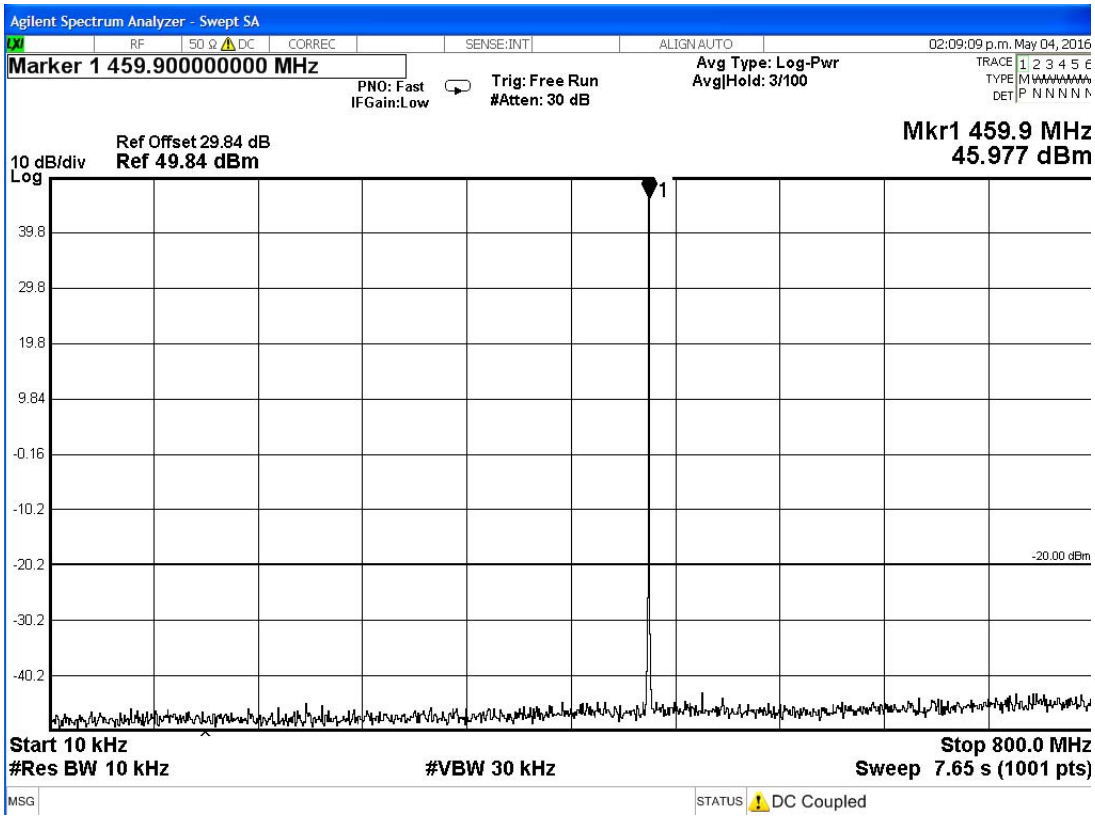
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

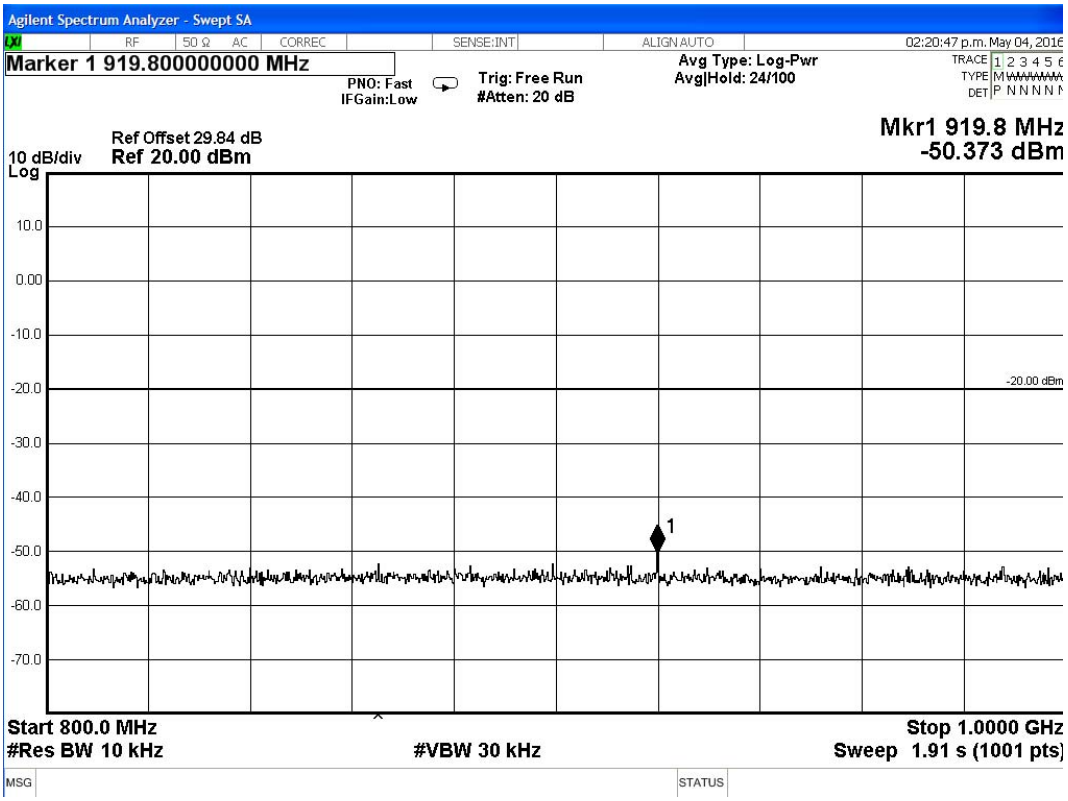
12.5 kHz Channel Spacing 459.9 MHz @ 40 W Emission Mask D

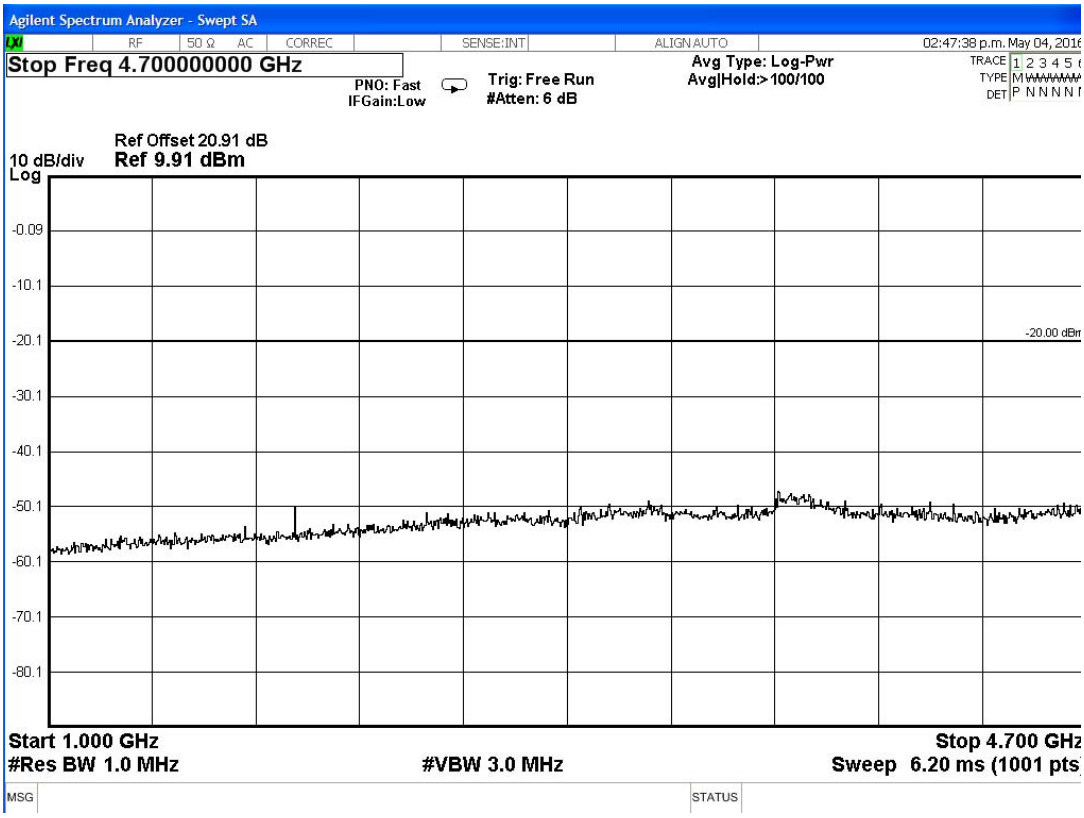
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing 459.9 MHz @ 2 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.		




Agilent Spectrum Analyzer - Swept SA
RF
50 Ω
AC
CORREC
SENSE:INT
ALIGN AUTO
02:20:47 p.m. May 04, 2016
Marker 1 919.800000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 24/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 29.84 dB
10 dB/div
Ref 20.00 dBm
Mkr1 919.8 MHz
-50.373 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-20.00 dBm
1
Start 800.0 MHz
#Res BW 10 kHz
#VBW 30 kHz
Stop 1.0000 GHz
Sweep 1.91 s (1001 pts)
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
RF
50 Ω
AC
CORREC
SENSE:INT
ALIGN AUTO
02:47:38 p.m. May 04, 2016
Stop Freq 4.700000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 6 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5
TYPE M
DET P N N N N
Ref Offset 20.91 dB
10 dB/div
Ref 9.91 dBm
Log
-0.09
-10.1
-20.1
-30.1
-40.1
-50.1
-60.1
-70.1
-80.1
-20.00 dBm
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 4.700 GHz
Sweep 6.20 ms (1001 pts)
MSG
STATUS

Spurious Emissions (Tx Conducted)

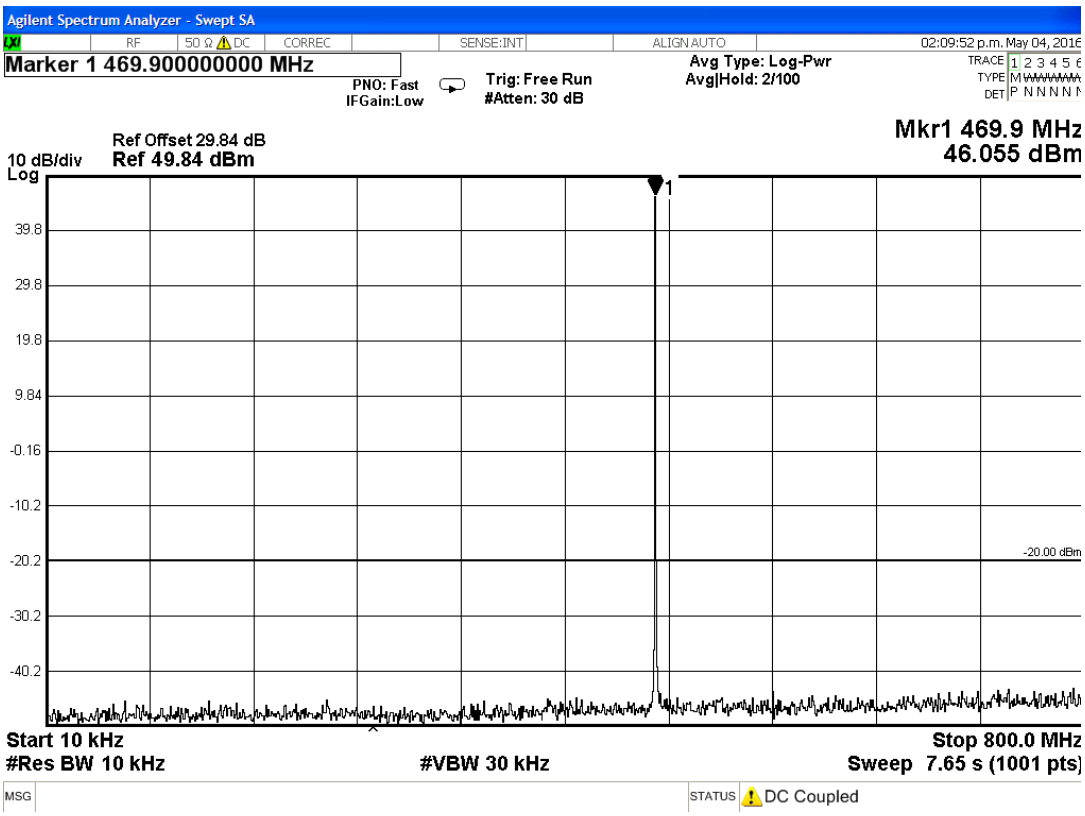
SPECIFICATION: FCC CFR 2.1051 RSS-119 5.8

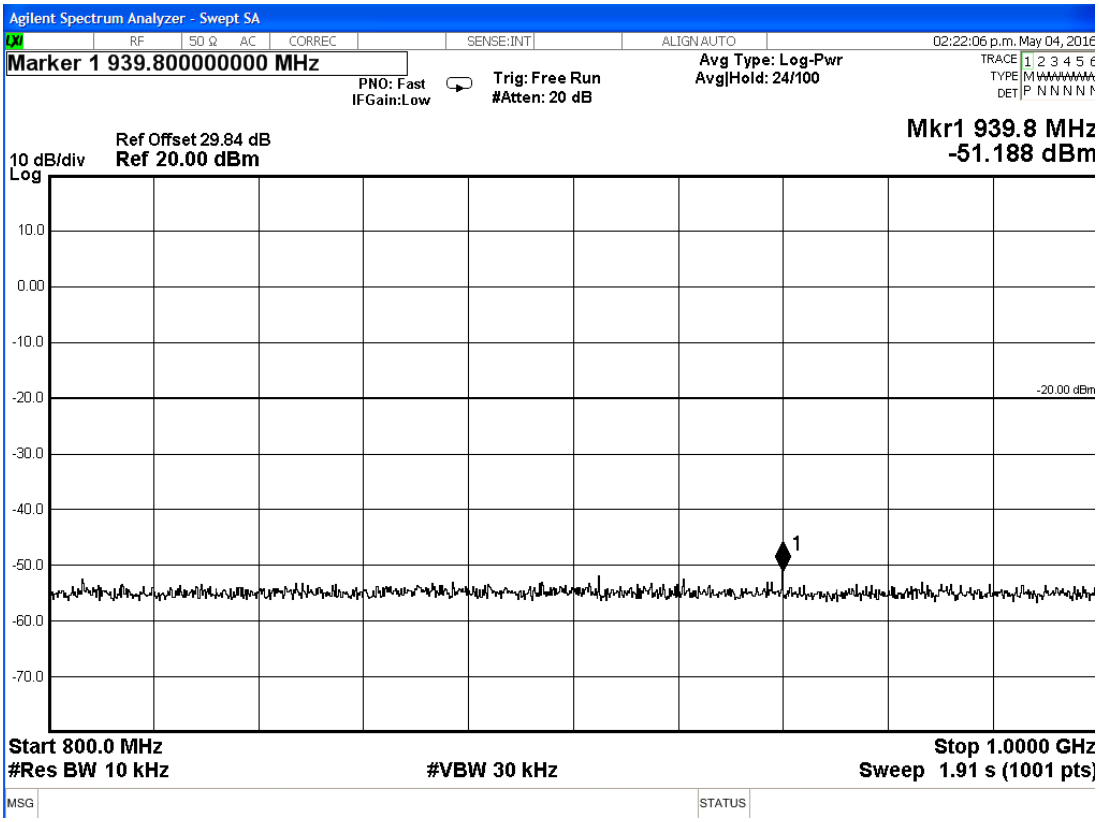
12.5 kHz Channel Spacing 469.9 MHz @ 40 W Emission Mask D

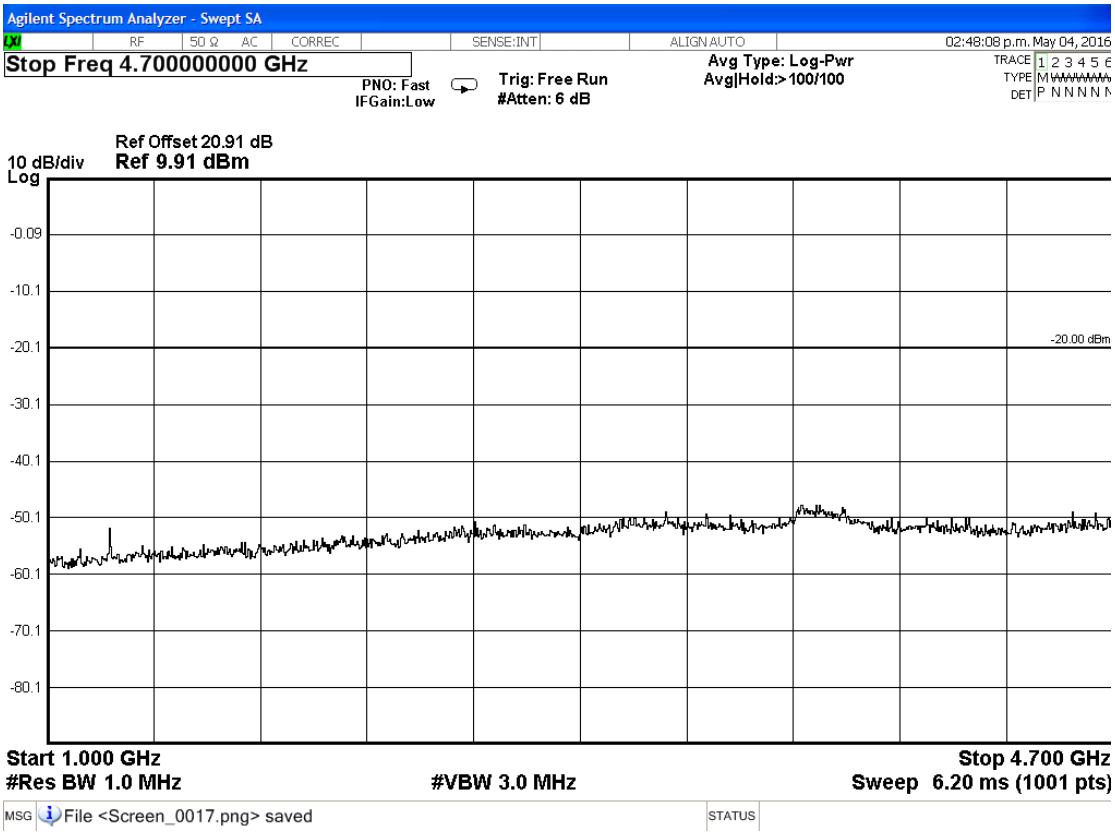
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~

12.5 kHz Channel Spacing 469.9 MHz @ 2 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.		




Agilent Spectrum Analyzer - Swept SA
RF
50 Ω AC
CORREC
SENSE:INT
ALIGN AUTO
02:22:06 p.m. May 04, 2016
Marker 1 939.800000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 24/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Mkr1 939.8 MHz
-51.188 dBm
Ref Offset 29.84 dB
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-20.00 dBm
1
Start 800.0 MHz
#Res BW 10 kHz
#VBW 30 kHz
Stop 1.0000 GHz
Sweep 1.91 s (1001 pts)
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
RF
50 Ω AC
CORREC
SENSE:INT
ALIGN AUTO
02:48:08 p.m. May 04, 2016
Stop Freq 4.700000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 6 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 20.91 dB
10 dB/div
Log
Ref 9.91 dBm
-0.09
-10.1
-20.1
-30.1
-40.1
-50.1
-60.1
-70.1
-80.1
-20.00 dBm
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 4.700 GHz
Sweep 6.20 ms (1001 pts)
MSG
File <Screen_0017.png> saved
STATUS

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 $50 + 10 \text{ Log}_{10} (P_{Watts})$	
40 W	-20 dBm	dBc
2 W	-20 dBm	dBc

TRANSMITTER SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC 47 CFR 2.1053

GUIDE: TIA-102.CAAA-C 2.2.6

MEASUREMENT PROCEDURE:
Initial Scan:

1. The EUT is placed in the S-Line TEM cell and emissions are measured from 30 MHz to 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)

SPECIFICATION: FCC CFR 2.1053

Tx FREQUENCY: 406.2 MHz

12.5 kHz Channel Spacing 406.2 MHz @ 40 W Emission Mask D

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

12.5 kHz Channel Spacing 406.2 MHz @ 2 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.		

Tx FREQUENCY: 418.1 MHz

12.5 kHz Channel Spacing 418.1 MHz @ 40 W Emission Mask D

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

12.5 kHz Channel Spacing 418.1 MHz @ 2 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.		

Tx FREQUENCY: 429.9 MHz

12.5 kHz Channel Spacing 429.9 MHz @ 40 W Emission Mask D

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

12.5 kHz Channel Spacing 429.9 MHz @ 2 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.		

Tx FREQUENCY: 450.1 MHz

12.5 kHz Channel Spacing 450.1 MHz @ 40 W Emission Mask D

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

12.5 kHz Channel Spacing 450.1 MHz @ 2 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.		

Tx FREQUENCY: 459.9 MHz

12.5 kHz Channel Spacing 459.9 MHz @ 40 W Emission Mask D

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

12.5 kHz Channel Spacing 459.9 MHz @ 2 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.		

Tx FREQUENCY: 469.9 MHz

12.5 kHz Channel Spacing 469.9 MHz @ 40 W Emission Mask D

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

12.5 kHz Channel Spacing 469.9 MHz @ 2 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.		

LIMITS: FCC CFR 2.1053

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

Tx Radiated Emissions - Continued

Open Area Test Site Results:

12.5 kHz Channel Spacing | 450.1 MHz @ 40 W | Emission Mask D

Harmonics Emission Frequency (MHz)	Level (dBm)	Level (dBc)
900.200000	-48.42	-94.42
1350.300000	-55.93	-101.93
1800.400000	-66.86	-112.86
2250.500000	-77.13	-123.13
2700.600000	-67.42	-113.42

Photo: OATS Setup

TRANSIENT FREQUENCY BEHAVIOR

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

GUIDE: TIA-102.CAAA-C 2.2.18

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

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

LIMIT CLAUSES: FCC 47 CFR 90.214 RSS-119 5.9

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 406.2 MHz 40 W 12.5 kHz Channel Spacing

406.2 MHz @ 40 W Tx

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	-0.6	N/A
t2	-0.5	N/A
t3	N/A	0.2

	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

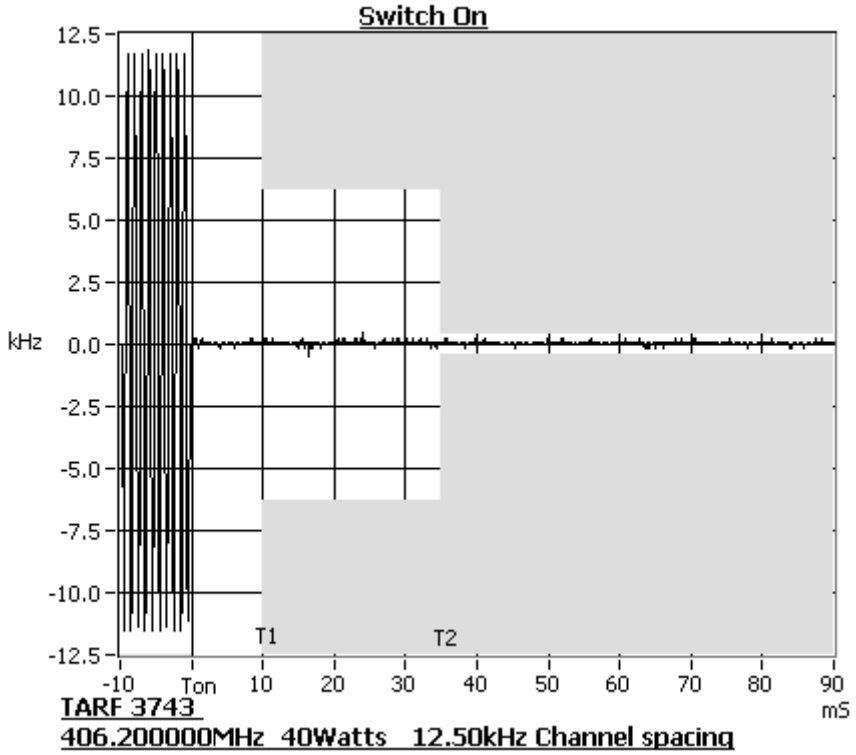
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

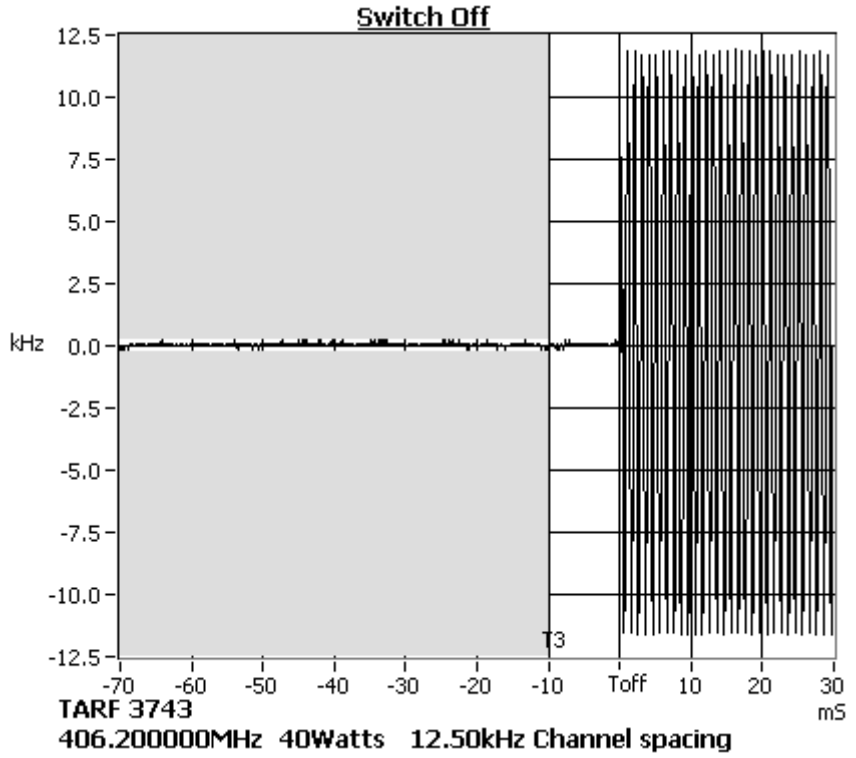
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214 RSS-119 5.9

Tx FREQUENCY: 406.2 MHz 40 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 418.1 MHz 40 W 12.5 kHz Channel Spacing

418.1 MHz @ 40 W Tx

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	0.4	N/A
t2	0.3	N/A
t3	N/A	-0.5

	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.	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

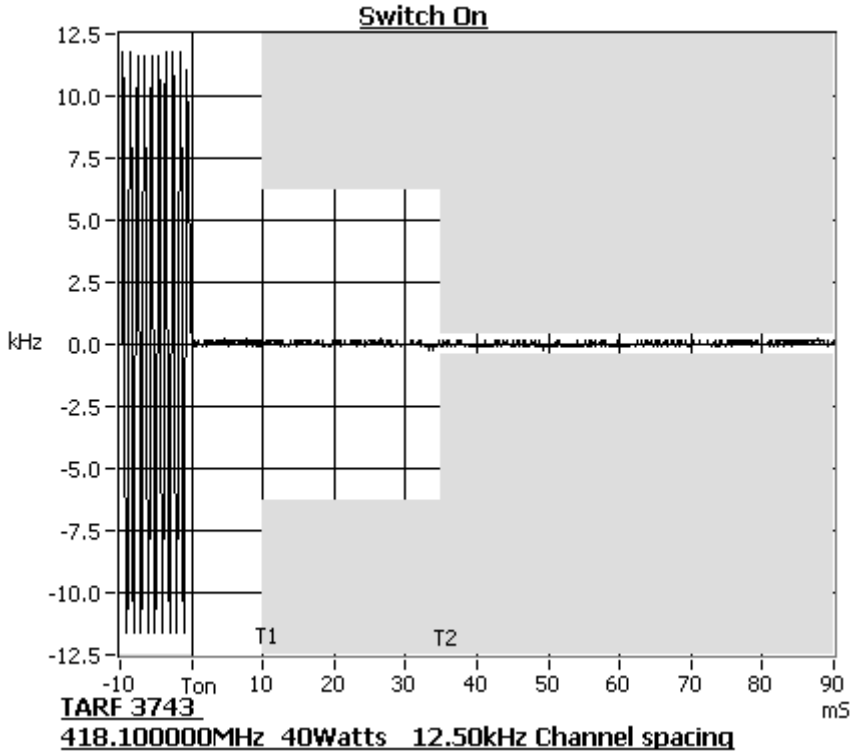
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

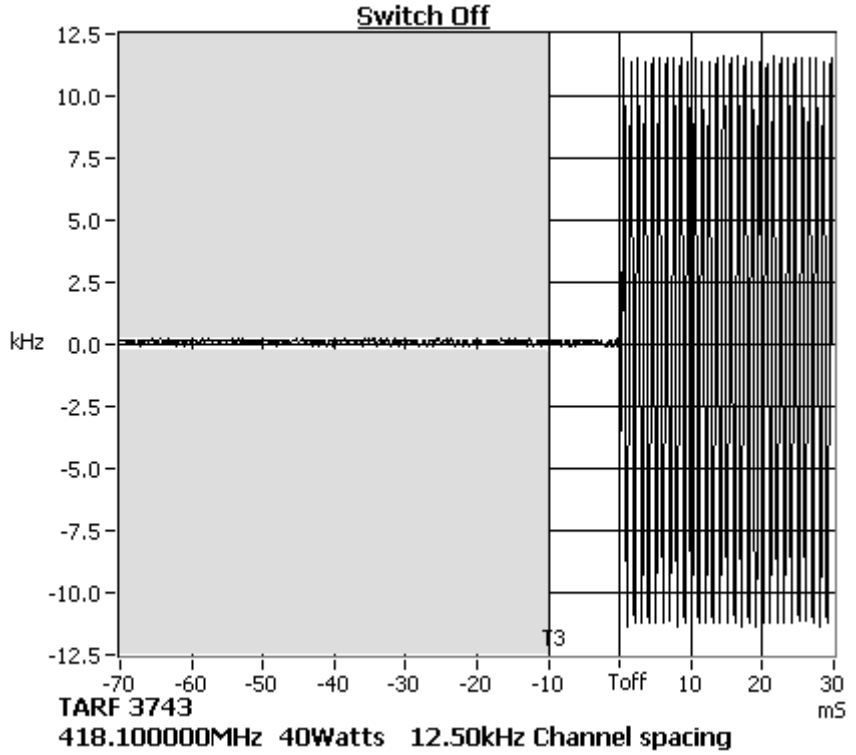
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 418.1 MHz 40 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 429.9 MHz 40 W 12.5 kHz Channel Spacing

429.9 MHz @ 40 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

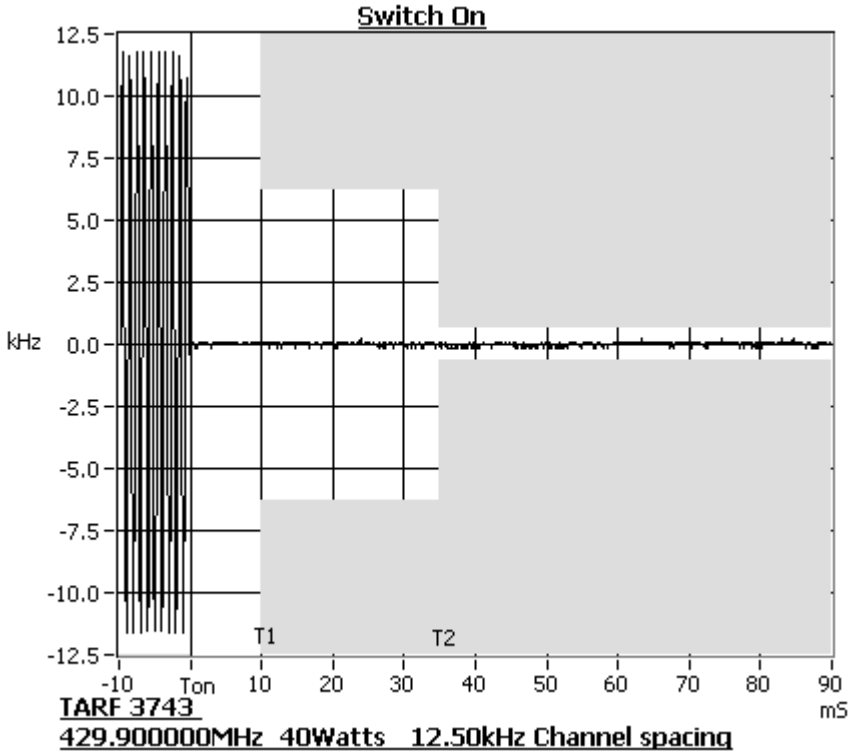
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

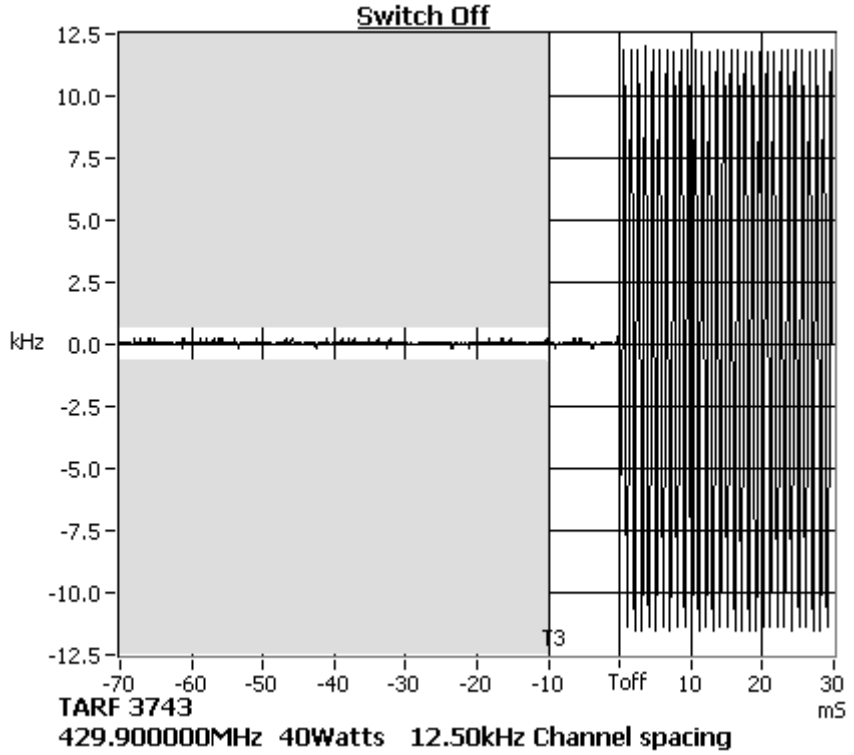
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 429.9 MHz 40 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 450.1 MHz 40 W 12.5 kHz Channel Spacing

450.1 MHz @ 40 W Tx

TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t1	-0.4	N/A
t2	-0.3	N/A
t3	N/A	0.2

Confirm that during periods t1 and t3 the frequency difference does not exceed the value of one channel separation.	YES	NO
	✓	☐
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

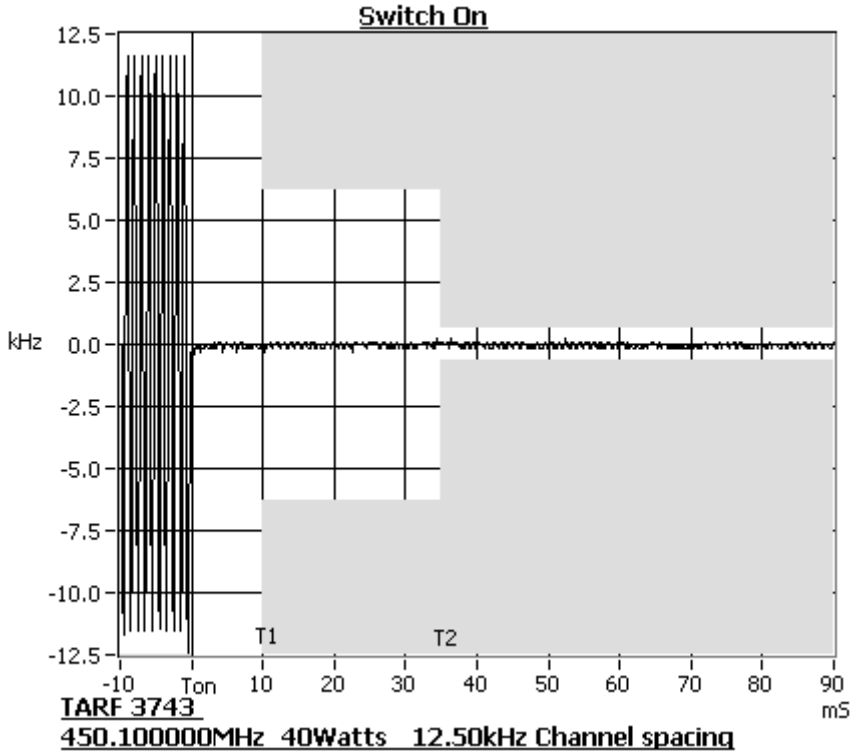
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

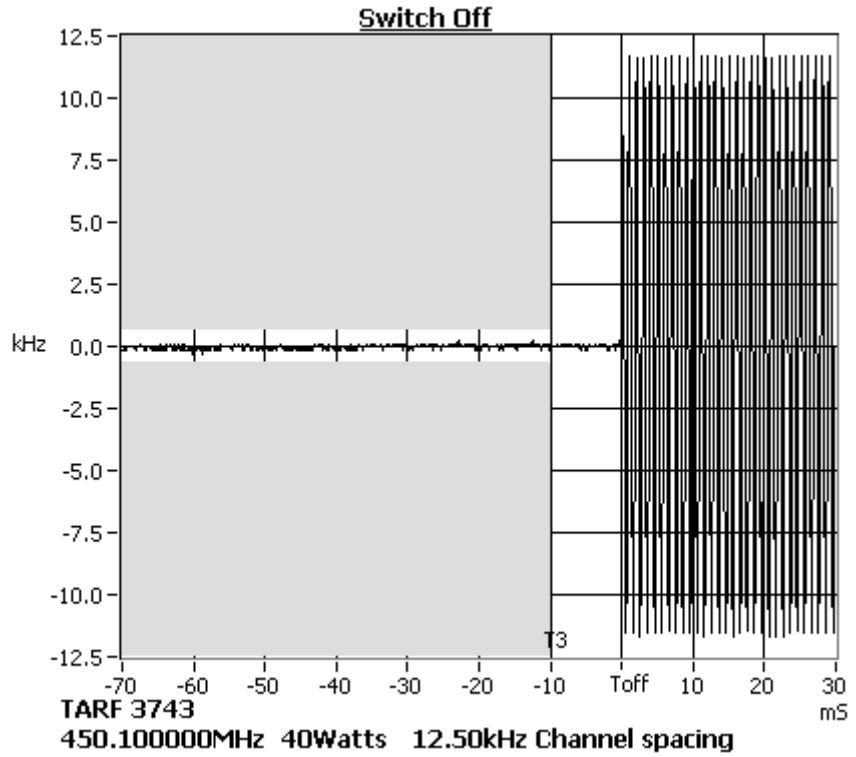
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 450.1 MHz 40 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 459.9 MHz 40 W 12.5 kHz Channel Spacing

459.9 MHz @ 40 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	0.7

	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

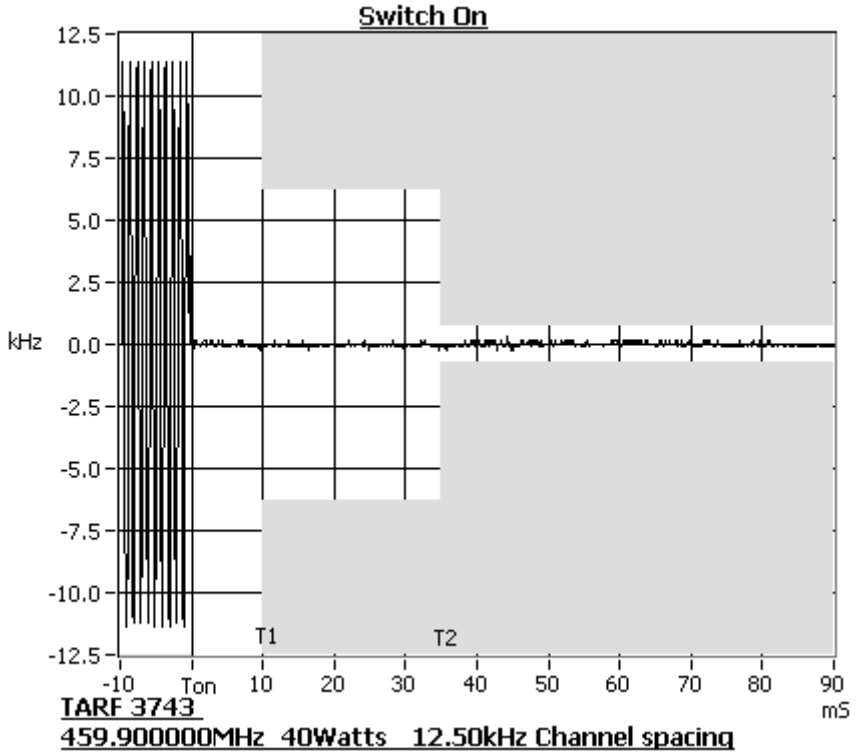
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

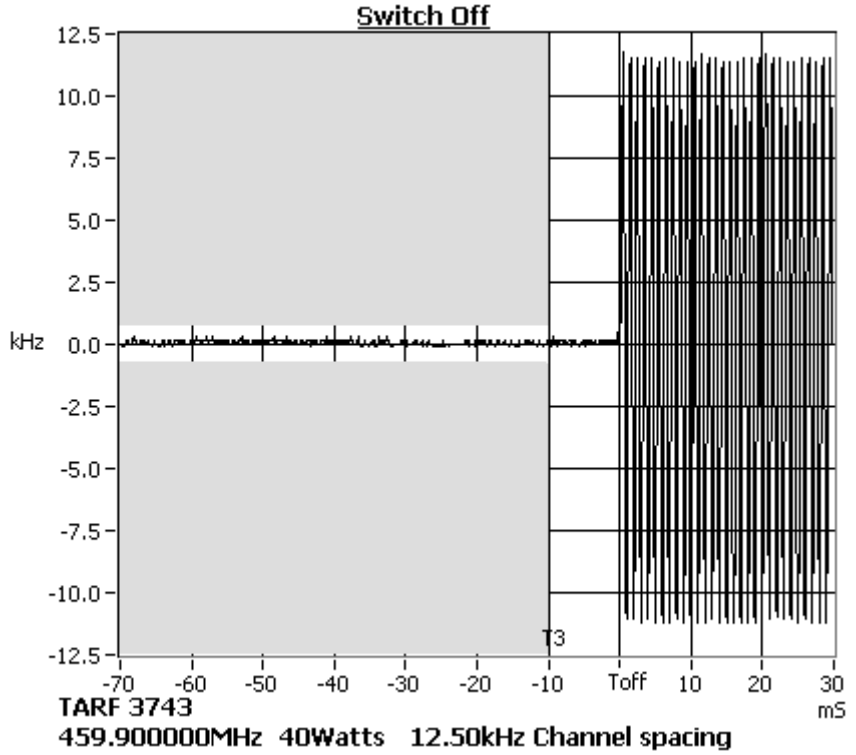
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 459.9 MHz 40 W 12.5 kHz Channel Spacing





Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 469.9 MHz 40 W 12.5 kHz Channel Spacing

469.9 MHz @ 40 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	0.7

	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

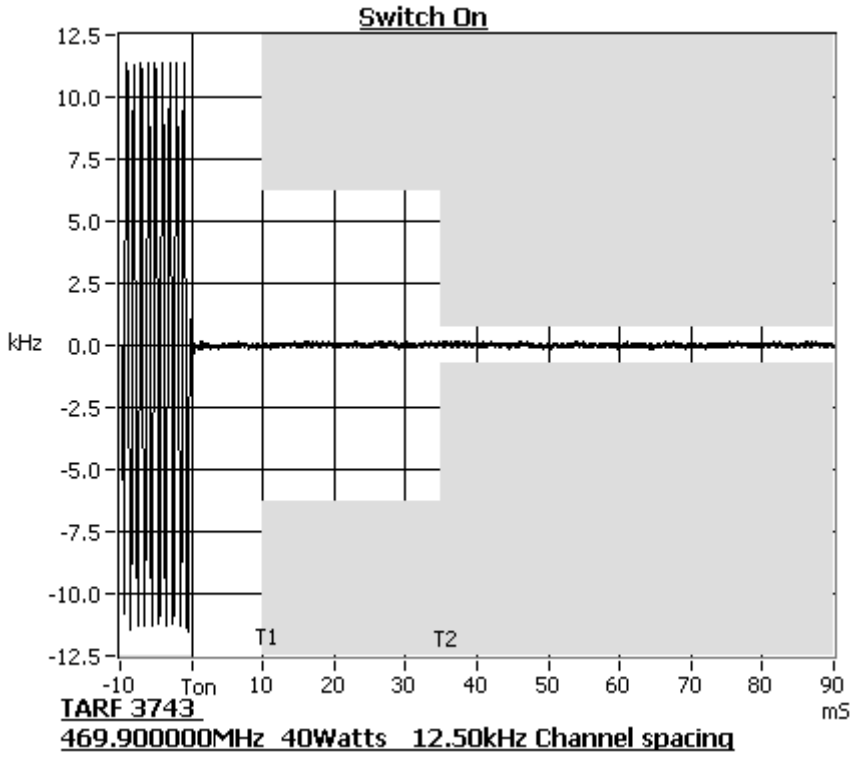
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
TRANSIENT PERIODS	Maximum Frequency Difference	FREQUENCY RANGE	
		138 – 174 MHz	406.1 – 470 MHz
t1 (ms)	± 12.5 kHz	5 ms	10 ms
t2 (ms)	± 6.25 kHz	20 ms	25 ms
t3 (ms)	± 12.5 kHz	5 ms	10 ms

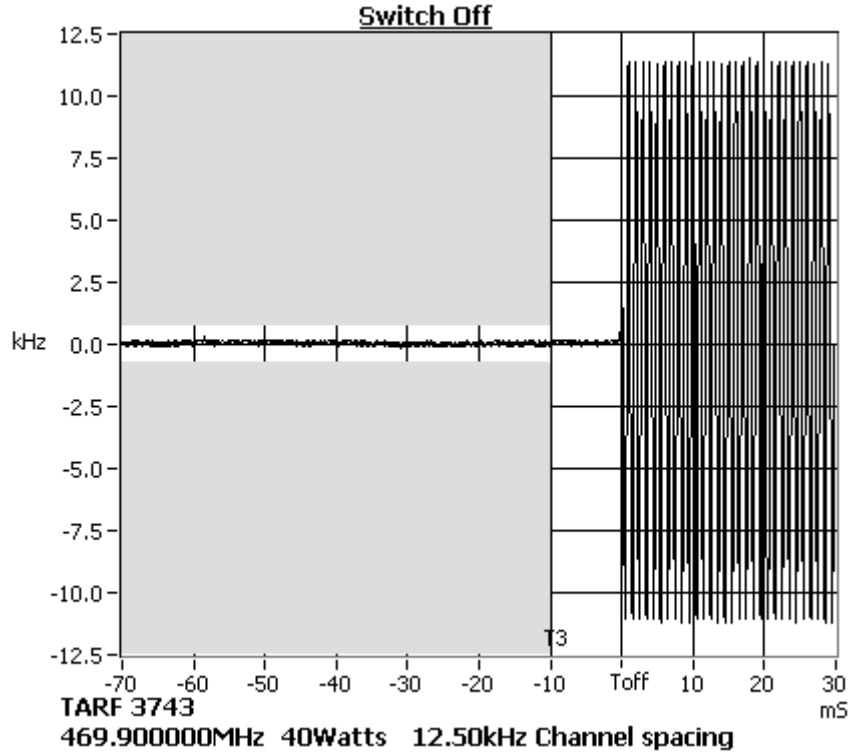
Note: RSS-119 5.9 - If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during the time periods t1 and t3 may exceed the maximum frequency difference for these time periods,

Transient Frequency Behavior

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 469.9 MHz 40 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).

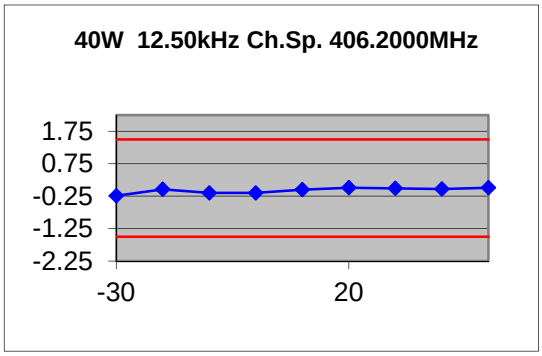
MEASUREMENT RESULTS:
See the plots on the following pages for 12.5 kHz & 25.0 kHz channel spacings.

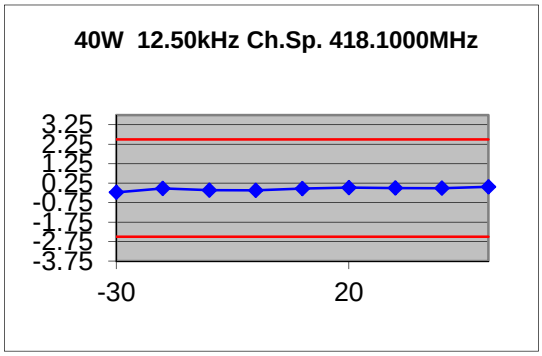
°C	406.2000MHz		418.1000MHz		429.9000MHz		450.1000MHz		459.9000MHz		469.9000MHz	
	Hz	ppm	Hz	ppm	Hz	ppm	Hz	ppm	Hz	ppm	Hz	ppm
-30	-96	-0.24	-93	-0.22	-100	-0.23	-101	-0.22	-103	-0.22	-112	-0.24
-20	-18	-0.04	-10	-0.02	-27	-0.06	-27	-0.06	-21	-0.05	-26	-0.06
-10	-62	-0.15	-44	-0.11	-59	-0.14	-62	-0.14	-70	-0.15	-64	-0.14
0	-62	-0.15	-50	-0.12	-62	-0.14	-69	-0.15	-72	-0.16	-66	-0.14
10	-19	-0.05	-14	-0.03	-19	-0.04	-26	-0.06	-22	-0.05	-20	-0.04
20	5	0.01	7	0.02	-3	-0.01	4	0.01	0	0	-1	0
30	-3	-0.01	0	0	-8	-0.02	-13	-0.03	-5	-0.01	-6	-0.01
40	-13	-0.03	-3	-0.01	-6	-0.01	-17	-0.04	-10	-0.02	-11	-0.02
50	5	0.01	26	0.06	-1	0	7	0.02	1	0	2	0

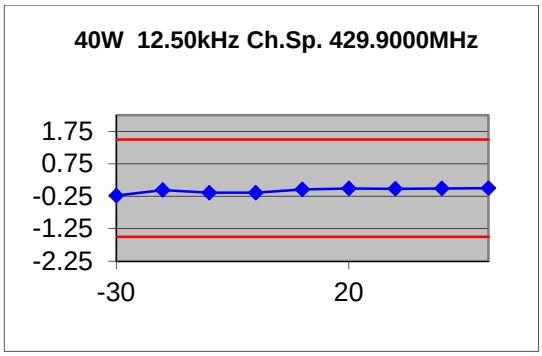
LIMIT: FCC 47 CFR 90.213 RSS-119 5.3

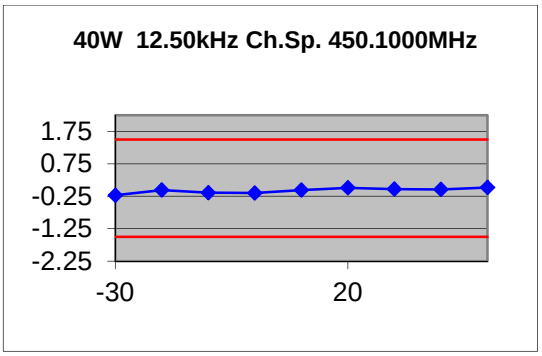
Channel Spacing (kHz)	Frequency Error (ppm)
12.5	2.5
25.0	5.0

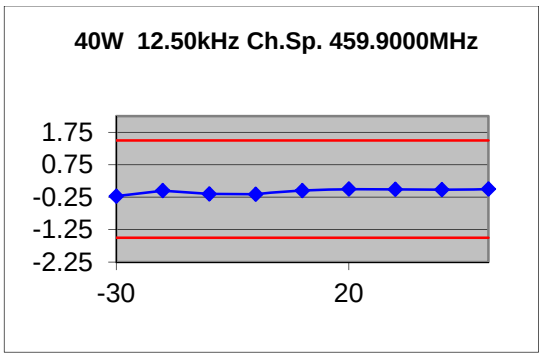
Transmitter Frequency Stability - Temperature

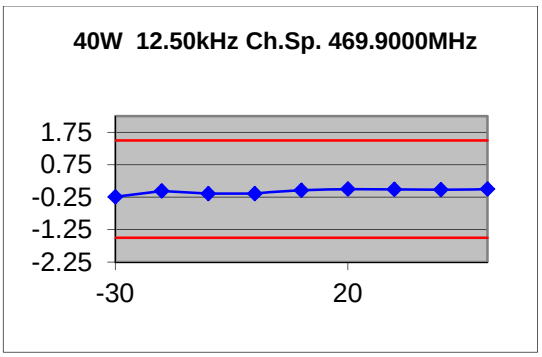












TRANSMITTER FREQUENCY STABILITY - VOLTAGE

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

RSS-119 5.3

GUIDE: TIA-102.CAAA-C 2.2.2

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

MEASUREMENT RESULTS: 40W

Voltage	FREQUENCY ERROR (ppm) for 12.5 kHz		
	406.2 MHz	418.1 MHz	429.9 MHz
13.8V_{DC}	0.01	-0.02	0.01
11.7V_{DC}	0.00	-0.03	0.00
15.9 V_{DC}	-0.01	-0.01	0.02
Max Frequency ppm	0.01	-0.03	0.02

40W

Voltage	FREQUENCY ERROR (ppm) for 12.5 kHz		
	450.1 MHz	459.9 MHz	469.9 MHz
13.8V_{DC}	-0.01	0.00	-0.01
11.7V_{DC}	0.00	-0.02	-0.03
15.9 V_{DC}	0.00	-0.02	-0.01
Max Frequency ppm	-0.01	-0.02	-0.03

LIMIT CLAUSES: FCC 47 CFR 90.213 RSS-119 5.3

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

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

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

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

RECEIVER SPURIOUS EMISSIONS (CONDUCTED)

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

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

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

LIMIT CLAUSE: RSS-Gen 6(b)

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

TRANSMITTER STANDBY SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: RSS-119 5.11

GUIDE: TIA-102.CAAA-C 2.1.2

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

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

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

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

TRANSMITTER STANDBY SPURIOUS EMISSIONS (CONDUCTED)

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

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

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

LIMIT CLAUSE: RSS-Gen 6(b)

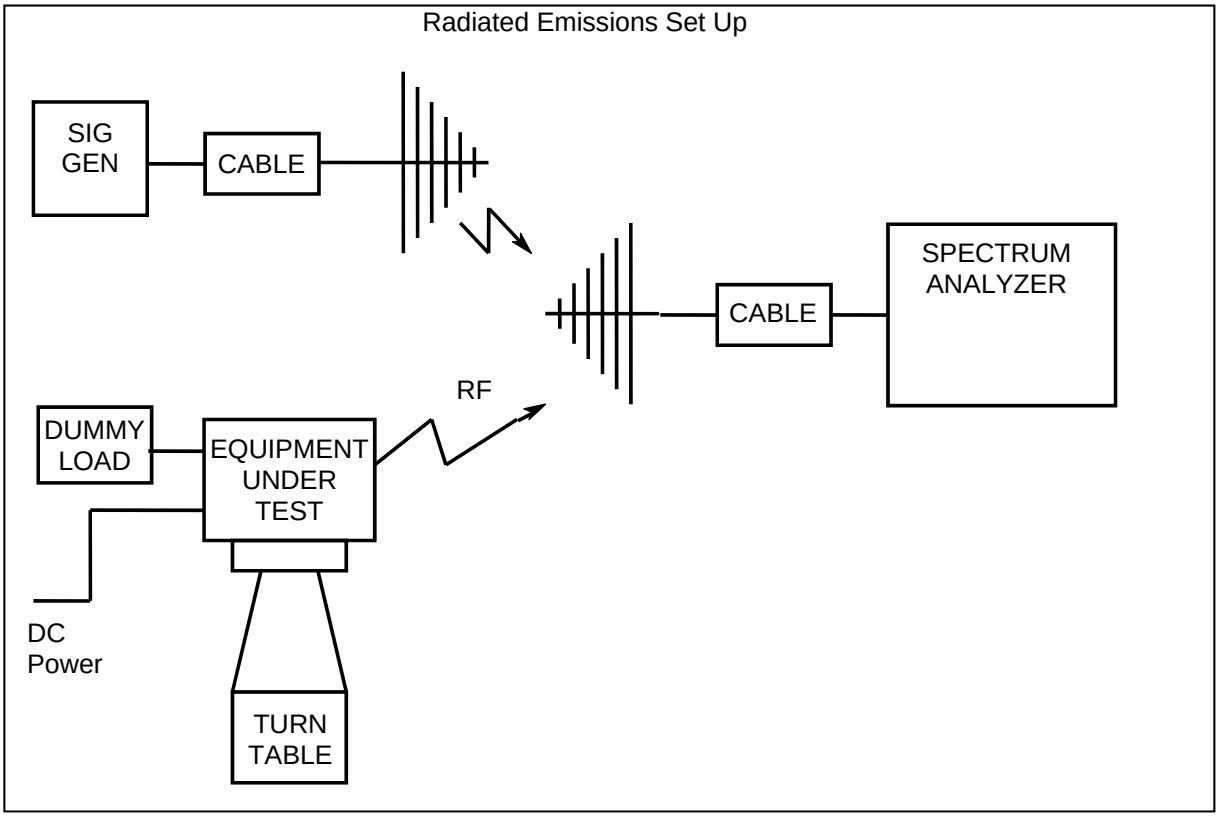
LIMIT	30 → 1000 MHz	2 nW	- 57 dBm
	> 1000 MHz	5 nW	- 53 dBm

TEST EQUIPMENT LIST

Equipment Type	Information	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
Signal Generator	Analog 3.2GHz	Hewlett Packard	HP8648C	3443U00543	E3558	16-Oct-16
Environ. Chamber	Chest	Contherm	Chest	E3397	E3397	1-Aug-17
Power Supply	TREVA2 60V/25A	Agilent	N5767A	US09F4901H	E4656	18-Oct-17
Antenna	Reference Dipoles	Emco	3121C DB1	9510-1164	E3559	14-Apr-19
Antenna	18GHz DRG	Emco	DRG3115	9512-4638	E3560	29-Apr-19
Antenna	18GHz DRG	Emco	DRG3115	2084	E3076	29-Apr-19
Spectrum Analyser	26.5GHz	Agilent	PXA N9030A	MY49432161	E4907	6-Jul-16
RF Chamber	S-LINE TEM CELL	Rohde & Schwarz	1089.9296.02	338232/003	E3636	29-Sep-16
Filter Notch		Tait		N/A	-	
RF Attenuator	10dB 150W	Weinschel	57-10-34	LB590	E3674	18-Oct-16
RF Attenuator	10dB 50W	Weinschel	24-10-34	AZ0401	E3388	18-Oct-16
RF Attenuator	20dB 50W	Weinschel	24-20-44	AW1266	E3562	15-Oct-16
RF Load	150W	Bird	8166	524	E3625	
Coax Cable	3m Blue	Suhner	Sucoflex 104A	44611/4A	E4620	18-Oct-16
Oscilloscope	400MHz	Tektronics	TDS380	B017095	E3782	13-Oct-17
Modulation Analyser	TREVA2	Hewlett Packard	HP8901B (Opt 002)	3704A05837	E3786	20-Oct-16
Signal Generator	TREVA2 Analog 3.3GHz	Rohde & Schwarz	SML03 1090.3000.13	100597	E4050	18-Oct-16
RF Combiner	TREVA2	Minicircuits	ZFSC-4-1	-	E4084	
ISN	CISPR22 2006	TESEQ	ISN T800	27956	E4658	29-Nov-15
OATS	Antenna Tower	Electrometrics	EM-4720-2	112	E4447	
OATS	Controller	Electrometrics	EM-4700	119	E4445	
OATS	Turntable	Electrometrics	EM-4704A	105	E4446	
RF Attenuator	30dB 350W	Weinschel	67-30-33	BR0531	E4280	18-Oct-16
Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack5	E4850	16-Oct-16
Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack6	E4849	16-Oct-16
Power Meter	TREVA2 Power Head for HP8901	Hewlett Packard	HP11722A	2716A02037	1575	20-Oct-16
Antenna	Collapsible Biconical and Balun	Schwarzbeck	FBAB 9177,VHA 9103	9104-2459	E4616	5-Aug-16
LISN		Schwarzbeck	NNBM 8125	8125-1127	E4618	19-Oct-16
LISN		Schwarzbeck	NNBM 8125	8125-1505	E4654	19-Oct-16
TREVA 2		Teltest	-	2	-	5-May-17
Coax Cable	2.5m Blue	Suhner	Sucoflex 104A	33449/4PEA	E4997	18-Oct-16
RF Chamber	Reverb - 0.5 - 18GHz Reverberation Chamber	Teseq	RVC XS	29765	E4855	
Antenna	Reverb - 1-18GHz DRG	Schwarzbeck	BBHA 9120 D	9120D-885	E4857	
Temp & Humidity datalogger		Hobo	U21-011	10134276	E4981	14-Aug-16
OATS	FCC Listing Registration			837095		12-May-16
Coax Cable	OATS Turntable Cable 2	Intelcom	RG215	OATS3	E4995	20-Oct-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.