

LABORATORY TEST REPORT

RADIO PERFORMANCE MEASUREMENTS

for the

TBCH0D Base Station Transceiver

Tested in accordance with:

FCC 47 CFR Parts 22, 74 & 90

RSS-119 Issue 12
RSS-Gen Issue 4

Report Revision: 1
Issue Date: 22 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.

This document must not be reproduced except in full, without the written permission of the Compliance Laboratory Manager

TELTEST Laboratories (A Division of Tait Communications)
PO Box 1645, 558 Wairakei Road, Christchurch, New Zealand.

Telephone: 64 3 358 3399
FAX: 64 3 359 4632

TABLE OF CONTENTS

REVISION 3

INTRODUCTION 4

STATEMENT OF COMPLIANCE 6

MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS 7

TEST RESULTS..... 8

 TRANSMITTER AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS..... 8

 TRANSMITTER MODULATION LIMITING 10

 TRANSMITTER OCCUPIED BANDWIDTH AND SPECTRUM MASKS 12

TEST EQUIPMENT LIST..... 22

ANNEX A – TEST SETUP DETAILS..... 23

REVISION

Date	Revision	Comments
22 April 2016	1	Initial test report

INTRODUCTION

Type approval testing of the TBCH0D, 50 Watt, Base Station transceiver in order to demonstrate compliance with FCC 47 Parts 22, 74 & 90, and RSS-119 Issue 11 & RSS-Gen Issue 4.
This Class-2 Permissive Change report adds Analogue FM and FFSK to the list of modulations supported.

The original test report is TARF 3532.

Test Report 3709 added analogue FM to frequencies covered by the TBCH2Y reciter (440MHz to 480MHz)

This report 3735 adds analogue FM to frequencies covered by the TBCH1Y reciter (400MHz to 440MHz) as well as adding FFSK to frequencies covered by both the TBCH1Y and TBCH2Y reciters (400MHz to 480MHz).

REPORT PREPARED FOR

Tait Ltd
245 Wooldridge Road
Harewood
Christchurch 8051
New Zealand

DESCRIPTION OF SAMPLE

Manufacturer: Tait Limited
Equipment: Base Station Transceiver
Type: TBCH0D
Frequency range: 400 → 440 MHz with TBCH1Y Reciter
440 → 480 MHz with TBCH2Y Reciter
Transmit Power: 50W

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

HARDWARE & SOFTWARE –

Quantity: 1 of each

Description	Product Code	Serial Number	Firmware Version	Hardware Version
Reciter 400-440MHz	T01-01105-KAAA	18226781	dmr-trunk.20160413T084418	01.00
Reciter 440-480MHz	T01-01105-LAAA	18226784	dmr-trunk.20160413T084418	01.00
Power Amplifier	TBA80H00000	18201462	0314	01.00
PMU	TBA30A0-0100	18203618	0316	01.00
Front Panel	T01-01110-CAAA	18203120	0.01.00.trunk.406630.20160303 T143908.0002	00.04

TEST CONDITIONS

All testing was performed between 15th → 18th April 2016, and under the following conditions:

Ambient temperature: 15°C → 30°C

Relative Humidity: 20% → 75%

Standard Test Voltage 120 V_{AC}

TEST PATTERNS

Analogue modulation is provided via an Ethernet UDP connection and is encoded according to ITU-T G.711 (μ-law).

FFSK tests were performed using a 511 bit pseudo-random sequence.

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: TBCH0D
With reciters: TBCH1Y (400 to 440 MHz)
TBCH2Y (440 to 480 MHz)
Quantity: 1 of each

Consisting Of:

HARDWARE & SOFTWARE – Analogue Modulation Testing

Description	Product Code	Serial Number	Firmware Version	Hardware Version
Reciter 400-440MHz	T01-01105-KAAA	18226781	dmr-trunk.20160413T084418	01.00
Reciter 440-480MHz	T01-01105-LAAA	18226784	dmr-trunk.20160413T084418	01.00
Power Amplifier	TBA80H00000	18201462	0314	01.00
PMU	TBA30A0-0100	18203618	0316	01.00
Front Panel	T01-01110-CAAA	18203120	0.01.00.trunk.406630.20160303 T143908.0002	00.04

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

FCC 47 CFR Parts 22, 74 & 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 1200bps

EMISSION DESIGNATORS:

Channel Spacing 12.5 kHz	
Analog FM	11K0F3E
FFSK Data 1200 bps	7K60F2D

CALCULATIONS

Equation: $B_n = 2M + 2Dk$

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

Analogue Voice 12.5 kHz Bandwidth

Necessary bandwidth

M = 3.0 kHz

D = 2.5 kHz

$$B_n = (2 \times 3.0) + (2 \times 2.5) \times 1 \\ = 11.0 \text{ kHz}$$

Emission Designator

11K0F3E

F3E represents an FM voice transmission

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

Necessary bandwidth

M = 1.8 kHz

D = 2.0 kHz

$$B_n = (2 \times 1.8) + (2 \times 2.0) \times 1 \\ = 7.6 \text{ kHz}$$

Emission Designator

7K60F2D

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

TEST RESULTS

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:

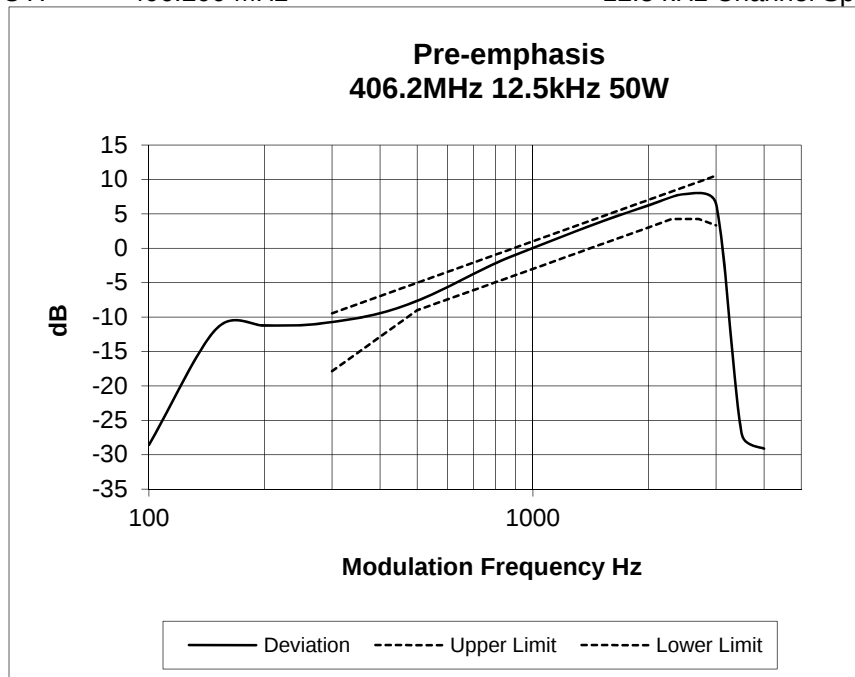
See the plots on the following pages for 12.5 kHz channel spacing tested at 50W transmit power.

NOTE: The upper audio frequency tested was 3800 Hz due to the 8000 Hz sample rate of the modulating signal.

LIMIT CLAUSE: TIA/EIA-603D 3.2.6

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 406.200 MHz 12.5 kHz Channel Spacing

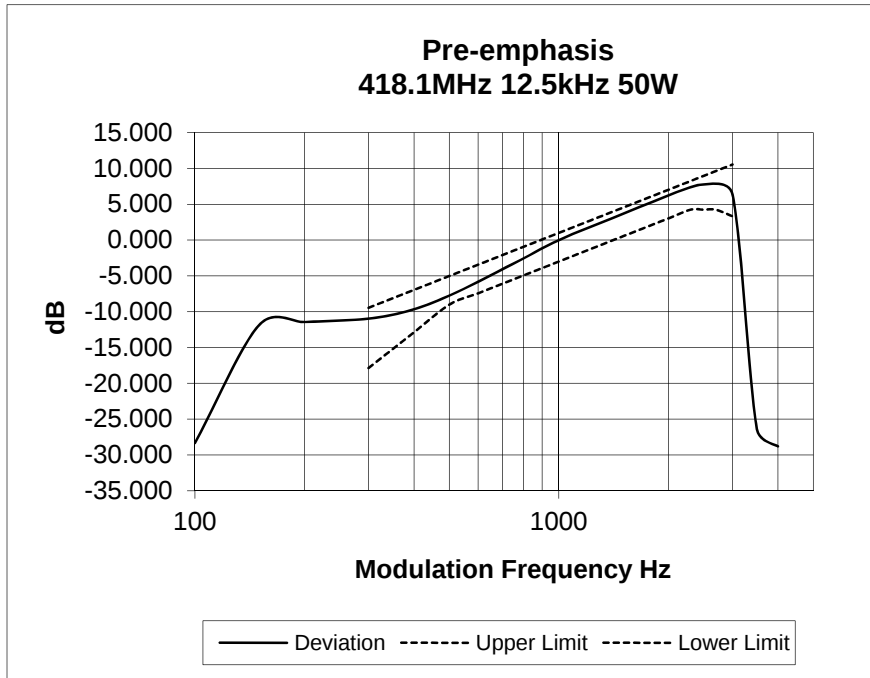


Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 418.100 MHz

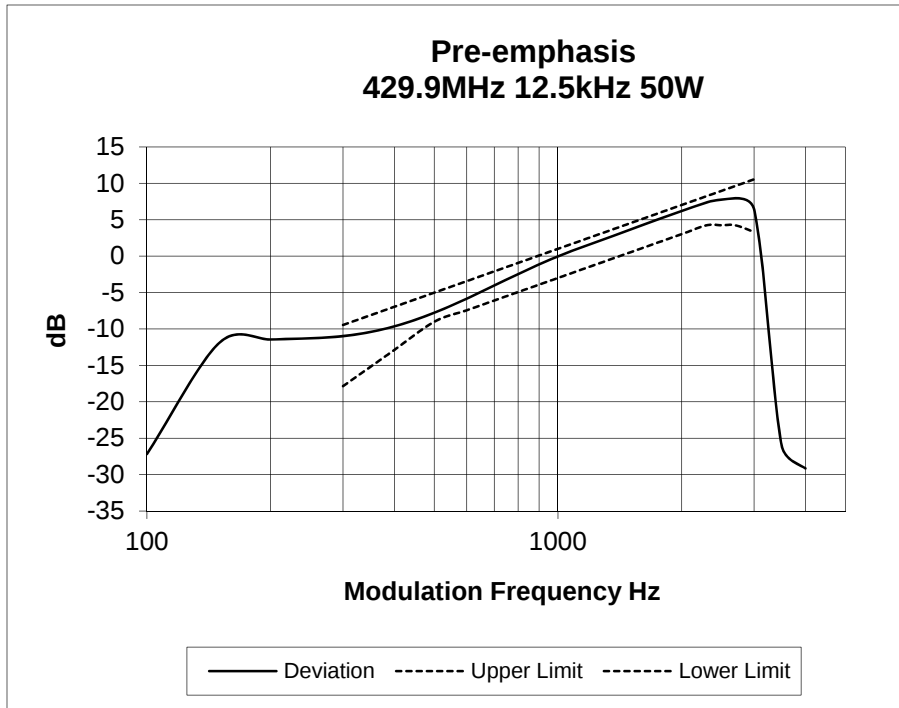
12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 429.900 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.

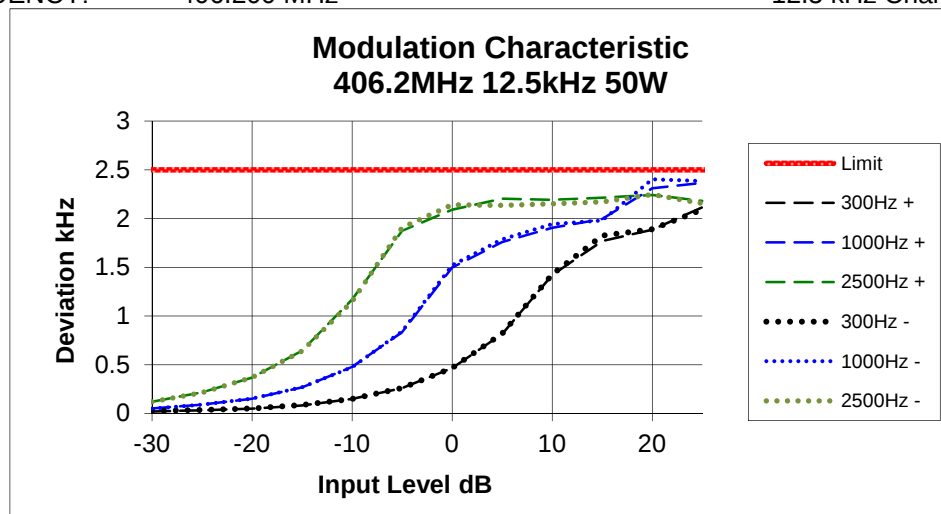
MEASUREMENT RESULTS:

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

LIMIT CLAUSE: TIA/EIA-603D 1.3.4.4

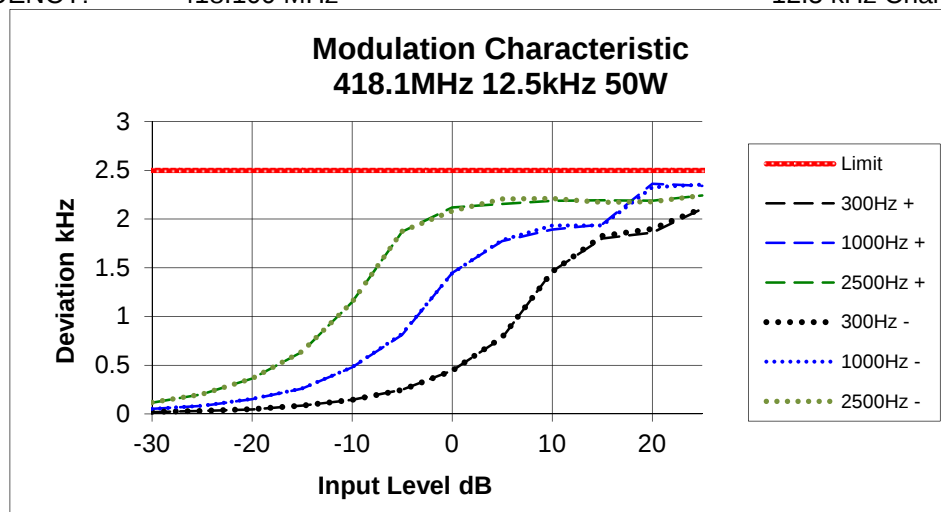
Tx FREQUENCY: 406.200 MHz

12.5 kHz Channel Spacing



Tx FREQUENCY: 418.100 MHz

12.5 kHz Channel Spacing

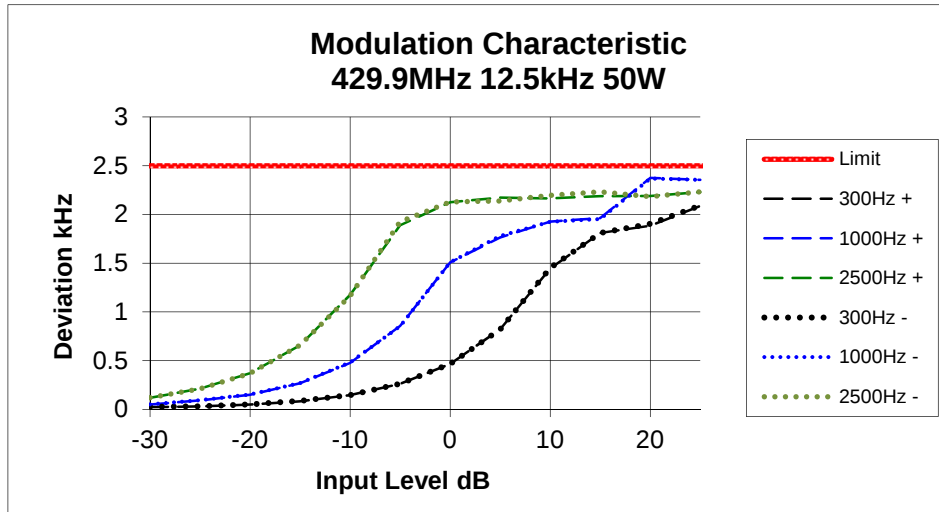


Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 429.900 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 analogue 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 Analogue, FFSK

DATA SPEED

FFSK 12.5 kHz Channel Spacing 1200 bps

Occupied Bandwidth and Spectrum Masks

Analogue FM

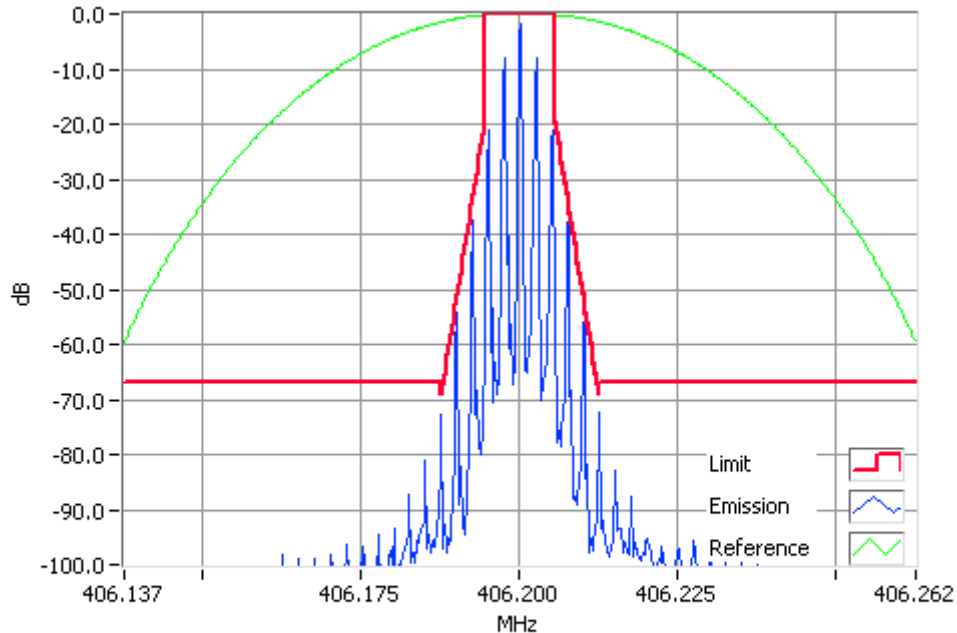
SPECIFICATION: FCC CFR 2.1049 (c) Mask- D

RSS-119 5.5 Mask-D

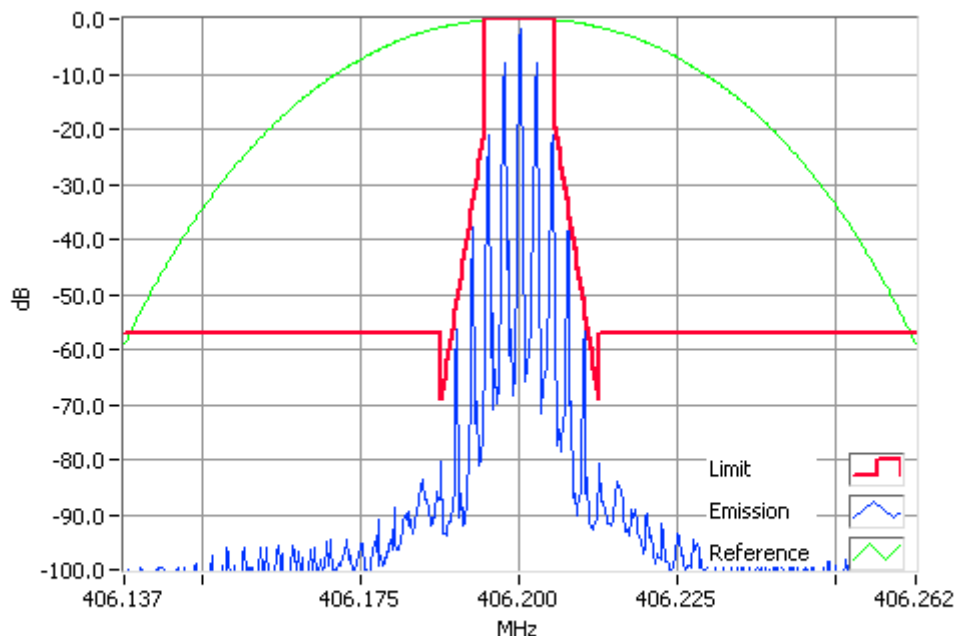
Tx FREQUENCY: 406.2 MHz

50W & 5W

12.5 kHz Channel Spacing



Analogue Modulation 406.2000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

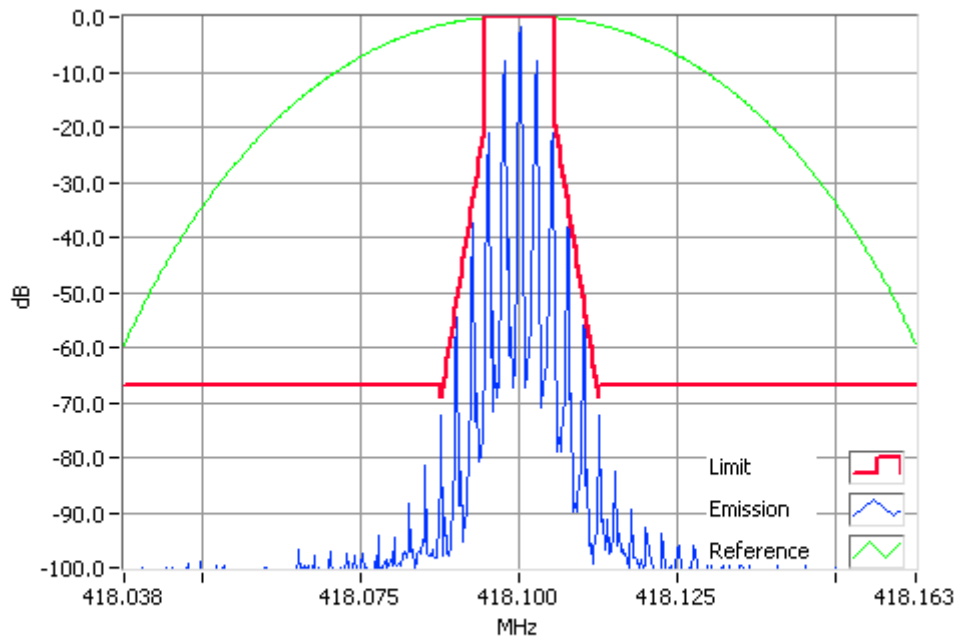


Analogue Modulation 406.2000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

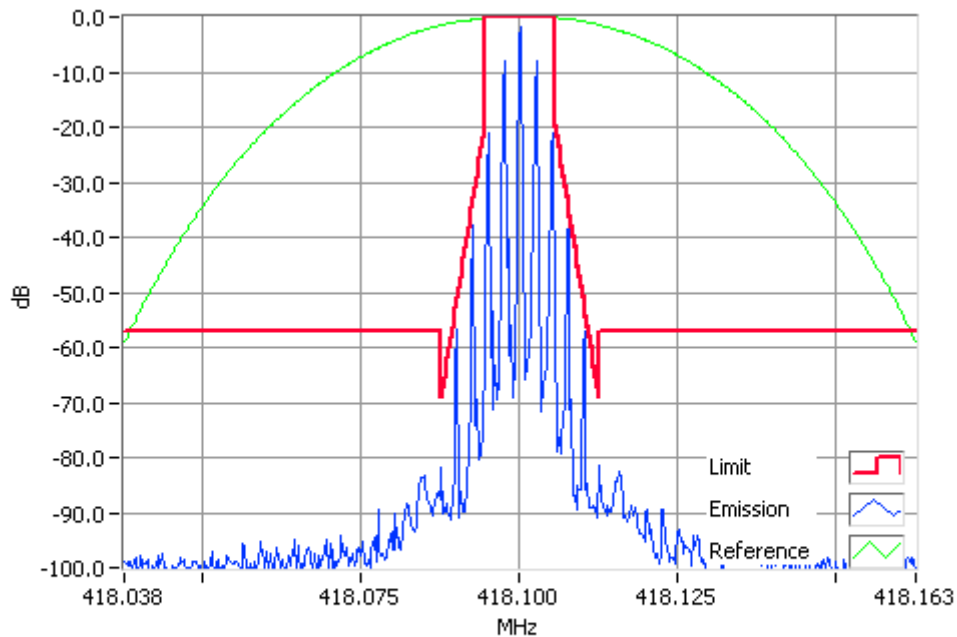
Occupied Bandwidth and Spectrum Masks

Analogue FM

Tx FREQUENCY: 418.1 MHz 50W & 5W 12.5 kHz Channel Spacing



Analogue Modulation 418.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

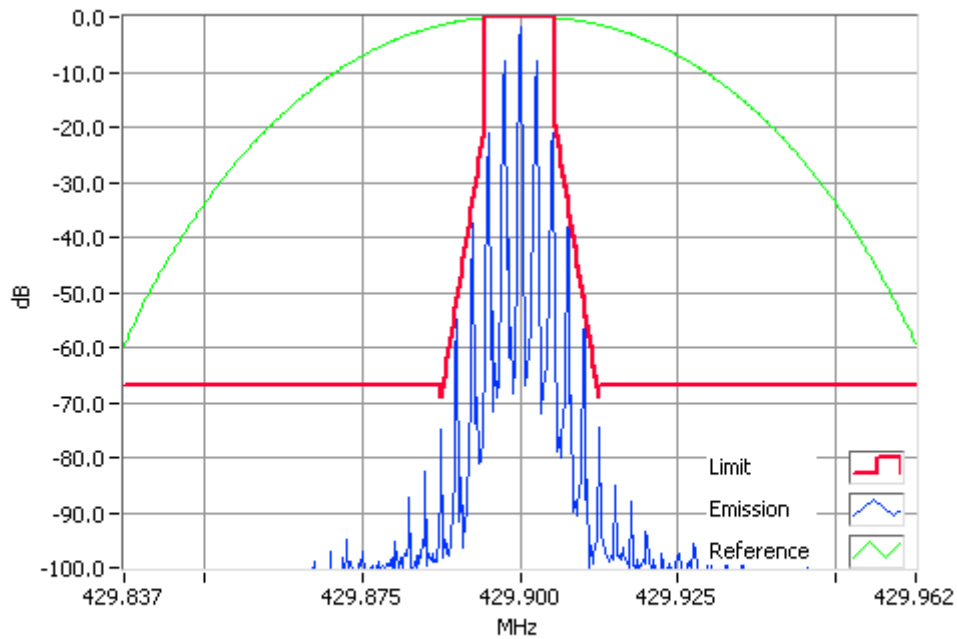


Analogue Modulation 418.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

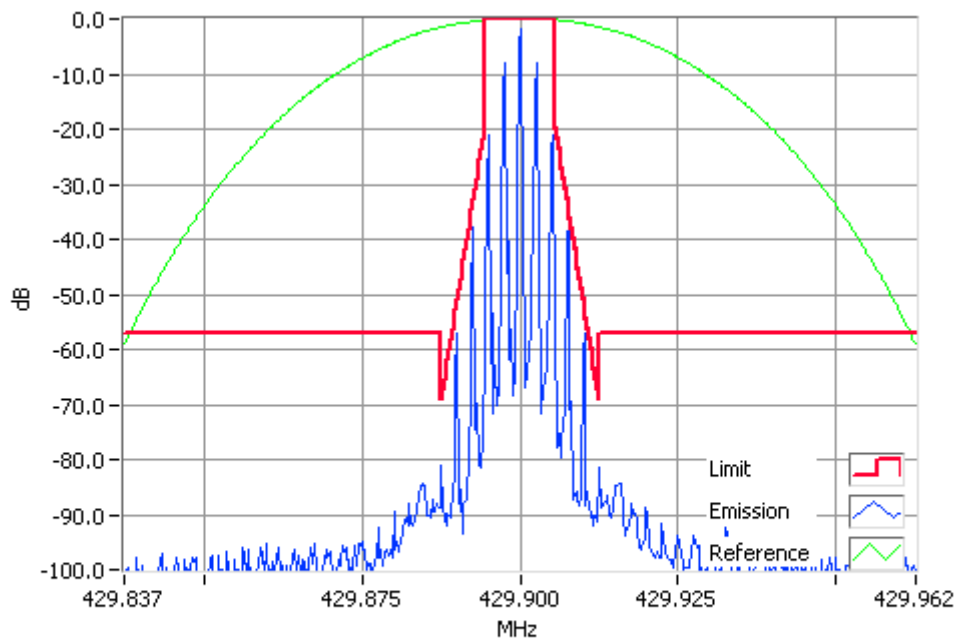
Occupied Bandwidth and Spectrum Masks

Analogue FM

Tx FREQUENCY: 429.9 MHz 50W & 5W 12.5 kHz Channel Spacing



Analogue Modulation 429.9000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass



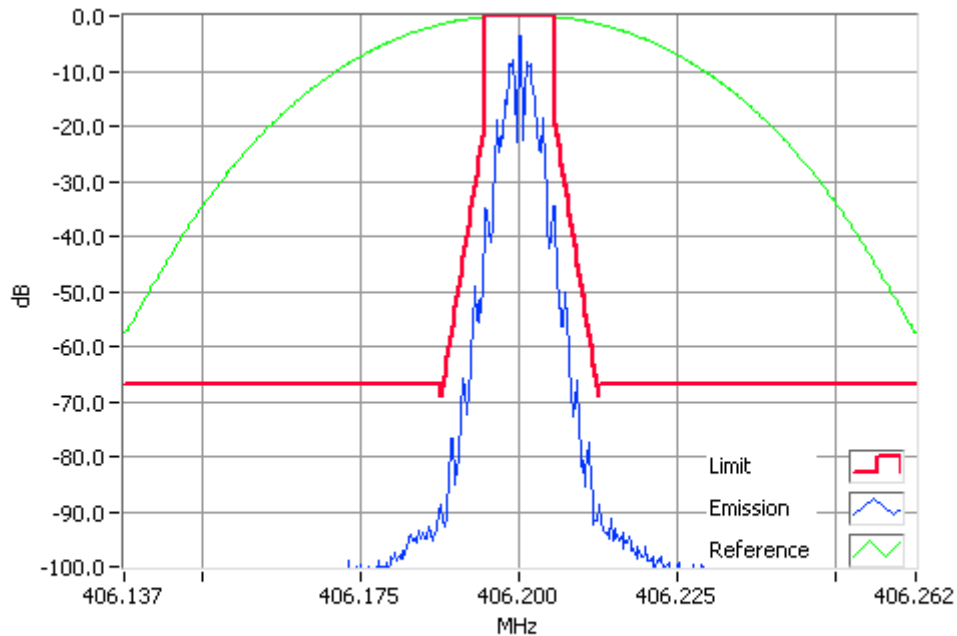
Analogue Modulation 429.9000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

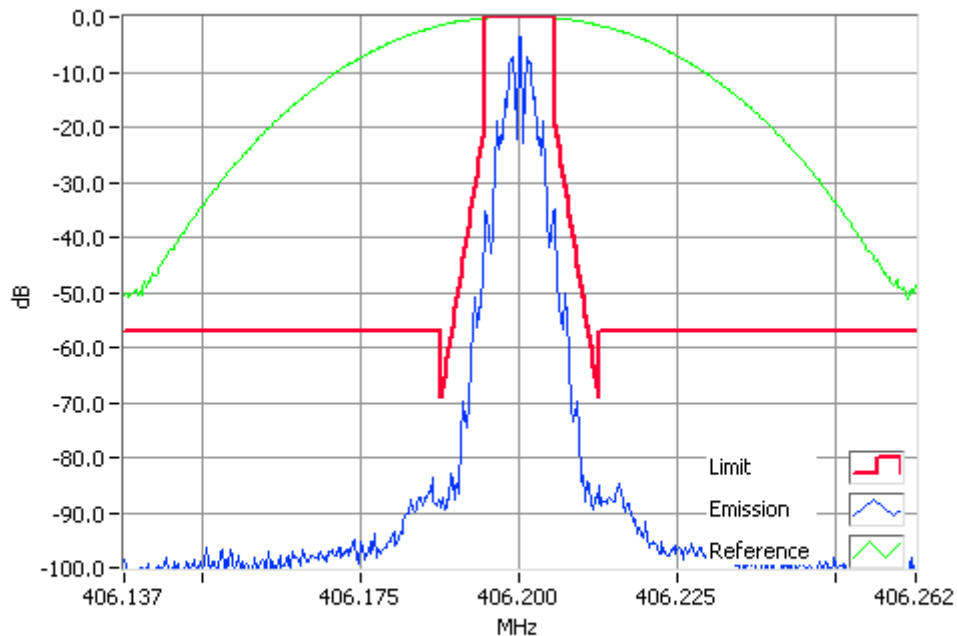
FFSK 1200 bps

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

Tx FREQUENCY: 406.2 MHz 50W & 5W 12.5 kHz Channel Spacing



FFSK1200 406.2000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

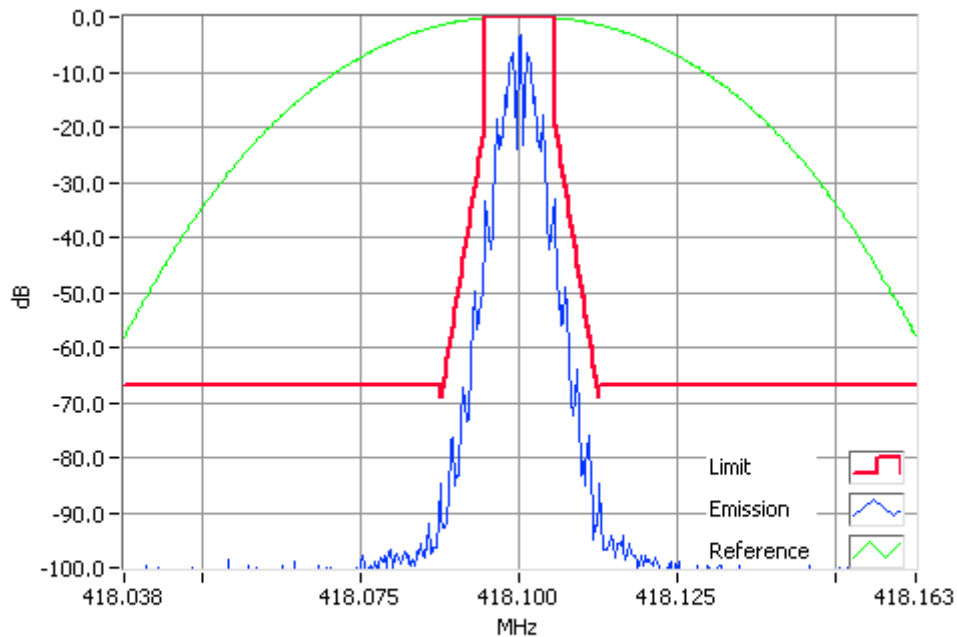


FFSK1200 406.2000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

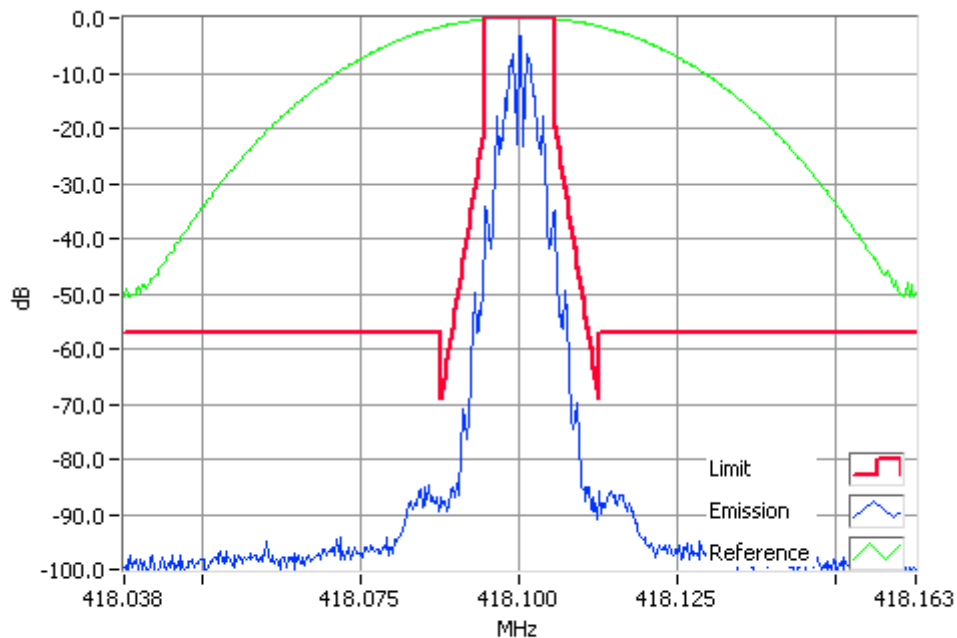
Occupied Bandwidth and Spectrum Masks

FFSK 1200 bps

Tx FREQUENCY: 418.1 MHz 50W & 5W 12.5 kHz Channel Spacing



FFSK1200 418.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

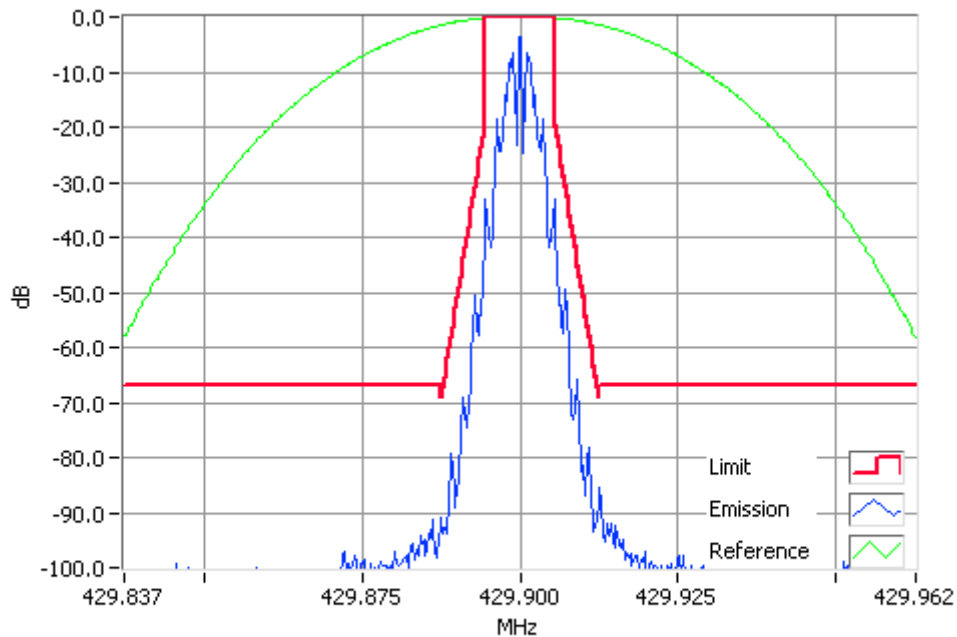


FFSK1200 418.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

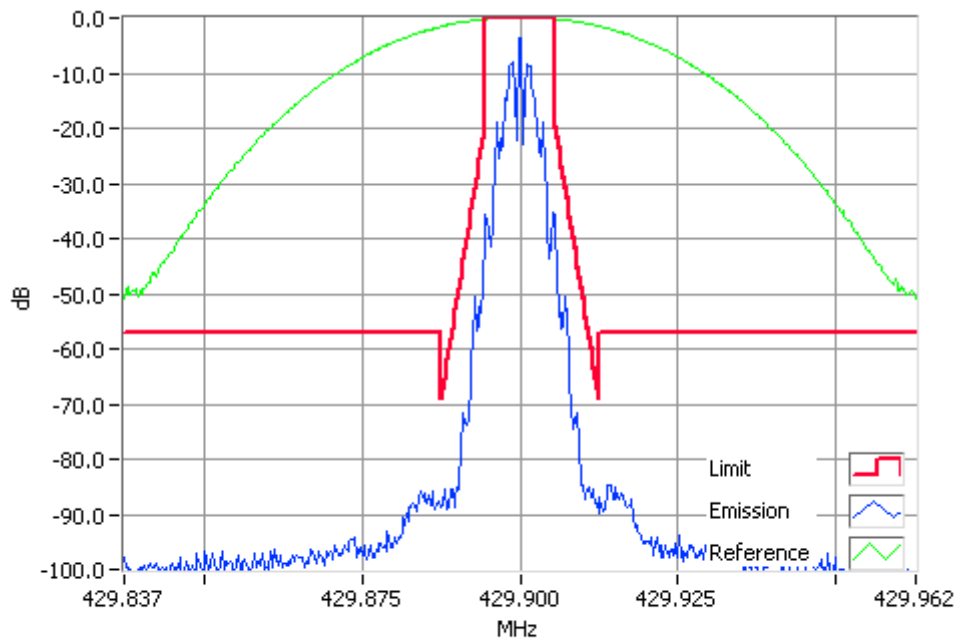
Occupied Bandwidth and Spectrum Masks

FFSK 1200 bps

Tx FREQUENCY: 429.9 MHz 50W & 5W 12.5 kHz Channel Spacing



FFSK1200 429.9000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

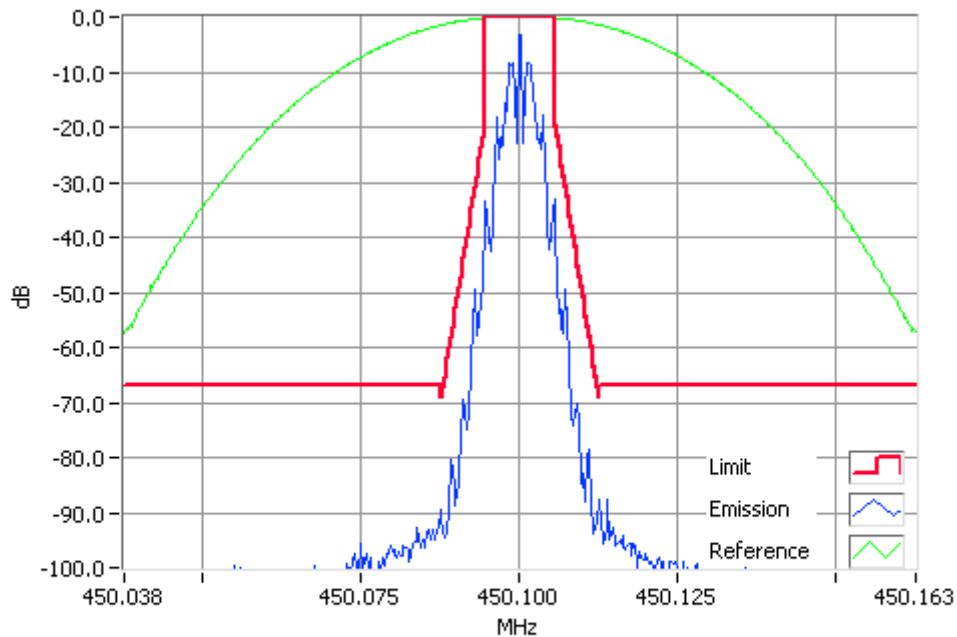


FFSK1200 429.9000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

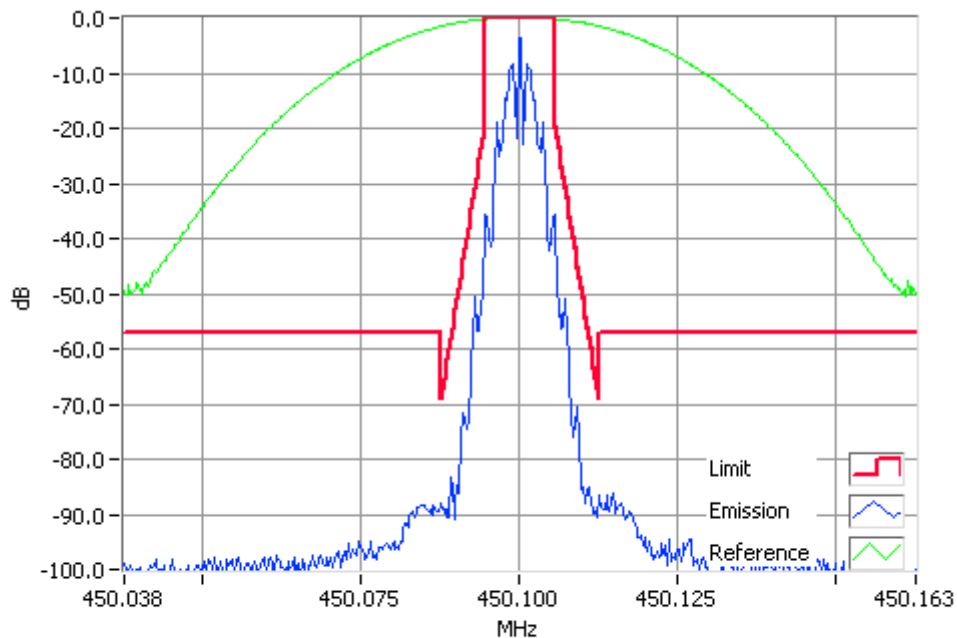
Occupied Bandwidth and Spectrum Masks

FFSK 1200 bps

Tx FREQUENCY: 450.1 MHz 50W & 5W 12.5 kHz Channel Spacing



FFSK1200 450.1000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

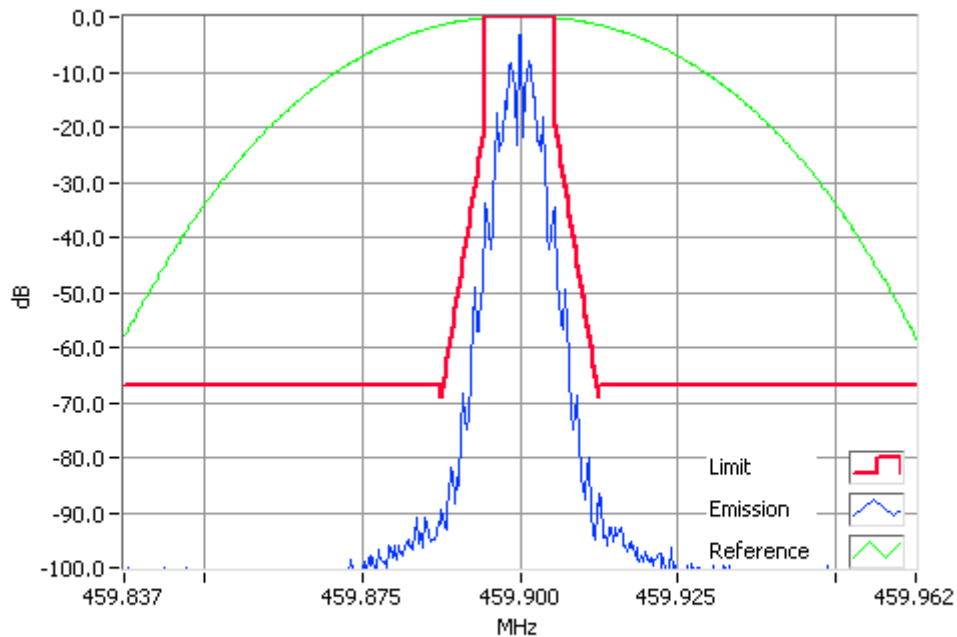


FFSK1200 450.1000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

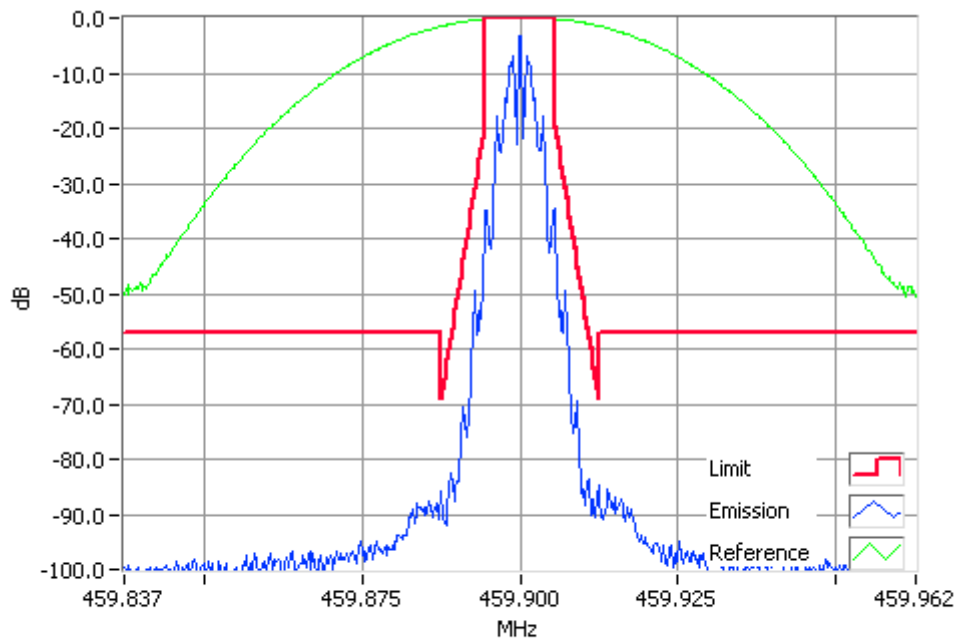
Occupied Bandwidth and Spectrum Masks

FFSK 1200 bps

Tx FREQUENCY: 459.9 MHz 50W & 5W 12.5 kHz Channel Spacing



FFSK1200 459.9000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

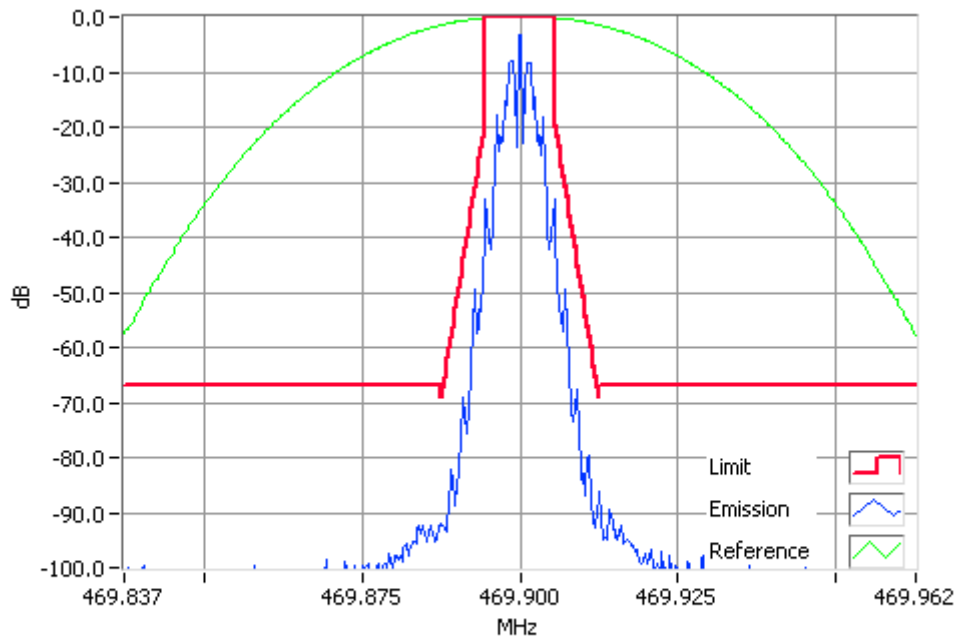


FFSK1200 459.9000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

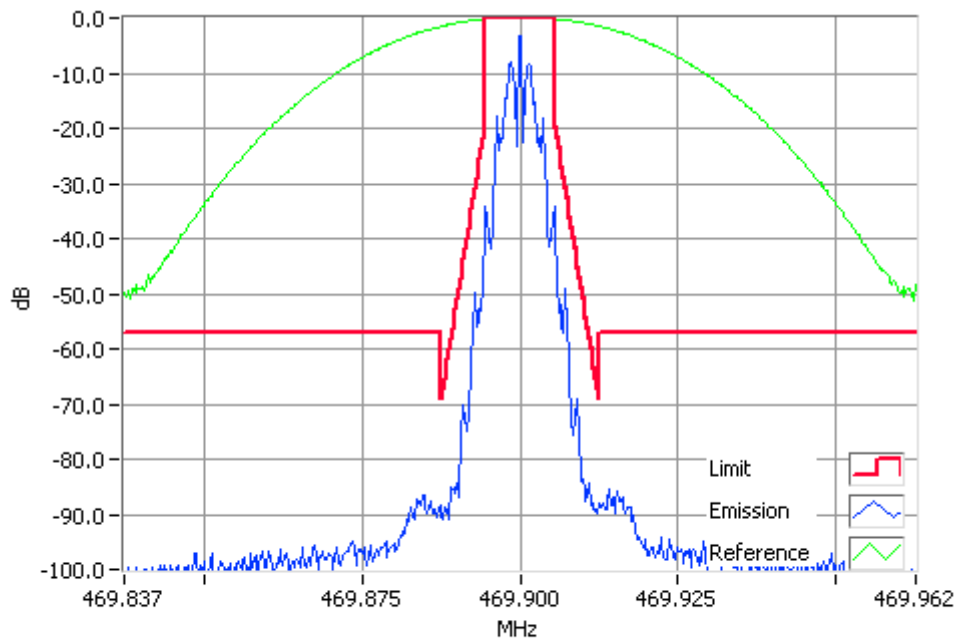
Occupied Bandwidth and Spectrum Masks

FFSK 1200 bps

Tx FREQUENCY: 469.9 MHz 50 & 5W 12.5 kHz Channel Spacing



FFSK1200 469.9000MHz Mask D 50W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass



FFSK1200 469.9000MHz Mask D 5W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

TEST EQUIPMENT LIST

Equipment Type	Information	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
AC Voltmeter		Tait		2		19-Aug-16
Audio Analyser	TREVA2	Hewlett Packard	HP8903B	2818A04275	E3710	20-Oct-16
Coax Cable	2m Black	Suhner	RG214HF/Nm/ Nm/2000	TeltestBlack4	E4653	16-Oct-16
Coax Cable	2m Black	Suhner	RG214HF/Nm/ Nm/2000	TeltestBlack5	E4850	16-Oct-16
Modulation Analyser	TREVA2	Hewlett Packard	HP8901B (Opt 002)	3704A05837	E3786	20-Oct-16
Power Meter	TREVA2 Power Head for HP8901	Hewlett Packard	HP11722A	2716A02037	1575	20-Oct-16
Power Supply	AC Variac	Yamabishi	S-260-5	TX-533	E1737	
RF Attenuator	TREVA2 20dB 150W	Weinschel	40-20-33	CJ405	E3733	20-Oct-16
RF Attenuator	30dB 350W	Weinschel	67-30-33	BR0531	E4280	18-Oct-16
RF Attenuator	TREVA2 3dB	Weinschel	Model 1	BL9950	E4080	
RF Combiner	TREVA2	Minicircuits	ZFSC-4-1	-	E4084	
Spectrum Analyser	26.5GHz	Agilent	PXA N9030A	MY49432161	E4907	6-Jul-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 testing is performed using the Teltest Radio **E**VAuation 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.

