

LABORATORY TEST REPORT

RADIO PERFORMANCE MEASUREMENTS

for the

TBCB1E 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:

22 February 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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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

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REVISION

| Date | Revision | Comments |
|------------------|----------|--|
| 3 February 2016 | 1 | Initial test report |
| 22 February 2016 | 2 | Correction to IC identifier in page footer |

INTRODUCTION

Type approval testing of the TBCB1E, 100 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 Class-2 Permissive Change report adds Analogue FM to the list of modulations supported. The original test report is TARF 3377. This report only applies to frequencies covered by the TBCB3Y reciter (148MHz to 174MHz)

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: TBCB1E
Quantity: 1

| Modulation | Channel Spacing | Speech Channels | Symbol Rate (symbols/sec) | Data Rate (bps) |
|-------------|-----------------|-----------------|---------------------------|-----------------|
| Analogue FM | 12.5 kHz | 1 | - | - |

HARDWARE & SOFTWARE

| Description | Product Code | Serial Number | Firmware Version | Hardware Version |
|-----------------|----------------|---------------|------------------|------------------|
| Reciter | T01-01105-DAZY | 18221342 | dmr-2.10.00.0004 | 0 |
| Power Amplifier | T01-01136-CBAA | 18218549 | 314 | 1 |
| PMU | TBA30A0-0100 | 18217789 | 316 | 1 |
| Front Panel | T01-01110-CCAA | 18218672 | 1.07.00.0002 | 0.04 |

TEST CONDITIONS

All testing was performed on 2 February 2016, and under the following conditions:

Ambient temperature: 15°C → 30°C
Relative Humidity: 20% → 75%
Standard Test Voltage 120 V_{AC}

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

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: TBCB1E
With reciter: TBCB3Y (148 to 174 MHz)
Quantity: 1 of each

Consisting Of:

HARDWARE & SOFTWARE – Analogue Modulation Testing

| Description | Product Code | Serial Number | Firmware Version | Hardware Version |
|-----------------|----------------|---------------|------------------|------------------|
| Reciter | T01-01105-DAZY | 18221342 | dmr-2.10.00.0004 | 0 |
| Power Amplifier | T01-01136-CBAA | 18218549 | 314 | 1 |
| PMU | TBA30A0-0100 | 18217789 | 316 | 1 |
| Front Panel | T01-01110-CCAA | 18218672 | 1.07.00.0002 | 0.04 |

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 (FM)

EMISSION DESIGNATORS:

| Channel Spacing 12.5 kHz | |
|--------------------------|---------|
| FM | 11K0F3E |

CALCULATIONS

FM

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

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.

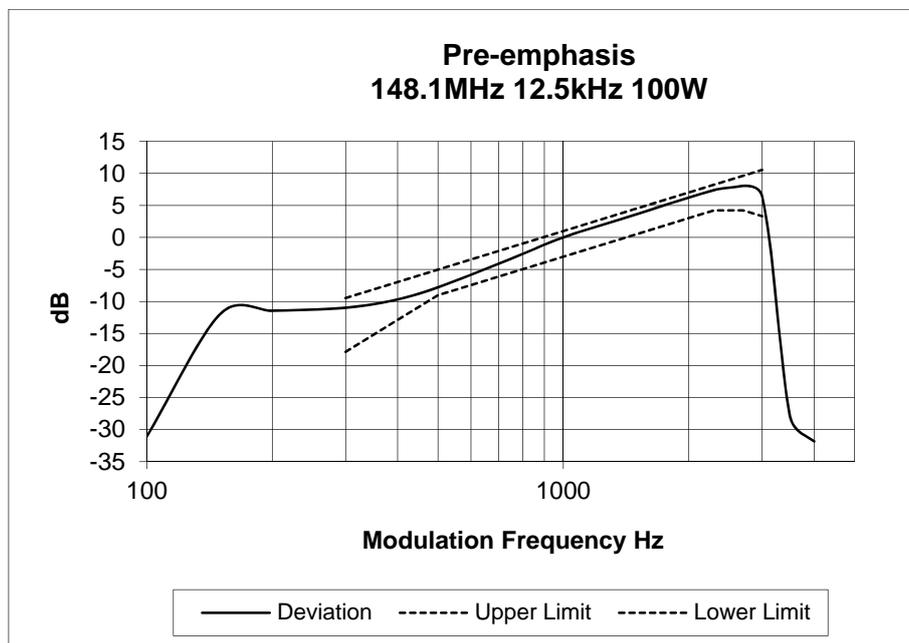
MEASUREMENT RESULTS:

See the plots on the following pages for 12.5 kHz channel spacing tested at 100 W transmit power.

LIMIT CLAUSE: TIA/EIA-603D 3.2.6

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 148.1 MHz 12.5 kHz Channel Spacing

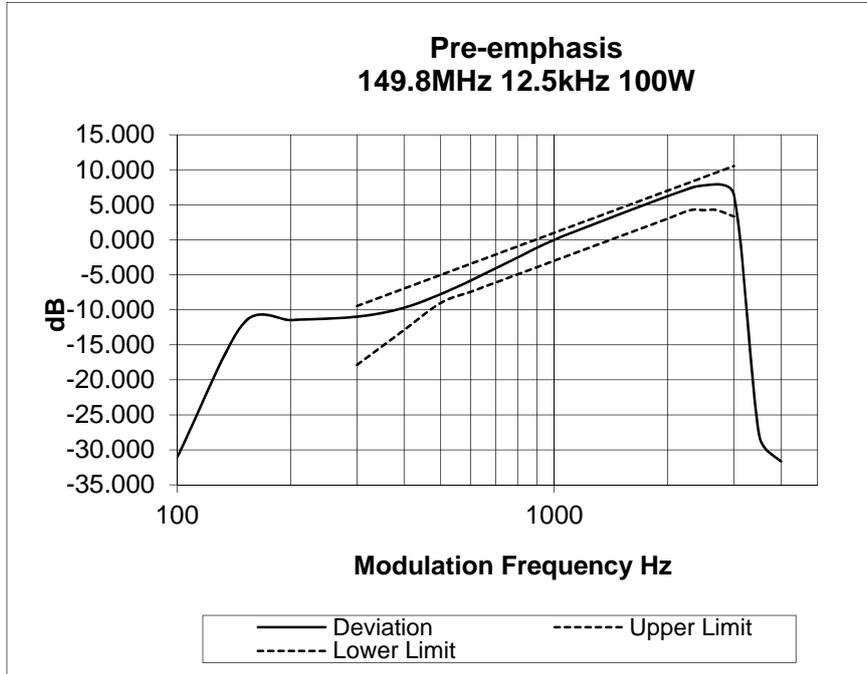


Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 149.8 MHz

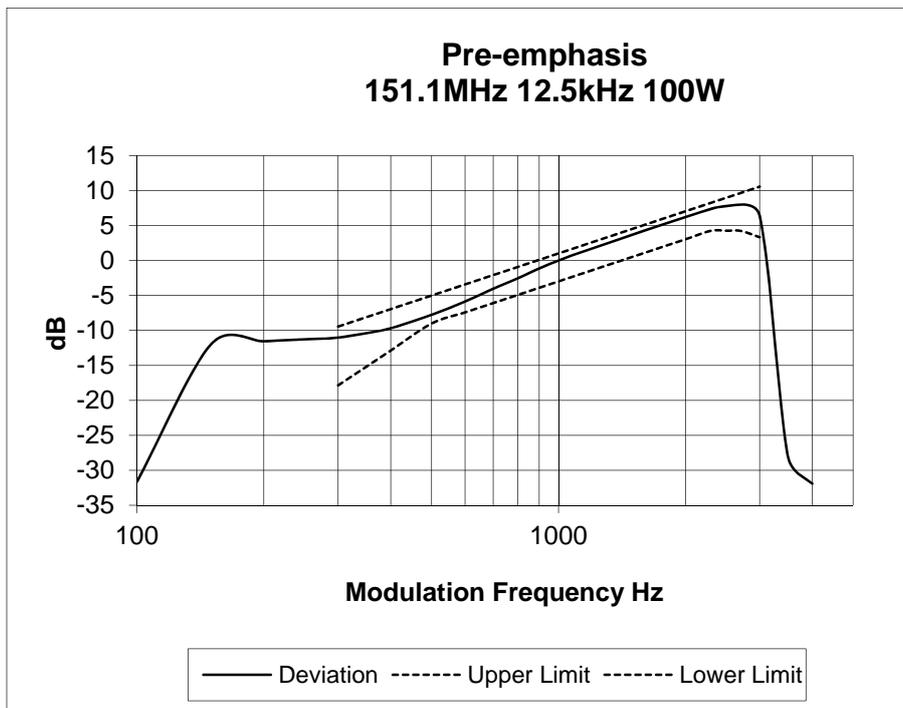
12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 151.1 MHz

12.5 kHz Channel Spacing

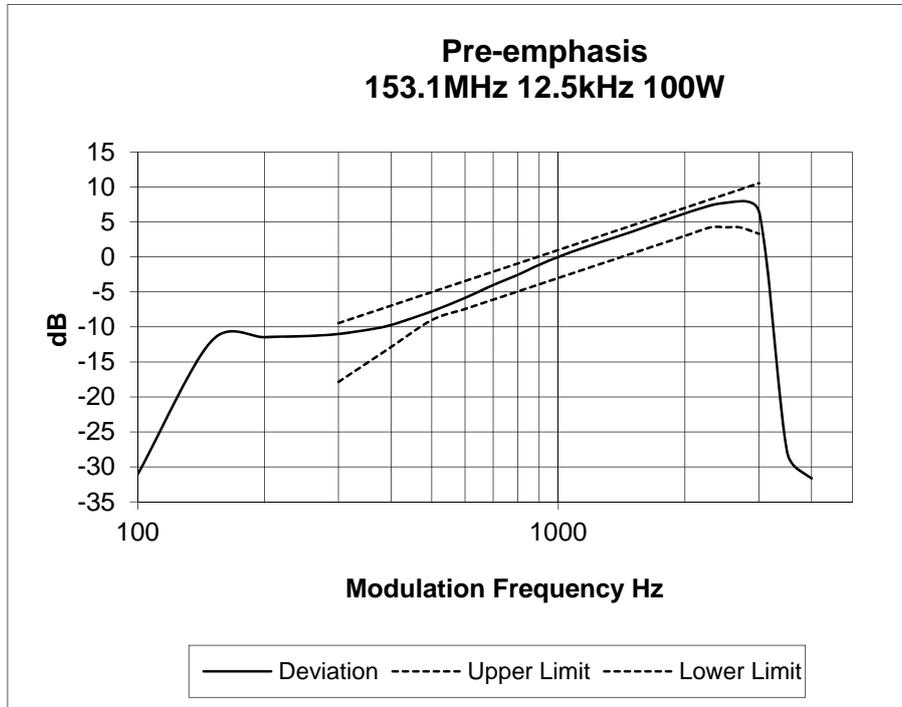


Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 153.1 MHz

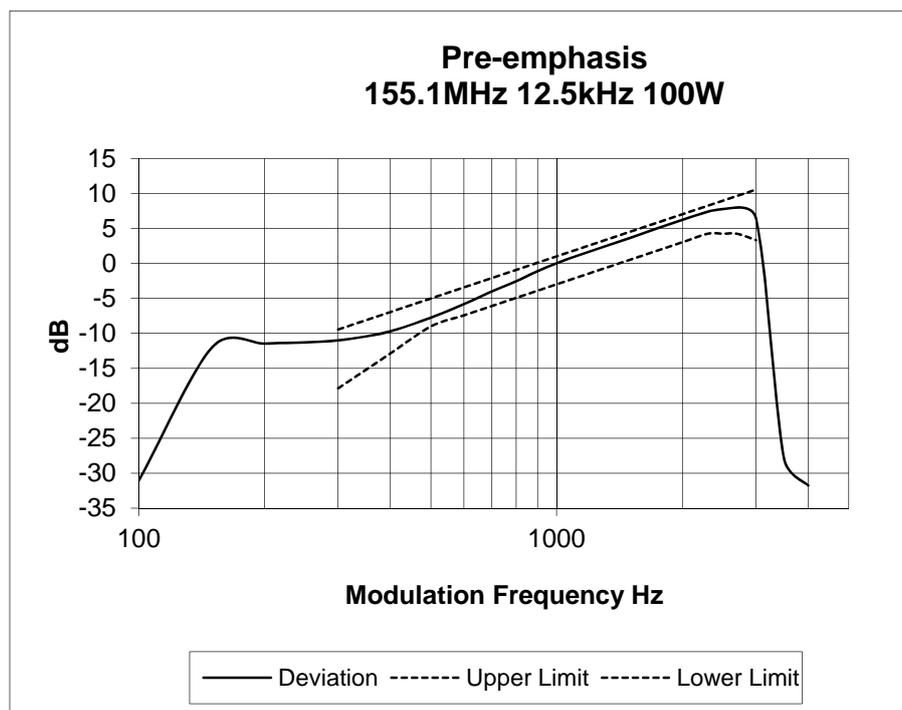
12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 155.1 MHz

12.5 kHz Channel Spacing

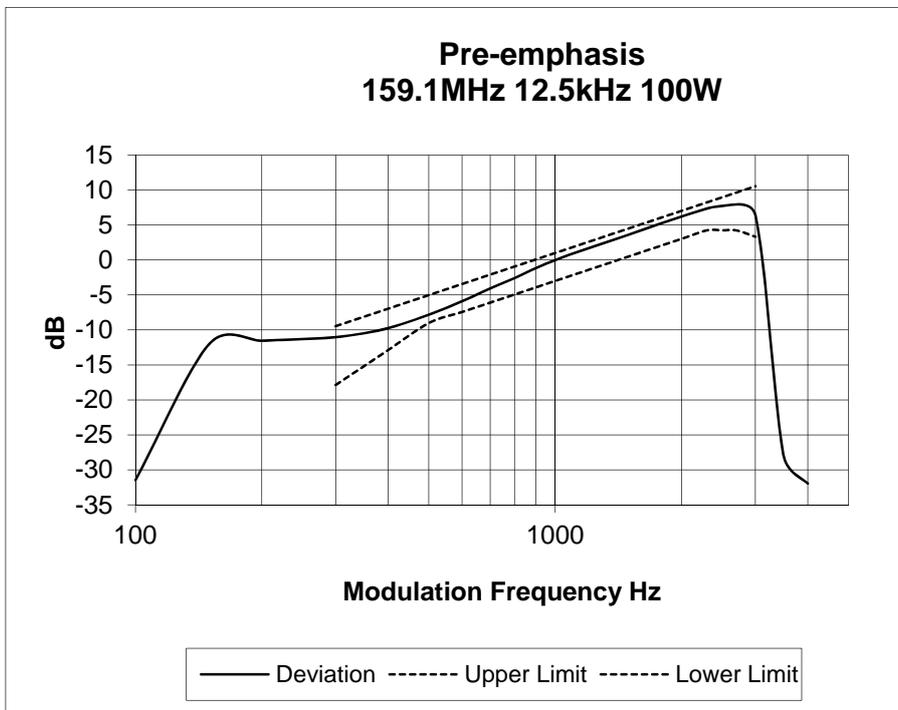


Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 159.1 MHz

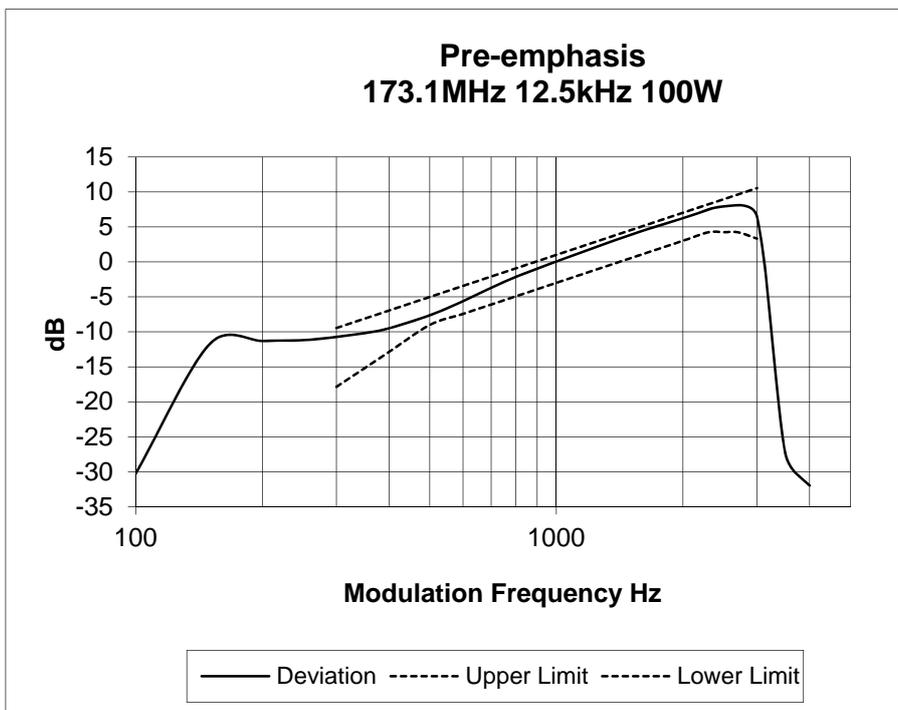
12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 173.1 MHz

12.5 kHz Channel Spacing



TRANSMITTER MODULATION LIMITING

SPECIFICATION: FCC 47 CFR 2.1047 (b)

GUIDE: TIA/EIA-603D 2.2.3

MEASUREMENT PROCEDURE:

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

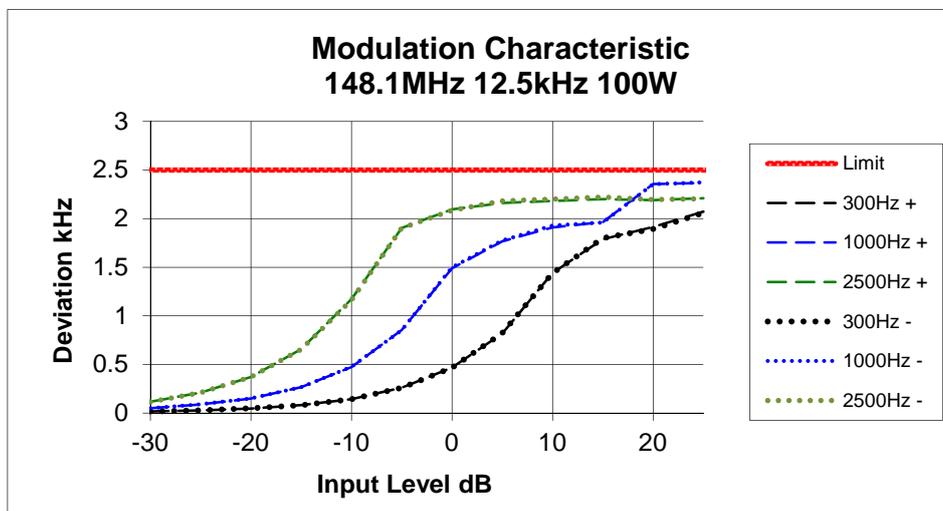
MEASUREMENT RESULTS:

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

LIMIT CLAUSE: TIA/EIA-603D 1.3.4.4

Tx FREQUENCY: 148.1 MHz

12.5 kHz Channel Spacing

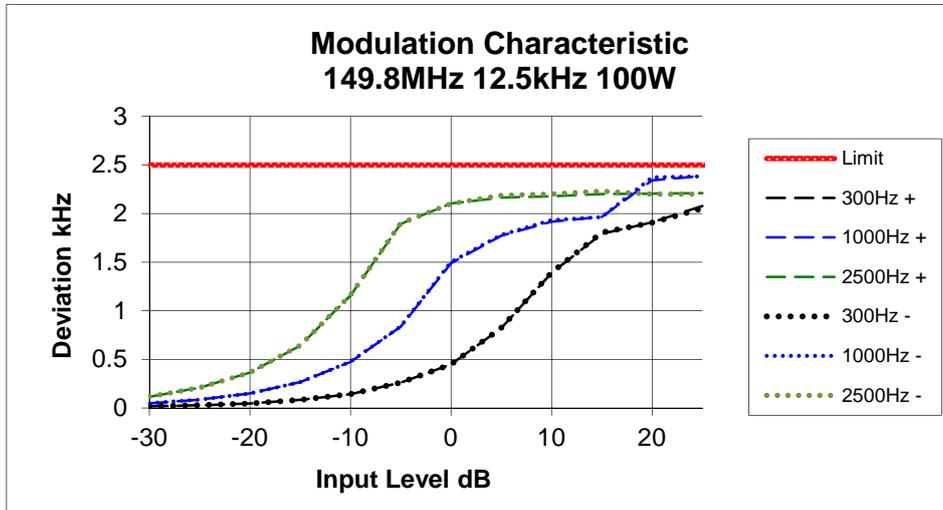


Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 149.8 MHz

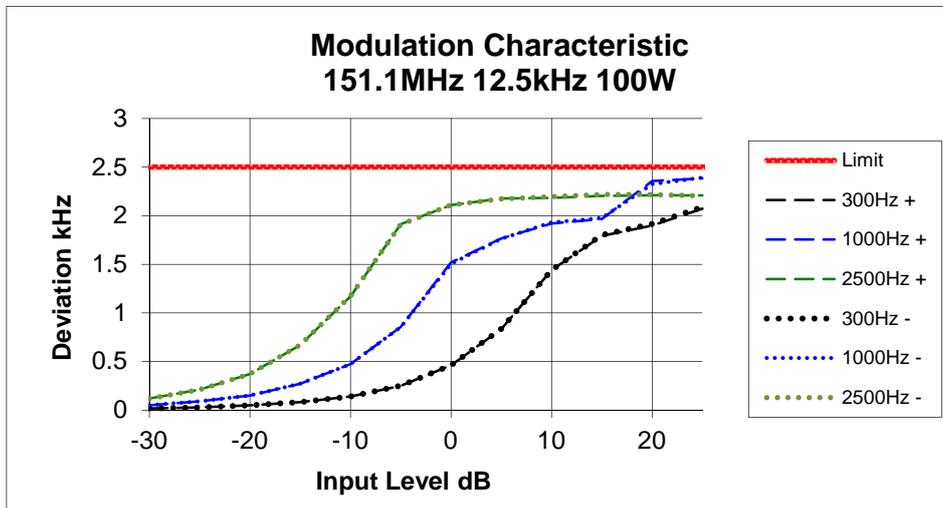
12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 151.1 MHz

12.5 kHz Channel Spacing

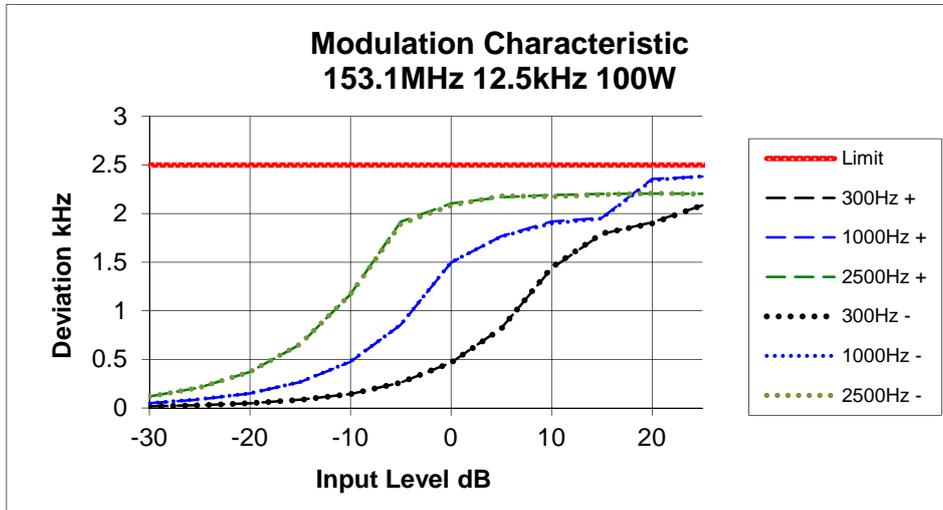


Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 153.1 MHz

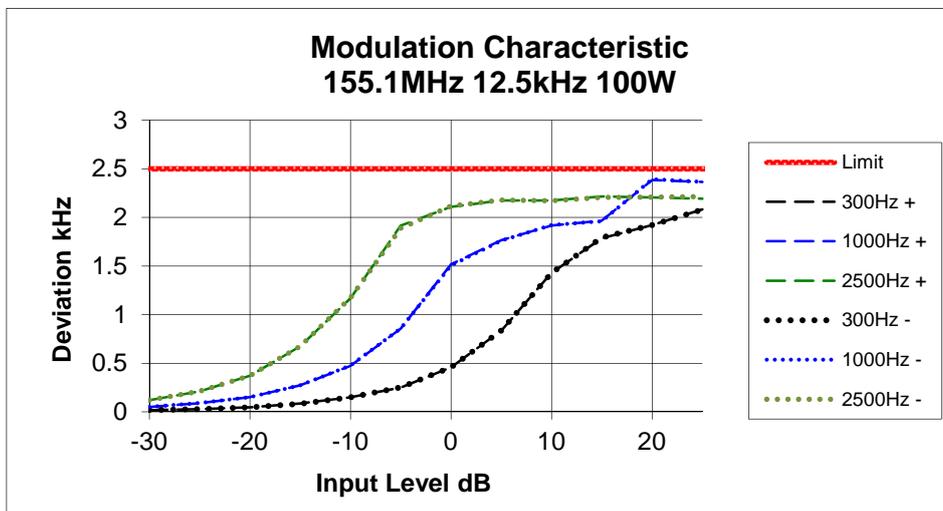
12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 155.1 MHz

12.5 kHz Channel Spacing

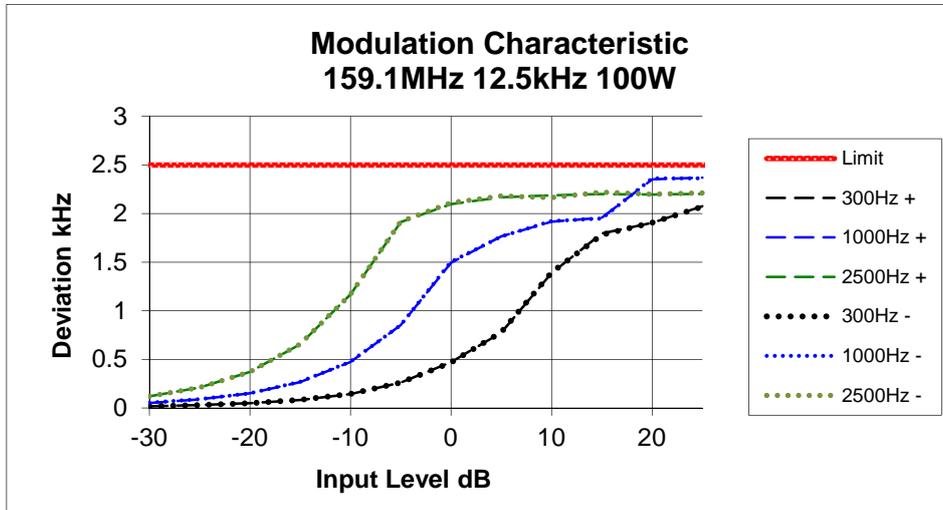


Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 159.1 MHz

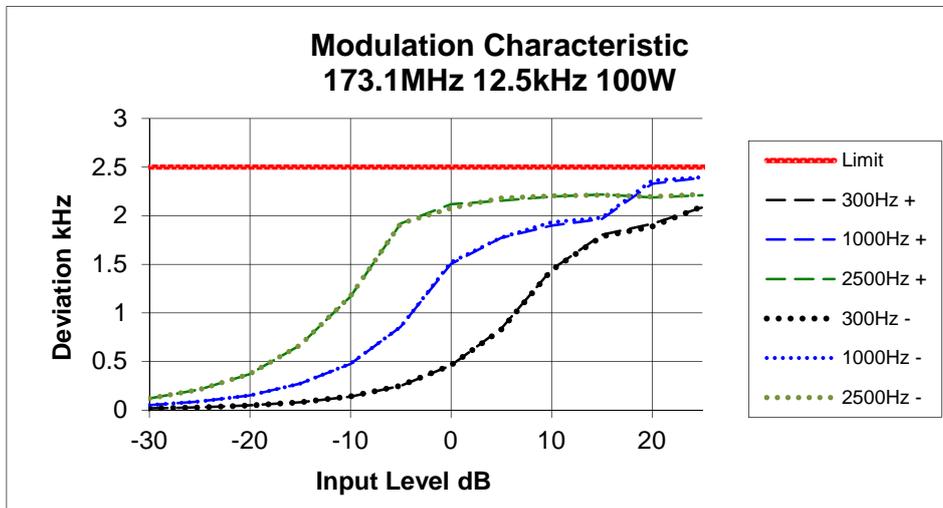
12.5 kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 173.1 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

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.
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

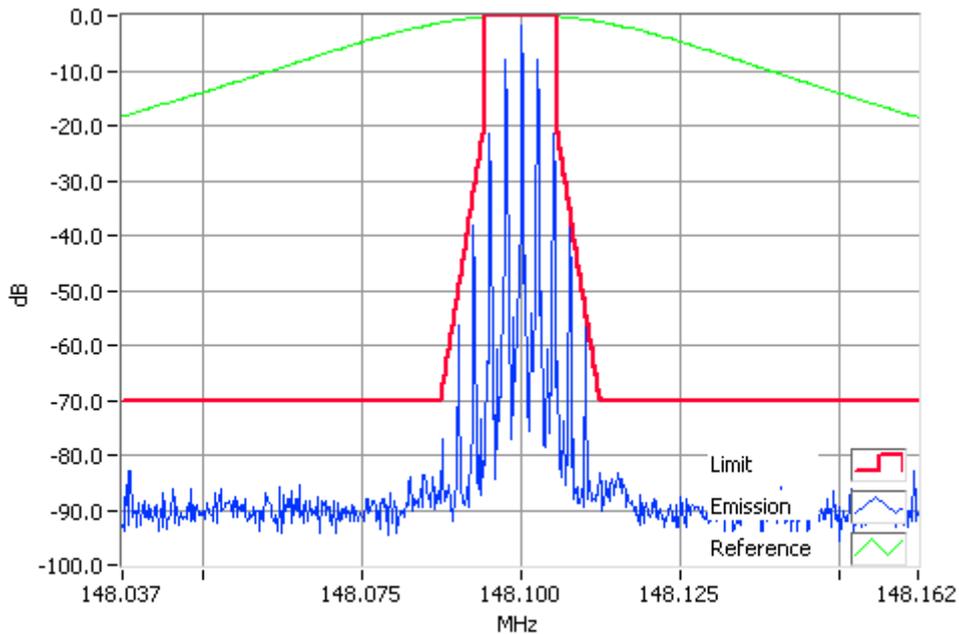
EMISSION MASKS

Emission Mask D 12.5 kHz Channel Spacing Analogue

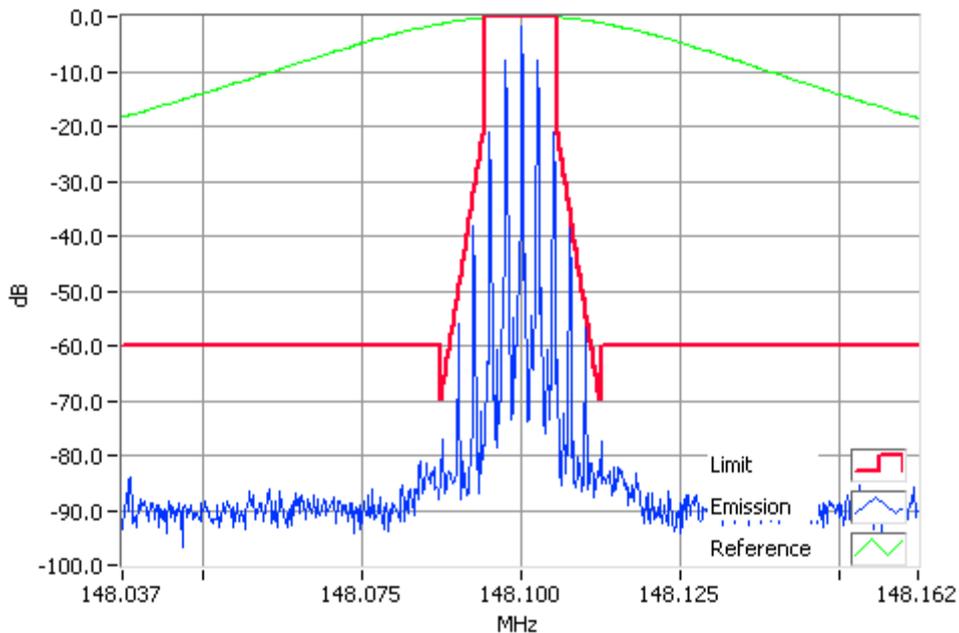
Occupied Bandwidth and Spectrum Masks

Analogue

SPECIFICATION: FCC CFR 2.1049 (c) Mask- D RSS-119 5.5 Mask-D
Tx FREQUENCY: 148.1 MHz 100W & 10 W 12.5 kHz Channel Spacing



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

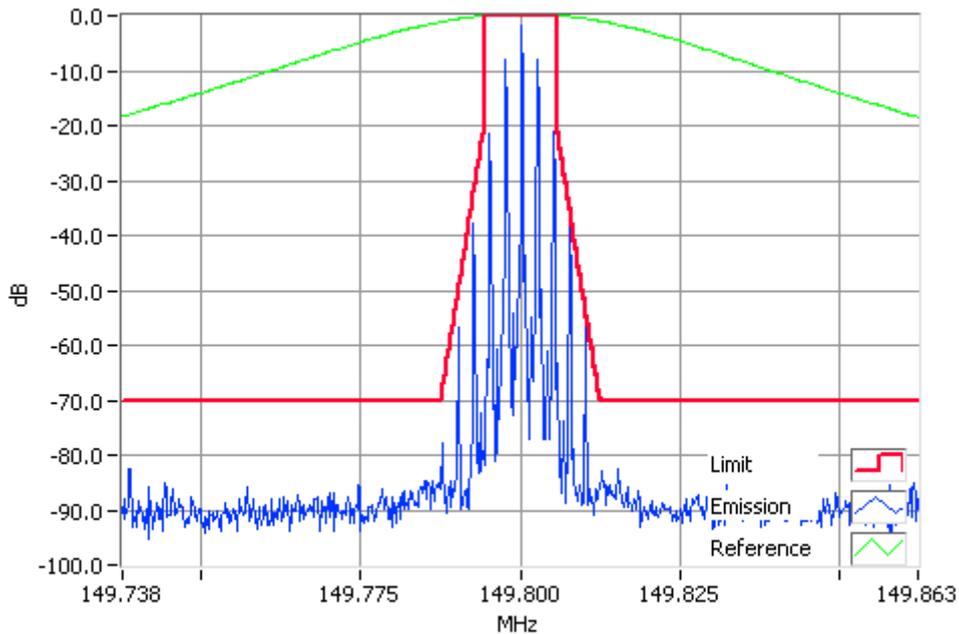


Analogue Modulation 148.1000MHz Mask D 10W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

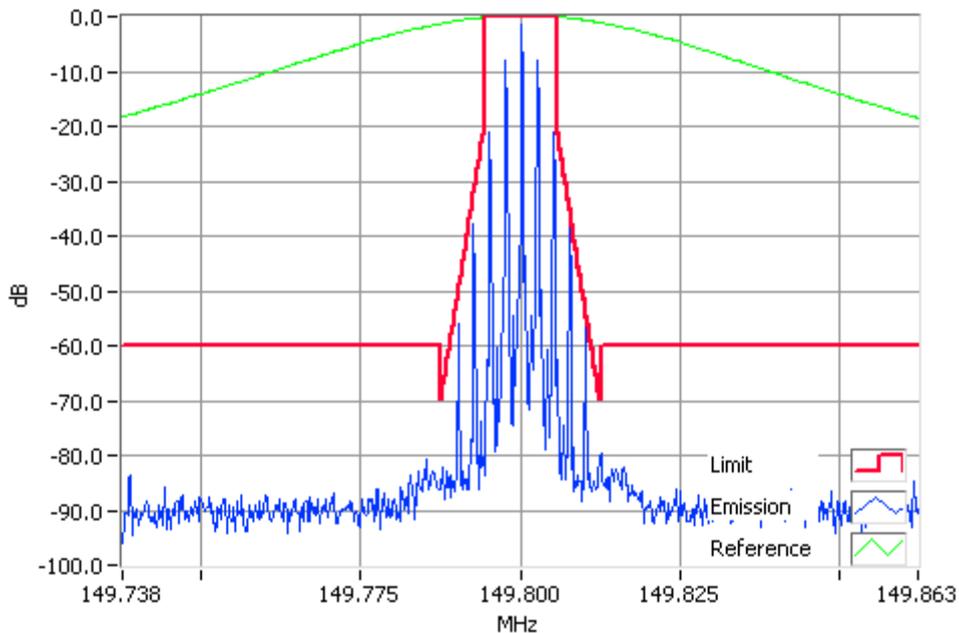
Occupied Bandwidth and Spectrum Masks

Analogue

SPECIFICATION: FCC CFR 2.1049 (c) Mask- D RSS-119 5.5 Mask-D
Tx FREQUENCY: 149.8 MHz 100W & 10 W 12.5 kHz Channel Spacing



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

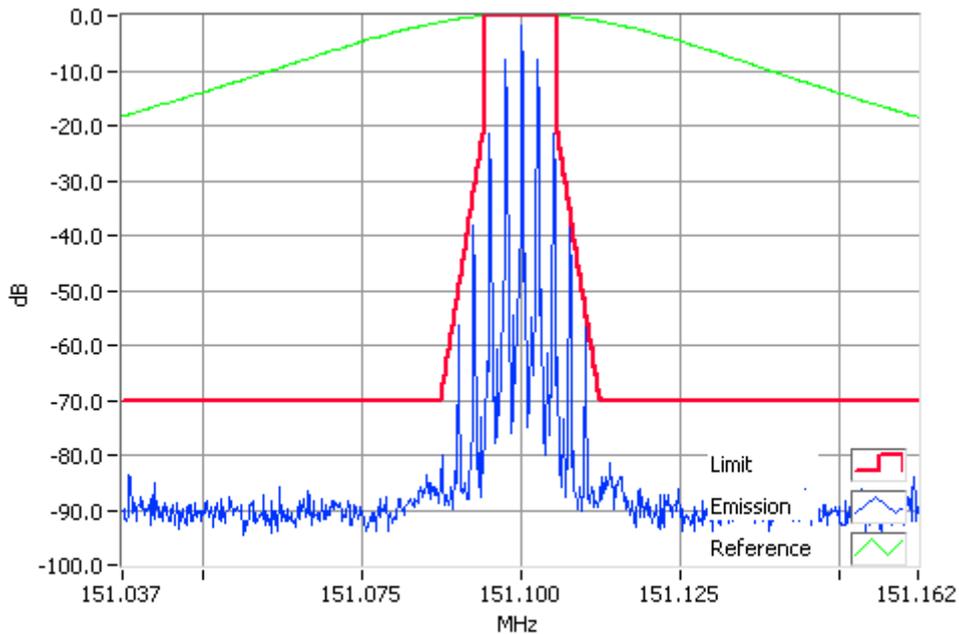


Analogue Modulation 149.8000MHz Mask D 10W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

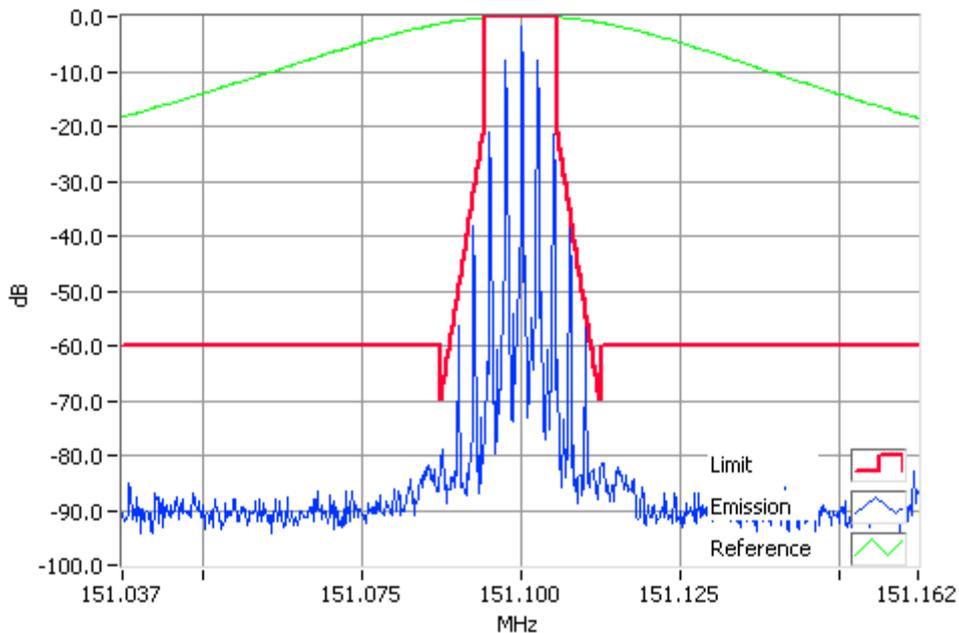
Occupied Bandwidth and Spectrum Masks

Analogue

SPECIFICATION: FCC CFR 2.1049 (c) Mask- D RSS-119 5.5 Mask-D
Tx FREQUENCY: 151.1 MHz 100W & 10 W 12.5 kHz Channel Spacing



Analogue Modulation 151.1000MHz Mask D 100W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

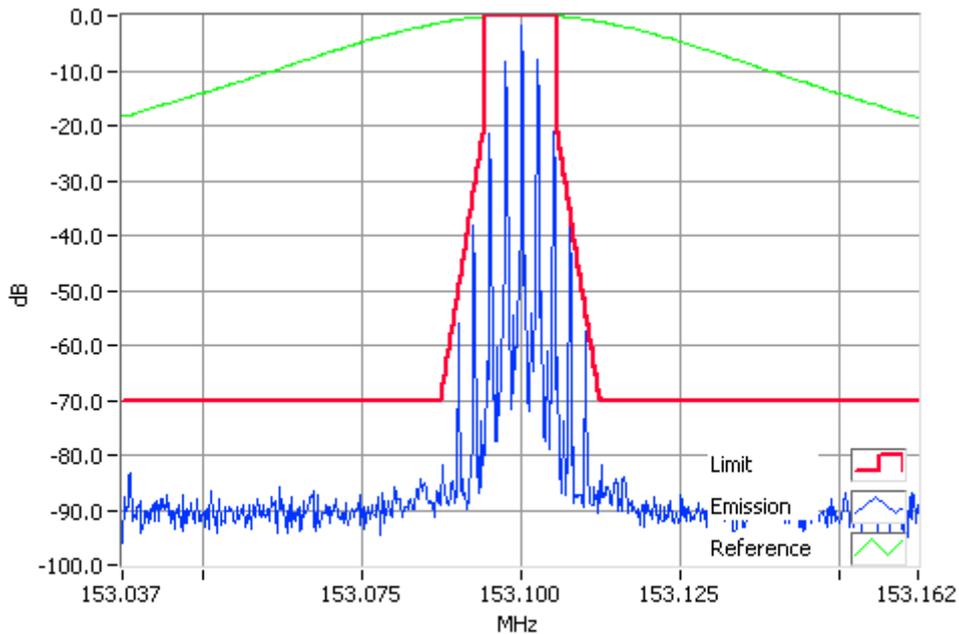


Analogue Modulation 151.1000MHz Mask D 10W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

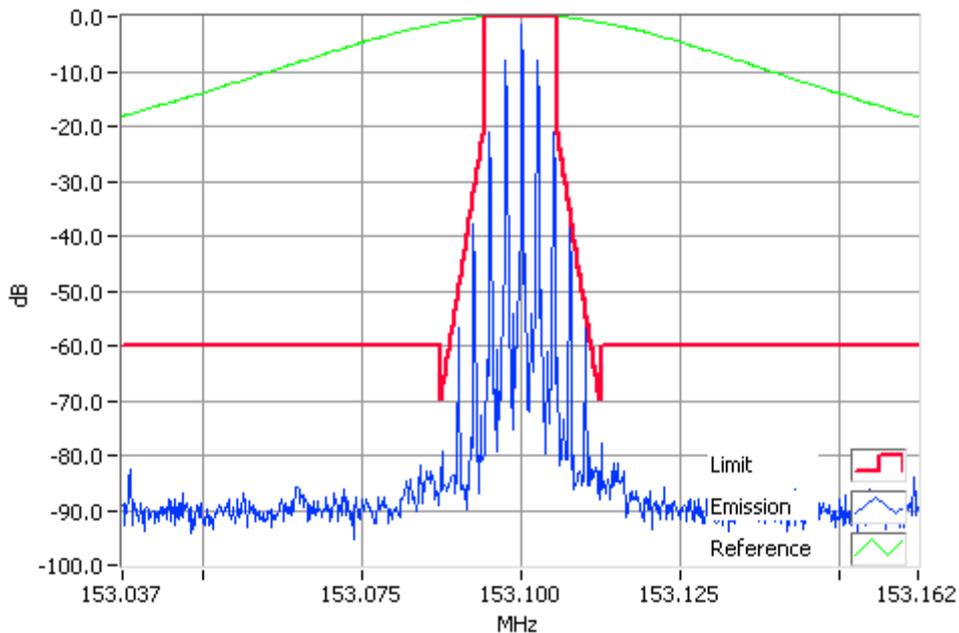
Occupied Bandwidth and Spectrum Masks

Analogue

SPECIFICATION: FCC CFR 2.1049 (c) Mask- D RSS-119 5.5 Mask-D
Tx FREQUENCY: 153.1 MHz 100W & 10 W 12.5 kHz Channel Spacing



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



Analogue Modulation 153.1000MHz Mask D 10W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

Analogue

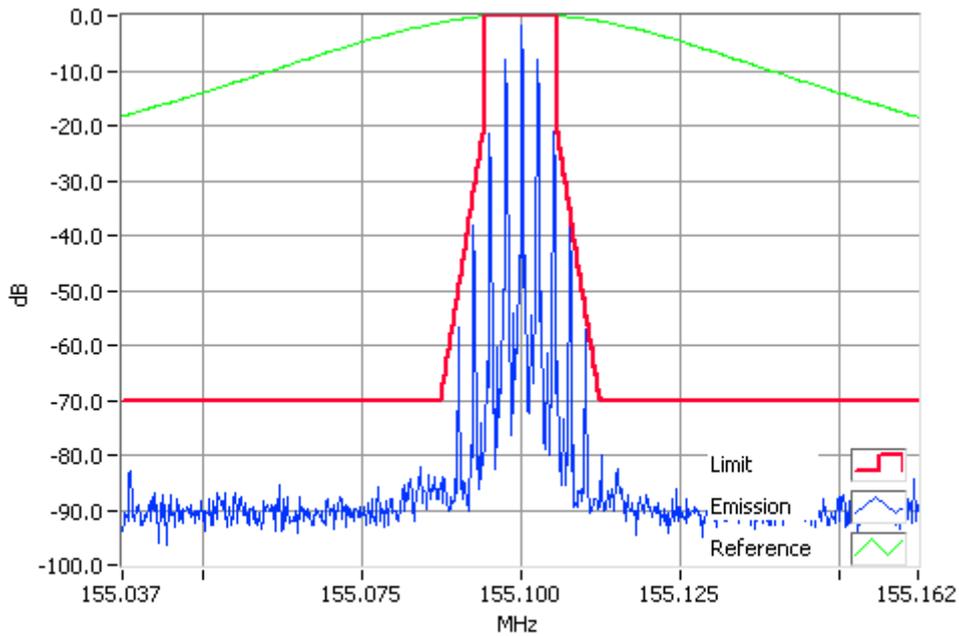
SPECIFICATION: FCC CFR 2.1049 (c) Mask- D

RSS-119 5.5 Mask-D

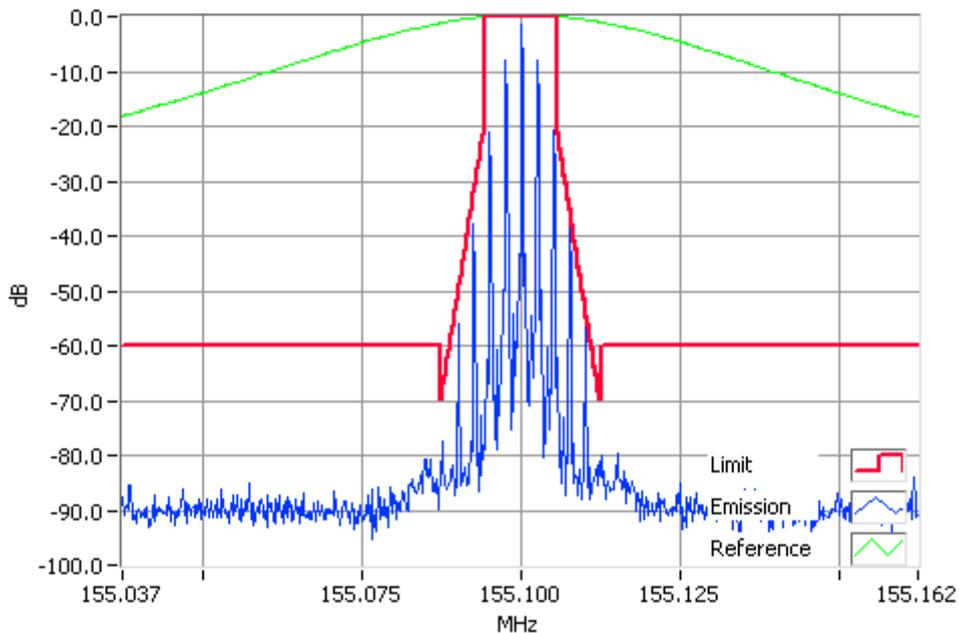
Tx FREQUENCY: 155.1 MHz

100W & 10 W

12.5 kHz Channel Spacing



**Analogue Modulation 155.1000MHz Mask D 100W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass**

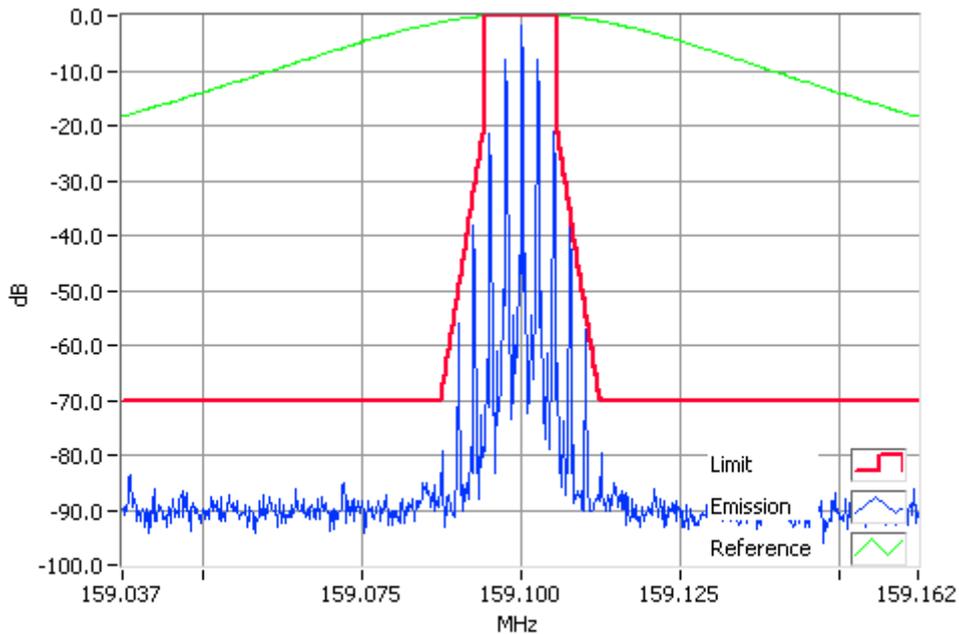


**Analogue Modulation 155.1000MHz Mask D 10W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass**

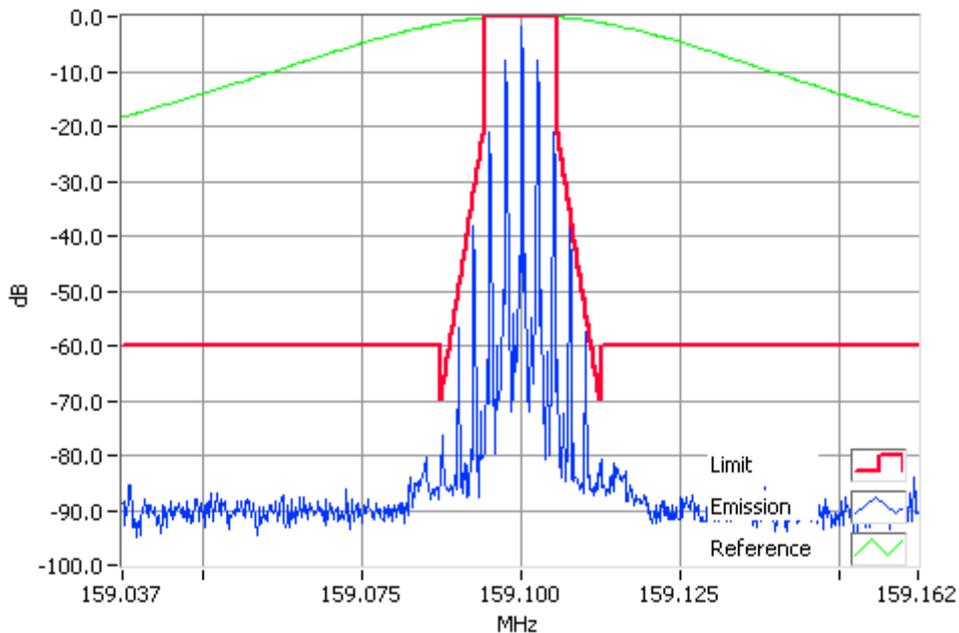
Occupied Bandwidth and Spectrum Masks

Analogue

SPECIFICATION: FCC CFR 2.1049 (c) Mask- D RSS-119 5.5 Mask-D
Tx FREQUENCY: 159.1 MHz 100W & 10 W 12.5 kHz Channel Spacing



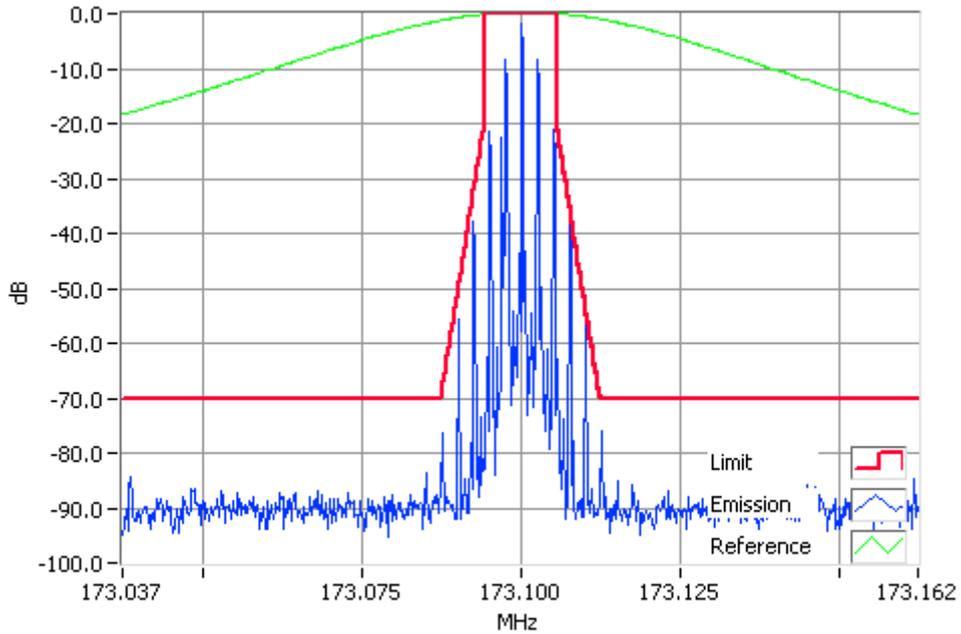
Analogue Modulation 159.1000MHz Mask D 100W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass



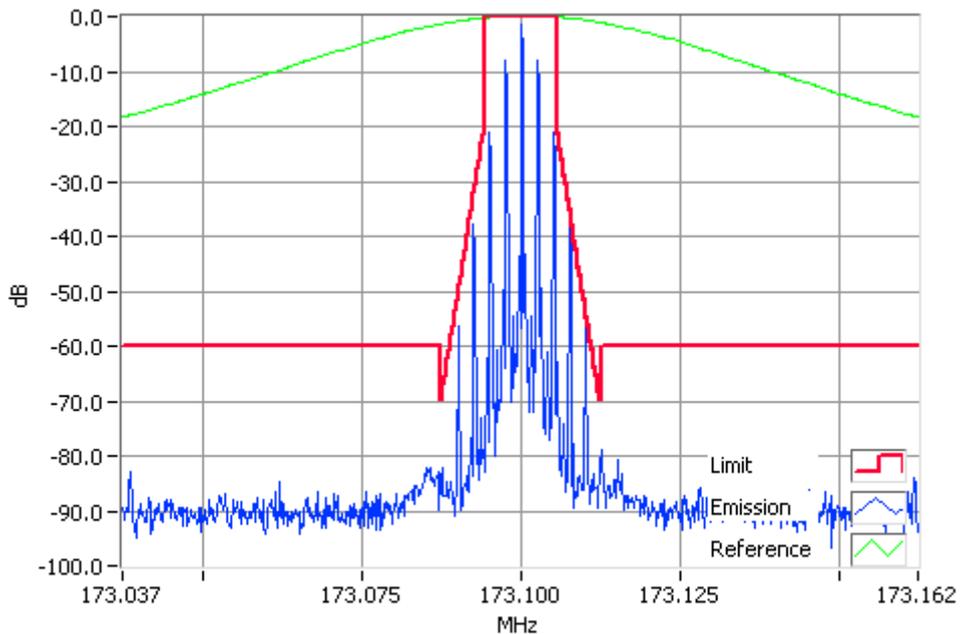
Analogue Modulation 159.1000MHz Mask D 10W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Analogue

SPECIFICATION: FCC CFR 2.1049 (c) Mask- D RSS-119 5.5 Mask-D
Tx FREQUENCY: 173.1 MHz 100W & 10 W 12.5 kHz Channel Spacing



**Analogue Modulation 173.1000MHz Mask D 100W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass**



**Analogue Modulation 173.1000MHz Mask D 10W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass**

TEST EQUIPMENT LIST

| Equipment Type | Information | Manufacturer | Model No | Serial No# | Tait ID | Cal Due |
|---------------------|------------------------------|-----------------|--------------------|---------------|---------|-----------|
| Audio Analyser | TREVA2 | Hewlett Packard | HP8903B | 2818A04275 | E3710 | 20-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 |
| 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 | 13.2GHz | Hewlett Packard | HP8562E | 3821A00779 | E3715 | 15-Oct-16 |
| TREVA 2 | | Teltest | - | 2 | - | 5-May-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 **EVAL**uation system (TREVA), which is configured as shown below. The Spectrum Analyser is connected to the EUT via the attenuator network for Conducted Emissions testing, and Occupied Bandwidth.

