Laboratory Test Report

For the

TMAB14-K500 Mobile Transceiver

Tested In accordance with

FCC 47 CFR Parts 22 and 90S

Report Revision: 1
Issue Date: 08-Feb-2007
FCC ID: CASTMAK5B

PREPARED BY: Robin Kidson _____
Test Technician

CHECKED & APPROVED BY: Steve Crompton _____
Laboratory Manager

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

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TABLE OF CONTENTS

REVISION HISTORY **2**

INTRODUCTION **3**

REPORT PREPARED FOR **3**

DESCRIPTION OF SAMPLE **3**

STATEMENT OF COMPLIANCE **3**

TEST CONDITIONS **3**

NECESSARY BANDWIDTH AND EMISSION DESIGNATORS **4**

TEST RESULTS **5**

TRANSMITTER OUTPUT POWER (CONDUCTED) 5
TRANSMITTER AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS 6
TRANSMITTER MODULATION LIMITING 8
OCCUPIED BANDWIDTH 10
ANALOGUE VOICE *11*
FFSK *13*
FFSK *14*
SPURIOUS EMISSIONS (CONDUCTED) 21
SPURIOUS EMISSIONS (RADIATED) 25
TRANSMITTER FREQUENCY STABILITY (TEMPERATURE) 30
TRANSMITTER FREQUENCY STABILITY (VOLTAGE) 31

TEST EQUIPMENT USED **33**

ANNEX A **34**

TEST SETUP DETAILS 34

REVISION HISTORY

Date	Revision	Comments
08-Feb-2007	1	Initial test report

INTRODUCTION

Type Approval Testing of the TMAB14-K500 (Serial No 19226261)
in accordance with:

FCC CFR 47 Parts 22 & 90S

REPORT PREPARED FOR

Tait Electronics Ltd
PO Box 1645
558 Wairakei Rd
Christchurch
New Zealand

DESCRIPTION OF SAMPLE

Equipment:	Mobile Transceiver
Type:	TMAK5B
Product code:	TMAB14-K500
Serial Numbers:	19226261
Quantity:	1

STATEMENT OF COMPLIANCE

The TMAB14-K500 mobile transceiver as tested in this report was found to conform to the following standards:

FCC CFR 47 Parts 22 & 90S

TEST CONDITIONS

All testing was performed at the following conditions.

Ambient Temperature	15°C → 30°C
Relative Humidity	20% → 75%
Standard Test Voltage	13.8 Vdc

NECESSARY BANDWIDTH AND EMISSION DESIGNATORS

SPECIFICATION: FCC 47 CFR 2.202

The Necessary Bandwidth is the minimum value of the occupied bandwidth sufficient to ensure the transmission of information at the rate and with the quality required for the system employed.
This is calculated using the following formula.

Bn = 2M + 2DK

Where: Bn = Necessary Bandwidth
M = Maximum modulation frequency
For Data transmission
M = B/2
Where: B = Modulation rate in Baud
D = Peak deviation
K = Constant
For Analogue transmission this is 1
For Data transmission this is typically 1.2

1. Analogue Voice

	Necessary bandwidth			Emission Designator
12.5kHz Bandwidth	M	=	3 kHz	**11K0F3E**
	D	=	2.5 kHz	F3E represents a FM voice transmission
	Bn	=	6 + 5 x 1	
		=	11kHz	
25kHz Bandwidth	Necessary bandwidth			Emission Designator
	M	=	3 kHz	**16K0F3E**
	D	=	5 kHz	F3E represents a FM voice transmission
	Bn	=	6 + 10 x 1	
		=	16 kHz	

2. Fast Frequency Shift Keying (FFSK)

	Necessary bandwidth			Emission Designator
12.5kHz Bandwidth	M	=	1.8 kHz	**6K60F2D**
	D	=	1.5 kHz	F2D represents a FM data transmission with the use of a modulating sub carrier
	Bn	=	3.6 + 3 x 1	
		=	6.6 kHz	
25kHz Bandwidth	Necessary bandwidth			Emission Designator
	M	=	1.8 kHz	**9K60F2D**
	D	=	3 kHz	F2D represents a FM data transmission with the use of a modulating sub carrier
	Bn	=	3.6 + 6 x 1	
		=	9.6 kHz	

3. Tait High Speed Data (THSD)

Due to the difficulties in determining the value of k, the necessary bandwidth has been measured using the 99% energy rule.

	Necessary bandwidth			Emission Designator
12.5kHz Bandwidth	Bn	=	7.7 kHz (99% bandwidth)	**7k70F1D**

TEST RESULTS

TRANSMITTER OUTPUT POWER (CONDUCTED)

SPECIFICATION: FCC 47 CFR 2.1046

GUIDE: TIA/EIA-603C 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: 35 W and 2 W

807.55 MHz	35 W nominal	2 W nominal
POWER (W)	35.0	2.0
Variation from Nominal (%)	0.0	0.0
Measurement Uncertainty	± 0.6 dB	

Manufacturer's Rated Output Power: Switchable: 35 W and 2 W

816.5125 MHz	35 W nominal	2 W nominal
POWER (W)	34.1	2.0
Variation from Nominal (%)	2.6	0.0
Measurement Uncertainty	± 0.6 dB	

LIMIT CLAUSE: FCC 47 CFR 90.205 (r)

Radio Type: Mobile Transceiver
Frequency Band: 806 MHz ~ 869 MHz

The output power shall not exceed by more than 20% the manufacturer's rated output power for the particular transmitter.

TRANSMITTER AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS

SPECIFICATION: FCC 47 CFR 2.1047 (a)

GUIDE: TIA/EIA-603C 2.2.6

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

MEASUREMENT RESULTS:
See the plots on the following pages for 12.5 kHz & 25.0 kHz channel spacings.
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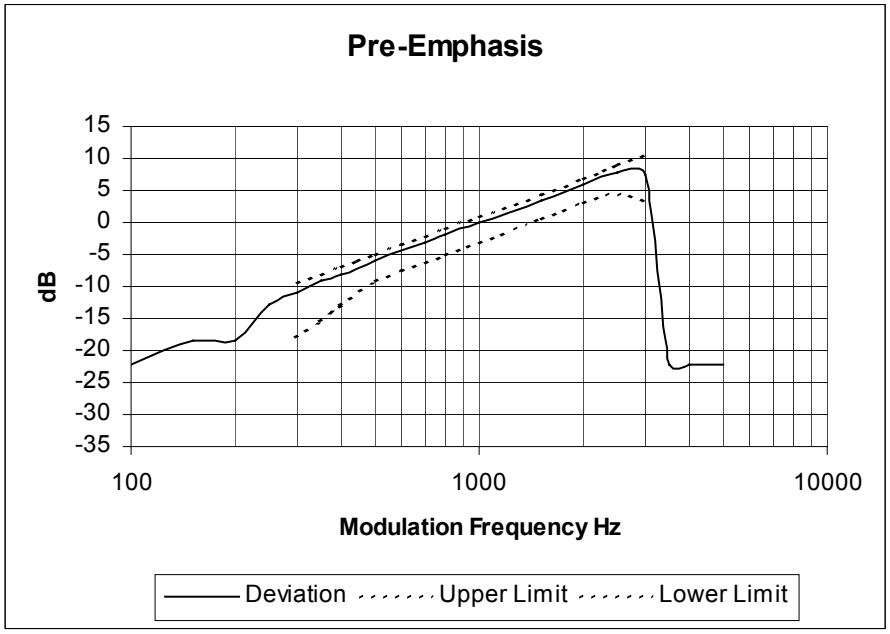
LIMIT CLAUSE: TIA/EIA-603C 3.2.6

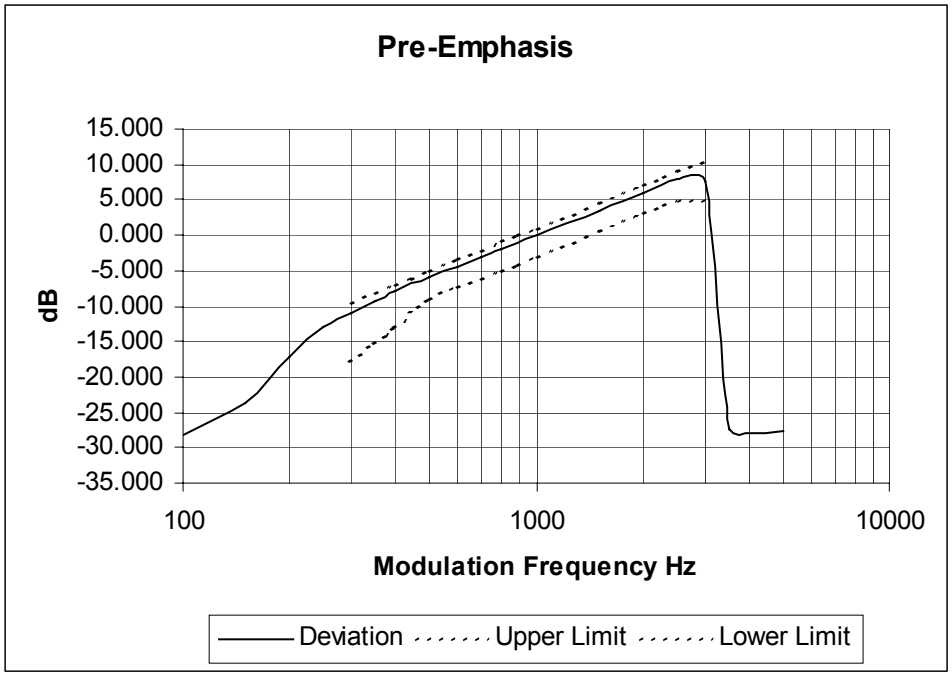
TRANSMITTER AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 807.55 MHz 12.5 kHz Channel Spacing



Tx FREQUENCY: 816.5125 MHz 25 kHz Channel Spacing



TRANSMITTER MODULATION LIMITING

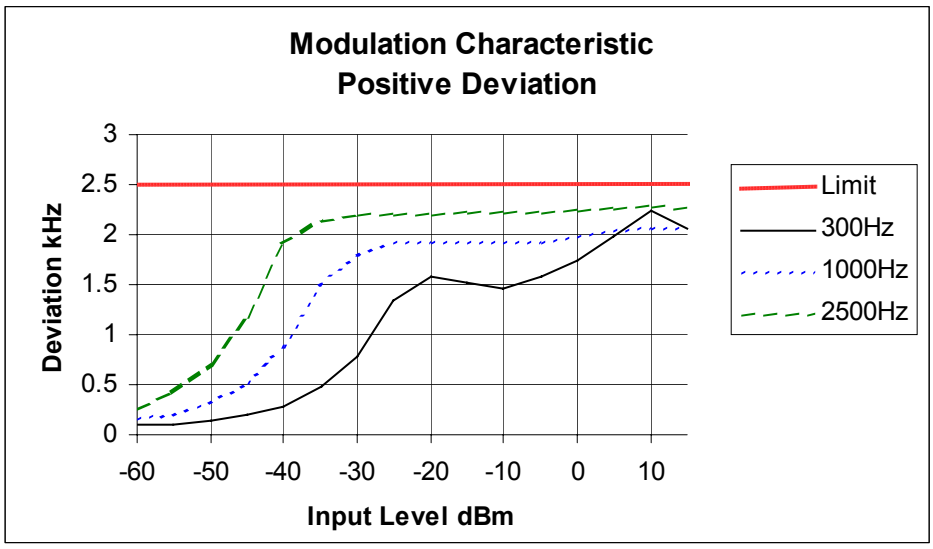
SPECIFICATION: FCC 47 CFR 2.1047 (b)

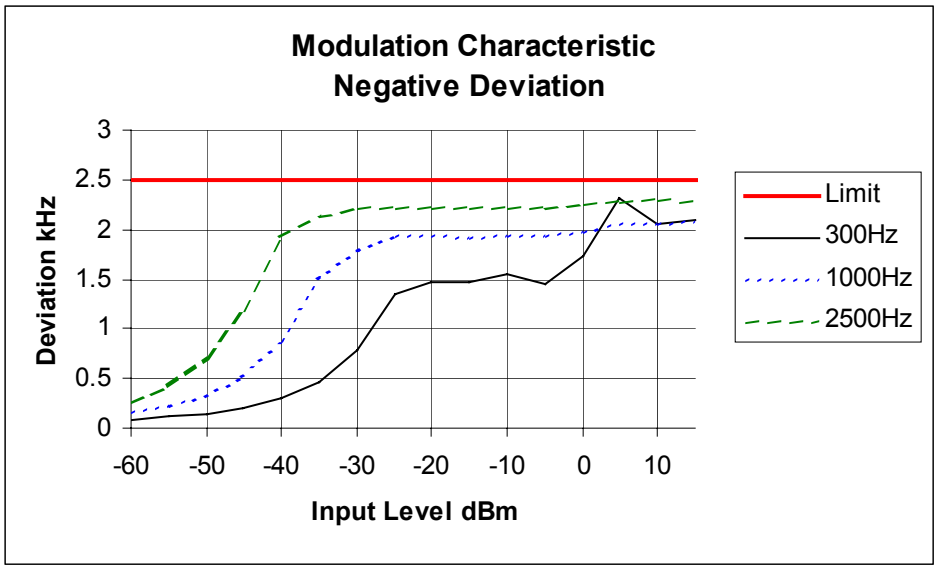
MEASUREMENT PROCEDURE:
1. Refer Annex A for Equipment set up.
2. The modulation response was measured at three audio frequencies while varying the input level.
3. Measurements were made for both Positive and Negative Deviation.

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

LIMIT CLAUSE: TIA/EIA-603C 1.3.4.4

Tx FREQUENCY: 807.55 MHz 12.5 kHz Channel Spacing

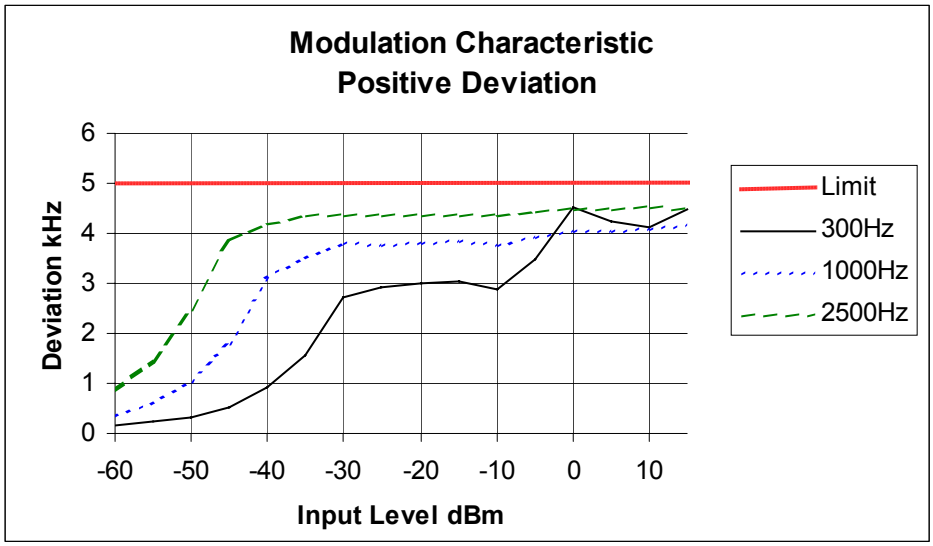


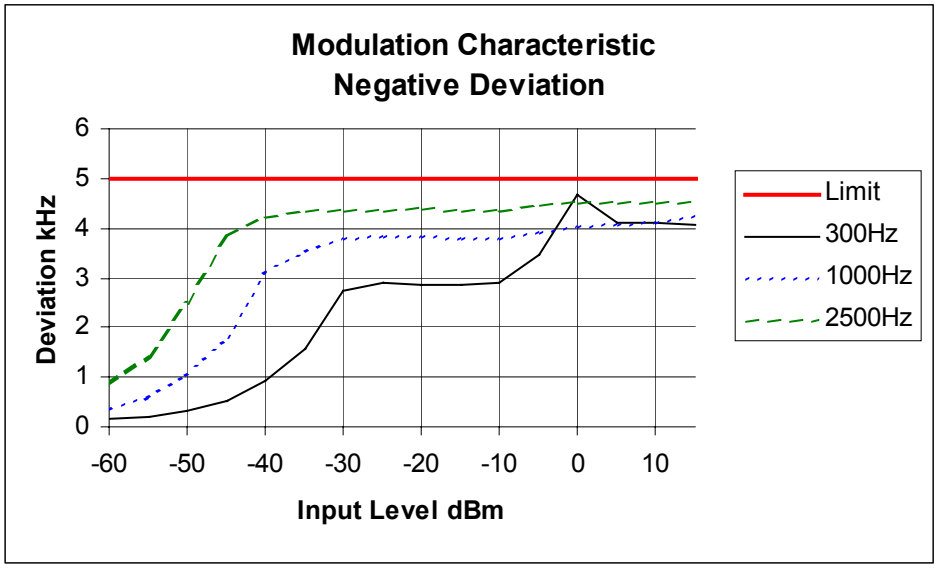


TRANSMITTER MODULATION LIMITING

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 816.5125 MHz 25.0 kHz Channel Spacing





OCCUPIED BANDWIDTH

SPECIFICATION: FCC 47 CFR 2.1049 (c)

GUIDE: TIA/EIA-603C 2.2.11

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment Set up.
2. For analogue measurements: The EUT was modulated by a 2500Hz tone at an input level 16dB 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 = 100Hz, Video Bandwidth = 1 kHz
   Emission Mask B, and C – Resolution bandwidth = 300Hz, Video Bandwidth = 3 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

EMISSION MASKS

Emission Mask D	12.5 kHz Channel Spacing	Analogue, FFSK, THSD;
Emission Mask B	25.0 kHz Channel Spacing	Analogue;
Emission Mask G	25.0 kHz Channel Spacing	FFSK.

DATA SPEED

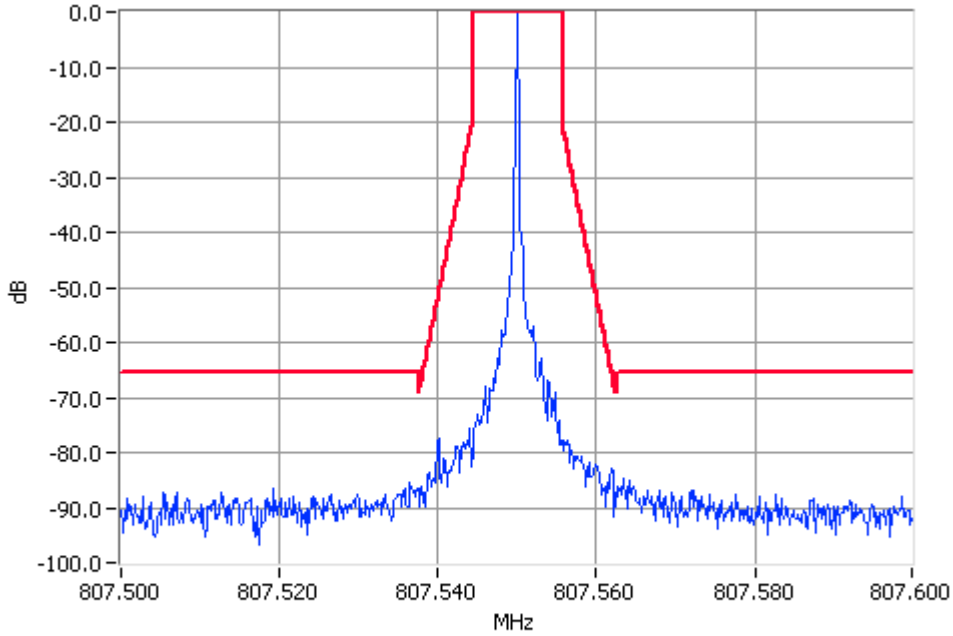
FFSK	1200 bps	12.5 kHz Channel Spacing
FFSK	1200 bps	25.0 kHz Channel Spacing
THSD	12000 bps	12.5 kHz Channel Spacing

OCCUPIED BANDWIDTH

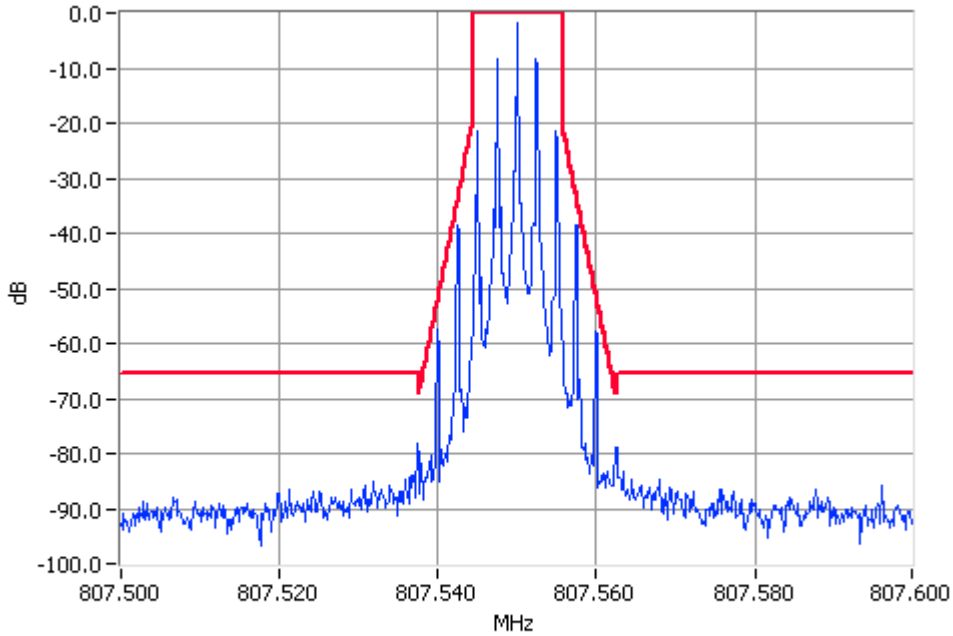
ANALOGUE VOICE

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 807.55 MHz 35 W 12.5 kHz Channel Spacing



Unmodulated 807.5500MHz Mask D 35W Pass
RBW=100Hz VBW=1000Hz



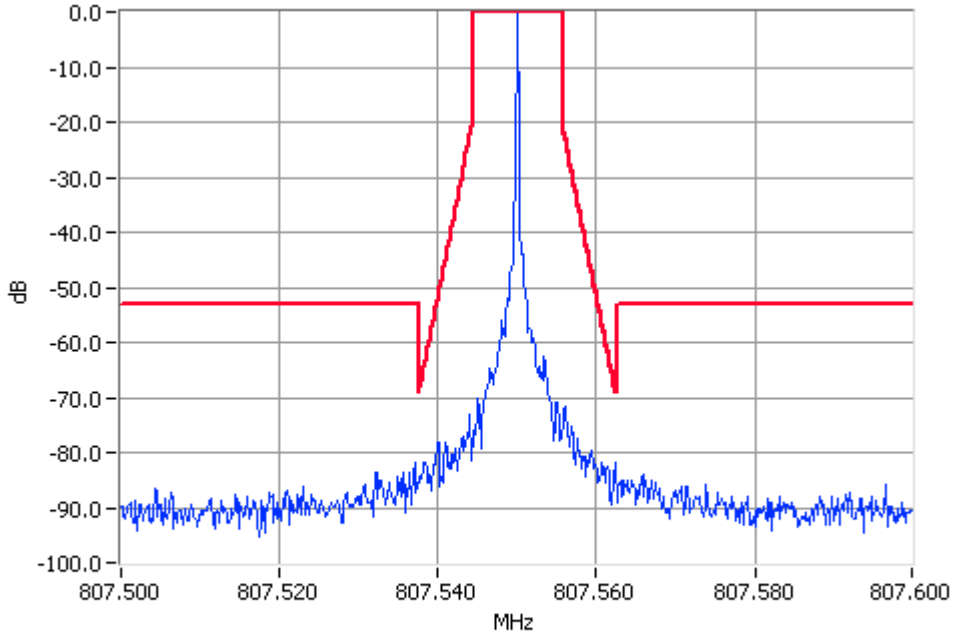
Analogue Modulation 807.5500MHz Mask D 35W Pass
RBW=100Hz VBW=1000Hz

OCCUPIED BANDWIDTH

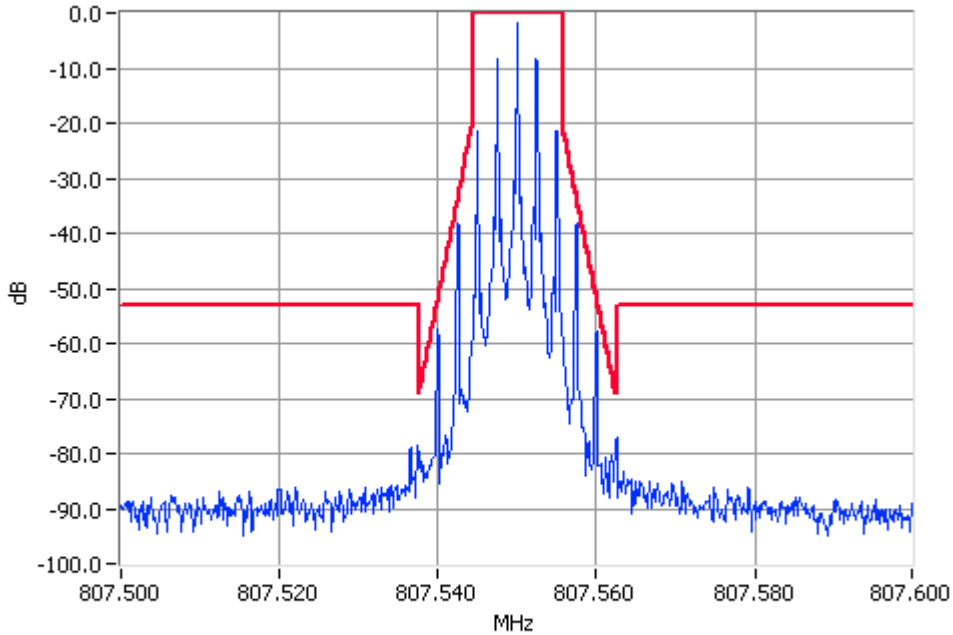
ANALOGUE VOICE

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 807.55 MHz 2 W 12.5 kHz Channel Spacing



Unmodulated 807.5500MHz Mask D 2W Pass
RBW=100Hz VBW=1000Hz



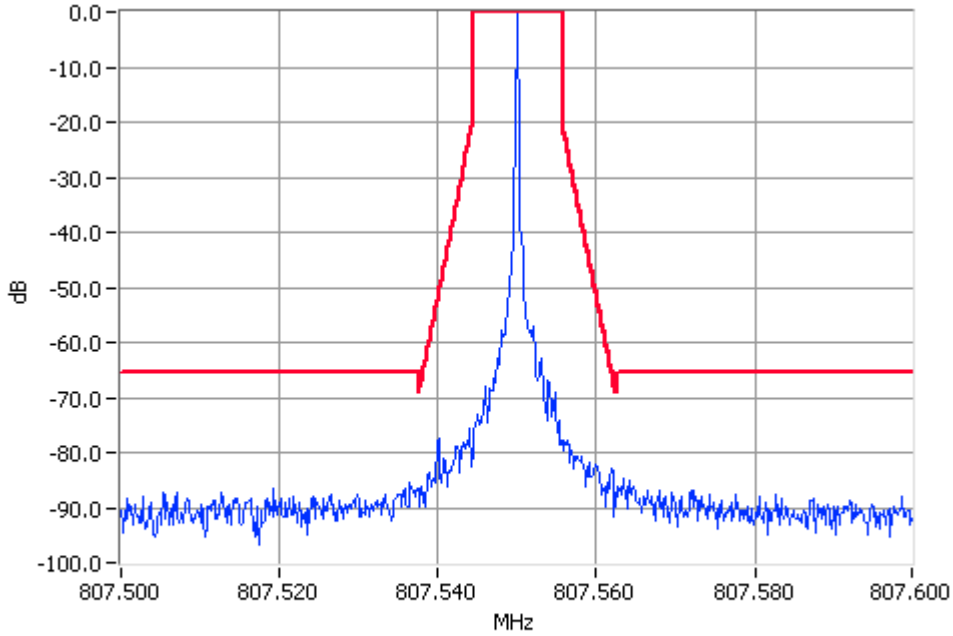
Analogue Modulation 807.5500MHz Mask D 2W Pass
RBW=100Hz VBW=1000Hz

OCCUPIED BANDWIDTH

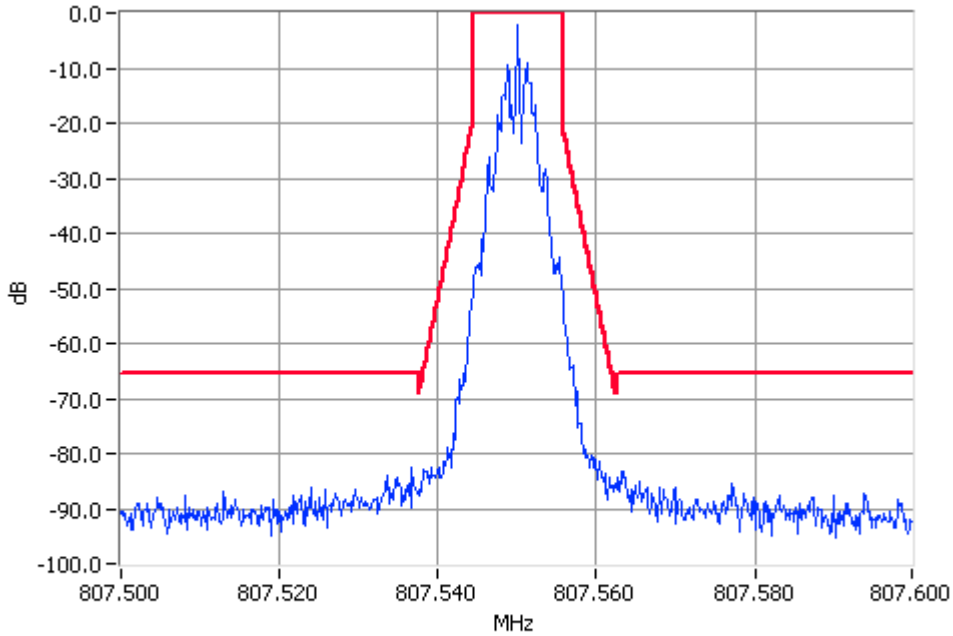
FFSK

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 807.55 MHz 35 W 12.5 kHz Channel Spacing



Unmodulated 807.5500MHz Mask D 35W Pass
RBW=100Hz VBW=1000Hz



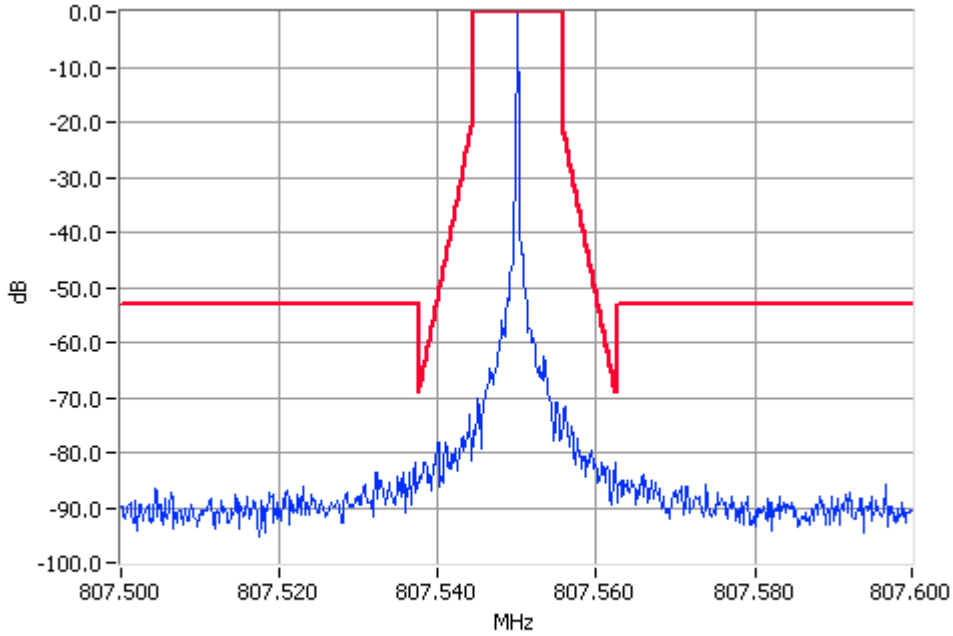
Digital Modulation 807.5500MHz Mask D 35W Pass
RBW=100Hz VBW=1000Hz

OCCUPIED BANDWIDTH

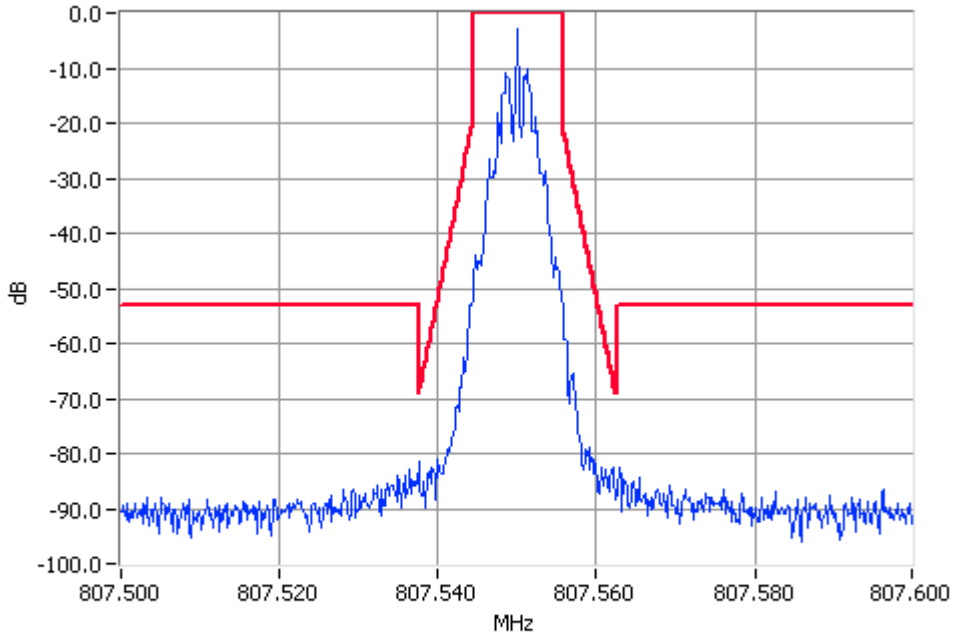
FFSK

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 807.55 MHz 2 W 12.5 kHz Channel Spacing



Unmodulated 807.5500MHz Mask D 2W Pass
RBW=100Hz VBW=1000Hz



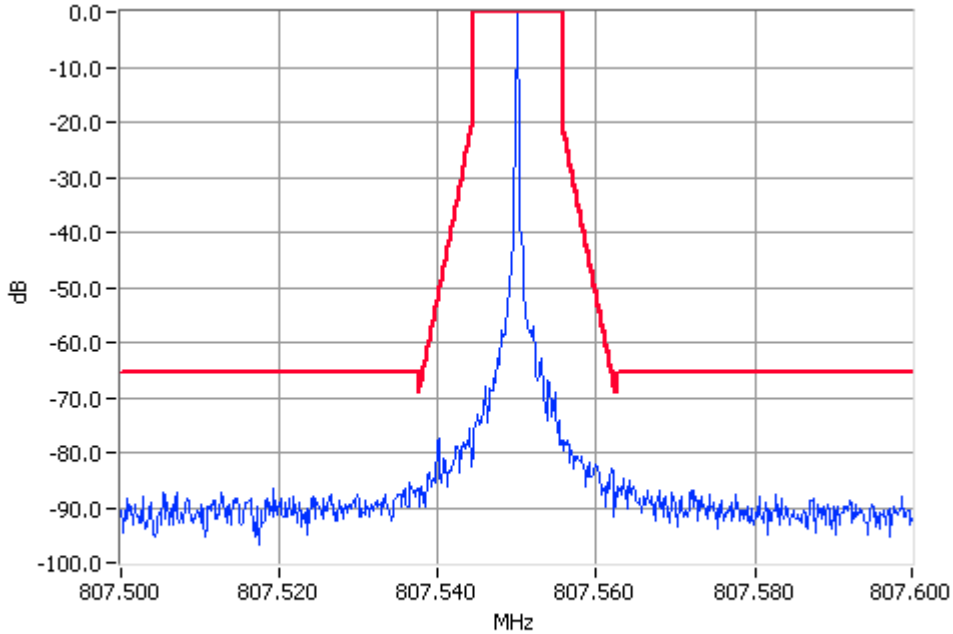
Digital Modulation 807.5500MHz Mask D 2W Pass
RBW=100Hz VBW=1000Hz

OCCUPIED BANDWIDTH

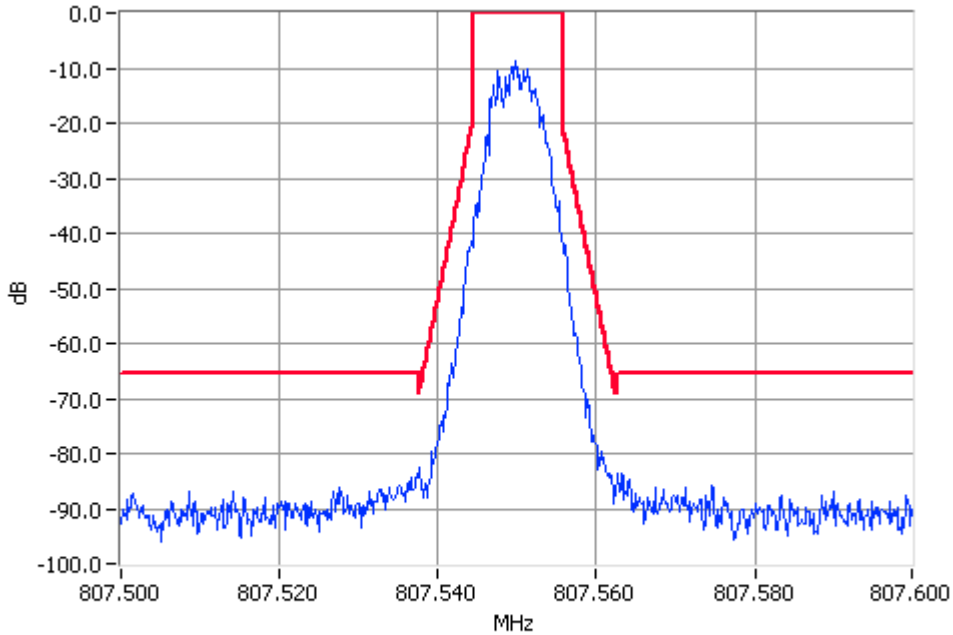
THSD

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 807.55 MHz 35 W 12.5 kHz Channel Spacing



Unmodulated 807.5500MHz Mask D 35W Pass
RBW=100Hz VBW=1000Hz



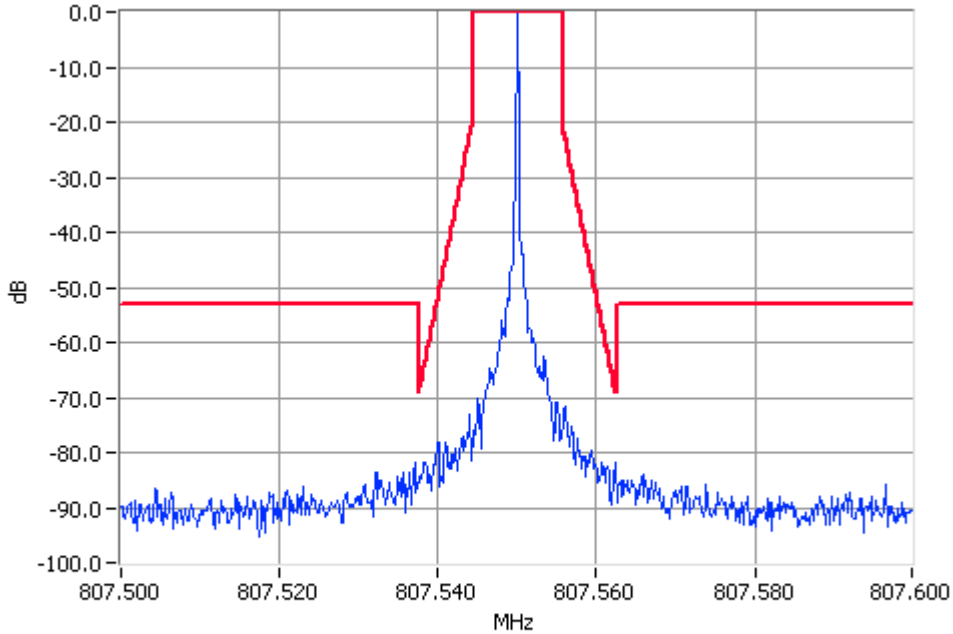
Digital Modulation 807.5500MHz Mask D 35W Pass
RBW=100Hz VBW=1000Hz

OCCUPIED BANDWIDTH

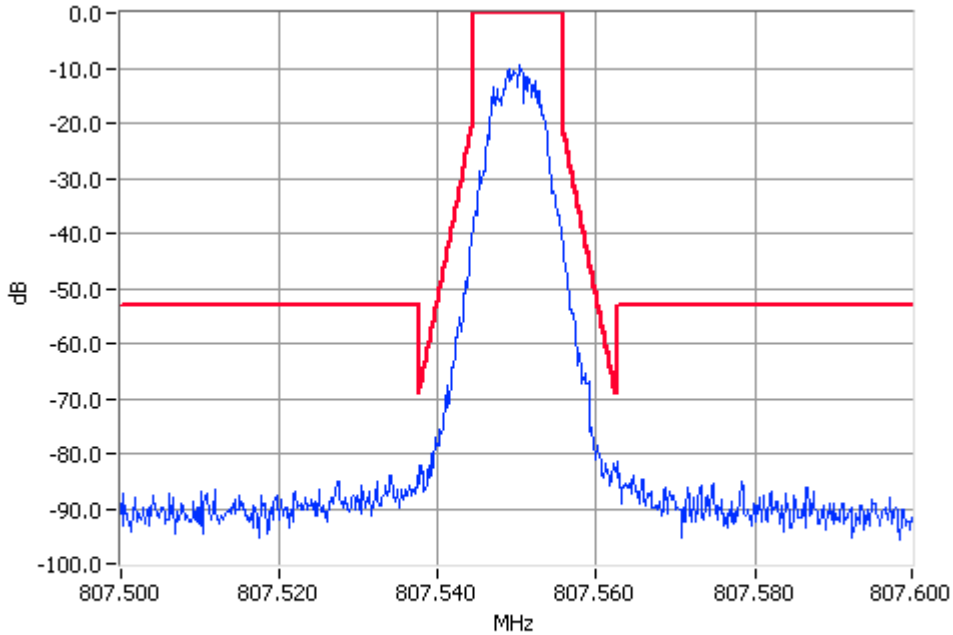
THSD

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 807.55 MHz 2 W 12.5 kHz Channel Spacing



Unmodulated 807.5500MHz Mask D 2W Pass
RBW=100Hz VBW=1000Hz



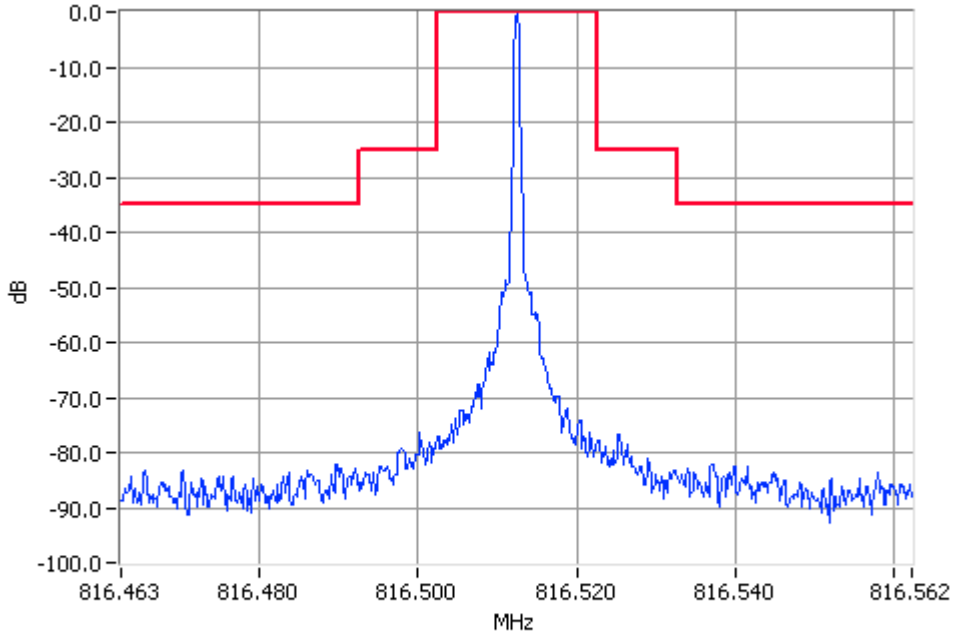
Digital Modulation 807.5500MHz Mask D 2W Pass
RBW=100Hz VBW=1000Hz

OCCUPIED BANDWIDTH

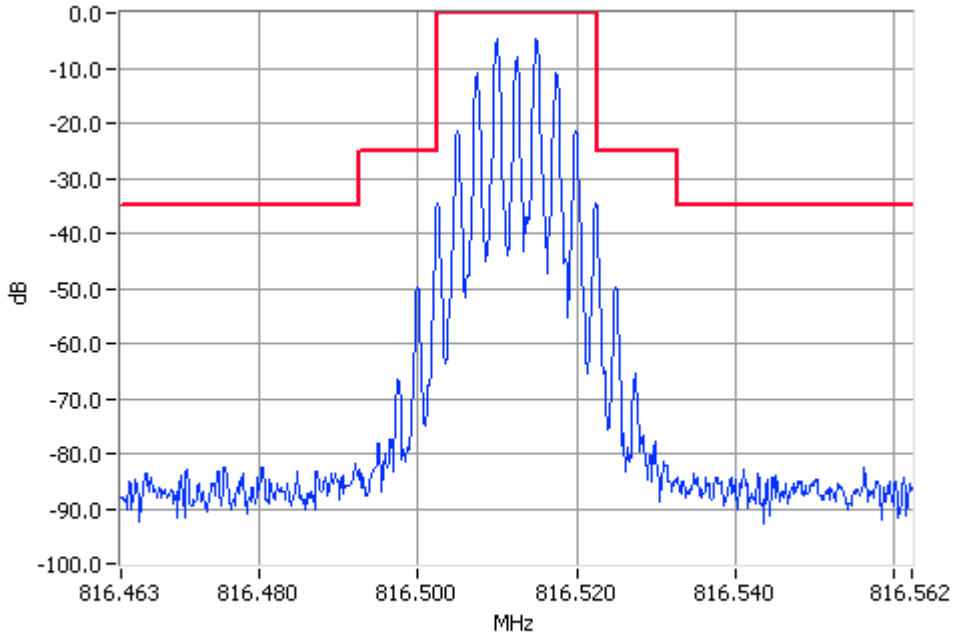
ANALOGUE VOICE

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 816.5125 MHz 35 W 25 kHz Channel Spacing



Unmodulated 816.5125MHz Mask B 35W Pass
RBW=300Hz VBW=3000Hz



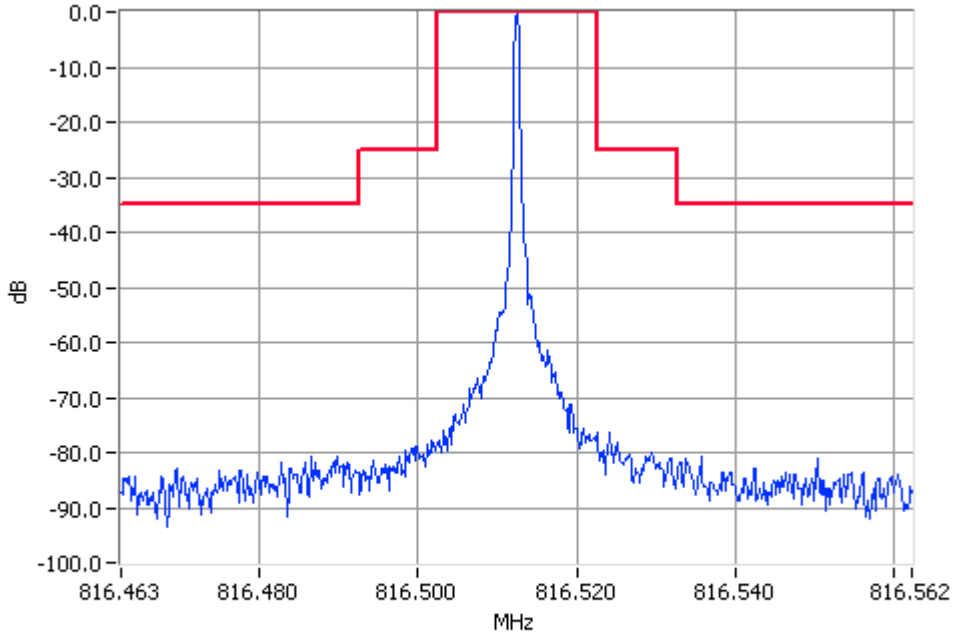
Analogue Modulation 816.5125MHz Mask B 35W Pass
RBW=300Hz VBW=3000Hz

OCCUPIED BANDWIDTH

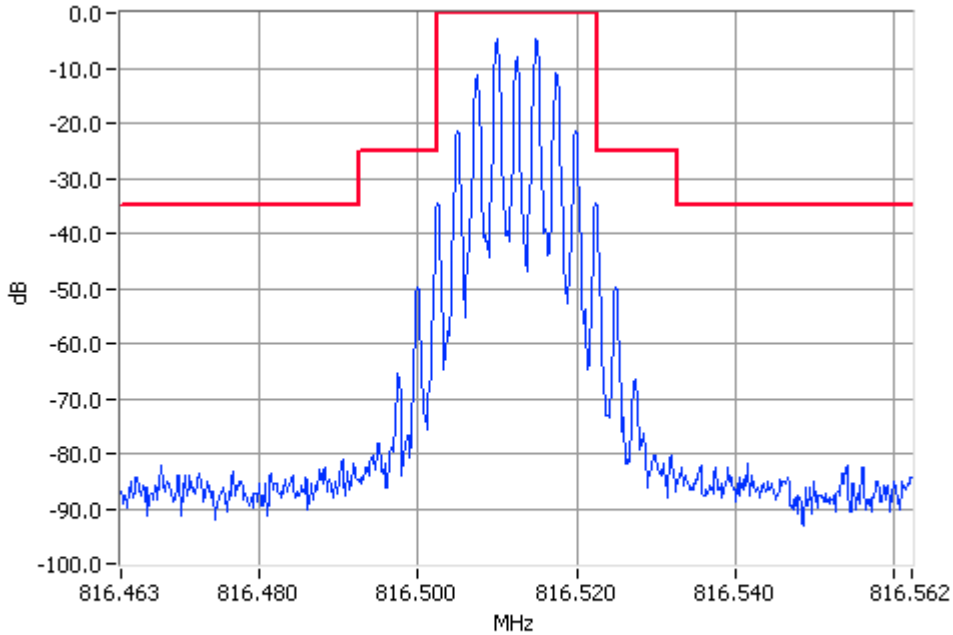
ANALOGUE VOICE

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 816.5125 MHz 2 W 25 kHz Channel Spacing



Unmodulated 816.5125MHz Mask B 2W Pass
RBW=300Hz VBW=3000Hz



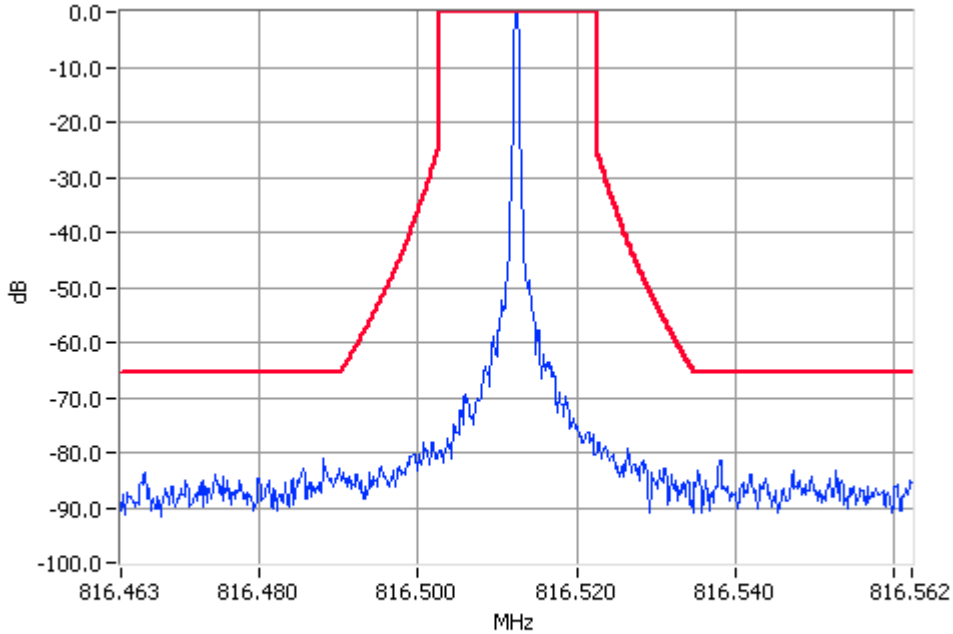
Analogue Modulation 816.5125MHz Mask B 2W Pass
RBW=300Hz VBW=3000Hz

OCCUPIED BANDWIDTH

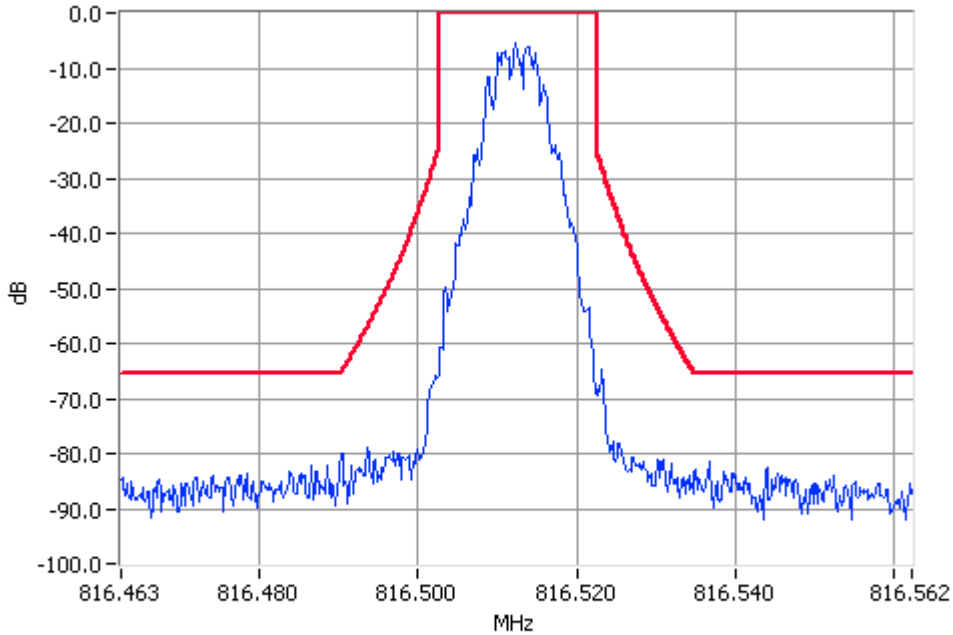
FFSK

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 816.5125 MHz 35 W 25 kHz Channel Spacing



Unmodulated 816.5125MHz Mask G 35W Pass
RBW=300Hz VBW=3000Hz



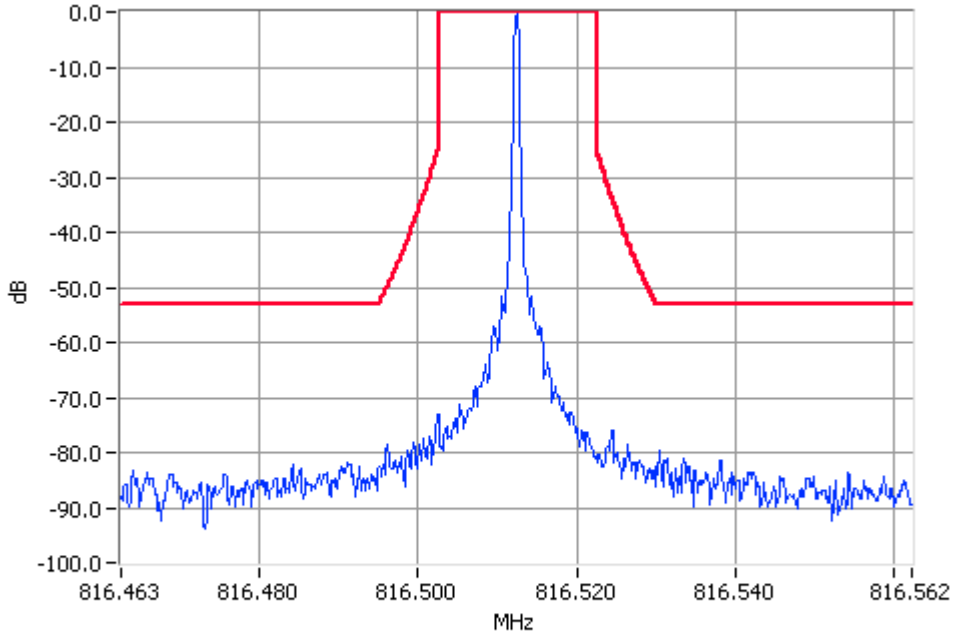
Digital Modulation 816.5125MHz Mask G 35W Pass
RBW=300Hz VBW=3000Hz

OCCUPIED BANDWIDTH

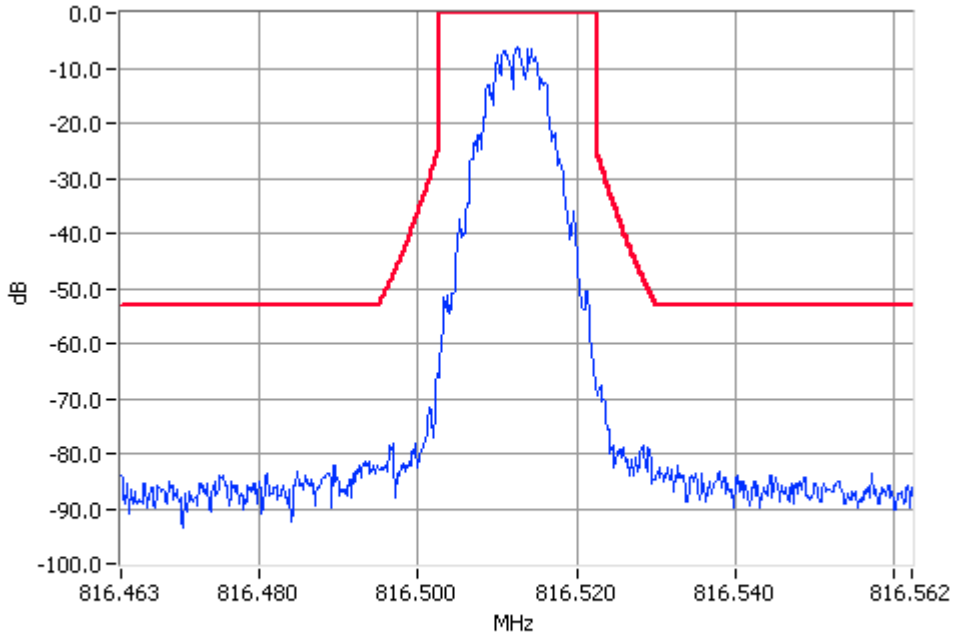
FFSK

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 816.5125 MHz 2 W 25 kHz Channel Spacing



Unmodulated 816.5125MHz Mask G 2W Pass
RBW=300Hz VBW=3000Hz



Digital Modulation 816.5125MHz Mask G 2W Pass
RBW=300Hz VBW=3000Hz

SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: FCC 47 CFR 2.1051

GUIDE: TIA/EIA-603C 2.2.13

MEASUREMENT PROCEDURE:

1. Refer Annex A for equipment set up.
2. The frequency range examined was from the lowest frequency generated within the EUT, to a frequency higher than the 10th Harmonic: 100kHz 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 20dB of the limit a second measurement is made with the carrier modulated, and a resolution bandwidth of 10 kHz, and a video bandwidth of 30kHz.
4. Spurious emissions which were attenuated more than 20dB below the limit were not recorded.

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

LIMIT CLAUSE: FCC 47 CFR 90.210

SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: FCC CFR 2.1051

Tx FREQUENCY: 807.55 MHz

12.5 kHz Channel Spacing	807.55 MHz @ 35 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
8075.5006	-39.6	85
No other emissions were detected at a level greater than 20 dB below the limit.		

LIMITS:

Carrier Output Power Watts	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
2 W	-20 dBm	53 dBc
35 W	-20 dBm	65 dBc

SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: FCC CFR 2.1051

Tx FREQUENCY: 807.55 MHz

12.5 kHz Channel Spacing	807.55 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:

Carrier Output Power Watts	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
2 W	-20 dBm	53 dBc
35 W	-20 dBm	65 dBc

SPECIFICATION: FCC CFR 2.1051

Tx FREQUENCY: 816.5125 MHz

25 kHz Channel Spacing	816.5125 MHz @ 35 W	Emission Mask B
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
No emissions were detected at a level greater than 20 dB below the limit.		

LIMITS:

Carrier Output Power Watts	Emission Mask B 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
2 W	-20 dBm	53 dBc
35 W	-20 dBm	65 dBc

SPECIFICATION: FCC CFR 2.1051

Tx FREQUENCY: 816.5125 MHz

25 kHz Channel Spacing	816.5125 MHz @ 2 W	Emission Mask B
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
No emissions were detected at a level greater than 20 dB below the limit.		

LIMITS:

Carrier Output Power Watts	Emission Mask B 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
2 W	-20 dBm	53 dBc
35 W	-20 dBm	65 dBc

SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC 47 CFR 2.1053

GUIDE: TIA/EIA-603C 2.2.12

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up.
2. Initial Scan
   a) The EUT is placed in S-Line TEM cell and emissions are measured from 30MHz to 1000MHz.
   Any emission within 10dB of the limit is them re-tested on the OATS along with measurements from 1000MHz to the 10th harmonic of the fundamental frequency.
3. OATS Measurement
   a) The EUT was placed on a wooden turntable at a distance of three metres from the test antenna. The output terminal was connected to an RF dummy load.
   b) The test antenna was raised from 1m to 4m to obtain a maximum reading, the turntable was then rotated through 360° to obtain the maximum response of each spurious emission. Valid emissions were determined by switching the EUT on and off.
   c) The EUT was 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 (RADIATED)

SPECIFICATION: FCC CFR 2.1053

Tx FREQUENCY: 807.55 MHz

12.5 kHz Channel Spacing	807.55 MHz @ 35 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:

Carrier Output Power Watts	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
2 W	-20 dBm	53 dBc
35 W	-20 dBm	65 dBc

SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC CFR 2.1053

Tx FREQUENCY: 807.55 MHz

12.5 kHz Channel Spacing	807.55 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:

Carrier Output Power Watts	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
2 W	-20 dBm	53 dBc
35 W	-20 dBm	65 dBc

SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC CFR 2.1053

Tx FREQUENCY: 816.5125 MHz

25 kHz Channel Spacing	816.5125 MHz @ 35 W	Emission Mask B
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
No emissions were detected at a level greater than 20 dB below the limit.		

LIMITS:

Carrier Output Power Watts	Emission Mask B 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
2 W	-20 dBm	53 dBc
35 W	-20 dBm	65 dBc

SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC CFR 2.1053

Tx FREQUENCY: 816.5125 MHz

25 kHz Channel Spacing	816.5125 MHz @ 2 W	Emission Mask B
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
No emissions were detected at a level greater than 20 dB below the limit.		

LIMITS:

Carrier Output Power Watts	Emission Mask B 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
2 W	-20 dBm	53 dBc
35 W	-20 dBm	65 dBc

TRANSMITTER FREQUENCY STABILITY (TEMPERATURE)

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

GUIDE: TIA/EIA-603C 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.

LIMIT CLAUSE: FCC 47 CFR 90.213

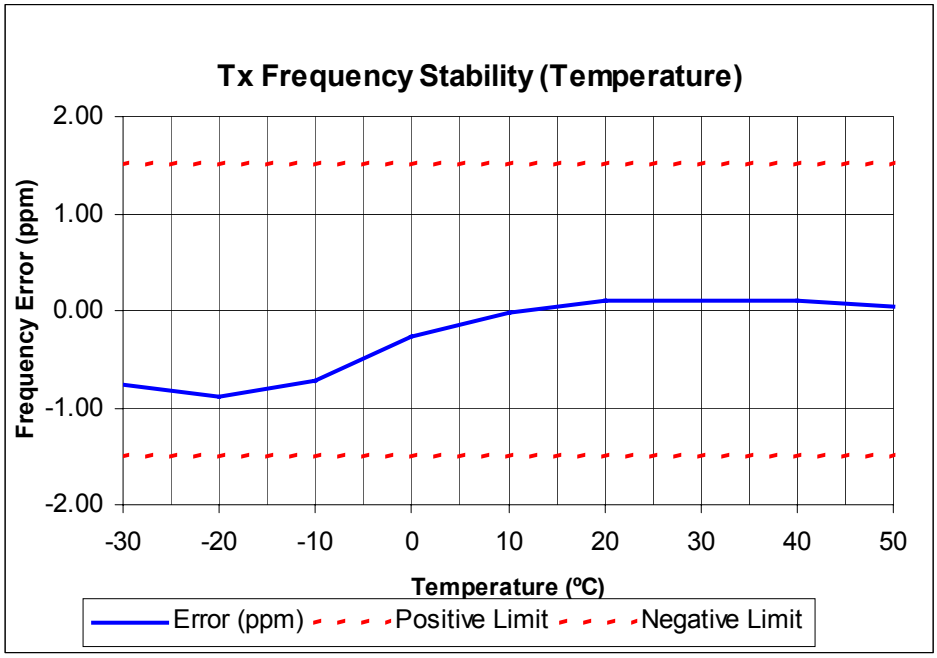
Frequency Range: 806 MHz ~ 869 MHz

Channel Spacing (kHz)	Frequency Error (ppm)
12.5	1.5

TRANSMITTER FREQUENCY STABILITY (TEMPERATURE)

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

Tx FREQUENCY: 807.55 MHz 35 W 12.5 kHz channel Spacing



TRANSMITTER FREQUENCY STABILITY (VOLTAGE)

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

GUIDE: TIA/EIA-603C 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: Frequency Range: 806 MHz ~ 869 MHz

Channel Spacing (kHz)	FREQUENCY ERROR (ppm) @ 807.55 MHz		
	11.7 V DC	13.8 V DC	15.9 V DC
12.5	0.13	0.13	0.15

LIMIT CLAUSE: FCC 47 CFR 90.213

Channel Spacing (kHz)	Frequency Error (ppm)
12.5	1.5

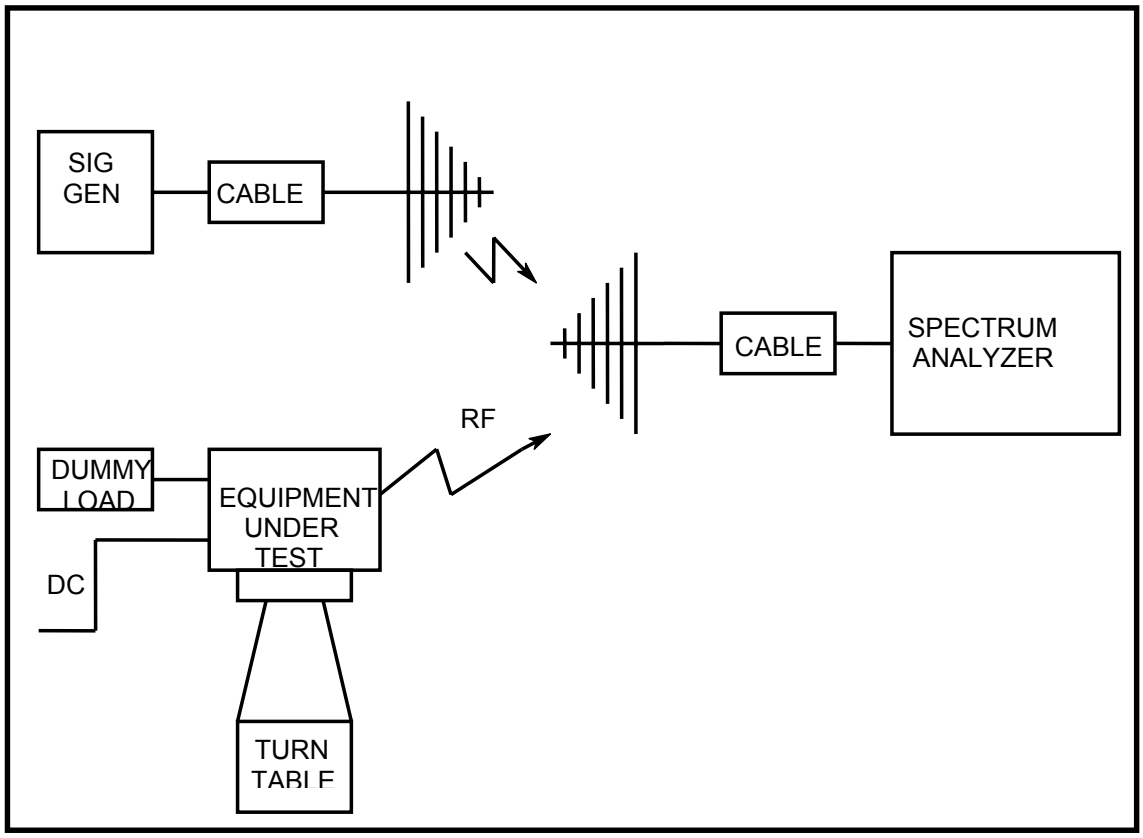
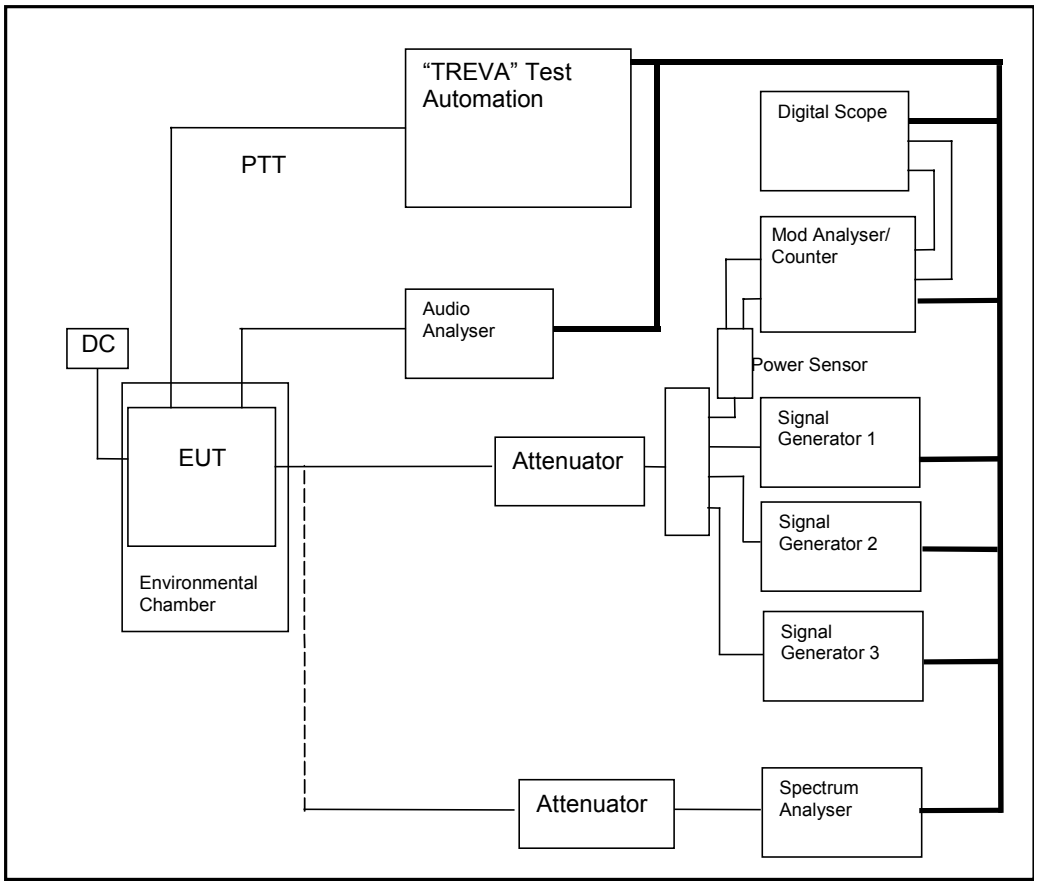
TEST EQUIPMENT USED

Signal Generator	Hewlett Packard	HP8648C	3443U00543	E3558	**Cal Due**
Power Meter	Rohde & Schwarz	NRVS 1020.1809.02	841954/005	E3555	1/11/2007
Power Sensor	Rohde & Schwarz	URV5- Z4 395.1619. 55	841498/003	E3557	1/11/2007
Power Supply	Rohde & Schwarz	NGS M32/10 192.0810.31	Fnr 434	E3556	16/10/2007
RF Attenuator 150W	Weinschel	40-06-34	KV457	E3561	1/11/2007
RF Termination 20W	Deltec		118.001	E3626	
Audio Analyser	Hewlett Packard	HP8903B	2818A04275	E3710	1/11/2007
Oscilloscope	Tektronics	TDS380	B017095	E3782	2/11/2007
Modulation Analyser	Hewlett Packard	HP8901B (Opt 002)	3704A05837	E3786	1/11/2007
Signal Generator	Agilent	E4433B	US38440446	E4147	10/08/2008
Signal Generator	Rohde & Schwarz	SML03 1090.3000.13	100597	E4050	1/11/2007
RF Attenuator	Weinschel	Model 1	BL9950	E4080	28/11/2007
RF Attenuator 150W Treva	Weinschel	40-20-23	MF817	E4082	30/10/2007
RF Splitter Combiner	Minicircuits	ZFSC-4-1	-	E4084	
Spectrum Analyser	Agilent	E4445A	MY42510072	E4139	4/07/2007
1m Multiflex Cable	Suhner	MF141	TT007	E4443	30/10/2007
1m Multiflex Cable	Suhner	MF141	TT086	E4444	30/10/2007

ANNEX A

TEST SETUP DETAILS

Radiated Emissions Set up.



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.