

REPORT NUMBER 2159

January 2005

Class II Permissive Change to Test Report Number 1513

RADIO PERFORMANCE MEASUREMENTS

On the TOP-K2610-CZ Hand Portable Transceiver

FCC ID: CASTEL0032

SN: 14267868

In accordance with

FCC 47 CFR Part 90.353

PREPARED BY:	Marcus Ludwig	_____
		Test Technician
CHECKED & APPROVED BY:	Hamish Newton	_____
		Senior Technician



TELTEST Laboratories

Tait Electronics Limited

PO Box 1645

558 Wairakei Road

Christchurch

New Zealand

Phone : (64) (3) 3583399

Fax: (64) (3) 3580432

REPORT ON :

Type Approval Testing of the TOP-K2610-CZ (Serial No 14267868)
in accordance with:

FCC CFR 47 Part 90.353

FCC ID: CASTEL0032

PREPARED FOR :

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

DISTRIBUTION :

TELTest Laboratory	Mr S Crompton	Copy No 1
Tait Electronics Ltd	Mr. Des Fox	Copy No 2
Tait Electronics Ltd	Mr. Anura Gamalath	Copy No 3

APPROVED :

Hamish Newton

Senior Technician

Date :

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.

Copy No:

TABLE OF CONTENTS

DECLARATION OF CONFORMITY.....	4
TEST CONDITIONS	5
NECESSARY BANDWIDTH AND EMISSION DESIGNATORS	5
TEST RESULTS.....	6
TRANSMITTER OUTPUT POWER (CONDUCTED)	6
TRANSMITTER AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS	7
TRANSMITTER MODULATION LIMITING	8
OCCUPIED BANDWIDTH	9
<i>ANALOGUE VOICE</i>	10
<i>FFSK</i>	12
TRANSMITTER FREQUENCY STABILITY (TEMPERATURE)	14
TRANSMITTER FREQUENCY STABILITY (VOLTAGE)	15
TEST EQUIPMENT USED.....	16
APPENDIX A	17
TEST SETUP DETAILS.....	17

DECLARATION OF CONFORMITY

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

Equipment: Hand Portable Transceiver

Type: T2020

Product code: TOP-K2610-CZ

Serial Numbers: 14267868

Quantity: 1

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

FCC CFR 47 Part 90.353

Signature: _____

S. A. Crompton
Compliance Laboratory Manager.

Date: _____

Test Conditions

All testing was performed at the following conditions.

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

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.

$B_n = 2M + 2DK$ Where: B_n = 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 12.5kHz Bandwidth

Necessary bandwidth	Emission Designator
$M = 3\text{kHz}$	11k0F3E
$D = 2.5\text{kHz}$	F3E represents a FM voice transmission
$B_n = 6 + 5 \times 1$ = 11kHz	

2. Fast Frequency Shift Keying (FFSK) 12.5kHz Bandwidth

Necessary bandwidth	Emission Designator
$M = 1.8\text{ kHz}$	6k60F2D
$D = 1.5\text{kHz}$ (60% of peak deviation)	F2D represents a FM data transmission with the use of a modulating sub carrier
$B_n = 3.6 + 3 \times 1$ = 6.6 kHz	

Test Results

TRANSMITTER OUTPUT POWER (CONDUCTED)

SPECIFICATION: FCC 47 CFR 2.1046

GUIDE: TIA/EIA-603B 2.2.1

MEASUREMENT PROCEDURE:

1. Refer Appendix 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: 3 W and 1 W

904.1 MHz	3 W nominal	1 W nominal
POWER (W)	2.9	1.0
Variation from Nominal (%)	-3.0	0.0
Measurement Uncertainty (dB)	+0.63 -0.68	

LIMIT CLAUSE: FCC 47 CFR 90.205 (r)

Radio Type: Hand Portable Transceiver

Frequency Band: 902 MHz ~ 928 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-603B 2.2.6

MEASUREMENT PROCEDURE:

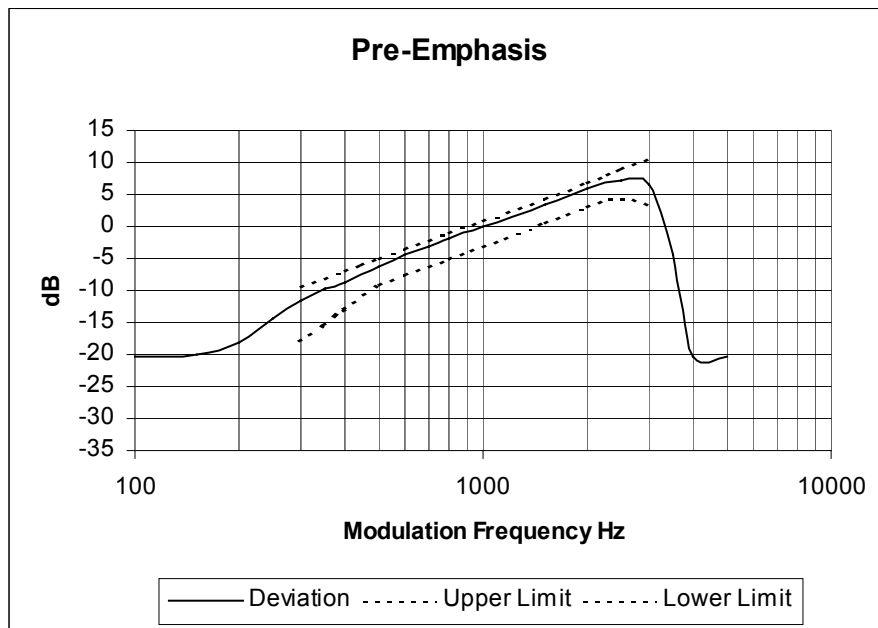
1. Refer Appendix A for Equipment set up.
2. An audio input tone of 1000Hz was applied with the level set to obtain 20% of maximum deviation. This was used as the 0dB reference point.
3. The AF was varied while the audio level was held constant.
4. The response in dB relative to 1000Hz was measured.

MEASUREMENT RESULTS:

Refer measurement plots below.

LIMIT CLAUSE: TIA/EIA-603B 3.2.6

Tx FREQUENCY: 904.1 MHz 12.5 kHz Channel Spacing



TRANSMITTER MODULATION LIMITING

SPECIFICATION: FCC 47 CFR 2.1047 (b)

MEASUREMENT PROCEDURE:

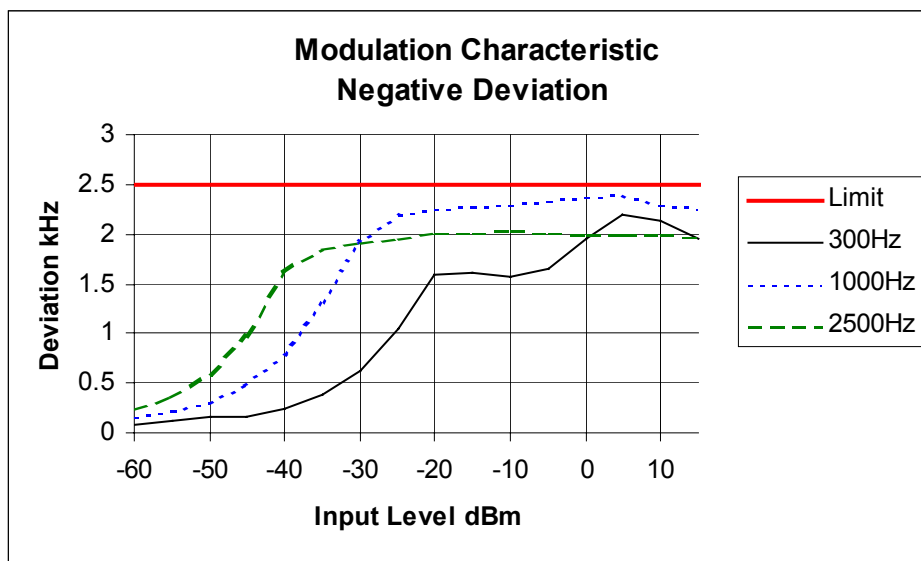
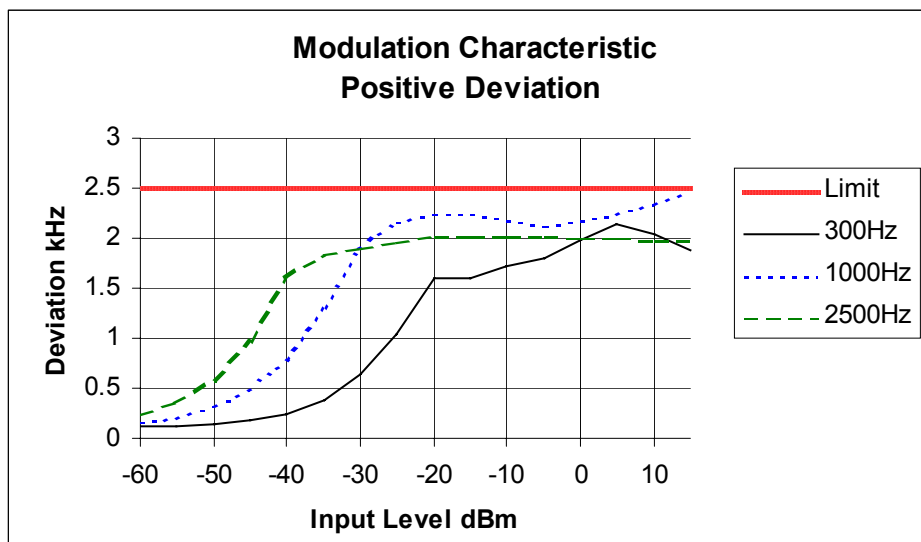
1. Refer Appendix A for Equipment set up.
2. The modulation response was measured at three audio frequencies while varying the input level.
3. Measurements were made for both Positive and Negative Deviation.

MEASUREMENT RESULTS:

Refer measurement plots below.

LIMIT CLAUSE: TIA/EIA-603B 1.3.4.4

Tx FREQUENCY: 904.1 MHz 12.5 kHz Channel Spacing



OCCUPIED BANDWIDTH

SPECIFICATION: FCC 47 CFR 2.1049 (c)

GUIDE: TIA/EIA-603B 2.2.11

MEASUREMENT PROCEDURE:

1. Refer Appendix 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 channel spacing.

LIMIT CLAUSE: FCC 47 CFR 90.210

EMISSION MASKS

Emission Mask D	12.5 kHz Channel Spacing	Analogue; FFSK
-----------------	--------------------------	----------------

DATA SPEED:

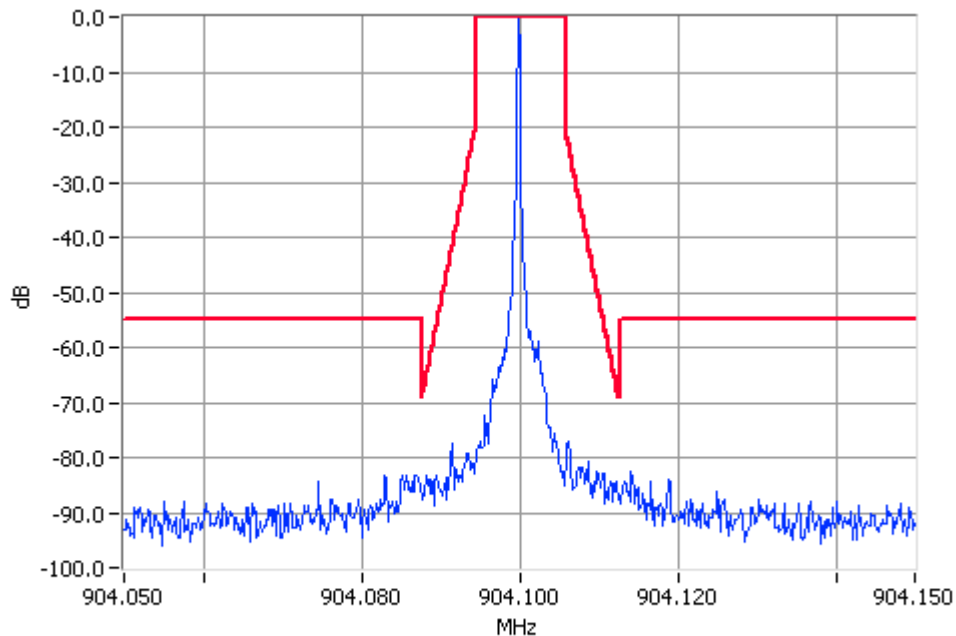
FFSK	1200 bps	12.5 kHz Channel Spacing
------	----------	--------------------------

OCCUPIED BANDWIDTH

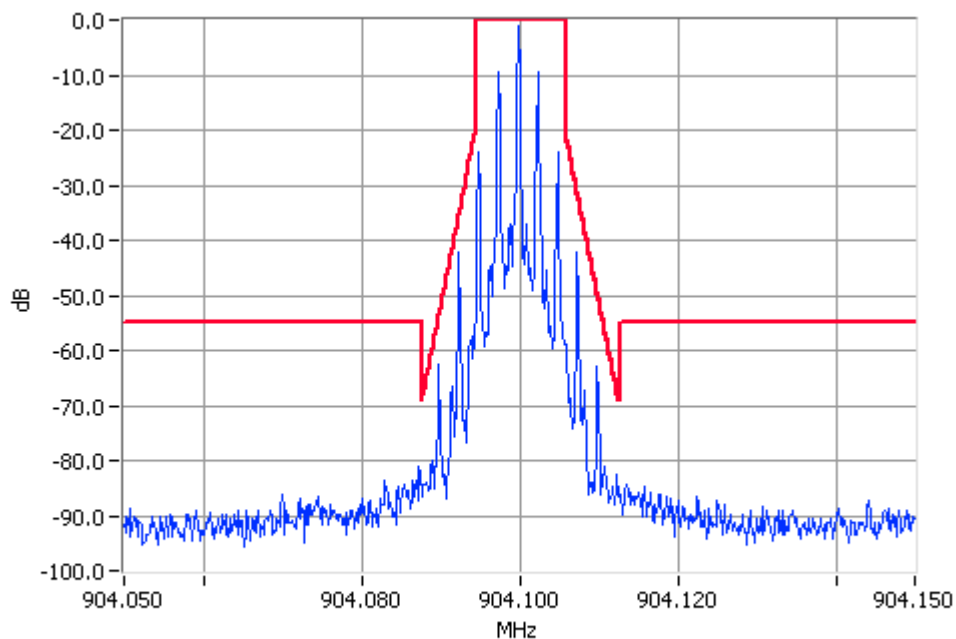
ANALOGUE VOICE

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 904.1 MHz 3 W 12.5 kHz Channel Spacing



Unmodulated 904.1000MHz Mask D 3W Pass
RBW=100Hz VBW=1000Hz



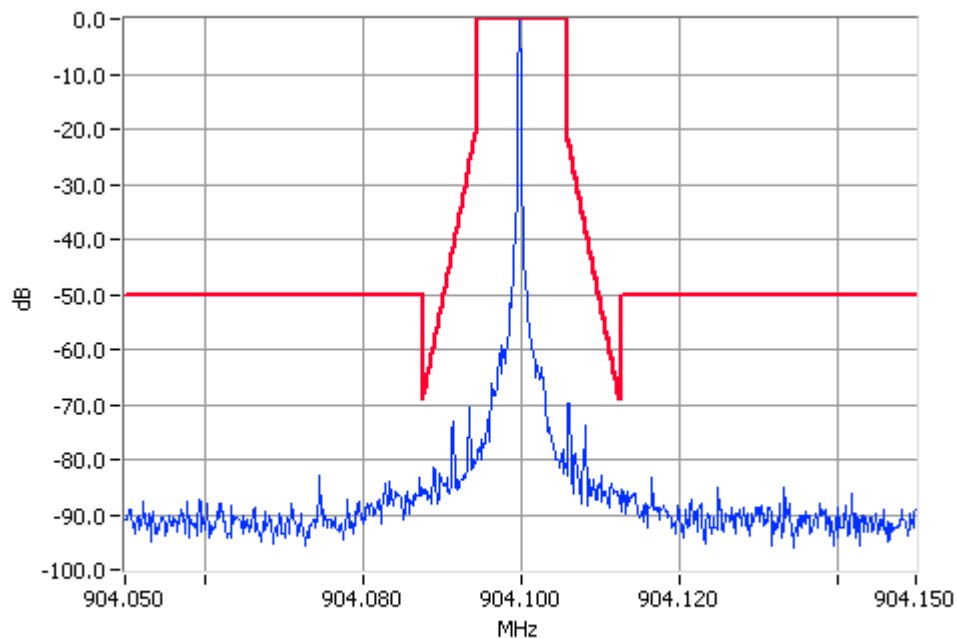
Analogue Modulation 904.1000MHz Mask D 3W Pass
RBW=100Hz VBW=1000Hz

OCCUPIED BANDWIDTH

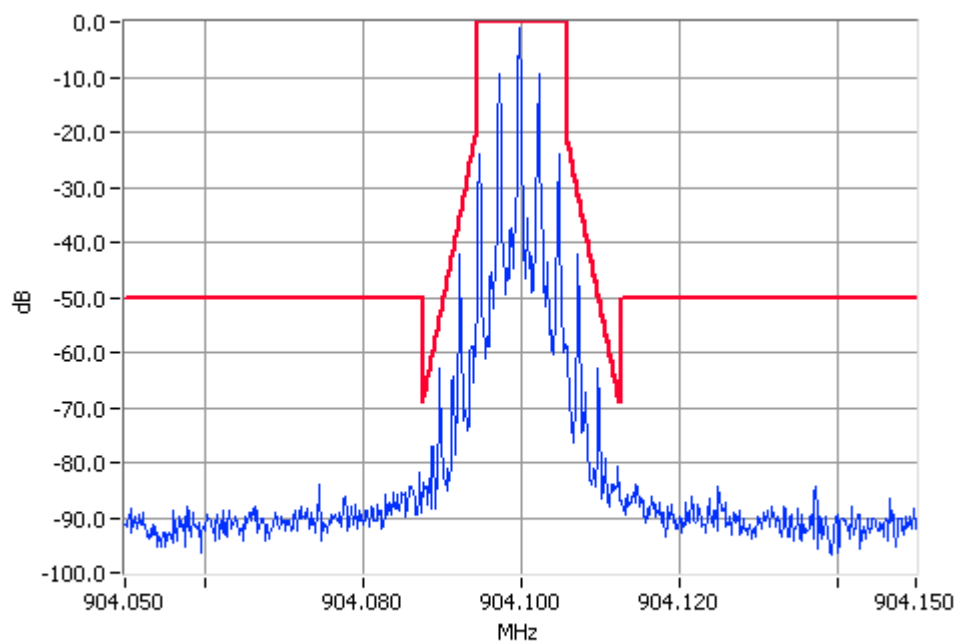
ANALOGUE VOICE

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 904.1 MHz 1 W 12.5 kHz Channel Spacing



Unmodulated 904.1000MHz Mask D 1W Pass
RBW=100Hz VBW=1000Hz



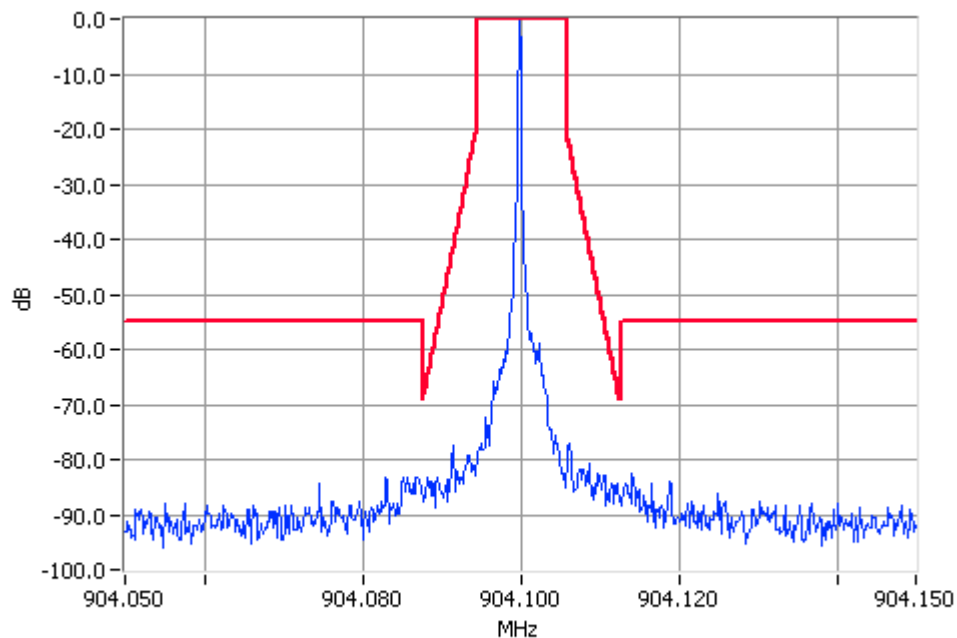
Analogue Modulation 904.1000MHz Mask D 1W Pass
RBW=100Hz VBW=1000Hz

OCCUPIED BANDWIDTH

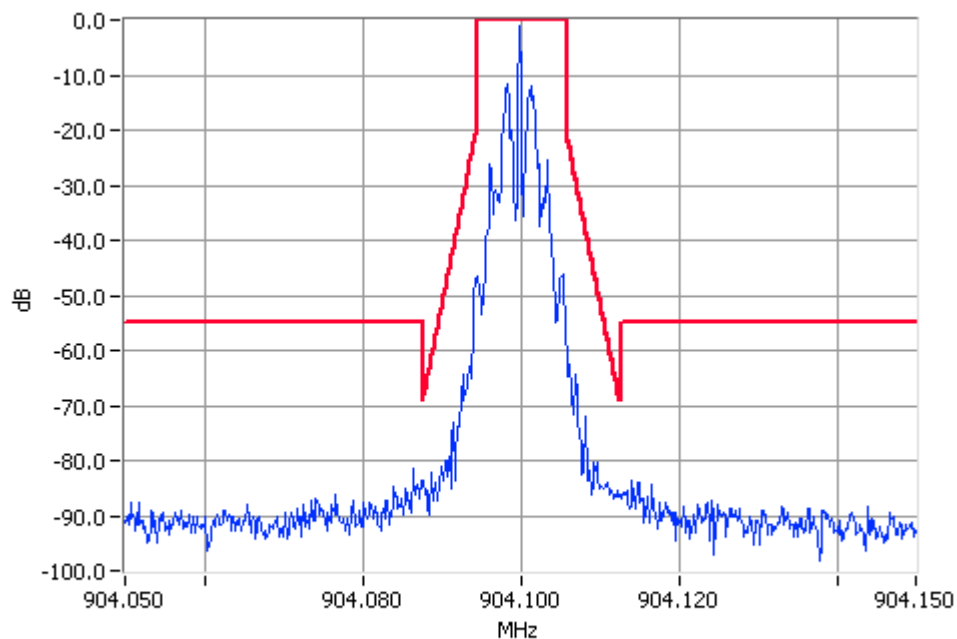
FFSK

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 904.1 MHz 3 W 12.5 kHz Channel Spacing



Unmodulated 904.1000MHz Mask D 3W Pass
RBW=100Hz VBW=1000Hz



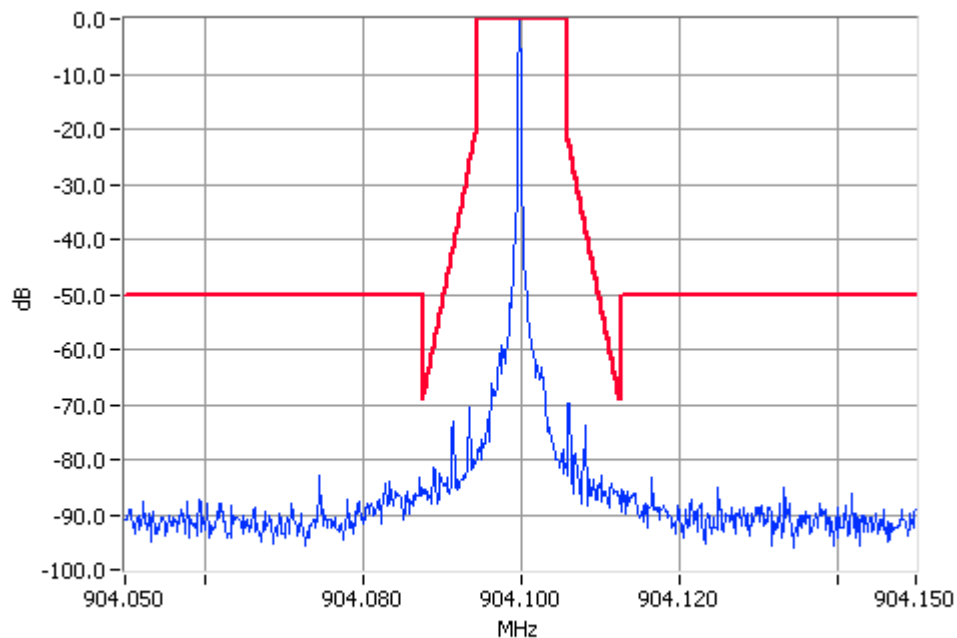
Digital Modulation 904.1000MHz Mask D 3W Pass
RBW=100Hz VBW=1000Hz

OCCUPIED BANDWIDTH

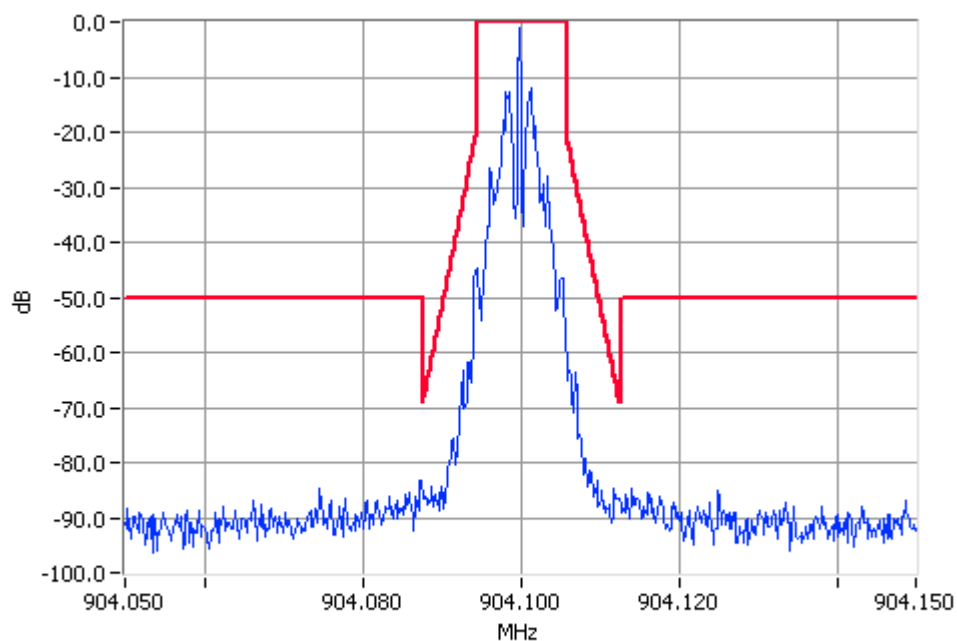
FFSK

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 904.1 MHz 1 W 12.5 kHz Channel Spacing



Unmodulated 904.1000MHz Mask D 1W Pass
RBW=100Hz VBW=1000Hz



Digital Modulation 904.1000MHz Mask D 1W Pass
RBW=100Hz VBW=1000Hz

TRANSMITTER FREQUENCY STABILITY (TEMPERATURE)

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

GUIDE: TIA/EIA-603B 2.2.2

MEASUREMENT PROCEDURE:

1. Refer Appendix A for equipment set up.
2. The EUT was tested for frequency error from -30°C to $+50^{\circ}\text{C}$ in 10°C increments
3. The frequency error was recorded in parts per million (ppm).

MEASUREMENT RESULTS:

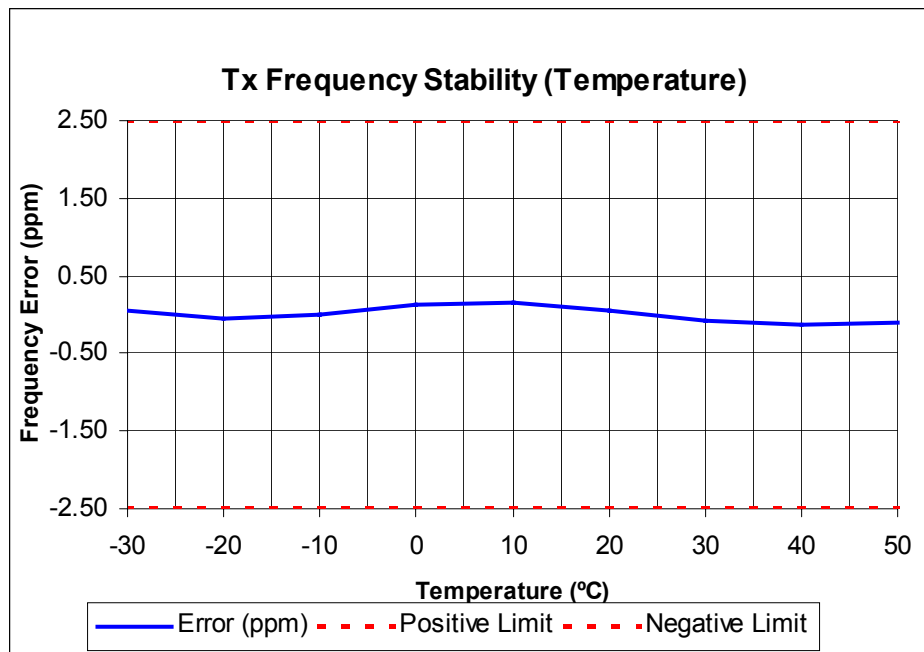
Refer measurement plot below.

LIMIT CLAUSE: FCC 47 CFR 90.213

Frequency Range: 902 MHz to 928 MHz

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

Tx FREQUENCY: 904.1 MHz 3 W 12.5 kHz channel Spacing



TRANSMITTER FREQUENCY STABILITY (VOLTAGE)

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

GUIDE: TIA/EIA-603B 2.2.2

MEASUREMENT PROCEDURE:

1. Refer Appendix 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: 902 MHz to 928 MHz

Channel Spacing (kHz)	FREQUENCY ERROR (ppm) @ 904.1 MHz		
	6.75 V DC	7.5 DC	7.5 V DC
12.5	-0.14	-0.14	-0.13

LIMIT CLAUSE: FCC 47 CFR 90.213

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

TEST EQUIPMENT USED

No#	Equipment	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
1	Signal Generator	Hewlett Packard	HP8642B (Opt 001)	2512A00176	E3064	15-Nov-05
11	Modulation Analyser	Hewlett Packard	HP8901B (Opt 002)	2441A00393	E3073	11-Sep-05
13	Audio Analyser	Hewlett Packard	HP8903A	2308A02597	E3074	15-Sep-05
14	Power Head	Hewlett Packard	HP11722A	2320A00688	E3307	08-Nov-05
86	1m Coax Cable (BLUE)	Suhner	Sucoflex 104A	25003/4A	E3690	13-Aug-05
87	Audio Analyser	Hewlett Packard	HP8903B	2818A04275	E3710	12-Nov-05
111	Modulation Analyser	Hewlett Packard	HP8901B (Opt 002)	3704A05837	E3786	06-Nov-05
114	Signal Generator	Rohde & Schwarz	SML03 1090.3000.13	100597	E4050	08-Nov-05
115	Environ. Chamber	Contherm	5400 RHSLT.M	1416	E4051	04-Mar-05

APPENDIX A

TEST SETUP DETAILS

All other 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.

