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FCC PART 90
TEST REPORT

APPLICANT	TELTRONIC, S.A.U.
	POLIGONO MALPICA CALLE F PARCELA 12 ZARAGOZA 50057 SPAIN
FCC ID	FCC ID: WT7PTRKTHTT500410
MODEL NUMBER	HTT-500 409-470 MHz
PRODUCT DESCRIPTION	PTT Handheld Radio
DATE SAMPLE RECEIVED	1/28/2010
DATE TESTED	1/29/2010
AMENDED	4/30/2010
TESTED BY	Nam Nguyen
APPROVED BY	Mario de Aranzeta
TIMCO REPORT NO.	226AUT10TestReport_Rev.pdf
TEST RESULTS	☒ PASS ☐ FAIL

ACCREDITED
Certificate # 0955-01

TABLE OF CONTENTS

ATTESTATIONS

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025:2005 requirements.

Testing Certificate # 0955-01

I attest that the necessary measurements were made, under my supervision, at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, Fl 32669

Authorized Signatory Name:

Mario de Aranzeta C.E.T.
Compliance Engineer/ Lab. Supervisor

Date: May 13, 2010

DUT SPECIFICATION

DUT Description	PTT HANDHELD RADIO
FCC Identified	FCC ID: WT7PTRKTHT500410
Model Number	HTT-500 409-470 MHz
Serial Number	N/A
Operating Frequency	(409.00 – 470.00) MHz
Type of Emission	20K0Q1E, 20K0Q1D, 20K0Q1W, 20K0D1E, 20K0D1D, ,20K0D1W
Modulation	π/4 - DQPSK
DUT Power Source	☐ 110–120Vac/50– 60Hz
	☐ DC Power 12V
	☒ Battery Operated Exclusively
Test Item	☐ Prototype
	☒ Pre-Production
	☐ Production
Type of Equipment	☐ Fixed
	☐ Mobile
	☒ Portable

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
3-Meter OATS	TEI	N/A	N/A	Listed 1/11/09	1/10/12
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	Listed 5/11/07	5/11/10
AC Voltmeter	HP	400FL	2213A14499	CAL 12/29/08	12/29/10
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 11/30/09	11/30/11
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 11/30/09	11/30/11
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 11/30/09	11/30/11
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 11/30/09	11/30/11
Coaxial Cable #64	Semflex Inc.	60637	Timco #64	CHAR 3/30/09	3/30/11
Antenna: Dipole Kit	Electro-Metrics	TDA-30/1-4	152	CAL 3/3/09	3/3/12
Antenna: Dipole Kit	Electro-Metrics	TDA-30/1-4	153	CHAR 4/5/09	4/5/12
Frequency Counter	HP	5385A	2730A03025	CAL 7/6/09	7/6/11
Hygro-Thermometer	Extech	445703	0602	CAL 11/15/09	11/15/11
Antenna: Log-Periodic	Electro-Metrics	LPA-25	1122	CAL 12/1/08	12/1/10
Measuring Tape-7.5M	Kraftixx	7.5M PROFI		CHAR 11/13/09	11/13/11
Modulation Analyzer	HP	8901A	3435A06868	CAL 5/9/09	5/9/11
Digital Multimeter	Fluke	FLUKE-77-3	79510405	CAL 5/14/09	5/14/11
Temperature Chamber	Tenney Engineering	TTRC	11717-7	CHAR 4/25/08	4/25/10

TEST PROCEDURES

Power Line Conducted Interference: The procedure used was ANSI/TIA 603-C: 2004 using a 50uH LISN. Both lines were observed with the DUT transmitting. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed.

Bandwidth 20 dB: The measurements were made with the spectrum analyzer's resolution bandwidth (RBW) = 1 MHz and the video bandwidth (VBW) = 3 MHz and the span set as shown on plot.

Power Output: The RF power output was measured at the antenna feed point using a peak power meter.

Antenna Conducted Emissions: The RBW = 100 kHz, VBW = 300 kHz and the span set to 10.0 MHz and the spectrum was scanned from 30 MHz to the 10th harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 MHz and the VBW = 3 MHz and the span to 50 MHz.

Radiation Interference: The test procedure used was ANSI/TIA 603-C: 2004 using an Agilent spectrum receiver with pre-selector. The bandwidth (RBW) of the spectrum receiver was 100 kHz up to 1 GHz and 1 MHz above 1 GHz with an appropriate sweep speed. The VBW above 1 GHz was 3 MHz. The analyzer was calibrated in dB above a micro volt at the output of the antenna.

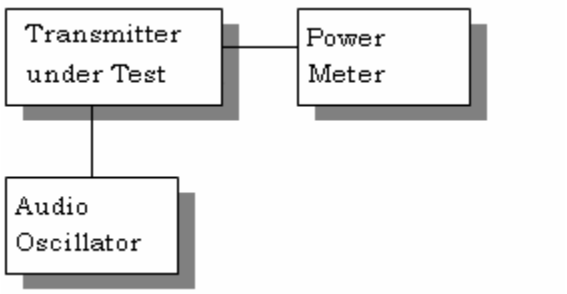
RF POWER OUTPUT

Rule Part No.: FCC Part 2.1046(a)

Test Requirements: FCC Part 2.1046(a)

Method of Measurement: RF power is measured by connecting a 50-ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage and the transmitter properly adjusted the RF output measures:

Test Setup Diagram:



Test Data:

OUTPUT POWER: HIGH – 32.6 dBm = 2 Watts
LOW – 13.7 dBm = 24 mW

Part 2.1033 (C)(8) DC Input into the final amplifier

FOR LOW POWER SETTING INPUT POWER: (7.40V)(1.00A) = 7.40 Watts
FOR HIGH POWER SETTING INPUT POWER: (7.40V)(2.50A) = 18.50 Watts

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: FCC Part 2.1051(a)

Requirements: 25 kHz Channel Spacing =
High power: 43 + 10 log (2.00) = 46.0
Low power: 43 + 10 log

Method of Measurement: The carrier was modulated 100%. The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard ANSI/TIA 603-C: 2004.

Test Data:

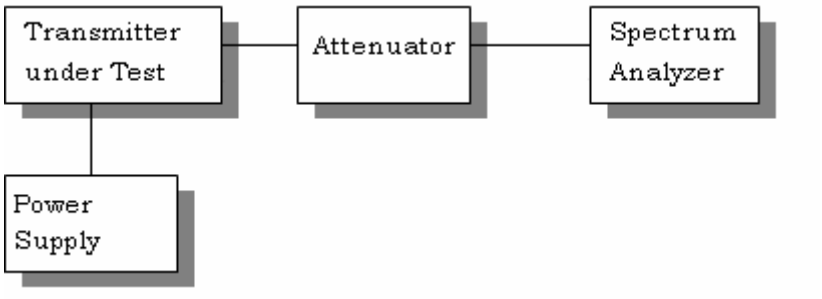
TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
410.00	820.00	81		410.00	820.00	82.47
	1230.00	93.2			1230.00	75.8
	1640.00	92.8			1640.00	74.4
	2050.00	93.4			2050.00	75.2
	2460.00	93.6			2460.00	75.7
	2870.00	93.8			2870.00	75.5
	3280.00	95.3			3280.00	75.2
	3690.00	93.8			3690.00	76.2
	4100.00	94.9			4100.00	75.7

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
440.00	880.00	84.9		440.00	880.00	83.1
	1320.00	92.8			1320.00	75.2
	1760.00	93			1760.00	75.3
	2200.00	93.4			2200.00	74
	2640.00	94.7			2640.00	75.5
	3080.00	94.1			3080.00	74.8
	3520.00	94.2			3520.00	75.2
	3960.00	94.4			3960.00	74.8
	4400.00	94.6			4400.00	76

continued

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
470.00	940.00	83.5		470.00	940.00	82.9
	1410.00	94.9			1410.00	75.7
	1880.00	94.6			1880.00	76.1
	2350.00	92.8			2350.00	74.4
	2820.00	93.5			2820.00	74.9
	3290.00	94.1			3290.00	75.5
	3760.00	95.1			3760.00	74.1
	4230.00	94			4230.00	75.4
	4700.00	93.9			4700.00	75.7

Method of Measuring Conducted Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was ANSI/TIA 603-C: 2004

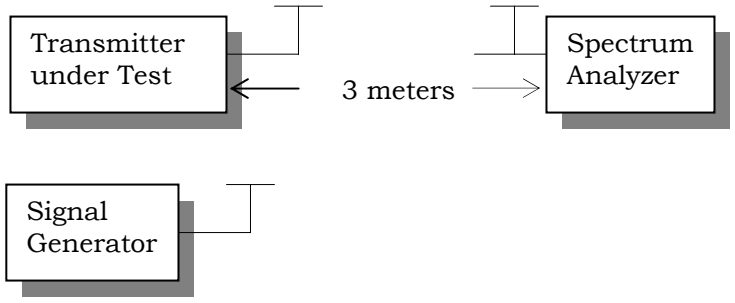
FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: FCC Part 2.1053

Requirements: The FCC limits for radiated emissions are the same as previously stated for the conducted emissions.

METHOD OF MEASUREMENT: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per ANSI/TIA 603-C: 2004 using the substitution method. Measurements were made at one of the test sites of TIMCO ENGINEERING, INC. located at 849 NW State Road 45, Newberry, FL 32669.

Test Setup Diagram:



Test Data:

(TF: 410.0 MHz)

High Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
820.00	V	78.81
1230.00	V	93.7
1640.00	V	95.17
2050.00	V	89.63
2460.00	V	90.69
2870.00	V	92.99
3280.00	V	88.53
3690.00	V	88.43
4100.00	V	87.51

Low Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
820.00	V	81.91
1230.00	V	73.6
1640.00	V	74.67
2050.00	V	70.03
2460.00	V	67.59
2870.00	V	75.09
3280.00	V	71.43
3690.00	V	70.23
4100.00	V	68.51

(TF: 440.0 MHz)

High Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
880.00	V	78.71
1320.00	V	91.7
1760.00	V	90.77
2200.00	V	89.03
2640.00	V	86.89
3080.00	V	86.99
3520.00	V	88.13
3960.00	V	85.73
4400.00	V	85.71

Low Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
880.00	V	81.21
1320.00	V	73.7
1760.00	V	72.77
2200.00	V	71.03
2640.00	V	68.89
3080.00	V	69.59
3520.00	V	69.73
3960.00	V	67.23
4400.00	V	67.61

(TF: 470.0 MHz)

HIGH POWER

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
940.00	V	81.01
1410.00	V	94
1880.00	V	92.17
2350.00	V	93.63
2820.00	V	91.89
3290.00	V	89.49
3760.00	V	89.63
4230.00	V	88.83
4700.00	V	87.61

LOW POWER

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
940.00	V	81.61
1410.00	V	77
1880.00	V	75.37
2350.00	V	75.43
2820.00	V	75.39
3290.00	V	70.89
3760.00	V	70.23
4230.00	V	70.43
4700.00	V	69.31

FREQUENCY STABILITY

Rule Parts. No.: FCC Part 2.1055, Part 90.213

Requirements: Temperature range requirements: -30 to +50° C.
Voltage Variation +, -15%
±1.5 PPM

Method of Measurements: ANSI/TIA 603-C: 2004

Test Data:

Assigned Frequency (Ref. Frequency) (MHz)		440.000062
Temperature (°C)	Frequency (MHz)	Frequency Stability (PPM)
-30	439.999831	-0.52
-20	439.999859	-0.46
-10	439.999883	-0.41
0	439.999978	-0.19
+10	440.000135	0.17
+20	440.000111	0.11
+30	440.000015	-0.11
+40	439.999931	-0.30
+50	439.999954	-0.25

Assigned Frequency (Ref. Frequency) (MHz)		
% Battery (%)	Frequency (MHz)	Frequency Stability (PPM)
-15%	440.000057	-0.01
	440.000062	0.00
+15%	440.000025	-0.08

TRANSIENT FREQUENCY BEHAVIOR

Rule Part No.: FCC Part 2.1055(a)(1), FCC Part 90.214

Requirements: Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time Intervals	Maximum frequency difference	All Equipment	
		150-174 MHz	421-512 MHz

Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels

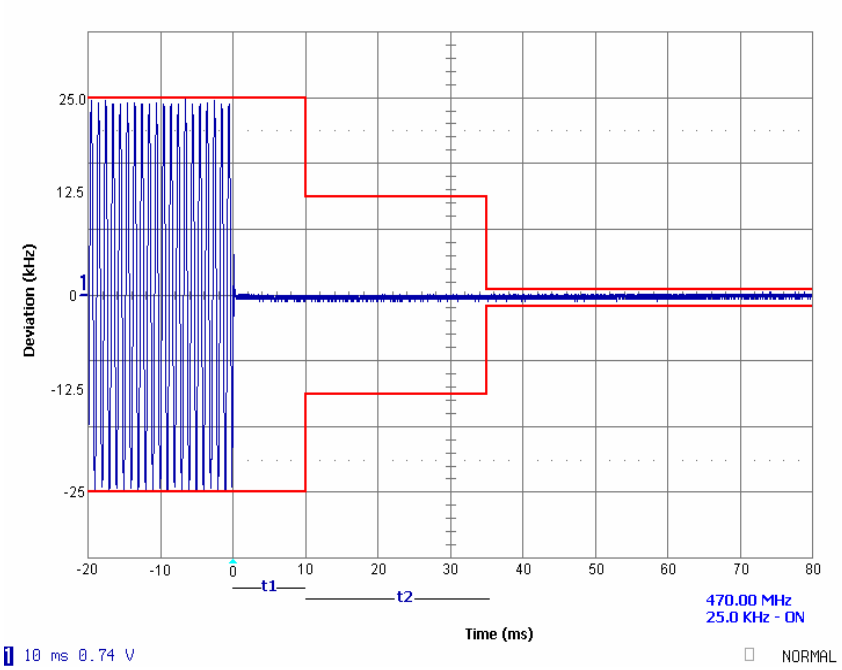
t_1[4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3[4]	±25.0 kHz	5.0 ms	10.0 ms

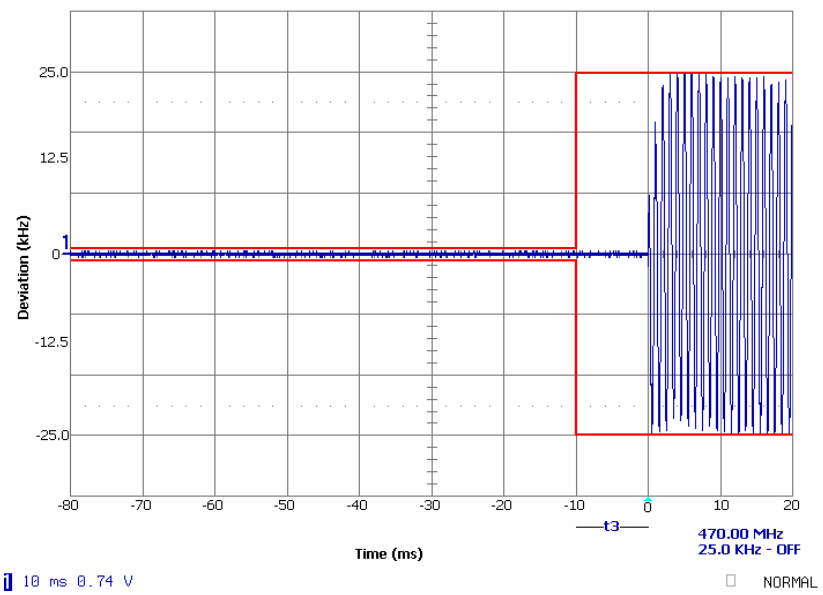
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels

t_1[4]	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3[4]	±12.5 kHz	5.0 ms	10.0 ms

Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels

t_1[4]	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3[4]	±6.25 kHz	5.0 ms	10.0 ms


25.0
12.5
0
-12.5
-25
Deviation (kHz)
1
-20
-10
0
10
20
30
40
50
60
70
80
t1
t2
Time (ms)
470.00 MHz
25.0 KHz - ON
10 ms 0.74 V
NORMAL

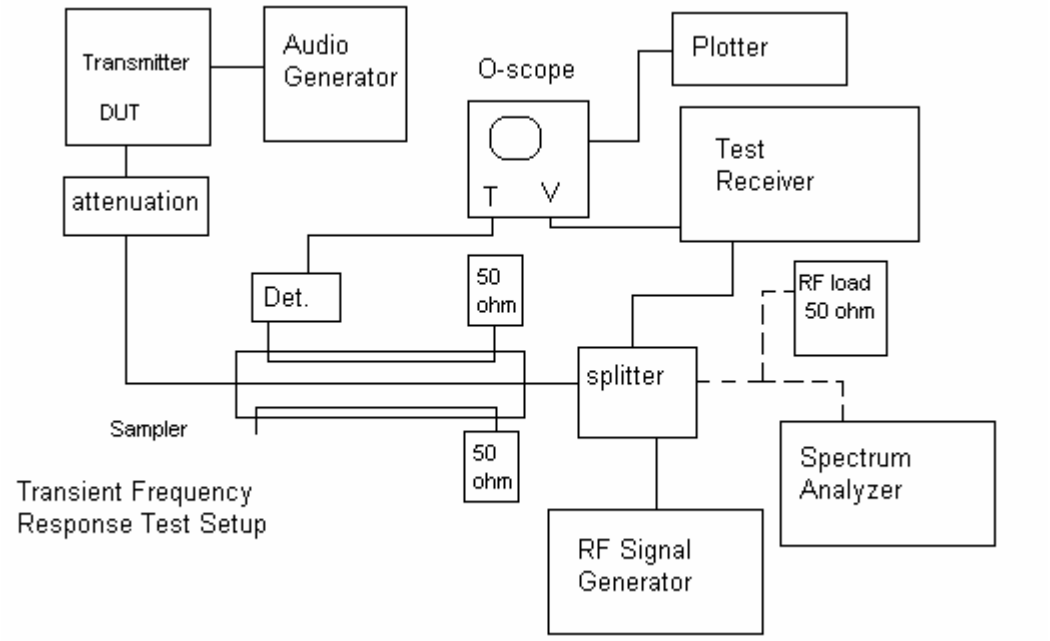

25.0
12.5
0
-12.5
-25.0
Deviation (kHz)
1
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
t3
Time (ms)
470.00 MHz
25.0 KHz - OFF
10 ms 0.74 V
NORMAL

TEST PROCEDURE: ANSI/TIA 603-C: 2004 PARA 2.2.19

1. Using the variable attenuator the transmitter level was set to 40 dB below the test receivers maximum input level, and then the transmitter was turned off.

2. With the transmitter off the signal generator was set 20dB below the level of the transmitter in the above step, this level will be maintained with the signal generator through-out the test.

3. Reduce the attenuation between the transmitter and the RF detector by 30 dB. With the levels set as above the transient frequency behavior was observed & recorded.



Transient Frequency Response Test Setup

MODULATION CHARACTERISTICS

Rule Part No.: FCC Pt 2.1033(c) (4), FCC Part 90.209, FCC Pt 90.207

Test Requirements: FCC Pt 2.1033(c) (4), FCC Part 90.209, FCC Pt 90.207

Type of Emission: 20K0Q1E, 20K0Q1D, 20K0Q1W, 20K0D1E, 20K0D1D, 20K0D1W

The modulation used is π/4-shifted Differential Quaternary Phase Shift Keying (π/4-DQPSK), with a modulation rate of 18k symbol/sec. (36k bit/sec).

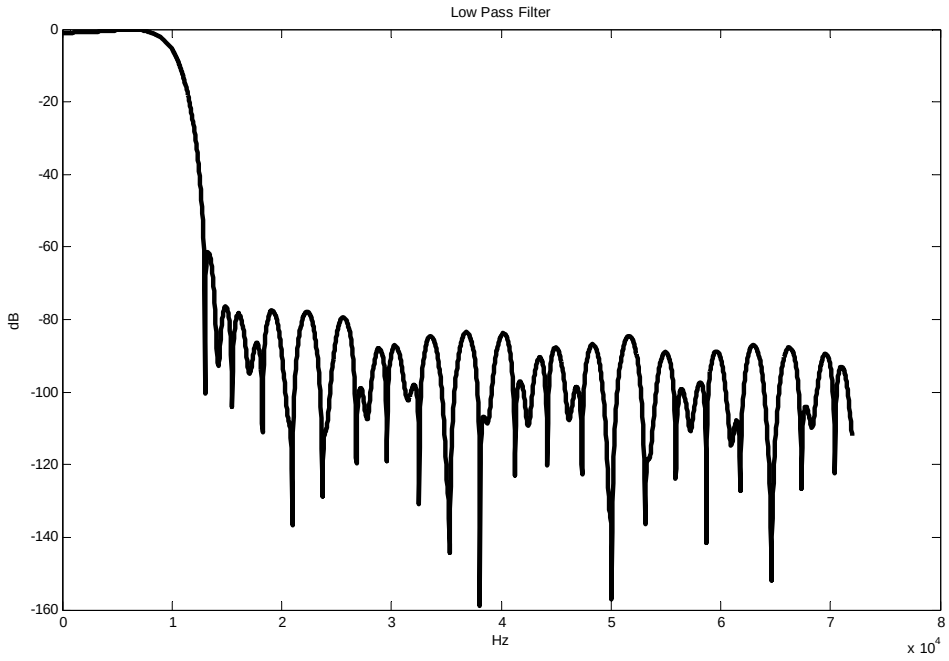
A root-raised-cosine filter (RRC) is used as transmitting and receiving filter in this digital communication system to perform matched filtering.
The combined response of two such filters is that of the raised-cosine filter.
The raised-cosine filter is a filter frequently used for pulse-shaping in digital modulation known for its ability to minimize intersymbol interference (ISI).

The main parameter of the RRC filter, at a given symbol rate, is the roll-off factor (α), which determines the width of the transmission band.
The roll-off factor (α) used is 0.2.

The access scheme is TDMA with 4 physical channels per carrier.

The following graph is the transfer function of the aforementioned filter.

(Plot provided by manufacturer).



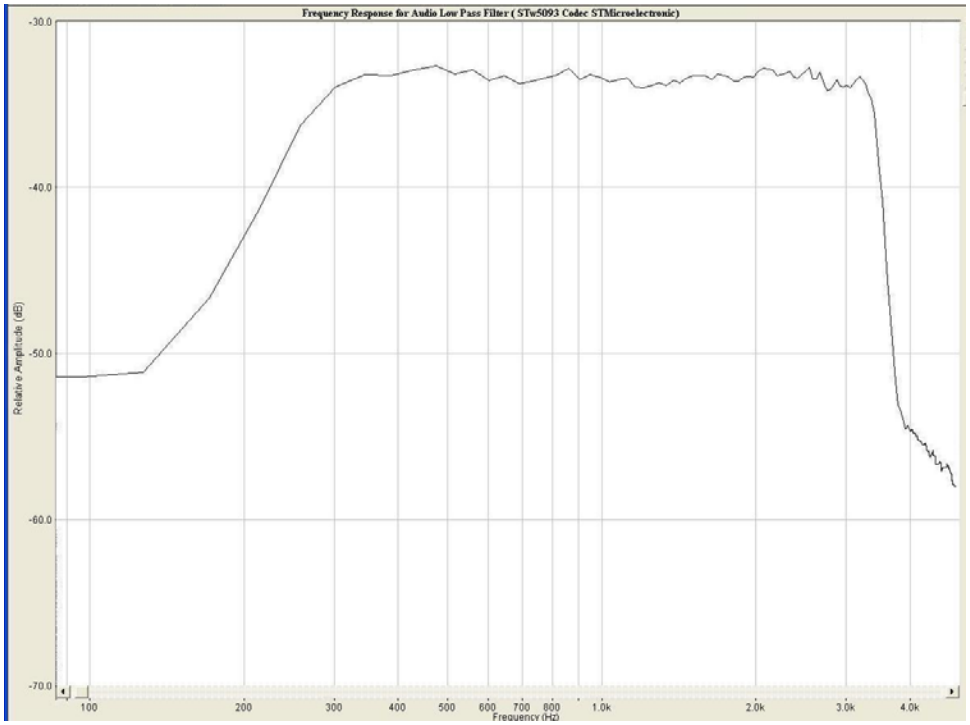
AUDIO LOW PASS FILTER

VOICE MODULATED COMMUNICATION EQUIPMENT

Part 2.1047(a) Voice modulated communication equipment: For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all the circuitry installed between the modulation limiter and the modulated stage shall be submitted

The modulation is limited by data characteristics and its filters.
In the previous section, the phase and quadrature branches (I and Q) are filtered with a root-raised-cosine filter (RRC) with a symbol rate of 18k symbol/sec. and a 0.2 roll-off factor. After that, the signal is π/4 DQPSK modulated (see the plot in the previous section).

Audio processing is carried out using a STMicroelectronics STw5093 codec that contains the following low pass filter, which is applied to the audio before generating the data.



OCCUPIED BANDWIDTH

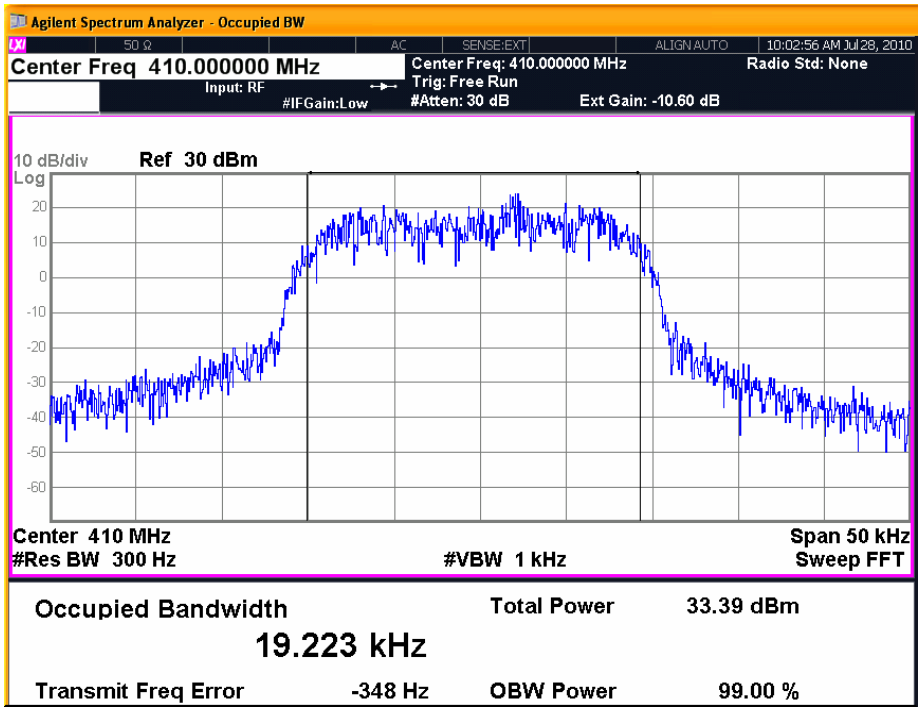
Occupied bandwidth measurement according to FCC CFR 47 Part 90.209

Test Equipment Used
EXA Signal Analyzer N9010A Agilent Technologies S/N : MY49060208
Attenuator (10dB / 50W) Model : 50-A-MFN-10 Bird

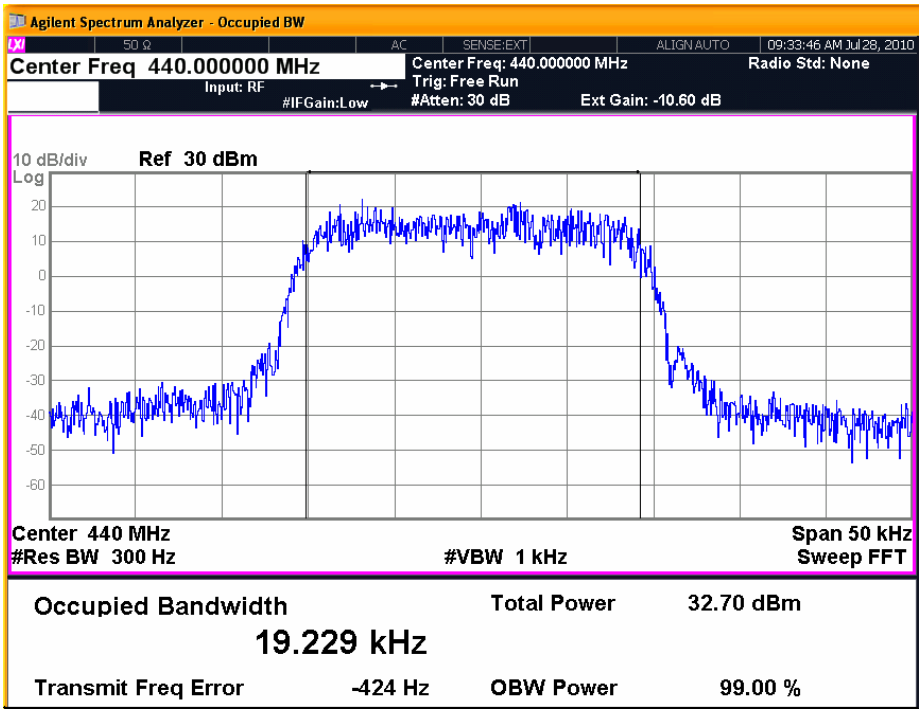
Test Results

Frequency (MHz)	Occupied Bandwidth (99%)
410.0	19.223 kHz
440.0	19.229 kHz
470.0	19.108 kHz

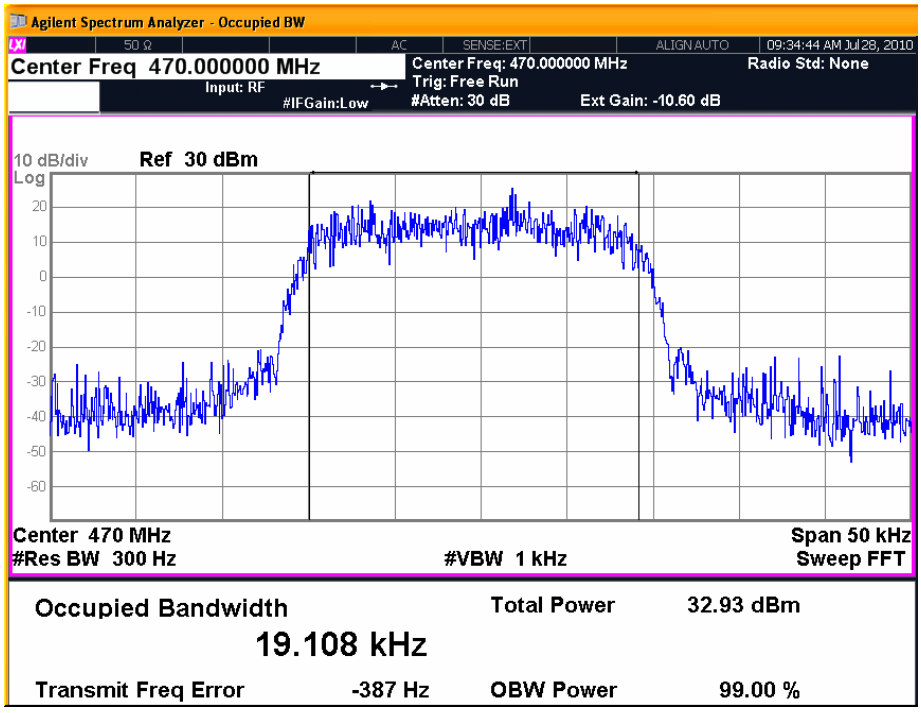
410.0 MHz



440.0 MHz



470.0 MHz



Rule Part No.: FCC Part 2.1049(c)

Requirements:

FCC Part 90.210(b) 25 kHz Channel Spacing – Emission Masks

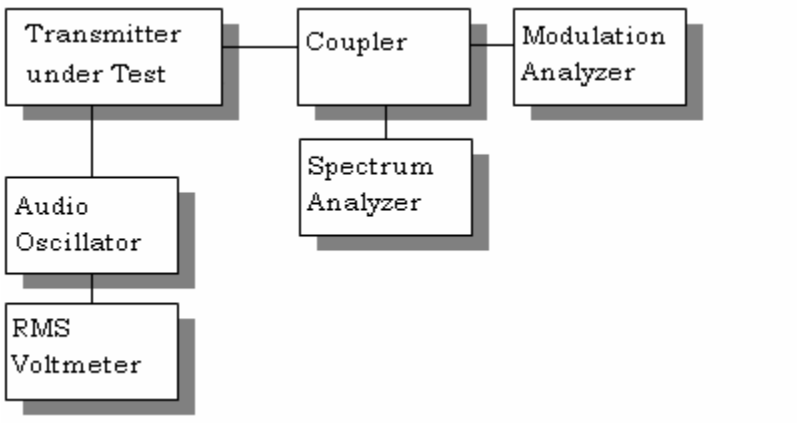
Data in the plots show that on any frequency removed from the assigned frequency by more than 50%, but not more than 100%: At least 25 dB. On any frequency removed from the assigned frequency by more than 100%, but not more than 250%: At least 35 dB. On any frequency removed from the assigned frequency by more than 250%, of the authorized bandwidth: At least 43 + 10log(P)dB.

OCCUPIED BANDWIDTH MEASUREMENT

Test procedure: ANSI/TIA-603-C: 2004 para 2.2.11.

Test Setup Diagram:

OCCUPIED BANDWIDTH MEASUREMENT



Test Data: See the plots below

NOTES:

FCC 90.210 Mask B