
RELM WIRELESS CORP. – BK RADIO
7100 TECHNOLOGY DRIVE
WEST MELBOURNE, FL 32903

FCC PART 90

TEST REPORT

APPLICANT	RELM WIRELESS CORP. – BK RADIO
	7100 TECHNOLOGY DRIVE
	WEST MELBOURNE FLORIDA 32094 USA
FCC ID	K95KNGM400
MODEL NUMBER	KNG-M400
PRODUCT DESCRIPTION	MOBILE UHF RADIO
DATE TESTED	10/22/10
TESTED BY	Ryan Challacomb
TIMCO REPORT NO.	K95KNGM400-Report.doc
TEST RESULTS	☒ PASS ☐ FAIL

**THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL
WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.**

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Applicant: RELM WIRELESS CORP. – BK RADIO

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GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Relm Wireless Corp. – BK Radio.

Summary

The device under test does:

- ☒ fulfill the general approval requirements as identified in this test report
☐ not fulfill the general approval requirements as identified in this test report

Attestations

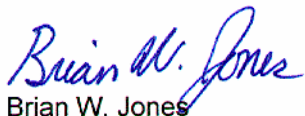
This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

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

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

Relm Wireless Corp. – BK Radio
7100 Technology Drive
West Melbourne, FL 32904

Authorized Signatory Name:



Brian W. Jones

Date: 11/30/10

Tested by: Ryan Challacomb

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GENERAL INFORMATION

DUT Specification

DUT Description	MOBILE UHF RADIO
FCC ID	K95KNGM400
Model Number	KNG-M400
Operating Frequency	380-470MHz
Type of Emission	16K0F3E/11K0F3E/8K10F1E/8K10F1D
Modulation	FM
DUT Power Source	☐ 110-120Vac/50- 60Hz
	☒ DC Power 13.4V
	☐ Battery Operated Exclusively
Test Item	☐ Prototype
	☒ Pre-Production
	☐ Production
Type of Equipment	☐ Fixed
	☒ Mobile
	☐ Portable
Test Conditions	The temperature was 26°C with a relative humidity of 50%.
Modification to the DUT	None
Test Exercise	The DUT was placed in continuous transmit mode.
Applicable Standards	ANSI/TIA 603-C:2004, FCC CFR 47 Part 90
Test Facility	Relm Wireless Corp. – BK Radio

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EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Power Meter	Rohde & Schwarz	NRT	102870	01/11/10	01/11/12
Power Sensor	Rohde & Schwarz	NRT-Z14	100100	01/11/10	01/11/12
DC Power Supply	Hewlett Packard	6032A	US38322063	08/17/10	08/17/11
RF Communication Test Set	Hewlett Packard	8920B	US35320620	03/19/10	03/19/11
Dynamic Signal Analyzer	Hewlett Packard	35670A	MY42506203	03/19/10	03/19/11
Spectrum Analyzer	Tektronix	3308A	J300156	10/08/10	10/08/11
Oscilloscope	Tektronix	MSO4104	C001715	01/11/08	01/11/11
Signal Generator	Rohde & Schwarz	SMB100A	100200	09/03/08	09/03/11

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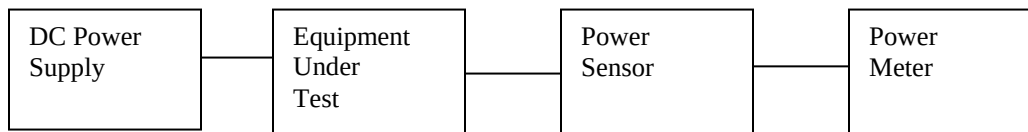
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TEST PROCEDURES

1. RF Output Power

Test Method: TIA/EIA-603-A 2.2.1

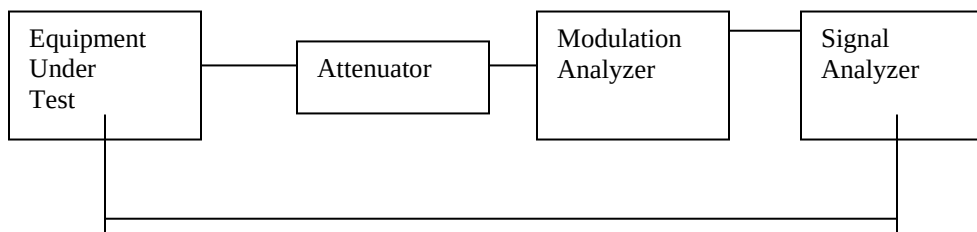
Equipment Used: Rohde & Schwarz NRT Power Meter (01-11-12), Rohde & Schwarz NRT-Z14 Power Sensor (01-11-12), Hewlett-Packard 6032A DC Power Supply (08-17-11)



2. Audio Frequency Response

Test Method: TIA/EIA-603-A 2.2.6

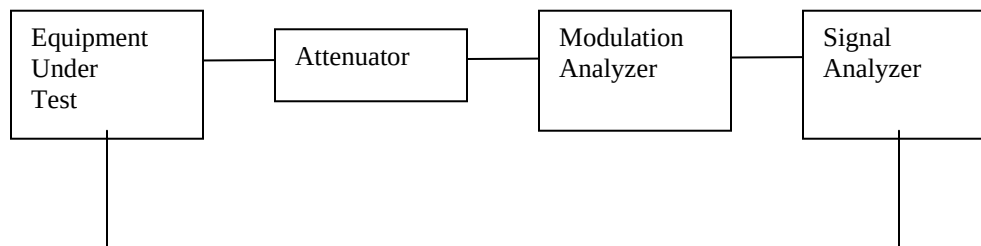
Equipment Used: Hewlett Packard 8920B RF Communication Test Set Modulation Analyzer (03-19-11), Hewlett Packard 35670A Signal Analyzer (03-19-11). No filters were used on the modulation analyzer.



3. Low Pass Filter Response

Test Method: TIA/EIA-603-A 2.2.15

Equipment Used: Hewlett Packard 8920B RF Communication Test Set Modulation Analyzer (03-19-11), Hewlett Packard 35670A Signal Analyzer (03-19-11). No filters were used on the modulation analyzer.



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4. **Occupied Bandwidth /Emission Mask**

No Modulation

16K0F3E

11K0F3E

8K10F1E

8K10F1D

Test Method: TIA/EIA-603-A 2.2.11

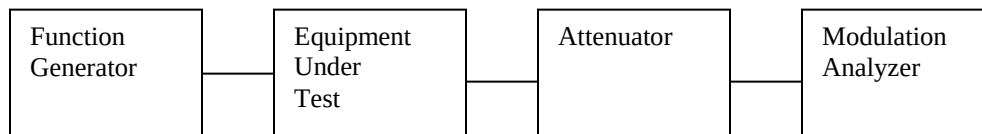
Equipment Used: Tektronix RSA 3308A Real-time Spectrum Analyzer (10-08-11)



5. **Modulation Limiting**

Test Method: TIA/EIA-603-A 2.2.3

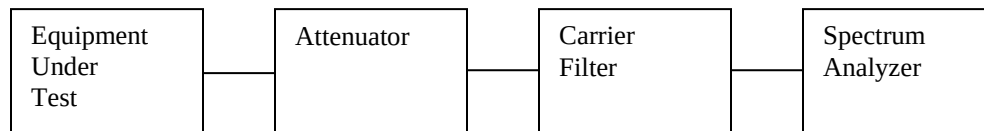
Equipment Used: Hewlett Packard 8920B RF Communication Test Set Modulation Analyzer (03-19-11)



6. **Conducted Spurious Emissions**

Test Method: TIA/EIA-603-A 2.2.13

Equipment Used: Tektronix RSA 3308A Real-time Spectrum Analyzer (10-08-11)



Applicant: RELM WIRELESS CORP. – BK RADIO

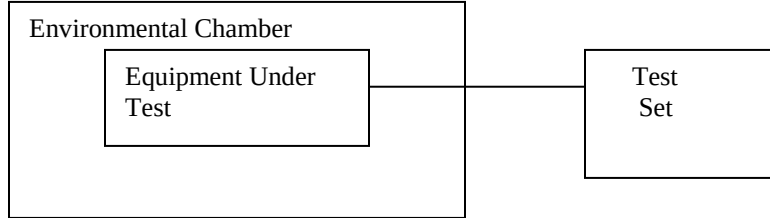
FCC ID: K95KNGM400

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7. Frequency Stability

Test Method: TIA/EIA-603-A 2.2.2

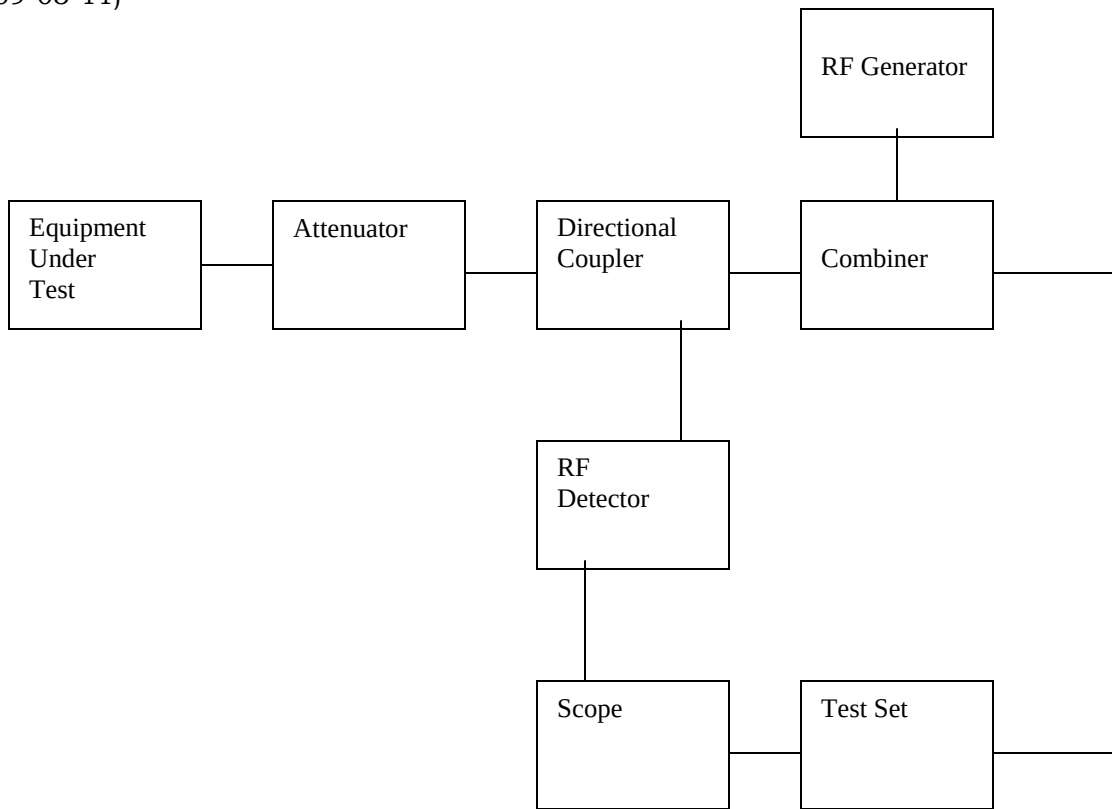
Equipment Used: Hewlett Packard 8920B RF Communication Test Set (03-19-11)



8. Transient Frequency Behavior

Test Method: TIA/EIA-603-A 2.2.19.3

Equipment Used: Hewlett Packard 8920B RF Communication Test Set (03-19-11), Tektronix MSO4104 Scope (01-11-11), Rohde & Schwarz SMB100A Signal generator (09-03-11)



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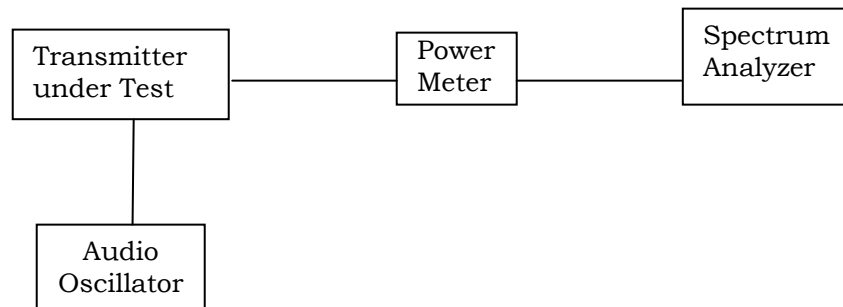
RF POWER OUTPUT

Rule Part No.: Part 2.1046(a), Part 90

Test Requirements:

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 – 60.5 Watts

Frequency (MHz)	Power (Watts)	Voltage (Volts)	Current (PA Device) (Amperes)
410	60.5	13.4	8.3
440	60.3	13.4	10.1
470	61.1	13.4	12.2

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

FOR HIGH POWER SETTING INPUT POWER: $(13.4V)(8.3A) = 115.24\text{Watts}$

Frequency (MHz)	Power (Watts)	Voltage (Volts)	Current (PA Device) (Amperes)	DC Input Power (Watts)
410	60.5	13.4	8.3	115.24
440	60.3	13.4	10.1	135.34
470	61.1	13.4	12.2	163.48

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MODULATION CHARACTERISTICS

Rule Part No.: Part 2.1047(a)(b)

Test Requirements:

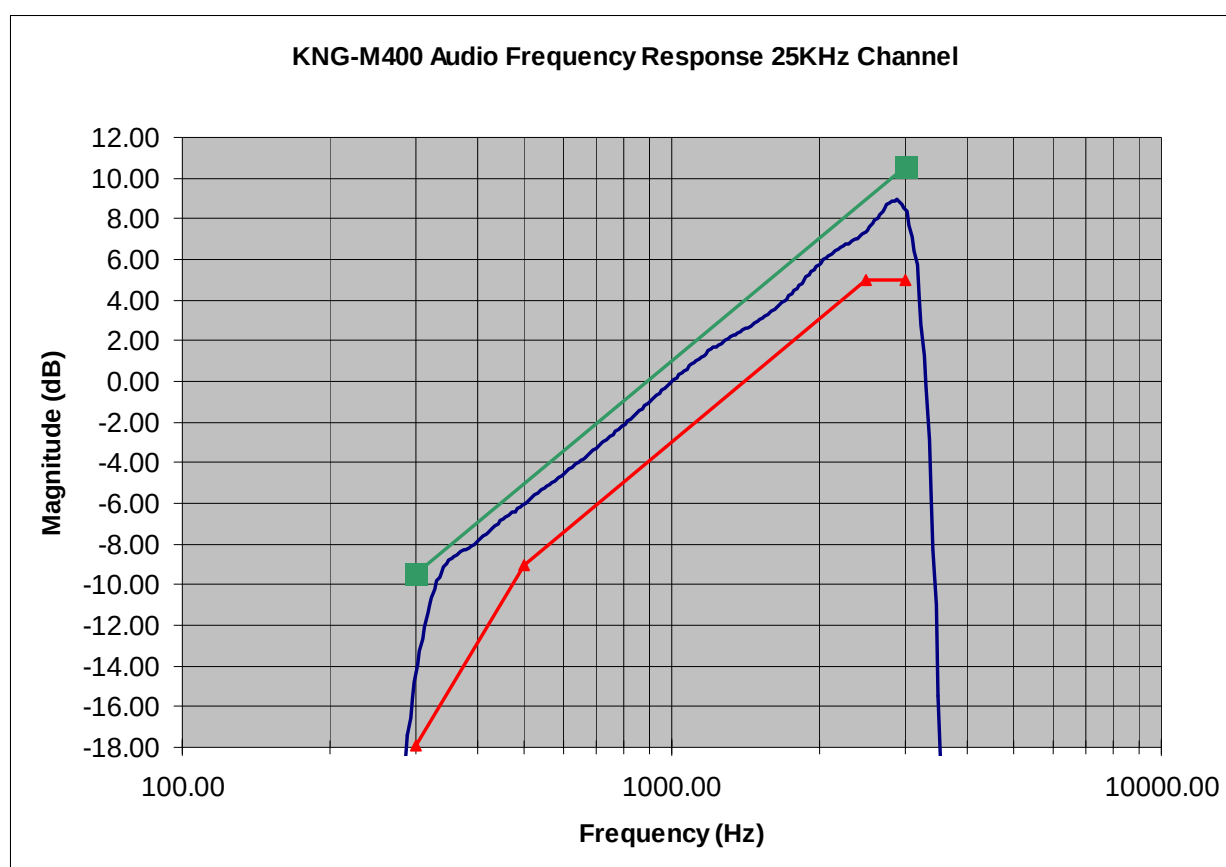
Method of Measurement:

Audio frequency response

The audio frequency response was measured in accordance with TIA/EIA Specification 603 with no exception. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 – 5000Hz shall be submitted. The audio frequency response curve is shown below.

AUDIO FREQUENCY RESPONSE PLOT

25KHz TX Audio Response 425MHz

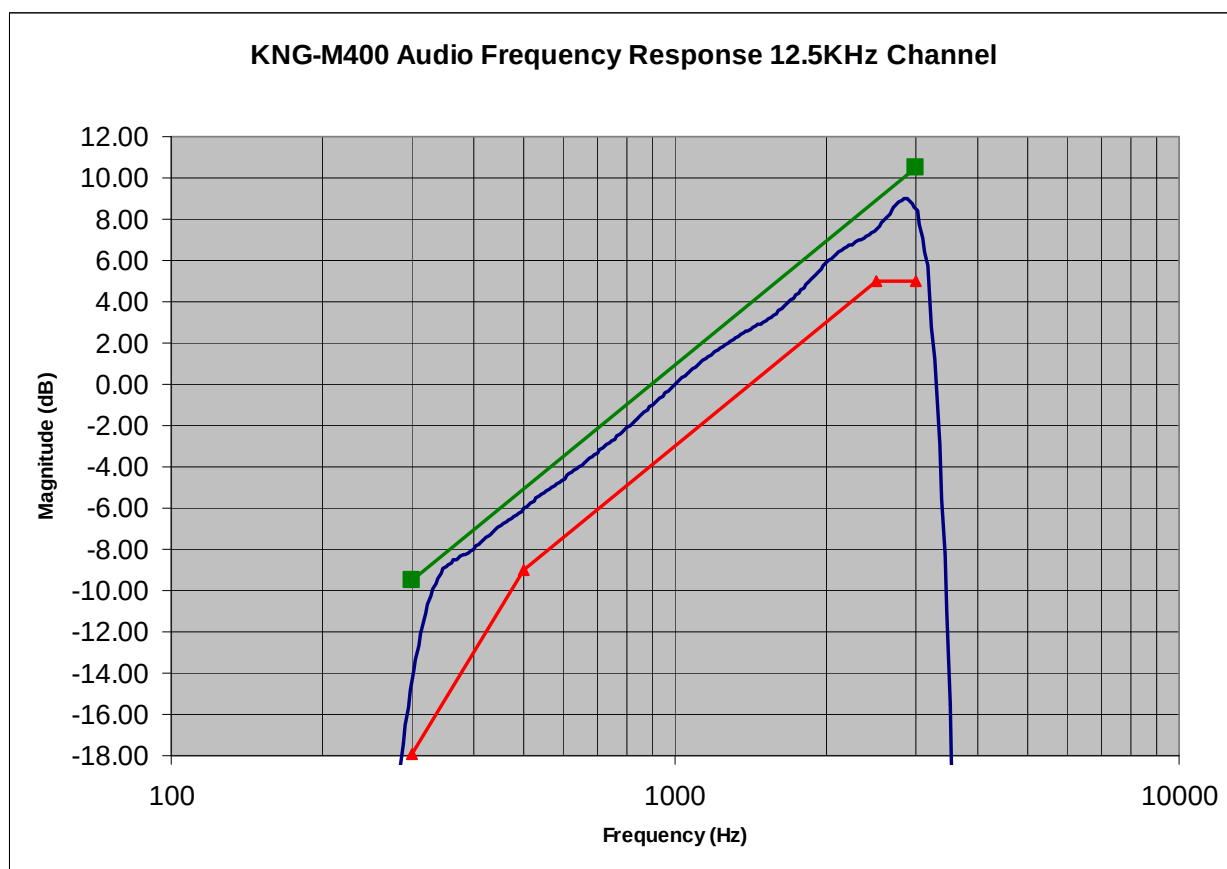


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12.5KHz TX Audio Response 425MHz



Applicant: RELM WIRELESS CORP. – BK RADIO

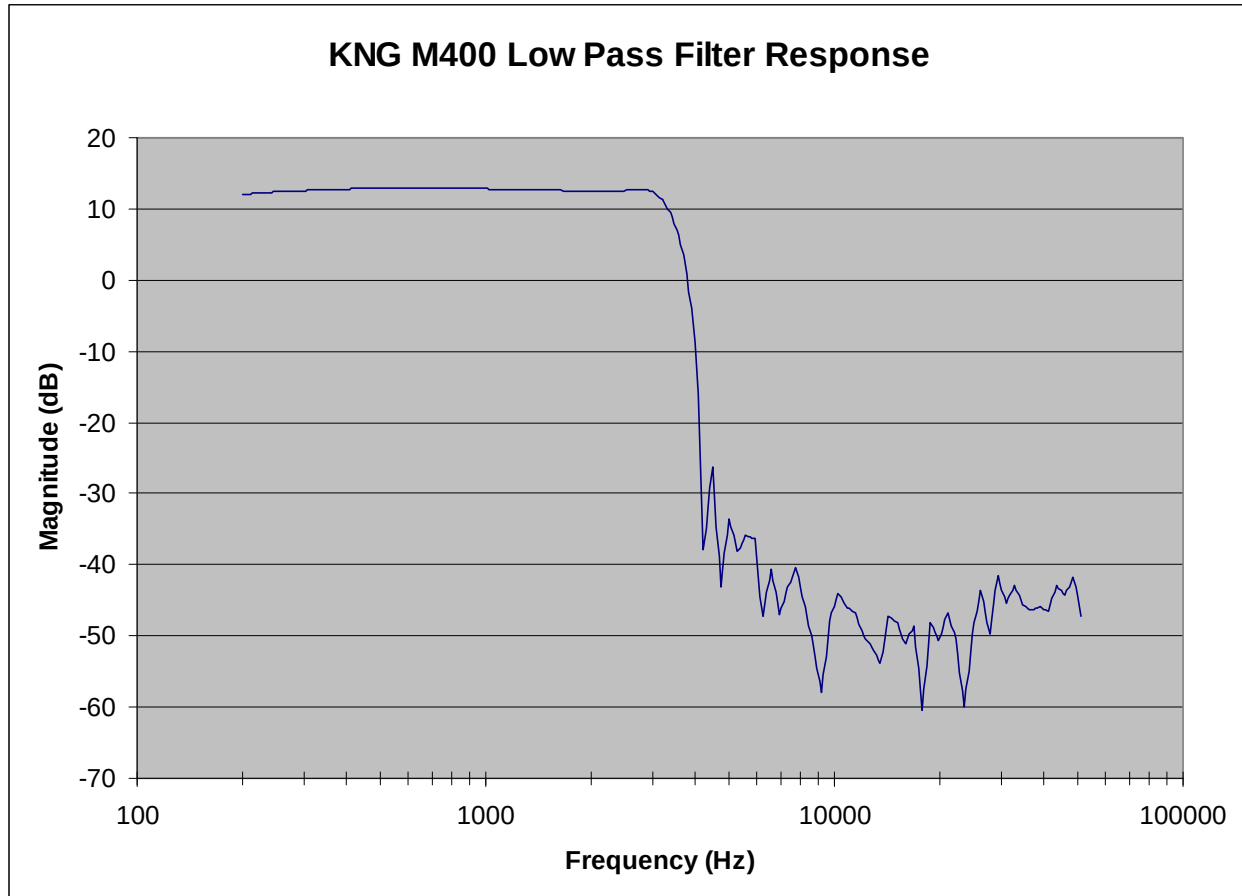
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VOICE MODULATED COMMUNICATION EQUIPMENT

Part 2.1047(a): 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.

AUDIO LOW PASS FILTER.



Applicant: RELM WIRELESS CORP. – BK RADIO

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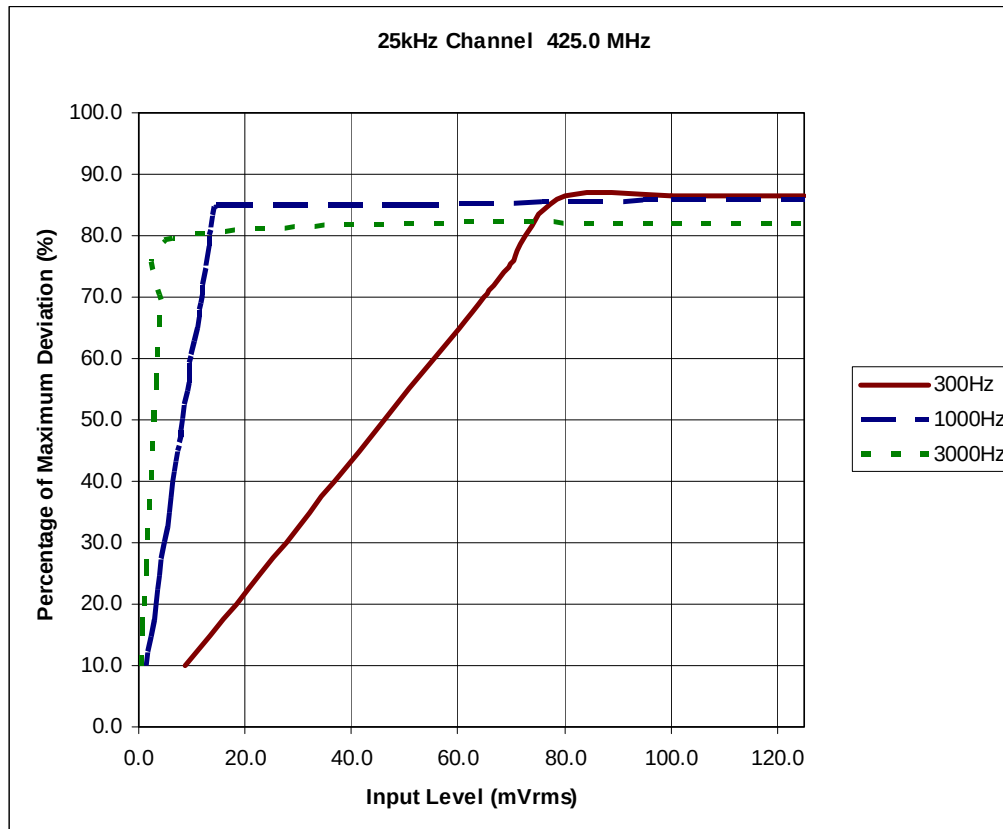
AUDIO INPUT VERSUS MODULATION

Rule Part No.: Part 2.1047(b) & 90

Test Requirements:

Method of Measurement: **Modulation cannot exceed 100%,** The audio input level needed for a particular percentage of modulation was measured in accordance with ANSI/TIA 603-C: 2004. The audio input curves versus modulation are shown below. Curves are provided for audio input frequencies of 300, 1000, and 3000 Hz.

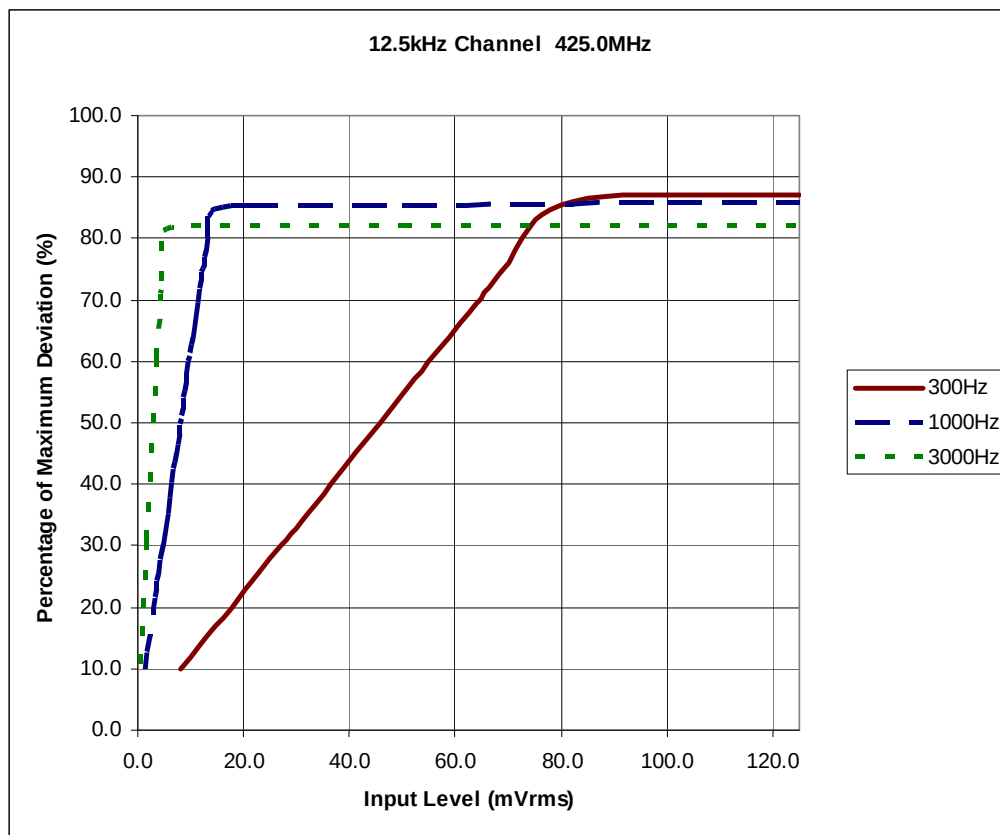
Test data:



Applicant: RELM WIRELESS CORP. – BK RADIO

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OTHER MODULATION CHARACTERISTICS – BANDWIDTH CALCULATIONS

Part 2.1033(c)

Part 2.1033(c) (4) Type of Emission: 16K0F3E

Part 90.209

Part 90.207 $BW=2*(M+D) = 2*(3KHZ+5KHZ)=16KHZ \rightarrow 16K0$

F3E indicates voice.

Designator is therefore: 16K0F3E

Part 2.1033(c)

Part 2.1033(c) (4) Type of Emission: 11K0F3E

Part 90.209

Part 90.207 $BW=2*(M+D)=2*(3KHZ+2.5KHZ)=11KHZ \rightarrow 11K0$

F3E indicates voice.

Designator is therefore: 11K0F3E

Part 2.1033(c)

Part 2.1033(c) (4) Type of Emission: 8K10F1D

Part 90.209

Part 90.207 $BW=8.1KHZ$ from using 99% energy bandwidth

F1D indicates digital data.

Designator is therefore: 8K10F1D

Part 2.1033(c)

Part 2.1033(c) (4) Type of Emission: 8K10F1E

Part 90.209

Part 90.207 $BW=8.1KHZ$ from using 99% energy bandwidth

F1E indicates digital voice.

Designator is therefore: 8K10F1E

Applicant: RELM WIRELESS CORP. – BK RADIO

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OCCUPIED BANDWIDTH

Part 2.1049(c) EMISSION BANDWIDTH:

Part 90.210(b) 25kHz Channel Spacing

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 25dB. 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 $43 + 10\log(P)$ dB.

Part 90.210(c) 12.5kHz Channel Spacing Not Equipped with a Low Pass Filter

For transmitters that are not equipped with an audio low pass filter pursuant to S90.211 (b), the power of any emission must be attenuated below the un-modulated carrier output power as follows; (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5 kHz but not more than 10 kHz: At least $83 \log(f_d/5)$ dB; (2) ON any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 10 kHz, but not more than 250% of the authorized bandwidth: At least $29 \log(f_d/11)$ dB or 50 dB, whichever is the lesser attenuation; (3) On any frequency removed from the center of the authorized bandwidth by more than 250% of the authorized bandwidth: At least $43 + 10 \log(P_o)$ dB.

Part 90.210(d) **Emission Mask D - 12.5 kHz channel BW equipment.**

For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (2) On any frequency from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27 (f_d - 2.88 \text{ kHz})$ dB.
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10\log(P)$ dB or 70 dB, whichever is the lesser attenuation.

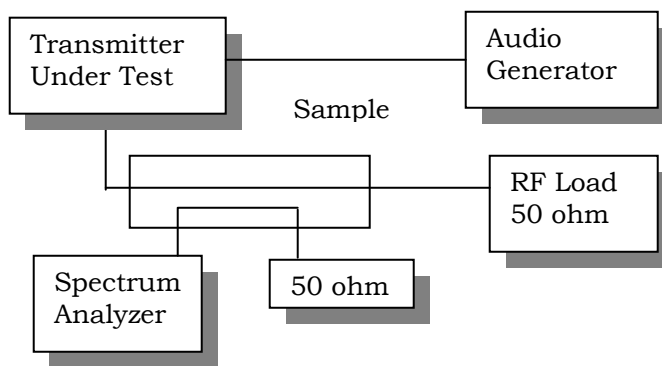
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FCC ID: K95KNGM400

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

Test Setup Diagram:



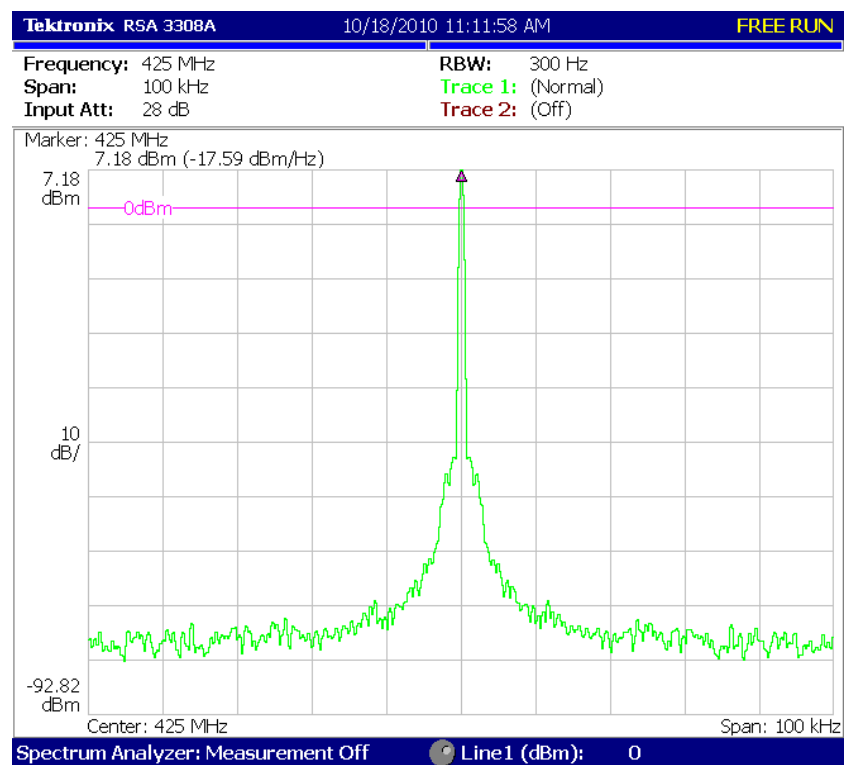
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FCC ID: K95KNGM400

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OCCUPIED BANDWIDTH PLOTS

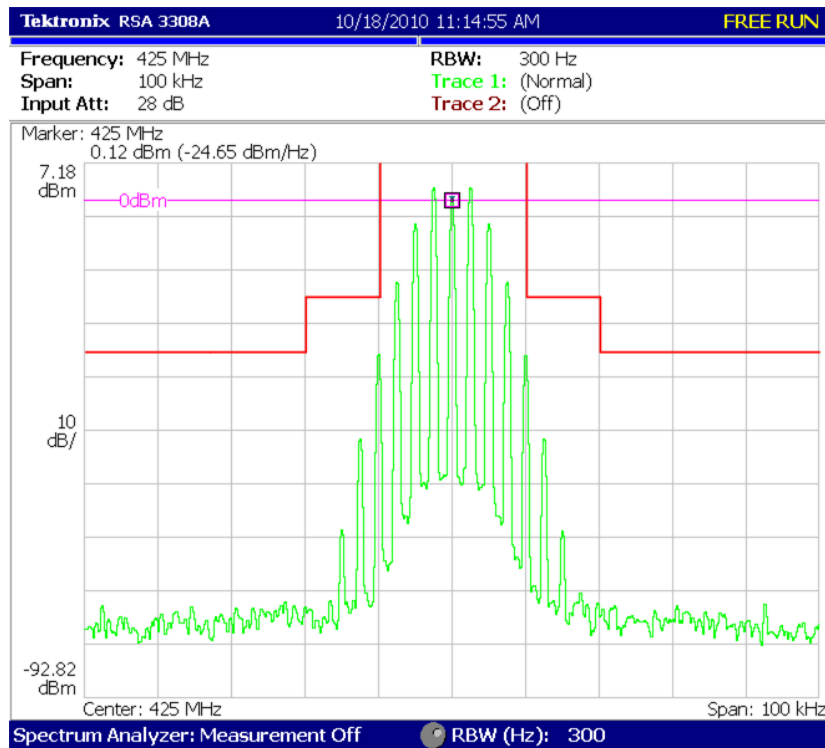
Occupied Bandwidth No Modulation



Applicant: RELM WIRELESS CORP. – BK RADIO

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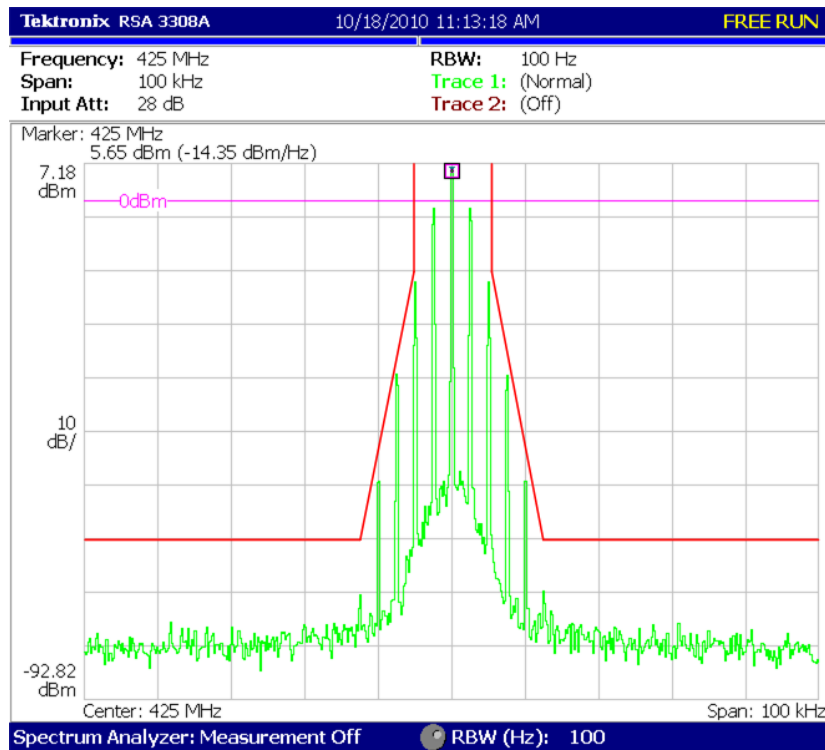
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Part 90.210(b)**Emission Mask B - 25 kHz channel****Analog Voice 16K0F3E**

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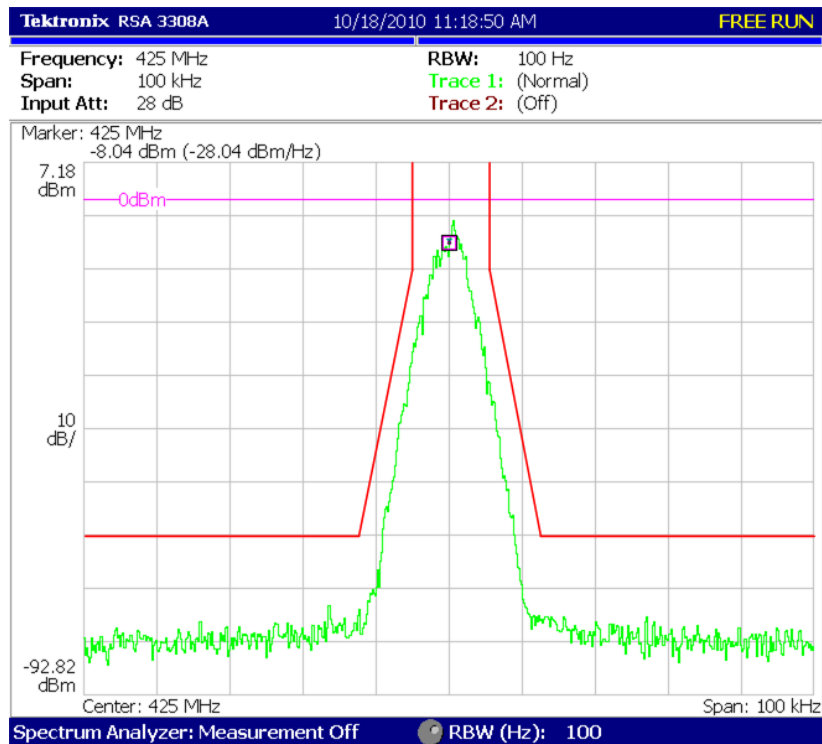
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Part 90.210(d)**Emission Mask D - 12.5 kHz channel****Analog Voice 11K0F3E**

Applicant: RELM WIRELESS CORP. – BK RADIO

FCC ID: K95KNGM400

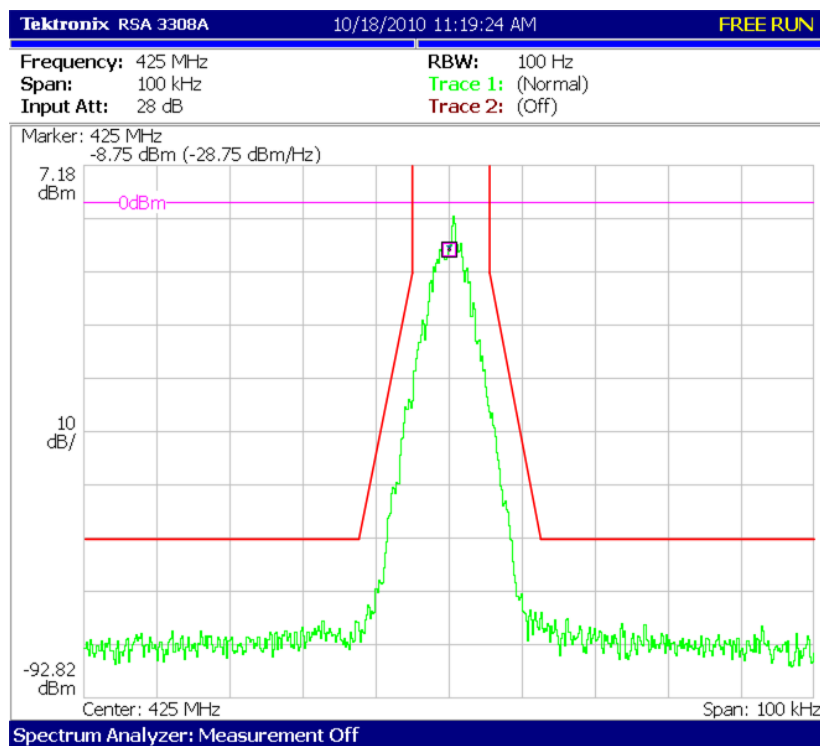
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Part 90.210(d) Emission Mask D - 12.5 kHz channel**Digital Voice 8K10F1E**

Applicant: RELM WIRELESS CORP. – BK RADIO

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Part 90.210(d) Emission Mask D - 12.5 kHz channel**Digital Data 8K10F1D**

Applicant: RELM WIRELESS CORP. – BK RADIO

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051(a)

Requirements: 25kHz Channel Spacing = $43 + 10\log(60) = 60.78$ dBc
12.5kHz Channel Spacing = $50 + 10\log(60) = 67.78$ dBc

Method of Measurement: The carrier was modulated 100% using a 2500 Hz tone. 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:

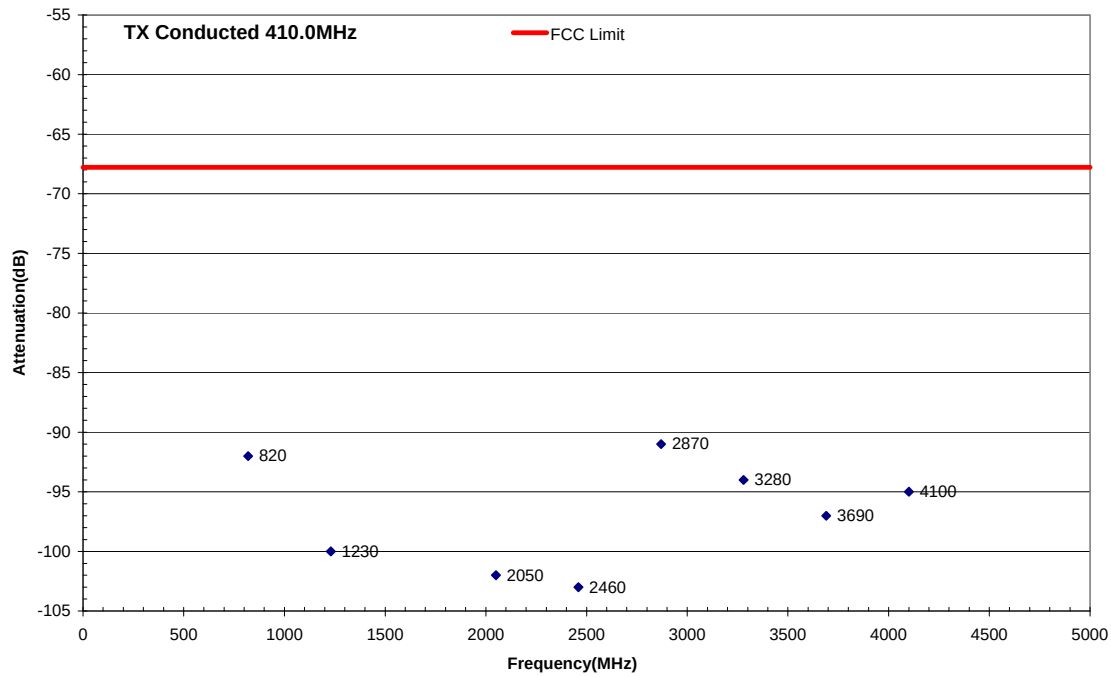
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Transmit conducted 410MHz

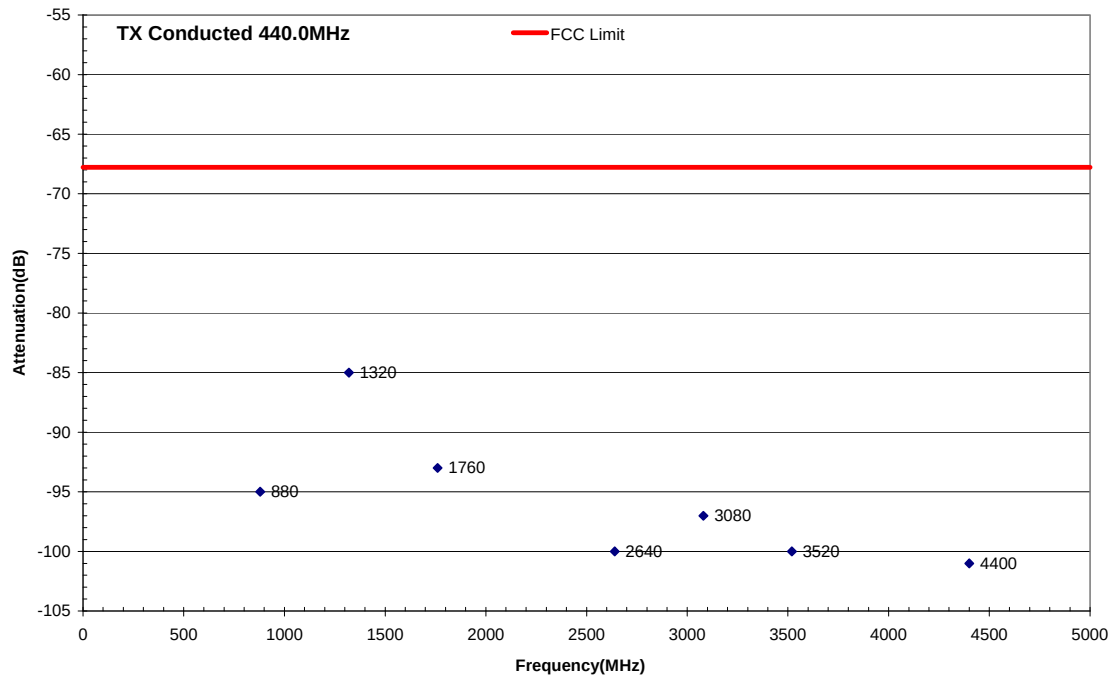


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Transmit conducted 440MHz

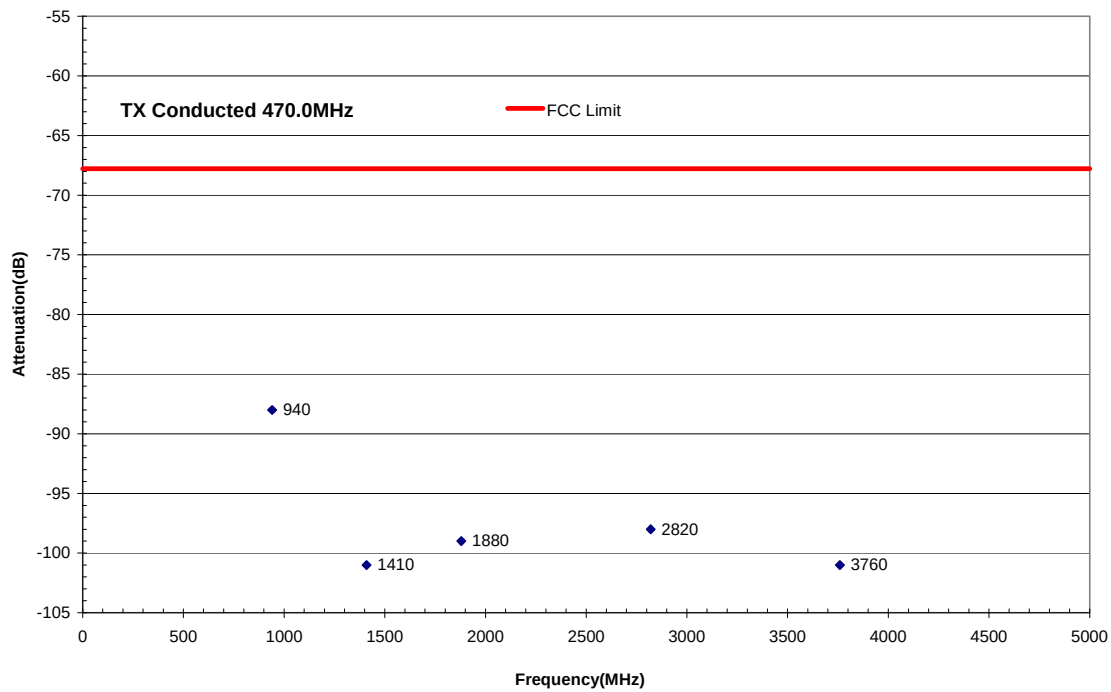


Applicant: RELM WIRELESS CORP. – BK RADIO

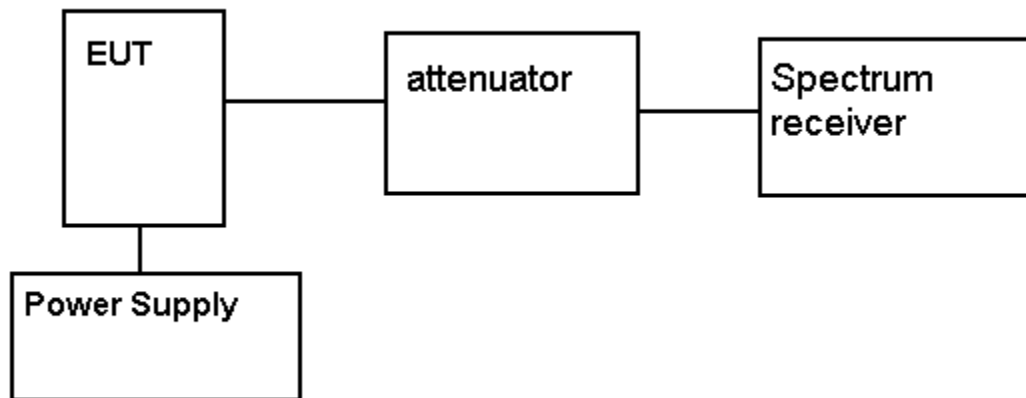
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Transmit conducted 470MHz



Method of Measuring Conducted Spurious Emissions



Applicant: RELM WIRELESS CORP. – BK RADIO

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FREQUENCY STABILITY

Rule Parts. No.: Part 2.1055, Part 90.213

Requirements: Temperature range requirements: -30 to +50° C.
Voltage Variation +, -15%
±2.5 PPM

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

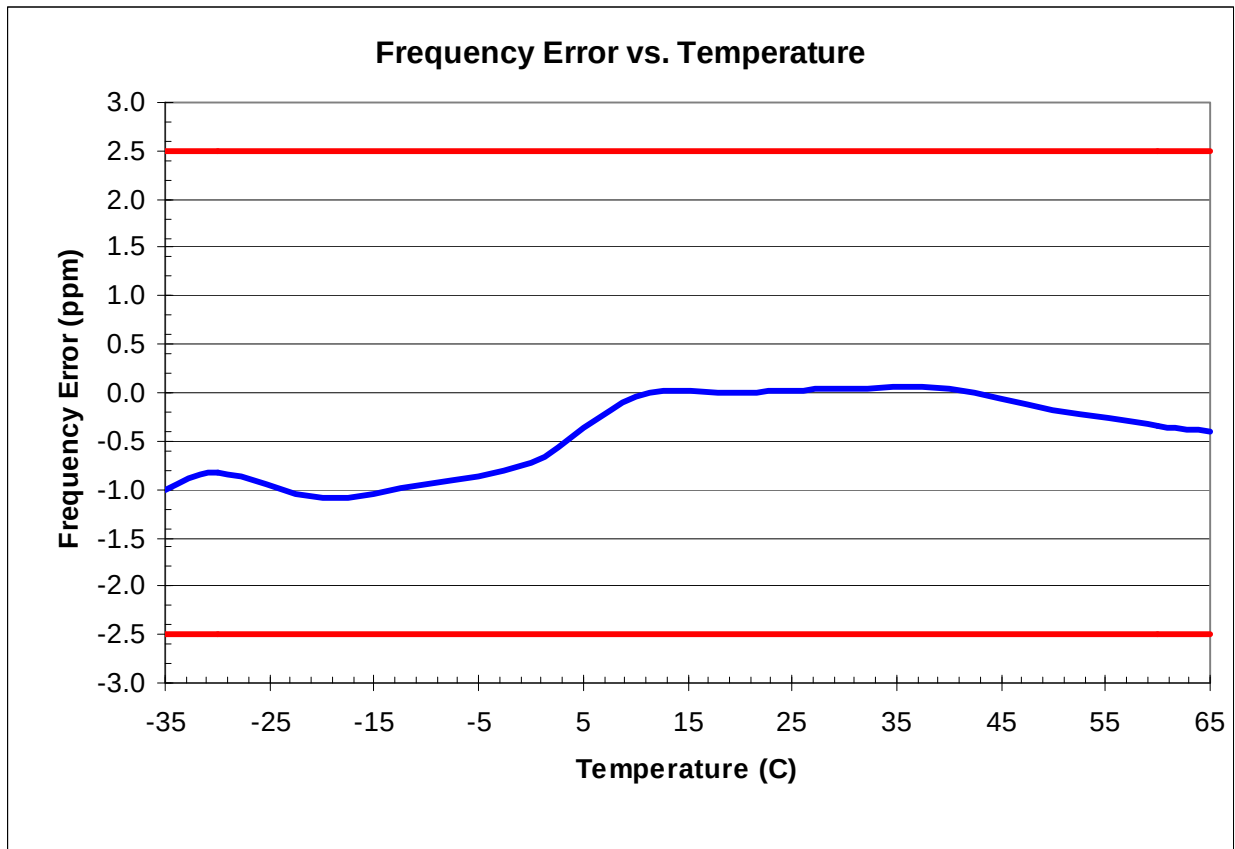
Test Data:

Assigned Frequency (Ref. Frequency) (MHz)		425
Temperature (°C)	Frequency (MHz)	Frequency Stability (PPM)
-30	424.999653	-0.816
-20	424.999540	-1.082
-10	424.999601	-0.939
0	424.999690	-0.729
+10	424.999983	-0.040
+20	425.000004	0.009
+30	425.000020	0.047
+40	425.000017	0.040
+50	424.999921	-0.186

Applicant: RELM WIRELESS CORP. – BK RADIO

FCC ID: K95KNGM400

Report: Y:\Active_Projects\Next Generation Radios\NexGen Mobiles\KNG-M400\FCC\Files
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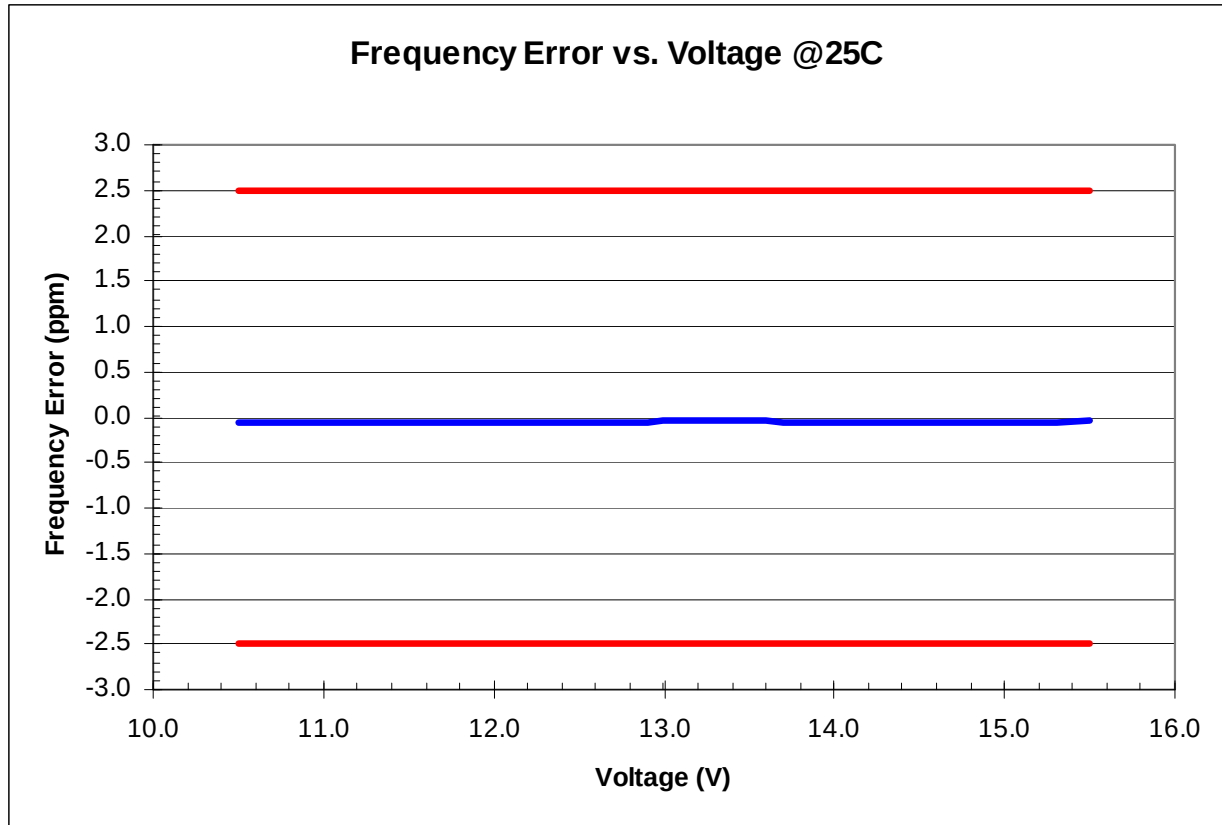


Assigned Frequency (Ref. Frequency) (MHz)		425
% Battery	Frequency (MHz)	Frequency Stability (PPM)
-15%	424.999979	-0.049
0	424.9999800	-0.047
+15%	424.9999790	-0.049

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TRANSIENT FREQUENCY BEHAVIOR

Part 90.214 Transient Frequency Behavior

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

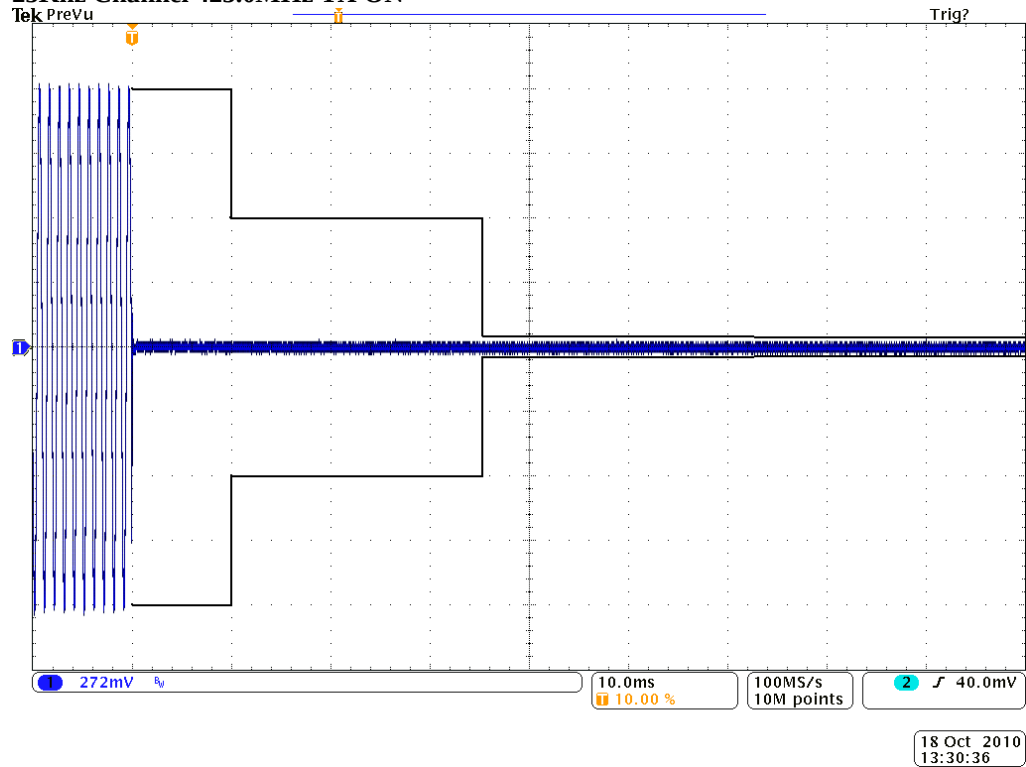
t_1^4	± 6.25 kHz	5.0 ms	10.0 ms
t_2	± 3.125 kHz	20.0 ms	25.0 ms
t_3^4	± 6.25 kHz	5.0 ms	10.0 ms

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25Khz Channel 425.0MHz TX ON

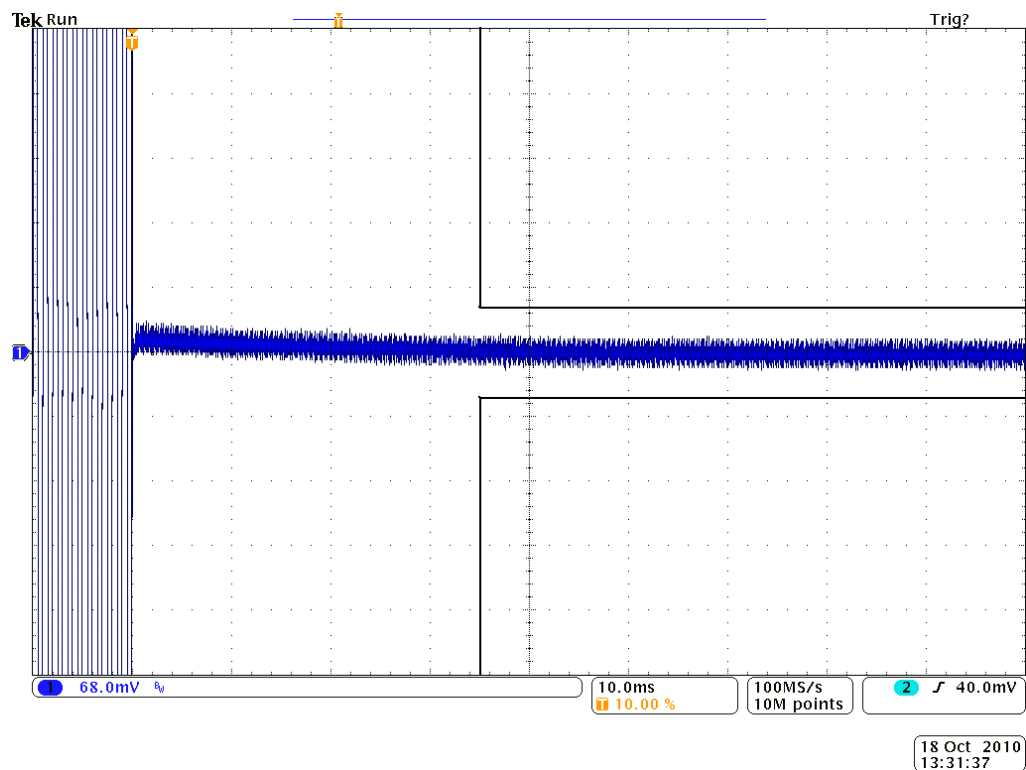


Applicant: RELM WIRELESS CORP. – BK RADIO

FCC ID: K95KNGM400

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25KHz Channel 425.0MHz TX ON ZOOMED

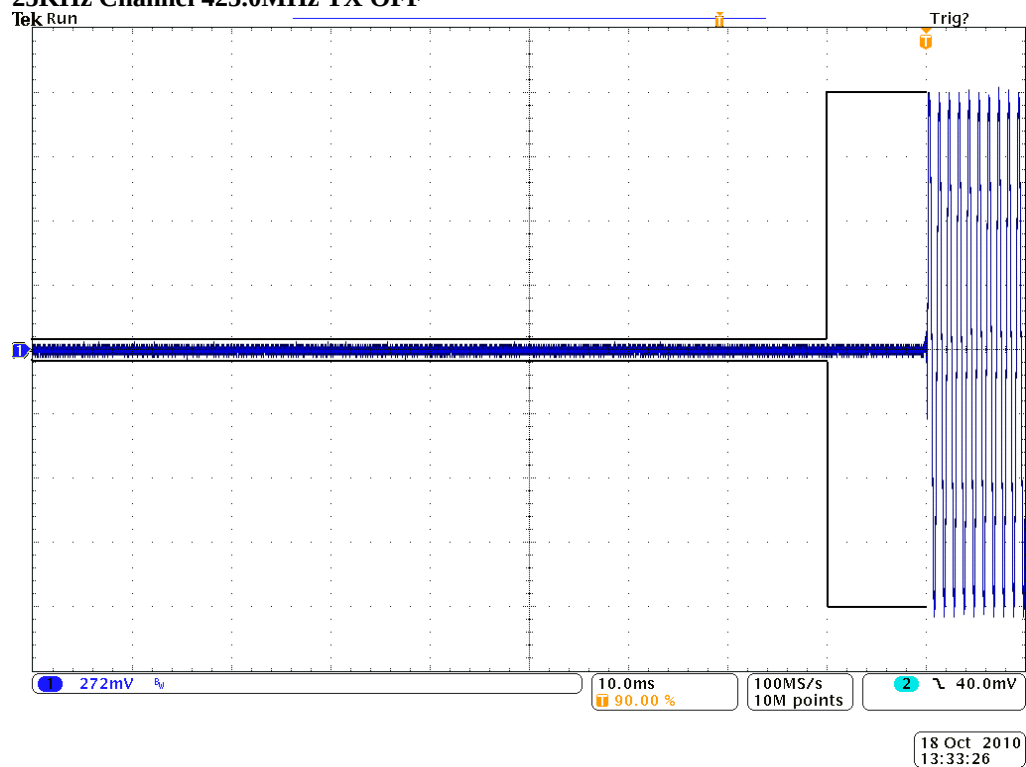


Applicant: RELM WIRELESS CORP. – BK RADIO

FCC ID: K95KNGM400

Report: Y:\Active_Projects\Next Generation Radios\NexGen Mobiles\KNG-M400\FCC\Files
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25KHz Channel 425.0MHz TX OFF

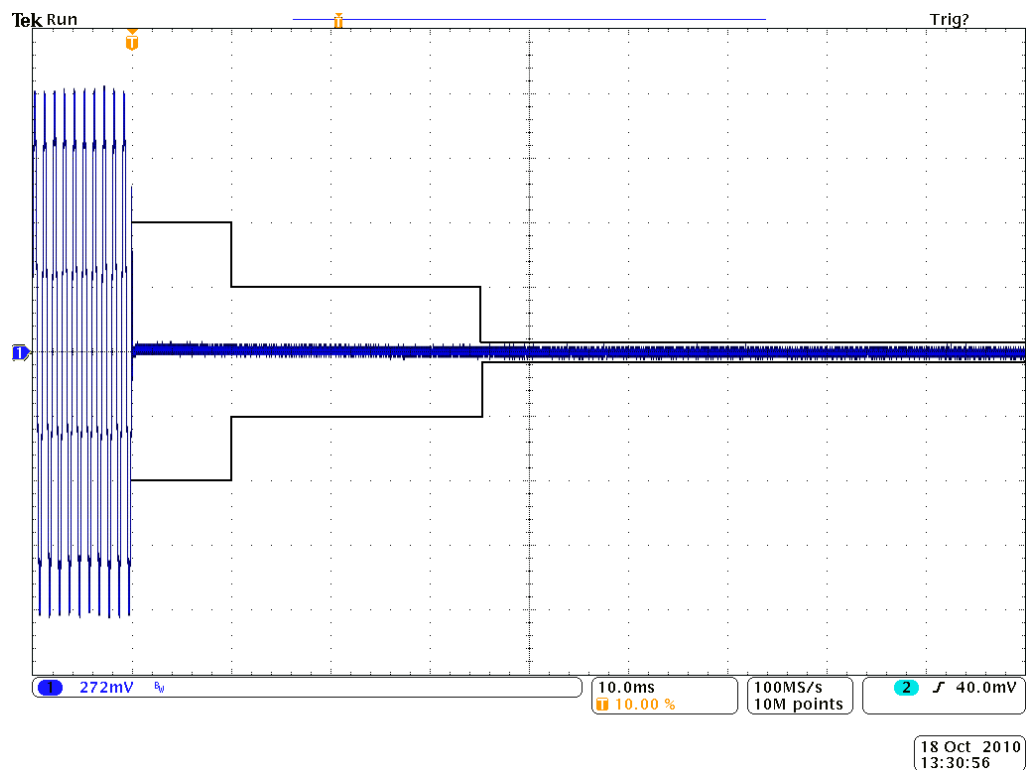


Applicant: RELM WIRELESS CORP. – BK RADIO

FCC ID: K95KNGM400

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12.5KHz Channel 425.0MHz TX ON

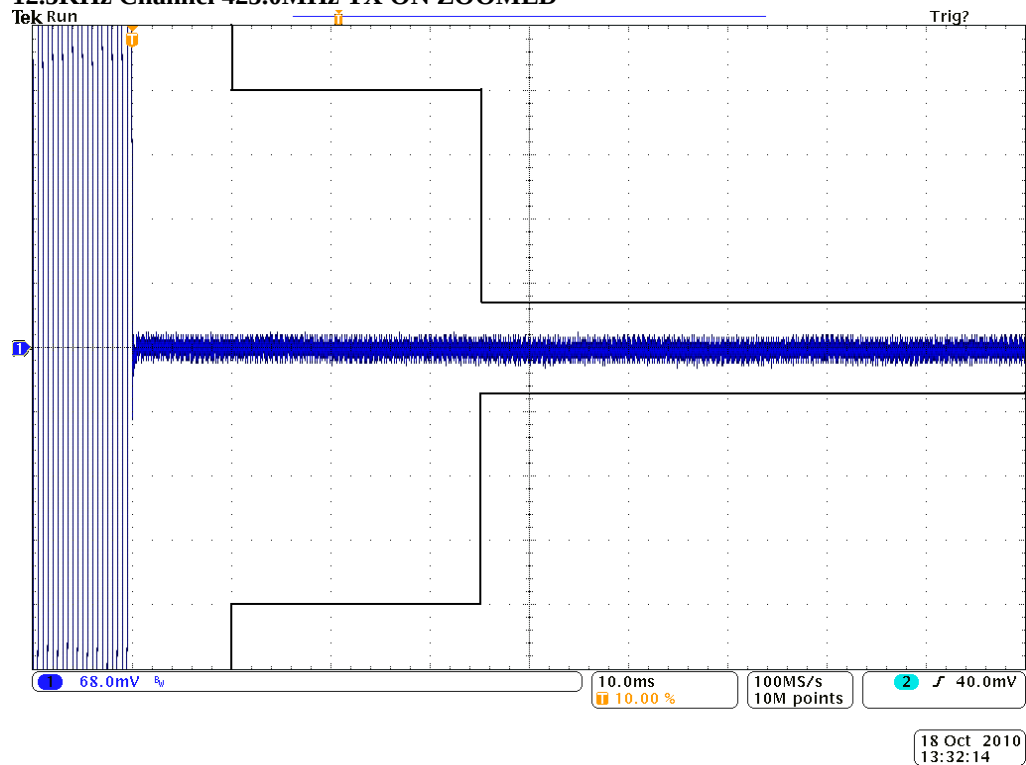


Applicant: RELM WIRELESS CORP. – BK RADIO

FCC ID: K95KNGM400

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12.5KHz Channel 425.0MHz TX ON ZOOMED

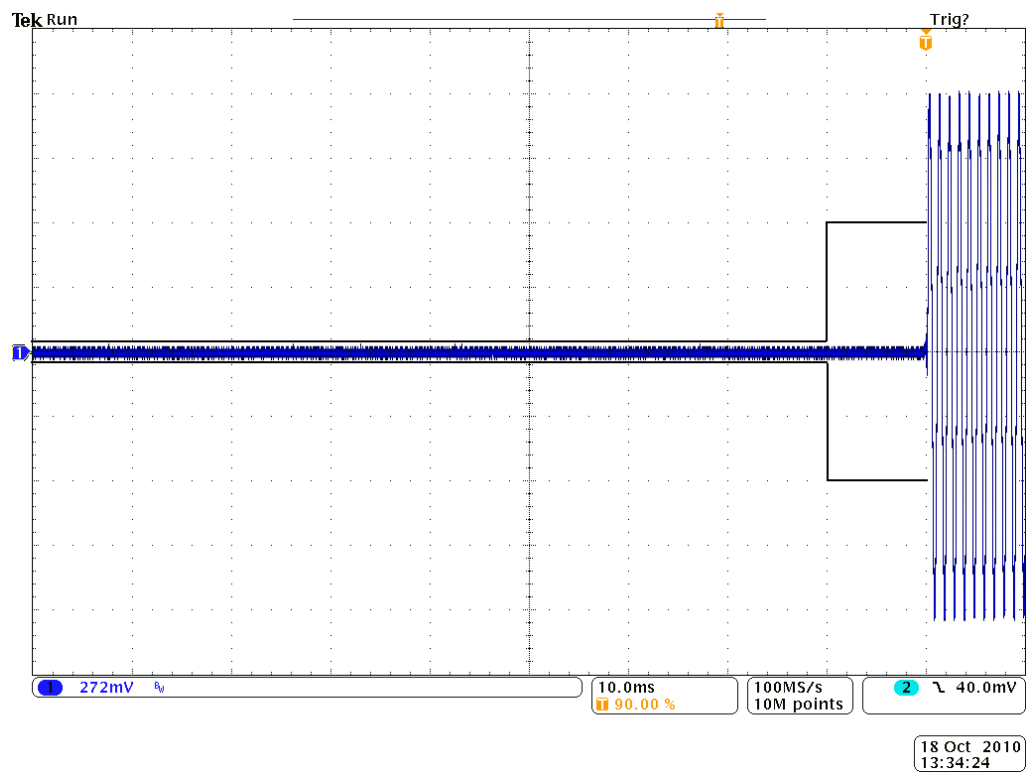


Applicant: RELM WIRELESS CORP. – BK RADIO

FCC ID: K95KNGM400

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12.5KHz Channel 425.0MHz TX OFF



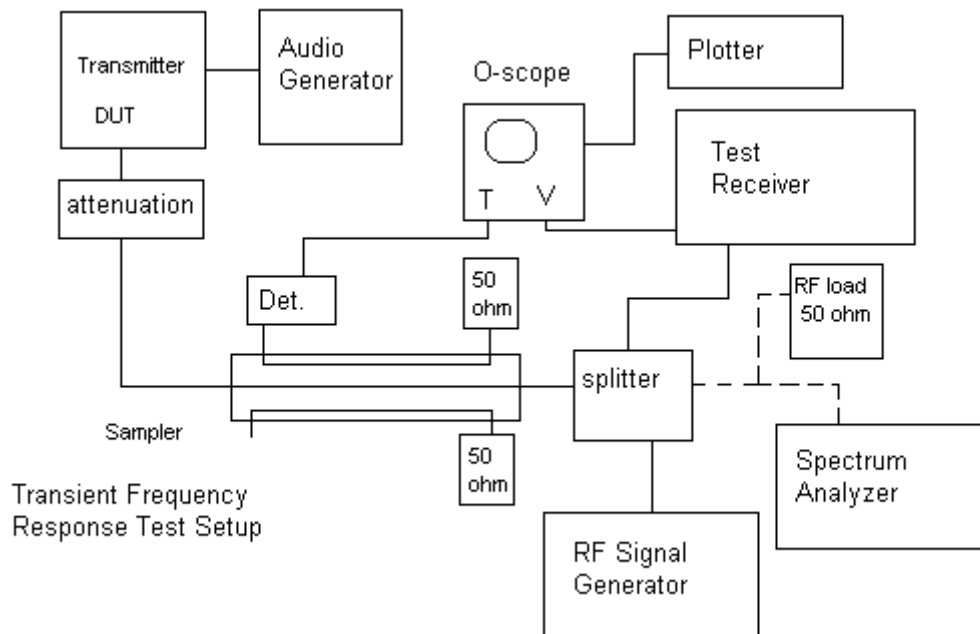
Applicant: RELM WIRELESS CORP. – BK RADIO

FCC ID: K95KNGM400

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TEST PROCEEDURE: ANSI/TIA 603-C:2004, the levels were set as follows:

1. Using the variable attenuator the transmitter level was set to 40 dB below the test receivers maximum input level, 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.
4. With the levels set as above, the transient frequency behavior was observed and recorded.



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