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FCC PART 90 TEST REPORT

APPLICANT	MIDLAND RADIO CORPORATION
	5900 PARRETTA DRIVE
	KANSAS CITY MISSOURI 64120 USA
FCC ID	MMA917100B
MODEL NUMBER	91-7100B
PRODUCT DESCRIPTION	BASE STATION TRANSMITTER
DATE SAMPLE RECEIVED	4/21/2009
DATE TESTED	6/8/2009
TESTED BY	Nam Nguyen
APPROVED BY	Mario de Aranzeta
TIMCO REPORT NO.	830AUT9TestReport_Rev.doc
TEST RESULTS	<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL

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



Certificate # 0955-01



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GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

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 17025:2005 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: 6/15/2009

Applicant: MIDLAND RADIO CORPORATION
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GENERAL INFORMATION

DUT Specification

DUT Description	BASE STATION TRANSMITTER
FCC ID	MMA917100B
Model Number	91-7100B
Type of Emission	16K0FID,F2D,F3E/11K0F3E,F2D,F1D
Modulation	FM, CQPSK
DUT Power Source	<input type="checkbox"/> 110-120Vac/50- 60Hz
	<input checked="" type="checkbox"/> DC Power 24V
	<input type="checkbox"/> Battery Operated Exclusively
Test Item	<input type="checkbox"/> Prototype
	<input type="checkbox"/> Pre-Production
	<input checked="" type="checkbox"/> Production
Type of Equipment	<input checked="" type="checkbox"/> Fixed
	<input type="checkbox"/> Mobile
	<input type="checkbox"/> Portable
Test Conditions	The temperature was 26°C 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	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.

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EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
3/10-Meter OATS	TEI	N/A	N/A	Listed 3/20/07	3/19/10
3-Meter OATS	TEI	N/A	N/A	Listed 2/5/09	2/5/12
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	Listed 5/11/07	5/11/10
AC Voltmeter	HP	400FL	2213A14499	CAL 3/23/09	3/23/11
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 11/30/07	11/30/09
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 11/30/07	11/30/09
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 11/30/07	11/30/09
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 11/30/07	11/30/09
Hygro-Thermometer	Extech	445703	0602	CAL 11/15/07	11/15/09
Measuring Tape-7.5M	Kraftixx	7.5M PROFI		CHAR 11/13/07	11/13/09
Digital Multimeter	Fluke	FLUKE-77-3	79510405	CAL 5/18/09	5/18/11
System One	Audio Precision	System One	SYS1-45868	CHAR 2/27/08	2/27/10
Temperature Chamber	Tenney Engineering	TTRC	11717-7	CHAR 4/25/08	4/25/10

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TEST PROCEDURE

Power Line Conducted Interference: The procedure used was ANSI/TIA 603-C:2004, using a 50uH LISN. Both lines were observed with the UUT 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 ANSI/TIA 603-C:2004, 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 microvolt at the output of the antenna. The ambient temperature of the UUT was 76°F with a humidity of 55%.

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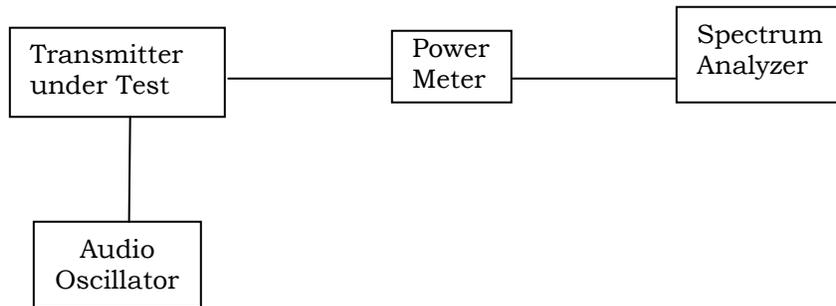
RF POWER OUTPUT

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 - 100.00 Watts
 LOW - 25.00 Watts

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

FOR HIGH POWER SETTING INPUT POWER: $(24.0V)(11.10A) = 266.0$ Watts
 FOR LOW POWER SETTING INPUT POWER: $(24.0V)(5.70A) = 137.0$ Watts

MODULATION CHARACTERISTICS

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

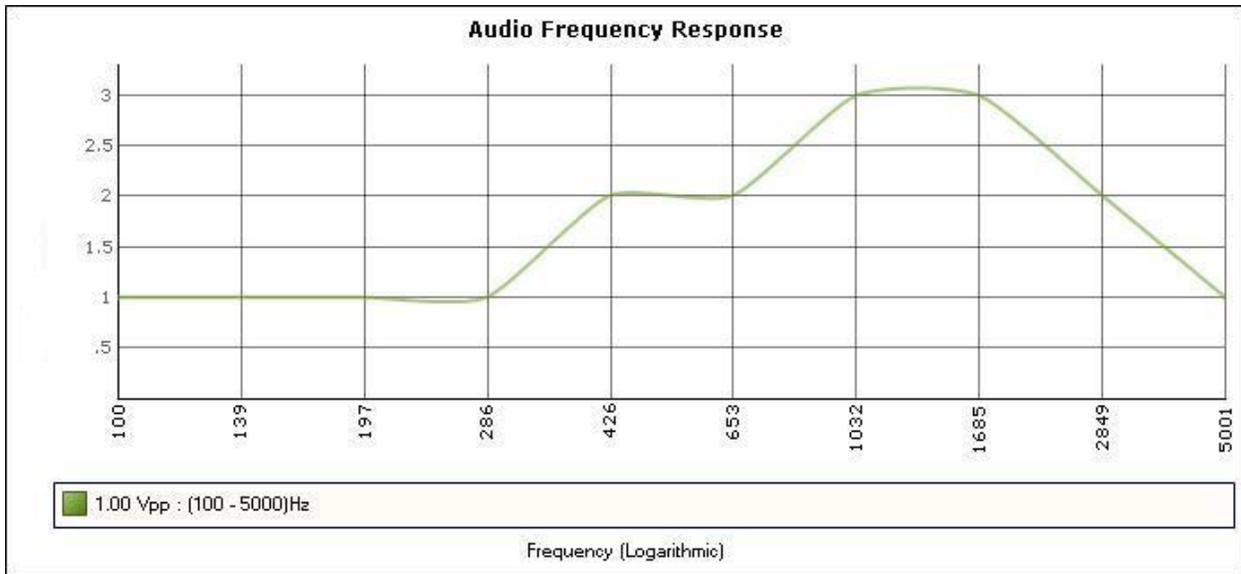
Test Requirements:

Method of Measurement:

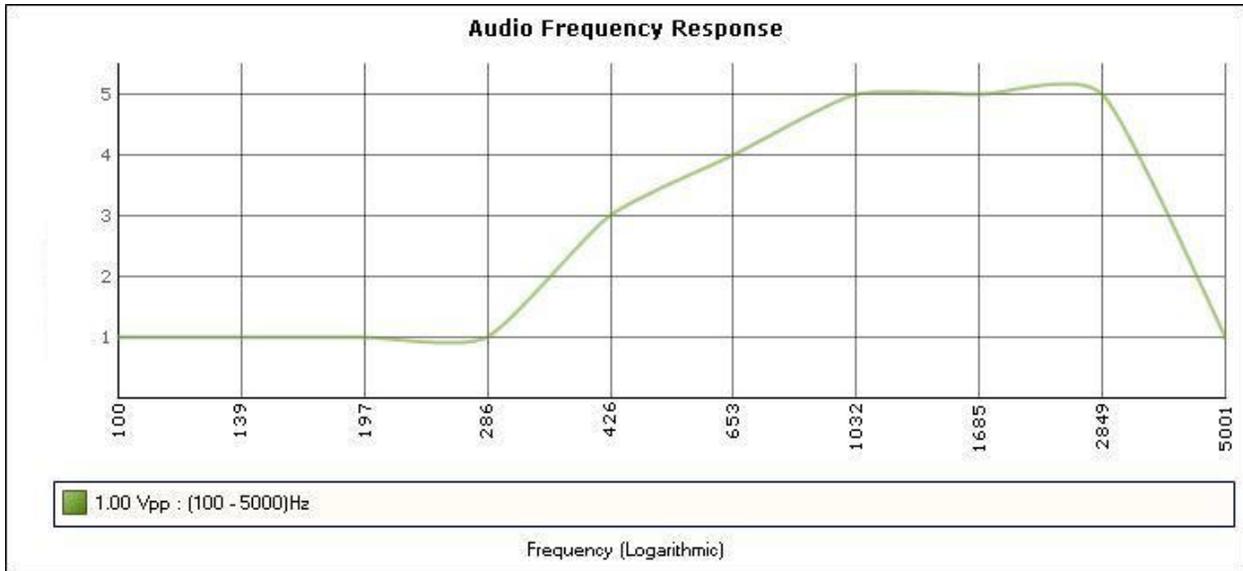
Audio frequency response

The audio frequency response was measured in accordance with ANSI/TIA 603-C:2004 with no exception. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 – 5000 Hz shall be submitted. The audio frequency response curve is shown below.

AUDIO FREQUENCY RESPONSE PLOT (narrow)



AUDIO FREQUENCY RESPONSE PLOT (wide)

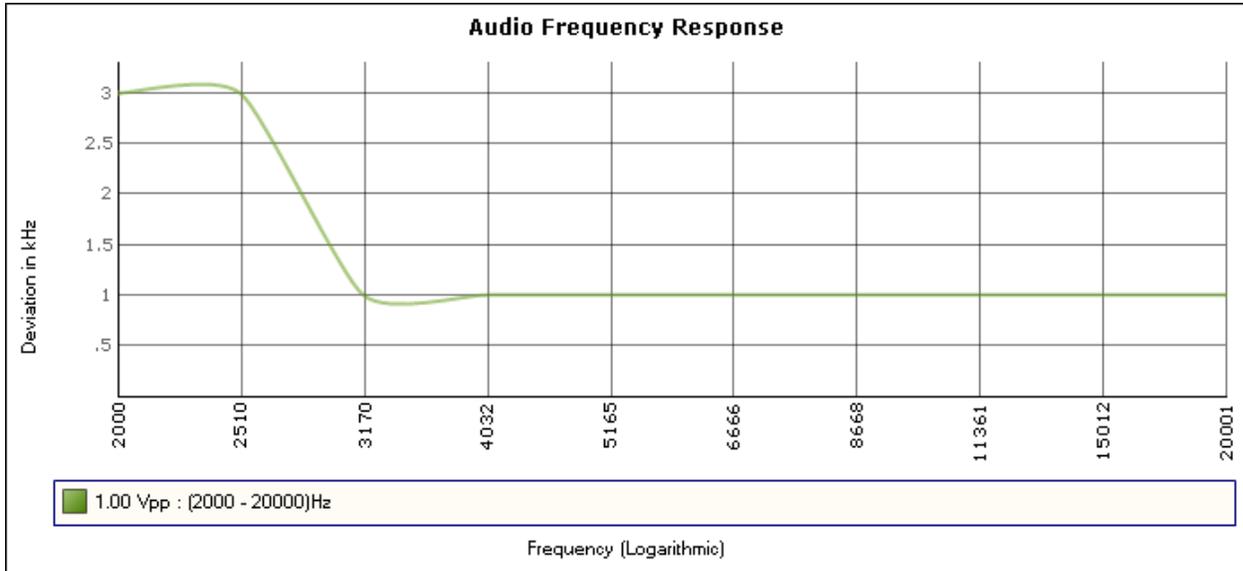


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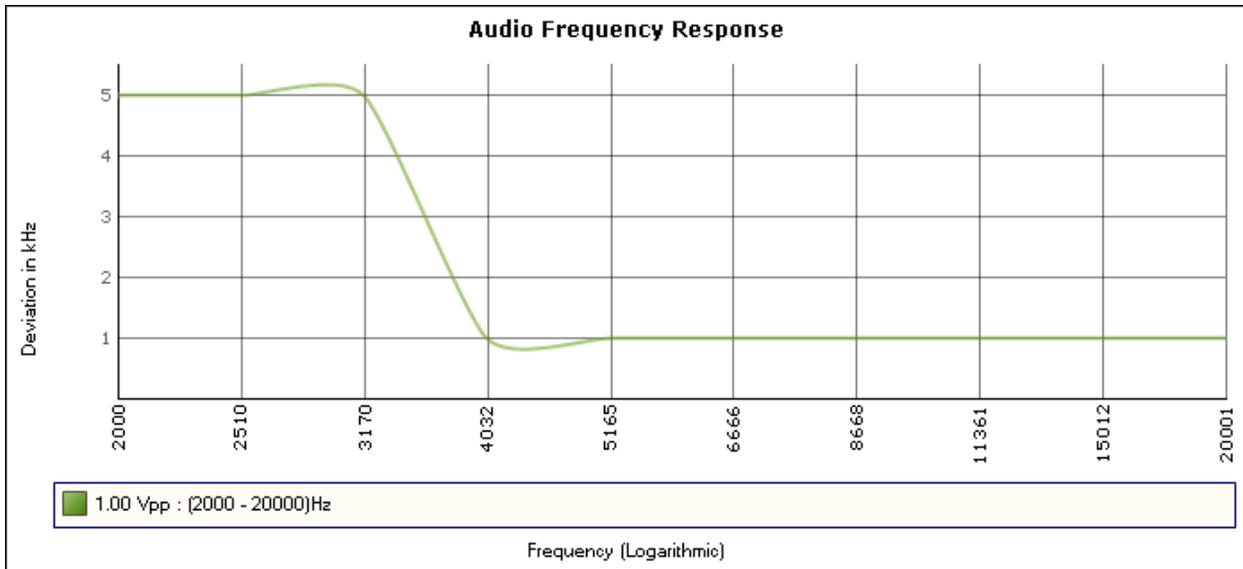
VOICE MODULATED COMMUNICATION EQUIPMENT

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 (narrow).



AUDIO LOW PASS FILTER (wide).



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AUDIO INPUT VERSUS MODULATION

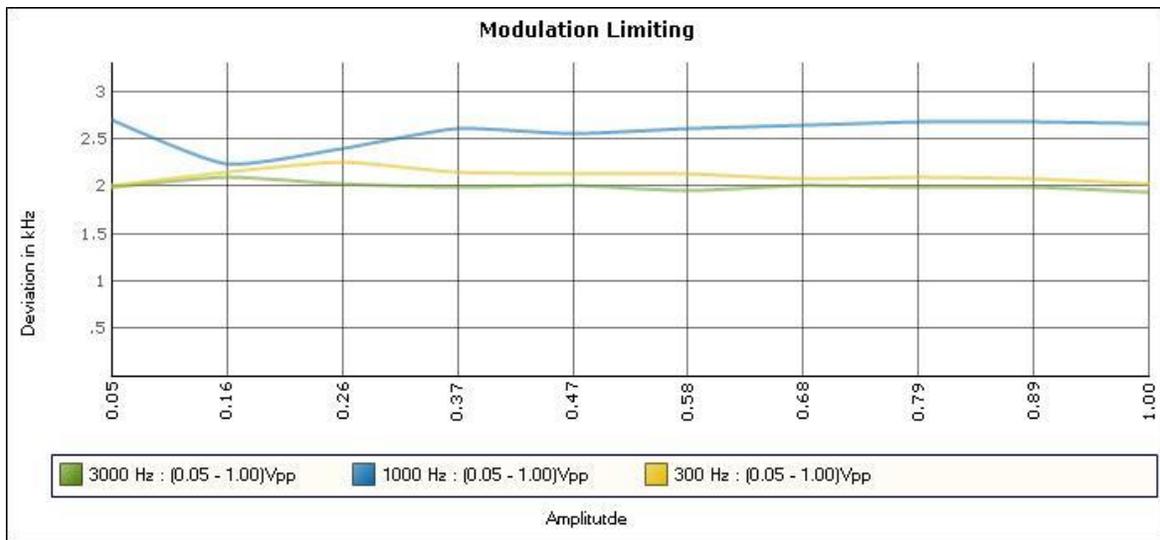
Rule Part No.: Part 2.1047(b) & 90

Test Requirements:

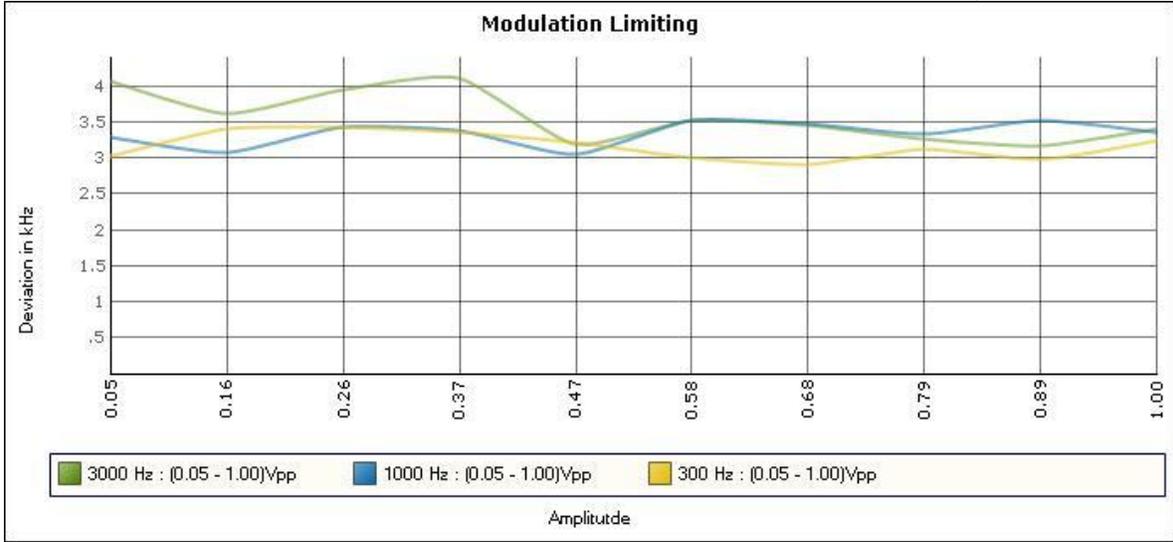
Method of Measurement: Modulation cannot exceed 100%, The audio input level needed for a particular percentage of modulation was measured in accordance with ANSI/TIA 603-C: 2004. The audio input curves versus modulation are shown below. Curves are provided for audio input frequencies of 300, 1000, and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

Test data:

Modulation Limiting Plot (12.5 kHz)



Modulation Limiting Plot (25.0 kHz)



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OTHER MODULATION CHARACTERISTICS

Part 2.1033(c)

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

Part 90.209

Part 2.1033(c) (4) Type of Emission: 11K2F3E

Part 90.209

Part 90.207 $B_n = 2M + 2DK$

$$M = 2000$$

$$D = 3000$$

$$K=1$$

$$B_n = 2(3000)+2(2000) = 10 \text{ k}$$

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

Part 90.209

Part 90.207 $B_n = 2M + 2DK$

$$M = 3000$$

$$D = 4200$$

$$K=1$$

$$B_n = 2(3000)+2(4200) = 14.4 \text{ k}$$

11K2F1D, 11K2F2D, 11K2F1E

16K0F1D, 16K0F2D, 16K0F1E

The radio is capable of CQPSK modulation described in APCO 25 or P-25.

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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 $29 \log(f_d^2/11)$ 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.

Part 90.210(e) Emission Mask E – 6.25 kHz channel BW equipment.

For transmitters designed to operate with a 6.25 kHz 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 3.0 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 3.0 kHz but no more than 4.6 kHz: At least $30 + 16.67(f_d - 3.0 \text{ kHz})$ or $55 + 10 \log(P)$ or 65, whichever us the lesser attenuation.
- (3) On any frequency removed from the center of the authorized bandwidth by more than 4.6kHz: At least $55 + 10\log(P)$ dB or 65 dB, whichever is the lesser attenuation.

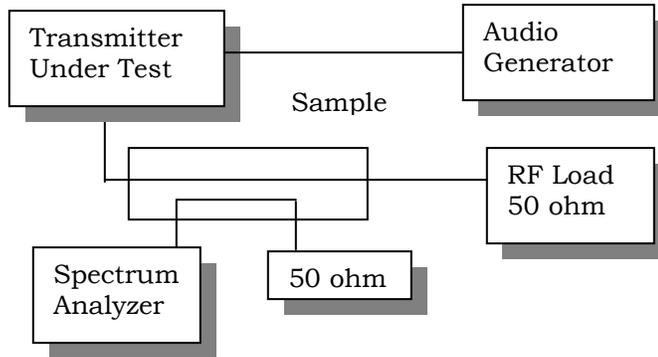
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Method of Measurement: ANSI/TIA 603-C: 2004

Test Setup Diagram:



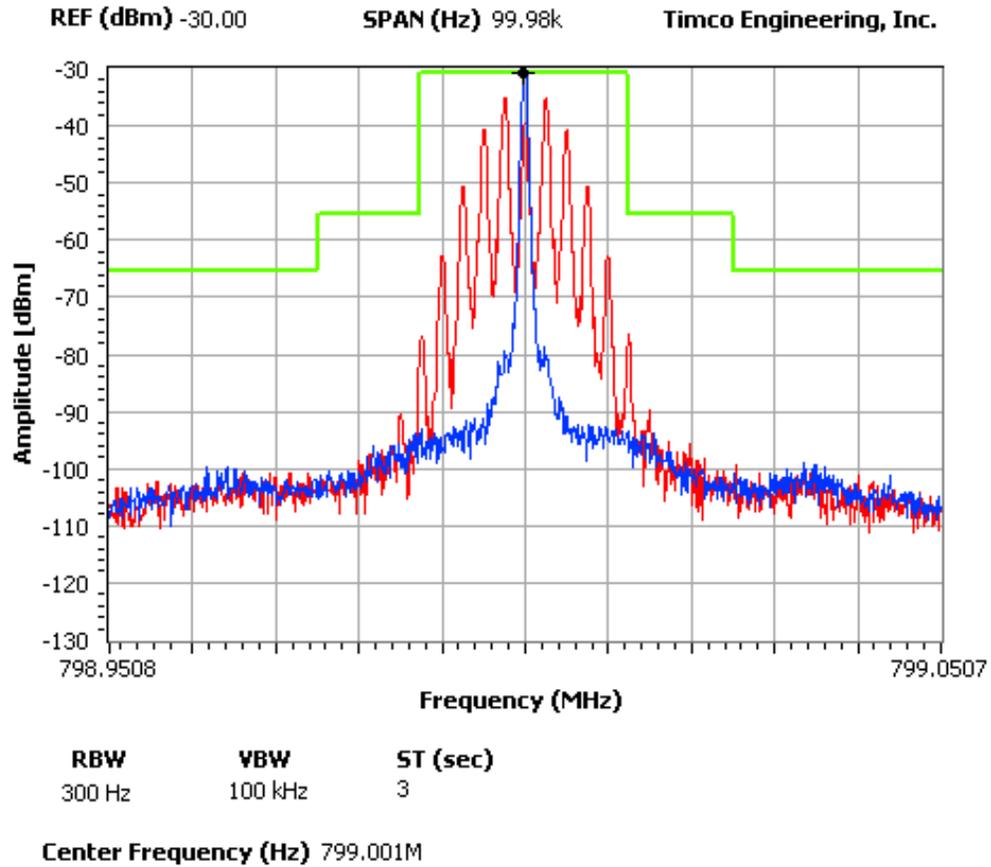
Test Data: See the plots below

OCCUPIED BANDWIDTH PLOTS
 Part 90.210(b) 25.0kHz Channel Spacing

NOTES:

MIDLAND RADIO CORPORATION - FCC ID: MMA917100
 OCCUPIED BANDWIDTH PLOT

FCC 90.210 Mask B



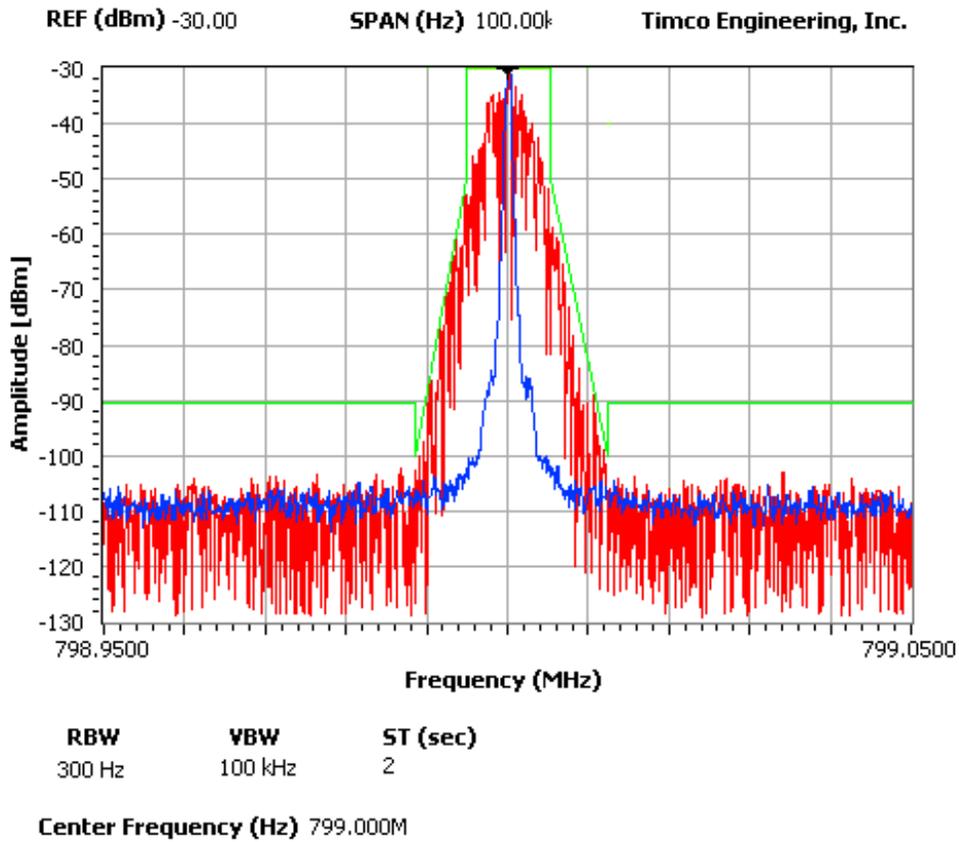
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OBW 12.5 kHz digital

NOTES:

MIDLAND RADIO CORPORATION - FCC ID: MMA917100
 OCCUPIED BANDWIDTH PLOTS -

FCC 90.210 Mask B



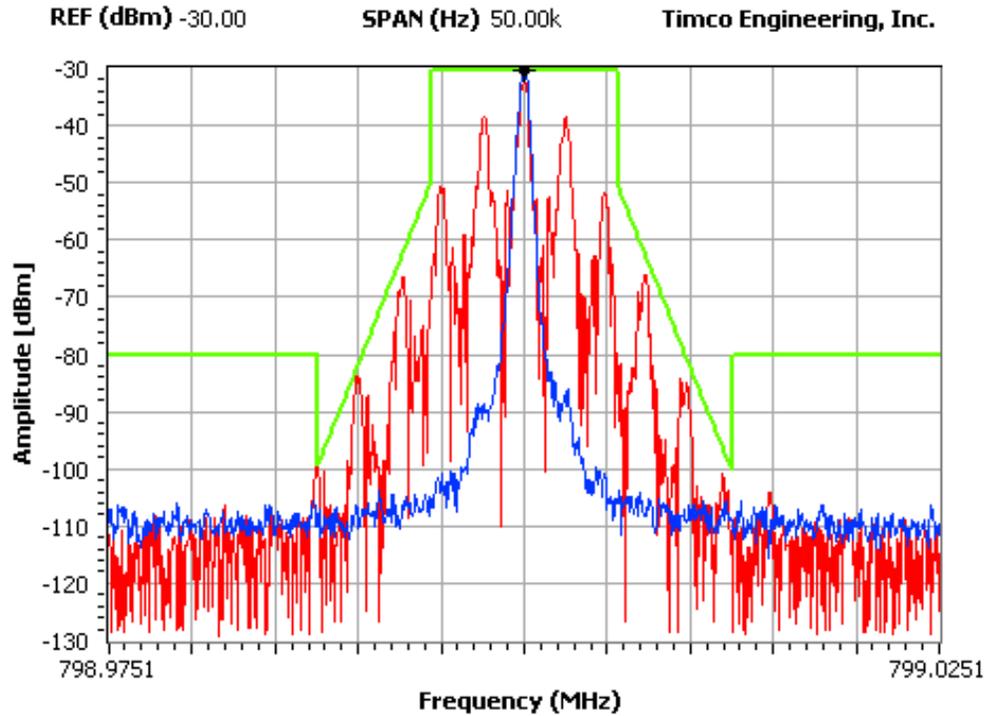
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Part 90.210 (d) Emission Mask D - 12.5 kHz channel

NOTES:

MIDLAND RADIO CORPORATION - FCC ID: MMA917100
 OCCUPIED BANDWIDTH PLOTS -

FCC 90.210 Mask D



RBW	VBW	ST (sec)
300 Hz	100 kHz	1

Center Frequency (Hz) 799.000M

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051(a)

Requirements: 25 kHz Channel Spacing = $43+10\log(OP)$ = dBc
 12.5 kHz Channel Spacing = $50+10\log(OP)$ = 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: High power: $50+10\log(100.00)$ = 70.00 dBc
 Low power: $50+10\log(25.00)$ = 64.00 dBc

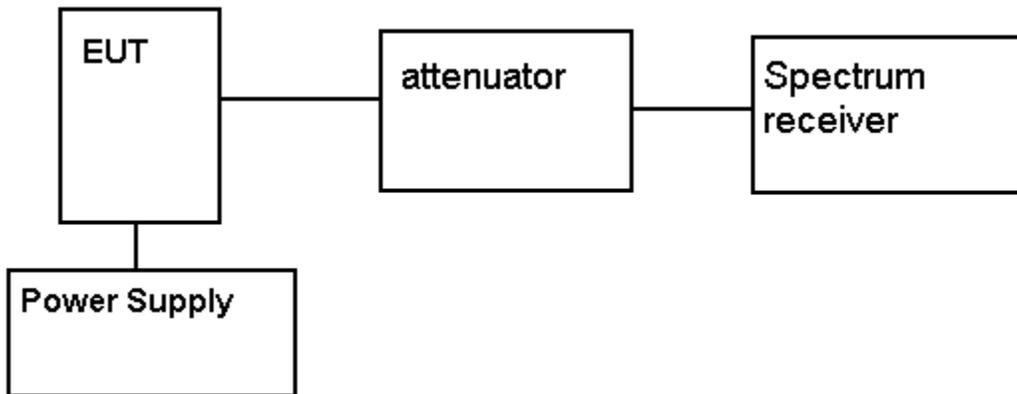
TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
792.00	1584.00	83.4		792.00	1584.00	81.8
	2376.00	86.4			2376.00	85
	3168.00	100.1			3168.00	93.3
	3960.00	100.2			3960.00	94.5
	4752.00	91.4			4752.00	100.7
	5544.00	114.9			5544.00	108.7
	6336.00	100.8			6336.00	99.2
	7128.00	110.5			7128.00	107.1
	7920.00	108.6			7920.00	107

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
799.00	1598.00	81.9		799.00	1598.00	92.7
	2397.00	79.2			2397.00	87.5
	3196.00	100.4			3196.00	96.6
	3995.00	104.2			3995.00	98.8
	4794.00	80.7			4794.00	96.2
	5593.00	109			5593.00	103.7
	6392.00	101.1			6392.00	100.5
	7191.00	110			7191.00	106.4
	7990.00	109.8			7990.00	107.6

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TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
806.00	1612.00	79.8		806.00	1612.00	83.7
	2418.00	84			2418.00	88.4
	3224.00	87.7			3224.00	100.7
	4030.00	91.5			4030.00	106.3
	4836.00	78.6			4836.00	93.5
	5642.00	104.7			5642.00	117.5
	6448.00	98.8			6448.00	112.5
	7254.00	101.6			7254.00	118.9
	8060.00	109.7			8060.00	116.4

Method of Measuring Conducted Spurious Emissions



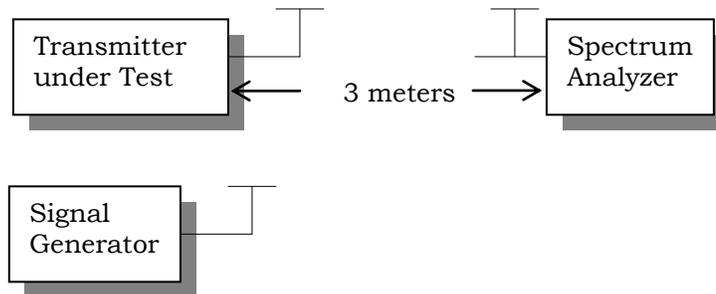
FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: Part 2.1053

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

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 the test site of TIMCO ENGINEERING, INC. located at 849 NW State Road 45, Newberry, FL 32669.

Test Setup Diagram:



Test Data:

High power: $50+10\log(100.00)$ = 70.00 dBc

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
792.00	0	0
1584.00	H	92.46
2376.00	H	89.03
3168.00	H	85.87
3960.00	H	93.22
4752.00	H	86.27
5544.00	H	89.80
6336.00	H	88.23
7128.00	H	100.94
7920.00	H	99.81

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
799.00	0	0
1598.00	H	94.36
2397.00	H	97.17
3196.00	H	86.67
3995.00	H	93.82
4794.00	H	87.82
5593.00	H	91.65
6392.00	H	89.06
7191.00	H	97.50
7990.00	H	93.09

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
806.00	0	0
1612.00	H	92.55
2418.00	H	96.81
3224.00	H	85.66
4030.00	H	86.48
4836.00	H	84.46
5642.00	H	86.90
6448.00	H	87.90
7254.00	H	92.86
8060.00	H	91.34



Low power: $50 + 10\log(25.00) = 64.00$ dBc

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
792.00	0	0
1584.00	H	84.64
2376.00	H	94.01
3168.00	H	84.55
3960.00	H	86.50
4752.00	H	84.35
5544.00	H	83.58
6336.00	H	80.71
7128.00	H	87.62
7920.00	H	101.49

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
799.00	0	0
1598.00	H	89.24
2397.00	H	93.15
3196.00	H	81.15
3995.00	H	84.00
4794.00	H	85.60
5593.00	H	85.03
6392.00	H	83.74
7191.00	H	87.78
7990.00	H	90.87

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
806.00	0	0
1612.00	H	86.33
2418.00	H	86.69
3224.00	H	79.14
4030.00	H	80.76
4836.00	H	80.24
5642.00	H	78.28
6448.00	H	84.38
7254.00	H	89.64
8060.00	H	87.72

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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: (91-7100B / 0.1 PPM)

Assigned Frequency (Ref. Frequency) (MHz)		799.000025
Temperature (°C)	Frequency (MHz)	Frequency Stability (PPM)
-30	798.999995	-0.04
-20	799.000006	-0.02
-10	799.000012	-0.02
0	799.000020	-0.01
+10	799.000022	0.00
+20	799.000021	-0.01
+30	799.000027	0.00
+40	799.000062	0.05
+50	799.000077	0.07

Assigned Frequency (Ref. Frequency) (MHz)		
% Battery	Frequency (MHz)	Frequency Stability (PPM)
-15%	799.000016	-0.01
0	799.000025	0
+15%	799.000037	0.02

Test Data: (91-7100B / 1.0 PPM)

Assigned Frequency (Ref. Frequency) (MHz)		798.999541
Temperature (°C)	Frequency (MHz)	Frequency Stability (PPM)
-30	798.999417	-0.16
-20	798.999401	-0.18
-10	798.999449	-0.12
0	798.999418	-0.15
+10	798.999521	-0.03
+20	798.999553	0.02
+30	798.999451	-0.11
+40	798.999294	-0.31
+50	798.999331	-0.26

Assigned Frequency (Ref. Frequency) (MHz)		
% Battery	Frequency (MHz)	Frequency Stability (PPM)
-15%	798.999558	0.02
0	798.999541	0
+15%	798.999523	-0.02

Applicant: MIDLAND RADIO CORPORATION
 FCC ID: MMA917100B
 Report: Y:\M\MidlandRadio_MMA\830AUT9\830AUT9TestReport_Rev.doc

FREQUENCY STABILITY (CONT'D)

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

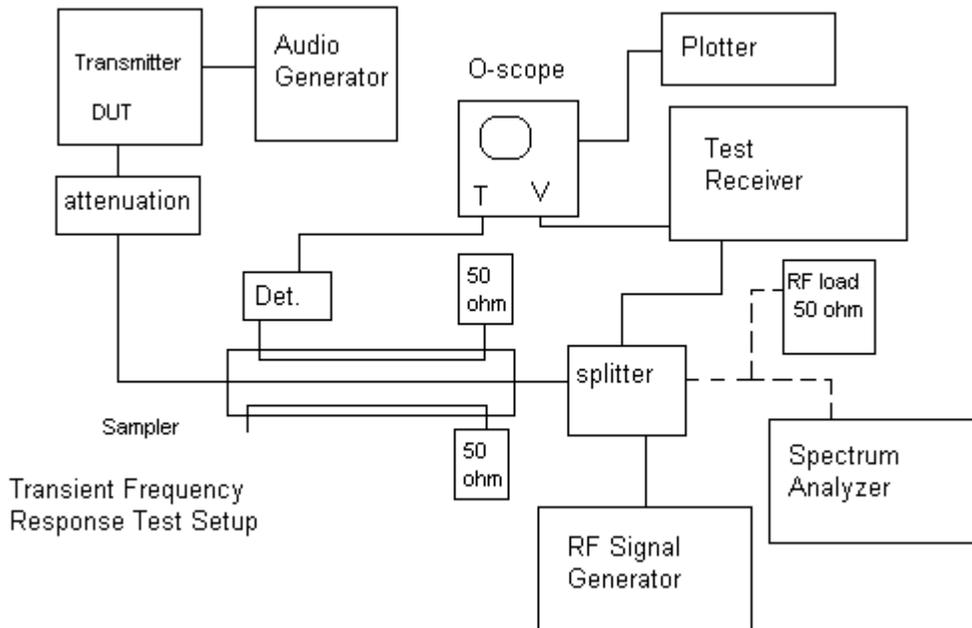
t ₁ ⁴	±12.5 kHz	5.0 ms	10.0 ms
t ₂	±6.25 kHz	20.0 ms	25.0 ms
t ₃ ⁴	±12.5 kHz	5.0 ms	10.0 ms

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

TEST PROCEDURE: 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.



ADJACENT CHANNEL POWER

Rule Part No.: FCC Part 90.543

Requirements: Transmitters designed to operate in 769–775 MHz and 799–805 MHz frequency bands must meet the emission limitations in paragraphs (a) through (d) of this section. Transmitters operating in 763–768 MHz and 793–798 MHz bands must meet the emission limitations in (e) of this section.

Test Data:

6.25 kHz Base Transmitter ACP Requirements (N/A)

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	(Limit) Maximum ACP (dBc)
6.25	6.25	-40
12.50	6.25	-60
18.75	6.25	-60
25.00	6.25	-65
37.50	25	-65
62.50	25	-65
87.50	25	-65
150.00	100	-65
250.00	100	-65
350.00	100	-65
>400 to 12 MHz	30 (s)	-80
12 MHz to paired receive band	30 (s)	-80
In the paired receive band	30 (s)	-100

Test Data

12.5 kHz Base Transmitter ACP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	ACP Measurement Reading (dBc)	(Limit) Maximum ACP (dBc)
9.375	6.25	-50.5	-40
15.625	6.25	-79.1	-60
21.875	6.25	-80.1	-60
37.5	25	-73.6	-60
62.5	25	-72	-65
87.5	25	-74.2	-65
150	100	-69.2	-65
250	100	-72.2	-65
350.00	100	-75.2	-65
>400 kHz to 12 MHz	30 (s)	-83.1	-80
12 MHz to paired receive band	30 (s)	-81.5	-80
In the paired receive band	30 (s)	-100	-100

Test Data

25 kHz Base Transmitter ACP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	ACP Measurement Reading (dBc)	(Limit) Maximum ACP (dBc)
15.625	6.25	-74.5	-40
21.875	6.25	-75.9	-60
37.5	25	-70.7	-60
62.5	25	-67.7	-65
87.5	25	-71.4	-65
150	100	-67.5	-65
250	100	-70.5	-65
350	100.00	-72.9	-65
>400 kHz to 12 MHz	30 (s)	-82.6	-80
12 MHz to paired receive band	30 (s)	-83.4	-80
In the paired receive band	30 (s)	-100	-100