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FCC PART 90 AND IC RSS-119, RSS-GEN TEST REPORT

APPLICANT	DAMM CELLULAR SYSTEMS A/S
	MOLLEGADE 68 6400 SONDERBORG DENMARK
FCC ID	Z5W105008
IC CERTIFICATION	10159A-105008
MODEL NUMBER	BS421 Base Station 805-825/851-869 MHz
PRODUCT DESCRIPTION	TRANSMITTER
DATE SAMPLE RECEIVED	12/12/2011
DATE TESTED	3/23/2012
TESTED BY	Joe Scoglio
APPROVED BY	Mario R. de Aranzeta
TIMCO REPORT NO.	2915AT11TestReport.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.

The test results relate only to the items tested.

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: March 23, 2012

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GENERAL INFORMATION
DUT Specification

DUT Description	DOOR SYSTEM - TRANSMITTER
FCC ID	Z5W-105008
IC Certification	10159A-105008
Model Number	BS421 Base Station 805-825/851-869 MHz
Serial Number	N/A
Operating Frequency	851-869 MHz
Test Frequencies	856.0, 863.0, 869.0 MHz
Type of Emission	21K0D1W, 21K0D1D, 21K0D1E, & 21K0D7W 20K0D1W, 20K0D1D, 20K0D1E, & 20K0D7W
Modulation	0.35 TETRA, 0.20 modified TETRA
DUT Power Source	<input checked="" type="checkbox"/> 110-120Vac/50- 60Hz
	<input type="checkbox"/> DC Power 12V
	<input type="checkbox"/> Battery Operated Exclusively
Test Item	<input type="checkbox"/> Prototype
	<input checked="" type="checkbox"/> Pre-Production
	<input 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 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, IC RSS-119, RSS-GEN
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.

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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.

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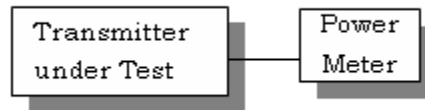
RF POWER OUTPUT

Rule Part No.: FCC Part 2.1046(a), IC RSS-119 4.1 and 5.4, RSS-GEN 4.8

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 – 13.3 W
LOW - 0.72 W

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

DC INPUT POWER: $(26.0V)(3\text{ A}) = 78\text{ Watts}$

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MODULATION CHARACTERISTICS

Part 2.1033(c)

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

Type of Emission: $\pi/4$ DQPSK TETRA as defined in EN 300 392-2.

TETRA is a digital, trunked radio technology that operates with Time Division Multiple Access (TDMA) in four-slot channels within a twenty-five kilohertz bandwidth.

This unit has two distinct and different but similar modulation schemes. One being as defined above and the second mode which is similar and implemented through a software change only where:

Description of the modified modulation:

From ETSI EN 300 392-2 part 5.5 the requirement for the output spectrum of a TETRA signal $G(f)$ is:

$$\begin{array}{ll}
 G(f) = 1 & \text{for } |f| \leq (1 - \alpha)/2T \\
 G(f) = \sqrt{0.5 \left(1 - \sin \left(\pi (2|f|T - 1)/2\alpha \right) \right)} & \text{for } (1 - \alpha)/2T \leq |f| \leq (1 + \alpha)/2T \\
 G(f) = 0 & \text{for } |f| \geq (1 + \alpha)/2T
 \end{array}$$

Where α is the roll-off factor, which determines the width of the transmission band at a given symbol rate. For TETRA the value of α shall be 0.35.

This spectrum can't fulfill the requirement of the FCC. Therefore the shape of the output spectrum has been modified by changing α from 0.35 to 0.20. This gives a narrowed spectrum that meets the FCC requirements for the 20 kHz bandwidth.

The TETRA and modified modulation meets the spectrum efficiency requirements of Part 90.

AUDIO FREQUENCY RESPONSE

Rule Part No.: FCC Part 2.1047(a)(b), IC RSS-119 5.2

Test Requirements:

Method of Measurement:

The audio frequency response was measured in accordance with ANSI/TIA 603-C: 2004. 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

Digitally encoded voice

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.

AUDIO LOW PASS FILTER

Digitally encoded voice

AUDIO INPUT VERSUS MODULATION

Rule Part No.: FCC Part 2.1047(b) & 90, IC RSS-119 5.2

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 2500 Hz.

Test data:

Modulation Limiting Plot

N/A

Digitally encoded voice

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OCCUPIED BANDWIDTH

FCC Part 2.1049(c), RSS-GEN 4.6 EMISSION BANDWIDTH

FCC Part 90.210(b) RSS-119 4.2 25 kHz 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) 25 kHz 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.

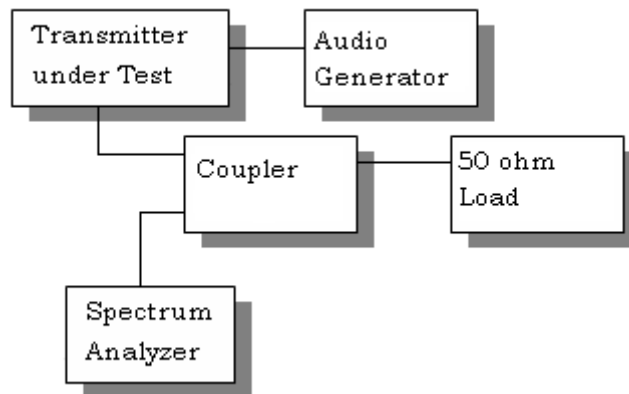
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OCCUPIED BANDWIDTH MEASUREMENT

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

Test Setup Diagram:

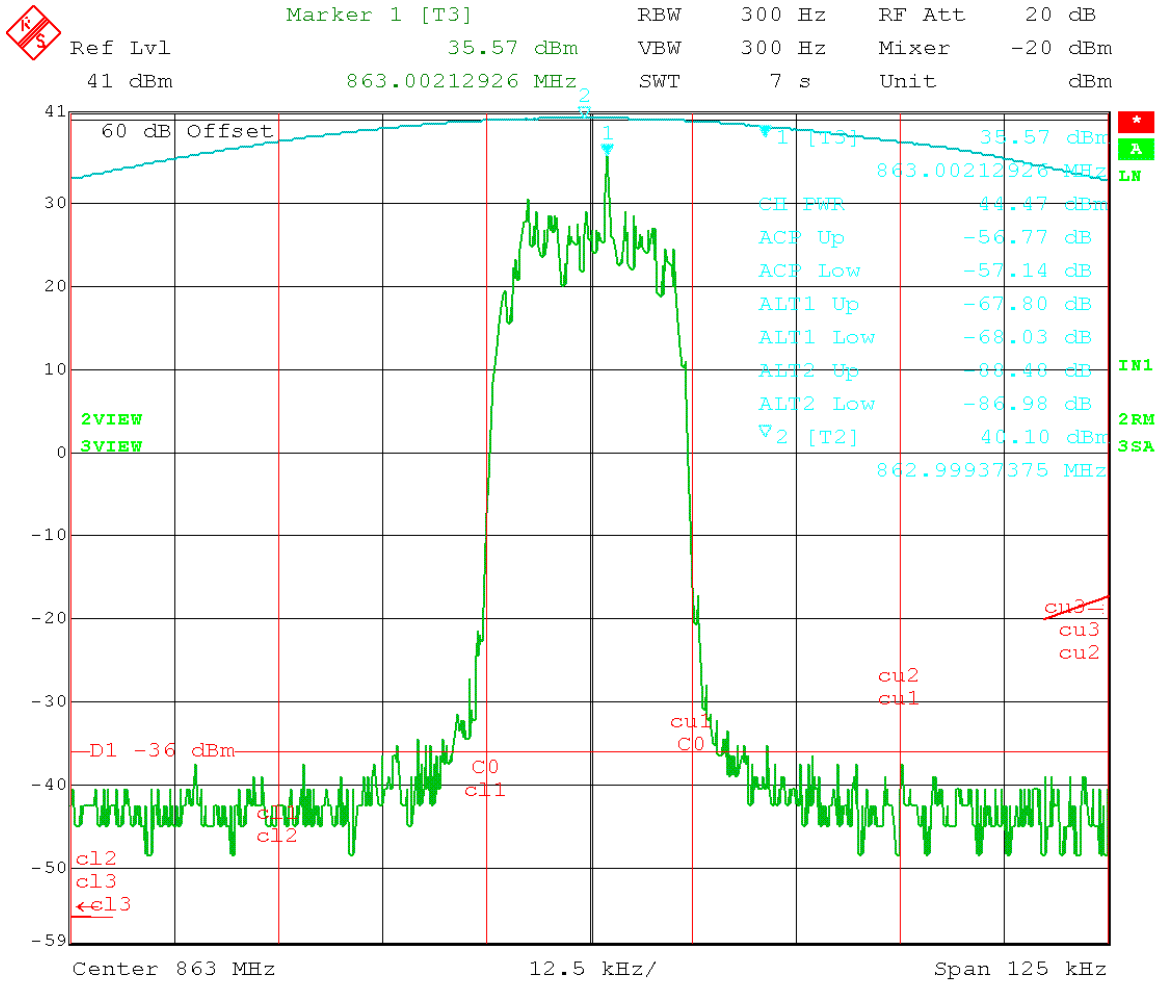
OCCUPIED BANDWIDTH MEASUREMENT



Test Data: See the plots below

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ADJACENT CHANNEL PLOT 0.35 TETRA



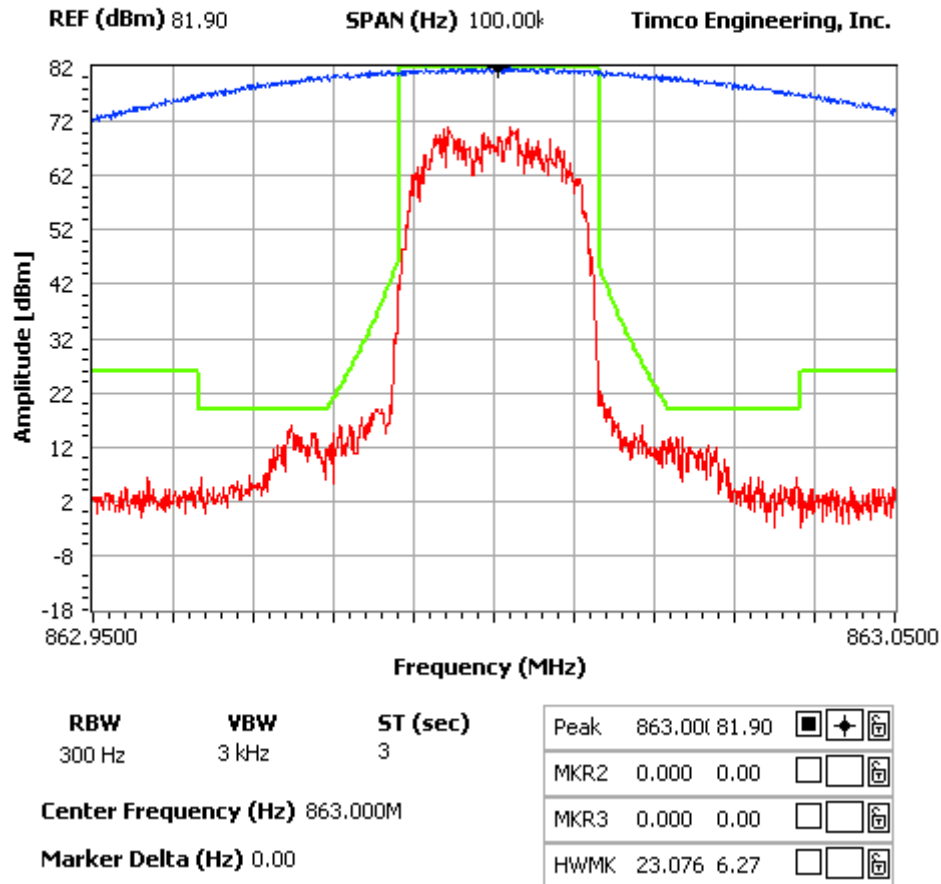
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**OCCUPIED BW
0.2 MODIFIED
MASK EA**

NOTES:

FCC 90.691 Mask

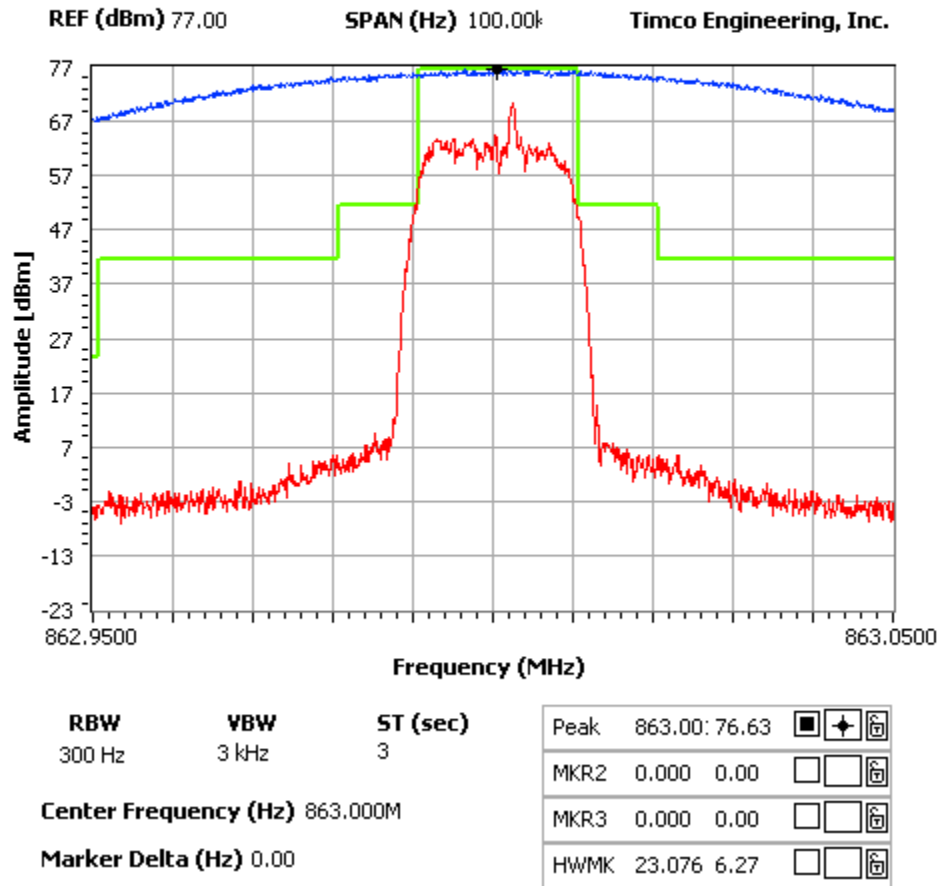


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OCCUPIED BANDWIDTH 0.2 Modified

NOTES:

FCC 90.210 Mask B

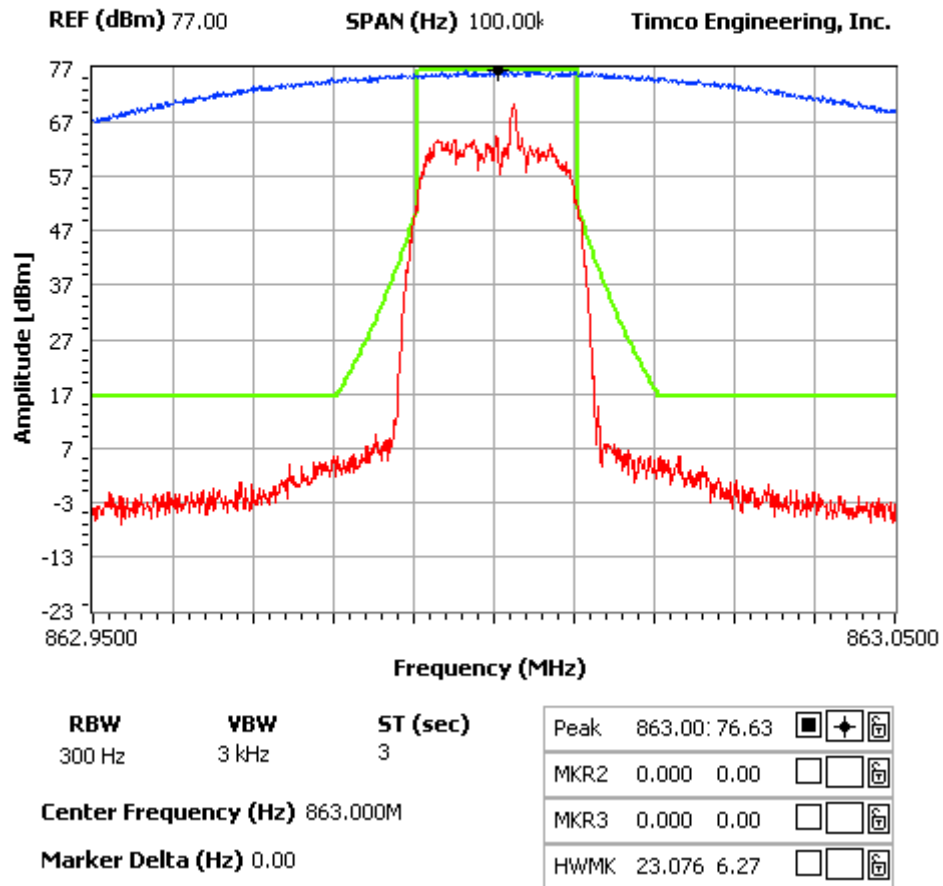


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OCCUPIED BANDWIDTH 0.2 Modified

NOTES:

FCC 90.210 Mask G



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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: FCC Part 2.1051(a), RSS-GEN 7.1.4

Requirements: 25 kHz Channel Spacing = 50 dBc (for 5 Watts)

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.

FCC Limit for:

25 kHz Channel Spacing = 50

12.5 kHz Spacing = 57

6.25 kHz Channel Spacing = N/A

Test Data:

TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
856	856	0		856	856	0
	1712	101.7			1712	104.8
	2568	107.5			2568	115.5
	3424	126.7			3424	117.7
	4280	121.3			4280	115.7
	5136	129.6			5136	118.4
	5992	119.6			5992	113.5
	6848	125.1			6848	111.9
	7704	123.9			7704	111.5
	8560	123.8			8560	112.9

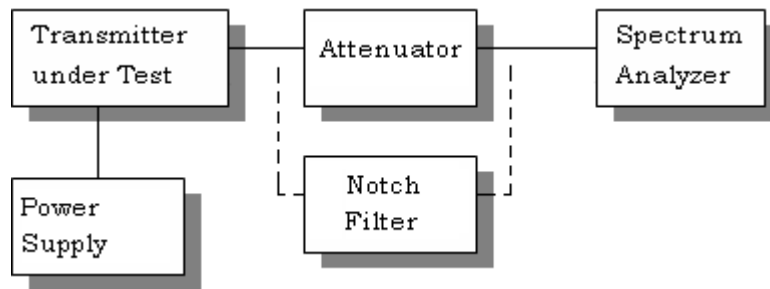
TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
863	863	0		863	863	0
	1726	101.8			1726	102.3
	2589	111.4			2589	115.9
	3452	127.2			3452	116.4
	4315	117.2			4315	116.7
	5178	125.8			5178	116
	6041	122.2			6041	111.9
	6904	124.5			6904	111.6
	7767	123.1			7767	111.4
	8630	124.1			8630	112

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TF HIGH POWER	EF	dB below carrier		TF LOW POWER	EF	dB below carrier
869	869	0		869	869	0
	1738	98.3			1738	102.1
	2607	111.9			2607	114.5
	3476	125			3476	118.2
	4345	120.5			4345	118.1
	5214	127.7			5214	119.7
	6083	124.3			6083	113.7
	6952	124.3			6952	112
	7821	124.4			7821	108.9
	8690	125.4			8690	111.1

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Method of Measuring Conducted Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was ANSI/TIA 603-C: 2004. The measurements were made at TIMCO ENGINEERING INC. 849 N.W. State Road 45, Newberry, Florida 32669.

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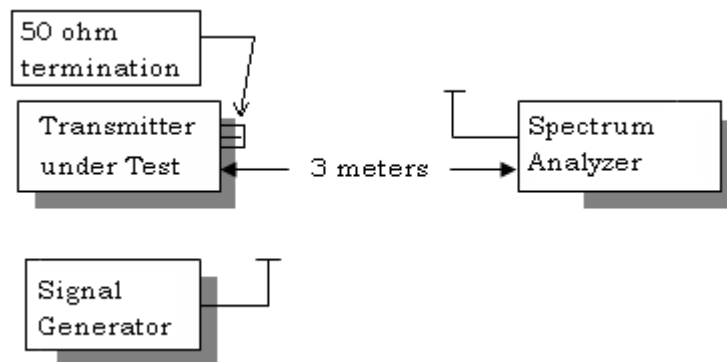
FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: FCC Part 2.1053, RSS-GEN 4.9

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

Test Setup Diagram:



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Test Data:

High Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
856.00	V	0
1712.00	V	85.1
2568.00	H	92.5
3424.00	H	98.3

Low Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
856.00	V	0
1712.00	V	78.6
2568.00	H	83.1

High Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
863.00	V	0
1726.00	H	80.1
2589.00	V	91.1
3452.00	H	96.7

Low Power

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
863.00	V	0
1726.00	V	75.8
2589.00	V	81.2

HIGH POWER

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
869	V	0
1738	H	74.8
2607	H	94.0
3476	H	94.1

LOW POWER

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
869	V	0
1738	H	73.7
2607	V	80.6

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FREQUENCY STABILITY

Rule Parts. No.: FCC Part 2.1055, Part 90.213, RSS-119 5.3, RSS-GEN 7.2.4

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)		
Temperature (°C)	Frequency (MHz)	Frequency Stability (PPM)
-30	865.000012	+0.014
-20	865.000010	+0.012
-10	865.000010	+0.012
0	865.000006	+0.007
+10	865.000004	+0.005
+20	865.000002	+0.002
+30	865.000002	+0.002
+40	865.000000	+0.000
+50	865.000000	+0.000

Assigned Frequency (Ref. Frequency) (MHz)		
% Mains (%)	Frequency (MHz)	Frequency Stability (PPM)
-15%	865.000000	+0.000
	865.000000	+0.000
+15%	865.000000	+0.000

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EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	Listed 5/10/10	5/10/12
AC Voltmeter	HP	400FL	2213A14499	CAL 6/12/11	6/12/13
Antenna: Active Loop	ETS-Lindgren	6502	00062529	CAL 9/23/10	9/23/12
Frequency Counter	HP	5385A	2730A03025	CAL 8/17/11	8/17/13
Hygro-Thermometer	Extech	445703	0602	CAL 6/15/11	6/15/13
Modulation Analyzer	HP	8901A	3435A06868	CAL 7/18/11	7/18/13
Digital Multimeter	Fluke	FLUKE-77	35053830	CAL 9/9/11	9/9/13
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 10/28/11	10/28/13
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 10/28/11	10/28/13
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 10/28/11	10/28/13
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 10/28/11	10/28/13
Temperature Chamber	Tenney Engineering	TTRC	11717-7	CHAR 4/25/10	4/25/12
Antenna	ETS	3117	41534	9/22/2010	9/22/2012
Antenna	Electro metrics	LPA-25	1122	5/04/2011	5/04/2013
Antenna	Electro metrics	BIA-25	1096	5/04/2011	5/04/2013

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