



849 NW STATE ROAD 45
NEWBERRY, FL 32669 USA
PH: 888.472.2424 OR 352.472.5500
FAX: 352.472.2030
EMAIL: INFO@TIMCOENGR.COM
[HTTP://WWW.TIMCOENGR.COM](http://WWW.TIMCOENGR.COM)

FCC PART 90 TEST REPORT

APPLICANT	ROHILL TECHNOLOGIES B.V.
	Edisonstraat 12 7903 AN Hoozeveen The Netherlands
FCC ID	2AGJ3R-8070-450MHZ
MODEL NUMBER	R-8070-450
PRODUCT DESCRIPTION	TETRA TRANSCEIVER
DATE SAMPLE RECEIVED	11/6/2015
FINAL TEST DATE	1/15/2016
TESTED BY	Cory Leverett
APPROVED BY	Tim Royer
TEST RESULTS	<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL

Report Number	Version Number	Description	Issue Date
113AUT16TestReport	Rev1	Initial Issue	1/27/2016

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

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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 requirements.

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:

A handwritten signature in black ink, appearing to read "Cory Leverett", is written over a faint, circular purple stamp. The stamp contains some illegible text, possibly a company seal or certification mark.

Cory Leverett
Project Manager/Testing Technician

Date: **1/27/2015**

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GENERAL INFORMATION

EUT Specification

EUT Description	TETRA TRANSCEIVER
FCC ID	2AGJ3R-8070-450MHZ
Model Number	R-8070-450
Operating Frequency	450 – 470 MHz
Test Frequencies	450.025, 460.025, 469.975 MHz
Type of Emission	22K0G7W
Modulation	Pi/4 DQPSK
EUT 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 24-26°C with a relative humidity of 50 - 65%.
Modification to the EUT	None
Test Exercise	The EUT was operated in a normal mode.
Applicable Standards	FCC CFR 47 Part 90, FCC 12-114
Measurement Procedures	ANSI/TIA 603-D:2010, FCC KDB 971168 v02r02
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.

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SUMMARY OF TEST RESULTS

Rule Part No.	Test Item	Result
2.1047(d)	Modulation Characteristics	Pass
90.205 (d)(3)(h), 2.1046	Maximum Conducted Power	Pass
90.209(b)(5), 2.1049	Occupied Bandwidth	Pass
90.221(a)(c), 2.1051	Adjacent Channel Power	Pass
90.221(d), 2.1051	Spurious Emissions At Antenna Terminals	Pass
90.221(d), 2.1053	Field Strength of Spurious Radiation	Pass
90.213(a), 2.1055	Frequency Stability	Pass

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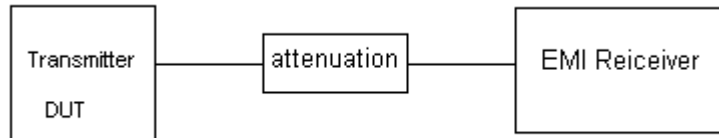
RF POWER OUTPUT

Rule Part No.: Part 2.1046(a), Part 90.205 (d)(3)(h)

Test Requirements: Reporting only, geographical area dependent limit

Method of Measurement: KDB 971168 v02r02, § 5.1.1 EMI Receiver Peak Power measurement

Test Setup Diagram:



Test Data: ERP Conducted Power Output

Tuned Frequency (MHz)	RF POWER (W)	
	HI	LOW
450.025	43.4	-
460.025	43.4	-
469.975	43.4	-

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MODULATION CHARACTERISTICS

Rule Part No.: 2.1047(d)

Requirements: A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed

Test Data: Customer provided Description

Modulation characteristics¶

Part-2.1033(c)·Part-2.1033(c)·(4)·FCC-Part-90.209,·IC-RSS-119.5.5·FCC-Part-90.207¶

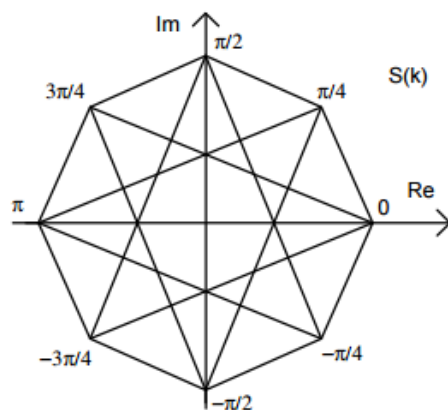
Type of Emission: $\pi/4$ DQPSK·TETRA as defined in EN-300-392-2·TETRA is a digital, trunked radio technology that operates with Time-Division-Multiple-Access (TDMA) in four-slot channels within a twenty-five kilohertz bandwidth.¶

The modulation rate is 36 kbit/s. For $\pi/4$ DQPSK modulation, the phase transitions are related to the modulation bits as shown in the table below:¶

B(2k-1)	B(2k)	D ϕ (k)
1	1	$-3\pi/4$
0	1	$+3\pi/4$
0	0	$+\pi/4$
1	0	$-\pi/4$

¶

Constellation diagram:¶



¶

¶

¶

Audio frequency response¶

¶

ACELP-digitally-encoded voice.¶

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Applicant: ROHILL TECHNOLOGIES B.V.
FCC ID: 2AGJ3R-8070-450MHZ
Report: 113AUT16TestReport_Rev1

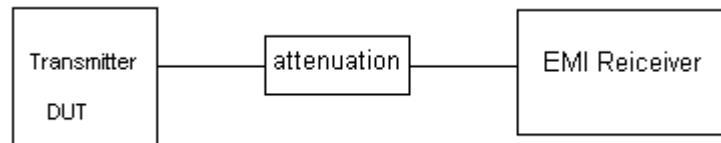
OCCUPIED BANDWIDTH

Rule Part No.: 2.1049

Requirements: The 99% Power Occupied Bandwidth must be \leq the authorized Bandwidth

Method of Measurement: KDB 971168 v02r02, § 4.2 Power BW 99% measurement

Test Setup Diagram:



Test Data: Occupied Bandwidth Measurement Table

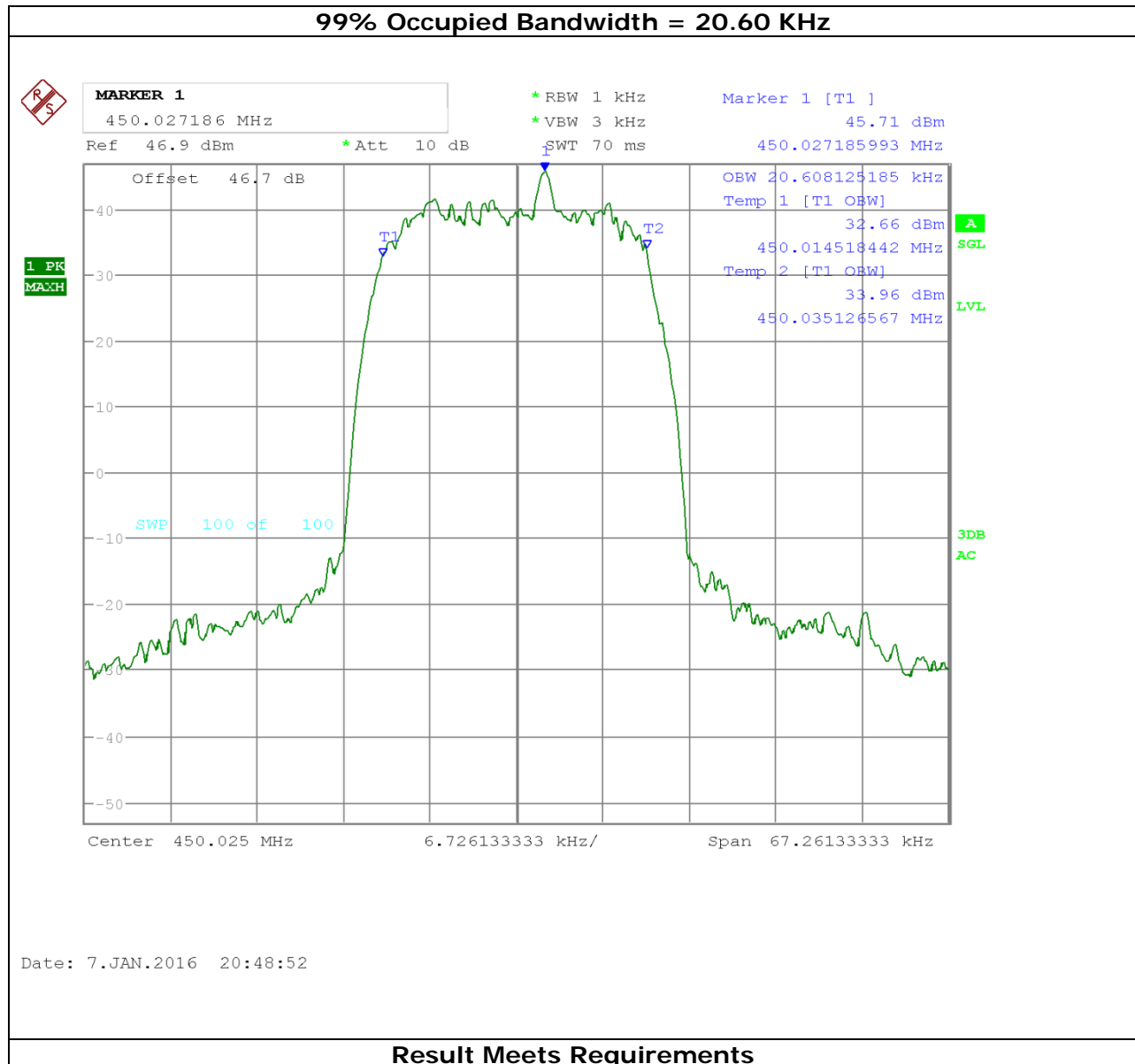
Tuned Frequency (MHz)	99% OBW (KHz)	Authorized BW (KHz)
450.025	20.6	≤ 22
460.025	20.47	
469.975	20.47	

Results Meet Requirements

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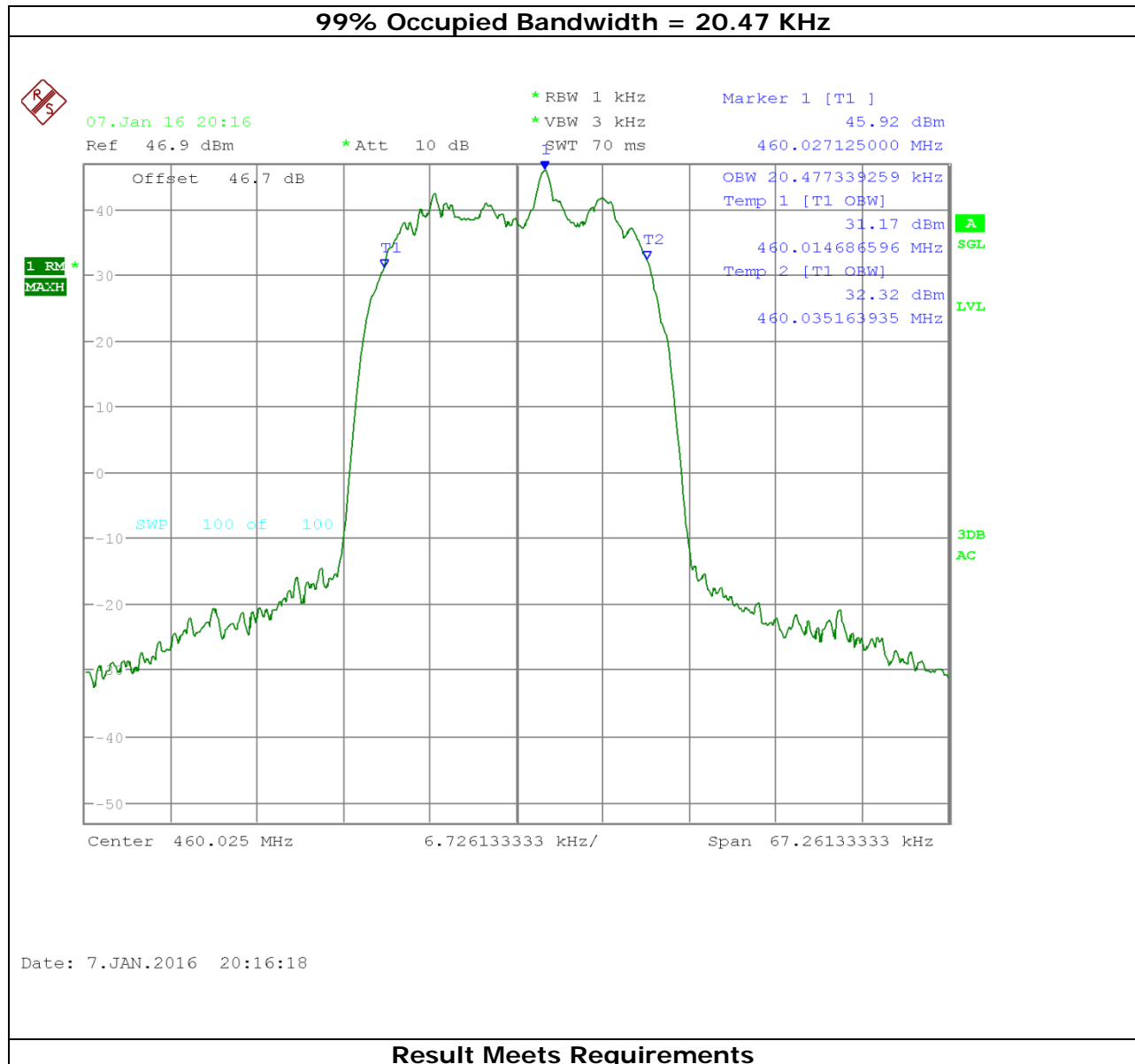
OCCUPIED BANDWIDTH

Test Data: Low End of Band



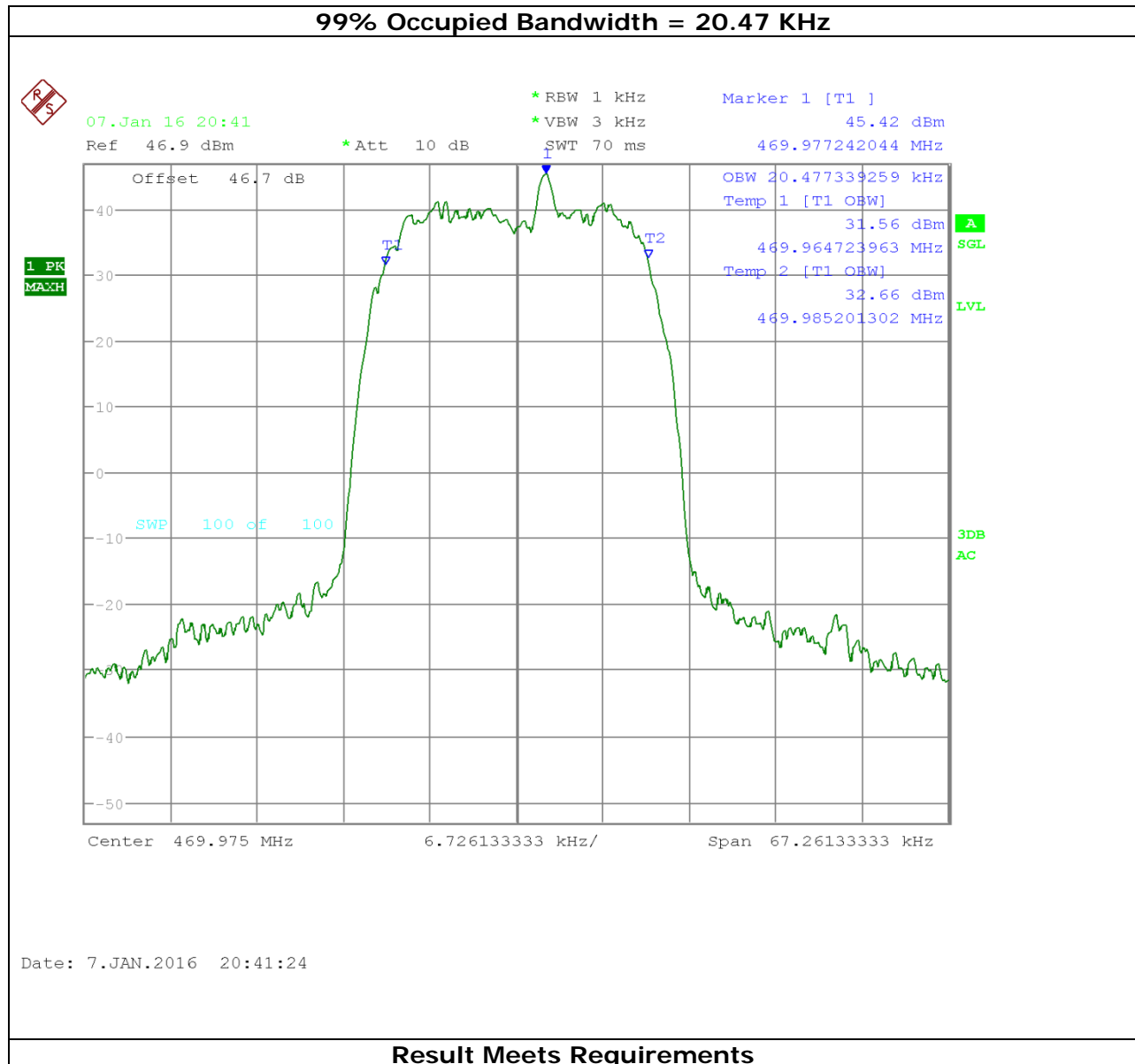
OCCUPIED BANDWIDTH

Test Data: Middle of Band



OCCUPIED BANDWIDTH

Test Data: High End of Band



ADJACENT CHANNEL POWER (ACP)

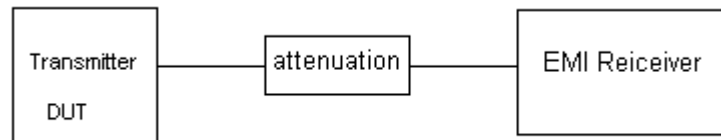
Rule Parts. No.: 90.221(a) & (c)

Requirements: Operations using equipment designed to operate with a 25 kHz channel bandwidth may be authorized up to a 22 kHz bandwidth if the equipment meets the adjacent channel power (ACP) limits below. The table specifies a value for the ACP as a function of the displacement from the channel center frequency and a measurement bandwidth of 18 kHz.

Max ACP levels for frequencies in the 450 - 470 MHz band		
Frequency Offset (KHz)	Max ACP for devices < 1 Watt (dBc)	Max ACP for devices < 1 Watt (dBc)
25	-55	-60
50	-70	-70
75	-70	-70

Method of Measurement: The EUT was configured at maximum power and modulation and connected to a EMI receiver through a cable and attenuator. The EMI receiver is capable of automatic ACP testing. The TETRA radio standard test function was configured per the requirements and used for this test.

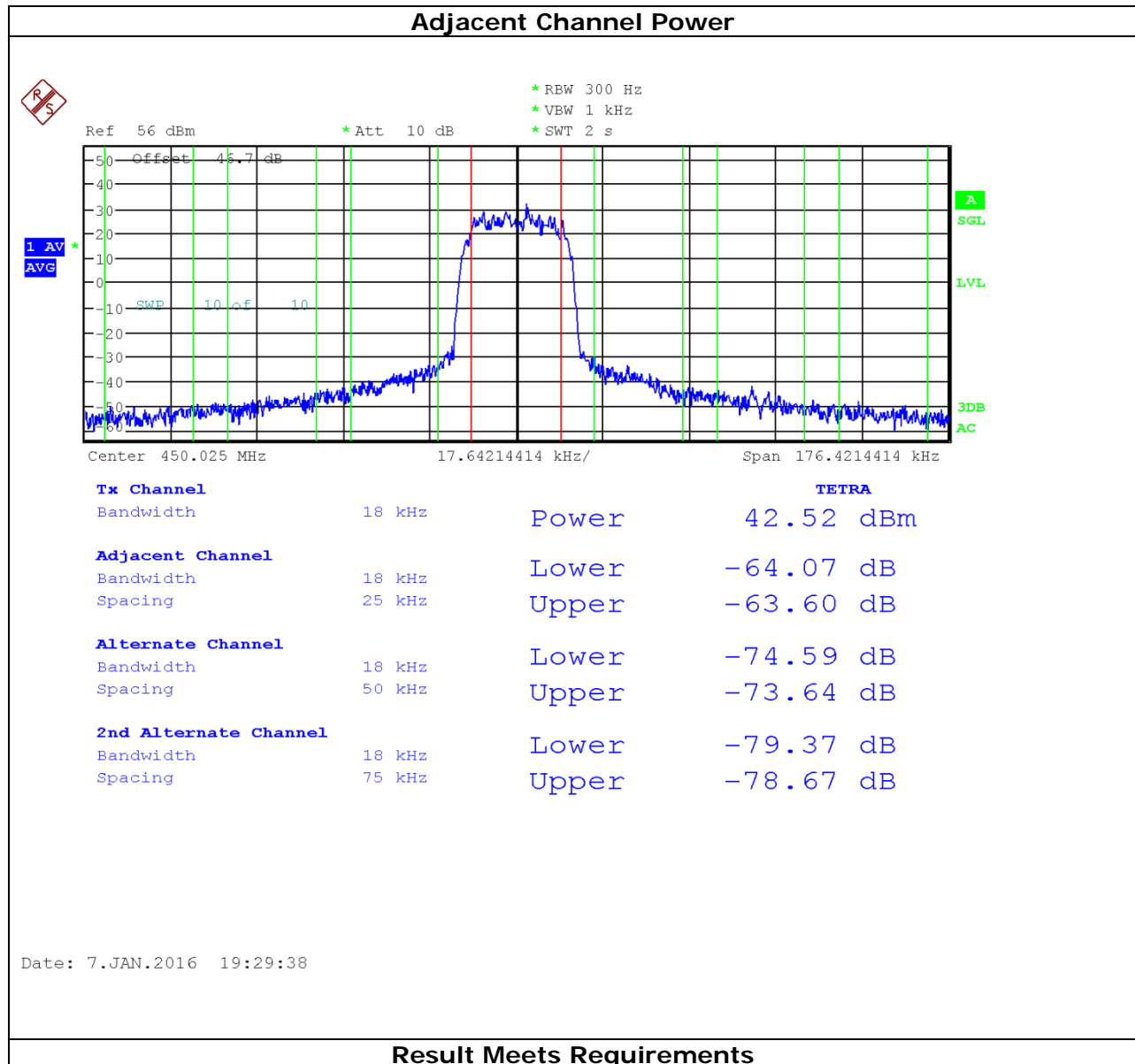
Test Setup Diagram:



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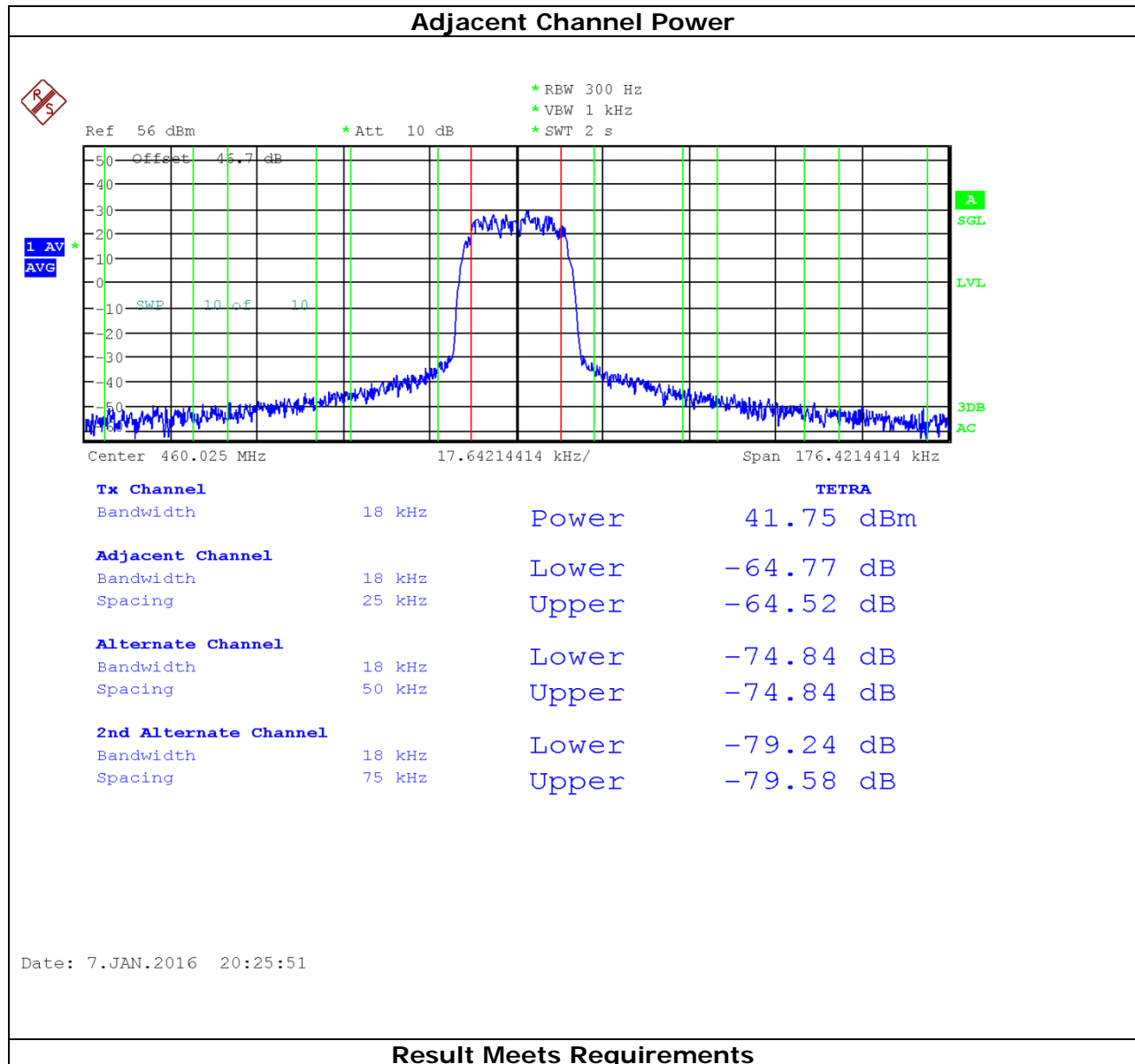
ADJACENT CHANNEL POWER (ACP)

Test Data: Low End of Band



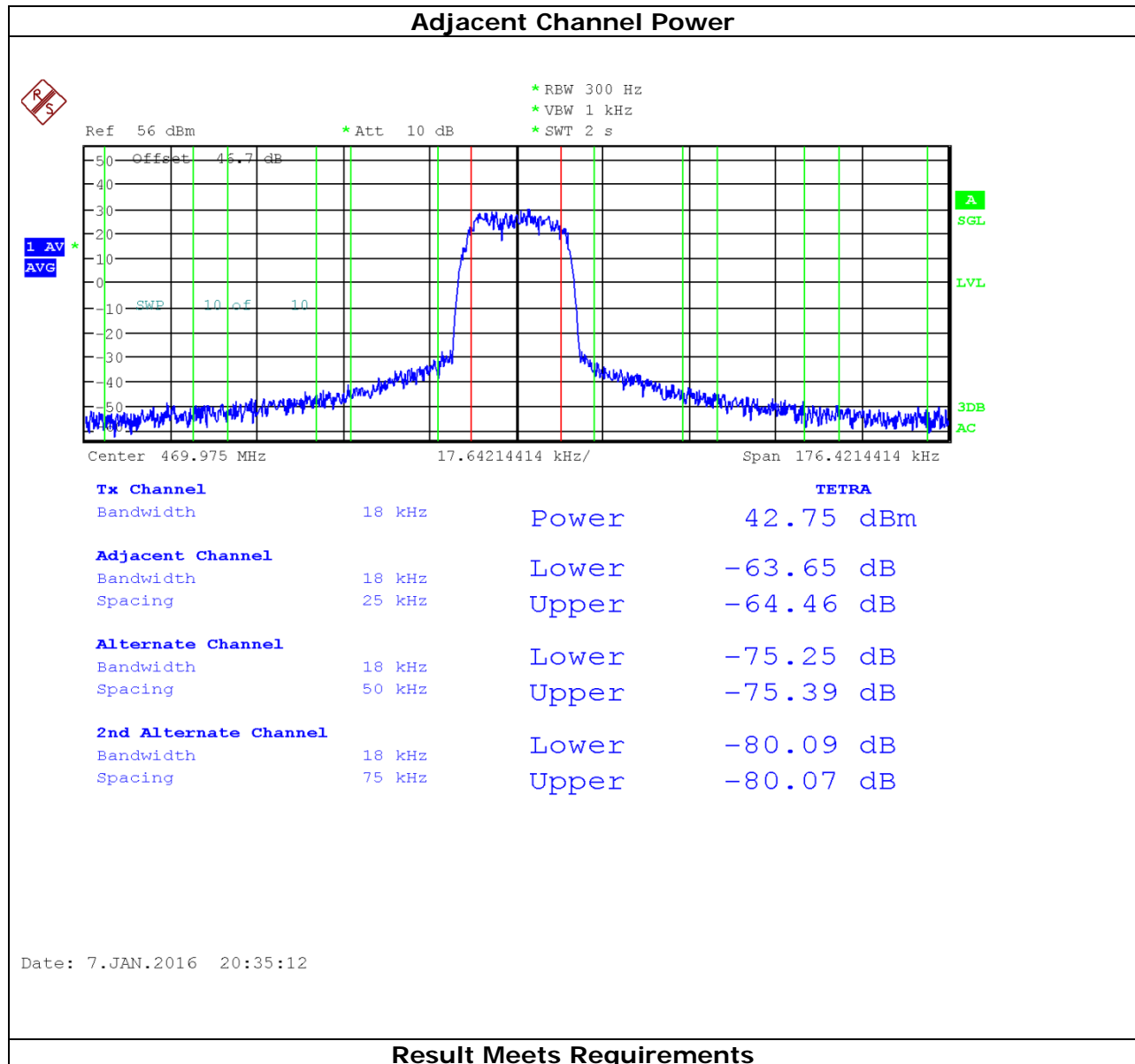
ADJACENT CHANNEL POWER (ACP)

Test Data: Middle of Band



ADJACENT CHANNEL POWER (ACP)

Test Data: High End of Band



SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051(a), 90.221 (d)

Requirements: On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least $43 + 10 \log$ (Pwatts) dB.

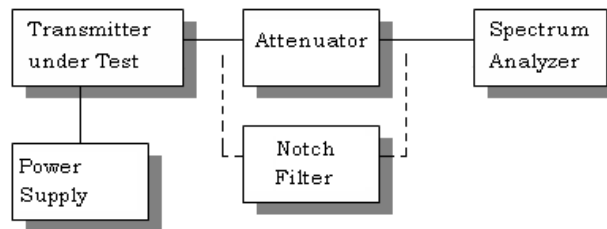
$$43 + 10 \log (33.4) = 58.24 \text{ dBc}$$

$$43 + 10 \log (36.6) = 58.64 \text{ dBc}$$

$$43 + 10 \log (33.2) = 58.21 \text{ dBc}$$

Method of Measurement: ANSI/TIA 603 § 2.2.13 Conducted Spurious

Test Setup Diagram:



Test Data: Low End of Band

	dBm	dBm	Watts
Power Output	46.4	46.4	43.4
	Frequency	dBm	dBc
	450.025	45.24	0
	900.050	-60.90	107.3
	1350.075	-56.50	102.9
	1800.100	-67.44	113.84
	2250.125	-69.84	116.24
	2700.150	-70.37	116.77
	3150.175	-65.23	111.63
*	3600.200	-59.82	106.22
*	4050.225	-61.14	107.54
*	4500.250	-60.19	106.59

* Indicates only the noise floor was present

Results meet requirements

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: Middle of Band

	dBm	dBm	Watts
Power Output	46.4	46.4	43.4
	Frequency	dBm	dBc
	460.025	46.4	0
	920.050	-66.09	112.49
	1380.075	-52.6	99
	1840.100	-67.44	113.84
	2300.125	-69.84	116.24
	2760.150	-67.87	114.27
	3220.175	-65.23	111.63
*	3680.200	-59.82	106.22
*	4140.225	-61.14	107.54
*	4600.250	-60.19	106.59

* Indicates only the noise floor was present

Results meet requirements

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: High End of Band

	dBm	dBm	Watts
Power Output	46.4	46.4	43.4
	Frequency	dBm	dBc
	469.975	-72.04	0.0
	939.950	-46.01	92.4
	1409.925	-68.66	115.1
	1879.900	-66.31	112.7
	2349.875	-67.64	114.0
	2819.850	-65.69	112.1
*	3289.825	-58.94	105.3
*	3759.800	-60.91	107.3
*	4229.775	-59.96	106.4
*	4699.750	-57.79	104.2

* Indicates only the noise floor was present

✓ Results meet requirements

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FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

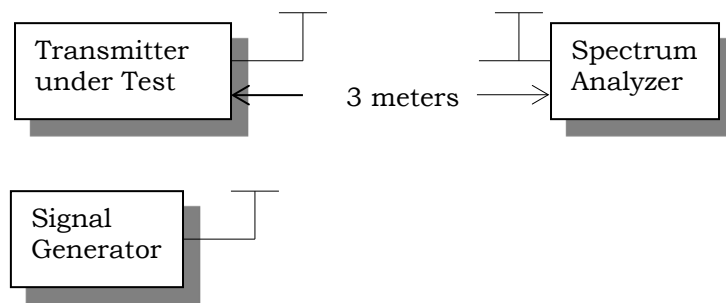
Rule Parts. No.: Part 2.1053, 90.221 (d)

Requirements: On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least $43 + 10 \log$ (Pwatts) dB.

$$43 + 10 \log (33.2) = 58.21 \text{ dBc}$$

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 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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FIELD STRENGTH OF SPURIOUS RADIATION EMISSIONS

Rule Parts. No.: Part 2.1053

Test Data: High End of Band

Emission Frequency (MHz)	Power Mode	ERP Power Output (dBm)	ERP Power Output (Watts)	IC Requirement dB	Bandwidth - BW - kHz
469.975	Hi	46.4	43.4	59.37	25.00
Emission Frequency (MHz)	Ant. Polarity	Below Carrier (dBc)		Margin	
939.95	H	96.98		37.61	
1,409.93	V	99.33		39.96	
1,879.90	V	97.05		37.68	
2,349.88	V	85.77		26.40	
2,819.85	H	96.29		36.92	
3,289.83	V	92.85		33.48	
3,759.80	V	91.79		32.42	
4,229.78	H	95.3		35.93	
4,699.75	H	98.59		39.22	

Note: 3 places in the band were investigated and the worst case reported

Results meet requirements

FREQUENCY STABILITY

Rule Parts. No.: Part 2.1055, Part 90.213 (a)

Requirements: Temperature range requirements: -30 to +50° C.

Voltage Variation +, -15%

450 – 470 MHz ± 2.5 PPM

Method of Measurements: ANSI/TIA 603 section 2.2.2 Carrier Frequency Stability

Test Data: Low End of Band

Temperature	Frequency MHz	Cycles	PPM
25°C (reference)	450.025333		
-30°C	450.025456	123	0.273
-20°C	450.025459	126	0.280
-10°C	450.025457	124	0.275
0°C	450.025450	117	0.261
10°C	450.025393	60	0.133
20°C	450.025363	30	0.067
30°C	450.025366	33	0.073
40°C	450.025474	141	0.313
50°C	450.025543	210	0.467
Battery Voltage	Frequency	Cycles	PPM
-15%	450.025339	6	0.013
15%	450.025336	3	0.007

Results Meet Requirements

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EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
24 Volt Power Supply	Astron	VLS-25M	9510040 NO	12/12/99	12/12/99
12 Volt Power Supply	Astron	RS-12A	9312779 NO	12/12/99	12/12/99
Antenna: Biconnical	Eaton	94455-1	1057 YES	11/18/15	11/18/17
DC Power Supply	HP	6264B	2032A04119 NO	12/12/99	12/12/99
Temperature Chamber LARGE	Tenney Engineering	TTRC	11717-7	08/19/14	08/19/16
AC Voltmeter	HP	400FL	2213A14728 NO	10/24/15	10/24/17
Digital Multimeter	Fluke	77	35053830	10/21/15	10/21/17
DC Power Supply	HP	6286A	2411A09414	12/12/99	12/12/99
Frequency Counter Large Chamber	HP	5352B	2632A00165 NO	07/01/15	07/01/17
CHAMBER	Panashield	N/A	N/A	01/05/16	03/01/16
Antenna: Double-Ridged Horn/ETS Horn 1	ETS-Lindgren	3117	00035923	06/13/14	06/13/16
Software: Field Strength Program	Timco	N/A	Version 4.0	12/12/99	12/12/99
Antenna: Active Loop	ETS-Lindgren	6502	00062529 YES	11/18/15	11/18/17
Hygro-Thermometer	Extech	445703	0602	06/30/15	06/30/17
Attenuator N 30dB 150W DC-6G	Narda	769-30	10267	06/26/15	06/26/17
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	03/11/14	03/11/16
Sweep/Signal Generator	Anritsu	68369B	985112	10/28/15	10/28/17
Service Monitor IFR FM/AM 500A	IFR	FM/AM 500A	5182	12/26/13	6/26/16

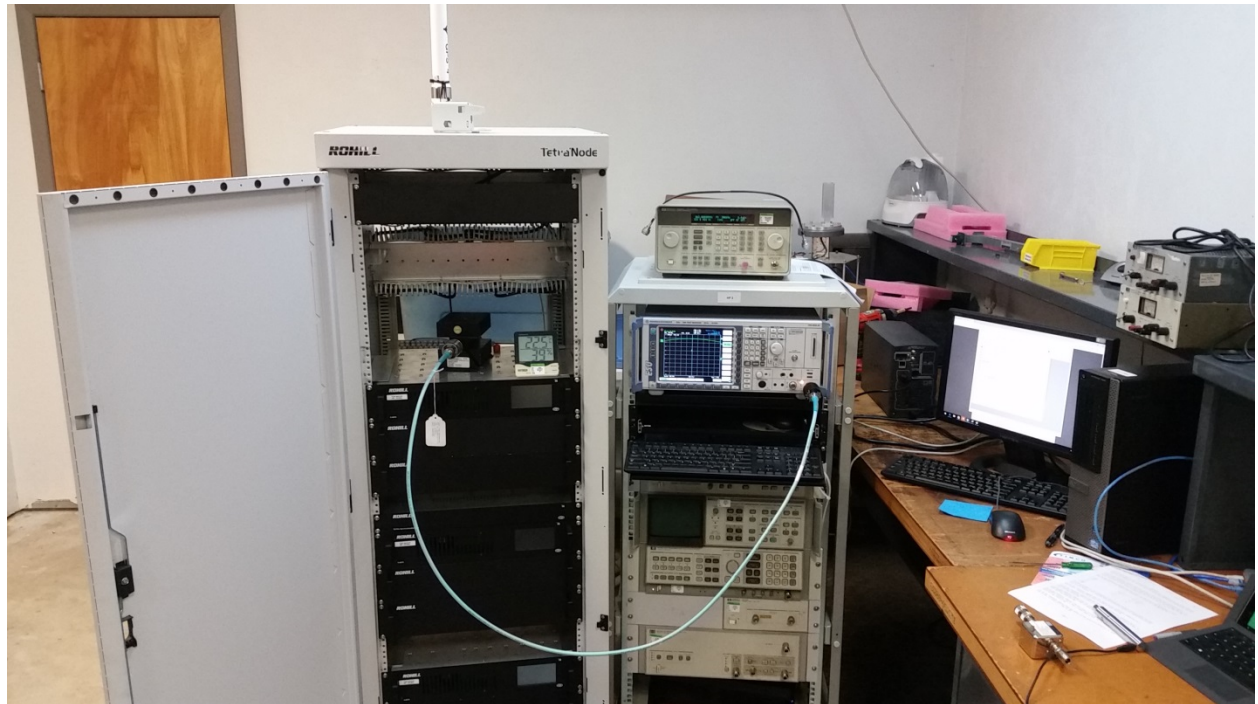
*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

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APPLICANT: ROHILL
FCC ID: 2AGJ3R-8080-450MHZ
TEST SET UP PHOTOS

OUTPUT POWER/OCCUPIED BANDWIDTH



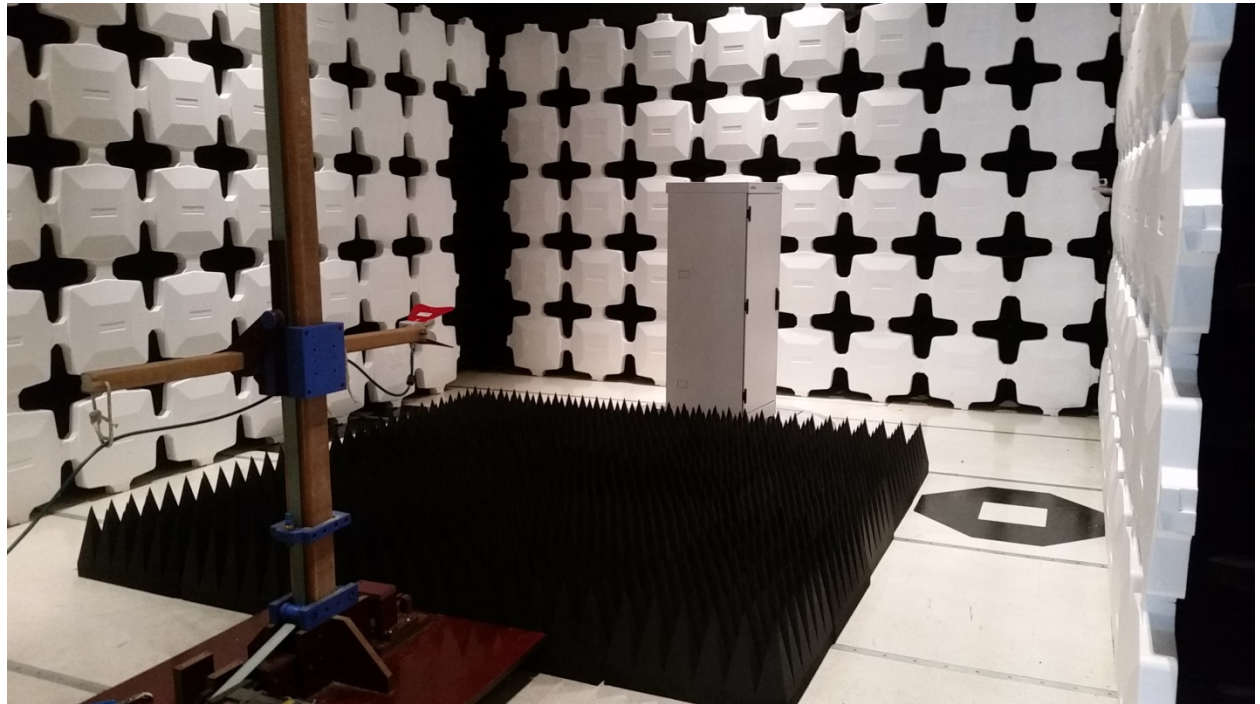
SPURIOUS EMISSIONS AT ANTENNA



FIELD STRENGTH SPURIOUS EMISSIONS BELOW 1 GHz



FIELD STRENGTH SPURIOUS EMISSIONS ABOVE 1 GHz



FIELD STRENGTH SPURIOUS EMISSIONS FINAL SETUP



Frequency Stability

