

# NORTHWEST EMC

## FreeWave Technologies, Inc.

Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)

FCC 15.207:2016

FCC 15.247:2016

915 MHz FHSS Radio

Report # FREW0054.5



NVLAP Lab Code: 200629-0

*This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government of the United States of America. This Report may only be duplicated in its entirety*

# CERTIFICATE OF TEST

Last Date of Test: January 18, 2016

FreeWave Technologies, Inc.

Model: Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)

## Radio Equipment Testing

### Standards

Specification	Method
FCC 15.207:2016	ANSI C63.10:2013
FCC 15.247:2016	ANSI C63.10:2013

### Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	Yes	Pass	
6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	
7.5	Duty Cycle	Yes	N/A	
7.8.2	Carrier Frequency Separation	Yes	Pass	
7.8.3	Number of Hopping Frequencies	Yes	Pass	
7.8.4	Dwell Time	Yes	Pass	
7.8.5	Output Power	Yes	Pass	
7.8.6	Band Edge Compliance	Yes	Pass	
7.8.6	Band Edge Compliance - Hopping Mode	Yes	Pass	
7.8.7	Occupied Bandwidth	Yes	Pass	
7.8.8	Spurious Conducted Emissions	Yes	Pass	
11.10.2	Power Spectral Density	No	N/A	Not required for FHSS devices.

### Deviations From Test Standards

None

### Approved By:



Rod Munro, Operations Manager

*Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information.*

# REVISION HISTORY

Revision Number		Description	Date	Page Number
00		None		

# ACCREDITATIONS AND AUTHORIZATIONS

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## United States

**FCC** - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

**A2LA** - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Northwest EMC to certify transmitters to FCC and IC specifications.

**NVLAP** - Each laboratory is accredited by NVLAP to ISO 17025

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## Canada

**IC** - Recognized by Industry Canada as a Certification Body (CB). Certification chambers and Open Area Test Sites are filed with IC.

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## European Union

**European Commission** – Validated by the European Commission as a Conformity Assessment Body (CAB) under the EMC directive and as a Notified Body under the R&TTE Directive.

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## Australia/New Zealand

**ACMA** - Recognized by ACMA as a CAB for the acceptance of test data.

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## Korea

**MSIP / RRA** - Recognized by KCC's RRA as a CAB for the acceptance of test data.

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## Japan

**VCCI** - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

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## Taiwan

**BSMI** – Recognized by BSMI as a CAB for the acceptance of test data.

**NCC** - Recognized by NCC as a CAB for the acceptance of test data.

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## Singapore

**IDA** – Recognized by IDA as a CAB for the acceptance of test data.

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## Israel

**MOC** – Recognized by MOC as a CAB for the acceptance of test data.

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## Hong Kong

**OFCA** – Recognized by OFCA as a CAB for the acceptance of test data.

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## Vietnam

**MIC** – Recognized by MIC as a CAB for the acceptance of test data.

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## SCOPE

For details on the Scopes of our Accreditations, please visit:

<http://www.nwemc.com/accreditations/>  
<http://gsi.nist.gov/global/docs/cabs/designations.html>

# MEASUREMENT UNCERTAINTY

## Measurement Uncertainty

When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

A measurement uncertainty estimation has been performed for each test per our internal quality document WP 342. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) for each test is on each data sheet. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

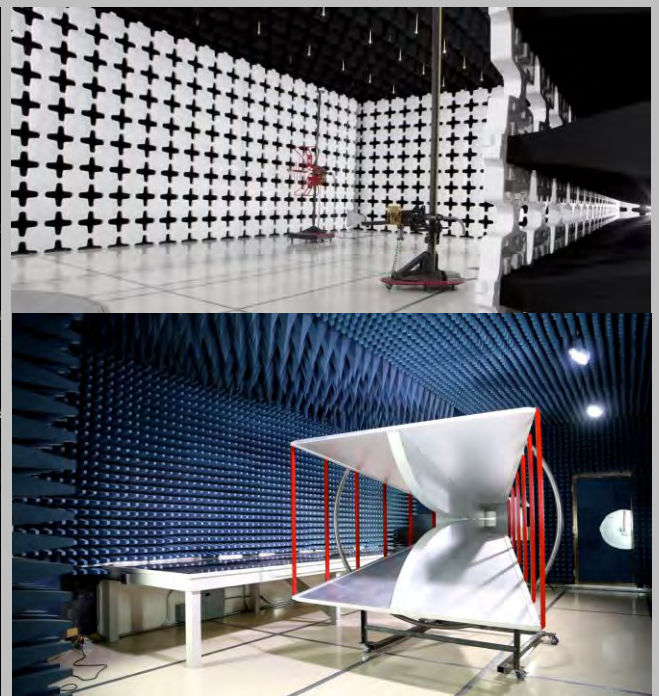
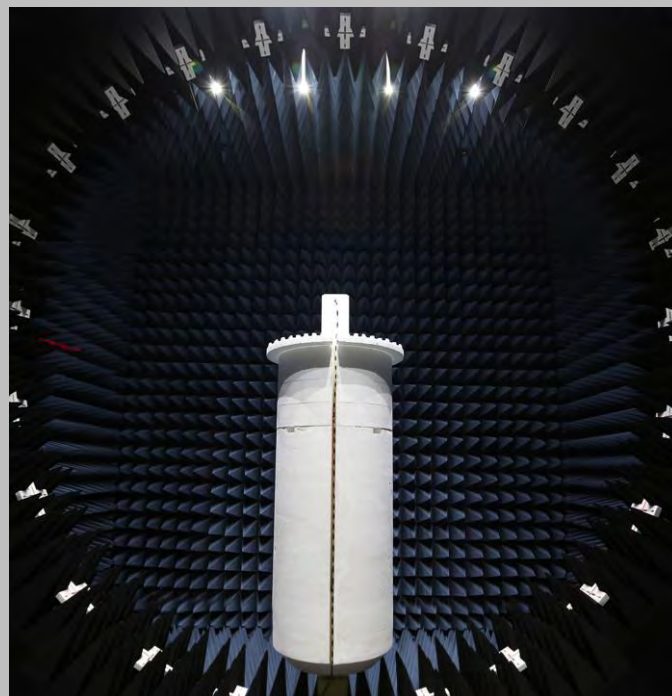
The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

<b>Test</b>	<b>+ MU</b>	<b>- MU</b>
Frequency Accuracy (Hz)	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	0.3 dB	-0.3 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.0 dB	-5.0 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

# FACILITIES



<b>California</b> Labs OC01-13 41 Tesla Irvine, CA 92618 (949) 861-8918	<b>Minnesota</b> Labs MN01-08, MN10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	<b>New York</b> Labs NY01-04 4939 Jordan Rd. Elbridge, NY 13060 (315) 554-8214	<b>Oregon</b> Labs EV01-12 22975 NW Evergreen Pkwy Hillsboro, OR 97124 (503) 844-4066	<b>Texas</b> Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	<b>Washington</b> Labs NC01-05 19201 120 <sup>th</sup> Ave NE Bothell, WA 98011 (425)984-6600
<b>NVLAP</b>					
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200761-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
<b>Industry Canada</b>					
2834B-1, 2834B-3	2834E-1	N/A	2834D-1, 2834D-2	2834G-1	2834F-1
<b>BSMI</b>					
SL2-IN-E-1154R	SL2-IN-E-1152R	N/A	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
<b>VCCI</b>					
A-0029	A-0109	N/A	A-0108	A-0201	A-0110
<b>Recognized Phase I CAB for ACMA, BSMI, IDA, KCC/RRR, MIC, MOC, NCC, OFCA</b>					
US0158	US0175	N/A	US0017	US0191	US0157





# PRODUCT DESCRIPTION

## Client and Equipment Under Test (EUT) Information

<b>Company Name:</b>	FreeWave Technologies, Inc.
<b>Address:</b>	5395 Pearl Parkway, Suite 100
<b>City, State, Zip:</b>	Boulder, CO 80301
<b>Test Requested By:</b>	Dean Busch
<b>Model:</b>	Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)
<b>First Date of Test:</b>	January 04, 2016
<b>Last Date of Test:</b>	January 18, 2016
<b>Receipt Date of Samples:</b>	January 04, 2016
<b>Equipment Design Stage:</b>	Production
<b>Equipment Condition:</b>	No Damage

## Information Provided by the Party Requesting the Test

<b>Functional Description of the EUT:</b>
902 MHz - 928 MHz FHSS Radio Module with a 7.15 dBi Antenna
<b>Testing Objective:</b>
Seeking to demonstrate compliance of the FHSS radio module under FCC 15.247 for operation in the 902 - 928 MHz Band.

# ISM RF Power Table – FCC 15.247

## Max Power Settings:

	Data Rate	
	115.2kb	250kb
Low Channel	30	30
Mid Channel	30	30
High Channel	30	30

## Power Settings for 7.15dBi Antenna:

	Data Rate	
	115.2kb	250kb
Low Channel	29	29
Mid Channel	29	29
High Channel	29	29



# CONFIGURATIONS

## Configuration FREW0054- 1

Software/Firmware Running during test					
Description				Version	
Firmware				FWT0001TA.69	

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
900 MHz Industrial Radio Module	Freewave Technologies, Inc.	Z9-T	402-669-0330
Translation Board	Freewave Technologies, Inc.	MM2-MR	402-661-3868
Radio Module (Includes models Z9-T and MM2-MR)	Freewave Technologies, Inc.	Z9-C	None

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
AC-DC Power Supply	Leader Electronics Inc	MT12-Y090100-A1	None
Laptop Computer	Dell	Latitude E6520	None

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
Serial to USB Cable	No	1.8m	No	Translation Board	Laptop Computer
DC Power	No	1.7m	No	AC-DC Power Supply	Translation Board

# CONFIGURATIONS

## Configuration FREW0054- 4

Software/Firmware Running during test			
Description	Version		
Firmware	FWT0001TA.69		

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
900 MHz Industrial Radio Module	Freewave Technologies, Inc.	Z9-T	402-669-0330
Translation Board	Freewave Technologies, Inc.	MM2-MR	402-661-3868
Radio Module (Includes models Z9-T and MM2-MR)	Freewave Technologies, Inc.	Z9-C	None

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
AC-DC Power Supply	Leader Electronics Inc	MT12-Y090100-A1	None
7.15dBi Elevated Feed Antenna	Antenex	EB8965C	None

Remote Equipment Outside of Test Setup Boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop Computer	Lenovo	T500	None

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
DC Power	No	1.7m	No	AC-DC Power Supply	Translation Board
Serial to USB Cable	No	1.8m	No	Serial Extension Cable	Laptop Computer
Serial Extension Cable	No	9.0m	No	Translation Board	Serial to USB Cable
Coaxial Cable	Yes	0.6m	No	900 MHz Industrial Radio Module	7.15dBi Elevated Feed Antenna

# CONFIGURATIONS

## Configuration FREW0054- 7

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
900 MHz Industrial Radio Module	Freewave Technologies, Inc.	Z9-T	402-669-0330
Translation Board	Freewave Technologies, Inc.	MM2-MR	402-661-3868
Radio Module (Includes models Z9-T and MM2-MR)	Freewave Technologies, Inc.	Z9-C	None

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
Laptop Computer	Lenovo	T500	None
AC Brick	Lenovo	42T4418	None
7.15dBi Elevated Feed Antenna	Antenex	EB8965C	None
DC Power Supply	Kikisui	PWC0620	1930492

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
Serial to USB Cable	No	1.8m	No	Translation Board	Laptop Computer
AC Power	No	0.8m	No	AC Mains	AC Brick
DC Power	No	1.6m	No	AC Brick	Laptop Computer
Coaxial Cable	Yes	0.6m	No	900 MHz Industrial Radio Module	7.15dBi Elevated Feed Antenna
DC Power	No	1.0m	No	DC Mains	Translation Board
AC Power	Yes	1.5m	No	AC Mains	DC Power Supply

# MODIFICATIONS

## Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	1/4/2016	Duty Cycle	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
2	1/4/2016	Band Edge Compliance	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
3	1/4/2016	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
4	1/4/2016	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
5	1/5/2016	Band Edge Compliance - Hopping Mode	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
6	1/6/2016	Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
7	1/5/2016	Dwell Time	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
8	1/5/2016	Number of Hopping Frequencies	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
9	1/5/2016	Carrier Frequency Separation	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
10	1/7/2016	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
11	1/18/2016	Powerline Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

# POWERLINE CONDUCTED EMISSIONS

## TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, conducted emissions tests were performed. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Per the standard, an insulating material was also added to ground plane between the EUT's power and remote I/O cables. Equipment is tested with power cords that are normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network), the 50ohm measuring port is terminated by a 50ohm EMI meter or a 50ohm resistive load. All 50ohm measuring ports of the LISN are terminated by 50ohm. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
LISN	Solar Electronics	9252-50-R-24-BNC	LIK	11/3/2015	11/3/2017
LISN	Solar Electronics	9252-50-R-24-BNC	LIM	11/3/2015	11/3/2016
Receiver	Rohde & Schwarz	ESCI	ARE	8/5/2015	8/5/2016
Cable - Conducted Cable Assembly	Northwest EMC	NC4, HHF, RKD	NC4A	12/28/2015	12/28/2016

## MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	2.4 dB	-2.4 dB

## CONFIGURATIONS INVESTIGATED

FREW0054-7

## MODES INVESTIGATED

Transmitting Mid Channel 56, 914.9184 MHz, 115.2kbps, Power Level = 29.  
Transmitting Mid Channel 37, 914.976 MHz, 250kbps, Power Level = 29.

# POWERLINE CONDUCTED EMISSIONS

EUT:	Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)	Work Order:	FREW0054
Serial Number:	402-669-0330	Date:	01/18/2016
Customer:	FreeWave Technologies, Inc.	Temperature:	23°C
Attendees:	None	Relative Humidity:	38%
Customer Project:	None	Bar. Pressure:	1016 mb
Tested By:	Richard Mellroth	Job Site:	NC05
Power:	110VAC/60Hz	Configuration:	FREW0054-7

## TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2016	ANSI C63.10:2013

## TEST PARAMETERS

Run #:	11	Line:	High Line	Add. Ext. Attenuation (dB):	0
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## COMMENTS

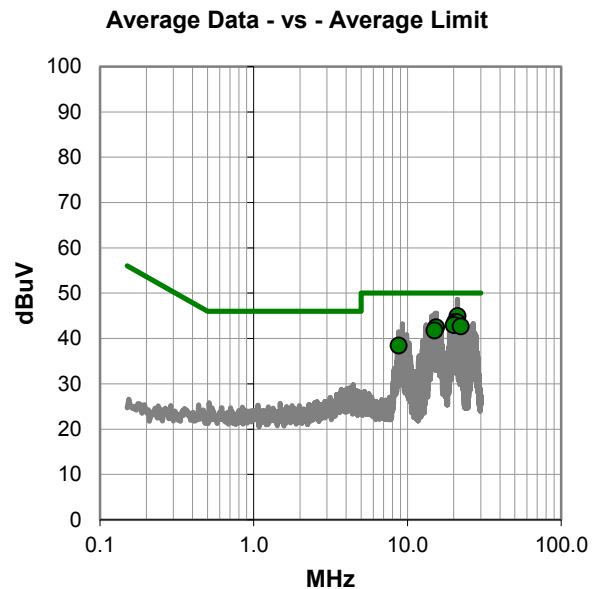
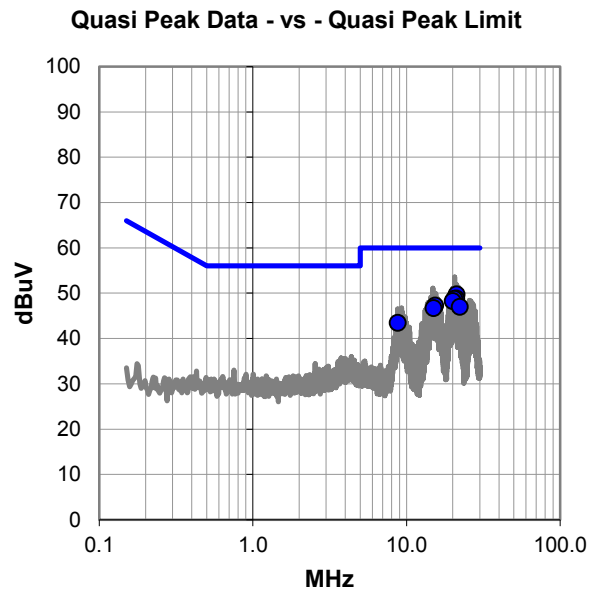
DC Power Supply powered by AC Mains, providing 9VDC to EUT
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## EUT OPERATING MODES

Transmitting Mid Channel 56, 914.9184 MHz, 115.2kbps, Power Level = 29.
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## DEVIATIONS FROM TEST STANDARD

None
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# POWERLINE CONDUCTED EMISSIONS

## RESULTS - Run #11

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
21.180	27.2	22.5	49.7	60.0	-10.3
21.075	26.3	22.5	48.8	60.0	-11.2
20.479	26.3	22.4	48.7	60.0	-11.3
20.077	25.8	22.4	48.2	60.0	-11.8
15.421	25.4	21.9	47.3	60.0	-12.7
22.285	24.3	22.7	47.0	60.0	-13.0
15.023	24.9	21.8	46.7	60.0	-13.3
8.777	22.4	21.0	43.4	60.0	-16.6

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
21.180	22.4	22.5	44.9	50.0	-5.1
20.479	21.2	22.4	43.6	50.0	-6.4
21.075	21.1	22.5	43.6	50.0	-6.4
20.077	20.5	22.4	42.9	50.0	-7.1
22.285	20.0	22.7	42.7	50.0	-7.3
15.421	20.6	21.9	42.5	50.0	-7.5
15.023	19.9	21.8	41.7	50.0	-8.3
8.777	17.4	21.0	38.4	50.0	-11.6

## CONCLUSION

Pass



Tested By



# POWERLINE CONDUCTED EMISSIONS

EUT:	Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)	Work Order:	FREW0054
Serial Number:	402-669-0330	Date:	01/18/2016
Customer:	FreeWave Technologies, Inc.	Temperature:	23°C
Attendees:	None	Relative Humidity:	38%
Customer Project:	None	Bar. Pressure:	1016 mb
Tested By:	Richard Mellroth	Job Site:	NC05
Power:	110VAC/60Hz	Configuration:	FREW0054-7

## TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2016	ANSI C63.10:2013

## TEST PARAMETERS

Run #:	12	Line:	Neutral	Add. Ext. Attenuation (dB):	0
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## COMMENTS

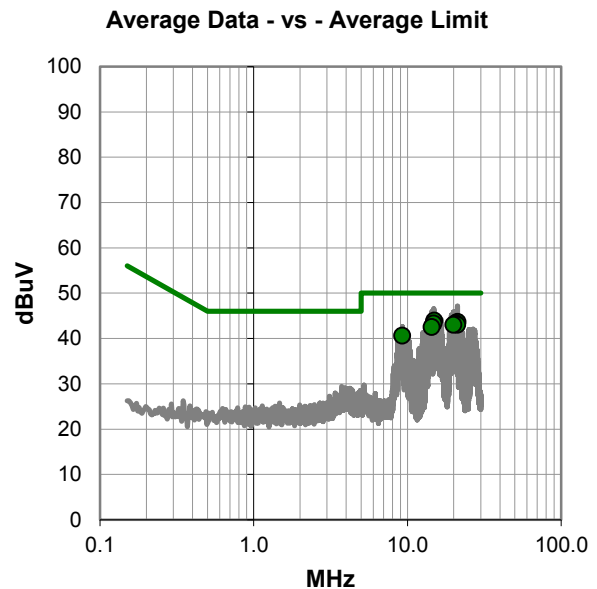
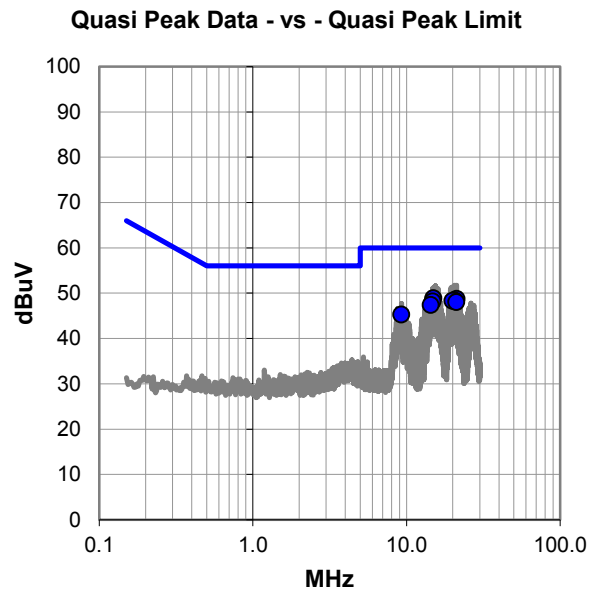
DC Power Supply powered by AC Mains, providing 9VDC to EUT
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## EUT OPERATING MODES

Transmitting Mid Channel 56, 914.9184 MHz, 115.2kbps, Power Level = 29.
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## DEVIATIONS FROM TEST STANDARD

None
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# POWERLINE CONDUCTED EMISSIONS

## RESULTS - Run #12

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
14.921	27.1	21.8	48.9	60.0	-11.1
21.177	26.2	22.5	48.7	60.0	-11.3
20.576	25.9	22.5	48.4	60.0	-11.6
19.968	25.9	22.4	48.3	60.0	-11.7
14.820	26.4	21.8	48.2	60.0	-11.8
21.077	25.5	22.5	48.0	60.0	-12.0
14.421	25.7	21.7	47.4	60.0	-12.6
9.278	24.2	21.1	45.3	60.0	-14.7

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
14.921	22.1	21.8	43.9	50.0	-6.1
21.177	21.1	22.5	43.6	50.0	-6.4
20.576	20.9	22.5	43.4	50.0	-6.6
14.820	21.5	21.8	43.3	50.0	-6.7
21.077	20.5	22.5	43.0	50.0	-7.0
19.968	20.6	22.4	43.0	50.0	-7.0
14.421	20.8	21.7	42.5	50.0	-7.5
9.278	19.5	21.1	40.6	50.0	-9.4

## CONCLUSION

Pass



Tested By

# POWERLINE CONDUCTED EMISSIONS

EUT:	Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)	Work Order:	FREW0054
Serial Number:	402-669-0330	Date:	01/18/2016
Customer:	FreeWave Technologies, Inc.	Temperature:	23°C
Attendees:	None	Relative Humidity:	38%
Customer Project:	None	Bar. Pressure:	1016 mb
Tested By:	Richard Mellroth	Job Site:	NC05
Power:	110VAC/60Hz	Configuration:	FREW0054-7

## TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2016	ANSI C63.10:2013

## TEST PARAMETERS

Run #:	13	Line:	High Line	Add. Ext. Attenuation (dB):	0
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## COMMENTS

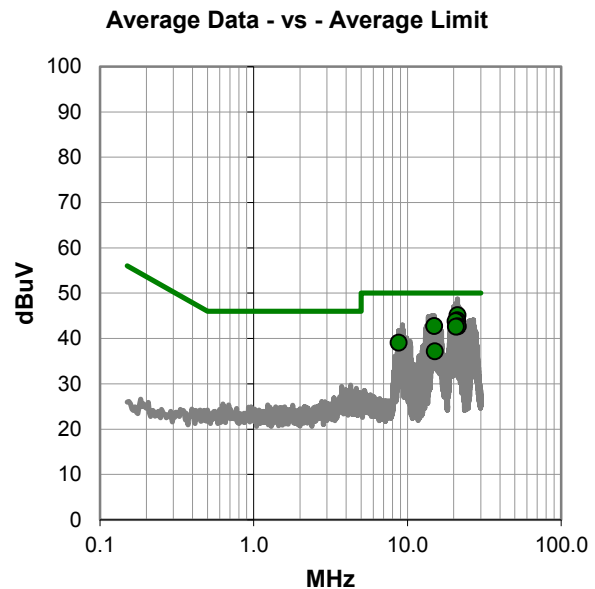
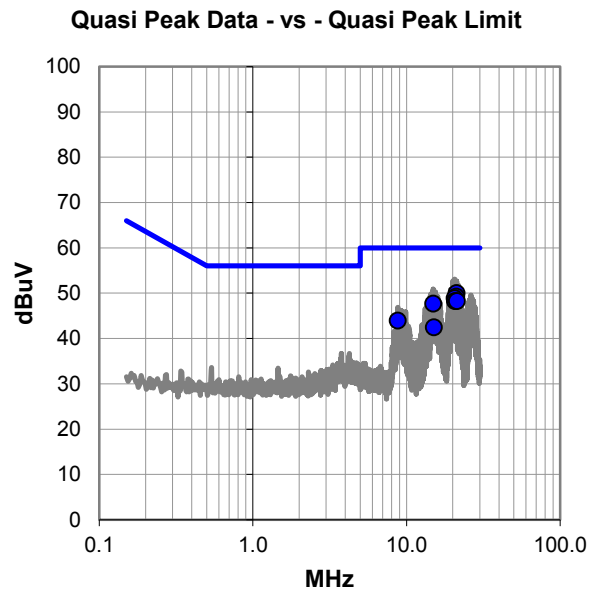
DC Power Supply powered by AC Mains, providing 9VDC to EUT
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## EUT OPERATING MODES

Transmitting Mid Channel 37, 914.976 MHz, 250kbps, Power Level = 29.
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## DEVIATIONS FROM TEST STANDARD

None
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# POWERLINE CONDUCTED EMISSIONS

## RESULTS - Run #13

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
21.177	27.5	22.5	50.0	60.0	-10.0
21.078	26.7	22.5	49.2	60.0	-10.8
20.576	26.4	22.5	48.9	60.0	-11.1
20.680	25.8	22.5	48.3	60.0	-11.7
21.278	25.7	22.5	48.2	60.0	-11.8
14.921	25.9	21.8	47.7	60.0	-12.3
8.779	22.9	21.0	43.9	60.0	-16.1
15.112	20.6	21.8	42.4	60.0	-17.6

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
21.177	22.6	22.5	45.1	50.0	-4.9
21.078	21.5	22.5	44.0	50.0	-6.0
20.576	21.3	22.5	43.8	50.0	-6.2
14.921	20.9	21.8	42.7	50.0	-7.3
21.278	20.1	22.5	42.6	50.0	-7.4
20.680	20.1	22.5	42.6	50.0	-7.4
8.779	18.0	21.0	39.0	50.0	-11.0
15.112	15.3	21.8	37.1	50.0	-12.9

## CONCLUSION

Pass



Tested By

# POWERLINE CONDUCTED EMISSIONS

EUT:	Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)	Work Order:	FREW0054
Serial Number:	402-669-0330	Date:	01/18/2016
Customer:	FreeWave Technologies, Inc.	Temperature:	23°C
Attendees:	None	Relative Humidity:	38%
Customer Project:	None	Bar. Pressure:	1016 mb
Tested By:	Richard Mellroth	Job Site:	NC05
Power:	110VAC/60Hz	Configuration:	FREW0054-7

## TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2016	ANSI C63.10:2013

## TEST PARAMETERS

Run #:	14	Line:	Neutral	Add. Ext. Attenuation (dB):	0
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## COMMENTS

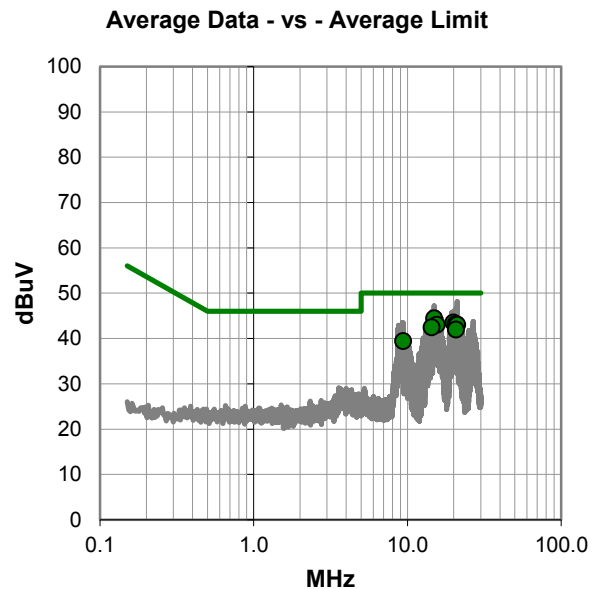
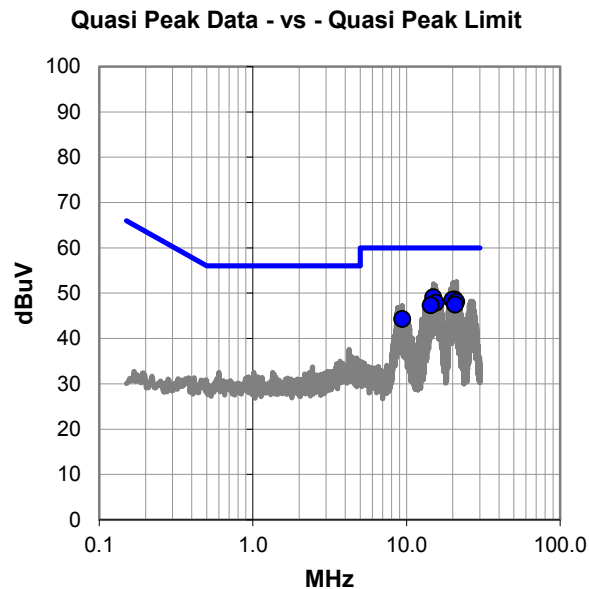
DC Power Supply powered by AC Mains, providing 9VDC to EUT
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## EUT OPERATING MODES

Transmitting Mid Channel 37, 914.976 MHz, 250kbps, Power Level = 29.
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## DEVIATIONS FROM TEST STANDARD

None
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# POWERLINE CONDUCTED EMISSIONS

## RESULTS - Run #14

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
14.920	27.3	21.8	49.1	60.0	-10.9
20.580	26.1	22.5	48.6	60.0	-11.4
19.974	26.1	22.4	48.5	60.0	-11.5
21.077	25.6	22.5	48.1	60.0	-11.9
15.522	26.0	21.9	47.9	60.0	-12.1
20.675	25.0	22.5	47.5	60.0	-12.5
14.419	25.6	21.7	47.3	60.0	-12.7
9.378	23.2	21.1	44.3	60.0	-15.7

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
14.920	22.6	21.8	44.4	50.0	-5.6
19.974	21.1	22.4	43.5	50.0	-6.5
20.580	20.7	22.5	43.2	50.0	-6.8
21.077	20.5	22.5	43.0	50.0	-7.0
15.522	21.1	21.9	43.0	50.0	-7.0
14.419	20.7	21.7	42.4	50.0	-7.6
20.675	19.5	22.5	42.0	50.0	-8.0
9.378	18.3	21.1	39.4	50.0	-10.6

## CONCLUSION

Pass



Tested By

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

## MODES OF OPERATION

Transmitting at 115.2kb at Maximum Duty Cycle, Low Channel 2, 902.4768 MHz
Transmitting at 115.2kb at Maximum Duty Cycle, Mid Channel 56, 914.9184 MHz
Transmitting at 115.2kb at Maximum Duty Cycle, High Channel 111, 927.5904 MHz
Transmitting at 250kb at Maximum Duty Cycle, Low Channel 1, 902.5344 MHz
Transmitting at 250kb at Maximum Duty Cycle, Mid Channel 37, 914.976 MHz
Transmitting at 250kb at Maximum Duty Cycle, High Channel 73, 927.4176 MHz

## POWER SETTINGS INVESTIGATED

9 VDC
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## CONFIGURATIONS INVESTIGATED

FREW0054 - 4
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## FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	12400 MHz
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## SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	6/23/2015	12 mo
Filter - Low Pass	Micro-Tronics	LPM50003	LFE	10/30/2015	12 mo
Filter - Band Pass/Notch	K&L Microwave	3TNF-500/1000-N/N	HHO	6/3/2015	12 mo
Filter - Low Pass	Micro-Tronics	LPM50004	LFF	3/6/2015	12 mo
Antenna - Biconilog	Teseq	CBL 6141B	AYL	7/30/2015	24 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	PAB	7/31/2015	12 mo
Cable	Northwest EMC	Bilog Cables	NC1	8/27/2015	12 mo
Filter - High Pass	Micro-Tronics	HPM50114	HFN	3/5/2015	12 mo
Antenna - Double Ridge	EMCO	3115	AHM	6/3/2014	24 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVZ	7/31/2015	12 mo
Cable	Northwest EMC	3115 Horn Cable	NC2	6/17/2015	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AOK	9/21/2015	12 mo
Antenna - Standard Gain	EMCO	3160-07	AHP	NCR	0 mo
Cable	Northwest EMC	Standard Gain Horn Cable	NC3	6/17/2015	12 mo

## MEASUREMENT BANDWIDTHS

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.01 - 0.15	1.0	0.2	0.2
0.15 - 30.0	10.0	9.0	9.0
30.0 - 1000	100.0	120.0	120.0
Above 1000	1000.0	N/A	1000.0

## TEST DESCRIPTION

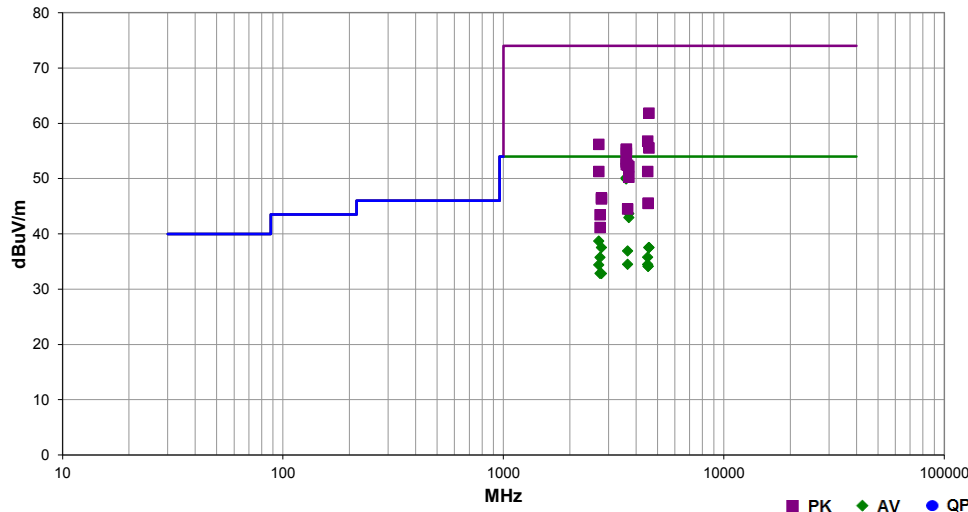
The highest gain of each type of antenna to be used with the EUT was tested. The EUT was configured for low, mid, and high band transmit frequencies. For each configuration, the spectrum was scanned throughout the specified range. In addition, measurements were made in the restricted bands to verify compliance. While scanning, emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and the EUT antenna in three orthogonal axis, and adjusting measurement antenna height and polarization. A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.




Work Order:	FREW0054	Date:	01/07/16	<i>Richard Mellroth</i>
Project:	None	Temperature:	22.5 °C	
Job Site:	NC01	Humidity:	29% RH	
Serial Number:	402-669-0330	Barometric Pres.:	1013 mbar	
Tested by: Richard Mellroth				
EUT:	Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)			
Configuration:	4			
Customer:	FreeWave Technologies, Inc.			
Attendees:	None			
EUT Power:	9 VDC			
Operating Mode:	Transmitting at 115.2kb at Maximum Duty cycle. See comments next to data points for EUT channel and orientation. See power table for power settings.			
Deviations:	None			
Comments:	None			

Test Specifications	Test Method
FCC 15.247:2016	ANSI C63.10:2013

Run #	70	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
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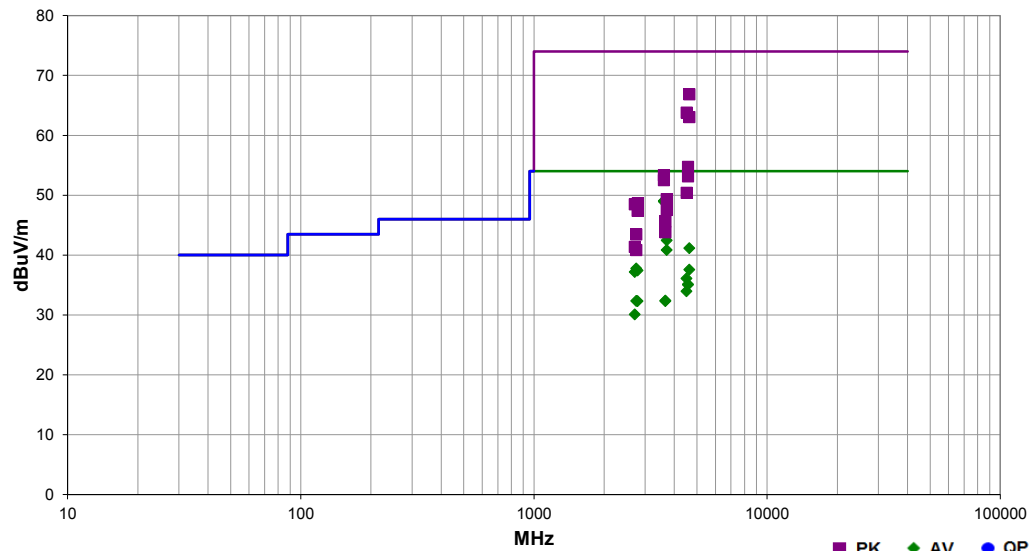


Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
3609.883	48.8	3.9	1.4	319.0	3.0	0.0	Horz	AV	0.0	52.7	54.0	-1.3	Low Ch, 115.2kb, EUT Flat
3609.858	48.8	3.9	1.4	320.0	3.0	0.0	Horz	AV	0.0	52.7	54.0	-1.3	Low Ch, 115.2kb, EUT on Side
3609.842	48.6	3.9	1.5	319.0	3.0	0.0	Horz	AV	0.0	52.5	54.0	-1.5	Low Ch, 115.2kb, EUT Vertical
3609.875	46.2	3.9	2.6	329.0	3.0	0.0	Vert	AV	0.0	50.1	54.0	-3.9	Low Ch, 115.2kb, EUT Vertical
3609.875	46.2	3.9	2.6	328.0	3.0	0.0	Vert	AV	0.0	50.1	54.0	-3.9	Low Ch, 115.2kb, EUT Flat
3609.867	46.0	3.9	3.1	333.0	3.0	0.0	Vert	AV	0.0	49.9	54.0	-4.1	Low Ch, 115.2kb, EUT on Side
3710.342	38.4	5.3	1.7	320.0	3.0	0.0	Horz	AV	0.0	43.7	54.0	-10.3	High Ch, 115.2kb, EUT Flat
3710.317	37.7	5.3	3.2	342.0	3.0	0.0	Vert	AV	0.0	43.0	54.0	-11.0	High Ch, 115.2kb, EUT Vert
4575.858	53.3	8.5	1.5	193.0	3.0	0.0	Horz	PK	0.0	61.8	74.0	-12.2	Mid Ch, 115.2kb, EUT Flat
2707.400	38.8	-0.1	1.5	265.0	3.0	0.0	Horz	AV	0.0	38.7	54.0	-15.3	Low Ch, 115.2kb, EUT Flat
4574.517	29.0	8.5	1.5	193.0	3.0	0.0	Horz	AV	0.0	37.5	54.0	-16.5	Mid Ch, 115.2kb, EUT Flat
4574.508	29.0	8.5	2.8	219.0	3.0	0.0	Vert	AV	0.0	37.5	54.0	-16.5	Mid Ch, 115.2kb, EUT Vert
2782.708	37.5	0.0	2.5	215.0	3.0	0.0	Horz	AV	0.0	37.5	54.0	-16.5	High Ch, 115.2kb, EUT Flat
3659.692	32.1	4.8	1.2	316.0	3.0	0.0	Horz	AV	0.0	36.9	54.0	-17.1	Mid Ch, 115.2kb, EUT Flat
4514.333	48.9	7.9	1.5	315.0	3.0	0.0	Horz	PK	0.0	56.8	74.0	-17.2	Low Ch, 115.2kb, EUT Flat
2707.475	56.3	-0.1	1.5	265.0	3.0	0.0	Horz	PK	0.0	56.2	74.0	-17.8	Low Ch, 115.2kb, EUT Flat
4512.375	27.9	7.9	1.5	146.0	3.0	0.0	Vert	AV	0.0	35.8	54.0	-18.2	Low Ch, 115.2kb, EUT Vert
2744.775	35.8	-0.1	1.5	251.0	3.0	0.0	Horz	AV	0.0	35.7	54.0	-18.3	Mid Ch, 115.2kb, EUT Flat
4576.250	47.0	8.5	2.8	219.0	3.0	0.0	Vert	PK	0.0	55.5	74.0	-18.5	Mid Ch, 115.2kb, EUT Vert
3610.150	51.4	3.9	1.4	319.0	3.0	0.0	Horz	PK	0.0	55.3	74.0	-18.7	Low Ch, 115.2kb, EUT on Side
3610.117	51.3	3.9	1.4	320.0	3.0	0.0	Horz	PK	0.0	55.2	74.0	-18.8	Low Ch, 115.2kb, EUT on Side
3610.425	50.7	3.9	1.5	319.0	3.0	0.0	Horz	PK	0.0	54.6	74.0	-19.4	Low Ch, 115.2kb, EUT Vertical
3659.733	29.7	4.8	1.5	190.0	3.0	0.0	Vert	AV	0.0	34.5	54.0	-19.5	Mid Ch, 115.2kb, EUT Vert
4512.292	26.6	7.9	1.5	315.0	3.0	0.0	Horz	AV	0.0	34.5	54.0	-19.5	Low Ch, 115.2kb, EUT Flat
2707.425	34.5	-0.1	3.1	191.0	3.0	0.0	Vert	AV	0.0	34.4	54.0	-19.6	Low Ch, 115.2kb, EUT Vert
4536.792	26.0	8.1	1.5	35.0	3.0	0.0	Vert	AV	0.0	34.1	54.0	-19.9	High Ch, 115.2kb, EUT Vert
4535.600	26.0	8.1	1.5	146.0	3.0	0.0	Horz	AV	0.0	34.1	54.0	-19.9	High Ch, 115.2kb, EUT Flat
3610.025	49.2	3.9	2.6	329.0	3.0	0.0	Vert	PK	0.0	53.1	74.0	-20.9	Low Ch, 115.2kb, EUT Vertical
3610.108	49.0	3.9	2.6	328.0	3.0	0.0	Vert	PK	0.0	52.9	74.0	-21.1	Low Ch, 115.2kb, EUT Flat
2744.700	32.9	-0.1	3.8	151.0	3.0	0.0	Vert	AV	0.0	32.8	54.0	-21.2	Mid Ch, 115.2kb, EUT Vert
2782.792	32.8	0.0	3.4	181.0	3.0	0.0	Vert	AV	0.0	32.8	54.0	-21.2	High Ch, 115.2kb, EUT Vert
3609.733	48.6	3.9	3.1	333.0	3.0	0.0	Vert	PK	0.0	52.5	74.0	-21.5	Low Ch, 115.2kb, EUT on Side
3660.225	47.6	4.8	1.2	316.0	3.0	0.0	Horz	PK	0.0	52.4	74.0	-21.6	Mid Ch, 115.2kb, EUT Flat
3711.158	46.9	5.3	1.7	320.0	3.0	0.0	Horz	PK	0.0	52.2	74.0	-21.8	High Ch, 115.2kb, EUT Flat
2707.208	51.4	-0.1	3.1	191.0	3.0	0.0	Vert	PK	0.0	51.3	74.0	-22.7	Low Ch, 115.2kb, EUT Vert
4512.667	43.4	7.9	1.5	146.0	3.0	0.0	Vert	PK	0.0	51.3	74.0	-22.7	Low Ch, 115.2kb, EUT Vert
3711.317	45.0	5.3	3.2	342.0	3.0	0.0	Vert	PK	0.0	50.3	74.0	-23.7	High Ch, 115.2kb, EUT Vert
2783.350	46.5	0.0	3.4	181.0	3.0	0.0	Vert	PK	0.0	46.5	74.0	-27.5	High Ch, 115.2kb, EUT Vert
2782.892	46.3	0.0	2.5	215.0	3.0	0.0	Horz	PK	0.0	46.3	74.0	-27.7	High Ch, 115.2kb, EUT Flat
4537.133	37.4	8.1	1.5	35.0	3.0	0.0	Vert	PK	0.0	45.5	74.0	-28.5	High Ch, 115.2kb, EUT Vert
4535.967	37.4	8.1	1.5	146.0	3.0	0.0	Horz	PK	0.0	45.5	74.0	-28.5	High Ch, 115.2kb, EUT Flat
3659.400	39.7	4.8	1.5	190.0	3.0	0.0	Vert	PK	0.0	44.5	74.0	-29.5	Mid Ch, 115.2kb, EUT Vert
2744.517	43.5	-0.1	1.5	251.0	3.0	0.0	Horz	PK	0.0	43.4	74.0	-30.6	Mid Ch, 115.2kb, EUT Flat
2744.925	41.2	-0.1	3.8	151.0	3.0	0.0	Vert	PK	0.0	41.1	74.0	-32.9	Mid Ch, 115.2kb, EUT Vert

Work Order:	FREW0054	Date:	01/07/16	
Project:	None	Temperature:	22.5 °C	
Job Site:	NC01	Humidity:	29% RH	
Serial Number:	402-669-0330	Barometric Pres.:	1013 mbar	
EUT:		Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)		
Configuration:	4			
Customer:	FreeWave Technologies, Inc.			
Attendees:	None			
EUT Power:	9 VDC			
Operating Mode:	Transmitting at 250kb at Maximum Duty cycle. See comments next to data points for EUT channel and orientation. See power table for power settings.			
Deviations:	None			
Comments:	None			

Test Specifications	FCC 15.247:2016	Test Method	ANSI C63.10:2013
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Run #	71	Test Distance (m)	3	Antenna Height(s)	1 to 4(m)	Results	Pass
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Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
3610.033	45.1	3.9	3.1	346.0	3.0	0.0	Vert	AV	0.0	49.0	54.0	-5.0	Low Ch, 250kb, EUT Vertical
3610.133	45.0	3.9	1.5	314.0	3.0	0.0	Horz	AV	0.0	48.9	54.0	-5.1	Low Ch, 250kb, EUT Flat
4638.292	57.7	9.2	1.9	216.0	3.0	0.0	Horz	PK	0.0	66.9	74.0	-7.1	High Ch, 250kb, EUT Flat
4514.783	55.9	7.9	1.5	188.0	3.0	0.0	Horz	PK	0.0	63.8	74.0	-10.2	Low Ch, 250kb, EUT Flat
4638.625	53.9	9.2	1.5	340.0	3.0	0.0	Vert	PK	0.0	63.1	74.0	-10.9	High Ch, 250kb, EUT Vertical
3709.617	37.2	5.2	1.5	218.0	3.0	0.0	Horz	AV	0.0	42.4	54.0	-11.6	High Ch, 250kb, EUT Flat
4636.858	32.0	9.1	1.9	216.0	3.0	0.0	Horz	AV	0.0	41.1	54.0	-12.9	High Ch, 250kb, EUT Flat
3709.708	35.6	5.2	2.5	188.0	3.0	0.0	Vert	AV	0.0	40.8	54.0	-13.2	High Ch, 250kb, EUT Vertical
2744.867	37.8	-0.1	2.2	221.0	3.0	0.0	Horz	AV	0.0	37.7	54.0	-16.3	Mid Ch, 250kb, EUT Flat
4637.342	28.4	9.1	1.5	340.0	3.0	0.0	Vert	AV	0.0	37.5	54.0	-16.5	High Ch, 250kb, EUT Vertical
2782.208	37.4	0.0	2.5	212.0	3.0	0.0	Horz	AV	0.0	37.4	54.0	-16.6	High Ch, 250kb, EUT Flat
2707.583	37.3	-0.1	1.5	250.0	3.0	0.0	Horz	AV	0.0	37.2	54.0	-16.8	Low Ch, 250kb, EUT Flat
4514.375	28.2	7.9	1.5	188.0	3.0	0.0	Horz	AV	0.0	36.1	54.0	-17.9	Low Ch, 250kb, EUT Flat
4574.625	26.6	8.5	1.5	151.0	3.0	0.0	Horz	AV	0.0	35.1	54.0	-18.9	Mid Ch, 250kb, EUT Flat
4576.525	26.5	8.5	3.1	251.0	3.0	0.0	Vert	AV	0.0	35.0	54.0	-19.0	Mid Ch, 250kb, EUT Vertical
4576.958	46.2	8.5	3.1	251.0	3.0	0.0	Vert	PK	0.0	54.7	74.0	-19.3	Mid Ch, 250kb, EUT Vertical
4510.658	26.1	7.8	1.5	311.0	3.0	0.0	Vert	AV	0.0	33.9	54.0	-20.1	Low Ch, 250kb, EUT Vertical
3610.117	49.4	3.9	1.5	314.0	3.0	0.0	Horz	PK	0.0	53.3	74.0	-20.7	Low Ch, 250kb, EUT Flat
4576.733	44.6	8.5	1.5	151.0	3.0	0.0	Horz	PK	0.0	53.1	74.0	-20.9	Mid Ch, 250kb, EUT Flat
3609.792	48.6	3.9	3.1	346.0	3.0	0.0	Vert	PK	0.0	52.5	74.0	-21.5	Low Ch, 250kb, EUT Vertical
3659.942	27.6	4.8	2.8	95.0	3.0	0.0	Vert	AV	0.0	32.4	54.0	-21.6	Mid Ch, 250kb, EUT Vertical
2744.950	32.4	-0.1	1.0	194.0	3.0	0.0	Vert	AV	0.0	32.3	54.0	-21.7	Mid Ch, 250kb, EUT Vertical
2782.175	32.3	0.0	3.0	179.0	3.0	0.0	Vert	AV	0.0	32.3	54.0	-21.7	High Ch, 250kb, EUT Vertical
3659.808	27.5	4.8	3.5	324.0	3.0	0.0	Horz	AV	0.0	32.3	54.0	-21.7	Mid Ch, 250kb, EUT Flat
4514.858	42.5	7.9	1.5	311.0	3.0	0.0	Vert	PK	0.0	50.4	74.0	-23.6	Low Ch, 250kb, EUT Vertical
2707.508	30.2	-0.1	1.5	136.0	3.0	0.0	Vert	AV	0.0	30.1	54.0	-23.9	Low Ch, 250kb, EUT Vertical
3709.100	44.1	5.2	1.5	218.0	3.0	0.0	Horz	PK	0.0	49.3	74.0	-24.7	High Ch, 250kb, EUT Flat
2782.108	48.6	0.0	2.5	212.0	3.0	0.0	Horz	PK	0.0	48.6	74.0	-25.4	High Ch, 250kb, EUT Flat
2707.633	48.6	-0.1	1.5	250.0	3.0	0.0	Horz	PK	0.0	48.5	74.0	-25.5	Low Ch, 250kb, EUT Flat
3710.217	42.3	5.3	2.5	188.0	3.0	0.0	Vert	PK	0.0	47.6	74.0	-26.4	High Ch, 250kb, EUT Vertical
2782.233	47.4	0.0	3.0	179.0	3.0	0.0	Vert	PK	0.0	47.4	74.0	-26.6	High Ch, 250kb, EUT Vertical
3660.733	40.8	4.8	3.5	324.0	3.0	0.0	Horz	PK	0.0	45.6	74.0	-28.4	Mid Ch, 250kb, EUT Flat
3659.925	39.0	4.8	2.8	95.0	3.0	0.0	Vert	PK	0.0	43.8	74.0	-30.2	Mid Ch, 250kb, EUT Vertical
2745.050	43.5	-0.1	2.2	221.0	3.0	0.0	Horz	PK	0.0	43.4	74.0	-30.6	Mid Ch, 250kb, EUT Flat
2707.192	41.5	-0.1	1.5	136.0	3.0	0.0	Vert	PK	0.0	41.4	74.0	-32.6	Low Ch, 250kb, EUT Vertical
2744.725	40.9	-0.1	1.0	194.0	3.0	0.0	Vert	PK	0.0	40.8	74.0	-33.2	Mid Ch, 250kb, EUT Vertical

# DUTY CYCLE

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	6/6/2015	12
Attenuator	S.M. Electronics	SA18H-20	REK	9/28/2015	12
Attenuator	S.M. Electronics	SA18H-10	REJ	9/18/2015	12
Block - DC	Fairview Microwave	SD3379	AMJ	6/6/2015	12
Generator - Signal	Agilent	N5183A	TIA	4/7/2014	24

## TEST DESCRIPTION

The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.


There is no compliance requirement to be met by this test, so therefore no Pass / Fail criteria.

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum. A direct connection was made between the RF output of the EUT and a spectrum analyzer. Attenuation and a DC block were used.

The duty cycle was calculated by dividing the transmission pulse duration (T) by the total period of a single on and total off time.

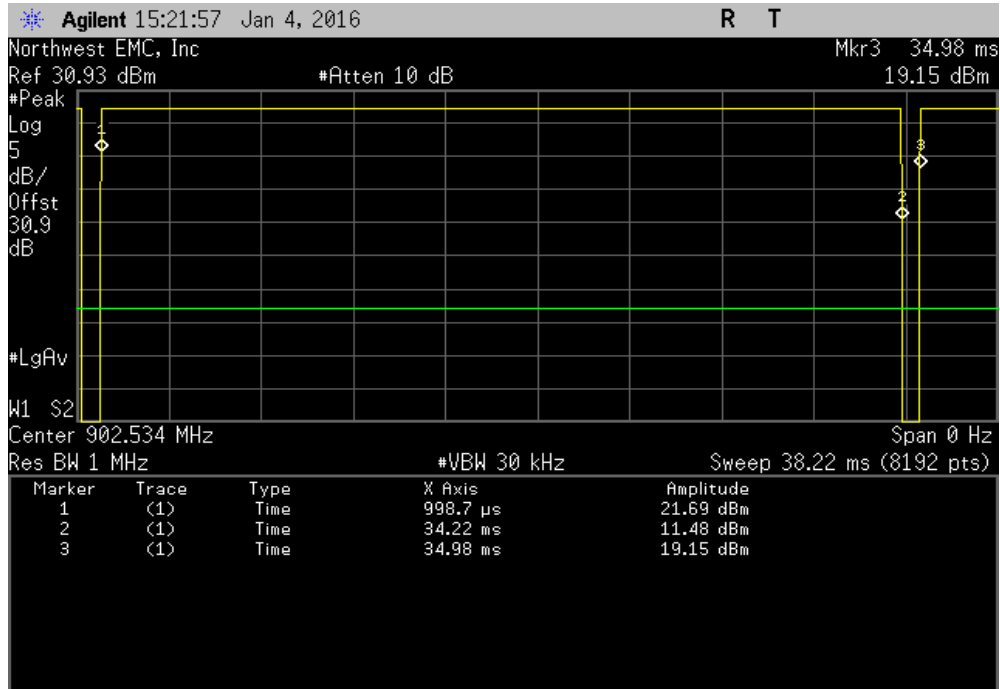
If the transmit duty cycle < 98 percent, burst gating may have been used during some of the other tests in this report to only take the measurement during the burst duration.

**NORTHWEST  
EMC**

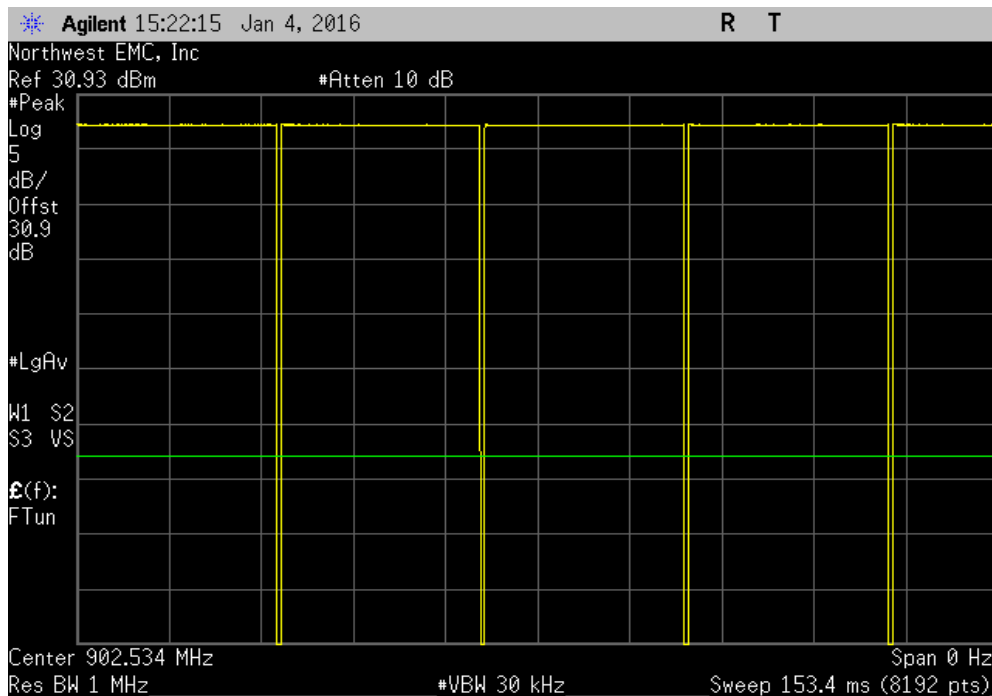
EUT: Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)				Work Order: FREW0054			
Serial Number: 402-669-0330				Date: 01/04/16			
Customer: FreeWave Technologies, Inc.				Temperature: 23°C			
Attendees: Dean Busch				Humidity: 29%			
Project: None				Barometric Pres.: 1009 mbar			
Tested by: Richard Mellroth				Power: 9 VDC		Job Site: NC02	
TEST SPECIFICATIONS				Test Method			
FCC 15.247:2016				ANSI C63.10:2013			
COMMENTS							
EUT power set at maximum = 30. For the 115.2kb rate, the test software provided for operation in a fixed, single channel mode allows the EUT to operate continuously at 100% Duty Cycle.							
DEVIATIONS FROM TEST STANDARD							
None							
Configuration #	1						
		Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
GFSK Modulation, 250kb							
	Low Channel 1, 902.5344 MHz	33.217 ms	33.983 ms	1	97.7	N/A	N/A
	Low Channel 1, 902.5344 MHz	N/A	N/A	5	N/A	N/A	N/A
	Mid Channel 37, 914.976 MHz	33.217 ms	33.983 ms	1	97.7	N/A	N/A
	Mid Channel 37, 914.976 MHz	N/A	N/A	5	N/A	N/A	N/A
	High Channel 73, 927.4176 MHz	33.217 ms	33.983 ms	1	97.7	N/A	N/A
	High Channel 73, 927.4176 MHz	N/A	N/A	5	N/A	N/A	N/A
GFSK Modulation, 115.2kb							
	Low Channel 2, 902.4768 MHz	N/A	N/A	N/A	100	N/A	N/A
	Mid Channel 56, 914.9184 MHz	N/A	N/A	N/A	100	N/A	N/A
	High Channel 111, 927.5904 MHz	N/A	N/A	N/A	100	N/A	N/A

# DUTY CYCLE

GFSK Modulation, 250kb, Low Channel 1, 902.5344 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	33.217 ms	33.983 ms	1	97.7	N/A	N/A

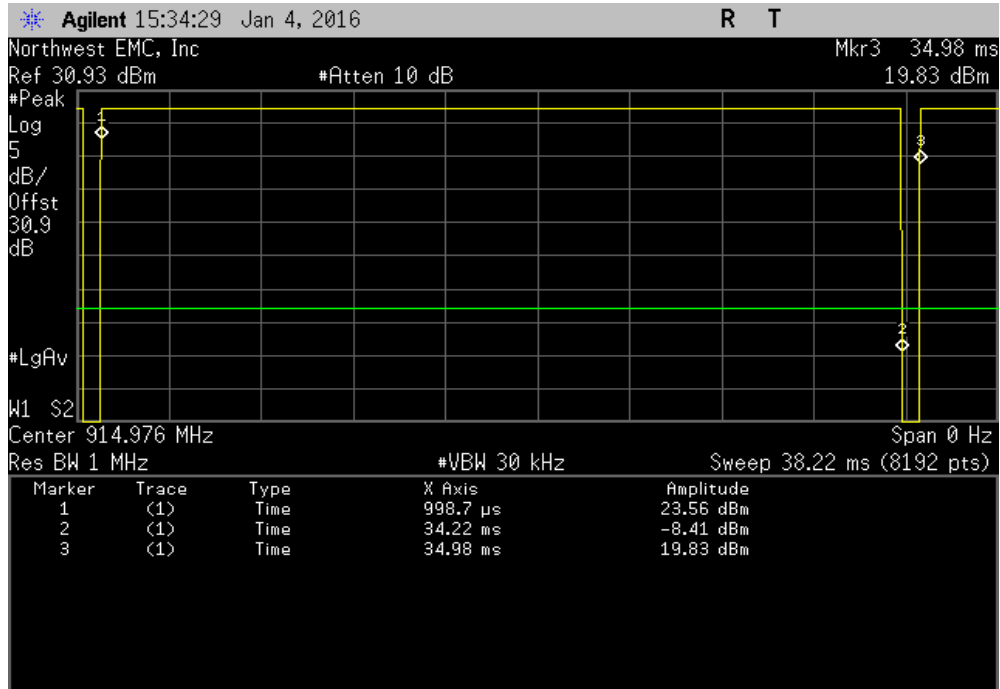


GFSK Modulation, 250kb, Low Channel 1, 902.5344 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

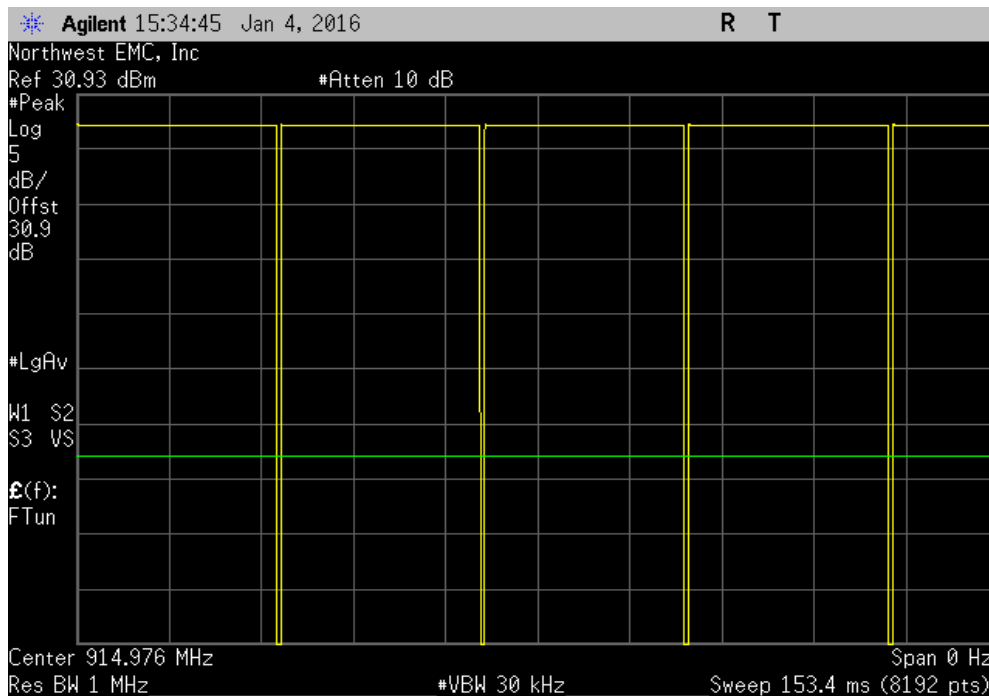


# DUTY CYCLE

GFSK Modulation, 250kb, Mid Channel 37, 914.976 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	33.217 ms	33.983 ms	1	97.7	N/A	N/A

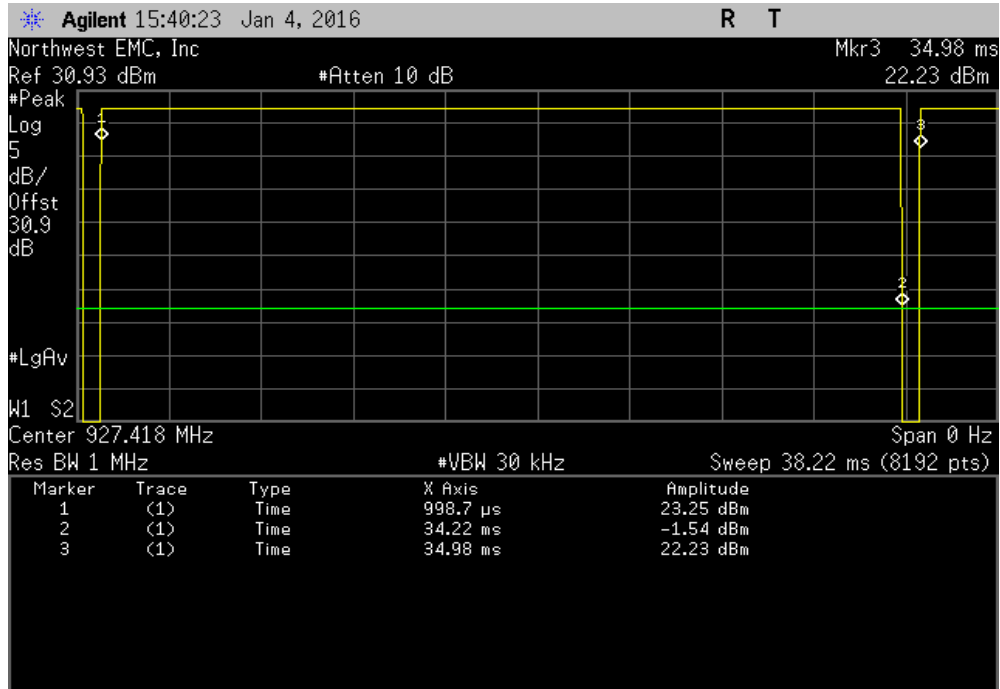


GFSK Modulation, 250kb, Mid Channel 37, 914.976 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

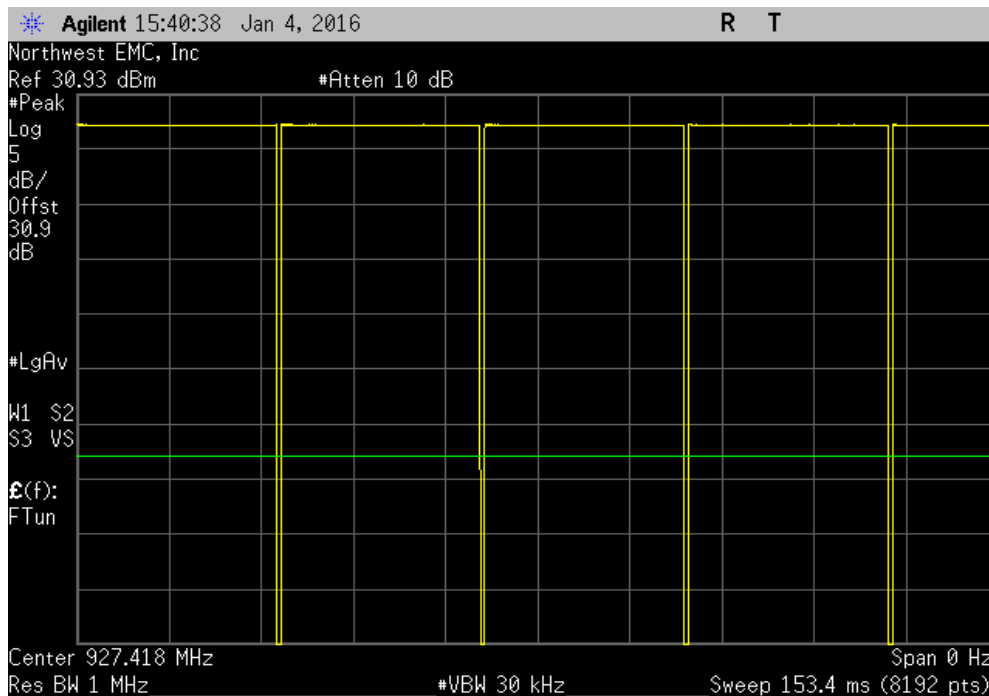


# DUTY CYCLE

GFSK Modulation, 250kb, High Channel 73, 927.4176 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	33.217 ms	33.983 ms	1	97.7	N/A	N/A



GFSK Modulation, 250kb, High Channel 73, 927.4176 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A





# CARRIER FREQUENCY SEPARATION

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.


## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12
Attenuator	S.M. Electronics	SA18H-20	REK	9/28/2015	12
Attenuator	S.M. Electronics	SA18H-10	REJ	9/18/2015	12
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	6/6/2015	12
Block - DC	Fairview Microwave	SD3379	AMJ	6/6/2015	12
Generator - Signal	Agilent	N5183A	TIA	4/7/2014	24

## TEST DESCRIPTION

The carrier frequency separation was measured between hopping channels in the middle of the authorized band. The measurements were made using a direct connection between the RF output of the EUT and the spectrum analyzer. The hopping function of the EUT was enabled.

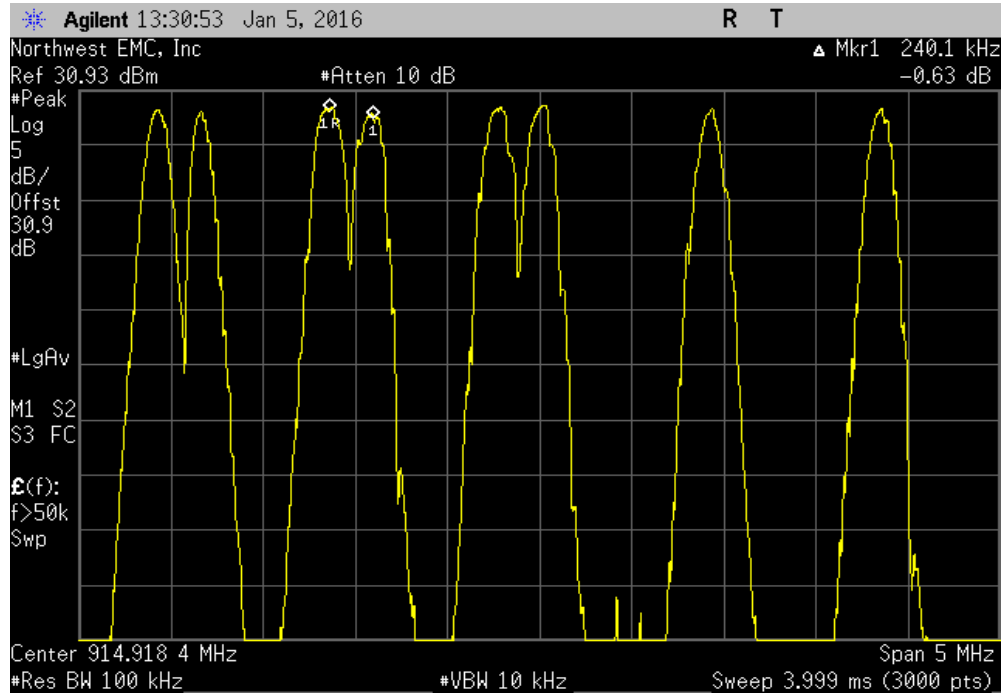
# CARRIER FREQUENCY SEPARATION

EUT: Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)		Work Order: FREW0054	
Serial Number: 402-669-0330		Date: 01/05/16	
Customer: FreeWave Technologies, Inc.		Temperature: 24°C	
Attendees: Dean Busch		Humidity: 26%	
Project: None		Barometric Pres.: 1002 mbar	
Tested by: Richard Mellroth	Power: 9 VDC	Job Site: NC02	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2016		ANSI C63.10:2013	
COMMENTS			
None			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature 	
		Value	Limit (±) Results
Hopping Mode			
GFSK Modulation, 115.2kb			
Mid Channel 56, 914.9184 MHz		240 kHz	140 kHz Pass
GFSK Modulation, 250kb			
Mid Channel 37, 914.976 MHz		322 kHz	300 kHz Pass

# CARRIER FREQUENCY SEPARATION

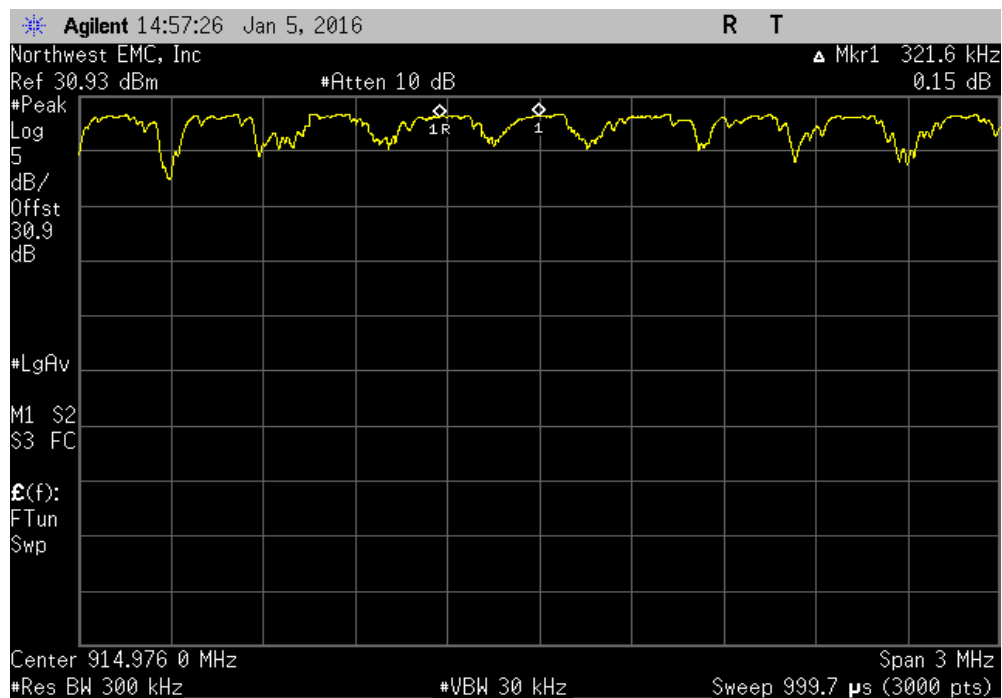
Hopping Mode, GFSK Modulation, 115.2kb, Mid Channel 56, 914.9184 MHz

	Value	Limit (≥)	Results
	240 kHz	140 kHz	Pass



Hopping Mode, GFSK Modulation, 250kb, Mid Channel 37, 914.976 MHz

	Value	Limit (≥)	Results
	322 kHz	300 kHz	Pass



# NUMBER OF HOPPING FREQUENCIES

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.


## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	6/6/2015	12
Attenuator	S.M. Electronics	SA18H-10	REJ	9/18/2015	12
Attenuator	S.M. Electronics	SA18H-20	REK	9/28/2015	12
Block - DC	Fairview Microwave	SD3379	AMJ	6/6/2015	12
Generator - Signal	Agilent	N5183A	TIA	4/7/2014	24

## TEST DESCRIPTION

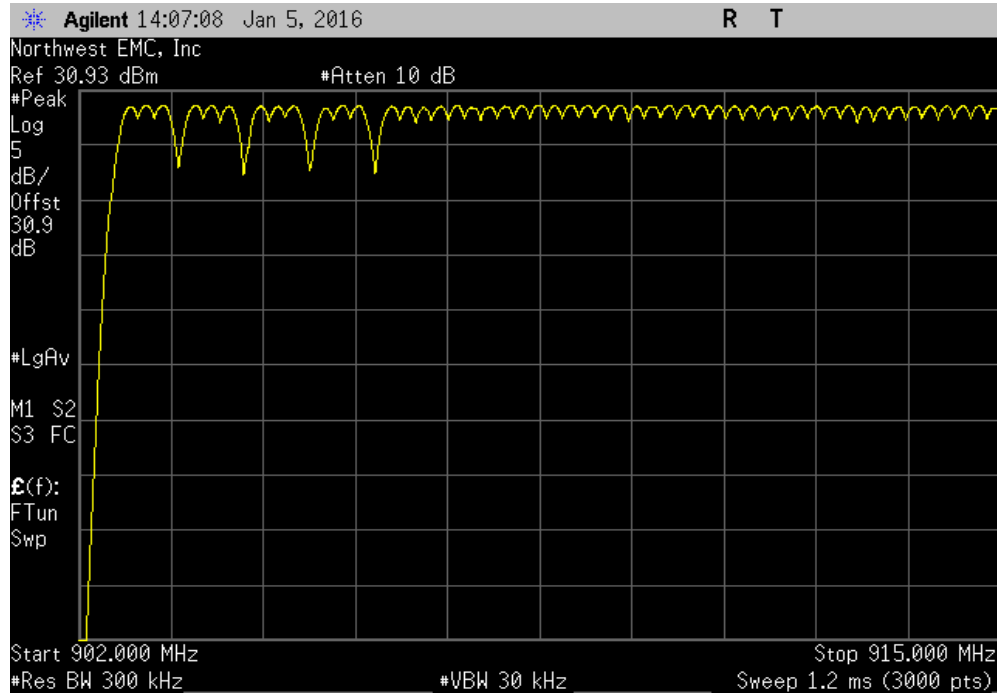
The number of hopping frequencies was measured across the authorized band. The measurements were made using a direct connection between the RF output of the EUT and the spectrum analyzer. The hopping function of the EUT was enabled.

# NUMBER OF HOPPING FREQUENCIES

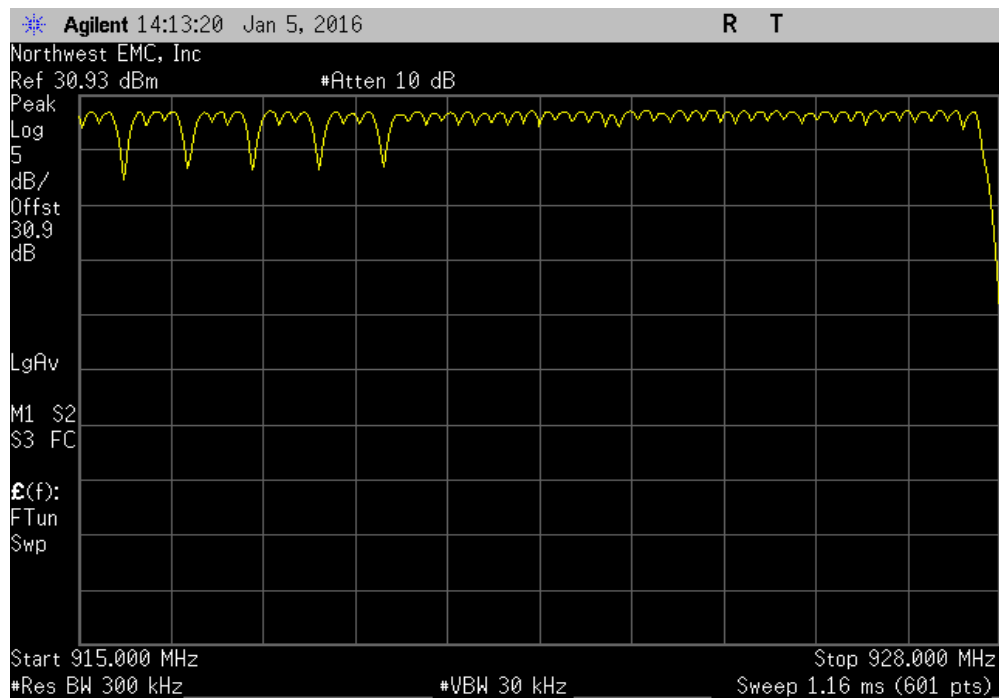
EUT: Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)		Work Order: FREW0054	
Serial Number: 402-669-0330		Date: 01/05/16	
Customer: FreeWave Technologies, Inc.		Temperature: 24°C	
Attendees: Dean Busch		Humidity: 26%	
Project: None		Barometric Pres.: 1002 mbar	
Tested by: Richard Mellroth	Power: 9 VDC	Job Site: NC02	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2016		ANSI C63.10:2013	
COMMENTS			
None			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature 	
		Number of Channels	Limit
Hopping Mode			Results
GFSK Modulation, 115.2kb			
Mid Channel 56, 914.9184 MHz (Span 1)		N/A	N/A
Mid Channel 56, 914.9184 MHz (Span 2)		100	≥ 50
GFSK Modulation, 250kb			
Mid Channel 37, 914.976 MHz		73	≥ 50
			Pass

# NUMBER OF HOPPING FREQUENCIES

Hopping Mode, GFSK Modulation, 115.2kb, Mid Channel 56, 914.9184 MHz (Span 1)						
				Number of Channels	Limit	Results
				N/A	N/A	N/A

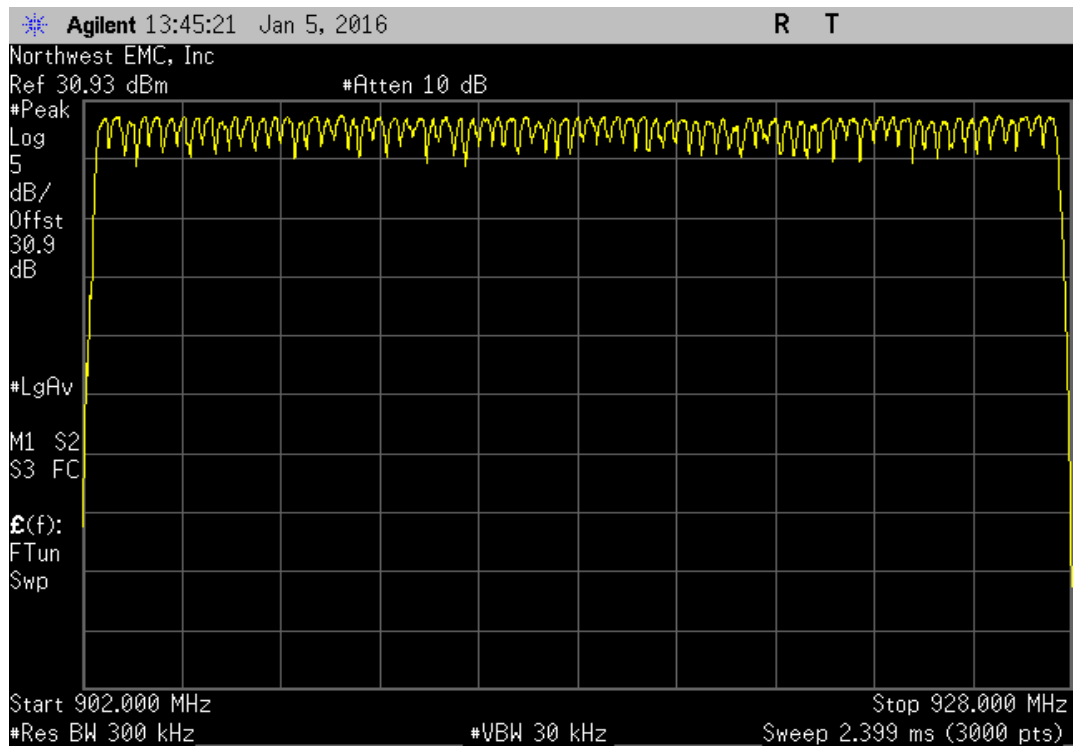


0						
				Number of Channels	Limit	Results
				100	≥ 50	Pass



# NUMBER OF HOPPING FREQUENCIES

Hopping Mode, GFSK Modulation, 115.2kb, Mid Channel 56, 914.9184 MHz (Span 1)							
				Number of Channels	Limit	Results	
				73	≥ 50	Pass	





# DWELL TIME

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

## TEST EQUIPMENT


Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	6/6/2015	12
Attenuator	S.M. Electronics	SA18H-10	REJ	9/18/2015	12
Attenuator	S.M. Electronics	SA18H-20	REK	9/28/2015	12
Block - DC	Fairview Microwave	SD3379	AMJ	6/6/2015	12
Generator - Signal	Agilent	N5183A	TIA	4/7/2014	24

## TEST DESCRIPTION

The average dwell time per hopping channel was measured at one hopping channel in the middle of the authorized band. The measurements were made using a direct connection between the RF output of the EUT and the spectrum analyzer. The hopping function of the EUT was enabled.

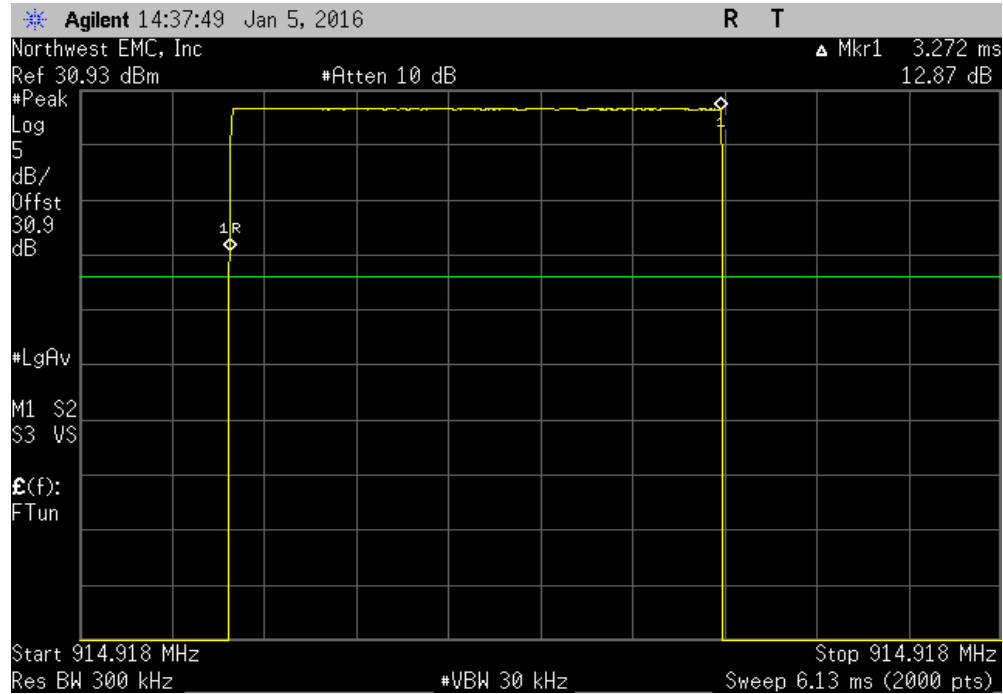
Per FCC 15.247 (a)(1)(i), the average time of occupancy on any frequency shall not be greater than 400mS within a 20 second period for hopping channels with a 20dB bandwidth less than 250kHz, and the average time of occupancy on any frequency shall not be greater than 400mS within a 10 second period for hopping channels with a 20dB bandwidth greater than 250kHz.

# DWELL TIME

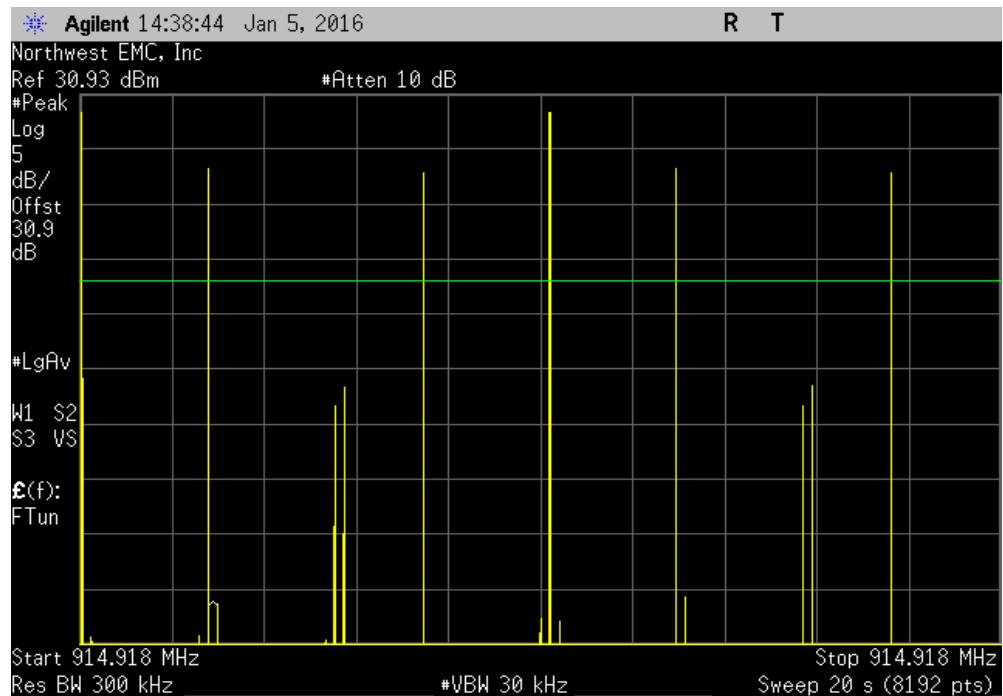
EUT: Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)		Work Order: FREW0054	
Serial Number: 402-669-0330		Date: 01/05/16	
Customer: FreeWave Technologies, Inc.		Temperature: 24°C	
Attendees: Dean Busch		Humidity: 26%	
Project: None		Barometric Pres.: 1002 mbar	
Tested by: Richard Mellroth		Power: 9 VDC	
Job Site: NC02			
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2016		ANSI C63.10:2013	
COMMENTS			
None			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature 	
		Pulse Width (ms)	Number of Pulses
		Average No. of Pulses	Scale Factor
		On Time (ms)	Limit (ms)
			Results
Hopping Mode			
GFSK Modulation, 115.2kb			
	Mid Channel 56, 914.9184 MHz	3.272	N/A
	Mid Channel 56, 914.9184 MHz	N/A	6
	Mid Channel 56, 914.9184 MHz	N/A	6
	Mid Channel 56, 914.9184 MHz	N/A	6
	Mid Channel 56, 914.9184 MHz	N/A	6
	Mid Channel 56, 914.9184 MHz	3.272	N/A
GFSK Modulation, 250kb			
	Mid Channel 37, 914.976 MHz	1.5	N/A
	Mid Channel 37, 914.976 MHz	N/A	5
	Mid Channel 37, 914.976 MHz	N/A	5
	Mid Channel 37, 914.976 MHz	N/A	5
	Mid Channel 37, 914.976 MHz	N/A	5
	Mid Channel 37, 914.976 MHz	1.5	N/A

# DWELL TIME

Hopping Mode, GFSK Modulation, 115.2kb, Mid Channel 56, 914.9184 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms)	Limit (ms)	Results
3.272	N/A	N/A	N/A	N/A	N/A	N/A

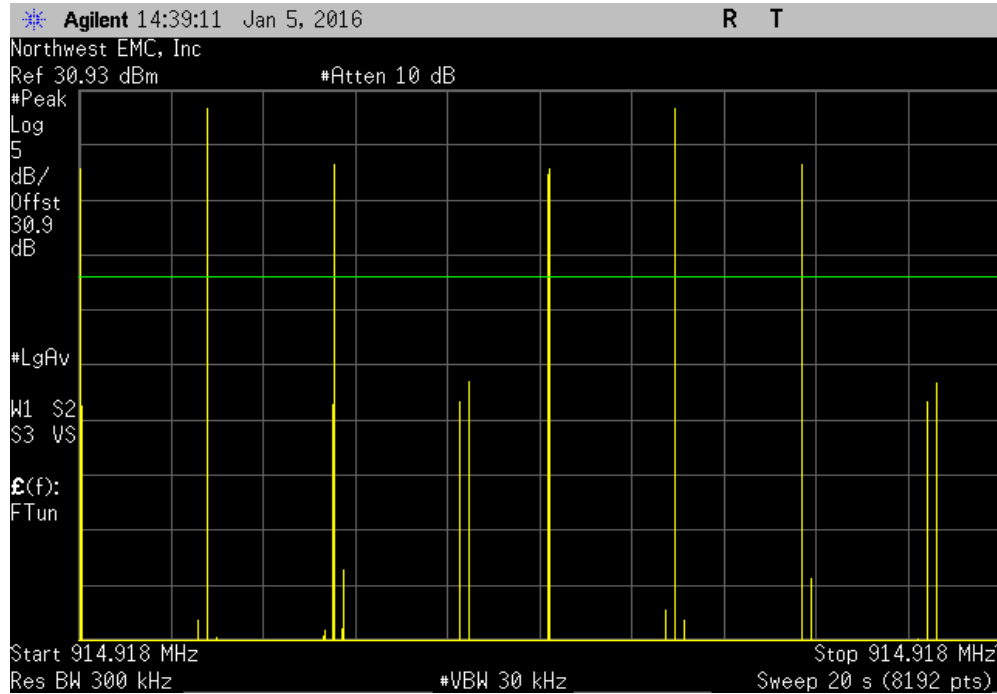


Hopping Mode, GFSK Modulation, 115.2kb, Mid Channel 56, 914.9184 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms)	Limit (ms)	Results
N/A	6	N/A	N/A	N/A	N/A	N/A

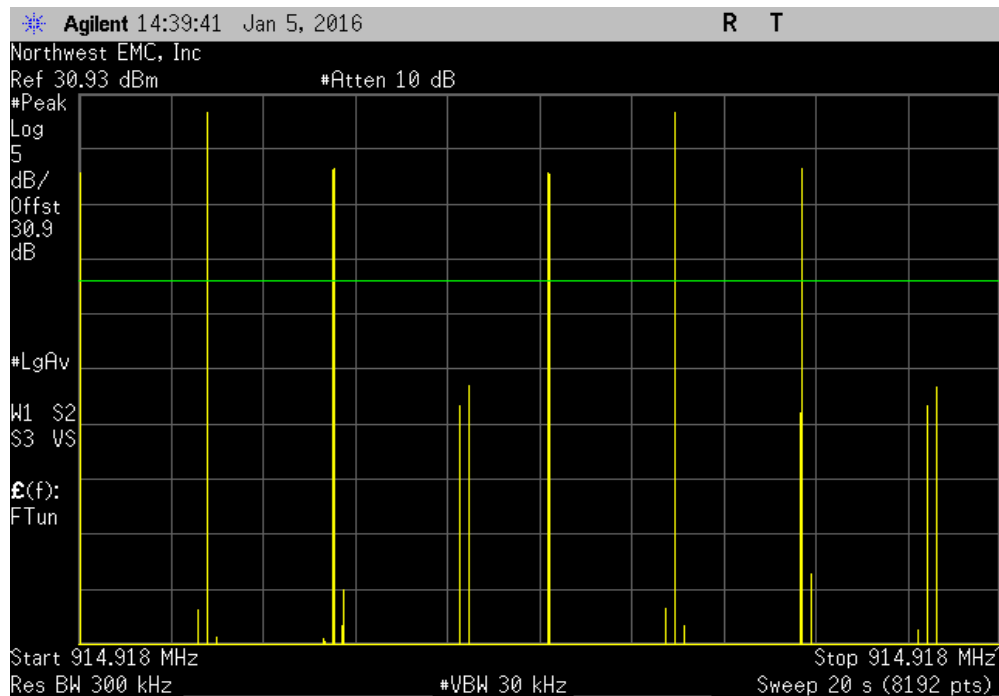


# DWELL TIME

Hopping Mode, GFSK Modulation, 115.2kb, Mid Channel 56, 914.9184 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms)	Limit (ms)	Results
N/A	6	N/A	N/A	N/A	N/A	N/A

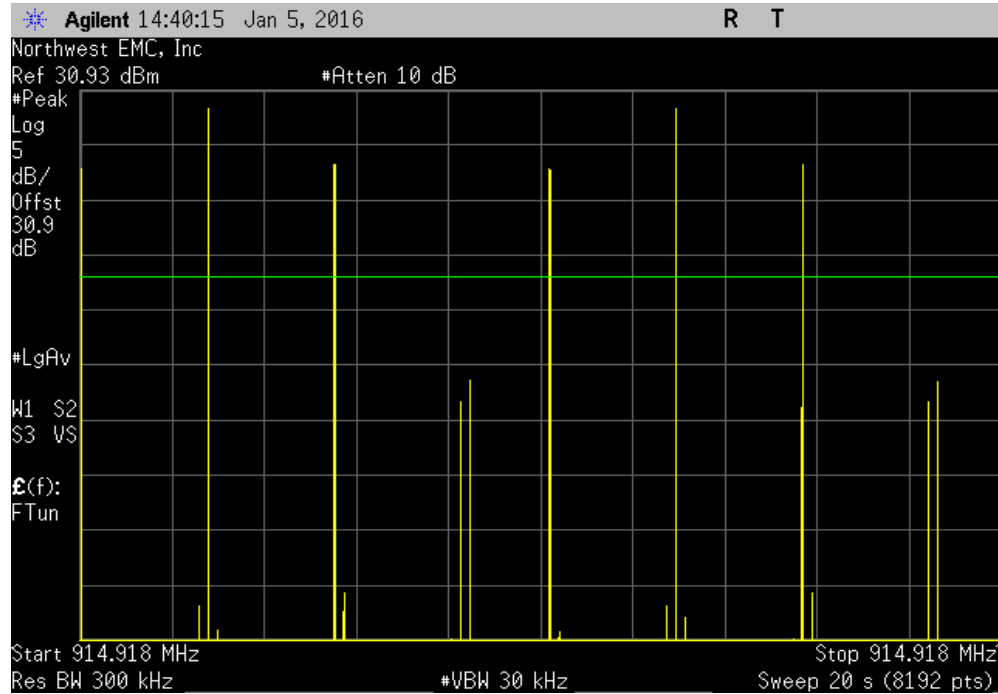


Hopping Mode, GFSK Modulation, 115.2kb, Mid Channel 56, 914.9184 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms)	Limit (ms)	Results
N/A	6	N/A	N/A	N/A	N/A	N/A



# DWELL TIME

Hopping Mode, GFSK Modulation, 115.2kb, Mid Channel 56, 914.9184 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms)	Limit (ms)	Results
N/A	6	N/A	N/A	N/A	N/A	N/A



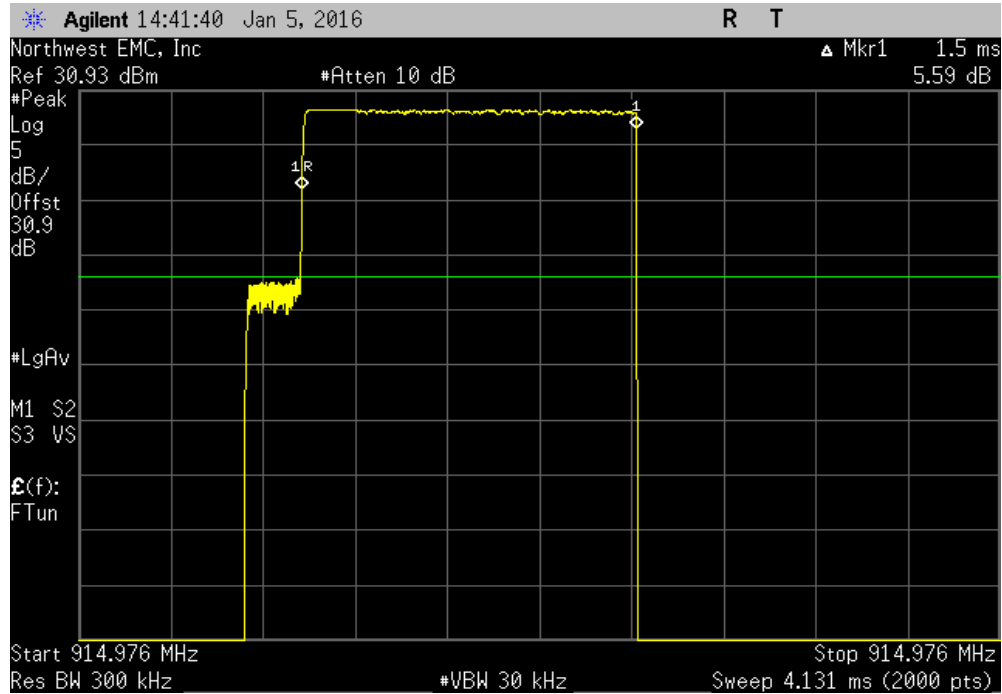
Hopping Mode, GFSK Modulation, 115.2kb, Mid Channel 56, 914.9184 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms)	Limit (ms)	Results
3.272	N/A	6	N/A	19.632	400	Pass

Calculation Only

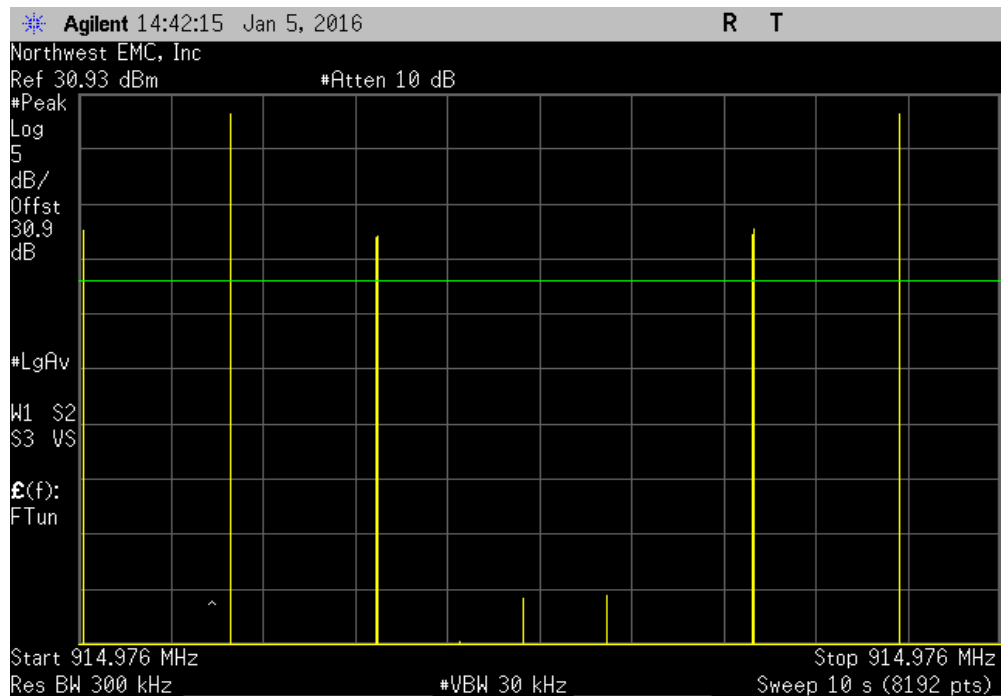
No Screen Capture Required

# DWELL TIME

Hopping Mode, GFSK Modulation, 250kb, Mid Channel 37, 914.976 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms)	Limit (ms)	Results
1.5	N/A	N/A	N/A	N/A	N/A	N/A

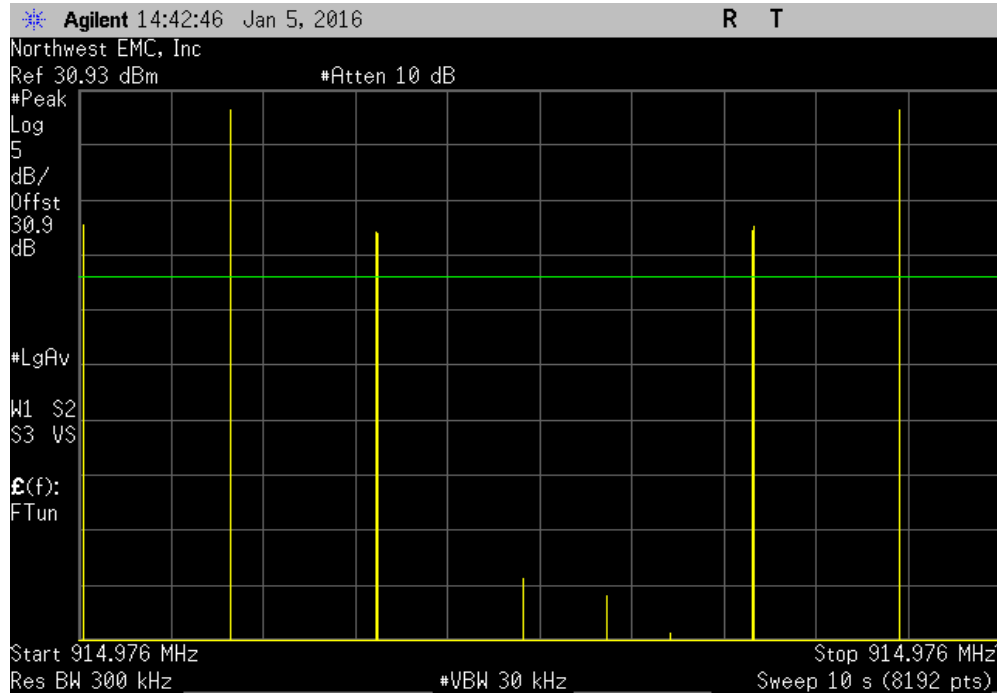


Hopping Mode, GFSK Modulation, 250kb, Mid Channel 37, 914.976 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms)	Limit (ms)	Results
N/A	5	N/A	N/A	N/A	N/A	N/A

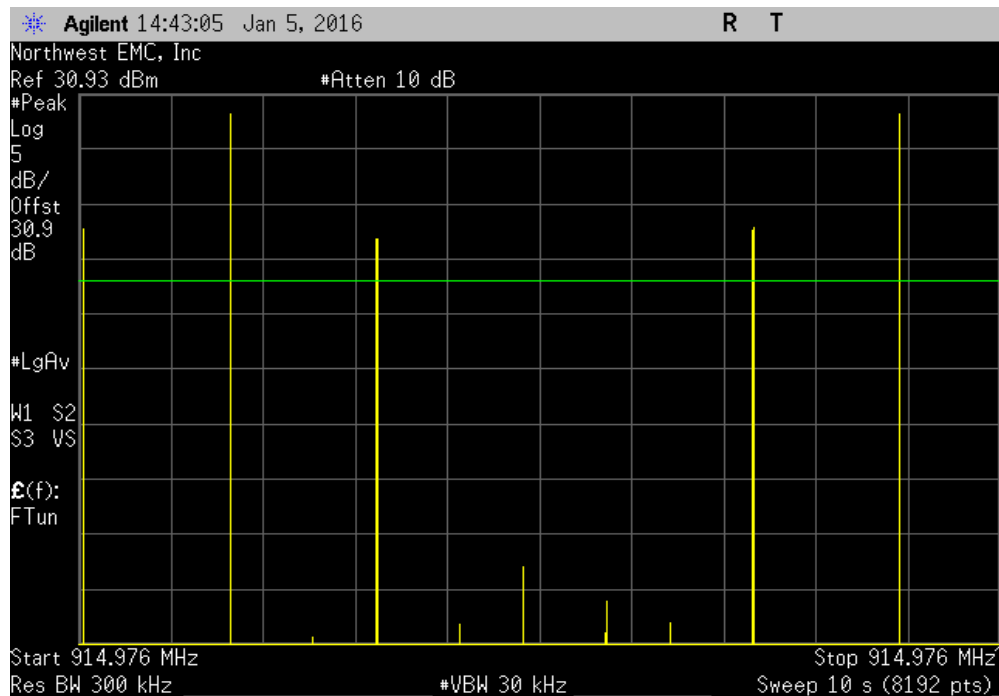


# DWELL TIME

Hopping Mode, GFSK Modulation, 250kb, Mid Channel 37, 914.976 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms)	Limit (ms)	Results
N/A	5	N/A	N/A	N/A	N/A	N/A

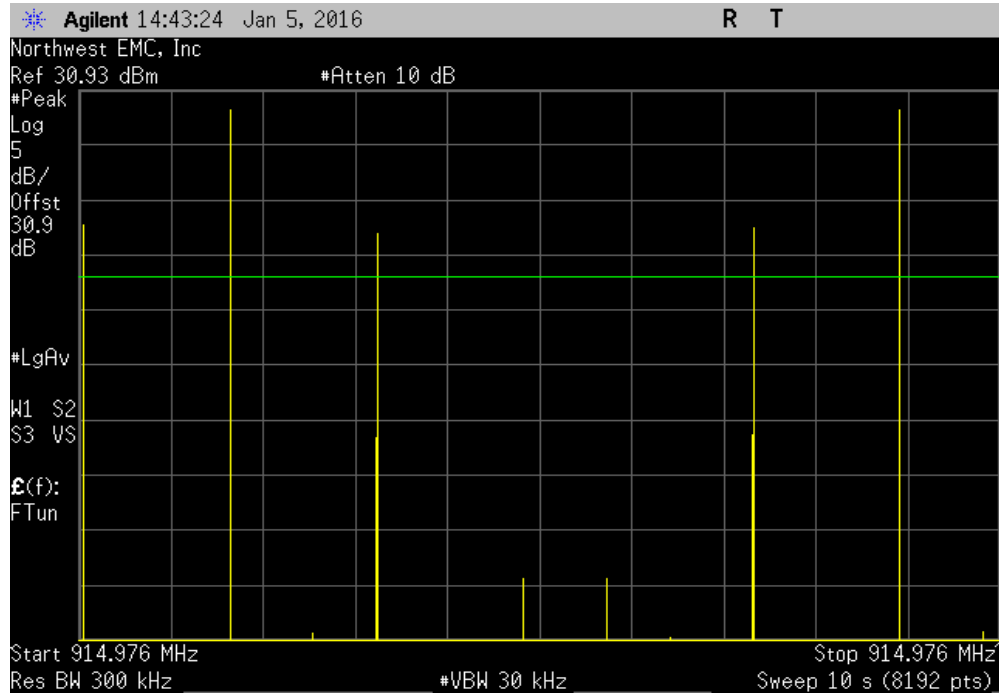


Hopping Mode, GFSK Modulation, 250kb, Mid Channel 37, 914.976 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms)	Limit (ms)	Results
N/A	5	N/A	N/A	N/A	N/A	N/A



# DWELL TIME

Hopping Mode, GFSK Modulation, 250kb, Mid Channel 37, 914.976 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms)	Limit (ms)	Results
N/A	5	N/A	N/A	N/A	N/A	N/A



Hopping Mode, GFSK Modulation, 250kb, Mid Channel 37, 914.976 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses	Scale Factor	On Time (ms)	Limit (ms)	Results
1.5	N/A	5	N/A	7.5	400	Pass

Calculation Only

No Screen Capture Required



# OUTPUT POWER

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

## TEST EQUIPMENT


Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	6/6/2015	12
Attenuator	S.M. Electronics	SA18H-20	REK	9/28/2015	12
Attenuator	S.M. Electronics	SA18H-10	REJ	9/18/2015	12
Block - DC	Fairview Microwave	SD3379	AMJ	6/6/2015	12
Generator - Signal	Agilent	N5183A	TIA	4/7/2014	24

## TEST DESCRIPTION

The peak output power was measured with the EUT set to low, medium and high transmit frequencies. The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The EUT was transmitting in a no hop mode at the data rate(s) listed in the datasheet.

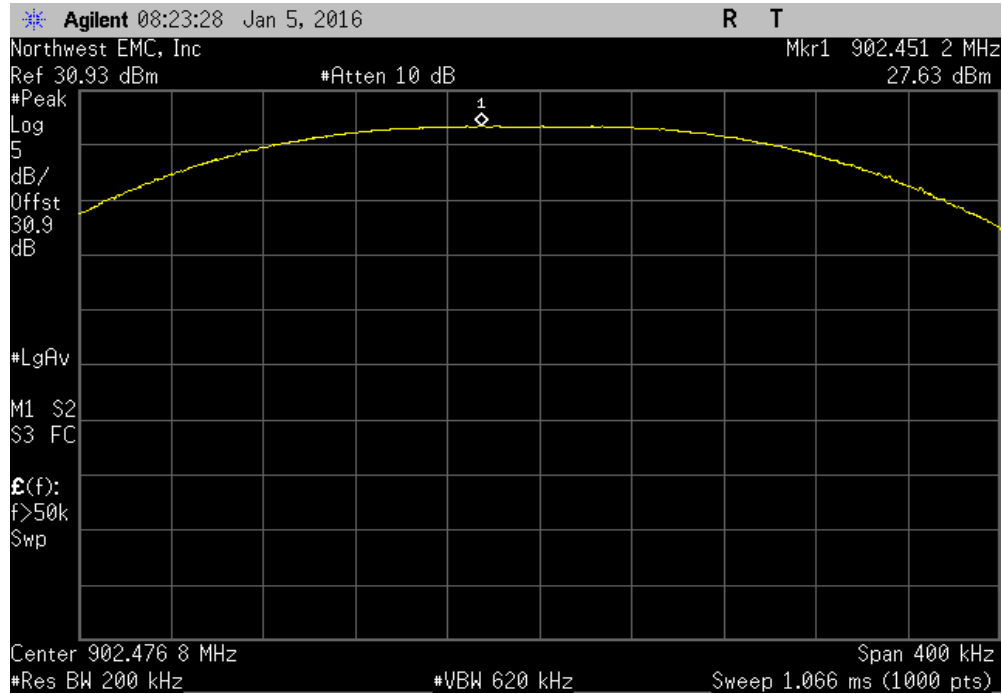
**De Facto EIRP Limit:** Per 47 CFR 15.247 (b)(1-3), the EUT meets the de facto EIRP limit of +36dBm.

# OUTPUT POWER

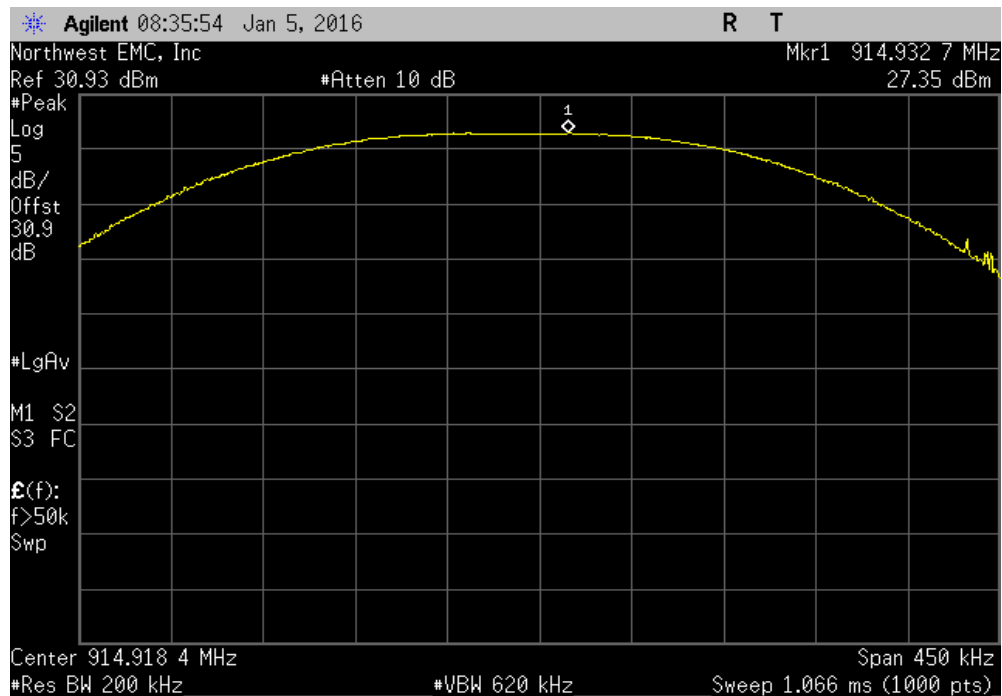
EUT: Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)		Work Order: FREW0054	
Serial Number: 402-669-0330		Date: 01/05/16	
Customer: FreeWave Technologies, Inc.		Temperature: 24°C	
Attendees: Dean Busch		Humidity: 26%	
Project: None		Barometric Pres.: 1002 mbar	
Tested by: Richard Mellroth	Power: 9 VDC	Job Site: NC02	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2016		ANSI C63.10:2013	
COMMENTS			
EUT power level = 29. Demonstrating compliance with a 7.15dBi antenna.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature 	
		Value	Limit
GFSK Modulation, 115.2kb			
	Low Channel 2, 902.4768 MHz	27.633 dBm	28.85 dBm
	Mid Channel 56, 914.9184 MHz	27.351 dBm	28.85 dBm
	High Channel 111, 927.5904 MHz	27.369 dBm	28.85 dBm
GFSK Modulation, 250kb			
	Low Channel 1, 902.5344 MHz	27.476 dBm	28.85 dBm
	Mid Channel 37, 914.976 MHz	27.36 dBm	28.85 dBm
	High Channel 73, 927.4176 MHz	27.373 dBm	28.85 dBm
		Result	
		Pass	
		Pass	
		Pass	
		Pass	
		Pass	
		Pass	

# OUTPUT POWER

GFSK Modulation, 115.2kb, Low Channel 2, 902.4768 MHz						
				Value	Limit	Result
				27.633 dBm	28.85 dBm	Pass



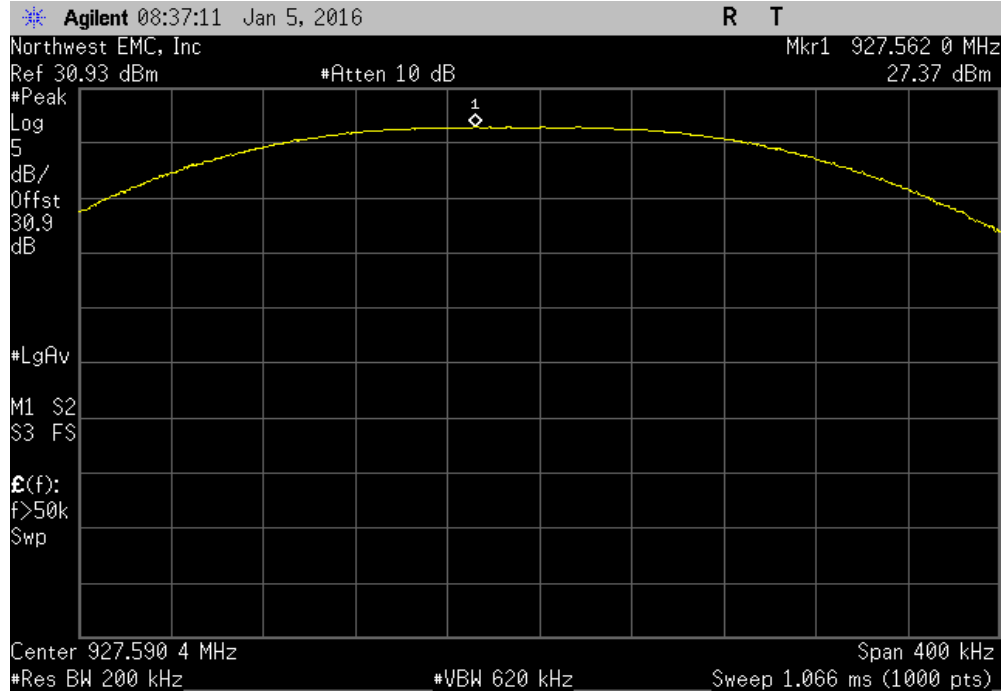
GFSK Modulation, 115.2kb, Mid Channel 56, 914.9184 MHz						
				Value	Limit	Result
				27.351 dBm	28.85 dBm	Pass



# OUTPUT POWER

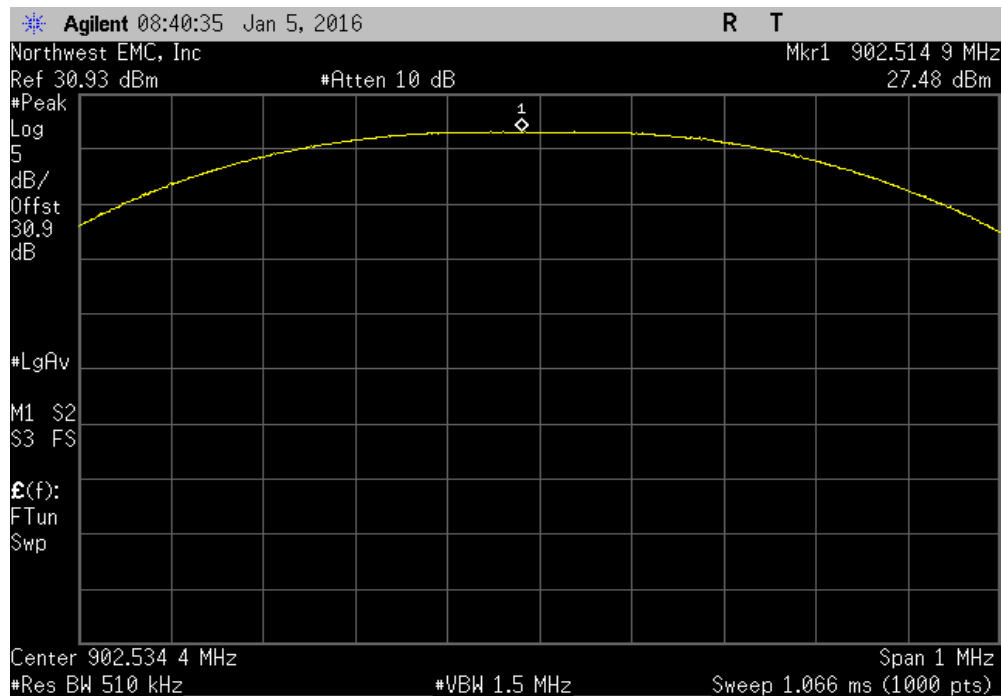
GFSK Modulation, 115.2kb, High Channel 111, 927.5904 MHz

				Value	Limit	Result
				27.369 dBm	28.85 dBm	Pass



GFSK Modulation, 250kb, Low Channel 1, 902.5344 MHz

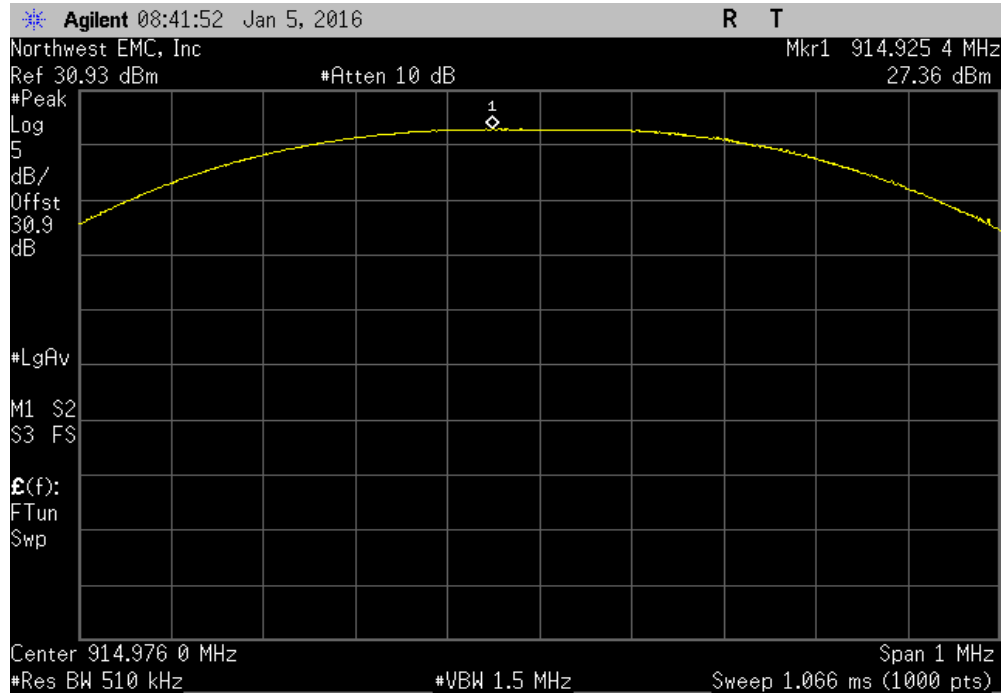
				Value	Limit	Result
				27.476 dBm	28.85 dBm	Pass



# OUTPUT POWER

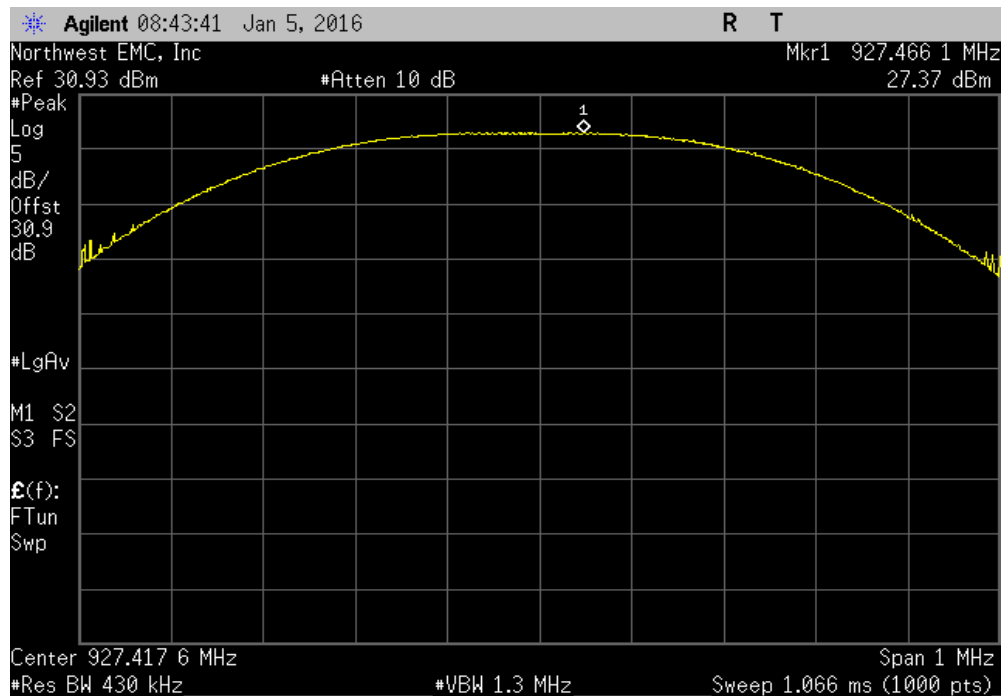
GFSK Modulation, 250kb, Mid Channel 37, 914.976 MHz

Value	Limit	Result
27.36 dBm	28.85 dBm	Pass



GFSK Modulation, 250kb, High Channel 73, 927.4176 MHz

Value	Limit	Result
27.373 dBm	28.85 dBm	Pass



# BAND EDGE COMPLIANCE

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

## TEST EQUIPMENT


Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	6/6/2015	12
Attenuator	S.M. Electronics	SA18H-20	REK	9/28/2015	12
Attenuator	S.M. Electronics	SA18H-10	REJ	9/18/2015	12
Block - DC	Fairview Microwave	SD3379	AMJ	6/6/2015	12
Generator - Signal	Agilent	N5183A	TIA	4/7/2014	24

## TEST DESCRIPTION

The spurious RF conducted emissions at the edges of the authorized band were measured with the EUT set to low and high transmit frequencies. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at the data rate(s) listed in the datasheet in a no hop mode. The channels closest to the band edges were selected.

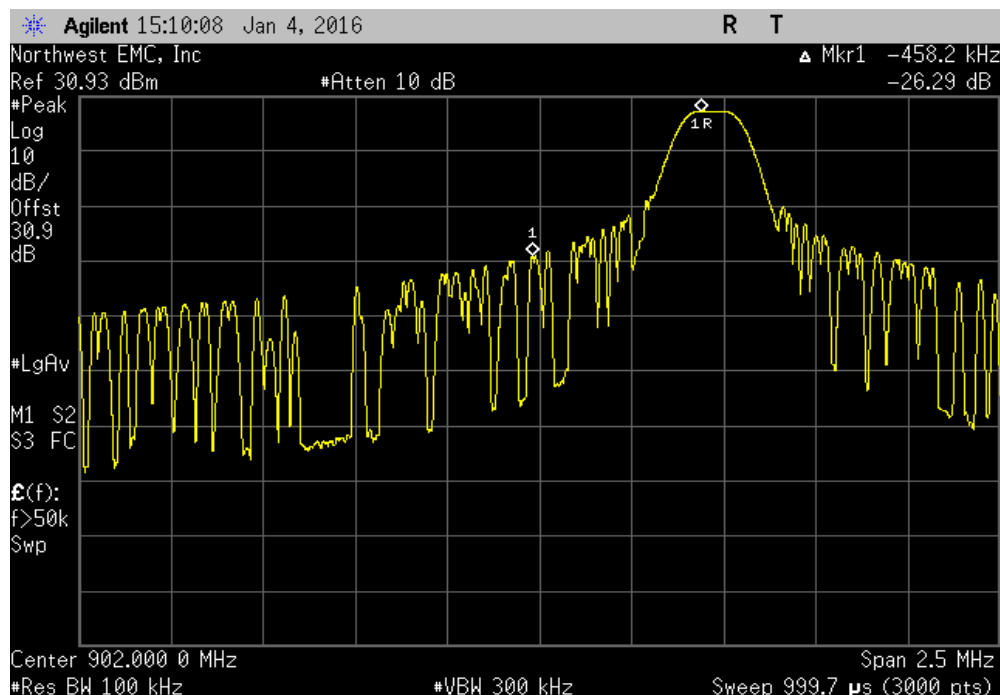
The spectrum was scanned below the lower band edge and above the higher band edge.

# BAND EDGE COMPLIANCE

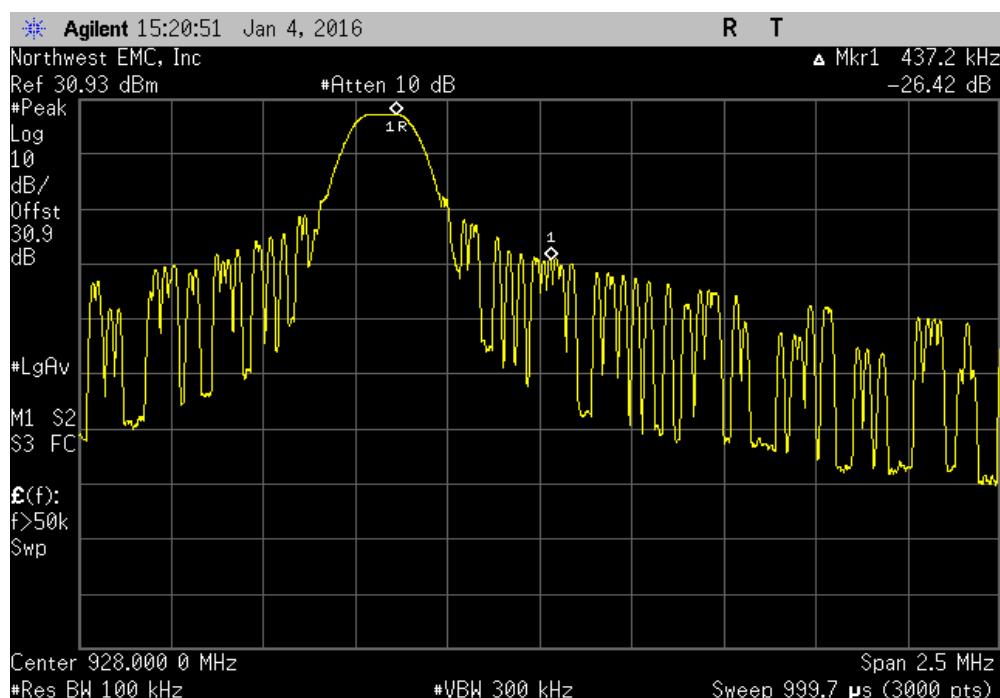
EUT: Z9-T (board unit w/TTL interface)		Work Order: FREW0054	
Serial Number: 402-669-0330		Date: 01/04/16	
Customer: FreeWave Technologies, Inc.		Temperature: 23°C	
Attendees: Dean Busch		Humidity: 29%	
Project: None		Barometric Pres.: 1009 mbar	
Tested by: Richard Mellroth	Power: 9 VDC	Job Site: NC02	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2016		ANSI C63.10:2013	
COMMENTS			
EUT power set at maximum = 30.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature 	
		Value (dBc)	Limit ≤ (dBc) Result
GFSK Modulation, 115.2kb			
Low Channel 2, 902.4768 MHz		-26.29	-20 Pass
High Channel 111, 927.5904 MHz		-26.42	-20 Pass
GFSK Modulation, 250kb			
Low Channel 1, 902.5344 MHz		-27.46	-20 Pass
High Channel 73, 927.4176 MHz		-29.44	-20 Pass

# BAND EDGE COMPLIANCE

GFSK Modulation, 115.2kb, Low Channel 2, 902.4768 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-26.29	-20	Pass



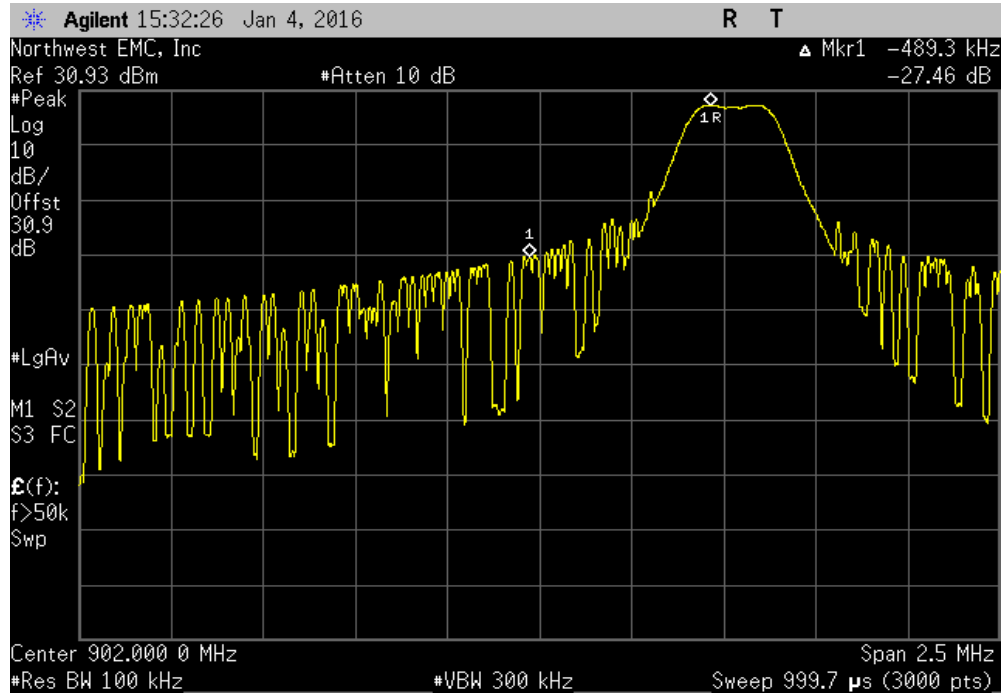
GFSK Modulation, 115.2kb, High Channel 111, 927.5904 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-26.42	-20	Pass



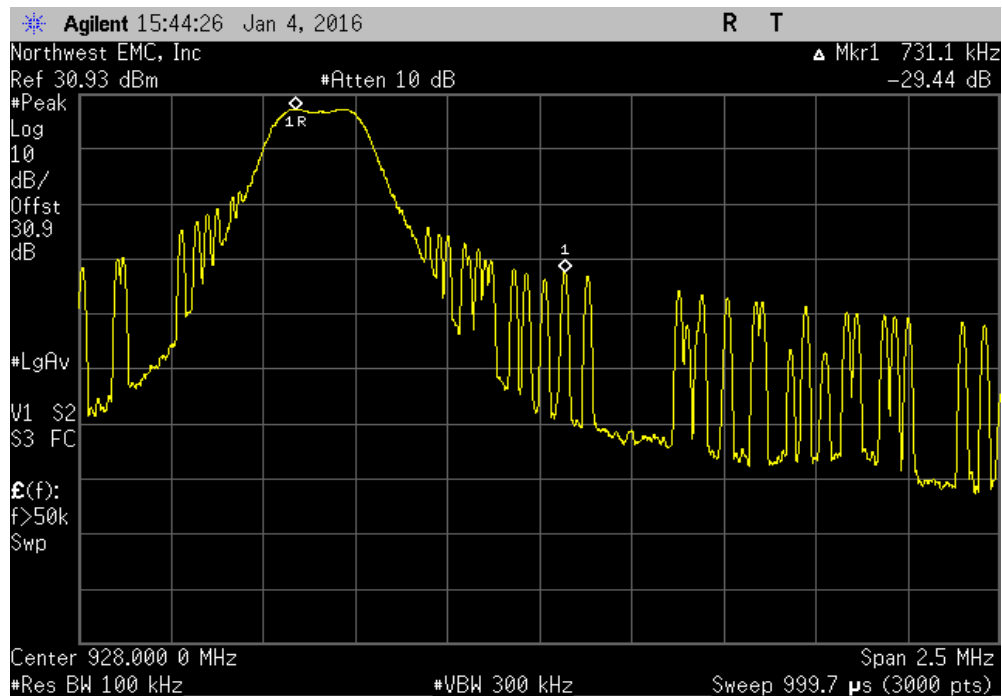


# BAND EDGE COMPLIANCE

GFSK Modulation, 250kb, Low Channel 1, 902.5344 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-27.46	-20	Pass



GFSK Modulation, 250kb, High Channel 73, 927.4176 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-29.44	-20	Pass



# BAND EDGE COMPLIANCE -HOPPING MODE



XMit 2015.01.14

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

## TEST EQUIPMENT


Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	6/6/2015	12
Attenuator	S.M. Electronics	SA18H-10	REJ	9/18/2015	12
Attenuator	S.M. Electronics	SA18H-20	REK	9/28/2015	12
Block - DC	Fairview Microwave	SD3379	AMJ	6/6/2015	12
Generator - Signal	Agilent	N5183A	TIA	4/7/2014	24

## TEST DESCRIPTION

The spurious RF conducted emissions at the edges of the authorized band were measured with the EUT set to its normal pseudo-random hopping sequence. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at the data rate(s) listed in the datasheet.

The spectrum was scanned below the lower band edge and above the higher band edge.

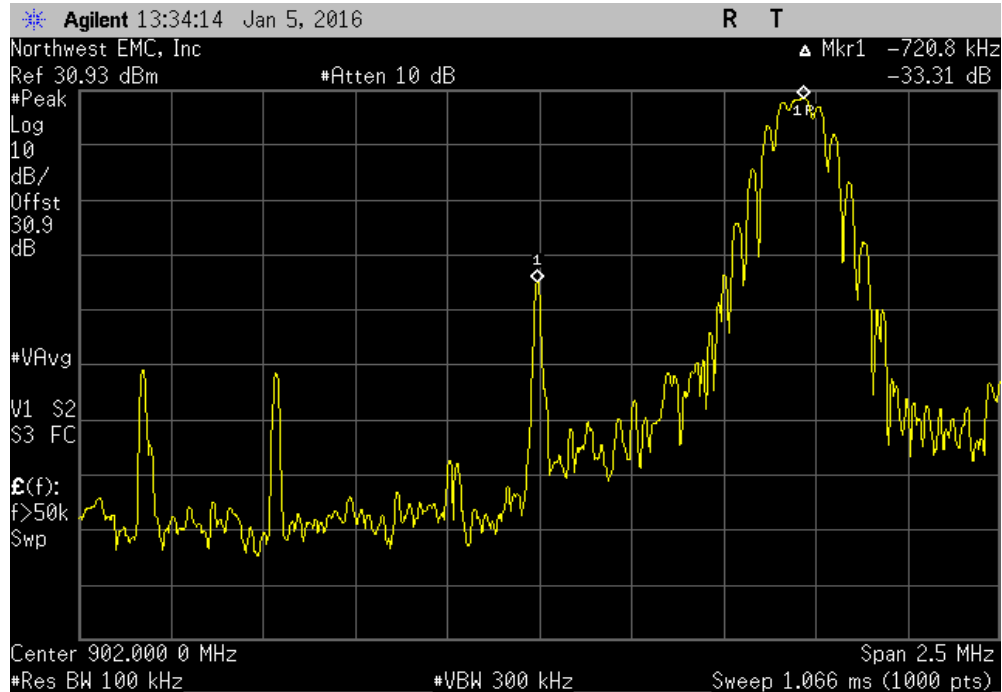
# BAND EDGE COMPLIANCE -HOPPING MODE

EUT: Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)		Work Order: FREW0054	
Serial Number: 402-669-0330		Date: 01/05/16	
Customer: FreeWave Technologies, Inc.		Temperature: 24°C	
Attendees: Dean Busch		Humidity: 26%	
Project: None		Barometric Pres.: 1002 mbar	
Tested by: Richard Mellroth	Power: 9 VDC	Job Site: NC02	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2016		ANSI C63.10:2013	
COMMENTS			
None			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature	
		Value (dBc)	Limit ≤ (dBc) Result
Hopping Mode			
GFSK Modulation, 115.2kb			
Low Channel 2, 902.4768 MHz		-33.31	-20 Pass
High Channel 111, 927.5904 MHz		-43.48	-20 Pass
GFSK Modulation, 250kb			
Low Channel 1, 902.5344 MHz		-36.87	-20 Pass
High Channel 73, 927.4176 MHz		-58.28	-20 Pass

# BAND EDGE COMPLIANCE -HOPPING MODE

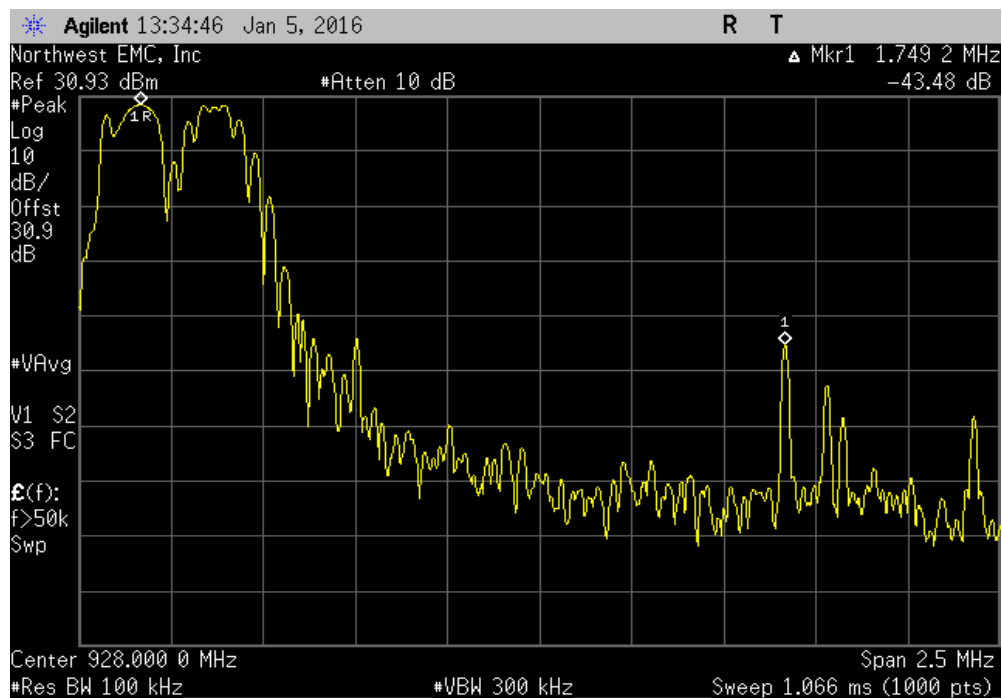
Hopping Mode, GFSK Modulation, 115.2kb, Low Channel 2, 902.4768 MHz

	Value (dBc)	Limit ≤ (dBc)	Result
	-33.31	-20	Pass



Hopping Mode, GFSK Modulation, 115.2kb, High Channel 111, 927.5904 MHz

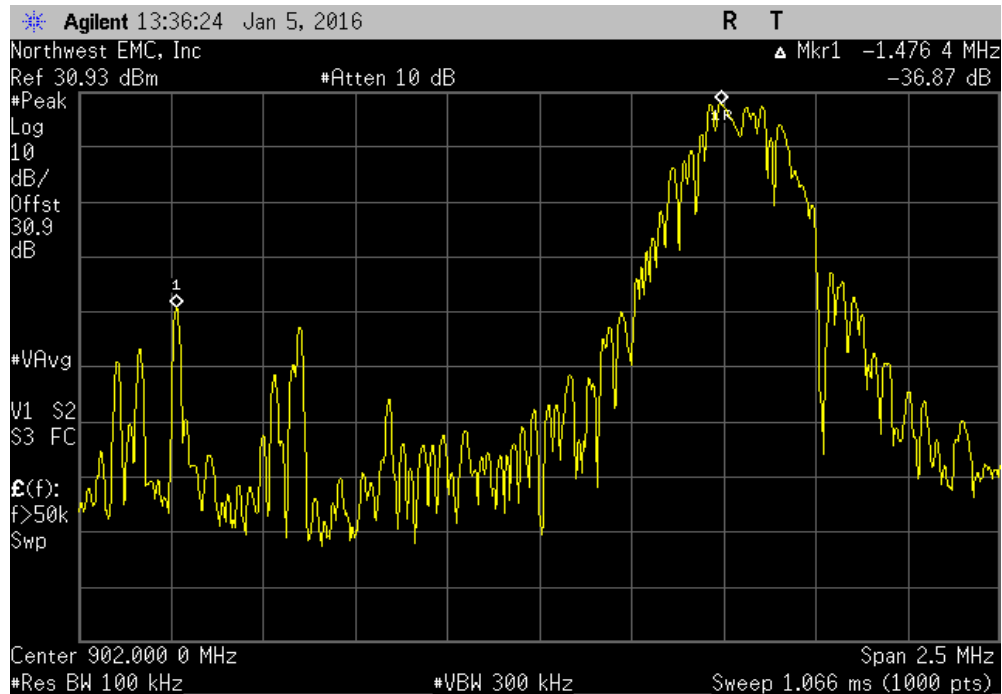
	Value (dBc)	Limit ≤ (dBc)	Result
	-43.48	-20	Pass



# BAND EDGE COMPLIANCE -HOPPING MODE

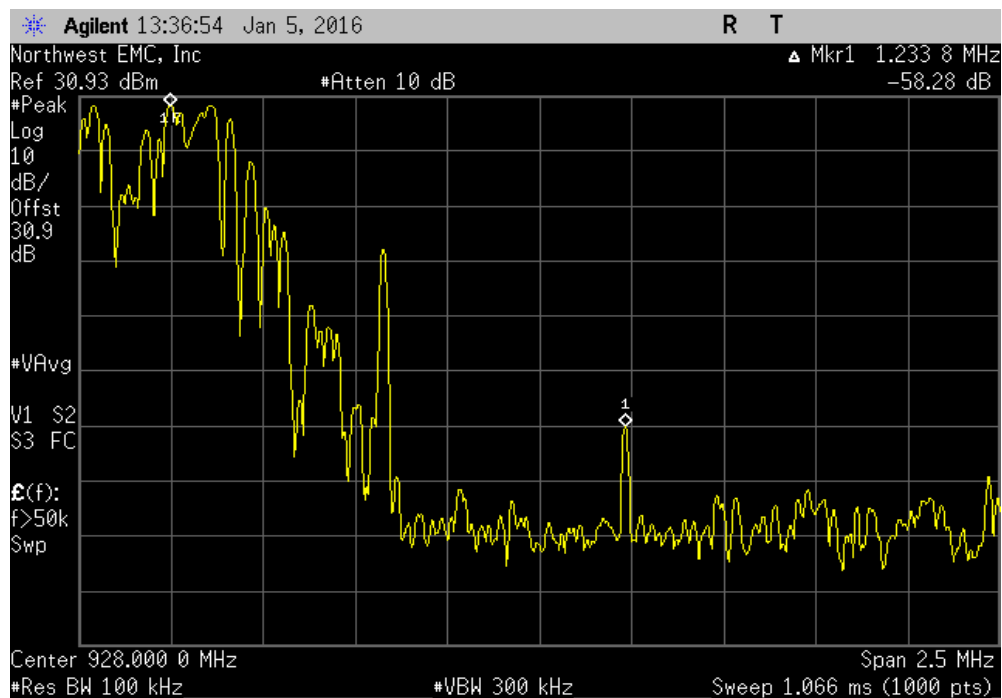
Hopping Mode, GFSK Modulation, 250kb, Low Channel 1, 902.5344 MHz

				Value (dBc)	Limit ≤ (dBc)	Result
				-36.87	-20	Pass



Hopping Mode, GFSK Modulation, 250kb, High Channel 73, 927.4176 MHz

				Value (dBc)	Limit ≤ (dBc)	Result
				-58.28	-20	Pass



# OCCUPIED BANDWIDTH

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.


## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	6/6/2015	12
Attenuator	S.M. Electronics	SA18H-10	REJ	9/18/2015	12
Attenuator	S.M. Electronics	SA18H-20	REK	9/28/2015	12
Block - DC	Fairview Microwave	SD3379	AMJ	6/6/2015	12
Generator - Signal	Agilent	N5183A	TIA	4/7/2014	24

## TEST DESCRIPTION

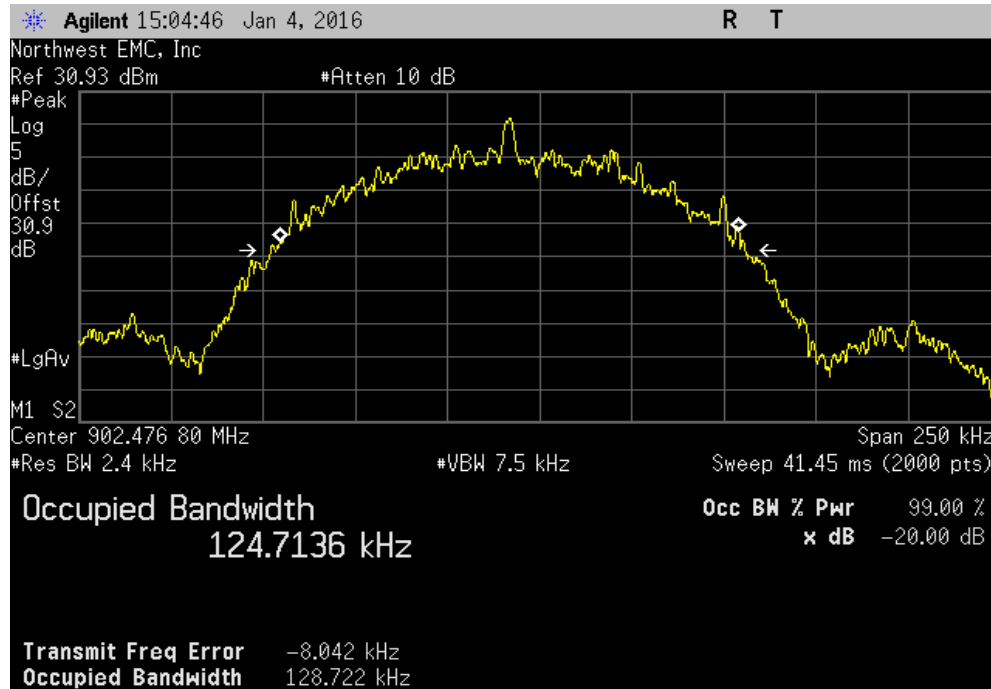
The occupied bandwidth was measured with the EUT set to low, medium and high transmit frequencies. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at the data rate(s) listed in the datasheet in a no-hop mode.

# OCCUPIED BANDWIDTH

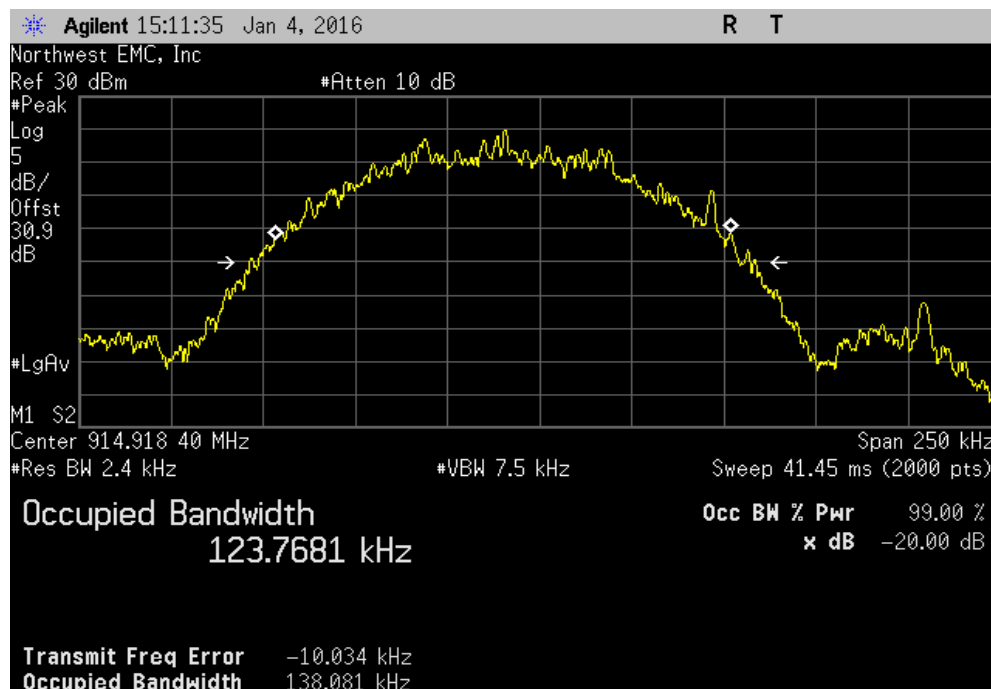
EUT: Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)		Work Order: FREW0054	
Serial Number: 402-669-0330		Date: 01/04/16	
Customer: FreeWave Technologies, Inc.		Temperature: 23°C	
Attendees: Dean Busch		Humidity: 29%	
Project: None		Barometric Pres.: 1009 mbar	
Tested by: Richard Mellroth	Power: 9 VDC	Job Site: NC02	
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2016		ANSI C63.10:2013	
COMMENTS			
EUT power set at maximum = 30.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature 	
		Value	Limit Result
GFSK Modulation, 115.2kb			
	Low Channel 2, 902.4768 MHz	128.722 kHz	≤ 500 kHz Pass
	Mid Channel 56, 914.9184 MHz	138.081 kHz	≤ 500 kHz Pass
	High Channel 111, 927.5904 MHz	132.825 kHz	≤ 500 kHz Pass
GFSK Modulation, 250kb			
	Low Channel 1, 902.5344 MHz	305.084 kHz	≤ 500 kHz Pass
	Mid Channel 37, 914.976 MHz	301.916 kHz	≤ 500 kHz Pass
	High Channel 73, 927.4176 MHz	283.817 kHz	≤ 500 kHz Pass

# OCCUPIED BANDWIDTH

GFSK Modulation, 115.2kb, Low Channel 2, 902.4768 MHz						
				Value	Limit	Result
				128.722 kHz	≤ 500 kHz	Pass



GFSK Modulation, 115.2kb, Mid Channel 56, 914.9184 MHz						
				Value	Limit	Result
				138.081 kHz	≤ 500 kHz	Pass

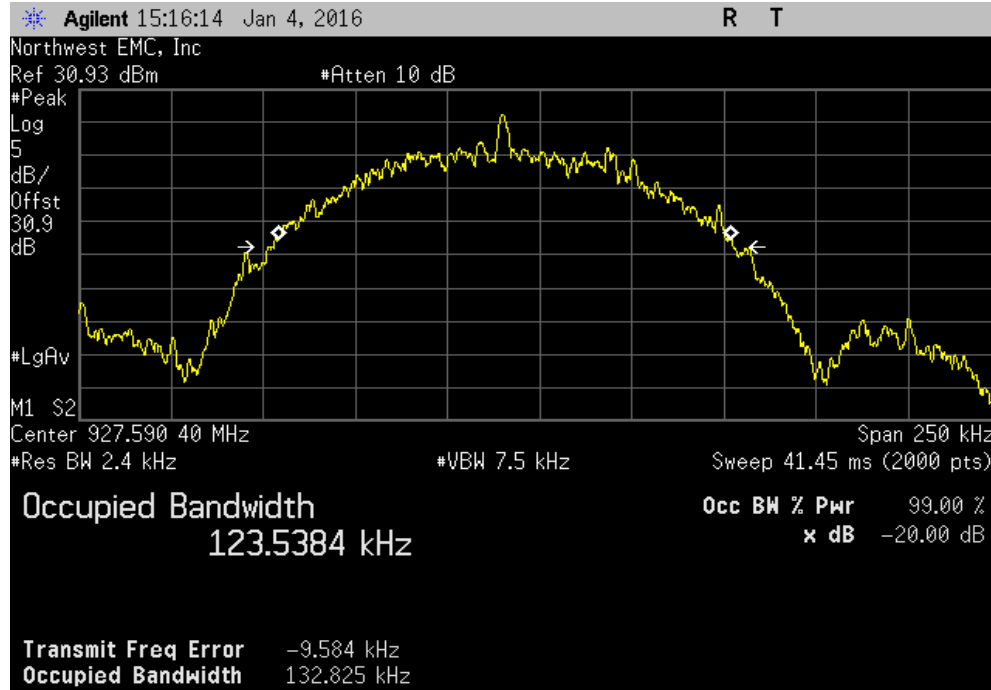




# OCCUPIED BANDWIDTH

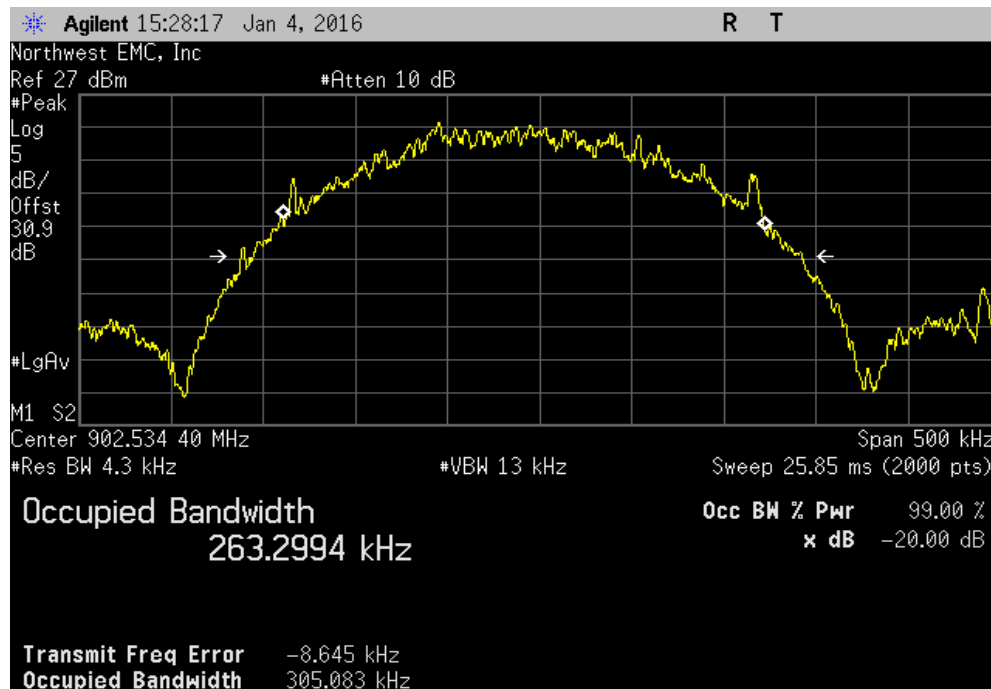
GFSK Modulation, 115.2kb, High Channel 111, 927.5904 MHz

				Value	Limit	Result
				132.825 kHz	≤ 500 kHz	Pass



GFSK Modulation, 250kb, Low Channel 1, 902.5344 MHz

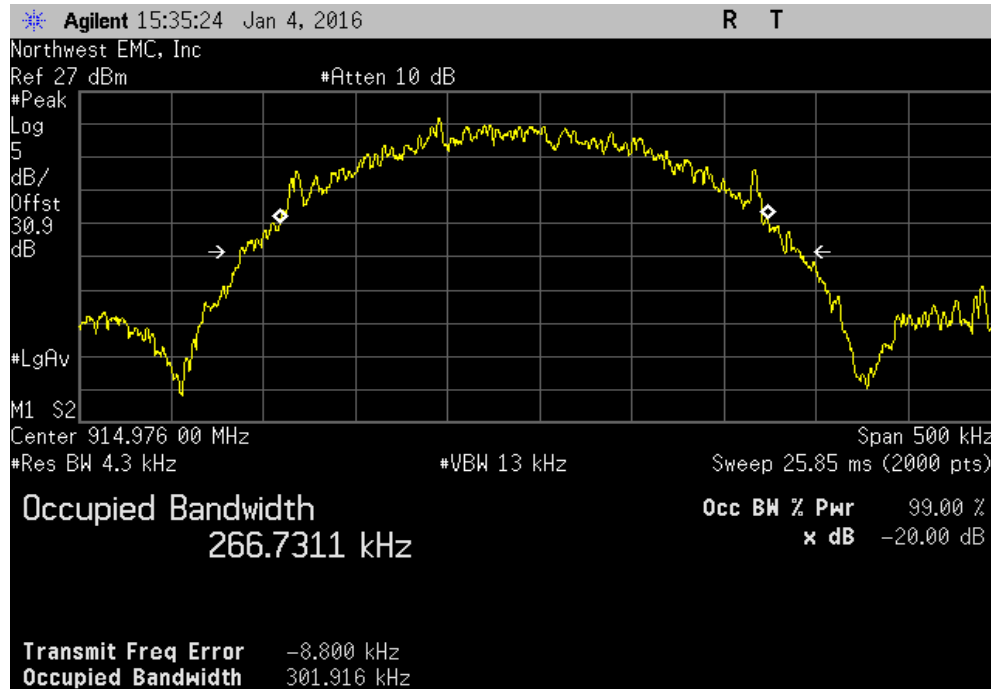
				Value	Limit	Result
				305.084 kHz	≤ 500 kHz	Pass



# OCCUPIED BANDWIDTH

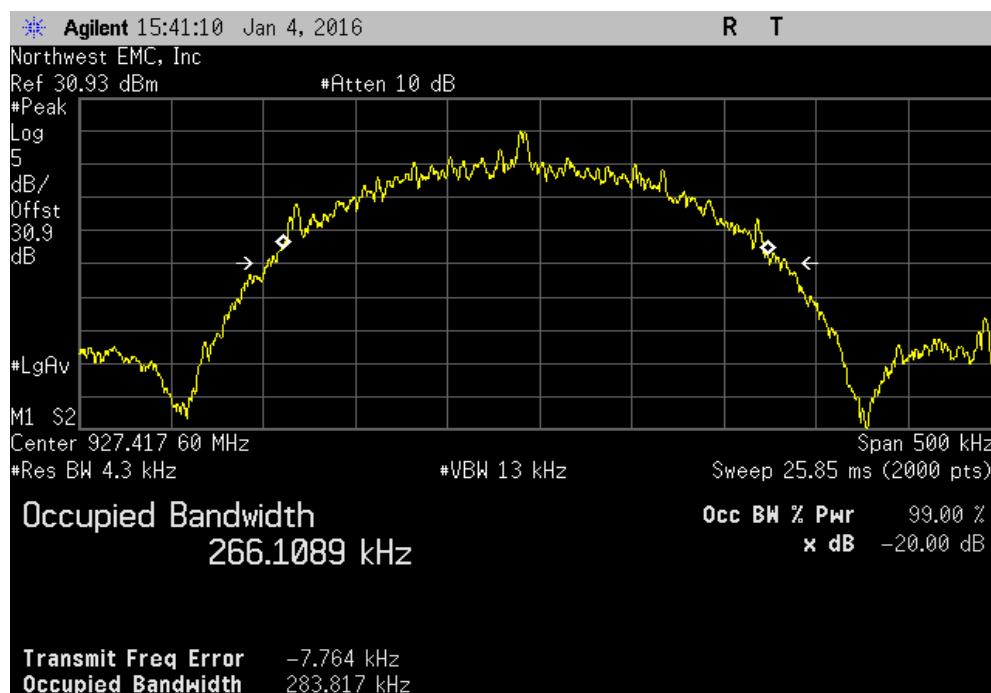
GFSK Modulation, 250kb, Mid Channel 37, 914.976 MHz

	Value	Limit	Result
	301.916 kHz	≤ 500 kHz	Pass



GFSK Modulation, 250kb, High Channel 73, 927.4176 MHz

	Value	Limit	Result
	283.817 kHz	≤ 500 kHz	Pass



# SPURIOUS CONDUCTED EMISSIONS

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.


## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval (mo)
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFE	6/22/2015	12
Cable	ESM Cable Corp.	TTBJ-141 KMKM-72	NC5	6/6/2015	12
Attenuator	S.M. Electronics	SA18H-20	REK	9/28/2015	12
Attenuator	S.M. Electronics	SA18H-10	REJ	9/18/2015	12
Block - DC	Fairview Microwave	SD3379	AMJ	6/6/2015	12
Generator - Signal	Agilent	N5183A	TIA	4/7/2014	24

## TEST DESCRIPTION

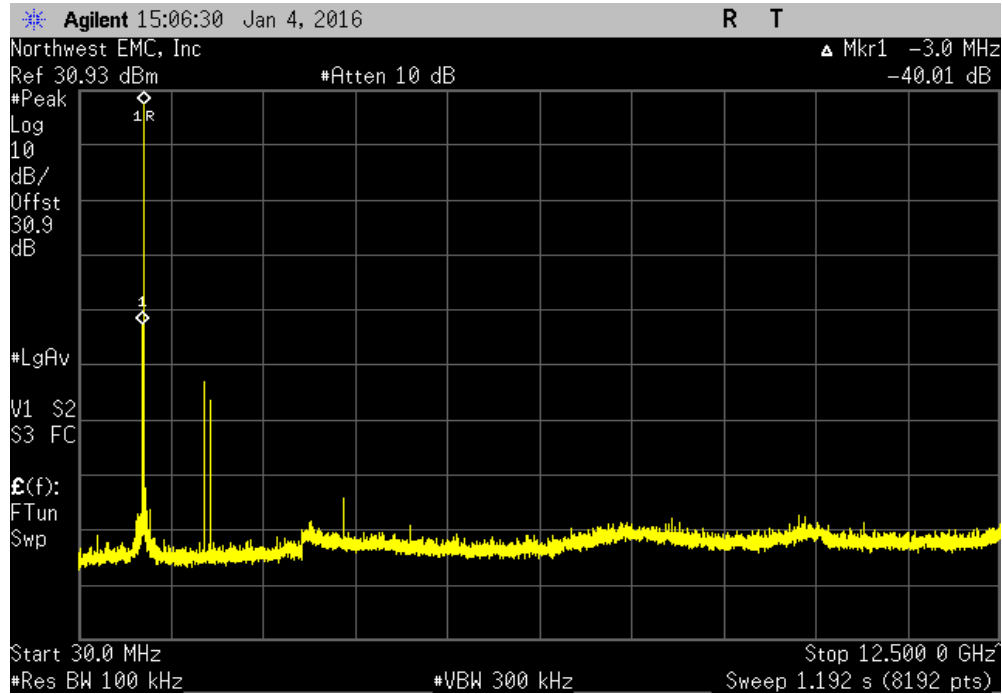
The spurious RF conducted emissions were measured with the EUT set to low, medium and high transmit frequencies. The measurements were made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at the data rate(s) listed in the datasheet in a no-hop mode. For each transmit frequency, the spectrum was scanned throughout the specified frequency range.

# SPURIOUS CONDUCTED EMISSIONS

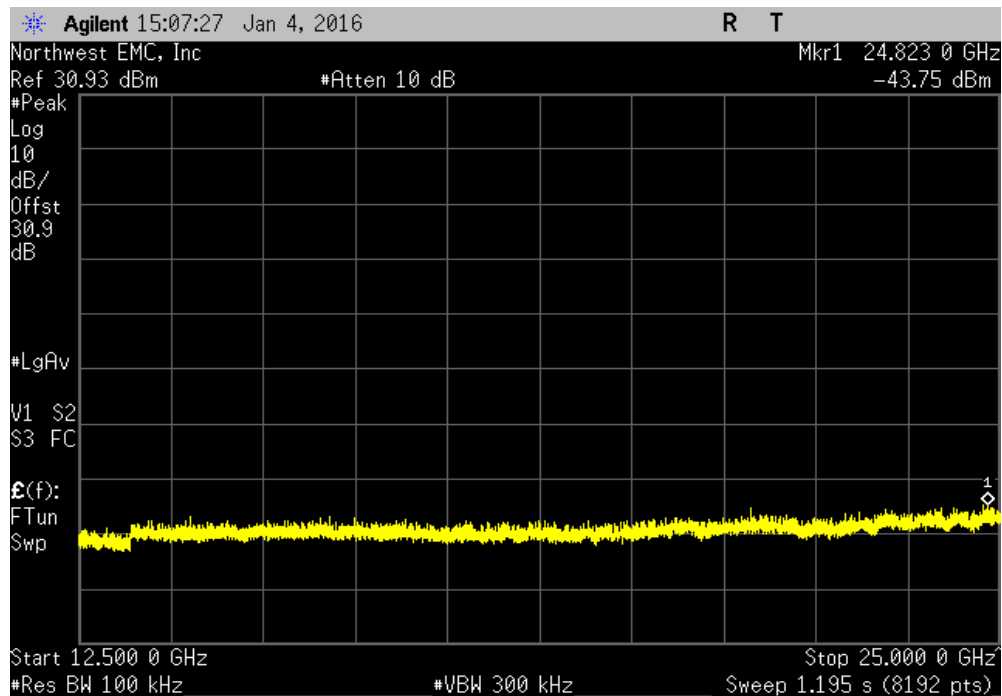
EUT: Z9-C (board unit w/RS232 interface), Z9-T (board unit w/TTL interface)		Work Order: FREW0054	
Serial Number: 402-669-0330		Date: 01/04/16	
Customer: FreeWave Technologies, Inc.		Temperature: 23°C	
Attendees: Dean Busch		Humidity: 29%	
Project: None		Barometric Pres.: 1009 mbar	
Tested by: Richard Mellroth		Power: 9 VDC	
Job Site: NC02			
TEST SPECIFICATIONS		Test Method	
FCC 15.247:2016		ANSI C63.10:2013	
COMMENTS			
EUT power set at maximum = 30.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1	Signature 	
		Frequency Range	Max Value (dBc)
			Limit ≤ (dBc)
			Result
GFSK Modulation, 115.2kb			
	Low Channel 2, 902.4768 MHz	30 MHz - 12.5 GHz	-40.01
	Low Channel 2, 902.4768 MHz	12.5 GHz - 25 GHz	-72.13
	Mid Channel 56, 914.9184 MHz	30 MHz - 12.5 GHz	-55.51
	Mid Channel 56, 914.9184 MHz	12.5 GHz - 25 GHz	-71.8
	High Channel 111, 927.5904 MHz	30 MHz - 12.5 GHz	-36.96
	High Channel 111, 927.5904 MHz	12.5 GHz - 25 GHz	-71.75
GFSK Modulation, 250kb			
	Low Channel 1, 902.5344 MHz	30 MHz - 12.5 GHz	-54.11
	Low Channel 1, 902.5344 MHz	12.5 GHz - 25 GHz	-71.7
	Mid Channel 37, 914.976 MHz	30 MHz - 12.5 GHz	-55.59
	Mid Channel 37, 914.976 MHz	12.5 GHz - 25 GHz	-72.01
	High Channel 73, 927.4176 MHz	30 MHz - 12.5 GHz	-48.42
	High Channel 73, 927.4176 MHz	12.5 GHz - 25 GHz	-72.27

# SPURIOUS CONDUCTED EMISSIONS

GFSK Modulation, 115.2kb, Low Channel 2, 902.4768 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
30 MHz - 12.5 GHz	-40.01	-20	Pass	

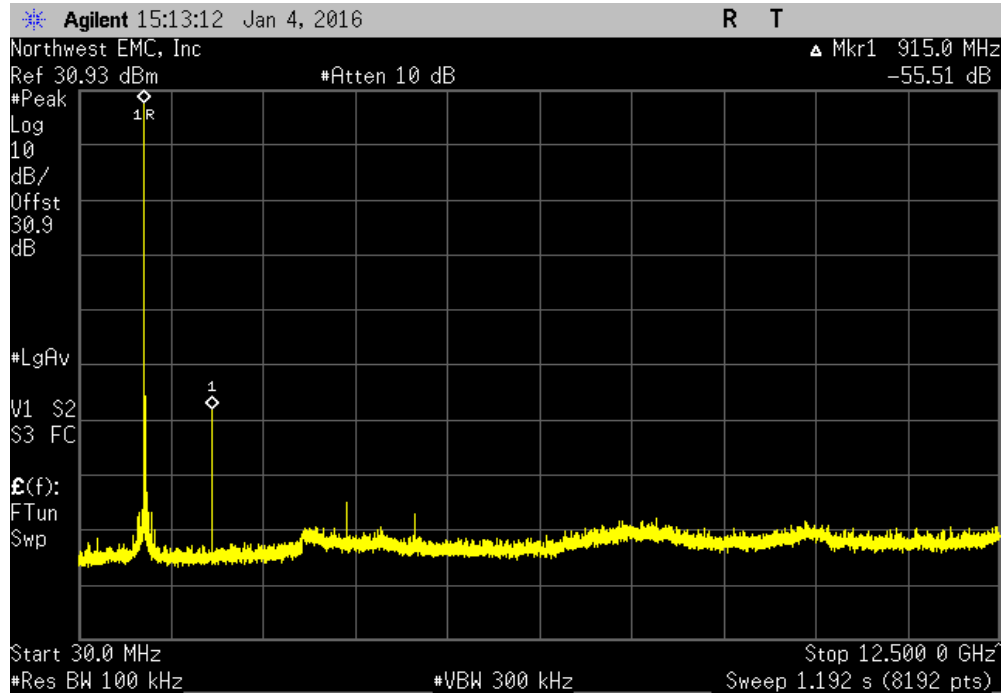


GFSK Modulation, 115.2kb, Low Channel 2, 902.4768 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
12.5 GHz - 25 GHz	-72.13	-20	Pass	

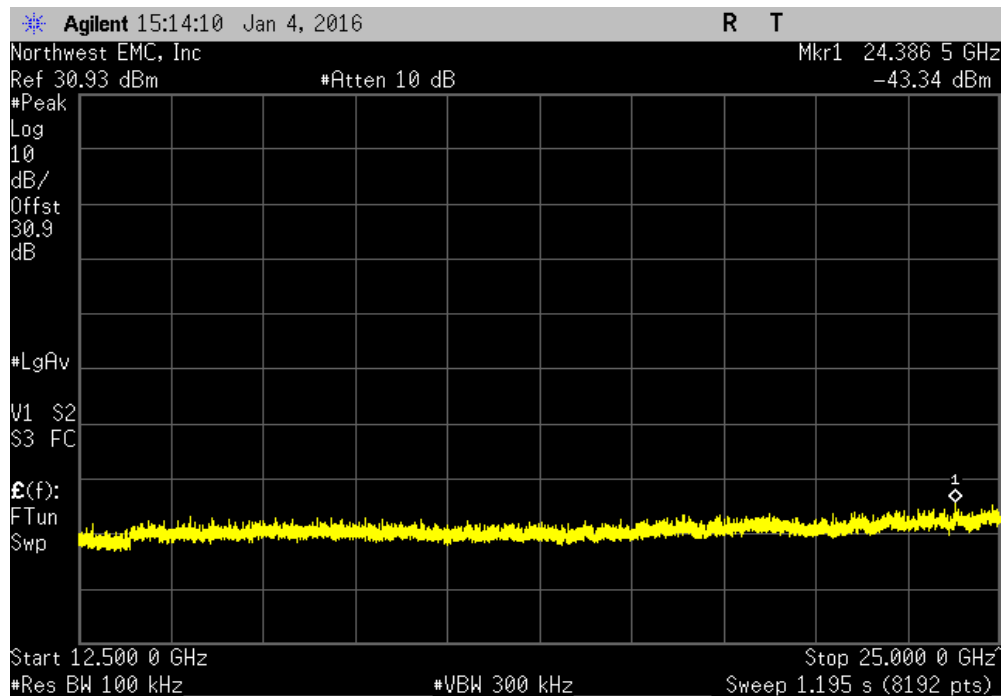


# SPURIOUS CONDUCTED EMISSIONS

GFSK Modulation, 115.2kb, Mid Channel 56, 914.9184 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
30 MHz - 12.5 GHz	-55.51	-20	Pass	

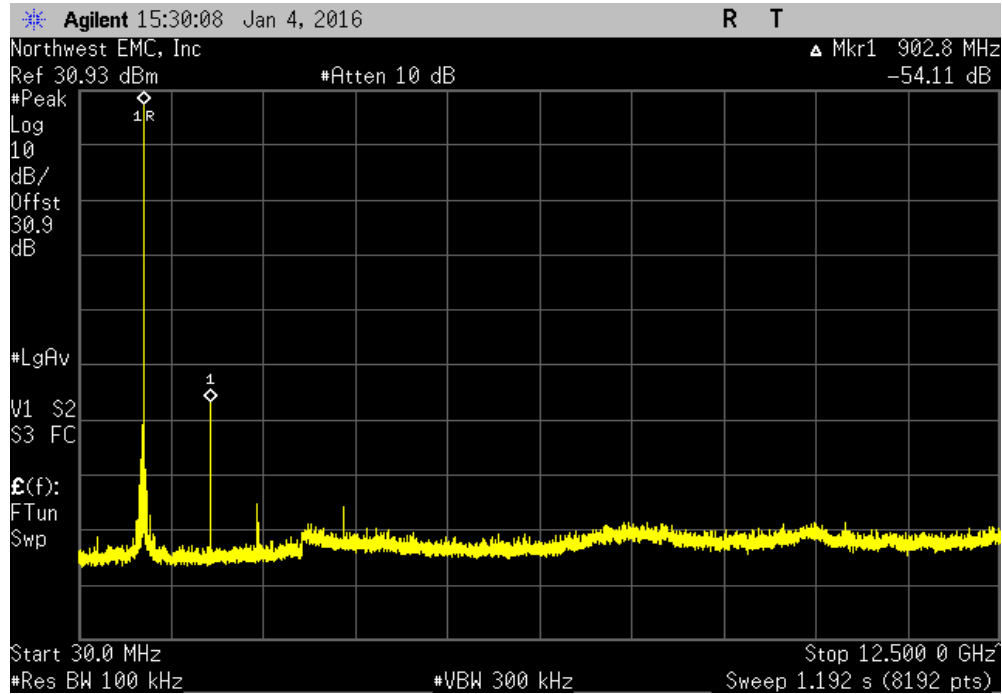


GFSK Modulation, 115.2kb, Mid Channel 56, 914.9184 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
12.5 GHz - 25 GHz	-71.8	-20	Pass	

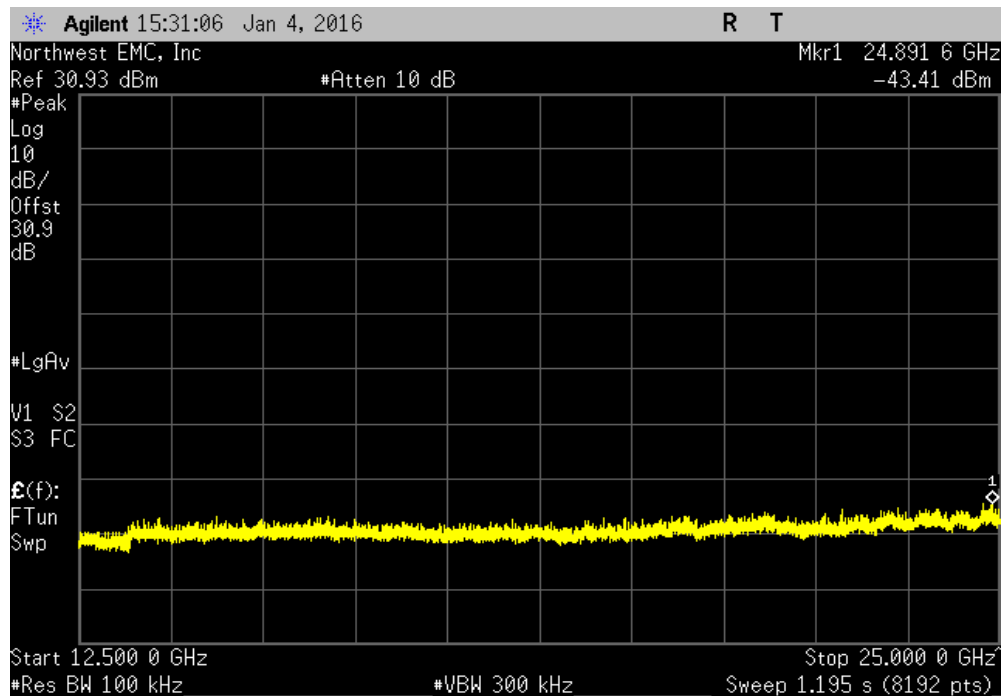


# SPURIOUS CONDUCTED EMISSIONS

GFSK Modulation, 250kb, Low Channel 1, 902.5344 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
30 MHz - 12.5 GHz	-54.11	-20	Pass	

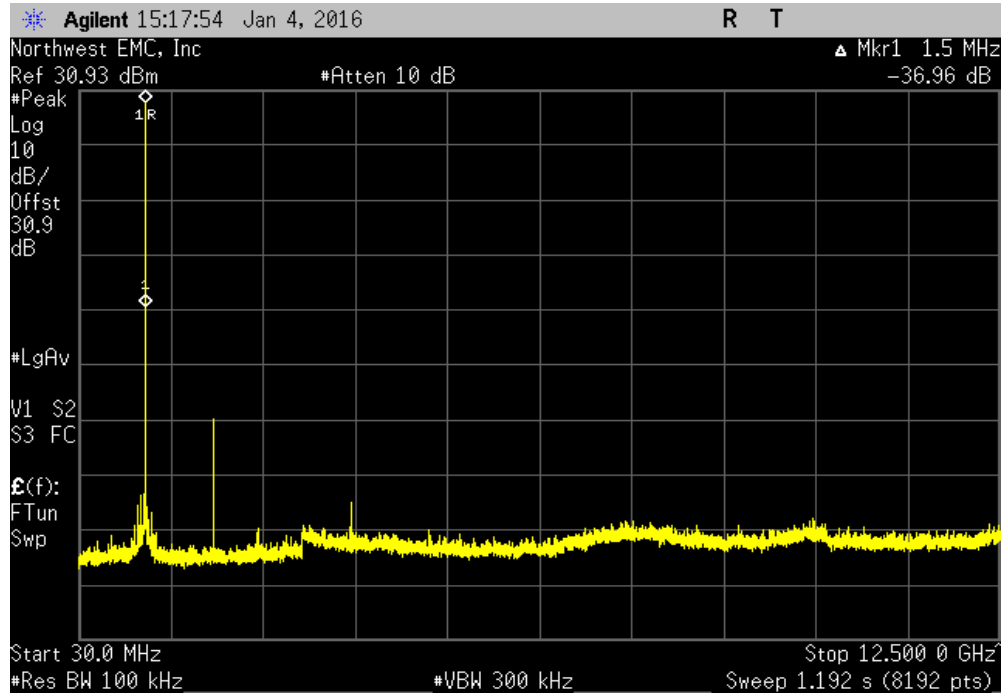


GFSK Modulation, 250kb, Low Channel 1, 902.5344 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
12.5 GHz - 25 GHz	-71.7	-20	Pass	

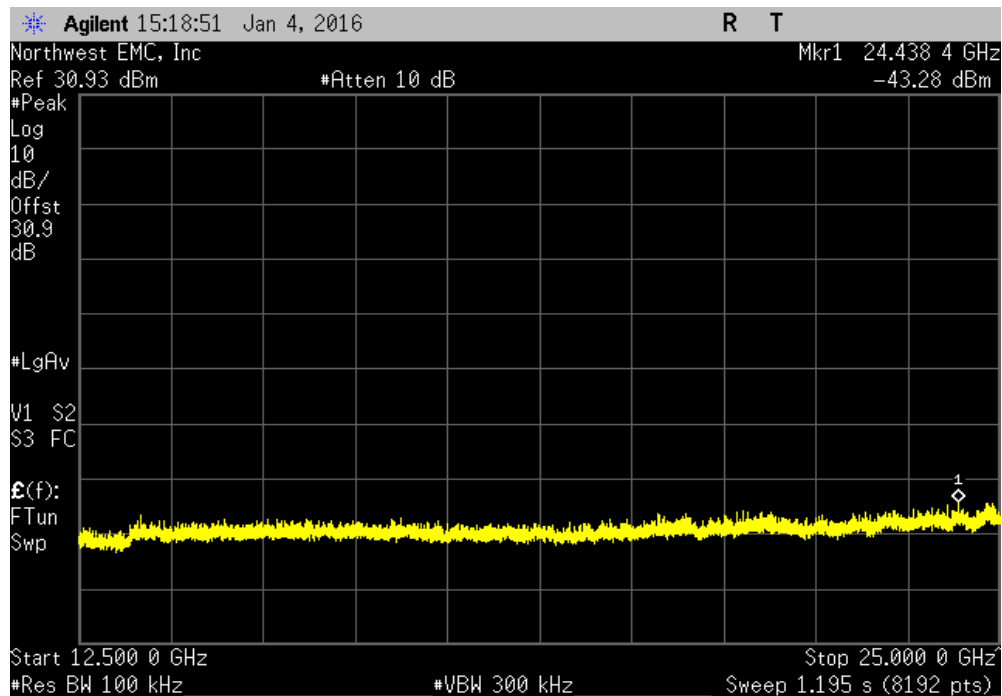


# SPURIOUS CONDUCTED EMISSIONS

GFSK Modulation, 115.2kb, High Channel 111, 927.5904 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
30 MHz - 12.5 GHz	-36.96	-20	Pass	



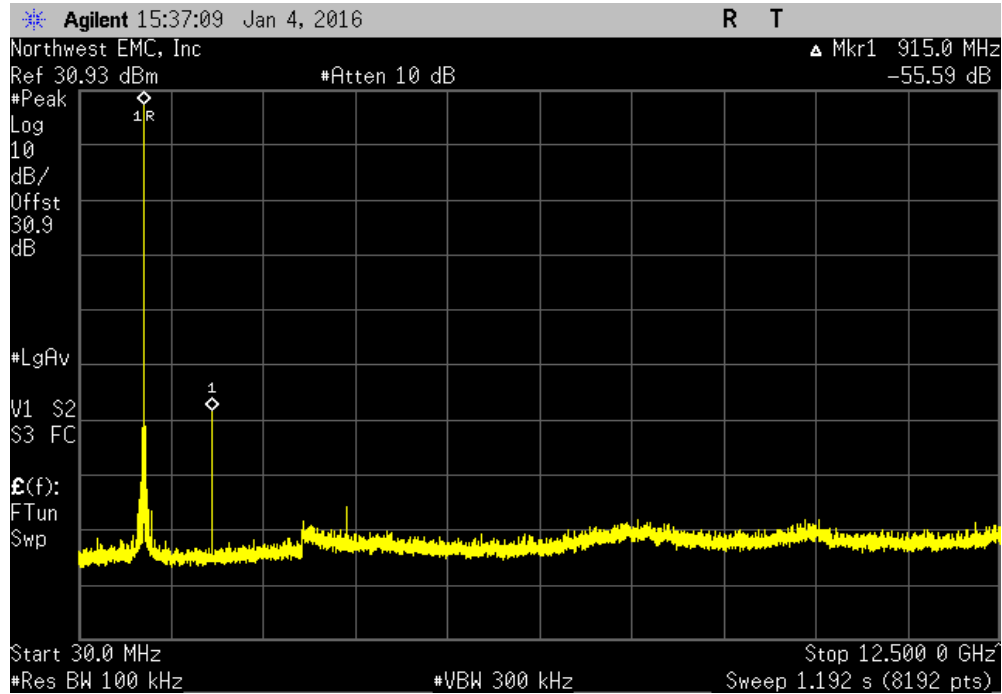
GFSK Modulation, 115.2kb, High Channel 111, 927.5904 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
12.5 GHz - 25 GHz	-71.75	-20	Pass	



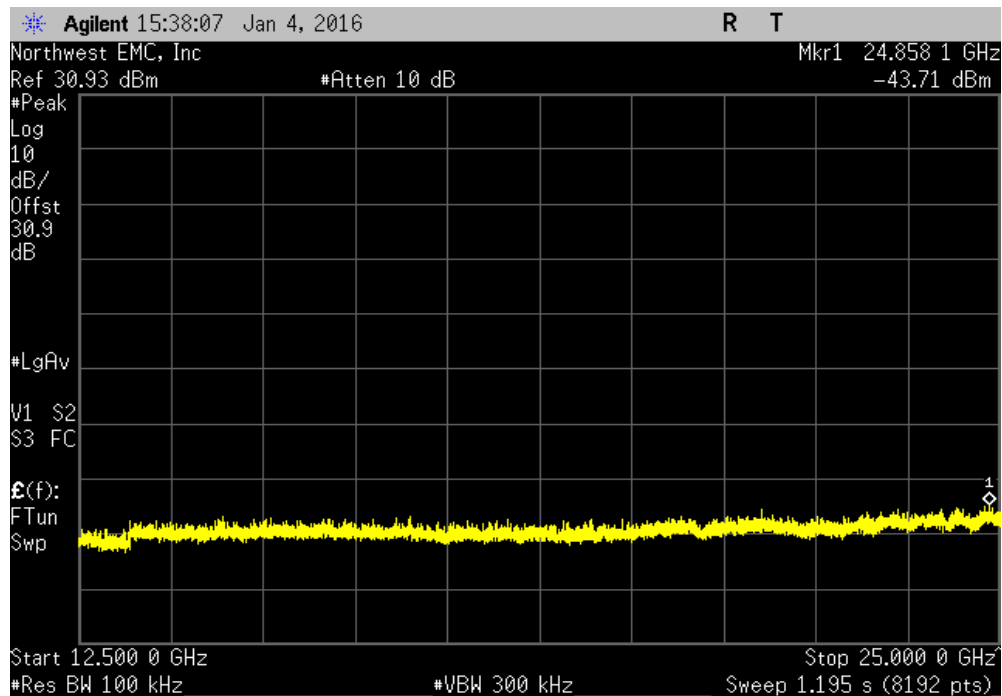


# SPURIOUS CONDUCTED EMISSIONS

GFSK Modulation, 250kb, Mid Channel 37, 914.976 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
30 MHz - 12.5 GHz	-55.59	-20	Pass	

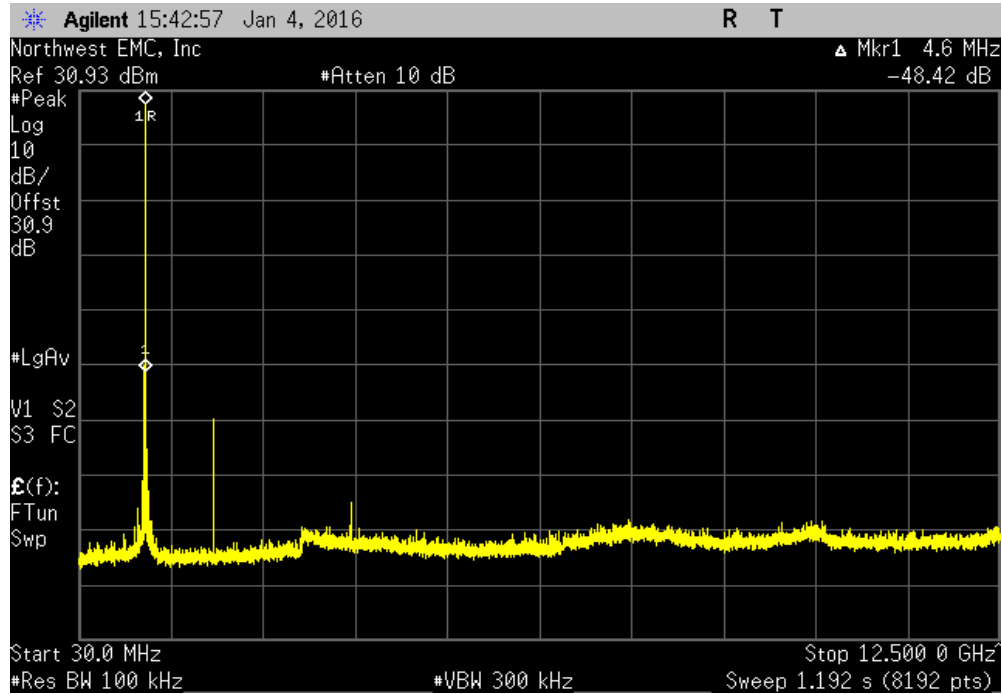


GFSK Modulation, 250kb, Mid Channel 37, 914.976 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
12.5 GHz - 25 GHz	-72.01	-20	Pass	



# SPURIOUS CONDUCTED EMISSIONS

GFSK Modulation, 250kb, High Channel 73, 927.4176 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
30 MHz - 12.5 GHz	-48.42	-20	Pass	



GFSK Modulation, 250kb, High Channel 73, 927.4176 MHz				
Frequency Range	Max Value (dBc)	Limit ≤ (dBc)	Result	
12.5 GHz - 25 GHz	-72.27	-20	Pass	

