NORTHWEST EMC

Garrett Metal Detectors

WR-1

FCC 2.1093:2016

2400-2483.5 MHz Transceiver

Report # GARR0027

NVLAP TESTING

NVLAP Lab Code: 201049-0

CERTIFICATE OF EVALUATION

NORTHWEST EMC
2014-12-10

Last Date of Evaluation: December 22, 2016
Garrett Metal Detectors
Model: WR-1

RF Exposure Evaluation

Standards

Specification	Method
FCC 2.1093:2016	FCC KDB 447498 D01 General RF Exposure Guidance v06

Results

Method Clause	Description	Applied	Results	Comments
4.3.1	SAR Evaluation Exclusion	Yes	Pass	

Deviations From Standards

None

Approved By:

Donald Facteau, IT Manager

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

REVISION HISTORY

NORTHWEST EMC
REV 2014.10.14

Revision Number	Description	Date	Page Number
00	None		

ACCREDITATIONS AND AUTHORIZATIONS

REV 2016.7.25

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

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB). Certification chambers and Open Area Test Sites are filed with ISED.

European Union

European Commission – Validated by the European Commission as a Notified Body under the R&TTE Directive.

Australia/New Zealand

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

Korea

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

Japan

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

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.

Singapore

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

Israel

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

Hong Kong

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

Vietnam

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

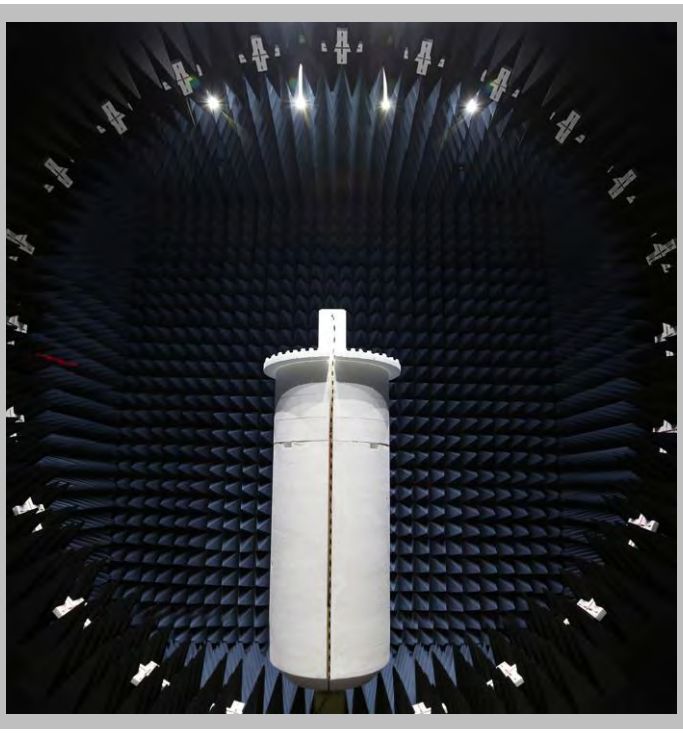
SCOPE

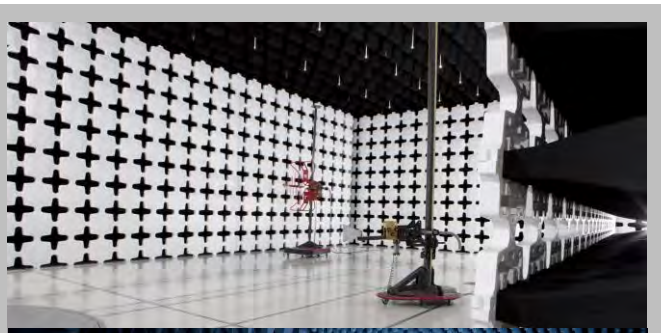
For details on the Scopes of our Accreditations, please visit:
http://www.nwemc.com/accreditations/
http://gsi.nist.gov/global/docs/cabs/designations.html

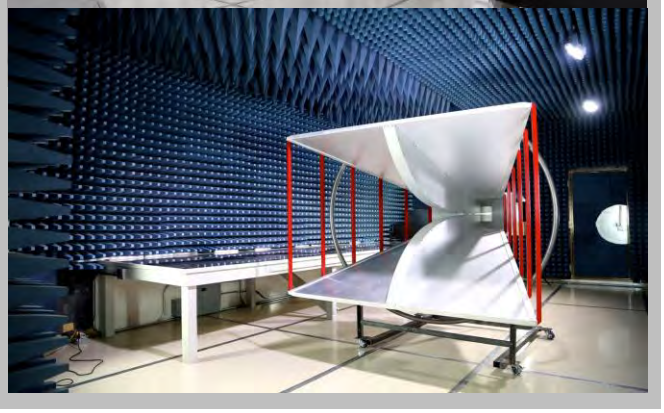
FACILITIES

NORTHWEST EMC
REV 2016.7.25

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







PRODUCT DESCRIPTION

NORTHWEST EMC
2014-12-10

Client and Equipment Under Evaluation Information

Company Name:	Garrett Metal Detectors
Address:	1881 W. State Street
City, State, Zip:	Garland, TX 75042
Evaluation Requested By:	Weldon Sanders
Model:	WR-1
Date of Evaluation:	December 22, 2016

Information Provided by the Party Requesting the Evaluation

Functional Description of the equipment:

The Garrett Z-LYNK Wireless Digital Transmission System consists of the Model WT-1 and Model WR-1 for use with Garret metal detectors to provide wireless audio functionality. The Model WT-1 and Model WR-1 use the identical radio chip and antenna.

The Model WT-1 is a part of the Garrett Z-LYNK Wireless Digital Transmission System operating in the 2.4GHz band. It is used with Garrett Metal Detectors hand-held hobby line of metal detectors and the Garrett Model WR-1. It is powered by a rechargeable 3.7 volt battery, receives audio from the detector via a short cable plugged into the headphone jack, and transmits that audio wirelessly to the WR-1 receiver. The WT-1 is mounted on the metal detector and used greater than 20 cm from the head or torso of a user.

The Model WR-1 is a part of the Garrett Z-LYNK Wireless Digital Transmission System operating in the 2.4GHz band. It is used with Garrett Metal Detectors hand-held hobby line of metal detectors and the Garrett Model WT-1. It is powered by a rechargeable 3.7 volt battery and receives audio from the detector via a wireless link from the Garrett Model WT-1. The user plugs his headphones into the WR-1. The WR-1 transmits handshake information back to the WT-1. The WR-1 has a belt clip and used within 20 cm of the torso of a user.

Objective:

To demonstrate compliance of WR-1 with FCC RF exposure requirements for 2.1093 portable devices.

DUTY CYCLE

NORTHWEST EMC

XMit 2016.05.06

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.	Cal. Due
Probe - Near Field Set	ETS Lindgren	7405	IPS	NCR	NCR
Cable	Fairview Microwave	SCK0963-60	TXF	10/24/2016	10/24/2017
Block - DC	Fairview Microwave	SD3379	AMM	2/25/2016	2/25/2017
Attenuator	Fairview Microwave	SA4018-20	TQY	2/25/2016	2/25/2017
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFL	10/4/2016	10/4/2017
Generator - Signal	Agilent	E4422B	TGS	3/27/2015	3/27/2018

TEST DESCRIPTION

A near-field probe was placed near the transmitter. A low-loss coaxial cable was used to connect the near-field probe to the spectrum analyzer. 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 when operating in it's typical audio transmit/receive mode.

The reference design manufacturer of the radio technology could not confirm an actual maximum duty cycle therefore an alternative method had to be used to measure the duty cycle used by the customer. A description of the test modes used are as follows: *The WT-1 and WR-1 modules function as a pair to wirelessly communicate audio from the metal detector to the headphones. Unless already paired, the audio transmitter (WT-1) module has to be triggered (button press) to look for available receiver (WR-1) modules. The WT-1 module then pairs with the WR-1 module with the strongest signal. Once paired, the WT-1 remembers its WR-1 partner even after power cycle. A previously paired WT-1 will automatically establish connection with the same WR-1 on power up as long as the WR-1 is available for connection.*

Once paired, the WT-1 digitizes the metal detector audio and transmits it over the radio link to the WR-1. This is the typical usage of the system and the radio.

If not paired or if the WR-1 is not available, the WT-1 radio does nothing until pairing is initiated or the WR-1 in memory becomes available.
If not paired or if the WT-1 is not available, the WR-1 radio sends a "pairing signal" that lets potential WT-1 modules know about availability in the WR-1 module's network.

Pairing is a one-time occurrence in most cases and the typical radio operation is when both the WT-1 and WR-1 are communicating and audio is being transmitted.

Investigation was done all three described modes. The worse case duty cycle was having both the WT-1 and WR-1 paired together and transmitting audio. This data is included in the report. The duty cycle was measured on low, mid and high channels and pulse on time, pulse number, and period were all recorded.

This particular Low Energy protocol implimentation limits transmission to 18 channels. In order to determine the total duty cycle from all channels, the worse case pulse width, period length, and number of pulses in a period were used and extrapolated to determine the duty cycle across all 18 channels. The formulas used are highlighted below.

Total Period across all channels (ms) = Total Channels * Worse case period per channel (ms) = 18 * 104.9 = 1888

Total Pulse on Time across all channels (ms) = Total Channels * Worse case # of pulses per channel * Worse case pulse width (ms) = 18 * 10 *.844 = 151.9

Duty Cycle % = (Total Pulse on Time across all channels / Total Period) * 100 = (151.9 / 1888)*100 = **8%**

DUTY CYCLE

NORTHWEST EMC

XMit 2016.05.06

EUT:	WR-1			**Work Order:**	GARR0027
Serial Number:	None			**Date:**	11/11/16
Customer:	Garrett Metal Detectors			**Temperature:**	23.5 °C
Attendees:	None			**Humidity:**	41% RH
Project:	None			**Barometric Pres.:**	1026 mbar
Tested by:	Jonathan Kiefer	**Power:**	Battery	**Job Site:**	TX02

TEST SPECIFICATIONS	Test Method
FCC 2.1093:2016	FCC KDB 447498 D01 General RF Exposure Guidance v06

COMMENTS

Transmitter and Receiver paired together. The measurements were taken on the Receiver unit. This operating mode is the actual mode used to transmit and receive audio in a typical operation. These results are used to calculate the total duty cycle across all 18 channels. Duty cycle is 8%. See the previous page for the complete calculation.

DEVIATIONS FROM TEST STANDARD

None

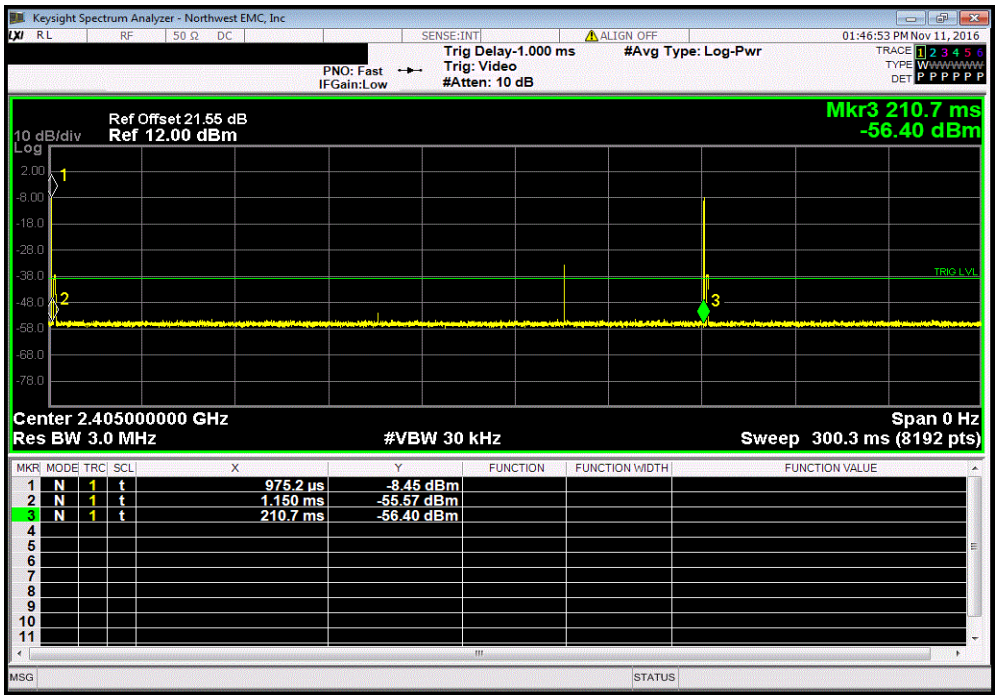
Configuration #	9	Signature	Jonathan Kiefer

	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
Low Channel, 2405 MHz	174.8 us	209.732 ms	3	N/A	N/A	N/A
Low Channel, 2405 MHz	N/A	N/A	6	N/A	N/A	N/A
Mid Channel, 2445 MHz	835.4 us	104.97 ms	10	N/A	N/A	N/A
Mid Channel, 2445 MHz	N/A	N/A	43	N/A	N/A	N/A
High Channel, 2476 MHz	844 us	210.034 ms	4	N/A	N/A	N/A
High Channel, 2476 MHz	N/A	N/A	15	N/A	N/A	N/A

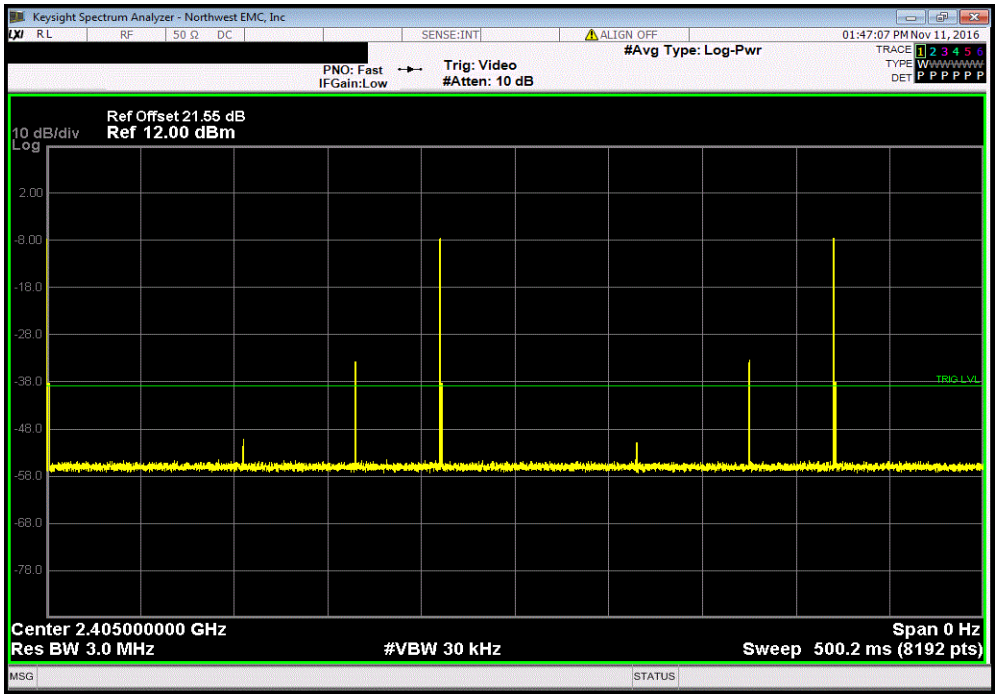
DUTY CYCLE

XMit 2016.05.06

Low Channel, 2405 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	174.8 us	209.732 ms	3	N/A	N/A	N/A



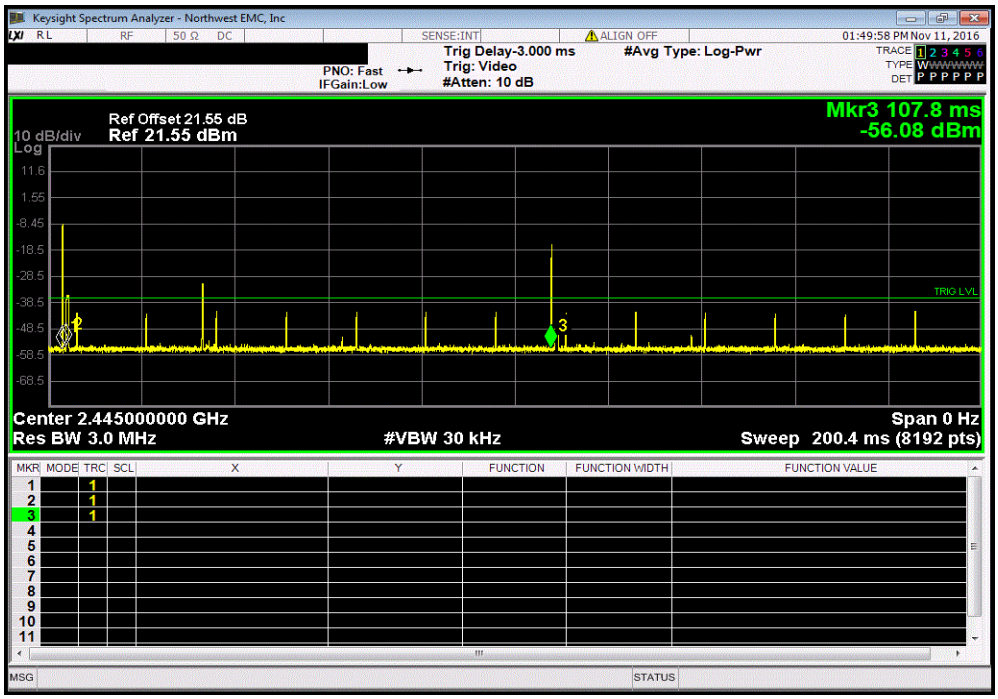
Low Channel, 2405 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	6	N/A	N/A	N/A



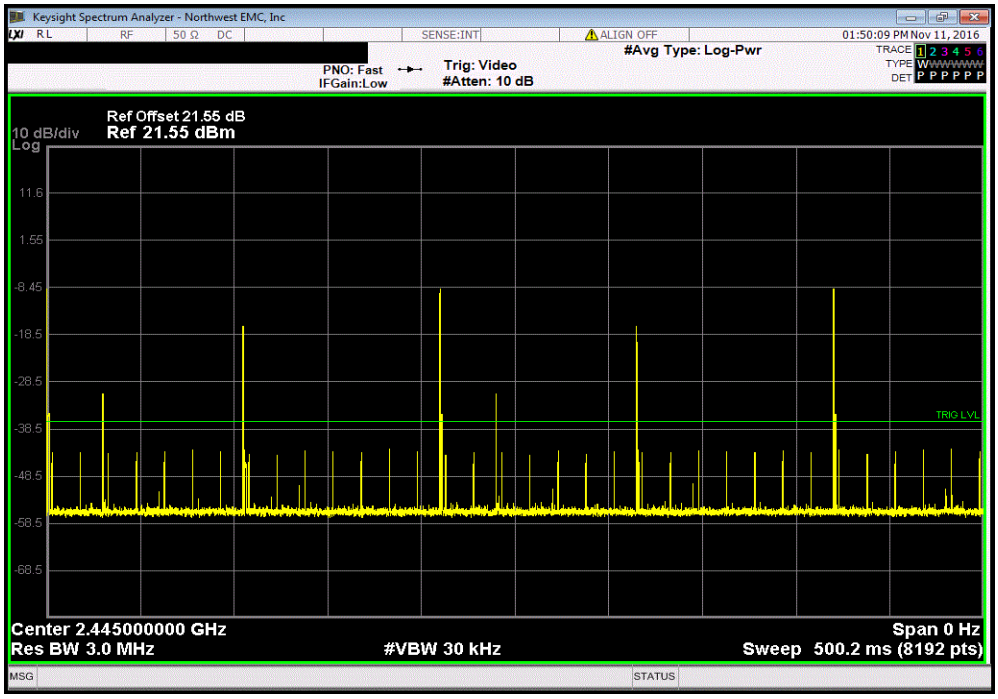
DUTY CYCLE

XMit 2016.05.06

Mid Channel, 2445 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	835.4 us	104.97 ms	10	N/A	N/A	N/A



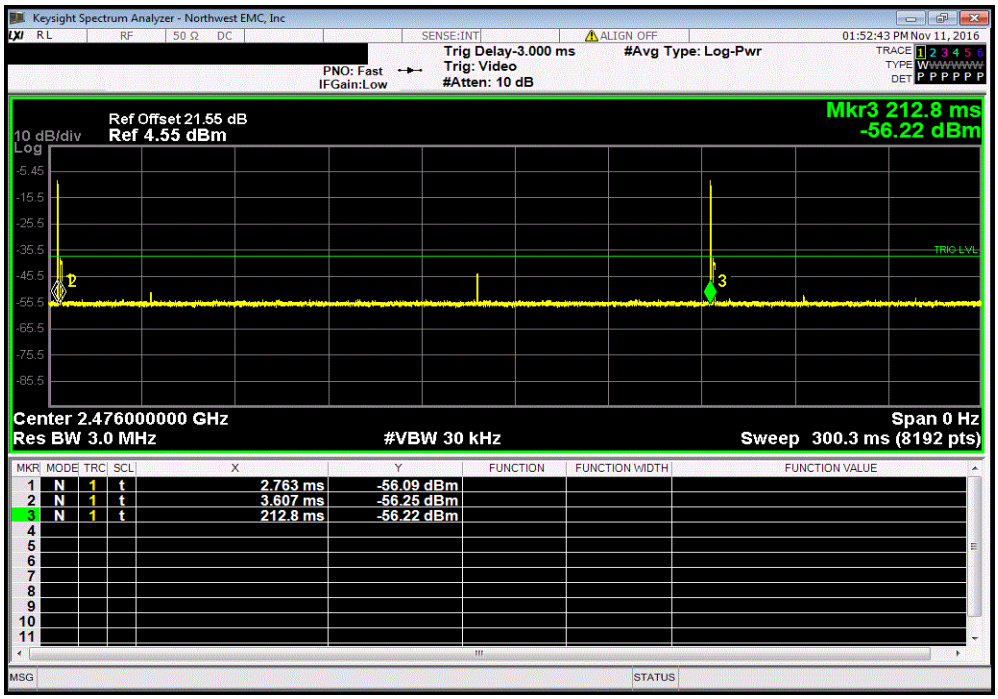
Mid Channel, 2445 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	43	N/A	N/A	N/A



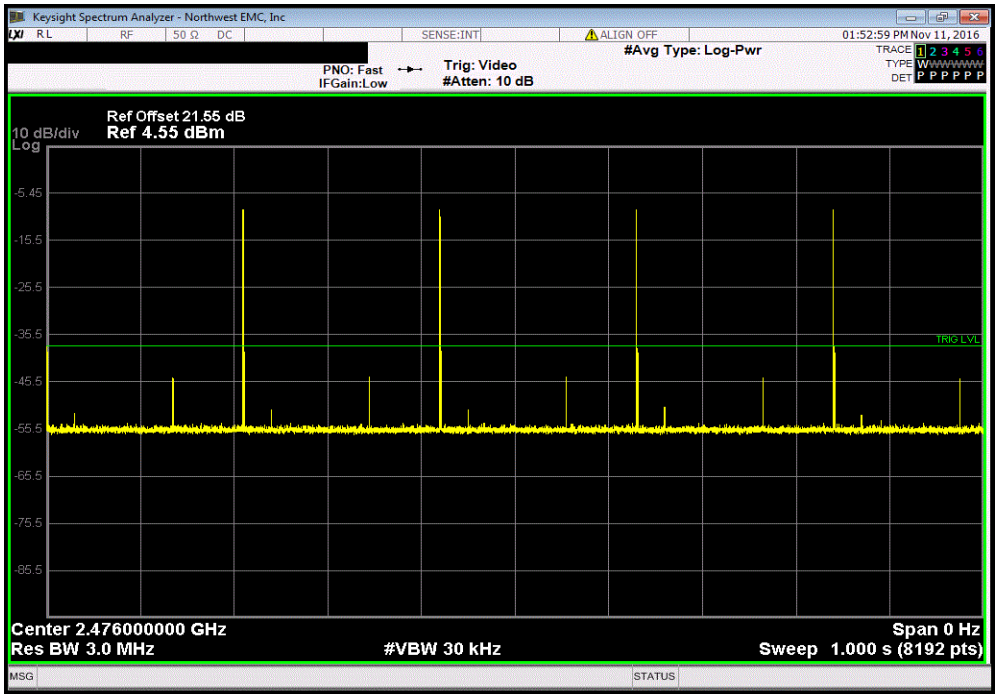
DUTY CYCLE

XMit 2016.05.06

High Channel, 2476 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	844 us	210.034 ms	4	N/A	N/A	N/A



High Channel, 2476 MHz						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	15	N/A	N/A	N/A



SAR TEST EXCLUSION

NORTHWEST EMC
EXRPT.2016.08.12.1

OVERVIEW

Human exposure to RF emissions from portable devices (47 CFR §2.1093) used with the radiating antenna closer than 20 cm to the user requires Specific Absorption Rate (SAR) to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation.

COMPLIANCE WITH FCC 2.1093

"Portable devices that operate in the Cellular Radiotelephone Service pursuant to part 22 of this chapter; the Personal Communications Service (PCS) pursuant to part 24 of this chapter; the Satellite Communications Services pursuant to part 25 of this chapter; the Miscellaneous Wireless Communications Services pursuant to part 27 of this chapter; the Maritime Services (ship earth station devices only) pursuant to part 80 of this chapter; the Specialized Mobile Radio Service, the 4.9 GHz Band Service, and the 3650 MHz Wireless Broadband Service pursuant to part 90 of this chapter; the Wireless Medical Telemetry Service (WMTS) and the Medical Device Radiocommunication Service (MedRadio), pursuant to subparts H and I of part 95 of this chapter, respectively, unlicensed personal communication service, unlicensed NII devices and millimeter wave devices authorized under §§15.253(f), 15.255(g), 15.257(g), 15.319(i), and 15.407(f) of this chapter; and the Citizens Broadband Radio Service pursuant to part 96 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use. All other portable transmitting devices are categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in §§1.1307(c) and 1.1307(d) of this chapter. Applications for equipment authorization of portable transmitting devices subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in paragraph (d) of this section. Technical information showing the basis for this statement must be submitted to the Commission upon request."

The EUT will be used with a separation distance of less than 20 centimeters between the radiating antenna and the body of the user or nearby persons and must therefore be considered a portable transmitter per 47 CFR 2.1093(b).

COMPLIANCE WITH FCC KDB 447498 D01 General RF Exposure Guidance v06

"KDB 447498 D01 General RF Exposure Guidance v06" provides the procedures, requirements, and authorization policies for mobile and portable devices.

Standalone radio SAR test exclusion is covered under section 4.3.1. Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Thresholds are met as shown in the Limits section below.

Simultaneous transmission SAR test exclusion is covered under section 4.3.2. SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneously transmitting antenna. When the sum of 1-g or 10-g SAR of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration.

SAR TEST EXCLUSION

NORTHWEST EMC

EXRPT.2016.08.12.1

LIMITS

Limits for General Population /Uncontrolled Exposure: 47 CFR 1.1310 (c)

The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.

For 100 MHz to 6 GHz and test separation distances = 50 mm, the SAR test exclusion thresholds are 1-g for head and body SAR and and 10-g SAR for extremity SAR.

ASSESSMENT

For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [vf(GHz)] = 3.0 for 1-g SAR and = 7.5 for 10-g extremity SAR,
where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation

- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step b below

The test exclusions are applicable only when the minimum test separation distance is = 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1f) is applied to determine SAR test exclusion.

The SAR Test Exclusion Threshold is summarized in the following table:

Radio	Transmit Frequency (MHz)	Measured Conducted Output Power (mW)	Duty Cycle	Highest Antenna Gain (dBi)	Minimum Antenna Cable Loss (dB)	Minimum Separation Distance (mm)	Exclusion Threshold	Limit	Compliant
2400-2483.5 MHz Transceiver	2480	2.806	0.08	5.44	0	5	0.071	3.0	Yes