



Digital Control Incorporated

DigiRadio 2 (DR2)

FCC 90.217:2013

FCC 15.109:2013

Report #: DIGC0168



Report Prepared By Northwest EMC Inc.

NORTHWEST EMC – (888) 364-2378 – www.nwemc.com

California – Minnesota – Oregon – New York – Washington

CERTIFICATE OF TEST

Last Date of Test: August 5, 2013
 Digital Control Incorporated
 Model: DigiRadio 2 (DR2)

Emissions

Test Description	Specification	Test Method	Pass/Fail
Occupied Bandwidth	FCC 90.217:2013	ANSI/TIA/EIA-603-C-2004	Pass
Emissions Mask	FCC 90.217:2013	ANSI/TIA/EIA-603-C-2004	Pass
Radiated Output Power	FCC 90.217:2013	ANSI/TIA/EIA-603-C-2004	Pass
Output Power	FCC 90.217:2013	ANSI/TIA/EIA-603-C-2004	Pass
Frequency Stability	FCC 90.217:2013	ANSI/TIA/EIA-603-C-2004	Pass
Spurious Conducted Emissions	FCC 90.217:2013	ANSI/TIA/EIA-603-C-2004	Pass
Receiver Spurious Emissions	FCC 15.109:2013	ANSI C63.4:2009	Pass
Transmitter Spurious Emissions	FCC 90.217:2013	ANSI/TIA/EIA-603-C:2004	Pass

Deviations From Test Standards

None

Approved By:



Tim O'Shea, Operations Manager



NVLAP Lab Code: 200630-0

Test Facility

The measurement facility used to collect the data is located at:

Northwest EMC, Inc.
 22975 NW Evergreen Parkway, Suite 400
 Hillsboro, OR 97124

Phone: (503) 844-4066 Fax: 844-3826

This site has been fully described in a report filed with and accepted by the FCC (Federal Communications Commission) and Industry Canada (Site filing #2834D-1).

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.

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. This Report may only be duplicated in its entirety. 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.

REVISION HISTORY

Revision Number	Description	Date	Page Number
00	None		

Barometric Pressure

The recorded barometric pressure has been normalized to sea level.

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 listed below. 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 16-4-1 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.

Test	+ MU	- MU
Frequency Accuracy (Hz)	0.12	-0.01
Amplitude Accuracy (dB)	0.49	-0.49
Conducted Power (dB)	0.41	-0.41
Radiated Power via Substitution (dB)	0.69	-0.68
Temperature (degrees C)	0.81	-0.81
Humidity (% RH)	2.89	-2.89
Field Strength (dB)	3.80	-3.80
AC Powerline Conducted Emissions (dB)	2.94	-2.94

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 Guide 65 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

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

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.

Australia/New Zealand

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

Korea

KCC / 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.

Hong Kong

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

Vietnam

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

Russia

GOST – Accredited by Certinform VNIINMASH, CERTINFO, SAMTES, and Federal CHEC to perform EMC and Hygienic testing for Information Technology products to GOST standards.

SCOPE

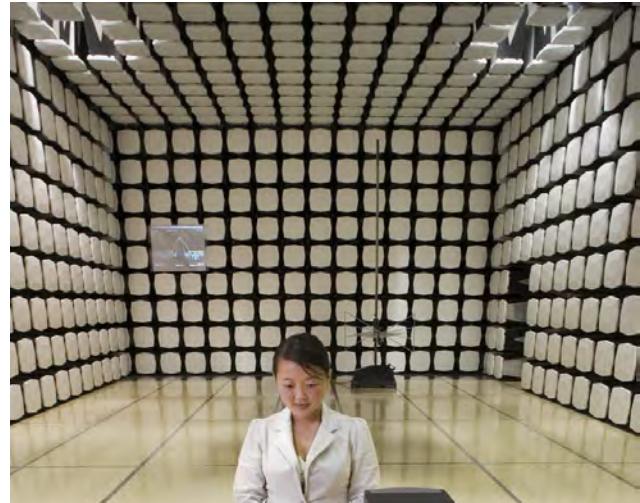
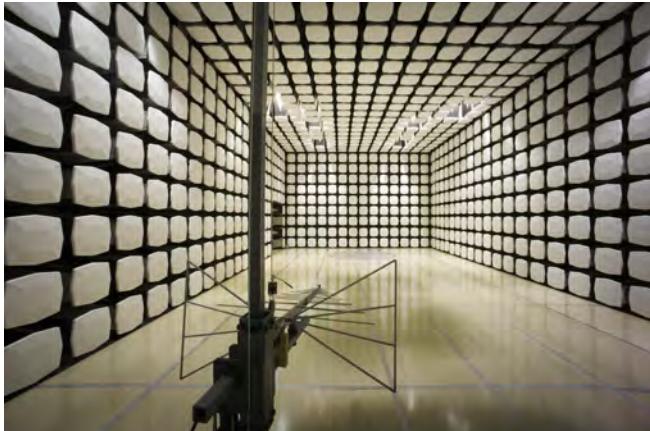
For details on the Scopes of our Accreditations, please visit:

<http://www.nwemc.com/accreditations/>

LOCATIONS



Oregon Labs EV01-12 22975 NW Evergreen Pkwy Hillsboro, OR 97124 (503) 844-4066	California Labs OC01-13 41 Tesla Irvine, CA 92618 (949) 861-8918	New York Labs NY01-04 4939 Jordan Rd. Elbridge, NY 13060 (315) 685-0796	Minnesota Labs MN01-08 9349 W Broadway Ave. Brooklyn Park, MN 55445 (763) 425-2281	Washington Labs NC01-05, SU02, SU07 19201 120 th Ave. NE Bothell, WA 98011 (425) 984-6600
VCCI				
A-0108	A-0029		A-0109	A-0110
Industry Canada				
2834D-1, 2834D-2	2834B-1, 2834B-2, 2834B-3		2834E-1	2834C-1
NVLAP				
NVLAP Lab Code: 200630-0	NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200761-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200629-0





PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	Digital Control Incorporated
Address:	19625 62nd Avenue South, Suite B103
City, State, Zip:	Kent, WA 98032
Test Requested By:	Amanda Hamm
Model:	DigiRadio2 (DR2)
First Date of Test:	April 30, 2013
Last Date of Test:	August 5, 2013
Receipt Date of Samples:	April 18, 2013
Equipment Design Stage:	Production
Equipment Condition:	No Damage

Information Provided by the Party Requesting the Test

Functional Description of the EUT (Equipment Under Test):

FM at 9600 bps (4800 Manchester bps) with an output power of 100mW. Operating at 464.5-469.55 MHz

Testing Objective:

Demonstrate compliance to FCC requirements of an UHF transmitter contained in a handheld locating device that receives a kHz signal and transmits in the UHF band to a remote display device.

Configuration DIGC0168- 1

EUT					
Description	Manufacturer	Model/Part Number	Serial Number		
Radio	Digital Control Incorporated	DigiRadio2 (DR2)	19		
Antenna (Bow-tie)	Digital Control Incorporated	420-5102-00	None		

Peripherals in test setup boundary					
Description	Manufacturer	Model/Part Number	Serial Number		
Host Board	Digital Control Incorporated	None	None		

Remote Equipment Outside of Test Setup Boundary					
Description	Manufacturer	Model/Part Number	Serial Number		
Laptop	HP	EliteBook 2740p	2CE03602DT		
Power Supply	Topward Electric	TPS2000	TPD		

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
DC Power Cables	No	1.5m	No	DC Power Supply	Host Board
USB to Serial Adapter	No	0.5m	No	Laptop	Serial to I/O Adapter
Serial to I/O Adapter	No	.25m	No	USB to Serial Adapter	Host Board
AC Power Cable	No	1m	No	AC mains	DC Power Supply

PA = Cable is permanently attached to the device. Shielding and/or presence of ferrite may be unknown.

Configuration DIGC0182- 1

EUT					
Description	Manufacturer	Model/Part Number	Serial Number		
Radio (Shielded)	Digital Control Incorporated	DigiRadio2 (DR2)	19		
Antenna (Bow-tie)	Digital Control Incorporated	420-5102-00	None		

Peripherals in test setup boundary					
Description	Manufacturer	Model/Part Number	Serial Number		
Host Board	Digital Control Incorporated	None	None		

Remote Equipment Outside of Test Setup Boundary					
Description	Manufacturer	Model/Part Number	Serial Number		
Laptop	HP	EliteBook 2740p	2CE03602DT		
Power Supply	Topward Electric	TPS2000	TPD		

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
DC Power Cables	No	1.5m	No	DC Power Supply	Host Board
USB to Serial Adapter	No	0.5m	No	Laptop	Serial to I/O Adapter
Serial to I/O Adapter	No	.25m	No	USB to Serial Adapter	Host Board
AC Power Cable	No	1m	No	AC mains	DC Power Supply

PA = Cable is permanently attached to the device. Shielding and/or presence of ferrite may be unknown.

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	4/30/2013	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.
2	4/30/2013	Frequency Stability	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	4/30/2013	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.
4	4/30/2013	Emissions Mask	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT left Northwest EMC and was returned to Digital Control Incorporated.
5	6/22/2013	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.
6	6/22/2013	Radiated Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT left Northwest EMC and was returned to Digital Control Incorporated.
7	8/5/2013	Receiver Spurious Emissions	Modified from delivered configuration.	Product was updated with new firmware. Modification approved by Amanda Hamm.	EUT remained at Northwest EMC following the test.
8	8/5/2013	Transmitter Spurious Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

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 DESCRIPTION

The Duty Cycle (x) were measured for each of the EUT operating modes. 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. The duty cycle was measured radiated in the RF chamber.

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

The EUT operates at 100% Duty Cycle.

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
DC Power Supply	Topward	TPS-2000	TPD	NCR	0
Multimeter	Tektronix	DMM912	MMH	2/5/2013	24
Attenuator, 6dB	S.M. Electronics	18N-06	AWN	3/25/2013	12
MXG Vector Signal Generator	Agilent	N5182A	TIF	NCR	0
Power Meter	Gigatronics	8651A	SPM	1/9/2012	24
Power Sensor	Gigatronics	80701A	SPL	7/8/2011	24
EV06 Direct Connect Cable	ESM Cable Corp.	TT	ECA	NCR	0
Attenuator, 6 dB, 'SMA'	N/A	93459 3330A-6	AUF	3/5/2013	12
40GHz DC Block	Miteq	DCB4000	AMD	6/25/2012	12
Spectrum Analyzer	Agilent	E4440A	AFD	7/5/2012	24

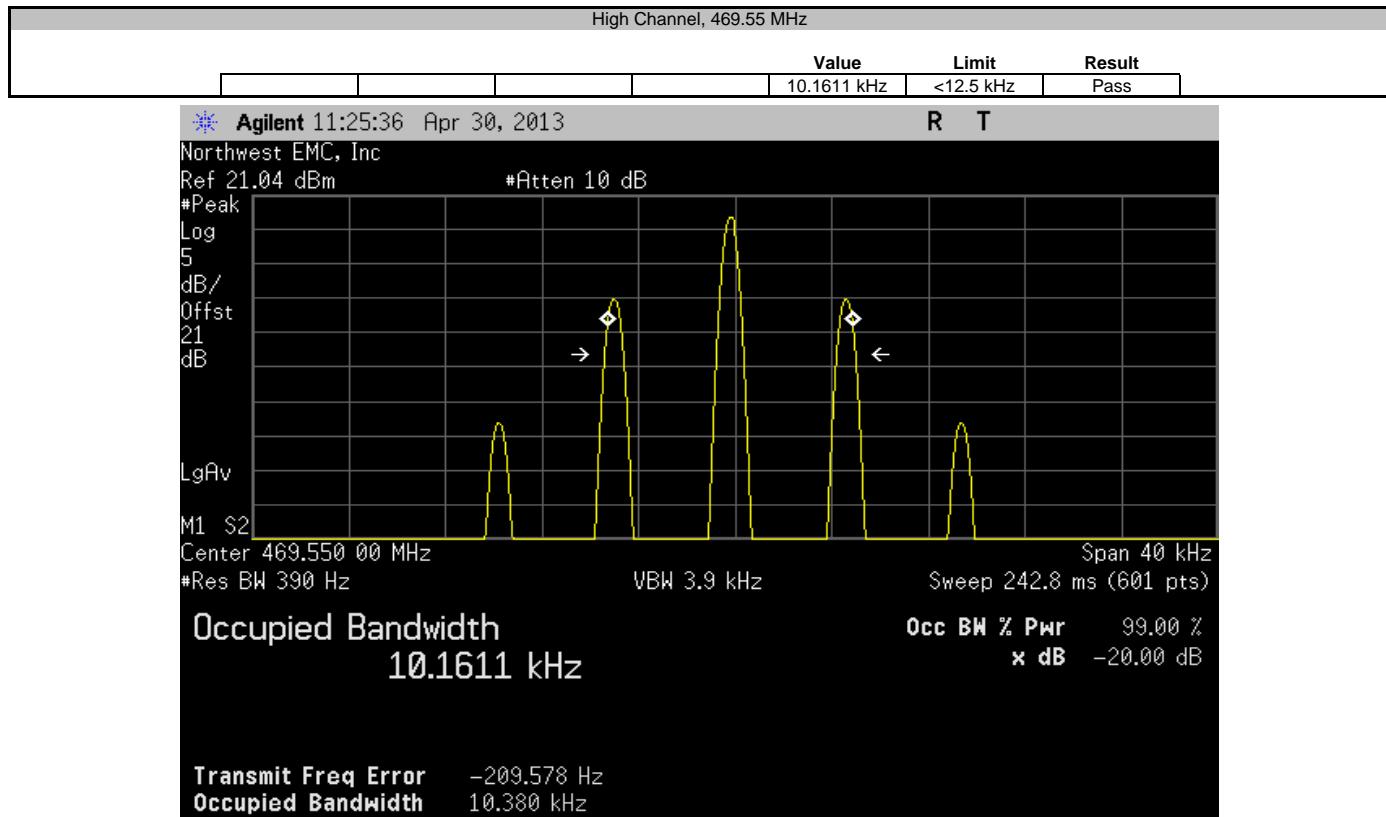
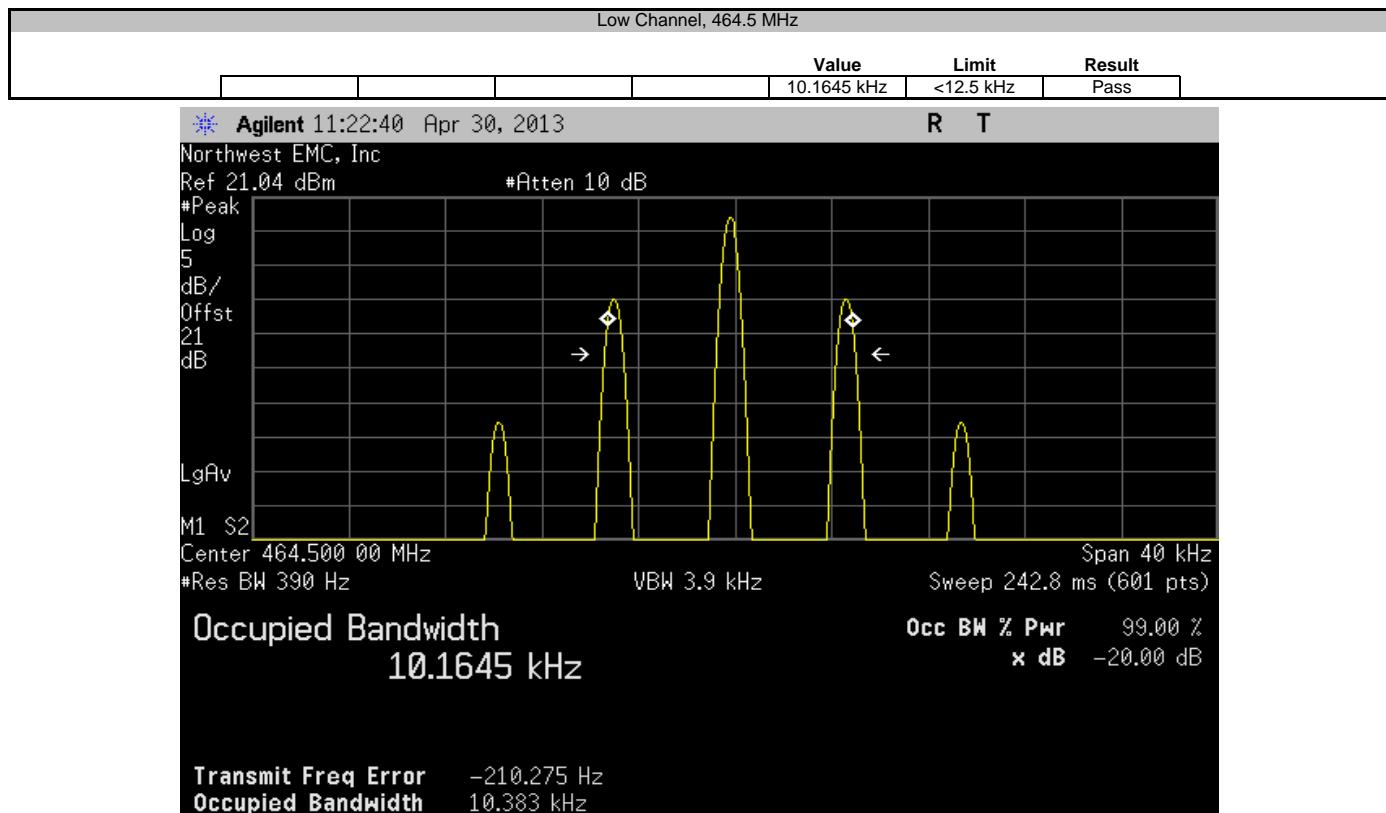
TEST DESCRIPTION

The 99% occupied bandwidth was measured with the EUT configured for continuous modulated operation at its lowest and highest transmit frequency.

The spectrum analyzer's resolution bandwidth was set to between 1% and 3% of the 20dB bandwidth and the video bandwidth was at least 3 times the resolution bandwidth. A peak detector was used.

OCCUPIED BANDWIDTH

EUT: DigiRadio 2 (DR2)		Work Order: DIGC0168	
Serial Number: 19		Date: 04/30/13	
Customer: Digital Control Incorporated		Temperature: 23.2°C	
Attendees: None		Humidity: 30%	
Project: None		Barometric Pres.: 1027	
Tested by: Brandon Hobbs	Power: 5VDC	Job Site: EV06	
TEST SPECIFICATIONS			
FCC 90.217:2013		Test Method: ANSI/TIA/EIA-603-C-2004	
COMMENTS			
The EUT is operating at 100% duty cycle with a power setting number of 127			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1		
Signature			
		Value	Limit
Low Channel, 464.5 MHz		10.1645 kHz	<12.5 kHz
High Channel, 469.55 MHz		10.1611 kHz	<12.5 kHz
		Pass	
		Pass	



EMISSION MASK

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
DC Power Supply	Topward	TPS-2000	TPD	NCR	0
Multimeter	Tektronix	DMM912	MMH	2/5/2013	24
Attenuator, 6dB	S.M. Electronics	18N-06	AWN	3/25/2013	12
MXG Vector Signal Generator	Agilent	N5182A	TIF	NCR	0
Power Meter	Gigatronics	8651A	SPM	1/9/2012	24
Power Sensor	Gigatronics	80701A	SPL	7/8/2011	24
EV06 Direct Connect Cable	ESM Cable Corp.	TT	ECA	NCR	0
Attenuator, 6 dB, 'SMA'	N/A	93459 3330A-6	AUF	3/5/2013	12
40GHz DC Block	Miteq	DCB4000	AMD	6/25/2012	12
Spectrum Analyzer	Agilent	E4440A	AFD	7/5/2012	24

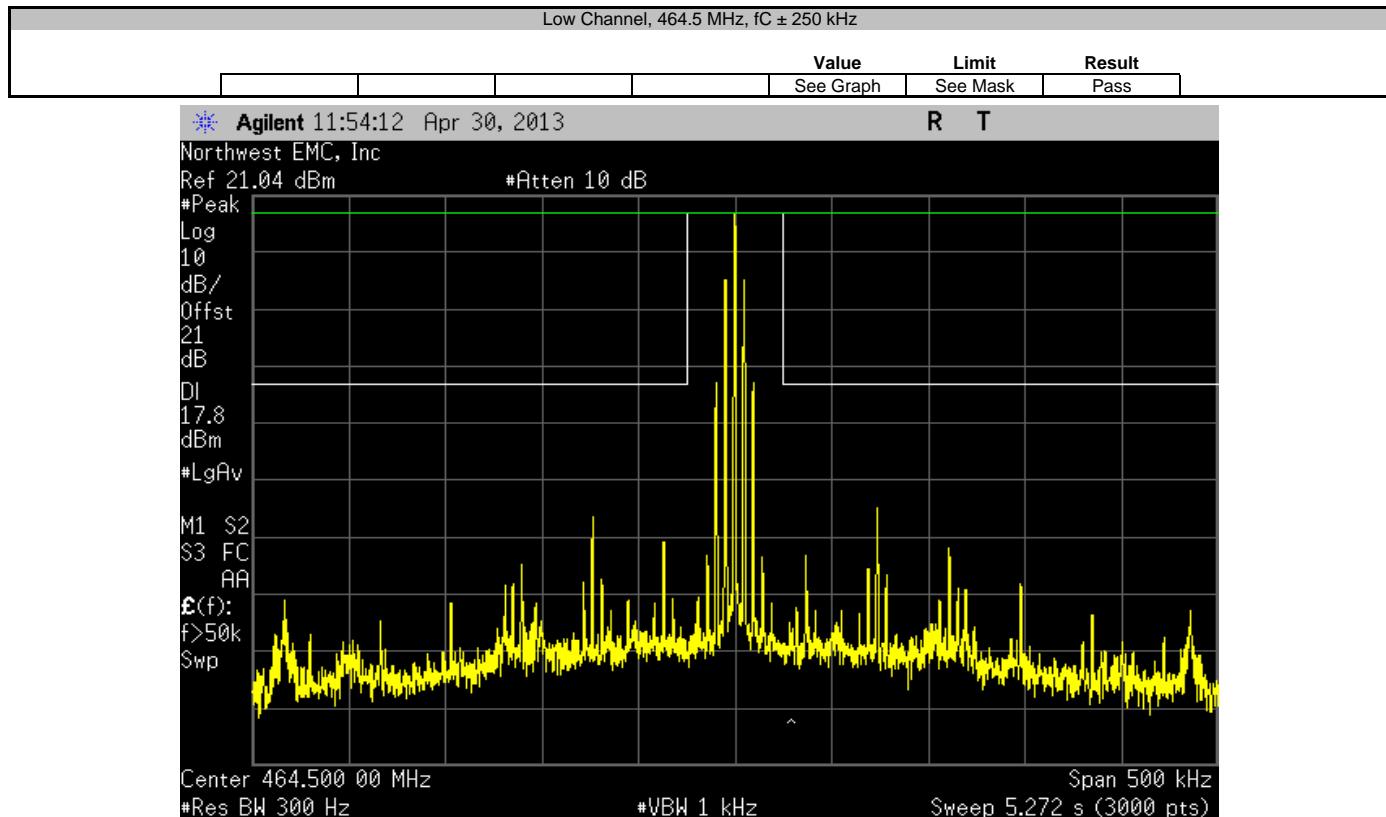
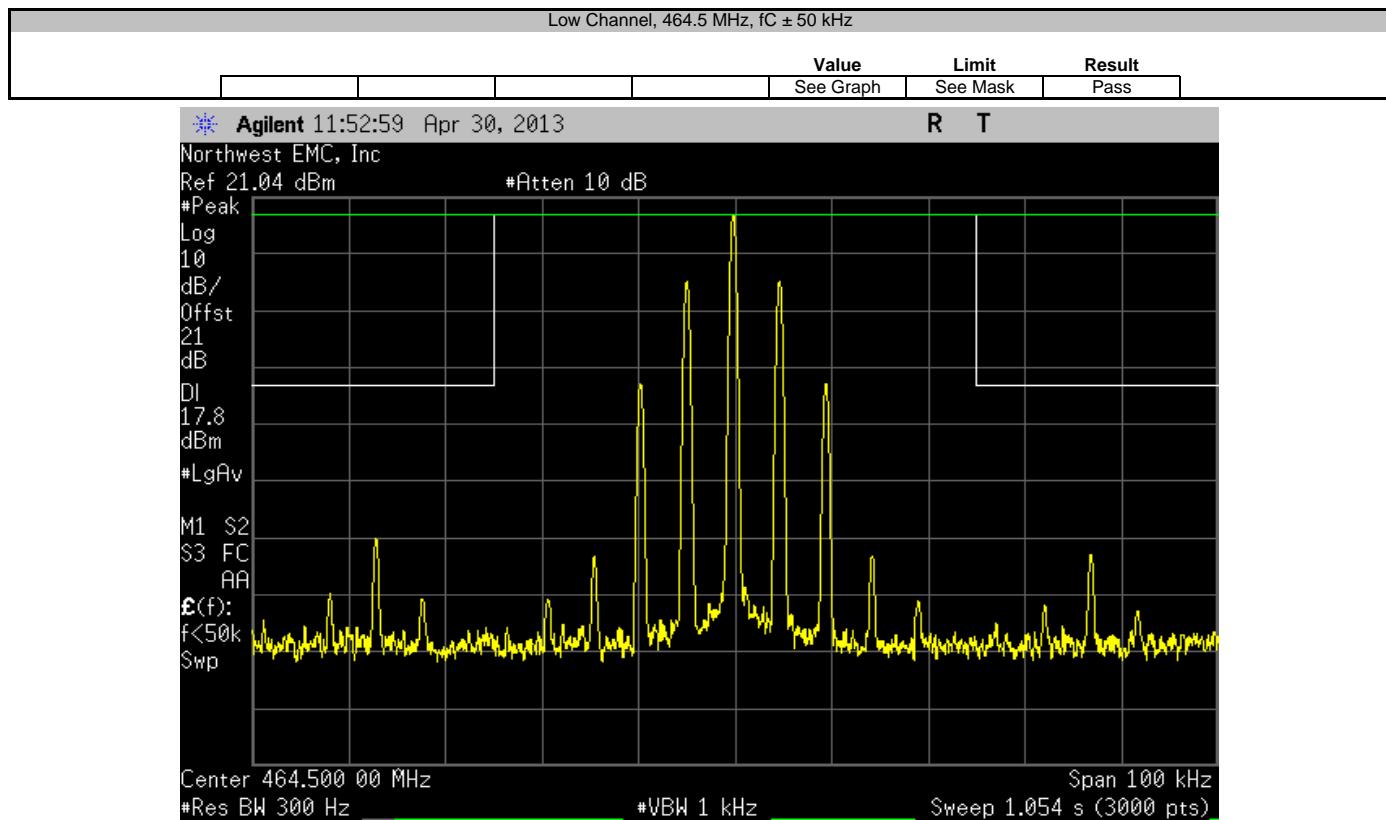
TEST DESCRIPTION

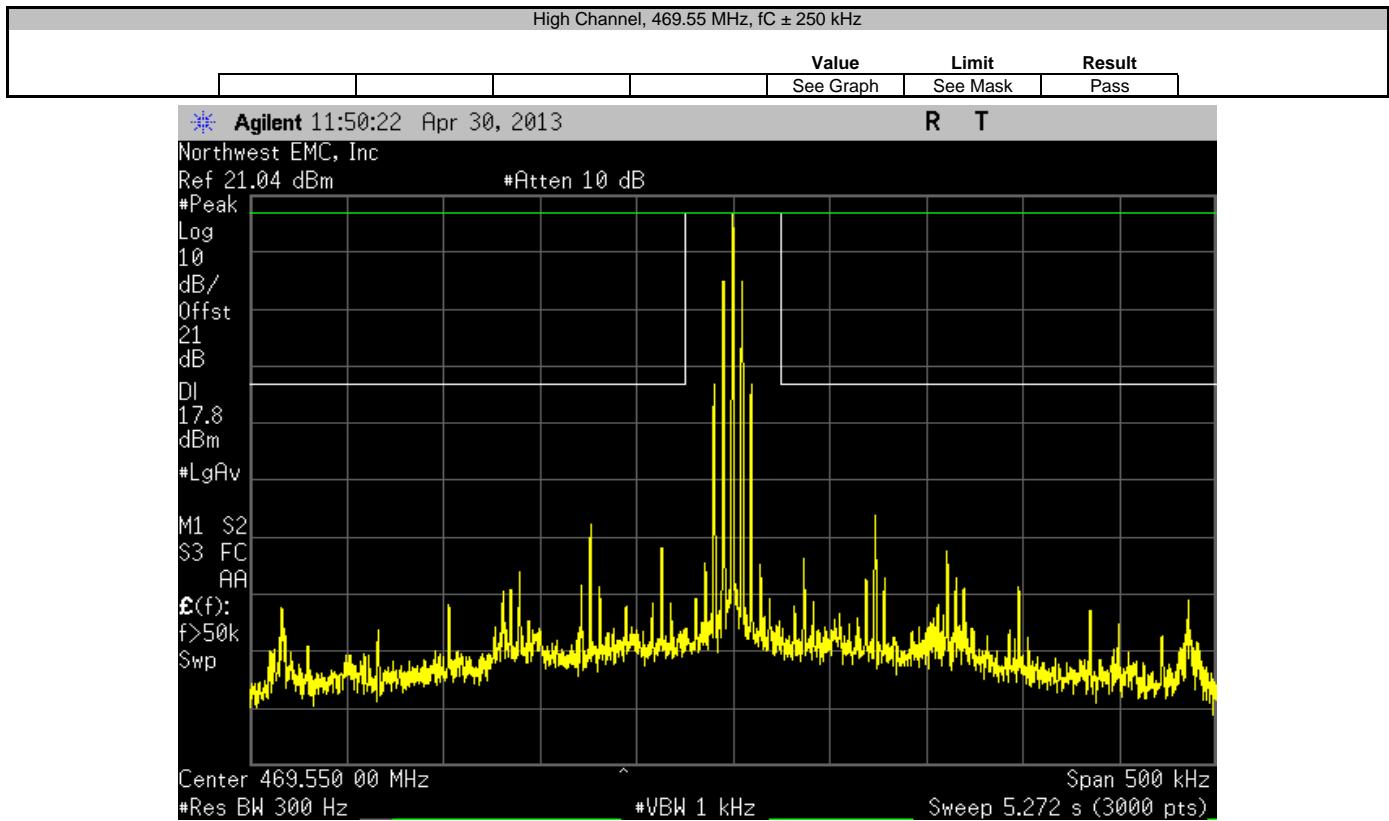
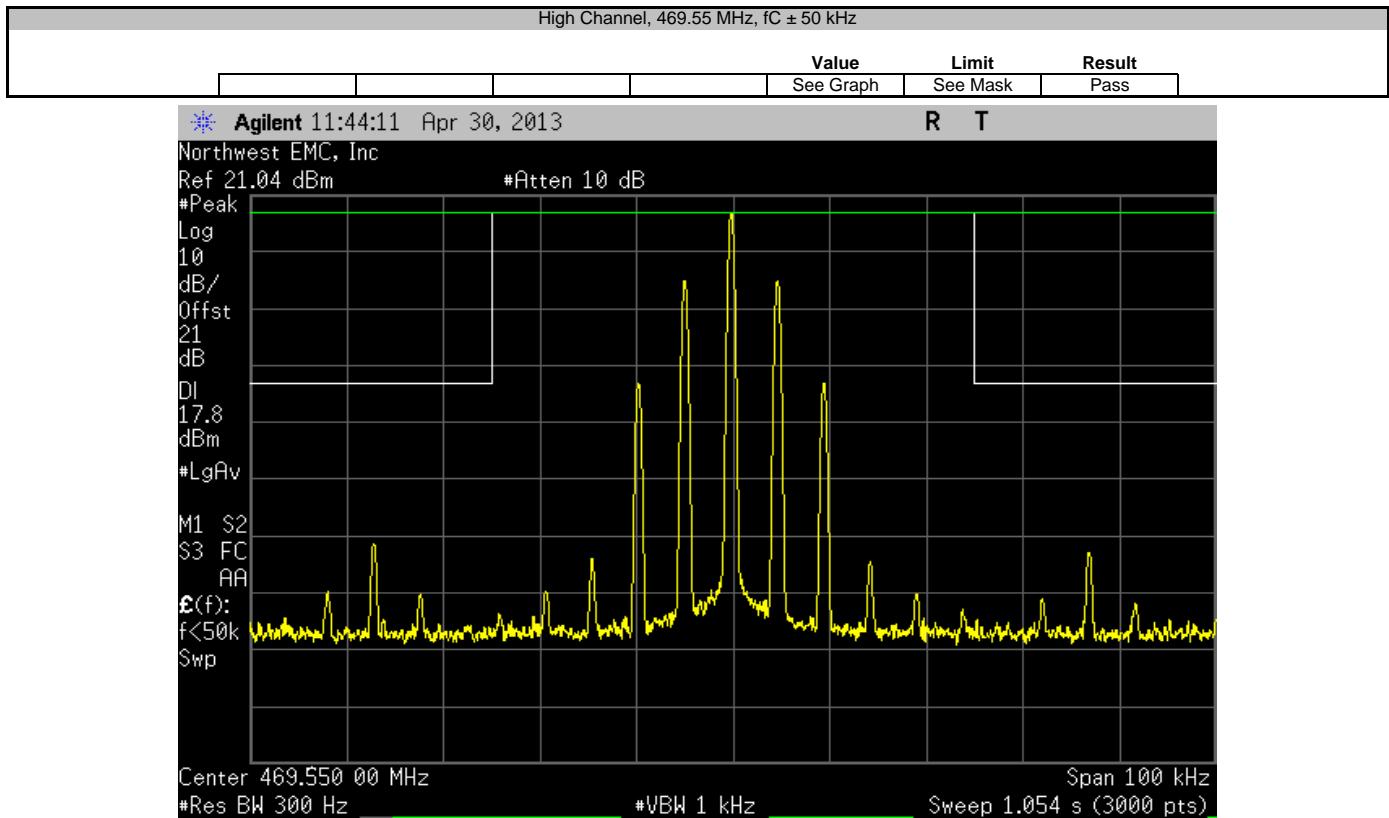
The emission mask defined by 90.217(b) for 12.5 kHz channel bandwidth devices is shown on each plot. The 0 dB reference for the mask is the measured output power of the un-modulated carrier at that frequency.

A 20 dB external attenuator was used. The attenuator and coaxial cable loss were compensated in the spectrum analyzer. A 300Hz resolution bandwidth with no video filtering and a peak detector were used.

EMISSION MASK

EUT: DigiRadio 2 (DR2)		Work Order: DIGC0168																						
Serial Number:	19	Date:	04/30/13																					
Customer:	Digital Control Incorporated	Temperature:	23.2°C																					
Attendees:	None	Humidity:	30%																					
Project:	None	Barometric Pres.:	1027																					
Tested by:	Brandon Hobbs	Power:	5VDC																					
TEST SPECIFICATIONS		Test Method																						
FCC 90.217:2013		ANSI/TIA/EIA-603-C-2004																						
COMMENTS																								
The EUT is operating at 100% duty cycle with a power setting number of 127																								
DEVIATIONS FROM TEST STANDARD																								
None																								
Configuration #	1	Signature 																						
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; width: 33.33%;">Value</th> <th style="text-align: center; width: 33.33%;">Limit</th> <th style="text-align: center; width: 33.33%;">Result</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Low Channel, 464.5 MHz</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;"> FC ± 50 kHz</td> <td style="text-align: center;">See Graph</td> <td style="text-align: center;">See Mask</td> </tr> <tr> <td style="text-align: center;"> FC ± 250 kHz</td> <td style="text-align: center;">See Graph</td> <td style="text-align: center;">Pass</td> </tr> <tr> <td style="text-align: center;">High Channel, 469.55 MHz</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;"> FC ± 50 kHz</td> <td style="text-align: center;">See Graph</td> <td style="text-align: center;">See Mask</td> </tr> <tr> <td style="text-align: center;"> FC ± 250 kHz</td> <td style="text-align: center;">See Graph</td> <td style="text-align: center;">Pass</td> </tr> </tbody> </table>				Value	Limit	Result	Low Channel, 464.5 MHz			FC ± 50 kHz	See Graph	See Mask	FC ± 250 kHz	See Graph	Pass	High Channel, 469.55 MHz			FC ± 50 kHz	See Graph	See Mask	FC ± 250 kHz	See Graph	Pass
Value	Limit	Result																						
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FC ± 250 kHz	See Graph	Pass																						
High Channel, 469.55 MHz																								
FC ± 50 kHz	See Graph	See Mask																						
FC ± 250 kHz	See Graph	Pass																						





RADIATED 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. 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, Constant Modulation, Final Power Level 99

POWER SETTINGS INVESTIGATED

5 VDC Nominal

CONFIGURATIONS INVESTIGATED

DIGC0168 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency | 464 MHz Stop Frequency | 470 MHz

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
Spectrum Analyzer	Agilent	E4446A	AAQ	2/7/2012	24 mo
Attenuator, 6dB	S.M. Electronics	18N-06	AWN	3/25/2013	12 mo
MXG Vector Signal Generator	Agilent	N5182A	TIF	NCR	0 mo
Power Meter	Gigatronics	8651A	SPM	1/9/2012	24 mo
Power Sensor	Gigatronics	80701A	SPL	7/8/2011	36 mo
Antenna, Dipole	AH Systems	FCC-4	ADEA	8/16/2010	36 mo
DC Power Supply	Topward	TPS-2000	TPD	NCR	0 mo
EV01 Cables	N/A	Bilog Cables	EVA	6/26/2012	12 mo
Antenna, Biconilog	EMCO	3141	AXG	4/10/2012	36 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

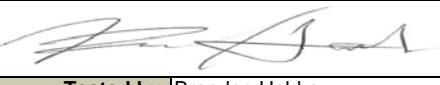
Radiated output power was measured in the far-field at an FCC Listed OATS at Low and High channel. A spectrum analyzer, signal generator, and linearly polarized antennas were used to measure the field strength of the fundamental. The orientation of the EUT and measurement antenna were manipulated to maximize the level of emissions. The EUT was configured to transmit at the highest output power.

For licensed transmitters, the FCC references TIA/EIA-603 as the measurement procedure standard. TIA/EIA-603 Section 2.2.17 describes a method for measuring radiated output power that utilizes an antenna substitution method:

At an approved test site, the transmitter is placed on a remotely controlled turntable, and the measurement antenna is placed 3 meters from the transmitter. The turntable azimuth is varied to maximize the level of spurious emissions. The height of the measurement antenna is also varied from 1 to 4 meters. The amplitude and frequency of the highest emissions are noted. The transmitter is then replaced with a ½ wave dipole that is successively tuned to each of the highest spurious emissions. A signal generator is connected to the dipole (horn antenna for frequencies above 1 GHz), and its output is adjusted to match the level previously noted for each frequency. The output of the signal generator is recorded, and by factoring in the cable loss to the dipole antenna and its gain; the power (dBm) into an ideal ½ wave dipole antenna is determined for each radiated spurious emission.

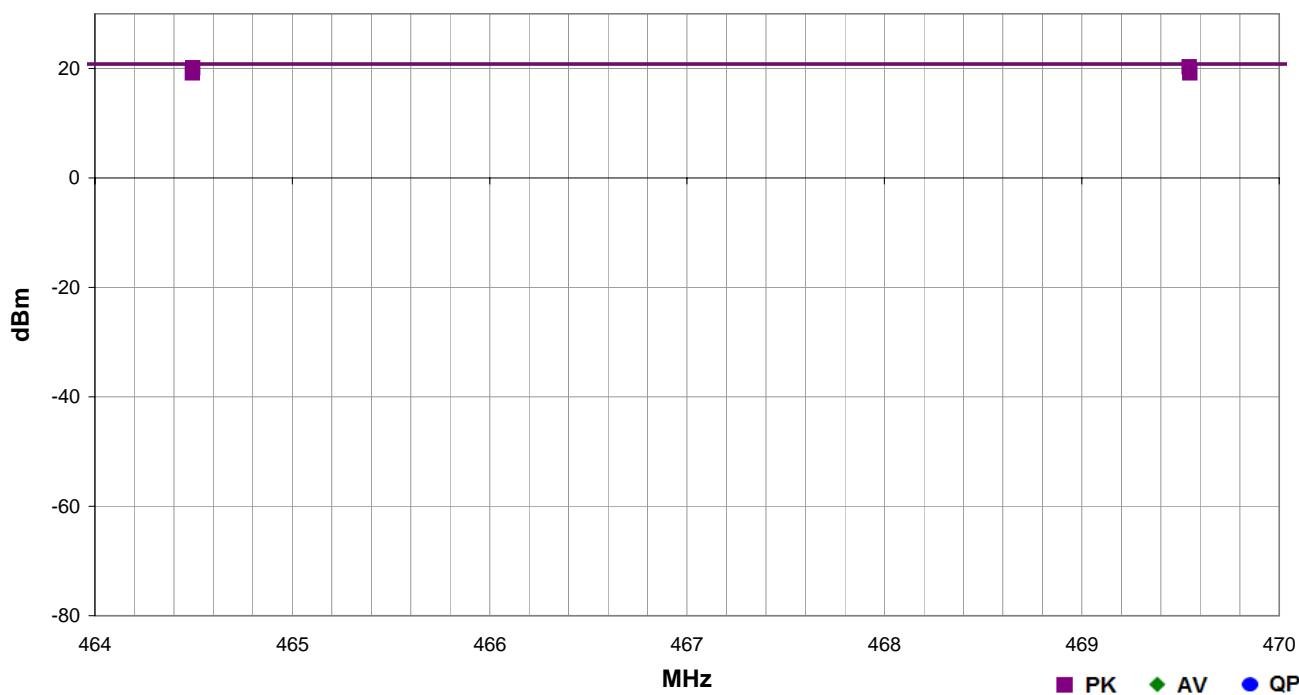
For the purposes of preliminary measurements, the field strength of the spurious emissions can be measured and compared with a 3 meter limit. The 3 meter limit was calculated to be 118.2 dBuV/m at 3 meters. The final measurements must be made utilizing the substitution method described above and applied against the ERP limit of 20.8 dBm determined from the maximum allowable power of 120 mW.

RADIATED OUTPUT POWER

Work Order:	DIGC0168	Date:	06/22/13	
Project:	None	Temperature:	25.4 °C	
Job Site:	EV01	Humidity:	39.5% RH	
Serial Number:	19	Barometric Pres.:	1014.9 mbar	
EUT:	DigiRadio 2 (DR2)		Tested by:	Brandon Hobbs
Configuration:	1			
Customer:	Digital Control Incorporated			
Attendees:	None			
EUT Power:	5 VDC Nominal			
Operating Mode:	Transmitting, Constant Modulation, Final Power level of 99			
Deviations:	None			
Comments:	See comments below for channel, frequency, EUT orientation, and power level.			

Test Specifications	Test Method
FCC 90.217:2013	ANSI C63.10:2009, TIA/EIA-603-B:2002

Run #	38	Test Distance (m)	3	Antenna Height(s)	1-4m	Results	Pass



	Freq (MHz)	Antenna Height (meters)	Azimuth (degrees)	Polarity/Transducer Type	Detector	ERP (Watts)	ERP (dBm)	Spec. Limit (dBm)	Compared to Spec. (dB)	Comments
	469.545	1.8	87.0	Horz	PK	1.07E-01	20.3	20.8	-0.5	PL = 99 High Ch. (469.55 MHz), EUT On Side
	464.497	1.8	83.0	Horz	PK	1.03E-01	20.1	20.8	-0.7	PL = 99 Low Ch. (464.5 MHz), EUT On Side
	469.548	1.1	322.0	Vert	PK	8.26E-02	19.2	20.8	-1.6	PL = 99 High Ch. (469.55 MHz), EUT Vert
	464.495	1.2	21.0	Vert	PK	8.28E-02	19.2	20.8	-1.6	PL = 99 Low Ch. (464.5 MHz), EUT Vert

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
DC Power Supply	Topward	TPS-2000	TPD	NCR	0
Multimeter	Tektronix	DMM912	MMH	2/5/2013	24
Attenuator, 6dB	S.M. Electronics	18N-06	AWN	3/25/2013	12
MXG Vector Signal Generator	Agilent	N5182A	TIF	NCR	0
Power Meter	Gigatronics	8651A	SPM	1/9/2012	24
Power Sensor	Gigatronics	80701A	SPL	7/8/2011	24
EV06 Direct Connect Cable	ESM Cable Corp.	TT	ECA	NCR	0
Attenuator, 6 dB, 'SMA'	N/A	93459 3330A-6	AUF	3/5/2013	12
40GHz DC Block	Miteq	DCB4000	AMD	6/25/2012	12
Spectrum Analyzer	Agilent	E4440A	AFD	7/5/2012	24

TEST DESCRIPTION

The peak output power was measured with the EUT set to low and high transmit frequencies. The EUT was transmitting with its normal modulation.

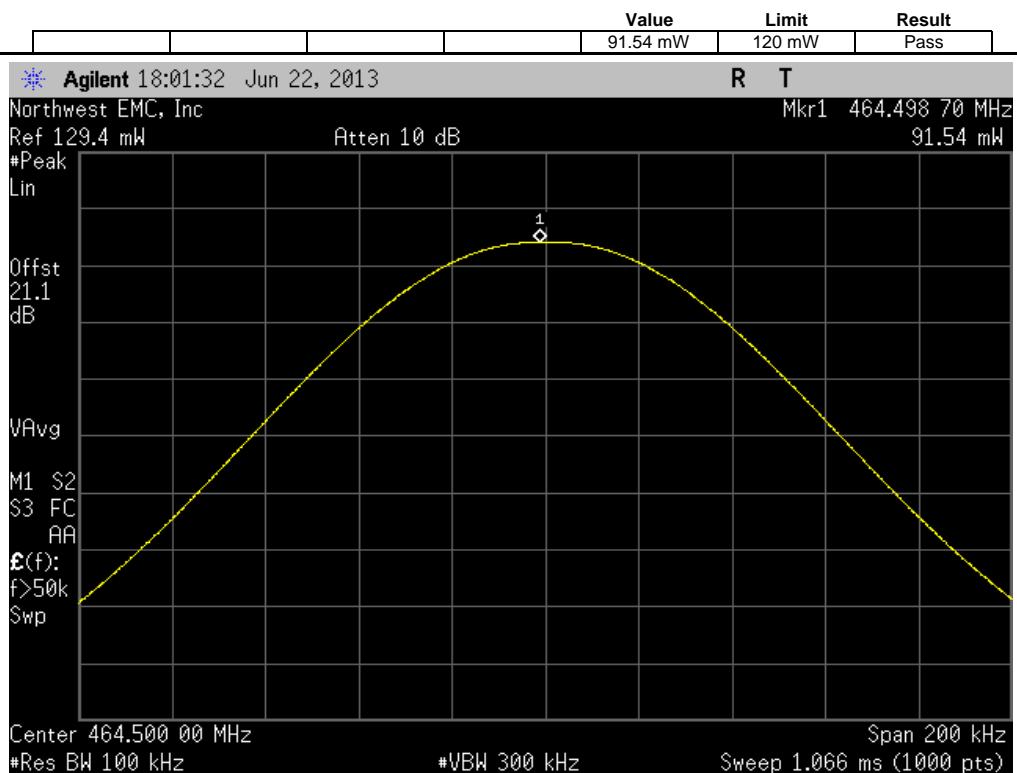
The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer in a linear mode.

OUTPUT POWER

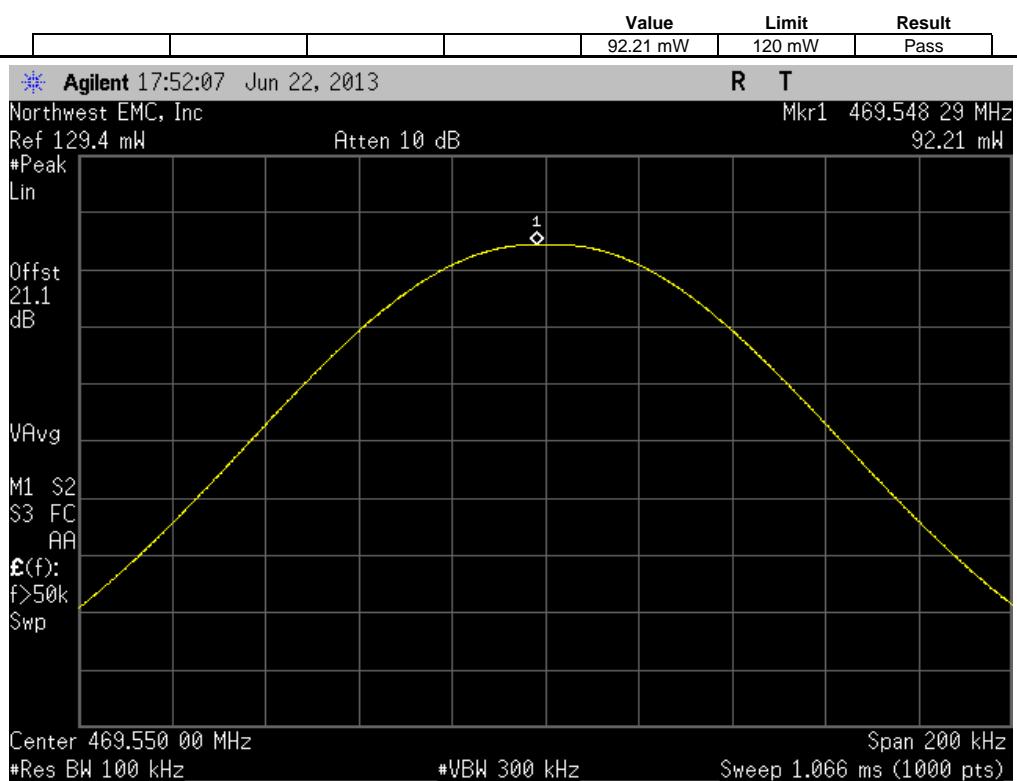
EUT:	DigiRadio 2 (DR2)		Work Order:	DIGC0168	
Serial Number:	19		Date:	06/22/13	
Customer:	Digital Control Incorporated		Temperature:	26.6°C	
Attendees:	None		Humidity:	39%	
Project:	None		Barometric Pres.:	1012.7	
Tested by:	Brandon Hobbs		Power:	5VDC	
TEST SPECIFICATIONS			Test Method		
FCC 90.217-2013			ANSI/TIA/EIA-603-C-2004		
COMMENTS					
The EUT is operating at 100% duty cycle with a power setting number of 99					
DEVIATIONS FROM TEST STANDARD					
None					
Configuration #	1	Signature		Value	Limit
				91.54 mW	120 mW
				92.21 mW	120 mW
				Pass	Pass

Low Channel, 464.5 MHz
High Channel, 469.55 MHz

Low Channel, 464.5 MHz



High Channel, 469.55 MHz



Frequency Stability

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
Humidity Temperature Meter	Omegalette	HH311	DTY	3/29/2011	36
Temp./Humidity Chamber	Cincinnati Sub Zero (CSZ)	ZH-32-2-2-H/AC	TBA	NCR	0
Multimeter	Tektronix	DMM912	MMH	2/5/2013	24
DC Power Supply	Topward	TPS-2000	TPD	NCR	0
Attenuator, 6dB	S.M. Electronics	18N-06	AWN	3/25/2013	12
MXG Vector Signal Generator	Agilent	N5182A	TIF	NCR	0
Power Meter	Gigatronics	8651A	SPM	1/9/2012	24
Power Sensor	Gigatronics	80701A	SPL	7/8/2011	24
EV06 Direct Connect Cable	ESM Cable Corp.	TT	ECA	NCR	0
Attenuator 20 dB, SMA M/F 26GHz	S.M. Electronics	SA26B-20	AUY	8/2/2012	12
40GHz DC Block	Miteq	DCB4000	AMD	6/25/2012	12
Spectrum Analyzer	Agilent	E4440A	AFD	7/5/2012	24

TEST DESCRIPTION

Variation of Supply Voltage

The primary supply voltage was varied from 85% to 115% of the nominal voltage. A DC lab supply was used to vary the supply voltage.

Variation of Ambient Temperature

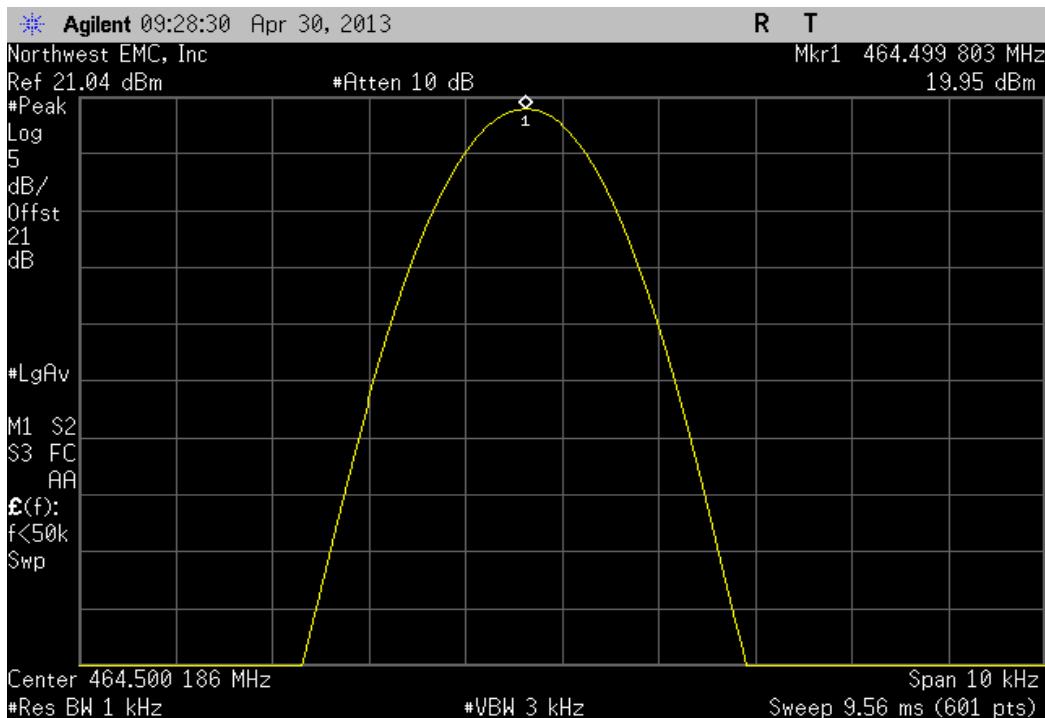
Using a temperature chamber, the transmit frequency was recorded at the extremes of the specified temperature range(-30°C to +50°C) and at 10°C intervals.

The measurement was made with a direct connection between the EUT antenna port and the test equipment. The spectrum analyzer is equipped with a precision frequency reference that exceeds the stability requirement of the EUT.

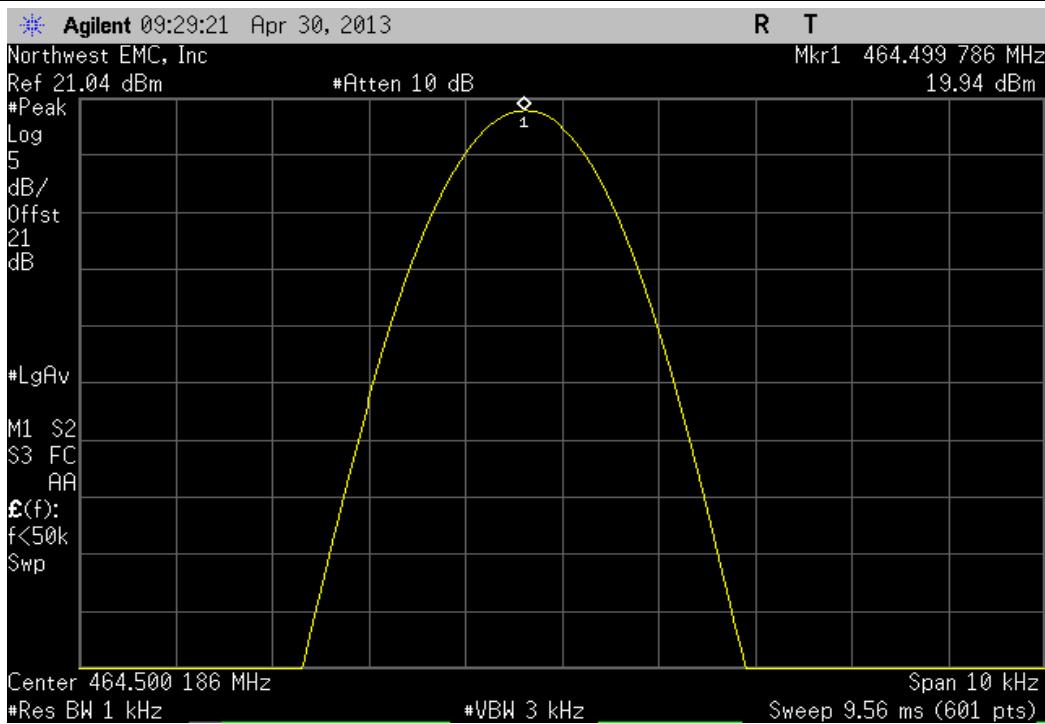
FCC Title 47 CFR requires the Part 2 tests to be performed for FCC Part 90. The FCC 2.1055 frequency stability section does not have a limit specified, and data is to be taken to ensure that the radio stays within band.

EUT: DigiRadio 2 (DR2)		Work Order: DIGC0168				
Serial Number: 19		Date: 04/30/13				
Customer: Digital Control Incorporated		Temperature: 23.2°C				
Attendees: None		Humidity: 30%				
Project: None		Barometric Pres.: 1027				
Tested by: Brandon Hobbs		Job Site: EV06				
TEST SPECIFICATIONS						
FCC 90.217:2013		Test Method: ANSI/TIA/EIA-603-C-2004				
COMMENTS						
The EUT is operating in CW mode with a power setting number of 127						
DEVIATIONS FROM TEST STANDARD						
None						
Configuration #	1	Signature				
		Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
Low Channel 464.5 MHz						
Voltage: 115%		464.499803	464.5	0.4	N/A	N/A
Voltage: 100%		464.499786	464.5	0.5	N/A	N/A
Voltage: 85%		464.499786	464.5	0.5	N/A	N/A
Temperature: +50°		464.499753	464.5	0.5	N/A	N/A
Temperature: +40°		464.499736	464.5	0.6	N/A	N/A
Temperature: +30°		464.499736	464.5	0.6	N/A	N/A
Temperature: +20°		464.499786	464.5	0.5	N/A	N/A
Temperature: +10°		464.499803	464.5	0.4	N/A	N/A
Temperature: 0°		464.499769	464.5	0.5	N/A	N/A
Temperature: -10°		464.499774	464.5	0.5	N/A	N/A
Temperature: -20°		464.499703	464.5	0.6	N/A	N/A
Temperature: -30°		464.499652	464.5	0.8	N/A	N/A
High Channel 469.55 MHz						
Voltage: 115%		469.549805	469.55	0.4	N/A	N/A
Voltage: 100%		469.549805	469.55	0.4	N/A	N/A
Voltage: 85%		469.549805	469.55	0.4	N/A	N/A
Temperature: +50°		469.549778	469.55	0.5	N/A	N/A
Temperature: +40°		469.549771	469.55	0.5	N/A	N/A
Temperature: +30°		469.549761	469.55	0.5	N/A	N/A
Temperature: +20°		469.549805	469.55	0.4	N/A	N/A
Temperature: +10°		469.549821	469.55	0.4	N/A	N/A
Temperature: 0°		469.549788	469.55	0.4	N/A	N/A
Temperature: -10°		469.549788	469.55	0.4	N/A	N/A
Temperature: -20°		469.549738	469.55	0.6	N/A	N/A
Temperature: -30°		469.549671	469.55	0.7	N/A	N/A

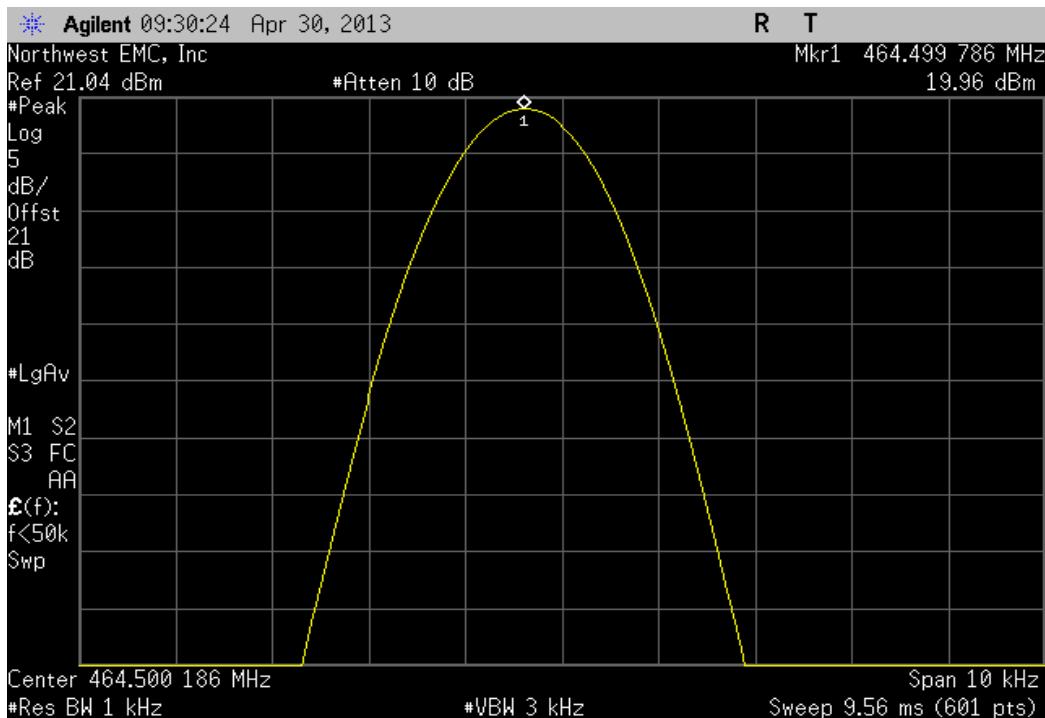
Low Channel 464.5 MHz, Voltage: 115%					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	464.499803	464.5	0.4	N/A	N/A



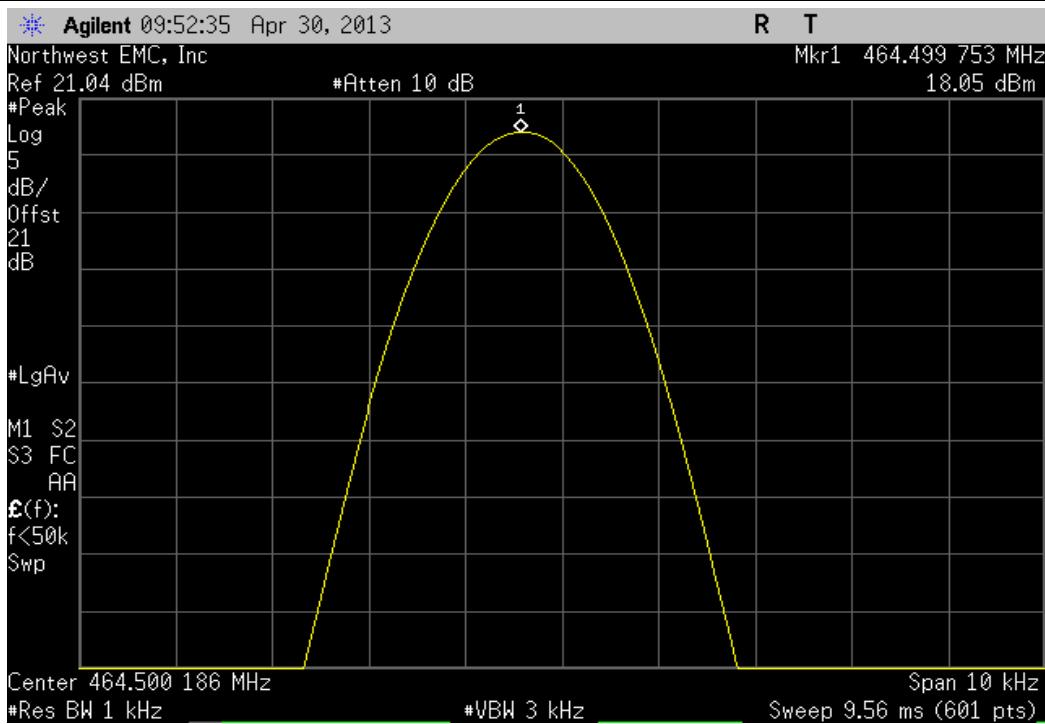
Low Channel 464.5 MHz, Voltage: 100%					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	464.499786	464.5	0.5	N/A	N/A



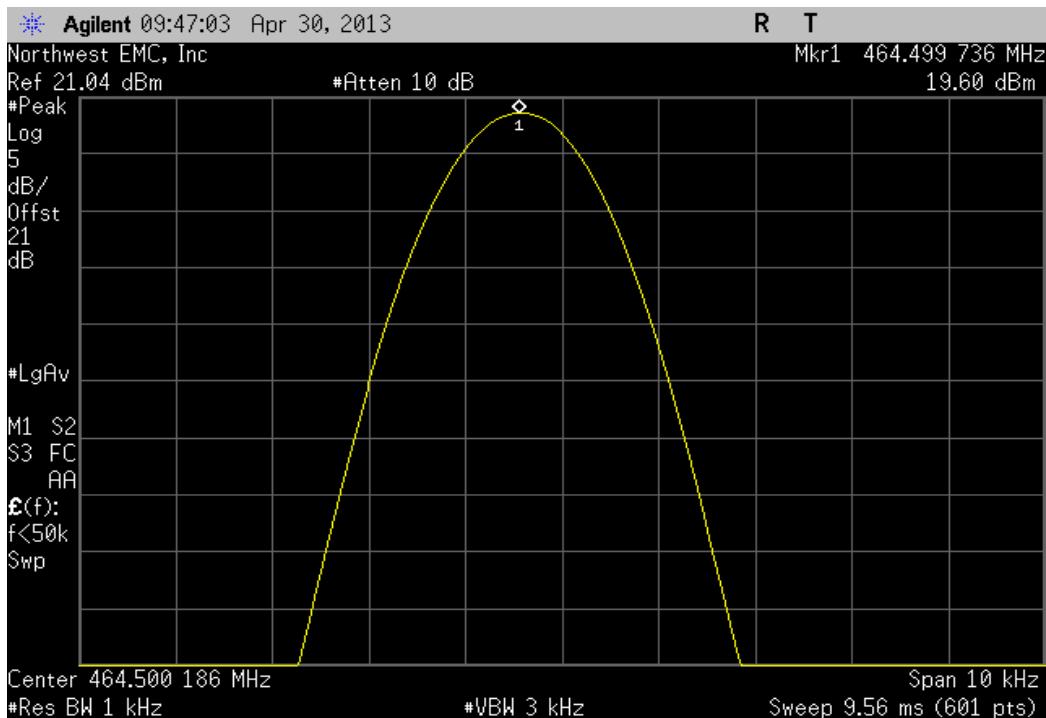
Low Channel 464.5 MHz, Voltage: 85%					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	464.499786	464.5	0.5	N/A	N/A



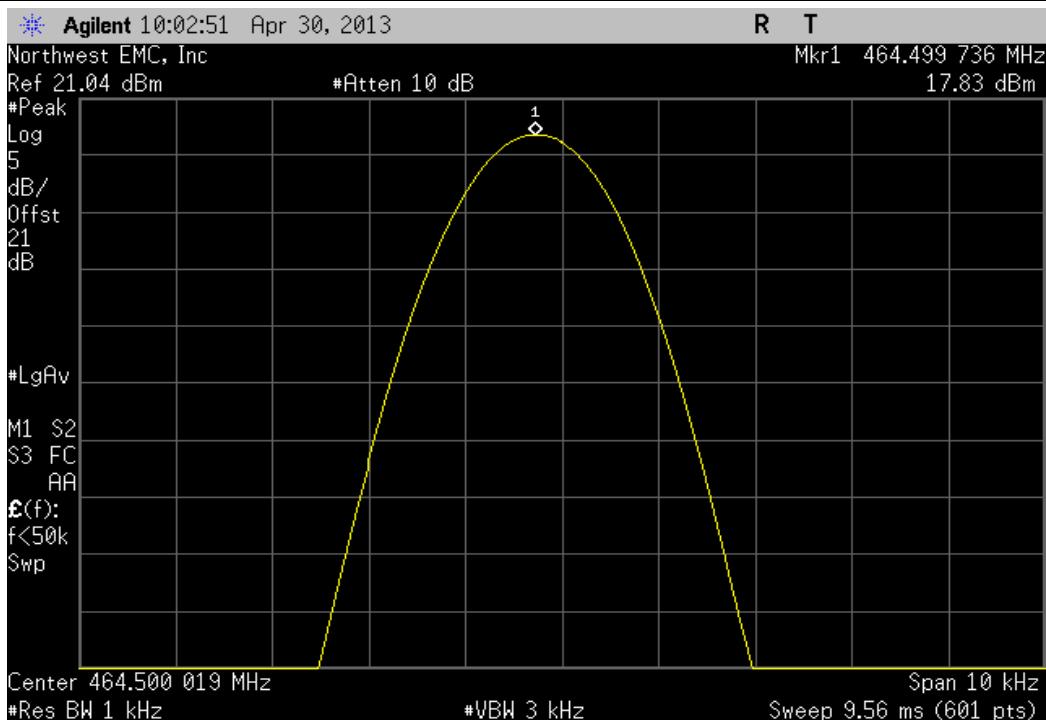
Low Channel 464.5 MHz, Temperature: +50°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	464.499753	464.5	0.5	N/A	N/A



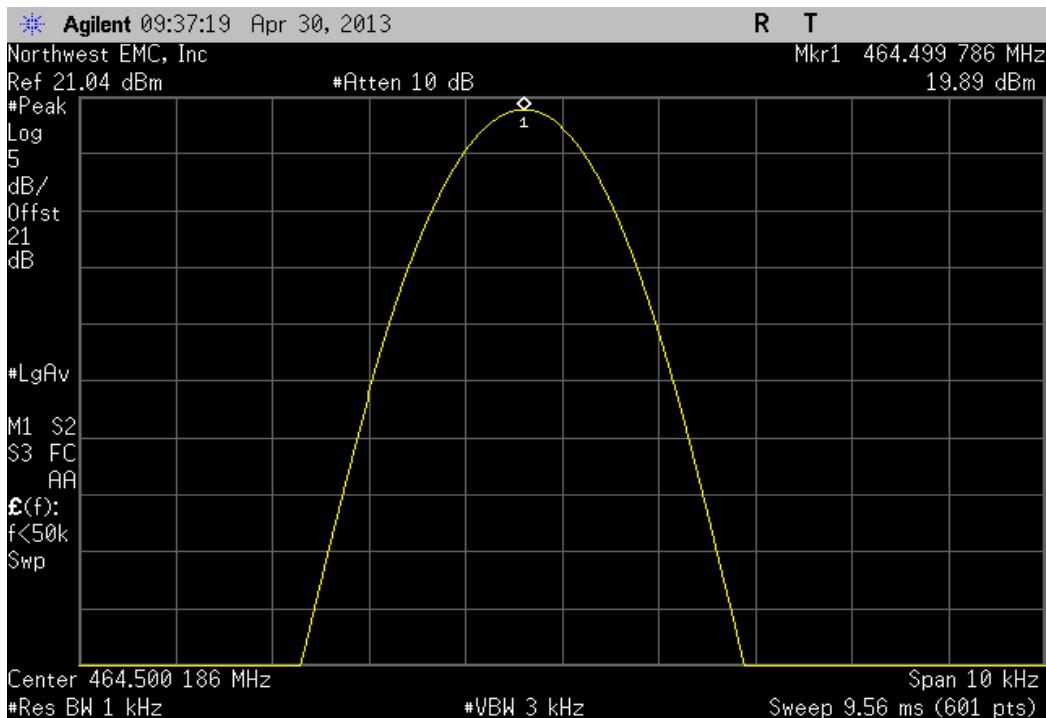
Low Channel 464.5 MHz, Temperature: +40°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	464.499736	464.5	0.6	N/A	N/A



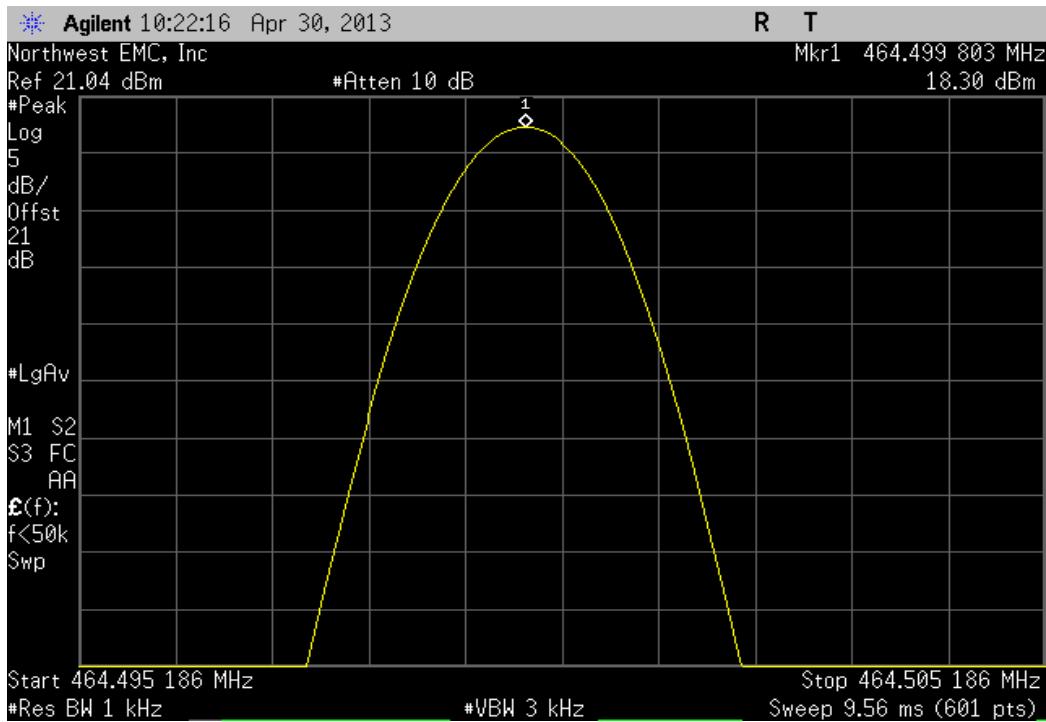
Low Channel 464.5 MHz, Temperature: +30°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	464.499736	464.5	0.6	N/A	N/A



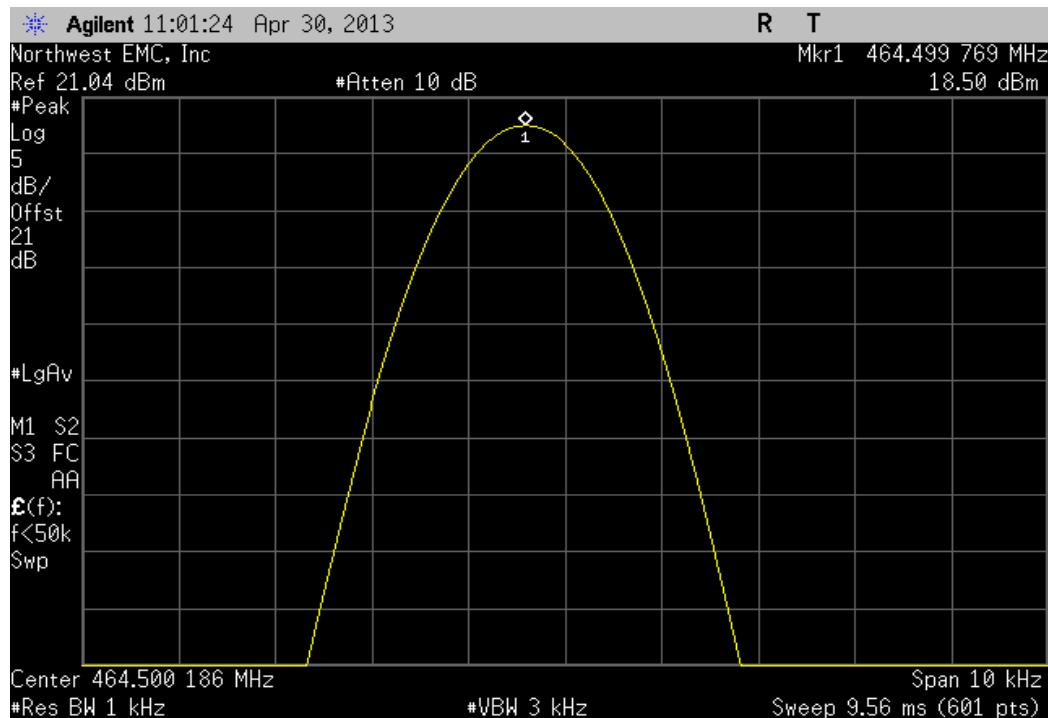
Low Channel 464.5 MHz, Temperature: +20°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	464.499786	464.5	0.5	N/A	N/A



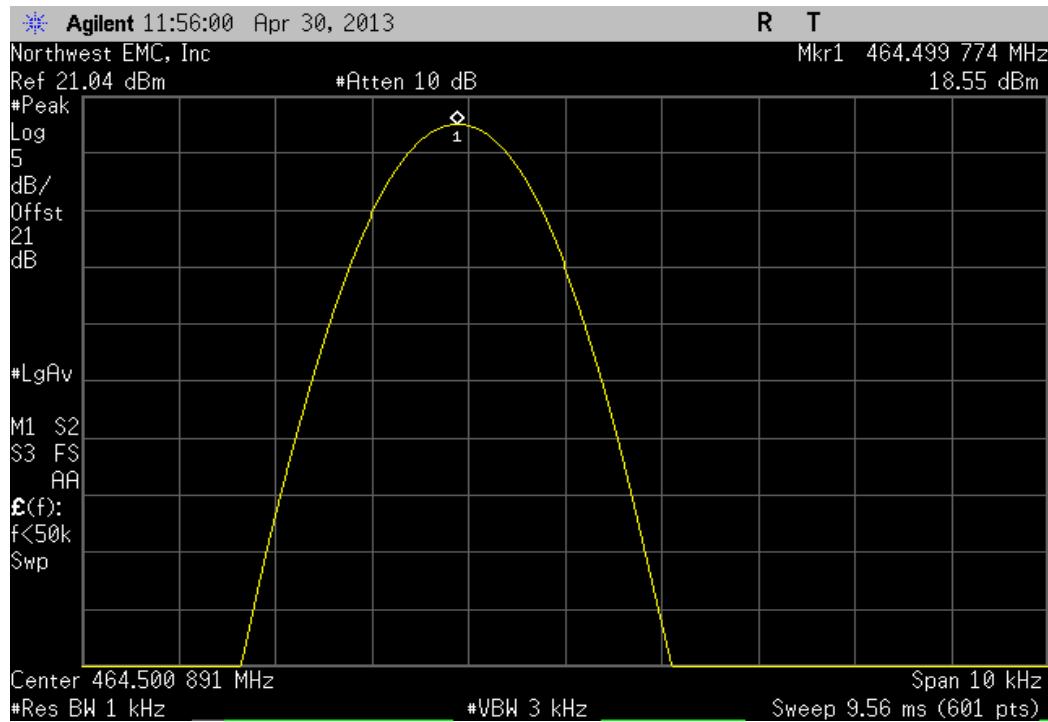
Low Channel 464.5 MHz, Temperature: +10°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	464.499803	464.5	0.4	N/A	N/A



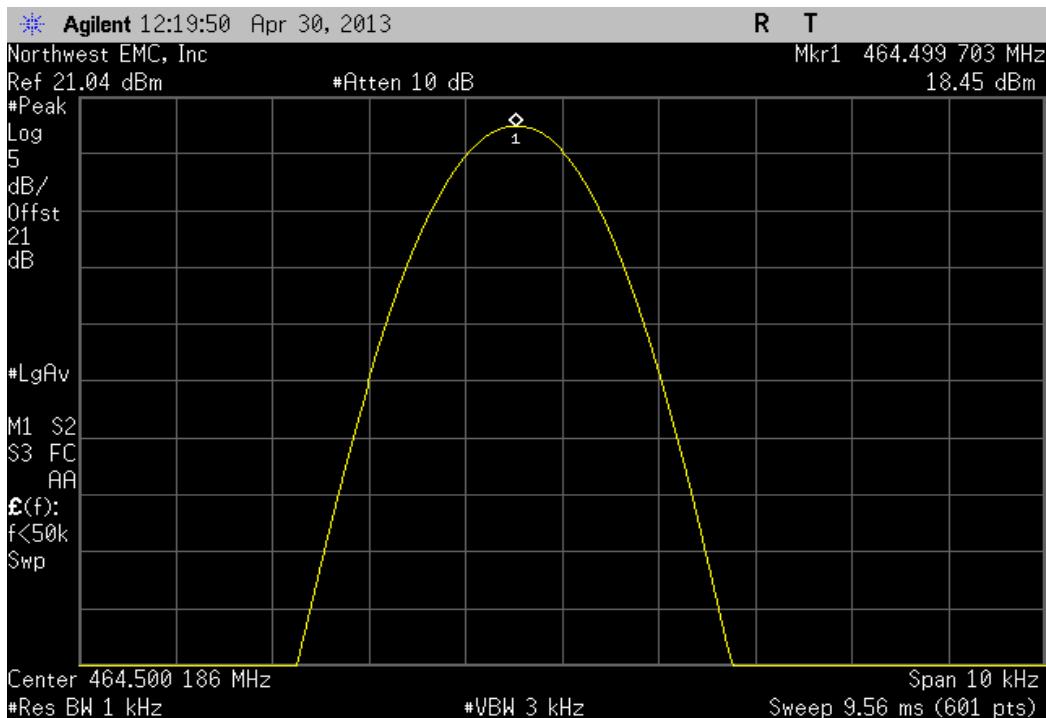
Low Channel 464.5 MHz, Temperature: 0°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	464.499769	464.5	0.5	N/A	N/A



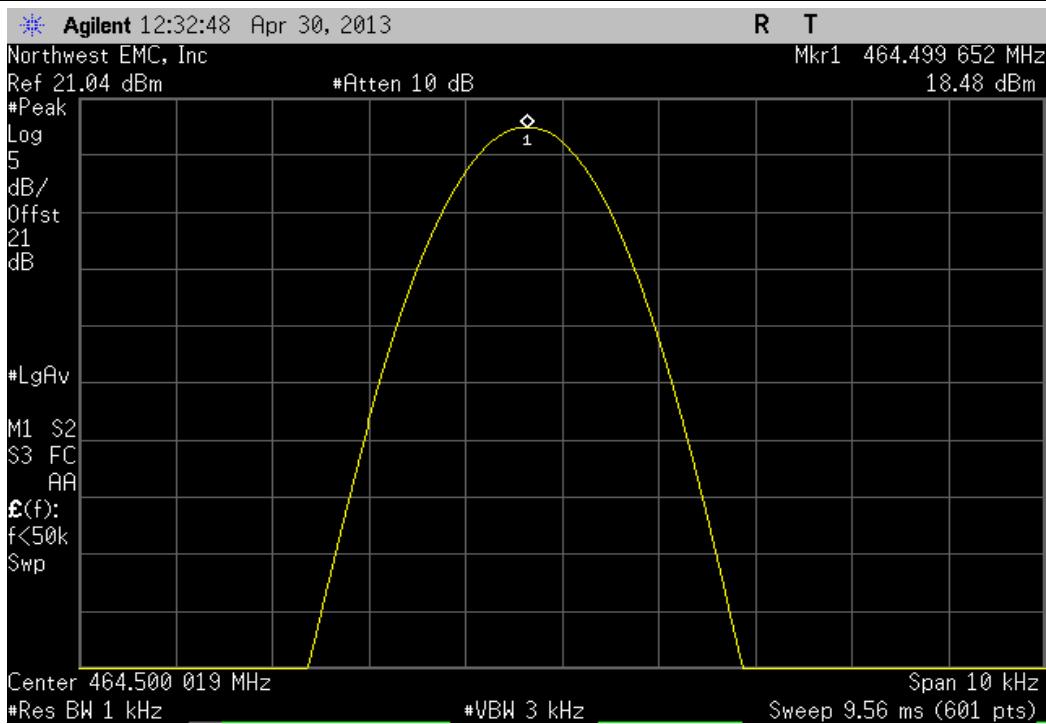
Low Channel 464.5 MHz, Temperature: -10°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	464.499774	464.5	0.5	N/A	N/A



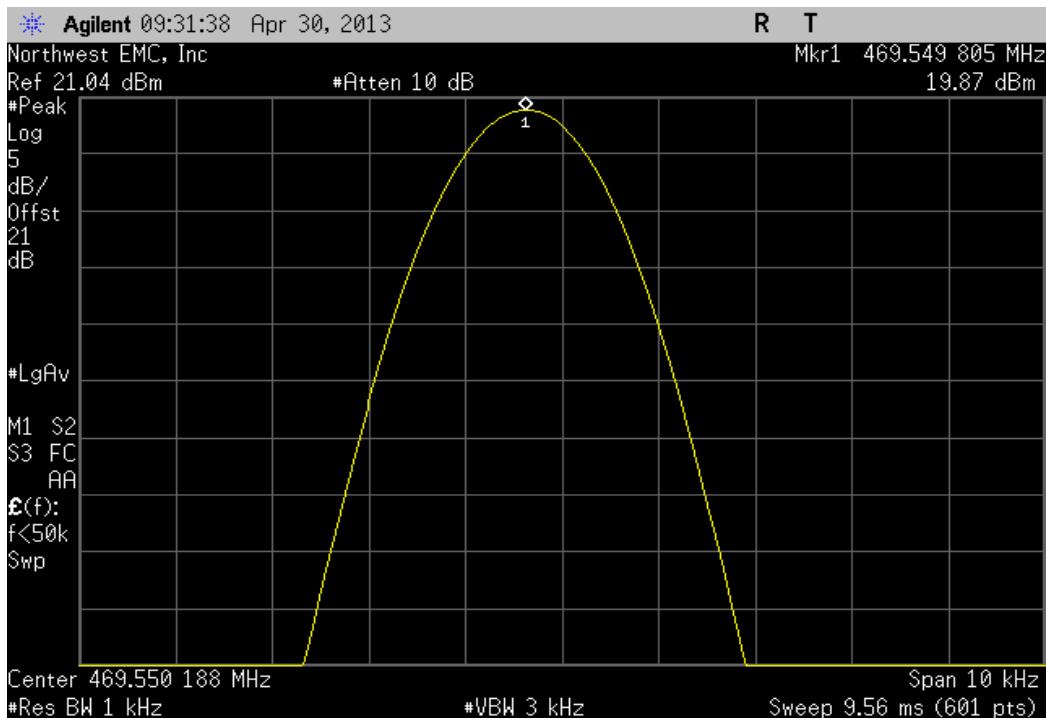
Low Channel 464.5 MHz, Temperature: -20°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	464.499703	464.5	0.6	N/A	N/A



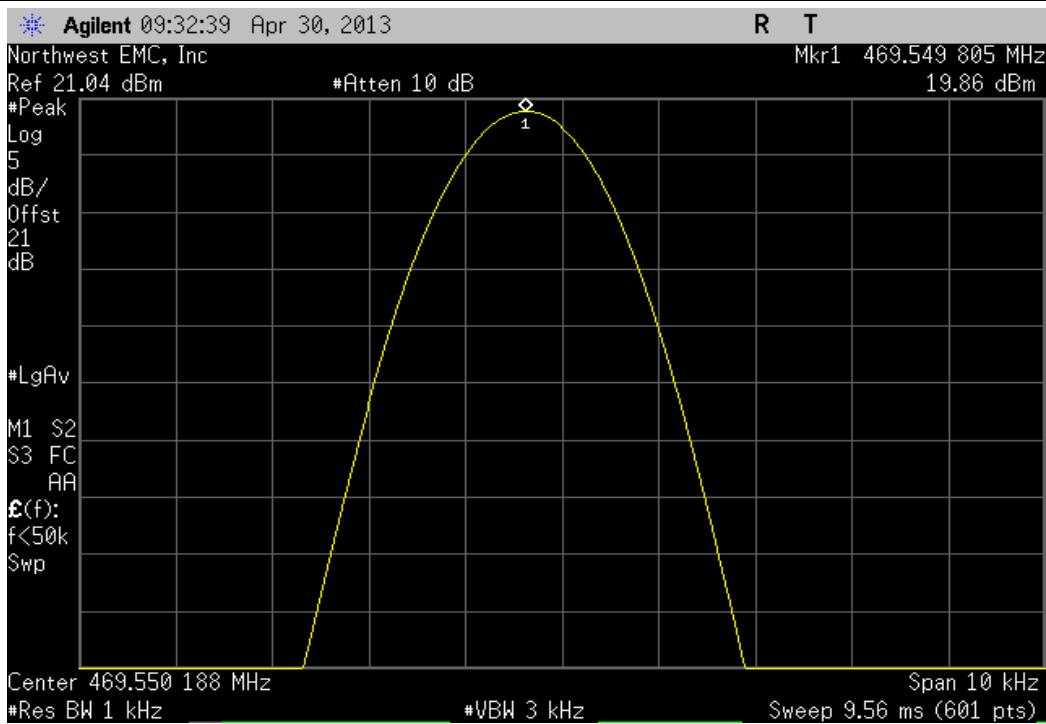
Low Channel 464.5 MHz, Temperature: -30°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	464.499652	464.5	0.8	N/A	N/A



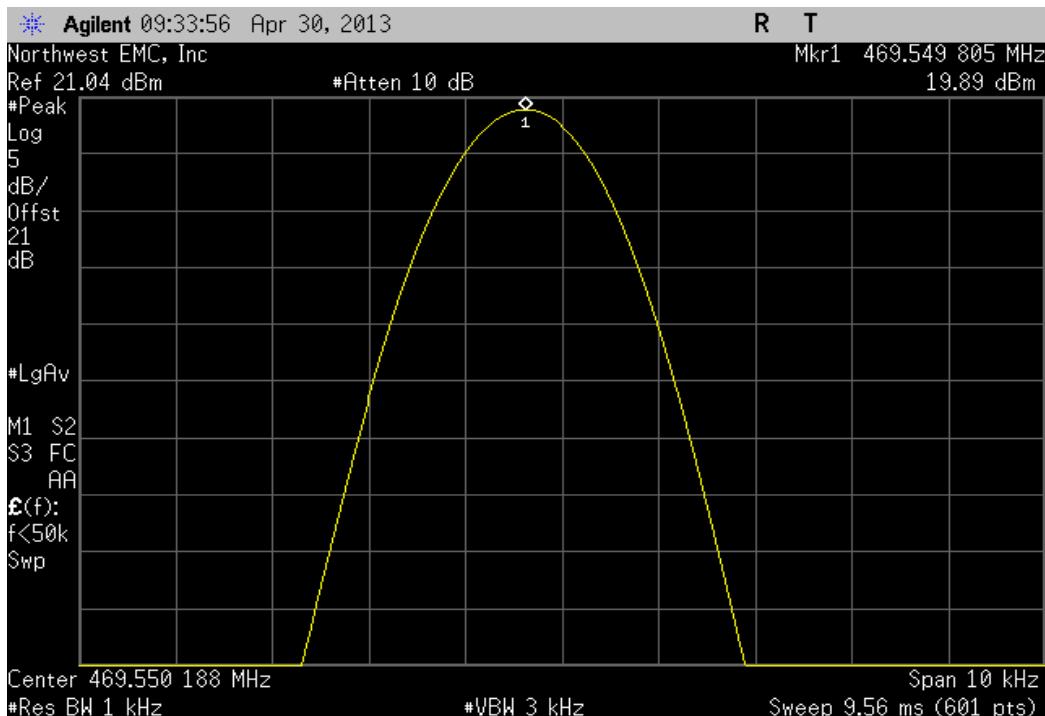
High Channel 469.55 MHz, Voltage: 115%					
Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result	
469.549805	469.55	0.4	N/A	N/A	



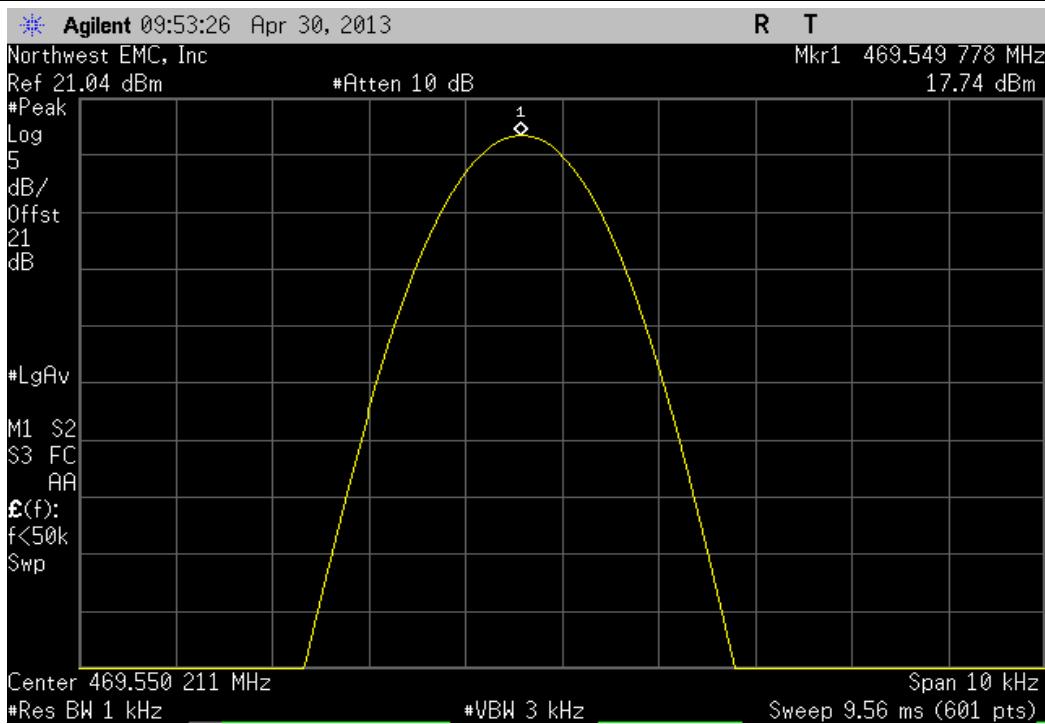
High Channel 469.55 MHz, Voltage: 100%					
Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result	
469.549805	469.55	0.4	N/A	N/A	



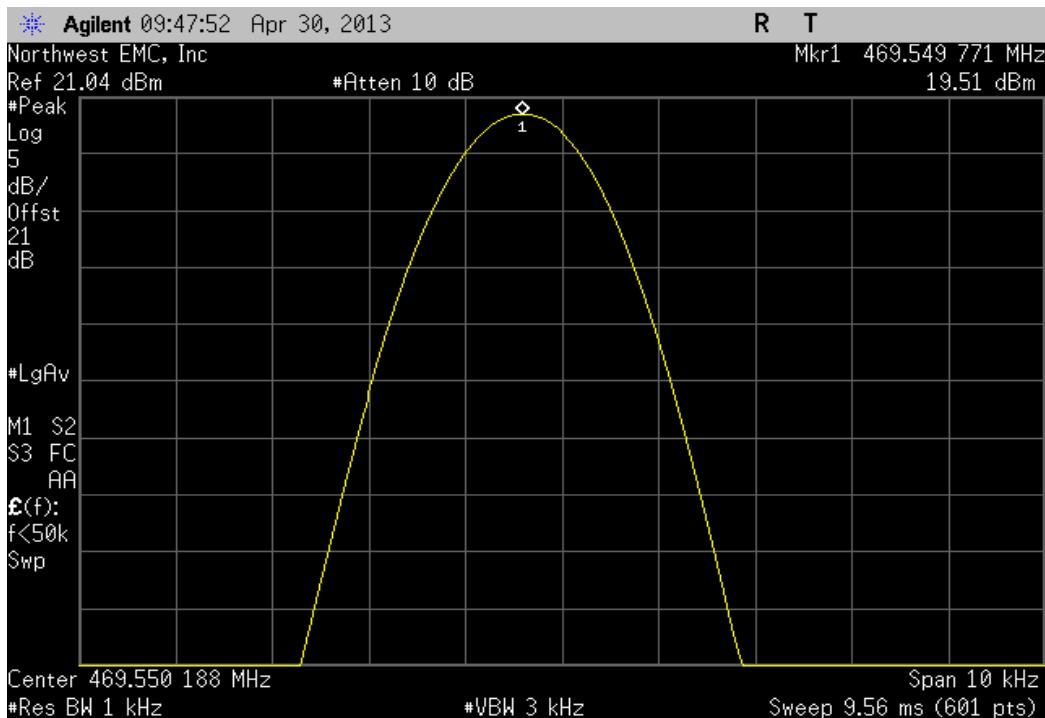
High Channel 469.55 MHz, Voltage: 85%					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	469.549805	469.55	0.4	N/A	N/A



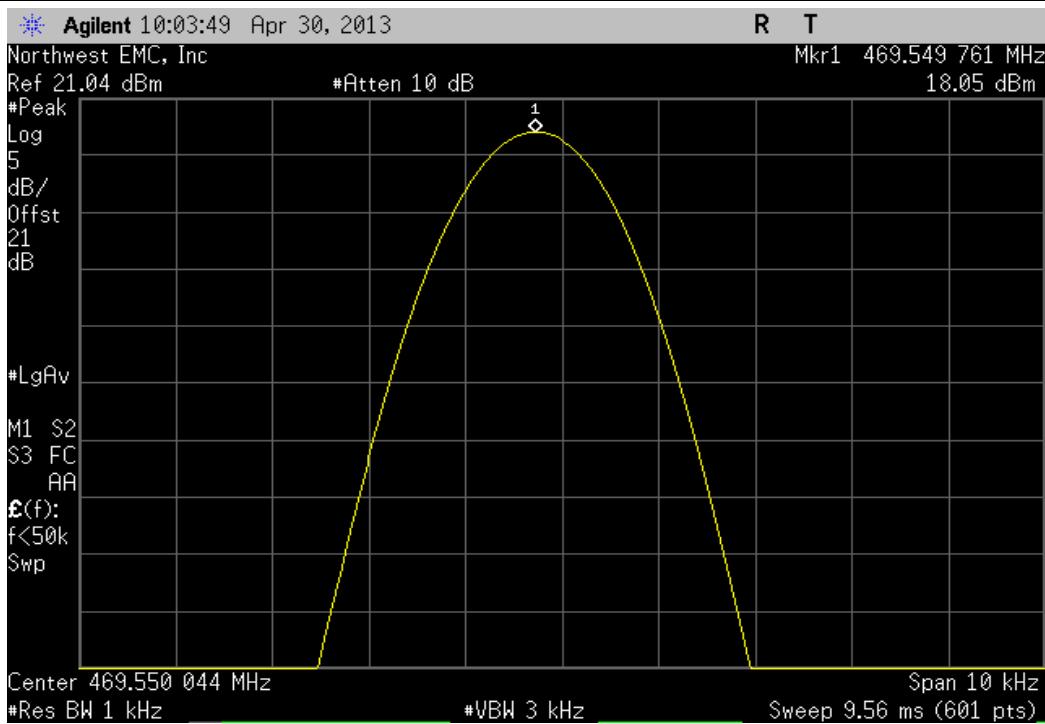
High Channel 469.55 MHz, Temperature: +50°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	469.549778	469.55	0.5	N/A	N/A



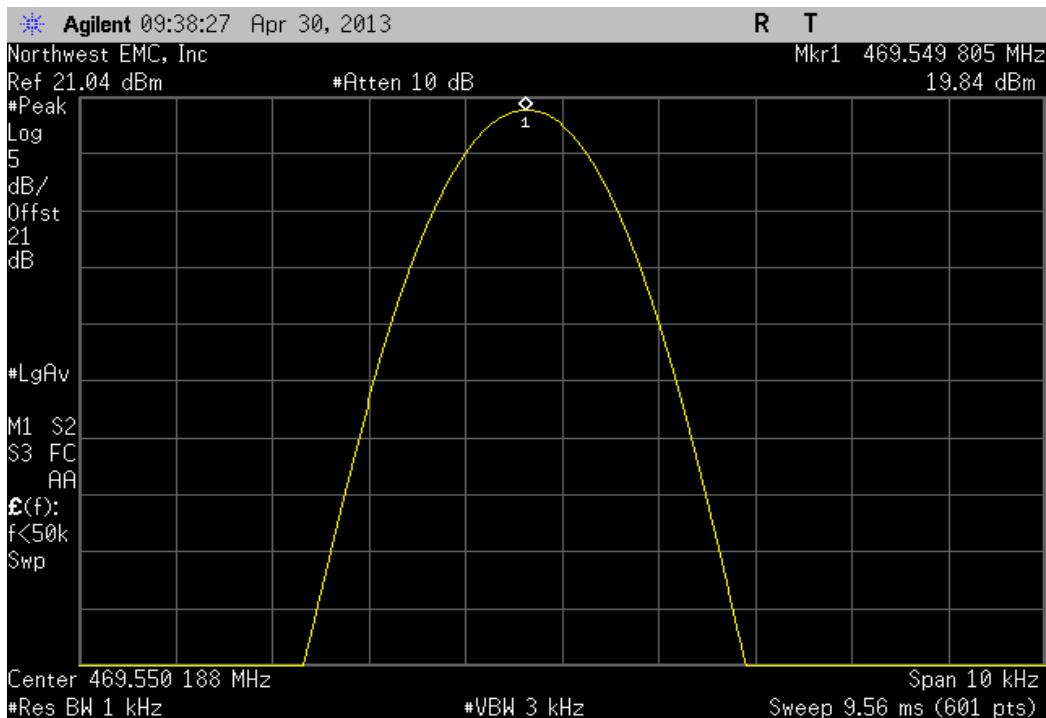
High Channel 469.55 MHz, Temperature: +40°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	469.549771	469.55	0.5	N/A	N/A



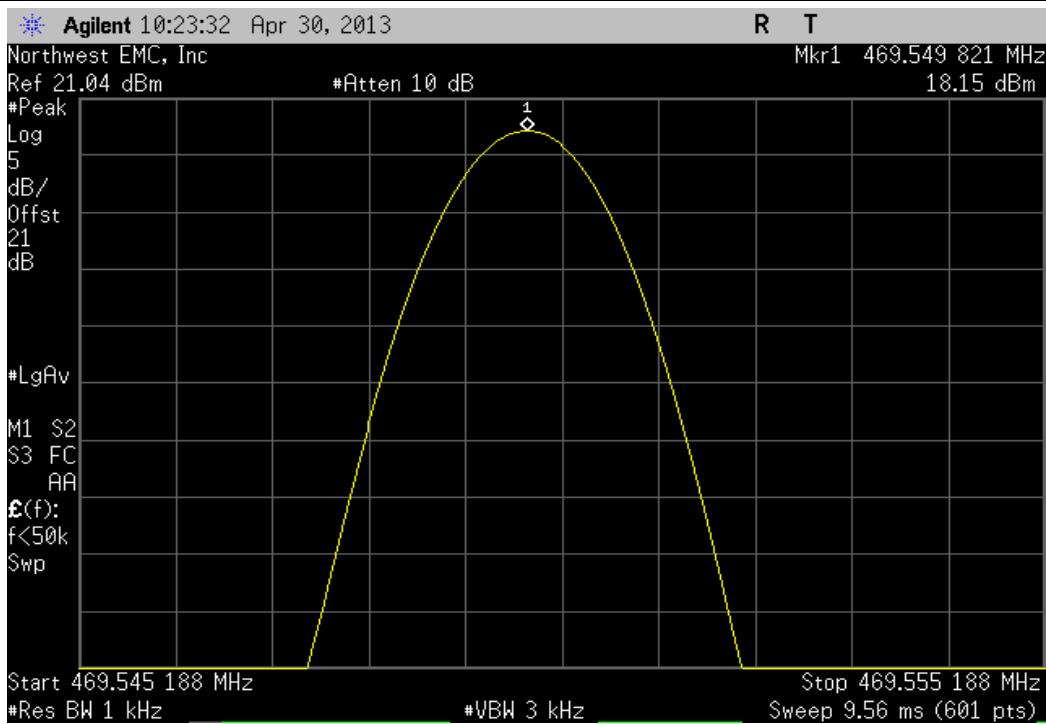
High Channel 469.55 MHz, Temperature: +30°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	469.549761	469.55	0.5	N/A	N/A



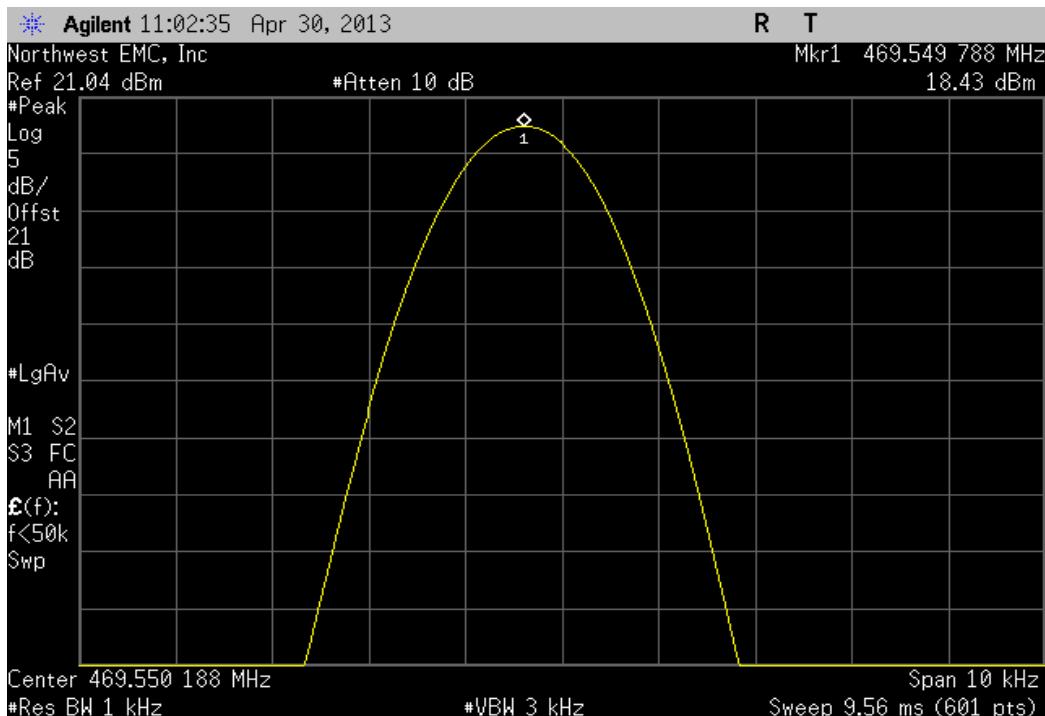
High Channel 469.55 MHz, Temperature: +20°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	469.549805	469.55	0.4	N/A	N/A



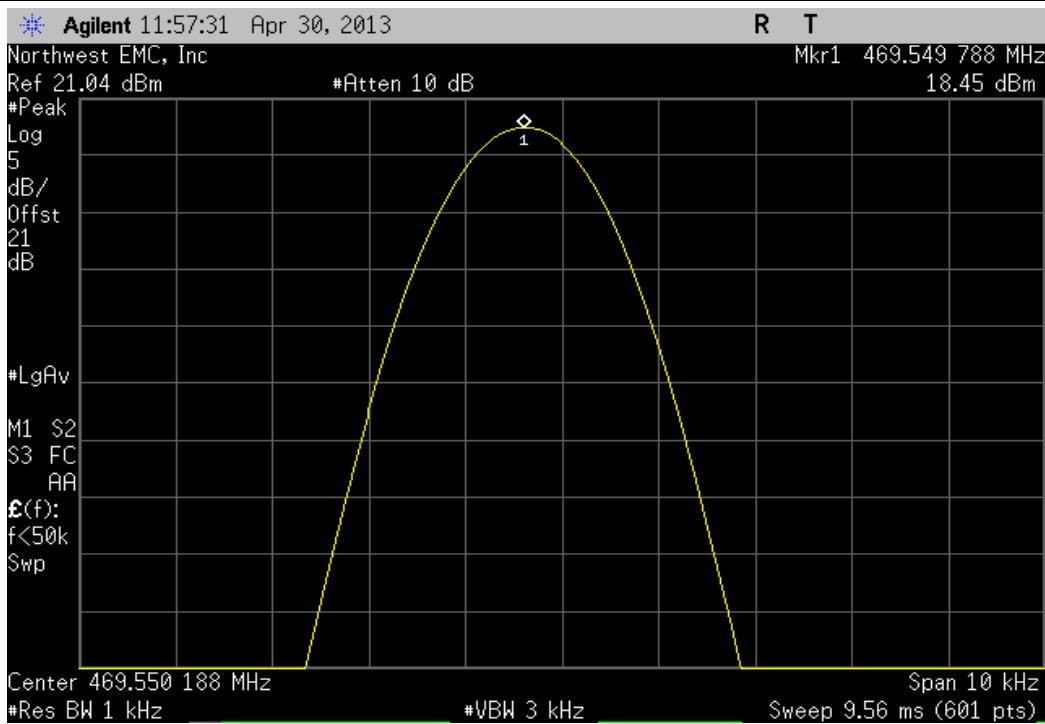
High Channel 469.55 MHz, Temperature: +10°					
	Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result
	469.549821	469.55	0.4	N/A	N/A



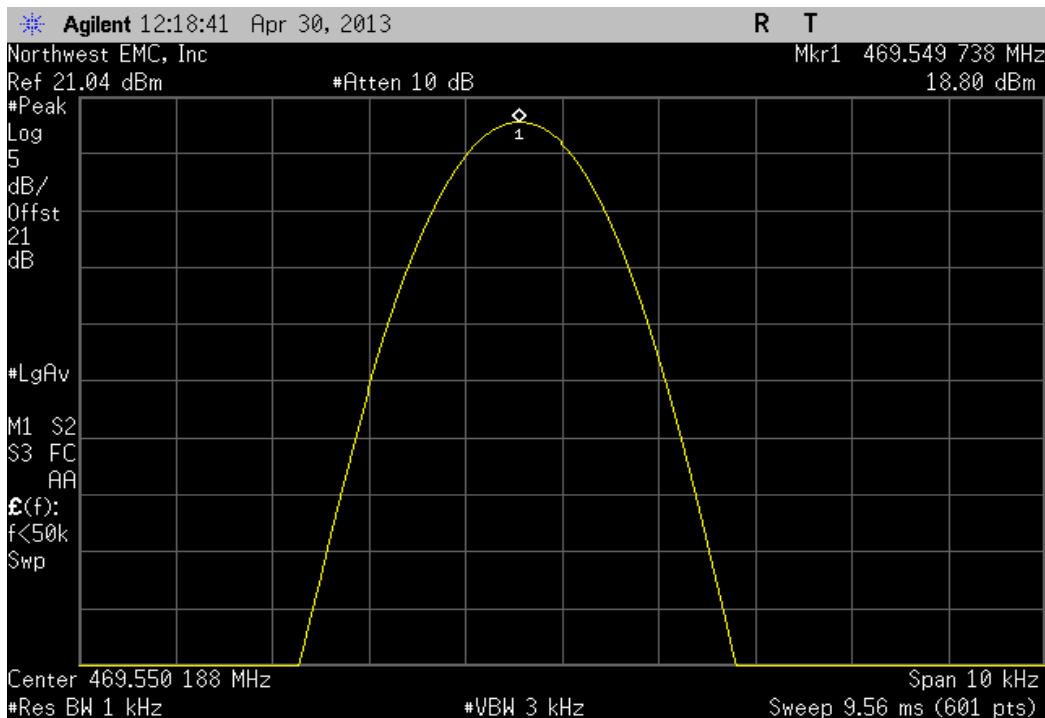
High Channel 469.55 MHz, Temperature: 0°					
Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result	
469.549788	469.55	0.4	N/A	N/A	



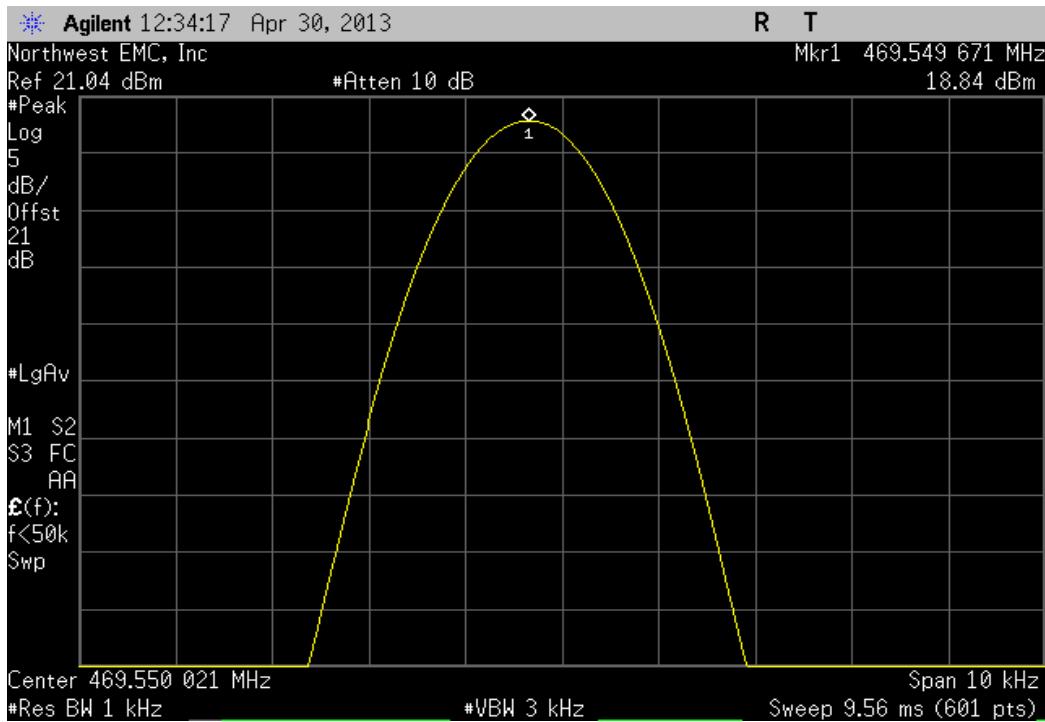
High Channel 469.55 MHz, Temperature: -10°					
Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result	
469.549788	469.55	0.4	N/A	N/A	



High Channel 469.55 MHz, Temperature: -20°					
Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result	
469.549738	469.55	0.6	N/A	N/A	



High Channel 469.55 MHz, Temperature: -30°					
Measured Value (MHz)	Assigned Value (MHz)	Error (ppm)	Limit (ppm)	Result	
469.549671	469.55	0.7	N/A	N/A	



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

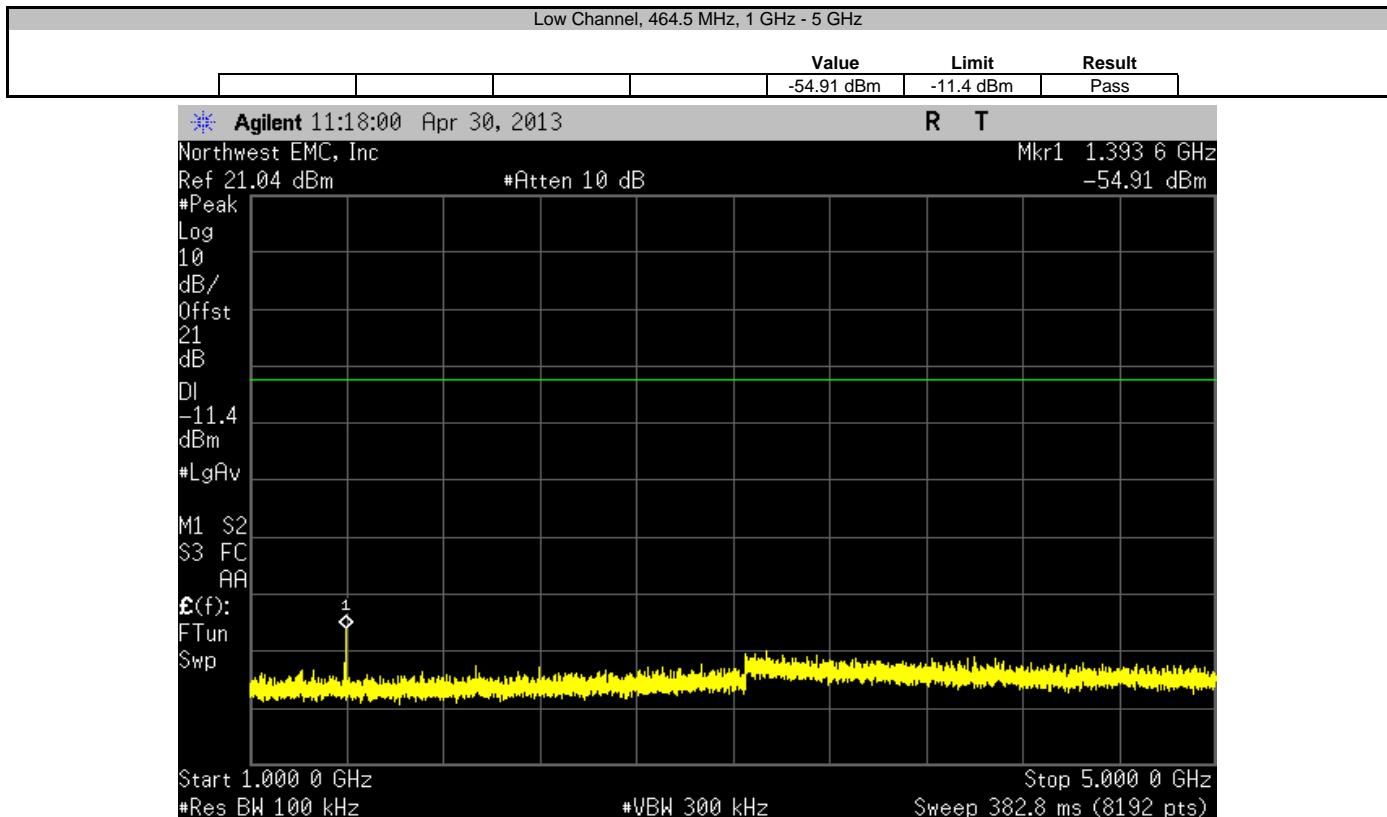
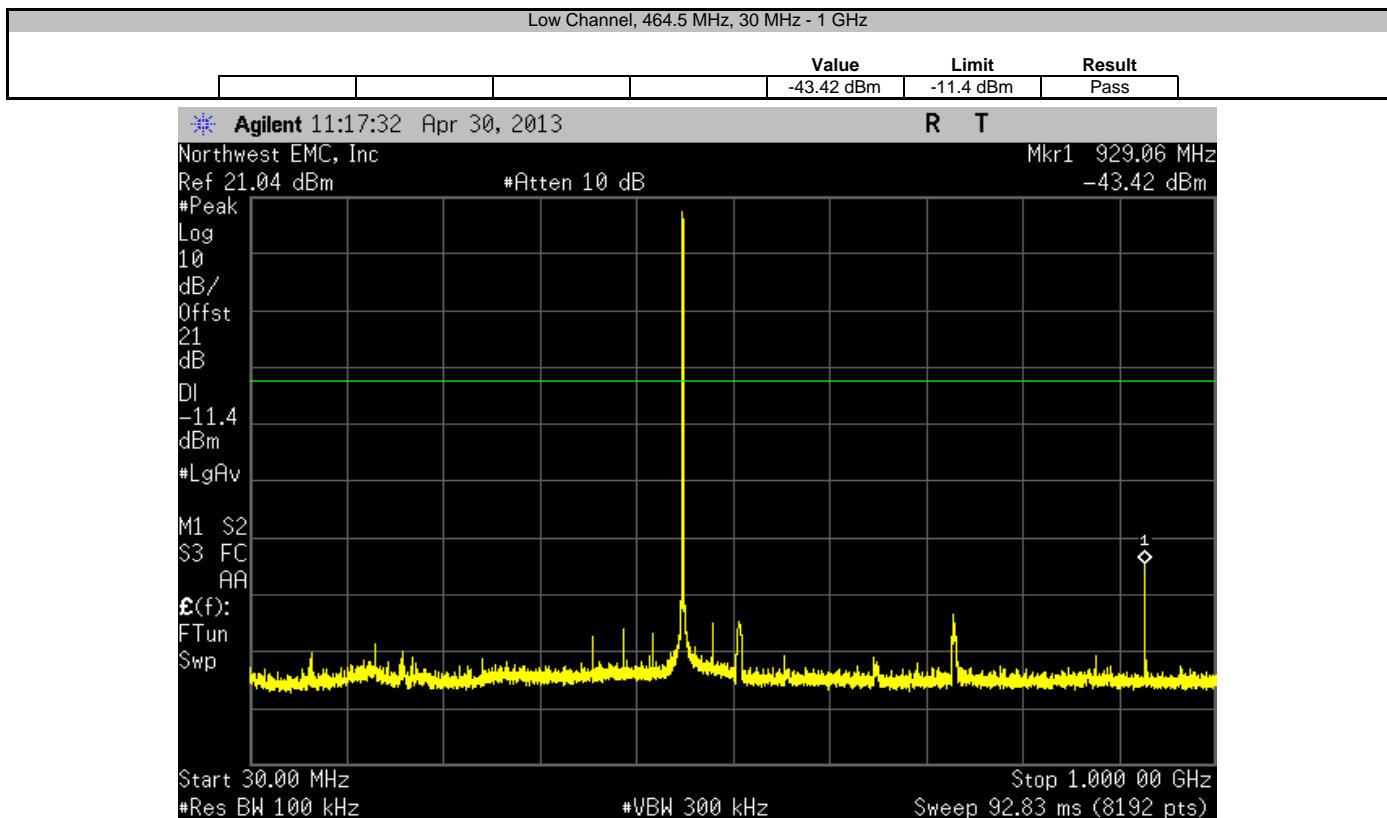
Description	Manufacturer	Model	ID	Last Cal.	Interval
DC Power Supply	Topward	TPS-2000	TPD	NCR	0
Multimeter	Tektronix	DMM912	MMH	2/5/2013	24
Attenuator, 6dB	S.M. Electronics	18N-06	AWN	3/25/2013	12
MXG Vector Signal Generator	Agilent	N5182A	TIF	NCR	0
Power Meter	Gigatronics	8651A	SPM	1/9/2012	24
Power Sensor	Gigatronics	80701A	SPL	7/8/2011	24
EV06 Direct Connect Cable	ESM Cable Corp.	TT	ECA	NCR	0
Attenuator, 6 dB, 'SMA'	N/A	93459 3330A-6	AUF	3/5/2013	12
40GHz DC Block	Miteq	DCB4000	AMD	6/25/2012	12
Spectrum Analyzer	Agilent	E4440A	AFD	7/5/2012	24

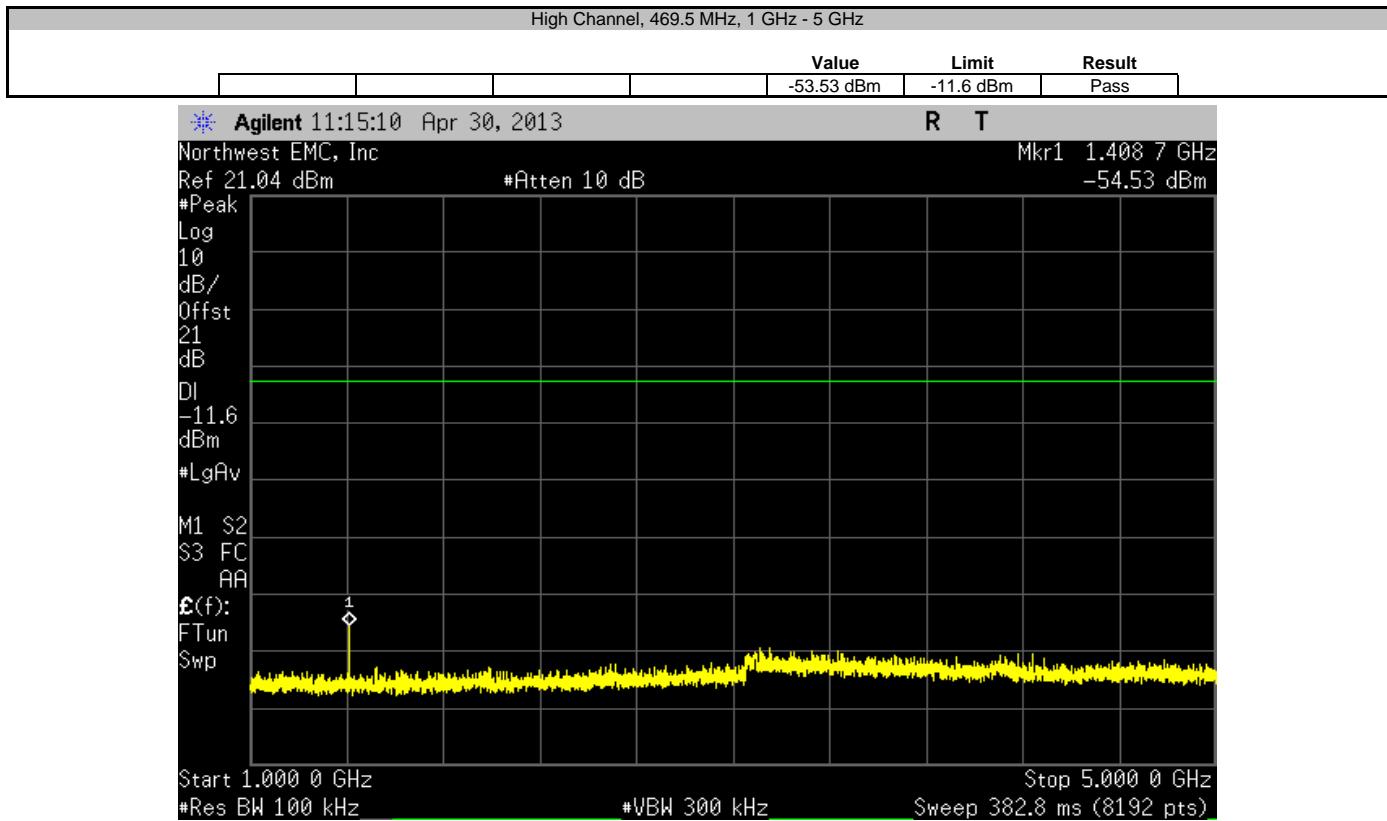
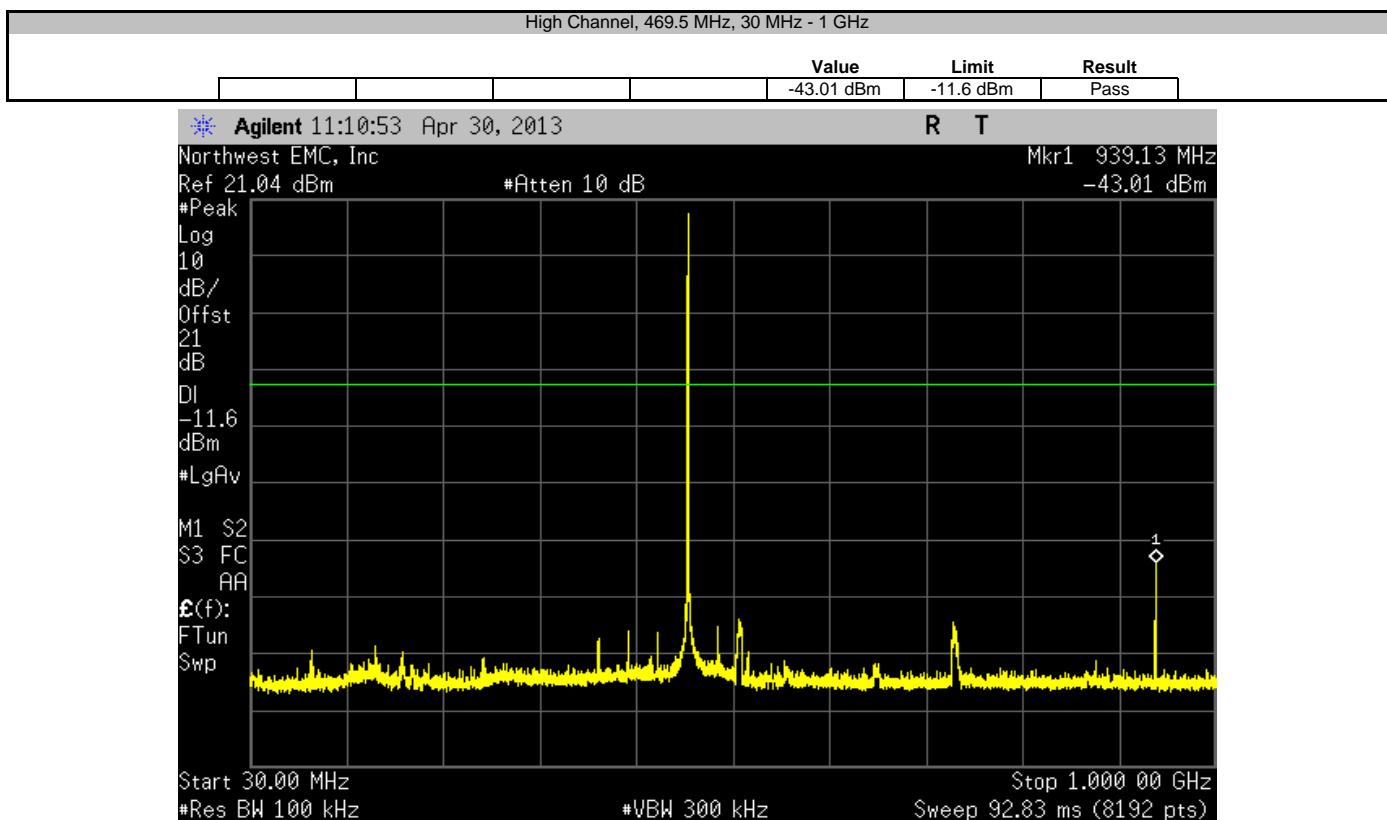
TEST DESCRIPTION

The antenna port spurious conducted emissions were measured at the RF output terminal of the EUT with 20dB of external attenuation on the RF input of the spectrum analyzer. Analyzer plots were made from 30 MHz to 5 GHz. The peak conducted power of spurious emissions, up to the 10th harmonic of the transmit frequency, were investigated to ensure they were less than or equal to the -30 dBc down from the carrier limit for both high and low channels.

Spurious Conducted Emissions

EUT: DigiRadio 2 (DR2)	Work Order: DIGC0168		
Serial Number: 19	Date: 04/30/13		
Customer: Digital Control Incorporated	Temperature: 23.2°C		
Attendees: None	Humidity: 30%		
Project: None	Barometric Pres.: 1027		
Tested by: Brandon Hobbs	Job Site: EV06		
TEST SPECIFICATIONS			
FCC 90.217:2013	Test Method: ANSI/TIA/EIA-603-C-2004		
COMMENTS			
The EUT is operating at 100% duty cycle with a power setting number of 127			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	1		
Signature 			
	Value	Limit	Result
Low Channel, 464.5 MHz			
30 MHz - 1 GHz	-43.42 dBm	-11.4 dBm	Pass
1 GHz - 5 GHz	-54.91 dBm	-11.4 dBm	Pass
High Channel, 469.5 MHz			
30 MHz - 1 GHz	-43.01 dBm	-11.6 dBm	Pass
1 GHz - 5 GHz	-53.53 dBm	-11.6 dBm	Pass





Receiver Spurious 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. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Receive Mode

CHANNELS TESTED

Low Channel, 464.5 MHz

High Channel, 469.55 MHz

POWER SETTINGS INVESTIGATED

5 VDC

CONFIGURATIONS INVESTIGATED

DIGC0182 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency | 30 MHz | Stop Frequency | 6000 MHz

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
EV01 Cables	N/A	Double Ridge Horn Cables	EVB	6/20/2013	12 mo
Pre-Amplifier	Miteq	AMF-4D-010100-24-10P	APW	6/20/2013	12 mo
Antenna, Horn	ETS	3115	AIZ	1/24/2011	36 mo
EV01 Cables	N/A	Bilog Cables	EVA	6/20/2013	12 mo
Pre-Amplifier	Miteq	AM-1616-1000	AOL	6/20/2013	12 mo
Antenna, Biconilog	EMCO	3141	AXG	4/10/2012	36 mo
Spectrum Analyzer	Agilent	E4446A	AAQ	2/7/2012	24 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

Using the mode of operation and configuration noted within this report, a final radiated emissions test was performed. The frequency range investigated (scanned), is also noted in this report. Radiated emissions measurements were made at the EUT azimuth and antenna height such that the maximum radiated emissions level was detected. This required the use of a turntable and an antenna positioner. The preferred method of a continuous azimuth search was utilized for frequency scans of the EUT field strength with both polarities of the measuring antenna. A calibrated, linearly polarized antenna was positioned at the specified distance from the periphery of the EUT. Tests were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna was varied in height above the conducting ground plane to obtain the maximum signal strength. Though specified in the report, the measurement distance was 3 meters or 10 meters. At any measurement distance, the antenna height was varied from 1 meter to 4 meters. These height scans apply for both horizontal and vertical polarization, except that for vertical polarization the minimum height of the center of the antenna was increased so that the lowest point of the bottom of the antenna cleared the ground surface by at least 25 cm.

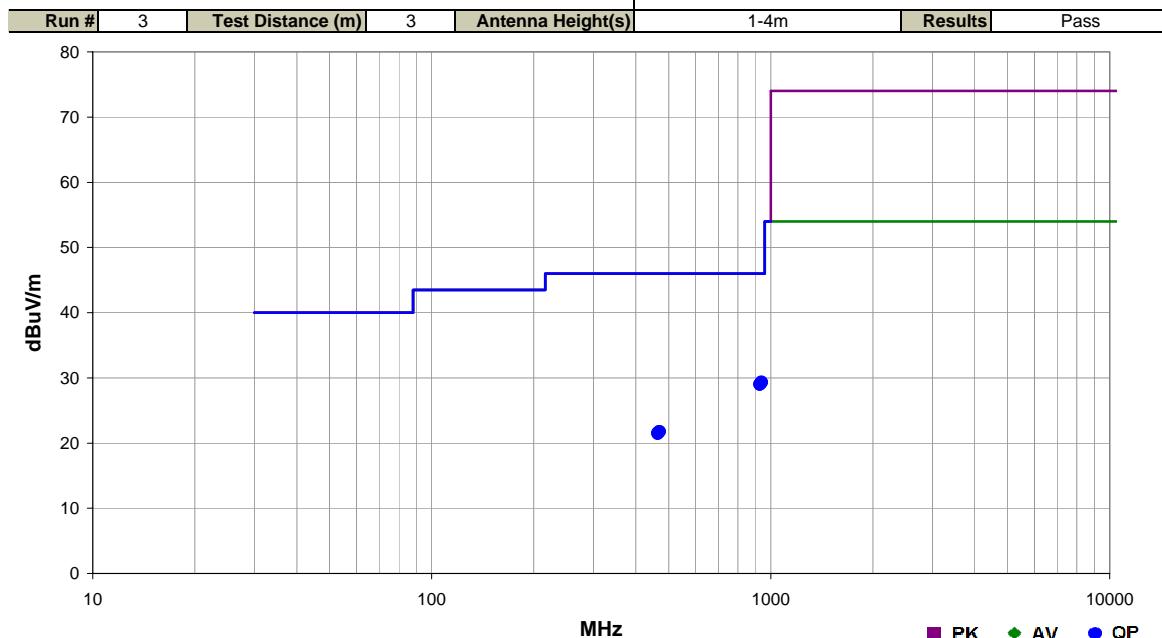
The EUT arrangement is configured as equivalent to that occurring in normal use. Tabletop equipment is placed on a 0.8 meter high non-conductive table. Floor-standing equipment is placed on, but insulated from a ground reference plane by the use of its own rollers or stand-off supports. If measurements above 1 GHz were required, the test setup was modified to meet the regulatory requirements for higher frequency measurements. If required, RF absorber was placed on the floor between the measurement antenna and EUT.

The diameter of the illumination area is the dimension of the line tangent to the EUT formed by 3 dB beamwidth of the measurement antenna at the measurement distance. At a 3 meter test distance, the diameter of the illumination area was 3.8 meters at 1 GHz and greater than 2.1 meters up to 6 GHz. The specified measurement detectors were used for comparison of the emissions to the peak and average specification limits.

Receiver Spurious Emissions

Work Order:	DIGC0182	Date:	08/05/13	
Project:	None	Temperature:	23.3 °C	
Job Site:	EV01	Humidity:	49% RH	
Serial Number:	None	Barometric Pres.:	1015 mbar	
EUT:	DigiRadio 2 (DR2)		Tested by:	Carl Engholm, Rod Peloquin
Configuration:	1			
Customer:	Digital Control Incorporated			
Attendees:	None			
EUT Power:	5 VDC			
Operating Mode:	Receive Mode			
Deviations:	None			
Comments:	See comments below for channel, frequency, and EUT orientation.			

Test Specifications	Test Method
FCC 15.109:2013	ANSI C63.4:2009



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
939.250	17.0	12.4	1.0	150.0	3.0	0.0	Vert	QP	0.0	29.4	46.0	-16.6	High Ch. (469.55 MHz), EUT Vertical
939.519	16.9	12.4	2.8	83.0	3.0	0.0	Horz	QP	0.0	29.3	46.0	-16.7	High Ch. (469.55 MHz), EUT Horizontal
928.897	17.0	12.0	1.0	104.0	3.0	0.0	Horz	QP	0.0	29.0	46.0	-17.0	Low Ch. (464.5 MHz), EUT Horizontal
928.760	17.0	12.0	1.2	198.0	3.0	0.0	Vert	QP	0.0	29.0	46.0	-17.0	Low Ch. (464.5 MHz), EUT Vertical
469.226	17.1	4.6	3.6	64.0	3.0	0.0	Horz	QP	0.0	21.7	46.0	-24.3	High Ch. (469.55 MHz), EUT Horizontal
469.174	17.1	4.6	1.2	301.0	3.0	0.0	Vert	QP	0.0	21.7	46.0	-24.3	High Ch. (469.55 MHz), EUT Vertical
464.118	17.2	4.3	1.0	19.0	3.0	0.0	Vert	QP	0.0	21.5	46.0	-24.5	Low Ch. (464.5 MHz), EUT Vertical
464.216	17.1	4.3	1.0	157.0	3.0	0.0	Horz	QP	0.0	21.4	46.0	-24.6	Low Ch. (464.5 MHz), EUT Horizontal

Work Order:	DIGC0182	Date:	08/05/13	
Project:	None	Temperature:	23.3 °C	
Job Site:	EV01	Humidity:	49% RH	
Serial Number:	None	Barometric Pres.:	1015 mbar	Tested by: Carl Engholm, Rod Peloquin
EUT:	DigiRadio 2 (DR2)			
Configuration:	1			
Customer:	Digital Control Incorporated			
Attendees:	None			
EUT Power:	5 VDC			
Operating Mode:	Receive Mode			
Deviations:	None			
Comments:	See comments below for channel, frequency, and EUT orientation.			

Test Specifications	Test Method
FCC 15.109:2013	ANSI C63.4:2009



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
3752.667	34.6	7.2	1.0	88.0	3.0	0.0	Horz	AV	0.0	41.8	54.0	-12.2	High Ch. (469.55 MHz), EUT Vertical
3752.644	34.2	7.2	1.3	344.0	3.0	0.0	Vert	AV	0.0	41.4	54.0	-12.6	High Ch. (469.55 MHz), EUT Horizontal
3712.273	34.1	7.0	1.4	241.0	3.0	0.0	Horz	AV	0.0	41.1	54.0	-12.9	Low Ch. (464.5 MHz), EUT Vertical
3712.287	31.7	7.0	2.0	6.0	3.0	0.0	Vert	AV	0.0	38.7	54.0	-15.3	Low Ch. (464.5 MHz), EUT Horizontal
3752.640	28.7	7.2	1.1	113.0	3.0	0.0	Horz	AV	0.0	35.9	54.0	-18.1	High Ch. (469.55 MHz), EUT Horizontal
3752.678	28.4	7.2	1.5	217.0	3.0	0.0	Vert	AV	0.0	35.6	54.0	-18.4	High Ch. (469.55 MHz), EUT Vertical
3752.667	40.7	7.2	1.0	88.0	3.0	0.0	Horz	PK	0.0	47.9	74.0	-26.1	High Ch. (469.55 MHz), EUT Vertical
3752.531	40.2	7.2	1.3	344.0	3.0	0.0	Vert	PK	0.0	47.4	74.0	-26.6	High Ch. (469.55 MHz), EUT Horizontal
3712.627	40.1	7.0	1.4	241.0	3.0	0.0	Horz	PK	0.0	47.1	74.0	-26.9	Low Ch. (464.5 MHz), EUT Vertical
3712.127	39.0	7.0	2.0	6.0	3.0	0.0	Vert	PK	0.0	46.0	74.0	-28.0	Low Ch. (464.5 MHz), EUT Horizontal
3752.651	38.3	7.2	1.5	217.0	3.0	0.0	Vert	PK	0.0	45.5	74.0	-28.5	High Ch. (469.55 MHz), EUT Vertical
3752.953	38.2	7.2	1.1	113.0	3.0	0.0	Horz	PK	0.0	45.4	74.0	-28.6	High Ch. (469.55 MHz), EUT Horizontal
1410.367	24.1	-2.2	1.3	129.0	3.0	0.0	Vert	AV	0.0	21.9	54.0	-32.1	High Ch. (469.55 MHz), EUT Horizontal
1409.727	24.1	-2.2	1.0	175.0	3.0	0.0	Horz	AV	0.0	21.9	54.0	-32.1	High Ch. (469.55 MHz), EUT Vertical
1394.180	23.9	-2.2	1.0	198.0	3.0	0.0	Horz	AV	0.0	21.7	54.0	-32.3	Low Ch. (464.5 MHz), EUT Vertical
1393.833	23.9	-2.2	1.0	343.0	3.0	0.0	Vert	AV	0.0	21.7	54.0	-32.3	Low Ch. (464.5 MHz), EUT Horizontal
1397.233	37.9	-2.2	1.0	343.0	3.0	0.0	Vert	PK	0.0	35.7	74.0	-38.3	Low Ch. (464.5 MHz), EUT Horizontal
1408.553	37.6	-2.2	1.3	129.0	3.0	0.0	Vert	PK	0.0	35.4	74.0	-38.6	High Ch. (469.55 MHz), EUT Horizontal
1396.660	37.1	-2.2	1.0	198.0	3.0	0.0	Horz	PK	0.0	34.9	74.0	-39.1	Low Ch. (464.5 MHz), EUT Vertical
1408.400	37.0	-2.2	1.0	175.0	3.0	0.0	Horz	PK	0.0	34.8	74.0	-39.2	High Ch. (469.55 MHz), EUT Vertical

Transmitter Spurious 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. 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, Constant Modulation, Power Level 99

CHANNELS TESTED

Low Channel, 464.5 MHz

High Channel, 469.55 MHz

POWER SETTINGS INVESTIGATED

5 VDC

CONFIGURATIONS INVESTIGATED

DIGC0182 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency 30 MHz Stop Frequency 6000 MHz

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
Antenna, Horn	EMCO	3115	AHC	6/20/2012	24 mo
Antenna, Dipole	AH Systems	FCC-4	ADEA	8/16/2010	36 mo
Attenuator, 'N'	Coaxicom	66702 5910-6	ATZ	3/20/2013	12 mo
Power Sensor	Gigatronics	80701A	SPL	7/8/2011	36 mo
Power Meter	Gigatronics	8651A	SPM	1/9/2012	24 mo
MXG Vector Signal Generator	Agilent	N5182A	TIF	NCR	0 mo
HP Filter	Micro-Tronics	HPM50108	HFV	7/6/2012	36 mo
Attenuator - 20dB, HF (1000MHz -	Coaxicom	3910-20	AXZ	6/20/2013	12 mo
Attenuator - 20dB, LF (30MHz -	Coaxicom	3910-20	AXY	6/20/2013	12 mo
EV01 Cables	N/A	Double Ridge Horn Cables	EVB	6/20/2013	12 mo
Pre-Amplifier	Miteq	AMF-4D-010100-24-10P	APW	6/20/2013	12 mo
Antenna, Horn	ETS	3115	AIZ	1/24/2011	36 mo
EV01 Cables	N/A	Bilog Cables	EVA	6/20/2013	12 mo
Pre-Amplifier	Miteq	AM-1616-1000	AOL	6/20/2013	12 mo
Antenna, Biconilog	EMCO	3141	AXG	4/10/2012	36 mo
Spectrum Analyzer	Agilent	E4446A	AAQ	2/7/2012	24 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

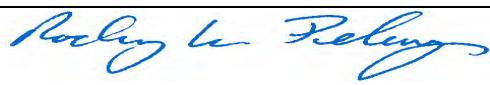
The Field Strength of Spurious Radiation was measured in the far-field at an FCC Listed OATS up to 10 GHz. Spectrum analyzer, signal generator, and linearly polarized antennas were used to measure radiated harmonics and spurious emissions. The orientation of the EUT and measurement antenna were manipulated to maximize the level of emissions. The EUT was configured to transmit at the highest output power.

For licensed transmitters, the FCC references TIA/EIA-603 as the measurement procedure standard. TIA/EIA-603 Section 2.2.12 describes a method for measuring radiated spurious emissions that utilizes an antenna substitution method:

At an approved test site, the transmitter is placed on a remotely controlled turntable, and the measurement antenna is placed 3 meters from the transmitter. The turntable azimuth is varied to maximize the level of spurious emissions. The height of the measurement antenna is also varied from 1 to 4 meters. The amplitude and frequency of the highest emissions are noted. The transmitter is then replaced with a 1/2 wave dipole that is successively tuned to each of the highest spurious emissions. A signal generator is connected to the dipole (horn antenna for frequencies above 1 GHz), and its output is adjusted to match the level previously noted for each frequency. The output of the signal generator is recorded, and by factoring in the cable loss to the dipole antenna and its gain; the power (dBm) into an ideal 1/2 wave dipole antenna is determined for each radiated spurious emission.

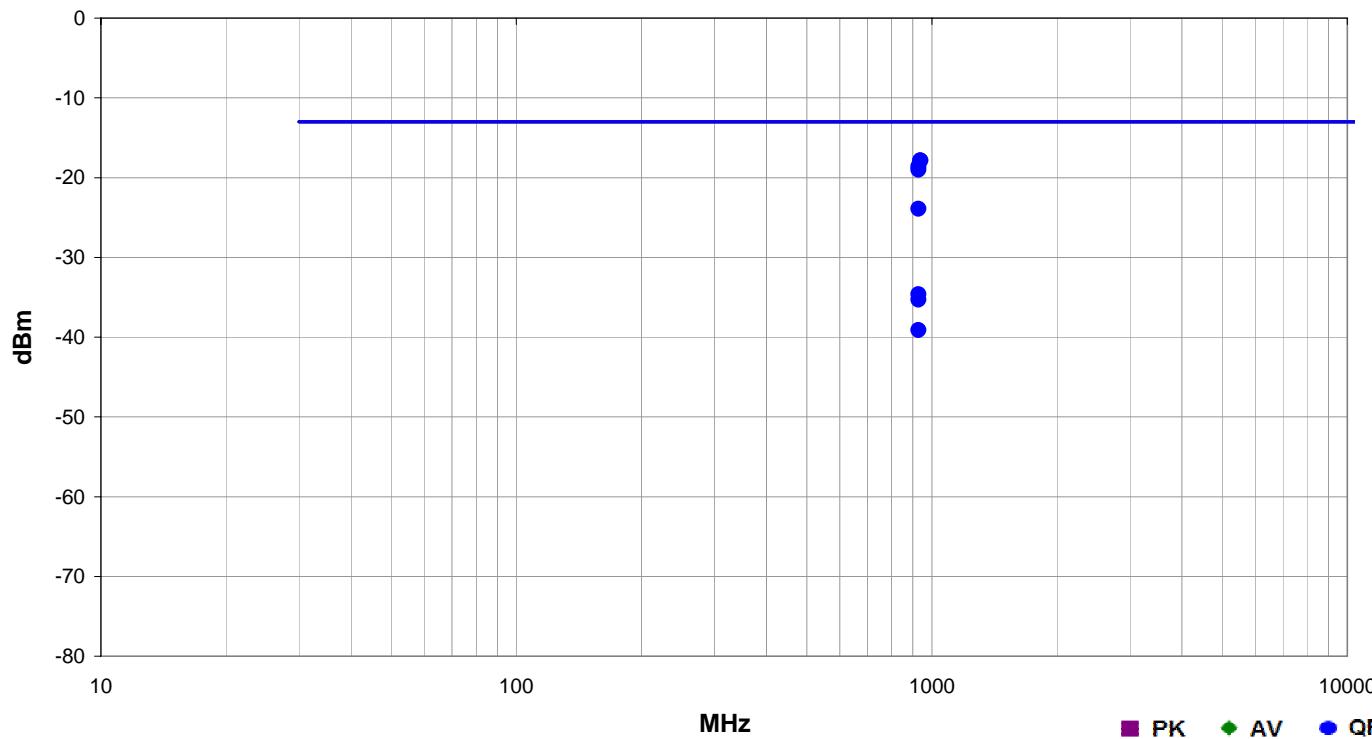
For the purposes of preliminary measurements, the field strength of the spurious emissions can be measured and compared with a 3 meter limit. The 3 meter limit was calculated to be 82.2 dB_µV/m at 3 meters. The final measurements must be made utilizing the substitution method described above and applied against the EIRP limit of -13 dBm.

Transmitter Spurious Emissions

Work Order:	DIGC0182	Date:	08/05/13	 Tested by: Carl Engholm, Rod Peloquin	
Project:	None	Temperature:	23.3 °C		
Job Site:	EV01	Humidity:	49% RH		
Serial Number:	None	Barometric Pres.:	1015 mbar		
EUT:	DigiRadio 2 (DR2)				
Configuration:	1				
Customer:	Digital Control Incorporated				
Attendees:	None				
EUT Power:	5 VDC				
Operating Mode:	Transmitting, Constant Modulation, Power Level 99				
Deviations:	None				
Comments:	See comments below for channel, frequency, and EUT orientation.				

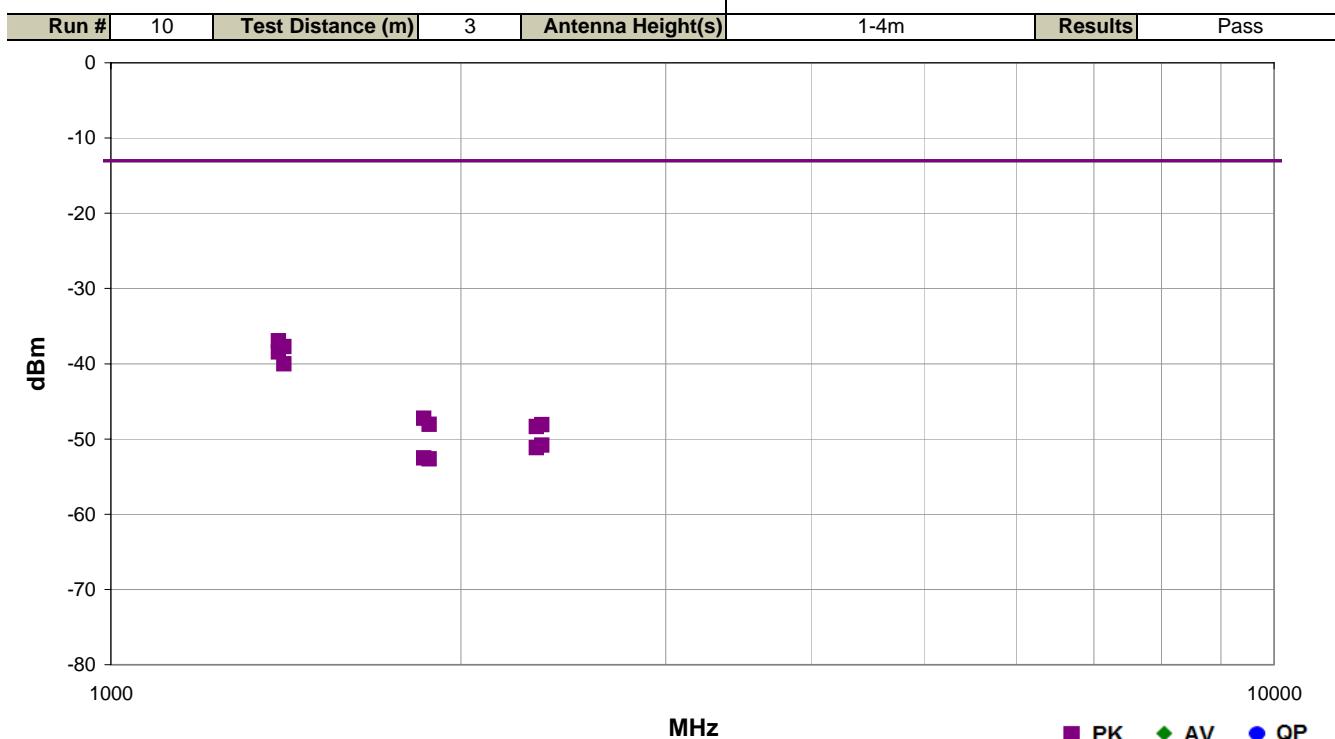
Test Specifications	Test Method
FCC 90.217:2013	ANSI/TIA/EIA-603-C:2003

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



	Freq (MHz)	Antenna Height (meters)	Azimuth (degrees)	Polarity/Transducer Type	Detector	EIRP (Watts)	EIRP (dBm)	Spec. Limit (dBm)	Compared to Spec. (dB)	Comments
939.107	1.2	289.0	Vert	QP	1.63E-05	-17.9	-13.0	-4.9	High Ch. (469.55 MHz), EUT Vertical	
939.107	2.2	4.0	Horz	QP	1.63E-05	-17.9	-13.0	-4.9	High Ch. (469.55 MHz), EUT Horizontal	
929.006	1.1	294.0	Vert	QP	1.38E-05	-18.6	-13.0	-5.6	Low Ch. (464.5 MHz), EUT Vertical	
929.006	2.2	354.0	Horz	QP	1.26E-05	-19.0	-13.0	-6.0	Low Ch. (464.5 MHz), EUT Horizontal	
929.006	2.1	6.0	Horz	QP	4.06E-06	-23.9	-13.0	-10.9	Low Ch. (464.5 MHz), EUT On Side	
929.006	1.8	277.0	Vert	QP	3.46E-07	-34.6	-13.0	-21.6	Low Ch. (464.5 MHz), EUT Horizontal	
929.004	1.8	281.0	Vert	QP	2.94E-07	-35.3	-13.0	-22.3	Low Ch. (464.5 MHz), EUT On Side	
929.004	1.9	8.0	Horz	QP	1.23E-07	-39.1	-13.0	-26.1	Low Ch. (464.5 MHz), EUT Vertical	

Work Order:	DIGC0182	Date:	08/05/13	 Tested by: Carl Engholm, Rod Peloquin
Project:	None	Temperature:	23.3 °C	
Job Site:	EV01	Humidity:	49% RH	
Serial Number:	None	Barometric Pres.:	1015 mbar	
EUT:	DigiRadio 2 (DR2)			
Configuration:	1			
Customer:	Digital Control Incorporated			
Attendees:	None			
EUT Power:	5 VDC			
Operating Mode:	Transmitting, Constant Modulation, Power Level 99			
Deviations:	None			
Comments:	See comments below for channel, frequency, and EUT orientation.			
Test Specifications			Test Method	
FCC 90.217:2013			ANSI/TIA/EIA-603-C:2003	



	Freq (MHz)	Antenna Height (meters)	Azimuth (degrees)	Polarity/Transducer Type	Detector	EIRP (Watts)	EIRP (dBm)	Spec. Limit (dBm)	Compared to Spec. (dB)	Comments
1393.493	1.3	273.0	Vert	PK	2.02E-07	-37.0	-13.0	-24.0	-24.0	Low Ch. (464.5 MHz), EUT Vertical
1408.613	1.3	275.0	Vert	PK	1.69E-07	-37.7	-13.0	-24.7	-24.7	High Ch. (469.55 MHz), EUT Vertical
1393.487	1.3	187.0	Horz	PK	1.43E-07	-38.5	-13.0	-25.5	-25.5	Low Ch. (464.5 MHz), EUT Horizontal
1408.667	1.3	188.0	Horz	PK	9.93E-08	-40.0	-13.0	-27.0	-27.0	High Ch. (469.55 MHz), EUT Horizontal
1857.967	1.6	348.0	Vert	PK	1.89E-08	-47.2	-13.0	-34.2	-34.2	Low Ch. (464.5 MHz), EUT Vertical
1878.253	1.2	353.0	Vert	PK	1.57E-08	-48.0	-13.0	-35.0	-35.0	High Ch. (469.55 MHz), EUT Vertical
2347.740	1.0	344.0	Vert	PK	1.54E-08	-48.1	-13.0	-35.1	-35.1	High Ch. (469.55 MHz), EUT Vertical
2322.580	1.3	340.0	Vert	PK	1.45E-08	-48.4	-13.0	-35.4	-35.4	Low Ch. (464.5 MHz), EUT Vertical
2347.733	1.5	304.0	Horz	PK	8.28E-09	-50.8	-13.0	-37.8	-37.8	High Ch. (469.55 MHz), EUT Horizontal
2322.420	1.0	24.0	Horz	PK	7.63E-09	-51.2	-13.0	-38.2	-38.2	Low Ch. (464.5 MHz), EUT Horizontal
1858.207	1.2	237.0	Horz	PK	5.57E-09	-52.5	-13.0	-39.5	-39.5	Low Ch. (464.5 MHz), EUT Horizontal
1878.193	1.1	273.0	Horz	PK	5.44E-09	-52.6	-13.0	-39.6	-39.6	High Ch. (469.55 MHz), EUT Horizontal