

NORTHWEST EMC

Digital Control Incorporated

BTW/BTP

FCC 15.209:2015

Report # DIGC0204



NVLAP Lab Code: 200630-0

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: August 28, 2015
Digital Control Incorporated
Model: BTW/BTP

Emissions

Standards

Specification	Method
FCC 15.209:2015	ANSI C63.10:2013

Results

Method Clause	Test Description	Applied	Results	Comments
6.4	Field Strength of Fundamental	Yes	Pass	
6.4, 6.5	Spurious Radiated Emissions	Yes	Pass	

Deviations From Test Standards

None

Approved By:



Kyle Holgate, 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

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

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

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>

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.

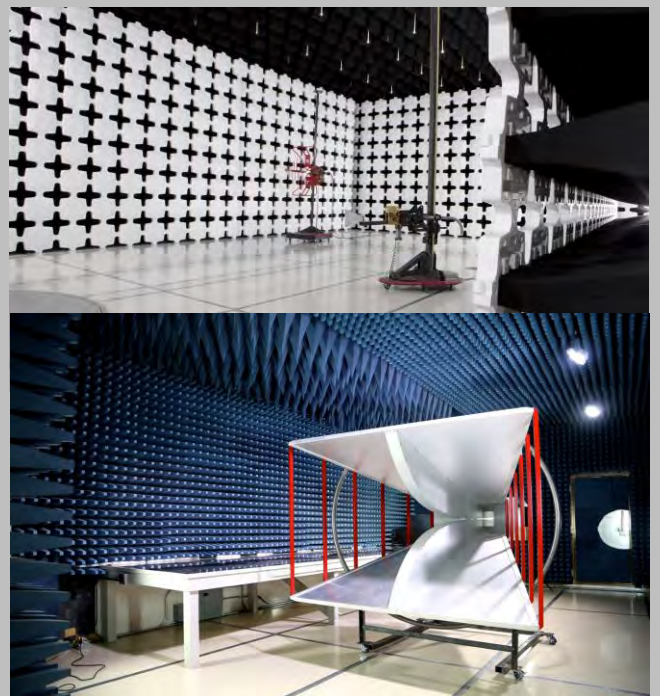
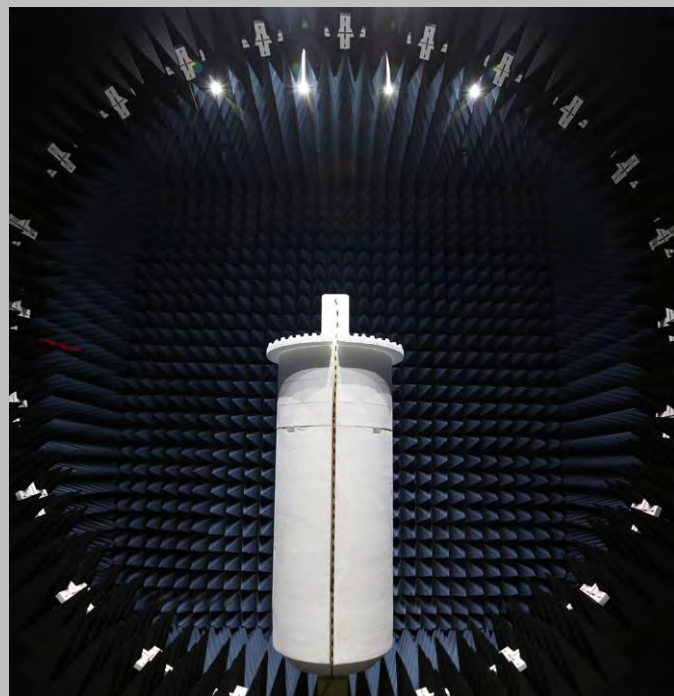
The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

Test	+ MU	- MU
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)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

FACILITIES



California Labs OC01-13 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-08, MN10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	New York Labs NY01-04 4939 Jordan Rd. Elbridge, NY 13060 (315) 554-8214	Oregon Labs EV01-12 22975 NW Evergreen Pkwy Hillsboro, OR 97124 (503) 844-4066	Texas Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Washington Labs NC01-05 19201 120 th Ave NE Bothell, WA 9801 (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
Industry 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/RRR, MIC, MOC, NCC, OFCA					
US0158	US0175	N/A	US0017	US0191	US0157



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:	BTW / BTP
First Date of Test:	July 20, 2015
Last Date of Test:	July 28, 2015
Receipt Date of Samples:	July 20, 2015
Equipment Design Stage:	Production
Equipment Condition:	No Damage

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Inductive telemetry transmitter that is used underground in a horizontal drilling application for drill head location.
Testing Objective:
To demonstrate compliance of the inductive portion of the device to FCC Part 15.209 specifications.

CONFIGURATIONS

Configuration DIGC0204- 1

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
BTW/BTP	Digital Control Incorporated	None	90000410

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	7/20/2015	Field Strength of Fundamental	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	7/28/2015	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

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

On Transmitting, 30Hz Data CW Depth mode 23.49kHz - 26.25kHz

POWER SETTINGS INVESTIGATED

3.0 VDC

CONFIGURATIONS INVESTIGATED

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FREQUENCY RANGE INVESTIGATED

Start Frequency	23.49 kHz	Stop Frequency	26.25 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
Spectrum Analyzer	Agilent	E4443A	AFB	3/17/2015	12 mo
Cable	None	10m Test Distance Cable	EVL	5/11/2015	12 mo
Antenna, Loop	EMCO	6502	AOA	6/24/2014	24 mo

TEST DESCRIPTION

The antennas to be used with the EUT were tested. The EUT was continuously transmitting while set to the channel specified.

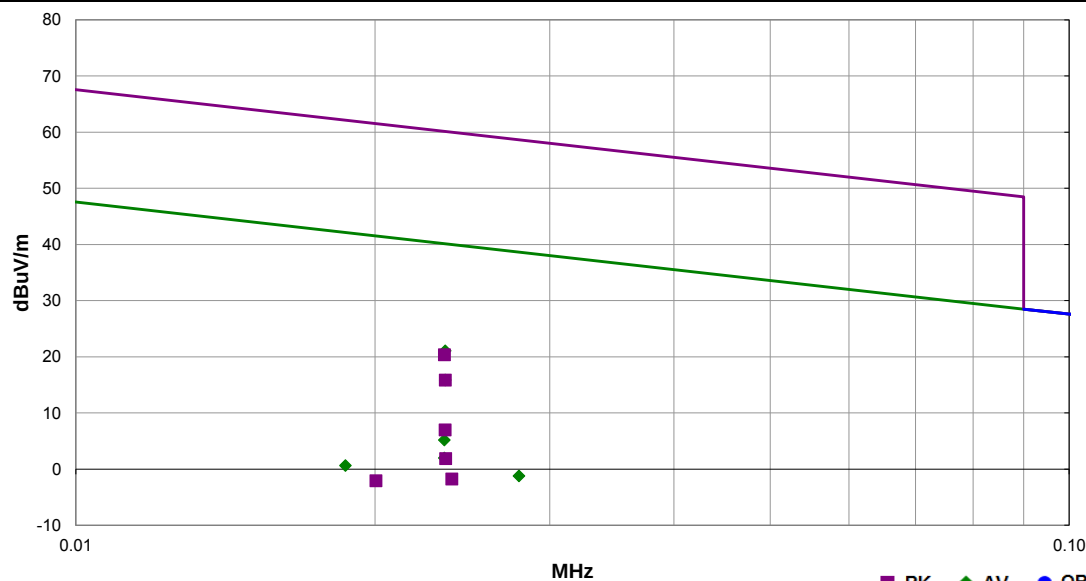
Per ANSI C63.10 sections 6.4.4.1 and 6.4.4.2, the emissions from the EUT were maximized by rotating the EUT on the turntable. Also, the EUT and/or associated antenna was positioned in 3 orthogonal planes. A calibrated active loop antenna was used for this test in order to provide sufficient measurement sensitivity per section 4.5.1. The center of the loop antenna was maintained at 1m above the ground plane during the testing.

As outlined in 15.209(e) and 15.31(f)(2), measurements may be performed at a distance closer than what is specified with the limit. The limit at the specified distance is shown on the data sheet. Measurements are made at a closer distance and the data is adjusted using a distance correction factor of 40dB/decade for comparison to the limit.

If there are no detectable emissions above the noise floor, the data included will show noise floor measurements for reference only.

Work Order:	DIGC0204	Date:	07/20/15	
Project:	None	Temperature:	23.7 °C	
Job Site:	EV11	Humidity:	43.4% RH	
Serial Number:	90000410	Barometric Pres.:	1016.6 mbar	
EUT:	BTW, BTP			
Configuration:	1			
Customer:	Digital Control Incorporated			
Attendees:	None			
EUT Power:	3.0 VDC			
Operating Mode:	On Transmitting, 30Hz Data CW Depth 23.49kHz - 26.25kHz			
Deviations:	None			
Comments:	None			

Test Specifications				Test Method			
FCC 15.209:2015				ANSI C63.10:2013			



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
0.024	66.4	13.7	1.0	356.0	10.0	0.0	Horz	AV	-59.1	21.1	40.1	-19.1	Ant perp to GND and perp to EUT, EUT Horz
0.024	61.2	13.7	1.0	106.0	10.0	0.0	Horz	AV	-59.1	15.9	40.1	-24.3	Ant perp to GND and para to EUT, EUT Horz
0.024	50.5	13.8	1.0	52.0	10.0	0.0	Horz	AV	-59.1	5.2	40.2	-35.0	Ant perp to GND and para to EUT, EUT Vert
0.024	47.3	13.8	1.0	217.0	10.0	0.0	Vert	AV	-59.1	2.0	40.2	-38.2	Ant para to GND and perp to EUT, EUT Horz
0.024	65.7	13.8	1.0	356.0	10.0	0.0	Horz	PK	-59.1	20.4	60.2	-39.8	Ant perp to GND and perp to EUT, EUT Horz
0.028	44.4	13.4	1.0	231.0	10.0	0.0	Horz	AV	-59.1	-1.2	38.7	-39.9	Ant perp to GND and perp to EUT, EUT Vert
0.019	45.1	14.6	1.0	198.0	10.0	0.0	Vert	AV	-59.1	0.6	42.2	-41.5	Ant para to GND and perp to EUT, EUT Vert
0.024	61.2	13.7	1.0	106.0	10.0	0.0	Horz	PK	-59.1	15.9	60.1	-44.3	Ant perp to GND and para to EUT, EUT Horz
0.024	52.3	13.8	1.0	52.0	10.0	0.0	Horz	PK	-59.1	7.0	60.2	-53.2	Ant perp to GND and para to EUT, EUT Vert
0.024	47.2	13.7	1.0	217.0	10.0	0.0	Vert	PK	-59.1	1.9	60.1	-58.3	Ant para to GND and perp to EUT, EUT Horz
0.024	43.6	13.7	1.0	198.0	10.0	0.0	Vert	PK	-59.1	-1.8	60.0	-61.8	Ant para to GND and perp to EUT, EUT Vert
0.020	43.0	14.0	1.0	231.0	10.0	0.0	Horz	PK	-59.1	-2.1	61.5	-63.6	Ant perp to GND and perp to EUT, EUT Vert

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

Powered on and transmitting Test3 RegularMode Data CW Depth 25Hz

Powered on and transmitting Test2 RegularMode Data CW Depth 30Hz

Powered on and transmitting Test1 CW Data CW Depth

POWER SETTINGS INVESTIGATED

3.0 VDC

CONFIGURATIONS INVESTIGATED

DIGC0204 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency	10 kHz	Stop Frequency	490 kHz
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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
Cable	None	10m Test Distance Cable	EVL	5/11/2015	12 mo
Antenna, Loop	EMCO	6502	AOA	6/24/2014	24 mo
Spectrum Analyzer	Agilent	E4443A	AFB	3/17/2015	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 antennas to be used with the EUT were tested. The EUT was continuously transmitting while set to the channel specified.

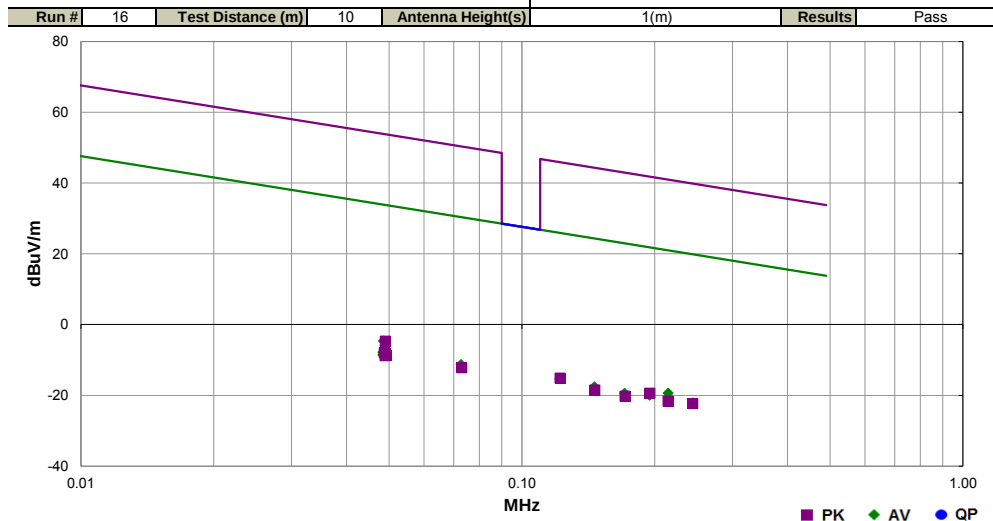
Per ANSI C63.10 sections 6.4.4.1 and 6.4.4.2, the emissions from the EUT were maximized by rotating the EUT on the turntable. Also, the EUT and/or associated antenna was positioned in 3 orthogonal planes. A calibrated active loop antenna was used for this test in order to provide sufficient measurement sensitivity per section 4.5.1. The center of the loop antenna was maintained at 1m above the ground plane during the testing.

For measurements below 30 MHz, as outlined in 15.209(e) and 15.31(f)(2), measurements may be performed at a distance closer than what is specified with the limit. The limit at the specified distance is shown on the data sheet. Measurements are made at a closer distance and the data is adjusted using a distance correction factor of 40dB/decade for comparison to the limit. Per FCC 15.33(a)(4), measurements were taken up to the highest frequency range of either the 10th harmonic of the fundamental or the applicable digital frequency test range.

If there are no detectable emissions above the noise floor, the data included will show noise floor measurements for reference only.

Work Order:	DIGC0204	Date:	07/28/15	
Project:	None	Temperature:	22 °C	
Job Site:	EV11	Humidity:	41% RH	
Serial Number:	90000410	Barometric Pres.:	1023.8 mbar	
EUT:	BTW, BTP			
Configuration:	1			
Customer:	Digital Control Incorporated			
Attendees:	None			
EUT Power:	3.0 VDC			
Operating Mode:	Powered on and transmitting			
Deviations:	None			
Comments:	Please see data comments for transmitter settings, EUT orientation and antenna orientation.			

Test Specifications	Test Method
FCC 15.209:2015	ANSI C63.10:2013

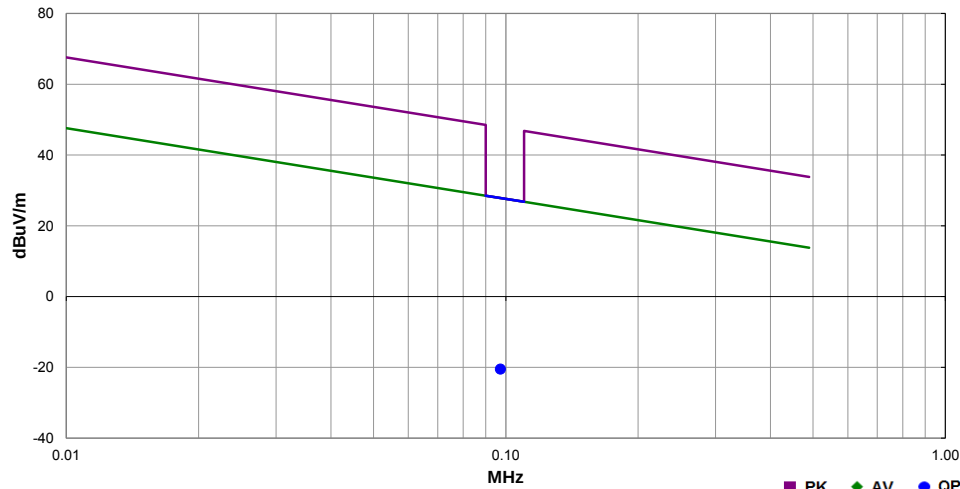


Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
0.049	43.2	11.3	1.0	20.0	10.0	0.0	See Comments	AV	-59.1	-4.6	33.9	-38.5	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.215	29.6	10.1	1.0	72.0	10.0	0.0	See Comments	AV	-59.1	-19.4	21.0	-40.4	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.049	41.1	11.2	1.0	217.0	10.0	0.0	See Comments	AV	-59.1	-6.8	33.8	-40.6	Ant perp to gnd/Ant para EUT, EUT vert, Regular data, CW depth 25Hz
0.122	33.5	10.3	1.0	157.0	10.0	0.0	See Comments	AV	-59.1	-15.3	25.9	-41.2	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.049	40.2	11.2	1.0	19.0	10.0	0.0	See Comments	AV	-59.1	-7.7	33.8	-41.5	Ant perp to gnd/Ant para EUT, EUT on side, Regular data, CW depth 25Hz
0.073	37.1	10.7	1.0	365.0	10.0	0.0	See Comments	AV	-59.1	-11.3	30.3	-41.7	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.048	40.0	11.3	1.0	286.0	10.0	0.0	See Comments	AV	-59.1	-7.8	33.9	-41.7	Ant para to gnd/Ant perp EUT, EUT vert, Regular data, CW depth 25Hz
0.195	29.0	10.1	1.0	274.0	10.0	0.0	See Comments	AV	-59.1	-20.0	21.8	-41.8	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.049	39.8	11.2	1.0	105.0	10.0	0.0	See Comments	AV	-59.1	-8.1	33.8	-41.9	Ant para to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.146	31.3	10.2	1.0	138.0	10.0	0.0	See Comments	AV	-59.1	-17.6	24.3	-41.9	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.244	26.9	10.1	1.0	176.0	10.0	0.0	See Comments	AV	-59.1	-22.1	19.9	-42.0	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.171	29.5	10.2	1.0	58.0	10.0	0.0	See Comments	AV	-59.1	-19.4	23.0	-42.4	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.048	39.3	11.3	1.0	145.0	10.0	0.0	See Comments	AV	-59.1	-8.5	33.9	-42.4	Ant perp to gnd/Ant para EUT, EUT vert, Regular data, CW depth 25Hz
0.049	43.2	11.2	1.0	20.0	10.0	0.0	See Comments	PK	-59.1	-4.7	53.8	-58.5	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.122	33.7	10.3	1.0	157.0	10.0	0.0	See Comments	PK	-59.1	-15.1	45.9	-61.0	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.195	29.6	10.1	1.0	274.0	10.0	0.0	See Comments	PK	-59.1	-19.4	41.8	-61.2	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.049	39.9	11.2	1.0	19.0	10.0	0.0	See Comments	PK	-59.1	-8.0	53.8	-61.8	Ant perp to gnd/Ant para EUT, EUT on side, Regular data, CW depth 25Hz
0.049	39.8	11.2	1.0	105.0	10.0	0.0	See Comments	PK	-59.1	-8.1	53.8	-61.9	Ant para to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.244	26.7	10.1	1.0	176.0	10.0	0.0	See Comments	PK	-59.1	-22.3	39.9	-62.2	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.049	39.2	11.2	1.0	217.0	10.0	0.0	See Comments	PK	-59.1	-8.7	53.7	-62.4	Ant perp to gnd/Ant para EUT, EUT vert, Regular data, CW depth 25Hz
0.049	39.2	11.2	1.0	286.0	10.0	0.0	See Comments	PK	-59.1	-8.7	53.8	-62.5	Ant para to gnd/Ant perp EUT, EUT vert, Regular data, CW depth 25Hz
0.073	36.2	10.7	1.0	365.0	10.0	0.0	See Comments	PK	-59.1	-12.2	50.3	-62.5	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.049	39.1	11.2	1.0	145.0	10.0	0.0	See Comments	PK	-59.1	-8.8	53.8	-62.6	Ant perp to gnd/Ant perp EUT, EUT vert, Regular data, CW depth 25Hz
0.214	27.4	10.1	1.0	72.0	10.0	0.0	See Comments	PK	-59.1	-21.6	41.0	-62.6	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.146	30.4	10.2	1.0	138.0	10.0	0.0	See Comments	PK	-59.1	-18.5	44.3	-62.8	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz
0.171	28.7	10.2	1.0	58.0	10.0	0.0	See Comments	PK	-59.1	-20.2	42.9	-63.2	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz

Work Order:	DIGC0204	Date:	07/28/15		
Project:	None	Temperature:	22 °C		
Job Site:	EV11	Humidity:	41% RH		
Serial Number:	90000410	Barometric Pres.:	1023.8 mbar	Tested by:	Cole Ghizzone
EUT:	BTW, BTP				
Configuration:	1				
Customer:	Digital Control Incorporated				
Attendees:	None				
EUT Power:	3.0 VDC				
Operating Mode:	Powered on and trasmtting				
Deviations:	None				
Comments:	Please see data coments for transmitter settings, EUT orientation and antenna orientation.				

Test Specifications	Test Method
FCC 15.209:2015	ANSI C63.10:2013

Run #	16	Test Distance (m)	10	Antenna Height(s)	1(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
0.097	28.2	10.4	1.0	198.0	10.0	0.0	See Comments	QP	-59.1	-20.5	27.8	-48.3	Ant perp to gnd/Ant perp EUT, EUT on side, Regular data, CW depth 25Hz