NORTHWEST EMC

Bluerail Trains LLC

BCWv4

Report # BLTR0005

NVLAP TESTING

NVLAP Lab Code: 200630-0

CERTIFICATE OF TEST

NORTHWEST EMC
2014-12-10

Last Date of Test: July 19, 2016
Bluerail Trains LLC
Model: BCWv4

Immunity

Standards

Specification	Method
EN 55024:2010	IEC 61000-4-2:2008
	IEC 61000-4-3:2010
	IEC 61000-4-4:2012
	IEC 61000-4-5:2014
	IEC 61000-4-6:2013
	IEC 61000-4-8:2009
	IEC 61000-4-11:2004

Results

Test Description	Performance Criteria			Comments
	Applied	Standard Specified	Observed Criteria	
Electrostatic Discharge (ESD)	Yes	B	A	
Radiated Immunity	Yes	B	A	
Electrical Fast Transients and Bursts (EFT)	Yes	B	A	
Surge	No	B	N/A	Not requested.
Conducted Immunity	Yes	B	A	
Magnetic Field Immunity	Yes	A	A	
Voltage Interruptions	No	C	N/A	Not requested.
Voltage Dips	No	B/C	N/A	Not requested.

Details on the application of the performance criteria, as well as any manufacturer provided performance criteria or acceptable degradation of performance, are all contained within the report.

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.

CERTIFICATE OF TEST

NORTHWEST EMC
2014-12-10

Last Date of Test: July 19, 2016
Bluerail Trains LLC
Model: BCWv4

Radio Equipment Testing

Standards

Specification	Method
EN 301 489-17 V2.2.1:2012	EN 301 489-01 V1.9.2:2011

Results

Reference Clause	Test Description	Performance Criteria			Comments
		Applied	Standard Specified	Observed Criteria	
9.2	Radiated Immunity	Yes	B	A	
9.3	Electrostatic Discharge (ESD)	Yes	B	A	
9.4	Electrical Fast Transients and Bursts (EFT)	Yes	B	A	
9.5	Conducted Immunity	Yes	B	A	
9.7	Voltage Interruptions	No	C	N/A	Not requested.
9.7	Voltage Dips	No	B/C	N/A	Not requested.
9.8	Surge	No	B	N/A	Not requested.

Details on the application of the performance criteria, as well as any manufacturer provided performance criteria or acceptable degradation of performance, are all contained within the report.

Deviations From Test Standards

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

NORTHWEST EMC
REV 2014.10.14

Revision Number	Description	Date	Page Number
00	None		

ACCREDITATIONS AND AUTHORIZATIONS

NORTHWEST EMC
REV 2016.3.22

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 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

EXPLANATION OF NWEMC PERFORMANCE CRITERIA

REV 2014.10.08

How Important Is It To Understand Performance Criteria?

It is the responsibility of the test laboratory to observe the performance of the equipment under test (EUT) and to accurately report those results. The manufacturer has the obligation to express the performance criteria in terms which relate to the performance of his specific product when used as intended. As the responsible party (manufacturer, importer, etc) one must take those results, compare them against the specifications and standards, then, if appropriate make a declaration of conformity.

Examples of functions defined by the manufacturer to be evaluated during testing include, but are not limited to, the following:

- essential operational modes and states;
- tests of all peripheral access (hard disks, floppy disks, printers, keyboard, mouse, etc.);
- quality of software execution;
- quality of data display and transmission;
- quality of speech transmission.

The variety and the diversity of the apparatus within the scope of the EMC Directive make it difficult to define precise criteria for the evaluation of the immunity test results for every product. If we are not provided a test plan documenting the expected performance criteria and acceptable degradation of performance, we will use the following:

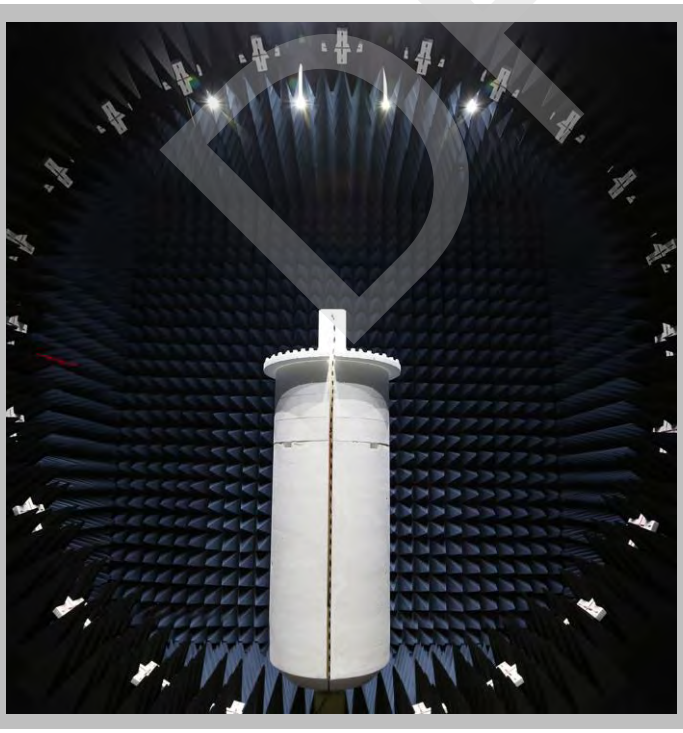
- Performance Criteria A
  - The EUT exhibited no change in performance when operating as specified by the manufacturer. In this case no changes were observed during the test.
- Performance Criteria B
  - The EUT exhibited a change in performance when operating as specified by the manufacturer. In this case the equipment returned to previous operation without any operator intervention, once the test stimulus was removed.
- Performance Criteria C
  - The EUT exhibited a change in performance when operating as specified by the manufacturer. In this case the equipment required some operator intervention in order to return to previous operation.
- Performance Criteria D
  - The EUT exhibited a change in performance when operating as specified by the manufacturer. In this case the equipment appears to have been damaged and would not recover.

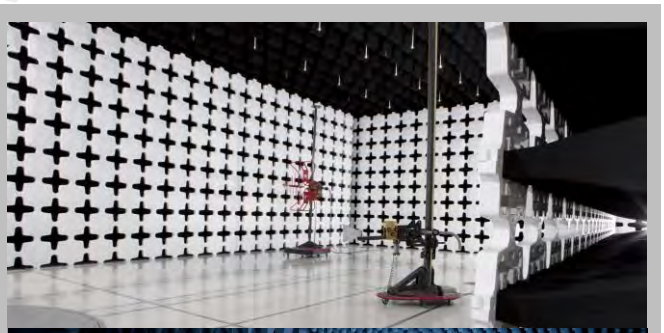
If we are provided a test plan or information detailing the precise criteria for evaluating the test results, we will use that information and reference it as part of the test data.

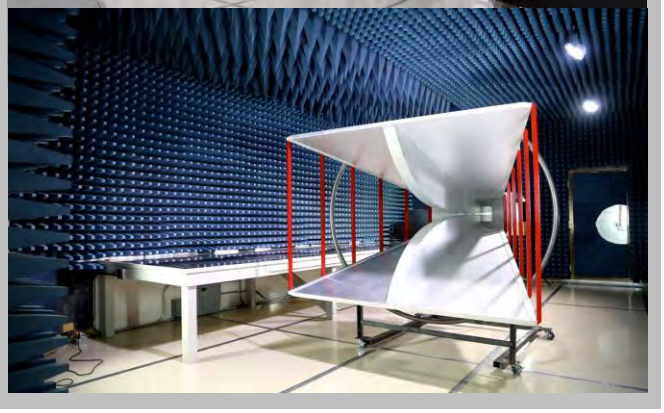
FACILITIES

NORTHWEST EMC
REV 2015.2.19

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
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/RRA, MIC, MOC, NCC, OFCA					
US0158	US0175	N/A	US0017	US0191	US0157







PRODUCT DESCRIPTION

NORTHWEST EMC
2014-12-10

Client and Equipment Under Test (EUT) Information

Company Name:	Bluerail Trains LLC
Address:	25 NW 23rd PL STE 6 PMB 181
City, State, Zip:	Portland, OR 97210-5599
Test Requested By:	Pete Skeggs
Model:	BCWv4
First Date of Test:	July 11, 2016
Last Date of Test:	July 19, 2016
Receipt Date of Samples:	July 11, 2016
Equipment Design Stage:	Production
Equipment Condition:	No Damage

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Bluetooth low energy module

Highest frequency generated or used in the device:
Assumes > 108 MHz and < 1 GHz

Testing Objective:
Provide the specific EMC testing requested by the customer.

EUT Photo

CONFIGURATIONS

NORTHWEST EMC 2014-12-10

Configuration BLTR0005- 1

Software/Firmware Running during test	
Description	**Version**
E-Z App Train Control	None

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
BLE Model Train Control Module	Bluerail Trains LLC	BCWv4	None

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Locomotive Simulator	Bluerail Trains LLC	None	None
Toy Transformer	SANDAN	SPA1601000WU	None

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
iPad Tablet	Apple	A1432	F4MK1D1WF193

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
DC Power Cable	No	1.9m	No	Toy Transformer	Locomotive Simulator

CONFIGURATIONS

NORTHWEST EMC 2014-12-10

Configuration BLTR0005- 2

Software/Firmware Running during test	
Description	**Version**
E-Z App Train Control	None

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Coal Tender Train with BLE Control Module Installed	Bluerail Trains LLC	ALCO 2-6-0 STEAM LOCO	Item: 51704

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Toy Transformer	SANDAN	SPA1601000WU	None
Track (Power Segment)	Bluerail Trains LLC	HO 18' R Terminal Rerailer	H4402A2-2
Standard Track x 4	Bluerail Trains LLC	E-Z Track HO 18'R 30	H4401B3-2

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
iPad Tablet	Apple	A1432	F4MK1D1WF193

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Power Segment Adapter Cable	No	0.04m	No	DC Power Cable	Track (Power Segment)
DC Power Cable	No	1.9m	No	Toy Transformer	Power Segment Adapter Cable

MODIFICATIONS

NORTHWEST EMC
2014-12-10

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	7/11/2016	Radiated Immunity	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	7/11/2016	Conducted Immunity	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	7/11/2016	Magnetic Field Immunity	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	7/11/2016	Electrical Fast and Transient Bursts	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Northwest EMC following the test.
5	7/19/2016	Electrostatic Discharge	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

ELECTROSTATIC DISCHARGE (ESD)

WTD.2016.05.18

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, the ESD Immunity test was performed according to the test method and the product related standard(s) listed on the data sheets. If called out, contact discharges were applied to the conductive accessible surfaces of the EUT and the coupling plane(s). If called out, air discharges were applied to accessible insulating surfaces and conductive non-accessible portions of accessible parts of the EUT as required by the product related standard. The number of discharges specified on the data sheets applies to each test voltage, preselected point, and each polarity (ie 25 at +4 kV and 25 at -4 kV). If the EUT was tested with a vertical coupling plane, testing on all four sides (front, back, left, right) was performed unless otherwise noted. The pictures depict one of those orientations. For devices isolated from protective earth, a resistor network was used to drain residual charges between ESD pulses, and where allowable by the standard, additional time greater than one second may have been used between discharges. If a response was detected after discharge, the type of response, discharge level, and location were noted.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
ESD Gun	703-777	NSG-437-AUTO	IGU	6/2/2016	12/2/2016

CONFIGURATIONS INVESTIGATED

BLTR0005-2

MODES INVESTIGATED

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor idle. Lights on.

ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

EUT:	BCWv4	Work Order:	BLTR0005
Serial Number:	None	Date:	07/19/2016
Customer:	Bluerail Trains LLC	Temperature:	23.9°C
Attendees:	None	Relative Humidity:	46.6%
Customer Project:	None	Bar. Pressure:	1011.6 mbar
Tested By:	Luke Richardson	Job Site:	EV03
Power:	110VAC/60Hz		

TEST SPECIFICATIONS

Specification:	Method:
EN 55024:2010	IEC 61000-4-2:2008

TEST PARAMETERS

Energy Storage Capacitor:	150pf	Discharge Resistance:	330 ohms
Polarity of Output Voltage:	Positive and Negative	Time Between Successive Discharges:	>= 1 sec

COMMENTS

Provided AC/DC Adapter (Toy Transformer) operates at 110VAC/60Hz only.

EUT OPERATING MODES

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor idle. Lights on.

DEVIATIONS FROM TEST STANDARD

None

EUT FUNCTIONS MONITORED

Ran train forwards and backwards after each ESD discharge. Monitored train lights for any change in state and toggled the lights on and off after each discharge. Verified a continuous Bluetooth Connection.

TEST RESULT

See the following data sheets.

CONCLUSION

Meets NWEMC Performance Criteria	A

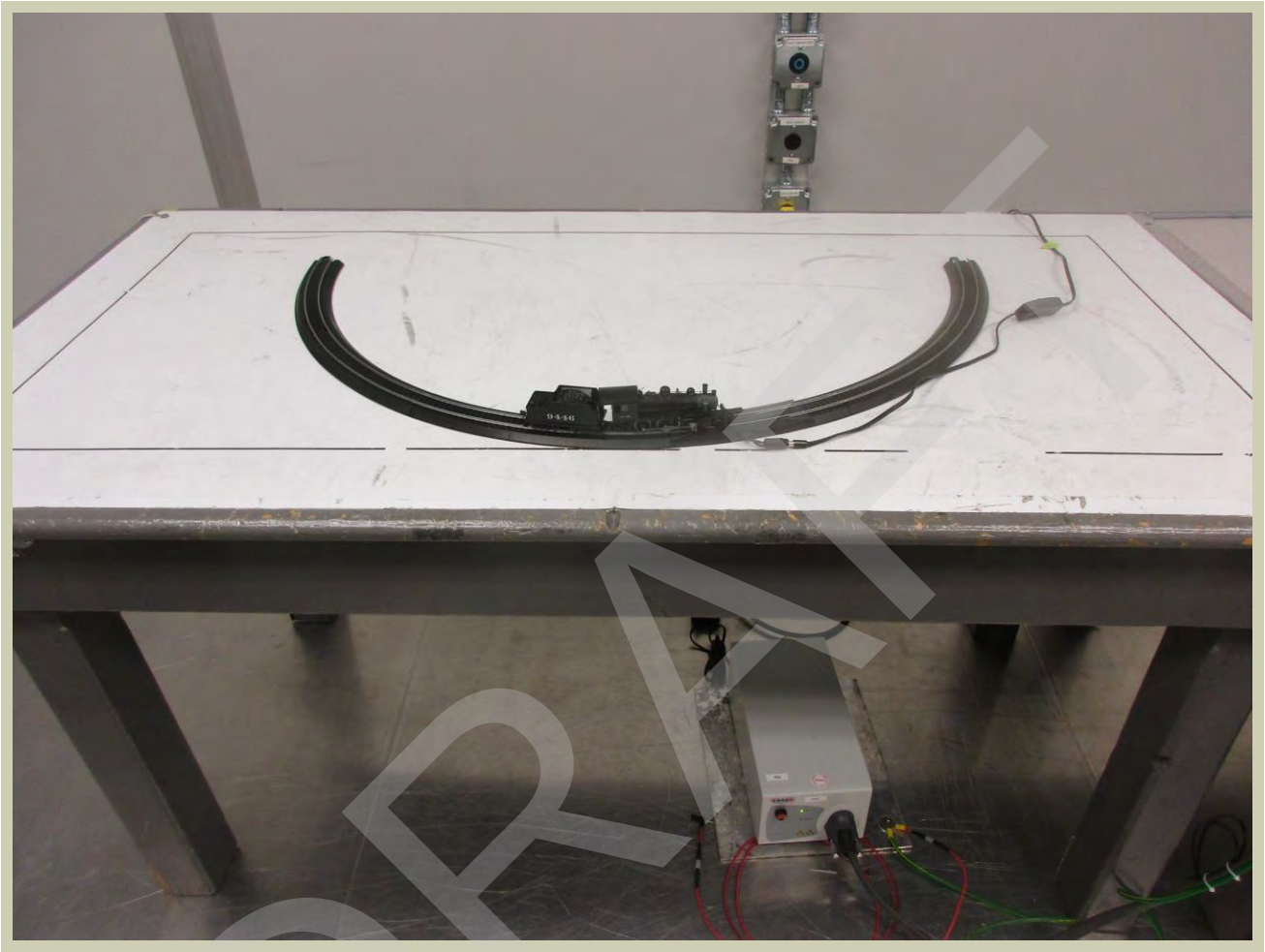
The EUT exhibited no change in performance when operating as specified by the manufacturer.

Tested By

ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

SETUP PHOTO



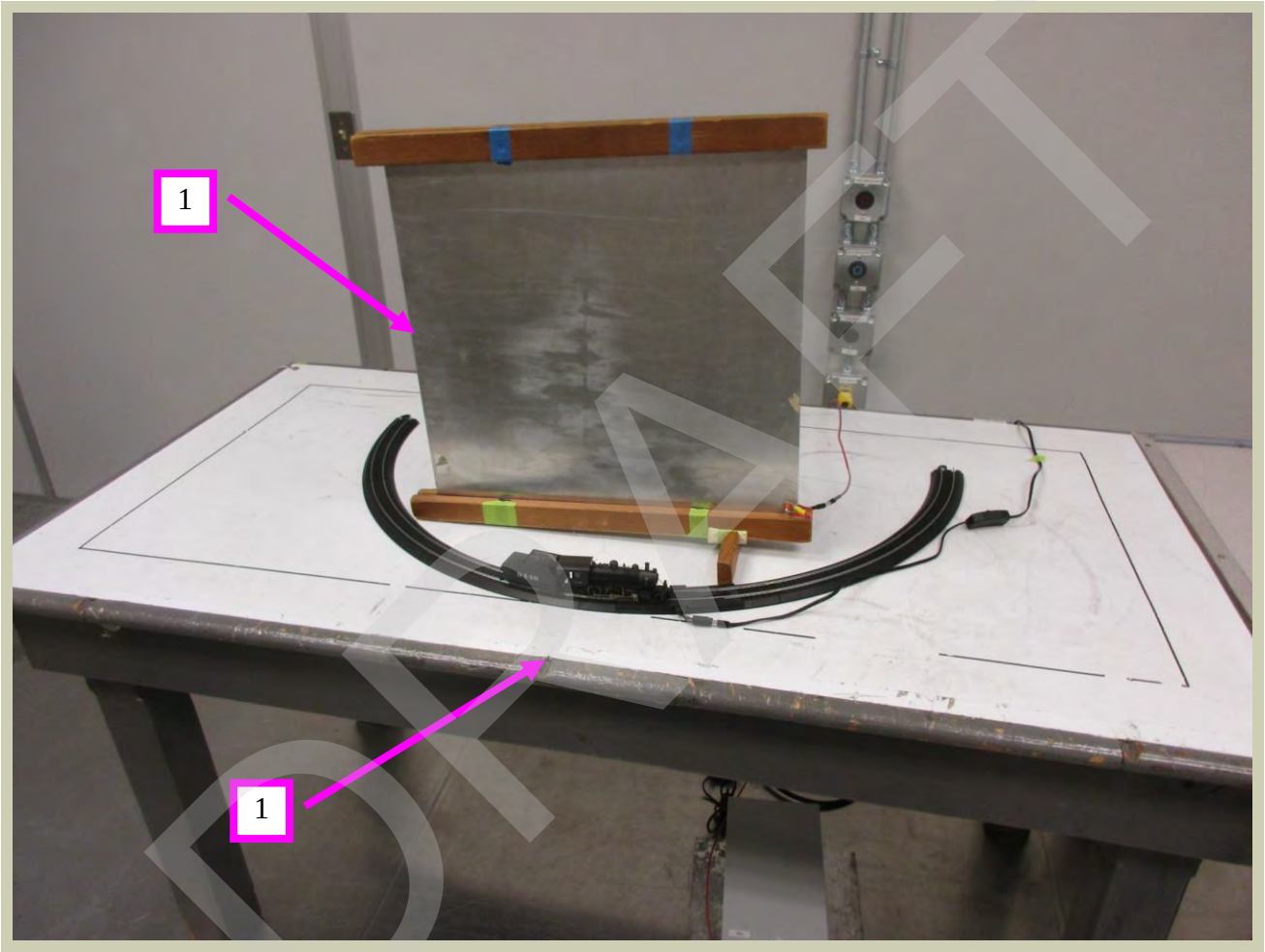
ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

CONTACT DISCHARGE – OBSERVATIONS

ESD Test Level (kV)	+/- 4
Number of Discharges, Each Polarity	25

Configuration:	BLTR0005-2



OBSERVATIONS (See Arrows)

Arrow No.	Voltage	Observation
1	All	No Phenomena Observed

Notes: The arrow colors have no meaning. For test points with observation notes, it is implied that no phenomena were observed at all other test levels (voltages, polarities) except what is noted.

ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

CONTACT DISCHARGE – OBSERVATIONS

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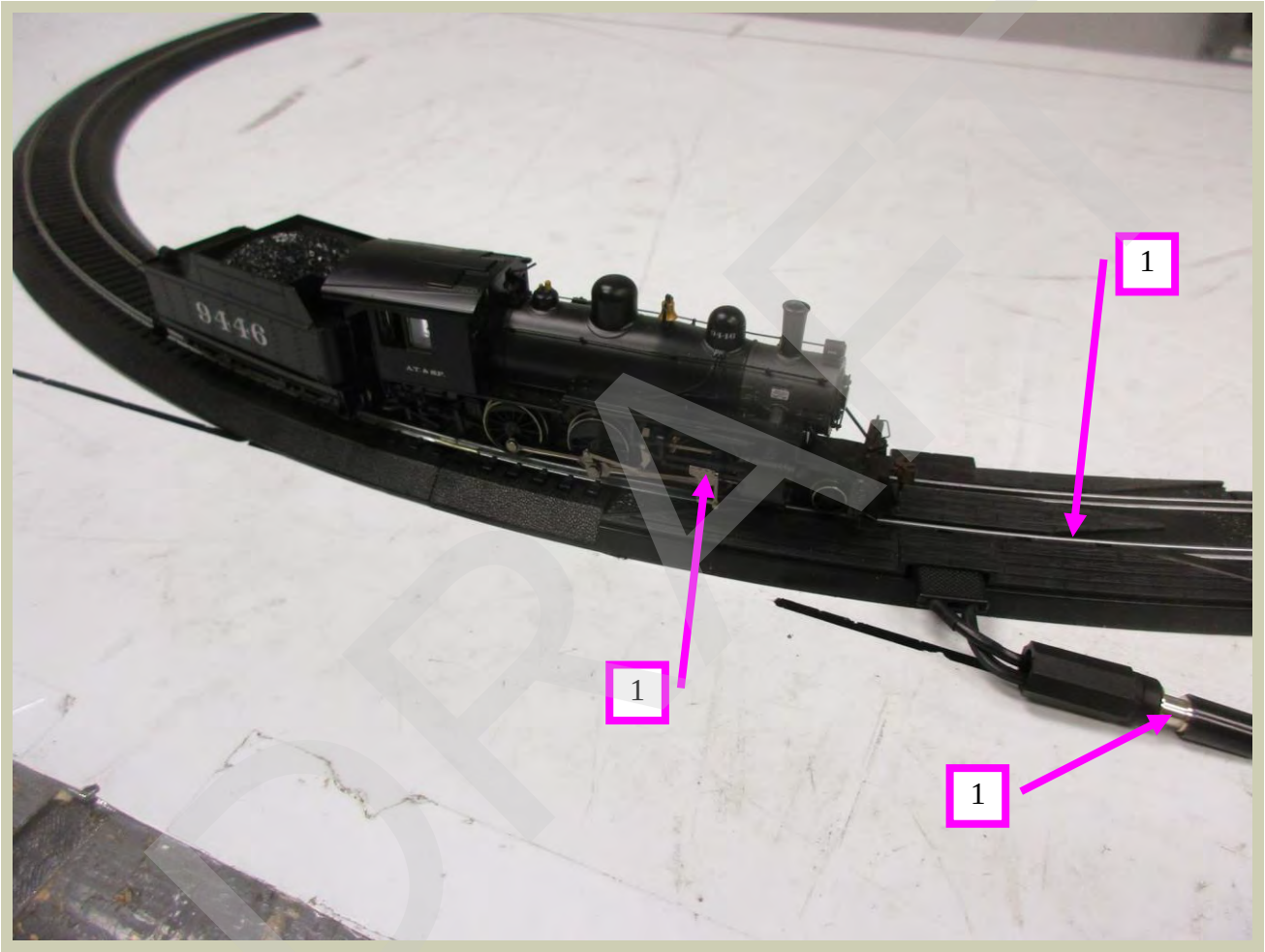

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ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

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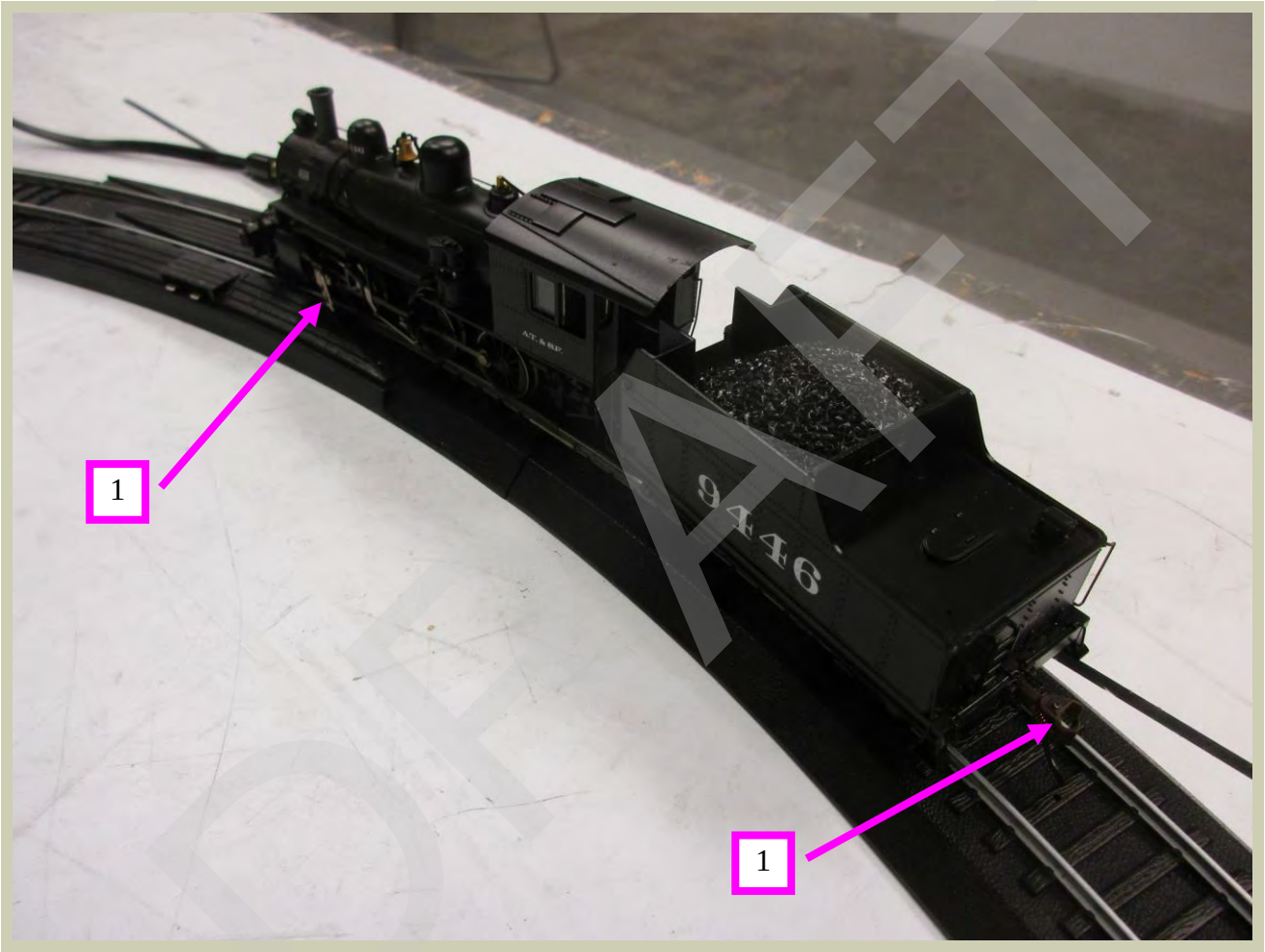

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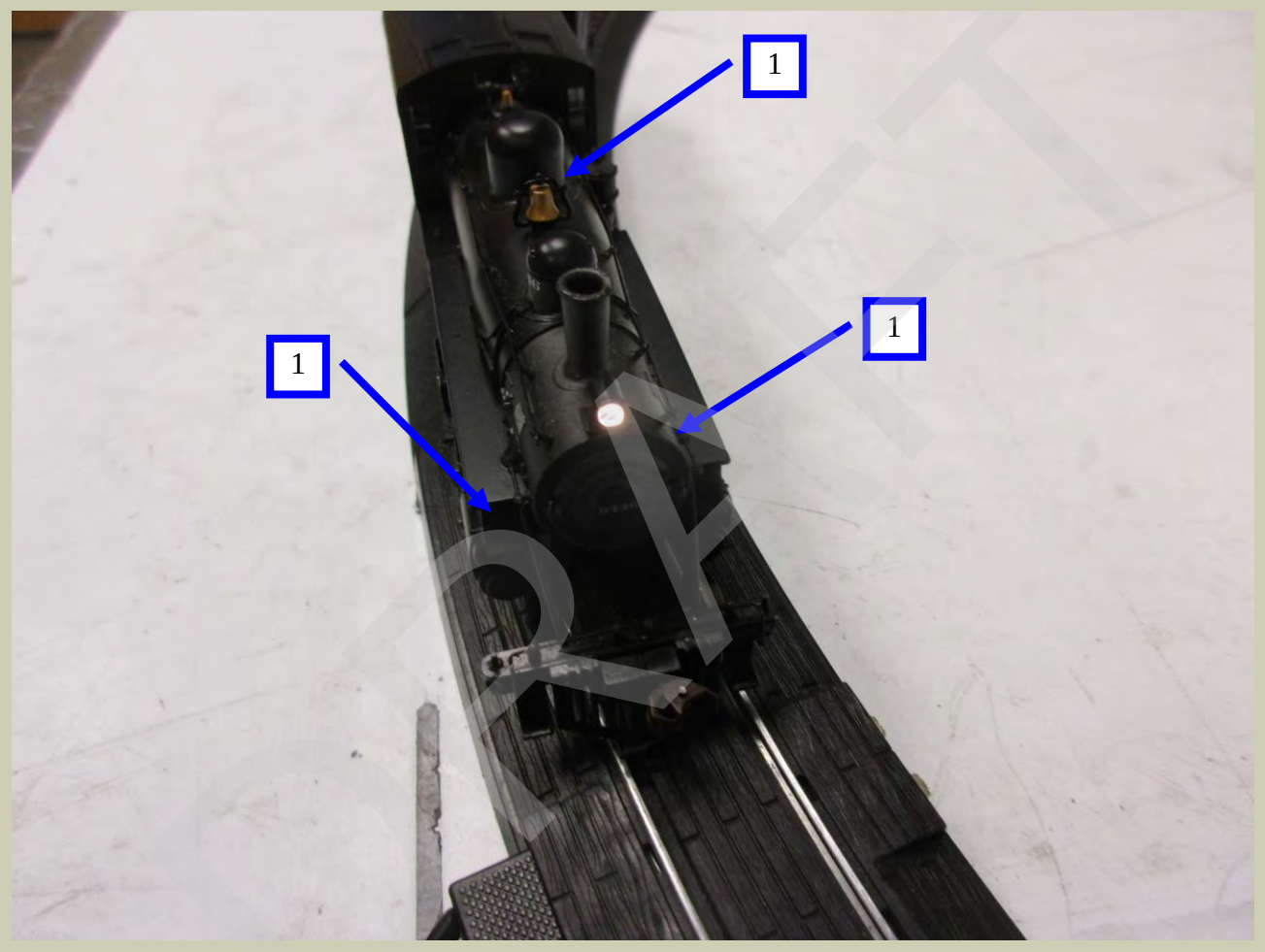
ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

AIR DISCHARGE – OBSERVATIONS

ESD Test Level (kV)	+/- 2	+/- 4	+/- 8
Number of Discharges, Each Polarity	10	10	10

Configuration:	BLTR0005-2



OBSERVATIONS (See Arrows)

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ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

AIR DISCHARGE – OBSERVATIONS

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Number of Discharges, Each Polarity	10	10	10

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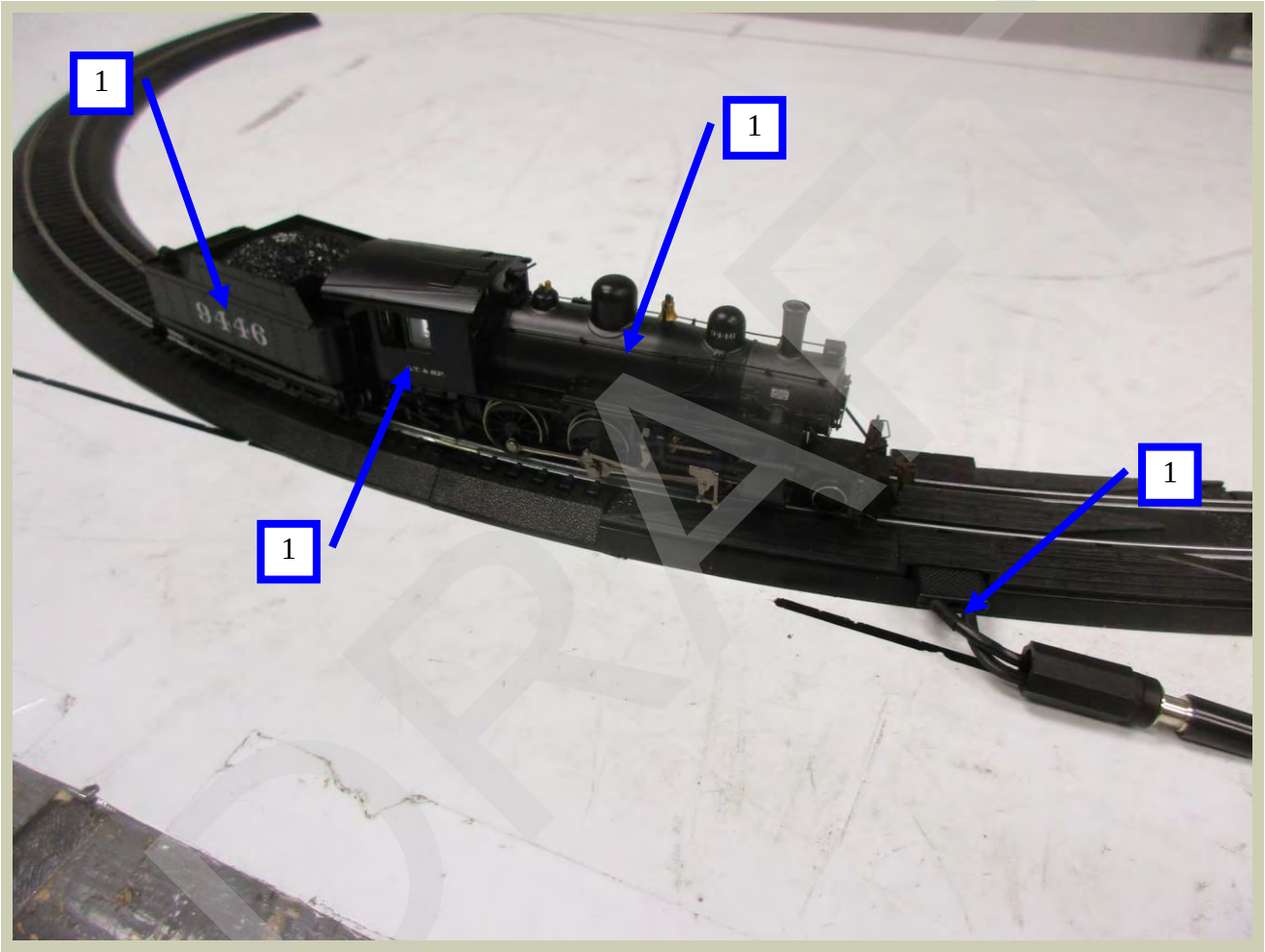

OBSERVATIONS (See Arrows)

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ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

AIR DISCHARGE – OBSERVATIONS

ESD Test Level (kV)	+/- 2	+/- 4	+/- 8
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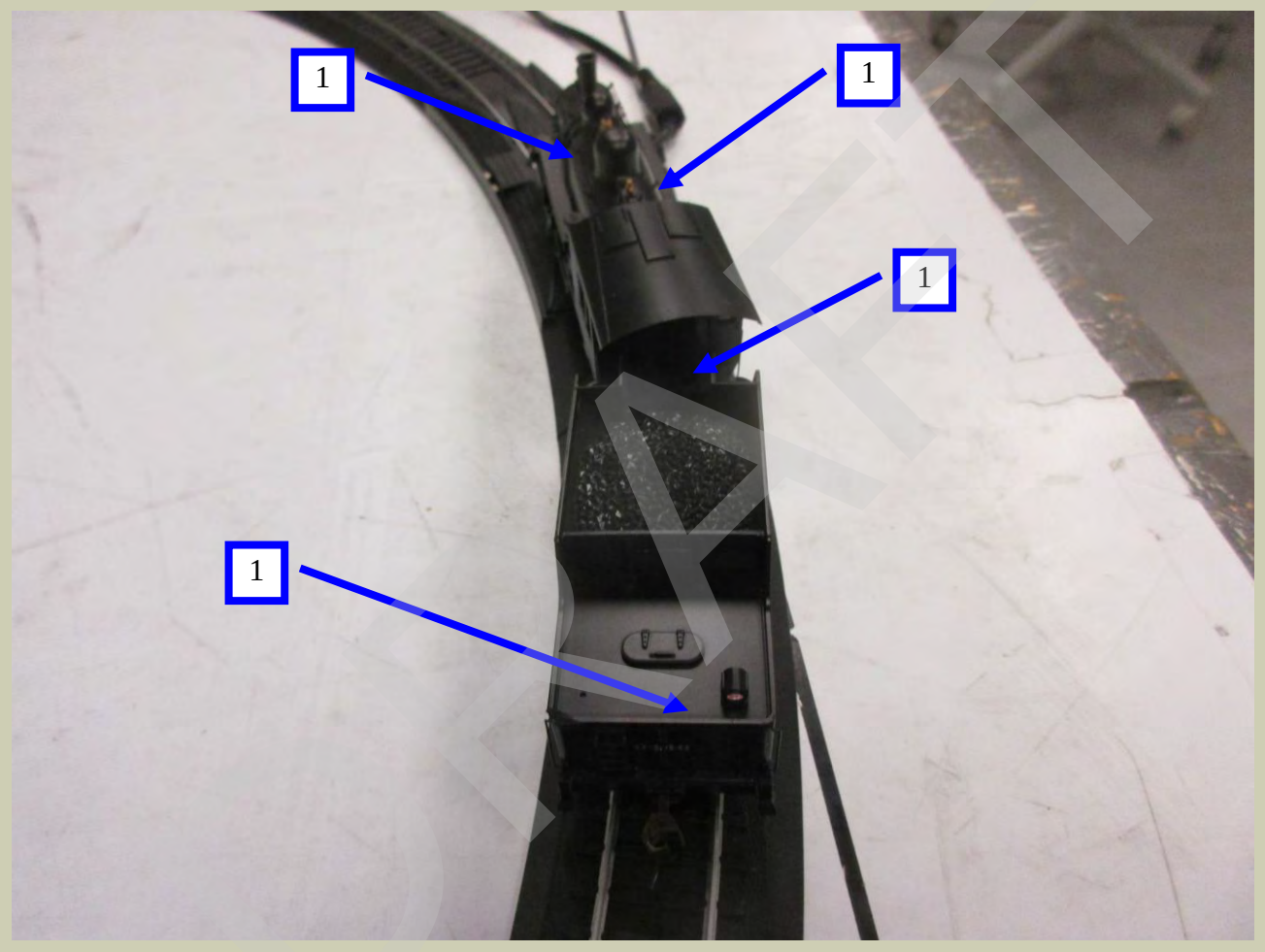

OBSERVATIONS (See Arrows)

Arrow No.	Voltage	Observation
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ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

TEST DESCRIPTION

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TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
ESD Gun	703-777	NSG-437-AUTO	IGU	6/2/2016	12/2/2016

CONFIGURATIONS INVESTIGATED

BLTR0005-2

MODES INVESTIGATED

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor idle. Lights on.

ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

EUT:	BCWv4	Work Order:	BLTR0005
Serial Number:	None	Date:	07/19/2016
Customer:	Bluerail Trains LLC	Temperature:	23.9°C
Attendees:	None	Relative Humidity:	46.6%
Customer Project:	None	Bar. Pressure:	1011.6 mbar
Tested By:	Luke Richardson	Job Site:	EV03
Power:	110VAC/60Hz		

TEST SPECIFICATIONS

Specification:	Method:
EN 301 489-17 V2.2.1:2012	EN 301 489-1 V1.9.2:2011

TEST PARAMETERS

Energy Storage Capacitor:	150pf	Discharge Resistance:	330 ohms
Polarity of Output Voltage:	Positive and Negative	Time Between Successive Discharges:	>= 1 sec

COMMENTS

Provided AC/DC Adapter (Toy Transformer) operates at 110VAC/60Hz only.

EUT OPERATING MODES

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor idle. Lights on.

DEVIATIONS FROM TEST STANDARD

None

EUT FUNCTIONS MONITORED

Ran train forwards and backwards after each ESD discharge. Monitored train lights for any change in state and toggled the lights on and off after each discharge. Verified a continuous Bluetooth Connection.

TEST RESULT

See the following data sheets.

CONCLUSION

Meets NWEMC Performance Criteria	A

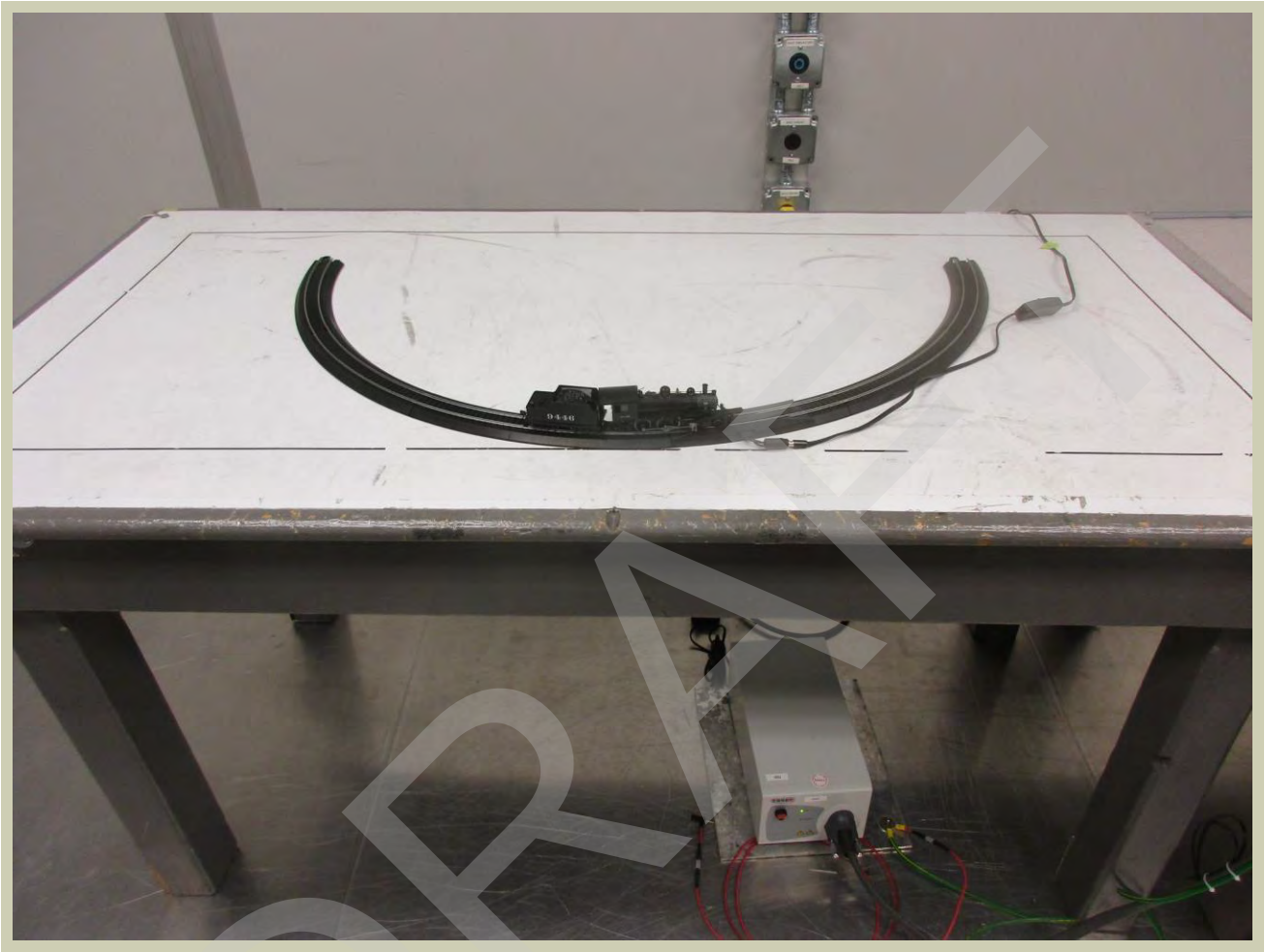
The EUT exhibited no change in performance when operating as specified by the manufacturer.

Tested By

ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

SETUP PHOTO



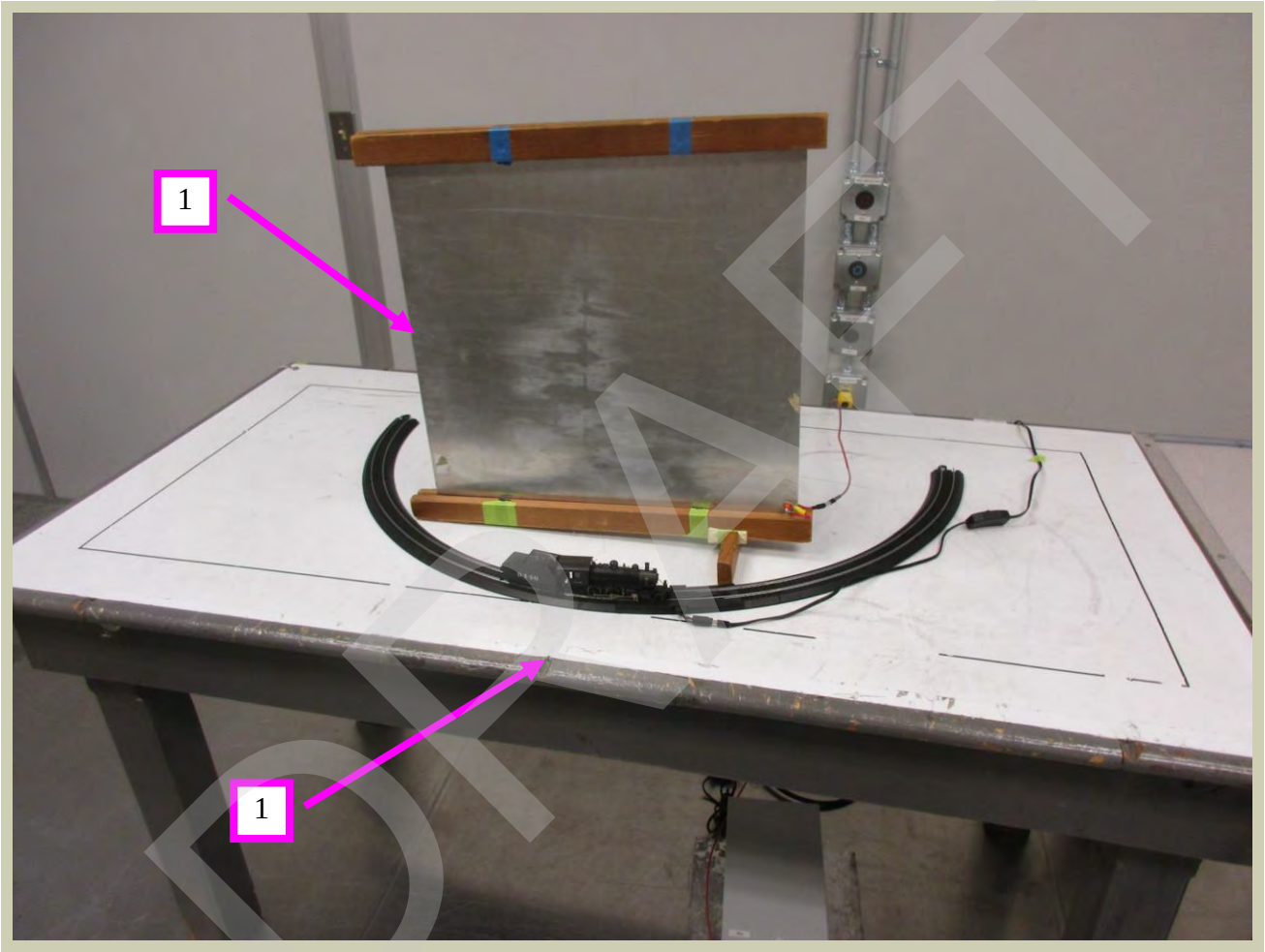
ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

CONTACT DISCHARGE – OBSERVATIONS

ESD Test Level (kV)	+/- 4
Number of Discharges, Each Polarity	10

Configuration:	BLTR0005-2



OBSERVATIONS (See Arrows)

Arrow No.	Voltage	Observation
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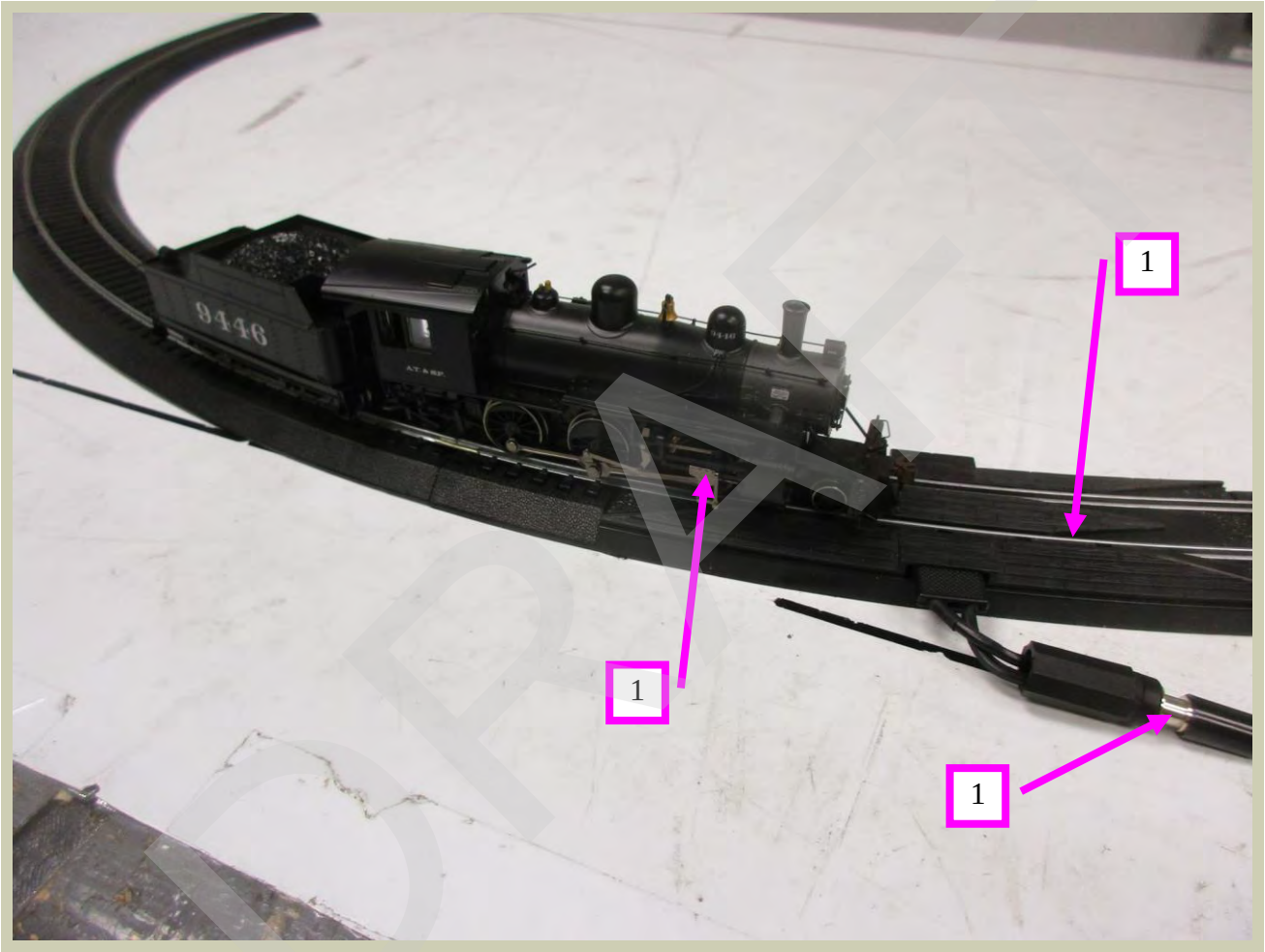
ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

CONTACT DISCHARGE – OBSERVATIONS

ESD Test Level (kV)	+/- 4
Number of Discharges, Each Polarity	10

Configuration:	BLTR0005-2



OBSERVATIONS (See Arrows)

Arrow No.	Voltage	Observation
1	All	No Phenomena Observed

Notes: The arrow colors have no meaning. For test points with observation notes, it is implied that no phenomena were observed at all other test levels (voltages, polarities) except what is noted.

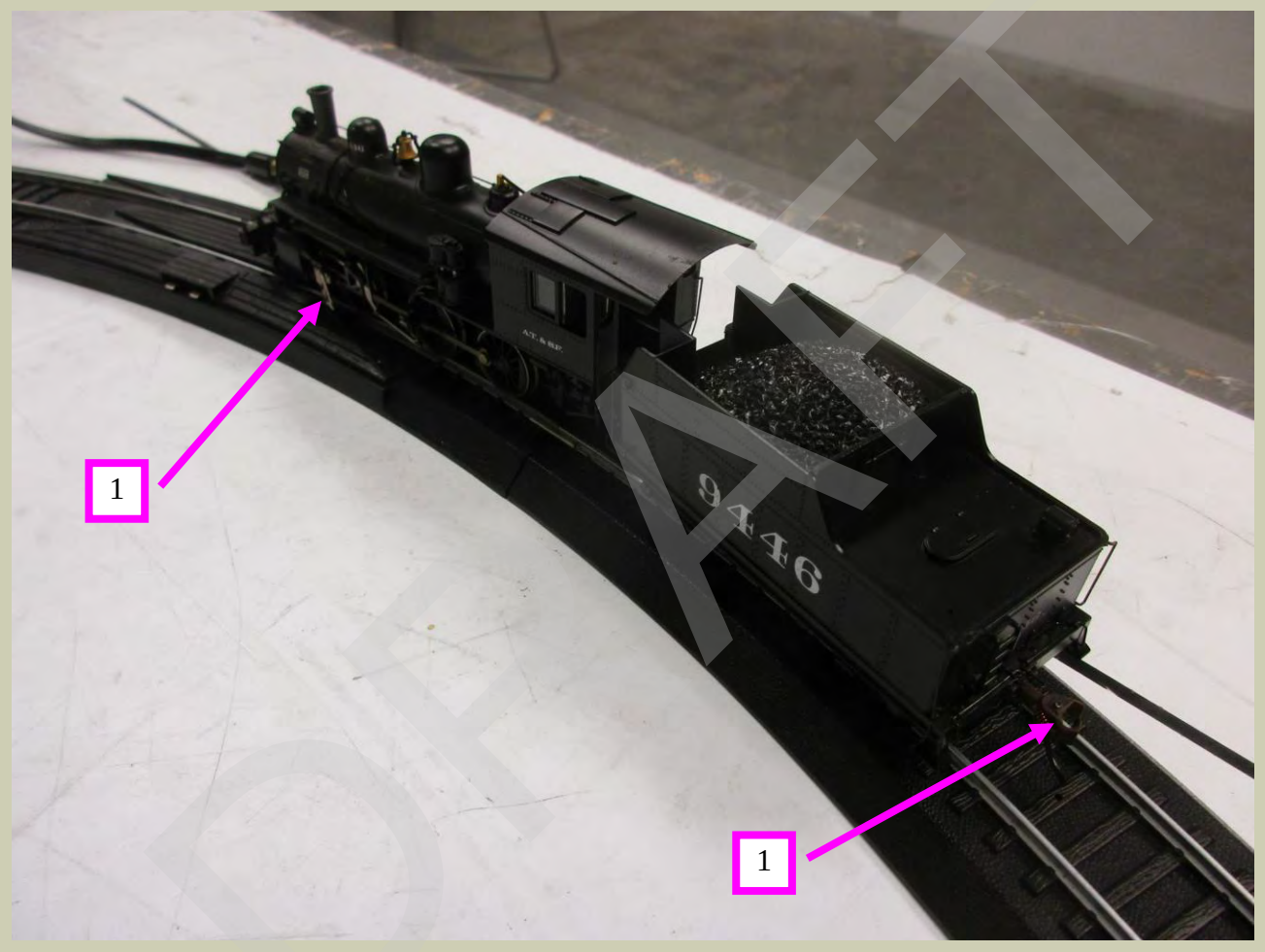
ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

CONTACT DISCHARGE – OBSERVATIONS

ESD Test Level (kV)	+/- 4
Number of Discharges, Each Polarity	10

Configuration:	BLTR0005-2



OBSERVATIONS (See Arrows)

Arrow No.	Voltage	Observation
1	All	No Phenomena Observed

Notes: The arrow colors have no meaning. For test points with observation notes, it is implied that no phenomena were observed at all other test levels (voltages, polarities) except what is noted.

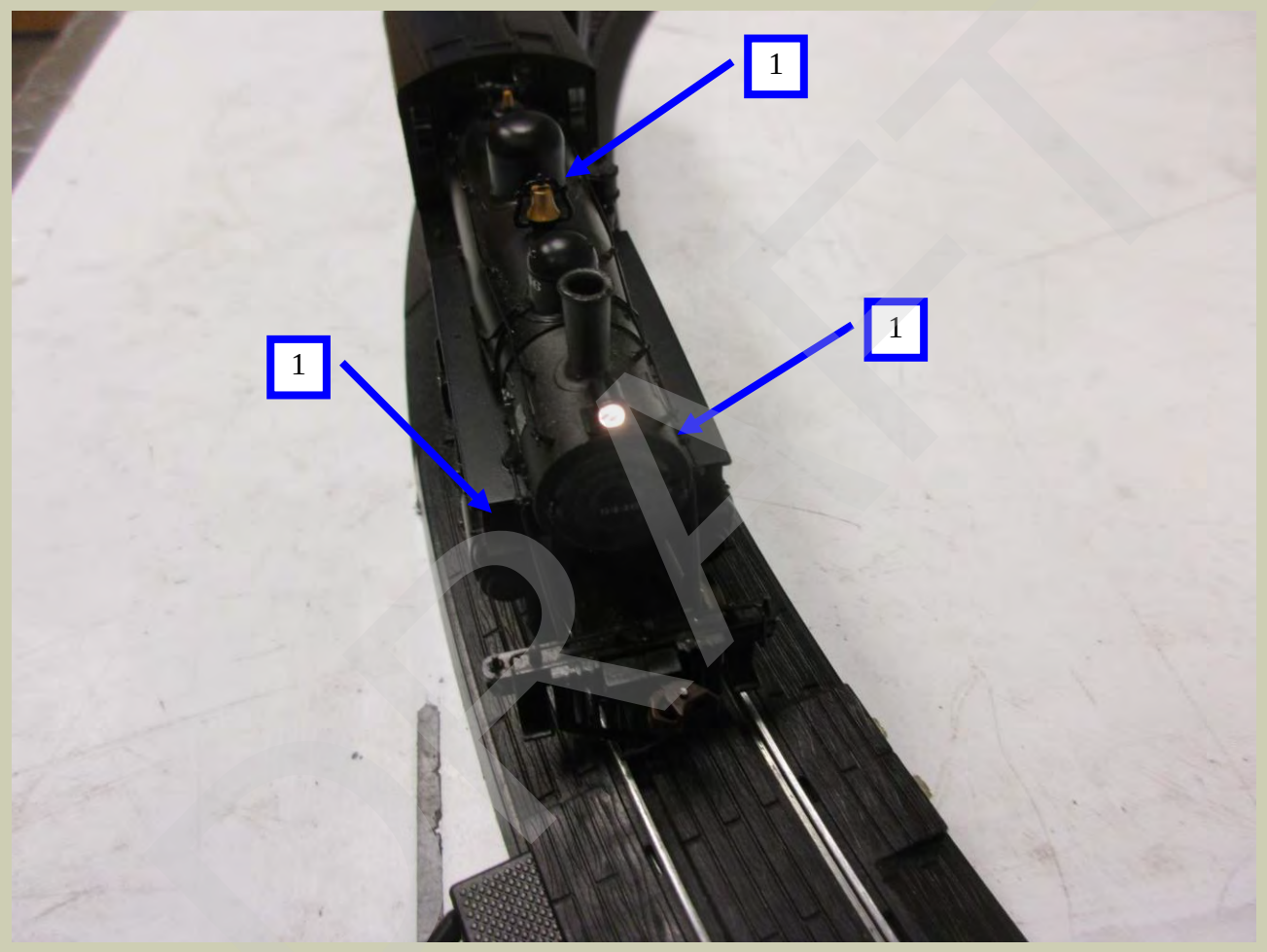
ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

AIR DISCHARGE – OBSERVATIONS

ESD Test Level (kV)	+/- 2	+/- 4	+/- 8
Number of Discharges, Each Polarity	10	10	10

Configuration:	BLTR0005-2



OBSERVATIONS (See Arrows)

Arrow No.	Voltage	Observation
1	All	No Phenomena Observed

Notes: The arrow colors have no meaning. For test points with observation notes, it is implied that no phenomena were observed at all other test levels (voltages, polarities) except what is noted.

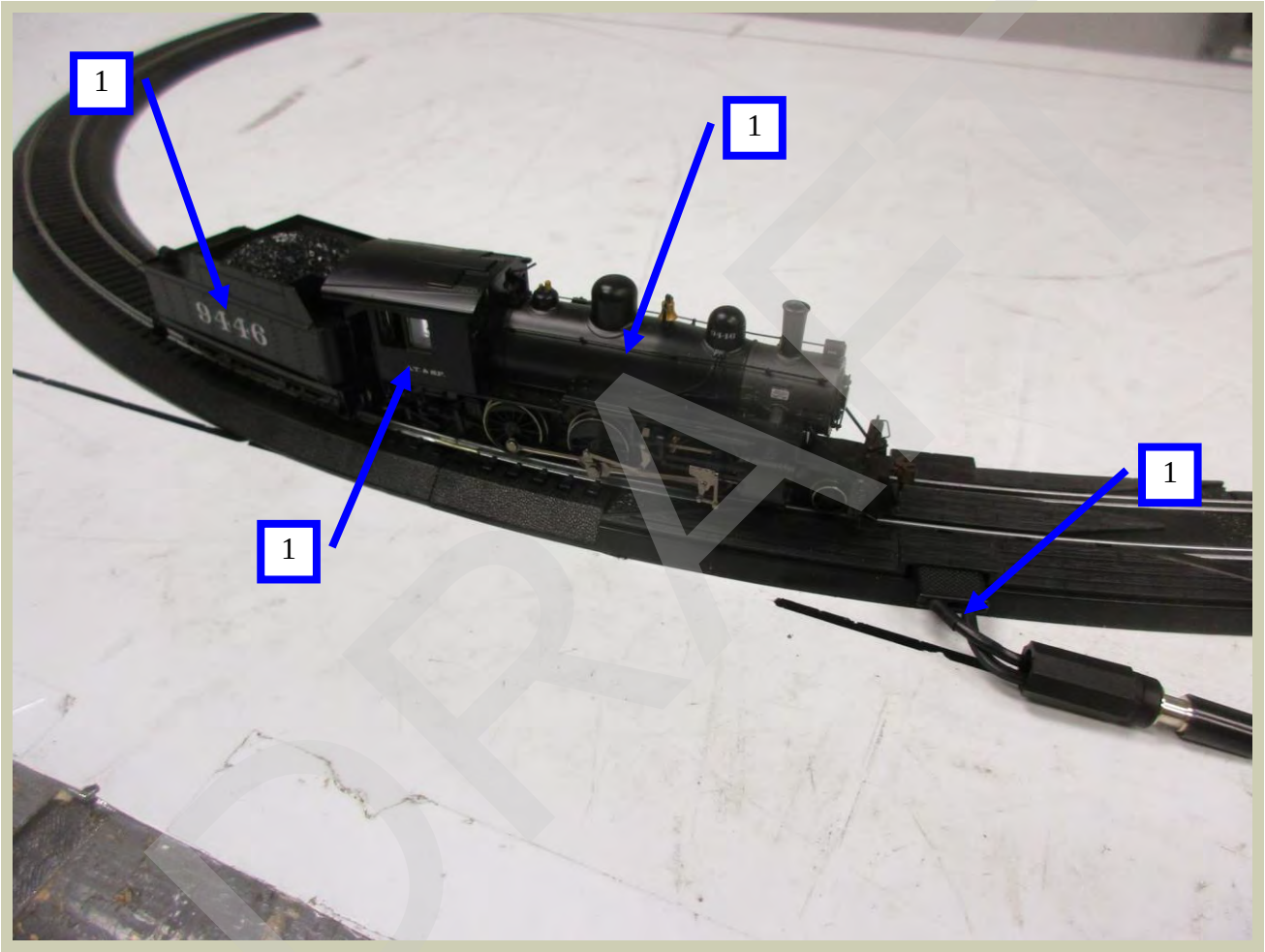
ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

AIR DISCHARGE – OBSERVATIONS

ESD Test Level (kV)	+/- 2	+/- 4	+/- 8
Number of Discharges, Each Polarity	10	10	10

Configuration:	BLTR0005-2



OBSERVATIONS (See Arrows)

Arrow No.	Voltage	Observation
1	All	No Phenomena Observed

Notes: The arrow colors have no meaning. For test points with observation notes, it is implied that no phenomena were observed at all other test levels (voltages, polarities) except what is noted.

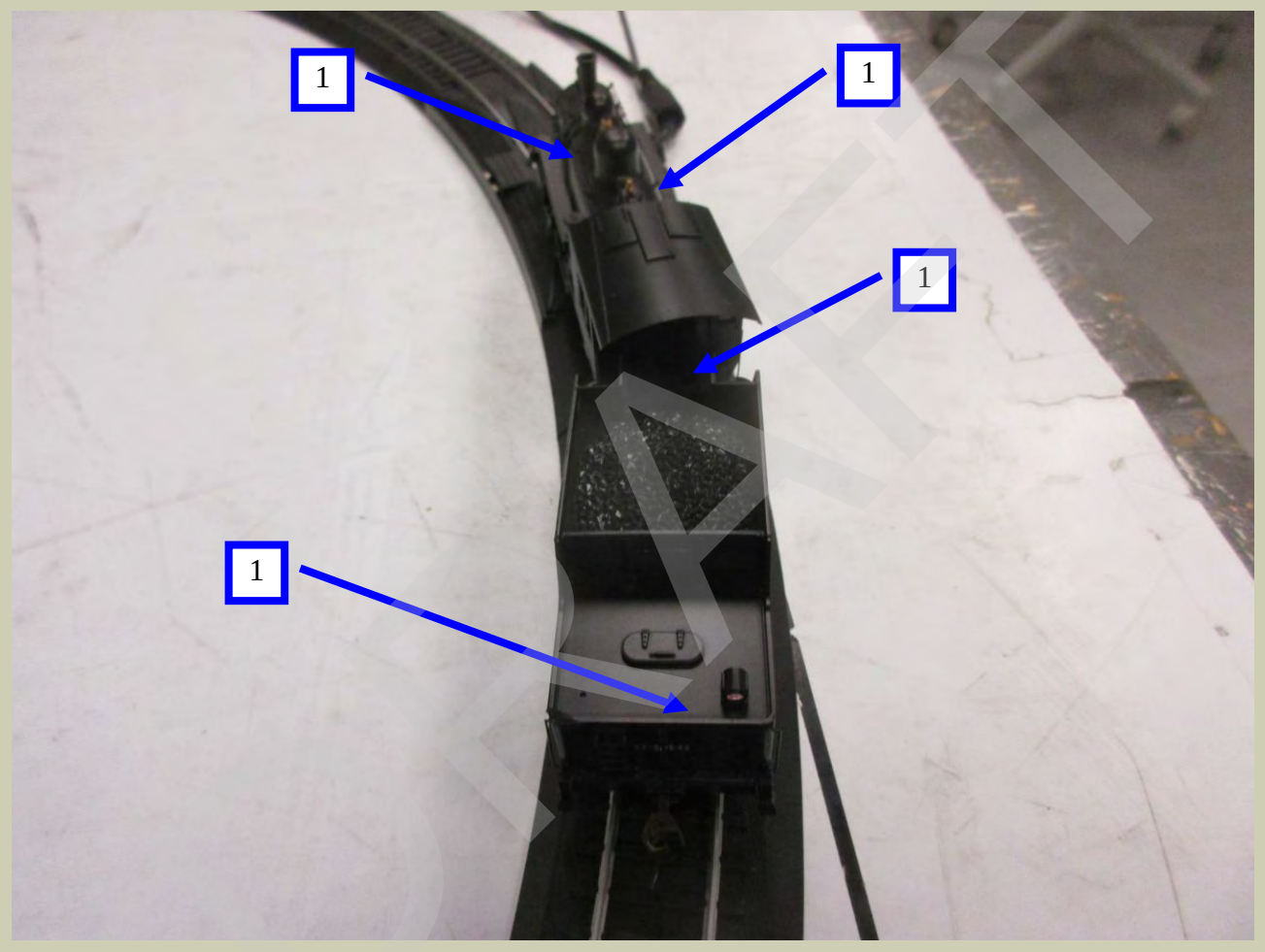
ELECTROSTATIC DISCHARGE (ESD)

NORTHWEST EMC
WTD.2016.05.18

AIR DISCHARGE – OBSERVATIONS

ESD Test Level (kV)	+/- 2	+/- 4	+/- 8
Number of Discharges, Each Polarity	10	10	10

Configuration:	BLTR0005-2



OBSERVATIONS (See Arrows)

Arrow No.	Voltage	Observation
1	All	No Phenomena Observed

Notes: The arrow colors have no meaning. For test points with observation notes, it is implied that no phenomena were observed at all other test levels (voltages, polarities) except what is noted.

RADIATED IMMUNITY

NORTHWEST EMC
WTD.2016.05.18

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, a Radiated RF Immunity test was performed according to IEC 61000-4-3. The field was first established with no EUT present then maintained at the specified level. If an error is detected, the field strength may have been reduced to a level in which the error disappeared. This would be determined as the threshold of susceptibility. The test was conducted using horizontal and vertical antenna orientations.

Where additional spot frequency test is required for equipment, the separation distance is not the test distance as defined in IEC 61000-4-3, but the expected operating distance between the EUT and the interfering wireless communication device. The 3 meters distance noted in the datasheets is the calibrated test distance used to generate the test levels noted by the standard.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5181A	TIG	3/28/2014	3/28/2017
Antenna - Log Periodic	EMCO	3144	ALJ	NCR	NCR
Monitor - Field	Amplifier Research	FL7040/Kit	IEP	10/29/2014	10/29/2016
Amplifier - RF	Amplifier Research	500W1000A	TTC	NCR	NCR
Meter - Power	Amplifier Research	PM2002	SQY	10/30/2015	10/30/2016
Directional Coupler	Amplifier Research	DC6180A	IRO	NCR	NCR
Power Sensor	Amplifier Research	PH2000	SQQ	10/30/2015	10/30/2016

CONFIGURATIONS INVESTIGATED

BLTR0005-1

MODES INVESTIGATED

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

RADIATED IMMUNITY

NORTHWEST EMC
WTD.2016.05.18

EUT:	BCWv4	Work Order:	BLTR0005
Serial Number:	None	Date:	07/11/2016
Customer:	Bluerail Trains LLC	Temperature:	22.6°C
Attendees:	None	Relative Humidity:	46.8%
Customer Project:	None	Bar. Pressure:	1011.6 mbar
Tested By:	Luke Richardson	Job Site:	EV12
Power:	110VAC/60Hz	Configuration:	BLTR0005-1

TEST SPECIFICATIONS

Specification:	Method:
EN 55024:2010	IEC 61000-4-3:2010

TEST PARAMETERS

Test Level:	>= 3 V/m	Spec. Level:	3 V/m	Mod. Type:	AM
Start Frequency:	80MHz	Stop Frequency:	1000MHz	Mod. Frequency:	1kHz
Mod. Depth:	80%	Step Size:	1%	Dwell Time:	1 Sec.

SIDES TESTED

Front, Back, Left, Right

POLARITIES TESTED

Horizontal, Vertical

TEST DISTANCE

3m

COMMENTS

Provided AC/DC Adapter (Toy Transformer) operates at 110VAC/60Hz only.

EUT OPERATING MODES

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

DEVIATIONS FROM TEST STANDARD

None

EUT FUNCTIONS MONITORED

Monitored motor speed for any fluctuations or shutdowns. Monitored train lights for any change in state. Verified a continuous Bluetooth connection.

CLOCKS AND OSCILLATORS

No Clocks or Oscillators were provided by the customer.

OBSERVATIONS

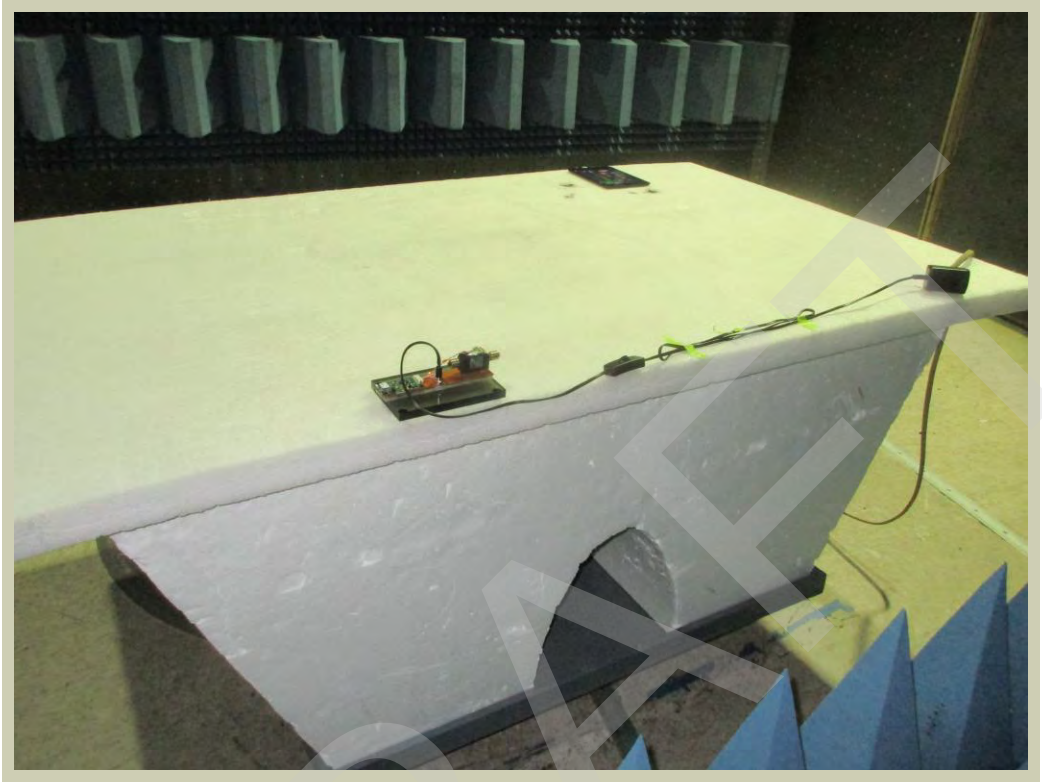
No Phenomena Observed.

CONCLUSION

Meets NWEMC Performance Criteria	A

The EUT exhibited no change in performance when operating as specified by the manufacturer.

Luke Richardson
Tested By



RADIATED IMMUNITY

NORTHWEST EMC
WTD.2016.05.18

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, a Radiated RF Immunity test was performed according to IEC 61000-4-3. The field was first established with no EUT present then maintained at the specified level. If an error is detected, the field strength may have been reduced to a level in which the error disappeared. This would be determined as the threshold of susceptibility. The test was conducted using horizontal and vertical antenna orientations.

Where additional spot frequency test is required for equipment, the separation distance is not the test distance as defined in IEC 61000-4-3, but the expected operating distance between the EUT and the interfering wireless communication device. The 3 meters distance noted in the datasheets is the calibrated test distance used to generate the test levels noted by the standard.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5181A	TIG	3/28/2014	3/28/2017
Antenna - Log Periodic	EMCO	3144	ALJ	NCR	NCR
Antenna - Double Ridge	EMCO	3115	AJI	NCR	NCR
Monitor - Field	Amplifier Research	FL7040/Kit	IEP	10/29/2014	10/29/2016
Amplifier - RF	Amplifier Research	500W1000A	TTC	NCR	NCR
Amplifier	Amplifier Research	100S1G6	TSD	NCR	NCR
Meter - Power	Amplifier Research	PM2002	SQY	10/30/2015	10/30/2016
Directional Coupler	Amplifier Research	DC6180A	IRO	NCR	NCR
Power Sensor	Amplifier Research	PH2000	SQQ	10/30/2015	10/30/2016
Directional Coupler	Amplifier Research	DC7200	RHN	NCR	NCR

CONFIGURATIONS INVESTIGATED

BLTR0005-1

MODES INVESTIGATED

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

RADIATED IMMUNITY

NORTHWEST EMC
WTD.2016.05.18

EUT:	BCWv4	Work Order:	BLTR0005
Serial Number:	None	Date:	07/11/2016
Customer:	Bluerail Trains LLC	Temperature:	22.6°C
Attendees:	None	Relative Humidity:	46.8%
Customer Project:	None	Bar. Pressure:	1011.6 mbar
Tested By:	Luke Richardson	Job Site:	EV12
Power:	110VAC/60Hz	Configuration:	BLTR0005-1

TEST SPECIFICATIONS

Specification:	Method:
EN 301 489-17 V2.2.1:2012	EN 301 489-1 V1.9.2:2011

TEST PARAMETERS

Test Level:	>= 3 V/m	Spec. Level:	3 V/m	Mod. Type:	AM
Start Frequency:	80MHz	Stop Frequency:	1000MHz	Mod. Frequency:	1kHz
Mod. Depth:	80%	Step Size:	1%	Dwell Time:	1 Sec.

TEST PARAMETERS

Test Level:	>= 3 V/m	Spec. Level:	3 V/m	Mod. Type:	AM
Start Frequency:	1400MHz	Stop Frequency:	2700MHz	Mod. Frequency:	1kHz
Mod. Depth:	80%	Step Size:	1%	Dwell Time:	1 Sec.

SIDES TESTED

Front, Back, Left, Right

POLARITIES TESTED

Horizontal, Vertical

TEST DISTANCE

3m

COMMENTS

Provided AC/DC Adapter (Toy Transformer) operates at 110VAC/60Hz only.

EUT OPERATING MODES

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

DEVIATIONS FROM TEST STANDARD

None

EUT FUNCTIONS MONITORED

Monitored motor speed for any fluctuations or shutdowns. Monitored train lights for any change in state. Verified a continuous Bluetooth connection.

CLOCKS AND OSCILLATORS

No Clocks or Oscillators were provided by the customer.

OBSERVATIONS

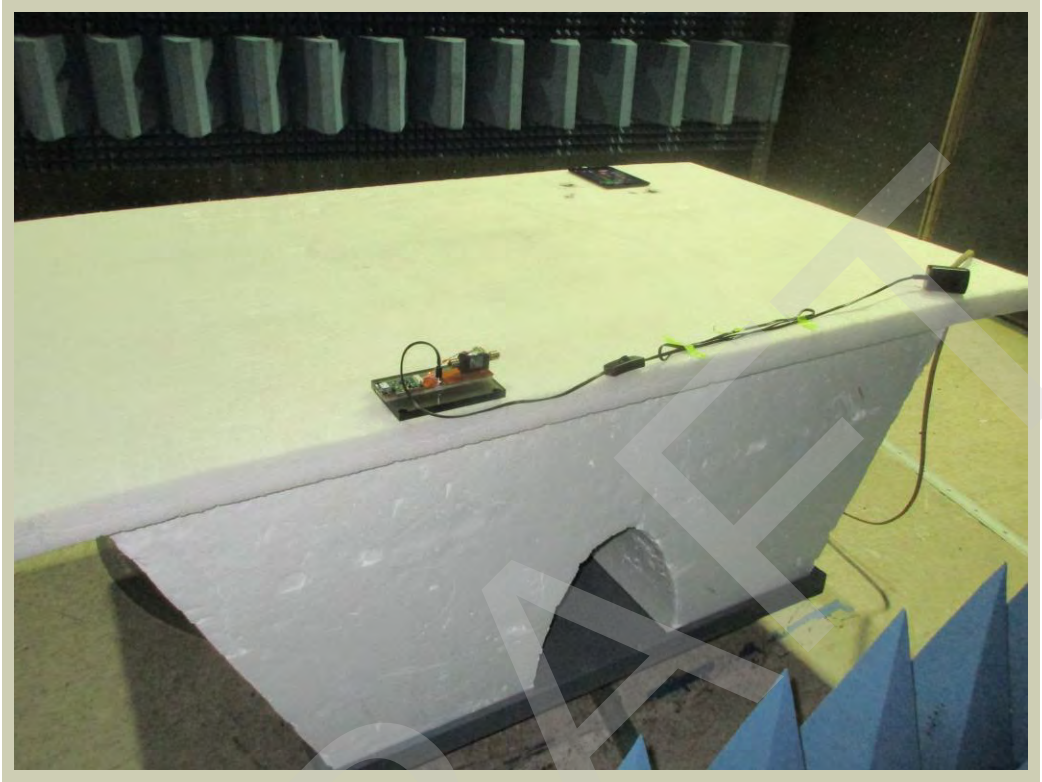
No Phenomena Observed.

CONCLUSION

Meets NWEMC Performance Criteria	A

The EUT exhibited no change in performance when operating as specified by the manufacturer.

Luke Richardson
Tested By



ELECTRICAL FAST TRANSIENTS AND BURSTS (EFT)

NORTHWEST EMC
WTD.2016.05.18

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, an EFT/Burst Immunity test was performed. The test is intended to demonstrate the immunity of electrical and electronic equipment when subjected to types of transient disturbances such as those originating from switching transients (interruption of inductive loads, relay contact bounce, etc.). The repetitive fast transient test is a test with bursts consisting of a number of fast transients, coupled into power supply, control and signal ports of electrical and electronic equipment. Significant for the test is short rise time, the repetition rate and the low energy of the transients. Unless noted, AC Terminals are tested using common mode coupling (simultaneous coupling to all lines versus the ground reference plane). The cable between the EUT and the coupling device, if detachable, shall be as short as possible to comply with the requirements. If the manufacturer provides a cable exceeding the distance between the coupling device end the point of entry of the EUT, the excess length of this cable shall be bundled and situated at a distance of 0.1m above the ground plane.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Transient Generator	EM Test	UCS 500M	IBI	10/16/2015	8/16/2016

CONFIGURATIONS INVESTIGATED

BLTR0005-1

MODES INVESTIGATED

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

ELECTRICAL FAST TRANSIENTS AND BURSTS (EFT)

NORTHWEST EMC
WTD.2016.05.18

EUT:	BCWv4	Work Order:	BLTR0005
Serial Number:	None	Date:	07/11/2016
Customer:	Bluerail Trains LLC	Temperature:	22.8°C
Attendees:	None	Relative Humidity:	46.5%
Customer Project:	None	Bar. Pressure:	1010.6 mbar
Tested By:	Luke Richardson	Job Site:	EV05
Power:	110VAC/60Hz	Configuration:	BLTR0005-1

TEST SPECIFICATIONS

Specification:	Method:
EN 55024:2010	IEC 61000-4-4:2012

TEST PARAMETERS

Period Time:	300mS ± 20%	Duration of Burst:	15mS ±20%,
Relation of Power Supply:	Asynchronous	Risetime of One Pulse:	5nS ± 30%
Frequency of Burst:	5kHz,	Impulse Duration:	50nS ± 30%
Test Duration per Port:	60 sec.		

COMMENTS

Provided AC/DC Adapter (Toy Transformer) operates at 110VAC/60Hz only.

EUT OPERATING MODES

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

DEVIATIONS FROM TEST STANDARD

None

EUT FUNCTIONS MONITORED

Monitored motor speed for any fluctuations or shutdowns. Monitored train lights for any change in state. Verified a continuous Bluetooth Connection.

OBSERVATIONS

Line	Voltage	Observation
AC Terminals (L1,N)	+1kV	No Phenomena Observed
AC Terminals (L1,N)	-1kV	No Phenomena Observed

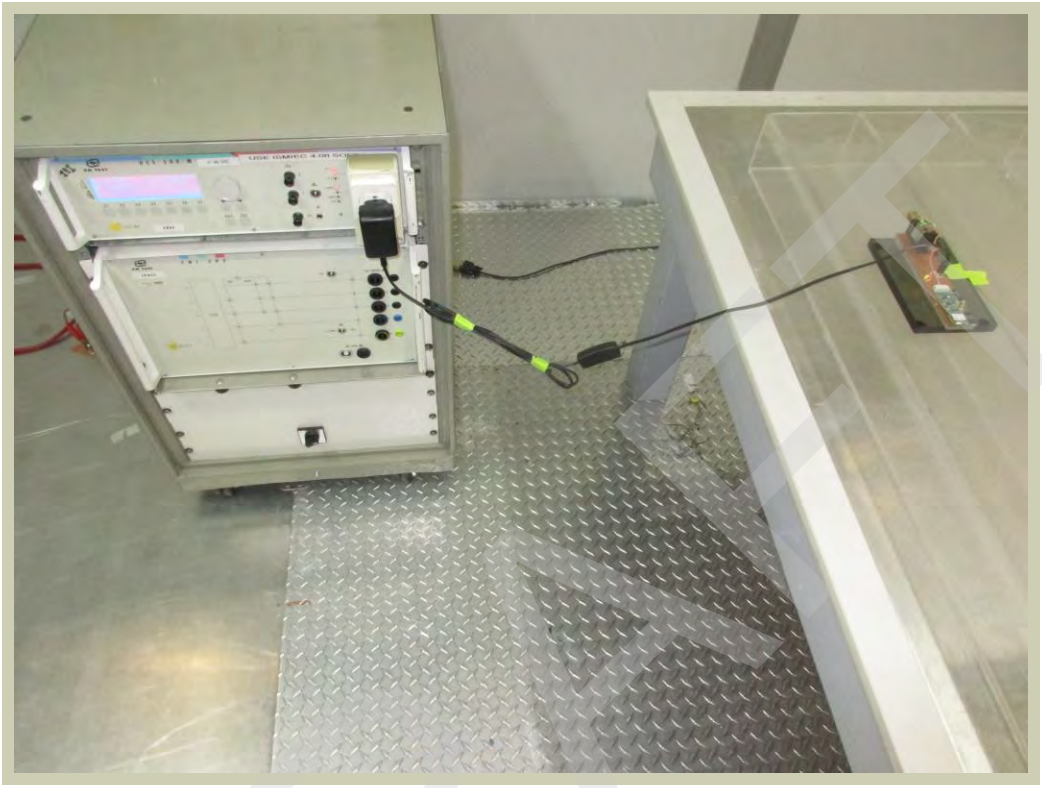
CONCLUSION

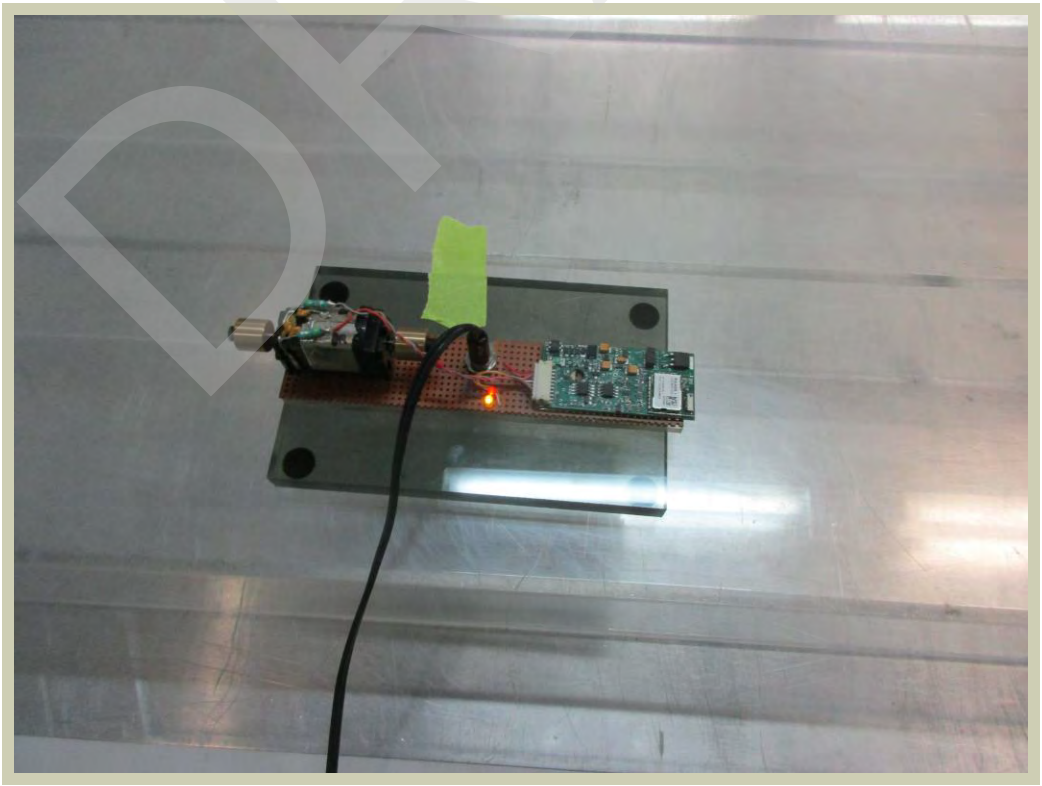
Meets NWEMC Performance Criteria	A

The EUT exhibited no change in performance when operating as specified by the manufacturer.

Tested By

ELECTRICAL FAST TRANSIENTS AND BURSTS (EFT)





ELECTRICAL FAST TRANSIENTS AND BURSTS (EFT)

NORTHWEST EMC
WTD.2016.05.18

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, an EFT/Burst Immunity test was performed. The test is intended to demonstrate the immunity of electrical and electronic equipment when subjected to types of transient disturbances such as those originating from switching transients (interruption of inductive loads, relay contact bounce, etc.). The repetitive fast transient test is a test with bursts consisting of a number of fast transients, coupled into power supply, control and signal ports of electrical and electronic equipment. Significant for the test is short rise time, the repetition rate and the low energy of the transients. Unless noted, AC Terminals are tested using common mode coupling (simultaneous coupling to all lines versus the ground reference plane). The cable between the EUT and the coupling device, if detachable, shall be as short as possible to comply with the requirements. If the manufacturer provides a cable exceeding the distance between the coupling device end the point of entry of the EUT, the excess length of this cable shall be bundled and situated at a distance of 0.1m above the ground plane.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Transient Generator	EM Test	UCS 500M	IBI	10/16/2015	8/16/2016

CONFIGURATIONS INVESTIGATED

BLTR0005-1

MODES INVESTIGATED

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

ELECTRICAL FAST TRANSIENTS AND BURSTS (EFT)

NORTHWEST EMC
WTD.2016.05.18

EUT:	BCWv4	Work Order:	BLTR0005
Serial Number:	None	Date:	07/11/2016
Customer:	Bluerail Trains LLC	Temperature:	22.8°C
Attendees:	None	Relative Humidity:	46.5%
Customer Project:	None	Bar. Pressure:	1010.6 mbar
Tested By:	Luke Richardson	Job Site:	EV05
Power:	110VAC/60Hz	Configuration:	BLTR0005-1

TEST SPECIFICATIONS

Specification:	Method:
EN 301 489-17 V2.2.1:2012	EN 301 489-1 V1.9.2:2011

TEST PARAMETERS

Period Time:	300mS ± 20%	Duration of Burst:	15mS ±20%,
Relation of Power Supply:	Asynchronous	Risetime of One Pulse:	5nS ± 30%
Frequency of Burst:	5kHz,	Impulse Duration:	50nS ± 30%
Test Duration per Port:	60 sec.		

COMMENTS

Provided AC/DC Adapter (Toy Transformer) operates at 110VAC/60Hz only.

EUT OPERATING MODES

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

DEVIATIONS FROM TEST STANDARD

None

EUT FUNCTIONS MONITORED

Monitored motor speed for any fluctuations or shutdowns. Monitored train lights for any change in state. Verified a continuous Bluetooth Connection.

OBSERVATIONS

Line	Voltage	Observation
AC Terminals (L1,N)	+1kV	No Phenomena Observed
AC Terminals (L1,N)	-1kV	No Phenomena Observed

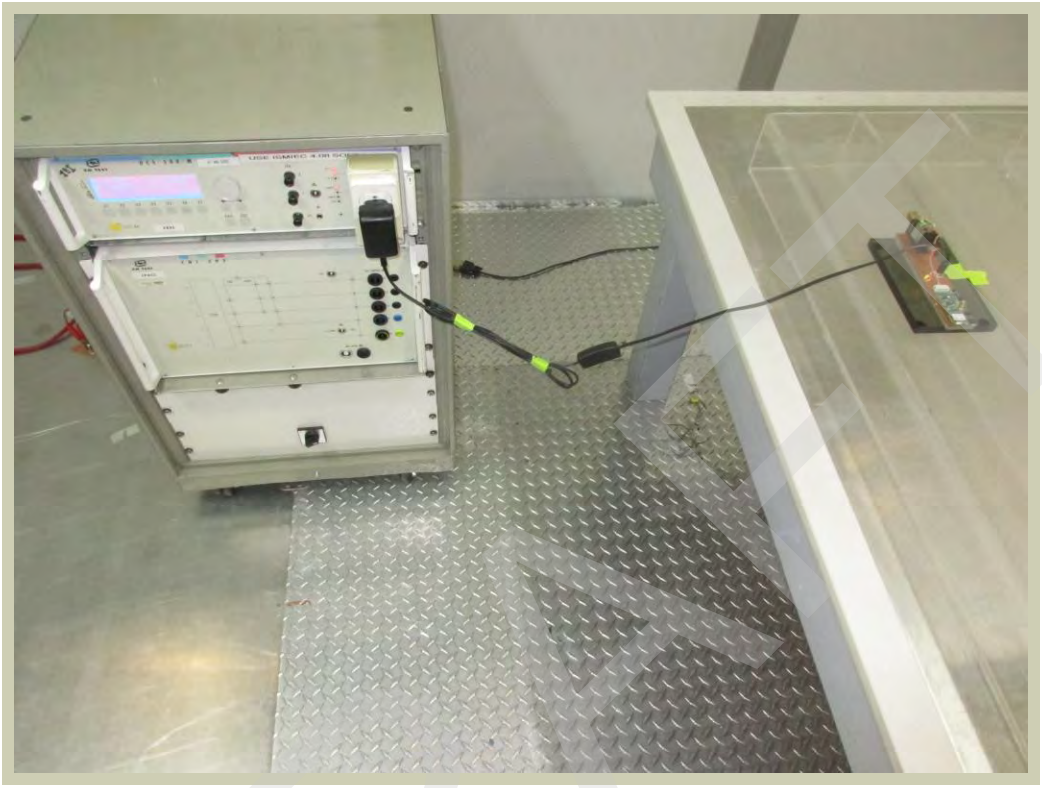
CONCLUSION

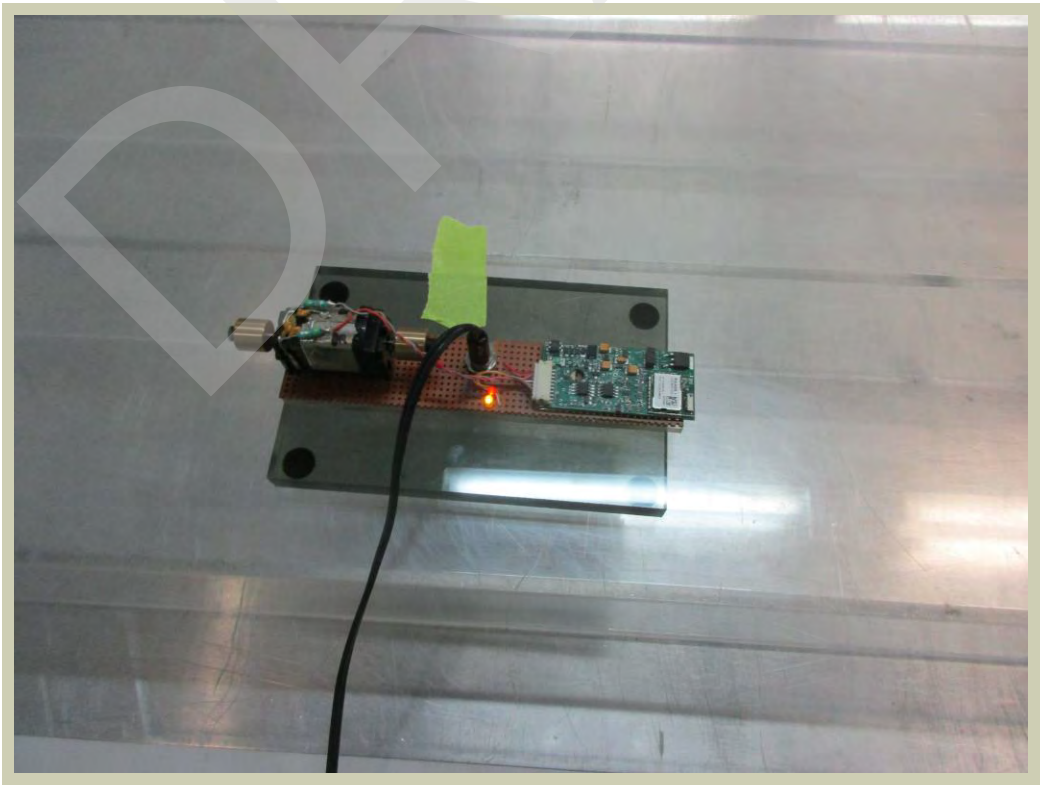
Meets NWEMC Performance Criteria	A

The EUT exhibited no change in performance when operating as specified by the manufacturer.

Luke Richardson
Tested By

ELECTRICAL FAST TRANSIENTS AND BURSTS (EFT)





CONDUCTED IMMUNITY

NORTHWEST EMC
WTD.2016.05.18

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, a Conducted RF Immunity test was performed. The source of disturbance covered by the standard is basically an electromagnetic field, coming from intended RF transmitters, that may act on the whole length of cables connected to installed equipment. The dimensions of the disturbed equipment, mostly a sub-part of a larger system, are assumed to be small compared with the wavelengths involved. The ingoing and outgoing leads: e.g. mains, communication lines, and interface cables, behave as passive receiving antenna networks because they can be several wavelengths long. The use of coupling and decoupling devices to apply the disturbing signal to one cable at a time, while keeping all other cables non-excited, can only approximate the real situation where disturbing sources act on all cables simultaneously, with a range of different amplitudes and phases. Coupling and decoupling devices are defined by their characteristics. Any coupling and decoupling device fulfilling these characteristics can be used. Unless permanently attached, the power cable between the coupling and decoupling devices and the EUT shall be as short as possible and shall not be bundled or wrapped. Their height above the ground reference plane shall be between 30 mm and 50 mm.

During testing, if anomalies are observed, the current is monitored by inserting an additional current probe in between the injection clamp and the EUT. If the current, exceeds the nominal circuit current value, then the test generator output level is reduced until the current equals the nominal circuit current level. The reduced test generator output value is recorded.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Rohde & Schwarz	SML01	TFV	11/9/2015	11/9/2018
Amplifier	Amplifier Research	75A250A	TTL	NCR	NCR
Meter - Power	Amplifier Research	PM2002	SQJ	9/2/2015	9/2/2016
Power Sensor	Amplifier Research	PH2000	SQK	2/29/2016	2/28/2017
Directional Coupler	Amplifier Research	DC2600A	IRT	NCR	NCR
Attenuator	S.M. Electronics	SA3N100-06F	REQ	9/25/2015	9/25/2016
CDN	Dressler	CDN-M2	ING	6/11/2016	6/11/2017
Adapter, 50-150 Ohm	Teseq	SL 403-403	RDS	10/20/2015	10/20/2016
Terminator	Teseq	SL 403-404	RDT	10/20/2015	10/20/2016

CONFIGURATIONS INVESTIGATED

BLTR0005-1

MODES INVESTIGATED

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

CONDUCTED IMMUNITY

NORTHWEST EMC
WTD.2016.05.18

EUT:	BCWv4	Work Order:	BLTR0005
Serial Number:	None	Date:	07/11/2016
Customer:	Bluerail Trains LLC	Temperature:	22.8°C
Attendees:	None	Relative Humidity:	46.4%
Customer Project:	None	Bar. Pressure:	1011.6 mbar
Tested By:	Luke Richardson	Job Site:	EV02
Power:	110VAC/60Hz	Configuration:	BLTR0005-1

TEST SPECIFICATIONS

Specification:	Method:
EN 55024:2010	IEC 61000-4-6:2013

TEST PARAMETERS

Test Level:	>= 3 VRMS	Spec. Level:	3 VRMS	Mod. Type:	AM
Start Frequency:	150kHz	Stop Frequency:	80MHz	Mod. Frequency:	1kHz
Mod. Depth:	80%	Step Size:	1%	Dwell Time:	1sec.

CABLES TESTED

AC Power

COMMENTS

Provided AC/DC Adapter (Toy Transformer) operates at 110VAC/60Hz only.

EUT OPERATING MODES

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

DEVIATIONS FROM TEST STANDARD

None

EUT FUNCTIONS MONITORED

Monitored motor speed for any fluctuations or shutdowns. Monitored train lights for any change in state. Verified a continuous Bluetooth connection.

CLOCKS AND OSCILLATORS

No Clocks or Oscillators were provided by the customer.

OBSERVATIONS

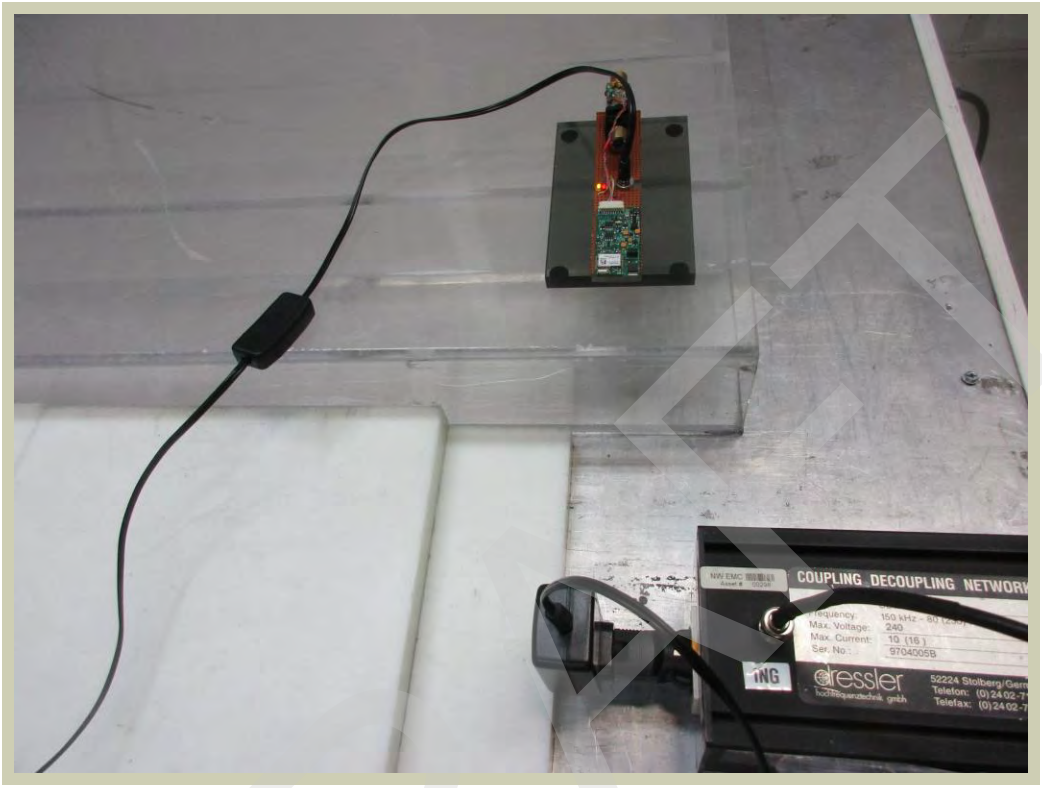
No Phenomena Observed.

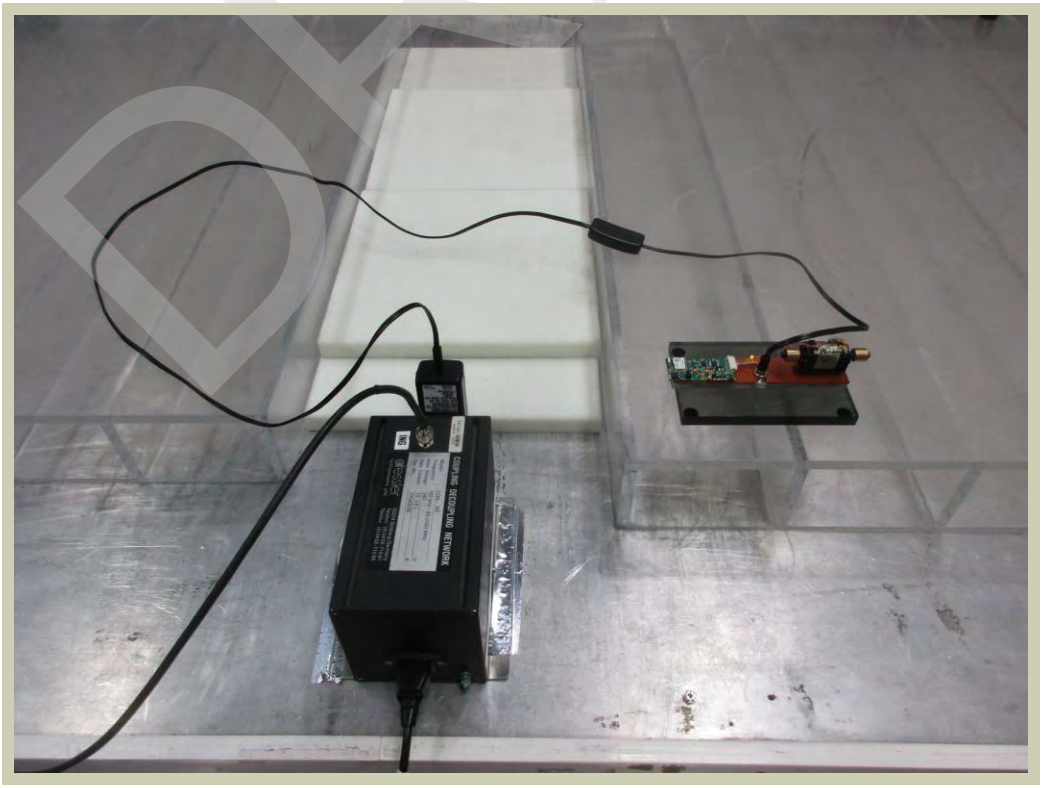
CONCLUSION

Meets NWEMC Performance Criteria	A

The EUT exhibited no change in performance when operating as specified by the manufacturer.

Tested By


COUPLING DECOUPLING NETWORK
Frequency:
Max. Voltage:
Max. Current:
Ser. No.:
ING
ressler


COUPLING DECOUPLING NETWORK

CONDUCTED IMMUNITY

NORTHWEST EMC
WTD.2016.05.18

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, a Conducted RF Immunity test was performed. The source of disturbance covered by the standard is basically an electromagnetic field, coming from intended RF transmitters, that may act on the whole length of cables connected to installed equipment. The dimensions of the disturbed equipment, mostly a sub-part of a larger system, are assumed to be small compared with the wavelengths involved. The ingoing and outgoing leads: e.g. mains, communication lines, and interface cables, behave as passive receiving antenna networks because they can be several wavelengths long. The use of coupling and decoupling devices to apply the disturbing signal to one cable at a time, while keeping all other cables non-excited, can only approximate the real situation where disturbing sources act on all cables simultaneously, with a range of different amplitudes and phases. Coupling and decoupling devices are defined by their characteristics. Any coupling and decoupling device fulfilling these characteristics can be used. Unless permanently attached, the power cable between the coupling and decoupling devices and the EUT shall be as short as possible and shall not be bundled or wrapped. Their height above the ground reference plane shall be between 30 mm and 50 mm.

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TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
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Meter - Power	Amplifier Research	PM2002	SQJ	9/2/2015	9/2/2016
Power Sensor	Amplifier Research	PH2000	SQK	2/29/2016	2/28/2017
Directional Coupler	Amplifier Research	DC2600A	IRT	NCR	NCR
Attenuator	S.M. Electronics	SA3N100-06F	REQ	9/25/2015	9/25/2016
CDN	Dressler	CDN-M2	ING	6/11/2016	6/11/2017
Adapter, 50-150 Ohm	Teseq	SL 403-403	RDS	10/20/2015	10/20/2016
Terminator	Teseq	SL 403-404	RDT	10/20/2015	10/20/2016

CONFIGURATIONS INVESTIGATED

BLTR0005-1

MODES INVESTIGATED

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

CONDUCTED IMMUNITY

NORTHWEST EMC
WTD.2016.05.18

EUT:	BCWv4	Work Order:	BLTR0005
Serial Number:	None	Date:	07/11/2016
Customer:	Bluerail Trains LLC	Temperature:	22.8°C
Attendees:	None	Relative Humidity:	46.4%
Customer Project:	None	Bar. Pressure:	1011.6 mbar
Tested By:	Luke Richardson	Job Site:	EV02
Power:	110VAC/60Hz	Configuration:	BLTR0005-1

TEST SPECIFICATIONS

Specification:	Method:
EN 301 489-17 V2.2.1:2012	EN 301 489-1 V1.9.2:2011

TEST PARAMETERS

Test Level:	>= 3 VRMS	Spec. Level:	3 VRMS	Mod. Type:	AM
Start Frequency:	150kHz	Stop Frequency:	80MHz	Mod. Frequency:	1kHz
Mod. Depth:	80%	Step Size:	1%	Dwell Time:	1sec.

CABLES TESTED

AC Power

COMMENTS

Provided AC/DC Adapter (Toy Transformer) operates at 110VAC/60Hz only.

EUT OPERATING MODES

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

DEVIATIONS FROM TEST STANDARD

None

EUT FUNCTIONS MONITORED

Monitored motor speed for any fluctuations or shutdowns. Monitored train lights for any change in state. Verified a continuous Bluetooth connection.

CLOCKS AND OSCILLATORS

No Clocks or Oscillators were provided by the customer.

OBSERVATIONS

No Phenomena Observed.

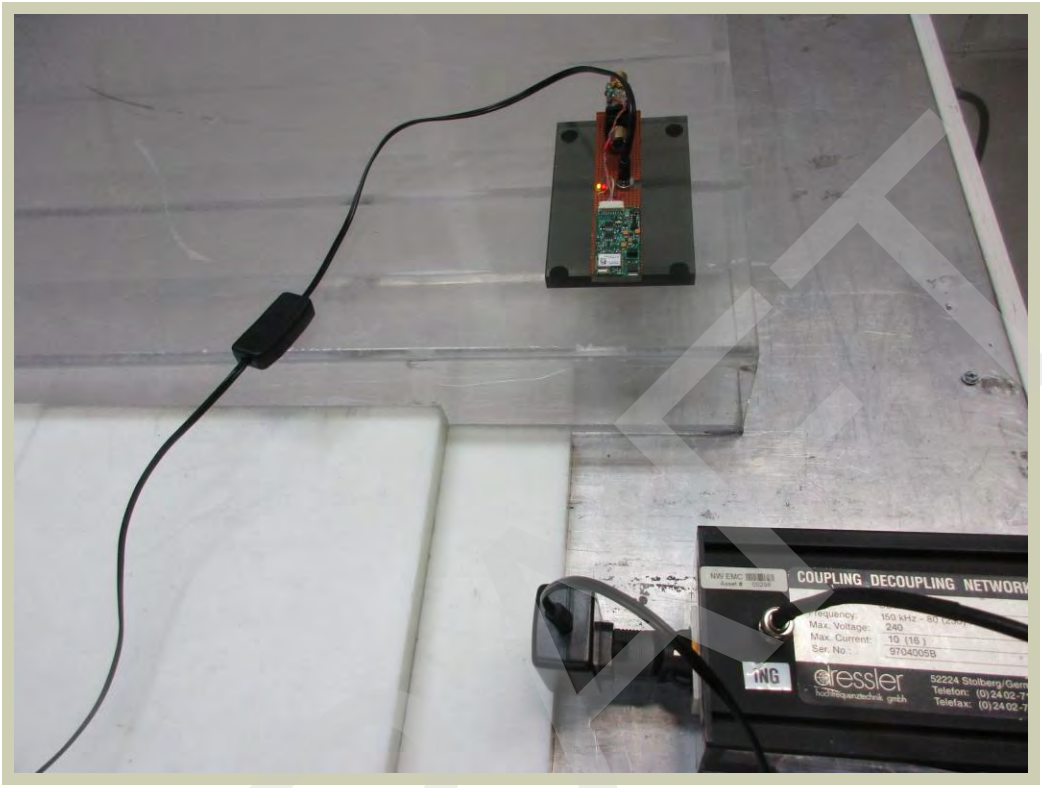
CONCLUSION

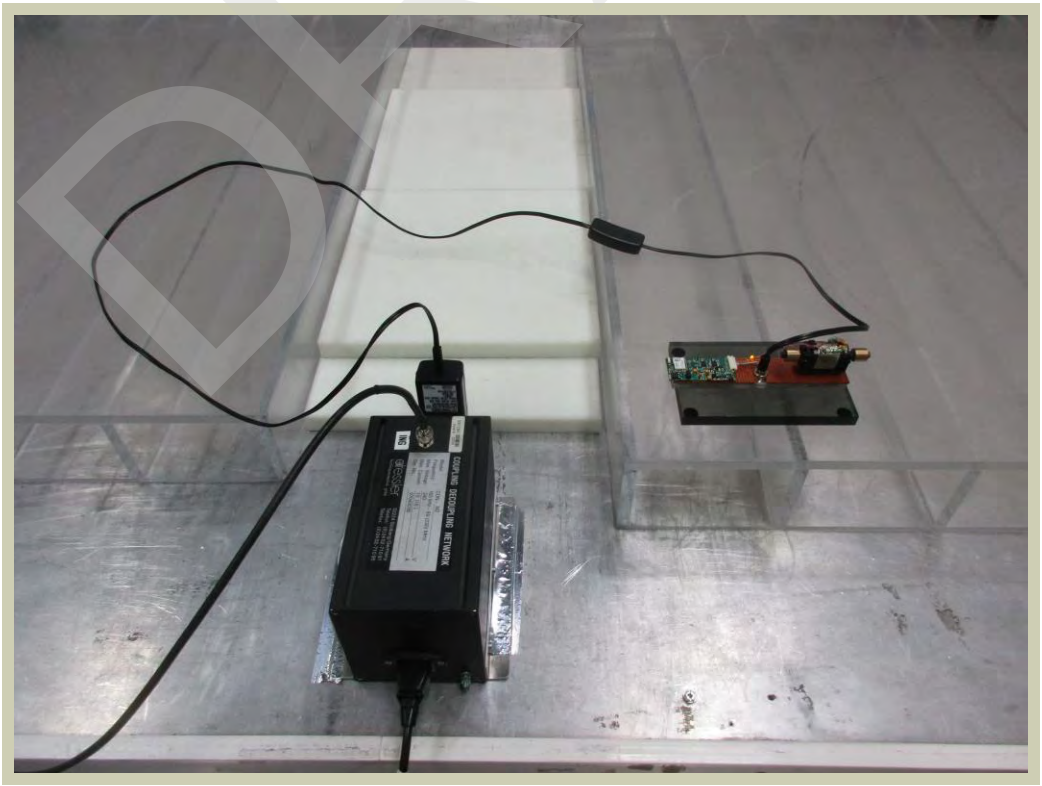
Meets NWEMC Performance Criteria	A

The EUT exhibited no change in performance when operating as specified by the manufacturer.

Tested By

CONDUCTED IMMUNITY





MAGNETIC FIELD IMMUNITY

NORTHWEST EMC
WTD.2016.05.18

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, a Power Frequency Magnetic Field Immunity test was performed. The tests are intended to demonstrate the immunity of equipment when subjected to power frequency magnetic fields related to the specific location and installation condition of the equipment (e.g. proximity of equipment to the disturbance source). The power frequency magnetic field is generated by power frequency current in conductors or, rarely, from other devices (e.g. leakage or transformers) in the proximity of equipment.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Coil - Helmholtz	Northwest EMC	N/A	IMK	2/2/2016	2/2/2019
Harmonics/Flicker Tester	Teseq	5001IX-CTS-208-411-413-SCH	TJA	1/27/2016	1/27/2017
Power Supply - AC	Teseq	NSG 1007-5	TJB	1/27/2016	1/27/2017

CONFIGURATIONS INVESTIGATED

BLTR0005-1

MODES INVESTIGATED

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

MAGNETIC FIELD IMMUNITY

NORTHWEST EMC
WTD.2016.05.18

EUT:	BCWv4	Work Order:	BLTR0005
Serial Number:	None	Date:	07/11/2016
Customer:	Bluerail Trains LLC	Temperature:	22.8°C
Attendees:	None	Relative Humidity:	46.5%
Customer Project:	None	Bar. Pressure:	1011.6 mbar
Tested By:	Luke Richardson	Job Site:	EV05
Power:	110VAC/60Hz	Configuration:	BLTR0005-1

TEST SPECIFICATIONS

Specification:	Method:
EN 55024:2010	IEC 61000-4-8:2009

TEST PARAMETERS

Test Level:	1 A/m	Test Frequency:	50Hz, 60Hz

COMMENTS

Provided AC/DC Adapter (Toy Transformer) operates at 110VAC/60Hz only.

EUT OPERATING MODES

Using the Bachman “E-Z App” on an iPad to control the Bluetooth LE Model Train Control Module. Motor speed set to MAX. Lights on.

DEVIATIONS FROM TEST STANDARD

None

EUT FUNCTIONS MONITORED

Monitored motor speed for any fluctuations or shutdowns. Monitored train lights for any change in state. Verified a continuous Bluetooth connection.

OBSERVATIONS

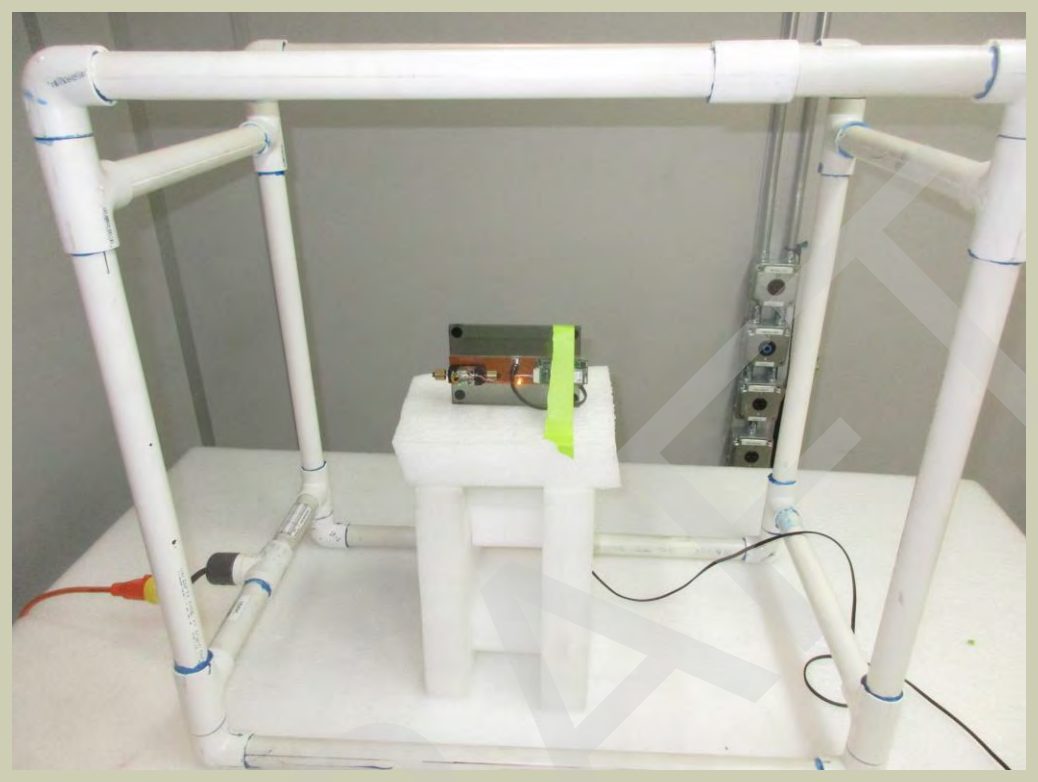
X	No Phenomena Observed
Y	No Phenomena Observed
Z	No Phenomena Observed

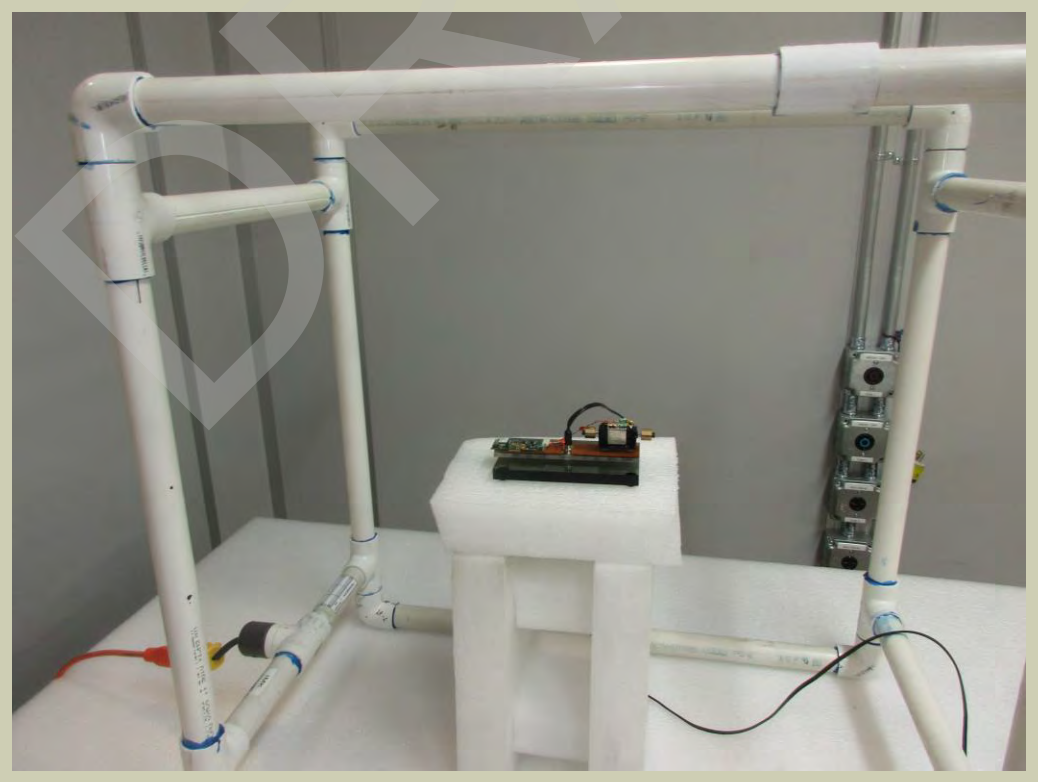
CONCLUSION

Meets NWEMC Performance Criteria	A

The EUT exhibited no change in performance when operating as specified by the manufacturer.

Tested By





MAGNETIC FIELD IMMUNITY