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FCC Part 15, Subpart C, Section 15.223
Test Report

On

4.5 MHz Transponder
FCC ID: 2AC9HJGA29001-6

Customer Name:	Bombardier Transportation
Customer P.O:	4500740877-P1U
Date of Report:	October 21, 2014
Test Report No:	R-2215P
Test Technician:	Brian Freedman
EMC Test Engineer:	David Rybicki, Dean Landers
Approved By:	Richard C. Gaynor
Report Prepared By:	C. Reitz

Technical Information

Report Number:	R-2215P
Customer:	Bombardier Transportation
Address:	1501 Lebanon Church Road
	Pittsburg, PA 15236
Manufacturer:	Bombardier Transportation
Manufacturer Address:	1501 Lebanon Church Road
	Pittsburg, PA 15236
Test Sample:	4.5 MHz Transponder
Model Number:	JGA29001/6
FCC ID:	2AC9HJGA29001-6
Power Requirements:	Derived from a 27.1 MHz RF Signal
Frequency of Operation:	4.44 MHz
Equipment Class:	DXX
Equipment Use:	Fixed

Test Specification:
FCC Rules and Regulations Part 15, Subpart C, Section 15.223

Test Procedure:
ANSI C63.4:2003

Test Facility:
Retlif Testing Laboratories
3131 Detwiler Road
Harleysville, PA 19438

Tests Performed

The test methods performed on the 4.5 MHz Transponder are shown below:

FCC Part 15, Subpart C	Test Method
15.223(a)	Bandwidth
15.223(a)	Field Strength of Fundamental / In Band Emissions
15.223(b) / 15.209	Out of Band / Band Edge Radiated Emissions (9 kHz to 272 MHz)

General Test Requirements

1. The measurement procedures of ANSI C63.4:2003 were utilized as specified in FCC Part 15, Subpart C, Section 15.31(a)(3).
2. All radiated emissions measurements were performed on an Open Area Test Site (OATS), listed with the FCC, in accordance with FCC Section 15.31(d).
3. The level of the fundamental field strength was measured with the position of the EUT over the scanner varied.
4. All measurements were performed at the specified 3 and 10 meter test distance as required by FCC Section 15.31(f).
5. The EUT was rotated throughout 360 degrees for all radiated emissions measurements as specified in FCC Section 15.31(f)(5).
6. All readily accessible EUT controls were adjusted in such a manner as to maximize the level of emissions in accordance with FCC Section 15.31(g).
7. Appropriate accessories were attached to all EUT ports during the performance of radiated emissions measurements as required by FCC Section 15.31(i).
8. The EUT operated at the frequency range of 4.44 MHz in accordance with FCC Section 15.31(m).
9. The frequency spectrum was investigated from the lowest frequency generated in the device up to the 10^{th} harmonic of the highest fundamental frequency in accordance with FCC Section 15.33(a)(1).
10. All measurements were taken with an average detector function as specified in FCC Section 15.223(a). An additional peak measurement was made in accordance with FCC Section 15.35(c), with the average limit increased by 20 dB.

Certification and Signatures

We certify that this report is a true representation of the results obtained from the tests of the equipment stated. We further certify that the measurements shown in this report were made in accordance with the procedures indicated and vouch for the qualifications of all Retlif Testing Laboratories personnel taking them.

David Rybicki
EMC Test Engineer
NVLAP Approved Signatory

Richard C. Gaynor
Laboratory Manager
iNARTE Certified Engineer EMC-000214-NE
NVLAP Approved Signatory

Non-Warranty Provision
The testing services have been performed, findings obtained and reports prepared in accordance with generally accepted laboratory principles and practices. This warranty is in lieu of all others, either expressed or implied.

Non-Endorsement
This test report contains only findings and results arrived at after employing the specific test procedures and standards listed herein. It is not intended to constitute a recommendation, endorsement or certification of the product or material tested. This test report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

Requirements and Test Results

Requirement:
FCC Section 15.223 – Operation in the band 1.705 – 10.0 MHz
(a) The field strength of any emission within the band 1.705 – 10.0 MHz shall not exceed 100 microvolts/meter at a distance of 30 meters. However, if the bandwidth of the emission is less than 10% of the center frequency, the field strength shall not exceed 15 microvolts/meter or (the bandwidth of the device in kHz) divided by (the center frequency of the device in MHz) microvolts/meter at a distance of 30 meters, whichever is the higher level. For the purposes of this section, bandwidth is determined at the points 6 dB down from the modulated carrier.

(b) The field strength of emissions outside of the band 1.705 – 10.0 MHz shall not exceed the general radiated emission limits in Section 15.209.

- Results:
  The 6 dB bandwidth was measured and found to be 117 kHz, 2.6 % of the center frequency.

Requirement:
FCC Section 15.209(a) - Radiated Emission Limits, General Requirements
Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 1.

Table 1 - Radiated Emission Limits

Frequency of Emission (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
1.705 to 30	30	30
30 to 88	100	3
88 to 216	150	3
216 to 960	200	3
Above 960	500	3

The Fundamental and Harmonic Emissions limits for a device operating at 4.44 MHz are listed in Table 2. This limit is derived from FCC Section 15.223(a).

Table 2 - Fundamental and Harmonic Limits

Frequency of Operation MHz	Fundamental µV/m	Harmonics µV/m
Average - 4.44	26.38	26.38
Peak – 4.44	263.8	263.8

- Results:
  The Fundamental and Harmonics field strengths did not exceed the limits specified in Table 2 at a test distance of 3 and 10 meters, taken with an Average and Peak Detector. See Table 3 for the Fundamental and Harmonic emissions test results.

Table 3 - Fundamental and Harmonics Test Results

Fundamental Frequency MHz	Maximum Fundamental µV/m	Maximum Harmonics µV/m
Average - 4.44	25.23	7.87
Peak – 4.44	12.5	0.99

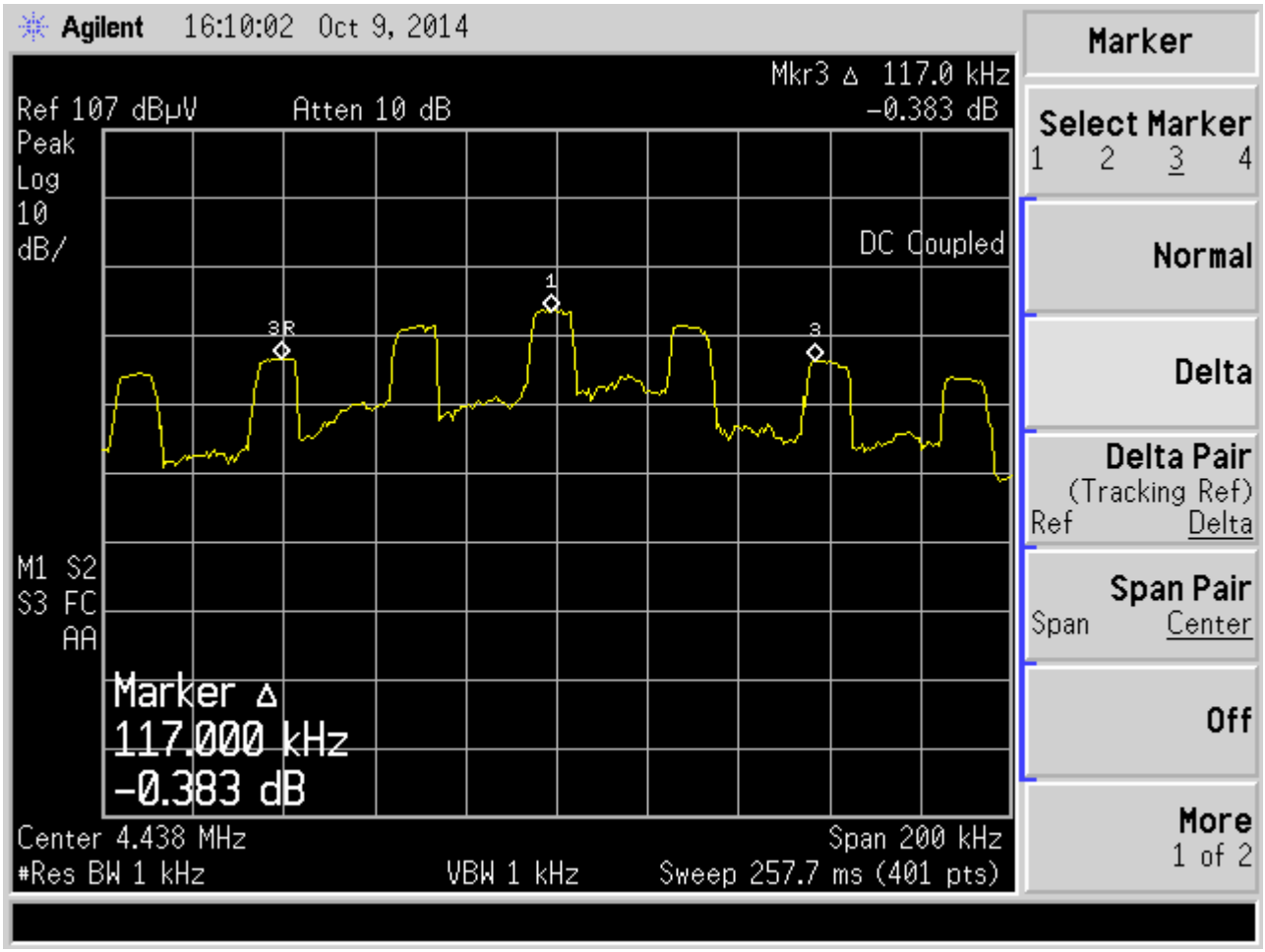
Equipment Lists

FCC Section 15.223(a) - Bandwidth
FCC Section 15.223(a) – Field Strength of Fundamental / In Band Emissions
FCC Section 15.223(b) – Out of Band / Band Edge Radiated Emissions (9 kHz to 272 MHz)

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
3207	EMCO	ACTIVE LOOP	10 KHZ- 30 MHZ	6502	1/22/2014	1/31/2015
8076	AGILENT / HP	SPECTRUM ANALYZER	100 Hz - 1.5 GHz	8568B	10/18/2013	10/31/2014
8077	AGILENT / HP	SPECTRUM ANALYZER		85662A	10/18/2013	10/31/2014
8079	ROHDE & SCHWARZ	EMI TEST RECEIVER		ESH3	6/30/2014	6/30/2015
8080	ROHDE & SCHWARZ	EMI TEST RECEIVER	20-1300 MHz	354-3000.56ESVP	12/16/2013	12/31/2014
8411	SONOMA INSTRUMENT	PRE-AMPLIFIER	9 kHz - 1 GHz	310N	9/4/2014	9/30/2015
8433	ETS LINDGREN	BICONILOG	20 - 6000 MHz	3142D	3/10/2014	9/30/2015

FCC Part 15, Subpart C
15.223(a), Bandwidth
4 MHz to 10 MHz
Test Data

EMISSIONS TEST DATA SHEET	
Test Specification:	**FCC Part 15, Subpart C**
Method:	15.223(a) Bandwidth
Job Number/Customer:	R – 2215P / Bombardier Transportation
Test Sample:	4.5 MHz Transponder
Model Number:	JGA 29001/6
Serial Number:	E1514000001
Operating Mode:	Continuously Sending Data
Technician:	D. Rybicki
Date(s):	10/10/14
Temperature:	15.6 ºC
Relative Humidity:	50 %



FCC Part 15, Subpart C
15.223 (b), Out of Band / Band Edge Radiated Emissions
9 kHz to 1.705 MHz
10 MHz to 272 MHz
Test Data

EMISSIONS TEST DATA SHEET

Test Specification:	**FCC Part 15, Subpart C**
Method:	15.223(a) Field Strength of Fundamental/In Band Emissions
Job Number/Customer:	R – 2215P / Bombardier Transportation
Test Sample:	4.5 MHz Transponder
Model Number:	JGA 29001/6
Serial Number:	E1514000001
Operating Mode:	Continuously Sending Data
Technician:	D. Rybicki
Date(s):	10/10/14
Temperature:	15.6 ºC
Relative Humidity:	50 %
Test Distance:	10 m converted to 30m
Detector:	Average

TEST PARAMETERS

Frequency	Antenna Polarization	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading	Corrected Reading	Limit
MHz	**Horizontal / Vertical**	**Degrees**	**dBuV**	**dB**	**dBuV/m**	**uV/m**	**uV/m**
4.00							26.38
I							I
4.4039	Parallel	109.6	27.5	-9.36	18.14	8.07	I
4.4039	Perpendicular	98.0	15.9	-9.36	6.54	2.12	I
I							I
4.4357	Parallel	125.9	31.3	-9.36	21.94	12.50	I
4.4357	Perpendicular	152.0	12.4	-9.36	3.04	1.42	I
I							I
4.4684	Parallel	103.7	27.9	-9.36	18.54	8.45	I
4.4684	Perpendicular	106.0	11.3	-9.36	1.94	1.25	I
I							I
4.4998	Parallel	98.2	24.0	-9.36	14.64	5.40	I
4.4998	Perpendicular	104.7	14.5	-9.36	5.14	1.81	I
I							I
8.8714	Parallel	88.4	7.2	-9.28	-2.08	0.79	I
8.8714	Perpendicular	132.7	9.2	-9.28	-0.08	0.99	I
I							I
10.00							26.38

The frequency range was scanned from 4 MHz to 10 MHz
The emissions observed from the EUT do exceed the limits specified. All emissions not recorded were more than 20dB below the specified limit

EMISSIONS TEST DATA SHEET

Test Specification:	**FCC Part 15, Subpart C**
Method:	15.223(a) Field Strength of Fundamental/In Band Emissions
Job Number/Customer:	R – 2215P / Bombardier Transportation
Test Sample:	4.5 MHz Transponder
Model Number:	JGA 29001/6
Serial Number:	E1514000001
Operating Mode:	Continuously Sending Data
Technician:	D. Rybicki
Date(s):	10/10/14
Temperature:	15.6 ºC
Relative Humidity:	50 %
Test Distance:	10 m converted to 30m
Detector:	Peak

TEST PARAMETERS

Frequency	Antenna Polarization	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading	Corrected Reading	Limit
MHz	Horizontal / Vertical	Degrees	dBuV	dB	dBuV/m	uV/m	uV/m
4.00							263.8
I							I
4.4039	Parallel	109.6	33.5	-9.36	24.14	16.11	I
4.4039	Perpendicular	98.0	29.9	-9.36	20.54	10.64	I
I							I
4.4357	Parallel	125.9	37.4	-9.36	28.04	25.23	I
4.4357	Perpendicular	152.0	28.1	-9.36	18.74	8.65	I
I							I
4.4684	Parallel	103.7	37.3	-9.36	27.94	24.94	I
4.4684	Perpendicular	106.0	28.4	-9.36	19.04	8.95	I
I							I
4.4998	Parallel	98.2	36.8	-9.36	27.44	23.55	I
4.4998	Perpendicular	104.7	34.0	-9.36	24.64	17.06	I
I							I
8.8714	Parallel	88.4	22.3	-9.28	13.02	4.48	I
8.8714	Perpendicular	132.7	27.2	-9.28	17.92	7.87	I
I							I
10.00							263.8

The frequency range was scanned from 4 MHz to 10 MHz
The emissions observed from the EUT do exceed the limits specified. All emissions not recorded were more than 20dB below the specified limit

FCC Part 15, Subpart C
15.223 (b), Out of Band / Band Edge Radiated Emissions
9 kHz to 1.705 MHz
10 MHz to 272 MHz
Test Data

EMISSIONS TEST DATA SHEET

Test Specification:	**FCC Part 15, Subpart C**
Method:	15.223(b) Out of Band / Band Edge Radiated Emissions
Job Number/Customer:	R – 2215P / Bombardier Transportation
Test Sample:	4.5 MHz Transponder
Model Number:	JGA 29001/6
Serial Number:	E1514000001
Operating Mode:	Continuously Sending Data
Technician:	B. Freedman / D. Rybicki
Date(s):	10/10/14
Temperature:	20.3 ºC
Relative Humidity:	47 %
Test Distance:	10 m converted to limit specified distance
Detector:	Quasi-Peak

TEST PARAMETERS

Frequency	Antenna Polarization	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading	Corrected Reading	Limit
MHz	Horizontal / Vertical	Degrees	dBuV	dB	dBuV/m	uV/m	uV/m
0.009							266.67 @ 300m
I							I
0.490							4.90 @ 300m
0.490							48.97 @ 30m
I							I
1.705							14.08 @ 30m
10.00							30.00 @ 30m
I							I
13.3071	Parallel	180.0	13.1	1.26	14.36	5.16	I
13.3071	Perpendicular	180.0	9.0	1.26	10.26	3.26	I
I							I
17.7428	Parallel	180.0	10.5	1.15	11.65	3.82	I
17.7428	Perpendicular	180.0	8.0	1.15	9.15	2.87	I
I							I
22.1785	Parallel	180.0	7.5	0.61	8.11	2.54	I
22.1785	Perpendicular	180.0	6.1	0.61	6.71	2.17	I
I							I
26.6142	Parallel	180.0	4.8	-0.12	4.68	1.71	I
26.6142	Perpendicular	180.0	18.3	-0.12	18.18	8.11	I
I							I
30.00							30.00 @ 30m

The frequency range was scanned from 9 kHz to 10 MHz and from 10 MHz to 30 MHz
The emissions observed from the EUT do not exceed the limits specified. All emissions not recorded were more than 20dB below the specified limit

EMISSIONS TEST DATA SHEET

Test Specification:	**FCC Part 15, Subpart C**
Method:	15.223(b) Out of Band / Band Edge Radiated Emissions
Job Number/Customer:	R – 2215P / Bombardier Transportation
Test Sample:	4.5 MHz Transponder
Model Number:	JGA 29001/6
Serial Number:	E1514000001
Operating Mode:	Continuously Sending Data
Technician:	B. Freedman / D. Rybicki
Date(s):	10/10/14
Temperature:	20.3 ºC
Relative Humidity:	47 %
Test Distance:	3 m
Detector:	Quasi-Peak

TEST PARAMETERS

Frequency	Antenna Polarization	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading	Corrected Reading	Limit
MHz	**Horizontal / Vertical**	**Degrees**	**dBuV**	**dB**	**dBuV/m**	**uV/m**	**uV/m**
30.00							100.00
I							I
31.0499	H / 1.00	180.0	11.7	17.56	29.26	29.07	I
31.0499	V / 1.00	180.0	20.1	17.56	37.66	76.38	I
I							I
34.4856	H / 1.00	180.0	9.9	15.68	25.58	19.01	I
34.4856	V / 1.00	180.0	20.8	15.68	36.48	66.68	I
I							I
39.9213	H / 4.00	180.0	10.7	12.84	23.54	15.03	I
39.9213	V / 1.00	180.0	17.4	12.84	30.24	32.51	I
I							I
44.3570	H / 4.00	180.0	15.3	10.97	26.27	20.58	I
44.3570	V / 1.00	180.0	19.3	10.97	30.27	32.62	I
I							I
88.00							100.00
88.00							150.00
I							I
216.00							150.00
216.00							200.00
I							I
272.00							200.00

The frequency range was scanned from 30 MHz to 272 MHz
The emissions observed from the EUT do not exceed the limits specified. All emissions not recorded were more than 20dB below the specified limit