Excellence in Compliance Testing

Certification Test Report

FCC ID: AJKPN822-2365

FCC Rule Part: CFR 47 Part 87

ACS Report Number: 10-0105.W03.11.A

Manufacturer: Rockwell Collins, Inc.
Model: LRA-2100

Test Begin Date: March 29, 2010
Test End Date: March 30, 2010

Report Issue Date: April 26, 2010

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report is not be used to claim certification, approval, or endorsement by NVLAP, NIST or any government agency.

Reviewed by: _____
Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

This report contains 17 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 2 Subpart J and Part 87 of the FCC's Code of Federal Regulations.

1.2 Product description

The LRA-2100 is a Digital Low-range Radio Altimeter (DLRA) designed to operate in the 4200 MHz to 4400 MHz band, per paragraph 87.173 under 14 CFR part 87. This frequency band is designated under Part 87 for use in Aeronautical Radionavigation.

The LRA-2100 transmits over the frequencies from 4225 MHz to 4375 MHz.

Manufacturer Information:
Rockwell Collins, Inc.
1100 W. Hibiscus Blvd.
Melbourne, FL 32901

Test Sample Serial Numbers: 34YWM

Test Sample Condition: The test samples were provided in good working order with no visible defects.

Detailed photographs of the EUT are filed separately with this filing.

1.3 Test Methodology and Considerations

The LRA-2100 was tested for frequency stability with the swept frequency function disabled with measurements made at the low and high end of the swept frequency range. All other measurements were made with the LRA-2100 functioning in normal swept frequency mode.

For radiated emissions the RF output ports were terminated in 50 Ohm non-radiated loads.

1.4 Emission Designator

The LRA-2100 produces a linear Frequency Modulated Continuous Wave (FMCW). Modulation is centered at 4300 MHz and linearly sweeps +/- 75 MHz.

Emissions Designator: 150MFXN

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment. In addition, ACS is compliant to ISO/IEC 17025 as certified by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 894540
Industry Canada Lab Code: IC 4175A-1
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

NVLAP Lab Code: 200612-0

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

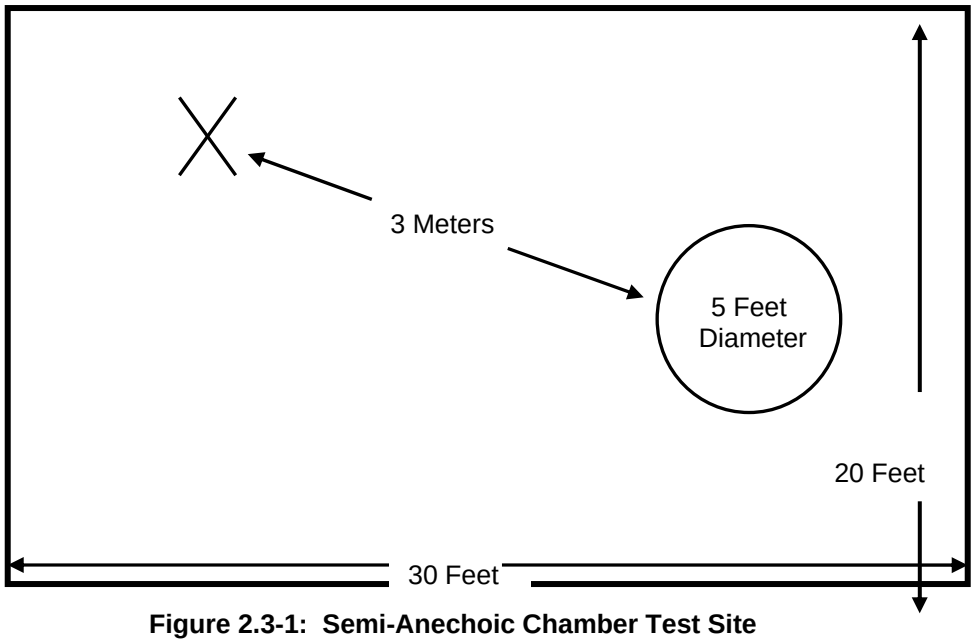

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2

Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

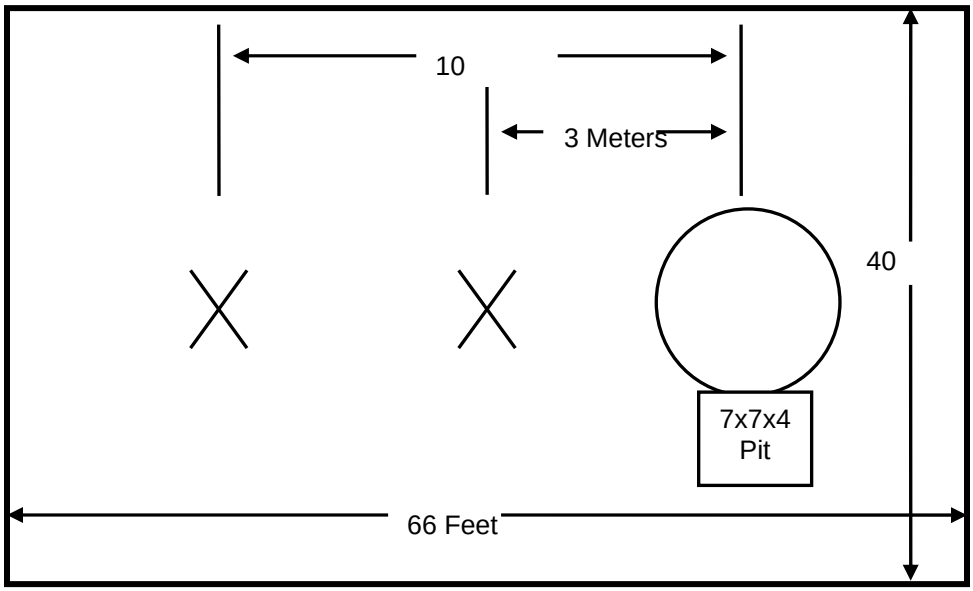

Figure 2.3-2: Open Area Test Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz - 2003
- 2 -US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures – 2009
- US Code of Federal Regulations (CFR): Title 47, Part 87, Aviation Services – 2009
- TIA-603-C: Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards – 2004

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

Equipment Calibration Information					
ACS#	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
1	Rohde & Schwarz	Spectrum Analyzers	ESMI - Display	833771/007	09-21-2010
2	Rohde & Schwarz	Spectrum Analyzers	ESMI-Receiver	839587/003	09-21-2010
25	Chase	Antennas	CBL6111	1043	09-02-2010
30	Spectrum Technologies	Antennas	DRH-0118	970102	05-08-2010
73	Agilent	Amplifiers	8447D	2727A05624	07-15-2010
167	ACS	Cable Set	Chamber EMI Cable Set	167	01-25-2011 (See Note1)
222	Andrew	Cables	F1-SMSM	473703-A0138A	08-14-2010 (See Note1)
267	Agilent	Power Meter	N1911A	MY45100129	11/16/2010
268	Agilent	Power Sensor	N1921A	MY45240184	11/16/2010
283	Rohde & Schwarz	Spectrum Analyzers	FSP40	1000033	09-21-2010
291	Florida RF Cables	Cables	SMRE-200W-12.0-SMRE	None	11-24-2010 (See Note1)
292	Florida RF Cables	Cables	SMR-290AW-480.0-SMR	None	11-24-2010 (See Note1)
329	A.H.Systems	Antennas	SAS-571	721	08-04-2010
332	Rohde & Schwarz	Amplifier	TS- PR40	100021	10-16-2010
333	Rohde & Schwarz	Antennas	3160-09	00049404	No Cal Req
334	Rohde & Schwarz	Antennas	3160-10	00045576	No Cal Req
335	Suhner	Cables	SF-102A	882/2A	10-16-2010
338	Hewlett Packard	Amplifiers	8449B	3008A01111	10-16-2010
340	Weinschel	Attenuators	AS-20	7136	10-16-2010 (See Note2)
346	Weinschel	Attenuators	54A-10	T1362	09-02-2010 (See Note2)
422	Florida RF	Cables	SMS-200AW-72.0-SMR	805	01-26-2011 (See Note1)
RE7	Agilent	Signal Generator	E8257D	MY46521977	06-10-2010

Note1: Items characterized on an annual cycle. The date shown indicates the next characterization due date.
Note2: Items verified on an annual cycle. The date shown indicates the next verification due date.

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Manufacturer	Equipment Type	Model Number	Serial Number
1	Narda	Termination	4377BM	N/A
2	Rockwell	Wiring Harness	N/A	N/A
3	Rockwell	Breakout Box	N/A	N/A
4	Elgar	Power Supply	CW1251M-LS	0036A1034
5	AeroFlex	Bus Analyzer	DT400H	N02202105
6	N/A	BNC Cables	RG-59B/U	N/A
7	Condor	12V AC Adaptor	D12-15A	3050
8	Narda	Directional Coupler	4244-10	7547
9	Narda	Attenuator	4774-40	N/A
10	Pasternak	Attenuator	7005-40	N/A
11	Teledyne	Delay Device	MBG1026B	26
12 (ACS Asset #346)	Weinschel	Attenuator	54A-10	T1362

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

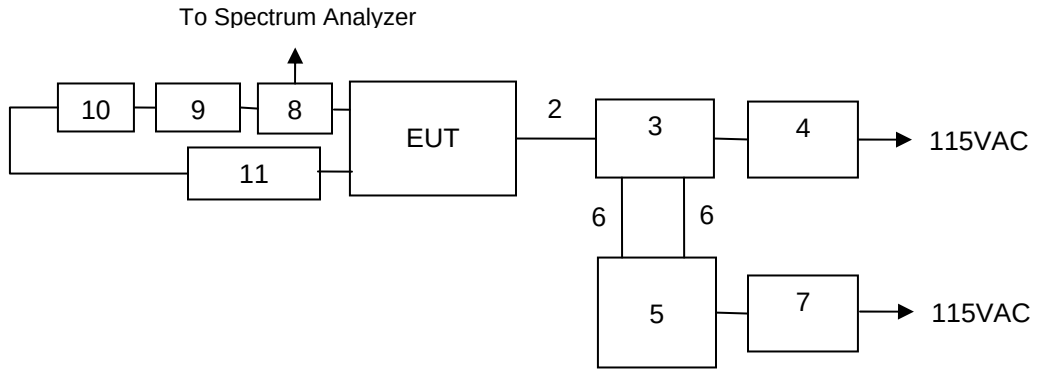

Figure 1: Frequency Stability / Output Power / Occupied Bandwidth Test Setup

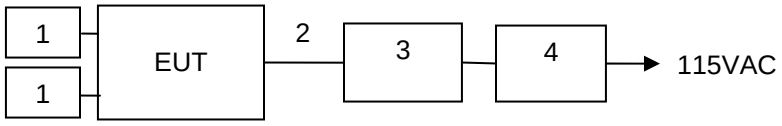

Figure 2: Radiated Emissions Test Setup

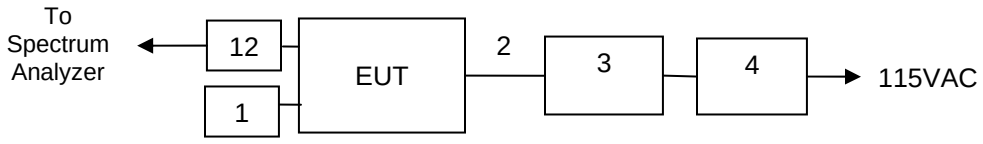

Figure 3: Spurious Emissions at Antenna Terminal Test Setup

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 RF Power Output – FCC Part 87.131

7.1.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the power meter through a 10 dB passive attenuator. The internal correction factors of the power meter were employed to correct for any cable or attenuator losses. Results are shown below.

7.1.2 Measurement Results

Table 7.1.2-1: Peak Output Power

Frequency (MHz)	Output Power (dBm)
4225-4375	25.36

7.2 Occupied Bandwidth (Emission Limits) – FCC Part 87.135

7.2.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through a 10 dB passive attenuator. The spectrum analyzer resolution and video bandwidths were set to 1 MHz and 3 MHz respectively. The internal correction factors of the spectrum analyzer were employed to correct for any cable or attenuator losses. The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% occupied bandwidth. Results of the test are shown below.

7.2.2 Measurement Results

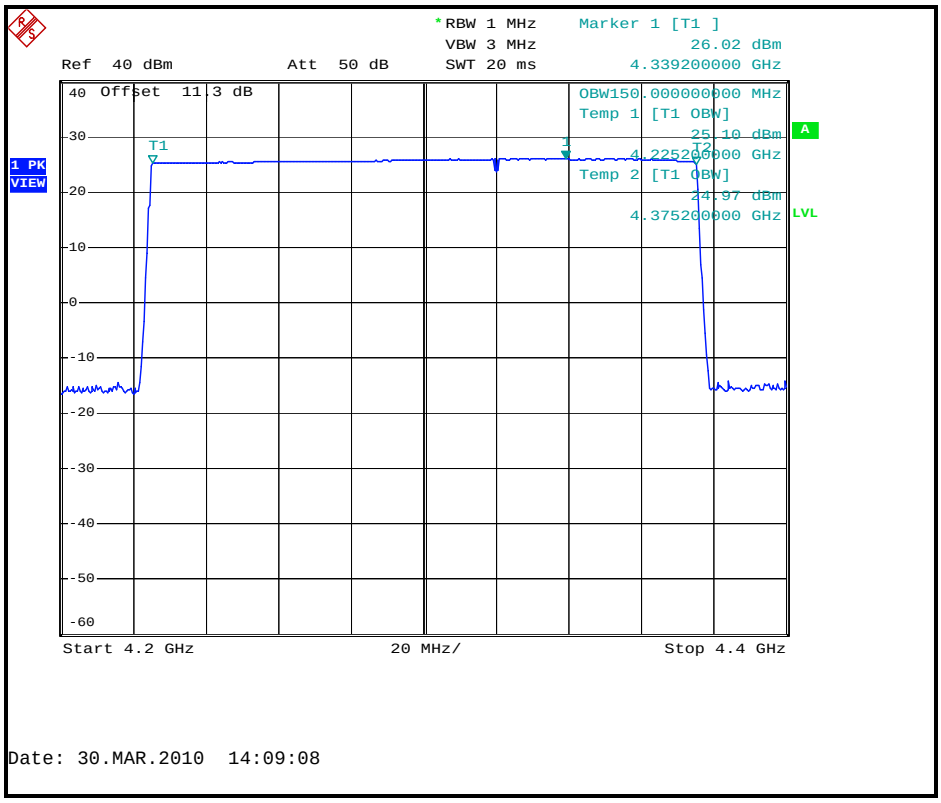

Figure 7.2.2-1: Occupied Bandwidth

7.3 Spurious Emissions at Antenna Terminals – FCC Part 87.139

7.3.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through a 10 dB passive attenuator. The spectrum analyzer resolution bandwidth was set to 1 MHz. The internal correction factors of the spectrum analyzer were employed to correct for any cable or attenuator losses. The spectrum was investigated in accordance to CFR 47 Part 2.1057. Results of the test are shown below.

7.3.2 Measurement Results

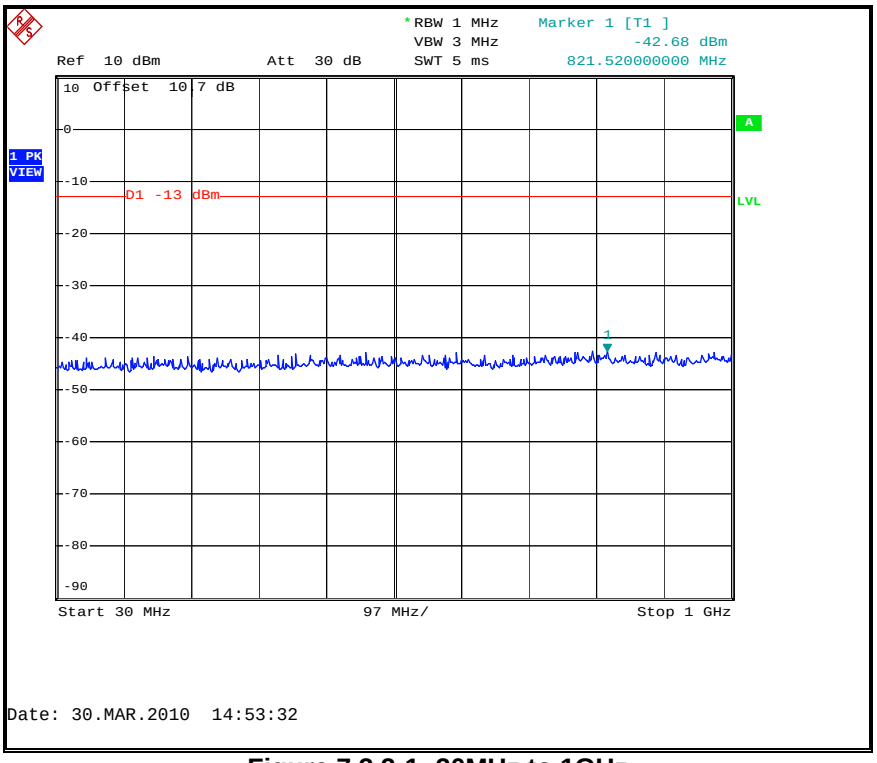

Figure 7.3.2-1: 30MHz to 1GHz

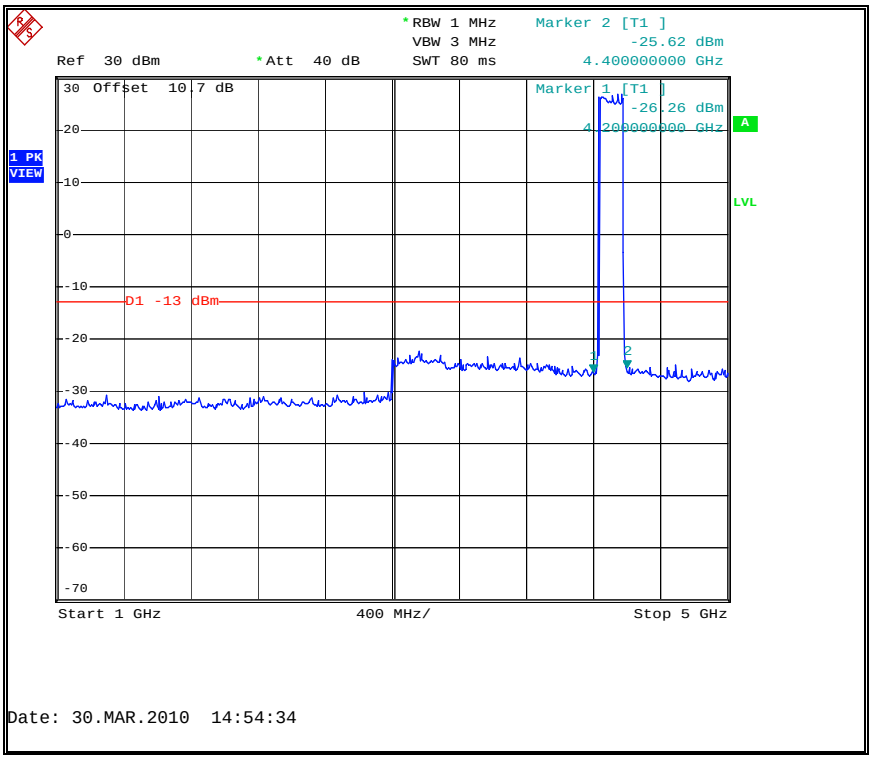

Figure 7.3.2-2: 1GHz to 5GHz

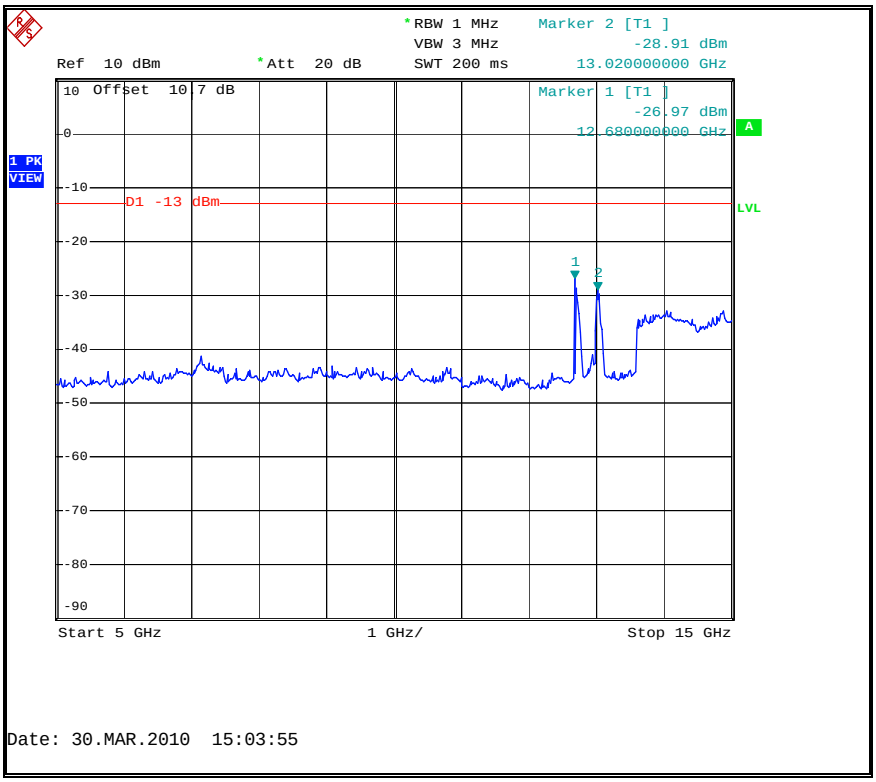

Figure 7.3.2-3: 5GHz to 15GHz

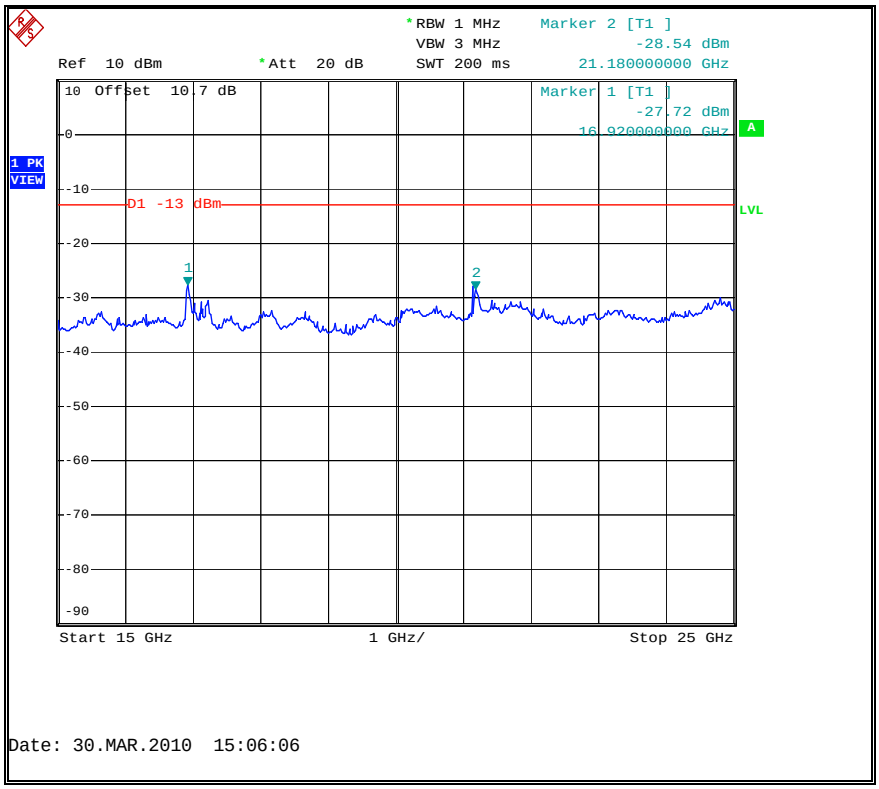

Figure 7.3.2-4: 15GHz to 25GHz

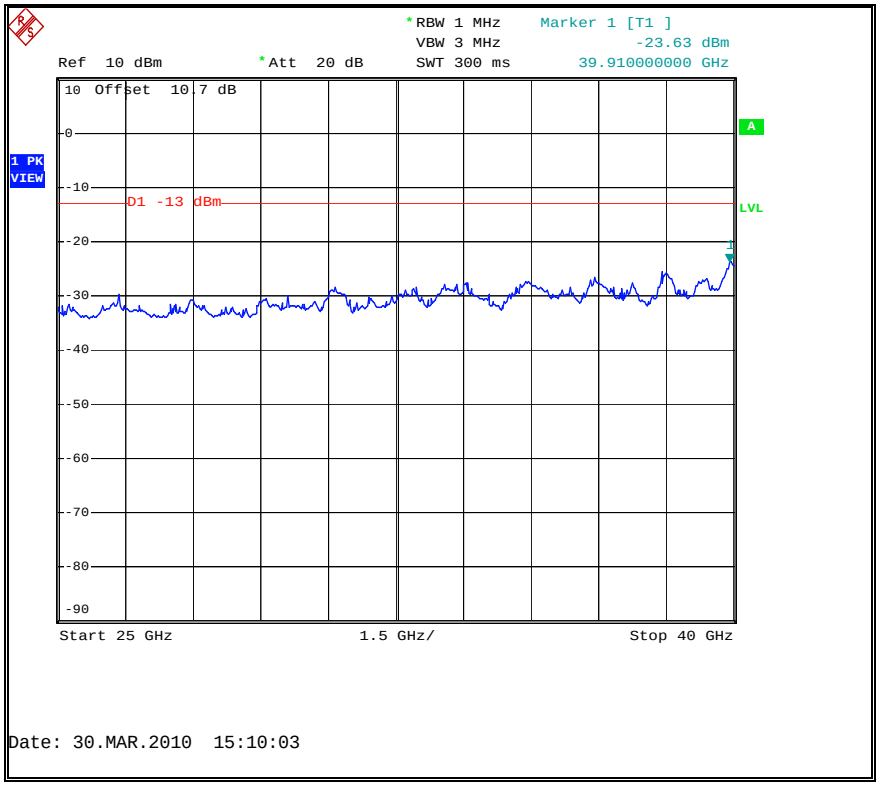

Figure 7.3.2-5: 25GHz to 40GHz

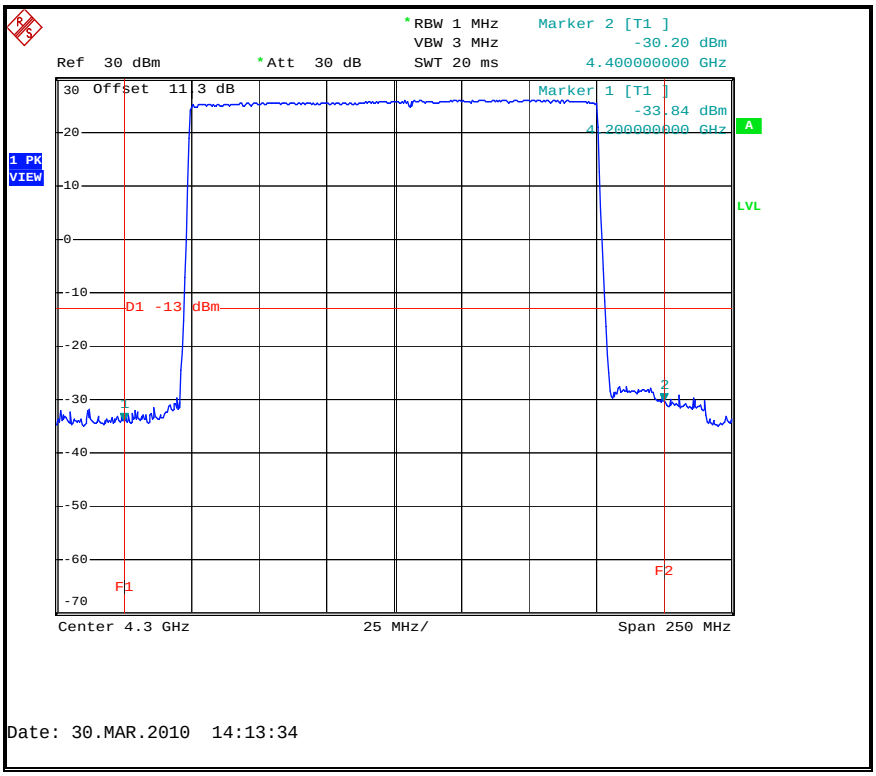

Figure 7.3.2-6: Band-edge

7.4

Field Strength of Spurious Emissions – FCC Part 87.139

7.4.1 Measurement Procedure

The equipment under test is placed in the Semi-Anechoic Chamber (described in section 2.3.1) on a wooden table at the turntable center. For each spurious emission, the antenna mast is raised and lowered from one (1) to four (4) meters and the turntable is rotated 360º and the maximum reading on the spectrum analyzer is recorded. This was repeated for both horizontal and vertical polarizations of the receive antenna.

The equipment under test is then replaced with a substitution antenna fed by a signal generator. The signal generator's frequency is set to that of the spurious emission recorded from the equipment under test. The antenna mast is raised and lowered from one (1) to four (4) meters to obtain a maximum reading on the spectrum analyzer. The output of the signal generator is then adjusted until the reading on the spectrum analyzer matches that obtained from the equipment under test. The signal generator level is recorded. The power in dBm of each spurious emission is calculated by correcting the signal generator level for the cable loss and gain of the substitution antenna referenced to a dipole. The spectrum was investigated in accordance to CFR 47 Part 2.1057.

Results of the test are shown below. The magnitude of all spurious emissions not reported were attenuated below the noise floor of the measurement system and therefore not specified in this report.

7.4.2 Measurement Results

All spurious emissions were below the noise floor of the measurement system and therefore attenuated below the transmit power (P) in watts by $43 + 10 \log_{10} (P)$ dB.

7.5

Frequency Stability – FCC Part 87.133

7.5.1 Measurement Procedure

The equipment under test is placed inside an environmental chamber. The RF output is directly coupled to the input of the measurement equipment via a 10 dB attenuator and a power supply is attached to the primary supply voltage.

Frequency measurements were made at the extremes of the of temperature range -20º C to +50º C and at intervals of 10º C at normal supply voltage. A period of time sufficient to stabilize all components of the equipment was allowed at each frequency measurement. At a temperature 20º C the supply voltage was varied to 85% and 115% of the nominal supply voltage. The maximum variation of frequency was recorded.

7.5.2 Measurement Results

Frequency Stability

Frequency (MHz): 4225

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VAC)
-20 C	**4224.998845**	**-0.273**	100%	115.00
-10 C	**4224.998797**	**-0.285**	100%	115.00
0 C	**4224.998685**	**-0.311**	100%	115.00
10 C	**4224.998292**	**-0.404**	100%	115.00
20 C	**4224.998531**	**-0.348**	100%	115.00
30 C	**4224.998748**	**-0.296**	100%	115.00
40 C	**4224.998850**	**-0.272**	100%	115.00
50 C	**4224.998872**	**-0.267**	100%	115.00
20 C	**4224.998515**	**-0.351**	85%	97.75
20 C	**4224.998518**	**-0.351**	115%	132.25

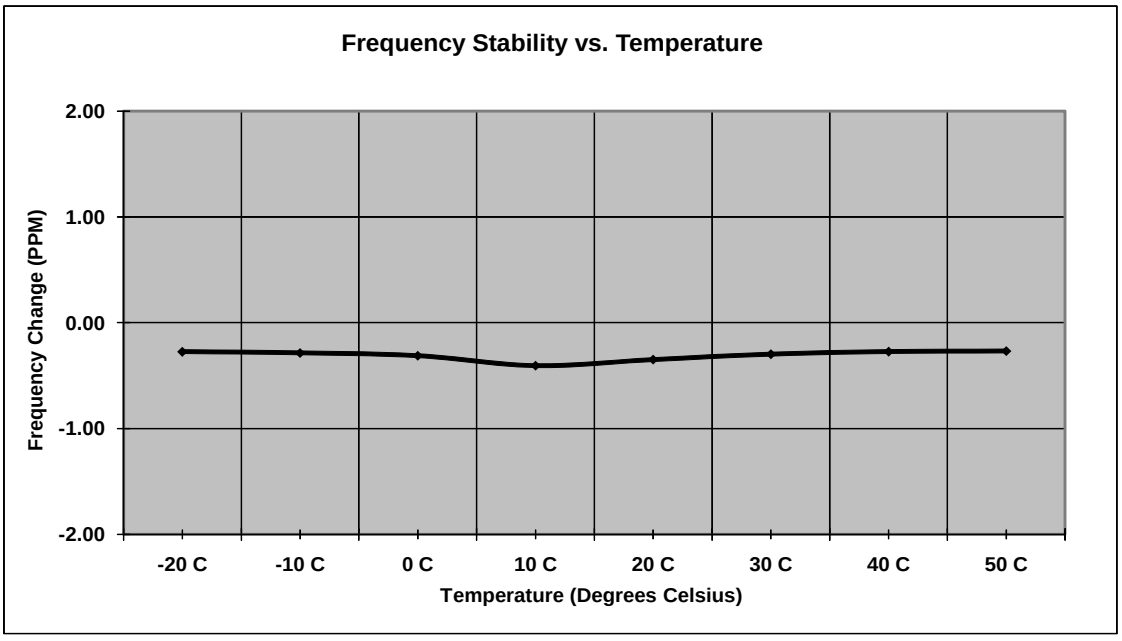

Figure 7.5.2-1: Frequency Stability – Low Channel

Frequency Stability

Frequency (MHz): 4375

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VAC)
-20 C	**4374.998718**	**-0.293**	100%	115.00
-10 C	**4374.998988**	**-0.231**	100%	115.00
0 C	**4374.998549**	**-0.332**	100%	115.00
10 C	**4374.998196**	**-0.412**	100%	115.00
20 C	**4374.998466**	**-0.351**	100%	115.00
30 C	**4374.998775**	**-0.280**	100%	115.00
40 C	**4374.998748**	**-0.286**	100%	115.00
50 C	**4374.998817**	**-0.270**	100%	115.00
20 C	**4374.998464**	**-0.351**	85%	97.75
20 C	**4374.998466**	**-0.351**	115%	132.25

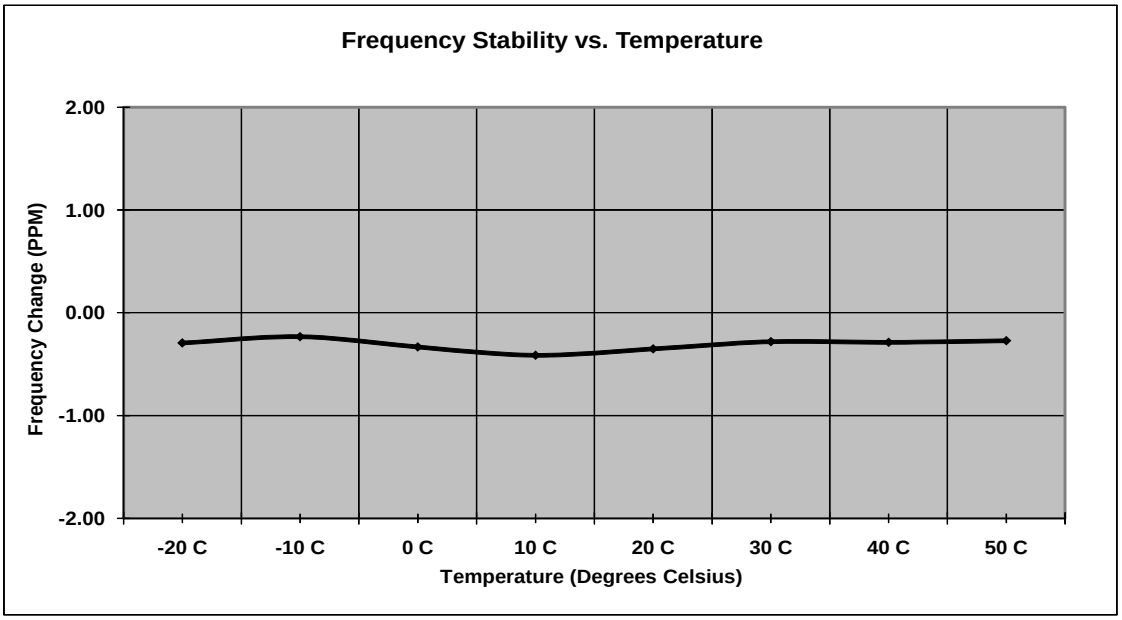

Figure 7.5.2-2: Frequency Stability – High Channel

8 CONCLUSION

In the opinion of ACS, Inc. the model LRA-2100, manufactured by Rockwell Collins, Inc. meets all the requirements of FCC Part 87 as applicable.

End Report