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ETC Report No.: t16e5034 Release1

Date: 2013-07-18

Emissions Testing of the RBB 850

In accordance with FCC Part 2.1053, Part 22 H, RSS-131 section 6.3.1 and 6.3.2.

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Prepared for: **Telcosat Inc.**

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1.0 INTRODUCTION

1.1 **Scope of report**

The purpose of this report is to present the results of compliance testing performed in accordance with FCC Part 2.1053, Part 22 H , RSS-GEN and RDD-131 section 6.3. All test procedures, limits, criteria, and results described in this report apply to the Telcosat Inc. RBB 850 test sample, referred to herein as the Equipment Under Test (EUT).

Test results reported in this document apply only to the test sample. This report does not imply product endorsement by the Electronics Test Centre (Airdrie), SCC, NAVLP, A2LA, or any Canadian Government agency.

1.2 **Applicant**

This test report has been prepared for Telcosat Inc., located in Calgary, Alberta, Canada.

1.3 **Test sample description**

As provided to ETC (Airdrie) by Telcosat Inc.:

Product Name:	Repeater (Base Station)
Model #	RBB 850
Serial #	000001
Size(cm)	47x 30.5 x7 6
Weight	25 Pounds (11.4 Kilograms)
Functional Description	Cellular booster/repeater. It increases the coverage and capacity of existing cellular wireless network for both indoor and outdoor use. GSM, EDGE and WCDMA protocols can simultaneously operate on the same unit.
Power:	110 to 240 VAC, Power Consumption= 20 Watts

More detailed information has been provided by Telcosat Inc. in Appendix A.

1.4 **General test conditions and assumptions**

The EUT was only operated and exercised in the mode(s) and configuration(s) described in this report.

All inputs and outputs to and from support equipment associated with the EUT were provided or simulated under the direction and responsibility of Telcosat Inc. A description of these signals and their provision is included in Appendix A.

Ambient temperature and humidity conditions are recorded at the time of testing.

1.5 Scope of testing

Testing of the RBB 850 was performed in accordance with FCC Part 2.1053, in order to verify that any emissions are below the limit given by 22.917(a) using the test methods described in EIA/TIA 603 and ANSI C63.4:2003.

1.5.1 Variations in test methodology

There were no variances from the specified test methodology.

1.5.2 Test sample configurations and modifications

EUT was positioned on a non –conductive turntable, 80cm above the ground plane. A low-level signal from signal generator of both Uplink and downlink was feeded to the repeater and repeater was configured at the maximum transmitting power. The output of the repeater was terminated with 30dB/50 Ohm terminator. The radiated emission was measured at 3 m distance with a test antenna and spectrum analyzer. EUT was tested for both Downlink/Uplink (low/mid/high channels) to determine the worse case operation mode. Worst-case emission was recorded with the rotation of the turntable and the raising and lowering of the test antenna. The tests of spurious emission have been carried out with the UL 9.5 software from UL.

The EUT met the requirements without modification.

1.5.3 Cables

EUT Cable List

QTY	Routing		Description	Cable length (m)
	From	To		
1	Chamber floor connector for signal Gen.	EUT	Rf cable	1
1	AC inlet	AC Feed	Power cable	3

1.5.4 Support Equipments

Position	QTY	Description	MODEL	Serial No.
1	01.	Signal Generator	HP 4437B	US39230102

Support Cable List

QTY	Routing		Description	Cable length (m)
	From	To		
1	Signal Gen.	Chamber floor connector for EUT	Rf cable	25

2.0 MEASUREMENT UNCERTAINTY

The factors contributing to uncertainty of measurement are identified and calculated in accordance with:

UKAS (United Kingdom Accreditation Service) document
"Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002."
As based on the "ISO Guide to the Expression of Uncertainty in Measurement,
1995."

Test Method	Frequency	Uncertainty
Conducted Emissions Level	9 KHz – 150 KHz	2.8 dB
Conducted Emissions Level	150 KHz – 30 MHz	2.7 dB
Radiated Emissions Level	30 MHz – 1 GHz	4.6 dB
Radiated Emissions Level	1 GHz – 10 GHz	6 dB

3.0 TEST CONCLUSIONS

STATEMENT OF COMPLIANCE

The client equipment referred to in this report was found to be compliant with the requirements as stated below.

The EUT was subjected to the following tests. Compliance status is reported as **PASS** or **FAIL**. Test conditions that are not applicable to the EUT are marked **n/a**. If testing was not performed at this time, the appropriate field is marked **n/t**.

Note: Maintenance of compliance is the responsibility of the Manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the EUT with respect to the standards detailed in this test report.

The following table summarizes the test results in terms of the class applicable, the test sample identification, and configuration as applicable.

TEST CASE	TEST TYPE	SPECIFICATION	CLASS/ LEVEL	TEST SAMPLE	CONFIGURATION	RESULT
§3.1	Power line AC Conducted Emissions	FCC Part 15.207 RSS-GEN 7.2.2	B	RBB 850	See § 1.5.2	PASS
§3.2	Radiated Spurious Emissions	FCC Part 2.1053,22.917 RSS 131	-13 dBm	RBB 850	See § 1.5.2	PASS

3.1 Conducted Emissions (Part 15.207)

Test Lab: Electronics Test Centre (Airdrie) Test Personnel: Marc Rousseau Test Date: 2013-05-02	Product: RBB 850																								
Test Result for RBB 850: PASS																									
Objectives/Criteria The Conducted emissions produced by a system or sub-system shall not exceed the limits for the specifications as stated. The EUT was assessed against the requirements for Class B . Temperature = 21°C Humidity = 17%	Specification: Part 15.207 <table><thead><tr><th rowspan="2">Frequency (MHz)</th><th colspan="2">Class A</th><th colspan="2">Class B</th></tr><tr><th>QP</th><th>Avg</th><th>QP</th><th>Avg</th></tr></thead><tbody><tr><td>0.150 - 0.50</td><td>79</td><td>66</td><td>66 - 56</td><td>56 - 46</td></tr><tr><td>0.50 - 5.0</td><td>73</td><td>60</td><td>56</td><td>46</td></tr><tr><td>5 - 30</td><td>73</td><td>60</td><td>60</td><td>50</td></tr></tbody></table> Units of measurement are dB μ V.	Frequency (MHz)	Class A		Class B		QP	Avg	QP	Avg	0.150 - 0.50	79	66	66 - 56	56 - 46	0.50 - 5.0	73	60	56	46	5 - 30	73	60	60	50
Frequency (MHz)	Class A		Class B																						
	QP	Avg	QP	Avg																					
0.150 - 0.50	79	66	66 - 56	56 - 46																					
0.50 - 5.0	73	60	56	46																					
5 - 30	73	60	60	50																					
Refer to the test data and plots for more detail.																									

Test Setup:

Downlink Configuration:

Donor antenna port is connected to RF Generator via a 7m RF cable and Area Fill antenna port is connected to RF load. The RF generator is transmitting a W-CDMA and is located outside the chamber.

Uplink Configuration:

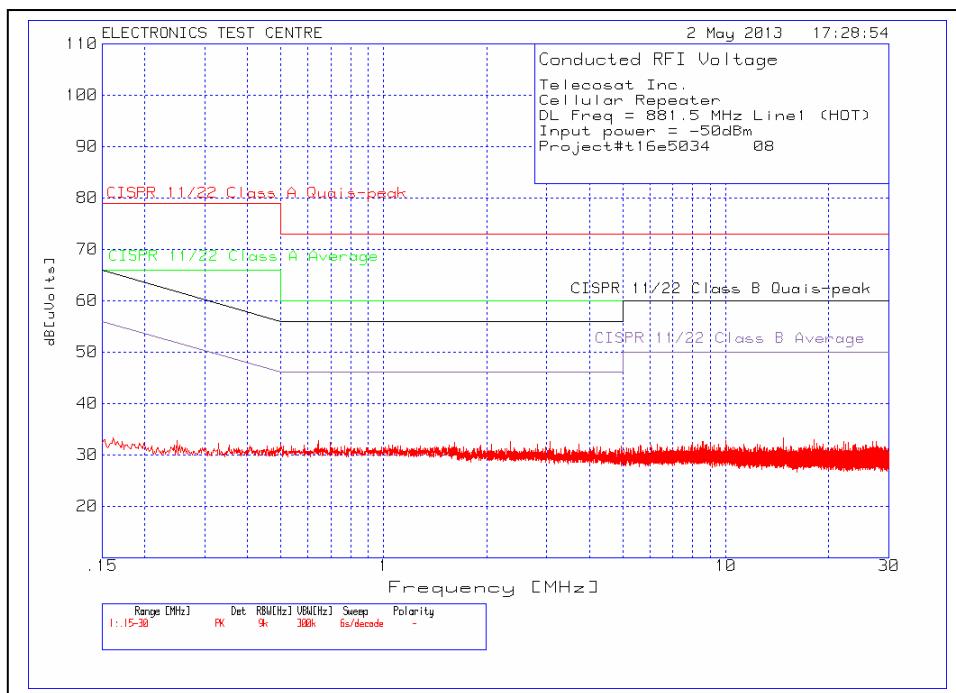
Donor antenna port is connected to RF load and Area Fill antenna port is connected to RF Generator via a 7m RF cable. The RF generator is transmitting a W-CDMA and is located outside the chamber.

Both lines of the EUT AC supply port are connected through LISNs. One Line is measured at the time.

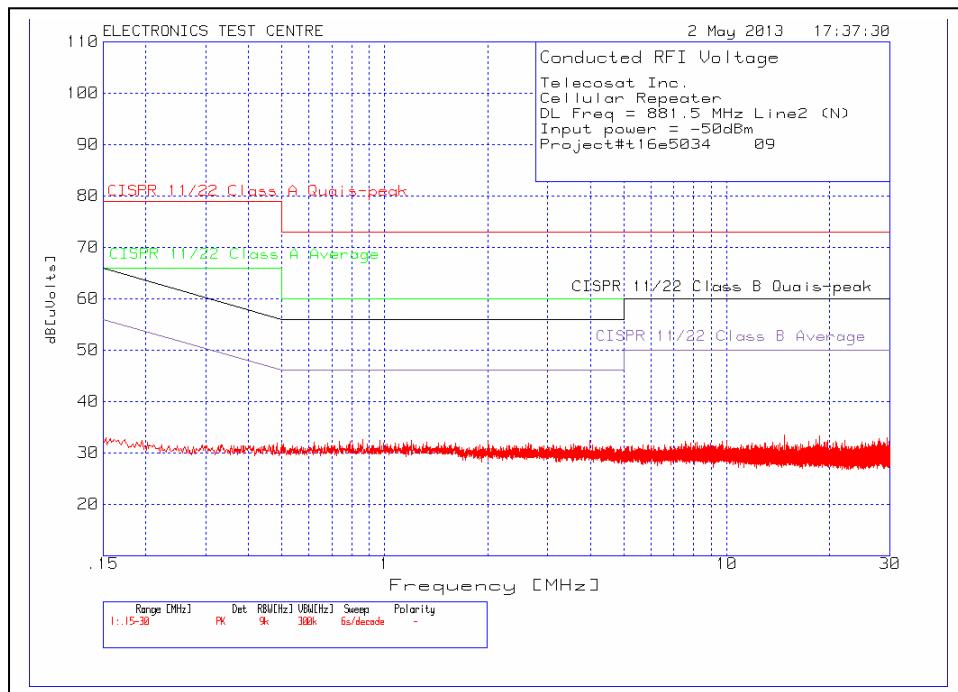
Line 1 is the AC neutral line.

Line 2 is the AC live line.

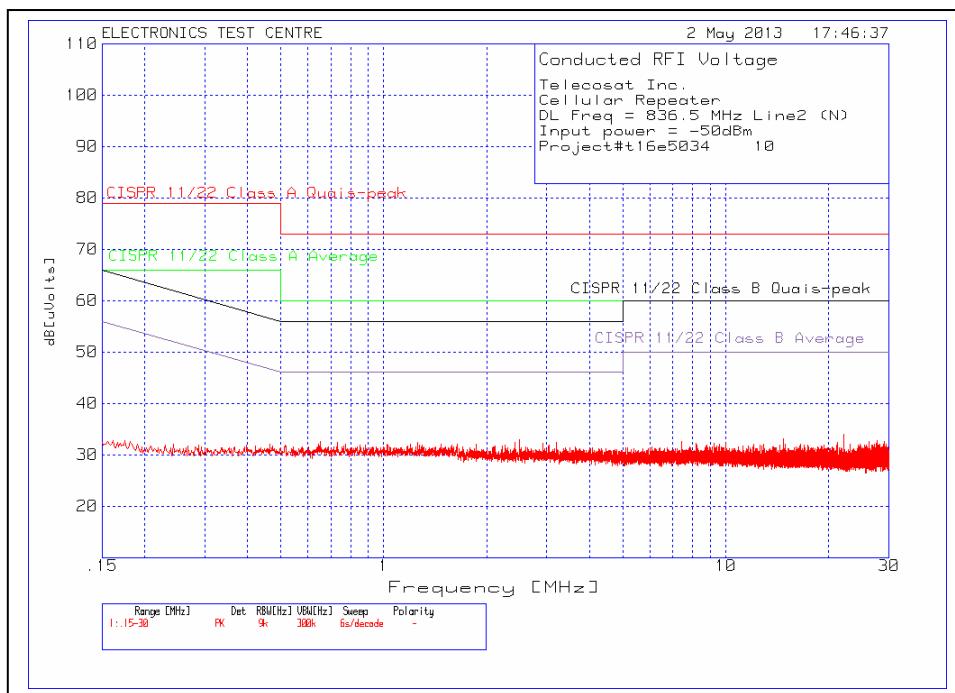
Plot of Conducted Emissions on AC Power Lines: Line 1 Downlink



Plot of Conducted Emissions on AC Power Lines: Line 2 Downlink



Plot of Conducted Emissions on AC Power Lines: Line 1 Uplink



Plot of Conducted Emissions on AC Power Lines: Line 2 Uplink

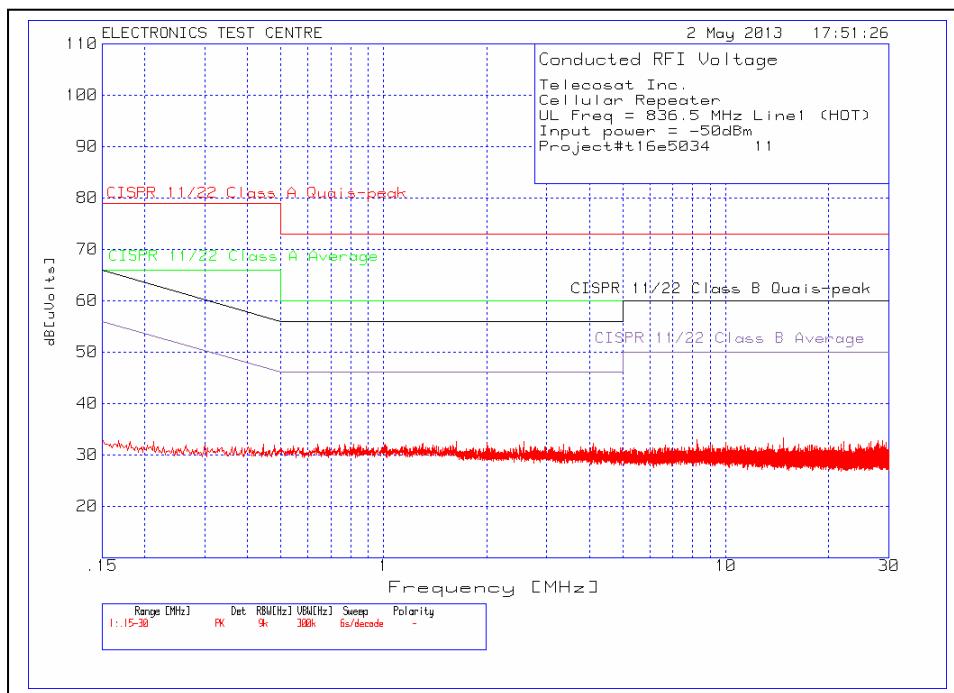


Photo of Conducted Emissions test setup:



3.2 Radiated Spurious Emissions

Test Lab: Electronics Test Centre (Airdrie) Test Personnel: Imran Akram Test Date: 2013-05-1,2	Product: RBB 850						
Test Result for RBB 850: PASS							
Objectives/Criteria The Radiated Spurious emissions produced by cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. a system or sub-system, measured at a distance of 3m from the EUT, shall not exceed the limits for the specifications as stated. Temperature =21.3°C Humidity =16.4%	Specification: FCC Part 22. 917 <table border="1"><thead><tr><th>Frequency [MHz]</th><th>Theoretical Peak@ 3m dBuV/m</th><th>ERP dBm</th></tr></thead><tbody><tr><td>30 - 10000</td><td>84.3</td><td>-13</td></tr></tbody></table> ERP Limit (dBm) = $P_d - (43 + 10 \log(P_w))$ Theoretical ERP Limit (dBuV/m) $120 + 20 \log(\text{SQRT}(49.2 * P_w) / 3)$	Frequency [MHz]	Theoretical Peak@ 3m dBuV/m	ERP dBm	30 - 10000	84.3	-13
Frequency [MHz]	Theoretical Peak@ 3m dBuV/m	ERP dBm					
30 - 10000	84.3	-13					

Test Setup:

Downlink Configuration:

Donor antenna port is connected to RF Generator via a 7m RF cable and Area Fill antenna port is connected to RF load. The RF generator is transmitting a W-CDMA and is located outside the chamber.

Uplink Configuration:

Donor antenna port is connected to RF load and Area Fill antenna port is connected to RF Generator via a 7m RF cable. The RF generator is transmitting a W-CDMA and is located outside the chamber.

Compliance Scan Summary with Radiated Data of the test plots for carrier test frequencies 836.5 MHz and 881.5 MHz.

Such factor as antenna factors, LNA Gain, cable loss etc are already included in the test results. The peak spurious emission plots were measured. In the table being, listed the critical peaks.

The EUT was tested to determine worst case operating modes (Both uplink and downlink at low/mid/high channels) to produce maximum peak spurious emissions.

Frequency (MHz)	Polarization	Measure d Level (dBuV/m)	Substitution Signal Generator. Level (dBm)	Substitution Antenna Gain. (dBD)	Tx Cable Loss (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
666	Vertical	41.2	-65	4.95	1.3	-61.35	-13	48.35
833	Vertical	42	-58.5	4.45	2.2	-56.25	-13	43.25
1082	Vertical	42.9	-60	4.45	2.3	-57.85	-13	44.85
1249	Vertical	41.7	-61	4.55	2.3	-58.75	-13	45.75
1249	Horizontal	42.6	-57	4.75	2.3	-54.55	-13	41.55
1833	Horizontal	44.8	-57	5.95	2.5	-53.55	-13	40.55
1833	Vertical	44.5	-61	6.25	2.5	-57.25	-13	44.25
4057	Horizontal	55.3	-51.5	7.65	4.6	-48.85	-13	35.45
4057	Horizontal	50.1	-59	7.65	4.1	-55.45	-13	42.45
4057	Vertical	54	-53.5	7.65	4.6	-50.45	-13	37.45
5023	Vertical	49	-61	8.75	4.8	-57.05	-13	44.05

Sample Calculation

Emission Level = Measured Level + Correction Factors

Margin = Limit – Emission Level

ERP Limit (dBm) = $P_d - (43 + 10 \log(P_w))$

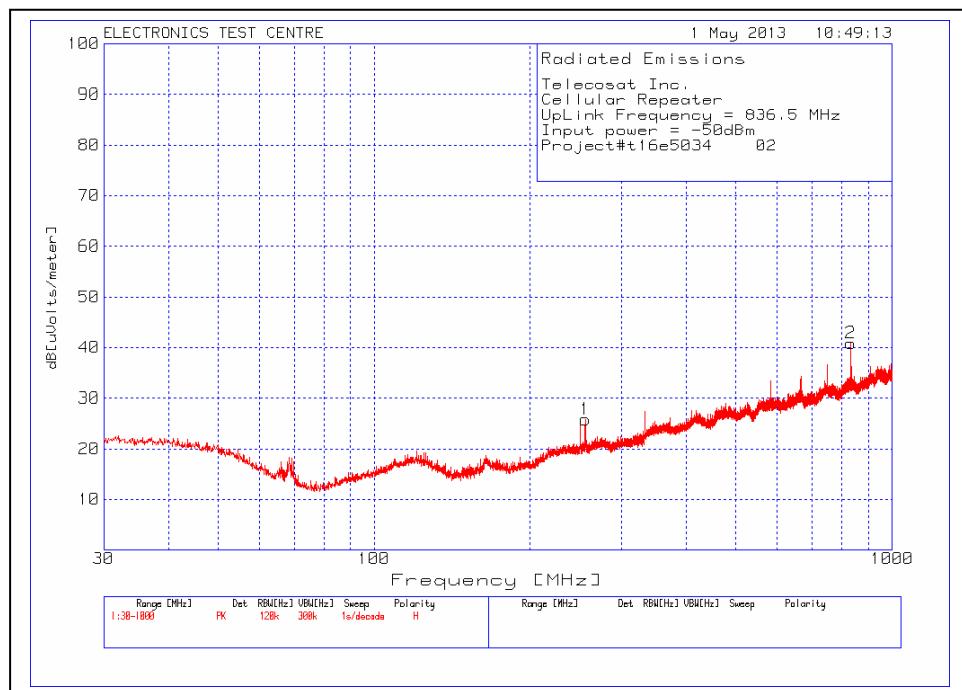
where P_d is the EUT power in dBm and P_w is the EUT power in watts

Theoretical ERP Limit (dBuV/m) $120 + 20 \log(\sqrt{49.2 \cdot P_w}) / 3$

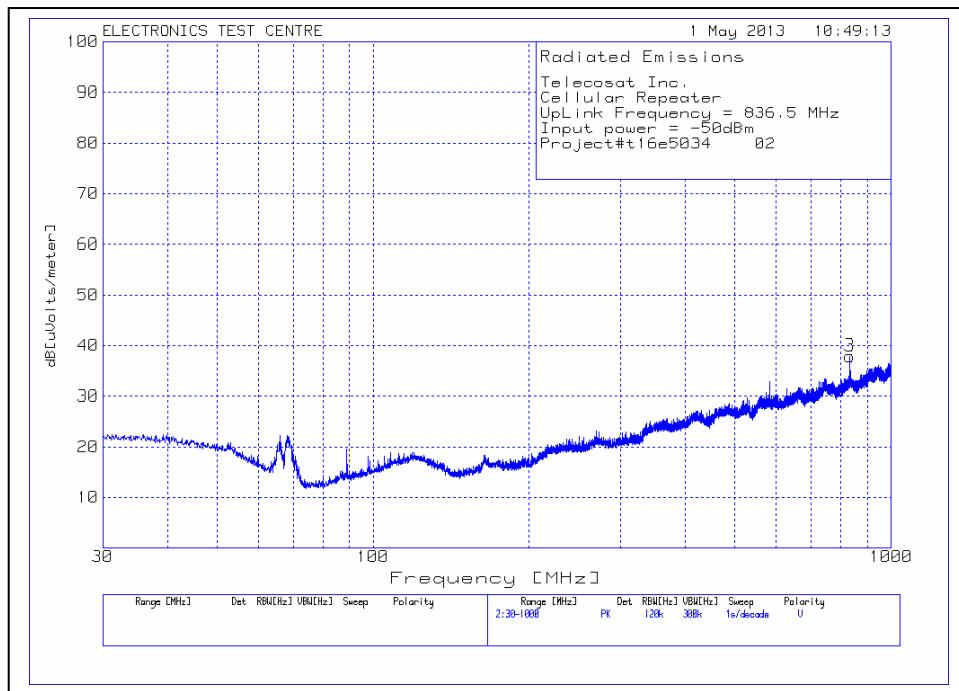
where P_w is the EUT power in watts

Frequency = 836.5 MHz

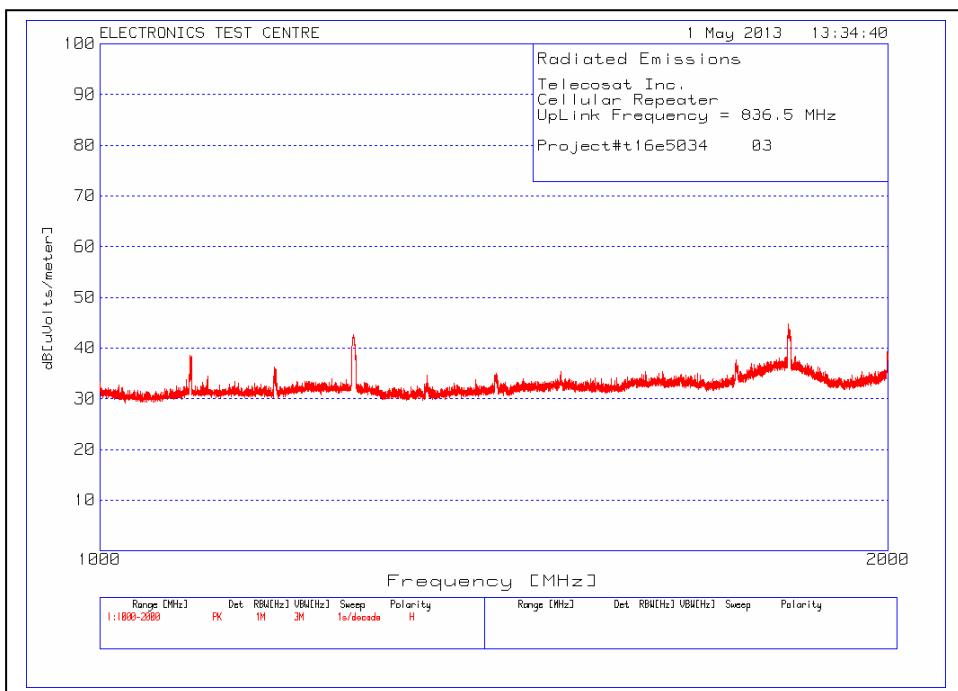
Plot of Radiated Emissions: Horizontal polarization



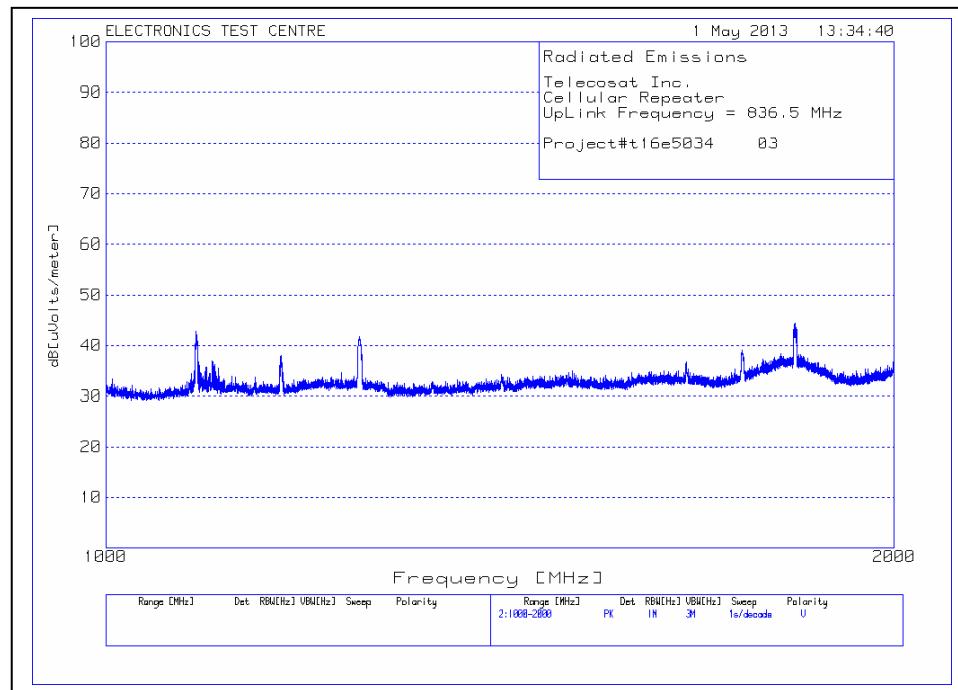
Plot of Radiated Emissions: Vertical polarization



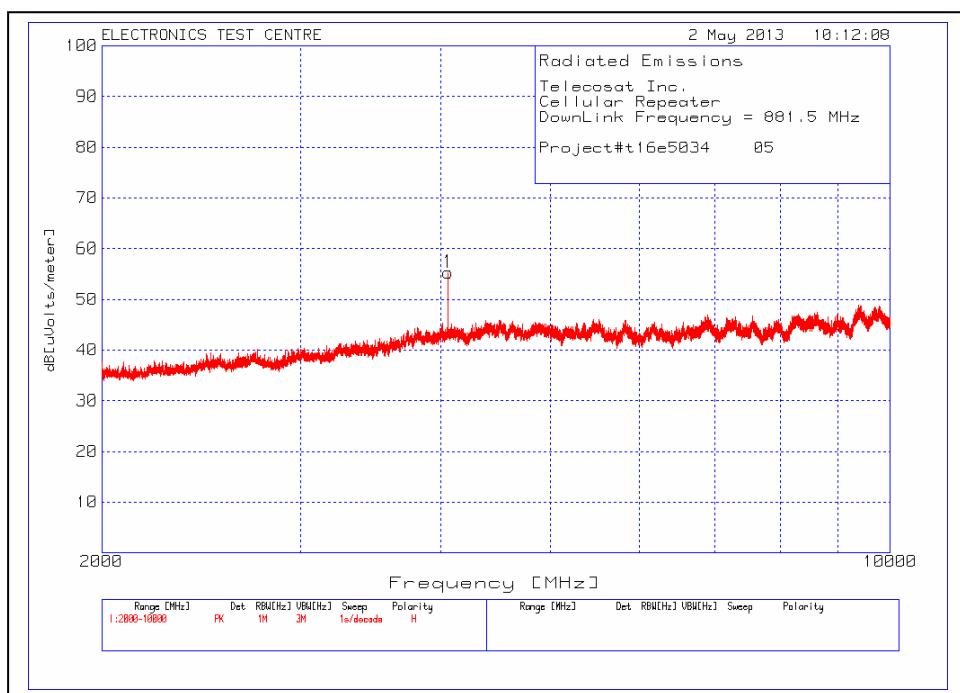
Plot of Radiated Emissions: Horizontal polarization



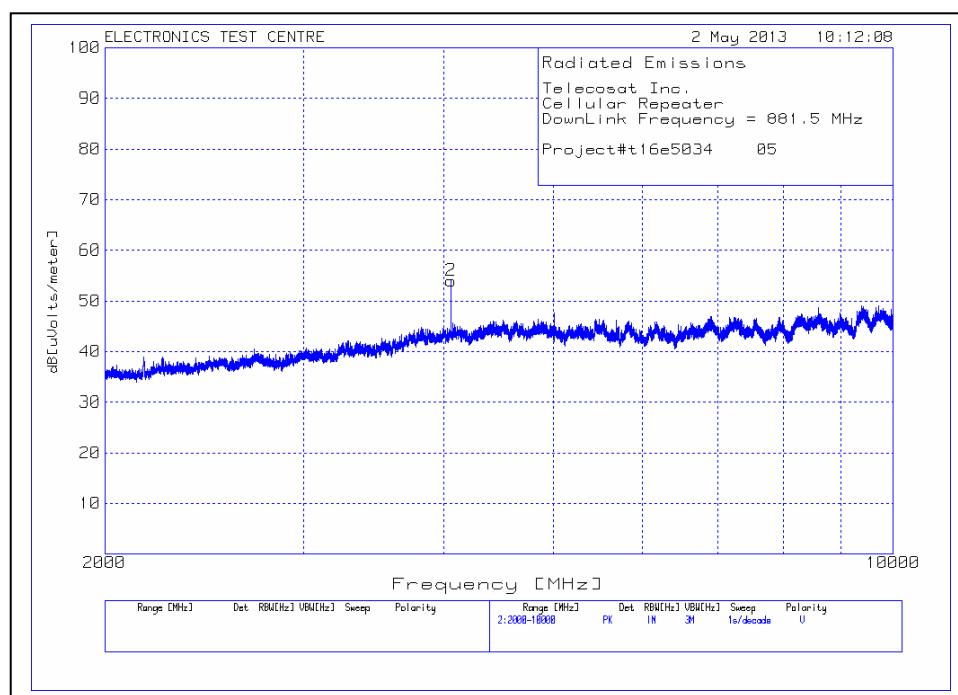
Plot of Radiated Emissions: Vertical polarization



Plot of Radiated Emissions: Horizontal polarization

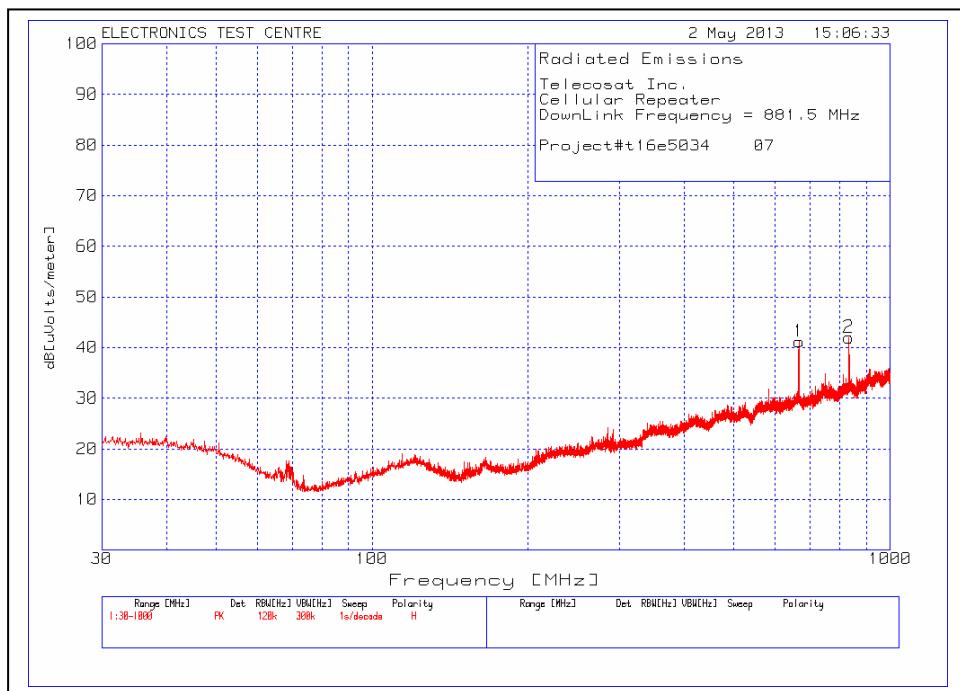


Plot of Radiated Emissions: Vertical polarization

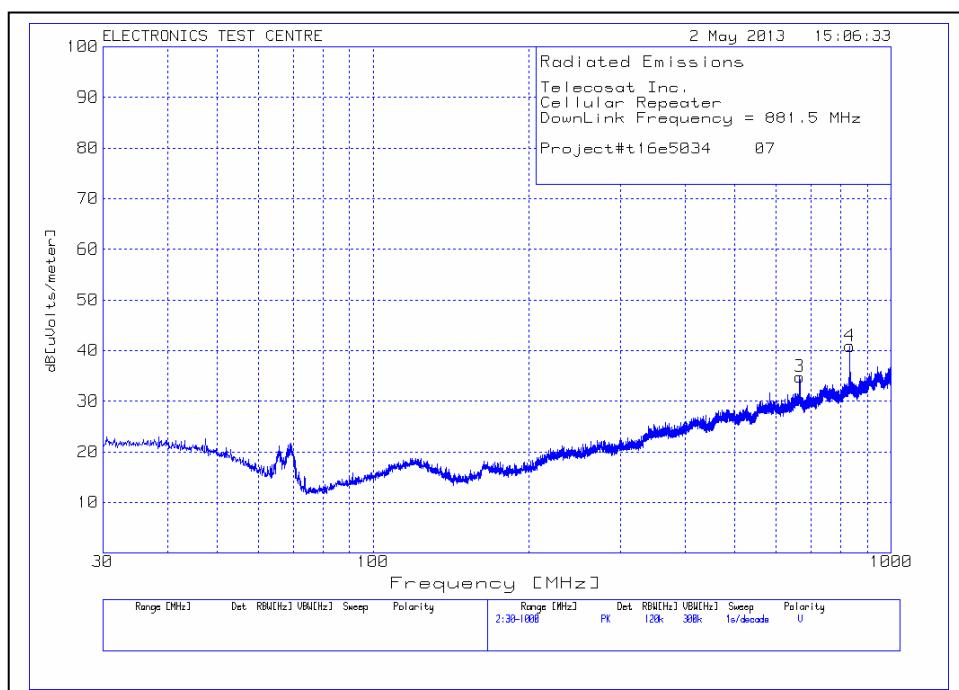


Frequency = 881.5 MHz

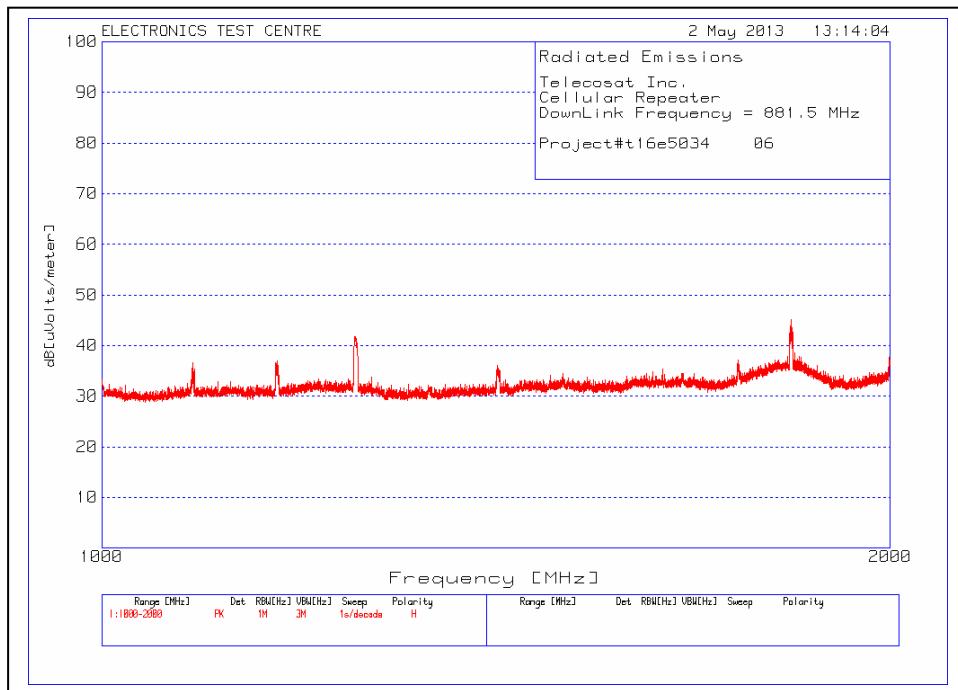
Plot of Radiated Emissions: Horizontal polarization



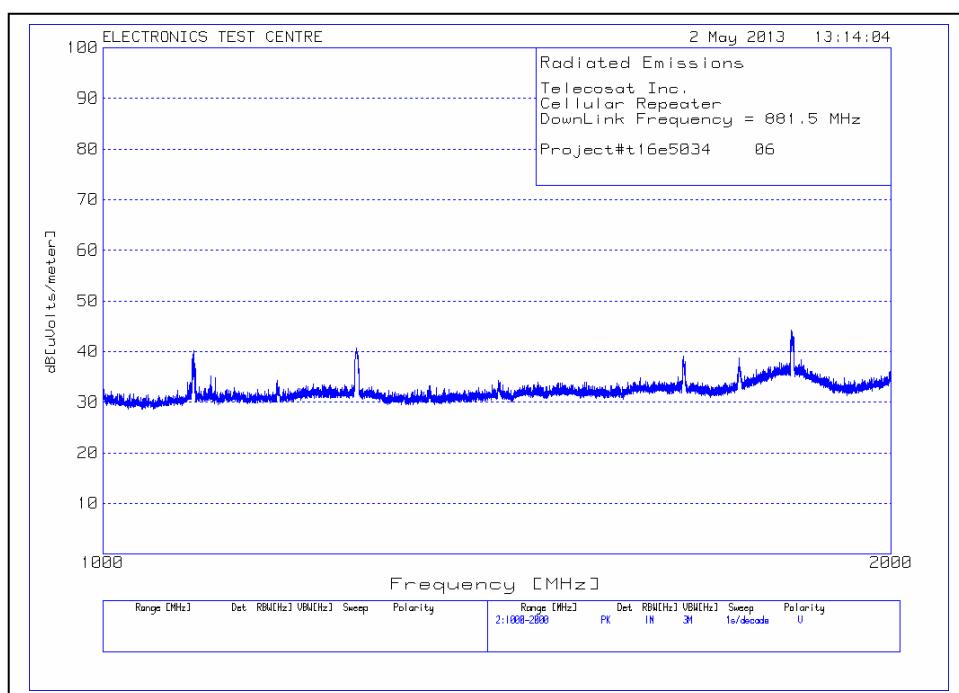
Plot of Radiated Emissions: Vertical polarization



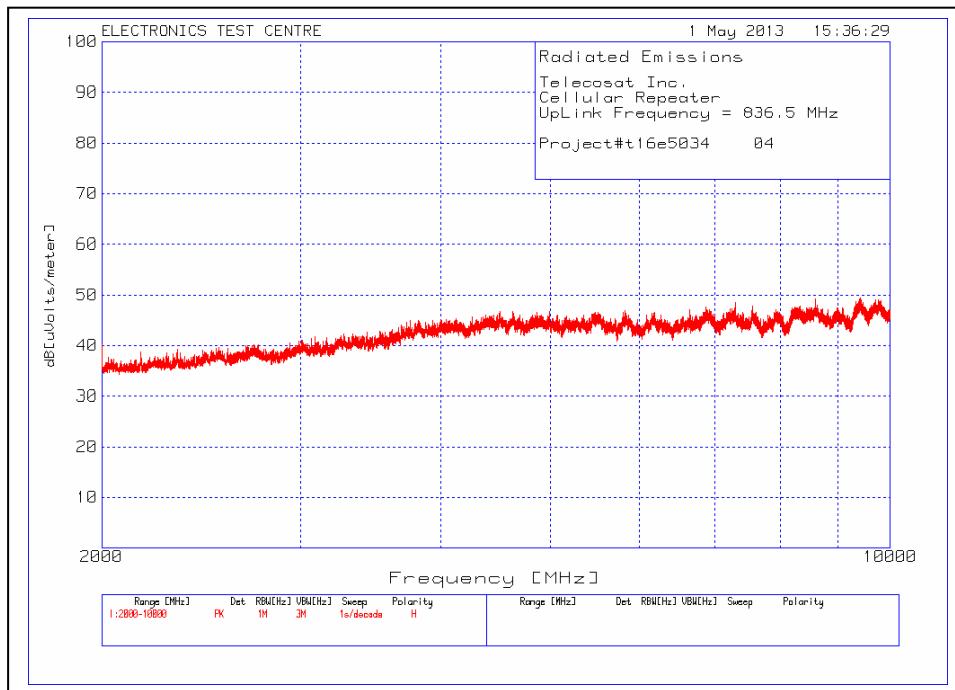
Plot of Radiated Emissions: Horizontal polarization



Plot of Radiated Emissions: Vertical polarization



Plot of Radiated Emissions: Horizontal polarization



Plot of Radiated Emissions: Vertical polarization

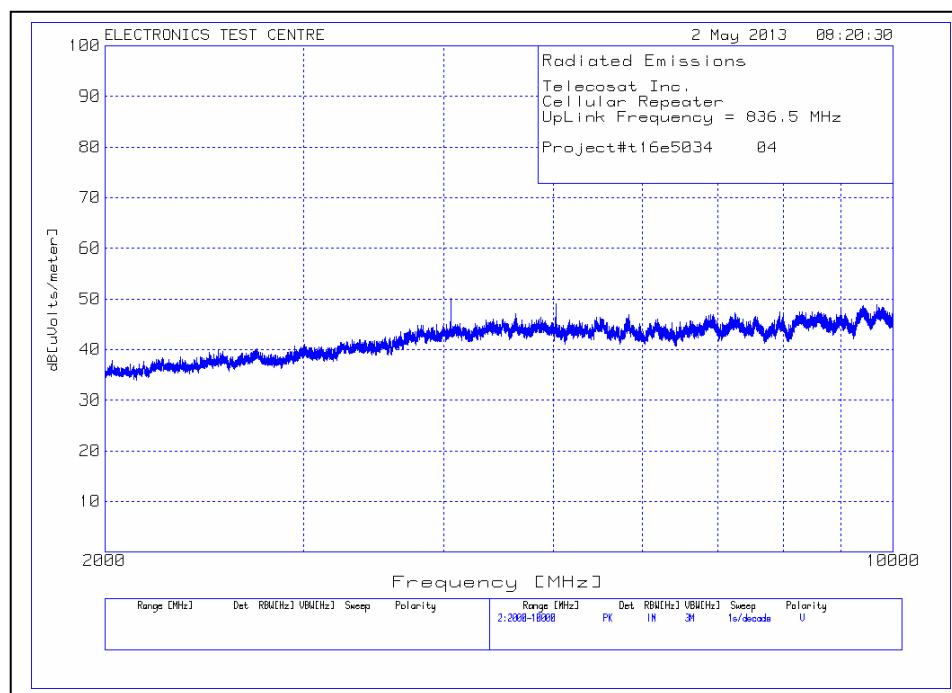


Photo of Radiated Emissions test setup:

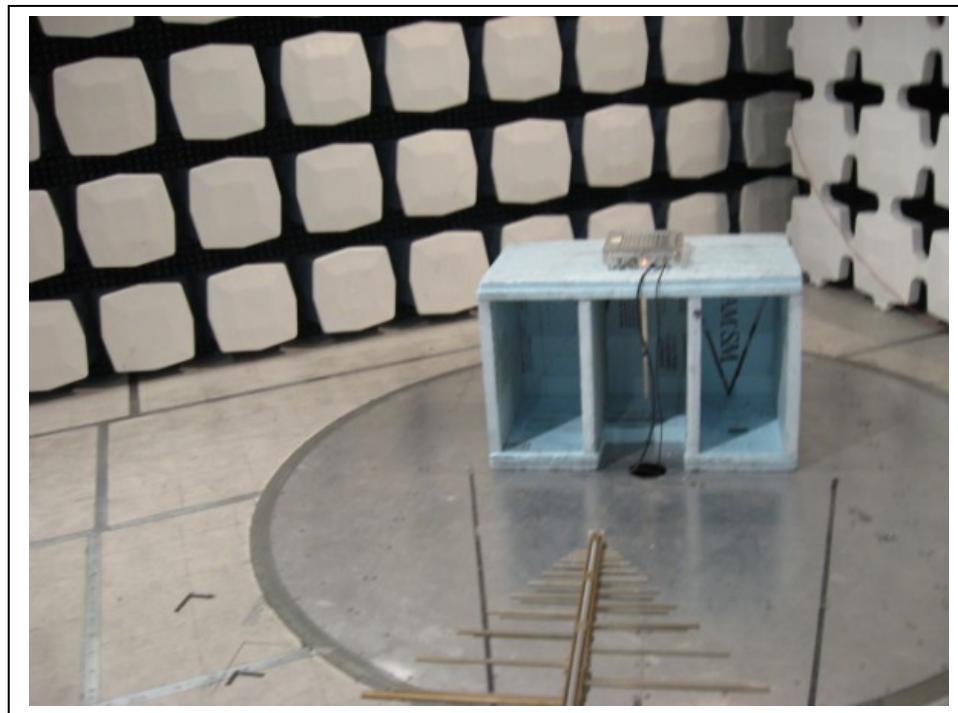


Photo of Radiated Emissions test setup:

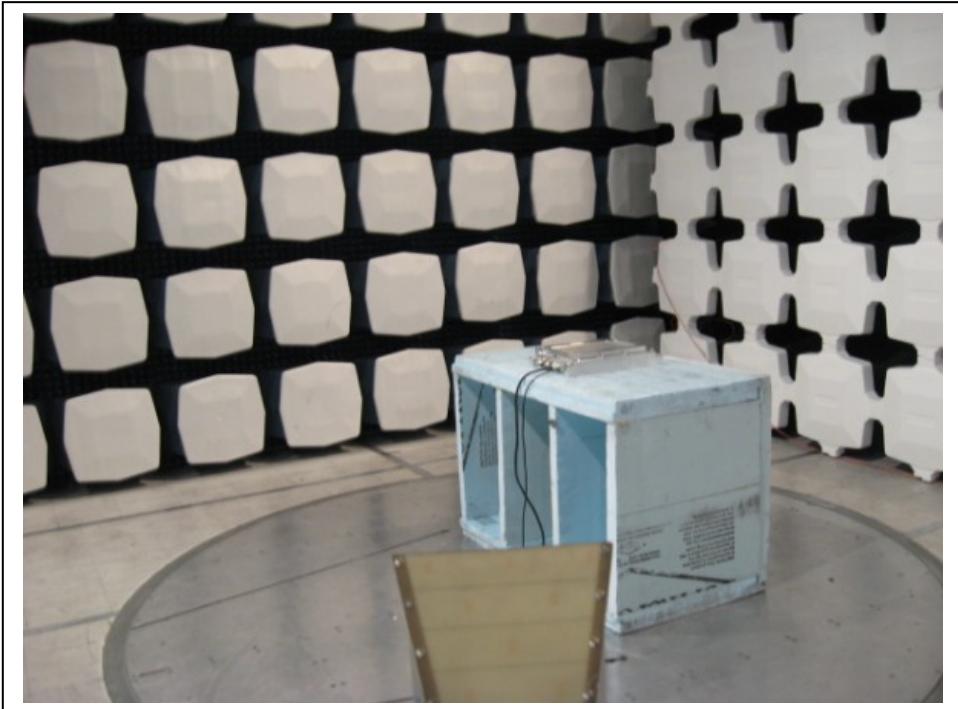


Photo of Radiated Emissions test setup:

4.0 TEST FACILITY

4.1 Location

The EUT was tested for Electromagnetic Compatibility at the Electronics Test Centre, located in Airdrie, Alberta, Canada.

The RF Anechoic Chamber (RFAC) is identified as Chamber 1, located in the main building complex at the Electronics Test Centre. Its usable working space measures 10.6 m long x 7.3 m wide x 6.5 m high.

This test site is listed with the FCC under Registration Number 90587. Measurements taken at this site are accepted by Industry Canada per file number IC 2046A-1.

The floor, walls and ceiling consist of annealed steel panels. The walls and ceiling are covered with ferrite tile, augmented by RF absorbant foam material on the end wall nearest the turntable, and on the adjacent walls and the ceiling. The chamber floor supports a 15 cm high internal floor, constructed of annealed steel panels, that forms the ground plane, and is bonded to the chamber walls.

The 3-m diameter turntable is flush-mounted with the floor. A sub-floor cable-way is provided to route cables between the turntable pit and EUT support equipment. Cables reach the EUT through an opening in the centre of the turntable.

Test instrumentation and EUT support equipment is located in two shielded vestibules located at the side of the main room. Cables are routed through bulkhead panels between the rooms as required. Power feeds are routed into the main room and vestibules through line filters providing at least 100 dB of attenuation between 10 kHz and 10 GHz.

4.2 Grounding Plan

The EUT was located on a Styrofoam table 80 cm above the ground plane. In accordance with Telcosat Inc. specifications, no ground connection was applied, other than through the power cable.

4.3 Power

All power was supplied via an Underwriter's Laboratories ULW100-69, 100 dB, 100 Ampere wall mounted filter. Filter bonding to ground is implemented at the chamber wall.

4.4 Emissions Profile

Ambient conducted and radiated electromagnetic emission profiles were generated throughout the tests and are included in the test data.

5.0 TEST EQUIPMENT

Equipment	Manufactuerer	Model	Asset#	Cal Due
Spectrum Analyzer & Display	Hewlett Packard	8566B & 85662	4473	06-JUL-13
RF Preselector	Hewlett Packard	85685A	9563	11-JUL-13
Quasi-Peak Adapter	Hewlett Packard	85650A	4411	10-JUL-13
Measurement System Software	Underwriters Laboratories	Version 9.5	4443	n/a
Biconilog Antenna	ARA	LPB-2520/A	4318	07-FEB-15
Digital Multimeter	Fluke	87	22208	11-Jun-13
DRG	EMCO	2028	9588	07-FEB-15
Low Noise Amplifier	MITEQ	JS43-01001800-21-5P	4354	MONIERED
DRG	EMCO	3115	19357	07-JUN-13
Log-periodic Array	EMCO	3147	21720	27-AUG-14

Appendix A
RBB 850
Test Sample Description
(From data provided by Telcosat Inc.)

TEST EUT DESCRIPTION

Description of EUT

EUT	Name	Model Revision	Serial Number
	RBB-850	RBB-850	000001

Classification Cellular Repeater (Base Station)

Frequency Range Uplink 824-849 MHz
Downlink 869-894 MHz

Transmitter duty cycle 100%

Operating Temperature -40°C to +50°C

Output power 25.0 dBm – based on two tone

Functional Description Cellular repeater

End of Document