FLEXTRONICS
Design Validation Centre

Radiated Emissions Report for Ericsson RD 2242 B13 LTE

Test Object

Product Name: RD 2242 B13

Product Number: KRY 901 334/1

Document number: **K002569-TR-EMC-03-R1**

Prepared for: **Ericsson Canada**

Report Summary:

Standard	Requirement	Compliant
FCC part 2.1053, 2.1057 FCC Part 27.53	Spurious Emissions	Yes
RSS-130 Section 4.6 RSS-GEN 6.13	Transmitter Unwanted Emissions	Yes

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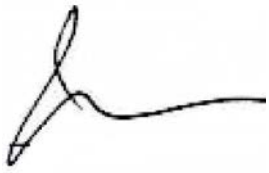

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The Design Validation Centre (DVC) is accredited by the Standards Council of Canada (SCC) to ISO/IEC 17025 in accordance with the scope of accreditation outlined at http://palcan.scc.ca/Specs/PDF/95_e.pdf. The DVC is accredited to FCC Part 2, FCC Part 27 and RSS-GEN.

Document revision control

Release	Date	Description
01	February 24, 2105	Initial release
02	March 3, 2015	Added regulatory information to Table 1 and inserted additional photos of receive antenna setup in Appendix A: Test setup photographs.

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1. Executive Summary

This document reports the Radiated Emissions results performed by the Flextronics Design Verification Centre (DVC) on the Ericsson RD 2242 B13 product. The RD 2242 is a Radio Unit (RU) forming part of the Ericsson's RBS equipment consisting of a Digital Unit (DU), Indoor Radio Unit (IRU 2242) and the Radio DOT (RD 2242).

The RD 2242 B13 was subjected to assessment while operating at the RBS (System) level and was found compliant to the spurious radiated emissions requirements of FCC Part 2, FCC Part 27, RSS-130 & RSS-GEN

2. Product Details

The test object is a RD 2242 B13 (Radio DOT) designed for use in LTE Radio Base Station (RBS) equipment. The RD 2242 product provides the radio access for mobile and fixed devices and is intended for the indoor environment.

Table 1: RD 2242 B13 Radio Unit Details

Model:	**RDS B13**
Part No.	KRY 901 334/1
Antenna Ports:	2 TX/RX Ports
IBW:	10MHz
FDD:	31MHz
Frequency:	TX (DL): 746 - 756MHz
	RX (UL): 777 - 787MHz
Nominal O/P per Antenna Port:	Single Carrier: 1 x 50mW (17dBm)
5MHz Carrier BW	Multi-Carrier: 2 x 25mW (14dBm)
Accuracy (Nominal):	+/- 0.1 PPM
Nominal Voltage:	-48 VDC @ 0.350A
RAT:	LTE: SC, MC
Modulation:	LTE: QPSK, 16QAM, 64QAM
Channel Bandwidth:	LTE: 5, 10MHz
Maximum Combined OBW per Port:	10MHz
IF Interface:	DL: 140.96 – 150.96MHz
	UL: 64.52 – 74.52MHz
Channel Raster:	100kHz
Regulatory Requirements:	FCC: CFR 47 Part 2, 27
	EMC: CFR 47 Part 15
	IC: RSS-GEN, RSS-130
	EMC: ICES-003
Multi-carrier	MIMO 2 x 2, TX Diversity
Regulatory ID:	FCC: TA8AKRY901334-1
	IC: 287AB-AS9013341
	IC Model: AS9013341
Operating Temperature:	+5°C to +40°C
Total Power based on IBW:	2 x 50mW
WCDMA Supported Carrier Configurations:	NA
LTE Supported Carrier Configurations:	BW=5 (1-2); BW=10 (1)

Figure 1: RD 2242 Product identification label

Table 2: EUT inventory

Product	Product number	Release number	Serial number
RD 2242 B13	KRY 901 334/1	R1B	C829165585

Photographs of the test setup are presented in Appendix A: Test setup photographs on page 21.

2.1 System modifications

The Equipment Under Test (EUT) was not modified.

2.2 Power and grounding requirements

DC Power and ground is provided via the RDI (Radio DOT Interface) cable.

2.3 Product port definition and EUT cable information

Table 3: System port definition

Port or cable designation	Interface description	Permanent connection	Shielded cable	Max cable length (m)	Max quantity
RDI	CAT6a IF Interface	Yes	Yes	100	1
RF Test Port A/B	Coaxial	No	Yes	NA	2

2.4 Software of the EUT

The software listed below was used to operate the EUT.

- BTS SW: CXP102051/22_ R46CU
- RDS SW (IRU + RD): CXP9013268/14_R59FJ

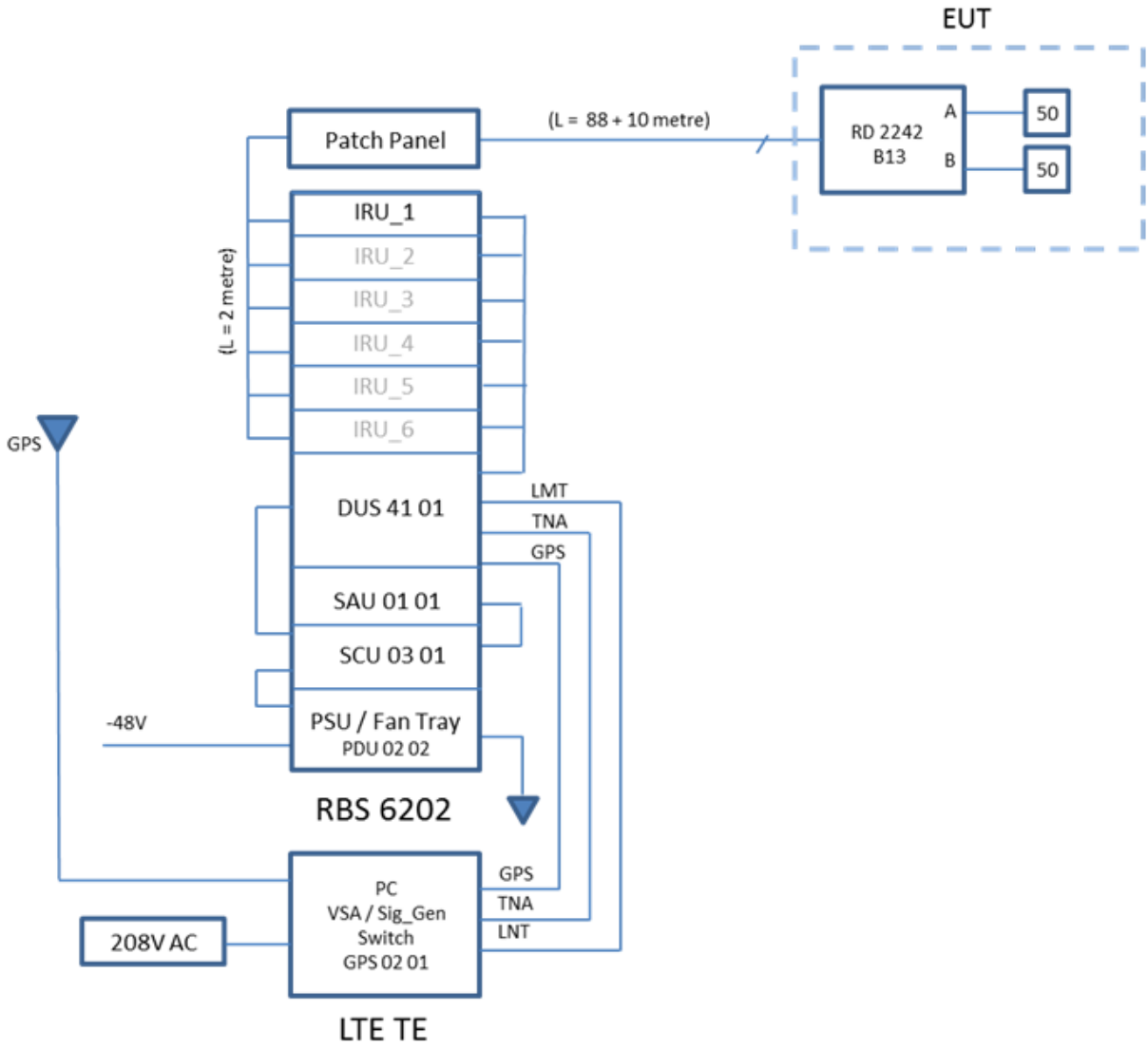
2.5 Support equipment

RBS 6202, BFM 901 351/1:

- DUS 4101, KDU 137 624/1 , Rev R7B, Serial CD3B327590
- PDU 02 02, BMG 980 336/5, REV R1V
- SCU 03 01, BGM 136 1006/3, REV R1B
- IRU 2242, KRC 161 444/1, REV R1C, Serial C828840967
- GPS 02 01, NCD 901 41/1, REV R1D
- HP Laptop with Linux OS
- RDI Cable Length = 100 Meter
- Power: -48 VDC

2.6 System Configuration

Figure 2: Setup for emissions testing



3. Emission Measurements

3.1 Description of test facilities

Emissions (RE) testing is performed in a 10-meter Ambient Free Chamber (AFC). The AFC consists of a shielded room lined with ferrite tiles and anechoic material.

The temperature and humidity in these test facilities are controlled and maintained between 15 ºC and 35 ºC with a relative humidity between 30 % and 60 %. Levels are recorded and any exceptions are included in the detailed test results sections of this report.

The facility is located at 1280 Teron Road, Ottawa, Ontario, Canada, K2K 2C1.

3.2 Test specification and limits

Table 4: Spurious radiated emissions requirements

Test Method	Level
RSS-130 Section 4.6.1 & 4.6.2 RSS-GEN 6.13	4.6.1 The power of any unwanted emissions in any 100 kHz bandwidth on any frequency outside the frequency range(s) within which the equipment is designed to operate shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 log10 (P) (watts) dB. 4.6.2 The power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least: (i) 76 + 10 log10 p (watts), dB, for base and fixed equipment, and (ii) 65 + 10 log10 p (watts), dB, for mobile and portable equipment. The e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.
FCC Part 2.1053, 2.1057	ANSI C63.4 [2], TIA-603-C [3]
FCC Part 27.53	ANSI C63.4 [2], TIA-603-C [3]

3.2.1 FCC Part 2.1053 Measurements required: Field strength of spurious radiation.

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of FCC 2.1049, as appropriate.

Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half wave dipole antennas.

3.2.2 FCC Part 2.1057 Frequency spectrum to be investigated.

The spectrum should be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower. Particular attention should be paid to harmonics and sub harmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked. The amplitude of spurious emissions, which are attenuated more than 20 dB below the permissible value, need not be reported.

3.2.3 RSS-130 4.6 Transmitter Unwanted Emissions.

4.6.1 The power of any unwanted emissions in any 100 kHz bandwidth on any frequency outside the frequency range(s) within which the equipment is designed to operate shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 $\log_{10}$ p (watts), dB. However, in the 100 kHz band immediately outside the equipment's operating frequency range, a resolution bandwidth of 30 kHz may be employed.

4.6.2 In addition to the limit outlined in Section 4.6.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

(a) The power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

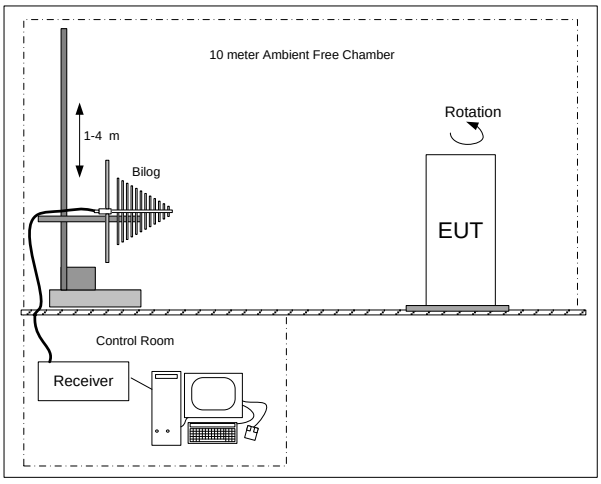
- *(i) 76 + 10 $\log_{10}$ p (watts), dB, for base and fixed equipment, and*
- *(ii) 65 + 10 $\log_{10}$ p (watts), dB, for mobile and portable equipment.*

(b) The e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and−80 dBW for discrete emission with bandwidth less than 700 Hz.

3.3 Test procedure

- For pre-measurements between **30 MHz and 1 GHz** the receive antenna (bi-log) was placed 3 m away from the EUT. An initial scan was performed to find emissions (frequencies) requiring detailed measurement. The pre-scan was performed by rotating the system 360 degrees while recording all emissions (frequency and amplitude). This procedure was repeated for antenna heights of 1 to 4 m, and for horizontal and vertical polarizations of the receiving antenna.
- For pre-measurements between **1 GHz and 10 GHz** the receive antenna (horn) was placed 3 m away from the EUT. An initial scan was performed to find emissions (frequencies) requiring detailed measurement. The pre-scan was performed by rotating the system 360 degrees while recording all emissions (frequency and amplitude). This procedure was repeated for antenna heights of 1 to 4 m, and for horizontal and vertical polarizations of the receiving antenna.
- The EUT was placed on a non-conducting support in the semi anechoic chamber.
- For **all the above frequency ranges** optimization was performed based on the pre-scan data. For each identified frequency, the EUT was rotated in azimuth over 360 degrees and the direction of maximum emission was noted. Antenna height was then varied from 1 to 4 m at this azimuth to obtain maximum emissions. The procedure was repeated for both horizontal and vertical polarizations (where applicable) of the search antenna. The maximum level measured was recorded. The spectrum analyzer was verified to make sure it was not saturating in the presence of the radio signal.
- The highest emissions were re-evaluated using the substitution method. This is accomplished by replacing the EUT by a calibrated antenna, cable and signal generator. This equipment is used to transmit a signal that will generate a RF meter reading level identical to the one recorded when the EUT was present for the optimization.

Figure 3: Setup for pre-measurements



3.3.1 Calculation of the compliance margin

The following parameters and coefficients are used to calculate and derive compliance levels and margins with respect to measurement results and test parameters. The example below illustrates the manner in which the field strength emissions levels are calculated.

The rows in these tables are defined as follows.

Meter Reading (dBµV) =	Voltage measured using the spectrum analyzer with quasi-peak adapter
Gain/Loss Factor (dB) =	Cumulative gain or loss of pre-amplifier and cables used in the measurement path (a negative value indicates gain)
Correction (dB) =	Gain/Loss Factor (dB) + Antenna factor (dB)
Level (dBµV/m) =	Corrected value or field strength, that is, the parameter of interest that is compared to the limit
Margin (dB) =	Level with respect to the appropriate limit (a positive Margin indicates that the Level is below the limit and that the measurement is a PASS)

The values in the Level row are calculated as follows:

Level = Meter Reading + Correction (dB)

The values in the Margin row are calculated as follows:

The following example shows the manner in which the compliance margin is calculated for ERP:

ERP = Effective Radiated Power or Equivalent Radiated Power

ERP (dBm) = Signal generator level (dBm) – Cable losses (dB) + Antenna gain (dBi) – half wave dipole gain (2.15 dB)

Margin = Limit – ERP

dBi to dBd conversion factor is 2.15

3.3.2 Measurement uncertainties

Uncertainty evaluation for pre-measurements has been calculated according to the method described in CISPR 16 for pre-measurements. The expanded measurement instrumentation uncertainty (with a 95 % level of confidence) on E-field RE is: ± 3.8 dB between 30 MHz and 1 GHz, ± 4.7 dB between 1 GHz and 10 GHz.

3.3.3 EUT modes of operation

The RD 2242 B13 was operated using test model E-TM1.1 (5 MHz carrier bandwidth). Single and two carrier configurations were assessed.

The RD 2242 B13 was configured to 1 x 17dBm per port for single carrier operation and 2 x 14dBm per port for 2 carrier operation.

Band 13 (IBW = 10MHz)

TX (DL): 746MHz – 756MHz

RX (UL): 777MHz – 787MHz

Duplex Spacing: 31MHz

BW: 10MHz

Test Model: E-TM1.1

Test Frequencies:

Single Carrier

Bandwidth	Transmit / DL (MHz)					
(MHz)	B	EARFCN	M	EARFCN	T	EARFCN
5	748.5	5205	751.0	5230	753.5	5255
10	751.0	5230	751.0	5230	751.0	5230

Bandwidth	Receive / UL (MHz)					
(MHz)	B	EARFCN	M	EARFCN	T	EARFCN
5	779.5	23205	782	23230	784.5	23255
10	782	23230	782	23230	782	23230

Multiple-Carriers (2x) IBW (MHz): 10

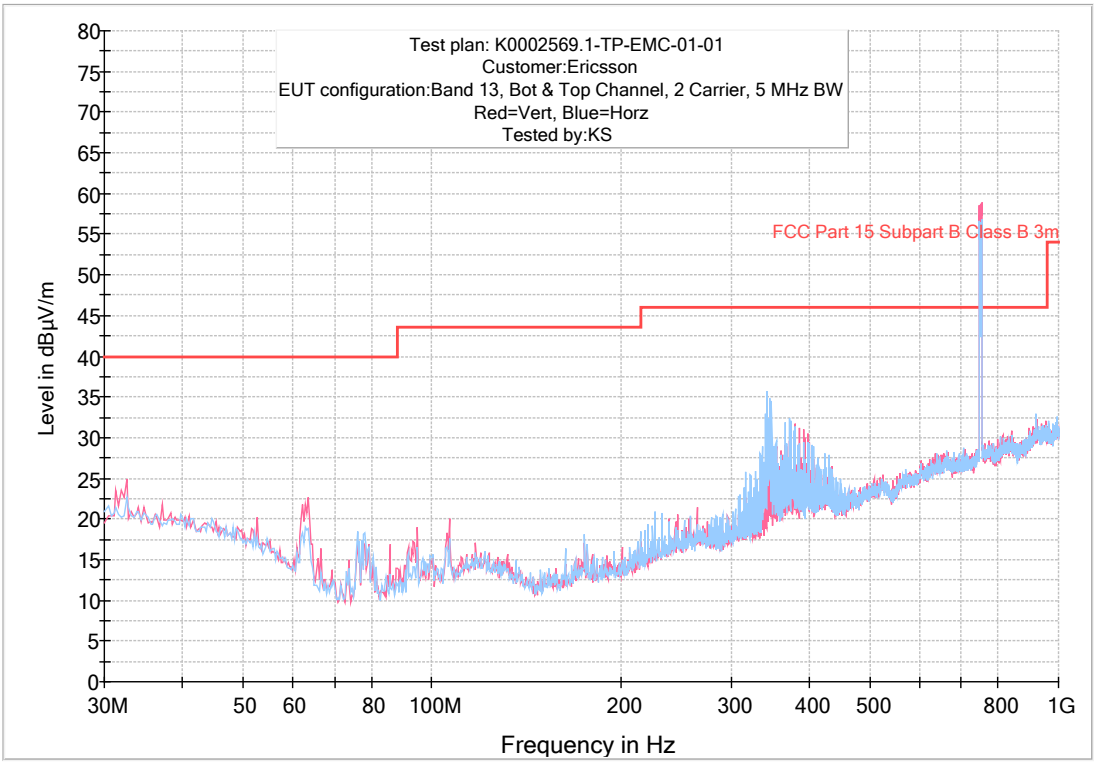
Bandwidth	Transmit / DL (MHz)											
(MHz)	B1	EARFCN	B2	EARFCN	M1	EARFCN	M2	EARFCN	T1	EARFCN	T2	EARFCN
5	748.5	5205	753.5	5255	748.5	5205	753.5	5255	748.5	5205	753.5	5255

Bandwidth	Receive / UL (MHz)											
(MHz)	B1	EARFCN	B2	EARFCN	M1	EARFCN	M2	EARFCN	T1	EARFCN	T2	EARFCN
5	779.5	23205	784.5	23255	779.5	23205	784.5	23255	779.5	23205	784.5	23255

3.3.4 Prescan results

Test Details: Tested February 9, 2015 at the DVC 10-meter AFC by Kasi Sivaratnam

Figure 4: RE at 3 m from 30 MHz to 1 GHz (2 Carrier – Bottom & Top))



Note: The visible peaks at 750 MHz are TX carriers.

Figure 5: RE at 3 m from 1 to 10 GHz (2 Carrier – Bottom & Top)

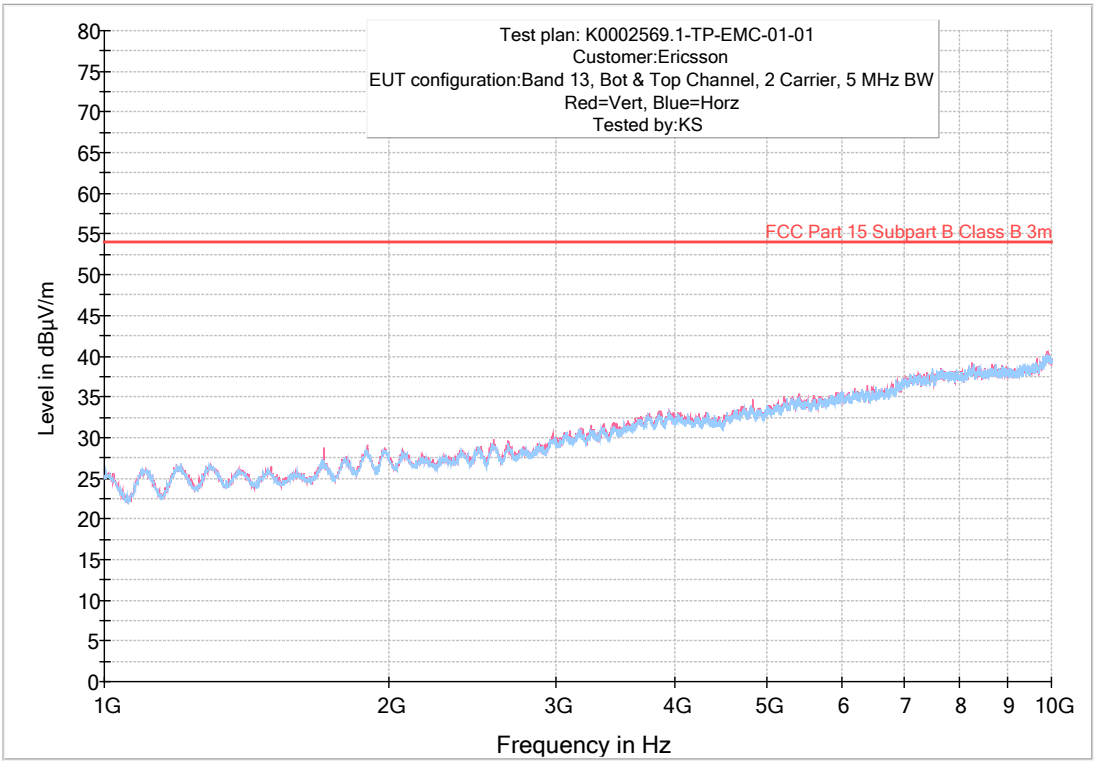
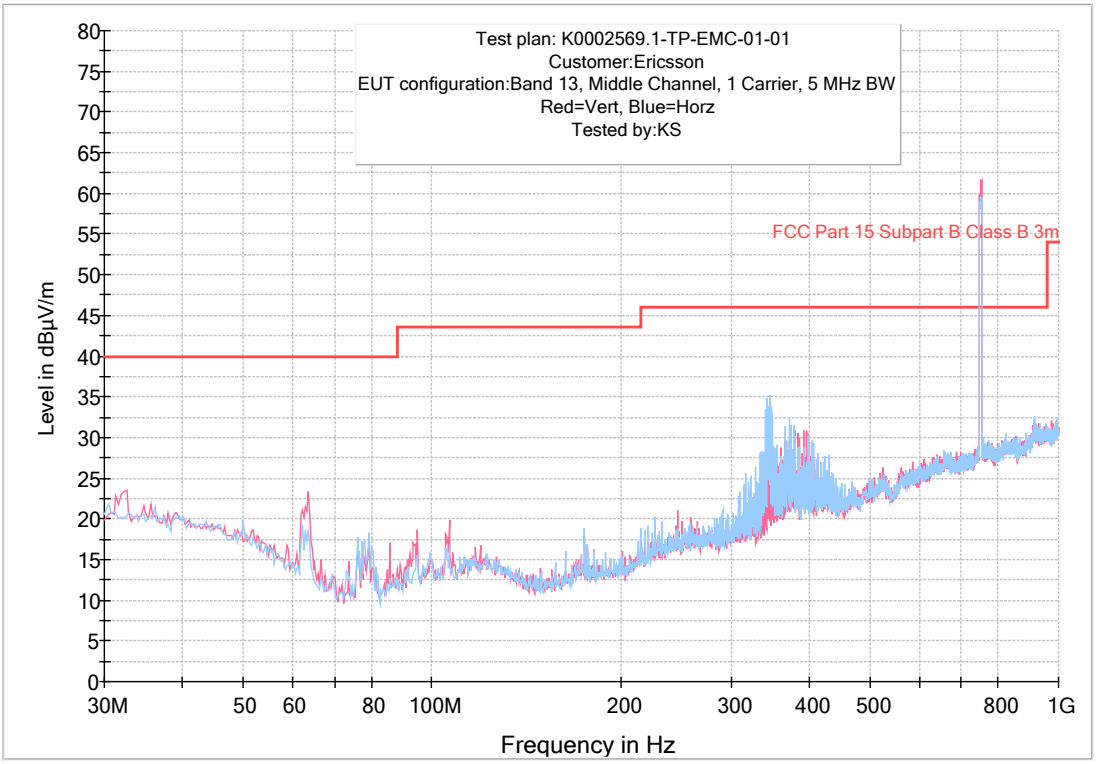
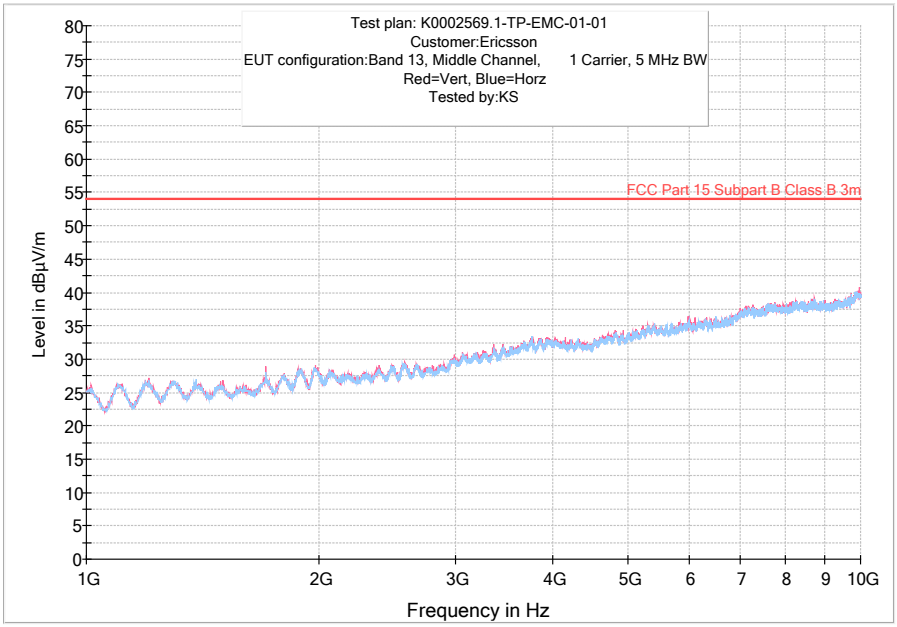


Figure 6: RE at 3 m from 30 MHz to 1 GHz (Single Carrier, Middle)



Note: The visible peak at 750 MHz is the TX carrier.

Figure 7: RE at 3 m from 1 to 10 GHz (Single Carrier, Middle)



3.3.5 Final substitution measurement test results

Tested February 12, 2015 in the DVC 10-meter AFC (3m position) by Scott Turner.

The effective radiated power (e.r.p.) was determined by a substitution measurement with a bi-log antenna. The test frequency was selected based on a review of pre-measurement results. TX carriers were excluded and all other visible peaks were identified. Measurements from the plots in Section 3.2.4 are converted to absolute levels in dBm using signal substitution conversion.

Using the substitution measurement procedure, the 346.35 MHz frequency was measured using a bi-log Tx antenna to determine the e.r.p. Table 5 lists the worst case emission. All other EUT emissions had either similar or greater passing margin.

Table 5: Spurious Emissions ERP Results RSS-130 4.6.1 & FCC Part 27

Frequency (MHz)	Meter reading dB(µV/m)	Signal Generator level (dBm)	Cable Loss (dB)	Polarization	Antenna Gain (dBi)	ERP (dBm)	Margin to RSS-130 4.6.1 FCC Part 27 (dB)
346.35	36.7	-65.6	3.8	H	-5.6	-66.0	53.0

There were no visible or measured peaks in the frequency bands 763-775 MHz or 793-806 MHz. There were no frequencies present in the 1559-1610 MHz frequency band.

The EUT met the fixed equipment requirements of RSS-130 4.6.2 with a passing margin of 20 dB.

3.3.6 Test equipment

The equipment used for E-field RE testing was as follows.

Table 6: Test equipment used for E-field RE

Description	Make	Model number	Asset ID	Calibration date	Calibration due
Pre- measurement test equipment					
Double Ridged Horn	Emco	3115	SSG012508	2015-01-12	2016-01-12
Coaxial Cable # 26	Huber & Suhner	ST18/Nm/Nm/36, Sucotest	SSG012785	2015-01-09	2016-01-09
Pre-Amplifier	BNR	LNA	SSG012360	2014-04-04	2015-04-04
Power Supply	Hewlett Packard	6216A	SSG013063	not required	not required
Bilog Antenna	Chase	CBL6111	SSG012564	2013-10-17	2015-10-17
Coaxial Cable # 14	Huber & Suhner	104PEA, Sucoflex	SSG012041	2015-01-07	2016-01-07
Coaxial Cable # 27	Huber & Suhner	ST18/Nm/Nm/36, Sucotest	SSG012786	2015-01-07	2016-01-07
EMI Receiver	Rohde & Schwarz	ESU40	SSG013672	2014-11-11	2015-11-11
Coaxial Cable # 6	Huber & Suhner	106A, Sucoflex	SSG012456	2015-01-06	2016-01-06
Coaxial Cable # 3	Huber & Suhner	106A, Sucoflex	SSG012455	2015-01-06	2016-01-06
Additional test equipment for Substitution Measurements					
Wiltron Sweep Generator	Wiltron	68369B	SSG012077	2014-04-09	2015-04-09
Coaxial Cable	Micro-Coax	FSCM64639	SSG012408	2014-12-15	2015-12-15
Bilog Antenna	Chase	CBL6111	SSG012564	2013-10-17	2015-10-17

4. References

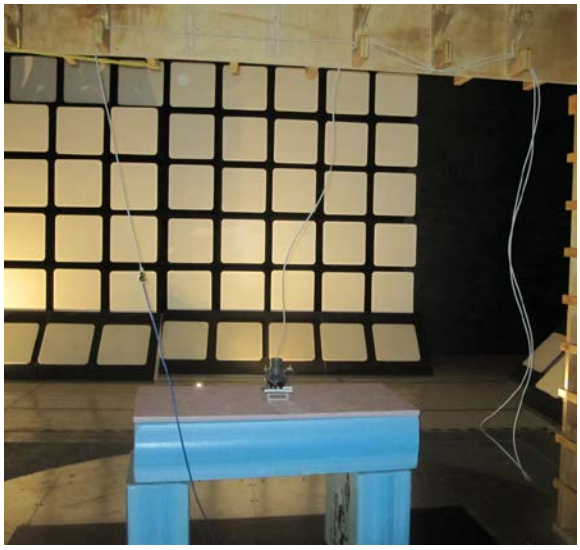
The documents, regulations, and standards that are referenced throughout this test report are listed alphabetically as follows.

1. ANSI C63.2-2009, American National Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz – Specifications.
2. ANSI C63.4-2003, Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
3. ANSI/TIA-603-C-2004, Land Mobile FM or PM Communications Equipment Measurement and Performance Standards.
4. APLAC, Asia Pacific Laboratory Accreditation Cooperation, Website (http://www.aplac.org)
5. CISPR 16 Publications (all parts and sections), Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 1: Radio Disturbance and Immunity Measuring Apparatus.
6. RSS-130 — Mobile Broadband Services (MBS) Equipment Operating in the Frequency Bands 698-756 MHz and 777-787 MHz, Issue 1, October 2013.
7. RSS Gen — General Requirements and Information for the Certification of Radio Apparatus, Issue 4, November 13, 2014.
8. FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations, U.S. Federal Communications Commission.
9. ICES-003 Issue 5 (2012), “Spectrum Management: Interference-causing equipment standard (Digital Apparatus)”. DVC Lab Operations Manual KG000347-QD-LAB-01.
10. DVC Quality Manual, K0000608-QD-QM-01.
11. EMC General Lab Test Procedure, KP000270-LP-EMC-01.
12. ILAC, International Laboratory Accreditation Cooperation, Website (http://www.ilac.org/)
13. Lab34 Edition 1, “The Expression of Uncertainty in EMC Testing”, UKAS, August 2002.
14. Standards Council of Canada, Scope of Accreditation for the Design Validation Centre of Flextronics Canada Design Services Inc. outlined at the following web site http://palcan.scc.ca/Specs/PDF/95_e.pdf

5. Appendices

5.1 Appendix A: Test setup photographs

Figure 8: Setup for radiated emission tests



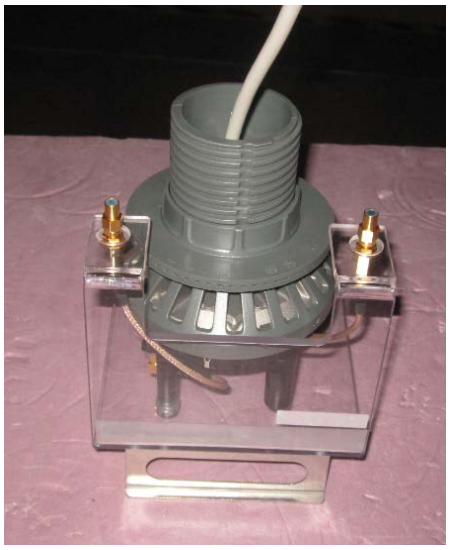


Figure 9: Photos of receive antennae

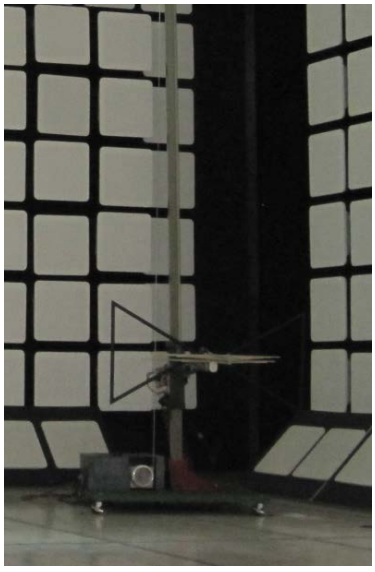


Figure 10: Substitution Measurement Setup

5.2 Appendix B: Abbreviations

The abbreviations of terms used in this document are as follows.

Term	Definition
AE	Auxiliary Equipment
AFC	Ambient Free Chamber
AVG	Average detector
CC	RF Current Clamp
CCC	Capacitive Coupling Clamp
CDN	Coupling-decoupling Network
dB	Decibel
DVC	Design Validation Centre (Flextronics)
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EN	European Normative
ETSI	European Telecommunications Standards Institute
EUT	Equipment Under Test
GND	Ground
NA, na	not applicable
NAMAS	National Measurement Accreditation Service
PK	Peak Detector
QP	Quasi-peak Detector
RBW	Resolution Bandwidth
RE	Radiated Emissions
RF	Radio-Frequency
RMS	Root-mean-square
SA	Spectrum Analyzer
SCC	Standards Council of Canada
SG	RF Signal Generator
VBW	Video Bandwidth

Flextronics Canada Design Services Inc.

Radiated Emissions Report

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