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Reference Date 2013-09-17 3P05643-F27 Page 1 (2)

NED. 1000 **ISO/IEC 17025**

Ericsson AB Camilla Karlsson PDU HW Lindholmspiren 11 417 56 Göteborg

Radio measurements on mRRUS 12 B13 radio equipment with FCC **ID: TA8AKRC161332**

(9 appendices)

Test object

Product name: mRRUS 12 B13 Product number: KRC 161 332/X, see appendix 1 for details.

Summary

Standard		Compliant	Appendix
FCC CFR 47			
2.1046	RF power output conducted	Yes	2
2.1046	RF power output radiated	Yes	3
2.1049	Occupied bandwidth	Yes	4
2.1051	Band edge	Yes	5
2.1051	Spurious emission at antenna terminals	Yes	6
2.1053	Field strength of spurious radiation	Yes	7
2.1055	Frequency stability	Yes	8

Measurements were performed according to ANSI procedures referenced by FCC and covered by SP's accreditation.

SP Technical Research Institute of Sweden **Electronics - EMC**

Performed by

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Description of the test object

Equipment:	Radio equipment mRRUS 12 B13 supporting LTE KRC 161 332/1, 110-240VAC internal antenna KRC 161 332/2, -48VDC internal antenna KRC 161 332/3, 110-240VAC no internal antenna KRC 161 332/4, -48VDC no internal antenna FCC ID: TA8AKRC161332		
Antenna ports:	2 TX/RX ports		
RF configurations:	Single carrier, multi carrier, MIMO		
Frequency bands:	TX: 746 – 756 MHz RX: 777 – 787 MHz		
Nominal output power per antenna port:	Single carrier:1x 37 dBm (1 x 5W)Multi carrier:2 x 34 dBm (2 x 2.5W)		
Modulations:	QPSK, 16QAM and 64QAM		
Channel bandwidth:	5 MHz, 10 MHz		
Nominal power voltage:	-48VDC, 120 VAC 60 Hz		



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Operation mode during measurements

Measurements were performed with the test object transmitting test models as defined in 3GPP TS 36.141. Test model E-TM1.1 was used to represent QPSK, test model E-TM3.2 to represent 16QAM and test model E-TM3.1 to represent 64QAM modulation.

The settings below were deemed representative for all traffic scenarios when settings with different modulations, channel bandwidths, number of carriers and RF configurations has been tested to find the worst case setting. The settings below were used for all measurements if not otherwise noted.

MIMO mode single carrier: E-TM1.1

MIMO mode multi carrier: 2 carriers E-TM1.1

All measurements were performed with the test object configured for the maximum transmit power applicable for the tested configuration.

Conducted measurements

The test object was supplied with -48 VDC by an external power supply. Additional connections are documented in the set-up drawings below.

All measurements were made on RF A and additional measurements on RF B to verify that the ports were electrical identical, as declared by the client.

Radiated measurements

The test object was powered with -48 VDC. All measurements were performed with the test object configured for maximum transmit power.

Purpose of test

The purpose of the tests is to verify compliance to the performance characteristics specified in applicable items of FCC CFR 47.

References

Measurements were done according to relevant parts of the following standards: ANSI 63.4-2009 ANSI/TIA/EIA-603-C-2004 CFR 47 part 2, October 1st, 2012 CFR 47 part 27, October 1st, 2012 3GPP TS 36.141, version 11.4.0



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Uncertainties

Measurement and test instrument uncertainties are described in the quality assurance documentation "SP-QD 10885". The uncertainties are calculated with a coverage factor k=2 (95% level of confidence).

Compliance evaluation is based on a shared risk principle with respect to the measurement uncertainty.

Reservation

The test results in this report apply only to the particular test object as declared in the report.

Delivery of test object

The test object was delivered 2013-08-09.

Manufacturer's representative

Christer Gustavsson

Test engineers

Tomas Isbring, Jörgen Wassholm, Hyder Khalaf and Kexin Chen SP

Test participants (partially)

Mihai Simon, Erik Nilsson





Appendix 1

Measurement equipment

	Calibration Due	SP number
Test site Tesla	2014-01	503 881
R&S ESU 26	2014-05	901 553
R&S FSQ 40	2014-03	504 143
R&S FSW 43	2014-07	902 073
Control computer with	-	503 899
R&S software EMC32 version 8.52.0		
High pass filter	2014-07	901 501
High pass filter	2014-07	901 502
High pass filter	2014-07	504 199
High pass filter	2014-09	901 373
High pass filter	2014-07	503 740
RF attenuator	2014-07	504 159
RF attenuator	2014-07	900 233
RF attenuator	2014-07	900 691
RF attenuator	2014-07	901 384
RF attenuator	2013-12	901 508
Chase Bilog Antenna CBL 6111A	2014-10	503 182
EMCO Horn Antenna 3115	2014-01	502 175
µComp Nordic, Low Noise Amplifier	2014-04	901 545
Temperature and humidity meter, Testo 635	2014-06	504 203
Temperature and humidity meter, Testo 625	2014-06	504 188
Temperature Chamber	2013-11	503 360
Multimeter Fluke 87	2014-08	502 190



Test frequencies during measurements

Single RAT TX test frequencies

EARFCN	Frequency	Symbolic	Comment
Downlink	[MHz]	name	
5205	748.5	В	TX bottom frequency in 5 MHz BW configuration
5230	751.0	М	TX middle frequency in 10 MHz BW configuration
5255	753.5	Т	TX bottom frequency in 5 MHz BW configuration
5205	748.5	M2	2 carrier TX band bottom constellation
5255	753.5		5 MHz BW configuration

All RX frequencies were configured 31 MHz below the corresponding TX frequency according the applicable duplex offset for the operating band.



Appendix 1

Test set-up conducted measurements



Test object:

1. Configuration AC: mRRUS 12 B13, KRC 161 332/3, rev. R1A, s/n: C827113798 Configuration DC: mRRUS 12 B13, KRC 161 332/4, rev. R1A, s/n: C827115345 working software CXP 901 7316/2, Rev. R51ML with FCC ID: TA8AKRC161332

Functional test equipment:

2.	Main Unit
	DUS 41 01 KDU 137 624/1 R5A, s/n: D168382181,
	hosted in SUP 6601 1/BFL 901 009/4, rev. R1E, s/n. BR88258854
3.	Switch Netgear PROSAFE GSM 7224, BAMS-1000850754
4	Computer Sun microsystems ultra 27, BAMS – 1000861874
5.	GPS 02 01, NCD 901 41/1, rev. R1D, s/n: TU8K356490
6.	GPS Active Antenna, KRE 101 2082/1
7.	SP Test Instrumentation according to measurement equipment list
8.	SP Test Instrumentation according to measurement equipment list
9.	Terminator, 50 ohm





Test set-up radiated measurements



Test object:

 I.
 Configuration DC: mRRUS 12 B13, KRC 161 332/2, rev. R1A, s/n: C827115310

 Configuration DC: mRRUS 12 B13, KRC 161 332/4, rev. R1A, s/n: C827115345

 working software CXP 901 7316/2, Rev. R51ML with FCC ID: TA8AKRC161332

Functional test equipment:

2.	Main Unit
	DUS 41 01 KDU 137 624/1 R5A, s/n: D168382181,
	hosted in SUP 6601 1/BFL 901 009/4, rev. R1E, s/n. BR88258854
3.	Switch Netgear PROSAFE GSM 7224, BAMS-1000850754
4.	Computer Sun microsystems ultra 27, BAMS – 1000861874
5.	Terminator
6.	GPS 02 01, NCD 901 41/1, rev. R1D, s/n: TU8K356428
7.	GPS Active Antenna, KRE 101 2082/1



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Appendix 1

Interfaces:	Type of port:
Power: -48 VDC	DC Power
Antenna port (A), N-connector, terminated	Antenna
Antenna port (B), N-connector, terminated	Antenna
Opto 1, Optical Interface Link, single mode opto fibre	Signal
Opto 2, Optical Interface Link, single mode opto fibre, not in use	Signal
Ext Alarm, unshielded multi wire	Signal
Ground wire	Ground

RBS software:

	Software	Revision	
DUS	CXP 102 051/19	R17Z	



RF power output measurements according to CFR 47 §27.50

Date	Temperature	Humidity
2013-09-04	$23 \degree C \pm 3 \degree C$	47 % ± 5 %

Test set-up and procedure

The test object was connected to a signal analyzer measuring peak and RMS output power in CDF mode. A resolution bandwidth of 50 MHz was used.

Measurement equipment	SP number
R&S FSW	902 073
RF attenuator	902 282
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 1.1 dB

Results

MIMO mode, single carrier

Rated output power level at RF connector 2x 37 dBm. Total nominal RF power 40 dBm.

Tested configuration	[RMS dBm/ PAR dB]		
BW and frequency	Port RF A	Port RF B	Total power ¹⁾
5 MHz, B	36.10/ 6.71	36.06/ 6.73	39.09
5 MHz, T	36.15/ 6.73	36.11/ 6.75	39.14
10 MHz, M	36.12/ 6.75	36.06/ 6.78	39.10
5 MHz, M2	36.06/ 6.78	36.04/ 6.80	39.06

¹⁾: summed output power according to FCC KDB662911 Multiple transmitter output v01r02

Limits

§27.50 (b): The maximum output power may not exceed 2000 W (ERP)/ MHz.

Complies?	Yes
e empnesi	1.00





SP SP SP

Appendix 3

RF power output measurements according to CFR 47 §27.50 (b), radiated

Date	Temperature	Humidity
2013-08-14	$22^{\circ}C \pm 3^{\circ}C$	44 % ± 5 %
2013-08-19	$23^{\circ}C \pm 3^{\circ}C$	46 % ± 5 %
2013-08-20	$23^{\circ}C \pm 3^{\circ}C$	47 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.4-2009.

The test was performed with continuous transmission.

The test of radiated emission was performed in a semi anechoic chamber. The measurements were performed with both horizontal and vertical polarizations of the antenna. The antenna distance was 3.0 m.

The fundamental was scanned with PEAK-detector with the antenna height was varied between 1-4 m and the turntable was rotated between 0-360 degrees for maximum response. The carrier power was measured with RMS- detector activated with a RBW of 1 MHz. The output power was verified with the substitution method .The antenna distance during the measurements was 3.0 m.

Measurement equipment

Measurement equipment	SP number
Semi anechoic chamber	503 881
R&S ESU 26	901 553
EMC 32 ver. 8.52.0	503 745
EMCO Horn Antenna 3115	502 175
EMCO Horn Antenna 3115	902 212
R&S SMB 100A	900 120
Attenuator	504 159
Testo 635 temperature and humidity meter	504 203

Measurement uncertainty:

3.2 dB



Appendix 3

The test set-up during the effective radiated output power measurements measurements is shown in the picture below, side mounted with Semi-Integrated Omni Antenna KRE 101 2245/1.



The test set-up during the effective radiated output power measurements is shown in the picture below, upright mounted with internal antenna.









The test set-up during the effective radiated output power measurements is shown in the picture below, side mounted with internal antenna.







Appendix 3

Results

Internal antenna, upright mounted

Bandwidth configuration (MHz)	Tested frequency B		Tested frequency M		Tested frequency T	
	Horizontal/ Vertical RMS power		Horizontal/ Vertical RMS power		Horizontal/ Vertical RMS power	
	dBm/ MHz W/ MHz		dBm/ MHz	W/ MHz	dBm/ MHz	W/ MHz
5	34.7/ 33.5	3.0/ 2.2	-	-	34.7/ 33.6	3.0/ 2.3
10	-	-	31.7/ 30.6	1.5/ 1.1	-	-

Internal antenna, side mounted

Bandwidth configuration (MHz)	Tested frequency B		Tested frequency M		Tested frequency T	
	Horizontal/ Vertical RMS power		Horizontal/ Vertical RMS power		Horizontal/ Vertical RMS power	
	dBm/ MHz W/ MHz		dBm/ MHz	W/ MHz	dBm/ MHz	W/ MHz
5	33.8/ 34.9	2.4/ 3.1	-	-	34.0/ 34.8	2.5/ 3.0
10	-	-	30.9/ 31.9	1.2/ 1.6	-	-

External antenna, side mounted (Semi-Integrated Omni Antenna KRE 101 2245/1)

Bandwidth configuration (MHz)	Tested frequency B		Tested frequency M		Tested frequency T	
	Horizontal/ Vertical RMS power		Horizontal/ Vertical RMS power		Horizontal/ Vertical RMS power	
	dBm/ MHz W/ MHz		dBm/ MHz	W/ MHz	dBm/ MHz	W/ MHz
5	27.0/ 32.0	0.5/ 1.6	-	-	26.9/ 32.5	0.5/ 1.8
10	-	-	24.3/ 28.0	0.3/ 0.6	-	-

Limits

27.50 (b): The maximum output power may not exceed 2000 W (ERP)/ MHz.

Complies?

Yes





Occupied bandwidth measurements according to 47 CFR 2.1049

Date	Temperature	Humidity
2013-09-04	$23 \ ^{\circ}C \pm 3 \ ^{\circ}C$	47 % ± 5 %
2013-09-05	$23 \ ^{\circ}C \pm 3 \ ^{\circ}C$	50 % \pm 5 %

Test set-up and procedure

The measurements were made per definition in §2.1049. The output was connected to a signal analyzer with the RMS detector activated. The signal analyzer was connected to an external 10 MHz reference standard during the measurements.

Measurement equipment	SP number
R&S FSW 902 073	902 073
RF attenuator	902 282
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

MIMO mode, single carrier

Diagram	BW configuration	Tested frequency	Tested Port	Occupied BW (99%) [MHz]
1	5 MHz	В	RF A	4.48
2	5 MHz	Т	RF A	4.48
3	10 MHz	М	RF A	8.93
4	10 MHz	М	RF B	8.93



Appendix 4

Diagram 1:



Date: 4.SEP.2013 12:00:13

Diagram 2:



Date: 4.SEP.2013 13:01:59





Appendix 4

Diagram 3:

MultiView 8	Spectrum									
Ref Level 60.	00 dBm	RBW	100 kHz							
Att	20 dB 💿 SWT	10 s VBW	1 MHz N	lode Auto Sweep						
TDF										
1 Occupied Bar	ndwidth									⊜1Rm Max
						м	11[1]			16.20 dBn
										751.00000 MH
50 dBm-			-							
40 dBm										
30 dBm-										
20 dBm										
20 00111			∀-				₹ ¥			
							1			
10 dBm							1			
0.40 m										
U UBIII										
			1							
-10 dBm							1			
-20 asm										
-30 dBm							-			
							٩			
******	*****		and the state of the					****	****	****
CF 751.0 MHz			60	01 pts		3.0 MHz	2/			Span 30.0 MHz
2 Marker Table	•			•						
Type Ref	Trc	Stimulus		Respons	e	Eunction			Function Resul	t
M1	1	751.0	MHZ	16.20 dB	m	rancaon			ansaonnesa	
T1	i	746 5357	4 MHz	15 90 d	3m Oc	c Bw		8.9	28511915	4Hz
T2	î	755.4642	6 MHz	16.08 di	3m					
	-	. 101 10 12		10100 0						

Date: 4.SEP.2013 10:11:22

Diagram 4:



Date: 5.SEP.2013 12:53:50





Band edge measurements according to CFR 47 §27.53(c)

Date	Temperature	Humidity
2013-09-04	$23 \ ^{\circ}C \pm 3 \ ^{\circ}C$	47 % ± 5 %
2013-09-05	$23 \ ^{\circ}C \pm 3 \ ^{\circ}C$	50 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §27.53(c). The test object was connected to a spectrum analyzer with the RMS detector activated. The spectrum analyzer was connected to an external 10 MHz reference standard during the measurements.

FCC rules specify a RBW of at least 30 kHz for offsets up to 100 kHz from the band edge and a RBW of 100 kHz for measurements of emissions more than 100 kHz away from the band edges.

Before comparing the results to the limit, 3 dB [10 log (2)] should be added according to method 2 "measure and add 10 log(N_{ANT})" of FCC KDB662911 D01 Multiple Transmitter Output v01r02

Measurement equipment	SP number
R&S FSW	902 073
RF attenuator	902 282
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB



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Appendix 5

Results

MIMO mode

Diagram	BW configuration	Tested	Tested Port
		frequency	
1	5 MHz	В	RF A
2	10 MHz	М	RF A
3	5 MHz	Т	RF A
4	5 MHz	Т	RF B
5	5 MHz	M2	RF A

Limits

CFR 47 §27.53(c)

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least $43 + 10 \log (P) dB$, resulting in a limit of -13 dBm.

1





Appendix 5

Diagram 1a:

MultiView	Spectrum	DBW 100 k	H-7						(
 Att 	20 dB 🖷 SWT	10 s VBW 1 M	Hz Mode	Auto Sweep					
TDF 1 Erections	Sween								⊖ I Pm
50 dBm							M1[1] —M2[1]		-23,56 746,0000 19,32 748,5000
4U dBm									
30 dBm									
20 dBm				M2	ļ				
10 dBm									
0.40.0									
U dBm-									
-10 dBm	H1 -13.000 dBm				⊨				
-20 dBm					 				
-30 dBm					<u></u>	M	,		
-40 dBm					www.		, ,		·····
-50 dBm			V1						
Start 730.0	MHz	1	4001 pt	S S		4.2	MHz/		Stop 772.0
2 Marker Ta	ble							_	
M1 M2 M3	et Irc 1 1	5timulus 746.0 MHz 748.5 MHz 756.0 MHz		Response -23.56 dBm 19.32 dBm -36.50 dBm		Functi	on	Fι	Inction Result
								Measuring 🚺	04.09.201

Date: 4.SEP.2013 11:37:47

Diagram 2:

MultiView	88 Spectrum				ſ
RefLevel 60 Att	0.00 dBm 20 dB - SWT	• RBW 100 kHz 10 s VBW 1 MHz	Mode Auto Sweep		<u> </u>
TDF	0				- 10
50 dBm	Sweep			M1[1] M2[1]	01Km -34.59 746.0000 16.35 751.0000
40 dBm					
30 dBm					
20 dBm			M2		
10 dBm					
0 dBm					
-10 dBm	H1 -13.000 dBm				
-20 dBm					
-30 dBm				M3	
-40 dBm	***				
-50 dBm			V1		
Start 730.0 M	1Hz		4001 pts	4.2 MHz/	Stop 772.0
2 Marker Tab Type Re	le f Trc	Stimulus	Response	Function	Function Result
M1 M2 M3	1 1 1	746.0 MHz 751.0 MHz 756.0 MHz	-34.59 dBm 16.35 dBm -35.17 dBm		
)[Меа	suring 🚺 🔰 🚧 😳 04.09.201 11:29:2

Date: 4.SEP.2013 11:29:27





Appendix 5

Diagram 3:

MultiView	Spectrum				
Ref Level 6	i0.00 dBm	 RBW 100 kHz 			
Att 🛛	20 dB 😑 SWT	10 s VBW 1 MHz	Mode Auto Sweep		
TDF	0				
Frequency	Sweep			M1613	○ 1Rm Max
				MILIJ	-35,82 dBr
50 dBm					19 12 dBn
				MZ[1]	753,5000 MH
40 dBm					
30 dBm					
				M2	
20 dBm			r		
10 dBm					
D dBm					
-10 dBm					
	H1 -13.000 dBm-				
-20 dBm				M3	
				I T I	
-30 dBm			/		
				human	
-40 dBm					
-50 dBm					
			V1		
Stort 720.0 M	10-2		4001 ptc	4.2 MHz/	Stop 772.0 MH
Monkon Tol			-001 pts	-1.2 MI 127	3top 772.0 Min.
	of Trc	Stimulue	Pernonso	Eunction	Function Result
MI KE		746 0 MHz	-35 82 dBm	rancdoff	r uncuon Result
M2	1	753.5 MH7	19.12 dBm		
MB	i	756.0 MHz	-23.61 dBm		
	Y				. 04.09.2013
				M	easuring 12:57:32

Date: 4.SEP.2013 12:57:32

Diagram 4:



Date: 5.SEP.2013 14:37:37





Appendix 5

Diagram 5:

MultiView	Spectrum										
Ref Level 59.9	95 dBm	RBV	N 100 kHz								
Att	20 dB 💩 SWT	10 s VBV	V 1 MHz	Mode #	Auto Sweep						
TDF											
1 Frequency Sv	veep										1Rm Max
								M1[1]			-26.14 dBm
E0 d0m											746.0000 MHz
50 dbiii								M2[1]			16.46 dBm
40 dBm										_	748.5000 MHz
10 0011											
30 dBm											
20 dBm-					M2	M3					
10 dBm											
						llí	11				
0 dBm						₩					
						W					
-10 dBm									-		
	H1 -13.000 dBm										
-20 dBm				MI				4			
				- T			- I " `				
-30 dBm											
								harmon			
-40 dBm											
-50 dBm							-v2				
				V1							
Start 730.0 MH	z	1	1	4001 pt	S	1	4.2	MHz/	1	-	Stop 772.0 MHz
2 Marker Table											
Type Ref	Trc	Stimul	us		Response		Functio	on		Function Resul	t
MI	1	746.0	4Hz		-26.14 dBn	1					
M2	1	748.5	Hz		16.46 dBn	1					
M3	1	753.5	Hz		16.44 dBn	1					
M4	1	756.0	Hz		-26.17 dBn	1					
									Measuring		05.09.2013
	L								mousanng	Construction of the local division of the lo	11:53:34

Date: 5.SEP.2013 11:53:34





Conducted spurious emission measurements according to CFR 47 §27.53(c)

Date	Temperature	Humidity
2013-09-04	$23 \ ^{\circ}C \pm 3 \ ^{\circ}C$	47 % ± 5 %
2013-09-05	$23 \ ^{\circ}C \pm 3 \ ^{\circ}C$	$50\%\pm5\%$
2013-09-09	$23 \ ^{\circ}C \pm 3 \ ^{\circ}C$	51 % ± 5 %

Test set-up and procedure

The measurements were made per definition in §27.53(c). The output was connected to a spectrum analyzer with a RBW setting of 1 MHz and RMS detector activated. The spectrum analyzer was connected to an external 10 MHz reference standard during the measurements.

Before comparing the results to the limit, 3 dB [10 log (2)] should be added according to method 2 "measure and add 10 log(N_{ANT})" of FCC KDB662911 D01 Multiple Transmitter Output v02

Measurement equipment	SP number
R&S FSW	902 073
RF attenuator	902 282
RF attenuator	900 691
HP filter	901 501
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

MIMO mode, Single and multi carrier

Diagram	BW configuration / [MHz]	Tested frequency	Tested Port
1 a+b+c+d	5 MHz	В	RF A
2 a+b+c+d	10 MHz	М	RF A
3 a+b+c+d	5 MHz	Т	RF A
4 a+b+c+d	5 MHz	M2	RF A
5 a+b+c+d	5 MHz	M2	RF B





Appendix 6

Diagram 1a:

MultiViev	v 😁 Spectrum	Ì						
Ref Level	63.94 dBm	RBW	1 MHz					
Att	20 dB 🖷 SWT	10 s VBW	10 MHz Mode	e Auto Sweep				
DF	v Sween							O 1 Rm Ma
	, oneep					M1[1]		29.73 dB
J dBm-								 748.500 MI
dDes								
dBm								
0 dBm							M1	
							1	
0 dBm								
							11	
0 dBm								
dBm								
.0 dBm	H1 -13.000 dBm							
:0 dBm								
				-				
io apin								
√_] H0 dBm								
50 dBm								
tart 9.0 kł	Hz		6001	pts	100.	0 MHz/		 Stop 1.0 GH
						Pr-	leasuring	12:09:32

Diagram 1b:

Ref Level 13.94	d dBm Offeet 1 00 dB					
Att	4 ubiii Offset 1.90 ub	• RBW 1 MHz				
	10 dB 🖶 SWT 10 s	VBW 10 MHz Mo	de Auto Sweep			
Frequency Sw	еер					⊝1Rm i
) dBm-				M	1[1]	-28.85
					1	4.318021
dBm						
.0 dBm	1 -13 000 dBm					
	1 10:000 00:00					
.U dBm-						
30 dBm		-	M1			
0 dBm						
i0 dBm-						
.0 dBm						
10 d8m						
o dom						
:0 dBm						
0 dBm						+
.00 dBm						+ + + + + + + + + + + + + + + + + + + +
tart 1.0 GHz		32001 pt	s	700.0 MH	z/	Stop 8.0

Date: 4.SEP.2013 12:13:40

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Appendix 6

Diagram 1c:

1ultiView 😁	Spectrum							
Ref Level 10.00	,) dBm	• RB	W 10 kHz					
Att	0 dB 🖷 SWT	30 s VB	№ 100 kHz Mod	le Auto Sweep				
DF Eroguopgy Sw	000							1 Drop May
Frequency Sw	eep					M1[1]		-59.91 dB 803.21020 MH
dBm								+
0 dBm								
0 dBm								
0 dBm								-
0 dBm								
0 dBm	L -46.000 dBm							
0 dBm	a the state of the second	and the local distribution of the local distribution of the local distribution of the local distribution of the	and a the standard		and the second secon	a la cal La distanti di California di California di California di California di California di California di Cal	erober al Relation - States de Marshall	M1
0 dBm								
0 dBm								-
0 dBm								
00 dBm								
art 763.0 MHz			2000	1 pts		4.2 MHz/		 Stop 805.0 MH
]							Measuring	 14:14:05

Diagram 1d:

MultiView	Spectrum	·							
Ref Level 10.	.00 dBm Offs	et 22.72 dB 🖷	RBW 1 MHz	Inda Auto Swoor					
Att 1 Frequency S	weep	10 5	VBW 10 MH2 IV	iode Auto Sweep)				• 1Rm Max
						M1[1]		1	-63.56 dBm .56302970 GHz
0 dBm									
-10 dBm									
-20 dBm									
-30 dBm									
-40 dBm									
-50 dBm	H1 -45.400 dBm-								
-60 dBm									
· · · · · · · · · · · · · · · · · · ·			-						
-70 dBm									
-80 dBm									
-90 dBm									
-100 dBm									
Start 1.559 GF	lz		32001 p	ts	5	5.1 MHz/			Stop 1.61 GHz
							Measuring		09.09.2013 15:27:22

Date: 9.SEP.2013 15:27:21



Appendix 6

Diagram 2a:

MultiView	Spectrum											
Ref Level 60.0	00 dBm	•	RBW :	1 MHz								
e Att	10 dB 😑 SWT	10 s	VBW 10	OMHz Moo	le Auto Swee	0						
TDF												040 14
1 Frequency Sv	weep							M1[1]				26.94 dBm 751.000 MHz
50 dBm									-		-	
40 dBm												
30 dBm									,	41		
20 dBm										ň		
10 dBm												
0 dBm												
-10 dBm	H1 -13.000 dBm-											
-20 dBm									_			
-30 dBm												
										L		
-40 dBm												
-50 dBm												
Start 9.0 kHz				600	1 pts		100).0 MHz/				Stop 1.0 GHz
									Measur	ing (03.09.2013 12:16:07

Date: 3.SEP.2013 12:16:07

Diagram 2b:

MultiView 😁 Spectrum	1		
RefLevel 13.94 dBm Offset 1.9 Att 10 dB • SWT	0 dB • RBW 1 MHz 10 s VBW 10 MHz Mode Auto Sweep		
IDF Frequency Sween			⊖ 1 Rm May
LO dBm		M1[1]	-28.96 dBr 4.318021 GH
dBm			
10 dBm H1 -13.000 dBm			
20 dBm			
30 dBm-	M1		
+0 dBm			
i0 dBm			
30 dBm			
/0 dBm			
:0 dBm			
0 dBm			
.00 dBm			
tart 1.0 GHz	32001 pts	700.0 MHz/	Stop 8.0 GH
		Measuring	03.09.2013 12:34:50

Date: 3.SEP.2013 12:34:50





Appendix 6

Diagram 2c:

4ultiView 😁	Spectrum							
Ref Level 10.00	0 dBm	RBW	10 kHz					
Att	0 dB 😑 SWT	30 s VBW	100 kHz Mode	e Auto Sweep				
IDF Frequency Sw	een							1Rm May
	000				M1[1]			-59.91 dB 803.21020 MH
dBm								-
LO dBm								
:0 dBm								
30 dBm								
0.40								
H	1 -46.000 dBm							
-0 dBm								MI
0 dBm	and the second se		an a		a sea a la contra de la contra d		and a state of the	
0 dBm								
0 dBm								
0 dBm					 			
00 dBm								
tart 763.0 MHz			20001	pts	4.2 MHz/		· .	Stop 805.0 MH
						Measuring		16.09.2013 14:23:30

Diagram 2d:

MultiView	B Spectrum								
Ref Level 10	.00 dBm Offs	et 22.72 dB 💿	RBW 1 MHz						
Att 1 Frequency S	Sabe Swi Sweep	IUS	ARM IOWHZ IM	iode Auto Sweep)				• 1Rm Max
						M1[1]			-63.47 dBm
0 dBm							-	+	.36302970 GH2
-10 dBm									
-20 dBm									
-30 dBm									
-40 dBm									
50 dbm	H1 -45.400 dBm								
-30 060									
-60 dBm									
-70 dBm									
-80 dBm									
-90 dBm									
-100 dBm									
Start 1.559 G	Hz		32001 p	ts	5	5.1 MHz/			Stop 1.61 GHz
	J						Measuring		09.09.2013 15:28:21

Date: 9.SEP.2013 15:28:21



Appendix 6

Diagram 3a:

MultiView 8	Spectrum							
Ref Level 63.	94 dBm	• RE	W 1 MHz	la Auto Swoon				
TDF	20 00 - 341	10.5 VB	W IOWINZ WOO	e Auto Sweep				
1 Frequency Sv	weep							⊜1Rm Max
60 dBm						M1[1]		29.74 dBm 753.500 MHz
50 dBm								
40 dBm								
							M1	
30 dBm								
20 dBm								
10 dBm								
0 dBm-								
-10 dBm-	H1 -13.000 dBm							
-20 dBm								
-30 dBm								
-40 dBm								
-50 dBm								
Start 9.0 kHz	_		600	1 pts	10	0.0 MHz/		Stop 1.0 GHz
							Measuring	 04.09.2013 12:50:04

Date: 4.SEP.2013 12:50:04

Diagram 3b:

MultiView 🔠 Spectrum	٦		
Ref Level 13.94 dBm Offset 1. Att 10 dB • SWT 10 dB • SWT	90 dB • RBW 1 MHz 10 s VBW 10 MHz Mode Auto Sweep		
IDF Frequency Sweep			O 18m May
LO dBm-		M1[1]	-28.90 dBr 4.318020 GH
dBm			
.0 dBm			
:0 d8m			
30 dBm	M1		
+0 dBm			
50 dBm			
50 dBm			
'0 dBm			
30 dBm			ļ
90 dBm			
00 dBm			
tart 1.0 GHz	32001 pts	700.0 MHz/	Stop 8.0 GH
		Measuring	04.09.2013

Date: 4.SEP.2013 12:47:12





Appendix 6

Diagram 3c:

MultiView 🕀	Spectrum								
Ref Level 10.0	0 dBm	● RBW	10 kHz						
Att	0 dB 😑 SWT 3	30 s VBW	100 kHz Mode	e Auto Sweep					
IDF Erequency Sm	reen								● 1 Bm Ma
Trequency of	.ccp					M1[1]			-59.91 dE
10-11							1	1	803.21020 M
dBm-									
0 dBm									
20 dBm				_					
30 dBm								-	
HO dBm									
+	1 -46.000 dBm								
ou dem-									
in dam									M1
and the stand in the second	and the second se		and and the state of the state	Real and in the states	and the state of the	and the state of the		a state of the sta	and the second
O dBm									
30 dBm				-					
0 dBm									
00.48m									
LOU UBIII									
			20001			10141-1			Char 005 0 M
tart 763.0 MH	2		20001	pts		4.2 MHZ/			16.09.2013
]	L						Measuring		14:19:03

Diagram 3d:

MultiView 🗄	Spectrum	ı)							
Ref Level 10.0	0 dBm Offs	et 22.72 dB 🖷	RBW 1 MHz						
Att 1 Frequency Sv	s dB e SWI veep	IUS	ARM IO MHS M	lode Auto Sweej	0				• 1Rm Max
						M1[1]			-63.61 dBm
0 dBm								+ 1	30302970 GH2
-10 dBm									
-20 dBm									
-30 dBm									
-40 dBm									
-50 dBm	41 -45.400 dBm								
60 d8m									
M1									
-70 dBm									
-80 dBm									
-90 dBm									
-100 dBm									
Start 1.559 GH:	Z		32001 p	ts	5	5.1 MHz/			Stop 1.61 GHz
							Measuring		09.09.2013 15:26:02

Date: 9.SEP.2013 15:26:02





Appendix 6

Diagram 4a:

MultiView 88	Spectrum								
Ref Level 63.9 Att	0 dBm 20 dB e SWT 1	• RBW 10 s VBW	1 MHz 10 MHz Mode	Auto Sweep					
TDF 1 Frequency Sw	veep								• 1Rm Max
60 dBm						M1[1]			26.90 dBm 748.500 MHz 26.90 dBm
50 dBm							1	1	753.500 MHz
40 dBm									
30 dBm				_					
20 dBm-				_					
10 dBm									
0 dBm				-					
-10 dBm	11 -13 000 dBm								
-20 dBm									
-30 dBm									
-40 dBm				_					
-50 dBm									
Start 9.0 kHz			6001	nts	11				Stop 1.0 GHz
			0001				Measuring		05.09.2013 12:08:02

Date: 5.SEP.2013 12:08:02

Diagram 4b:

MultiView 🕄 Spect	rum				
Ref Level 13.85 dBm Att 10 dB	Offset 1.90 dB RBW 11 SWT 10 s VBW 101	1Hz 1Hz Mode Auto Sweep			
1 Frequency Sweep					1Rm Max
10 dBm			M1[1]		-28.87 dBm 4.318021 GHz
0 dBm					
-10 dBm	18.m				
-20 dBm					
-30 dBm		M1			
-40 dBm					
-50 dBm					
-60 dBm					
-70 dBm					
-80 dBm					
-90 dBm					
-100 dBm					
Start 1.0 GHz		32001 pts	700.0 MHz/		Stop 8.0 GHz
				Measuring 🚺 🗰	05.09.2013 12:13:42

Date: 5.SEP.2013 12:13:43





Appendix 6

Diagram 4c:

MultiView 😁	Spectrum							
Ref Level 10.0	0 dBm	RBW	10 kHz					
Att	0 dB 🖷 SWT	30 s VBW	100 kHz Mode	Auto Sweep				
Erequency Sw	een							1Rm May
	000					M1[1]		-59.91 dBi 803.21020 MH
dBm								
10 dBm								
20 dBm								
30 dBm								
10 10 -								
+0 UBIII	1 -46.000 dBm							
30 dBm								MI
50 dBm	and the second		den der eller er eller bereitigt	and all all and the state	in the second	and the state of the		Live and the second sec
70 dBm								
30 dBm								
90 dBm								
100 dBm								
tart 763.0 MHz			20001	pts		4.2 MHZ/		 stop 805.0 MF
							Measuring	 14:26:10

Diagram 4d:

MultiView	🗄 Spectrum								
Ref Level 10	0.00 dBm Offs	et 22.72 dB 🖷	RBW 1 MHz						
Att	5 dB 🕳 SWT	10 s	VBW 10 MHz N	lode Auto Sweep	>				
1 Frequency S	Sweep					M1[1]		1	 IRm Max -63.29 dBm .56302970 GHz
0 dBm									
-10 dBm									
-20 dBm									
-30 dBm									
-40 dBm									
-50 dBm	H1 -45.400 dBm-								
-60 dBm									
×									
-70 asm-									
-80 dBm									
-90 dBm									
-100 dBm									
Start 1.559 G	Hz		32001 p	ts	5	5.1 MHz/			Stop 1.61 GHz
	ا						Measuring		09.09.2013 14:59:46

Date: 9.SEP.2013 14:59:46





Appendix 6

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Diagram 5a:

 Spectrum

 Ref Level 63.90 dbm
 RBW 1 MHz

 Att
 20 dB • SWT 10 s
 VBW 10 MHz
 Mode Auto Sweep
 TDF 1 Frequency Sweep M1[1] 26.80 dBn 748.500 MH 26.78 dBn 753.500 MH 60 dBm M2[1] 50 dBr 40 dB 30 dB M 20 dB 10 dBr dB -10 dBr H1 -13.000 dBm 20 dB 40 dE 50 dBr 6001 pts Stop 1.0 GHz Start 9.0 kHz 100.0 MHz/ Measuring... 🚺 🗰 5.09.2013 12:42:59 // Date: 5.SEP.2013 12:42:59

Diagram 5b:

MultiView 88	Spectrum							
Ref Level 13.8 Att	5 dBm Offsei 10 dB = SWT	t 1.90 dB • RE 10 s VE	SW 1 MHz SW 10 MHz Mo	ode Auto Sweep				
TDF	(000							O 1 Date May
T Frequency Sw	/eep					M1[1]		-28,84 dBm
10 dBm								4.318021 GHz
0 dBm								
-10 dBm	1 -12 000 d8m							
l'	12 -13.000 000							
-20 dBm-								
				M1				
-30 dBm								
-40 dBm								-
-50 dBm								-
-60 dBm								 -
-70 dBm								 -
-80 dBm								
-90 dBm								
-100 dBm								 +
Start 1.0 GHz	,		32001 p	ts	70	0.0 MHz/		 Stop 8.0 GHz
							Measuring	 05.09.2013 12:26:35

Date: 5.SEP.2013 12:26:35



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Appendix 6

Diagram 5c:

AultiView 😁	Spectrum								
Ref Level 10.00	, 0 dBm	RBW	10 kHz						
Att	0 dB 💩 SWT	30 s VBW	100 kHz Mode	e Auto Sweep					
Erequency Sw	een								• 1Rm Ma
	000					M1[1]			-59.91 dB 803.21020 MI
dBm									
.0 dBm									
0 dBm				-					
0 dBm									
0 dBm									
H	1 -46.000 dBm								
J dBm									M1
D dBm	and the second		a de la classe de la compañía de la	and the distribution of	-	and the state of the		-	-
D dBm									
D dBm									
) dBm									
00 dBm									
out 762.0 MU			20001			4.2 MU57			Ptop 205 0 M
art 703.0 MHz			20001	pts					16.09.2013
							Measuring		14:29:05

Diagram 5d:

MultiView	B Spectrum								
Ref Level 10	0.00 dBm Offs	et 22.72 dB 🖷	RBW 1 MHz						
Att 1 Frequency \$	S dB e SWI	IUS	ARM IO MHZ IM	iode Auto Sweej	0				• 1Rm Max
						M1[1]			-63.61 dBm
0 dBm								+'	
-10 dBm								_	
-20 dBm									
-30 dBm									
-40 dBm									
-50 d8m-	H1 -45.400 dBm-								
-60 dBm M1									
-70 dBm									
-80 dBm									
-90 dBm									
-100 dBm									
Start 1.559 G	Hz		32001 p	ts	5	5.1 MHz/			Stop 1.61 GHz
							Measuring	•••••	09.09.2013 15:17:43

Date: 9.SEP.2013 15:17:42

SP SP voir de

Appendix 6

Page

12(12)

Remark

The emission at 9 kHz on the plots was not generated by the test object. A complementary measurement with a smaller RBW showed that it was related to the LO feed-through.

The highest fundamental frequency is 756 MHz. The measurements were made up to 8 GHz (10x756 MHz = 7.56 GHz).

Limits

§27.53(c), (f)

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least $43 + 10 \log (P) dB$, resulting in a limit of -13 dBm per 1 MHz RBW.

On all frequencies between 763-775 MHz and 793-805 MHz the power of any emission shall be attenuated below the transmitter power (P), by at least $76 + 10 \log (P) dB$ in a 6.25 kHz band segment, resulting in a limit of -46 dBm measured with 10 kHz RBW.

Emissions in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP). With respect of the representative antenna gain 5.4 dBi resulting in a limit of -45.4 dBm per 1 MHz RBW.

Complies?	Yes
-----------	-----





Field strength of spurious radiation measurements according to 47 CFR 27.53 (c)

Date	Temperature	Humidity
2013-08-12	$23^{\circ}C \pm 3^{\circ}C$	51 % ± 31 %
2013-08-13	$23^{\circ}C \pm 3^{\circ}C$	45 % ± 34 %

Test set-up and procedure

The test sites are listed at FCC, Columbia with registration number: 93866. The test site complies with RSS-Gen, Industry Canada file no. 3482A-1.

The measurements were performed with both horizontal and vertical polarization of the antenna. The antenna distance was 3 m in the frequency range 30 MHz - 8 GHz.

The measurement was performed with a RBW according to table below:

Frequency range	RBW
30-763 MHz	1 MHz
763-775 MHz	10 kHz
775-793 MHz	1 MHz
793-805 MHz	10 kHz
805-8000 MHz	1 MHz

A propagation loss in free space was calculated. The used formula was

 $\gamma = 20 \log \left(\frac{4\pi D}{\lambda} \right)$, γ is the propagation loss and D is the antenna distance.

The measurement procedure was as the following:

- 1. The pre-measurement was first performed with peak detector. The EUT was measured in eight directions and with the antenna at three heights, 1.0 m, 1.5 m and 2.0 m.
- 2. Spurious radiation on frequencies closer than 20 dB to the limit in the pre-measurement is scanned 0-360 degrees and the antenna is scanned 1-4 m for maximum response. The emission is then measured with the RMS detector and the RMS value is reported. Frequencies closer than 10 dB to the limit when measured with the RMS detector were measured with the substitution method according to the standard.



1111

Date	Reference	Page
2013-09-17	3P05643-F27	2(5)

Appendix 7

The test set-up during the spurious radiation measurements is shown in the picture below:



Measurement equipment

Measurement equipment	SP number
Semi anechoic chamber	503 881
R&S ESU 26	901 553
EMC 32 ver. 8.52.0	503 899
Chase Bilog Antenna CBL 6111A	503 182
EMCO Horn Antenna 3115	502 175
High pass filter, RLC Electronics	901 373
µComp Nordic, Low Noise Amplifier	901 545
Temperature and humidity meter, Testo 625	504 188



Appendix 7

Tested configurations

В	
М	
M2	
Т	

Results, representing worst case

M2, BW 5 MHz: Diagram 1 a-c

	Spurious emission level (dBm)					
Frequency (MHz)	Vertical	Horizontal				
30-8 000	All emission > 20 dB below limit	All emission > 20 dB below limit				

Measurement uncertainty:

3.2 dB up to 18 GHz

Limits

§27.53(c)

Outside a licensee's frequency band(s) of operation the power of any emission shall be attenuated below the transmitter power (P) by at least $43 + 10 \log (P) dB$, resulting in a limit of -13 dBm per 100 kHz RBW.

On all frequencies between 763-775 MHz and 793-805 MHz the power of any emission shall be attenuated below the transmitter power (P), by at least $76 + 10 \log (P) dB$ in a 6.25 kHz band segment, resulting in a limit of -46 dBm measured with 10 kHz RBW.

Complies?	Yes
-----------	-----



Note: The emission between 746 MHz and 756 MHz is the carrier frequency and shall be ignored in the context.

Diagram 1b: (zoom of diagram 1a)







Appendix 7

Diagram 1c:







Frequency stability measurements according to CFR 47 §27.54

Date	Temperature	Humidity
2013-08-13	$23 \ ^{\circ}C \pm 3 \ ^{\circ}C$	45 % ± 5 %
2013-08-14	$22 \degree C \pm 3 \degree C$	44 % ± 5 %
2013-08-15	23 °C ± 3 °C	45 % ± 5 %

Test set-up and procedure

The measurement was made per 3GPP TS 36.141. The output was connected to a spectrum analyzer. The spectrum analyzer was connected to an external 10 MHz reference standard during the measurements.

Measurement equipment	SP number
R&S FSQ 40	504 143
RF attenuator 30 dB Weinschel 6405 (EAB equipment)	900 233
Temperature Chamber	503 360
Testo 635, temperature and humidity meter	504 203
Multimeter Fluke 87	502 190





Appendix 8

Results

Nominal Voltage -48 V DC

Maximum output power at mid channel (M)

Channel Bandwidth 5MHz

Test conditions		Frequency error (Hz)
Supply voltage DC (V)	T (°C)	Test model E-TM1.1
-48.0	+20	+3
-55.2	+20	+4
-40.8	+20	+3
-48.0	+30	-3
-48.0	+40	-2
-48.0	+50	-2
-48.0	+10	+2
-48.0	0	-2
-48.0	-10	-2
-48.0	-20	-2
-48.0	-30	+3
Maximum freq. e	rror (Hz)	4
Measurement unc	certainty	$< \pm 1 \times 10^{-7}$







Appendix 8

Nominal Voltage 120 V AC 60 Hz

Maximum output power at mid channel (M)

Channel Bandwidth 5MHz

Test conditions		Frequency error (Hz)
Supply voltage AC (V)	T (°C)	Test model E-TM1.1
120	+20	-1
102	+20	+1
138	+20	-2
Maximum freq. error (Hz)		2
Measurement unc	ertainty	$<\pm 1 \times 10^{-7}$

Remark

It was deemed sufficient to test one combination of TX frequency, channel bandwidth configuration and test model (modulation), as all combinations share a common internal reference to derive the TX frequency from.





Remark

It was deemed sufficient to test one combination of TX frequency, channel bandwidth configuration and test model (modulation), as all combinations share a common internal reference to derive the TX frequency from.

Limits

Limit according to 3GPP TS 36.141:

The frequency error shall be within \pm 0.05 PPM \pm 12 Hz (±49.55 Hz).

§27.54

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Complies?	Yes









111-



