



REPORT

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Radio measurements on 700 MHz cellular equipment with FCC ID: TA8AKRC161241-1

(8 appendices)

Test object

RRUS 11 B12 RRU, KRC 161 241/1 Rev. R1D, S/N (S)CB4E780229

Appendix 1 provides information about the test object and the test set-up.
Appendix 8 provides external photos of the test object.

Summary

Standard	Compliant	Appendix	Comment
FCC CFR 47	Yes		
2.1046 RF power output	Yes	2	-
2.1049 Occupied bandwidth	Yes	3	-
2.1051 Band edge	Yes	4	-
2.1051 Spurious emission at antenna terminals	Yes	5	-
2.1053 Field strength of spurious radiation	Yes	6	-
2.1055 Frequency stability	Yes	7	-
15.111 Receiver spurious emissions	N.A.	-	Note 1

Note 1: The client declared that the test object has no stand-by mode. Both TX are always active. RX measurements were considered not applicable.

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FCC ID: TA8AKRC161241-1

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FCC ID: TA8AKRC161241-1

Appendix 1

Description of test object

Equipment:	Radio equipment RRUS 11 B12 in LTE mode
Frequency band	TX: 728 - 746 MHz RX: 698 - 716 MHz
Supported channel bandwidth configuration	5 MHz (15 RB), 10 MHz (50 RB) and 15 MHz (75 RB) according 3GPP 36.141 section 5.6
Modulation and access scheme	OFDMA in FDD
OFDM subcarrier modulation	System information and pilots use BPSK and QPSK. For payload data QPSK, 16QAM and 64QAM can be used.
Maximum rated output power:	2x 44.8 dBm (2x 30 W)
Number of antenna ports:	2 combined TX/RX ports
Supported configuration:	Dual single carrier. Both RF chains are identical.
Nominal power voltage:	-48 VDC

Tested frequencies and EARFCNs for TX measurements

EARFCN	Frequency / [MHz]	BW configuration / [MHz]	Comment
5025	730.5	5	B - Lowest supported TX carrier frequency
5050	733.0	10	B - Lowest supported TX carrier frequency
5075	735.5	15	B - Lowest supported TX carrier frequency
5090	737.0	5, 10 and 15	M - TX band center frequency common for all BW configurations
5105	738.5	15	T - Highest supported TX carrier frequency
5130	741.0	10	T - Highest supported TX carrier frequency
5155	743.5	5	T - Highest supported TX carrier frequency

Both test object RF chains were always configured to the same EARFCN. The RX were set to the corresponding EARFCN offset by a value of +18000 in respect to the TX EARFCN.

Note: EARFCN are derived from 3GPP TS 36.141 Version 8.5.0, table 5.7.3-1.



Operation mode during measurements

The test object was powered with -48 VDC. Measurements were performed with both TRX RF chains activated and both TX transmitting at maximum nominal power the test models 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 payload modulation. The RF port not tested was via an attenuator terminated into 50 ohm.

The setting maximum nominal output power 44.8 dBm (30 W) in channel bandwidth configuration 5 MHz transmitting E-TM1.1 was found to be representative for all traffic scenarios when several settings with the different modulations were tested to find the worst case setting. This setting was used for all measurements unless noted otherwise.

Conducted measurements

Complete TX measurements were done at connector RF A. Limited complementary TX measurements were done at connector RF B to verify identical performance for both transmitter chains. RX measurements were not applicable, the test object can not provide a stand-by mode. Both TX are always active.

Radiated measurements

During the measurements both output ports RF A and RF B were via RF attenuators and a directional coupler connected to functional test equipment outside the shielded chamber for supervision of the transmitted signals.

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:
FCC CFR 47, part 27, October 2010
ANSI/TIA/EIA-603-B-2002
3GPP TS 36.141, Version 8.5.0

Measurement equipment

Measurement equipment	Calibration Due	SP number
Test site Tesla	2012-10	503 881
ROHDE & SCHWARZ FSQ 40	2011-07	504 143
ROHDE & SCHWARZ ESI 26	2011-08	503 292
High pass filter Lorch 1 – 15 GHz	2011-07	502 758
RF attenuator	2011-07	504 159
RF step attenuator	2012-07	503 096
Boonton RF Peak power meter/analyzer	2011-10	503 144
Boonton Power sensor 56518-S/4	2012-10	503 145
Chase Bilog antenna CBL 6111A	2011-10	503 182
EMCO Horn Antenna 3115	2011-01	502 175
MITEQ Low Noise Amplifier	2011-07	503 285
Climate chamber 3	2012-05	503 546
Multimeter Fluke 87	2011-03	502 190
Testo 635 temperature and humidity meter	2011-03	504 203
Testo 625 temperature and humidity meter	2011-06	504 188

Uncertainties

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

Reservation

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

Delivery of test object

The test object was delivered 2010-11-01.

Manufacturer's representative

Mats Falk, Ericsson AB

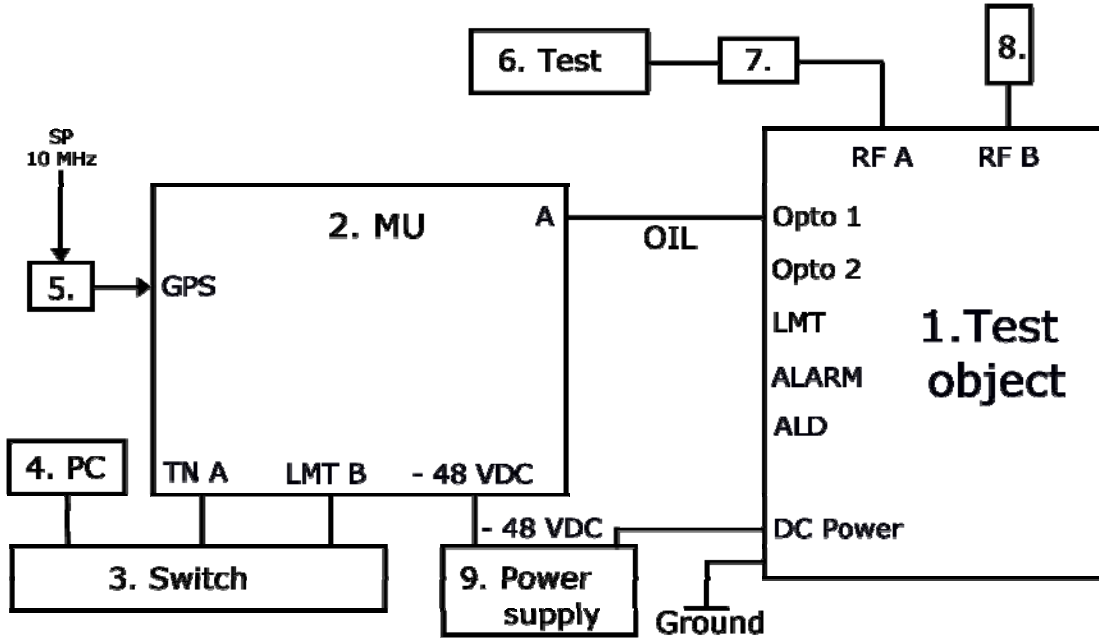
Test engineers

Jörgen Wassholm, Andreas Johnsson, Jonas Bremholt and Reinhold Reul

Test participants

Christer Hjorth, Ericsson AB (Partially)

Test set-up conducted measurements



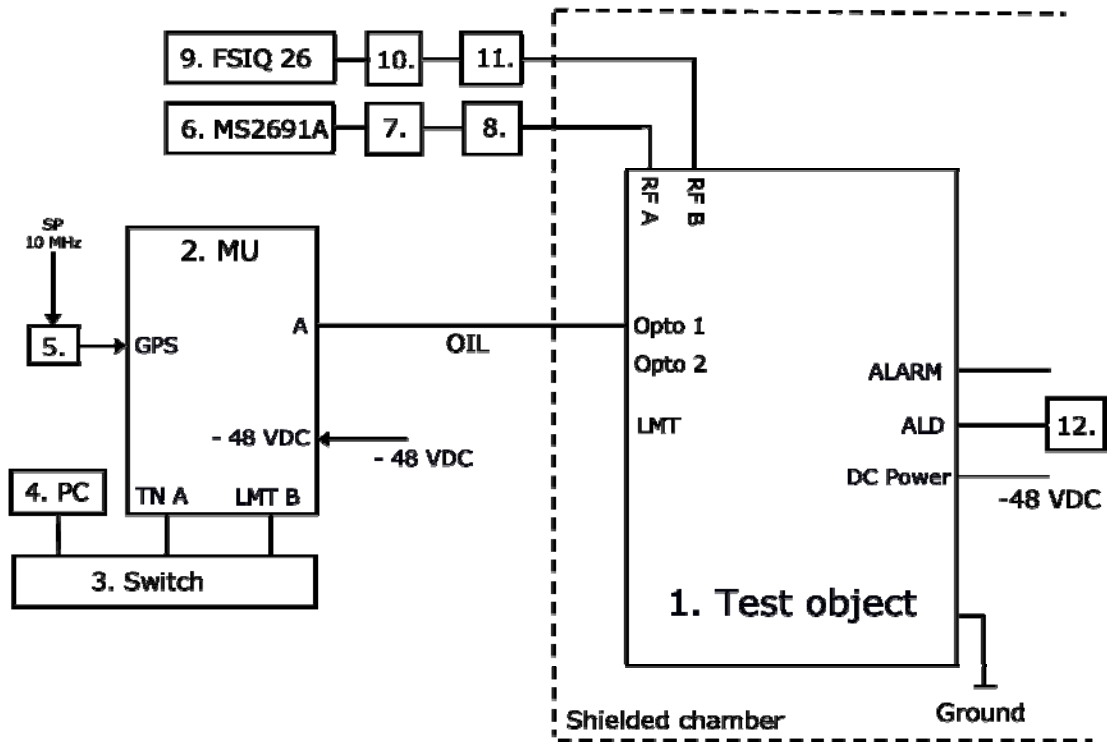
Test object

1. RRUS 11 B12 RRU, KRC 161 241/1 rev. R1D, S/N (S)CB4E780229
FCC ID: TA8AKRC161241-1 with software CXP 102 051/10 rev. R5FZ

Functional test equipment

2. Main unit RBS 6601 with
Power supply SUP 6601, product 1/BFL 901 009/1, rev. R3B, SN (S)BR80983118
DUL 20 01, product (1P)KDU 137 533/4, rev. R1A, SN (S)C823774053
3. Switch Netgear Model FS726
4. Computer Sun Ultra 27 BAMS-1000758440
5. Interface converter BNC to RJ-45, product NCD 901 40/1, rev. R1A, SN A401222715
6. Test equipment according equipment list in respective appendix
7. Attenuator & filter according equipment list in respective appendix
8. Attenuator Weinschel Associates, Model WA48-20, SN 2990 and
termination Weinschel Corp. model 1429-3, SN BC0893
9. DC power supply Delta Elektronika SM 70-22, BAMS 10009062893

Test set-up radiated measurements



Test object

1. RRUS 11 B12 RRU, KRC 161 241/1 rev. R1D, S/N (S)CB4E780229
FCC ID: TA8AKRC161241-1 with software CXP 102 051/10 rev. R5FZ

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DUL 20 01, product (1P)KDU 137 533/4, rev. R1A, SN (S)C823774053
3. Switch Netgear Model FS726
4. Computer Sun Ultra 27 BAMS-1000758440
5. Interface converter BNC to RJ-45, product NCD 901 40/1, rev. R1A, SN A401222715
6. Anritsu MS2691A Signal Analyzer, BAMS 1000739661
for supervision of the transmitted signal
7. Directional coupler Microlab FXR model CK-D55, BAMS-1000739626
8. Attenuator Weinschel model 40-30-33 s/n BJ4349
9. Rohde & Schwarz FSIQ 26, BAMS 1000375423
10. Directional coupler
11. Attenuator Weinschel Corp. model 48-30-33, SN BJ4350
12. Remote Electrical Tilt unit AISG 2.0,
product KRY 121 67/2, rev. R1G, BAMS 1000610277



Test object ports

Interface:	Type of port:
Ground connection	Ground
Supply power -48 VDC	DC Power
Antenna port "RF A", 7/16 connector, female, combined TX/RX	Antenna
Antenna port "RF B", 7/16 connector, female, combined TX/RX	Antenna
Opto 1, connected via optical data link to DUL port A	Signal
Opto 2, unconnected	Signal
LMT, unconnected	Signal
ALARM, external alarm, not connected during conducted measurements, connected to 15 m shielded multiwire during radiated measurements	Signal
ALD, not connected during conducted measurements, connected to remote electrical tilt unit during radiated measurements	Signal



RF power output measurements according to 47 CFR 2.1046

Date	Temperature	Humidity
2010-11-09	23 °C ± 3 °C	18 % ± 5 %
2010-11-10	23 °C ± 3 °C	20 % ± 5 %

Test set-up and procedure

The output was connected to a peak power analyzer with the CDF mode activated.

Measurement equipment	SP number
Boonton RF Peak power meter/analyzer	503 144
Boonton Power sensor 56518-S/4	503 145
RF attenuator	504 159
Multimeter Fluke 87	502 190
Testo 635 temperature and humidity meter	504 203

Measurement uncertainty: 0.5 dB

Results

Rated output power level at connector RF A (maximum): 44.8 dBm (30 W).

Test conditions, Test model in BW configuration T _{nom} 23 °C/ V _{nom} -48 V DC	Transmitter power RMS (dBm) / PAR (dB)		
	Channel B	Channel M	Channel T
E-TM1.1 in 5 MHz	44.6 / 7.0	44.7 / 6.5	44.7 / 6.6
E-TM1.1 in 10 MHz	44.6 / 7.0	44.6 / 6.4	44.6 / 6.6
E-TM1.1 in 15 MHz	44.4 / 6.8	44.4 / 6.8	44.4 / 6.6

Limit

Derived from CFR 47 § 27.50 (c) (3): Base stations transmitting in the 698 –746 MHz band with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz.

The peak-to-average ratio (PAR) shall not exceed 13 dB.

Complies?	Yes
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**Occupied bandwidth measurements according to 47 CFR 2.1049**

Date	Temperature	Humidity
2010-11-09	23 °C ± 3 °C	18 % ± 5 %
2010-11-10	23 °C ± 3 °C	20 % ± 5 %

Test set-up and procedure

The measurements were made as defined in §2.1049. The output 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.

Measurement instrument	SP number
ROHDE & SCHWARZ FSQ40	504 143
RF attenuator	504 159
Testo 635 temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

The results are shown in appendix 3.1

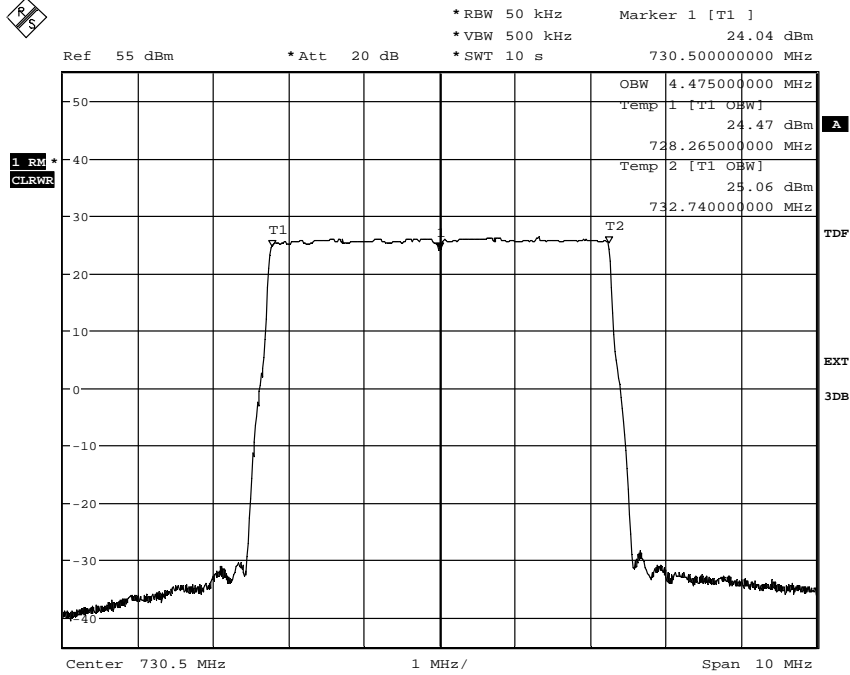
	BW configuration	Tested port	Channel	OBW
Diagram 1	5 MHz	RF A	B	4.475 MHz
Diagram 2	5 MHz	RF A	M	4.480 MHz
Diagram 3	5 MHz	RF A	T	4.480 MHz
Diagram 4	10 MHz	RF A	B	8.935 MHz
Diagram 5	10 MHz	RF A	M	8.940 MHz
Diagram 6	10 MHz	RF A	T	8.935 MHz
Diagram 7	15 MHz	RF A	B	13.410 MHz
Diagram 8	15 MHz	RF A	M	13.418 MHz
Diagram 9	15 MHz	RF A	T	13.410 MHz
Diagram 10	5 MHz	RF B	B	4.478 MHz

Remark

Test of one configuration was repeated for the transmitter chain at port RF B, giving identical results within measurement uncertainty.

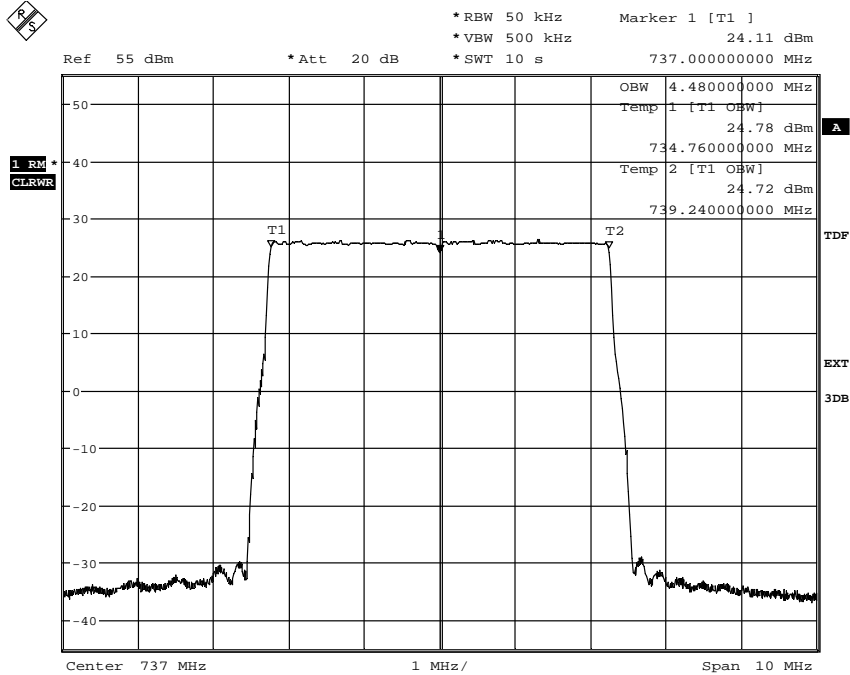


Diagram 1:



Date: 9.NOV.2010 12:45:08

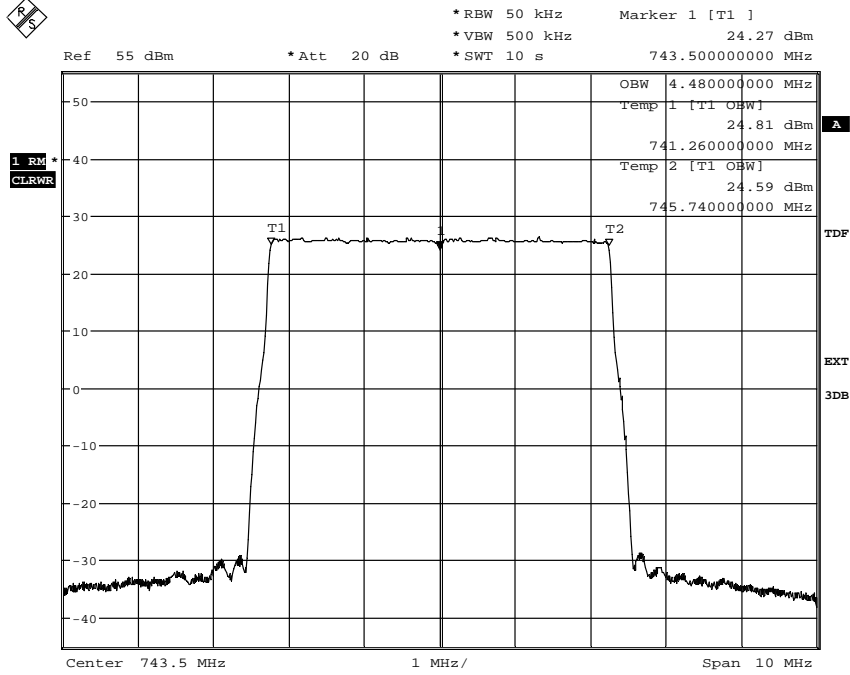
Diagram 2:



Date: 9.NOV.2010 15:47:44

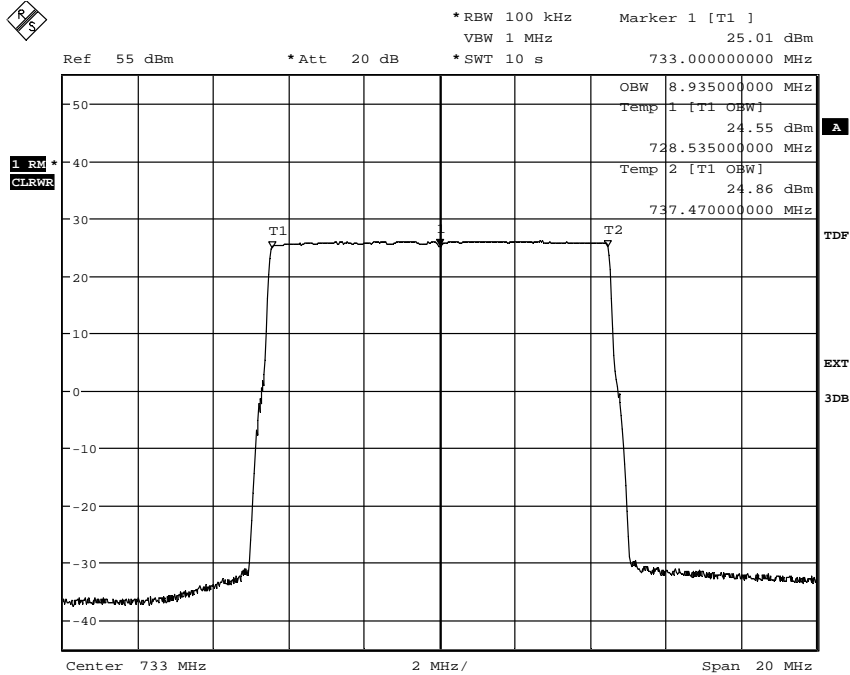


Diagram 3:



Date: 9.NOV.2010 15:32:23

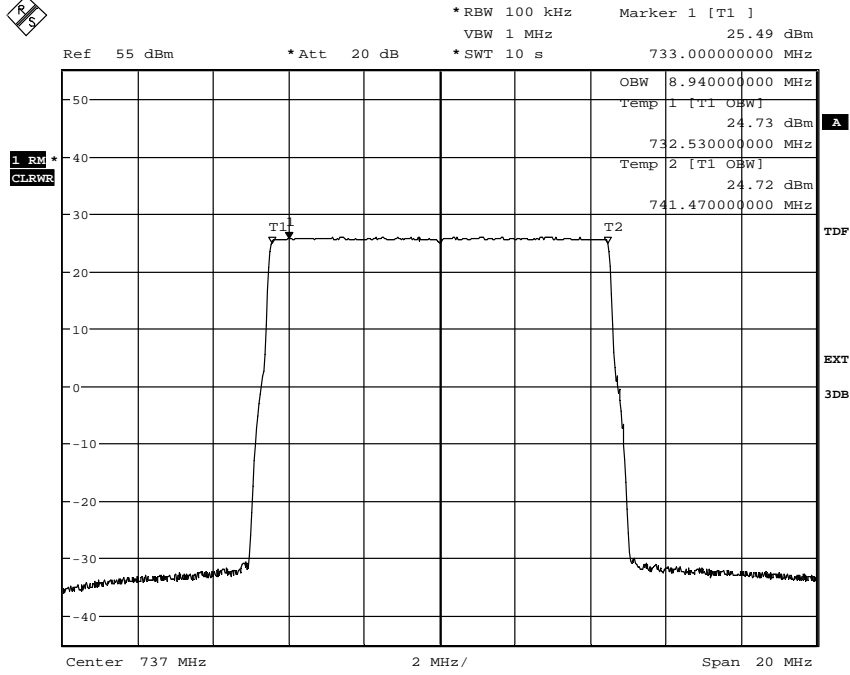
Diagram 4:



Date: 9.NOV.2010 16:10:35

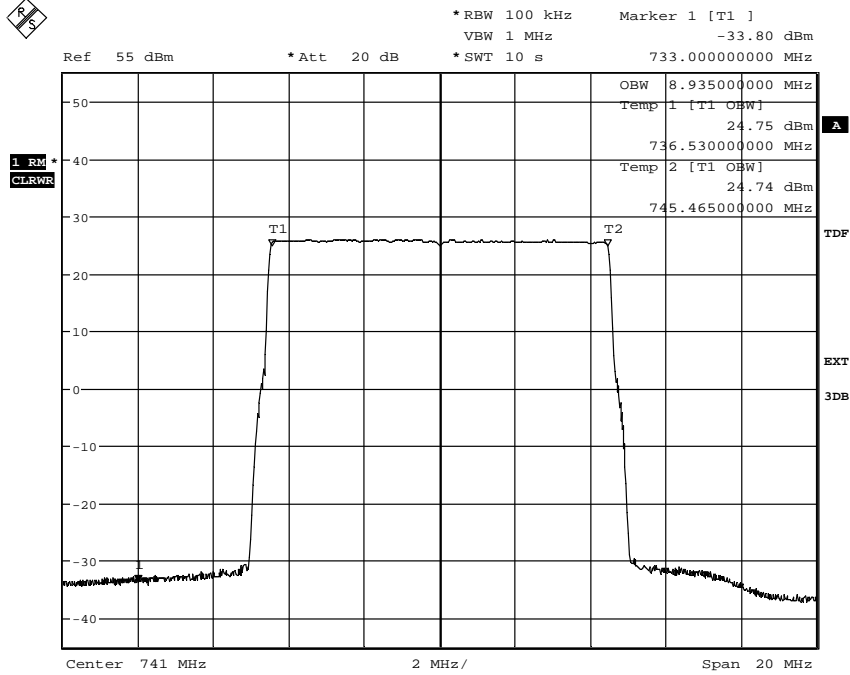


Diagram 5:



Date: 10.NOV.2010 09:36:45

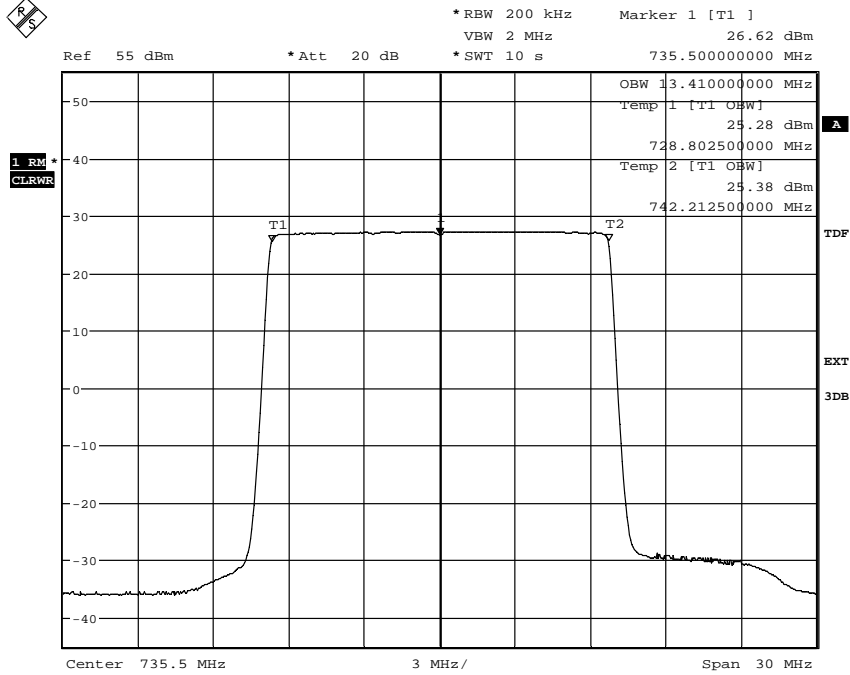
Diagram 6:



Date: 10.NOV.2010 09:21:49

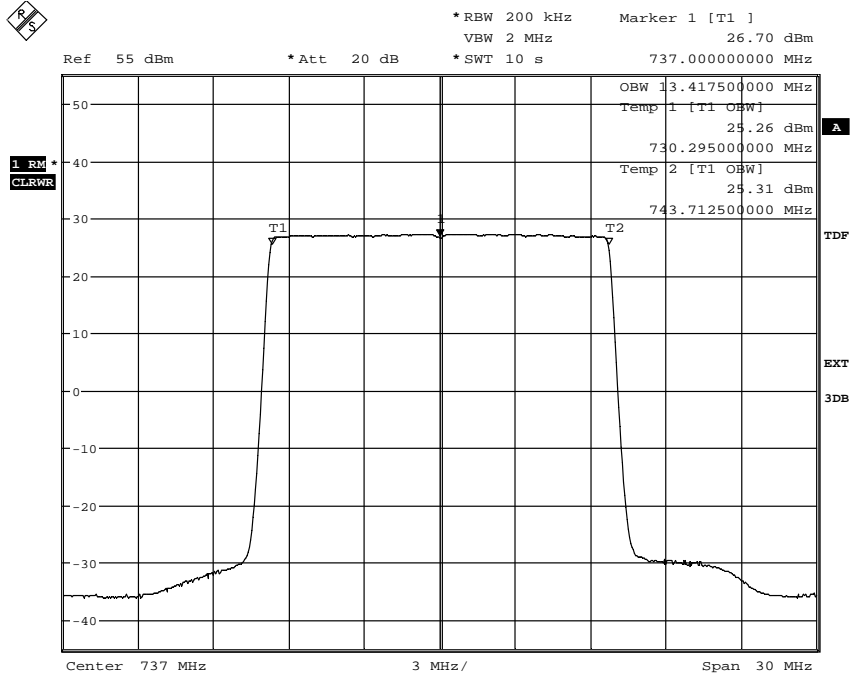


Diagram 7:



Date: 10.NOV.2010 09:46:44

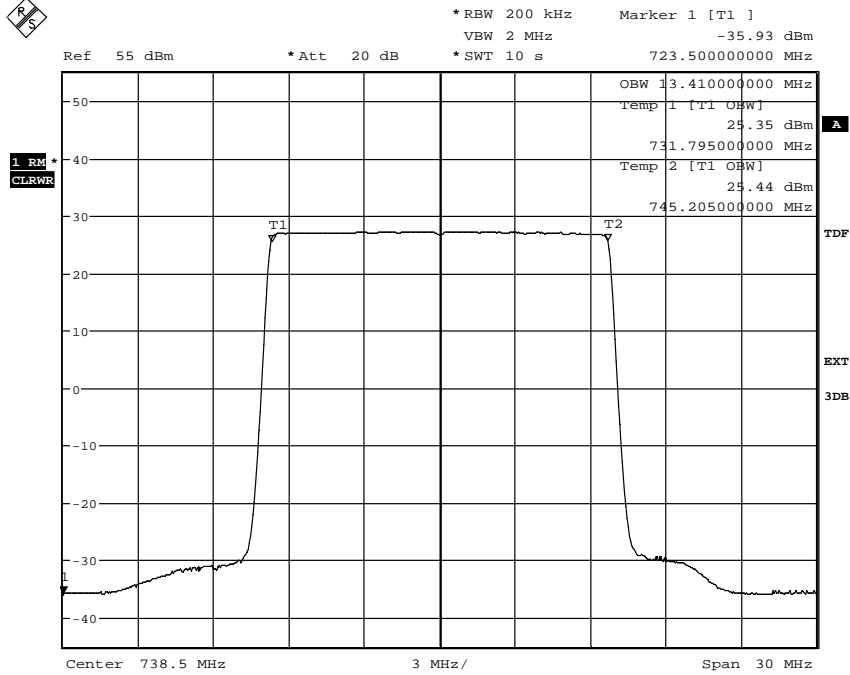
Diagram 8:



Date: 10.NOV.2010 11:04:41

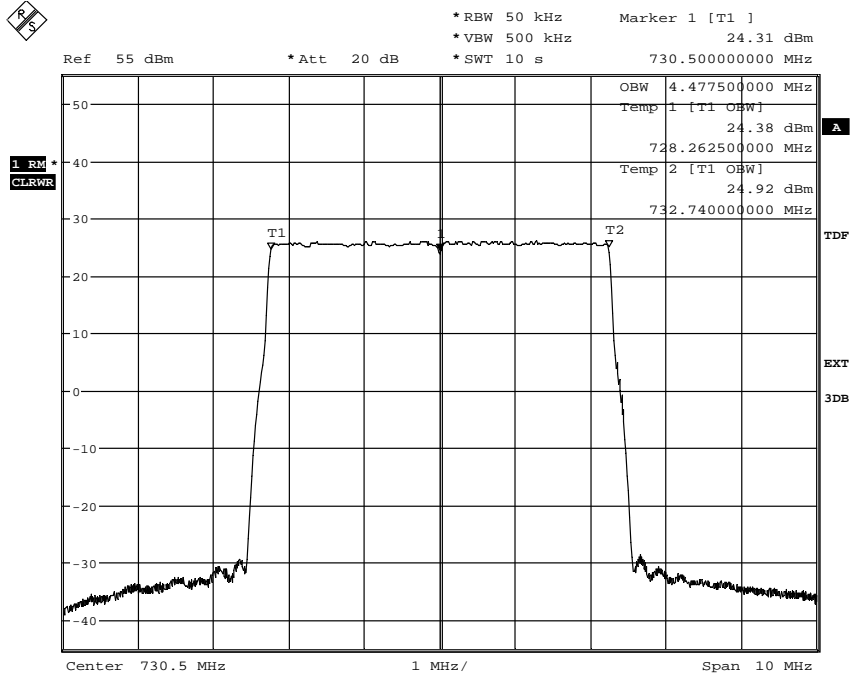


Diagram 9:



Date: 10.NOV.2010 10:50:52

Diagram 10:



Date: 10.NOV.2010 15:50:11



Band edge measurements according to 47 CFR 2.1051

Date	Temperature	Humidity
2010-11-09	23 °C ± 3 °C	18 % ± 5 %
2010-11-10	23 °C ± 3 °C	20 % ± 5 %

Test set-up and procedure

The test object output 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.

The measurements were made as defined in §27.53 (g). A resolution bandwidth of 30 kHz was used for frequencies offset up to 5 MHz from the band edges. After the 100 kHz immediately outside the band edges the limit was adjusted -5.2 dB (10 log (30/100)) to -18.2 dBm in order to compensate for the reduced measurement bandwidth.

Measurement instrument	SP number
ROHDE & SCHWARZ FSQ40	504 143
RF attenuator	504 159
Testo 635 temperature and humidity meter	504 188

Measurement uncertainty: 3.7 dB

Results

The results are shown in appendix 4.1

	Bandwidth configuration	Channel
Diagram 1 a & b	5 MHz	B
Diagram 2 a & b	5 MHz	T
Diagram 3 a & b	10 MHz	B
Diagram 4 a & b	10 MHz	T
Diagram 5 a & b	15 MHz	B
Diagram 6 a & b	15 MHz	T

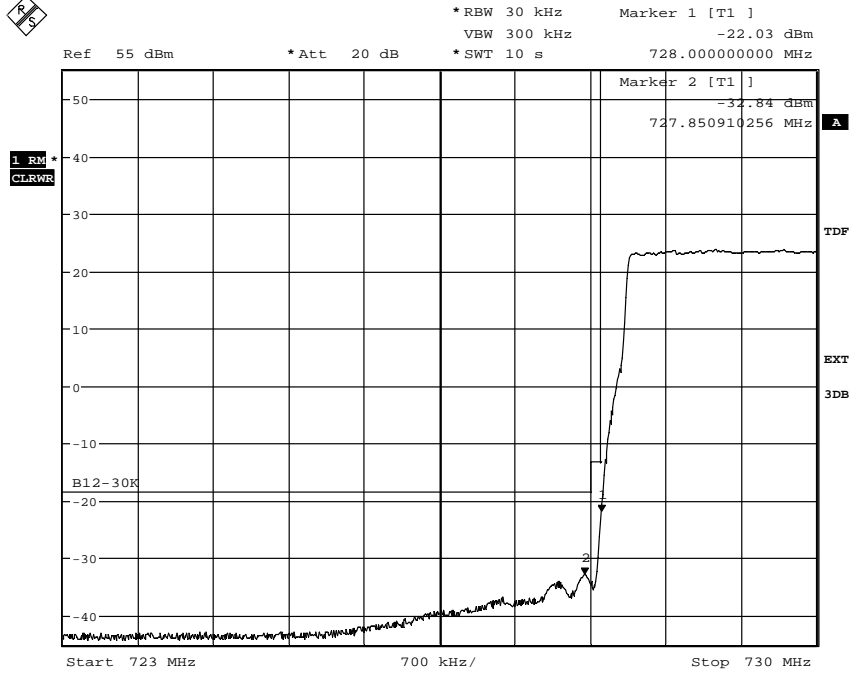
Limits

Derived from CFR 47 § 27.53 (g): Outside 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.

Complies?	Yes
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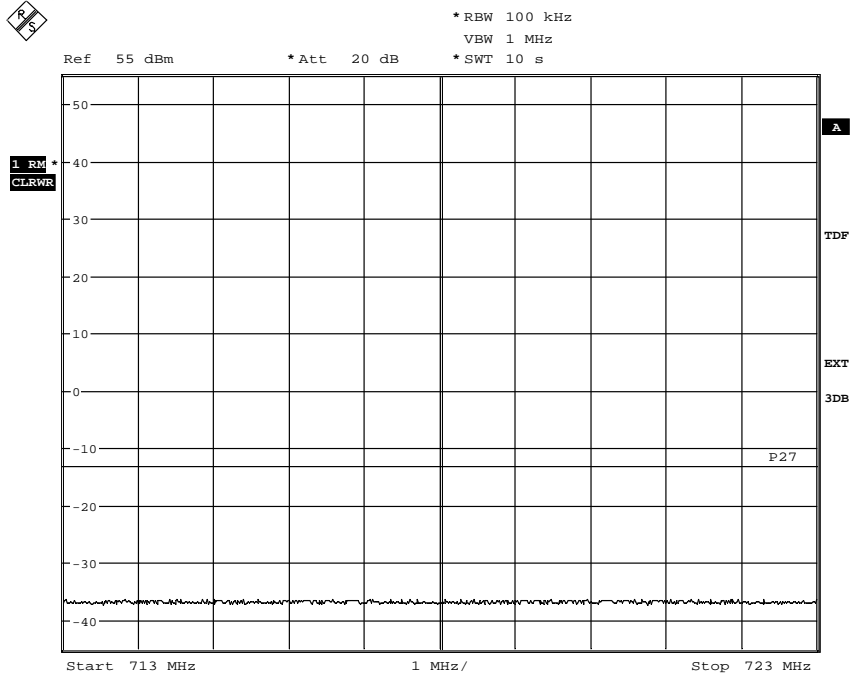


Diagram 1 a:



Date: 9.NOV.2010 13:21:59

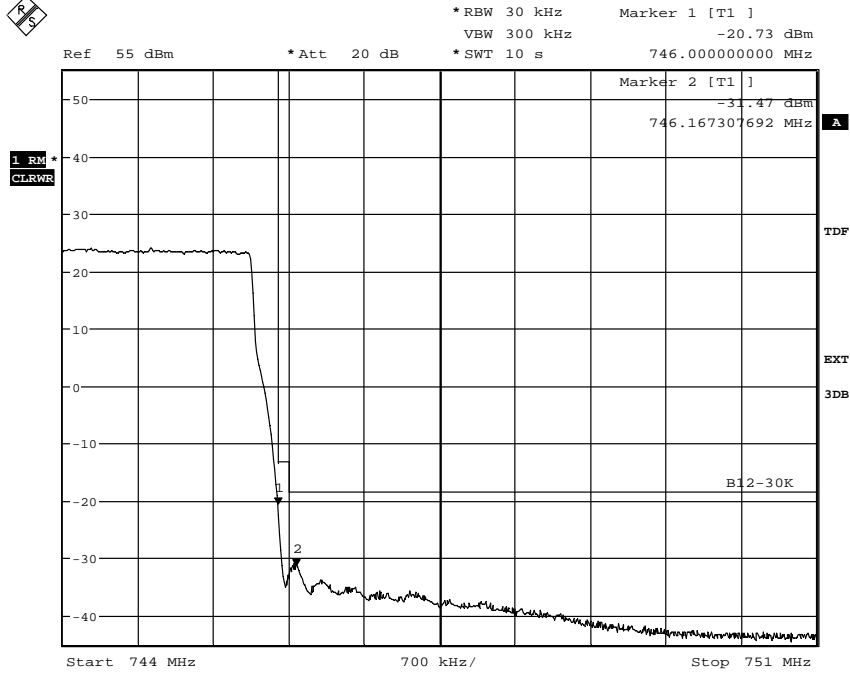
Diagram 1 b:



Date: 9.NOV.2010 13:41:25

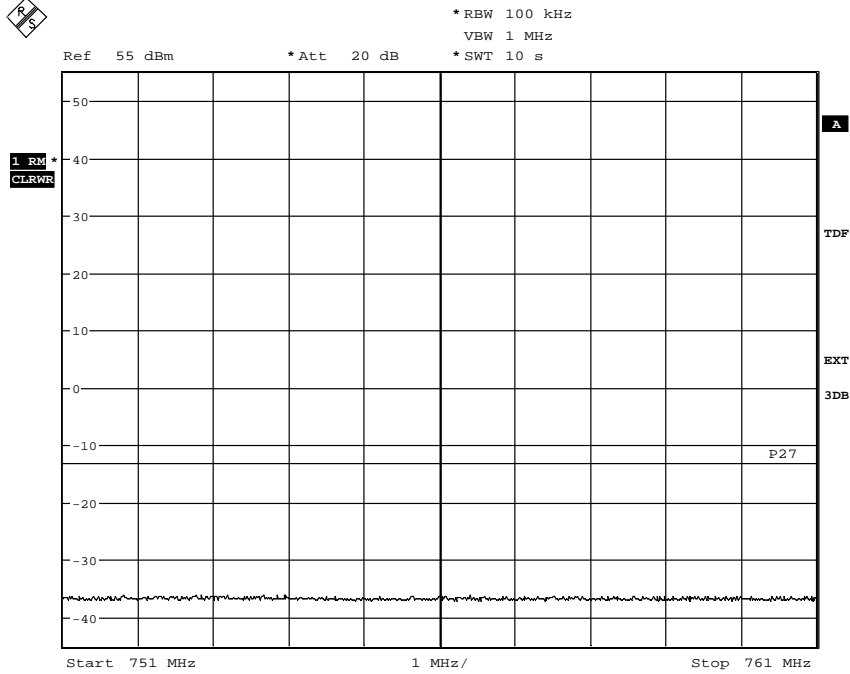


Diagram 2 a:



Date: 9.NOV.2010 15:28:02

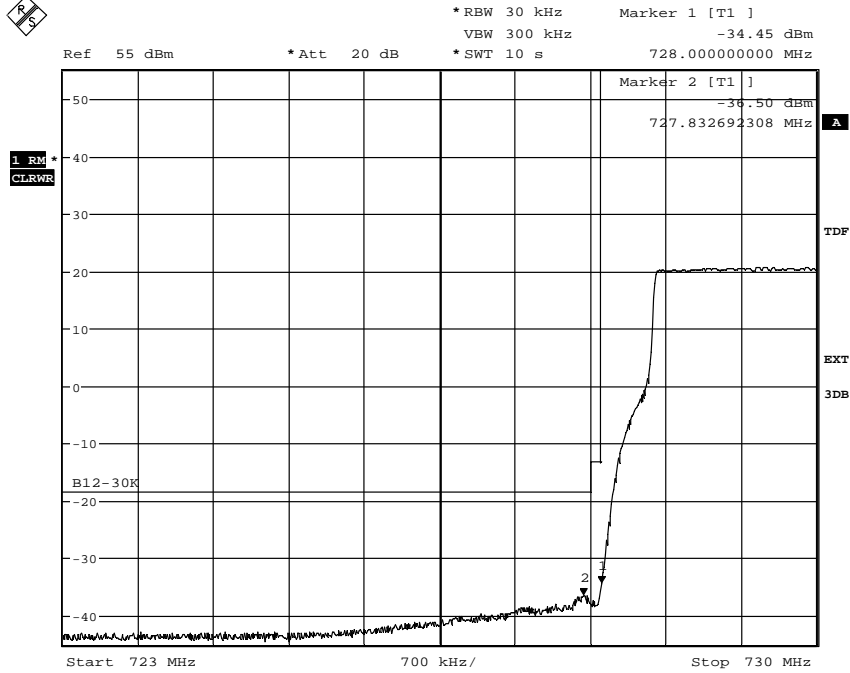
Diagram 2 b:



Date: 9.NOV.2010 15:30:07

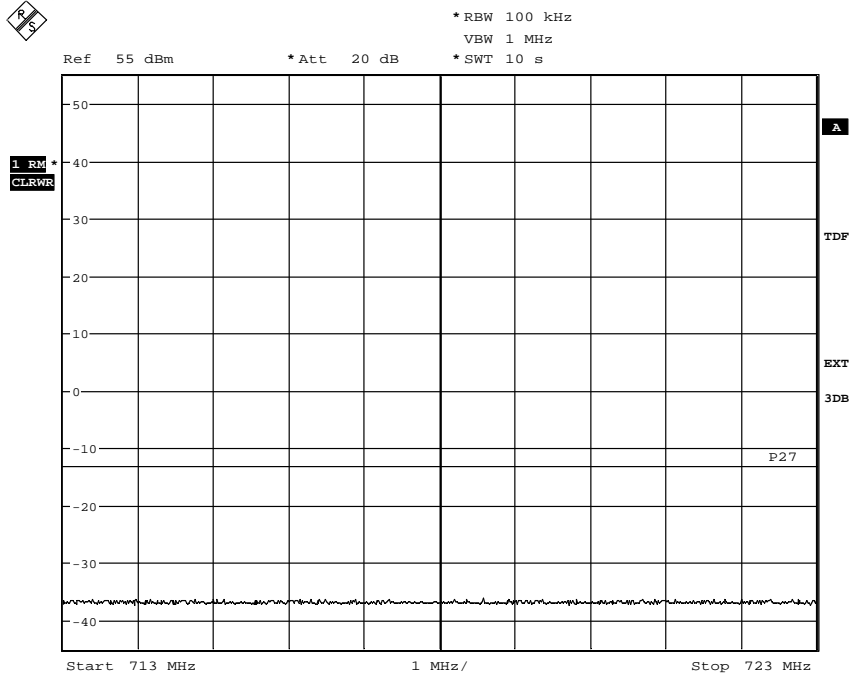


Diagram 3 a:



Date: 9.NOV.2010 15:57:55

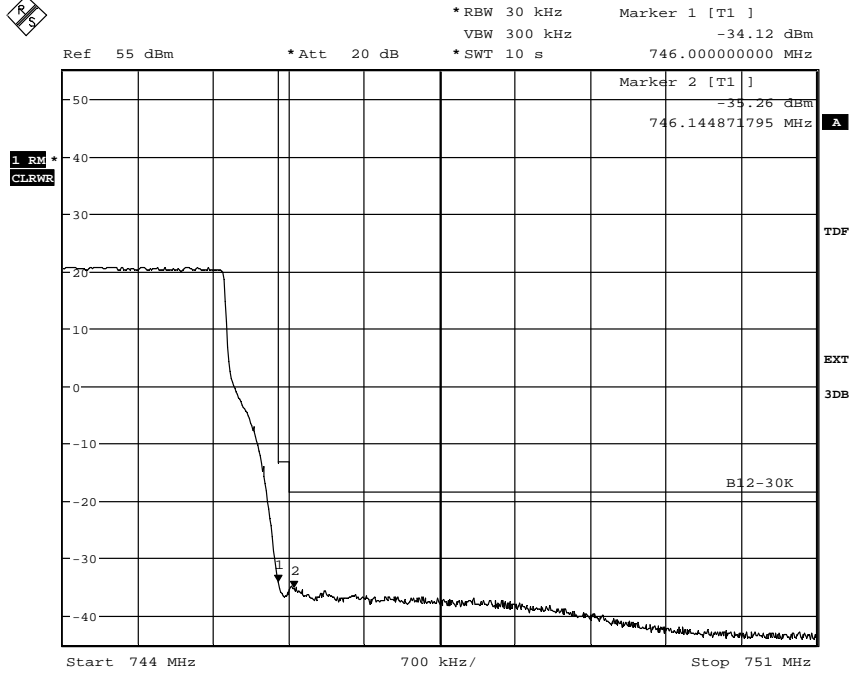
Diagram 3 b:



Date: 9.NOV.2010 15:59:36

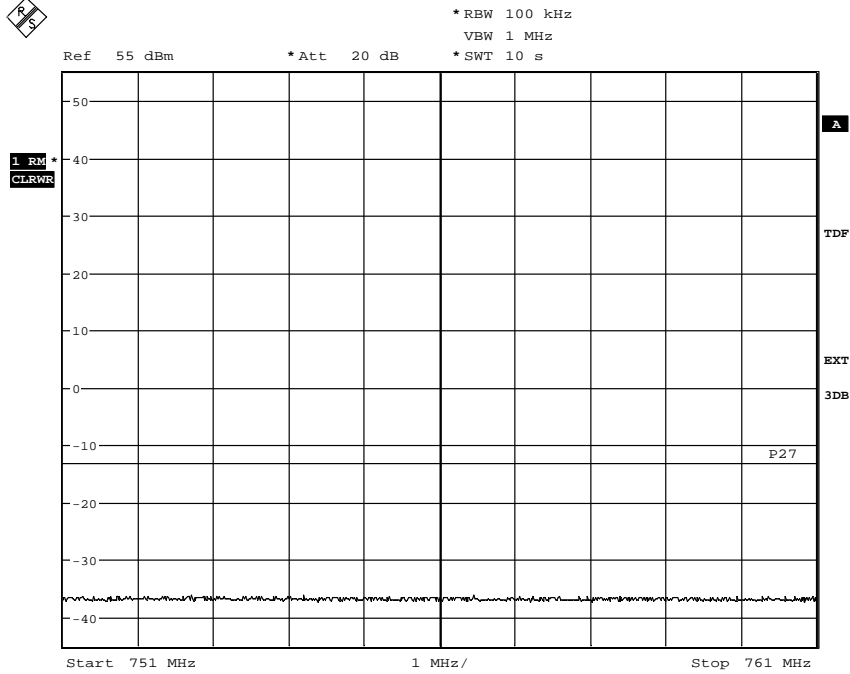


Diagram 4 a:



Date: 10.NOV.2010 09:25:29

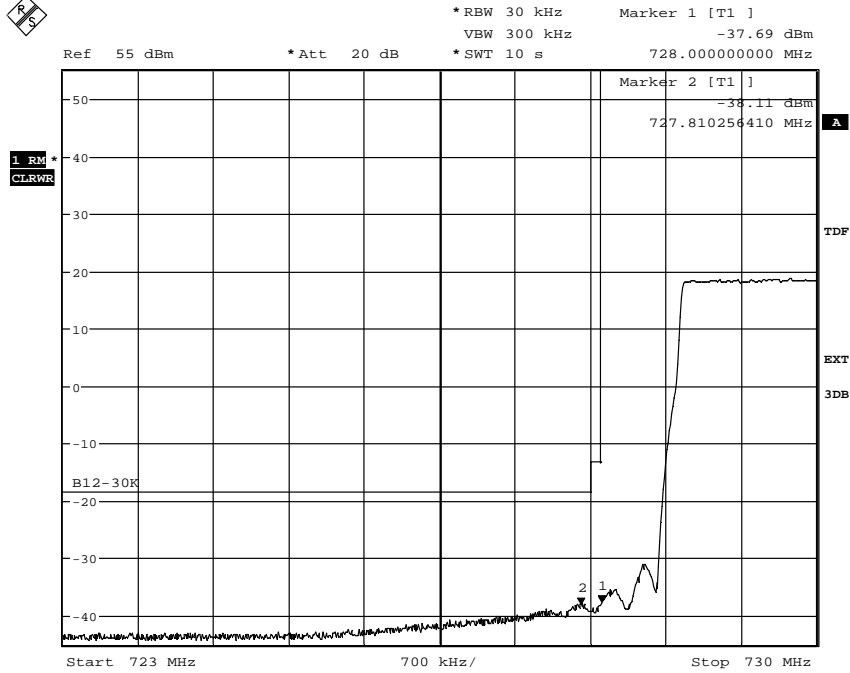
Diagram 4 b:



Date: 10.NOV.2010 09:26:15

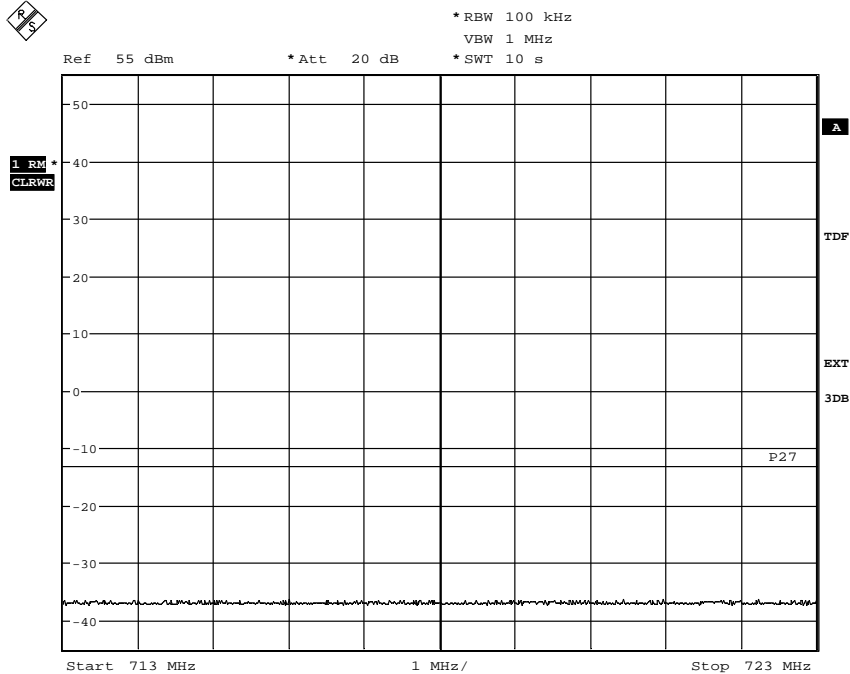


Diagram 5 a:



Date: 10.NOV.2010 09:49:37

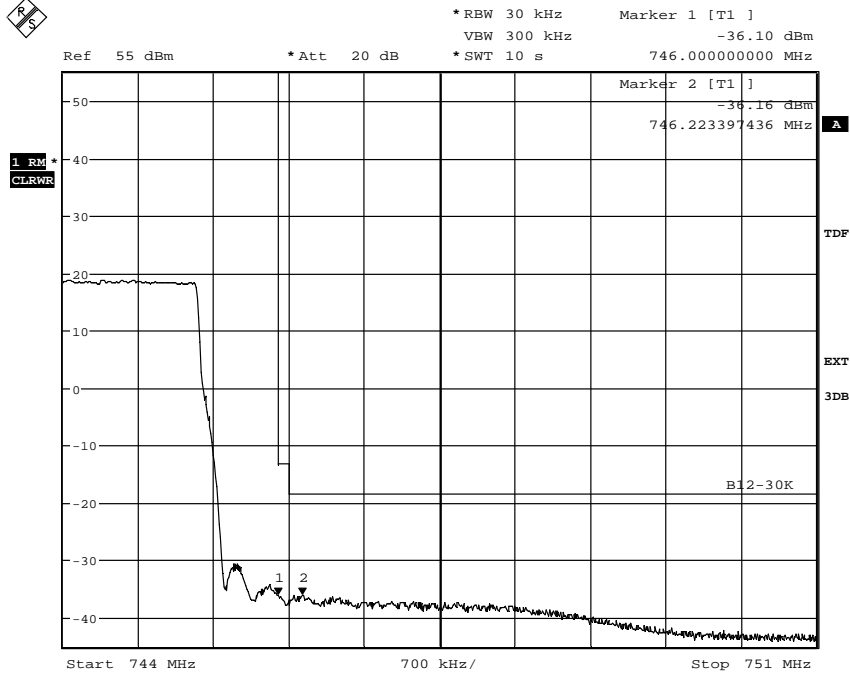
Diagram 5 b:



Date: 10.NOV.2010 09:50:53

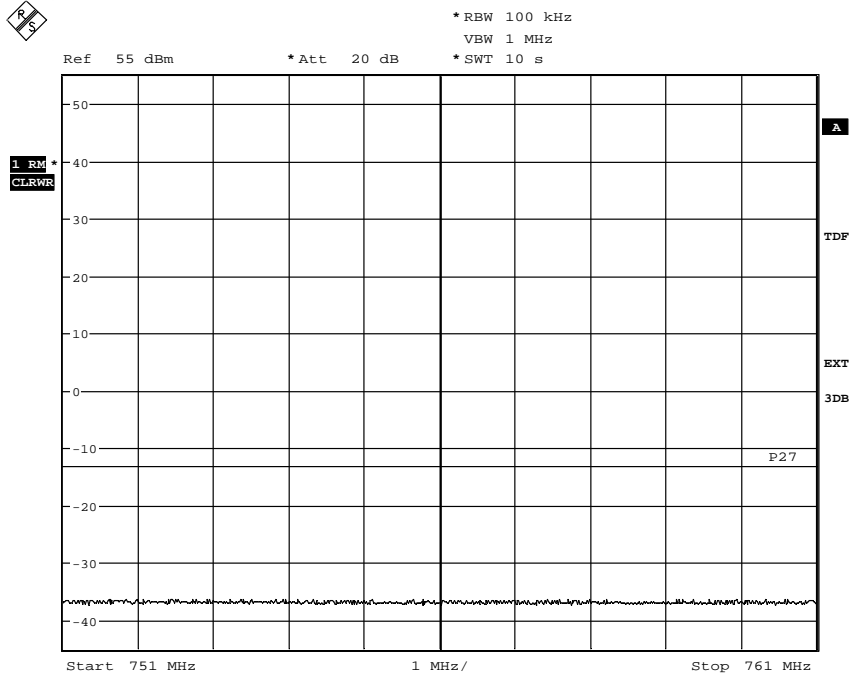


Diagram 6 a:



Date: 10.NOV.2010 10:52:47

Diagram 6 b:



Date: 10.NOV.2010 10:53:54



Conducted spurious emission measurements according to 47 CFR 2.1051

Date	Temperature	Humidity
2010-11-09	23 °C ± 3 °C	18 % ± 5 %
2010-11-10	23 °C ± 3 °C	20 % ± 5 %

Test set-up and procedure

The output was connected to a spectrum analyzer. First a pre-measurement with activated peak detector was performed. Emissions close to or above the limit is measured with activated RMS detector and the RMS measurement result is noted. The spectrum analyzer was connected to an external 10 MHz reference standard during the measurements.

Measurement equipment	SP number
ROHDE & SCHWARZ FSQ40	504 143
RF attenuator	504 159
High pass filter	502 758
Testo 635 temperature and humidity meter	504 203

Measurement uncertainty: 3.7 dB

Results

The results are shown in appendix 5.1

	Bandwidth configuration	Tested port	TX channel	Measured range
Diagram 1 a	5 MHz	RF A	B	9 kHz – 1 GHz
Diagram 1 b	5 MHz	RF A	B	1 GHz – 15 GHz
Diagram 2 a	10 MHz	RF A	B	9 kHz – 1 GHz
Diagram 2 b	10 MHz	RF A	B	1 GHz – 15 GHz
Diagram 3a	15 MHz	RF A	B	9 kHz – 1 GHz
Diagram 3b	15 MHz	RF A	B	1 GHz – 15 GHz
Diagram 4 a	5 MHz	RF A	M	9 kHz – 1 GHz
Diagram 4 b	5 MHz	RF A	M	1 GHz – 15 GHz
Diagram 5 a	5 MHz	RF A	T	9 kHz – 1 GHz
Diagram 5 b	5 MHz	RF A	T	1 GHz – 15 GHz
Diagram 6 a	5 MHz	RF B	B	9 kHz – 1 GHz
Diagram 6 b	5 MHz	RF B	B	1 GHz – 15 GHz

Remarks

The emission at 9 kHz on some 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 internal frequency as declared by the client was 1.47456 GHz, thus the choice of the upper frequency boundary to 10x1.5 GHz = 15 GHz for TX emission measurements. A comparative test of one configuration was done for the transmitter chain at port RF B.

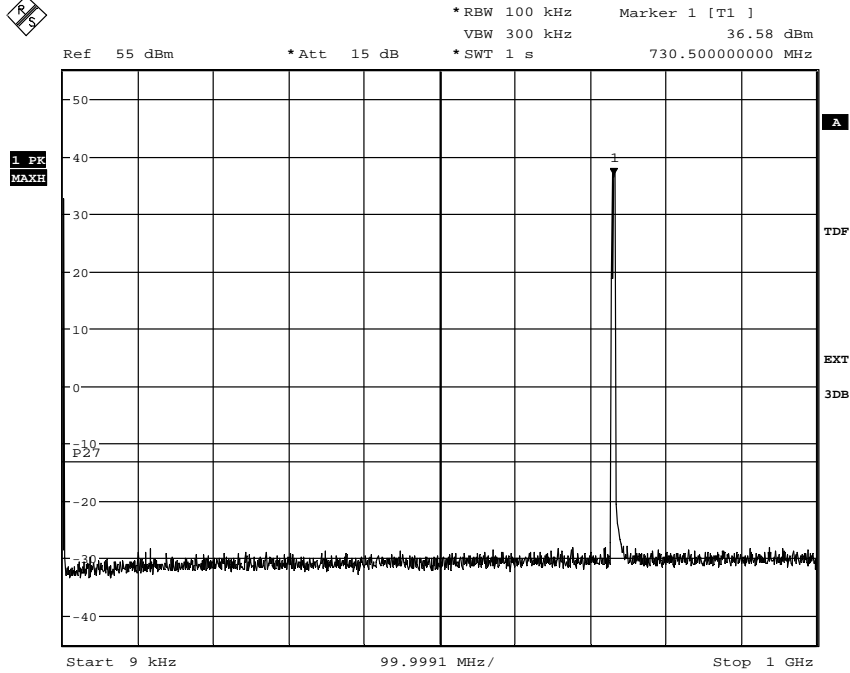
Limits

Derived from CFR 47 § 27.53 (g): 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.

Complies?	Yes
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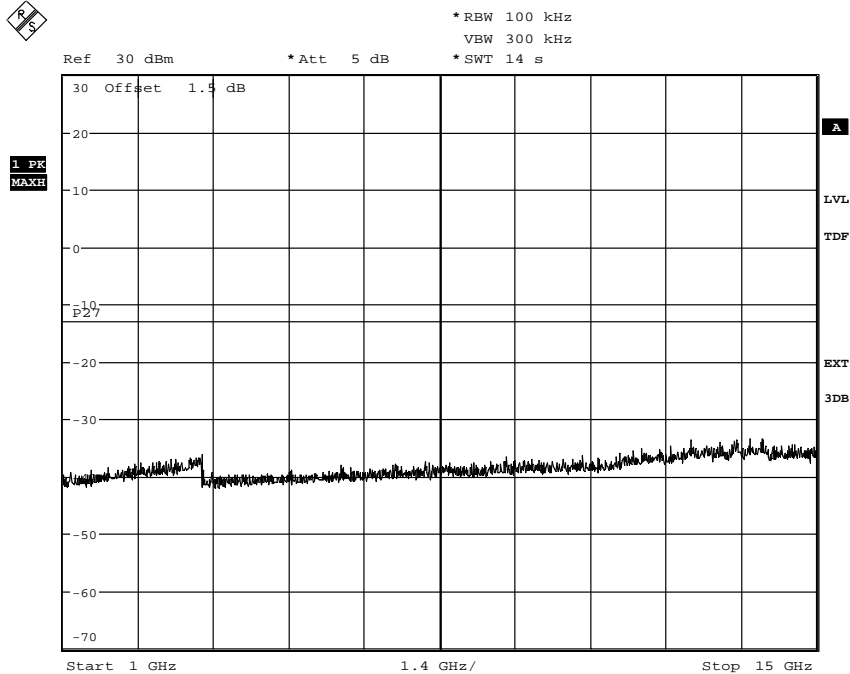


Diagram 1 a:



Date: 9.NOV.2010 13:32:18

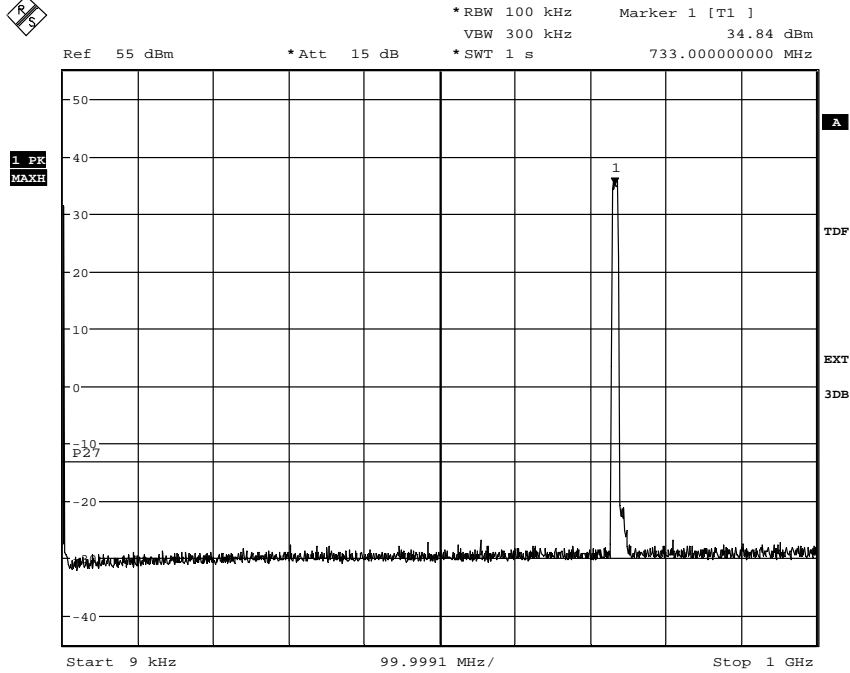
Diagram 1 b:



Date: 9.NOV.2010 13:51:31

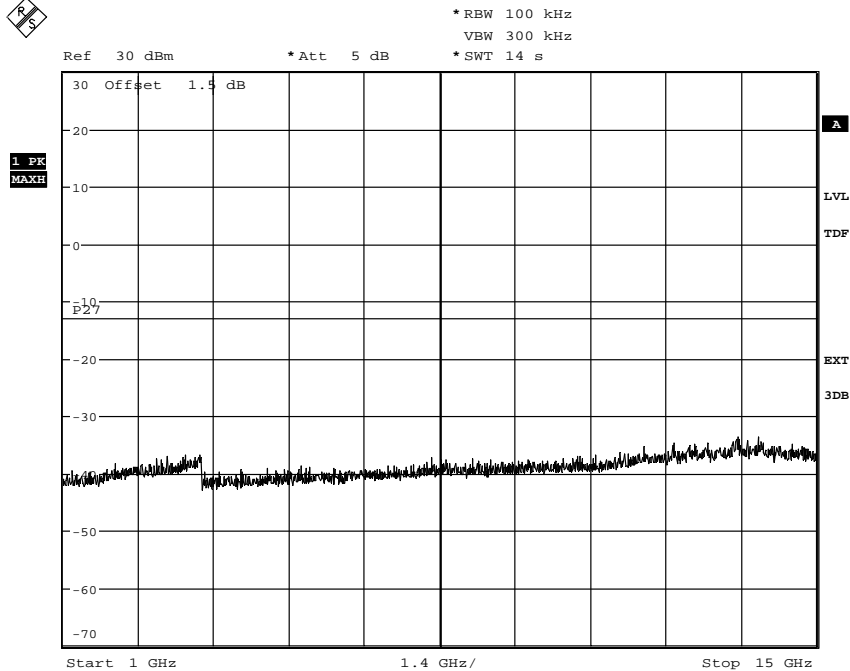


Diagram 2 a:



Date: 9.NOV.2010 16:19:02

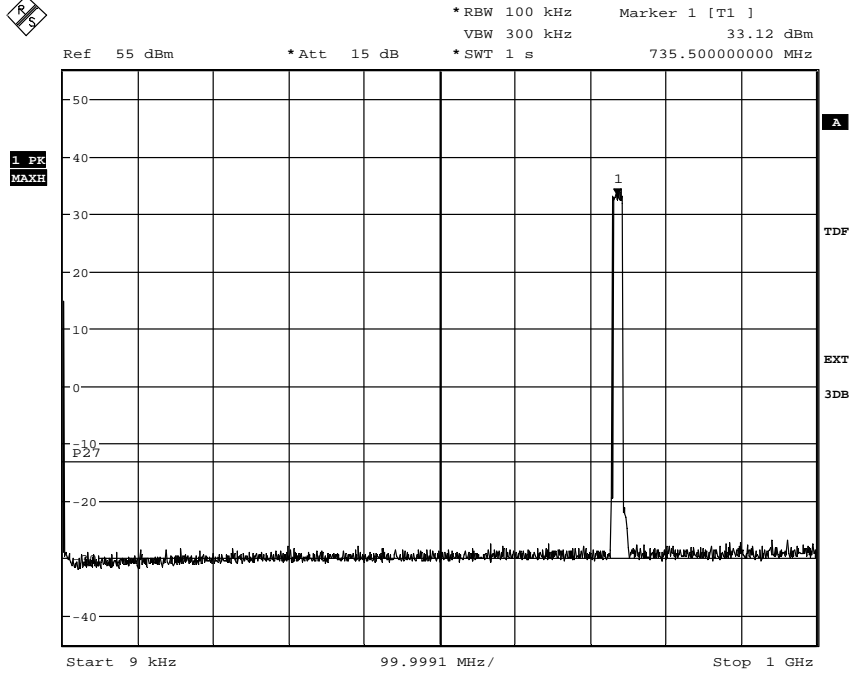
Diagram 2 b:



Date: 9.NOV.2010 16:20:48

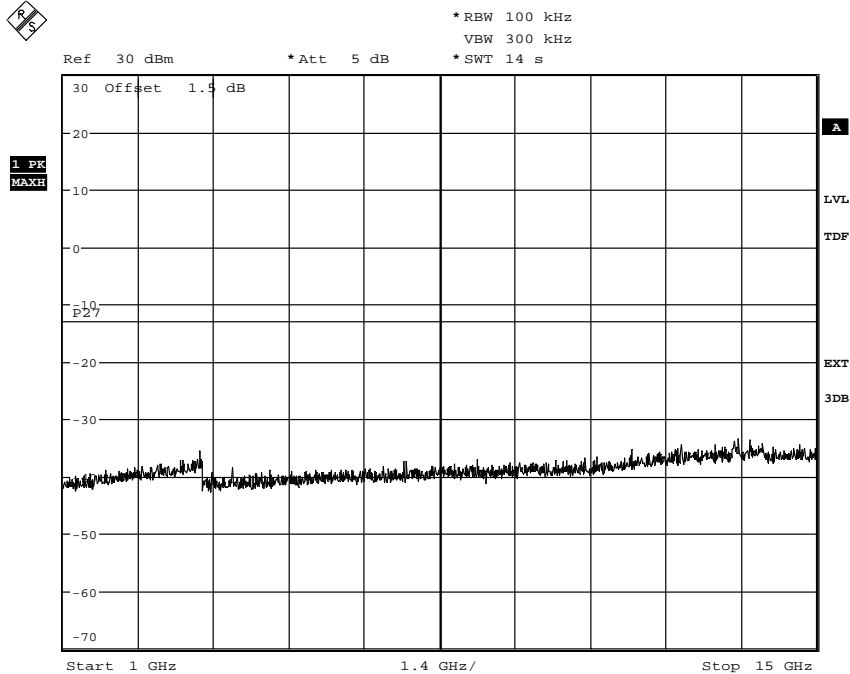


Diagram 3 a:



Date: 10.NOV.2010 10:37:51

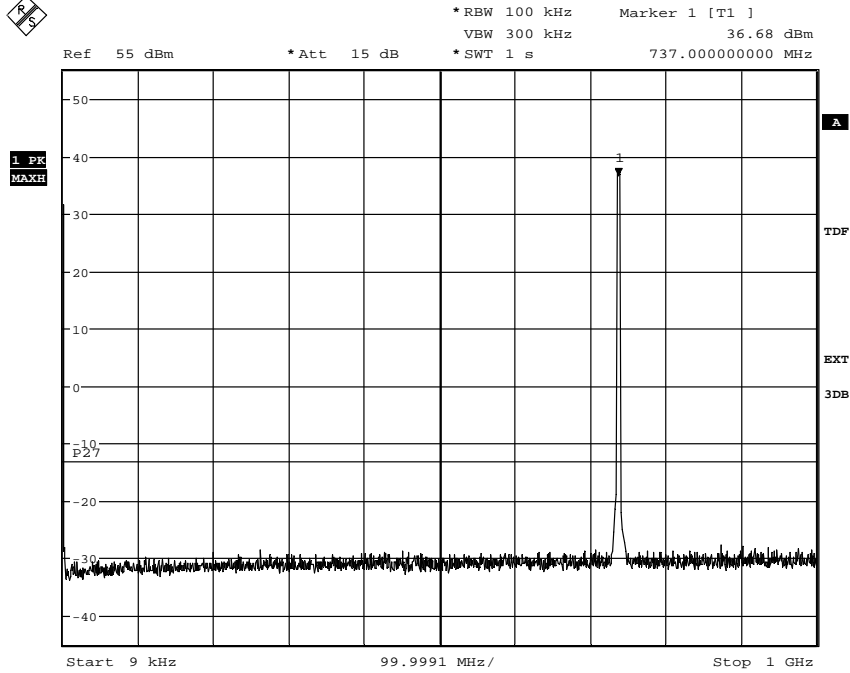
Diagram 3 b:



Date: 10.NOV.2010 10:40:04

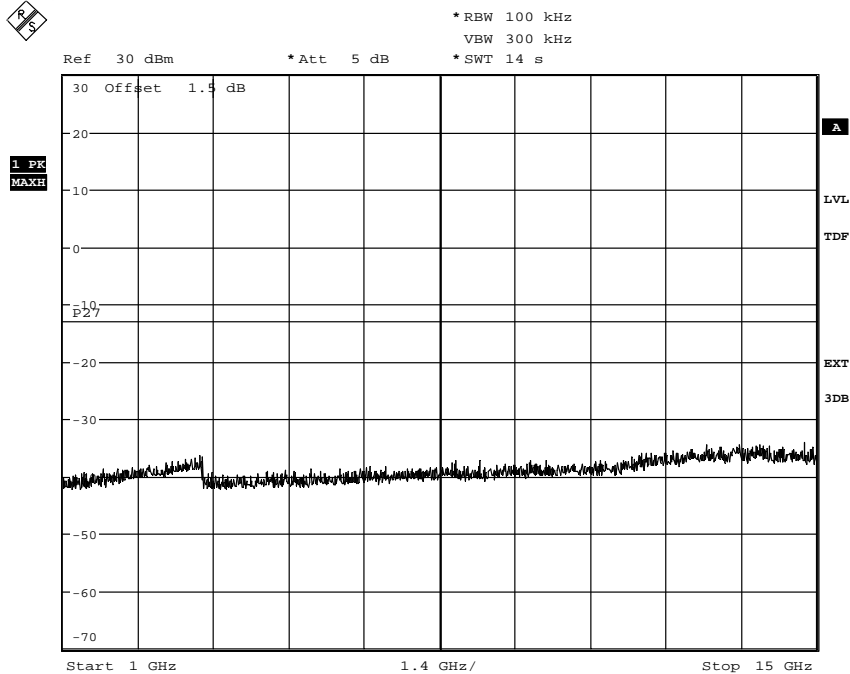


Diagram 4 a:



Date: 9.NOV.2010 15:49:22

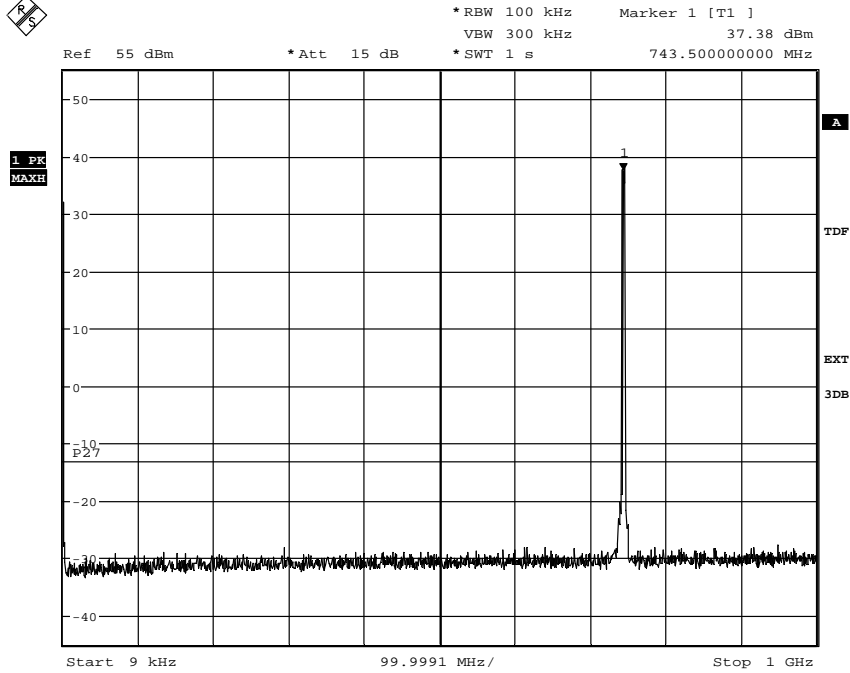
Diagram 4 b:



Date: 9.NOV.2010 15:51:56

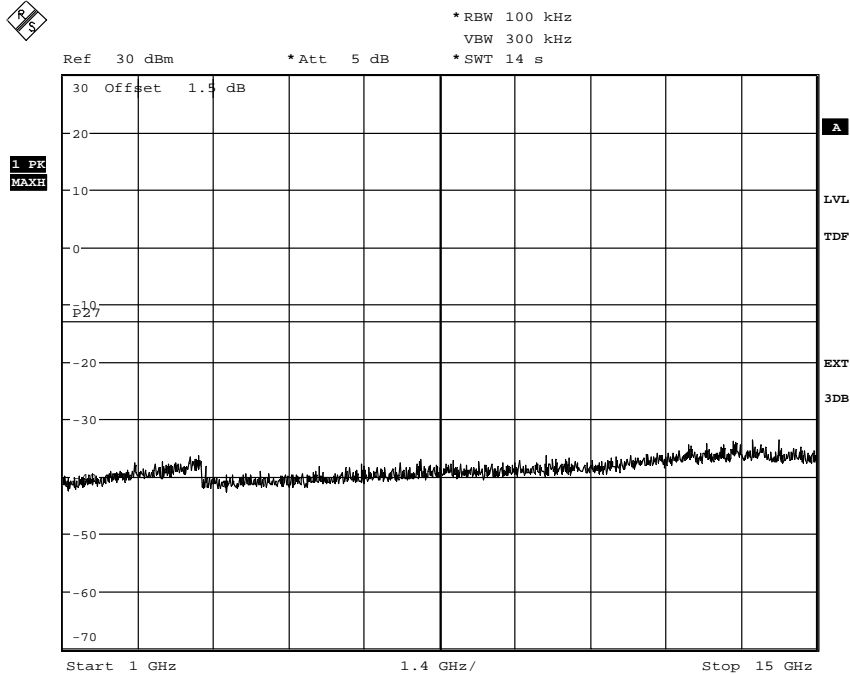


Diagram 5 a:



Date: 9.NOV.2010 15:37:43

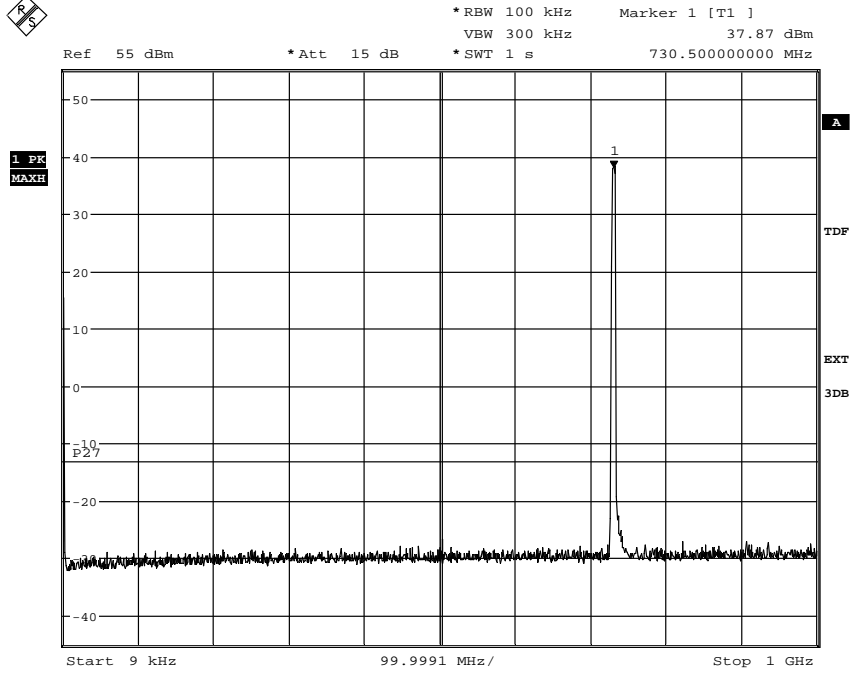
Diagram 5 b:



Date: 9.NOV.2010 15:39:48

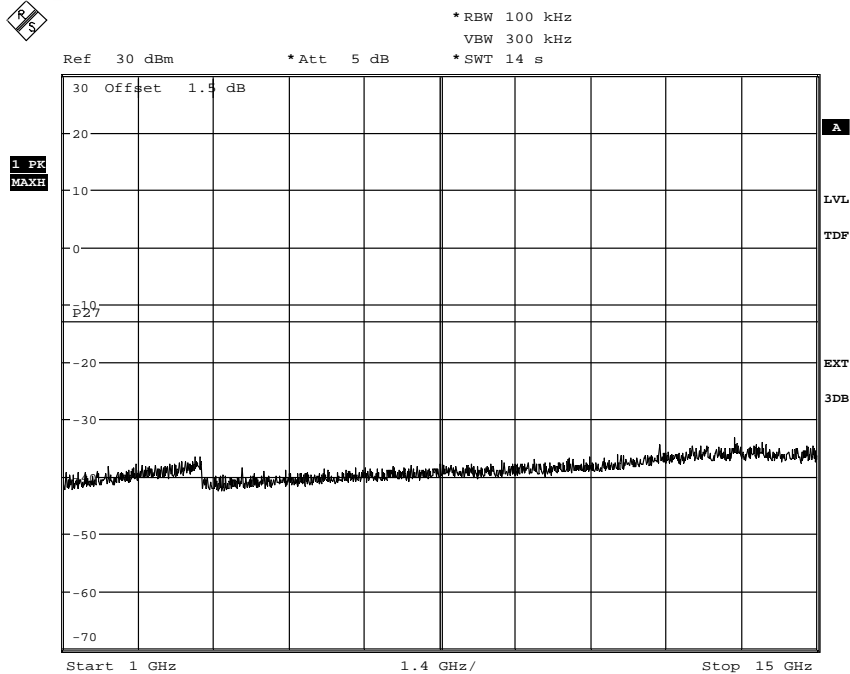


Diagram 6 a:



Date: 10.NOV.2010 15:48:53

Diagram 6 b:



Date: 10.NOV.2010 16:05:44



Field strength of spurious radiation measurements according to 47 CFR 2.1053

Date	Temperature	Humidity
2010-03-11	22 °C ± 3 °C	18 % ± 5 %
2010-03-12	22 °C ± 3 °C	18 % ± 5 %

Test set-up and procedure

The test site is listed at FCC, Columbia with registration number: 93866. The test site also 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.

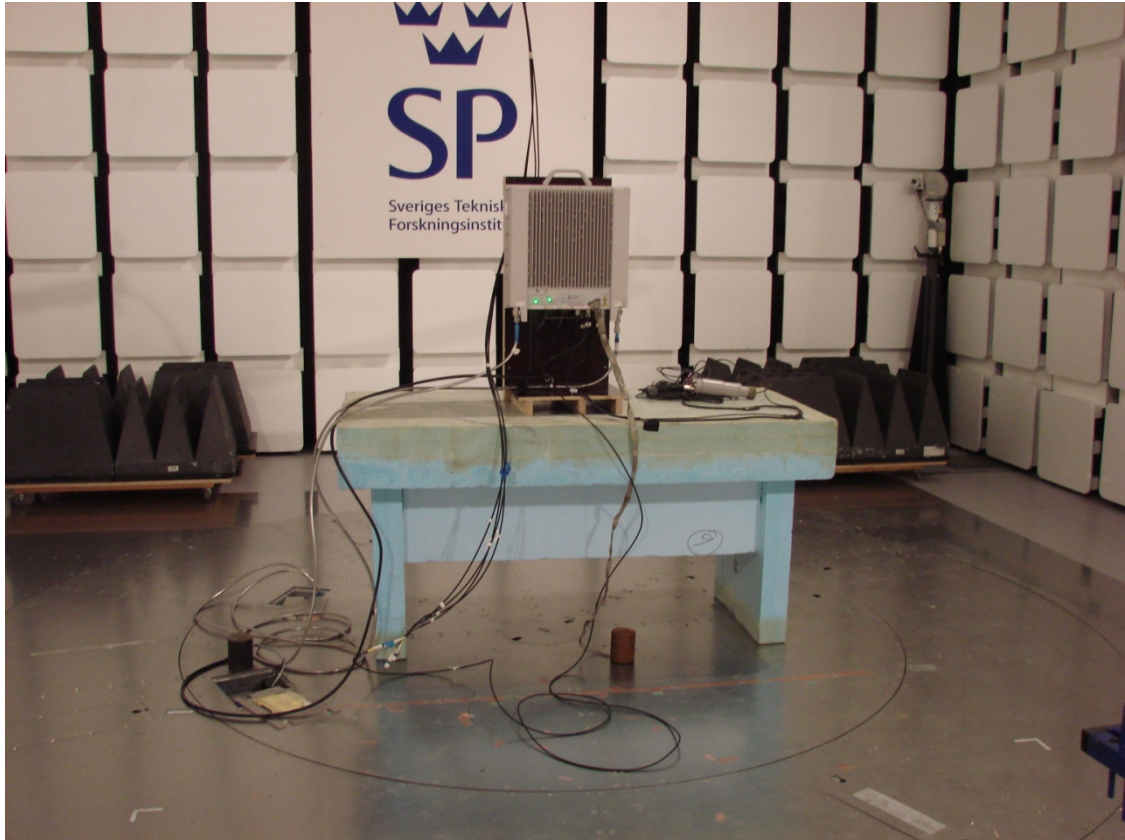
1. A pre-measurement was first performed:
2. In the frequency range 30 MHz-15 GHz the measurement was performed in power with a RBW of 100 kHz. A propagation loss in free space was calculated. The used formula was,

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

3. The measurement procedure was as the following:
4. 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.
5. Spurious radiation on frequencies closer than 20 dB to the limit 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 measured with the RMS detector were measured with the substitution method according to the standard.

Measurement equipment	SP number
Test site Tesla	503 881
ROHDE & SCHWARZ ESI 26	503 292
Control computer	503 479
Software: ROHDE & SCHWARZ EMC32, ver. 8.20.1	-
Chase Bilog antenna CBL 6111A	503 182
EMCO Horn Antenna 3115	502 175
MITEQ Low Noise Amplifier	503 285
Testo 625 temperature and humidity meter	504 188

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



Results

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30 - 15000	All emission > 20 dB below limit	All emission > 20 dB below limit
Measurement uncertainty 4.7 dB		

Limits

Derived from CFR 47 § 27.53 (g): 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.

Complies?	Yes
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Frequency stability according to 47 CFR 2.1055

Date 2010-10-28 to 2010-11-02 2010-11-12	Temperature (test equipment) 22-23°C ± 3 °C 23°C ± 3 °C	Humidity (test equipment) 30-43 % ± 5 % 20 % ± 5 %
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Test set-up and procedure

The measurement was made per 3GPP TS 36.141. Port RF A was connected to a spectrum analyzer. Port RF B was terminated in a 50 ohm load. The spectrum analyzer was connected to an external 10 MHz reference standard.

Measurement equipment	SP number
ROHDE & SCHWARZ FSQ 40	504 143
Climate chamber 3	503 546
Testo 635 temperature and humidity meter	504 203

Results

Nominal supply voltage: -48.0 V DC. E-TM1.1 in 5 MHz channel BW configuration was transmitted at the TX band center frequency (M) 737.0 MHz at maximum nominal output power 44.8 dBm (30 W) for both transmitter branches.

Test conditions		Frequency error (Hz)
Supply voltage DC (V)	T (°C)	
-48.0	+23	+2
-55.2	+23	-2
-40.8	+23	+2
-48.0	+30	-3
-48.0	+40	+2
-48.0	+50	-2
-48.0	+10	-2
-48.0	0	+2
-48.0	-10	-3
-48.0	-20	-2
-48.0	-30	-3
Maximum freq. error (Hz)		-3
Measurement uncertainty		< ± 1 x 10 ⁻⁷

Limit according to 3GPP TS 36.141 Version 8.5.0:
The frequency error shall be within ± 0.05 PPM ± 12 Hz (±48.85 Hz).

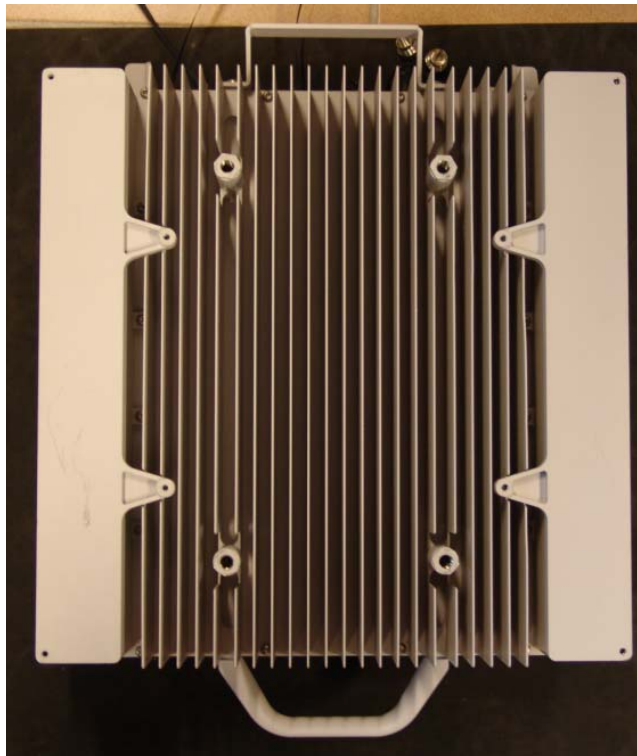
Complies?	Yes
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External photos of the test object

Front side



Rear side



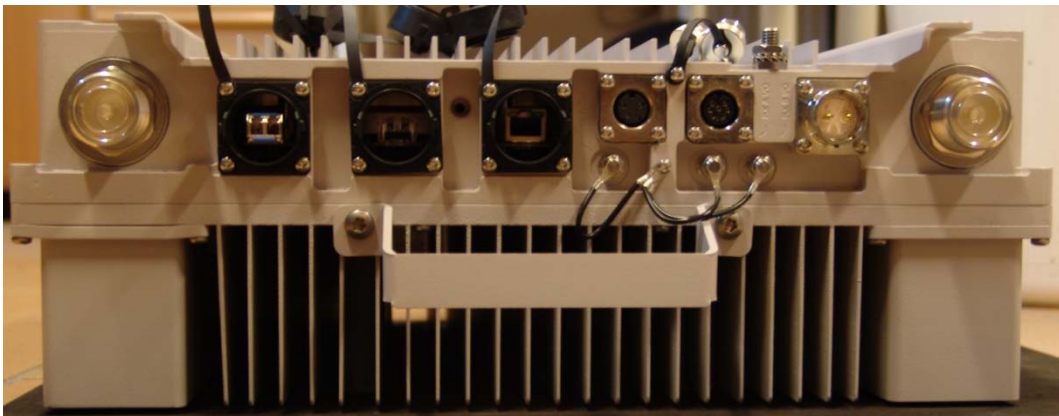
Left side



Right side



Bottom side



Top side

