

FCC Part 22 Compliance Test Report

Test Report no.:	EMC_BO_001846	Date of Report:	11-July-2013
Number of pages:	31	Project support engineer:	Robert Müller

Customer:	novero GmbH, Meesmannstrasse 103, 44807 Bochum, Germany		
Customers contact:	Hindersmann, Jürgen		
Manufacturer:	novero GmbH		
EUT ident.:	Novero, HT-6g		
FCC ID:	WJLHT-6G	IC ID:	7847A-HT6G

Referred documents:	CFR 47, FCC rules Part 22, TIA-603-C-2004 and IC standards RSS-GEN (Issue 3), RSS-132 (Issue 2). Deviations or clarifications to these standards are noted in the related test result under "test reference and limit".
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	FCC listing no.:	881111	IC recognition no.: 7847A-1
	Laboratory manager:	Jürgen Mitterer	

Test result	The EUT does comply with the requirements made in the referred test documents.
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Signature:

11-July-2013, Jürgen Mitterer
Manager Validation Services
Approval

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Project support engineer:	Robert Müller	Test Report for FCC Part 22H
Date of issue:	11-July-2013	Template version 1.0
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1. Summary for FCC Part 22 Compliance Test Report

Date of receipt	02-May-2013
Testing completed	09-July-2013
The customer's contact person	Hindersmann, Jürgen
Notes	None

1.1. EUT and Accessory Information

The EUT is a 12V DC powered device with quad band GSM / tri band WCDMA device (GSM850/900/1800/1900; FDDII/IV/V) with an external antenna connector and internal back-up antenna. EUT is tested with maximum rated TX power, modulated with pseudo random bit sequence (PRBS9). No dedicated external antenna specified by the manufacturer. Since the device has only one cellular port which will be switched to internal antenna or external antenna connector, radiated measurements were done with internal antenna and conducted related measurements via the external antenna connector.

Product	Type	IMEI	HW	MV	SW	DUT
Onboard Connectivity Unit	HT-6g	004402000061519	0531	--	X478	DIS065
Onboard Connectivity Unit	HT-6g	004402000061527	0531	--	X478	DIS066

1.2. Summary of Test Results

Section	Section in CFR 47	Section in RSS-GEN or RSS-132	Name of the test	Result
3	2.1046(a), 22.913(a)	5.4	Conducted RF output power	PASS
4	24.232(d)	5.4	Peak to average power ratio	PASS
5	2.1049(h)	4.6.1	99% occupied bandwidth	PASS
6	22.917(a)	5.5	Band edge compliance	PASS
7	22.917(a), 2.1051	5.5	Spurious emissions at antenna terminals	PASS
8	22.917(a), 2.1053	5.5	Spurious radiated emissions	PASS
9	2.1055(a)	5.3	Frequency stability, temperature variation	PASS
10	2.1055(d)	5.3	Frequency stability, voltage variation	PASS

PASS: The EUT complies with the essential requirements in the standard.
 FAIL: The EUT does not comply with the essential requirements in the standard.
 NP: The test was not performed.
 NA: The test was not applicable

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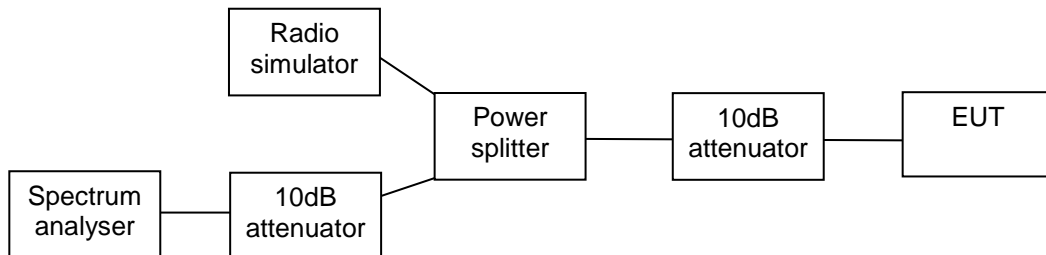
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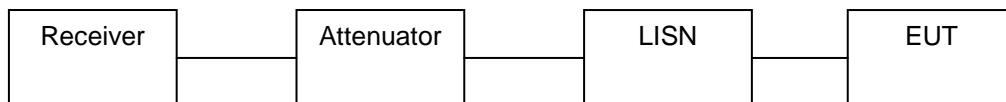
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2. Test setups

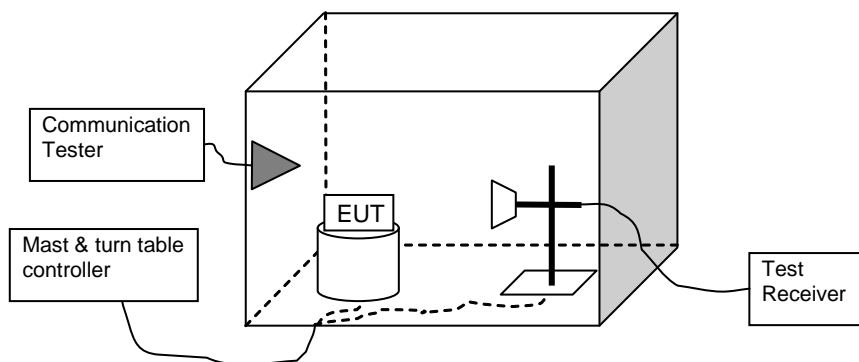
2.1. Conducted test setup



2.2. Conducted AC power line conducted emissions test setup



2.3. Radiated test setup



3. Conducted RF output power (FCC §22.913(a)(2), §2.1046(a), RSS-132 5.4)

EUT with DUT number	DIS066
Accessories with DUT numbers	None
Operation Voltage [V] / [Hz]	13.2 / DC
Result	PASS
Remarks	None
Temp [°C] / Humidity [%RH]	25 / 45
Date of measurements	09.July.2013
Measured by	Robert Müller

3.1. Test reference and limit

The measurement is made according to FCC rules parts 22, IC standard RSS-132 and TIA-603-C by reading the maximum peak power values from the signalisation unit (CMU200).

Limits for conducted RF output power measurements

Frequency range [MHz]	Limit [W]	Limit [dBm]
824 - 849	7	38.45

3.2. GSM850 Test results

3.2.1 GSM mode

Channel / f_c [MHz]	Peak Power [dBm]	Average Power [dBm]	ERP [dBd]	Result
128 / 824.2	32.20	32.02	35.20	PASS
190 / 836.6	32.40	32.23	35.40	PASS
251 / 848.8	32.24	32.08	35.24	PASS

Antenna gain: 3dBi

3.2.2 EGPRS mode

Channel / f_c [MHz]	Peak Power [dBm]	Average Power [dBm]	ERP [dBd]	Result
128 / 824.2	29.59	26.50	32.59	PASS
190 / 836.6	29.78	26.73	32.78	PASS
251 / 848.8	29.77	26.73	32.77	PASS

Antenna gain: 3dBi

3.3. WCDMA850 Test results

3.3.1 FDD5 mode, RMC

Channel / f_c [MHz]	Peak Power [dBm] (Peak)	Average Power [dBm] (RMS)	ERP [dBd]	Result
4132 / 826.4	25.87	22.42	28.87	PASS
4175 / 835	25.94	22.09	28.94	PASS
4233 / 846.6	25.86	22.44	28.86	PASS

Antenna gain: 3dBi

4. Peak to average power ratio (FCC §24.232(d), RSS-132 5.4)

EUT with DUT number	DIS066
Accessories with DUT numbers	None
Operation Voltage [V] / [Hz]	13.2 / DC
Result	PASS
Remarks	None
Temp [°C] / Humidity [%RH]	25 / 45
Date of measurements	09.July.2013
Measured by	Robert Müller

4.1. Test reference and limit

The measurement is made according to FCC rules parts 22, IC standard RSS-132 and TIA-603-C by reading the power values from the signalisation unit (CMU200).

Limits for peak to average power ratio measurements

Limit [dBm]
13

4.2. GSM850 Test results

4.2.1 GSM mode

Channel / f_c [MHz]	Peak Power [dBm]	Average Power [dBm]	PAPR [dB]	Result
128 / 824.2	32.20	32.02	0.18	PASS
190 / 836.6	32.40	32.23	0.17	PASS
251 / 848.8	32.24	32.08	0.16	PASS

4.2.2 EGPRS mode

Channel / f_c [MHz]	Peak Power [dBm]	Average Power [dBm]	PAPR [dB]	Result
128 / 824.2	29.59	26.50	3.09	PASS
190 / 836.6	29.78	26.73	3.05	PASS
251 / 848.8	29.77	26.73	3.04	PASS

4.3. WCDMA850 Test results

4.3.1 FDD5 mode, RMC

Channel / f_c [MHz]	Peak Power [dBm] (Peak)	Average Power [dBm] (RMS)	PAPR [dB]	Result
4132 / 826.4	25.87	22.42	3.45	PASS
4175 / 835	25.94	22.09	3.85	PASS
4233 / 846.6	25.86	22.44	3.42	PASS

5. 99% occupied bandwidth (FCC §2.1049(h), RSS-132 4.6.1)

EUT with DUT number	DIS066
Accessories with DUT numbers	None
Operation Voltage [V] / [Hz]	13.2 / DC
Result	PASS
Remarks	None
Temp [°C] / Humidity [%RH]	25 / 45
Date of measurements	03.May.2013
Measured by	Robert Müller

5.1. Test reference and limit

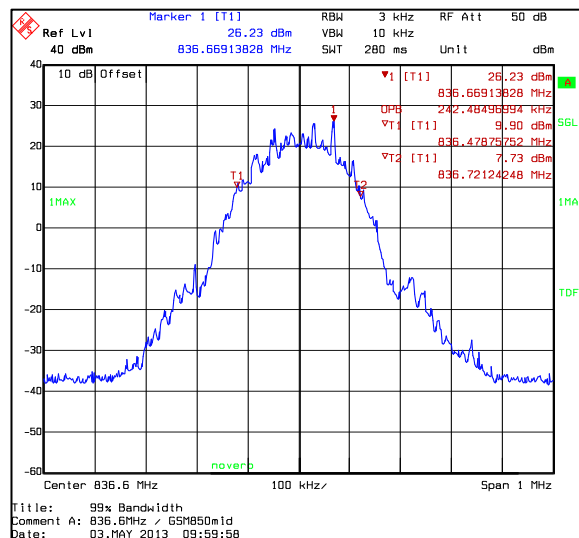
The measurement is made according to FCC rules parts 22, IC standard RSS-GEN, RSS-132 and TIA-603-C.

5.2. GSM850 Test results

5.2.1 GSM mode

Channel / f _c [MHz]	99% occupied bandwidth [kHz]	Result
190 / 836.6	242.49	PASS

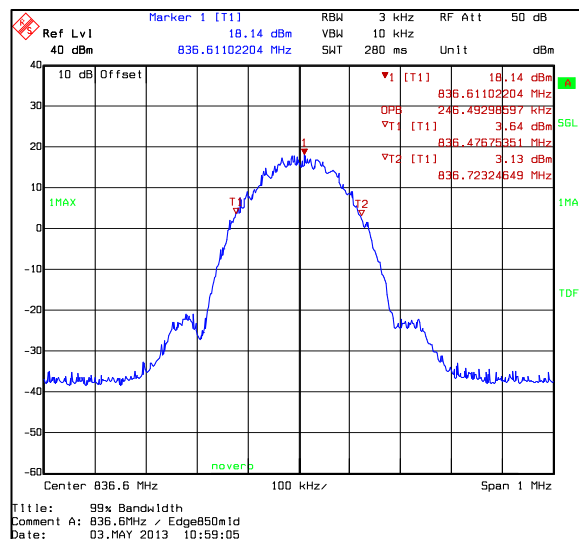
Channel 190 / 836.6 MHz



5.2.2 EGPRS mode

Channel / f _c [MHz]	99% occupied bandwidth [kHz]	Result
190 / 836.6	246.49	PASS

Channel 190 / 836.6 MHz

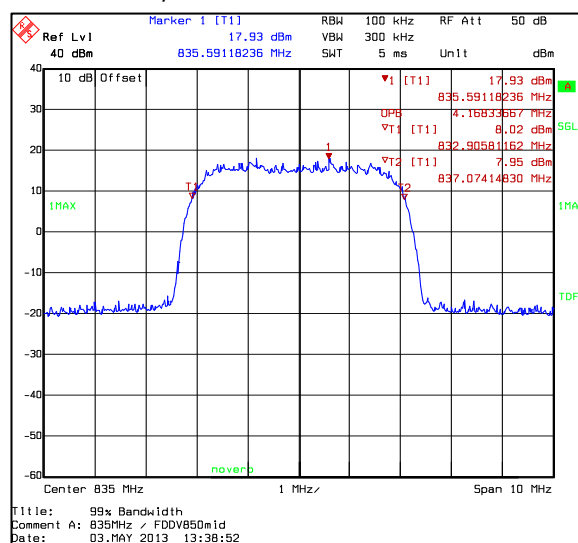


5.3. WCDMA850 Test results

5.3.1 FDD5 mode, RMC

Channel / f _c [MHz]	99% occupied bandwidth [kHz]	Result
4175 / 835	4168.34	PASS

Channel 4175 / 835 MHz



6. Band edge compliance

(FCC §22.917(b), RSS-132 4.5)

EUT with DUT number	DIS066
Accessories with DUT numbers	None
Operation Voltage [V] / [Hz]	13.2 / DC
Result	PASS
Remarks	None
Temp [°C] / Humidity [%RH]	25 / 45
Date of measurements	03.May.2013
Measured by	Robert Müller

6.1. Test reference and limit

The measurement is made according to FCC rules parts 22 and IC standard RSS-132.

Limits for band edge compliance measurements

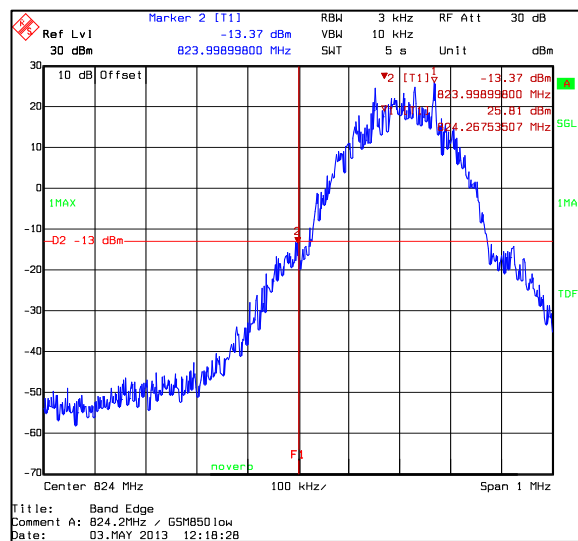
Frequency range [MHz]	Limit [dBm]
Below 824 and above 849	-13

6.2. GSM850 Test results

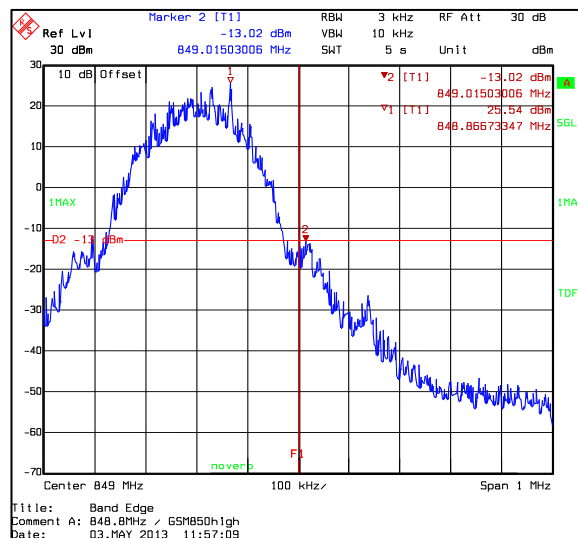
6.2.1 GSM mode

Channel / f _c [MHz]	Level [dBm]	Result
128 / 824.2	-13.37	PASS
251 / 848.8	-13.02	PASS

Channel 128 / 824.2 MHz



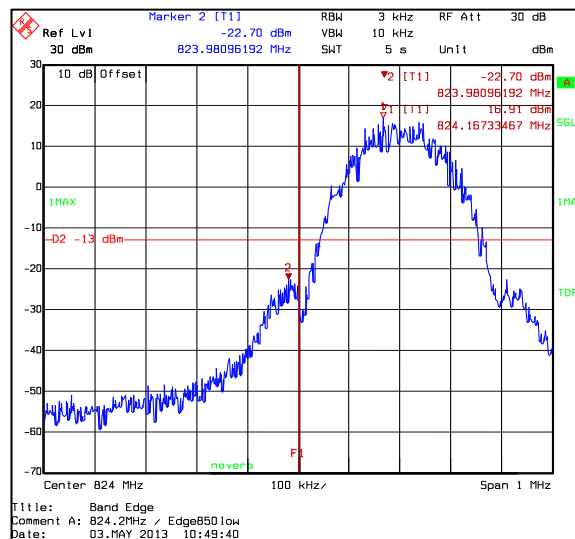
Channel 251 / 848.8 MHz



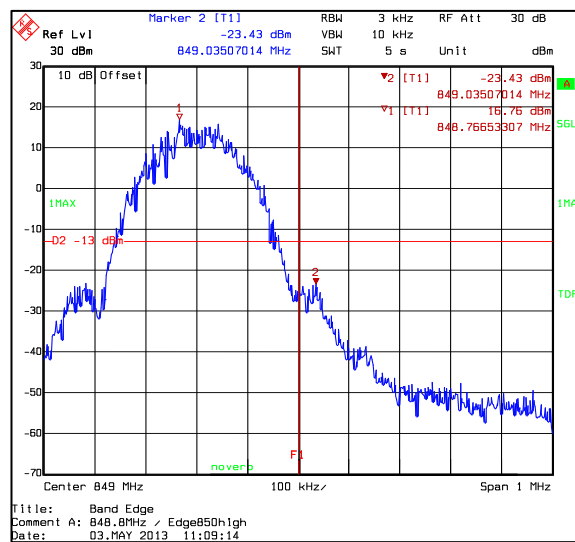
6.2.2 EGPRS mode

Channel / f _c [MHz]	Level [dBm]	Result
128 / 824.2	-22.70	PASS
251 / 848.8	-23.43	PASS

Channel 128 / 824.2 MHz



Channel 251 / 848.8 MHz

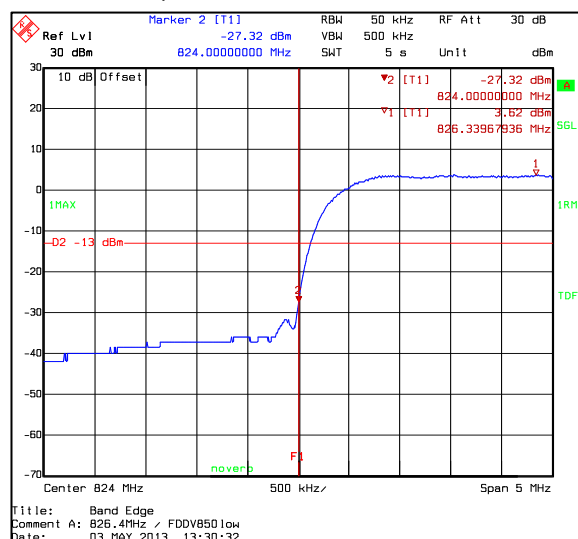


6.3. WCDMA850 Test results

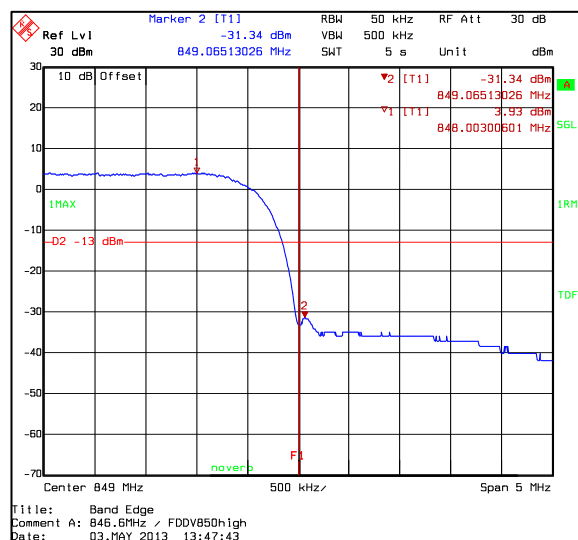
6.3.1 FDD5 mode, RMC

Channel / f _c [MHz]	Level [dBm]	Result
4132 / 826.4	-27.32	PASS
4233 / 846.6	-31.34	PASS

Channel 4132 / 826.4 MHz



Channel 4233 / 846.6 MHz



7. Spurious emissions at antenna terminals

(FCC §22.917(a), §2.1051 RSS-132 4.5)

EUT with DUT number	DIS066
Accessories with DUT numbers	None
Operation Voltage [V] / [Hz]	13.2 / DC
Result	PASS
Remarks	None
Temp [°C] / Humidity [%RH]	25 / 45
Date of measurements	03.May.2013
Measured by	Robert Müller

7.1. Test reference and limit

The measurement is made according to TIA-603-C

Limits for spurious emissions at antenna terminals measurements

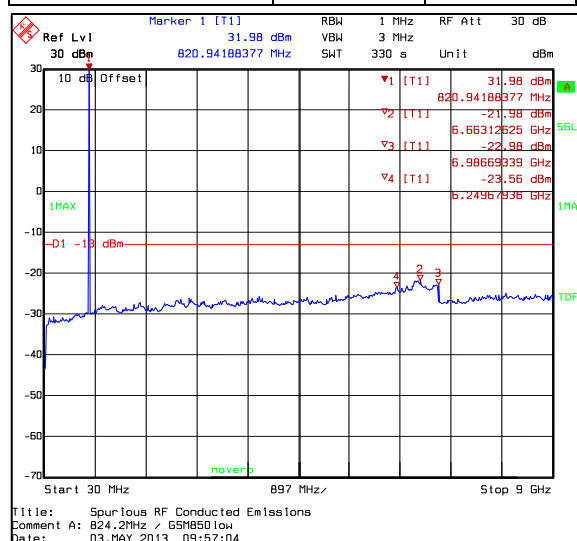
Frequency range [MHz]	Limit [dBm]
1 – 9000	-13

7.2. GSM850 Test results

7.2.1 GSM mode

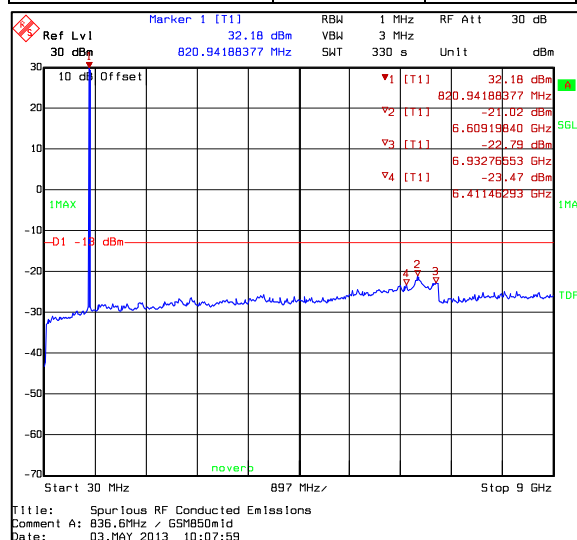
Channel 128 / 824.2 MHz

Frequency [MHz]	P [dBm]	Result
6249.68	-23.56	PASS
6663.13	-21.98	PASS
6986.69	-22.98	PASS



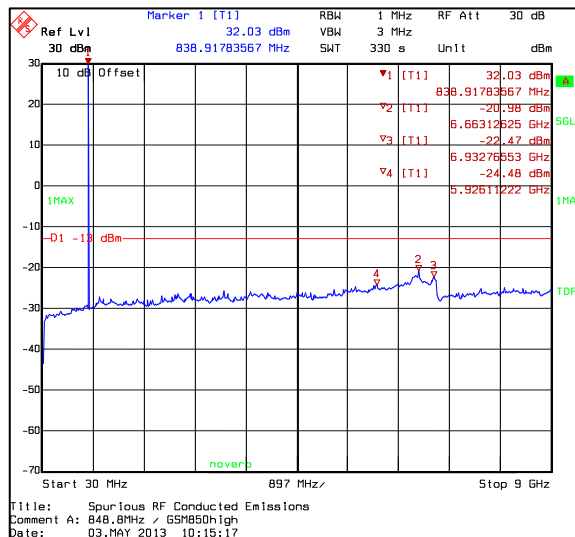
Channel 190 / 836.6 MHz

Frequency [MHz]	P [dBm]	Result
6411.46	-23.47	PASS
6609.20	-21.02	PASS
6932.77	-22.79	PASS



Channel 251 / 848.8 MHz

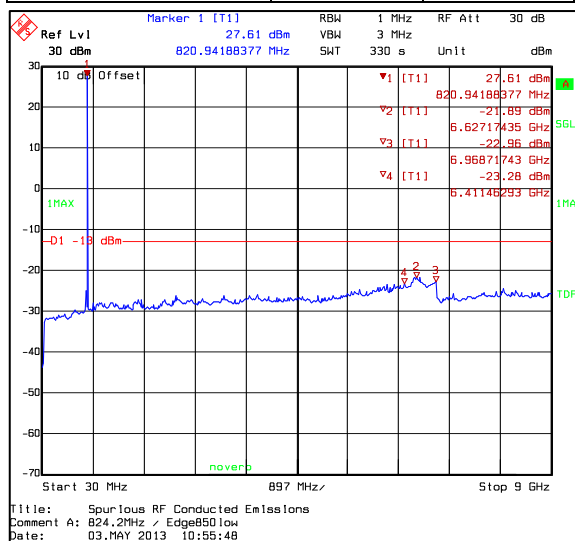
Frequency [MHz]	P [dBm]	Result
6926.11	-24.48	PASS
6663.13	-20.98	PASS
6932.77	-22.47	PASS



7.2.2 EGPRS mode

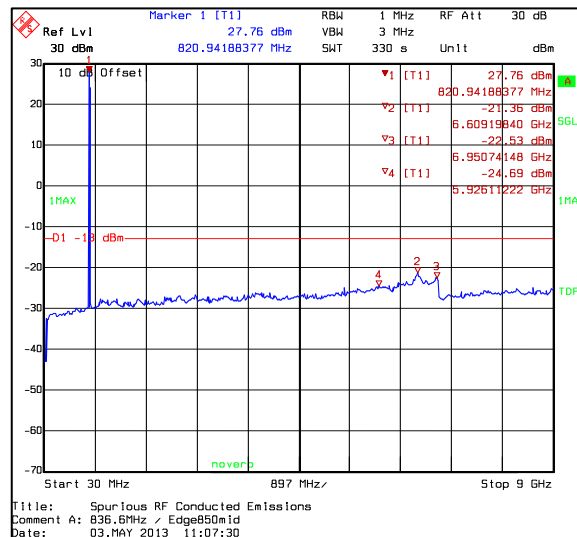
Channel 128 / 824.2 MHz

Frequency [MHz]	P [dBm]	Result
6411.46	-23.28	PASS
6627.17	-21.89	PASS
6968.72	-22.96	PASS



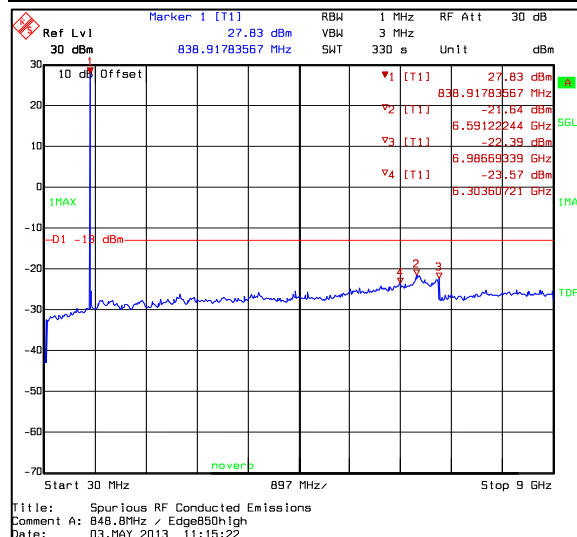
Channel 190 / 836.6 MHz

Frequency [MHz]	P [dBm]	Result
5926.11	-24.69	PASS
6609.20	-21.36	PASS
6950.74	-22.53	PASS



Channel 251 / 848.8 MHz

Frequency [MHz]	P [dBm]	Result
6303.61	-23.57	PASS
6591.22	-21.64	PASS
6986.69	-22.39	PASS

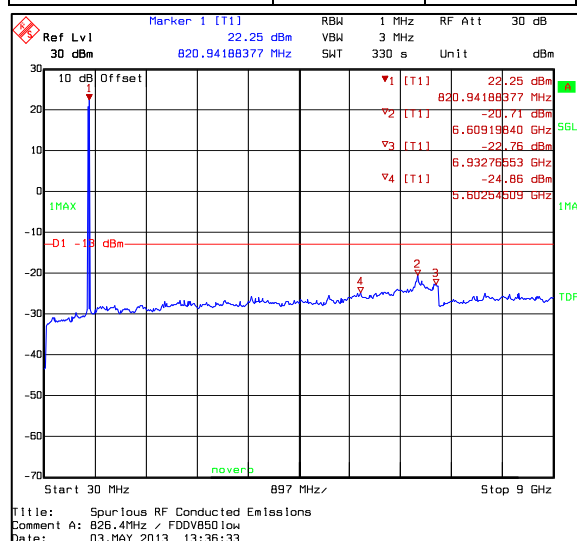


7.3. WCDMA850 Test results

7.3.1 FDD5 mode, RMC

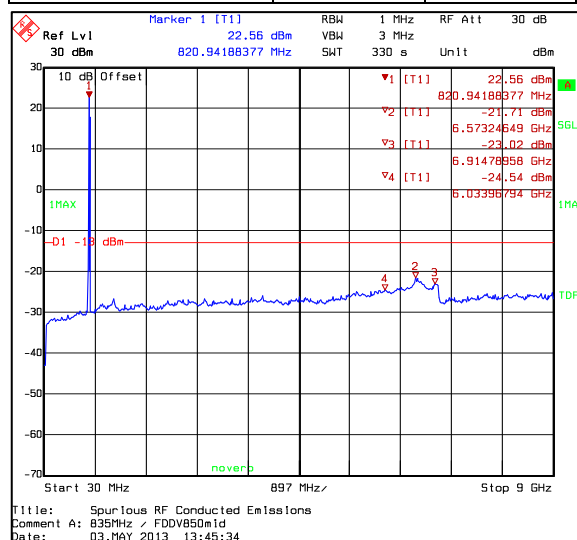
Channel 4132 / 826.4 MHz

Frequency [MHz]	P [dBm]	Result
5602.55	-24.86	PASS
6609.20	-20.71	PASS
6932.77	-22.76	PASS



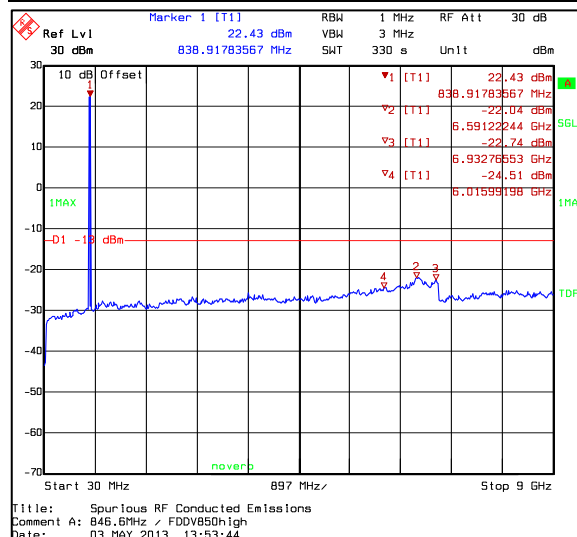
Channel 4175 / 835 MHz

Frequency [MHz]	P [dBm]	Result
6033.97	-24.54	PASS
6573.25	-21.71	PASS
6914.79	-23.02	PASS



Channel 4233 / 846.6 MHz

Frequency [MHz]	P [dBm]	Result
6016.00	-24.51	PASS
6591.22	-22.04	PASS
6932.77	-22.74	PASS



8. Spurious radiated emissions

(FCC §22.917(a), §2.1053, RSS-132 4.5)

EUT with DUT number	DIS065
Accessories with DUT numbers	None
Operation Voltage [V] / [Hz]	13.2 / DC
Result	PASS
Remarks	None
Temp [°C] / Humidity [%RH]	25 / 45
Date of measurements	02.May.2013
Measured by	Robert Müller

8.1. Test reference and limit

The measurement is made according to TIA-603-C as follows:

Below 3GHz:

The Preliminary Measurement and the Final Measurement is performed in 3m distance by rotating the turntable of 360 degrees at fixed height.

The Preliminary Measurement and the Final Measurement with absorbers on the floor and measuring antenna at fixed height using 2-axis EUT position system.

The Final Measurement is performed, if the Preliminary Measurement results are closer than 20 dB to the permissible limit.

Above 3GHz:

The Preliminary Measurement and the Final Measurement is performed in 1.5m distance by rotating the turntable of 360 degrees at fixed height.

The Preliminary Measurement and the Final Measurement with absorbers on the floor and measuring antenna at fixed height using 2-axis EUT position system.

The Final Measurement is performed, if the Preliminary Measurement results are closer than 20 dB to the permissible limit.

General:

Regarding RSS-GEN I3 Section 4.3 (i), the transmitter spurious emissions have been measured in 3 channels, see section 6 "Spurious emissions at antenna terminals" of this test report. The spurious radiated emission test shows emissions radiated from the enclosure of the EUT in one TX channel.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The EUT is placed at nonconductive plate at the turntable center.

The emissions less than 20 dB below the permissible value are reported.

The substitution method is used. Substitution values at each frequencies are measured in beforehand and saved to the test software. The substitution corrections are obtained as described below:

$$A_{SUBST} = P_{SUBST\ TX} - P_{SUBST\ RX} - L_{SUBST\ CABLES} + G_{SUBST\ TX\ ANT}$$

Where A_{SUBST} is the final substitution correction including receive antenna gain. $P_{SUBST\ TX}$ is the signal generator level, $P_{SUBST\ RX}$ is receiver level, A_{SUBST} and $L_{SUBST\ CABLES}$ is cable losses including both TX and RX cables and $G_{SUBST\ TX\ ANT}$ is substitution antenna gain.

The measurement results are obtained as described below:

$$P[dBm] = P_{MEAS} + A_{CF}$$

Where P_{MEAS} is the receiver reading in dBm and A_{CF} is the correction factor including cable loss and substitution correction ($A_{CF} = L_{CABLES} G_{PREAMP} + A_{SUBST}$).

Limits for spurious radiated emissions measurements

Frequency range [MHz]	Limit [dBm]
30 - 9000	-13

8.2. GSM850 Test results

8.2.1 GSM mode

Channel 190 / 836.6 MHz

Frequency [MHz]	P [dBm]	P [μ W]	P _{MEAS} [dBm]	A _{CF} [dB]	Polarisation	Result
1673.14	-45.30	0.030	-44.60	-0.70	VERTICAL	PASS
2509.89	-30.80	0.832	-37.70	6.90	HORIZONTAL	PASS
3346.15	-42.50	0.056	-40.20	-2.30	VERTICAL	PASS
4182.69	-45.40	0.029	-44.10	-1.30	VERTICAL	PASS

Substitution method could not be utilized as no emission above noise floor were found during measurements

8.2.2 EGPRS mode

Channel 190 / 836.6 MHz

Frequency [MHz]	P [dBm]	P [μ W]	P _{MEAS} [dBm]	A _{CF} [dB]	Polarisation	Result
1673.14	-54.10	0.004	-53.40	-0.70	VERTICAL	PASS
2509.39	-50.70	0.009	-57.60	6.90	HORIZONTAL	PASS
3346.15	-54.30	0.004	-52.00	-2.30	VERTICAL	PASS
4184.19	-56.30	0.002	-55.00	-1.30	VERTICAL	PASS

Substitution method could not be utilized as no emission above noise floor were found during measurements

8.3. WCDMA850 Test results

8.3.1 FDD5 mode, RMC

Channel 4175 / 835.0 MHz

Frequency [MHz]	P [dBm]	P [μ W]	P _{MEAS} [dBm]	A _{CF} [dB]	Polarisation	Result
1668.80	-51.90	0.006	-50.70	-1.20	HORIZONTAL	PASS
2502.90	-48.70	0.013	-55.40	6.70	HORIZONTAL	PASS
3335.74	-47.80	0.017	-45.60	-2.20	VERTICAL	PASS
4170.37	-46.60	0.022	-45.00	-1.60	HORIZONTAL	PASS

Substitution method could not be utilized as no emission above noise floor were found during measurements

9. Frequency stability, temperature variation (FCC §2.1055(a), RSS-132 4.3)

EUT with DUT number	DIS066
Accessories with DUT numbers	None
Operation Voltage [V] / [Hz]	13.2 / DC
Result	PASS
Remarks	None
Temp [°C] / Humidity [%RH]	-30 to +50 / 45
Date of measurements	03.May.2013
Measured by	Robert Müller

9.1. Test reference and limit

The measurement is made according to FCC rules parts 22, IC standard RSS-132 and TIA-603-C as follows:

1. The climate chamber temperature is set to the maximum value and the temperature is allowed to stabilize.
2. The EUT is placed in the chamber.
3. The EUT is set in idle mode for 15minutes.
4. The EUT is set to transmit.
5. The transmit frequency error was measured immediately.
6. The steps 3-5 were repeated for each temperature.

Limits for frequency stability, temperature variation measurements

Frequency deviation [ppm]
+/- 2.5

9.2. GSM850 Test results

9.2.1 GSM mode

Temperature [°C]	Frequency [MHz]	Deviation [Hz]	Deviation [ppm]	Result
50	824.2	-36.35	-0.0441	PASS
	836.6	-34.16	-0.0408	PASS
	848.8	-34.22	-0.0403	PASS
40	824.2	-28.09	-0.0341	PASS
	836.6	-27.83	-0.0333	PASS
	848.8	-33.25	-0.0392	PASS
30	824.2	-32.54	-0.0395	PASS
	836.6	-29.12	-0.0348	PASS
	848.8	-34.29	-0.0404	PASS
20	824.2	-25.76	-0.0313	PASS
	836.6	-30.74	-0.0367	PASS
	848.8	-26.15	-0.0308	PASS
10	824.2	-21.63	-0.0262	PASS
	836.6	-27.25	-0.0326	PASS
	848.8	-29.77	-0.0351	PASS
0	824.2	-26.15	-0.0317	PASS
	836.6	-29.83	-0.0357	PASS
	848.8	-30.03	-0.0354	PASS
-10	824.2	-25.38	-0.0308	PASS
	836.6	-28.02	-0.0335	PASS
	848.8	-26.28	-0.0310	PASS
-20	824.2	-24.80	-0.0301	PASS
	836.6	-20.60	-0.0246	PASS
	848.8	-28.93	-0.0341	PASS
-30	824.2	-24.67	-0.0299	PASS
	836.6	-22.92	-0.0274	PASS
	848.8	-23.37	-0.0275	PASS

10. Frequency stability, voltage variation (FCC §2.1055(d), RSS-132 4.3)

EUT with DUT number	DIS066
Accessories with DUT numbers	None
Operation Voltage [V] / [Hz]	6.0 to 15.6 / DC
Result	PASS
Remarks	None
Temp [°C] / Humidity [%RH]	25 / 45
Date of measurements	03.May.2013
Measured by	Robert Müller

10.1. Test reference and limit

The measurement is made according to FCC rules parts 22, IC standard RSS-132 and TIA-603-C as follows:

The EUT is connected to an adjustable power supply. The frequency stability was measured at nominal voltage and at the operation end point.

Limits for frequency stability, voltage variation measurements

Frequency deviation [ppm]
+/- 2.5

10.2. GSM850 Test results

10.2.1 GSM mode

Voltage [V]	Frequency [MHz]	Deviation [Hz]	Deviation [ppm]	Result
Maximum (15.6)	824.2	-35.77	-0,0434	PASS
	836.6	-28.09	-0,0336	PASS
	848.8	-27.64	-0,0326	PASS
Nominal (13.2)	824.2	-29.96	-0,0364	PASS
	836.6	-28.28	-0,0338	PASS
	848.8	-27.77	-0,0327	PASS
Operation end point (6.0)	824.2	-32.29	-0,0392	PASS
	836.6	-24.99	-0,0299	PASS
	848.8	-30.22	-0,0356	PASS

11. Test equipment

11.1. Conducted measurements

Equipment	Type	Manufacturer	Calibrated	Cycle [Years]
EMI Test Receiver	ESCS 30	R&S	Aug 2012	1
LISN 50 µH	ESH3-Z5	R&S	Aug 2012	1
LISN 50 µH	ESH3-Z5	R&S	Aug 2012	1
V network	ESH3-Z6	R&S	Apr 2012	1
V network	ESH3-Z6	R&S	Apr 2012	1
T-ISN	ISN T800	Teseq	Aug 2012	2
Thermo- Hygrograph	OPUS 10	Lufft	Jun 2011	2
EM Injection clamp	F-33-1	Fischer	Apr 2012	2
Signal generator	SML01	R&S	Apr 2012	2
Digital Radio Communication Tester	CMU200	R&S	Aug 2012	1
RF Emission Software	ES-K1 v.1.71	R&S	n.a.	--
EMI Test Receiver	FSEM30	R&S	Aug 2012	1
Temperature Test system	VT4004	Vötsch	Jul 2012	2
Power Supply	E3632A	Agilent	Jul 2012	1
Signal generator	SMP02	R&S	Jun 2011	2
BT/WLAN Tester	N 4010 A	Agilent	May 2011	2
Digital Radio Communication Tester	CMU200	R&S	Jun 2012	2
RF Radio Software	RADIO	novero	n.a.	--

11.2. Radiated measurements

Equipment	Type	Manufacturer	Calibrated	Cycle [Years]
Controller	2090	ETS	n.a.	--
MAST	2075	ETS	n.a.	--
Ultra Broadband Antenna	HL562	R&S	Jul 2012	3
Digital Radio Communication Tester	CMU200	R&S	Jul 2011	2
EMI Test receiver	ESIB26	R&S	Jul 2012	1
EMI Test receiver	ESU26	R&S	Jul 2011	2
Yaesu controller	G-1000DXC	YAESU	n.a.	--
Computer controller (Yaesu)	GS-232B	YAESU	n.a.	--
Anechoic chamber	3 meter semi/full anechoic chamber	ETS Euroshield	Mar 2012	3
Horn Antenna	3115	EMCO	Apr 2012	3
Horn Antenna	BBHA9120LF	Schwarzbeck	Aug 2011	3
Standard Horn Antenna	3160-09	EMCO	n.a.	--
Thermo- Hygrograph	OPUS 10	Lufft	Jun 2011	2
Band Reject Filter	WRCG 2400/2485 - 2375/2510 - 60/20EE	Wainwright	Mar 2013	1
Notch Filter GSM850	WRCD 800/880-0,2/40-5SSSD	Wainwright	Mar 2013	1
Band Reject Filter WCDMA850	WRCG 832/838-825/845-40/5SS	Wainwright	Mar 2013	1
Notch Filter GSM1900	WRCD 1700/2000-0,2/40-5SSSD	Wainwright	Mar 2013	1
Band Reject Filter AWS 1700	WRCGV1729.4/1735.4-1722.4/1742.4-40/6SS	Wainwright	Mar 2013	1