FCC Part 24 Compliance Test Report

Test Report no.:	EMC_BO_001847	**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:**	7847A-HT6G

Referred documents:	CFR 47, FCC rules Part 24, TIA-603-C-2004 and IC standards RSS-GEN (Issue 3), RSS-133 (Issue 5). Deviations or clarifications to these standards are noted in the related test result under "test reference and limit".

Testing Laboratory:	novero Test Center, Meesmannstr.103, 44807 Bochum, Germany			
	Tel.:	+49 234/51668-0	e-mail:	product-validation@novero.com
	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.

Signature:

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

1. Summary for FCC Part 24 Compliance Test Report

Date of receipt	02-May-2013
Testing completed	03-May-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	SN	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

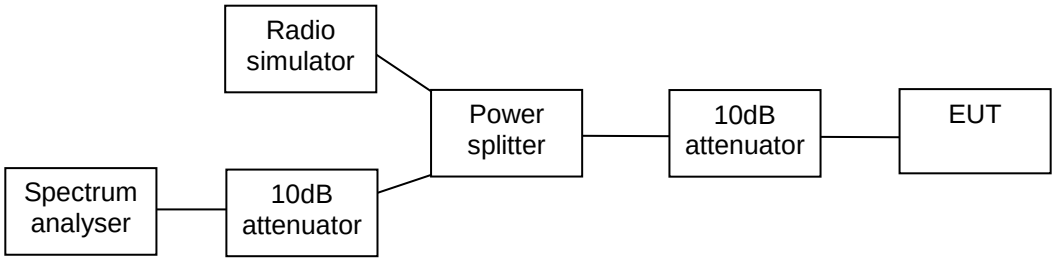
Section	Section in CFR 47	Section in *RSS-GEN* or RSS-133	Name of the test	Result
3	2.1046(a)	6.4	Conducted RF output power	PASS
4	24.232(d)	6.4	Peak to average power ratio	PASS
5	2.1049(h)	4.6.1	99% occupied bandwidth	PASS
6	24.238(a)	6.5	Band edge compliance	PASS
7	24.238(a), 2.1051	6.5	Spurious emissions at antenna terminals	PASS
8	24.238(a), 2.1053	6.5	Spurious radiated emissions	PASS
9	2.1055(a)	6.3	Frequency stability, temperature variation	PASS
10	2.1055(d)	6.3	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.

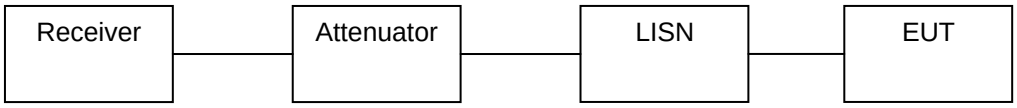
CONTENTS

2. Test setups

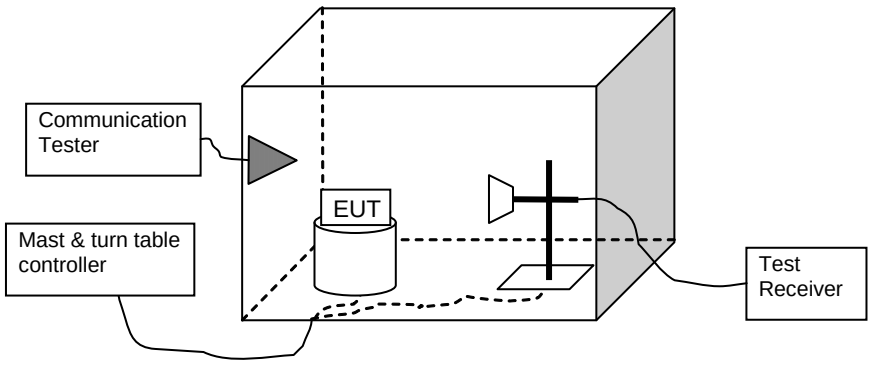
2.1. Conducted test setup



2.2. Conducted AC power line conducted emissions test setup



2.3. Radiated test setup



3. Conducted RF output power

(FCC §24.232 §2.1046(a), RSS-133 6.4)

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 24, IC standard RSS-133 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]
1850 – 1910	2	33

3.2. GSM1900 Test results

3.2.1 GSM mode

Channel / f_C [MHz]	Peak Power [dBm]	Average Power [dBm]	EIRP [dBi]	Result
512 / 1850.2	29.47	29.29	32.47	PASS
661 / 1880.0	29.32	29.15	32.32	PASS
810 / 1909.8	29.13	28.95	32.13	PASS

Antenna gain: 3dBi

3.2.2 EGPRS mode

Channel / f_C [MHz]	Peak Power [dBm]	Average Power [dBm]	EIRP [dBi]	Result
512 / 1850.2	27.07	23.95	30.07	PASS
661 / 1880.0	26.95	23.67	29.95	PASS
810 / 1909.8	26.60	23.41	29.60	PASS

Antenna gain: 3dBi

3.3. WCDMA1900 Test results

3.3.1 FDD2 mode, RMC

Channel / f_C [MHz]	Peak Power [dBm] (PEAK)	Average Power [dBm] (RMS)	EIRP [dBd]	Result
9262 / 1852.4	25.24	23.04	28.24	PASS
9400 / 1880	24.84	22.29	27.84	PASS
9538 / 1907.6	24.84	21.83	27.84	PASS

Antenna gain: 3dBi

4. Peak to average power ratio

(FCC §24.232(d), RSS-133 6.4)

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 24, IC standard RSS-133 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. GSM1900 Test results

4.2.1 GSM mode

Channel / f_C [MHz]	Peak Power [dBm]	Average Power [dBm]	PAPR [dB]	Result
512 / 1850.2	29.47	29.29	0.18	PASS
661 / 1880.0	29.32	29.15	0.17	PASS
810 / 1909.8	29.13	28.95	0.18	PASS

4.2.2 EGPRS mode

Channel / f_C [MHz]	Peak Power [dBm]	Average Power [dBm]	PAPR [dB]	Result
512 / 1850.2	27.07	23.95	3.12	PASS
661 / 1880.0	26.95	23.67	3.28	PASS
810 / 1909.8	26.60	23.41	3.19	PASS

4.3. WCDMA1900 Test results

4.3.1 FDD2 mode, RMC

Channel / f_C [MHz]	Peak Power [dBm] (PEAK)	Average Power [dBm] (RMS)	PAPR [dB]	Result
9262 / 1852.4	25.24	23.04	2.20	PASS
9400 / 1880	24.84	22.29	2.55	PASS
9538 / 1907.6	24.84	21.83	3.01	PASS

5. 99% occupied bandwidth

(FCC §2.1049(h), RSS-133 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

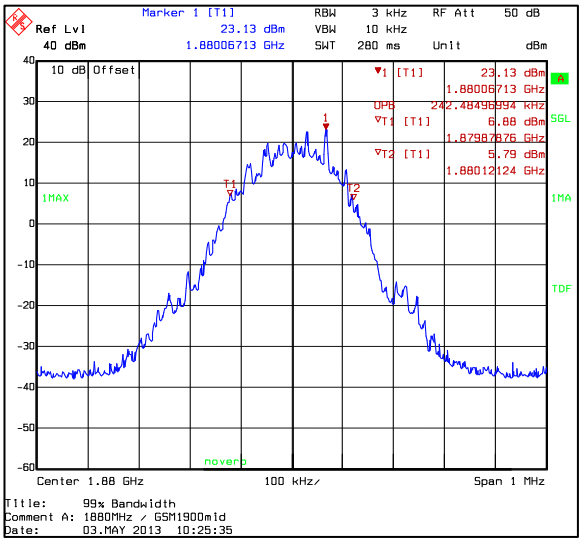
The measurement is made according to FCC rules parts 24, IC standard RSS-GEN, RSS-133 and TIA-603-C.

5.2. GSM1900 Test results

5.2.1 GSM mode

Channel / f_C [MHz]	99% occupied bandwidth [kHz]	Result
661 / 1880	242.49	PASS

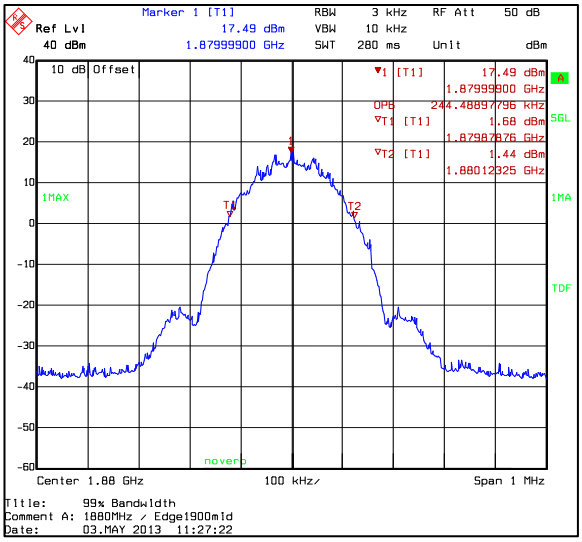
Channel 661 / 1880 MHz



5.2.2 EGPRS mode

Channel / f_C [MHz]	99% occupied bandwidth [kHz]	Result
661 / 1880	244.49	PASS

Channel 661 / 1880 MHz

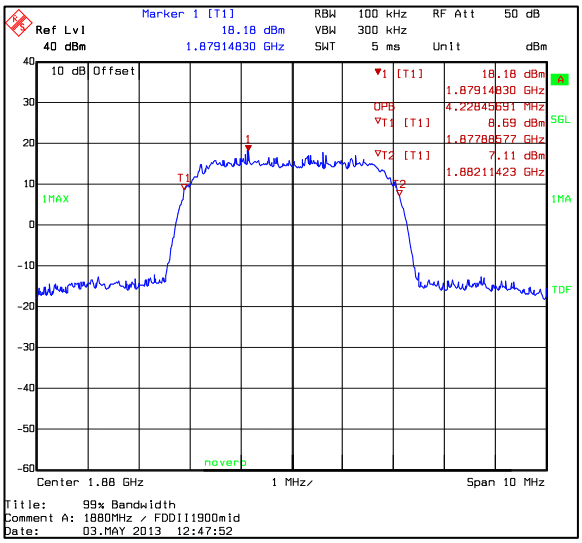


5.3. WCDMA1900 Test results

5.3.1 FDD2 mode, RMC

Channel / f_C [MHz]	99% occupied bandwidth [kHz]	Result
9400 / 1880	4228.46	PASS

Channel 9400 / 1880 MHz



6. Band edge compliance

(FCC §24.238(a), RSS-133 6.5)

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 24 and IC standard RSS-133.

Limits for band edge compliance measurements

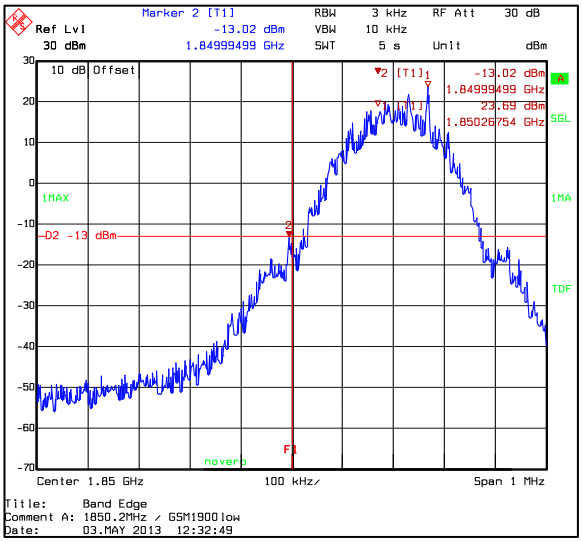
Frequency range [MHz]	Limit [dBm]
Below 1850 and above 1910	-13

6.2. GSM1900 Test results

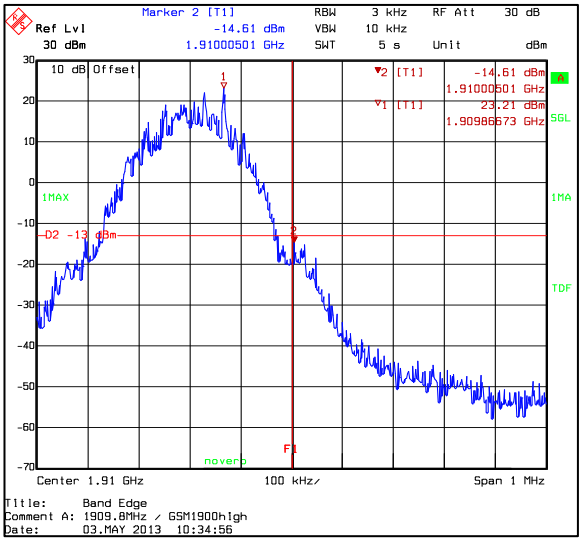
6.2.1 GSM mode

Channel / f_C [MHz]	Level [dBm]	Result
512 / 1850.2	-13.02	PASS
810 / 1909.8	-14.61	PASS

Channel 512 / 1850.2 MHz



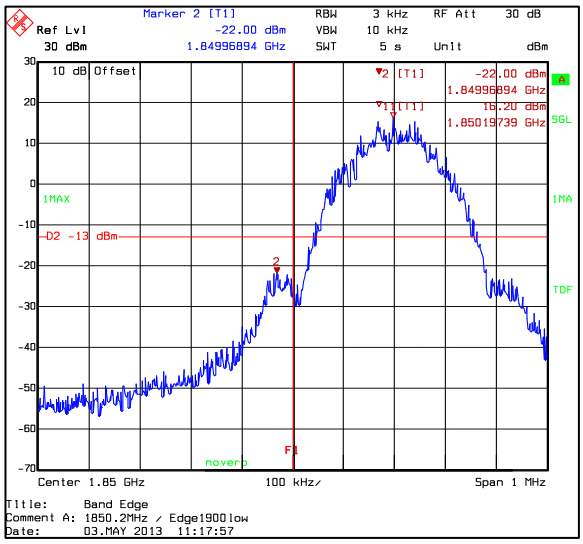
Channel 810 / 1909.8 MHz



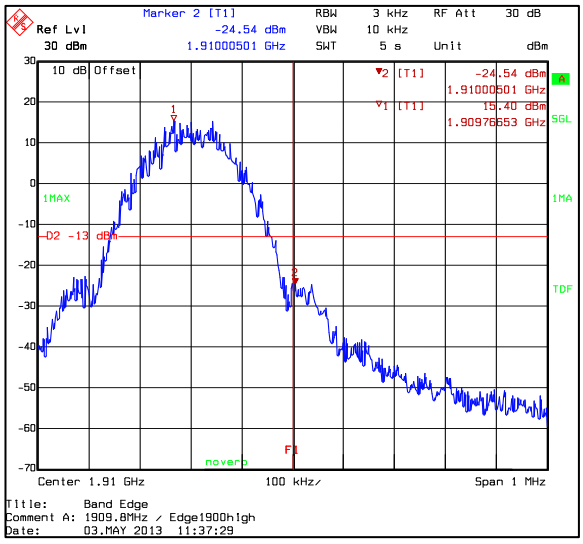
6.2.2 EGPRS mode

Channel / f_C [MHz]	Level [dBm]	Result
512 / 1850.2	-22.00	PASS
810 / 1909.8	-24.54	PASS

Channel 512 / 1850.2 MHz



Channel 512 / 1909.8 MHz

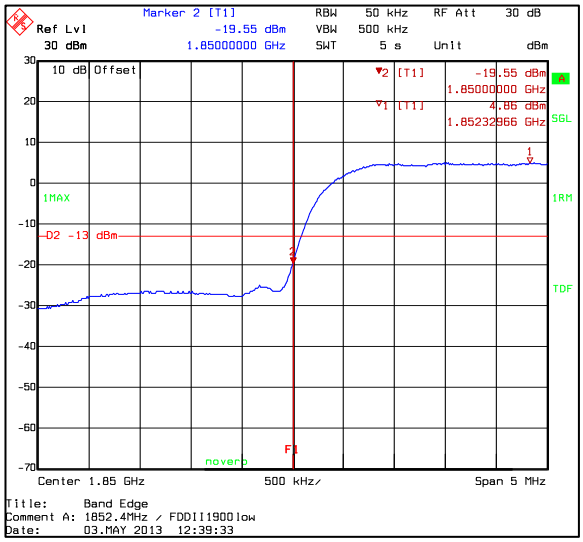


6.3. WCDMA1900 Test results

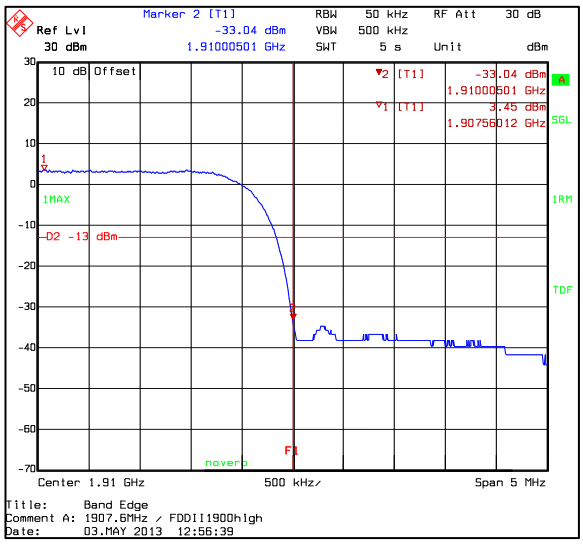
6.3.1 FDD2 mode, RMC

Channel / f_C [MHz]	Level [dBm]	Result
9262 / 1852.4	-19.55	PASS
9538 / 1907.6	-32.64	PASS

Channel 9262 / 1852.4 MHz



Channel 9538 / 1907.6 MHz



7. Spurious emissions at antenna terminals

(FCC §24.238(a), §2.1051 RSS-133 6.5)

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 FCC rules parts 24, IC standard RSS-GEN, RSS-133 and TIA-603-C.

Limits for spurious emissions at antenna terminals measurements

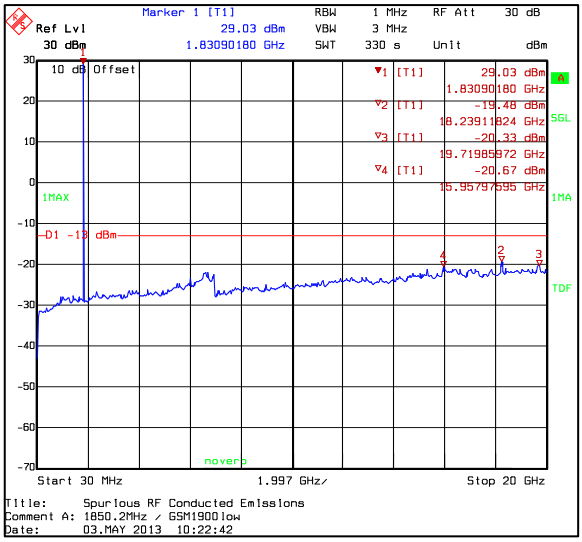
Frequency range [MHz]	Limit [dBm]
30 – 20000	-13

7.2. GSM1900 Test results

7.2.1 GSM mode

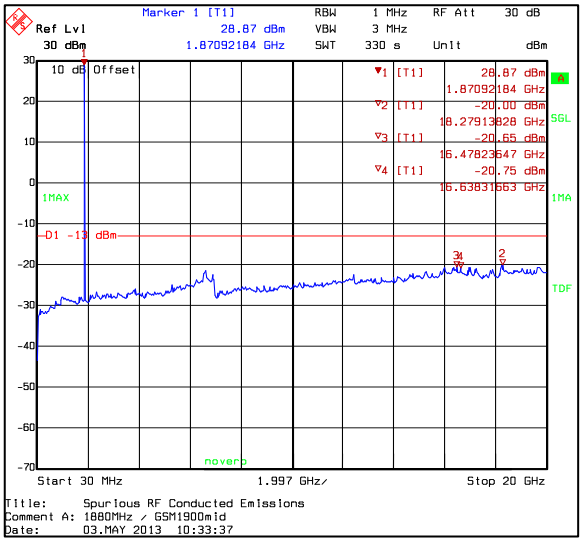
Channel 512 / 1850.2 MHz

Frequency [MHz]	P [dBm]	Result
15957.98	-20.67	PASS
18239.12	-19.48	PASS
19719.86	-20.33	PASS



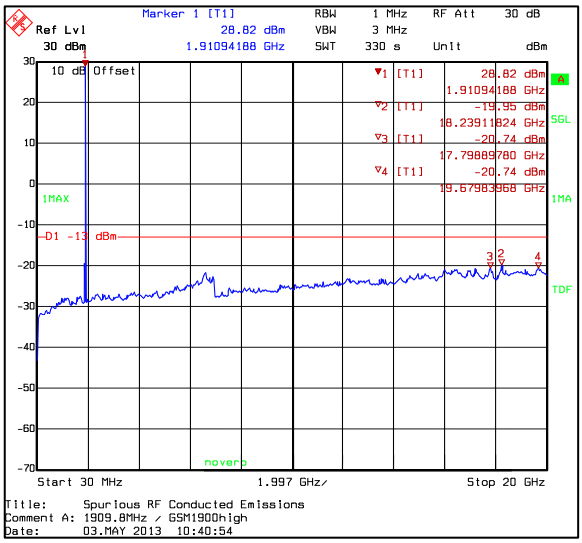
Channel 661 / 1880.0 MHz

Frequency [MHz]	P [dBm]	Result
16478.24	-20.65	PASS
16638.32	-20.75	PASS
18279.14	-20.00	PASS



Channel 810 / 1909.8 MHz

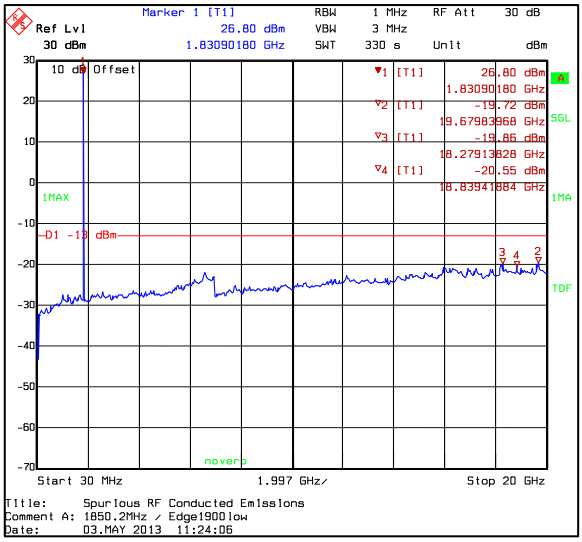
Frequency [MHz]	P [dBm]	Result
17798.90	-20.74	PASS
18239.11	-19.95	PASS
19679.84	-20.74	PASS



7.2.2 EGPRS mode

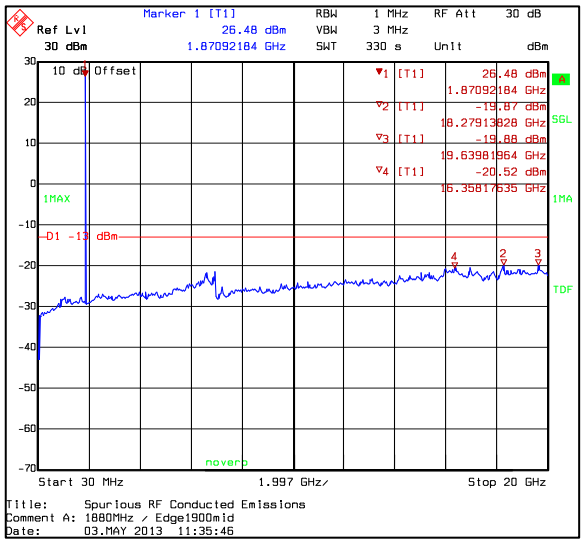
Channel 512 / 1850.2 MHz

Frequency [MHz]	P [dBm]	Result
18279.14	-19.86	PASS
18839.42	-20.55	PASS
19679.84	-19.72	PASS



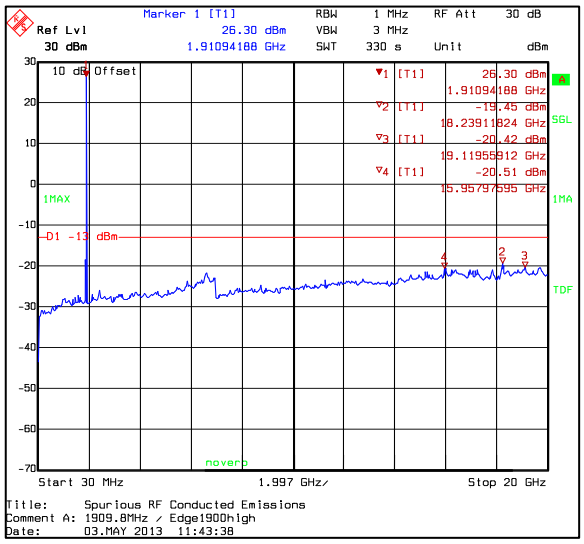
Channel 661 / 1880.0 MHz

Frequency [MHz]	P [dBm]	Result
16358.18	-20.52	PASS
18279.14	-19.87	PASS
19639.82	-19.88	PASS



Channel 810 / 1909.8 MHz

Frequency [MHz]	P [dBm]	Result
15957.98	-20.51	PASS
18239.12	-19.45	PASS
19119.56	-20.42	PASS

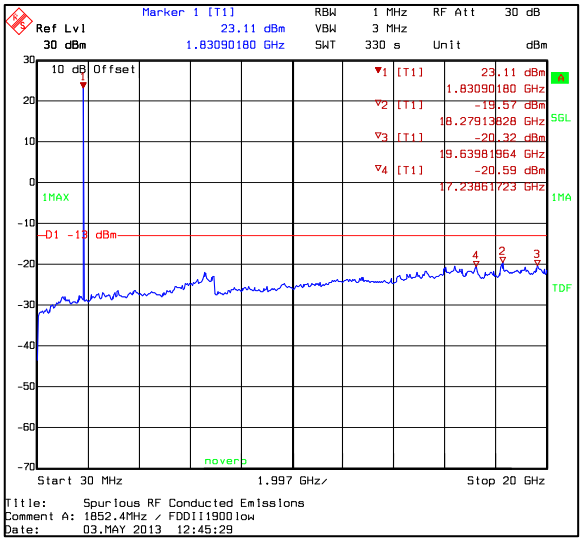


7.3. WCDMA1900 Test results

7.3.1 FDD2 mode, RMC

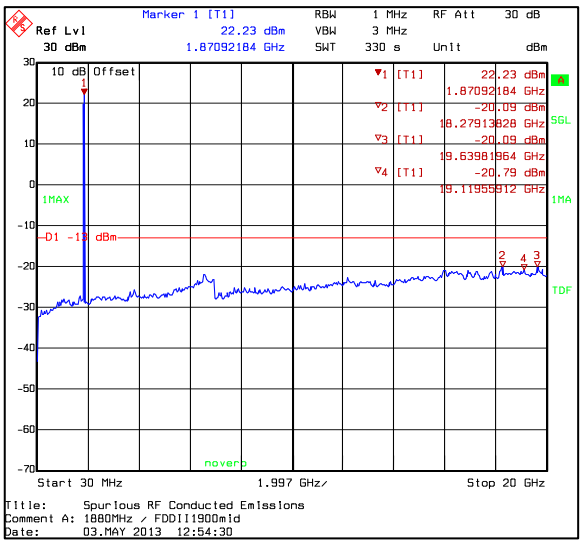
Channel 9262 / 1852.4 MHz

Frequency [MHz]	P [dBm]	Result
17238.62	-20.59	PASS
18279.14	-19.57	PASS
19639.82	-20.32	PASS



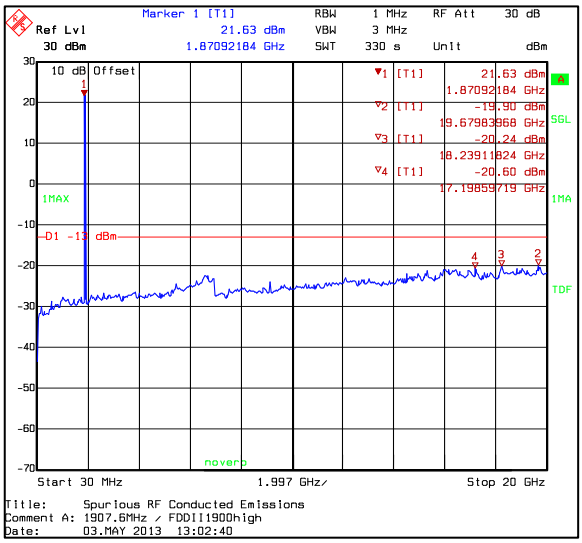
Channel 9400 / 1880 MHz

Frequency [MHz]	P [dBm]	Result
18279.14	-20.09	PASS
19119.56	-20.79	PASS
19639.82	-20.09	PASS



Channel 9538 / 1907.6 MHz

Frequency [MHz]	P [dBm]	Result
17198.60	-20.06	PASS
18239.12	-20.24	PASS
19679.84	-19.90	PASS



8. Spurious radiated emissions

(FCC §24.238(a), §2.1053, RSS-133 6.5)

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-2004 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 - 20000	-13

8.2. GSM1900 TX Test results

8.2.1 GSM mode

Channel 661 / 1880.0 MHz

Frequency [MHz]	P [dBm]	P [µW]	P_{MEAS} [dBm]	A_{CF} [dB]	Polarisation	Result
3760.12	-43.20	0.048	-43.00	-0.20	HORIZONTAL	PASS
5639.92	-37.00	0.200	-40.80	3.80	HORIZONTAL	PASS
7520.23	-39.40	0.115	-45.30	5.90	HORIZONTAL	PASS

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

8.2.2 EGPRS mode

Channel 661 / 1880.0 MHz

Frequency [MHz]	P [dBm]	P [µW]	P_{MEAS} [dBm]	A_{CF} [dB]	Polarisation	Result
3760.12	-48.70	0.013	-48.90	0.20	VERTICAL	PASS
5640.03	-44.70	0.034	-48.70	4.00	VERTICAL	PASS
7520.23	-46.20	0.024	-52.10	5.90	HORIZONTAL	PASS

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

8.3. WCDMA1900 TX Test results

8.3.1 FDD2 mode, RMC

Channel 9400 / 1880.0 MHz

Frequency [MHz]	P [dBm]	P [µW]	P_{MEAS} [dBm]	A_{CF} [dB]	Polarisation	Result
3757.91	-34.50	0.355	-34.30	-0.20	HORIZONTAL	PASS
5637.82	-45.30	0.030	-49.10	3.80	VERTICAL	PASS
7515.23	-33.10	0.490	-39.00	5.90	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-133 6.3

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 24, IC standard RSS-133 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. GSM1900 Test results

9.2.1 GSM mode

Temperature [°C]	Frequency [MHz]	Deviation [Hz]	Deviation [ppm]	Result
50	1850.2	-91.69	-0.0496	PASS
	1880.0	-108.42	-0.0577	PASS
	1909.8	-92.98	-0.0487	PASS
40	1850.2	-107.77	-0.0582	PASS
	1880.0	-96.73	-0.0515	PASS
	1909.8	-98.15	-0.0514	PASS
30	1850.2	-92.40	-0.0499	PASS
	1880.0	-100.73	-0.0536	PASS
	1909.8	-87.37	-0.0457	PASS
20	1850.2	-86.91	-0.0470	PASS
	1880.0	-89.95	-0.0478	PASS
	1909.8	-82.91	-0.0434	PASS
10	1850.2	-100.28	-0.0542	PASS
	1880.0	-77.87	-0.0414	PASS
	1909.8	-89.75	-0.0470	PASS
0	1850.2	-93.05	-0.0503	PASS
	1880.0	-67.80	-0.0361	PASS
	1909.8	-79.55	-0.0417	PASS
-10	1850.2	-82.14	-0.0444	PASS
	1880.0	-73.87	-0.0393	PASS
	1909.8	-68.64	-0.0359	PASS
-20	1850.2	-81.17	-0.0439	PASS
	1880.0	-79.94	-0.0425	PASS
	1909.8	-69.74	-0.0365	PASS
-30	1850.2	-65.67	-0.0355	PASS
	1880.0	-69.80	-0.0371	PASS
	1909.8	-67.09	-0.0351	PASS

10. Frequency stability, voltage variation

(FCC §2.1055(d), RSS-133 6.3

EUT with DUT number	DIS066
Accessories with DUT numbers	None
Operation Voltage [V] / [Hz]	6.0 to 15.6 / 45
Result	PASS
Remarks	None
Temp [°C] / Humidity [%RH]	24 / 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 24 and IC standard RSS-133 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. GSM1900 Test results

10.2.1 GSM mode

Voltage [V]	Frequency [MHz]	Deviation [Hz]	Deviation [ppm]	Result
Maximum (15.6)	1850.2	-100.09	-0.0541	PASS
	1880.0	-86.33	-0.0459	PASS
	1909.8	-100.15	-0.0524	PASS
Nominal (13.2)	1850.2	-94.98	-0.0513	PASS
	1880.00	-100.80	-0.0536	PASS
	1909.8	-106.61	-0.0558	PASS
Operation end point (6.0)	1850.2	-98.34	-0.0532	PASS
	1880.00	-90.14	-0.0480	PASS
	1909.8	-106.93	-0.0560	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	ESI26	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
RF Emission Software	ES-K1 v.1.71	R&S	n.a.	--