FCC RF Exposure Report
(MPE Calculation)

Test Report no.:	EMC_BO_001739	Date of Report:	06-Aug-2012
Number of pages:	6	Project support engineer:	Robert Müller

Customer:	novero GmbH, Meesmannstrasse 103, 44807 Bochum, Germany
Customers contact:	Jürgen Hindersmann
Manufacturer	novero GmbH
EUT ident.:	**Hands-Free Unit with Bluetooth, WLAN and GSM/WCDMA, HT-5**
FCC ID	WJLHT-5	IC:	7847A-HT5

Referred documents:	FCC rules Part 2 and IC standards RSS-102; FCC Test Reports with FCC ID / IC ID mentioned above

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FCC listing no.:	881111	IC recognition no.:	7847A-1
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Test result	The EUT complies with the requirements made in the referred test documents.

Date and signature:

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1. Maximum Permissible Exposure

1.1. Calculation method and limit

1.1.1. §1.1310

Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure) are specified in Table 1B of 47 CFR 1.1310 and table chapter 4.2 of RSS-102 standard.

Frequency range [MHz]	Power Density[mW/cm²]
300 – 1500	f/1500
1500 – 100,000	1.0

Calculations can be made with the following equation according to OET bulletin 65:

$$S = \frac{EIRP}{4\pi R^2} = \frac{P * G}{4\pi R^2}$$

S = power density
P = power input of the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the centre of radiation of the antenna
EIRP = equivalent (or effective) isotropic radiated power

1.1.2. §2.1091

Subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if they operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watt or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more.

For 850 MHz Operations:
G = 10*log 1500mW [ERP] - Conducted Peak Power [dBm] + Duty Cycle [dB] + 2.15dB

For 1900 MHz Operations
(§ 24.232 to be considered for the maximum transmitter power limit of 2W EIRP):
G = 10*log 2000mW [EIRP] - Conducted Peak Power [dBm] + Duty Cycle [dB]

1.2.   Results

1.2.1.   Results for 850 MHz Operations (Part 22)

§1.1310: Maximum Gain [dBi] = 10*log (S * 4πR²) – Conducted Peak Power [dBm] + Duty Cycle [dB]
§2.1091: Maximum Gain [dBi] = 10*log 1500mW [ERP] - Conducted Peak Power [dBm] + Duty Cycle [dB] + 2.15dB

Band	Channel	Frequency [MHz]	Conducted Peak Power [dBm]	Duty Cycle [dB]	Average Power [dBm]	MPE Limit [mW/cm²]	§ 1.1310 Max. Gain [dBi]	§ 2.1091 (c) Max. Gain [dBi]
GSM	128	824.2	33.04	-9.03	24.01	0.5495	10.40	9.90
	192	837.0	32.94	-9.03	23.91	0.5580	10.57	10.00
	251	848.8	33.02	-9.03	23.99	0.5659	10.55	9.92
GPRS	128	824.2	33.45	-3.01	30.44	0.5495	**3.97**	**3.47**
	192	837.0	33.33	-3.01	30.32	0.5580	4.16	3.59
	251	848.8	33.42	-3.01	30.41	0.5659	4.13	3.50
EGPRS	128	824.2	30.34	-3.01	27.33	0.5495	7.08	6.58
	192	837.0	30.34	-3.01	27.33	0.5580	7.15	6.58
	251	848.8	30.47	-3.01	27.46	0.5659	7.08	6.45
FDD V	4132	826.4	29.29	0.00	29.29	0.5509	5.13	4.62
	4175	835.0	28.49	0.00	28.49	0.5567	5.98	5.42
	4233	846.6	29.42	0.00	29.42	0.5644	5.11	4.49

For GPRS/EGPRS mode Multislot Class12 (maximal 4 Uplink time slots) is considered for duty cycle.

1.2.2.   Results for 1900 MHz Operations (Part 24)

§1.1310: Maximum Gain [dBi] = 10*log (S * 4πR²) – Conducted Peak Power [dBm] + Duty Cycle [dB]
§24.232: Maximum Gain [dBi] = 10*log 2000mW [EIRP] - Conducted Peak Power [dBm] + Duty Cycle [dB]

Band	Channel	Frequency [MHz]	Conducted Peak Power [dBm]	Duty Cycle [dB]	Average Power [dBm]	MPE Limit [mW/cm²]	§ 1.1310 Max. Gain [dBi]	§ 2.1091 (c) § 24.232 (c) Max. Gain [dBi]
GSM	512	1850.2	30.14	-9.03	21.11	1.0	15.90	11.90
	661	1880.0	30.37	-9.03	21.34	1.0	15.67	11.67
	810	1908.8	30.27	-9.03	21.24	1.0	15.77	11.77
GPRS	512	1850.2	30.46	-3.01	27.45	1.0	9.56	5.56
	661	1880.0	30.68	-3.01	27.67	1.0	**9.34**	**5.34**
	810	1908.8	30.56	-3.01	27.55	1.0	9.46	5.46
EGPRS	512	1850.2	28.71	-3.01	25.70	1.0	11.31	7.31
	661	1880.0	28.76	-3.01	25.75	1.0	11.26	7.26
	810	1908.8	28.53	-3.01	25.52	1.0	11.49	7.49

For GPRS/EGPRS mode Multislot Class12 (maximal 4 Uplink time slots) is considered for duty cycle.

1.2.3. Results for ISM 2.4GHz Operations (Part 15)

§1.1310: Maximum Gain [dBi] = 10*log (S * 4πR²) – Conducted Peak Power [dBm] + Duty Cycle [dB]
§2.1091: Maximum Gain [dBi] = 10*log 3000mW [ERP] - Conducted Peak Power [dBm] + Duty Cycle [dB]

Band	Channel	Frequency [MHz]	Conducted Peak Power [dBm]	Duty Cycle [dB]	Average Power [dBm]	MPE Limit [mW/cm²]	§ 1.1310 Max. Gain [dBi]	§ 2.1091 (c) Max. Gain [dBi]
BT 1Mbps	1	2402	-0.75	3.24	24.01	1.0	34.52	32.28
	39	2441	0.33	3.24	23.91	1.0	33.44	31.20
	79	2480	0.94	3.24	23.99	1.0	**32.83**	**30.59**
BT 3Mbps	1	2402	-0.75	3.24	30.44	1.0	34.52	32.28
	39	2441	0.21	3.24	30.32	1.0	33.56	31.32
	79	2480	0.81	3.24	30.41	1.0	32.96	30.72
WLAN 1Mbps	1	2412	14.56	0.46	27.33	1.0	21.99	19.75
	6	2437	14.50	0.46	27.33	1.0	22.05	19.81
	11	2462	14.43	0.46	27.46	1.0	22.12	19.88
WLAN 6Mbps	1	2412	19.06	2.60	29.29	1.0	15.35	13.11
	6	2437	19.35	2.60	28.49	1.0	**15.06**	**12.82**
	11	2462	18.98	2.60	29.42	1.0	15.43	13.19

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1.3. Prediction

1.3.1. Prediction for 850 MHz band (Part 22)

The maximum allowed MPE value of 0.5495mW/cm² will be reached in a distance of 20 cm in case that an antenna with an antenna gain of 3.97dBi would be used. This means that the power density levels in a distance of 20 cm are in accordance with the FCC regulations as long as the used antenna has a gain below 3.97dBi.

Considering the max output power of 1.5 Watts ERP (FCC §2.1091) for mobile devices the maximum antenna gain is 3.47dBi.

Therefore the maximum allowed antenna gain of an external antenna for the product mentioned above is limited to **3.47dBi**.

1.3.2. Prediction for 1900 MHz band (Part 24)

The maximum allowed MPE value of 1mW/cm² will be reached in a distance of 20 cm in case that an antenna with an antenna gain of 9.34dBi would be used. This means that the power density levels in a distance of 20 cm are in accordance with the FCC regulations as long as the used antenna has a gain below 9.34dBi.

Considering the max output power of 2 Watts EIRP (FCC §24.232) for mobile devices the maximum antenna gain is 5.34dBi.

Therefore the maximum allowed antenna gain of an external antenna for the product mentioned above is limited to **5.34dBi**.

1.3.3. Prediction for 2400 MHz band (Part 15)

The maximum allowed MPE value of 1mW/cm² will be reached in a distance of 20 cm in case that an antenna with an antenna gain of 32.83dBi would be used for Bluetooth and 15.06dBi for WLAN. This means that the power density levels in a distance of 20 cm are in accordance with the FCC regulations as long as the used antenna has a gain below 32.83dBi (BT) and 15.06dBi (WLAN).

Considering the max output power of 3 Watts EIRP (FCC §2.1091) for mobile devices the maximum antenna gain is 30.59dBi (BT) and 12.82dBi (WLAN).

Since the integrated antenna for Bluetooth/WLAN with an antenna gain of 4.58dBi / 4.45dBi is below the calculated maximum allowed antenna gain this requirement is deemed to be fulfilled.