

EMI – TEST REPORT

- Human Exposure -

Type / Model Name : MS32018

Product Description : DRAEGER WCM9113 802.11ABGN VG2

Applicant : Draeger Medical Systems Inc.

Address : 6 Tech drive
ANDOVER, MA 01810

Manufacturer : Draeger Medical Systems Inc.

Address : 3135 Quarry Road
TELFORD, PA 18969-1042

Licence holder : Draeger Medical Systems Inc.

Address : 3135 Quarry Road
TELFORD, PA 18969-1042

Test Result according to the standards
listed in clause 1 test standards:

POSITIVE

Test Report No. : **T40046-03-12HS**

20. January 2016
Date of issue



Deutsche
Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test results
without the written permission of the test laboratory.

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ATTACHMENT A and C as separate supplement

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 1, Subpart I - Procedures Implementing the National Environmental Policy Act of 1969

Part 1, Subpart I, Section 1.1310 Radiofrequency radiation exposure limits

Part 1, Subpart 2, Section 2.1093 Radiofrequency radiation exposure evaluation: portable device

OET Bulletin 65, 65A, 65B Edition 97-01, August 1997 – Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

KDB 447498 D01 v06 RF Exposure procedures and equipment authorisation policies for mobile and portable devices, October 23, 2015.

KDB 865664 D01 SAR Measurement Requirements for 100 MHz to 6 GHz, August 7, 2015.

ANSI C95.1: 2005 IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

ETSI TR 100 028 V1.3.1: 2001-03, Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT – Detailed photos see ATTACHMENT C

2.2 Equipment type

WLAN - Client

2.3 Short description of the equipment under test (EUT)

The EUT is a WLAN-module. The EUT is compatible with 802.11b, 802.11g Standard in the 2.4 GHz frequency band. The firmware does not support ad-hoc modes and gives the user no possibility to choose the channel for data transmission or power setting. It supports no beam forming. The transmissions according the 802.11a, n Standard are disabled by firmware.

Number of tested samples: 1

Serial number: The module is labelled by bar code only. A serial number is reserved for end-device.

Firmware version, M540: 1.2.5

EUT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

2.4 Variants of the EUT

There are no variants

2.5 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan WLAN Standard 802.11b/g, HT20:

Channel	Frequency (MHz)
1	2412
2	2417
3	2422
4	2427
5	2432
6	2437
7	2442
8	2447
9	2452
10	2457
11	2462

Note: the marked frequencies are determined for final testing.

2.6 Transmit operating modes

The EUT use DSSS or OFDM modulation and may operate under operating mode 2 and provide following data rates with auto-fall-back:

- | | | |
|----------------|-----------------------------------|------------------------------|
| - 802.11b mode | 11, 5.5, 2, 1 Mbps | (Mbps = megabits per second) |
| - 802.11g mode | 54, 48, 36, 24, 18, 12, 9, 6 Mbps | (Mbps = megabits per second) |

2.7 Antenna

The following antennas shall be used with the EUT:

Number	Characteristic	Model number	Plug	Frequency range (GHz)	Gain (dBi)	Cable loss (dB)	Effective gain (dBi)
1	Omni	CU5006-2, Antenova	Ufl	2.4	2.4	0	2.4

2.8 Power supply system utilised

M540:

- Power supply voltage, V_{nom} : 7.2 VDC Battery
Power supply voltage (alternative) : Input: 100-240 VAC, 47-63 Hz, 1 ϕ Power supply,
Output: +24 VDC.

2.9 Peripheral devices and interface cables

The following peripheral devices and interface cables are connected during the measurements:

- _____ Model : _____
- _____ Model : _____
- _____ Model : _____

2.10 Determination of worst case conditions for final measurement

Measurements are made in all three orthogonal axes and the settings of the EUT are changed to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in X position.

The tests are carried out in the following frequency band:

2400 MHz – 2483.5 MHz

Preliminary tests are performed to find the worst case mode from all possible combinations between available modulations and data rates. The maximum output power depends on used data rate. The output power can be set by application software from 1 dBm to 18 dBm (P1 to P18) in 1 dB steps.

The test software for the EUT provides free power setting, the special test mode RX and the TX continuous mode, modulated. The EUT was set with test modulation to transmit data during the tests with a maximum duty cycle (x) from an internal packet generator.

For the final test the following channels and test modes are selected:

WLAN	Available channel	Tested channels	Power setting	Modulation	Modulation type	Data rate
802.11b	1 to 11	1, 6, 11	P18, P10	DSSS	DBPSK	1 Mbps
802.11g	1 to 11	1, 6, 11	P16, P10	OFDM	BPSK	6 Mbps

- TX continuous mode, 802.11 b
- TX continuous mode, 802.11 g

2.10.1 Test jig

The WLAN module is integrated in the end-product "Infinity M540" to provide power supply and control signals in order to generate the test pattern. The "Infinity M300" is a final product, too. The device M300 is a subset of the M540. The values of the RF-devices and the arrangement are identical, too.

The radiated and conducted measurements have been performed under the support of test jigs (M300 and M540). The worst case means the M540 and is listed only. The test software can be used only for the special prepared test jigs.

2.10.2 Test software

The test software for the EUT provides free power setting, the special test mode TX continuous, modulated. The EUT is set with test modulation to transmit data during the tests with a duty cycle (X) of assumed $X = 1$.

3 TEST RESULT SUMMERY

WLAN device using digital modulation:

Operating in the 2400 MHz – 2483.5 MHz:

FCC Rule Part	RSS Rule Part	Description	Result
15.247(i)	RSS 102, 2.5.2	MPE	passed
KDB 447498	RSS 102, 2.5.1	SAR exclusion consideration	passed
OET Bulletin 65	RSS102, 3.2	Co-location, Co-transmission	not applicable

The mentioned RSS Rule Parts in the above table are related to:
RSS 102, Issue 5, March 2015

3.1 Final assessment

The equipment under test fulfills the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 07 October 2015

Testing concluded on : 08 October 2015

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Hermann Smetana
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 °C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.4 Measurement protocol for FCC and IC

4.4.1 General information

4.4.1.1 Test methodology

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

IC 3009A-1

In compliance with RSS 247 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.4.1.2 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.4.1.3 Details of test procedures

In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

5 TEST CONDITIONS AND RESULTS

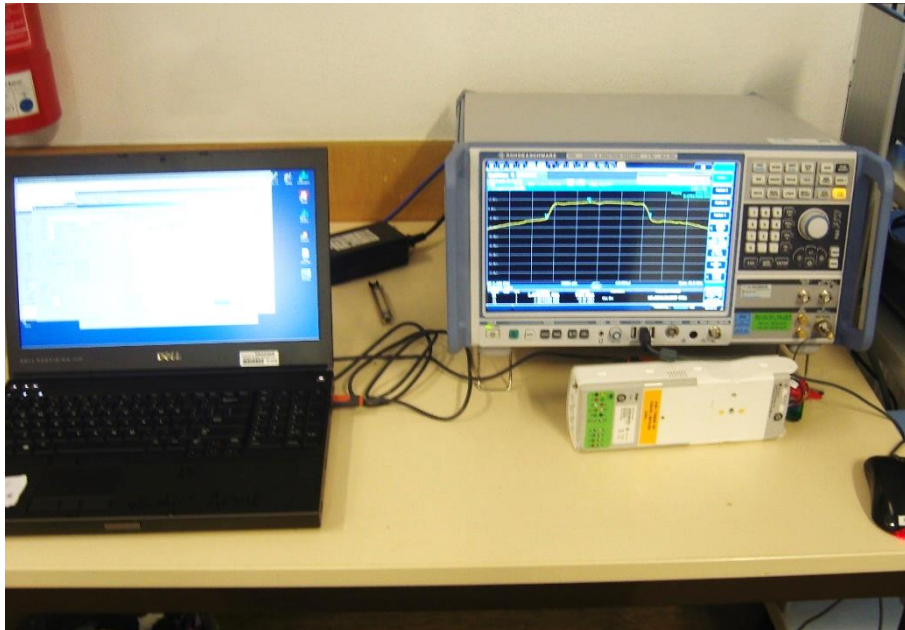
5.1 Maximum average conducted output power

For test instruments and accessories used see section 6 Part **CPC 3**.

5.1.1 Description of the test location

Test location: AREA4

5.1.2 Photo documentation of the test set-up



5.1.3 Applicable standard

According to FCC Part 15, Section 15.247(b)(3):

For systems using digital modulation in the 2400 – 2483.5 MHz band, the maximum peak output power of the transmitter shall not exceed 1 Watt. The limit is based on transmitting antennas of directional gain that do not exceed 6 dBi.

5.1.4 Description of Measurement

The measurement method is AVGSA-1.

5.1.5 Test result

WLAN Standard 802.11b

802.11b, 1 Mbps, 1 TX		Test results conducted		
Duty cycle: 100%				
Average values		A [P18]	Limit	Margin
		(dBm)	(dBm)	(dB)
Lowest frequency: CH1				
T_{nom}	V_{nom}	18.2	30.0	-11.8
Middle frequency: CH6				
T_{nom}	V_{nom}	17.6	30.0	-12.4
Highest frequency: CH11				
T_{nom}	V_{nom}	17.7	30.0	-12.3

WLAN Standard 802.11g

802.11g, 6 Mbps, 1 TX		Test results conducted		
Duty cycle: 100%				
Average values		A [P15] (dBm)	Limit (dBm)	Margin (dB)
Lowest frequency: CH1				
T_{nom}	V_{nom}	16.5	30.0	-13.5
Middle frequency: CH6				
T_{nom}	V_{nom}	16.6	30.0	-13.4
Highest frequency: CH11				
T_{nom}	V_{nom}	16.9	30.0	-13.1

Peak Power Limit according to FCC Part 15, Section 15.247(b)(3):

Frequency (MHz)	Peak Power Limit	
	(dBm)	(Watt)
902-928	30	1.0
2400-2483.5	30	1.0
5725-5850	30	1.0

The requirements are **FULFILLED**.

Remarks:

6 HUMAN EXPOSURE

6.1 Maximum permissible exposure (MPE)

For test instruments and accessories used see section 6 Part **CPC 3**.

6.1.1 Description of the test location

Test location: AREA4

6.1.2 Applicable standard

According to FCC Part 15, Section 15.247(i):

Systems operating under the provisions of this section shall be operated in a manner that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

The test methods used comply with ANSI/IEEE C95.1, "IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz".

This test report shows the compliance with the limits for Maximum Permissible Exposure (MPE) specified in FCC Part 1, Section 1.1310 and the criteria to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in FCC Part 1, Section 1.1307(b).

6.1.3 Description of Measurement

The maximum total power input to the antenna has been measured conducted as described in clause 5.3 of this document. Through the Friis transmission formula, the known maximum gain of the antenna and the maximum power, can be calculated the MPE in a defined distance away from the product.

Friis transmission formula:

$$P_d = \frac{P_{out} * G}{4 * \pi * r^2}$$

Where:

P_d = power density (mW/cm²)

P_{out} = output power to antenna (mW)

G = gain of antenna (linear scale)

r = distance between antenna and observation point (cm)

According to FCC Rules 47CFR 2.1093(b) the EUT is not a portable device. The EUT is designed to be used that radiating structures are 20 cm outside of the body of the user. ($r = 20$ cm)

6.1.4 Test result

The limits according RSS102 are applied.

WLAN Standard 802.11b

Channel No.	Power	A (dBm)	Antgain (dBi)	A (mW)	G linear	P (W)	S (mW/cm ²)	Limit S_{ed} (mW/cm ²)	Margin (mW/cm ²)
1	P18	18.2	2.4	66.07	1.74	0.1148	0.0228	0.54	-0.52
6	P18	17.6	2.4	57.54	1.74	0.1000	0.0199	0.54	-0.52
11	P18	17.7	2.4	58.88	1.74	0.1023	0.0204	0.54	-0.52

WLAN Standard 802.11g

Channel No.	Power	A (dBm)	Antgain (dBi)	A (mW)	G linear	P (W)	S (mW/cm ²)	Limit S _{eq} (mW/cm ²)	Margin (mW/cm ²)
1	P16	16.5	2.4	44.67	1.74	0.0776	0.0154	0.54	-0.52
6	P16	16.6	2.4	45.71	1.74	0.0794	0.0158	0.54	-0.52
11	P16	16.9	2.4	48.98	1.74	0.0851	0.0169	0.54	-0.52

Limits for maximum permissible exposure (MPE) according KDB 447498 D01:

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(B) Limits for General Population / Uncontrolled Exposure				
0.3 – 3.0	614	1.63	100	30
3.0 – 30	824/ <i>f</i>	2.19/ <i>f</i>	180/ <i>f</i> ²	30
30 - 300	27.5	0.073	0.2	30
300-1500	---	---	<i>f</i> /1500	30
1500-100000	---	---	1.0	30

f = Frequency in MHz

Limits for maximum permissible exposure (MPE) according RSS102:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-1021	83	90	-	Instantaneous*
0.1-10	-	0.73/ <i>f</i>	-	6**
1.1-10	87/ <i>f</i> ^{0.5}	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ <i>f</i> ^{0.25}	0.1540/ <i>f</i> ^{0.25}	8.944/ <i>f</i> ^{0.5}	6
48-300	22.06	0.05852	1,291	6
300-6000	3.142 <i>f</i>^{0.3417}	0.008335 <i>f</i>^{0.3417}	0.02619 <i>f</i>^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616000/ <i>f</i> ^{1.2}

Note: *f* is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).

The requirements are **FULFILLED**.

Remarks:

6.2 Co-location and Co-transmission

Applicable standard:

OET Bulletin 65, Edition 97-01, Section 2: Multiple-transmitter sites and Complex Environments

The FCC's MPE limits vary with frequency. Therefore, in mixed or broadband RF fields where several sources and frequencies are involved, the fraction of the recommended limit (in terms of power density or square of the electric or magnetic field strength) incurred within each frequency interval should be determined, and the sum of all fractional contributions should not exceed 1.0, or 100 % in terms of percentage.

Remarks: Not applicable, the EUT has one transmitter.

6.3 SAR test exclusion considerations for mobile applications (FCC)

6.3.1 Applicable standard

According to RF exposure guidance:

Systems operating under the provisions of this section shall be operated in a manner that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

6.3.2 Determination of the standalone SAR test exclusion threshold

The minimum separation distance results from the application of the M300 which is body supported. This distance is assumed to ≤ 50 mm from antenna to the body of the user.

The body of the user is the nearest of a human being therefore the threshold for 1-g is determined.

The formula under 4.3.1 1) for 100 MHz to 6 GHz for standalone equipment is used:

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] * [\sqrt{f(\text{GHz})}] \leq 3.0;$$

The max power P18 is according the equipment:

WLAN 2.4 GHz:	Distance:	12.0 mm			
	Max Power	18.2 dBm	Gain:	2.4 dBi	EIRP: 114.82 mW
	Frequenz	2.44 GHz			

Separation distance ≤ 50 mm;	P/D	$\sqrt{2.437}$	
1g Threshold	9.57	1.56	14.94 ≤ 3.0

Conclusion: The Threshold level is much higher than the limit, SAR measurement is necessary.

➡ The output power has to be reduced!

The OEM must adjust the highest output power to power level P10 (12 dBm) for body worn applications to satisfy RF Exposure SAR Test Exclusion limit at separation distance of 12 mm

WLAN 2.4 GHz:	Distance:	12.0 mm			
	Max Power	10.4 dBm	Gain:	2.4 dBi	EIRP: 19.05 mW
	Frequenz	2.44 GHz			

Separation distance ≤ 50 mm;	P/D	$\sqrt{2.437}$	
1g Threshold	1.59	1.56	2.48 ≤ 3.0

Conclusion: The EUT has to be limited for body supported applications in output power to P10. At P10 the output power is lower than the exemption limit, SAR measurement is NOT necessary.

The requirements are **FULFILLED**.

Remarks:

6.4 Exemption limits for routine evaluation - SAR evaluation (IC)

6.4.1 Applicable standard

According to RSS-102, item 2.5.1:

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance 4, 5

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤ 300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

4 The exemption limits in Table 1 are based on measurements and simulations of half-wave dipole antennas at separation distances of 5 mm to 25 mm from a flat phantom, providing a SAR value of approximately 0.4 W/kg for 1 g of tissue. For low frequencies (300 MHz to 835 MHz), the exemption limits are derived from a linear fit. For high frequencies (1900 MHz and above), the exemption limits are derived from a third order polynomial fit.

5 Transmitters operating between 0.003-10 MHz, meeting the exemption from routine SAR evaluation, shall demonstrate compliance to the instantaneous limits in Section 4.

6.4.2 Conclusions according RSS-102.

Separation	12 mm		
Output power, conducted	18.2 dBm	Antenna gain	2.4 dBi
Output power, ERP	18.5 dBm		

The application of the M300 is surveillance a patient by transmitting puls frequency, oxygen in blood or blood pressure every minute. The highest data rate is maximum 500 kBit, this means at the lowest transmission rate of 1 Mb/s a duty cycle of max 50%.

Duty cycle TX/RX	-3 dB	
Remaining average output power	15.5 dBm	35.5 mW
Exemption limit calculated for 12 mm	11.8 mW	

Maximum output power at 2450 MHz, **35.5 mW** is > 11.8 mW;

Conclusion: The Threshold level is much higher than the limit, SAR measurement would be necessary.

➡ The output power has to be reduced!

The OEM must adjust the highest output power to power level P10 (12 dBm) for body supported applications to satisfy RF Exposure SAR Test Exclusion limit at separation distance of 12 mm.

Remaining output power 10.7 dBm 11.7 mW

Maximum output power at 2450 MHz, **11.7 mW** is < 11.8 mW;

Conclusion: The EUT has to be limited for body supported applications in output power to P10. At P10 the output power is lower than the exemption limit, SAR measurement is NOT necessary.

The requirements are **FULFILLED**.

Remarks: The output power of the module has to be reduced for body worn applications.

7 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
CPC 3	FSW43	02-02/11-15-001	05/08/2016	05/08/2015		