RADIO TEST REPORT

No. 606445R1

EQUIPMENT UNDER TEST

Equipment:	Container Security Device	
Type / model:	CG-CSD03	
Manufacturer:	Low volume	High volume
	AB Distatic Gotlundagatan 2-4 Bandhagen S-124 71 Sweden	GE Security, Tualatin 12345 SW Leveton Drive Tualatin, OR 97062-6001 USA
Tested by request of:	GE CommerceGuard AB	

SUMMARY

The equipment complies with the requirements of the following standards:

FCC, Part 15, Subpart B (2005) and Subpart C (2005);
RSS-210, Issue 6 (September 2005); RSS-Gen, Issue 1 (September 2005).

Industry Canada listed test facility No. IC 3481

Date of issue: 2006-07-12

Tested by: Niklas Boström Approved by: Lars-Olov Johansson

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1. CLIENT INFORMATION

The EUT has been tested by request of

Company:	GE CommerceGuard AB
Name of contact:	Gustavslundsvägen 151A S-167 51 Bromma, Sweden Contact: Ola Myrin, Project Manager Telephone: +46 (709) 2221 85 E Mail: ola.myrin@allset.se

2. EQUIPMENT UNDER TEST (EUT)

2.1 Identification of the EUT according to the manufacturer/client declaration

Equipment:	Container Security Device
Type/Model:	CG-CSD03
Brand name:	CommerceGuard Container Security Device
Manufacturer (low volume):	AB Distatic Gotlundagatan 2-4 Bandhagen S-124 71 Sweden
Manufacturer (high volume):	GE Security, Tualatin 12345 SW Leveton Drive Tualatin, OR 97062-6001 USA
Rating/Supplying voltage:	3,6 V lithium battery
Rating RF output power:	4 dBm
Antenna gain:	0 dBi
External antenna connector:	No
Operating temperature range:	-20 to +70 °C
Frequency range:	2400 - 2483,5 MHz
Number of channels:	1 channel at 2440 MHz
Modulation characteristics:	OFDM
Stand by mode supported:	Yes

2.2 Additional hardware information about the EUT

The EUT consists of the following units:

Unit	Type and version information on label	Serial number on label	Used for
CG-CSD03	TST 10035/1P1ARev. 1	1000111	Radiated measurements
CG-CSD03	TST 10035/1P1ARev. 1	000361@1111	Conducted measurements

2.3 Additional software information about the EUT

During the tests the EUT supported the following software:

Software	Version	Comment
CDS_PCBTEST	R1A	Test software for regulatory testing

2.4 Peripheral equipment

Peripheral equipment is defined as equipment needed for correct operation of the EUT during the tests, but not included as a part of the testing and evaluation of the EUT.

Equipment	Manufacturer / Type	Serial number

No peripheral equipment needed

2.5 Modifications during the test

One unit was modified with an antenna connector (type SMA) for conducted measurements.

No other modifications have been made during the tests

3. TEST SPECIFICATIONS

3.1 Standards

FCC 47 CFR part 15 (2005) Subpart B – Unintentional radiators
FCC 47 CFR part 15 (2005) Subpart C – Intentional Radiators; §15.247 Operation within the bands 902-928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz.

Measurements methods according to ANSI C63.4-2003

RSS-210, Issue 6 (September 2005): Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment.

RSS-Gen, Issue 1 (September 2005): General Requirements and Information for the Certification of Radiocommunication Equipment.

3.2 Additions, deviations and exclusions from standards

No additions, deviations or exclusions have been made from standards.

3.3 Test set-up

Measurement set-ups for the test of conducted disturbance voltage in the frequency range 0,15-30 MHz and out-of-band spurious emissions test are described in corresponding sections. During other tests the EUT was connected to the spectrum analyser by cable.

3.4 Operating environment

If not additionally specified, the tests were performed under the following environmental conditions:

Air temperature:	20 - 26	°C
Relative humidity:	30 - 60	%

4. TEST SUMMARY

The results in this report apply only to the sample tested.

FCC reference	Industry Canada reference	Test	Result	Note
15.247(b)	A8.4(2)	Peak output power	PASS	1
15.247(a)	A8.1(1)	6 dB Bandwidth	PASS	1
15.247(a)	A8.1(2)	Carrier frequency separation	NA	1
15.247(a)	A8.1(4)	Number of hopping frequencies (channels)	NA	1
15.247(a)	A8.1(4)	Time of occupancy (dwell time)	NA	1
15.247	A8.1	Band edge compliance	PASS	1
15.247(e)	A8.2	Power spectral density	PASS	1
15.247(d)	2.7, A2.9(1), A8.5	Out of band spurious emissions, radiated	PASS	1
15.247(d)	2.7, A8.5	Out of band spurious emissions, conducted	PASS	1
15B	6 (a)(Table1)	Out of band spurious emissions, radiated	PASS	2
15B	7.2.2 (Table 2)	Conducted emission at AC port	NA	2

NA = Not Applicable

Notes:

1. Industry Canada reference: RSS-210, Issue 6 (September 2005)

2. Industry Canada reference: RSS-Gen, Issue 1 (September 2005)

5. PEAK OUTPUT POWER

5.1 Test protocol

Date of test: 2006-06-22

EUT mode of operation: TX

The peak output power was measured at the antenna port on the unit modified with an SMA-connector.

Spectrum analyzer settings:

Span: 25 MHz
RBW: 3 MHz
VBW: 3 MHz
Sweep time: Auto
Detector: Peak
Trace: Max Hold

Channel (MHz)	Peak Output Power (dBm)	Limit value (dBm)
2440	4,0	< 30

Measurement results are corrected for attenuations in the set-up.

Example calculation:

Peak output power [dBm] = Analyser reading [dBm] + cable loss [dB] + attenuator loss [dB]

5.2 MPE calculations

Directives

OET Bulletin 65, supplement C
RSS 102 (Issue 2), November 2005

Calculations

EIRP = Peak Power to the Antenna port [dBm] + Maximum Antenna gain [dBi]

EIRP = 4,0 dBm + 0 dBi = - 4 dBm = 2,5 mW

The product has a duty cycle (dc) of less than 40 % according to the manufacturer. The manual recommends that the operator is not closer than (r) 20 cm to the transmitter's antenna.

A worst case calculation is as follows:

$$S = \frac{4 \times dc \times EIRP}{4 \times \pi \times r^2}$$ (Power density with 100 % reflection)

S = 4 x 0,4 x 2,5 / (4 x π x 20^2) = 0,0008 mW/cm^2

Reference level limit according to OET Bulletin 65, supplement C and RSS 102 for power density at 2400 MHz is 1 mW/cm^2.

Considering the calculations above it is determined that the requirements according to the referred directive are fulfilled without further testing.

6. 6 dB BANDWIDTH

6.1 Test protocol

Date of test: 2006-06-21

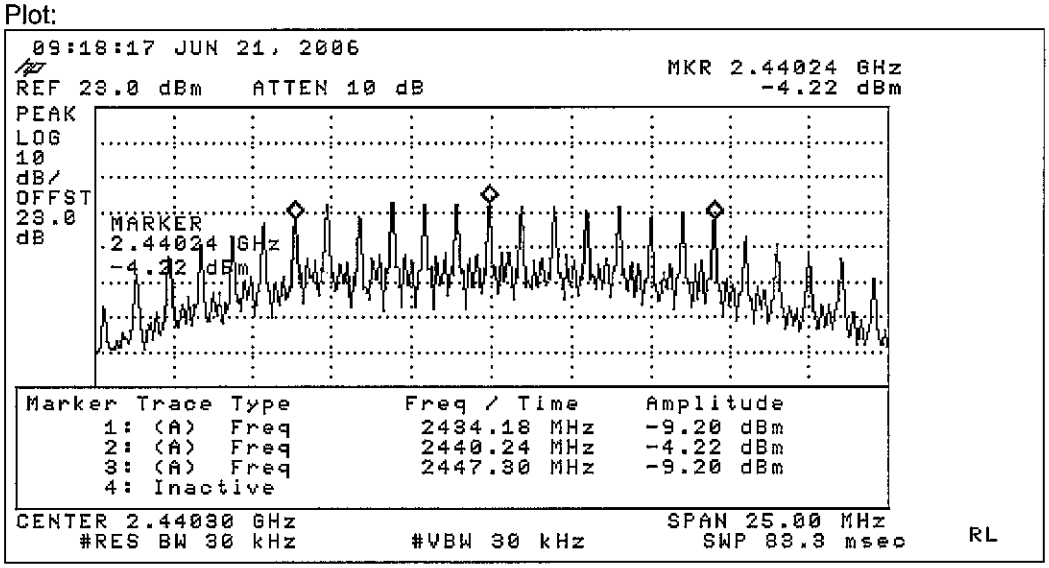
EUT mode of operation: TX.

The 6dB bandwidth was measured at the antenna port on the unit modified with an SMA-connector.

Spectrum analyzer settings:

Span: 25 MHz
RBW: 30 kHz
VBW: 30 kHz
Sweep time: Auto
Detector: Peak
Trace: Max Hold

Plot:



Channel (MHz)	6 dB Bandwidth (MHz)	Limit value (MHz)
2440	13,1	> 0,5

7. BAND EDGE COMPLIANCE (CONDUCTED MEASUREMENT)

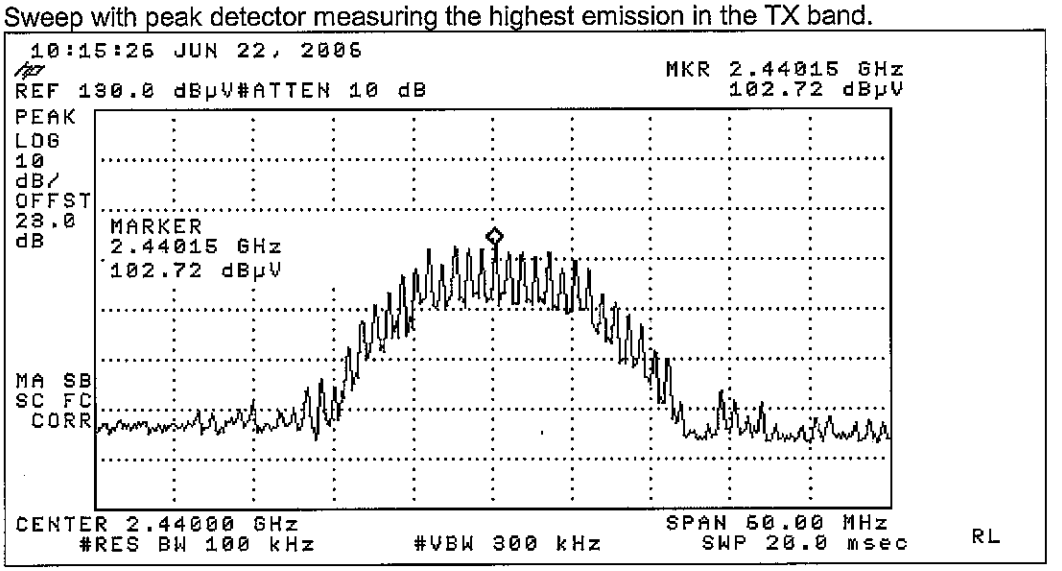
7.1 Test protocol

Date of test: 2006-06-22

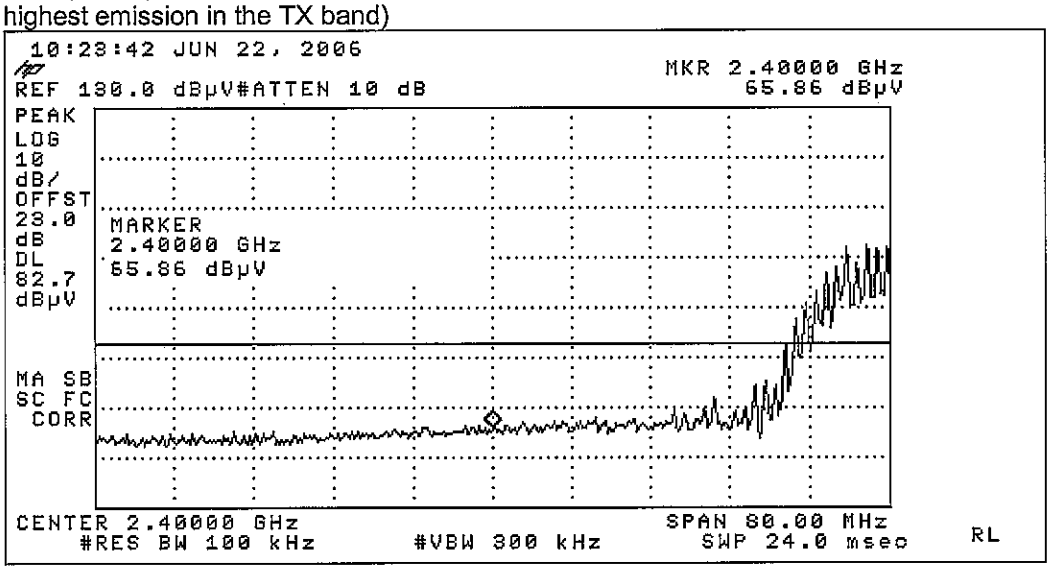
EUT mode of operation: TX.

The band edge compliance was measured at the antenna port on the unit modified with an SMA-connector.

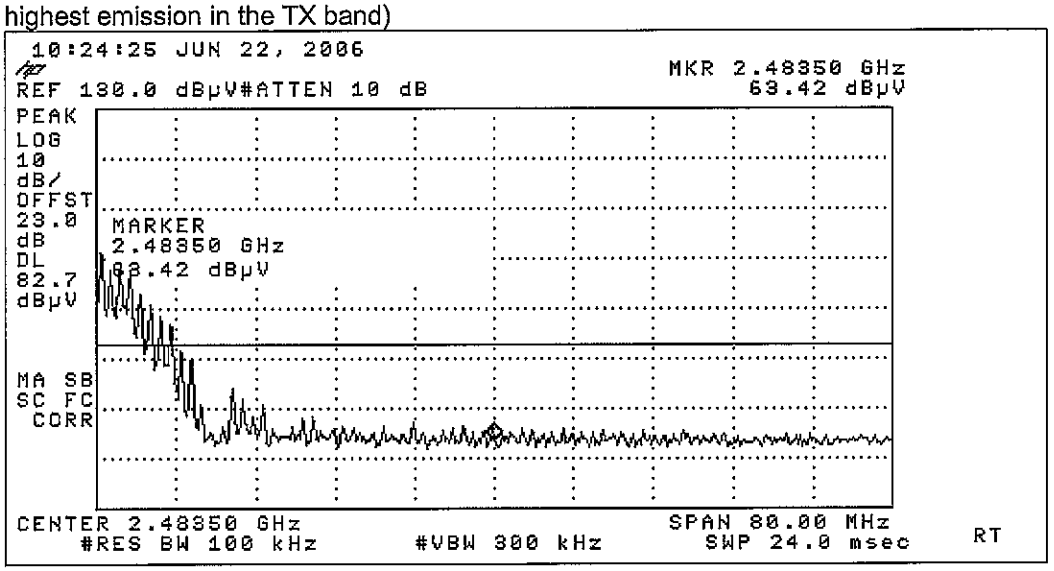
Sweep with peak detector measuring the highest emission in the TX band.



Sweep with peak detector measuring emissions below the TX band (limit line is 20dB below the highest emission in the TX band)



Sweep with peak detector measuring emissions above the TX band (limit line is 20dB below the highest emission in the TX band)



The measurements of radiated spurious emission (section 9) showed that the highest emission in the restricted band 2310-2390 MHz was well below the requirements in 476CFR §15.209.

8. POWER SPECTRAL DENSITY

8.1 Test protocol

Date of test: 2006-06-21

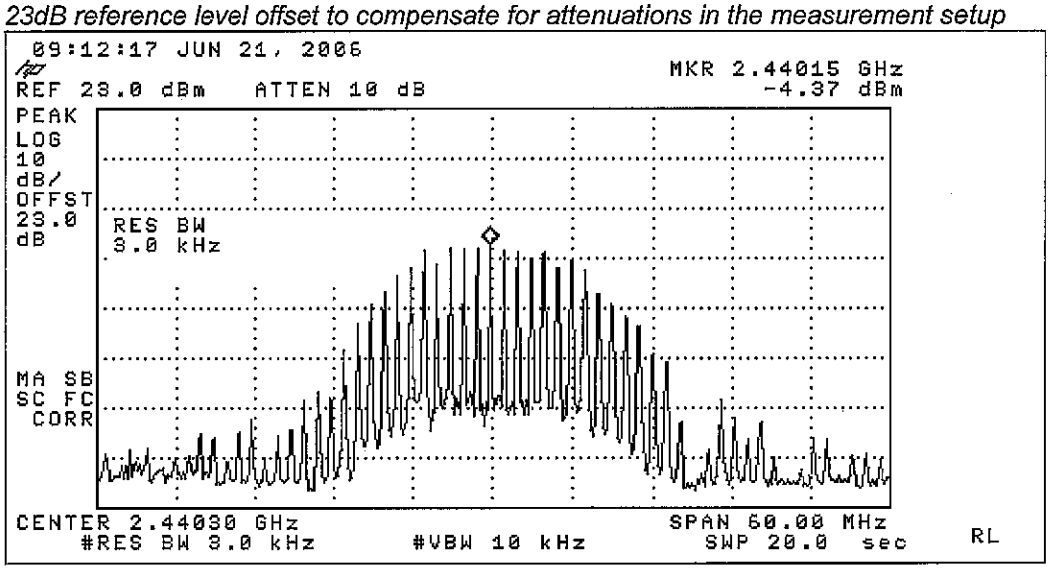
EUT mode of operation: TX.

The power spectral density was measured at the antenna port on the unit modified with an SMA-connector.

Spectrum analyzer settings:

Span: 60 MHz
RBW: 3 kHz
VBW: 10 kHz
Sweep time: Auto
Detector: Peak
Trace: Max Hold

Plot
23dB reference level offset to compensate for attenuations in the measurement setup



Channel (MHz)	Peak Power Spectral Density (dBm)	Limit value (dBm)
2440	-4,4	< 8

Measurement results are corrected for attenuations in the set-up configuration.

Example calculation:

Peak output power [dBm] = Analyser reading [dBm] + cable loss [dB] + attenuator loss [dB]

9. RADIATED SPURIOUS EMISSIONS

9.1 Measurement uncertainty

Radiated disturbance electric field intensity, 30 – 1000 MHz: ± 4,6 dB
Radiated disturbance electric field intensity, 1000 – 18000 MHz: ± 6,0 dB

The measurement uncertainty describes the overall uncertainty of the given measured value during operation of the EUT.

Measurement uncertainty is calculated in accordance with EA-4/02-1997.
The measurement uncertainty is given with a confidence of 95%.

9.2 Test equipment

Equipment	Manufacturer	Type	SEMKO No.
Test site: Semi-anechoic shielded chamber, 10 x 20 x 8,5 m (W x L x H)			30300
Software:	Rohde & Schwarz	ES-K1, V1.71	
Measurement receiver:	Rohde & Schwarz	ESAI	2973/2974
Antenna amplifier:	SEMKO		7992/7993
Antenna, bilog:	Chase	CBL6111A	971
Test site: Bluetooth anechoic shielded chamber, 3,7 x 7,0 x 2,4 m (W x L x H)			12285
Software:	Rohde & Schwarz	ES-K1, V1.70	
Signal analyser:	Rohde & Schwarz	FSIQ 40	40023
Preamplifier:	MITEQ	AFS6/AFS44	12335
Antennas:			
Double Ridge Guide Horn:	EMCO	3115	4936
Horn antenna:	EMCO	3160-08	30099
Horn antenna:	EMCO	3160-09	30101
Band rejection filter	K & L	6N45-2450/T 100-0/0	12389
Transformer	Tufvassons	AFM-1500	30317

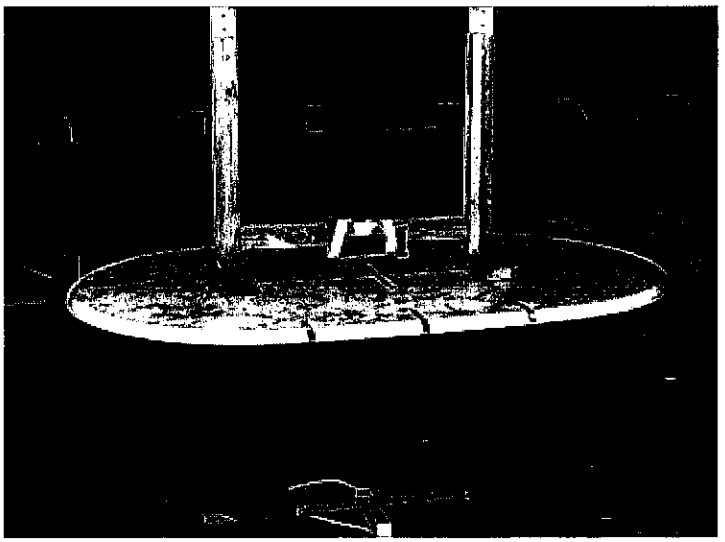
9.3 Measurement set-up
Test site: Semi-anechoic shielded chamber (30 – 1000 MHz)

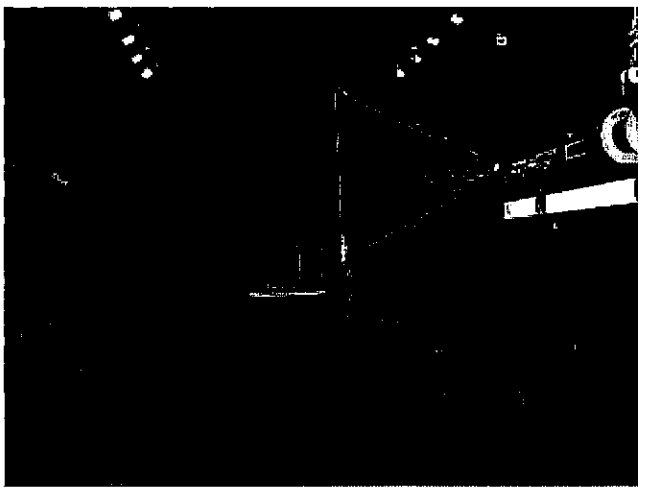
The radiated disturbance electric field intensity was measured in a semi-anechoic chamber at a distance of 10 m and the EUT was placed on a non-metallic table, 0,8 m above the reference ground plane. The specified test mode was enabled. Test set-up photos are given below.

An overview sweep with peak detection of the electric field intensity was performed with the measurement receiver in max-hold and with the antenna placed 1,5 m, 2,5 m and 3,5 m above the floor. The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 90-degree steps.

At the frequencies where high disturbance levels were found a search for max disturbance level was performed. With the EUT and antenna in the worst-case configuration new measurements with quasi-peak detector were carried out.

Test set-up photos:





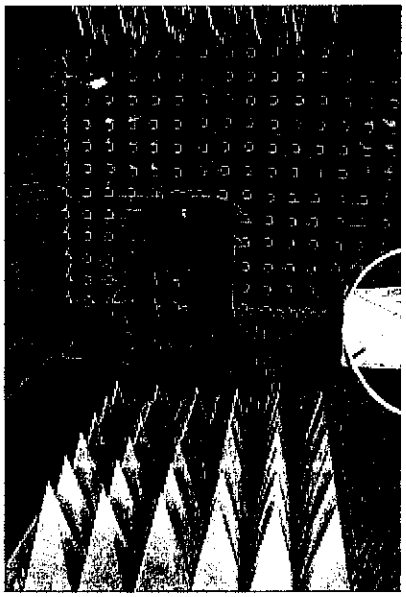
Test site: Bluetooth anechoic shielded chamber (1 – 26 GHz)

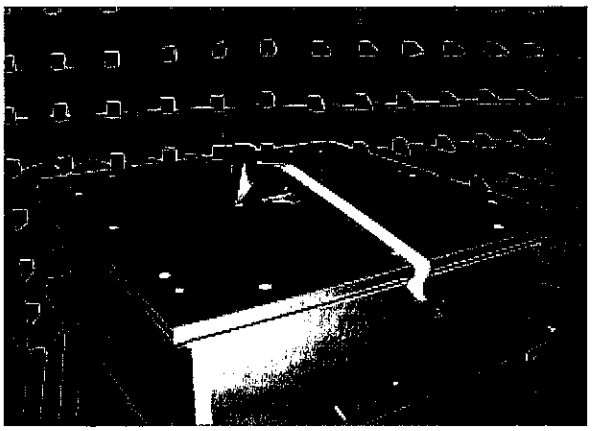
In the Bluetooth anechoic chamber the EUT was placed on a non-metallic table, 1,4 m above the floor. The radiated disturbance electric field intensity was measured at a distance of 3 m. The specified test mode was enabled.

An overview sweep with peak detection of the electric field intensity was performed with the spectrum analyser in max-hold and with the antenna height adjusted at the level of the EUT center (placed 1,4 m above the floor). The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 90-degree steps.

At the frequencies where high disturbance levels were found a search for max disturbance level was performed. With the EUT and antenna in the worst-case configuration new measurements with peak and average detectors were carried out.

Test set-up photos:



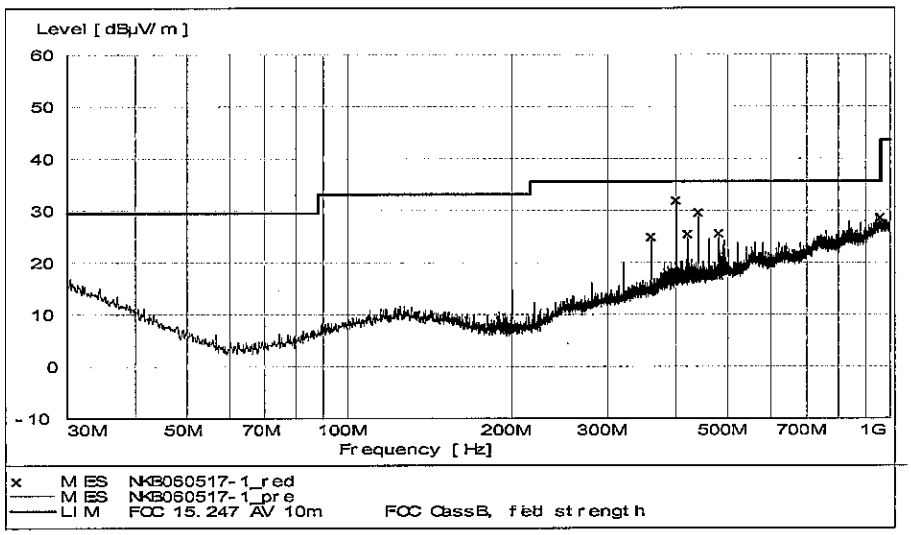


9.4 Test protocol

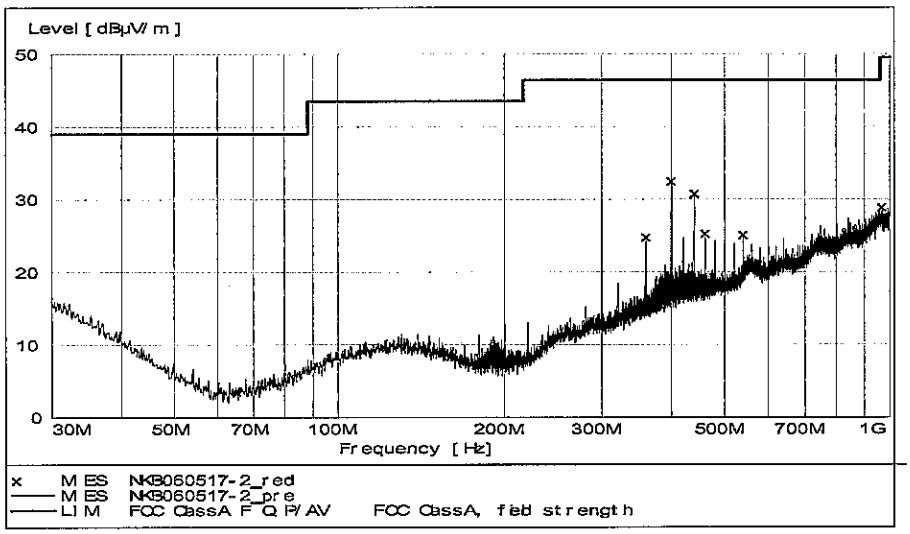
Semi-anechoic shielded chamber

Date of test: 2006-05-17

30 – 1000 MHz, max peak at a distance of 10 m in TX mode



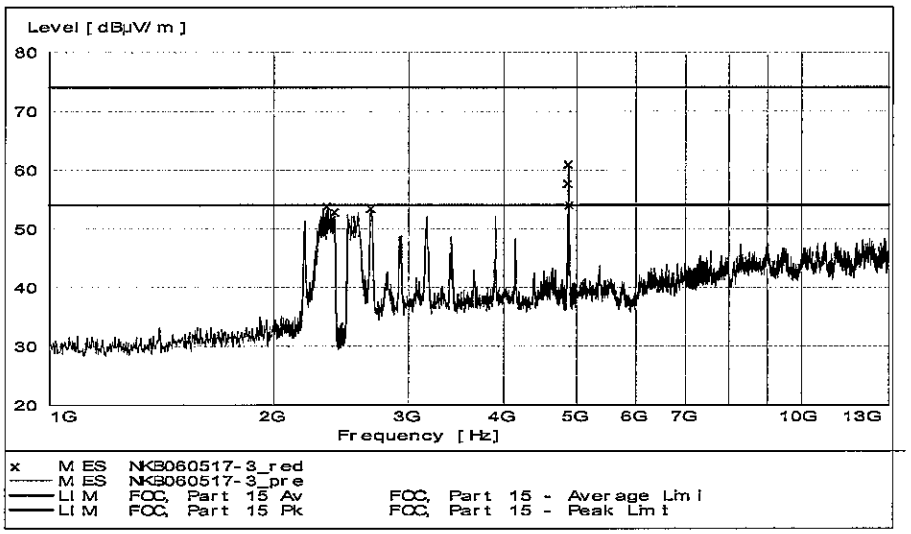
30 – 1000 MHz, max peak at a distance of 10 m in RX mode



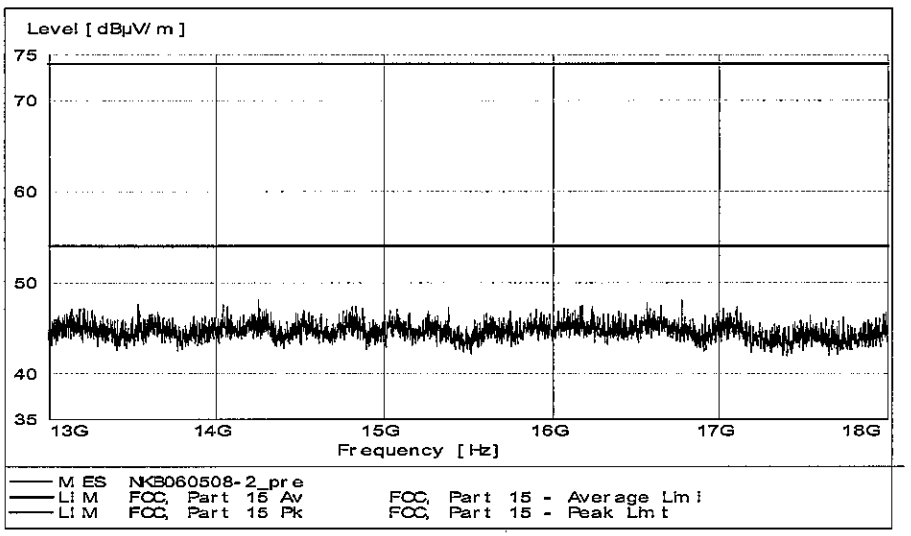
Bluetooth anechoic shielded chamber

Date of test: 2006-05-18

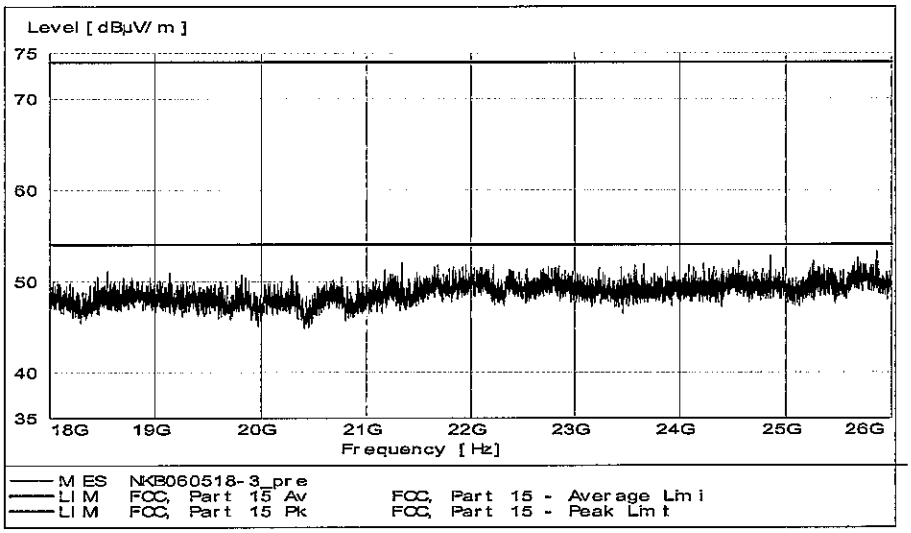
1000 – 13000 MHz, max peak at a distance of 3 m in TX mode
Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0



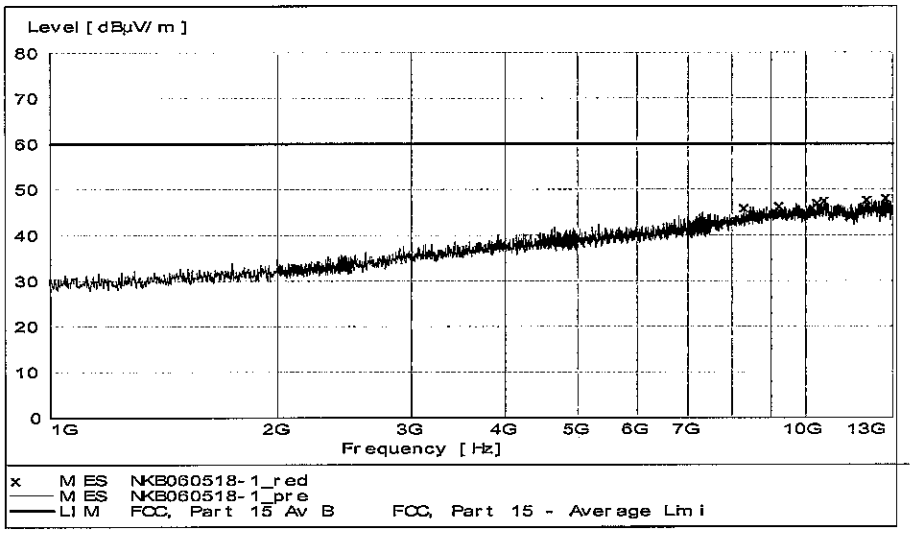
13 – 18 GHz, max peak at a distance of 3 m in TX mode



18 – 26 GHz, max peak at a distance of 3 m in TX mode



1000 – 13000 MHz, max peak at a distance of 3 m in the RX mode



Data summary (TX mode)

Field strength of spurious emissions						
Frequency	RBW	Measured level		Limit		Note
		Peak	QP/AV	Peak	QP/AV	
[MHz]	[kHz]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	
30 – 88	120	< 20	-	-	29,5	10 m distance, noise floor
88 – 216	120	< 20	-	-	33	10 m distance, noise floor
400,9	120	35,2	-	-	35,6	10 m distance
960 – 1000	120	< 30	-	-	43,5	10 m distance, noise floor
2349,5	1000	55,9	32,7*	74	54	3 m distance, highest emission near band edge
2678,4	1000	56,0	38,6*	74	54	3 m distance
3903,8	1000	53,4	41,7*	74	54	3 m distance
4152,8	1000	49,4	46,3*	74	54	3 m distance
4881,0	1000	62,2	47,6*	74	54	3 m distance
13000 – 18000	1000	< 48	-	74	54	3 m distance, noise floor
18000 – 26000	1000	< 52	-	74	54	3 m distance, noise floor

* Theses average readings have been corrected with the dutycycle correction factor of -8.2dB (see calculations in section 9.5)

Data summary (RX mode)

Field strength of spurious emissions						
Frequency	RBW	Measured level		Limit*		Note
		Peak	QP/AV	Peak	QP/AV	
[MHz]	[kHz]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	
30 – 88	120	< 20	-	-	39,1	10 m distance, noise floor
88 – 216	120	< 20	-	-	43,5	10 m distance, noise floor
400,9	120	34,1	-	-	46,4	10 m distance
960 – 1000	120	< 30	-	-	49,5	10 m distance, noise floor
1000 – 13000	1000	< 49		80	60	3 m distance, noise floor

* The limit is for Class A equipment.

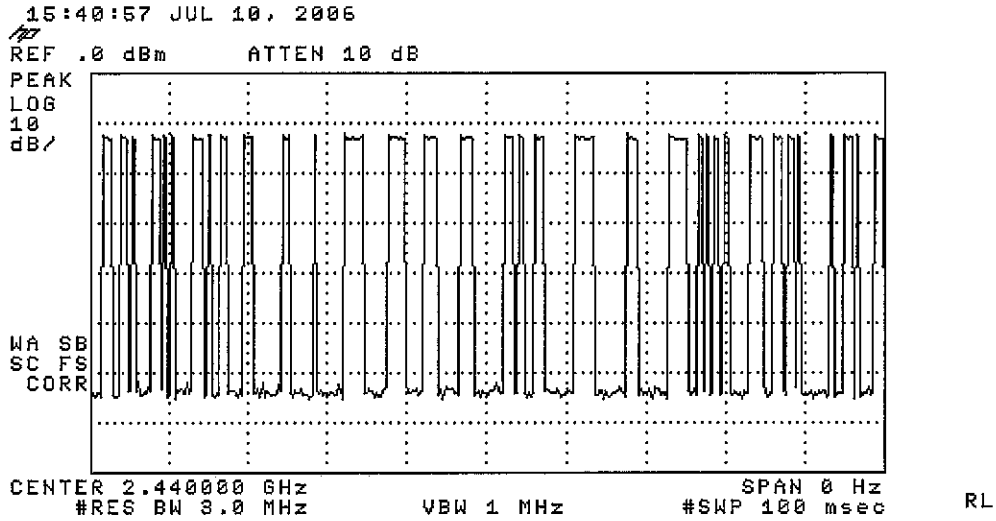
The limit at 10 m test distance was calculated using an inverse linear extrapolation factor 20 dB/decade.

Example calculation:

Measured level [dBµV/m] = Analyser reading [dBµV] + cable loss [dB] – preamplifier gain [dB] + antenna factor [1/m]

9.5 Duty cycle calculations

The EUT antenna output port was connected to the input of the spectrum analyzer. The analyzer center frequency was set to EUT RF channel carrier. The SWEEP function on the analyzer was set to ZERO SPAN. The transmitter ON time was determined from the resultant time-amplitude display:



Counting the ON and OFF samples in this sweep gives a 39,15 % duty cycle.

This gives a correction factor of 20 * $\log_{10}$ (0,3915) dB = - 8,2 dB

10. CONDUCTED SPURIOUS EMISSIONS AT ANTENNA PORT

10.1 Measurement uncertainty

Measurement uncertainty for conducted disturbances at the antenna port: ± 3,6 dB

The measurement uncertainty describes the overall uncertainty of the given measured value during operation of the EUT. Measurement uncertainty is calculated in accordance with EA-4/02-1997. The uncertainty is given with a level of confidence of approximately 95% (k=2).

10.2 Test protocol

Date of test: 2006-07-10

Strength of conducted spurious emissions				
Frequency [MHz]	RBW [kHz]	Measured peak level [dBm]	Limit* [dBm}	Note
30 - 500	100	< - 75	-38,4	
500 - 1000	100	< - 80	-38,4	
1000 - 2000	100	< - 76	-38,4	
2000 - 2400	100	< - 55	-38,4	
2483,5 - 2700	100	< - 56	-38,4	
2700 - 5000	100	< - 53	-38,4	
5000 - 10000	100	< - 73	-38,4	Noise floor
10000 - 15000	100	< - 71	-38,4	Noise floor
15000 - 20000	100	< - 66	-38,4	Noise floor
20000 - 25000	100	< - 65	-38,4	Noise floor

* Measured level of emission in the operating frequency band is equal to -18,4 dBm.

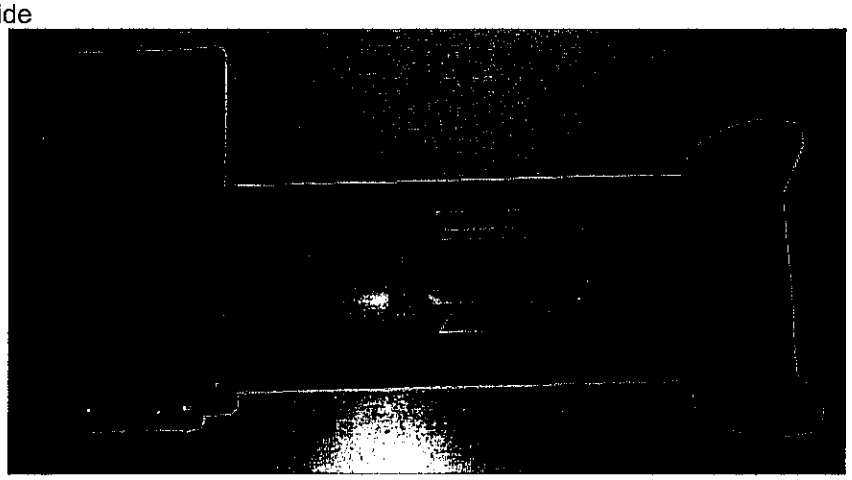
Limit: In any 100 kHz bandwidth outside the operating frequency band (2400 – 2483,5 MHz), the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

Example calculation:

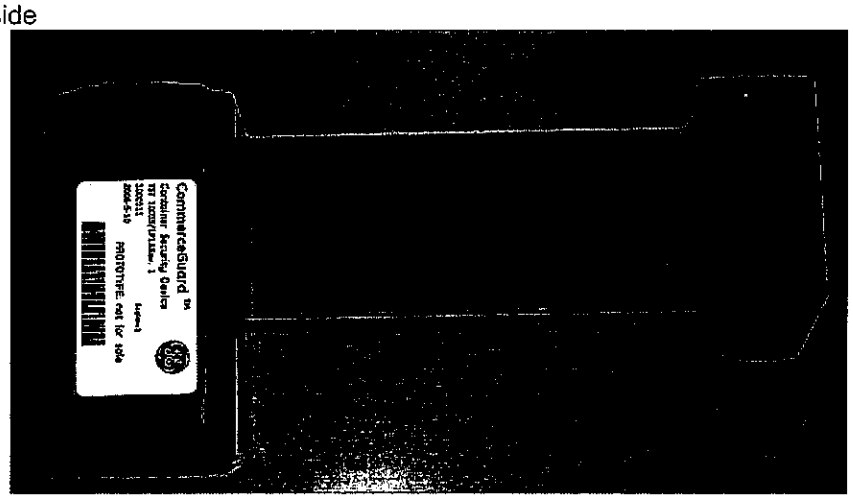
Measured level [dBm] = Analyser reading [dBm]

APPENDIX I – PHOTOS OF THE EUT

EUT, front side

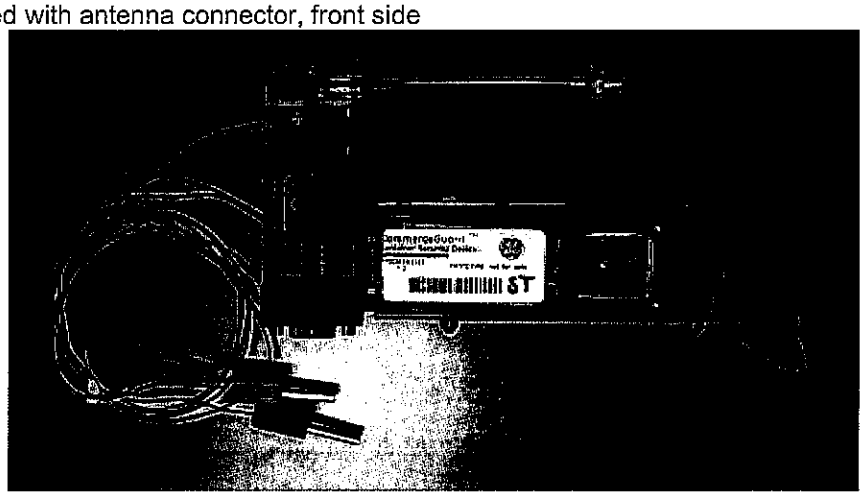


EUT, back side

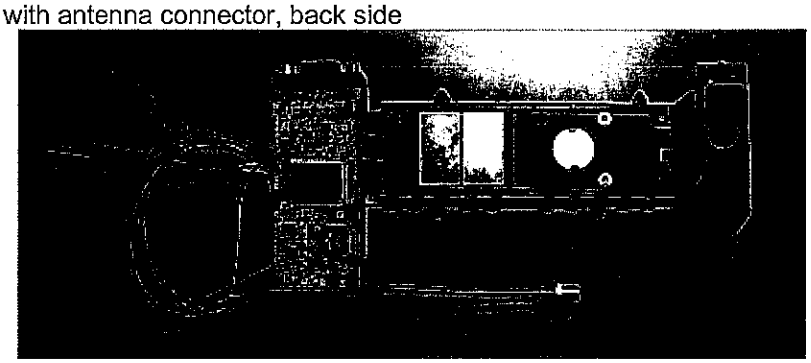


EUT, identification photo

Unit modified with antenna connector, front side



Unit modified with antenna connector, back side



Unit modified with antenna connector, identification label