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# Test Report

Report Number: F102732E1

Applicant:

**7 layers AG**

Manufacturer:

**DATALOGIC MOBILE SRL**

Equipment under Test (EUT):

**ELF 701-902**

Laboratory (CAB) accredited by  
Deutsche Gesellschaft für Akkreditierung mbH  
in compliance with DIN EN ISO/IEC 17025  
under the Reg. No. DGA-PL-105/99-22,  
FCC Test site registration number 90877



## REFERENCES

- [1] **ANSI C63.4-2009** American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- [2] **FCC CFR 47 Part 15 (October 2009)** Radio Frequency Devices
- [3] **FCC Public Notice DA 00-705 (March 2000)**
- [4] **Publication Number 913591 (March 2007)** Measurement of radiated emissions at the edge of the band for a Part 15 RF Device

## TEST RESULT

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test.

The complete test results are presented in the following.

Test engineer:	Thomas KÜHN		29 October 2010
	_____ Name	_____ Signature	_____ Date
Authorized reviewer:	Bernd STEINER		29 October 2010
	_____ Name	_____ Signature	_____ Date

## RESERVATION

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The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalisations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

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# 1 IDENTIFICATION

## 1.1 Applicant

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Fax:	+49 21 02 749 - 350
eMail Address:	holger.leutfeld@7layers.de
Applicant represented during the test by the following person:	-

## 1.2 Manufacturer

Name:	DATALOGIC MOBILE SRL
Address:	Via S. Vitalino n. 13 Lippo di Calderara di Reno 40012- Bologna
Country:	Italy
Name for contact purposes:	Davide E. Vaccaneo
Phone:	+39 051 314 72 16
Fax:	+39 051 314 75 61
eMail Address:	davide.vaccaneo@datalogic.com
Applicant represented during the test by the following person:	-

## 1.3 Test laboratory

The tests were carried out at: **PHOENIX TESTLAB GmbH**  
**Königswinkel 10**  
**32825 Blomberg**  
**Germany**

accredited by DGA Deutsche Gesellschaft für Akkreditierung mbH in compliance with  
DIN EN ISO/IEC 17025 under Reg. No. DGA-PL-105/99-22, FCC Test site registration number  
90877.

## 1.4 EUT (Equipment Under Test)

Test object: *	ELF
Type: *	Mobile Computer
FCC ID: *	U4G-004W
Serial number: *	D10P00128
Hardware version: *	1.0
Software version: *	1.40

\*: Declared by the applicant

## 1.5 Technical data of equipment

Antenna type: *	Internal
Antenna gain: *	0.5 dBi
Type of modulation: *	OFDM, 2GFSK, 4GFSK, DBPSK, DQPSK (for a,b,g mode)
Operating frequency range: *	5.150 GHz to 5.350 GHz 5.470 GHz to 5.725 GHz 5.725 GHz to 5.850 GHz
Number of channels: *	8 (5.150 GHz to 5.350 GHz) 11 (5.470 GHz to 5.725 GHz) 5 (5.725 GHz to 5.850 GHz)

\*: Declared by the applicant

**The following external I/O cables were used:**

Identification	Connector		Length *
	EUT	Ancillary	
Power supply (for back up the internal battery)	Mini USB	-	2.0 m
-	-	-	-
-	-	-	-
-	-	-	-

\*: Length during the test if no other specified.

## 1.6 Dates

Date of receipt of test sample:	08 September 2010
Start of test:	22 September 2010
End of test:	22 September 2010

## 2 OPERATIONAL STATES

The EUT is a mobile computer with an integrated WLAN module. The tested sample was equipped with a temporary SMA antenna connector.

During all tests the EUT was powered by the internal battery, which was buffered by an external power supply type PSM08R-050.

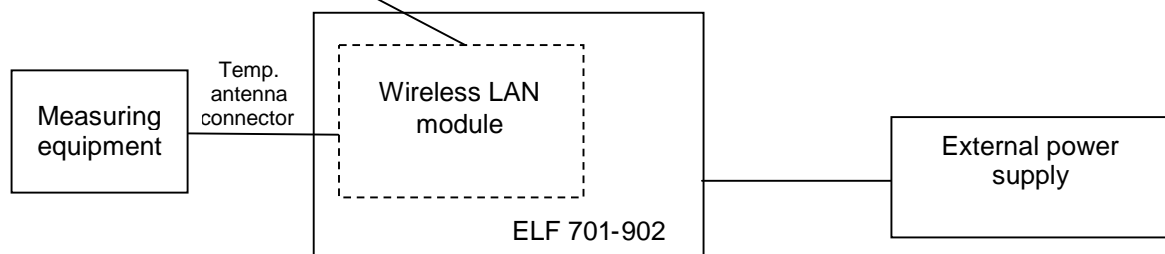
The operation mode was adjusted with the help of a configuration-software on the EUT. With this software the used RF channel and the data rate could be chosen.

The EUT contains also a 2.4 GHz WLAN and a GSM-module. Object of this test report is the 5.8 GHz WLAN, which falls into the requirements of FCC 47 CFR Part 15 section C. The results of the measurements of the 5.2 GHz WLAN and the 5.6 GHz WLAN (FCC 47 CFR Part 15 section E) will be documented in a separate test report.

The following operation modes were used during the tests:

Operation mode	Description of the operation mode
1	Continuous transmitting on 5745 MHz, with all applicable data rates
2	Continuous transmitting on 5785 MHz, with all applicable data rates
3	Continuous transmitting on 5825 MHz, with all applicable data rates

Physical boundary of the EUT



Preliminary tests were performed in different data rates to find worst-case configuration. The data rate shown in the table below shows the found worst-case rate with respect to specific test item. The following table shows a list of the test modes used for the worst-case results, documented in this report.

The following test modes were adjusted during the tests:

Test item	Operation mode
6 dB bandwidth	1 – 3 with 9 Mbps
Maximum peak output power	1 – 3 with 9 Mbps
Power spectral density	1 – 3 with 9 Mbps
Band edge compliance (conducted)	1 – 3 with 9 Mbps
Conducted emissions (transmitter)	1 – 3 with 9 Mbps

### 3 ADDITIONAL INFORMATION

None

### 4 OVERVIEW

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section	Status	Refer page
6 dB bandwidth	General	15.247 (a) (2)	Passed	8 et seq.
Maximum peak output power	5745 - 5825	15.247 (b) (3), (4)	Passed	11 et seq.
Power spectral density	5745 - 5825	15.247 (e)	Passed	12 et seq.
Band edge compliance	5745 - 5825	15.247 (d)	Passed	15 et seq.
Conducted emissions (transmitter)	0.009 – 40,000	15.205 (a) 15.209 (a)	Passed	17 et seq.
Radiated emissions (transmitter)	30 – 40,000	15.205 (a) 15.209 (a)	Not ordered by the applicant	-
Conducted emissions on supply line	0.15 – 30	15.207 (a)	Not ordered by the applicant	-

## 5 TEST RESULTS

### 5.1 6 dB bandwidth

#### 5.1.1 Method of measurement (6 dB bandwidth)

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed. The EUT has to be switched on, the transmitter shall work with its worst-case data rate.

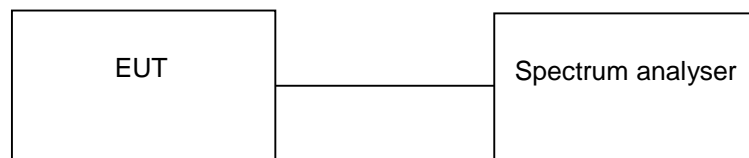
The following spectrum analyser settings shall be used:

- Span: App. 2 to 3 times the 6 dB bandwidth, centred on the actual channel.
- Resolution bandwidth: 100 kHz.
- Video bandwidth: 100 kHz.
- Sweep: Auto.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 6 dB below the first line (or the peak marker). The frequency lines shall be set on the intersection points between the second display line and the measured curve.

The measurement will be performed at the upper, the lower end and the middle of the assigned frequency band.

Test set-up:

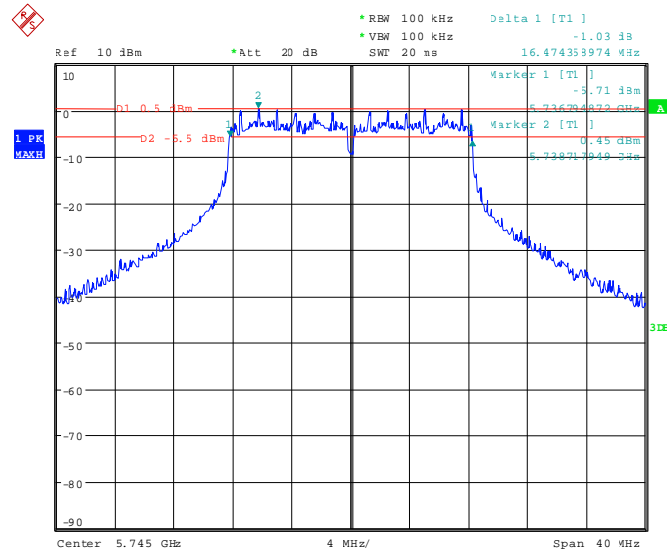




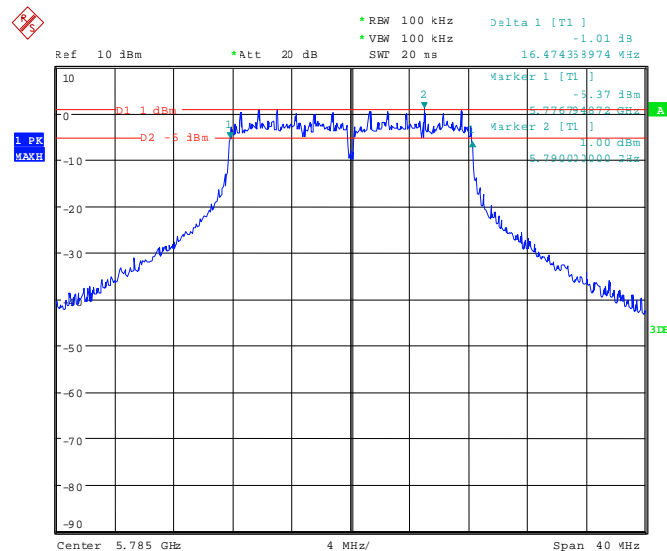
### 5.1.2 Test results (6 dB bandwidth)

Ambient temperature	20 °C	Relative humidity	52 %
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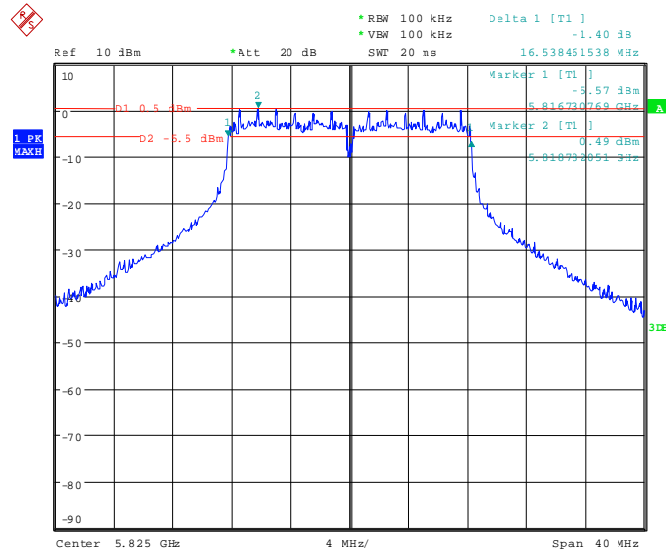
102732\_001.wmf: 6 dB bandwidth at the lower end of the assigned frequency band, 9 Mbps:



102732\_002.wmf: 6 dB bandwidth at the middle of the assigned frequency band, 9 Mbps:



102732\_003.wmf: 6 dB bandwidth at the upper end of the assigned frequency band, 9 Mbps:



Operation mode 1 to 3 with 9 Mbps data rate (worst-case)		
Channel number	Channel frequency [MHz]	6dB bandwidth [MHz]
149	5745	16.474359
157	5785	16.474359
165	5825	16.538461
Measurement uncertainty		$< \pm 1 \cdot 10^{-7}$

TEST EQUIPMENT USED FOR THE TEST:

30

## 5.2 Maximum peak output power

### 5.2.1 Method of measurement (maximum peak output power)

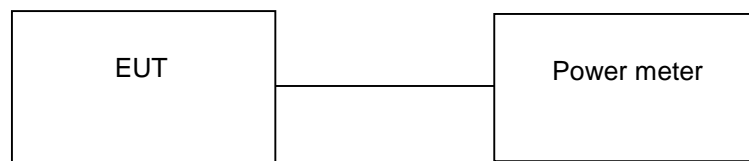
The calibration of the power meter has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the power meter via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed. The EUT has to be switched on.

The following power meter settings shall be used:

- Filter No. auto.
- Measuring time 0.136 s to 26 s.
- Used peak sensor NRV –Z32.

The measurement will be performed at the upper and lower end and the middle of the assigned frequency band.

Test set-up:



### 5.2.2 Test results (maximum peak output power)

Ambient temperature	20 °C	Relative humidity	52 %
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Operation mode 1 to 3 with 9 Mbps data rate (worst case)				
Channel number	Channel frequency [MHz]	Maximum peak output power [dBm]	Antenna gain [dBi]	Peak power limit [dBm]
149	5745	18.9	0.5	30.0
157	5785	18.7	0.5	30.0
165	5825	18.8	0.5	30.0
Measurement uncertainty			+0.66 dB / -0.72 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
132, 133

## 5.3 Power spectral density

### 5.3.1 Method of measurement (power spectral density)

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed.

The following spectrum analyser settings shall be used:

- Span: 1.5 MHz, centred on the maximum signal peak.
- Resolution bandwidth: 3 kHz.
- Video bandwidth: 30 kHz.
- Sweep: 500 s.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. The indicated level is the power spectral density.

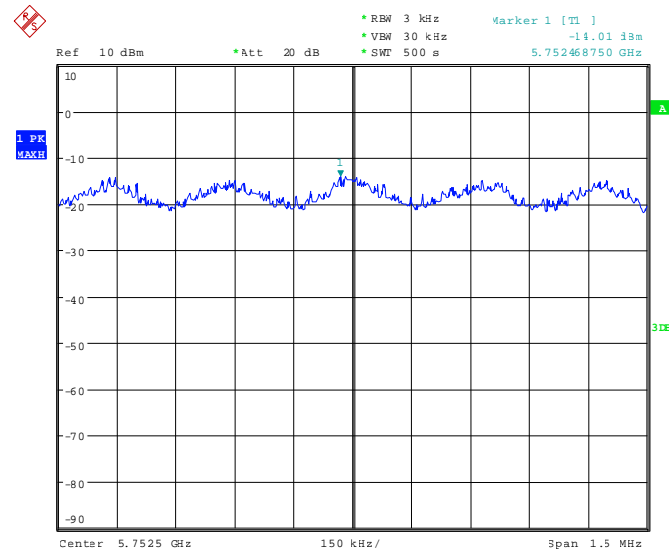
Test set-up:



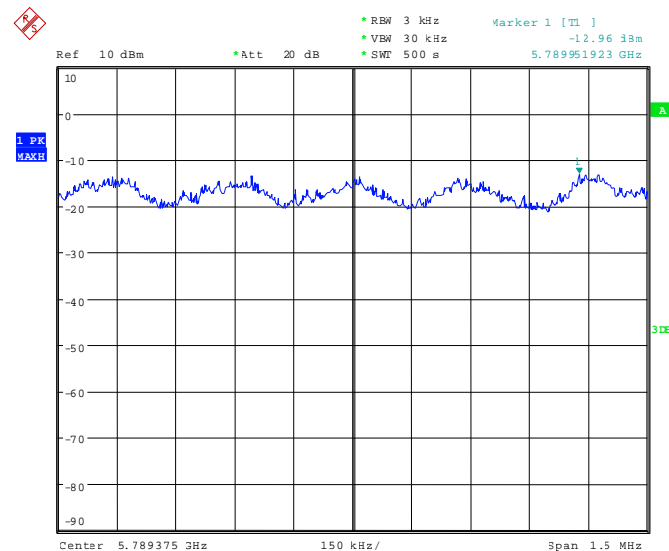
### 5.3.2 Test results (power spectral density)

Ambient temperature	20 °C	Relative humidity	52 %
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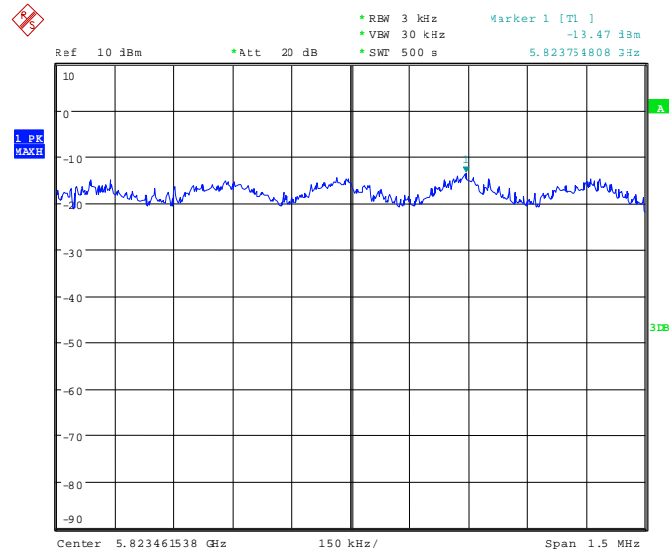
102732\_006.wmf: Power spectral density at the lower end of the assigned frequency band, 9 Mbps:



102732\_005.wmf: Power spectral density at the middle of the assigned frequency band, 9 Mbps:



102732\_004.wmf: Power spectral density at the upper end of the assigned frequency band, 9 Mbps:



Operation mode 1 to 3 with 9 Mbps data rate (worst case)				
Channel number	Channel frequency [MHz]	Power spectral density [dBm / 3 kHz]	Antenna gain [dBi]	Power spectral density limit [dBm / 3 kHz]
149	5745	-12.5	0.5	8.0
157	5785	-11.5	0.5	8.0
165	5825	-12.0	0.5	8.0
Measurement uncertainty			+1.1 dB / -1.5 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

30

## 5.4 Band edge compliance

### 5.4.1 Method of measurement (band edge compliance)

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator.

The following spectrum analyser settings shall be used:

- Span: Wide enough to capture the peak level of the emission on the channel closest to the band-edge, as well as any modulation products, which fall outside the assigned frequency band.
- Resolution bandwidth: 100 kHz.
- Video bandwidth:  $\geq$  the resolution bandwidth.
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 20 dB below the first line (or the peak marker). The frequency line shall be set on the edge of the assigned frequency band. Set the second marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is higher than that at the band-edge. This frequency shall be measured with the EMI receiver with a 100 kHz resolution bandwidth.

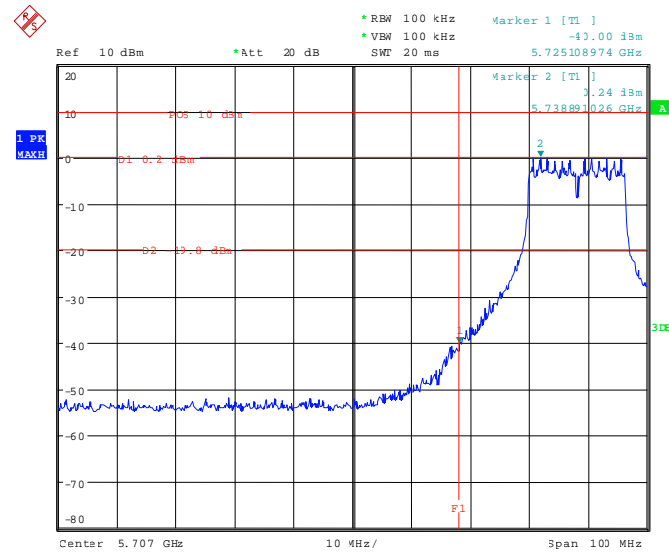
The measurement will be performed at the upper end of the assigned frequency band.

The plots at the next pages are showing radiated band-edge compliance with the worst case operation mode. The display line 1 (D1) in these plots represents the highest level within the assigned frequency band. The display line 2 (D2) represents the 20 dB offset to this highest level and shows the compliance with FCC 47 CFR Part 15.247 (d). The frequency line 1 (F1) shows the edge of the assigned frequency.

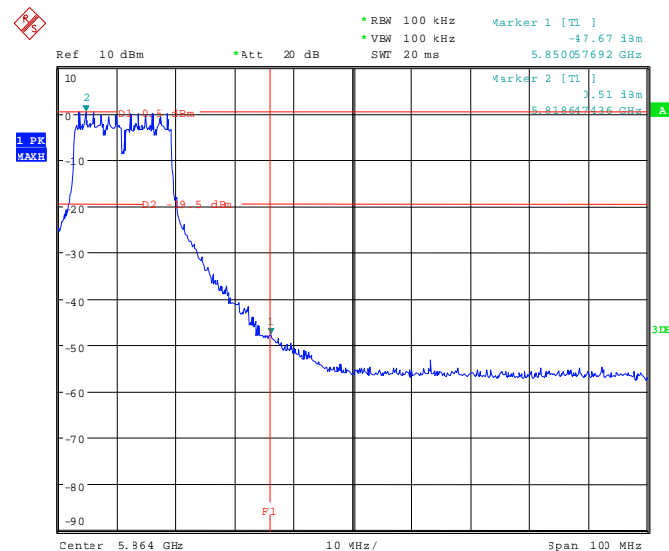
## 5.4.2 Test results (band edge compliance)

Ambient temperature	20 °C	Relative humidity	52 %
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102732\_007.wmf: Conducted band-edge compliance, lower band edge, 9 Mbps:



102732\_008.wmf: Conducted band-edge compliance, upper band edge, 9 Mbps:



The emissions at the band edge are attenuated at least by 39.8 dB.

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
30



## 5.5 Conducted emissions

### 5.5.1 Method of measurement (conducted emissions)

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed.

The following spectrum analyser settings shall be used:

Spectrum analyser setting for preliminary conducted emission test:

Frequency range	Resolution bandwidth	Video bandwidth	Sweep time	Detector	Trace mode
9 kHz to 150 kHz	200 Hz	200 Hz	Auto	Peak	Max hold
150 kHz to 30 MHz	10 kHz	10 kHz	Auto	Peak	Max hold
30 MHz to 1 GHz	100 kHz	100 kHz	Auto	Peak	Max hold
1 GHz to 40 GHz	1 MHz	1 MHz	Auto	Peak	Max hold

After trace stabilisation the marker shall be set on the signal peak. The correct frequency of the emission should be measured. On the found emission a final measurement with the settings as stated below should be carried out.

EMI receiver setting for final conducted emission test:

Frequency range	Resolution bandwidth	Sweep time	Detector
9 kHz to 90 kHz	200 Hz	Auto	Average
90 kHz to 110 kHz	200 Hz	Auto	Quasi Peak
110 kHz to 490 kHz	200 Hz (below 150 kHz) 10 kHz (above 150 kHz)	Auto	Average
490 kHz to 30 MHz	10 kHz	Auto	Quasi Peak
30 MHz to 1 GHz	100 kHz	Auto	Quasi Peak
1 GHz to 40 GHz	1 MHz	Auto	Average

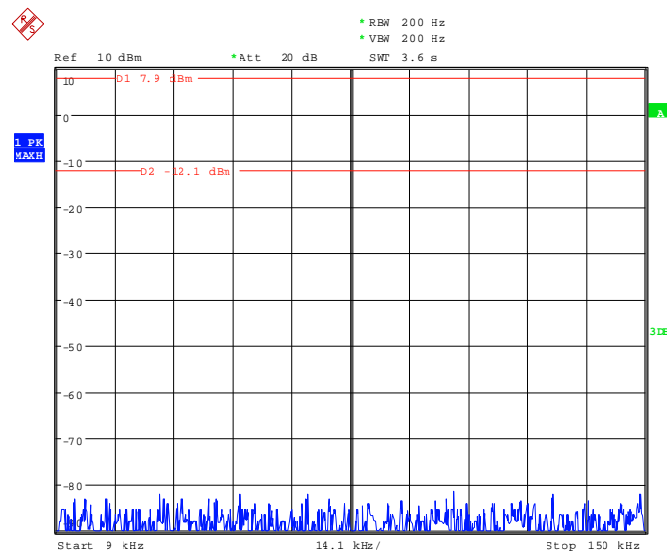
The plots at the next pages are showing conducted emissions with the worst case operation mode. The display line 1 (D1) in these plots represents the highest level within the assigned frequency band (wanted signal). The display line 2 (D2) represents the 20 dB offset to this highest level and shows the compliance with FCC 47 CFR Part 15.247 (d).

## 5.5.2 Test results (conducted emissions)

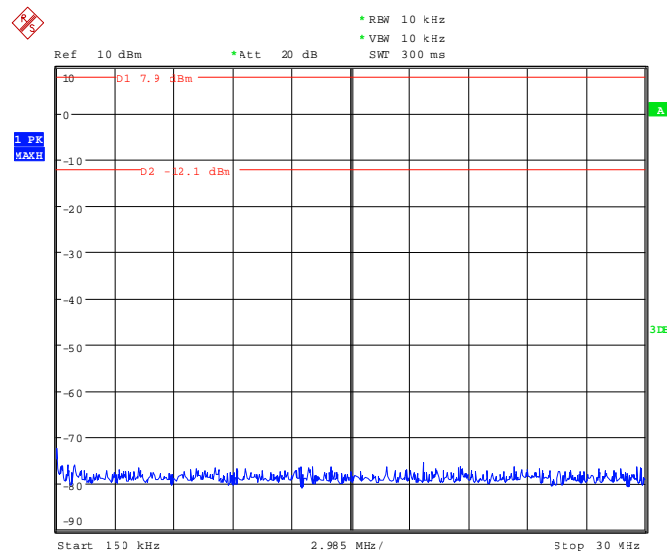
Ambient temperature	20 °C	Relative humidity	52 %
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**Transmitter operates at the lower end of the assigned frequency band:**

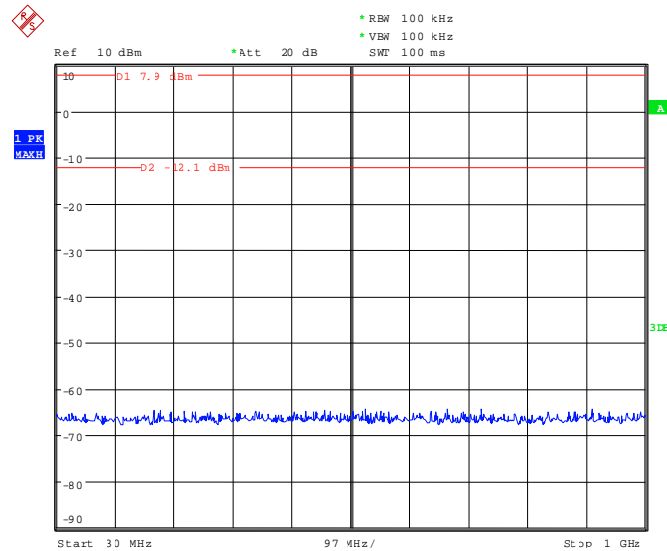
102732\_017.wmf: conducted spurious emissions from 9 kHz to 150 kHz (operation mode 1, 9 Mbps):



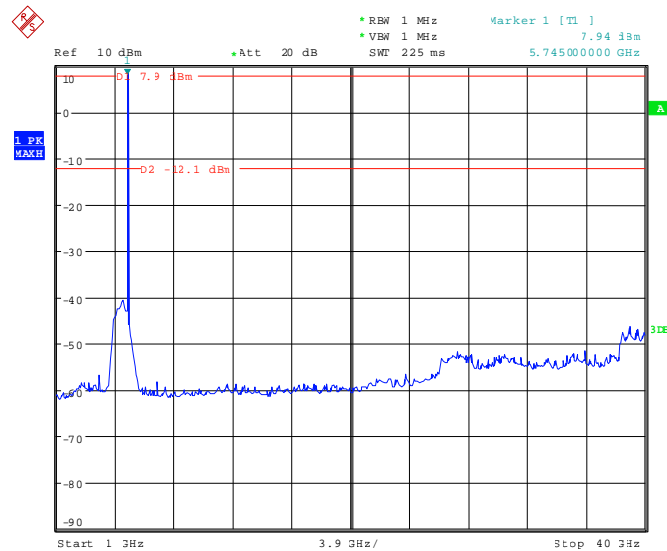
102732\_016.wmf: conducted spurious emissions from 150 kHz to 30 MHz (operation mode 1, 9 Mbps):



102732\_015.wmf: conducted spurious emissions from 30 MHz to 1 GHz (operation mode 1, 9 Mbps):



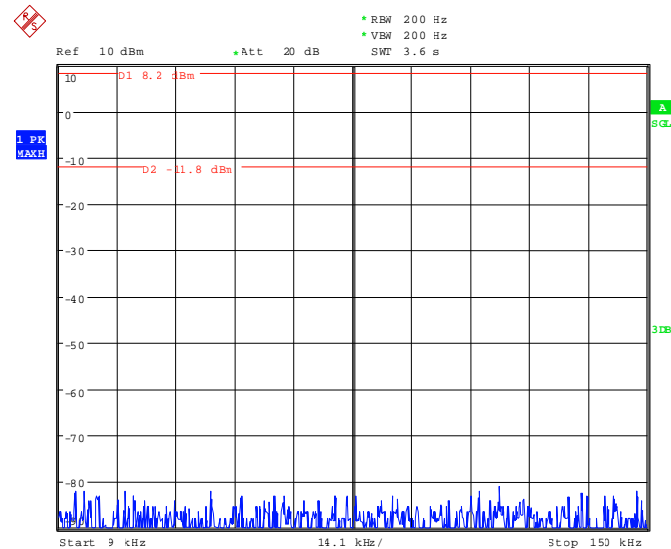
102732\_014.wmf: conducted spurious emissions from 1 GHz to 40 GHz (operation mode 1, 9 Mbps):



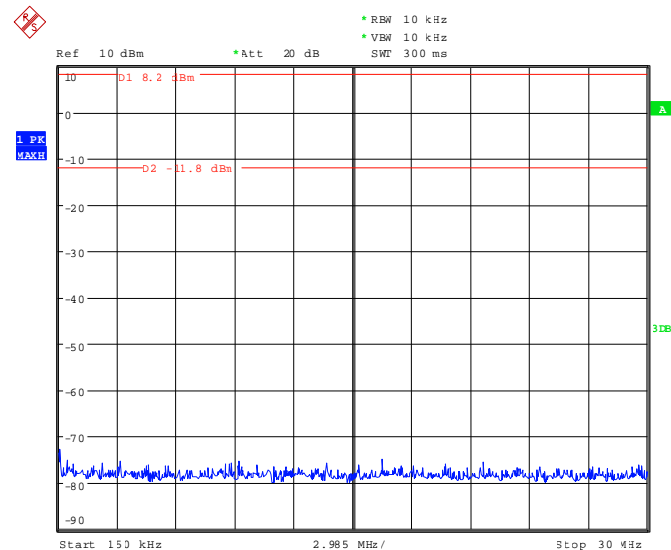
All emissions were at least 35 dB below the limit during the preliminary measurement, so no final measurement was carried out

**Transmitter operates at the middle of the assigned frequency band:**

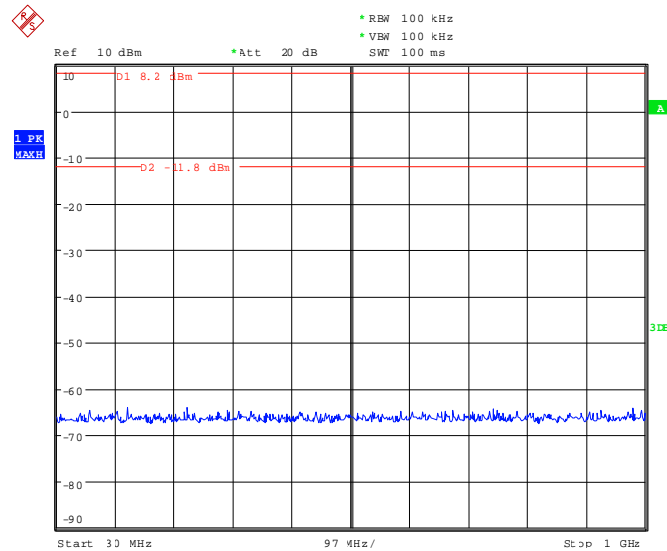
**102732\_021.wmf: conducted spurious emissions from 9 kHz to 150 kHz (operation mode 2, 9 Mbps):**



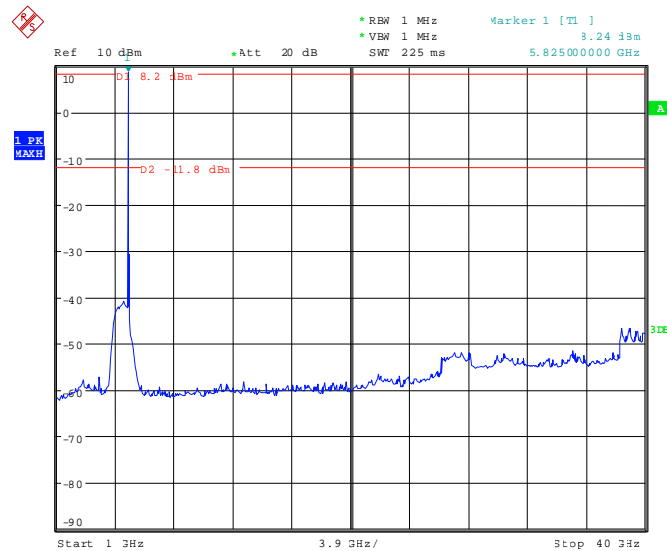
**102732\_020.wmf: conducted spurious emissions from 150 kHz to 30 MHz (operation mode 2, 9 Mbps):**



102732\_019.wmf: conducted spurious emissions from 30 MHz to 1 GHz (operation mode 2, 9 Mbps):



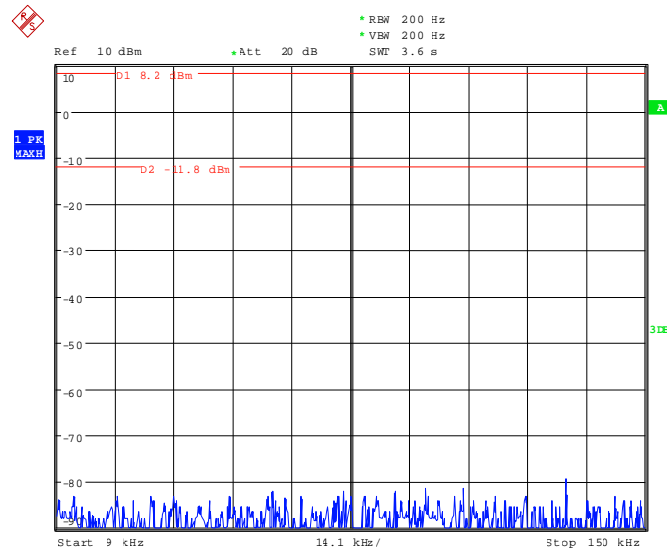
102732\_018.wmf: conducted spurious emissions from 1 GHz to 40 GHz (operation mode 2, 9 Mbps):



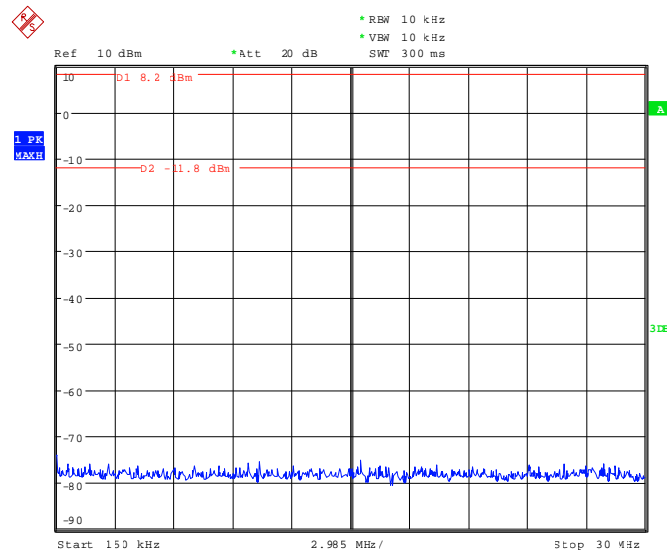
All emissions were at least 35 dB below the limit during the preliminary measurement, so no final measurement was carried out

**Transmitter operates at the upper end of the assigned frequency band:**

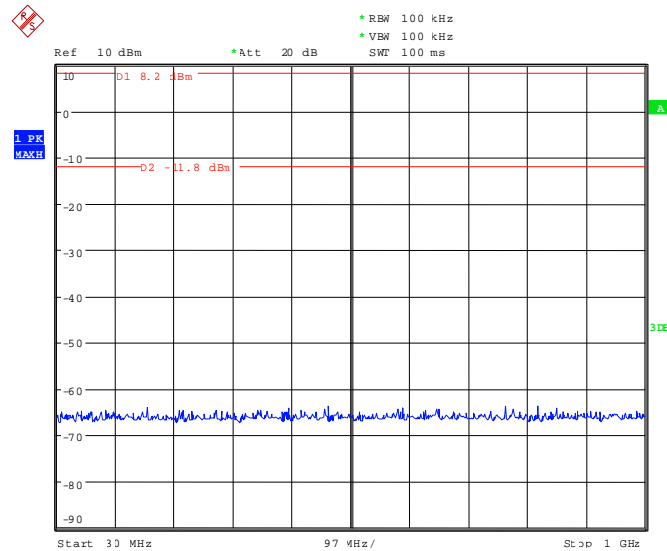
102732\_013.wmf: conducted spurious emissions from 9 kHz to 150 kHz (operation mode 3, 9 Mbps):



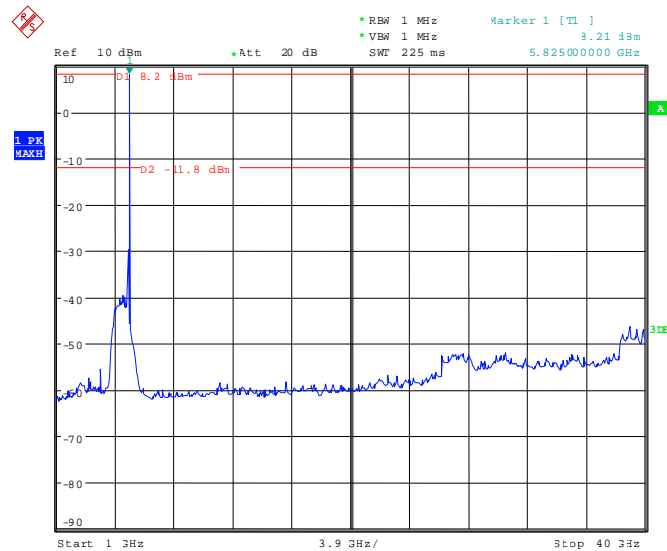
102732\_012.wmf: conducted spurious emissions from 150 kHz to 30 MHz (operation mode 3, 9 Mbps):



102732\_011.wmf: conducted spurious emissions from 30 MHz to 1 GHz (operation mode 3, 9 Mbps):



102732\_010.wmf: conducted spurious emissions from 1 GHz to 40 GHz (operation mode 3, 9 Mbps):



All emissions were at least 35 dB below the limit during the preliminary measurement, so no final measurement was carried out

TEST EQUIPMENT USED FOR THE TEST:

30

## 6 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
30	Spectrum analyser	FSU	Rohde & Schwarz	200125	480956	04/15/2010	04/2012
132	Power Meter	NRVD	Rohde & Schwarz	828110/026	480267	03/15/2010	03/2012
133	Thermal Power Sensor	NRV-Z51	Rohde & Schwarz	825489/004	480247	03/15/2010	03/2012

## 7 REPORT HISTORY

Report Number	Date	Comment
F102732E1	29 October 2010	Document created

## 8 LIST OF ANNEXES

ANNEX A TEST SETUP PHOTOS 1 page

102732\_a.jpg: ELF 701-902, test set-up

ANNEX B INTERNAL PHOTOGRAPHS 15 pages

102732\_23.jpg: ELF 701-902, internal view  
 102732\_16.jpg: ELF 701-902, detail view to rear housing  
 102732\_19.jpg: ELF 701-902, main PCB, top view  
 102732\_24.jpg: ELF 701-902, main PCB, top view, display removed  
 102732\_22.jpg: ELF 701-902, main PCB, top view, shielding removed  
 102732\_18.jpg: ELF 701-902, main PCB, bottom view  
 102732\_21.jpg: ELF 701-902, main PCB, bottom view, WLAN-module removed  
 102732\_20.jpg: ELF 701-902, main PCB, bottom view, shielding removed  
 102732\_17.jpg: ELF 701-902, main PCB, bottom view, GSM-module removed  
 102732\_14.jpg: ELF 701-902, GSM-module, top view  
 102732\_15.jpg: ELF 701-902, GSM-module, bottom view  
 102732\_8.jpg: ELF 701-902, WLAN-module, top view  
 102732\_9.jpg: ELF 701-902, WLAN-module, top view, shielding removed  
 102732\_10.jpg: ELF 701-902, WLAN-module, bottom view  
 102732\_11.jpg: ELF 701-902, Display PCB

Annex C EXTERNAL PHOTOGRAPHS 6 pages

102732\_1.jpg: ELF 701-902, 3-D view 1  
 102732\_2.jpg: ELF 701-902, 3-D view 2  
 102732\_3.jpg: ELF 701-902, type plate (rear) view  
 102732\_25.jpg: ELF 701-902, type plate (battery cover) view  
 102732\_4.jpg: ELF 701-902, rear view (battery cover removed)  
 102732\_5.jpg: ELF 701-902, AC/DC adaptor