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TEST REPORT

Test Report Reference: F091735E2

Equipment under Test: SePem01 Logger

FCC ID: WSP-SF01A0110

IC: 7994A-SF01A0110

Applicant: Hermann Sewerin GmbH

Manufacturer: Hermann Sewerin GmbH

**Test Laboratory
(CAB)**

**accredited by DATech in der TGA GmbH
in compliance with DIN EN ISO/IEC 17025
under the Reg. No. DAT-P-105/99-21,**

**recognized by Bundesnetzagentur
under the Reg.-No. BNetzA-CAB-02/21-104/1,**

CAB Designation Number DE0004,

listed by

FCC 31040/SIT1300F2

**FCC Test site registration number 90877
Industry Canada Test site registration IC3469A-1**

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1 IDENTIFICATION

1.1 APPLICANT

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1.2 MANUFACTURER

Name:	Hermann Sewerin GmbH
Address:	Robert-Bosch-Strasse 3
	33334 Gütersloh
Country:	Germany
Name for contact purposes:	Mr. Christian KREIENBRINK
Tel:	+ 49 52 41 934-319
Fax:	+49 52 41 934-444
e-mail address:	christian.kreienbrinck@sewerin.com

1.3 DATES

Date of receipt of test sample:	21 September 2009
Start of test:	21 September 2009
End of test:	28 September 2009

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1.4 TEST LABORATORY

The tests were carried out at:

PHOENIX TESTLAB GmbH
Königswinkel 10
D-32825 Blomberg
Germany

Phone: +49 (0) 52 35 / 95 00-0
Fax: +49 (0) 52 35 / 95 00-10

Test engineer: Thomas KÜHN
Name



Signature

01 October 2009
Date

Test report checked: Bernd STEINER
Name



Signature

01 October 2009
Date

PHOENIX TESTLAB GmbH
Königswinkel 10
32825 Blomberg
Tel. 0 52 35 / 95 00-0
Fax 0 52 35 / 95 00-10

Stamp

1.5 RESERVATION

This test report is only valid in its original form.

Any reproduction of its contents without written permission of the accredited test laboratory
PHOENIX TESTLAB GmbH is prohibited.

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 REFERENCE.

1.6 NORMATIVE REFERENCES

- [1] **ANSI / TIA-603-C-2004** Land Mobile FM and PM – Communications equipment – Measurement and Performance Standards
- [2] **ANSI C63.4-2003** 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.
- [3] **FCC 47 CFR Part 2** Frequency allocations and radio treaty matters, General Rules and Regulations
- [4] **FCC 47 CFR Part 90** Private land mobile radio services
- [5] **RSS-119 Issue 9 June 2007** Land Mobile and Fixed Radio Transmitters and Receivers Operating in the Frequency Range 27.41-960 MHz
- [6] **RSS-Gen Issue 2 June 2007** General Requirements and Information for the Certification of Radiocommunication Equipment

1.7 TEST RESULTS

The requirements of this test document are fulfilled by the equipment under test. The complete test results are presented in the following.

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2 TECHNICAL DATA OF EQUIPMENT

2.1 DEVICE UNDER TEST

Type of equipment: *	Noise Logger
Type designation: *	SePem 01 Logger
FCC ID: *	WSP-SF01A0110
IC: *	7994A-SF01A0110
Antenna type: *	External antenna ANT-433-CW-QW from ANTENNAFACTOR
Antenna gain: *	No antenna gain available
Antenna connector: *	SMA
Power supply: *	3.6 V DC by internal lithium battery
Type of modulation: *	GFSK
Operating frequency range: *	461.0375 MHz to 464.5625 MHz (transmit) 466.0375 MHz to 469.5625 MHz (receive)
Channel spacing: *	12.5 kHz
Number of channels: *	282
Temperature range: *	-20 °C to 70 °C
Lowest internal Frequency: *	32 kHz

*: declared by the applicant

The following external I/O cables were used:

No cables were connectable to the EUT.

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2.2 PERIPHERY DEVICES

The following equipment was used as control unit and ancillary equipment:

- A SePem01 Master with special configuration software was used to set the SePem 01 Data Logger in the requested operation mode.

3 OPERATIONAL STATES AND PHYSICAL BOUNDARIES

The test was carried out with an unmodified test sample operating in test mode. The test mode was implemented by the applicant. To enter the test mode, the EUT has to be activated with the help of a permanent magnet, presented on the housing of the EUT. So the operational state of the SePem 01 Logger could be chosen with the help of a SePem 01 Master.

During the spurious emission and radiation measurement the test sample was powered by the internal 3.6 V battery.

For measurements under extreme conditions, an external power supply was connected to the battery contacts of the EUTs transmitter.

As declared by the applicant, the EUT is intended to be used in the frequency range –20 °C to + 70 °C. Due to this fact the measurements under extreme conditions were carried out, using this temperature range.

The EUT is equipped with a permanent external antenna connector, but is intended to be used with the antenna type ANT-433-CW-QW from ANTENNAFACTOR only (dedicated antenna).

During the tests, the EUT was not labelled.

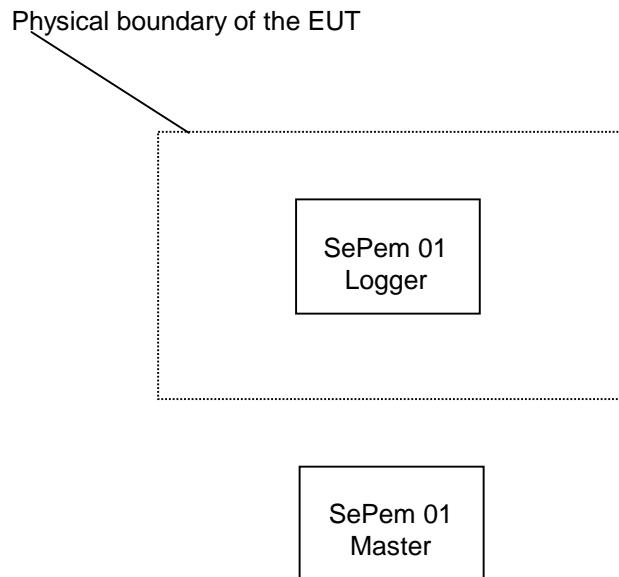
The following operation modes were used during the tests:

Operation mode	Description of the operation mode
1	Continuous transmitting on 461.0375 MHz with and without modulation *
2	Continuous transmitting on 462.8625 MHz with and without modulation *
3	Continuous transmitting on 464.5625 MHz with and without modulation *
4	Continuous receiving on 466.0375 MHz
5	Continuous receiving on 467.8625 MHz
6	Continuous receiving on 469.5625 MHz

*: The following options were selectable:

- Unmodulated carrier
- Modulated signal with continuous 01 bit sequence
- Modulated signal with data telegrams (burst operation)

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4 APPLICATION OVERVIEW

Application	Frequency range [MHz]	FCC 47 CFR section	RSS 119, Issue 9 [5] or RSS-Gen, Issue 2 [6]	Status	Refer page
RF Output Power	General	2.1046 (a)	5.4 [5]	Passed	8 et seq.
Spectrum Mask	General	90.217 (b)	5.10 [5]	Passed	10 et seq.
Radiated emissions (transmitter)	30 - 5,000	2.1053	5.8.3 [5]	Passed	16 et seq.
Frequency Stability	General	90.213	5.3 [6]	Passed	25 et seq.
Radiated emissions (receiver)	30 - 2,500	15.109 (a)	5.11 [5], 6 [6]	Passed	35 et seq.
Conducted emissions (receiver)	30 - 2,500	15.111 (a)	6 [6]	Passed	44 et seq.
99 % Bandwidth	General	-	4.6.1 [6]	-	1 et seq. of F091735E2 Annex D

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5 TEST RESULTS

5.1 OUTPUT POWER

5.1.1 METHOD OF MEASUREMENT (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 -Z51.

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

Test set-up:



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5.1.2 TEST RESULTS (OUTPUT POWER)

Ambient temperature	21 °C	Relative humidity	50 %
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TEST CONDITION	MEASURED OUTPUT POWER (dBm)		
T_{nom} (20 °C)	461.0375 MHz	462.8625 MHz	464.5625 MHz
U_{nom} (3.6 V DC)	13.7	13.7	13.7
U_{min} (3.1 V DC)	13.5	13.5	13.5
U_{max} (3.7 V DC)	13.7	13.7	13.7
Measurement uncertainty	± 0.2 dB		

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

54, 65, 66

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5.2 SPECTRUM MASK

5.2.1 METHOD OF MEASUREMENT (SPECTRUM MASK)

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: 100 kHz, centred on the actual channel.
- Resolution bandwidth: 100 Hz.
- Video bandwidth: 100 kHz.
- Sweep: 50 s.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set to the peak of the unmodulated carrier. This value has to set to the Reference Level. The measurement has to be repeated with all kinds of modulation to find the worst case.

Test set-up:



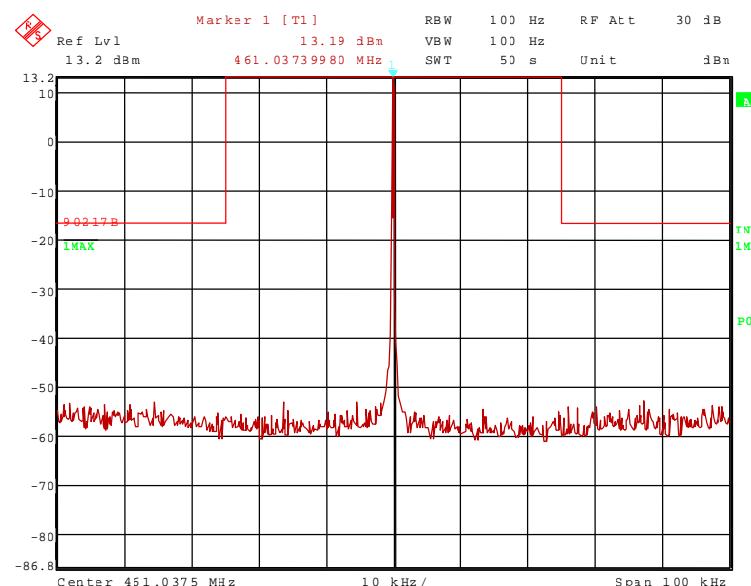
TEST REPORT REFERENCE: F091735E2

5.2.2 TEST RESULTS (SPECTRUM MASK)

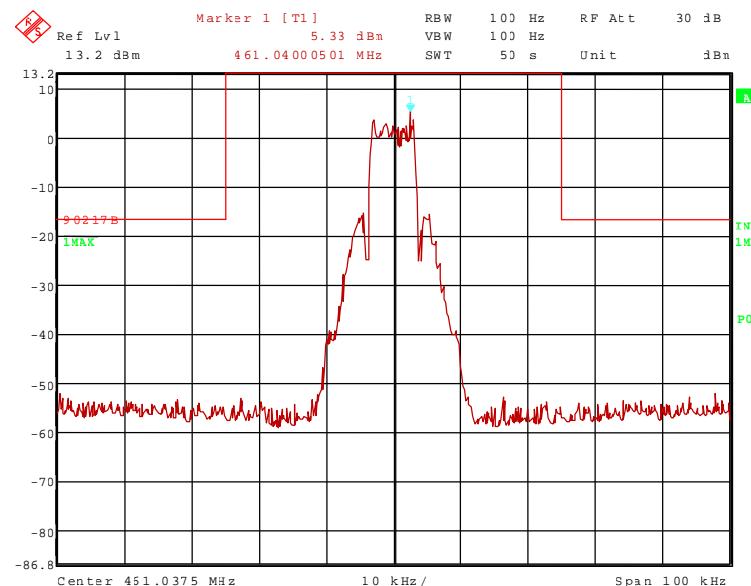
Ambient temperature	21 °C	Relative humidity	50 %
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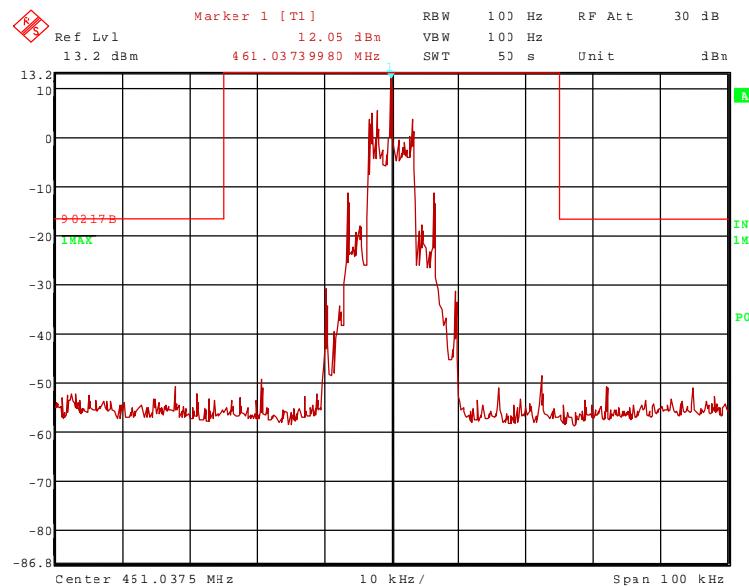
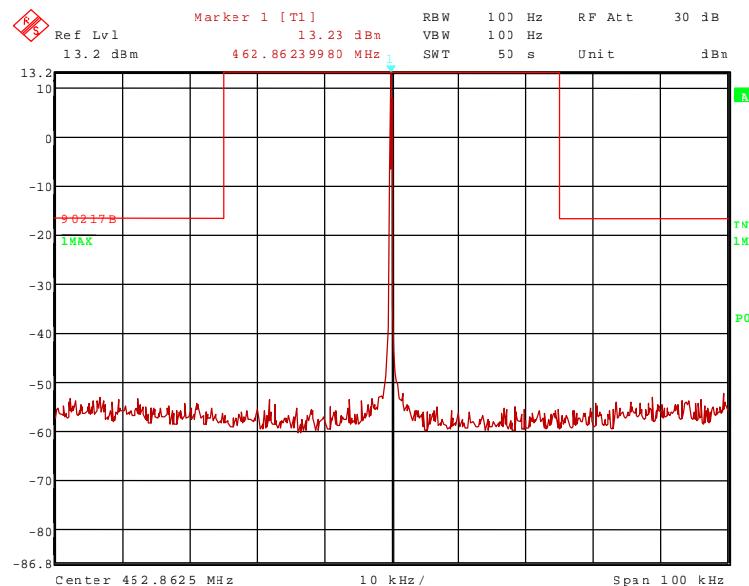
Transmitter operates on 461.0375 MHz (operation mode 1):

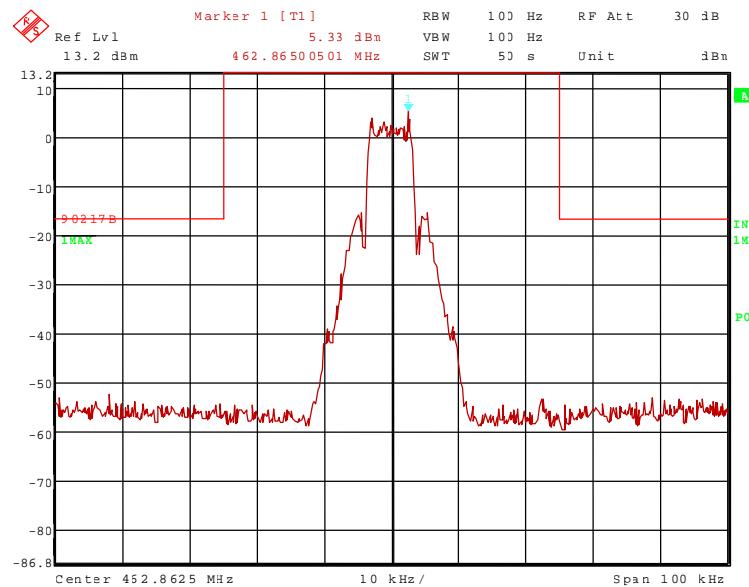
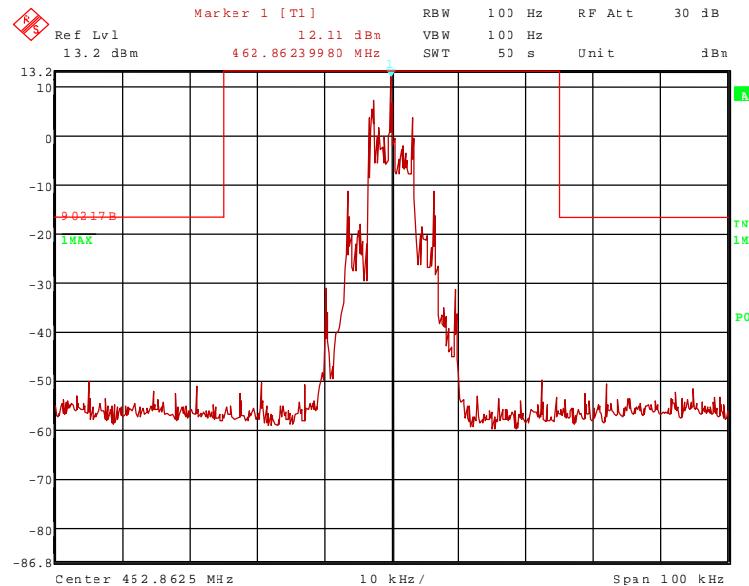
91735_25.wmf: Spectrum mask, transmitter operates without modulation (operation mode 1):



91735_26.wmf: Spectrum mask, transmitter operates continuous modulation (operation mode 1):



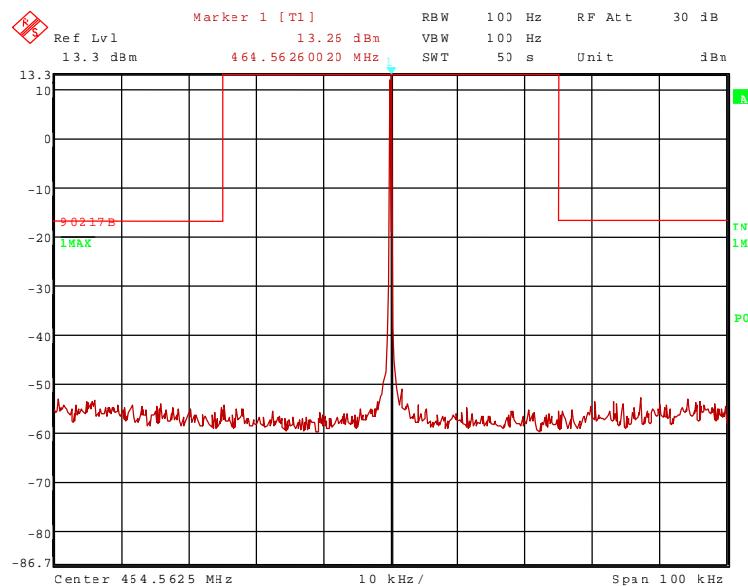
TEST REPORT REFERENCE: F091735E2
91735_27.wmf: Spectrum mask, transmitter operates with burst modulation (operation mode 1):

Transmitter operates on 462.8625 MHz (operation mode 2):
91735_28.wmf: Spectrum mask, transmitter operates without modulation (operation mode 2):


TEST REPORT REFERENCE: F091735E2
91735_29.wmf: Spectrum mask, transmitter operates continuous modulation (operation mode 2):

91735_30.wmf: Spectrum mask, transmitter operates with burst modulation (operation mode 2):


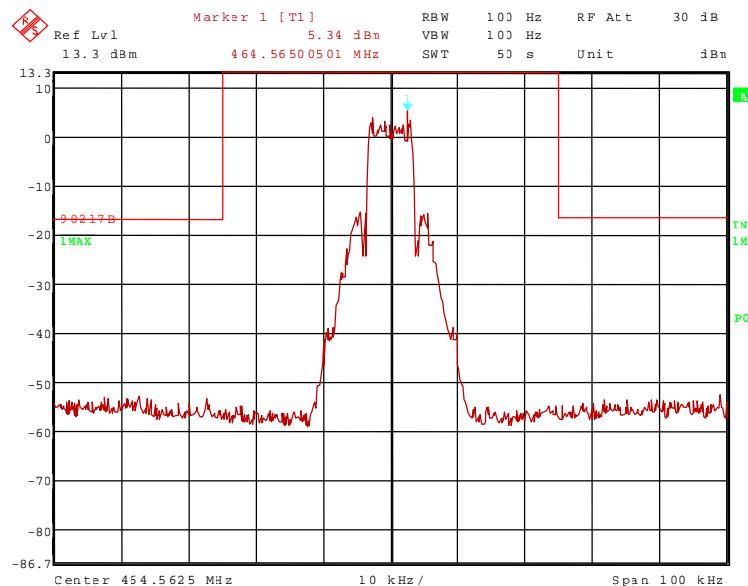
TEST REPORT REFERENCE: F091735E2

Transmitter operates on 464.5625 MHz (operation mode 3):

91735_31.wmf: Spectrum mask, transmitter operates without modulation (operation mode 3):

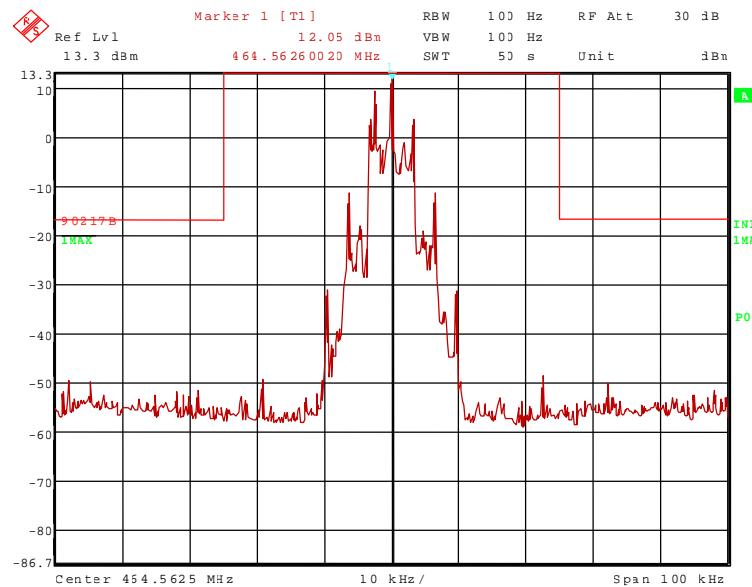


91735_32.wmf: Spectrum mask, transmitter operates continuous modulation (operation mode 3):



TEST REPORT REFERENCE: F091735E2

91735_33.wmf: Spectrum mask, transmitter operates with burst modulation (operation mode 3):



Test: Passed

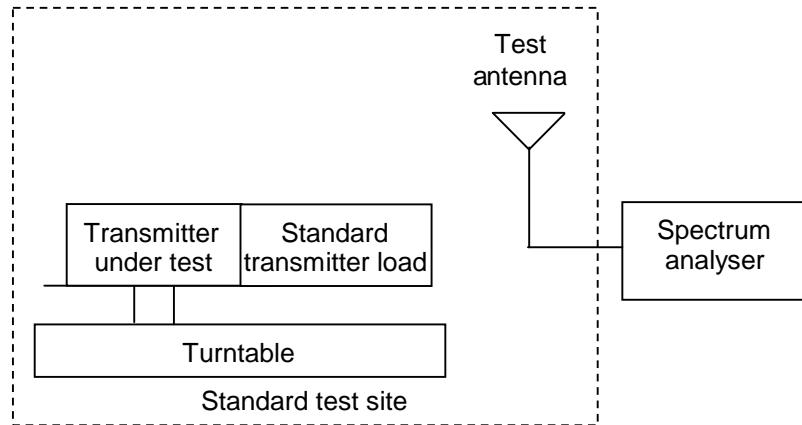
TEST EQUIPMENT USED FOR THE TEST:

31

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5.3 RADIATED EMISSIONS (TRANSMITTER)

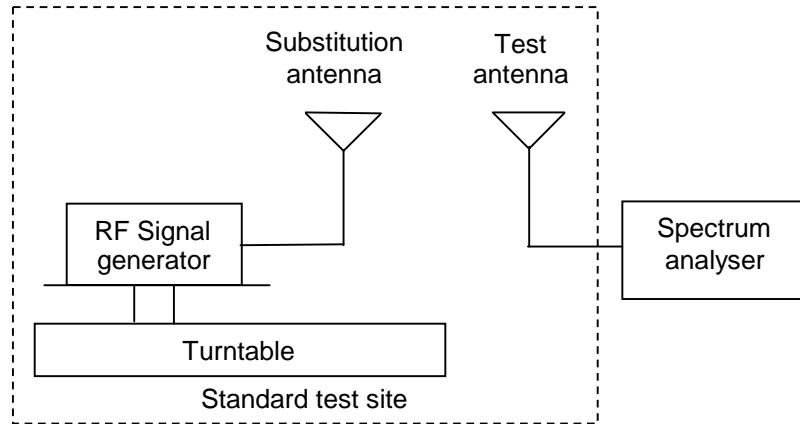
5.3.1 METHOD OF MEASUREMENT (RADIATED TRANSMITTER EMISSIONS)



- a) Connect the equipment as illustrated.
- b) Adjust the spectrum analyzer for the following settings:
 - Resolution Bandwidth = 10 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1GHz.
 - Video Bandwidth = 300 kHz for spurious emissions below 1 GHz, and 3 MHz for spurious emissions above 1 GHz.
 - Sweep Speed slow enough to maintain measurement calibration.
 - Detector Mode = Positive Peak.
- c) Place the transmitter to be tested on the turntable in the standard test site, or an FCC listed site compliant with ANSI C63.4-2001 clause 5.4. The transmitter is transmitting into a nonradiating load that is placed on the turntable. The RF cable to this load should be of minimum length. For transmitters with integral antennas, the tests are to be run with the unit operating into the integral antenna.
- d) For each spurious measurement the test antenna should be adjusted to the correct length for the frequency involved. This length may be determined from a calibration ruler supplied with the equipment. Measurements shall be made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier, except for the region close to the carrier equal to \pm the test bandwidth (see 1.3.4.4).
- e) Key the transmitter.
- f) For each spurious frequency, raise and lower the test antenna from 1 m to 4 m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Then the turntable should be rotated 360° to determine the maximum reading. Repeat this procedure to obtain the highest possible reading. Record this maximum reading.

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g) Repeat step f) for each spurious frequency with the test antenna polarized vertically.



h) Reconnect the equipment as illustrated.

i) Keep the spectrum analyzer adjusted as in step b).

j) Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At the lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground.

k) Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a nonradiating cable. With the antennas at both ends horizontally polarized, and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output.

l) Repeat step k) with both antennas vertically polarized for each spurious frequency.

m) Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps k) and l) by the power loss in the cable between the generator and the antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna by the following formula:

$$P_d(\text{dBm}) = P_g(\text{dBm}) - \text{cable loss (dB)} + \text{antenna gain (dB)}$$

where: P_d is the dipole equivalent power and
 P_g is the generator output power into the substitution antenna.

n) The P_d levels record in step m) are the absolute levels of radiated spurious emissions in dBm. The radiated spurious emissions in dB can be calculated by the following:

$$\text{Radiated spurious emissions (dB)} = 10 \log (\text{TX power in watts} / 0.001) - \text{levels in step m)}$$

NOTE: It is permissible to use other antennas provided they can be referenced to a dipole.

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5.3.2 TEST RESULTS (RADIATED TRANSMITTER EMISSIONS)

5.3.2.1 PRELIMINARY MEASUREMENT (9 kHz to 5 GHz)

Ambient temperature	20 °C	Relative humidity	57 %
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Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m. For further information of the set up refer to the pictures in annex A of this test report.

Cable guide: No cables were connectable to the EUT.

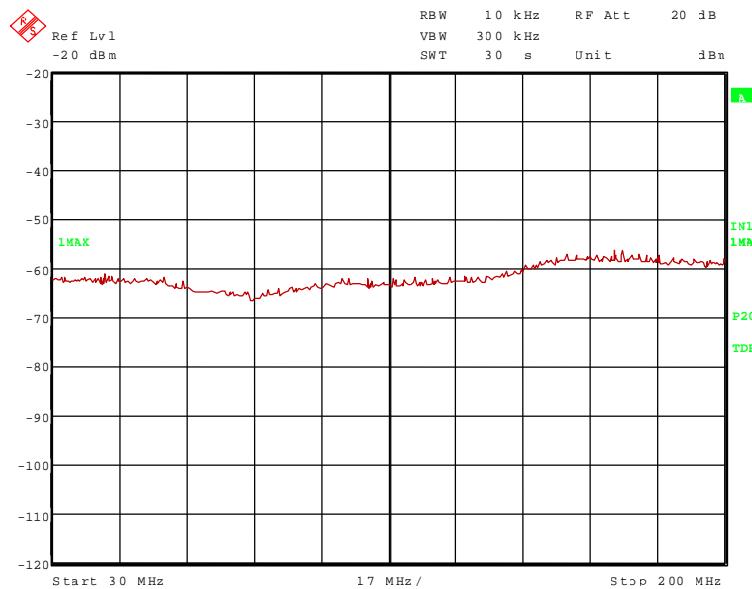
Test record: Where not otherwise stated the test was carried out in test mode 2 of the EUT, because there was no difference to the other test modes. All results are shown in the following.

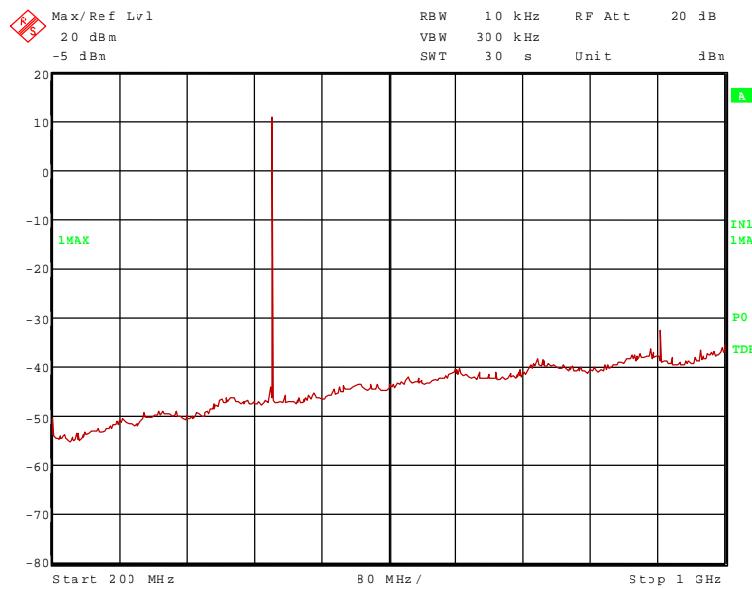
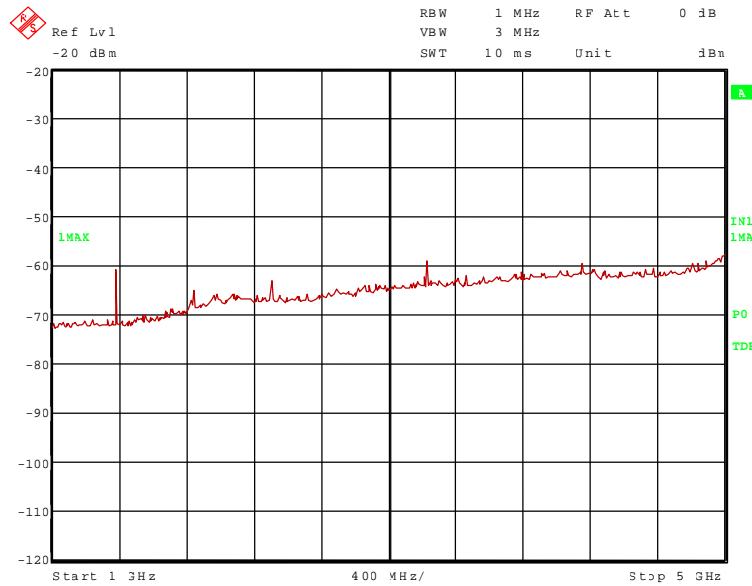
Supply voltage: During all measurements the EUT was supplied with 3.6 V DC via the internal battery.

Remark: The EUT is intended to operate a dedicated antenna, therefore the radiated emission measurement was not carried out with the antenna port terminated by a standard transmitter load; the dedicated antenna was used.

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)

91735_2.wmf: Spurious emissions from 30 MHz to 200 MHz (operation mode 1):



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91735_1.wmf: Spurious emissions from 200 MHz to 1 GHz (operation mode 1):

91735_9.wmf: Spurious emissions from 1 GHz to 5 GHz (operation mode 1):


The following frequencies were found during the preliminary radiated emission test:

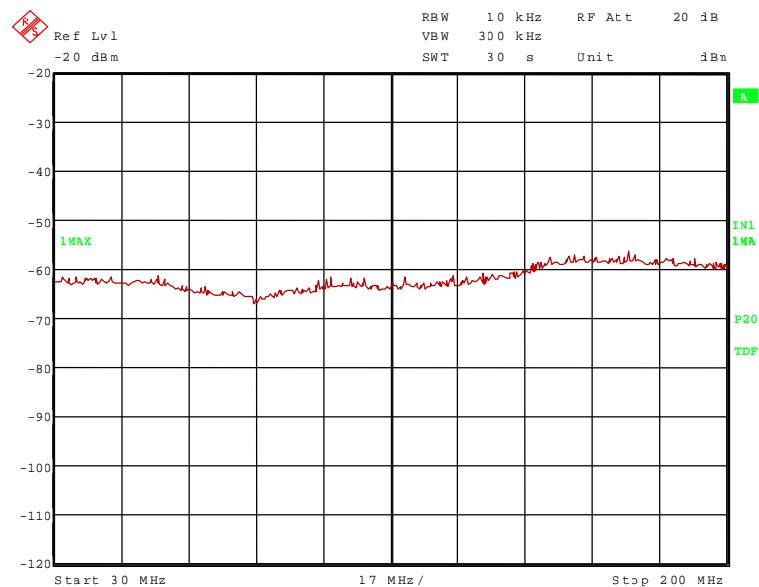
- 461.0375 MHz, 922.075 MHz, 1383.1125 MHz and 3227.2625 MHz.

The results of the final measurement were presented in the following.

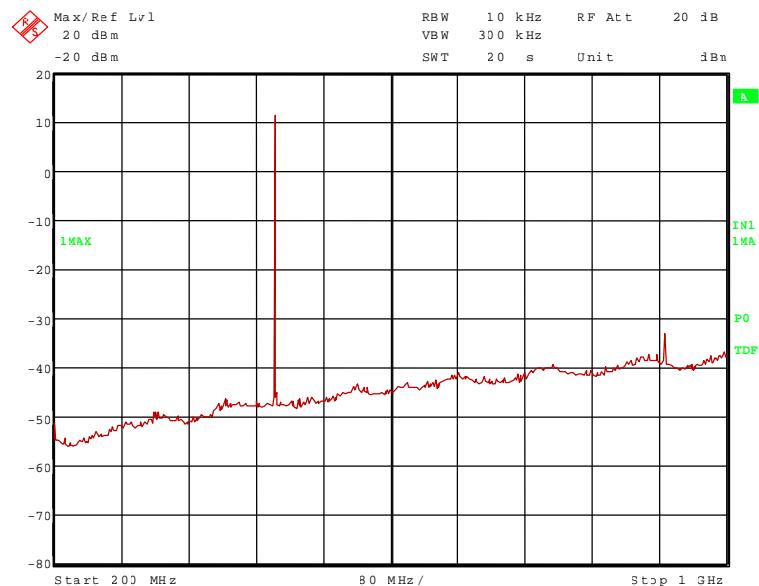
TEST REPORT REFERENCE: F091735E2

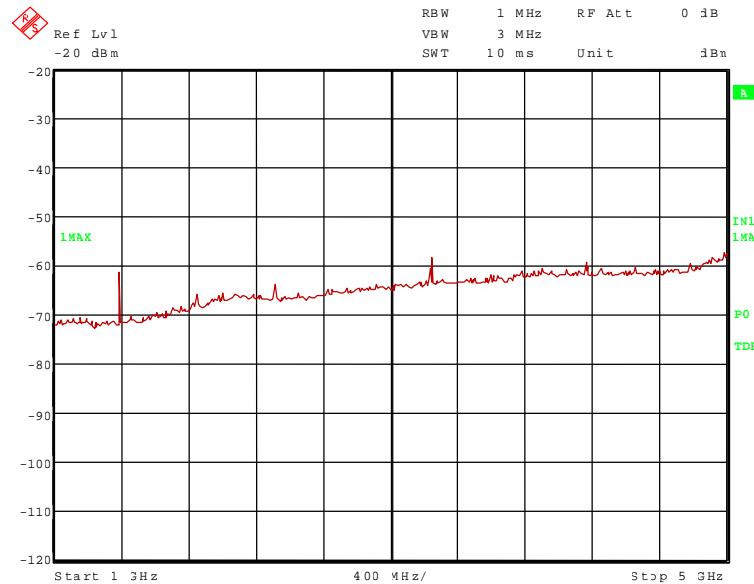
Transmitter operates at the middle of the assigned frequency band (operation mode 2)

91735_3.wmf: Spurious emissions from 30 MHz to 200 MHz (operation mode 2):



91735_4.wmf: Spurious emissions from 200 MHz to 1 GHz (operation mode 2):

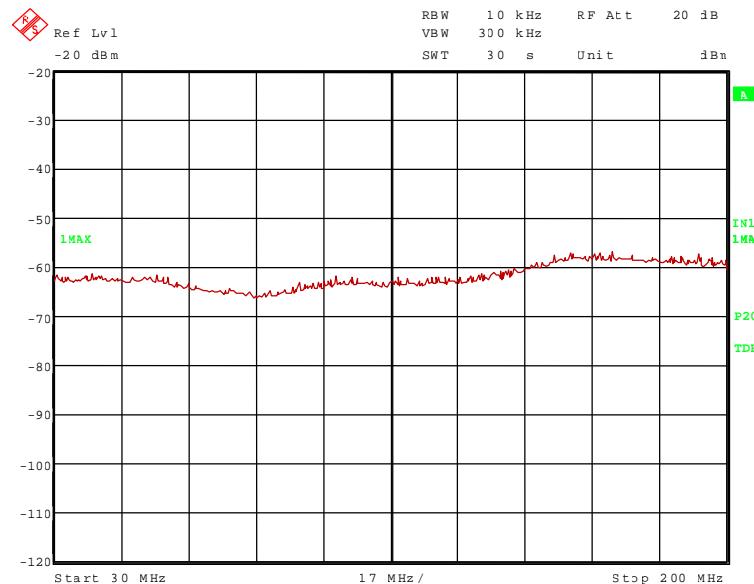


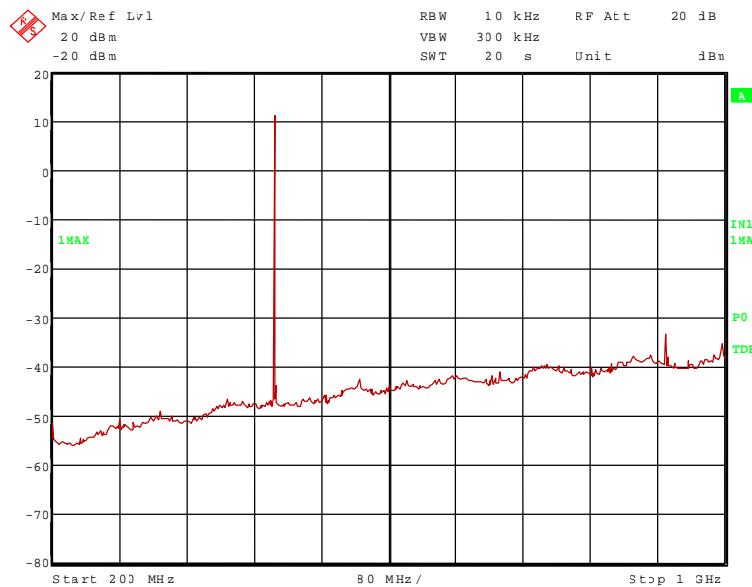
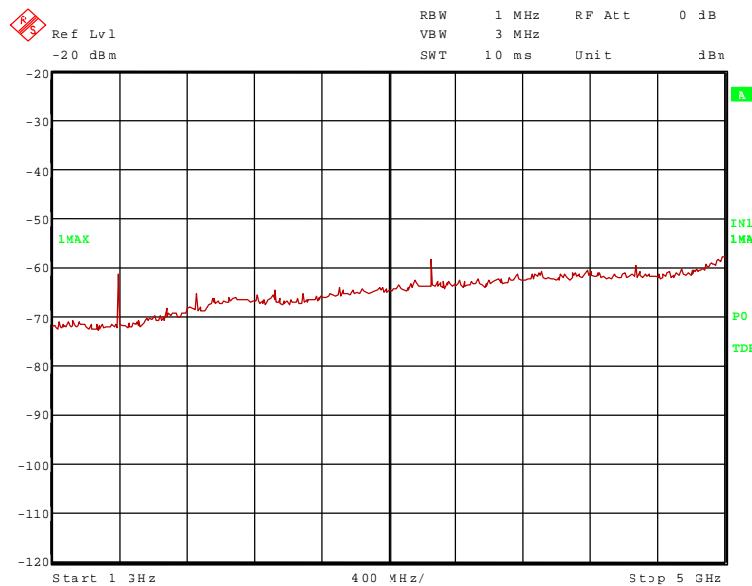
TEST REPORT REFERENCE: F091735E2
91735_8.wmf: Spurious emissions from 1 GHz to 5 GHz (operation mode 2):


The following frequencies were found during the preliminary radiated emission test:

- 462.8625 MHz, 925.725 MHz, 1388.5875 MHz and 3240.0375 MHz.

The results of the final measurement were presented in the following.

Transmitter operates at the upper end of the assigned frequency band (operation mode 3)
91735_6.wmf: Spurious emissions from 30 MHz to 200 MHz (operation mode 3):


TEST REPORT REFERENCE: F091735E2
91735_5.wmf: Spurious emissions from 200 MHz to 1 GHz (operation mode 3):

91735_7.wmf: Spurious emissions from 1 GHz to 5 GHz (operation mode 3):


The following frequencies were found during the preliminary radiated emission test:

- 464.5625 MHz, 929.125 MHz, 1393.6875 MHz and 3251.9375 MHz.

The results of the final measurement were presented in the following.

TEST EQUIPMENT USED FOR THE TEST:

29, 31 – 36, 43, 44, 49, 58, 67

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5.3.2.2 FINAL MEASUREMENT (30 MHz to 1 GHz)

Ambient temperature	20 °C	Relative humidity	45 %
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Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m. For further information of the set up refer to the pictures in annex A of this test report.

Cable guide: No cables were connectable to the EUT.

Supply voltage: During all measurements the EUT was supplied with 3.6 V DC via the internal battery.

Bandwidth: For all measurements a resolution bandwidth of 10 kHz and a video bandwidth of 300 kHz was used.

Remark: The EUT is intended to operate a dedicated antenna, therefore the radiated emission measurement was not carried out with the antenna port terminated by a standard transmitter load; the dedicated antenna was used.

The results of the standard subsequent measurement on the open area test site are indicated in the table below. The limits as well as the measured results (levels) refer to the above mentioned standard while taking account of the specified requirements for a 3 m measuring distance

Result measured with the quasipeak detector:

Spurious emissions							
Transmitter operation mode	Frequency MHz	Result mW / dBm	Limit mW / dBm	Margin dB	Height cm	Azimuth deg	Pol.
Operation mode 1	461.0375	31.6 / 15.0	120 / 20.8	5.8	100	40	Vertical
	922.075	0.42 * 10 ⁻³ / -33.8	0.032 / -15.0	18.8	100	188	Vertical
Operation mode 2	462.8625	33.1 / 15.2	120 / 20.8	5.6	100	39	Vertical
	925.725	0.28 * 10 ⁻³ / -35.6	0.033 / -14.8	20.8	100	357	Vertical
Operation mode 3	464.5625	33.1 / 15.2	120 / 20.8	5.6	100	40	Vertical
	929.125	0.34 * 10 ⁻³ / -34.7	0.033 / -14.8	19.9	100	357	Vertical
Measurement uncertainty				+2.2 dB / -3.6 dB			

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

14 – 20, 60, 61, 63

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5.3.2.3 FINAL MEASUREMENT (1 GHz to 5 GHz)

Ambient temperature	20 °C	Relative humidity	57 %
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Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m. For further information of the set up refer to the pictures in annex A of this test report.

Supply voltage: During all measurements the EUT was supplied with 3.6 V DC via the internal battery.

Bandwidth: For all measurements a resolution bandwidth of 1 MHz and a video bandwidth of 3 MHz was used.

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)

Frequency MHz	Corr. value dBm	Limit dBm	Margin dB	Preamp	Height cm	Polarisation
1383.1125	-61.3	-15.0	46.3	Yes	150	Vertical
3227.2625	-60.4	-15.0	45.4	Yes	150	Horizontal
Measurement uncertainty					+2.2 dB / -3.6 dB	

Transmitter operates at the middle of the assigned frequency band (operation mode 2)

Frequency MHz	Corr. value dBm	Limit dBm	Margin dB	Preamp	Height cm	Polarisation
1388.5875	-61.7	-14.8	46.9	Yes	150	Vertical
3240.0375	-58.9	-14.8	44.1	Yes	150	Horizontal
Measurement uncertainty					+2.2 dB / -3.6 dB	

Transmitter operates at the upper end of the assigned frequency band (operation mode 3)

Frequency MHz	Corr. value dBm	Limit dBm	Margin dB	Preamp	Height cm	Polarisation
1393.6875	-62.0	-14.8	47.2	Yes	150	Vertical
3251.9375	-58.8	-14.8	44.0	Yes	150	Horizontal
Measurement uncertainty					+2.2 dB / -3.6 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

14 – 18, 36, 44, 49, 58, 60, 62, 63, 67

TEST REPORT REFERENCE: F091735E2

5.4 CONDUCTED EMISSIONS (TRANSMITTER)

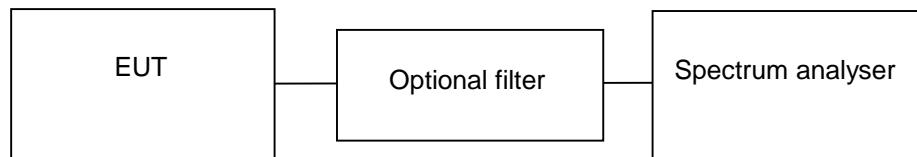
5.4.1 METHOD OF MEASUREMENT (CONDUCTED TRANSMITTER EMISSIONS)

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator for every found frequency. 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 and the hopping function has to be disabled (if applicable).

Analyser Parameter	Frequency range		
	150 kHz to 30 MHz	30 MHz to 1 GHz	1 GHz to 25 GHz
Start frequency	150 kHz	30 MHz	1 GHz
Stop frequency	30 MHz	1 GHz	25 GHz
Resolution bandwidth	10 kHz	10 kHz	1 MHz
Video bandwidth	30 kHz	30 kHz	3 MHz
Detector function	Average	Average	Average
Trace mode	Max hold	Max hold	Max hold

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

Test set-up:



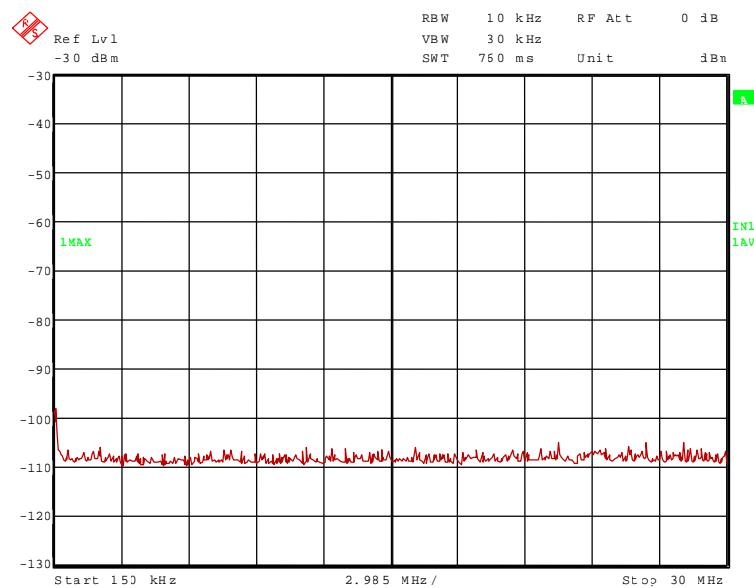
TEST REPORT REFERENCE: F091735E2

5.4.2 TEST RESULTS (CONDUCTED TRANSMITTER EMISSIONS)

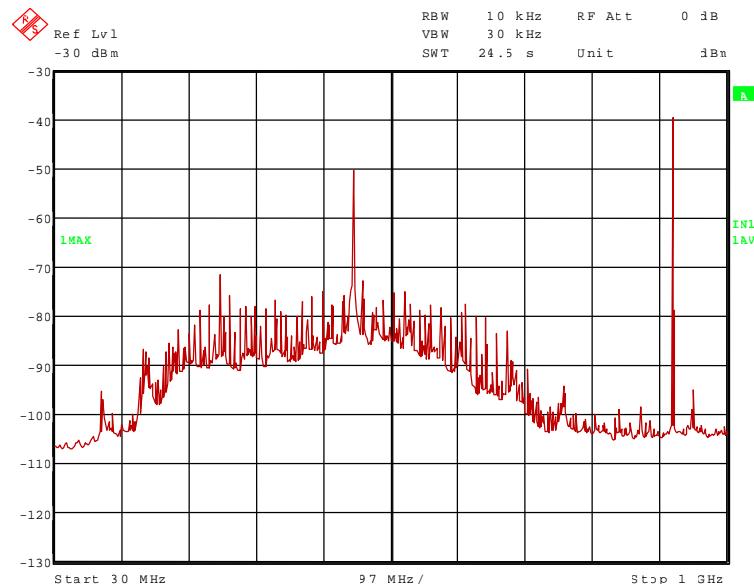
Ambient temperature	20 °C	Relative humidity	52 %
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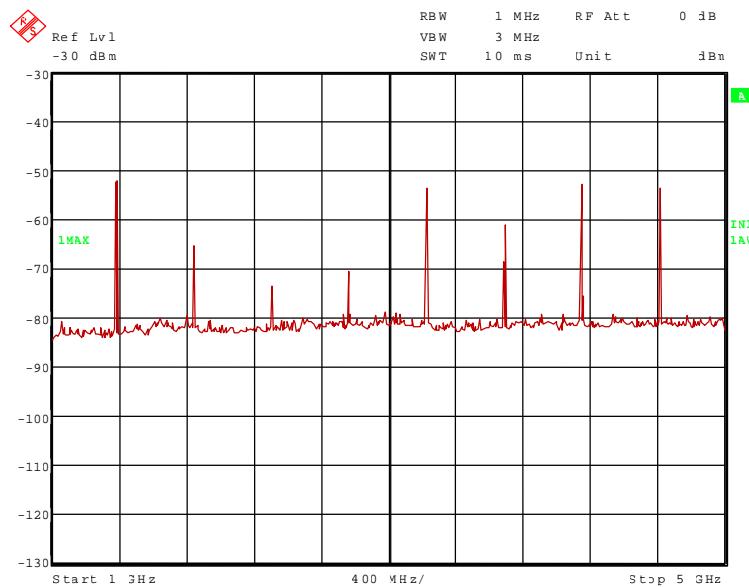
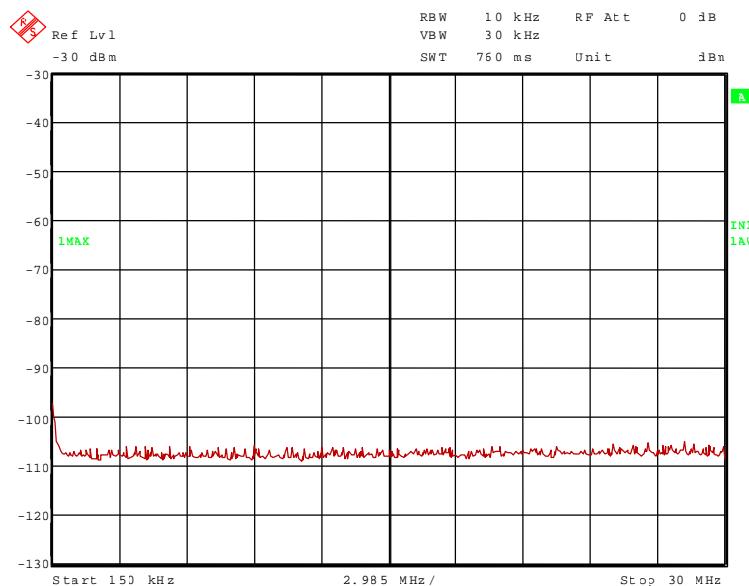
Transmitter operates at the lower end of the assigned frequency band (operation mode 1)

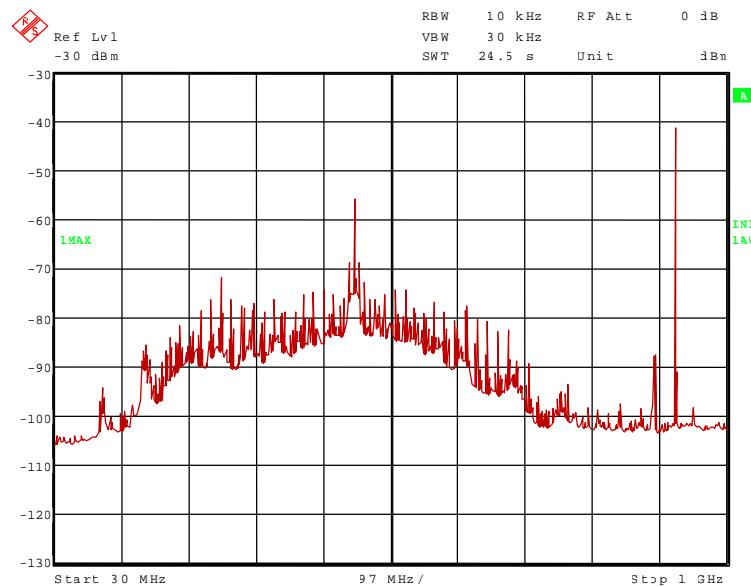
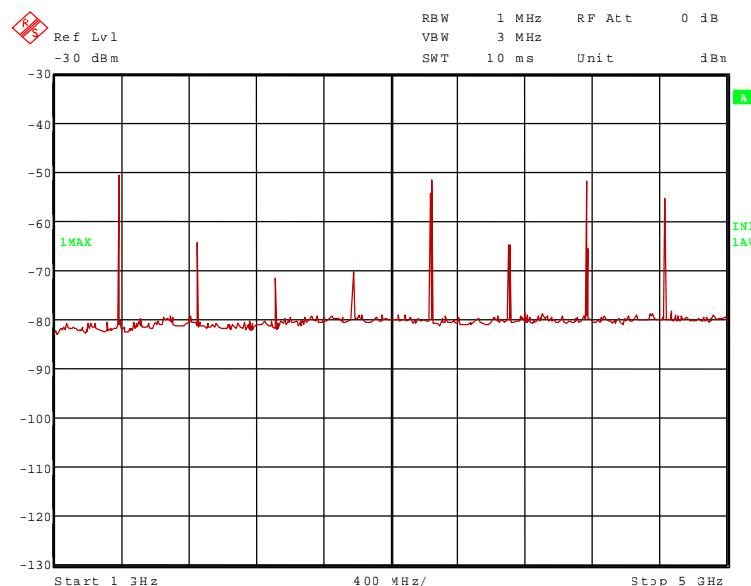
91735_86.wmf: Conducted spurious emissions from 150 kHz to 30 MHz (operation mode 1):



91735_85.wmf: Conducted spurious emissions from 30 MHz to 1 GHz (operation mode 1, carrier notched):



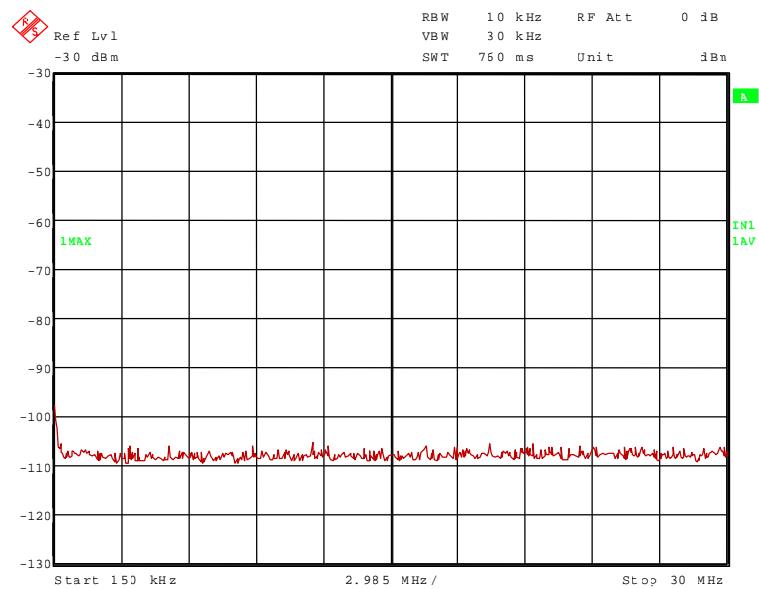
TEST REPORT REFERENCE: F091735E2
91735_84.wmf: Conducted spurious emissions from 1 GHz to 5 GHz (operation mode 1):

Transmitter operates at the middle of the assigned frequency band (operation mode 2)
91735_81.wmf: Conducted spurious emissions from 150 kHz to 30 MHz (operation mode 2):


TEST REPORT REFERENCE: F091735E2
91735 82.wmf: Conducted spurious emissions from 30 MHz to 1 GHz (operation mode 2, carrier notched):

91735 83.wmf: Conducted spurious emissions from 1 GHz to 5 GHz (operation mode 2):


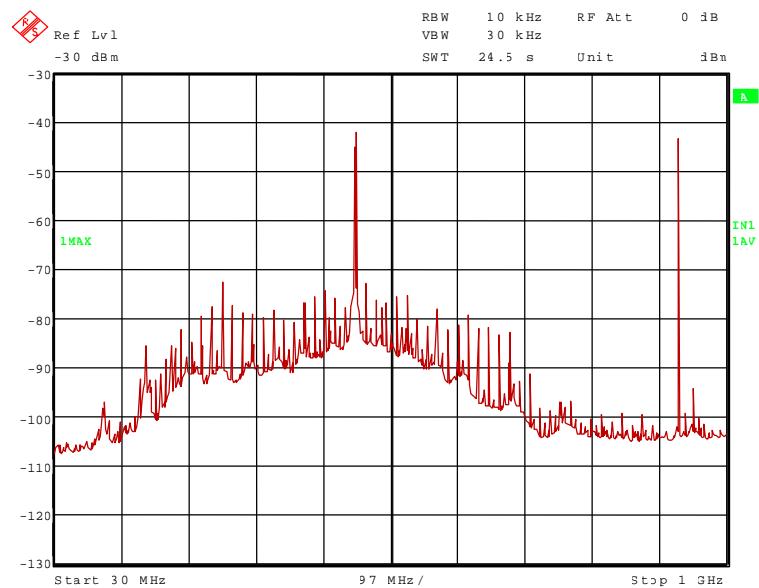
TEST REPORT REFERENCE: F091735E2

Transmitter operates at the upper end of the assigned frequency band (operation mode 3)

91735_87.wmf: Conducted spurious emissions from 150 kHz to 30 MHz (operation mode 3):

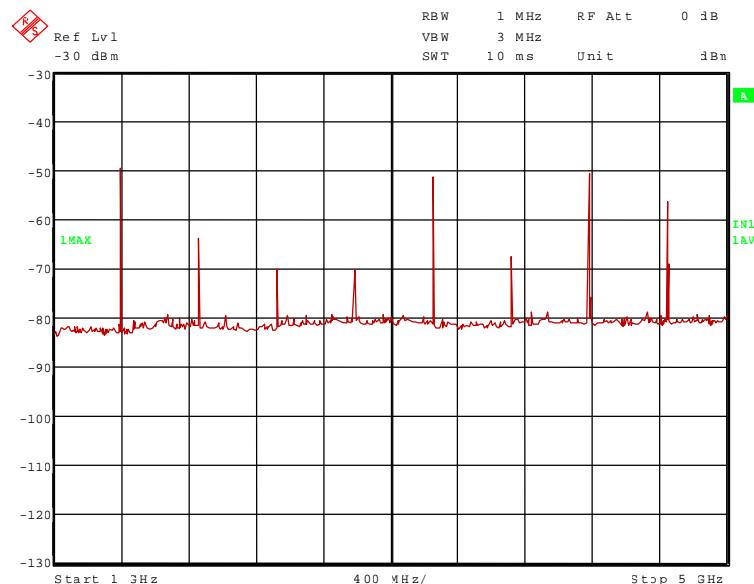


91735_88.wmf: Conducted spurious emissions from 30 MHz to 1 GHz (operation mode 3, carrier notched):



TEST REPORT REFERENCE: F091735E2

91735_89.wmf: Conducted spurious emissions from 1 GHz to 5 GHz (operation mode 3):



TEST REPORT REFERENCE: F091735E2

Conducted emissions with transmitter operates at the lower end of the assigned frequency band						
Frequency MHz	Result dBm	Limit dBm	Margin dB	Reading dBm	Cable loss dB	Reference level [dBm]
922.075	-39.3	-16.3	23.0	-39.6	0.3	13.7
1383.1125	-51.8	-16.3	35.5	-52.2	0.4	13.7
1844.15	-64.6	-16.3	48.3	-65.2	0.6	13.7
3227.2625	-52.3	-16.3	36.0	-53.6	1.3	13.7
3688.3	-59.3	-16.3	43.0	-60.8	1.5	13.7
4149.3375	-50.6	-16.3	34.3	-52.6	1.7	13.7
4610.375	-51.5	-16.3	35.2	-53.5	2.0	13.7
Conducted emissions with transmitter operates at the middle of the assigned frequency band						
Frequency MHz	Result dBm	Limit dBm	Margin dB	Reading dBm	Cable loss dB	Reference level [dBm]
925.7250	-41.1	-16.3	24.8	-41.4	0.3	13.7
1388.5875	-50.1	-16.3	33.8	-50.5	0.4	13.7
1851.45	-63.8	-16.3	47.5	-64.4	0.6	13.7
3240.0375	-50.4	-16.3	66.7	-51.7	1.3	13.7
3702.9	-63.0	-16.3	46.7	-64.5	1.5	13.7
4165.7625	-50.2	-16.3	33.9	-51.9	1.7	13.7
4628.625	-53.3	-16.3	37.0	-55.3	2.0	13.7
Conducted emissions with transmitter operates at the upper end of the assigned frequency band						
Frequency MHz	Result dBm	Limit dBm	Margin dB	Reading dBm	Cable loss dB	Reference level [dBm]
929.125	-43.0	-16.3	26.7	-43.3	0.3	13.7
1393.6875	-49.2	-16.3	32.9	-49.6	0.4	13.7
1858.25	-63.0	-16.3	46.7	-63.6	0.6	13.7
3251.9375	-49.8	-16.3	33.5	-51.1	1.3	13.7
3716.5	-65.6	-16.3	49.3	-67.1	1.5	13.7
4181.0625	-48.8	-16.3	32.5	-50.5	1.7	13.7
4645.625	-54.2	-16.3	37.9	-56.2	2.0	13.7
Measurement uncertainty					+0.66 dB / -0.72 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

31, 54, 67, 68

TEST REPORT REFERENCE: F091735E2

5.5 FREQUENCY STABILITY

5.5.1 METHOD OF MEASUREMENT (FREQUENCY STABILITY)

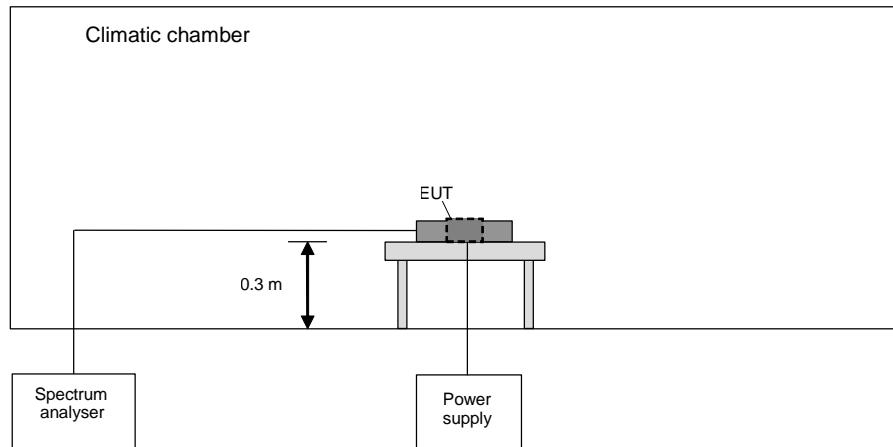
The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a test fixture shall be used.

The following procedure will be used:

- 1) Place the EUT in the climatic chamber.
- 2) Switch on the EUT and check the correct function and the settings of the spectrum analyser.
- 3) Switch off the EUT and tune the climatic chamber to a temperature of 50 °C. Wait until the thermal balance is obtained.
- 4) Switch the EUT on and record the frequencies at start-up and 2, 5 and 10 minutes after powering on.
- 5) Repeat 4) with the minimum and the maximum of the supply voltage.
- 6) Switch off the EUT and tune the climatic chamber to a temperature range of 50 °C to –20 °C to in ten-degree steps. Wait until the thermal balance is obtained for every step.
- 7) Switch the EUT on and record the frequencies at start-up and 2, 5 and 10 minutes after powering on.
- 8) Repeat 7) with the minimum and the maximum of the supply voltage at 20 °C.
- 9) Repeat 6) with the next temperature step until –20 °C were reached.

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

Test set-up:



TEST REPORT REFERENCE: F091735E2

5.5.2 TEST RESULTS (FREQUENCY STABILITY)

Ambient temperature	20 °C	Relative humidity	53 %
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Test set-up: For this test the EUT was fixed on a wooden table inside the climatic chamber.

Cable guide: For further information of the cable guide refer to the pictures in annex A of this test report.

Remark: The table below shows the worst case frequency error with regard to the power-on time.

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)

Temperature	Supply voltage	Frequency [MHz]	Allowed tolerance	Measured tolerance	Result
70 °C	3.6 V DC	461.037369	±5.0 ppm	-0.284 ppm	Passed
60 °C	3.6 V DC	461.037365	±5.0 ppm	-0.293 ppm	Passed
50 °C	3.6 V DC	461.037350	±5.0 ppm	-0.325 ppm	Passed
40 °C	3.6 V DC	461.037309	±5.0 ppm	-0.414 ppm	Passed
30 °C	3.6 V DC	461.037341	±5.0 ppm	-0.345 ppm	Passed
20 °C	3.1 V DC (U _{min})	461.037356	±5.0 ppm	-0.312 ppm	Passed
	3.6 V DC (U _{nom})	461.037356	±5.0 ppm	-0.312 ppm	Passed
	3.7 V DC (U _{max})	461.037356	±5.0 ppm	-0.312 ppm	Passed
10 °C	3.6 V DC	461.037295	±5.0 ppm	-0.445 ppm	Passed
0 °C	3.6 V DC	461.037242	±5.0 ppm	-0.560 ppm	Passed
-10 °C	3.6 V DC	461.037300	±5.0 ppm	-0.434 ppm	Passed
-20 °C	3.6 V DC	461.037331	±5.0 ppm	-0.366 ppm	Passed
Measurement uncertainty			<± 1*10 ⁻⁷		

Transmitter operates at the middle of the assigned frequency band (operation mode 2)

Temperature	Supply voltage	Frequency [MHz]	Allowed tolerance	Measured tolerance	Result
70 °C	3.6 V DC	462.862338	±5.0 ppm	-0.350 ppm	Passed
60 °C	3.6 V DC	462.862341	±5.0 ppm	-0.344 ppm	Passed
50 °C	3.6 V DC	462.862316	±5.0 ppm	-0.398 ppm	Passed
40 °C	3.6 V DC	462.862283	±5.0 ppm	-0.469 ppm	Passed
30 °C	3.6 V DC	462.862312	±5.0 ppm	-0.406 ppm	Passed
20 °C	3.1 V DC (U _{min})	462.862327	±5.0 ppm	-0.374 ppm	Passed
	3.6 V DC (U _{nom})	462.862327	±5.0 ppm	-0.374 ppm	Passed
	3.7 V DC (U _{max})	462.862327	±5.0 ppm	-0.374 ppm	Passed
10 °C	3.6 V DC	462.862259	±5.0 ppm	-0.521 ppm	Passed
0 °C	3.6 V DC	462.862214	±5.0 ppm	-0.618 ppm	Passed
-10 °C	3.6 V DC	462.862272	±5.0 ppm	-0.493 ppm	Passed
-20 °C	3.6 V DC	462.862312	±5.0 ppm	-0.406 ppm	Passed
Measurement uncertainty			<± 1*10 ⁻⁷		

TEST REPORT REFERENCE: F091735E2

Transmitter operates at the upper end of the assigned frequency band (operation mode 3)

Temperature	Supply voltage	Frequency [MHz]	Allowed tolerance	Measured tolerance	Result
70 °C	3.6 V DC	464.562434	±5.0 ppm	-0.142 ppm	Passed
60 °C	3.6 V DC	464.562445	±5.0 ppm	-0.118 ppm	Passed
50 °C	3.6 V DC	464.562418	±5.0 ppm	-0.177 ppm	Passed
40 °C	3.6 V DC	464.562390	±5.0 ppm	-0.237 ppm	Passed
30 °C	3.6 V DC	464.562414	±5.0 ppm	-0.185 ppm	Passed
20 °C	3.1 V DC (U _{min})	464.562424	±5.0 ppm	-0.164 ppm	Passed
	3.6 V DC (U _{nom})	464.562424	±5.0 ppm	-0.164 ppm	Passed
	3.7 V DC (U _{max})	464.562424	±5.0 ppm	-0.164 ppm	Passed
10 °C	3.6 V DC	464.562360	±5.0 ppm	-0.301 ppm	Passed
0 °C	3.6 V DC	464.562313	±5.0 ppm	-0.403 ppm	Passed
-10 °C	3.6 V DC	464.562373	±5.0 ppm	-0.273 ppm	Passed
-20 °C	3.6 V DC	464.562413	±5.0 ppm	-0.187 ppm	Passed
Measurement uncertainty			<± 1*10 ⁻⁷		

Test result: Passed

TEST EQUIPMENT USED FOR THE TEST:

31, 54, 64

TEST REPORT REFERENCE: F091735E2

5.6 RADIATED EMISSIONS (RECEIVER)

5.6.1 METHOD OF MEASUREMENT (RADIATED RECEIVER EMISSIONS)

The radiated emission measurement is subdivided into four stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 30 MHz to 1 GHz.
- A final measurement carried out on an open area test side with reflecting ground plane and various antenna height in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with a variable antenna distance and height in the frequency range 1 GHz to 25 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 25 GHz.

All measurements will be carried out with the EUT working on the middle and upper and lower edge of the assigned frequency band. For this reason the hopping function of the EUT has to be disabled.

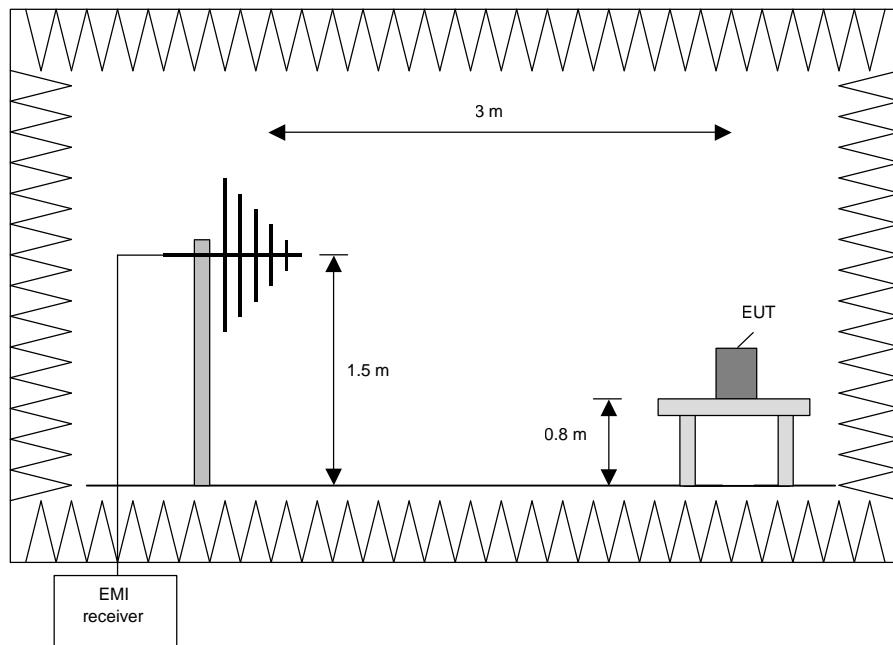
Preliminary measurement (30 MHz to 1 GHz)

In the first stage a preliminary measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003 [1].

The frequency range 30 MHz to 1 GHz will be measured with an EMI Receiver set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 230 MHz	100 kHz
230 MHz to 1 GHz	100 kHz



TEST REPORT REFERENCE: F091735E2

Procedure preliminary measurement:

Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz. The following procedure will be used:

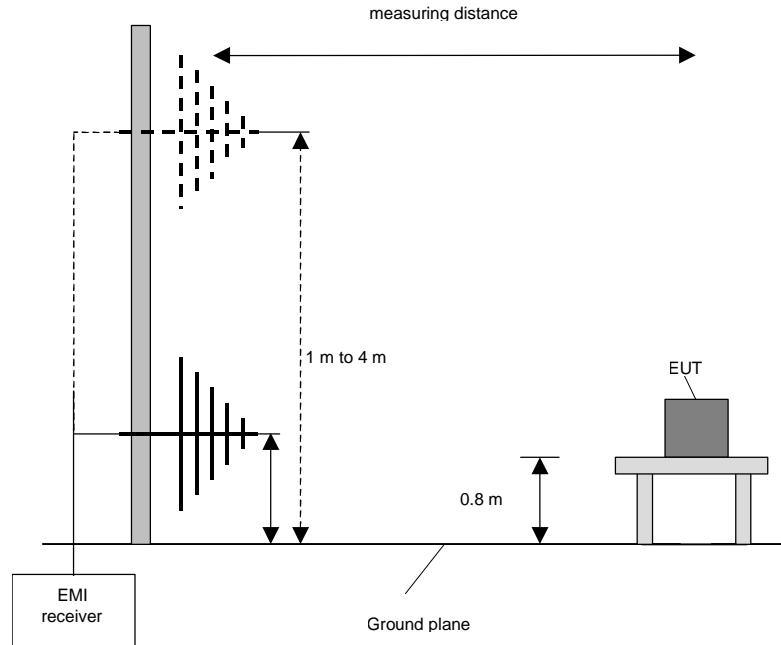
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
6. Repeat 1) to 4) with the other orthogonal axes of the EUT (if handheld equipment).
7. Repeat 1) to 5) with the vertical polarisation of the measuring antenna.

Final measurement (30 MHz to 1 GHz)

A final measurement on an open area test site will be performed on selected frequencies found in the preliminary measurement. During this test the EUT will be rotated in the range of 0 ° to 360 °, the measuring antenna will be set to horizontal and vertical polarisation and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



TEST REPORT REFERENCE: F091735E2

Procedure final measurement:

The following procedure will be used:

- 1) Measure on the selected frequencies at an antenna height of 1 m and a EUT azimuth of 23 °.
- 2) Move the antenna from 1 m to 4 m and note the maximum value at each frequency.
- 3) Rotate the EUT by 45 ° and repeat 2) until an azimuth of 337 ° is reached.
- 4) Repeat 1) to 3) for the other orthogonal antenna polarization.
- 5) Move the antenna and the turntable to the position where the maximum value is detected.
- 6) Measure while moving the antenna slowly +/- 1 m.
- 7) Set the antenna to the position where the maximum value is found.
- 8) Measure while moving the turntable +/- 45 °.
- 9) Set the turntable to the azimuth where the maximum value is found.
- 10) Measure with Final detector and note the value.
- 11) Repeat 5) to 10) for each frequency.
- 12) Repeat 1) to 11) for each orthogonal axes of the EUT (if handheld equipment).
- 13) Replace the EUT by a suitable substitution antenna and connect this antenna to a signal generator.
- 14) Set the turntable to the azimuth and the antenna to the position where the maximum value is found
- 15) Variate the output power for each frequency, until the level of the EUTs emission is found.
- 16) Note the output power of the signal generator.

Preliminary and final measurement (1 GHz to 25 GHz)

This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003 [1].

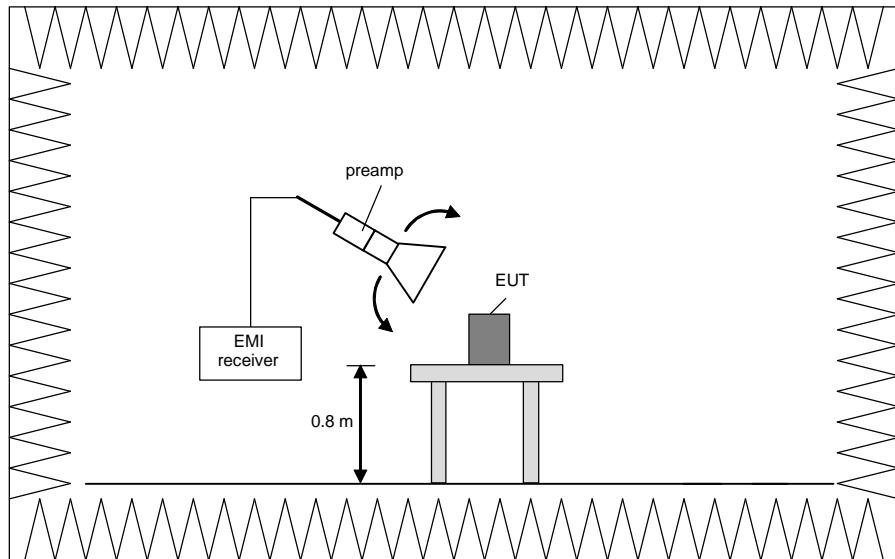
Preliminary measurement (1 GHz to 25 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna, the antenna close to the EUT and while moving the antenna over all sides of the EUT. With the spectrum analyser in CLEAR / WRITE mode the cone of the emission should be found and than the measuring distance will be set to 3 m with the receiving antenna moving in this cone of emission. At this position the final measurement will be carried out.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	100 kHz
4 GHz to 12 GHz	100 kHz
12 GHz to 18 GHz	100 kHz
18 GHz to 25 GHz	100 kHz

TEST REPORT REFERENCE: F091735E2

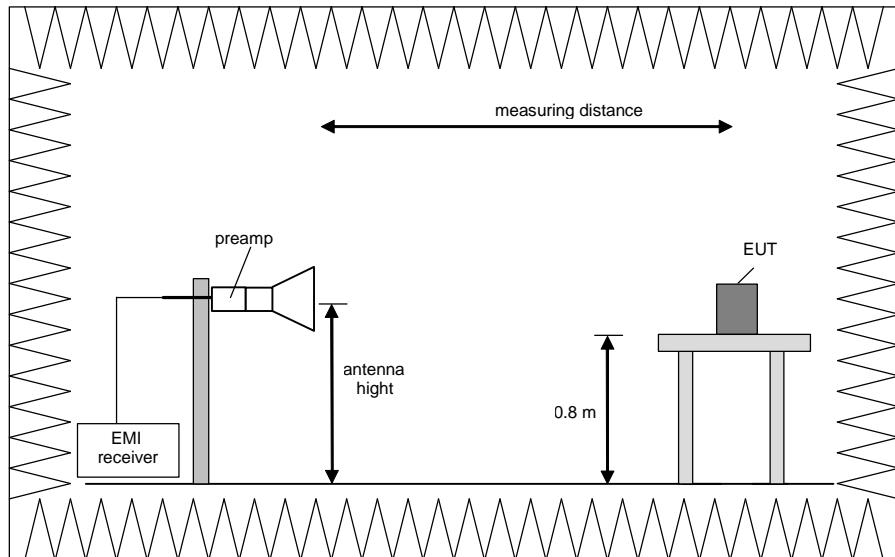


Final measurement (1 GHz to 25 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 ° in order to have the antenna inside the cone of radiation.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 25 GHz	1 MHz



TEST REPORT REFERENCE: F091735E2

Procedure of measurement:

The measurements were performed in the frequency range 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz and 18 GHz to 25 GHz.

The following procedure will be used:

- 1) Monitor the frequency range at horizontal polarisation and move the antenna over all sides of the EUT (if necessary move the EUT to another orthogonal axis).
- 2) Change the antenna polarisation and repeat 1) with vertical polarisation.
- 3) Make a hardcopy of the spectrum.
- 4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
- 5) Change the analyser mode to Clear / Write and found the cone of emission.
- 6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3 m and the antenna will be still inside the cone of emission.
- 7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarisation and azimuth and the peak and average detector, which causes the maximum emission.
- 8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.
- 9) Replace the EUT by a suitable substitution antenna and connect this antenna to a signal generator.
- 10) Set the turntable to the azimuth to the position where the maximum value is found
- 11) Variate the output power for each frequency, until the level of the EUTs emission is found.
- 12) Note the output power of the signal generator.

Step 1) to 6) are defined as preliminary measurement.

TEST REPORT REFERENCE: F091735E2

5.6.2 TEST RESULTS (RADIATED RECEIVER EMISSIONS)

5.6.2.1 PRELIMINARY MEASUREMENT (9 kHz to 2.5 GHz)

Ambient temperature	20 °C	Relative humidity	57 %
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Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m. For further information of the set up refer to the pictures in annex A of this test report.

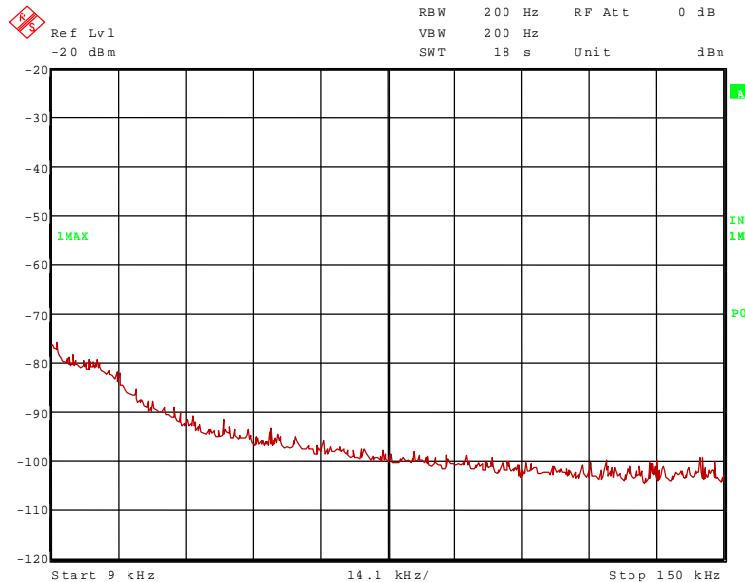
Cable guide: No cables were connectable to the EUT.

Test record: Where not otherwise stated the test was carried out in test mode 5 of the EUT, because there was no difference to the test modes 4 or 6. All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 3.6 V DC via the internal battery.

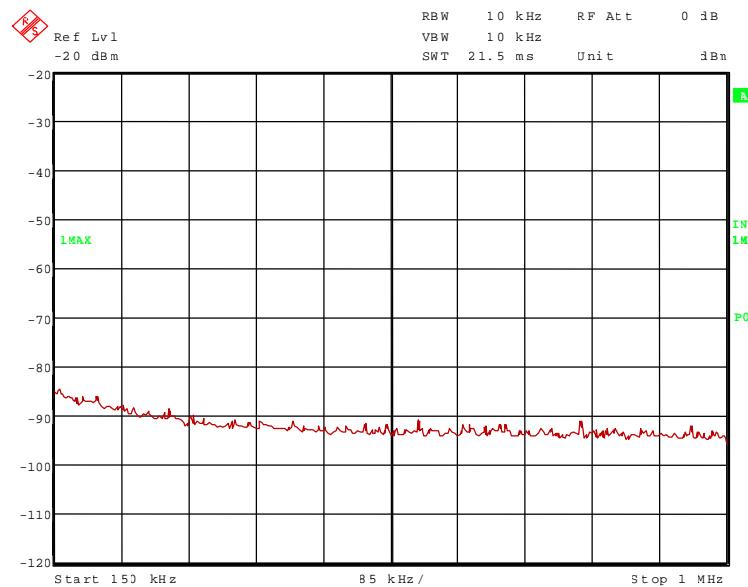
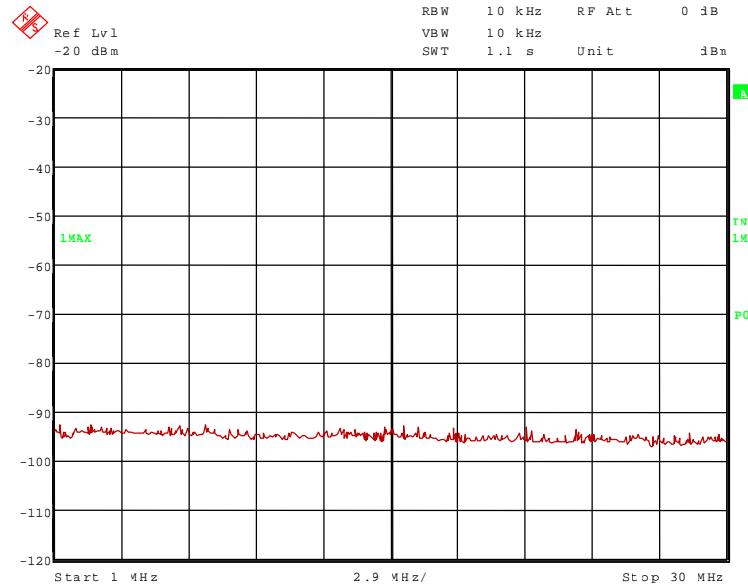
Remark: All measurements were carried out with the dedicated antenna connected to the antenna connector of the EUT.

91735_14.wmf: Spurious radiation from 9 kHz to 150 kHz (operation mode 5):

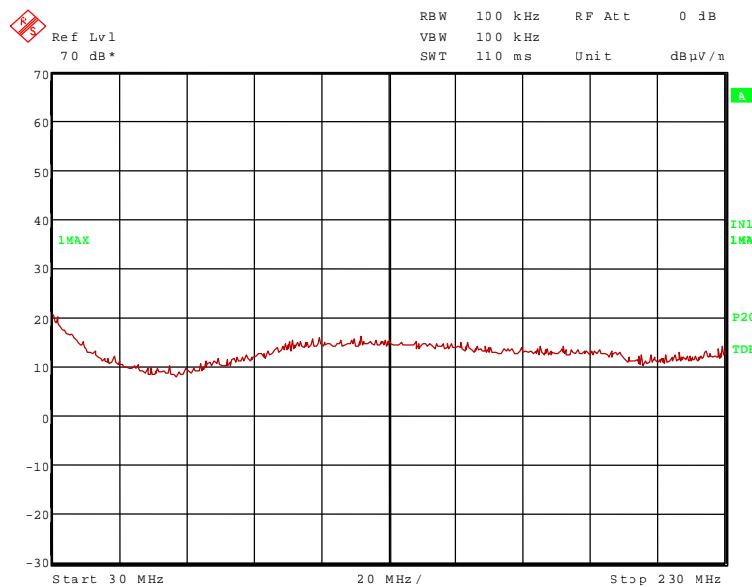
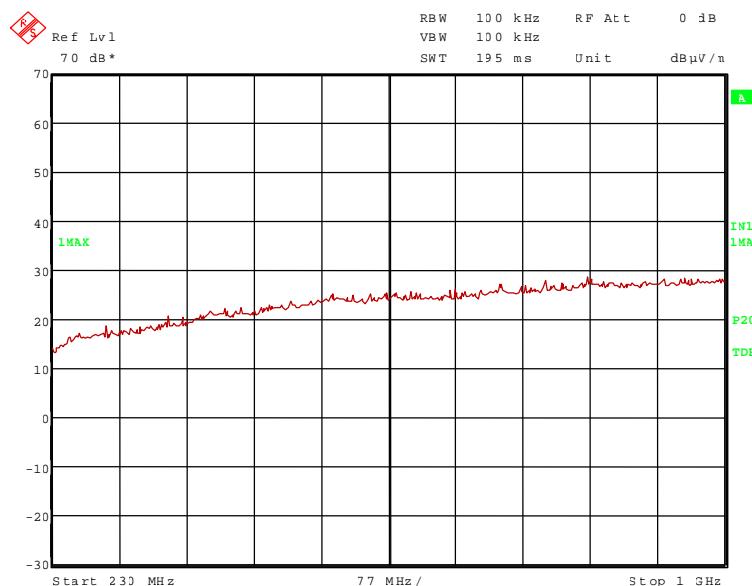


TEST EQUIPMENT USED FOR THE TEST:

29, 31 – 36, 43, 44, 49, 58

TEST REPORT REFERENCE: F091735E2
91735_15.wmf: Spurious radiation from 150 kHz to 1 MHz (operation mode 5):

91735_16.wmf: Spurious radiation from 1 MHz to 30 MHz (operation mode 5):


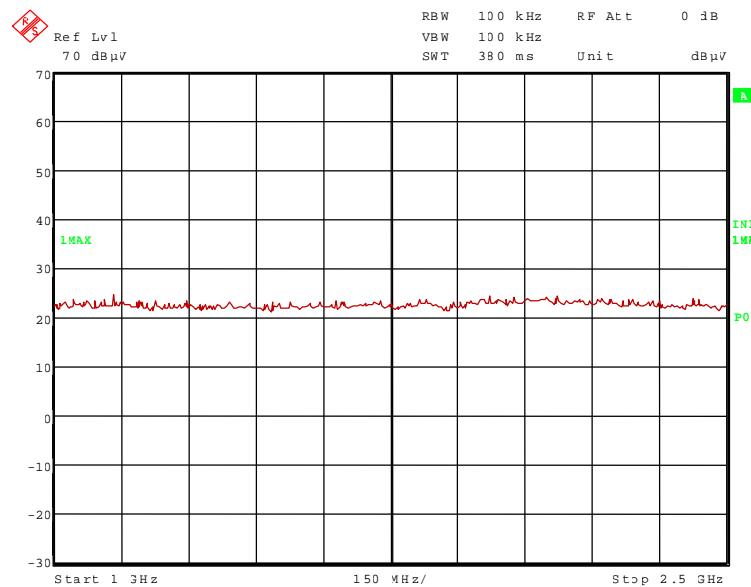
No significant emissions above the noise floor of the measuring system found in this frequency range, so no final measurement on the outdoor test site were carried out.

TEST REPORT REFERENCE: F091735E2
91735 17.wmf: Spurious radiation from 30 MHz to 230 MHz (operation mode 5):

91735 18.wmf: Spurious radiation from 230 MHz to 1 GHz (operation mode 5):


No significant emissions above the noise floor of the measuring system found in this frequency range, so no final measurement on the open area test site were carried out.

TEST REPORT REFERENCE: F091735E2

91735_10.wmf: Spurious radiation from 1 GHz to 2.5 GHz (operation mode 5):



No significant emissions above the noise floor of the measuring system found in this frequency range, so no final measurements were carried out.

TEST REPORT REFERENCE: F091735E2

5.7 CONDUCTED EMISSIONS (RECEIVER)

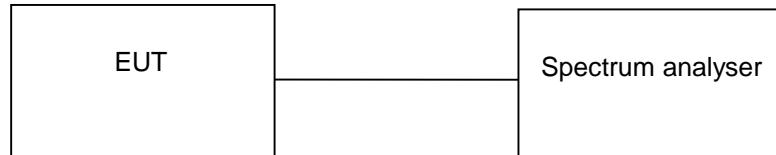
5.7.1 METHOD OF MEASUREMENT (RECEIVER CONDUCTED EMISSIONS)

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 EUT has to be switched on and the hopping function has to be disabled (if applicable).

Analyser Parameter	Frequency range			
	9 kHz to 150 kHz	150 kHz to 30 MHz	30 MHz to 1 GHz	1 GHz to 2.5 GHz
Start frequency	9 kHz	150 kHz	30 MHz	1 GHz
Stop frequency	150 kHz	30 MHz	1 GHz	25 GHz
Resolution bandwidth	200 Hz	10 kHz	100 kHz	1 MHz
Video bandwidth	200 Hz	10 kHz	100 kHz	1 MHz
Sweep	Auto	Auto	Auto	Auto
Detector function	Peak	Peak	Peak	Peak
Trace mode	Max hold	Max hold	Max hold	Max hold

The measurement will be performed with the EUT operates at the middle of the assigned frequency band.

Test set-up:

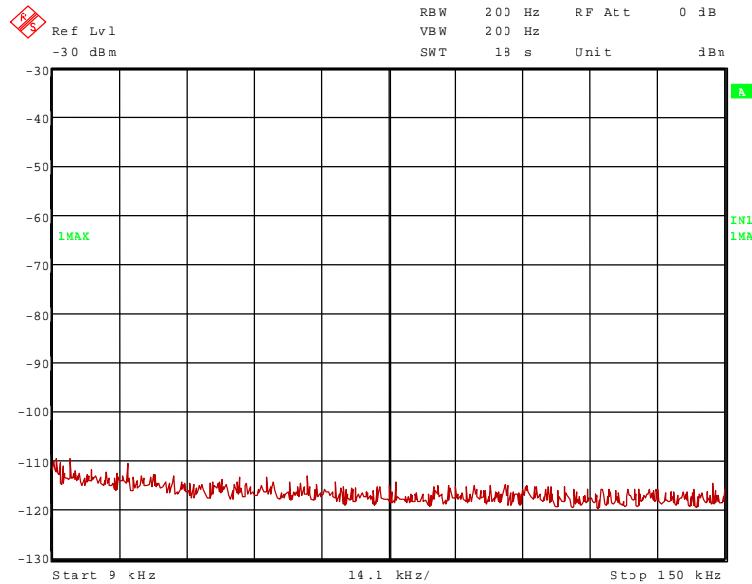


TEST REPORT REFERENCE: F091735E2

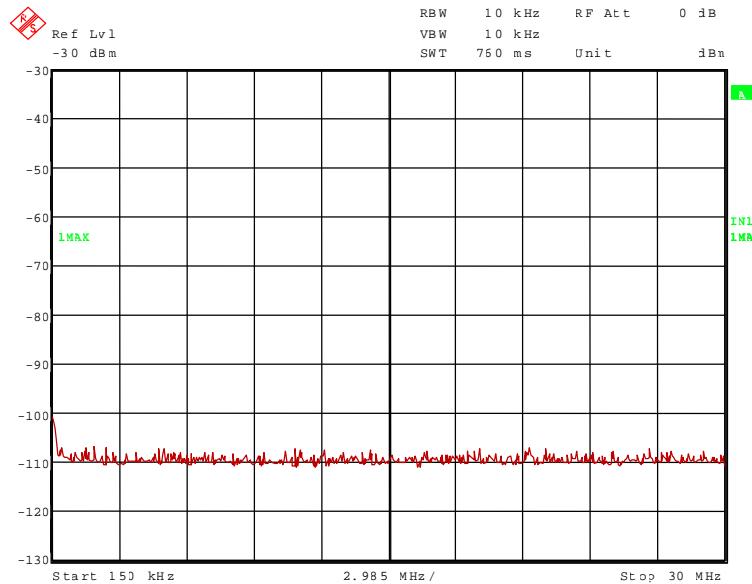
5.7.2 TEST RESULTS (RECEIVER CONDUCTED EMISSIONS)

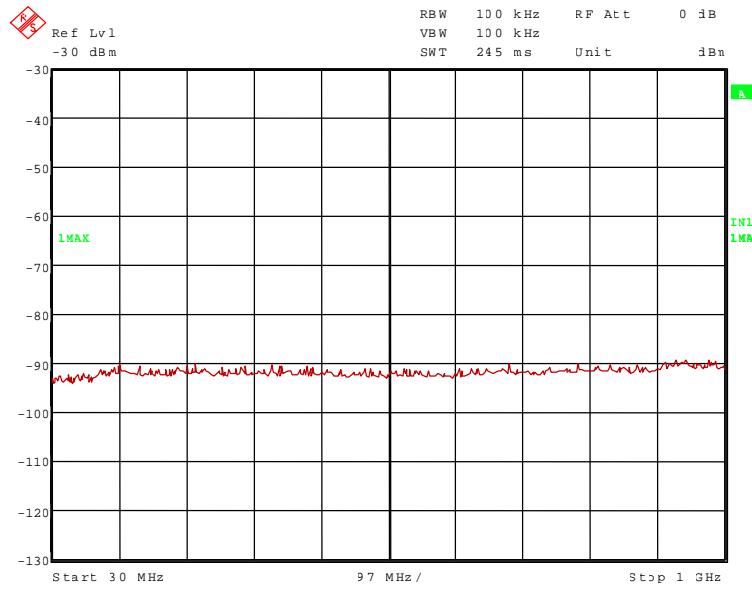
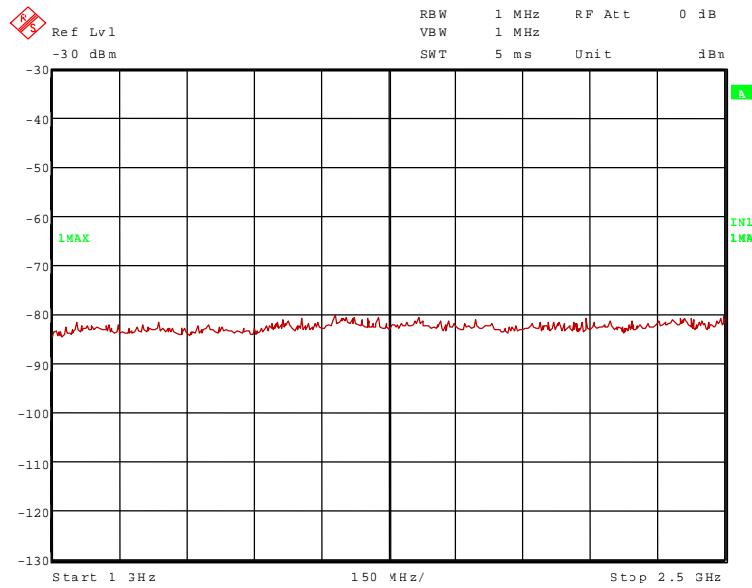
Ambient temperature	20 °C	Relative humidity	52 %
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91735_77.wmf: Conducted spurious emissions from 9 kHz to 150 kHz (operation mode 5):



91735_78.wmf: Conducted spurious emissions from 150 kHz to 30 MHz (operation mode 5):



TEST REPORT REFERENCE: F091735E2
91735_79.wmf: Conducted spurious emissions from 30 MHz to 1 GHz (operation mode 5):

91735_80.wmf: Conducted spurious emissions from 1 GHz to 2.5 GHz (operation mode 5):


Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

31, 54, 67, 68

TEST REPORT REFERENCE: F091735E2

6 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
15	Measuring receiver	ESIB 7	Rohde & Schwarz	100276	480479	02/26/2008	02/2010
16	Controller	HD100	Deisel	100/670	480139	-	-
17	Turntable	DS420HE	Deisel	420/620/80	480087	-	-
18	Antenna support	AS615P	Deisel	615/310	480086	-	-
19	Antenna	CBL6111 A	Chase	1643	480147	08/01/2007	08/2012
18	Antenna support	AS615P	Deisel	615/310	480086	-	-
19	Antenna	CBL6111 A	Chase	1643	480147	08/01/2007	08/2012
20	EMI Software	ES-K1	Rohde & Schwarz	-	480111	-	-
29	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
31	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	02/25/2008	02/2010
32	Controller	MCU	Maturo GmbH	MCU/043/971107	480832	-	
33	Turntable	DS420HE	Deisel	420/620/80	480315	-	
34	Antenna support	AS615P	Deisel	615/310	480187	-	
35	Antenna	CBL6112 B	Chase	2688	480328	10/11/2005	10/2010
36	Antenna	3115 B	EMCO	9609-4918	480184	09/11/2008	09/2013
43	RF-cable No. 30	RTK 081	Rosenberger	-	410141	Weekly verification (system cal.)	
44	RF-cable No. 31	RTK 081	Rosenberger	-	410142	Weekly verification (system cal.)	
49	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	Six month verification (system cal.)	
54	System Power Supply	TOE8872	Toellner	54158	480424	04/17/2008	04/2010
58	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	02/19/2008	02/2013
60	Signal generator	83650L	Agilent	3844A00554	480333	02/26/2008	02/2010
61	Precision Dipole	HZ 13	Rohde & Schwarz	831782/02	480062	Six month verification (system cal.)	
62	Horn Antenna	3115 A	EMCO	9609-4922	480183	Six month verification (system cal.)	
63	RF-cable No. 1	RTK 081	Rosenberger	-	410093	Weekly verification (system cal.)	
64	Climatic chamber	MK 240	BINDER	05-79022	480462	07/01/2009	01/2011
65	Power Meter	NRVD	Rohde & Schwarz	828110/026	480267	02/26/2008	02/2010
66	Thermal Power Sensor	NRV-Z51	Rohde & Schwarz	825489/004	480247	02/22/2008	02/2010
67	High Pass Filter	WHJS1000C11 /60EF	Wainwright Instruments GmbH	1	480413	-	-
68	Tunable Notch Filter	TTR 375-3EE	TELONIC Berkeley	-	480330	-	-

TEST REPORT REFERENCE: F091735E2

7 LIST OF ANNEXES

ANNEX A	PHOTOGRAPHS OF THE TEST SET-UPS:	6 pages
	SePem 01 Logger, test setup fully anechoic chamber	91735_d.jpg
	SePem 01 Logger, test setup fully anechoic chamber	91735_b.jpg
	SePem 01 Logger, test setup fully anechoic chamber	91735_a.jpg
	SePem 01 Logger, test setup fully anechoic chamber	91735_c.jpg
	SePem 01 Logger, test setup open area test site	91735_j.jpg
	SePem 01 Logger, test setup climatic chamber	91735_q.jpg
ANNEX B	EXTERNAL PHOTOGRAPHS OF THE TEST SAMPLE:	4 pages
	SePem 01 Logger, 3-D-view 1	91735_13.jpg
	SePem 01 Logger, 3-D view 2	91735_14.jpg
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	SePem 01 Logger, detail view to antenna connector	91735_16.jpg
ANNEX C	INTERNAL PHOTOGRAPHS OF THE TEST SAMPLE:	4 pages
	SePem 01 Logger, internal view	91735_17.jpg
	SePem 01 Logger, PCB, top view	91735_19.jpg
	SePem 01 Logger, PCB, top view, battery removed	91735_20.jpg
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ANNEX D	ADDITIONAL RESULTS FOR INDUSTRY CANADA:	2 pages