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Test Report

Report Number: F110464E1

Applicant:

OTT Messtechnik GmbH & Co. KG

Manufacturer:

OTT Messtechnik GmbH & Co. KG

Equipment under Test (EUT):

RLS

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 and
Industry Canada Test site registration IC3469A-1

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 2010)** Radio Frequency Devices

[3] **RSS-210 Issue 8 (December 2010)** Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment

[4] **RSS-Gen Issue 4 (December 2010)** General Requirements and Information for the Certification of Radio Apparatus

[5] **Hewlett Packard Application note 150-2 (November 1971)** Spectrum Analysis Pulsed RF

TEST RESULT

The requirements of the tests performed as shown in the overview (chapter 4 of this test report) were fulfilled by the equipment under test.
The complete test results are presented in the following.

Test engineer:	Thomas KÜHN		07 March 2011
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		07 March 2011
	Name	Signature	Date

RESERVATION

This test report is only valid in its original form.

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1 IDENTIFICATION

1.1 Applicant

Name:	OTT MESSTECHNIK GmbH & Co. KG
Address:	Ludwigstrasse 16 87437 Kempten
Country:	Germany
Name for contact purposes:	Mr. Martin KENNERKNECHT
Phone:	+ 49 831 56 17-310
Fax:	+ 49 831 56 17-309
eMail Address:	m.kennerknecht@ott.com
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	OTT MESSTECHNIK GmbH & Co. KG
Address:	Ludwigstrasse 16 87437 Kempten
Country:	Germany
Name for contact purposes:	Mr. Martin KENNERKNECHT
Phone:	+ 49 831 56 17-310
Fax:	+ 49 831 56 17-309
eMail Address:	m.kennerknecht@ott.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 and Industry Canada Test site registration IC3469A-1.

1.4 EUT (Equipment Under Test)

Test object:	Radar level sensor
Type:	RLS
FCC ID:	OA6OTTRLS
IC:	7253A-OTTRLS
Serial number:	277864
Software version:	None

1.5 Technical data of equipment

Power supply voltage range	9.6 V DC to 28 V DC by external power supply
Highest/Lowest internal frequency:	24 GHz / 3.57 MHz

The following external I/O cables were used:

An unshielded 8-pole connection cable with power supply and data in and out lines was connected to the EUT's connector. All wires were connected to the EUT (used and unused). A laptop computer could be used to read out the data from the data logger, it was not connected during the tests.

1.6 Dates

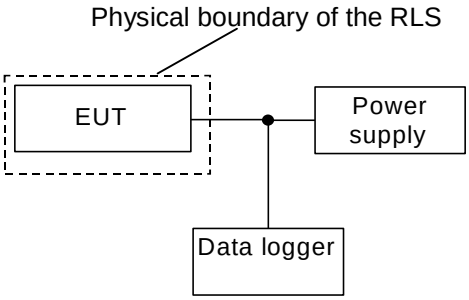
Date of receipt of test sample:	25 February 2011
Start of test:	02 March 2011
End of test:	04 March 2011

2 OPERATIONAL STATES

For all measurements the RLS was tested in normal operation mode. This means that the transmitter is switched on every 280 ns for approximately 1.5 ns after the EUT is powered on. The receiver is switched on time shifted after the transmitter pulse is off with the same timing than the transmitter. Because the receiver is only on for 1.2 ns after the transmitter is off and it will not be switched on separately, no measurements of the receiver were possible.

The EUT is intended to be wall mounted on a bridge head and its antenna will be orientated down to the surface of the water below. The cone of emissions is directed to the water surface. For details of the positioning during the measurements please refer the photographs in Annex A of this test report.

The physical boundaries of the Equipment Under Test are shown below.



2.1 Periphery devices

The following ancillary equipment was used:

- A data logger type OTT LogoSens 2 was connected to the data in and out line of the EUT.

3 ADDITIONAL INFORMATION

The results documented in this test report are taken into consideration the mounting conditions of the EUT in the field. The EUT is categorised as wall mounted equipment and covered by a steel cover for vandalism protection.

4 OVERVIEW

Conducted emissions (FCC 47 CFR Part 15 section 15.207 (a)[2] and RSS Gen [4] section 7.2.4)

Application	Frequency range	Limits	Reference standard	Remark	Status
On AC supply line	0.15 to 0.5 MHz 0.5 to 5 MHz 5 to 30 MHz	66 to 56 dBµV (QP) * 56 to 46 dBµV (AV) * 56 dBµV (QP) 46 dBµV (AV) 60 dBµV (QP) 50 dBµV (AV)	ANSI C63.4 (2009)	Refer page 5.3 et seq.	Passed

*: Decreases with the logarithm of the frequency

Radiated emissions (FCC 47 CFR Part 15 section 15.209 and RSS Gen [4] section 7.2.5)

Application	Frequency of Emission	Limits ***	Reference standard	Remark	Status
Radiated emissions	9 kHz to 490 kHz 490 kHz to 1.705 MHz 1.705-30 MHz 30 to 88 MHz 88 to 216 MHz 216 to 960 MHz Above 960 MHz	2400/F* µV/m at 300 m 24000/F* µV/m at 30 m 30 µV/m at 30 m 40 dBµV/m at 3 m** 43 dBµV/m at 3 m** 46 dBµV/m 3 m** 54 dBµV/m 3m	ANSI C63.4 (2009);	Refer page 5.2 et seq.	Passed

* F in kHz

** Except as provided in paragraph (g) (of Part 15.209), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54 – 72 MHz, 76 – 88 MHz, 174 – 216 MHz or 470 – 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

*** The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

Antenna requirement (FCC 47 CFR Part 15 section 15.203 [2])

	Status
The EUT has an integrated antenna only	Passed

99 % bandwidth (RSS Gen [4] section 4.6.1)

Frequency range	Remark	Status
24,333 MHz	Refer Annex D page 1 et seq.	-

5 TEST RESULTS

5.1 Pulse data

5.1.1 Method of measurement (Pulse data)

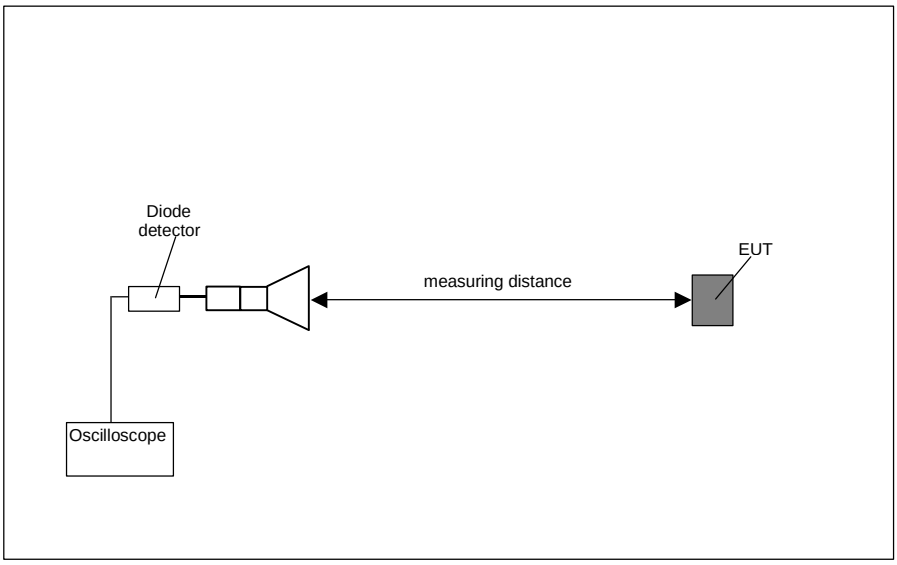
The measurement antenna has to be connected to the oscilloscope via the diode detector. Because the measurement distance has an influence in the result, it was agreed between the test laboratory and the applicant to use a measuring distance of ten to twenty times higher than the wavelength of the observed signal in order to decrease the measurement uncertainty and the statistical spread.

For the pulse repetition time measurement a horizontal scale of app. 1.5 times the pulse repetition time should be used.

The measurement of the pulse width shall be carried out with a horizontal scale, which displays as much of the pulse in question as possible in order to increase the reading accuracy.

The vertical scale for both measurements shall be as large as possible without being larger that the display range.

Because of the used diode detector, positive RF-peaks are negative in the above plots.



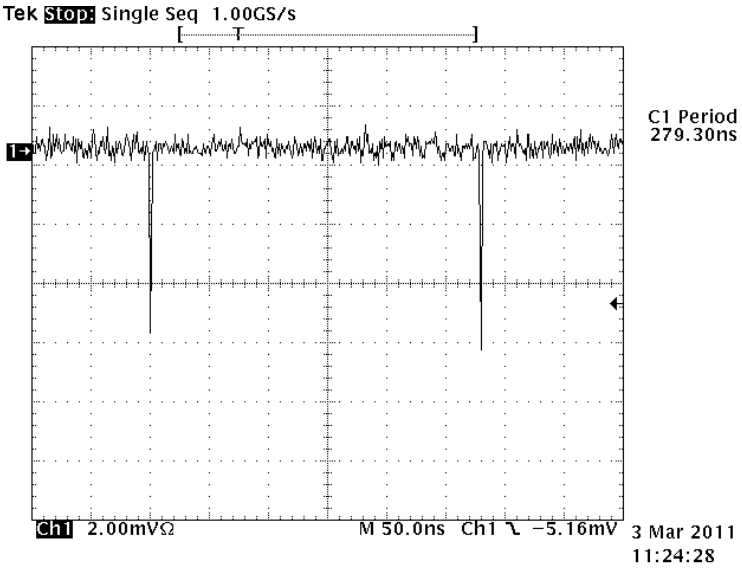
5.1.2 Test results (pulse data)

Ambient temperature	21 °C	Relative humidity	30 %

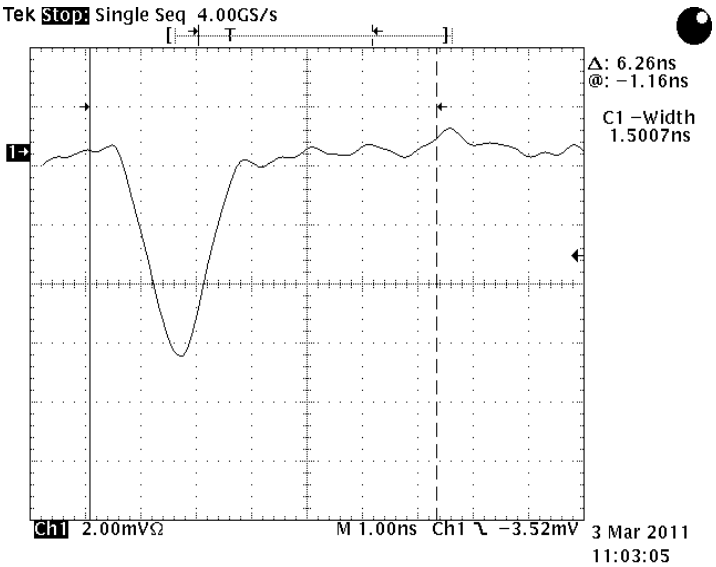
Position of EUT: The EUT was set-up on a non-conducting table with a distance of 24.8 cm to the measuring antenna.

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

110464_002.tiff: Pulse repetition time:



110464_001.tiff: Pulse width



TEST EQUIPMENT USED FOR THE TEST:

40, 69, 73, 74

5.1.3 Calculation of the peak desensitization factor

Because of pulsed transmission a desensitization factor has to be calculated and added to the measured peak value in order to find the true peak of the signal. The relevant measurements were carried out with a peak detector and the true peak and the average value is calculated as required in the HP application note 150-2 [5].

The observed spectrum is a line spectrum, because the spacing between the spectrum lines will not change when the analysers sweep time is changed and the amplitude of the lines will not change if the resolution bandwidth of the analyser is changed as long as the resolution bandwidth is below the pulse repetition frequency.

For measuring a line spectrum two conditions have to be fulfilled:

1.) The resolution bandwidth of analyser has to be below 0.3 times the pulse repetition time ($B < 0.3 \times PRF$).
2.) The sweep time of the analyser has to be smaller than the span divided by the squared resolution bandwidth ($T_s > F_s / B^2$).

With the used resolution bandwidth of 100 kHz, a frequency span of 500 MHz, a sweep time of 125 ms and a pulse repetition time of 3.6 MHz the two conditions were fulfilled (refer page 27 for detailed measurement plot).

In accordance to the HP application note 150-2 [5] the pulse desensitization factor was calculated as follows:

$\alpha_L = 20 \log (\tau_{eff} / T)$

With τ_{eff} = 1.5 ns and T = 279.3 ns the α_L is calculates to: $\underline{\alpha_L = -45.4\ dB}$.

5.1.4 Calculation of the average correction factor

In order to find the average value of pulsed emissions an average correction factor was calculated to convert the true peak value of the emission to an average value.

The average correction factor is calculated as follows:

Because of pulsed transmission a desensitization factor has to be calculated and added to the measured peak value in order to find the true peak of the signal. The relevant measurements were carried out with a peak detector and the true peak and the average value is calculated as required in the HP application note 150-2 [5].

$\alpha_{AV} = 20 \log (\tau_{eff} \times PRF)$

With τ_{eff} = 1.5 ns and PRF = 3.6 MHz the α_{AV} is calculates to: $\underline{\alpha_{AV} = -45.4\ dB}$.

5.2 Radiated emissions

5.2.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into five stages.
A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 9 kHz to 1 GHz.
A final measurement carried out on an outdoor test side without reflecting ground plane and a fixed antenna height in the frequency range 9 kHz to 30 MHz.
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 100 GHz.
A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 100 GHz.

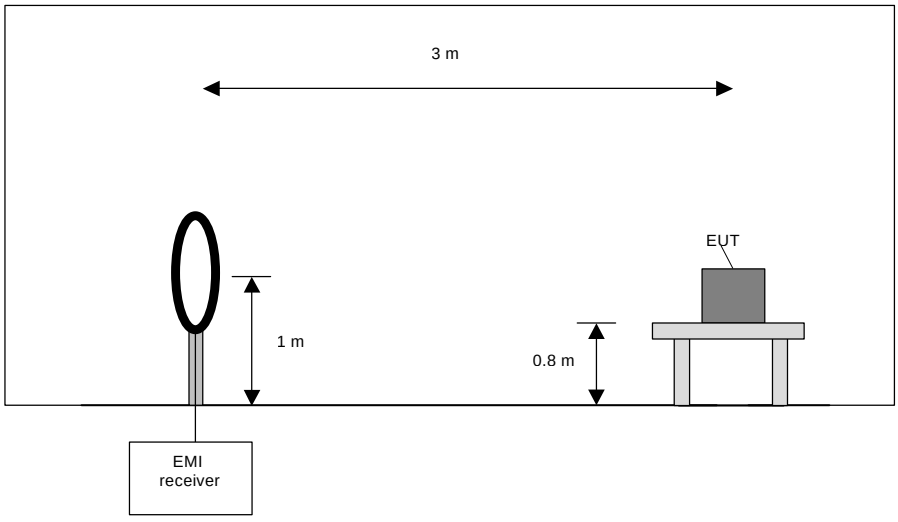
Preliminary measurement (9 kHz to 30 MHz):

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of
3 meters. 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 C63.4-2009 [1].

The frequency range 9 kHz to 30 MHz will be monitored with a spectrum analyser while the system and its cables will be manipulated to find out the configuration with the maximum emission levels if applicable. The EMI Receiver will be set to MAX Hold mode. The EUT and the measuring antenna will be rotated around their vertical axis to found the maximum emissions.

The resolution bandwidth of the spectrum analyser will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	10 kHz



Preliminary measurement procedure:

Prescans were performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.

The following procedure will be used:
Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
Manipulate the system cables within the range to produce the maximum level of emission.
Rotate the EUT by 360 ° to maximize the detected signals.
Make a hardcopy of the spectrum.
Measure the frequencies of highest detected emission with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
Repeat steps 1) to 5) with the other orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).
Rotate the measuring antenna and repeat steps 1) to 5).

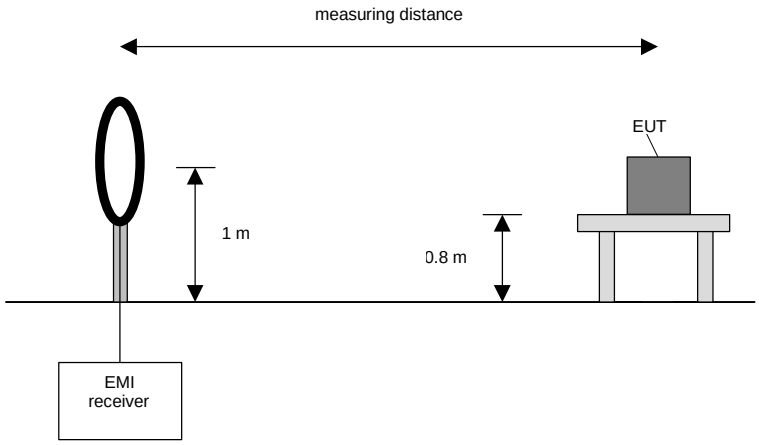
Final measurement (9 kHz to 30 MHz):

In the second stage a final measurement will be performed on an open area test site with no conducting ground plane in a measuring distances of 3 m, 10 m and 30 m. In the case where larger measuring distances are required the results will be extrapolated based on the values measured on the closer distances according to Section 15.31 (f) (2) [2]. The final measurement will be performed with a EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where an average detector will be used according Section 15.209 (d) [2].

On the during the preliminary measurement detected frequencies the final measurement will be performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum value is found.

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

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz



Final measurement procedure:

The following procedure will be used:
Monitor the frequency range with the measuring antenna at vertical orientation parallel to the EUT at an azimuth of 0 °.
Rotate the EUT by 360 ° to maximize the detected signals and note the azimuth and orientation.
Rotate the measuring antenna to find the maximum and note the value.
Rotate the measuring antenna and repeat steps 1) to 3) until the maximum value is found.
Repeat steps 1) to 4) with the other orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).

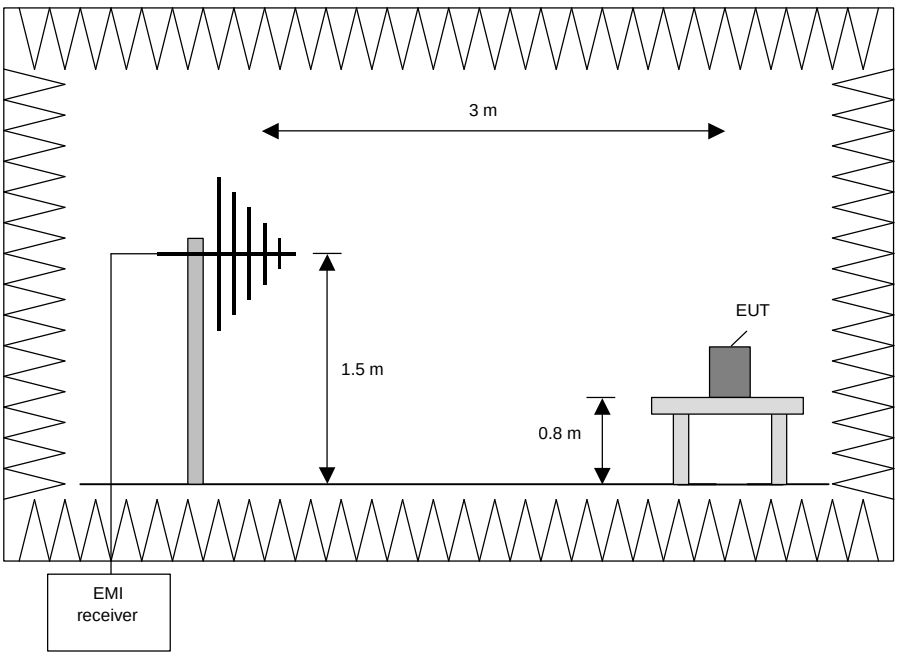
Preliminary measurement (30 MHz to 1 GHz)

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 C63.4-2009 [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



Procedure preliminary measurement:

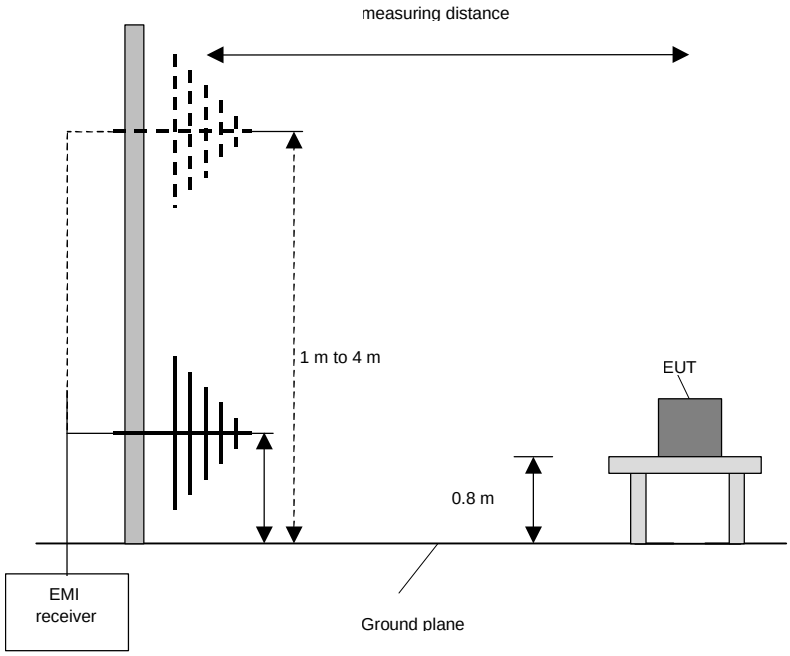
Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.
The following procedure will be used:
Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
Manipulate the system cables within the range to produce the maximum level of emission.
Rotate the EUT by 360 ° to maximize the detected signals.
Make a hardcopy of the spectrum.
Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
Repeat 1) to 4) with the other orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).
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



Procedure final measurement:

The following procedure will be used:

Measure on the selected frequencies at an antenna height of 1 m and a EUT azimuth of 23 °.
Move the antenna from 1 m to 4 m and note the maximum value at each frequency.
Rotate the EUT by 45 ° and repeat 2) until an azimuth of 337 ° is reached.
Repeat 1) to 3) for the other orthogonal antenna polarization.
Move the antenna and the turntable to the position where the maximum value is detected.
Measure while moving the antenna slowly +/- 1 m.
Set the antenna to the position where the maximum value is found.
Measure while moving the turntable +/- 45 °.
Set the turntable to the azimuth where the maximum value is found.
Measure with Final detector (QP and AV) and note the value.
Repeat 5) to 10) for each frequency.
Repeat 1) to 11) for each orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).

Preliminary and final measurement (1 GHz to 100 GHz)

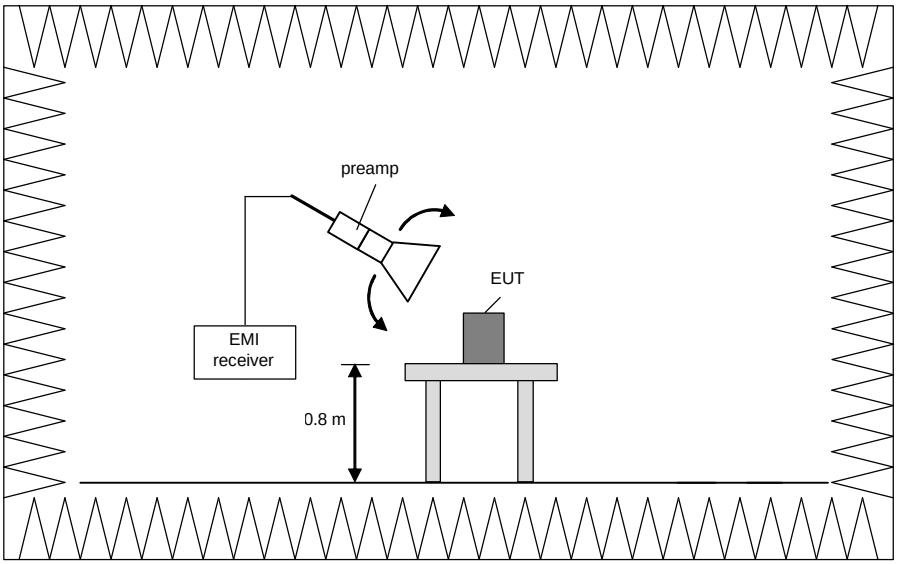
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2009 [1].

Preliminary measurement (1 GHz to 40 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 26.5 GHz	100 kHz
26.5 GHz to 40 GHz	100 kHz
40 GHz to 60 GHz	100 kHz
60 GHz to 75 GHz	100 kHz
75 GHz to 100 GHz	100 kHz

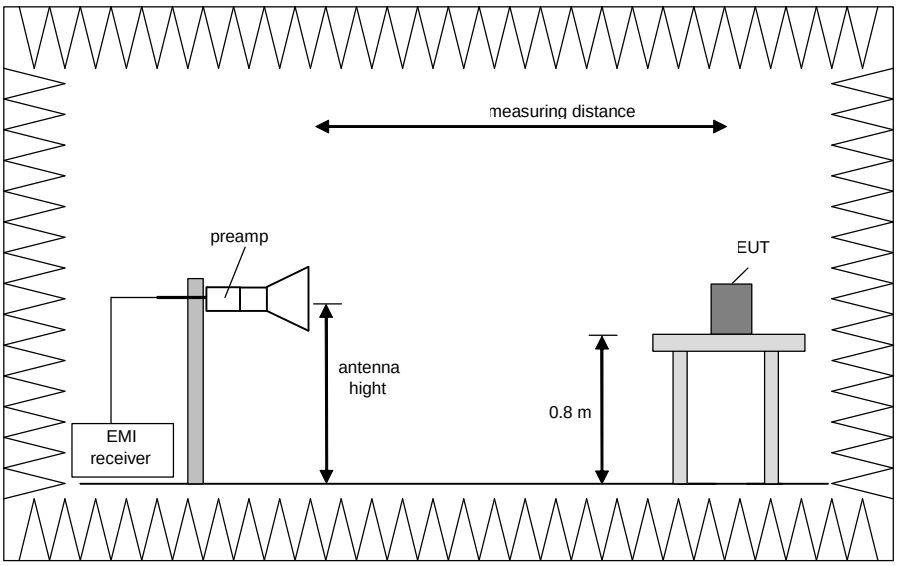


Final measurement (1 GHz to 100 GHz)

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 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz
40 GHz to 60 GHz	1 MHz
60 GHz to 75 GHz	1 MHz
75 GHz to 100 GHz	1 MHz



Procedure of measurement:

The measurements were performed in the frequency ranges 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 26.5 GHz, 26.5 GHz to 40 GHz, 40 GHz to 60 GHz, 60 GHz to 75 GHz and 75 GHz to 100 GHz.
The following procedure will be used:
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).
Change the antenna polarisation and repeat 1) with vertical polarisation.
Make a hardcopy of the spectrum.
Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
Change the analyser mode to Clear / Write and found the cone of emission.
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.
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.
Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.

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

5.2.2 Test results (preliminary radiated emission test (9 kHz to 100 GHz))

Ambient temperature	21 °C	Relative humidity	32 %

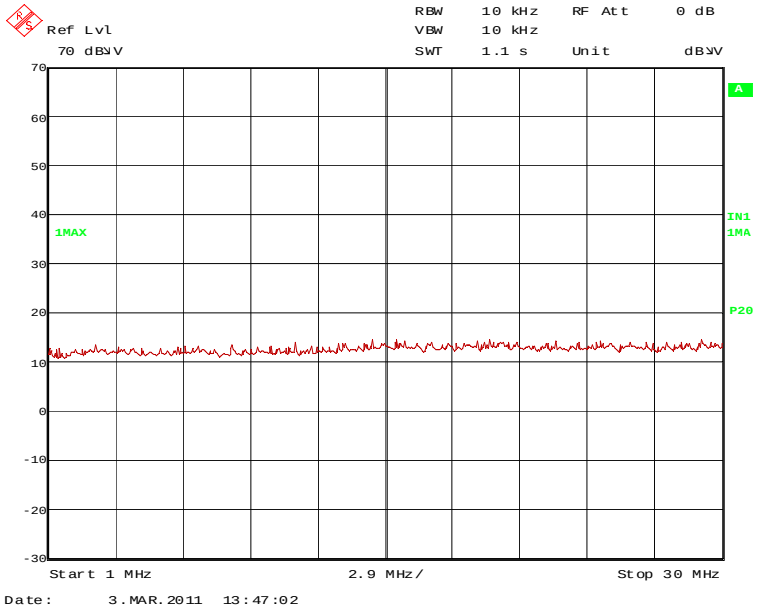
Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and the antenna was 3 m (1 MHz to 1 GHz), 1 m (1 GHz to 40 GHz) and 10 cm (40 GHz to 100 GHz).

Cable guide: The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

Test record: The test was carried out in transmit mode of the EUT.

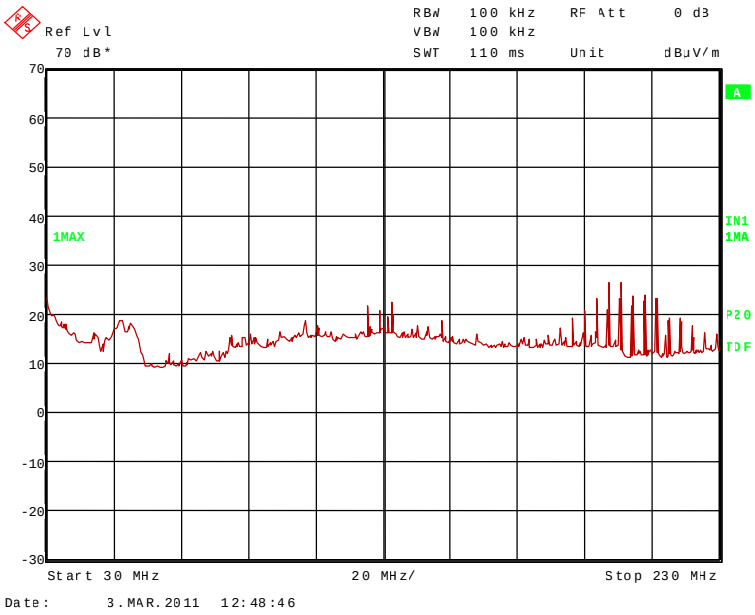
Supply voltage: The EUT was supplied by the external power supply with 12 V DC.

110464_11.wmf: Spurious emissions from 1 MHz to 30 MHz:

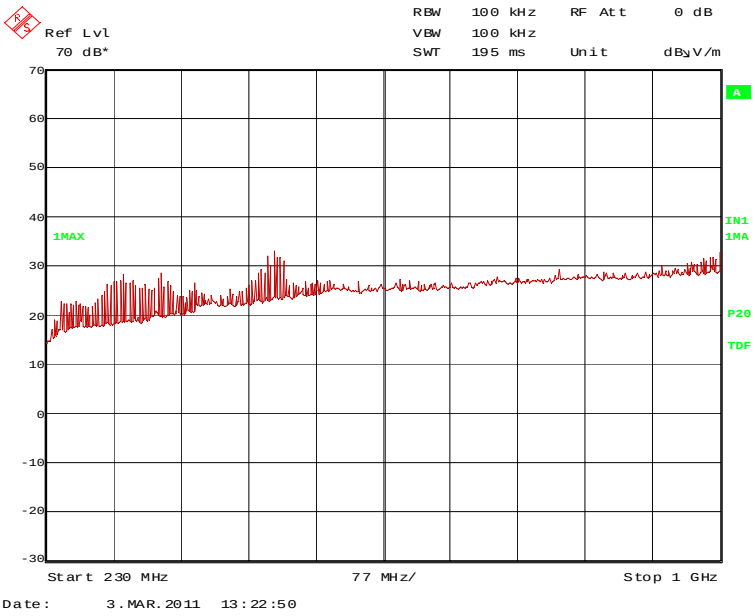


No significant emissions found, above the noise floor of the measuring system, so no measurements on the outdoor test site were carried out.

110464_9.wmf: Spurious emissions from 30 MHz to 230 MHz:



110464_10.wmf: Spurious emissions from 230 MHz to 1 GHz:

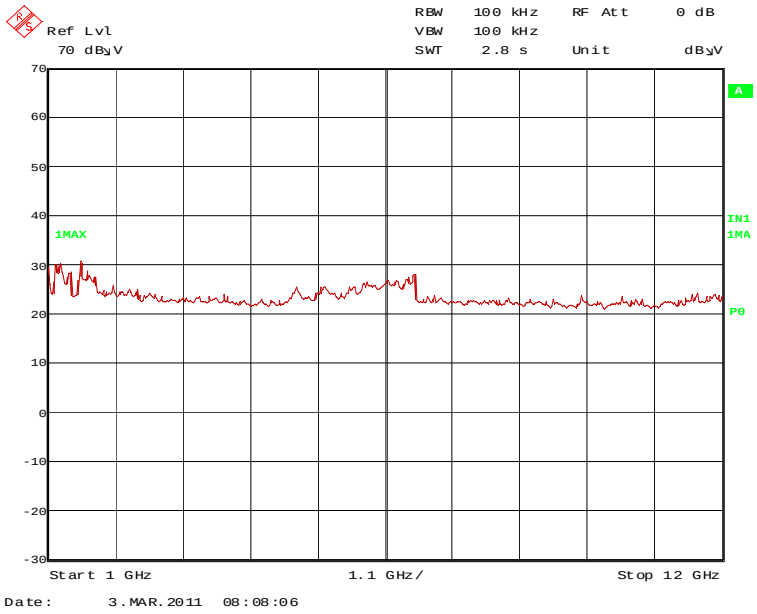


The following frequencies were found during the preliminary radiated emission test:

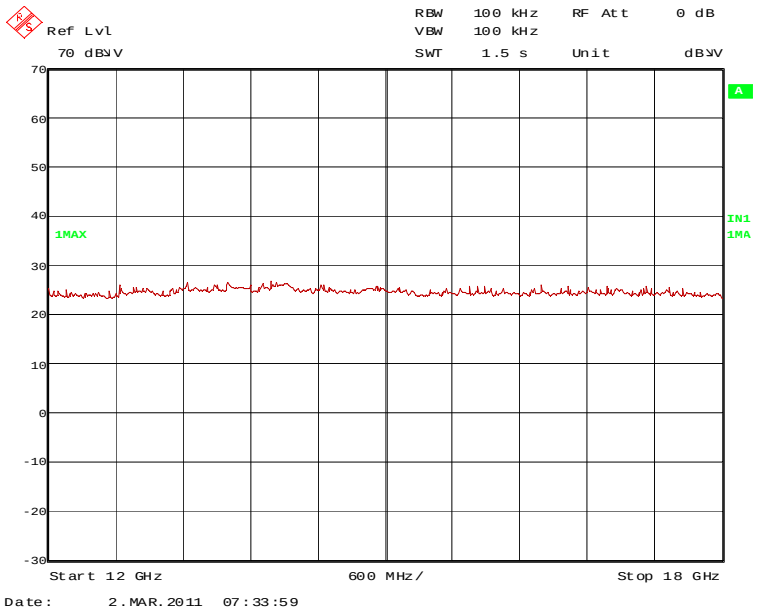
55.460 MHz, 125.332 MHz, 132.705 MHz, 196.865 MHz, 200.444 MHz, 318.562 MHz, 361.516 MHz, 483.212 MHz, 490.372 MHz, 998.642 MHz

These frequencies have to be measured on the open area test site. The results of this final measurement are shown in subclause 5.2.3 of this test report.

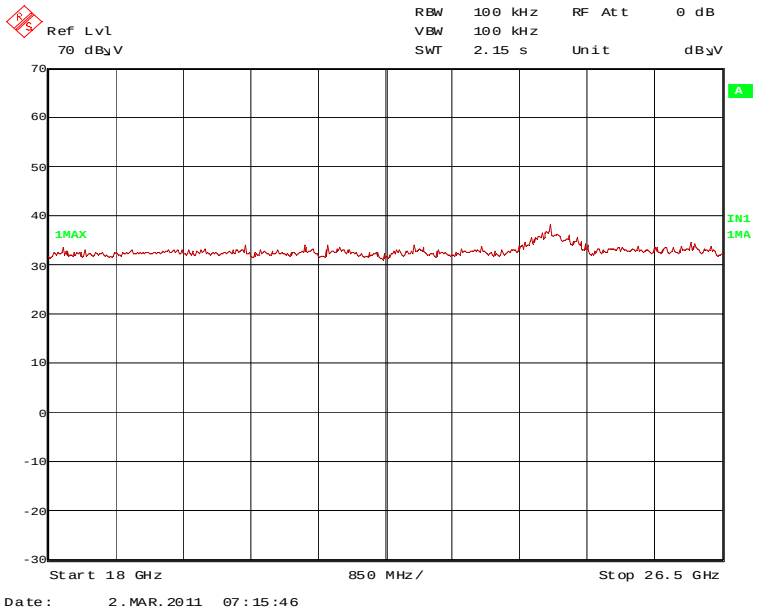
110464_8.wmf: Spurious emissions from 1 GHz to 12 GHz:



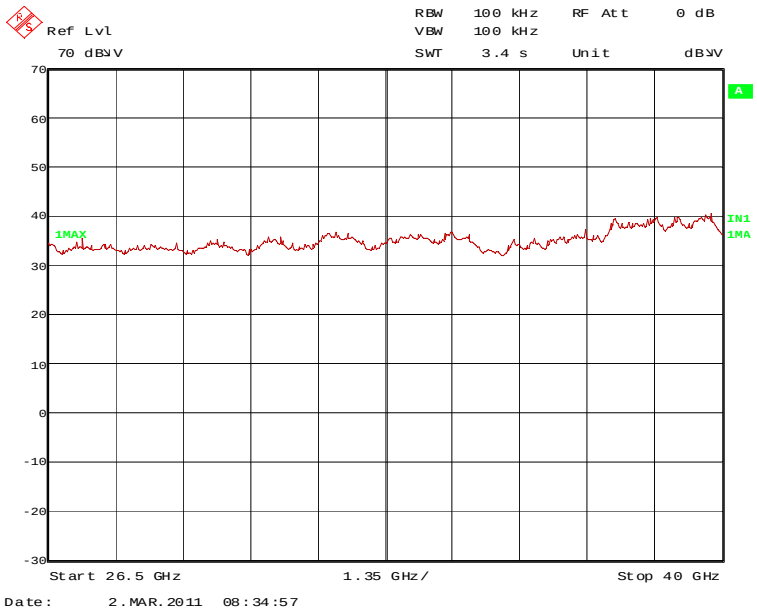
110464_3.wmf: Spurious emissions from 12 GHz to 18 GHz:



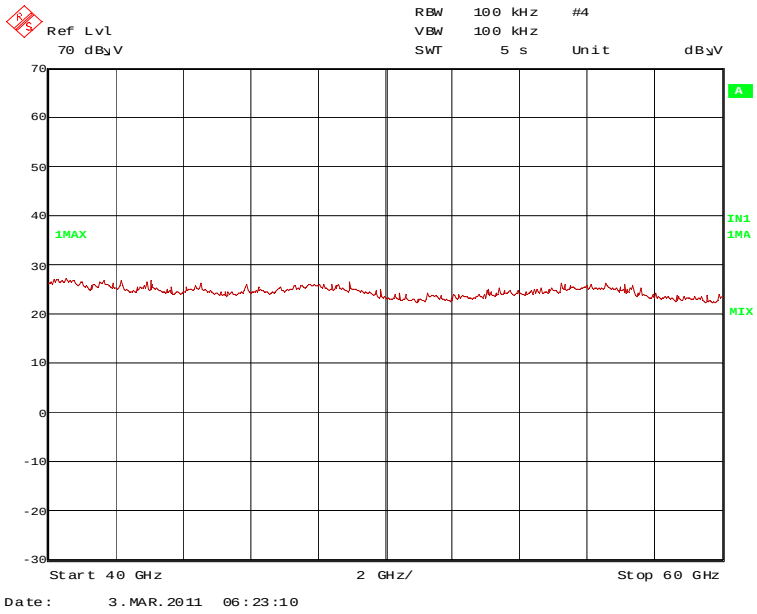
110464_2.wmf: Spurious emissions from 18 GHz to 26.5 GHz:



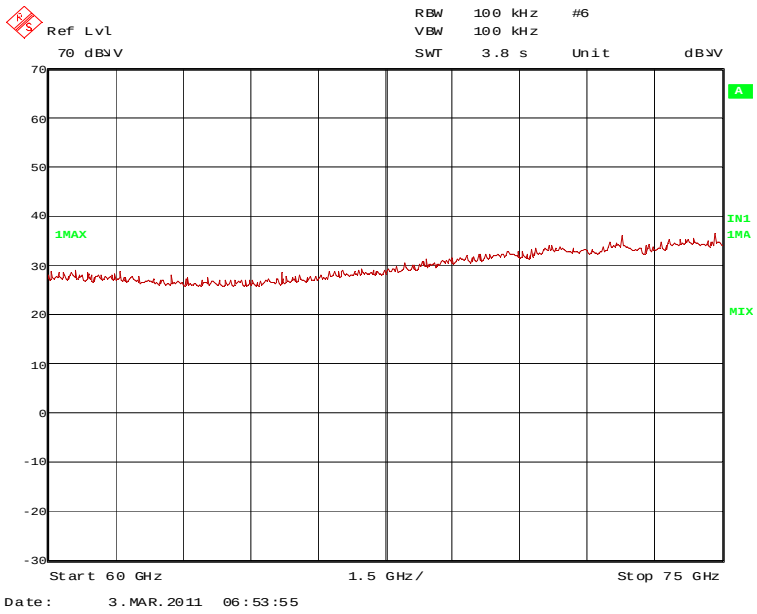
110464_4.wmf: Spurious emissions from 26.5 GHz to 40 GHz:



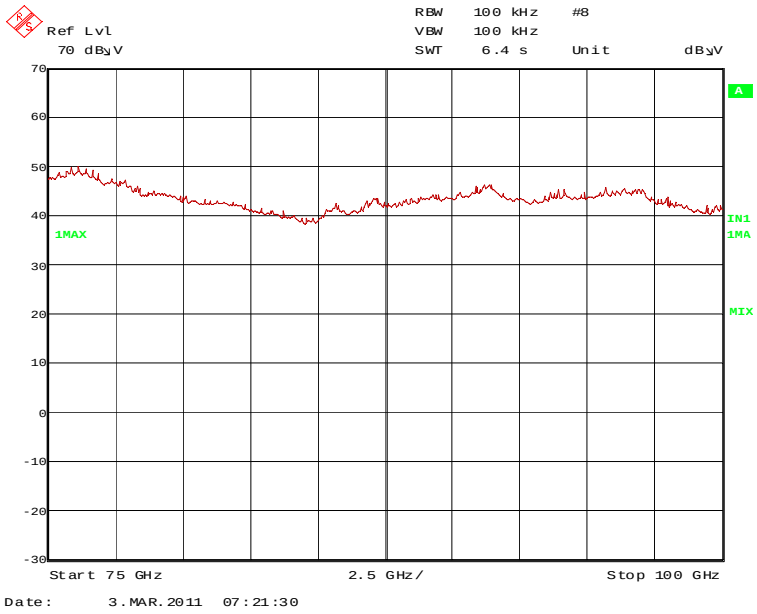
110464_5.wmf: Spurious emissions from 40 GHz to 60 GHz:



110464_6.wmf: Spurious emissions from 60 GHz to 75 GHz:



110464_7.wmf: Spurious emissions from 75 GHz to 100 GHz:



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

1202.600 MHz, 1542.7 MHz and 24.333 GHz.

On these frequencies a final measurement has to take place. The results of this final measurement are shown in subclause 5.2.4 / 5.2.5 of this test report. All other emissions were below the noise floor of the measuring distance.

TEST EQUIPMENT USED FOR THE TEST:

29, 31 – 36, 37, 39, 41, 43, 44, 46, 49 – 52, 56 – 61, 69, 72

5.2.3 Test results (final radiated emission test (30 MHz to 1 GHz))

Ambient temperature	21 °C	Relative humidity	30 %

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.

Cable guide: The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

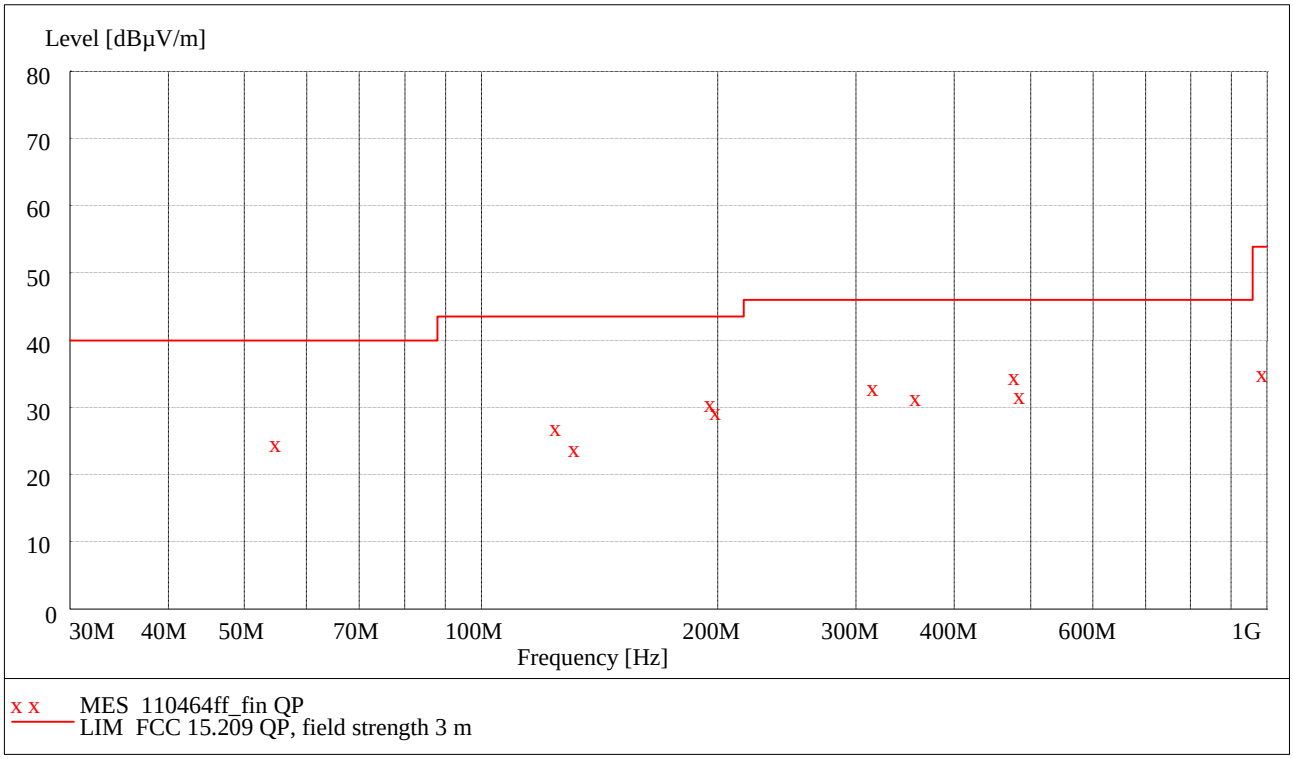
Test record: The test was carried out in transmit mode of the EUT.

Supply voltage: The EUT was supplied by the external power supply with 12 V DC.

Test results: The test results were calculated with the following formula:

Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m]

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above-mentioned standard. The measured points marked with an x are the measured results of the standard final measurement on the open area test site.



Data record name: 110464ff

The results of the standard final 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.

The measurement was carried out with the use of a quasi-peak detector.

Result measured with the peak detector:
(These values are marked in the above diagram by x)

Spurious emissions on open area test site									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Cable loss dB	Height cm	Azimuth deg	Pol.
55.460	25.2	40.0	14.8	17.5	6.9	0.8	100.0	118.0	Hor.
125.332	27.7	43.5	15.8	14.1	12.4	1.2	100.0	235.0	Hor.
132.705	24.6	43.5	18.9	11.3	12.0	1.3	100.0	168.0	Hor.
196.865	31.3	43.5	12.2	20.9	8.9	1.5	100.0	247.0	Hor.
200.444	30.1	43.5	13.4	19.7	8.9	1.5	100.0	112.0	Hor.
318.562	33.7	46.0	12.3	18.5	13.3	1.9	100.0	112.0	Hor.
361.516	32.0	46.0	14.0	15.6	14.3	2.1	200.0	292.0	Hor.
483.212	35.1	46.0	10.9	15.6	17.1	2.4	150.0	247.0	Hor.
490.372	32.3	46.0	13.7	12.5	17.3	2.5	100.0	293.0	Vert.
998.642	35.7	54.0	18.3	8.5	23.7	3.5	150.0	157.0	Hor.
Measurement uncertainty				+2.2 dB / -3.6 dB					

The test results were calculated with the following formula:

Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m]

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
14 – 20

5.2.4 Test results (final radiated emission (non pulsed) test (1 GHz to 100 GHz))

Ambient temperature	21 °C	Relative humidity	32 %

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 1 m (1 GHz to 40 GHz) and 0.1 m (40 GHz to 100 GHz).

Cable guide: The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

Test record: The test was carried out in transmit mode of the EUT.

Supply voltage: The EUT was supplied by the external power supply with 12 V DC.

Remark: The emissions documented in this clause are emissions, not caused by the pulsing of the transmitter. So no peak desensitization factor was used.

For all measurements a resolution bandwidth of 1 MHz was used.

Results measured with the peak detector:										
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Measuring distance m
1202.6	36.6	74.0	37.4	35.6	24.9	26.5	2.6	150	Vert.	3
1542.7	38.3	74.0	35.7	36.5	25.3	26.5	3.0	150	Hor.	3
Results measured with the average detector:										
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Measuring distance m
1202.6	29.0	54.0	25.0	28.0	24.9	26.5	2.6	150	Hor.	3
1542.7	29.4	54.0	24.6	27.6	25.3	26.5	3.0	150	Hor.	3
Measurement uncertainty						+2.2 dB / -3.6 dB				

The test results were calculated with the following formula:

Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m] – gain of preamplifier [dB]

Test result: Passed

TEST EQUIPMENT USED FOR THE TEST:

29, 31 – 34, 36, 44, 49

5.2.5 Test results (final radiated emission (pulsed) test (1 GHz to 100 GHz)

Ambient temperature	21 °C	Relative humidity	32 %

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 1 m.

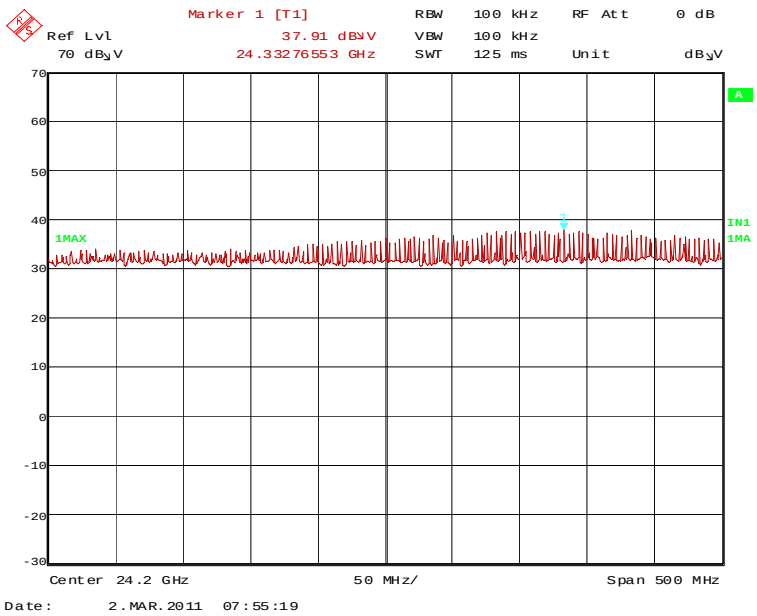
Cable guide: The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

Test record: The test was carried out in transmit mode of the EUT.

Supply voltage: The EUT was supplied by the external power supply with 12 V DC.

Remark: The emissions documented in this clause are emissions, caused by the pulsing of the transmitter. So the peak desensitization factor has to be used.

110464_1.wmf: Wanted signal:



Result measured with the peak detector:											
Frequency MHz	True peak value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Peak desensitization factor α_L dB	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Measuring distance m
24333	83.7	84.0 *	0.3	37.9	-45.4	37.2	38.7	1.9	100	Vert.	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

* Remark: Limit corrected with 20 dB per decade

The true peak value was calculated with the following formula:

True peak value [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m]
– gain of preamplifier [dB] – pulse desensitization factor [dB]

Calculation of the average result:								
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	True peak value dBµV/m	Average correction factor α_{AV} dB	Height cm	Pol.	Measuring distance m
24333	38.3	64.0 *	25.7	83.7	-45.4	100	Vert.	1
Measurement uncertainty					+2.2 dB / -3.6 dB			

* Remark: Limit corrected with 20 dB per decade

The test result was calculated with the following formula:

Result [dBµV/m] = True peak value [dBµV/m] + average correction factor [dB]

Test result: Passed

TEST EQUIPMENT USED FOR THE TEST:

29, 31 – 34, 36, 39, 46, 51

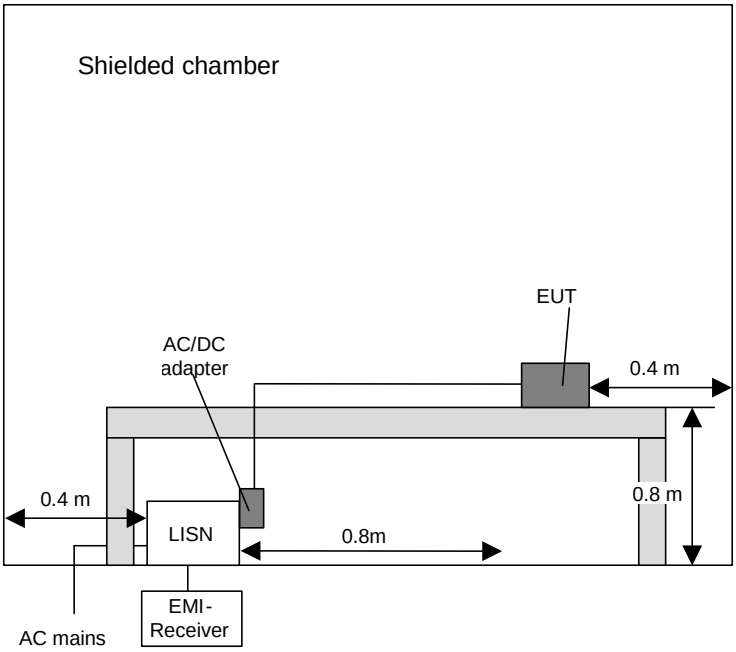
5.3 Conducted emissions on power supply lines

5.3.1 Method of measurement (conducted emissions on power supply lines)

This test will be carried out in a shielded 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 above the ground plane. Floor-standing devices will be placed directly on the ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2009 [1].

The frequency range 150 kHz to 30 MHz will be measured with an EMI Receiver set to MAX Hold mode with peak and average detector and a resolution bandwidth of 9 kHz. A scan will be carried out on the phase (or plus pole in case of DC powered devices) of the AC mains network. If levels detected 10 dB below the appropriable limit, this emission will be measured with the average and quasi-peak detector on all lines.

Frequency range	Resolution bandwidth
150 kHz to 30 MHz	9 kHz



5.3.2 Test results (conducted emissions on power supply lines)

Ambient temperature	21 °C	Relative humidity	30 %

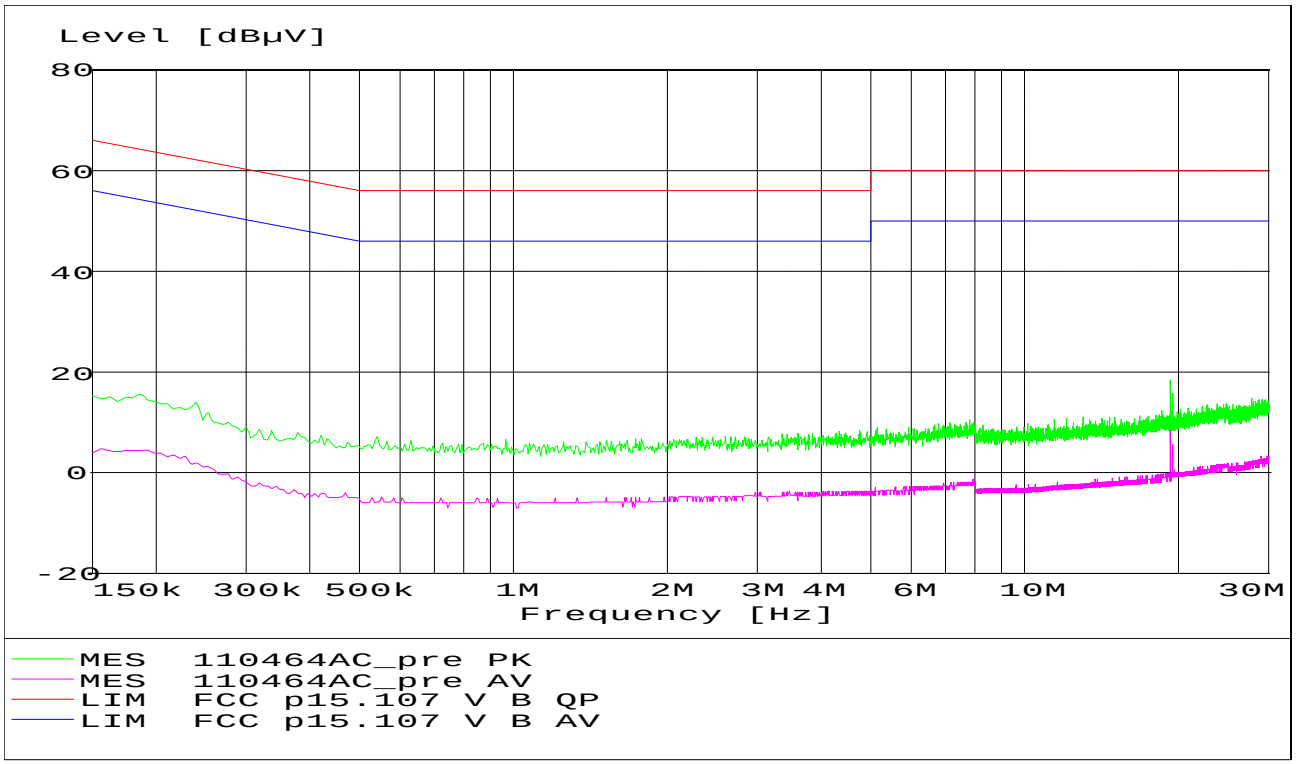
Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m.

Cable guide: The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 12.0 V DC via the AC / DC adaptor type Friwo FE 3288.

Measurement uncertainty: +3.6 dB / -4.5 dB



Data record name: 110464AC

Test result: Passed

TEST EQUIPMENT USED FOR THE TEST:

1 – 3, 4, 20

6 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
1	Shielded chamber M4	-	Siemens	B83117S1-X158	480088	Weekly verification (system cal.)	
2	EMI Receiver	ESIB 26	Rohde & Schwarz	1088.7490	481182	02/08/2010	02/2012
3	LISN	NSLK8128	Schwarzbeck	8128161	480138	05/07/2010	05/2012
4	High pass filter	HR 0.13-5ENN	FSY Microwave Inc.	DC 0109 SN 002	480340	Weekly verification (system cal.)	
14	Open area test site	-	Phoenix Test-Lab	-	480085	Weekly verification (system cal.)	
15	Measuring receiver	ESIB7	Rohde & Schwarz	100304	480521	03/15/2010	03/2012
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	CBL6111D	Teseq GmbH	25761	480894	09/18/2008	09/2011
20	EMI Software	ES-K1	Rohde & Schwarz	-	480111	-	-
29	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
30	Spectrum analyser	FSU	Rohde & Schwarz	200125	480956		
31	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	03/17/2010	03/2012
32	Controller	MCU	Maturo	MCU/043/971107	480832	-	-
33	Turntable	DS420HE	Deisel	420/620/80	480315	-	-
34	Antenna support	AS615P	Deisel	615/310	480187	-	-
35	Antenna	CBL6112B	Chase	2917	480447	09/28/2010	09/2013
36	Antenna	3115 A	EMCO	9609-4918	480183	04/11/2008	11/2011
37	Standard Gain Horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294	Six month verification (system cal.)	
39	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	411	480297	Six month verification (system cal.)	
40	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	410	480296	Six month verification (system cal.)	
41	Standard Gain Horn 26.4 GHz – 40.1 GHz	22240-20	Flann Microwave	469	480299	Six month verification (system cal.)	
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.)	
46	RF-cable 1 m	KPS-1533-400-KPS	Insulated Wire	-	480301	Six month verification (system cal.)	
49	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	Six month verification (system cal.)	
50	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343	Six month verification (system cal.)	
51	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342	Six month verification (system cal.)	

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
52	Preamplifier	JS3-26004000-25-5A	Miteq	563593	480344	Six month verification (system cal.)	
56	Standard Gain Horn 40 GHz – 60 GHz	24240-20	Flann Microwave	133313		Six month verification (system cal.)	
57	Harmonic Mixer 40 - 60 GHz	FS-Z60	Rohde&Schwarz	100071	480481	Six month verification (system cal.)	
58	Standard Gain Horn 50 GHz – 75 GHz	25240-20	Flann Microwave	135181		Six month verification (system cal.)	
59	Harmonic Mixer 50 - 75 GHz	FS-Z75	Rohde&Schwarz	100045	480480	Six month verification (system cal.)	
60	Standard Gain Horn 75 GHz – 110 GHz	27240-20	Flann Microwave	132148		Six month verification (system cal.)	
61	Harmonic Mixer 75 - 10 GHz	FS-Z110	Rohde&Schwarz	100049	480482	Six month verification (system cal.)	
69	Microwave-Cable	-	Rohde&Schwarz	-	480487	Six month verification (system cal.)	
72	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	03/10/2010	03/2012
73	Zero Bais Schottky Detector	303AK	KRYTAR	00663	481287	Six month verification (system cal.)	
74	Sampling Oscilloscope	TDS784D	Tektronix	B022158	480393	03/08/2010	03/2011
132	Thermal Power Sensor	NRV-Z51	Rohde & Schwarz	825489/004	480247	03/16/2010	03/2012

7 REPORT HISTORY

Report Number	Date	Comment
F110464E1	07 March 2011	Document created

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110464_6.jpg	RLS, test set-up fully anechoic chamber
110464_10.jpg	RLS, test set-up fully anechoic chamber
110464_7.jpg	RLS, test set-up open area test site
110464_1.jpg	RLS, test set-up for pulses and bandwidth

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110464_g.jpg	RLS, PCB, top view, covers removed
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