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Test Report

Report Number: F113961E2

Applicant:

SICK AG

Manufacturer:

SICK AG

Equipment under Test (EUT):

RFU630

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 (August 2011)** Radio Frequency Devices

[3] **FCC Public Notice DA 00-705 (March 2000)**

[4] **RSS-210 Issue 8 (December 2010)** Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

[5] **RSS-Gen Issue 3 (December 2010)** General Requirements and Information for the Certification of Radiocommunication Equipment

TEST RESULT

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

Test engineer:	Thomas KÜHN		06 December 2011
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		06 December 2011
	Name	Signature	Date

RESERVATION

This test report is only valid in its original form.

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

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1 IDENTIFICATION

1.1 Applicant

Name:	SICK AG
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Country:	Germany
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eMail Address:	michael.rehse@sick.de
Applicant represented during the test by the following person:	Mr. Michael REHSE

1.2 Manufacturer

Name:	SICK AG
Address:	Merkurring 20 22143 Hamburg
Country:	Germany
Name for contact purposes:	Mr. Michael REHSE
Phone:	+ 49 40 61 16 80 - 248
Fax:	+ 49 40 61 16 80 - 201
eMail Address:	michael.rehse@sick.de
Manufacturer represented during the test by the following person:	Mr. Michael REHSE

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: *	UHF RFID reader
Model name: *	RFU630
FCC ID: *	**WRMRFU630**
IC: *	**10066A-RFU630**
Serial number: *	1144 1002
PCB identifier: *	4067209, 4067208-V626 and 406871
Hardware version: *	0000
Software version: *	T1.10RC02

1.5 Technical data of equipment

Channel 0	RX:	902.75 MHz	TX:	902.75 MHz
Channel 24	RX:	914.75 MHz	TX:	914.75 MHz
Channel 49	RX:	927.25 MHz	TX:	927.25 MHz

Rated RF output power: *	30 dBm (conducted)					
Antenna type: *	Internal or external (Kathrein type UHF RFID Ultra Low Range-Antenna (ULORA) or SICK type RFA 641-3440 UHF Antenna patch antenna)					
Antenna gain: *	6 dBi (internal), 6.0 (patch antenna, cable loss included), -30 dBi (ULORA)					
Antenna connector: *	Reverse TNC					
Adaptive frequency agility: *	Yes					
Modulation: *	PR-ASK / DSB-ASK					
Supply Voltage: *	U_{nom}=	24.0 V DC	U_{min}=	12.0 V DC	U_{max}=	30.0 V DC
Temperature range: *	-30 °C to +60 °C					
Ancillary used for test:	A switchbox typ CDB620-001 was used to connect the EUT to the power supply, AC / DC adaptor type MINI-PS-100-240AC/24DC/1 (conducted emissions on AC mains only).					

* declared by the applicant.

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
External antenna port	RP-BNC	RP-BNC	1.0 m
Ethernet	4-pin M12-connector	-	2.0 m
Power / RS422 and external Sensor	17-pin M12-connector	SubD 15pin (CDB620-001)	1.5 m

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	02 November 2011
Start of test:	24 November 2011
End of test:	30 November 2011

2 OPERATIONAL STATES

All tests were carried out with an unmodified sample with integral antenna and three external antenna ports.

During all tests the RFU630 was powered by an external 24.0 V DC power supply. During the emission measurement on the AC supply line the EUT was powered by an AC / DC adaptor type MINI-PS-100-240AC/24DC/1.

The operation mode could be chosen with the help of a laptop computer with a test-software, communicates with the EUT via the Ethernet line.

As declared by the applicant the output of the EUTs power amplifier is switched to a multiplexer that switched the power amplifier to one of the ports at the same time. Therefore no combiner was necessary for measurements on the antenna ports. All conducted measurements were carried out on antenna port 1, because there was no measurable difference to the other ports.

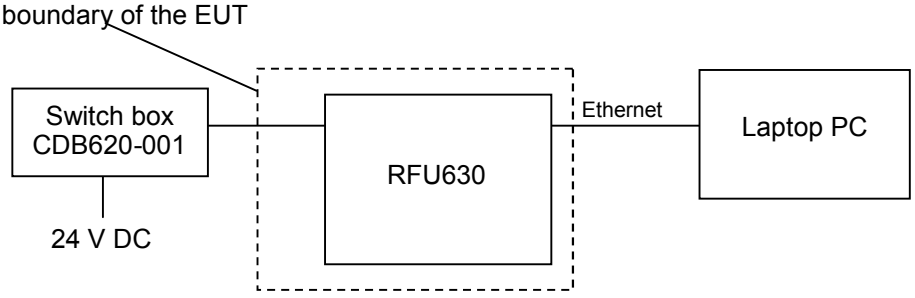
For all measurements the output power of the EUT was set to 30 dBm (maximum value).

All measurements were performed with DSB-ASK modulation, because pre-tests have shown that this modulation causes the worst case measurement results for every tested item.

The following operation modes were used during the tests:

Operation mode	Description of the operation mode
1	Transmit on 902.750 MHz (channel 0)
2	Transmit on 914.750 MHz (channel 24)
3	Transmit on 927.250 MHz (channel 49)
4	Transmit on all channels (hopping enabled)
5	Receive on 902.750 MHz (channel 0)
6	Receive on 914.750 MHz (channel 24)
7	Receive on 927.250 MHz (channel 49)

Physical boundary of the EUT



3 ADDITIONAL INFORMATION

As declared by the applicant the EUT is available in different variants. For these variants the model name is extended as described below:

RFU630-13101 1 x internal antenna, 3 x external antennas
RFU630-10101 1 x internal antenna, no external antenna
RFU630-04101 no internal antenna, 4 x external antennas

The tests documented in this test report were carried out with an RFU630-13101.

As declared by the applicant the combination of antenna gain and cable loss will not exceed 6.0 dBi.

During the tests the EUT was not labelled as required by FCC / IC.

4 OVERVIEW

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS 210, Issue 8 [4] or RSS-Gen, Issue 3 [5]	Status	Refer page
20 dB bandwidth	General	15.247 (a) (1) (i)	A8.1 (c) [4]	Passed	9 et seq.
Carrier frequency separation	General	15.247 (a) (1) (i)	-	Passed	12 et seq.
Number of hopping channels	902.0 – 928.0	15.247 (a) (1) (i)	A8.1 (c) [4]	Passed	15 et seq.
Dwell time	902.0 – 928.0	15.247 (a) (1) (i)	A8.1 (c) [4]	Passed	17 et seq.
Maximum peak output power	902.0 – 928.0	15.247 (b) (2)	A8.4 (1) [4]	Passed	19 et seq.
Radiated emissions (transmitter)	0.009 - 10,000	15.247 (d) 15.205 (a) 15.209 (a)	A8.5 [4] 2.5 [4] 7.2.2 [5]	Passed	22 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	7.2.4 [5]	Passed	66 et seq.
Radiated emissions (receiver)	30 – 5,000	15.109 (a)	6.1 [5]	Passed	Annex D

5 TEST RESULTS

5.1 20 dB bandwidth

5.1.1 Method of measurement (20 dB bandwidth)

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

The following spectrum analyser settings shall be used:

- Span: App. 2 to 3 times the 20 dB bandwidth, centred on the actual hopping channel.
- Resolution bandwidth: ≥ 1 % of the 20 dB bandwidth.
- Video bandwidth: ≥ the resolution bandwidth.
- Sweep: Auto.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 20 dB below the first line (or the peak marker). The frequency lines shall be set on the intersection points between the second display line and the measured curve.

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

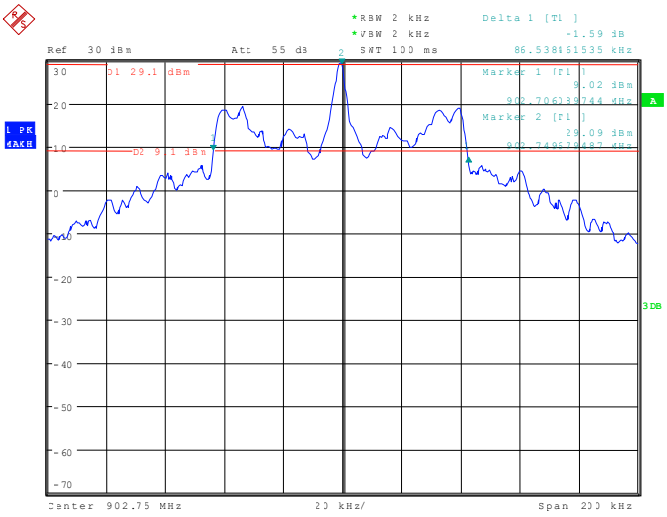
Test set-up:

5.1.2 Test results (20 dB bandwidth)

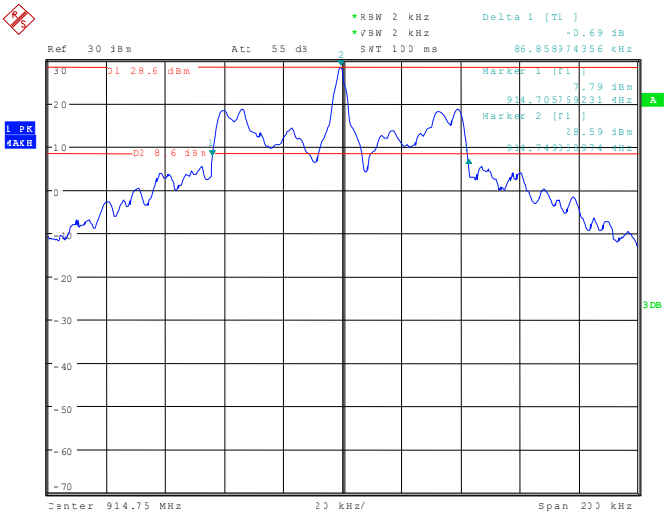
Ambient temperature	21 °C

Relative humidity	33 %

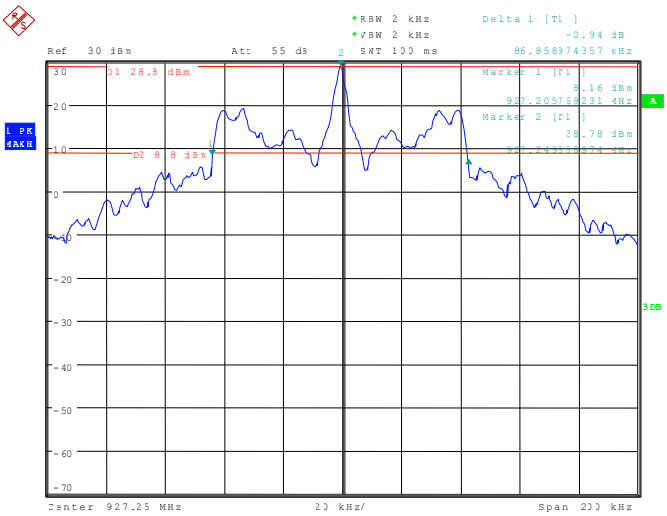
113961_107.wmf: 20 dB bandwidth at the lower end of the assigned frequency band:



113961_106.wmf: 20 dB bandwidth at the middle of the assigned frequency band:



113961_108.wmf: 20 dB bandwidth at the upper end of the assigned frequency band:



Channel number	Channel frequency [MHz]	20 dB bandwidth [kHz]
0	902.750	86.538
24	914.750	86.859
49	927.250	86.859
Measurement uncertainty		+0.66 dB / -0.72 dB

TEST EQUIPMENT USED FOR THE TEST:
30

5.2 Carrier frequency separation

5.2.1 Method of measurement (carrier frequency separation)

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 enabled.

The following spectrum analyser settings shall be used:

- Span: Wide enough to capture the peaks of two adjacent channels.
- Resolution bandwidth: ≥ 1 % of the span.
- Video bandwidth: ≥ the resolution bandwidth.
- Sweep: Auto.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker and the delta marker function will be used to determine the separation between the peaks of two adjacent channel signals.

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

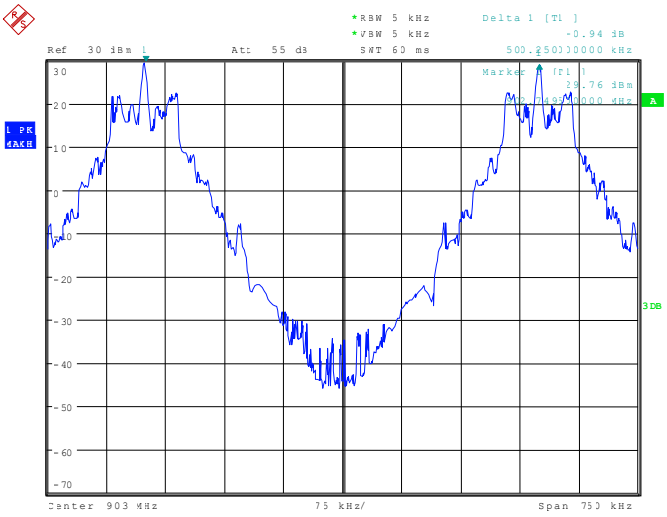
Test set-up:

5.2.2 Test results (carrier frequency separation)

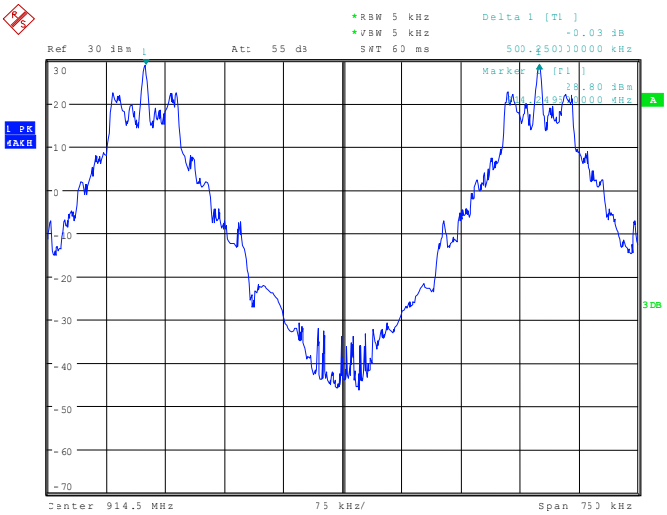
Ambient temperature	21 °C

Relative humidity	33 %

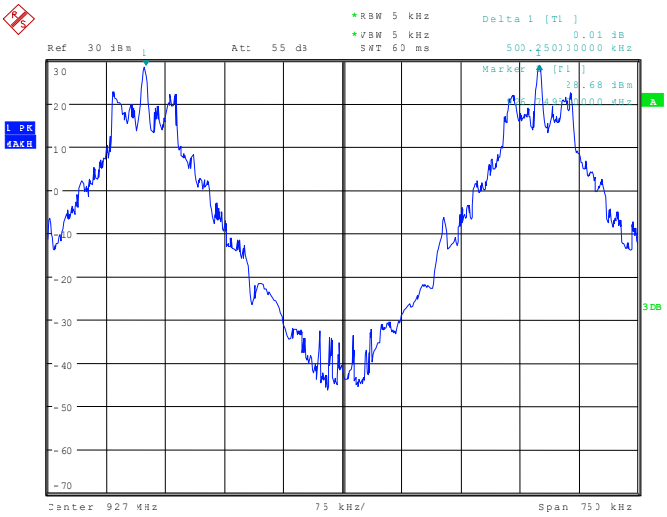
113961_109_.wmf: Channel separation at the lower end of the assigned frequency band:



113961_110.wmf: Channel separation at the middle of the assigned frequency band:



113961_111.wmf: Channel separation at the upper end of the assigned frequency band:



Channel number	Channel frequency [MHz]	Channel separation [kHz]	Minimum limit [kHz]
0	902.750	500.250	86.538 (the 20 dB bandwidth)
24	914.750	500.250	86.859 (the 20 dB bandwidth)
49	927.250	500.250	86.859 (the 20 dB bandwidth)
Measurement uncertainty			$<10^{-7}$

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
30

5.3 Number of hopping frequencies

5.3.1 Method of measurement (number of hopping frequencies)

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 enabled.

The following spectrum analyser settings shall be used:

- Span: Equal to the assigned frequency band.
- Resolution bandwidth: ≥ 1 % of the span.
- Video bandwidth: ≥ the resolution bandwidth.
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

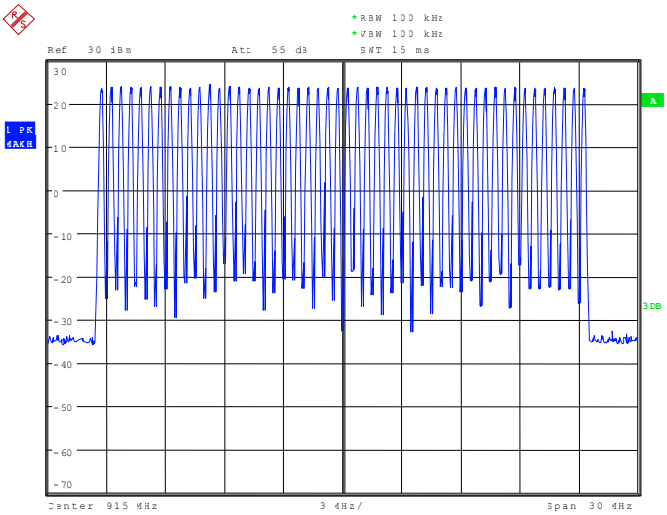
After trace stabilisation the number of hopping channels could be counted. It might be possible to divide the span into some sub ranges in order to clearly show all hopping frequencies.

Test set-up:

5.3.2 Test results (number of hopping frequencies)

Ambient temperature	21 °C	Relative humidity	33 %

113961_104.wmf: Number of hopping channels:



Number of hopping channels	Limit
Operation mode 4	
50	At least 50

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
30

5.4 Dwell time

5.4.1 Method of measurement (dwell time)

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 enabled.

The following spectrum analyser settings shall be used:

- Span: Zero, centred on a hopping channel.
- Resolution bandwidth: 1 MHz.
- Video bandwidth: ≥ the resolution bandwidth.
- Sweep: As necessary to capture the entire dwell time per hopping channel.
- Detector function: peak.
- Trace mode: Max hold.

The marker and delta marker function of the spectrum analyser will be used to determine the dwell time.

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

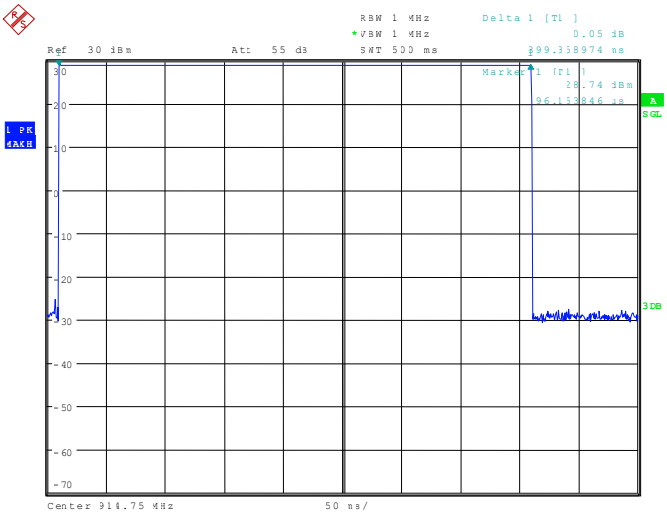
If the EUT is possible to operate with different mode of operation (data rates, modulation formats etc.) the test will be repeated with every different operation mode of the EUT.

Test set-up:

5.4.2 Test results (dwell time)

Ambient temperature	21 °C	Relative humidity	33 %

113961_116.wmf: Dwell time at the middle of the assigned frequency band:



The dwell time is calculated with the following formula:

Dwell time = t_{pulse} x n_{hops} / number of hopping channels x 20 s

Where:

t_{pulse} is the measured pulse time (pls. refer the plots of the spectrum analyser above) [s],
n_{hops} is the number of hops per second in the actual operating mode of the transmitter [1/s].

The hopping rate of the system is 2.5 hops per second and the system uses 50 channels.

Channel number	Channel frequency [MHz]	t_{pulse} [ms]	Dwell time [ms]	Limit [ms]
25	914.750	399.359	399.359	400
Measurement uncertainty			$<10^{-7}$	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
30

5.5 Maximum peak output power

5.5.1 Method of measurement (maximum peak output power)

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 disenabled.

The following spectrum analyser settings shall be used:

- Span: Approx. 5 times the 20 dB bandwidth, centred on a hopping channel.
- Resolution bandwidth: > the 20 dB bandwidth of the emission being measured.
- Video bandwidth: ≥ the resolution bandwidth.
- Sweep: Auto.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. The indicated level is the peak output power, which has to be corrected with the value of the cable loss and an external attenuation (if necessary).

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

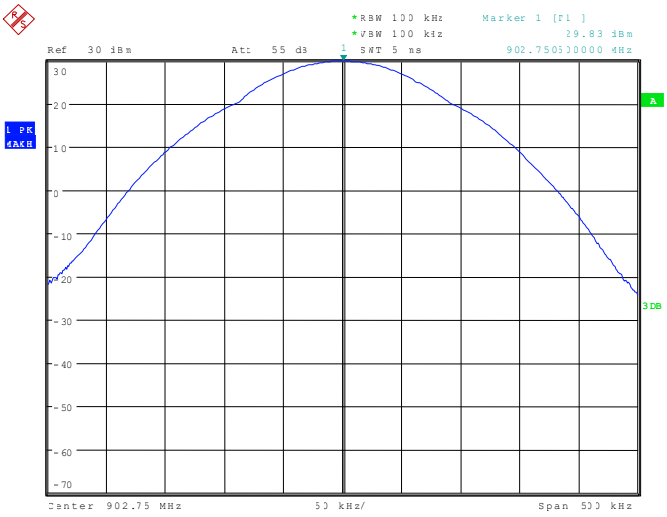
Test set-up:

5.5.2 Test results (maximum peak output power)

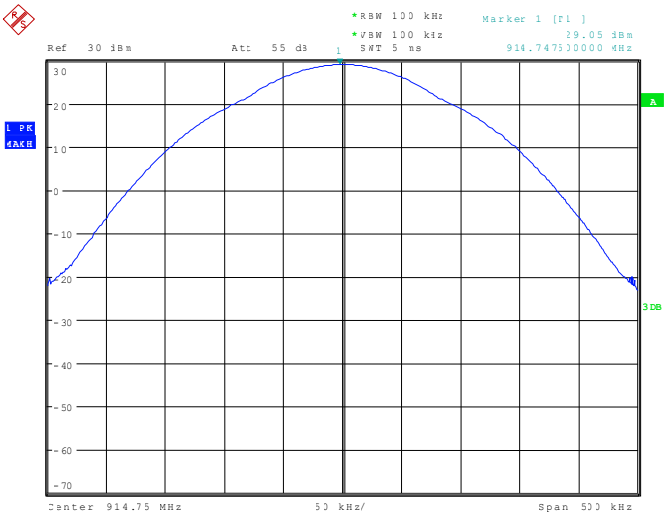
Ambient temperature	21 °C

Relative humidity	33 %

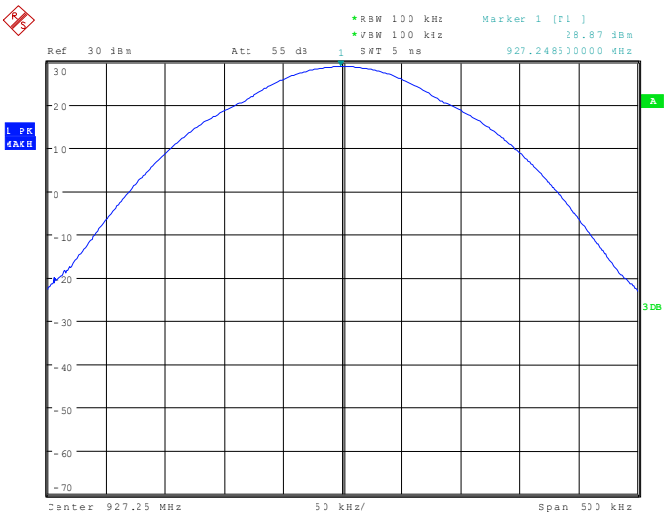
113961_114.wmf: Maximum peak output power at the lower end of the assigned frequency band:



113961_113.wmf: Maximum peak output power at the middle of the assigned frequency band:



113961_112.wmf: Maximum peak output power at the upper end of the assigned frequency band:



Operation mode	Channel number	Channel frequency [MHz]	Maximum peak output power [dBm]	Antenna gain [dBi]	Peak power limit [dBm]
1	0	902.750	29.8	6.0	30.0
2	24	914.750	29.1	6.0	30.0
3	49	927.250	28.9	6.0	30.0
Measurement uncertainty				+0.66 dB / -0.72 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
30

5.6 Radiated emissions

5.6.1 Method of measurement (radiated 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 110 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 110 GHz.

All measurements will be carried out with the EUT working on the middle of the assigned frequency band.

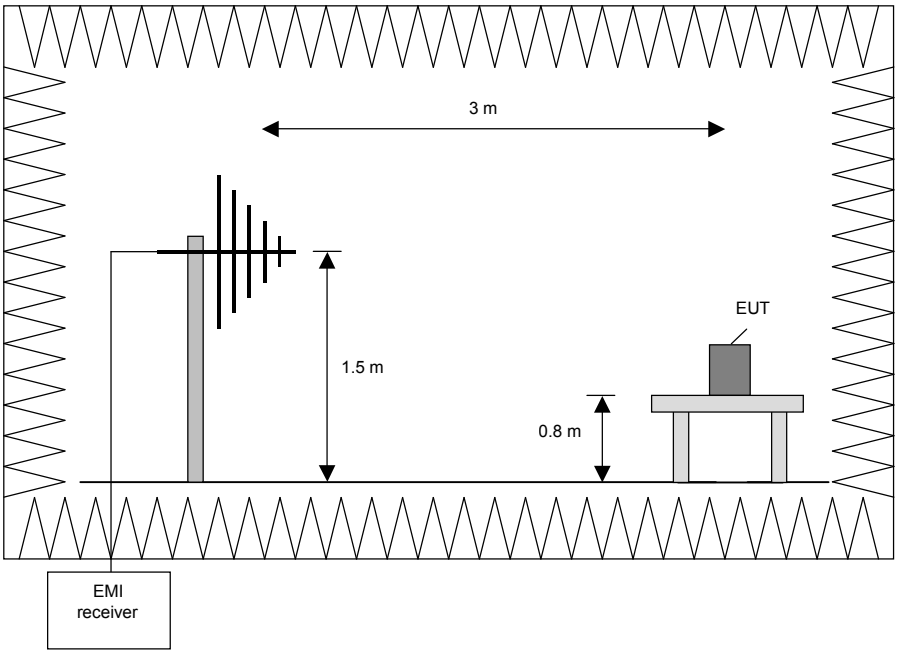
Preliminary measurement (30 MHz to 1 GHz)

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:

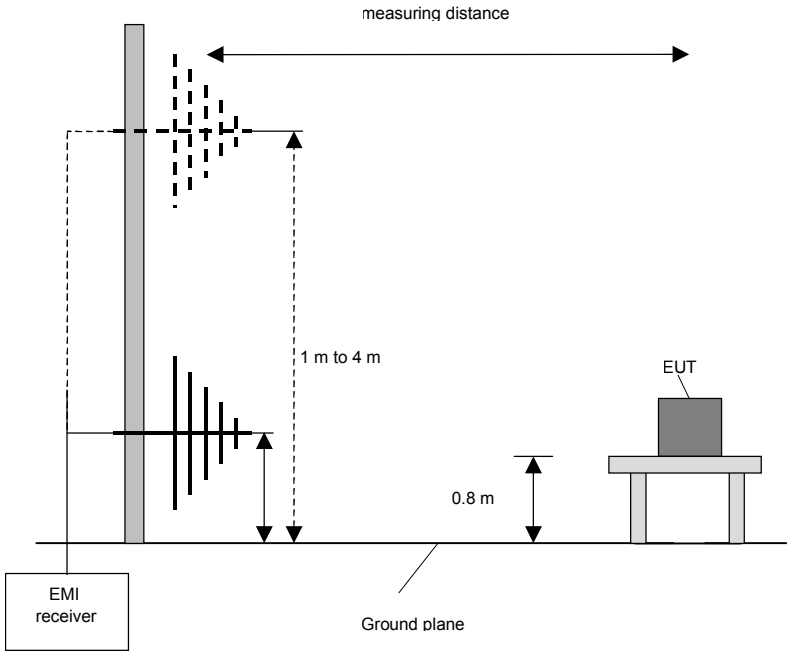
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the 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 (because of EUT is a module and might be used in a handheld equipment application).
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



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 (QP and AV) and note the value.
11) Repeat 5) to 10) for each frequency.
12) 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 110 GHz)

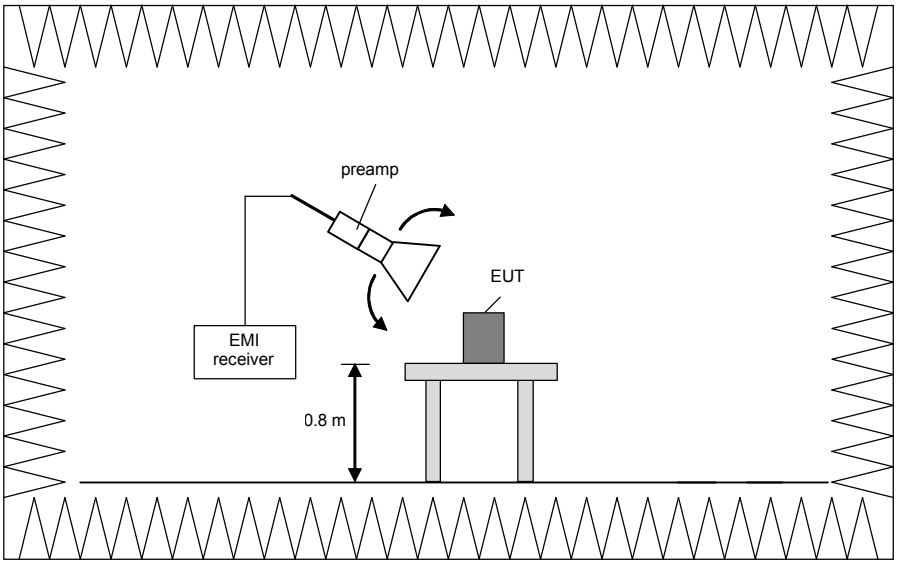
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance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

Preliminary measurement (1 GHz to 110 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
50 GHz to 75 GHz	100 kHz
75 GHz to 110 GHz	100 kHz

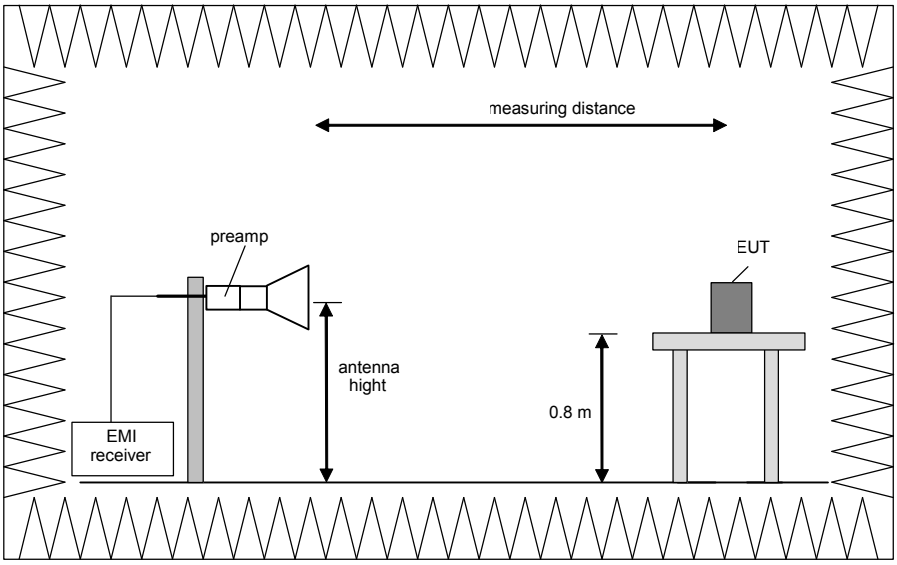


Final measurement (1 GHz to 110 GHz)

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
50 GHz to 75 GHz	1 MHz
75 GHz to 110 GHz	1 MHz



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, 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 110 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.

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

5.6.2 Test results (radiated emissions)

5.6.2.1 Preliminary radiated emission measurement with internal antenna

Ambient temperature	21 °C	Relative humidity	35 %

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: For detail information of test set-up and the cable guide refer to the pictures in annex A of this test report.

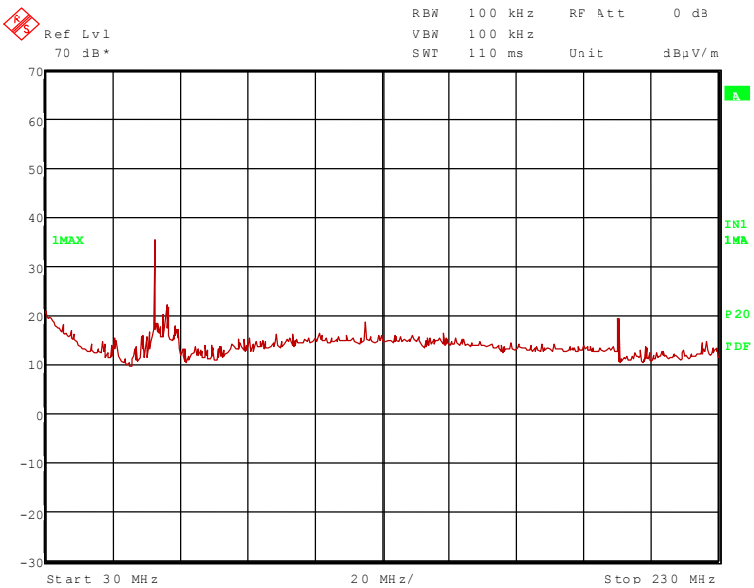
Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 24 V DC by an external power supply.

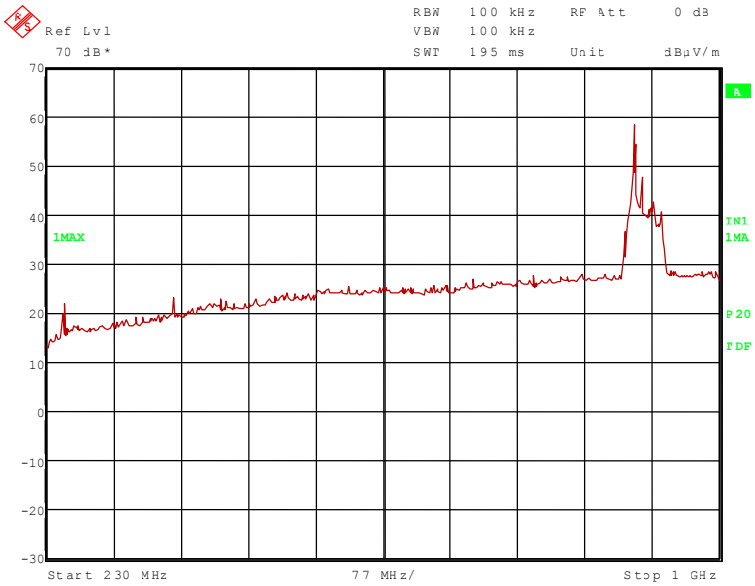
Remark: As pre-tests have shown, the emissions in the frequency range 1 MHz to 30 MHz are not depending on the transmitter operation mode. Therefore the emissions in this frequency range were measured only with the transmitter operates in operation mode 2.

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

113961_61.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 1):



113961_60.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 1, carrier notched):



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

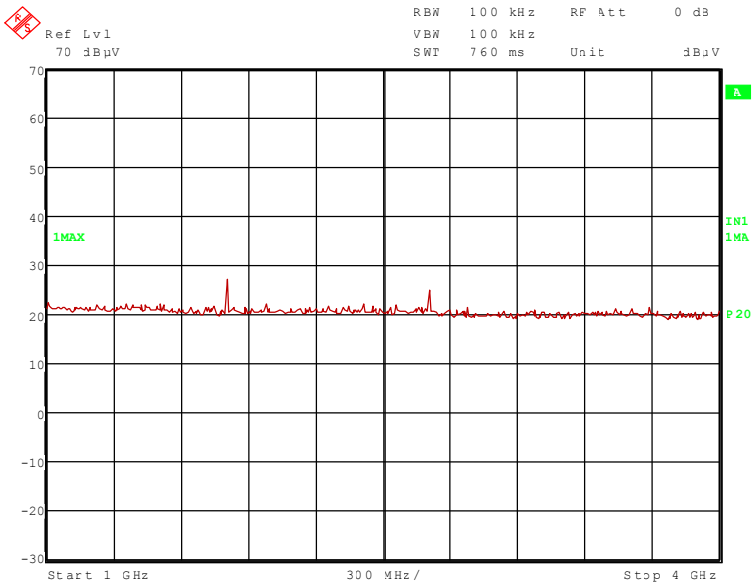
- 62.500 MHz, 66.435 MHz, 200.000 MHz, 375.000 MHz and 902.750 MHz.

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

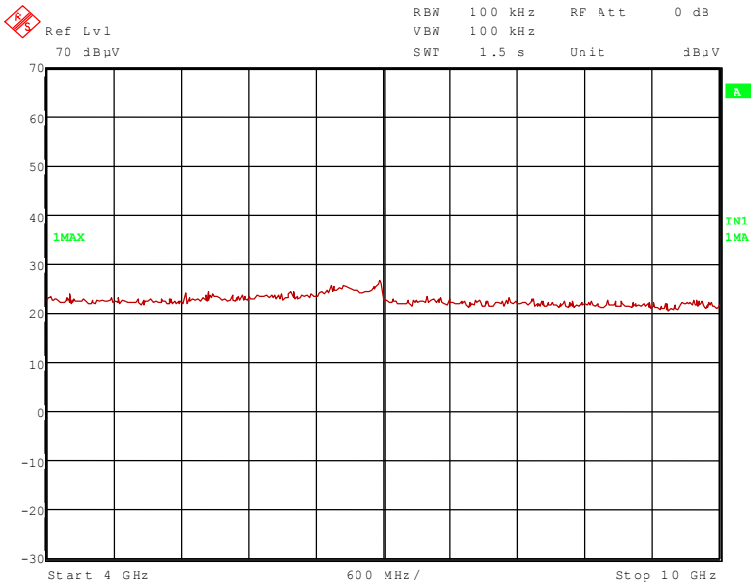
- 125.000 MHz and 250.000 MHz.

These frequencies have to be measured on the open area test site. The result is presented in the following.

113961_68.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 1):



113961_71.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 1):



The following frequency was found inside the restricted bands during the preliminary radiated emission test:

- 2.70825 GHz.

The following frequency was found outside the restricted bands during the preliminary radiated emission test:

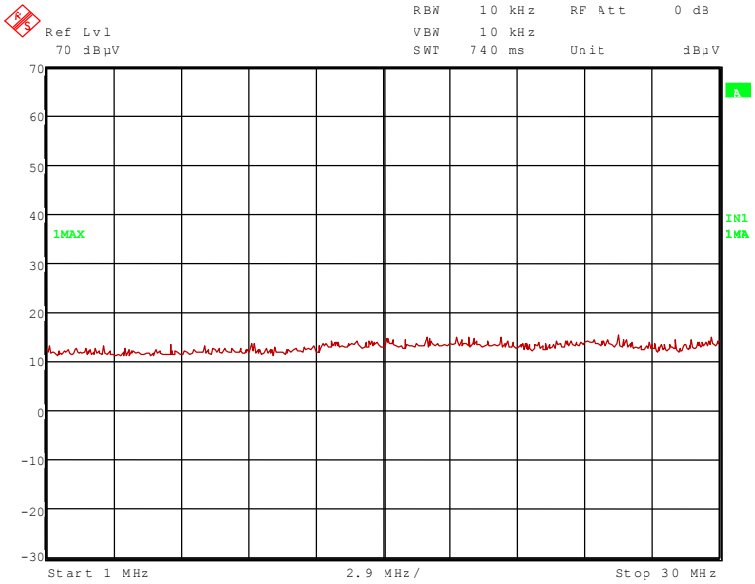
- 1.8055 GHz.

These frequencies have to be measured in a final measurement. The results were presented in the following.

TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 36, 43, 44, 49, 55, 73, 75

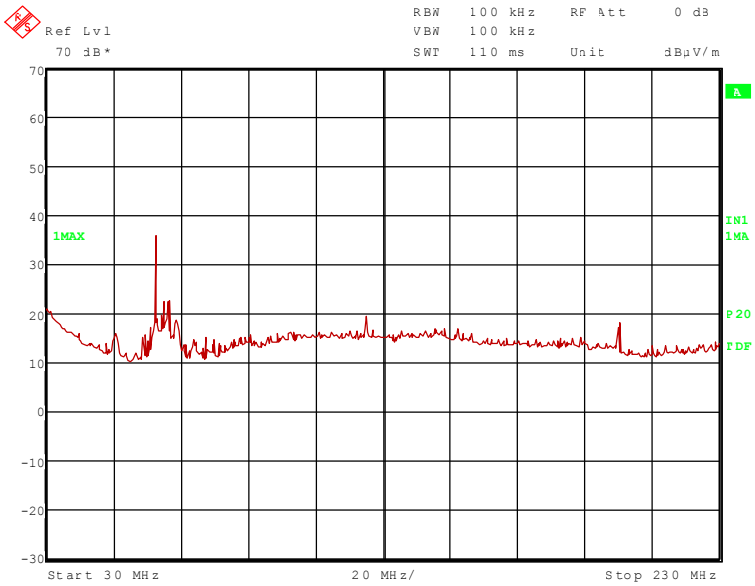
Transmitter operates on the middle of the assigned frequency band (operation mode 2)

113961_99.wmf: Spurious emissions from 1 MHz to 30 MHz (operation mode 2):

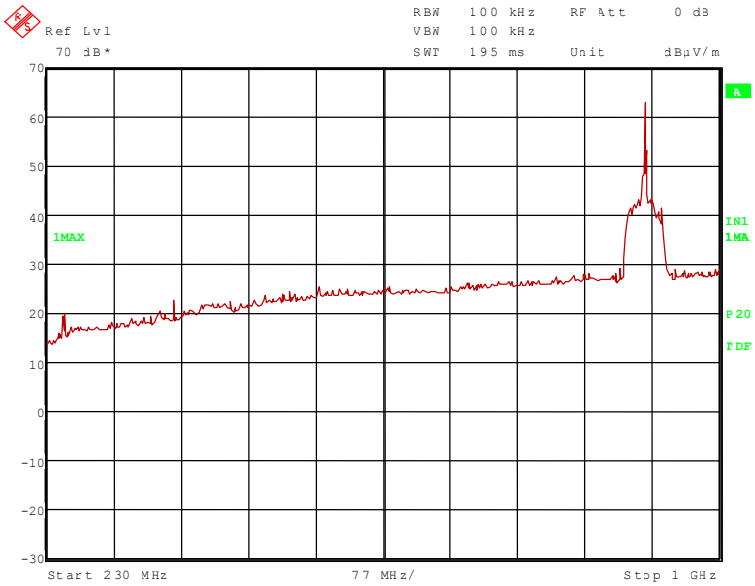


No significant frequencies above the noise floor of the system were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.

113961_64.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 2):



113961_65.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 2, carrier notched):



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

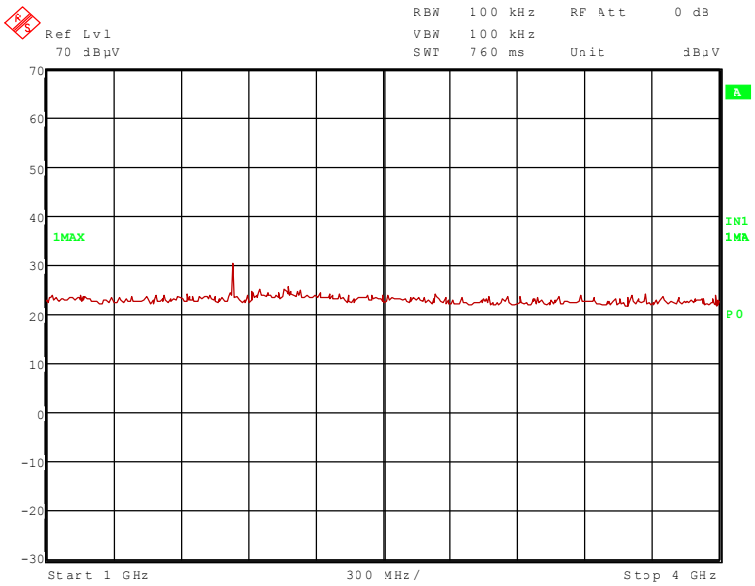
- 62.500 MHz, 66.4271 MHz, 200.000 MHz, 375.000 MHz and 914.750 MHz.

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

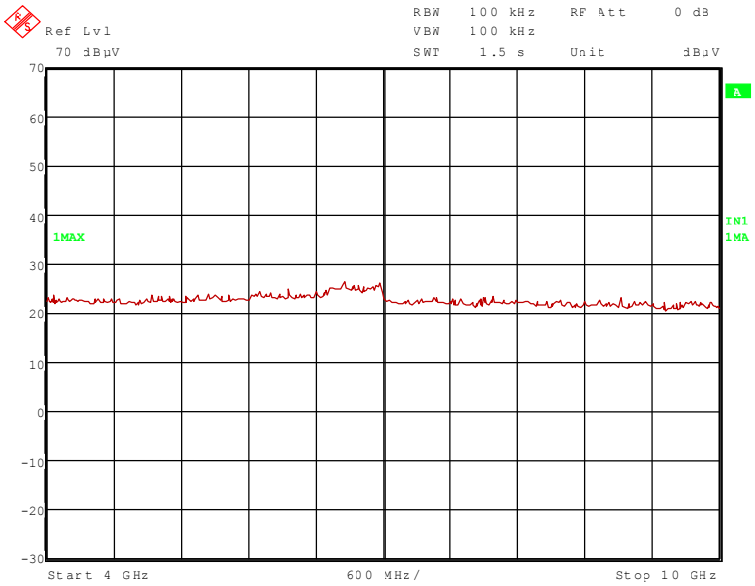
- 125.000 MHz and 250.000 MHz.

These frequencies have to be measured on the open area test site. The result is presented in the following.

113961_66.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 2):



113961_70.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 2):



No frequency was found inside the restricted bands during the preliminary radiated emission test.

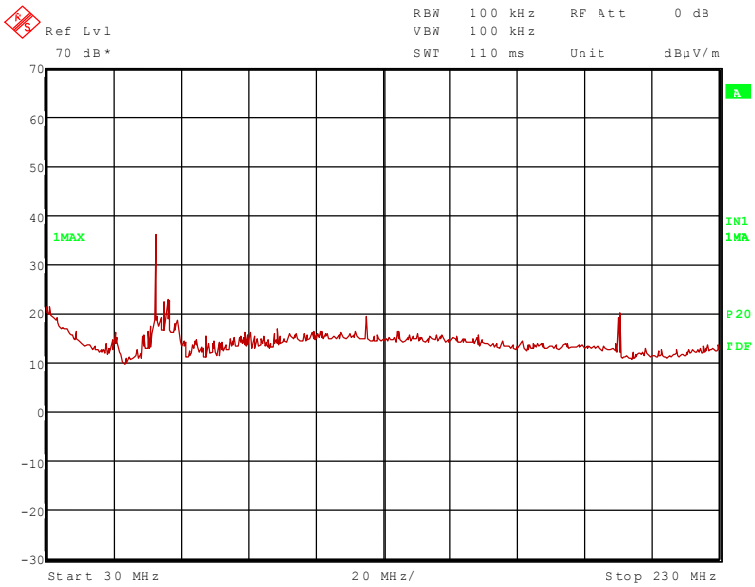
The following frequency was found outside the restricted bands during the preliminary radiated emission test:

- 1.8295 GHz.

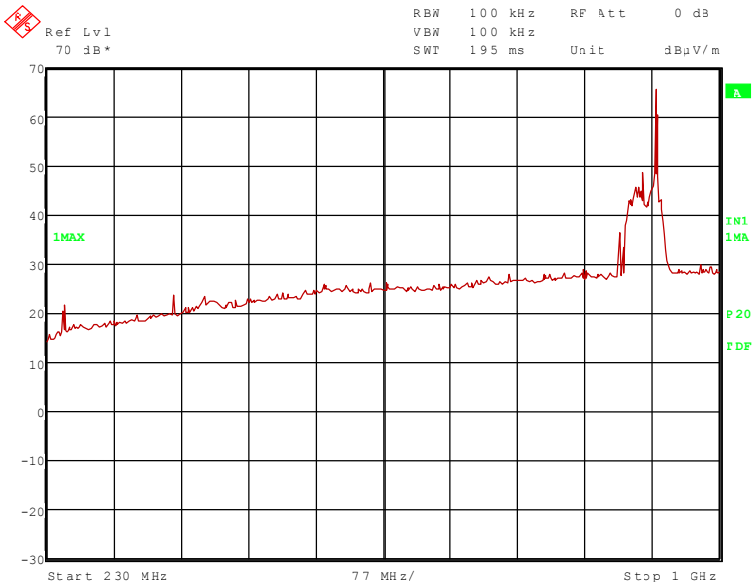
This frequency has to be measured in a final measurement. The results were presented in the following.

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

113961_63.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 3):



113961_62.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 3, carrier notched):



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

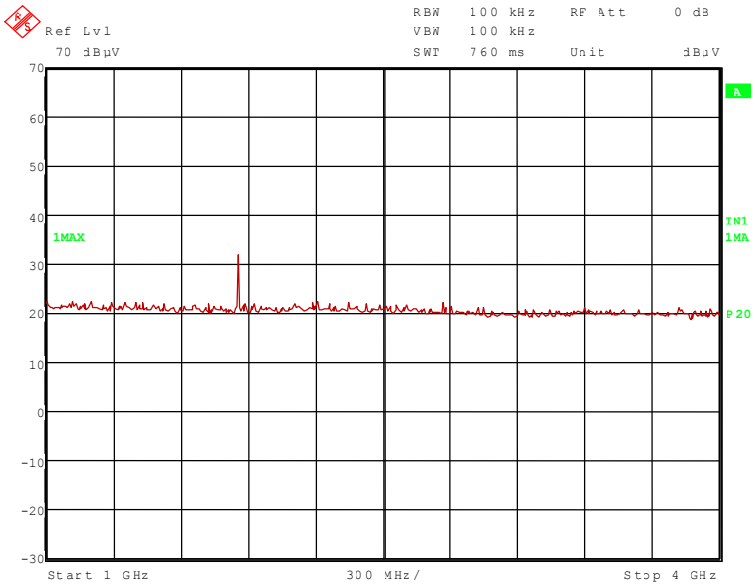
- 62.500 MHz, 66.258 MHz, 200.000 MHz, 375.000 MHz and 927.250 MHz.

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

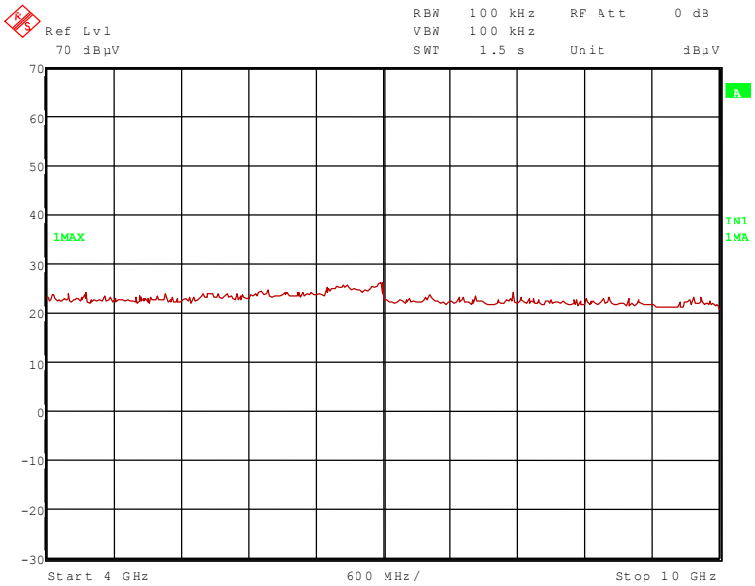
- 125.000 MHz and 250.000 MHz.

These frequencies have to be measured on the open area test site. The result is presented in the following.

113961_67.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 3):



113961_69.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 3):



No frequencies were found inside the restricted bands during the preliminary radiated emission test.

The following frequency was found outside the restricted bands during the preliminary radiated emission test:

- 1.8545 GHz.

This frequency has to be measured in a final measurement. The results were presented in the following.

5.6.2.2 Final radiated emission measurement (30 MHz to 1 GHz) with internal antenna

Ambient temperature	21 °C	Relative humidity	29 %

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: For detail information of test set-up and 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 24 V DC by an external power supply.

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

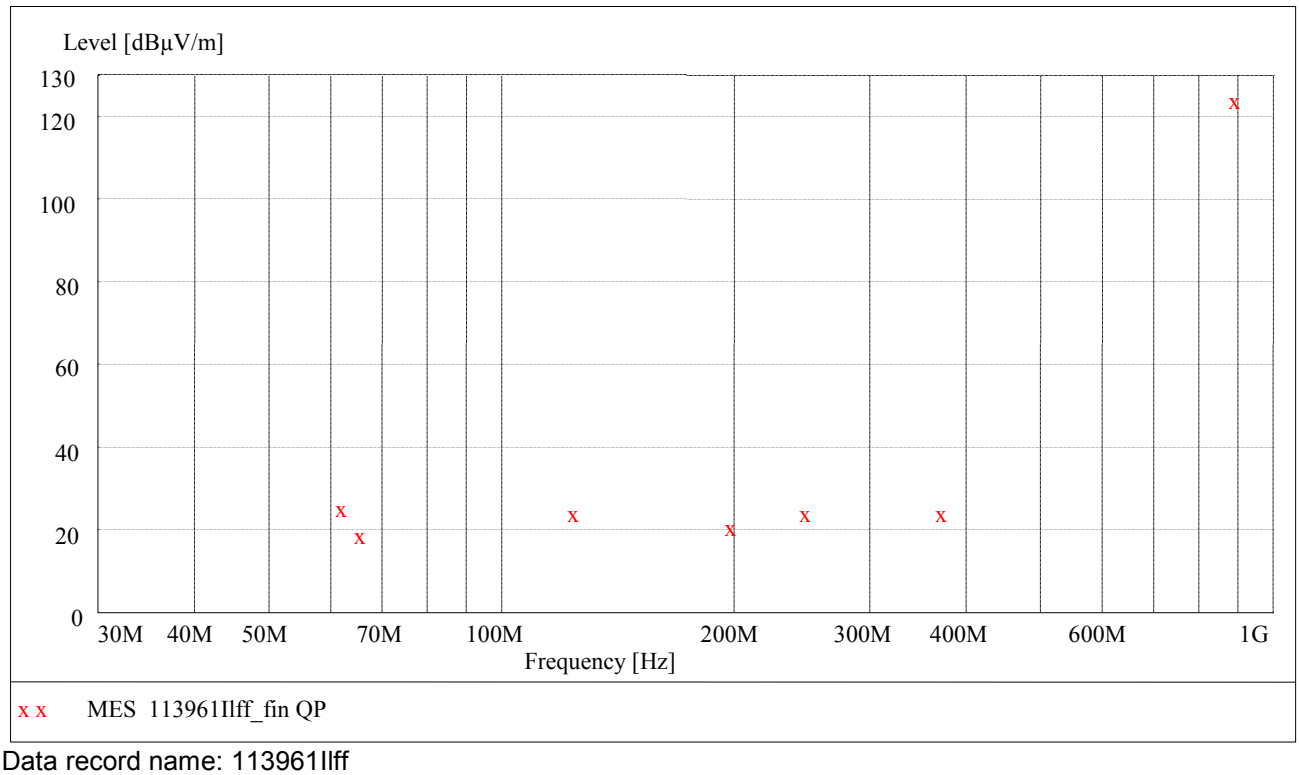
Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m]

The measured points and the limit line in the following diagrams 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.

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.

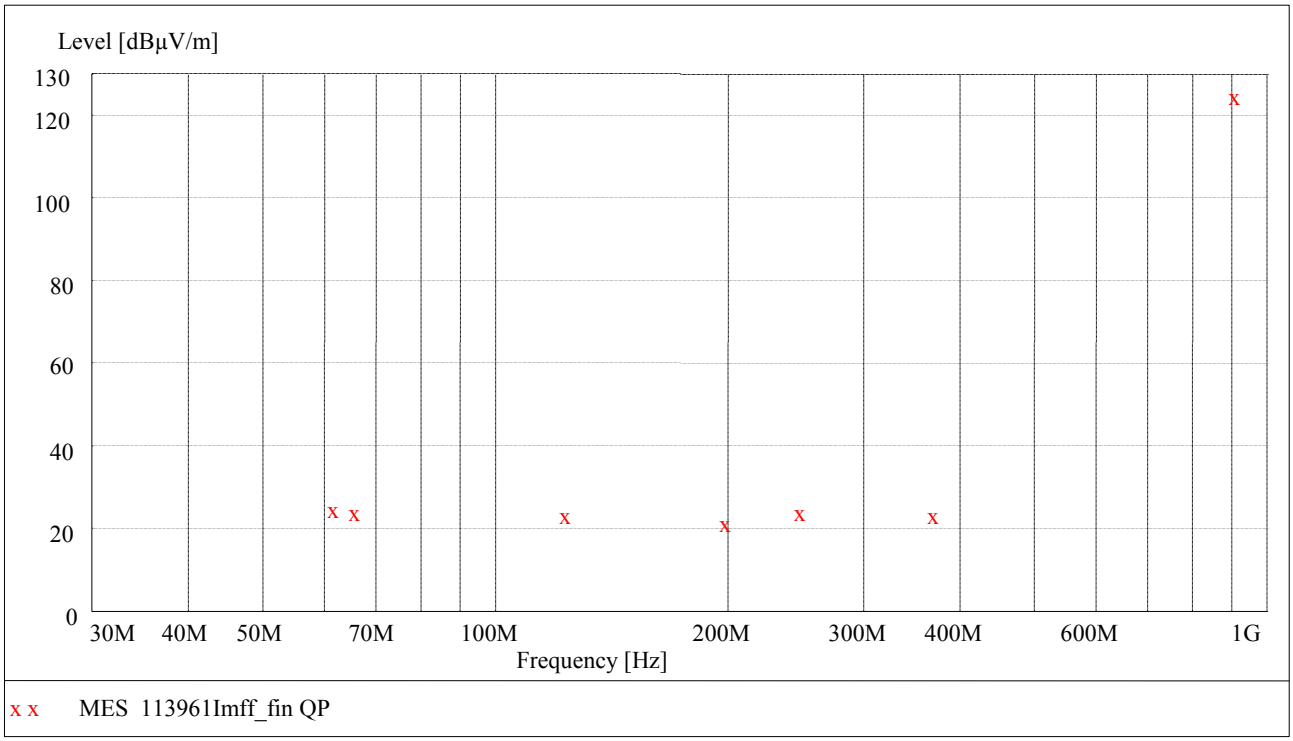
The measurement time with the quasi-peak measuring detector is 1 second.

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



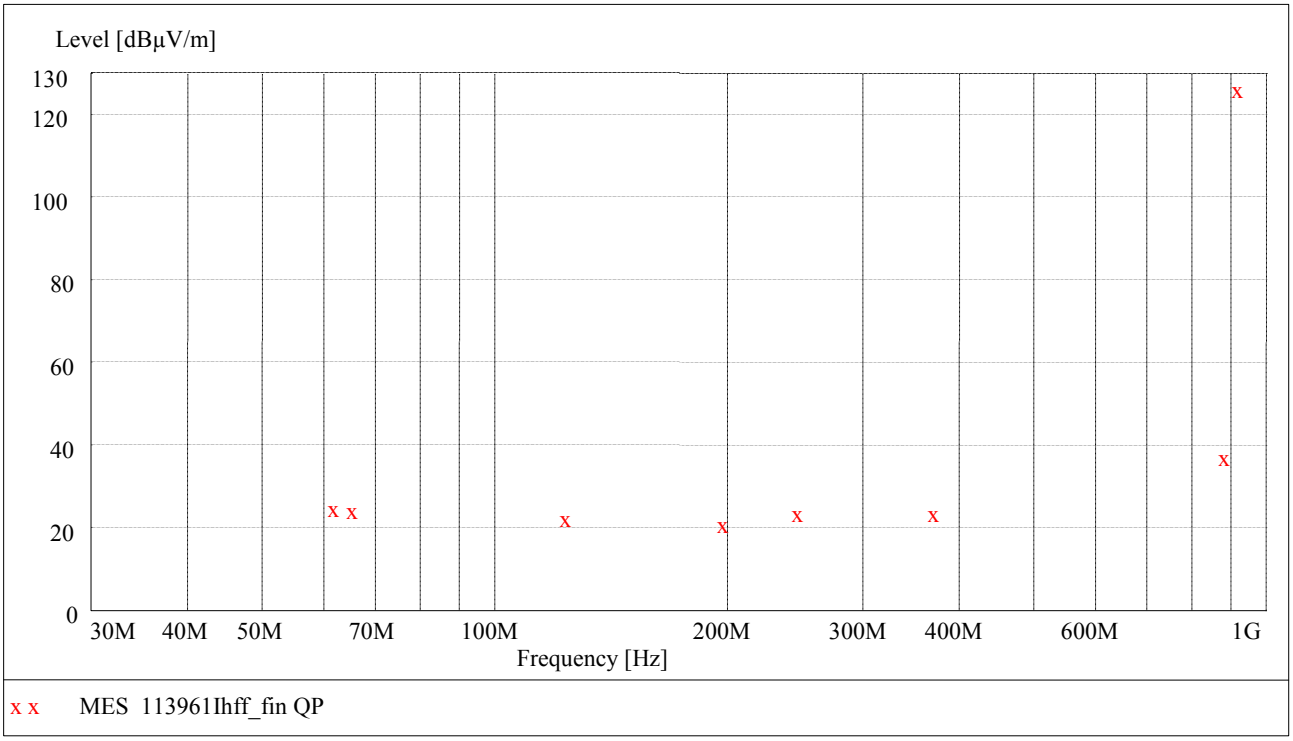
Data record name: 113961Ilff

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



Data record name: 113961Imff

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



Data record name: 113961Ihff

Result measured with the quasi-peak detector:
(These values were marked in the diagrams by an x)

Transmitter operates on the lower end of the assigned frequency band (operation mode 1)									
Spurious emissions outside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
62.500	26.3	105.0	78.7	19.3	6.1	0.9	137.0	136.0	Vert.
66.435	19.6	105.0	85.4	12.6	6.1	0.9	400.0	355.0	Hor.
200.000	21.9	105.0	83.1	11.5	8.9	1.5	103.0	19.0	Vert.
375.000	24.8	105.0	80.2	7.8	14.8	2.2	105.0	308.0	Vert.
902.750	125.0	-	-	99.1	22.5	3.4	151.0	16.0	Vert.
Spurious emissions inside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
125.000	24.7	43.5	18.8	11.1	12.4	1.2	393.0	125.0	Vert.
250.000	25.2	46.0	20.8	11.3	12.1	1.8	100.0	218.0	Vert.
Transmitter operates on the middle of the assigned frequency band (operation mode 2)									
Spurious emissions outside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
62.500	25.8	105.3	79.5	18.8	6.1	0.9	121.0	90.0	Vert.
66.271	24.6	105.3	80.7	17.6	6.1	0.9	175.0	135.0	Vert.
200.000	22.1	105.3	83.2	11.7	8.9	1.5	100.0	225.0	Vert.
375.000	24.4	105.3	80.9	7.4	14.8	2.2	225.0	110.0	Vert.
914.750	125.3	-	-	99.1	22.8	3.4	156.0	41.0	Vert.
Spurious emissions inside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
125.000	24.4	43.5	19.1	10.8	12.4	1.2	387.0	180.0	Vert.
250.000	25.2	46.0	20.8	11.3	12.1	1.8	125.0	225.0	Vert.
Transmitter operates on the upper end of the assigned frequency band (operation mode 3)									
Spurious emissions outside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
62.500	26.0	106.8	80.8	19.0	6.1	0.9	148.0	181.0	Vert.
66.258	25.3	106.8	81.5	18.3	6.1	0.9	175.0	240.0	Vert.
200.000	22.1	106.8	84.7	11.7	8.9	1.5	100.0	234.0	Vert.
375.000	24.4	106.8	82.4	7.4	14.8	2.2	112.0	110.0	Vert.
890.466	38.1	106.8	68.7	12.5	22.1	3.5	100.0	24.0	Vert.
927.250	126.8	-	-	100.0	23.4	3.4	100.0	45.0	Vert.
Spurious emissions inside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
125.000	23.3	43.5	20.2	9.7	12.4	1.2	225.0	156.0	Hor.
250.000	24.6	46.0	21.4	10.7	12.1	1.8	109.0	222.0	Vert.
Measurement uncertainty				+2.2 dB / -3.6 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
14 - 20

5.6.2.3 Final radiated emission measurement (1 GHz to 10 GHz) with internal antenna

Ambient temperature	21 °C	Relative humidity	35 %

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: For detail information of test set-up and 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 24 V DC by an external power supply.

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

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

Result measured with the peak detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.80550	37.7	105.0	67.3	34.7	26.5	26.5	3.0	150	Hor.	No
2.70825	39.5	74.0	34.5	33.2	28.7	26.4	4.0	150	Hor.	Yes
Measurement uncertainty							+2.2 dB / -3.6 dB			

Result measured with the average detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.80550	25.7	105.0	79.3	22.7	26.5	26.5	3.0	150	Hor.	No
2.70825	26.8	54.0	27.2	20.5	28.7	26.4	4.0	150	Hor.	Yes
Measurement uncertainty							+2.2 dB / -3.6 dB			

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

Result measured with the peak detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8295	39.5	105.3	65.8	36.0	26.7	26.5	3.3	150	Vert.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Result measured with the average detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8295	28.0	105.3	77.3	24.5	26.7	26.5	3.3	150	Vert.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

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

Result measured with the peak detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8545	41.3	106.8	65.5	37.2	27.0	26.5	3.6	150	Vert.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Result measured with the average detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8545	30.3	106.8	76.5	26.2	27.0	26.5	3.6	150	Vert.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 34, 36, 44, 49, 73

5.6.2.4 Preliminary radiated emission measurement with external patch antenna

Ambient temperature	21 °C	Relative humidity	35 %

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: For detail information of test set-up and the cable guide refer to the pictures in annex A of this test report.

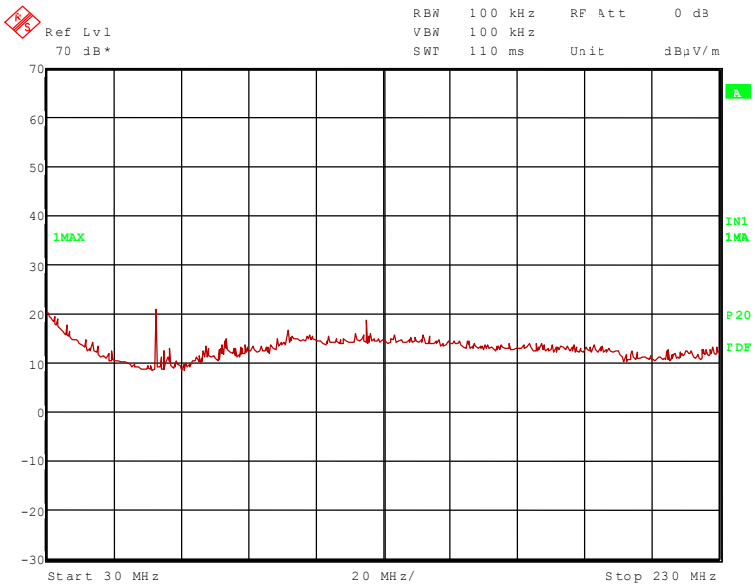
Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 24 V DC by an external power supply.

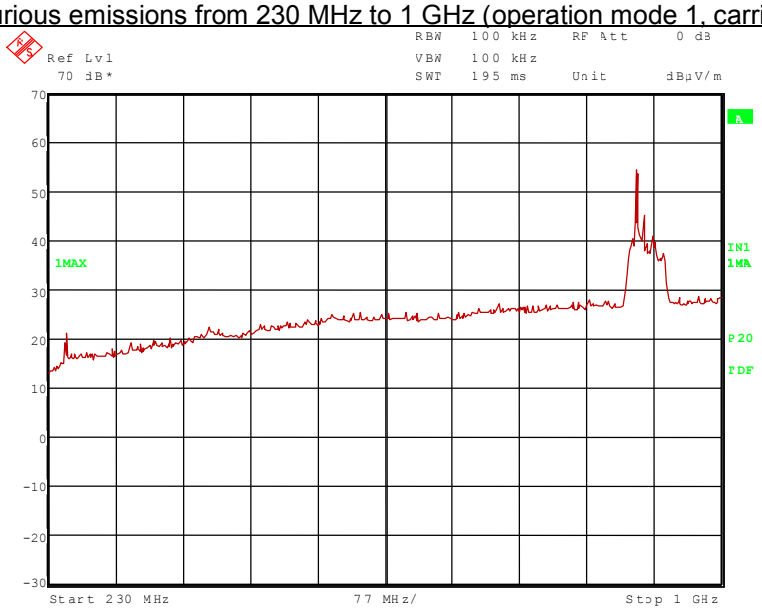
Remark: As pre-tests have shown, the emissions in the frequency range 1 MHz to 30 MHz are not depending on the transmitter operation mode. Therefore the emissions in this frequency range were measured only with the transmitter operates in operation mode 2.

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

113961_83.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 1):



113961_82.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 1, carrier notched):



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

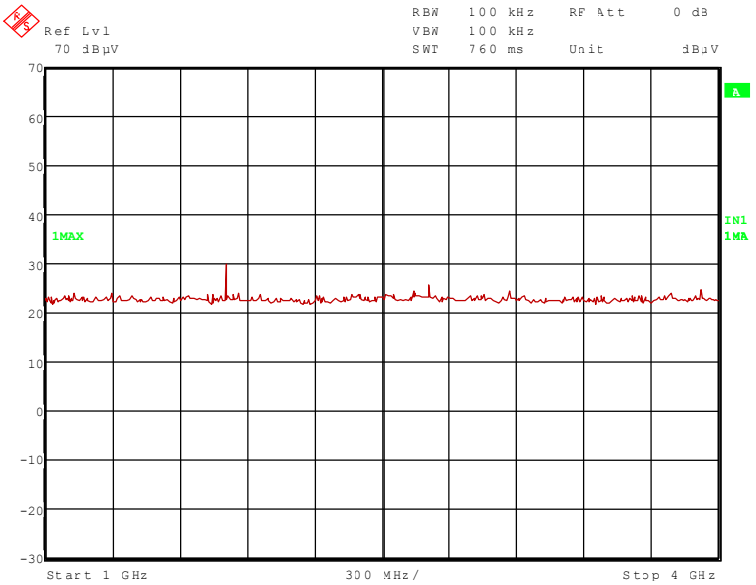
- 62.500 MHz, 902.750 MHz and 912.072 MHz.

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

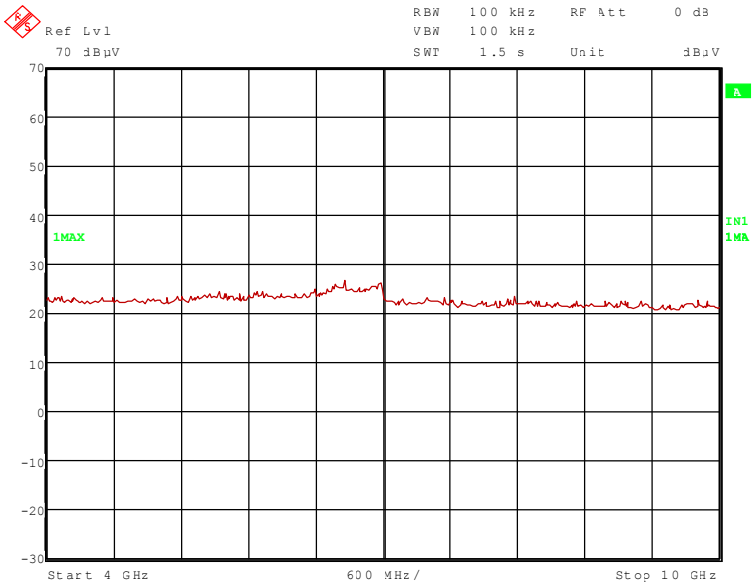
- 125.000 MHz and 250.000 MHz.

These frequencies have to be measured on the open area test site. The result is presented in the following.

113961_72.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 1):



113961_77.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 1):



No frequency was found inside the restricted bands during the preliminary radiated emission test.

The following frequency was found outside the restricted bands during the preliminary radiated emission test:

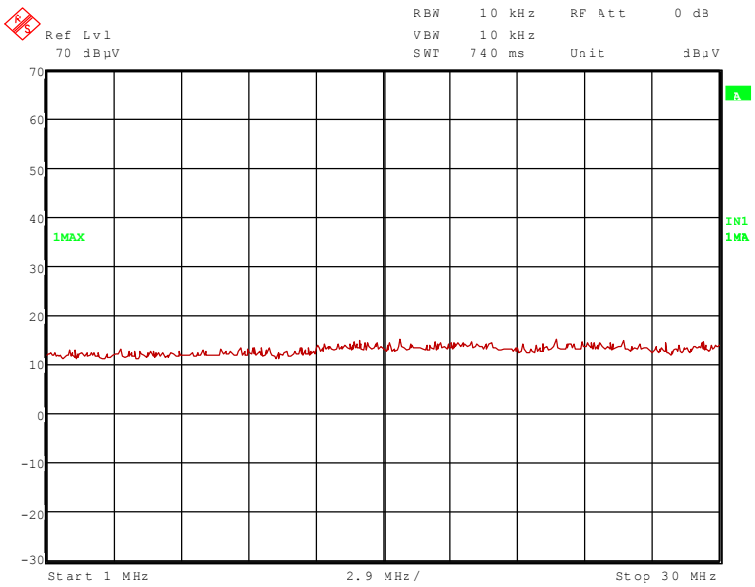
- 1.8055 GHz.

These frequencies have to be measured in a final measurement. The results were presented in the following.

TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 36, 43, 44, 49, 55, 73, 75

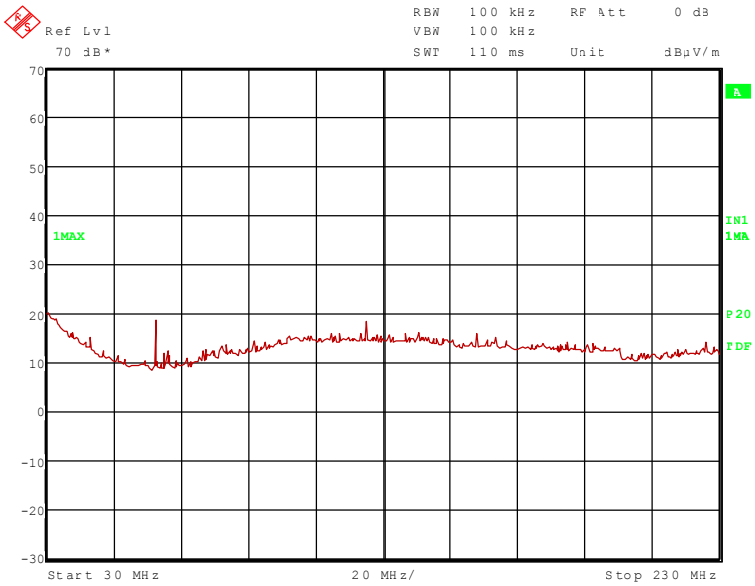
Transmitter operates on the middle of the assigned frequency band (operation mode 2)

113961_98.wmf: Spurious emissions from 1 MHz to 30 MHz (operation mode 2):

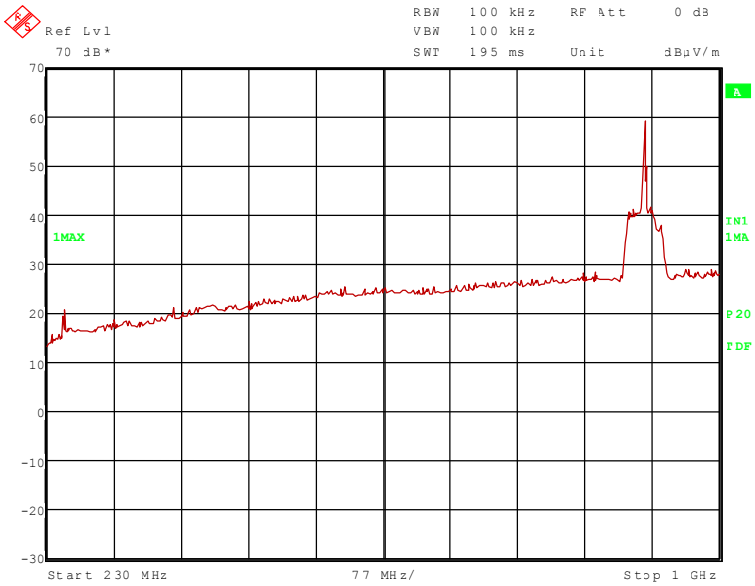


No significant frequencies above the noise floor of the system were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.

113961_80.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 2):



113961_81.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 2, carrier notched):



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

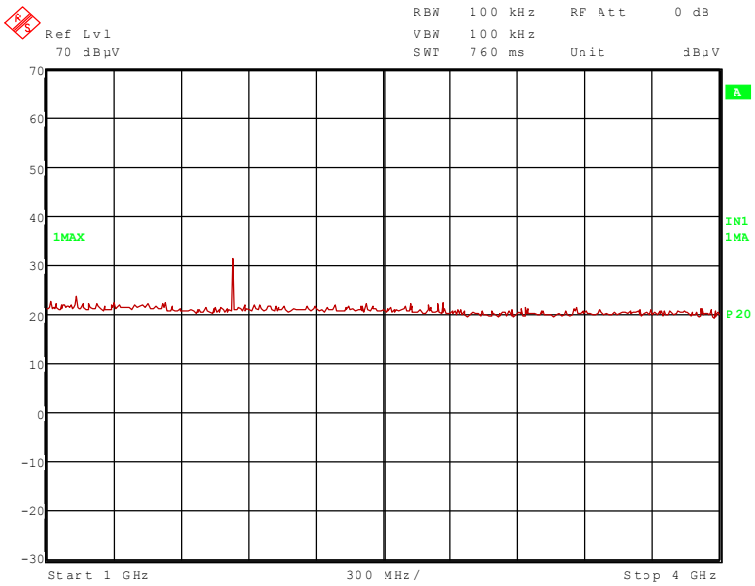
- 62.500 MHz, 909.346 MHz and 914.750 MHz.

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

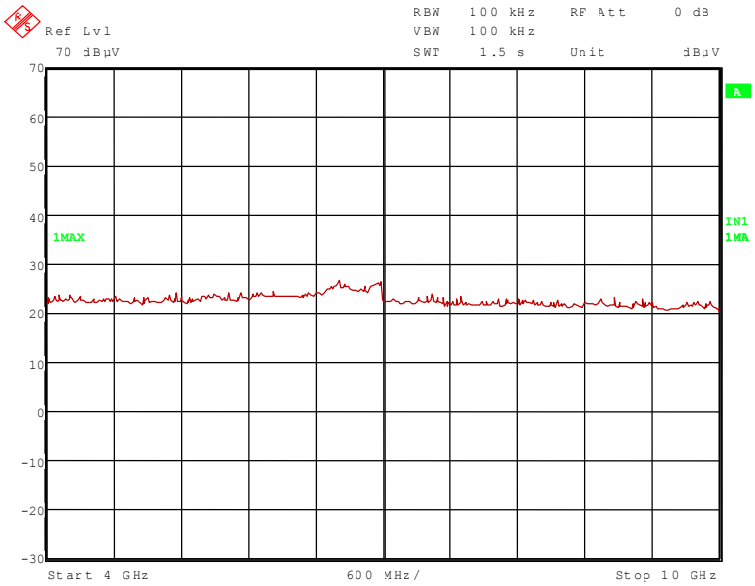
- 125.000 MHz and 250.000 MHz.

These frequencies have to be measured on the open area test site. The result is presented in the following.

113961_73.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 2):



113961_76.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 2):



No frequency was found inside the restricted bands during the preliminary radiated emission test.

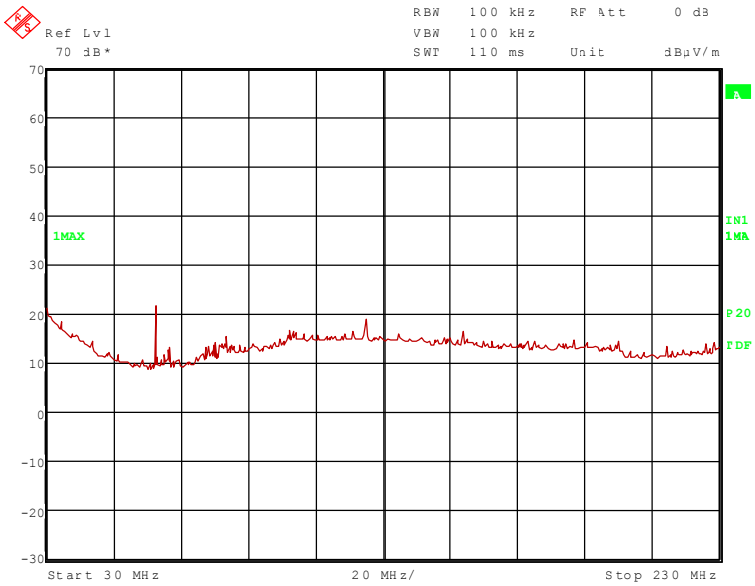
The following frequency was found outside the restricted bands during the preliminary radiated emission test:

- 1.8295 GHz.

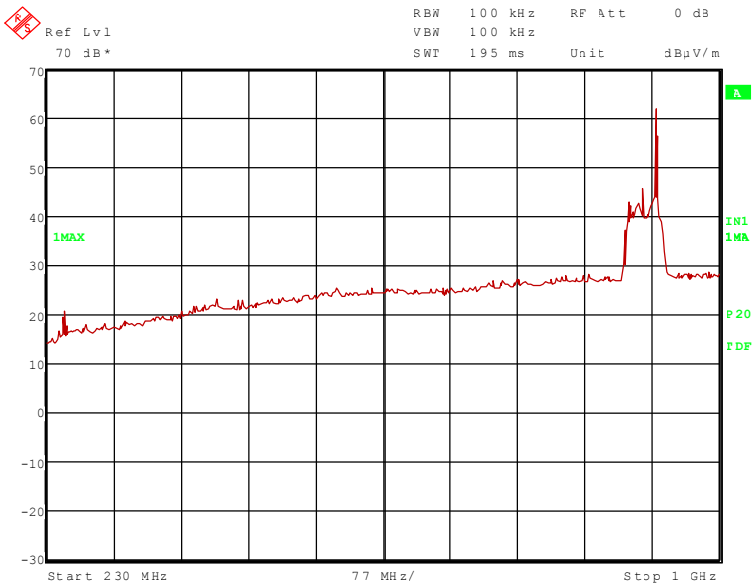
This frequency has to be measured in a final measurement. The results were presented in the following.

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

113961_79.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 3):



113961_78.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 3, carrier notched):



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

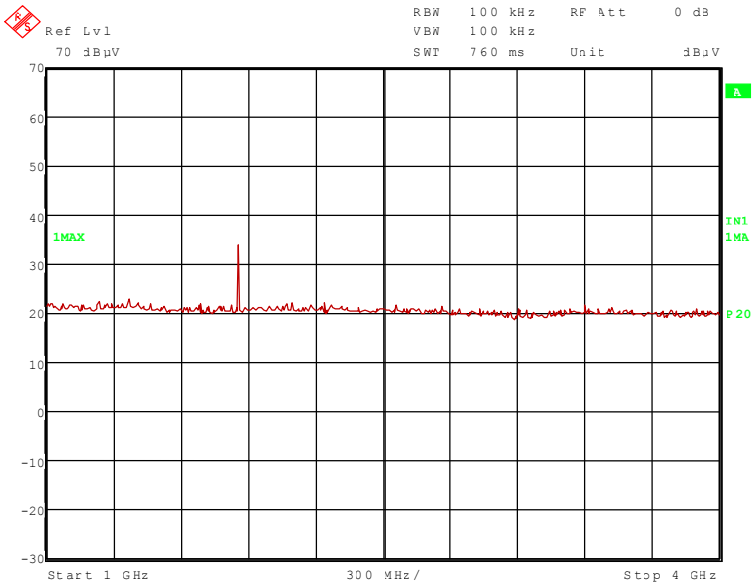
- 62.500 MHz, 912.000 MHz, 894.126 MHz and 927.250 MHz.

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

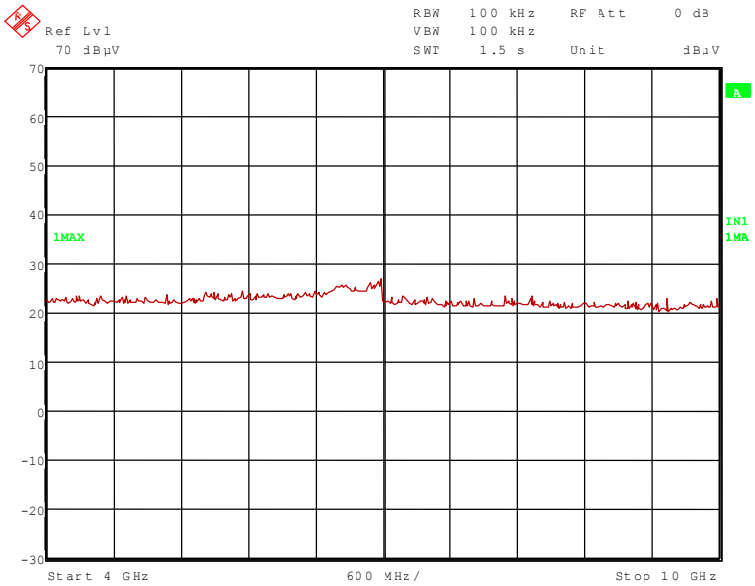
- 125.000 MHz and 250.000 MHz.

These frequencies have to be measured on the open area test site. The result is presented in the following.

113961_74.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 3):



113961_75.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 3):



No frequencies were found inside the restricted bands during the preliminary radiated emission test.

The following frequency was found outside the restricted bands during the preliminary radiated emission test:

- 1.8545 GHz.

This frequency has to be measured in a final measurement. The results were presented in the following.

5.6.2.5 Final radiated emission measurement (30 MHz to 1 GHz) with external patch antenna

Ambient temperature	21 °C	Relative humidity	29 %

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: For detail information of test set-up and 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 24 V DC by an external power supply.

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

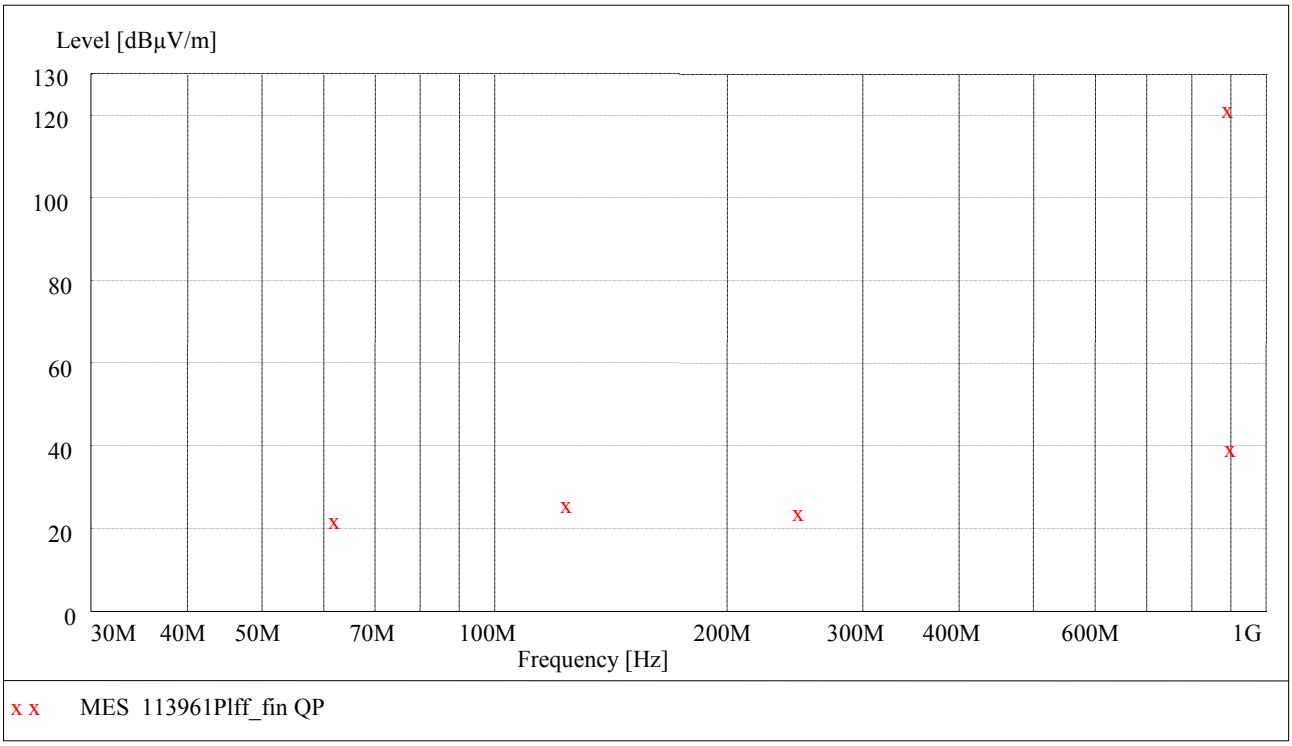
Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m]

The measured points and the limit line in the following diagrams 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.

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.

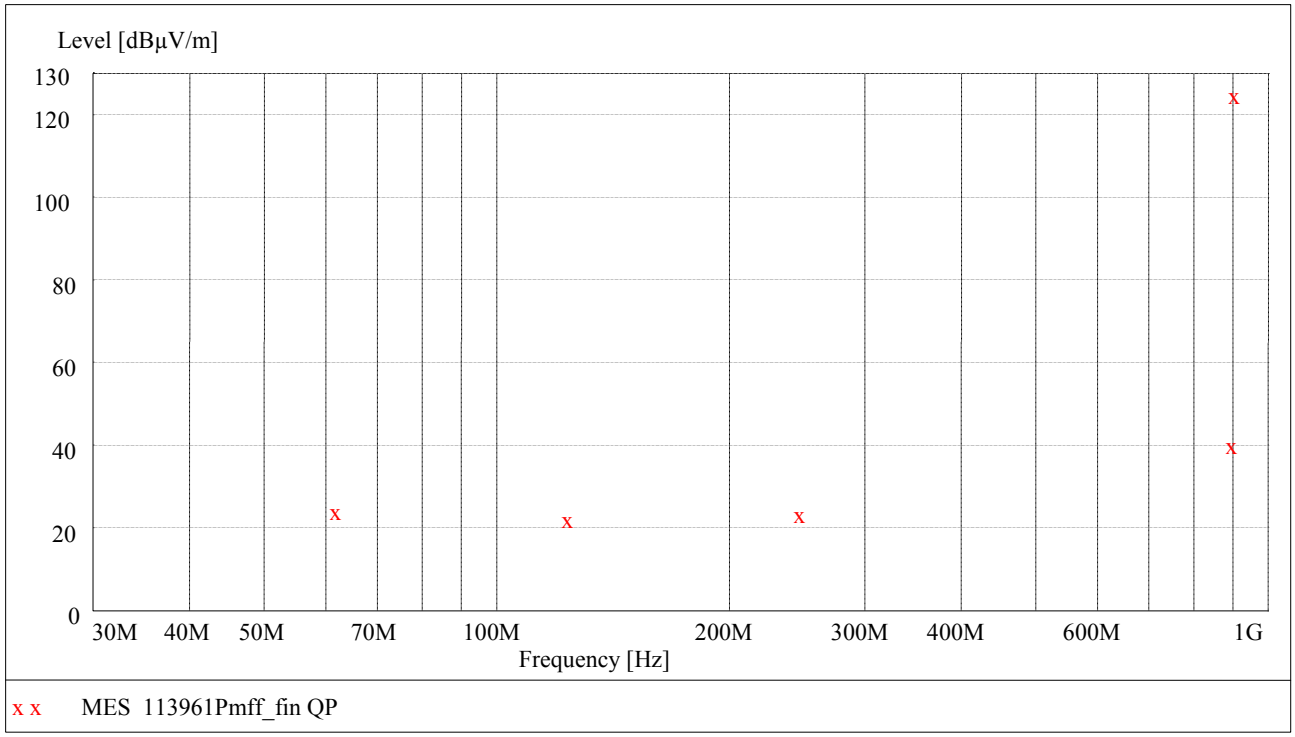
The measurement time with the quasi-peak measuring detector is 1 second.

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



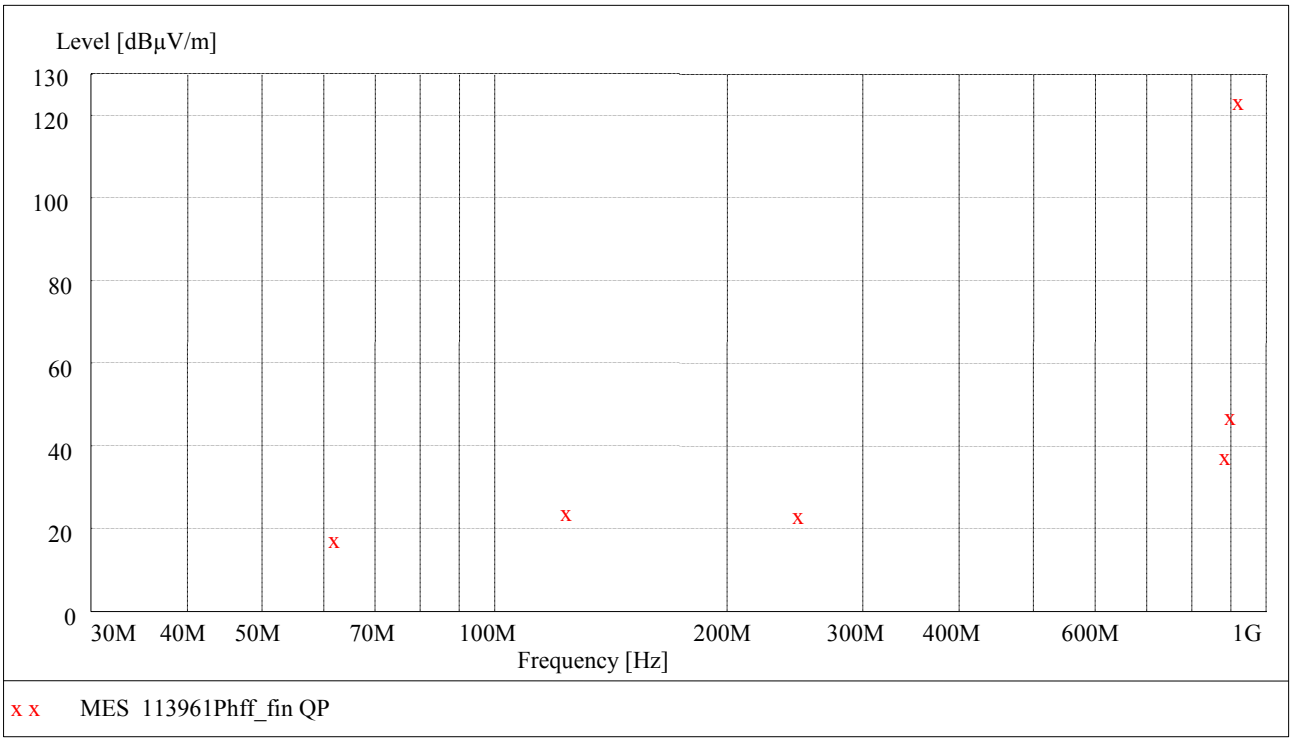
Data record name: 113961Plff

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



Data record name: 113961Pmff

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



Data record name: 113961Phff

Result measured with the quasi-peak detector:

(These values were marked in the diagrams by an x)

Transmitter operates on the lower end of the assigned frequency band (operation mode 1)									
Spurious emissions outside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
62.500	23.2	102.5	79.3	16.2	6.1	0.9	158.0	263.0	Vert.
902.750	122.5	-	-	96.6	22.5	3.4	286.0	15.0	Hor.
912.072	40.6			14.5	22.7	3.4	260.0	28.0	Hor.
Spurious emissions inside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
125.000	27.1	43.5	16.4	13.5	12.4	1.2	175.0	250.0	Vert.
250.000	24.9	46.0	21.1	11.0	12.1	1.8	100.0	226.0	Vert.
Transmitter operates on the middle of the assigned frequency band (operation mode 2)									
Spurious emissions outside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
62.500	25.0	105.6	80.6	18.0	6.1	0.9	158.0	245.0	Vert.
909.346	41.0	105.6	64.6	15.0	22.6	3.4	175.0	22.0	Hor.
914.750	125.6	-	-	99.4	22.8	3.4	177.0	29.0	Hor.
Spurious emissions inside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
125.000	23.0	43.5	20.5	9.4	12.4	1.2	125.0	222.0	Hor.
250.000	24.2	46.0	21.8	10.3	12.1	1.8	112.0	225.0	Vert.
Transmitter operates on the upper end of the assigned frequency band (operation mode 3)									
Spurious emissions outside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
62.500	18.2	104.1	85.9	11.2	6.1	0.9	377.0	182.0	Hor.
894.126	38.3	104.1	65.8	12.6	22.2	3.5	109.0	21.0	Vert.
912.000	48.0	104.1	56.1	21.9	22.7	3.4	175.0	34.0	Hor.
927.250	124.1	-	-	97.3	23.4	3.4	178.0	44.0	Hor.
Spurious emissions inside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
125.000	24.9	43.5	18.6	11.3	12.4	1.2	225.0	91.0	Vert.
250.000	24.6	46.0	21.4	10.7	12.1	1.8	100.0	213.0	Vert.
Measurement uncertainty				+2.2 dB / -3.6 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
14 – 20

5.6.2.6 Final radiated emission measurement (1 GHz to 10 GHz) with external patch antenna

Ambient temperature	21 °C	Relative humidity	35 %

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: For detail information of test set-up and 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 24 V DC by an external power supply.

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

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

Result measured with the peak detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8055	38.1	102.5	64.4	35.1	26.5	26.5	3.0	150	Hor.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Result measured with the average detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8055	26.4	102.5	76.1	23.4	26.5	26.5	3.0	150	Hor.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

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

Result measured with the peak detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8295	40.4	105.6	65.2	36.9	26.7	26.5	3.3	150	Vert.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Result measured with the average detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8295	29.3	105.6	76.3	25.8	26.7	26.5	3.3	150	Vert.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

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

Result measured with the peak detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8545	42.9	104.1	61.2	38.8	27.0	26.5	3.6	150	Vert.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Result measured with the average detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8545	32.6	104.1	71.5	28.5	27.0	26.5	3.6	150	Vert.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 34, 36, 44, 49, 73

5.6.2.7 Preliminary radiated emission measurement with external ULORA antenna

Ambient temperature	21 °C	Relative humidity	35 %

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: For detail information of test set-up and the cable guide refer to the pictures in annex A of this test report.

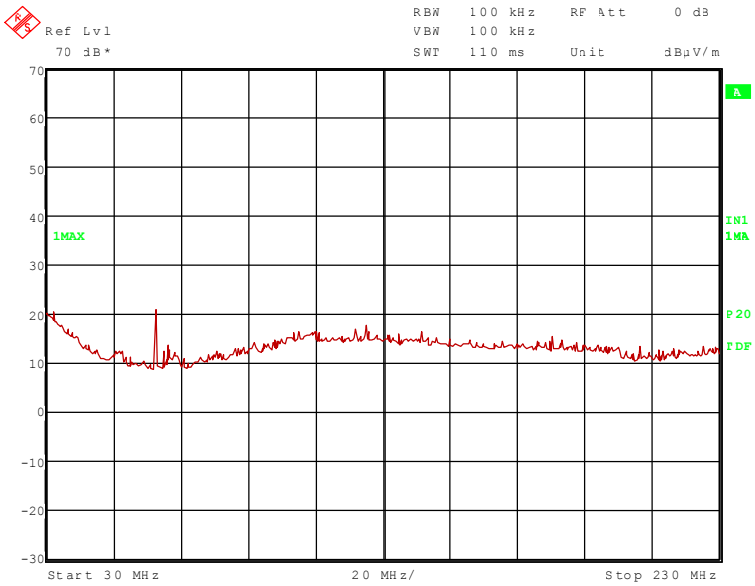
Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 24 V DC by an external power supply.

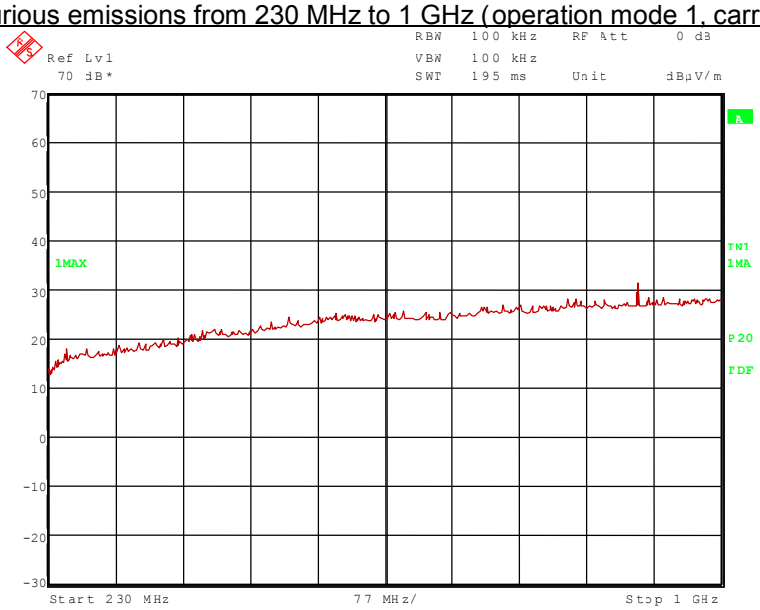
Remark: As pre-tests have shown, the emissions in the frequency range 1 MHz to 30 MHz are not depending on the transmitter operation mode. Therefore the emissions in this frequency range were measured only with the transmitter operates in operation mode 2.

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

113961_85.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 1):



113961_86.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 1, carrier notched):



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

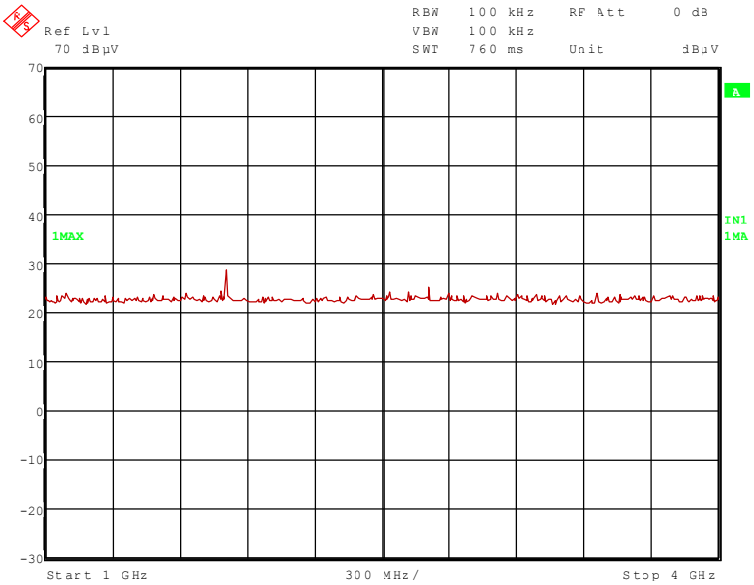
- 62.500 MHz and 902.750 MHz.

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

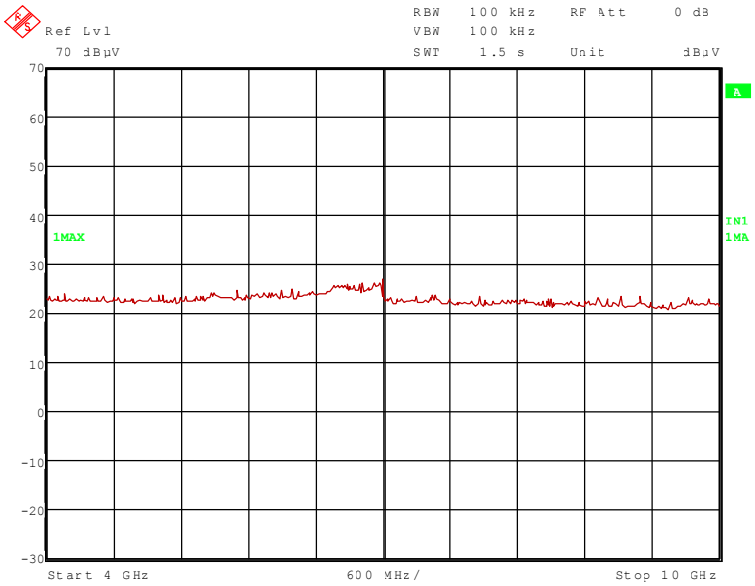
- 125.000 MHz.

These frequencies have to be measured on the open area test site. The result is presented in the following.

113961_93.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 1):



113961_94.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 1):



No frequency was found inside the restricted bands during the preliminary radiated emission test.

The following frequency was found outside the restricted bands during the preliminary radiated emission test:

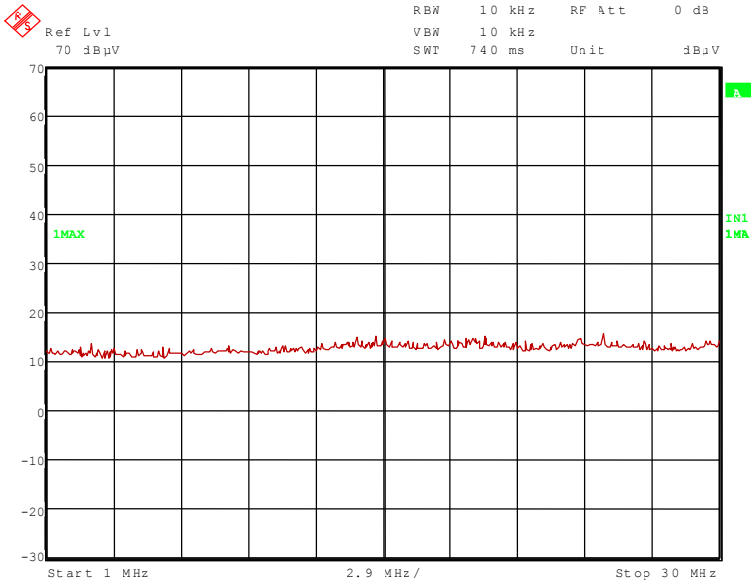
- 1.8055 GHz.

These frequencies have to be measured in a final measurement. The results were presented in the following.

TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 36, 43, 44, 49, 55, 73, 75

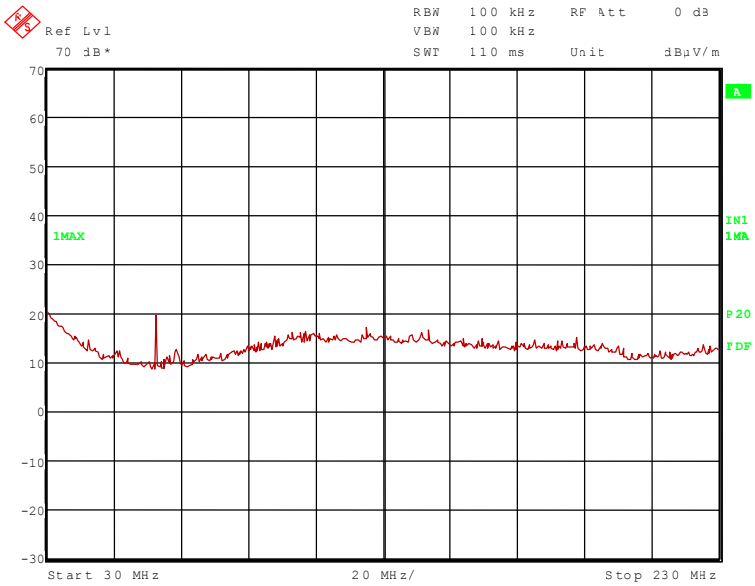
Transmitter operates on the middle of the assigned frequency band (operation mode 2)

113961_97.wmf: Spurious emissions from 1 MHz to 30 MHz (operation mode 2):

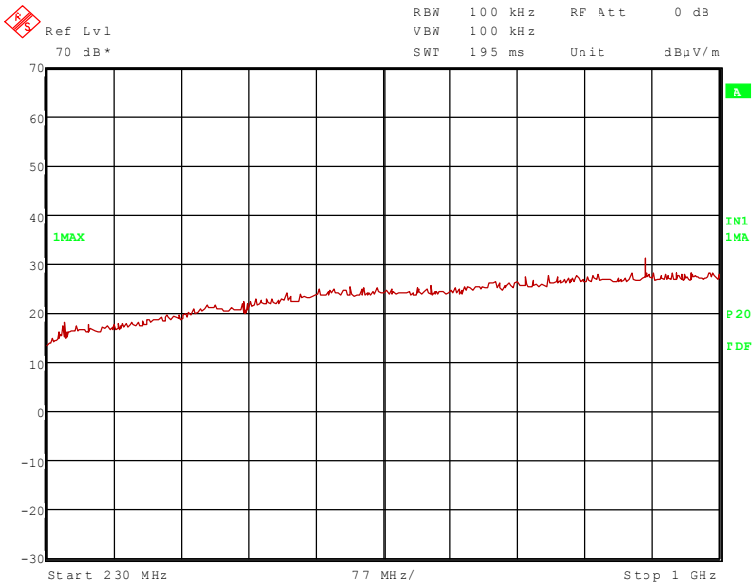


No significant frequencies above the noise floor of the system were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.

113961_88.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 2):



113961_87.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 2, carrier notched):



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

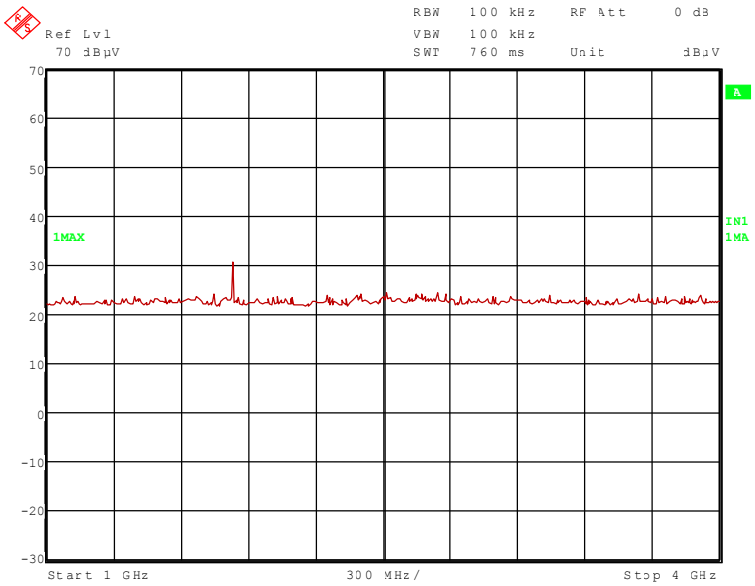
- 62.500 MHz, and 914.750 MHz.

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

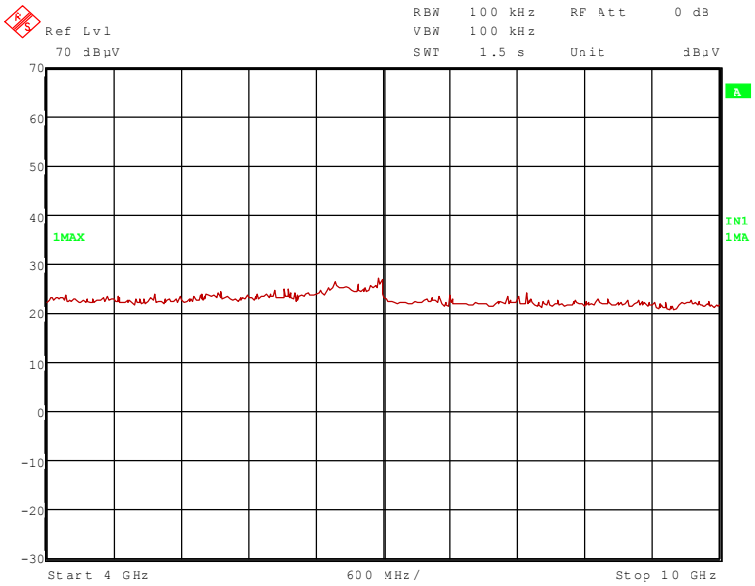
- 125.000 MHz and 250.000 MHz.

These frequencies have to be measured on the open area test site. The result is presented in the following.

113961_92.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 2):



113961_95.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 2):



No frequency was found inside the restricted bands during the preliminary radiated emission test.

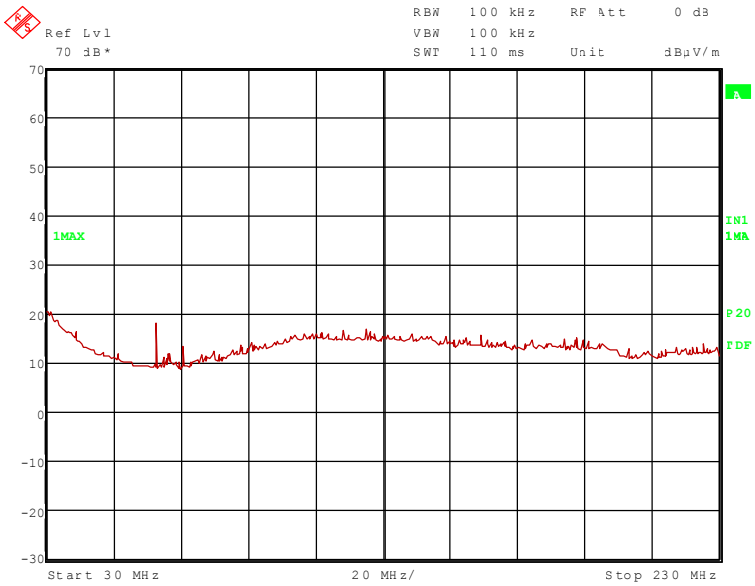
The following frequency was found outside the restricted bands during the preliminary radiated emission test:

- 1.8295 GHz.

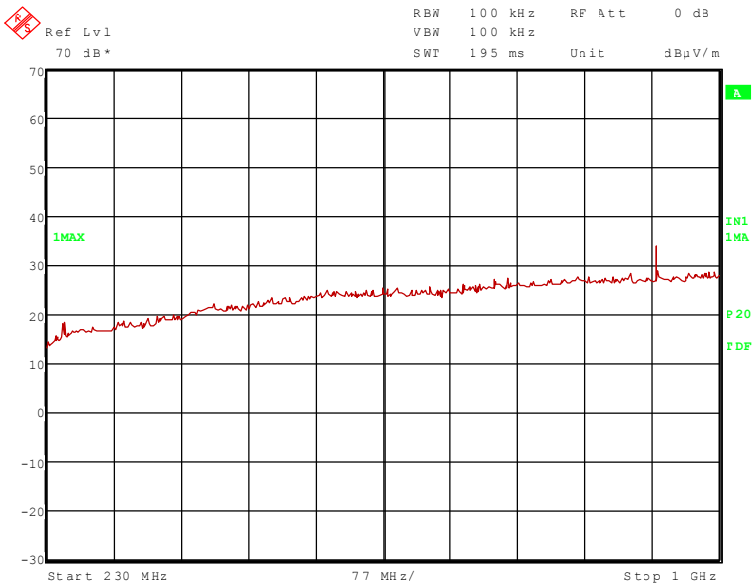
This frequency has to be measured in a final measurement. The results were presented in the following.

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

113961_89.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 3):



113961_90.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 3, carrier notched):



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

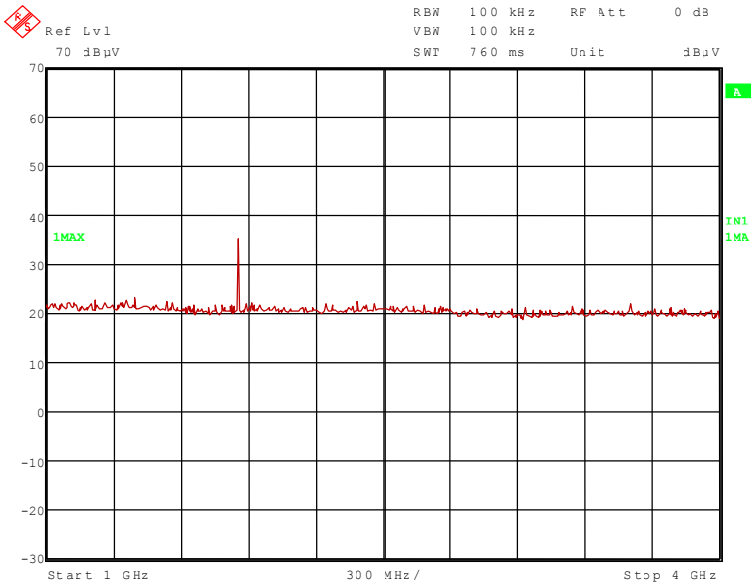
- 62.500 MHz, and 927.250 MHz.

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

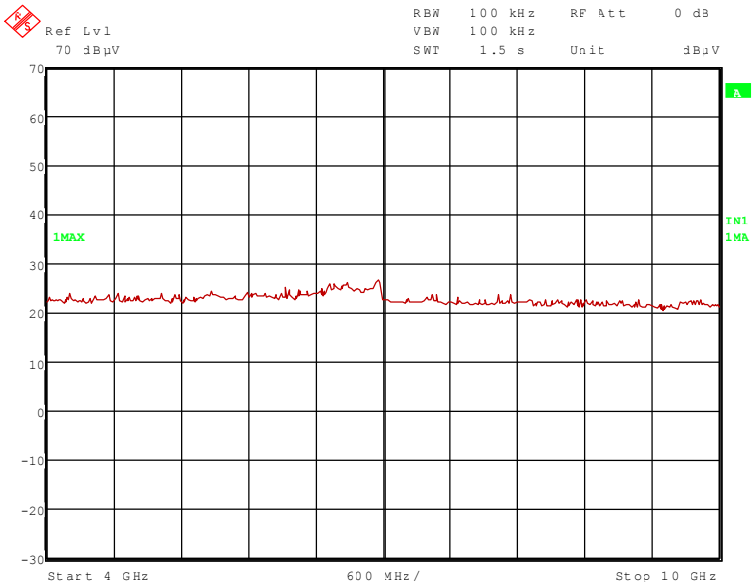
- 125.000 MHz and 250.000 MHz.

These frequencies have to be measured on the open area test site. The result is presented in the following.

113961_91.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 3):



113961_96.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 3):



No frequencies were found inside the restricted bands during the preliminary radiated emission test.

The following frequency was found outside the restricted bands during the preliminary radiated emission test:

- 1.8545 GHz.

This frequency has to be measured in a final measurement. The results were presented in the following.

5.6.2.8 Final radiated emission measurement (30 MHz to 1 GHz) with external ULORA antenna

Ambient temperature	21 °C	Relative humidity	29 %

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: For detail information of test set-up and 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 24 V DC by an external power supply.

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

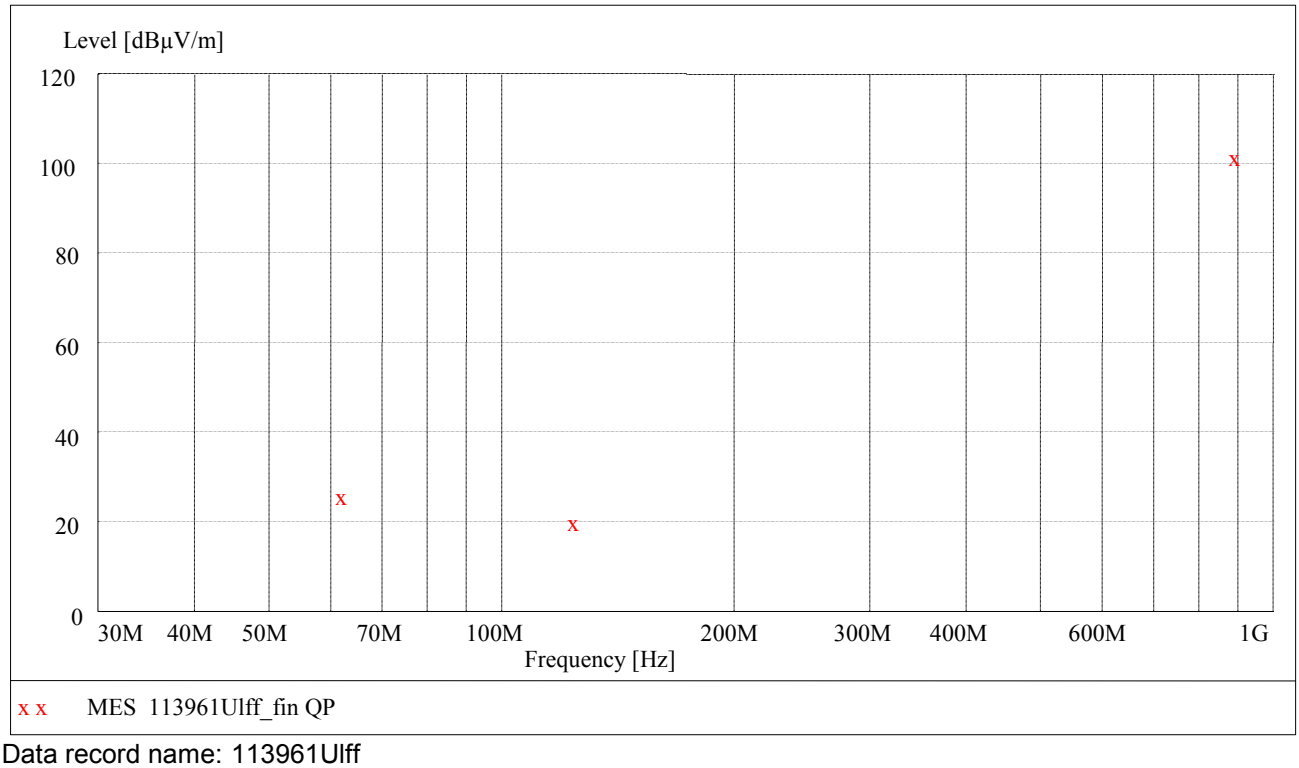
Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m]

The measured points and the limit line in the following diagrams 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.

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.

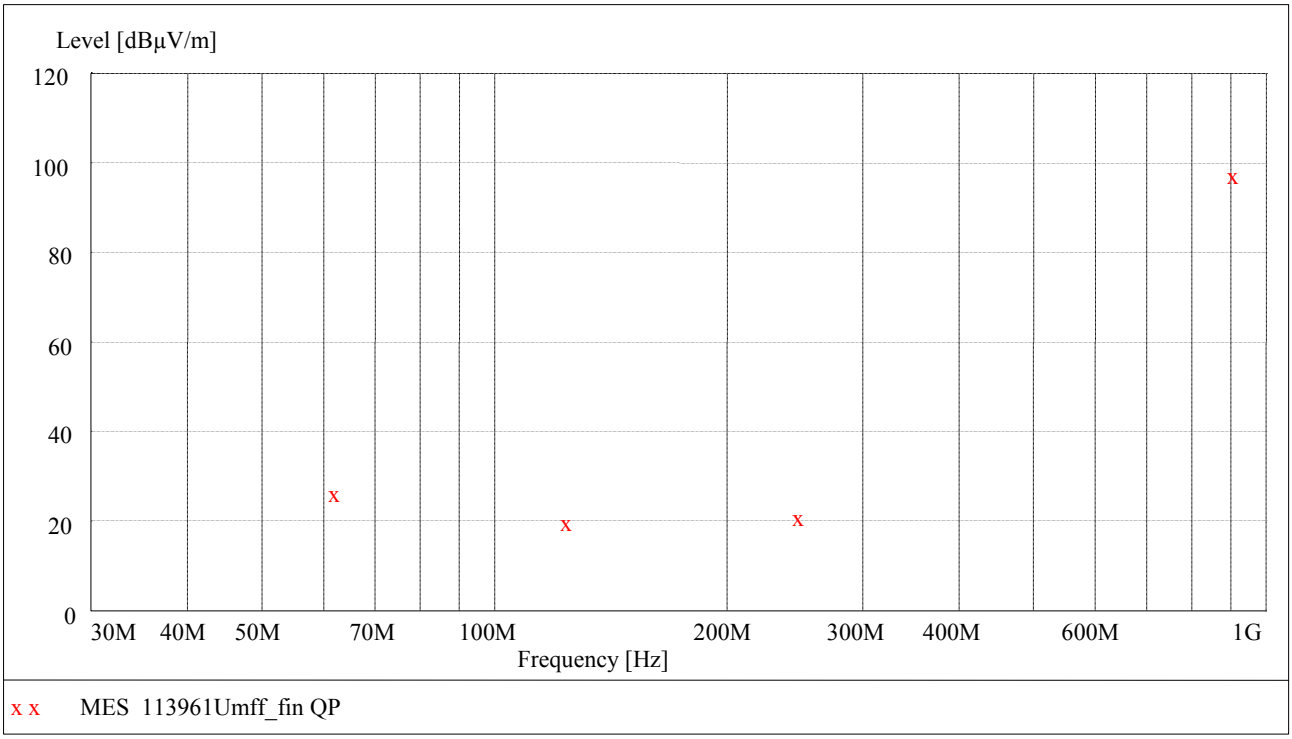
The measurement time with the quasi-peak measuring detector is 1 second.

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



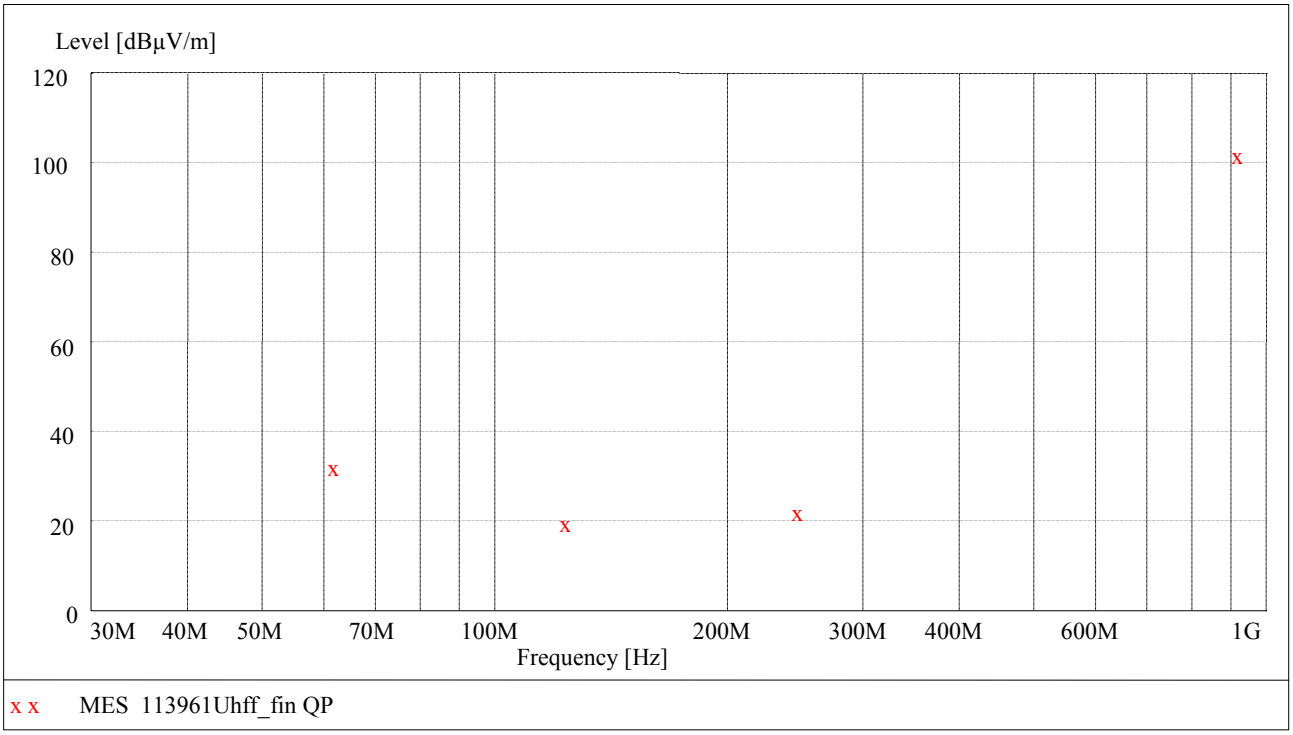
Data record name: 113961Ulff

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



Data record name: 113961Umff

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



Data record name: 113961Uhff

Result measured with the quasi-peak detector:

(These values were marked in the diagrams by an x)

Transmitter operates on the lower end of the assigned frequency band (operation mode 1)									
Spurious emissions outside restricted bands									
Frequency	Result	Limit	Margin	Readings	Antenna factor	Cable loss	Height	Azimuth	Pol.
MHz	dBµV/m	dBµV/m	dB	dBµV	dB/m	dB	cm	deg	
62.500	26.9	82.6	55.7	19.9	6.1	0.9	100.0	315.0	Vert.
902.750	102.6	-	-	76.7	22.5	3.4	100.0	24.0	Vert.
Spurious emissions inside restricted bands									
Frequency	Result	Limit	Margin	Readings	Antenna factor	Cable loss	Height	Azimuth	Pol.
MHz	dBµV/m	dBµV/m	dB	dBµV	dB/m	dB	cm	deg	
125.000	20.5	43.5	23.0	6.9	12.4	1.2	129.0	315.0	Hor.
Transmitter operates on the middle of the assigned frequency band (operation mode 2)									
Spurious emissions outside restricted bands									
Frequency	Result	Limit	Margin	Readings	Antenna factor	Cable loss	Height	Azimuth	Pol.
MHz	dBµV/m	dBµV/m	dB	dBµV	dB/m	dB	cm	deg	
62.500	27.2	77.8	50.6	20.2	6.1	0.9	182.0	135.0	Vert.
914.750	97.8	-	-	71.6	22.8	3.4	142.0	1.0	Vert.
Spurious emissions inside restricted bands									
Frequency	Result	Limit	Margin	Readings	Antenna factor	Cable loss	Height	Azimuth	Pol.
MHz	dBµV/m	dBµV/m	dB	dBµV	dB/m	dB	cm	deg	
125.000	20.4	43.5	23.1	6.8	12.4	1.2	377.0	57.0	Hor.
250.000	21.9	46.0	24.1	8.0	12.1	1.8	115.0	92.0	Vert.
Transmitter operates on the upper end of the assigned frequency band (operation mode 3)									
Spurious emissions outside restricted bands									
Frequency	Result	Limit	Margin	Readings	Antenna factor	Cable loss	Height	Azimuth	Pol.
MHz	dBµV/m	dBµV/m	dB	dBµV	dB/m	dB	cm	deg	
62.500	32.8	82.4	49.6	25.8	6.1	0.9	166.0	215.0	Vert.
927.250	102.4	-	-	75.6	23.4	3.4	100.0	44.0	Vert.
Spurious emissions inside restricted bands									
Frequency	Result	Limit	Margin	Readings	Antenna factor	Cable loss	Height	Azimuth	Pol.
MHz	dBµV/m	dBµV/m	dB	dBµV	dB/m	dB	cm	deg	
125.000	20.6	43.5	22.9	7.0	12.4	1.2	183.0	224.0	Hor.
250.000	22.8	46.0	23.2	8.9	12.1	1.8	153.0	90.0	Vert.
Measurement uncertainty				+2.2 dB / -3.6 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
14 – 20

5.6.2.9 Final radiated emission measurement (1 GHz to 10 GHz) with external ULORA antenna

Ambient temperature	21 °C	Relative humidity	35 %

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: For detail information of test set-up and 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 24 V DC by an external power supply.

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

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

Result measured with the peak detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8055	37.5	82.6	45.1	34.5	26.5	26.5	3.0	150	Vert.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Result measured with the average detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8055	25.6	82.6	57.0	22.6	26.5	26.5	3.0	150	Vert.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

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

Result measured with the peak detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8295	39.5	77.8	38.3	36.0	26.7	26.5	3.3	150	Hor.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Result measured with the average detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8295	27.6	77.8	50.2	24.1	26.7	26.5	3.3	150	Hor.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

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

Result measured with the peak detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8545	43.8	82.4	38.6	39.7	27.0	26.5	3.6	150	Hor.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Result measured with the average detector:

Frequency GHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8545	33.6	82.4	48.8	29.5	27.0	26.5	3.6	150	Hor.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 34, 36, 44, 49, 73

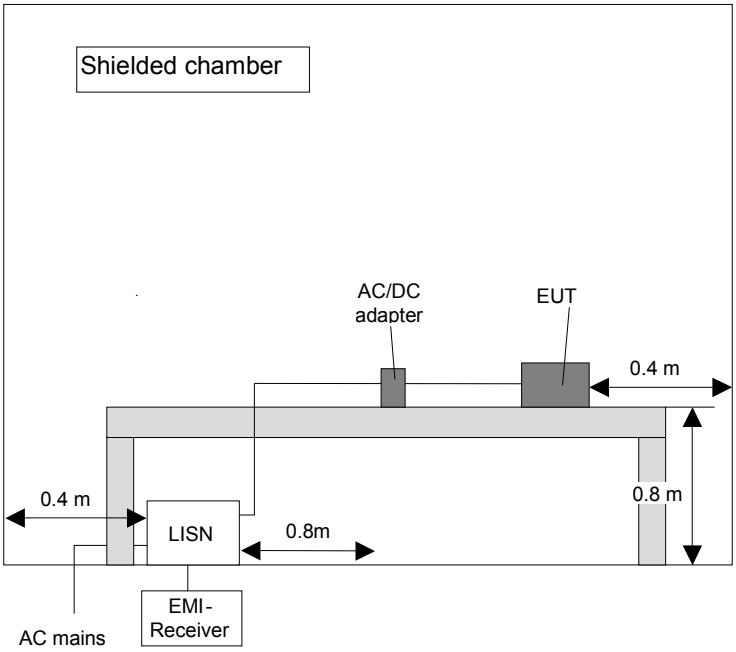
5.7 Conducted emissions on power supply lines (150 kHz to 30 MHz)

5.7.1 Method of measurement

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



5.7.2 Test results (conducted emissions on power supply lines)

Ambient temperature	21 °C	Relative humidity	32 %

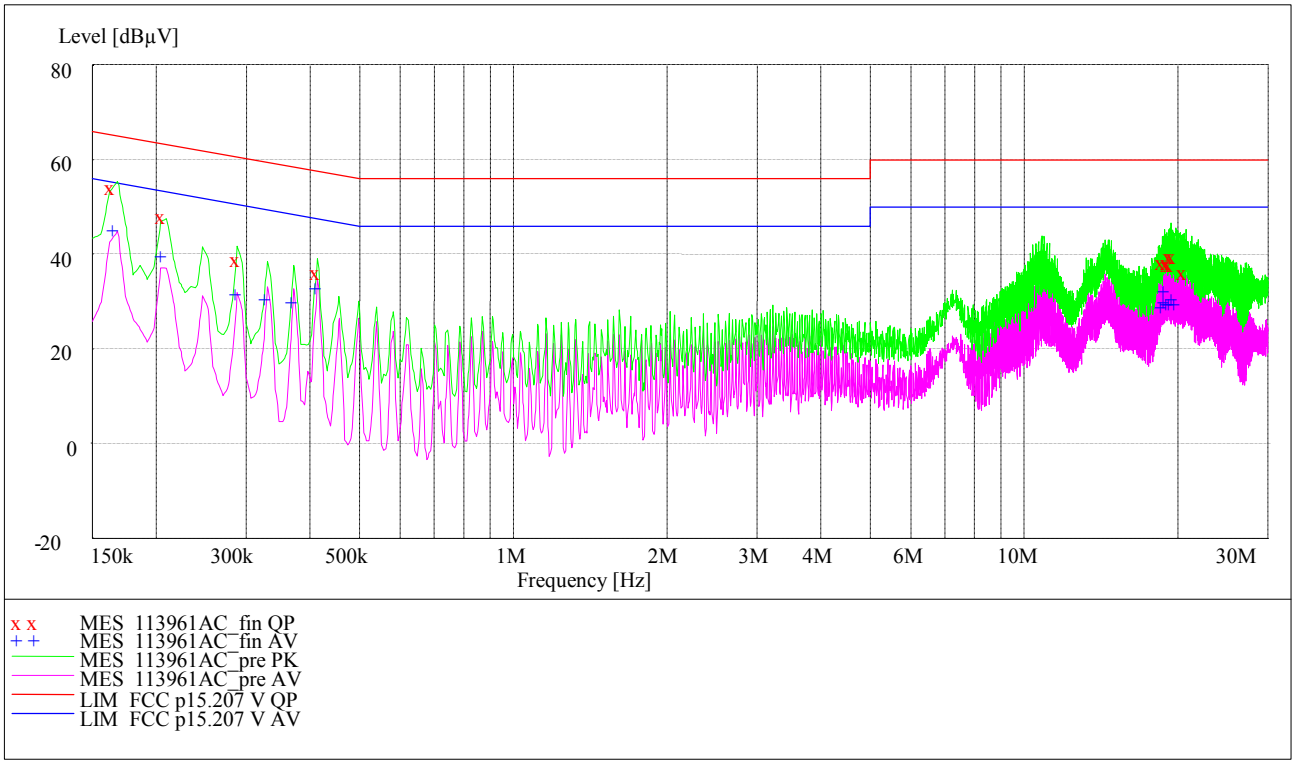
Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m.

Cable guide: The cables of the EUT were 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 24.0 V DC by an AC / DC adaptor type MINI-PS-100-240AC/24DC/1, which was supplied by 120 V AC / 60 Hz.

The curves in the diagram only represent for each frequency point the maximum measured value of all preliminary measurements, which were made for each power supply line. The top measured curve represents the peak measurement and the bottom measured curve the average measurement.



Data record name: 113961AC

Result measured with the quasipeak detector (marked in the diagram by an x):

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.165300	55.1	1.1	65.2	10.1	L1	FLO
0.207600	48.7	0.8	63.3	14.6	L1	FLO
0.289500	39.9	0.7	60.5	20.6	N	FLO
0.413700	36.9	0.7	57.6	20.7	L1	FLO
18.882600	39.5	3.8	60.0	20.5	L1	FLO
19.185900	38.6	3.9	60.0	21.4	L1	FLO
19.283100	39.3	3.9	60.0	20.7	L1	FLO
19.434300	38.6	3.9	60.0	21.4	L1	FLO
19.538700	40.1	3.9	60.0	19.9	L1	FLO
19.842000	40.4	4.0	60.0	19.6	L1	FLO
20.752800	37.0	4.2	60.0	23.0	L1	FLO

Result measured with the average detector (marked in the diagram by an +):

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.166200	45.8	1.1	55.1	9.4	L1	FLO
0.206700	40.5	0.8	53.3	12.8	L1	FLO
0.289500	32.5	0.7	50.5	18.0	L1	FLO
0.330900	31.4	0.7	49.4	18.1	N	FLO
0.372300	30.7	0.7	48.4	17.8	L1	FLO
0.414600	33.5	0.7	47.6	14.1	L1	FLO
18.893400	29.8	3.8	50.0	20.2	L1	FLO
19.015800	30.9	3.8	50.0	19.1	L1	FLO
19.166100	32.8	3.9	50.0	17.2	L1	FLO
19.308300	30.4	3.9	50.0	19.6	L1	FLO
19.433400	30.3	3.9	50.0	19.7	L1	FLO
19.842000	31.2	4.0	50.0	18.8	L1	FLO
19.967100	30.5	4.0	50.0	19.5	L1	FLO

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
1 - 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 M47	-	Albatross Projects	B83117-C6439-T262 -	480662	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	CBL6111 D	Chase	25761	480894	09/18/2008	09/2012
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	04/15/2010	04/2012
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	CBL6112 B	Chase	2688	480328	04/21/2011	04/2014
36	Antenna	3115 B	EMCO	9609-4922	480184	09/28/2011	09/2014
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.)	
55	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	03/10/2010	03/2012
73	High Pass Filter	WHJS1000C 11/60EF	Wainwright Instruments GmbH	1	480413	Weekly verification (system cal.)	
75	High Pass Filter	WHKX4.0/18 G-8SS	Wainwright Instruments GmbH	1	480587		

7 REPORT HISTORY

Report Number	Date	Comment
F113961E2	06 December 2011	Document created

8 LIST OF ANNEXES

ANNEX A TEST SET-UP PHOTOS 10 pages

113961_l.JPG: EUT with internal antenna, test set-up fully anechoic chamber
113961_o.JPG: EUT with external patch antenna, test set-up fully anechoic chamber
113961_w.JPG: EUT with external ULORA antenna, test set-up fully anechoic chamber
113961_h1.JPG: EUT with internal antenna, test set-up fully anechoic chamber
113961_t.JPG: EUT with external patch antenna, test set-up fully anechoic chamber
113961_y.JPG: EUT with external ULORA antenna, test set-up fully anechoic chamber
113961_d1.JPG: EUT with internal antenna, test set-up open area test site
113961_c1.JPG: EUT with external patch antenna, test set-up open area test site
113961_z.JPG: EUT with external ULORA antenna, test set-up open area test site
113961_j1.JPG: Test set-up shielded room

ANNEX B INTERNAL PHOTOGRAPHS 10 pages

113961_15.JPG: RFU630, internal view 1
113961_16.JPG: RFU630, internal view 2
113961_22.JPG: RFU630, internal view 3
113961_23.JPG: RFU630, internal view 4
113961_19.JPG: RFU630, PCB 1, top view
113961_18.JPG: RFU630, PCB 1, bottom view
113961_20.JPG: RFU630, PCB 2, top view
113961_21.JPG: RFU630, PCB 2, bottom view
113961_24.JPG: RFU630, PCB 3, top view
113961_25.JPG: RFU630, PCB 3, bottom view

ANNEX C EXTERNAL PHOTOGRAPHS 4 pages

113961_12.JPG: RFU630, 3-D-view 1
113961_11.JPG: RFU630, 3-D-view 2
113961_13.JPG: RFU630, connector view
113961_14.JPG: RFU630, type plate view

ANNEX D RESULTS OF THE RECEIVER MEASUREMENTS 12 pages