

TEST REPORT

Test Report Reference: R40634 Edition 2

Equipment under Test: SA4-ECU220

Serial Number: none

Article Number: 446 220 012 0

FCC ID: SA4-ECU220

Applicant: WABCO GmbH & Co. OHG

Manufacturer: WABCO GmbH & Co. OHG

**Test Laboratory
(CAB)
accredited by
DATech e.V.
in compliance with DIN EN ISO/IEC 17025
under the
Reg. No. TTI-P-G071/94-11
and listed by
FCC 31040/SIT1300F2**

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1 IDENTIFICATION

1.1 APPLICANT

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Applicant represented during the test by the following person:	Mr. Frank HINTZE, Mr. Gregor ILNICKI

1.2 MANUFACTURER

Name:	WABCO GmbH & Co. OHG
Address:	Am Lindener Hafen 21 30453 Hannover
Country:	Germany
Name for contact purposes:	Mr. Lutz DANNE
Phone:	+49 511 922 1990
Fax:	+49 511 922 4990
Mail address:	lutz.danne@wabco-auto.com
Manufacturer represented during the test by the following person:	Mr. Frank HINTZE, Mr. Gregor ILNICKI

1.3 DATES

Date of receipt of test sample:	21 June 2004
Start of test:	21 June 2004
End of test:	22 June 2004

1.4 TEST LABORATORY

The tests were carried out at:

PHOENIX TEST-LAB GmbH
Königswinkel 10
D-32825 Blomberg
Germany

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

accredited by DATech e.V. in compliance with DIN EN ISO/IEC 17025 under Reg. No. TTI-P-G071/94-11 and listed by FCC 31040/SIT1300F2.

Test engineer:

Bernd STEINER

Name



Signature

13 September 2004

Date

Test report checked:

Thomas KÜHN

Name



Signature

13 September 2004

Date

Phoenix TEST-LAB GmbH
Königswinkel 10
32825 Blomberg
Tel. 0 52 35 / 95 00-0
Fax 0 52 35 / 95 00-10

Stamp

1.5 RESERVATION

This test report is only valid in its original form.

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

The test results herein refer only to the tested sample. PHOENIX TEST-LAB 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 TEST-LAB Logo and the TEST REPORT REFERENCE.

1.6 NORMATIVE REFERENCES

[1] **ANSI C63.4-2001** 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 47 CFR Part 15 (April 2004)** Radio Frequency Devices

1.7 TEST RESULTS

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

2 TECHNICAL DATA OF EQUIPMENT

2.1 DEVICE UNDER TEST

Type of equipment:	Tire pressure transmitter for truck use
Type designation:	SA4-ECU220
Article No.:	446 220 012 0
FCC ID:	SA4-ECU220
Highest internal frequency	433.92 MHz
Antenna type:	Integral
Software	V040216T

The following external I/O cables were used:

A representative cableharness was connected to the SA4-ECU220. Via this cableharness the equipment under test was supplied by an external DC power supply with 24 VDC. Furthermore a CAN communication was established via fibreoptic converterters to an external notebook.

2.2 PEREPHERY DEVICES

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

Notebook located outside the test environment (supplied by the applicant)

3 OPERATIONAL STATES AND PHYSICAL BOUNDARIES

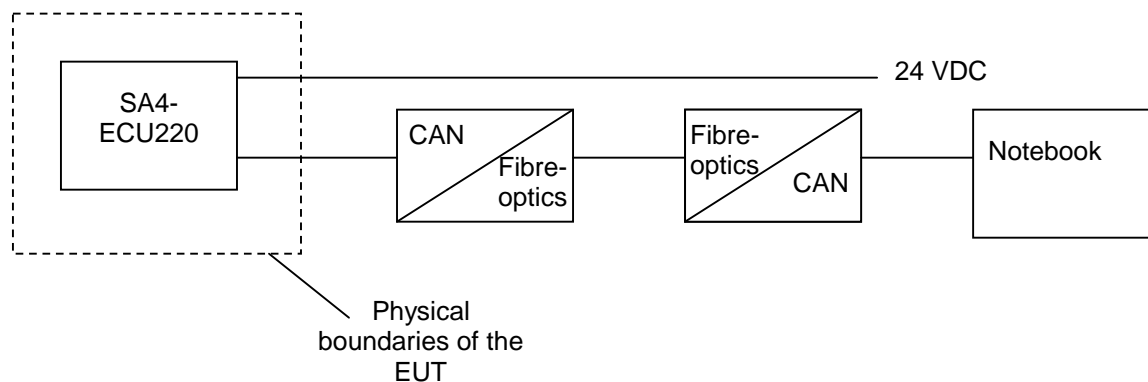
For the dutycycle measurement a unmodified testsample of SA4-ECU220 was used. Via the CAN Bus the sample was set to a configuration mode. As declared by the applicant the testsample has its maximum ON Airtime with the highest repetition rate in this mode.

Because the equipment under test SA4-ECU220 is not designed for continuous transmission, the testsample was modified by applicant. With this modification the SA4-ECU220 transmits continuously and unmodulated. This modified sample was used for the emission measurements.

During the tests the EUT was supplied by an external DC Powersupply with 24 VDC.

For the whole frequency range a preliminary (30 MHz to 1 GHz) and a final (1 GHz to 5 GHz) measurement in a fully anechoic chamber with a measuring distance of 3 m was carried out to determine the frequencies, which were radiated by the EUT. The final measurement for the frequency range of 30 MHz to 1 GHz on the detected frequencies was carried on an open area test site with ground plane.

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



4 LIST OF TEST MODULES

Radiated Emissions fundamental frequency FCC 47 CFR Part 15 section 15.231 (b) [2]							
No.	Application	Fundamental Frequency	Limits		Reference standard	Remark	Status
1	Intentional radiator (fundamental frequency)	433.92 MHz	80.82dBµV/m at 3m		ANSI C63.4 (2001);	-	Passed
Spurious Emissions FCC 47 CFR Part 15 section 15.231 (b) [2]							
No.	Application	Fundamental Frequency	Limits		Reference standard	Remark	Status
2	Intentional radiator (spurious emissions)	433.92 MHz	60.82dBµV/m at 3m		ANSI C63.4 (2001);	-	Passed
Radiated emissions in restricted bands FCC 47 CFR Part 15 section 15.209							
No.	Application	Frequency of emission	Limits		Reference standard	Remark	Status
3	Radiated emissions	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz Above 960 MHz	40 dBµV/m at 3 m* 43 dBµV/m at 3 m* 46 dBµV/m 3 m* 54 dBµV/m 3m		ANSI C63.4 (2001);	-	Passed
* 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.							
Conducted emissions on the DC Line FCC 47 CFR Part 15 section 15.107 (a) [2]							
No.	Application	Frequency of emission	Limits (dBµV)		Reference standard	Remark	Status
4	Conducted emissions	0.15 to 0.50 MHz 0.5 to 5 MHz 5 to 30 MHz	66 to 56** 56 60	56 to 46** 46 50	ANSI C63.4 (2001);	-	Passed
** Decreases with the logarithm of the frequency							
Radiated emissions receive mode (non intentional radiator) FCC 47 CFR Part 15 section 15.109 (a)							
No.	Application	Frequency of emission	Limits		Reference standard	Remark	Status
3	Radiated emissions	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz Above 960 MHz	40 dBµV/m at 3 m 43 dBµV/m at 3 m 46 dBµV/m 3 m 54 dBµV/m 3m		ANSI C63.4 (2001);	-	Passed

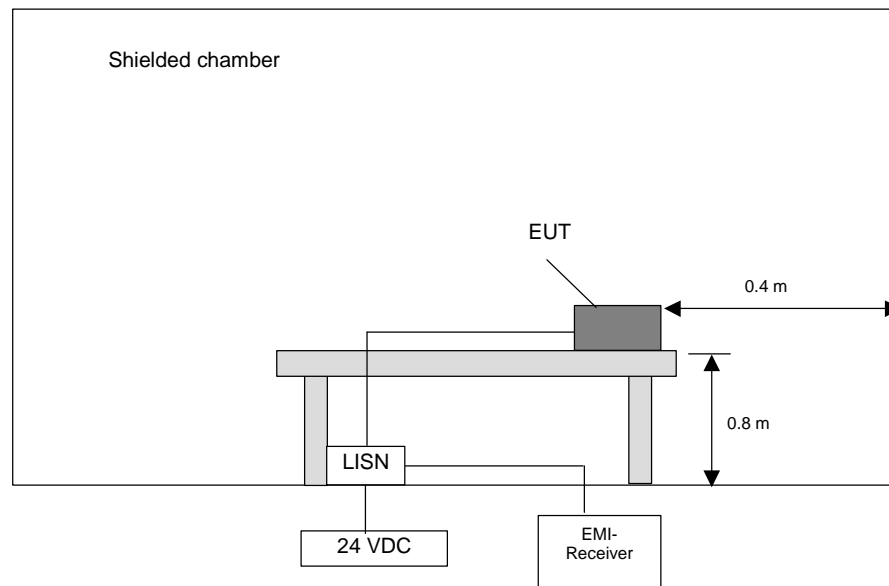
5 METHOD OF MEASUREMENT

5.1 CONDUCTED EMISSIONS ON AC MAINS (150 kHz to 30 MHz)

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 C63.4-2001 [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 of the AC mains network. If levels detected 10 dB below the appropriate 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



5.2 RADIATED EMISSIONS 30 MHz to 1 GHz

The radiated emission measurement is divided into two stages.

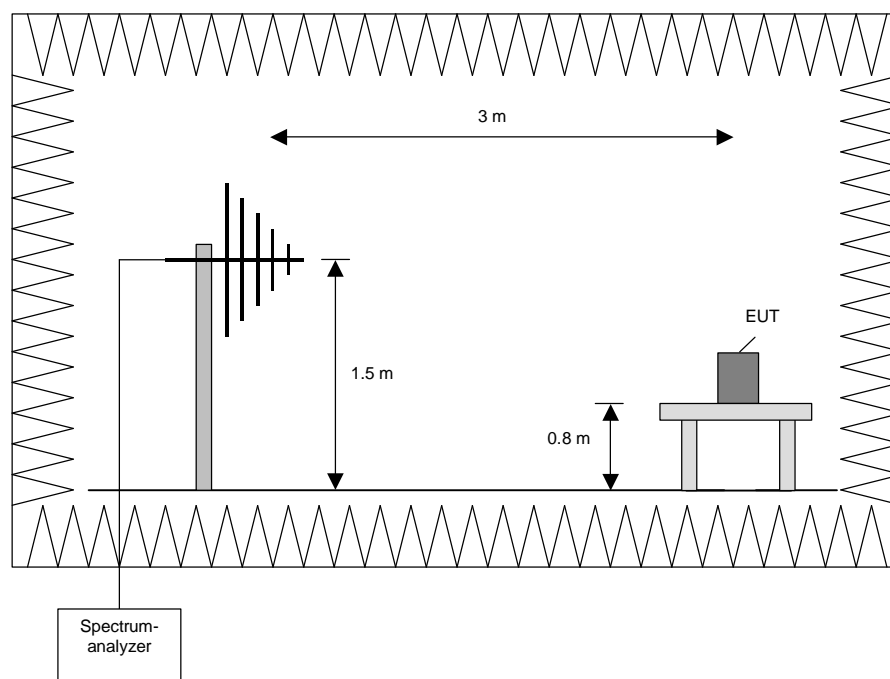
Preliminary measurement:

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 C63.4-2001 [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 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:

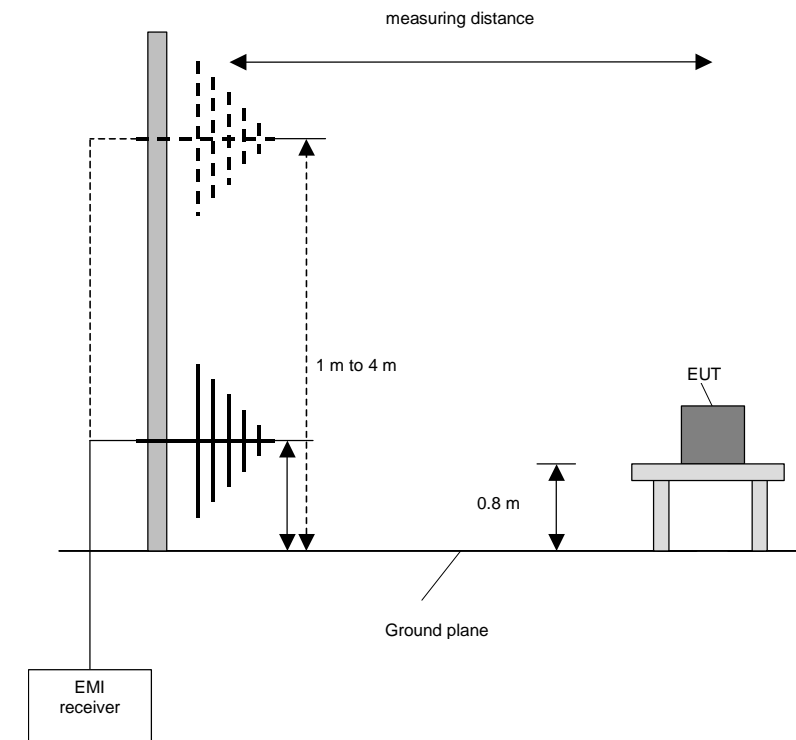
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °
2. Manipulate the system cables within the range to produce the maximum level of emission
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum
5. Measure the frequency of 3 highest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

Final Measurement:

In the second stage 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



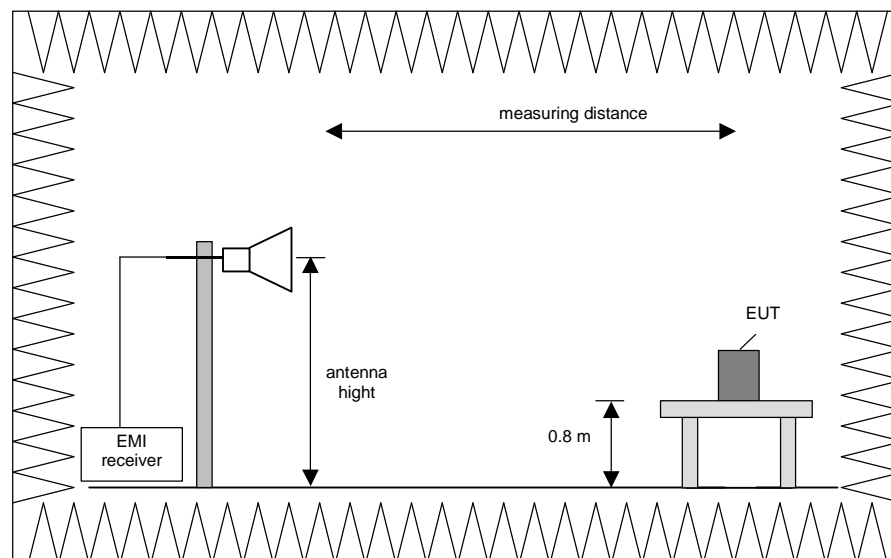
Procedure final measurement:

- 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 (Peak) and note the value
- 11) Repeat 5) to 10) for each frequency
- 12) Repeat 1) to 11) for each orthogonal axes of the EUT if handheld equipment

5.3 RADIATED EMISSIONS (1 GHz TO 5 GHz)

This measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter and will be also divided into a preliminary and final measurement. 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 C63.4-2001 [1].

The measurement set-up will be the same for preliminary and final measurement and will be shown schematically below:



Preliminary measurement:

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 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 °. If the EUT is larger than the antenna beamwidth, the antenna will be moved to various positions, to cover the whole surface of the EUT. It might be possible to shorter the measuring distance to higher the measurement sensitivity.

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

Frequency range	Resolution bandwidth
1 GHz to 5 GHz	100 kHz

Procedure of measurement:

The measurement was performed in the frequency range 1 GHz to 5 GHz.

The following procedure will be used:

- 1) Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
- 2) Rotate the EUT by 360 ° to maximize the detected signals.
- 3) Change the antenna polarisation.
- 4) Rotate the EUT by 360 ° to maximize the detected signals.
- 5) Make a hardcopy of the spectrum.
- 6) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
- 7) Measure the level of the detected frequency with the antenna polarisation and azimuth, which causes the maximum emission.
- 8) Repeat steps 1) to 7) with the other orthogonal axes of the EUT.
- 9) Repeat steps 1) to 8) for the next antenna spot if the EUT is larger than the antenna beamwidth.

Final measurement:

During this measurement the frequencies, which are found during the preliminary measurement were measured with the correct resolution bandwidth and detector.

Frequency range	Resolution bandwidth
1 GHz to 5 GHz	1 MHz

The measurement was performed in the frequency range 1 GHz to 5 GHz.

The following procedure will be used:

- 1) The position (orthogonal direction and azimuth) of the EUT and if applicable with the antenna spot, at which the maximum emission was detected.
- 2) Change the antenna polarisation to the one at which the maximum emission was detected.
- 3) Measure the level of the emission correct resolution bandwidth (1MHz) and the peak and average detector
- 4) Repeat steps 1) to 3) for all other frequencies, which were found during the preliminary measurement.

5.4 CALCULATION OF THE MEASUREMENT RESULTS

Because of pulsed transmission all measurements were carried out with a peak detector and the average value is calculated over a pulse train of 100 ms as required in Part 15.35.

To calculate the average value a complete pulse train was measured. A detail view to a pulse period was taken and the transmitter-on-time was recorded. This time was used to calculate to average correction factor.

Summary of the complete pulsetrain:

One pulsetrain consists of

2 pulses type 1: $2 * 472.945\mu\text{s} = 945.890\mu\text{s}$
23 pulses type 2: $23 * 230.461\mu\text{s} = 5300.603\mu\text{s}$
67 pulses type 3: $67 * 112.224\mu\text{s} = 7519.008\mu\text{s}$

total on time of the pulsetrain = $13765.501\mu\text{s}$
total length of pulsetrain = 99.198397ms

Duty cycle correction factor according to 15.35c

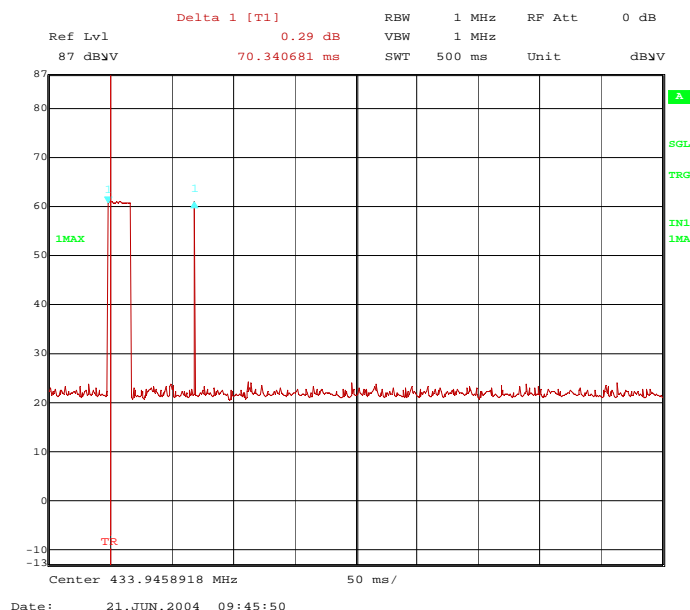
$$F [\text{dB}] = 20 * \log (13765.501 \mu\text{s} / 99.198397 \text{ ms}) = -17.15 \text{ dB}$$

Please refer also to the plots in the following.

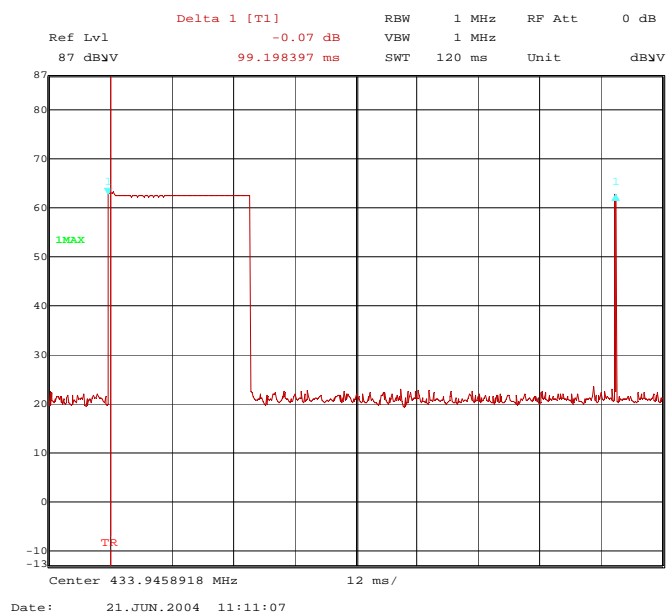


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40634_1.WMF (view of complete pulsetrain)



40634_3.WMF (detail view of complete pulsetrain)

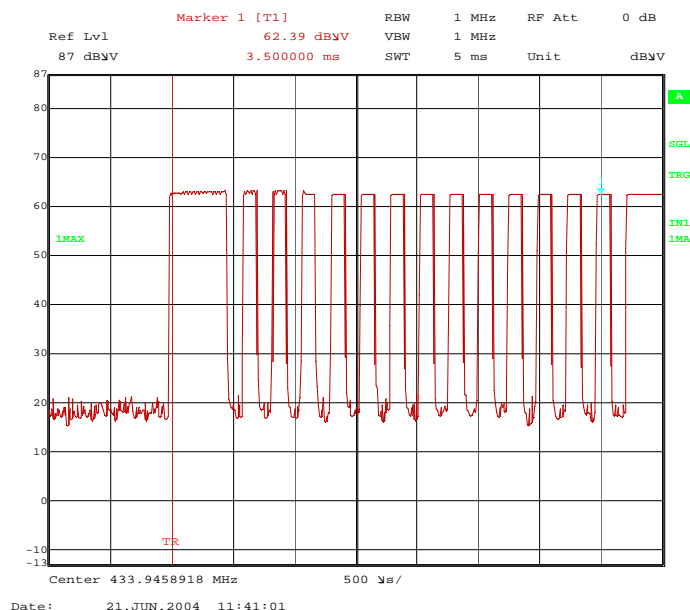


Total length of pulse emission= 99.198397ms

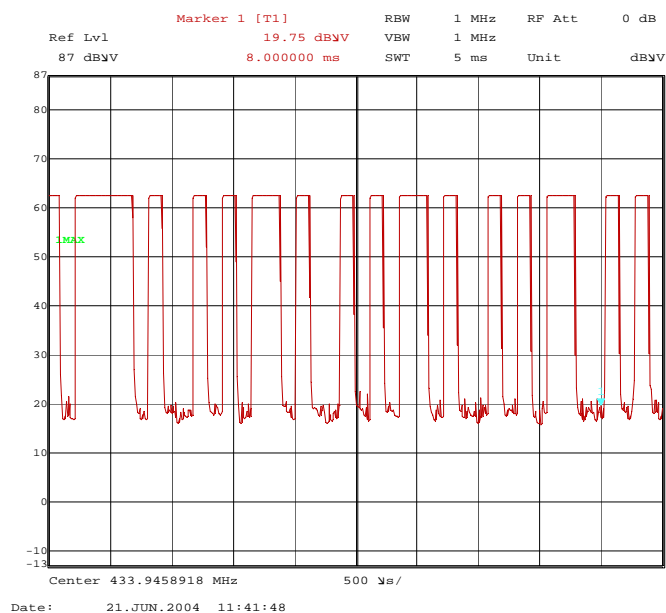


TEST REPORT REFERENCE: R40634 Edition 2

40634_15.WMF (1st detail view to sub pulse train):



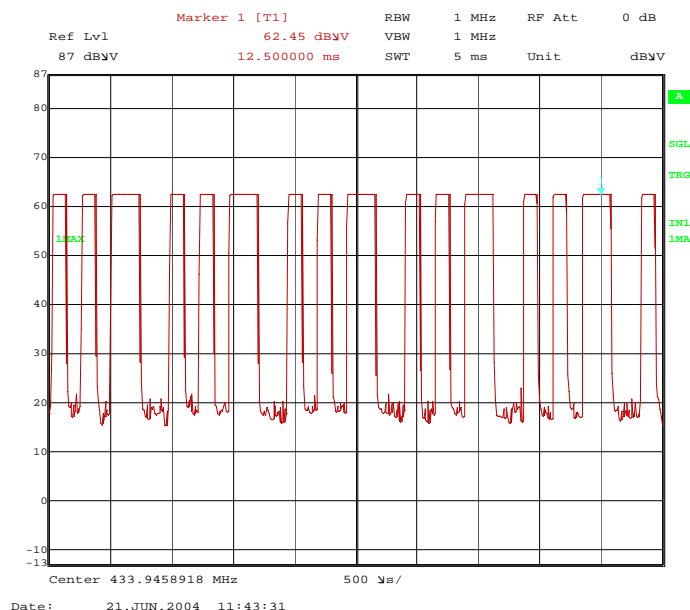
40634_16.WMF (2nd detail view to sub pulse train):



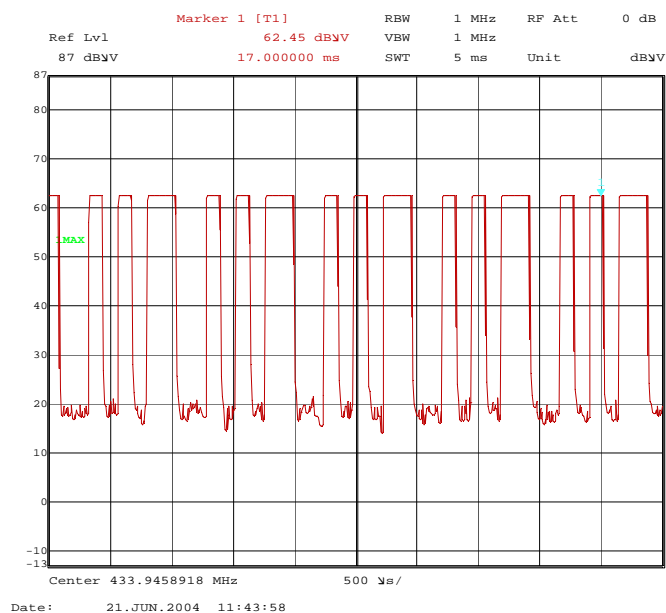


TEST REPORT REFERENCE: R40634 Edition 2

40634_17.WMF (3rd detail view to sub pulse train):



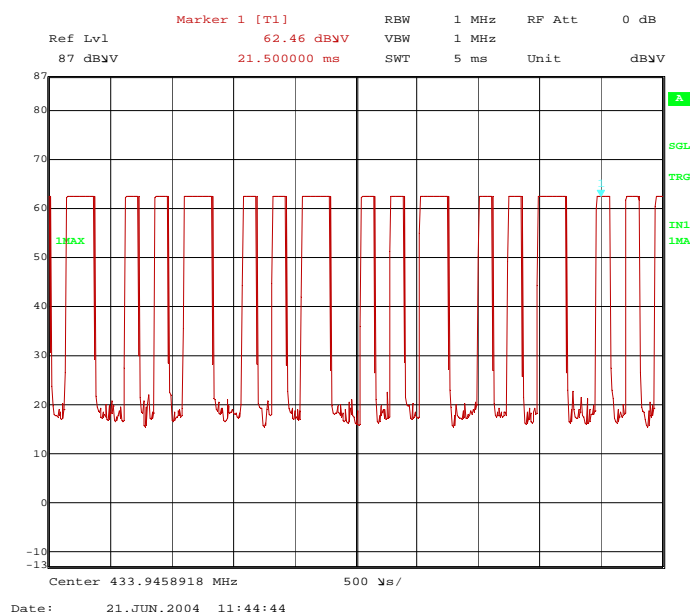
40634_18.WMF(4th detail view to sub pulse train):



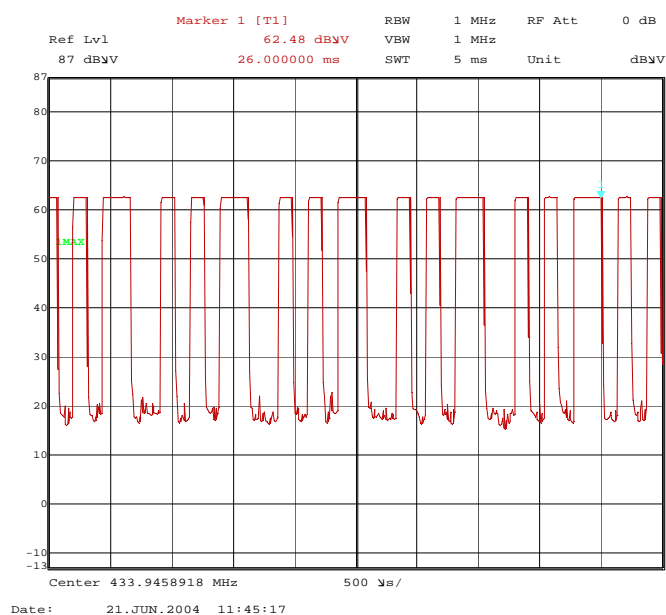


TEST REPORT REFERENCE: R40634 Edition 2

40634_19.WMF (5th detail view to sub pulse train):



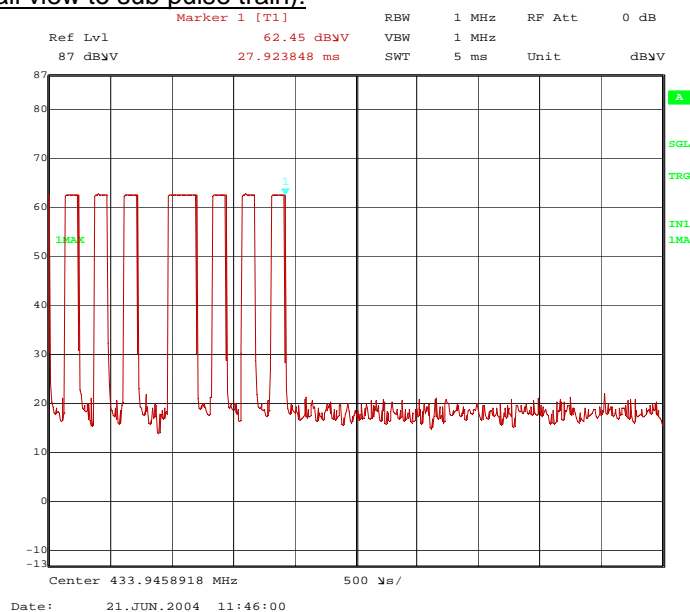
40634_20.WMF(6th detail view to sub pulse train):



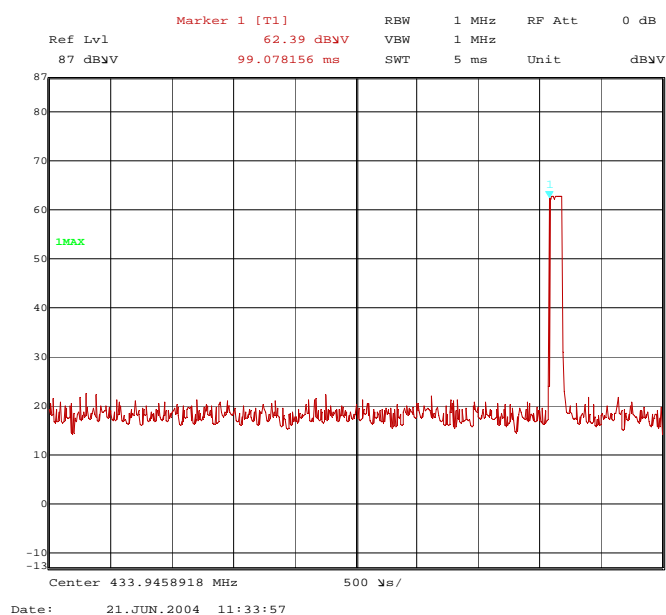


TEST REPORT REFERENCE: R40634 Edition 2

40634_21.WMF(7th detail view to sub pulse train):



40634_14.WMF (8th detail view to sub pulse train):



6 TEST RESULTS

6.1 EMISSION TEST TRANSMIT MODE

6.1.1 PRELIMINARY RADIATED EMISSION TEST (30 MHz to 1 GHz)

Ambient temperature	20 °C	Relative humidity	25 %
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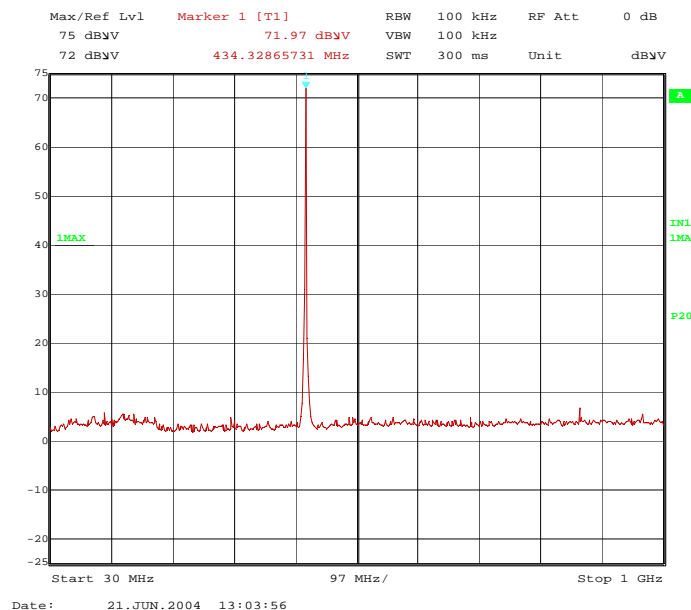
Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: A typical cable harness was connected to the equipment under test. The cable runs horizontal on the table and was bundled because of the length. See also the photographs of the test setup in the annex to this report.

Test record: The test was carried out in continuous transmission mode of the EUT. All results are shown in the following.

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

40634_22.WMF(30 MHz to 1000 MHz):



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

- 433.902 MHz; 867.815 MHz.

The following frequencies were found inside the restricted bands according to FFC 47 CFR Part 15 section 15.205 [2].

- No frequencies found inside the restricted bands.

These frequencies have to be measured on the open area test site. The results of this final measurement are shown in subclause 6.2 of this test report.

TEST EQUIPMENT USED FOR THE TEST:

29, 31 – 35, 43, 54

6.1.2 FINAL RADIATED EMISSION TEST (30 MHz to 1 GHz)

Ambient temperature	21 °C	Relative humidity	35 %
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Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: A typical cable harness was connected to the equipment under test. The cable runs horizontal on the table and was bundled because of the length. See also the photographs of the test setup in the annex to this report.

Test record: The test was carried out in continuous transmission mode of the EUT. All results are shown in the following.

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

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.

Results measured with the peak detector (and calculated to average):

Fundamental emission										
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings Peak dBµV	Antenna factor 1/m	Cable loss dB	Average correction factor [dB]	Height cm	Azimuth deg	Pol.
433.902	78.75	80.82	2.07	75.90	16.4	3.6	-17.15	200	148	Hor.
Highest spurious emissions outside restricted bands										
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings Peak dBµV	Antenna factor 1/m	Cable loss dB	Average correction factor [dB]	Height cm	Azimuth Deg	Pol.
867.815	17.95	60.82	42.87	7.60	22.1	5.4	-17.15	349	270	Hor.
Three highest spurious emissions in restricted bands										
No emissions in restricted bands found										

The test results were calculated with the following formula:

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

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

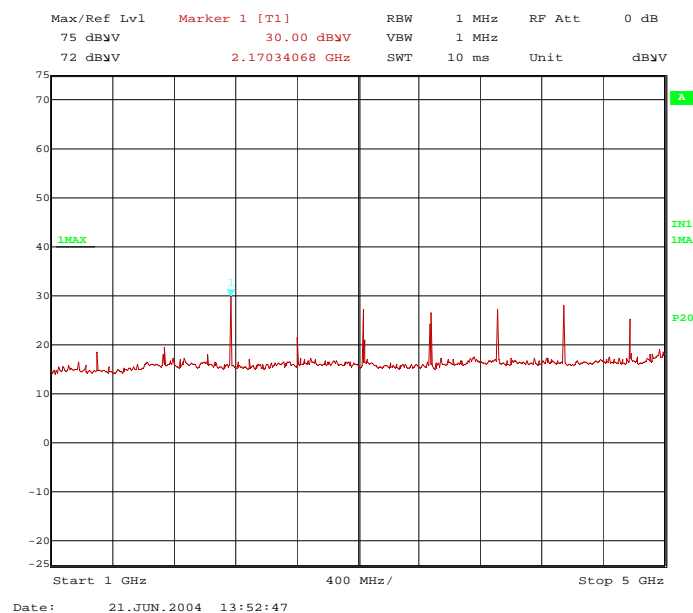
14 – 20, 54

6.1.3 PRELIMINARY RADIATED EMISSION TEST (1 GHz to 5 GHz)

Ambient temperature	21 °C	Relative humidity	28 %
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- Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m. The distance between EUT and antenna was 3 m.
- Cable guide: A typical cable harness was connected to the equipment under test. The cable runs horizontal on the table and was bundled because of the length. See also the photographs of the test setup in the annex to this report.
- Test record: The test was carried out in continuous transmission mode of the EUT. All results are shown in the following.
- Supply voltage: During all measurements the EUT was supplied by an external DC power supply with 24 VDC.

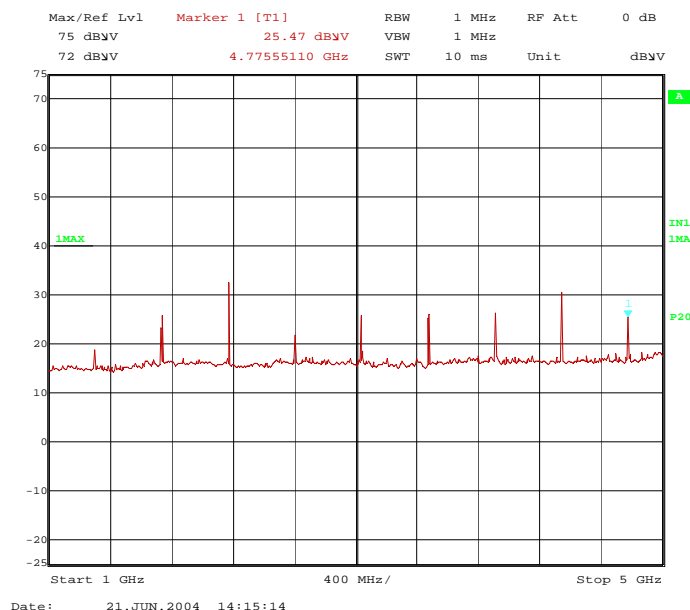
40634_31.WMF (1 GHz to 5 GHz, horizontal polarisation):





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40634_32.WMF (1 GHz to 5 GHz, vertical polarisation):



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

- 1735.605 MHz;
- 2169.510 MHz;
- 2603.415 MHz;
- 3037.320 MHz;
- 3471.220 MHz.

The following frequencies were found inside the restricted bands according to FFC 47 CFR Part 15 section 15.205 [2].

- 1301.710 MHz;
- 3905.118 MHz;
- 4339.019 MHz;
- 4772.925 MHz

On these frequencies a final measurement have to take place. The results of this final measurement are shown in subclause 6.4 of this test report.

TEST EQUIPMENT USED FOR THE TEST:

29, 31 – 34, 36, 43, 54

6.1.4 FINAL RADIATED EMISSION TEST (1 GHz to 5 GHz)

Ambient temperature	21 °C	Relative humidity	28 %
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Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: A typical cable harness was connected to the equipment under test. The cable runs horizontal on the table and was bundled because of the length. See also the photographs of the test setup in the annex to this report.

Test record: The test was carried out in continuous transmission mode of the EUT. All results are shown in the following.

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

Results measured with the peak detector (and calculated to average):

Three highest spurious emissions outside restricted bands										
Frequency MHz	Result dBμV/m	Limit dBμV/m	Margin dB	Readings dBμV	Antenna factor 1/m	Cable loss dB	Average correction factor [dB]	Height cm	Azimuth deg	Pol.
2169.510	46.50	60.82	14.32	32.35	27.9	3.4	-17.15	150	42	Vert.
3037.320	44.46	60.82	16.36	27.11	30.5	4.0	-17.15	150	63	Hor.
3471.220	45.03	60.82	15.79	26.38	31.5	4.3	-17.15	150	96	Hor.
Three highest spurious emissions in restricted bands										
Frequency MHz	Result dBμV/m	Limit dBμV/m	Margin DB	Readings dBμV	Antenna factor 1/m	Cable loss dB	Average correction factor [dB]	Height cm	Azimuth deg	Pol.
3905.118	47.34	54.0	6.66	27.19	32.9	4.4	-17.15	150	132	Hor.
4339.019	50.38	54.0	3.62	30.43	32.4	4.7	-17.15	150	174	Vert.
4772.925	46.52	54.0	7.48	25.47	33.1	5.1	-17.15	150	155	Vert.
Other spurious emissions outside restricted bands										
Frequency MHz	Result dBμV/m	Limit dBμV/m	Margin DB	Readings dBμV	Antenna factor 1/m	Cable loss dB	Average correction factor [dB]	Height cm	Azimuth deg	Pol.
1735.605	38.79	60.82	22.03	25.64	27.3	3.0	-17.15	150	69	Vert.
2603.415	37.04	60.82	23.78	21.69	28.8	3.7	-17.15	150	212	Vert.
Other spurious emissions inside restricted bands										
1301.710	29.22	54.0	24.78	18.57	25.2	2.6	-17.15	150	196	Vert.

The test results were calculated with the following formula:

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

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

29, 31 – 34, 36, 43, 54

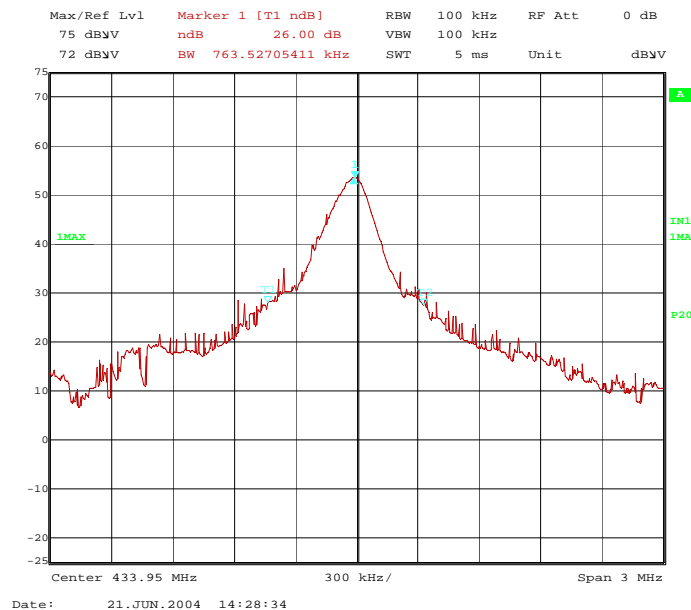
TEST REPORT REFERENCE: R40634 Edition 2

6.2 OCCUPIED BANDWIDTH

Ambient temperature:	20 °C	Relative humidity:	62 %
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Supply voltage: During all measurements the EUT was supplied by the internal power supply.

40634_33.wmf: Occupied bandwidth



Measured Bandwidth	Limit
763.52kHz	1.08 MHz (0.25% of 433.92MHz)

Test: Passed

TEST EQUIPMENT USED THE TEST:

29, 31 - 34, 35, 43, 54

6.3 CONDUCTED EMISSION MEASUREMENT ON DC POWER SUPPLY LINES

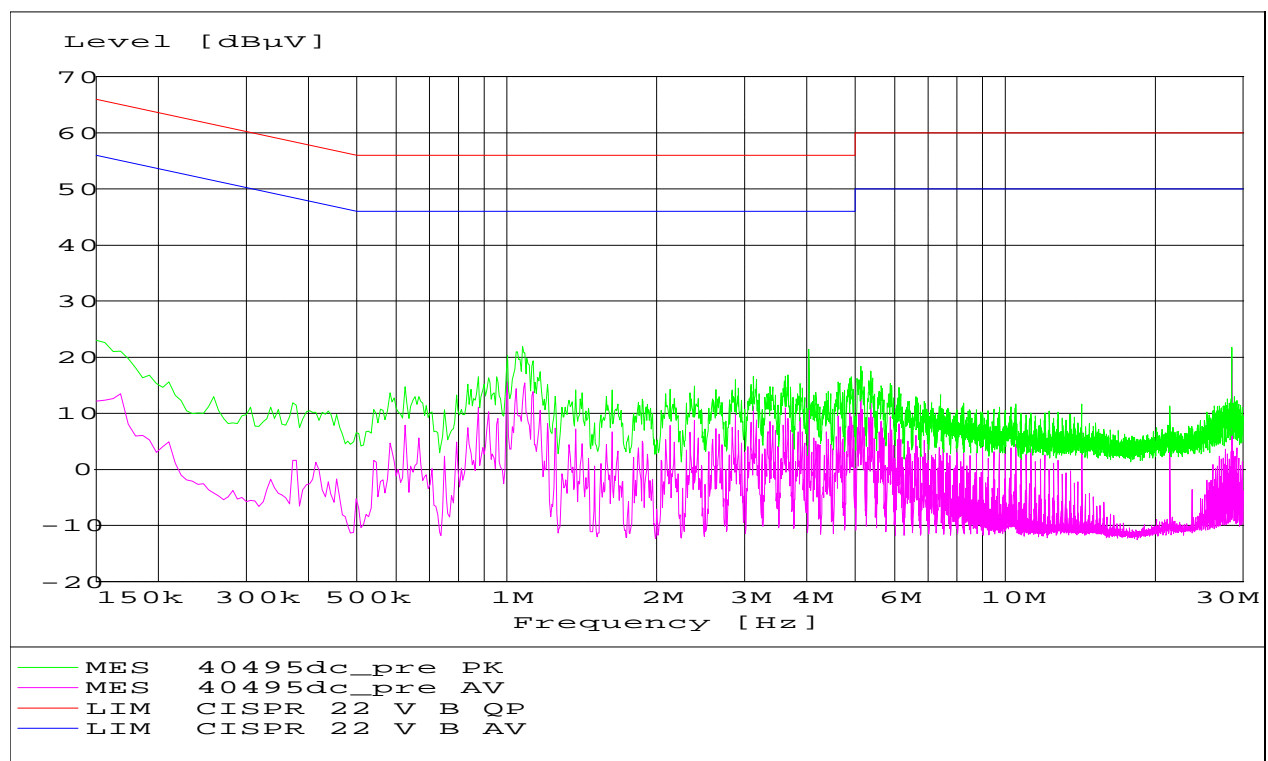
Ambient temperature	20 °C	Relative humidity	59 %
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Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m.

Cable guide: All cables of the EUT were fixed on the wooden table. For further information of the cable guide refer to the pictures in annex C of this test report.

Test record: The test was carried out in EUT operation mode as described in clause 3 of this test report. All results are shown in the following.

Power supply: During this test the EUT was powered by a DC power supply with 24 VDC.



Data record name: 40634dc

of 22.06.04

Test: Passed

TEST EQUIPMENT USED:

1 - 3, 5, 6, 54

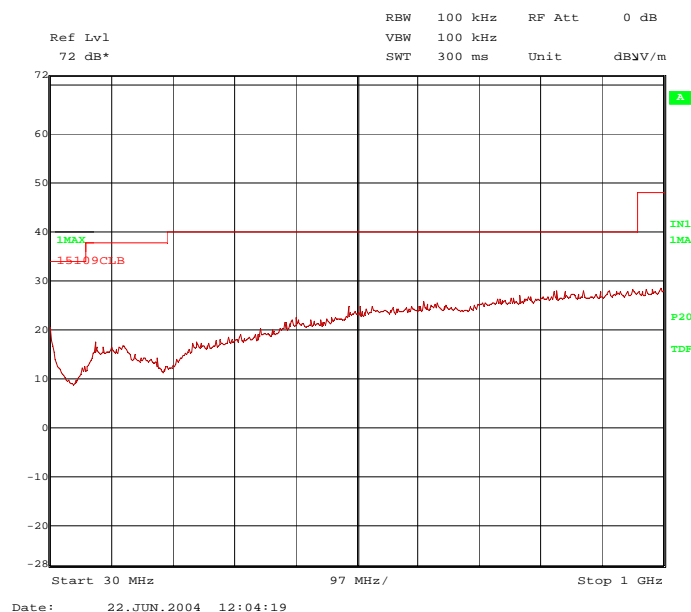
6.4 TEST RESULTS EMISSION TEST RECEIVE MODE

6.4.1 PRELIMINARY RADIATED EMISSION TEST (30 MHz to 1 GHz)

Ambient temperature	20 °C	Relative humidity	25 %
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- Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m. The distance between EUT and antenna was 3 m.
- Cable guide: A typical cable harness was connected to the equipment under test. The cable runs horizontal on the table and was bundled because of the length. See also the photographs of the test setup in the annex to this report.
- Test record: The test was carried out in continuous transmission mode of the EUT. All results are shown in the following.
- Supply voltage: During all measurements the EUT was supplied by an external DC power supply with 24 VDC.

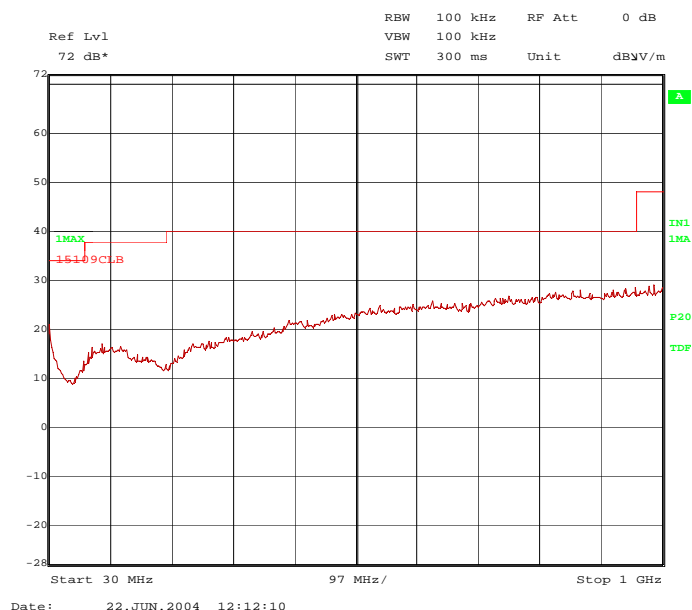
40634RX1.WMF(30 MHz to 1000 MHz horizontal polarisation):





TEST REPORT REFERENCE: R40634 Edition 2

40634RX2.WMF(30 MHz to 1000 MHz vertical polarisation):



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

- No frequencies found

TEST EQUIPMENT USED FOR THE TEST:

29, 31 – 35, 43, 54

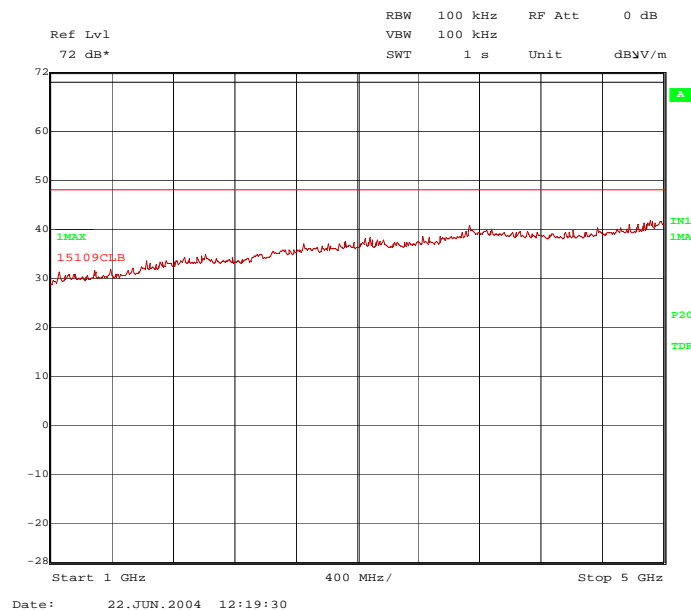
TEST REPORT REFERENCE: R40634 Edition 2

6.4.2 PRELIMINARY RADIATED EMISSION TEST (1 GHz to 5 GHz)

Ambient temperature	21 °C	Relative humidity	28 %
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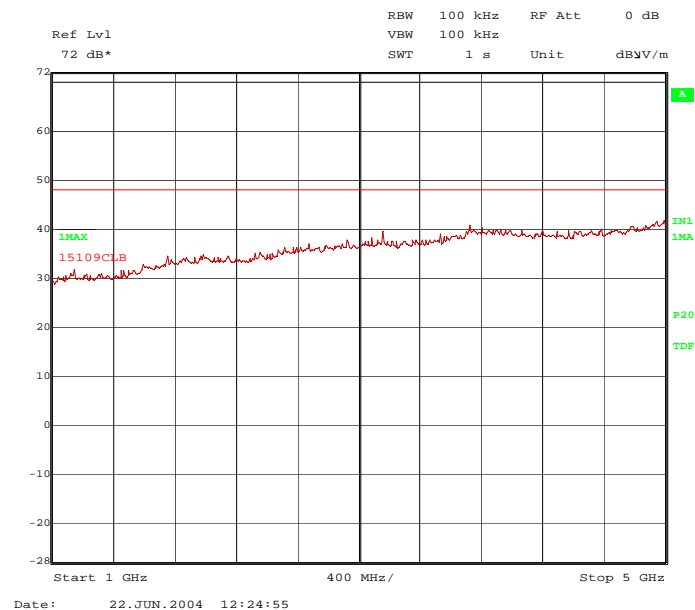
- Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m. The distance between EUT and antenna was 3 m.
- Cable guide: A typical cable harness was connected to the equipment under test. The cable runs horizontal on the table and was bundled because of the length. See also the photographs of the test setup in the annex to this report.
- Test record: The test was carried out in continuous transmission mode of the EUT. All results are shown in the following.
- Supply voltage: During all measurements the EUT was supplied by an external DC power supply with 24 VDC.

40634RX3.WMF (1 GHz to 5 GHz, horizontal polarisation):



TEST REPORT REFERENCE: R40634 Edition 2

40634RX4.WMF (1 GHz to 5 GHz, vertical polarisation):



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

- none

TEST EQUIPMENT USED FOR THE TEST:

29, 31 – 34, 36, 43, 54

7 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

Emission measurement at AC mains and DC in / out ports at M4					
No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
1	Shielded chamber M4	-	Siemens	B83117S1-X158	480088
2	Measuring receiver	ESAI	Rohde & Schwarz	831953/001 833181/018	480025 480026
3	LISN	NSLK8128	Schwarzbeck	8128155	480058
4	DC-filter	B84266-A21-E13	Siemens	940164525	480099
5	AC-filter	B84299-D87-E3	Siemens	930262292	480097
6	EMI-Software	ES-K1	Rohde & Schwarz	-	480111

Radiated emission measurement at M5					
No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
7	Fully anechoic chamber M5	-	Siemens	B83177-S1-X156	480073
8	Measuring receiver	ESVS30	Rohde & Schwarz	829673/012	480024
9	Controller	HD100	Deisel	100/324	480067
10	Antenna support	MA240	Deisel	228/314	480069
11	Turntable	DS412	Deisel	412/317	480070
12	Antenna	CBL6112C	Chase	2689	480327
13	EMI Software	ES-K1	Rohde & Schwarz	-	480111

Radiated emission measurement at M6					
No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
14	Open area test site	-	Phoenix Test-Lab	-	480085
15	Measuring receiver	ESVS30	Rohde & Schwarz	829673/012	480024
16	Controller	HD100	Deisel	100/670	480139
17	Turntable	DS420HE	Deisel	420/620/80	480087
18	Antenna support	AS615P	Deisel	615/310	480086
19	Antenna	CBL6111 A	Chase	1643	480147
20	EMI Software	ES-K1	Rohde & Schwarz	-	480111

Radiated emission measurement at M8					
No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
21	Fully anechoic chamber M8	-	Siemens	B83117-E7019-T231	480190
22	Measuring receiver	ESMI	Rohde & Schwarz	843977/001 843530/018	480179 480180

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
23	Measuring receiver	ESCS 30	Rohde & Schwarz	828985/014	480270
24	Controller	HD100	Deisel	100/427	480181
25	Turntable	DS420	Deisel	420/435/97	480186
26	Antenna support	AS615P	Deisel	615/310	480187
27	Antenna	CBL6112 A	Chase	2034	480185
28	EMI Software	ES-K1	Rohde & Schwarz	-	480111

Radiated emission measurement at M20					
No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
29	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303
30	Measuring receiver	ESMI	Rohde & Schwarz	843977/001 843530/018	480179 480180
31	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355
32	Controller	HD100	Deisel	100/670	480326
33	Turntable	DS420HE	Deisel	420/620/80	480315
34	Antenna support	AS615P	Deisel	615/310	480187
35	Antenna	CBL6112 B	Chase	2688	480328
36	Antenna	3115 A	EMCO	9609-4918	480183
37	Standard Gain Horn 11.9GHz – 18GHZ	18240-20	Flann Microwave	483	480294
38	Standard Gain Horn 11.9GHz – 18GHZ	18240-20	Flann Microwave	482	480295
39	Standard Gain Horn 17.9GHz – 26.7GHZ	20240-20	Flann Microwave	411	480297
40	Standard Gain Horn 17.9GHz – 26.7GHZ	20240-20	Flann Microwave	410	480296
41	Standard Gain Horn 26.4GHz – 40.1GHZ	22240-20	Flann Microwave	469	480299
42	Standard Gain Horn 26.4GHz – 40.1GHZ	22240-20	Flann Microwave	468	480298
43	RF-cable No. 30	RTK 081	Rosenberger	-	410141
44	RF-cable No. 31	RTK 081	Rosenberger	-	410142
45	RF-cable 1m	KPS-1533-400-KPS	Insulated Wire	-	480300
46	RF-cable 1m	KPS-1533-400-KPS	Insulated Wire	-	480301
47	RF-cable 2m	KPS-1533-400-KPS	Insulated Wire	-	480302
48	RF-cable No. 5	RTK 081	Rosenberger	-	410097

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
49	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337
50	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343
51	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342
52	Preamplifier	JS3-26004000-25-5A	Miteq	563593	480344
53	EMI Software	ES-K1	Rohde & Schwarz	-	480111

Ancillary equipment used for testing					
No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
54	Power supply	TOE 8752	Toellner	31566	480010
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

All used measurement equipment was calibrated (if necessary). The calibration intervals and the calibration history will be given out on request.

8 LIST OF ANNEXES

ANNEX A	PHOTOGRAPHS OF THE TEST SET-UPS:	6 pages
	SA4-ECU220 detail view of table test set-up fully anechoic chamber	40634d.JPG
	SA4-ECU220 test set-up fully anechoic chamber front view	40634a.JPG
	SA4-ECU220 test set-up fully anechoic chamber rear view	40634c.JPG
	SA4-ECU220 test set-up open area test site	40634j.JPG
	SA4-ECU220 test set-up conducted emission test	40634k.JPG
	SA4-ECU220 detail view of test set-up conducted emission test	40634m.JPG
ANNEX B	EXTERNAL PHOTOGRAPHS OF THE TEST SAMPLE:	3 pages
	SA4-ECU220 top view	40634EUT3.JPG
	SA4-ECU220 rear view	40634EUT5.JPG
	SA4-ECU220 label	40634EUT4.JPG
ANNEX C	INTERNAL PHOTOGRAPHS OF THE TEST SAMPLE:	2 pages
	SA4-ECU220 PCB front view	40634EUT1.JPG
	SA4-ECU220 PCB rear view	40634EUT2.JPG