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## **Bluetooth test report for RM-94**

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## 1 LABORATORY INFORMATION


Test laboratory:	TCC Tampere Sinitaival 5 FIN-33720 TAMPERE
	Tel. +358 7180 46800 Fax. +358 7180 46880
FCC registration number:	94436 (June 14, 2002)
IC file number:	IC 3608 (March 5, 2003)

## 2 CUSTOMER INFORMATION

Client:	Nokia Corporation Nokia Technology Platform Lise-Meitner-Strasse 10 D-89081 Ulm / Germany
	Tel. +49 731 1754 6728 Fax. +49 731 1754 6806
Contact person:	Thomas Reitmayer
Receipt of EUT:	19.1.2005
Date of testing:	21.1-22.3.2005
Date of report:	23.3.2005

The tests listed in this report have been done to demonstrate compliance to the FCC rules section §15.247 and IC standard RSS-210.

Contents approved:


Jari Jantunen EMC test engineer

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### 3 SUMMARY OF TEST RESULTS

Rule part in CFR 47	Section in RSS-210		Result
15.247, a1	6.2.2 (o), a1	Carrier frequency separation	PASS
15.247, a1ii	6.2.2 (o), a3	Number of hopping frequencies	PASS
15.247, a1ii, 15.247, f	6.2.2 (o), a3	Time of occupancy	PASS
15.247, a	6.2.2 (o), a1	20dB bandwidth	PASS
15.247, b1	6.2.2 (o), a3	Peak output power	PASS
15.247, c	6.2.2 (o), e1	Band-edge compliance of RF emissions	PASS
15.207	6.6	AC powerline conducted emissions	PASS
15.247, c	6.2.2 (o), e1	Spurious RF conducted emissions	PASS
15.247, c	6.2.2 (o), e1	Spurious radiated emissions	PASS

## 4 EUT INFORMATION

The EUT and accessories used in the tests are listed below. Later in this report only EUT numbers are used as reference.

	Name	Type	S/N	HW	SW	EUT number
EUT	RM-94	Phone	004400591701014	3055	3.71	40153
	RM-94	Phone	004400591699366	3055	3.71	40162
Accessories	BL-5B	Battery	L403C10314647	-	-	40155
	BL-5B	Battery	L403C10315876	-	-	40156
	ACP-12	Charger	-	5.0	-	40121

Notes: -

### 4.1 EUT description

The EUT is a triple band (GSM900/1800/1900 EGPRS) mobile phone with Bluetooth connection.

The EUT was not modified during the tests.

## 5 EUT TEST SETUPS

For each test the EUT was exercised to find out the worst case of operation modes and device configuration.

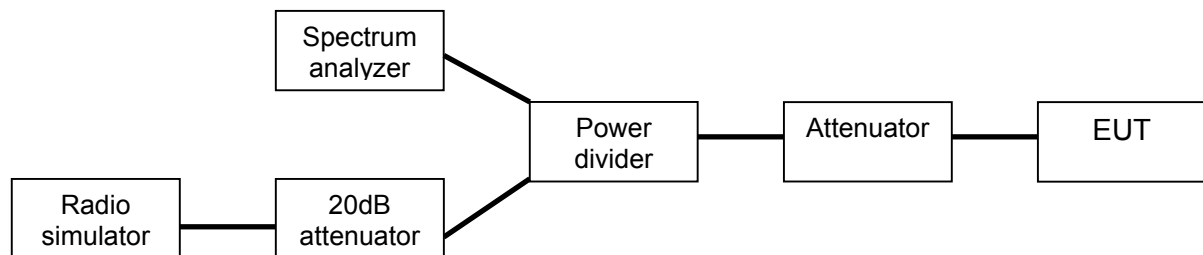
Two different test setups were used: one for conducted measurements, another for radiated measurements. One EUT was equipped with an external antenna connector for conductive measurements.

### 5.1 Setup A (conducted measurements)

This setup was used in conducted measurements. The Bluetooth simulator was used to control the following:

- set the EUT channel (0 –78)
- set the EUT to TX, RX and TX/RX mode
- enable/disable frequency hopping

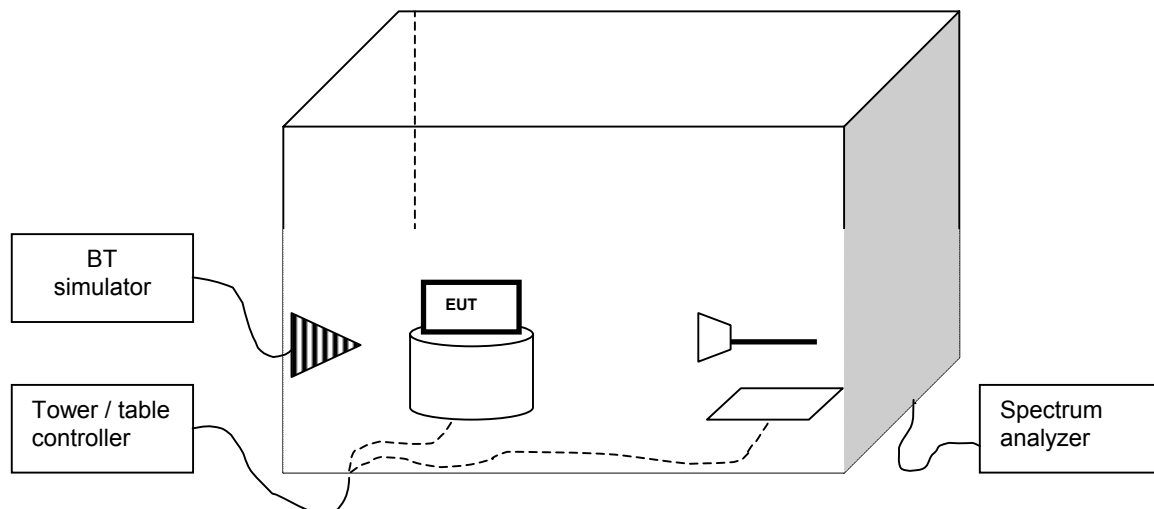
In tests, where absolute level reporting were required, the results were corrected with all applicable factors as detailed in the result section of each measurement.



### 5.2 Setup B (radiated measurements)

The EUT was set on a non-conductive turn table in a semi anechoic chamber. In the corner of the chamber there was a communication antenna, which was connected to the BT simulator located outside the chamber. The radiated power from the EUT was measured with an antenna fixed to a antenna tower. The tower and turn table were remotely controlled to turn the EUT and change the antenna polarization. The measured signal was routed from the measuring antenna to the spectrum analyzer. The Bluetooth simulator was used to the same as in conducted measurements.

In tests, where absolute level reporting were required, the results were corrected with all applicable factors as detailed in the result section of each measurement.



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## 6 STANDARDS AND MEASUREMENT METHODS

The tests were performed in guidance of CFR 47 Part 15.247, Part 2, FCC public notice DA 00-705 (March 30, 2000), ANSI C63.4 (2003), RSS-210 (Issue 5, November 2001) and CISPR-22. Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method".



## 7 CARRIER FREQUENCY SEPARATION

EUT	40162
Accessories	40121, 40156
Test setup	A
Temp, Humidity, Air Pressure	24°C 38 %RH 1028 mbar
Date of measurement	25.1.2005
FCC rule part	§15.247 (a) (1)
RSS-210 section	6.2.2 (o), a1
Measured by	Jari Jantunen
Result	<b>PASS</b>

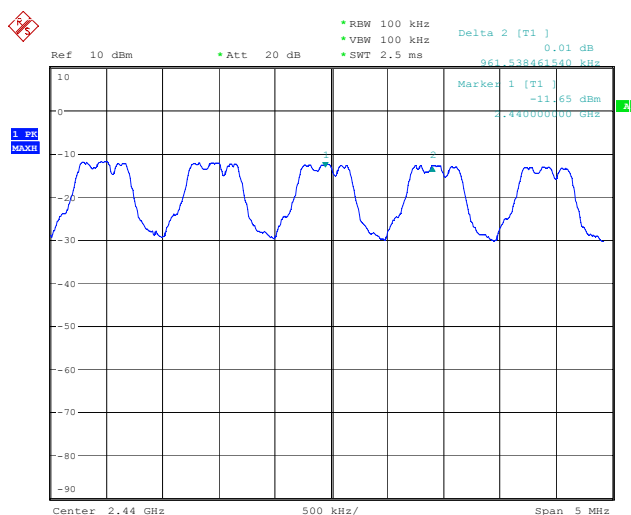
### 7.1 EUT operation mode

EUT operation mode	Connection, DH5 packet type
EUT channel	Hopping
EUT TX power level	Nominal

### 7.2 Limits and results

Limit (MHz)	Result (MHz)
≥ 0.025 or 20dB BW	0.962

### 7.3 Screen shot



Date: 25.JAN.2005 08:27:42

**Picture 1** Carrier frequency separation of channels 38 and 39

## 8 NUMBER OF HOPPING FREQUENCIES

EUT	40162
Accessories	40121, 40156
Test setup	A
Temp, Humidity, Air Pressure	24°C 38%RH 1028 mbar
Date of measurement	25.1.2005
FCC rule part	§15.247(a) (2)
RSS-210 section	6.2.2 (o), a3
Measured by	Jari Jantunen, Jan-Erik Lilja
Result	<b>PASS</b>

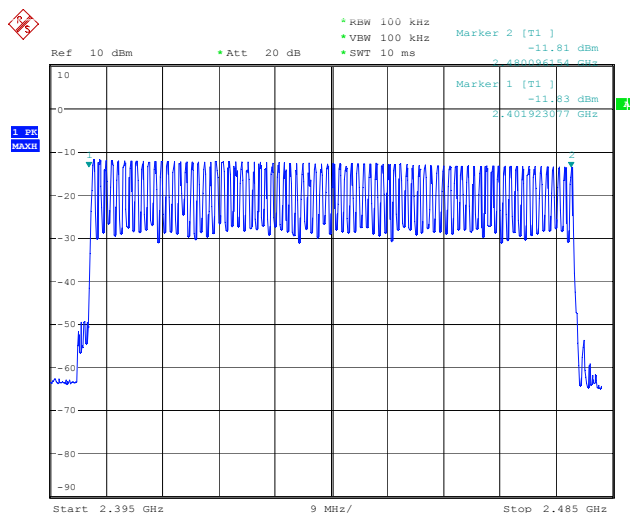
### 8.1 EUT operation mode

EUT operation mode	Connection, DH5 packet type
EUT channel	Hopping
EUT TX power level	Nominal

### 8.2 Limits and results

Number	Measured value
≥ 75	79

### 8.3 Screen shot



Date: 25.JAN.2005 09:54:42

**Picture 2 Number of hopping frequencies**

## 9 TIME OF OCCUPANCY

EUT	40162
Accessories	40121, 40155
Test setup	A
Temp, Humidity, Air Pressure	22°C 40 %RH 1016 mbar
Date of measurement	22.3.2005
FCC rule part	§15.247 (a) (3)
RSS-210 section	6.2.2 (o), a3
Measured by	Jari Jantunen
Result	<b>PASS</b>

### 9.1 Connection mode

#### 9.1.1 EUT operation mode

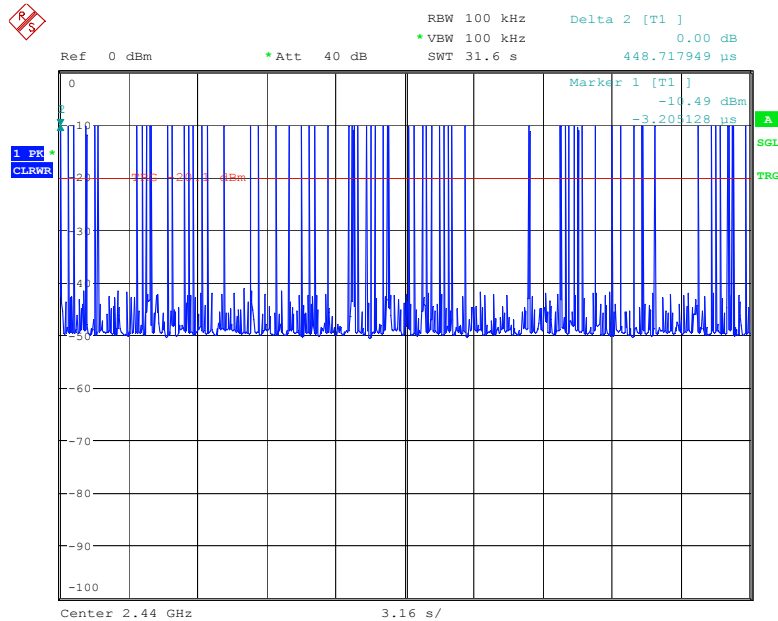
EUT operation mode	Connection, DH5 packet type
EUT channel	Hopping
EUT TX power level	Nominal

### 9.2 Limits and results

Limit (s)	Measured value (s)
≤ 0.4	0.192

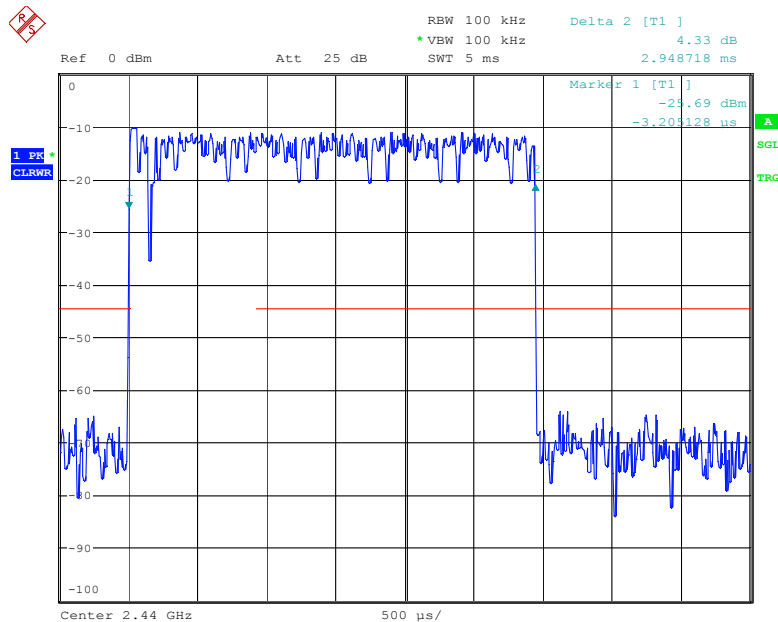
In measurement time of 31.6 s, total of 65 transmissions occurred. The duration of one transmission was 2.948 ms.  $65 \times 2.949 = 191.685$  ms.

Screen shots



Date: 22.MAR.2005 16:44:53

Picture 3. Number of transmissions



Date: 22.MAR.2005 16:17:43

Picture 4. Duration of one transmission DH5, channel 38

## 10 20dB BANDWIDTH

EUT	40162
Accessories	40121, 40155
Test setup	A
Temp, Humidity, Air Pressure	24°C 38 %RH 1028 mbar
Date of measurement	25.1.2005
FCC rule part	§15.247 (a) (1)
RSS-210 section	6.2.2 (o), a1
Measured by	Jari Jantunen, Jan-Erik Lilja
Result	<b>PASS</b>

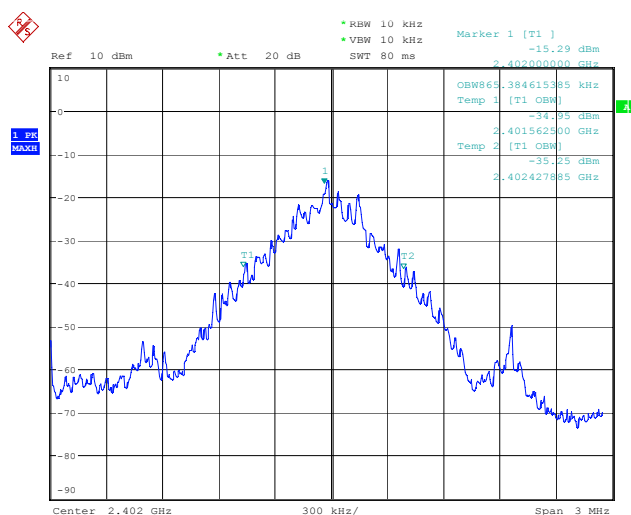
### 10.1 EUT operation mode

EUT operation mode	Connection, DH5 packet type
EUT channel	0, 38 and 78
EUT TX power level	Nominal

### 10.2 Limits and results

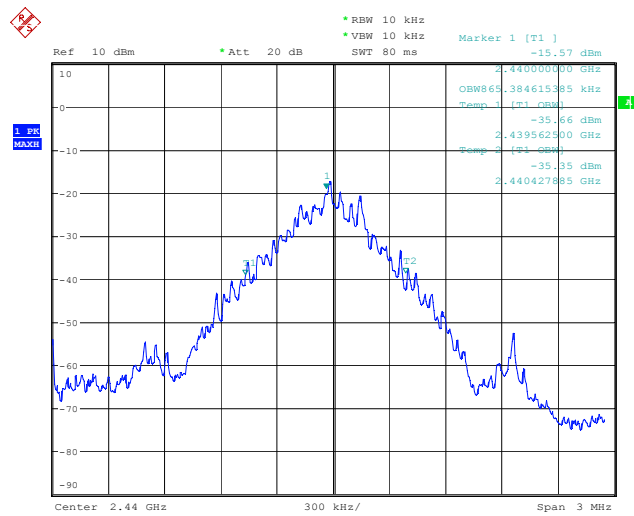
EUT Channel	Limit (MHz)	Measured value (MHz)
0	≤1.0	0.865
38		0.865
78		0.865

### 10.3 Screen shots



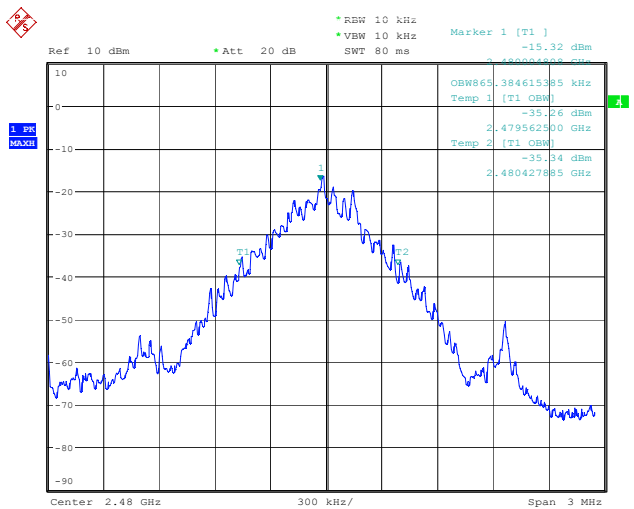
Date: 25.JAN.2005 10:27:10

Picture 5. 20dB bandwidth, channel 0



Date: 25.JAN.2005 10:31:25

Picture 6. 20dB bandwidth, channel 38



Date: 25.JAN.2005 10:34:19

Picture 7. 20dB bandwidth, channel 78

## 11 PEAK OUTPUT POWER

EUT	40162
Accessories	40121, 40155
Test setup	A
Temp, Humidity, Air Pressure	24°C 38 %RH 1028 mbar
Date of measurement	25.1.2005
FCC rule part	§15.247 (b) (1)
RSS-210 section	6.2.2 (o), a3
Measured by	Jari Jantunen, Jan-Erik Lilja
Result	<b>PASS</b>

### 11.1 EUT operation mode

EUT operation mode	Connection, DH5 packet type
EUT channel	0, 38 and 78
EUT TX power level	Nominal

### 11.2 Limits and results

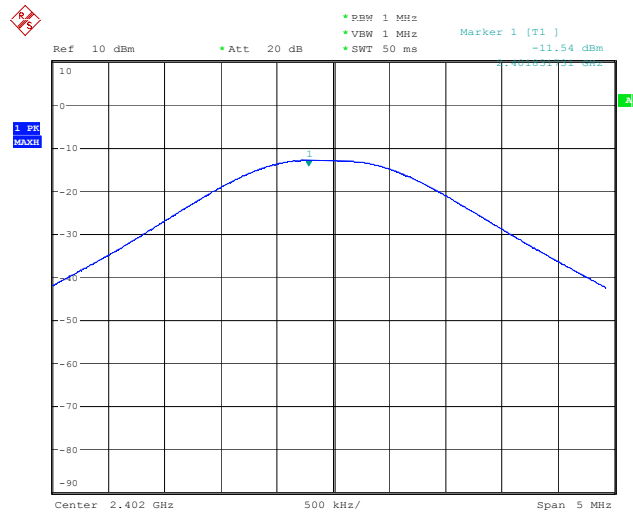
EUT Channel	Limit (W)	Test result (W)
0	≤ 1	0.00119
38		0.00120
78		0.00119

The measured power values were corrected with the attenuation of the cables, attenuator and power divider using the formula:

$$P[W] = \frac{10^{(P_{Meas}[dBm] + L_{Cables}[dB] + L_{Attenuator}[dB] + L_{Divider}[dB])}}{1000}$$

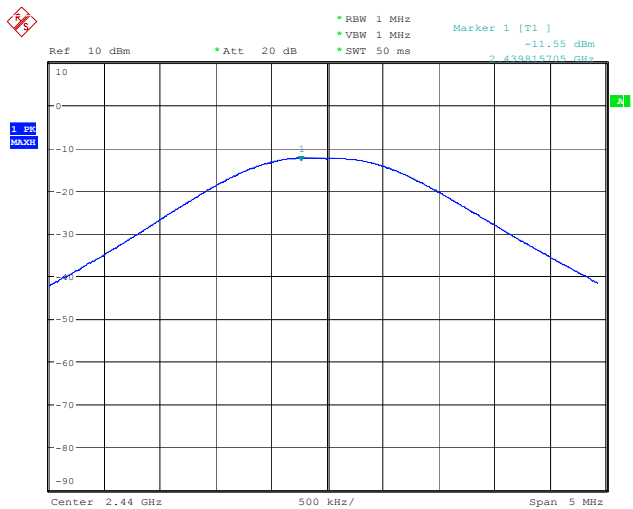
EUT Channel	Measured value [dBm]	Signal path loss [dB]	Peak output power [dBm]	Peak output power [W]
0	-11.54	12.29	0.75	0.00119
38	-11.55	12.35	0.8	0.00120
78	-11.53	12.30	0.77	0.00119

### 11.3 Screen shots



Date: 25.JAN.2005 10:52:30

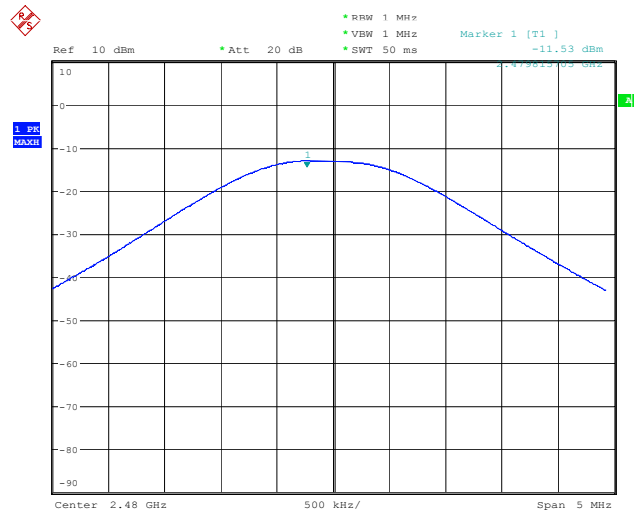
**Picture 8. Peak output power on channel 0**



Date: 25.JAN.2005 10:49:45

**Picture 9. Peak output power on channel 38**





Date: 25.JAN.2005 10:45:51

**Picture 10. Peak output power on channel 78**

## 12 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

### 12.1 Hopping enabled

EUT	40162
Accessories	40121, 40155
Test setup	A
Temp, Humidity, Air Pressure	24°C 38 %RH 1028 mbar
Date of measurement	25.1.2005
FCC rule part	§15.247 (c) (1)
RSS-210 section	6.2.2 (o), e1
Measured by	Jan-Erik Lilja
Result	PASS

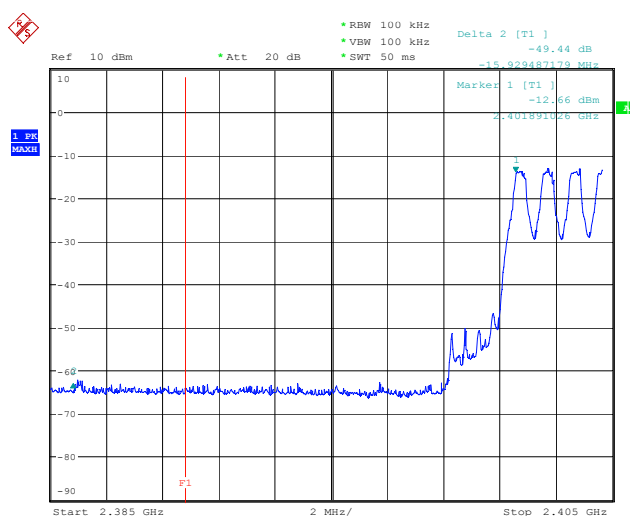
#### 12.1.1 EUT operation mode

EUT operation mode	Connection, DH5 packet type
EUT channel	Hopping
EUT TX power level	Nominal

#### 12.1.2 Limits and results

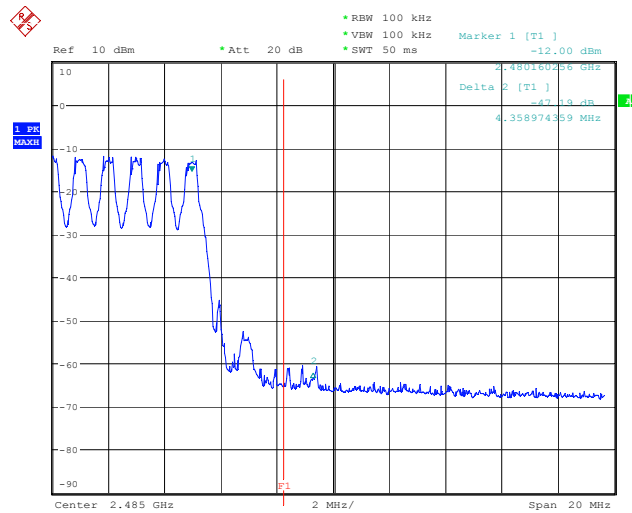
Channel	Limit (dBc)	Result (dBc)
0	≤ -20	-49.44
78		-47.19

#### 12.1.3 Screen shots



Date: 25.JAN.2005 11:25:24

**Picture 11. Bandedge compliance, low end**



Date: 25.JAN.2005 11:20:43

**Picture 12. Bandedge compliance, high end**

## 12.2 Hopping disapled

EUT	40162
Accessories	40121, 40155
Test setup	A
Temp, Humidity, Air Pressure	24°C 38 %RH 1028 mbar
Date of measurement	25.1.2005
FCC rule part	§15.247 (c) (1)
RSS-210 section	6.2.2 (o), e1
Measured by	Jan-Erik Lilja
Result	<b>PASS</b>

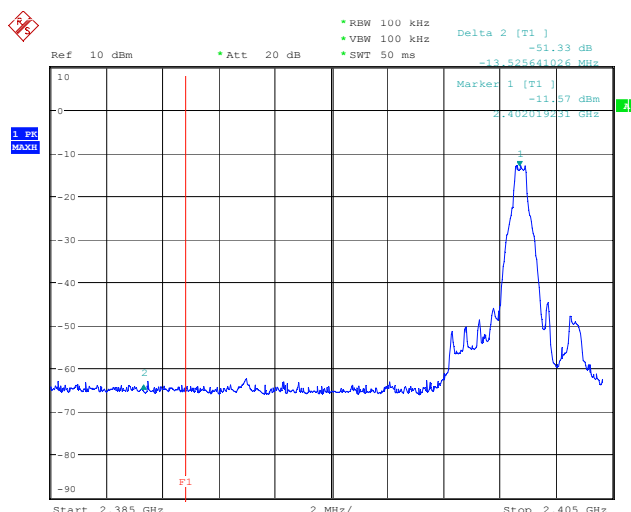
### 12.2.1 EUT operation mode

EUT operation mode	Connection, DH5 packet type
EUT channel	0 and 78
EUT TX power level	Nominal

### 12.2.2 Limits and results

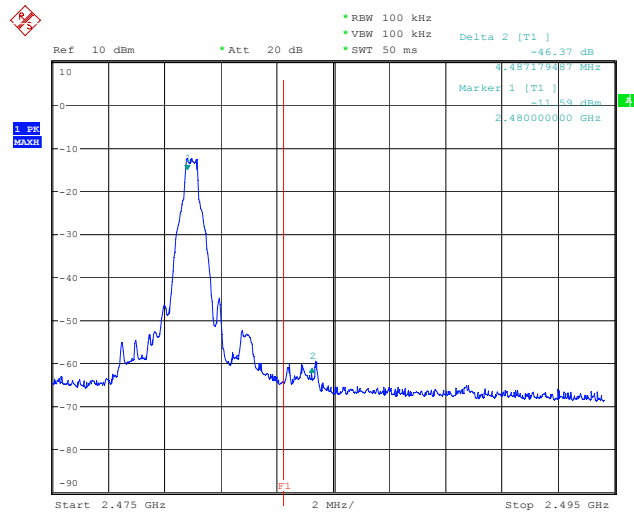
Frequency	Limit (dBc)	Result (dBc)
0	$\leq -20$	-51.33
78		-46.37

### 12.2.3 Screen shots



Date: 25.JAN.2005 11:11:44

**Picture 13. Bandedge compliance, low end**



Date: 25.JAN.2005 11:15:33

Picture 14. Bandedge compliance, high end

### 13 AC POWERLINE CONDUCTED EMISSIONS

EUT	40153		
Accessories	40121, 40155		
Temp, Humidity, Air Pressure	19 °C	51 %RH	1014 mbar
Date of measurement	24.1.2005		
FCC rule part	§15.207		
RSS-210 section	6.6		
Measured by	Jari Jantunen		
Result	<b>PASS</b>		

#### 13.1 Test setup

The EUT was set according to ANSI C63.4-1992, figure 9a.

#### 13.2 EUT operation mode

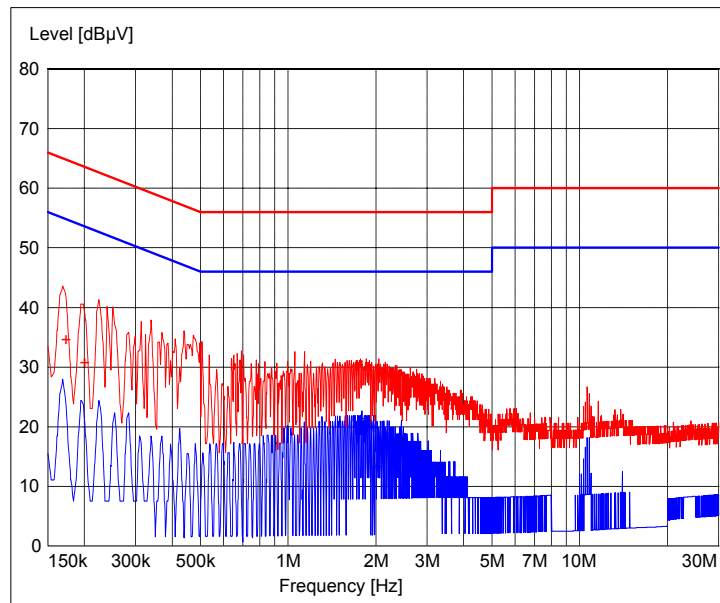
EUT operation mode	Connection, DH5 packet type
EUT channel	38
EUT TX power level	Nominal
EUT operation voltage	115VAC/60Hz

#### 13.3 Limit

Frequency band (MHz)	Quasi-peak limit (dB $\mu$ V)	Average limit (dB $\mu$ V)
0.15 – 0.5	66 – 56	56 – 46
0.5 – 5	56	46
5 – 30	60	50

#### 13.4 Results

The measurement results were adjusted with the attenuation of the cable between the LISN and receiver by the computer controlling the test system.



Picture 15 AC powerline emissions

Table 1 Emission measurement data, average detector

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin	Detector dB	Line	PE
1.779000	21.40	10.40	46.00	24.60	AV	N	GND
1.864500	20.90	10.40	46.00	25.10	AV	N	GND
1.923000	20.00	10.40	46.00	26.00	AV	N	GND
1.954500	19.80	10.40	46.00	26.20	AV	N	GND
2.008500	13.30	10.40	46.00	32.70	AV	N	GND

Table 2 Emission measurement data, quasi-peak detector

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin	Detector dB	Line	PE
0.172500	34.50	10.10	64.80	30.30	QP	L1	GND
0.199500	30.70	10.10	63.60	32.90	QP	N	GND

## 14 SPURIOUS RF CONDUCTED EMISSIONS

EUT	40162
Accessories	40121, 40155
Test setup	A
Temp, Humidity, Air Pressure	24°C 38 %RH 1028 mbar
Date of measurement	25.1.2005
FCC rule part	§15.247 (c) (2)
RSS-210 section	6.2.2 (o), e1
Measured by	Jan-Erik Lilja
Result	<b>PASS</b>

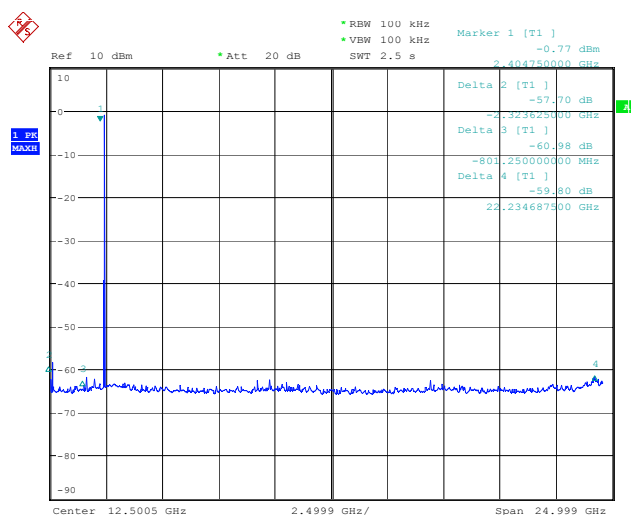
### 14.1 EUT operation mode

EUT operation mode	Connection, DH5 packet type
EUT channel	0, 38 and 78
EUT TX power level	Nominal

### 14.2 Limits and results

EUT Channel	Limit (dBc)	Result (dBc)
0	≤ -20	-57.70
38		-57.71
78		-58.21

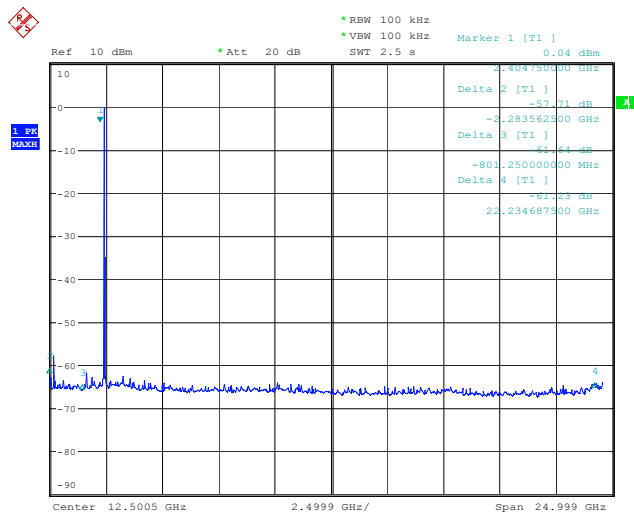
### 14.3 Screen shots



Date: 25.JAN.2005 12:07:20

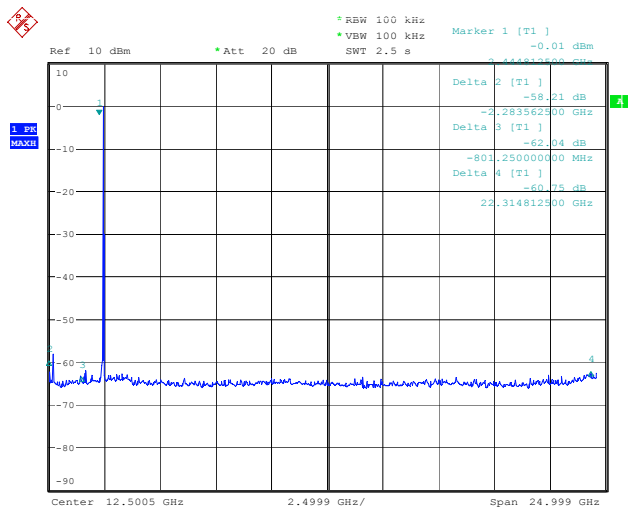
Picture 16. Spurious RF conducted emissions, TX on channel 0





Date: 25.JAN.2005 12:00:31

Picture 17. Spurious RF conducted emissions, TX on channel 38



Date: 25.JAN.2005 11:56:12

Picture 18. Spurious RF conducted emissions, TX on channel 78

## 15 SPURIOUS RADIATED EMISSIONS

EUT	40153
Accessories	40121, 40155
Test setup	B
Temp, Humidity, Air Pressure	21°C 47 %RH 980 mbar
Date of measurement	21.1.2005
FCC rule part	§15.247 (c) (1)
RSS-210 section	6.2.2 (o), e1
Measured by	Jari Jantunen
Result	<b>PASS</b>

### 15.1 Test method

- The spectrum analyzer with peak detector was used to find all the emissions generated by the EUT.
- All suspicious frequencies with emission levels were recorded.
- The test was repeated with the EUT in three orthogonal orientations.
- For each frequency detected in (b), the emissions were maximized by moving the turn table and measuring antenna and manipulating the EUT.
- The maximized emissions were measured and reported.

### 15.2 EUT operation mode

EUT operation mode	Connection, DH5 packet type
EUT channel	0, 38 and 78
EUT TX power level	Nominal

### 15.3 Limits, 3m measuring distance

Frequency band (MHz)	Limit (µV/m)	Limit (dBµV/m)	Detector
30 – 88	100	40	QP
88 -216	150	43.5	QP
216 - 960	200	46	QP
960 - 1000	500	54.0	QP
1000 - 25000	500	54.0	Av
1000 - 25000	5000	74.0	Pk

As default, all emissions were compared against the general limits. If any emission exceeded that limit, it was further checked, if it was outside the restricted band thus complying with the -20dBc requirement.

### 15.4 Results

The results were corrected with the cable and filter losses, preamplifier gain, antenna factor and measurement distance.

**Table 3 Emission levels, channel 0, Average detector**

Frequency MHz	Level dB $\mu$ V/m
4804.000000	27.40
7206.000000	29.40
9608.000000	32.70
12010.000000	34.10
14412.000000	36.80
16814.000000	35.00

**Table 4 Emission levels, channel 0, Peak detector**

Frequency MHz	Level dB $\mu$ V/m
4804.000000	40.30
7206.000000	42.20
9608.000000	45.90
12010.000000	47.00
14412.000000	49.70
16814.000000	47.50

**Table 5 Emission levels, channel 38, Quasi-peak detector**

Frequency MHz	Level dB $\mu$ V/m
44.509820	14.30

**Table 6 Emission levels, channel 38, Average detector**

Frequency MHz	Level dB $\mu$ V/m
4880.259519	32.40
7307.623246	30.10
7318.139279	30.20
7396.785571	30.10
17990.989980	42.40
4880.259519	32.40

**Table 7 Emission levels, channel 38, Peak detector**

Frequency MHz	Level dB $\mu$ V/m
4880.259519	44.80
7315.623246	42.70
7323.639279	43.30
7396.785571	43.20
17998.489980	54.90
4880.259519	44.80

**Table 8 Emission levels, channel 78, Average detector**

Frequency MHz	Level dB $\mu$ V/m
4960.000000	28.10
7440.000000	30.30
9920.000000	32.90
12400.000000	34.30
14880.000000	35.40
17360.000000	37.50

**Table 9 Emission levels, channel 78, Peak detector**

Frequency MHz	Level dB $\mu$ V/m
4960.000000	41.30
7440.000000	42.90
9920.000000	46.20
12400.000000	46.90
14880.000000	48.70
17360.000000	50.90

## 16 TEST EQUIPMENT

Each test equipment is calibrated once a year.

### 16.1 Conducted measurements

Equipment	Manufacturer	Model
Spectrum analyzer	Rohde & Schwarz	FSU
Radio communication tester	Rohde & Schwarz	CMU-200
Attenuator 10 dB	Huber+Suhner AG	6251.17.A
Step attenuator 110dB	Hewlett-Packard	8496A
Power splitter	Hewlett-Packard	11667A
High pass filter	Trilithic	WHK2010-10SS
Low pass filter	Trilithic	WLK1750-10SS
Tunable notch filter	Wainwright	WRCD1850/1910-0.2/40
Temperature chamber	Vötsch	VT4002
DC power supply	HP	6632A
Multimeter	Fluke	87

### 16.2 Radiated measurements

Equipment	Manufacturer	Model
3m semi-anechoic chamber	TDK	
EMI receiver	Rohde & Schwarz	ESI 40
Preamplifier	MITEQ	AMF-5D-020180-26-10P
Preamplifier	MITEQ	AMF-4D-10M-3G-25-20P
Dipole antenna	EMCO	3125-870
Dipole antenna	EMCO	3125-1880
Biconilog antenna	Rohde & Schwarz	HL562
Double ridged waveguide antenna	EMCO	3115
Horn antenna	EMCO	3116
Reference dipole set	Schwarzbeck	UHAP/VHAP
Communication antenna	EMC Automation	LPA-8020
Radio communication tester	Rohde & Schwarz	CMU-200
Signal generator	Hewlett-Packard	83640L
Step attenuator 110dB	Hewlett-Packard	8496A
Power splitter	Hewlett-Packard	11667A
High pass filter	Trilithic	WHK2010-10SS
Low pass filter	Trilithic	WLK1750-10SS
Tunable notch filter	Wainwright	WRCD1850/1910-0.2/40
Turntable controller	Deisel	HD-100
Turntable	Deisel	DS412
Antenna mast controller	EMCO	2090
Antenna mast	EMCO	2075
Temperature chamber	Vötsch	VT4002
DC power supply	Hewlett-Packard	6632A
Multimeter	Fluke	87