
Bluetooth test report for RM-58

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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 Joensuunkatu 7 FIN-24100 SALO BOX 86 FIN-24101 SALO Salo Tel. +358-71-8008000 Fax. +358-71-8044277
Contact person:	Jorma Hanni
Receipt of EUT:	3.1.2005
Date of testing:	5-10.1.2005
Date of report:	10.1.2005

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

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-58	Phone	004400521659514	0721	2.10	40149
	RM-58	Phone	004400521659605	0721	2.10	40150
Accessories	BL-5C	Battery	-	6.0	-	40123
	ACP-12	Charger	-	5.0	-	40121

Notes: -

4.1 EUT description

The EUT is a triple band (GSM850/1800/1900 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.

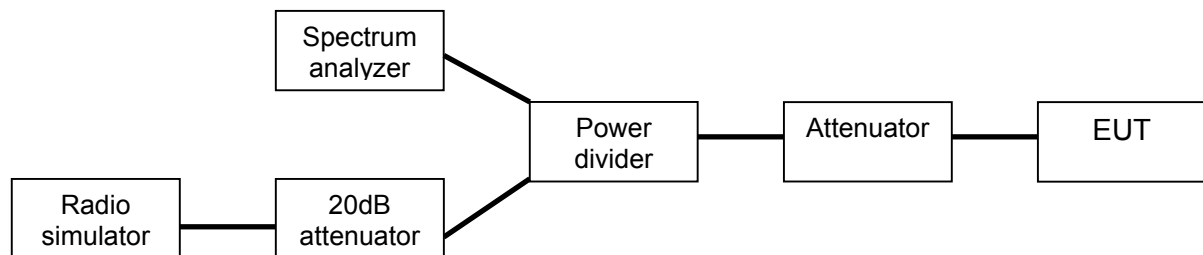
Two different test setups were used: one for conducted measurements, another for radiated measurements. One EUT was equipped with an external antenna connector for conductive measurements.

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

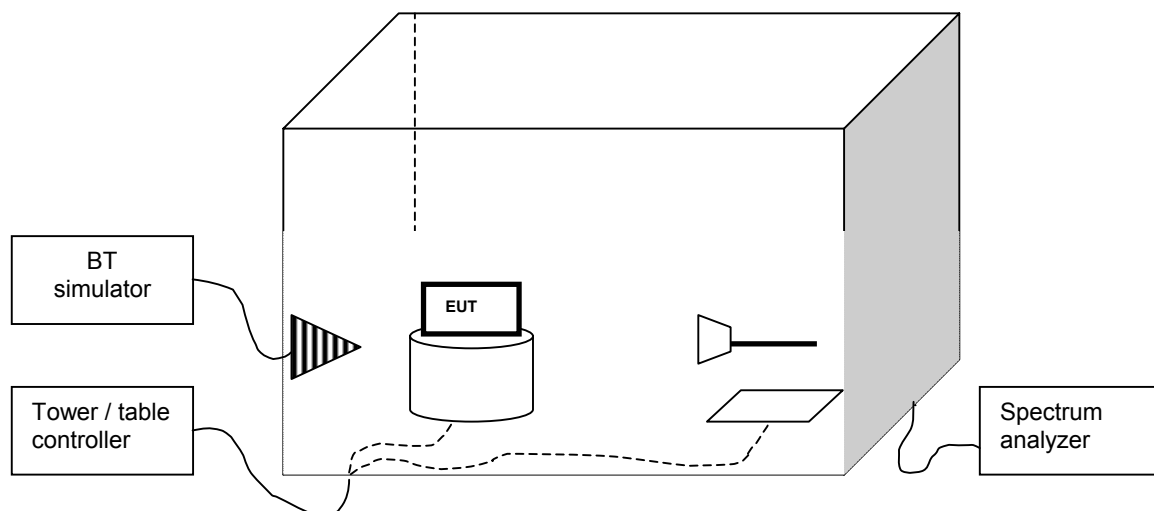
In tests, where absolute level reporting were required, the results were corrected with all applicable factors as detailed in the result section of each measurement.



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.



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 (1992), 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	40149
Accessories	40123
Test setup	A
Temp, Humidity, Air Pressure	23 °C 37 %RH 983 mbar
Date of measurement	5.1.2005
FCC rule part	§15.247 (a) (1)
RSS-210 section	6.2.2 (o), a1
Measured by	Jan-Erik Lilja
Result	PASS

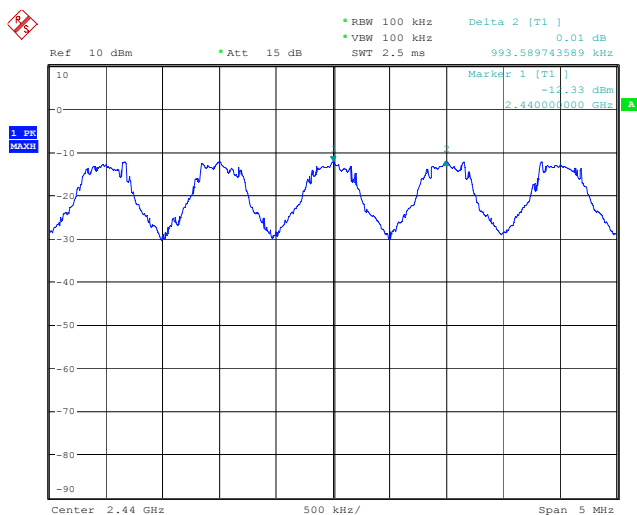
7.1 EUT operation mode

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	0.994

7.3 Screen shot



Date: 5.JAN.2005 12:04:45

Picture 1 Carrier frequency separation of channels 38 and 39

8 NUMBER OF HOPPING FREQUENCIES

EUT	40149		
Accessories	40123		
Test setup	A		
Temp, Humidity, Air Pressure	23 °C	37 %RH	983 mbar
Date of measurement	5.1.2005		
FCC rule part	§15.247(a) (2)		
RSS-210 section	6.2.2 (o), a3		
Measured by	Jan-Erik Lilja		
Result	PASS		

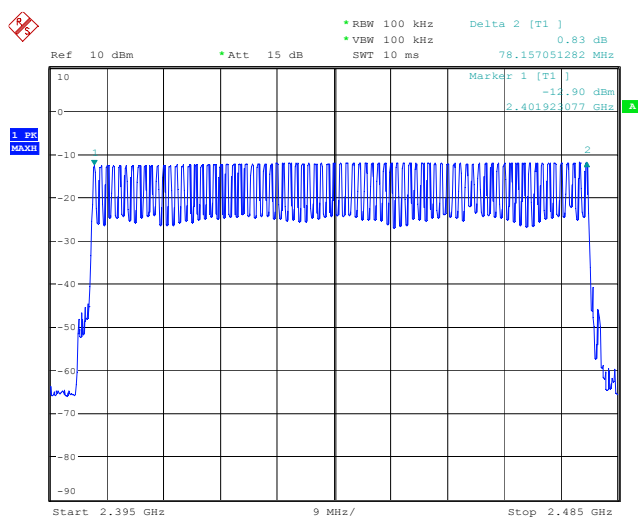
8.1 EUT operation mode

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: 5.JAN.2005 12:47:49

Picture 2 Number of hopping frequencies

9 TIME OF OCCUPANCY

EUT	40149
Accessories	40123
Test setup	A
Temp, Humidity, Air Pressure	23 °C 37 %RH 983 mbar
Date of measurement	5.1.2005
FCC rule part	§15.247 (a) (3)
RSS-210 section	6.2.2 (o), a3
Measured by	Jan-Erik Lilja
Result	PASS

9.1 Connection mode

9.1.1 EUT operation mode

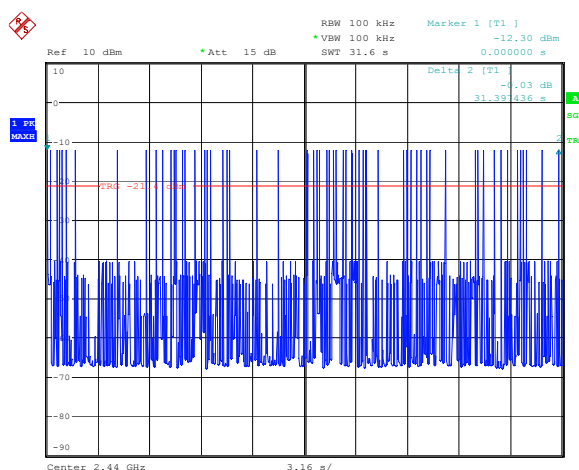
EUT operation mode	Connection, DH5 packet type
EUT channel	Hopping
EUT TX power level	Nominal

9.2 Limits and results

Limit (s)	Measured value (s)
≤ 0.4	0.187

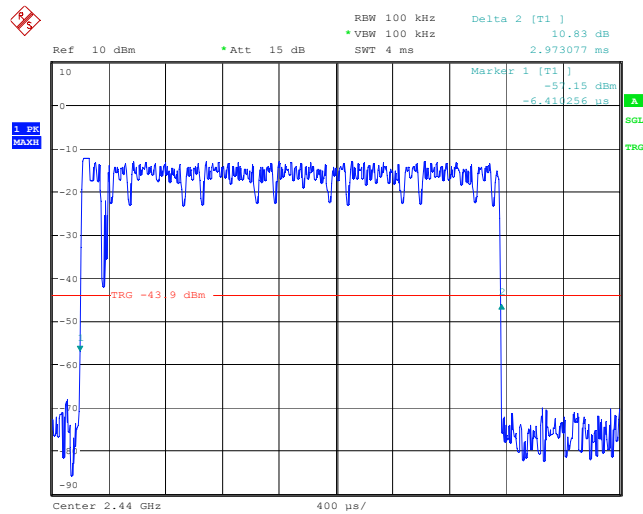
In measurement time of 31.6 s, total of 63 transmissions occurred. The duration of one transmission was 2.97 ms. $75 \times 2.97 = 187$ ms.

Screen shots



Date: 5.JAN.2005 12:52:13

Picture 3. Number of transmissions, channel 38



Date: 5.JAN.2005 12:54:22

Picture 4. Duration of one transmission, channel 38

10 20dB BANDWIDTH

EUT	40149
Accessories	40123
Test setup	A
Temp, Humidity, Air Pressure	23 °C37 %RH983 mbar
Date of measurement	5.1.2005
FCC rule part	§15.247 (a) (1)
RSS-210 section	6.2.2 (o), a1
Measured by	Jan-Erik Lilja
Result	PASS

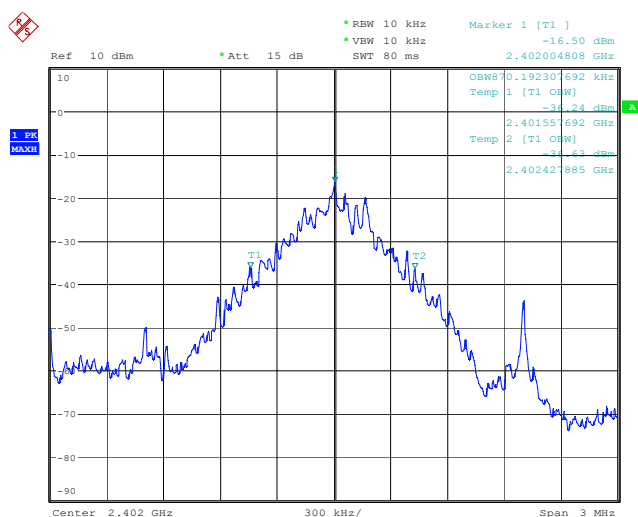
10.1 EUT operation mode

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

10.2 Limits and results

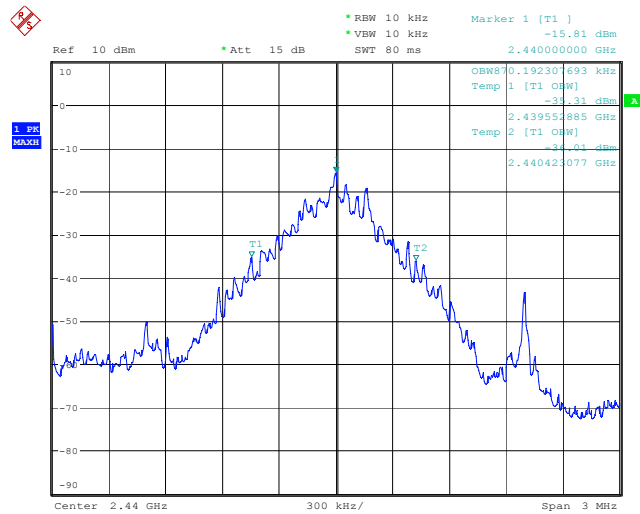
EUT Channel	Limit (MHz)	Measured value (MHz)
0	≤1.0	0.870
38		0.870
78		0.875

10.3 Screen shots



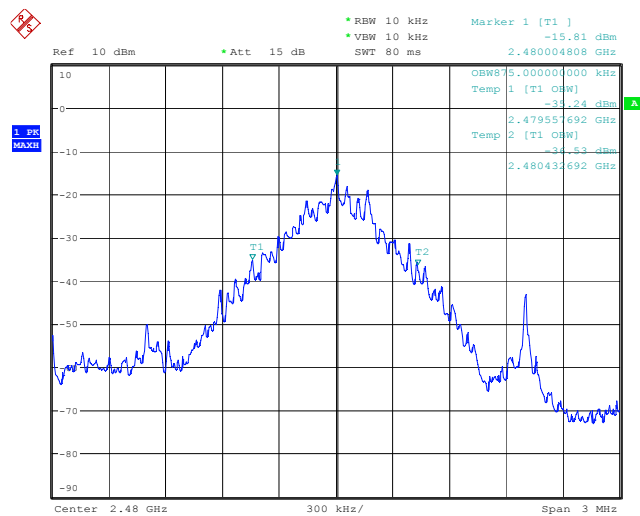
Date: 5.JAN.2005 12:57:49

Picture 5. 20dB bandwidth, channel 0



Date: 5.JAN.2005 12:59:41

Picture 6. 20dB bandwidth, channel 38



Date: 5.JAN.2005 13:01:03

Picture 7. 20dB bandwidth, channel 78

11 PEAK OUTPUT POWER

EUT	40149
Accessories	40123
Test setup	A
Temp, Humidity, Air Pressure	23 °C 37 %RH 983 mbar
Date of measurement	5.1.2005
FCC rule part	§15.247 (b) (1)
RSS-210 section	6.2.2 (o), a3
Measured by	Jan-Erik Lilja
Result	PASS

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

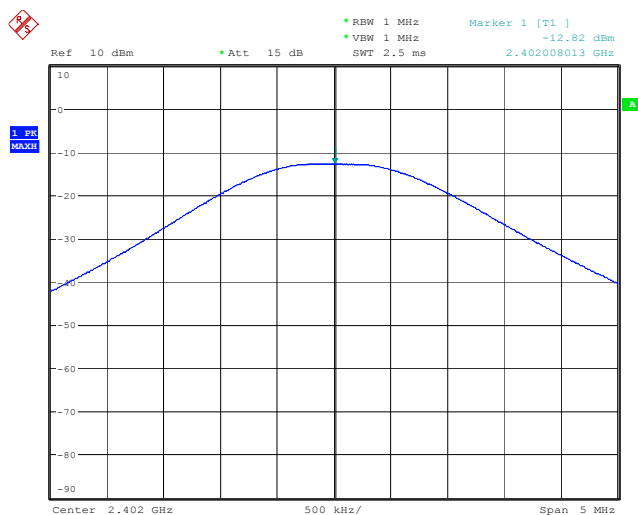
EUT Channel	Limit (W)	Test result (W)
0	≤ 1	0.00114
38		0.00115
78		0.00096

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

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

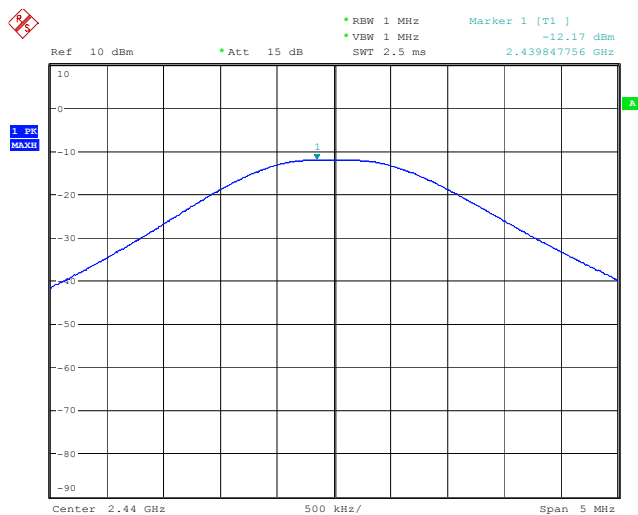
EUT Channel	Measured value [dBm]	Signal path loss [dB]	Peak output power [dBm]	Peak output power [W]
0	-12.00	12.57	0.57	0.00114
38	-12.17	12.77	0.6	0.00115
78	-12.82	12.66	-0.16	0.00096

11.3 Screen shots



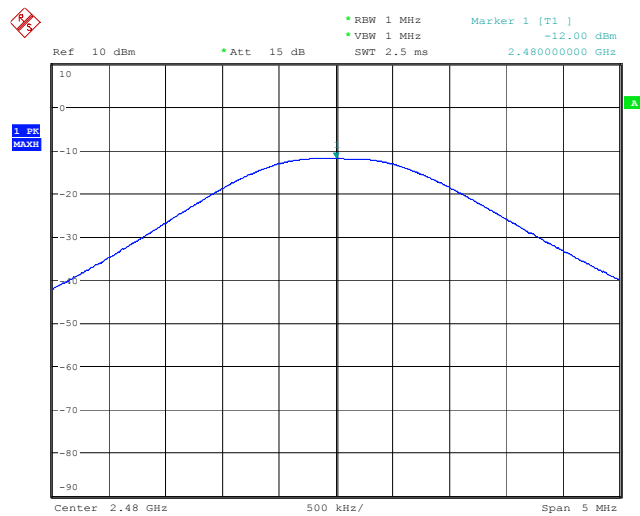
Date: 5.JAN.2005 13:05:33

Picture 8. Peak output power on channel 0



Date: 5.JAN.2005 13:04:18

Picture 9. Peak output power on channel 38



Date: 5.JAN.2005 13:02:43

Picture 10. Peak output power on channel 78

12 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

12.1 Hopping enabled

EUT	40149
Accessories	40123
Test setup	A
Temp, Humidity, Air Pressure	23 °C 37 %RH 983 mbar
Date of measurement	5.1.2005
FCC rule part	§15.247 (c) (1)
RSS-210 section	6.2.2 (o), e1
Measured by	Jan-Erik Lilja
Result	PASS

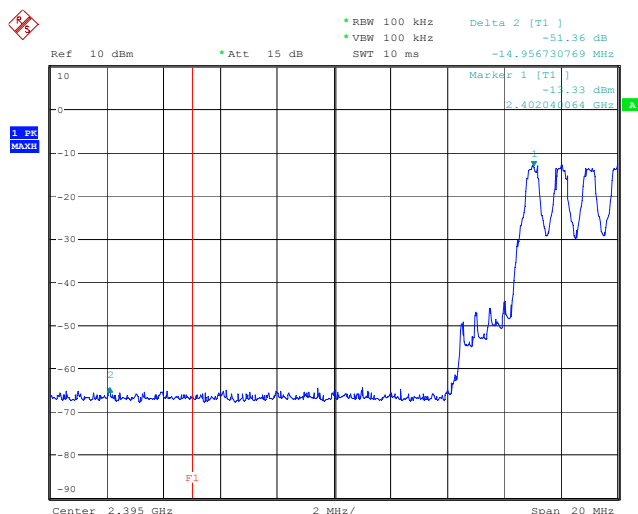
12.1.1 EUT operation mode

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

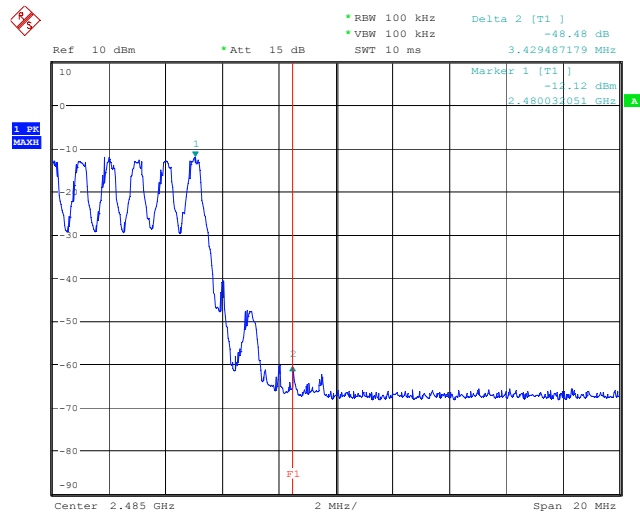
12.1.2 Limits and results

Frequency	Limit (dBc)	Result (dBc)
Low	≤ -20	-51.4
High		-48.5

12.1.3 Screen shots



Picture 11. Bandedge compliance, low end



Date: 5.JAN.2005 13:38:26

Picture 12. Bandedge compliance, high end

12.2 Hopping disapled

EUT	40149		
Accessories	40123		
Test setup	A		
Temp, Humidity, Air Pressure	23 °C	37 %RH	983 mbar
Date of measurement	5.1.2005		
FCC rule part	§15.247 (c) (1)		
RSS-210 section	6.2.2 (o), e1		
Measured by	Jan-Erik Lilja		
Result	PASS		

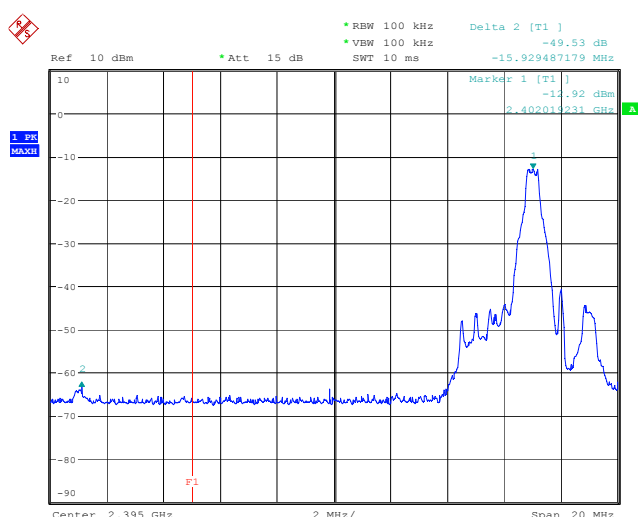
12.2.1 EUT operation mode

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

12.2.2 Limits and results

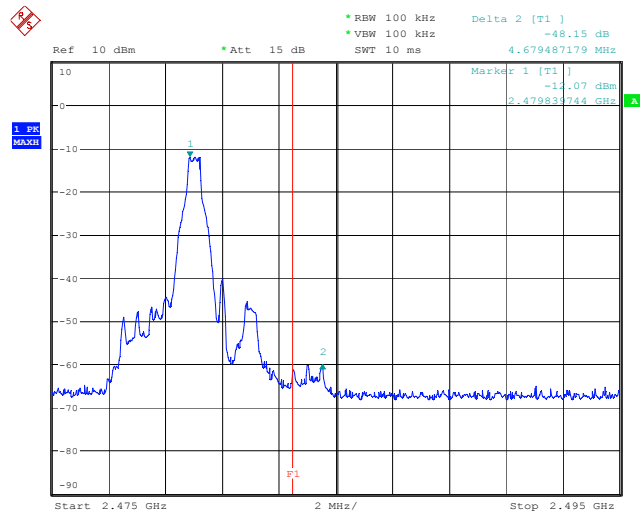
Frequency	Limit (dBc)	Result (dBc)
0	≤ -20	-49.5
78		-48.2

12.2.3 Screen shots



Date: 5.JAN.2005 13:33:45

Picture 13. Bandedge compliance, low end



Picture 14. Bandedge compliance, high end

13 AC POWERLINE CONDUCTED EMISSIONS

EUT	40150		
Accessories	40121, 40123		
Temp, Humidity, Air Pressure	23 °C	42 %RH	1002 mbar
Date of measurement	10.1.2005		
FCC rule part	§15.207		
RSS-210 section	6.6		
Measured by	Jari Jantunen		
Result	PASS		

13.1 Test setup

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

13.2 EUT operation mode

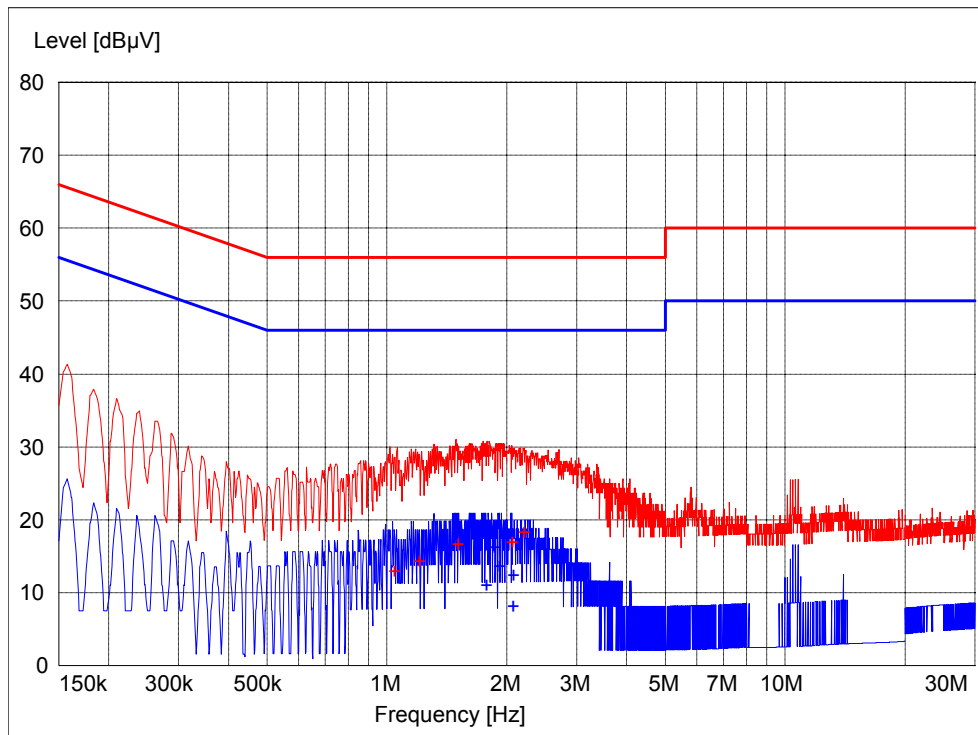
EUT operation mode	Connection, DH-5 packet type
EUT channel	40
EUT TX power level	Nominal
EUT operation voltage	115VAC/60Hz

13.3 Limit

Frequency band (MHz)	Quasi-peak limit (dB μ V)	Average limit (dB μ 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 Highest emissions, average detector

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin	Detector dB	Line	PE
1.779000	11.00	10.40	46.00	35.00	AV	N	GND
1.864500	16.20	10.40	46.00	29.80	AV	N	GND
1.918500	13.70	10.40	46.00	32.30	AV	N	GND
2.076000	8.20	10.40	46.00	37.80	AV	N	GND
2.080500	12.40	10.40	46.00	33.60	AV	N	GND

Table 2 Highest emissions, quasi-peak detector

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin	Detector dB	Line	PE
1.045500	13.00	10.30	56.00	43.00	QP	L1	GND
1.207500	14.30	10.30	56.00	41.70	QP	N	GND
1.509000	16.60	10.40	56.00	39.40	QP	L1	GND
2.071500	16.90	10.40	56.00	39.10	QP	L1	GND
2.211000	18.30	10.50	56.00	37.70	QP	N	GND

14 SPURIOUS RF CONDUCTED EMISSIONS

EUT	40149		
Accessories	40123		
Test setup	A		
Temp, Humidity, Air Pressure	23 °C	37 %RH	983 mbar
Date of measurement	5.1.2005		
FCC rule part	§15.247 (c) (2)		
RSS-210 section	6.2.2 (o), e1		
Measured by	Jan-Erik Lilja		
Result	PASS		

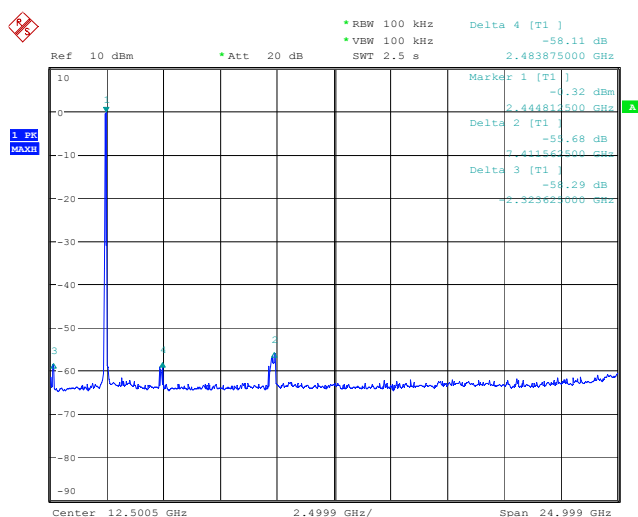
14.1 EUT operation mode

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

14.2 Limits and results

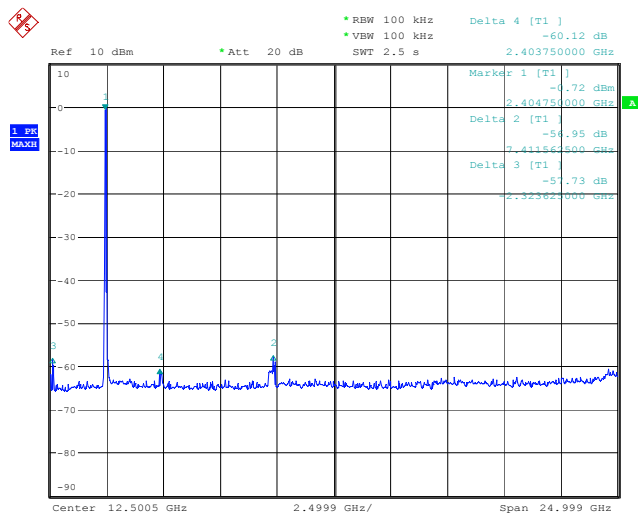
EUT Channel	Limit (dBc)	Result (dBc)
0	≤ -20	-55.7
38		-57.0
78		-54.4

14.3 Screen shots



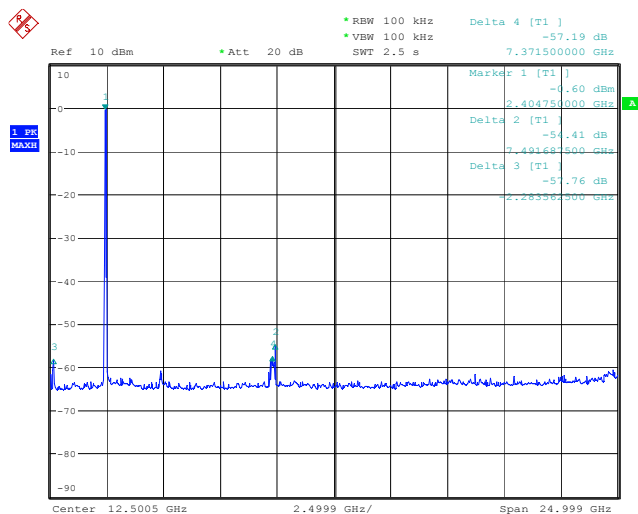
Date: 5.JAN.2005 11:56:00

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



Date: 5.JAN.2005 11:21:13

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



Date: 5.JAN.2005 11:15:53

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

15 SPURIOUS RADIATED EMISSIONS

EUT	40150
Accessories	40121, 40123
Test setup	B
Temp, Humidity, Air Pressure	19 °C 49 %RH 994 mbar
Date of measurement	4.1.2004
FCC rule part	§15.247 (c) (1)
RSS-210 section	6.2.2 (o), e1
Measured by	Jari Jantunen
Result	PASS

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 mode, DH5, PRBS
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 dBμV/m
4804.000000	26.70
7206.000000	29.30
9608.000000	32.50
12010.000000	34.10
14412.000000	36.70
16814.000000	34.90

Table 4 Emission levels, channel 0, Peak detector

Frequency MHz	Level dBμV/m
4804.000000	39.60
7206.000000	42.20
9608.000000	45.40
12010.000000	47.40
14412.000000	49.50
16814.000000	47.80

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

Frequency MHz	Level dBμV/m
37.976353	8.30
51.243287	15.30
118.877956	14.20

Table 6 Emission levels, channel 38, Average detector

Frequency MHz	Level dBμV/m
4880.000000	26.90
7320.000000	30.30
9760.000000	31.80
12200.000000	33.70
14640.000000	35.80
17080.000000	35.80

Table 7 Emission levels, channel 38, Peak detector

Frequency MHz	Level dBμV/m
4880.000000	39.60
7320.000000	43.00
9760.000000	45.00
12200.000000	46.80
14640.000000	48.70
17080.000000	49.00

Table 8 Emission levels, channel 78, Average detector

Frequency MHz	Level dB μ V/m
4960.000000	27.80
7440.000000	30.10
9920.000000	32.80
12400.000000	34.30
14880.000000	35.20
17360.000000	37.40

Table 9 Emission levels, channel 78, Peak detector

Frequency MHz	Level dB μ V/m
4960.000000	40.50
7440.000000	42.80
9920.000000	46.10
12400.000000	47.10
14880.000000	47.80
17360.000000	50.80

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