Nemko TEST REPORT

Date:	**ESPOO 02.07.2004**	Page:	**1 (37)**
		Appendices	–

Number: No. 1 / 1 **1032275**

Date of handing in: 28.05.2004

Tested by:

Timo Hietala, Test Engineer

Reviewed by:

Timo Leismala, Test Manager

SORT OF EQUIPMENT: **Triple band (900/1800/1900) GPRS GSM Mobile phone with BT**

MARKETING NAME:

TYPE: ***RM-25*** ***Bluetooth***

MANUFACTURER: ***Nokia Corporation***

CLIENT: **Nokia Corporation**

ADDRESS: **Frederikskaj, DK-1790 Copenhagen, Denmark**

TELEPHONE: **+45 40620059, Ole Hoffmann Soerensen**

TEST LABORATORY: **Nemko Oy**

FCC REG. NO. **91087 August 27, 2001**

IC FILE NO. **IC 4627 July 2, 2003**

SUMMARY:

In regard to the performed tests the equipment under test fulfils the requirements defined in the test specifications, see page 2 for details

Nemko Oy • P.O.Box 19, FIN-02601 Espoo, Finland
Street address: Perkkaantie 11, FIN-02600 Espoo
Telephone +358 (0)424 5454 1 • Telefax +358 (0)9 5489 6371

Summary of performed tests and test results

Section 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	20 dB 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**
15.247, c	6.2.2(o), e1	Spurious RF conducted emissions	**PASS**
15.247, c	6.2.2(o), e1	Spurious radiated emissions	**PASS**
15.207	6.6	AC power line conducted emissions	**PASS**

Explanations:

PASS The EUT passed that particular test.
FAIL The EUT failed that particular test.
X The measurement was done, but there is no applicable performance criteria.

Contents

1. EUT and Accessory Information

1.1 EUT description

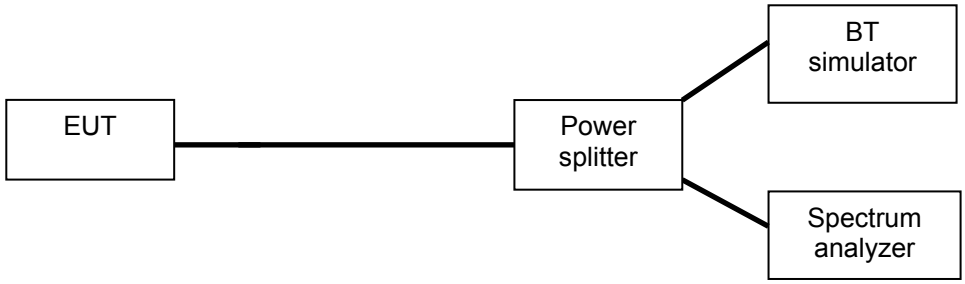
The EUT is a Triple band (900/1800/1900) GPRS GSM mobile phone with Bluetooth.

1.2 EUT and accessories

	unit	*type*	*S/N*
EUT1	**Mobile phone**	**RM-25**	**004400/48/160976/4**
EUT2	**Mobile phone**	**RM-25**	**004400/48/160973/1**
Accessories	**Battery, EUT 1** **Battery, EUT 2** **Memory card** **AC Charger** **Antenna adapter**	**BL-4C** **BL-4C** **MC12UO64DACA-0QA00** **ACP-12E** **Special fixed, EUT2**	**L101931237789** **L101931237759** **0675294** **394349J093110013379**

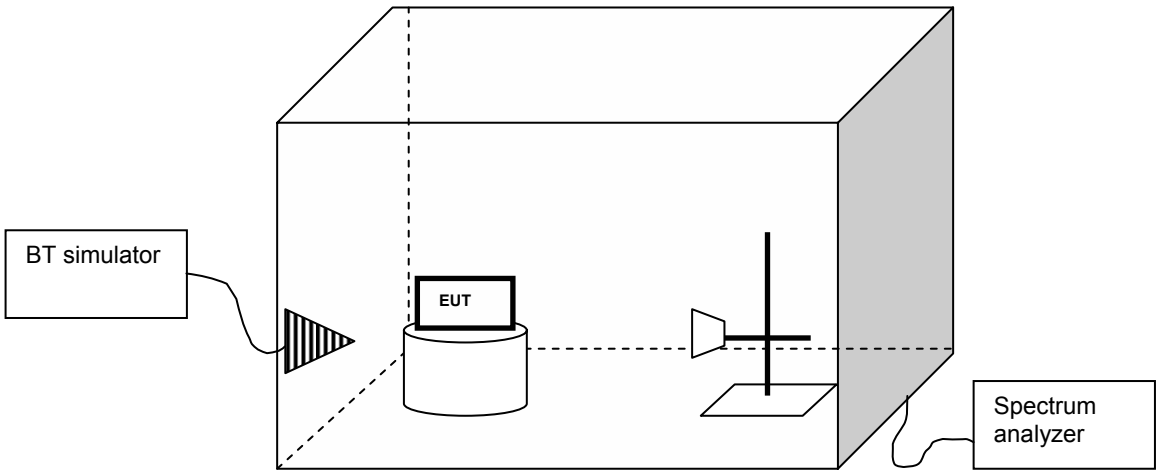
2. Test setups

Setup 1 (Conducted measurements)
The test was performed inside a shielded room. The Bluetooth simulator was used to control the EUT channel, number of EUT TX slots, enable/disable frequency hopping and modulate the TX signal with different bit patterns.



Setup 2 (Radiated measurements)

The test was performed inside a semi anechoic shielded room. For the duration of the test the EUT was placed on a non-conductive support 0.8 m high standing on the turntable. In the corner of the chamber there was a communication antenna, which was connected to the BT simulator located outside the room. 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 BT simulator was used to set the TX channel and modulate the TX signal with different bit patterns.



3. Standards and measurement methods

The test were performed in guidance of the CFR 47 part 15.247, part 2, FCC public notice DA 00-705 (March 30, 2000, ANSI C63.4 (1992) and RSS-210 (Issue 5, November 2001) and CISPR-22

4. Test results

4.1 Carrier frequency separation

The test was performed as a compliance test. The test parameters concerned were as follows:

EUT	EUT2, setup 2
Site name	Nemko Oy / Perkkaa
FCC rule part	§ 15.247, a1
Section in RSS-210	6.2.2(o), a1
Date of testing	01.07.2004
Test equipment	42, 546, X2
Test conditions	24 °C, 52 % RH
Test result	**PASS**

4.1.1 EUT operation mode

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

4.1.2 Limits and test results

Limit (MHz)	*Result (MHz)*
≥ 0.025 or 20 dB BW	**1.005**

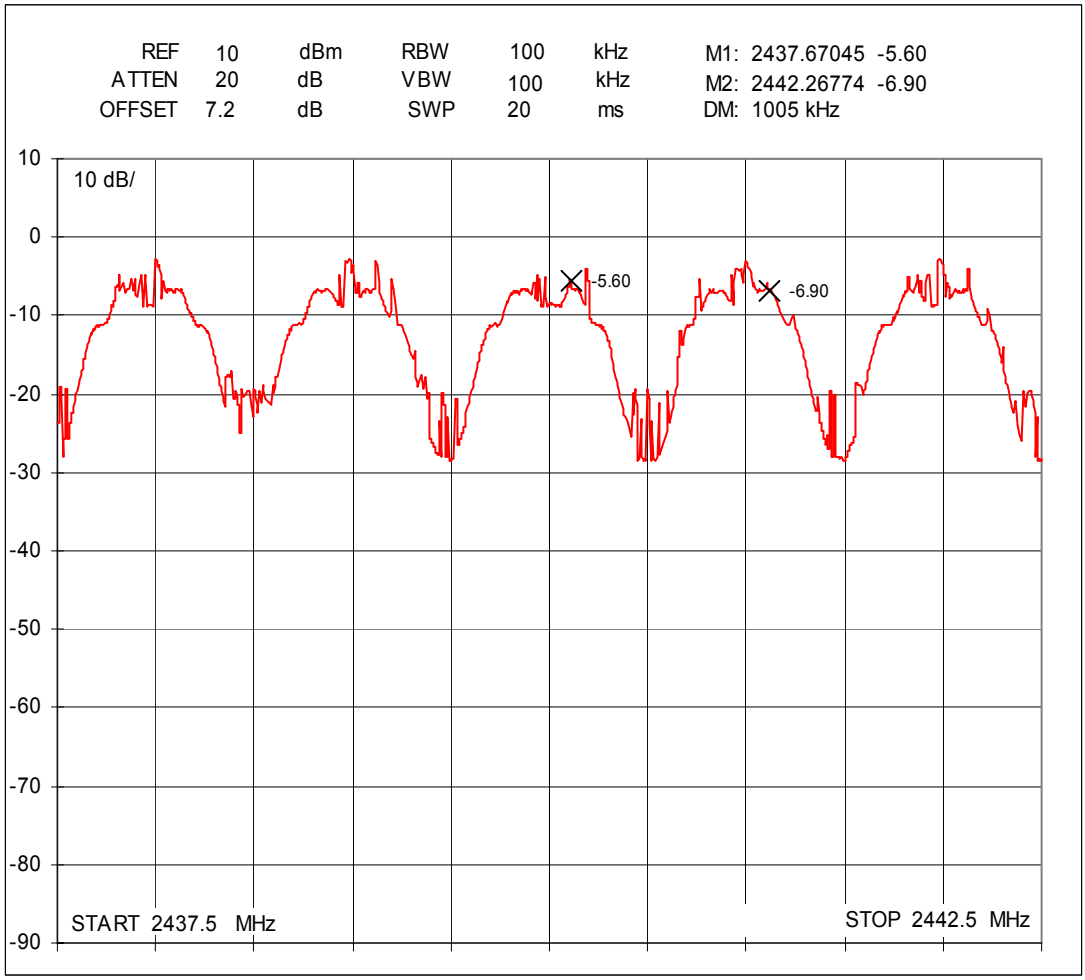


Figure 1. Carrier frequency separation

4.2 Number of hopping frequencies

The test was performed as a compliance test. The test parameters concerned were as follows:

EUT	EUT2, setup 2
Site name	Nemko Oy / Perkkaa
FCC rule part	§ 15.247, a2
Section in RSS-210	6.2.2(o), a3
Date of testing	01.07.2004
Test equipment	42, 546, X2
Test conditions	24 °C, 52 % RH
Test result	**PASS**

4.2.1 EUT operation mode

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

4.2.2 Limits and test results

Number	*Measured value*
≥ 75	**79**

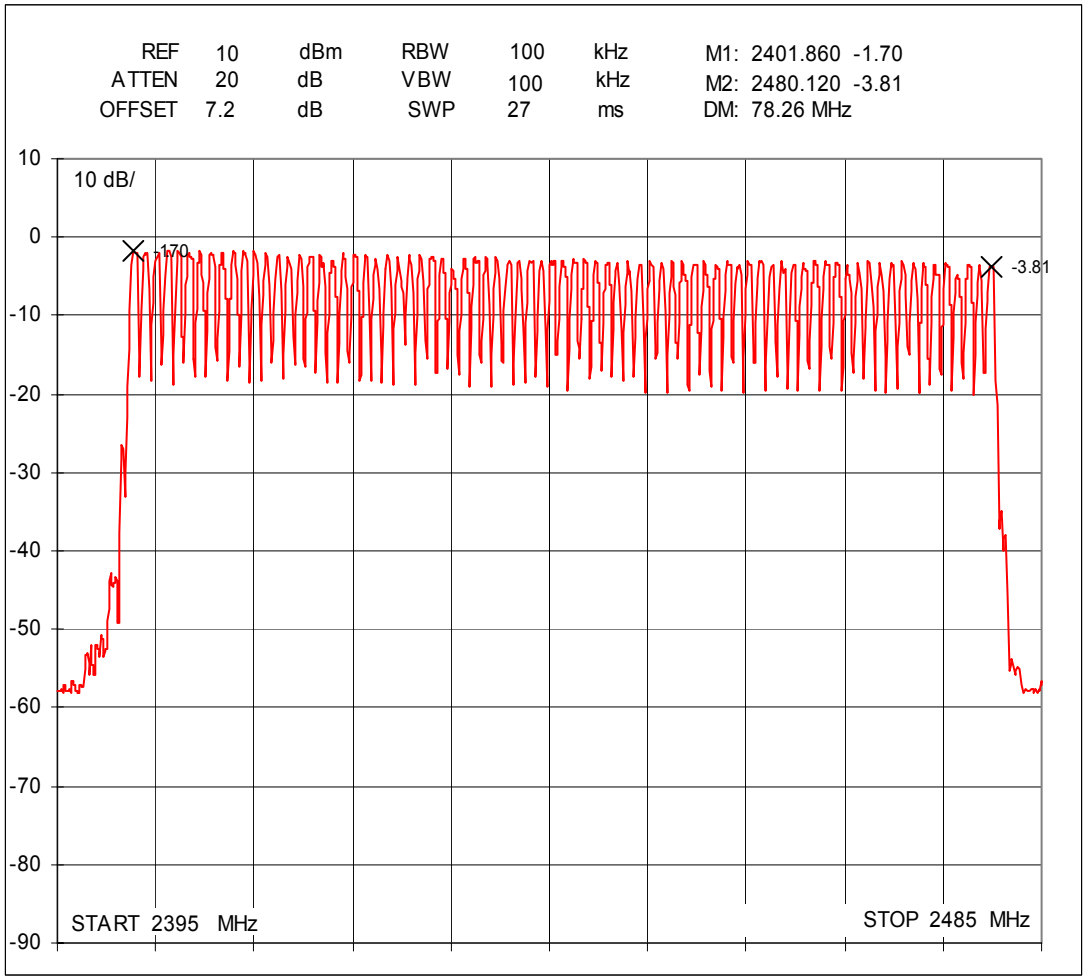


Figure 2. Number of hopping frequencies

4.3 Time of occupancy

The test was performed as a compliance test. The test parameters concerned were as follows:

EUT	EUT2, setup 2
Site name	Nemko Oy / Perkkaa
FCC rule part	§ 15.247, a3
Section in RSS-210	6.2.2(o), a3
Date of testing	01.07.2004
Test equipment	42, 45, 546, X2
Test conditions	24 °C, 52 % RH
Test result	**PASS**

4.3.1 EUT operation mode

EUT operation mode	**Page**
EUT channel	**Hopping**
EUT TX power level	**Nominal**

4.3.2 Limits and test results

Number	*Measured value (s)*
≤ 0.4	**0.036**

The complete paging cycle took 2.56s, during which the transmitter operated every 10.00 ms.
The duration of one transmission was 141.5 µs (2.56 s/0.01) * 0.1415 ms = 36.22 ms

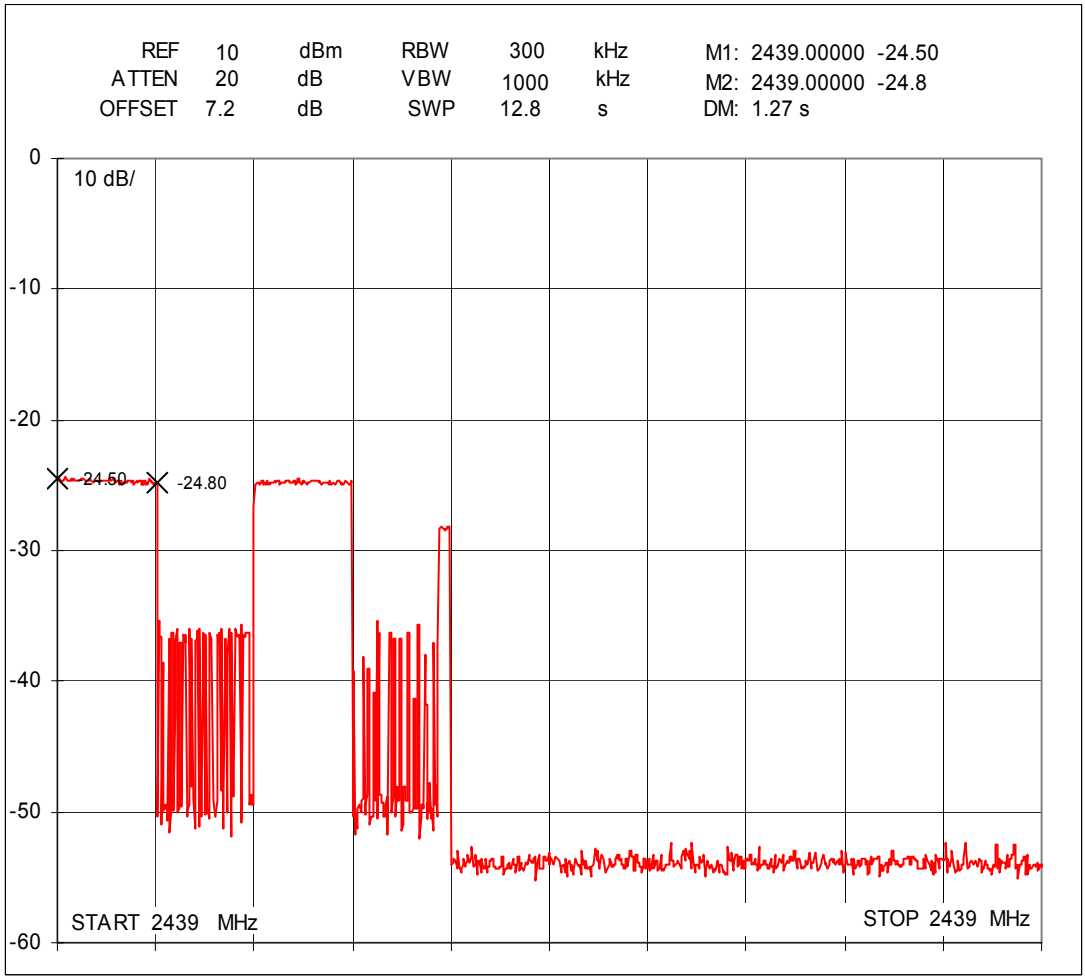


Figure 3. Complete paging cycle

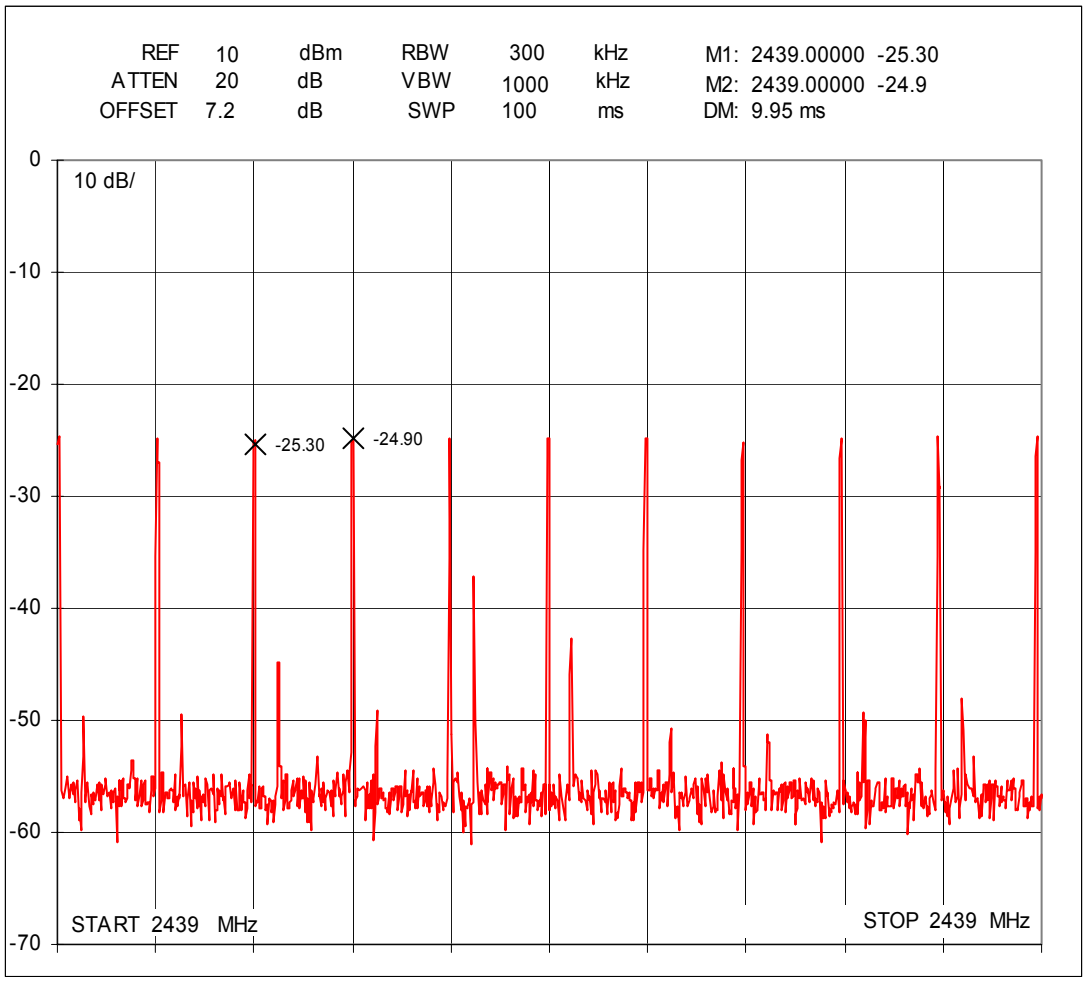


Figure 4. Paging repetition frequency

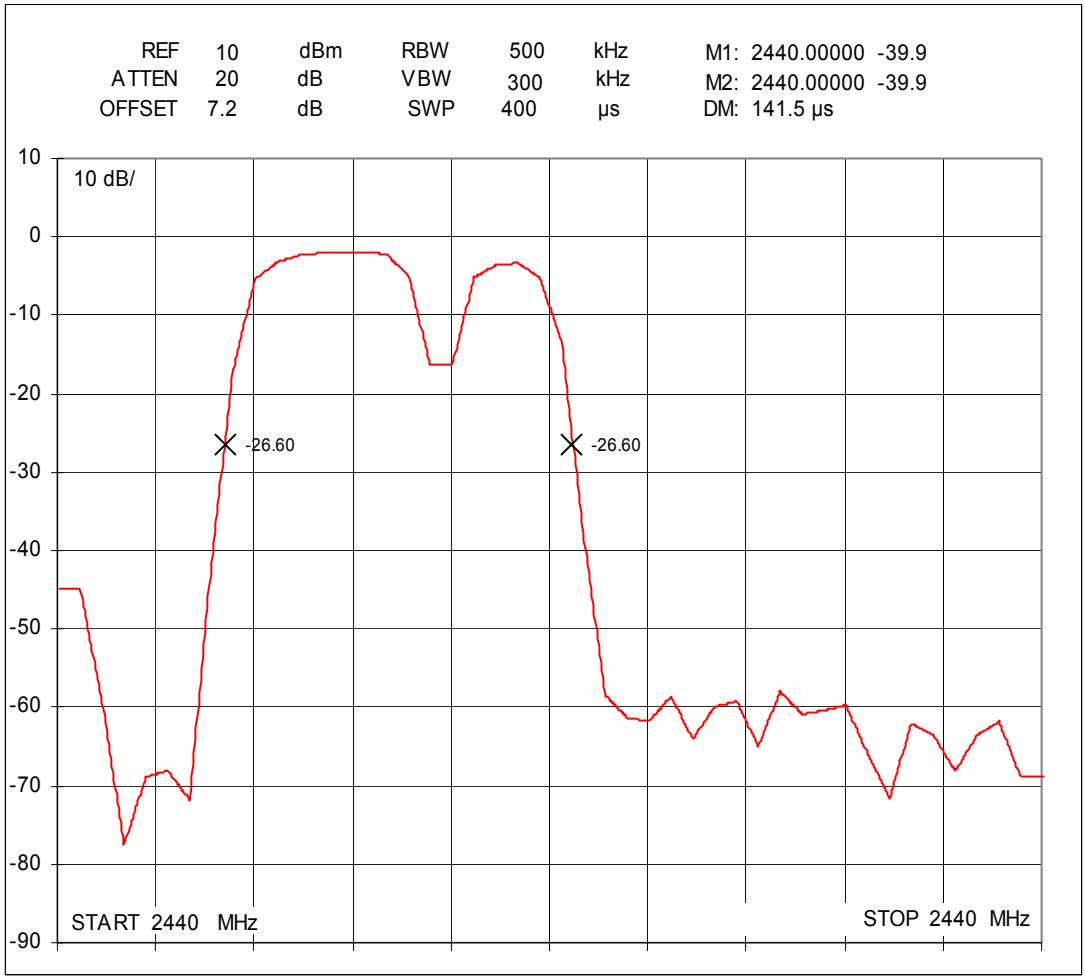


Figure 5. Duration of one transmission

4.3.3 EUT operation mode

EUT operation mode	**Inquiry**
EUT channel	**Hopping**
EUT TX power level	**Nominal**

4.3.4 Limits and test results

Number	*Measured value (s)*
≤ 0.4	**0.105**

The complete paging cycle took 7.42s, during which the transmitter operated every 10.00 ms.
The duration of one transmission was 141.5 µs (7.42 s/0.01) * 0.1415 ms = 105.0 ms

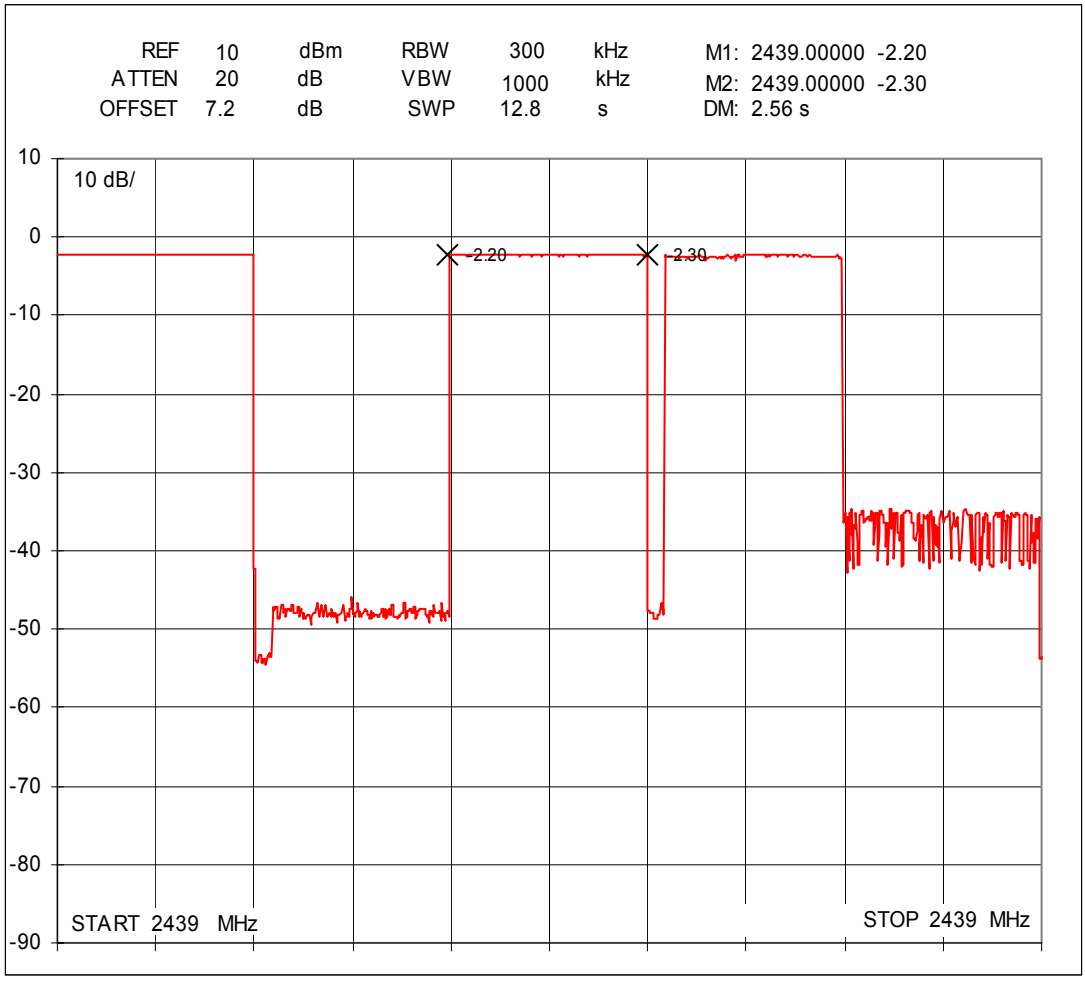


Figure 6. Complete inquiry cycle

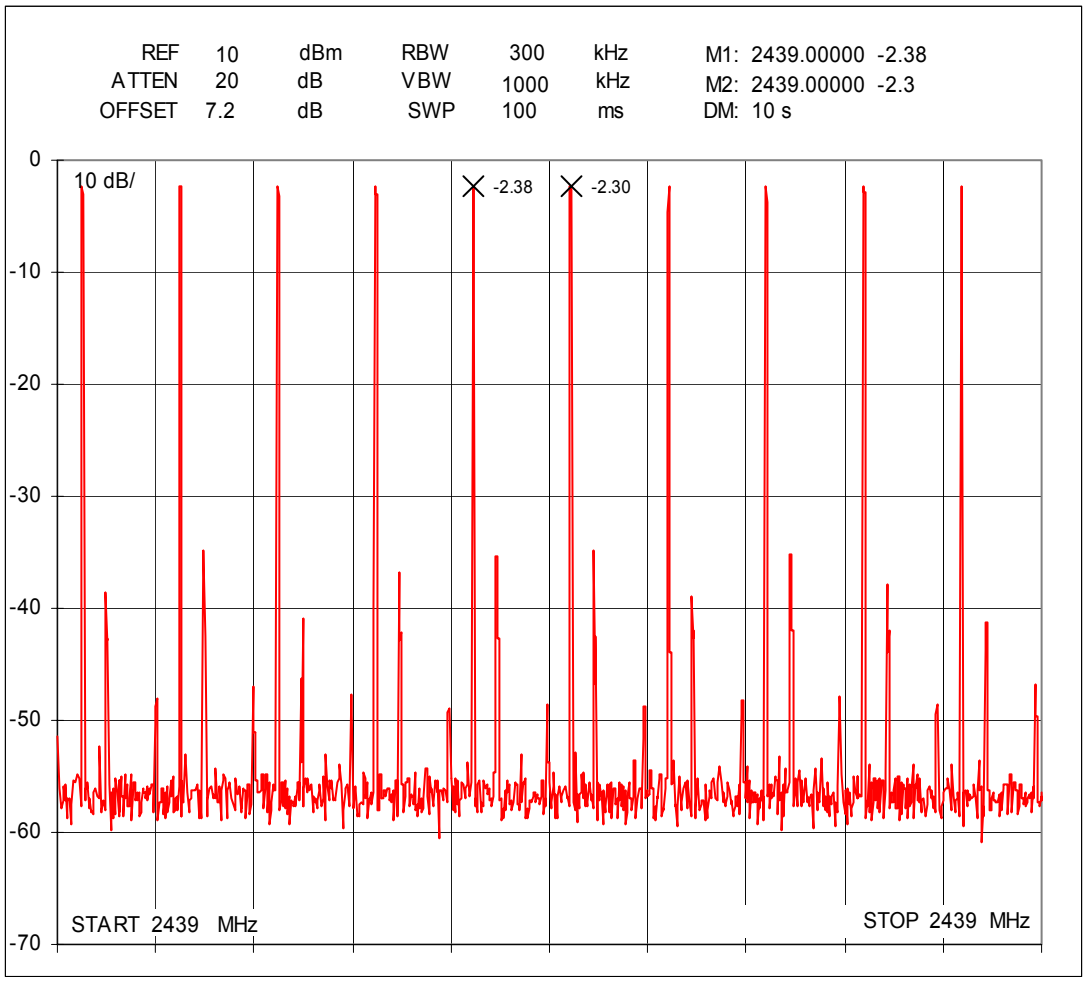


Figure 7. Inquiry repetition frequency

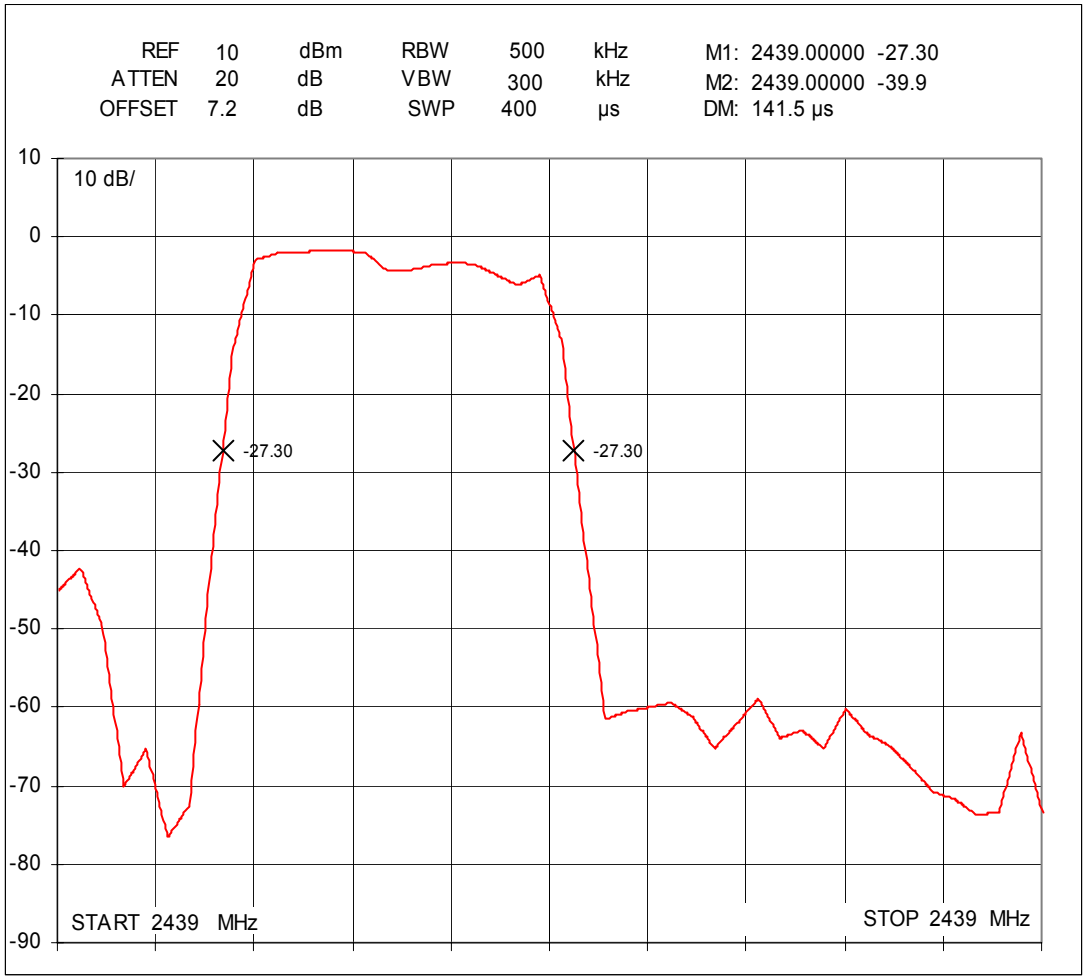


Figure 8. Duration of one transmission

4.3.5 EUT operation mode

EUT operation mode	**Connection**
EUT channel	**Hopping**
EUT TX power level	**Nominal**

4.3.6 Limits and test results

Number	*Measured value (s)*
≤ 0.4	**0.301**

In measurement time of 16 s total of 51 transmissions occurred.
The duration of one transmission was 2.95 ms. 2x51x 2.95 = 301 ms

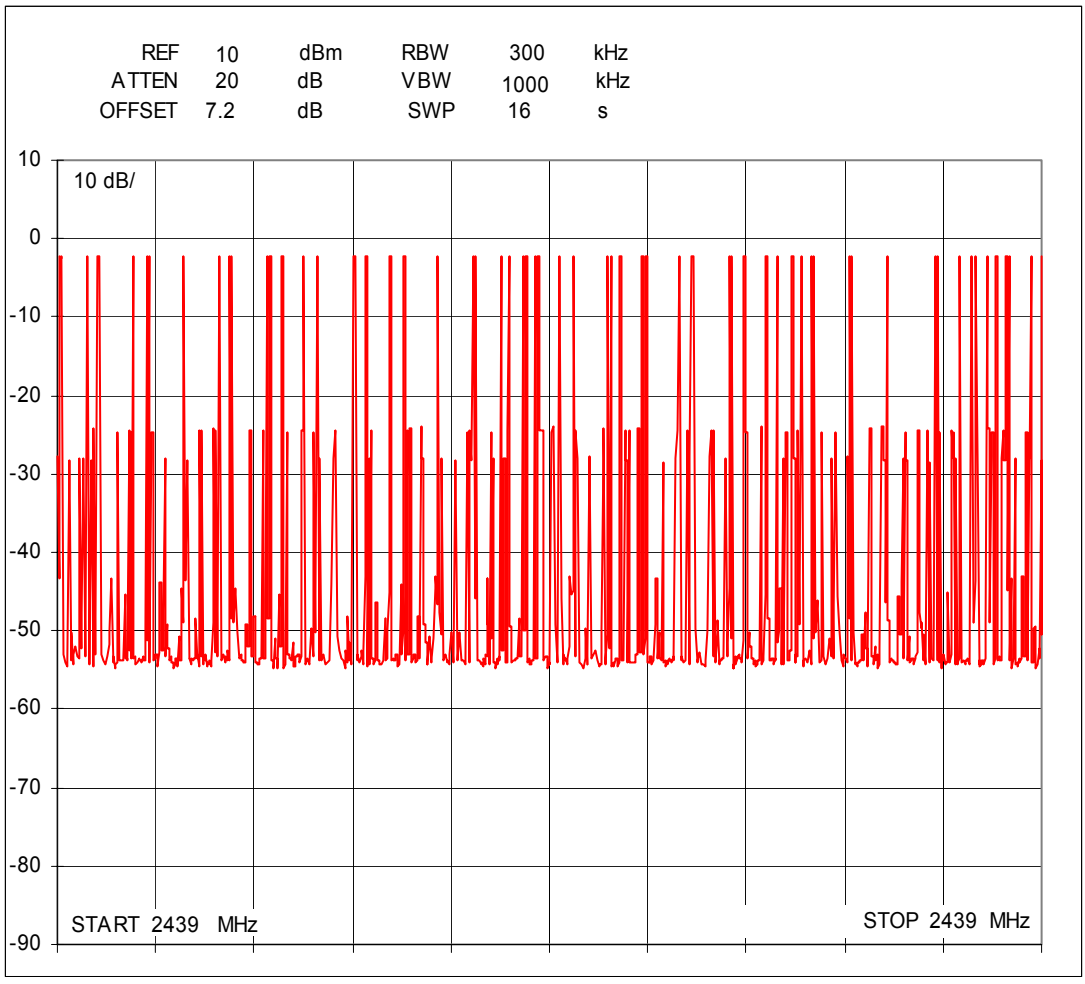


Figure 9. Number of transmissions

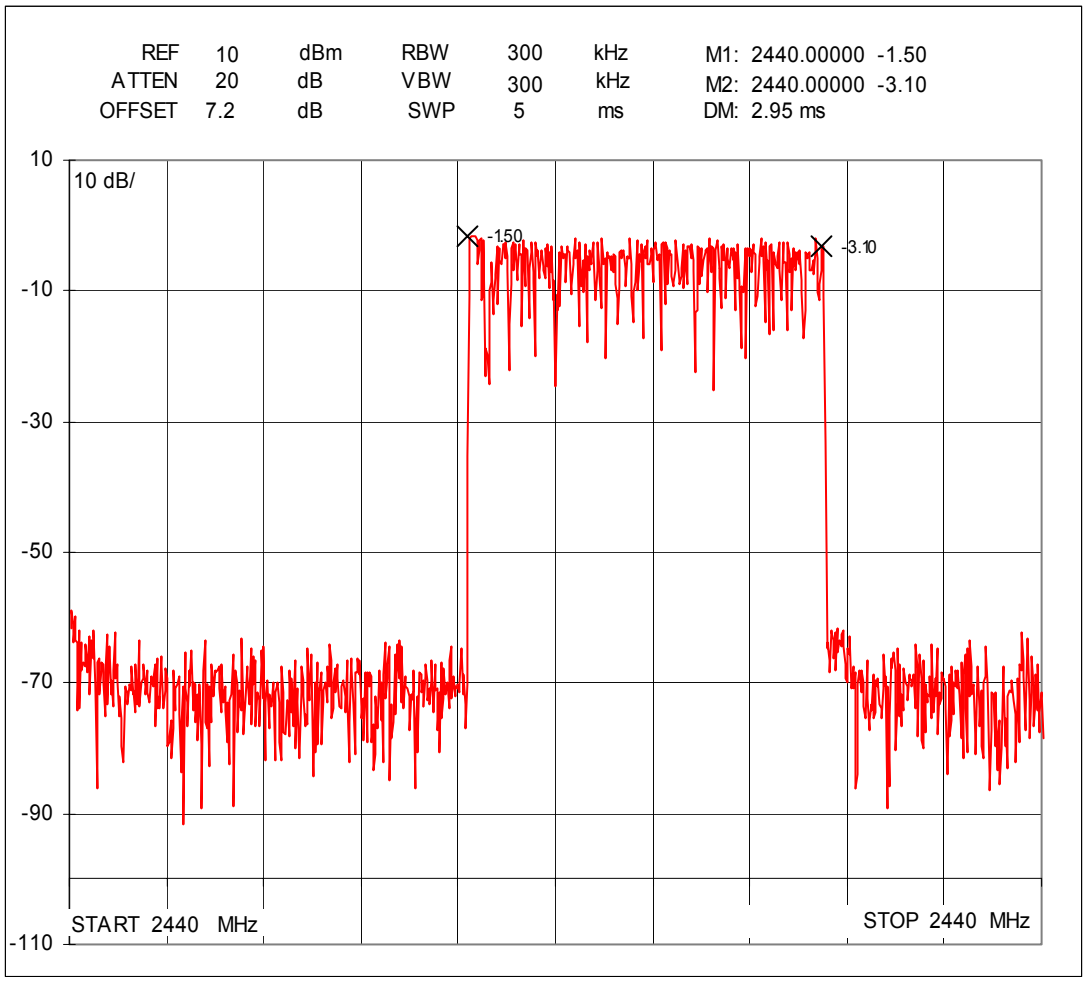


Figure 10. Duration of one transmission

4.4 20 dB bandwidth

The test was performed as a compliance test. The test parameters concerned were as follows:

EUT	EUT2, setup 2
Site name	Nemko Oy / Perkkaa
FCC rule part	§ 15.247, a1
Section in RSS-210	6.2.2(o), a1
Date of testing	01.07.2004
Test equipment	42, 546, X2
Test conditions	24 °C, 52 % RH
Test result	**PASS**

4.4.1 EUT operation mode

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

4.4.2 Limits and test results

EUT Channel	*Limit (MHz)*	*Measured value (MHz)*
0	**≤ 1.0**	**0.852**
38	**≤ 1.0**	**0.849**
78	**≤ 1.0**	**0.855**

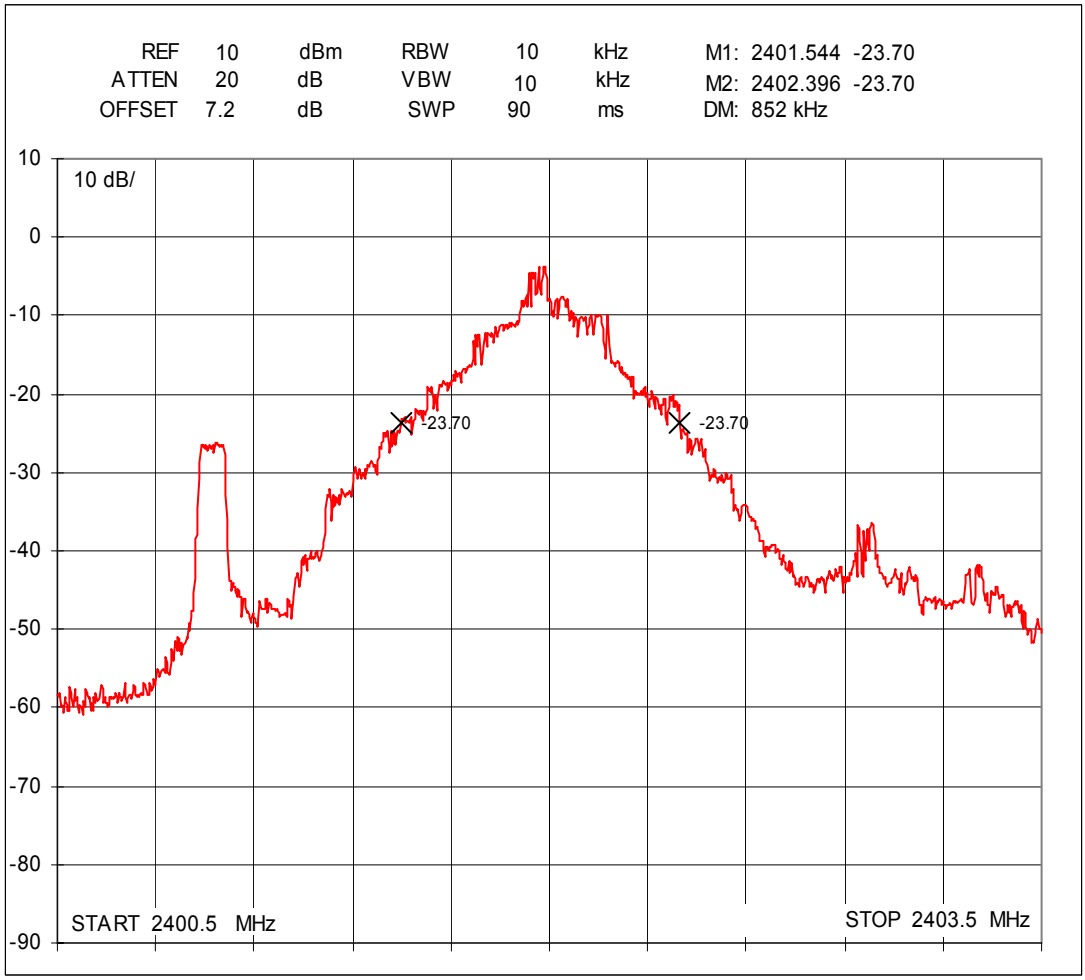


Figure 11. 20 dB bandwidth, channel 0

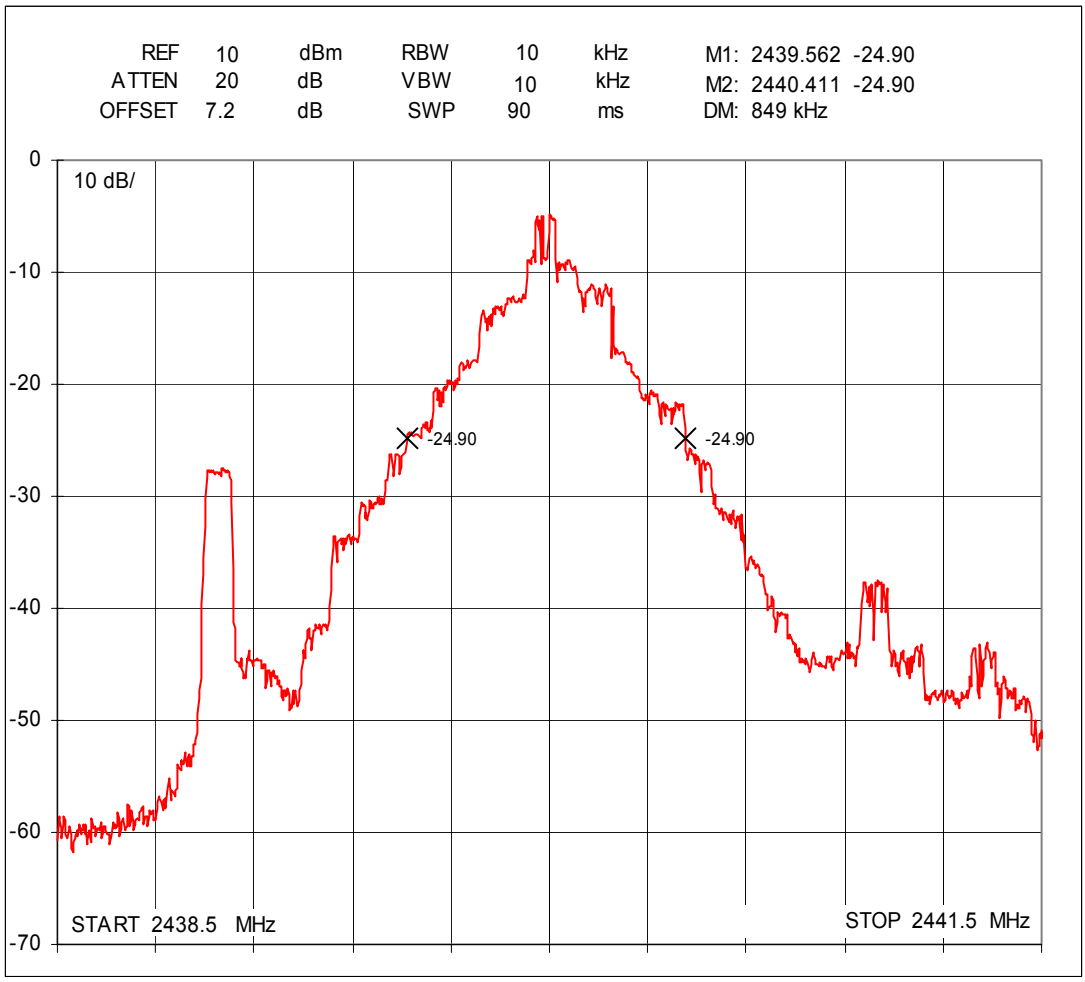


Figure 12. 20 dB bandwidth, channel 38

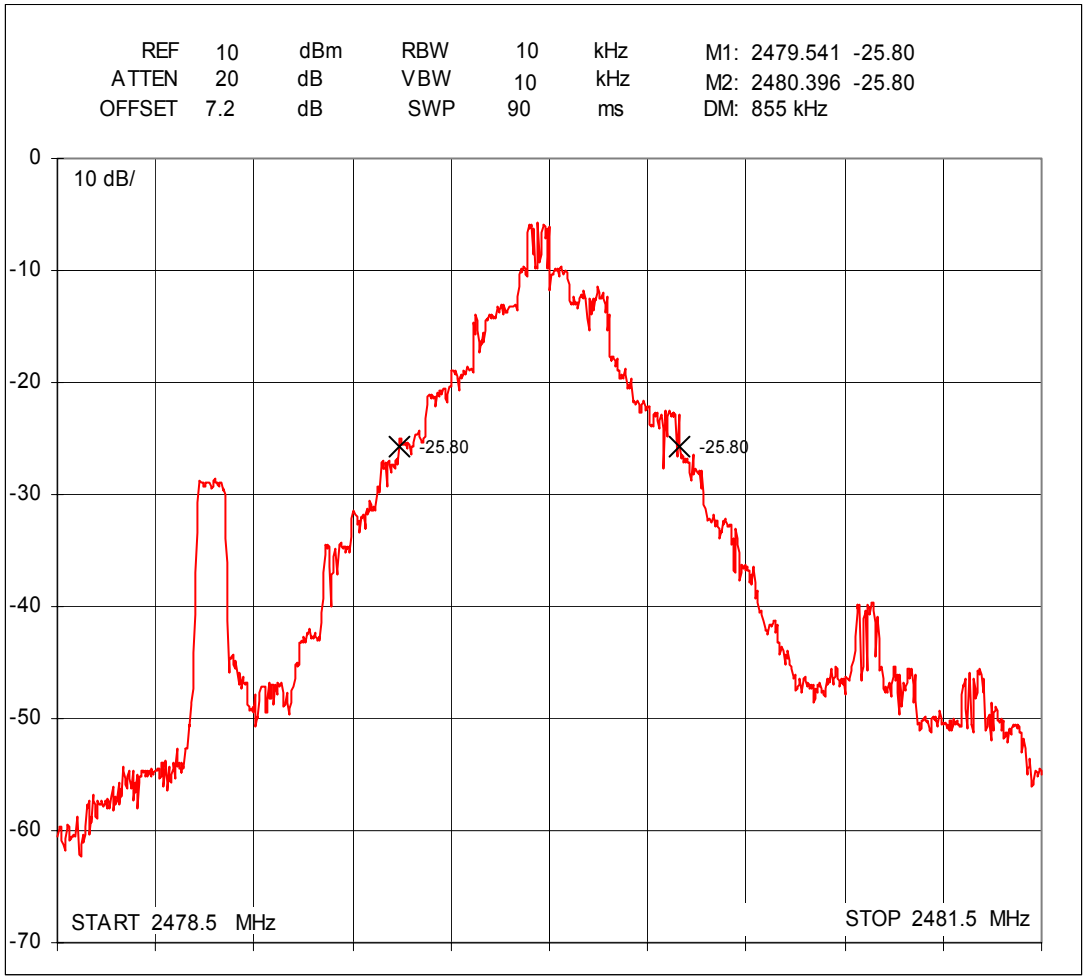


Figure 13. 20 dB bandwidth, channel 78

4.5 Peak output power

The test was performed as a compliance test. The test parameters concerned were as follows:

EUT	EUT2, setup 2
Site name	Nemko Oy / Perkkaa
FCC rule part	§ 15.247, b1
Section in RSS-210	6.2.2(o), a3
Date of testing	01.07.2004
Test equipment	42, 546, X2
Test conditions	24 °C, 52 % RH
Test result	**PASS**

4.5.1 EUT operation mode

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

4.5.2 Limits and test results

EUT Channel	*Limit (W)*	*Measured value (W)*
0	**≤ 1.0**	**0.00083**
38	**≤ 1.0**	**0.00062**
78	**≤ 1.0**	**0.00051**

The formula below was used to calculate the power of the EUT.

$P_{[dbm]} = P_{Measured[dBm]} + L_{Cable+Divider[dB]}$

Where

$P_{Measured[dBm]}$ measured power level from the EUT

$L_{Cable+divider[dB]}$ loss of the cables between EUT and spectrum analyzer

4.5.3 Test results

EUT Channel	***$P_{Measured}$ [dBm]***	***$L_{Cable +Divider}$ [dB]***	***P [dBm]***	***P [mW]***
0	-8.0	7.2	-0.8	0.83
38	-9.3	7.2	-2.1	0.62
78	-10.1	7.2	-2.9	0.51

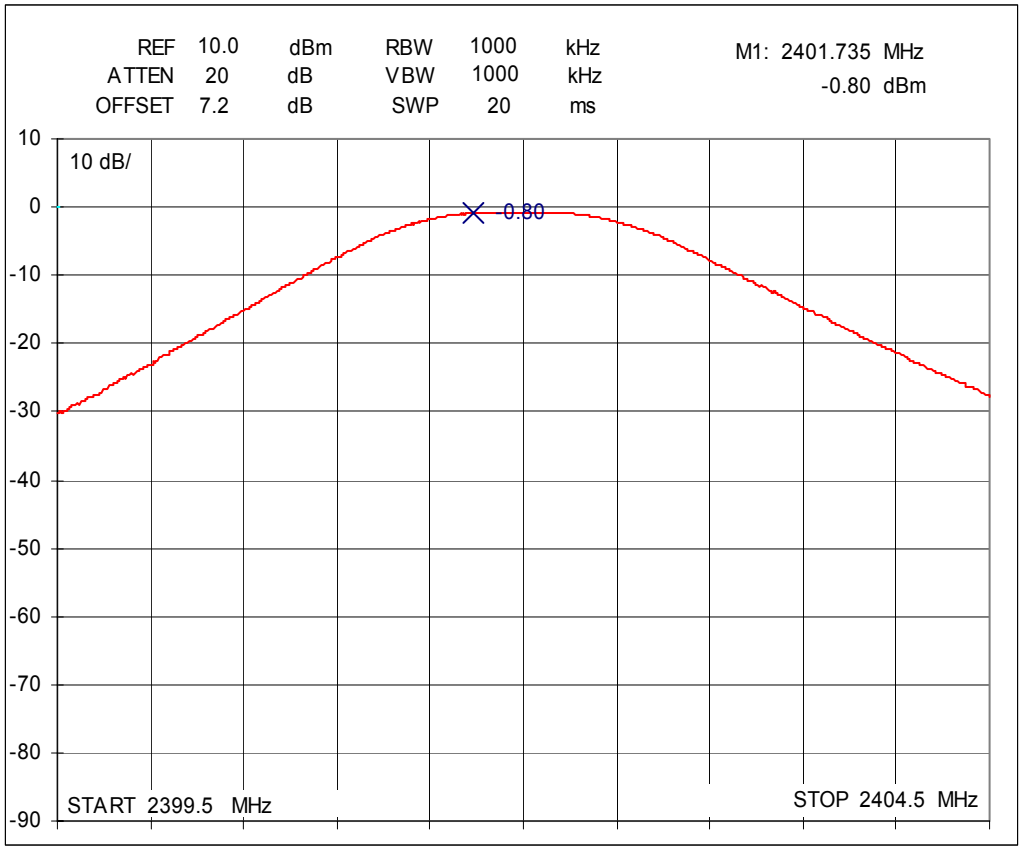


Figure 14. Peak output power on channel 0

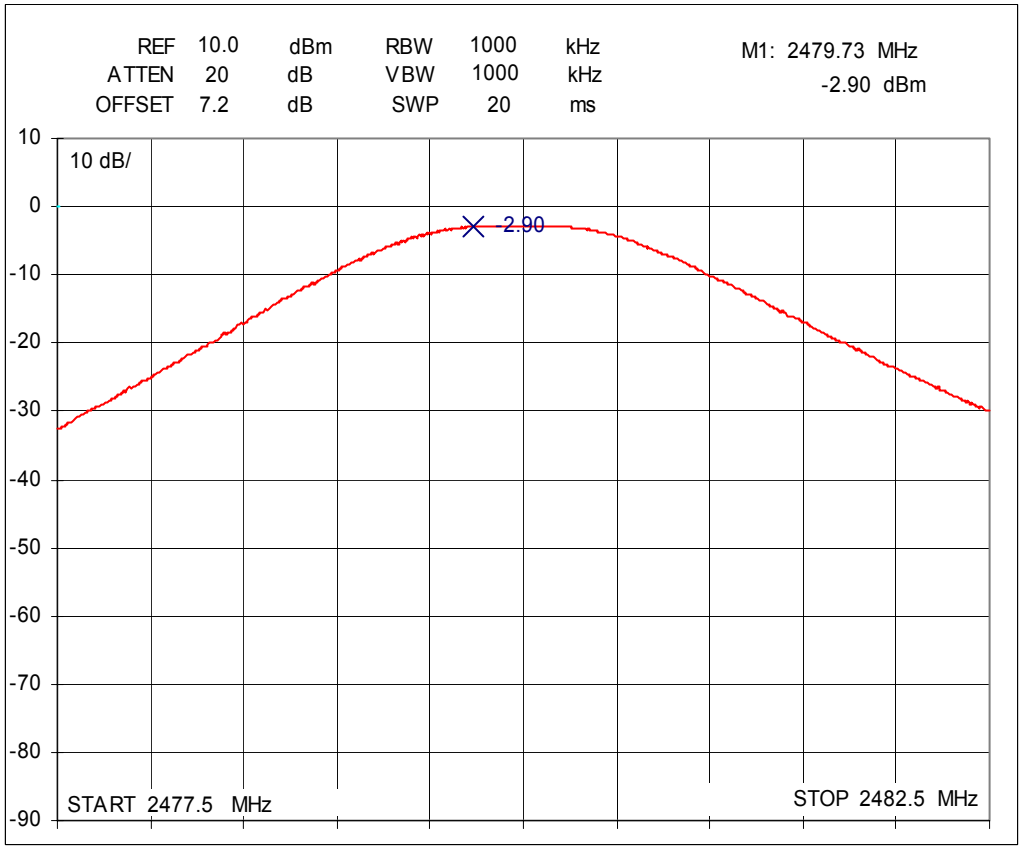


Figure 15. Peak output power on channel 78

4.6 Band-edge compliance of RF conducted emissions

The test was performed as a compliance test. The test parameters concerned were as follows:

EUT	EUT2, setup 2
Site name	Nemko Oy / Perkkaa
FCC rule part	§ 15.247, c1
Section in RSS-210	6.2.2(o), e1
Date of testing	01.07.2004
Test equipment	42, 546, X2
Test conditions	24 °C, 52 % RH
Test result	**PASS**

4.6.1 EUT operation mode

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

4.6.2 Limits and test results

EUT Channel	*Limit (dBc)*	*Result (dBc)*
0	**≤ -20**	**-41.3**
78	**≤ -20**	**-52.2**

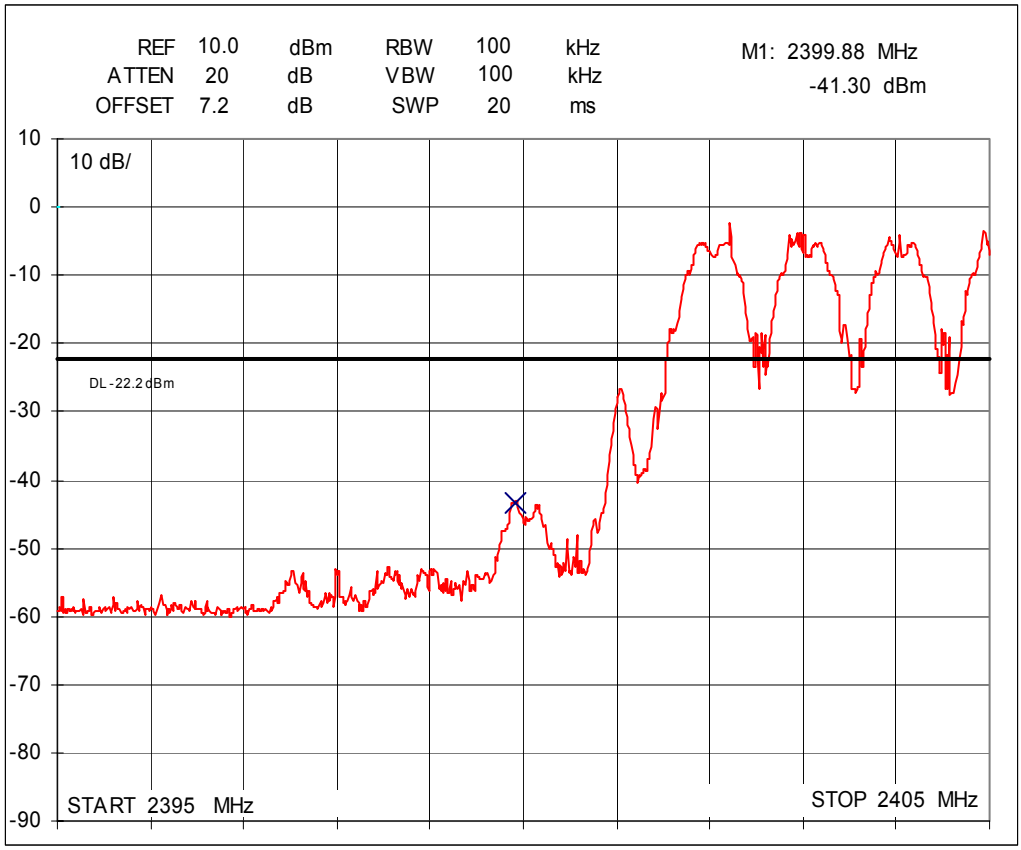


Figure 16. Band-edge compliance, low end

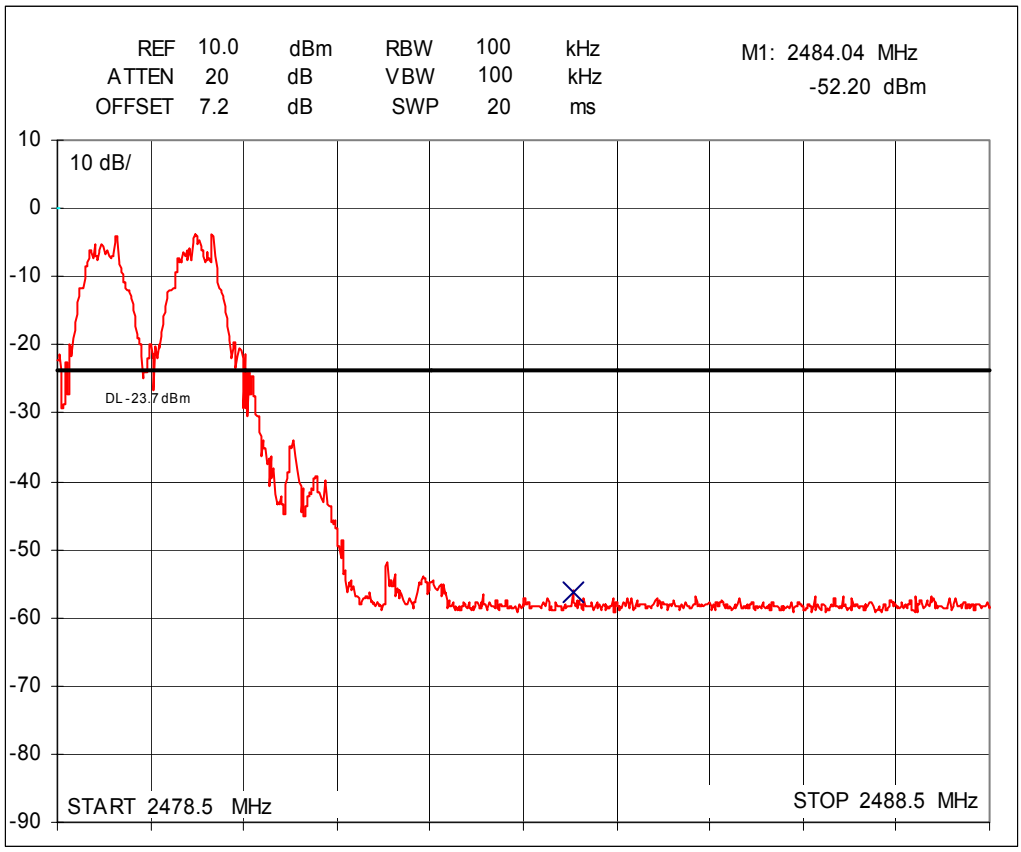


Figure 17. Band-edge compliance, high end

4.6.3 EUT operation mode

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

4.6.4 Limits and test results

EUT Channel	*Limit (dBc)*	*Result (dBc)*
0	**≤ -20**	**-43.3**
78	**≤ -20**	**-55.4**

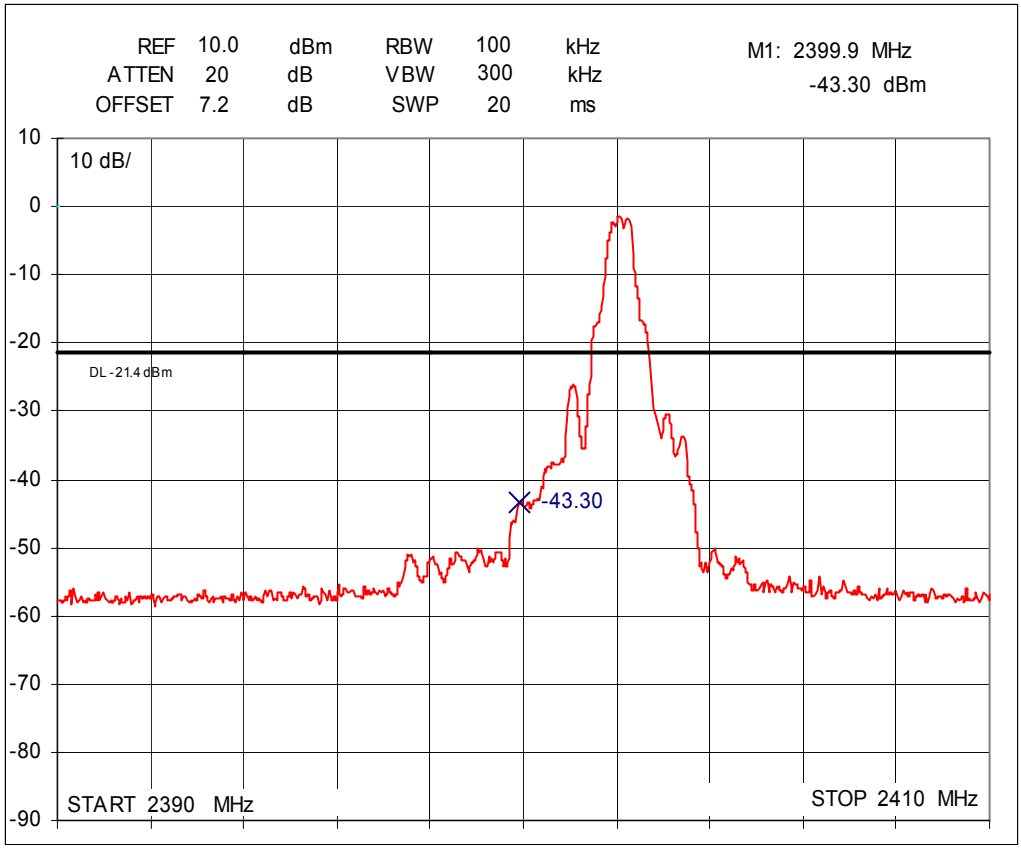


Figure 18. Band-edge compliance, low end

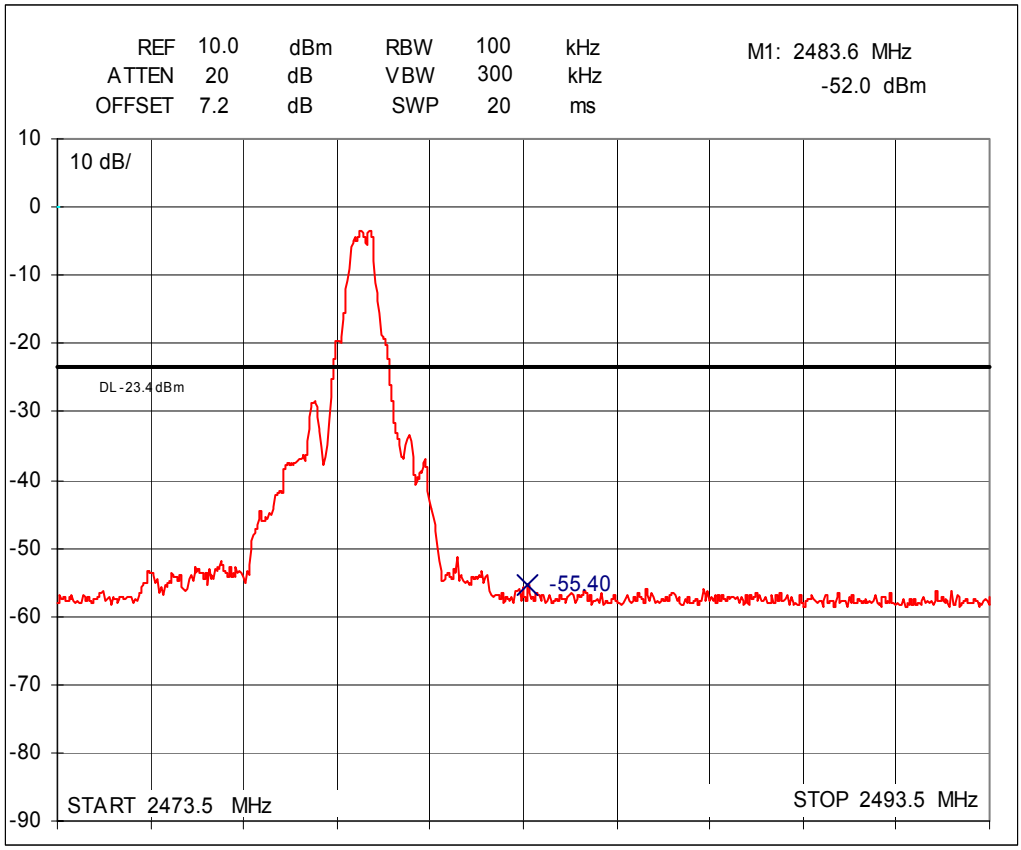


Figure 19. Band-edge compliance, high end

4.7 Spurious RF conducted emission

The test was performed as a compliance test. The test parameters concerned were as follows:

EUT	EUT2, setup 2
Site name	Nemko Oy / Perkkaa
FCC rule part	§ 15.247, c2
Section in RSS-210	6.2.2(o), e1
Date of testing	01.07.2004
Test equipment	42, 546, 559, X2
Test conditions	24 °C, 52 % RH
Test result	**PASS**

4.7.1 EUT operation mode

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

4.7.2 Limits and test results

EUT Channel	*Limit (dBc)*	*Result (dBc)*
0	**≤ -20**	**<-40**
38	**≤ -20**	**<-40**
78	**≤ -20**	**<-40**

4.8 Spurious radiated emission

The test was performed as a compliance test. The test parameters concerned were as follows:

EUT	EUT1, setup 1
Site name	Nemko Oy / Perkkaa
FCC rule part	§ 15.247, c1
Section in RSS-210	6.2.2(o), e1
Date of testing	19.06.2004
Test equipment	42, 543, 559, 525, 546, 350
Test conditions	23 °C, 40 % RH
Test result	**PASS**

4.8.1 EUT operation mode

EUT operation mode	**Connection, static PRBS, DH5 packet type**
EUT channel	**0, 38 and 78**
EUT TX power level	**Nominal**
EUT operation voltage	**115 V / 60 Hz**

4.8.2 Test method and limit

The test was performed in a semi-anechoic shielded room. The EUT was placed on a non-conductive 0.8 m high table standing on the turntable (photograph 1). During the test in the frequency range 30-2000 MHz the distance from the EUT to the measuring antenna was 3 m. During the test in the frequency range 2000-25000 MHz the distance from the EUT to the measuring antenna was 1.5 m. The excess length of the cables of the EUT were made into bundles 30-40 cm in length. In order to find the maximum levels of the disturbance radiation the angle of the turntable, the height of the measuring antenna and the lay-out of the EUT cables were varied during the tests. The test was performed with the measuring antenna being both in horizontal and vertical polarizations.

Vertical and horizontal polarizations in the frequency range 30 – 1000 MHz was measured by using the peak detector. During the peak detector scan. the turntable was rotated from 0° to 360° with 30° step with the antenna heights 1.0 m and 3.0 m. The highest levels of the radiated interference field strength measured by using the quasi-peak detector were recorded.

Vertical and horizontal polarizations in the frequency range 1000 – 25000 MHz was measured by using the peak detector. During the measurement the turntable was rotated from 0° to 360° and the antenna was raised from 1.0 m and 4.0 m.

The CFR 47 Part 15. Subpart B. Class B limit of 500 µV/m has been calculated to correspond 54 dB(µV/m) as follows: [dB(µV/m)]=20log[µV/m].

EN 55022 Class B limit (3m measuring distance)

Frequency band MHz	*Quasi-peak dB(µV/m)*
30 - 230	**40**
230 - 1000	**47**

Class B limit (3m measuring distance)

Frequency band MHz	*Average limit dB(µV/m)*	*Peak limit dB(µV/m)*
1000 - 25000	**54**	**74**

4.8.3 Test results

The measurement results were obtained as described below.

$$E\,[\mu V/m] = U_{RX} + A_{CABLE} + AF - G_{PREAMP}$$

Where

U_{RX} receiver reading

A_{CABLE} attenuation of the cable

AF antenna factor

G_{PREAMP} gain of the preamplifier

TX on channel 0

Frequency MHz	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4804.0	**38**	**54**	**16.0**
7206.0	**44**	**54**	**10.0**
9608.0	**42**	**54**	**12.0**

TX on channel 38

Frequency MHz	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4880.0	**38**	**54**	**16.0**
7320.0	**44**	**54**	**10.0**
9760.0	**42**	**54**	**12.0**

TX on channel 78

Frequency MHz	*Result dB(µV/m)*	*Limit dB(µV/m)*	*Margin dB*
4960.0	**38**	**54**	**16.0**
7440.0	**45**	**54**	**9.0**
9920.0	**42**	**54**	**12.0**

4.9 AC power line conducted emissions

The test was performed as a compliance test. The test parameters concerned were as follows:

EUT	EUT1, setup1, AC-charger
Site name	Nemko / Perkkaa
FCC rule part	§ 15.207
Section in RSS-210	6.6
Date of testing	02.07.2004
Test equipment	5, 167, 348, 184, 545, 371
Test conditions	24 °C, 52 % RH
Test result	**PASS**

4.9.1 Test method and limit

The test was performed inside a shielded room where the floor and one of the walls of the test site comprised the reference ground plane (RGP). For the duration of the test the EUT was placed on a non-conductive table 0.8 m high standing on the reference ground plane (see photograph 2). The excess length of the cables of the EUT were made into bundles 30-40 cm in length. The power input cable of the EUT was connected to an artificial mains network. The test was performed separately on the phase and also on the neutral wire.

The disturbances were first examined by performing a spectrum scan by using a peak detector. The general procedure in the conducted disturbance emission test is that no further measurements are necessary if the disturbance levels measured by using the peak detector are below the limit value defined for the measurement performed by using an average detector.

If not, then at the test frequencies concerned the measurement is performed also by using a quasi-peak detector. If the disturbance levels measured by using the quasi-peak detector are below the limit value defined for the measurement performed by using an average detector, then measurements by using the average detector are not necessary.

Frequency band MHz	*Quasi-peak dB(µV)*	*Average limit dB(µV)*
0.15 – 0.5	**66 – 56**	**56 – 46**
0.5 – 5	**56**	**46**
5 - 30	**60**	**50**

4.9.2 EUT operation mode

EUT operation mode	**Connection, static PRBS, DH5 packet type**
EUT channel	**Hopping**
EUT TX power level	**Nominal**
EUT operation voltage	**115 V / 60 Hz**

4.9.3 Test results

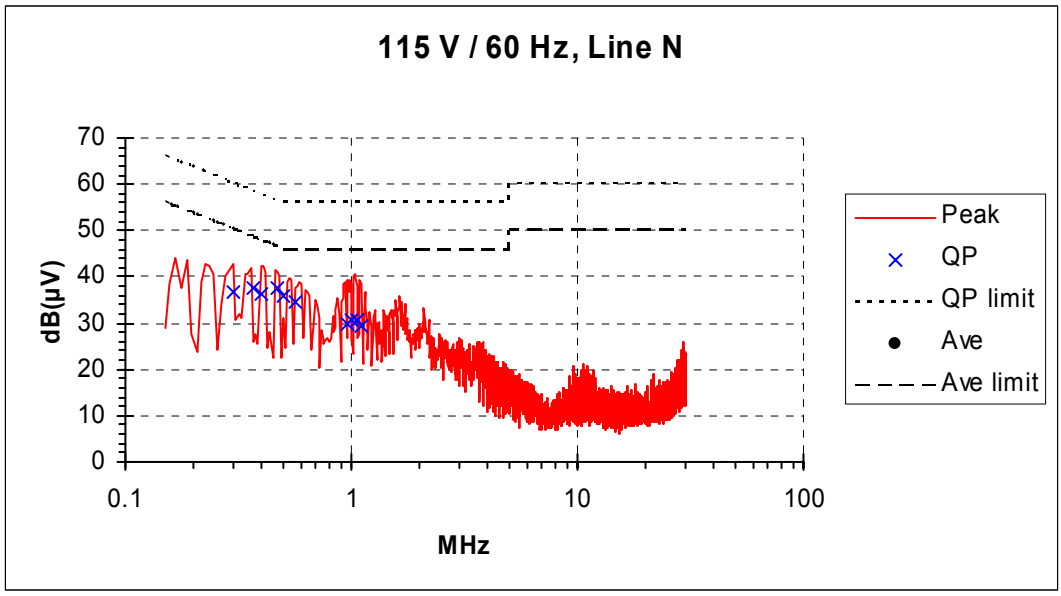


Figure 20. AC powerline emissions, Line N

Highest emissions:

Frequency MHz	*Result Quasi-peak dB(µV)*	*Limit value Quasi-peak dB(µV)*	*Margin Quasi-peak dB*	*Result Average dB(µV)*	*Limit value Average dB(µV)*	*Margin Average dB*
0.298	36.8	60.3	23.5	-	46 / 56	-
0.368	37.8	58.6	20.8			-
0.398	36.3	57.9	21.6			-
0.468	37.4	56.6	19.2			-
0.498	36.0	56.0	20.0			-
0.568	34.4	56.0	21.6			-
0.963	30.0	56.0	26.0			-
1.000	30.7	56.0	25.3			-
1.054	30.7	56.0	25.3			-
1.101	29.4	56.0	26.6			-

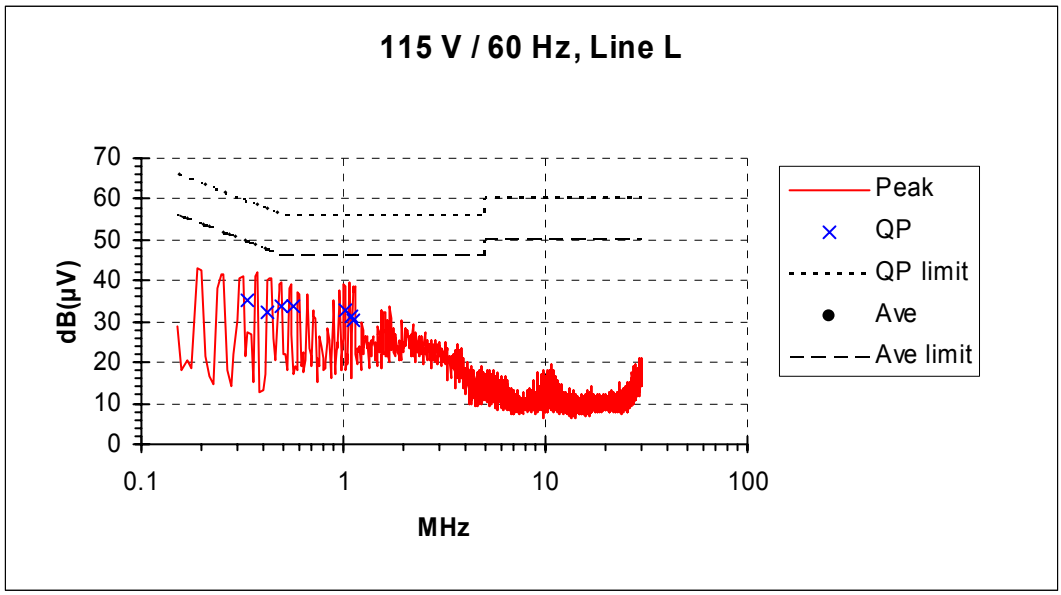


Figure 21. AC powerline emissions, Line L

Highest emissions:

Frequency MHz	*Result Quasi-peak dB(µV)*	*Limit value Quasi-peak dB(µV)*	*Margin Quasi-peak dB*	*Result Average dB(µV)*	*Limit value Average dB(µV)*	*Margin Average dB*
0.333	35.3	59.4	24.1	-	46 / 56	-
0.418	32.4	57.5	25.1			-
0.498	33.8	56.0	22.2			-
0.568	33.6	56.0	22.4			-
1.033	32.8	56.0	23.2			-
1.090	31.4	56.0	24.6			-
1.119	30.3	56.0	25.7			-

5. List of test equipment

Each active test equipment is calibrated once a year, antennas every 18 months and other passive equipment every 24 months.

Nr.	Equipment	Type	Manufacturer	Serial number
5	Test receiver	ESH-3	Rohde & Schwarz	894718/015
42	Spectrum analyzer	8566B	Hewlett Packard	2637A04102
45	Spectrum analyzer	FSBS	Rohde & Schwarz	862563/010
167	Artificial Mains	NSLK 8126	Schwartzbeck	8126101
184	Temp. & humidity meter	H MI 32	Vaisala	63837
319	Antenna	CBL6112	Chase	2018
348	Shielded room	RFSD-100	Euroshield Oy	1320
350	Semianechoic shielded room	RFD-F-100	Euroshield Oy	1327
351	RF generator	SMT 06	Rohde & Schwarz	845715/001
371	AC Power source	500i-400	California Instr.	HK 52064
519	RF High-Power Attenuator	765-20	Narda	
525	Double-Ridged Horn	3115	Emco	6691
542	Double-Ridged Horn	3115	Emco	00023905
543	RF-amplifier	JCA018-501	JCA Technologies	103
544	RF-amplifier	ZFL-2000VH2	Mini-Circuits	D01080
545	GSM MS Test System	CMU	Rohde & Schwarz	836536/049
546	Bluetooth Test Set	MT8850A	Anritsu	6K00000092
559	Highpass Filter	WHKX3.0/18G-10SS	Wainwright Instruments	1
550	Notch Filter	WRCD1800/2000-0.2/40-5SSSD	Wainwright Instruments	1
X1	RF-Generator	8341B	Hewlett Packard	2802A01090
X2	Power splitter	1870A	Weinschel	1798
X3	Antenna	3125-1880	ETS	00028029

6. Photographs

See "1032275_test_setup_photographs"