

FCC Part 15C Compliance Test Report

Test Report no.:	Tre_FCC_0538_01.doc	Date of Report:	3.10.2005
Number of pages:	24	Customer's Contact person:	Marcus Göke
Testing laboratory:	TCC Nokia Tampere Laboratory P.O. Box 68 Sinitaival 5 FIN-33720 TAMPERE, FINLAND Tel. +358 (0) 7180 46800 Fax. +358 (0) 7180 46880	Client:	Nokia Corporation Rensingstrasse 15 44807 BOCHUM GERMANY Tel. +49 234 984 0
FCC listing no.:	94436		
IC recognition no.:	3608		
Tested devices/ accessories:	RM-67 / BL-5C, AC-3E, HS-23, CA-53, Laptop IBM Thinkpad T22, AC adapter 02K6543, Printer HP deskjet 1600CC3540A, Digital camera FUJI DS-7, Serial cable for camera, Parallel cable for printer		
FCC ID:	OW3RM-67	IC:	661AA-RM67
Supplement reports:	-		
Testing has been carried out in accordance with:	CFR 47, FCC rules Part 15 Subpart C, ANSI C63.4 (2003) and IC standard RSS-210. Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".		
Documentation:	The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 15 years at TCC Nokia.		
Test Results:	The EUT complies with the requirements in respect of all parameters subject to the test. The test results relate only to devices specified in this document.		
Date and signature for the contents:			

Jari Jantunen, System Manager

1. Summary for FCC Part 15C Compliance Test Report

Date of receipt	19.9.2005
Testing completed	27.9.2005
The customer's contact person	Marcus Göke
Test Plan referred to	\ Projects\RM-67\TestPlan_RS\ RM-67_EMC_Testplan.xls
Notes	-
Document name	T:\Projects\RM-67\results\emc\FCC\Tre_FCC_0538_01.doc

1.1. EUT and Accessory Information

The EUT is a Bluetooth device. Bluetooth is tested with maximum rated TX power.

Product	Type	SN	HW	MV	SW	DUT
GSM phone	RM-67	004400741980852	6000	-	V1.0536.1.02	40368
GSM phone	RM-67	004400741680324	6000	-	V1.0536.1.02	40346
GSM phone	RM-67	004400741681405	6000	-	V1.0536.1.02	40347
Battery	BL-5C	M20522CP53559	-	-	-	40369
Battery	BL-5C	M20522CP53634	-	-	-	40348
Battery	BL-5C	M20522CP53641	-	-	-	40349
AC-Charger	AC-3E	-	-	-	-	40350
Headset	HS-23	FM2550741Q	-	-	-	40351
Data cable	CA-53	108382534101	-	-	-	40352
Laptop	IBM Thinkpad T22	555V2PT	-	-	-	40201
AC Adapter	02K6543	-	-	-	-	40202
Printer	HP deskjet 1600CC3540A	USB8302546	-	-	-	40077
Digital camera	FUJI DS-7	7102516	-	-	-	40076
Serial cable for camera	-	-	-	-	-	40088
Parallel cable for printer	-	-	-	-	-	40087

1.2. Summary of Test Results

Bluetooth:

Section in CFR 47	Section in RSS-210	Name of the test	Result
15.247(b)(1)	6.2.2(o)(a3)	Peak output power	Passed
15.247(c)	6.2.2 (o)(e1)	Band edge compliance of RF emissions	Passed
15.247(c)	6.2.2 (o)(e1)	Spurious RF conducted emissions	Passed
15.247(c), 15.209	6.2.2 (o)(e1)	Spurious radiated emissions	Passed
15.207	6.6	AC powerline conducted emissions	Passed
15.247(a)(1)	6.2.2(o)(a3)	20 dB bandwidth	Passed
15.247(a)(1)	6.2.2(o)(a1)	Carrier frequency separation	Passed
15.247(a)(1)(iii)	Amend I(ii)	Number of hopping frequencies	Passed
15.247(a)(1)(iii)	Amend I(ii)	Time of occupancy	Passed

PASSED

FAILED

NP

The EUT complies with the essential requirements in the standard.

The EUT does not comply with the essential requirements in the standard.

The test was not performed by the TCC Nokia Tampere Laboratory.

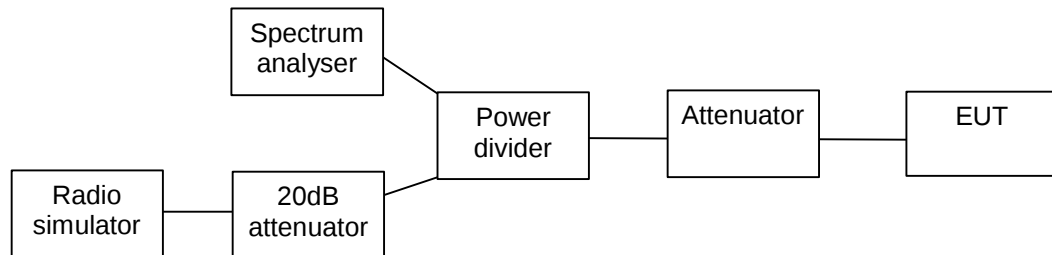
CONTENTS

1. Summary for FCC Part 15C Compliance Test Report.....	2
1.1. EUT and Accessory Information	2
1.2. Summary of Test Results	2
2. Test setups.....	5
2.1. Conducted RF test setup	5
2.2. AC powerline conducted emissions test setup.....	5
2.3. Spurious radiated emissions test setup	5
3. Peak output power (FCC §15.247(b)(1), RSS-210 6.2.2(o)(a3))	6
3.1. Test method and limit.....	6
3.2. Bluetooth Test results	6
4. Band edge compliance of RF emissions (FCC §15.247(c), RSS-210 6.2.2(o)(e1))	8
4.1. Test method and limit.....	8
4.2. Bluetooth Test results	8
5. Spurious RF conducted emissions (FCC §15.247(c), RSS-210 6.2.2(o)(e1))	11
5.1. Test method and limit.....	11
5.2. Bluetooth Test results	11
6. Spurious radiated emissions (FCC §15.247(c), §15.209, RSS-210 6.2.2(o)(e1))	13
6.1. Test method and limit.....	13
6.2. Bluetooth Test results	14
7. AC powerline conducted emissions (FCC §15.207, RSS-210 6.6).....	16
7.1. Test method and limit.....	16
7.2. Bluetooth Test results	17
8. 20 dB bandwidth (FCC §15.247(a)(1), RSS-210 6.2.2(o)(a3))	18
8.1. Test method and limit.....	18
8.2. Bluetooth Test results	18
9. Carrier frequency separation (FCC §15.247(a)(1), RSS-210 6.2.2(o)(a1))	20
9.1. Test method and limit.....	20
9.2. Bluetooth Test results	20
10. Number of hopping frequencies (FCC §15.247(a)(1)(iii), RSS-210 Amend I(ii))	21
10.1. Test method and limit.....	21
10.2. Bluetooth Test results	21
11. Time of occupancy (FCC §15.247(a)(1)(iii), RSS-210 Amend I(ii))	22

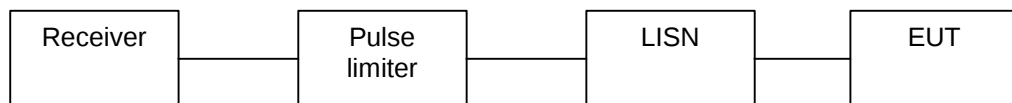
11.1.	Test method and limit	22
11.2.	Bluetooth test results	22
12.	Test Equipment	24
12.1.	Conducted measurements	24
12.2.	Radiated measurements	24

2. Test setups

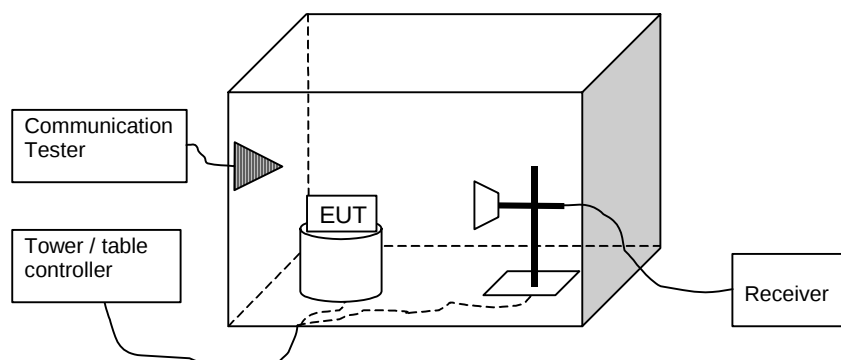
2.1. Conducted RF test setup



2.2. AC powerline conducted emissions test setup



2.3. Spurious radiated emissions test setup



3. Peak output power (FCC §15.247(b)(1), RSS-210 6.2.2(o)(a3))

EUT with DUT number	RM-67: DUT 40368
Accessories with DUT numbers	BL-5C: DUT 40369
Operation Voltage [V] / [Hz]	-
Result	Passed
Remarks	-
Temp [°C] / Humidity [%RH] / Air Pressure [kPa]	24/47/102.1
Date of measurements	23.9.2005
Measured by	Jan-Erik Lilja

3.1. Test method and limit

The measurement is made according to FCC rules part 15.247 and IC standard RSS-210.

Limits for peak output power measurements

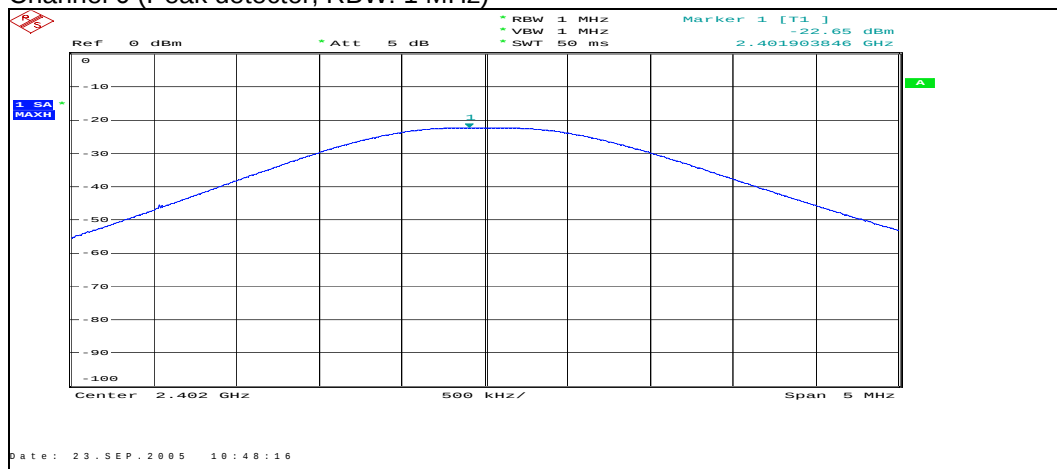
Frequency range [MHz]	Limit [W]	Limit [dBm]
2400 – 2483.5	≤ 1	≤ 30

3.2. Bluetooth Test results

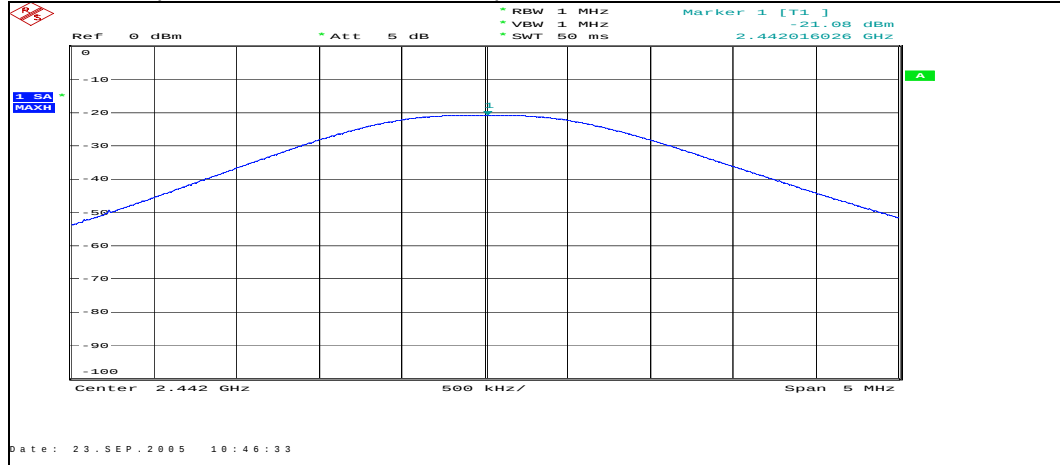
3.2.1 GSKF modulation, PRBS packet type

Channel	P [dBm]	P [W]	Result
0	0.05	0.001	Passed
40	1.62	0.002	Passed
78	1.15	0.001	Passed

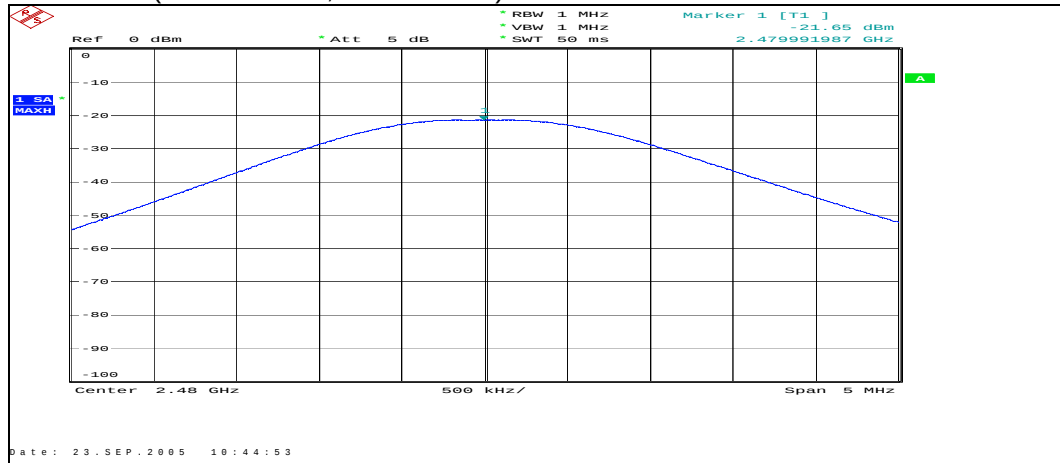
Channel 0 (Peak detector, RBW: 1 MHz)



Channel 40 (Peak detector, RBW: 1 MHz)



Channel 78 (Peak detector, RBW: 1 MHz)



4. Band edge compliance of RF emissions (FCC §15.247(c), RSS-210 6.2.2(o)(e1))

EUT with DUT number	RM-67 DUT 40347
Accessories with DUT numbers	BL-5C DUT 40348, AC-3E DUT 40350, HS-23 DUT 40351
Operation Voltage [V] / [Hz]	115 / 60
Result	Passed
Remarks	-
Temp [°C] / Humidity [%RH] / Air Pressure [kPa]	22 / 43 / 101.2
Date of measurements	19.9.2005
Measured by	Jari Jantunen

4.1. Test method and limit

The measurement is made according to FCC rules part 15.247 and IC standard RSS-210.

Limits for band edge compliance of RF emissions measurements (3 m measurement distance)

Frequency range [MHz]	Limit Average [dBμV/m]	Limit Peak [dBμV/m]
Below 2390 and above 2483.5	≤ 54	≤ 74

4.2. Bluetooth Test results

4.2.1 GFSK modulation, PRBS packet type

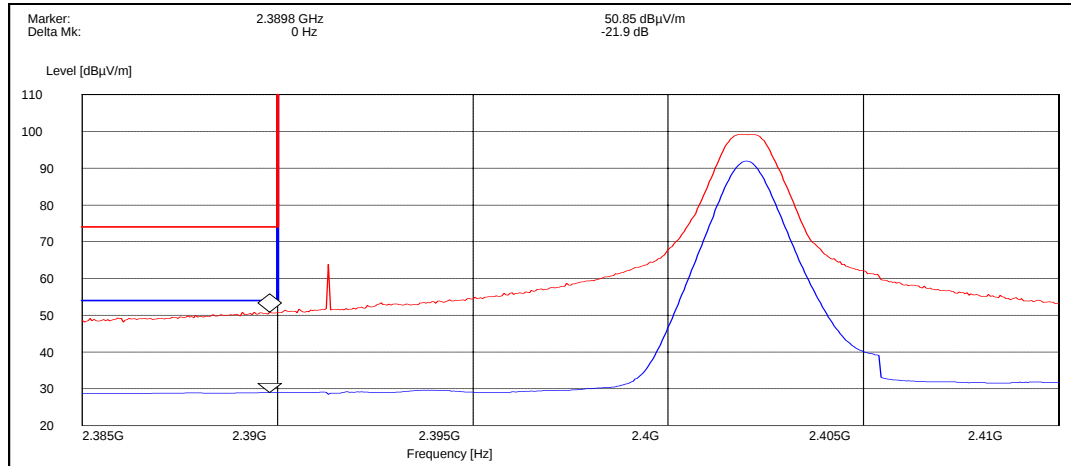
Average (RBW: 1 MHz)

Channel	E [dBμV/m]	Result
0	28.95	PASSED
78	31.82	PASSED
Hopping on, low end	28.49	PASSED
Hopping on, high end	30.79	PASSED

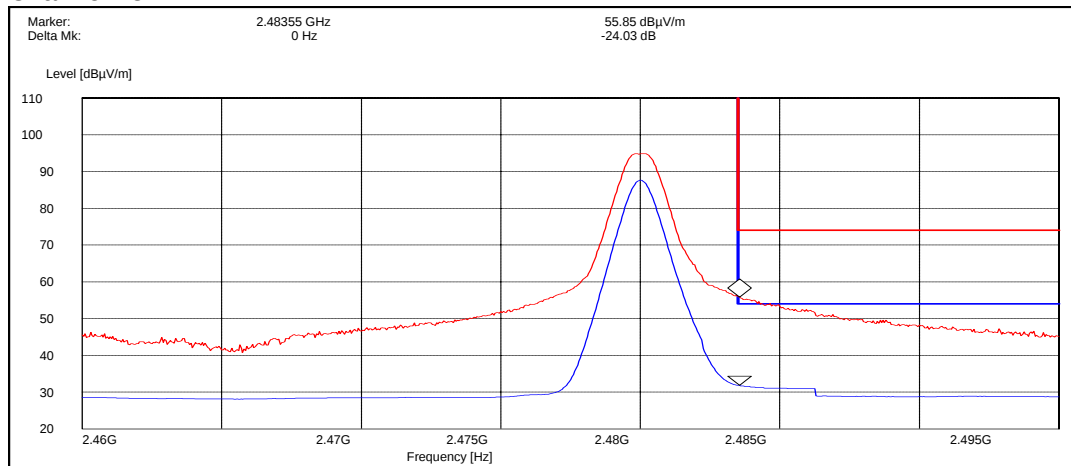
Peak (RBW: 1 MHz)

Channel	E [dBμV/m]	Result
0	50.85	PASSED
78	55.85	PASSED
Hopping on, low end	50.94	PASSED
Hopping on, high end	57.47	PASSED

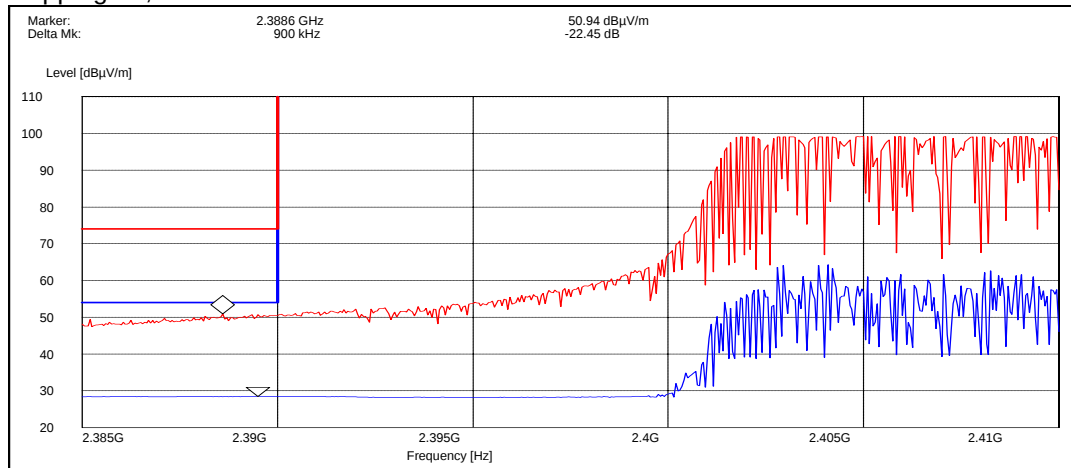
Channel 0



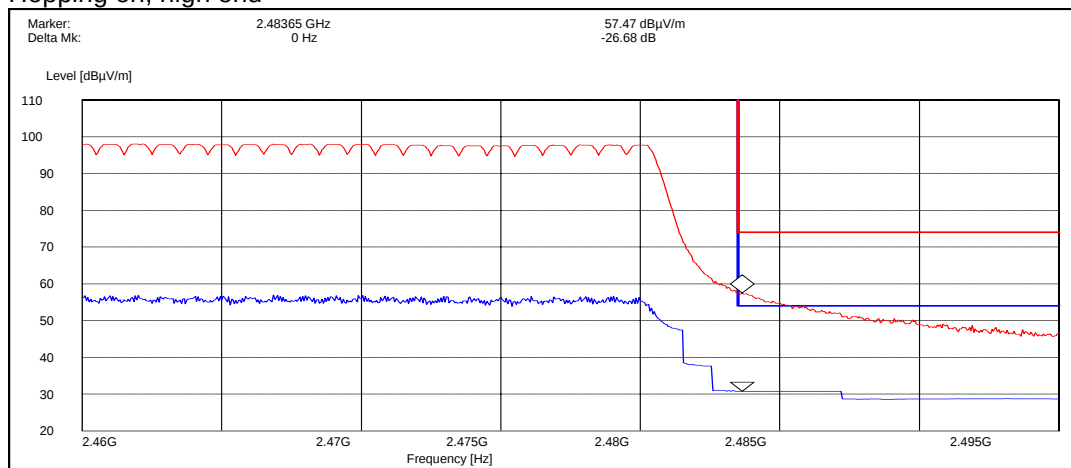
Channel 78



Hopping on, low end



Hopping on, high end



5. Spurious RF conducted emissions (FCC §15.247(c), RSS-210 6.2.2(o)(e1))

EUT with DUT number	RM-67: DUT 40368
Accessories with DUT numbers	BL-5C: DUT 40369
Operation Voltage [V] / [Hz]	-
Result	Passed
Remarks	-
Temp [°C] / Humidity [%RH] / Air Pressure [kPa]	24/47/102.1
Date of measurements	23.9.2005
Measured by	Jan-Erik Lilja

5.1. Test method and limit

The measurement is made according to FCC rules part 15.247 and IC standard RSS-210.

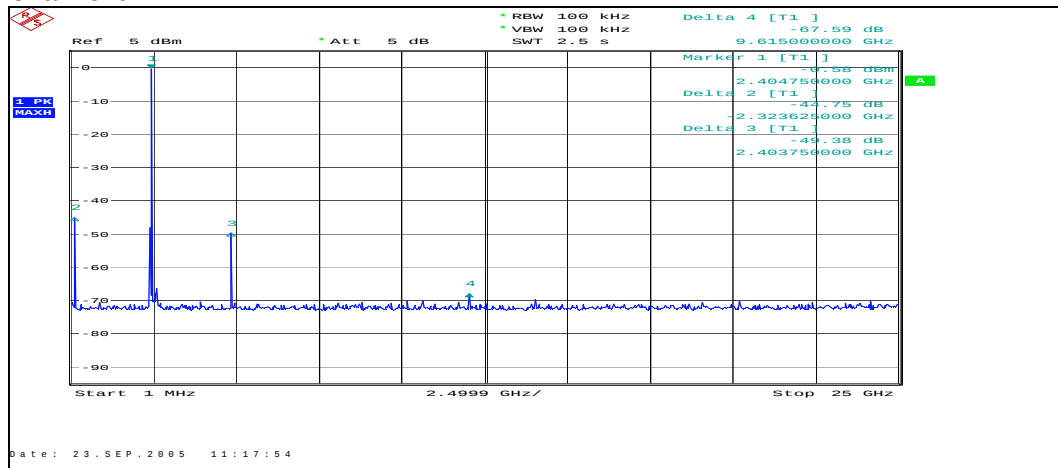
Limits for spurious RF conducted emissions measurements

Frequency range [MHz]	Limit [dBc]
1 – 25000	≤ -20

5.2. Bluetooth Test results

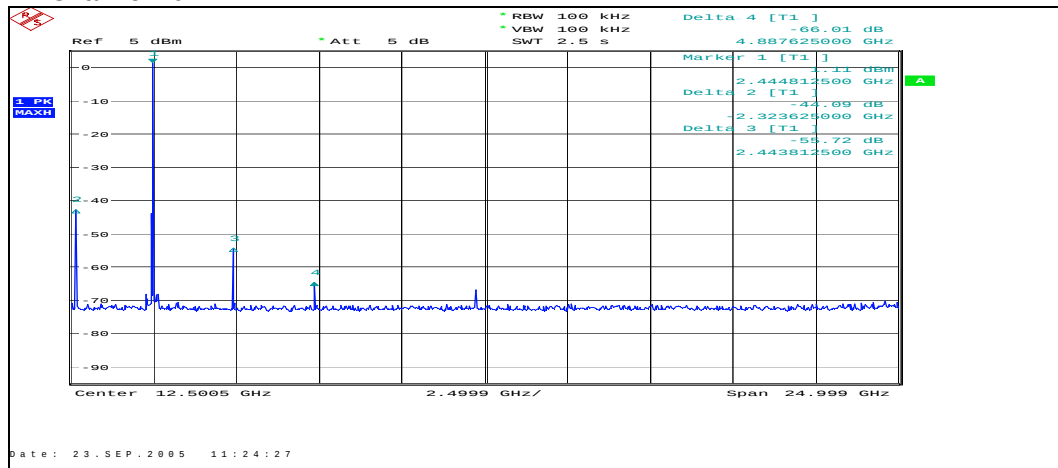
5.2.1 GFSK modulation, PRBS packet type

Channel 0



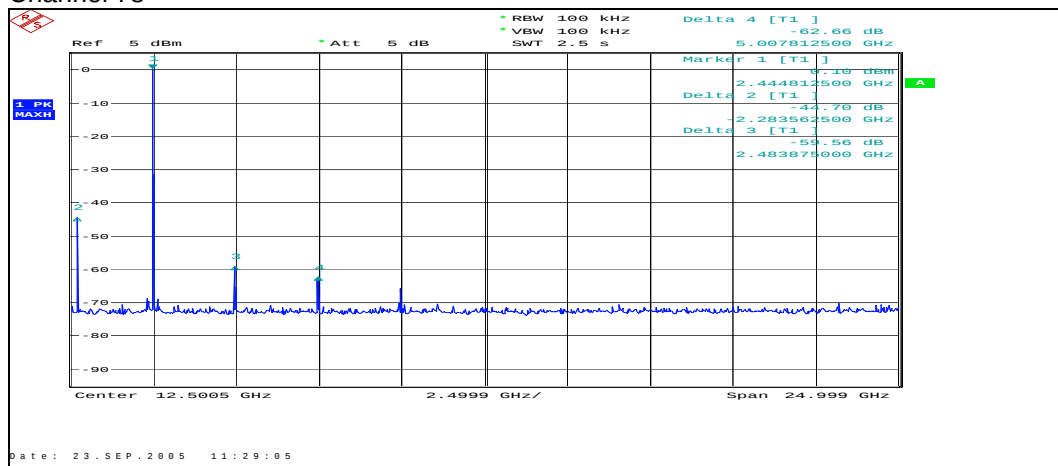
Frequency [MHz]	P [dBc]	Result
81.125	-44.75	Passed
4808.5	-49.38	Passed
12019.75	-64.59	Passed

Channel 40



Frequency [MHz]	P [dBc]	Result
121.1875	-44.09	Passed
4888.625	-55.72	Passed
7332.4375	-66.01	Passed

Channel 78



Frequency / MHz	Level / dBc	Result
161.25	-44.70	Passed
4928.6875	-59.56	Passed
7452.625	-62.66	Passed

6. Spurious radiated emissions (FCC §15.247(c), §15.209, RSS-210 6.2.2(o)(e1))

EUT with DUT number	RM-67 DUT 40347
Accessories with DUT numbers	BL-5C DUT 40348, AC-3E DUT 40350, HS-23 DUT 40351
Operation Voltage [V] / [Hz]	115 / 60
Result	PASSED
Remarks	BT TX (ch 0, 40, 78), GSM 1900 idle(ch 512, 661, 810), FM radio on
Temp [°C] / Humidity [%RH] / Air Pressure [kPa]	23 / 42 / 101.7
Date of measurements	27.9.2005
Measured by	Jari Jantunen

6.1. Test method and limit

The measurement is made according to FCC rules part 15.247 and IC standard RSS-210 as follows:

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with absorbers on the floor and measuring antenna at fixed height using 2-axis EUT position system.

The Final Measurement is performed in the Semi-Anechoic Chamber with conducting metal floor, if the Preliminary Measurement results are closer than 20 dB to the permissible value.

The EUT is placed at nonconductive plate at the turntable center.

For each suspected frequency, the turntable is rotated 360 degrees and antenna is scanned from 1 to 4 m. This is repeated for both horizontal and vertical receive antenna polarizations.

The emissions less than 20 dB below the permissible value are reported.

The measurement results are obtained as described below:

$$E [\mu V/m] = U_{RX} + A_{TOT}$$

Where U_{RX} is receiver reading and A_{TOT} is total correction factor including cable loss, antenna factor and preamplifier gain ($A_{TOT} = L_{CABLES} + AF - G_{PREAMP}$).

Limits for spurious radiated emissions measurements (3 m measurement distance)

Frequency range [MHz]	Limit [$\mu\text{V/m}$]	Limit [dB $\mu\text{V/m}$]	Detector
30 – 88	100	40	Quasi peak
88 – 216	150	43.5	Quasi peak
216 – 960	200	46	Quasi peak
960 – 1000	500	54	Quasi peak
Above 1000	500	54	Average
Above 1000	5000	74	Peak

6.2. Bluetooth Test results

6.2.1 GFSK modulation, PRBS packet type

Channel 0

Peak (RBW: 1 MHz)

Frequency [MHz]	E [dB $\mu\text{V/m}$]	E [$\mu\text{V/m}$]	U _{RX} [dB μV]	A _{TOT} [dB]	Polarisation	Result
4804.000000	48.40	263.03	48.70	-0.30	HORIZONTAL	PASSED
7206.000000	43.70	153.11	40.70	3.00	VERTICAL	PASSED
9608.000000	46.20	204.17	36.90	9.30	VERTICAL	PASSED

Average (RBW: 1 MHz)

Frequency [MHz]	E [dB $\mu\text{V/m}$]	E [$\mu\text{V/m}$]	U _{RX} [dB μV]	A _{TOT} [dB]	Polarisation	Result
4804.000000	38.40	83.18	38.70	-0.30	HORIZONTAL	PASSED
7206.000000	31.20	36.31	28.20	3.00	VERTICAL	PASSED
9608.000000	34.00	50.12	24.70	9.30	VERTICAL	PASSED

Channel 40

Peak (RBW: 1 MHz)

Frequency [MHz]	E [dB $\mu\text{V/m}$]	E [$\mu\text{V/m}$]	U _{RX} [dB μV]	A _{TOT} [dB]	Polarisation	Result
3318.637275	54.30	518.80	59.70	-5.40	HORIZONTAL	PASSED
4805.611222	57.80	776.25	58.10	-0.30	VERTICAL	PASSED
7323.645291	47.00	223.87	43.60	3.40	VERTICAL	PASSED
17999.493988	57.70	767.36	35.40	22.30	HORIZONTAL	PASSED

Average (RBW: 1 MHz)

Frequency [MHz]	E [dB $\mu\text{V/m}$]	E [$\mu\text{V/m}$]	U _{RX} [dB μV]	A _{TOT} [dB]	Polarisation	Result
3318.637275	44.30	164.06	49.70	-5.40	HORIZONTAL	PASSED
4805.611222	43.50	149.62	43.80	-0.30	VERTICAL	PASSED
7323.645291	32.50	42.17	29.10	3.40	VERTICAL	PASSED
17995.493988	43.60	151.36	21.40	22.20	HORIZONTAL	PASSED

Channel 78

Peak (RBW: 1 MHz)

Frequency [MHz]	E [dB μ V/m]	E [μ V/m]	U _{RX} [dB μ V]	A _{TOT} [dB]	Polarisation	Result
4960.000000	46.50	211.35	46.60	-0.10	HORIZONTAL	PASSED
7440.000000	48.90	278.61	44.50	4.40	VERTICAL	PASSED
9920.000000	48.40	263.03	39.20	9.20	VERTICAL	PASSED

Average (RBW: 1 MHz)

Frequency [MHz]	E [dB μ V/m]	E [μ V/m]	U _{RX} [dB μ V]	A _{TOT} [dB]	Polarisation	Result
4960.000000	35.70	60.95	35.80	-0.10	HORIZONTAL	PASSED
7440.000000	37.00	70.79	32.60	4.40	VERTICAL	PASSED
9920.000000	35.10	56.89	25.90	9.20	VERTICAL	PASSED

7. AC powerline conducted emissions (FCC §15.207, RSS-210 6.6)

EUT with DUT number	RM-67 DUT 40347
Accessories with DUT numbers	BL-5C DUT 40348, AC-3E DUT 40350, CA-53 DUT 40352, IBM Thinkpad T22 DUT 40201, 02K6543 DUT 40202, HP deskjet 1600CC3540A DUT 40077, FUJI DS-7 DUT 40076, Serial cable for camera DUT 40088, Parallel cable for printer DUT 40087
Operation Voltage [V] / [Hz]	115 / 60
Result	PASSED
Remarks	BT TX ch 40, GSM 1900 idle ch 661, FM radio on
Temp [°C] / Humidity [%RH] / Air Pressure [kPa]	19 / 42 / 101.7
Date of measurements	27.9.2005
Measured by	Jari Jantunen

7.1. Test method and limit

The measurement is made according to FCC rules part 15.247 and IC standard RSS-210 as follows:

The EUT is placed on a wooden table 80 cm above the reference groundplane.

The EUT is connected via LISN to a test power supply.

The measurement results are obtained as described below:

$$U [dB\mu V] = U_{RX} + A_{TOT}$$

Where U_{RX} is receiver reading and A_{TOT} is total correction factor including cable and pulse limiter attenuations.

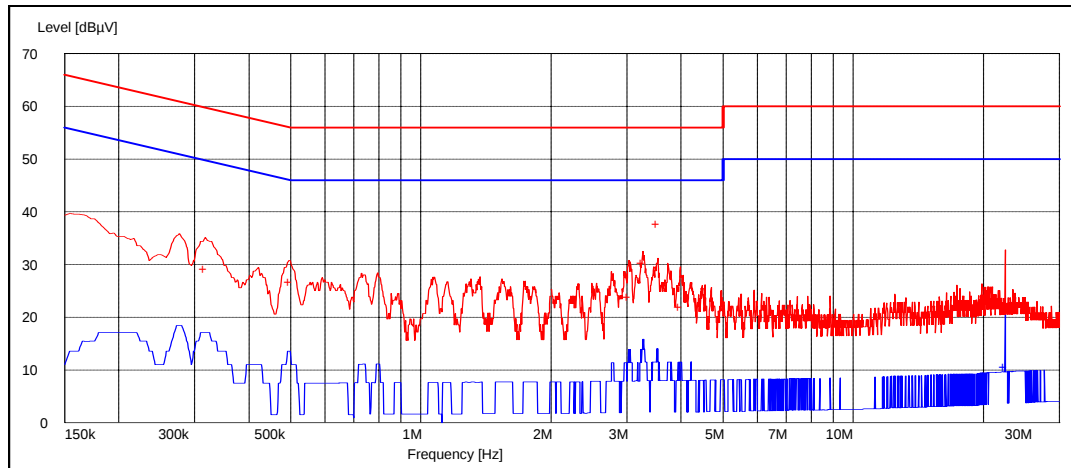
CISPR 22 Class B limits

Frequency range [MHz]	Quasi peak limit [dBμV]	Average limit [dBμV]
0.15 - 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

7.2. Bluetooth Test results

7.2.1 GFSK modulation, PRBS packet type

Channel 40



Quasi peak (RBW: 9 kHz)

Frequency [MHz]	U [dBμV]	Line	Result
0.316834	29.10	N	PASSED
0.498497	26.70	N	PASSED
3.028056	23.90	N	PASSED
3.262525	30.20	N	PASSED
3.533066	37.70	N	PASSED
3.983968	22.00	N	PASSED

Average (RBW: 9 kHz)

Frequency [MHz]	U [dBμV]	Line	Result
22.484970	10.60	N	PASSED

8. 20 dB bandwidth (FCC §15.247(a)(1), RSS-210 6.2.2(o)(a3))

EUT with DUT number	RM-67: DUT 40368
Accessories with DUT numbers	BL-5C: DUT 40369
Operation Voltage [V] / [Hz]	-
Result	Passed
Remarks	-
Temp [°C] / Humidity [%RH] / Air Pressure [kPa]	24/43/102.3
Date of measurements	22.09.2005
Measured by	Jan-Erik Lilja

8.1. Test method and limit

The measurement is made according to FCC rules part 15.247 and IC standard RSS-210.

Limits for 20 dB bandwidth measurements

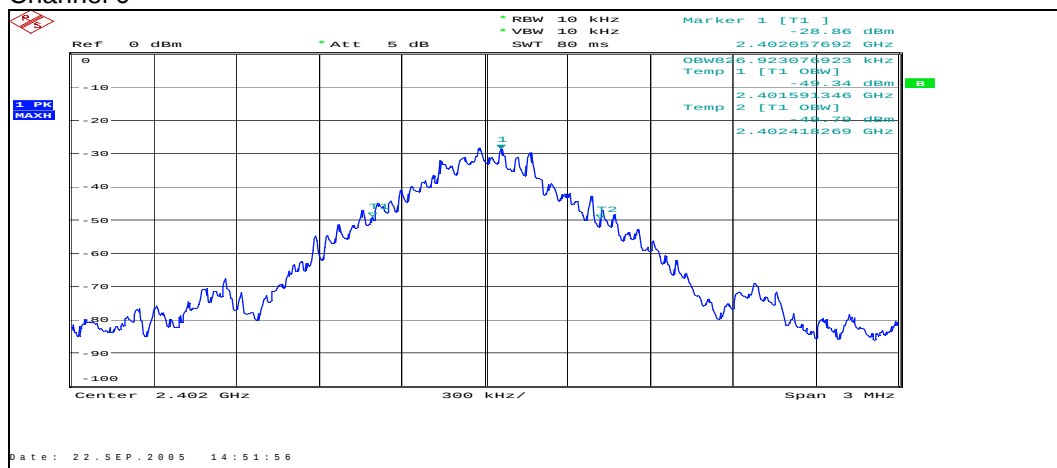
Limit [MHz]
≤ 1

8.2. Bluetooth Test results

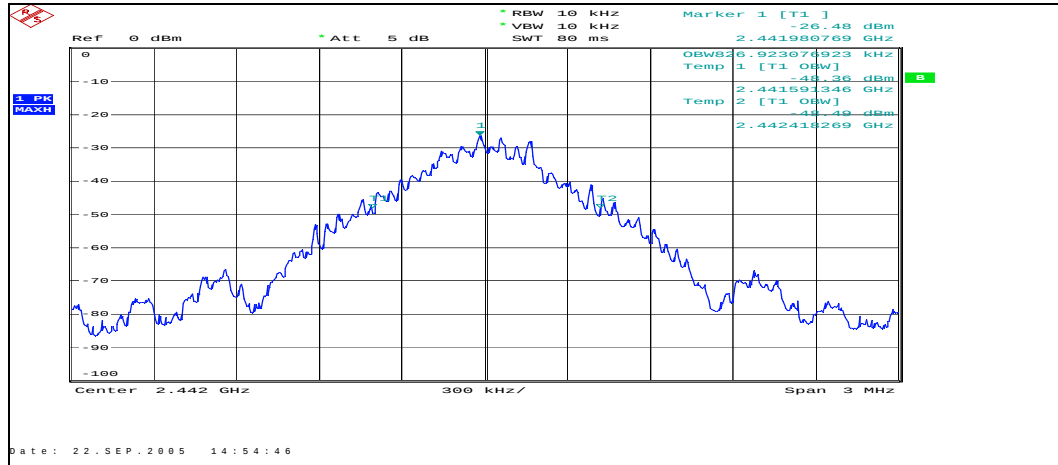
8.2.1 GFSK modulation, PRBS packet type

Channel	20 dB bandwidth [kHz]	Result
0	826.923	Passed
40	826.923	Passed
78	826.923	Passed

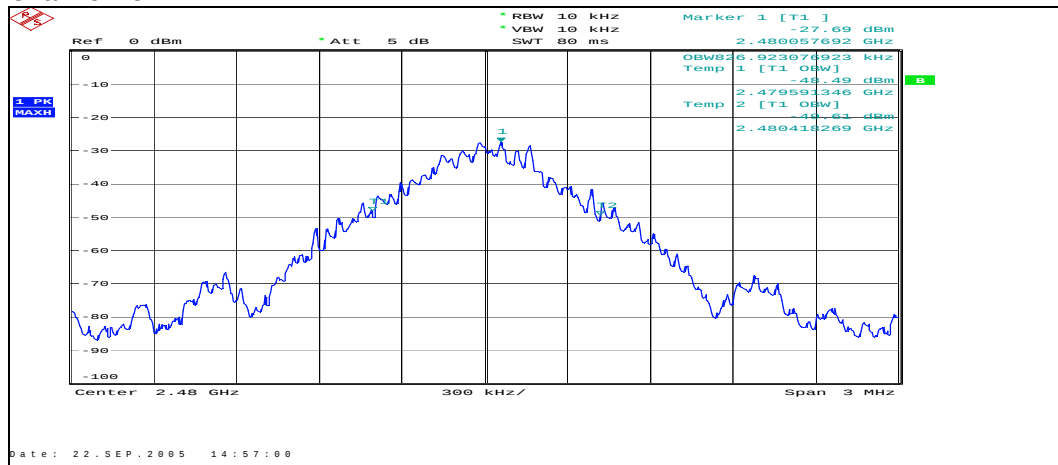
Channel 0



Channel 40



Channel 78



9. Carrier frequency separation (FCC §15.247(a)(1), RSS-210 6.2.2(o)(a1))

EUT with DUT number	RM-67: DUT 40368
Accessories with DUT numbers	BL-5C: DUT 40369
Operation Voltage [V] / [Hz]	-
Result	Passed
Remarks	-
Temp [°C] / Humidity [%RH] / Air Pressure [kPa]	24/43/102.3
Date of measurements	22.09.2005
Measured by	Jan-Erik Lilja

9.1. Test method and limit

The measurement is made according to FCC rules part 15.247 and IC standard RSS-210.

Limits for carrier frequency separation measurements

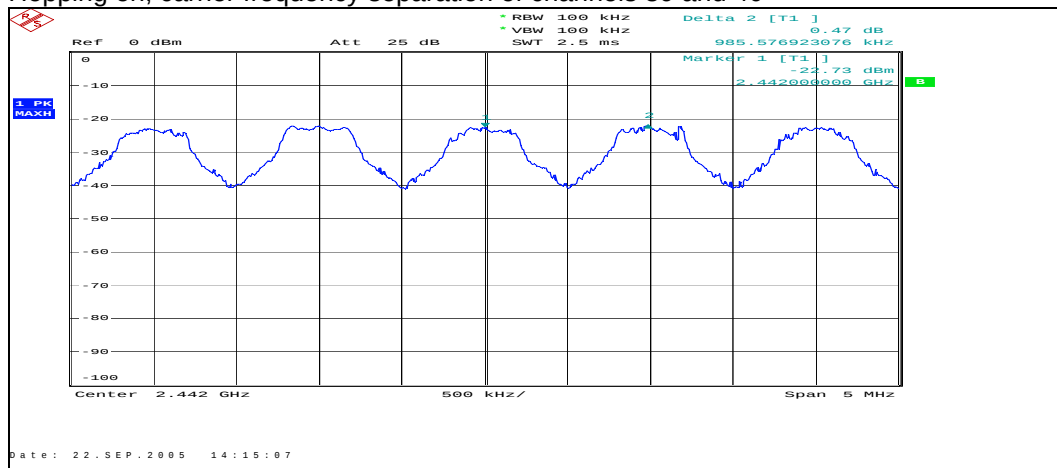
Limit [MHz]
≥ 0.025 or 20 dB bandwidth

9.2. Bluetooth Test results

9.2.1 GFSK modulation, PRBS packet type

Carrier frequency separation [kHz]	Result
985.577	Passed

Hopping on, carrier frequency separation of channels 39 and 40



10. Number of hopping frequencies (FCC §15.247(a)(1)(iii), RSS-210 Amend I(ii))

EUT with DUT number	RM-67: DUT 40368
Accessories with DUT numbers	BL-5C: DUT 40369
Operation Voltage [V] / [Hz]	-
Result	Passed
Remarks	-
Temp [°C] / Humidity [%RH] / Air Pressure [kPa]	24/43/102.3
Date of measurements	22.09.2005
Measured by	Jan-Erik Lilja

10.1. Test method and limit

The measurement is made according to FCC rules part 15.247 and IC standard RSS-210.

Limits for number of hopping frequencies measurements

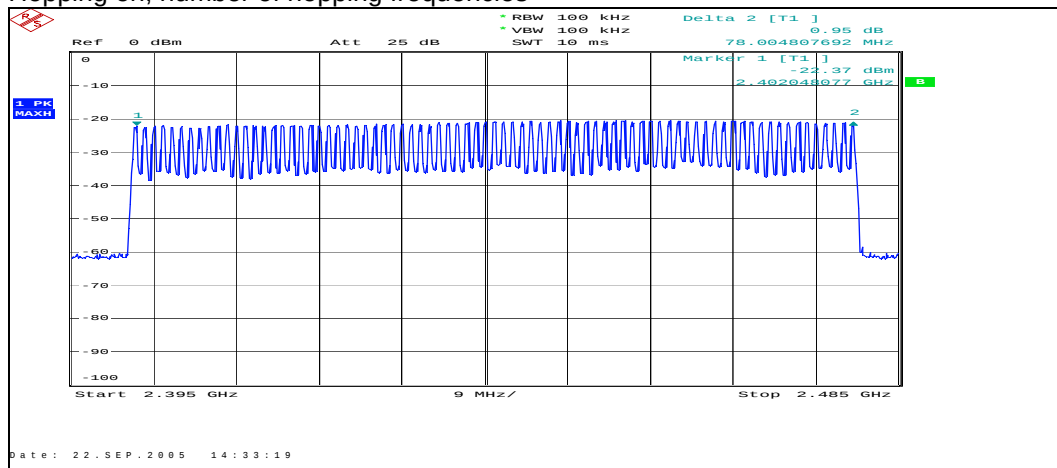
Limit [number]
≥ 75

10.2. Bluetooth Test results

10.2.1 GFSK modulation, PRBS packet type

Measured number of hopping frequencies	Result
79	Passed

Hopping on, number of hopping frequencies



11. Time of occupancy (FCC §15.247(a)(1)(iii), RSS-210 Amend I(ii))

EUT with DUT number	RM-67: DUT 40368
Accessories with DUT numbers	BL-5C: DUT 40369
Operation Voltage [V] / [Hz]	-
Result	Passed
Remarks	-
Temp [°C] / Humidity [%RH] / Air Pressure [kPa]	24/43/102.3
Date of measurements	22.09.2005
Measured by	Jan-Erik Lilja

11.1. Test method and limit

The measurement is made according to FCC rules part 15.247 and IC standard RSS-210 as follows:

The total time of occupancy is get by multiplying the measured number of transmissions occurred during 31.6 second period with the duration of one transmission.

Limits for time of occupancy measurements

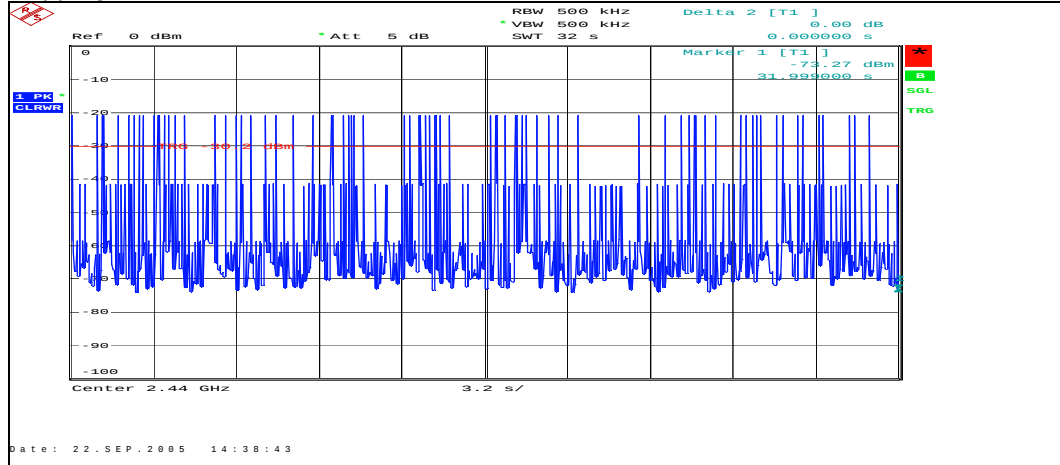
Limit [s]
≤ 0.4

11.2. Bluetooth test results

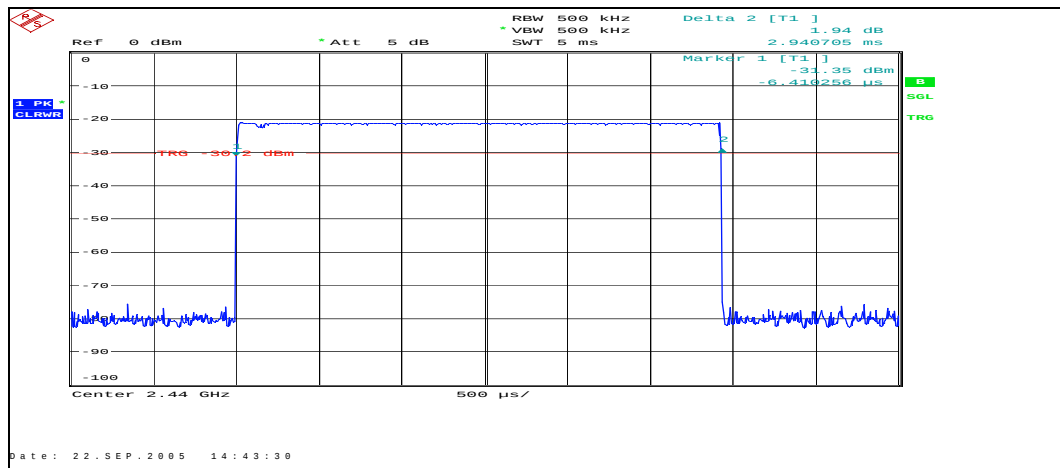
11.2.1 GFSK modulation, PRBS packet type

Measured number of transmissions	Duration of one transmission [μs]	Time of occupancy [s]	Result
68	2940.7	0.20	Passed

Hopping on, number of transmissions, channel 40



Hopping on, duration of one transmission, channel 40



12. Test Equipment

12.1. Conducted measurements

Eq. No	Equipment	Type	Manufacturer	Used in
TM37610	Spectrum analyzer	FSU	R&S	15C,22/24
TM37678	Radio communication tester	CMU-200	R&S	15C,22/24
	Attenuator 10 dB	6251.17.A	Huber+Suhner AG	15C,22/24
TM22901	Step attenuator 110dB	8496A	Agilent	15C,22/24
TM37499	Power splitter	11667A	Agilent	15C,22/24
	Temperature chamber	VT4002	Vötsch	15C,22/24
TM38112	DC power supply	6632A	Agilent	15C,22/24
TM38111	Multimeter	34401A	Agilent	15C,22/24
TM38845	EMI receiver	ESI 40	R&S	15B,15C
TM37773	Radio communication tester	CMU-200	R&S	15B,15C
TM38631	Signal generator	83640L	Agilent	15B,15C
TM38114	DC power supply	6632A	Agilent	15B,15C
TM22835	Multimeter	87	Fluke	15B,15C
TM30600	Pulse Limiter	ESH3-Z2	R&S	15B,15C
TM26490	LISN 50 µH	ESH3-Z5/	R&S	15B,15C
TM30636	LISN 50 µH	L2-16/	PMM	15B,15C

12.2. Radiated measurements

Eq. No	Equipment	Type	Manufacturer	Used in
TM30599	3m semi-anechoic chamber		TDK	15B,15C, 22/24
TM38845	EMI receiver	ESI 40	R&S	15B,15C, 22/24
TM37498	Preamplifier	AMF-5D-020180-26-10P	MITEQ	15B,15C, 22/24
TM37523	Preamplifier	AMF-4D-10M-3G-25-20P	MITEQ	15B,15C, 22/24
TM37516	Biconilog antenna	HL562	R&S	15B,15C, 22/24
TM26496	Double ridged waveguide antenna	3115	EMCO	15B,15C, 22/24
TM39158	Horn antenna	3116	EMCO	15B,15C, 22/24
TM26492	Reference dipole set	UHAP/VHAP	Schwarzbeck	15B,15C, 22/24
TM37501	Dipole antenna	3125-870	EMCO	22/24
TM37502	Dipole antenna	3125-1880	EMCO	22/24
TM37773	Radio communication tester	CMU-200	R&S	15B,15C, 22/24
TM38631	Signal generator	83640L	Agilent	15B,15C, 22/24
TM38066	High pass filter	4HC3000/18000-3-KK	Trilithic	15B,15C, 22/24
	High pass filter	WHK2010-10SS	Trilithic	15B,15C, 22/24
	Low pass filter	WLK1750-10SS	Trilithic	15B,15C, 22/24
TM26511	Tunable notch filter	WRCA870	Wainwright	22/24
TM38215	Tunable notch filter	WRCD1850/1910-0.2/40	Wainwright	22/24
TM38214	Band reject filter	WRCT 2402/2480-2400/2483.5-30	Wainwright	15C
TM30642	Turntable controller	HD-100	Deisel	15B,15C, 22/24
TM26500	Turntable	DS412	Deisel	15B,15C, 22/24
TM38842	Antenna mast controller	2090	EMCO	15B,15C, 22/24
TM38843	Antenna mast	2075	EMCO	15B,15C, 22/24
TM38114	DC power supply	6632A	Agilent	15B,15C, 22/24
TM22835	Multimeter	87	Fluke	15B,15C, 22/24