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Radio Satellite Communication

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RSC14

issue test report consist of 75 Pages

Page 1 (75)



TTI-P-G 166/98-30

Accredited Bluetooth™ Test Facility (BQTF)

Test report no.: 4_0448-02-02/01
FCC Part 15.247 / CANADA RSS-210
NPL-1

CETECOM – ICT Services GmbH
Untertürkheimerstr. 6-10
66117 Saarbrücken, Germany

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1 General information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in 1.5. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM ICT Services GmbH.

1.2 Testing laboratory

CETECOM ICT Services GmbH

Untertürkheimer Straße 6 - 10

66117 Saarbrücken

Germany

Telefone : + 49 681 598 - 9100

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Internet : www.cetecom.de

Accredited testing laboratory

DAR-registration number : TTI-P-G 166/98-30

Accredited Bluetooth™ Test Facility (BQTF)

BLUETOOTH is a trademark owned by Bluetooth SIG, Inc. and licensed to CETECOM

1.3 Details of Applicant

Name : Nokia Mobile Phones
Street : Wilhelm-Runge-Str. 11
City : D-89081 Ulm
Country : Germany
Telephone : +49 (0) 731 505-08
Telefax : +49 (0) 731 505-68 06
Contact : Mr. Thomas Reitmayer
Telephone : +49 (0) 731 505-67 28

1.4 Application Details

Date of receipt of application : 05.12.01
Date of receipt of test item : 06.12.01
Date of test : 06.-07.12.01

1.5 Test Item

Type of equipment : **GSM Tri Band Mobile Phone with integrated BLUETOOTH module**
Type designation : NPL-1
Manufacturer : Applicant
Street :
City :
Country :
IMEI : 004400.00.161068.0
Additional information :
Frequency : 2402 – 2480 MHz
Type of modulation : 1M00FXD / 79M0FXD
Number of channels : 79
Antenna : Integral antenna
Power supply : 3.6 VDC accu Li-Polymer
Output power : Bluetooth : ca. 1,0mW
Type of equipment : Temperature range : -30°C - +60°C
FCC – ID : PPINPL-1
Hardware : B3.0
Software : 2.08

1.6 Test standards: **FCC Part 15 §15.247**
CANADA RSS-210

2 Technical test**2.1 Summary of test results**

The radiated measurements were performed vertical and horizontal over the whole frequency range. We start at 1 m high with vertical receiving antenna and rotate the dish continuously. During rotation we use the antenna lift system to vary the high from 1 to 4 m. So we find maximum radiation output. At this points we do manual remeasurements. After this we do the same measurements in horizontal position of the receiving antenna. This (horizontal and vertical) is made for all the three planes of the test sample. We use the maximum received results.

The detector function and selection of bandwidth are according ANSI C63.2-1996 item 8.2.1 and ANSI C63.4-1992 Item 4.2.

Antennas are conform with ANSI C63.2-1996 item 15.

150 kHz - 30 MHz: Quasi Peak measurement, 9kHz Bandwidth, passive loop antenna.

30 MHz - 200 MHz: Quasi Peak measurement, 120KHz Bandwidth, biconical antenna

200MHz - 1GHz: Quasi Peak measurement, 120KHz Bandwidth, log periodic antenna

1GHz: Average, RBW 1MHz, VBW 10 MHz, waveguide horn

The antenna gain measurement was performed by the difference between conducted and radiated output measurement.

All measurement settings are according to FCC 15.35, 15.205, 15.209, 15.247 and the „Measurement guidelines for FHSS systems“.

The product fullfills also the requirements for CANACA RSS-210

No deviations from the technical specification(s) were ascertained in the course of the tests performed.

Final verdict : PASS

Technical responsibility for area of testing :

11.12.01 RSC 8411 Berg M.

Date

Section

Name

Signature



Technical responsibility for area of testing :

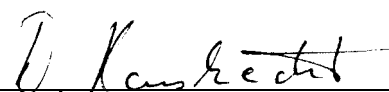
11.12.01 RSC8412 Hausknecht D.

Date

Section

Name

Signature



2.2 Testreport

TEST REPORT

Testreport no. : 4_0448-02-02/01

TEST REPORT REFERENCE

LIST OF MEASUREMENTS

Paragraph	PARAMETER TO BE MEASURED	PAGE
	Transmitter parameters	
§ 15.204	Antenna gain	7
§ 15.247 (a)	Carrier frequency separation	8
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§ 15.247 (a)	Time of occupancy (dwell time)	11
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Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

Antenna Gain

SUBCLAUSE § 15.204

The gain is –1,0 dBi

(measured effectiv radiated power over dipol– measured conducted power with a temporary RF-connector)

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

-

Test report nr.: 4_0448-02-02/01

Issue Date: 06.12.2001

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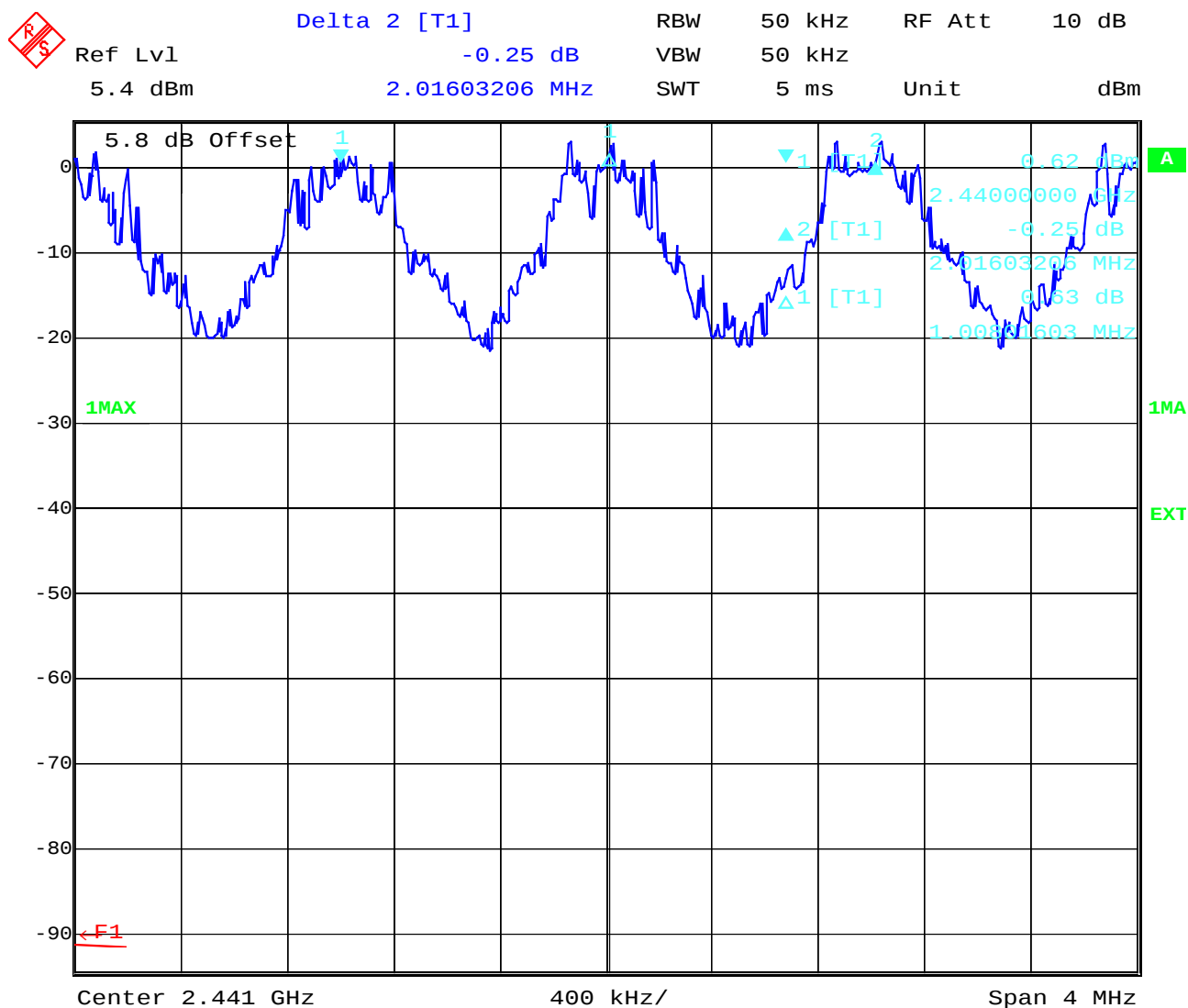
Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

Carrier frequency separation

§15.247(a)



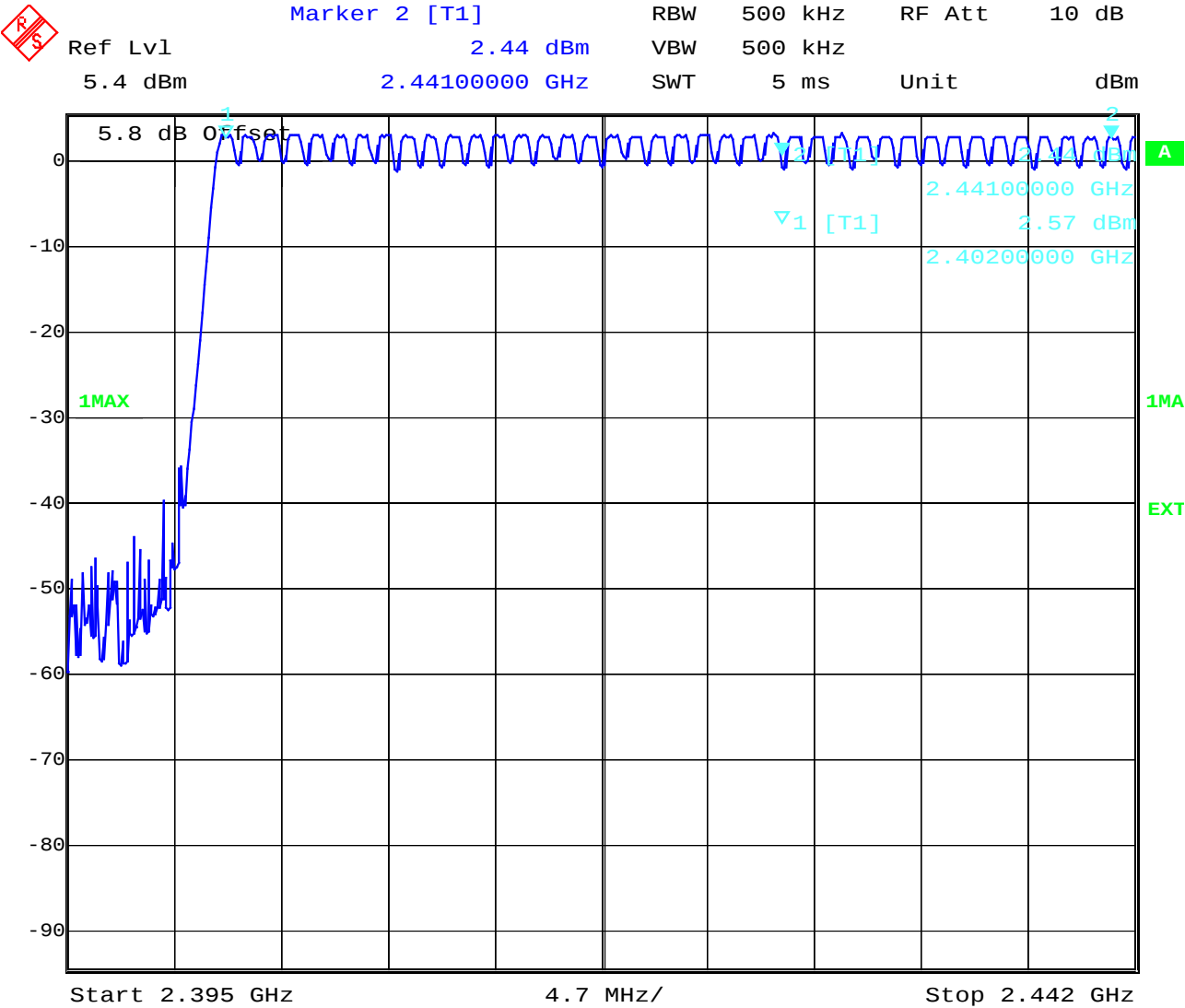
Date: 10.DEC.2001 08:29:02

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

Equipment under test : NPL-1
Ambient temperature : 21,5°C
Relative humidity : 32%

Number of hopping channels §15.247(a)
Channel 1 - 39



Date: 10.DEC.2001 08:31:31

The number of hopping channels is 79.

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

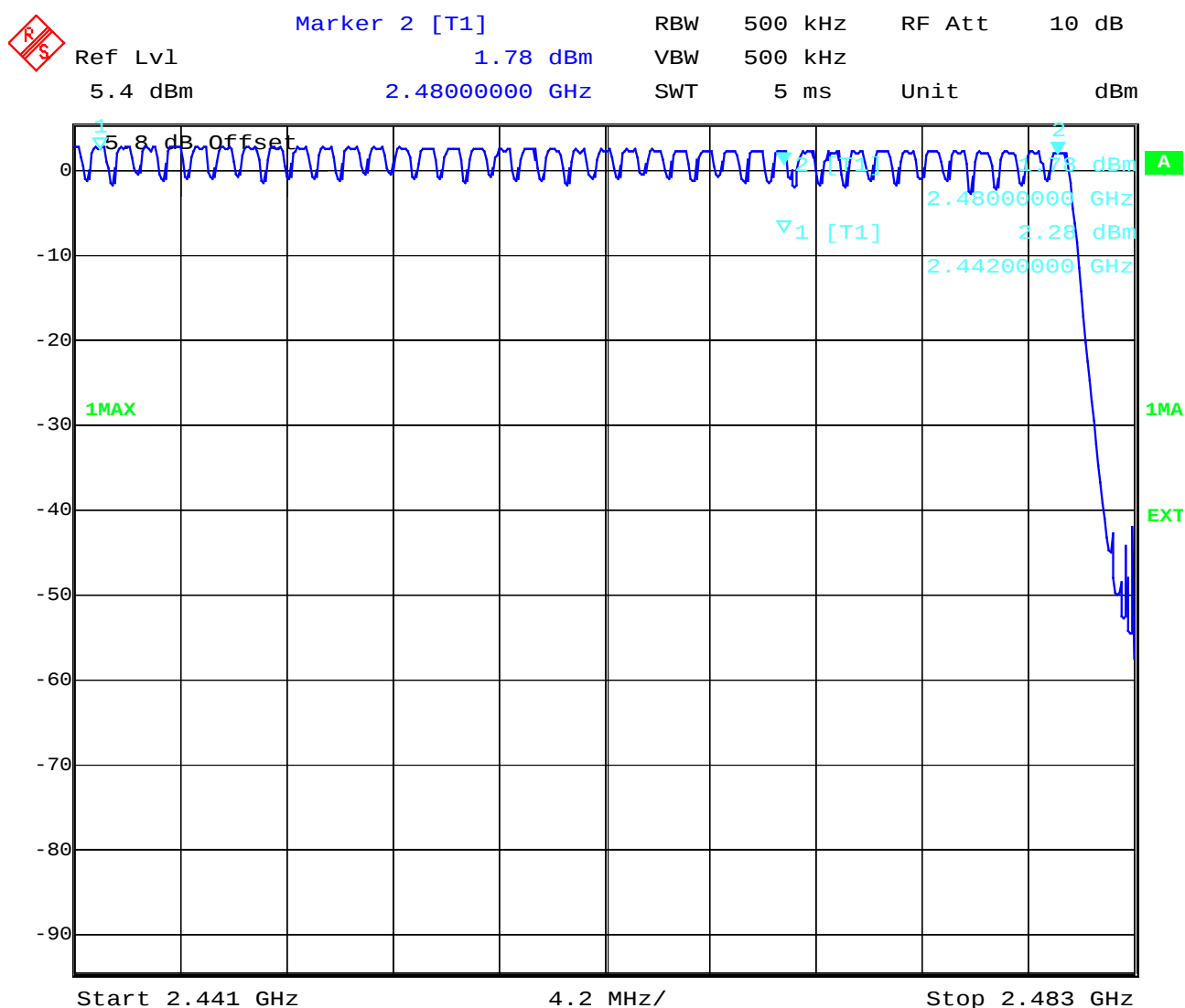
Ambient temperature : 21,5°C

Relative humidity : 32%

Number of hopping channels

Channel 40-79

§15.247(a)



Date: 10.DEC.2001 08:33:33

The number of hopping channels is 79.

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

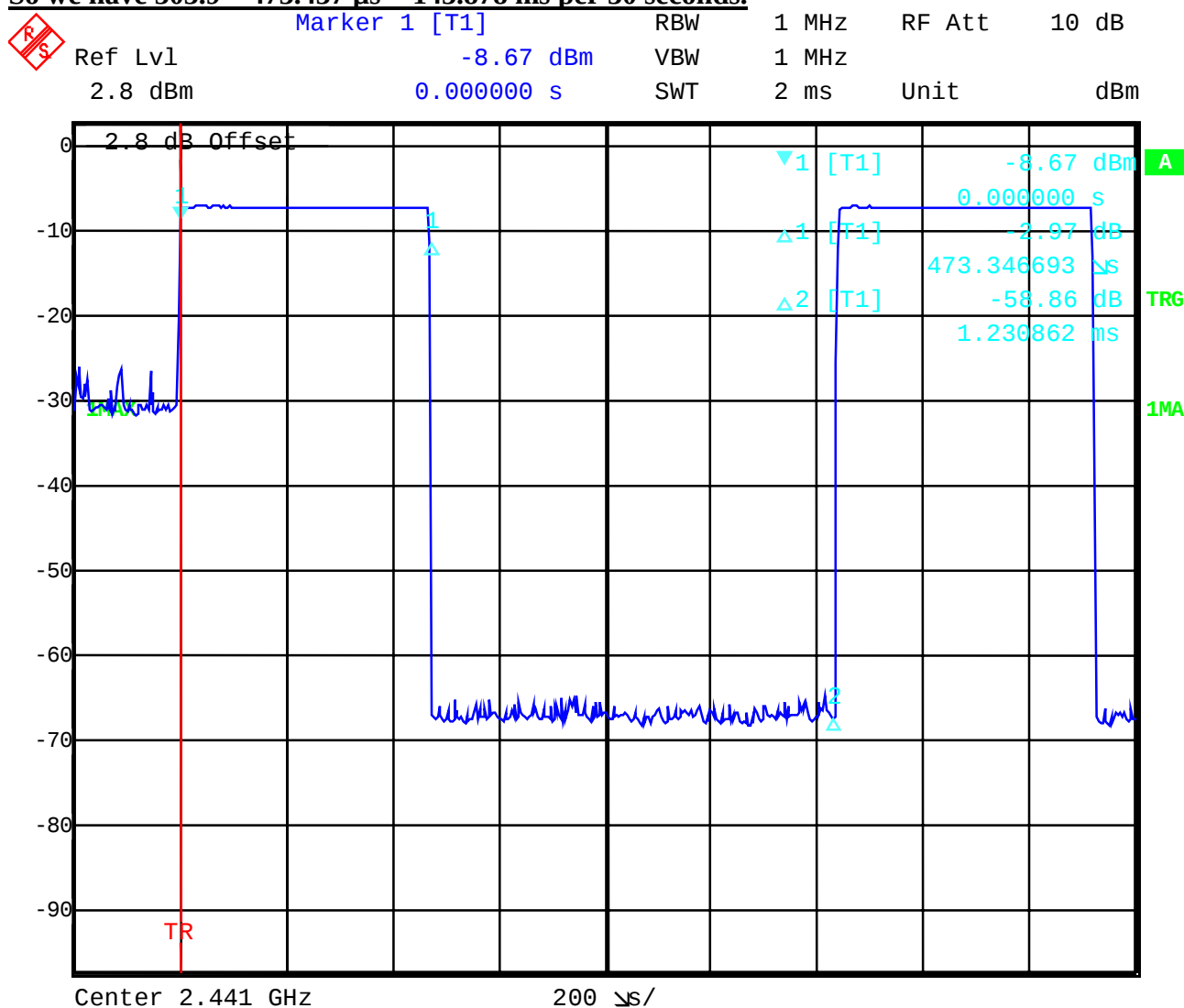
Time of occupancy (dwell time) for DH1

§15.247(a)

The system makes worst case 1600 hops per second or 1 time slot has a length of 625 μ s with 79 channels. A DH1 Packet need 1 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 800 hops per second with 79 channels. So you have each channel 10.13 times per second and for 30 seconds you have 303.9 times of appearance .

Each tx-time per appearance is 473.437 μ s.

So we have $303.9 \times 473.437 \mu\text{s} = 143.878 \text{ ms}$ per 30 seconds.



Date: 10.DEZ.2001 11:09:10

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

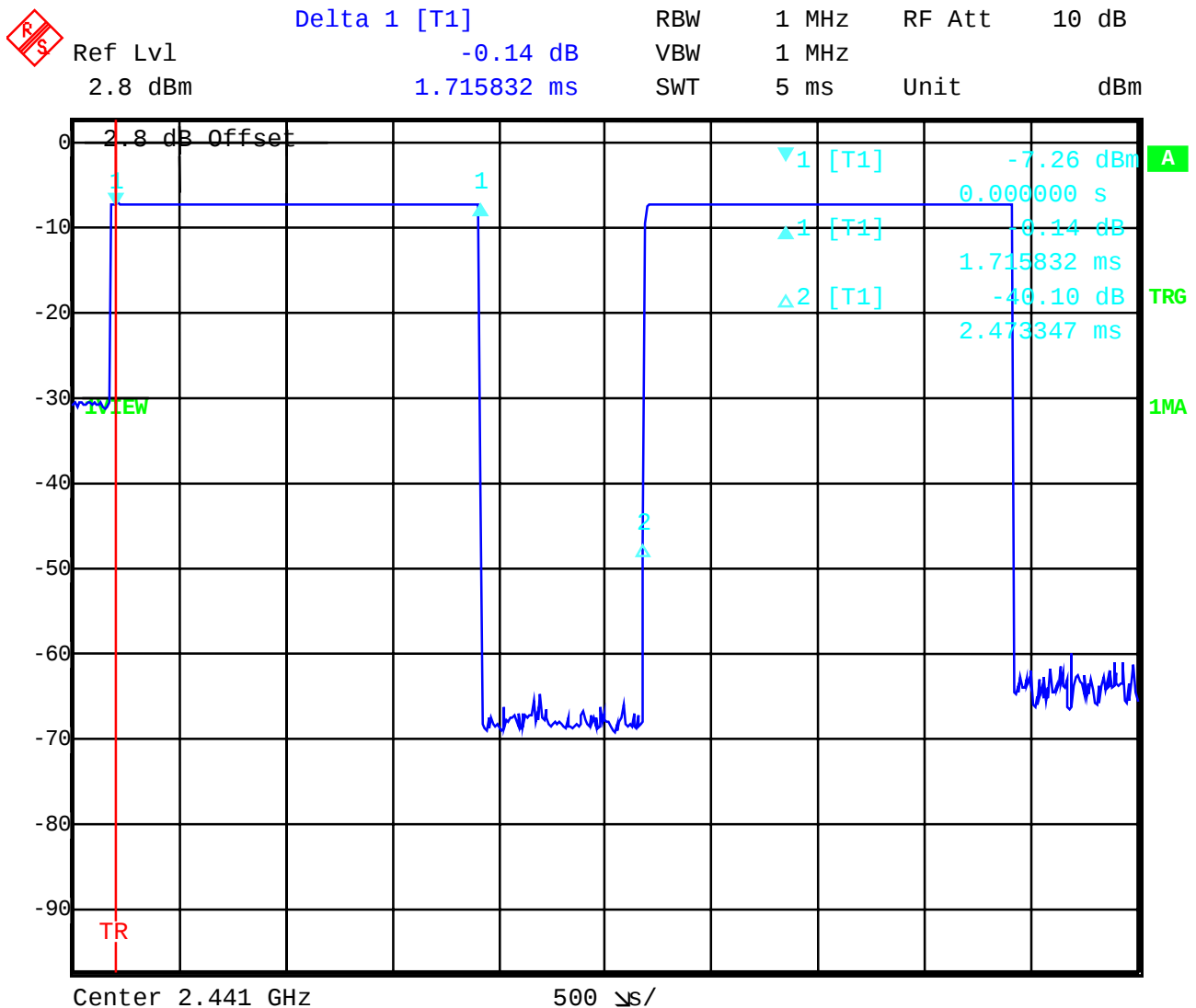
Time of occupancy (dwell time) for DH3

§15.247(a)

A DH3 Packets need 3 time slots for transmit and 1 for receiving, then the system makes worst case 400 hops per second with 79 channels. So you have each channel 5.1 times per second and for 30 seconds you have 153 times of appearance .

Each tx-time per appearance is 1.716 ms.

So we have $153 * 1.716 \text{ ms} = 262.548 \text{ ms}$ per 30 seconds.



Date: 10.DEZ.2001 11:10:40

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
 (for reference numbers see test equipment listing)

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Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

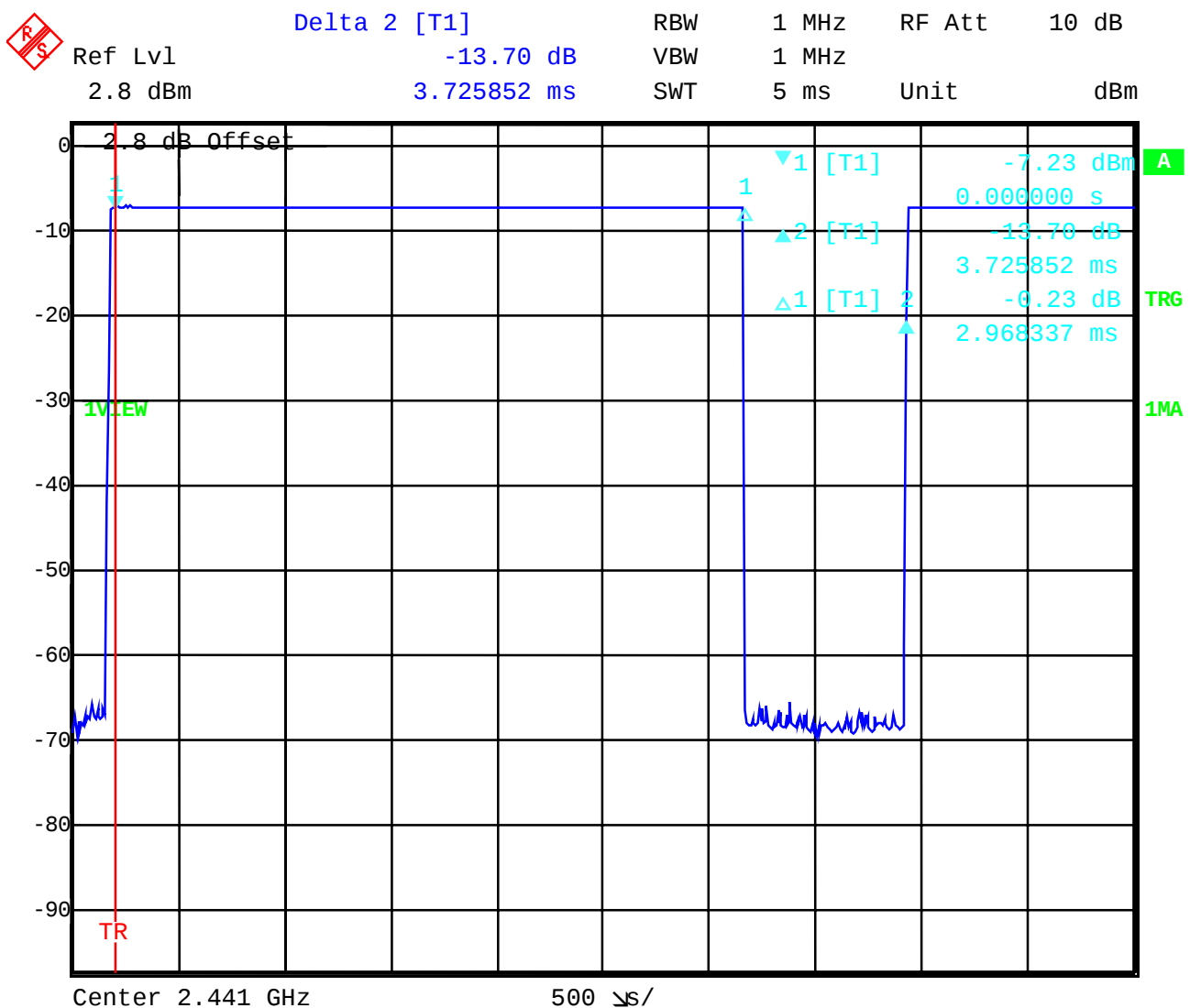
Time of occupancy (dwell time) for DH5

\$15.247(a)

At DH5 Packets you need 5 time slots for transmit and 1 for receiving, so the system makes worst case 266,7 hops per second with 79 channels. So you have each channel 3.36 times per second and for 30 seconds you have 100,8 times of appearance .

Each tx-time per appearance is 2.968 ms.

So we have $100,8 * 2.968 \text{ ms} = 299.174 \text{ ms}$ per 30 seconds.



Date: 10.DEZ.2001 11:12:33

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

Time of occupancy (dwell time) for page mode /Inquiry mode (TX-on time) §15.247(a)

At paging mode the system makes first hopping with 16 channels. One sequence(called train A) lasts 10 ms. Every 1.28s frequencies change and a second train A starts with different frequencies. After max $7 \cdot 1.28$ s 16 new more distance frequencies (Train B) are used.

So we have in the worst case (same frequency is in every train) the following time scedule.

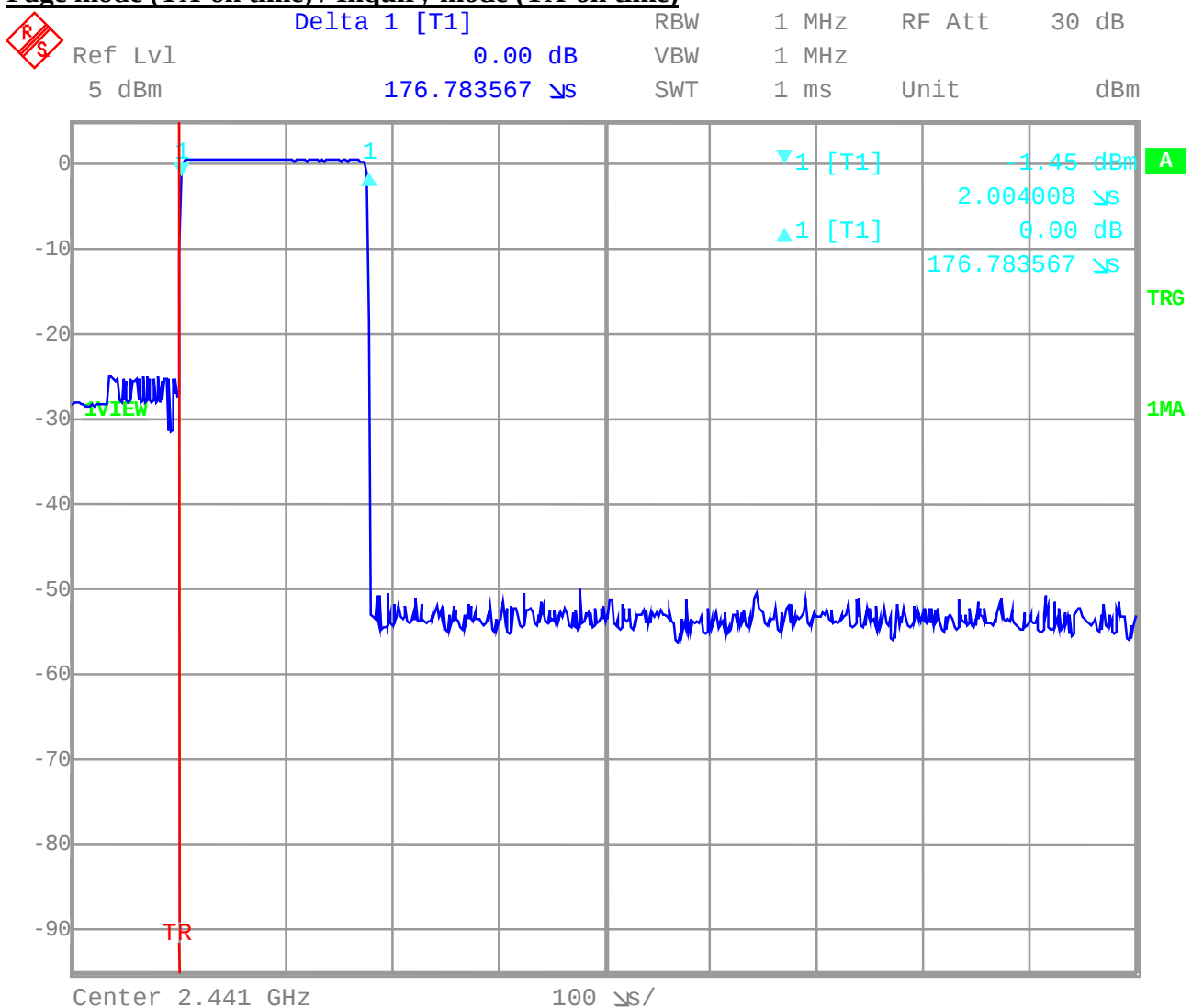
First: $7 \cdot 128 \cdot 10$ ms. For the next 7 seconds train B with other frequencies.

Then train A and B changes frequently.

⇒ so we have $7 \cdot 128 \cdot 176.784 \mu$ s, then 8.96 s other frequencies, then again $7 \cdot 128 \cdot 176.784 \mu$ s

⇒ together in 30 s maximal 2 sequences => maximal 0.317 s per 30 second period.

Page mode (TX-on time) / Inquiry mode (TX-on time)



Date: 10.DEZ.2001 11:15:27

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

Test report nr.: 4_0448-02-02/01

Issue Date: 06.12.2001

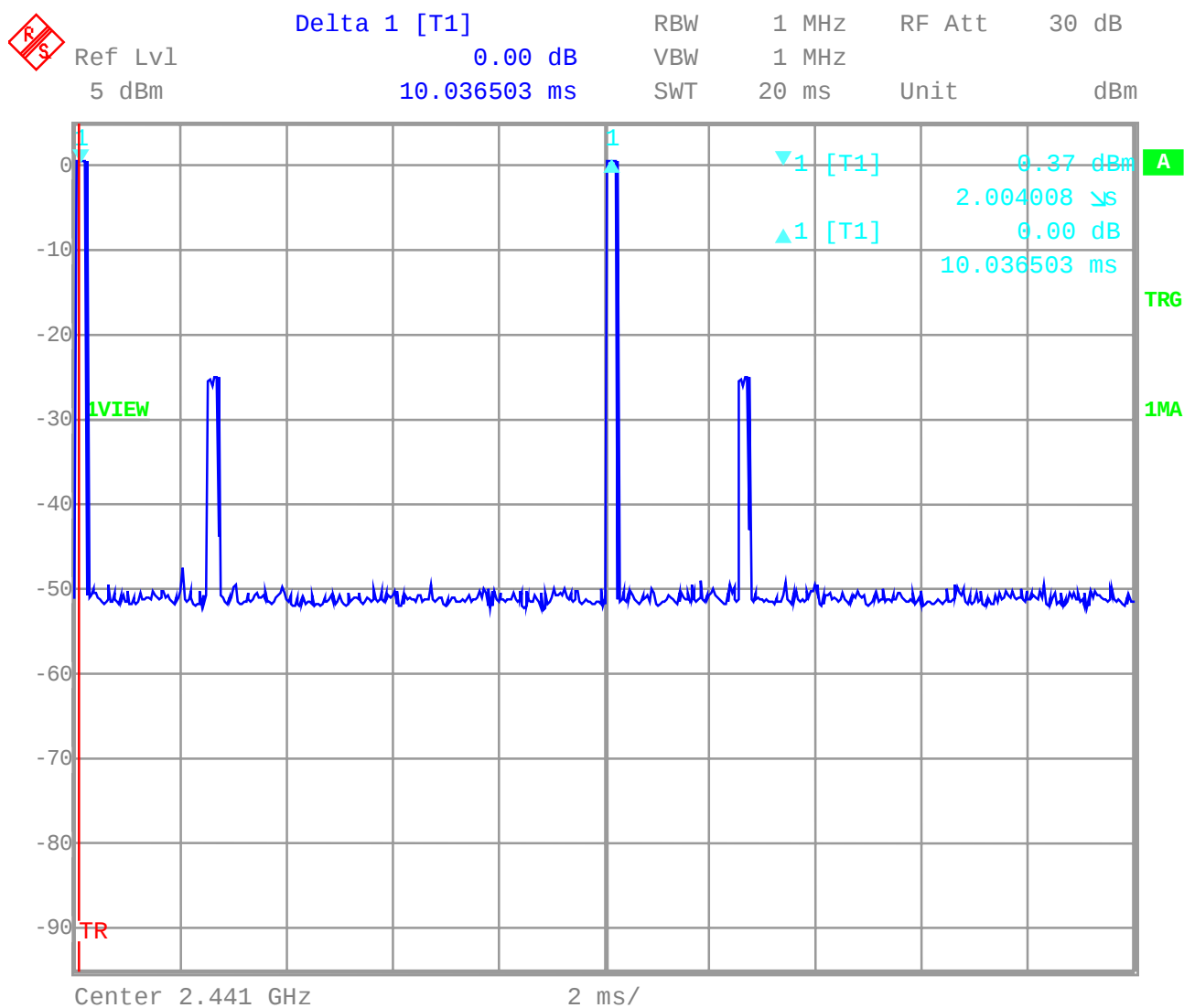
Page 15 (75)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

Page mode (complete sequence) / Inquiry mode (complete sequence)



Date: 10.DEZ.2001 11:17:21

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

Spectrum Bandwidth of a FHSS System

§15.247(a)

20 dB bandwidth

TEST CONDITIONS		20 dB BANDWIDTH (kHz)		
Frequency (MHz)		2402	2441	2480
T _{nom} (23)°C	V _{nom} (3,6)V	919.840	931.864	931.864
Measurement uncertainty		±1kHz		

RBW / VBW as provided in the „Measurement Guidelines“ (DA 00-705, March 30, 2000)

LIMIT

SUBCLAUSE §15.247(a) (1)

The maximum 20dB bandwidth shall be at maximum 1000 KHz

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

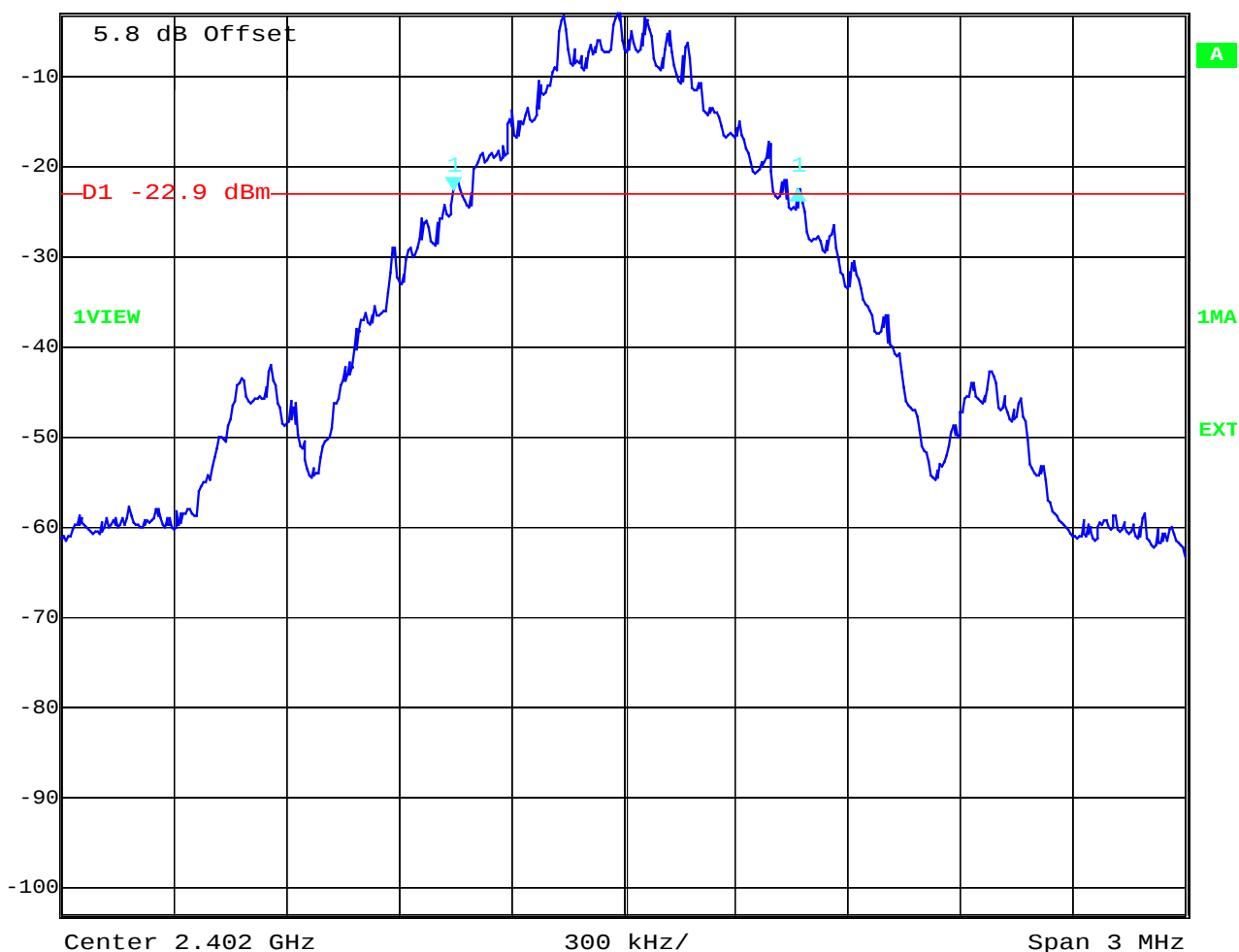
Spectrum Bandwidth of a FHSS System
20 dB bandwidth

§15.247(a)

Channel 1



Delta 1 [T1] RBW 10 kHz RF Att 20 dB
Ref Lvl -0.13 dB VBW 10 kHz
-2.9 dBm 919.83967936 kHz SWT 76 ms Unit dBm



Date: 10.DEC.2001 08:06:11

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

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Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

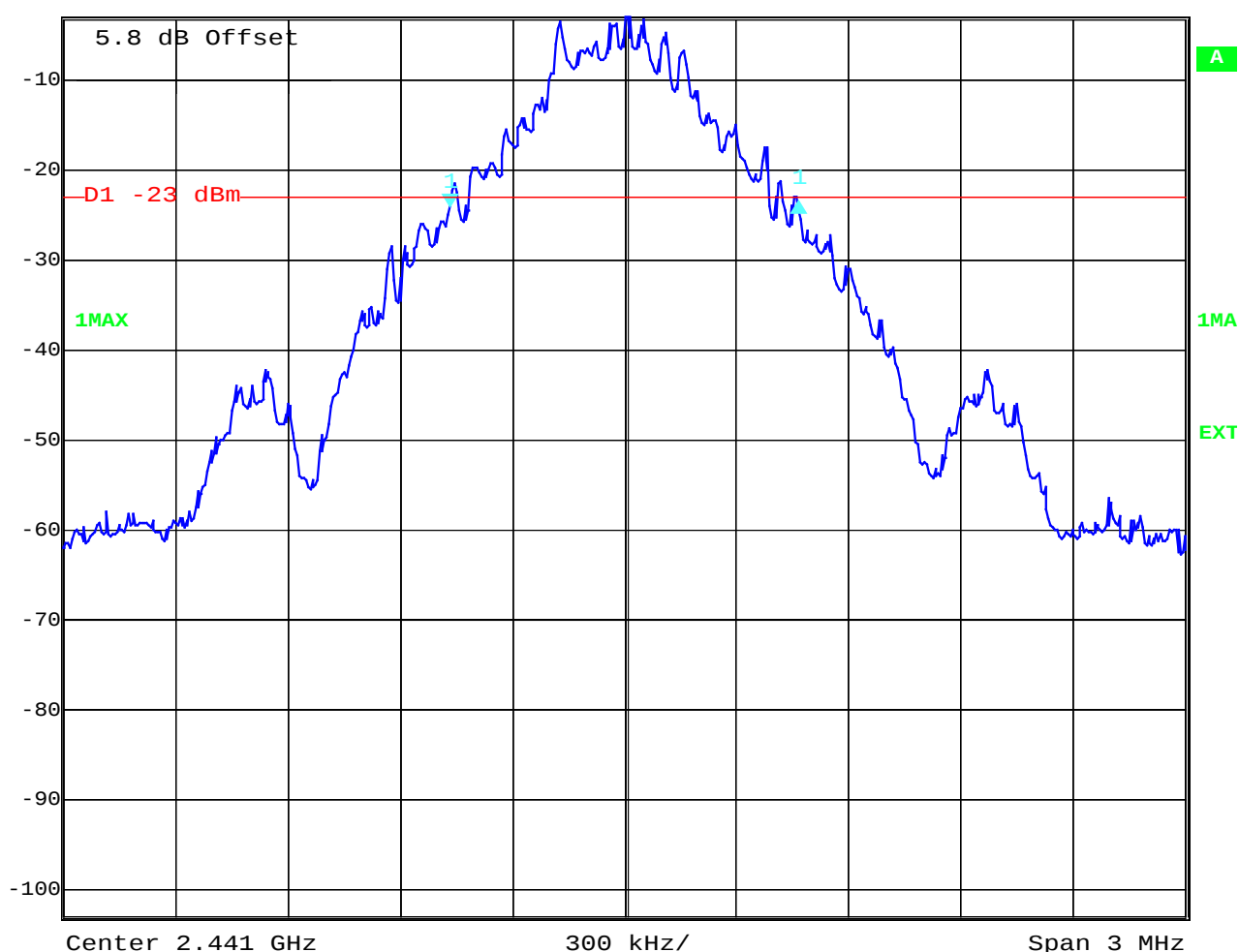
Spectrum Bandwidth of a FHSS System

§15.247(a)

20 dB bandwidth

Channel 2


 Delta 1 [T1] RBW 10 kHz RF Att 20 dB
 Ref Lvl 0.57 dB VBW 10 kHz
 -3 dBm 931.86372746 kHz SWT 76 ms Unit dBm



Date: 10.DEC.2001 08:07:57

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

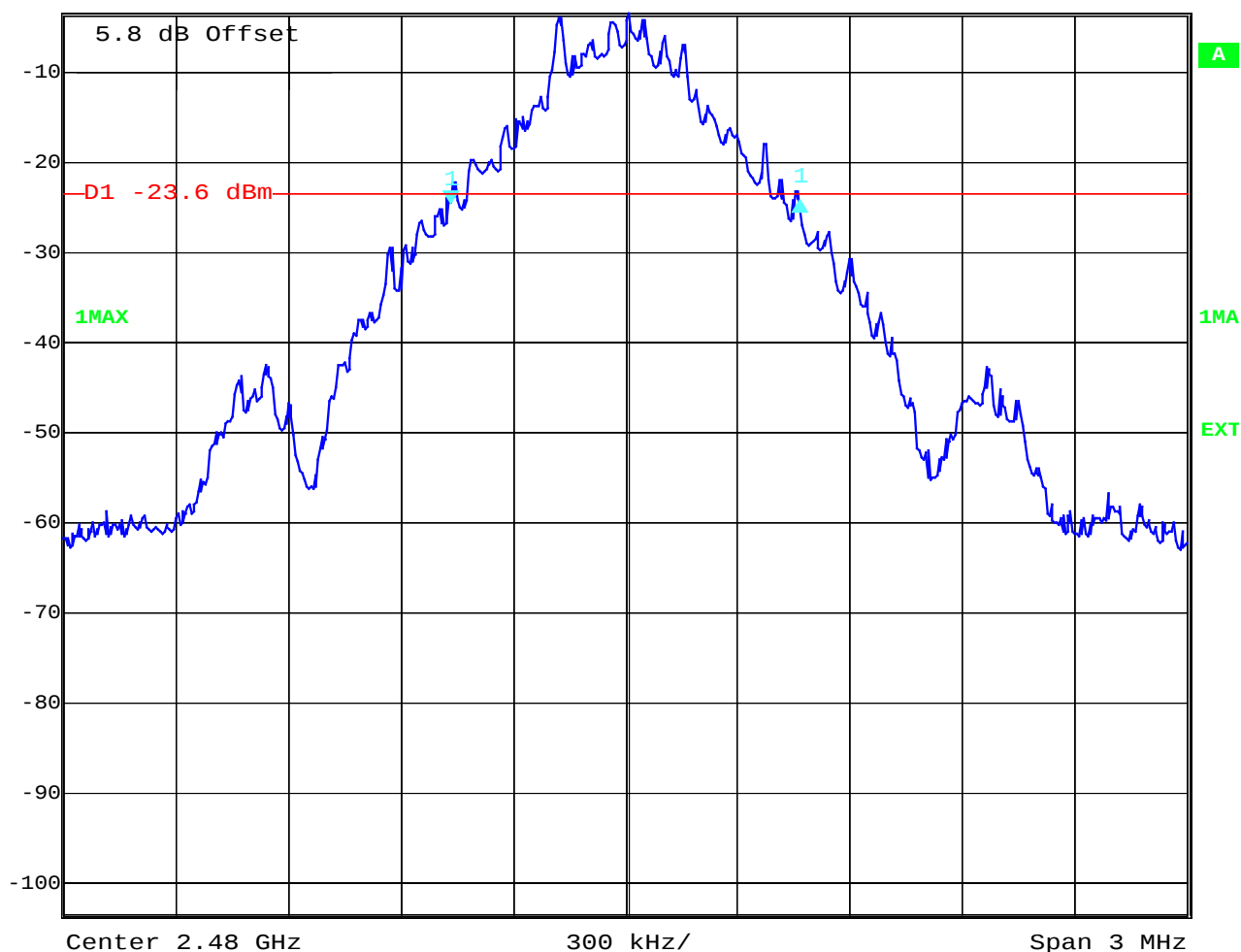
Spectrum Bandwidth of a FHSS System
20 dB bandwidth

§15.247(a)

Channel 3:



Delta 1 [T1] RBW 10 kHz RF Att 20 dB
Ref Lvl 0.38 dB VBW 10 kHz
-3.6 dBm 931.86372746 kHz SWT 76 ms Unit dBm



Date: 10.DEC.2001 08:09:44

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

MAXIMUM PEAK OUTPUT POWER (conducted)

SUBCLAUSE § 15.247 (b) (1)

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (mW)			
		2402		2442	2480
Frequency (MHz)					
T _{nom} (23)°C	V _{nom} (3,6)V	PK	1.88	1.77	1.58
		AV	1.50	1.41	1.26
Maximum deviation from output power under extreme test conditions (dBc)		not applicable		not applicable	not applicable
Measurement uncertainty		±3dB			

RBW / VBW : 3 MHz

LIMIT

SUBCLAUSE § 15.247 (b) (1)

Frequency range	RF power output
2400-2483.5 MHz	1.0 Watt

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

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Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

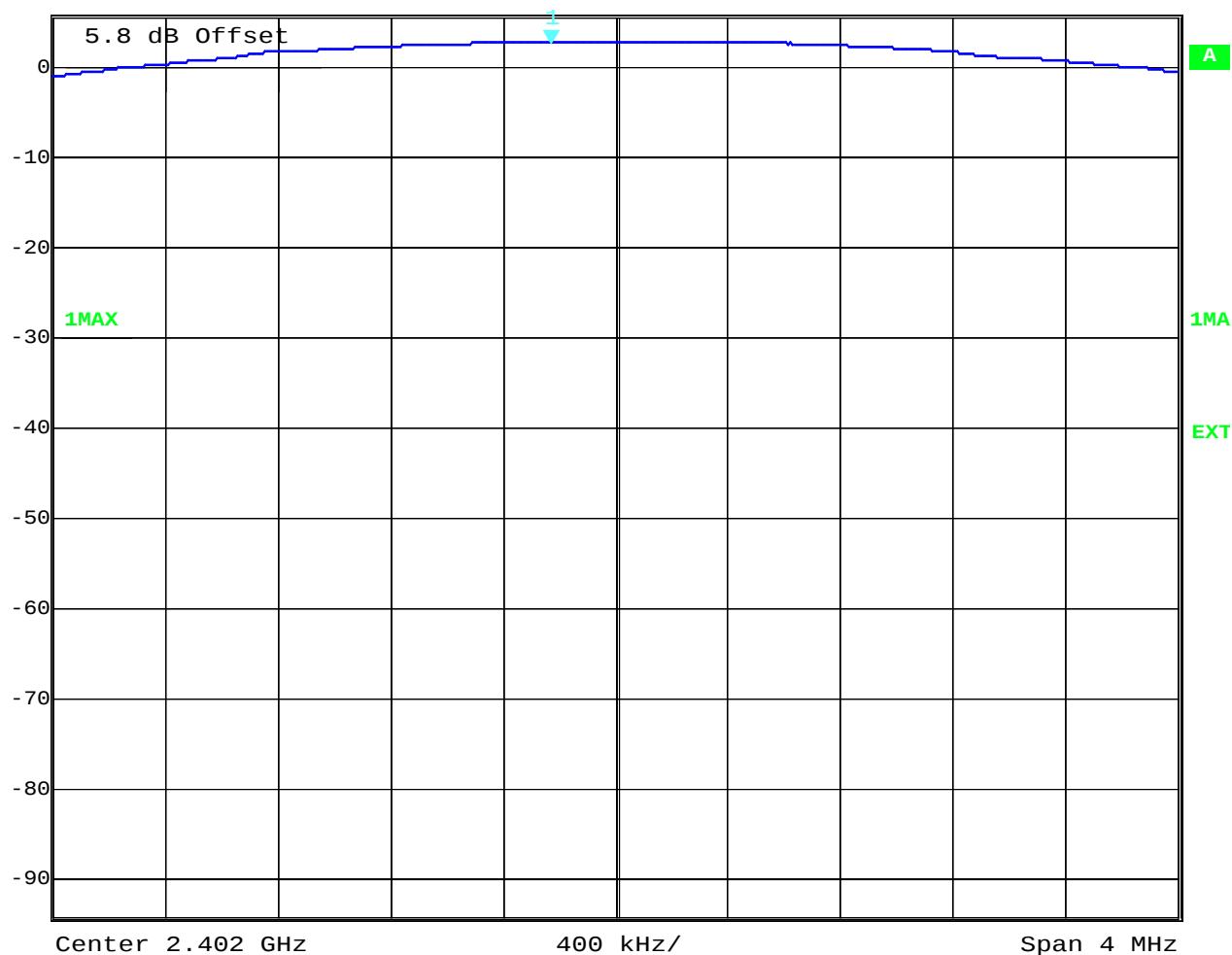
Peak output power (conducted)

§15.247 (b)

Channel 1: 2.75 dBm at 2402 MHz

De facto EIRP with -1.0 dBI max. antenna gain is 1.75 dBm / 1.50 mW


 Ref Lvl 5.8 dBm
 Marker 1 [T1] 2.75 dBm
 RBW 3 MHz
 VBW 3 MHz
 RF Att 30 dB
 SWT 5 ms
 Unit dBm



Date: 10.DEC.2001 08:02:51

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Test report nr.: 4_0448-02-02/01

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Equipment under test : NPL-1

Ambient temperature : 21,5°C

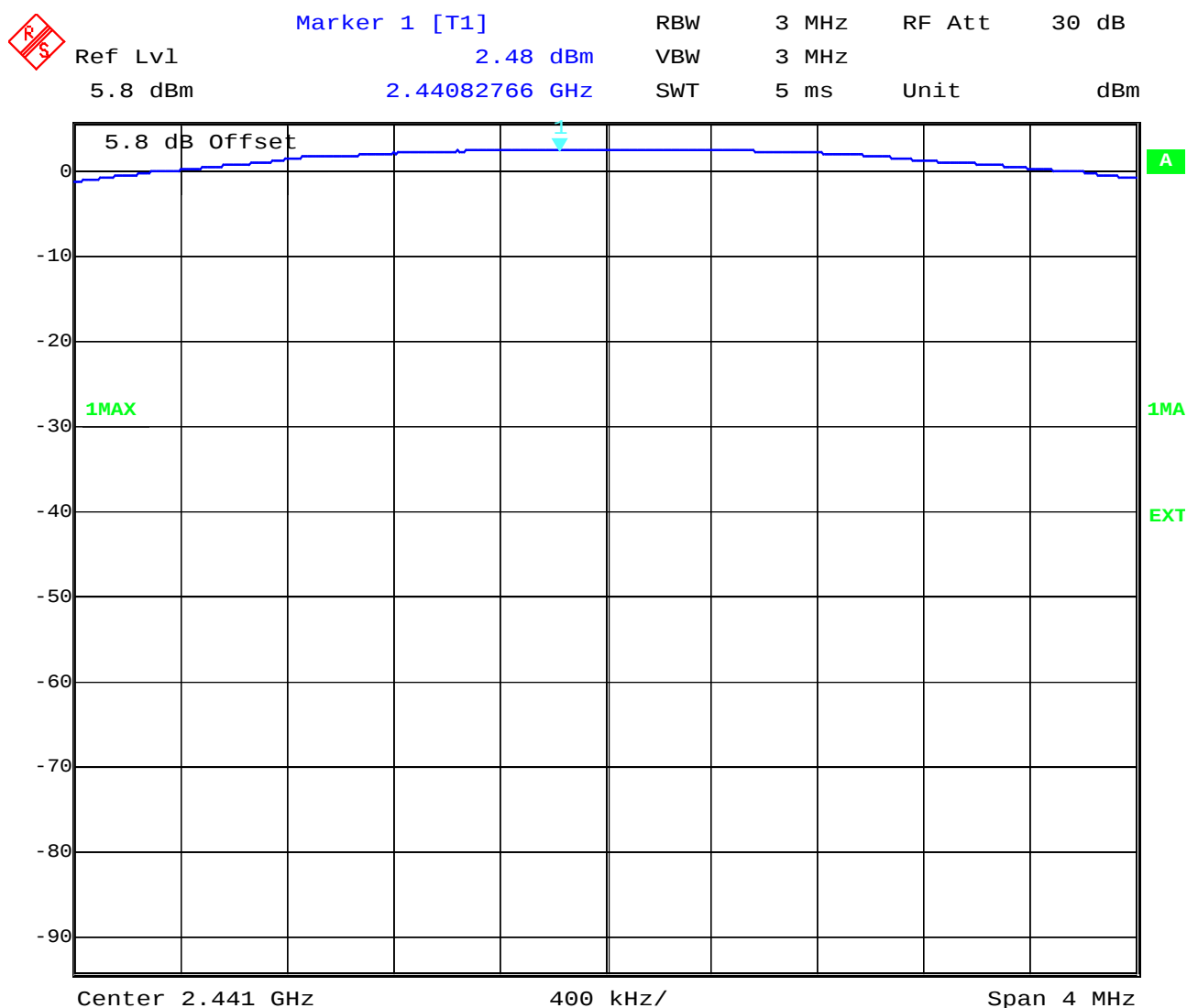
Relative humidity : 32%

Peak output power (conducted)

§15.247 (b)

Channel 2: 2.48 dBm at 2441 MHz

De facto EIRP with 1.0 dBI max. antenna gain is 1.48 dBm / 1.41 mW



Date: 10.DEC.2001 08:02:09

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

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Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

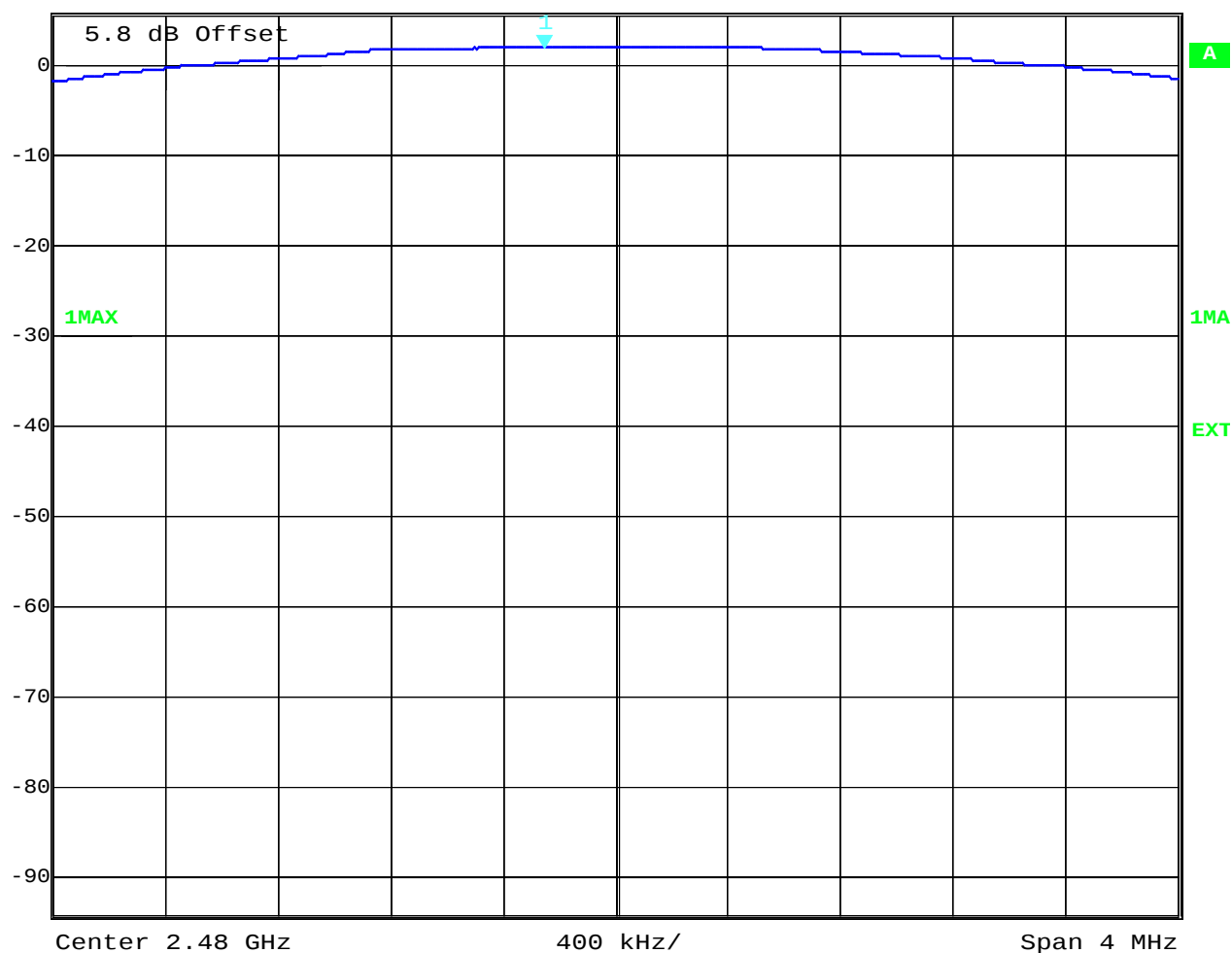
Peak output power (conducted)

§15.247 (b)

Channel 3: 1.97 dBm at 2480 MHz

De facto EIRP with -1.0 dBI max. antenna gain is 0.97 dBm / 1.25 mW


 Marker 1 [T1] RBW 3 MHz RF Att 30 dB
 Ref Lvl 1.97 dBm VBW 3 MHz
 5.8 dBm 2.47974749 GHz SWT 5 ms Unit dBm



Date: 10.DEC.2001 08:00:35

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

MAXIMUM PEAK OUTPUT POWER (RADIATED)

SUBCLAUSE § 15.247 (b) (1)

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (mW)		
Frequency (MHz)		2402	2441	2480
$T_{nom}(20)^{\circ}C$	$V_{nom}(3,6)V$	1.70	1.28	1.23
Maximum deviation from output power under extreme test conditions (dBc)		not applicable	not applicable	not applicable
Measurement uncertainty		$\pm 3dB$		

RBW/VBW : 3 MHz

Measured at a distance of 3m

LIMIT

SUBCLAUSE § 15.247 (b) (1)

Frequency range	RF power output
2400-2483.5 MHz	1.0 Watt

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

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Equipment under test : NPL-1

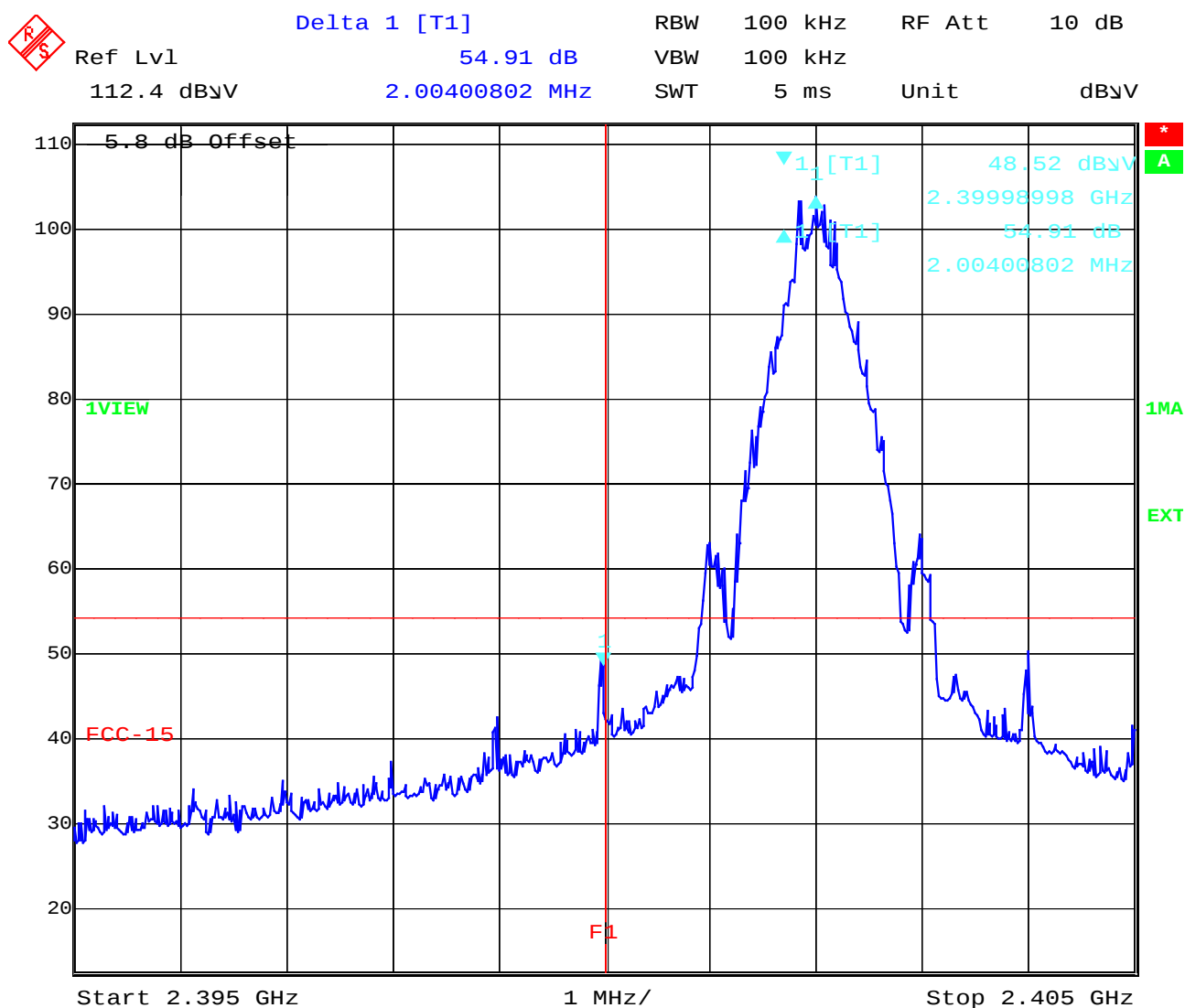
Ambient temperature : 21,5°C

Relative humidity : 32%

Band-edge compliance of conducted emissions

§15.247 (c)

Low frequency section (hopping off)



Date: 10.DEC.2001 08:25:31

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Test report nr.: 4_0448-02-02/01

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Equipment under test : NPL-1

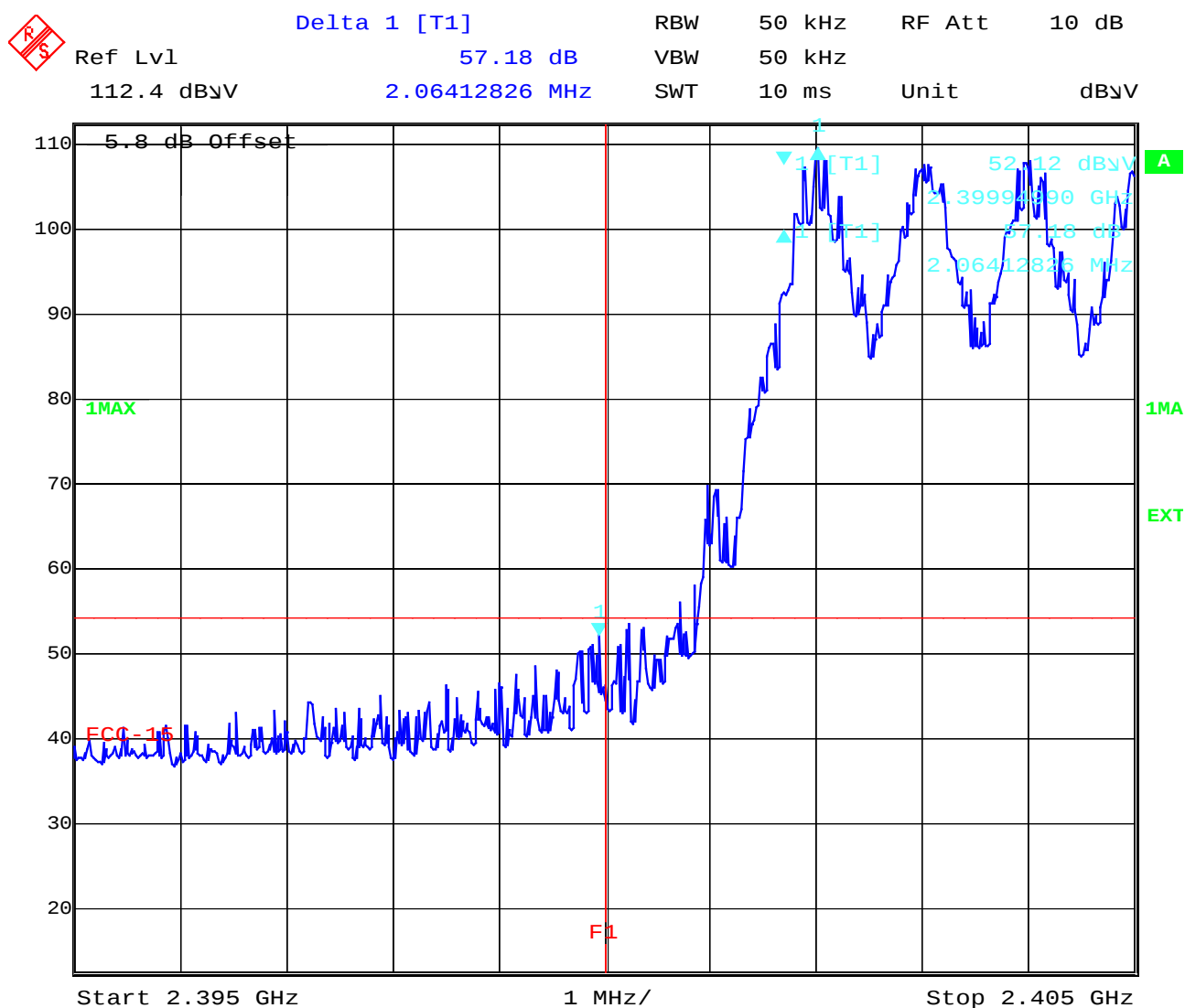
Ambient temperature : 21,5°C

Relative humidity : 32%

Band-edge compliance of conducted emissions

§15.247 (c)

Low frequency section (hopping on)



Date: 10.DEC.2001 08:19:02

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

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Equipment under test : NPL-1

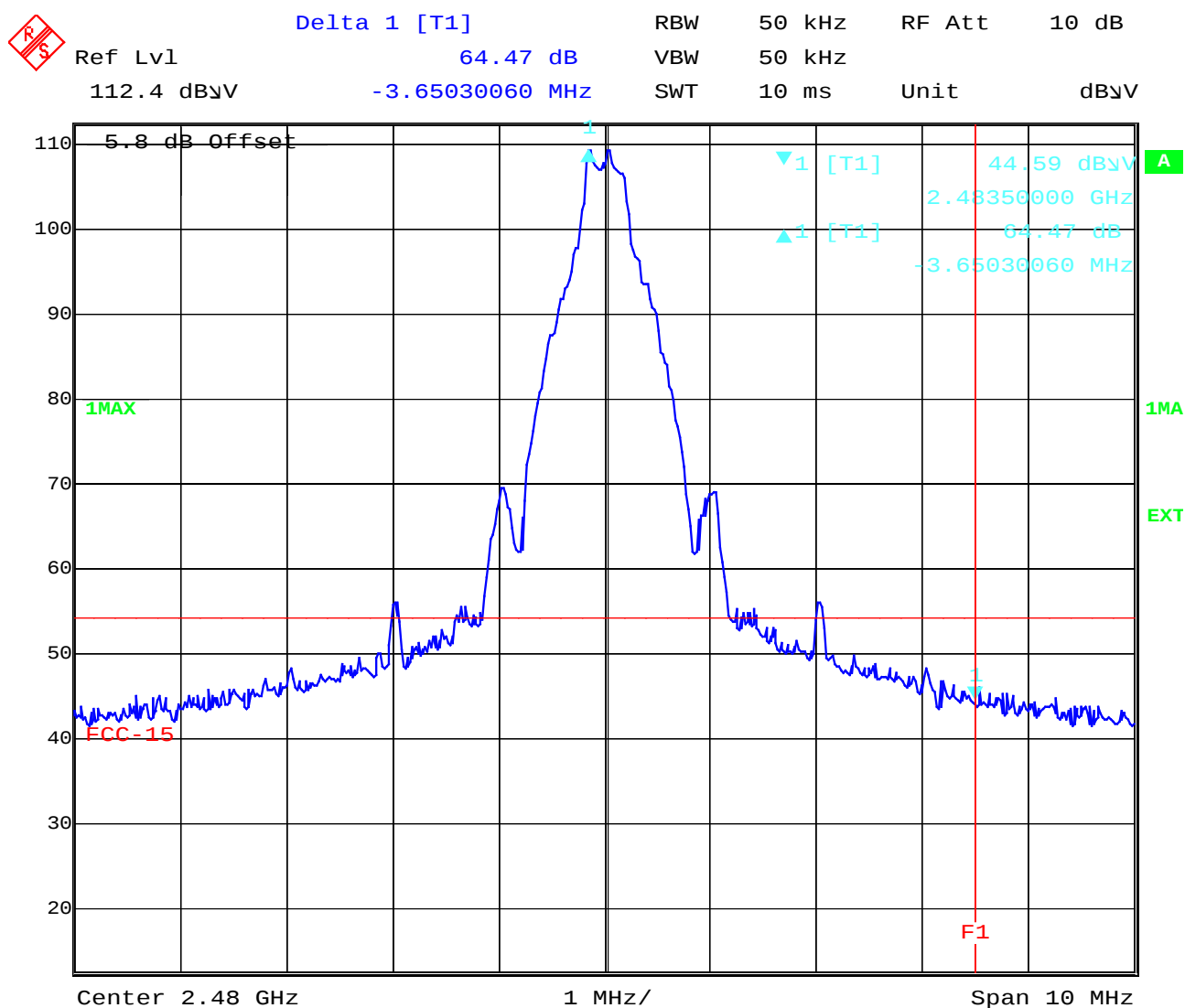
Ambient temperature : 21,5°C

Relative humidity : 32%

Band-edge compliance of conducted emissions

§15.247 (c)

high frequency section (hopping off)



Date: 10.DEC.2001 08:14:24

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

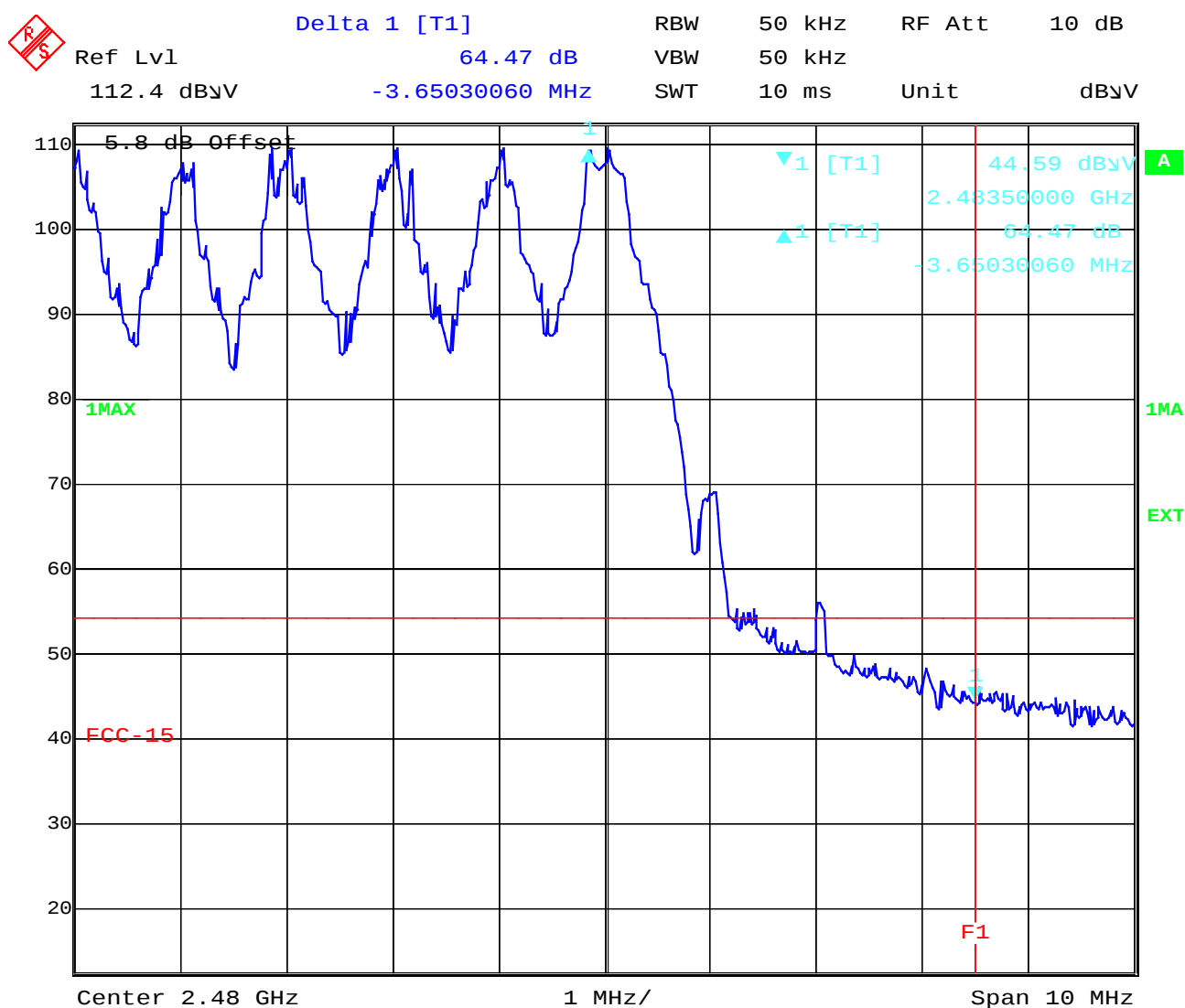
Ambient temperature : 21,5°C

Relative humidity : 32%

Band-edge compliance of conducted emissions

§15.247 (c)

high frequency section (hopping on)



Date: 10.DEC.2001 08:17:28

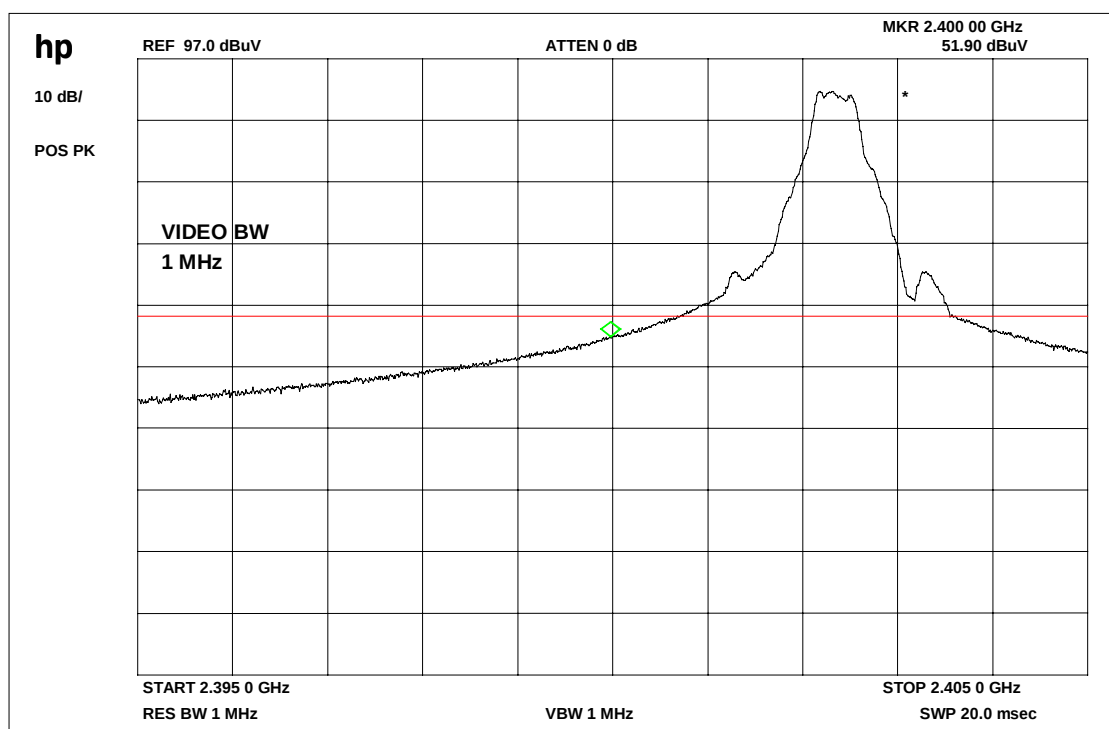
REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

Band-edge compliance radiated



REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

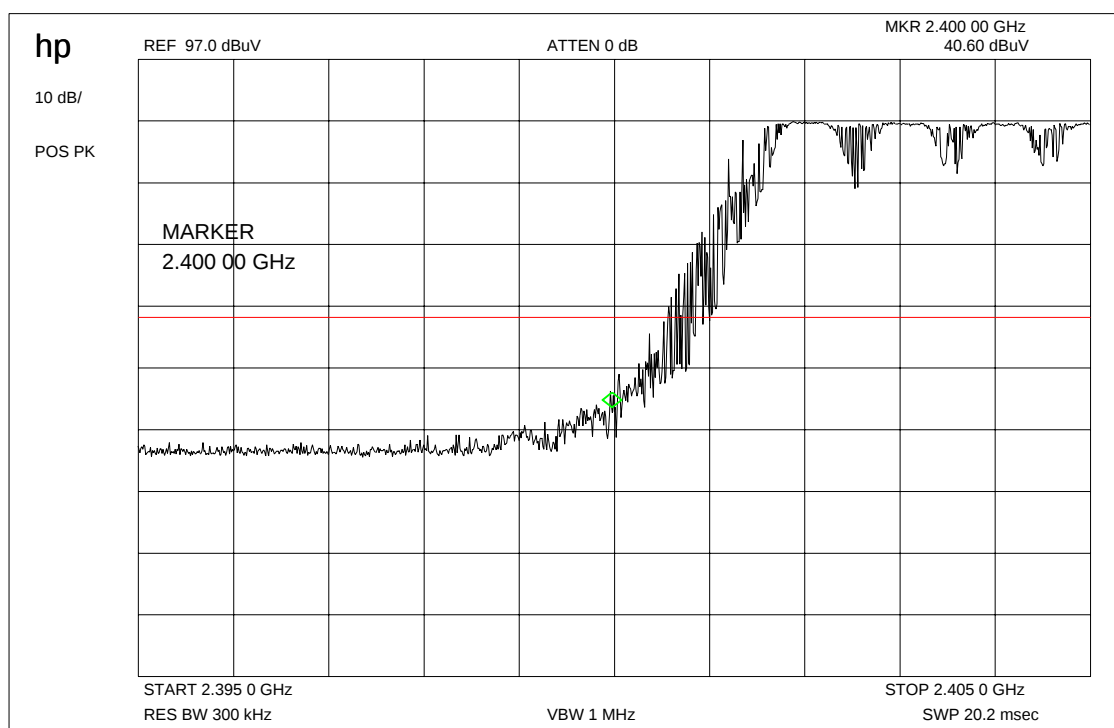
17-24

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

Band-edge compliance radiated



This measurement was made to show that the behavior of the system is conform to

FCC 15.205 (restricted bands)

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

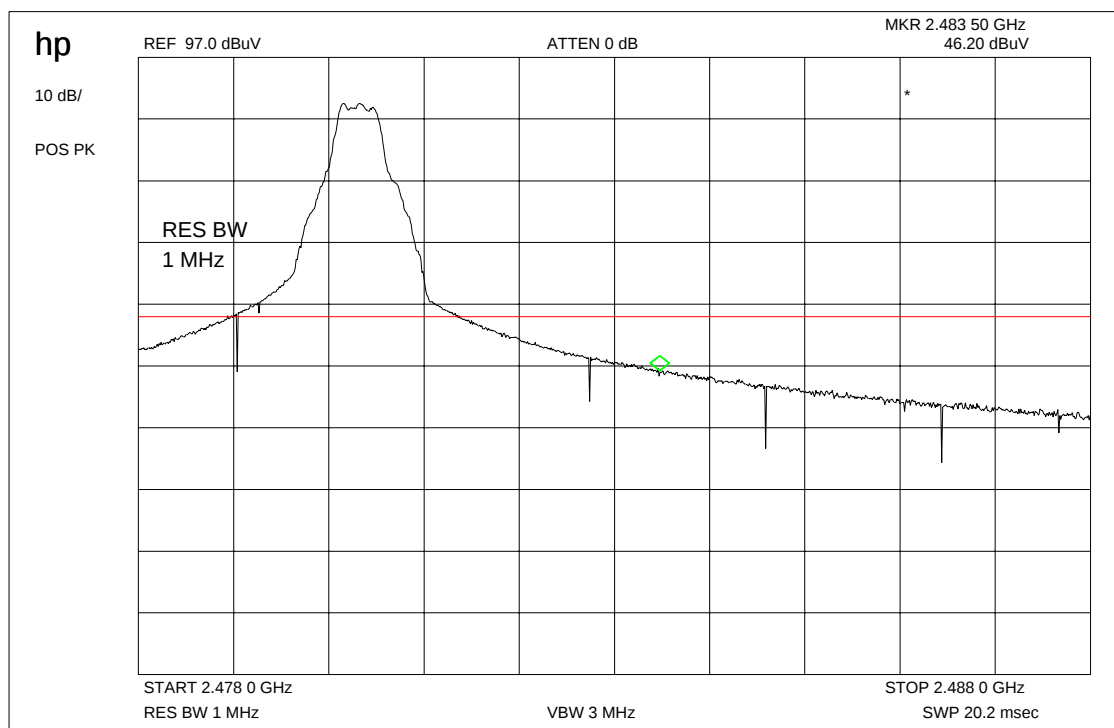
17-24

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

Band-edge compliance radiated



This measurement was made to show that the behavior of the system is conform to

FCC 15.205 (restricted bands)

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

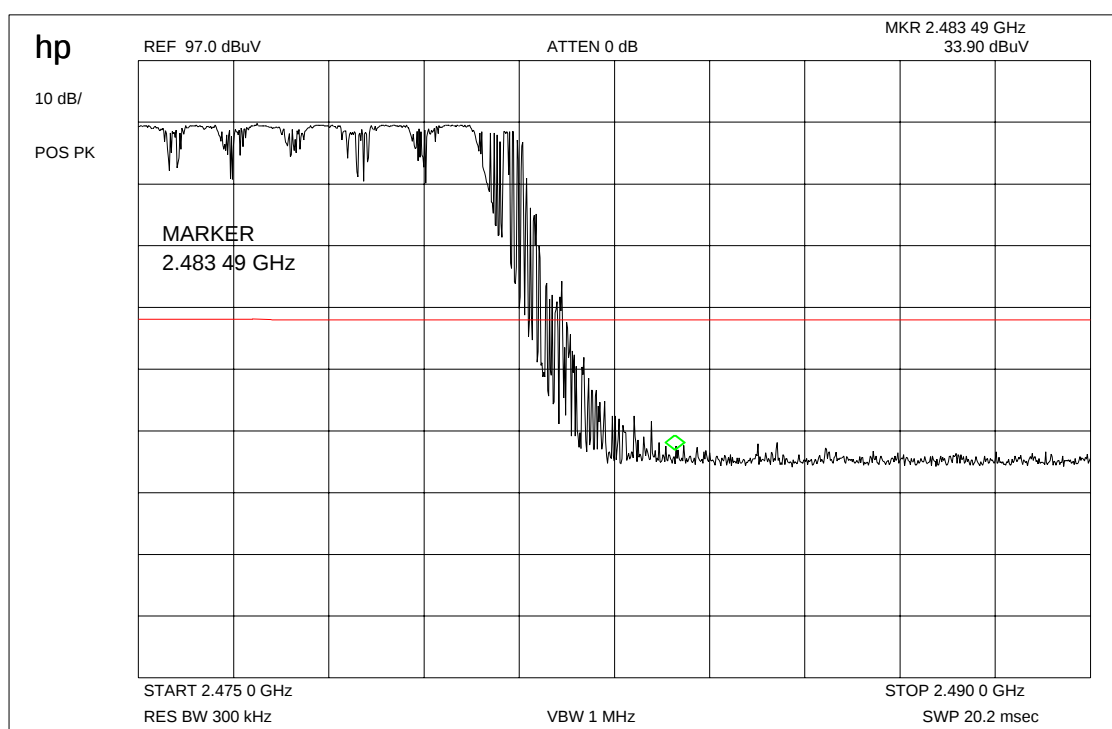
17-24

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

Band-edge compliance radiated



This measurement was made to show that the behavior of the system is conform to
FCC 15.205 (restricted bands)

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

17-24

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS- Conducted (Transmitter)

§ 15.247 (c) (1)

EMISSION LIMITATIONS					
f (MHz)		amplitude of emission (dBm)	limit max. allowed emmission power	actual attenuation below frequency of operation (dB)	results
2402		2.75	30 dBm	-	Operating frequency
all peaks <<limit			-20 dBc	see plot	complies
2441		2.48	30 dBm	-	Operating frequency
all peaks <<limit			-20 dBc	see plot	complies
2480		1.98	30 dBm		Operating frequency
all peaks <<limit			-20 dBc	see plot	complies
Measurement uncertainty		± 3dB			

RBW : 100 kHz VBW: 1 MHz

For emissions that fall into restricted bands you find the radiated emissions later in the report.

LIMITS

SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Equipment under test : NPL-1

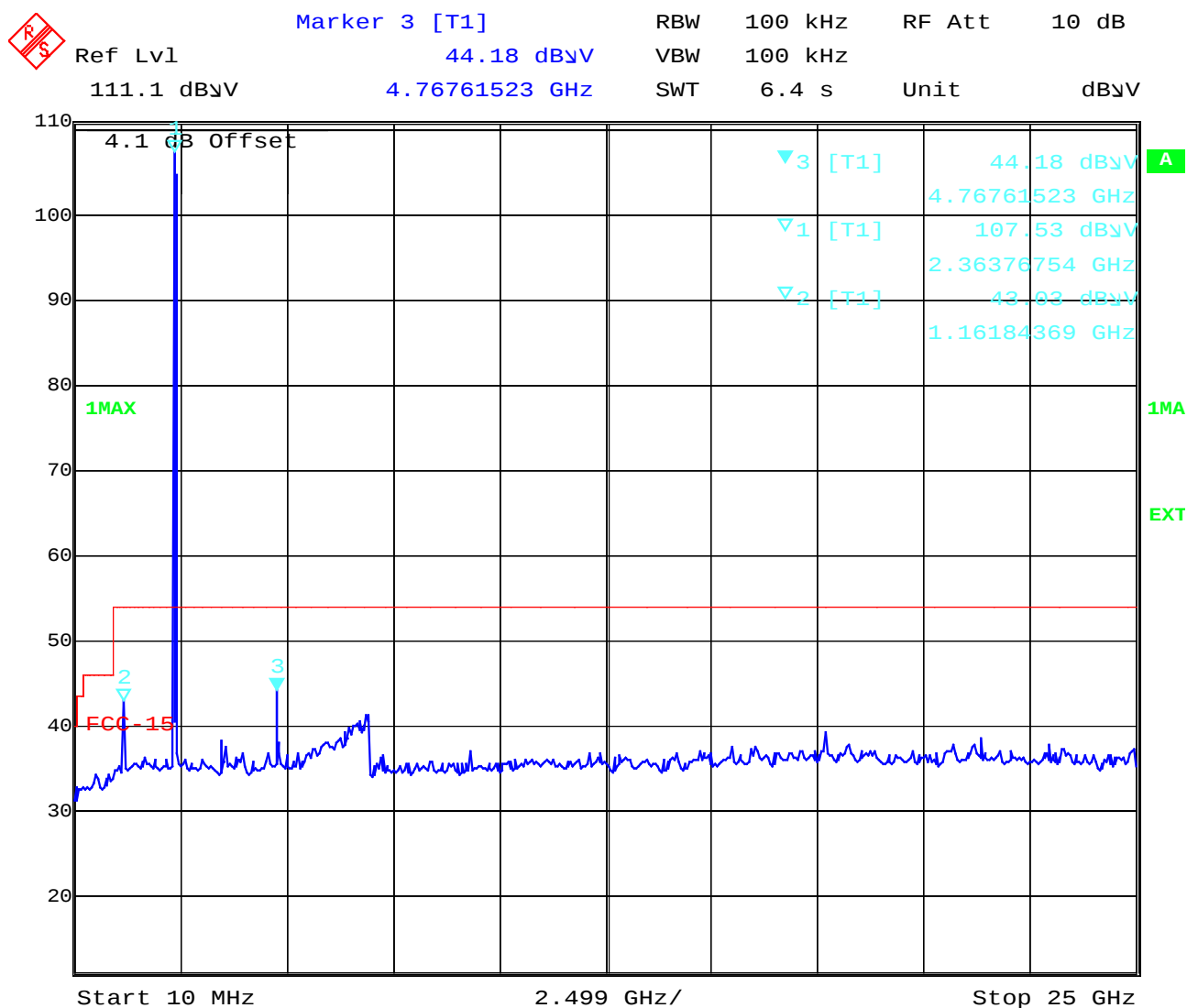
Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS- Conducted (Transmitter)

§ 15.247 (c) (1)

Channel 1: 10 MHz - 25 GHz



Date: 10.DEC.2001 07:52:56

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Test report nr.: 4_0448-02-02/01

Issue Date: 06.12.2001

Page 35 (75)

Equipment under test : NPL-1

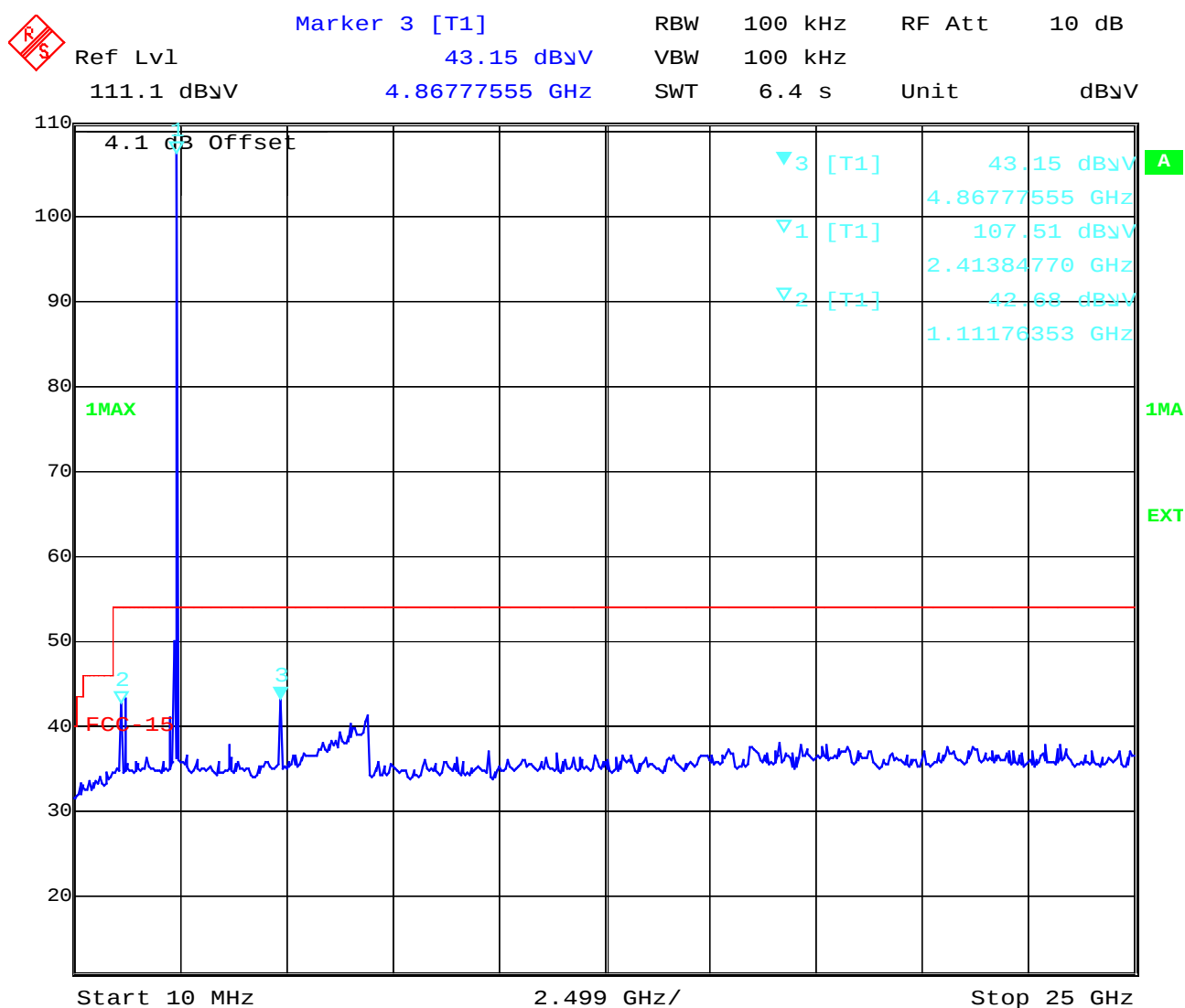
Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS- Conducted (Transmitter)

§ 15.247 (c) (1)

Channel 2: 10 MHz – 25 GHz



Date: 10.DEC.2001 07:54:57

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Test report nr.: 4_0448-02-02/01

Issue Date: 06.12.2001

Page 36 (75)

Equipment under test : NPL-1

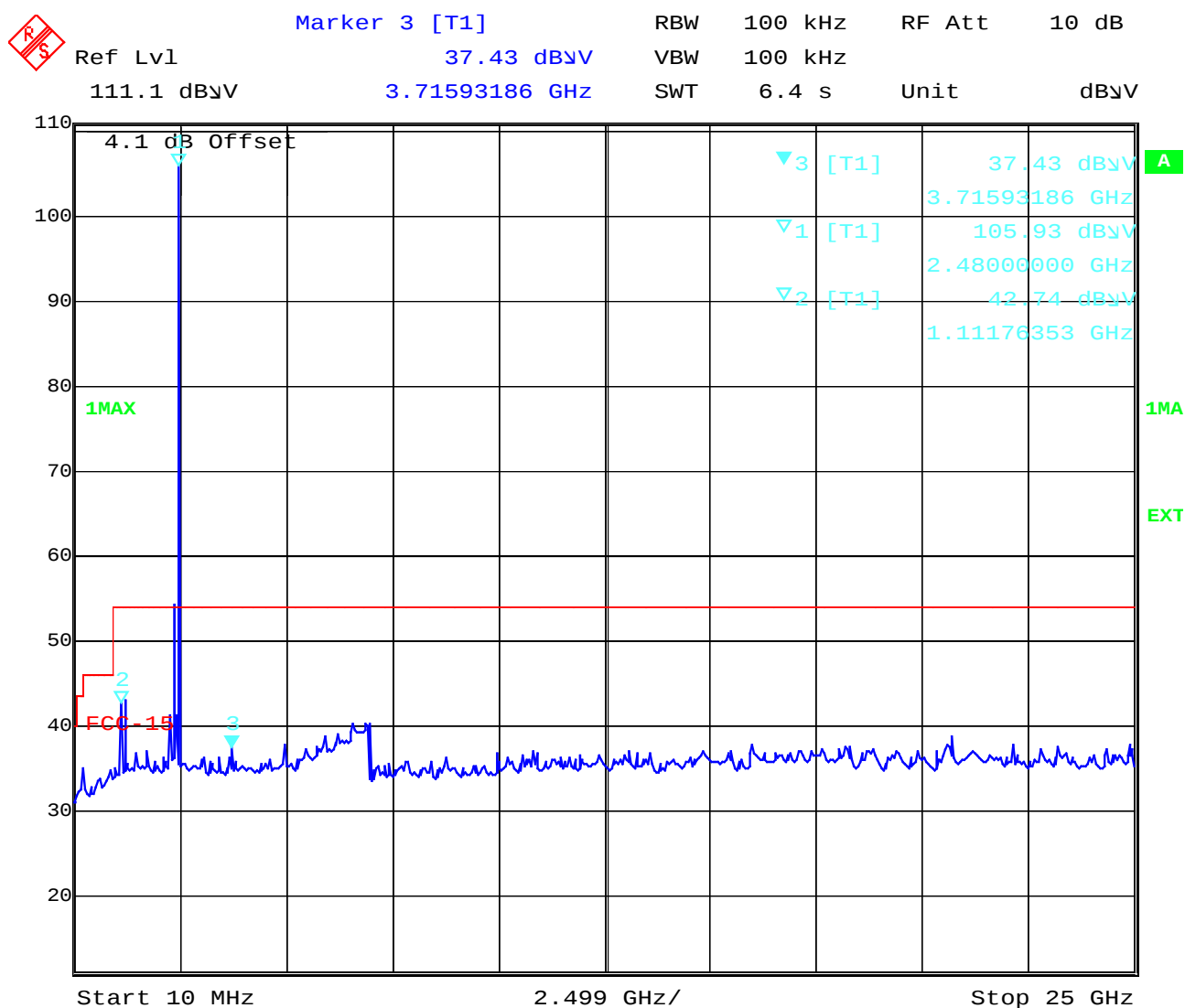
Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS- Conducted (Transmitter)

§ 15.247 (c) (1)

Channel 3: 10 MHz – 25 GHz



Date: 10.DEC.2001 07:56:38

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

SPURIOUS RADIATED EMISSION

§ 15.247 (c) (1)

EMISSION LIMITATIONS					
f (MHz)	polarization	amplitude of emission (dBµV/m) QUASIPeAK	amplitude of emission (dBµV/m) average	limit max. allowed emmission power (dBµV/m)	results
CH 1					
no peak found					
CH 2					
no peak found					
CH 3					
no peak found					
Measurement uncertainty			± 3dB		

LIMITS

SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

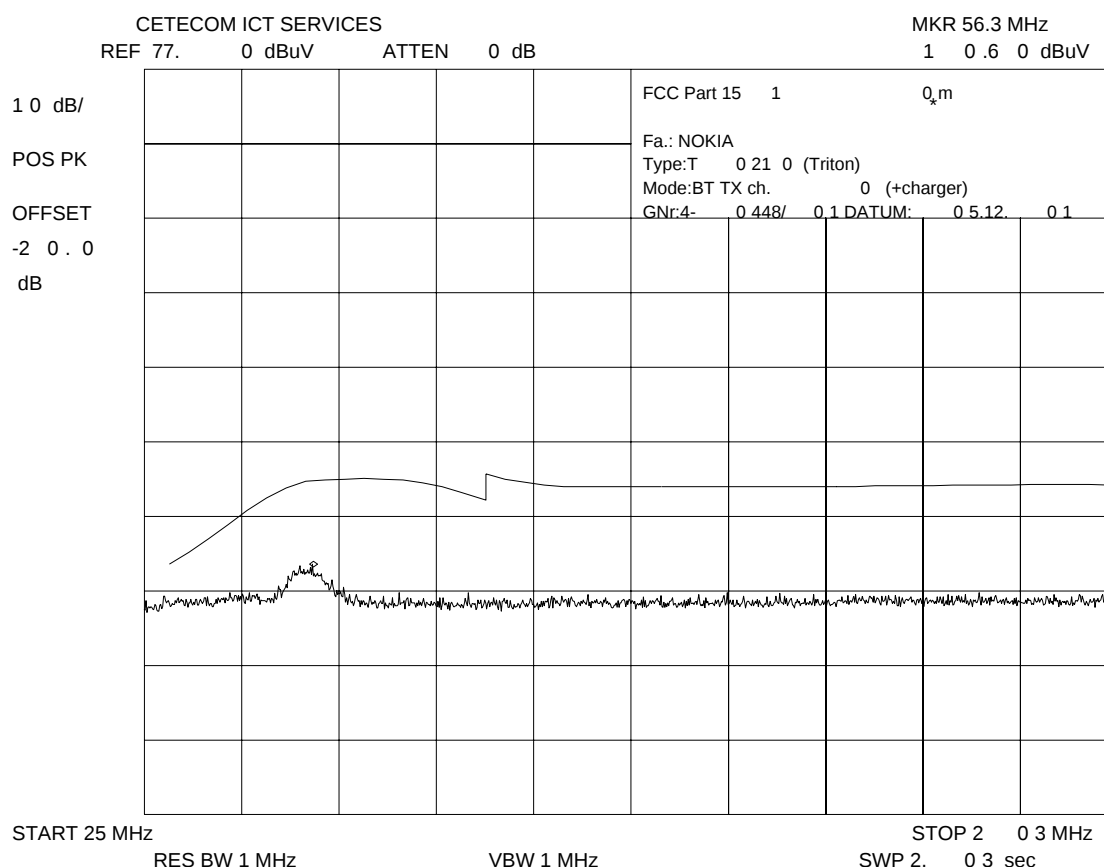
Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS (Transmitter) SUBCLAUSE § 15.247 (c) (1)

2402 MHz



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

LIMITS

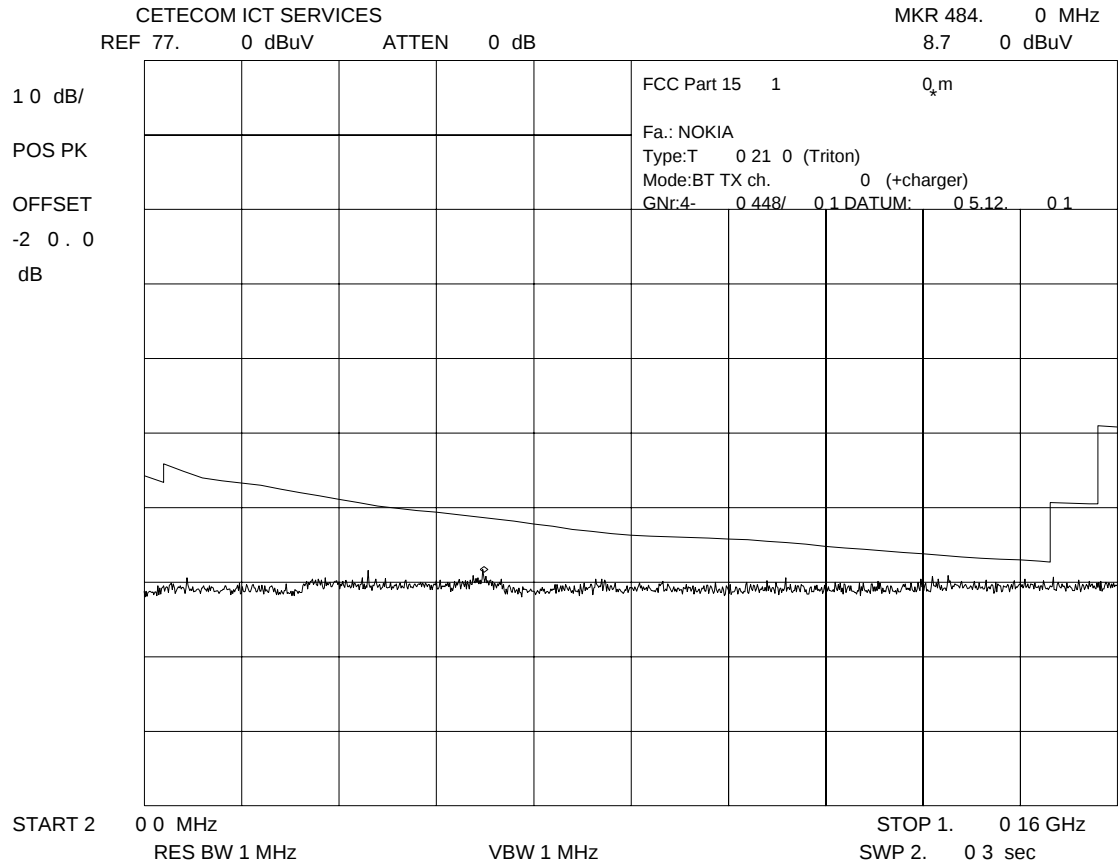
SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1
Ambient temperature : 21,5°C
Relative humidity : 32%
EMISSION LIMITATIONS (Transmitter) SUBCLAUSE § 15.247 (c) (1)

2402 MHz



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz $f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

LIMITS **SUBCLAUSE § 15.247 (c)**

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

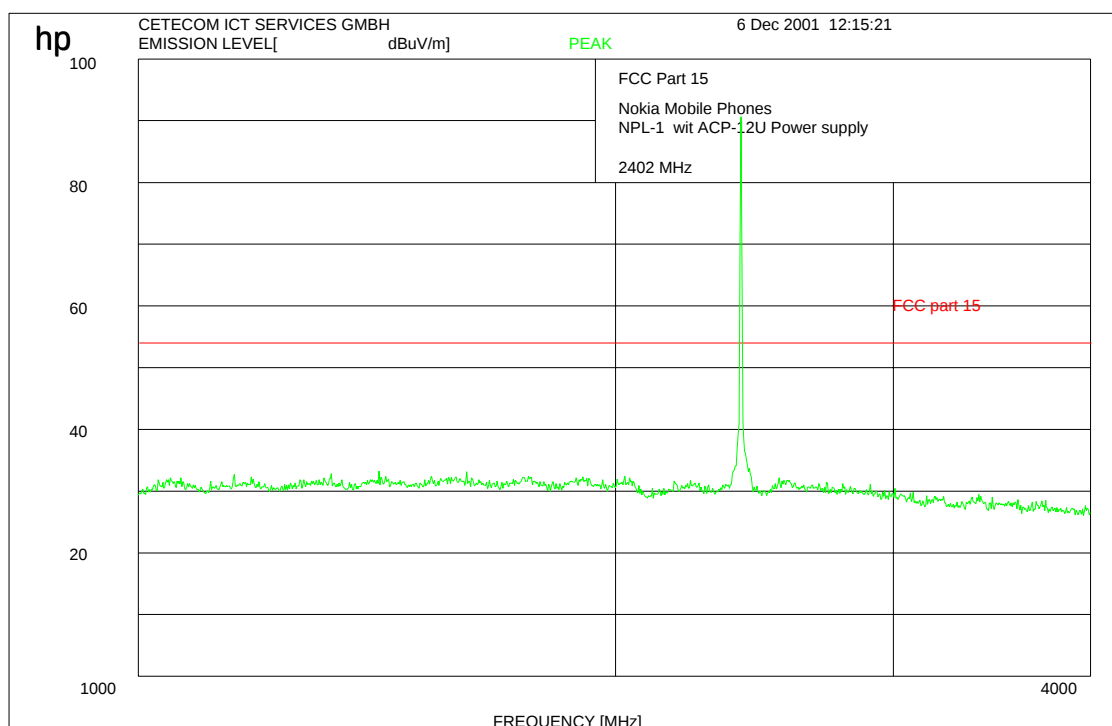
Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS (Transmitter) SUBCLAUSE § 15.247 (c) (1)

2402 MHz



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

LIMITS

SUBCLAUSE § 15.247 (c)

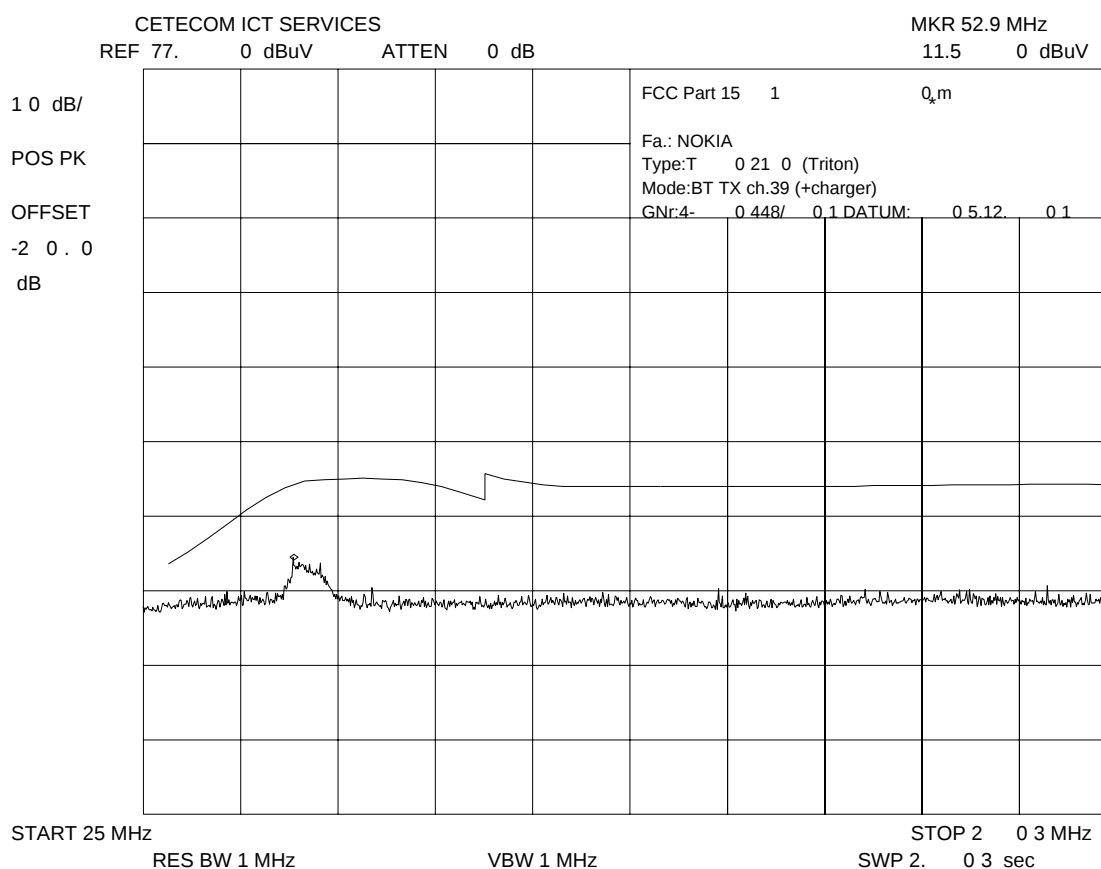
In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1
 Ambient temperature : 21,5°C
 Relative humidity : 32%

EMISSION LIMITATIONS (Transmitter) SUBCLAUSE § 15.247 (c) (1)

2441 MHz



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

LIMITS

SUBCLAUSE § 15.247 (c)

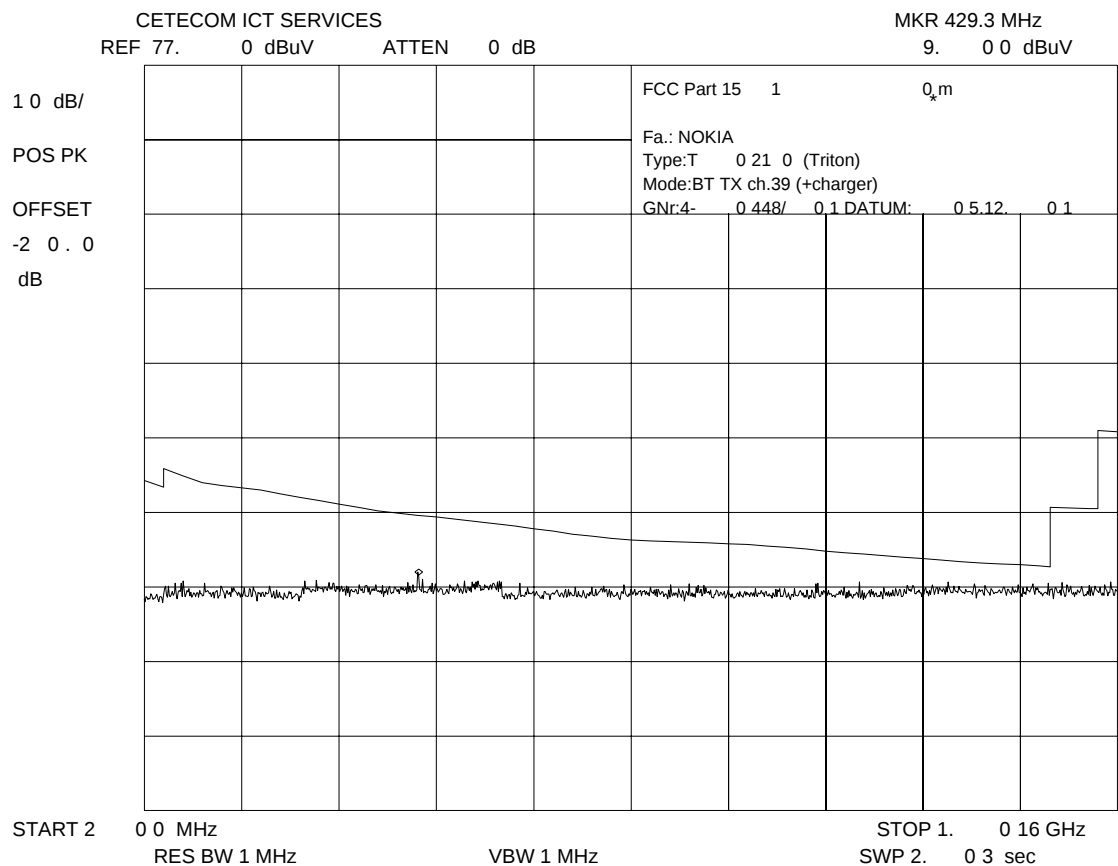
In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
 (for reference numbers see test equipment listing)

Equipment under test : NPL-1
Ambient temperature : 21,5°C
Relative humidity : 32%

EMISSION LIMITATIONS (Transmitter) SUBCLAUSE § 15.247 (c) (1)

2441 MHz



f < 1 GHz : RBW/VBW: 100 kHz

f ≥ 1GHz : RBW/VBW: 1 MHz

LIMITS

SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

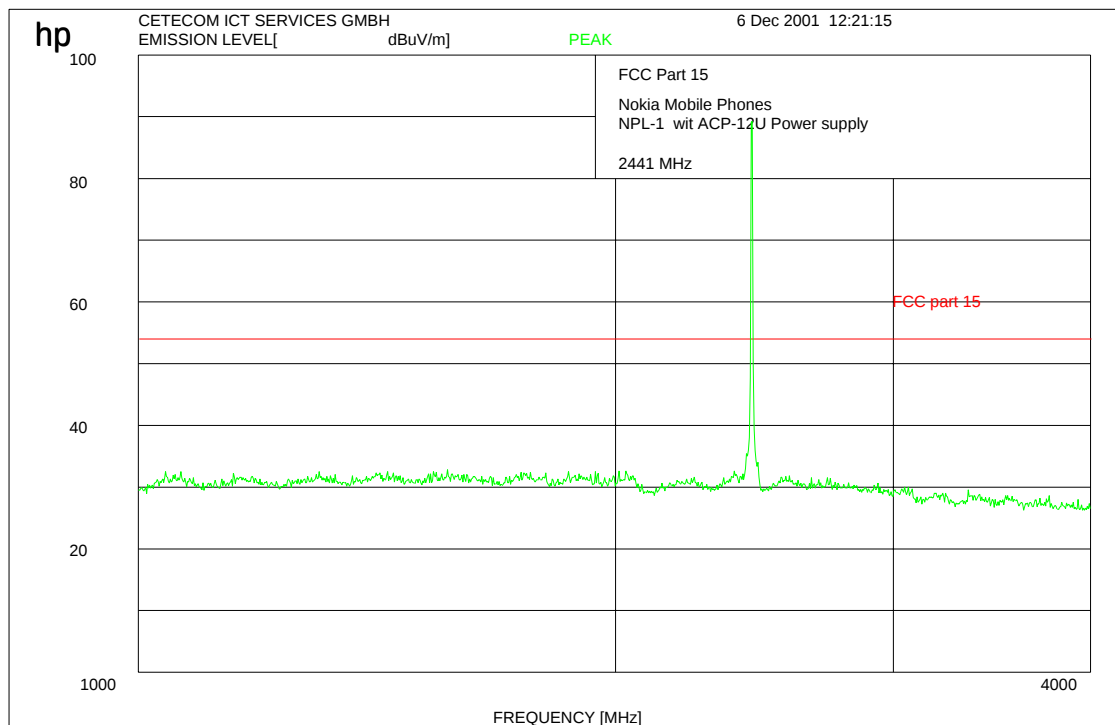
Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS (Transmitter) SUBCLAUSE § 15.247 (c) (1)

2441 MHz



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

LIMITS

SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Test report nr.: 4_0448-02-02/01 Issue Date: 06.12.2001 Page 44 (75)

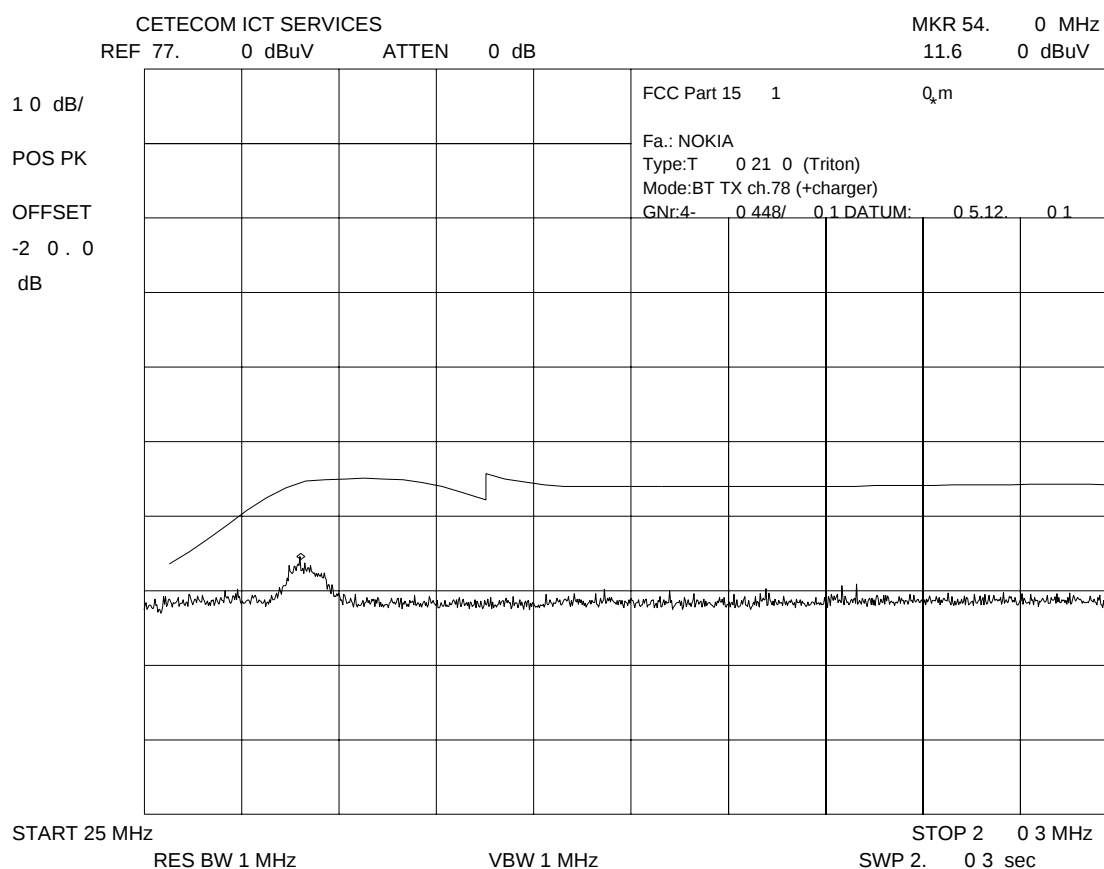
Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS (Transmitter) SUBCLAUSE § 15.247 (c) (1)

2480 MHz



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

LIMITS

SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

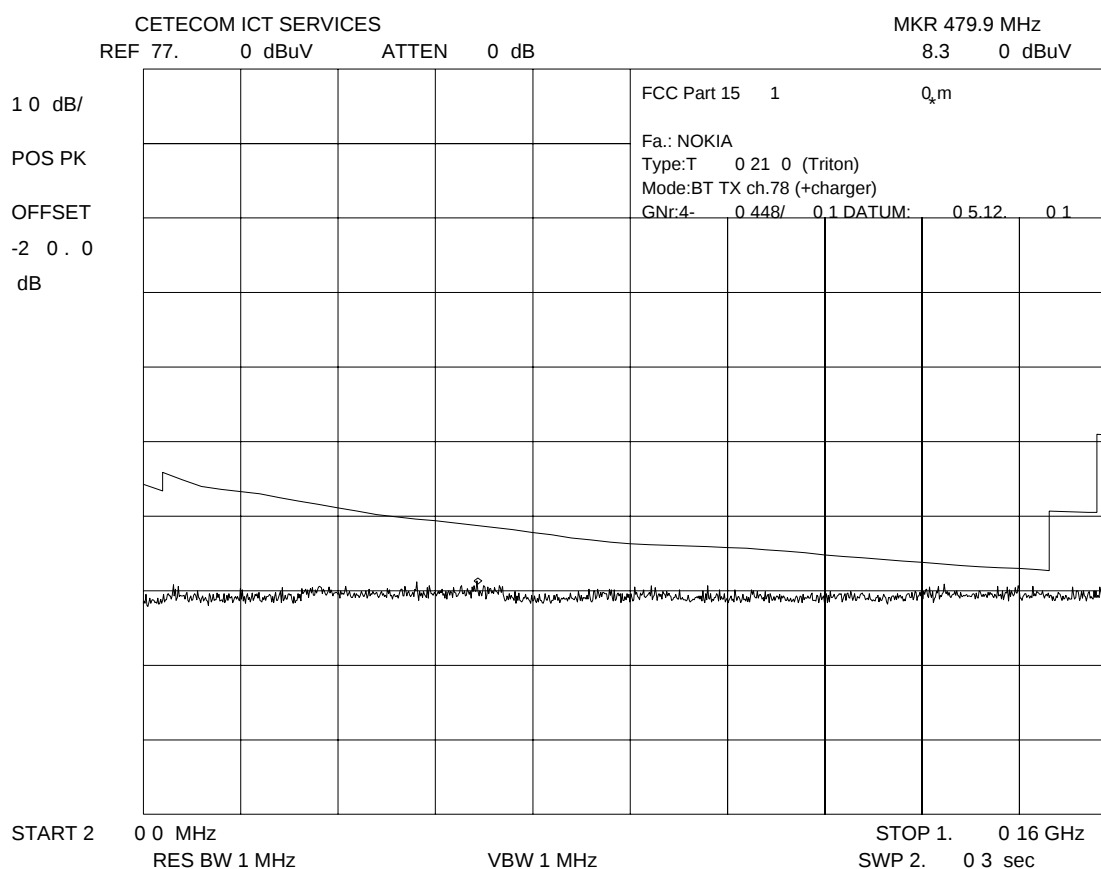
Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS (Transmitter) SUBCLAUSE § 15.247 (c) (1)

2480 MHz



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

LIMITS

SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

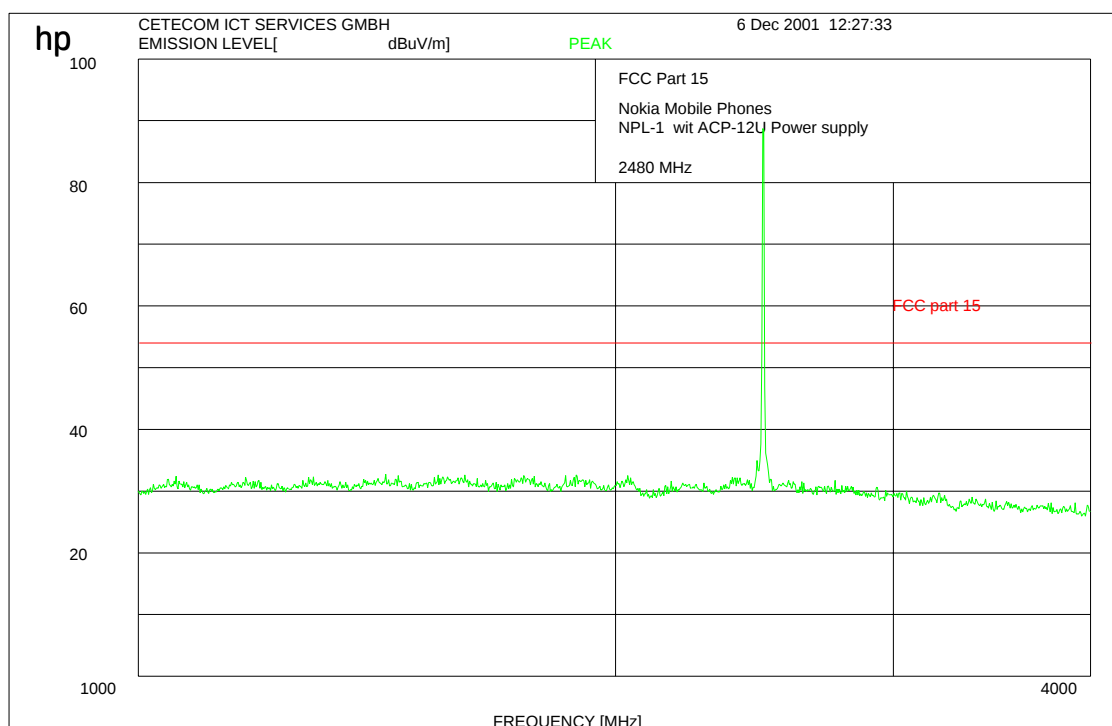
Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS (Transmitter) SUBCLAUSE § 15.247 (c) (1)

2480 MHz



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

LIMITS

SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

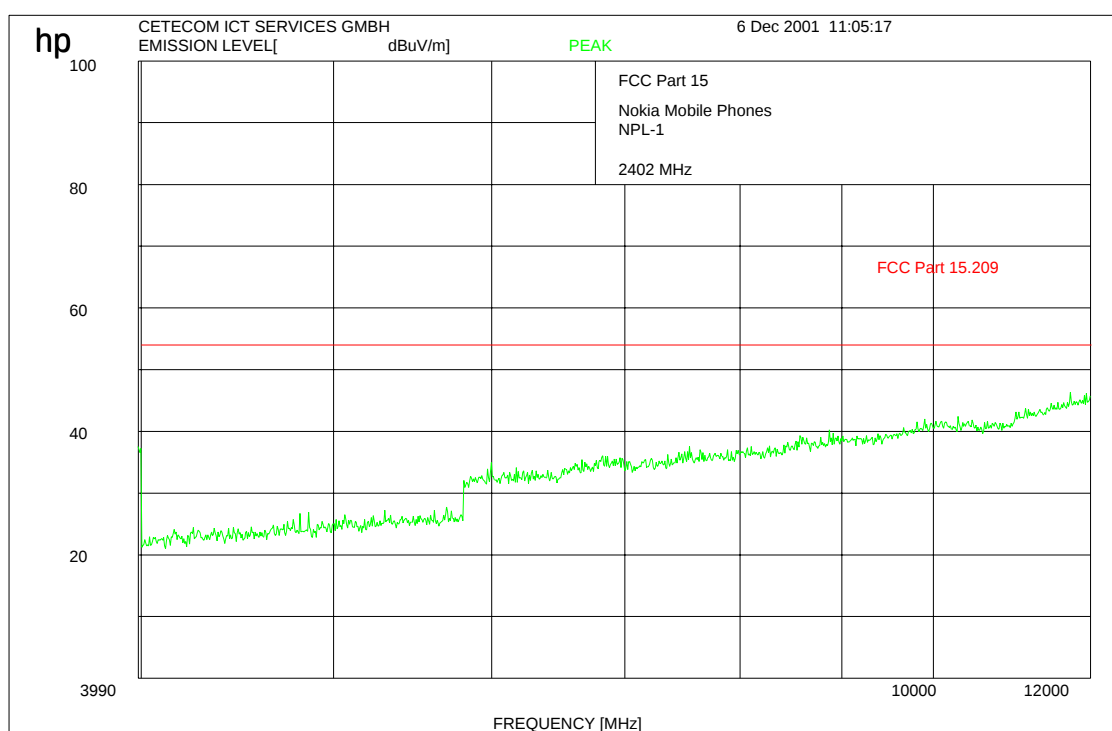
Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS (Transmitter)

CLAUSE § 15.247 (c) (1)

Channel 1



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

Carrier was suppressed by a stub tuner to avoid overload of the system.

LIMITS

SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

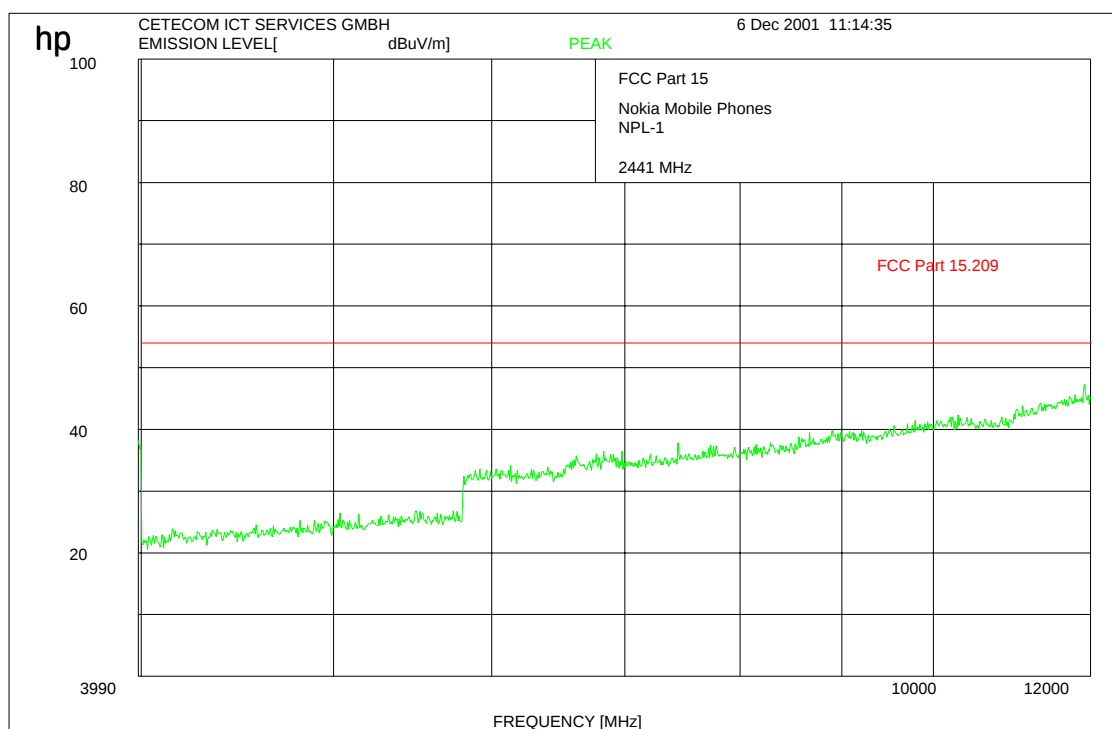
Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS (Transmitter)

CLAUSE § 15.247 (c) (1)

Channel 2



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

LIMITS

SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

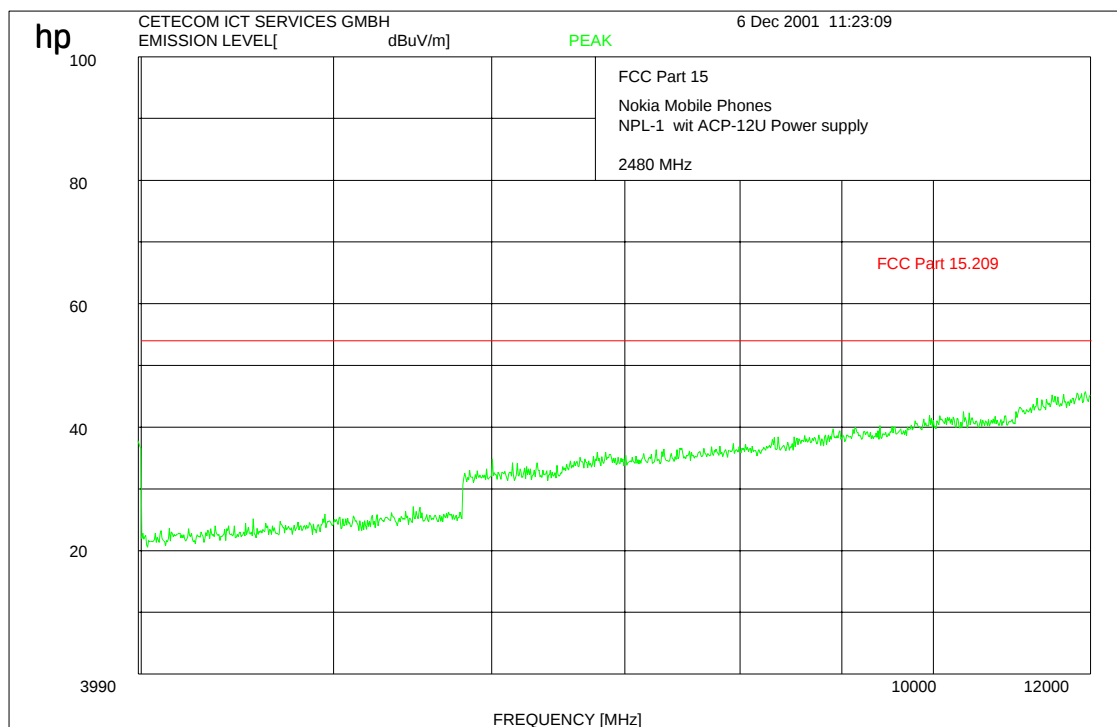
Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS (Transmitter)

CLAUSE § 15.247 (c) (1)

Channel 3



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

Carrier was suppressed by a stubb tuner to avoid overload of the system.

LIMITS

SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS (Transmitter)

CLAUSE § 15.247 (c) (1)

Channel 1-3 (this is valid for all 3 channels)



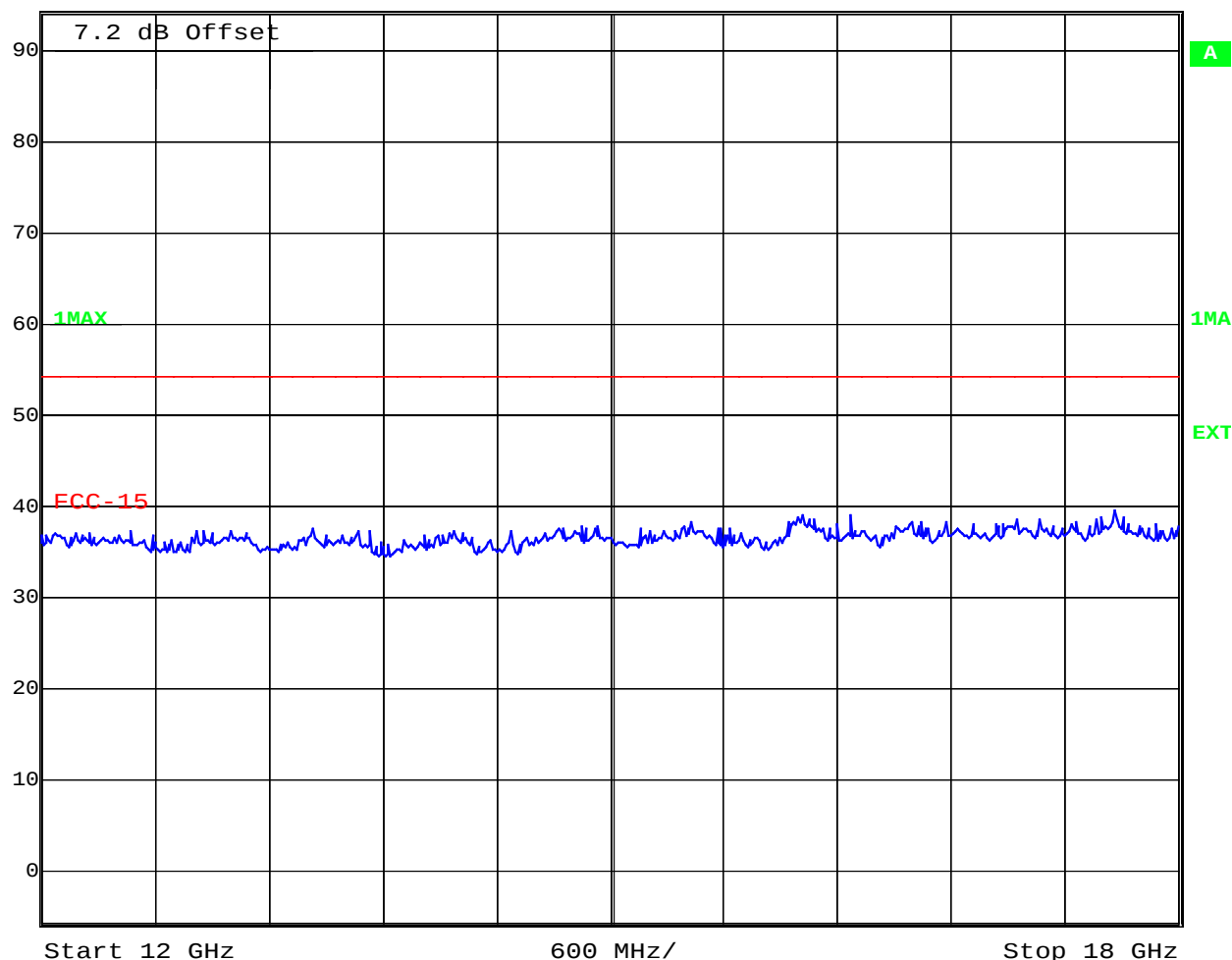
Ref Lvl

94.2 dBµV

RBW 1 MHz RF Att 0 dB

VBW 1 MHz

SWT 34 ms Unit dBµV



Date: 10.DEC.2001 11:12:04

LIMITS

SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

EMISSION LIMITATIONS (Transmitter)

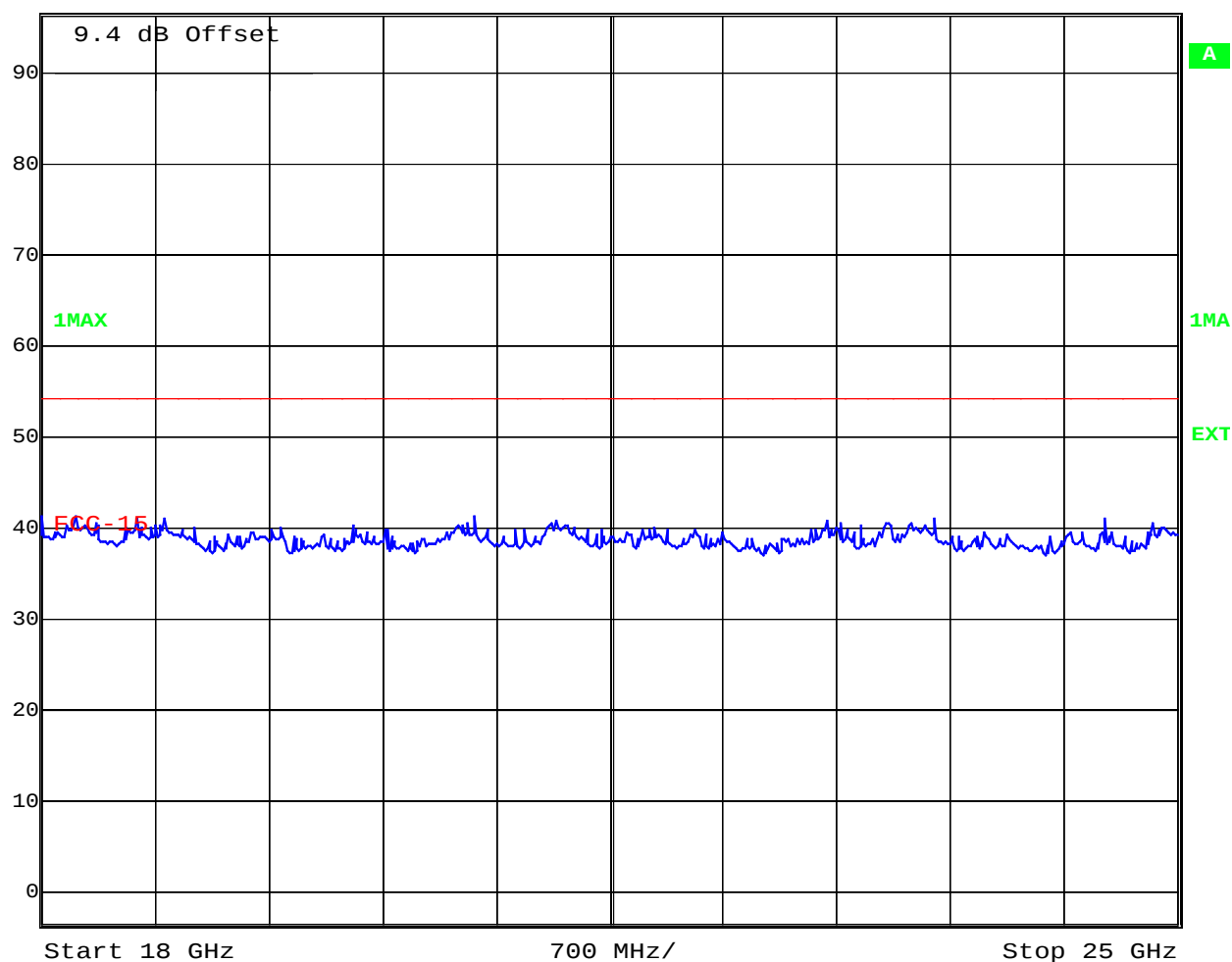
CLAUSE § 15.247 (c) (1)

Channel 1-3 (this is valid for all 3 channels)



Ref Lvl
96.4 dBµV

RBW 1 MHz RF Att 0 dB
VBW 1 MHz
SWT 40 ms Unit dBµV



Date: 10.DEC.2001 11:13:15

LIMITS

SUBCLAUSE § 15.247 (c)

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

RECEIVER SPURIOUS RADIATION

§ 15.209

Radiated

SPURIOUS EMISSIONS LEVEL (µV/m)								
CH 1 / 2 / 3								
f (MHz)	Detector	Level (µV/m)	f (MHz)	Detector	Level (µV/m)	f (MHz)	Detector	Level (µV/m)
no	peaks	found						
Measurement uncertainty			±3 dB					

 $f < 1 \text{ GHz} : \text{RBW/VBW: } 100 \text{ kHz}$
 $f \geq 1 \text{ GHz} : \text{RBW/VBW: } 1 \text{ MHz}$

Measurement distance see table

Limits

SUBCLAUSE § 15.209

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
above 960	500	3

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

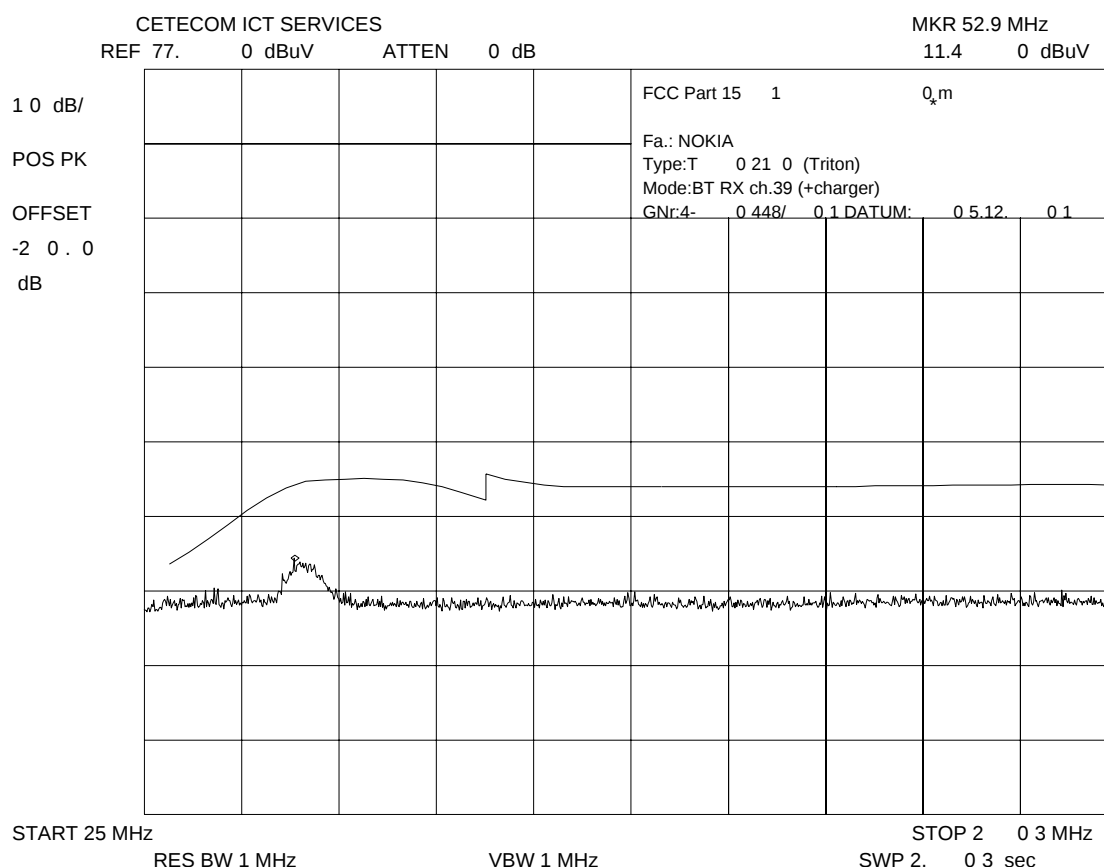
Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

RECEIVER SPURIOUS RADIATION

§ 15.209



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

Limits

SUBCLAUSE § 15.209

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
above 960	500	3

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

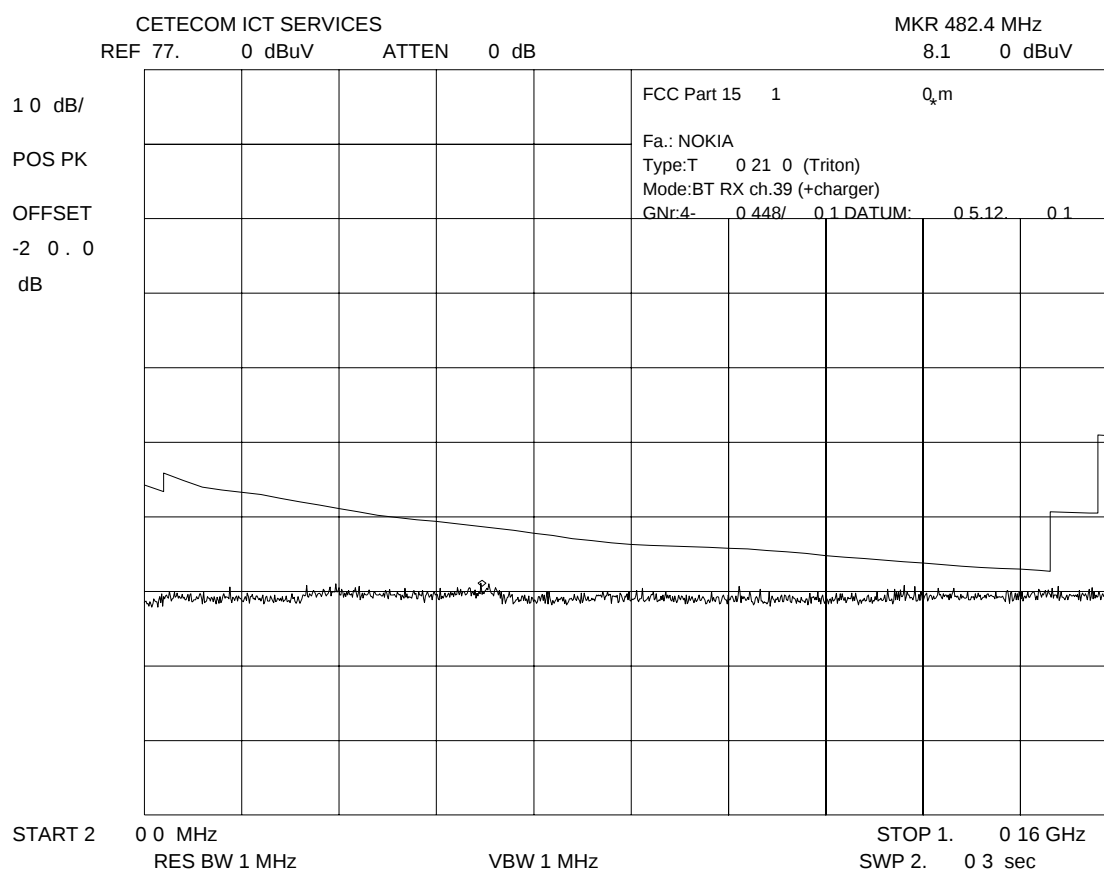
Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

RECEIVER SPURIOUS RADIATION

§ 15.209



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

Limits

SUBCLAUSE § 15.209

Frequency (MHz)	Field strength ($\mu\text{V/m}$)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
above 960	500	3

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

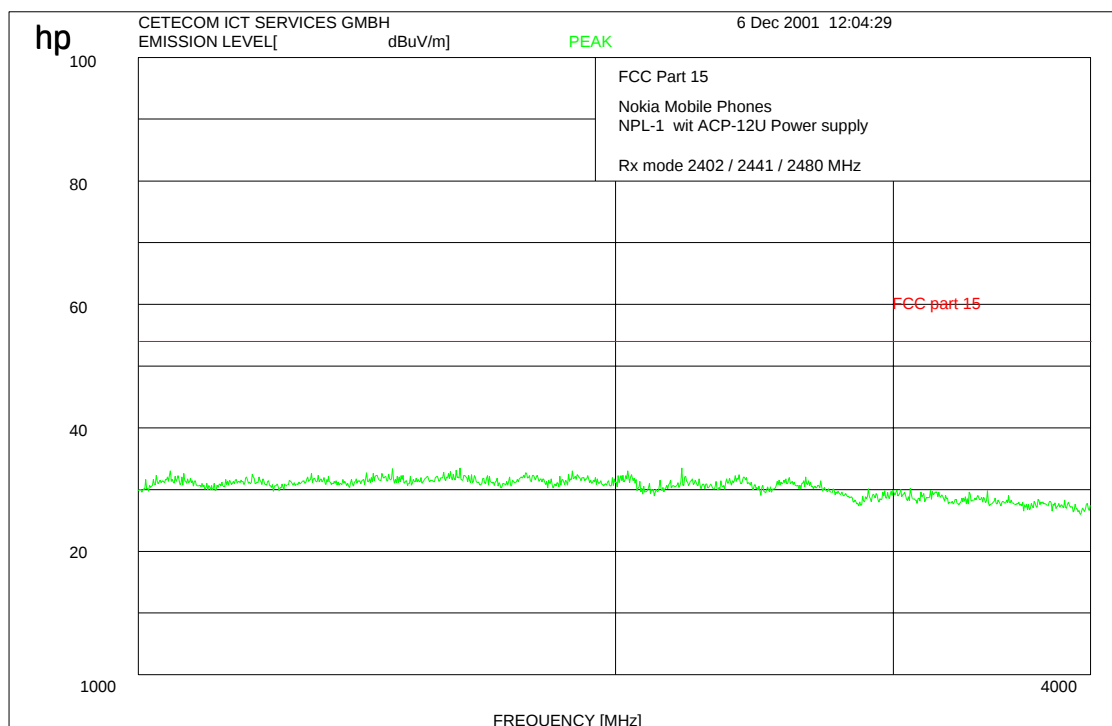
Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

RECEIVER SPURIOUS RADIATION

§ 15.209



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

Limits

SUBCLAUSE § 15.209

Frequency (MHz)	Field strength ($\mu\text{V/m}$)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
above 960	500	3

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

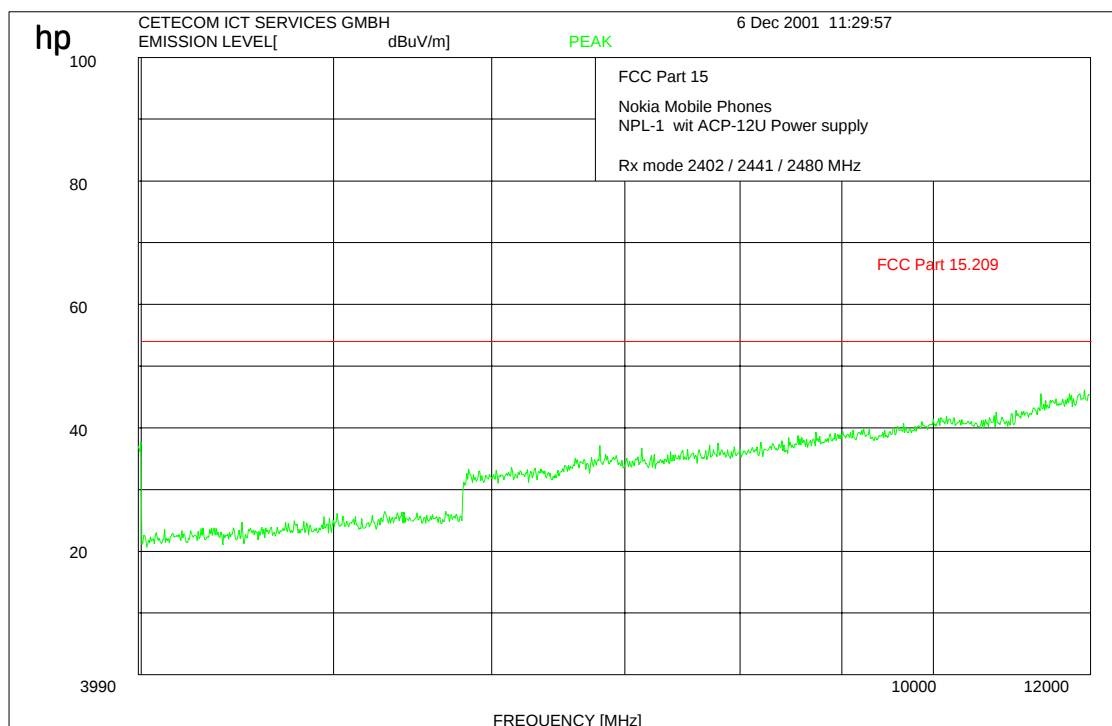
Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

RECEIVER SPURIOUS RADIATION

§ 15.209



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

Limits

SUBCLAUSE § 15.209

Frequency (MHz)	Field strength ($\mu\text{V/m}$)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
above 960	500	3

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED
(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

RECEIVER SPURIOUS RADIATION

§ 15.209

Peak



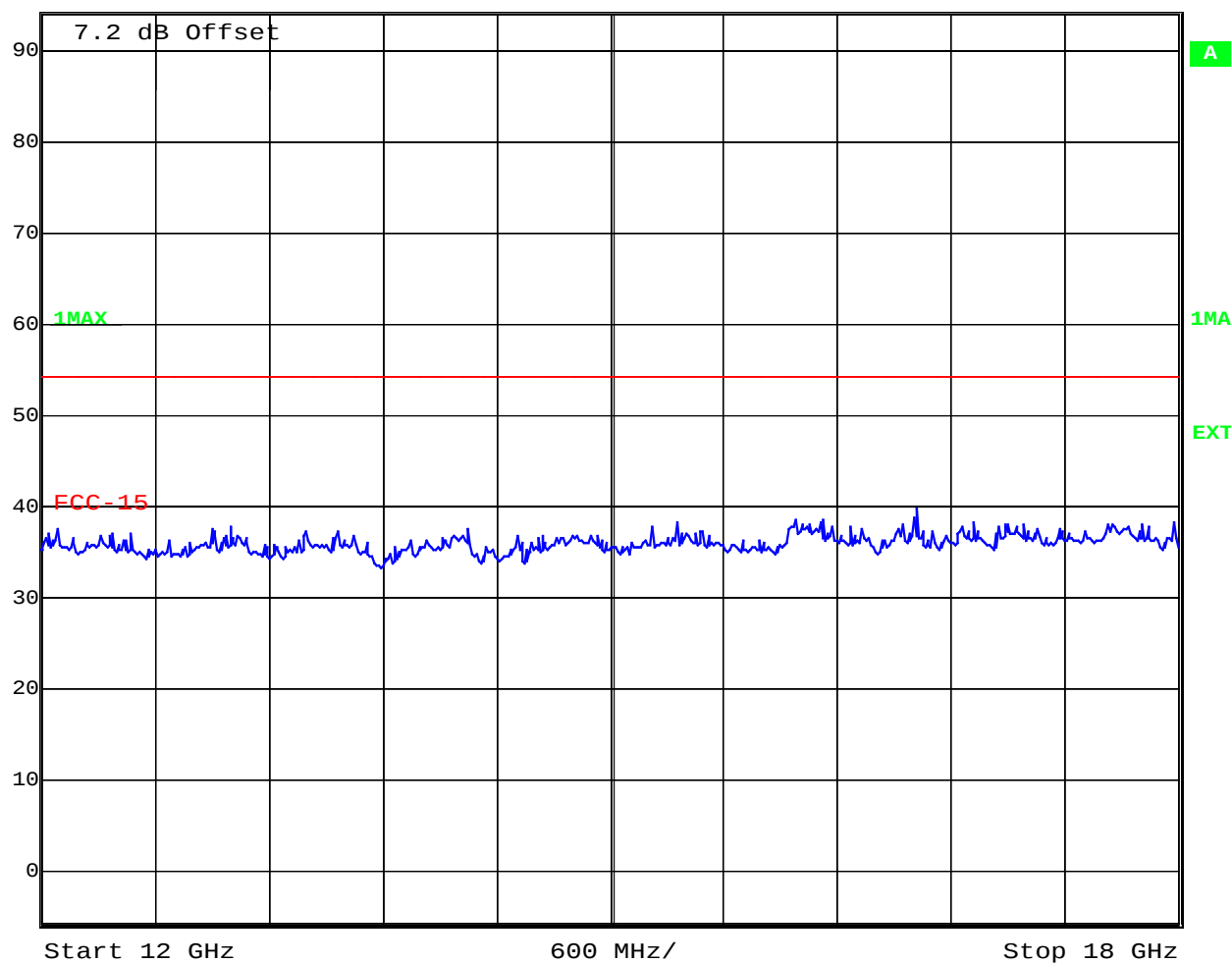
Ref Lvl

94.2 dBµV

RBW 1 MHz RF Att 0 dB

VBW 1 MHz

SWT 34 ms Unit dBµV



Date: 10.DEC.2001 11:12:26

f < 1 GHz : RBW/VBW: 100 kHz

f ≥ 1GHz : RBW/VBW: 1 MHz

Limits

SUBCLAUSE § 15.209

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
above 960	500	3

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

RECEIVER SPURIOUS RADIATION

§ 15.209

Peak



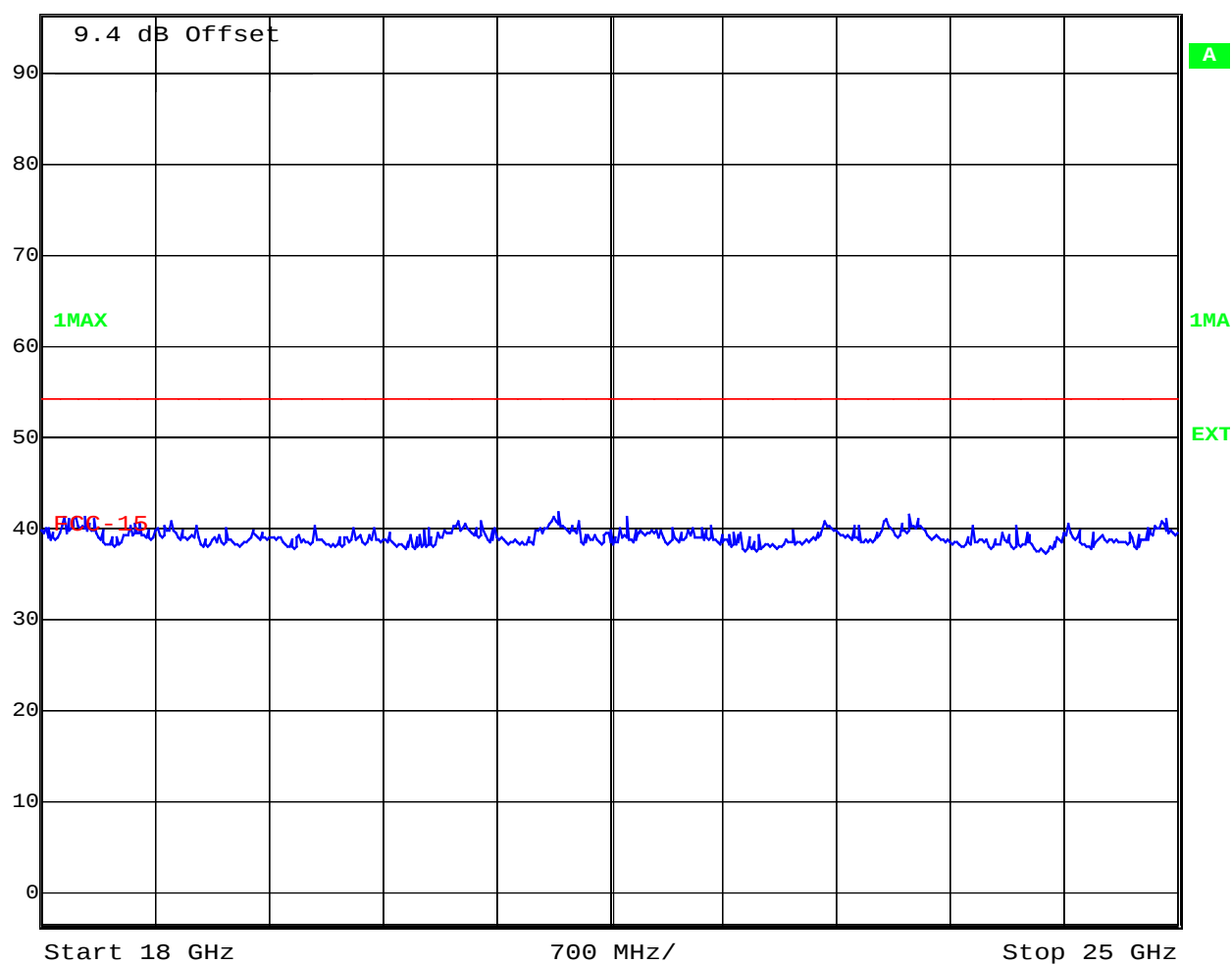
Ref Lvl

96.4 dBµV

RBW 1 MHz RF Att 0 dB

VBW 1 MHz

SWT 40 ms Unit dBµV



Date: 10.DEC.2001 11:12:59

$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW/VBW: 1 MHz

Limits

SUBCLAUSE § 15.209

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
above 960	500	3

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

Conducted emissions

§ 15.107

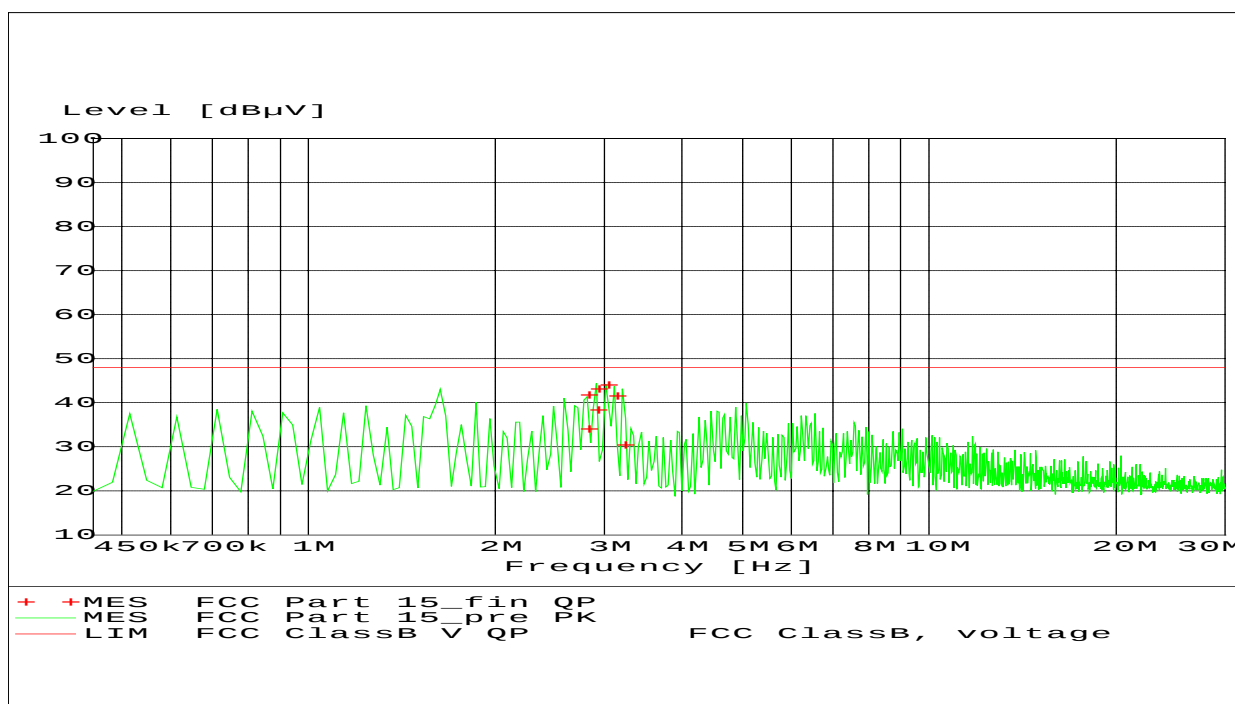
FCC Rule 47 Part 15

Operating condition: Idle mode

SCANTABELLE: "FCC Part 15 AC"

Kurzbeschreibung: Voltage Mains 1.60

Start-Frequenz	Stop-Frequenz	Schrittweite	Detektor	Meßzeit	ZF-Bandbr.	Transducer
450.0 kHz	30.0 MHz	6.0 kHz	MaxPeak	10.0 ms	10 kHz	ESH3-Z5 L1 2209



MEßERGEBNIS: "FCC Part 15 fin QP"

04.09.01 11:25

Frequenz MHz	Pegel dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
--------------	------------	-----------	------------	-----------	------	----

2.808000	33.90	10.4	48	14.1	L1	FLO
2.814000	41.60	10.4	48	6.4	L1	FLO
2.910000	38.20	10.4	48	9.8	N	GND
2.916000	43.00	10.4	48	5.0	N	GND
3.024000	43.80	10.4	48	4.1	N	GND
3.126000	41.40	10.4	48	6.5	N	FLO
3.216000	30.30	10.5	48	17.7	N	GND

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

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Equipment under test : NPL-1

Ambient temperature : 21,5°C

Relative humidity : 32%

Conducted emissions

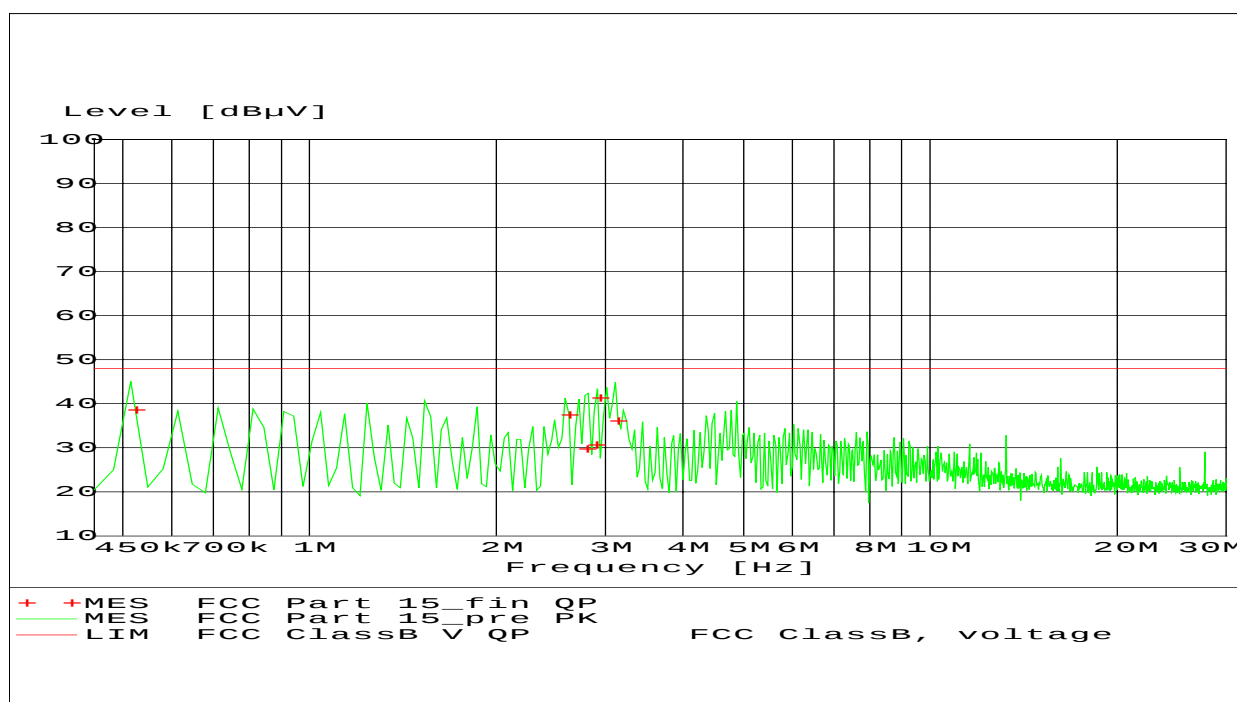
§ 15.107/207

Operating condition: Tx mode

SCANTABELLE: "FCC Part 15 AC"

Kurzbeschreibung: Voltage Mains 1.60

Start-Frequenz	Stop-Frequenz	Schrittweite	Detektor	Meßzeit	ZF-Bandbr.	Transducer
450.0 kHz	30.0 MHz	6.0 kHz	MaxPeak	10.0 ms	10 kHz	ESH3-Z5 L1 2209



MEßERGEBNIS: "FCC Part 15_fin QP"

04.09.01 11:34

Frequenz MHz	Pegel dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.522000	38.50	10.1	48	9.5	N	FLO
2.604000	37.20	10.3	48	10.7	L1	FLO
2.784000	29.60	10.4	48	18.4	L1	FLO
2.886000	30.50	10.4	48	17.5	N	GND
2.922000	41.20	10.4	48	6.8	N	GND
3.126000	36.00	10.4	48	11.9	N	FLO

REFERENCE NUMBER(S) OF TEST EQUIPMENT USED

(for reference numbers see test equipment listing)

TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

To simplify the identification on each page of the test equipment used, on each page of the test report, each item of test equipment and ancillaries such as cables are identified (numbered) by the Test Laboratory, below.

No	Instrument/Ancillary	Type	Manufacturer	Serial No.
01	Spectrum Analyzer	8566 A	Hewlett-Packard	1925A00257
02	Analyzer Display	8566 A	Hewlett-Packard	1925A00860
03	Oscilloscope	7633	Tektronix	230054
04	Radio Analyzer	CMTA 54	Rohde & Schwarz	894 043/010
05	System Power Supply	6038 A	Hewlett-Packard	2848A07027
06	Signal Generator	8111 A	Hewlett-Packard	2215G00867
07	Signal Generator	8662 A	Hewlett-Packard	2224A01012
08	Funktionsgenerator	AFGU	Rohde & Schwarz	862 480/032
09	Regeltrenntrafo	MPL	Erfi	91350
10	Netznachbildung	NNLA 8120	Schwarzbeck	8120331
11	Relais-Matrix	PSU	Rohde & Schwarz	893 285/020
12	Power-Meter	436 A	Hewlett-Packard	2101A12378
13	Power-Sensor	8484 A	Hewlett-Packard	2237A10156
14	Power-Sensor	8482 A	Hewlett-Packard	2237A00616
15	Modulationsmeter	9008	Racal-Dana	2647
16	Frequenzzähler	5340 A	Hewlett-Packard	1532A03899
17	Absorber Schirmkabine	---	MWB	87400/002
18	Spectrum Analyzer	85660 B	Hewlett-Packard	2747A05306
19	Analyzer Display	85662 A	Hewlett-Packard	2816A16541
20	Quasi Peak Adapter	85650 A	Hewlett-Packard	2811A01131
21	RF-Preselector	85685 A	Hewlett-Packard	2833A00768
22	Biconical Antenne	3104	Emco	3758
23	Log. Per. Antenne	3146	Emco	2130
24	Double Ridge Horn	3115	Emco	3088
25	EMI-Testreceiver	ESAI	Rohde & Schwarz	863 180/013
26	EMI-Analyzer-Display	ESAI-D	Rohde & Schwarz	862 771/008
27	Biconical Antenne	HK 116	Rohde & Schwarz	888 945/013
28	Log. Per. Antenne	HL 223	Rohde & Schwarz	825 584/002
29	Relais-Switch-Unit	RSU	Rohde & Schwarz	375 339/002
30	Highpass	HM985955	FSY Microwave	001
31	Amplifier	P42-GA29	Tron-Tech	B 23602
32	Absorber Schirmkabine		Frankonia	
33	Steuerrechner	PSM 7	Rohde & Schwarz	834 621/004
34	EMI Test Reciever	ESMI	Rohde & Schwarz	827 063/010
35	EMI Test Receiver	Display	Rohde & Schwarz	829 808/010

TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

To simplify the identification on each page of the test equipment used, on each page of the test report, each item of test equipment and ancillaries such as cables are identified (numbered) by the Test Laboratory, below.

No	Instrument/Ancillary	Type	Manufacturer	Serial No.
36	Controler	HD 100	Deisel	100/322/93
37	Relais Matrix	PSN	Rohde & Schwarz	829 065/003
38	Control Unit	GB 016 A2	Rohde & Schwarz	344 122/008
39	Relais Switch Unit	RSU	Rohde & Schwarz	316 790/001
40	Power Supply	6032A	Hewlett Packard	2846A04063
41	Spektrum Monitor	EZM	Rohde & Schwarz	883 720/006
42	Meßempfänger	ESH 3	Rohde & Schwarz	890 174/002
43	Meßempfänger	ESVP	Rohde & Schwarz	891 752/005
44	Biconi Ant. 20-300MHz	HK 116	Rohde & Schwarz	833 162/011
45	Logper Ant. 0.3-1 GHz	HL 223	Rohde & Schwarz	832 914/010
46	Amplifier 0.1-4 GHz	AFS4	Miteq Inc.	206461
47	Logper Ant. 1-18 GHz	HL 024 A2	Rohde & Schwarz	342 662/002
48	Polarisationsnetzwerk	HL 024 Z1	Rohde & Schwarz	341 570/002
49	Double Ridge G Horn Antenne 1-26.5 GHz	3115	EMCO	9107-3696
50	Microw. Sys. Amplifier 0.5- 26.5 GHz	8317A	Hewlett Packard	3123A00105
51	Audio Analyzer	UPD	Rohde & Schwarz	1030.7500.04
52	Steuerrechner	PSM 7	Rohde & Schwarz	883 086/026
53	DC V-Netzwerk	ESH3-Z6	Rohde & Schwarz	861 406/005
54	DC V-Netzwerk	ESH3-Z6	Rohde & Schwarz	893 689/012
55	AC 2 Phasen V- Netzwerk	ESH3-Z5	Rohde & Schwarz	861 189/014
56	AC 2 Phasen V- Netzwerk	ESH3-Z5	Rohde & Schwarz	894 981/019
57	AC-3 Phasen V- Netzwerk	ESH2-Z5	Rohde & Schwarz	882 394/007
58	Stromversorgung	6032A	Rohde & Schwarz	2933A05441
59	HF-Test Empfänger	ESVP.52	Rohde & Schwarz	881 487/021
60	Spectrum Monitor	EZM	Rohde & Schwarz	883 086/026
61	HF-Test Empfänger	ESH3	Rohde & Schwarz	881 515/002
62	Relais Matrix	PSU	Rohde & Schwarz	882 943/029
63	Relais Matrix	PSU	Rohde & Schwarz	828 628/007
64	Spectrum Analyzer	FSIQ 26	Rohde & Schwarz	119.6001.27
65	Spectrum Analyzer	HP 8565E	Hewlett Packard	3473A00773
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