CETECOM Inc.

CETECOM Inc.

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**FCC LISTED, REG. NO.: 101450
&
RECOGNIZED BY INDUSTRY CANADA
IC – 3925**

**Test report no.:173FCC/2001_2BT
FCC Part 15.247
FCC ID: B94xt1000bt
(HP Omnibook xt1000)**

Table of Contents

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 Inc. USA 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 Inc USA.

TEST REPORT PREPARED BY:
EMC & Radio Engineer: Harpreet Sidhu

1.2   Testing laboratory

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411 Dixon Landing Road, Milpitas, CA-95035, USA

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E-mail: lothar.schmidt@cetecomusa.com

Internet: www.cetecom.com

1.3   Details of applicant

Name   **: Hewlett Packard**
Street   **: 19310 Pruneridge Ave.**
City   **: Cupertino CA**
Country   **: USA**
Contact   **: Richard Barbin**
Telephone : 408 343 7972
Telefax   **: 408 343 7366**
e-mail   richard_barbin@hp.com
:

1.4   Application details

Date of receipt of application   : 2001-07-10
Date of receipt of test item   : 2001-10-01
Date of test   : 2001-10-01/02/04

1.5   Test item

Manufacturer	:	3 COM
Name of EUT	:	SL-1021 installed into HP Omnibook xt1000
Description	:	Bluetooth wireless Module
Model No.		SL-1021
Serial No.	:	N/A
FCC ID	:	B94xt1000BT

Additional information

Frequency	:	2.4 – 2.48 GHz
Type of modulation	:	Bluetooth Standard
Number of channels	:	79
Antenna	:	Internal
Power supply	:	5V
Output power	:	0 dBm
Extreme Vol. Limits	:	
Extreme Temp. Limits	:	0°C - +40°C

1.6   Test standards: FCC Part 15 §15.247

2   Technical test

2.1   Summary of test results

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

Technical responsibility for area of testing :

2001-11-07	EMC & Radio	Lothar Schmidt	*Schmidt*
Date	**Section**	**Name**	**Signature**

2.2   Testreport

TEST REPORT

Test report no. : 173FCC/2001_2BT
FCC ID: B94xt1000BT
(HP Omnibook xt1000)

TEST REPORT REFERENCE

LIST OF MEASUREMENTS

Antenna Gain   **SUBCLAUSE § 15.204**

The max gain is +1.2dBi

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

CARRIER FREQUENCY SEPERATION   §15.247(a)
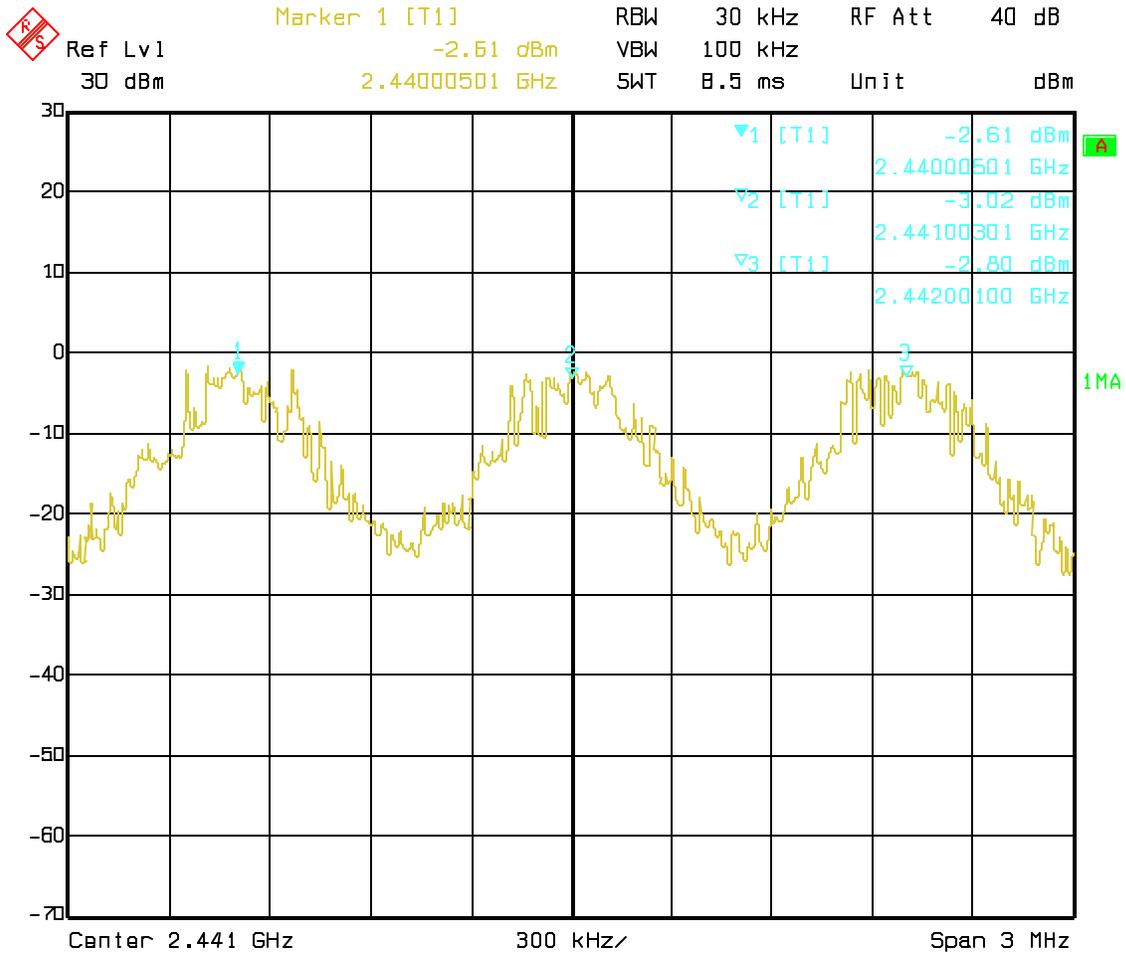
NUMBER OF HOPPING CHANNELS   §15.247(a)

The number of hopping channels is 79 (see next 4 plots)
The right red line corresponds to the left red line from the next plot.

Plot 1: Total 23

Plot 2: Total 25

		Marker 2 [T1]		RBW	300 kHz	RF Att	40 dB
	Ref Lvl		0.15 dBm	VBW	300 kHz		
	30 dBm		2.42409820 GHz	SWT	5 ms	Unit	dBm

Marker values:
- ▼2 [T1] 0.15 dBm 2.42409820 GHz
- ▽1 [T1] 1.17 dBm 2.44902605 GHz

Start 2.423 GHz   2.7 MHz/   Stop 2.45 GHz
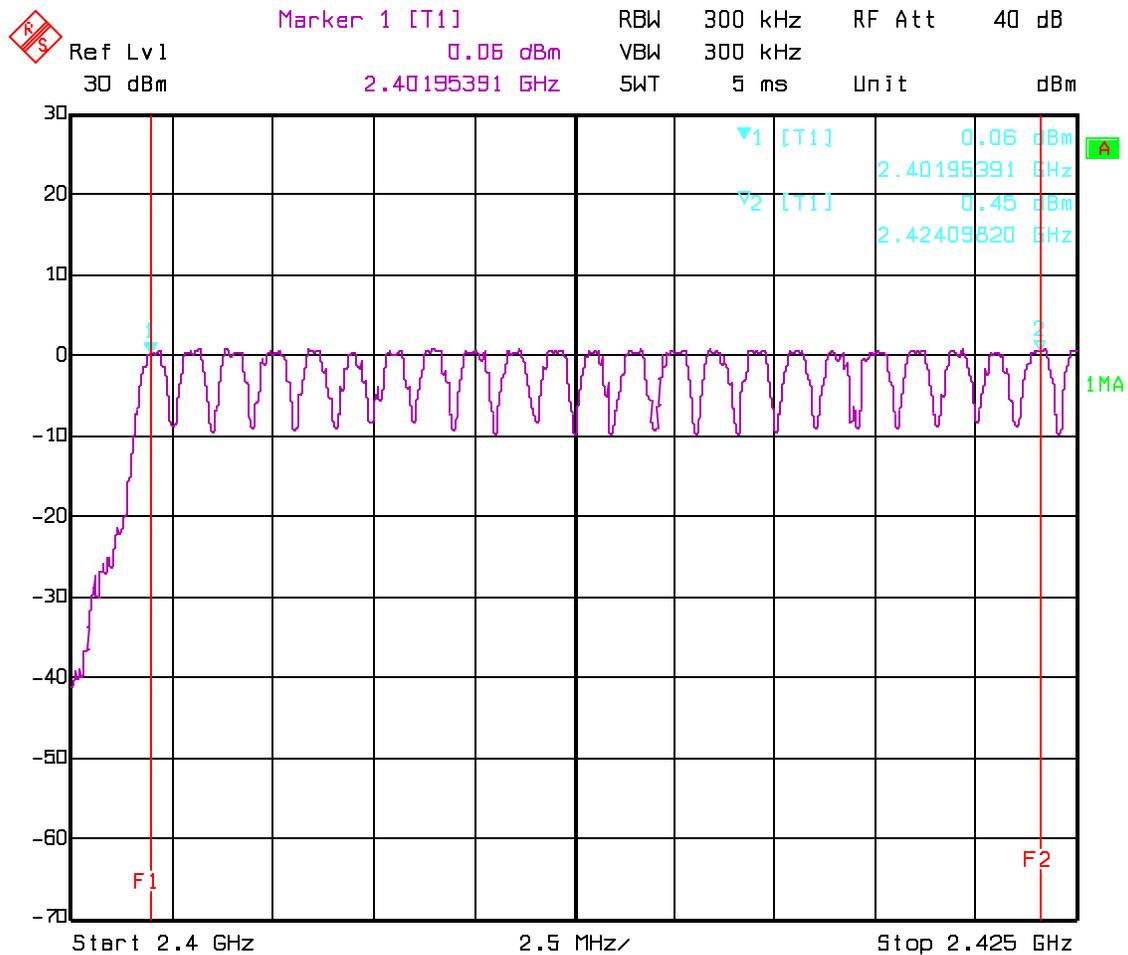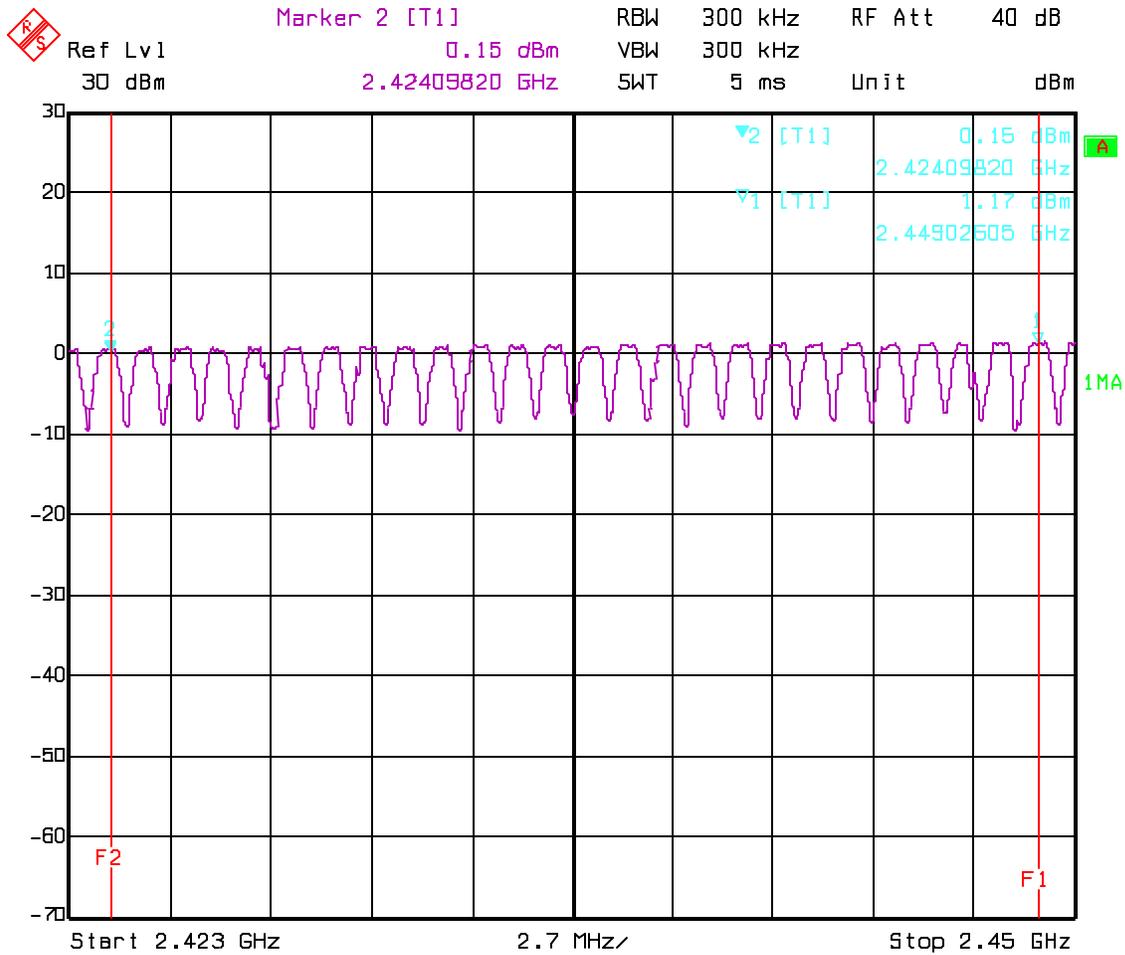
Date: 4.OCT.01   20:35:41

Plot 3: Total 19

	Marker 1 [T1]		RBW	300 kHz	RF Att	40 dB
Ref Lvl		0.87 dBm	VBW	300 kHz	
30 dBm		2.44902605 GHz	SWT	5 ms	Unit	dBm

```
              Marker 1 [T1]              RBW   300 kHz   RF Att    40 dB
    Ref Lvl                   0.87 dBm   VBW   300 kHz
    30 dBm              2.44902605 GHz   SWT     5 ms   Unit        dBm
30                                          ▼1 [T1]          0.87 dBm   [A]
                                                       2.44902605 GHz
20                                          ▼2 [T1]          1.93 dBm
                                                       2.46804609 GHz
10
                                                                      1MA
 0
-10
-20
-30
-40
-50
-60
        F1                                                F2
-70
   Start 2.445 GHz            2.5 MHz/          Stop 2.47 GHz
Date:       4.OCT.01   20:43:31
```

Plot 4: Total 12

Marker 1 [T1]		RBW 300 kHz	RF Att 40 dB
Ref Lvl	1.96 dBm	VBW 300 kHz	
30 dBm	2.48003006 GHz	SWT 5 ms	Unit dBm

▼1 [T1] 1.96 dBm 2.48003006 GHz
▽2 [T1] 1.74 dBm 2.46804609 GHz

Start 2.465 GHz   2 MHz/   Stop 2.485 GHz

Date: 4.OCT.01 20:58:39

TIME OF OCCUPANCY (DWELL TIME) FOR DH1   §15.247(a)

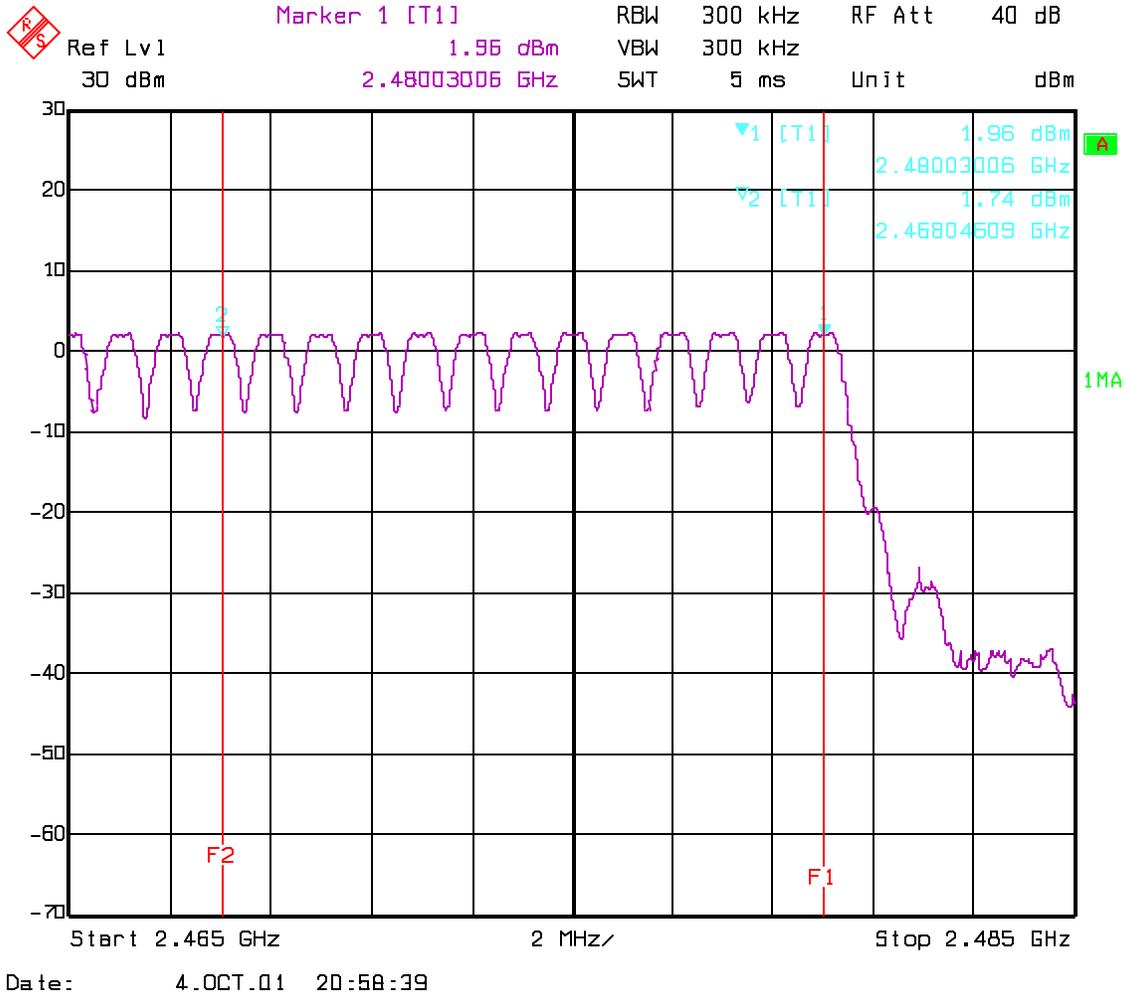The system makes worst case 1600 hops per second or 1 time slot has a length of 625µs with 79 channels. A DH1 Packet need 1 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 800 hops per second with 79 channels. So you have each channel 10.13 times per second and so for 30 seconds you have 303.9 times of appearence .
Each Tx-time per appearence is 376.75 µs.
<u>So we have 303.9 * 376.75 µs = 114.49 ms per 30 seconds.</u>
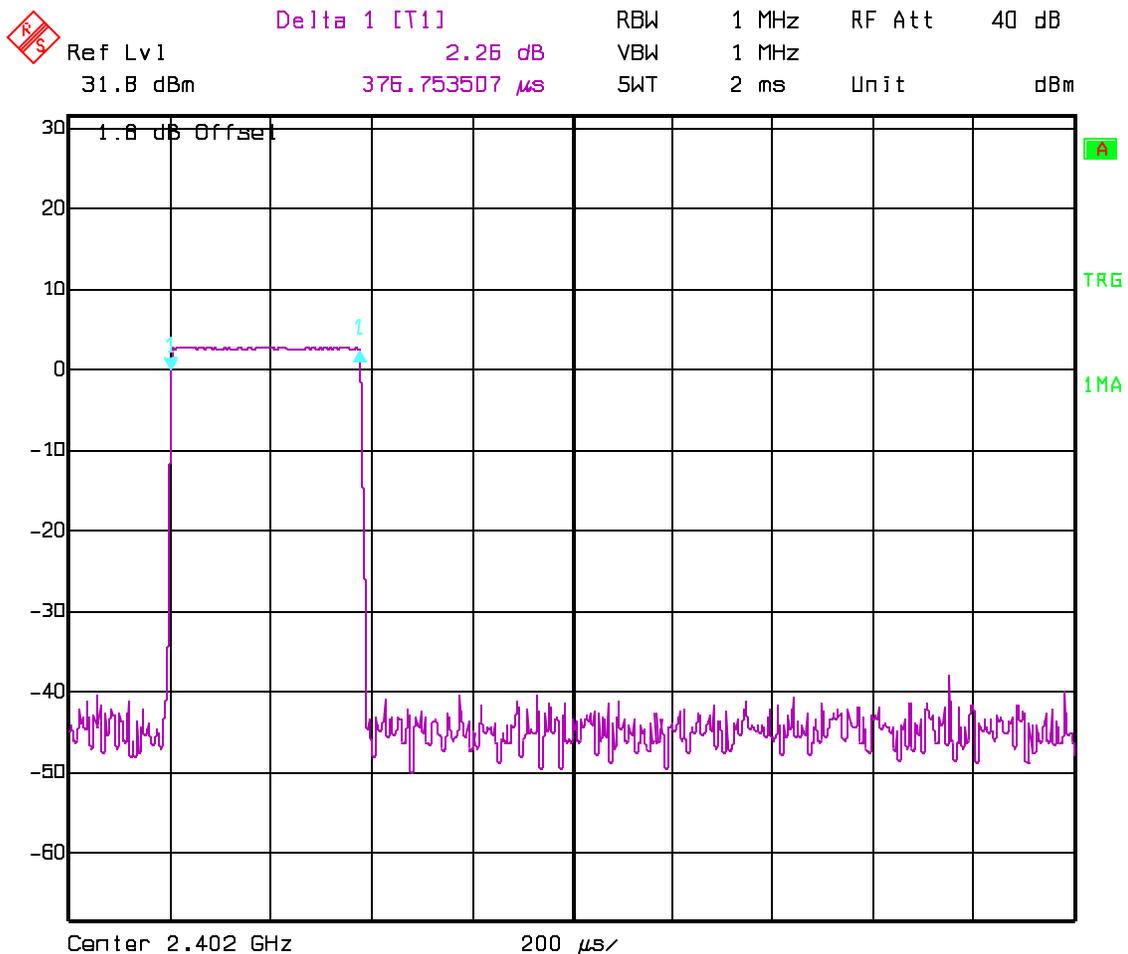
TIME OF OCCUPANCY (DWELL TIME) FOR DH3   §15.247(a)

A DH3 Packets need 3 time slots for transmit and 1 for receicing, then the system makes worst case 400 hops per second with 79 channels. So you have each channel 5.1 times per second and so for 30 seconds you have 153 times of appearence .
Each Tx-time per appearence is 1.65 ms.
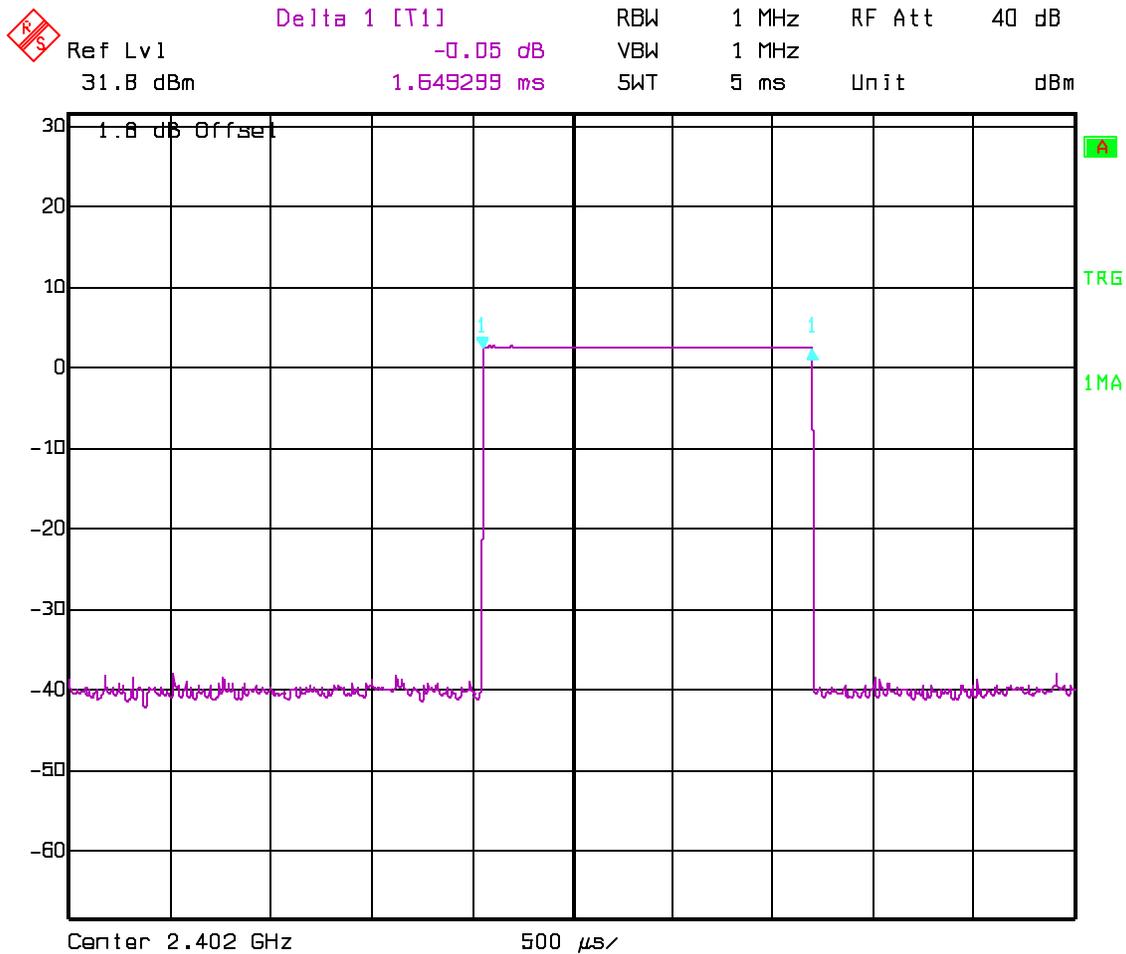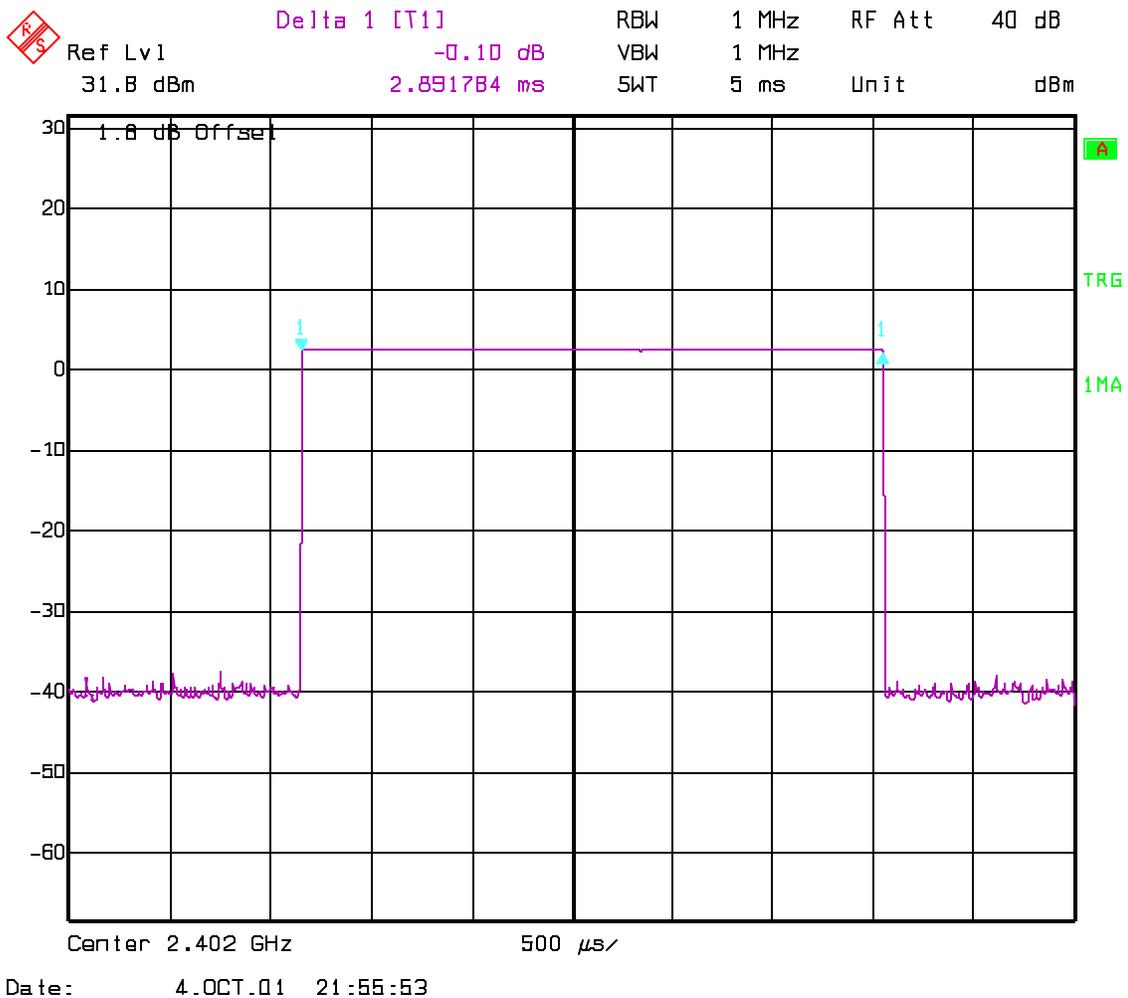**So we have 153 * 1.65 ms = 252.45 ms per 30 seconds.**

TIME OF OCCUPANCY (DWELL TIME) FOR DH5 §15.247(a)

At DH5 Packets you need 5 time slots for transmit and 1 for receicing,then the system makes worst case 266,7 hops per second with 79 channels. So you have each channel 3.36 times per second and so for 30 seconds you have 100,8 times of appearence .
Each tx-time per appearence is 2.89 ms.
So we have 100.8 * 2.89ms = 291.31 ms per 30 seconds.

	Delta 1 [T1]		RBW	1 MHz	RF Att	40 dB	
Ref Lvl		-0.10 dB	VBW	1 MHz			
31.8 dBm		2.891784 ms	SWT	5 ms	Unit	dBm	

```
30 ┬ 1.8 dB Offset                                          [A]
   │
20 ┤
   │
10 ┤                                                        TRG
   │   ▽1                                        1△
 0 ┤   │                                         │
   │   │                                         │          1MA
-10 ┤  │                                         │
   │   │                                         │
-20 ┤  │                                         │
   │   │                                         │
-30 ┤  │                                         │
   │   │                                         │
-40 ┤~~~┘                                         └~~~~~~~~~
   │
-50 ┤
   │
-60 ┤
   │
   └────────────────────────────────────────────────────
     Center 2.402 GHz                 500 µs/
```

Date: 4.OCT.01 21:55:53

SPECTRUM BANDWIDTH OF 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}(5)V	885.77	993.46	868.73
Measurement uncertainty		**±3dB**		

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

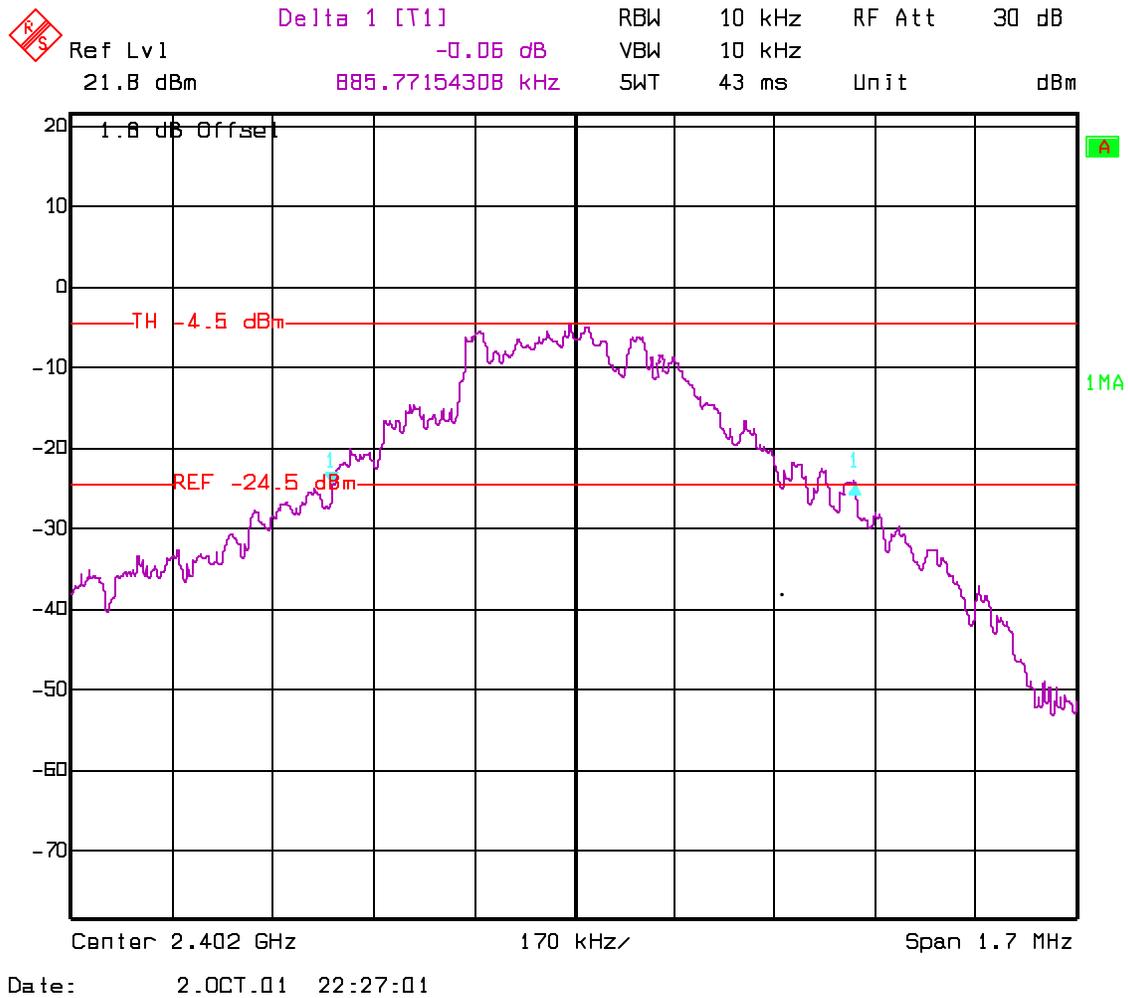**LIMIT**   **SUBCLAUSE §15.247(a) (1)**

> **The maximum 20dB bandwith shall be at maximum 1000 KHz**

SPECTRUM BANDWIDTH OF FHSS SYSTEM   §15.247(a)
20 dB bandwidth

Lowest Channel: 2402MHz

	Delta 1 [T1]		RBW	10 kHz	RF Att	30 dB
Ref Lvl		-0.06 dB	VBW	10 kHz		
21.8 dBm		885.77154308 kHz	SWT	43 ms	Unit	dBm

Center 2.402 GHz   170 kHz/   Span 1.7 MHz

Date: 2.OCT.01   22:27:01

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SPECTRUM BANDWIDTH OF FHSS SYSTEM   §15.247(a)
20 dB bandwidth
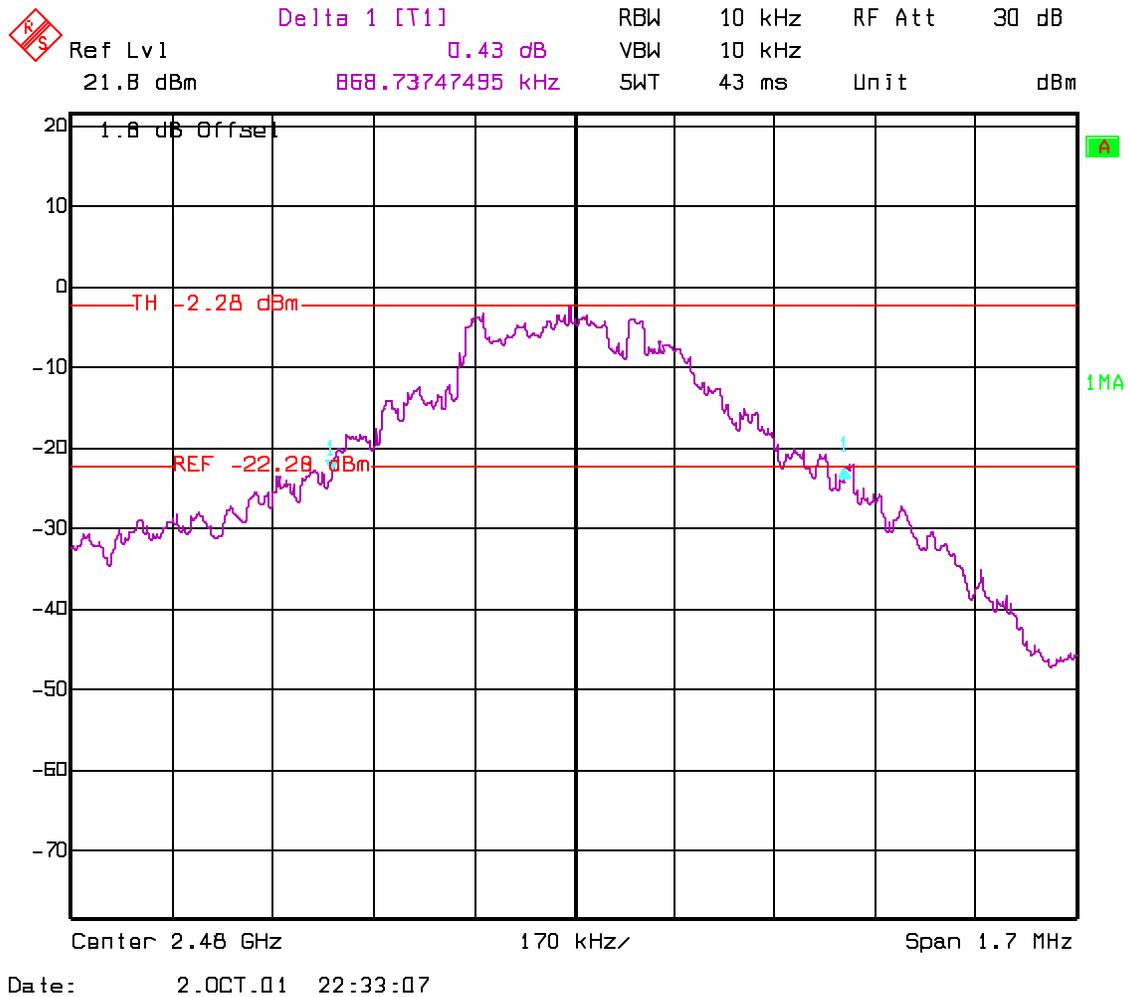
Mid Channel: 2441MHz
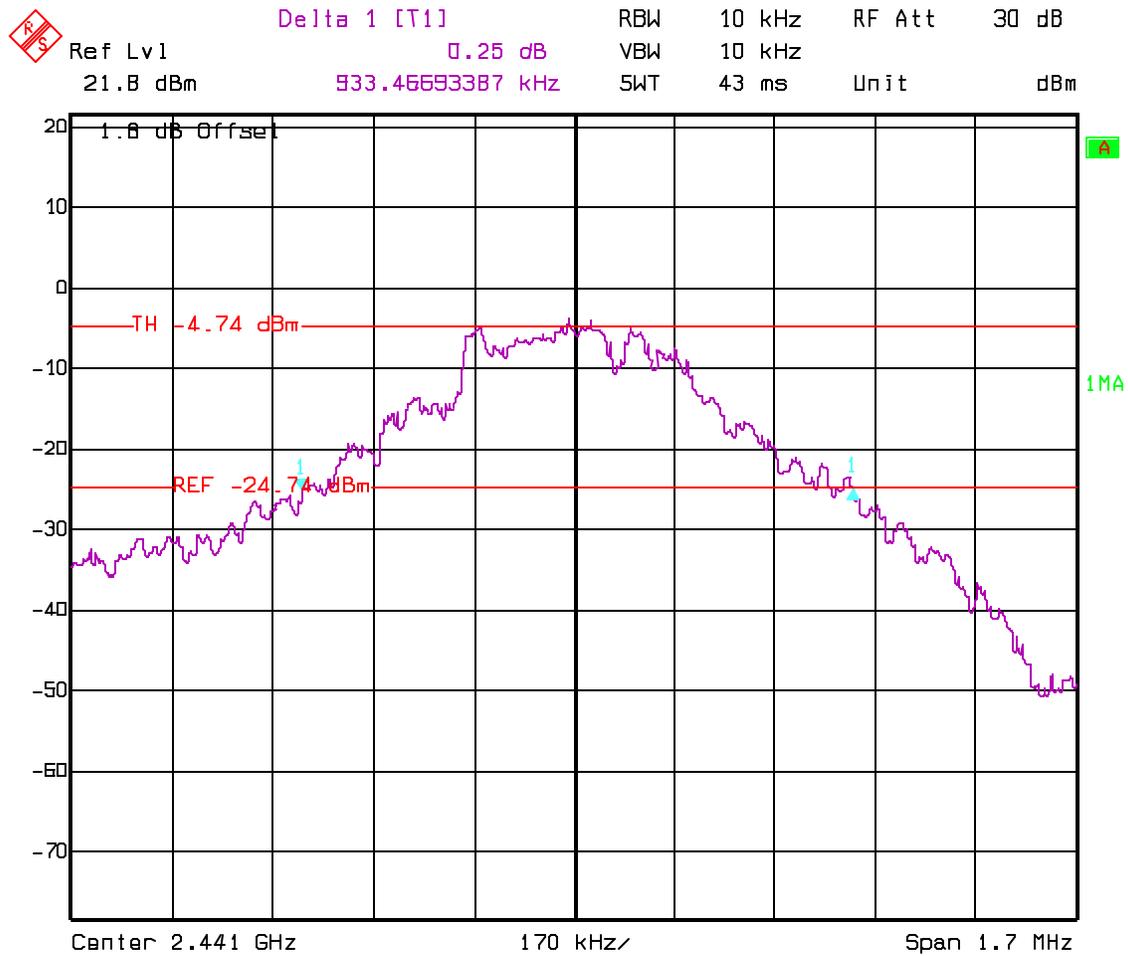
Date: 2.OCT.01   22:30:32

SPECTRUM BANDWIDTH OF FHSS SYSTEM   §15.247(a)
20 dB bandwidth

Highest Channel: 2480MHz

MAXIMUM PEAK OUTPUT POWER   **SUBCLAUSE § 15.247 (b) (1)**
(conducted)

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		**2402**	**2441**	**2480**
T_{nom}(23)°C	V_{nom}(5)V	**PK** 2.54	3.21	4.39
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**

PEAK OUTPUT POWER (CONDUCTED)   §15.247 (b)

Lowest Channel: 2402MHz


```
         R/S        Marker 1 [T1]              RBW    3 MHz    RF Att    30 dB
             Ref Lvl                  2.54 dBm  VBW    3 MHz
             21.8 dBm         2.40205010 GHz    SWT    5 ms    Unit        dBm
```

Center 2.402 GHz   1 MHz/   Span 10 MHz

Date: 2.OCT.01   20:47:04
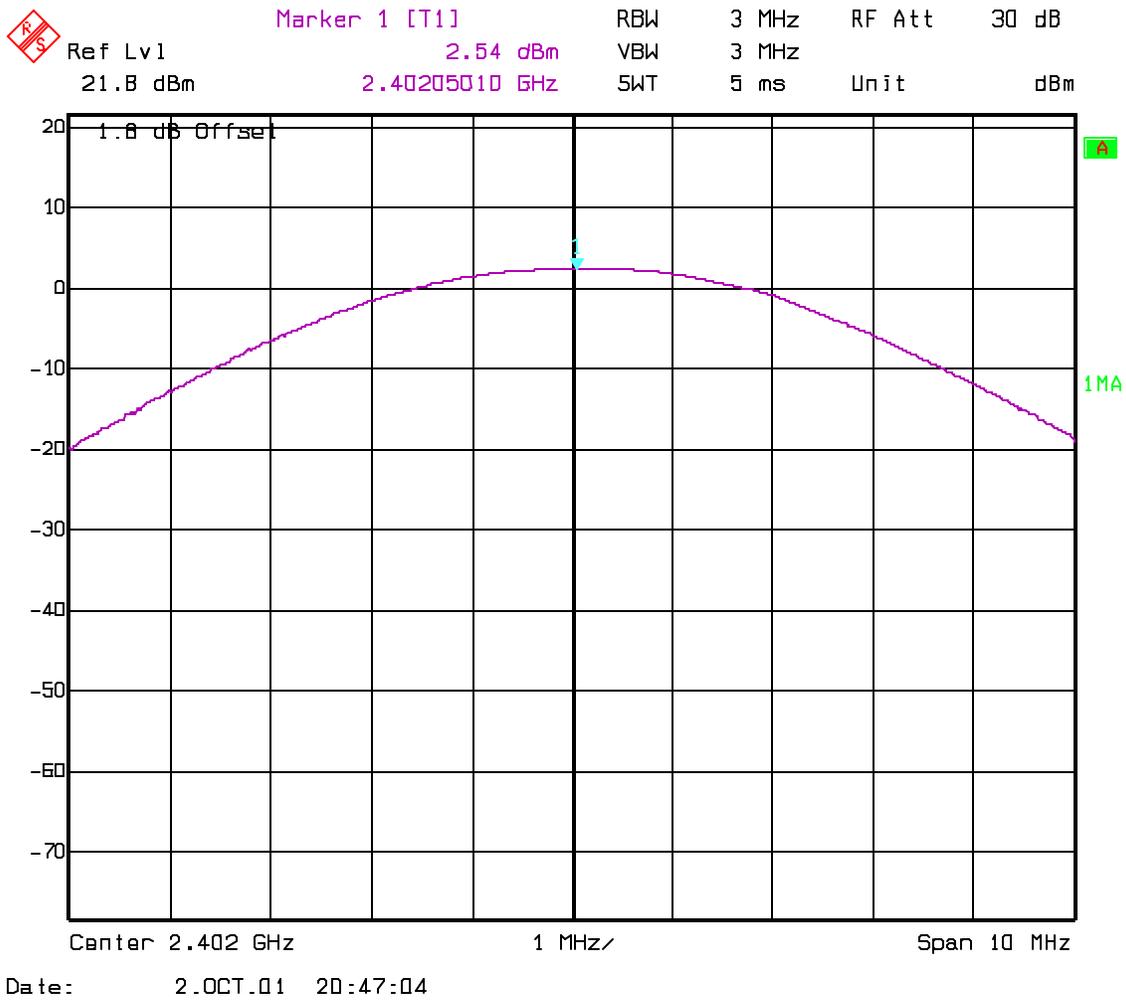
PEAK OUTPUT POWER (CONDUCTED)   §15.247 (b)

Mid Channel: 2441MHz


```
                    Marker 1 [T1]            RBW    3 MHz   RF Att    30 dB
       Ref Lvl                   3.21 dBm   VBW    3 MHz
       21.8 dBm            2.44117034 GHz   SWT    5 ms    Unit        dBm
```

Center 2.441 GHz   1 MHz/   Span 10 MHz

Date: 2.OCT.01 20:49:17

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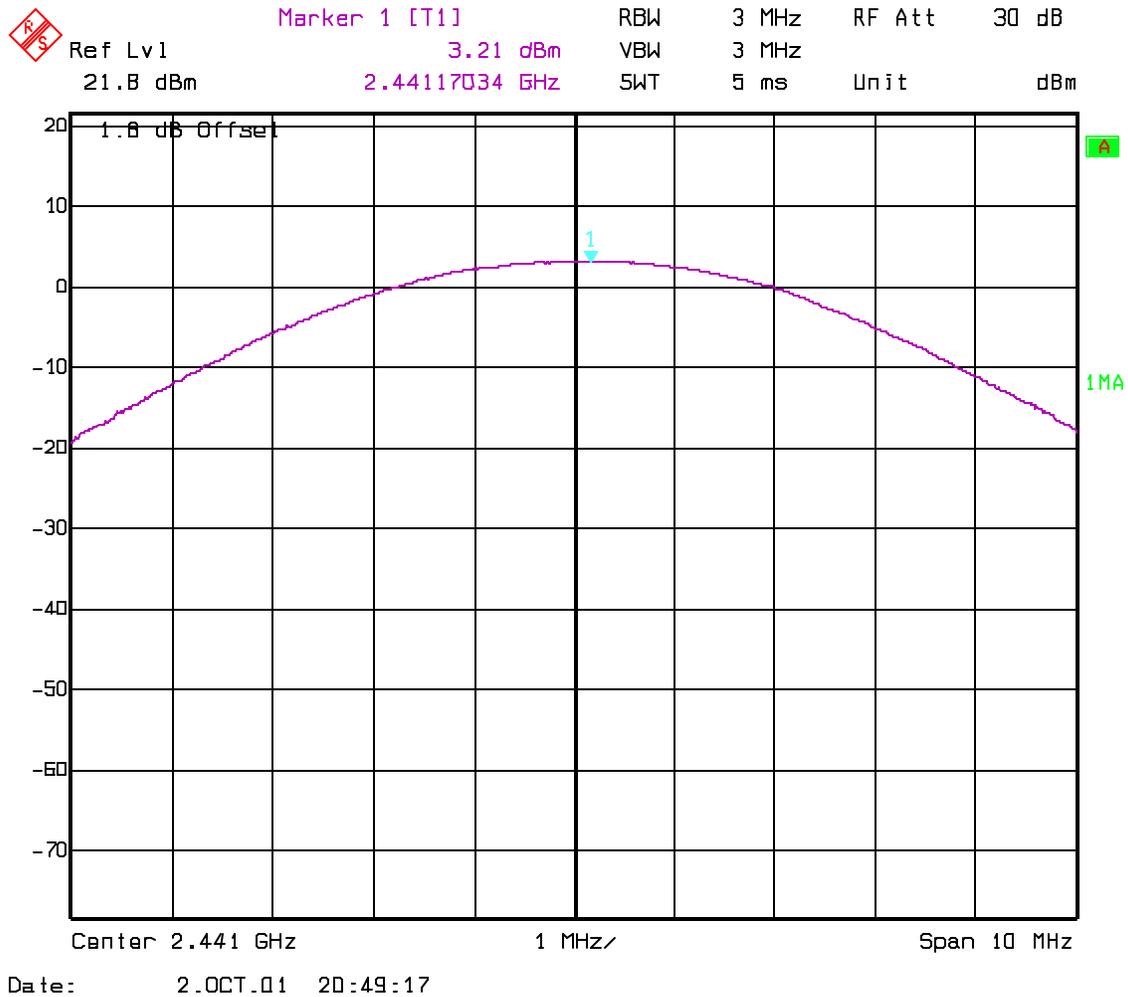
PEAK OUTPUT POWER (CONDUCTED)   §15.247 (b)

Highest Channel: 2480MHz


```
              Marker 1 [T1]           RBW    3 MHz   RF Att   30 dB
   Ref Lvl                 4.39 dBm   VBW    3 MHz
   21.B dBm          2.47996994 GHz   SWT    5 ms    Unit        dBm
```

Center 2.48 GHz   1 MHz/   Span 10 MHz

Date: 2.OCT.01 20:52:56
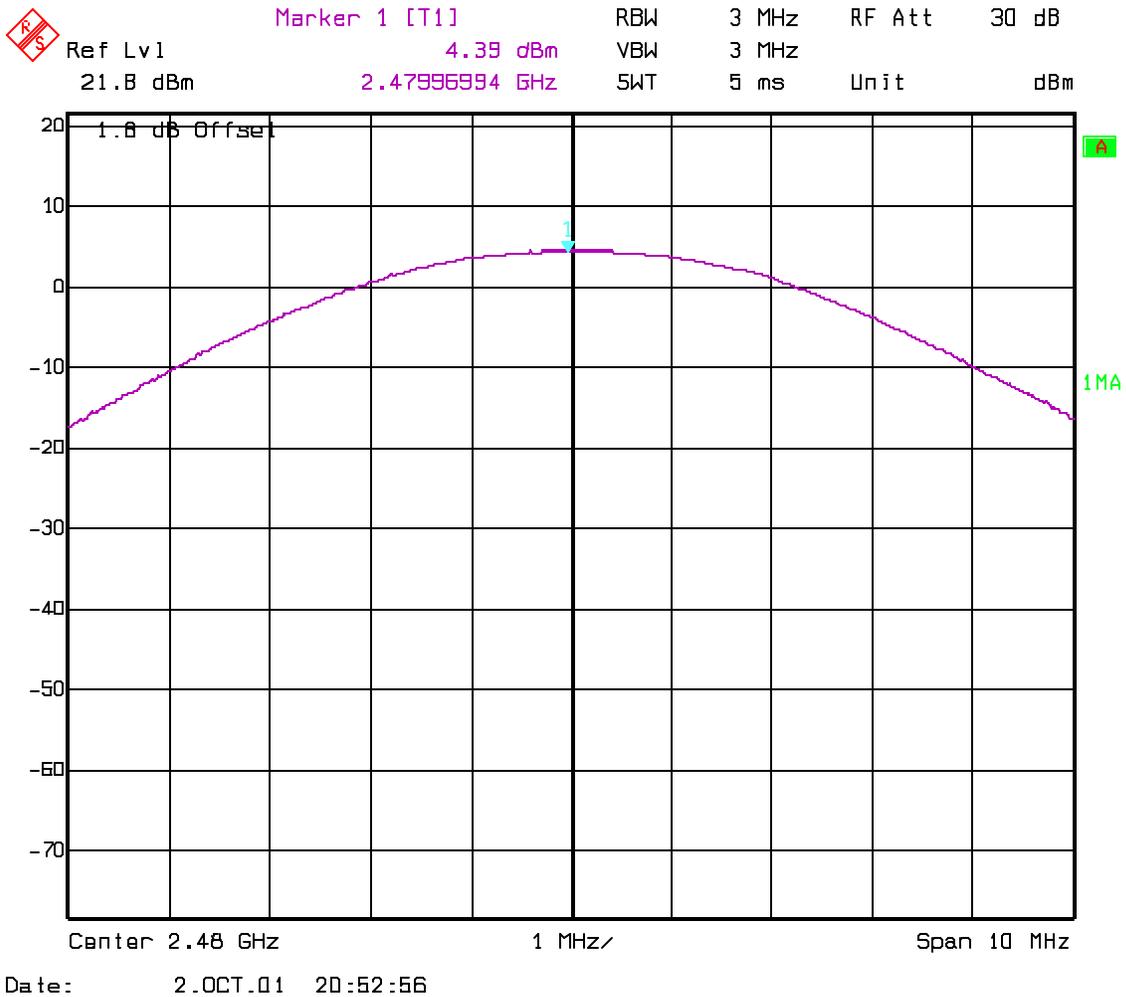
MAXIMUM PEAK OUTPUT POWER (RADIATED)   **SUBCLAUSE § 15.247 (b) (1)**

EIRP:

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		**2402**	**2441**	**2480**
$T_{nom}(23)°C$	$V_{nom}(5)V$	**4.71**	**5.50**	**3.51**
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**

PEAK OUTPUT POWER (RADIATED)   §15.247 (b) (1)

Lowest Channel: 2402MHz

ANALYZER SETTINGS: RBW = 3MHz   VBW = 3MHz

```
Marker:        2.401809619 GHz        4.71 dBm
```

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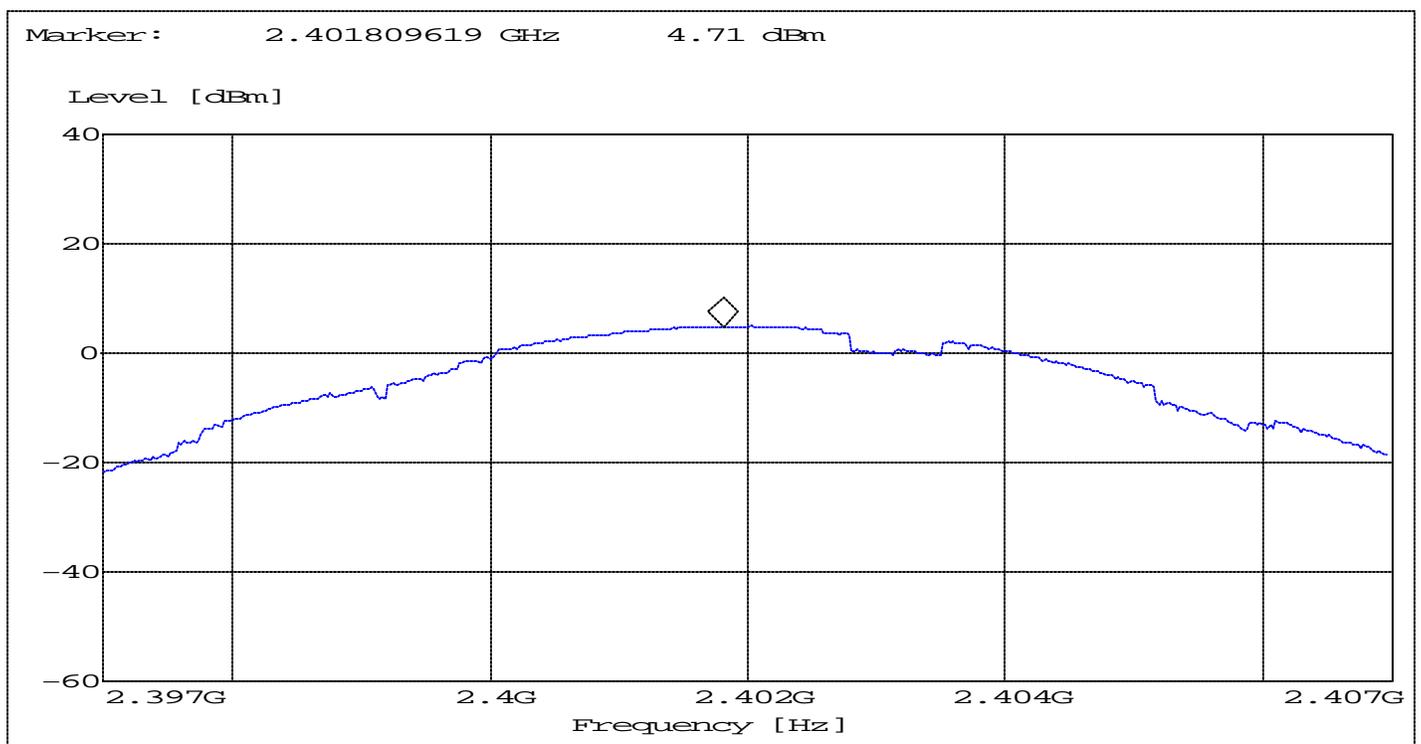
PEAK OUTPUT POWER (RADIATED)   **§15.247 (b) (1)**

Mid Channel: 2441MHz

ANALYZER SETTINGS: RBW = 3MHz   VBW = 3MHz

Marker: 2.440789579 GHz   5.5 dBm

PEAK OUTPUT POWER (RADIATED)   §15.247 (b) (1)

Highest Channel: 2480MHz

ANALYZER SETTINGS: RBW = 3MHz   VBW = 3MHz
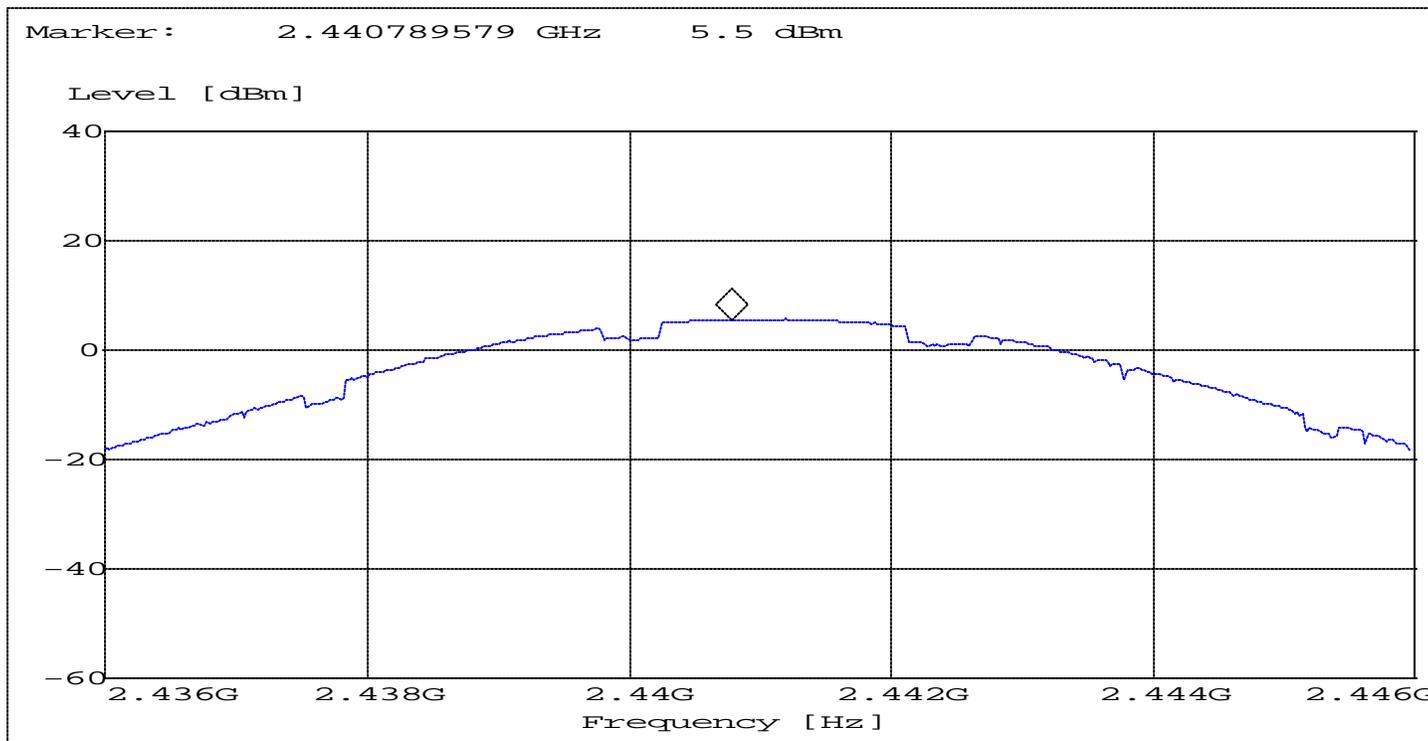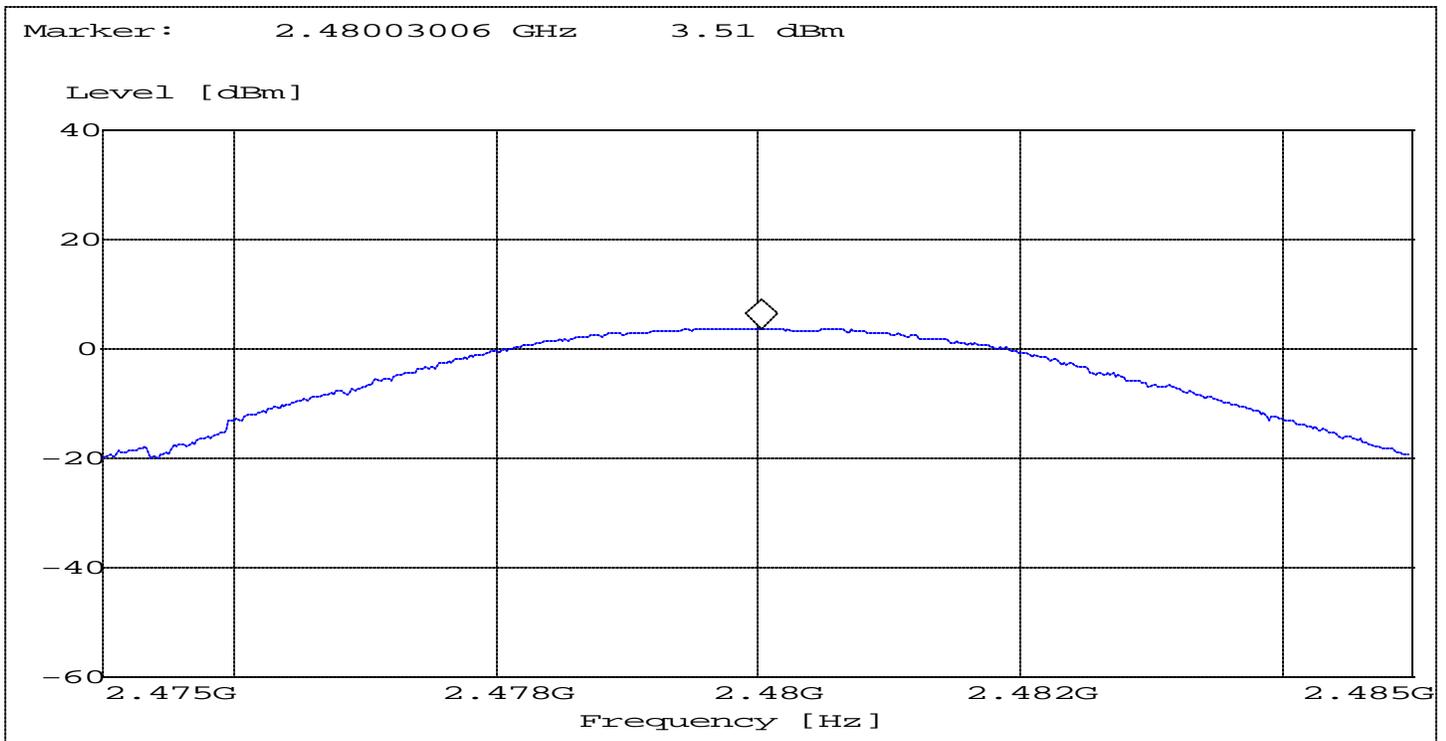

Marker: 2.48003006 GHz   3.51 dBm

BAND EDGE COMPLIANCE   **§15.247 (c)**

Low frequency section
(valid for both hopping ON & OFF)

	Marker 1 [T1]		RBW	100 kHz	RF Att	30 dB
Ref Lvl		2.20 dBm	VBW	200 kHz		
21.8 dBm		2.40185631 GHz	SWT	5 ms	Unit	dBm

Center 2.3987 GHz   1 MHz/   Span 10 MHz
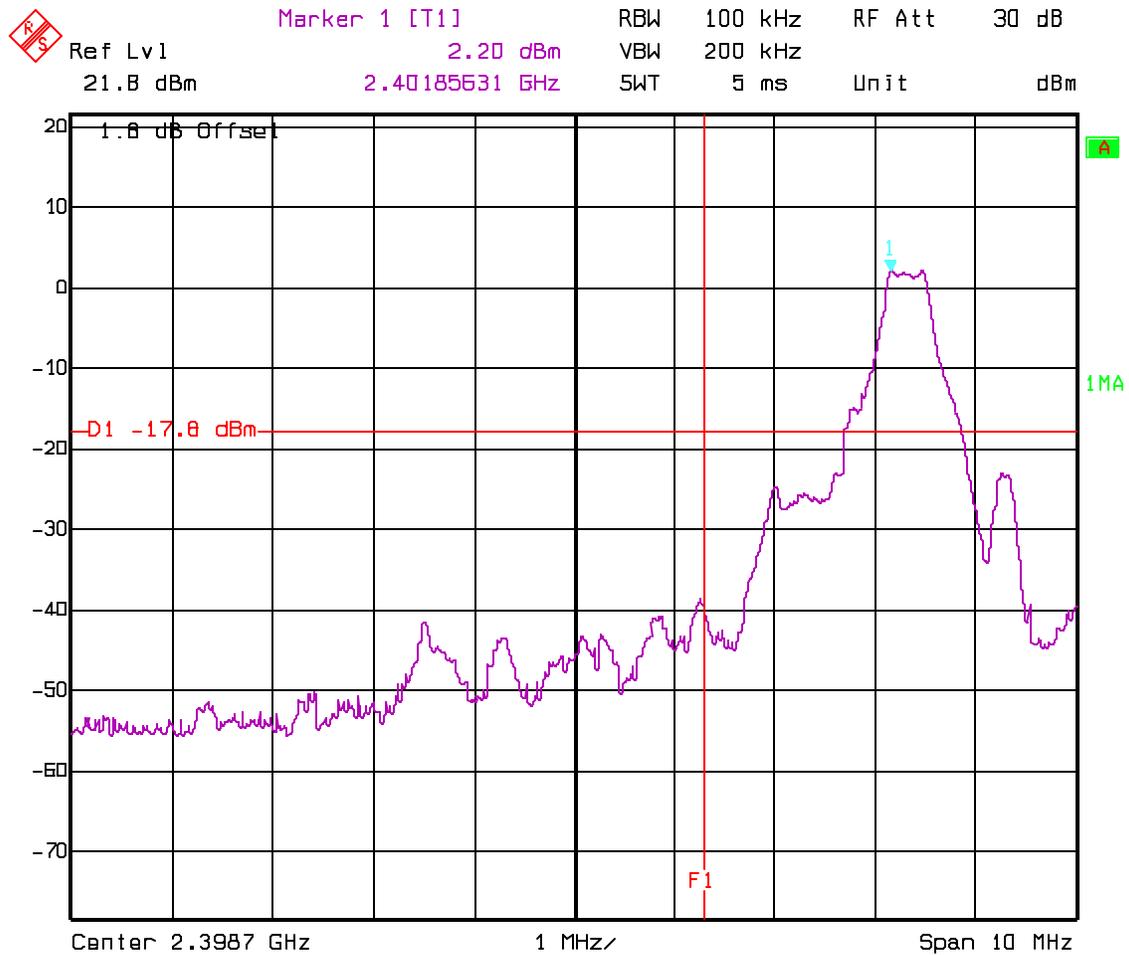
Date: 2.OCT.01   22:13:11
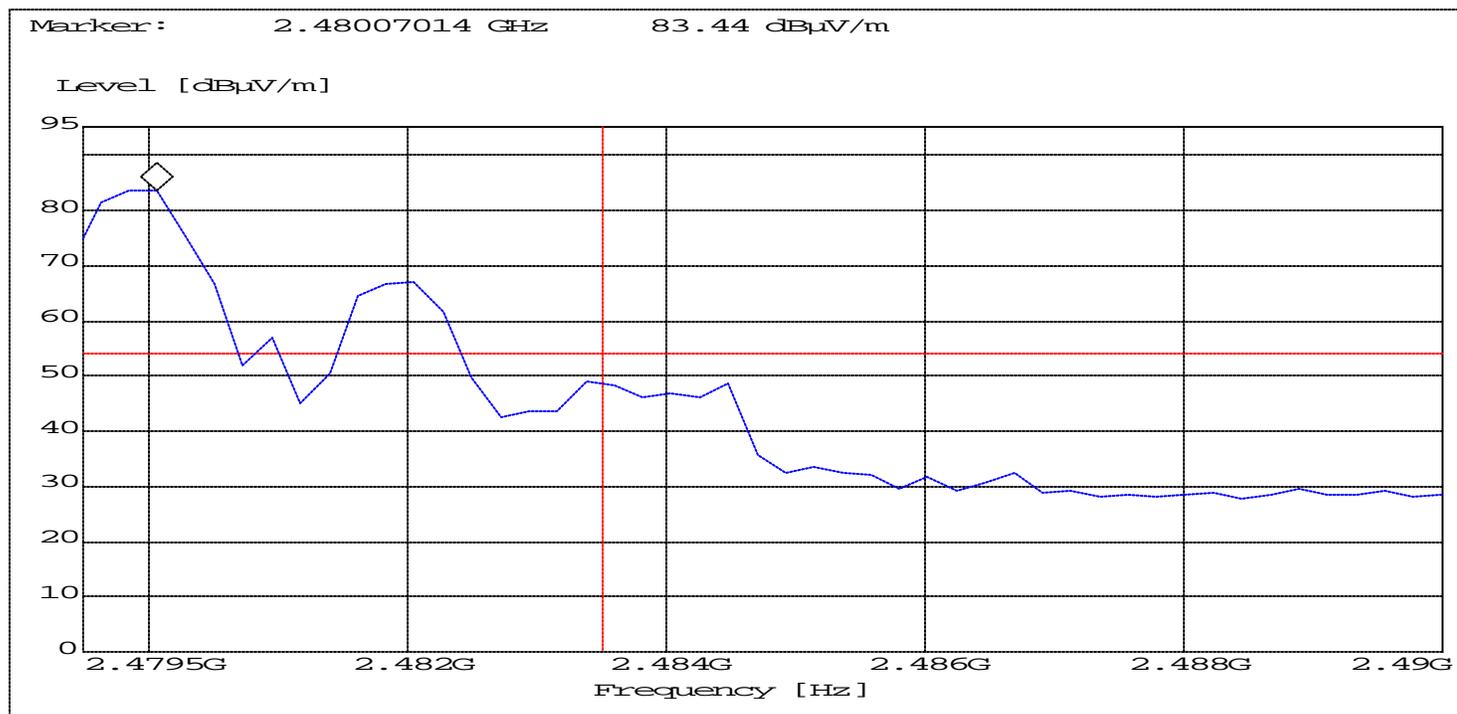
BAND EDGE COMPLIANCE   **§15.247 (c)**

high frequency section
(valid for both hopping ON & OFF)

ANALYZER SETTINGS: RBW = 100KHz   VBW = 200KHz

EMISSION LIMITATIONS - Conducted (Transmitter)   **§ 15.247 (c) (1)**

LIMITS

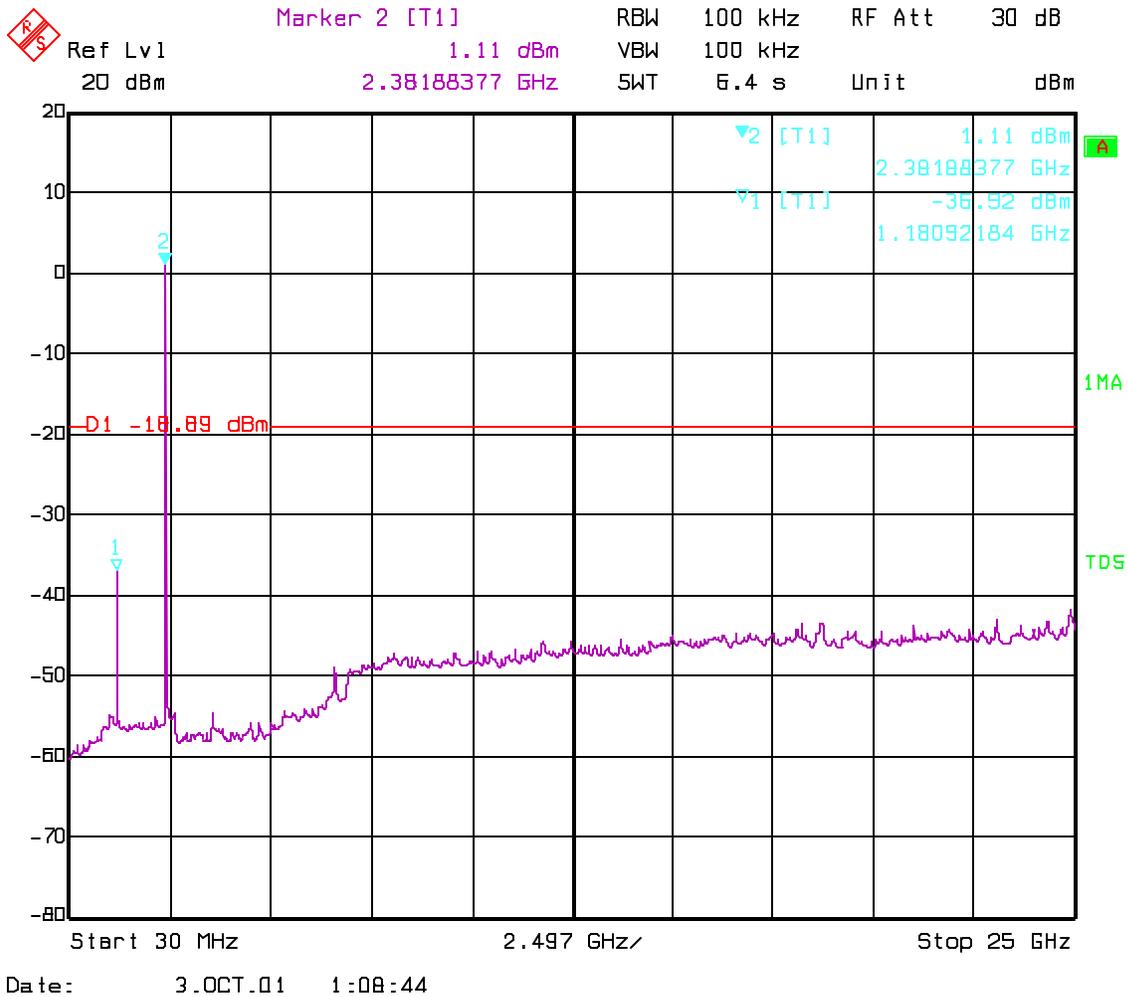In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

NOTE: Frequency resolution is not fine enough to show the exact frequency of the carrier, refer to plots under EIRP.

EMISSION LIMITATIONS - Conducted (Transmitter)   **§ 15.247 (c) (1)**
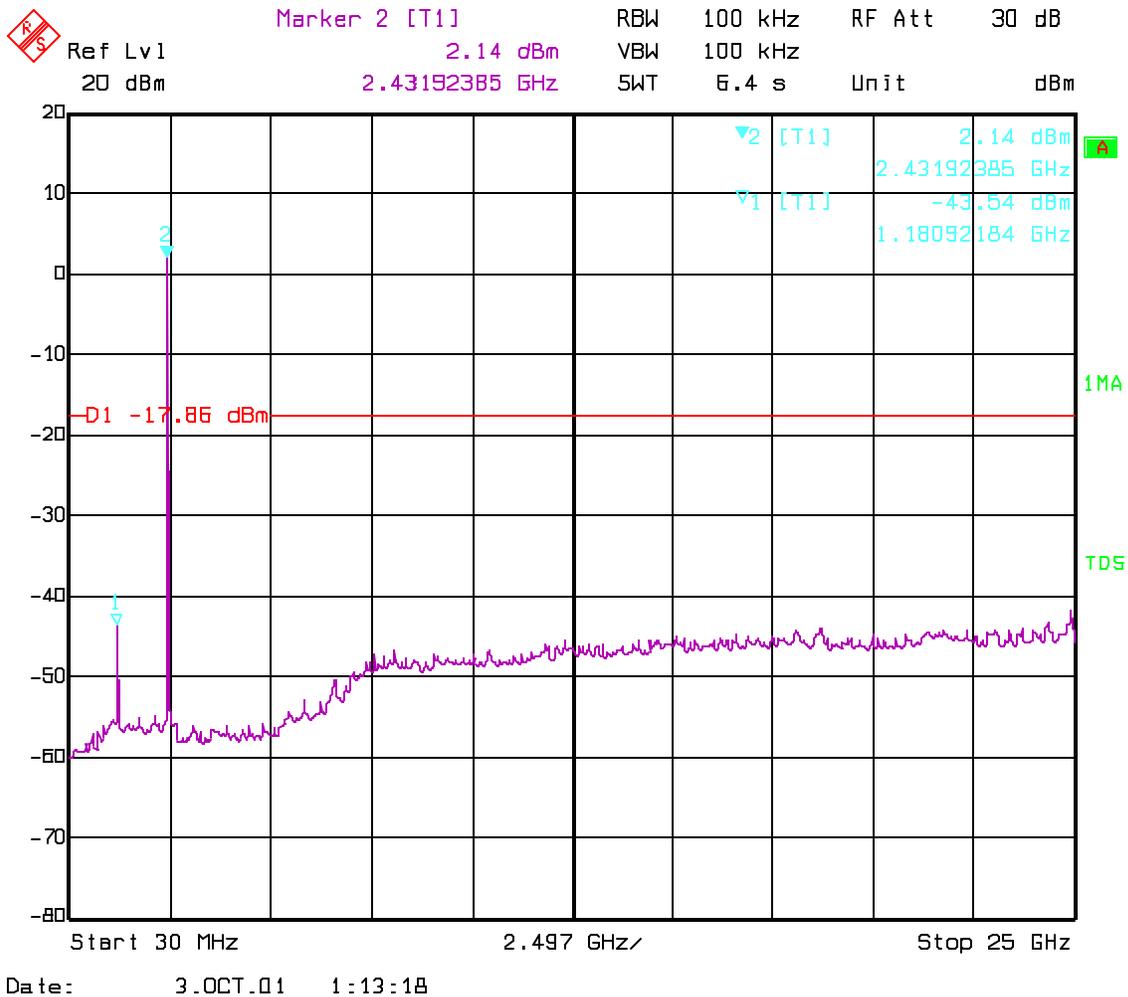
Lowest Channel(2402MHz): 30MHz - 25 GHz

```
         R          Marker 2 [T1]            RBW   100 kHz   RF Att    30 dB
         S    Ref Lvl              1.11 dBm  VBW   100 kHz
              20 dBm         2.38188377 GHz  SWT   6.4 s     Unit        dBm

     20 ┌─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┐
        │                          ▼2 [T1]        1.11 dBm │  A
        │                             2.38188377 GHz       │
     10 │                          ▼1 [T1]       -36.92 dBm│
        │                             1.18092184 GHz       │
        │  2                                               │
      0 │  ▼                                               │
        │                                                  │
    -10 │                                                  │
        │                                                  │  1MA
    -20 │D1 -18.89 dBm ═══════════════════════════════════│
        │                                                  │
    -30 │                                                  │
        │  1                                               │
    -40 │  ▽                                               │  TDS
        │                                                  │
    -50 │                                                  │
        │                                                  │
    -60 │                                                  │
        │                                                  │
    -70 │                                                  │
        │                                                  │
    -80 └─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┘
         Start 30 MHz            2.497 GHz/          Stop 25 GHz

      Date:       3.OCT.01   1:08:44
```

NOTE: The peak above the limit is the carrier frequency.

EMISSION LIMITATIONS - Conducted (Transmitter)   **§ 15.247 (c) (1)**
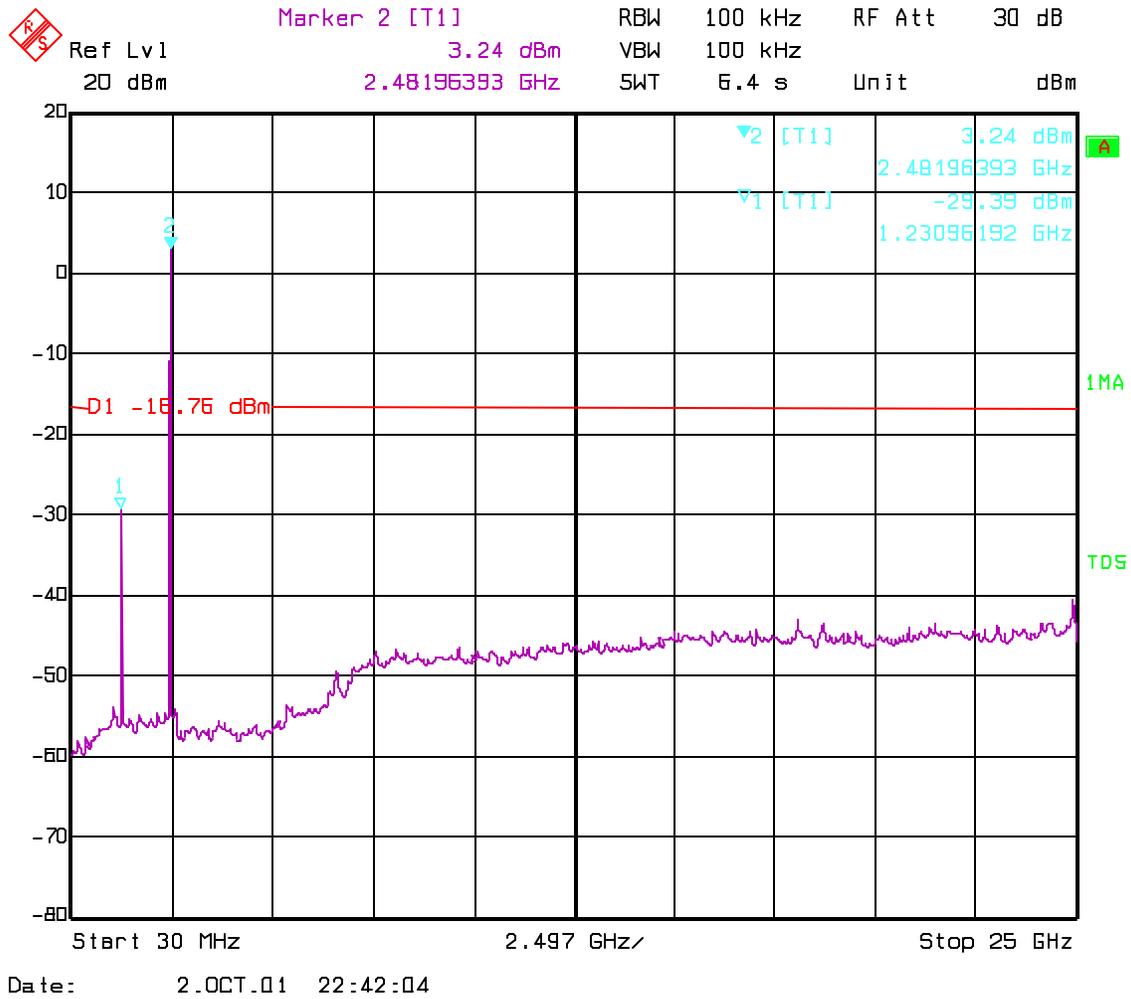
Mid Channel(2441MHz): 30MHz - 25GHz

Marker 2 [T1]   RBW   100 kHz   RF Att   30 dB
Ref Lvl   2.14 dBm   VBW   100 kHz
20 dBm   2.43192385 GHz   SWT   6.4 s   Unit   dBm

▼2 [T1]   2.14 dBm
2.43192385 GHz
▼1 [T1]   -43.54 dBm
1.18092184 GHz

D1 -17.86 dBm

Start 30 MHz   2.497 GHz/   Stop 25 GHz

Date: 3.OCT.01   1:13:18

NOTE: The peak above the limit is the carrier frequency.

EMISSION LIMITATIONS - Conducted (Transmitter)   **§ 15.247 (c) (1)**

Highest Channel(2480MHz): 30MHz - 25GHz

Marker 2 [T1]		RBW	100 kHz	RF Att	30 dB

Ref Lvl 20 dBm — Marker 2 [T1] 3.24 dBm 2.48196393 GHz

RBW 100 kHz VBW 100 kHz SWT 6.4 s RF Att 30 dB Unit dBm

▼2 [T1] 3.24 dBm 2.48196393 GHz
▼1 [T1] -29.39 dBm 1.23096192 GHz

D1 -16.76 dBm

Start 30 MHz   2.497 GHz/   Stop 25 GHz

Date: 2.OCT.01 22:42:04

NOTE: The peak above the limit is the carrier frequency.

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

LIMITS

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)).

NOTE:
1. The radiated emissions were done with different settings, using the relevant pre-amplifiers for the relevant frequency ranges. This is the reason that the graphs show different noise levels. In the range between 18 and 25 GHz very short cable connections to the antenna was used to minimize the noise level.

2. Frequency resolution is not fine enough to show the exact frequency of the carrier, refer to plots under EIRP.

Results for the radiated measurements below 30MHz according § 15.33

Frequency	Measured values	Remarks
10KHz-30MHz	No emissions found, caused by the EUT	This is valid for all the tested channels

EMISSION LIMITATIONS - Radiated (Transmitter)   SUBCLAUSE § 15.247 (c) (1)
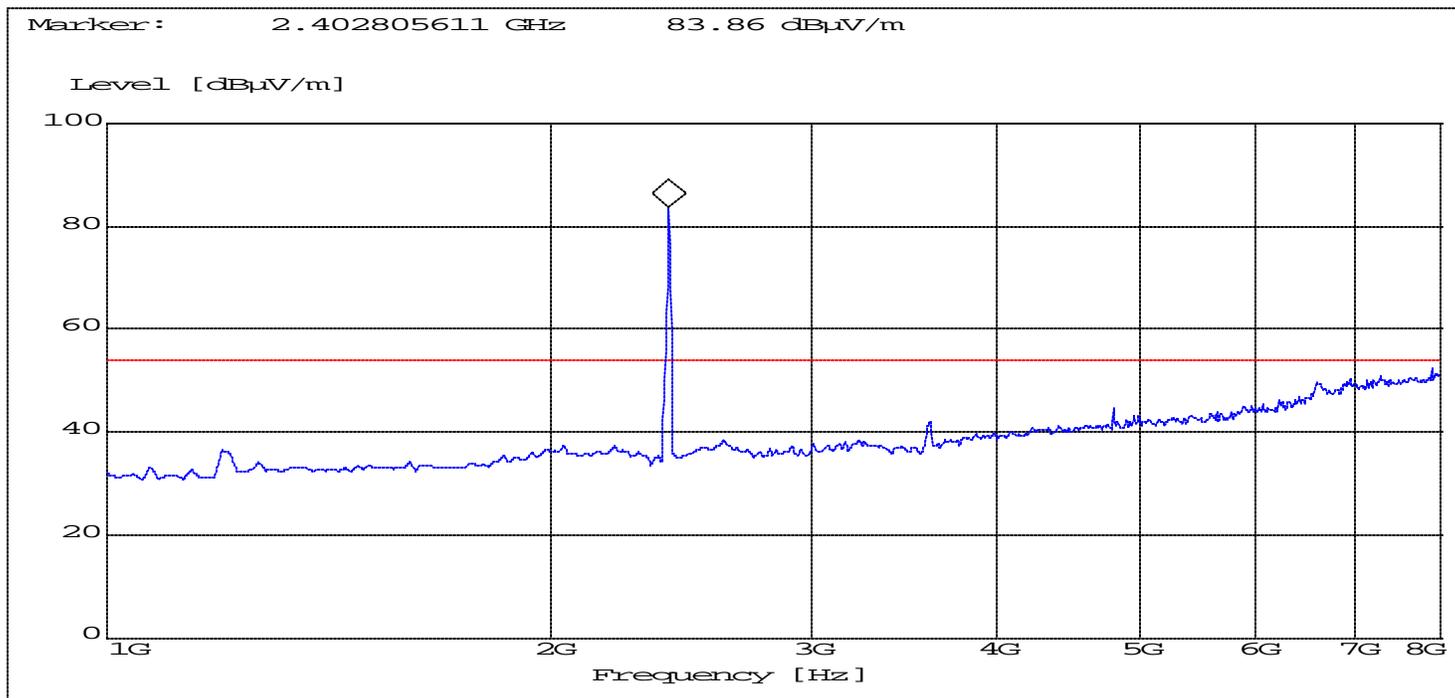
Lowest Channel(2402MHz): 30MHz – 1GHz

ANALYZER SETTINGS: RBW = 100KHz   VBW = 100KHz

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EMISSION LIMITATIONS - Radiated (Transmitter)   **SUBCLAUSE § 15.247 (c) (1)**

Lowest Channel(2402MHz): 1GHz – 8GHz

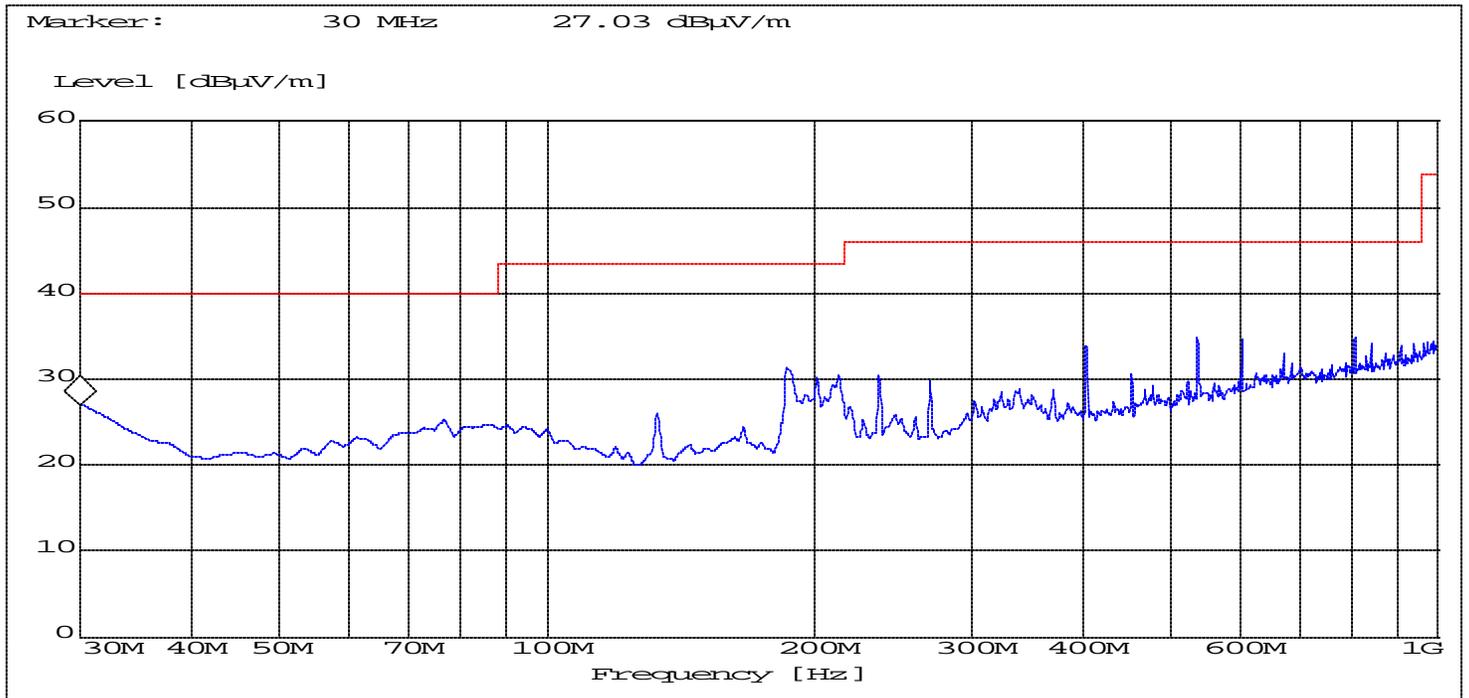**NOTE: The peak above the limit is the carrier frequency.**

ANALYZER SETTINGS: RBW = 1MHz   VBW = 1MHz

EMISSION LIMITATIONS - Radiated (Transmitter)   **SUBCLAUSE § 15.247 (c) (1)**

Mid Channel(2441MHz): 30MHz – 1GHz
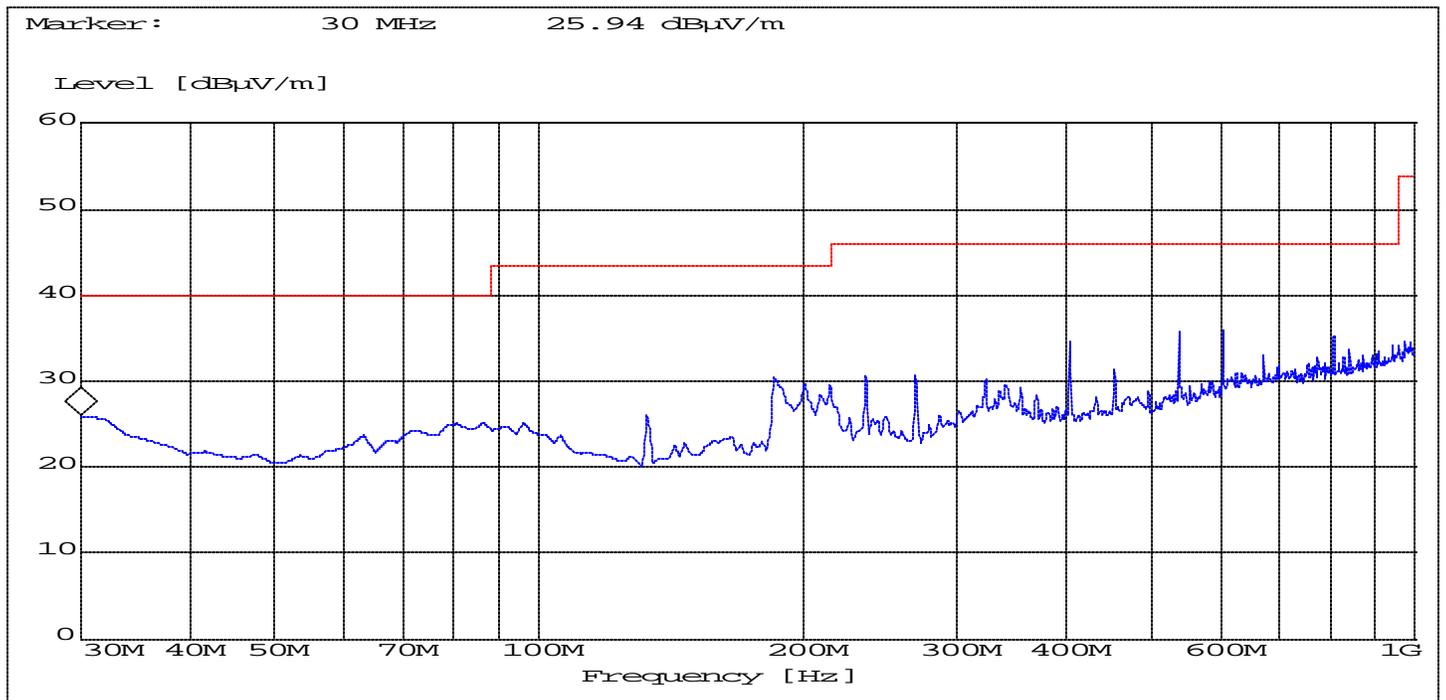

ANALYZER SETTINGS: RBW = 100KHz   VBW = 100KHz

EMISSION LIMITATIONS - Radiated (Transmitter)   **SUBCLAUSE § 15.247 (c) (1)**

Mid Channel(2441MHz): 1GHz – 8GHz

NOTE: The peak above the limit is the carrier frequency.


```
Marker:        2.430861723 GHz        82.45 dBµV/m
```

ANALYZER SETTINGS: RBW = 1MHz   VBW = 1MHz

EMISSION LIMITATIONS - Radiated (Transmitter)   **SUBCLAUSE § 15.247 (c) (1)**
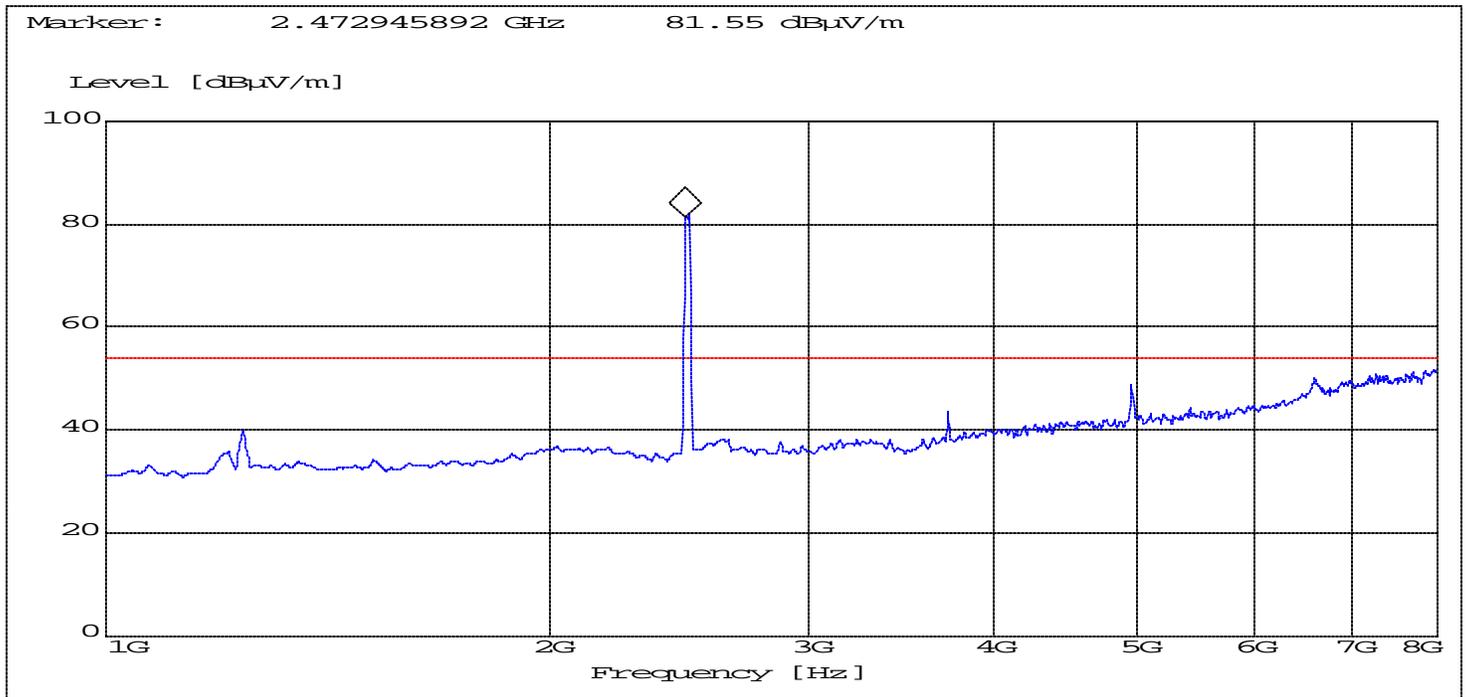
Highest Channel(2480MHz): 30MHz – 1GHz


```
Marker:          30 MHz        25.94 dBµV/m

Level [dBµV/m]
```

ANALYZER SETTINGS: RBW = 100KHz   VBW = 100KHz

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EMISSION LIMITATIONS - Radiated (Transmitter)   **SUBCLAUSE § 15.247 (c) (1)**

Highest Channel: 1GHz – 8GHz

NOTE: The peak above the limit is the carrier frequency.

```
Marker:        2.472945892 GHz        81.55 dBµV/m
```
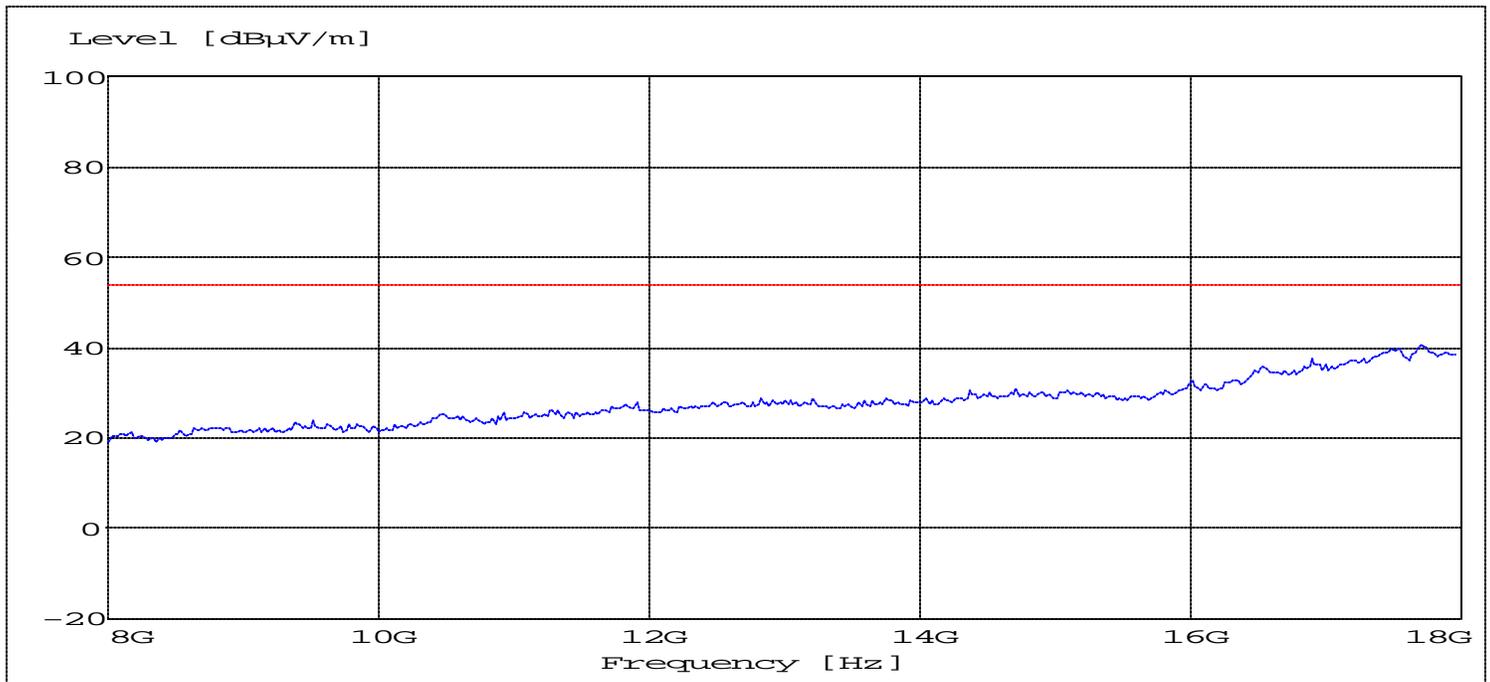

ANALYZER SETTINGS: RBW = 1MHz   VBW = 1MHz

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

8GHz – 18GHz
(This plot is valid for all three channels)

ANALYZER SETTINGS: RBW = 1MHz   VBW = 1MHz

CETECOM Inc.

EMISSION LIMITATIONS - Radiated (Transmitter)   **SUBCLAUSE § 15.247 (c) (1)**

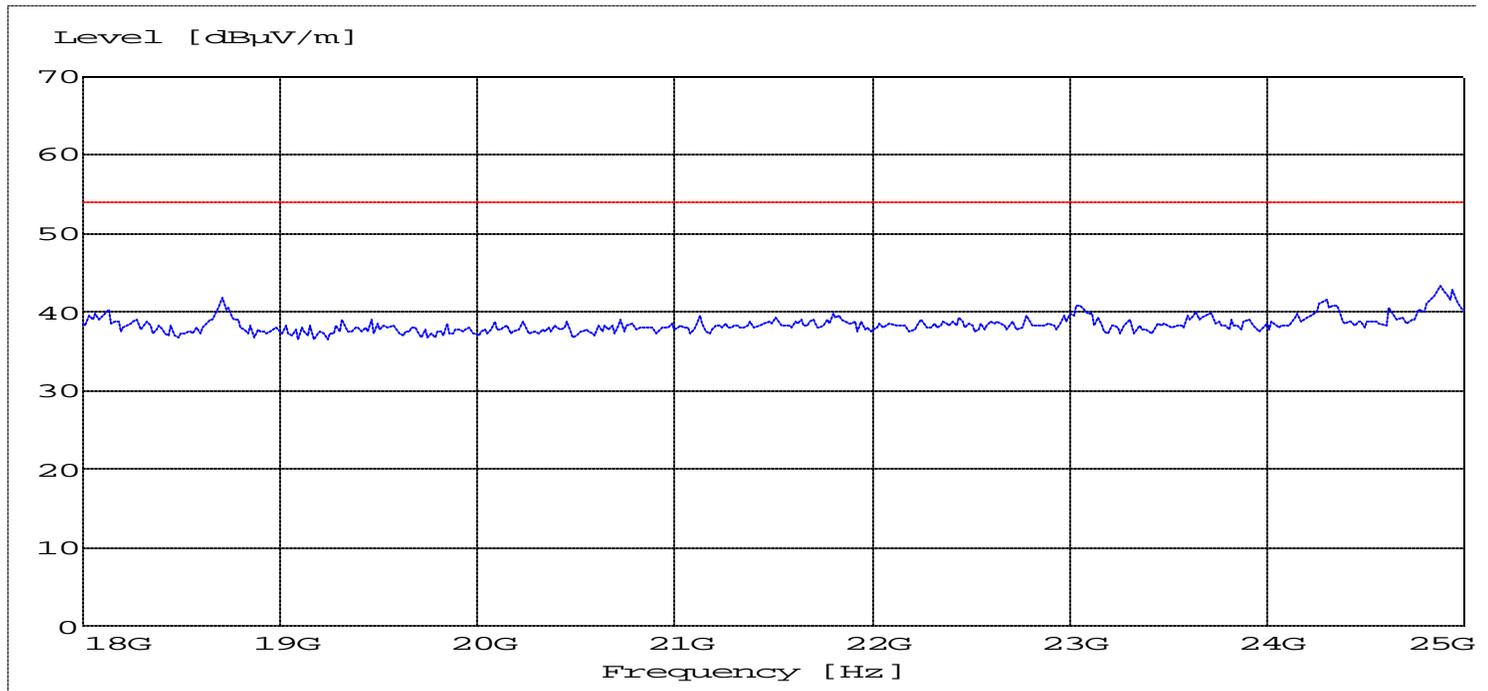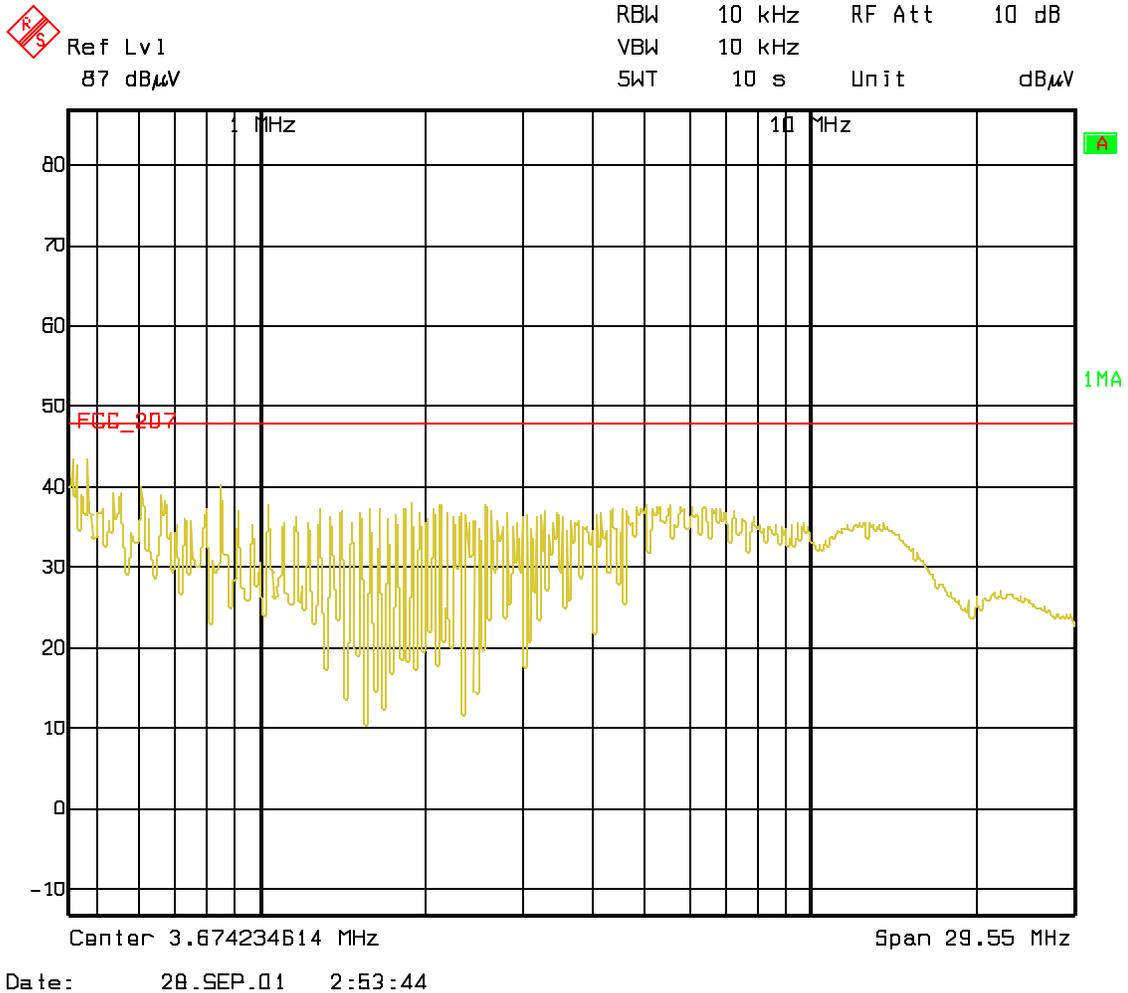**18GHz – 25GHz**
(This plot is valid for all three channels)

ANALYZER SETTINGS: RBW = 1MHz   VBW = 1MHz

CONDUCTED EMISSIONS   **§ 15.107/207**

Measured with AC/DC power adapter

Phase: Line

Technical specification: 15.107 / 15.207 (Revised as of October 1, 1991)

Limit

0.45 to 30 MHz	250 µV / 47.96dBµV

ANALYZER SETTINGS: RBW = 10KHz   VBW = 10KHz

Phase: Neutral
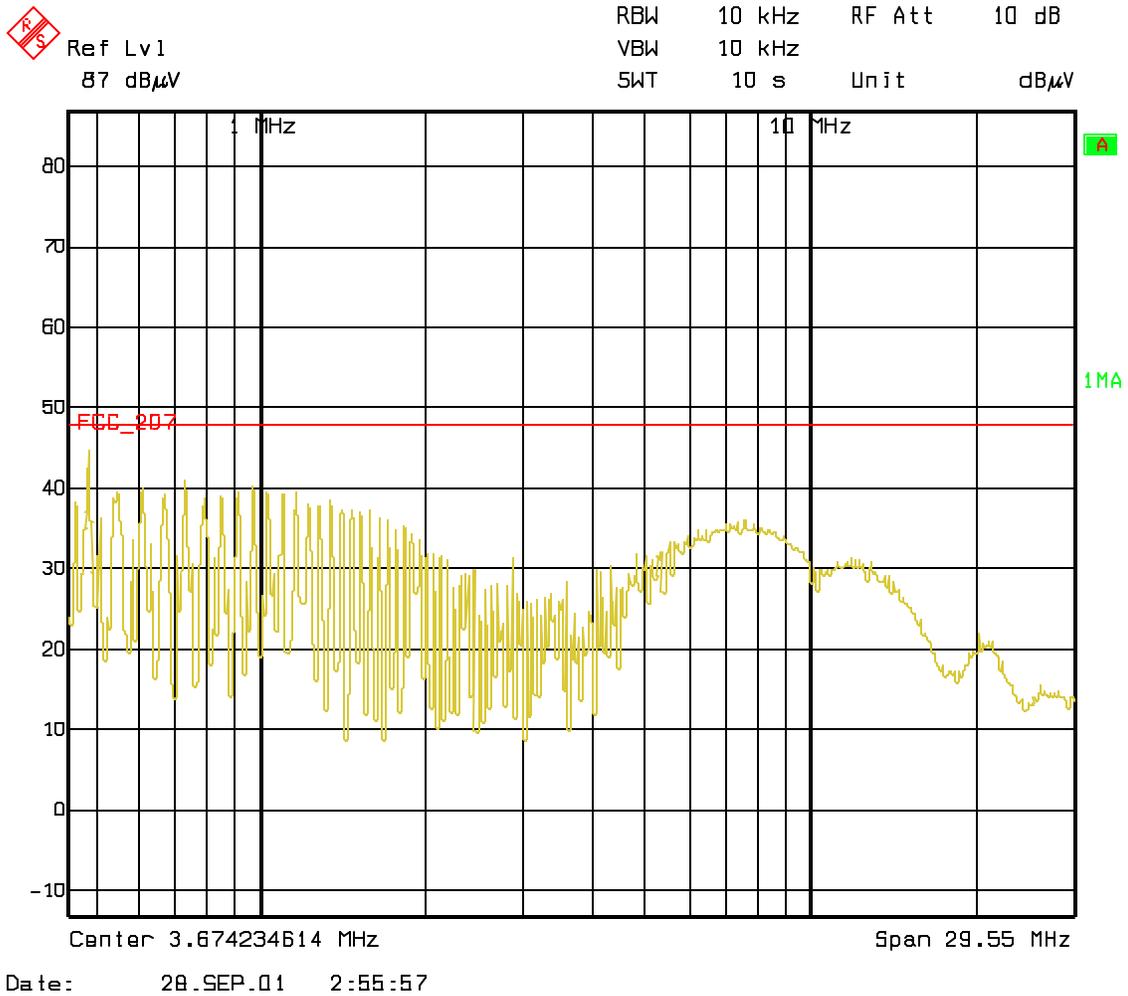

Technical specification: 15.107 / 15.207 (Revised as of October 1, 1991)

Limit

0.45 to 30 MHz	250 µV / 47.96dBµV

ANALYZER SETTINGS: RBW = 10KHz   VBW = 10KHz

CETECOM Inc.

RECEIVER SPURIOUS RADIATION § 15.209

Limits

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

<u>**NOTE:**</u>
1. The radiated emissions were done with different settings, using the relevant pre-amplifiers for the relevant frequency ranges. This is the reason that the graphs show different noise levels. In the range between 18 and 25 GHz very short cable connections to the antenna was used to minimize the noise level.

2. Measurements were done on low, mid & high channels, but plots depicting the worst case are submitted in the test report.

RECEIVER SPURIOUS RADIATION   § 15.209

30MHz – 1GHz
(This plot is valid for all three channels)

ANALYZER SETTINGS: RBW = 100KHz   VBW = 100KHz

CETECOM Inc.
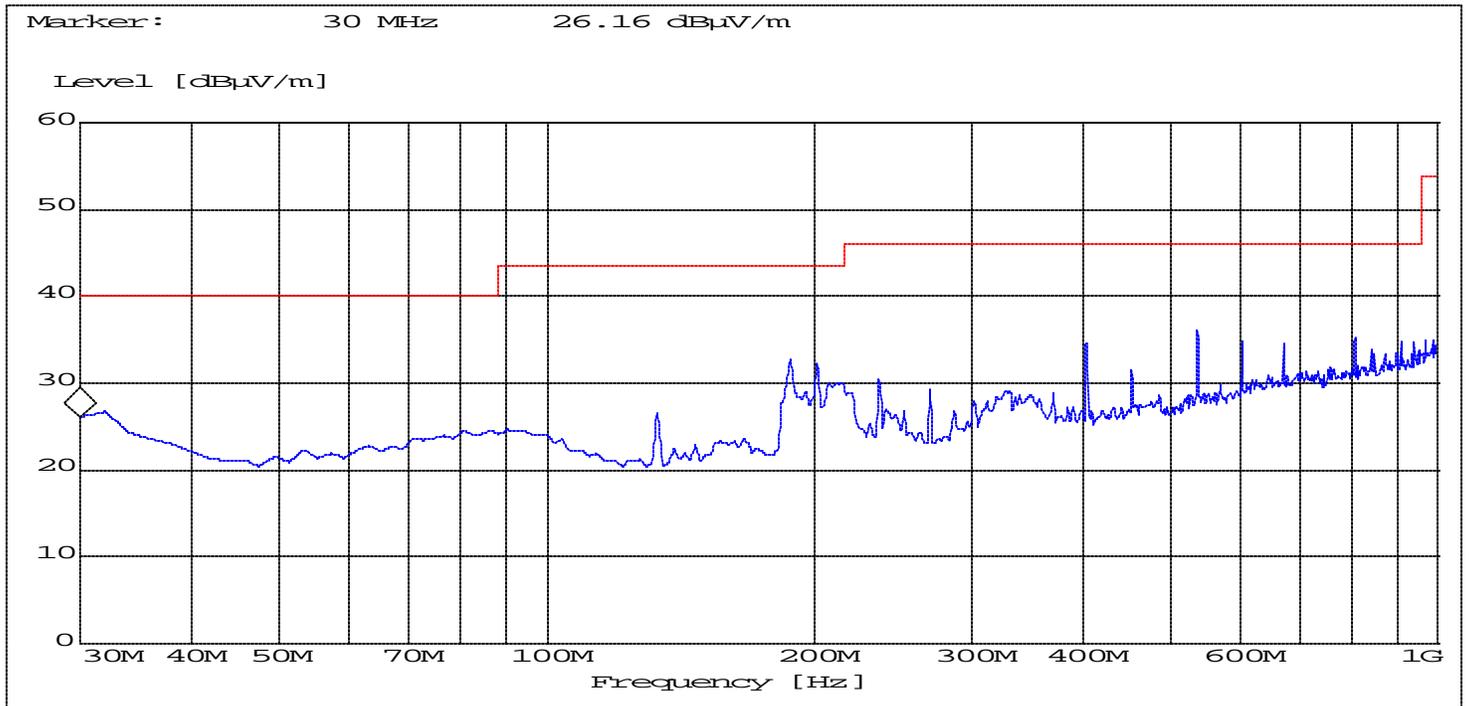
RECEIVER SPURIOUS RADIATION   **§ 15.209**

1GHz – 8GHz
(This plot is valid for all three channels)


```
Marker:        1 GHz        31.25 dBµV/m

  Level [dBµV/m]
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ANALYZER SETTINGS: RBW = 1MHz   VBW = 1MHz

RECEIVER SPURIOUS RADIATION   **§ 15.209**

8GHz – 18GHz
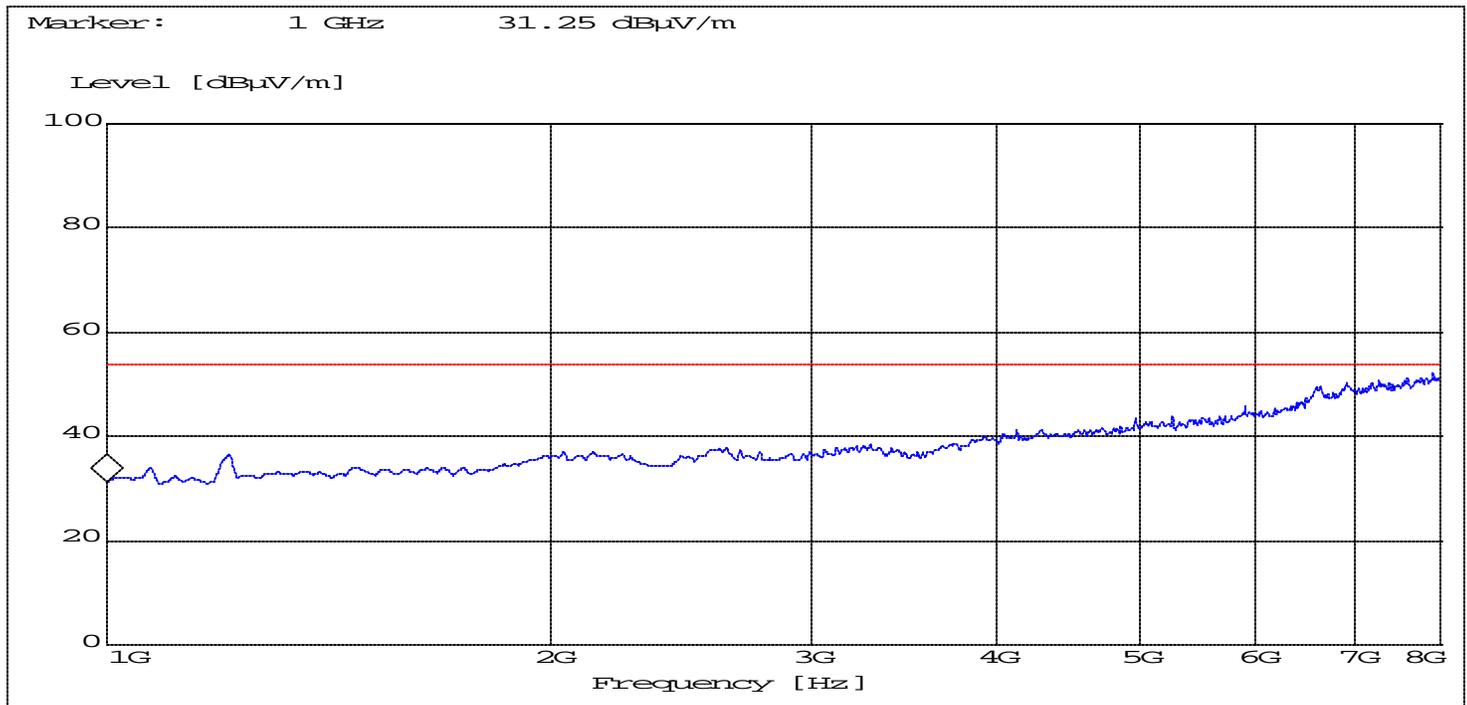**(This plot is valid for all three channels)**

ANALYZER SETTINGS: RBW = 1MHz   VBW = 1MHz

RECEIVER SPURIOUS RADIATION   § 15.209

18GHz – 26GHz
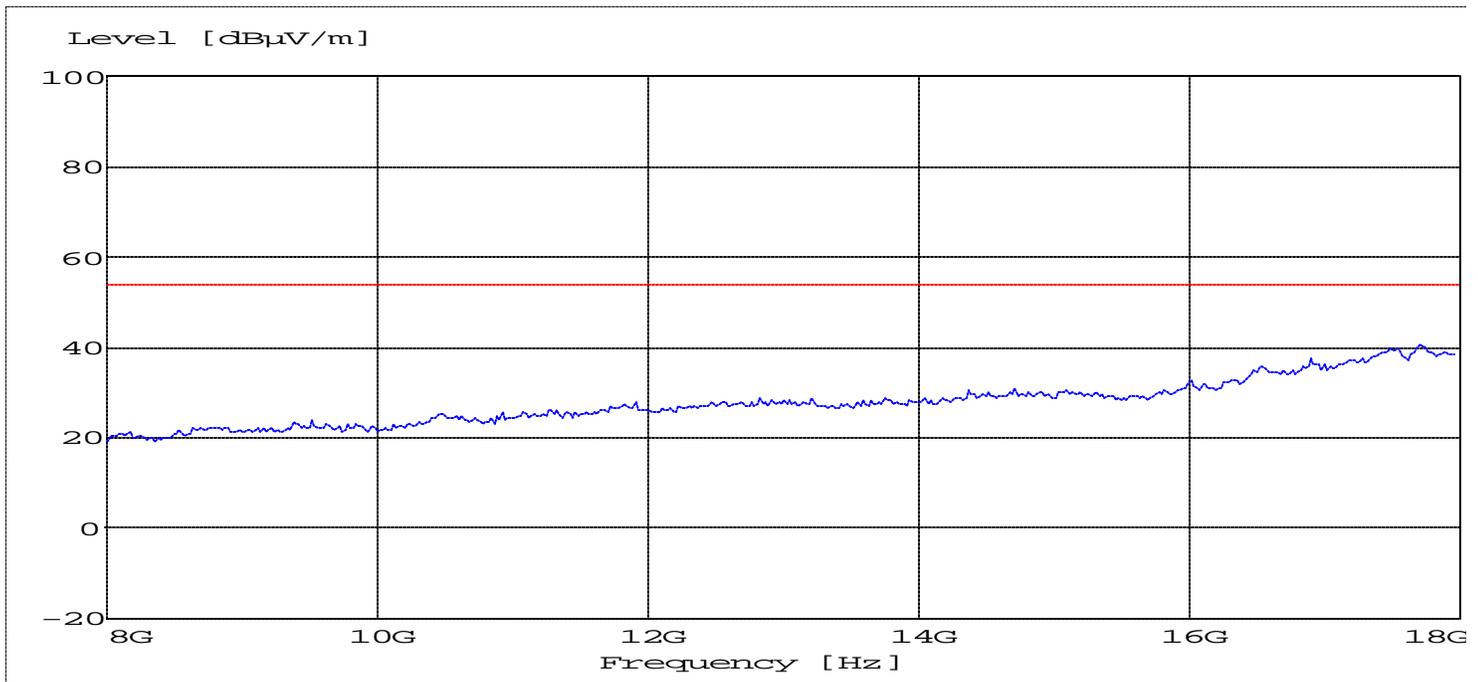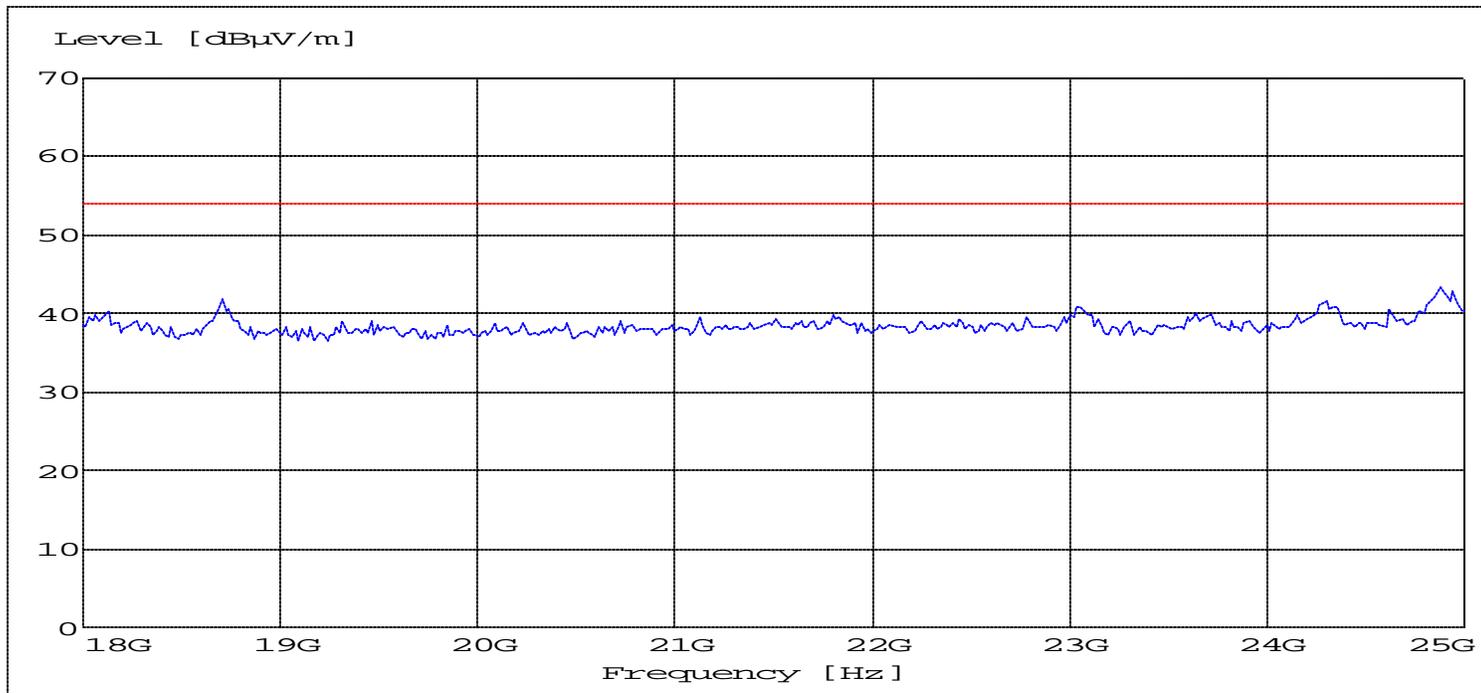**(This plot is valid for all three channels)**

ANALYZER SETTINGS: RBW = 1MHz   VBW = 1MHz

TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No	Instrument/Ancillary	Type	Manufacturer	Serial No.
01	Spectrum Analyzer	FSEM 30	Rohde & Schwarz	826880/010
02	Signal Generator	SMY0	Rohde & Schwarz	836878/011
03	Power-Meter	NRVD	Rohde & Schwarz	0857.8008.02
04	Power Amlifier	250W1000	Amplifier Research	300031
05	Biconilog Antenna	3141	EMCO	0005-1186
06	Horn Antenna	SAS-200/571	AH Systems	325
07	Power Splitter	11667B	Hewlett Packard	645348
08	Climatic Chamber	VT4004	Votch	G1115
09	Pre-Amplifier	JS4-00102600	Miteq	00616
10	Power Sensor	URV5-Z2	Rohde & Schwarz	DE30807
11	Power Sensor	URV5-Z2	Rohde & Schwarz	DE30808