FCC Test Report

Test report no.: EMC_644FCC15.247_2004_HDW-3

FCC Part 15.247 for FHSS systems / CANADA RSS-210
Model: HDW-3
FCC ID: PYAHDW-3
IC: 661V-HDW3

Deutscher Akkreditierungs Rat

TTI-P-G 081/94-A0

Accredited according to **ISO/IEC 17025**

Bluetooth Qualification Test Facility (BQTF)

FCC listed # 101450

IC recognized # 3925

***CETECOM* Inc.**
411 Dixon Landing Road ◆ Milpitas, CA 95035 ◆ U.S.A.
Phone: + 1 (408) 586 6200 ◆ Fax: + 1 (408) 586 6299 ◆ E-mail: info@cetecomusa.com ◆ http://www.cetecom.com
CETECOM Inc. is a Delaware Corporation with Corporation number: 2113686
Board of Directors: Dr. Harald Ansorge, Dr. Klaus Matkey, Hans Peter May

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 generalizations 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 Engineer: Harpreet Sidhu

1.2 Testing laboratory

CETECOM Inc.
411 Dixon Landing Road, Milpitas, CA-95035, USA
Phone: +1 408 586 6200 Fax: +1 408 586 6299
E-mail: lothar.schmidt@cetecomusa.com
Internet: www.cetecom.com

1.3 Details of applicant

Name	**:**	**Nokia Corporation**
Street	**:**	**P.O Box 86 (Joensuunkatu 7E)**
City / Zip Code	**:**	**FIN-24101 SALO/24101**
Country	**:**	**Finland**
Contact	**:**	**Ari Havela**
Telephone	**:**	**+358 7180 42799**

1.4 Application details

Date of receipt test item	:	2004-04-14
Date of test	:	2004-04-19/20

1.5 Test item

Marketing Name	:	HDW-3
Model No.	:	HDW-3
Description	:	Bluetooth Headset
FCC-ID	:	PYAHDW-3
IC ID	:	661V-HDW3

Additional information

Frequency	:	2402MHz – 2480MHz
Type of modulation	:	GFSK
Number of channels	:	79
Antenna	:	Internal
Power supply	:	NiMH Battery (170mAH)
Output power	:	0.79dBm (1.2mW) max. conducted peak power
Extreme vol. Limits	:	2.2 – 2.9VDC (2.5VDC nominal)
Extreme temp. Tolerance	:	0ºC-55ºC

1.6 Test standards: FCC Part 15 §15.247 (DA00-705) / RSS 210

Note: All radiated measurements were made in all three orthogonal planes. The values reported are the maximum values.

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	
Final Verdict: (only "passed" if all single measurements are "passed")	**Passed**

Technical responsibility for area of testing:

Date	Section	Name	Signature
2004-05-10	EMC & Radio	Siegfried Lehmann (Technical Manager)	

Responsible for test report and project leader:

Date	Section	Name	Signature
2004-05-10	EMC & Radio	Harpreet Sidhu (EMC Engineer)	

2.2 Test report

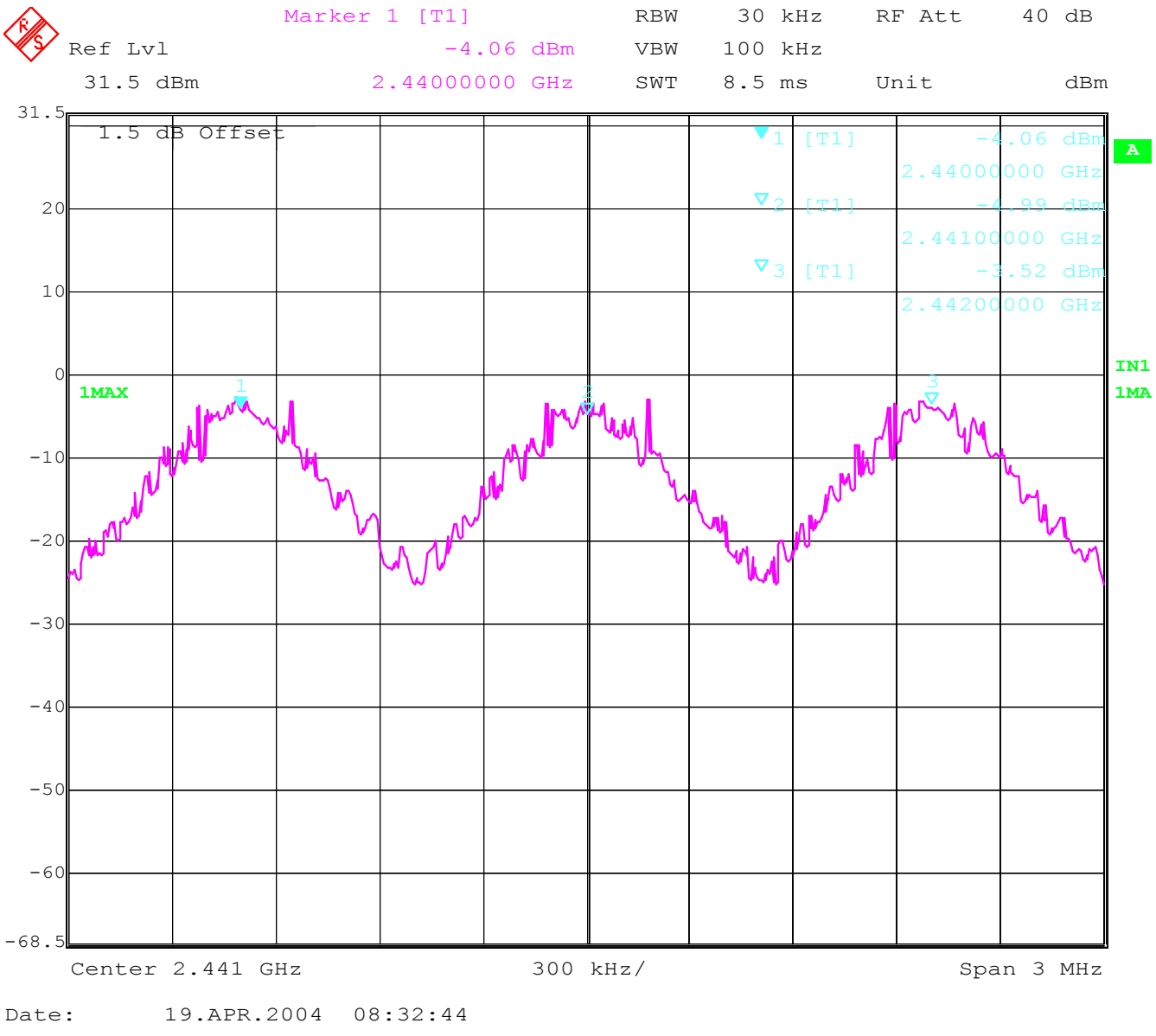
TEST REPORT

Test report no.: EMC_644FCC15.247_2004_HDW-3

TEST REPORT REFERENCE

LIST OF MEASUREMENTS

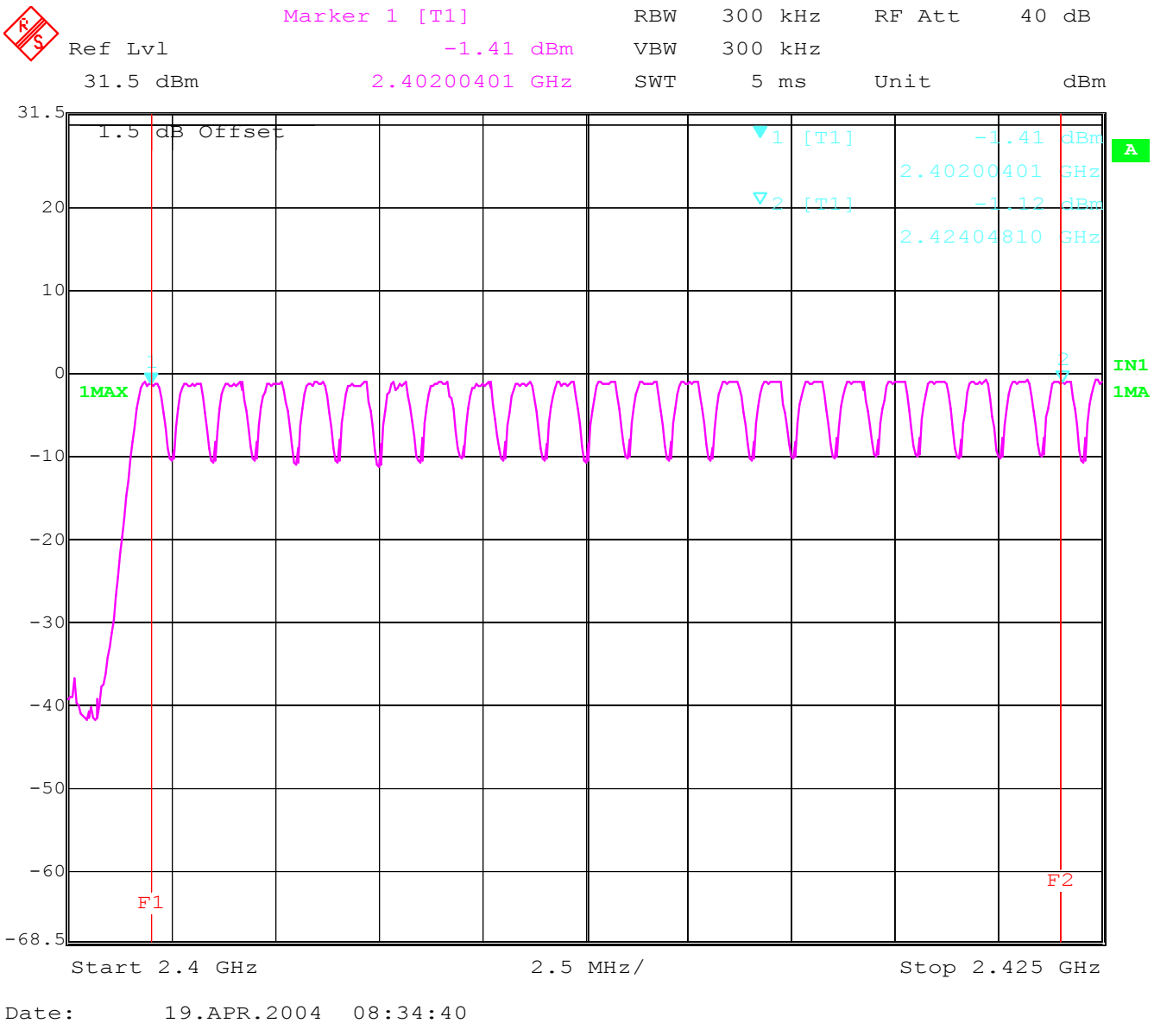
CARRIER FREQUENCY SEPERATION §15.247(a)



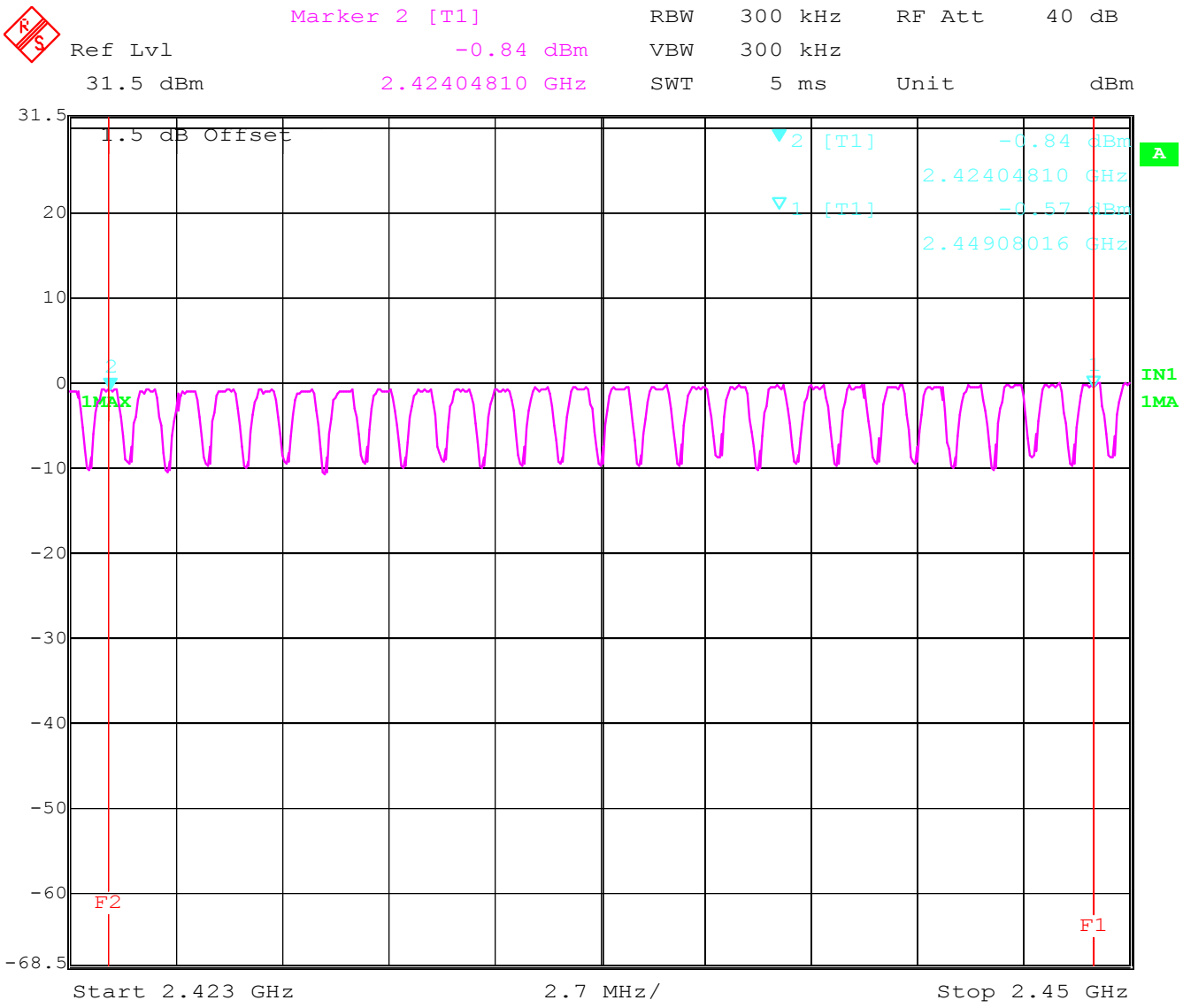
NUMBER OF HOPPING CHANNELS §15.247(a)

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.

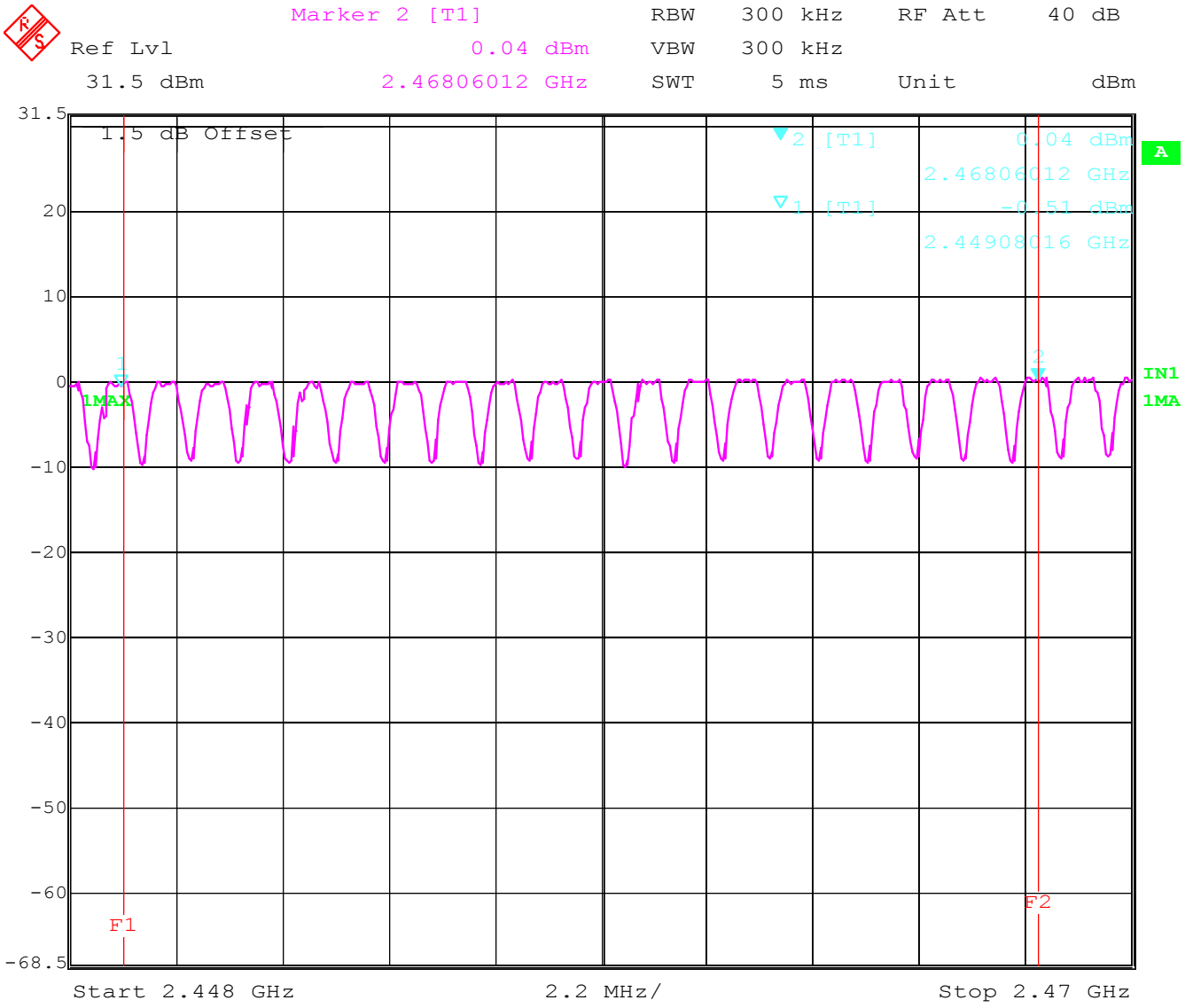
Plot 1: Total 23



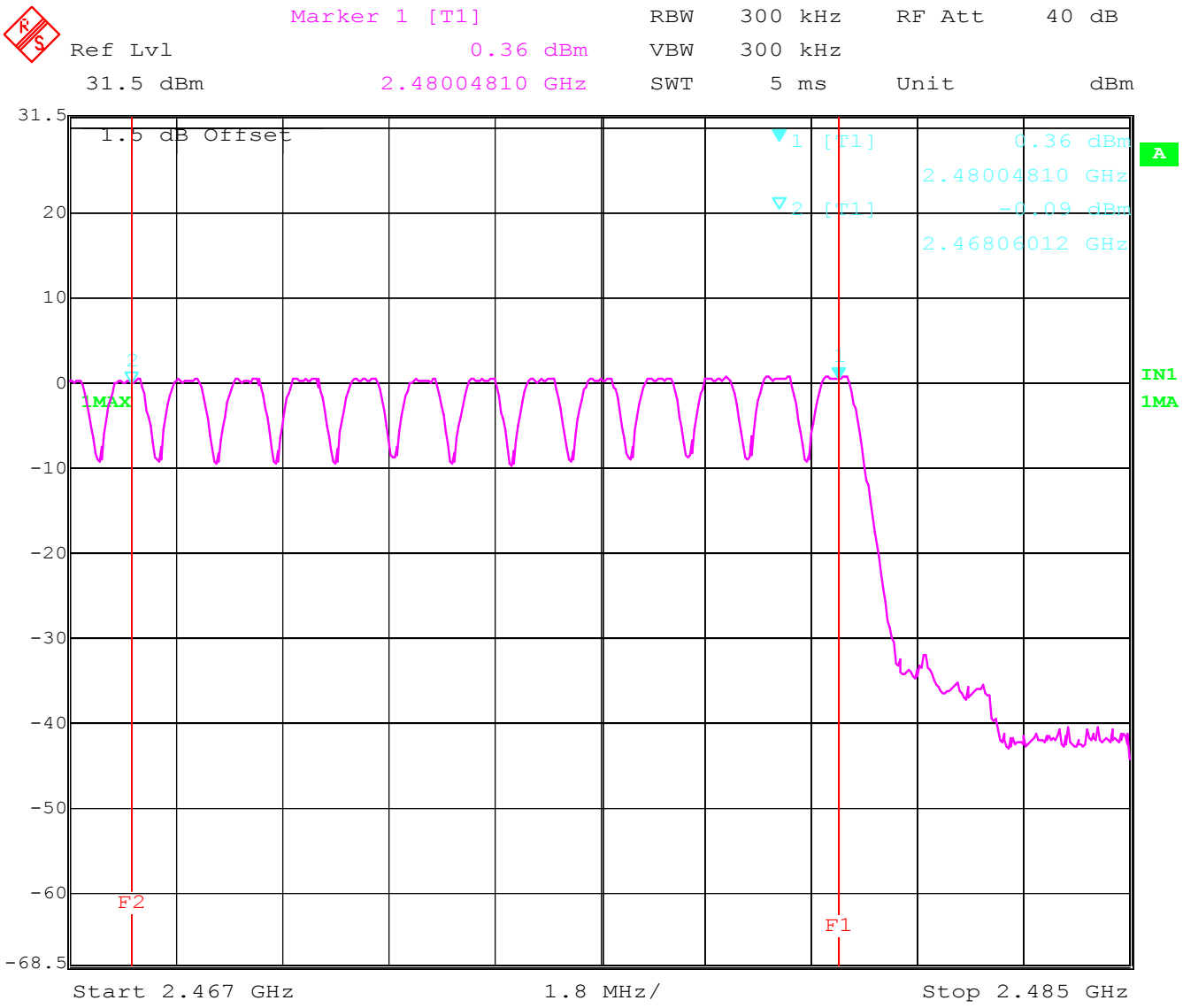
Plot 2: Total 25



Plot 3: Total 19



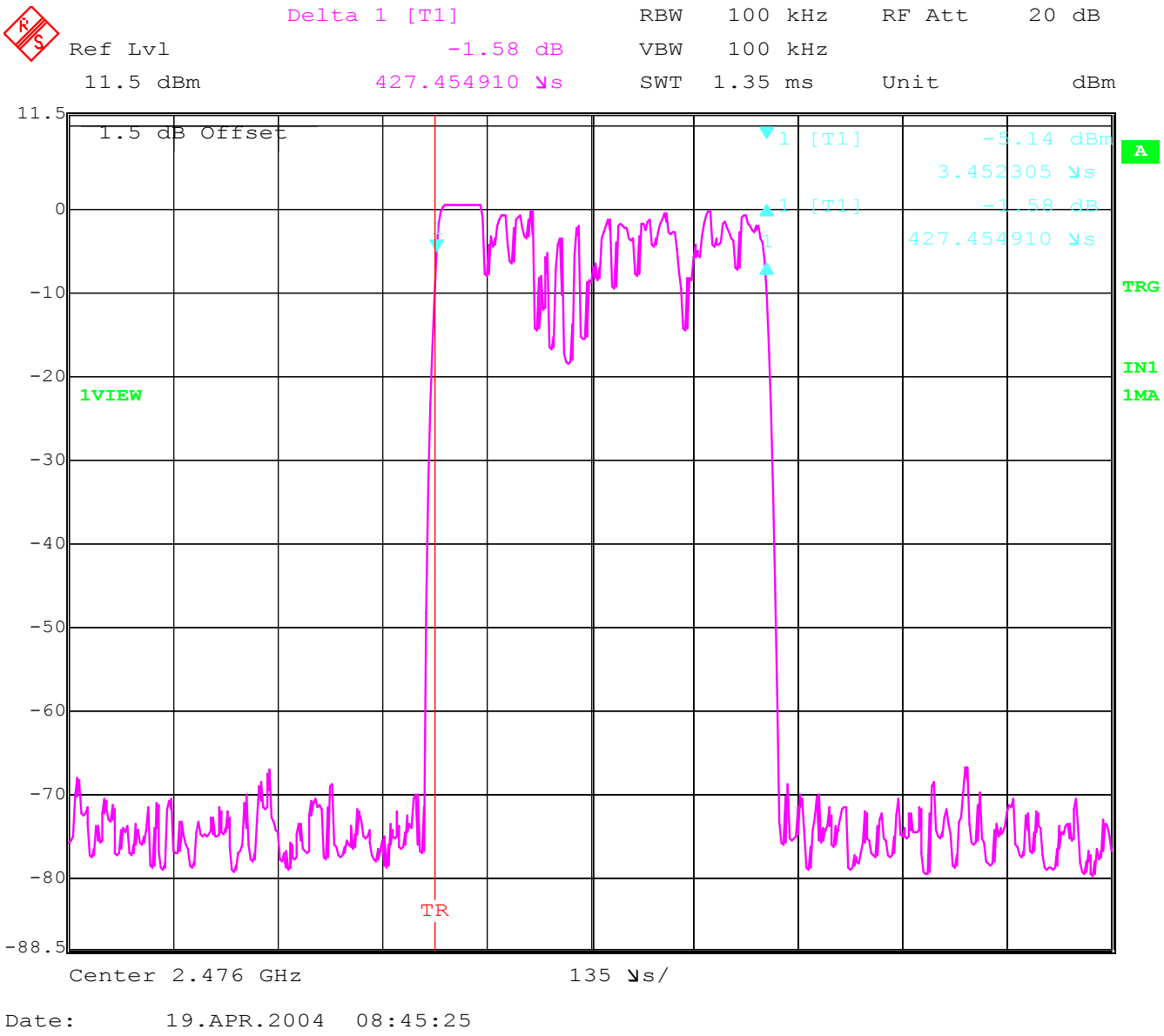
Plot 4: Total 12



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

DH1 – Packet

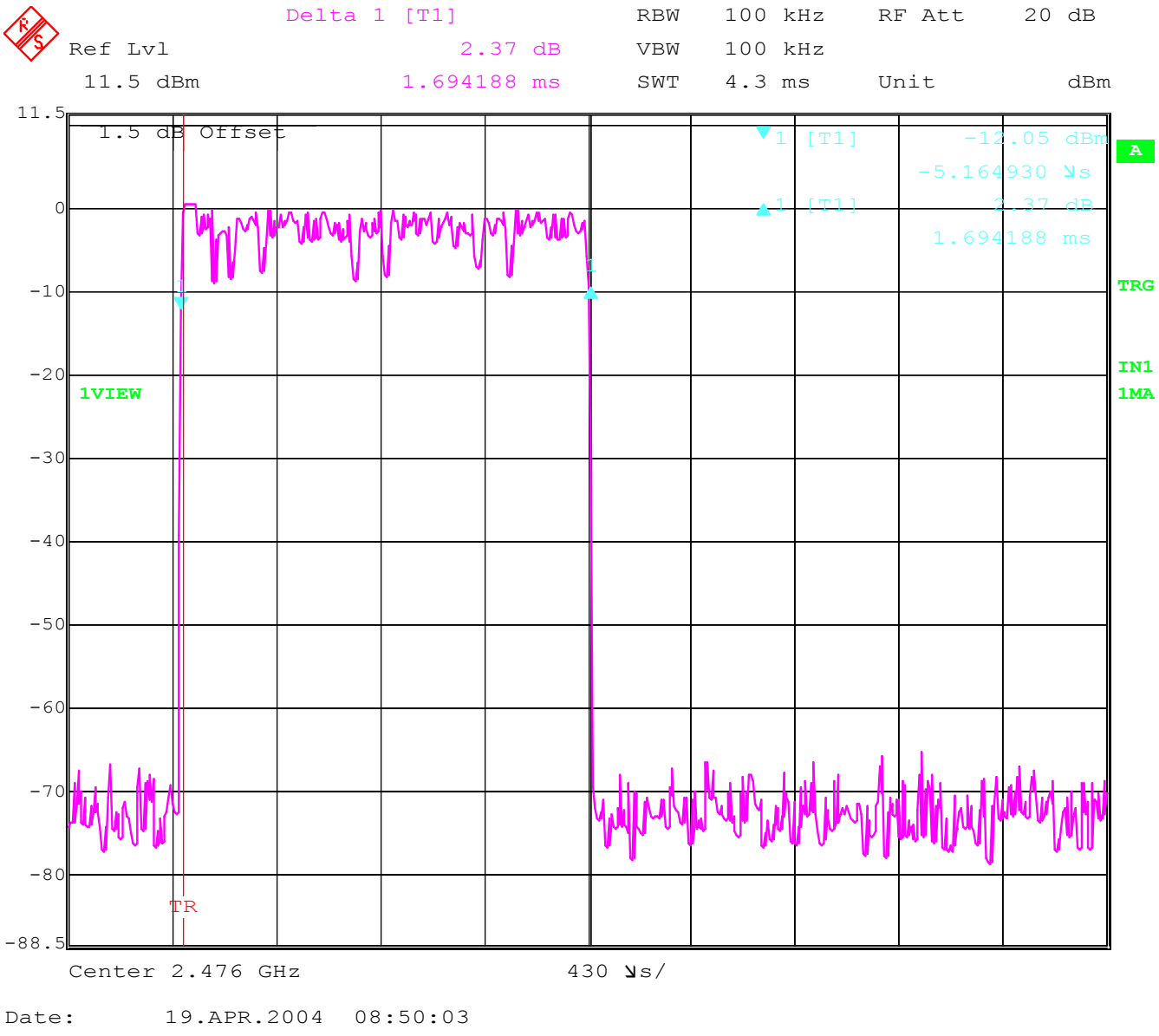
The system makes worst case 1600 hops per second or 1 time slot has a length of 625µs with 79 channels. A DH1 Packet need 1 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 800 hops per second with 79 channels. So you have each channel 10.13 times per second and so for 31.6 seconds you have 320.108 times of appearance.
Each Tx-time per appearance is 427.45µs.
<u>So we have 320.108 * 427.45µs = 136.83ms per 31.6 seconds.</u>



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

DH3 – Packet

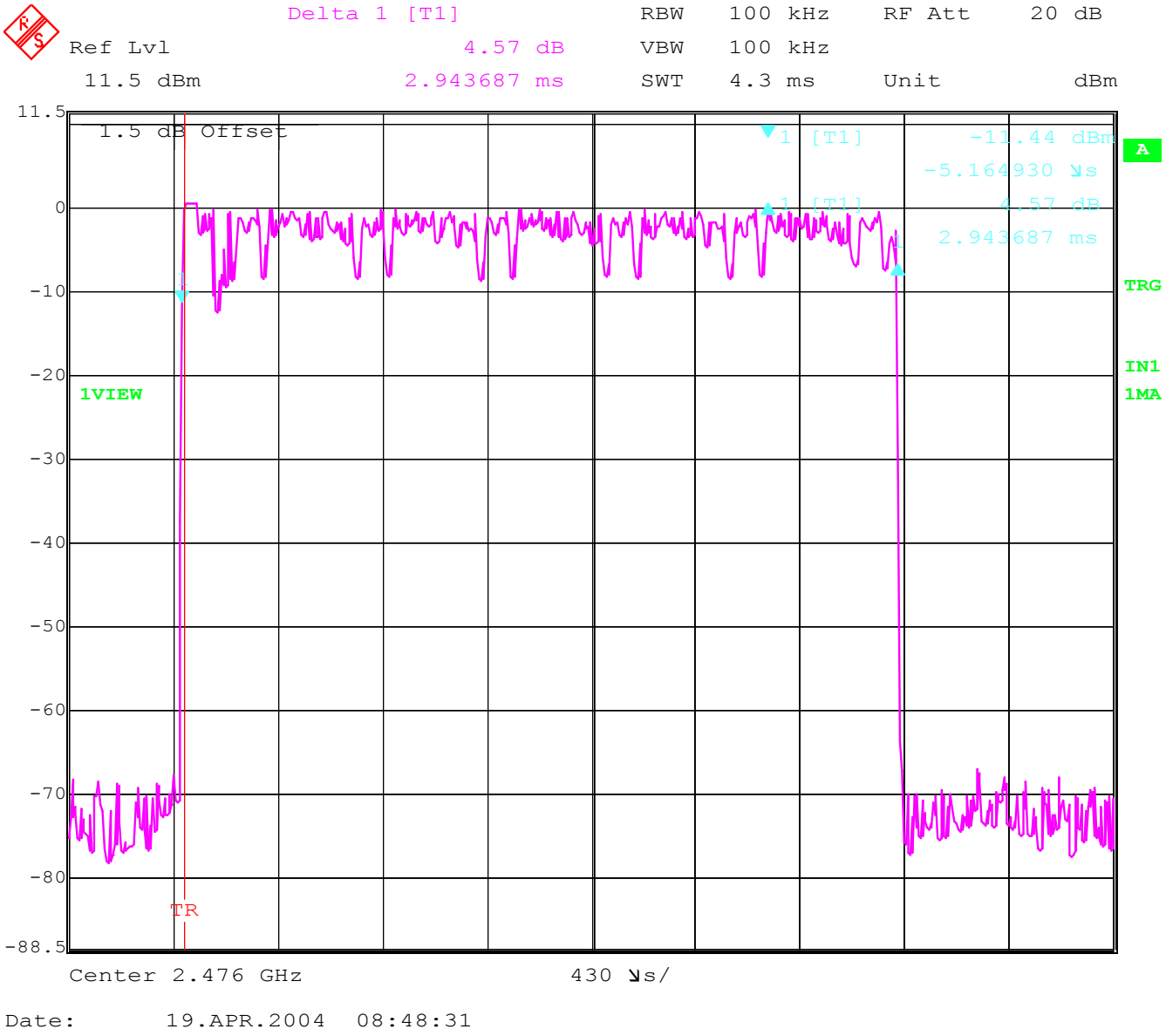
A DH3 Packets need 3 time slots for transmit and 1 for receiving, then the system makes worst case 400 hops per second with 79 channels. So you have each channel 5.1 times per second and so for 31.6 seconds you have 161.16 times of appearance.
Each Tx-time per appearance is 1.69ms.
So we have 161.16 * 1.69ms = 272.36ms per 31.6 seconds.



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

DH5 – Packet

At DH5 Packets you need 5 time slots for transmit and 1 for receiving, 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 106.176 times of appearance.
Each Tx-time per appearance is 2.94ms.
<u>So we have 106.176 * 2.94ms = 312.15ms per 31.6 seconds.</u>



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}(2.5)VDC	869.73	869.73	869.73

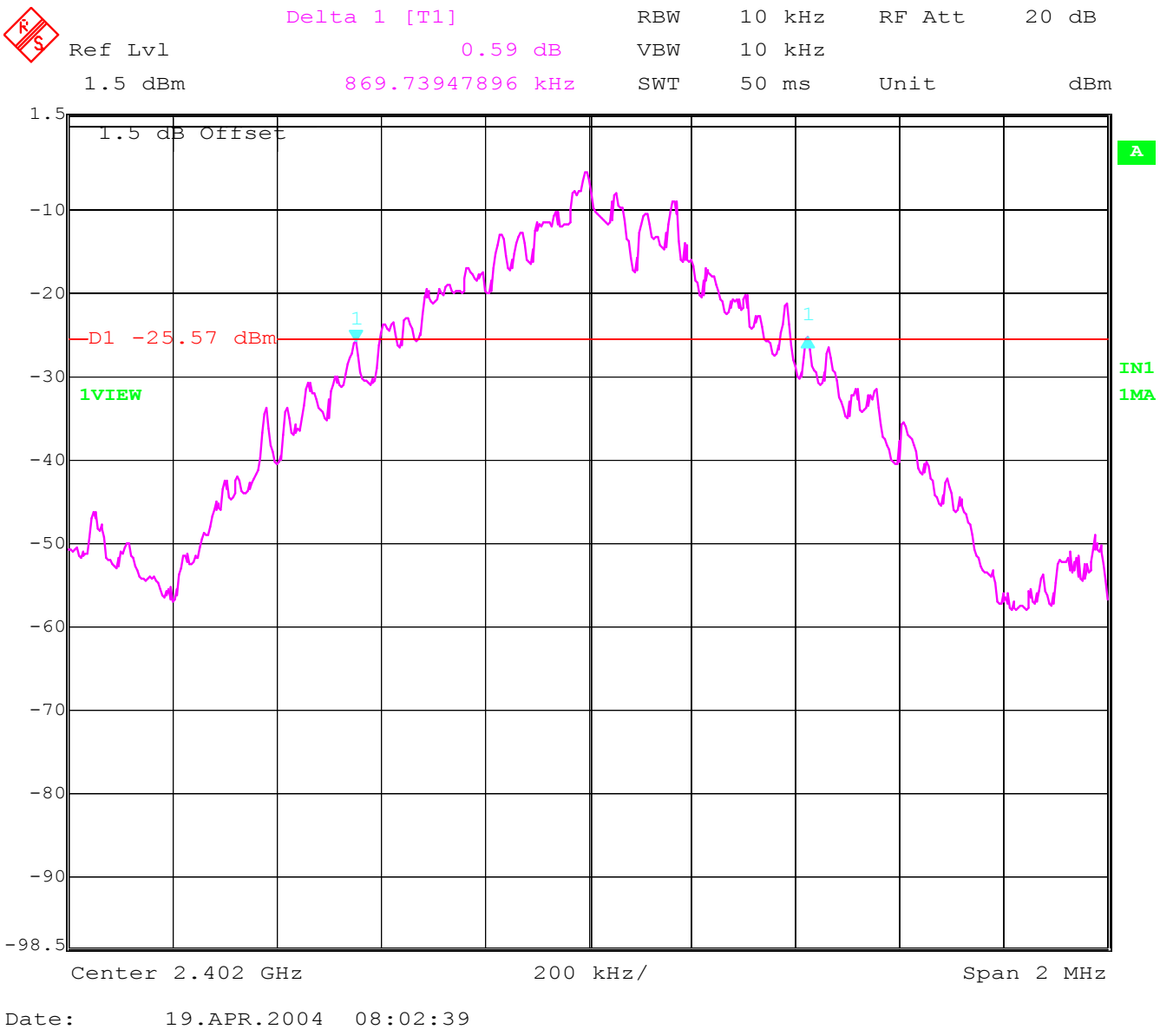
RBW / VBW as provided in the "Measurement Guidelines'' (DA 00-705, March 30, 2000)

LIMIT **SUBCLAUSE §15.247(a) (1)**

The maximum 20dB bandwidth shall be at maximum 1000 KHz

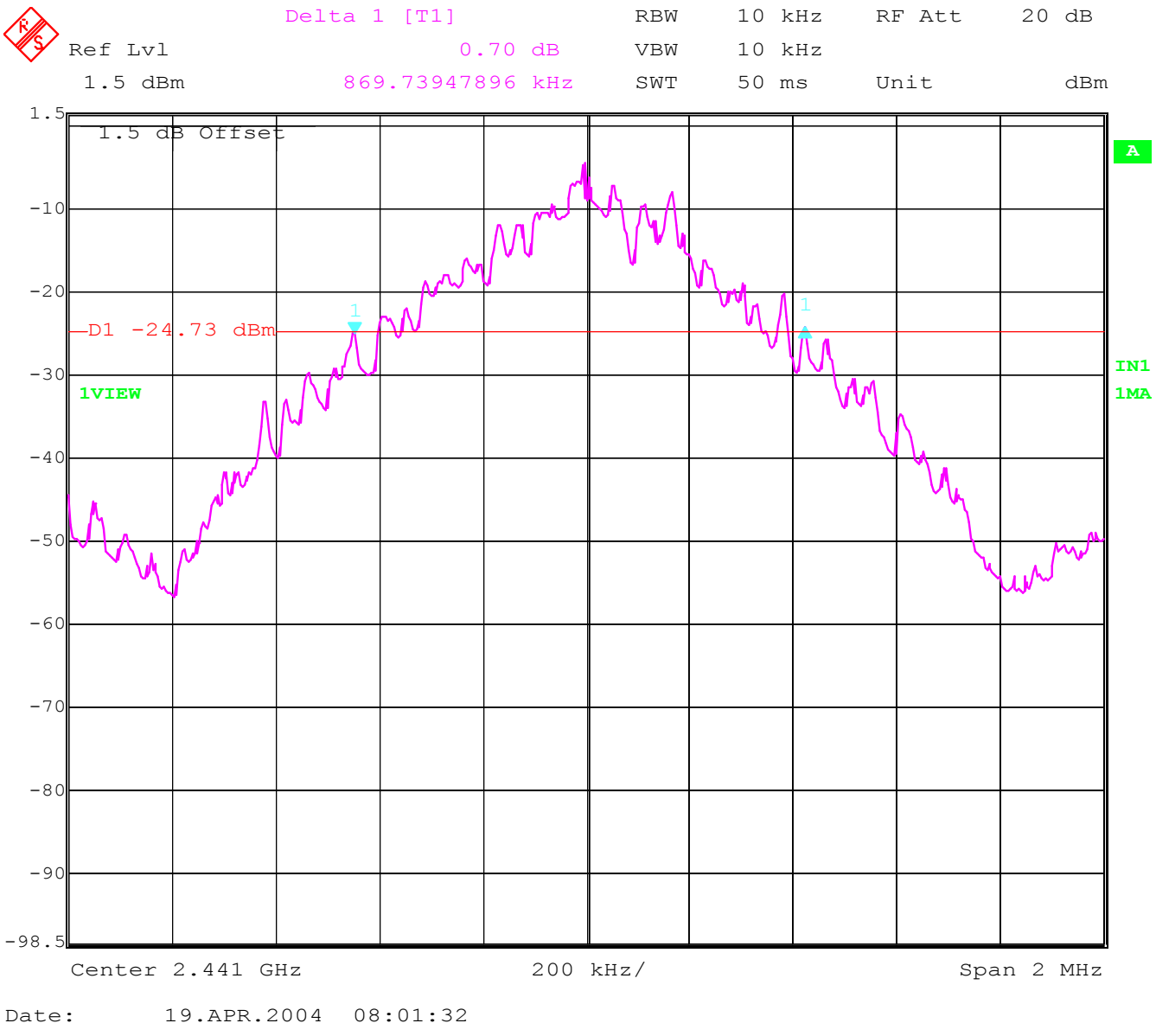
SPECTRUM BANDWIDTH OF FHSS SYSTEM §15.247(a)
20 dB bandwidth

Lowest Channel: 2402MHz



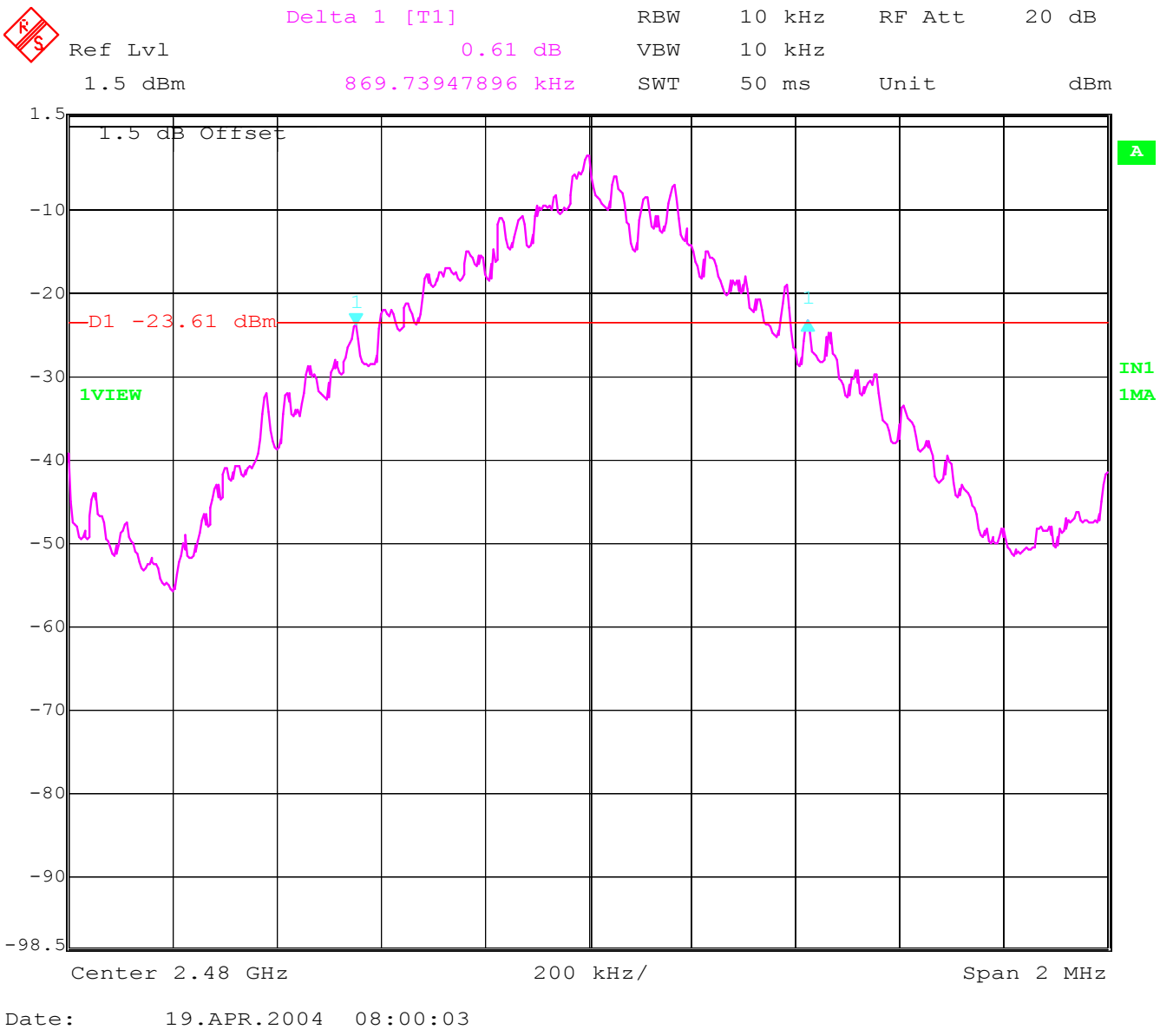
SPECTRUM BANDWIDTH OF FHSS SYSTEM §15.247(a)
20 dB bandwidth

Mid Channel: 2441MHz



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

Highest Channel: 2480MHz



MAXIMUM PEAK OUTPUT POWER (Conducted) § 15.247 (b) (1)

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		2402	2441	2480
T_{nom}(23)°C	V_{nom}(2.5)VDC	-1.12	-0.27	0.79
Measurement uncertainty		±0.5dBm		

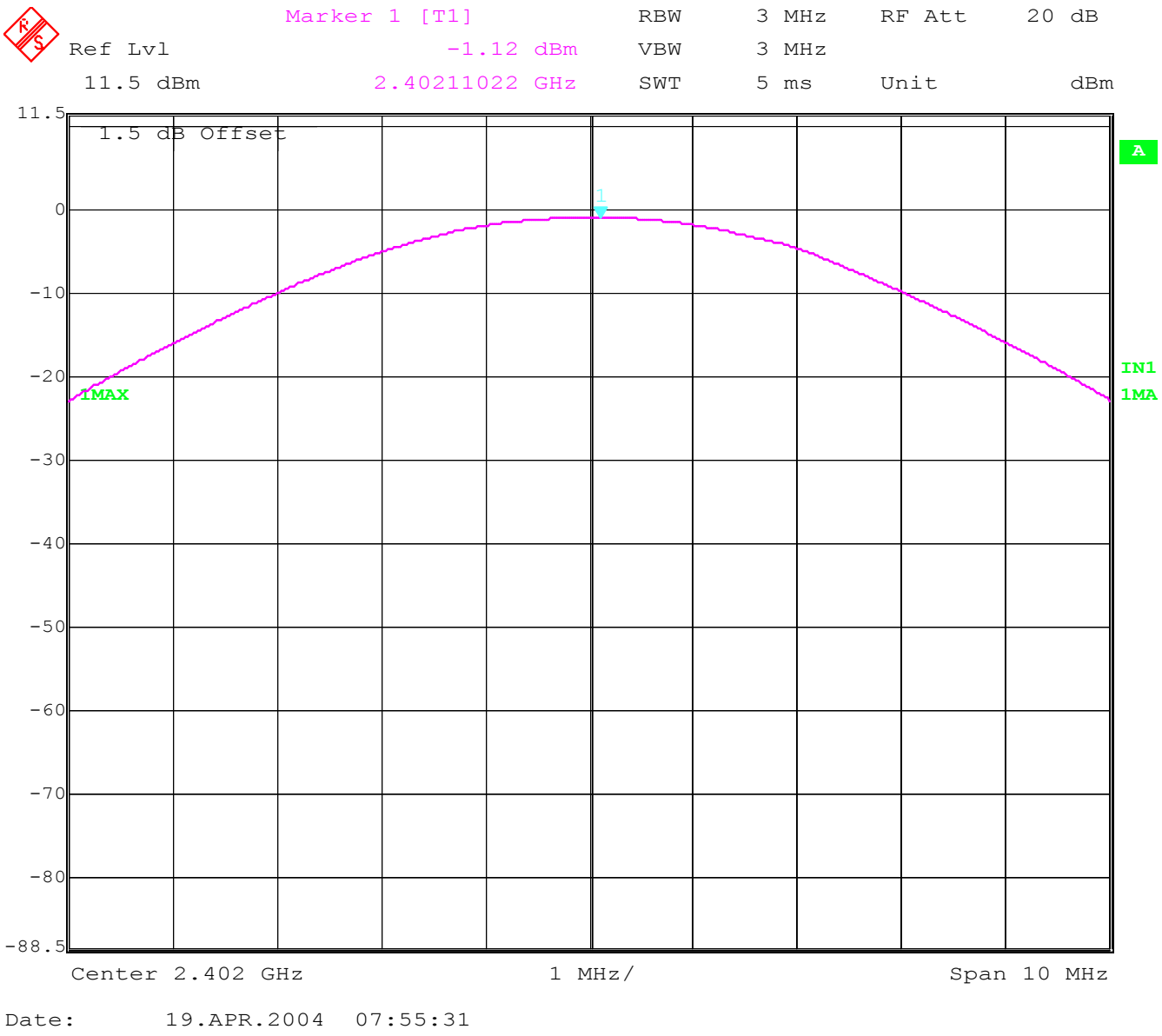
RBW / VBW: 3 MHz

LIMIT SUBCLAUSE § 15.247 (b) (1)

Frequency range	RF power output
2400-2483.5 MHz	1.0 Watt

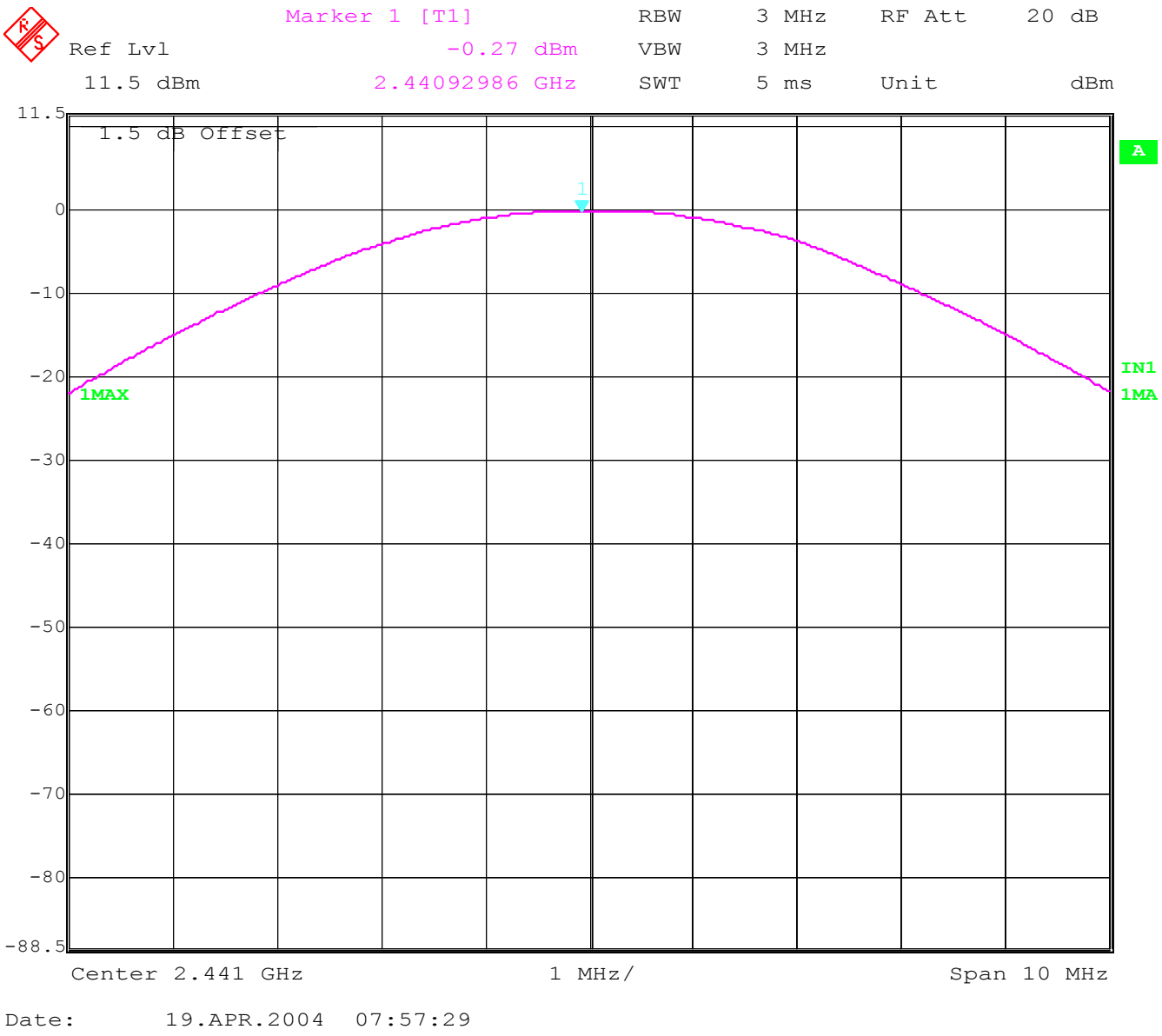
PEAK OUTPUT POWER (CONDUCTED) §15.247 (b)

Lowest Channel: 2402MHz



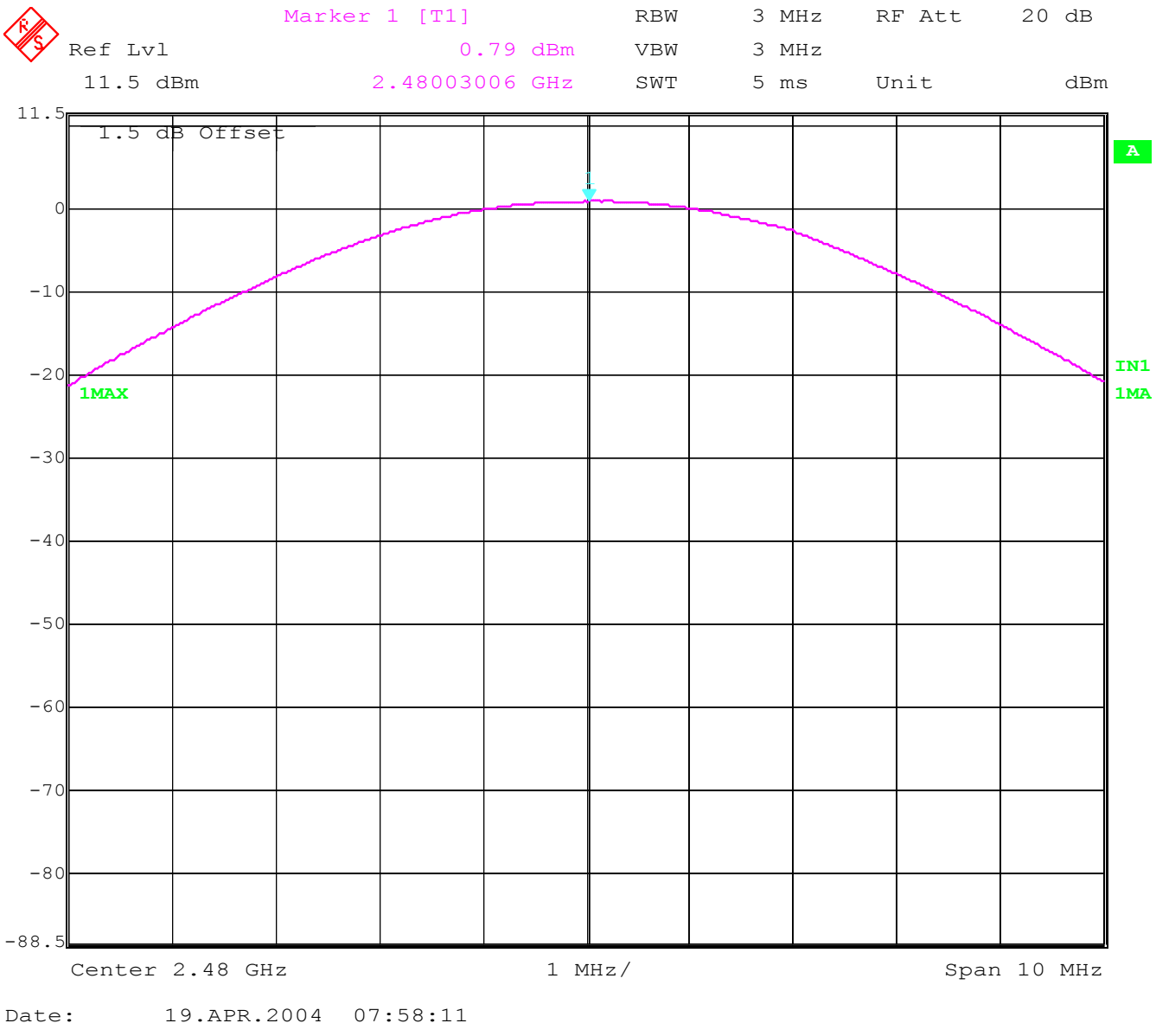
PEAK OUTPUT POWER (CONDUCTED) §15.247 (b)

Mid Channel: 2441MHz



PEAK OUTPUT POWER (CONDUCTED) §15.247 (b)

Highest Channel: 2480MHz



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

EIRP:

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		2402	2441	2480
T_{nom}(23)°C	V_{nom}(2.5)VDC	-1.58	0.84	-0.01
Measurement uncertainty		±0.5dBm		

RBW/VBW: 3 MHz

LIMIT SUBCLAUSE § 15.247 (b) (1)

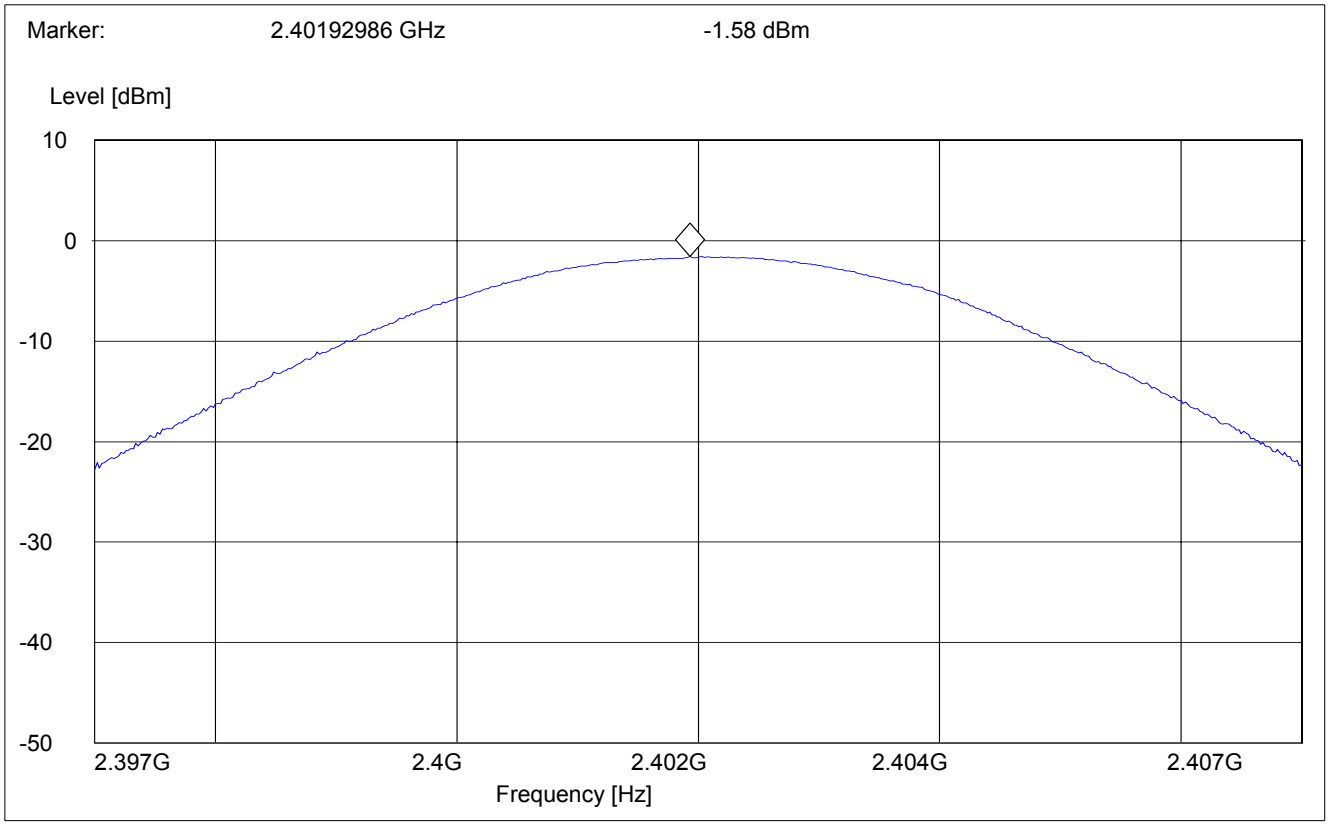
Frequency range	RF power output
2400-2483.5 MHz	1.0 Watt

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

Lowest Channel: 2402MHz

SWEEP TABLE: "EIRP BT low channel"

Short Description:		EIRP Bluetooth channel-2402MHz		
Start Frequency	Stop Frequency	Detector	Meas. Time	IF BW
2.397GHz	2.407GHz	MaxPeak	Coupled	3 MHz

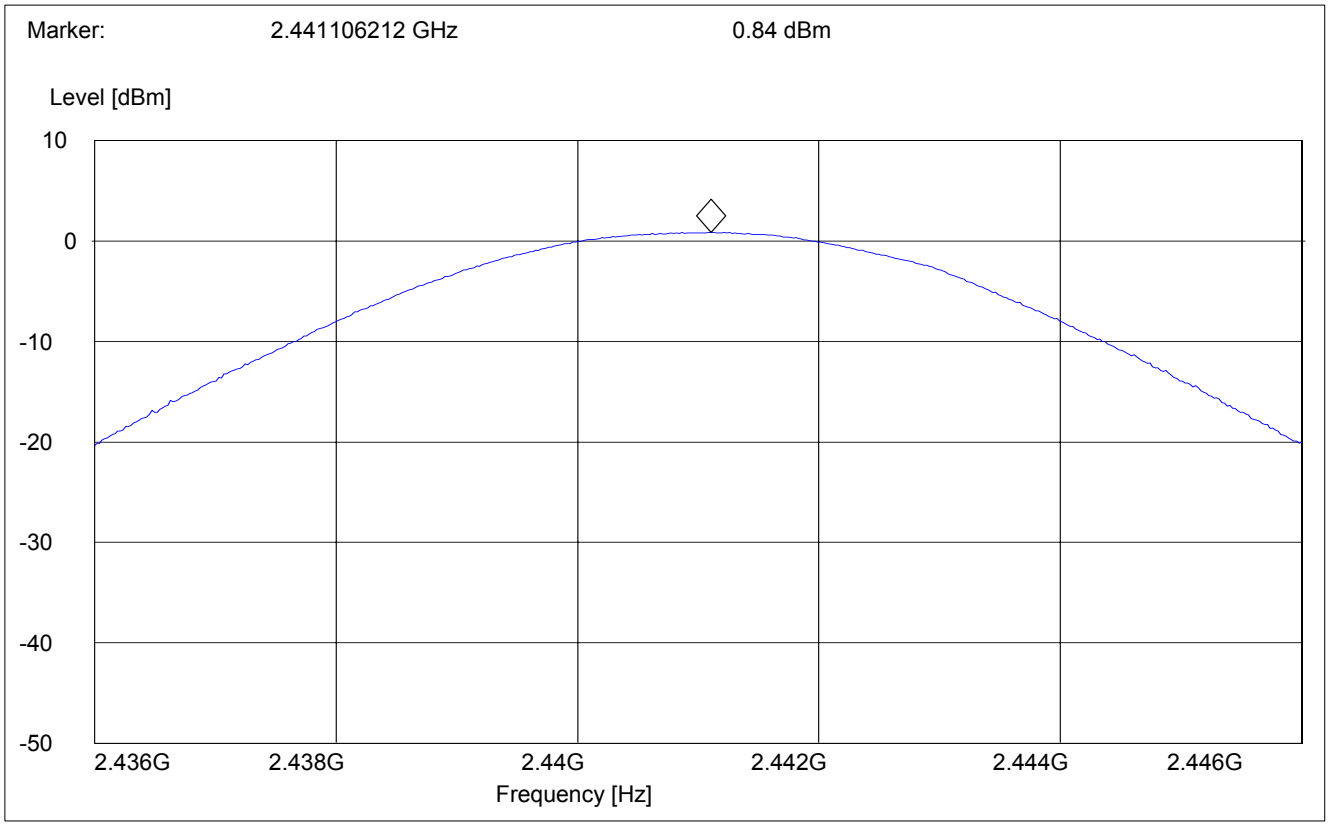


PEAK OUTPUT POWER (RADIATED) §15.247 (b) (1)

Mid Channel: 2441MHz

SWEEP TABLE: "EIRP BT Mid channel"

Short Description:		EIRP Bluetooth channel-2441MHz		
Start Frequency	Stop Frequency	Detector	Meas. Time	IF BW
2.436GHz	2.446GHz	MaxPeak	Coupled	3 MHz

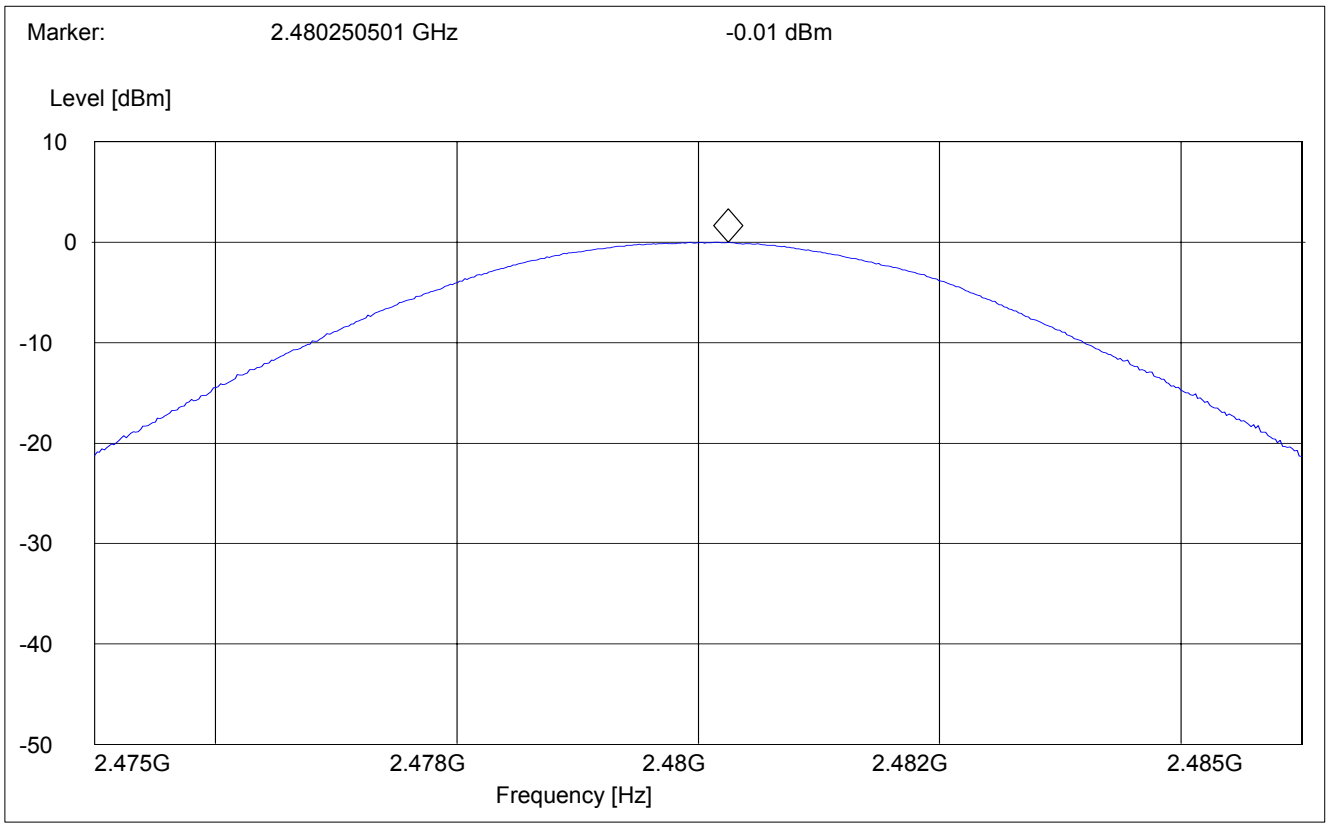


PEAK OUTPUT POWER (RADIATED) §15.247 (b) (1)

Highest Channel: 2480MHz

SWEEP TABLE: "EIRP BT High channel"

Short Description:		EIRP Bluetooth channel-2480MHz		
Start Frequency	Stop Frequency	Detector	Meas. Time	IF BW
2.475GHz	2.485GHz	MaxPeak	Coupled	3 MHz

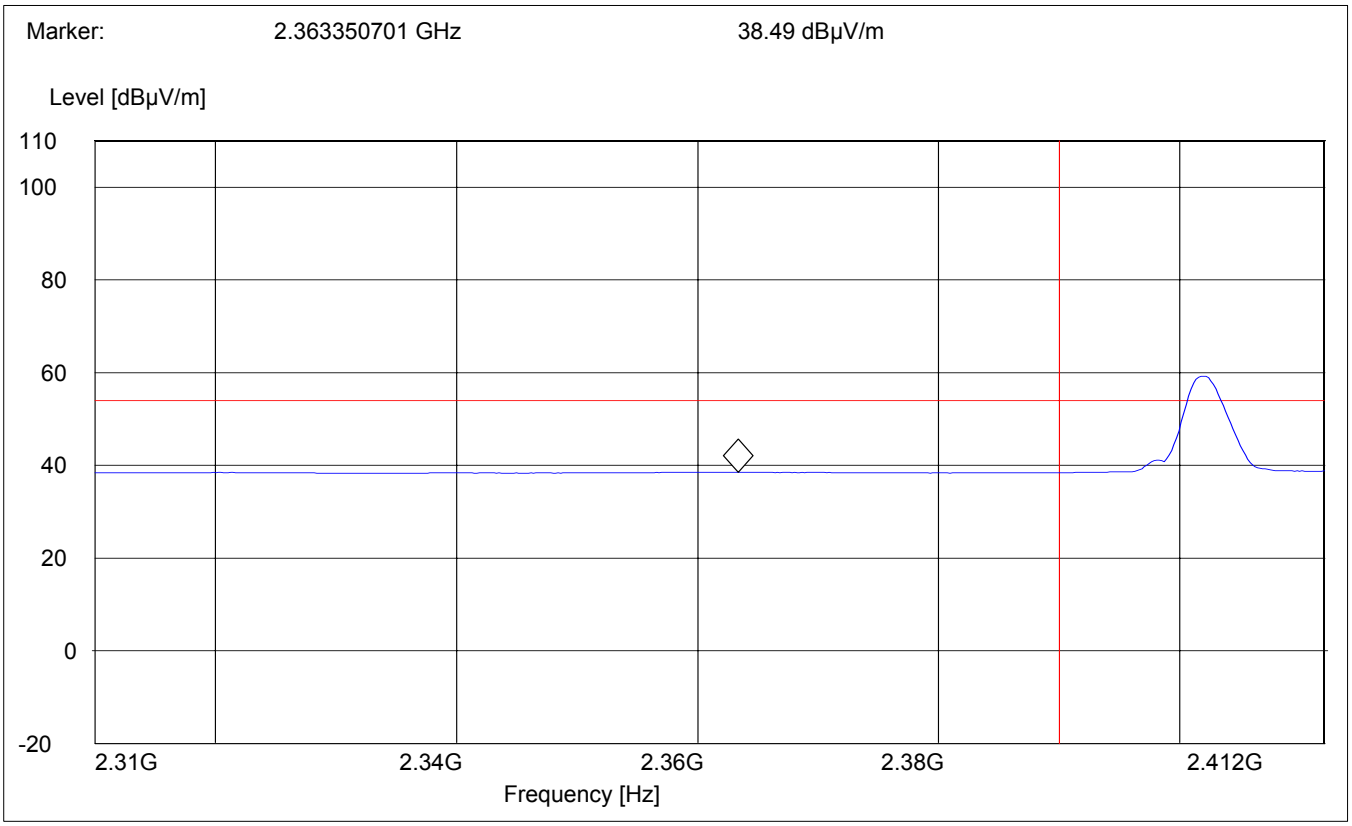


BAND EDGE COMPLIANCE §15.247 (c)

Low frequency section (spurious in the restricted band 2310 – 2390 MHz)
Average Measurement
(This plot is valid for both Hopping ON & OFF)

Operating condition : Tx at 2402MHz
SWEEP TABLE : "FCC15.247 LBE_AVG"
Short Description : FCC15.247 BT Low-band-edge
Limit Line : 54dBµV

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
2.31 GHz	2.412 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)

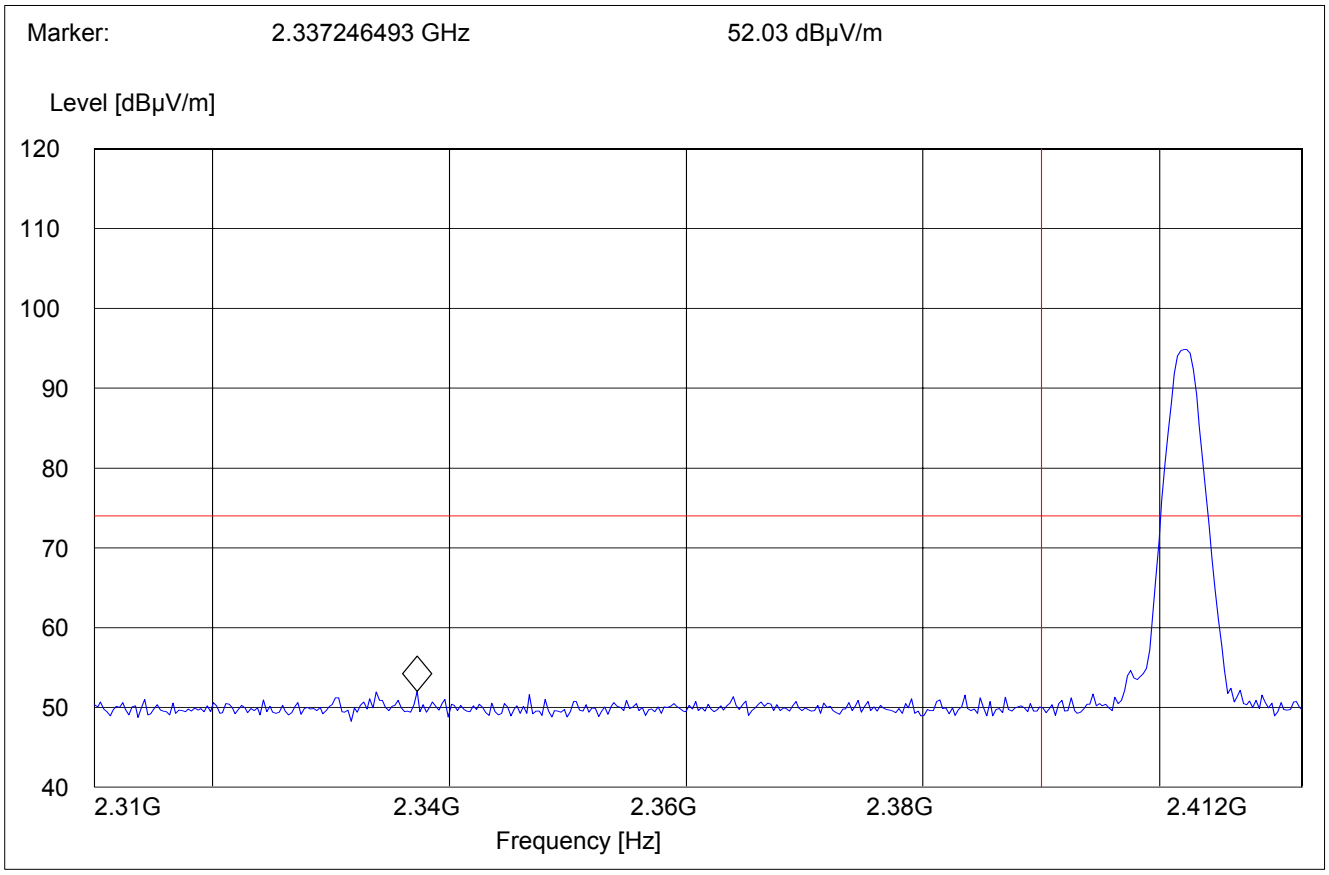


BAND EDGE COMPLIANCE §15.247 (c)

Low frequency section (spurious in the restricted band 2310 – 2390 MHz)
Peak Measurement
(This plot is valid for both Hopping ON & OFF)

Operating condition	:	Tx at 2402MHz
SWEEP TABLE	:	"FCC15.247 LBE_Pk"
Short Description	:	FCC15.247 BT Low-band-edge
Limit Line	:	74dBµV

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
2.31 GHz	2.412 GHz	MaxPeak	Coupled	1 MHz	1MHz	#326 horn (dBi)

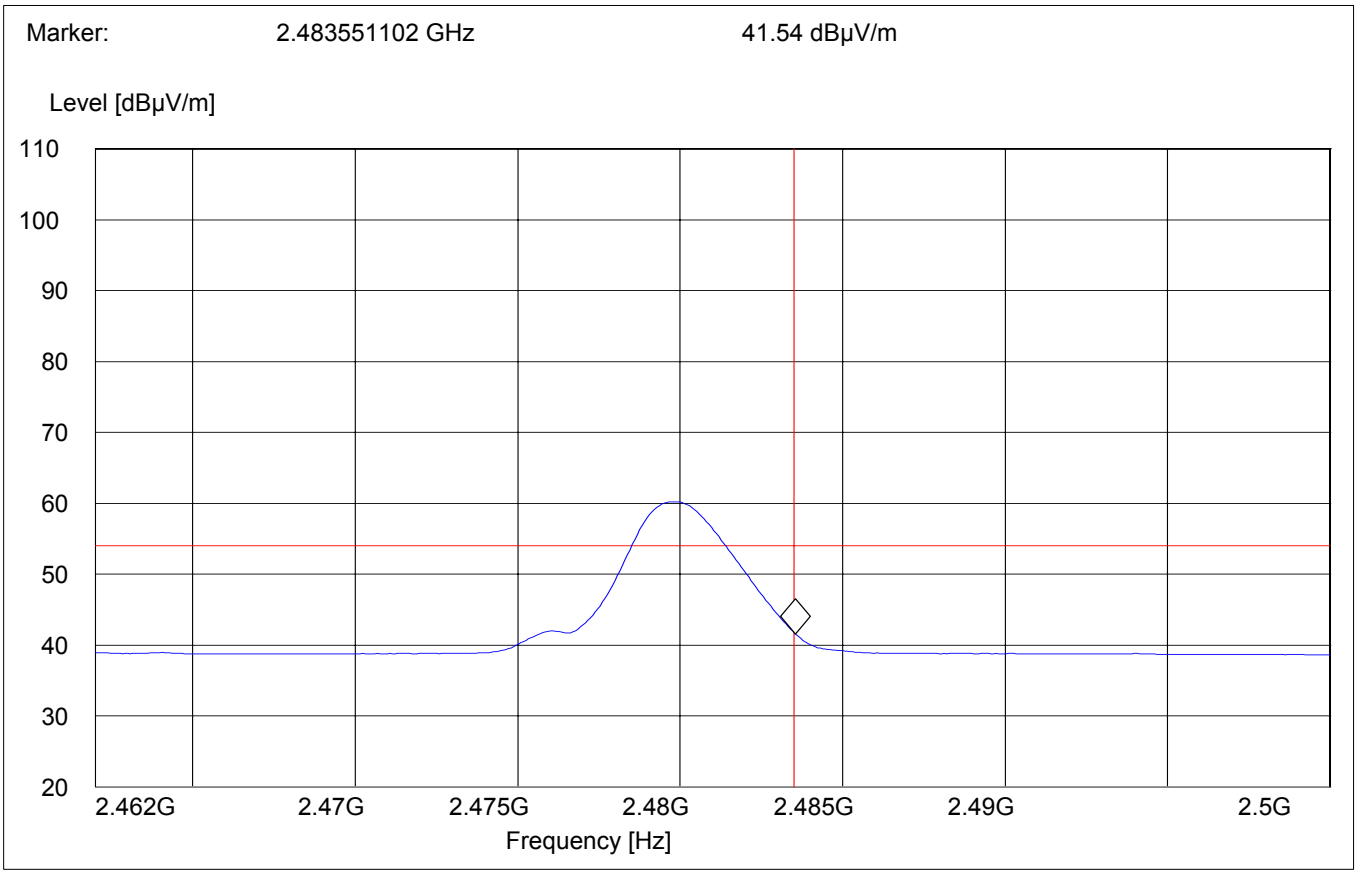


BAND EDGE COMPLIANCE §15.247 (c)

High frequency section (spurious in the restricted band 2483.5 – 2500 MHz)
Average Measurement
(This plot is valid for both Hopping ON & OFF)

Operating condition	:	Tx at 2480MHz
SWEEP TABLE	:	"FCC15.247 HBE_AVG"
Short Description	:	FCC15.247 BT High-band-edge
Limit Line	:	54dBµV

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
2.462 GHz	2.5 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)

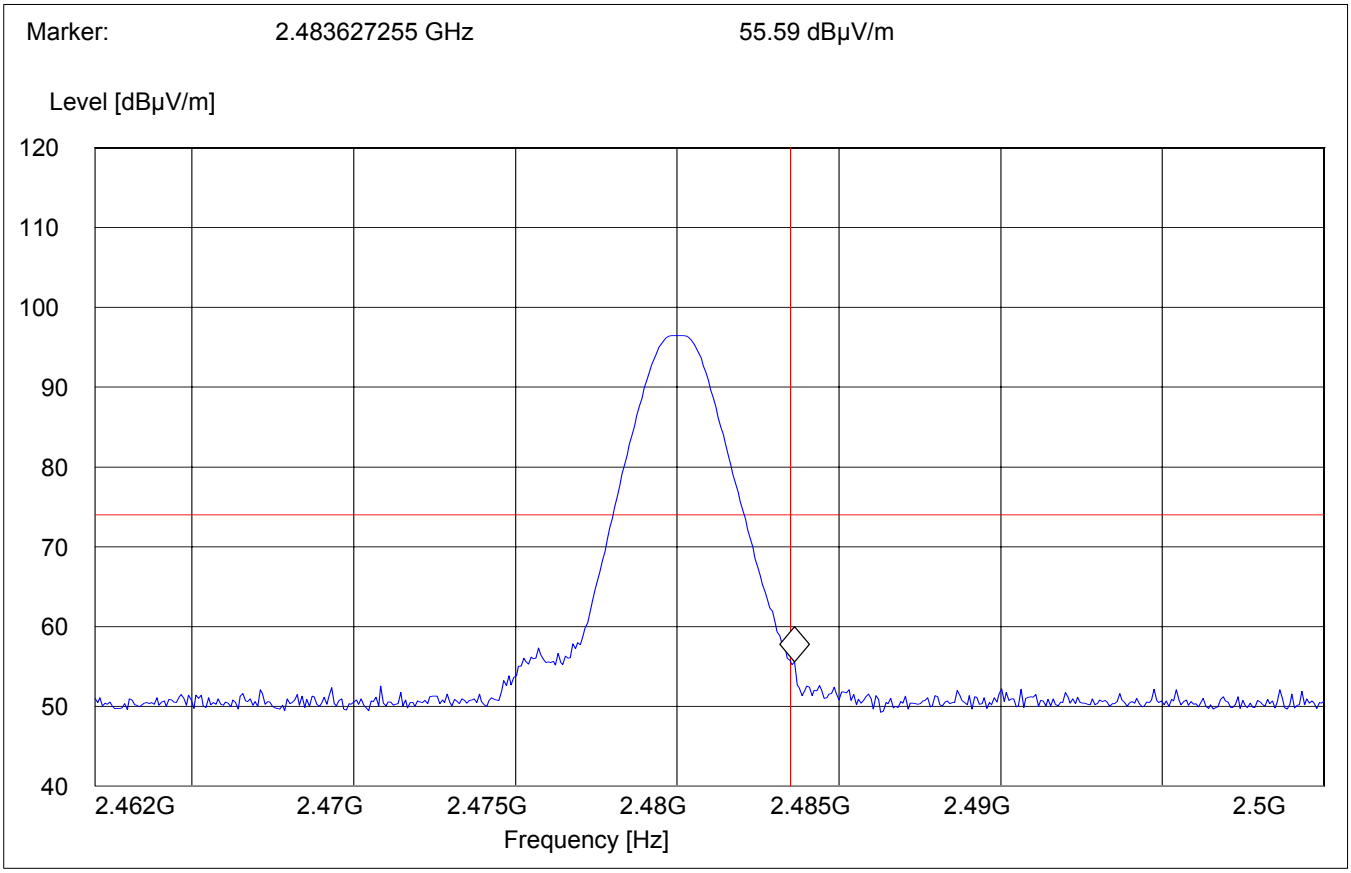


BAND EDGE COMPLIANCE §15.247 (c)

High frequency section (spurious in the restricted band 2483.5 – 2500 MHz)
Peak Measurement
(This plot is valid for both Hopping ON & OFF)

Operating condition	:	Tx at 2480MHz
SWEEP TABLE	:	"FCC15.247 HBE_PK"
Short Description	:	FCC15.247 BT High-band-edge
Limit Line	:	74dBµV

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
2.462 GHz	2.5 GHz	MaxPeak	Coupled	1 MHz	1MHz	#326 horn (dBi)



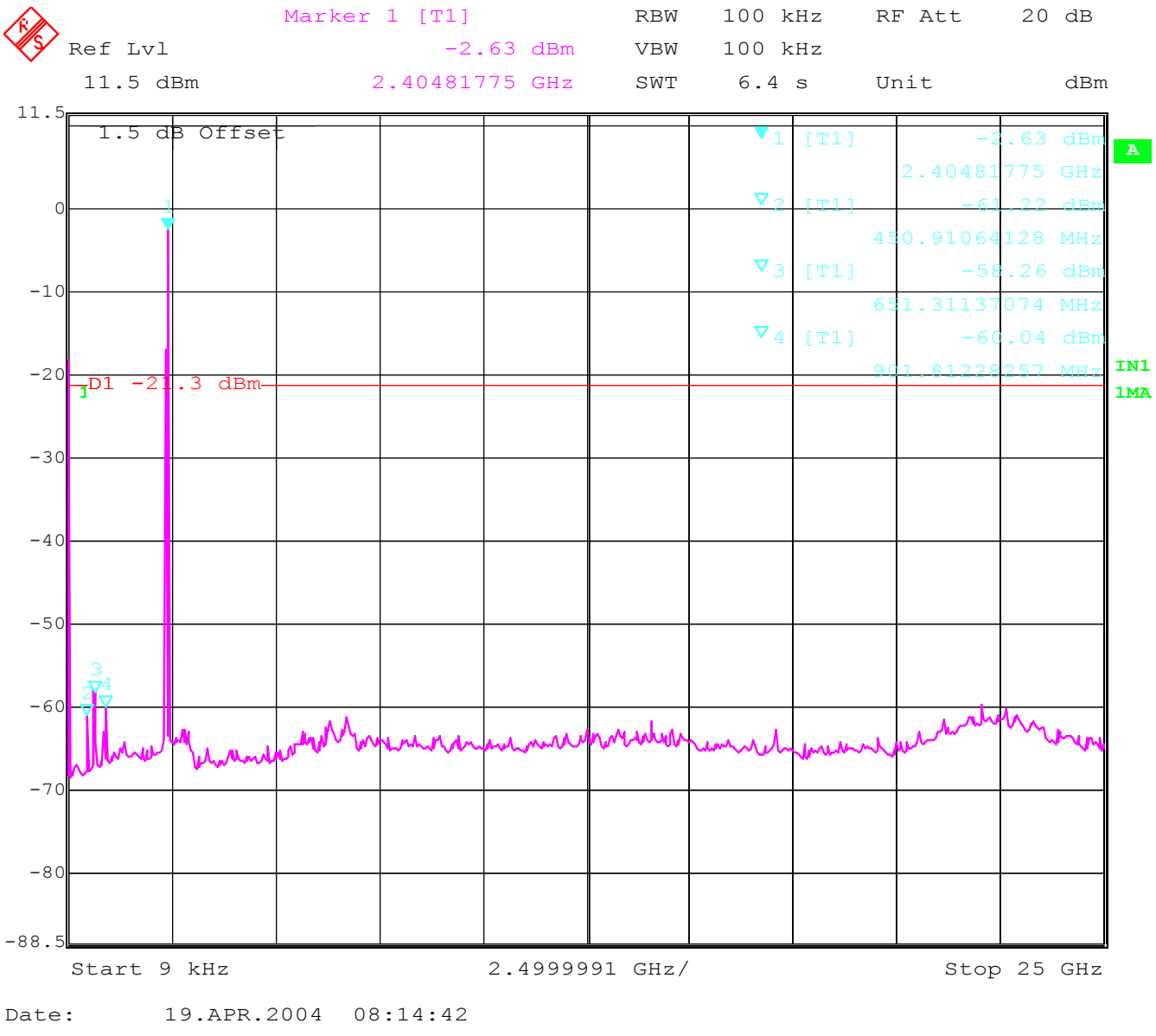
EMISSION LIMITATIONS **§ 15.247 (c) (1)**
Transmitter (Conducted)
LIMITS

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions that 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.

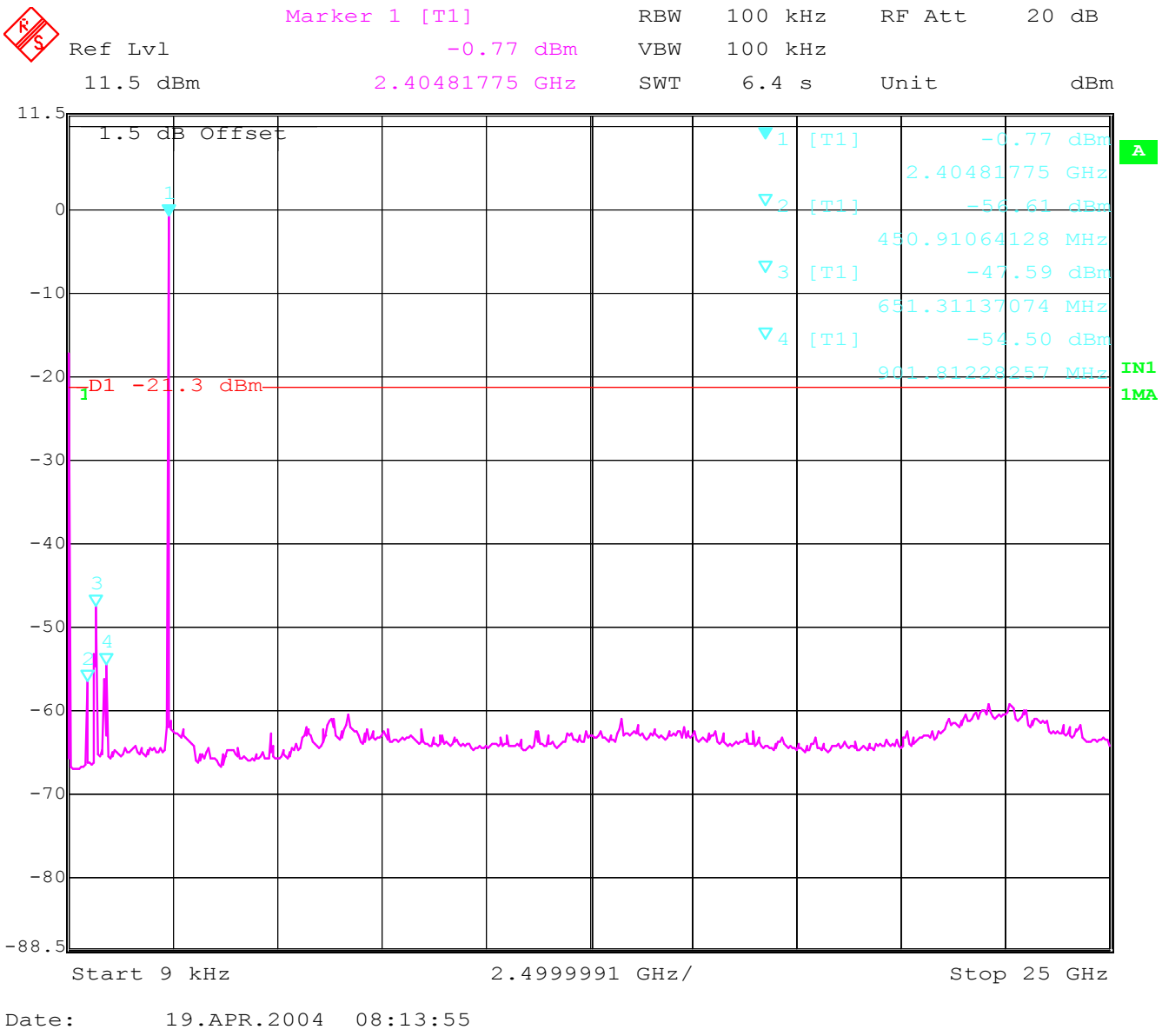
EMISSION LIMITATIONS - Conducted (Transmitter) § 15.247 (c) (1)

Lowest Channel (2402MHz): 9KHz - 25GHz



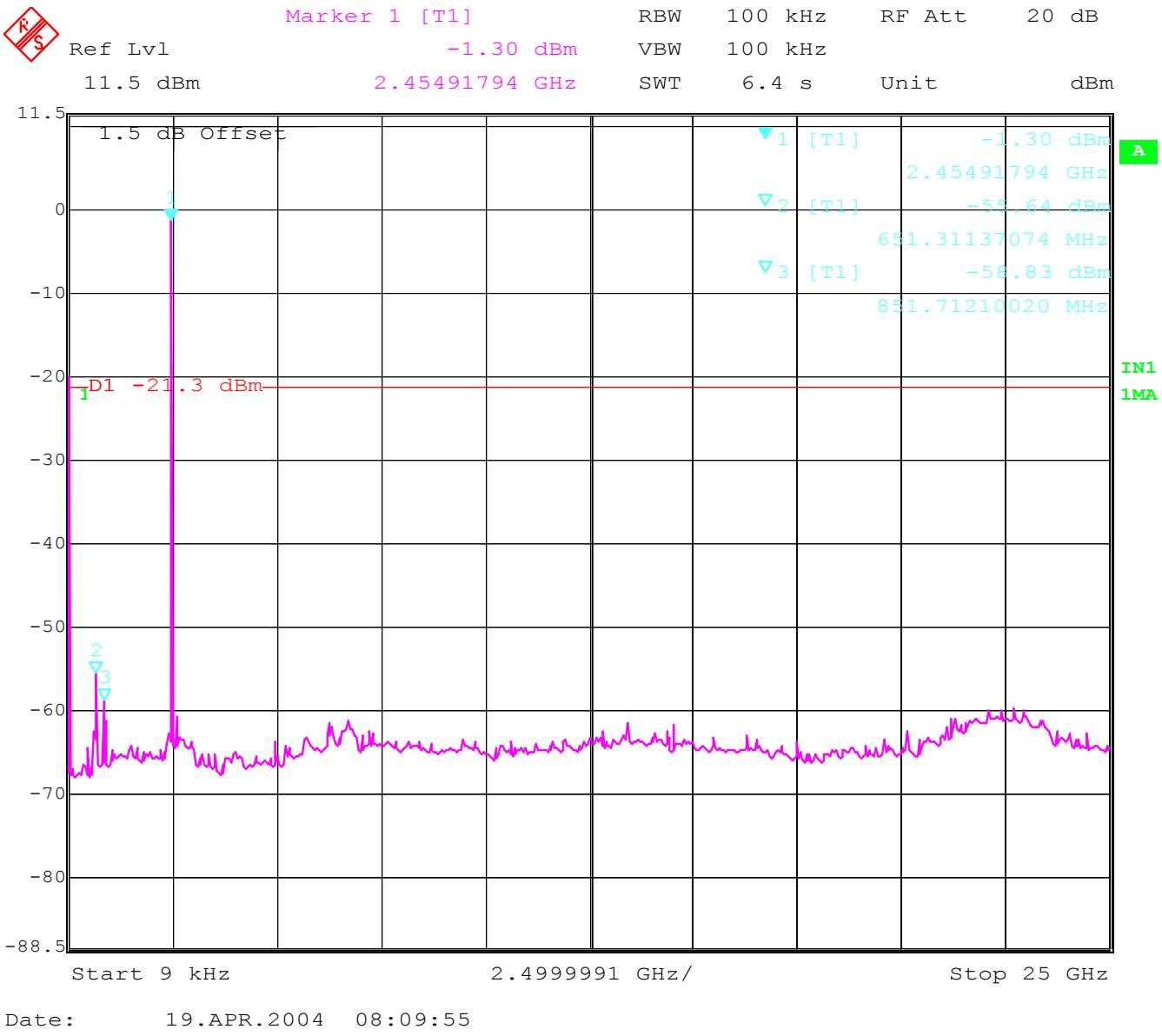
EMISSION LIMITATIONS - Conducted (Transmitter) § 15.247 (c) (1)

Mid Channel (2441MHz): 9KHz - 25GHz



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

Highest Channel (2480MHz): 9KHz - 25GHz



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

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 that 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 3 and 26.5 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.

3. All measurements are done in peak mode unless specified with plots.

Results for the radiated measurements below 30MHz according § 15.33

Frequency	Measured values	Remarks
9KHz – 30MHz	No emissions found, caused by the EUT	This is valid for all the tested channels

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

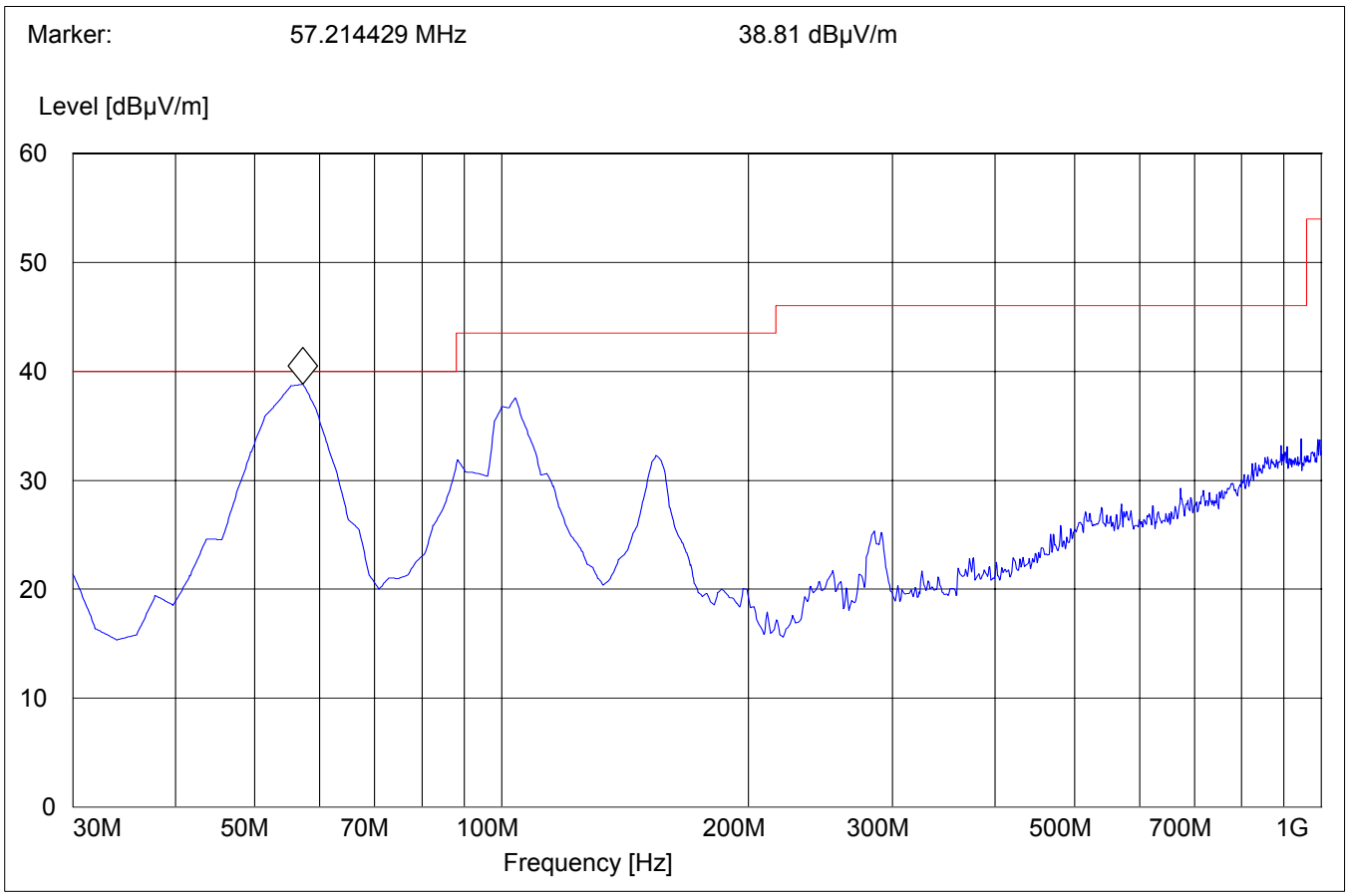
Note: All radiated measurements were made in all three orthogonal planes. The values reported are the maximum values.

Transmit at Lowest channel Frequency 2402MHz			
Frequency (MHz)	Level (dBµV/m)		
	Peak	Quasi-Peak	Average
4781.56	53.3		31.99
Transmit at Middle channel Frequency 2441MHz			
Frequency (MHz)	Level (dBµV/m)		
	Peak	Quasi-Peak	Average
4883.76	51.22		29.55
Transmit at Highest channel Frequency 2480MHz			
Frequency (MHz)	Level (dBµV/m)		
	Peak	Quasi-Peak	Average
4951.90	49.8		28.41

EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
30MHz – 1GHz
Antenna: vertical

Note: This plot is valid for low, mid & high channels (worst-case plot)

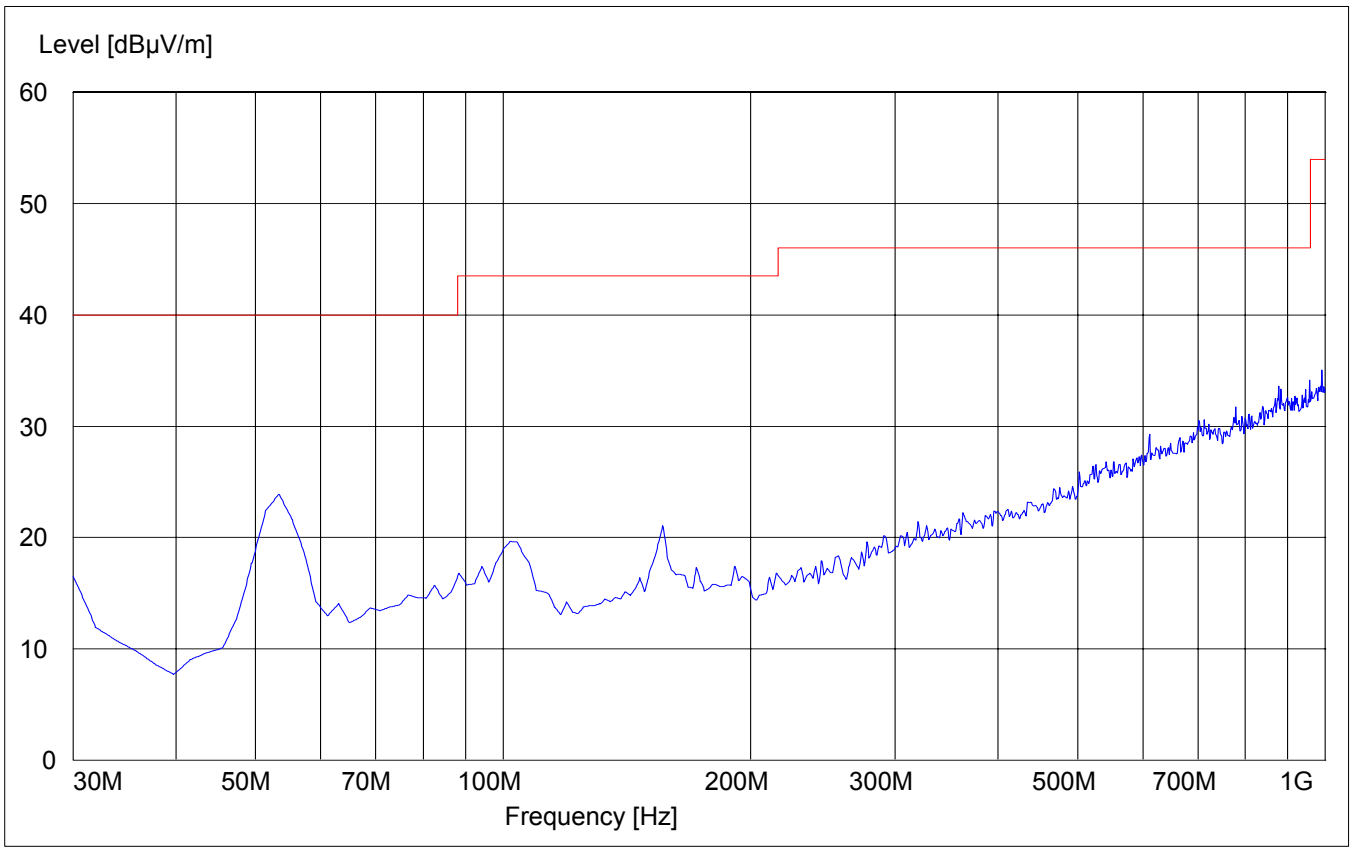
SWEEP TABLE:		"BT Spuri hi 30-1G"			
Short Description:		Bluetooth 30MHz-1GHz			
Start Frequency	Stop Frequency	Detector	Meas. Time	RBW VBW	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186



EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
30MHz – 1GHz
Antenna: horizontal

Note: This plot is valid for low, mid & high channels (worst-case plot)

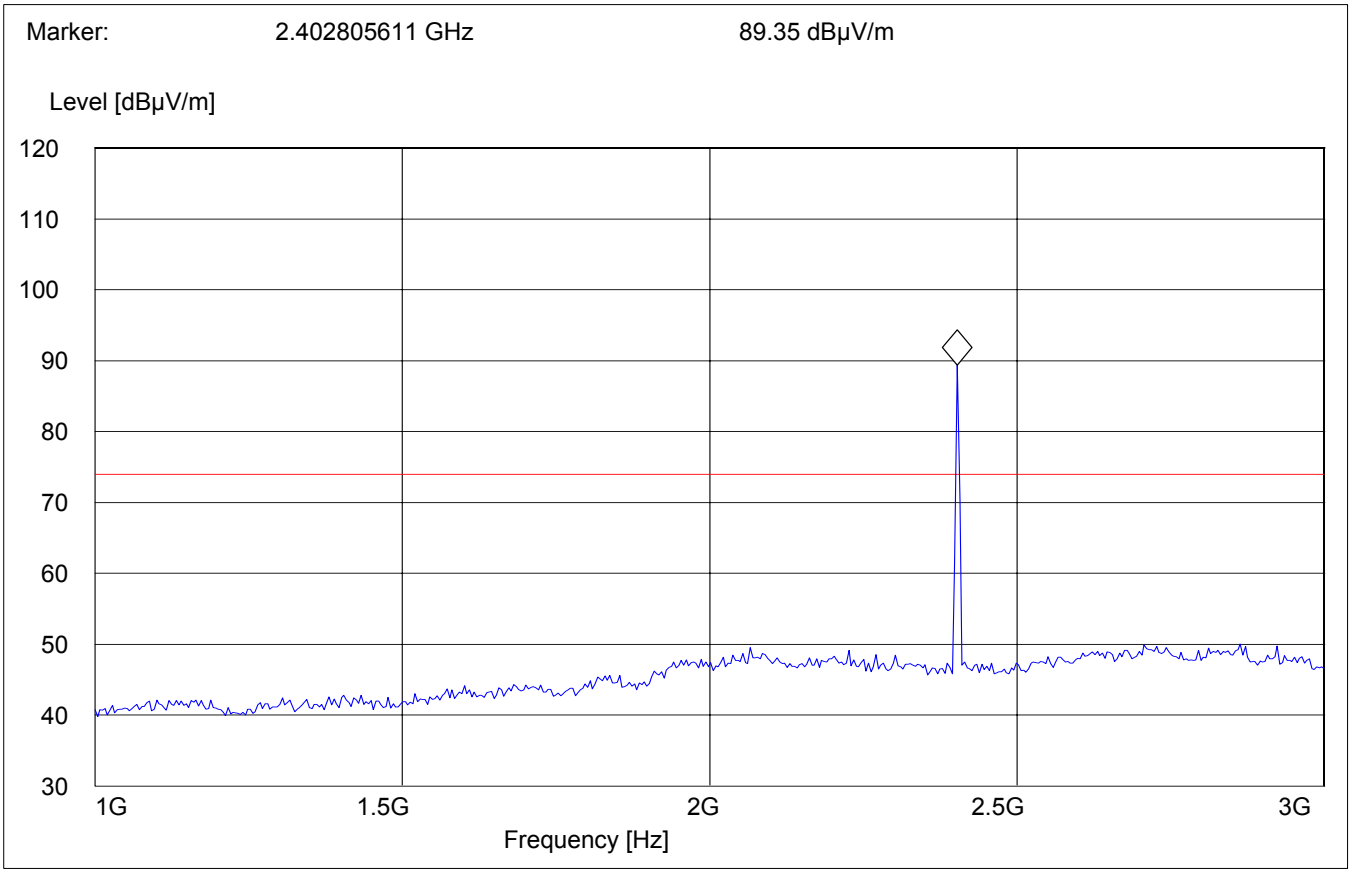
SWEEP TABLE:		"BT Spuri hi 30-1G"			
Short Description:		Bluetooth 30MHz-1GHz			
Start Frequency	Stop Frequency	Detector	Meas. Time	RBW VBW	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186



EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Lowest Channel (2402MHz): 1GHz – 3GHz

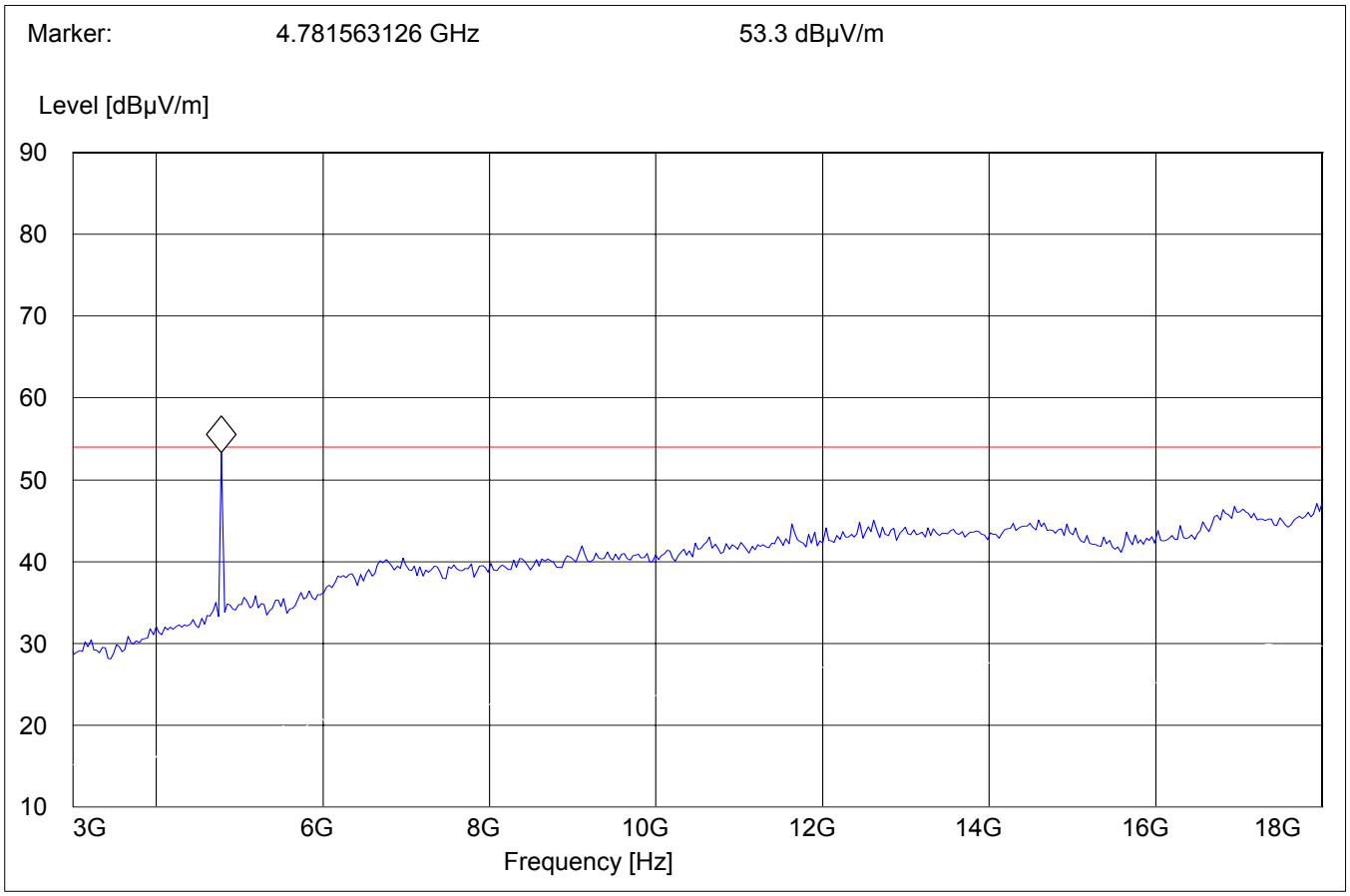
NOTE: The peak above the limit is the carrier frequency.

SWEEP TABLE:		"BT Spuri hi 1-3G"			
Short Description:		Bluetooth Spurious 1-3GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
1.0 GHz	3.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)



EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Lowest Channel (2402MHz): 3GHz – 18GHz

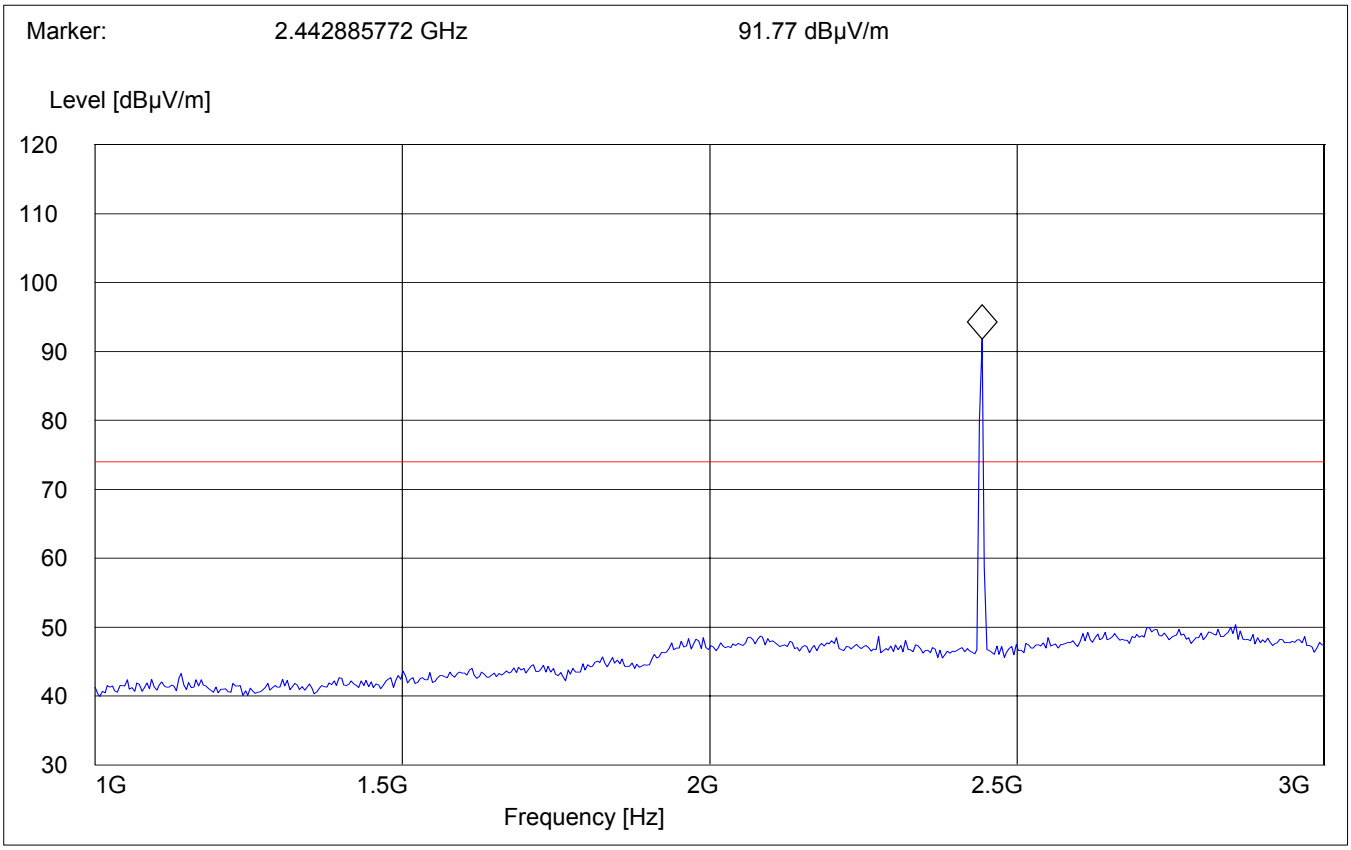
SWEEP TABLE:		"BT Spuri hi 3-18G"			
Short Description:		Bluetooth Spurious 3-18 GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
3.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)



EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Middle Channel (2441MHz): 1GHz – 3GHz

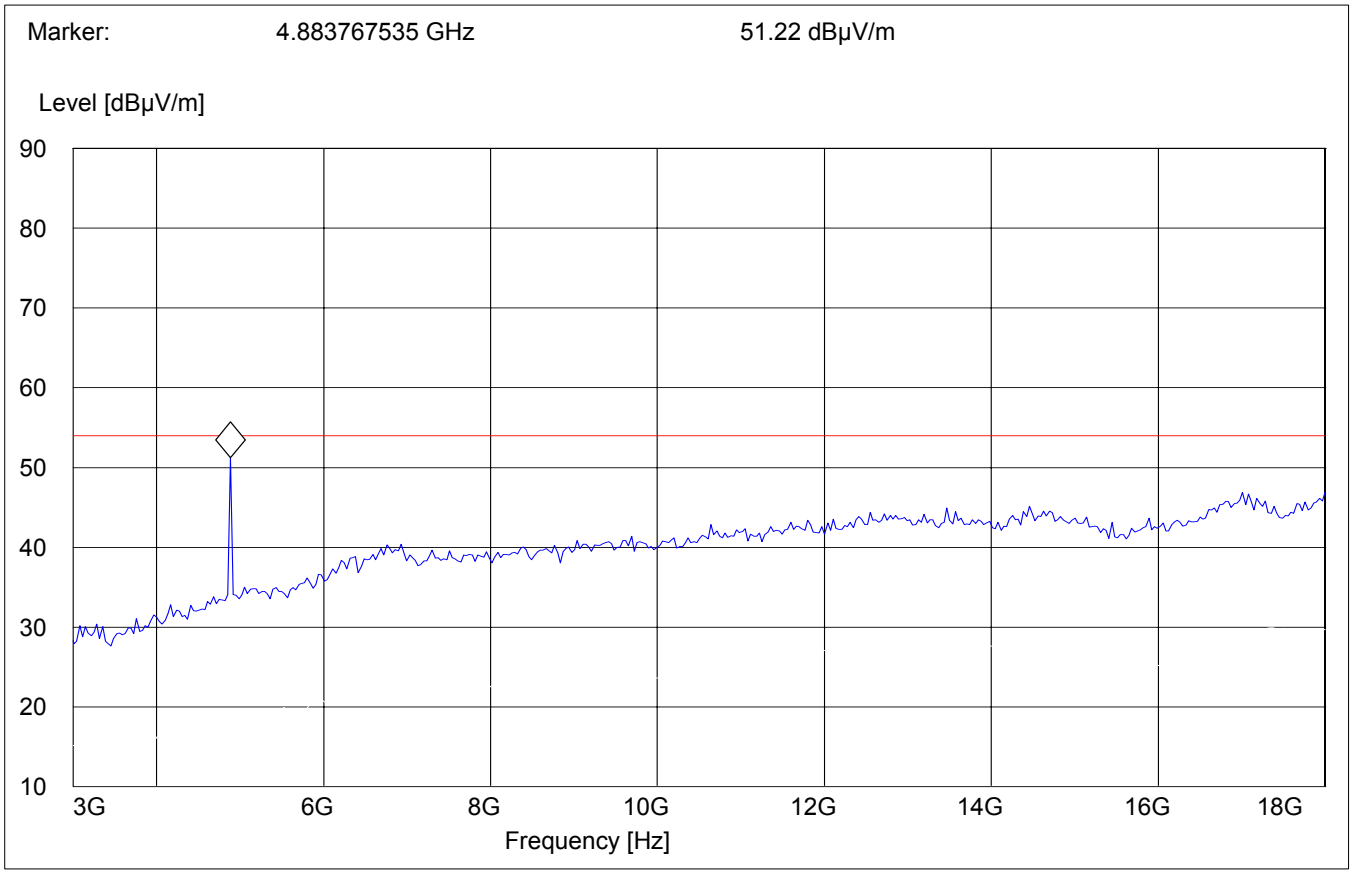
NOTE: The peak above the limit is the carrier frequency.

SWEEP TABLE:		"BT Spuri hi 1-3G"			
Short Description:		Bluetooth Spurious 1-3GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
1.0 GHz	3.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)



EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Middle Channel (2441MHz): 3GHz – 18GHz

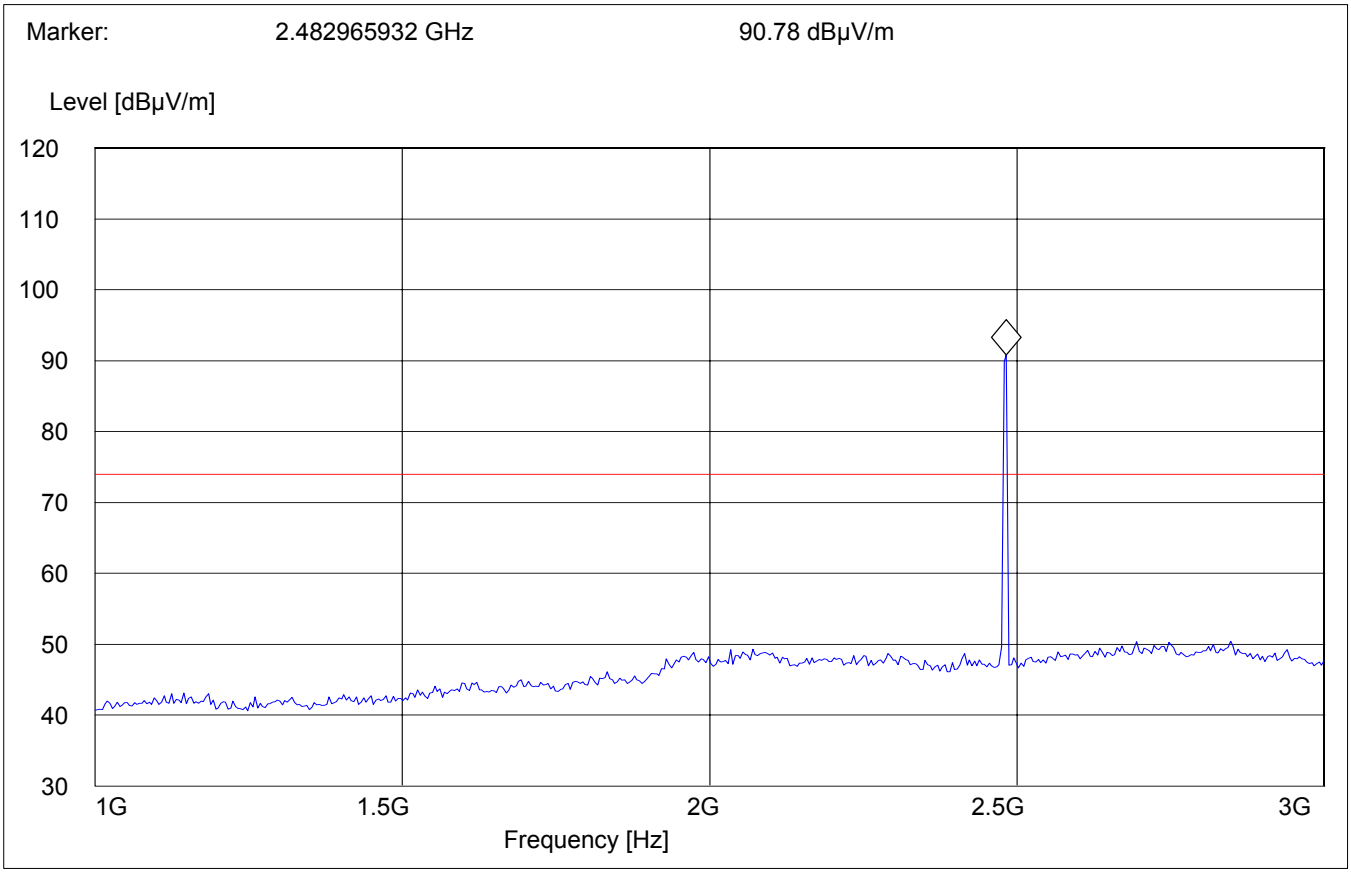
SWEEP TABLE:		"BT Spuri hi 3-18G"			
Short Description:		Bluetooth Spurious 3-18GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
3.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)



EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Highest Channel (2480MHz): 1GHz – 3GHz

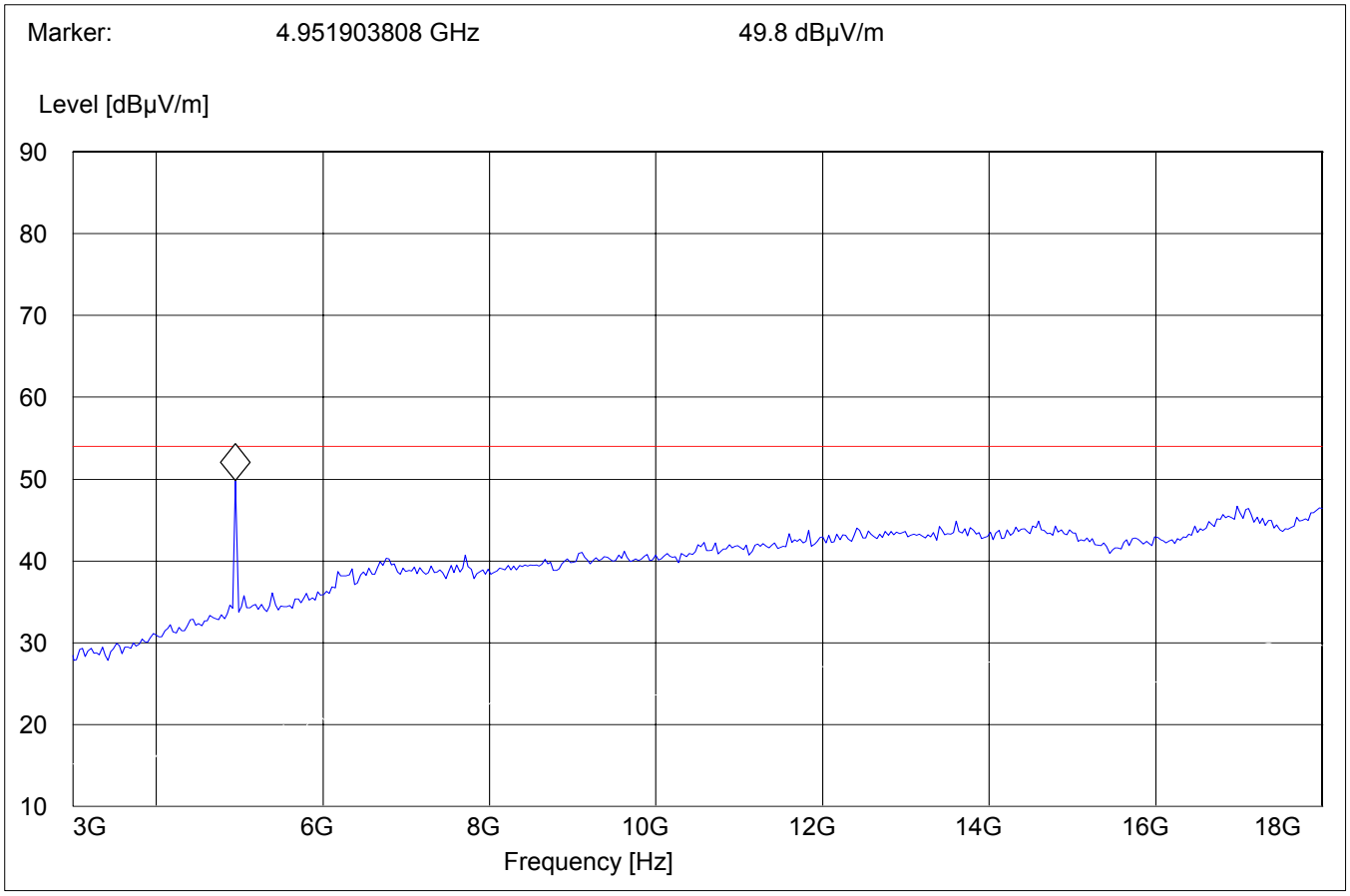
NOTE: The peak above the limit is the carrier frequency.

SWEEP TABLE:		"BT Spuri hi 1-3G"			
Short Description:		Bluetooth Spurious 1-3GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
1.0 GHz	3.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)



EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Highest Channel (2480MHz): 3GHz – 18GHz

SWEEP TABLE:		"BT Spuri hi 3-18G"			
Short Description:		Bluetooth Spurious 3-18GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
3.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)

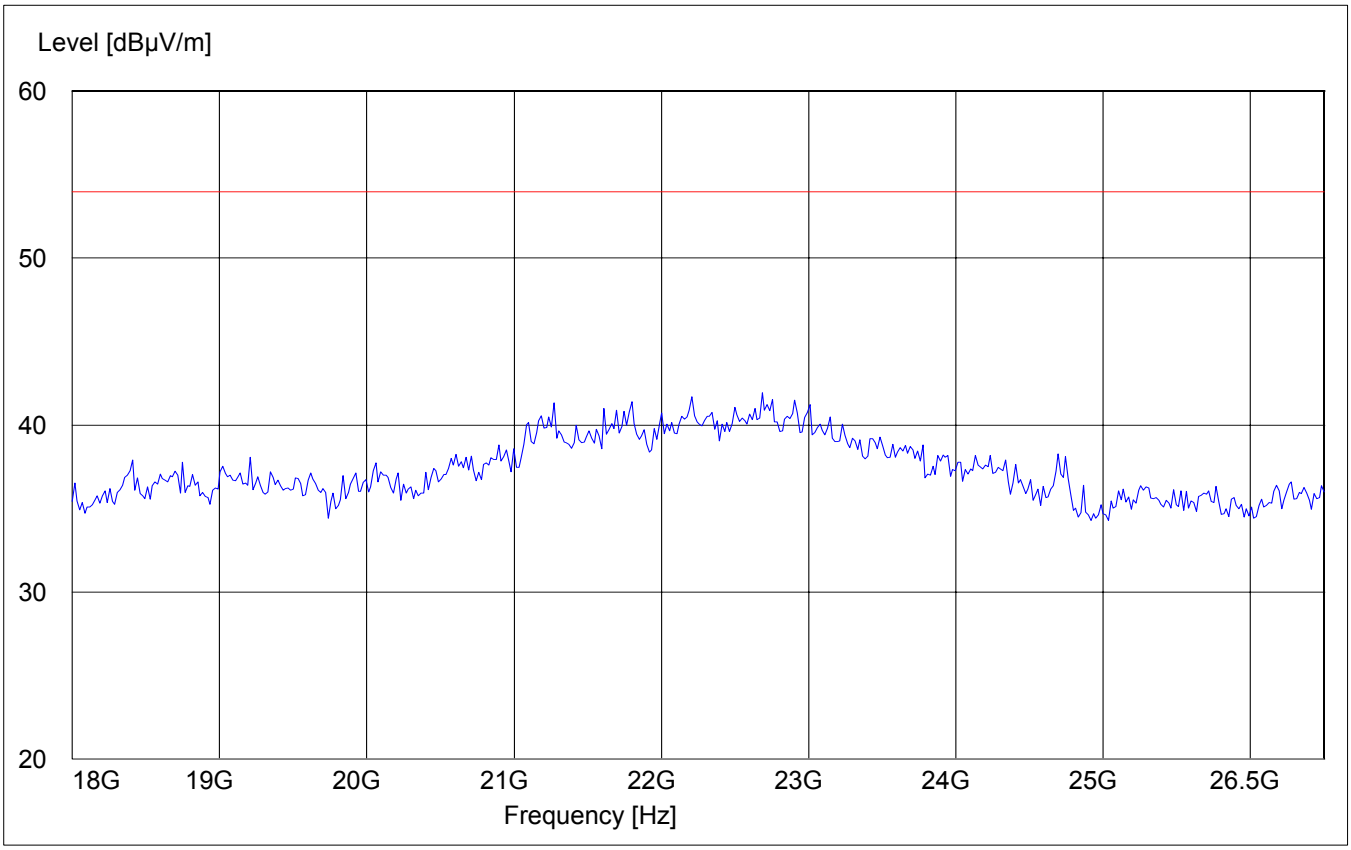


EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)

18GHz – 26.5GHz

Note: This plot is valid for low, mid & high channels (worst-case plot)

SWEEP TABLE:		"BT Spuri hi 18-26.5G"			
Short Description:		Bluetooth Spurious 18-26.5GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
18 GHz	26.5 GHz	MaxPeak	Coupled	1 MHz	#141 horn (dBi)



CONDUCTED EMISSIONS § 15.107/207

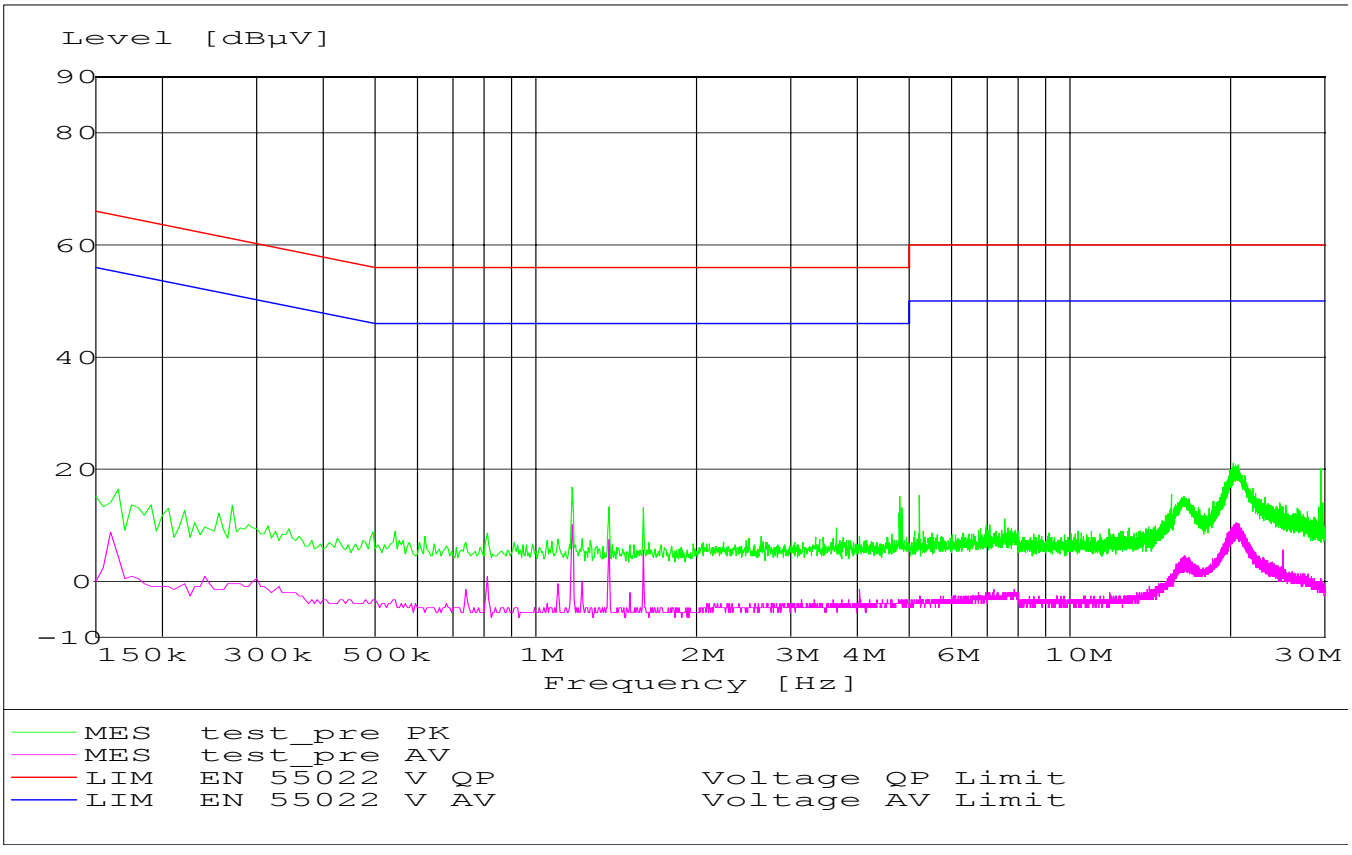
Measured with AC/DC power adapter model# Nokia ACP-7U

Technical specification: 15.107 / 15.207 (Revised as of August 20, 2002)

Limit

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50
* Decreases with logarithm of the frequency		

ANALYZER SETTINGS: RBW = 10KHz VBW = 10KHz



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

NOTE:

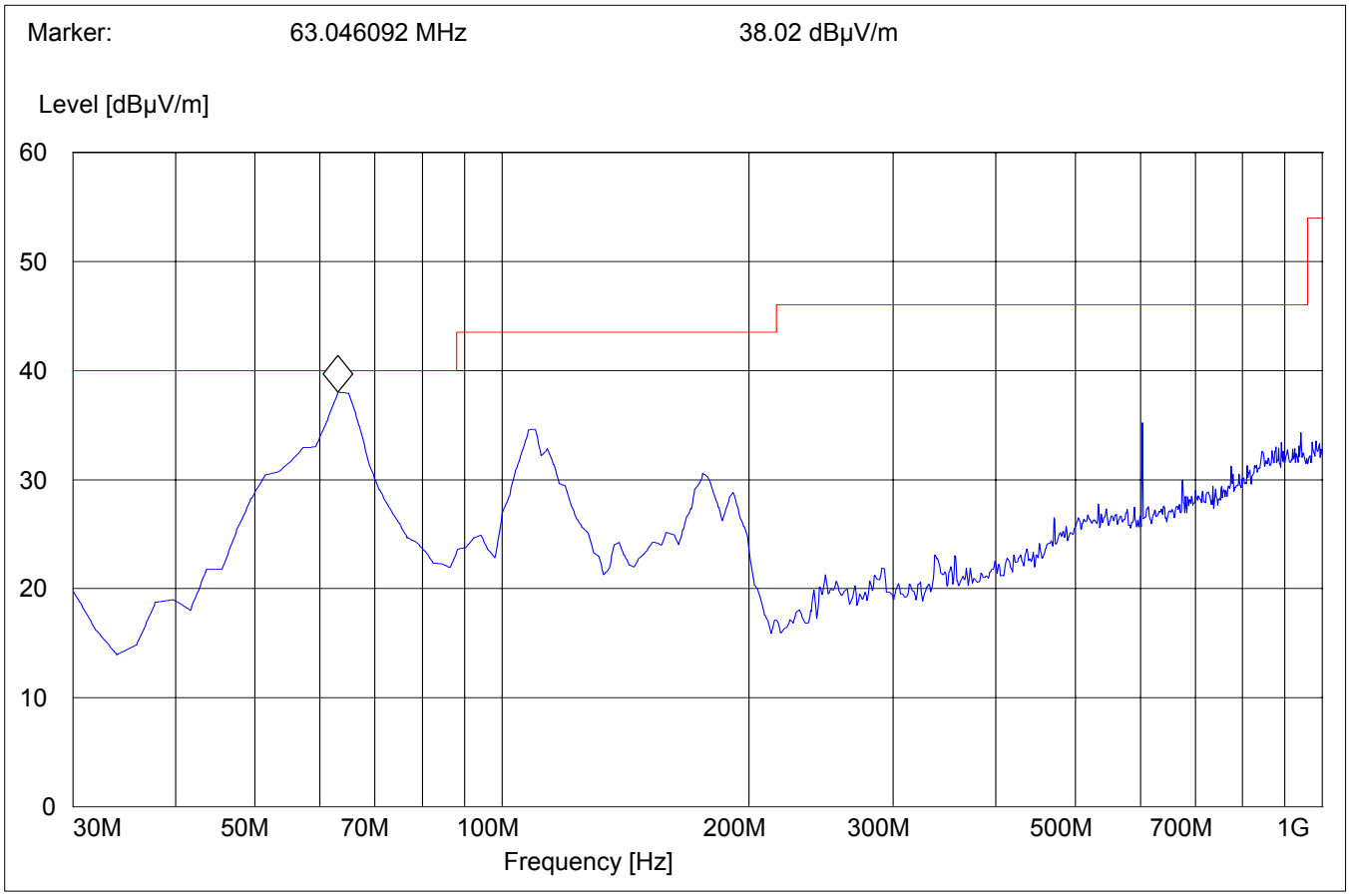
1. The radiated emissions were done with different settings, using the relevant pre-amplifiers for the relevant frequency ranges. This is the reason that the graphs show different noise levels. In the range between 3 and 26.5 GHz very short cable connections to the antenna was used to minimize the noise level.
2. All measurements are done in peak mode unless specified with the plots.

RECEIVER SPURIOUS RADIATION § 15.209

30MHz – 1GHz

Antenna: vertical (worst-case plot)

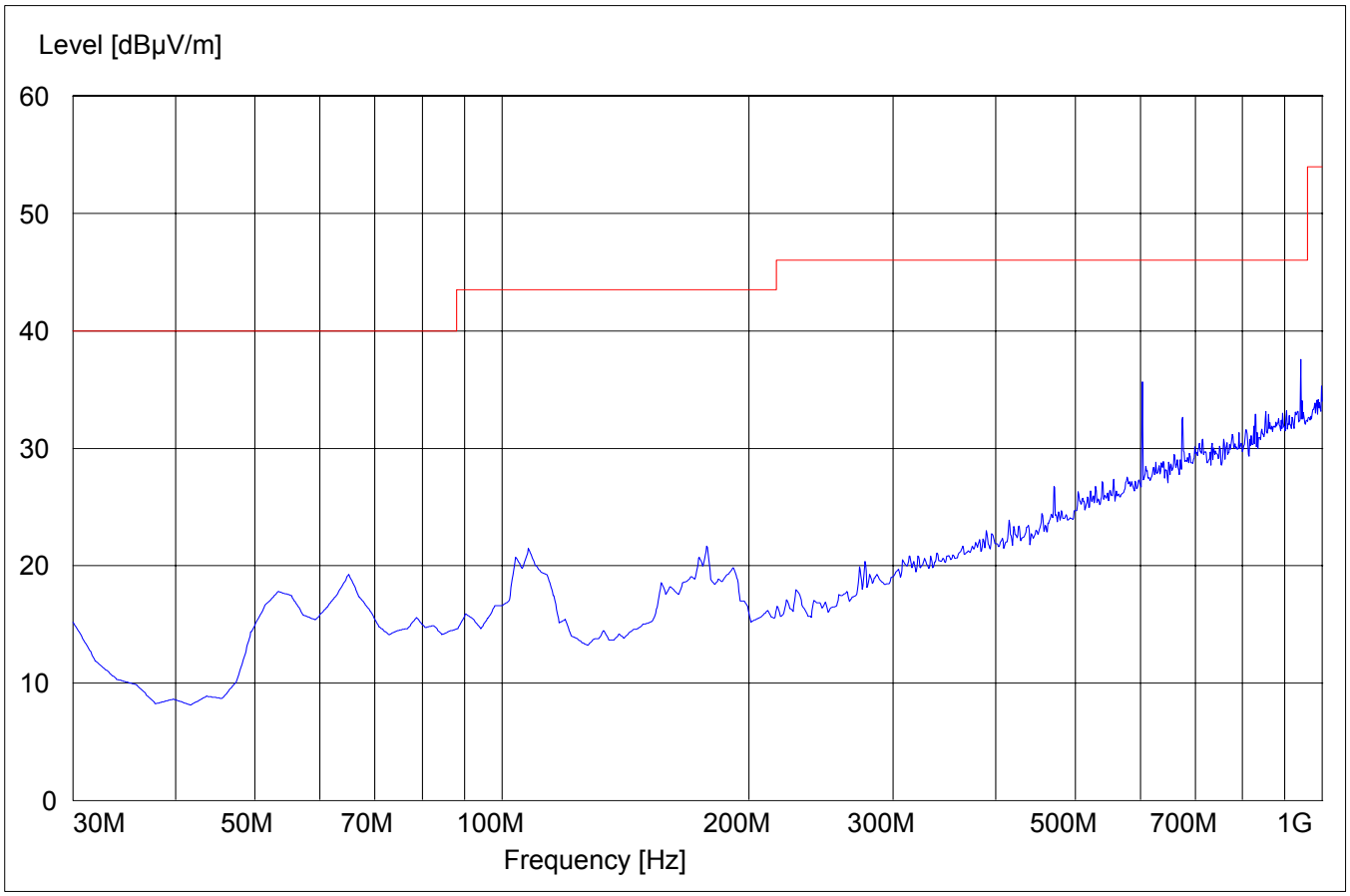
SWEEP TABLE:		"BT Spuri hi 30-1G"			
Short Description:		Bluetooth 30MHz-1GHz			
Start Frequency	Stop Frequency	Detector	Meas. Time	RBW VBW	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186



RECEIVER SPURIOUS RADIATION § 15.209
1GHz – 3GHz

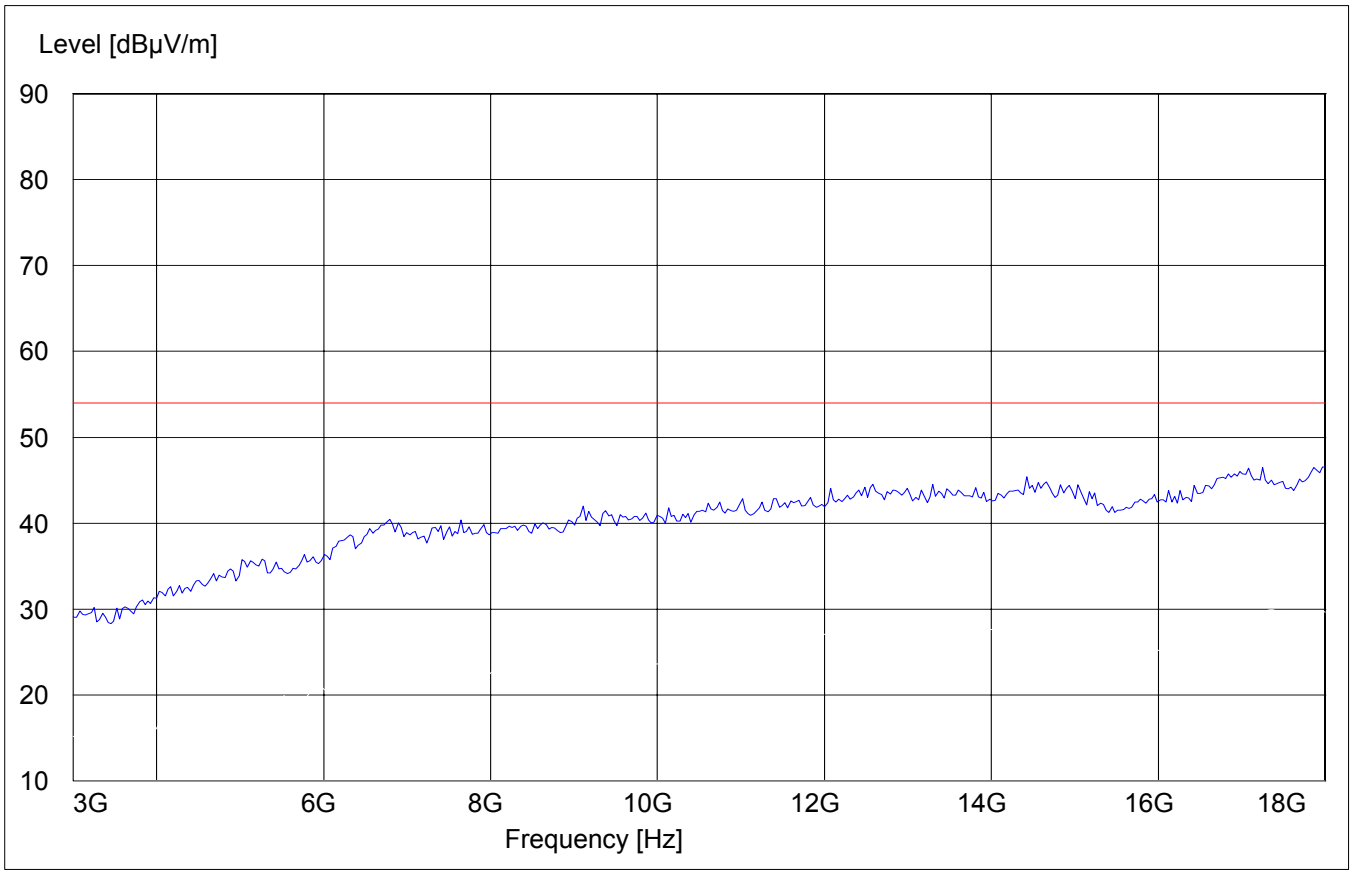
SWEEP TABLE: "BT Spuri hi 1-3G"
Short Description: Bluetooth Spurious 1-3GHz

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
1.0 GHz	3.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)



RECEIVER SPURIOUS RADIATION § 15.209
3GHz – 18GHz

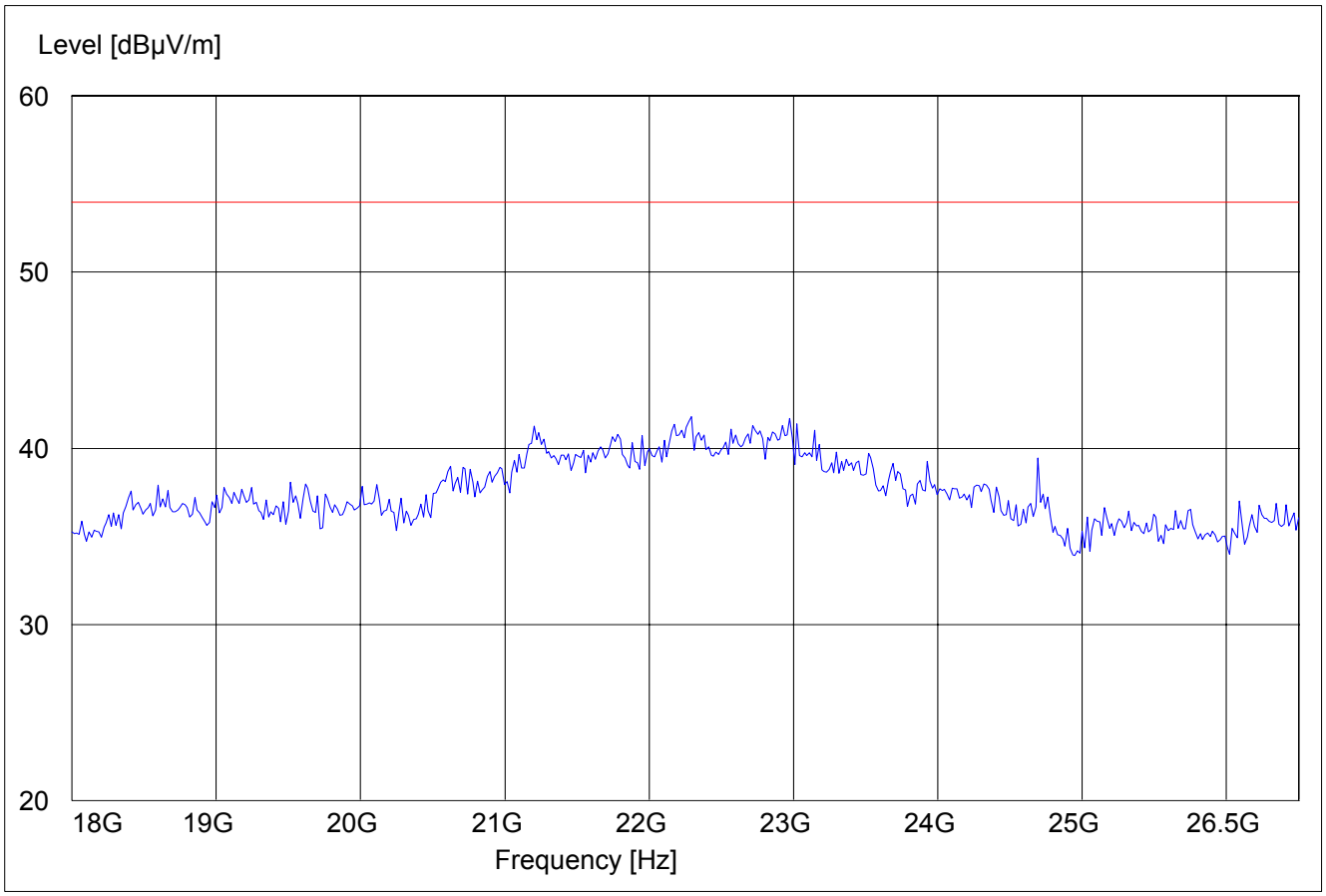
SWEEP TABLE:		"BT Spuri hi 3-18G"			
Short Description:		Bluetooth Spurious 3-18 GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
3.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)



RECEIVER SPURIOUS RADIATION § 15.209
18GHz – 26.5GHz

SWEEP TABLE: "BT Spuri hi 18-26.5G"
Short Description: Bluetooth Spurious 18-26.5GHz

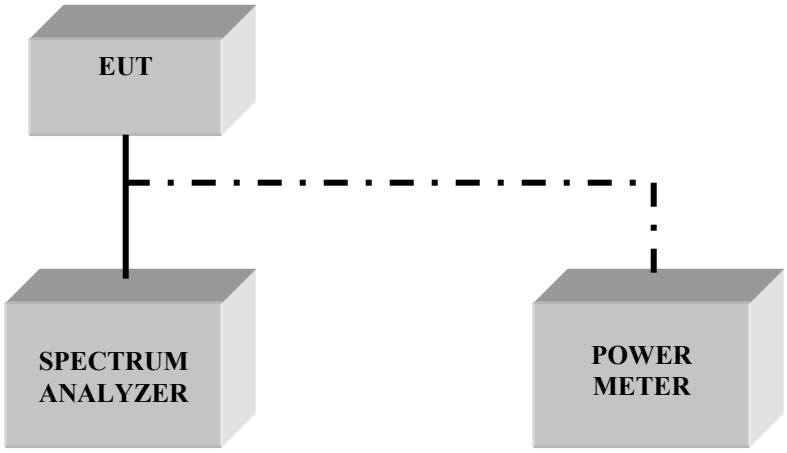
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
18.0 GHz	26.5 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)



TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No	Instrument/Ancillary	Type	Manufacturer	Serial No.
01	Spectrum Analyzer	ESIB 40	Rohde & Schwarz	100107
02	Spectrum Analyzer	FSEM 30	Rohde & Schwarz	826880/010
03	Biconilog Antenna	3141	EMCO	0005-1186
04	Horn Antenna (700M-18GHz)	SAS-200/571	AH Systems	325
05	Horn Antenna (18-26.5GHz)	3160-09	EMCO	1240
06	2-3GHz Band reject filter	BRM50701	Microtronics	6
07	Pre-Amplifier	TS-ANA	Rohde & Schwarz	--
08	Pre-Amplifier	JS4-00102600	Miteq	00616

BLOCK DIAGRAMS
Conducted Testing



Radiated Testing