TÜV Rheinland
Product Safety GmbH
Am Grauen Stein D - 51105 Köln

TÜV

Prüfbericht - Nr.: *Test Report No.*	**14004957 001**	Seite 1 von 20 *Page 1 of 20*

Auftraggeber: *Client:*
Gigawavetech Pte Ltd.
1 Jalan Kilang Timor
#07-02 Pacific Tech Centre
Singapore

Gegenstand der Prüfung: *Test item:* **Bluetooth Headset**

Bezeichnung: *Identification:* **GWT-BTH1**
FCCID: QXZGWTBTH1

Serien-Nr.: *Serial No.* **Engineering sample**

Wareneingangs-Nr.: *Receipt No.:* **031208012**

Eingangsdatum: *Date of receipt:* **08.12.2003**

Prüfort: *Testing location:* **Refer to section 4.1**

Prüfgrundlage: *Test specification:*
FCC Part 15, Subpart C
ANSI C63.4-1992
CISPR 22:1997

Prüfergebnis: *Test Result*
Der vorstehend beschriebene Prüfgegenstand wurde geprüft und entspricht oben genannter Prüfgrundlage.
The a. m. test item passed.

geprüft / *tested by:*	**kontrolliert** / *reviewed by*
Hugo Wan	**Stephan Wald**
10.12.2003	10.12.2003
Datum *Date* / **Unterschrift** *Signature*	**Datum** *Date* / **Unterschrift** *Signature*

Sonstiges / *Other Aspects:*

Abkürzungen:			Abbreviations:		
	OK, Pass	= entspricht Prüfgrundlage		OK, Pass	= passed
	Fail	= entspricht nicht Prüfgrundlage		Fail	= failed
	N/A	= nicht anwendbar		N/A	= not applicable

Dieser Prüfbericht bezieht sich nur auf den o.g. Prüfgegenstand und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.
This test report relates to the a. m. test item. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark on this or similar products.

Authorized format 16.12.1996, R.M.

1 Test Summary

7.1.1 ANTENNA CONNECTOR SUBCLAUSE 15.203

7.1.2 ANTENNA TYPE SUBCLAUSE 15.204

7.1.3 DISTURBANCE VOLTAGE ON AC MAINS SUBCLAUSE 15.207(A)
RESULT: Pass
Limit Subclause 15.207(a)

7.1.4 CARRIER FREQUENCY SEPERATION SUBCLAUSE 15.247(A)(1)
RESULT: Pass
Limit Subclause 15.247(a)(1)

7.1.5 DWELL TIME SUBCLAUSE 15.247(A)(1)(III)
RESULT: Pass
Limit Subclause 15.247(a)(1)(iii)

7.1.6 20DB BANDWIDTH SUBCLAUSE 15.247(A)(1)

7.1.7 HOPPING SEQUENCE SUBCLAUSE 15.247(A)(1)

7.1.8 RECEIVER INPUT BANDWIDTH SUBCLAUSE 15.247(A)(1)

7.1.9 PEAK OUTPUT POWER SUBCLAUSE 15.247(B)(1)
RESULT: Pass
Limit Subclause 15.247(b)(1)

7.1.10 BAND EDGE COMPLIANCE SUBCLAUSE 15.247(C)
RESULT: Pass
Limit Subclause 15.247(c)

7.1.11 SPURIOUS CONDUCTED EMISSIONS SUBCLAUSE 15.247(C)
RESULT: Pass
Limit Subclause 15.247(c)

7.1.12 SPURIOUS RADIATED EMISSIONS SUBCLAUSE 15.247(C)
RESULT: Pass
Limit Subclause 15.247(c)

2 Contents

1 TEST SUMMARY 2
2 CONTENTS 3
3 GENERAL REMARKS 4
3.1 COMPLEMENTARY MATERIALS 4
4 TEST SITES 4
4.1 TEST FACILITIES 4
4.2 LIST OF TEST AND MEASUREMENT INSTRUMENTS 5
5 GENERAL PRODUCT INFORMATION 6
5.1 PRODUCT FUNCTION AND INTENDED USE 6
5.2 RATINGS AND SYSTEM DETAILS 6
5.3 INDEPENDENT OPERATION MODES 6
5.4 SUBMITTED DOCUMENTS 7
6 TEST SET-UP AND OPERATION MODE 7
6.1 PRINCIPLE OF CONFIGURATION SELECTION 7
6.2 TEST OPERATION AND TEST SOFTWARE 7
6.3 SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT 7
7 TEST RESULTS 8
7.1.1 Antenna connector Subclause 15.203 8
7.1.2 Antenna type Subclause 15.204 8
7.1.3 Disturbance voltage on AC mains Subclause 15.207(a) 9
7.1.4 Carrier frequency seperation Subclause 15.247(a)(1) 11
7.1.5 Dwell time Subclause 15.247(a)(1)(iii) 12
7.1.6 20dB bandwidth Subclause 15.247(a)(1) 13
7.1.7 Hopping sequence Subclause 15.247(a)(1) 14
7.1.8 Receiver input bandwidth Subclause 15.247(a)(1) 15
7.1.9 Peak output power Subclause 15.247(b)(1) 16
7.1.10 Band edge compliance Subclause 15.247(c) 17
7.1.11 Spurious conducted emissions Subclause 15.247(c) 18
7.1.12 Spurious radiated emissions Subclause 15.247(c) 19

3 General Remarks

3.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix 1: Test Results
Appendix 2: Test Setup
Appendix 3: EUT Photos
Appendix 4: FCCID Label, Block Diagram, Schematics and User Manual

4 Test Sites

4.1 Test Facilities

Hong Kong Productivity Council
HKPC Building
78 Tat Chee Avenue
Kowloon
Hong Kong

4.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

	Kind of Equipment	Manufacturer	Type	S/N
☒	Test Receiver	Rohde & Schwarz	ESHS30	847115/005
☒	L/I/S/N	Rohde & Schwarz	ESH 3-Z5	849876/026
☐	Oscilloscope	HP	54713B	US34510455
☐	Test Receiver	Rohde & Schwarz	ESVP	882402/033
☐	Absorbing Clamp	Rohde & Schwarz	MDS-21	979 3/4
☒	Test Receiver 20 – 1000MHz	Rohde & Schwarz	ESVS30	842807/009
☒	Biconical Antenna	Rohde & Schwarz	HK116	841489/015
☒	Log.-Periodic Antenna	Rohde & Schwarz	HL223	841516/017
☐	Universal Power Analyzer	Voltech	PM3000A	9915
☐	Reference Impedance Network	Voltech	IEC 555 Standard	9946
☐	AC Power Source	California Instr.	4500L	HK51895
☐	Trip-Loop Antenna	Chase	LLA6142	1019
☒	Double Ridge Horn Antenna	EMCO	3115	9002-3351
☒	Double Ridge Horn Antenna	EMCO	3116	9002-3347
☐	RF Comms Test Set	HP	8920B	US36492628
☐	Spectrum Analyser + Tracking Gen.	HP	8596E	3639A00758
☐	Signal Generator	Rohde & Schwarz	SMY 01	844146/024
☐	Signal Generator	Rohde & Schwarz	SMY 01	844146/023
☐	BiLog Antenna	EMCO	3143	9607-1287
☐	Isotropic Field Probe	Holladay	HI-4422	90956
☐	Power Amplifier	Kalmus	757-LC	7620-1
☐	Power Amplifier	Kalmus	122-FC	7620-2
☐	Coupling Clamp	Schaffner	CDN 126	312
☐	Couple Device Network	Fischer	CDN-M2	9604
☒	Spectrum Analyzer	Rohde & Schwarz	FSP30	1093.4495K30
☐	Temperature Chamber	Binder	MK 240	9020-0028
☐	EFT,ESD,SURGE, DIPS tester	Schaffner	Best 96	IN3796-011

5 General Product Information

5.1 Product Function and Intended Use

The submitted sample is a wireless headset based on the Bluetooth technology.
Bluetooth is a short-range radio link intended to be a cable replacement between portable and/or fixed electronic devices.
Bluetooth operates in the unlicensed ISM Band at 2.4 GHz. In the US a band of 83.5 MHz width is available. In this band, 79 RF channels spaced 1MHz apart are defined.
The channel is represented by a pseudo-random hopping sequence through the 79 channels. The channel is divided into time slots, with a nominal slot length of 625µs, where each slot corresponds to different RF hop frequencies. The nominal hop rate is 1600 hops/s. The symbol rate on the channel is 1 Ms/s.

5.2 Ratings and System Details

		Receiver	Transmitter
Frequency range	:	2402 - 2480MHz	2402 - 2480MHz
Number of channels	:	79	79
Channel separation	:	1MHz	1MHz
Type of antenna	:	Metal strip PIFA antenna	Metal strip PIFA antenna
Power supply	:	3.7V Lithium Battery supply	3.7V Lithium Battery supply

5.3 Independent Operation Modes

a) Inquiry scan
b) Page scan
c) Connection state:
ACL link
SCO link

For further information, please refer to the user manual.

5.4 Submitted Documents

Schematics
Block Diagram
PCB Layout
User manual

6 Test Set-up and Operation Mode

6.1 Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

6.2 Test Operation and Test Software

Refer to Test set-up in chapter 7.

6.3 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessory:

1. Nokia 8910i
   Serial number: 351103/40/005161/8

7 Test Results

7.1.1 Antenna connector — Subclause 15.203

The antenna is permanently attached on the PCB.

7.1.2 Antenna type — Subclause 15.204

The EUT has a Metal strip PIFA antenna soldered to the circuit board. The antenna gain is 0dBi.

7.1.3 Disturbance voltage on AC mains Subclause 15.207(a)

RESULT: **Pass**

Test Specification : CISPR 22: 1997
Mode of operation : Charging only / Normal use during charging
Port of testing : AC power port of the charger of the EUT
Supply voltage : AC 110V
Temperature : 26°C
Humidity : 57%

Operation mode: Charging only
For Live measurement

Frequency	QP reading	QP limit	Av reading	Av limit
MHz	dBµV	dBµV	dBµV	dBµV
0.306	18.5	66 – 56*	0.1	56 – 46*
0.498	17.3	66 – 56*	0.1	56 – 46*

For Neutral measurement

Frequency	QP reading	QP limit	Av reading	Av limit
MHz	dBµV	dBµV	dBµV	dBµV
0.396	22.5	66 – 56*	0.1	56 – 46*
28.632	4.8	66 – 56*	0.1	56 – 46*

Operation mode: Normal use during charging
For Live measurement

Frequency	QP reading	QP limit	Av reading	Av limit
MHz	dBµV	dBµV	dBµV	dBµV
0.492	19.4	66 – 56*	0.1	56 – 46*
24.267	17.6	66 – 56*	12.6	56 – 46*

For Neutral measurement

Frequency	QP reading	QP limit	Av reading	Av limit
MHz	dBµV	dBµV	dBµV	dBµV
0.396	23.8	66 – 56*	0.1	56 – 46*
24.261	21.3	66 – 56*	16.2	56 – 46*

* Decreases with the logarithm of the frequency.

The radio frequency voltage conducted back onto the Live and the Neutral power lines complies with the limits.

For test results refer to Appendix 1, page 1-5

Limit **Subclause 15.207(a)**

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN).

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66-56*	56-46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

7.1.4 Carrier frequency separation Subclause 15.247(a)(1)

RESULT: **Pass**

Test specification	:	FCC § 15.31
Mode of operation	:	Tx mode (hopping on), DH1 packet
Port of testing	:	Temporary antenna port
Detector	:	PK
RBW/VBW	:	100kHz/300kHz
Supply voltage	:	3.7V Lithium Battery supply
Temperature	:	26°C
Humidity	:	57%

The centre frequencies of the hopping channels are separated by more than the 20dB bandwidth.
For test results refer to Appendix 1, page 6

Limit **Subclause 15.247(a)(1)**

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

7.1.5 Dwell time Subclause 15.247(a)(1)(iii)

RESULT: **Pass**

Test specification	:	FCC § 15.31
Mode of operation	:	Tx mode (2441MHz), DH5 packet
Port of testing	:	Temporary antenna port
Detector	:	PK
RBW/VBW	:	1MHz/3MHz
Supply voltage	:	3.7V Lithium Battery supply
Temperature	:	26°C
Humidity	:	57%

The screenshot in Appendix1 P.8 shows the occurance of a channel in a 12.8s time period. In inquiry and page scan mode Bluetooth is using 32 hopping channels only. The frequency was used 27 times. The dwell time for the longest supported packet type is about 3ms. As a result the average time of occupancy will not be greater than 400ms.

i.e. Time period calculation:

$$0.4 \times 32 = 12.8\text{s}$$

Limit calculation:

$$27 \times 2.944 \times 10^{-3} = 79.490 \times 10^{-3}\,\text{s}$$
$$\leq 400 \times 10^{-3}\,\text{s}$$

For test results please refer to Appendix 1, page 7-8.

Limit **Subclause15.247(a)(1)(iii)**

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

7.1.6 20dB bandwidth Subclause 15.247(a)(1)

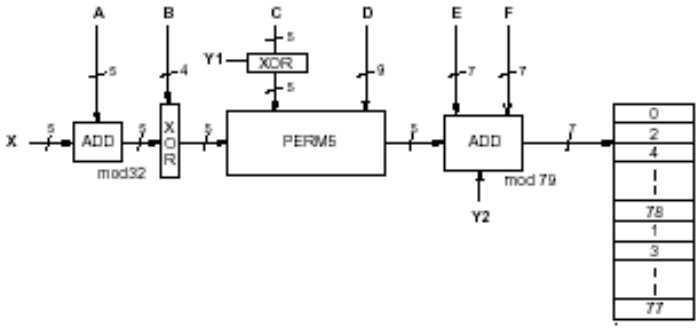
Test specification	:	FCC § 15.31
Mode of operation	:	Tx mode (2402MHz, 2441MHz, 2480MHz), DH5 packet
Port of testing	:	Temporary antenna port
Detector	:	PK
RBW/VBW	:	30kHz/100kHz
Supply voltage	:	3.7V Lithium Battery supply
Temperature	:	26°C
Humidity	:	57%

20dB bandwidth (MHz)		
2402	2441	2480
(0.468)-(-0.456) = 0.924	(0.456)-(-0.456) = 0.912	(0.456)-(-0.452) = 0.908

For test results refer to Appendix 1, page 9-11.

7.1.7 Hopping sequence **Subclause 15.247(a)(1)**

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master. The X input determines the phase in the 32-hop segment, whereas Y1 and Y2 selects between master-to-slave and slave-to-master transmission. The inputs A to D determine the ordering within the segment, the inputs E and F determine the mapping onto the hop frequencies.



Example data:

```
Hop sequence {k} for CONNECTION STATE:
CLK start: 0x0000010
ULAP: 0x00000000
#ticks: 00 02 | 04 06 | 08 0a | 0c 0e | 10 12 | 14 16 | 18 1a | 1c 1e |
-------------------------------------------------------------
0x0000010: 08 66 | 10 70 | 12 19 | 14 23 | 16 01 | 18 05 | 20 33 | 22 37 |
0x0000030: 24 03 | 26 07 | 28 35 | 30 39 | 32 72 | 34 76 | 36 25 | 38 29 |
0x0000050: 40 74 | 42 78 | 44 27 | 46 31 | 48 09 | 50 13 | 52 41 | 54 45 |
0x0000070: 56 11 | 58 15 | 60 43 | 62 47 | 32 17 | 36 19 | 34 49 | 38 51 |
0x0000090: 40 21 | 44 23 | 42 53 | 46 55 | 48 33 | 52 35 | 50 65 | 54 67 |
0x00000b0: 56 37 | 60 39 | 58 69 | 62 71 | 64 25 | 68 27 | 66 57 | 70 59 |
0x00000d0: 72 29 | 76 31 | 74 61 | 78 63 | 01 41 | 05 43 | 03 73 | 07 75 |
0x00000f0: 09 45 | 13 47 | 11 77 | 15 00 | 64 49 | 66 53 | 68 02 | 70 06 |
0x0000110: 01 51 | 03 55 | 05 04 | 07 08 | 72 57 | 74 61 | 76 10 | 78 14 |
0x0000130: 09 59 | 11 63 | 13 12 | 15 16 | 17 65 | 19 69 | 21 18 | 23 22 |
0x0000150: 33 67 | 35 71 | 37 20 | 39 24 | 25 73 | 27 77 | 29 26 | 31 30 |
0x0000170: 41 75 | 43 00 | 45 28 | 47 32 | 17 02 | 21 04 | 19 34 | 23 36 |
0x0000190: 33 06 | 37 08 | 35 38 | 39 40 | 25 10 | 29 12 | 27 42 | 31 44 |
0x00001b0: 41 14 | 45 16 | 43 46 | 47 48 | 49 18 | 53 20 | 51 50 | 55 52 |
0x00001d0: 65 22 | 69 24 | 67 54 | 71 56 | 57 26 | 61 28 | 59 58 | 63 60 |
0x00001f0: 73 30 | 77 32 | 75 62 | 00 64 | 49 34 | 51 42 | 57 66 | 59 74 |
0x0000210: 53 36 | 55 44 | 61 68 | 63 76 | 65 50 | 67 58 | 73 03 | 75 11 |
0x0000230: 69 52 | 71 60 | 77 05 | 00 13 | 02 38 | 04 46 | 10 70 | 12 78 |
0x0000250: 06 40 | 08 48 | 14 72 | 16 01 | 18 54 | 20 62 | 26 07 | 28 15 |
0x0000270: 22 56 | 24 64 | 30 09 | 32 17 | 02 66 | 06 74 | 10 19 | 14 27 |
0x0000290: 04 70 | 08 78 | 12 23 | 16 31 | 18 03 | 22 11 | 26 35 | 30 43 |
0x00002b0: 20 07 | 24 15 | 28 39 | 32 47 | 34 68 | 38 76 | 42 21 | 46 29 |
0x00002d0: 36 72 | 40 01 | 44 25 | 48 33 | 50 05 | 54 13 | 58 37 | 62 45 |
0x00002f0: 52 09 | 56 17 | 60 41 | 64 49 | 34 19 | 36 35 | 50 51 | 52 67 |
0x0000310: 38 21 | 40 37 | 54 53 | 56 69 | 42 27 | 44 43 | 58 59 | 60 75 |
0x0000330: 46 29 | 48 45 | 62 61 | 64 77 | 66 23 | 68 39 | 03 55 | 05 71 |
0x0000350: 70 25 | 72 41 | 07 57 | 09 73 | 74 31 | 76 47 | 11 63 | 13 00 |
0x0000370: 78 33 | 01 49 | 15 65 | 17 02 | 66 51 | 70 67 | 03 04 | 07 20 |
0x0000390: 68 55 | 72 71 | 05 08 | 09 24 | 74 59 | 78 75 | 11 12 | 15 28 |
0x00003b0: 76 63 | 01 00 | 13 16 | 17 32 | 19 53 | 23 69 | 35 06 | 39 22 |
0x00003d0: 21 57 | 25 73 | 37 10 | 41 26 | 27 61 | 31 77 | 43 14 | 47 30 |
0x00003f0: 29 65 | 33 02 | 45 18 | 49 34 | 19 04 | 21 08 | 23 20 | 25 24
```

7.1.8 Receiver input bandwidth Subclause 15.247(a)(1)

The receiver bandwidth is equal to the receiver bandwidth in the 79 hopping channel mode, which is 1 MHz. The receiver bandwidth is indirectly verified during Bluetooth RF conformance testing.

7.1.9 Peak output power Subclause 15.247(b)(1)

RESULT: **Pass**

Test specification	:	FCC § 15.31
Mode of operation	:	Tx mode (2402MHz, 2441MHz, 2480MHz), DH1 packet
Port of testing	:	Temporary antenna port
Detector	:	PK
RBW/VBW	:	1MHz/3MHz
Supply voltage	:	3.7V Lithium Battery supply
Temperature	:	26°C
Humidity	:	57%

Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Actual value (dBm)
2402	-0.79	4.30	3.51
2441	-1.09	4.15	3.06
2480	-1.43	4.50	3.07

All three transmit frequency modes comply with the maximum peak output power limit.
For test results refer to Appendix 1, page 12-14

Limit **Subclause15.247(b)(1)**

Frequency range	RF output power
2.400-2.483,5MHz	0.125W (21.0dBm)

7.1.10 Band edge compliance Subclause 15.247(c)

RESULT: **Pass**

Test specification	:	FCC § 15.31
Mode of operation	:	Tx mode (2402MHz, 2441MHz, 2480MHz), DH1 packet
Port of testing	:	Temporary antenna port
Detector	:	PK
RBW/VBW	:	300kHz/1.0MHz
Supply voltage	:	3.7V Lithium Battery supply
Temperature	:	26°C
Humidity	:	57%

There is no peak found outside any 100kHz bandwidth of the operating frequency band in the three transmit frequency. All three transmit frequency modes comply with the limit stated in subclause 15.247(c).
For test results refer to Appendix 1, page 15-17.

Limit **Subclause 15.247(c)**

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

7.1.11 Spurious conducted emissions Subclause 15.247(c)

RESULT: **Pass**

Test specification : FCC § 15.31
Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz), DH1 packet
Port of testing : Temporary antenna port
Detector : PK
RBW/VBW : 100kHz/300kHz
Supply voltage : 3.7V Lithium Battery supply
Temperature : 26°C
Humidity : 57%

Operating frequency : 2402MHz

Spurious Frequency (MHz)	Power level (dBm)	Reference value (dBm)	Delta to reference level (dB)
No Peak Found	-	-	-

Operating frequency : 2441MHz

Spurious Frequency (MHz)	Power level (dBm)	Reference value (dBm)	Delta to reference level (dB)
No Peak Found	-	-	-

Operating frequency : 2480MHz

Spurious Frequency (MHz)	Power level (dBm)	Reference value (dBm)	Delta to reference level (dB)
No Peak Found	-	-	-

All three transmit frequency modes comply with the 20dB limit stated in subclause 15.247(c).
For test results refer to Appendix 1, page 18-27.

Limit **Subclause 15.247(c)**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

7.1.12 Spurious radiated emissions Subclause 15.247(c)

RESULT: **Pass**

Test specification : ANSI C63.4 - 1992
Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz), DH1 packet
Port of testing : Enclosure
Measurement Location: 10m Semi Anechoic Chamber
Measurement Distance: 3m
Measurement BW : 1 MHz
Supply voltage : 3.7V Lithium Battery supply

Tx frequency 2402MHz, Polarization Vertical

Freq	Reading	AF	Cable att.	Pre –amp	Filter att.	Level	Limit/ Detector
MHz	dBuV	dB(1/m)	dB	dB	dB	dBuV/m	dBuV/m
-	-	-	-	-	-	-	-

Tx frequency 2402MHz, Polarization Horizontal

Freq	Reading	AF	Cable att.	Pre –amp	Filter att.	Level	Limit/ Detector
MHz	dBuV	dB(1/m)	dB	dB	dB	dBuV/m	dBuV/m
1200.500	47.78	24.40	1.52	37.10	1.87	38.47	74.0 / P

Tx frequency 2441MHz, Polarization Vertical

Freq	Reading	AF	Cable att.	Pre –amp	Filter att.	Level	Limit/ Detector
MHz	dBuV	dB(1/m)	dB	dB	dB	dBuV/m	dBuV/m
1220.000	45.07	24.40	1.52	37.10	1.87	35.76	74.0 / P

Tx frequency 2441MHz, Polarization Horizontal

Freq	Reading	AF	Cable att.	Pre –amp	Filter att.	Level	Limit/ Detector
MHz	dBuV	dB(1/m)	dB	dB	dB	dBuV/m	dBuV/m
1219.980	38.60	24.40	1.52	37.10	1.87	29.29	74.0 / P

Tx frequency 2480MHz, Polarization Vertical

Freq	Reading	AF	Cable att.	Pre –amp	Filter att.	Level	Limit/ Detector
MHz	dBuV	dB(1/m)	dB	dB	dB	dBuV/m	dBuV/m
1239.500	41.66	24.40	1.52	37.10	1.87	32.35	74.0 / P

Tx frequency 2480MHz, Polarization Horizontal

Freq	Reading	AF	Cable att.	Pre –amp	Filter att.	Level	Limit/ Detector
MHz	dBuV	dB(1/m)	dB	dB	dB	dBuV/m	dBuV/m
1239.500	47.72	24.40	1.52	37.10	1.87	38.41	74.0 / P

All three transmit frequency modes comply with the field strength within the restricted bands.
For test results refer to Appendix 1, page 28-63.

Limit **Subclause 15.247(c)**

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Field strength limits within the restricted bands using average detector:

Frequency (MHz)	Field strength (microvolts/meter)	Field strength (dBµV/m)	Measurement distance (meters)
30-88	100	20*log(100) = 40.0	3
88-216	150	20*log(150) = 43.5	3
216-960	200	20*log(200) = 46.0	3
960-2500	500	20*log(500) = 54.0	3

According to section 15.35(b), on any frequency or frequencies above 1000 MHz the radiated limits shown are based upon the use of measurement instrumentation employing an average detector function. When average radiated emission measurements are specified in this part, including emission measurements below 1000 MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated.

Disturbance Voltage on AC Mains

Date: 2 Dec 2003
EUT: GWT-BTH1
Company: Gigawavetech Pte Ltd.
Humidity: 57%
Temperature: 26ºC
Voltage supply: 110V
Test by: Hugo Wan

Operation mode: Charging only
Live measurement

Frequency (MHz)	QP reading (dBµV)	Av reading (dBµV)	Results
0.306	18.5	0.1	Pass
0.498	17.3	0.1	Pass

Neutral measurement

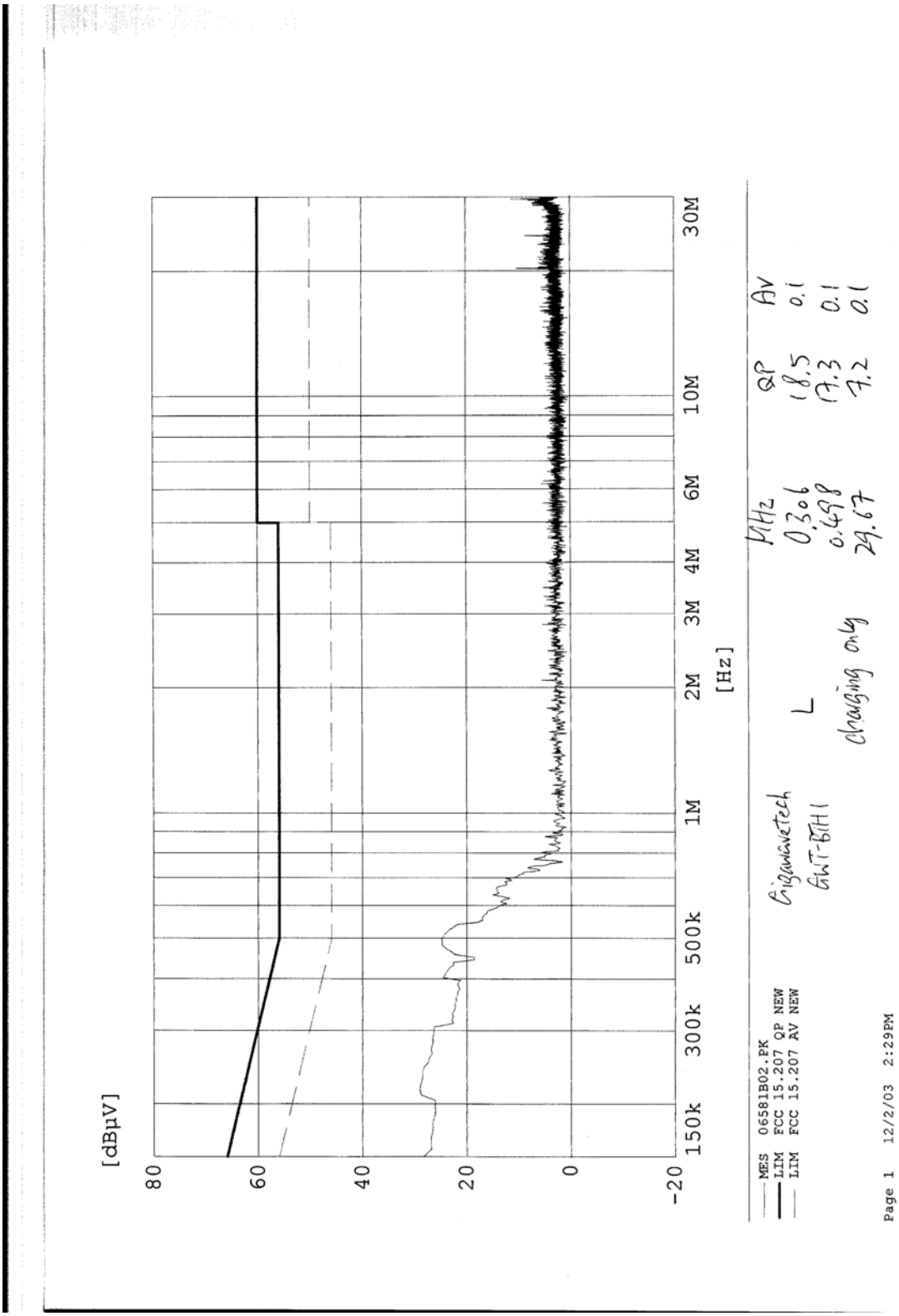
Frequency (MHz)	QP reading (dBµV)	Av reading (dBµV)	Results
0.396	22.5	0.1	Pass
28.632	4.8	0.1	Pass

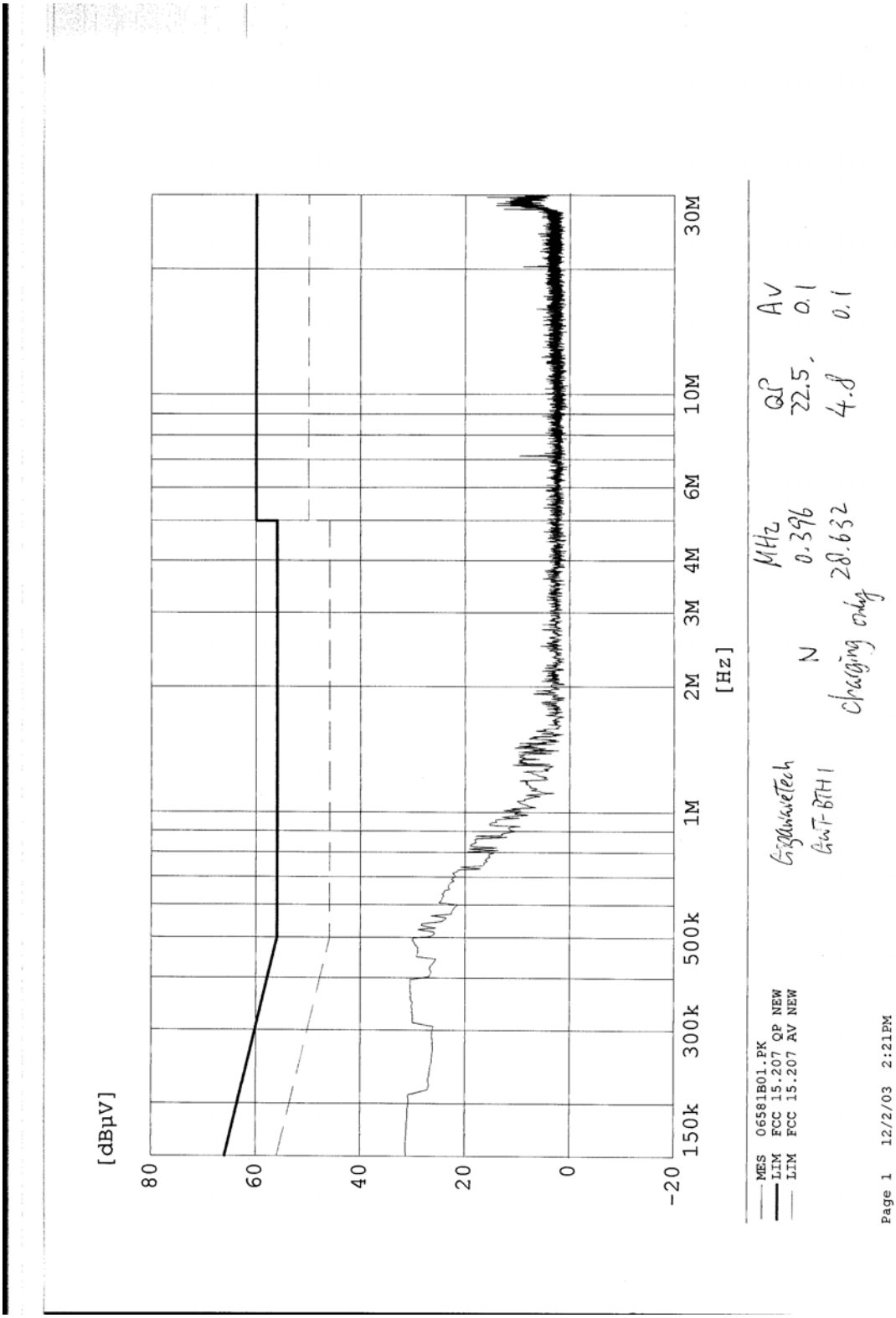
Operation mode: Normal use during charging
Live measurement

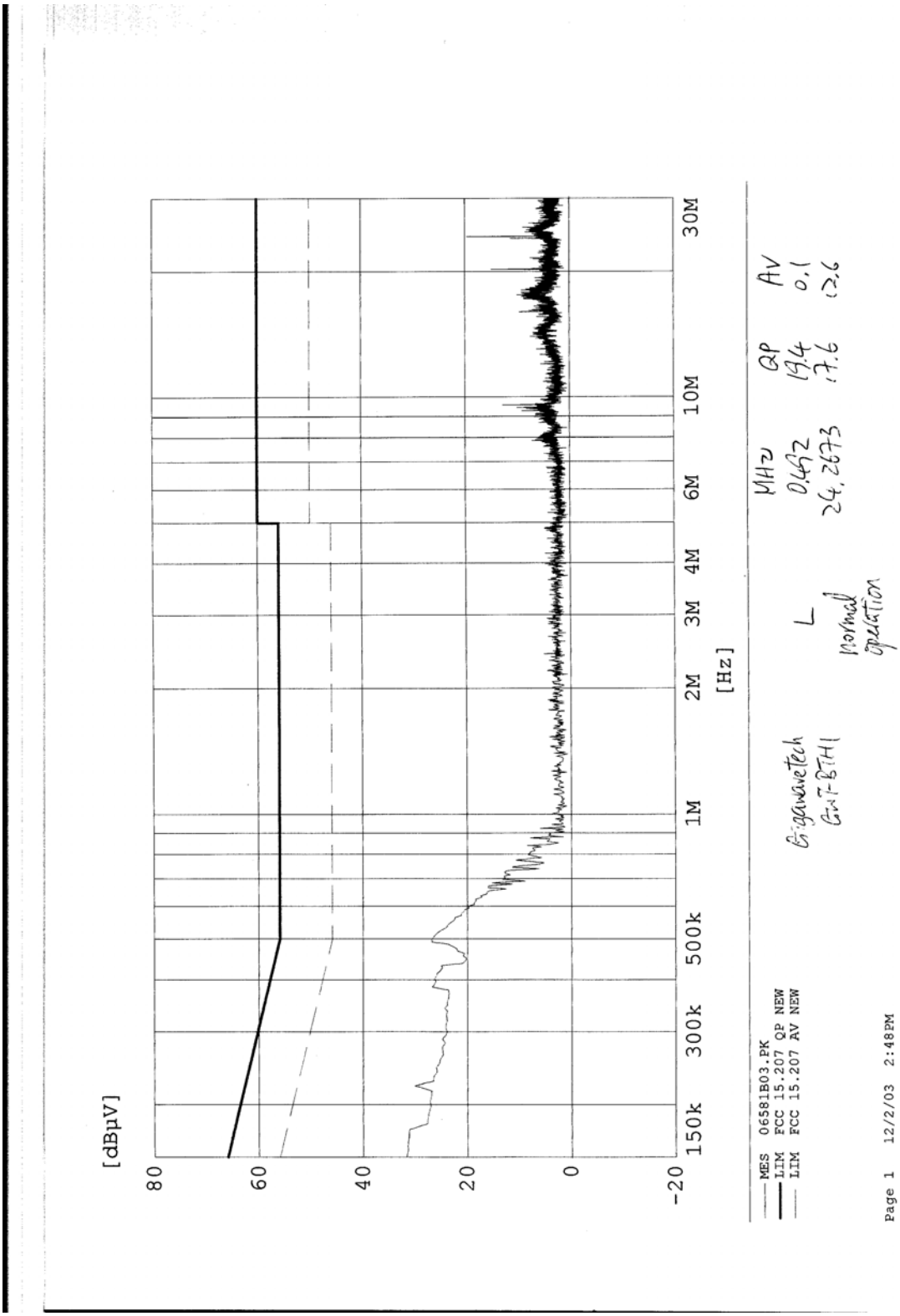
Frequency (MHz)	QP reading (dBµV)	Av reading (dBµV)	Results
0.492	19.4	0.1	Pass
24.267	17.6	12.6	Pass

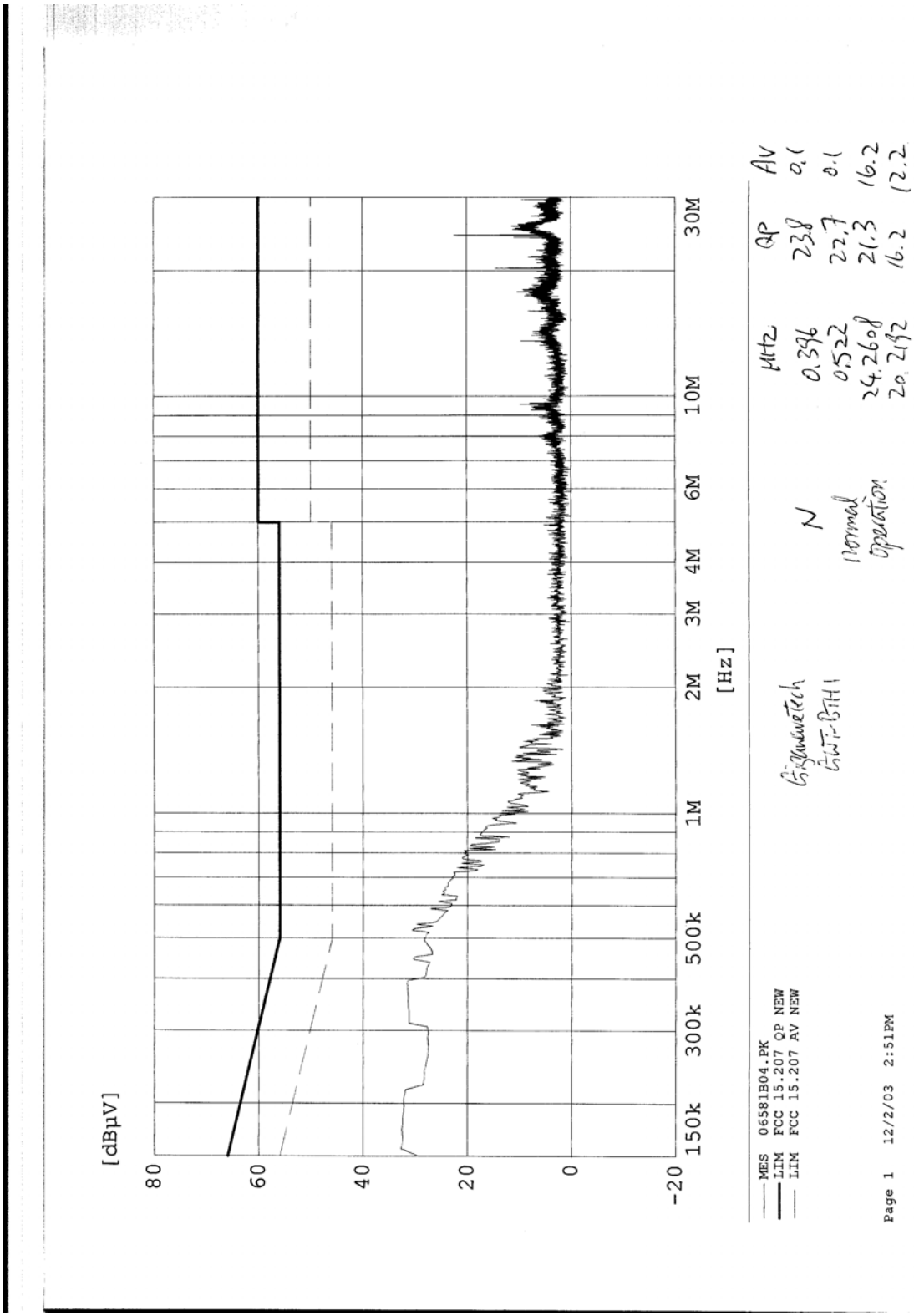
Neutral measurement

Frequency (MHz)	QP reading (dBµV)	Av reading (dBµV)	Results
0.396	23.8	0.1	Pass
24.261	21.3	16.2	Pass


[dBµV]
80
60
40
20
0
-20
150k
300k
500k
1M
2M
3M
4M
6M
10M
30M
[Hz]
MES 06581B02.PK
LIM FCC 15.207 QP NEW
LIM FCC 15.207 AV NEW
Page 1 12/2/03 2:29PM
Gigawavetech
GWT-BTH1
L
charging only
MHz
0.306
0.498
29.67
QP
18.5
17.3
7.2
AV
0.1
0.1
0.1


[dBµV]
80
60
40
20
0
-20
150k
300k
500k
1M
2M
3M
4M
6M
10M
30M
[Hz]
MES 06581B01.PK
LIM FCC 15.207 QP NEW
LIM FCC 15.207 AV NEW
Page 1 12/2/03 2:21PM
Gigawavetech
GWT-BTH1
N
charging only
MHz
0.396
28.632
QP
22.5
4.8
Av
0.1
0.1

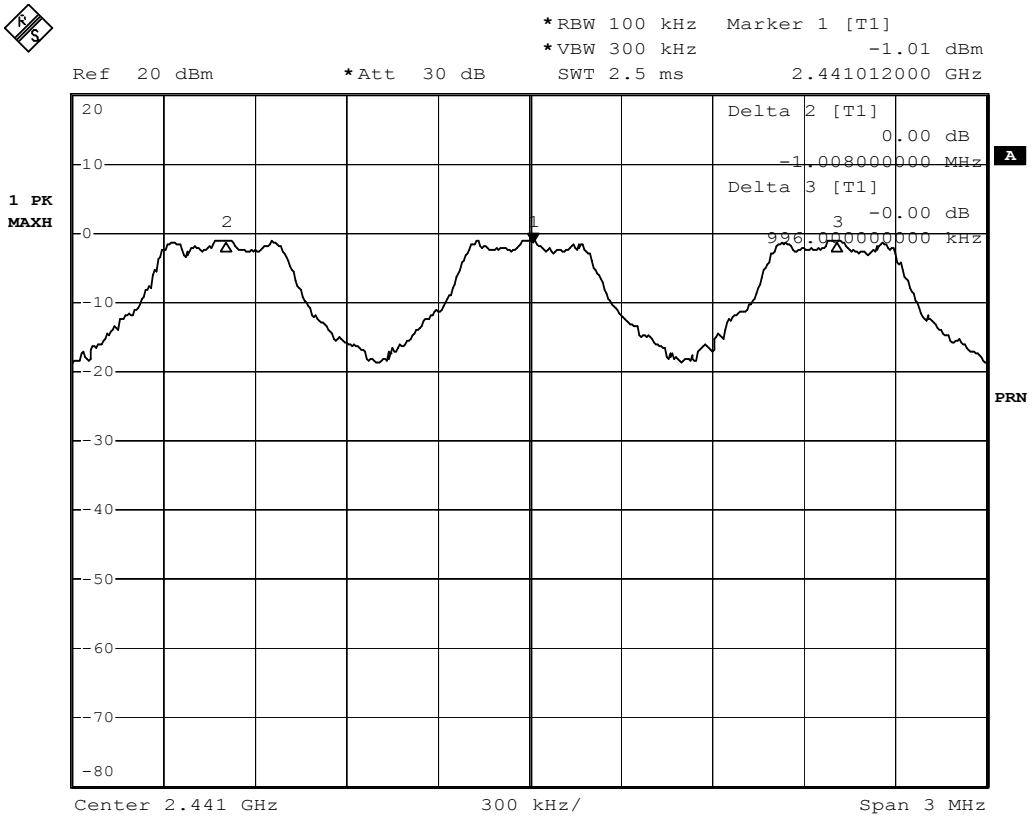

[dBµV]
80
60
40
20
0
-20
150k
300k
500k
1M
2M
3M
4M
6M
10M
30M
[Hz]
MES 06581B03.PK
LIM FCC 15.207 QP NEW
LIM FCC 15.207 AV NEW
Page 1 12/2/03 2:48PM
Gigawavetech
GWT-BTH1
L
normal operation
MHz
0.492
24.2673
QP
19.4
17.6
AV
0.1
12.6


[dBµV]
80
60
40
20
0
-20
150k
300k
500k
1M
2M
3M
4M
6M
10M
30M
[Hz]
MES 06581B04.PK
LIM FCC 15.207 QP NEW
LIM FCC 15.207 AV NEW
Page 1 12/2/03 2:51PM
N
Normal operation
µHz QP AV
0.396 23.8 0.(
0.522 22.7 0.(
24.260 21.3 16.2
20.292 16.2 12.2

Carrier Frequency Seperation

Date: 27 Nov 2003
EUT: GWT-BTH1
Company: Gigawavetech Pte Ltd.
Humidity: 57%
Temperature: 26ºC
Voltage supply: 3.7V Lithium battery
Test by: Hugo Wan
Op. mode: Hopping on

Reference frequency (MHz)	Channel Separation (MHz)	Results
2441.012	0.996	Pass

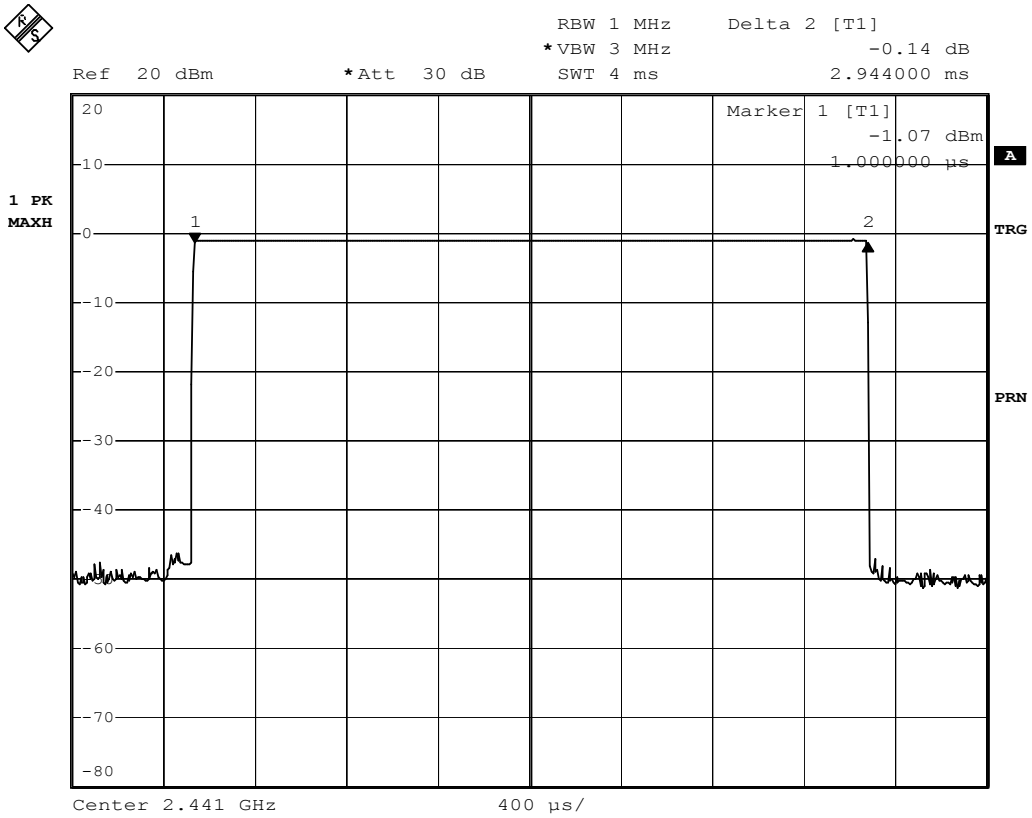


Date: 27.NOV.2003 16:41:24

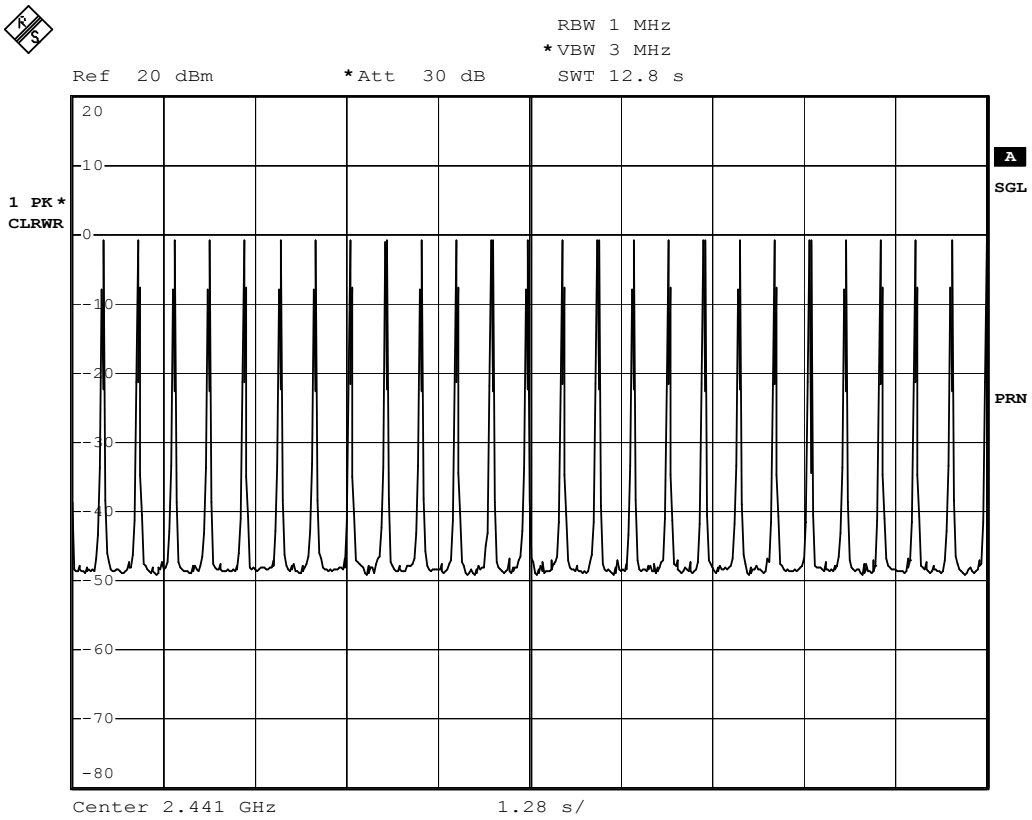
Dwell Time

Date: 27 Nov 2003
EUT: GWT-BTH1
Company: Gigawavetech Pte Ltd.
Humidity: 57%
Temperature: 26ºC
Voltage supply: 3.7V Lithium battery
Test by: Hugo Wan
Op. mode: Hopping on

Burst Duration (ms)	Number of hopping	Time of occupancy (s)	Results
2.944	27	0.002944 x 27 = 0.07949	Pass



Date: 27.NOV.2003 16:43:50

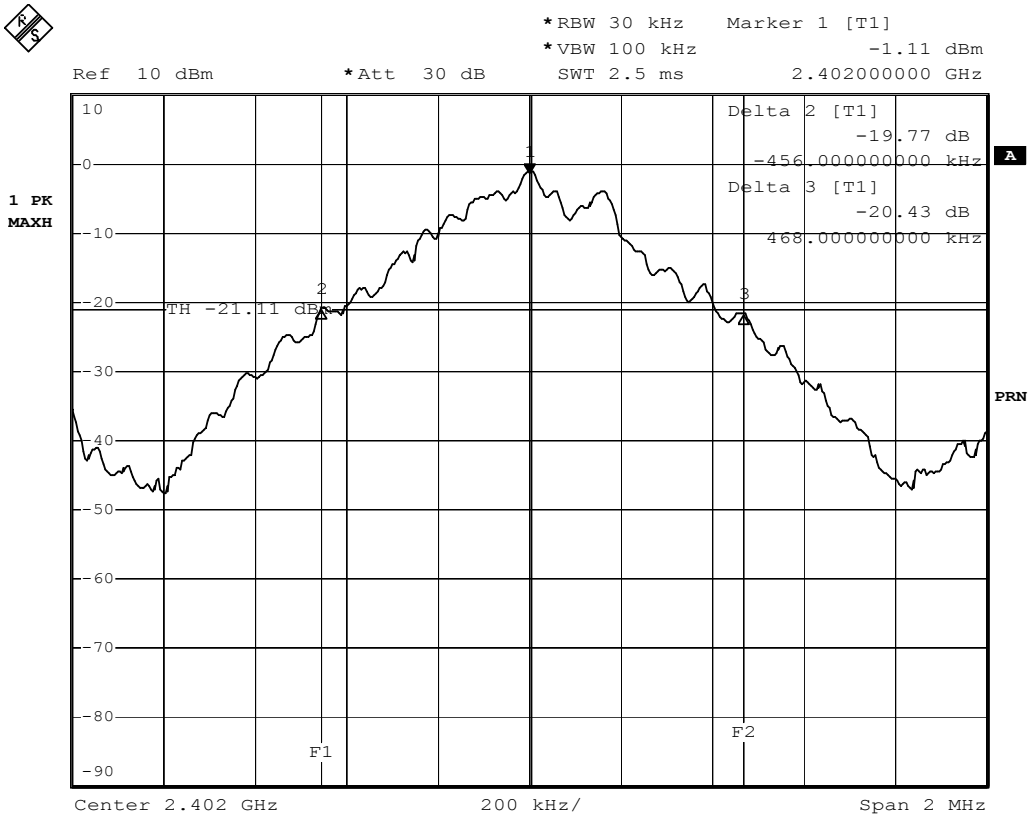


Date: 27.NOV.2003 16:44:56

20dB Bandwidth

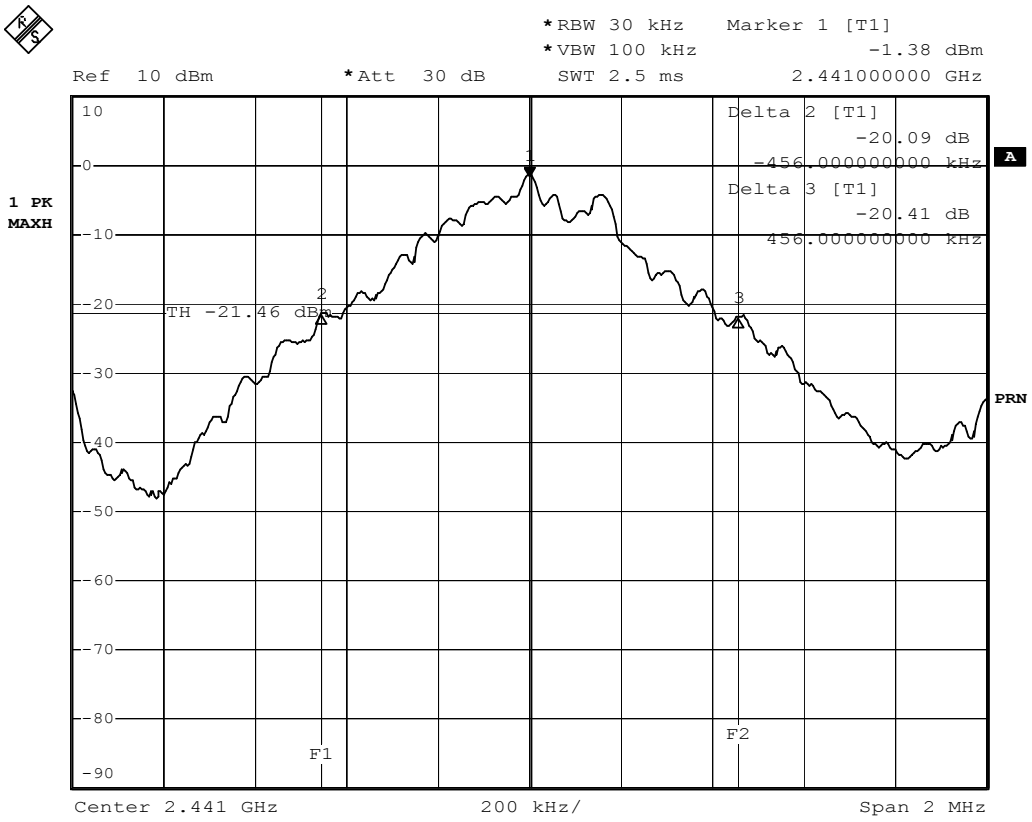
Date: 27 Nov 2003
EUT: GWT-BTH1
Company: Gigawavetech Pte Ltd.
Humidity: 57%
Temperature: 26ºC
Voltage supply: 3.7V Lithium battery
Test by: Hugo Wan
Op. mode: TX mode, DH5 with PRBS9 payload

Tx frequency (MHz)	Δf_L (MHz)	Δf_H (MHz)	$\lvert\Delta f_H\rvert+\lvert\Delta f_L\rvert$ (MHz)	Results
2402	-0.456	0.468	0.924	Pass
2441	-0.456	0.456	0.912	Pass
2480	-0.452	0.456	0.908	Pass



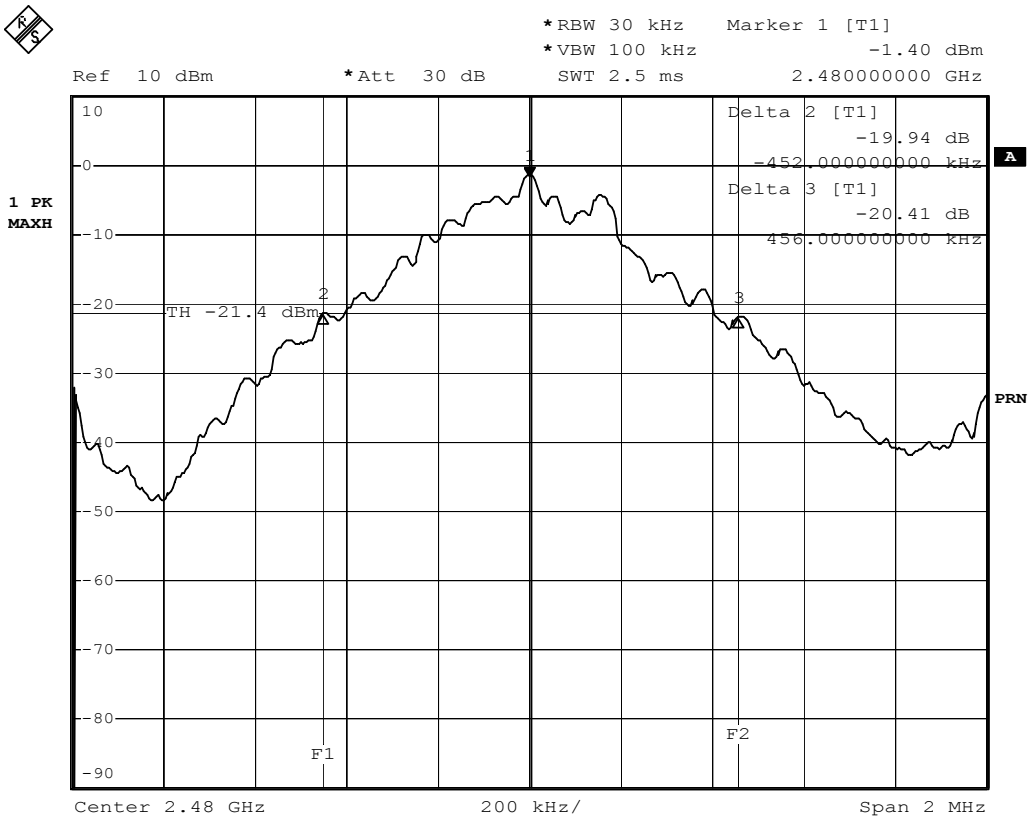
Date: 27.NOV.2003 16:49:34

Tx frequency: 2402MHz



Date: 27.NOV.2003 16:53:06

Tx frequency: 2441MHz



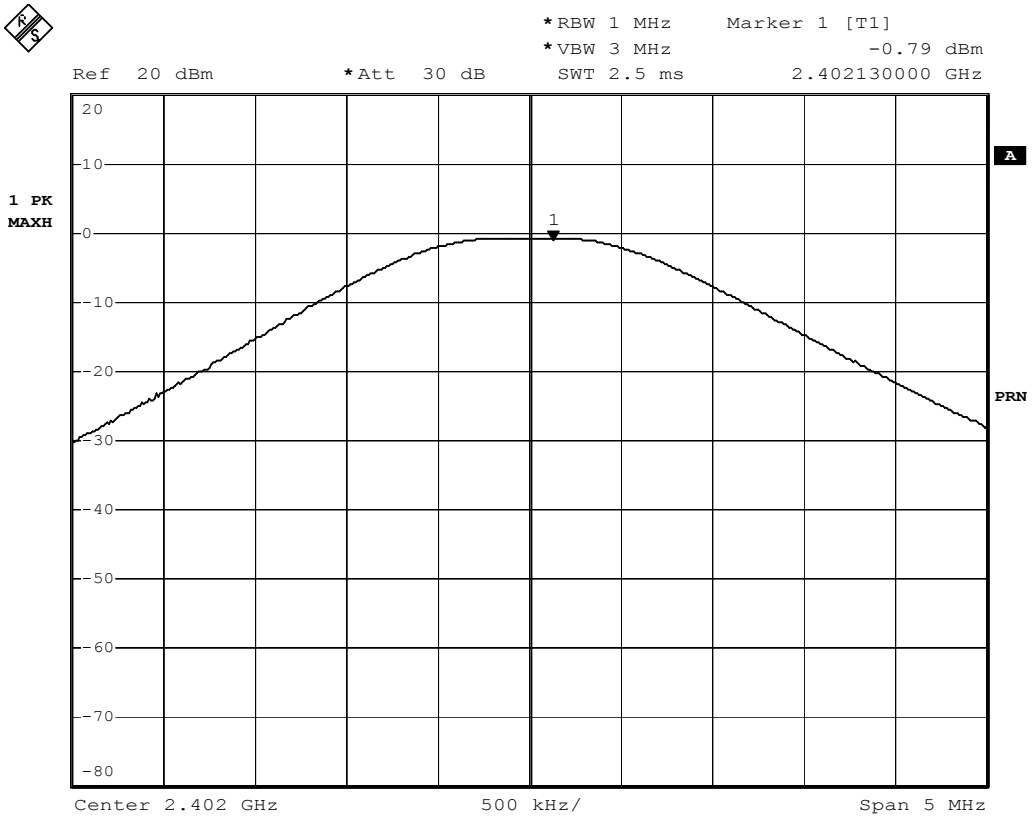
Date: 27.NOV.2003 16:55:52

Tx frequency: 2480MHz

Peak Output Power

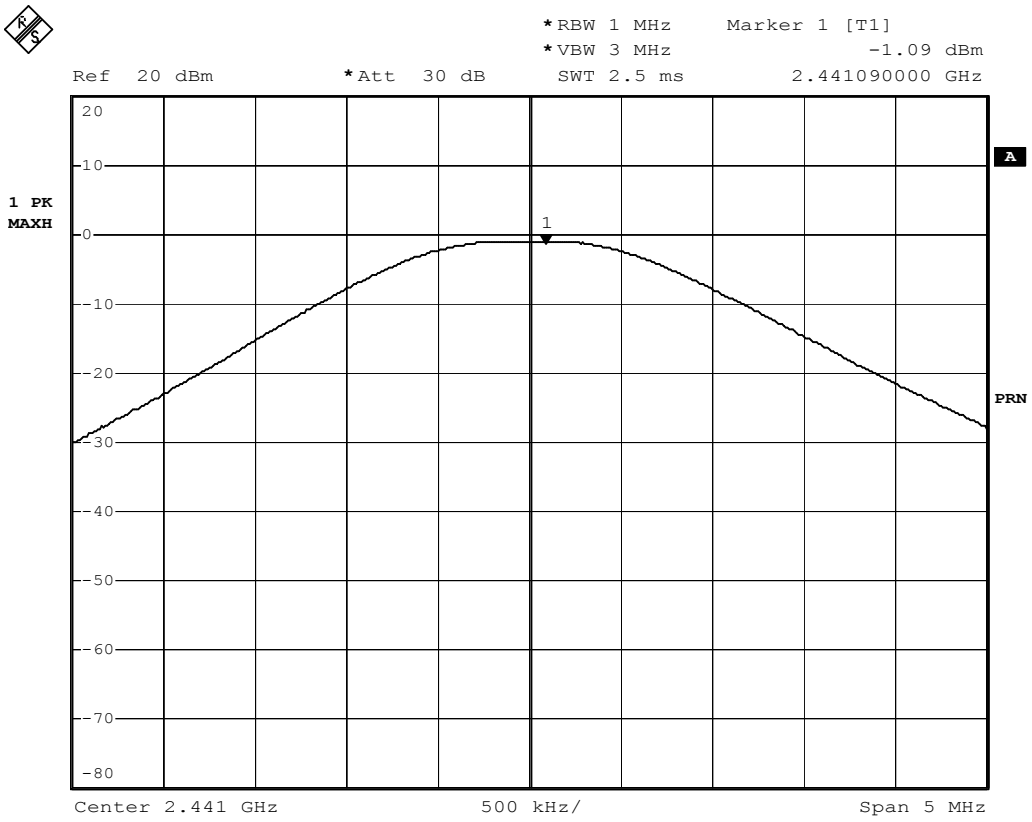
Date: 27 Nov 2003
EUT: GWT-BTH1
Company: Gigawavetech Pte Ltd.
Humidity: 57%
Temperature: 26ºC
Voltage supply: 3.7V Lithium battery
Test by: Hugo Wan
Op. mode: TX mode, DH1 with PRBS9 payload

Tx Frequency (MHz)	Cable Attenuation (dB)	Power P_{PK} (dBm)	Actual Peak Power (dBm)	Results
2402	4.30	-0.79	3.51	Pass
2441	4.15	-1.09	3.06	Pass
2480	4.50	-1.43	3.07	Pass



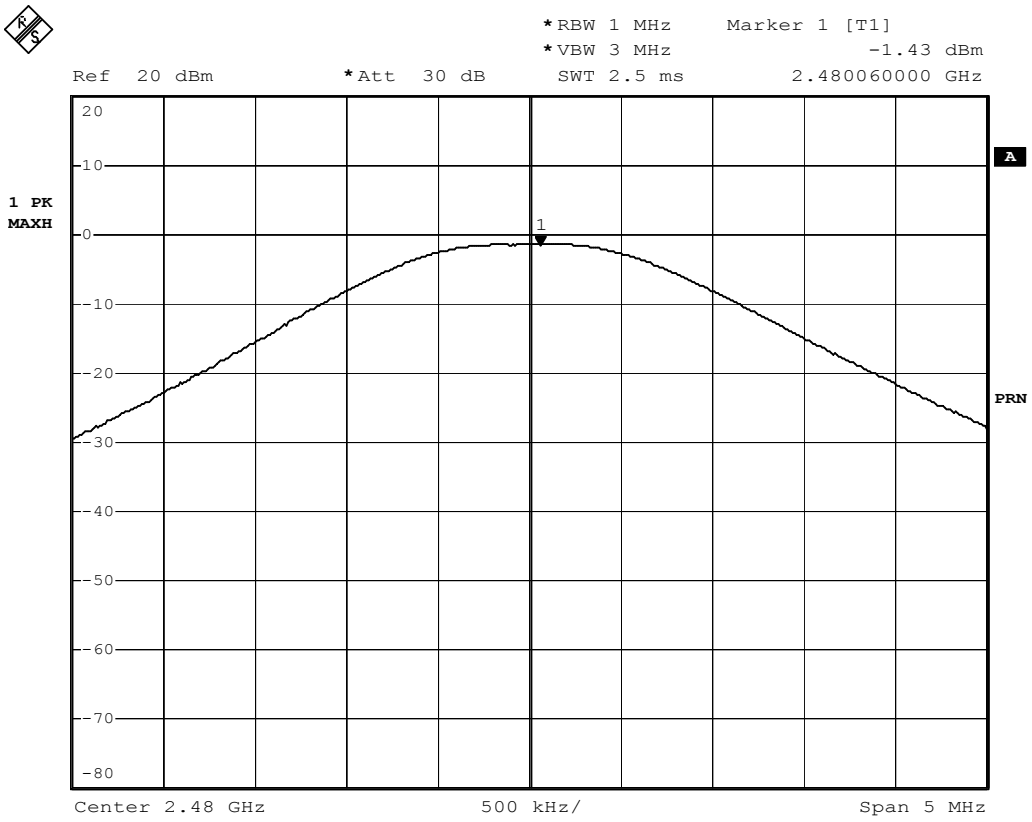
Date: 27.NOV.2003 17:01:18

Tx frequency: 2402MHz



Date: 27.NOV.2003 17:02:30

Tx frequency: 2441MHz



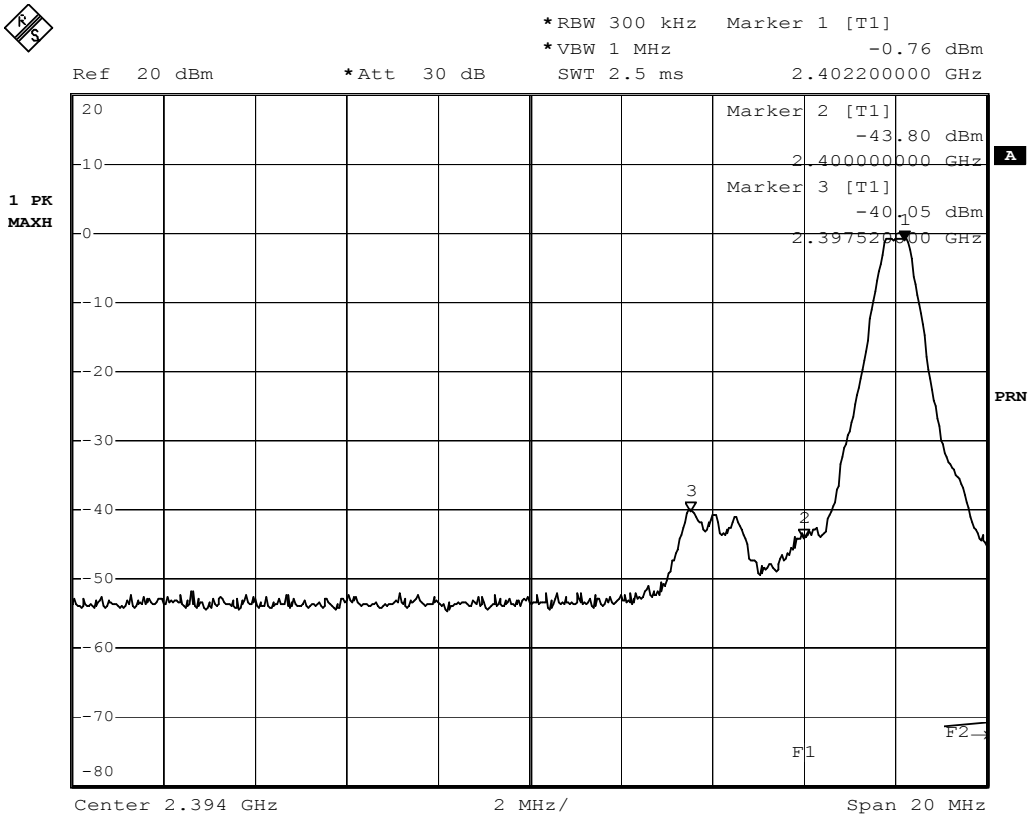
Date: 27.NOV.2003 17:03:34

Tx frequency: 2480MHz

Band Edge Compliance

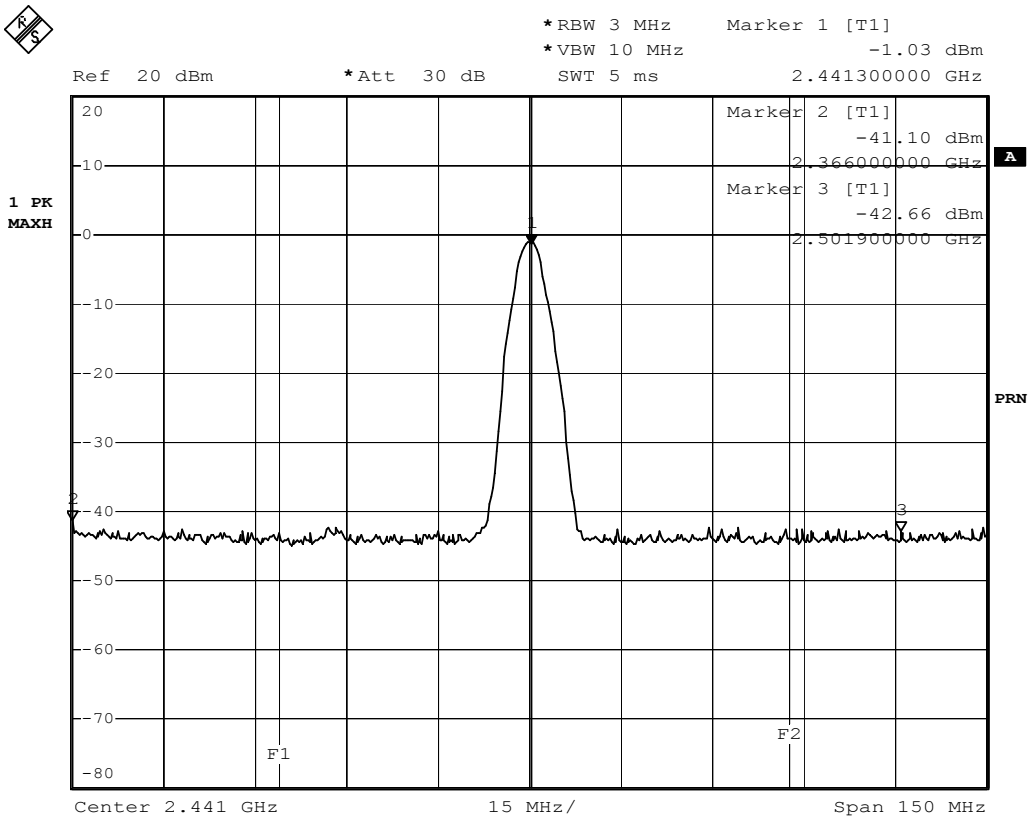
Date: 27 Nov 2003
EUT: GWT-BTH1
Company: Gigawavetech Pte Ltd.
Humidity: 57%
Temperature: 26ºC
Voltage supply: 3.7V Lithium battery
Test by: Hugo Wan
Op. mode: TX mode, DH1 with PRBS9 payload

Tx Frequency (MHz)	Peak in band Power level (dBm)	RF power outside 100kHz BW (MHz)	RF power difference outside 100kHz BW (dB)	Results
2402	-0.76	No Peak	-	Pass
2480	-1.29	No Peak	-	Pass



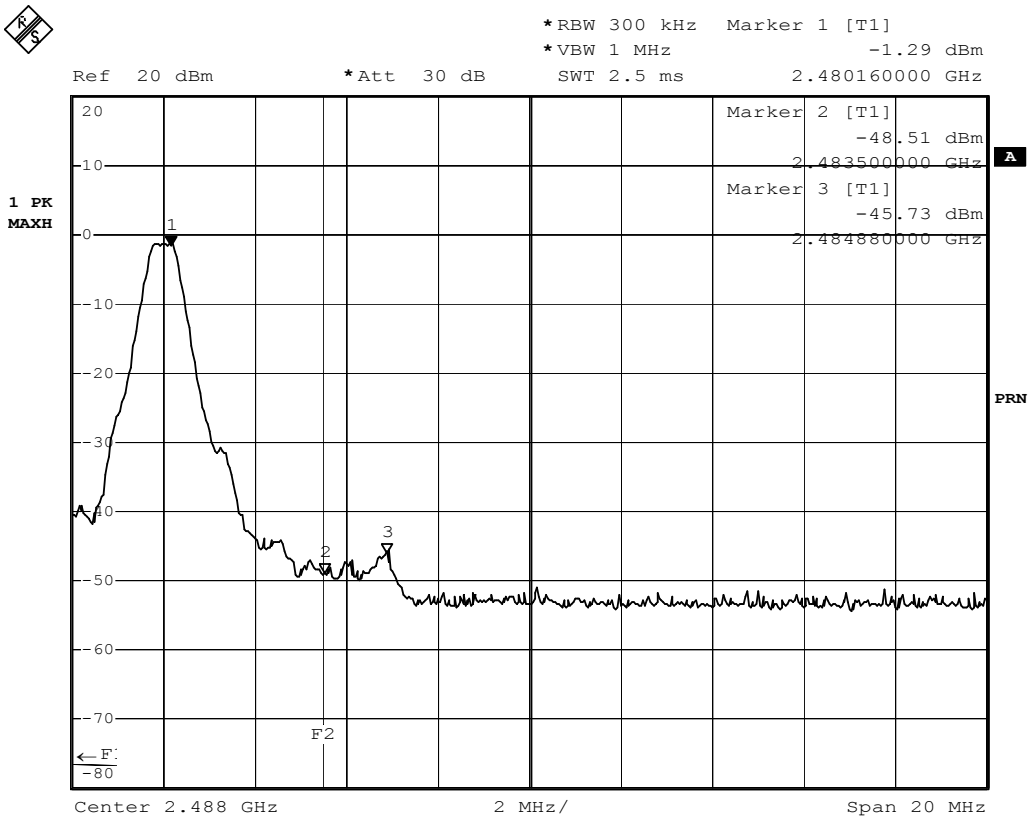
Date: 27.NOV.2003 17:11:10

Tx frequency: 2402MHz



Date: 27.NOV.2003 17:08:29

Tx frequency: 2441MHz



Date: 27.NOV.2003 17:06:59

Tx frequency: 2480MHz

Spurious Emissions - Conducted

Date: 27 Nov 2003
EUT: GWT-BTH1
Company: Gigawavetech Pte Ltd.
Humidity: 57%
Temperature: 26ºC
Voltage supply: 3.7V Lithium battery
Test by: Hugo Wan
Op. mode: TX mode, DH1 with PRBS9 payload

Tx frequency : 2402MHz

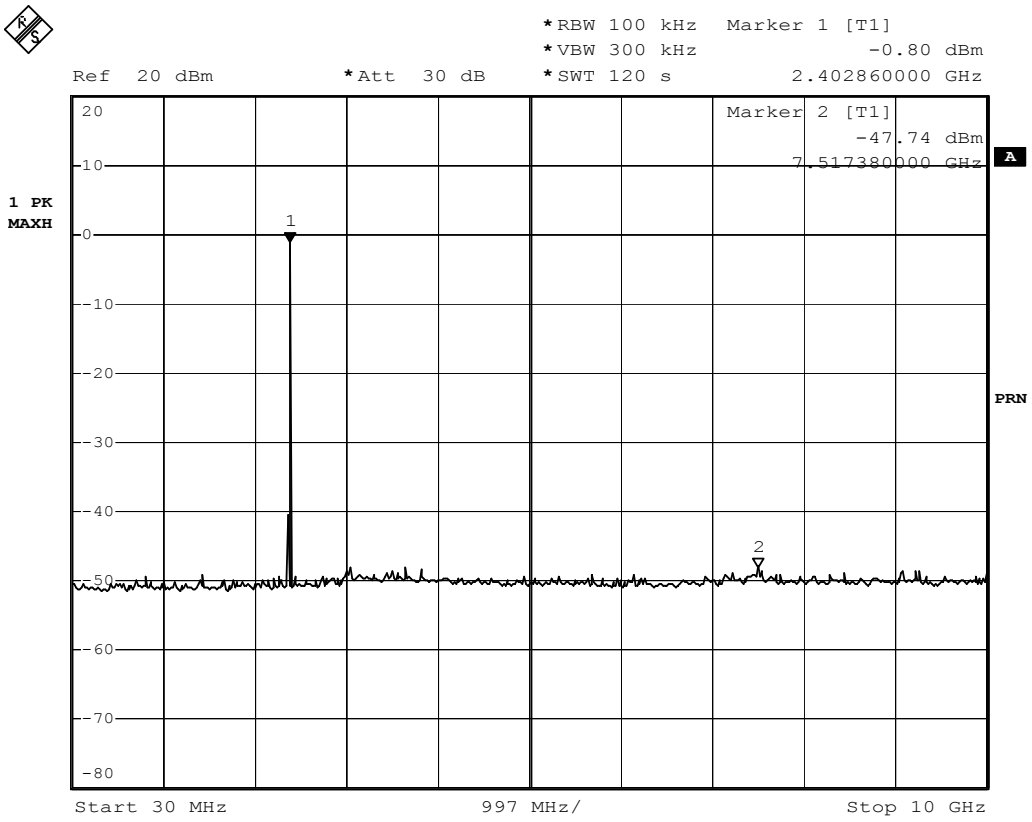
Spurious Frequency (MHz)	Power level (dBm)	Reference value (dBm)	Delta to reference level (dB)	Results
No peak found	-	-	-	Pass

Tx frequency : 2441MHz

Spurious Frequency (MHz)	Power level (dBm)	Reference value (dBm)	Delta to reference level (dB)	Results
No peak found	-	-	-	Pass

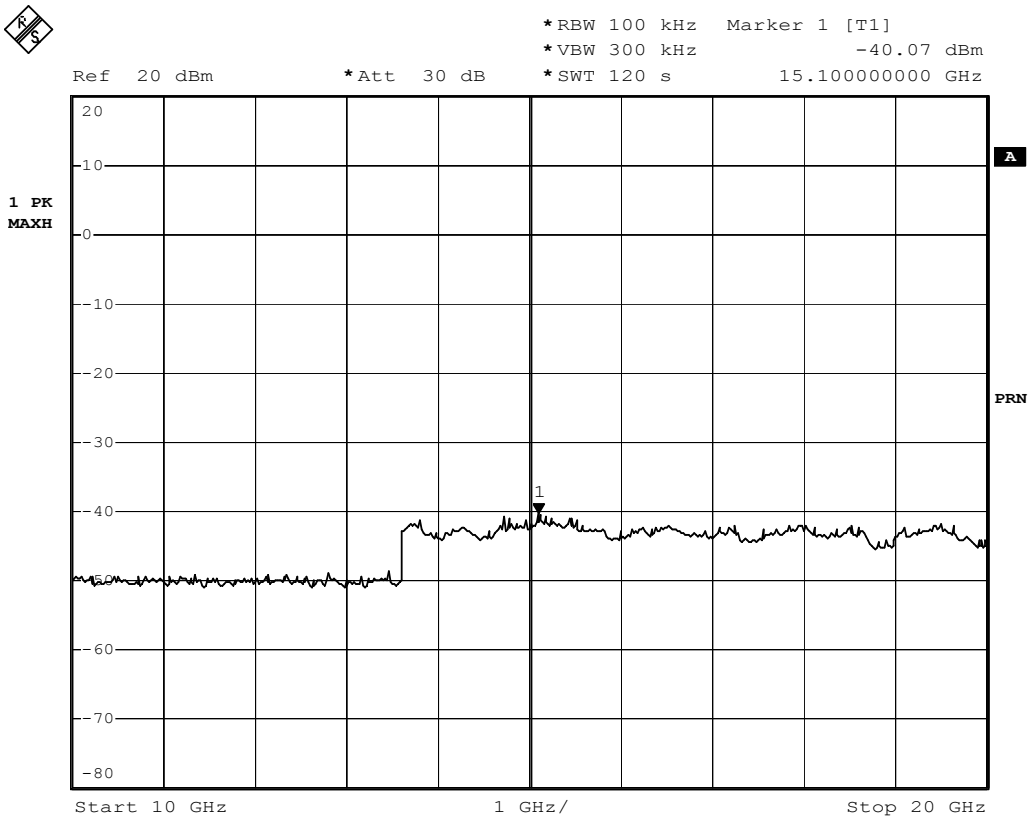
Tx frequency : 2480MHz

Spurious Frequency (MHz)	Power level (dBm)	Reference value (dBm)	Delta to reference level (dB)	Results
No peak found	-	-	-	Pass



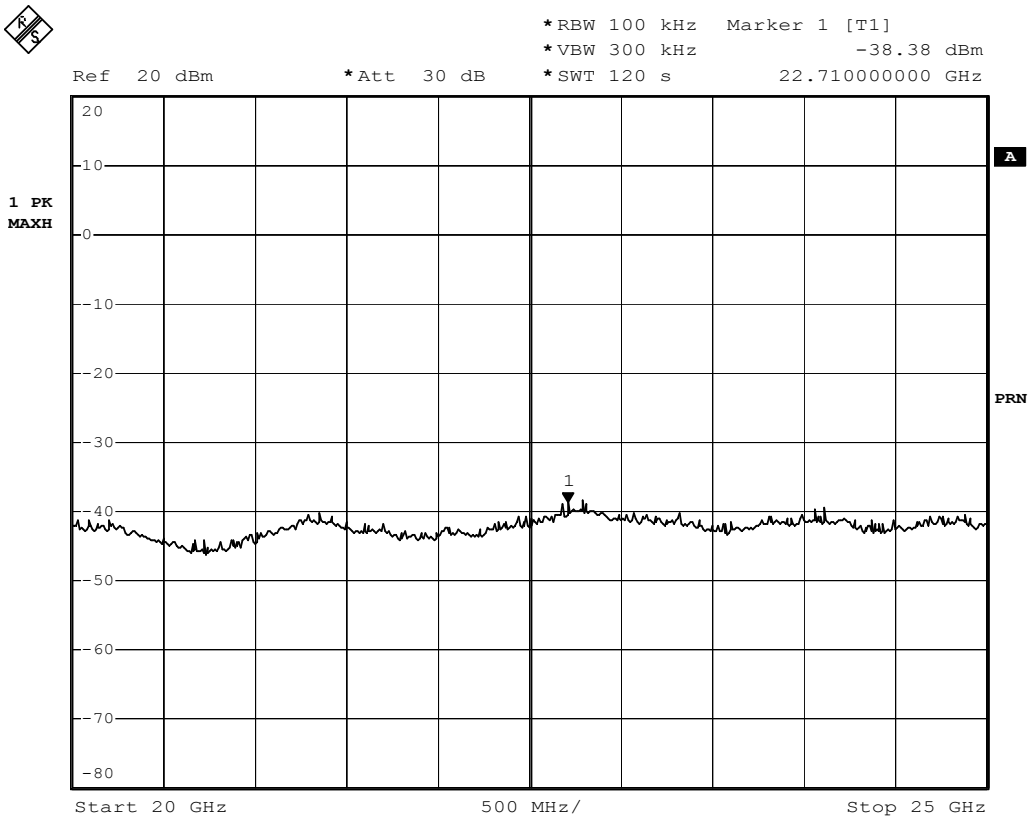
Date: 27.NOV.2003 17:22:15

Tx frequency: 2402MHz



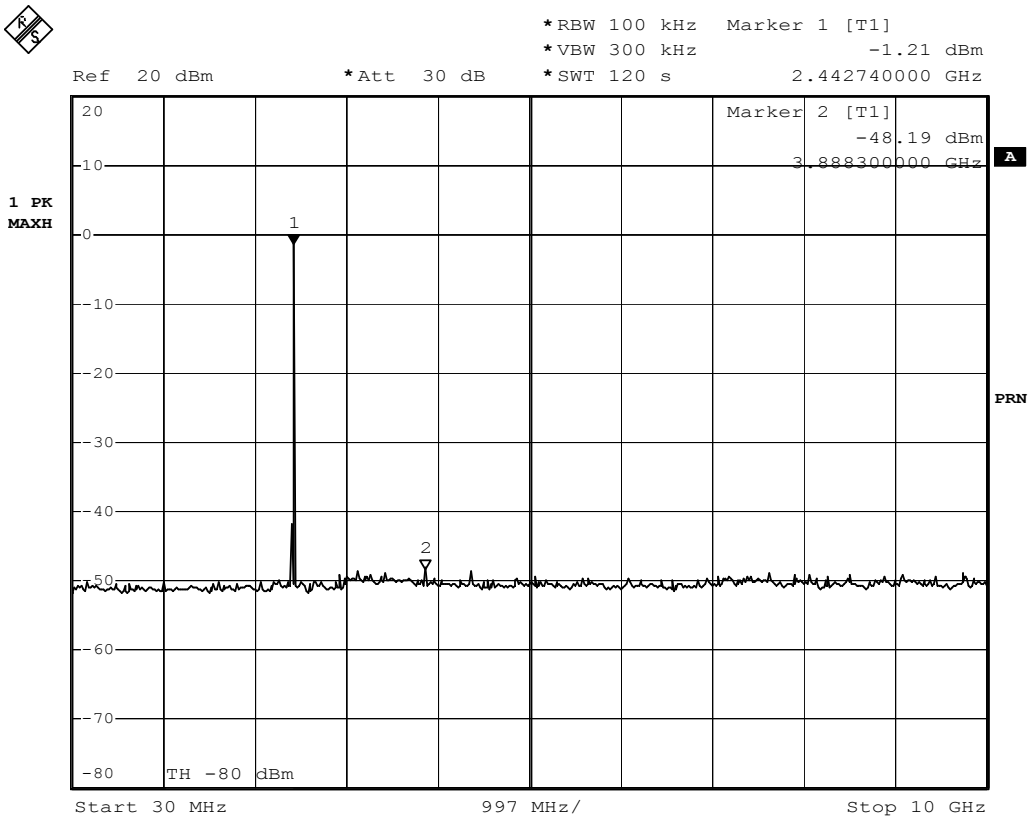
Date: 27.NOV.2003 17:28:16

Tx frequency: 2402MHz



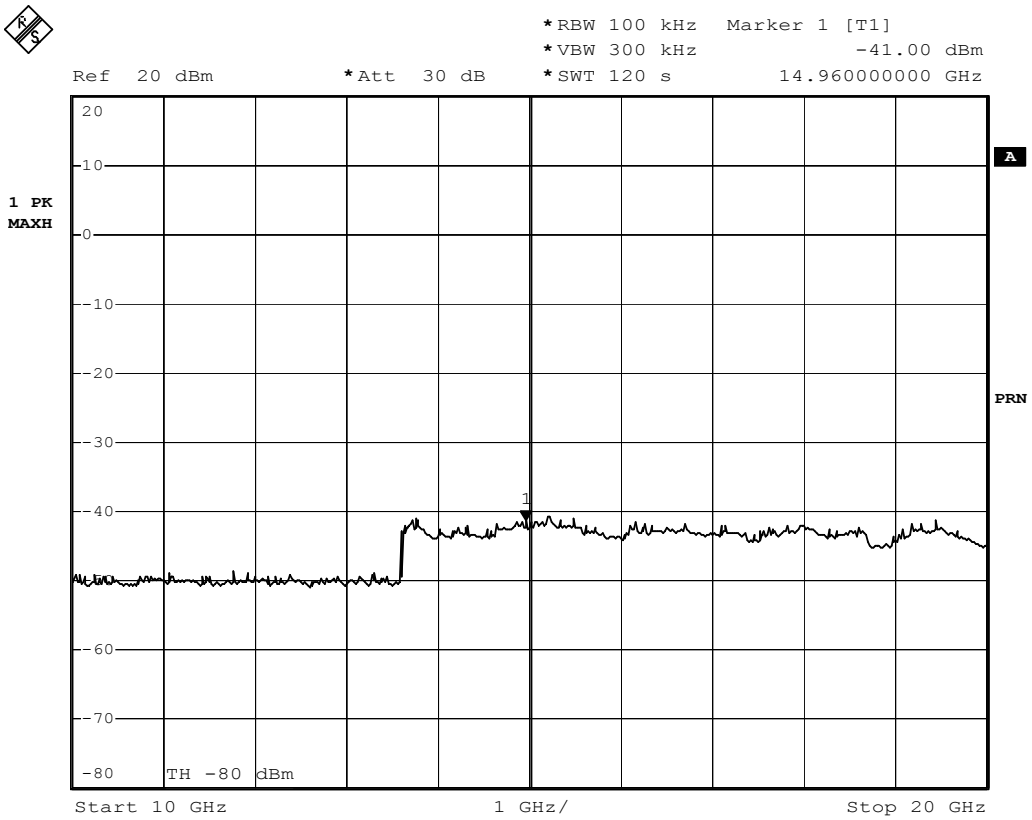
Date: 27.NOV.2003 17:31:03

Tx frequency: 2402MHz



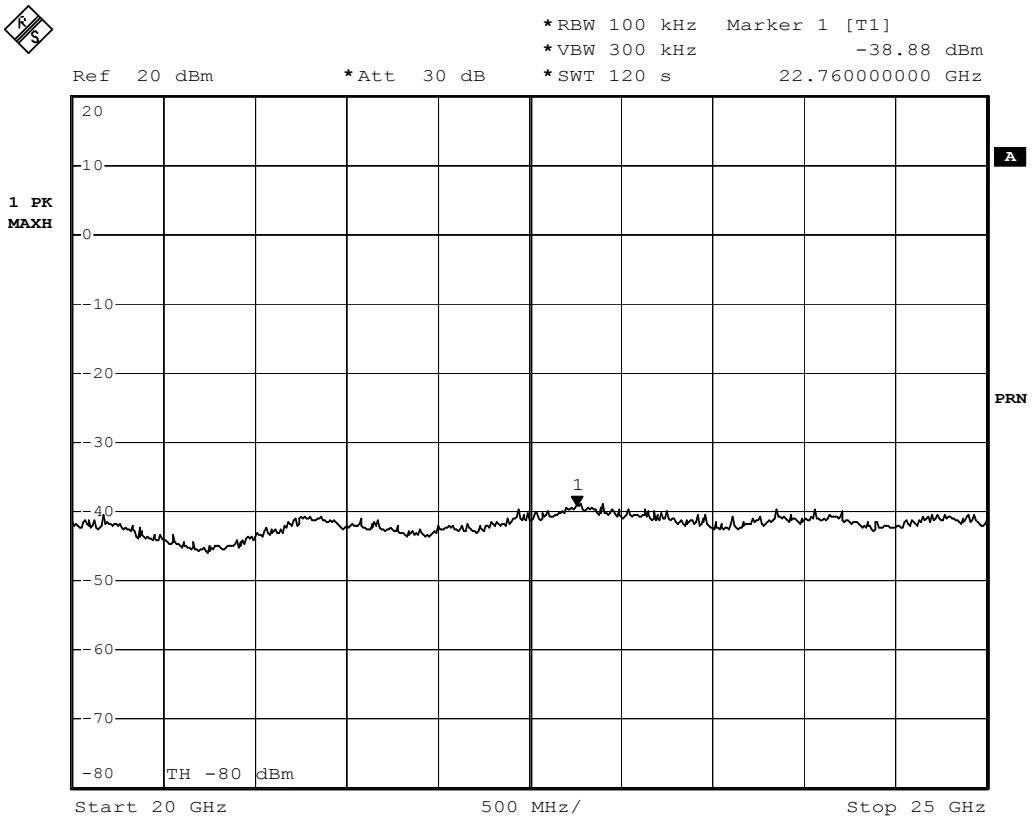
Date: 27.NOV.2003 17:49:24

Tx frequency: 2441MHz



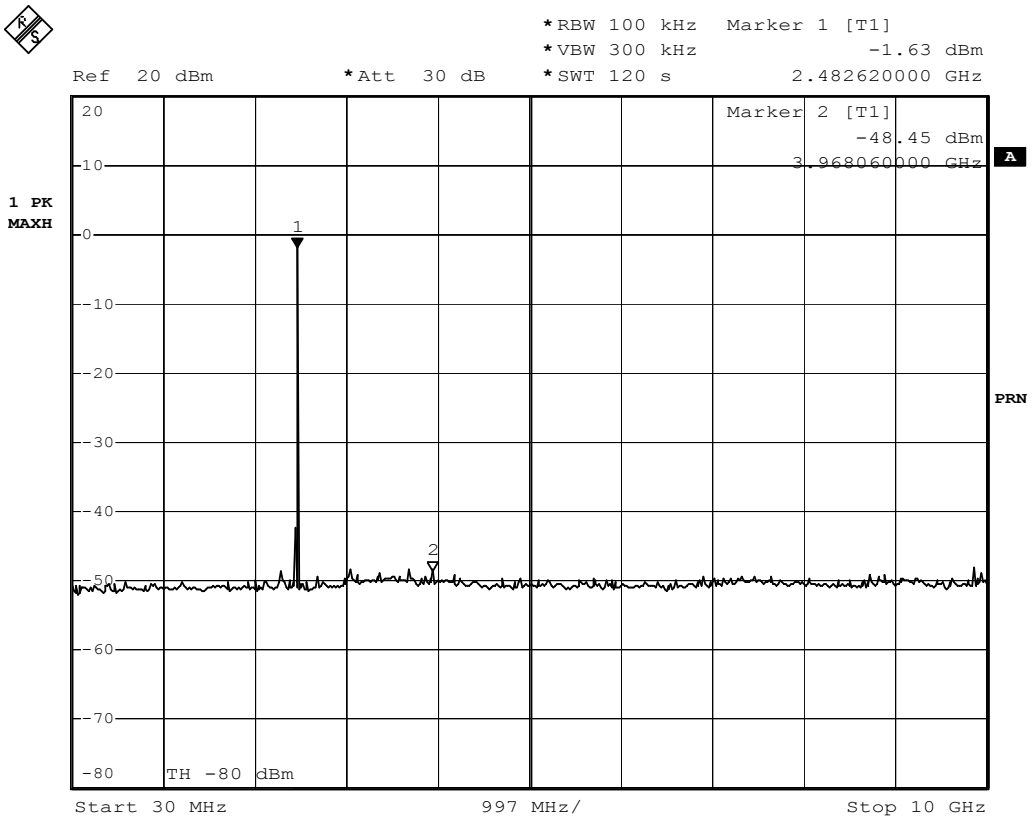
Date: 27.NOV.2003 17:44:42

Tx frequency: 2441MHz



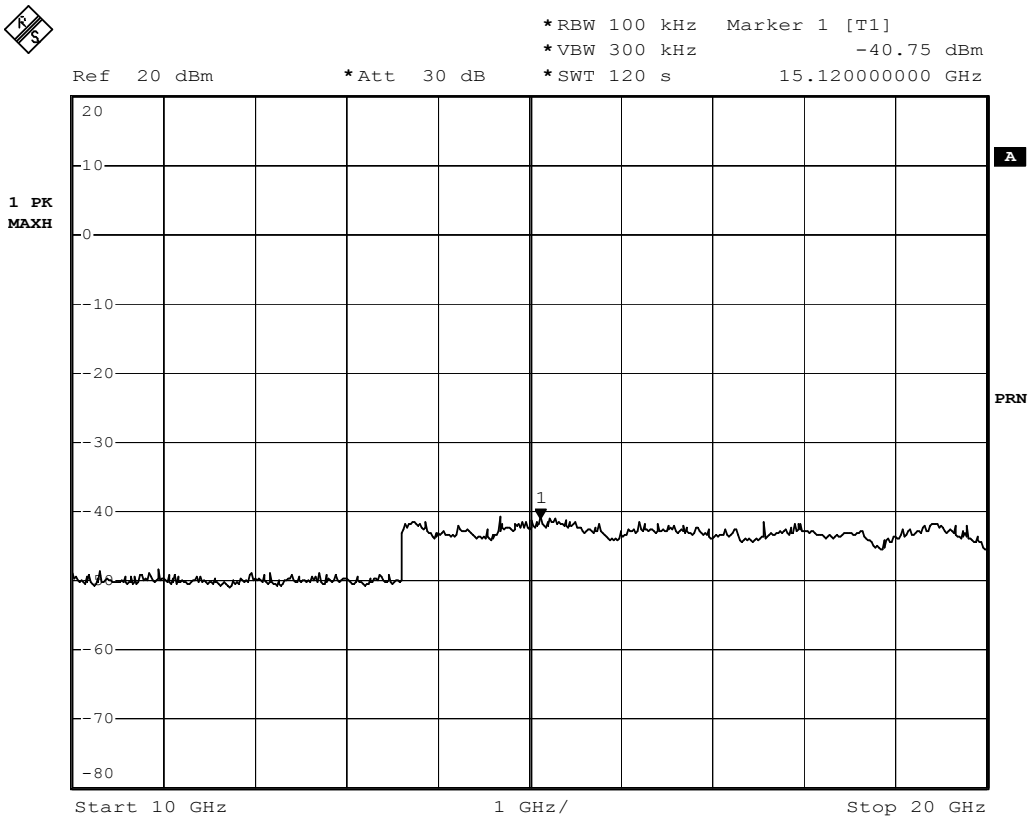
Date: 27.NOV.2003 17:38:42

Tx frequency: 2441MHz



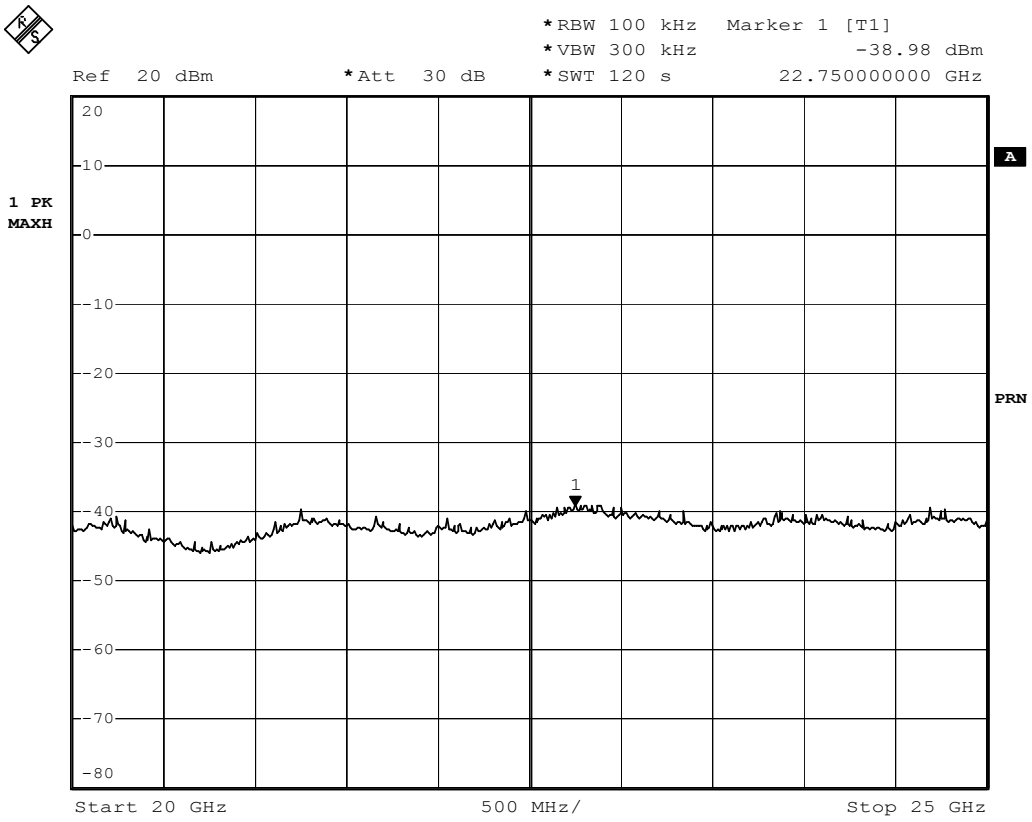
Date: 27.NOV.2003 17:55:39

Tx frequency: 2480MHz



Date: 27.NOV.2003 18:03:16

Tx frequency: 2480MHz



Date: 27.NOV.2003 18:08:52

Tx frequency: 2480MHz

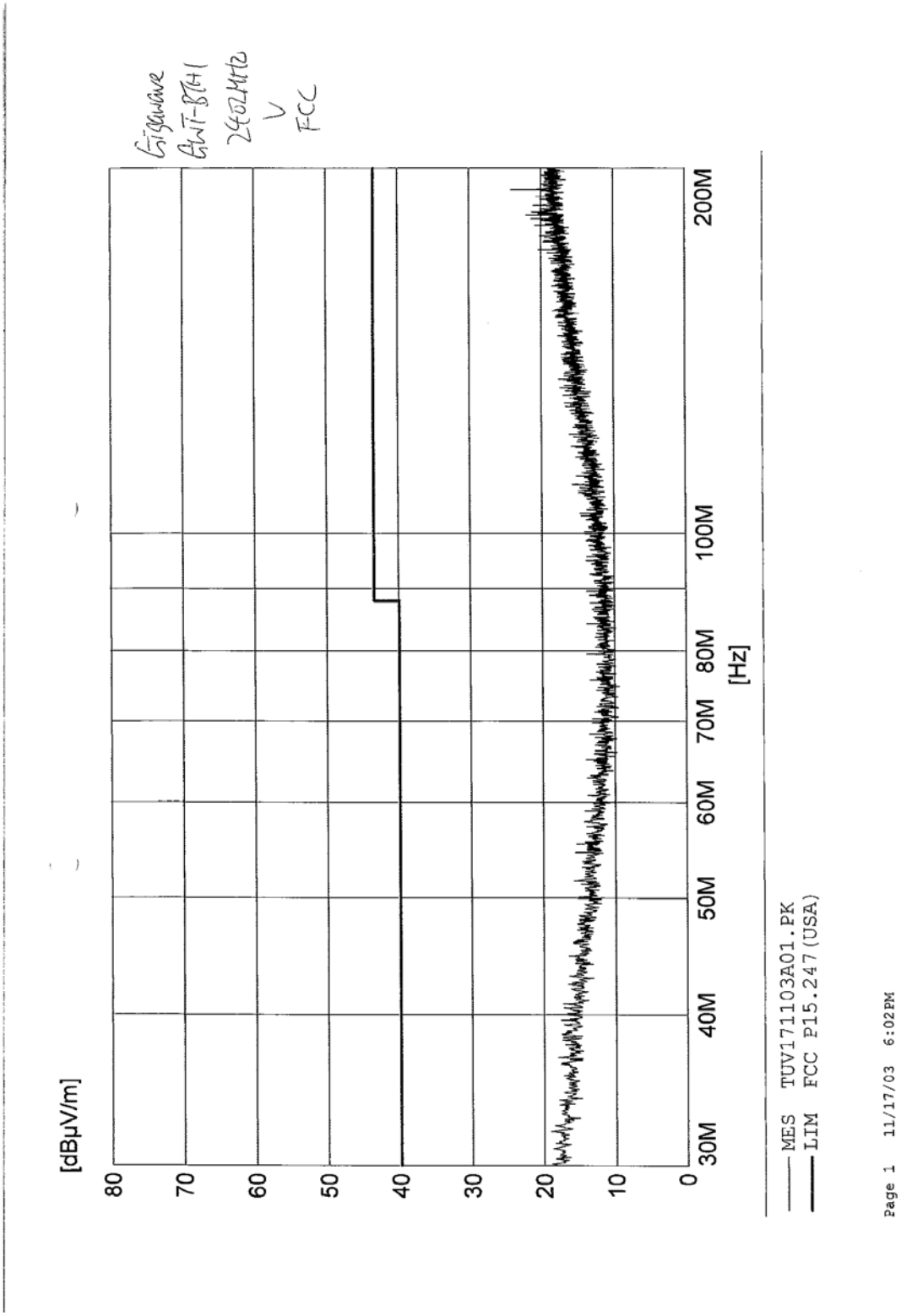
Spurious Emissions - Radiated

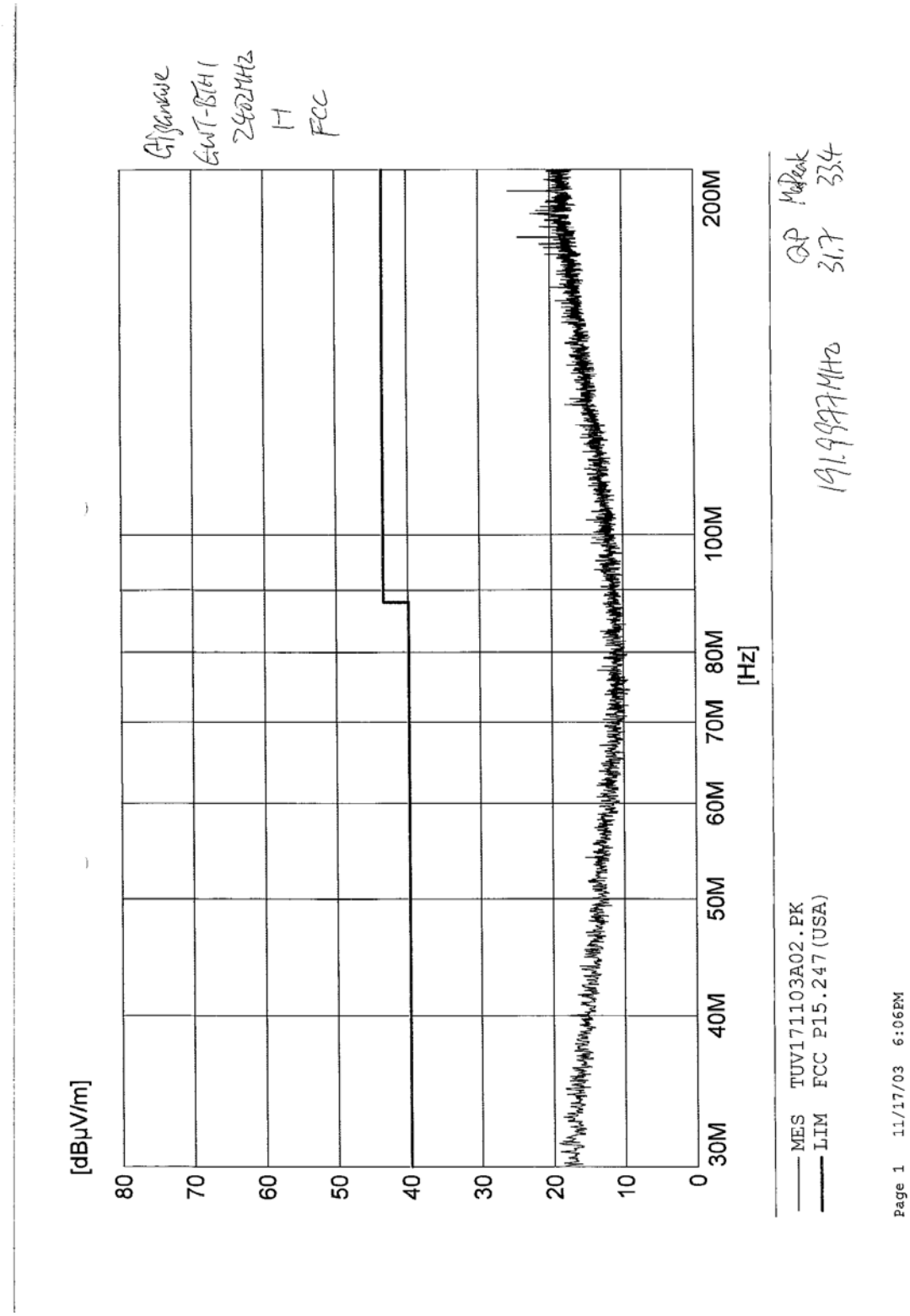
Date: 17 Nov 2003
EUT: GWT-BTH1
Company: Gigawavetech Pte Ltd.
Voltage supply: 3.7V Lithium battery
Test by: Hugo Wan
Op. mode: TX mode, DH1 with PRBS9 payload

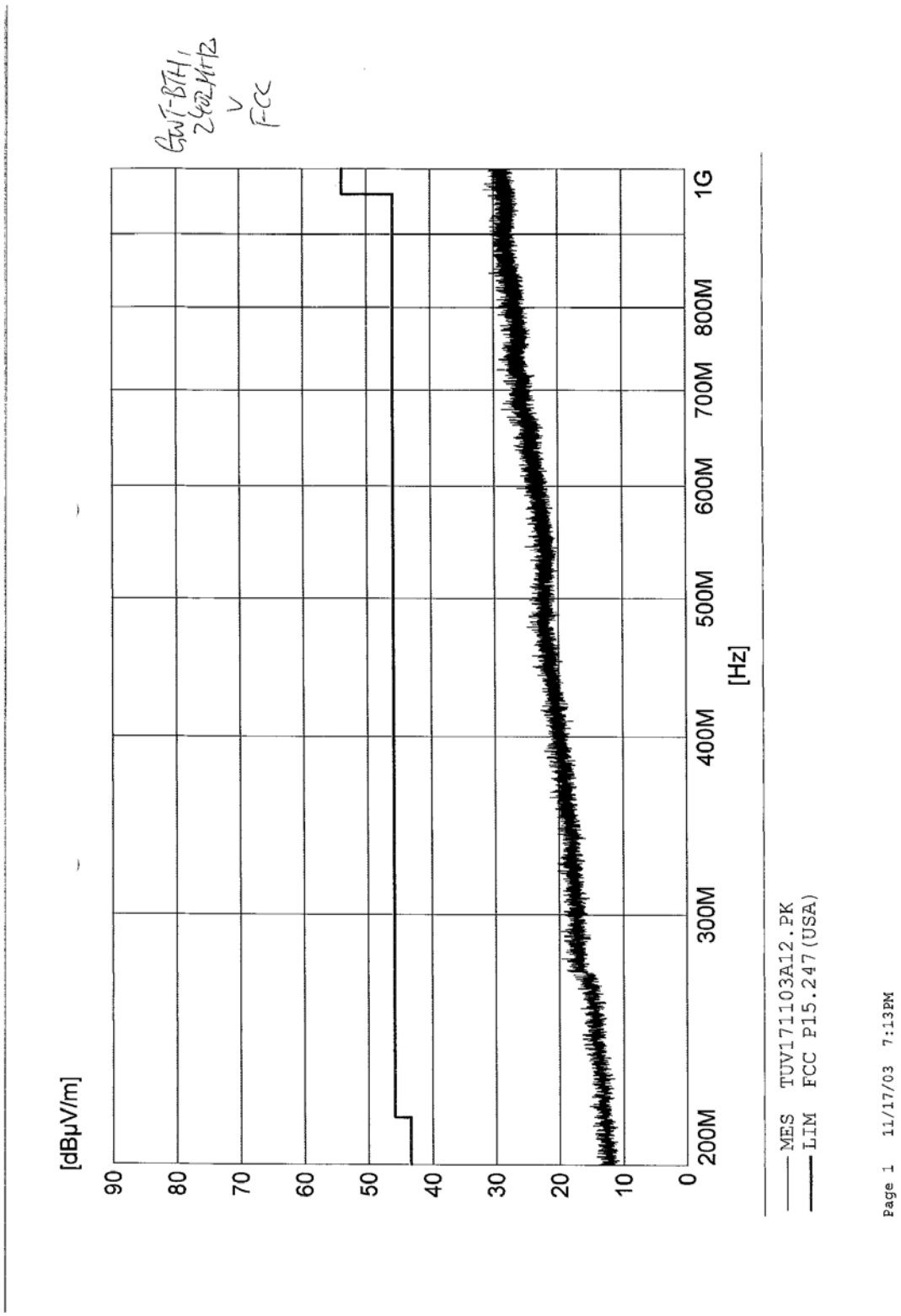
Tx frequency (MHz)	Polarization	Spurious Frequency (MHz)	Power Level (dBuV/m)	Detector (P/QP/A)
2402	H	1200.500	38.47	P

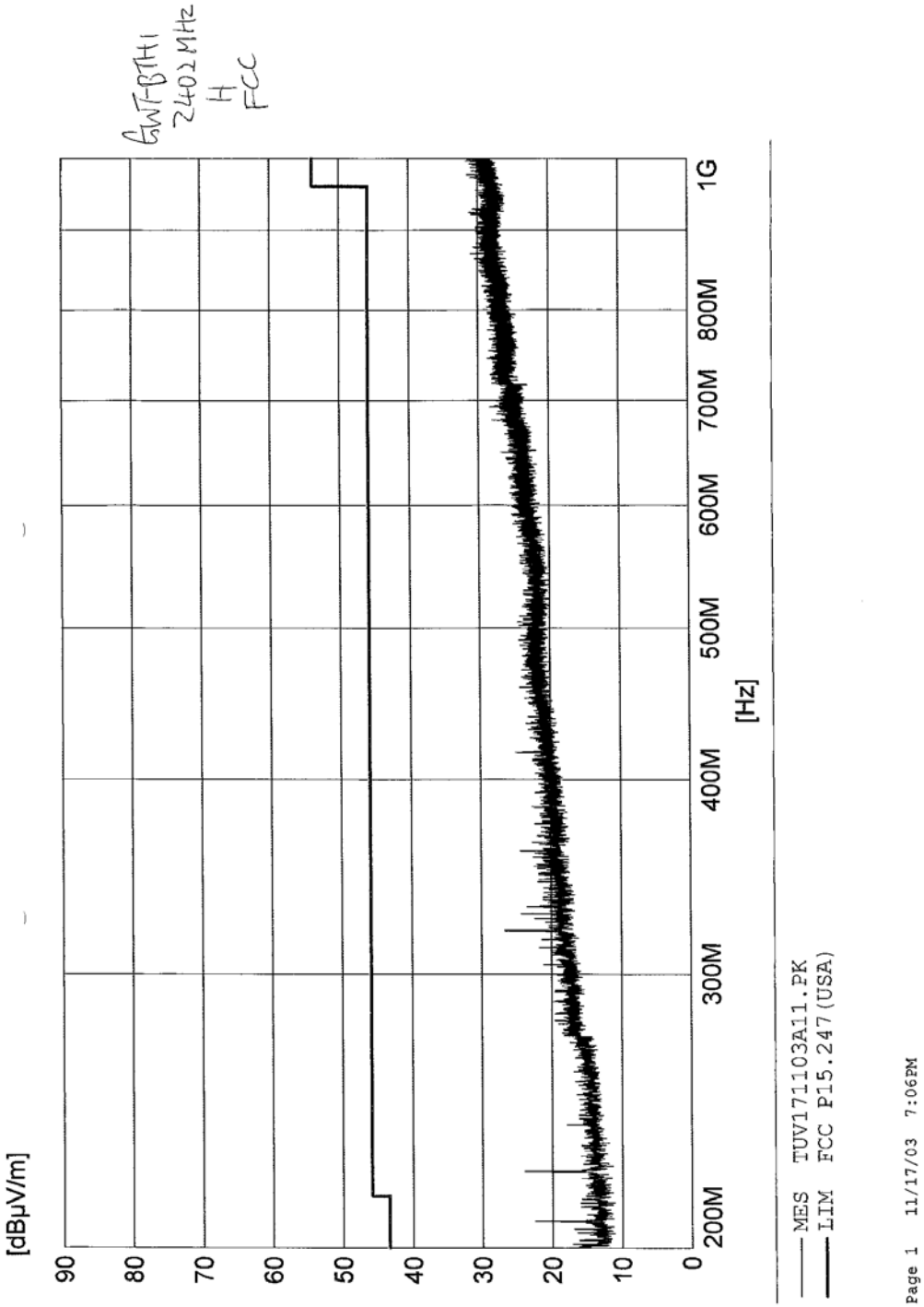
Tx frequency (MHz)	Polarization	Spurious Frequency (MHz)	Power Level (dBuV/m)	Detector (P/QP/A)
2441	V	1220.000	35.76	P
2441	H	1219.980	29.29	P

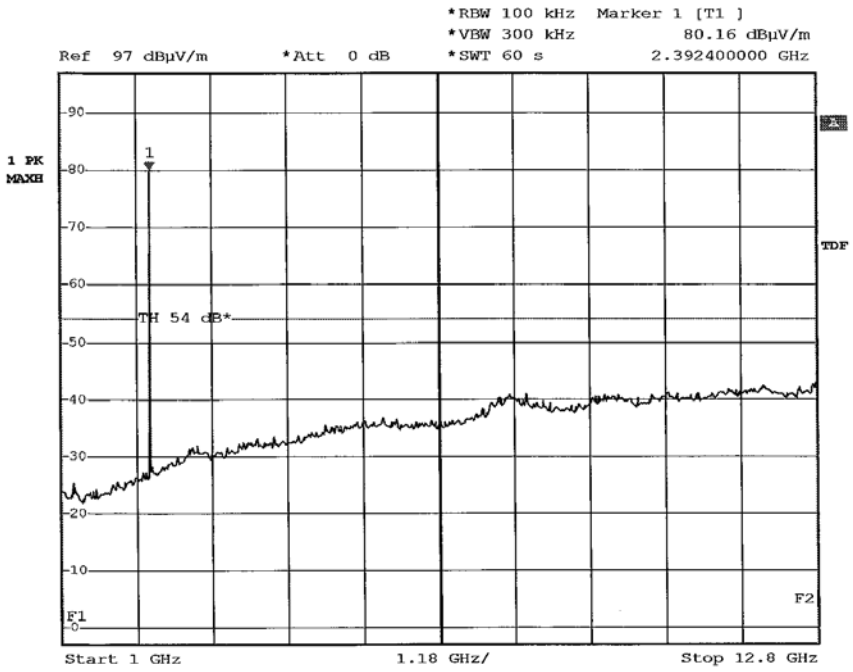
Tx frequency (MHz)	Polarization	Spurious Frequency (MHz)	Power Level (dBuV/m)	Detector (P/QP/A)
2480	V	1239.500	32.35	P
2480	H	1239.500	38.41	P


Gigawave
GWT-8TH1
2402MHz
V
FCC
[dBµV/m]
80
70
60
50
40
30
20
10
0
30M
40M
50M
60M
70M
80M
100M
200M
[Hz]
MES TUV171103A01.PK
LIM FCC P15.247(USA)
Page 1 11/17/03 6:02PM


[dBµV/m]
80
70
60
50
40
30
20
10
0
30M
40M
50M
60M
70M
80M
100M
200M
[Hz]
MES TUV171103A02.PK
LIM FCC P15.247(USA)
Page 1 11/17/03 6:06PM

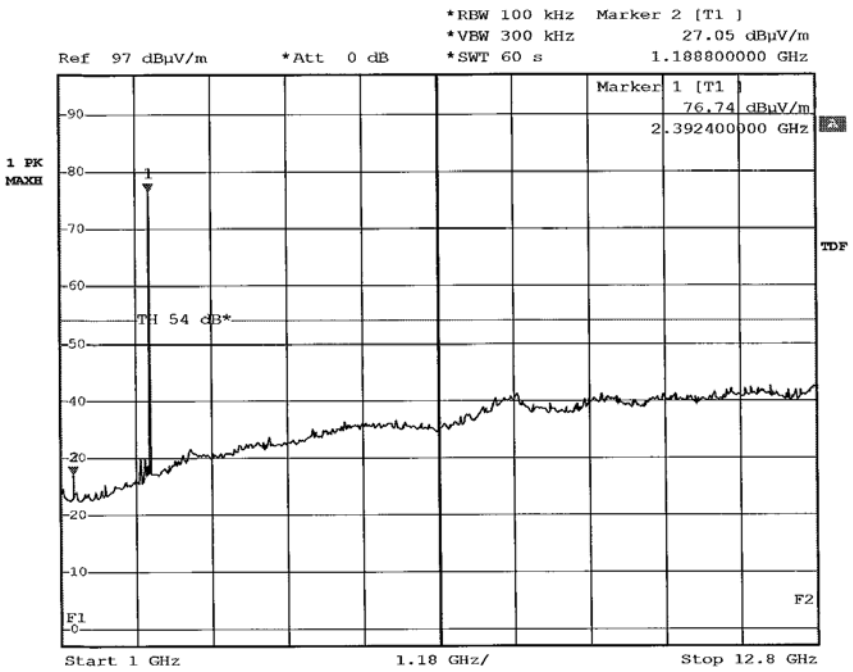

GWT-BTH, 2402MHz
V
FCC
[dBµV/m]
90
80
70
60
50
40
30
20
10
0
200M
300M
400M
500M
600M
700M
800M
1G
[Hz]
MES TUV171103A12.PK
LIM FCC P15.247(USA)
Page 1 11/17/03 7:13PM


GWT-BTH1
2402 MHz
H
FCC
[dBµV/m]
90
80
70
60
50
40
30
20
10
0
200M
300M
400M
500M
600M
700M
800M
1G
[Hz]
MES TUV171103A11.PK
LIM FCC P15.247(USA)
Page 1 11/17/03 7:06PM



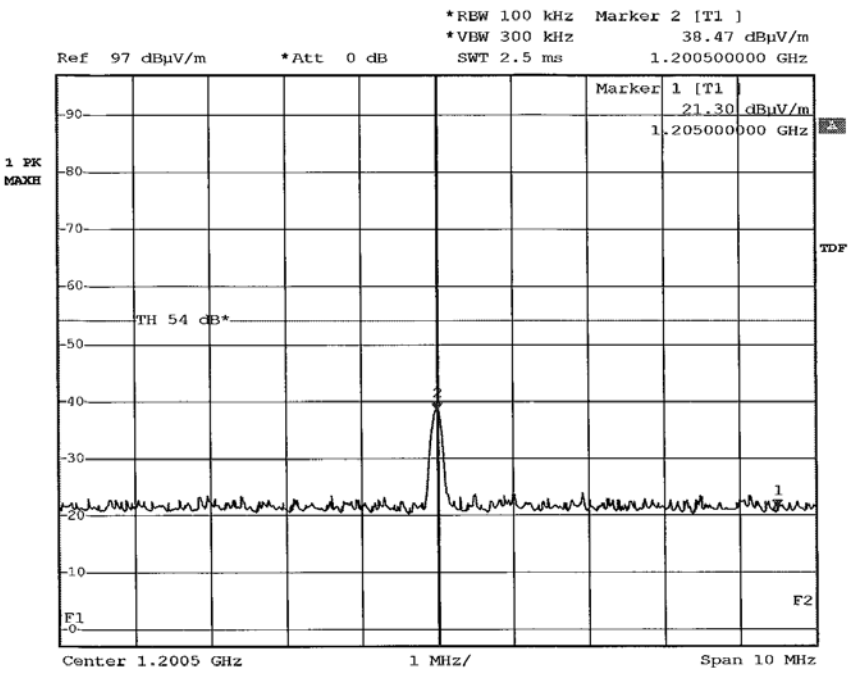
Date: 20.NOV.2003 11:47:29

GWT-BTH1
2402MHz
V
FCC



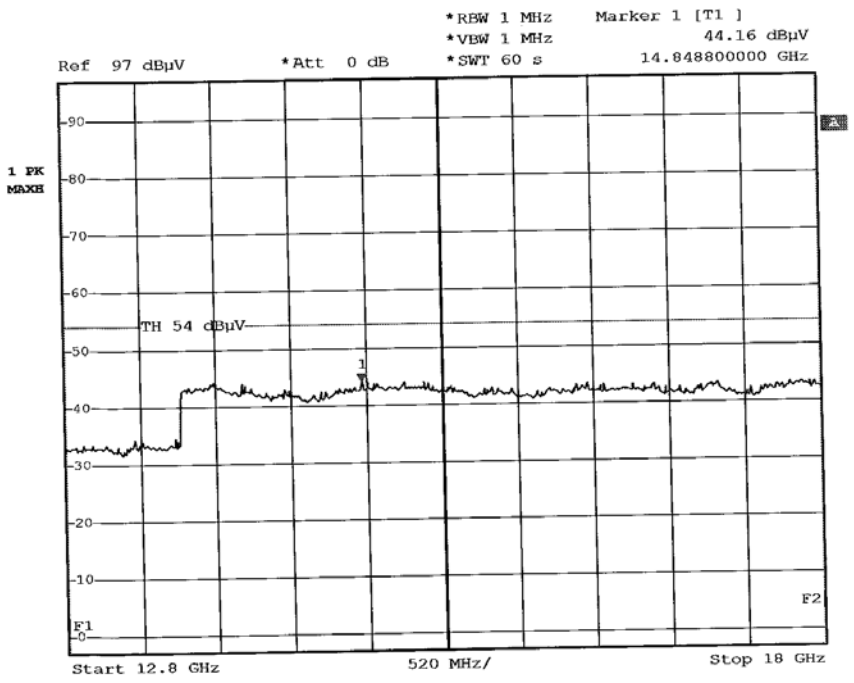
Date: 20.NOV.2003 11:39:16

GWT-BTH1
2402MHz
H
FCC



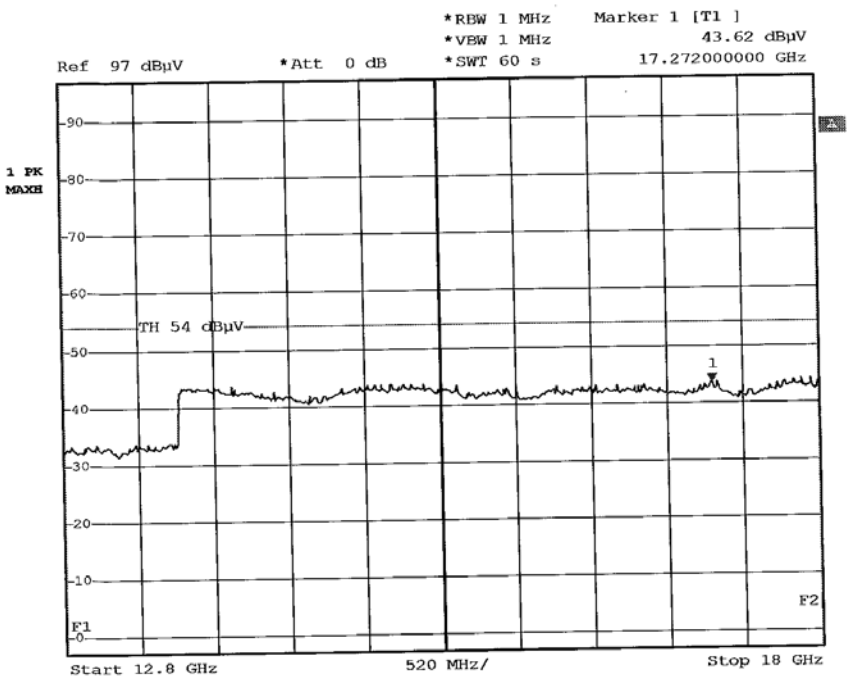
Date: 20.NOV.2003 11:44:07

GWT-B/H1
2402MHz
H
FCC



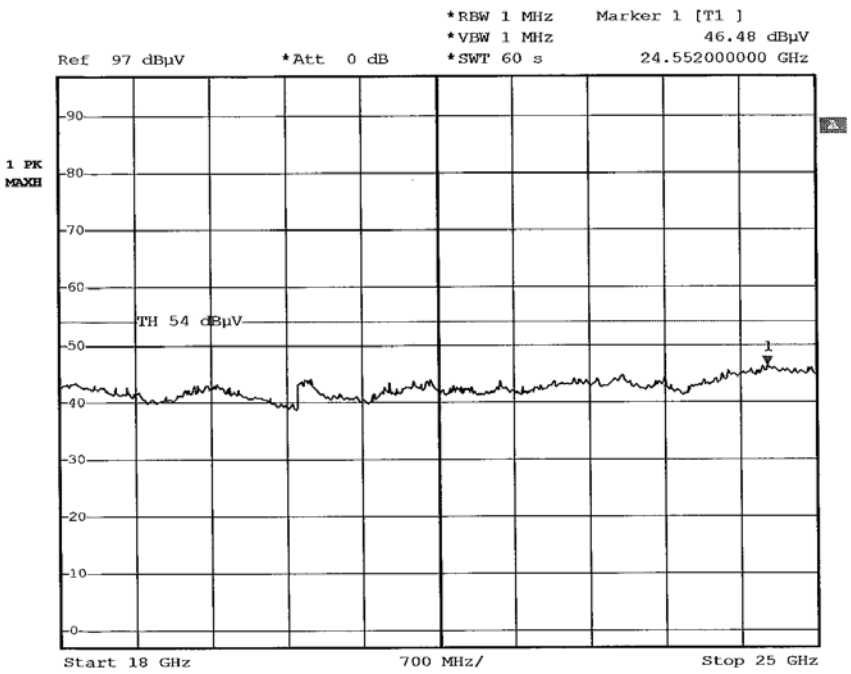
Date: 27.NOV.2003 12:33:13

GWT-BTH1
2402 MHz
V
FCC



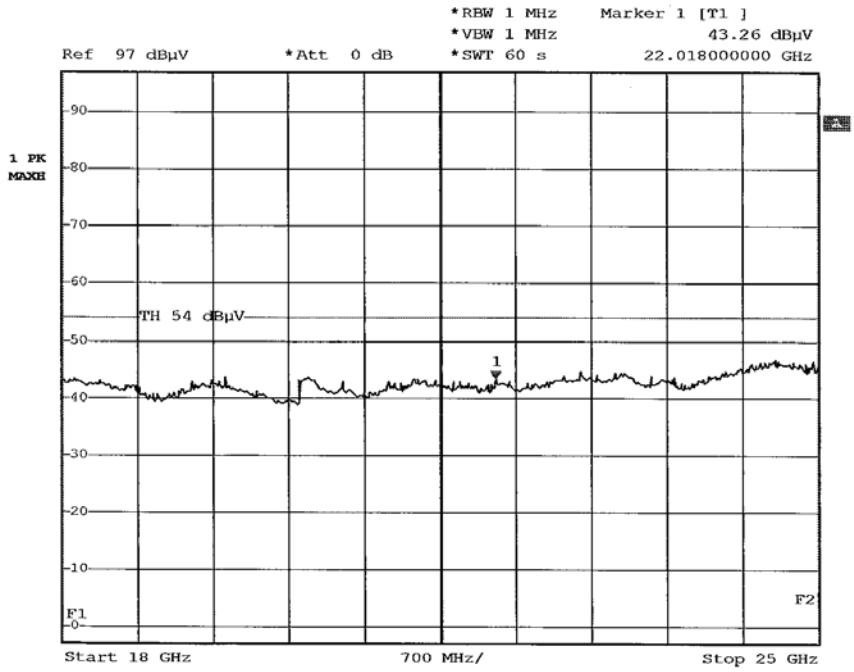
Date: 27.NOV.2003 12:36:58

GWT-BTH1
2402MHz
H
Fcc



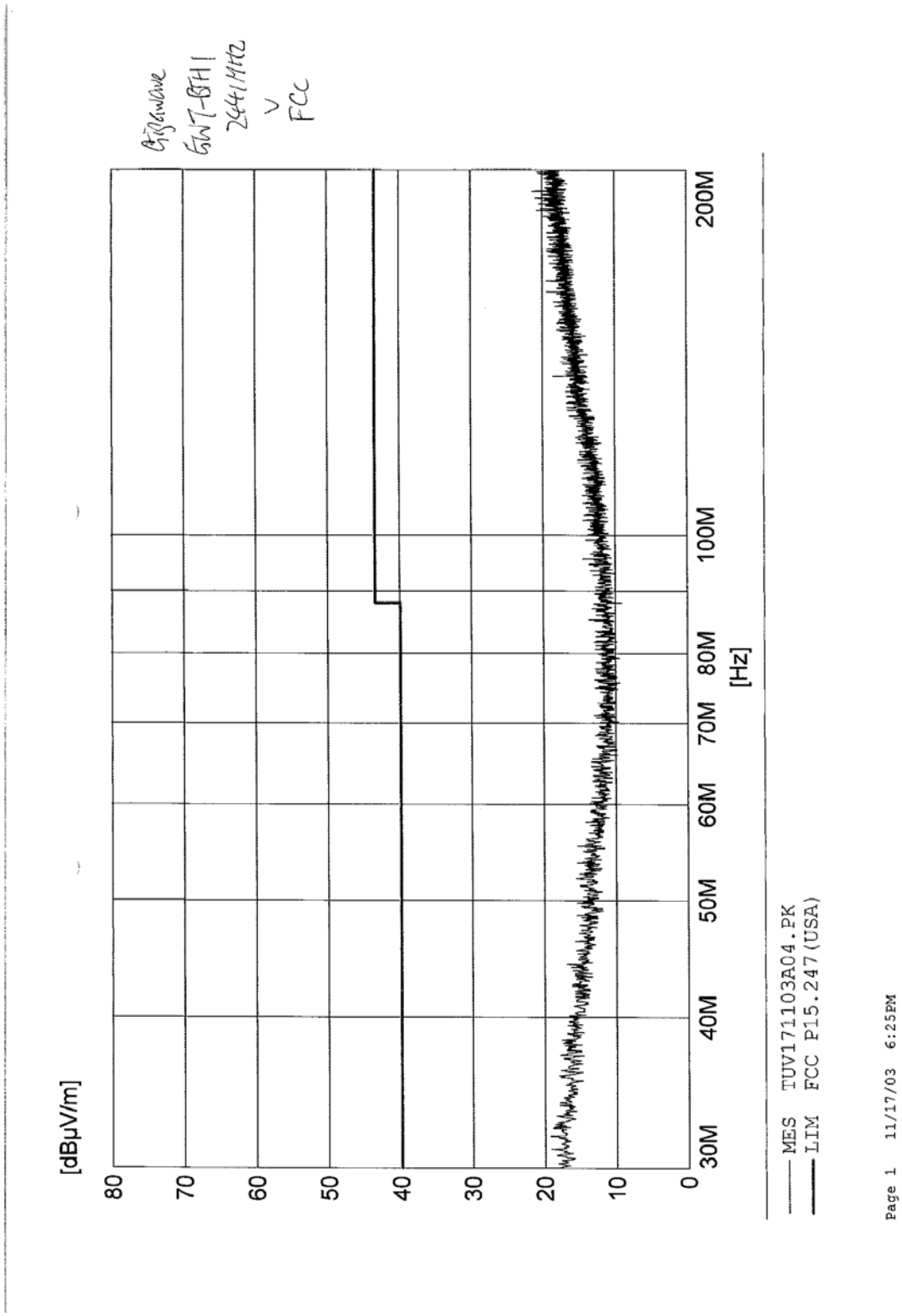
Date: 27.NOV.2003 13:12:19

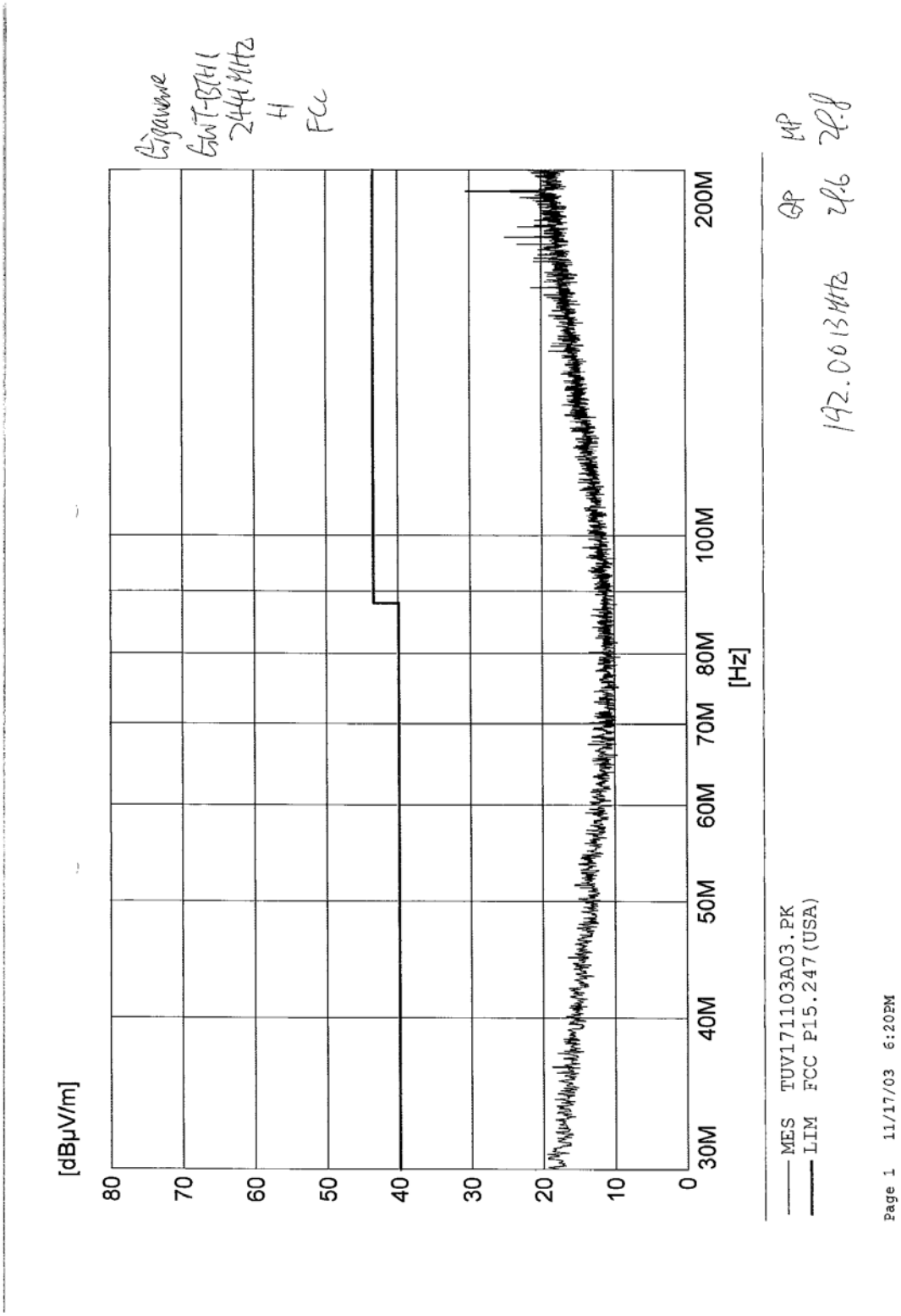
GWT-B(H)
2402MHz
V
FCC

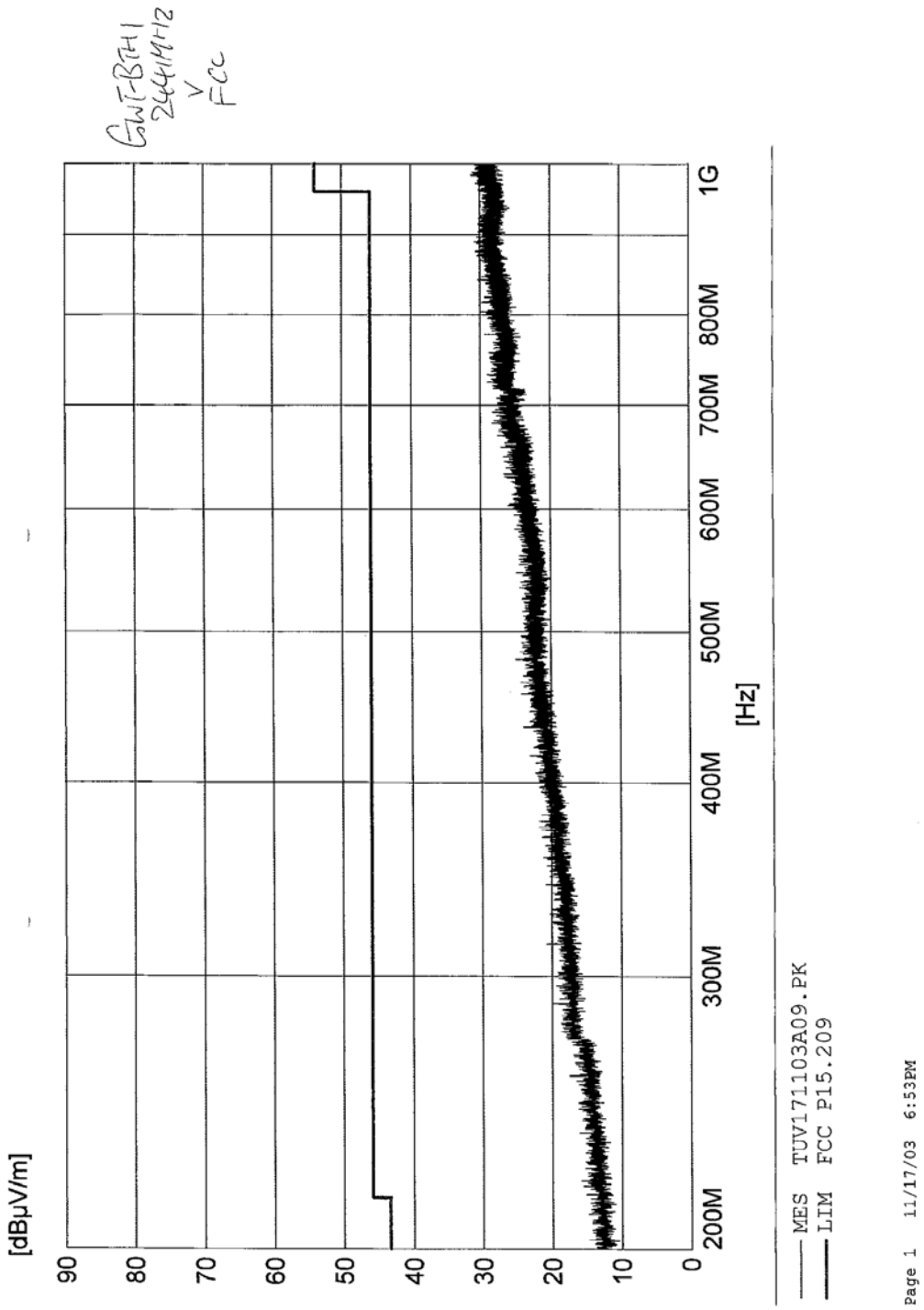


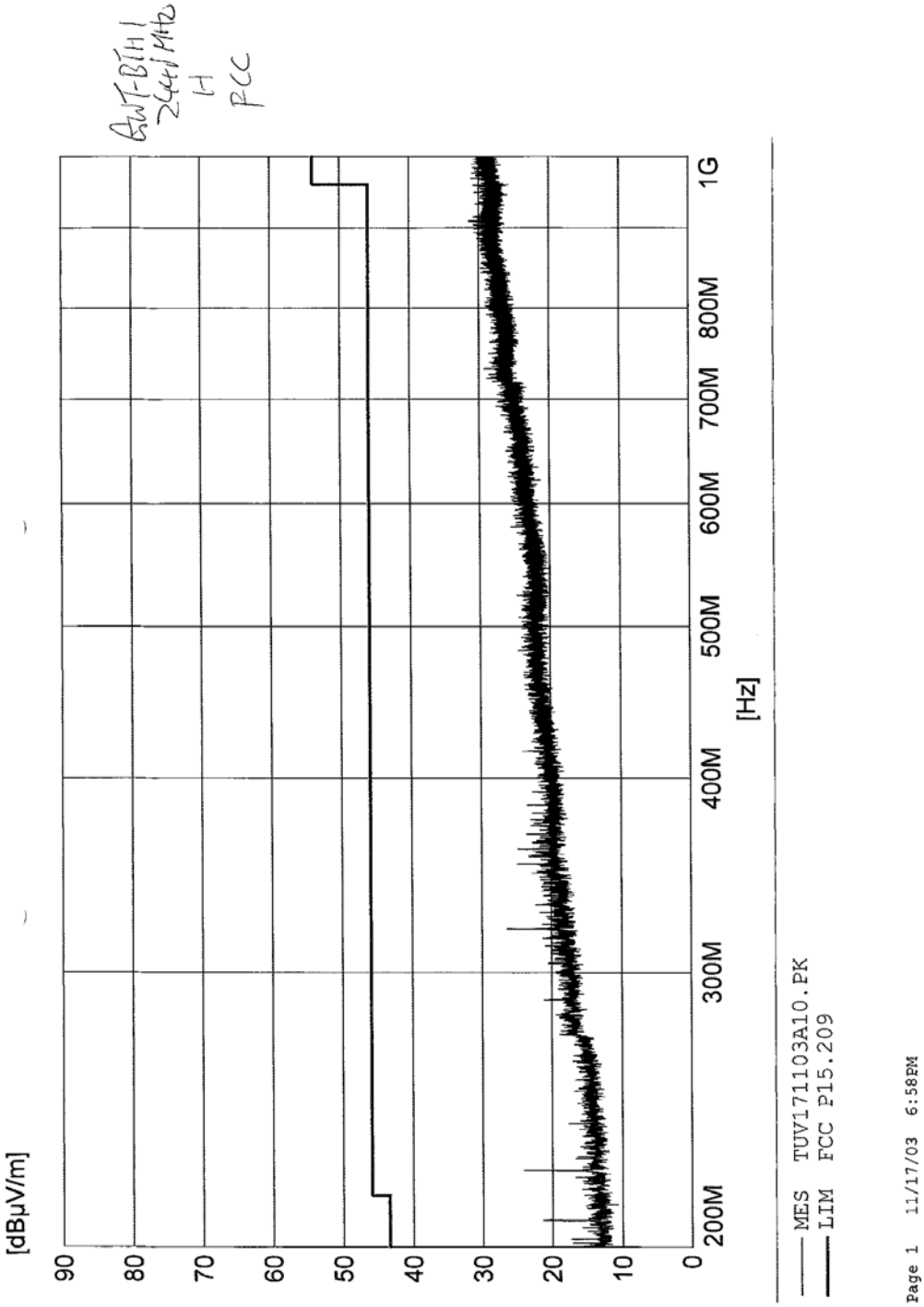
Date: 27.NOV.2003 13:06:23

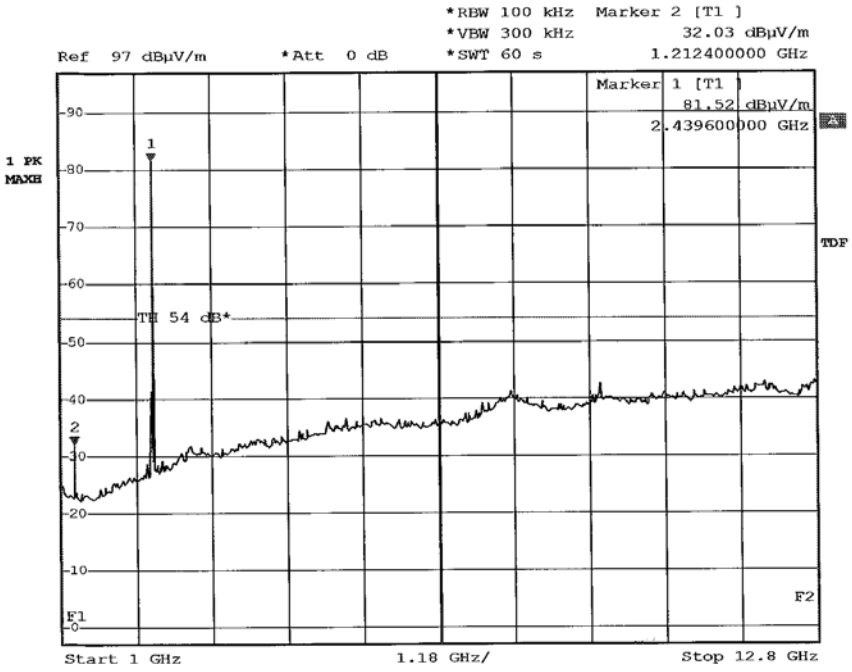
GWT-BTH1
2402MHz
H
FCC


Gigawave
GWT-BH1
2441MHz
V
FCC
[dBµV/m]
80
70
60
50
40
30
20
10
0
30M
40M
50M
60M
70M
80M
100M
200M
[Hz]
MES TUV171103A04.PK
LIM FCC P15.247(USA)
Page 1 11/17/03 6:25PM


[dBµV/m]
80
70
60
50
40
30
20
10
0
30M
40M
50M
60M
70M
80M
100M
200M
[Hz]
MES TUV171103A03.PK
LIM FCC P15.247(USA)
Page 1 11/17/03 6:20PM

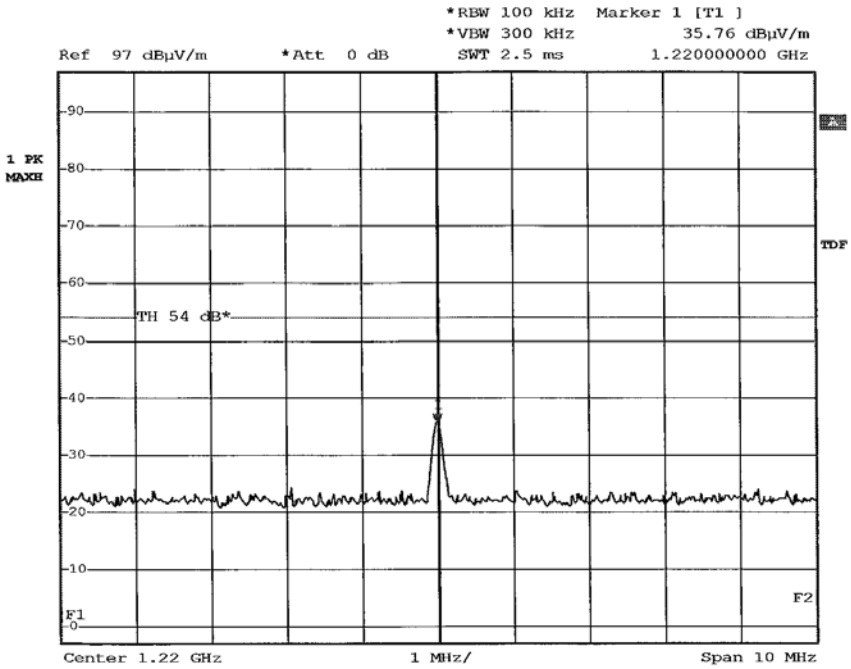

GWT-BTH
244MHz
V
FCC
[dBµV/m]
90
80
70
60
50
40
30
20
10
0
200M
300M
400M
500M
600M
700M
800M
1G
[Hz]
MES TUV171103A09.PK
LIM FCC P15.209
Page 1 11/17/03 6:53PM


AWT-BTH1
2441 MHz
H
FCC
[dBµV/m]
90
80
70
60
50
40
30
20
10
0
200M
300M
400M
500M
600M
700M
800M
1G
[Hz]
MES TUV171103A10.PK
LIM FCC P15.209
Page 1 11/17/03 6:58PM



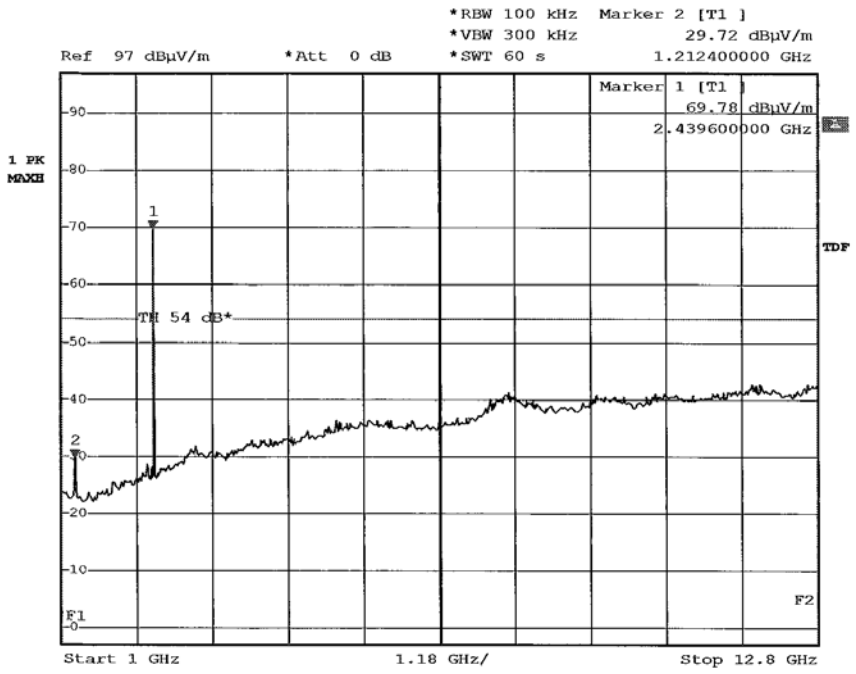
Date: 20.NOV.2003 11:56:44

GWT-BTH1
2441 MHz
v
FCC



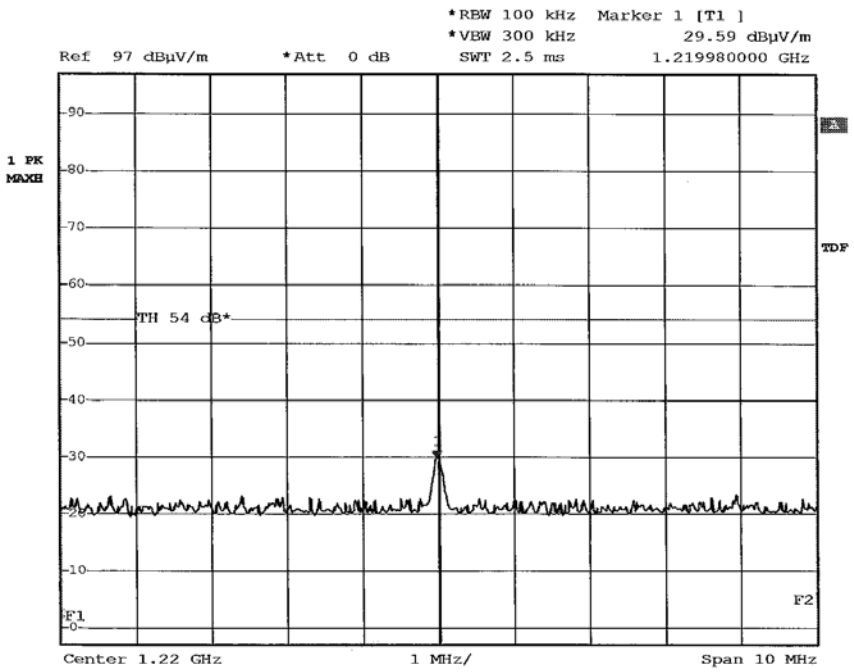
Date: 20.NOV.2003 11:58:49

GWT-BTH
2544 MHz
V
FCC



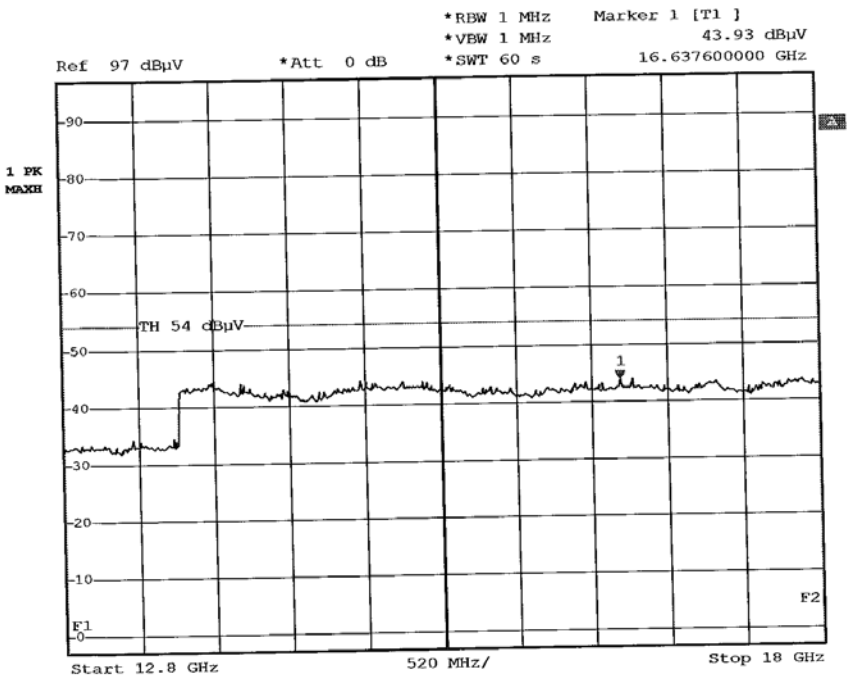
Date: 20.NOV.2003 12:01:45

GWT-BTH1
2441 MHz
H
FCC



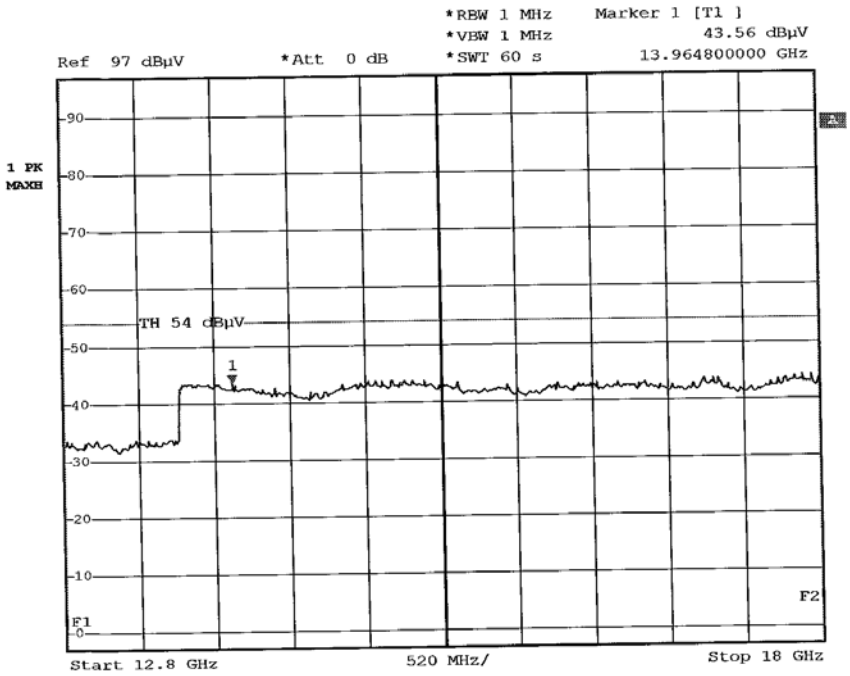
Date: 20.NOV.2003 11:59:13

GWT-BTH1
2441MHz
H
FCC



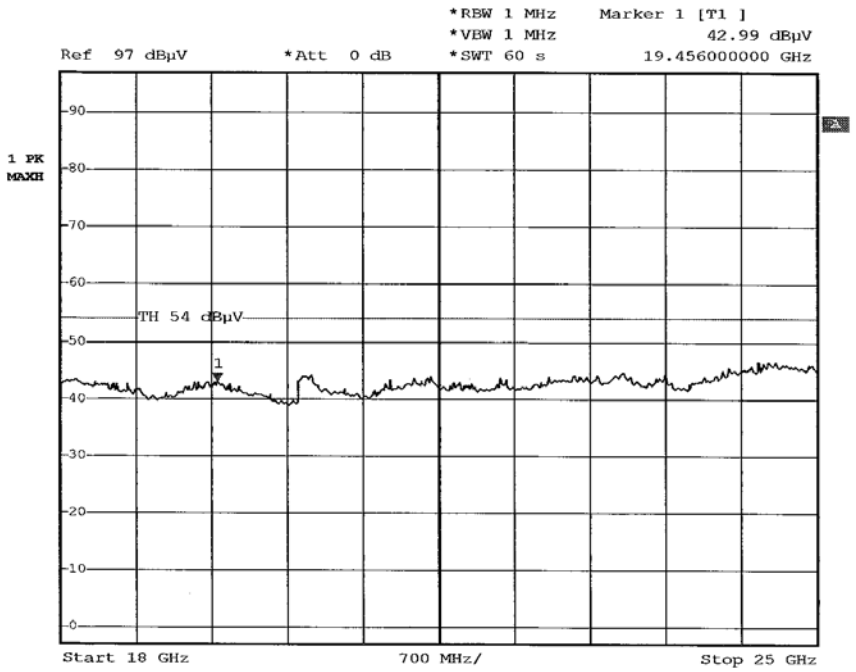
Date: 27.NOV.2003 12:33:38

GWT-BTH1
2441MHz
V
FCC



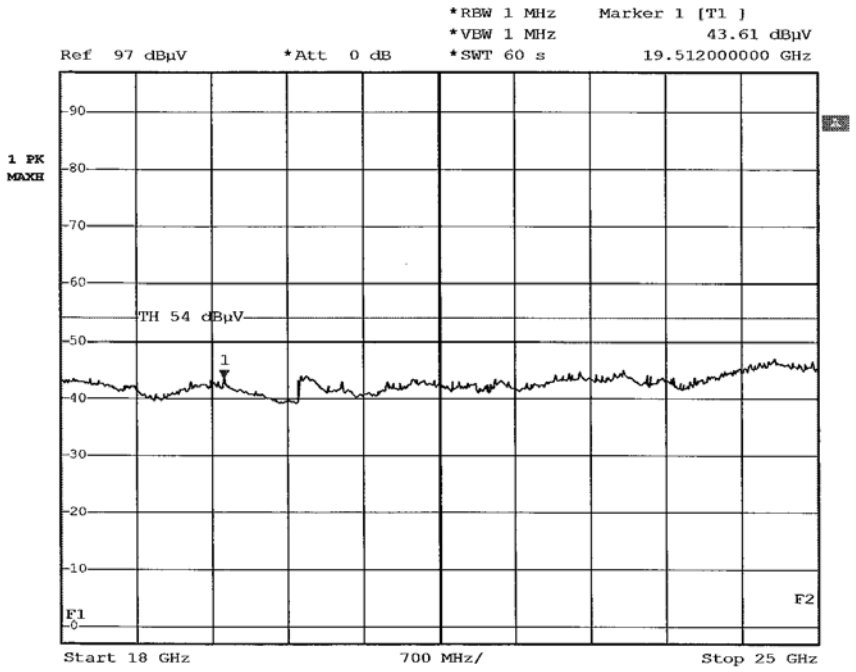
Date: 27.NOV.2003 12:37:30

EWT-BTH1
2441MHz
H
FCC



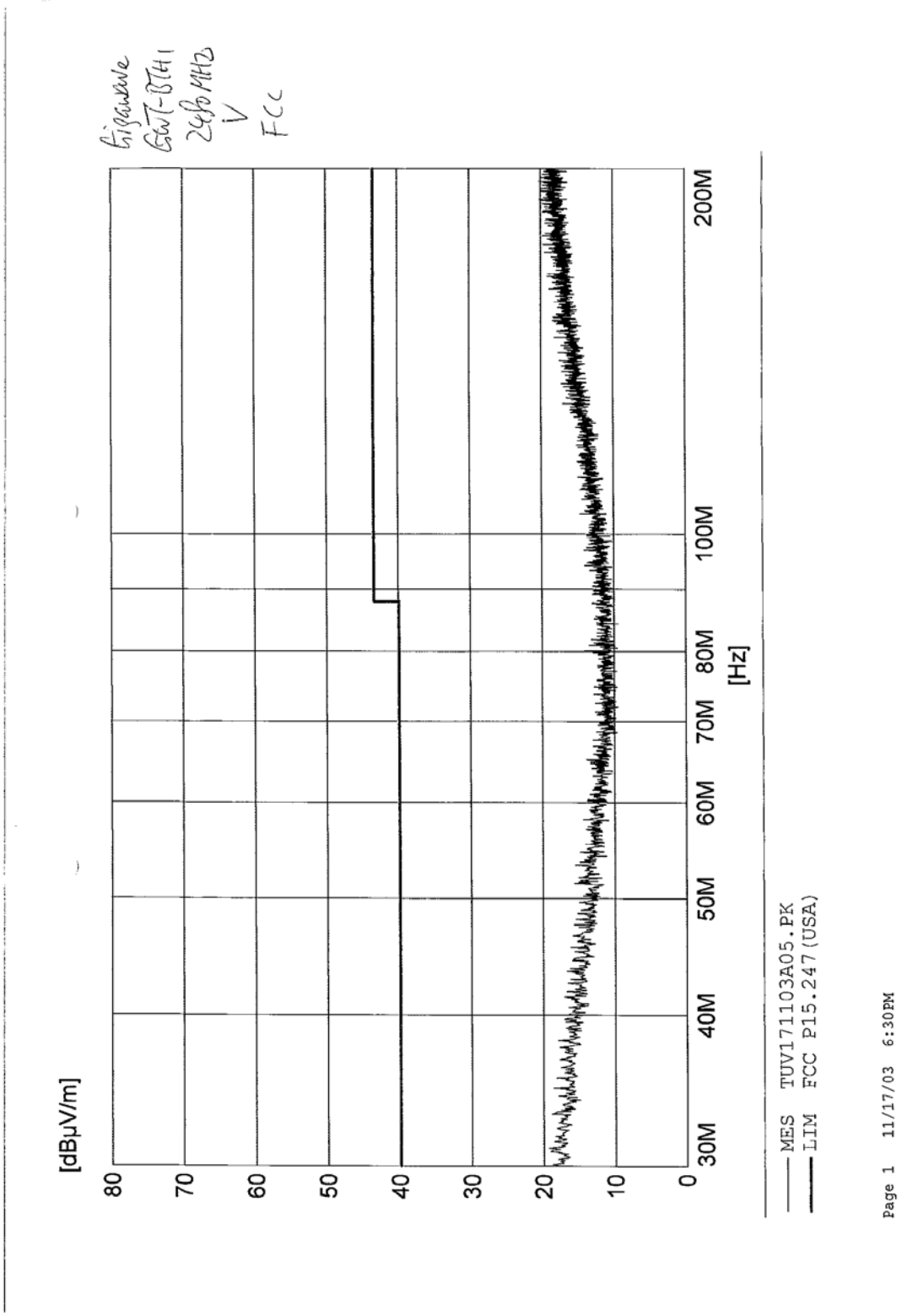
Date: 27.NOV.2003 13:13:07

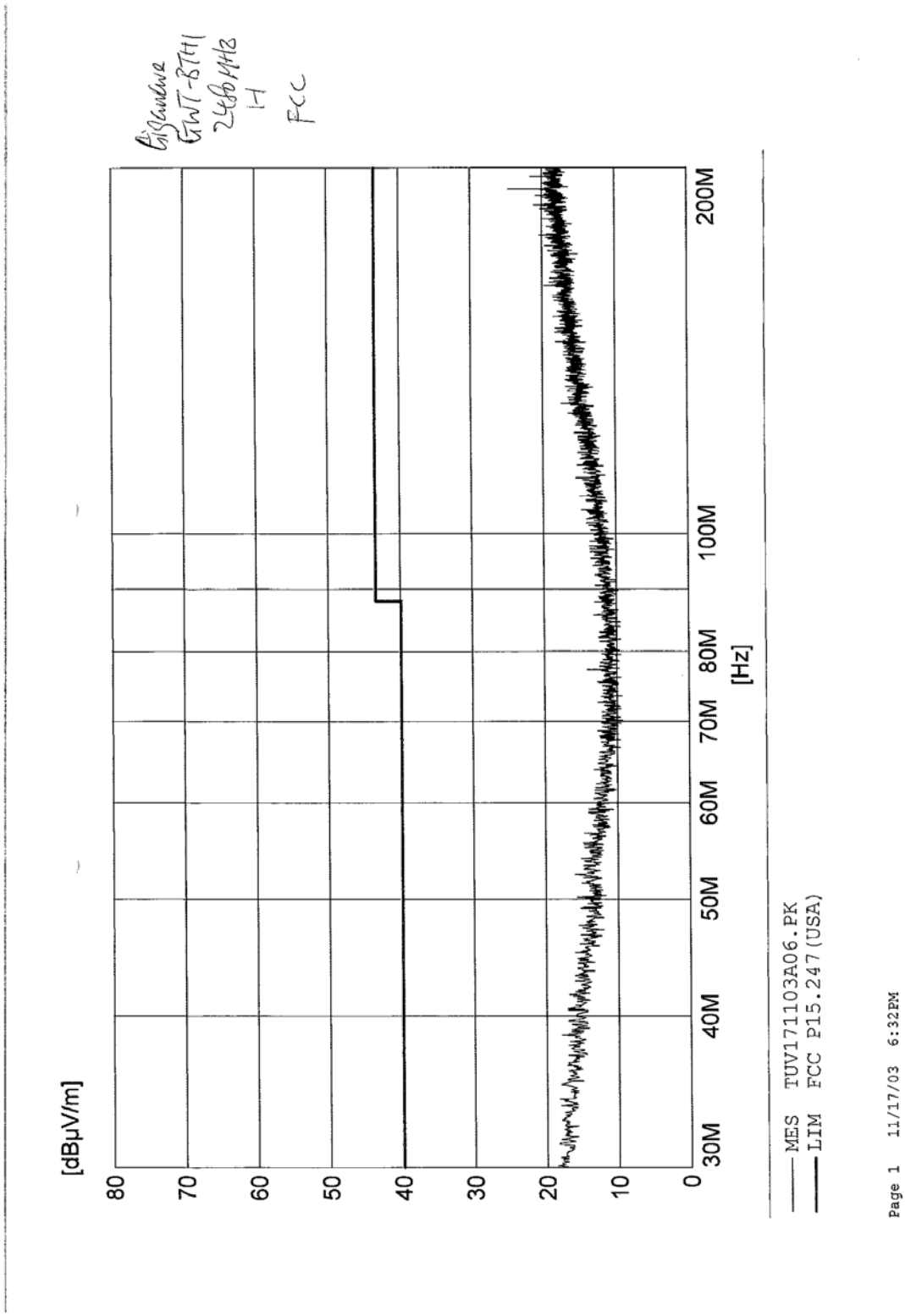
GWT-BTH1
2441 MHz
V
FCC

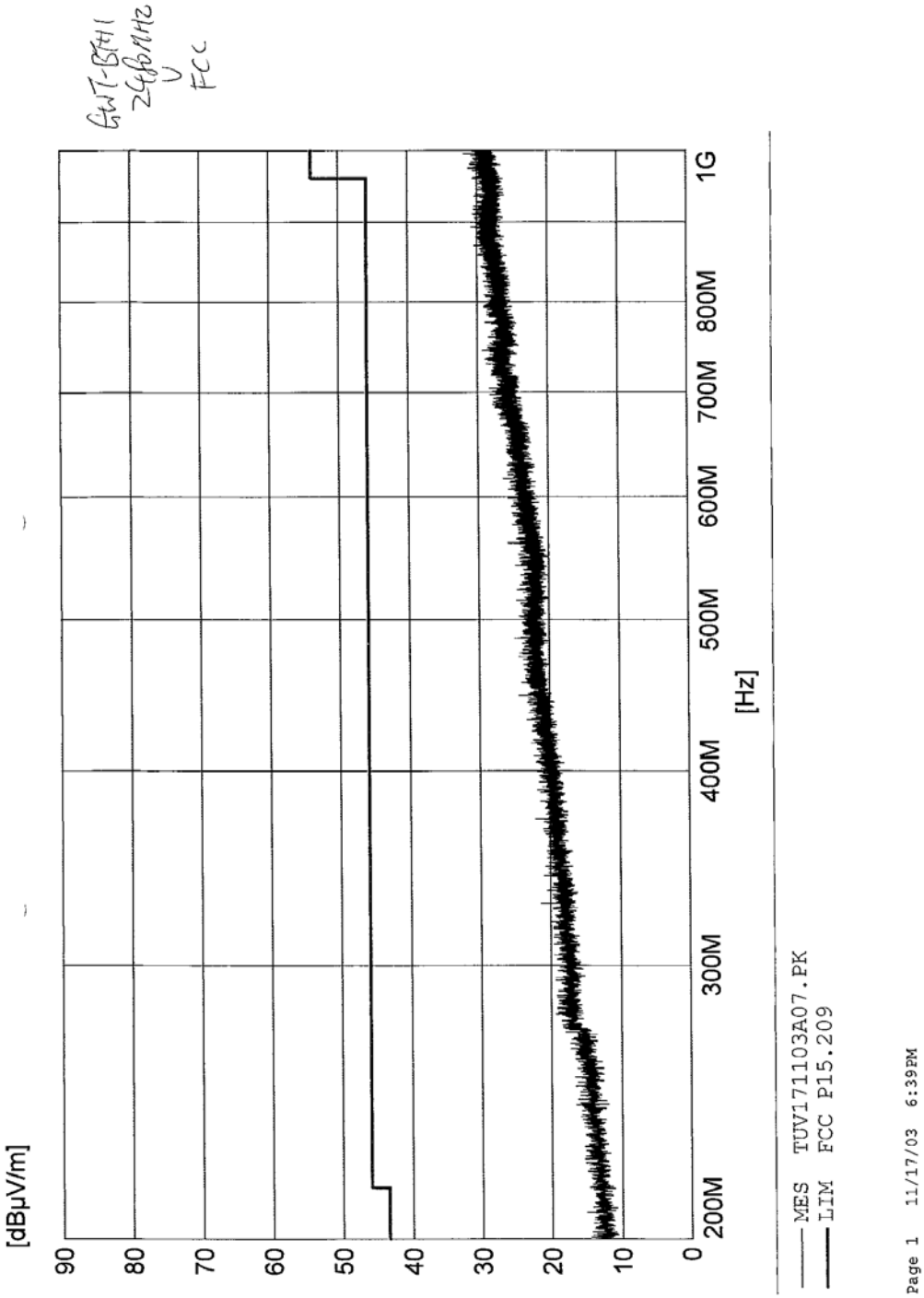


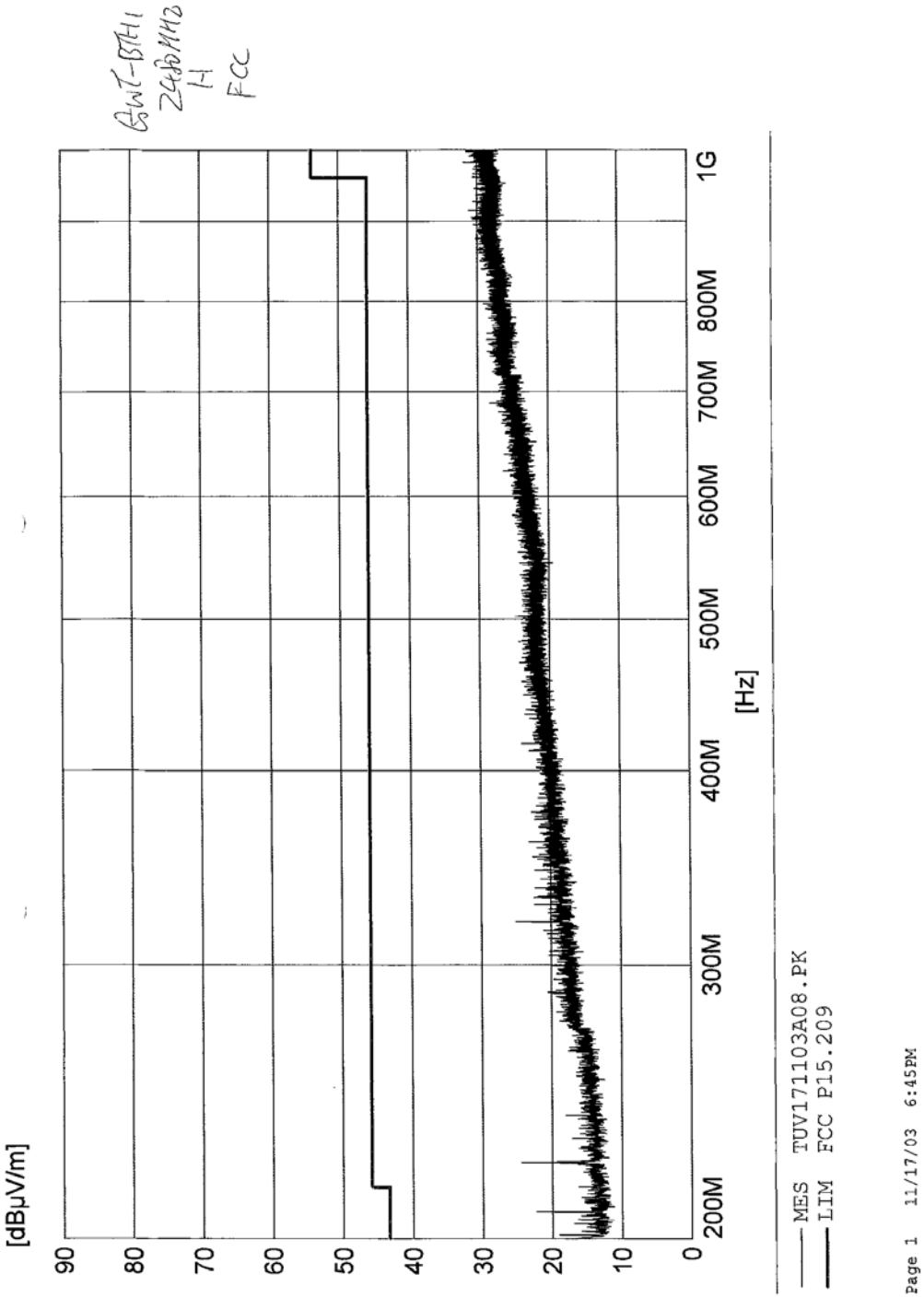
Date: 27.NOV.2003 13:07:35

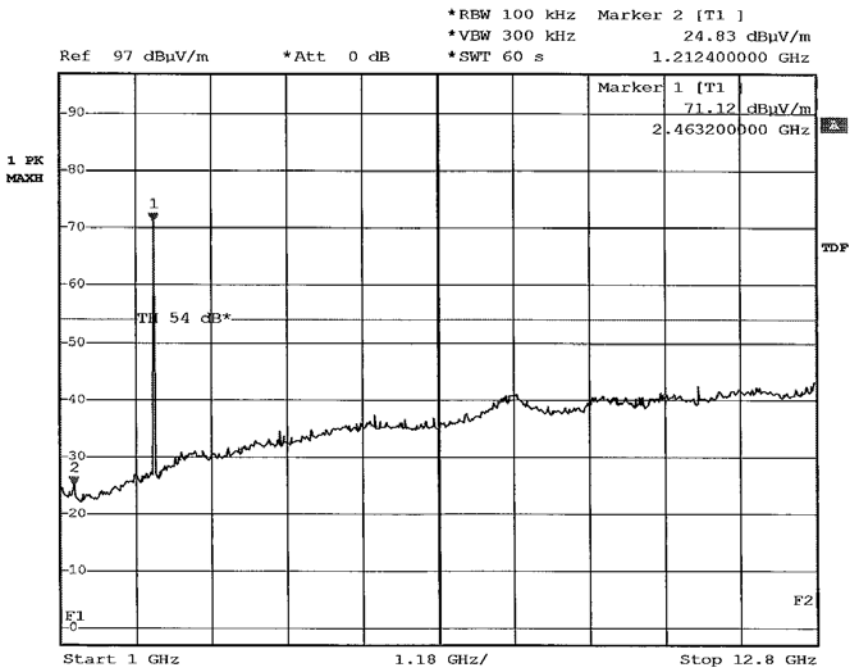
GWT-B(H)
2441MHz
H
FCC


Gigawave
GWT-BTH1
2480 MHz
V
FCC
[dBµV/m]
80
70
60
50
40
30
20
10
0
30M
40M
50M
60M
70M
80M
100M
200M
[Hz]
MES TUV171103A05.PK
LIM FCC P15.247(USA)
Page 1 11/17/03 6:30PM


Bigamewe
GWT-BTH1
2480 MHz
H
FCC
[dBµV/m]
80
70
60
50
40
30
20
10
0
30M
40M
50M
60M
70M
80M
100M
200M
[Hz]
MES TUV171103A06.PK
LIM FCC P15.247(USA)
Page 1 11/17/03 6:32PM

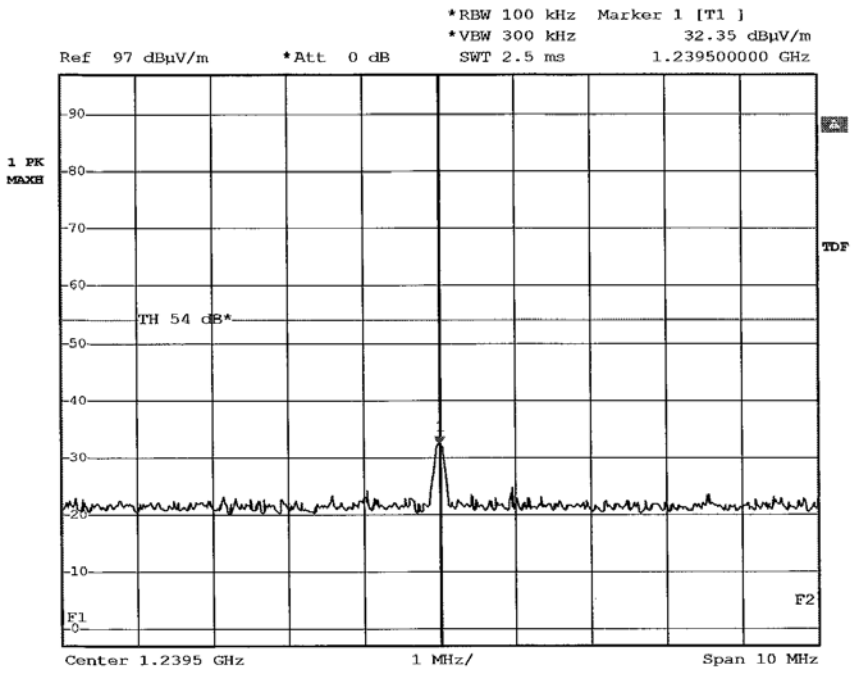

GWT-BFH1
2468MHz
V
FCC
[dBµV/m]
90
80
70
60
50
40
30
20
10
0
200M
300M
400M
500M
600M
700M
800M
1G
[Hz]
MES TUV171103A07.PK
LIM FCC P15.209
Page 1 11/17/03 6:39PM


BGWT-BTH1
2480MHz
H
FCC
[dBµV/m]
90
80
70
60
50
40
30
20
10
0
200M
300M
400M
500M
600M
700M
800M
1G
[Hz]
MES TUV171103A08.PK
LIM FCC P15.209
Page 1 11/17/03 6:45PM



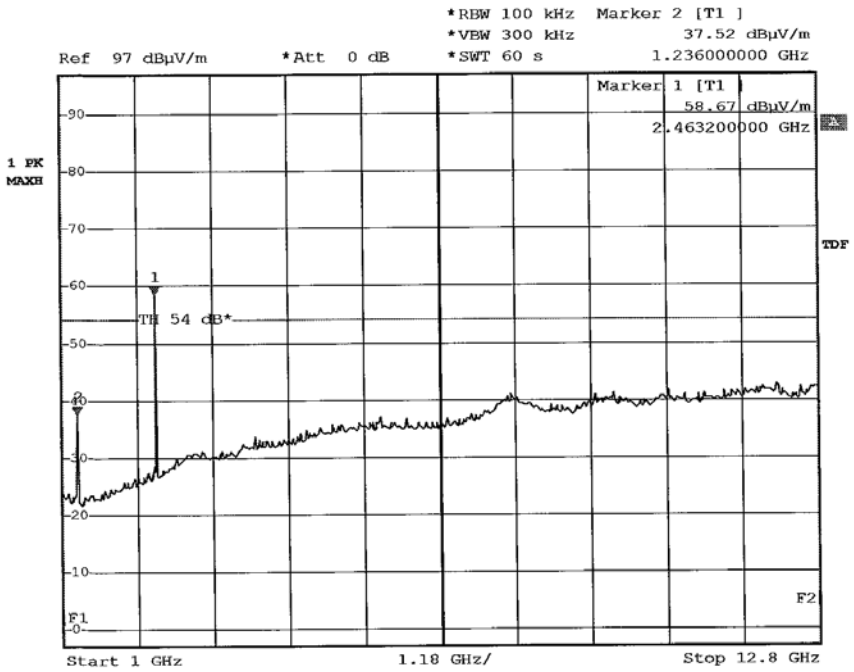
Date: 20.NOV.2003 12:15:14

GWT-BTH(
2480 MHz)
V
FCC



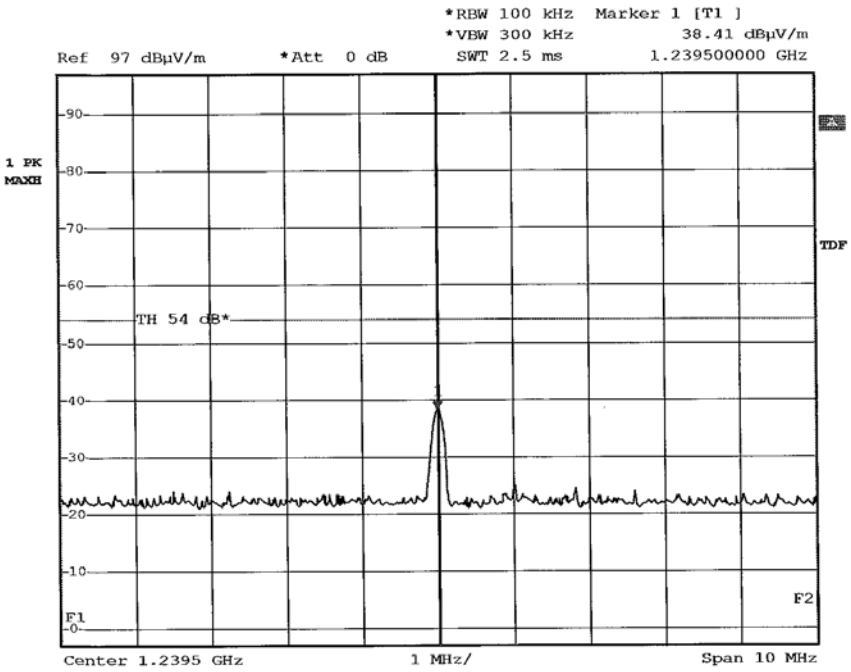
Date: 20.NOV.2003 12:12:29

GWT-BTH1
2480 MHz
V
FCC



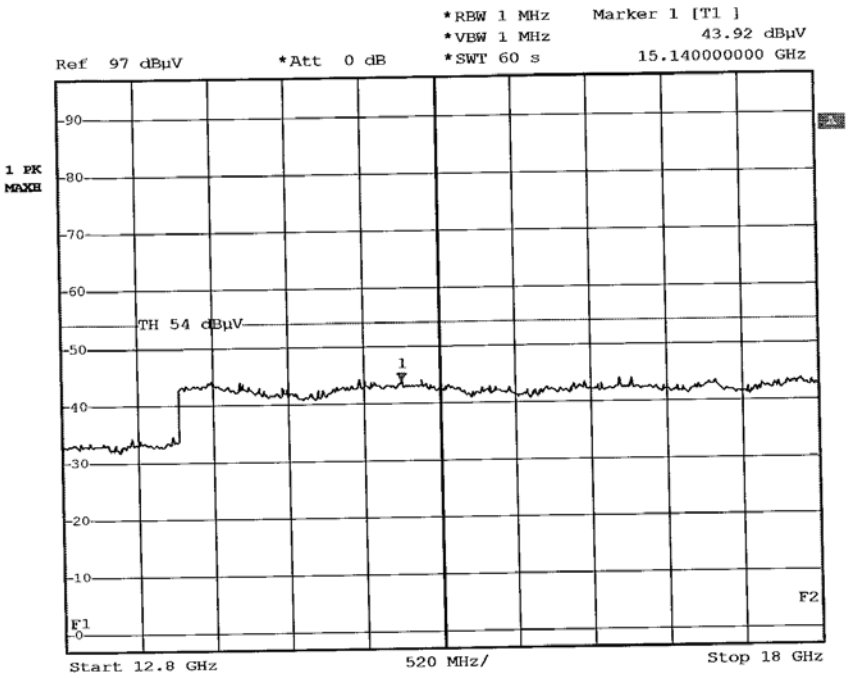
Date: 20.NOV.2003 12:09:04

GWT-BTH1
2480MHz
H
FCC



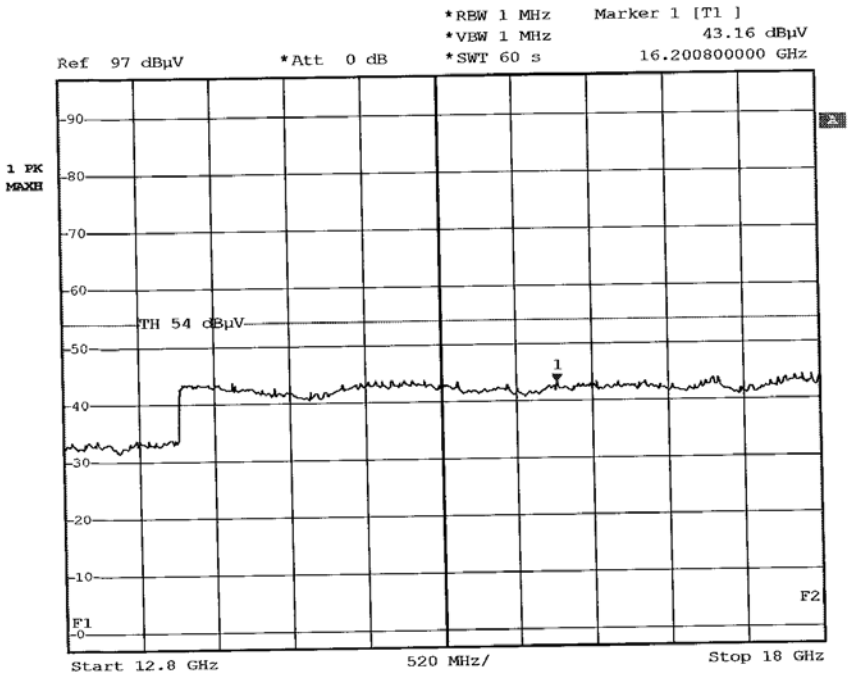
Date: 20.NOV.2003 12:11:44

GWT-BTH1
2480 MHz
H
FCC



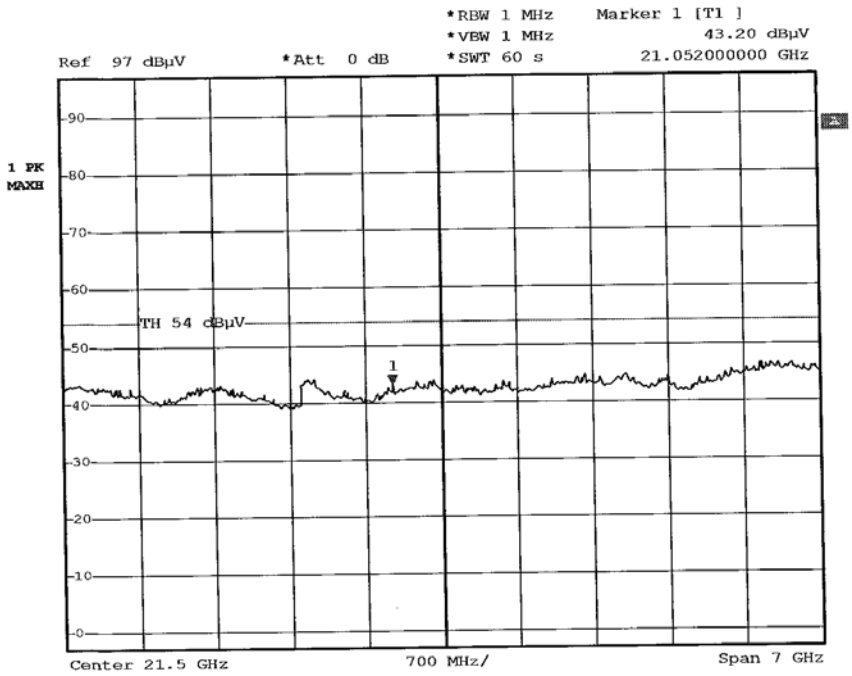
Date: 27.NOV.2003 12:34:09

GWFBTH1
2480 MHz
V
FCC



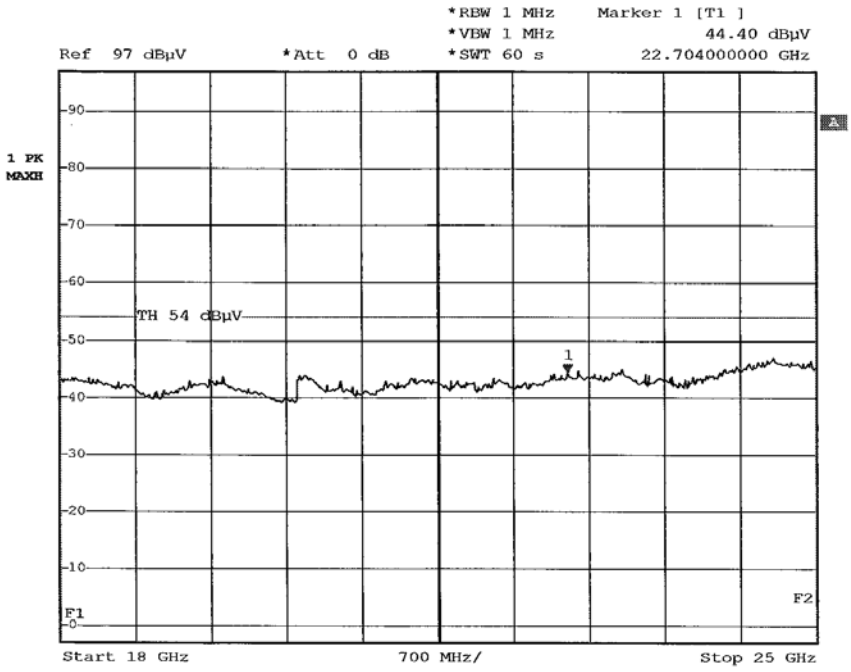
Date: 27.NOV.2003 12:37:15

GWT-BTH1
2460MHz
H
FCC



Date: 27.NOV.2003 13:14:08

GWT-BT141
2480 MHz
V
FCC



Date: 27.NOV.2003 13:08:34

GWT-BTH1
2480MHz
H
FCC