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

TÜV

Prüfbericht - Nr.: *Test Report No.*	**14002633 001**	Seite 1 von 19 *Page 1 of* 19

Auftraggeber: *Client:*	**Innovi Technologies Ltd.** **Suite 501-3, 5/F.** **Chinachem Leighton Plaza** **29 Leighton Road** **Causeway Bay** **Hong Kong**
Gegenstand der Prüfung: *Test item:*	**Bluetooth Dongle**

Bezeichnung: *Identification:*	**V27**	**Serien-Nr.:** *Serial No.*	**Engineering sample**
Wareneingangs-Nr.: *Receipt No.:*	**021113015**	**Eingangsdatum:** *Date of receipt:*	**13.11.2002**
Prüfort: *Testing location:*	**Refer to section 4.1**		
Prüfgrundlage: *Test specification:*	**FCC Part 15, Subpart C** **ANSI C63.4-1992**		
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*
Fred Wai	**Stephan Wald**
22.01.2003	22.01.2003
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

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
RESULT: N/A

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

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 SUBCLAUSE 15.247(C)
RESULT: Pass
Limit Subclause 15.247(c)

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

2 Contents

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 and Schematics

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	ESH-3	890173/033
☐	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	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 Bluetooth dongle for use with a mobile Phone to connect to a Bluetooth Headset.
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 devided 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	:	Embedded ceramic antenna	Embedded ceramic antenna
Power supply	:	Battery operated	Battery operated

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
User manual
PCB Layout

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

Battery charger for V27 Bluetooth dongle.

Input : AC 100-240V, 15A, 50-60Hz
Output : DC 6.2V, 190mA

The dongle cannot be operated whilst connected to the charger.

7 Test Results

7.1.1 Antenna connector **Subclause 15.203**

The EUT has no antenna connector. The antenna is soldered on the circuit board.

7.1.2 Antenna type **Subclause 15.204**

The EUT has an embedded ceramic antenna. The maximum gain is 1.2 dBi.

7.1.3 Disturbance voltage on AC mains Subclause 15.207

RESULT: **N/A**

The Bluetooth dongle cannot be operated during the charging mode. Hence this test has been skipped.

7.1.4 Carrier frequency seperation **Subclause 15.247(a)(1)**

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	:	DC 3,7V
Temperature	:	19.5°C
Humidity	:	52%

The centre frequencies of the hopping channels are separated by 1MHz.
For test results, please refer to Appendix 1, page 17

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	:	DC 3,7V
Temperature	:	19.5°C
Humidity	:	52%

The screenshot in annex 1 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:

$$27 \times 2.98 \times 10^{-3} = 80.46 \times 10^{-3}\text{s}$$

$$\leq 400 \times 10^{-3}\text{s}$$

For test results refer to Appendix 1, page 13 – 16.

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

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlopping 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 chasnnels employed.

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

RESULT: **Pass**

Test specification	:	FCC § 15.31
Mode of operation	:	Tx mode (2402MHz, 2441MHz, 2480MHz), DH5 packet
Port of testing	:	Temporary antenna port
Detector	:	Peak
RBW/VBW	:	30kHz/100kHz
Supply voltage	:	DC 3,7V
Temperature	:	19.5°C
Humidity	:	52%

20dB bandwidth (MHz)		
2402	2441	2480
(0.420)-(-0.368) = 0.788	(0.416)-(-0.372) = 0.788	(0.424)-(-0.38) = 0.804

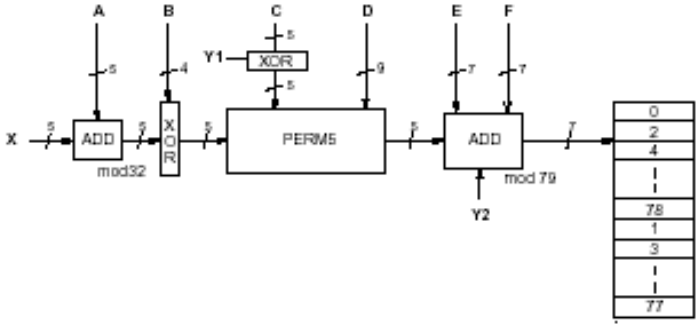
For test results refer to Appendix 1, page 01 – 03.

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

The occupied bandwidth shall not exceed 1000kHz

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	:	DC 3,7V
Temperature	:	19.5°C
Humidity	:	52%

Maximum peak output power (dBm)		
2402 MHz	2441 MHz	2480 MHz
-9.69	-8.59	-7.44
Cable attenuation (dB)		
0.76	0.68	0.73
Corrected value (dBm)		
-8.93	-7.91	-6.71

All three transmit frequency modes comply with the maximum peak output power limit.
For test results refer to Appendix 1, page 04 - 06

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	:	DC 3,7V
Temperature	:	19.5°C
Humidity	:	52%

All three transmit frequency modes comply with the limit stated in subclause 15.247(c).
For test results refer to Appendix 1, page 10 - 12

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 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	:	DC 3,7V
Temperature	:	19.5°C
Humidity	:	52%

All three transmit frequency modes comply with the limit stated in subclause 15.247(c).
For test results refer to Appendix 1, page 07 - 09

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 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
Mesurement Distance : 3m
Detector : See table
Measurement BW : 1 MHz
Supply voltage : DC 3,7V
Temperature : 19.5°C
Humidity : 52%

Frequency 2402MHz, Polarization Vertical

Frequ.	Reading	AF	Cable att.	Pre.-amp.	Filter att.	Level	Limit	Detector
GHz	dBuV	dB(1/m)	dB	dB	dB	dBuV/m	dBuV/m	P/QP/A
1.200,8	69.2	24.4	1.52	37.1	1.87	59.89	74	P
1.200,8	61.59	24.4	1.52	37.1	1.87	52.28	54	A

Frequency 2402MHz, Polarization Horizontal

Frequ.	Reading	AF	Cable att.	Pre.-amp.	Filter att.	Level	Limit	Detector
GHz	dBuV	dB(1/m)	dB	dB	dB	dBuV/m	dBuV/m	P/QP/A
1.200,8	61.54	24.4	1.52	37.1	1.87	52.23	74	P
1.200,8	54.73	24.4	1.52	37.1	1.87	45.42	54	A

Frequency 2441MHz, Polarization Vertical

Frequ.	Reading	AF	Cable att.	Pre.-amp.	Filter att.	Level	Limit	Detector
GHz	dBuV	dB(1/m)	dB	dB	dB	dBuV/m	dBuV/m	P/QP/A
1.220,2	68.76	24.4	1.52	37.1	1.87	59.45	74	P
1.220,2	60.4	24.4	1.52	37.1	1.87	51.09	54	A

Frequency 2441MHz, Polarization Horizontal

Frequ.	Reading	AF	Cable att.	Pre.-amp.	Filter att.	Level	Limit	Detector
GHz	dBuV	dB(1/m)	dB	dB	dB	dBuV/m	dBuV/m	P/QP/A
1.220,2	57.55	24.4	1.52	37.1	1.87	48.24	74	P
1.220,2	50.12	24.4	1.52	37.1	1.87	40.81	54	A

Frequency 2480MHz, Polarization Vertical

Frequ.	Reading	AF	Cable att.	Pre.-amp.	Filter att.	Level	Limit	Detector
GHz	dBuV	dB(1/m)	dB	dB	dB	dBuV/m	dBuV/m	P/QP/A
1.238,0	45.8	24.4	1.52	37.1	1.87	36.49	74	P
1.238,0	40.79	24.4	1.52	37.1	1.87	31.48	54	A

Frequency 2480MHz, Polarization Horizontal

Frequ.	Reading	AF	Cable att.	Pre.-amp.	Filter att.	Level	Limit	Detector
GHz	dBuV	dB(1/m)	dB	dB	dB	dBuV/m	dBuV/m	P/QP/A
1.238,0	36.66	24.4	1.52	37.1	1.87	27.35	74	P
1.238,0	29.98	24.4	1.52	37.1	1.87	20.67	54	A

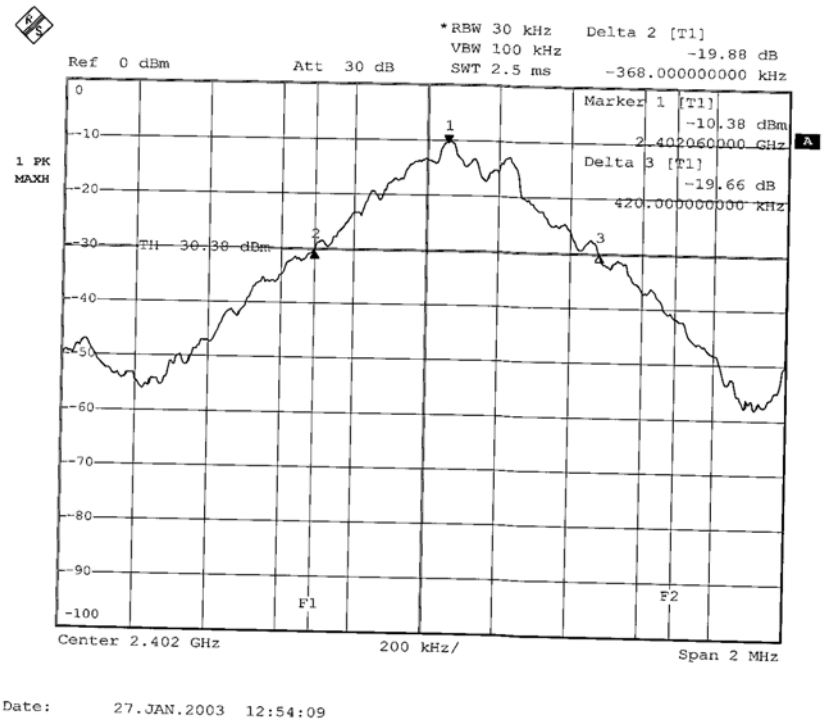
Limit **Subclause 15.247(c)**

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)).

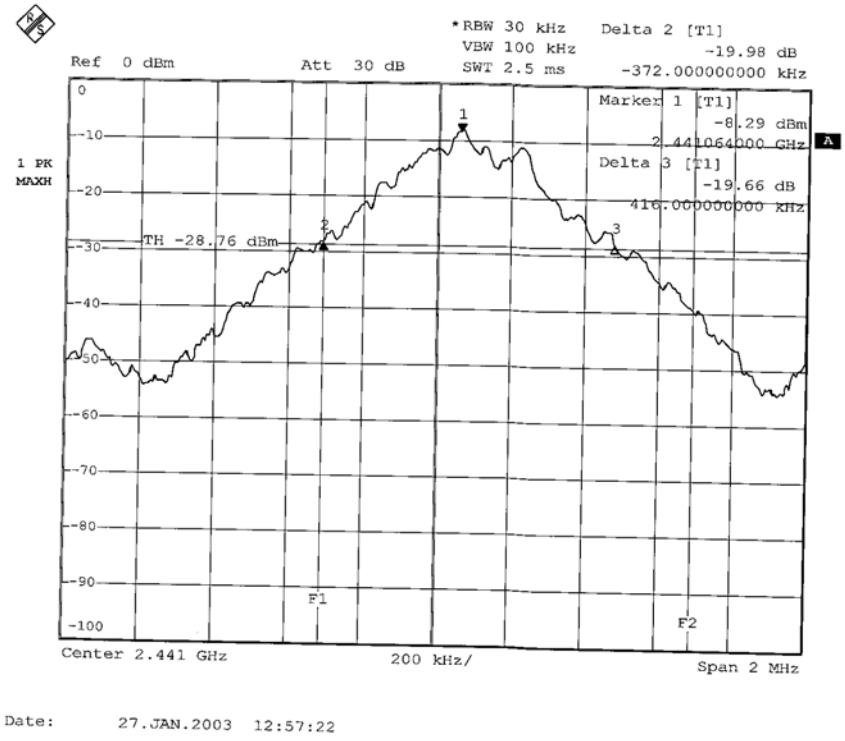
Field strength limits within the restricted bands

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

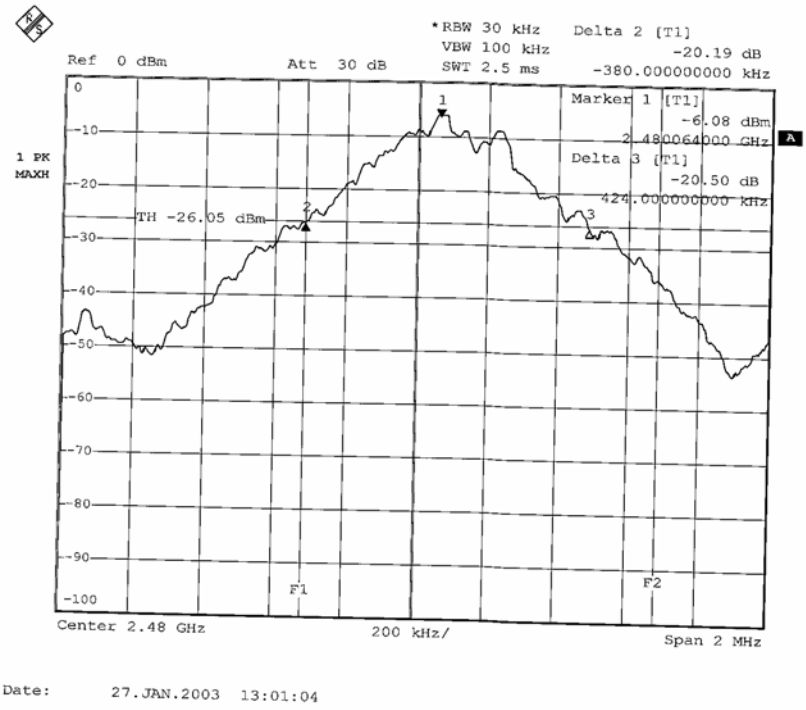
20dB bandwidth – 2402MHz



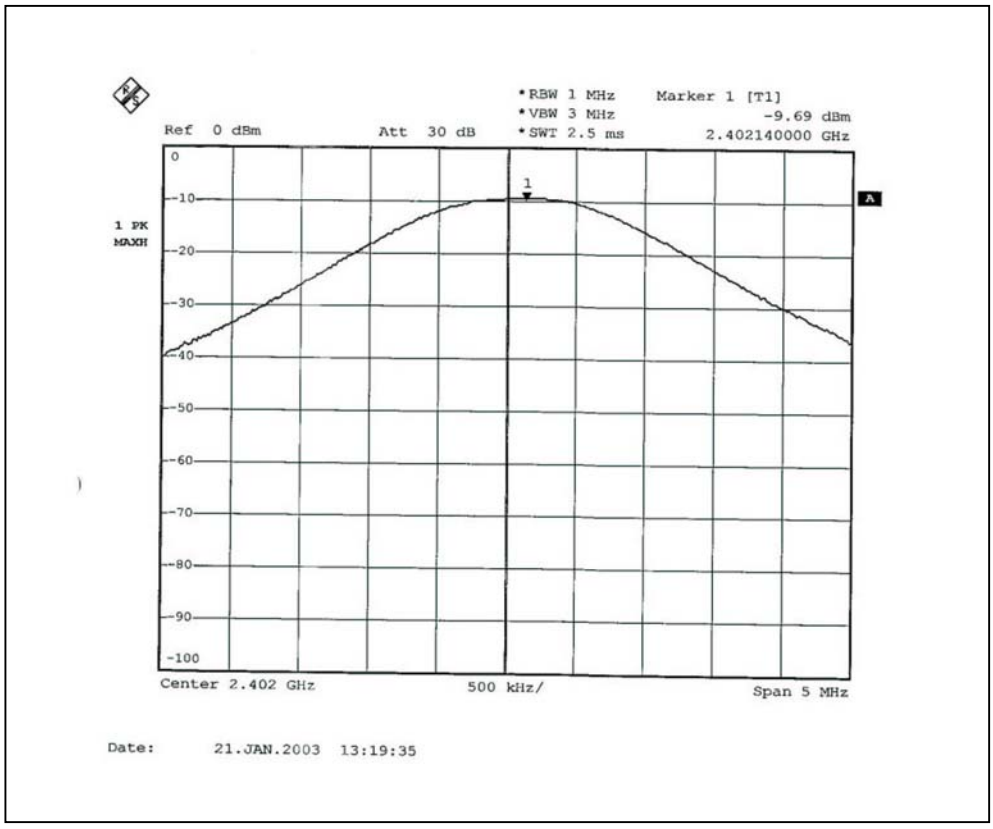
20dB bandwidth – 2441MHz



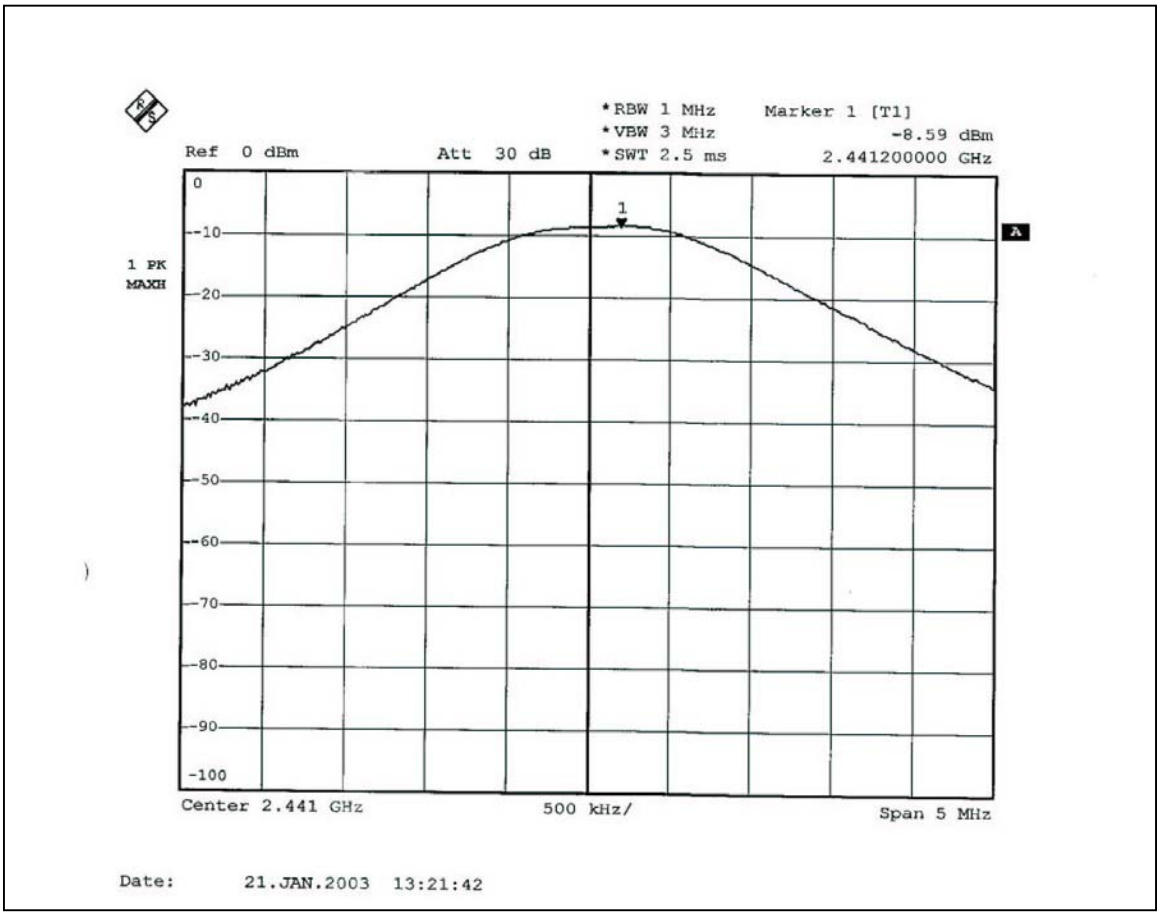
20dB bandwidth – 2480MHz



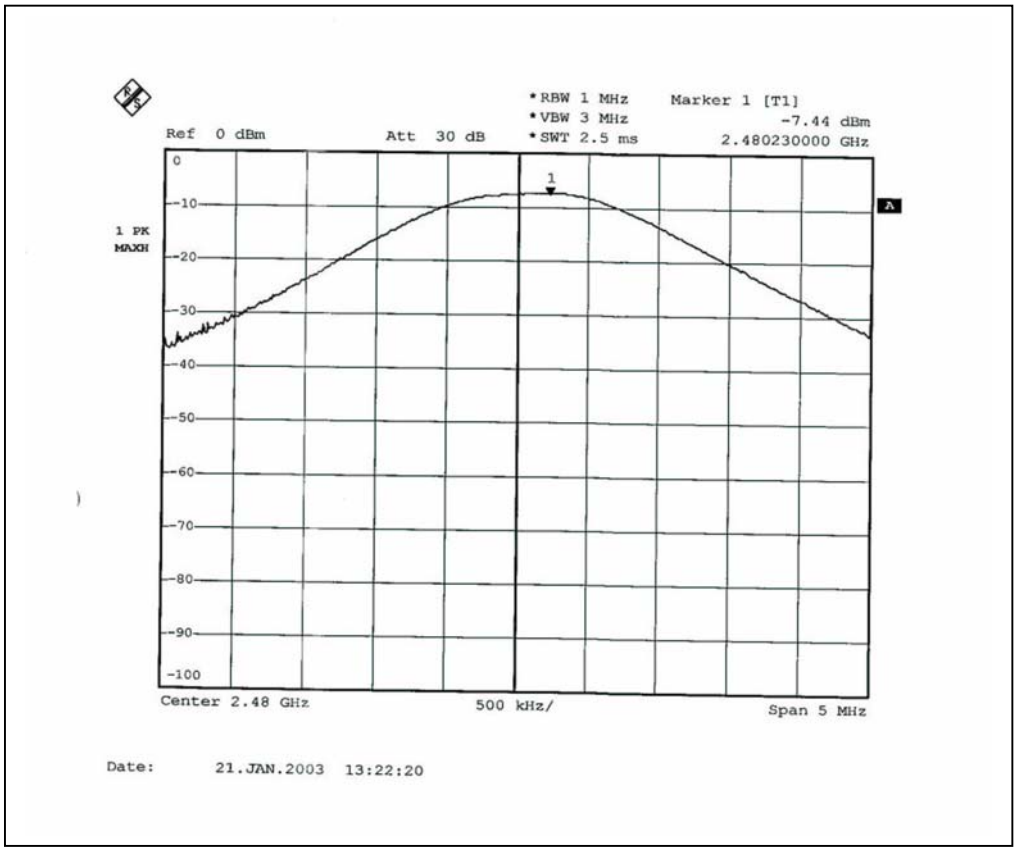
Peak power output – 2402MHz



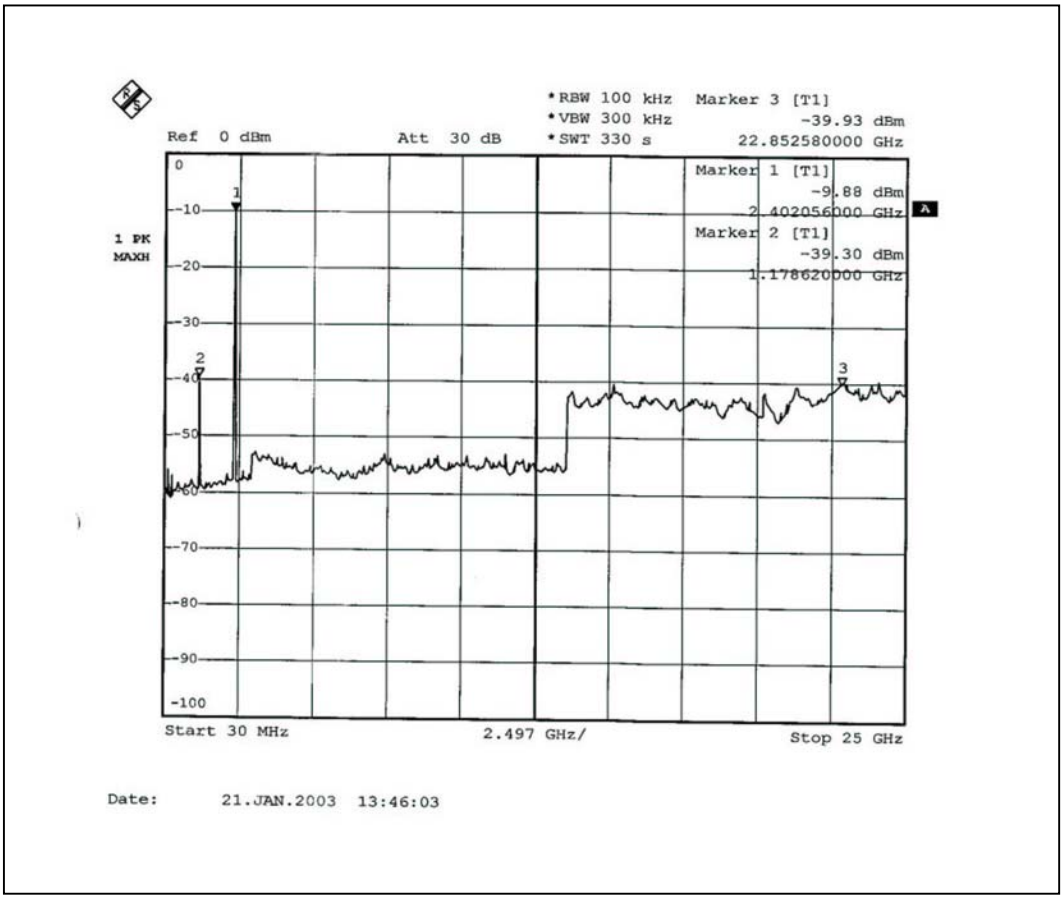
Peak power output – 2441MHz



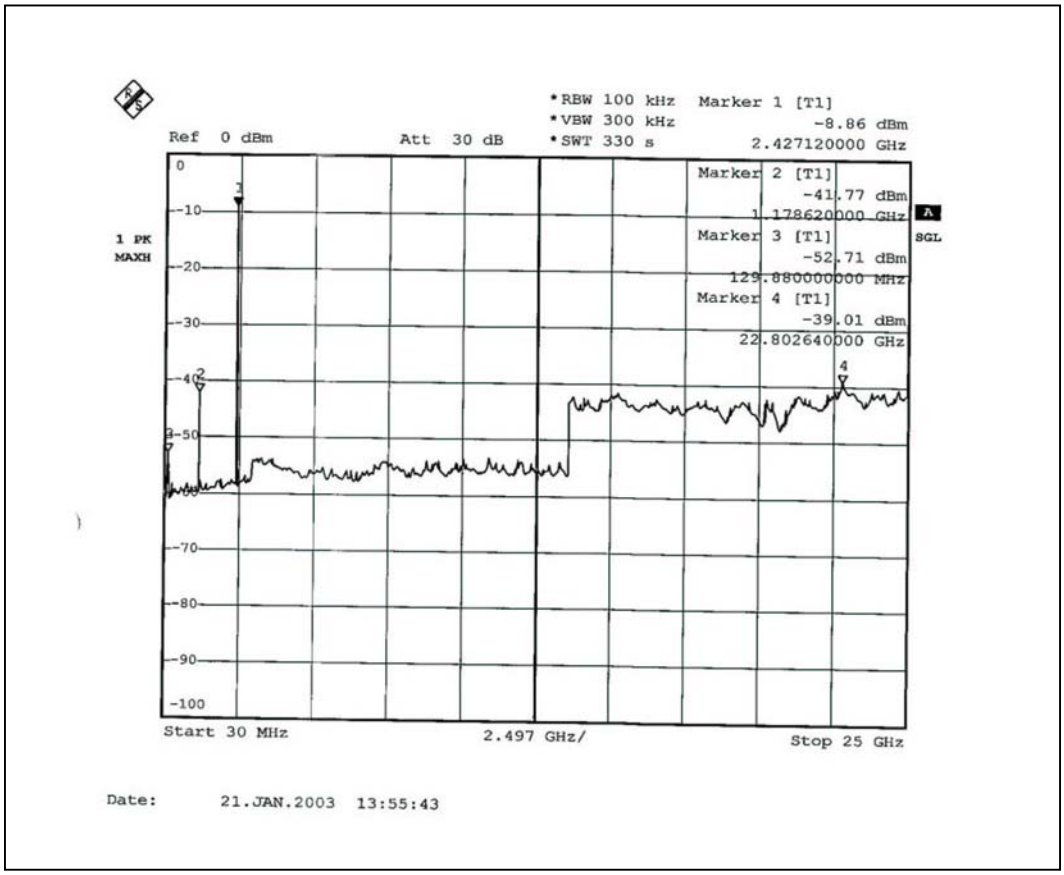
Peak power output – 2480MHz



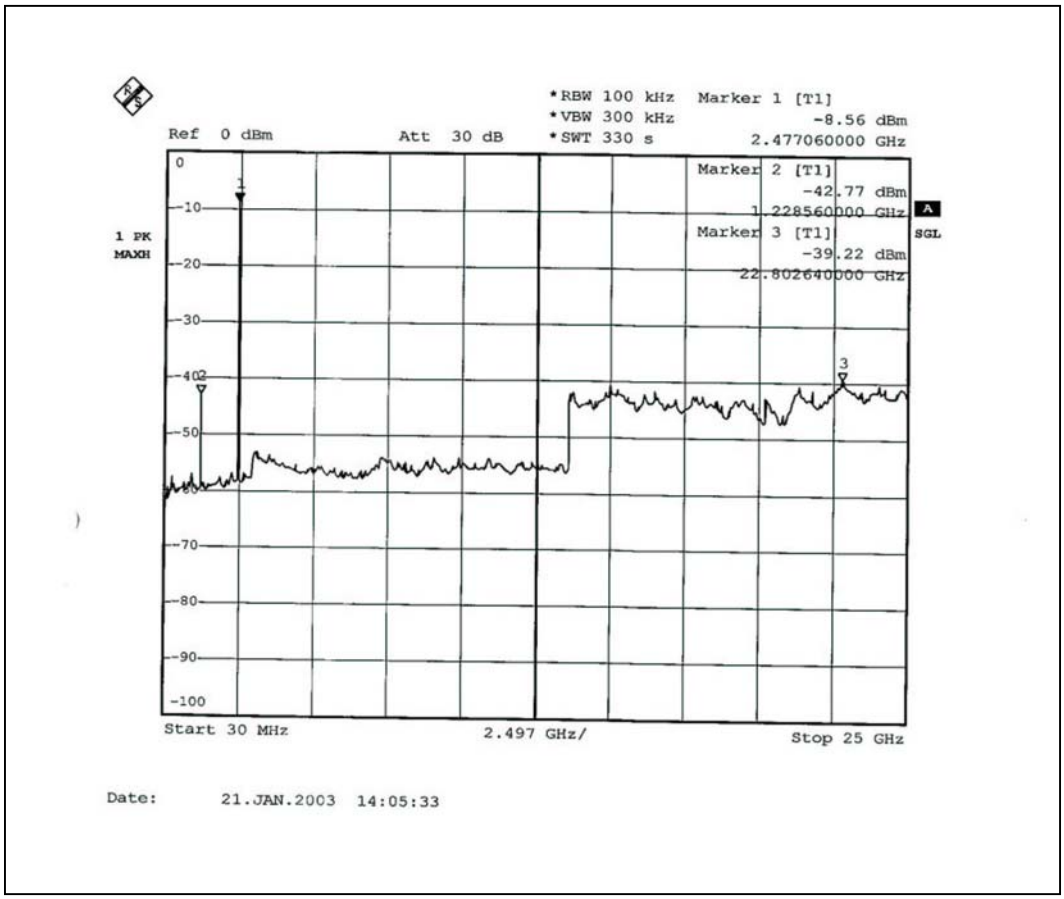
Spurious emission, conducted – 2402MHz
(30MHz - 25GHz)



Spurious emission, conducted – 2441MHz
(30MHz – 25GHz)

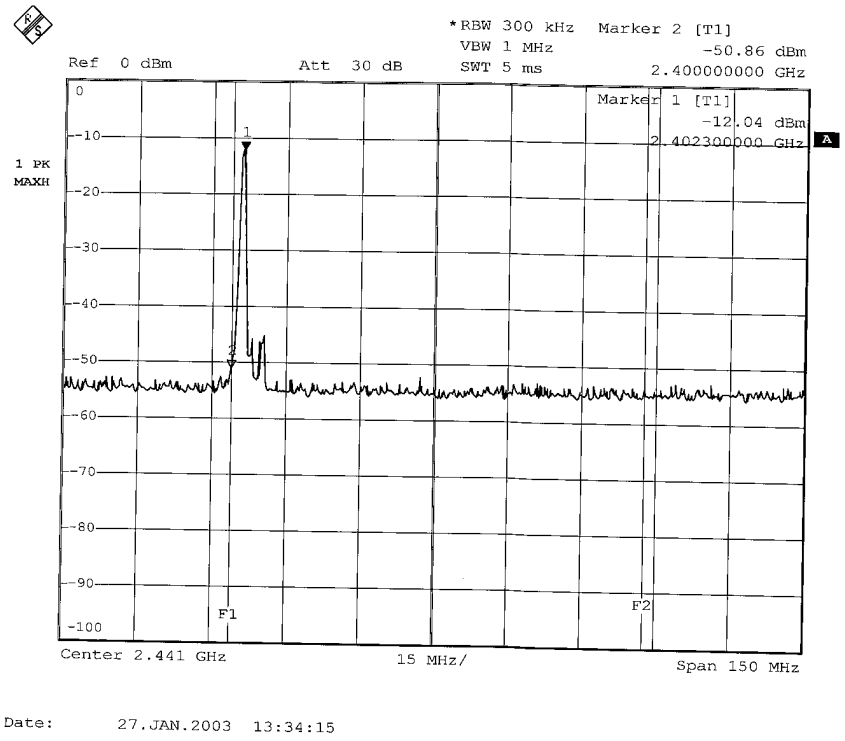


Spurious emission, conducted – 2480MHz
(30MHz – 25GHz)



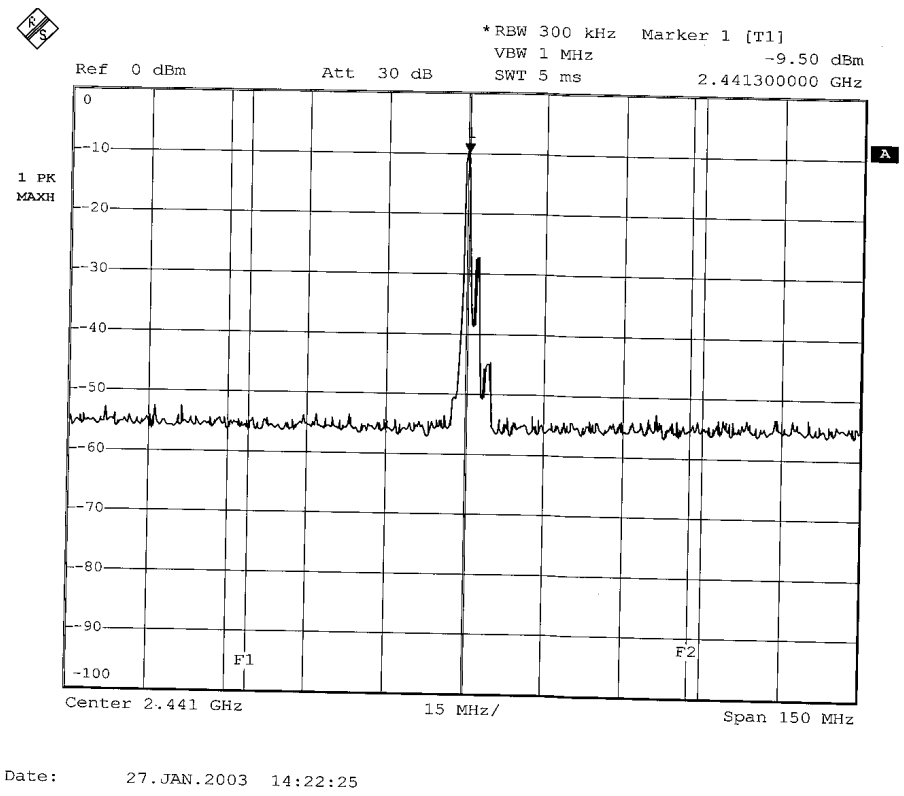
Spurious emissions, conducted – 2402MHz

Band-edge compliance



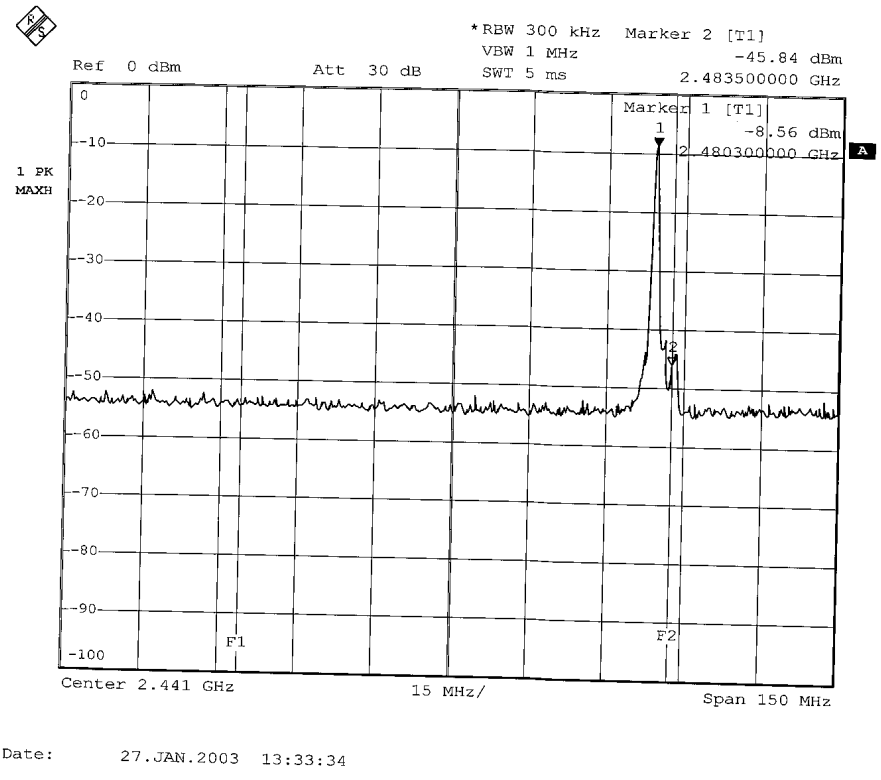
Spurious emissions, conducted – 2441MHz

Band-edge compliance



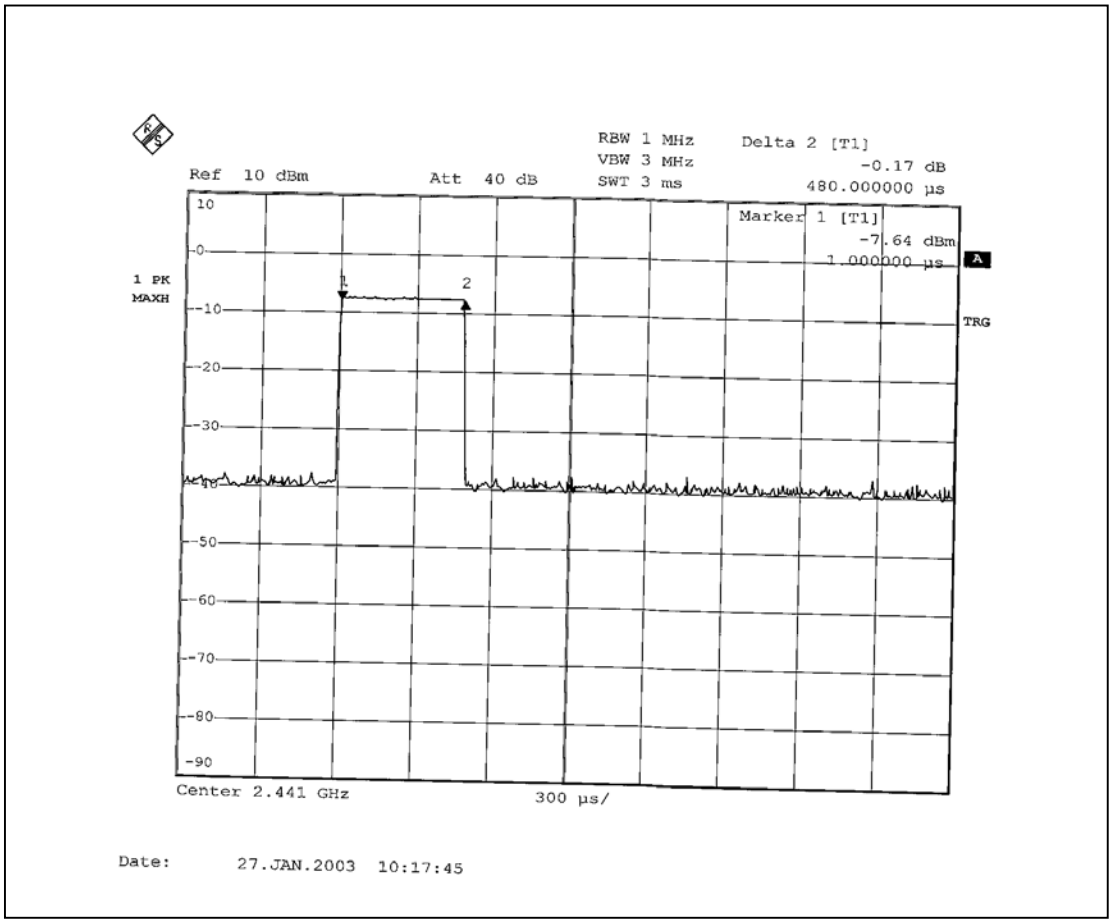
Spurious emissions, conducted – 2480MHz

Band-edge compliance



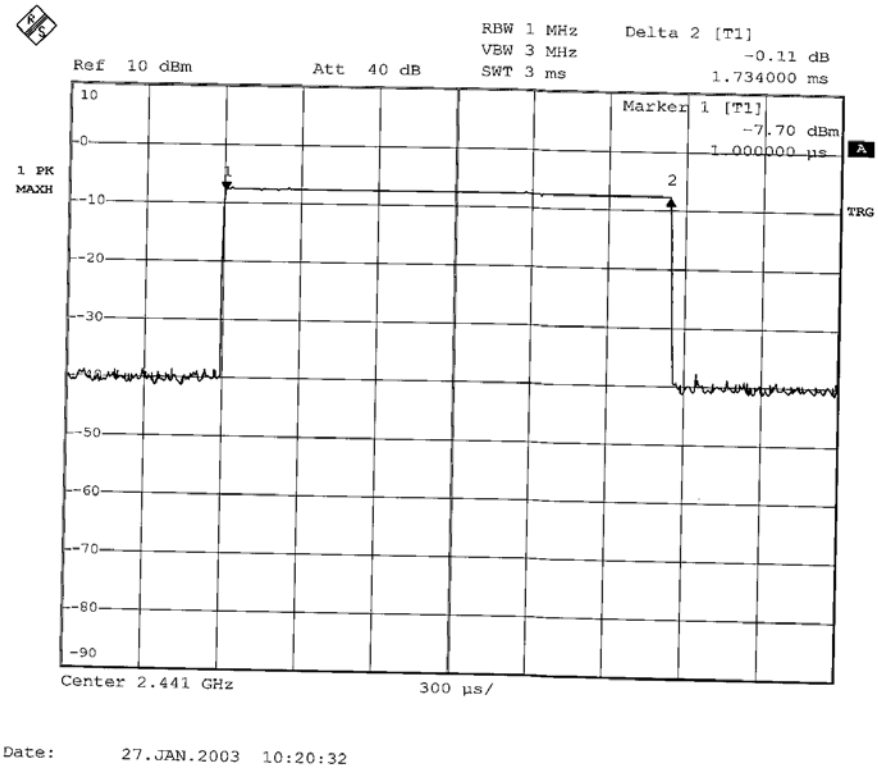
Dwell time

Burst duration DH1 packet



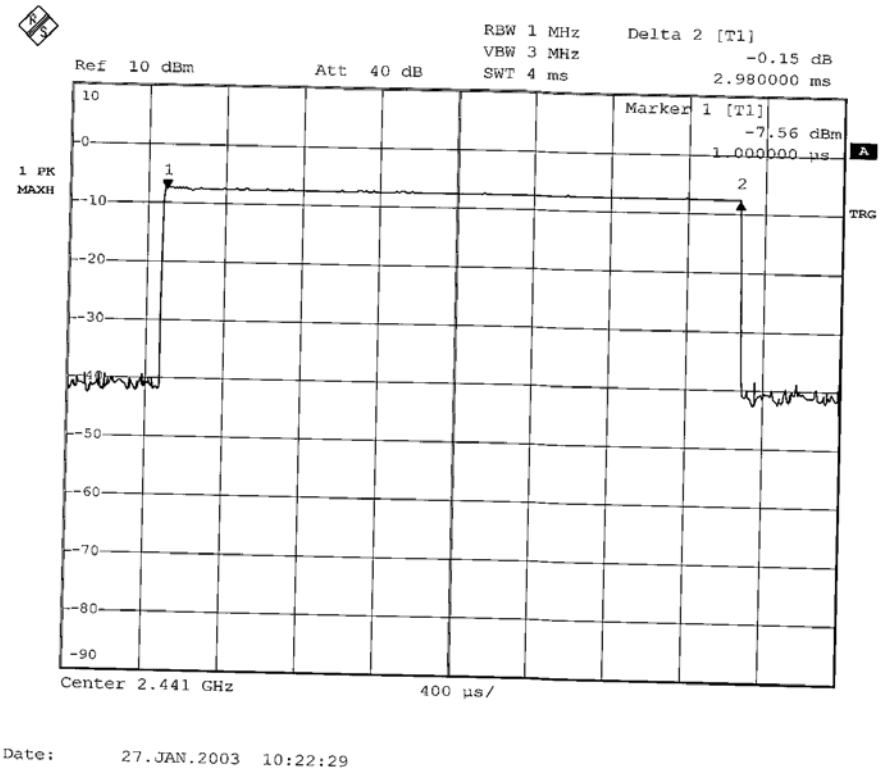
Dwell time

Burst duration DH3 packet



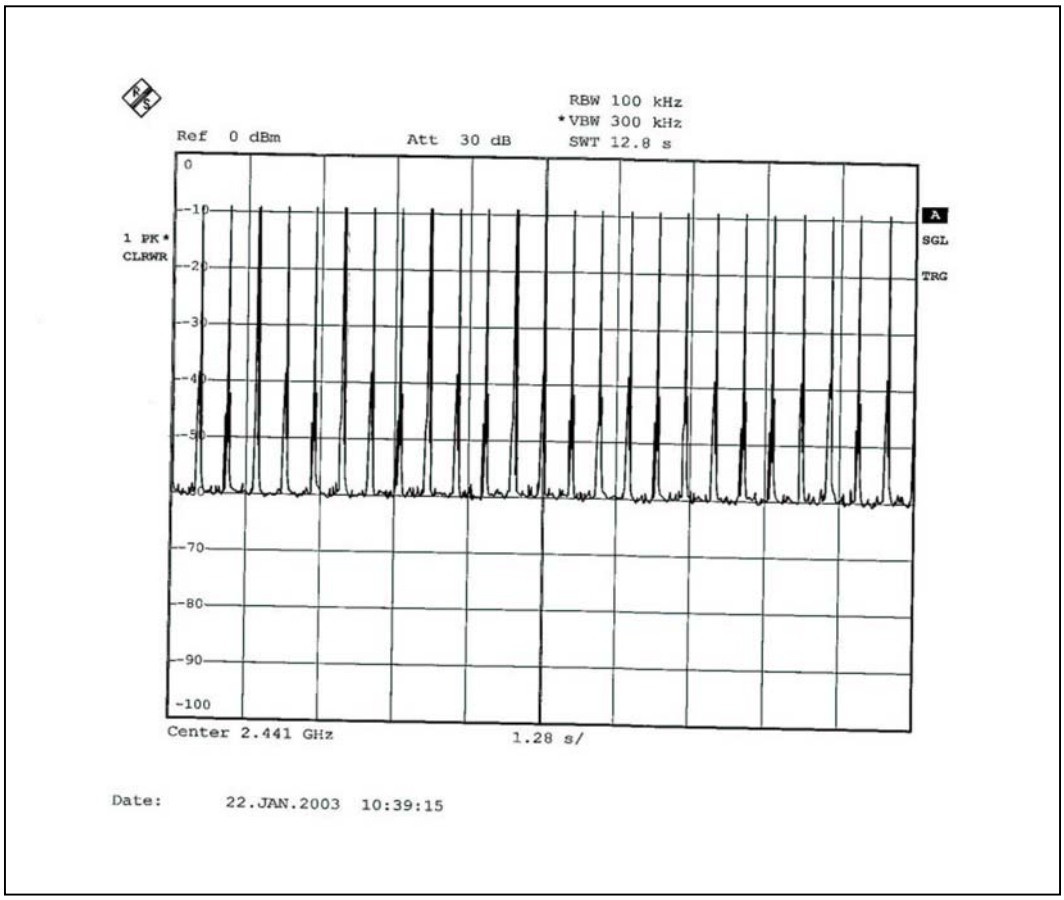
Dwell time

Burst duration DH5 packet



Dwell time

Channel occupancy DH5 packet



Channel separation