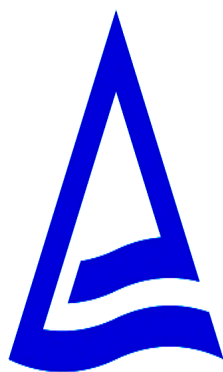


FCC Part 15 TEST REPORT



TÜV

TÜV Rheinland Group

December 8, 2004

TUV Rheinland Korea Ltd.

TEST REPROT CERTIFICATION

Applicant : DOnetworks Co., Ltd.
Adderss : 3F Yangjae Bldg, #264-3, Yangjae-dong, Seocho-gu, Seoul,
137-130, Republic of Korea
EUT Name : DOFree Dongle
Model No. : DDD-400
Serial No. : Prototype
FCCID : SPQDODDD-400
Testing location : Nex1 Future Co.,Ltd.
133, Gongdan-dong, Gumi-City , Gyeongbuk 730-703, R.O.K
Applied : FCC Part 15 , ANSI C63.4-2003
specification
Test result : The above mentioned test item passed.

Tested by : Gye-Woog Lee

Reviewed by : Uon-Chae Song

December 8,2004



December 8,2004



Date

Signature

Date

Signature

I HEREBY CERTIFY THAT the data shown in this report were made in accordance with the Procedures given in the applied specification and I assume full responsibility for accuracy and completeness of these data.

Note : 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.

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1. General Information

1.1 Product Description

Product Name : DOFree Dongle
Product ID : DDD-400
Serial No. : Prototype
FCC ID : SPQDODDD-400

1.2 Project data

Receipt of EUT : November 20, 2004
Date of Test : December 3, 2004
Data of report : December 8, 2004

1.3 Applicant

Company Name : DOnetworks Co., Ltd.
Address : 3F Yangjae Bldg, #264-3, Yangjae-dong, Seocho-gu, Seoul,
137-130, Republic of Korea
Contact Person : Jung Won Kang

1.4 Manufacturer

Company Name : DOnetworks Co., Ltd.
Address : 3F Yangjae Bldg, #264-3, Yangjae-dong, Seocho-gu, Seoul,
137-130, Republic of Korea
Contact Person : Jung Won Kang

2. EUT Information

2.1 General EUT Information

Type	Transmitter	Receiver
FCC Classification	FHSS Sequence Spread Spectrum (FHSS)	FHSS Sequence Spread Spectrum (FHSS)
Frequency Range	2402 – 2480 MHz	2402 – 2480 MHz
Number of Channels	79	79
Channel Separation	1MHz	1MHz
Type of Antenna	Chip Antenna	Chip Antenna
Power Supply	DC 3.7 V Li-ion Polymer	DC 3.7 V Li-ion Polymer

2.2 Center Frequency of Tested Channel

Frequency	Tx (MHz)	Rx (MHz)
Lowest	2402	2402
Middle	2441	2441
Highest	2480	2480

2.3 Test Environment

Temperature	25°C
Relative Humidity	30 ~ 60%
Voltage	DC 3.7V

2.4 Accessories and Ancillary Equipment

Equipment	Model No.	Serial Number	Maker
Laptop PC	PS428L-OE142	30014068J	Toshiba

3. Testing Facilities

NEX1 FUTURE Co.,Ltd.

133, Gongdan-dong, Gumi-City , Gyeongbuk 730-703, R.O.K

4. EUT Description and Operational Description

4.1 General Description

Automatically link to other non Bluetooth mobile phones up to 10 meters(33 ft) away using DOFreeDongle(Audio Gateway).

Much work has gone into making the DOFree Dongle as practical and easy to use as possible.

The DOFree Dongle is the ideal accessory for people who lead an active life.

4.2 Product Function and intended use

The smallest size, ultra lightweight

DOFree Dongle is ultra lightweight; extremely portable. Transmitting-receiving with headset

The high quality of your conversation

The DOFree headset, the latest technology of DOnetworks, was developed to acquire the highest quality of the telephonic communication. DOFree improves your ability to hear conversations clearly even in noisy environments.

Automatic stand-by mode

30 seconds after you finish talking, DOFree Bluetooth Dongle turns to stand-by mode automatically to prevent the draining the battery.

Easy to Use

LED Light indicator for power on/off and easy to use on/off switch.

Not necessary to know bluetooth technologies.

Compatibility with Non Bluetooth cell-phone

The Dongle of DOnetworks enables to use the Bluetooth headset for the non Bluetooth cell-phone user. The Dongle is ultra lightweight, micro-sized, stylish designed.

Safe High-Capacity Li-ion Polymer Battery used

The latest High-technology Li-ion Polymer battery helps reduce the unit's size.

It is not harmful to humans, and can be used for a longer time.

Connect to the cellular phone.

Insert the 2.5mm "Ear Plug" into the earphone jack of your cellular phone

5. Test Set-up

5.1 Principle of configuration

Conducted : The equipment under test (EUT) was configured with a temporary SMA Connector and EUT transmits the related packet type with PRBS 9 as payload.

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

For details, please refer to the Operation mode in chapter 7.

5.2 Operational Modes

Page Scan,

Inquiry Scan

Hopping Mode

Fixed mode (2402Mhz, 2441Mhz and 2480Mhz)

5.3 Applied Specification

FCC Part 15

ANSI C63.4-2003

6. Test Report Summary

Related Clause	Test Cases	FCC Part Sections	Result (Note1)
7.1	Antenna Connector Requirements	15.203 15.204	C
7.2	AC Connected Emission	15.207	NA
7.3	Carrier Frequency Separation	15.247	Pass
7.4	Time of Occupancy(Dwell time)	15.247	Pass
7.5	20dB Bandwidth	15.247	Pass
7.6	Number of Hopping Frequencies Requirements	15.247	C
7.7	Pseudorandom Frequency Hopping Sequence and Equal Hopping Frequency use Requirements	15.247	C
7.8	Receiver Input Bandwidth Requirements	15.247	C
7.9	Peak Output Power	15.247	Pass
7.10	Band-edge Compliance	15.247	Pass
7.11	Spurious Conducted emissions	15.247	Pass
7.12	Spurious Radiated emissions	15.247	Pass

* Note1: C: Complies, Pass: Passed, Fail : Failed and NA: Not Applicable

7. Test Results

7.1 Antenna Connector Requirements

Requirements

Subclause 15.203 and 15.204(c)

According to the Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to the Part 15.204(c), only the antenna with which an intentional radiator is authorized may be used with the intentional radiator.

Test results

RESULT:

Complies

The antenna is permanently attached on the PCB.

The EUT has a Chip Antenna soldered to the circuit board.

For more information on antenna follows:

Antenna gain : 0dBi.

Manufacturer : AUTO Electronic Corp.

Model No. : AEC_DAG_001

Type : Surface Chip Antenna

7.2 AC Connected Emission

Test Mode and conditions

N/A

Requirements

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 μ H/50 ohms line impedance stabilization network (LISN).

Frequency of Emission (M Hz)	Conducted Limit (dB μ V)	
	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.

Test results

It is not applicable because it is designed not to operate during charging process.

Frequency (MHz)	QP reading (dB μ V)	QP limit (dB μ V)	Av reading (dB μ V)	Av limit (dB μ V)	Test Result
Live measurement					
					N/A
Neutral measurement					
					N/A

* Decreases with the logarithm of the frequency.

7.3 Carrier Frequency Separation

Test Mode and conditions

Mode of operation : Tx mode (hopping on), DH1 packet with PRBS9 payload
Measurement Method : Conducted
Detector : PK
Trace : Max hold
RBW/VBW : 100kHz/300kHz

Requirements

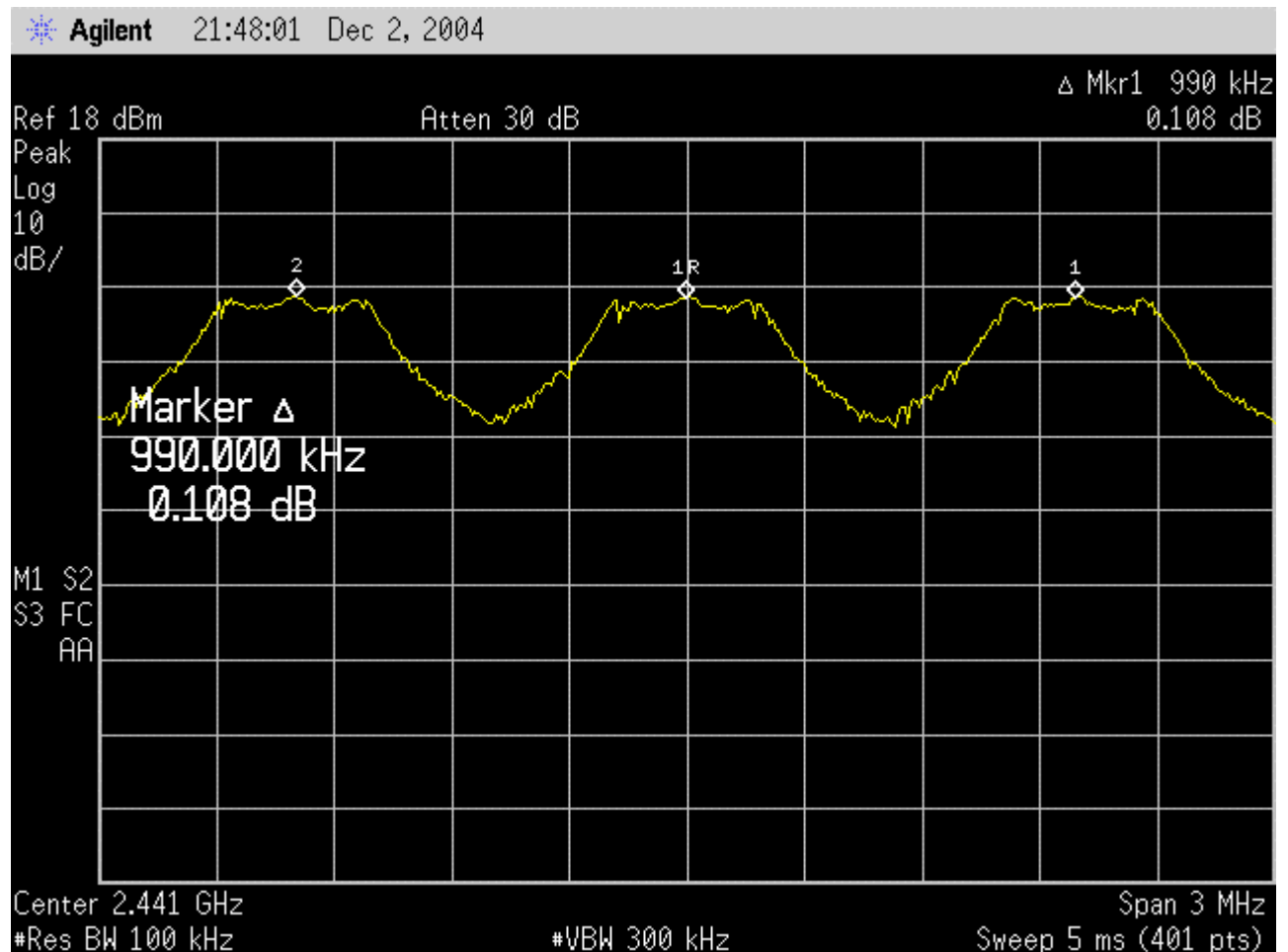
Subclause 15.247(a)(1)

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.

Test results

Reference frequency (MHz)	Channel Separation (kHz)	Limit	Results
2441.000	990	Minimum of 25kHz or the 20dB bandwidth	Pass

Carrier Frequency Separation Plot



7.4 Time of Occupancy(Dwell time)

Test Mode and conditions

Mode of operation : Hopping on , DH5 packet with PRBS9 payload
Measurement Method : Conducted
Detector : PK
Trace : Max hold
RBW/VBW : 100kHz/300kHz

Requirements

Subclause 15.247(a)(1)(iii)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 75 hopping frequencies. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

Test results

The system makes 1600 hops per second or has a length of 625us.

Let take DH5 packet in worst case. A DH5 packet has 5 slots for transmitting and 1 slot for receiving. It means it can have maximum 266.67 (=1600/6)hops per second.

Therefore it has 3.38 hops(=266.67/79) per second for each channel.

And it has 106.81hops appearance for 31.6 seconds (= 0.4x79channels).

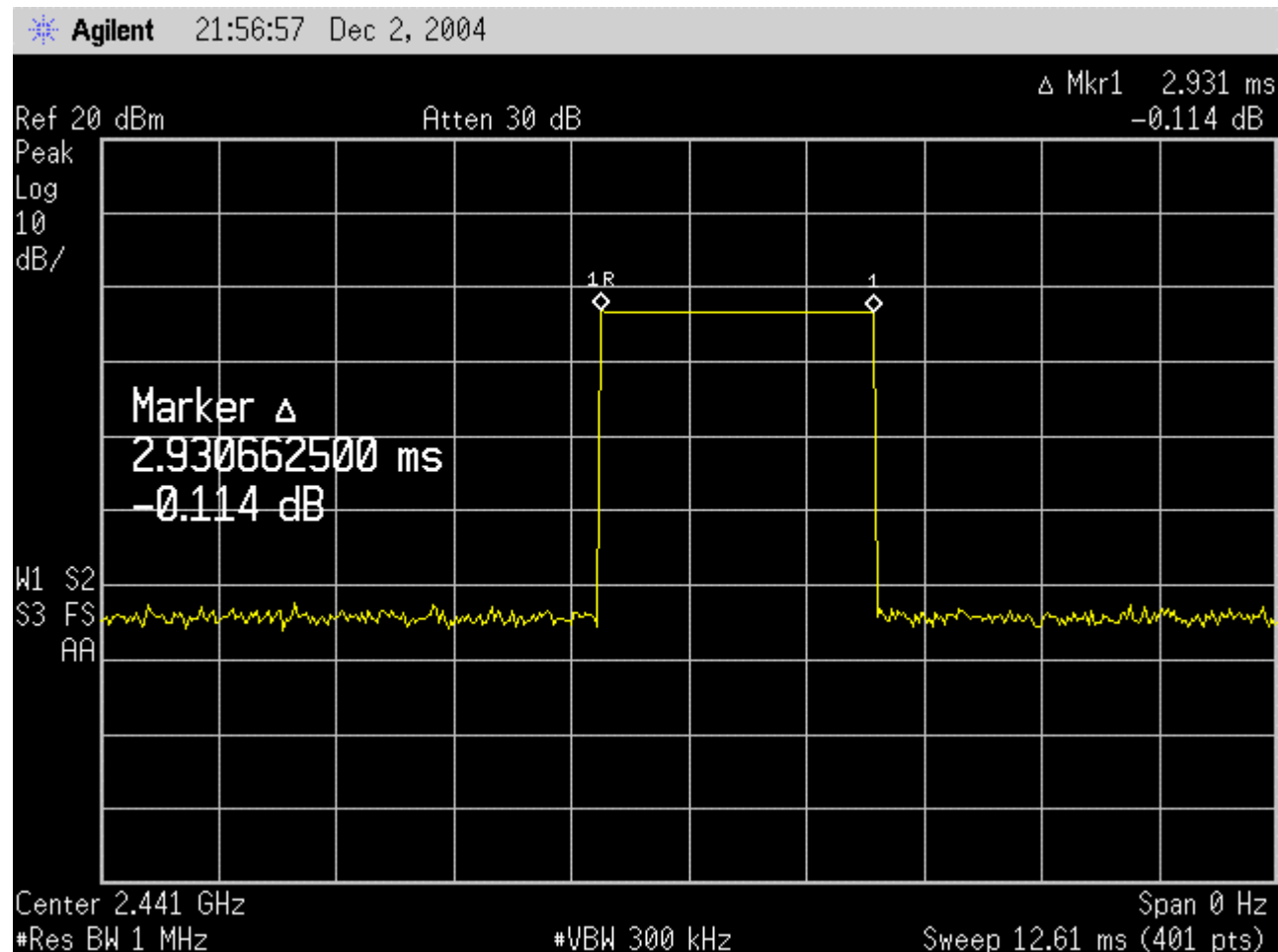
Each TX length per appearance is 2.89 ms.

i.e. The dwell time for DH5 Packet (in worst case) :

$$106.81 \times 2.93 \text{ ms} = 312.95 \text{ ms}$$

Dwell Time	Limit	Results
312.95 ms	0.4 seconds	Pass

Time of Occupancy Plot



7.5 20dB Bandwidth

Test Mode and conditions

Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz),
DH5 packet with PRBS9 payload
Measurement Method : Conducted
Detector : PK
Trace : Max hold
RBW/VBW : 30kHz/100kHz

Requirements

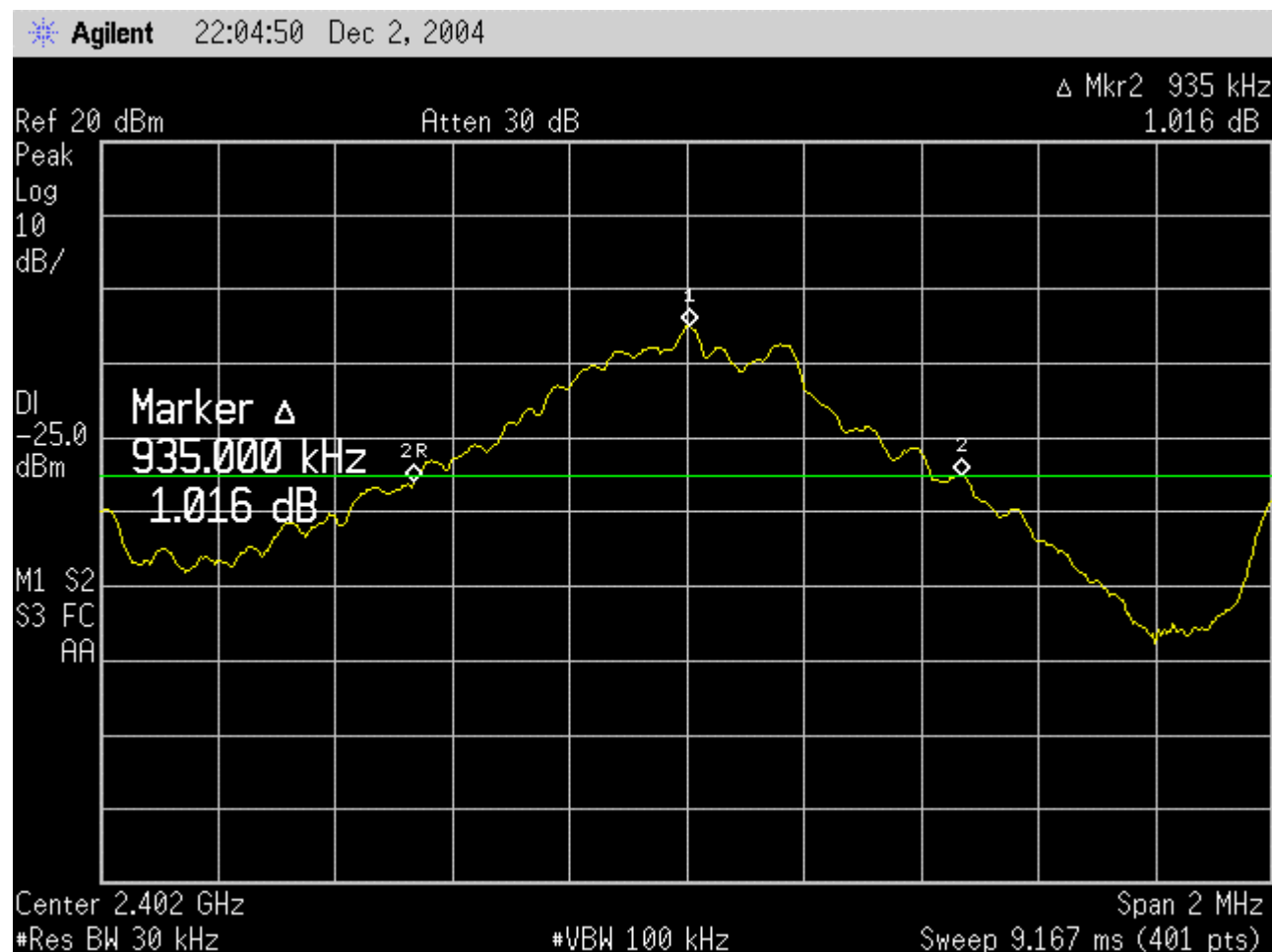
Subclause 15.247(a)(1)

It is mentioned implicitly as the maximum 20dB bandwidth of the hopping channel is 1Mhz.

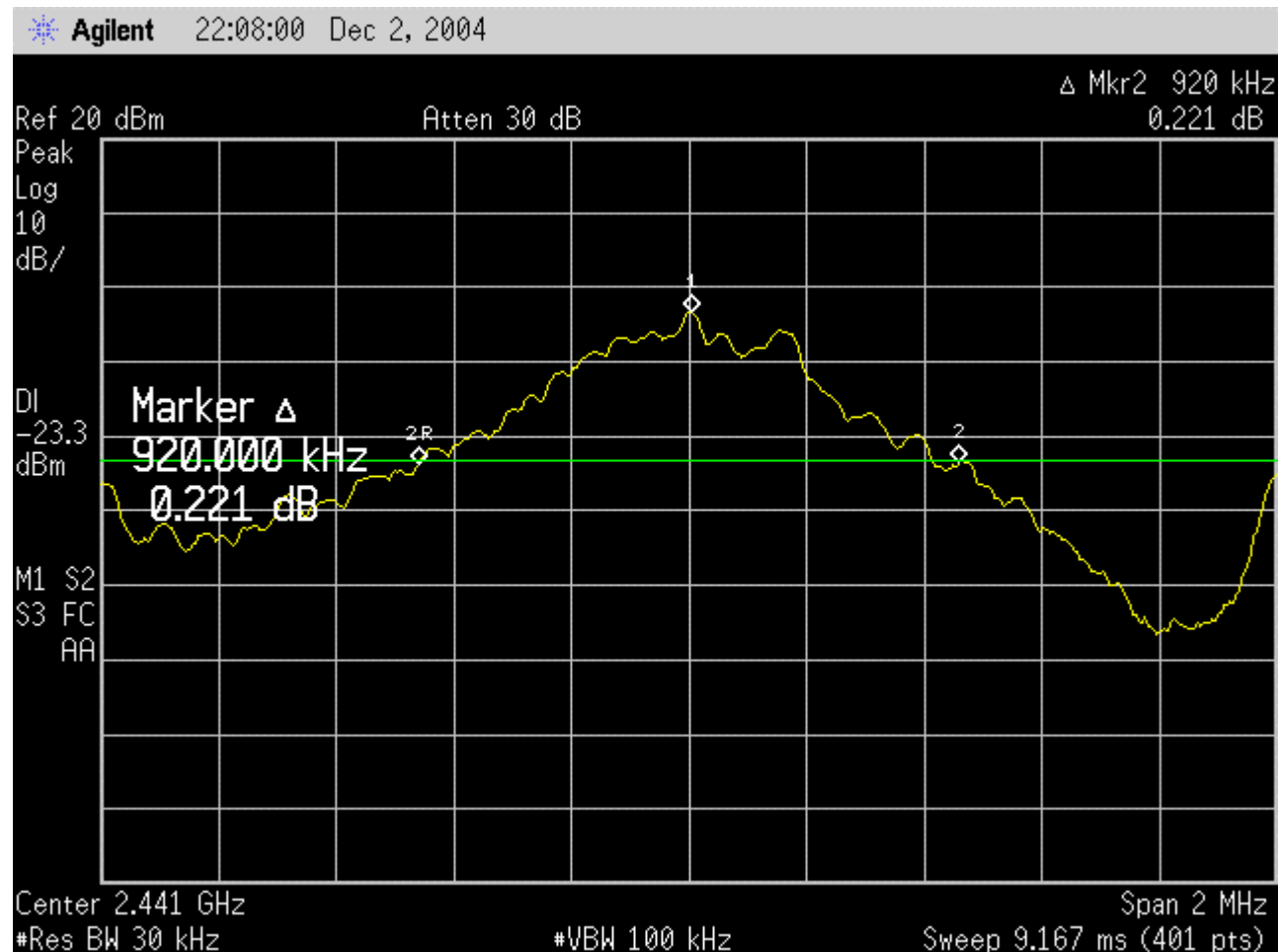
Test results

Operating frequency (MHz)	20dB Bandwidth (MHz)	Limit	Results
2402	0.935	< 1 Mhz	Pass
2441	0.920	< 1 Mhz	Pass
2480	0.930	< 1 Mhz	Pass

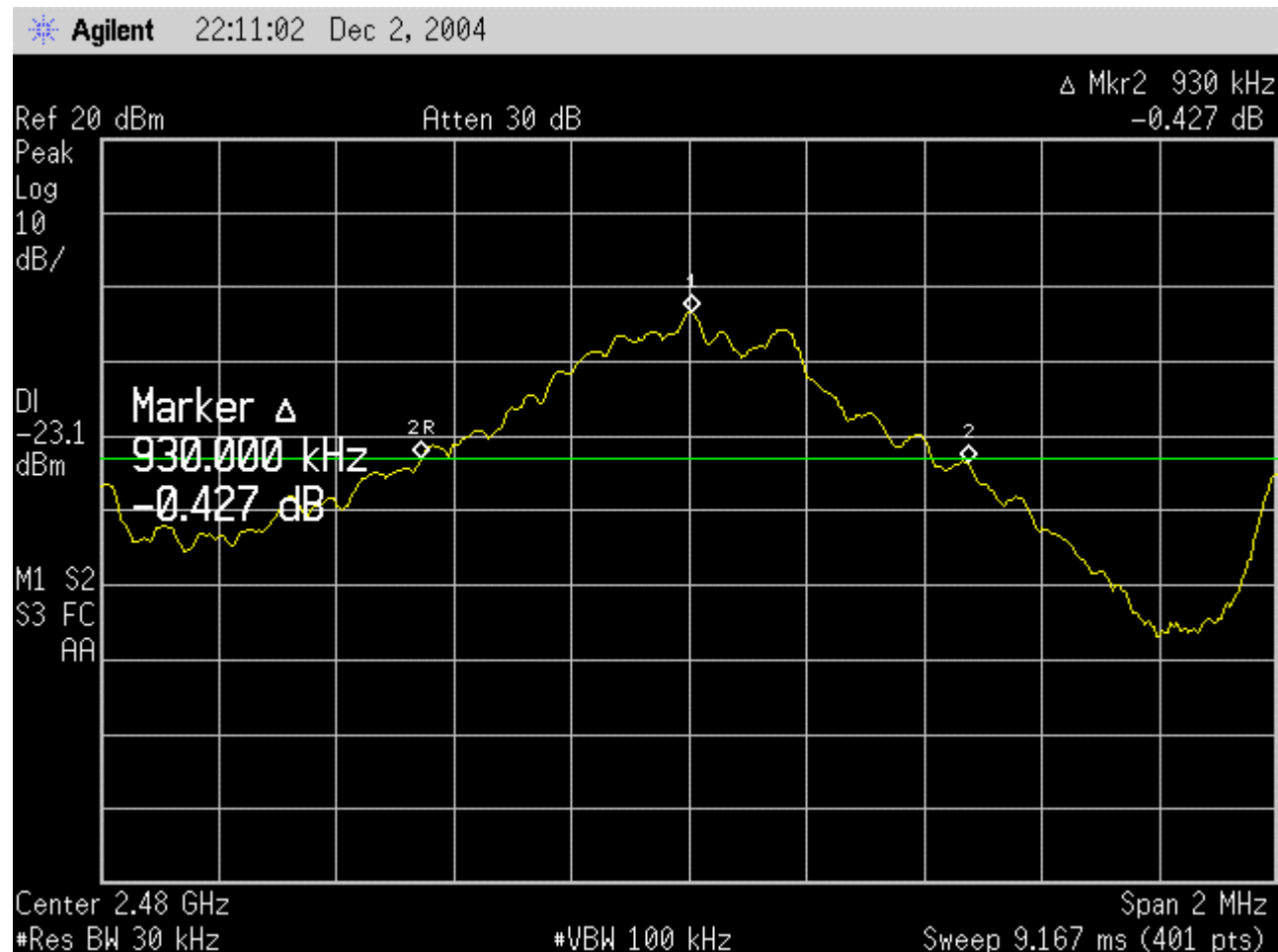
20dB Bandwidth Plot – 2402Mhz



20dB Bandwidth Plot – 2441Mhz



20dB Bandwidth Plot – 2480Mhz



7.6 Number of Hopping Frequencies Requirements

Test Mode and conditions

Mode of operation : Hopping, DH1 with PRBS9 payload
Measurement Method : Conducted
Detector : PK
Trace : Max hold
RBW/VBW : 100kHz/100kHz

Requirements

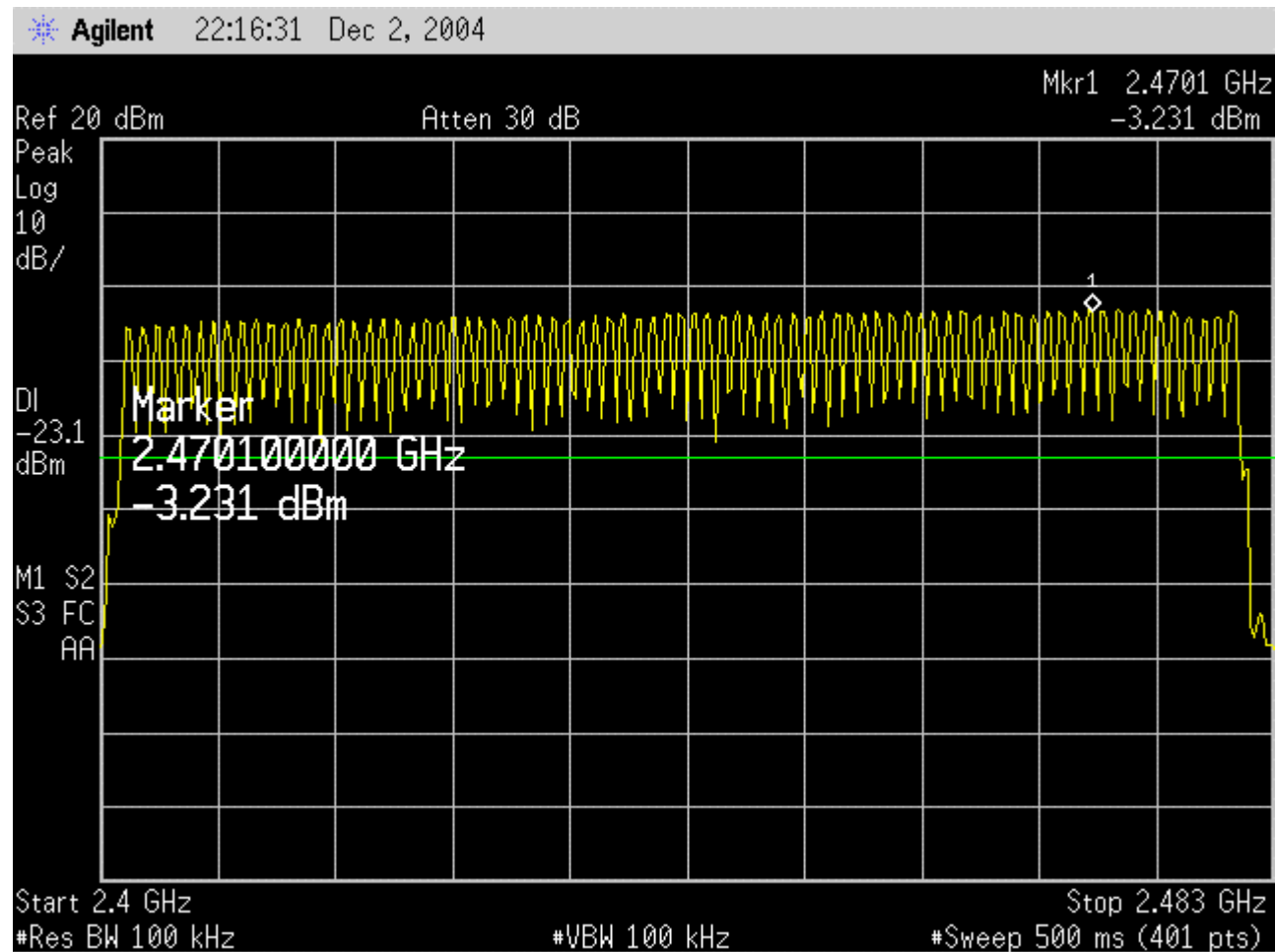
15.247(a)(1)(iii)

Frequency hopping systems in the 2400-2483.5 Mhz band shall use at least 15 non-overlapping Channels.

Test results

Operating frequency (MHz)	Number of Hopping	Limit	Results
2402~2480	79	≥ 15	Pass

Number of Hopping Frequencies Plot



7.7 Pseudorandom FHS and Equal Hopping Frequency use Requirements

Requirements

Subclause 15.247 (a)(1)

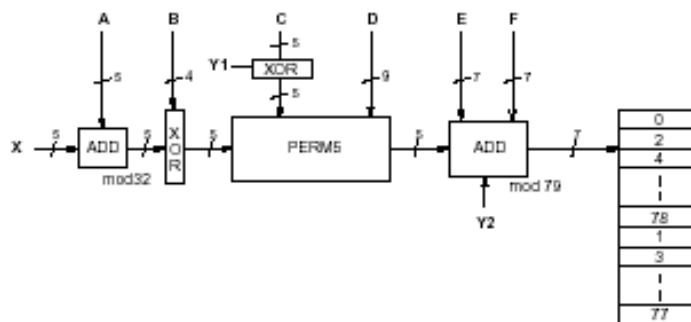
The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter.

RESULT

Complies

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. For details, refer to the figure 1. 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.

The algorithm in the Bluetooth specifications shows the each of its hopping channels is used equally on average also.



< Figure 1 : Block diagram of hop selection kernel for 79 hop system >

7.8 Receiver Input Bandwidth Requirements

Requirements

Subclause 15.247 (a)(1)

The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in the synchronization with the transmitted signals.

RESULT

Complies

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.

7.9 Peak Output Power

Test Mode and conditions

Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz),
DH1 packet with PRBS 9 payload
Measurement Method : Conducted
Detector : PK
Trace : Max hold
RBW/VBW : 1MHz/3MHz

Requirements

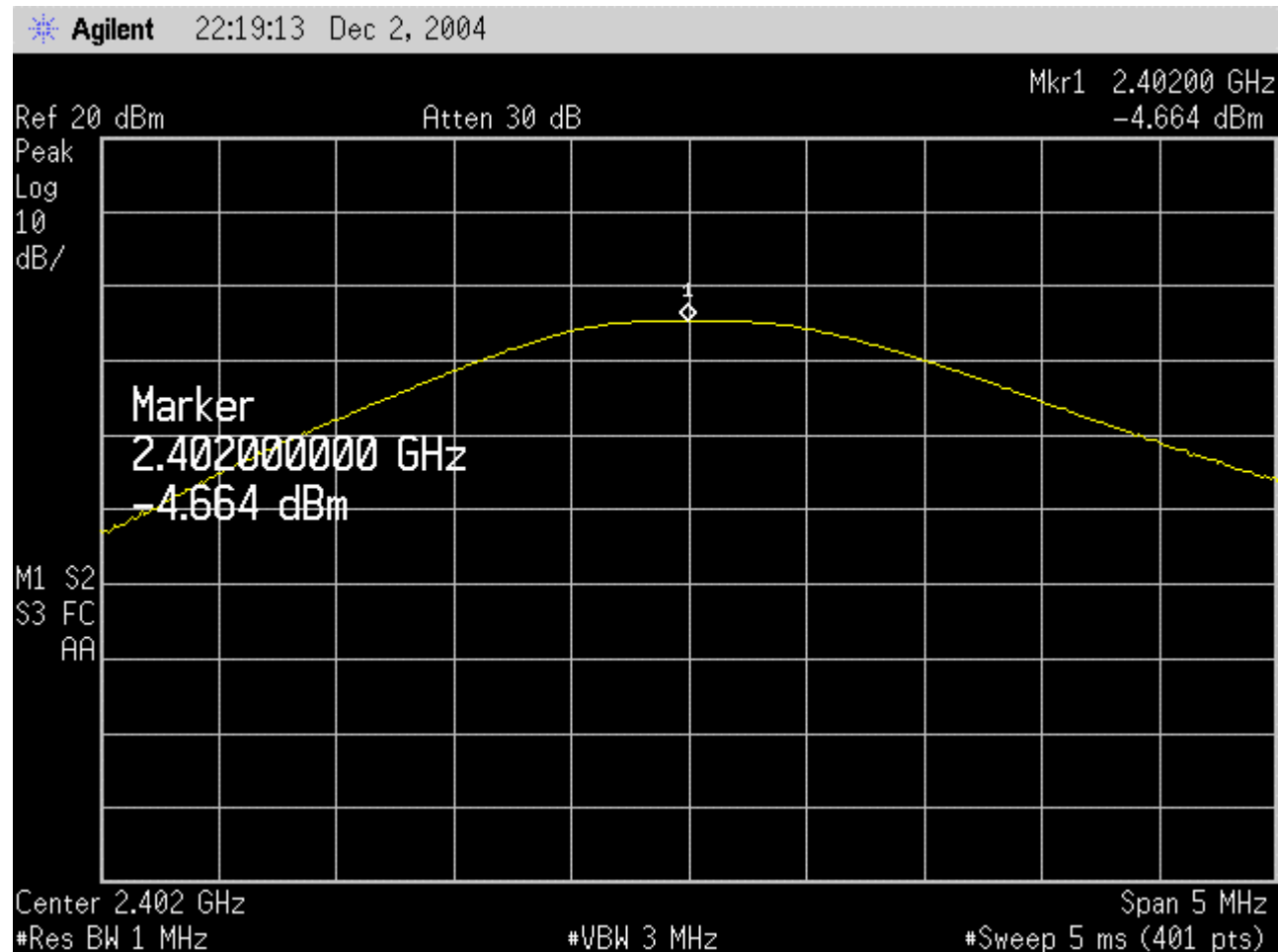
Subclause 15.247(b)(1)

For frequency hopping systems operating in the 2400~2483.5 Mhz band employing at least 75hopping channels, the maximum output power of the intentional radiator shall not exceeded 1 watt.

Test results

Operating Frequency (MHz)	Reading (dBm)	Cable attenuation (dB)	Actual Value (W)	Limit (W)	Results
2402	-4.664	1.80	0.000517	<1.0	Pass
2441	-3.190	1.83	0.000731	<1.0	Pass
2480	-3.007	1.85	0.000766	<1.0	Pass

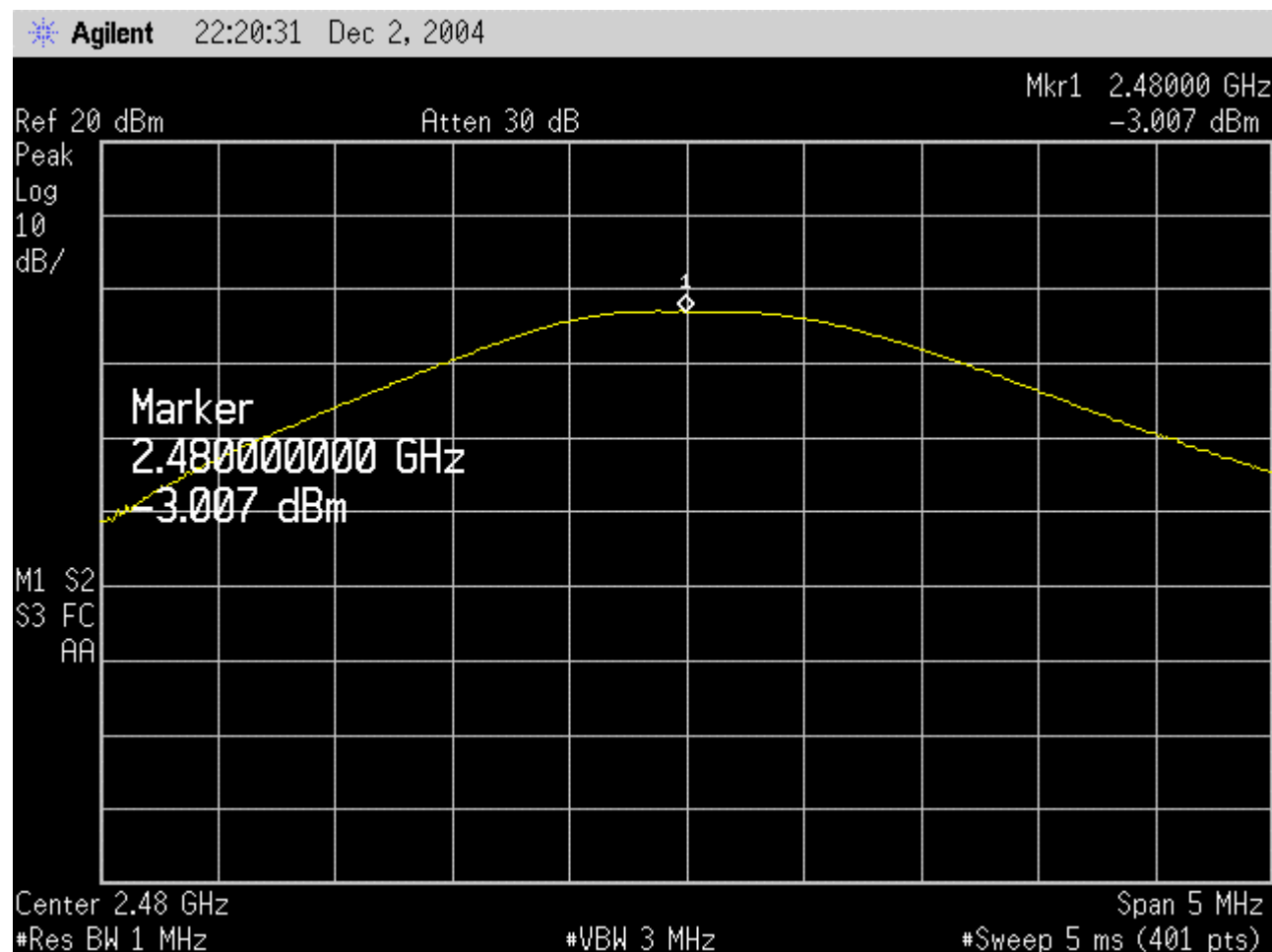
Peak Output Power Plot - 2402



Peak Output Power Plot – 2441



Peak Output Power Plot – 2480



7.10 Band-edge Compliance

Test Mode and conditions

Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz), DH1 packet
Measurement Method : Conducted
Detector : PK
Trace : Max hold
RBW/VBW : 300kHz/1.0MHz

Requirements

Subclause 15.247(c)

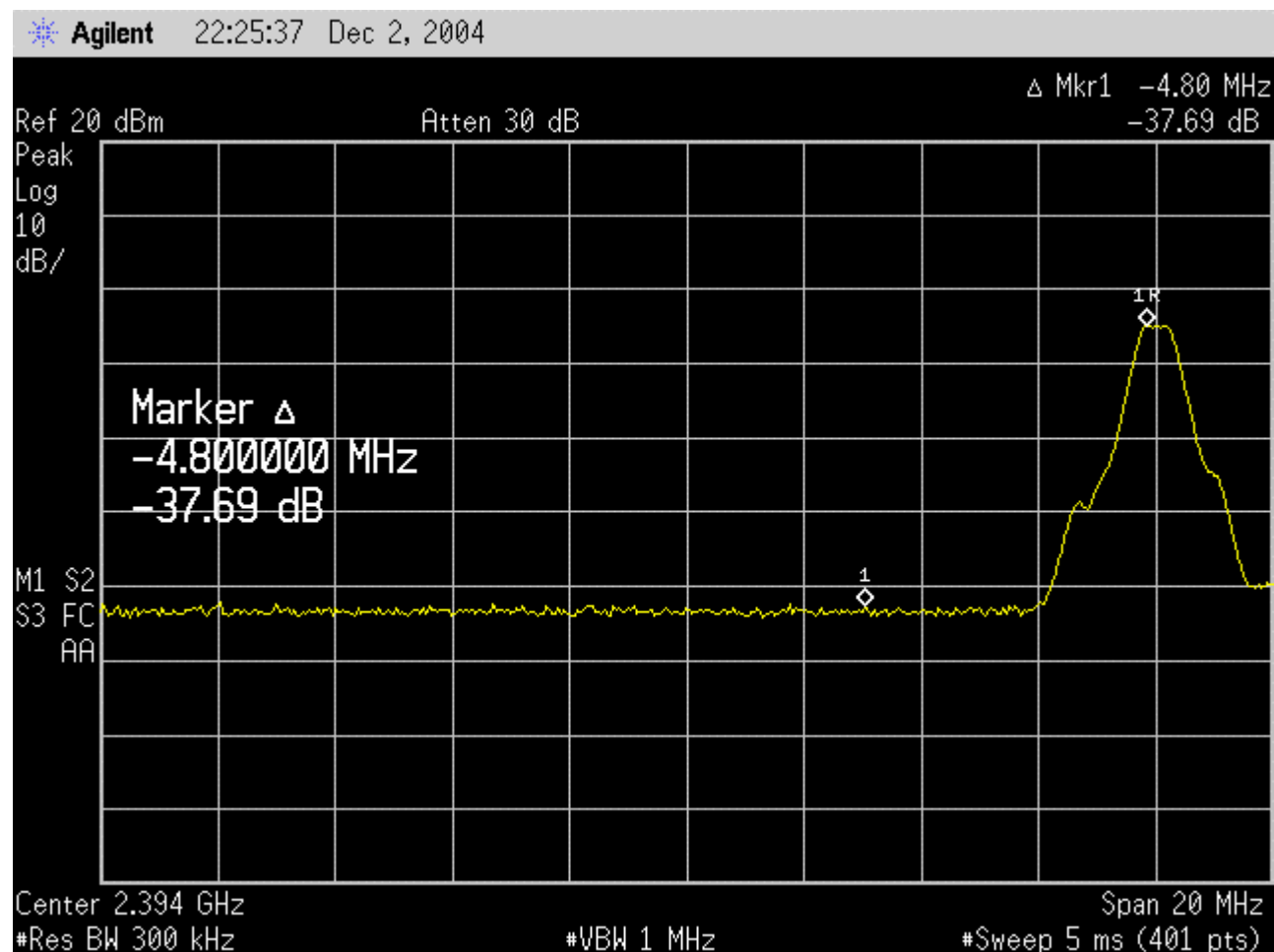
In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

Test results

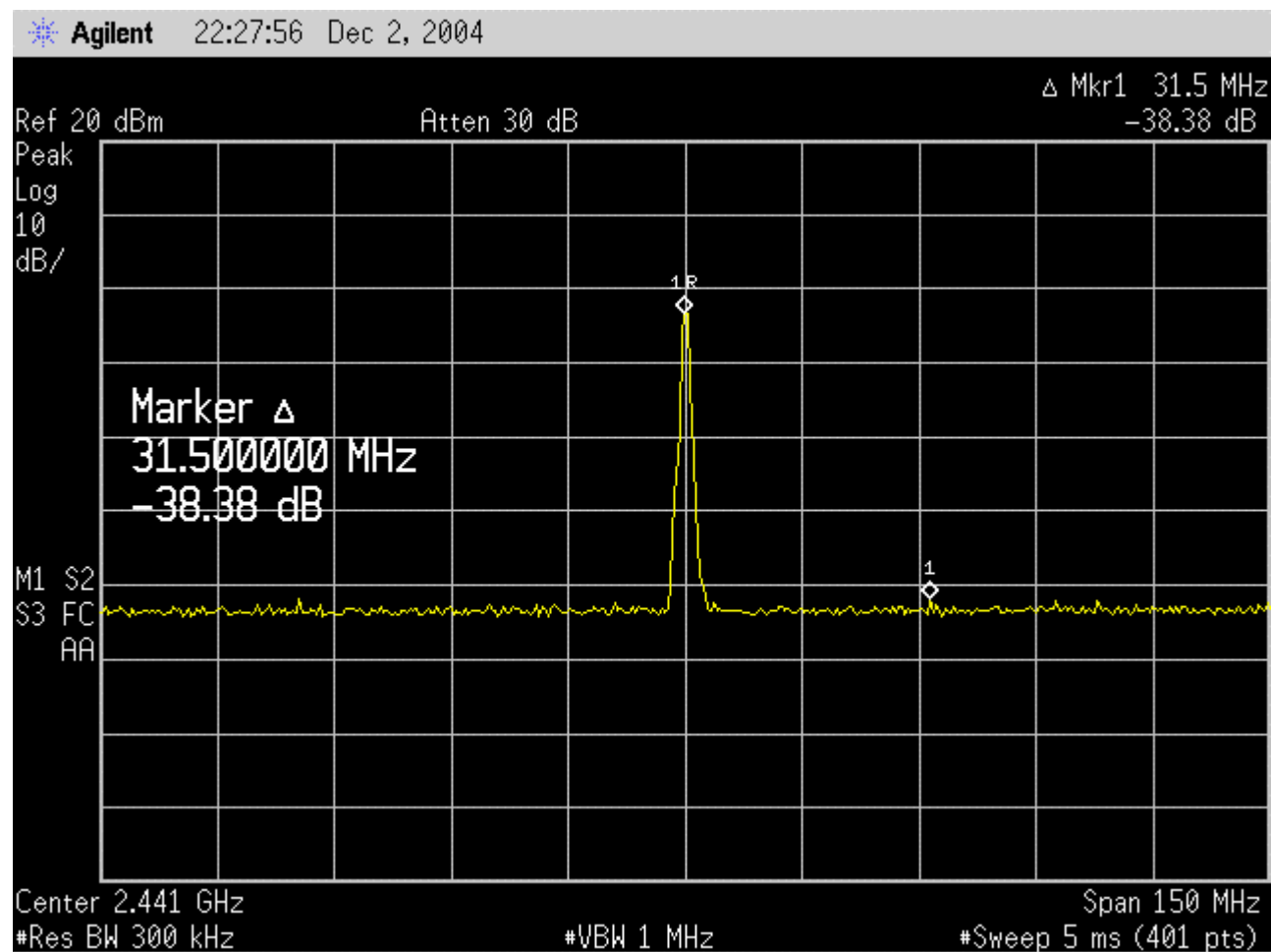
There is no peak found outside any 100kHz bandwidth of the operating frequency band in the three transmit frequency.

Tx Frequency (MHz)	RF power outside 100kHz BW (MHz)	Limit	Results
2402	No peak above 20dB	20dB below	Pass
2441	No peak above 20dB	20dB below	Pass
2480	No peak above 20dB	20dB below	Pass

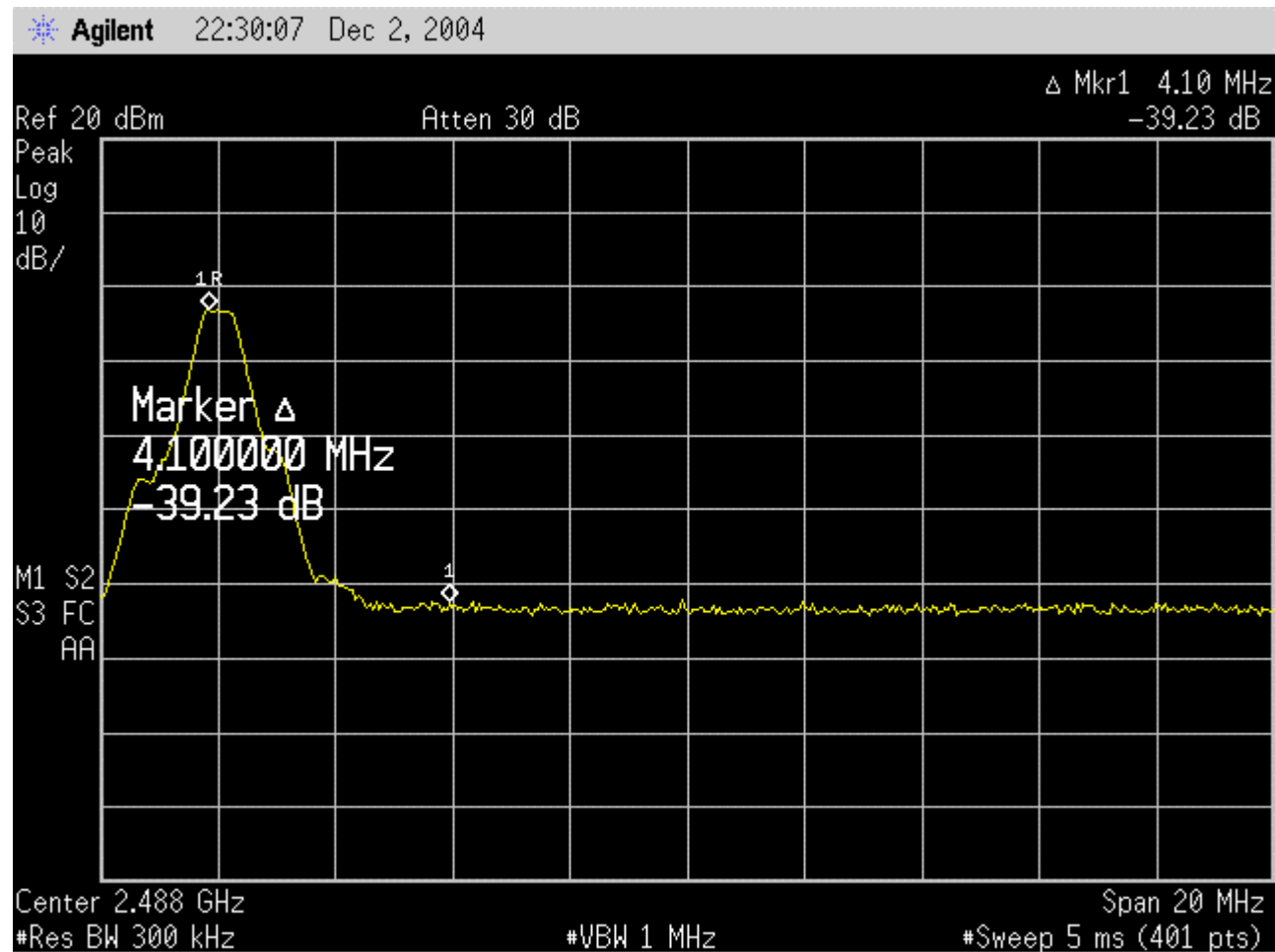
Band-edge Compliance Plot - 2402



Band-edge Compliance Plot – 2441



Band-edge Compliance Plot – 2480



7.11 Spurious Conducted emissions

Test Mode and conditions

Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz), DH1 packet
 Measurement Method : Conducted
 Detector : PK
 Trace : Max hold
 RBW/VBW : 100kHz/300kHz

Requirements

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. Attenuation below the general limits specified in Section 15.209(a) is not required.

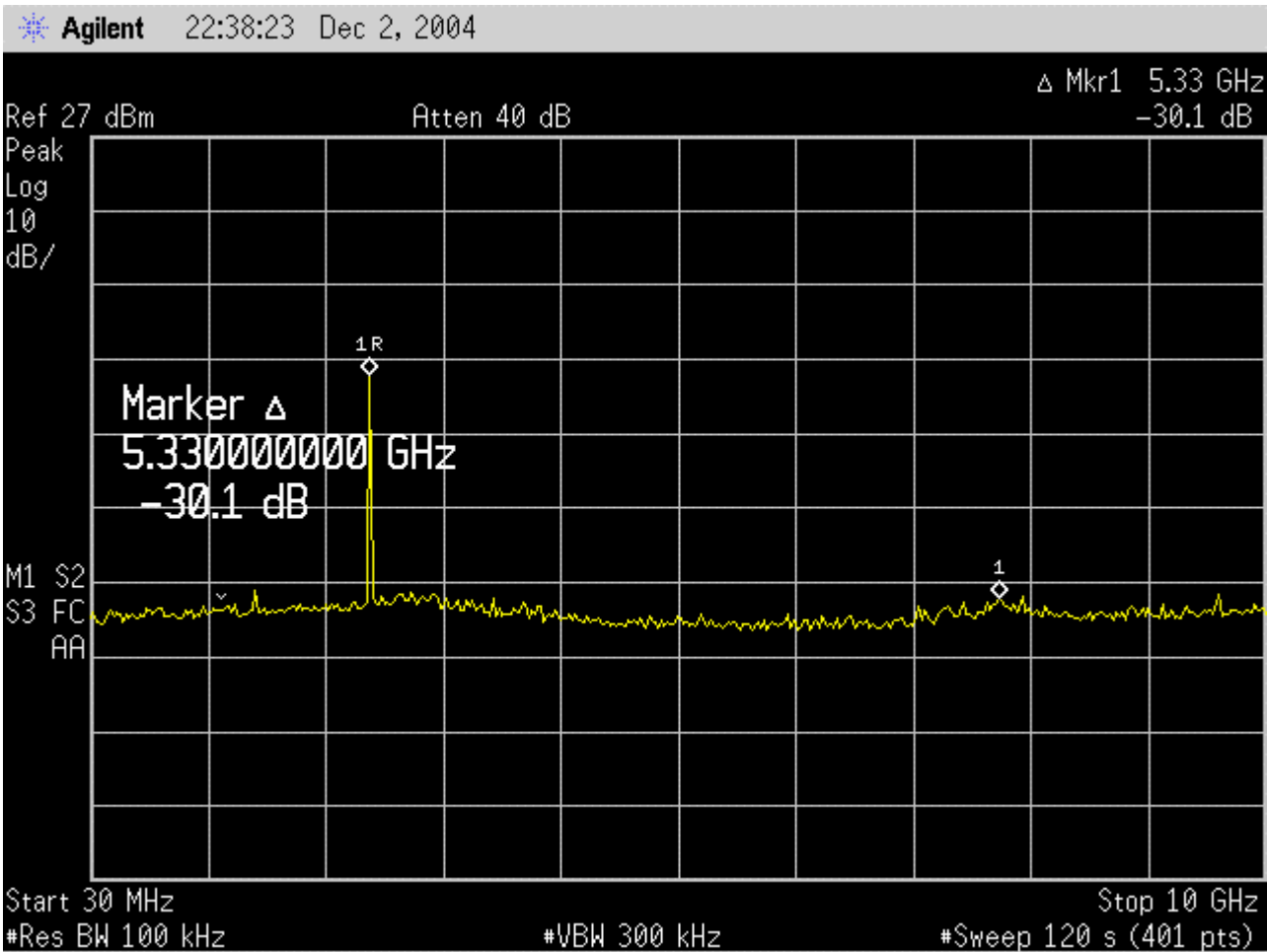
Test results

Frequency (MHz)	Reading Value (dBm)	Correction Factor (dB)	Results (dBm)	Reference Value (dBm)	Delta to Reference (dB)
<i>Operating frequency : 2402MHz</i>					
5330	-30.1	3.4	-26.7	-24.66	2.04
12500	-35.55	6.7	-28.85	-24.66	4.19
23880	-34.09	6.7	-27.39	-24.66	2.73

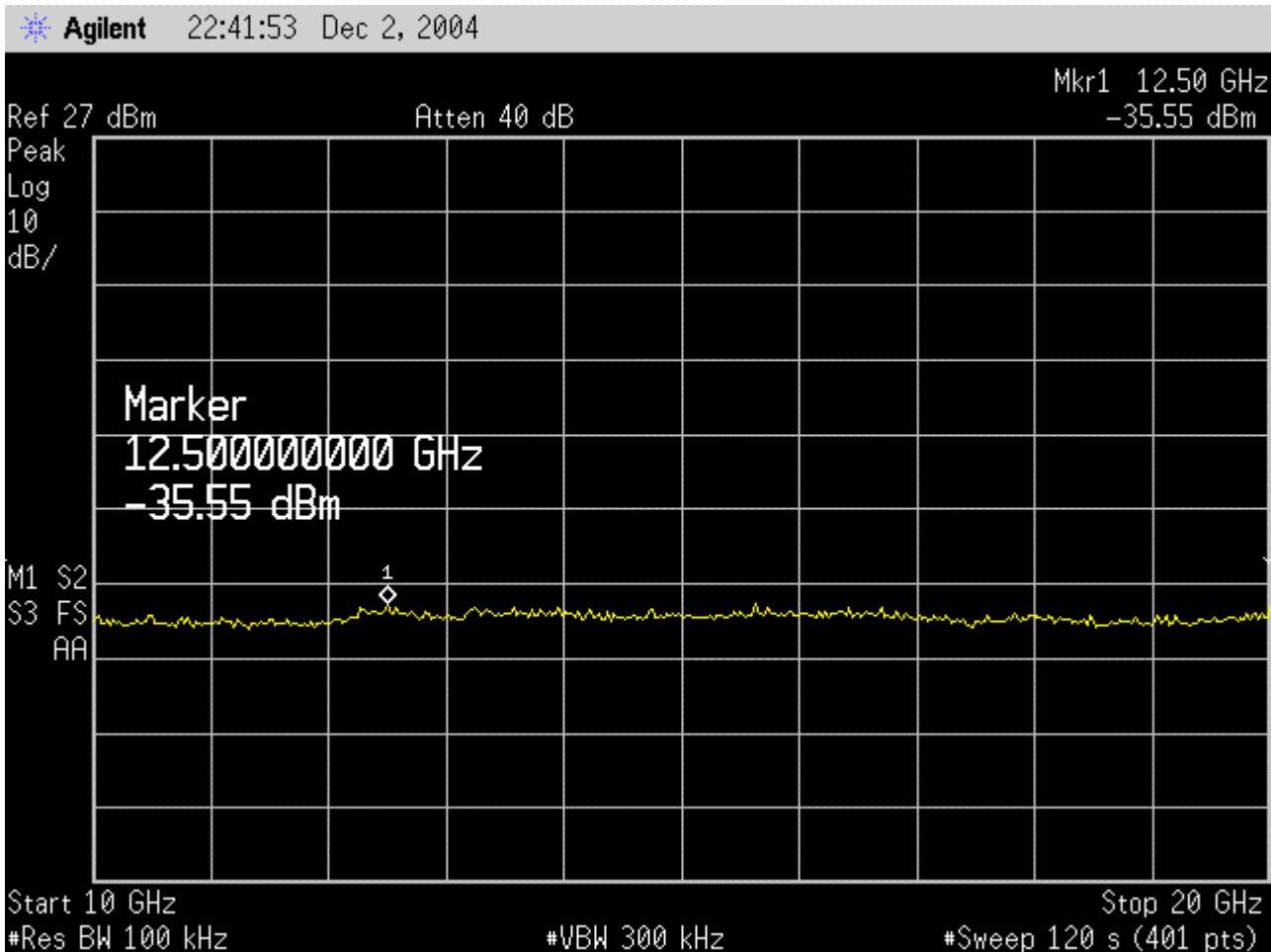
Frequency (MHz)	Reading Value (dBm)	Correction Factor (dB)	Results (dBm)	Reference Value (dBm)	Delta to Reference (dB)
<i>Operating frequency : 2441MHz</i>					
7760	-31.49	3.4	-28.09	-23.19	4.90
15650	-35.11	6.7	-28.41	-23.19	5.22
20380	-34.22	6.7	-27.52	-23.19	4.33

Frequency (MHz)	Reading Value (dBm)	Correction Factor (dB)	Results (dBm)	Reference Value (dBm)	Delta to Reference (dB)
<i>Operating frequency : 2480MHz</i>					
7410	-36.26	3.4	-32.86	-23	9.86
16380	-34.99	6.0	-28.99	-23	5.99
23690	-34.94	6.7	-28.24	-23	5.24

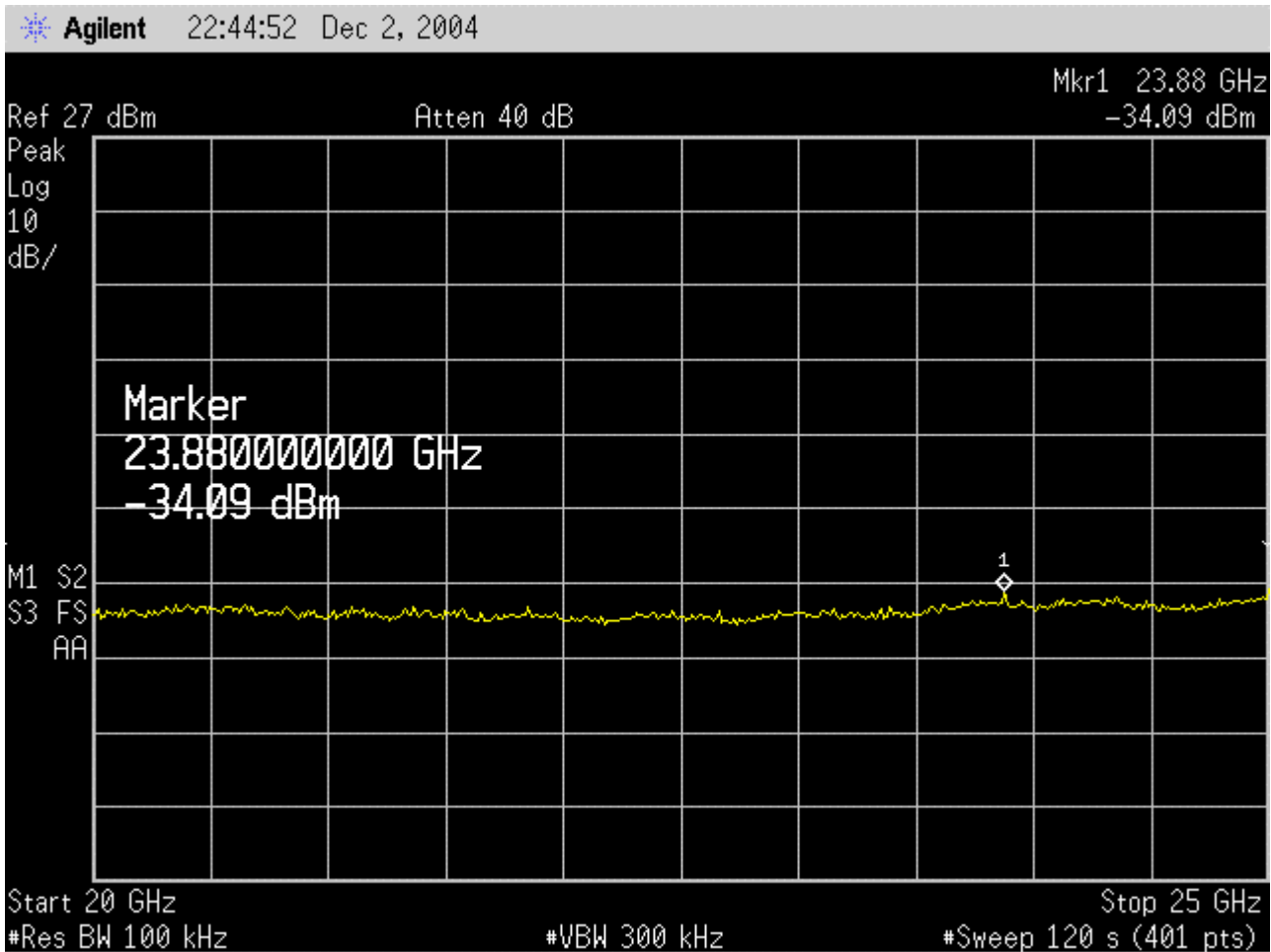
Spurious Conducted emissions plot- 2402 (30MHz~10GHz)



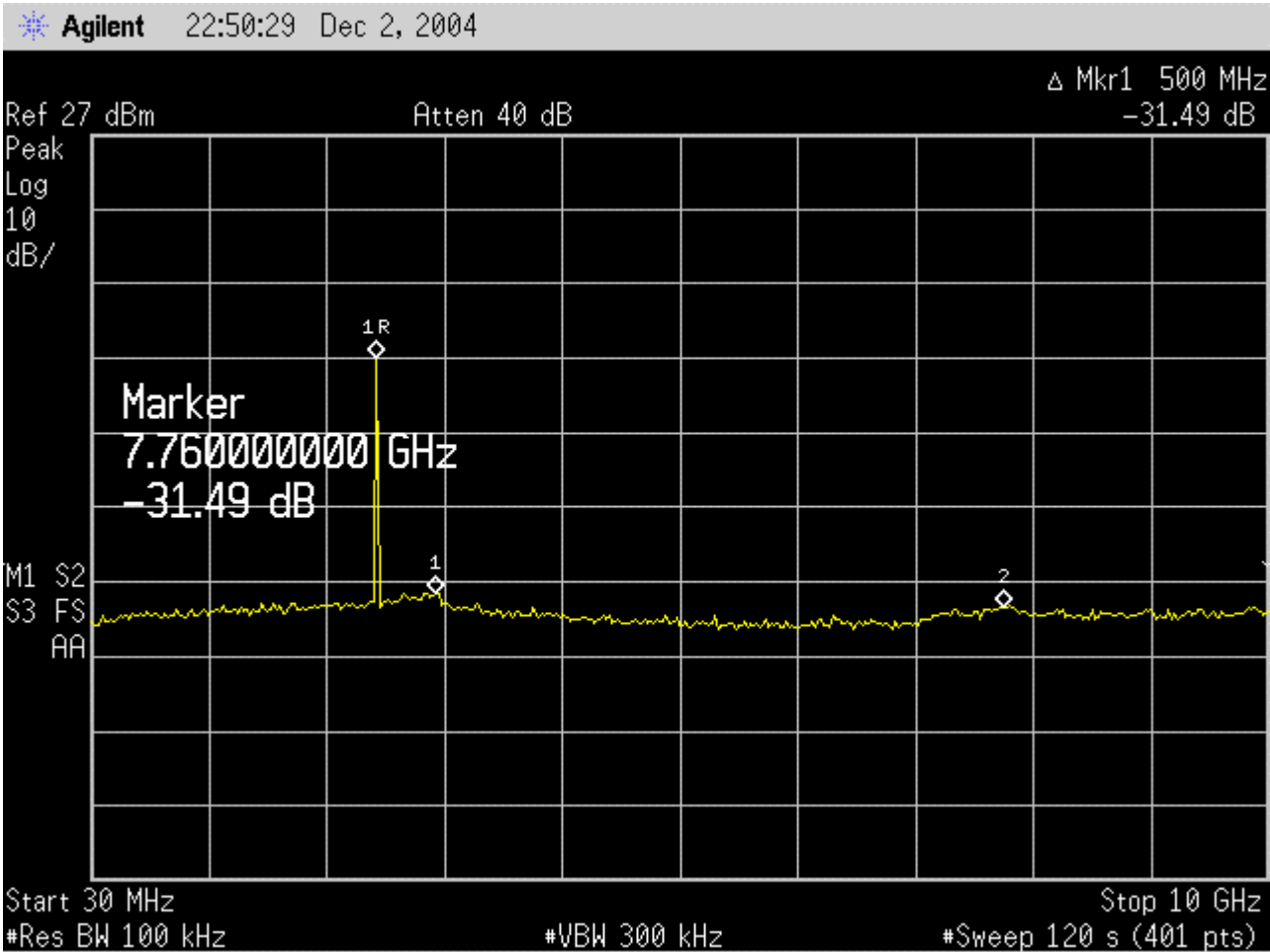
Spurious Conducted emissions plot- 2402 (10GHz~20GHz)



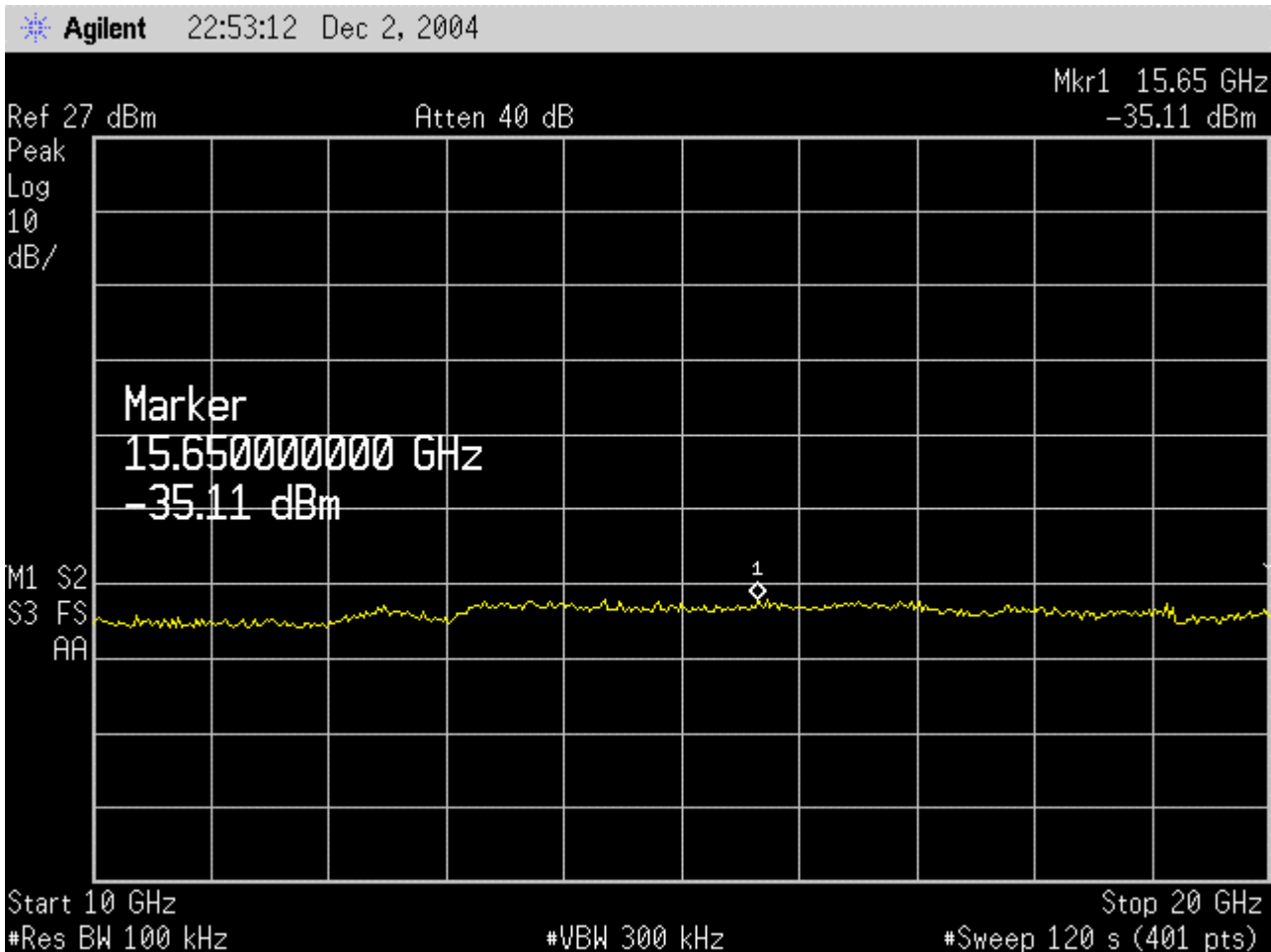
Spurious Conducted emissions plot- 2402 (20GHz~25GHz)



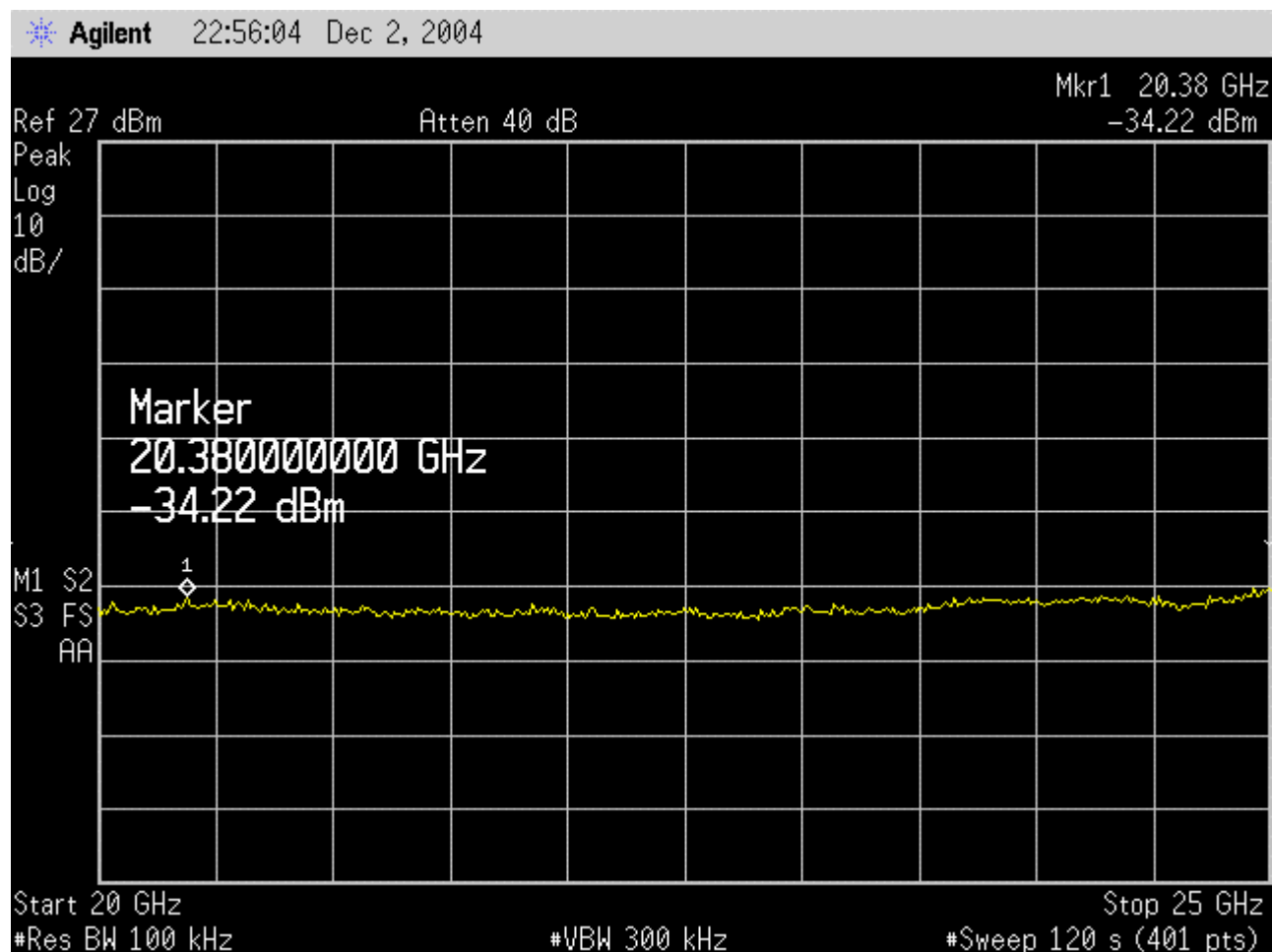
Spurious Conducted emissions plot- 2441 (30MHz~10GHz)



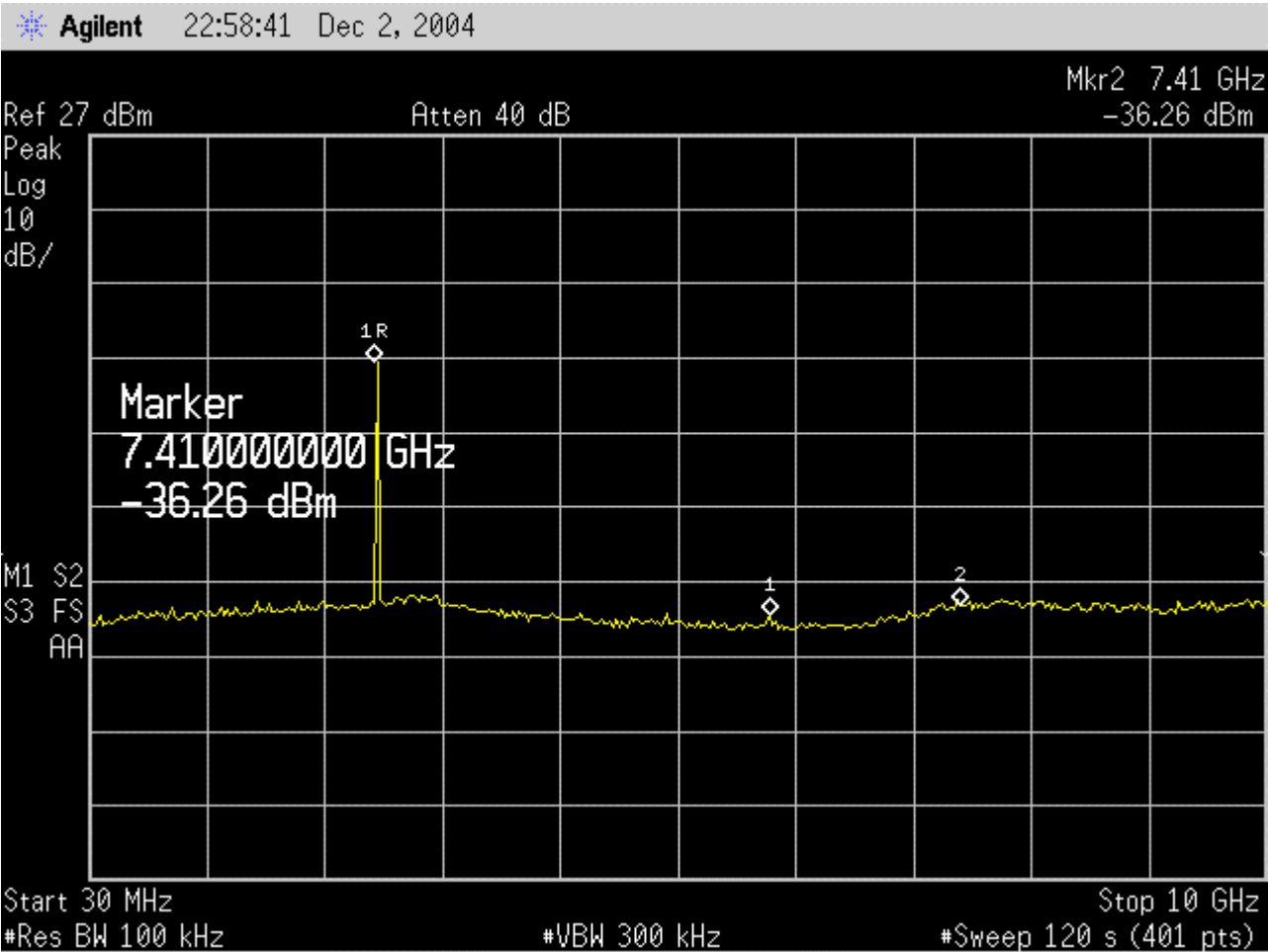
Spurious Conducted emissions plot- 2441 (10GHz~20GHz)



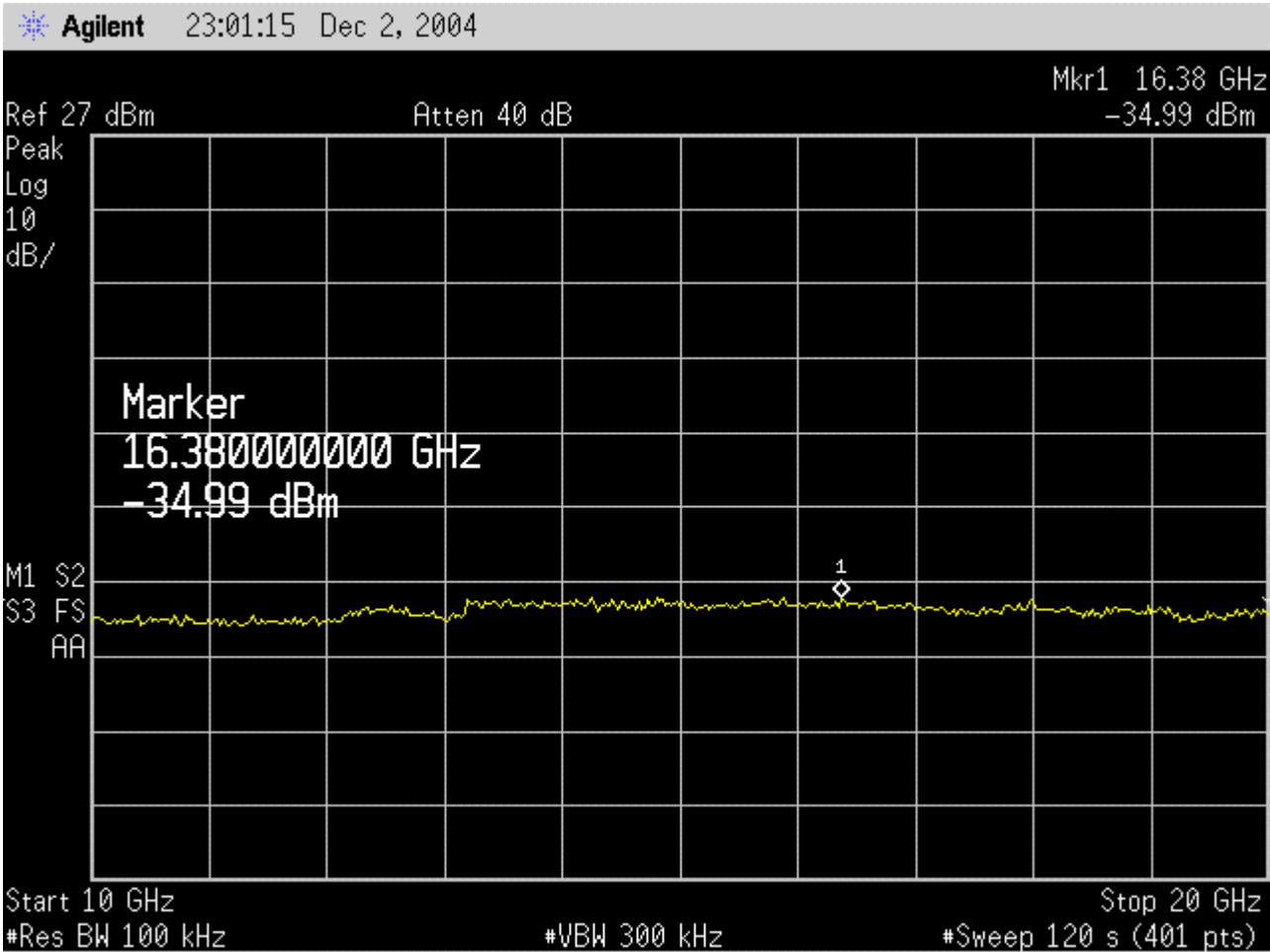
Spurious Conducted emissions plot- 2441 (20GHz~25GHz)



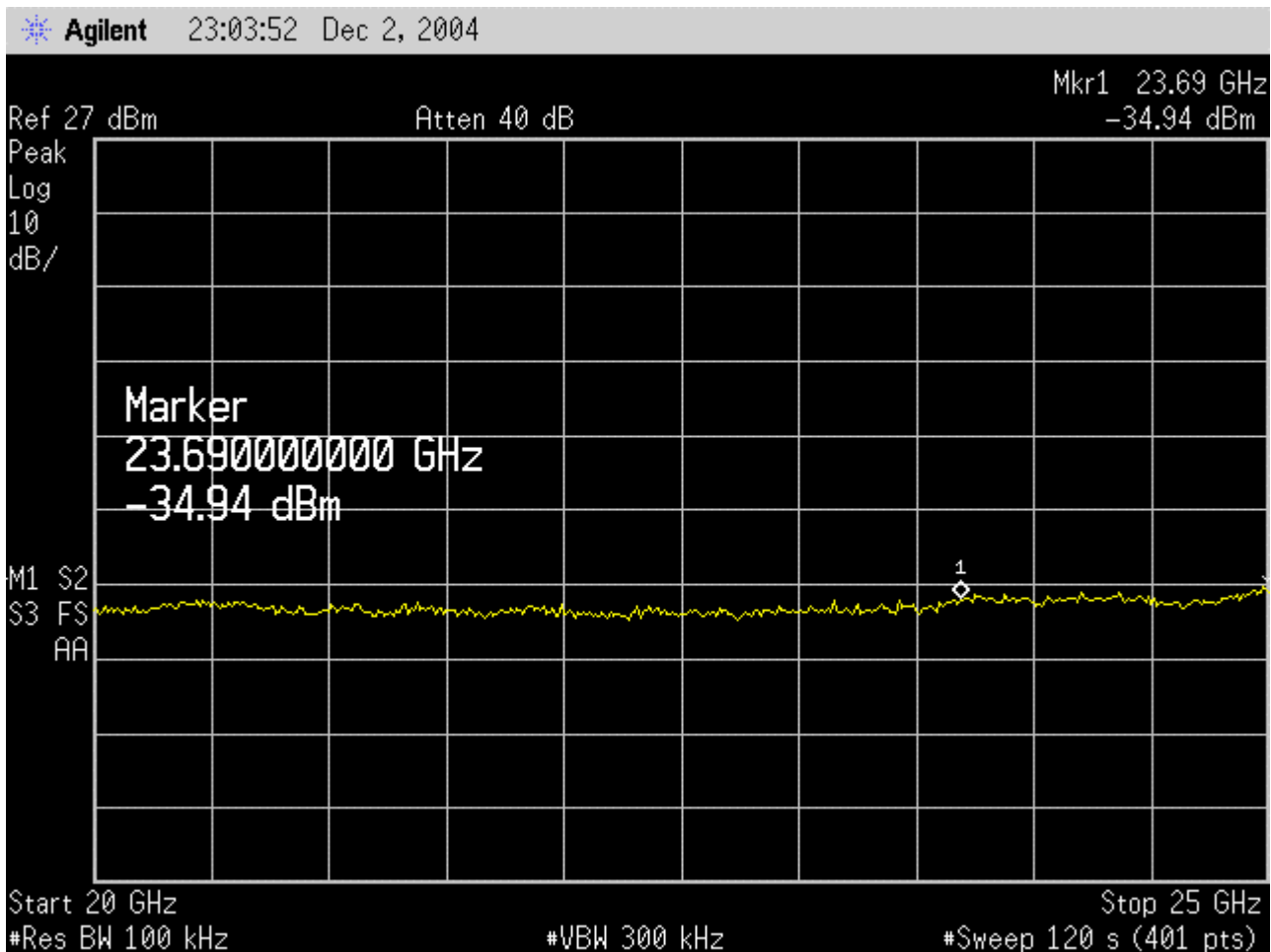
Spurious Conducted emissions plot- 2480 (30MHz~10GHz)



Spurious Conducted emissions plot- 2480 (10GHz~20GHz)



Spurious Conducted emissions plot- 2480 (20GHz~25GHz)



7.12 Spurious Radiated emissions

Test Mode and conditions

Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz),
DH1 packet

Detector : PK

Trace : Max hold

Measurement Method : Radiated- Enclosure

Measurement Distance : 3m

Measurement BW : 1 MHz for $f \geq 1$ GHz, 100kHz for $f < 1$ GHz

Requirements

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)).

According to Section 15.209(a) , except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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

** Except as provided in paragraph(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72Mhz, 76-88Mhz, 174-216Mhz or 470-806Mhz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

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

Test results

Frequency (MHz)	Polarization (H/V)	Corr. Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Table Angle (Deg.)	Ant. Height (m)
Operating frequency : 2402Mhz							
4803	V	11.9	56.54	74	17.46	154.5	2.58
4804	H	11.9	57.37	74	16.63	325.5	3.51

Frequency (MHz)	Polarization (H/V)	Corr. Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Table Angle (Deg.)	Ant. Height (m)
Operating frequency : 2441Mhz							
4883	V	11.9	56.23	74	17.77	103.5	4.20
4882	H	11.9	46.42	74	27.58	342.5	3.02

Frequency (MHz)	Polariz- ation (H/V)	Corr. Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Table Angle (Deg.)	Ant. Height (m)
Operating frequency : 2480Mhz							
4943	H	11.9	57.14	74	16.86	301.5	134.0
4958	V	11.9	53.67	74	20.33	164.5	2.58

Note :

1. Remark “*” means that the emission frequency is produced by local oscillator.
2. Remark “-” means that the emission level is too low to be measured.
3. The measurement uncertainty of the radiated emission test is $\pm 3\text{dB}$

8. List of Test and Measurement Instruments

	Kind of Equipment	Type	Manufacturer	S/N
☒	EMI Test Receiver	ESMI	R/S	1032.5510.53
☐	Spectrum Analyzer	FSP30	R/S	1093.4495.30
☐	Tracking Generator	ESMI-B1	R/S	1033.3240.52
☐	Spectrum Analyzer	8566B	HP	3638A0857E
☒	Spectrum Analyzer	E4407B	HP	MY41310181
☐	Wave Dipole Antenna	HZ-12	R/S	842006/0012
☐	Wave Dipole Antenna	HZ-12	R/S	846556/0004
☒	Biconical Antenna	3104C	EMCO	9408-4667
☐	Biconical Antenna	3109	EMCO	9405-2812
☒	Log-Periodic Antenna	3146A	EMCO	1064
☐	Biconilog Antenna	3142	EMCO	9710-1220
☐	V-Network	ESH3-Z5	R/S	847265/030
☐	V-Network	ESH3-Z6	R/S	847250/016
☐	T-Network	E-Z10	R/S	84480/011
☐	LISN	6338-5-PJ-50-N	Solar	953938/953939
☒	Turn Table	2081	EMCO	
☒	Antenna Tower	2075	EMCO	
☒	Multi Device Controller	2090	EMCO	9708-1255
☐	Printer	C4569A	HP	SG78K1H1FS
☐	Absorbing Clamp	MDS 21	R/S	847905/005
☐	Signal Generator	2023	MARCONI	112246067
☐	Swept Signal Generator	83620B	HP	3722A00549
☐	10dB Attenuator	23-10-34	Weinschel co	BD4316
☐	10dB Attenuator	33-10-34	Weinschel co	BB9784
☒	Antenna	3142	EMCO	9710-1220
☒	Antenna	3115	EMCO	9511-4612

☒	Antenna	3160-08	EMCO	1168
☒	Antenna	3160-09	EMCO	1304
☒	Amplifier	HP8447F	HP	3113A06911
☒	Amplifier	HP83006	HP	3104A00611
☒	Amplifier	HP8449B	HP	3008A00859
☒	EMI test receiver	ESCS30	R&S	839809/003
☒	Artificial mains network	ESH2-Z5	R&S	829991/009
☒	Artificial hand	FCC-AH-1	Fischer custom communications Inc.	2008

9. Complementary Materials

9.1 ID Label and Location Information

9.2 Operational Description

9.3 Test Setup Photos

9.4 Internal Photos

9.5 External Photos

9.6 User Manual

9.7 Technical Documents

- **Schematics**
- **Block Diagram**
- **Bill of Materials**