Emission Test Report
Standard: FCC Part 15 Subpart C / IC RSS-210

Document Number : FCC 19-0211-0

Product: Intel PRO/Wireless LAN 2100 3B Mini PCI Adapter

measured with **IBM ThinkPad T40 Series**

FCC ID: ANO20020201CLK
IC: 349E-WM3B2100

February 3, 2003

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MEASUREMENT / TECHNICAL REPORT – Part 15 Subpart C
(Intentional Radiator)

Intel PRO/Wireless LAN 2100 3B Mini PCI Adapter
(with ThinkPad T40 Series)

FCC ID : ANO20020201CLK

February 3, 2003

This report concerns: (check one)
Original Grant ✓
Class I change
Class II change

Equipment type: Wireless LAN device

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The measurement results contained in this report relate only to the item which was tested.

Measurement procedure used is ANSI C63.4-2000 unless otherwise specified.
Other test procedure:

The FCC has issued provisional acceptance of this test laboratory for Declaration of Conformity testing per letter dated 1997.

APPLICANT ANTI-DRUG ABUSE CERTIFICATION:
By checking yes, the applicant certifies that, in the case of an individual applicant, he or she is not subject to a denial of federal benefits, that includes FCC benefits, pursuant to Section 5301 of the Anti-Drug Abuse of 1988, 21 U.S.C. 853(a), or, in the case of a non-individual applicant (e.g. corporation, partnership or other unincorporated association), no party to the application is subject to a denial of federal benefits, that includes FCC benefits, pursuant to that section. For the definition of a "party" for these purposes, see 47 CFR 1.2002(b).

(Yes) or No

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A. General Information

APPLICANT	: IBM Japan, Ltd.
TEST SITE	: IBM Japan, Ltd., Yamato Semi-anechoic chamber #1
TEST SITE ADDRESS	: 1623 – 14 Shimotsuruma, Yamato-shi, Kanagawa 242-8502 Japan Tel: +81-46-215-4779, Fax: +81-46-273-7420
REGULATION	: FCC Part 15 Subpart C Industry Canada RSS-210 (Issue No.5)
MODEL NAME	: Intel PRO/Wireless LAN 2100 3B Mini PCI Adapter
FCC ID IC Certification Number	: ANO20020201CLK : 349E-WM3B2100
SERIAL NUMBER	: 0004234572F6
PYSICAL CONDITION	: Preproduction
KIND OF EQUIPMENT	: DTS: IEEE802.11b Wireless LAN Mini-PCI card
TESTED DATE	: January 28, 29, 30 and 31, 2003

A.1 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4-2000.
Radiated testing was performed at an antenna to EUT distance of 3 meters.

A.2 Test Facility / NVLAP Accreditation

The semi-anechoic chamber #2 used to correct the data are located in Yamato Laboratory, IBM Japan.

- This facility has been fully described in a report dated September 1998, submitted to the FCC office, and accepted in a letter, dated Nov. 2,1998(31040/SIT).
- IBM Yamato EMC Engineering is recognized under the National Voluntary Laboratory Accreditation Program for satisfactory compliance with Criteria established in Title 15, Part 285 Code of Federal Regulations.(NVLAP Lab code: 200198-0)
- This facility is accepted by **Industry Canada** in a letter dated March 19, 2001 as number **IC 349E** for chamber #2, and January 25, 2002 as number **IC 4221** for chamber #1.

A.3 EUT details

Table A EUT details

Model and S/N	**FCC ID** **IC Certification Number**	**Description**
Intel PRO/Wireless LAN 2100 3B Mini PCI Adapter (s/n 0004234572F6)	FCC ID: ANO20020201CLK IC:349E-WM3B2100	**Applying modular transmitter** Built_in type IEEE802.11b Wireless LAN Mini-PCI card without antenna
ThinkPad T40 Series M/T 2373-92U (s/n ZZ-00129)	N/A	Host equipment IBM Notebook PC with built_in antenna CPU: Intel® Pentium® M Processor, 1.6GHz
P/N 02K6746	N/A	Universal AC adapter 72W, Unshielded power cord

B. Summary of Test Results

Table-B presents the list of the measurement items for Spread Spectrum, Direct Sequence devices under FCC Part 15 Subpart C and Industry Canada RSS-210.
The section numbers of upper portion are showing FCC number, and the other (lower) ones are for IC.

Table-B List of the measurements

Section(s)	Test Items		Condition	Result
	Transmit mode (TX):			
15.247(a)(2) **5.9.1**	Bandwidth at 6 dB below		Conducted	Pass
15.247(c) **5.9.1** **6.2.2 (o) (e1)**	Occupied BW (or Band-edge) Out of Band Emissions (Bandwidth at 20 dB below)	The radiated emission in any 100kHz of outband shall be at least 20dB below the highest inband spectral density.	Conducted	Pass
15.247(b) **6.2.2 (o) (b)**	Transmitter output power	Shall not exceed 1.0 W.	Conducted	Pass
15.247(d) **6.2.2 (o) (b)**	Transmitter power spectral Density	Shall not be greater than 8 dBm in any 3kHz band.	Conducted	Pass
15.207 **6.6**	AC Wireline Conducted Emissions 150kHz - 30MHz	Class B: Freq.(MHz) QP(dBμV) Ave.(dBμV) 0.15 - 0.5 66 - 56 56 - 46 0.5 - 5 56 46 5 - 30 60 50	Conducted	Pass
15.205 / 209 **6.2.1 / 6.3**	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Shall not exceed the limits specified in FCC 15.209 or RSS-210 Table3.	Radiated (30MHz - 1GHz)	Pass
			Radiated (1– 25GHz)	Pass

	Receive mode (RX):			
15.207 **7.4**	AC Wireline Conducted Emissions 150kHz - 30MHz	Class B: Freq.(MHz) QP(dBμV) Ave.(dBμV) 0.15 - 0.5 66 - 56 56 - 46 0.5 - 5 56 46 5 - 30 60 50	Conducted	Pass
15.209 **7.3**	General Field Strength Limits (Radiated Emission Limits)	Shall not exceed the limits specified in RSS-210.	Radiated (30MHz - 1GHz)	Pass
			Radiated (1– 25GHz)	Pass

C. Operation Mode of EUT

All tests were performed using the “CRTU Program”, Version 1.1.5. Three kinds of modulation are used for transmission with appropriate bit rates:

Table C-1 Transmit mode (TX)

Operation Frequency [GHz]	Rated output power (conducted) [dBm]		Test performed
	Bit rate 1/2Mbps	Bit rate 5.5/11Mbps	
2.412 (Ch. 1)	+17	+17	X
2.417 (Ch. 2)	+17	+17	
2.422 (Ch. 3)	+17	+17	
2.427 (Ch. 4)	+17	+17	
2.432 (Ch. 5)	+17	+17	
2.437 (Ch. 6)	+17	+17	X
2.442 (Ch. 7)	+17	+17	
2.447 (Ch. 8)	+17	+17	
2.452 (Ch. 9)	+17	+17	
2.457 (Ch. 10)	+17	+17	
2.462 (Ch. 11)	+17	+17	X

Table C-2 Receive mode (RX)

Operation Frequency [GHz]	Test performed
2.412 (Ch. 1)	
2.417 (Ch. 2)	
2.422 (Ch. 3)	
2.427 (Ch. 4)	
2.432 (Ch. 5)	
2.437 (Ch. 6)	X
2.442 (Ch. 7)	
2.447 (Ch. 8)	
2.452 (Ch. 9)	
2.457 (Ch. 10)	
2.462 (Ch. 11)	

D. Test Instruments

Table-D List of Measuring Instruments

Description	Model	Serial Number	Calibration Date	Calibration Interval
Computer	IBM 5551-L	#4	N/A	N/A
Computer	IBM 6589-13J	97-15613	N/A	N/A
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	3019A05155	02/15/02	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2841A04252	06/17/02	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2601A02634	08/28/02	1 year
Spectrum Analyzer Display	HP 85662A	3026A19353	02/15/02	1 year
Spectrum Analyzer Display	HP 85662A	2816A16831	06/17/02	1 year
Spectrum Analyzer Display	HP 85662A	2542A12308	08/28/02	1 year
Quasi-Peak Adapter	HP 85650A	2811A01156	06/17/02	1 year
Quasi-Peak Adapter	HP 85650A	3033A01449	02/15/02	1 year
Quasi-Peak Adapter	HP 85650A	2043A00062	08/28/02	1 year
Amplifier (100KHz - 1.3GHz) - for 30-200MHz - for 200-1000MHz Amplifier (1GHz - 26.5GHz)	 HP 8447D HP 8447D HP 8449B	 2805A02919 2944A03506 3008A00582	 04/15/02 04/15/02 06/13/02	 1 year 1 year 1 year
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003	07/18/02	1 year
Receiver (9kHz-30MHz)	R&S ESH3	891806/012	10/07/02	1 year
Receiver (20MHz-1.3GHz)	R&S ESVP	893202/018	02/06/02	1 year
Biconical Antenna (30-200MHz)	EMCO 3108	2309	05/06/02	1 year
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	1585	05/06/02	1 year
Horn Antenna (1- 18GHz)	EMCO 3115	9903-5774	07/18/02	1 year
Horn Antenna (3.95- 5.85GHz)	EMCO 3160-5	1099	04/17/02	1 year
Horn Antenna (5.85- 8.20GHz)	EMCO 3160-6	9712-1044	04/17/02	1 year
Horn Antenna (8.20- 12.40GHz)	EMCO 3160-7	1156	04/17/02	1 year
Horn Antenna (18- 26.5GHz)	EMCO 3160-9	0004-1202	04/17/02	1 year
LISN	EMCO 3825/2	1426	09/01/02	1 year
Power Meter	HP 437B	3043U03437	11/08/02	1 year
Power Sensor	HP 8481A	US41030582	11/08/02	1 year
Switch/control unit	HP 3488A	2719A17226 2719A17228	N/A N/A	N/A N/A
Plotter	HP 7550A	2631A33619	N/A	N/A
Coaxial cables (1 – 18GHz): - Horn Ant <=> RF Amp. - RF Amp.<=>Spectrum Analyzer Coaxial cables (18 – 25GHz): - Horn Ant <=> RF Amp. - RF Amp.<=>Spectrum Analyzer N-Coax cables: - Bi-coni Ant <=> 10m Cable	Length: 6 m 15m 3m 1m 9 m	 - EM206SCO - EM215SCO - SF102-20167 - SF102-21105 - EM103L01	 09/05/02 09/05/02 09/05/02 09/05/02 04/15/02	 1 year 1 year 1 year 1 year 1 year

- 10m Cable <=> Shield Panel	10 m	- EM103L02	04/15/02	1 year
- Shield Panel <=> RF Amp	7 m	- EM103L03	04/15/02	1 year
- RF Amp <=> Power Splitter	0.5m	- EM103L04	04/15/02	1 year
- Log-peri Ant <=> 10m Cable	9 m	- EM103H01	04/15/02	1 year
- 10m Cable <=> Shield Panel	10 m	- EM103H02	04/15/02	1 year
- Shield Panel <=> RF Amp	7 m	- EM103H03	04/15/02	1 year
- RF Amp <=> Power Splitter	0.5m	- EM103H04	04/15/02	1 year
Coax cables:				
- Lisn-L <=> SW/Con.unit (SW100)	4 m	- EMIC-L	04/15/02	1 year
- Lisn-N <=> SW/Con.unit (SW101)	4 m	- EMIC-N	04/15/02	1 year
- SW/Con.unit <=> RCVR (Input)	1 m	- EMIC-R	04/15/02	1 year
- SW/Con.unit<=> Spe Ana.(Signal In)	1 m	- EMIC-S	04/15/02	1 year
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM103L05	04/15/02	1 year
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM103L06	04/15/02	1 year
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM103H05	04/15/02	1 year
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM103H06	04/15/02	1 year
- SW/Con.unit <=> Receiver (Input)	2 m	- EM1RCV	04/15/02	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	2 m	- EM1SPL	04/15/02	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM1SPH	04/15/02	1 year

Notes.

- The above equipment calibration is traceable to National standards.
- HP: Hewlett Packard, R&S: Rohde & Schwarz

E. Measurement Uncertainty

Uncertainties of the both, the Yamato EMI radiated test facilities (EMI chambers, #1 and #2) and the Yamato EMI conducted test facility are derived with the NIS 81 " Treatment of uncertainty in EMC measurements" 1994.

Estimated site uncertainty values are as follows.

EMI chamber #1 : 4.39dB
EMI chamber #2 : 4.40dB
EMI conducted measurement system : 2.4dB

Detail should be referred to "Treatment of Uncertainty, Calculations and Policy" report, document number TCR 10-0015.

F. Temperature and Humidity

The temperature is controlled within range of 17° to 28°.
The relative humidity is controlled within range of 40% to 70%.

G. Related Submittal(s)/Grant(s)/Notes

The host unit with full peripheral devices including the applying modular as an unintentional radiator is classified as a Digital Device under the FCC Part 15 Subpart B or the Industry Canada Class B Emission Compliance (ICES-003), and subject to SDoC.

Prepared by T. Asano

1. Bandwidth at 6 dB below

1.1 Test Procedure

The bandwidth at 6 dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.
The spectrum analyzer is set to:
RBW=100kHz, VBW=100kHz*1, Span=30MHz, Sweep=suitable duration based on the EUT specification
*1: To be adjusted accordingly based on the spectrum stability

1.2 Test Instruments and Measurement Setup

Table 1-1 : 6 dB Bandwidth Test Instruments

Description	**Model**	**Serial Number**
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003
Coax cables: - Spectrum Analyzer <=> EUT	Length: Loss: 110 cm 1.3 dB	

Notes: - R&S: Rohde & Schwarz

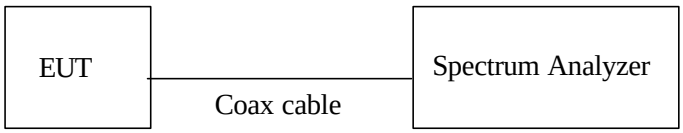


Figure 1: Measurement setup for 6dB bandwidth test

1.3 Measurement Results

Test Date: January 28, 2003

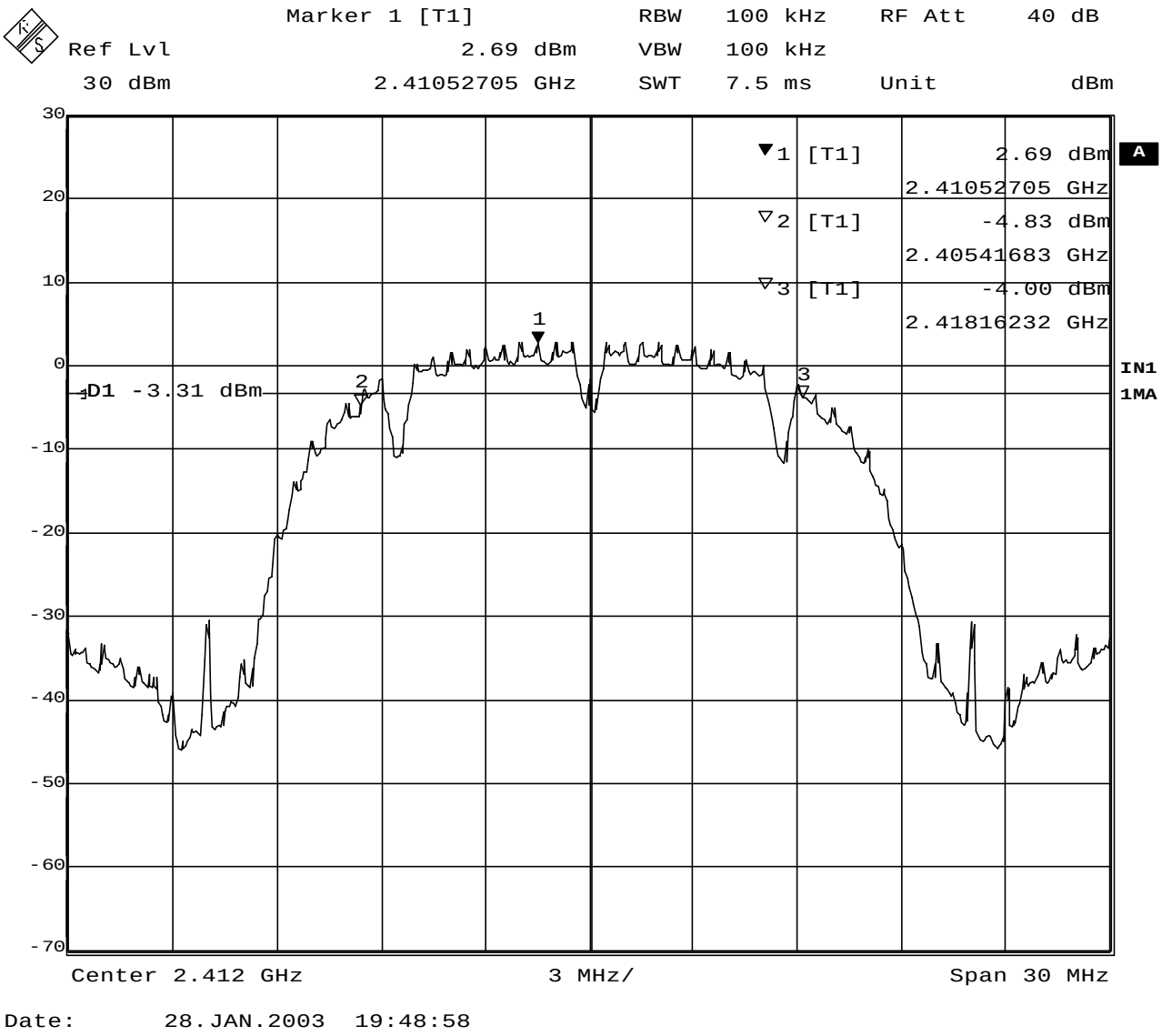
Table 1-2-1. EUT: M/T 2373-92U, s/n ZZ-00129 , TX mode 1Mbps

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)
2412 (ch. 1)	Plot 1-1	2405.42	2418.16	12.74
2437 (ch. 6)	Plot 1-2	2430.42	2443.10	12.68
2462 (ch. 11)	Plot 1-3	2455.42	2468.10	12.68

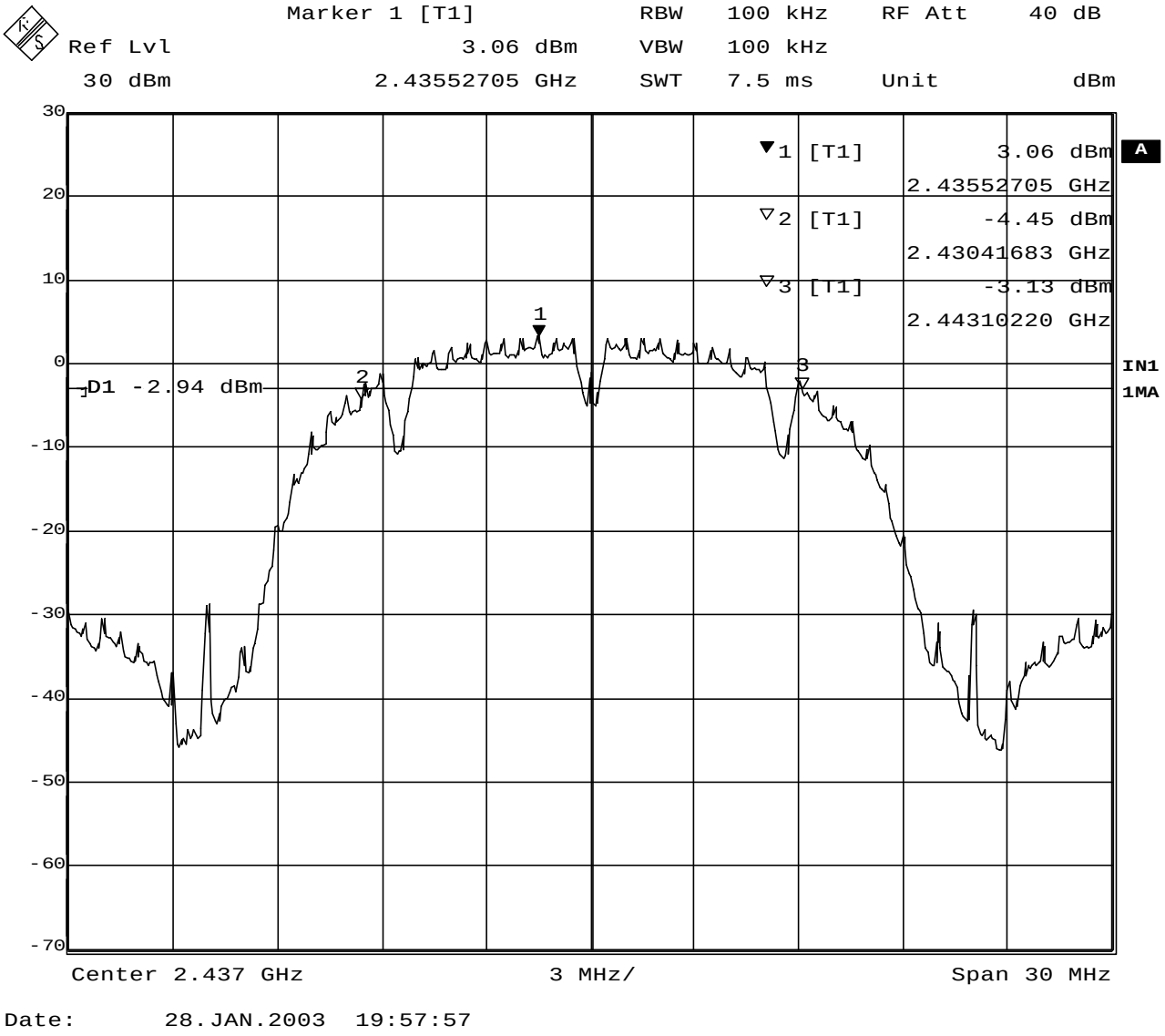
Table 1-2-2. EUT: M/T 2373-92U, s/n ZZ-00129 , TX mode 11Mbps

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)
2412 (ch. 1)	Plot 1-4	2405.90	2417.86	11.96
2437 (ch. 6)	Plot 1-5	2430.90	2442.86	11.96
2462 (ch. 11)	Plot 1-6	2455.36	2467.86	12.50

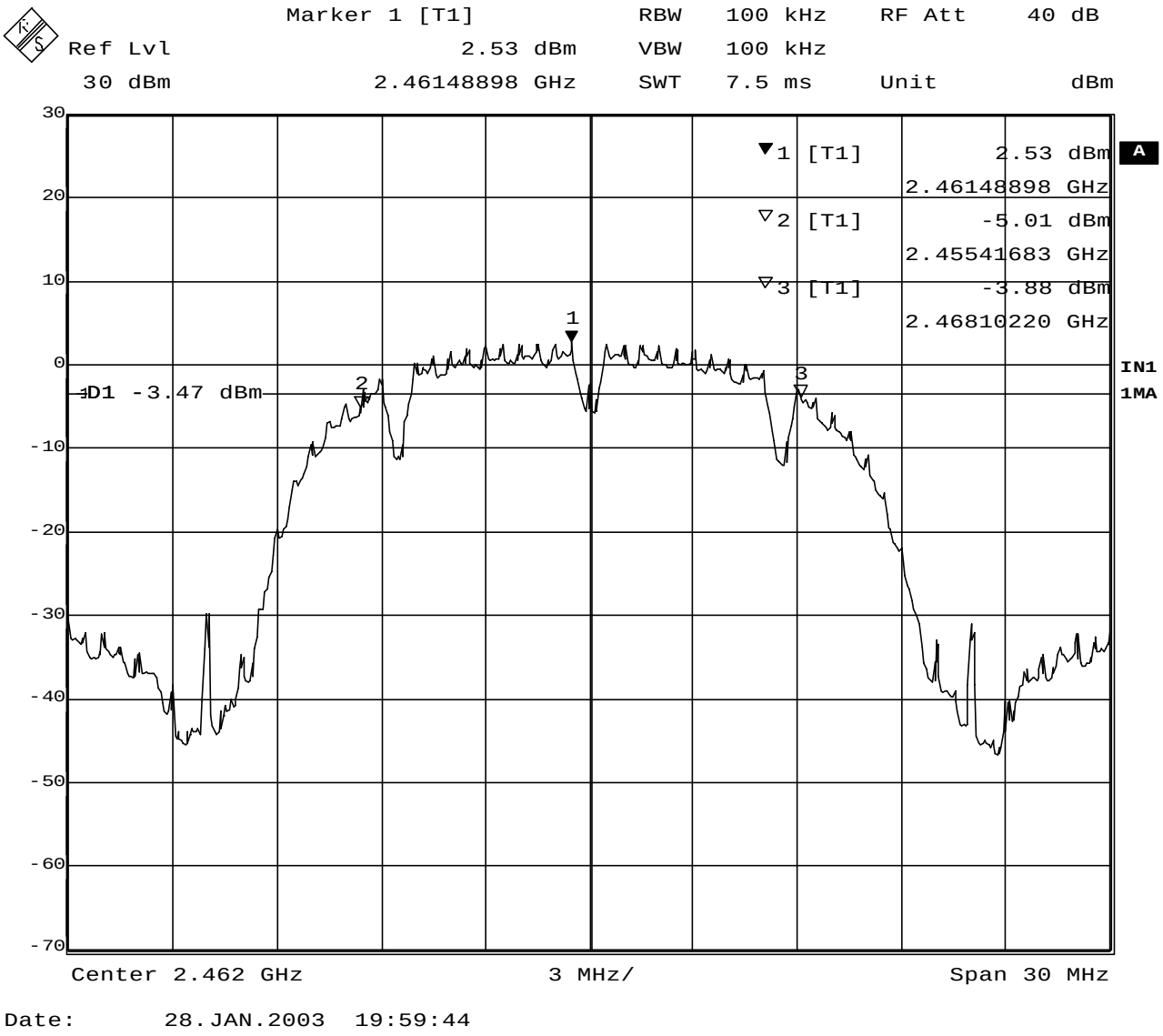
1.4 Trace Data



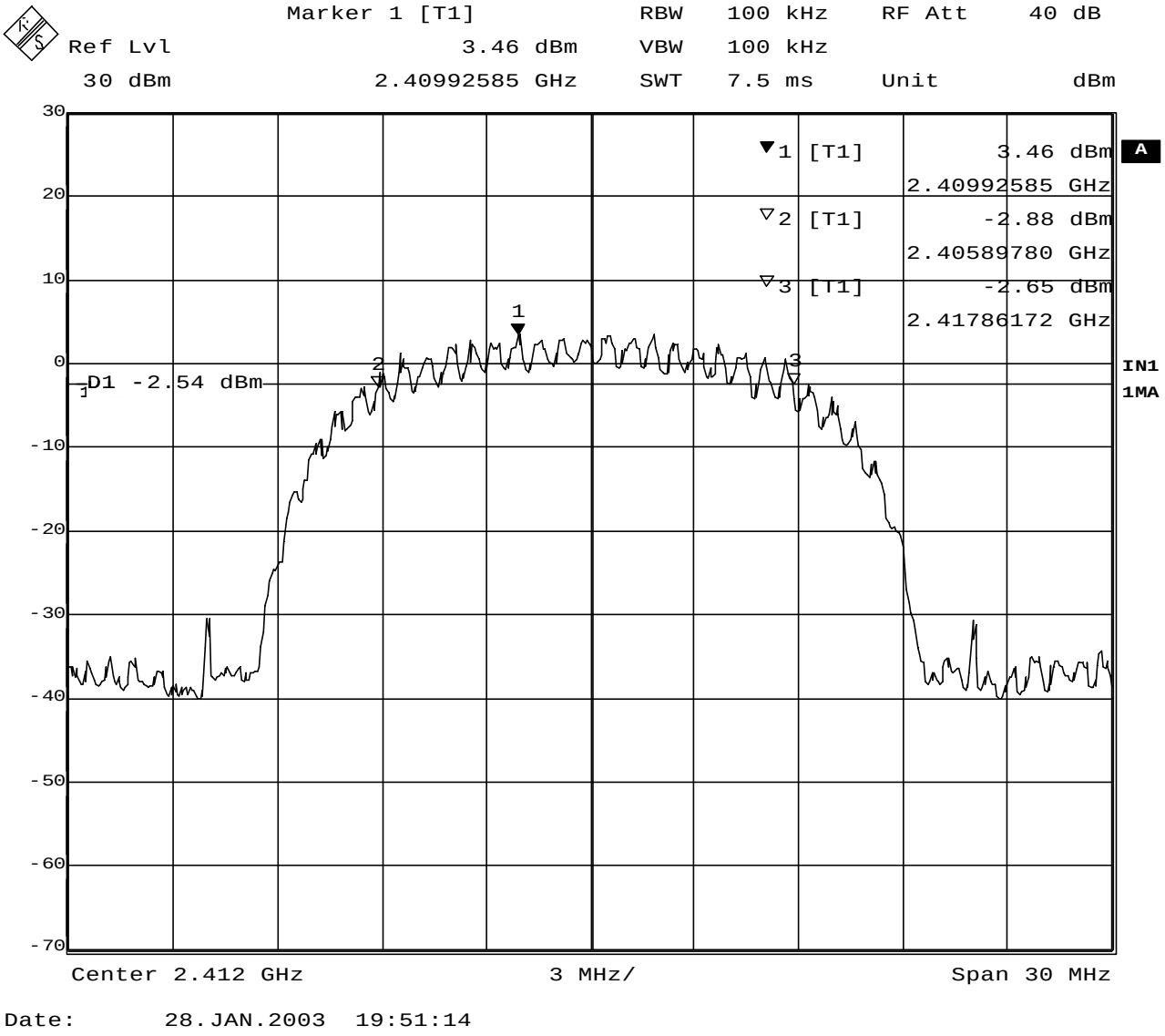
Plot 1-1. 6dB BW at 2412MHz (1Mbps)



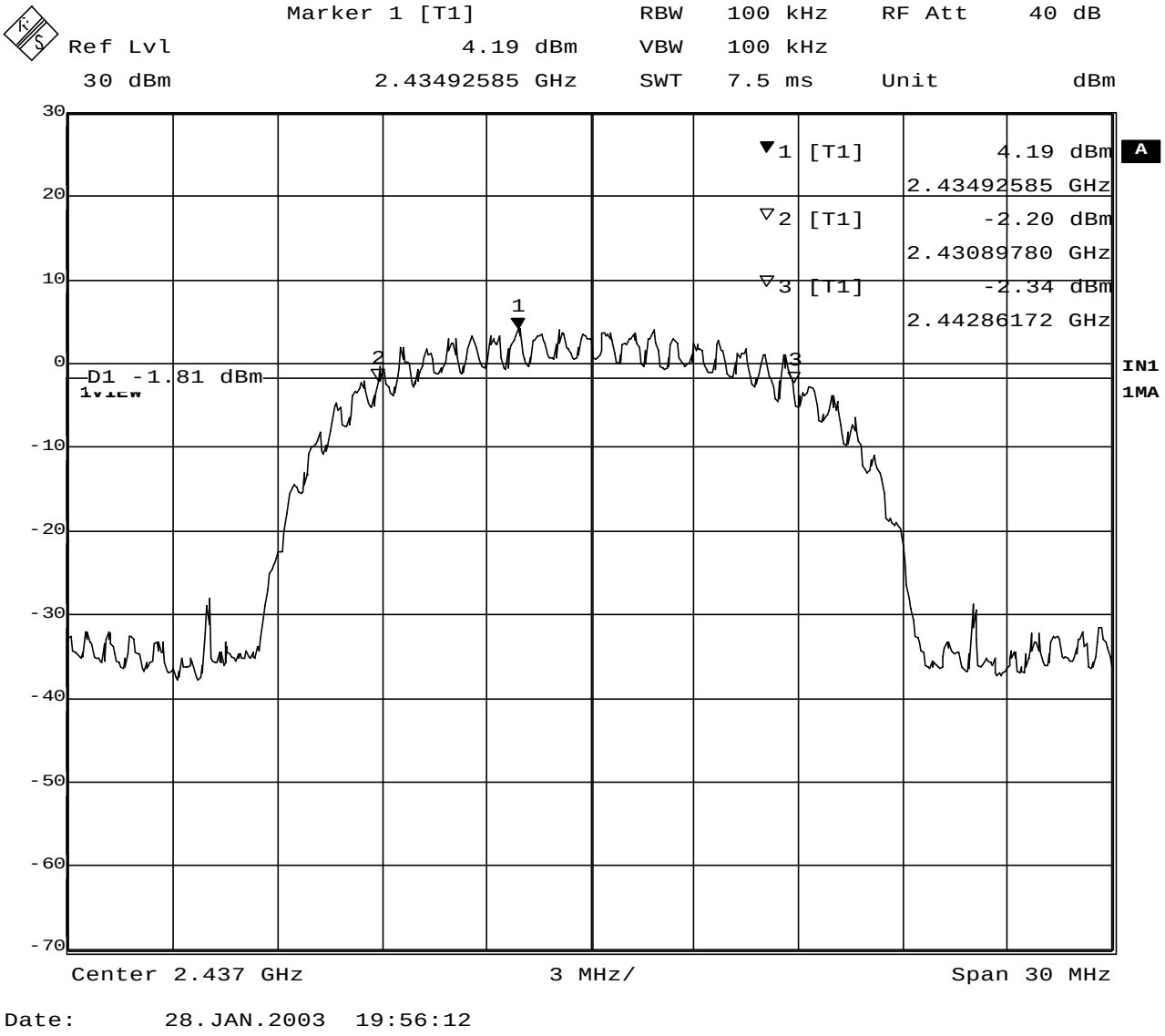
Plot 1-2. 6dB BW at 2437MHz (1Mbps)



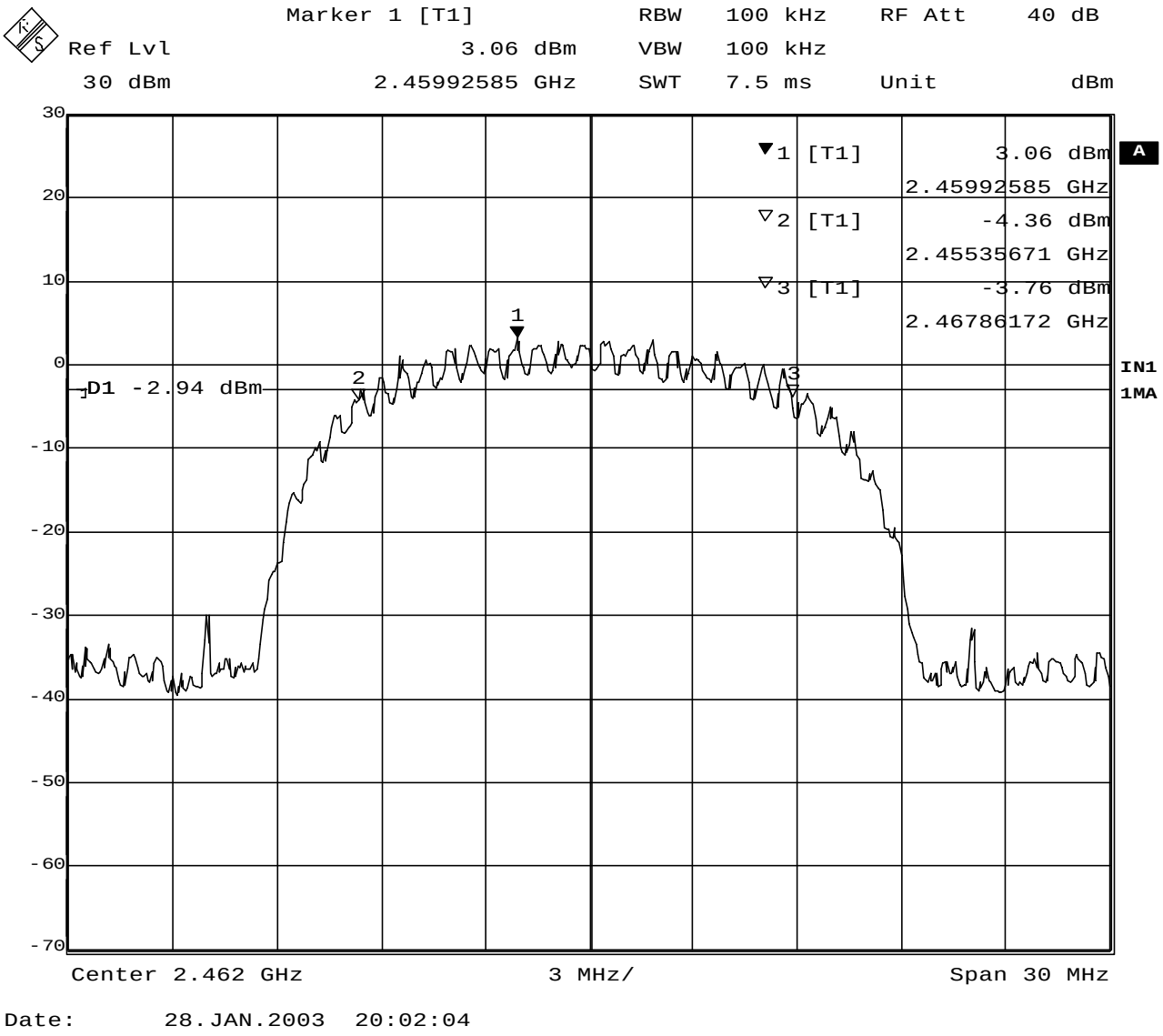
Plot 1-3. 6dB BW at 2462MHz (1Mbps)



Plot 1-4. 6dB BW at 2412MHz (11Mbps)



Plot 1-5. 6dB BW at 2437MHz (11Mbps)



Plot 1-6. 6dB BW at 2462MHz (11Mbps)

2. Occupied Bandwidth / Band-edge (at 20 dB below), and Out of Band Emissions

2.1 Test Procedure

The bandwidth at 20 dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.
The spectrum analyzer is set to:
RBW=100kHz, VBW=100kHz*1, Span=50MHz, Sweep=suitable duration based on the EUT specification
*1: To be adjusted accordingly based on the spectrum stability

2.2 Test Instruments and Measurement Setup

Same as the Chapter 1(Table 1-1 & Figure 1).

2.3 Measurement Results of Occupied Bandwidth / Band-edge

Test Date: January 28, 2003

Table 2-1-1. EUT: M/T 2373-92U, s/n ZZ-00129 , TX mode 1Mbps

Center Frequency (MHz)	Trace number	Lower Frequency (MHz)	Upper Frequency (MHz)	Bandwidth at 20 dB below (MHz)	Margin to Lower limit (MHz)	Margin to Upper limit (MHz)
2412 (ch. 1)	Plot 2-1	2403.35	2420.67	17.32	3.35	
2437 (ch. 6)	Plot 2-2	2428.30	2445.67	17.37		
2462 (ch. 11)	Plot 2-3	2453.35	2470.67	17.32		12.83

Table 2-1-2. EUT: M/T 2373-92U, s/n ZZ-00129 , TX mode 11Mbps

Center Frequency (MHz)	Trace number	Lower Frequency (MHz)	Upper Frequency (MHz)	Bandwidth at 20 dB below (MHz)	Margin to Lower limit (MHz)	Margin to Upper limit (MHz)
2412 (ch. 1)	Plot 2-4	2403.35	2420.57	17.22	3.35	
2437 (ch. 6)	Plot 2-5	2428.30	2445.57	17.27		
2462 (ch. 11)	Plot 2-6	2453.25	2470.57	17.32		12.93

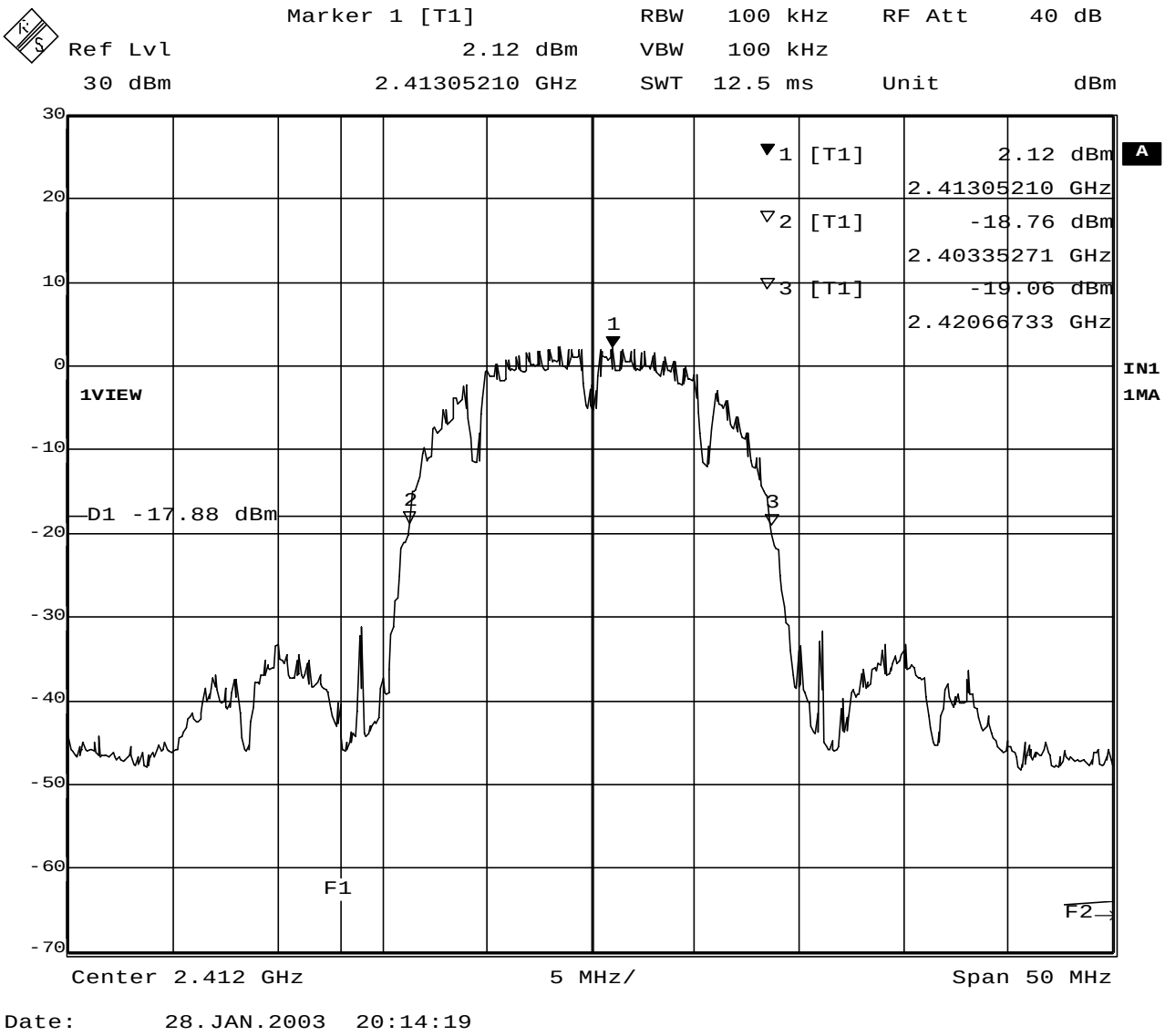
2.4 Measurement Results of Out of Band Emissions

All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density.

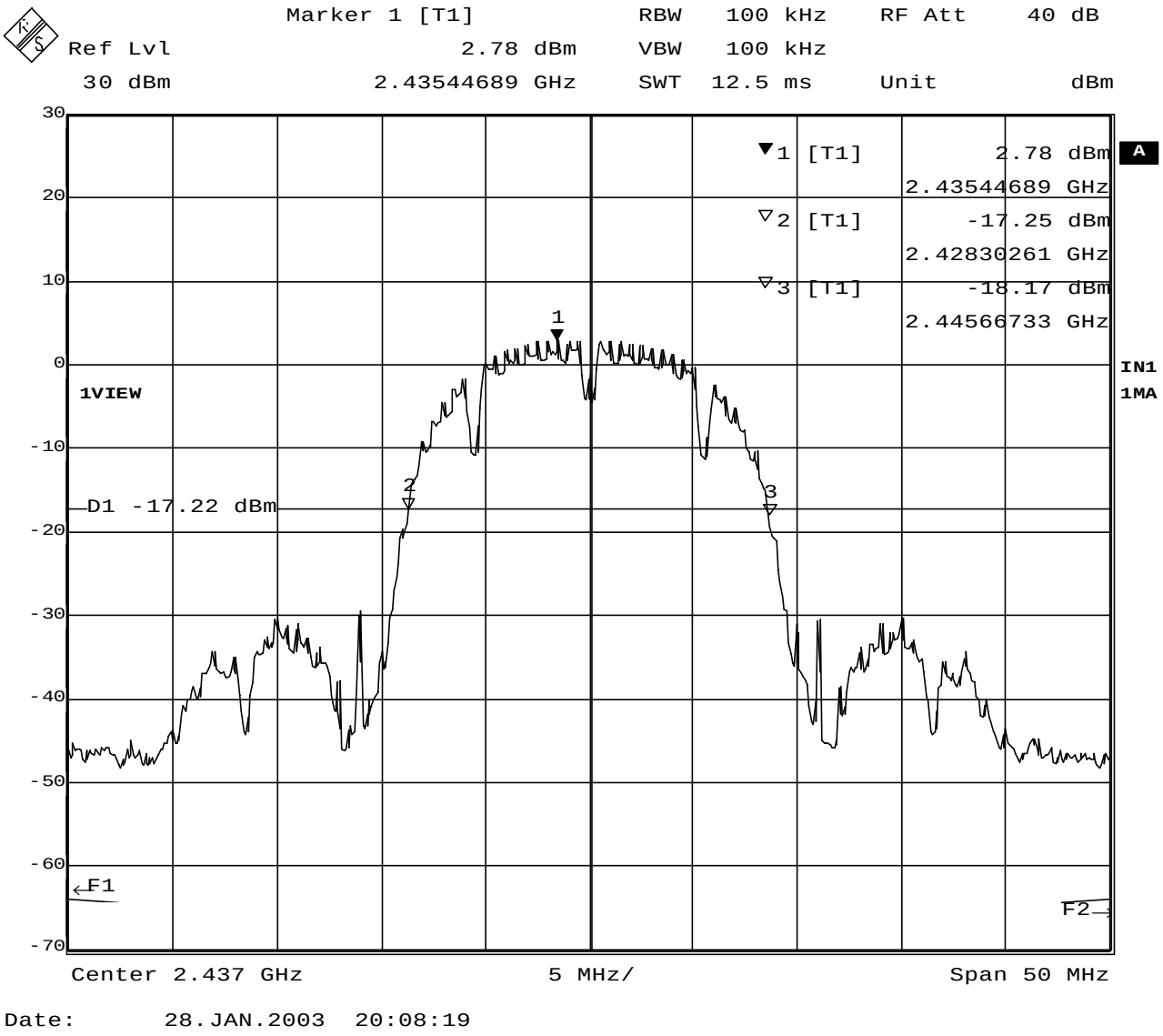
Test Date: January 28, 2003 : See Plot 2-7 to 2-12

Prepared by T. Asano

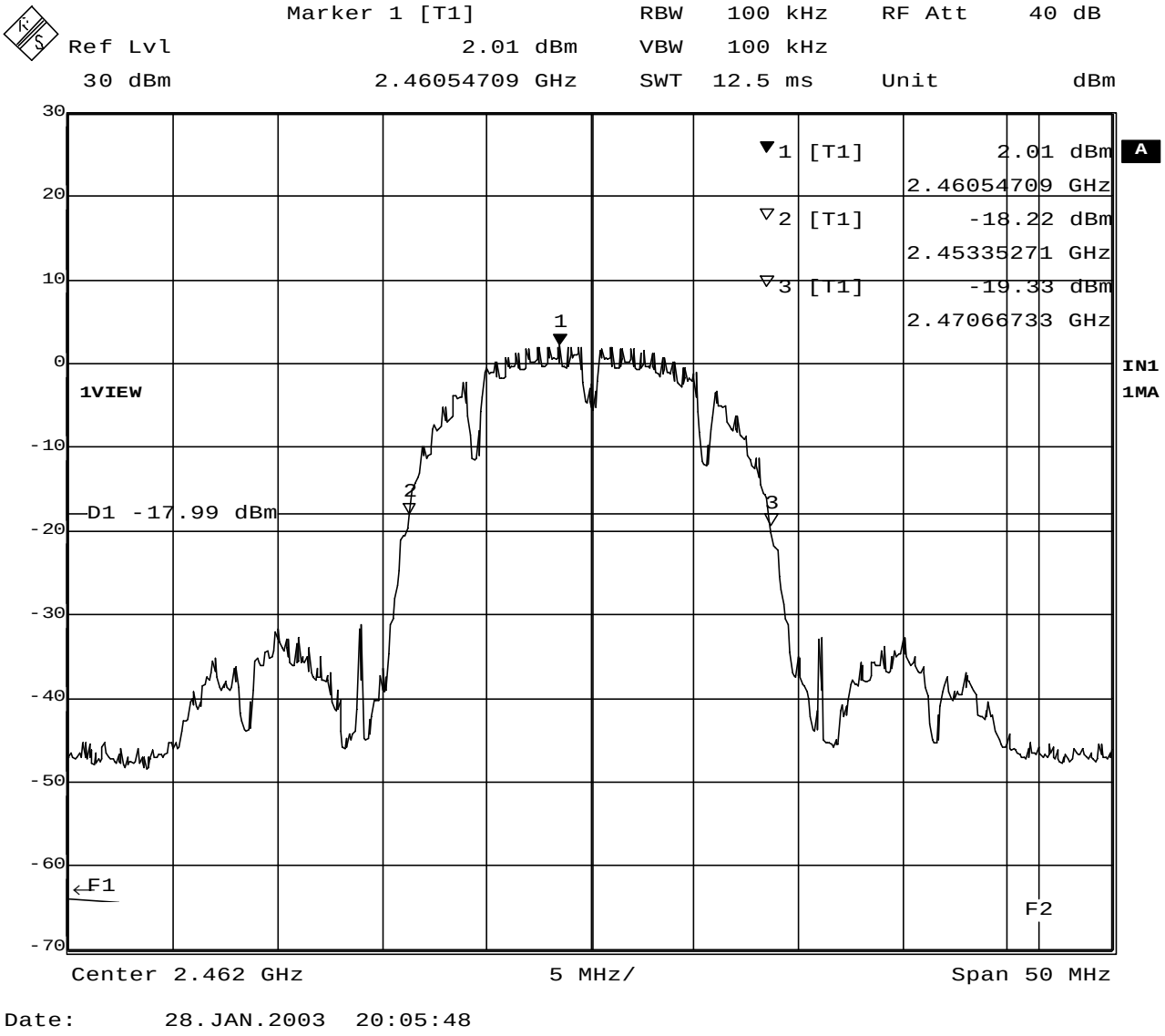
2.5 Trace Data of Band-edge



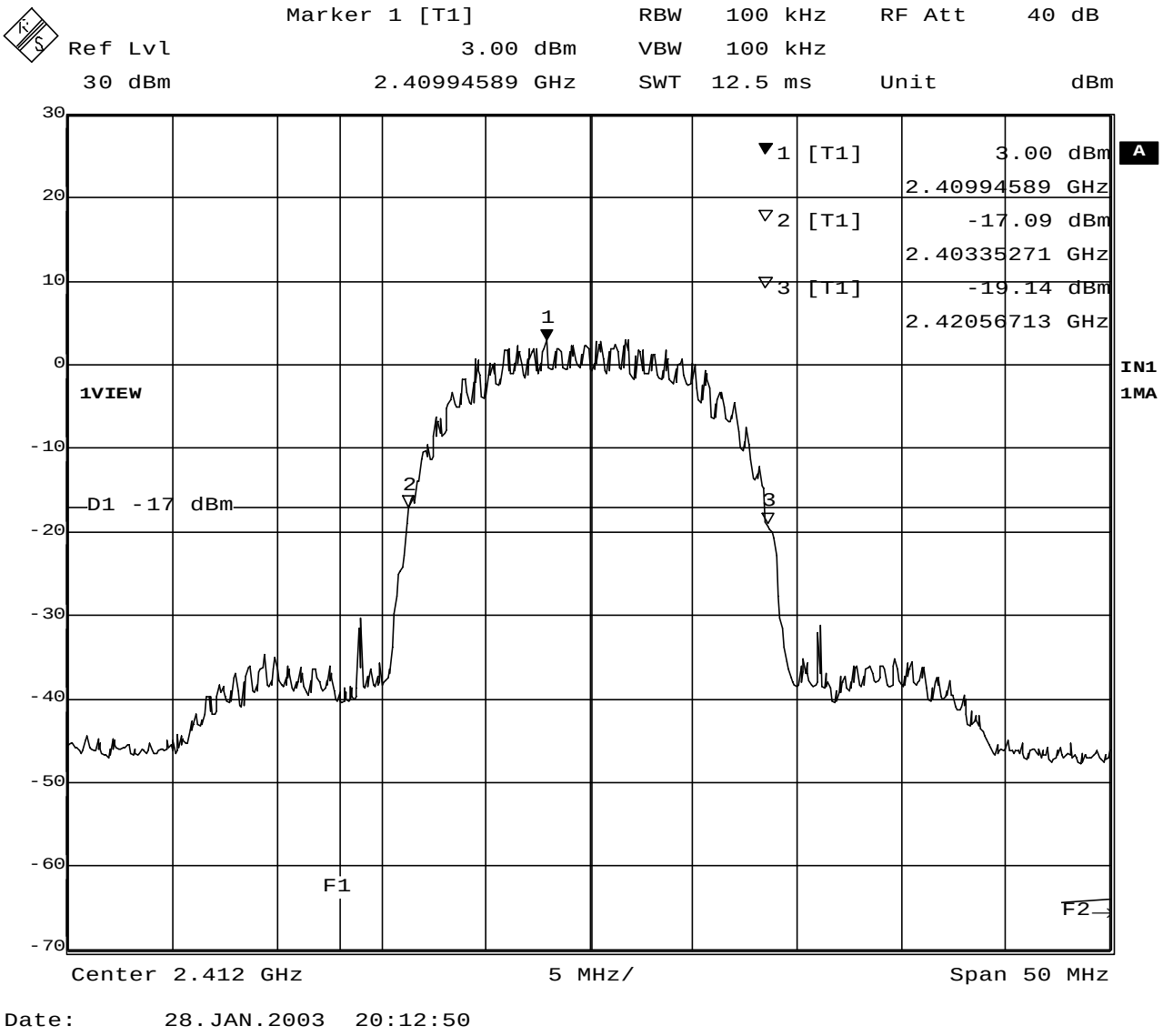
Plot 2-1. 20dB BW at 2412MHz (1Mbps)



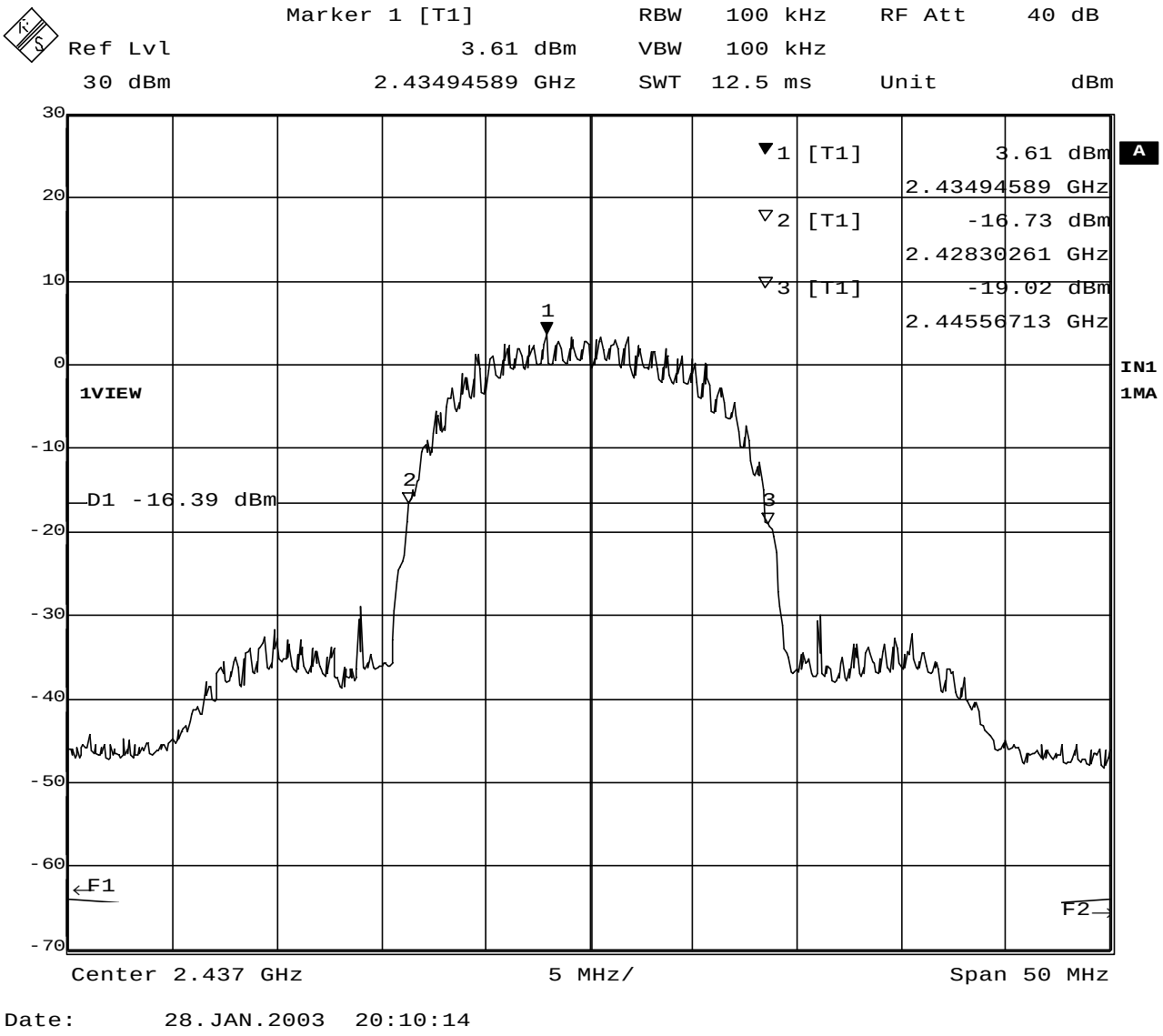
Plot 2-2. 20dB BW at 2437MHz (1Mbps)



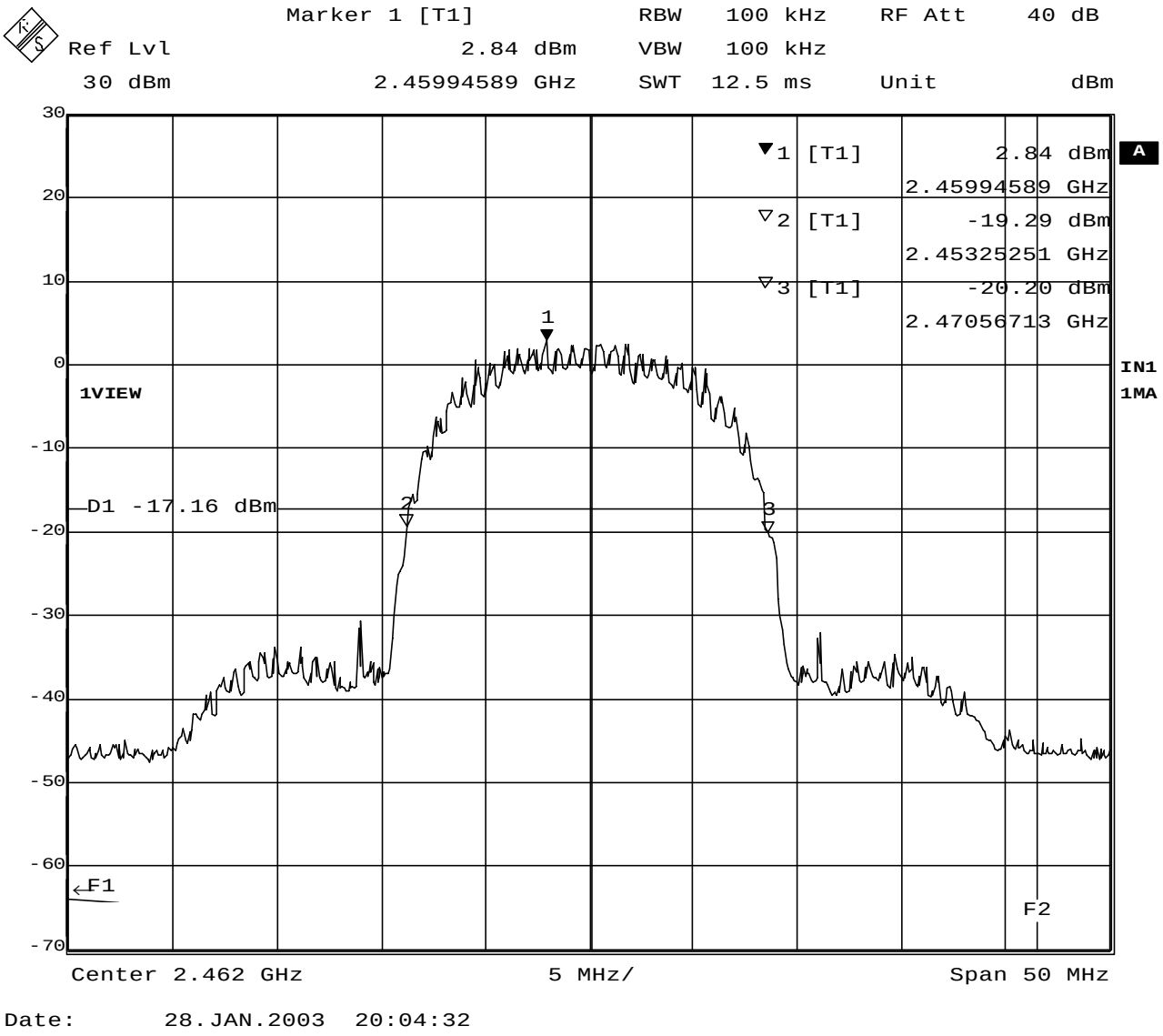
Plot 2-3. 20dB BW at 2462MHz (1Mbps)



Plot 2-4. 20dB BW at 2412MHz (11Mbps)

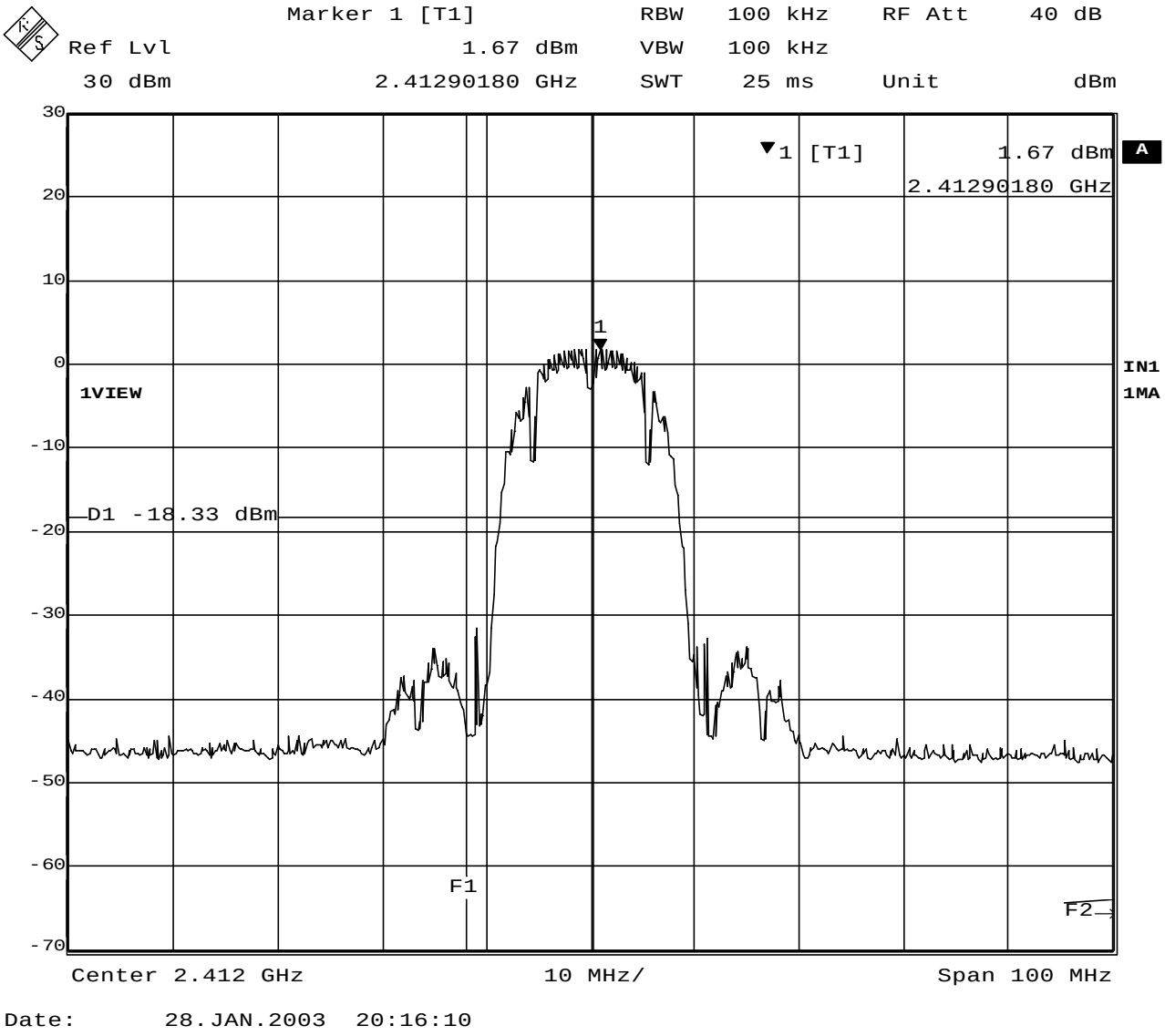


Plot 2-5. 20dB BW at 2437MHz (11Mbps)

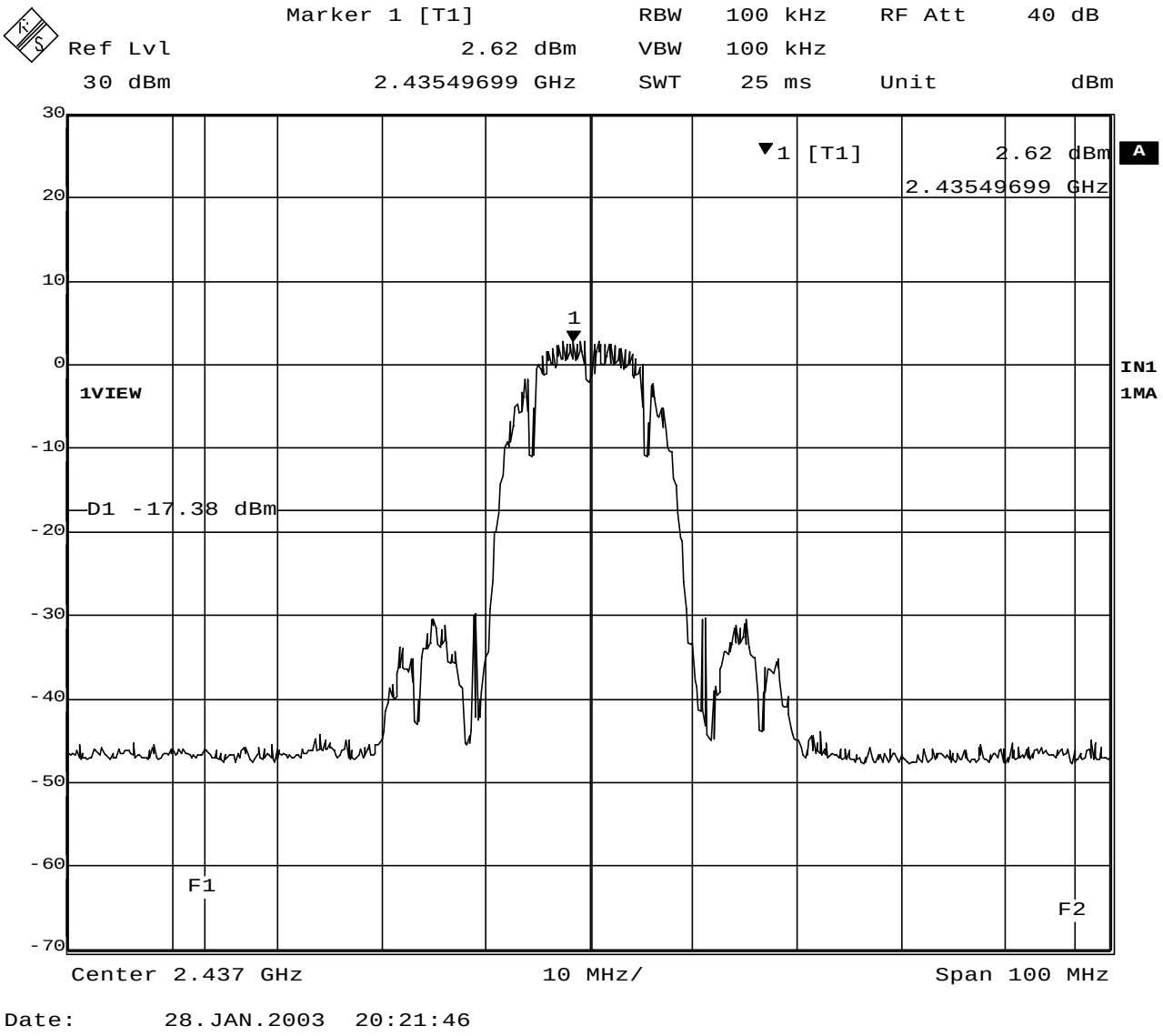


Plot 2-6. 20dB BW at 2462MHz (11Mbps)

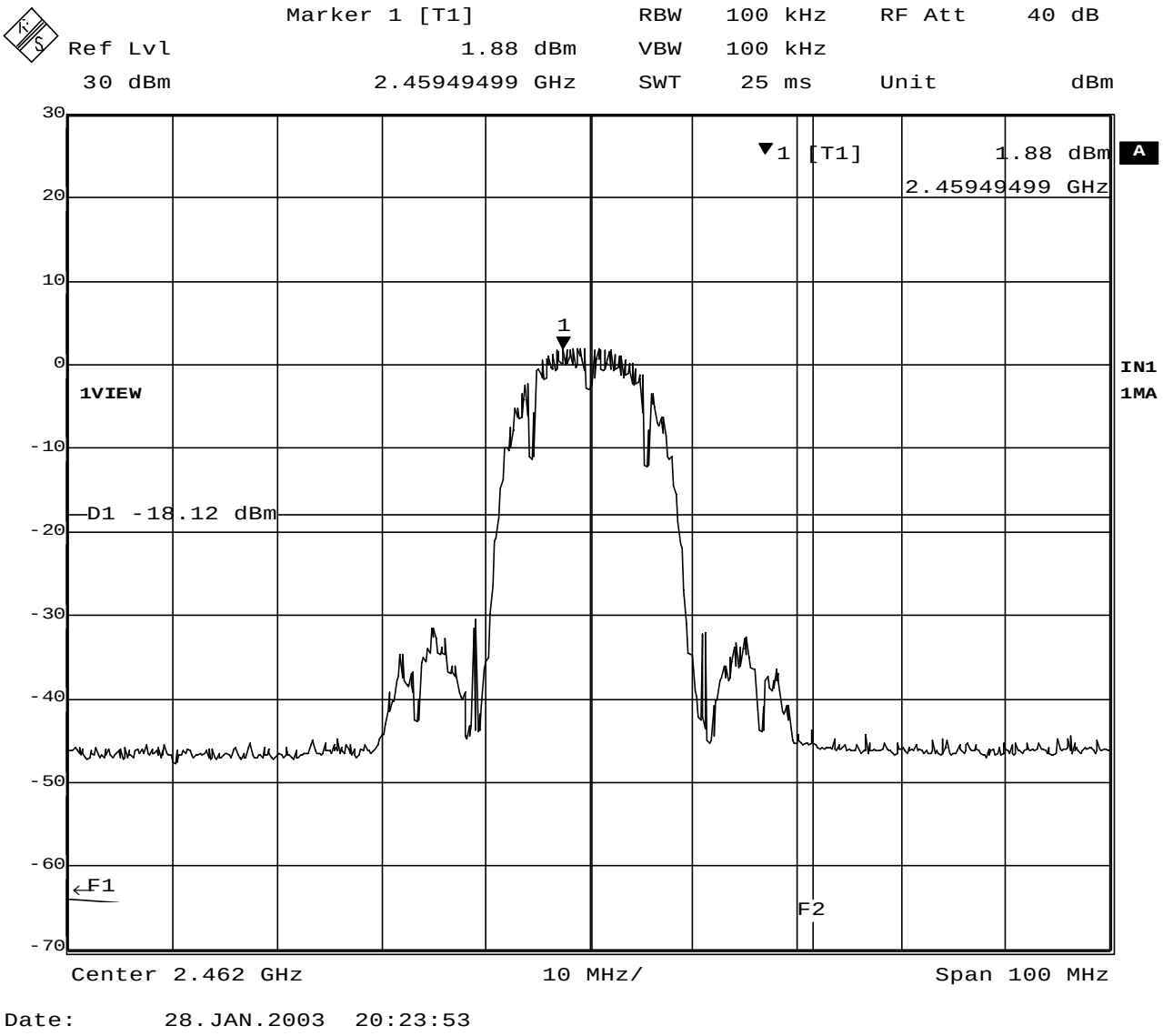
2.6 Trace Data of Out of Band Emissions



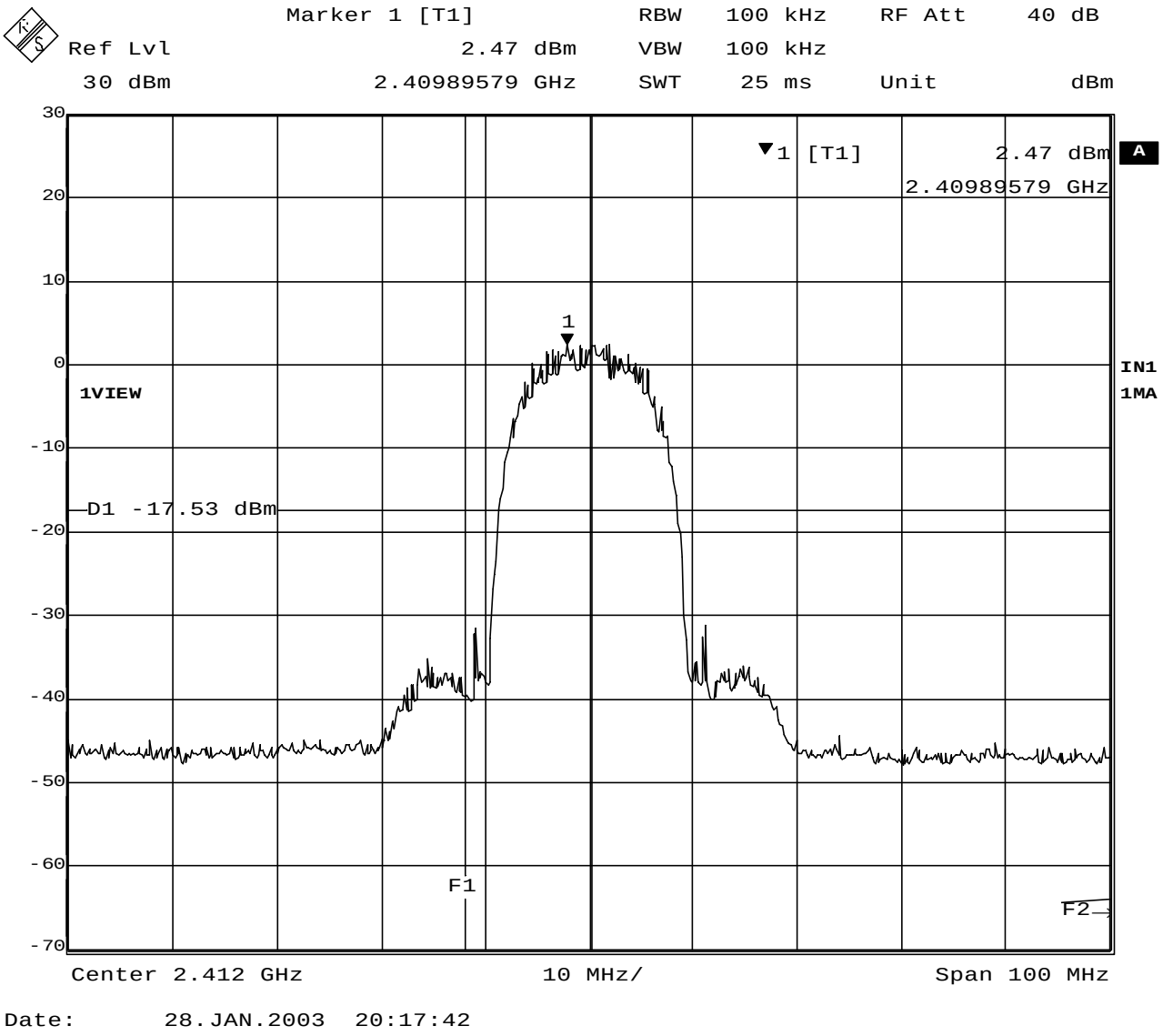
Plot 2-7. Out of band emissions around 2412MHz (1Mbps)



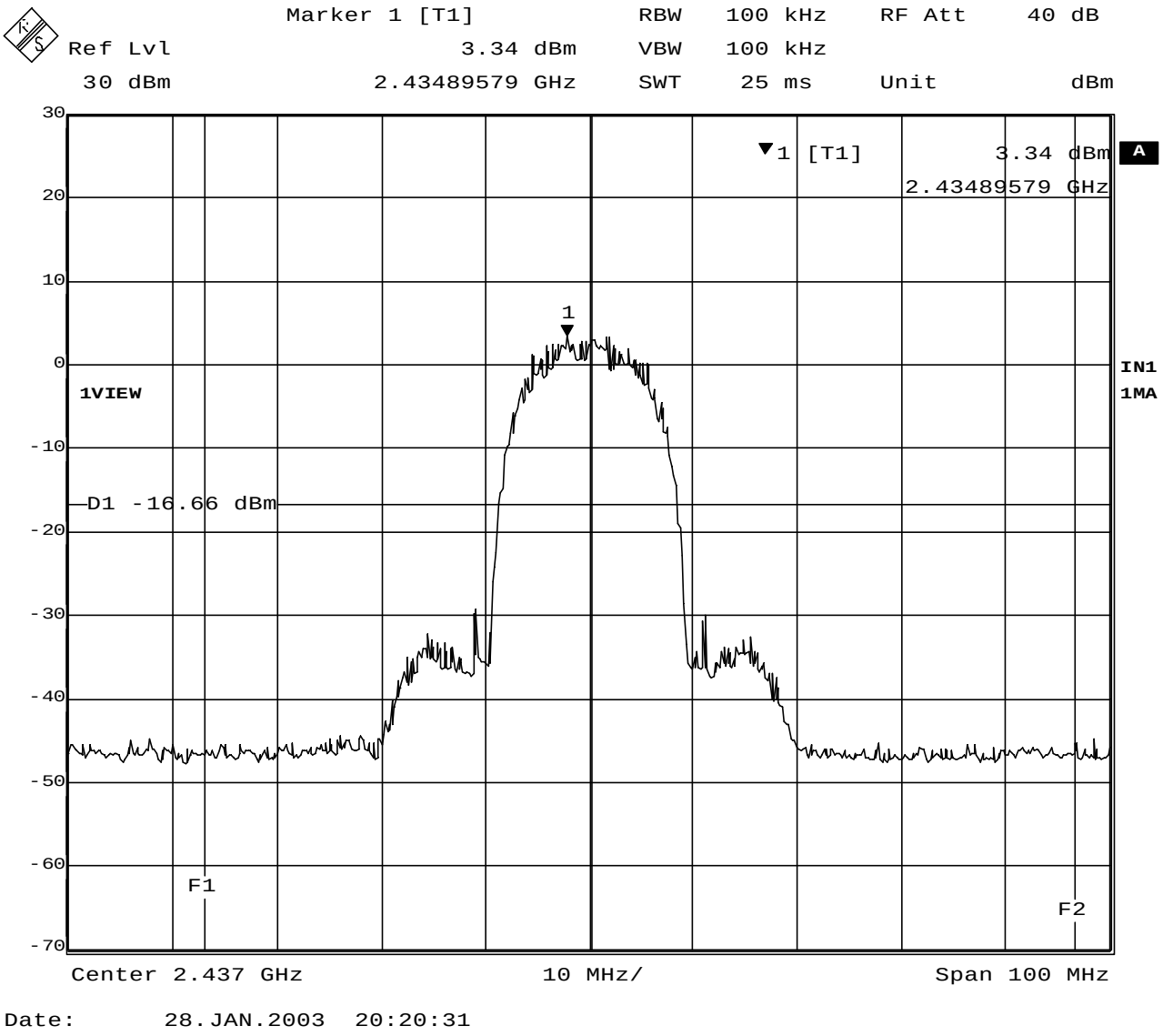
Plot 2-8. Out of band emissions around 24372MHz (1Mbps)



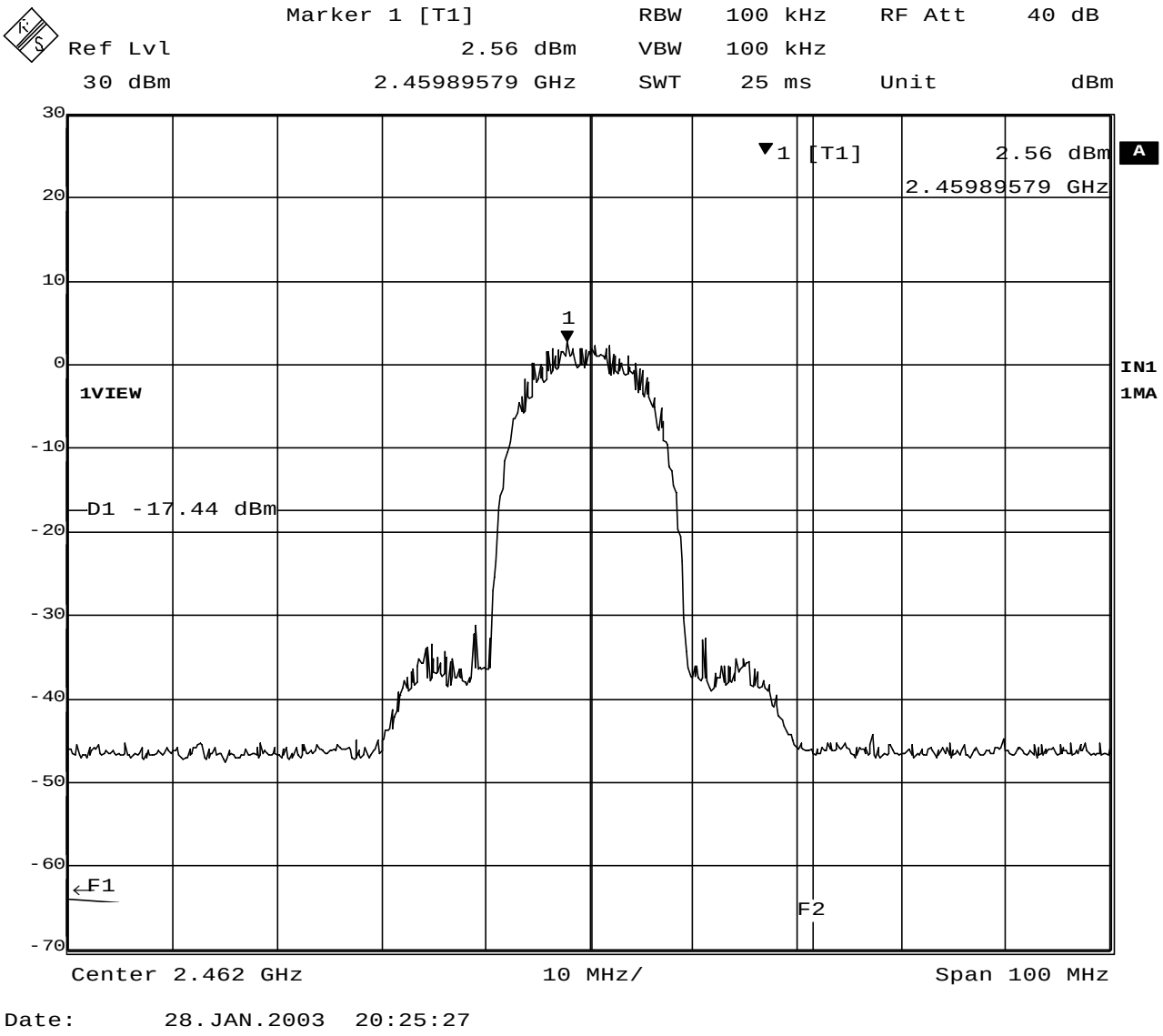
Plot 2-9. Out of band emissions around 2462MHz (1Mbps)



Plot 2-10. Out of band emissions around 2412MHz (11Mbps)



Plot 2-11. Out of band emissions around 24372MHz (11Mbps)



Plot 2-12. Out of band emissions around 2462MHz (11Mbps)

3. Transmitter Output Power

3.1 Test Procedure

- A transmitter antenna terminal of EUT is connected to the input of a RF power sensor.
- Measurement is made while EUT is operating in transmission mode at the appropriate center frequency.

Table 3-1 : 6 dB Bandwidth Test Instruments

Description	**Model**	**Serial Number**
Power Meter	HP 437B	3043U03437
Power Sensor	HP 8481A	US41030582
Coax cables: - Power Sensor <=> EUT	Length: Loss: 20 cm 0.7dB	

Notes: - HP: Hewlett Packard

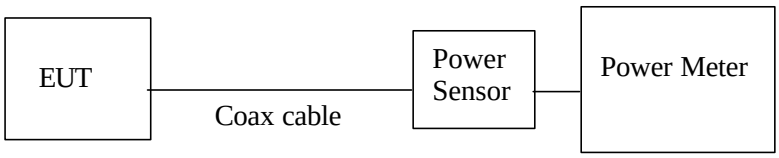


Figure 3: Measurement setup for RF output power

3.2 Measurement Results

Test Date: January 28, 2003

Table 3-2. EUT: M/T 2373-92U, s/n ZZ-00129, TX mode 1Mbps

Measured Frequency (MHz)	Power Meter Reading (dBm)	Cable Loss (dB)	Results		Limit [1W] (dBm)	Margin (dB)
			(dBm)	(W)		
2412 (ch. 1)	16.30	0.7	17.0	0.0501	30.0	13.0
2437 (ch. 6)	16.66	0.7	17.4	0.0550	30.0	12.6
2462 (ch. 11)	16.65	0.7	17.4	0.0550	30.0	12.6

Table 3-3. EUT: M/T 2373-92U, s/n ZZ-00129, TX mode 11Mbps

Measured Frequency (MHz)	Power Meter Reading (dBm)	Cable Loss (dB)	Results		Limit [1W] (dBm)	Margin (dB)
			(dBm)	(W)		
2412 (ch. 1)	16.21	0.7	16.9	0.0490	30.0	13.1
2437 (ch. 6)	16.43	0.7	17.1	0.0513	30.0	12.9
2462 (ch. 11)	16.66	0.7	17.4	0.0550	30.0	12.6

4. Transmitter Power Spectral Density

4.1 Test Procedure

The peak power density is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.
The spectrum analyzer is set to:
RBW= 3kHz, VBW=100kHz, Span=10MHz, Sweep = 2.8 seconds

4.2 Test Instruments and Measurement Setup

Same as the Chapter 1(Table 1-1 & Figure 1).

4.3 Measurement Results

Test Date: January 28, 2003

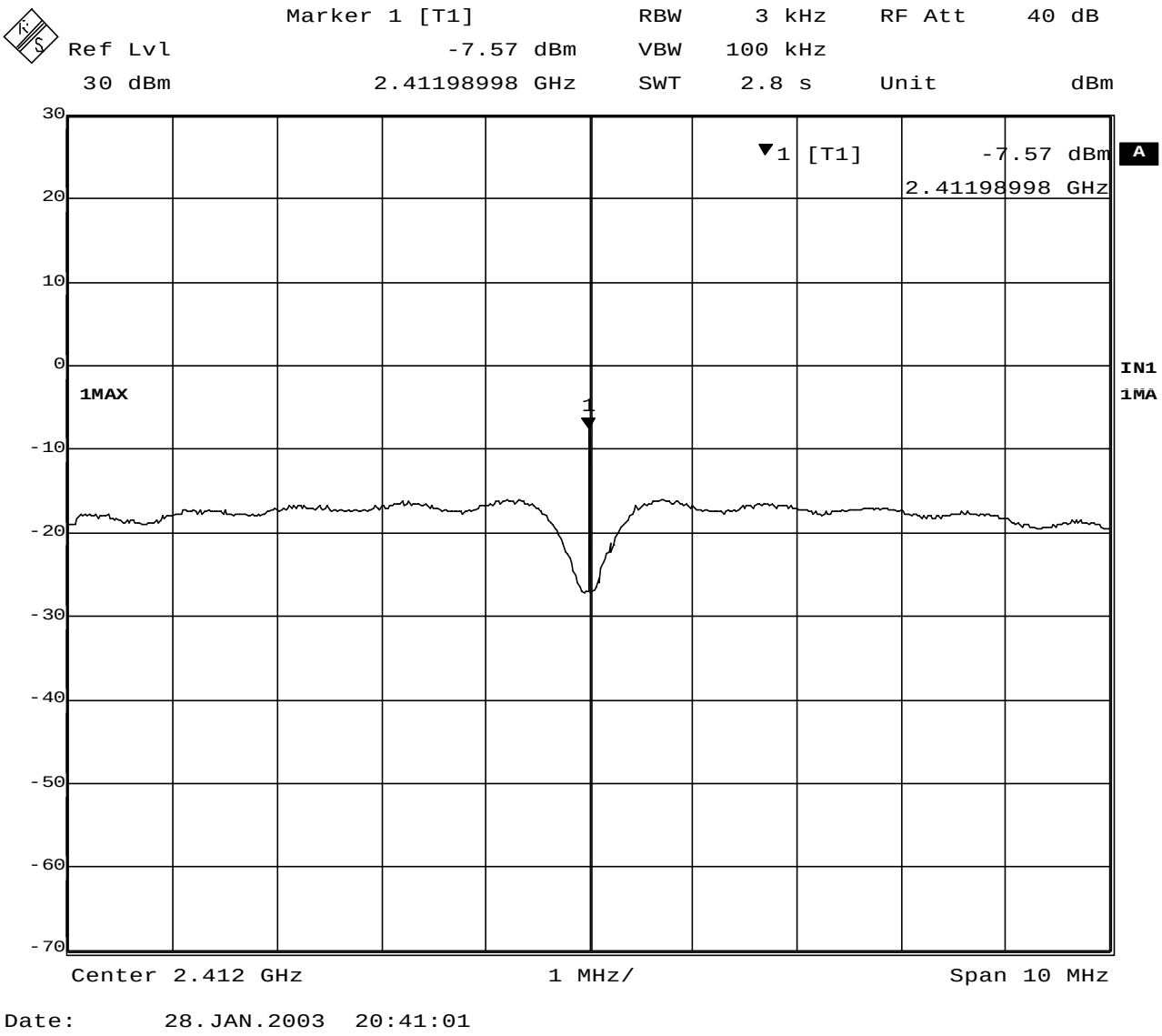
Table 4-1-1. EUT: M/T 2373-92U, s/n ZZ-00129 , TX mode 1Mbps

Ch No.	Frequency (MHz)	Analyzer Reading (dBm)	Trace number	Cable loss (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
1	2411.99	-7.57	Plot 4-1	1.3	- 6.3	8.0	14.3
6	2436.99	-6.68	Plot 4-2	1.3	- 5.4	8.0	13.4
11	2461.99	-6.32	Plot 4-3	1.3	- 5.0	8.0	13.0

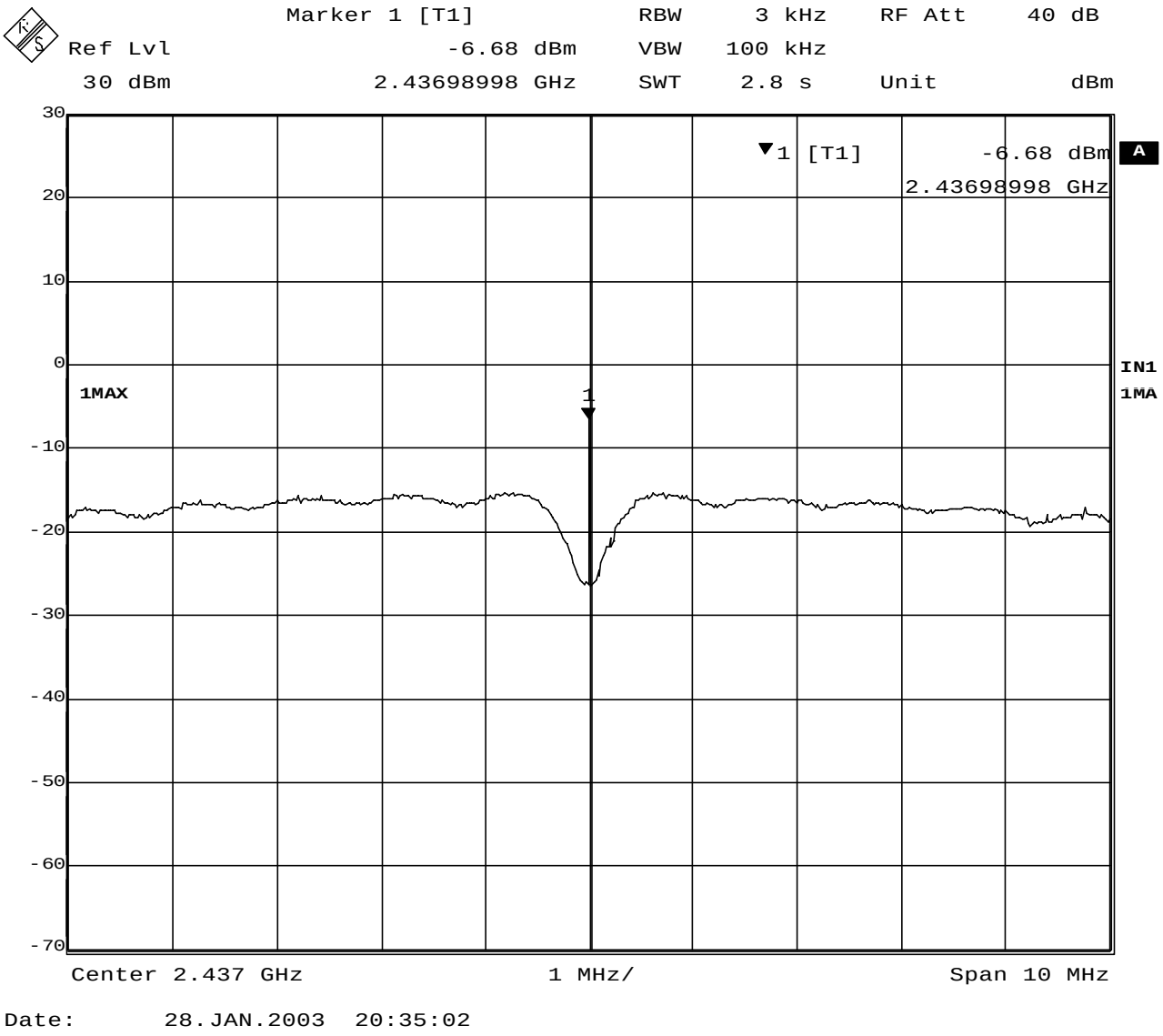
Table 4-1-2. EUT: M/T 2373-92U, s/n ZZ-00129 , TX mode 11Mbps

Ch No.	Frequency (MHz)	Analyzer Reading (dBm)	Trace number	Cable loss (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
1	2412.51	-4.94	Plot 4-4	1.3	- 3.6	8.0	11.6
6	2437.51	-4.50	Plot 4-5	1.3	- 3.2	8.0	11.2
11	2462.51	-5.19	Plot 4-6	1.3	- 3.9	8.0	11.9

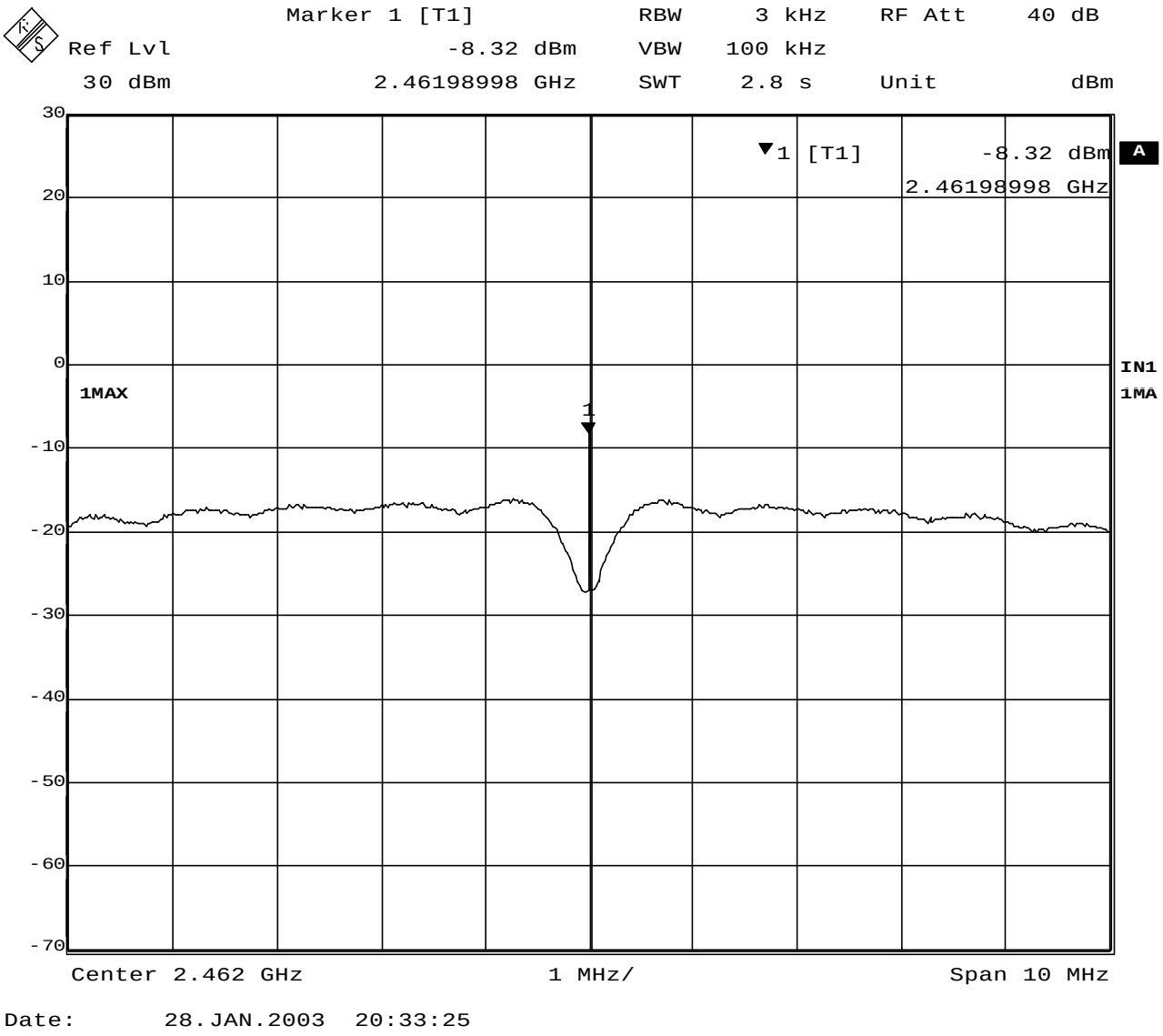
4.4 Trace Data



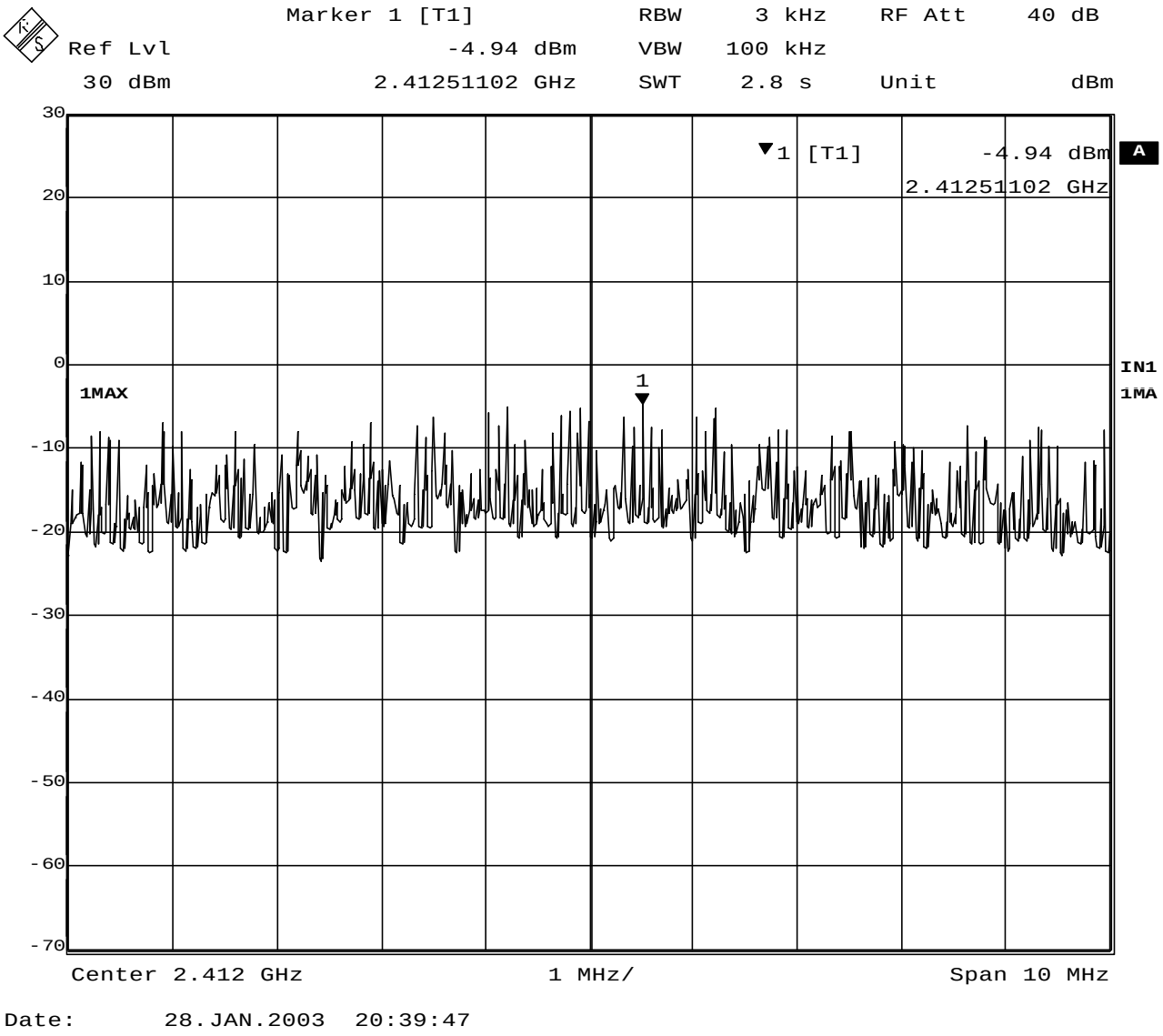
Plot 4-1. Peak Power Spectral Density of 2412MHz (1Mbps)



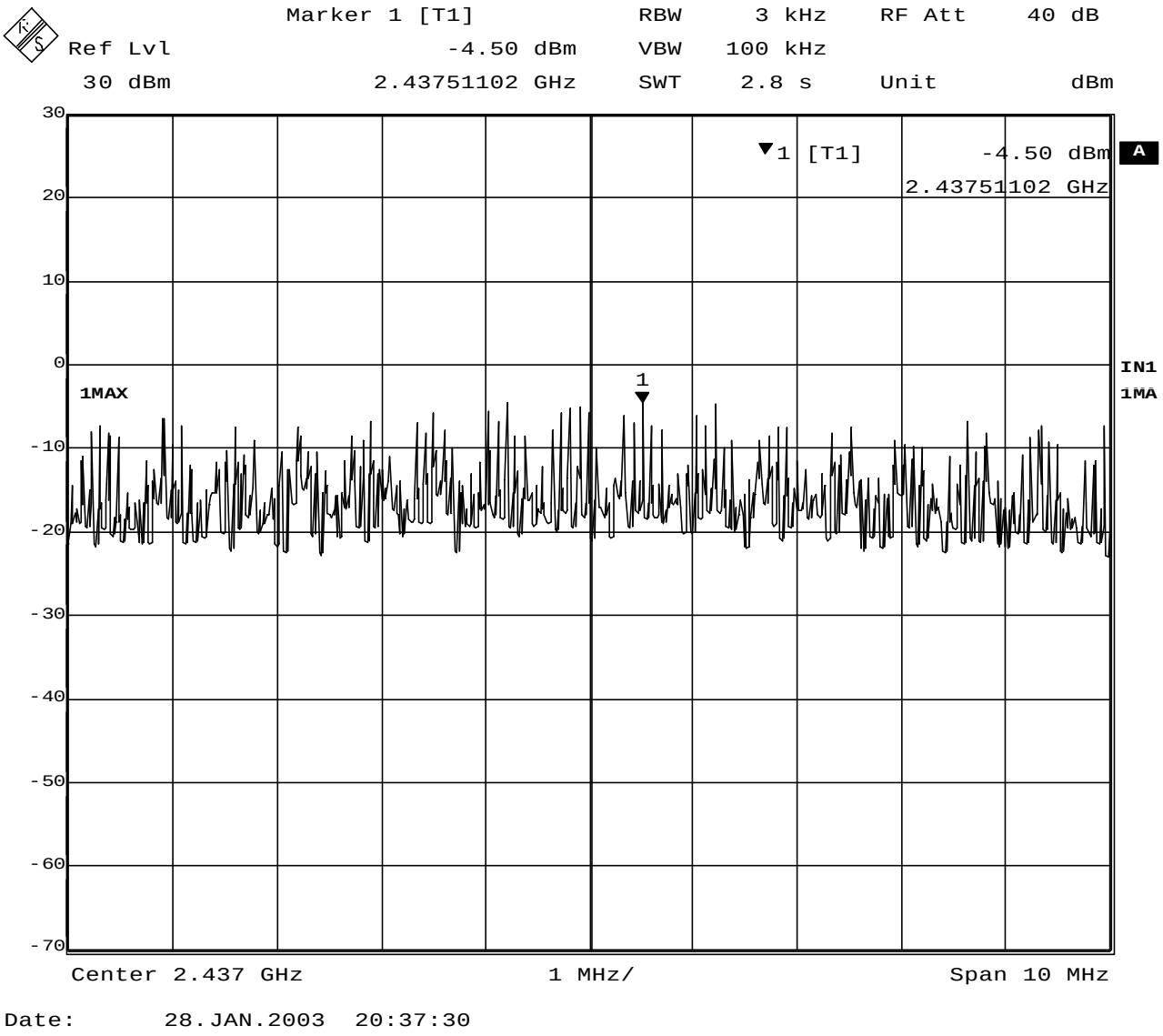
Plot 4-2. Peak Power Spectral Density of 2437MHz (1Mbps)



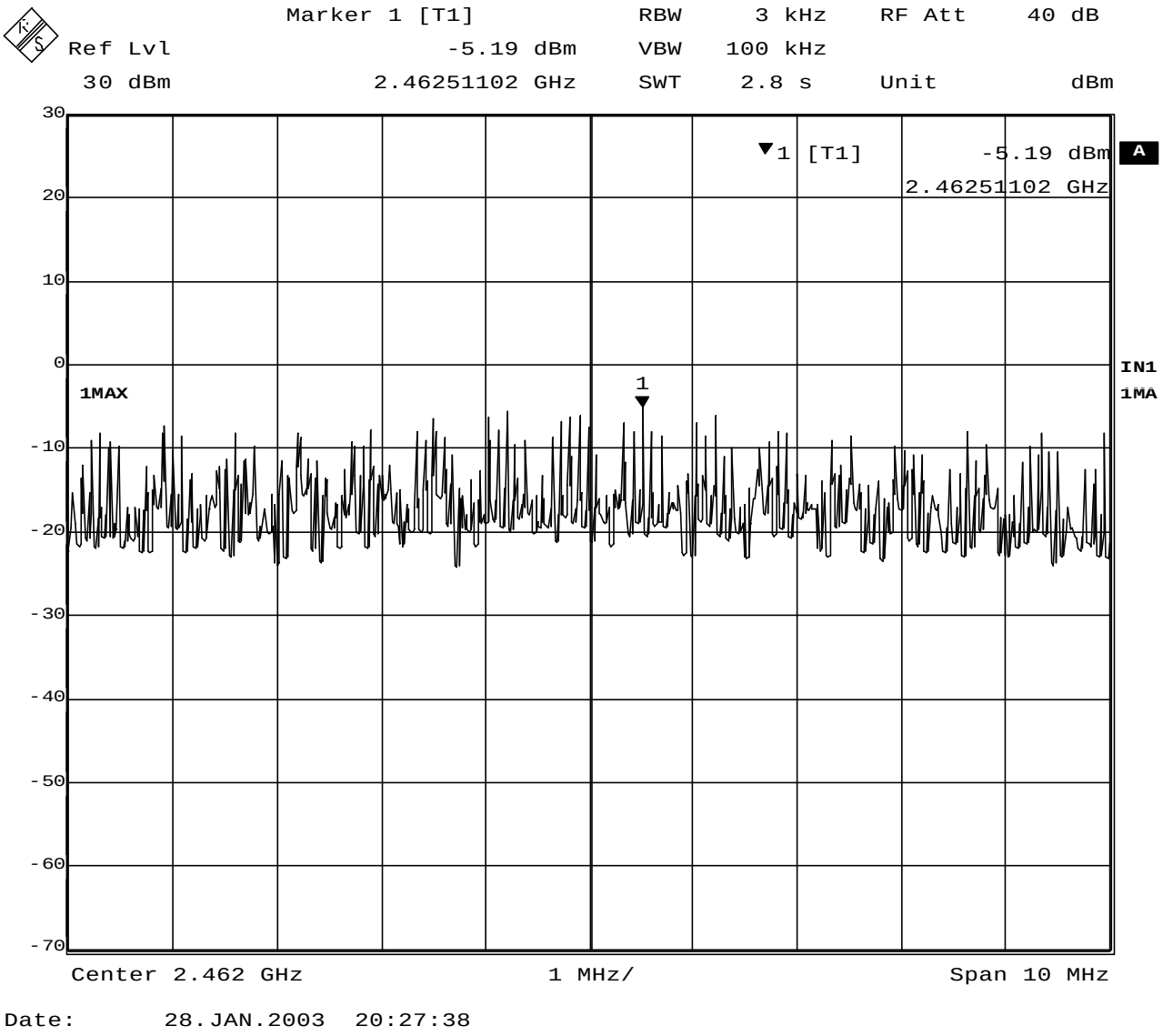
Plot 4-3. Peak Power Spectral Density of 2462MHz (1Mbps)



Plot 4-4. Peak Power Spectral Density of 2412MHz (11Mbps)



Plot 4-5. Peak Power Spectral Density of 2437MHz (11Mbps)



Plot 4-6. Peak Power Spectral Density of 2462MHz (11Mbps)

5. AC WIRELINE CONDUCTED EMISSIONS (150KHz – 30MHz)

5.1 Test Procedure

The conducted emissions are measured in the IBM shielded room with a spectrum analyzer in peak hold. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9KHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

5.2 Test Instruments and Measurement Setup

Table 5-1. Conducted Emission Test Instrumentation

Description	**Model**	**Serial Number**
Computer	IBM 6589-13J	97-15613
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2601A02634
Spectrum Analyzer Display	HP 85662A	2542A12308
Quasi-Peak Adapter	HP 85650A	2043A00062
Receiver (9kHz-30MHz)	R&S ESH3	891806/012
LISN	EMCO 3825/2	1426
Switch/control unit	HP 3488A	2719A17228
Plotter	HP 7550A	2631A33619
Coax cables: - Lisn-L <=> SW/Con.unit (SW100) - Lisn-N <=> SW/Con.unit (SW101) - SW/Con.unit <=> RCVR (Input) - SW/Con.unit<=> Spe Ana.(Signal In)	Length: 4 m 4 m 1 m 1 m	 - EMIC-L - EMIC-N - EMIC-R - EMIC-S

Notes: - HP: Hewlett Packard, R&S: Rohde & Schwarz

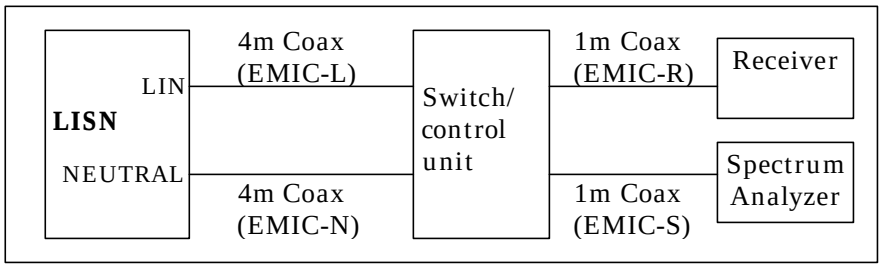


Figure 5. Cables for Conducted Emission Test

5.3 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 10.3dB. The 6 highest emissions relative to the limits are reported.

Test Date: January 31, 2003

1) EUT in transmission mode

Table 5-2-1. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.1(2412MHz) TX mode 11Mbps

Frequency (MHz)	Phase	QP Voltage (dBμV)	CISPR22 QP Limit (dBμV)	AV Voltage (dBμV)	CISPR22 AV Limit (dBμV)
0.1962	LINE	53.5	63.8	42.7	53.8
0.2859	NEUTRAL	39.7	60.6	31.1	50.6
0.3861	LINE	33.2	58.1	27.8	48.1
0.4848	LINE	30.3	56.3	24.9	46.3
0.6262	LINE	28.2	56.0	25.4	46.0
1.2237	NEUTRAL	26.9	56.0	24.0	46.0

Table 5-2-2. EUT: M/T 2373-92U, s/n ZZ-00129 , Ch.6(2437MHz) TX mode 11Mbps

Frequency (MHz)	Phase	QP Voltage (dBμV)	CISPR22 QP Limit (dBμV)	AV Voltage (dBμV)	CISPR22 AV Limit (dBμV)
0.2041	LINE	52.2	63.4	41.1	53.4
0.3029	LINE	38.0	60.2	28.2	50.2
0.5171	LINE	29.5	56.0	23.4	46.0
0.6342	LINE	27.8	56.0	25.2	46.0
0.7369	LINE	28.5	56.0	24.4	46.0
0.8310	NEUTRAL	26.6	56.0	21.6	46.0

Table 5-2-3. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.11(2462MHz) TX mode 11Mbps

Frequency (MHz)	Phase	QP Voltage (dBμV)	CISPR22 QP Limit (dBμV)	AV Voltage (dBμV)	CISPR22 AV Limit (dBμV)
0.1944	LINE	49.1	63.8	39.4	53.8
0.2853	LINE	37.7	60.7	29.6	50.7
0.4116	LINE	31.1	57.6	26.7	47.6
0.5160	LINE	29.1	56.0	23.6	46.0
1.2918	LINE	28.3	56.0	26.0	46.0
1.9241	LINE	29.1	56.0	26.0	46.0

2) EUT in receiving mode

Table 5-2-4. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.6(2437MHz) RX mode

Frequency (MHz)	Phase	QP Voltage (dBμV)	CISPR22 QP Limit (dBμV)	AV Voltage (dBμV)	CISPR22 AV Limit (dBμV)
0.1932	LINE	48.5	63.9	38.6	53.9
0.2958	LINE	36.9	60.4	27.7	50.4
0.4090	LINE	28.7	57.7	22.3	47.7
0.5153	LINE	27.3	56.0	23.9	46.0
0.7376	LINE	27.6	56.0	23.4	46.0
1.2907	LINE	27.6	56.0	25.3	46.0

6. RESTRICTED BANDS RADIATIONS (30MHz – 1GHz)

6.1 Test Procedure

Preliminary radiated emissions are measured in the semi-anechoic chamber at a 3 meter distance on every azimuth in both horizontal and vertical polarity. The antennas are also scanned in height. The emissions are recorded with a spectrum analyzer in peak hold mode. The identified emissions are further maximized by a cable manipulation. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120kHz. The highest emissions relative to the limit are listed.

6.2 Test Instruments and Measurement Setup

Table 6-1 Radiated Emission Test Instrumentation

Description	**Model**	**Serial Number**
Computer	IBM 5551-L	#4
Spectrum Analyzer (100Hz-1.5GHz) for 30-200MHz	HP 85680B	3019A05155
Spectrum Analyzer Display for 30-200MHz	HP 85662A	3026A19353
Quasi-Peak Adapter for 30-200MHz	HP 85650A	3033A01449
Spectrum Analyzer (100Hz-1.5GHz) for 200-1000MHz	HP 85680B	2841A04252
Spectrum Analyzer Display for 200-1000MHz	HP 85662A	2816A16831
Quasi-Peak Adapter for 200-1000MHz	HP 85650A	2811A01156
Amplifier (100KHz-1.3GHz) - for 30-200MHz - for 200-1000MHz	 HP 8447D HP 8447D	 2805A02919 2944A03506
Biconical Antenna (30-200MHz)	EMCO 3108	2309
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	1585
Receiver (20MHz-1.3GHz)	R&S ESVP	893202/018
Switch/control unit	HP 3488A	2719A17226
N-Coax cables: - Bi-coni Ant <=> 10m Cable - 10m Cable <=> Shield Panel - Shield Panel <=> RF Amp - RF Amp <=> Power Splitter - Log-peri Ant <=> 10m Cable - 10m Cable <=> Shield Panel - Shield Panel <=> RF Amp - RF Amp <=> Power Splitter	Length: 9 m 10 m 7 m 0.5m 9 m 10 m 7 m 0.5m	 - EM103L01 - EM103L02 - EM103L03 - EM103L04 - EM103H01 - EM103H02 - EM103H03 - EM103H04
Coax cables: - Power Splitter <=> SW/Con.unit (SW110) - Power Splitter <=> SW/Con.unit (SW300) - Power Splitter <=> SW/Con.unit (SW100) - Power Splitter <=> SW/Con.unit (SW301) - SW/Con.unit <=> Receiver (Input) - SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	 1 m 1 m 1 m 1 m 2 m 2 m	 - EM103L05 - EM103L06 - EM103H05 - EM103H06 - EM1RCV - EM1SPL

- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM1SPH

Notes:
- HP: Hewlett Packard, R&S: Rohde & Schwarz

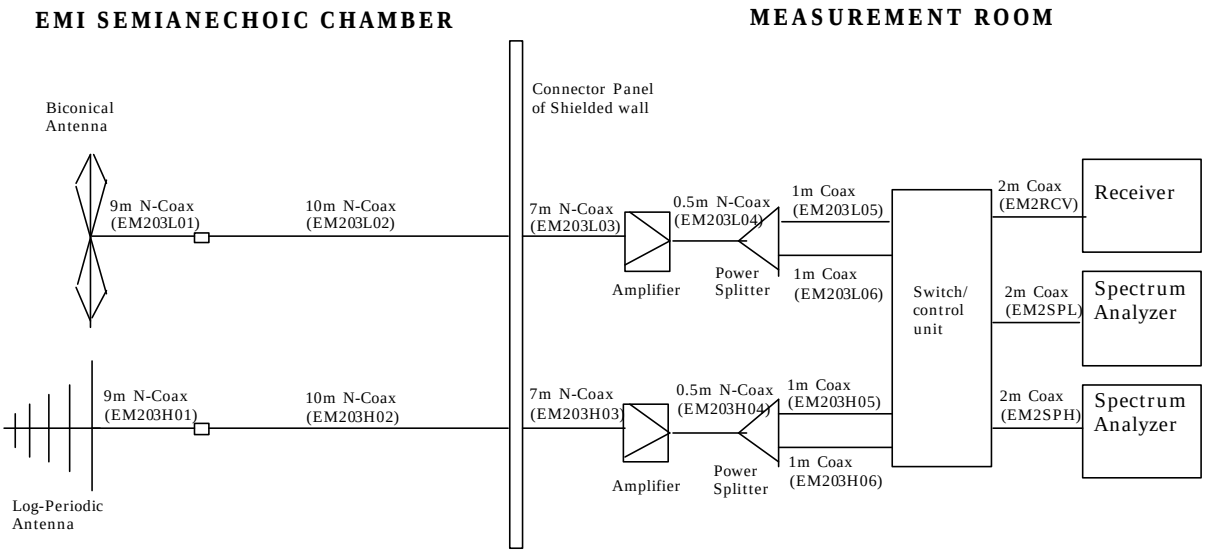


Figure 6 Cables for Radiated Emission Test

6.3 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver. All factors are included in the reported data.

$$FS = R + AF + CORR$$

where:

FS	=	Field Strength
R	=	Measured Receiver Input Amplitude
AF	=	Antenna Factor
CORR	=	Correction Factor = CL - AG
CL	=	Cable Loss
AG	=	Amplifier Gain

For example:
Given a Receiver input reading of 51.5dBμV; Antenna Factor of 8.5dB/m; Cable Loss of 1.3dB; and an Amplifier Gain of 26dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 = 35.3 dB\mu V/m$$

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

$$Level(dB\mu V/m) = 20 \times Log(Level(\mu V/m))$$

40dBμV/m = 100μV/m
48dBμV/m = 250μV/m

6.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 5.1 dB at 30MHz - 1000MHz band.
The 6 highest emissions relative to the limits are reported.

Test Date: January 29, 2003

1) EUT in transmission mode

Table 6-2-1. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.1(2412MHz) TX mode 11Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
100.226	H	34.8	8.9	-17.4	26.3	43.5	20.7	150
127.195	V	32.6	11.7	-17.0	27.3	43.5	23.2	150
200.452	V	29.9	11.3	-12.6	28.6	43.5	26.9	150
229.088	V	37.2	10.7	-14.8	33.1	46.0	45.2	200
257.998	V	35.4	12.0	-14.6	32.8	46.0	43.7	200
800.459	V	30.1	20.9	-10.4	40.6	46.0	107.2	200

Table 6-2-2. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.6(2437MHz) TX mode 11Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
131.475	V	35.9	11.9	-16.8	31.0	43.5	35.5	150
199.176	V	32.9	13.8	-15.8	30.9	43.5	35.1	150
229.088	V	37.7	10.7	-14.8	33.6	46.0	47.9	200
258.122	V	36.3	12.0	-14.6	33.7	46.0	48.4	200
700.380	V	28.5	20.9	-11.6	37.8	46.0	77.6	200
800.434	V	28.8	20.9	-10.4	39.3	46.0	92.3	200

Table 6-2-3. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.11(2462MHz) TX mode 11Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
32.997	H	33.8	12.9	-18.8	27.9	40.0	24.8	100
199.275	H	33.7	13.8	-15.8	31.7	43.5	38.5	150
258.122	V	35.1	12.0	-14.6	32.5	46.0	42.2	200
399.624	V	31.7	15.2	-14.3	32.6	46.0	42.7	200
700.374	H	27.0	20.9	-11.6	36.3	46.0	65.3	200
800.427	V	30.4	20.9	-10.4	40.9	46.0	110.9	200

2) EUT in receiving mode

Table 6-2-4. EUT: M/T 2373-92U, s/n ZZ-00129, RX mode

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
32.999	H	33.3	12.9	-18.8	27.4	40.0	23.4	100
132.309	V	33.4	11.9	-16.8	28.5	43.5	26.6	150
199.510	V	37.0	13.8	-15.9	34.9	43.5	55.6	150
229.088	V	37.8	10.7	-14.8	33.7	46.0	48.4	200
258.122	V	36.4	12.0	-14.6	33.8	46.0	49.0	200
700.375	V	29.9	20.9	-11.6	39.2	46.0	91.2	200

7. RESTRICTED BANDS RADIATIONS (1GHz – 25GHz)

7.1 Test Procedure

Radiated emissions were measured in the frequency range with 1 GHz to 25GHz in transmitting mode and 1 GHz to 12.5 GHz in receiving mode. All tests were performed in the semi-anechoic chamber at a 3-meter distance (except for the frequency range with 18 GHz to 25 GHz where test distance was reduced to 1 meter) on both horizontal and vertical polarities. The antenna was also scanned in height. The emissions are recorded with a spectrum analyzer in peak hold mode. The identified emissions are further maximized as a function of cable manipulation, azimuth, and antenna height. The emissions closest to the limits are measured in the peak mode with the tuned spectrum analyzer using a bandwidth of 1MHz and the average setting mode with the tuned spectrum analyzer using resolution bandwidth of 1MHz / video bandwidth of 1kHz or 100Hz. The highest emissions relative to the limit are listed.

7.2 Test Instruments and Measurement Setup

Table 7 Radiated Emission Test Instrumentation (1GHz – 25GHz)

Description	**Model**	**Serial Number**
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003
Amplifier (1-26.5GHz)	HP 8449B	3008A00582
Horn Antenna (1- 18GHz)	EMCO 3115	9903-5774
Horn Antenna (3.95 – 5.85GHz)	EMCO 3160-5	1099
Horn Antenna (5.85 – 8.20GHz)	EMCO 3160-6	9712-1044
Horn Antenna (8.20 – 12.40GHz)	EMCO 3160-7	1156
Horn Antenna (18- 26.5GHz)	EMCO 3160-9	0004-1202
Coaxial cables: - Horn Ant <=> RF Amp. (1-18GHz) - RF Amp.<=>Spectrum Analyzer (1-18GHz) - Horn Ant <=> RF Amp. (18-25GHz) - RF Amp.<=>Spectrum Analyzer (18-25GHz)	Length: 6 m 15 m 3m 1m	 - EM206SCO - EM215SCO - SF102-20167 - SF102-21105

Notes: - HP: Hewlett Packard, R&S: Rohde & Schwarz

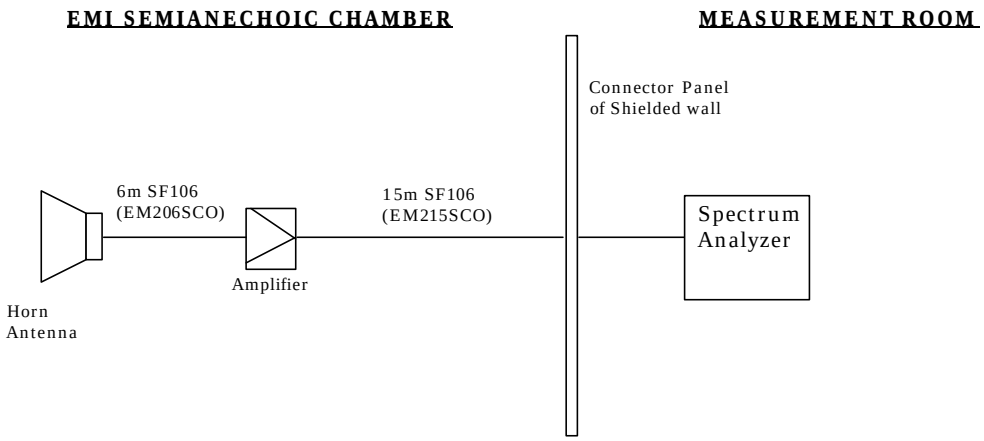


Figure 7-1. Cables for Radiated Emission Test (1-18GHz)

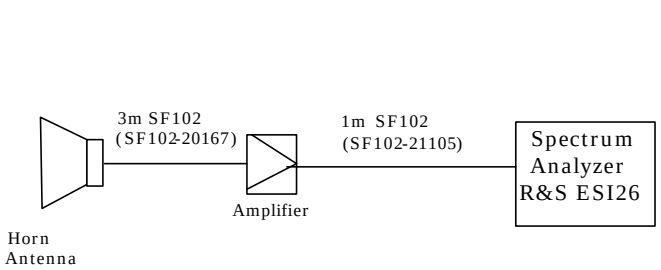


Figure 7-2. Cables for Radiated Emission Test (18 - 25GHz)

7.3 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

FS = R + AF + CORR - FO

where:

FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL-AG
CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor

For example:

Given a Spectrum Analyzer input reading of 51.5 dBμV; Antenna Factor of 8.5 dB/m; Cable Loss of 1.3 dB; Falloff Factor of 0 dB; and an Amplifier Gain of 26 dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 – 26 – 0.0 = 35.6 dBμV/m

Conversions between dBμV/m (or dBμV) and μV/m (or μV) are done as :

Level(dBμV/m) = 20 × Log (Level(μV/m))
40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

7.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 5.1 dB. The measurement was done for the frequency range of 1 GHz to 25 GHz in TX mode and 1 GHz to 12.5GHz in RX mode.

Test Date: January 30 and 31, 2003

1) EUT in transmission mode

Table 7-2-1. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.1(2412MHz) TX mode 11Mbps

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ***(peak)***	Measured (dBμV) ***(average)***	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ***(peak)***	FCC Limit (dBμV/m) ***(peak)***	Field Strength (dBμV/m) ***(average)***	FCC Limit (dBμV/m) ***(average)***
1.130	V	50.4	-	24.6	-32.4	0.0	42.6	74.0	-	54.0
1.199	V	51.3	-	25.2	-32.3	0.0	44.2	74.0	-	54.0
2.330	H	48.8	-	28.0	-30.3	0.0	46.5	74.0	-	54.0
2.386	H	62.2	50.1	28.2	-30.4	0.0	60.0	74.0	47.9	54.0
2.390	H	62.1	51.1	28.2	-30.4	0.0	59.9	74.0	48.9	54.0
2.411	H	115.8	105.8	28.3	-30.4	0.0	113.7	OB*	103.7	OB*
4.826	H	36.8	-	27.1	-27.2	0.0	36.7	74.0	-	54.0
7.238	H	38.5	-	30.0	-25.8	0.0	42.7	74.0	-	54.0

*Note: OB means “operation band” (2400-2483.5MHz); in this case limit is 1W (measured conducted with power meter).

Table 7-2-2. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.6(2437MHz) TX mode 11Mbps

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ***(peak)***	Measured (dBμV) ***(average)***	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ***(peak)***	FCC Limit (dBμV/m) ***(peak)***	Field Strength (dBμV/m) ***(average)***	FCC Limit (dBμV/m) ***(average)***
1.129	V	51.9	-	24.5	-32.5	0.0	43.9	74.0	-	54.0
1.199	V	52.3	-	25.2	-32.3	0.0	45.2	74.0	-	54.0
1.398	V	49.3	-	25.8	-31.8	0.0	43.3	74.0	-	54.0
2.390	H	54.9	-	28.2	-30.4	0.0	52.7	74.0	-	54.0
2.435	H	115.8	105.9	28.4	-30.3	0.0	113.9	OB*	104.0	OB*
2.484	H	51.8	-	28.4	-30.2	0.0	50.0	74.0	-	54.0
4.876	V	38.6	-	27.0	-26.9	0.0	38.7	74.0	-	54.0
7.313	H	38.3	-	29.9	-25.8	0.0	42.4	74.0	-	54.0

*Note: OB means “operation band” (2400-2483.5MHz); in this case limit is 1W (measured conducted with power meter).

Table 7-2-3. EUT: M/T 2373-92U, s/n ZZ-00163, Ch.11(2462MHz) TX mode 11Mbps

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ***(peak)***	Measured (dBμV) ***(average)***	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ***(peak)***	FCC Limit (dBμV/m) ***(peak)***	Field Strength (dBμV/m) ***(average)***	FCC Limit (dBμV/m) ***(average)***
1.130	V	50.8	-	24.6	-32.4	0.0	43.0	74.0	-	54.0
1.199	V	53.6	-	25.2	-32.3	0.0	46.5	74.0	-	54.0
1.398	V	50.0	-	25.8	-31.8	0.0	44.0	74.0	-	54.0
2.461	H	115.5	105.8	28.4	-30.2	0.0	113.7	OB*	104.0	OB*
2.484	H	57.6	47.4	28.4	-30.2	0.0	55.8	74.0	45.6	54.0
4.926	H	38.5	-	27.0	-27.7	0.0	37.8	74.0	-	54.0
7.384	H	40.8	-	29.8	-26.2	0.0	44.4	74.0	-	54.0

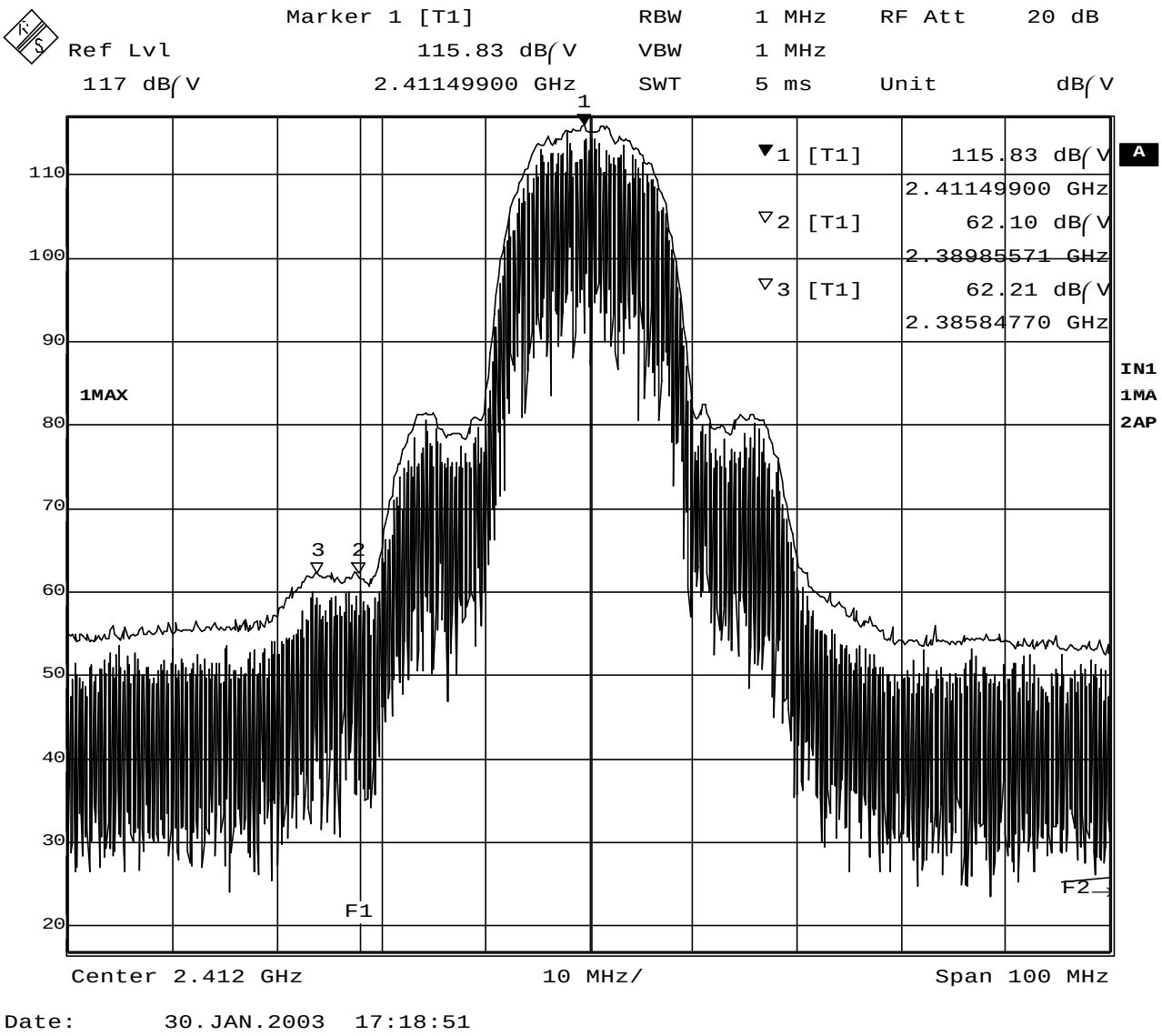
*Note: OB means “operation band” (2400-2483.5MHz); in this case limit is 1W (measured conducted with power meter).

2) EUT in receiving mode

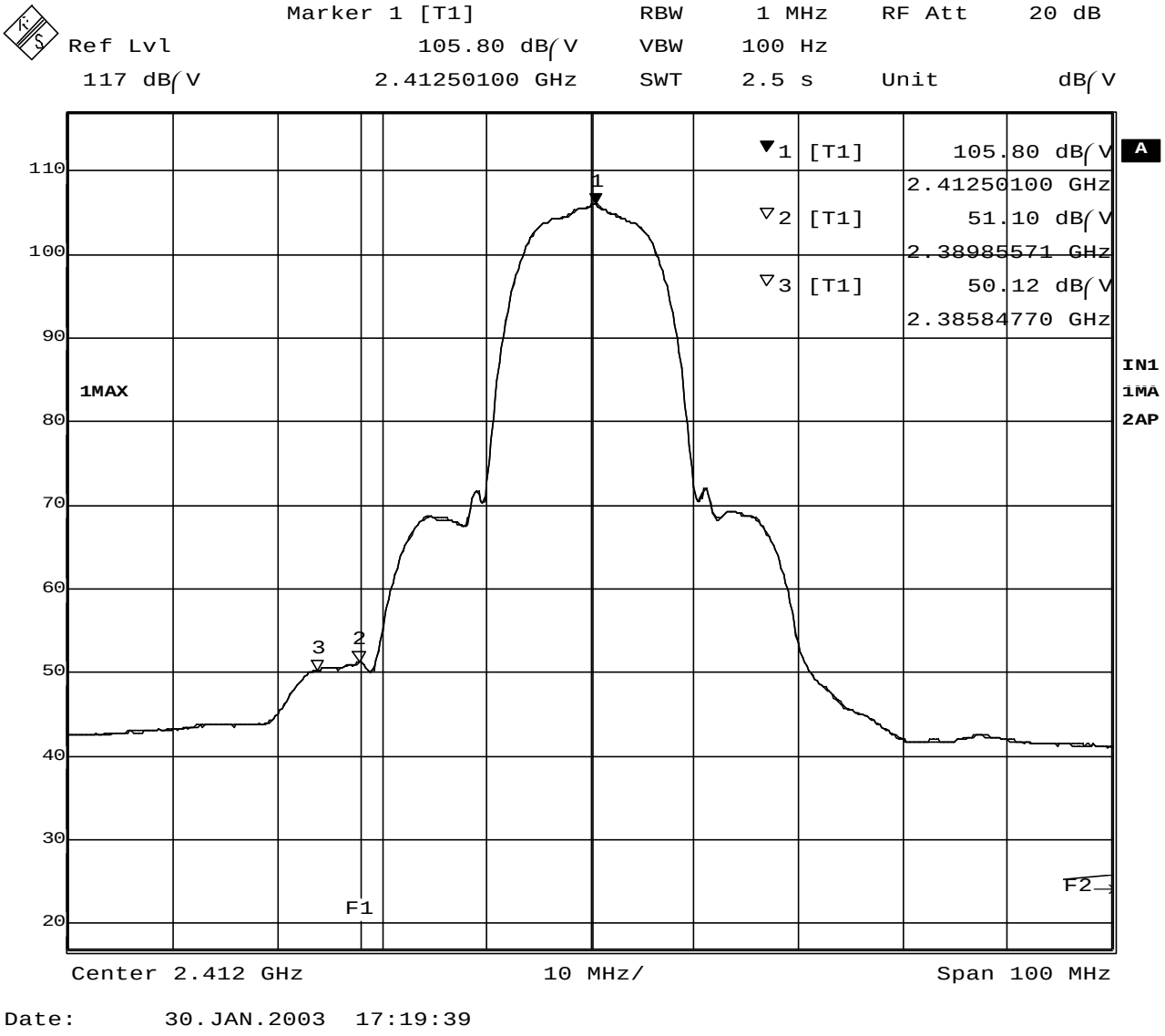
Table 7-2-4. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.6(2437MHz) RX mode

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ***(peak)***	Measured (dBμV) ***(average)***	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ***(peak)***	FCC Limit (dBμV/m) ***(peak)***	Field Strength (dBμV/m) ***(average)***	FCC Limit (dBμV/m) ***(average)***
1.066	V	50.2	-	24.6	-32.7	0.0	42.1	74.0	-	54.0
1.199	V	51.7	-	25.2	-31.9	0.0	45.0	74.0	-	54.0
1.398	V	48.0	-	25.8	-31.8	0.0	42.0	74.0	-	54.0

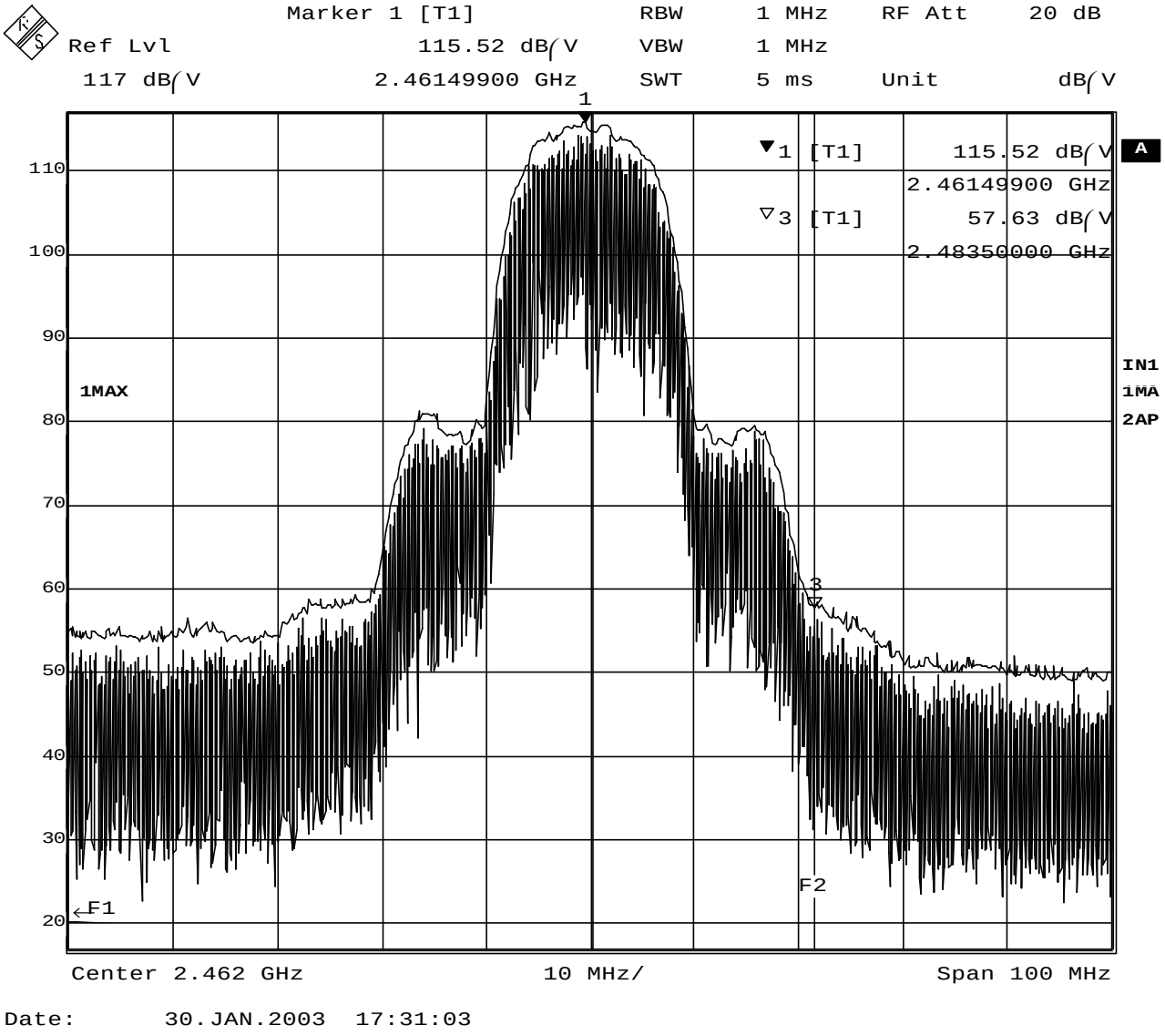
Measurement plots for adjacent restricted band



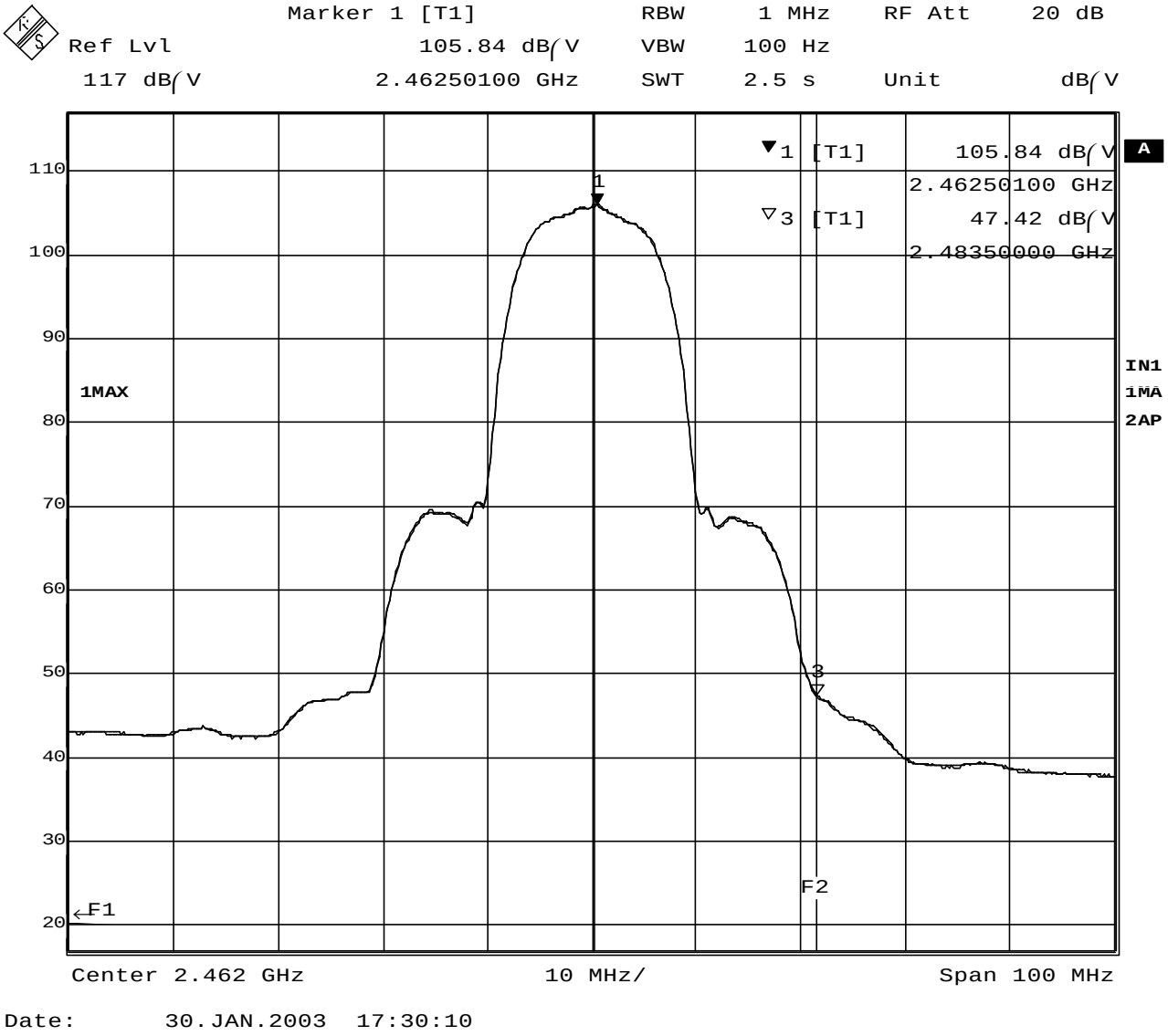
Plot 7-2-1 Ch.1 2412MHz TX 11Mb/s (Peak)



Plot 7-2-2 Ch.1 2412MHz TX11Mb/s (Average)



Plot 7-2-3 Ch.11 2462MHz TX 11Mb/s (Peak)



Plot 7-2-4 Ch.11 2462MHz TX 11Mb/s (Average)