



Test Reports

for
IBM 11a/b/g Wireless LAN Mini PCI Adapter
 with
ThinkPad T40 Series
ThinkPad X30 Series

This exhibit covers the following emission measurement results.

FCC Part 15C : DTS device

IEEE802.11g, 2412M-2462MHz band OFDM transmission modes

*Document number : **FCC 19-0217-0** ; Test Report for IBM ThinkPad X30 Series*
***FCC 19-0247-0** ; Test Report for IBM ThinkPad T40 Series*

[Transmission mode details]

MHz (Ch.No.)	IEEE802.11b			IEEE802.11g							
	1/2M bps	5.5M bps	11M bps	6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	18M bps	54M bps
2.412 (Ch. 1)	See the separate Test Report exhibit.			0	0	0	0	0	0	0	0
2.417 (Ch. 2)				0	0	0	0	0	0	0	0
2.422 (Ch. 3)				0	0	0	0	0	0	0	0
2.427 (Ch. 4)				0	0	0	0	0	0	0	0
2.432 (Ch. 5)				0	0	0	0	0	0	0	0
2.437 (Ch. 6)				0	0	0	0	0	0	0	0
2.442 (Ch. 7)				0	0	0	0	0	0	0	0
2.447 (Ch. 8)				0	0	0	0	0	0	0	0
2.452 (Ch. 9)				0	0	0	0	0	0	0	0
2.457 (Ch. 10)				0	0	0	0	0	0	0	0
2.462 (Ch. 11)				0	0	0	0	0	0	0	0
				IEEE802.11a							
5.745 (Ch.149)	N/A			See the separate Test Report exhibit.							
5.765 (Ch.153)											
5.785 (Ch.157)											
5.805 (Ch.161)											
5.825 (Ch.165)											

Emission Test Report

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

Document Number : FCC 19-0217-0

Product: IBM 11a/b/g Wireless LAN Mini PCI Adapter

measured with IBM ThinkPad X30 Series

FCC ID: ANO20030400LEG
IC: 349E-PH12127E

June 12, 2003

Prepared :
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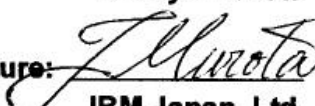
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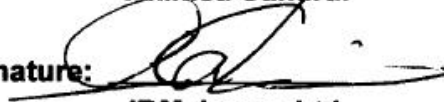
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MEASUREMENT / TECHNICAL REPORT – Part 15 Subpart C
(Intentional Radiator)**IBM 11a/b/g Wireless LAN Mini PCI Adapter**
with
IBM ThinkPad X30 Series
(Machine type : 2672, 2673, 2890, 2891)**FCC ID : ANO20030400LEG****June 12, 2003**

This report concerns: (check one)	
Original Grant	_____
Class I change	_____
Class II change	<u>✓</u> _____
Equipment type: <u>Wireless LAN device</u>	
This report shall not be reproduced except in full, without the written permission of this test lab.	
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.	
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- Index -

A. GENERAL INFORMATION.....	5
A.1 TEST METHODOLOGY	5
A.2 TEST FACILITY / NVLAP ACCREDITATION.....	5
A.3 EUT DETAILS.....	5
B. SUMMARY OF TEST RESULTS.....	6
C. OPERATION MODE OF EUT.....	7
D. JUSTIFICATION.....	7
E. TEST INSTRUMENTS.....	8
F. MEASUREMENT UNCERTAINTY.....	9
G. TEMPERATURE AND HUMIDITY.....	9
H. RELATED SUBMITTAL(S)/GRANT(S)/NOTES	9
1. BANDWIDTH AT 6 DB BELOW.....	10
1.1 TEST PROCEDURE.....	10
1.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	10
1.3 MEASUREMENT RESULTS.....	10
1.4 TRACE DATA	11
2. OUT OF BAND EMISSIONS AND OCCUPIED BANDWIDTH AT 20 DB BELOW / BANDEDGE	17
2.1 TEST PROCEDURE.....	17
2.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	17
2.3 MEASUREMENT RESULTS OF OCCUPIED BANDWIDTH / BAND-EDGE	17
2.4 MEASUREMENT RESULTS OF OUT OF BAND EMISSIONS	17
2.5 TRACE DATA OF BAND-EDGE	18
2.6 TRACE DATA OF OUT OF BAND EMISSIONS.....	24
3. CONDUCTED PEAK OUTPUT POWER	30
3.1 TEST PROCEDURE.....	30
3.2 MEASUREMENT RESULTS.....	31
3.3 TRACE DATA OF CONDUCTED PEAK OUTPUT POWER	32
4. TRANSMITTER POWER SPECTRAL DENSITY	35
4.1 TEST PROCEDURE.....	35
4.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	35
4.3 MEASUREMENT RESULTS.....	35
4.4 TRACE DATA	36
5. AC WIRELINE CONDUCTED EMISSIONS (150KHZ – 30MHZ).....	42
5.1 TEST PROCEDURE.....	42
5.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	42
5.3 POWERLINE VOLTAGE CALCULATION.....	43
5.4 MEASUREMENT RESULTS.....	44
6. RESTRICTED BANDS RADIATIONS (30MHZ – 1GHZ)	46
6.1 TEST PROCEDURE.....	46
6.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	46
6.3 FIELD STRENGTH CALCULATION.....	48
6.4 MEASUREMENT RESULTS.....	49

7. RESTRICTED BANDS RADIATIONS (1GHZ – 25GHZ)	51
7.1 TEST PROCEDURE	51
7.2 TEST INSTRUMENTS AND MEASUREMENT SETUP	51
7.3 FIELD STRENGTH CALCULATION	53
7.4 MEASUREMENT RESULTS	54
7.5 MEASUREMENT PLOTS OF ADJACENT RESTRICTED BAND	56

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 : IBM 11a/b/g Wireless LAN Mini PCI Adapter
 FCC ID : ANO20030400LEG
 IC Certification Number : 349E-PH12127E
 SERIAL NUMBER : A310037307
 PHYSICAL CONDITION : Preproduction
 KIND OF EQUIPMENT : Personal computer with an IEEE802.11a, 11b & 11g Wireless LAN
 Mini-PCI Combo Card ([Composite application](#))
 TESTED DATE : May 9, 12, 13, 15 and 23, 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 #1 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
IBM 11a/b/g Wireless LAN Mini PCI Adapter (s/n A310037307)	FCC ID: ANO20030400LEG IC: 349E-PH12127E	Applying equipment IEEE802.11a & b Wireless LAN Mini-PCI Combo Card without antenna
ThinkPad X30 Series M/T 2672-CBU (s/n 97-877N3)	N/A	IBM Notebook PC with built_in antenna CPU: Intel® Pentium® M Processor, 1.3GHz
P/N 02K6808	N/A	Universal AC adapter 56W, Unshielded power cord

B. Summary of Test Results

Table-B presents the list of the measurement items for DTS (Digital Transmissions System) 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 : Transmit mode (TX):		Condition	Result
15.247(a)(2) —	Bandwidth at 6 dB below	FCC requirement	Conducted	Pass
— 5.9.1	Bandwidth at 20 dB below Occupied BW(or Band-edge)	IC requirement		Pass
15.247(c) 6.2.2(o)(e1)	Out of Band Emissions	The radiated emission in any 100kHz of outband shall be at least 20dB below the highest inband spectral density.		Pass
15.247(b)(3) 6.2.2(o)(b)	Transmitter peak output power	Shall not exceed 1.0 W.		Pass
15.247(d) 6.2.2(o)(b)	Transmitter power spectral Density	Shall not be greater than 8 dBm in any 3kHz band.		Pass
15.207 6.2.2(o)(e3) / 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		Pass
15.205 / 209 6.2.1 / 6.2.2(o)(e3) / 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

	Test Items : Receive mode (RX):			
15.207 6.2.2(o)(e3) / 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
15.205 / 209 6.2.1 / 6.2.2(o)(e3) / 7.3	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

	Other requirements		Result
15.247(b)(4)(i) —	Antenna gain	Peak gain of the device : 1.28 dBi	N/A
15.203 6.2.2(o)(e2)	Unique antenna connector	The device employs an unique electronic handshake connector. Refer to “Confidential_BIOS_Lock” exhibit.	complies
— 6.2.2(o)(d1)	Power Spectral density for 2.4GHz unlicensed use	Conducted power / 20dB BW = 2.6mW/MHz (ch.6, 18Mb/s)	complies

C. Operation Mode of EUT

1. All tests were performed using the “Atheros Radio Test” program. This tool supports the continuous transmission mode for the testing purpose.
2. The following frequencies were chosen for the measurements.
- 2412MHz (lowest), 2437MHz(middle), and 2462MHz (highest)
3. 18Mbps transmission mode was selected for full testing (i.e. conducted and radiated measurements) as the worse case samplings. See “Chapter 3. Conducted Peak Output Power” as to the determination of measurement plots.
Also 6Mbps transmission mode was used for 6dB band width and other conducted testing.
4. As for the RF receiving test, the middle channel (2437MHz) was selected representatively.

Table-C Transmission mode of EUT (The measurement plots are shown in shading.)

Operation Frequency [GHz]	Rated output power (conducted) [dBm]										
	IEEE802.11b			IEEE802.11g							
	1/2M bps	5.5M bps	11M bps	6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	18M bps	54M bps
2.412 (Ch. 1)	*1			+14	+14	+14	+14	+14	14	13.5	11.5
2.417 (Ch. 2)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.422 (Ch. 3)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.427 (Ch. 4)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.432 (Ch. 5)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.437 (Ch. 6)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.442 (Ch. 7)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.447 (Ch. 8)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.452 (Ch. 9)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.457 (Ch. 10)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.462 (Ch. 11)				+14	+14	+14	+14	+14	14	13.5	11.5
IEEE802.11a											
5.745 (Ch.149)	N/A			*1							
5.765 (Ch.153)											
5.785 (Ch.157)											
5.805 (Ch.161)											
5.825 (Ch.165)											

*1: See the separate test report (Document number: FCC 19-0215-0).

D. Justification

The EUT was investigated for both main (left) and auxiliary (right) antennas. The worse case data taken in this report represents the measurement result of the right antenna that has comparatively higher gain in 2.4GHz band as shown in the following table.

Table-D Peak Antenna Gains of EUT

2.4GHz band	Left Antenna gain	0.62 dBi (peak)
	Right Antenna gain	1.28 dBi (peak)

E. Test Instruments

Table-E List of Measuring Instruments

Description	Model	Serial Number	Calibration Date	Calibration Interval
Computer	IBM 6868-30J	97-901X3	N/A	N/A
Computer	IBM 6589-13J	97-15613	N/A	N/A
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2601A02634	08/28/02	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2841A04242	10/30/02	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2841A04254	06/17/02	1 year
Spectrum Analyzer Display	HP 85662A	2542A12308	08/28/02	1 year
Spectrum Analyzer Display	HP 85662A	2816A16827	10/30/02	1 year
Spectrum Analyzer Display	HP 85662A	2816A16831	06/17/02	1 year
Quasi-Peak Adapter	HP 85650A	2043A00062	08/28/02	1 year
Quasi-Peak Adapter	HP 85650A	2811A01156	06/17/02	1 year
Quasi-Peak Adapter	HP 85650A	2811A01126	10/30/02	1 year
Amplifier (100KHz - 1.3GHz)				
- for 30-200MHz	HP 8447D	2805A02919	04/14/03	1 year
- for 200-1000MHz	HP 8447D	2727A05190	04/14/03	1 year
Amplifier (1 - 18GHz)	HP 8449B	3008A00582	06/13/02	1 year
Amplifier (18 - 25GHz)	Agilent 83051A	3950M00193	01/06/03	1 year
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003	05/01/03	1 year
Receiver (9kHz-30MHz)	R&S ESH3	891806/012	10/07/02	1 year
Receiver (20MHz-1.3GHz)	R&S ESVP	892111/030	03/17/03	1 year
Biconical Antenna (30-200MHz)	EMCO 3108	2536	04/23/03	1 year
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	2849	04/23/03	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	07/18/02	1 year
Horn Antenna (5.85- 8.20GHz)	EMCO 3160-6	9712-1044	07/18/02	1 year
Horn Antenna (8.2- 12.4GHz)	EMCO 3160-7	1156	07/18/02	1 year
Horn Antenna (18- 26.5GHz)	EMCO 3160-9	0004-1202	07/18/02	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	N/A	N/A
		2719A17228	N/A	N/A
Plotter	HP 7550A	2631A33619	N/A	N/A
Coaxial cables (1 – 18GHz):	Length:			
- Horn Ant <=> RF Amp.	6 m	- EM206SCO	09/05/02	1 year
- RF Amp.<=>Spectrum Analyzer	16m	- GEM0101	03/27/03	1 year
Coaxial cables (18 – 25GHz):				
- Horn Ant <=> RF Amp.	3m	- SF102-20167	09/05/02	1 year
- RF Amp.<=>Spectrum Analyzer	1m	- SF102-21105	09/05/02	1 year
N-Coax cables:				
- Bi-coni Ant <=> 10m Cable	9 m	- EM103L01	04/14/03	1 year

- 10m Cable <=> Shield Panel	10 m	- EM103L02	04/14/03	1 year
- Shield Panel <=> RF Amp	7 m	- EM103L03	04/14/03	1 year
- RF Amp <=> Power Splitter	0.5m	- EM103L04	04/14/03	1 year
- Log-peri Ant <=> 10m Cable	9 m	- EM103H01	04/14/03	1 year
- 10m Cable <=> Shield Panel	10 m	- EM103H02	04/14/03	1 year
- Shield Panel <=> RF Amp	7 m	- EM103H03	04/14/03	1 year
- RF Amp <=> Power Splitter	0.5m	- EM103H04	04/14/03	1 year
Coax cables:				
- Lism-L <=> SW/Con.unit (SW100)	4 m	- EMIC-L	04/14/03	1 year
- Lism-N <=> SW/Con.unit (SW101)	4 m	- EMIC-N	04/14/03	1 year
- SW/Con.unit <=> RCVR (Input)	1 m	- EMIC-R	04/14/03	1 year
- SW/Con.unit<=> Spe Ana.(Signal In)	1 m	- EMIC-S	04/14/03	1 year
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM103L05	04/14/03	1 year
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM103L06	04/14/03	1 year
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM103H05	04/14/03	1 year
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM103H06	04/14/03	1 year
- SW/Con.unit <=> Receiver (Input)	2 m	- EM1RCV	04/14/03	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	2 m	- EM1SPL	04/14/03	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM1SPH	04/14/03	1 year

Notes.

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

F. 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.

G. Temperature and Humidity

The temperature is controlled within range of 17° to 28°.

The relative humidity is controlled within range of 40% to 70%.

H. 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 DoC.

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: 110 cm Loss: 1.3 dB	

Notes: - R&S: Rohde & Schwarz

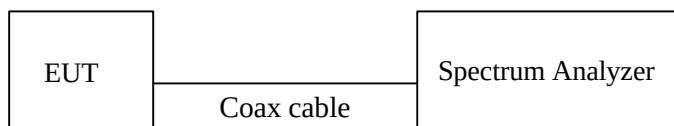


Figure 1: Measurement setup for 6dB bandwidth test

1.3 Measurement Results

Test Date: May 9, 2003

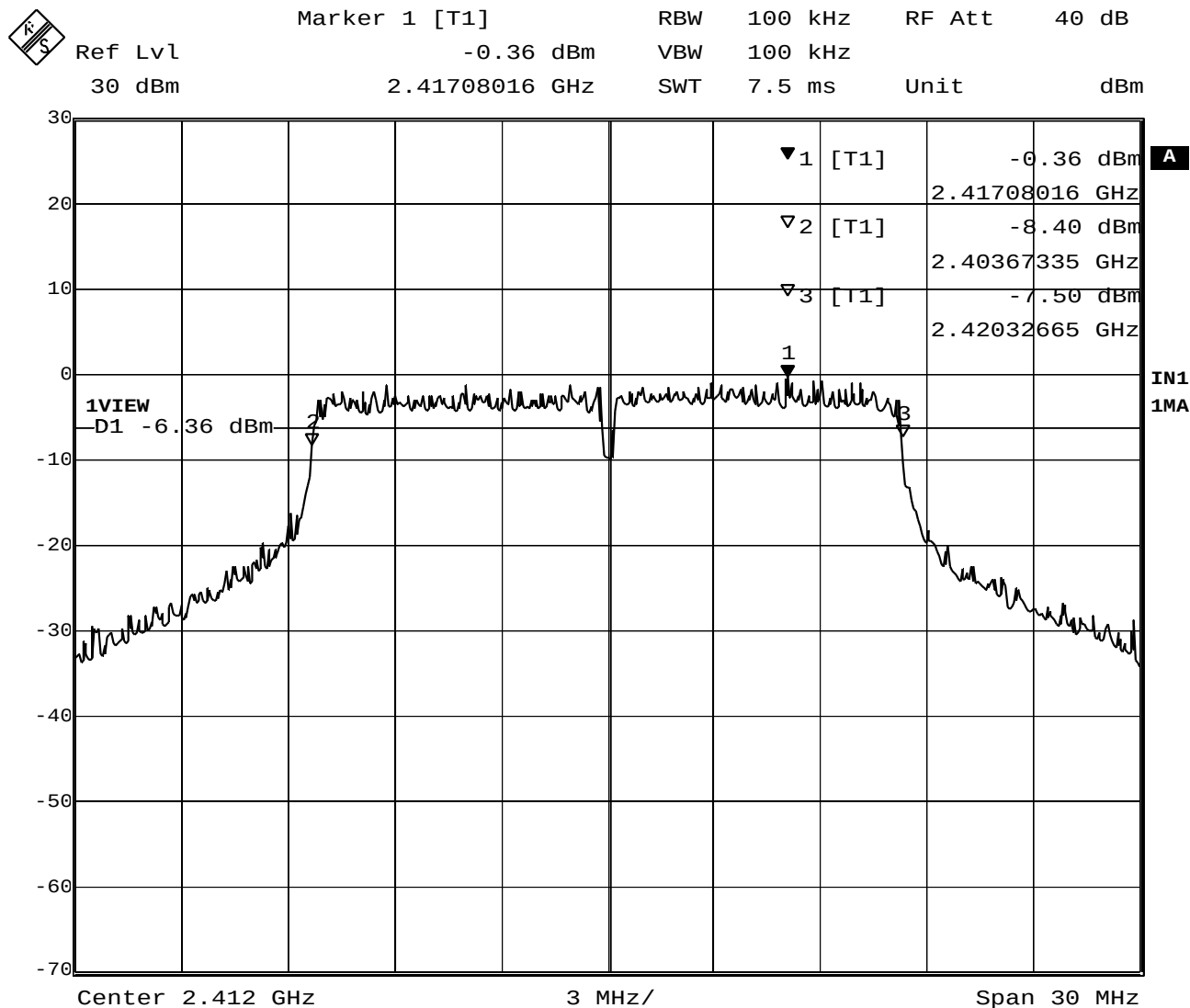
Table 1-2-1. EUT: M/T 2672-CBU, s/n 97-877N3 , TX mode 6Mbps

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)
2412 (ch. 1)	Plot 1-1	2403.67	2420.33	16.66
2437 (ch. 6)	Plot 1-2	2428.67	2445.33	16.66
2462 (ch. 11)	Plot 1-3	2453.67	2470.33	16.66

Table 1-2-2. EUT: M/T 2672-CBU, s/n 97-877N3 , TX mode 18Mbps

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)
2412 (ch. 1)	Plot 1-4	2403.73	2420.33	16.60
2437 (ch. 6)	Plot 1-5	2428.73	2445.33	16.60
2462 (ch. 11)	Plot 1-6	2453.73	2470.33	16.60

1.4 Trace Data

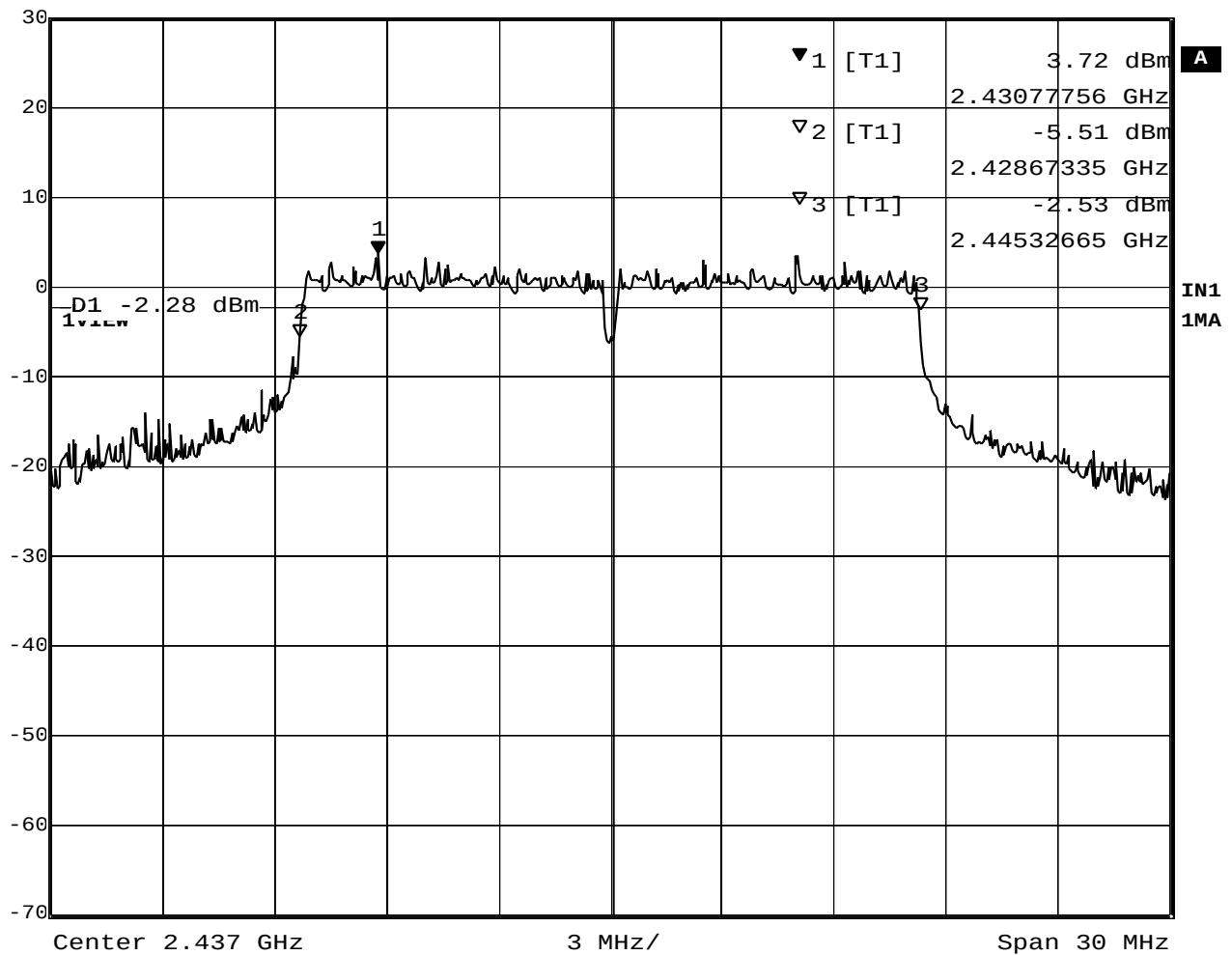


Date: 9.MAY.2003 17:50:06

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



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 3.72 dBm VBW 100 kHz
30 dBm 2.43077756 GHz SWT 7.5 ms Unit dBm

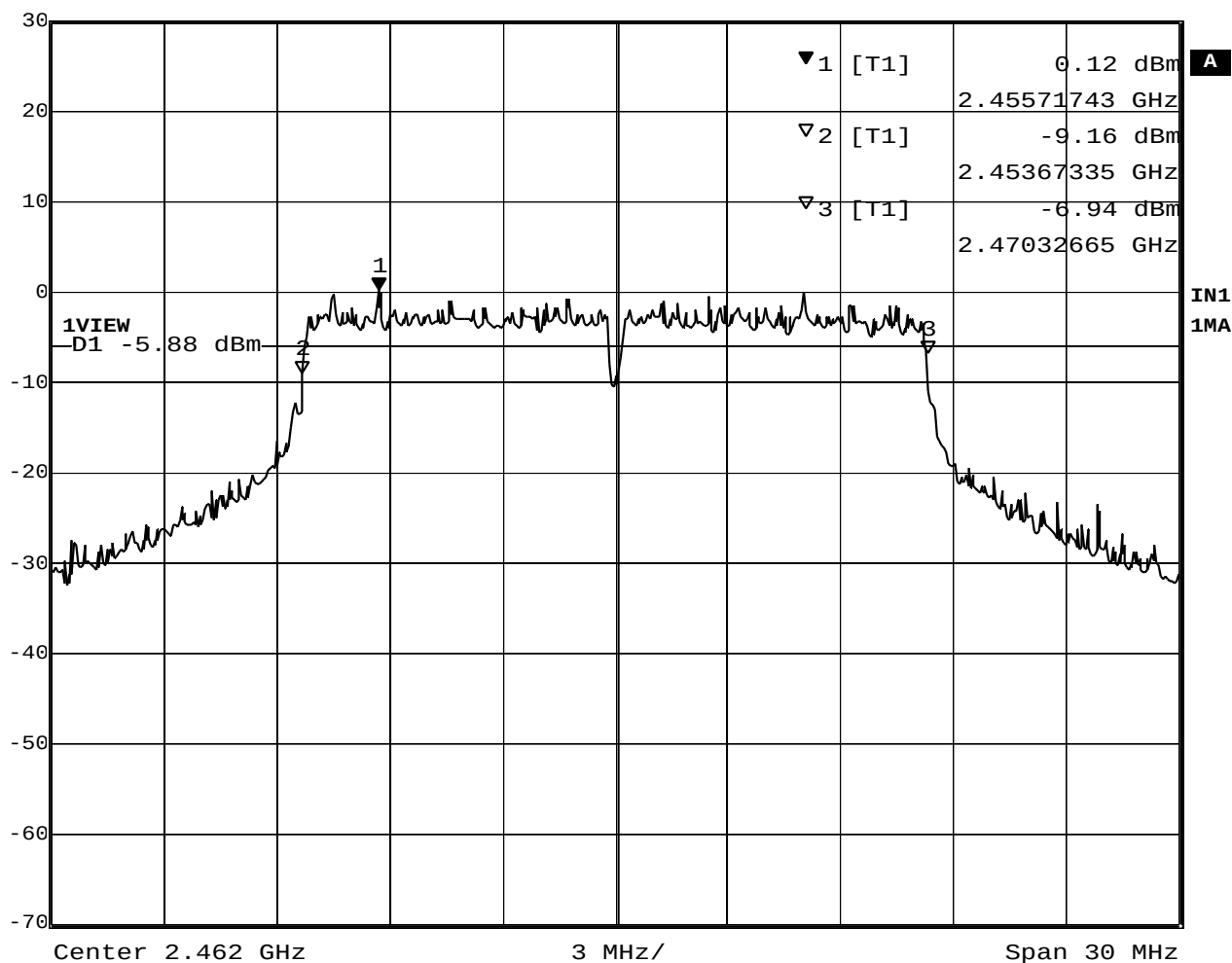


Date: 9.MAY.2003 17:44:19

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



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 0.12 dBm VBW 100 kHz
30 dBm 2.45571743 GHz SWT 7.5 ms Unit dBm

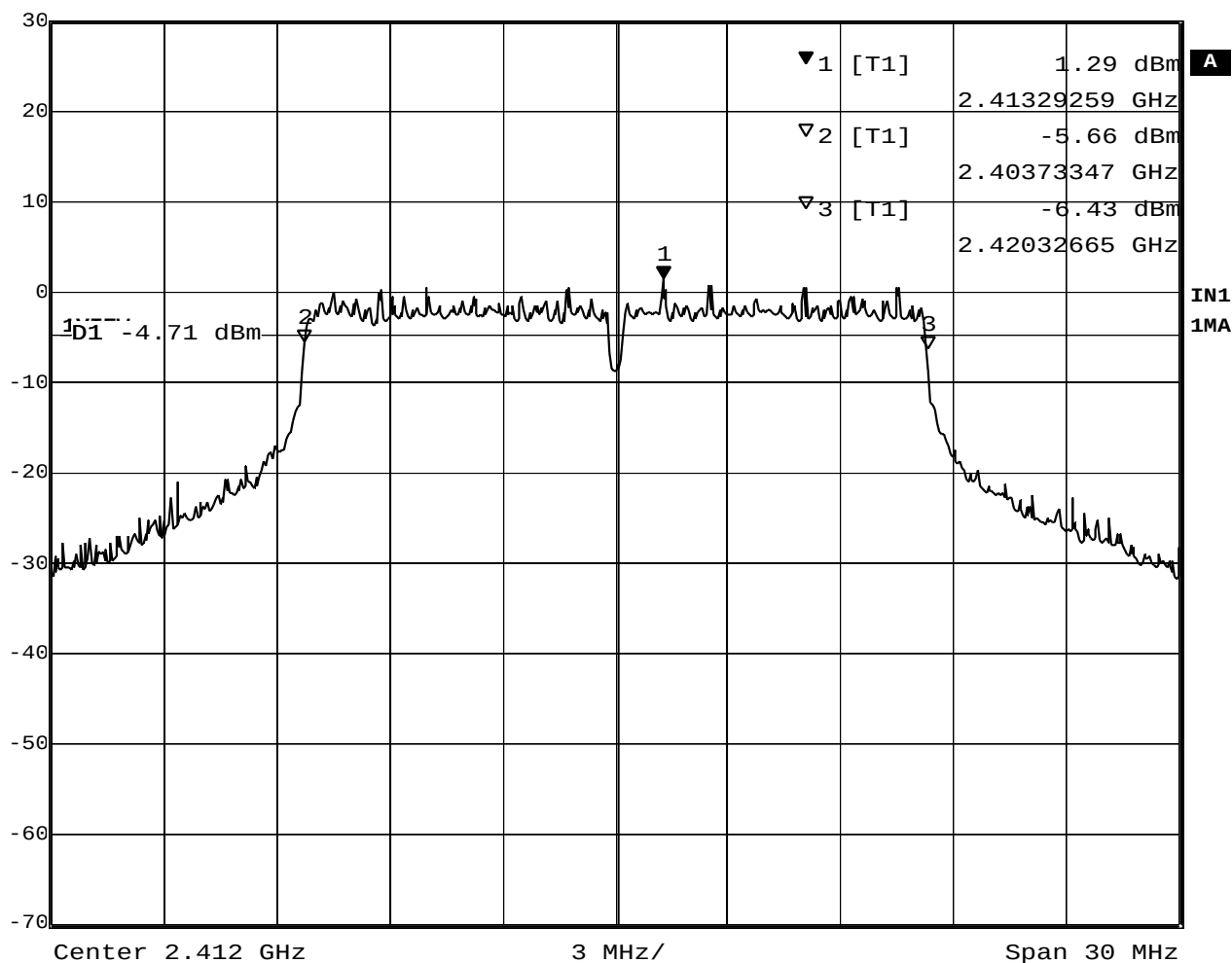


Date: 9.MAY.2003 17:39:11

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



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 1.29 dBm VBW 100 kHz
30 dBm 2.41329259 GHz SWT 7.5 ms Unit dBm

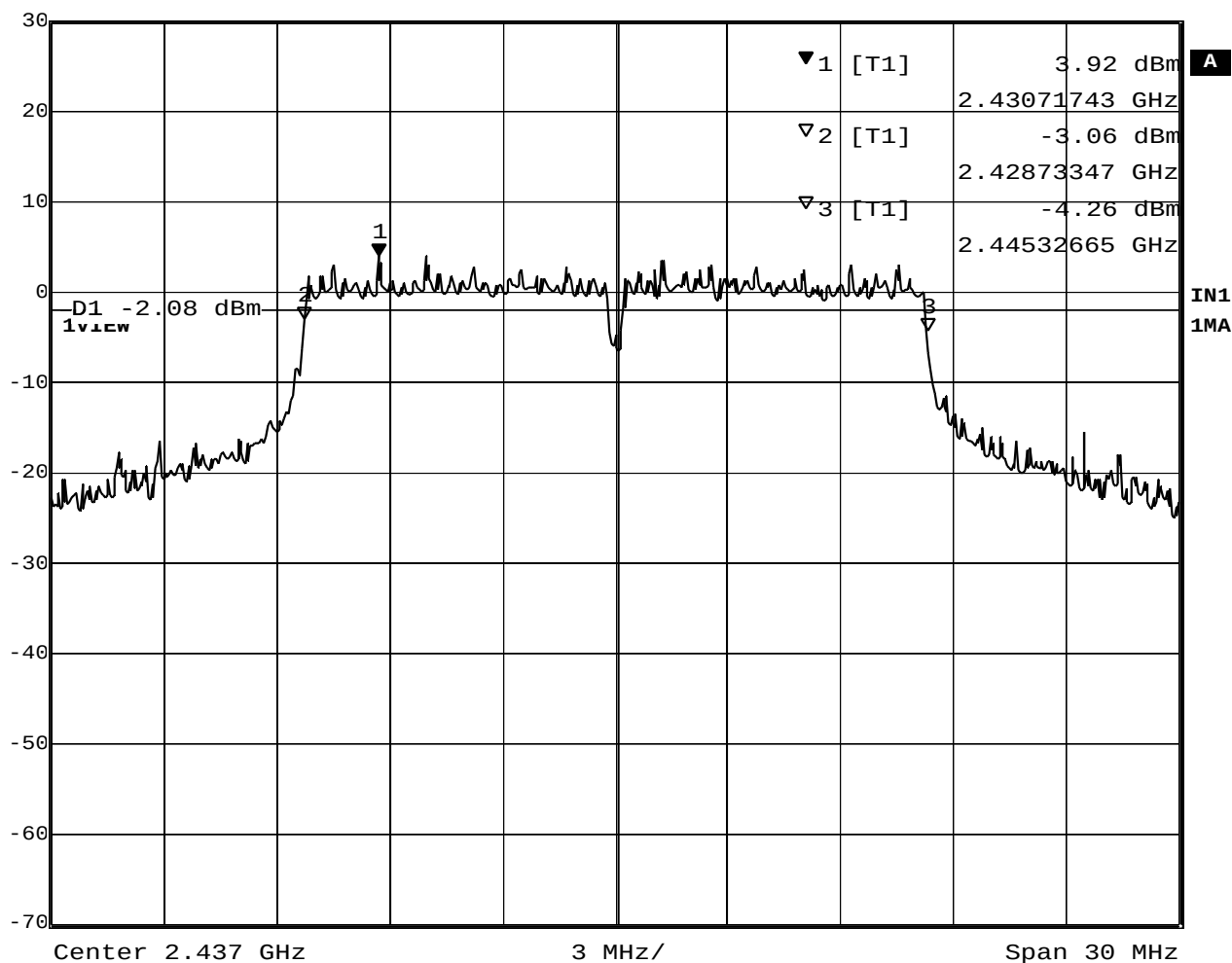


Date: 9.MAY.2003 17:31:23

Plot 1-4. 6dB BW at 2412MHz (18Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 3.92 dBm VBW 100 kHz
30 dBm 2.43071743 GHz SWT 7.5 ms Unit dBm

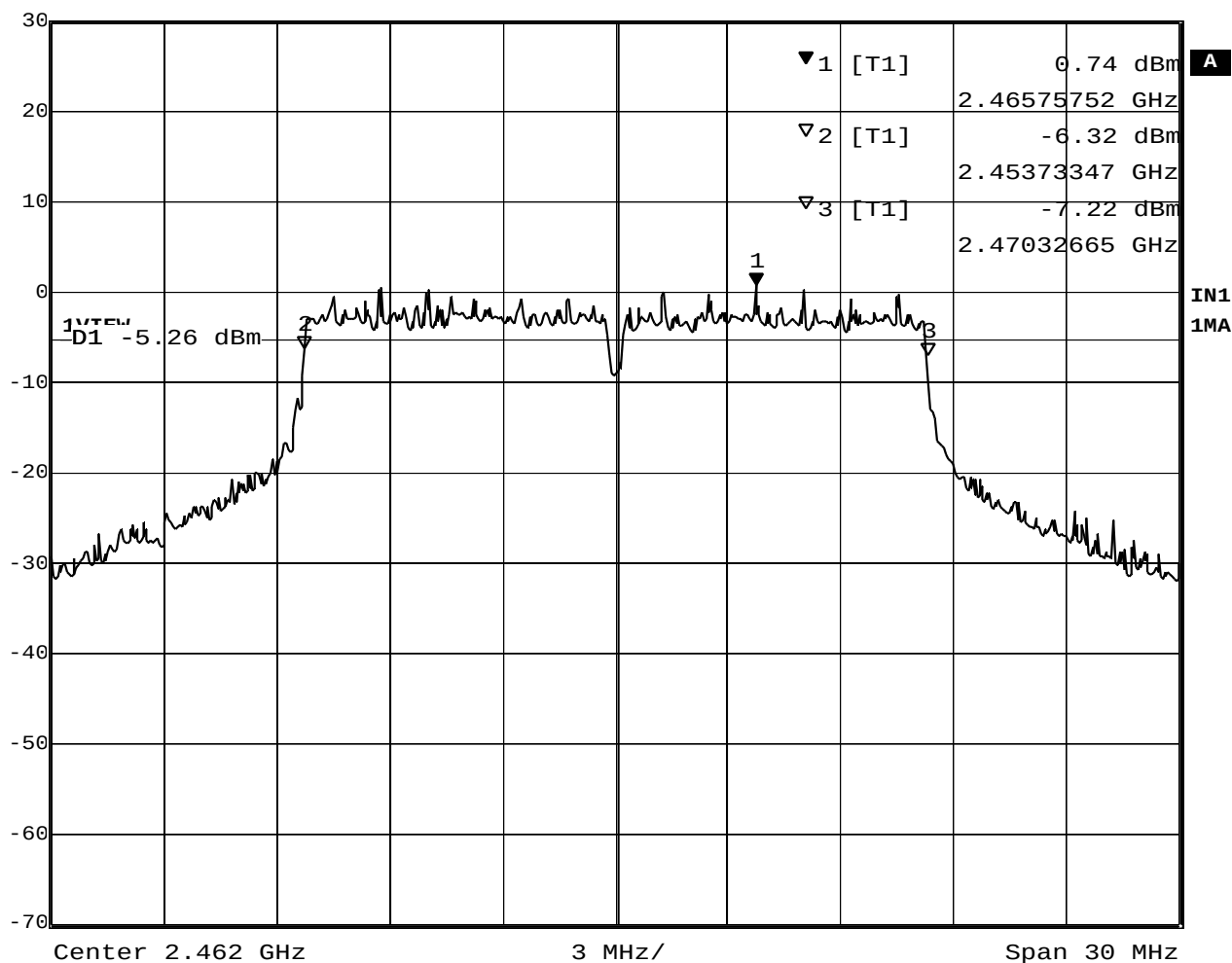


Date: 9.MAY.2003 17:34:12

Plot 1-5. 6dB BW at 2437MHz (18Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 0.74 dBm VBW 100 kHz
30 dBm 2.46575752 GHz SWT 7.5 ms Unit dBm



Date: 9.MAY.2003 17:36:41

Plot 1-6. 6dB BW at 2462MHz (18Mbps)

2. Out of Band Emissions and Occupied Bandwidth at 20 dB below / Bandedge

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 note) Canadian requirement

Test Date: May 9, 2003

Table 2-1-1. EUT: M/T 2672-CBU, s/n 97-877N3 , TX mode 6Mbps

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	2402.73	2421.87	19.14	2.73	
2437 (ch. 6)	Plot 2-2	2426.68	2447.37	20.69		
2462 (ch. 11)	Plot 2-3	2452.43	2471.53	19.10		11.97

Table 2-1-2. EUT: M/T 2672-CBU, s/n 97-877N3 , TX mode 18Mbps

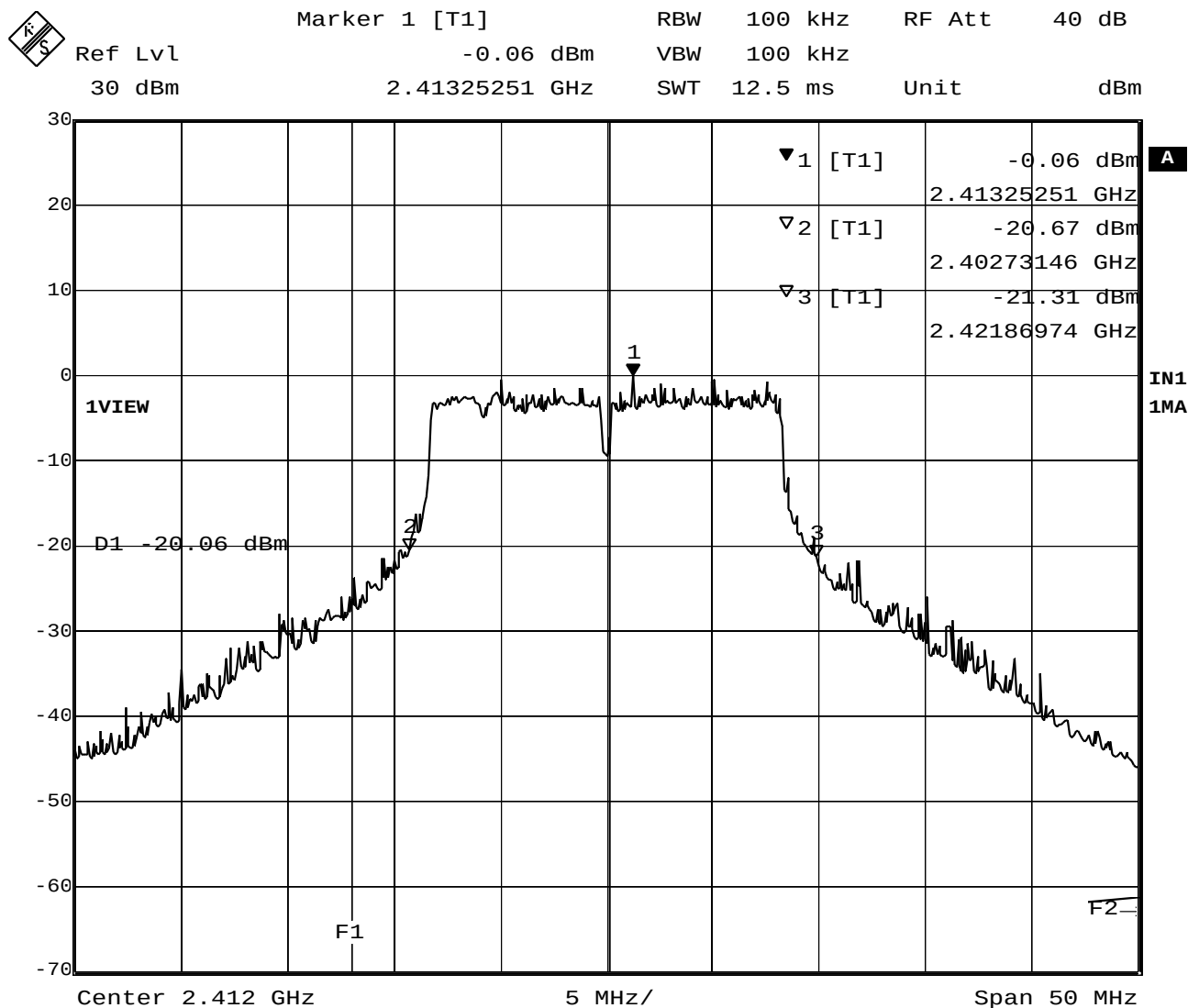
Center Frequency (MHz)	Trace number	Lower Frequency (MHz)	Upper Frequency (MHz)	Bandwidth at 20 dB below (MHz)	Margin to Lower limit (MHz)	Margin to Upper limit (MHz)
2412 (ch. 1)	Plot 2-4	2402.87	2421.13	18.26	2.87	
2437 (ch. 6)	Plot 2-5	2426.93	2447.48	20.55		
2462 (ch. 11)	Plot 2-6	2452.83	2471.03	18.20		12.47

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: May 9, 2003 : See Plot 2-7 to 2-12

2.5 Trace Data of Band-edge

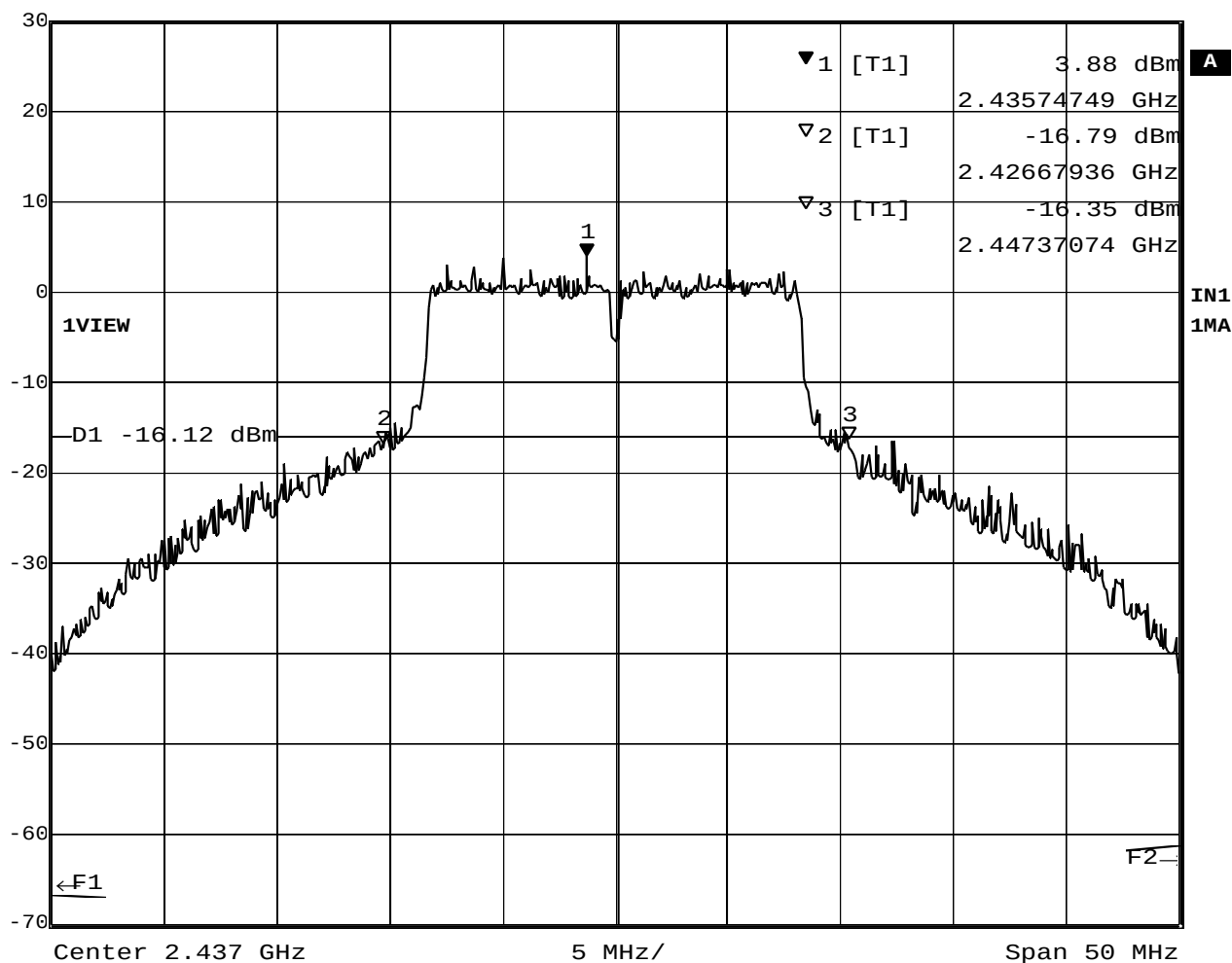


Date: 9.MAY.2003 18:31:22

Plot 2-1. 20dB BW at 2412MHz (6Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 3.88 dBm VBW 100 kHz
30 dBm 2.43574749 GHz SWT 12.5 ms Unit dBm

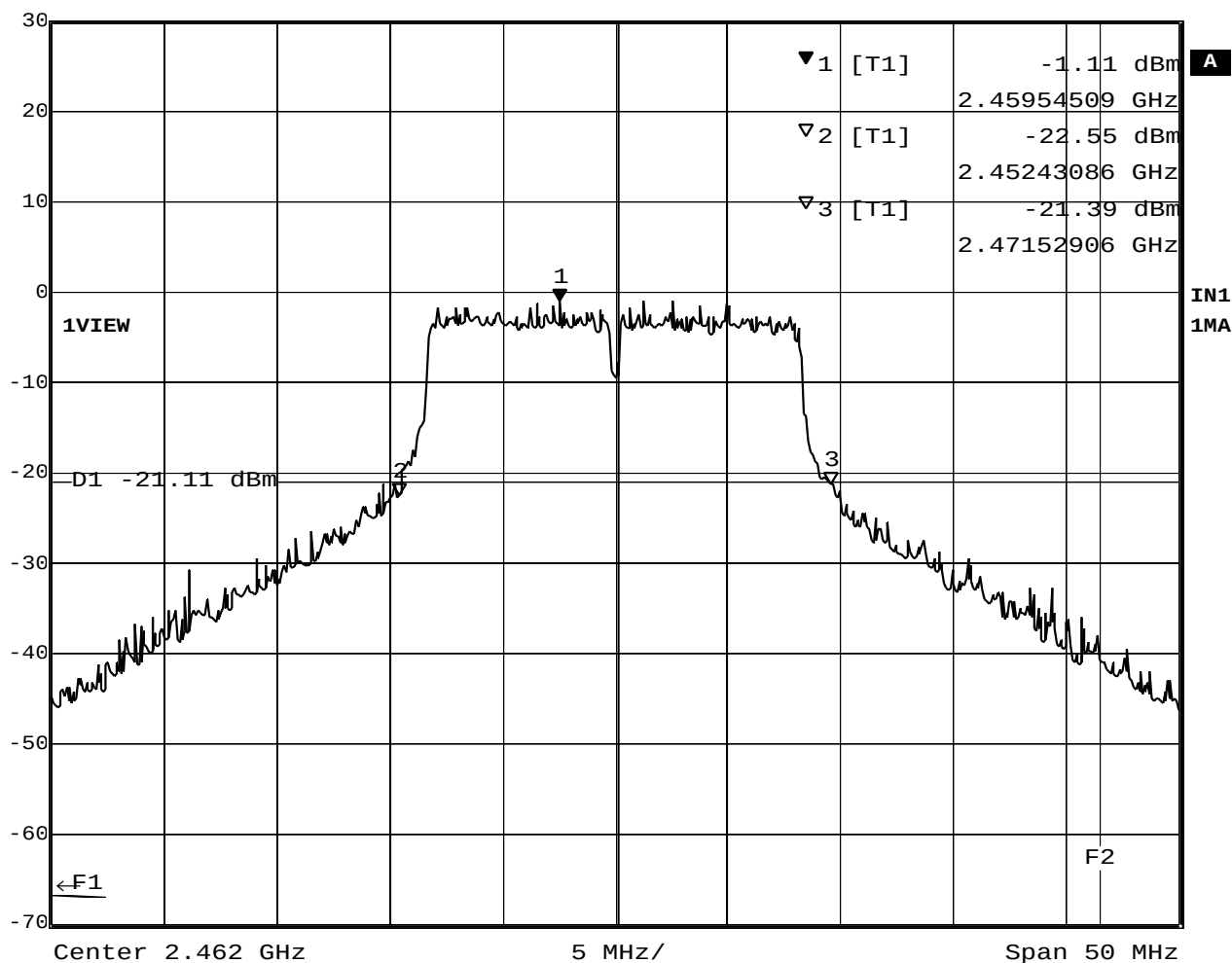


Date: 9.MAY.2003 18:25:36

Plot 2-2. 20dB BW at 2437MHz (6Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl -1.11 dBm VBW 100 kHz
30 dBm 2.45954509 GHz SWT 12.5 ms Unit dBm

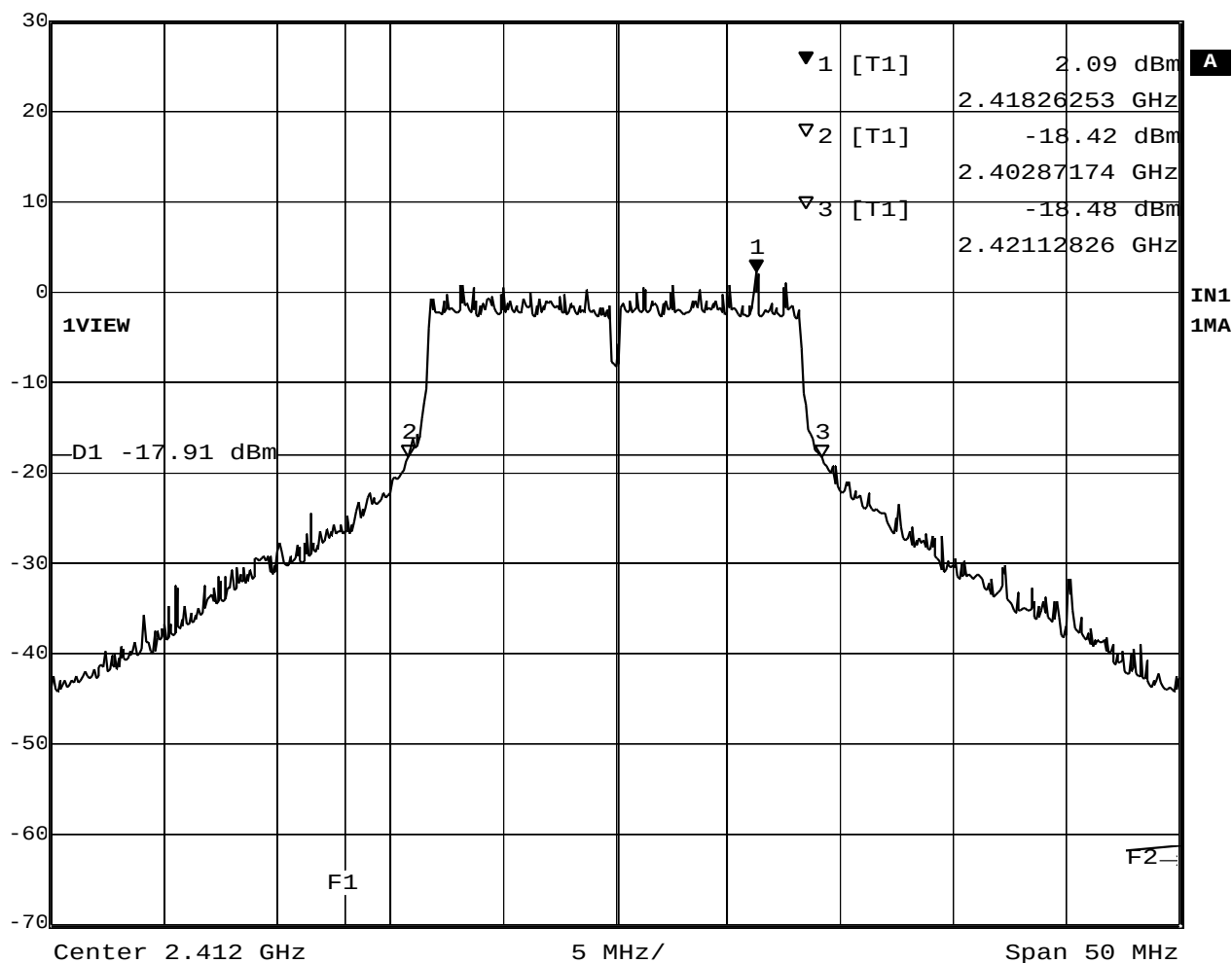


Date: 9.MAY.2003 18:14:39

Plot 2-3. 20dB BW at 2462MHz (6Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 2.09 dBm VBW 100 kHz
30 dBm 2.41826253 GHz SWT 12.5 ms Unit dBm

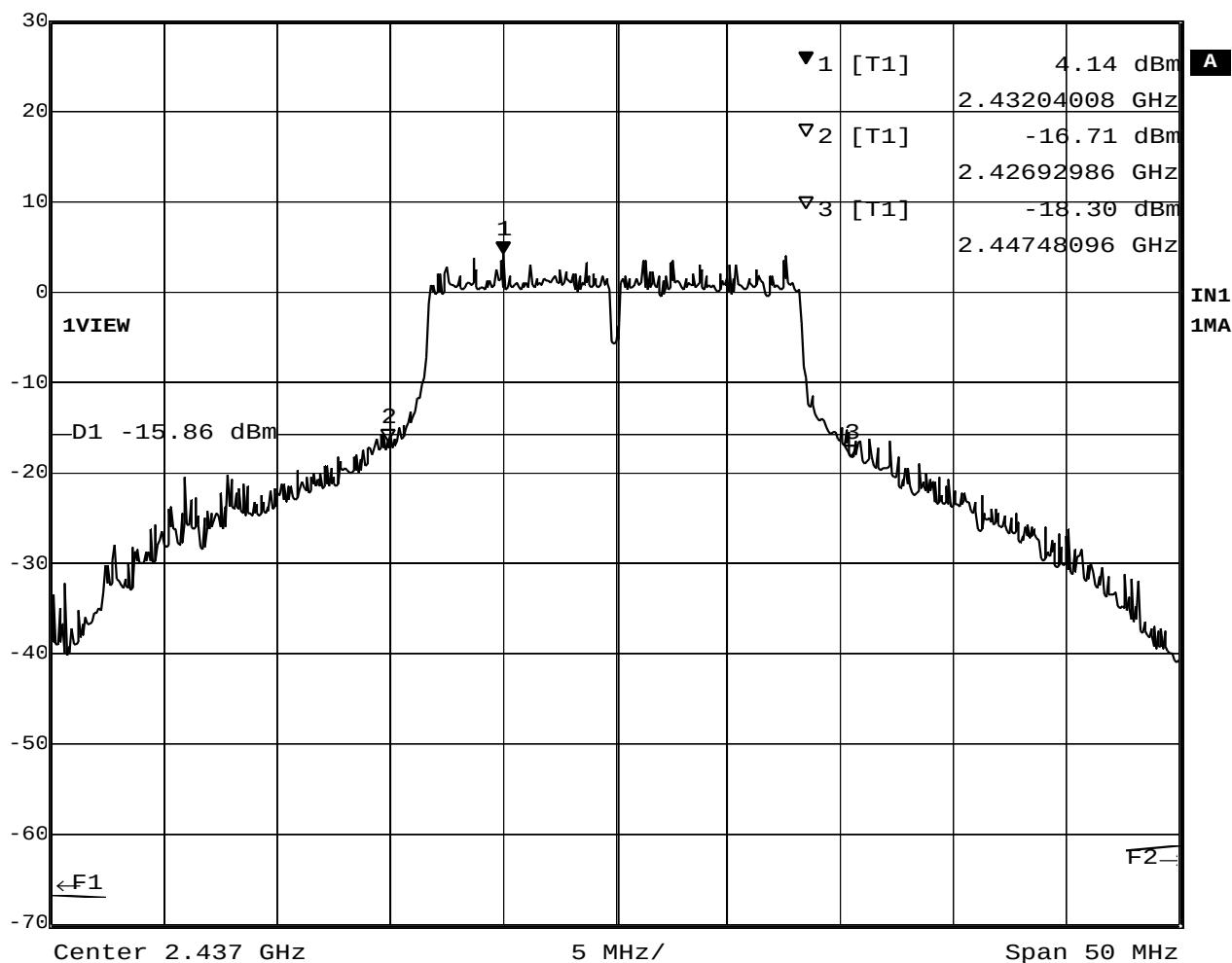


Date: 9.MAY.2003 18:00:43

Plot 2-4. 20dB BW at 2412MHz (18Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 4.14 dBm VBW 100 kHz
30 dBm 2.43204008 GHz SWT 12.5 ms Unit dBm

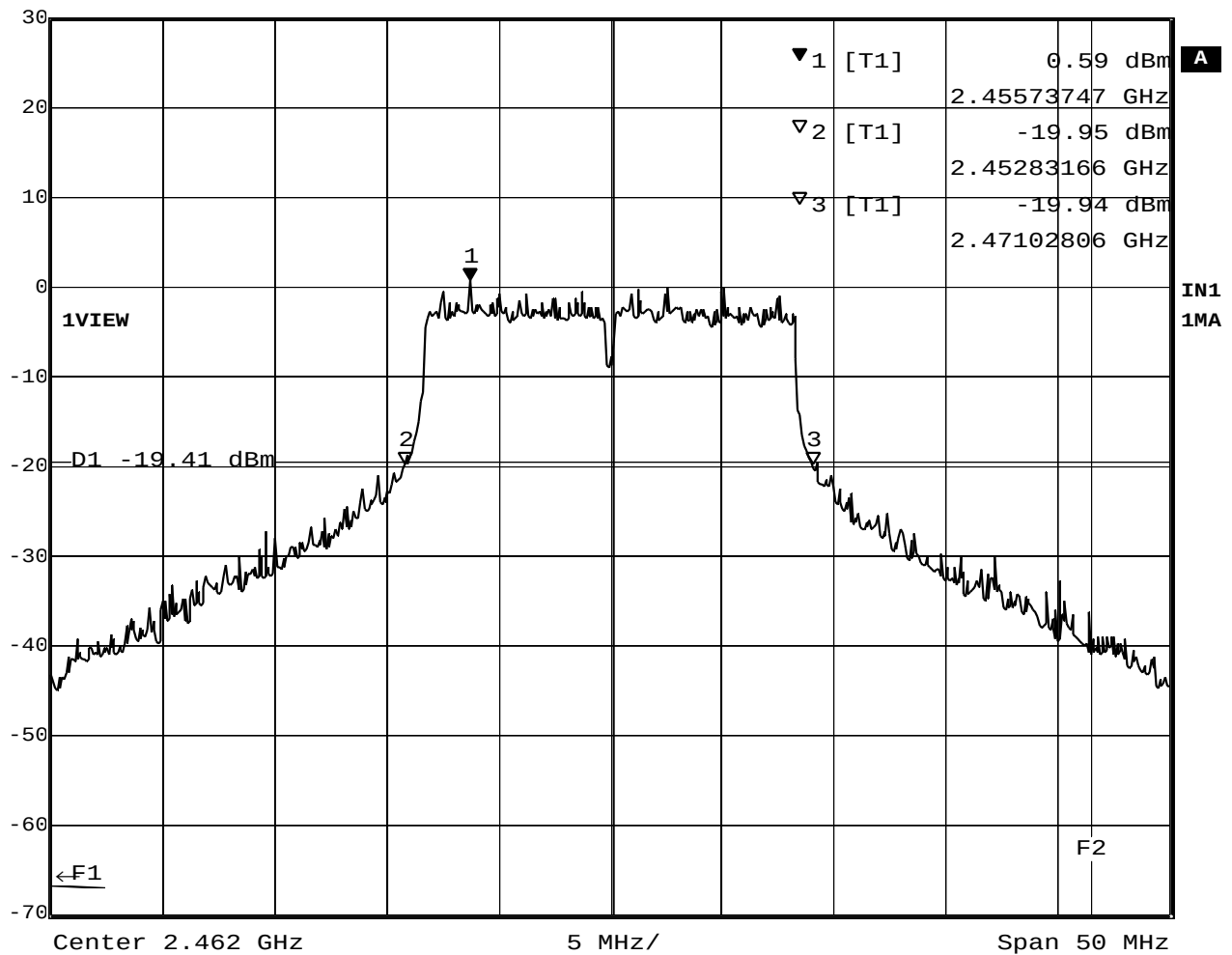


Date: 9.MAY.2003 18:07:39

Plot 2-5. 20dB BW at 2437MHz (18Mbps)



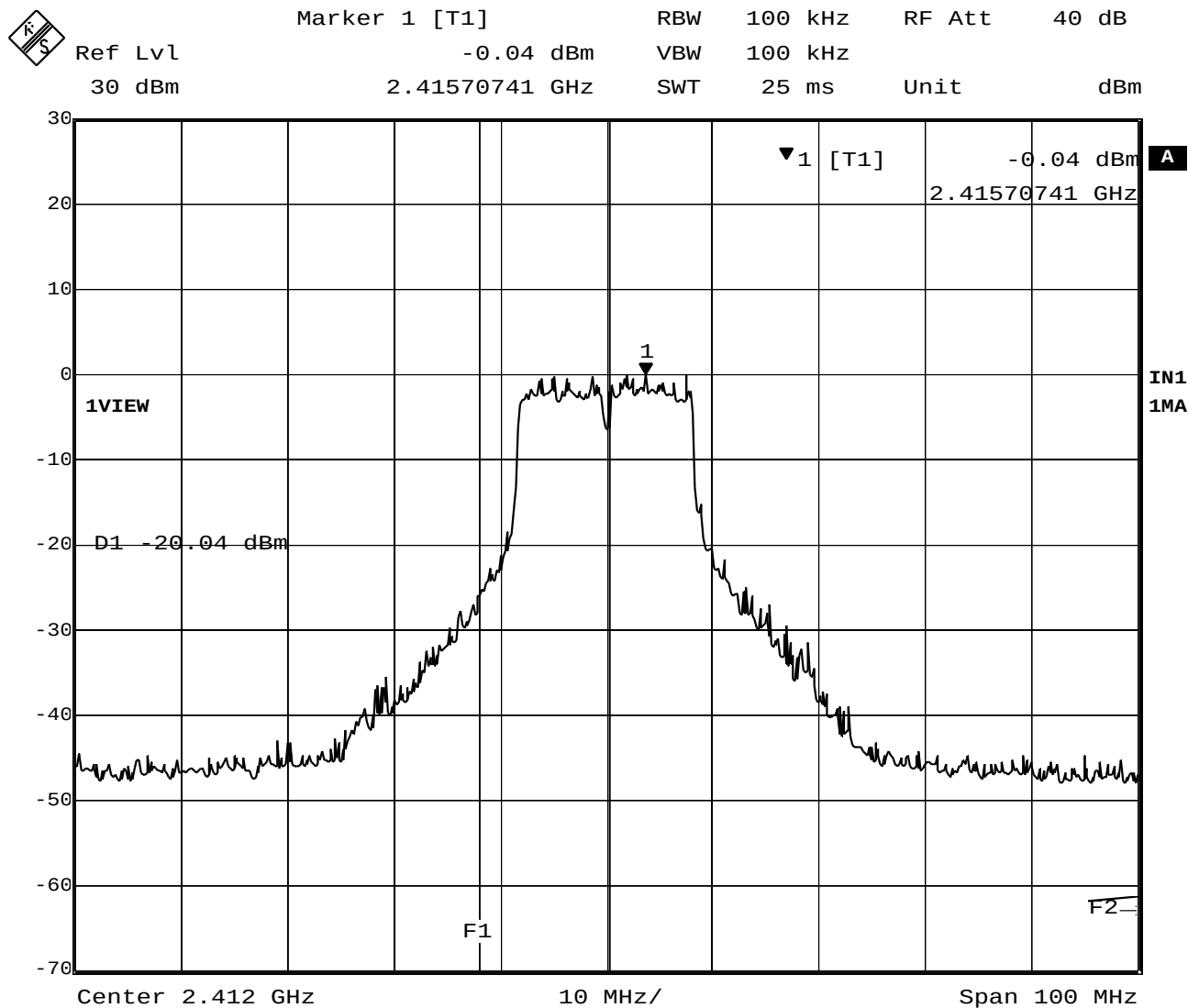
Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 0.59 dBm VBW 100 kHz
30 dBm 2.45573747 GHz SWT 12.5 ms Unit dBm



Date: 9.MAY.2003 18:12:39

Plot 2-6. 20dB BW at 2462MHz (18Mbps)

2.6 Trace Data of Out of Band Emissions

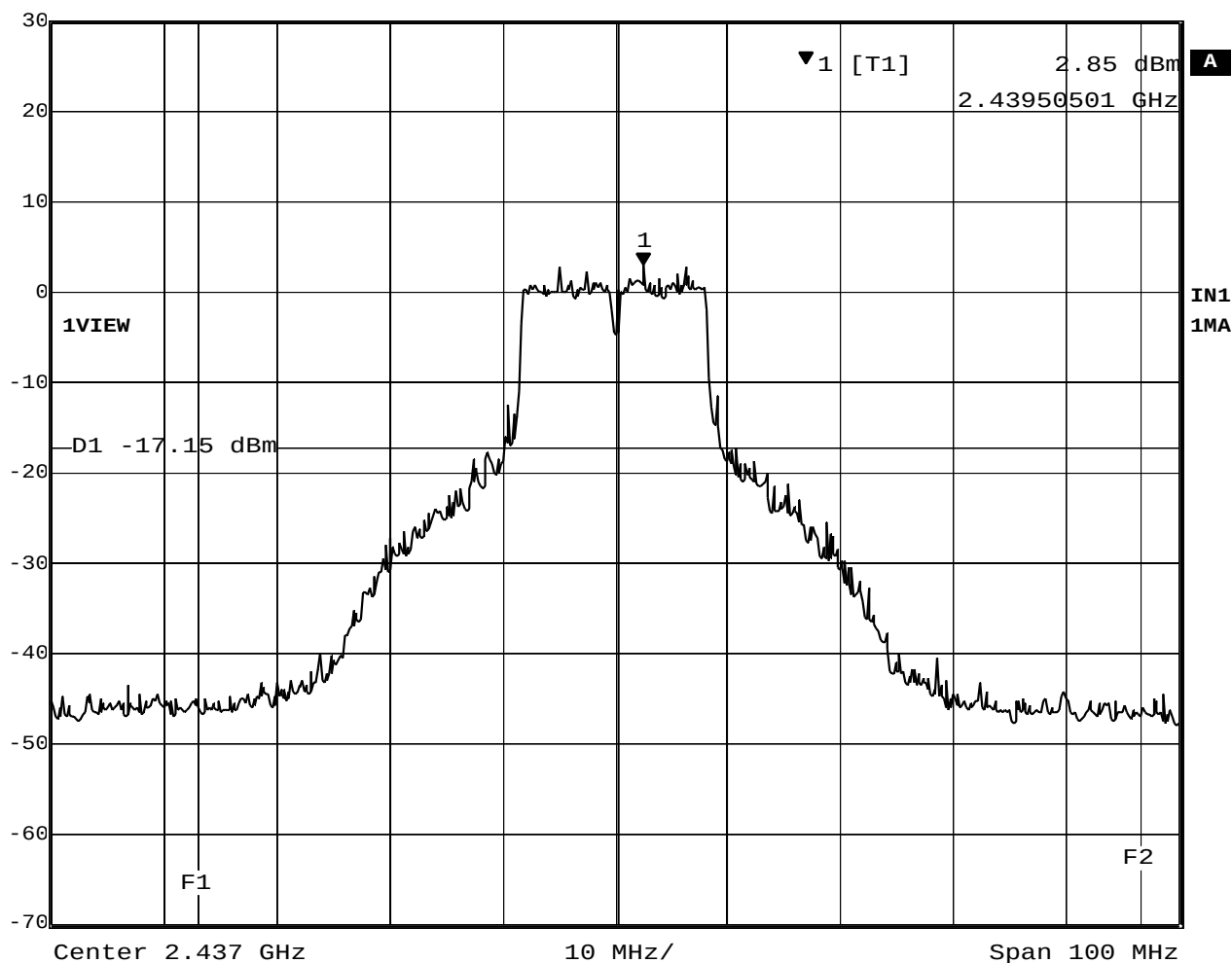


Date: 9.MAY.2003 18:38:21

Plot 2-7. Out of band emissions around 2412MHz (6Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 2.85 dBm VBW 100 kHz
30 dBm 2.43950501 GHz SWT 25 ms Unit dBm

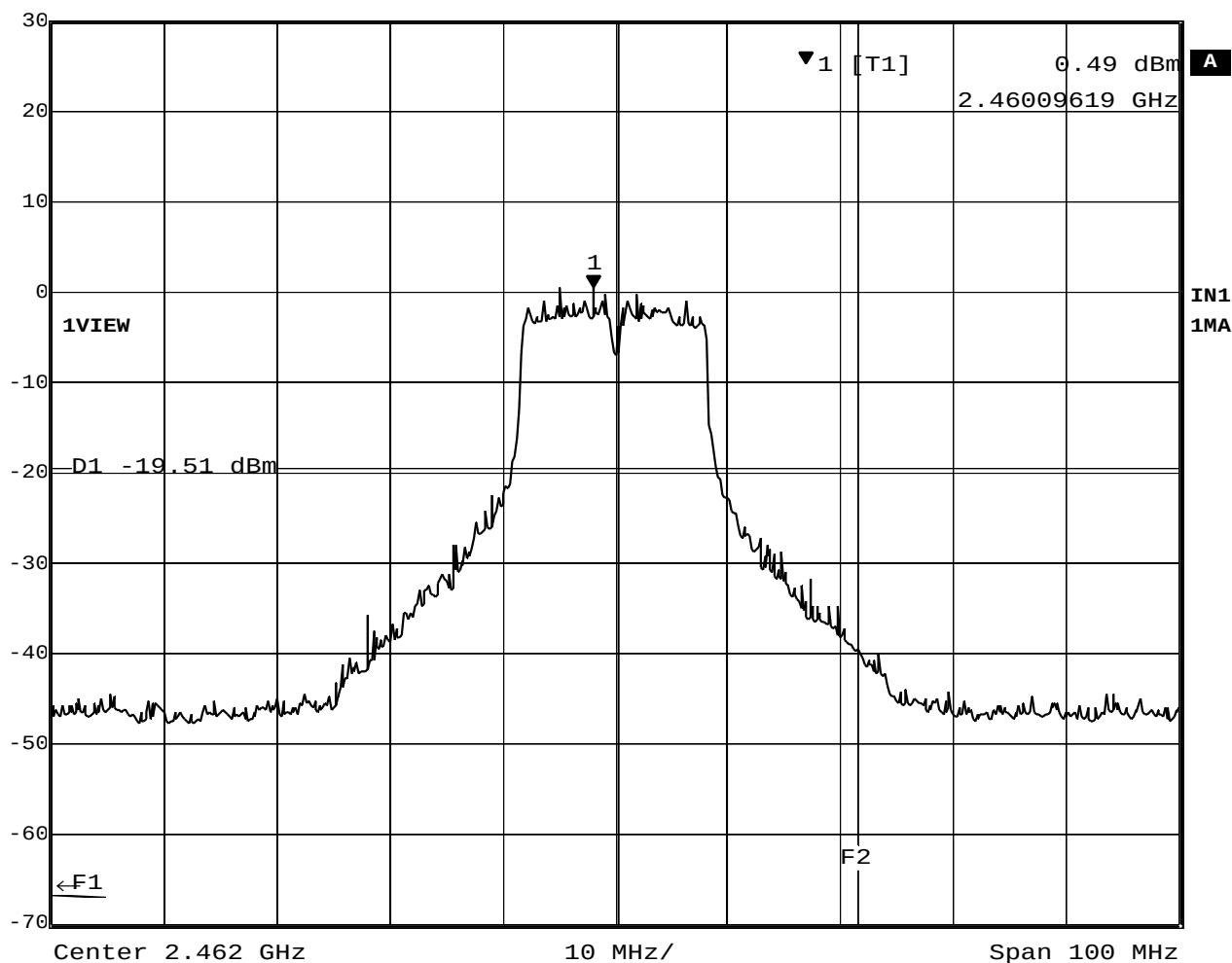


Date: 9.MAY.2003 18:42:20

Plot 2-8. Out of band emissions around 2437.2MHz (6Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 0.49 dBm VBW 100 kHz
30 dBm 2.46009619 GHz SWT 25 ms Unit dBm

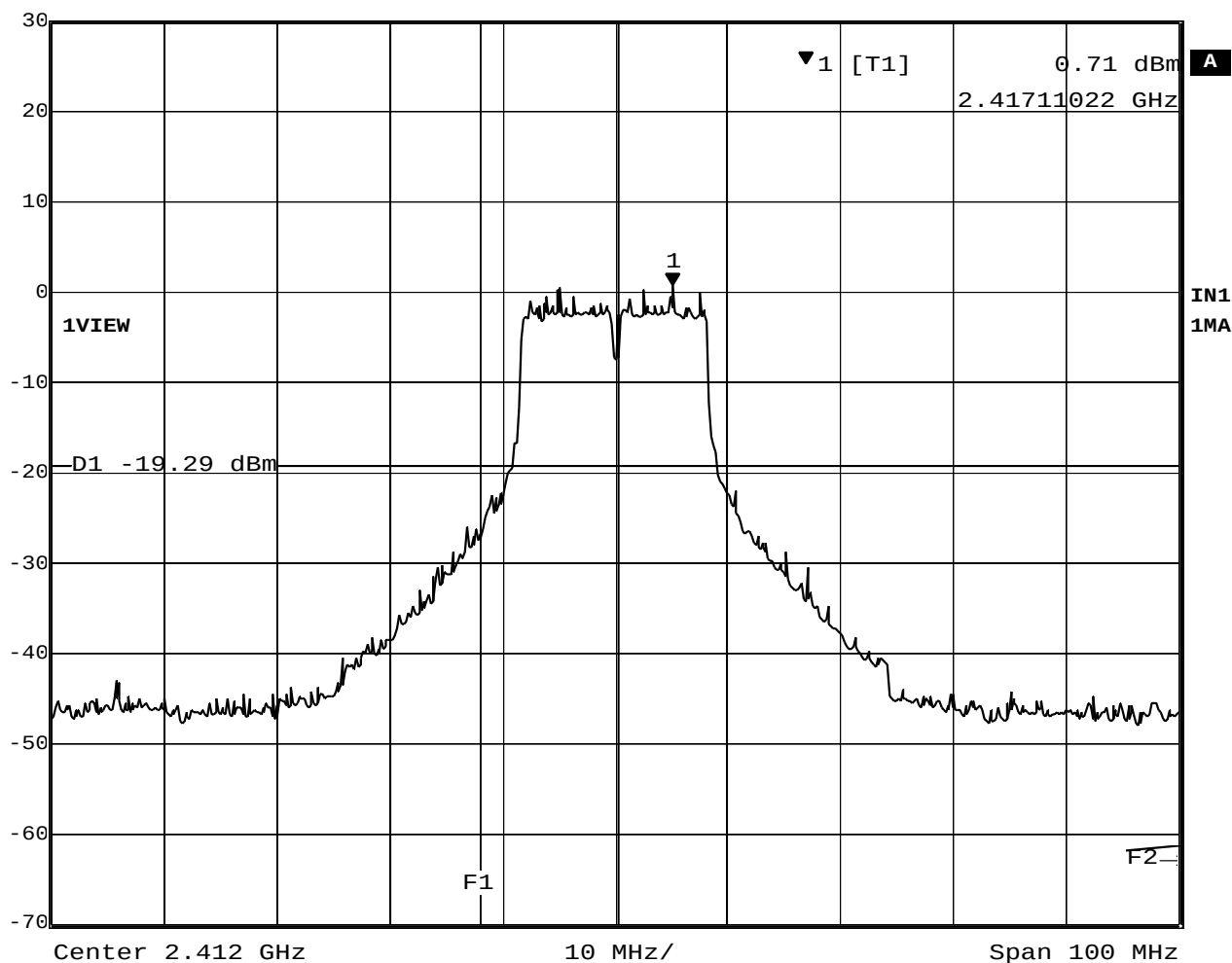


Date: 9.MAY.2003 18:46:21

Plot 2-9. Out of band emissions around 2462MHz (6Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 0.71 dBm VBW 100 kHz
30 dBm 2.41711022 GHz SWT 25 ms Unit dBm

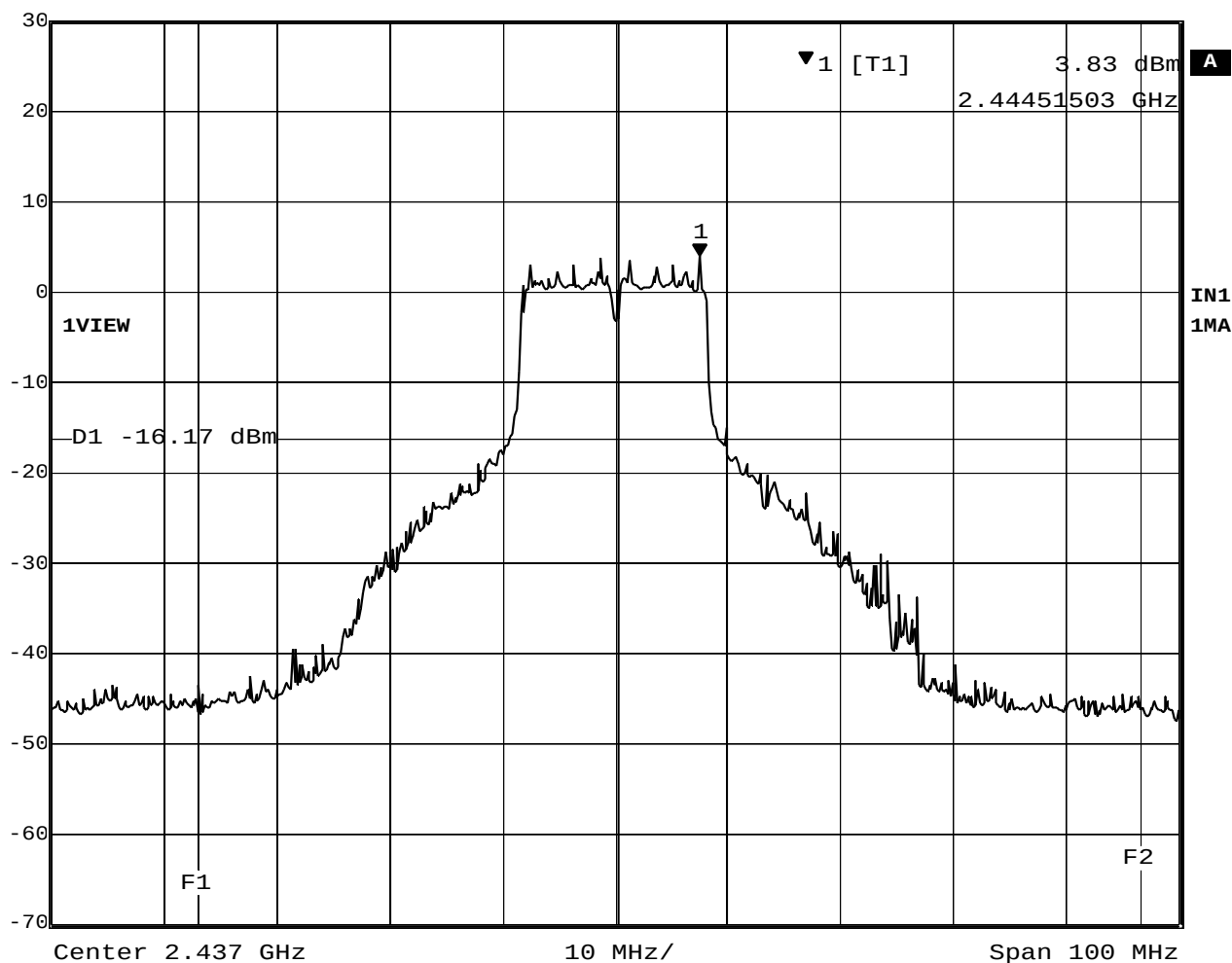


Date: 9.MAY.2003 18:52:54

Plot 2-10. Out of band emissions around 2412MHz (18Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 3.83 dBm VBW 100 kHz
30 dBm 2.44451503 GHz SWT 25 ms Unit dBm

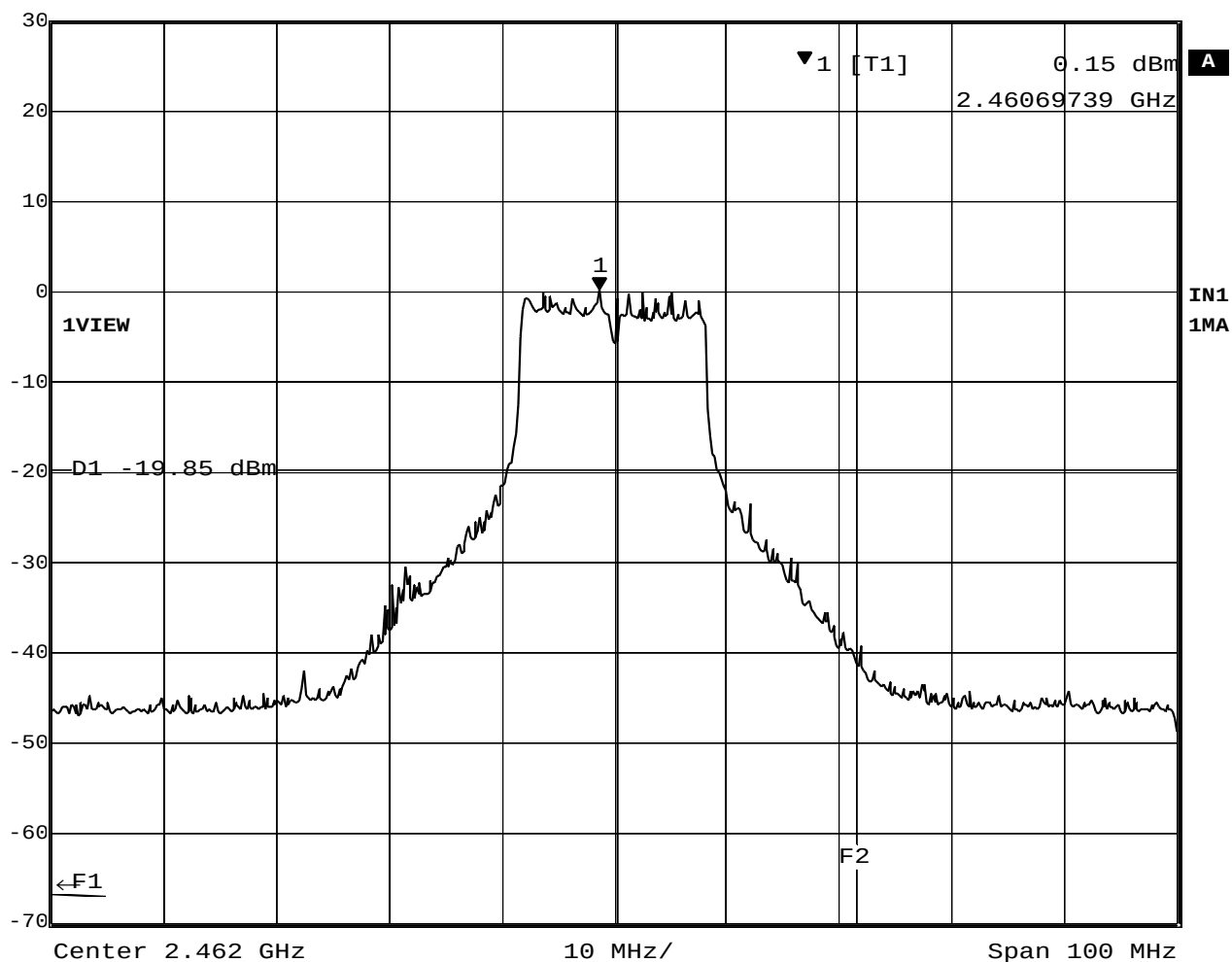


Date: 9.MAY.2003 18:50:43

Plot 2-11. Out of band emissions around 2437MHz (18Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 0.15 dBm VBW 100 kHz
30 dBm 2.46069739 GHz SWT 25 ms Unit dBm



Date: 9.MAY.2003 18:48:26

Plot 2-12. Out of band emissions around 2462MHz (18Mbps)

3. Conducted Peak Output Power

The test was performed with two kinds of measurement methods using power meter or spectrum analyzer.

3.1 Test Procedure

3.1.1 Power Meter measurement method

- A transmitter antenna terminal of EUT was connected to the input of a RF power sensor.
- Measurement was performed while EUT was operating in continuous transmission mode at the appropriate center frequencies. i.e. the lowest = 2412MHz, middle = 2437MHz, and highest frequency = 2462MHz.

Table 3-1 : Test Instruments of power meter method

Description	Model	Serial Number
Power Meter	HP 437B	3043U03437
Power Sensor	HP 8481A	US41030582
Coax cables: - Power Sensor <=> EUT	Length: 20 cm Loss: 0.7dB (for 2.4GHz) 1.3dB (for 5.8GHz)	

Notes: - HP: Hewlett Packard

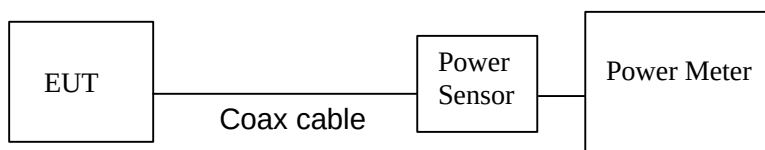


Figure 3-1: Measurement setup of power meter method

3.1.2 Spectrum Analyzer measurement method

The spectrum analyzer was connected to the antenna terminal, while EUT was operating in continuous transmission mode (shown in the Chapter C) at the appropriate center frequencies.

The spectrum analyzer was set to :

VBW= 30kHz, RBW=1MHz,

Span=30-40MHz encompassing the entire 6 dB emission bandwidth of the transmission signal,

Mode= sample detector, Trigger= free run

The band power measurement function was used to measure the peak power of each transmission mode selected by the step 3.1.1. The analyzer computed the peak power by integrating the spectrum across the 6 dB emission bandwidth given by the previous chapter.

The test instruments and setup configuration are the same as the Table 1-1 and Figure 1.

3.2 Measurement Results

Test Date: May 9, 2003

Table 3-2-1. Power meter measurement results (EUT: M/T 2672-CBU, s/n 97-877N3)

Operation Frequency [GHz]	Rated output power (conducted) [dBm]							
	6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	48M bps	54M bps
2.412 (Aux)	13.34	13.44	13.53	13.54	13.45	12.92	-	-
Specification	14						13.5	11.5
2.437 (Aux)	16.43	16.48	16.55	16.56	16.44	-	-	-
Specification	17					15.5	13.5	11.5
2.462 (Aux)	12.84	12.92	12.99	13.01	12.96	12.54	-	-
Specification	14						13.5	11.5

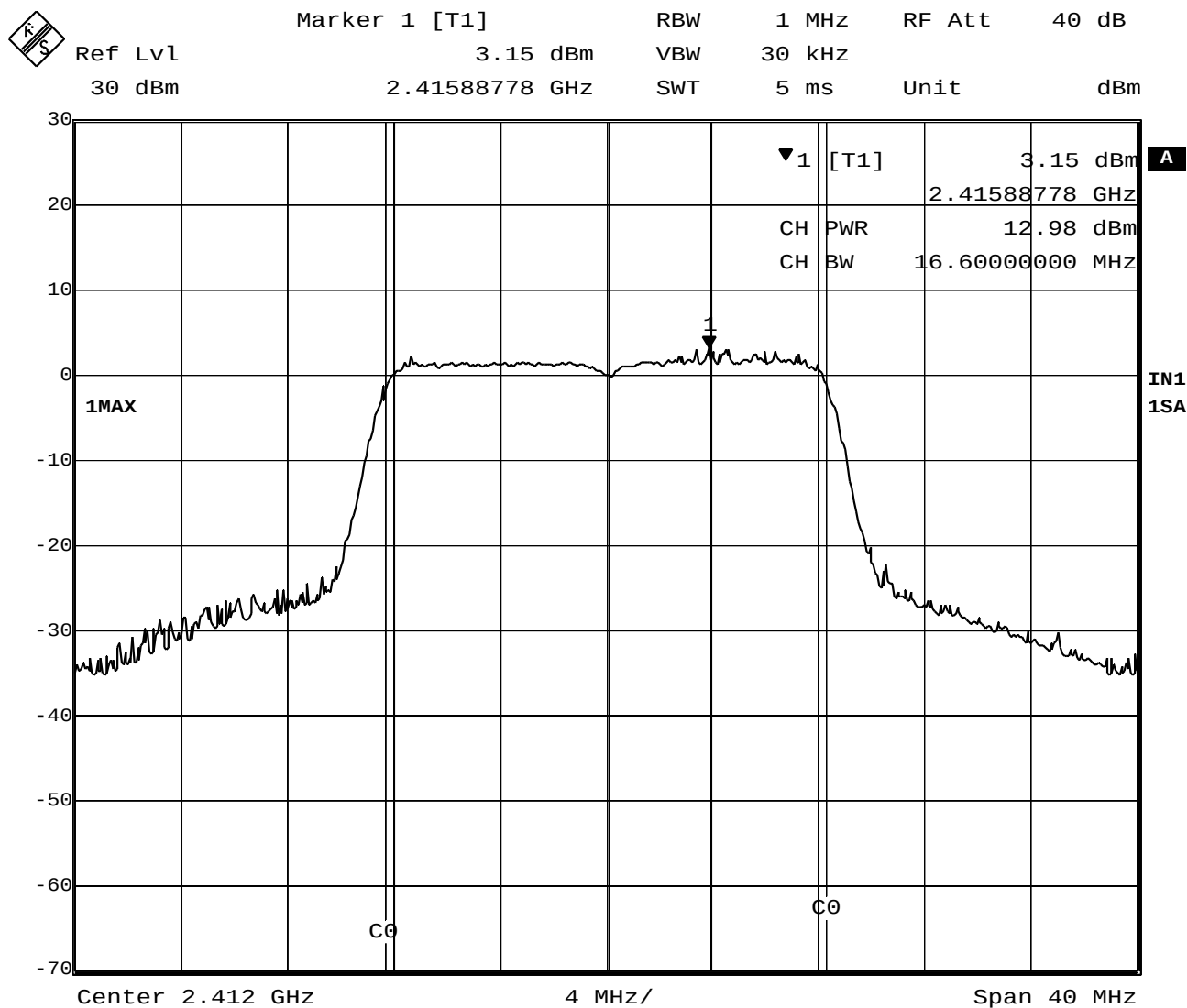
[Calculation table]

Measured Frequency (MHz)	Power Meter Reading (dBm)	Cable Loss (dB)	Results (dBm)	Limit		Margin to limit (dBi)
				FCC (dBm)	IC (dBm)	
2412 (ch. 1)	13.54	0.7	14.24	30	30	15.76
2437 (ch. 6)	16.56	0.7	17.26			12.74
2462 (ch.11)	13.01	0.7	13.71			16.29

Table 3-2-2. Spectrum analyzer measurement results (EUT: M/T 2672-CBU, s/n 97-877N3)

Measured Frequency (MHz)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	Results (dBm)	Limit		Margin to limit (dBi)
					FCC (dBm)	IC (dBm)	
2412 (ch. 1)	12.98	Plot 3-1	1.3	14.28	30	30	15.72
2437 (ch. 6)	16.01	Plot 3-2	1.3	17.31			12.69
2462 (ch.11)	12.44	Plot 3-3	1.3	13.74			16.26

3.3 Trace Data of Conducted Peak Output Power

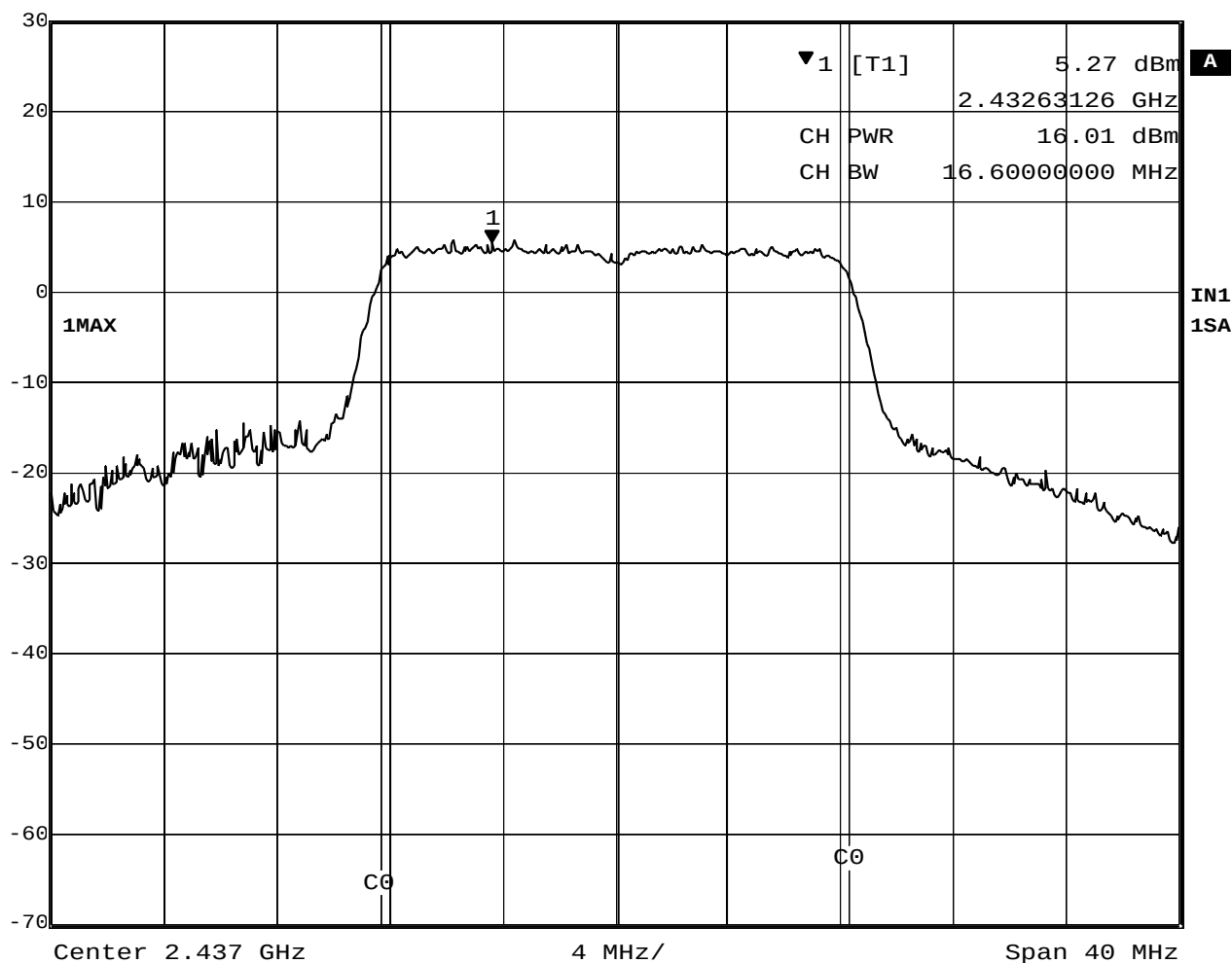


Date: 9.MAY.2003 19:02:22

Plot 3-1. Conducted Peak Output Power of 2412MHz



Marker 1 [T1] RBW 1 MHz RF Att 40 dB
Ref Lvl 5.27 dBm VBW 30 kHz
30 dBm 2.43263126 GHz SWT 5 ms Unit dBm

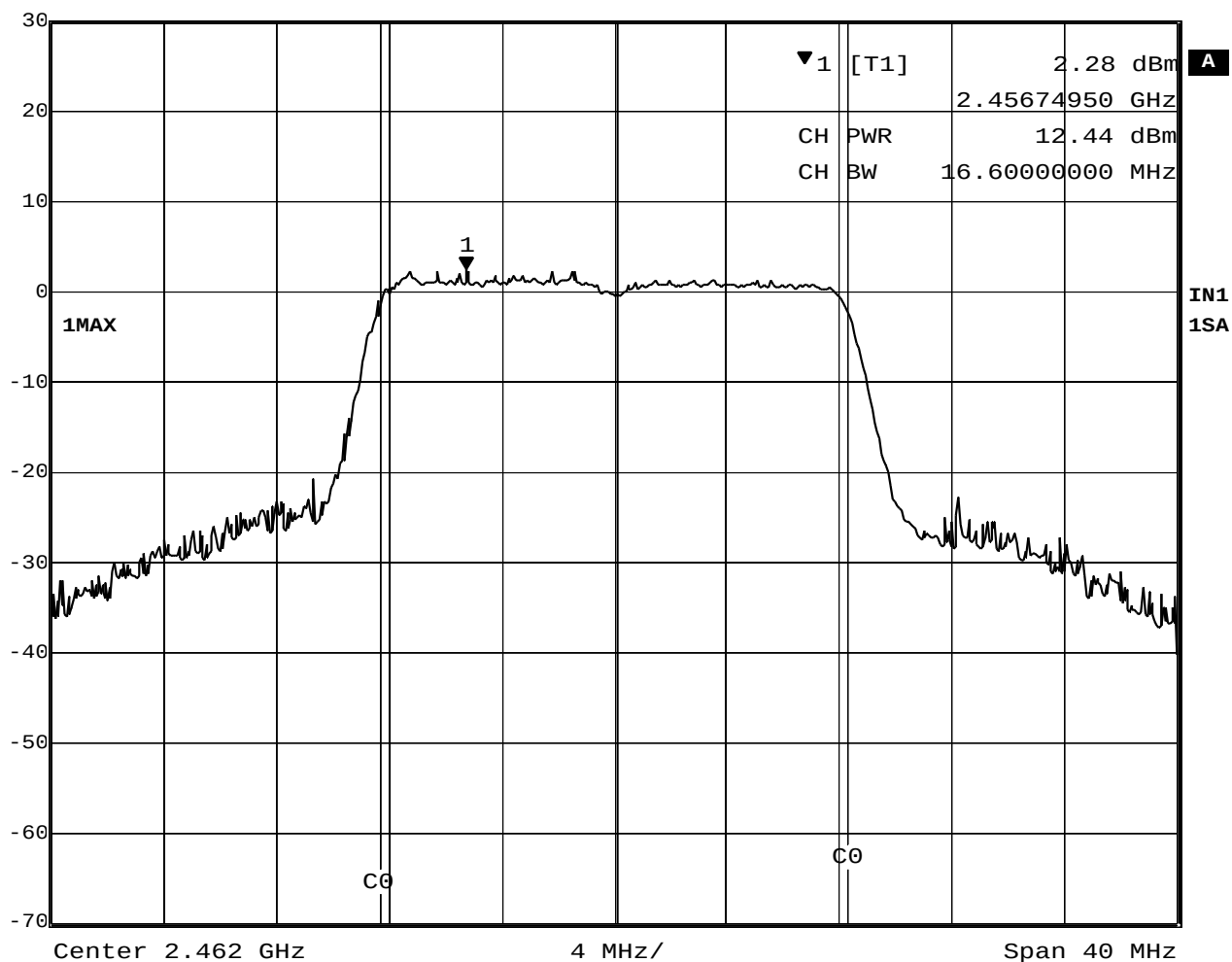


Date: 9.MAY.2003 19:18:18

Plot 3-2. Conducted Peak Output Power of 2437MHz



Marker 1 [T1] RBW 1 MHz RF Att 40 dB
Ref Lvl 30 dBm 2.28 dBm VBW 30 kHz
2.45674950 GHz SWT 5 ms Unit dBm



Date: 9.MAY.2003 19:20:13

Plot 3-3. Conducted Peak Output Power of 2462MHz

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: May 9, 2003

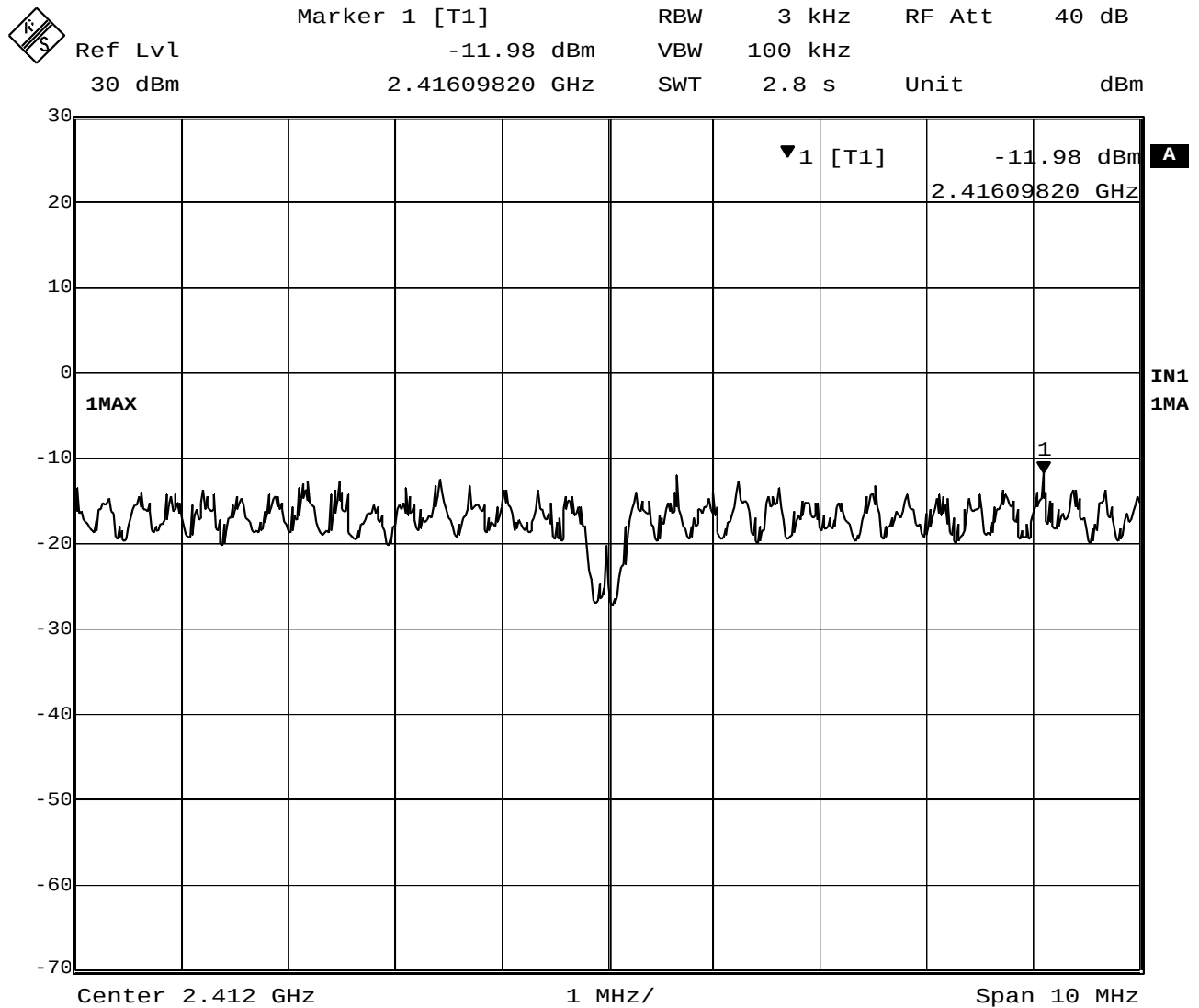
Table 4-1-1. EUT: M/T 2672-CBU, s/n 97-877N3 , TX mode 6Mbps

Ch No.	Frequency (MHz)	Analyzer Reading (dBm)	Trace number	Cable loss (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
1	2416.10	-11.98	Plot 4-1	1.3	-10.7	8.0	18.7
6	2440.44	-9.97	Plot 4-2	1.3	- 8.7	8.0	16.7
11	2458.86	-13.07	Plot 4-3	1.3	-11.8	8.0	19.8

Table 4-1-2. EUT: M/T 2672-CBU, s/n 97-877N3 , TX mode 18Mbps

Ch No.	Frequency (MHz)	Analyzer Reading (dBm)	Trace number	Cable loss (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
1	2412.27	-11.79	Plot 4-4	1.3	-10.5	8.0	18.5
6	2439.47	-8.91	Plot 4-5	1.3	- 7.6	8.0	15.6
11	2460.13	-12.69	Plot 4-6	1.3	-11.4	8.0	19.4

4.4 Trace Data

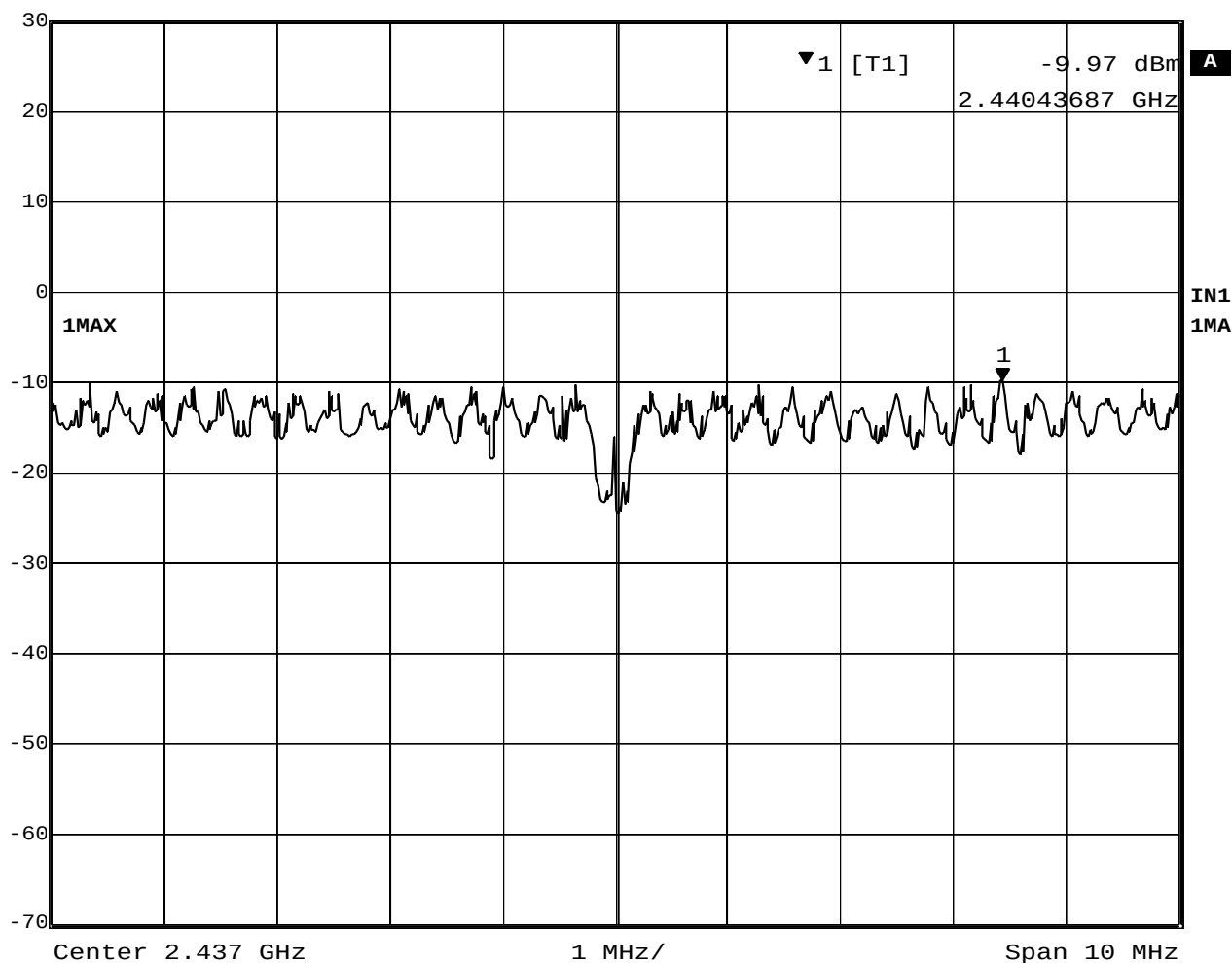


Date: 9.MAY.2003 19:26:39

Plot 4-1. Peak Power Spectral Density of 2412MHz (6Mbps)



Marker 1 [T1] RBW 3 kHz RF Att 40 dB
Ref Lvl -9.97 dBm VBW 100 kHz
30 dBm 2.44043687 GHz SWT 2.8 s Unit dBm

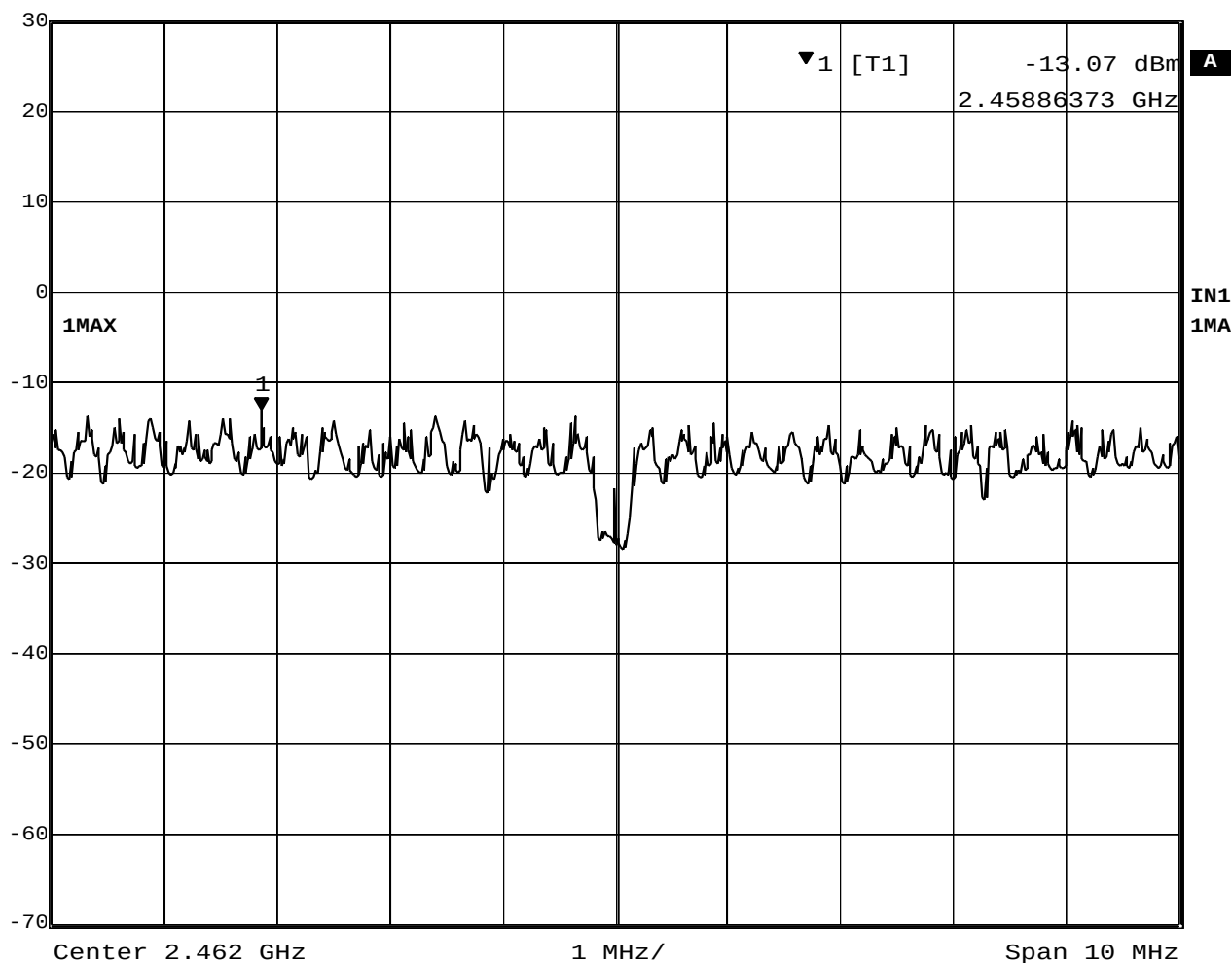


Date: 9.MAY.2003 19:27:55

Plot 4-2. Peak Power Spectral Density of 2437MHz (6Mbps)



Marker 1 [T1] RBW 3 kHz RF Att 40 dB
Ref Lvl -13.07 dBm VBW 100 kHz
30 dBm 2.45886373 GHz SWT 2.8 s Unit dBm

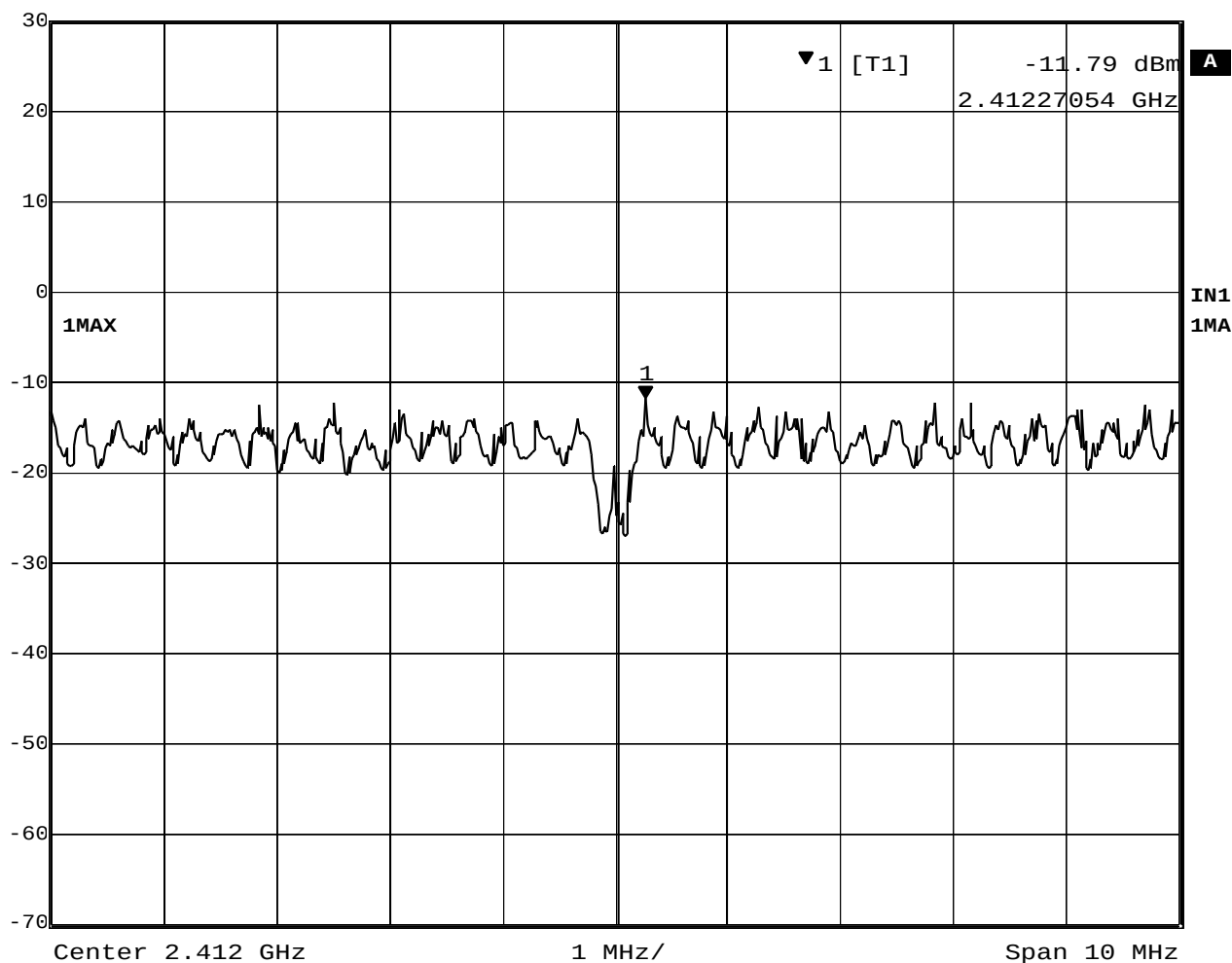


Date: 9.MAY.2003 19:29:43

Plot 4-3. Peak Power Spectral Density of 2462MHz (6Mbps)



Marker 1 [T1] RBW 3 kHz RF Att 40 dB
Ref Lvl -11.79 dBm VBW 100 kHz
30 dBm 2.41227054 GHz SWT 2.8 s Unit dBm

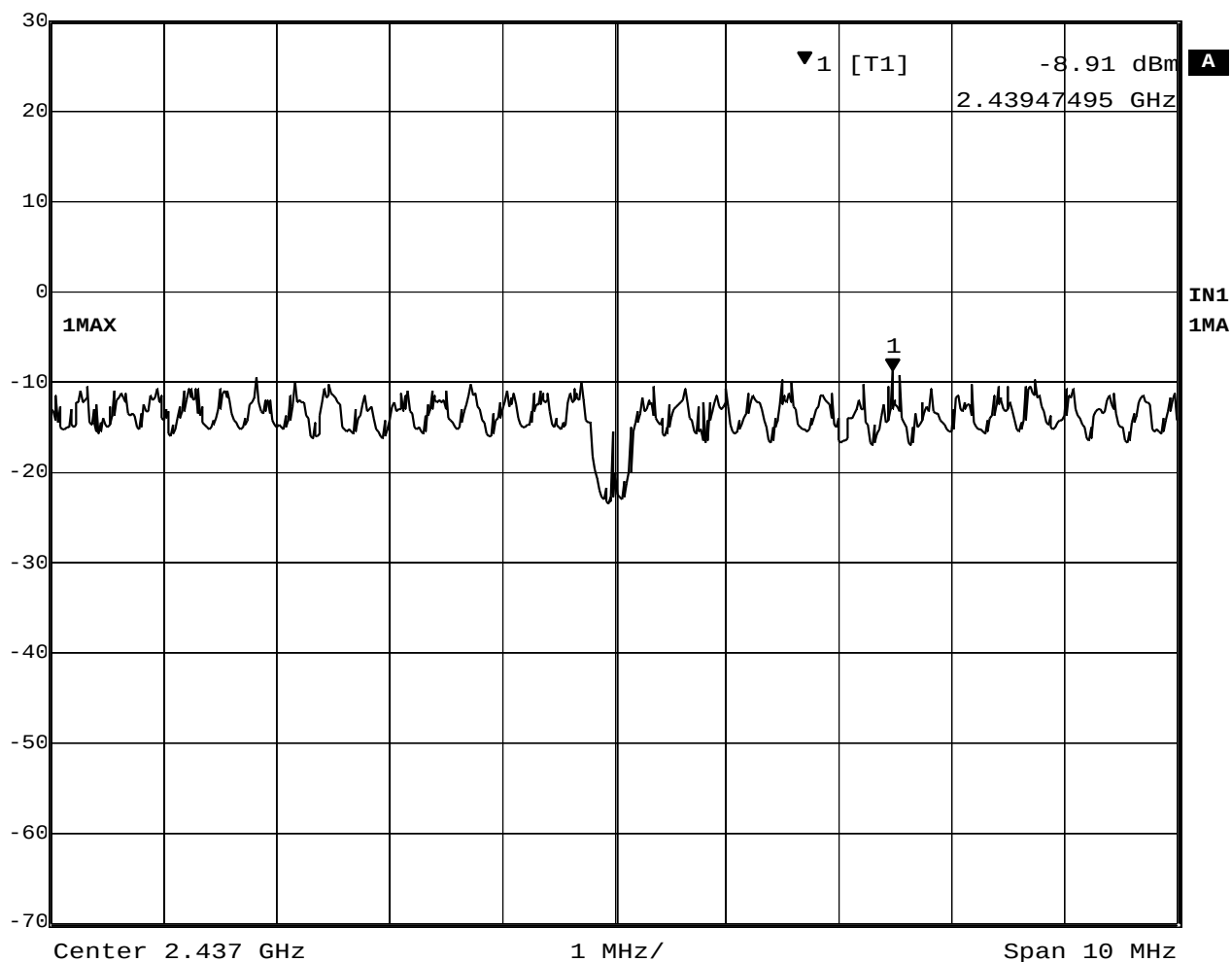


Date: 9.MAY.2003 19:24:42

Plot 4-4. Peak Power Spectral Density of 2412MHz (18Mbps)



Marker 1 [T1] RBW 3 kHz RF Att 40 dB
Ref Lvl -8.91 dBm VBW 100 kHz
30 dBm 2.43947495 GHz SWT 2.8 s Unit dBm

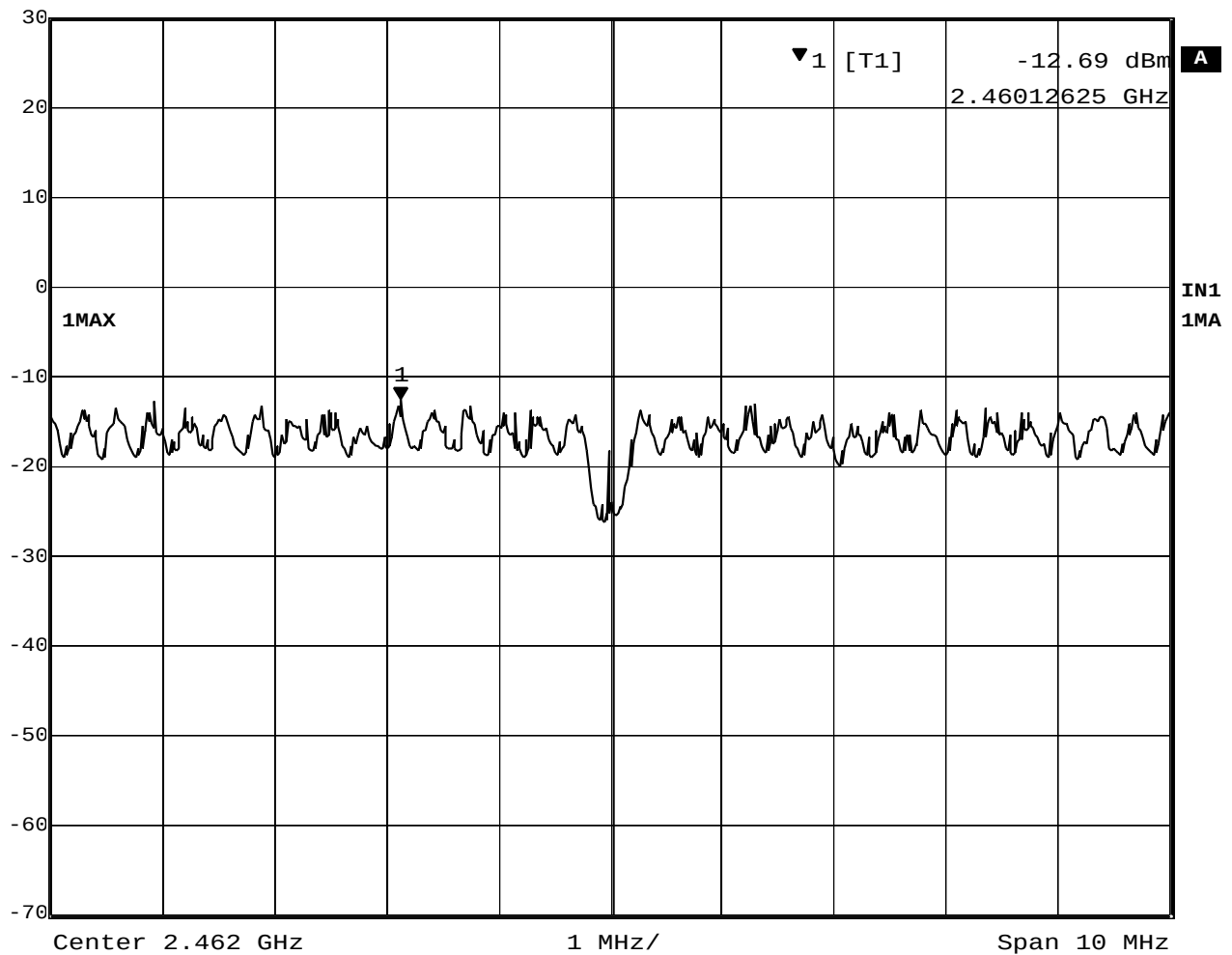


Date: 9.MAY.2003 19:23:32

Plot 4-5. Peak Power Spectral Density of 2437MHz (18Mbps)



Marker 1 [T1] RBW 3 kHz RF Att 40 dB
Ref Lvl -12.69 dBm VBW 100 kHz
30 dBm 2.46012625 GHz SWT 2.8 s Unit dBm



Date: 9.MAY.2003 19:22:33

Plot 4-6. Peak Power Spectral Density of 2462MHz (18Mbps)

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: - Lisen-L <=> SW/Con.unit (SW100) - Lisen-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

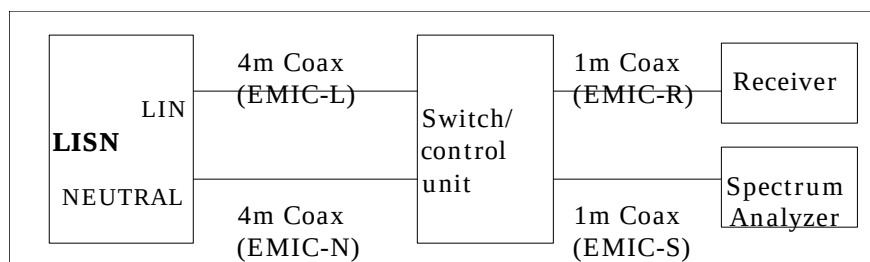


Figure 5. Cables for Conducted Emission Test

5.3 Powerline Voltage Calculation

The powerline voltage is calculated by adding insertion losses of LISN, Cable, Switch control unit and Pulse limiter to the measured reading. All factors are included in the reported data.

$$PV = R + CORR$$

where:

PV = Powerline Voltage (dBμV)

R = Measured Receiver Input Amplitude (dBμV)

CORR = Correction Factor (dB) = LL+CL+SWL+PLL

LL = Insertion loss of LISN (dB)

CL = Insertion loss of Cable (dB)

SWL = Insertion loss of Switch control unit (dB)

PLL = Insertion loss of Pulse Limiter (dB)

Given a Receiver input reading of 50.0 dBμV, LISN loss of 0.6 dB, Cable loss of 0.1dB, Switch control unit loss of 0.1dB and Pulse limiter loss of 0.2dB. The Powerline Voltage of the measured emission is:

$$CORR = 0.6 + 0.1 + 0.1 + 0.2 = 1.0 \text{ (dB)}$$

$$PV = 50.0 + 1.0 = 51.0 \text{ (dBμV)}$$

5.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 14.9dB. The 6 highest emissions relative to the limits are reported.

Test Date: May 13, 2003

1) EUT in transmission mode

Table 5-2-1. EUT: M/T 2672-CBU, s/n 97-877N3, Ch.1(2412MHz) TX mode 18Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dB μ V)	CISPR22 AV Limit (dB μ V)	Phase
	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)			
0.2053	44.4	0.4	44.8	38.1	0.4	38.5	63.4	53.4	Line
0.2709	34.6	0.5	35.1	28.8	0.5	29.3	61.1	51.1	Line
0.3369	29.8	0.5	30.3	24.3	0.5	24.8	59.3	49.3	Line
0.4044	25.6	0.5	26.1	20.5	0.5	21.0	57.8	47.8	Line
0.4692	24.6	0.5	25.1	20.9	0.5	21.4	56.5	46.5	Line
0.6062	22.7	0.5	23.2	19.2	0.5	19.7	56.0	46.0	Line

Table 5-2-2. EUT: M/T 2672-CBU, s/n 97-877N3 , Ch.6(2437MHz) TX mode 18Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dB μ V)	CISPR22 AV Limit (dB μ V)	Phase
	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)			
0.2004	42.7	0.4	43.1	35.9	0.4	36.3	63.6	53.6	Line
0.2702	33.0	0.5	33.5	27.6	0.5	28.1	61.1	51.1	Line
0.3359	28.7	0.5	29.2	22.9	0.5	23.4	59.3	49.3	Line
0.4036	24.5	0.5	25.0	20.3	0.5	20.8	57.8	47.8	Line
0.4696	25.0	0.5	25.5	21.6	0.5	22.1	56.5	46.5	Line
0.6054	22.3	0.5	22.8	18.8	0.5	19.3	56.0	46.0	Line

Table 5-2-3. EUT: M/T 2672-CBU, s/n 97-877N3, Ch.11(2462MHz) TX mode 18Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dB μ V)	CISPR22 AV Limit (dB μ V)	Phase
	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)			
0.1985	39.3	0.4	39.7	32.9	0.4	33.3	63.7	53.7	Line
0.2699	32.4	0.5	32.9	26.9	0.5	27.4	61.1	51.1	Line
0.3380	29.0	0.5	29.5	22.8	0.5	23.3	59.3	49.3	Line
0.4708	25.4	0.5	25.9	21.8	0.5	22.3	56.5	46.5	Line
0.5416	21.9	0.5	22.4	17.2	0.5	17.7	56.0	46.0	Neutral
0.6057	22.7	0.5	23.2	19.4	0.5	19.9	56.0	46.0	Line

2) EUT in receiving mode

Table 5-2-4. EUT: M/T 2672-CBU, s/n 97-877N3, Ch.6(2437MHz) RX mode

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dB μ V)	CISPR22 AV Limit (dB μ V)	Phase
	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)			
0.2008	35.9	0.4	36.3	31.1	0.4	31.5	63.6	53.6	Line
0.2733	35.2	0.5	35.7	30.2	0.5	30.7	61.0	51.0	Line
0.3407	28.7	0.5	29.2	25.1	0.5	25.6	59.2	49.2	Line
0.4128	25.6	0.5	26.1	20.1	0.5	20.6	57.6	47.6	Line
0.4776	25.0	0.5	25.5	22.1	0.5	22.6	56.4	46.4	Line
0.6151	23.2	0.5	23.7	20.3	0.5	20.8	56.0	46.0	Line

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 6868-30J	97-901X3
Spectrum Analyzer (100Hz-1.5GHz) for 30-200MHz	HP 85680B	2841A04242
Spectrum Analyzer Display for 30-200MHz	HP 85662A	2816A16827
Quasi-Peak Adapter for 30-200MHz	HP 85650A	2811A01126
Spectrum Analyzer (100Hz-1.5GHz) for 200-1000MHz	HP 85680B	2841A04254
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	HP 8447D	2805A02919
- for 200-1000MHz	HP 8447D	2727A05190
Biconical Antenna (30-200MHz)	EMCO 3108	2536
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	2849
Receiver (20MHz-1.3GHz)	R&S ESVP	892111/030
Switch/control unit	HP 3488A	2719A17226
N-Coax cables:	Length:	
- Bi-coni Ant <=> 10m Cable	9 m	- EM103L01
- 10m Cable <=> Shield Panel	10 m	- EM103L02
- Shield Panel <=> RF Amp	7 m	- EM103L03
- RF Amp <=> Power Splitter	0.5m	- EM103L04
- Log-peri Ant <=> 10m Cable	9 m	- EM103H01
- 10m Cable <=> Shield Panel	10 m	- EM103H02
- Shield Panel <=> RF Amp	7 m	- EM103H03
- RF Amp <=> Power Splitter	0.5m	- EM103H04
Coax cables:		
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM103L05
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM103L06
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM103H05
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM103H06
- SW/Con.unit <=> Receiver (Input)	2 m	- EM1RCV
- SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	2 m	- EM1SPL
- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM1SPH

Notes:

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

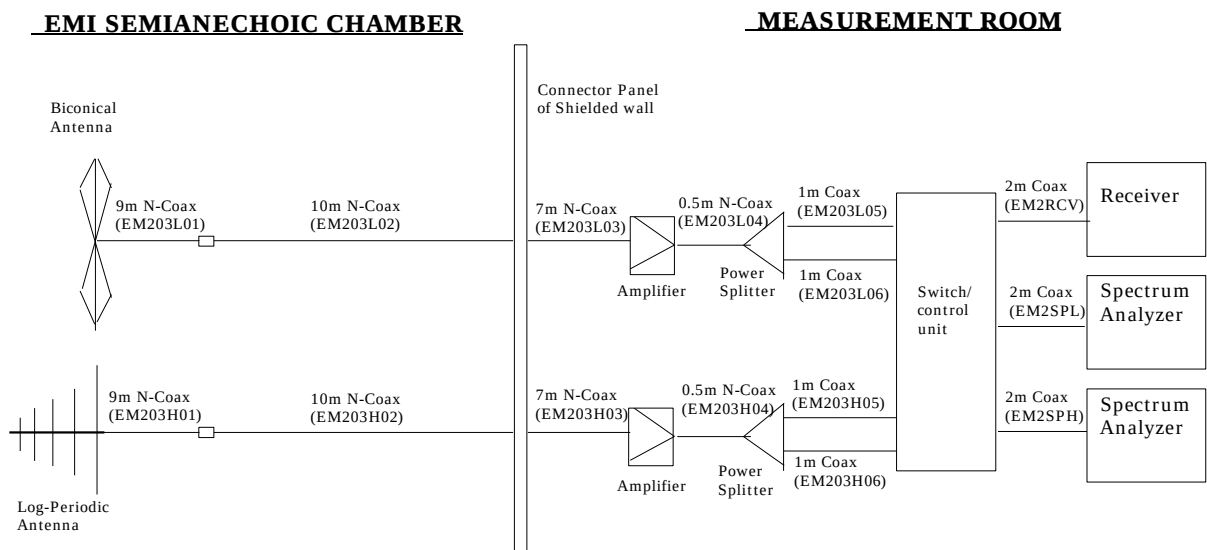


Figure 6 Cables for Radiated Emission Test

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 51.5dB μ V; 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:

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

Conversion between dB μ V/m (or dB μ V) and μ V/m (or μ V) are done as:

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

$$40\text{dB}\mu\text{V/m} = 100\mu\text{V/m}$$

$$48\text{dB}\mu\text{V/m} = 250\mu\text{V/m}$$

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 4.4 dB at 30MHz - 1000MHz band.

The 6 highest emissions relative to the limits are reported.

Test Date: May 15, 2003

1) EUT in transmission mode

Table 6-2-1. EUT: M/T 2672-CBU, s/n 97-877N3, Ch.1(2412MHz) TX mode 18Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dB μ V)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dB μ V/m)	Limit (dB μ V/m)	Field Strength (μ V/m)	Limit (μ V/m)
269.795	V	34.4	12.5	-14.2	32.7	46.0	43.2	200
324.839	V	33.8	14.2	-14.0	34.0	46.0	50.1	200
454.774	V	38.9	16.5	-13.8	41.6	46.0	120.2	200
575.991	V	29.6	18.4	-12.9	35.1	46.0	56.9	200
666.523	V	26.7	20.5	-12.3	34.9	46.0	55.6	200
800.325	V	24.6	21.2	-10.4	35.4	46.0	58.9	200

Table 6-2-2. EUT: M/T 2672-CBU, s/n 97-877N3, Ch.6(2437MHz) TX mode 18Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dB μ V)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dB μ V/m)	Limit (dB μ V/m)	Field Strength (μ V/m)	Limit (μ V/m)
269.802	V	34.6	12.5	-14.2	32.9	46.0	44.2	200
292.355	V	33.6	13.6	-14.1	33.1	46.0	45.2	200
454.775	V	38.9	16.5	-13.8	41.6	46.0	120.2	200
575.991	V	29.8	18.4	-12.9	35.3	46.0	58.2	200
664.597	V	26.4	20.4	-12.1	34.7	46.0	54.3	200
803.994	V	21.4	21.3	-10.3	32.4	46.0	41.7	200

Table 6-2-3. EUT: M/T 2672-CBU, s/n 97-877N3, Ch.11(2462MHz) TX mode 18Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dB μ V)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dB μ V/m)	Limit (dB μ V/m)	Field Strength (μ V/m)	Limit (μ V/m)
292.281	V	34.1	13.6	-14.1	33.6	46.0	47.9	200
324.839	V	33.2	14.2	-14.0	33.4	46.0	46.8	200
454.774	V	38.7	16.5	-13.8	41.4	46.0	117.5	200
575.991	V	31.0	18.4	-12.9	36.5	46.0	66.8	200
666.494	V	26.5	20.5	-12.3	34.7	46.0	54.3	200
799.044	V	26.0	21.1	-10.4	36.7	46.0	68.4	200

2) EUT in receiving mode

Table 6-2-4. EUT: M/T 2672-CBU, s/n 97-877N3, RX mode

Frequency (MHz)	Polarity (H/V)	Measured (dB μ V)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dB μ V/m)	Limit (dB μ V/m)	Field Strength (μ V/m)	Limit (μ V/m)
259.872	H	35.1	12	-14.8	32.3	46.0	41.2	200
269.784	H	37.3	12.5	-14.2	35.6	46.0	60.3	200
292.264	H	36.0	13.6	-14.1	35.5	46.0	59.6	200
454.775	V	38.2	16.5	-13.8	40.9	46.0	110.9	200
666.189	V	24.2	20.5	-12.1	32.6	46.0	42.7	200
797.834	V	21.7	21.1	-10.6	32.2	46.0	40.7	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 100Hz or 10Hz. 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 (1-18GHz)	HP 8449B	3008A00582
Amplifier (18-25GHz)	Agilent 83051A	3950M00193
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:	Length:	
- Horn Ant <=> RF Amp. (1-18GHz)	6 m	- EM206SCO
- RF Amp.<=>Spectrum Analyzer (1-18GHz)	16 m	- GEM0101
- Horn Ant <=> RF Amp. (18-25GHz)	3m	- SF102-20167
- RF Amp.<=>Spectrum Analyzer (18-25GHz)	1m	- SF102-21105

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

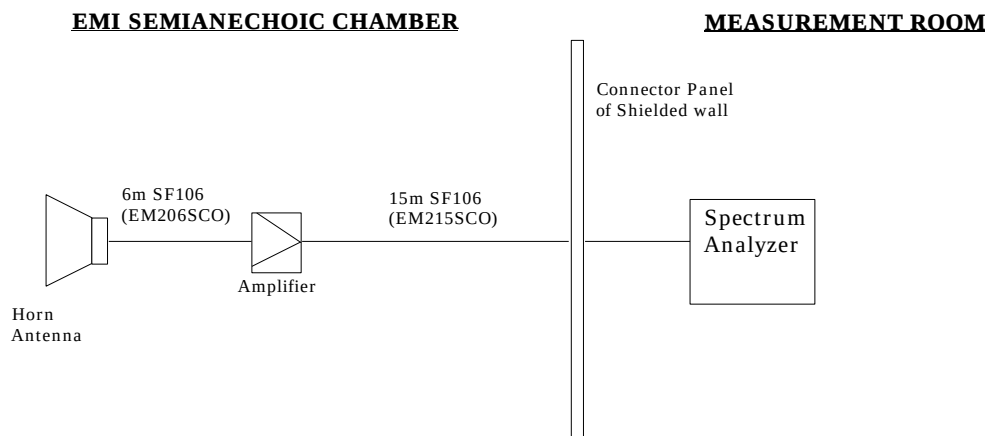


Figure 7-1. Cables for Radiated Emission Test (1-18GHz)

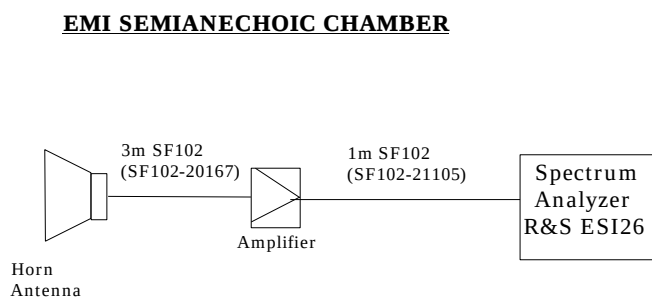


Figure 7-2. Cables for Radiated Emission Test (18 - 25GHz)

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 dB μ V; 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:

$$FS = 51.5 + 8.5 + 1.3 - 26 - 0.0 = 35.6 \text{ dB}\mu\text{V/m}$$

Conversions between dB μ V/m (or dB μ V) and μ V/m (or μ V) are done as :

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

$$40 \text{ dB}\mu\text{V/m} = 100 \mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250 \mu\text{V/m}$$

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 3.8 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: May 9 and 12, 2003

1) EUT in transmission mode

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

Table 7-2-1. EUT: M/T 2672-CBU, s/n 97-877N3, Ch.1(2412MHz) TX mode 18Mbps

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)
Inband 2.409	H	107.1	94.7	28.3	-29.7	0.0	105.7	OB*	93.3	OB*
Adjacent RB 2.368	H	58.0	51.1	28.1	-29.6	0.0	56.5	74.0	49.6	54.0
2.390	H	69.3	51.1	28.2	-29.7	0.0	67.8	74.0	49.6	54.0
1.065	V	53.8	-	24.6	-32.0	0.0	46.4	74.0	-	54.0
1.152	V	51.7	-	24.6	-31.7	0.0	44.6	74.0	-	54.0
1.199	V	56.9	-	25.2	-31.6	0.0	50.5	74.0	-	54.0
1.599	V	52.9	-	25.6	-30.8	0.0	47.7	74.0	-	54.0
2.272	H	48.4	-	27.8	-29.8	0.0	46.4	74.0	-	54.0
4.826	V	38.3	27.5	27.1	-27.3	0.0	38.1	74.0	-	54.0

Table 7-2-2. EUT: M/T 2672-CBU, s/n 97-877N3, Ch.6(2437MHz) TX mode 18Mbps

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)
Inband 2.440	H	110.0	98.2	28.4	-29.6	0.0	108.8	OB*	97.0	OB*
Adjacent RB 2.368	H	59.7	51.7	28.1	-29.6	0.0	58.2	74.0	50.2	54.0
2.380	H	58.4	45.3	28.2	-29.7	0.0	56.9	74.0	43.8	54.0
2.496	H	55.3	44.4	28.4	-29.6	0.0	54.1	74.0	43.2	54.0
1.065	V	56.0	-	24.6	-32.0	0.0	48.6	74.0	-	54.0
1.152	V	54.7	-	24.6	-31.7	0.0	47.6	74.0	-	54.0
1.199	V	52.8	-	25.2	-31.6	0.0	46.4	74.0	-	54.0
1.599	V	53.0	-	25.6	-30.8	0.0	47.8	74.0	-	54.0
2.272	H	51.3	-	27.8	-29.8	0.0	49.3	74.0	-	54.0
4.880	V	41.7	-	27.0	-27.0	0.0	41.7	74.0	-	54.0
7.312	V	40.5	-	29.9	-25.1	0.0	45.3	74.0	-	54.0

Table 7-2-3. EUT: M/T 2672-CBU, s/n 97-877N3, Ch.11(2462MHz) TX mode 18Mbps

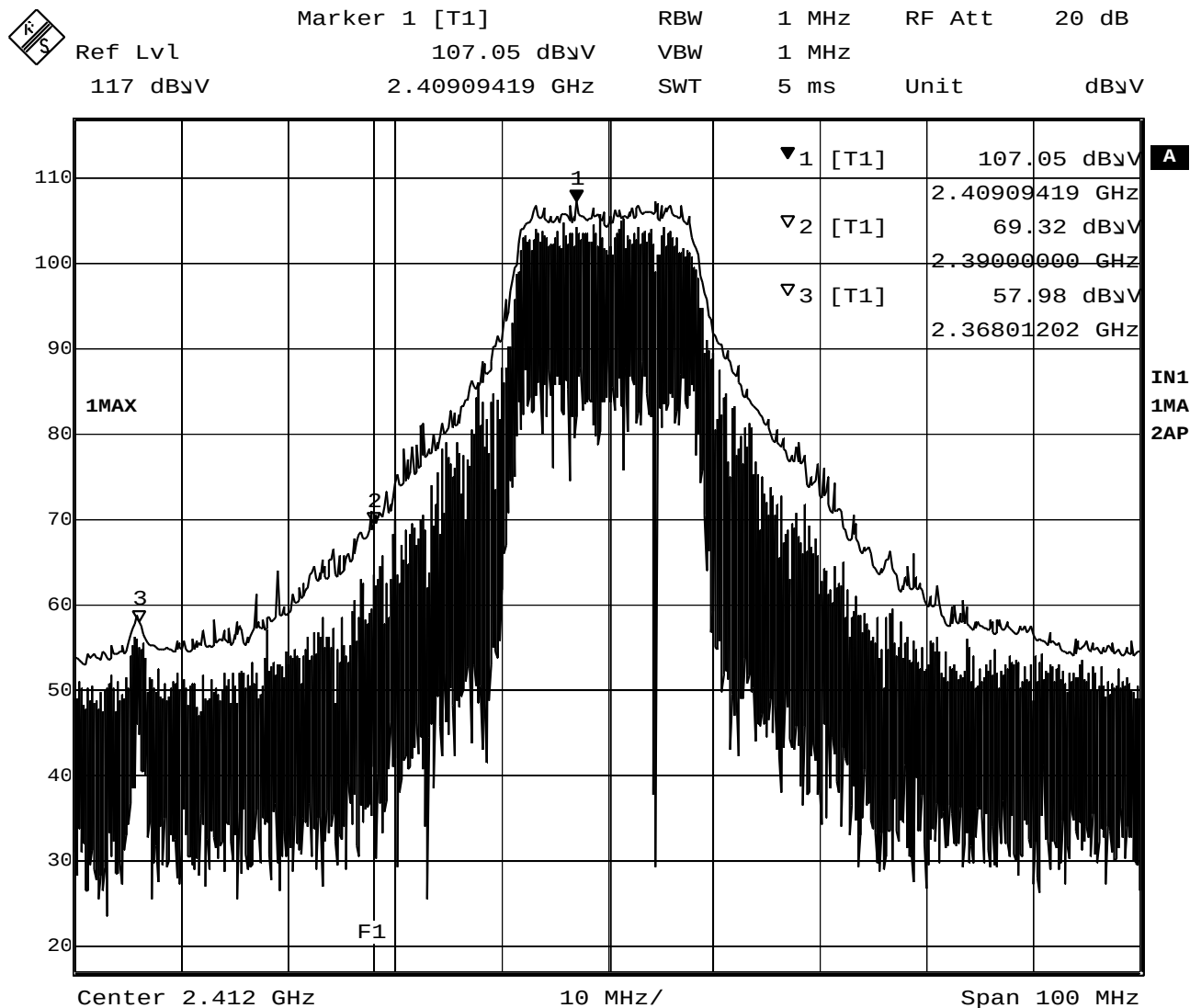
Frequency (GHz)	Polarity (H/V)	Measured (dB μ V) (<i>peak</i>)	Measured (dB μ V) (<i>average</i>)	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dB μ V/m) (<i>peak</i>)	FCC Limit (dB μ V/m) (<i>peak</i>)	Field Strength (dB μ V/m) (<i>average</i>)	FCC Limit (dB μ V/m) (<i>average</i>)
Inband 2.459	H	107.3	95.2	28.4	-29.6	0.0	106.1	OB*	94.0	OB*
Adjacent RB 2.484	H	70.5	51.0	28.4	-29.6	0.0	69.3	74.0	49.8	54.0
2.496	H	56.6	44.7	28.4	-29.6	0.0	55.4	74.0	43.5	54.0
1.065	V	58.4	-	24.6	-32.0	0.0	51.0	74.0	-	54.0
1.152	V	58.0	-	24.6	-31.7	0.0	50.9	74.0	-	54.0
1.199	V	52.1	-	25.2	-31.6	0.0	45.7	74.0	-	54.0
1.599	V	54.2	-	25.6	-30.8	0.0	49.0	74.0	-	54.0
2.272	H	50.2	-	27.8	-29.8	0.0	48.2	74.0	-	54.0
2.369	H	56.2	50.1	28.1	-29.6	0.0	54.7	74.0	48.6	54.0
4.926	V	43.6	-	27.0	-27.0	0.0	43.6	74.0	-	54.0
7.385	H	37.9	-	29.8	-25.1	0.0	42.6	74.0	-	54.0

2) EUT in receiving mode

Table 7-2-4. EUT: M/T 2672-CBU, s/n 97-877N3, Ch.6(2437MHz) RX mode

Frequency (GHz)	Polarity (H/V)	Measured (dB μ V) (<i>peak</i>)	Measured (dB μ V) (<i>average</i>)	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dB μ V/m) (<i>peak</i>)	FCC Limit (dB μ V/m) (<i>peak</i>)	Field Strength (dB μ V/m) (<i>average</i>)	FCC Limit (dB μ V/m) (<i>average</i>)
1.065	V	57.2	-	24.6	-32.0	0.0	49.8	74.0	-	54.0
1.152	V	53.7	-	24.6	-31.7	0.0	46.6	74.0	-	54.0
1.199	V	54.1	-	25.2	-31.6	0.0	47.7	74.0	-	54.0
1.599	V	53.5	-	25.6	-30.8	0.0	48.3	74.0	-	54.0

7.5 Measurement plots of adjacent restricted band

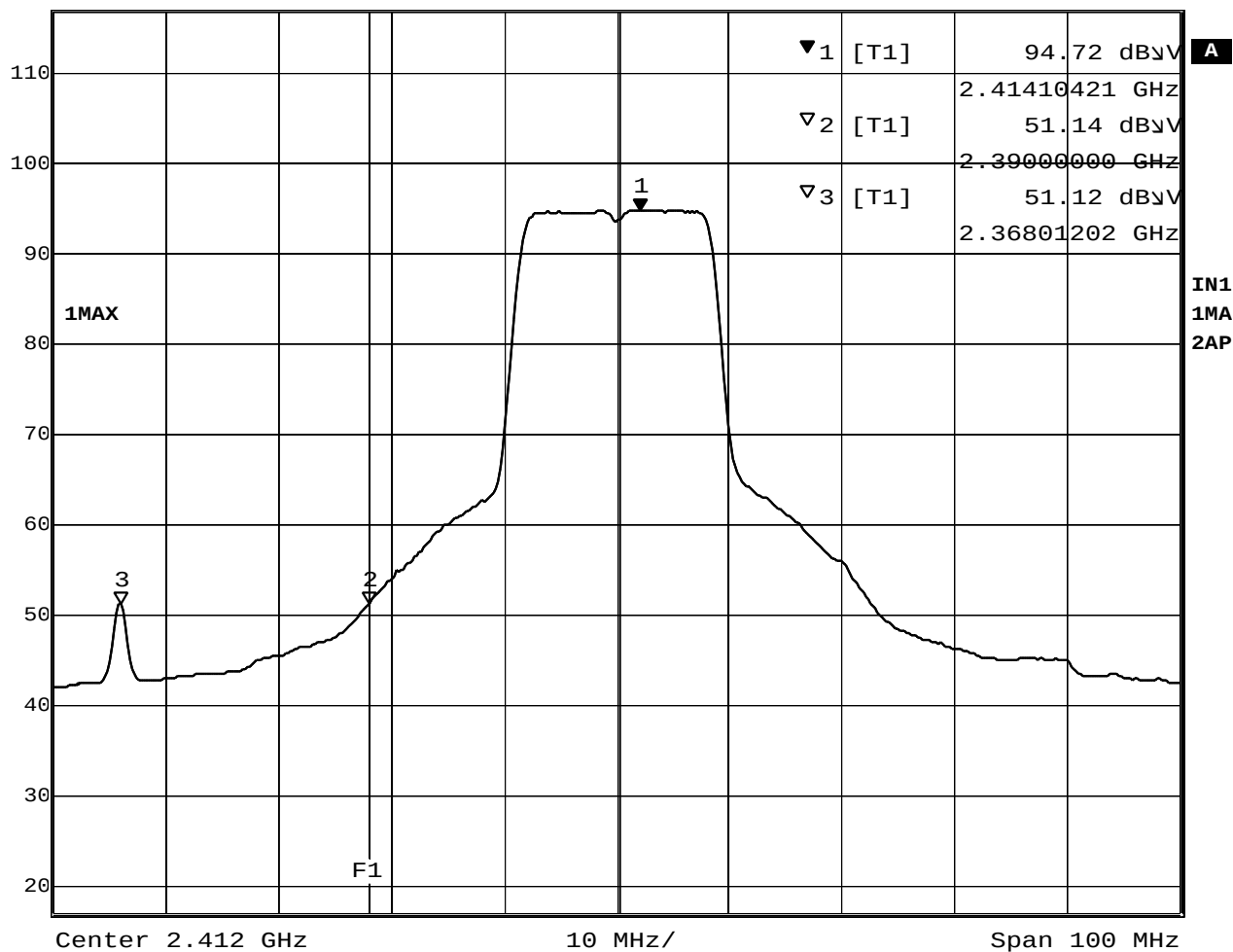


Date: 9.MAY.2003 19:48:14

Plot 7-2-1 Ch.1 2412MHz TX 18Mb/s (Peak)



Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	20 dB
117 dBμV	94.72 dBμV	VBW	10 Hz		
	2.41410421 GHz	SWT	25 s	Unit	dBμV

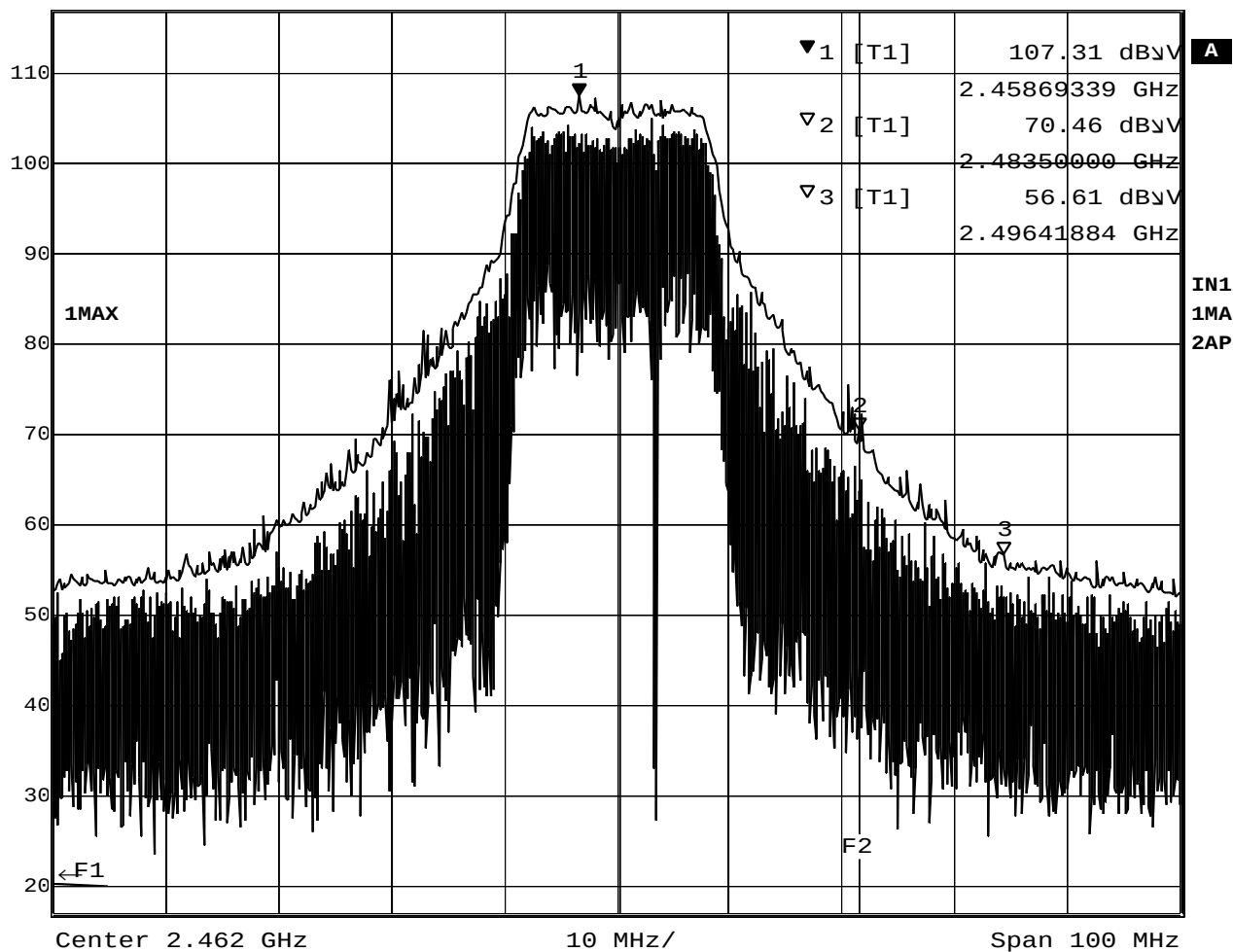


Date: 9.MAY.2003 19:49:01

Plot 7-2-2 Ch.1 2412MHz TX18Mb/s (Average)



Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	20 dB
117 dBμV	107.31 dBμV	VBW	1 MHz		
	2.45869339 GHz	SWT	5 ms	Unit	dBμV

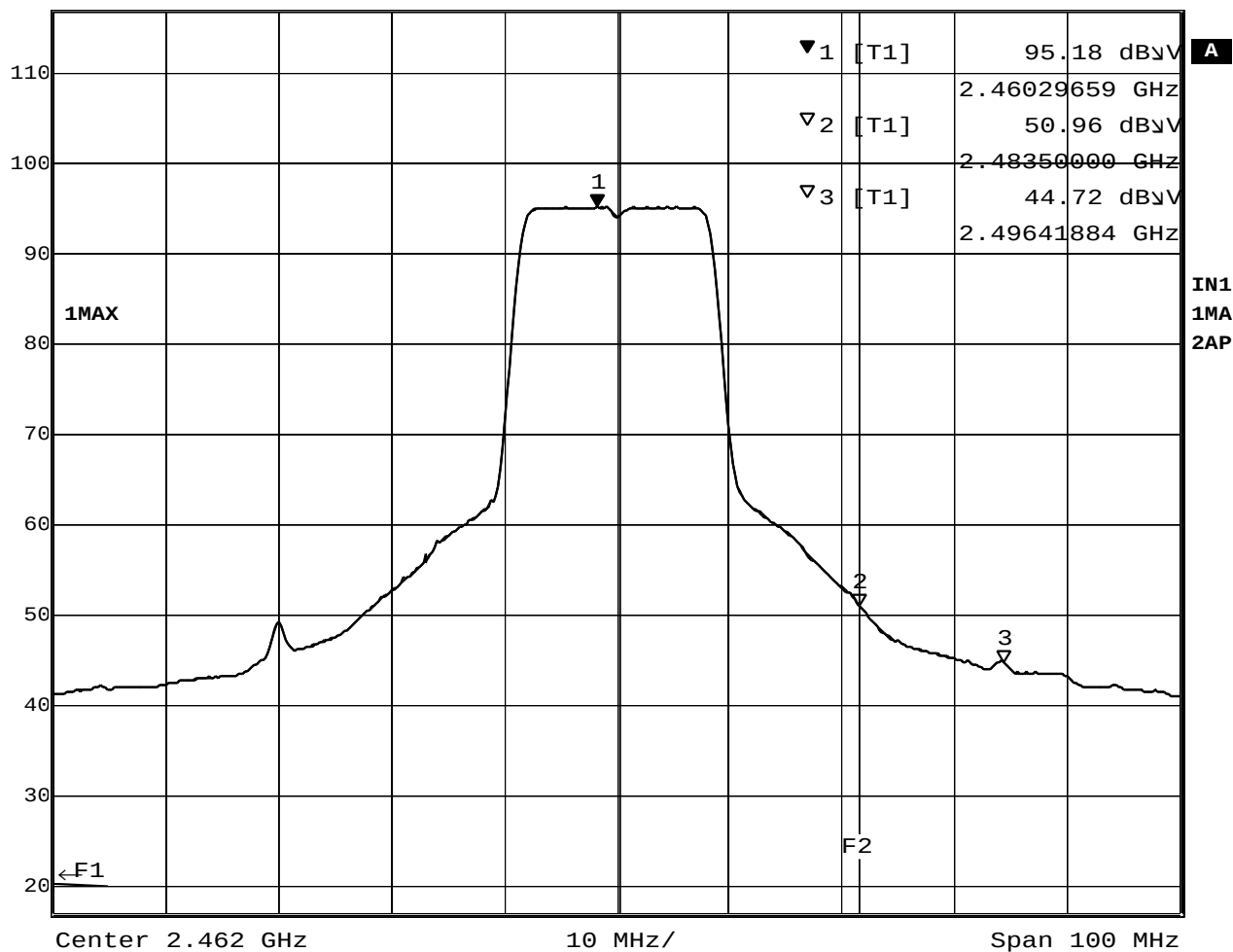


Date: 9.MAY.2003 20:05:41

Plot 7-2-3 Ch.11 2462MHz TX 18Mb/s (Peak)



Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	20 dB
117 dBμV	95.18 dBμV	VBW	10 Hz		
	2.46029659 GHz	SWT	25 s	Unit	dBμV



Date: 9.MAY.2003 20:04:47

Plot 7-2-4 Ch.11 2462MHz TX 18Mb/s (Average)

Emission Test Report

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

Document Number : FCC 19-0247-0

Product: IBM 11a/b/g Wireless LAN Mini PCI Adapter

measured with IBM ThinkPad T40 Series

FCC ID: ANO20030400LEG

IC: 349E-PH12127E

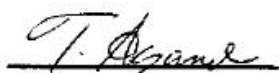
July 3, 2003

Prepared:

EMC R&D Staff Engineer

Takeshi Asano

Signature:



IBM Japan, Ltd.

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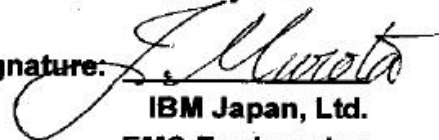
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Phone: +81-46-215-2613

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E-Mail: akihisa@jp.ibm.com

MEASUREMENT / TECHNICAL REPORT – Part 15 Subpart C
(Intentional Radiator)**IBM 11a/b/g Wireless LAN Mini PCI Adapter**
with
IBM ThinkPad T40 Series
(Machine type : 2373, 2374, 2375, 2376, 2378, 2379)**FCC ID : ANO20030400LEG****July 3, 2003**

This report concerns: (check one)	
Original Grant	_____
Class I change	_____
Class II change	<u>✓</u>
Equipment type: <u>Wireless LAN device</u>	
This report shall not be reproduced except in full, without the written permission of this test lab.	
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). <u>Yes</u> or No	
“Report shall not be reproduced except in full, without the written approval of the laboratory” “the report must not be used by the client to claim product endorsement by NVLAP or any agency of the US government”	
Prepared by: Takeshi Asano IBM Japan Corporation, Yamato EMC Engineering LAB-S59, 1623-14, Shimotsuruma, Yamato-shi Kanagawa-ken 242-8502, Japan Tel: +81-46-215-4779 Fax: +81-46-273-7420	

- Index -

A. GENERAL INFORMATION.....	5
A.1 TEST METHODOLOGY	5
A.2 TEST FACILITY / NVLAP ACCREDITATION.....	5
A.3 EUT DETAILS.....	5
B. SUMMARY OF TEST RESULTS.....	6
C. OPERATION MODE OF EUT.....	7
D. JUSTIFICATION.....	7
E. TEST INSTRUMENTS.....	8
F. MEASUREMENT UNCERTAINTY.....	9
G. TEMPERATURE AND HUMIDITY.....	9
H. RELATED SUBMITTAL(S)/GRANT(S)/NOTES	9
1. BANDWIDTH AT 6 DB BELOW.....	10
1.1 TEST PROCEDURE.....	10
1.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	10
1.3 MEASUREMENT RESULTS.....	10
1.4 TRACE DATA	11
2. OUT OF BAND EMISSIONS AND OCCUPIED BANDWIDTH AT 20 DB BELOW / BANDEDGE	17
2.1 TEST PROCEDURE.....	17
2.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	17
2.3 MEASUREMENT RESULTS OF OCCUPIED BANDWIDTH / BAND-EDGE	17
2.4 MEASUREMENT RESULTS OF OUT OF BAND EMISSIONS	17
2.5 TRACE DATA OF BAND-EDGE	18
2.6 TRACE DATA OF OUT OF BAND EMISSIONS.....	24
3. CONDUCTED PEAK OUTPUT POWER	30
3.1 TEST PROCEDURE.....	30
3.2 MEASUREMENT RESULTS.....	31
3.3 TRACE DATA OF CONDUCTED PEAK OUTPUT POWER	32
4. TRANSMITTER POWER SPECTRAL DENSITY	35
4.1 TEST PROCEDURE.....	35
4.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	35
4.3 MEASUREMENT RESULTS.....	35
4.4 TRACE DATA	36
5. AC WIRELINE CONDUCTED EMISSIONS (150KHZ – 30MHZ).....	42
5.1 TEST PROCEDURE.....	42
5.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	42
5.3 POWERLINE VOLTAGE CALCULATION.....	43
5.4 MEASUREMENT RESULTS.....	44
6. RESTRICTED BANDS RADIATIONS (30MHZ – 1GHZ)	46
6.1 TEST PROCEDURE.....	46
6.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	46
6.3 FIELD STRENGTH CALCULATION.....	48
6.4 MEASUREMENT RESULTS.....	49

7. RESTRICTED BANDS RADIATIONS (1GHZ – 25GHZ)	51
7.1 TEST PROCEDURE	51
7.2 TEST INSTRUMENTS AND MEASUREMENT SETUP	51
7.3 FIELD STRENGTH CALCULATION	53
7.4 MEASUREMENT RESULTS	54
7.5 MEASUREMENT PLOTS OF ADJACENT RESTRICTED BAND	56

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 : IBM 11a/b/g Wireless LAN Mini PCI Adapter
 FCC ID : ANO20030400LEG
 IC Certification Number : 349E-PH12127E
 SERIAL NUMBER : A310037374
 PHYSICAL CONDITION : Preproduction
 KIND OF EQUIPMENT : Personal computer with an IEEE802.11a, 11b & 11g Wireless LAN
 Mini-PCI Combo Card ([Composite application](#))
 TESTED DATE : May 23, June 26, 27, 30 and July 2, 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 #1 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
IBM 11a/b/g Wireless LAN Mini PCI Adapter (s/n A310037374)	FCC ID: ANO20030400LEG IC: 349E-PH12127E	Applying equipment IEEE802.11a/b/g Wireless LAN Mini-PCI Combo Card without antenna
ThinkPad T40 Series M/T 2373-GEU (s/n ZZ-02250)	N/A	IBM Notebook PC with built_in antenna CPU: Intel® Pentium® M Processor, 1.7GHz
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 DTS (Digital Transmissions System) 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 : Transmit mode (TX):		Condition	Result
15.247(a)(2) –	Bandwidth at 6 dB below	FCC requirement	Conducted	Pass
– 5.9.1	Bandwidth at 20 dB below Occupied BW(or Band-edge)	IC requirement		Pass
15.247(c) 6.2.2(o)(e1)	Out of Band Emissions	The radiated emission in any 100kHz of outband shall be at least 20dB below the highest inband spectral density.		Pass
15.247(b)(3) 6.2.2(o)(b)	Transmitter peak output power	Shall not exceed 1.0 W.		Pass
15.247(d) 6.2.2(o)(b)	Transmitter power spectral Density	Shall not be greater than 8 dBm in any 3kHz band.		Pass
15.207 6.2.2(o)(e3) / 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	Radiated (30MHz-1GHz)	Pass
15.205 / 209 6.2.1 /6.2.2(o)(e3) /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 (1– 25GHz)	Pass

	Test Items : Receive mode (RX):			
15.207 6.2.2(o)(e3) / 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
15.205 / 209 6.2.1 /6.2.2(o)(e3) /7.3	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

	Other requirements		Result
15.247(b)(4)(i) –	Antenna gain	Peak gain of the device : 0.99 dBi	N/A
15.203 6.2.2(o)(e2)	Unique antenna connector	The device employs an unique electronic handshake connector. Refer to “Confidential_BIOS_Lock” exhibit.	complies
– 6.2.2(o)(d1)	Power Spectral density for 2.4GHz unlicensed use	Conducted power / 20dB BW = 3.0mW/MHz (ch.6, 18Mb/s)	complies

C. Operation Mode of EUT

1. All tests were performed using the “Atheros Radio Test” program. This tool supports the continuous transmission mode for the testing purpose.
2. The following frequencies were chosen for the measurements.
- 2412MHz (lowest), 2437MHz(middle), and 2462MHz (highest)
3. 18Mbps transmission mode was selected for full testing (i.e. conducted and radiated measurements) as the worse case samplings. See “Chapter 3. Conducted Peak Output Power” as to the determination of measurement plots.
Also 6Mbps transmission mode was used for 6dB band width and other conducted testing.
4. As for the RF receiving test, the middle channel (2437MHz) was selected representatively.

Table-C Transmission mode of EUT (The measurement plots are shown in shading.)

Table 3: Transmission mode of ECF (The measurement plots are shown in shading.)											
Operation Frequency [GHz]	Rated output power (conducted) [dBm]										
	IEEE802.11b			IEEE802.11g							
	1/2M bps	5.5M bps	11M bps	6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	18M bps	54M bps
2.412 (Ch. 1)	*1			+14	+14	+14	+14	+14	14	13.5	11.5
2.417 (Ch. 2)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.422 (Ch. 3)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.427 (Ch. 4)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.432 (Ch. 5)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.437 (Ch. 6)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.442 (Ch. 7)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.447 (Ch. 8)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.452 (Ch. 9)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.457 (Ch. 10)				+17	+17	+17	+17	+17	15.5	13.5	11.5
2.462 (Ch. 11)				+14	+14	+14	+14	+14	14	13.5	11.5
				IEEE802.11a							
5.745 (Ch.149)	N/A			*1							
5.765 (Ch.153)											
5.785 (Ch.157)											
5.805 (Ch.161)											
5.825 (Ch.165)											

*1: See the separate test report (Document number: FCC 19-0246-0).

D. Justification

The EUT was investigated for both the main (left) and the auxiliary (right) antennas for each Tx mode. The worse case data taken in this report represents the measurement result of the left antenna that has comparatively higher gain in 2.4GHz as shown below.

Table-D Peak Antenna Gains of EUT

2.4GHz	Left Antenna gain	0.99 dBi (peak)
	Right Antenna gain	-0.48 dBi (peak)

E. Test Instruments

Table-E List of Measuring Instruments

Description	Model	Serial Number	Calibration Date	Calibration Interval
Computer	IBM 6868-30J	97-901X3	N/A	N/A
Computer	IBM 6589-13J	97-15613	N/A	N/A
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2601A02634	08/28/02	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2841A04242	10/30/02	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2732A03651	02/28/03	1 year
Spectrum Analyzer Display	HP 85662A	2542A12308	08/28/02	1 year
Spectrum Analyzer Display	HP 85662A	2816A16827	10/30/02	1 year
Spectrum Analyzer Display	HP 85662A	2648A15255	02/28/03	1 year
Quasi-Peak Adapter	HP 85650A	2043A00062	08/28/02	1 year
Quasi-Peak Adapter	HP 85650A	2521A00968	02/28/03	1 year
Quasi-Peak Adapter	HP 85650A	2811A01126	10/30/02	1 year
Amplifier (100KHz - 1.3GHz)				
- for 30-200MHz	HP 8447D	2805A02919	04/14/03	1 year
- for 200-1000MHz	HP 8447D	2727A05190	04/14/03	1 year
Amplifier (1 - 26.5GHz)	HP 8449B	3008A00582	06/11/03	1 year
Amplifier (26.5 - 40GHz)	Agilent 83051A	3950M00193	01/06/03	1 year
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003	05/01/03	1 year
Receiver (9kHz-30MHz)	R&S ESH3	891806/012	10/07/02	1 year
Receiver (20MHz-1.3GHz)	R&S ESVP	892111/030	03/17/03	1 year
Biconical Antenna (30-200MHz)	EMCO 3108	2536	04/23/03	1 year
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	2849	04/23/03	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	07/18/02	1 year
Horn Antenna (5.85- 8.20GHz)	EMCO 3160-6	9712-1044	07/18/02	1 year
Horn Antenna (8.2- 12.4GHz)	EMCO 3160-7	1156	07/18/02	1 year
Horn Antenna (18- 26.5GHz)	EMCO 3160-9	0004-1202	07/18/02	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	N/A	N/A
		2719A17228	N/A	N/A
Plotter	HP 7550A	2631A33619	N/A	N/A
Coaxial cables (1 – 18GHz):	Length:			
- Horn Ant <=> RF Amp.	6 m	- EM206SCO	09/05/02	1 year
- RF Amp.<=>Spectrum Analyzer	16m	- GEM0101	03/27/03	1 year
Coaxial cables (18 – 25GHz):				
- Horn Ant <=> RF Amp.	3m	- SF102-20167	09/05/02	1 year
- RF Amp.<=>Spectrum Analyzer	1m	- SF102-21105	09/05/02	1 year
N-Coax cables:				
- Bi-coni Ant <=> 10m Cable	9 m	- EM103L01	04/14/03	1 year

- 10m Cable <=> Shield Panel	10 m	- EM103L02	04/14/03	1 year
- Shield Panel <=> RF Amp	7 m	- EM103L03	04/14/03	1 year
- RF Amp <=> Power Splitter	0.5m	- EM103L04	04/14/03	1 year
- Log-peri Ant <=> 10m Cable	9 m	- EM103H01	04/14/03	1 year
- 10m Cable <=> Shield Panel	10 m	- EM103H02	04/14/03	1 year
- Shield Panel <=> RF Amp	7 m	- EM103H03	04/14/03	1 year
- RF Amp <=> Power Splitter	0.5m	- EM103H04	04/14/03	1 year
Coax cables:				
- Lisen-L <=> SW/Con.unit (SW100)	4 m	- EMIC-L	04/14/03	1 year
- Lisen-N <=> SW/Con.unit (SW101)	4 m	- EMIC-N	04/14/03	1 year
- SW/Con.unit <=> RCVR (Input)	1 m	- EMIC-R	04/14/03	1 year
- SW/Con.unit<=> Spe Ana.(Signal In)	1 m	- EMIC-S	04/14/03	1 year
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM103L05	04/14/03	1 year
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM103L06	04/14/03	1 year
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM103H05	04/14/03	1 year
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM103H06	04/14/03	1 year
- SW/Con.unit <=> Receiver (Input)	2 m	- EM1RCV	04/14/03	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	2 m	- EM1SPL	04/14/03	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM1SPH	04/14/03	1 year

Notes.

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

F. 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.

G. Temperature and Humidity

The temperature is controlled within range of 17° to 28°.

The relative humidity is controlled within range of 40% to 70%.

H. 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 DoC.

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: 110 cm Loss: 1.3 dB	

Notes: - R&S: Rohde & Schwarz

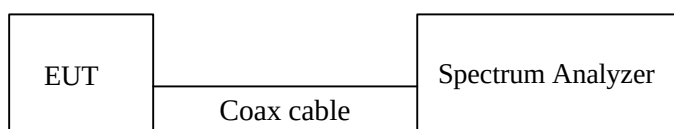


Figure 1: Measurement setup for 6dB bandwidth test

1.3 Measurement Results

Test Date: May 23, 2003

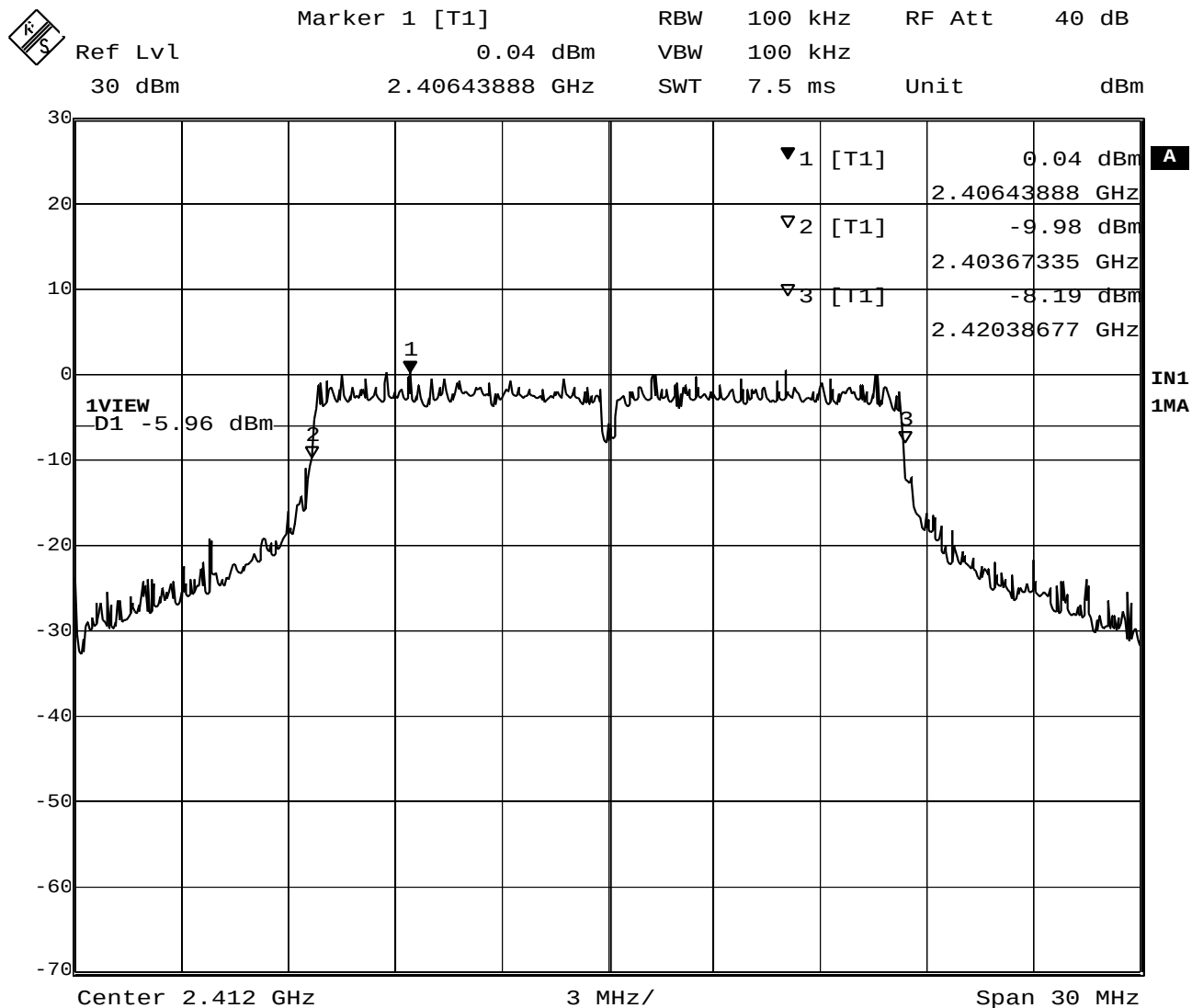
Table 1-2-1. EUT: M/T 2373-GEU, s/n ZZ-02250 , TX mode 6Mbps

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)
2412 (ch. 1)	Plot 1-1	2403.67	2420.39	16.72
2437 (ch. 6)	Plot 1-2	2428.73	2445.39	16.66
2462 (ch. 11)	Plot 1-3	2453.67	2470.33	16.66

Table 1-2-2. EUT: M/T 2373-GEU, s/n ZZ-02250 , TX mode 18Mbps

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)
2412 (ch. 1)	Plot 1-4	2403.73	2420.33	16.60
2437 (ch. 6)	Plot 1-5	2428.73	2445.33	16.60
2462 (ch. 11)	Plot 1-6	2453.73	2470.33	16.60

1.4 Trace Data

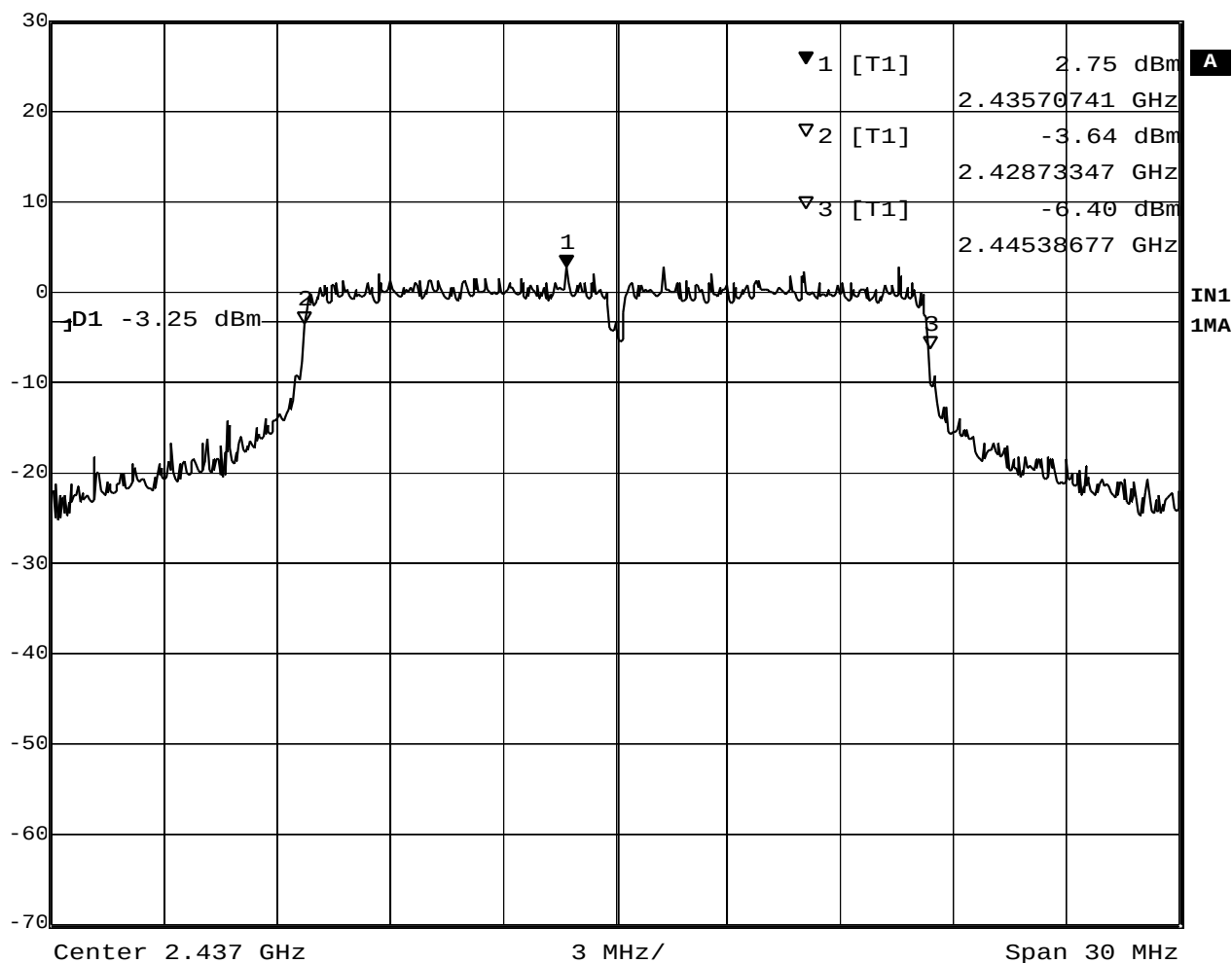


Date: 23.MAY.2003 11:00:51

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



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 2.75 dBm VBW 100 kHz
30 dBm 2.43570741 GHz SWT 7.5 ms Unit dBm

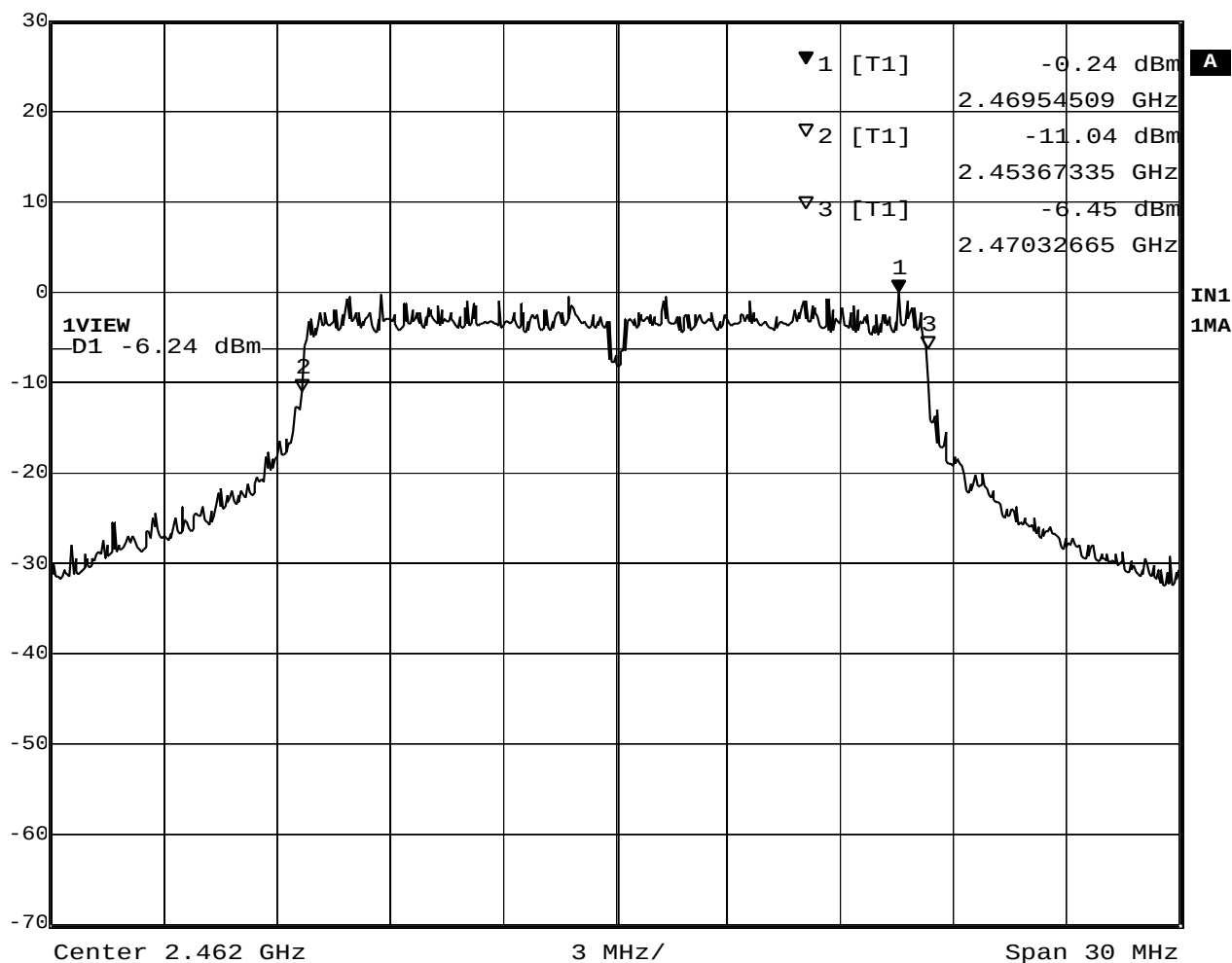


Date: 23.MAY.2003 11:24:07

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



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl -0.24 dBm VBW 100 kHz
30 dBm 2.46954509 GHz SWT 7.5 ms Unit dBm

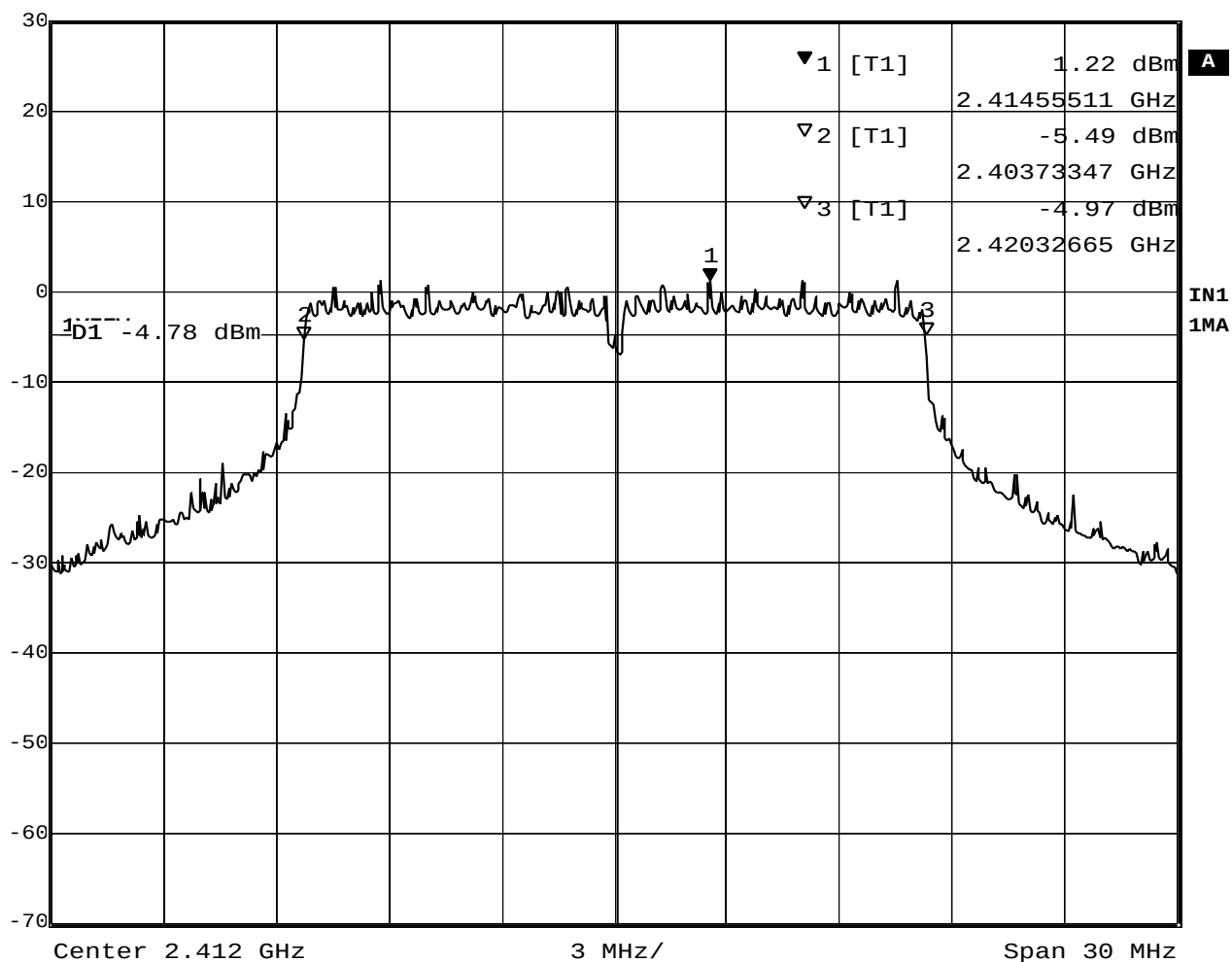


Date: 23.MAY.2003 11:29:30

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



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 1.22 dBm VBW 100 kHz
30 dBm 2.41455511 GHz SWT 7.5 ms Unit dBm

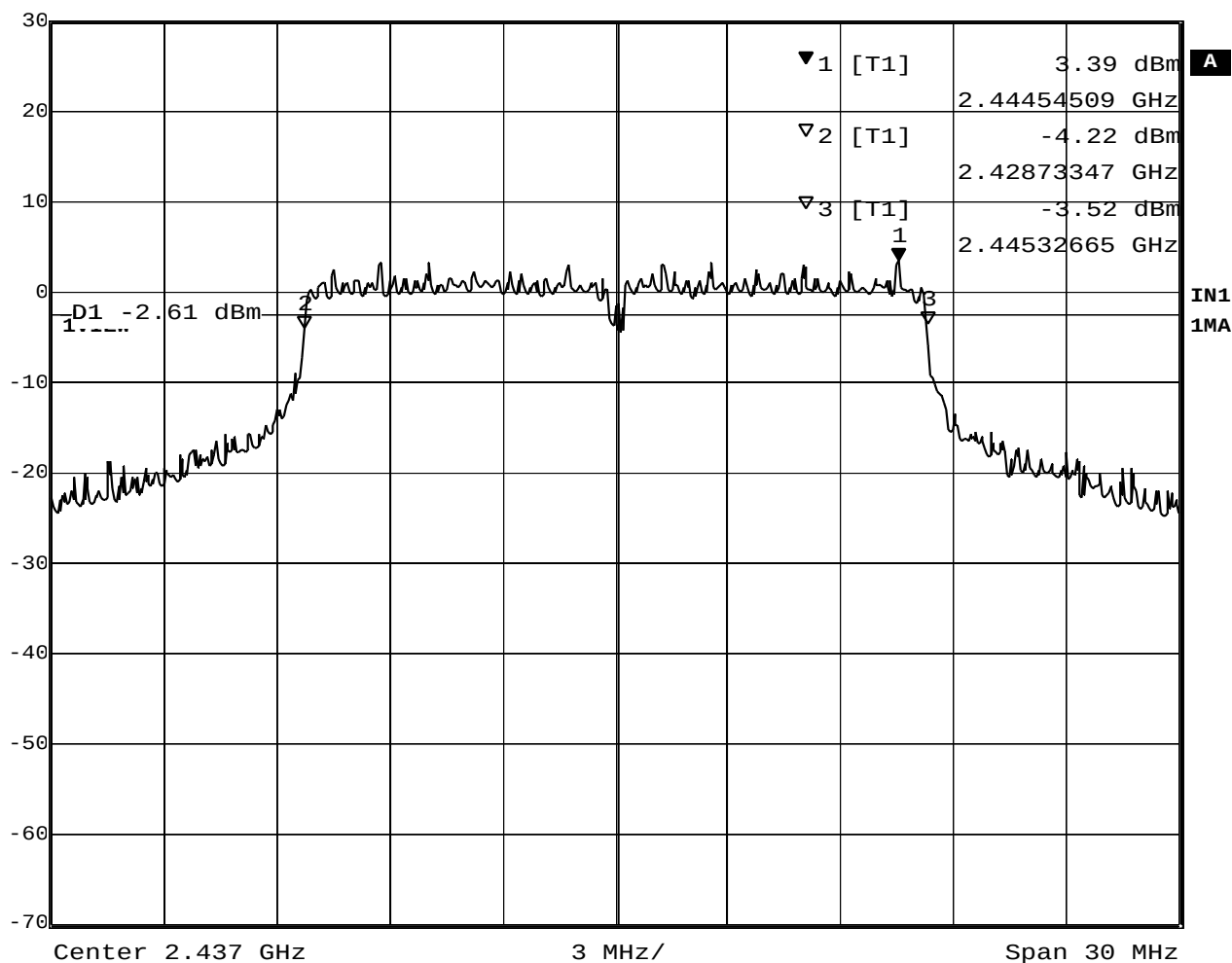


Date: 23.MAY.2003 10:57:28

Plot 1-4. 6dB BW at 2412MHz (18Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 3.39 dBm VBW 100 kHz
30 dBm 2.44454509 GHz SWT 7.5 ms Unit dBm

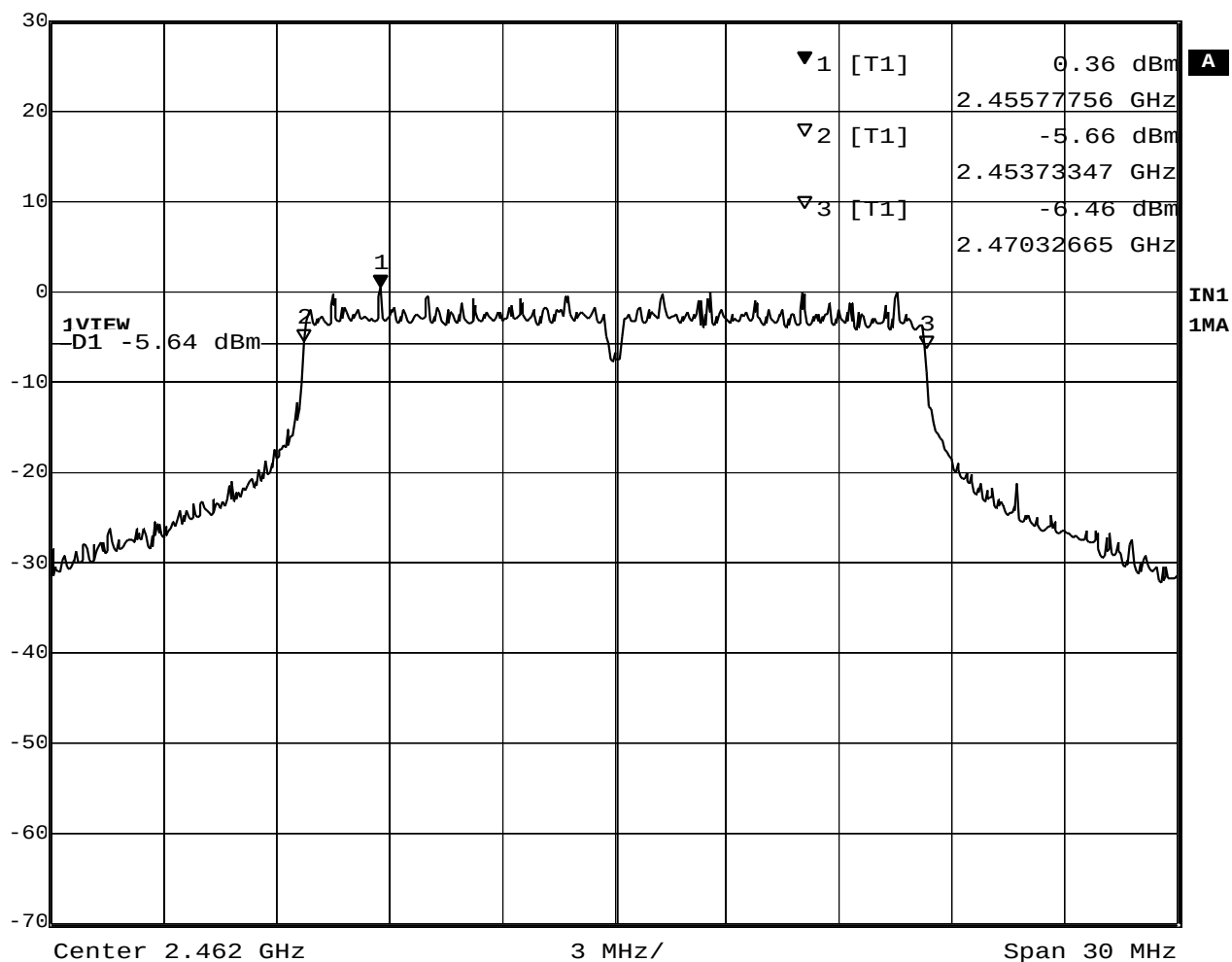


Date: 23.MAY.2003 11:22:13

Plot 1-5. 6dB BW at 2437MHz (18Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 0.36 dBm VBW 100 kHz
30 dBm 2.45577756 GHz SWT 7.5 ms Unit dBm



Date: 23.MAY.2003 11:26:43

Plot 1-6. 6dB BW at 2462MHz (18Mbps)

2. Out of Band Emissions and Occupied Bandwidth at 20 dB below / Bandedge

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 note) Canadian requirement

Test Date: May 23, 2003

Table 2-1-1. EUT: M/T 2373-GEU, s/n ZZ-02250 , TX mode 6Mbps

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	2402.35	2421.49	19.14	2.35	
2437 (ch. 6)	Plot 2-2	2427.43	2447.64	20.21		
2462 (ch. 11)	Plot 2-3	2451.93	2471.19	19.26		12.31

Table 2-1-2. EUT: M/T 2373-GEU, s/n ZZ-02250 , TX mode 18Mbps

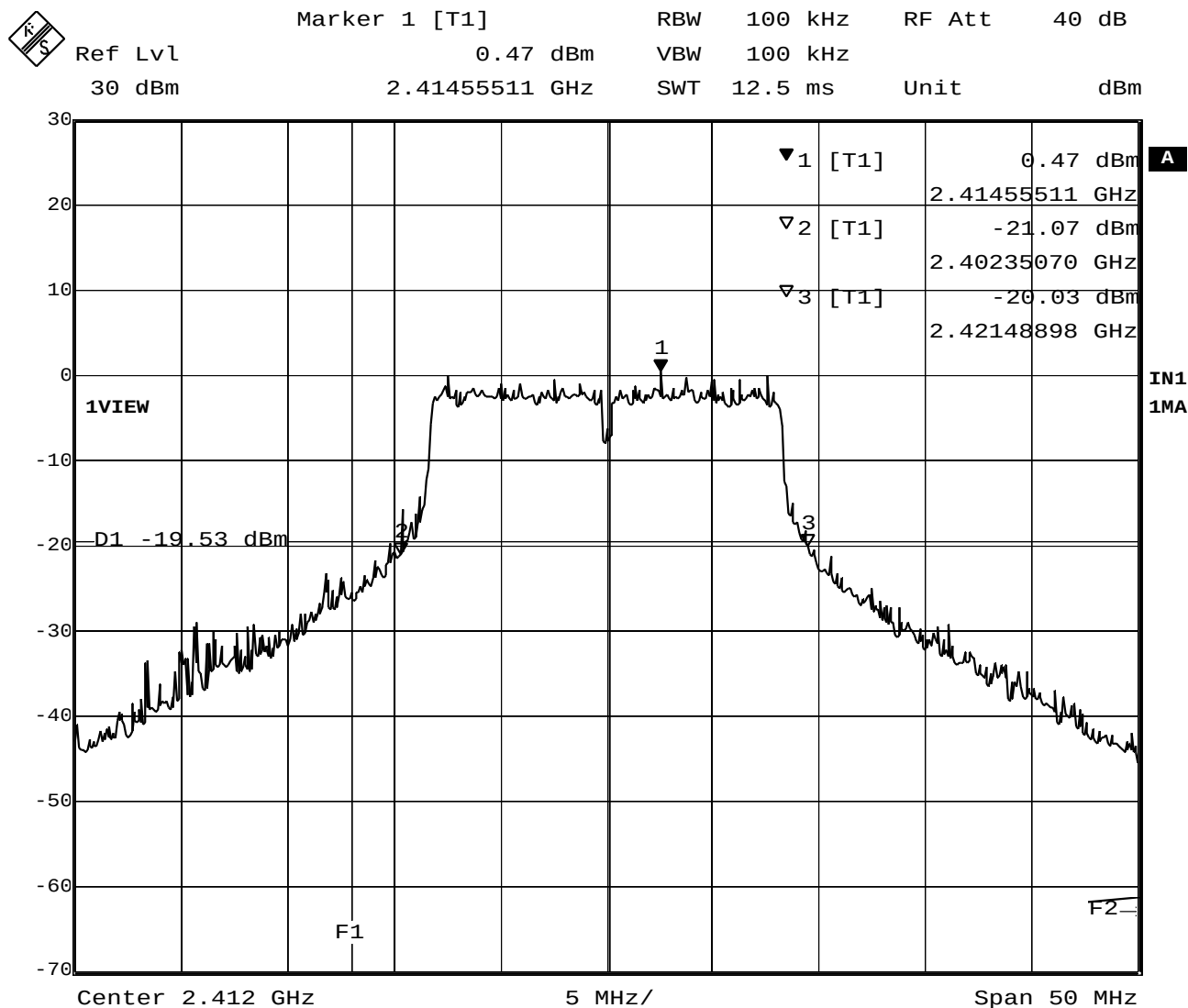
Center Frequency (MHz)	Trace number	Lower Frequency (MHz)	Upper Frequency (MHz)	Bandwidth at 20 dB below (MHz)	Margin to Lower limit (MHz)	Margin to Upper limit (MHz)
2412 (ch. 1)	Plot 2-4	2402.75	2421.19	18.44	2.75	
2437 (ch. 6)	Plot 2-5	2427.43	2447.04	19.61		
2462 (ch. 11)	Plot 2-6	2452.53	2471.29	18.76		12.21

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: May 23, 2003 : See Plot 2-7 to 2-12

2.5 Trace Data of Band-edge

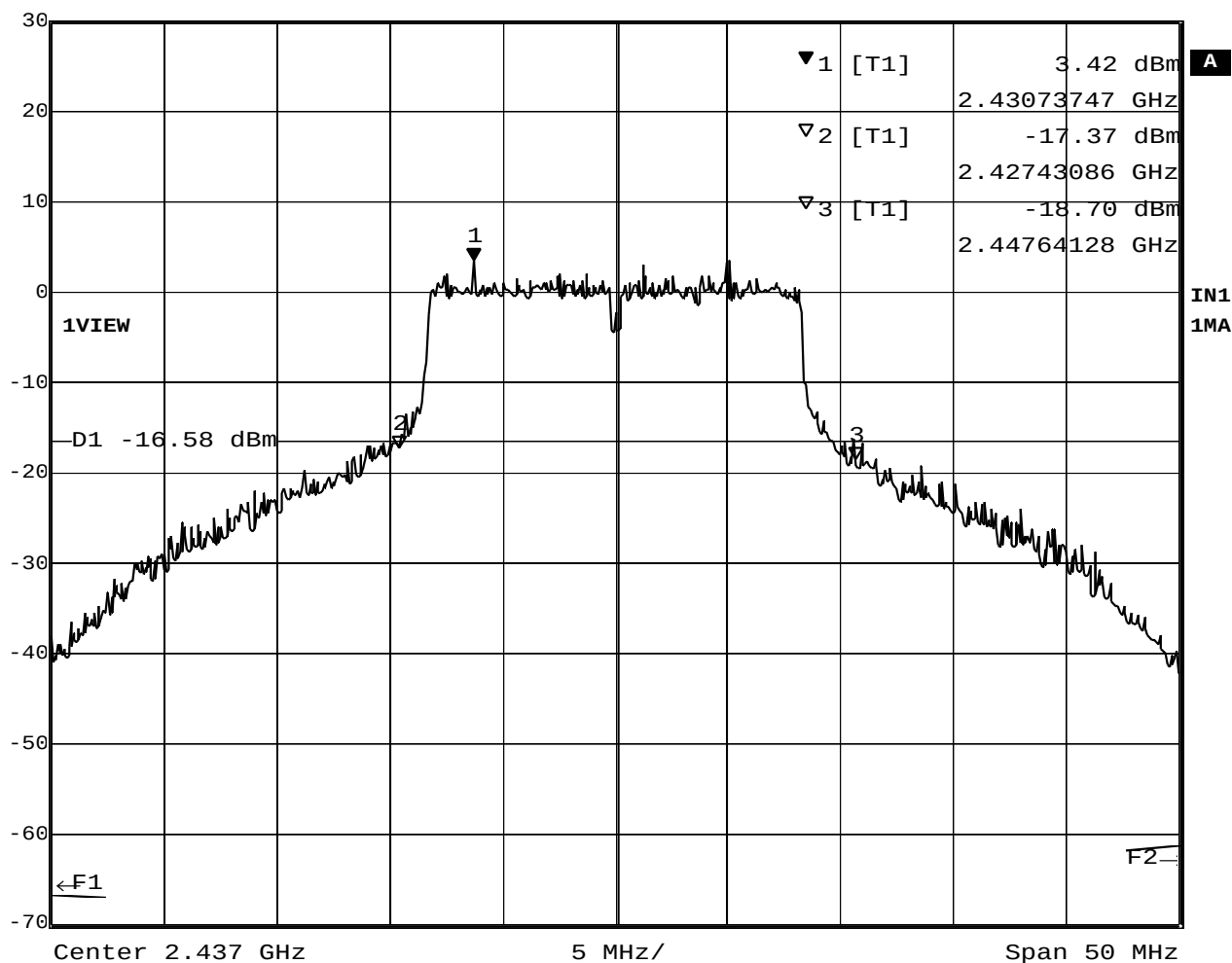


Date: 23.MAY.2003 11:56:10

Plot 2-1. 20dB BW at 2412MHz (6Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 3.42 dBm VBW 100 kHz
30 dBm 2.43073747 GHz SWT 12.5 ms Unit dBm

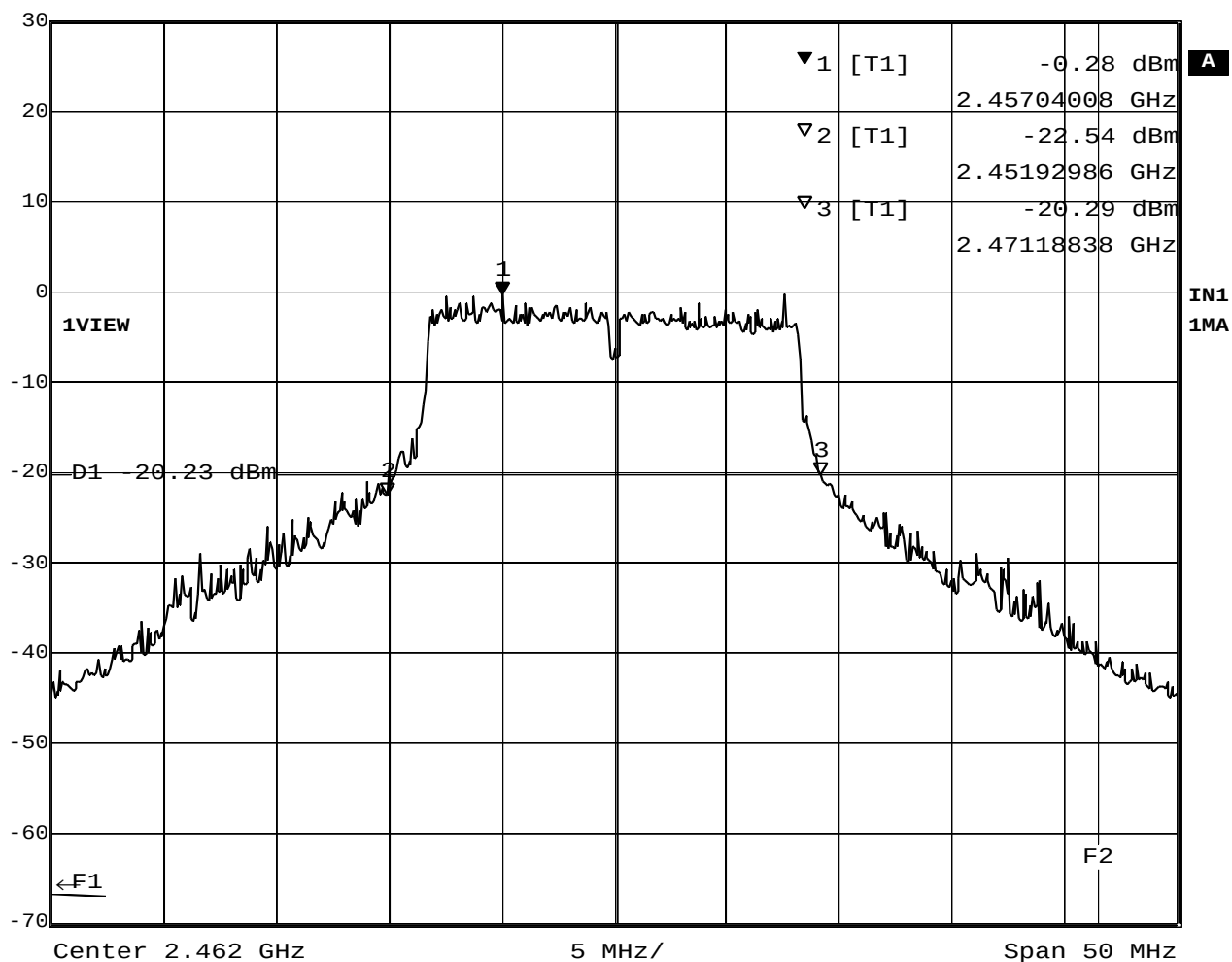


Date: 23.MAY.2003 12:06:27

Plot 2-2. 20dB BW at 2437MHz (6Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl -0.28 dBm VBW 100 kHz
30 dBm 2.45704008 GHz SWT 12.5 ms Unit dBm

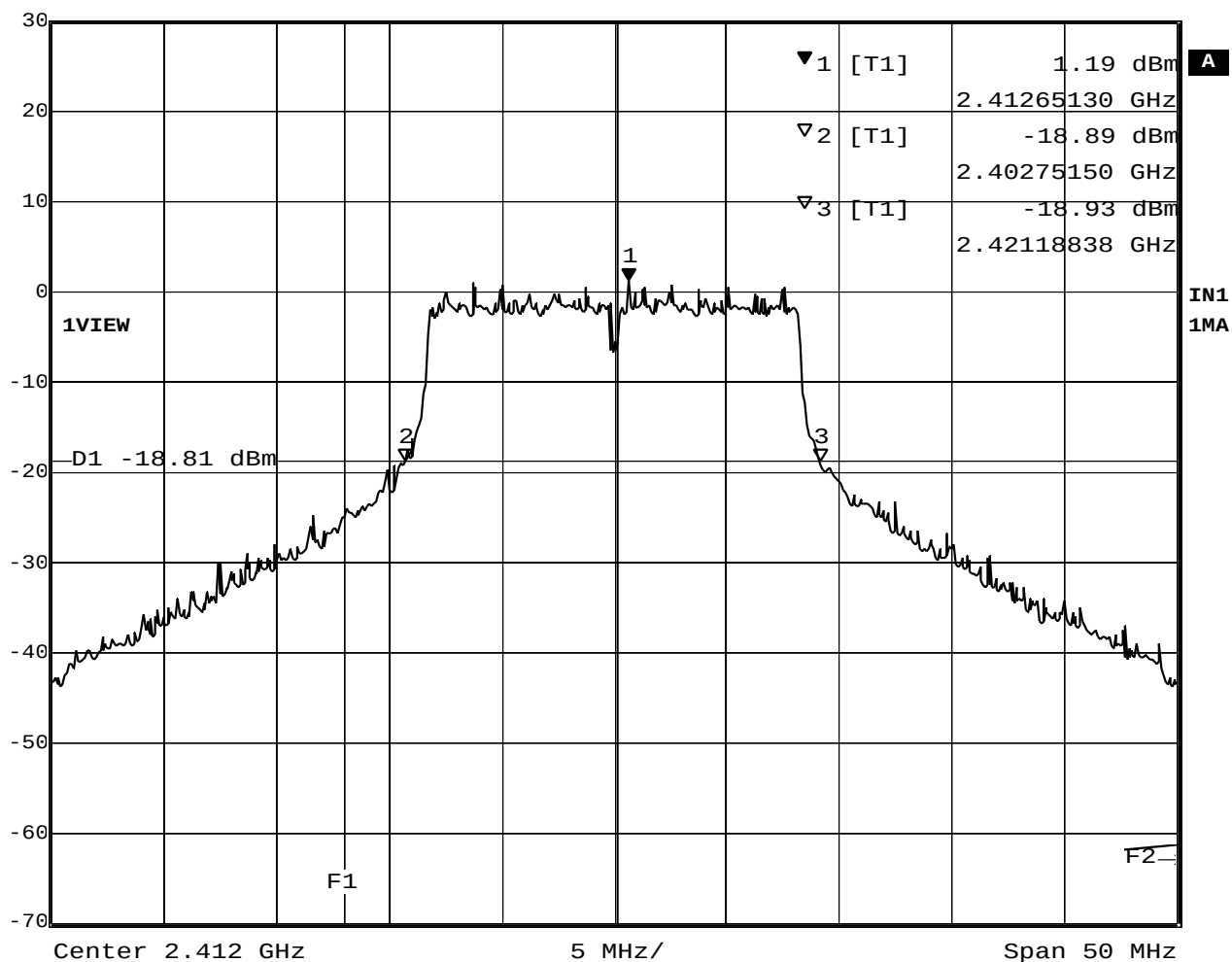


Date: 23.MAY.2003 12:12:29

Plot 2-3. 20dB BW at 2462MHz (6Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 1.19 dBm VBW 100 kHz
30 dBm 2.41265130 GHz SWT 12.5 ms Unit dBm

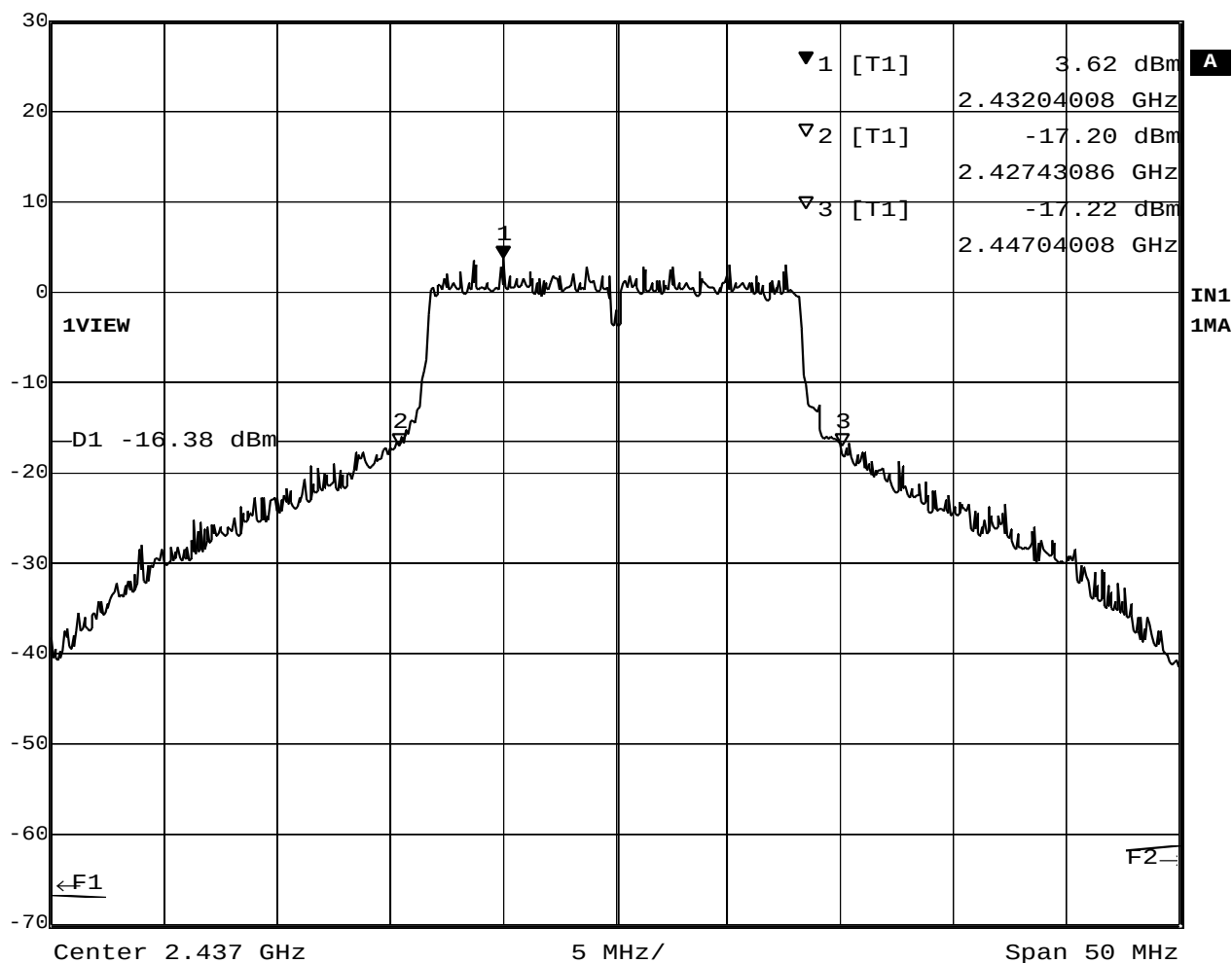


Date: 23.MAY.2003 11:53:38

Plot 2-4. 20dB BW at 2412MHz (18Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 3.62 dBm VBW 100 kHz
30 dBm 2.43204008 GHz SWT 12.5 ms Unit dBm

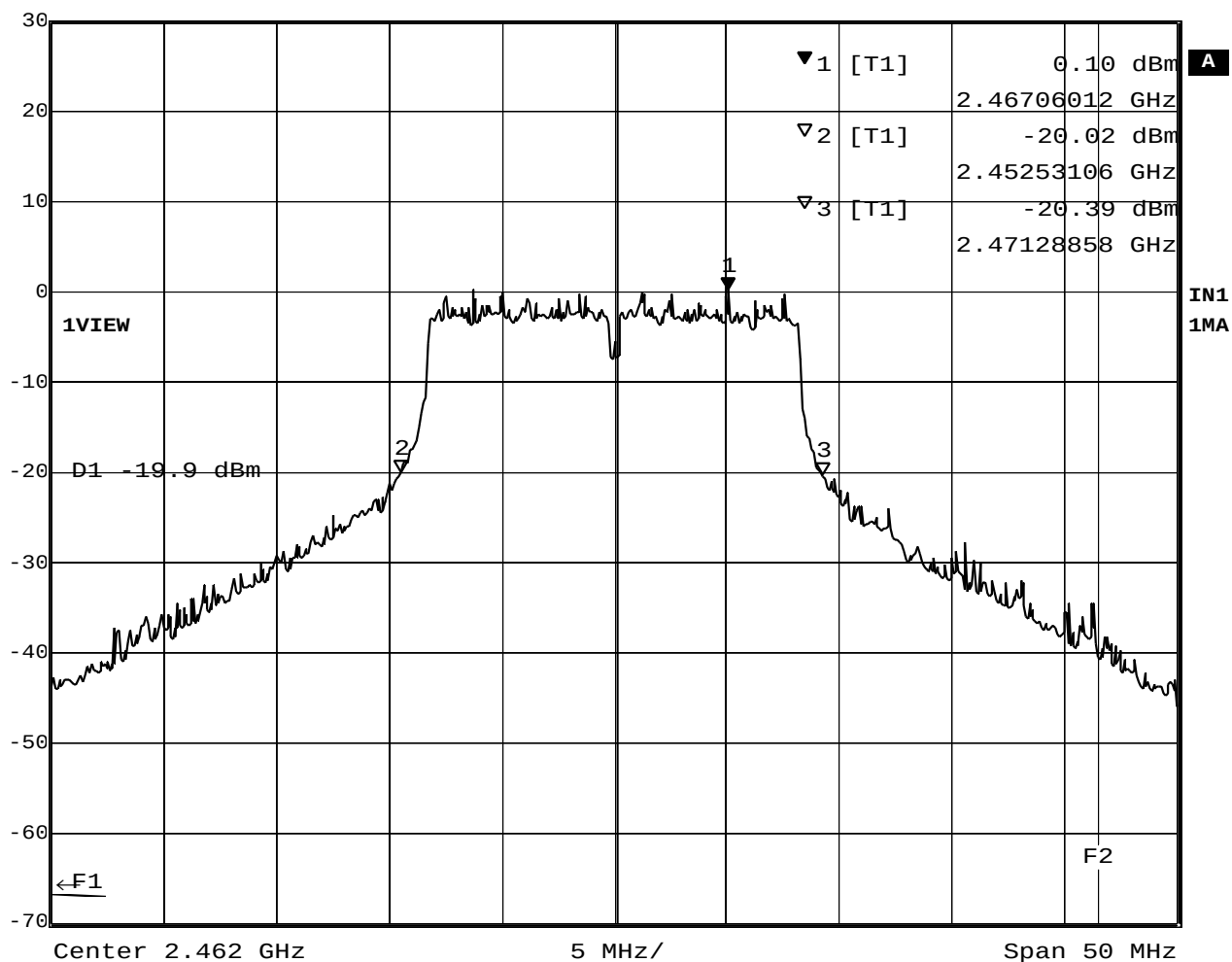


Date: 23.MAY.2003 12:04:07

Plot 2-5. 20dB BW at 2437MHz (18Mbps)



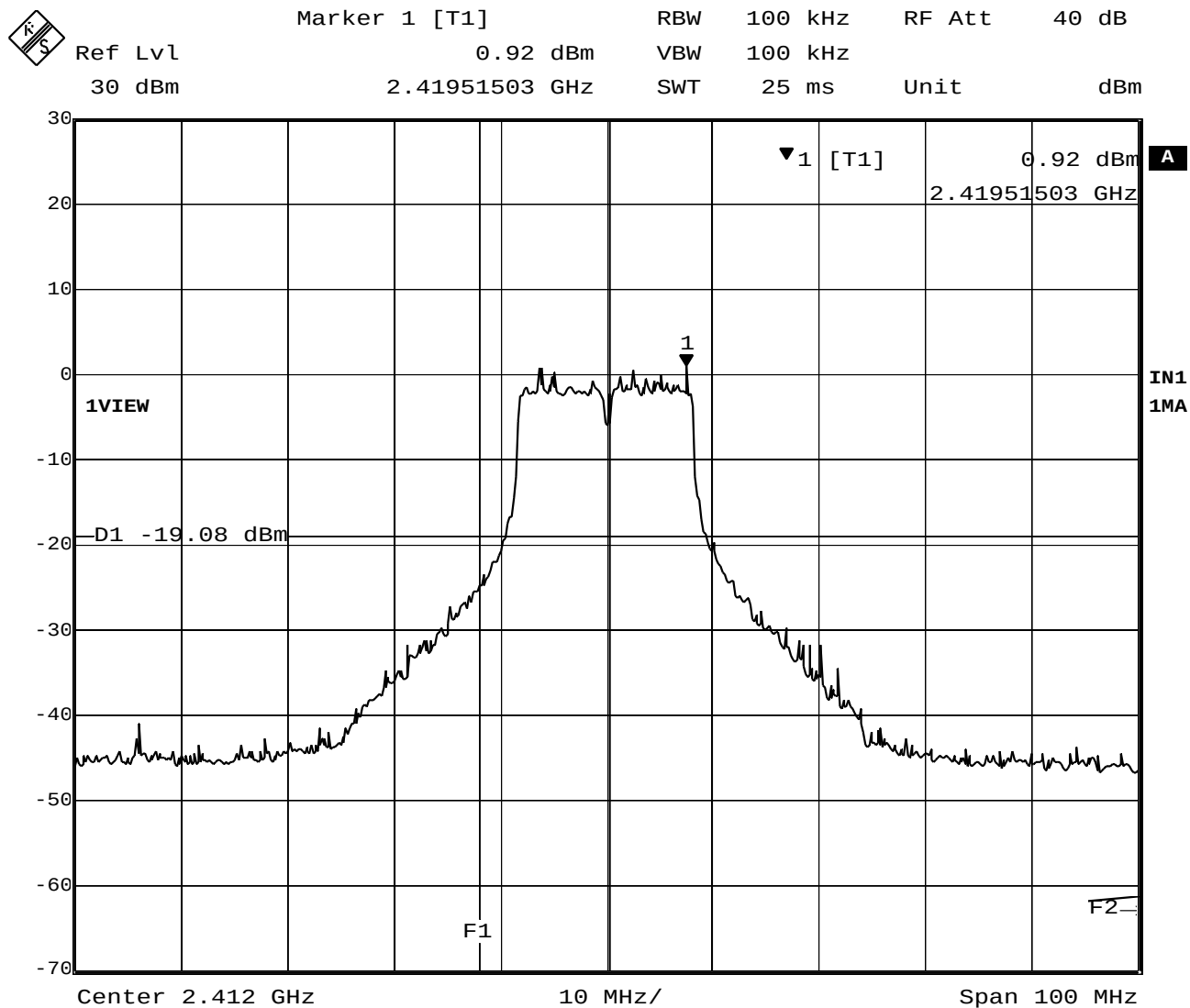
Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 0.10 dBm VBW 100 kHz
30 dBm 2.46706012 GHz SWT 12.5 ms Unit dBm



Date: 23.MAY.2003 12:10:15

Plot 2-6. 20dB BW at 2462MHz (18Mbps)

2.6 Trace Data of Out of Band Emissions

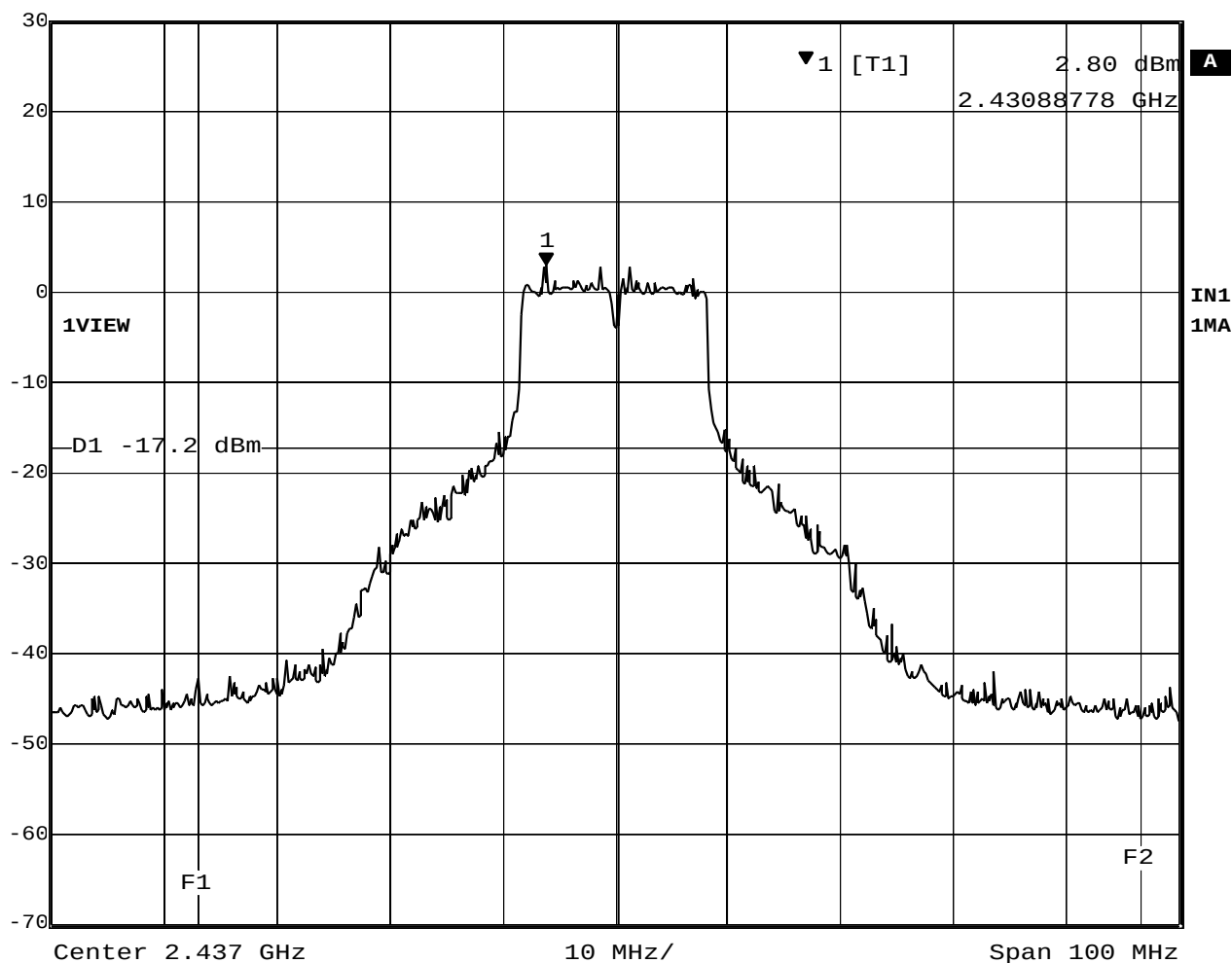


Date: 23.MAY.2003 12:38:40

Plot 2-7. Out of band emissions around 2412MHz (6Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 2.80 dBm VBW 100 kHz
30 dBm 2.43088778 GHz SWT 25 ms Unit dBm

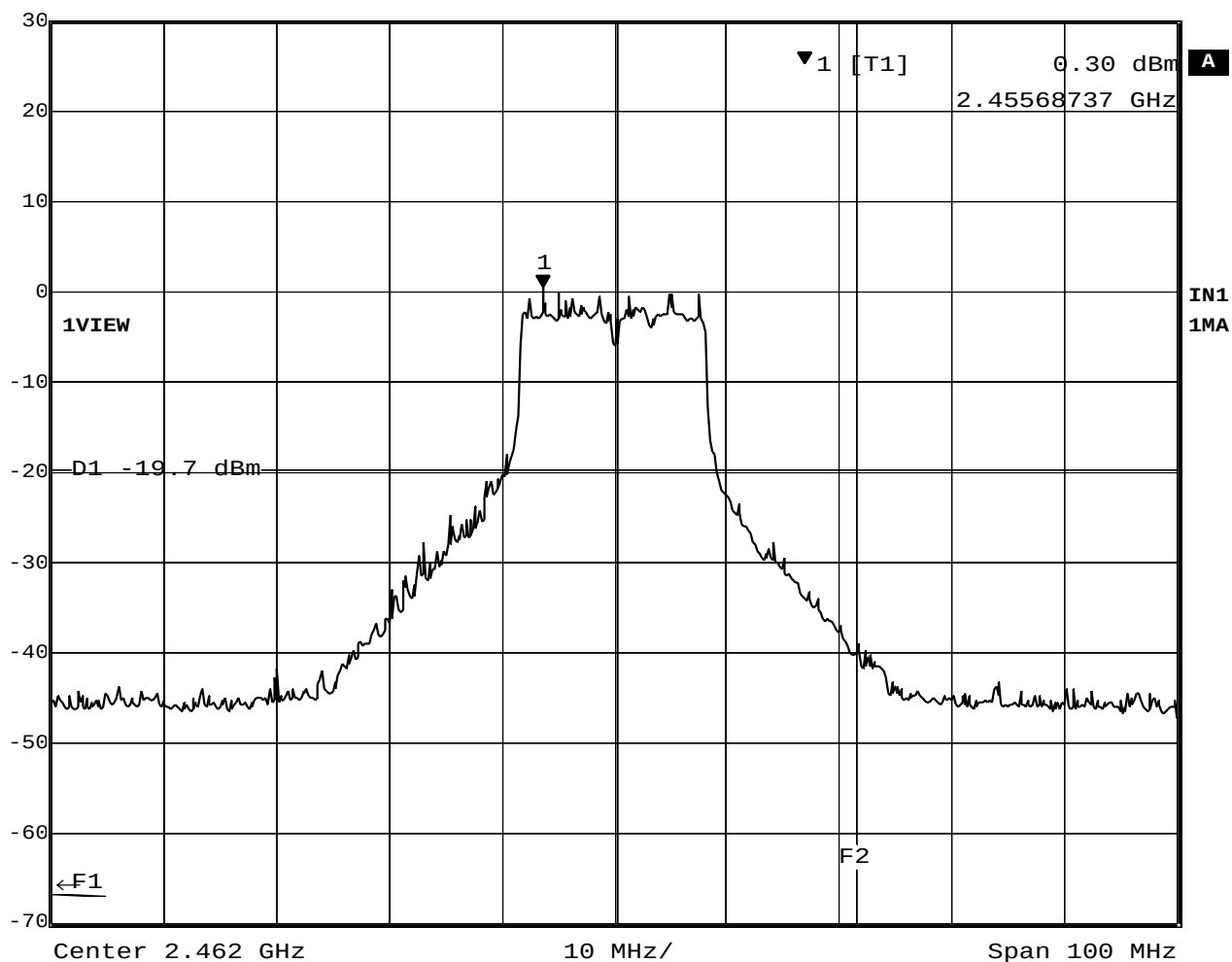


Date: 23.MAY.2003 12:34:43

Plot 2-8. Out of band emissions around 2437.2MHz (6Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 0.30 dBm VBW 100 kHz
30 dBm 2.45568737 GHz SWT 25 ms Unit dBm

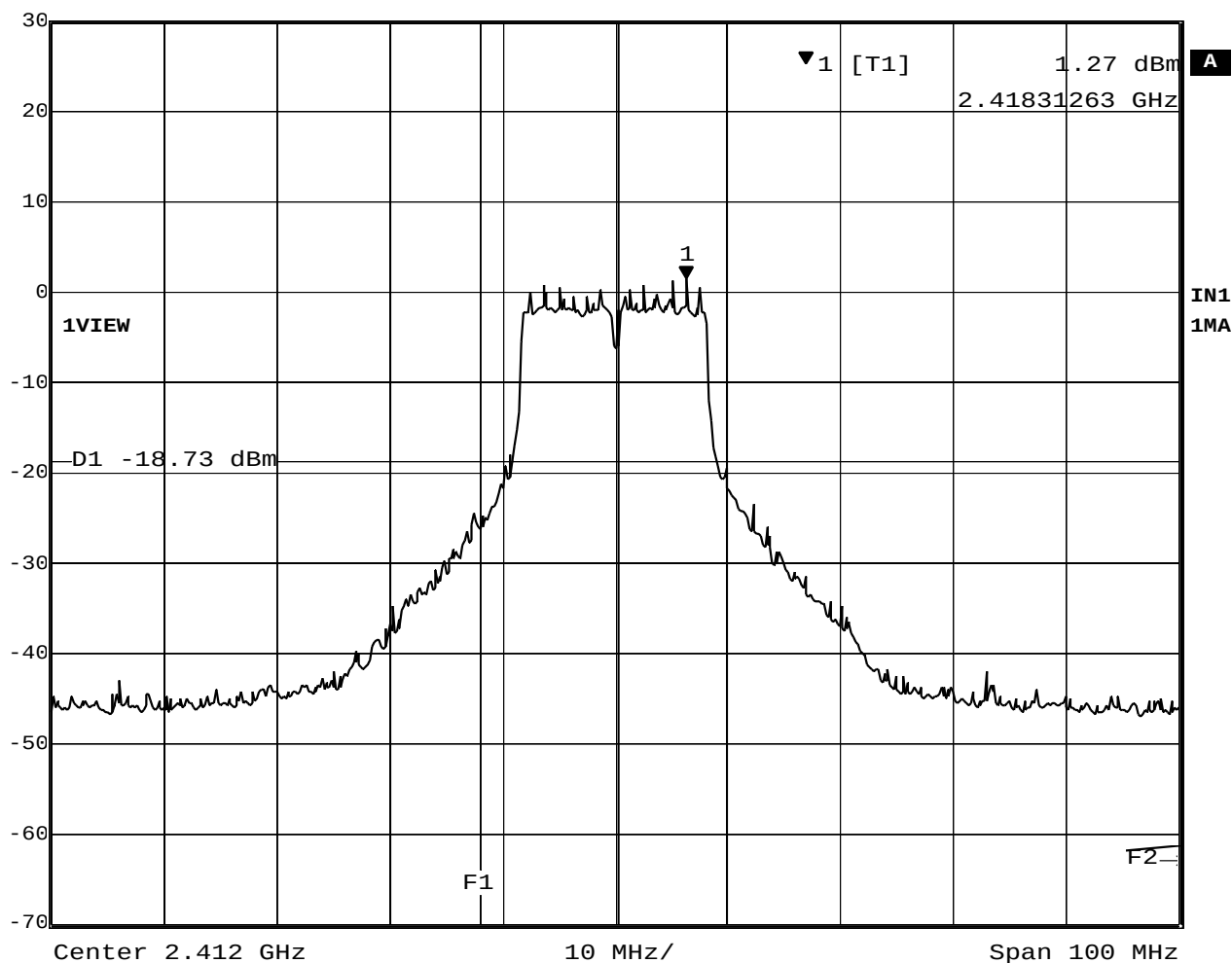


Date: 23.MAY.2003 12:16:22

Plot 2-9. Out of band emissions around 2462MHz (6Mbps)



Ref Lvl	Marker 1 [T1]	RBW	100 kHz	RF Att	40 dB
30 dBm	1.27 dBm	VBW	100 kHz		
	2.41831263 GHz	SWT	25 ms	Unit	dBm

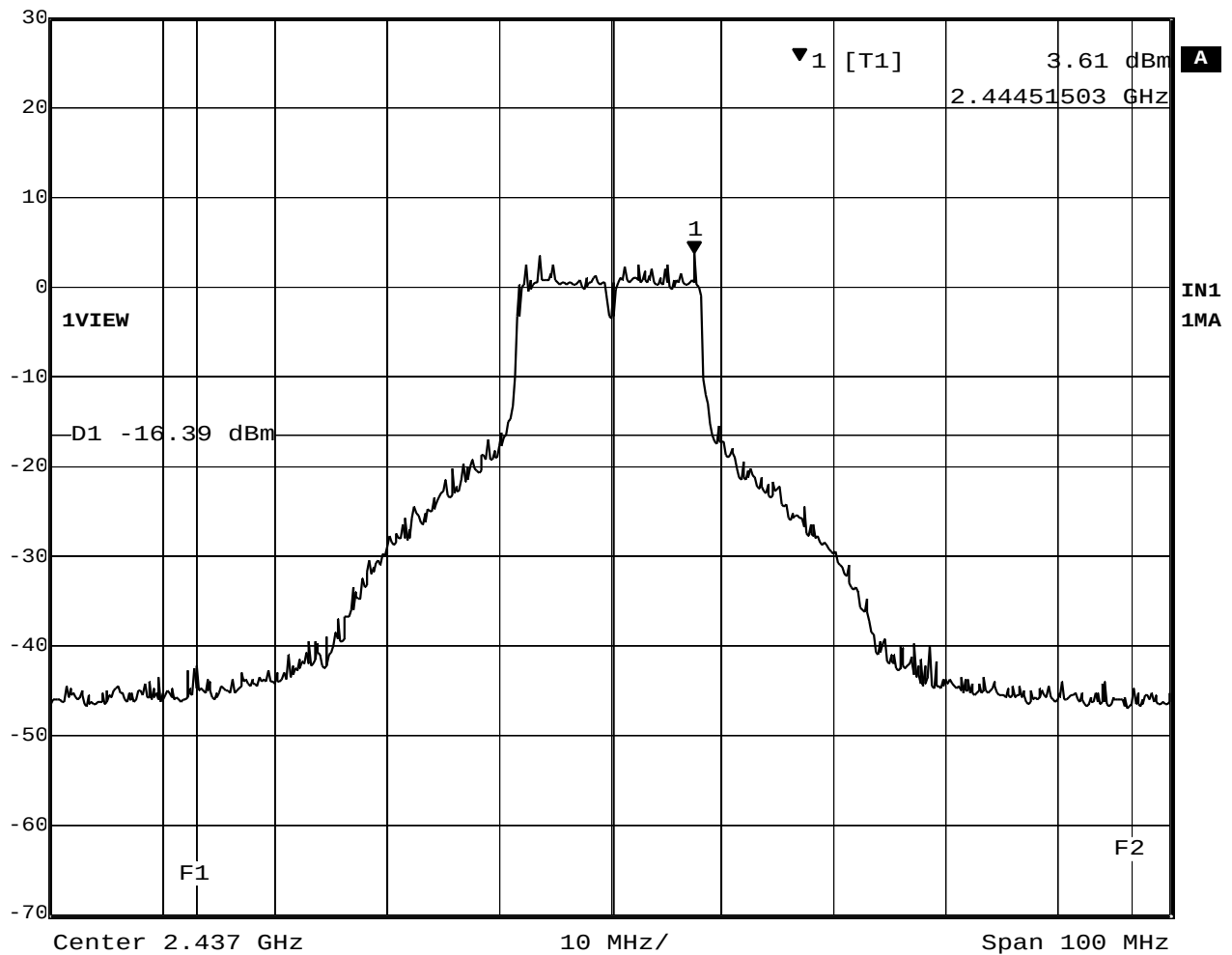


Date: 23.MAY.2003 12:36:53

Plot 2-10. Out of band emissions around 2412MHz (18Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 3.61 dBm VBW 100 kHz
30 dBm 2.44451503 GHz SWT 25 ms Unit dBm

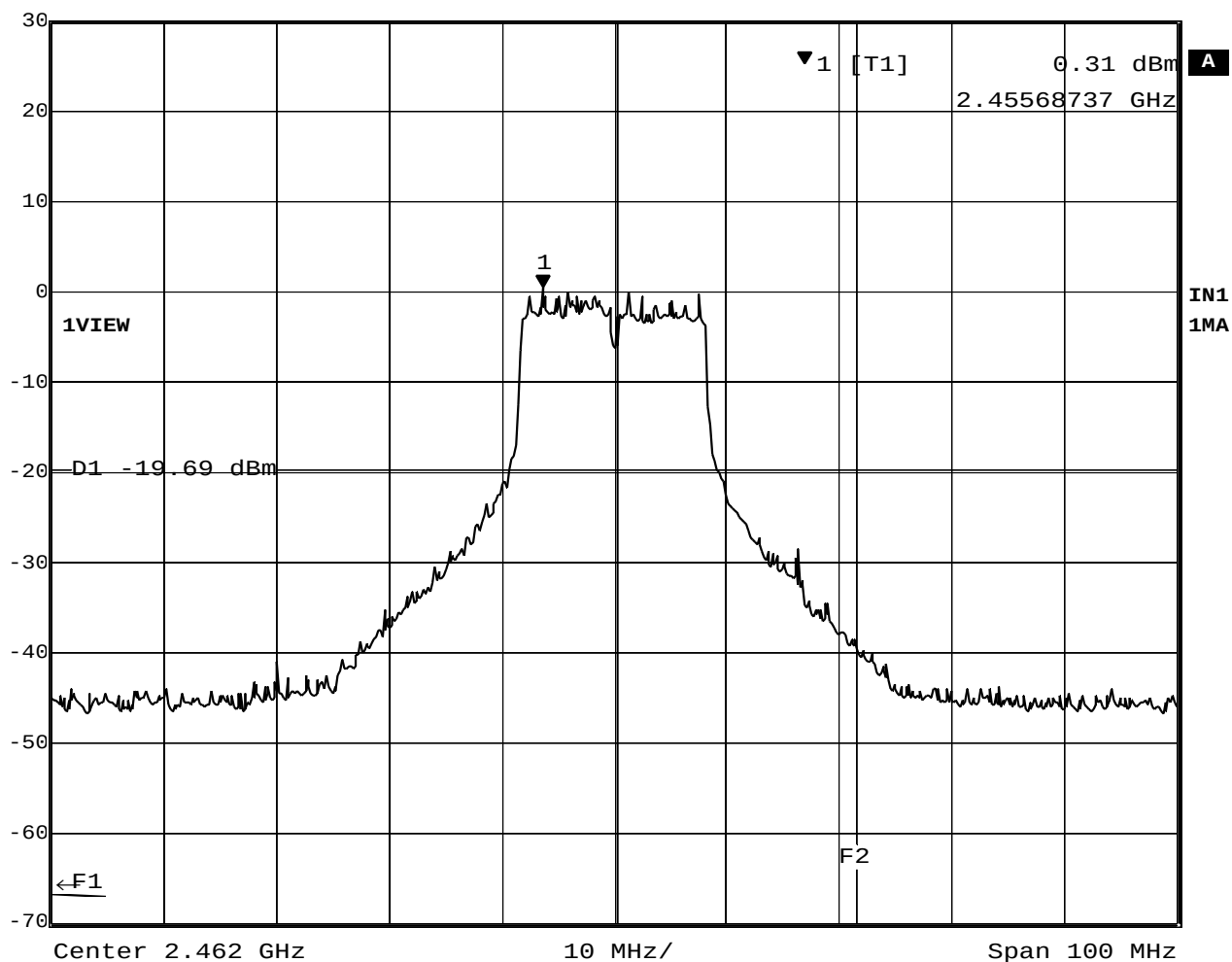


Date: 23.MAY.2003 12:29:03

Plot 2-11. Out of band emissions around 2437MHz (18Mbps)



Marker 1 [T1] RBW 100 kHz RF Att 40 dB
Ref Lvl 0.31 dBm VBW 100 kHz
30 dBm 2.45568737 GHz SWT 25 ms Unit dBm



Date: 23.MAY.2003 12:15:16

Plot 2-12. Out of band emissions around 2462MHz (18Mbps)

3. Conducted Peak Output Power

The test was performed with two kinds of measurement methods using power meter or spectrum analyzer.

3.1 Test Procedure

3.1.1 Power Meter measurement method

- A transmitter antenna terminal of EUT was connected to the input of a RF power sensor.
- Measurement was performed while EUT was operating in continuous transmission mode at the appropriate center frequencies. i.e. the lowest = 2412MHz, middle = 2437MHz, and highest frequency = 2462MHz.

Table 3-1 : Test Instruments of power meter method

Description	Model	Serial Number
Power Meter	HP 437B	3043U03437
Power Sensor	HP 8481A	US41030582
Coax cables: - Power Sensor <=> EUT	Length: 20 cm Loss: 0.7dB (for 2.4GHz)	

Notes: - HP: Hewlett Packard

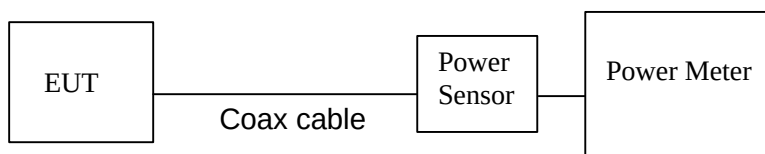


Figure 3-1: Measurement setup of power meter method

3.1.2 Spectrum Analyzer measurement method

The spectrum analyzer was connected to the antenna terminal, while EUT was operating in continuous transmission mode (shown in the Chapter C) at the appropriate center frequencies.

The spectrum analyzer was set to :

VBW= 30kHz, RBW=1MHz,

Span=30-40MHz encompassing the entire 6 dB emission bandwidth of the transmission signal,

Mode= sample detector, Trigger= free run

The band power measurement function was used to measure the peak power of each transmission mode selected by the step 3.1.1. The analyzer computed the peak power by integrating the spectrum across the 6 dB emission bandwidth given by the previous chapter.

The test instruments and setup configuration are the same as the Table 1-1 and Figure 1.

3.2 Measurement Results

Test Date: May 23, 2003

Table 3-2-1. Power meter measurement results (EUT: M/T 2373-GEU, s/n ZZ-02250)

Operation Frequency [GHz]	Rated output power (conducted) [dBm]							
	6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	48M bps	54M bps
2.412 (Main)	13.32	13.46	13.54	13.56	13.47	12.92	-	-
Specification	14						13.5	11.5
2.437 (Main)	16.45	16.52	16.63	16.65	16.45	-	-	-
Specification	17					15.5	13.5	11.5
2.462 (Main)	12.87	12.95	13.05	13.07	13.00	12.59	-	-
Specification	14						13.5	11.5

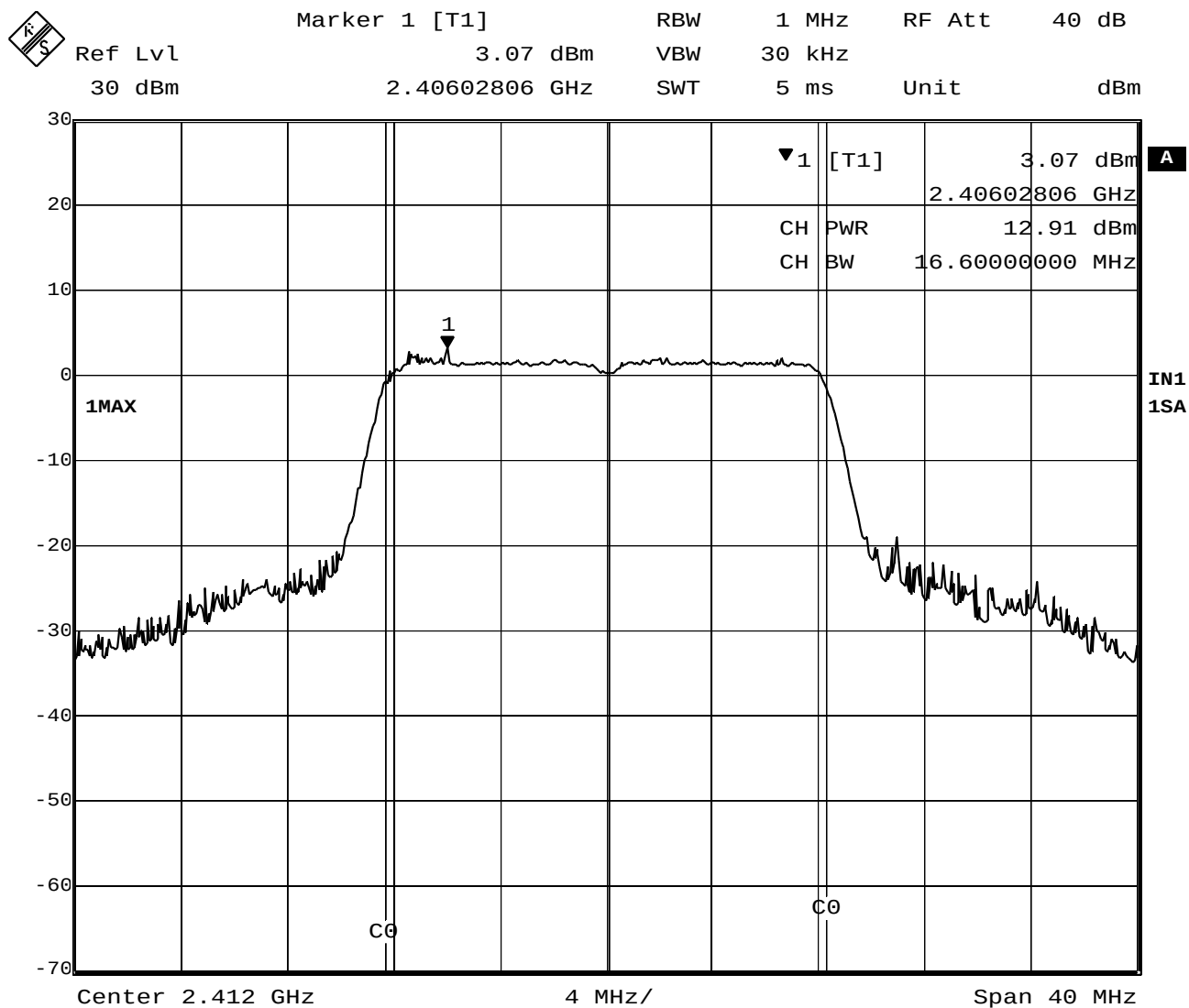
[Calculation table]

Measured Frequency (MHz)	Power Meter Reading (dBm)	Cable Loss (dB)	Results (dBm)	Limit		Margin to limit (dBi)
				FCC (dBm)	IC (dBm)	
2412 (ch. 1)	13.57	0.7	14.27	30	30	15.73
2437 (ch. 6)	16.38	0.7	17.08			12.92
2462 (ch.11)	13.02	0.7	13.72			16.28

Table 3-2-2. Spectrum analyzer measurement results (EUT: M/T 2373-GEU, s/n ZZ-02250)

Measured Frequency (MHz)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	Results (dBm)	Limit		Margin to limit (dBi)
					FCC (dBm)	IC (dBm)	
2412 (ch. 1)	12.91	Plot 3-1	1.3	14.21	30	30	15.79
2437 (ch. 6)	15.75	Plot 3-2	1.3	17.05			12.95
2462 (ch.11)	12.37	Plot 3-3	1.3	13.67			16.33

3.3 Trace Data of Conducted Peak Output Power

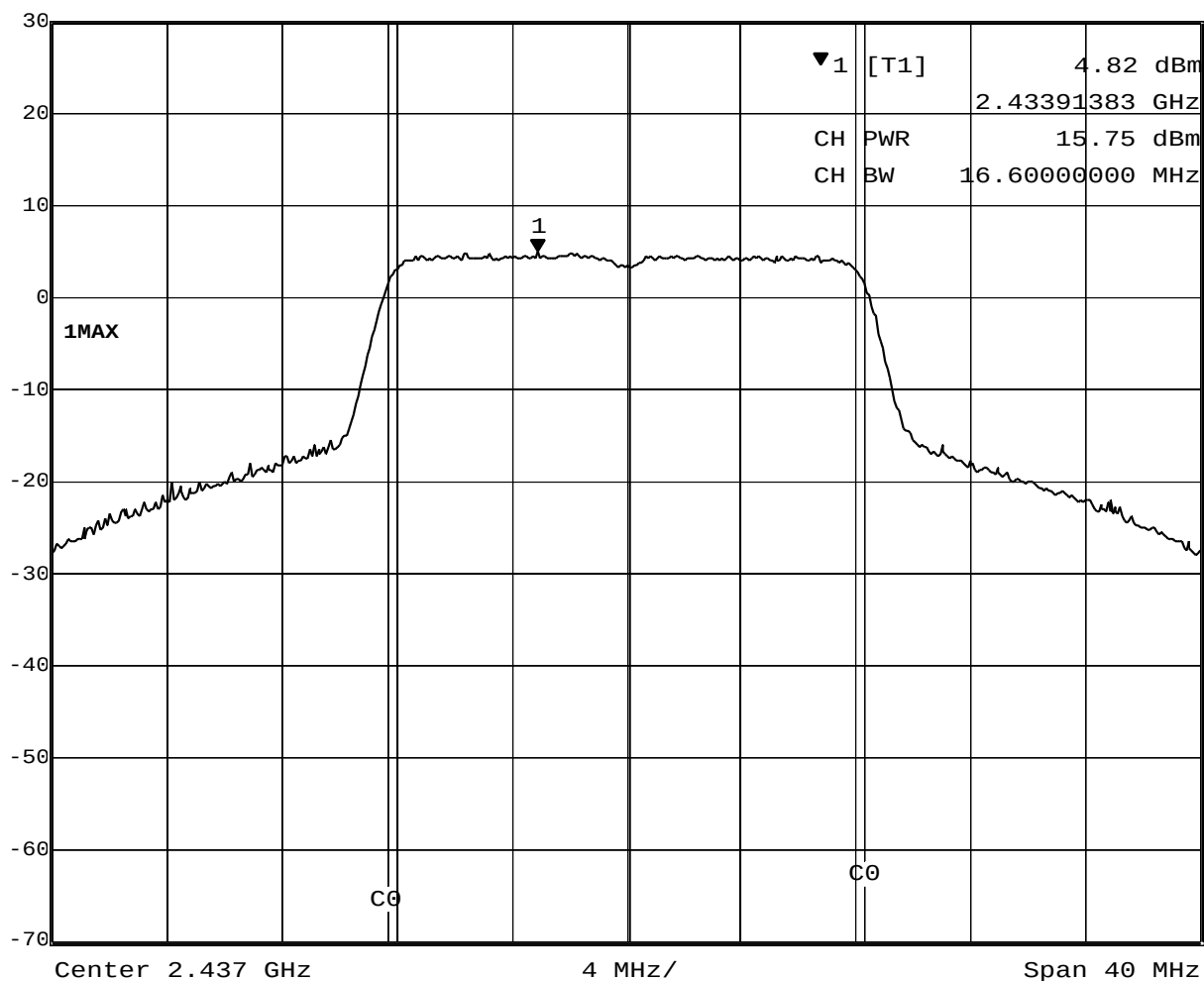


Date: 23.MAY.2003 12:47:41

Plot 3-1. Conducted Peak Output Power of 2412MHz



Marker 1 [T1] RBW 1 MHz RF Att 40 dB
Ref Lvl 4.82 dBm VBW 30 kHz
30 dBm 2.43391383 GHz SWT 5 ms Unit dBm

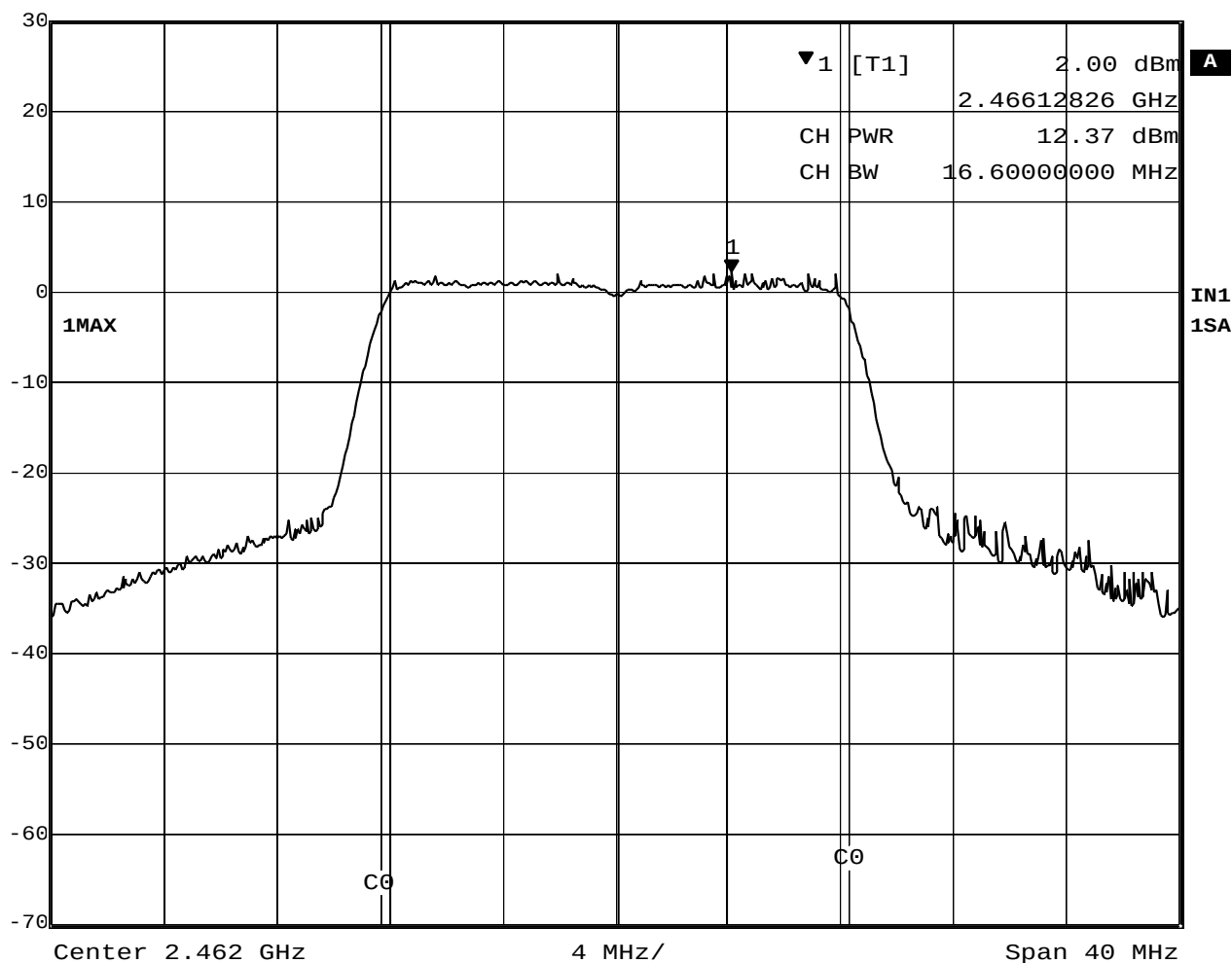


Date: 23.MAY.2003 12:58:59

Plot 3-2. Conducted Peak Output Power of 2437MHz



Marker 1 [T1] RBW 1 MHz RF Att 40 dB
Ref Lvl 2.00 dBm VBW 30 kHz
30 dBm 2.46612826 GHz SWT 5 ms Unit dBm



Date: 23.MAY.2003 13:02:50

Plot 3-3. Conducted Peak Output Power of 2462MHz

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: May 23, 2003

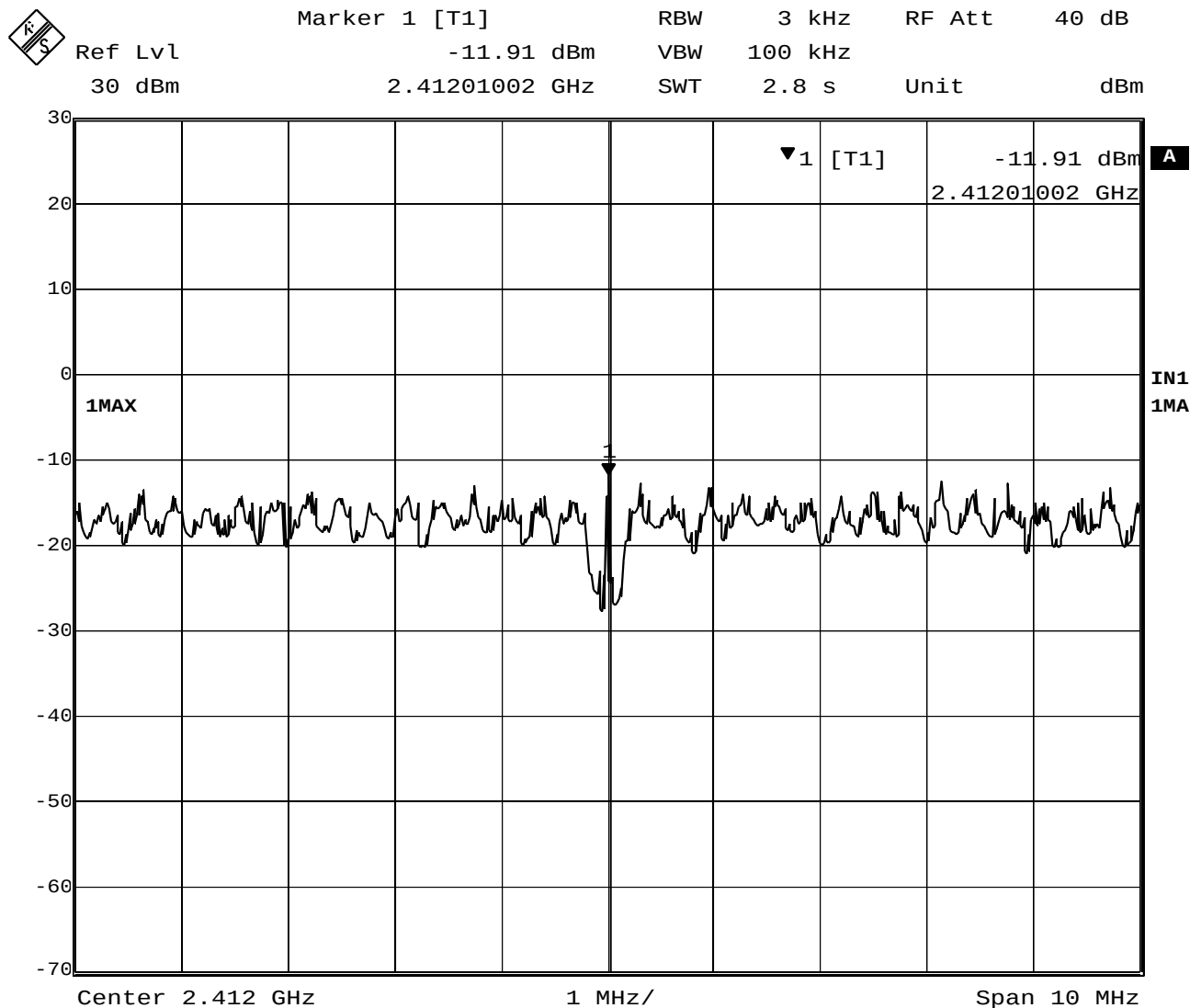
Table 4-1-1. EUT: M/T 2373-GEU, s/n ZZ-02250 , TX mode 6Mbps

Ch No.	Frequency (MHz)	Analyzer Reading (dBm)	Trace number	Cable loss (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
1	2412.01	-11.91	Plot 4-1	1.3	-10.6	8.0	18.6
6	2437.01	-8.38	Plot 4-2	1.3	- 7.1	8.0	15.1
11	2457.24	-12.12	Plot 4-3	1.3	-10.8	8.0	18.8

Table 4-1-2. EUT: M/T 2373-GEU, s/n ZZ-02250 , TX mode 18Mbps

Ch No.	Frequency (MHz)	Analyzer Reading (dBm)	Trace number	Cable loss (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
1	2412.01	-11.58	Plot 4-4	1.3	-10.3	8.0	18.3
6	2437.01	-7.38	Plot 4-5	1.3	- 6.1	8.0	14.1
11	2462.01	-10.53	Plot 4-6	1.3	- 9.2	8.0	17.2

4.4 Trace Data

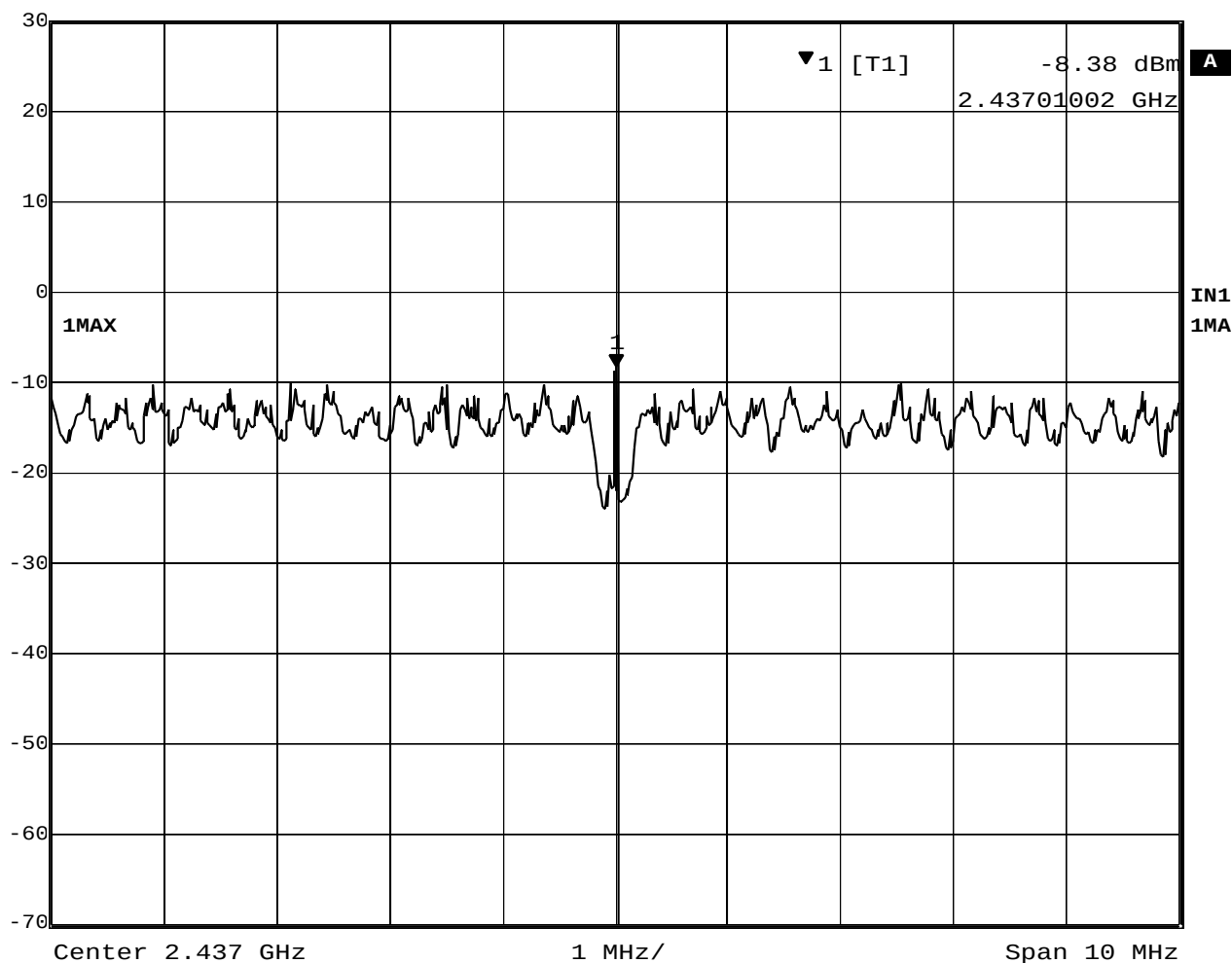


Date: 23.MAY.2003 14:16:20

Plot 4-1. Peak Power Spectral Density of 2412MHz (6Mbps)



Marker 1 [T1] RBW 3 kHz RF Att 40 dB
Ref Lvl -8.38 dBm VBW 100 kHz
30 dBm 2.43701002 GHz SWT 2.8 s Unit dBm

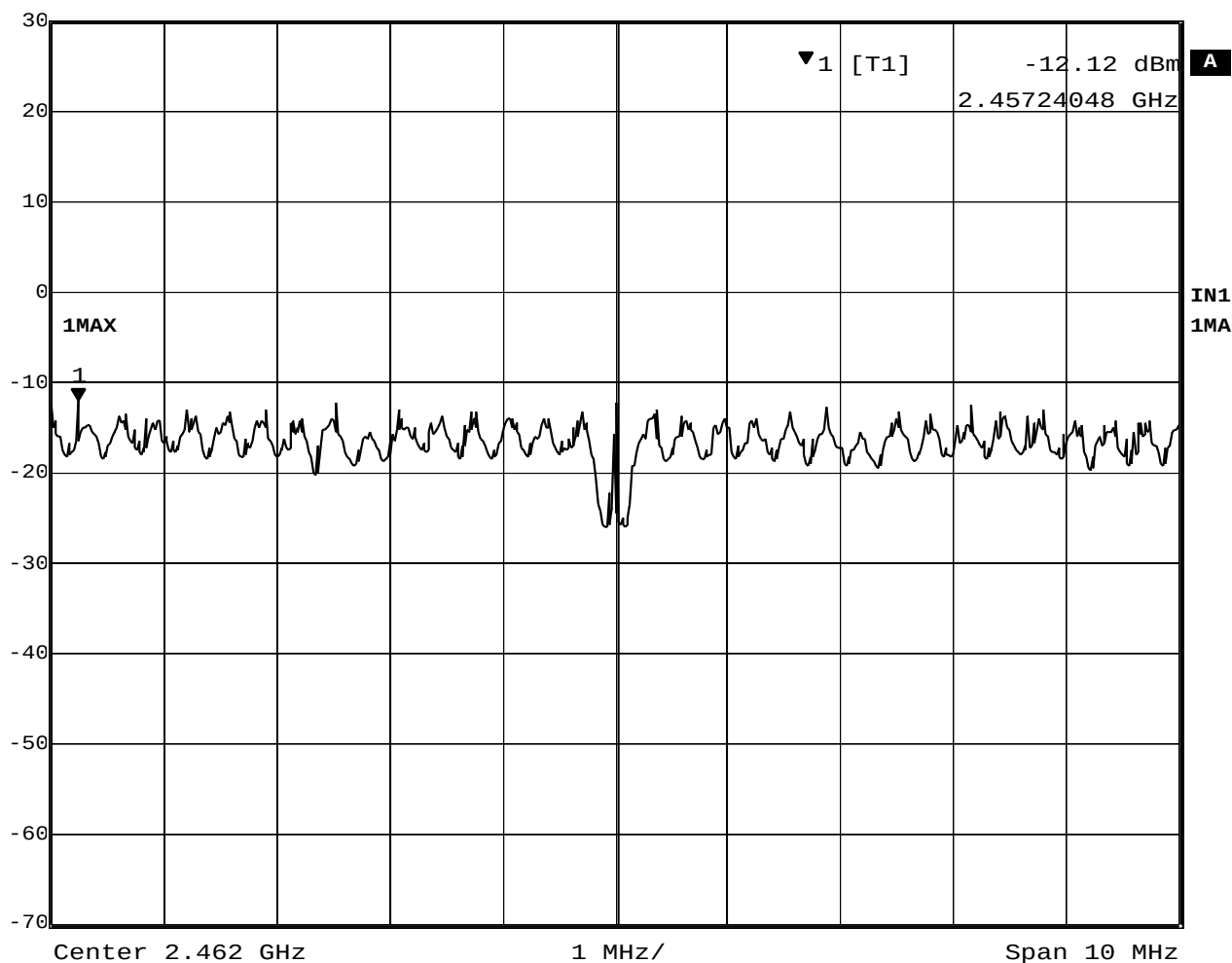


Date: 23.MAY.2003 14:18:57

Plot 4-2. Peak Power Spectral Density of 2437MHz (6Mbps)



Marker 1 [T1] RBW 3 kHz RF Att 40 dB
Ref Lvl -12.12 dBm VBW 100 kHz
30 dBm 2.45724048 GHz SWT 2.8 s Unit dBm

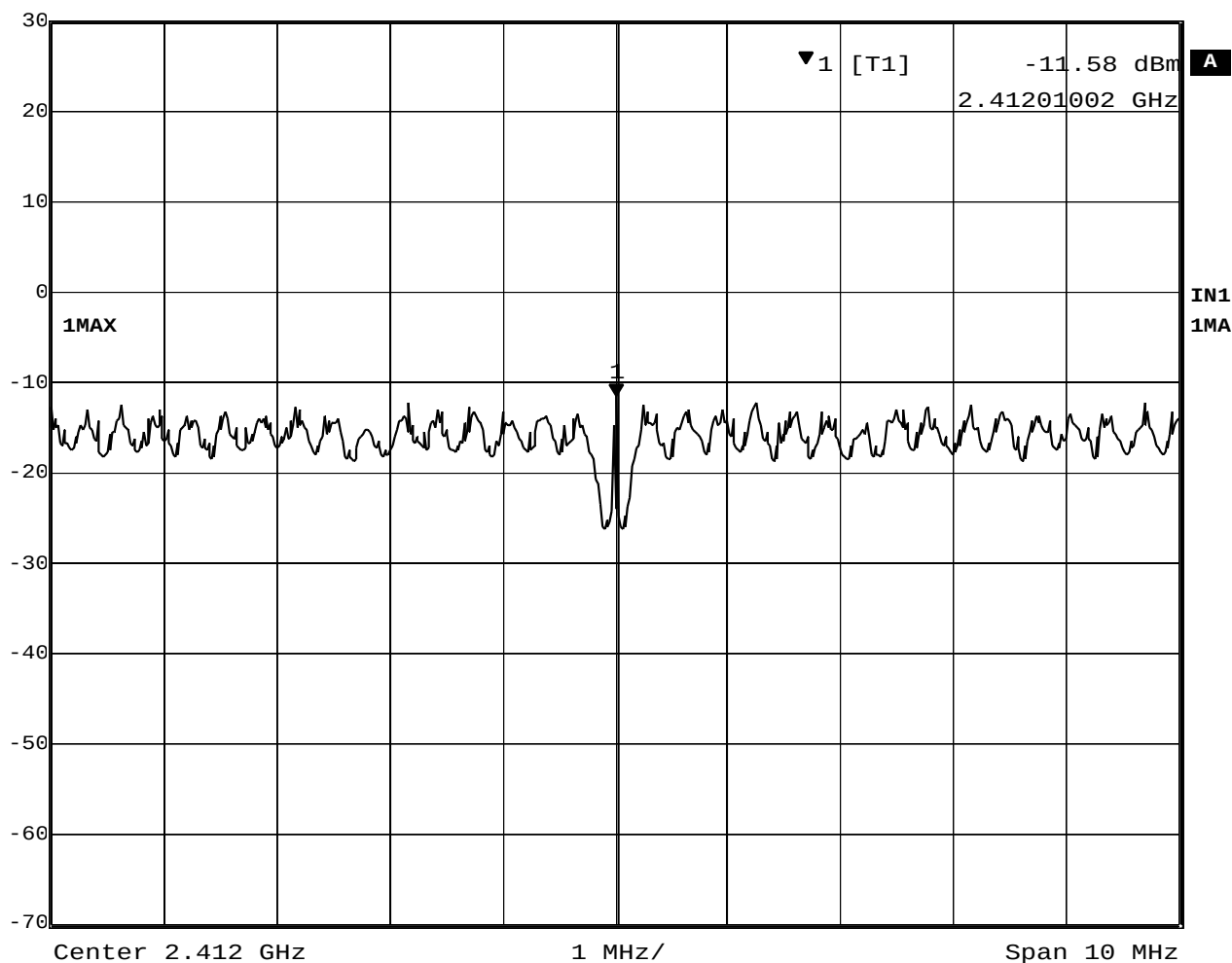


Date: 23.MAY.2003 14:23:23

Plot 4-3. Peak Power Spectral Density of 2462MHz (6Mbps)



Marker 1 [T1] RBW 3 kHz RF Att 40 dB
Ref Lvl -11.58 dBm VBW 100 kHz
30 dBm 2.41201002 GHz SWT 2.8 s Unit dBm

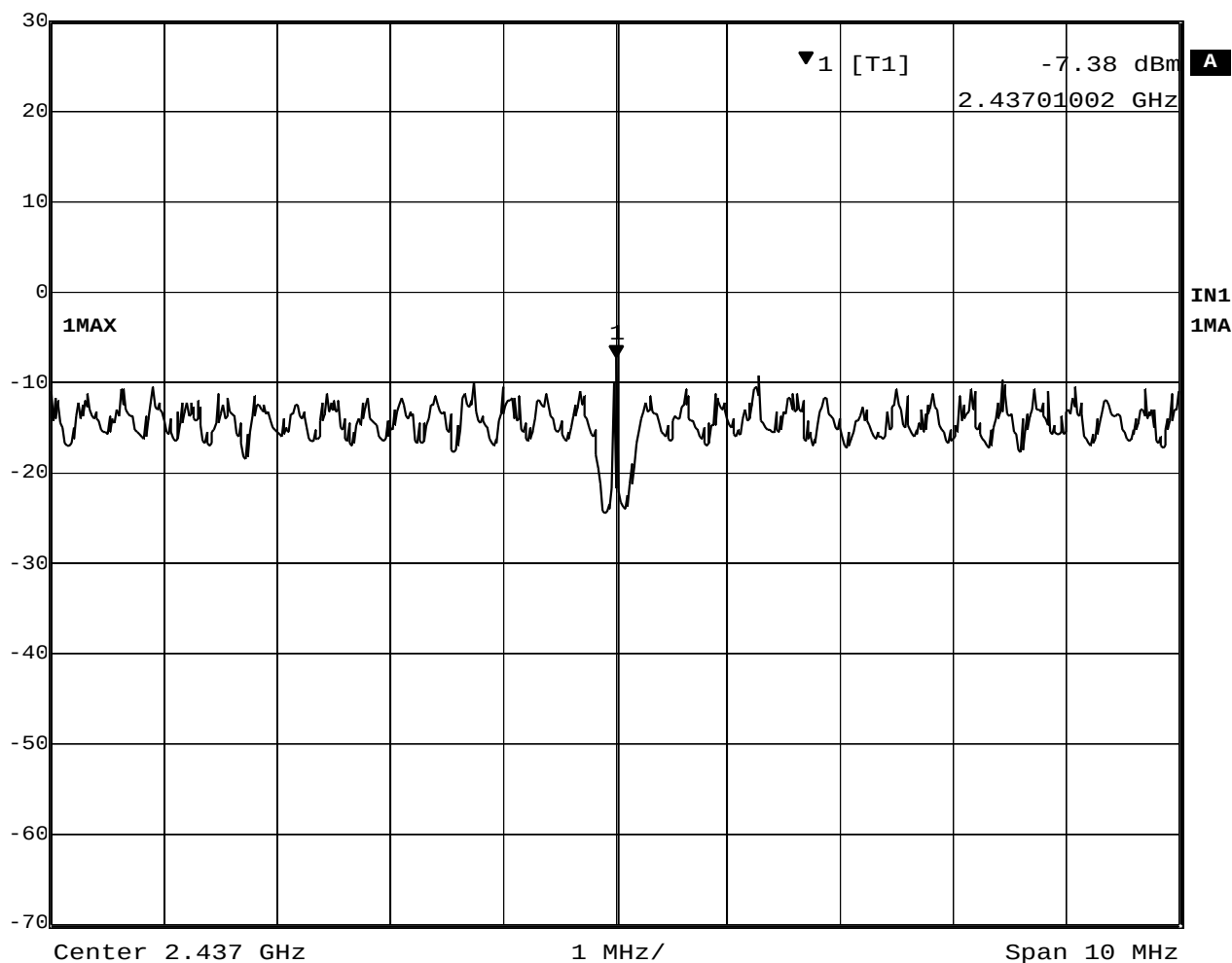


Date: 23.MAY.2003 14:15:20

Plot 4-4. Peak Power Spectral Density of 2412MHz (18Mbps)



Marker 1 [T1] RBW 3 kHz RF Att 40 dB
Ref Lvl -7.38 dBm VBW 100 kHz
30 dBm 2.43701002 GHz SWT 2.8 s Unit dBm

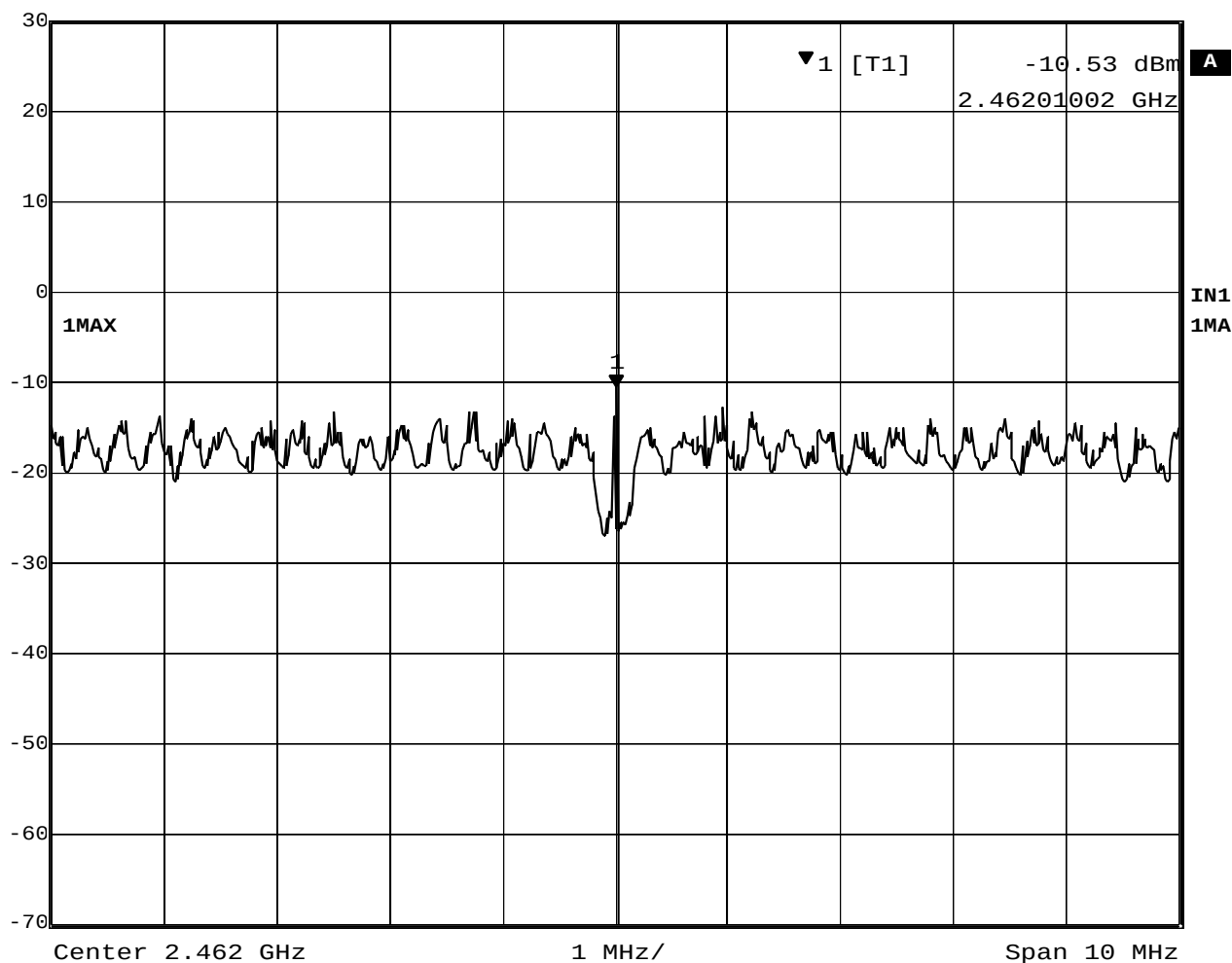


Date: 23.MAY.2003 14:18:08

Plot 4-5. Peak Power Spectral Density of 2437MHz (18Mbps)



Ref Lvl	Marker 1 [T1]	RBW	3 kHz	RF Att	40 dB
30 dBm	-10.53 dBm	VBW	100 kHz		
	2.46201002 GHz	SWT	2.8 s	Unit	dBm



Date: 23.MAY.2003 14:20:46

Plot 4-6. Peak Power Spectral Density of 2462MHz (18Mbps)

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: - Lisen-L <=> SW/Con.unit (SW100) - Lisen-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

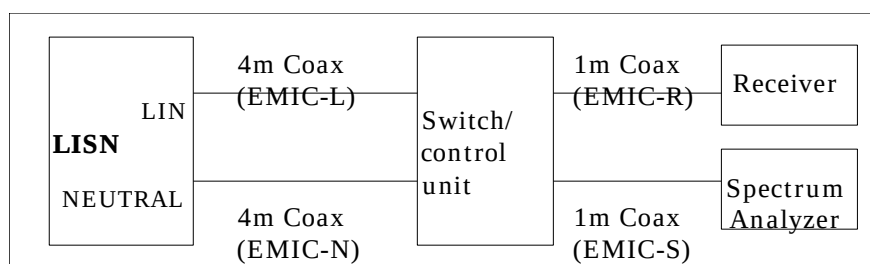


Figure 5. Cables for Conducted Emission Test

5.3 Powerline Voltage Calculation

The powerline voltage is calculated by adding insertion losses of LISN, Cable, Switch control unit and Pulse limiter to the measured reading. All factors are included in the reported data.

$$PV = R + CORR$$

where:

PV = Powerline Voltage (dBμV)

R = Measured Receiver Input Amplitude (dBμV)

CORR = Correction Factor (dB) = LL+CL+SWL+PLL

LL = Insertion loss of LISN (dB)

CL = Insertion loss of Cable (dB)

SWL = Insertion loss of Switch control unit (dB)

PLL = Insertion loss of Pulse Limiter (dB)

Given a Receiver input reading of 50.0 dBμV, LISN loss of 0.6 dB, Cable loss of 0.1dB, Switch control unit loss of 0.1dB and Pulse limiter loss of 0.2dB. The Powerline Voltage of the measured emission is:

$$CORR = 0.6 + 0.1 + 0.1 + 0.2 = 1.0 \text{ (dB)}$$

$$PV = 50.0 + 1.0 = 51.0 \text{ (dBμV)}$$

5.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 18.8dB. 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-GEU, s/n ZZ-02250, Ch.1(2412MHz) TX mode 18Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dB μ V)	CISPR22 AV Limit (dB μ V)	Phase
	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)			
0.1874	40.9	0.4	41.3	25.9	0.4	26.3	64.1	54.1	Line
0.2521	35.4	0.5	35.9	21.3	0.5	21.8	61.7	51.7	Line
0.3163	30.5	0.5	31.0	18.5	0.5	19.0	59.8	49.8	Line
0.4562	26.6	0.5	27.1	16.1	0.5	16.6	56.8	46.8	Line
0.5250	36.0	0.5	36.5	24.2	0.5	24.7	56.0	46.0	Line
0.5712	31.3	0.5	31.8	23.5	0.5	24.0	56.0	46.0	Line

Table 5-2-2. EUT: M/T 2373-GEU, s/n ZZ-02250 , Ch.6(2437MHz) TX mode 18Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dB μ V)	CISPR22 AV Limit (dB μ V)	Phase
	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)			
0.1875	39.9	0.4	40.3	25.6	0.4	26.0	64.1	54.1	Line
0.2510	34.0	0.5	34.5	19.5	0.5	20.0	61.7	51.7	Line
0.3903	29.1	0.5	29.6	21.2	0.5	21.7	58.1	48.1	Line
0.5235	36.7	0.5	37.2	25.8	0.5	26.3	56.0	46.0	Line
0.5711	31.4	0.5	31.9	24.9	0.5	25.4	56.0	46.0	Line
0.7190	27.6	0.5	28.1	17.4	0.5	17.9	56.0	46.0	Line

Table 5-2-3. EUT: M/T 2373-GEU, s/n ZZ-02250, Ch.11(2462MHz) TX mode 18Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dB μ V)	CISPR22 AV Limit (dB μ V)	Phase
	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)			
0.1890	40.5	0.4	40.9	26.2	0.4	26.6	64.1	54.1	Line
0.2517	34.3	0.5	34.8	20.2	0.5	20.7	61.7	51.7	Line
0.3164	29.3	0.5	29.8	17.9	0.5	18.4	59.8	49.8	Line
0.3801	26.5	0.5	27.0	18.4	0.5	18.9	58.3	48.3	Neutral
0.5233	36.7	0.5	37.2	25.9	0.5	26.4	56.0	46.0	Line
0.5713	31.6	0.5	32.1	24.3	0.5	24.8	56.0	46.0	Line

2) EUT in receiving mode

Table 5-2-4. EUT: M/T 2373-GEU, s/n ZZ-02250, Ch.6(2437MHz) RX mode

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dB μ V)	CISPR22 AV Limit (dB μ V)	Phase
	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)	Measured Reading (dB μ V)	Corr. Factor (dB)	Powerline Voltage (dB μ V)			
0.3785	27.4	0.5	27.9	20.8	0.5	21.3	58.3	48.3	Neutral
0.4567	31.6	0.5	32.1	21.5	0.5	22.0	56.8	46.8	Line
0.5221	33.7	0.5	34.2	23.5	0.5	24.0	56.0	46.0	Neutral
0.5857	32.4	0.5	32.9	23.2	0.5	23.7	56.0	46.0	Line
0.6539	32.4	0.5	32.9	21.2	0.5	21.7	56.0	46.0	Line
25.2228	28.4	1.8	30.2	22.2	1.8	24.0	60.0	50.0	Line

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 6868-30J	97-901X3
Spectrum Analyzer (100Hz-1.5GHz) for 30-200MHz	HP 85680B	2732A03651
Spectrum Analyzer Display for 30-200MHz	HP 85662A	2648A15255
Quasi-Peak Adapter for 30-200MHz	HP 85650A	2521A00968
Spectrum Analyzer (100Hz-1.5GHz) for 200-1000MHz	HP 85680B	2841A04242
Spectrum Analyzer Display for 200-1000MHz	HP 85662A	2816A16827
Quasi-Peak Adapter for 200-1000MHz	HP 85650A	2811A01126
Amplifier (100KHz-1.3GHz)		
- for 30-200MHz	HP 8447D	2805A02919
- for 200-1000MHz	HP 8447D	2727A05190
Biconical Antenna (30-200MHz)	EMCO 3108	2536
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	2849
Receiver (20MHz-1.3GHz)	R&S ESVP	892111/030
Switch/control unit	HP 3488A	2719A17226
N-Coax cables:	Length:	
- Bi-coni Ant <=> 10m Cable	9 m	- EM103L01
- 10m Cable <=> Shield Panel	10 m	- EM103L02
- Shield Panel <=> RF Amp	7 m	- EM103L03
- RF Amp <=> Power Splitter	0.5m	- EM103L04
- Log-peri Ant <=> 10m Cable	9 m	- EM103H01
- 10m Cable <=> Shield Panel	10 m	- EM103H02
- Shield Panel <=> RF Amp	7 m	- EM103H03
- RF Amp <=> Power Splitter	0.5m	- EM103H04
Coax cables:		
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM103L05
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM103L06
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM103H05
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM103H06
- SW/Con.unit <=> Receiver (Input)	2 m	- EM1RCV
- SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	2 m	- EM1SPL
- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM1SPH

Notes:

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

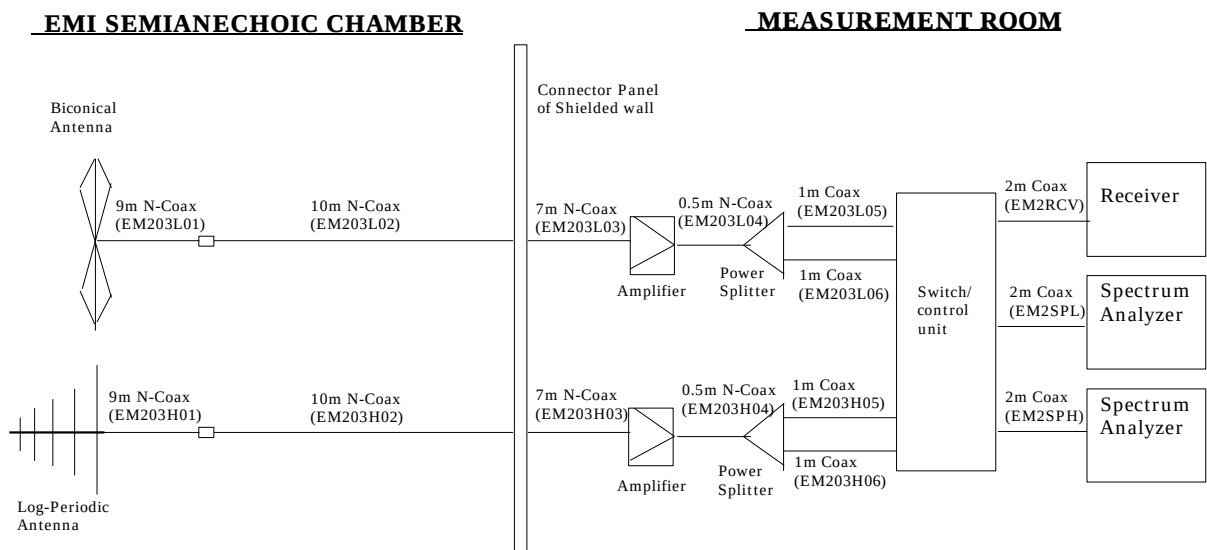


Figure 6 Cables for Radiated Emission Test

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 51.5dB μ V; 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:

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

Conversion between dB μ V/m (or dB μ V) and μ V/m (or μ V) are done as:

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

$$40\text{dB}\mu\text{V/m} = 100\mu\text{V/m}$$

$$48\text{dB}\mu\text{V/m} = 250\mu\text{V/m}$$

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 7.1 dB at 30MHz - 1000MHz band.

The 6 highest emissions relative to the limits are reported.

Test Date: June 27, 2003

1) EUT in transmission mode

Table 6-2-1. EUT: M/T 2373-GEU, s/n ZZ-02250, Ch.1(2412MHz) TX mode 18Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dB μ V)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dB μ V/m)	Limit (dB μ V/m)	Field Strength (μ V/m)	Limit (μ V/m)
30.001	V	34.1	13.2	-18.8	28.5	40.0	26.6	100
128.439	V	30.8	11.8	-16.9	25.7	43.5	19.3	150
200.452	V	33.9	11.4	-12.6	32.7	43.5	43.2	150
257.065	V	33.0	12.0	-14.7	30.3	46.0	32.7	200
430.847	V	24.1	15.8	-13.6	26.3	46.0	20.7	200
664.210	V	21.0	20.4	-12.1	29.3	46.0	29.2	200

Table 6-2-2. EUT: M/T 2373-GEU, s/n ZZ-02250, Ch.6(2437MHz) TX mode 18Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dB μ V)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dB μ V/m)	Limit (dB μ V/m)	Field Strength (μ V/m)	Limit (μ V/m)
30.135	V	33.8	13.2	-18.8	28.2	40.0	25.7	100
166.403	V	26.9	12.4	-16.3	23.0	43.5	14.1	150
200.452	H	37.2	11.4	-12.6	36.0	43.5	63.1	150
257.065	V	34.1	12.0	-14.7	31.4	46.0	37.2	200
431.171	V	24.7	15.8	-13.6	26.9	46.0	22.1	200
730.216	V	23.6	21.0	-11.1	33.5	46.0	47.3	200

Table 6-2-3. EUT: M/T 2373-GEU, s/n ZZ-02250, Ch.11(2462MHz) TX mode 18Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dB μ V)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dB μ V/m)	Limit (dB μ V/m)	Field Strength (μ V/m)	Limit (μ V/m)
33.117	V	31.5	12.8	-18.7	25.6	40.0	19.1	100
196.606	H	35.2	13.6	-15.8	33.0	43.5	44.7	150
200.452	H	36.4	11.4	-12.6	35.2	43.5	57.5	150
257.065	V	32.9	12.0	-14.7	30.2	46.0	32.4	200
497.529	V	20.3	17.7	-13.4	24.6	46.0	17.0	200
828.108	V	17.0	21.6	-9.7	28.9	46.0	27.9	200

2) EUT in receiving mode

Table 6-2-4. EUT: M/T 2373-GEU, s/n ZZ-02250, RX mode

Frequency (MHz)	Polarity (H/V)	Measured (dB μ V)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dB μ V/m)	Limit (dB μ V/m)	Field Strength (μ V/m)	Limit (μ V/m)
32.851	V	34.8	12.8	-18.8	28.8	40.0	27.5	100
198.340	H	30.4	13.7	-15.9	28.2	43.5	25.7	150
200.452	H	37.6	11.4	-12.6	36.4	43.5	66.1	150
257.065	V	34.0	12.0	-14.7	31.3	46.0	36.7	200
400.504	V	31.4	15.3	-14.3	32.4	46.0	41.7	200
661.904	V	21.0	20.3	-12.2	29.1	46.0	28.5	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 100Hz or 10Hz. 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 (1-18GHz)	HP 8449B	3008A00582
Amplifier (18-25GHz)	Agilent 83051A	3950M00193
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:	Length:	
- Horn Ant <=> RF Amp. (1-18GHz)	6 m	- EM206SCO
- RF Amp.<=>Spectrum Analyzer (1-18GHz)	16 m	- GEM0101
- Horn Ant <=> RF Amp. (18-25GHz)	3m	- SF102-20167
- RF Amp.<=>Spectrum Analyzer (18-25GHz)	1m	- SF102-21105

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

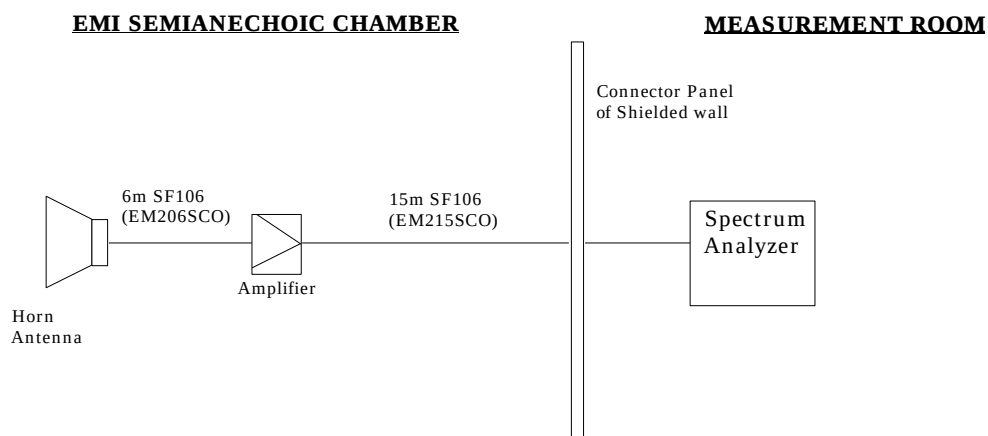


Figure 7-1. Cables for Radiated Emission Test (1-18GHz)

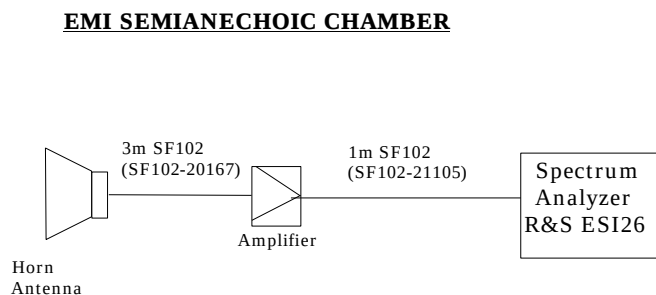


Figure 7-2. Cables for Radiated Emission Test (18 - 25GHz)

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 dB μ V; 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:

$$FS = 51.5 + 8.5 + 1.3 - 26 - 0.0 = 35.6 \text{ dB}\mu\text{V/m}$$

Conversions between dB μ V/m (or dB μ V) and μ V/m (or μ V) are done as :

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

$$40 \text{ dB}\mu\text{V/m} = 100 \mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250 \mu\text{V/m}$$

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 0.8 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: June 26, 30 and July 2, 2003

1) EUT in transmission mode

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

Table 7-2-1. EUT: M/T 2373-GEU, s/n ZZ-02250, Ch.1(2412MHz) TX mode 18Mbps

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)
Inband 2.415	H	111.8	99.1	28.3	-29.6	0.0	110.5	OB*	97.8	OB*
Adjacent RB 2.368	H	54.8	-	28.1	-29.6	0.0	53.3	74.0	-	54.0
2.390	H	73.3	54.6	28.2	-29.6	0.0	71.9	74.0	53.2	54.0
1.001	V	48.5	-	24.1	-32.3	0.0	40.3	74.0	-	54.0
1.163	V	50.3	-	24.6	-31.7	0.0	43.2	74.0	-	54.0
1.198	V	52.6	-	25.2	-31.6	0.0	46.2	74.0	-	54.0
1.331	V	54.9	-	25.2	-31.3	0.0	48.8	74.0	-	54.0
2.278	H	50.5	-	27.8	-29.8	0.0	48.5	74.0	-	54.0
2.357	H	55.7	44.3	28.1	-29.6	0.0	54.2	74.0	42.8	54.0
4.832	H	39.7	-	27.0	-27.1	0.0	39.6	74.0	-	54.0

Table 7-2-2. EUT: M/T 2373-GEU, s/n ZZ-02250, Ch.6(2437MHz) TX mode 18Mbps

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)
Inband 2.441	H	114.8	103.0	28.4	-29.6	0.0	113.6	OB*	101.8	OB*
Adjacent RB 2.368	H	58.4	47.8	28.1	-29.6	0.0	56.9	74.0	46.3	54.0
2.484	H	58.9	47.0	28.4	-29.6	0.0	57.7	74.0	45.8	54.0
2.496	H	59.4	52.6	28.4	-29.6	0.0	58.2	74.0	51.4	54.0
1.001	V	51.6	-	24.1	-32.3	0.0	43.4	74.0	-	54.0
1.130	V	49.6	-	24.6	-31.8	0.0	42.4	74.0	-	54.0
1.224	V	49.7	-	25.2	-31.5	0.0	43.4	74.0	-	54.0
1.328	V	55.0	-	25.6	-31.3	0.0	49.3	74.0	-	54.0
2.274	H	48.9	-	27.8	-29.8	0.0	46.9	74.0	-	54.0
2.318	H	50.9	-	28.0	-29.7	0.0	49.2	74.0	-	54.0
2.337	H	51.7	-	28.1	-29.6	0.0	50.2	74.0	-	54.0
4.878	H	42.4	-	27.0	-27.0	0.0	42.4	74.0	-	54.0
7.316	V	47.2	-	29.8	-24.8	0.0	52.2	74.0	-	54.0

Table 7-2-3. EUT: M/T 2373-GEU, s/n ZZ-00163, Ch.11(2462MHz) TX mode 18Mbps

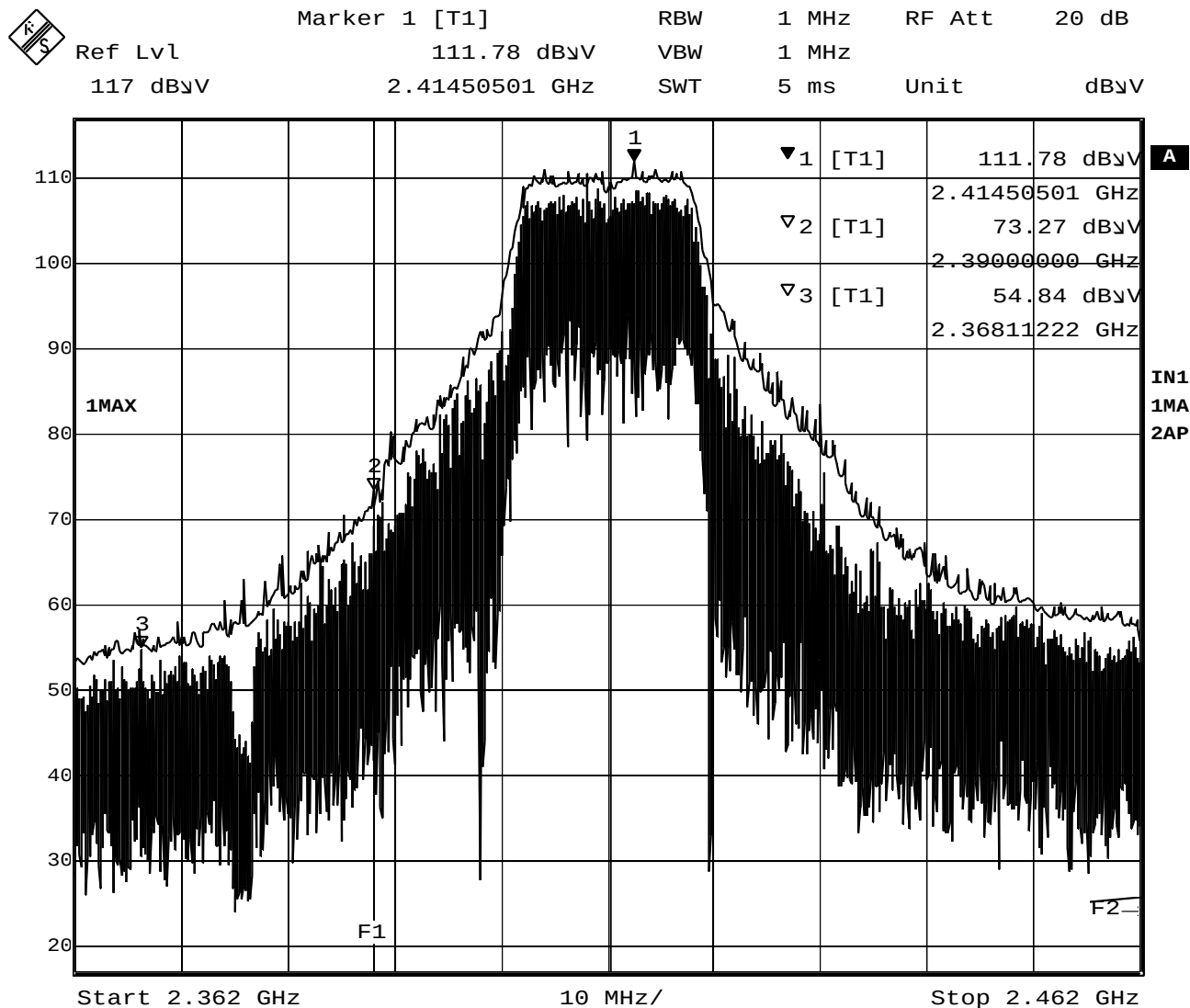
Frequency (GHz)	Polarity (H/V)	Measured (dB μ V) (<i>peak</i>)	Measured (dB μ V) (<i>average</i>)	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dB μ V/m) (<i>peak</i>)	FCC Limit (dB μ V/m) (<i>peak</i>)	Field Strength (dB μ V/m) (<i>average</i>)	FCC Limit (dB μ V/m) (<i>average</i>)
Inband 2.458	H	112.1	99.6	28.4	-29.6	0.0	110.9	OB*	98.4	OB*
Adjacent RB 2.484	H	72.8	54.1	28.4	-29.6	0.0	71.6	74.0	52.9	54.0
2.496	H	60.0	51.7	28.4	-29.6	0.0	58.8	74.0	50.5	54.0
1.000	V	57.1	-	24.1	-32.3	0.0	48.9	74.0	-	54.0
1.180	V	51.9	-	24.9	-31.6	0.0	45.2	74.0	-	54.0
1.328	V	55.0	-	25.6	-31.3	0.0	49.3	74.0	-	54.0
1.492	V	50.6	-	25.5	-30.9	0.0	45.2	74.0	-	54.0
2.274	H	48.1	-	27.8	-29.8	0.0	46.1	74.0	-	54.0
2.337	H	52.7	-	28.1	-29.6	0.0	51.2	74.0	-	54.0
2.369	H	54.2	-	28.1	-29.6	0.0	52.7	74.0	-	54.0
2.389	H	54.4	-	28.2	-29.6	0.0	53.0	74.0	-	54.0
4.922	H	43.0	-	27.0	-27.0	0.0	43.0	74.0	-	54.0
7.384	V	41.0	-	29.8	-24.9	0.0	45.9	74.0	-	54.0

2) EUT in receiving mode

Table 7-2-4. EUT: M/T 2373-GEU, s/n ZZ-02250, Ch.6(2437MHz) RX mode

Frequency (GHz)	Polarity (H/V)	Measured (dB μ V) (<i>peak</i>)	Measured (dB μ V) (<i>average</i>)	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dB μ V/m) (<i>peak</i>)	FCC Limit (dB μ V/m) (<i>peak</i>)	Field Strength (dB μ V/m) (<i>average</i>)	FCC Limit (dB μ V/m) (<i>average</i>)
1.001	V	50.0	-	24.1	-32.3	0.0	41.8	74.0	-	54.0
1.175	V	49.6	-	24.9	-31.6	0.0	42.9	74.0	-	54.0
1.331	V	54.1	-	25.6	-31.3	0.0	48.4	74.0	-	54.0
1.495	V	49.6	-	25.5	-30.9	0.0	44.2	74.0	-	54.0

7.5 Measurement plots of adjacent restricted band

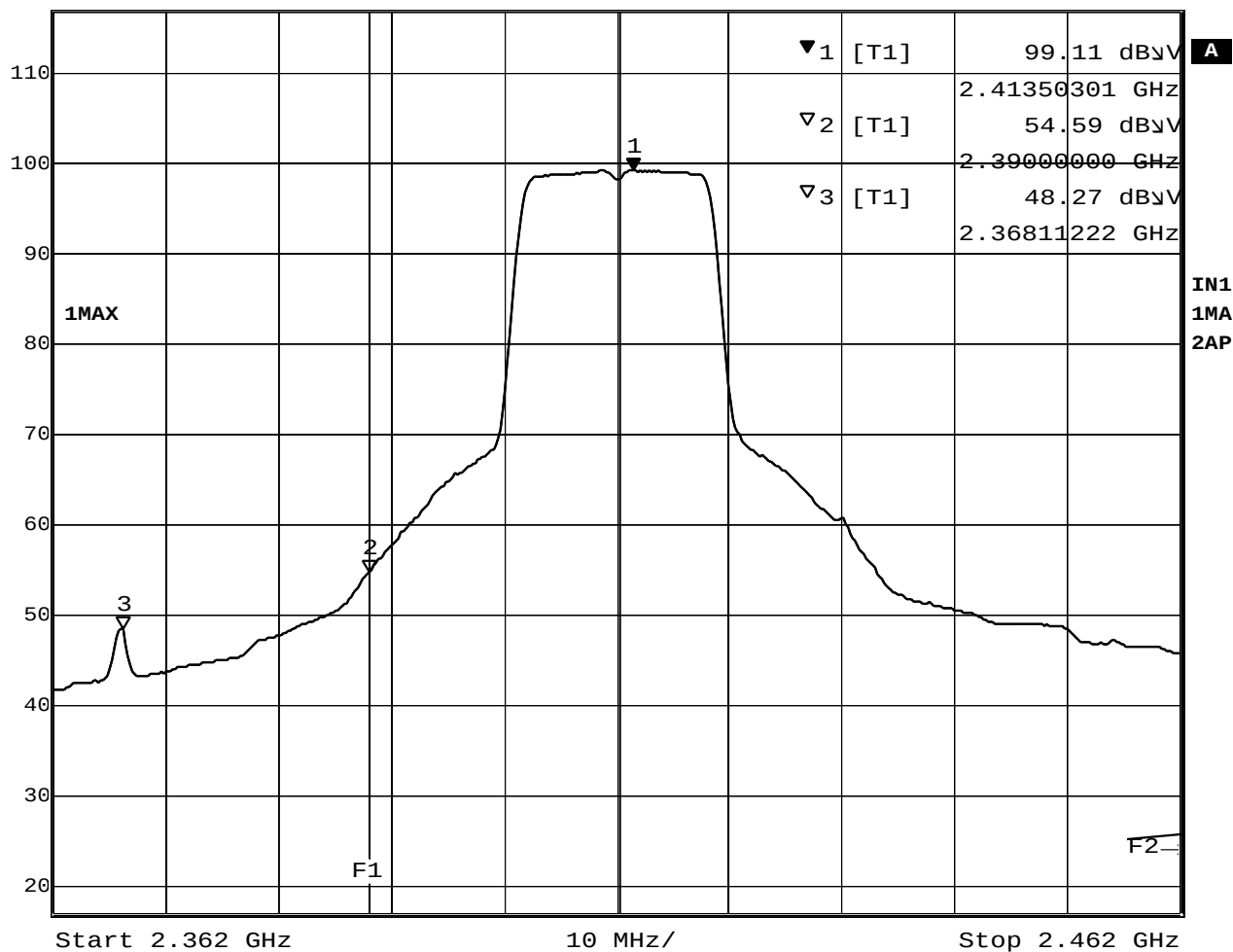


Date: 26.JUN.2003 11:24:56

Plot 7-2-1 Ch.1 2412MHz TX 18Mb/s (Peak)



Marker 1 [T1] RBW 1 MHz RF Att 20 dB
Ref Lvl 99.11 dBμV VBW 10 Hz
117 dBμV 2.41350301 GHz SWT 25 s Unit dBμV

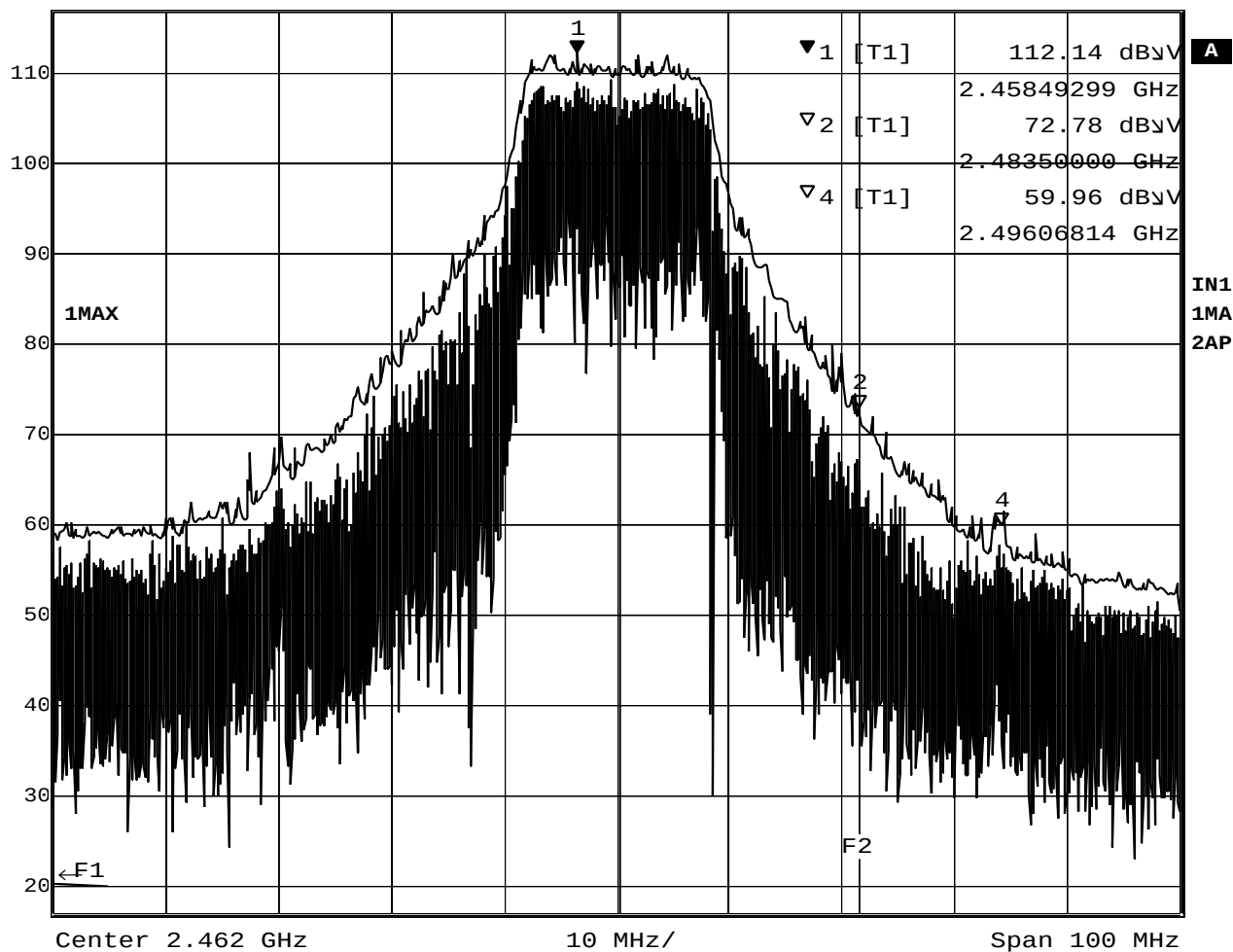


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Plot 7-2-2 Ch.1 2412MHz TX18Mb/s (Average)



Marker 1 [T1] RBW 1 MHz RF Att 20 dB
Ref Lvl 112.14 dBμV VBW 1 MHz
117 dBμV 2.45849299 GHz SWT 5 ms Unit dBμV

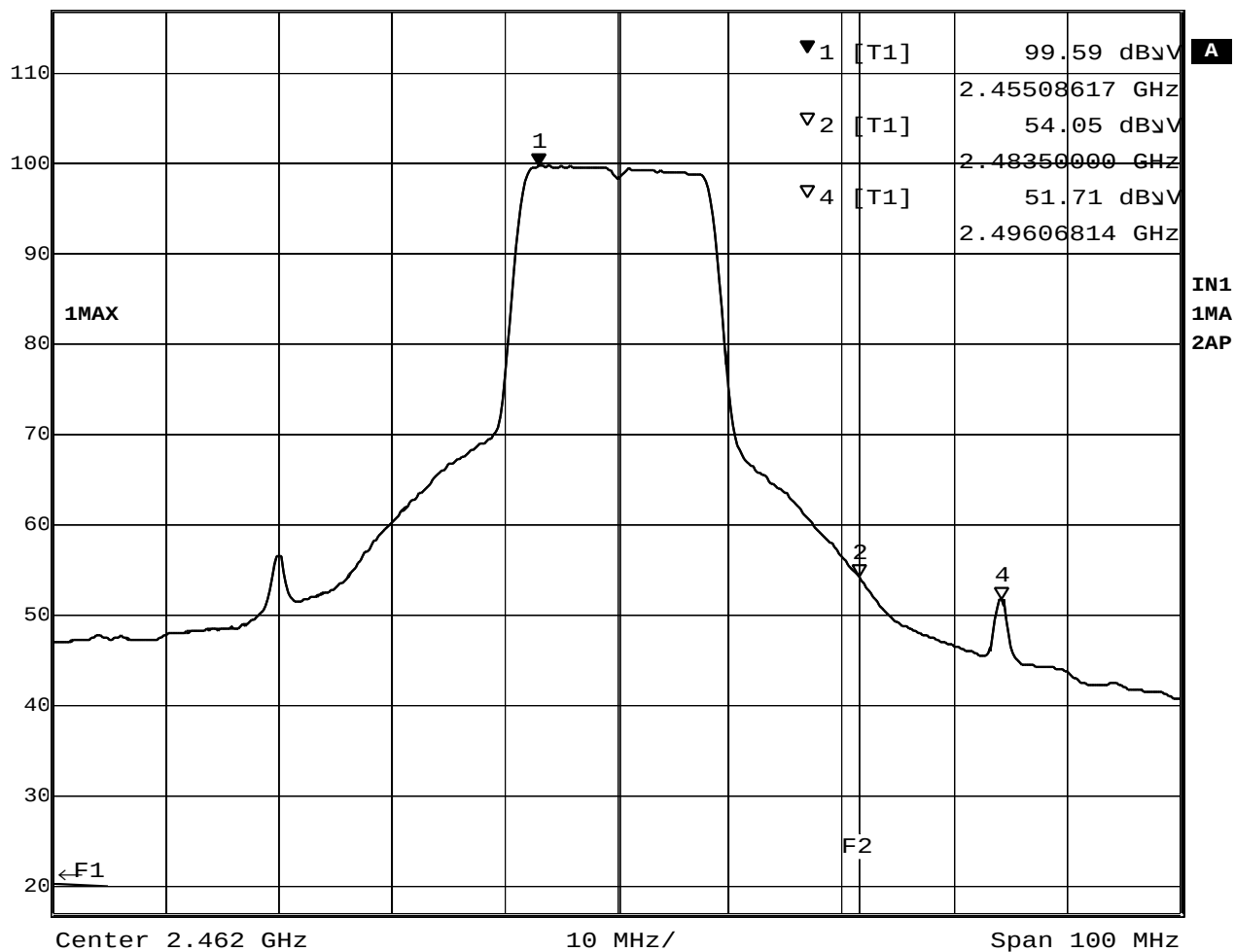


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Plot 7-2-3 Ch.11 2462MHz TX 18Mb/s (Peak)



Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	20 dB
117 dBμV	99.59 dBμV	VBW	10 Hz		
	2.45508617 GHz	SWT	25 s	Unit	dBμV



Date: 26.JUN.2003 11:50:19

Plot 7-2-4 Ch.11 2462MHz TX 18Mb/s (Average)