

Emission Test Report
Standard: FCC Part 15 Subpart C / IC RSS-210
Class II Permissive change

Document Number : FCC 19-0221-0

Product: IBM integrated Bluetooth with 56K Modem

measured with **IBM ThinkPad T40 Series**

FCC ID: ANO20020100MTN
IC: 349E-BMDC200

January 20, 2003

**Prepared :
EMC Staff Engineer**

Takeshi Asano

Signature: 
IBM Japan, Ltd.
EMC Engineering
LAB-S59

**1623-14, Shimotsuruma,
Yamato-shi Kanagawa-ken 242, Japan
Phone: +81-46-215-4779
Fax: +81-46-273-7420
E-Mail: asano@jp.ibm.com**

**Reviewed and Checked :
EMC Staff Engineer**

Toshiya Murota

Signature: 
IBM Japan, Ltd.
EMC Engineering
LAB-S59

**1623-14, Shimotsuruma,
Yamato-shi Kanagawa-ken 242, Japan
Phone: +81-46-215-6574
Fax: +81-46-273-7420
E-Mail: murota@jp.ibm.com**

**Approved :
Manager, EMC Engineering**

Akihisa Sakurai

Signature: 
IBM Japan, Ltd.
EMC Engineering
LAB-S59

**1623-14, Shimotsuruma,
Yamato-shi Kanagawa-ken 242, Japan
Phone: +81-46-215-2613
Fax: +81-46-273-7420
E-Mail: akihisa@jp.ibm.com**

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

**IBM integrated Bluetooth with 56K Modem
with ThinkPad T40 Series
Host PC Machine Type: 2373/2374/2375/2376**

FCC ID : ANO20020100MTN

January 20, 2003

This report concerns: (check one)

Original Grant _____

Class I change _____

Class II change ✓

Equipment type: Wireless LAN device

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).

Yes 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. TEST INSTRUMENTS	8
E. MEASUREMENT UNCERTAINTY.....	9
F. TEMPERATURE AND HUMIDITY	9
G. RELATED SUBMITTAL(S)/GRANT(S)/NOTES.....	9
1. CARRIER FREQUENCY SEPARATION.....	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. NUMBER OF HOPPING FREQUENCIES.....	12
2.1 TEST PROCEDURE.....	12
2.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	12
2.3 MEASUREMENT RESULTS.....	12
2.4 TRACE DATA.....	13
3. 20 DB BANDWIDTH.....	17
3.1 TEST PROCEDURE.....	17
3.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	17
3.3 MEASUREMENT RESULTS.....	17
3.4 TRACE DATA.....	18
4. TIME OF OCCUPANCY (DWEIL TIME)	23
4.1 TEST PROCEDURE.....	23
4.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	23
4.3 MEASUREMENT RESULTS.....	23
4.4 TRACE DATA.....	24
5. PEAK OUTPUT POWER.....	30
5.1 TEST PROCEDURE.....	30
5.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	30
5.3 MEASUREMENT RESULTS.....	30
5.4 TRACE DATA.....	31
6. BAND-EDGE (AT 20 DB BLOW).....	36
6.1 TEST PROCEDURE.....	36
6.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	36
6.3 MEASUREMENT RESULTS.....	36
6.4 TRACE DATA.....	37

7. OUT OF BAND EMISSIONS.....	39
7.1 TEST PROCEDURE.....	39
7.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	39
7.3 MEASUREMENT RESULTS.....	39
7.4 TRACE DATA.....	40
8. TRANSMITTER POWER SPECTRAL DENSITY	43
8.1 TEST PROCEDURE.....	43
8.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	43
8.3 MEASUREMENT RESULTS.....	43
8.4 TRACE DATA.....	44
9. AC WIRELINE CONDUCTED EMISSIONS (150 KHZ – 30 MHZ)	46
9.1 TEST PROCEDURE.....	46
9.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	46
9.3 MEASUREMENT RESULTS.....	47
10. RESTRICTED BANDS RADIATIONS (30 MHZ – 1 GHZ)	49
10.1 TEST PROCEDURE.....	49
10.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....	49
10.3 FIELD STRENGTH CALCULATION.....	51
10.4 MEASUREMENT RESULTS.....	52
11. RESTRICTED BANDS RADIATIONS (1 GHZ – 25 GHZ)	54
11.1 TEST PROCEDURE.....	54
11.2 TEST INSTRUMENTS AND MEASUREMENT.....	54
11.3 FIELD STRENGTH CALCULATION.....	55
11.4 MEASUREMENT RESULTS.....	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 Integrated Bluetooth with 56K Modem
 FCC ID : ANO20020100MTN
 IC Certification Number : 349E-BMDC200
 SERIAL NUMBER : 5A2-T2094
 PHYSICAL CONDITION : Preproduction
 KIND OF EQUIPMENT : DTS: Bluetooth modular device
 TESTED DATE : November 28, December 2, 18, 2002 and January 9, 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 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 Integrated Bluetooth with 56K Modem (s/n 5A2-T2094)	FCC ID: ANO20020100MTN IC:349E-BMDC200	Applying modular transmitter Built_in type Bluetooth card without antenna
ThinkPad T40 Series M/T 2373-92U (s/n ZZ-00129)	N/A	Host equipment IBM Notebook PC with built_in antenna CPU: Intel® Pentium® M Processor, 1.6GHz
P/N 02K6746	N/A	Universal AC adapter 72W, Unshielded power cord

B. Summary of Test Results

Table-B presents the list of the measurement items for Spread Spectrum, Direct Sequence devices under FCC Part 15 Subpart C and Industry Canada RSS-210.

The section numbers of upper portion are showing FCC number, and the other (lower) ones are for IC.

Table-B List of the measurements

Section(s)	Test Items		Condition	Result
	Transmit mode (TX):			
15.247(a)(1) 6.2.2(o)(a1)	Carrier Frequency Separation	min. 25 kHz	Conducted	Pass
15.247(a)(1) 6.2.2(o)(a3)	Number of Hopping Frequencies	at least 75 hops		Pass
	20 dB Bandwidth	max. 1 MHz		Pass
	Dwell Time	0.4 seconds within a 30 second period per any frequency		Pass
15.247(f) 6.2.2 (o)(c2)	Hybrid Dwell Time	0.4 seconds within a 12.8 second (32 hops × 0.4sec) period		Pass
15.247(b)(1) 6.2.2(o)(a3)	Peak output power	Shall not exceed 1.0 W.		Pass
15.247(c) 5.9.1 6.2.2 (o) (e1)	Band-edge (or Occupied BW for IC)	$2400 \text{ MHz} \leq \chi \leq 2483.5 \text{ MHz}$		Pass
	Out of Band Emissions (Bandwidth at 20 dB blow)	The radiated emission to any 100 kHz of outband shall be at least 20 dB below the highest inband spectral density.		Pass
15.247(f) 6.2.2 (o)(c2)	Transmitter power spectral density for Hybrid System	Shall not be greater than 8 dBm in any 3 kHz band.		Pass
15.207 6.6	AC Wireline Conducted emissions 150 kHz – 30 MHz	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 / 6.3	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Shall not exceed the limits specified in FCC 15.209, or RSS-210, Table 3.	Radiated (30M -1GHz)	Pass
			Radiated (1G –25GHz)	Pass
	Receive mode (RX):			
15.207 7.4	AC Wireline Conducted Emissions 150 kHz – 30 MHz	Class B: Freq.(MHz) QP(dBμV) Ave.(dBμV) 0.15 - 0.5 66 - 56 56 - 46 0.5 - 5 56 46 5 - 30 60 50	Conducted	Pass
15.209 7.3	General Field Strength Limits (Radiated Emission Limits)	Shall not exceed the limits specified in FCC 15.209, or RSS-210, Table 3.	Radiated (30M -1GHz)	Pass
			Radiated (1G –25GHz)	Pass

C. Operation Mode of EUT

All tests were performed using the “BlueTest version 1.4” and “BlueChat version 2.2”.

Hopping channels

The applying wireless card is designed to the Bluetooth Standard. The lowest hopping frequency is 2402MHz, and the highest one 2480MHz. Total 79 hopping channels are used with each 1MHz of channel spacing.

Ch.	Operation Frequency [GHz]	Ch.	Operation Frequency [GHz]	Ch.	Operation Frequency [GHz]	Ch.	Operation Frequency [GHz]
1	2.402	21	2.422	41	2.442	61	2.462
2	2.403	22	2.423	42	2.443	62	2.463
3	2.404	23	2.424	43	2.444	63	2.464
4	2.405	24	2.425	44	2.445	64	2.465
5	2.406	25	2.426	45	2.446	65	2.466
6	2.407	26	2.427	46	2.447	66	2.467
7	2.408	27	2.428	47	2.448	67	2.468
8	2.409	28	2.429	48	2.449	68	2.469
9	2.410	29	2.430	49	2.450	69	2.470
10	2.411	30	2.431	50	2.451	70	2.471
11	2.412	31	2.432	51	2.452	71	2.472
12	2.413	32	2.433	52	2.453	72	2.473
13	2.414	33	2.434	53	2.454	73	2.474
14	2.415	34	2.435	54	2.455	74	2.475
15	2.416	35	2.436	55	2.456	75	2.476
16	2.417	36	2.437	56	2.457	76	2.477
17	2.418	37	2.438	57	2.458	77	2.478
18	2.419	38	2.439	58	2.459	78	2.479
19	2.420	39	2.440	59	2.460	79	2.480
20	2.421	40	2.441	60	2.461		

Test Frequencies (Section 15.31m)

In line with the Section 15.31(m) of Public Notice DA 00-705 dated March/30/2000, some measurements are performed at the highest, middle, and lowest available channels with the hopping function disabled. (i.e. at **2402MHz**, **2441MHz** and **2480MHz**)

Unless otherwise specified the above condition, the test was performed while EUT had its hopping function enabled.

D. Test Instruments

Table-D List of Measuring Instruments

Description	Model	Serial Number	Calibration Date	Calibration Interval
Computer	IBM 5551-L	#4	N/A	N/A
Computer	IBM 6589-13J	97-15613	N/A	N/A
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2601A02634	08/28/02	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	3019A05155	02/15/02	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	3026A19353	02/15/02	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	3033A01449	02/15/02	1 year
Quasi-Peak Adapter	HP 85650A	2811A01156	06/17/02	1 year
Amplifier (100KHz - 1.3GHz)				
- for 30-200MHz	HP 8447D	2805A02919	04/15/02	1 year
- for 200-1000MHz	HP 8447D	2944A03506	04/15/02	1 year
Amplifier (1GHz - 26.5GHz)	HP 8449B	3008A00582	06/13/02	1 year
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003	07/18/02	1 year
Receiver (9kHz-30MHz)	R&S ESH3	891806/012	10/07/02	1 year
Receiver (20MHz-1.3GHz)	R&S ESVP	893202/018	02/06/02	1 year
Biconical Antenna (30-200MHz)	EMCO 3108	2309	05/06/02	1 year
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	1585	05/06/02	1 year
Horn Antenna (1- 18GHz)	EMCO 3115	9903-5774	07/18/02	1 year
Horn Antenna (3.95- 5.85GHz)	EMCO 3160-5	1099	04/17/02	1 year
Horn Antenna (5.85- 8.20GHz)	EMCO 3160-6	9712-1044	04/17/02	1 year
Horn Antenna (18- 26.5GHz)	EMCO 3160-9	0004-1202	04/17/02	1 year
LISN	EMCO 3825/2	1426	09/01/02	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
SF106 cables:	Length:			
- Horn Ant <=> RF Amp.	6 m	- EM206SCO	09/05/02	1 year
- RF Amp.<=>Spectrum Analyzer	15m	- EM215SCO	09/05/02	1 year
N-Coax cables:				
- Bi-coni Ant <=> 10m Cable	9 m	- EM103L01	04/15/02	1 year
- 10m Cable <=> Shield Panel	10 m	- EM103L02	04/15/02	1 year
- Shield Panel <=> RF Amp	7 m	- EM103L03	04/15/02	1 year
- RF Amp <=> Power Splitter	0.5m	- EM103L04	04/15/02	1 year
- Log-peri Ant <=> 10m Cable	9 m	- EM103H01	04/15/02	1 year
- 10m Cable <=> Shield Panel	10 m	- EM103H02	04/15/02	1 year
- Shield Panel <=> RF Amp	7 m	- EM103H03	04/15/02	1 year

- RF Amp <=> Power Splitter Coax cables:	0.5m	- EM103H04	04/15/02	1 year
- Lism-L <=> SW/Con.unit (SW100)	4 m	- EMIC-L	04/15/02	1 year
- Lism-N <=> SW/Con.unit (SW101)	4 m	- EMIC-N	04/15/02	1 year
- SW/Con.unit <=> RCVR (Input)	1 m	- EMIC-R	04/15/02	1 year
- SW/Con.unit<=> Spe Ana.(Signal In)	1 m	- EMIC-S	04/15/02	1 year
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM103L05	04/15/02	1 year
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM103L06	04/15/02	1 year
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM103H05	04/15/02	1 year
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM103H06	04/15/02	1 year
- SW/Con.unit <=> Receiver (Input)	2 m	- EM1RCV	04/15/02	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	2 m	- EM1SPL	04/15/02	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM1SPH	04/15/02	1 year

Notes.

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

E. Measurement Uncertainty

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

Estimated site uncertainty values are as follows.

EMI chamber #1 : 4.39dB

EMI chamber #2 : 4.40dB

EMI conducted measurement system : 2.4dB

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

F. Temperature and Humidity

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

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

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

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

1. Carrier Frequency Separation

1.1 Test Procedure

- The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.
- The spectrum analyzer was set to :
 Span = 3 MHz (wide enough to capture the peaks of two adjacent channels),
 Resolution Bandwidth (RBW) = 30 kHz (1% of the span or more),
 Video Bandwidth (VBW) = 30 kHz (= RBW or more), Sweep = auto,
 Detector function = peak, Trace = max hold
- After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

1.2 Test Instruments and Measurement Setup

Table 1-1 : 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

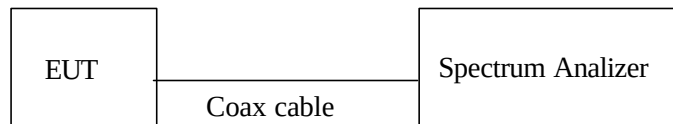


Figure 1: Measurement setup for the carrier frequency separation

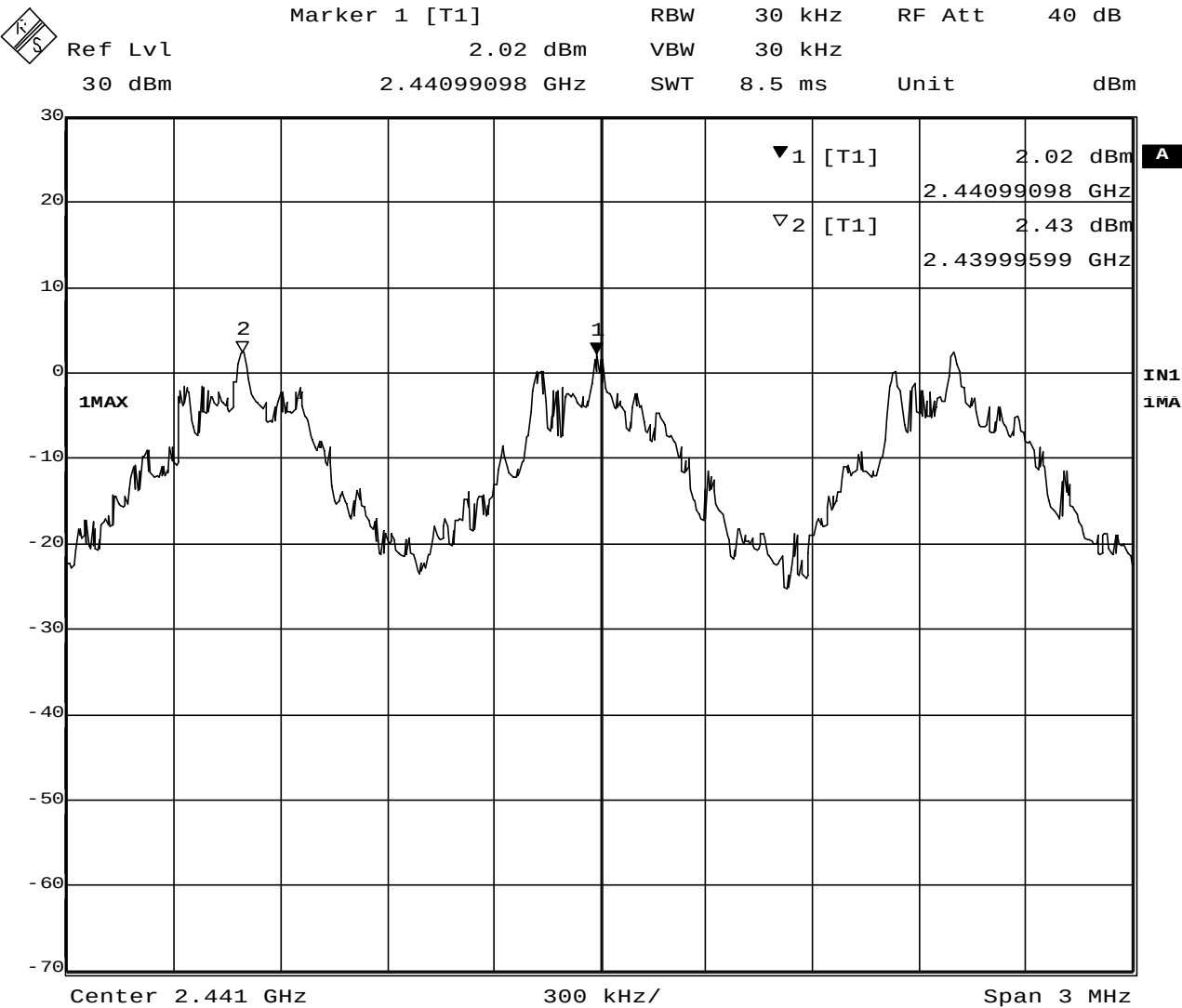
1.3 Measurement Results

Test Date: December 18, 2002

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

Frequency of marker #1 (MHz)	Frequency of marker #2 (MHz)	Carrier Frequency Separation (MHz)	Note
2440.00	2440.99	0.99	Min. 25 kHz

1.4 Trace Data



Date: 18.DEC.2002 09:54:24

Carrier Frequency Separation

2. Number of Hopping Frequencies

2.1 Test Procedure

- The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.
- To get higher resolution, four frequency ranges within the 2400 - 2483.5 MHz FH band were examined.
- The spectrum analyzer was set to :

Frequency range 1: Start = 2389.5 MHz, Stop = 2414.5 MHz

2: Start = 2414.5 MHz, Stop = 2439.5 MHz

3: Start = 2439.5 MHz, Stop = 2464.5 MHz

4: Start = 2464.5 MHz, Stop = 2489.5 MHz

RBW $\geq$ 1% of the span, VBW $\geq$ RBW, Sweep = auto, Detector function = peak,
Trace = max hold

2.2 Test Instruments and Measurement Setup

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

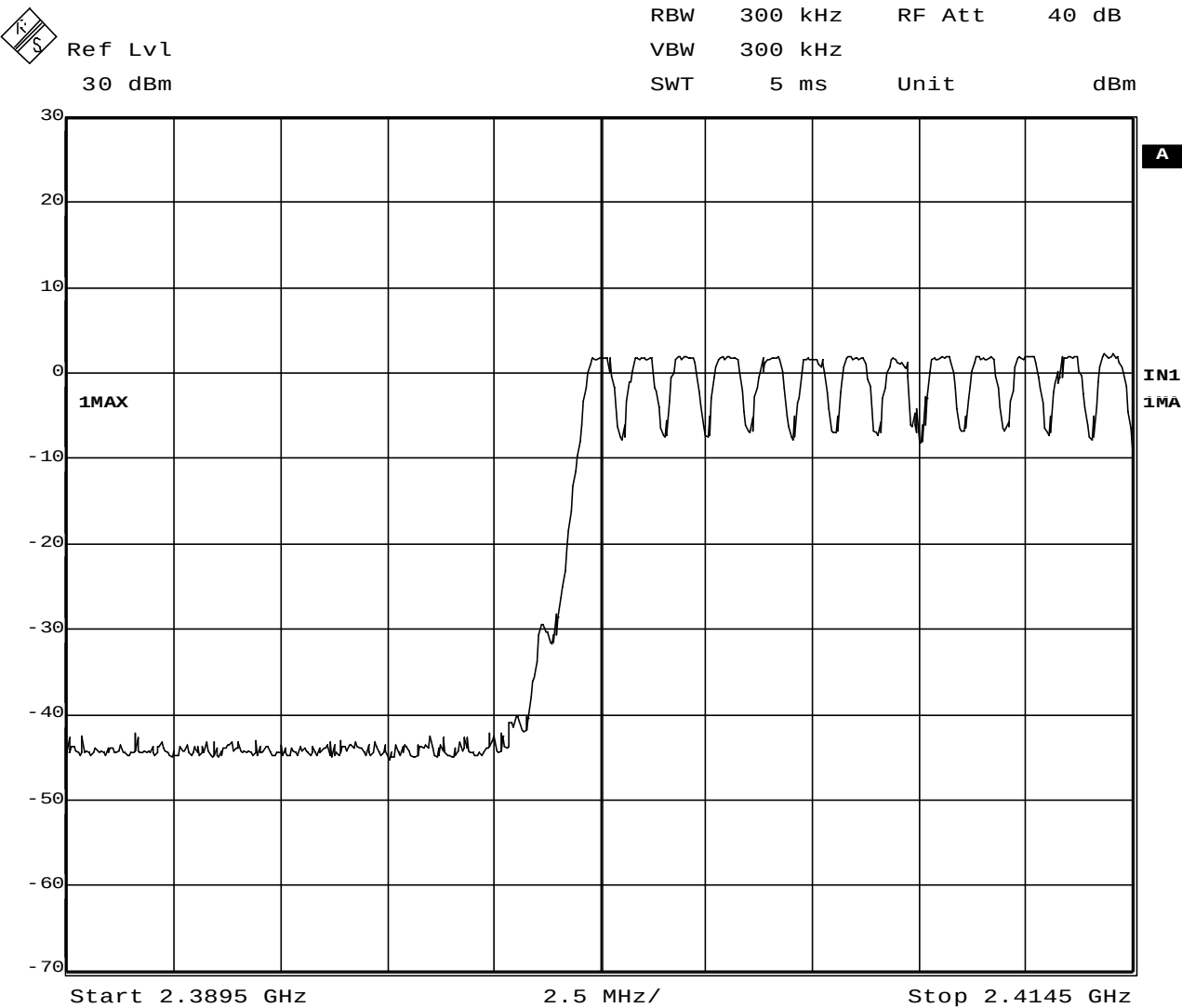
2.3 Measurement Results

Test Date: December 18, 2002

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

Total number of Hopping Channels	Note
79	Min. 75 hops

2.4 Trace Data



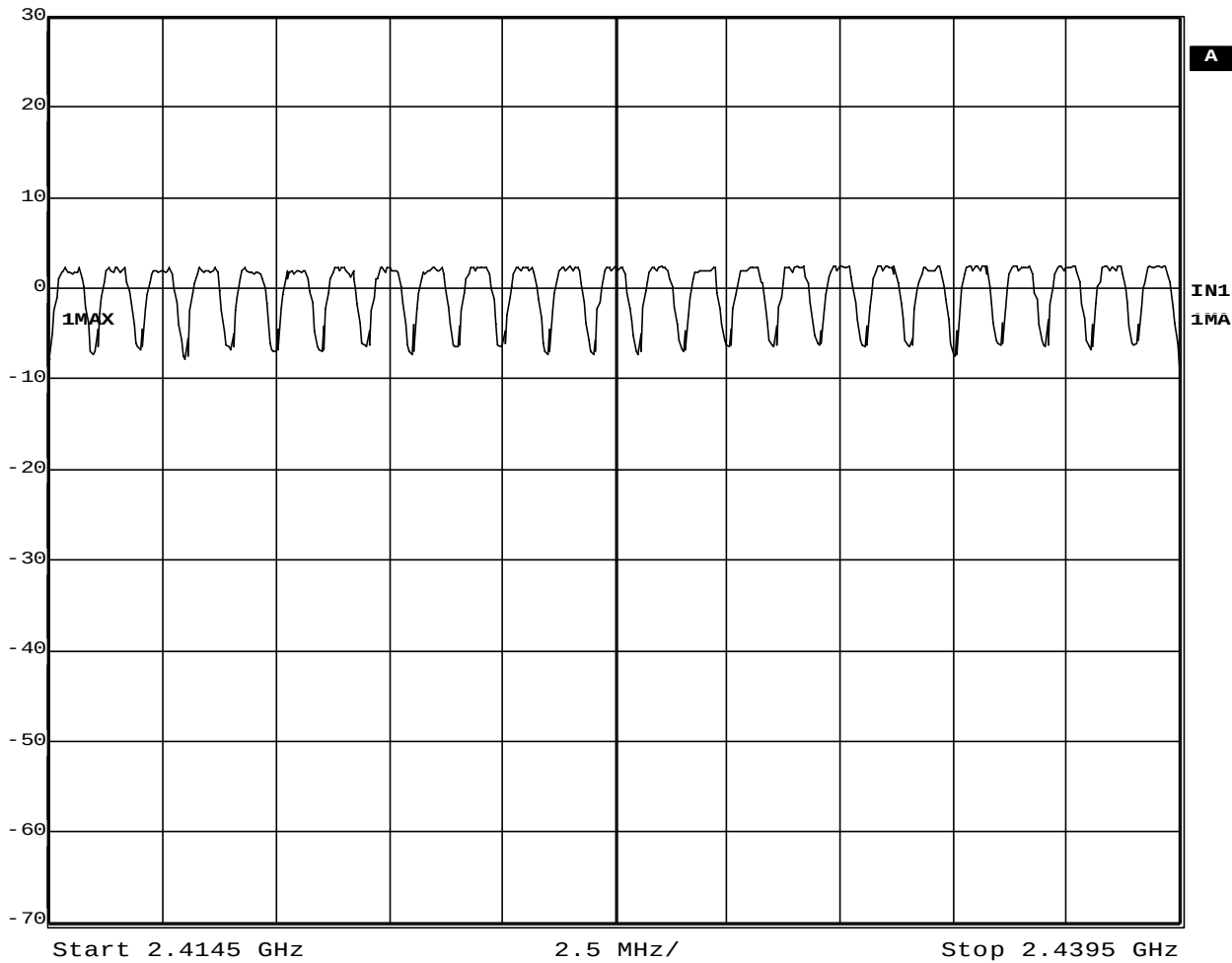
Date: 18.DEC.2002 09:56:45

Number of Hopping Frequencies (range 1)



Ref Lvl
30 dBm

RBW 300 kHz RF Att 40 dB
VBW 300 kHz
SWT 5 ms Unit dBm



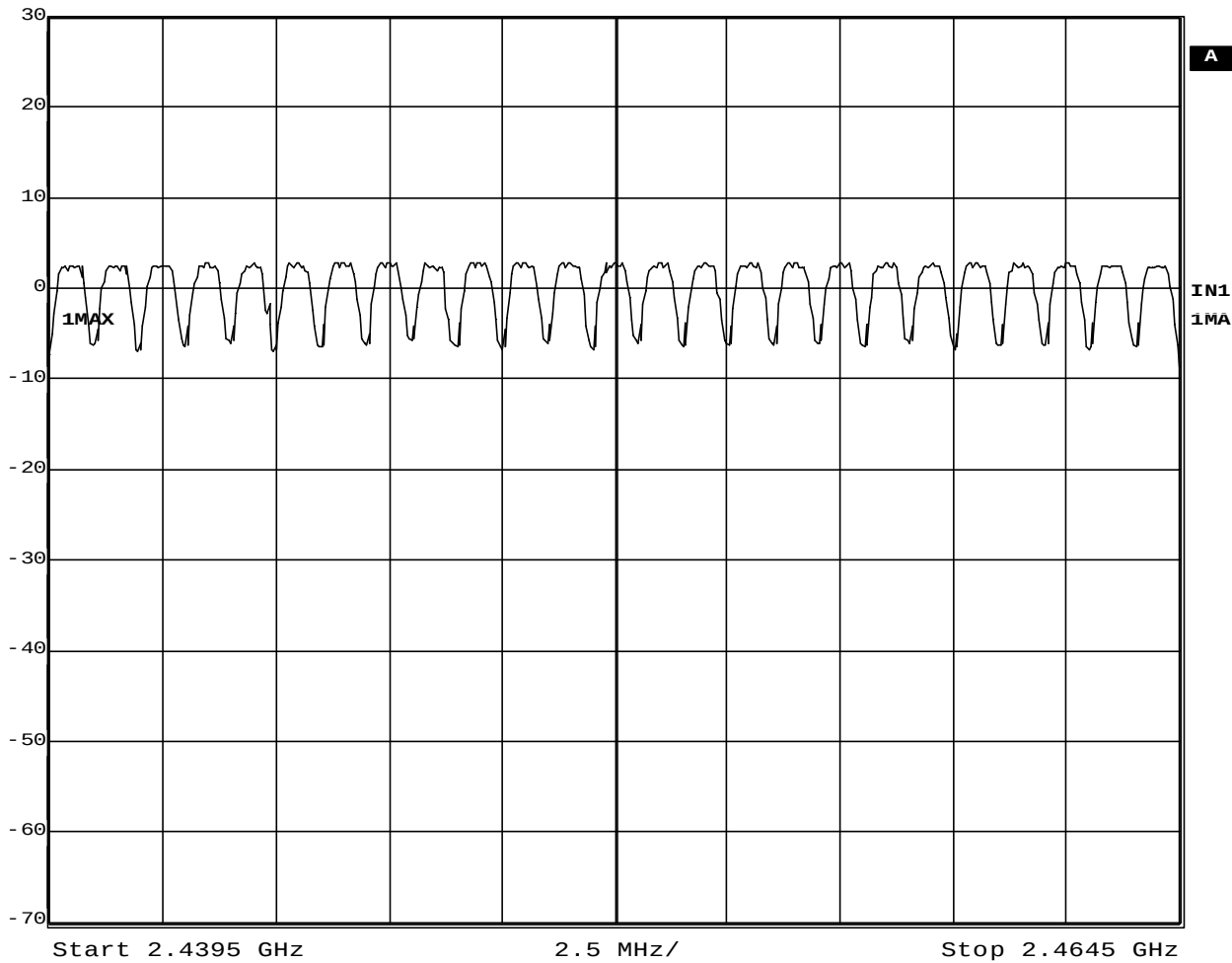
Date: 18.DEC.2002 09:59:59

Number of Hopping Frequencies (range 2)



Ref Lvl
30 dBm

RBW 300 kHz RF Att 40 dB
VBW 300 kHz
SWT 5 ms Unit dBm



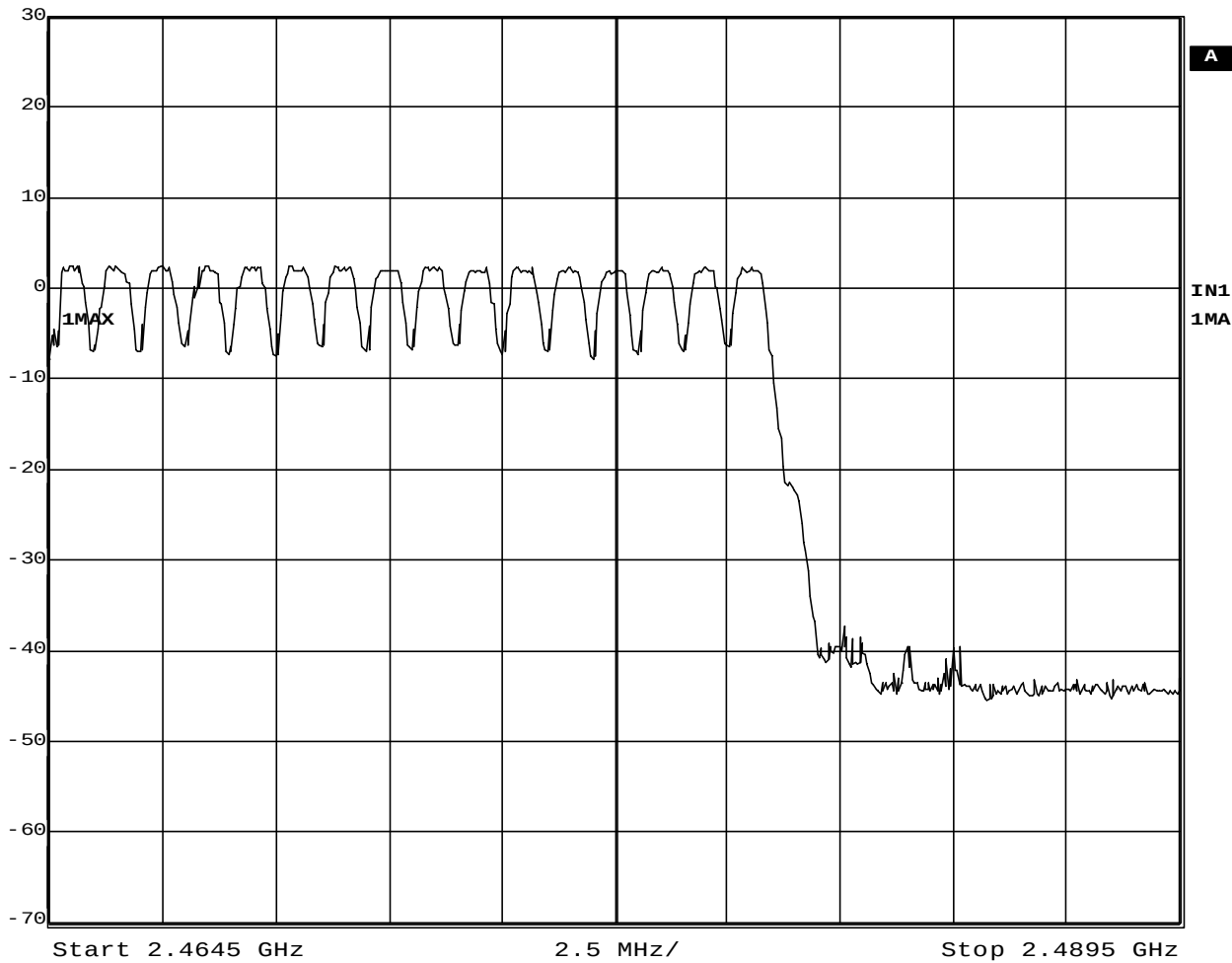
Date: 18.DEC.2002 10:02:34

Number of Hopping Frequencies (range 3)



Ref Lvl
30 dBm

RBW 300 kHz RF Att 40 dB
VBW 300 kHz
SWT 5 ms Unit dBm



Date: 18.DEC.2002 10:03:51

Number of Hopping Frequencies (range 4)

3. 20 dB Bandwidth

3.1 Test Procedure

- The bandwidth at 20 dB below the highest inband spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels.
- The spectrum analyzer was set to :
 - Center frequency = the highest, middle and the lowest channels,
 - Span : approximately 2 or 3 times of the 20 dB bandwidth = 2 MHz
 - RBW : 1% of the 20 dB bandwidth or more = 10 kHz
 - VBW : equal to RBW or more = 30 kHz
 - Sweep = auto, Detector function = peak, Trace = max hold
- After the trace being stable. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.

3.2 Test Instruments and Measurement Setup

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

3.3 Measurement Results

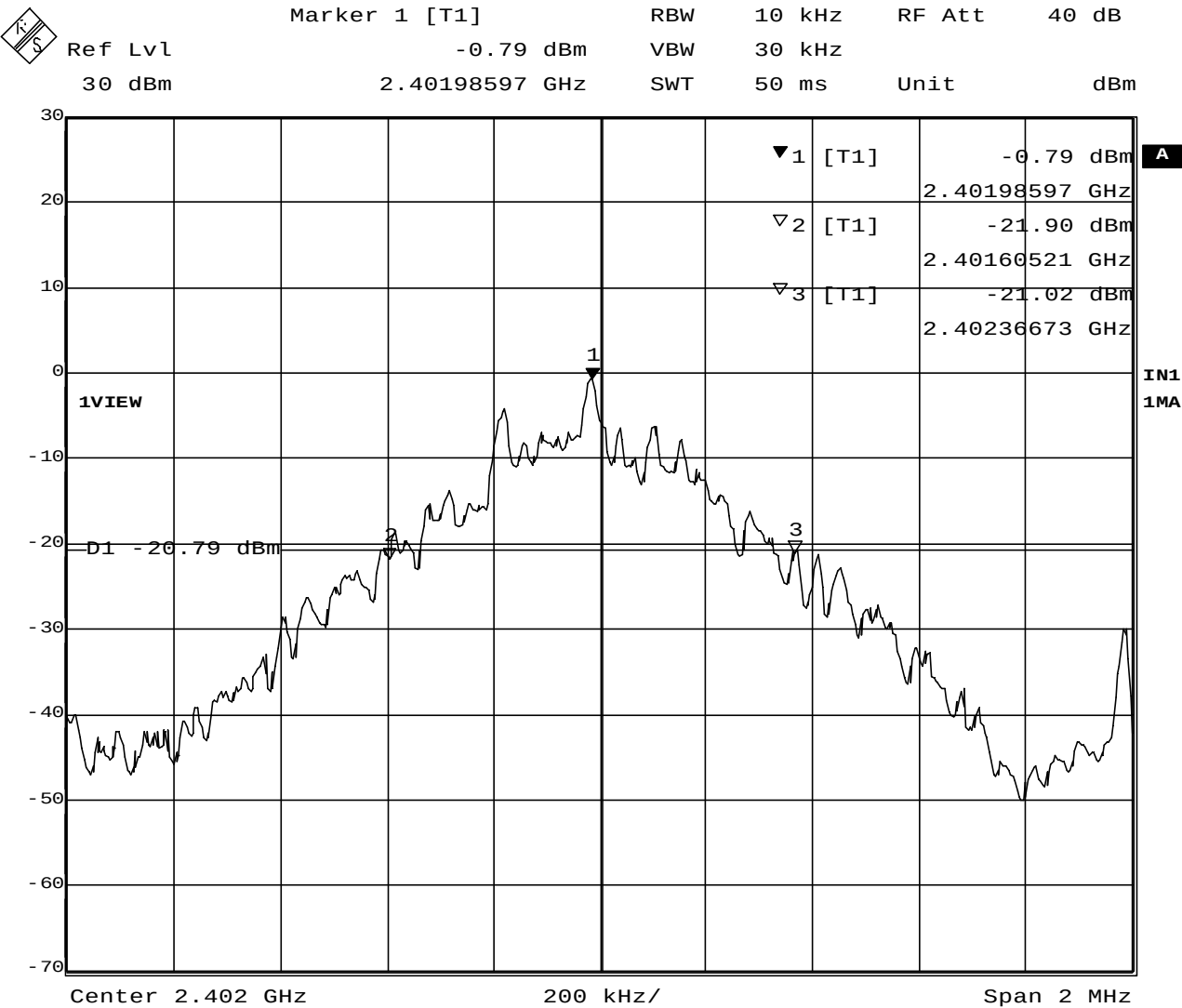
Test Date: December 18, 2002

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

	Measured Bandwidth (MHz)	Limit
Tx at the lowest ch. (2402 MHz)*1	0.762	1 MHz
Tx at the middle ch.(2441 MHz)*1	0.745	
Tx at the highest ch.(2480 MHz)*1	0.790	
Inquiry	0.621	
Paging	0.631	

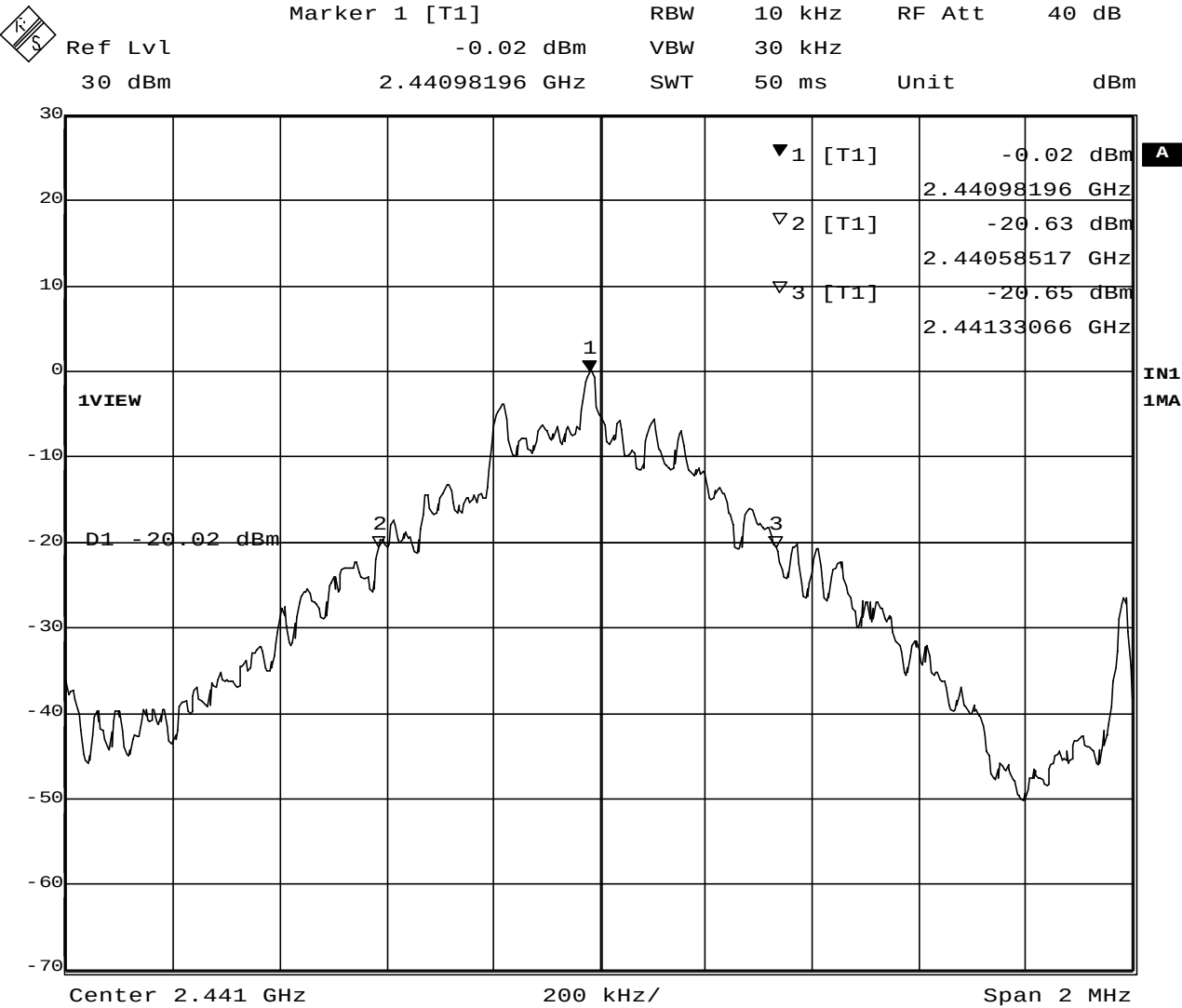
*1 : In line with Section 15.31(m) of Public Notice DA 00-705 dated March 30, 2000, the measurement was performed at the highest, middle and lowest available channels.

3.4 Trace Data



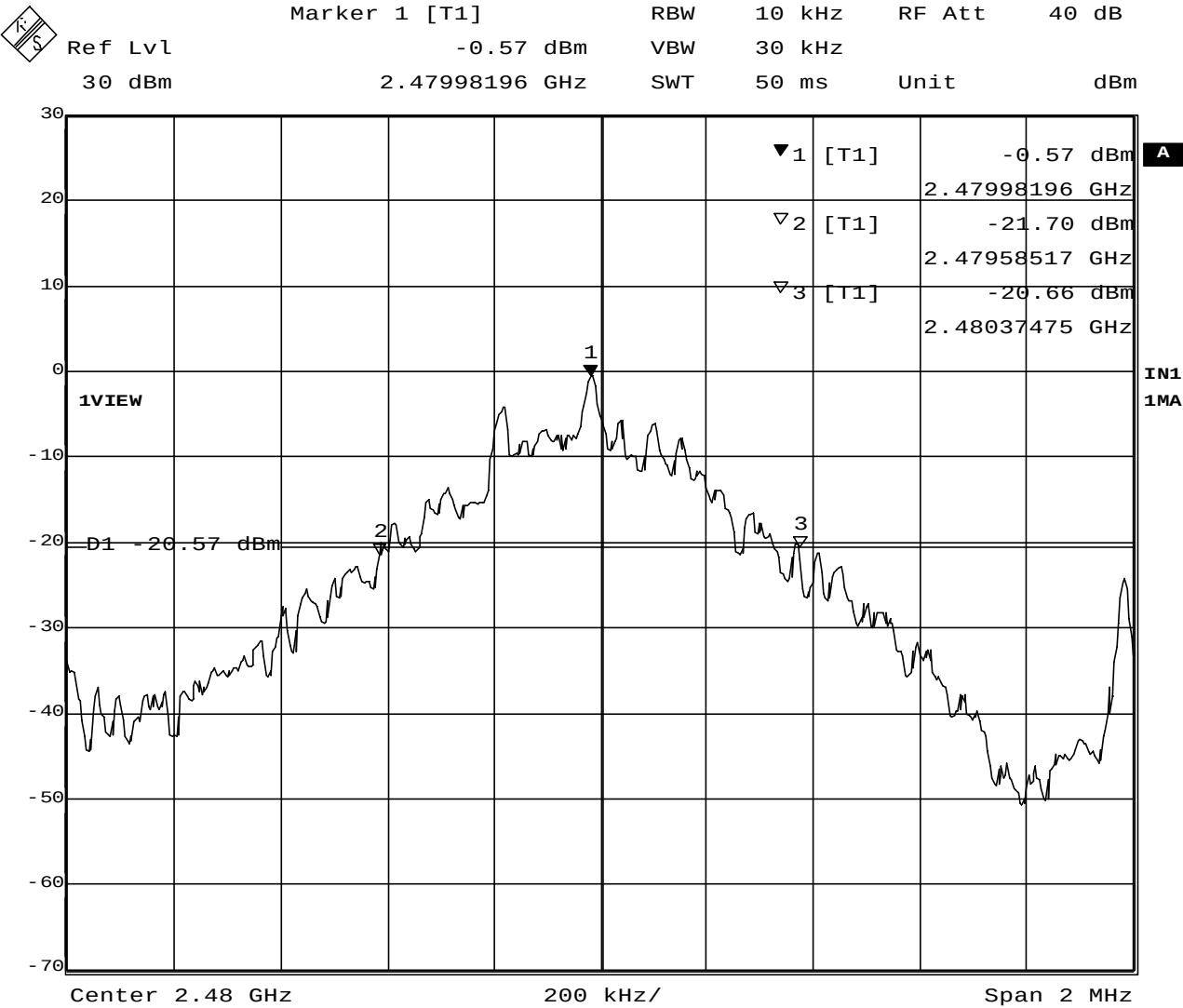
Date: 18.DEC.2002 10:08:17

20 dB Bandwidth (TX on 2402MHz)



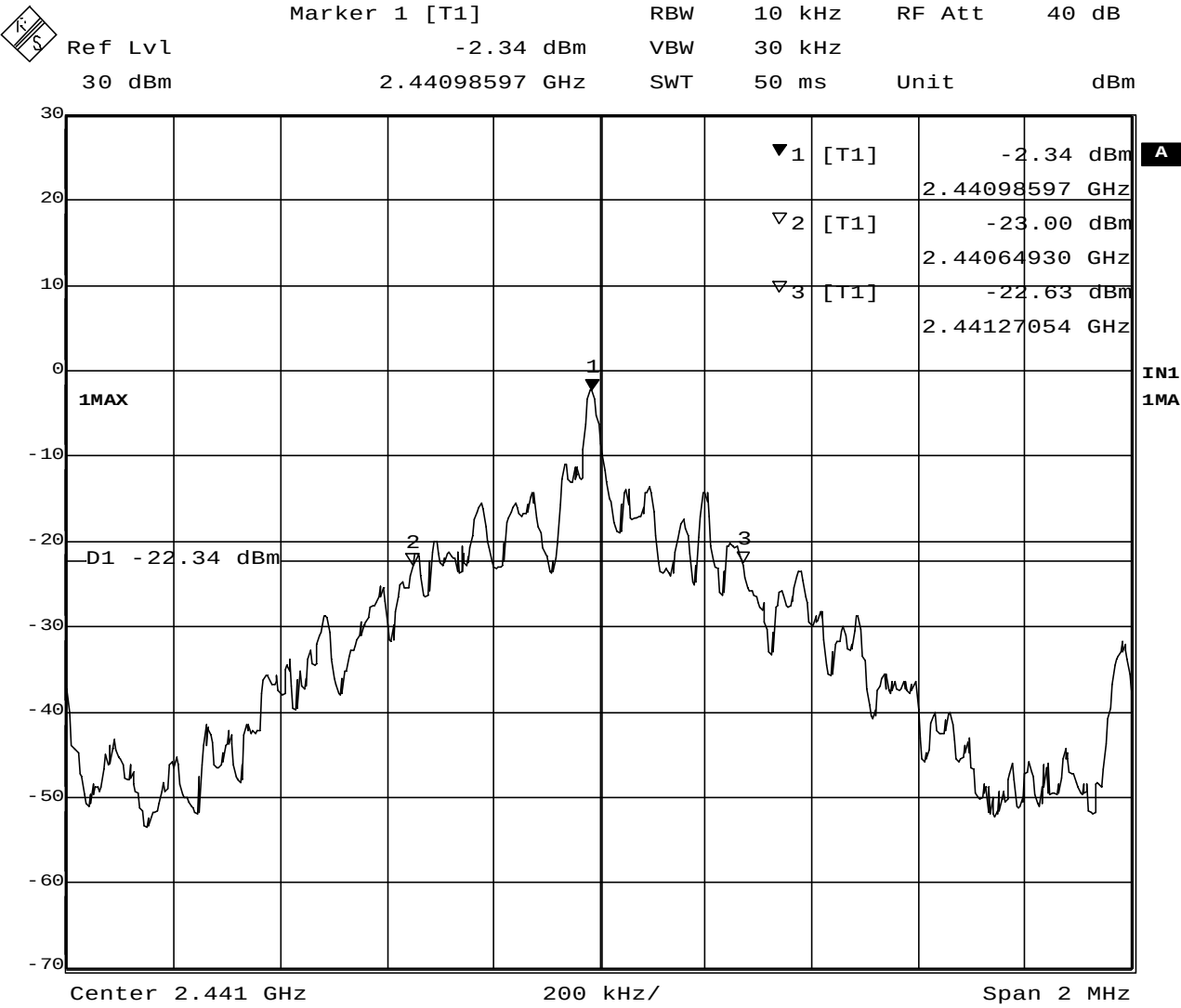
Date: 18.DEC.2002 10:10:36

20 dB Bandwidth (TX on 2441MHz)



Date: 18.DEC.2002 10:12:38

20 dB Bandwidth (TX on 2480MHz)

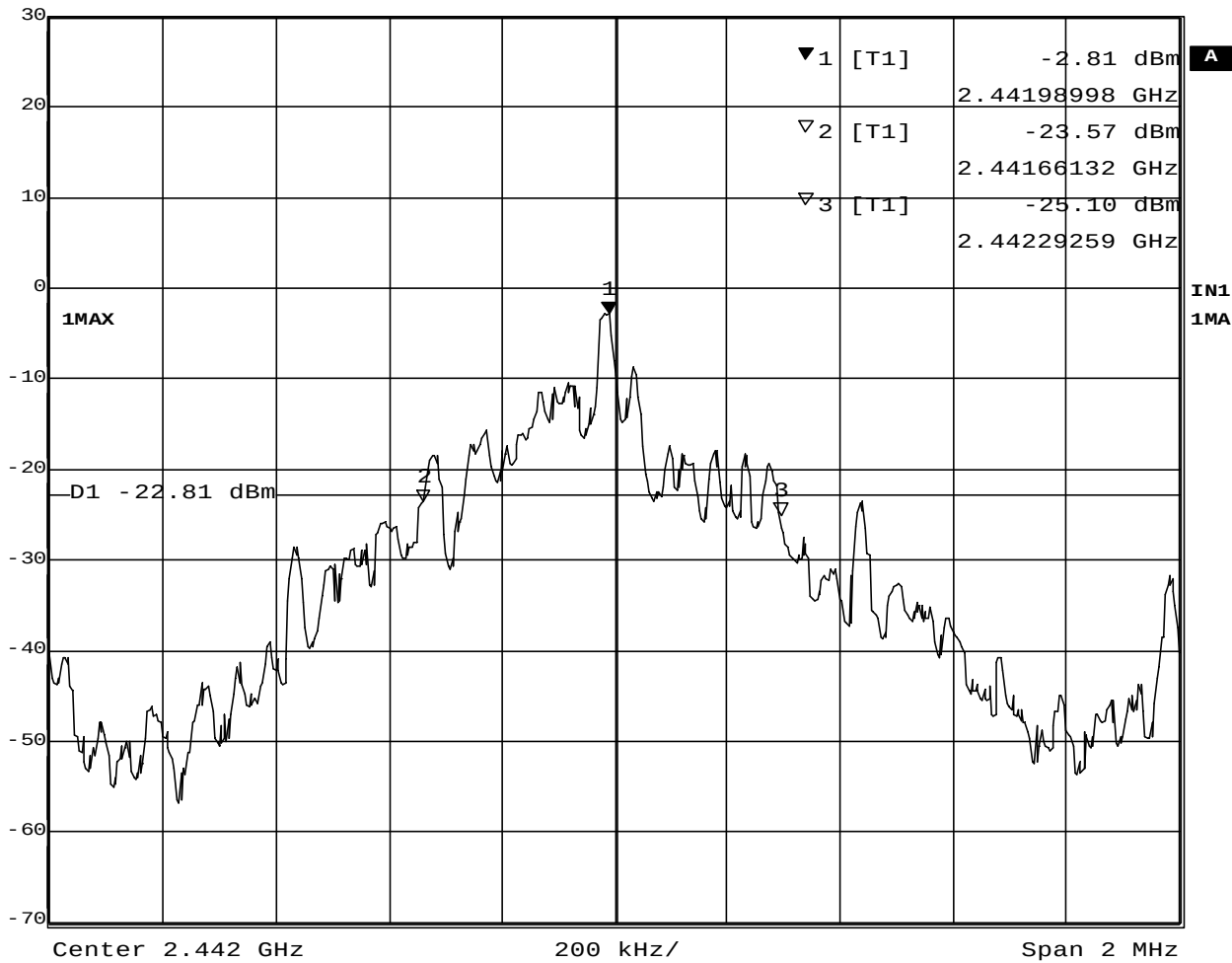


Date: 18.DEC.2002 10:16:45

20 dB Bandwidth (Inquiry)



Ref Lvl	Marker 1 [T1]	RBW	10 kHz	RF Att	40 dB
30 dBm	-2.81 dBm	VBW	30 kHz		
	2.44198998 GHz	SWT	50 ms	Unit	dBm



Date: 18.DEC.2002 10:21:25

20 dB Bandwidth (Paging)

4. Time of Occupancy (Dwell Time)

4.1 Test Procedure

- The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.
- The spectrum analyzer was set to :
 Center Frequency: 2441MHz (for Inquiry / Data Transmission), 2442MHz (for Paging)
 RBW = 500 kHz, VBW = 500 kHz (= RBW or more), Span = zero,
 Detector function = peak, Trace = max hold,
 Sweep : Inquiry ; 300 μ s for Burst duration, 100 ms for Repetition rate
 Paging ; 300 μ s for Burst duration, 100 ms for Repetition rate
 Data transmission ; 1 ms for Burst duration, 500 ms for Repetition rate

4.2 Test Instruments and Measurement Setup

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

4.3 Measurement Results

Test Date: December 18, 2002

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

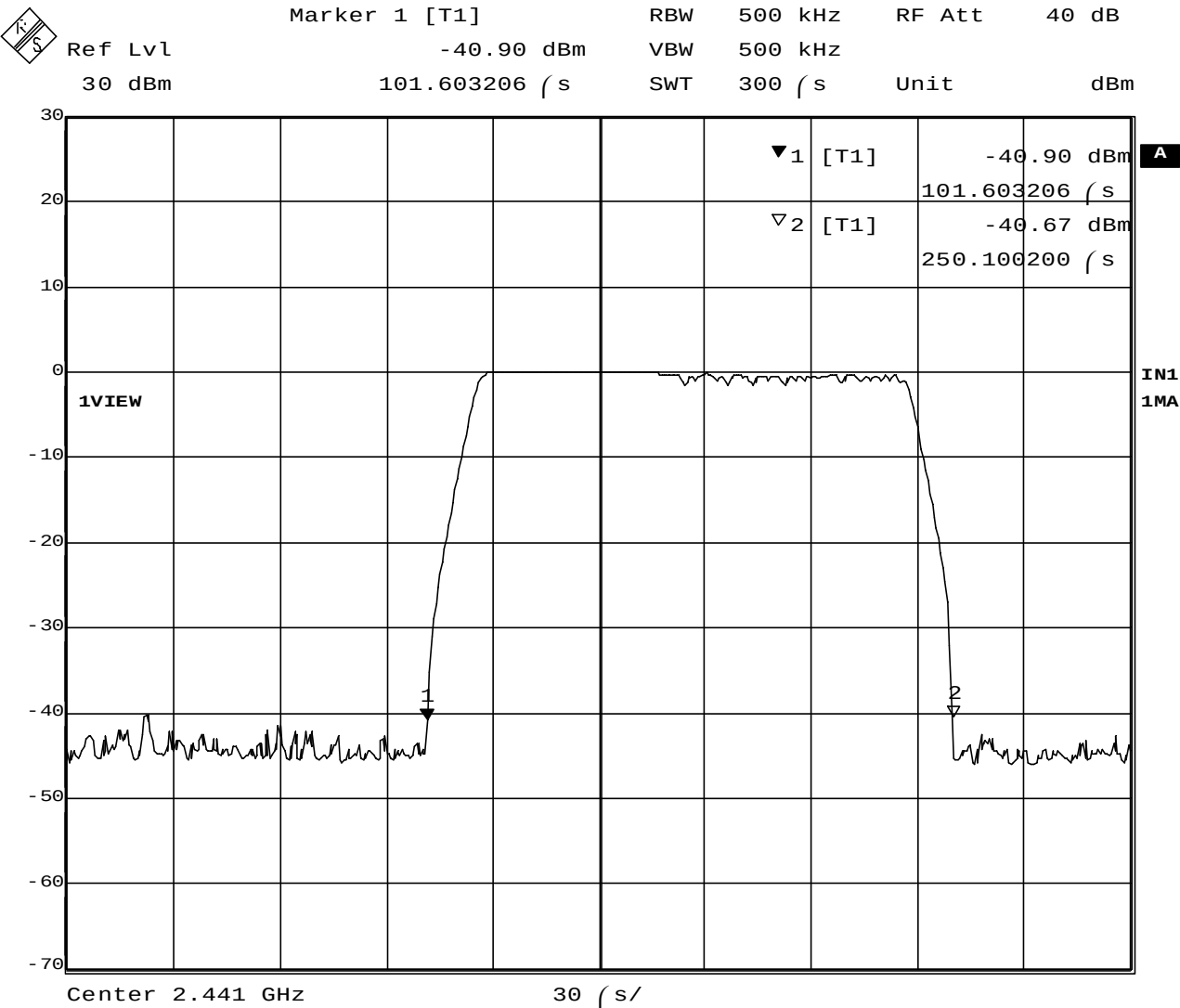
Hopping phase	Burst duration in one hop (μ s) *1	Repetition rate on one channel *2	Dwell Time (mS) *1 $\times$ *2	Limit
Inquiry	148.50	1280	190.08	less than 400 mS in 12.8 ^{*3} seconds period
Paging	149.80	640	95.87	
Data transmission	452.91	300	135.87	less than 400 mS in 30 seconds period

***1** : attached measurement plot

***2** : - (number of hops in measurement plot) $\times$ 12800 ms / 100 ms for Inquiry/Paging
 - (number of hops in measurement plot) $\times$ 30000 ms / 500 ms for Data transmission

***3** : 32 hops (Bluetooth Standard) $\times$ 0.4sec

4.4 Trace Data



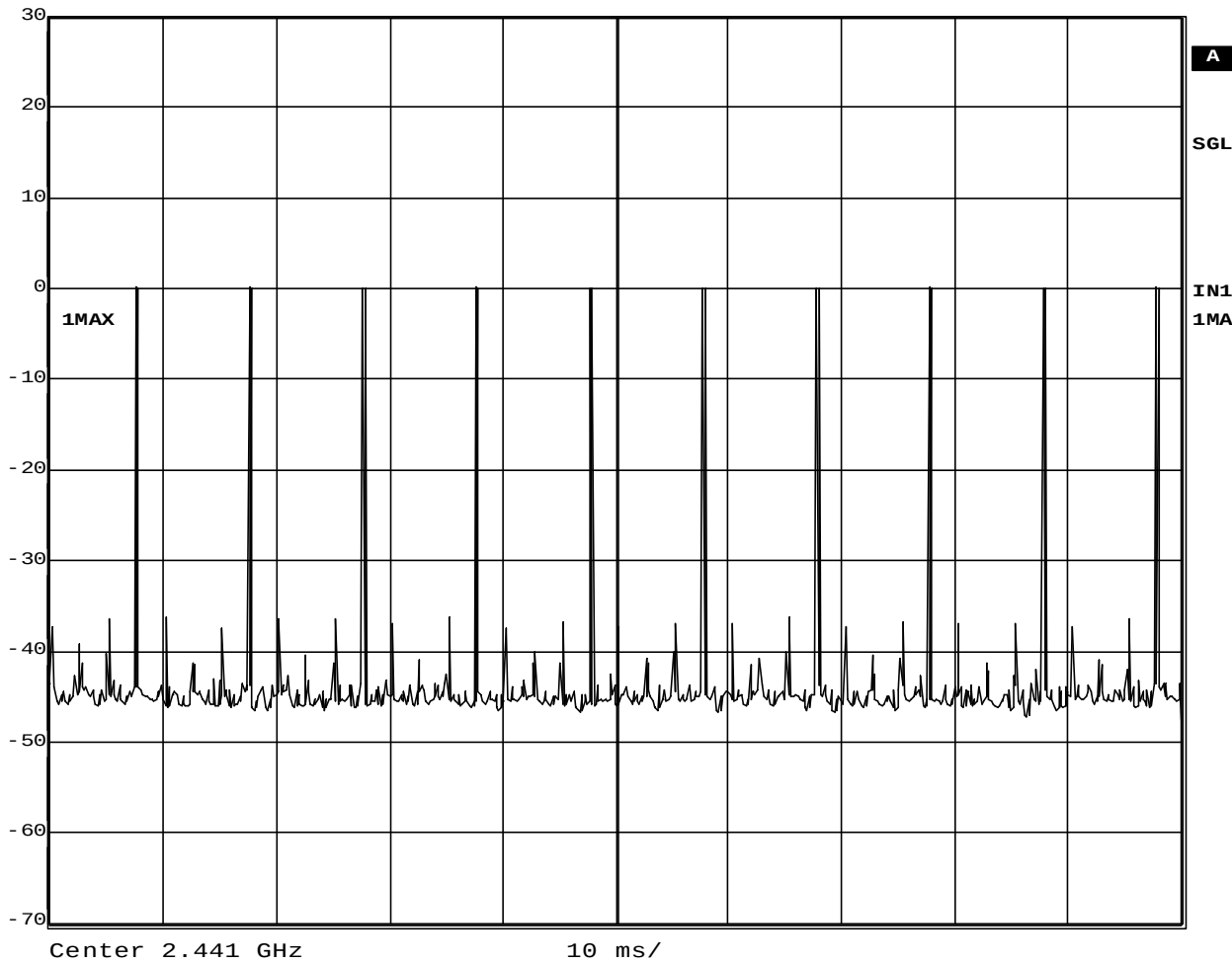
Date: 18.DEC.2002 10:25:00

Time of Occupancy (Inquiry, Burst duration)



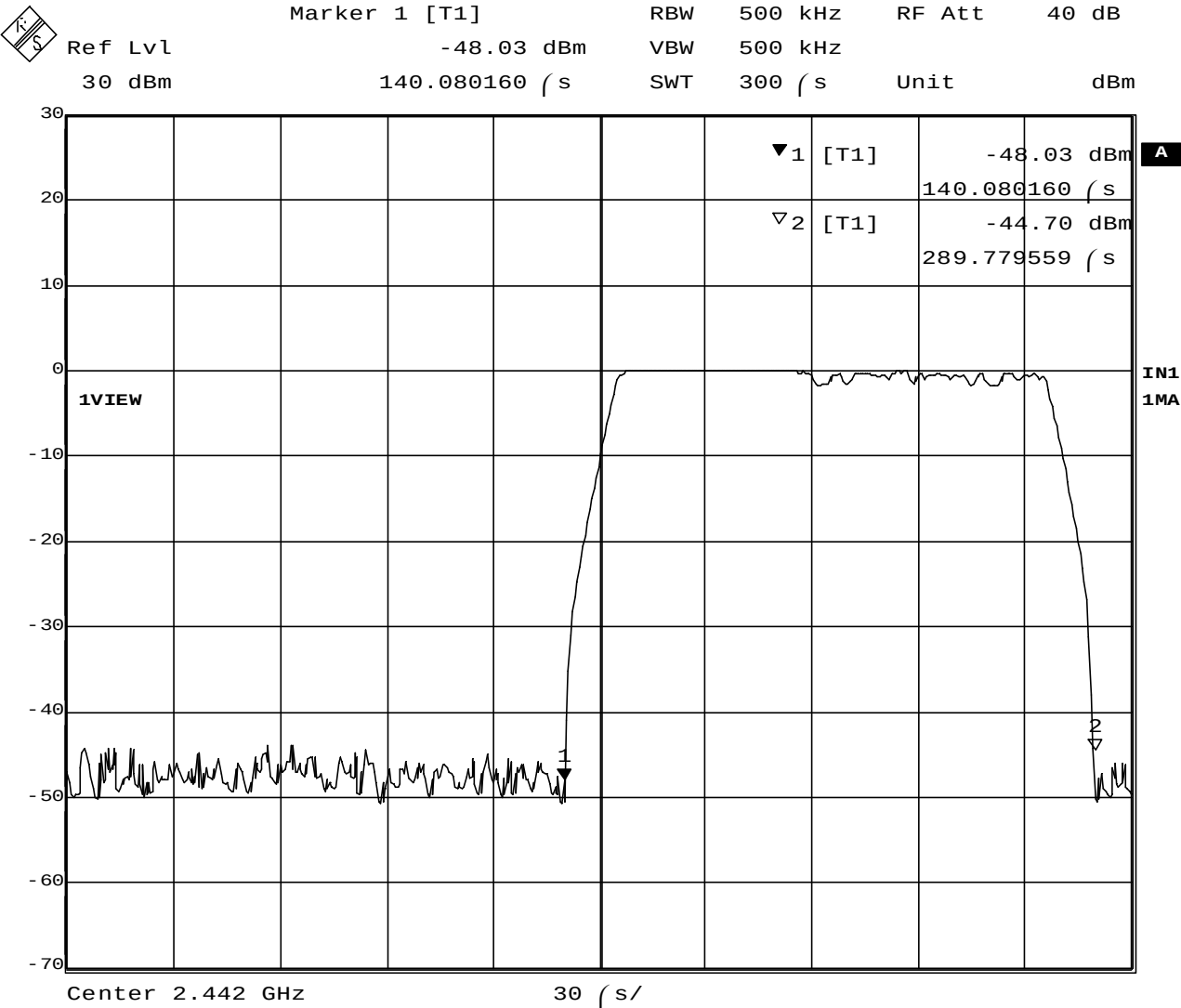
Ref Lvl
30 dBm

RBW 500 kHz RF Att 40 dB
VBW 500 kHz
SWT 100 ms Unit dBm



Date: 18.DEC.2002 10:26:44

Time of Occupancy (Inquiry, Repetition rate)



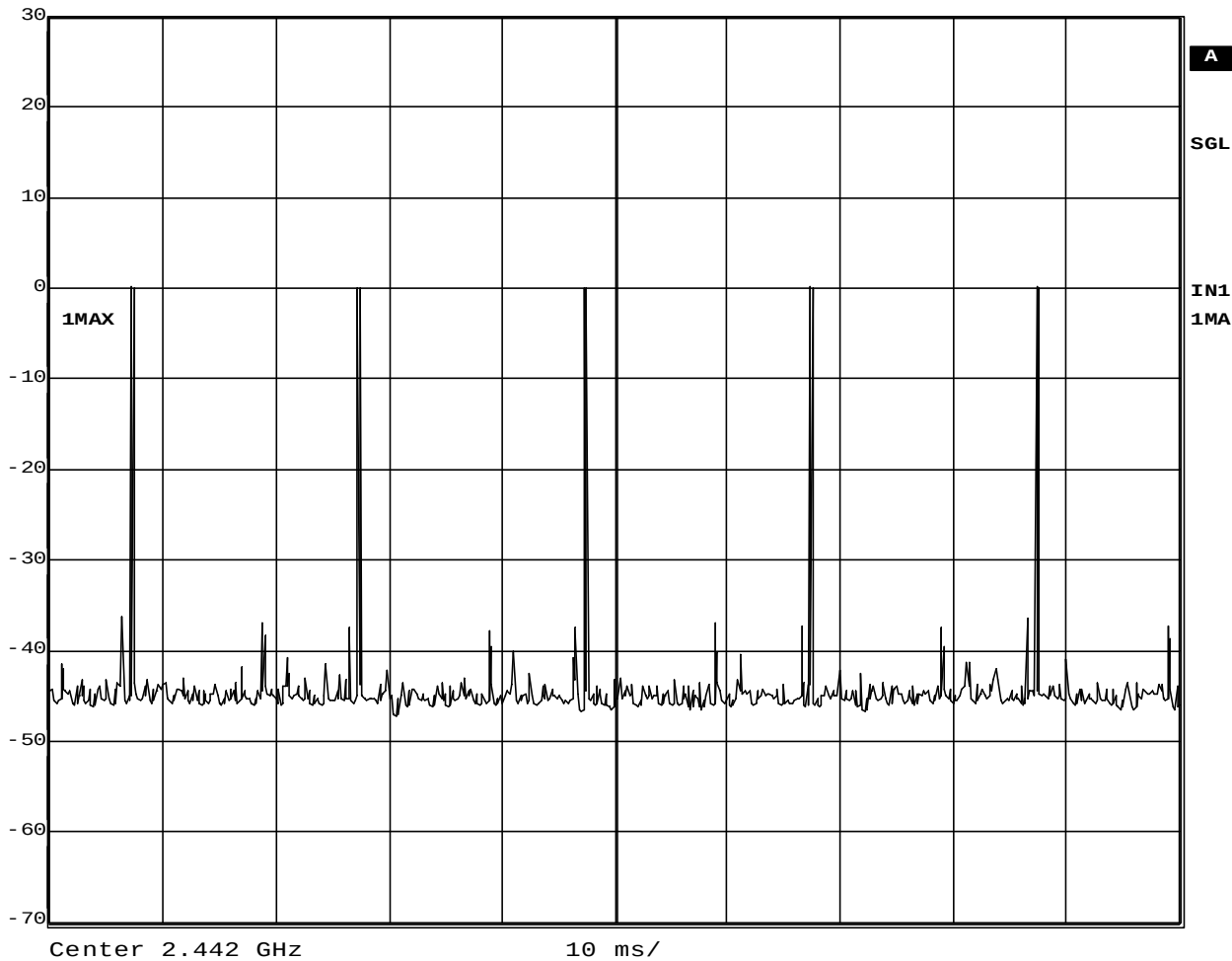
Date: 18.DEC.2002 10:30:23

Time of Occupancy (Paging, Burst duration)



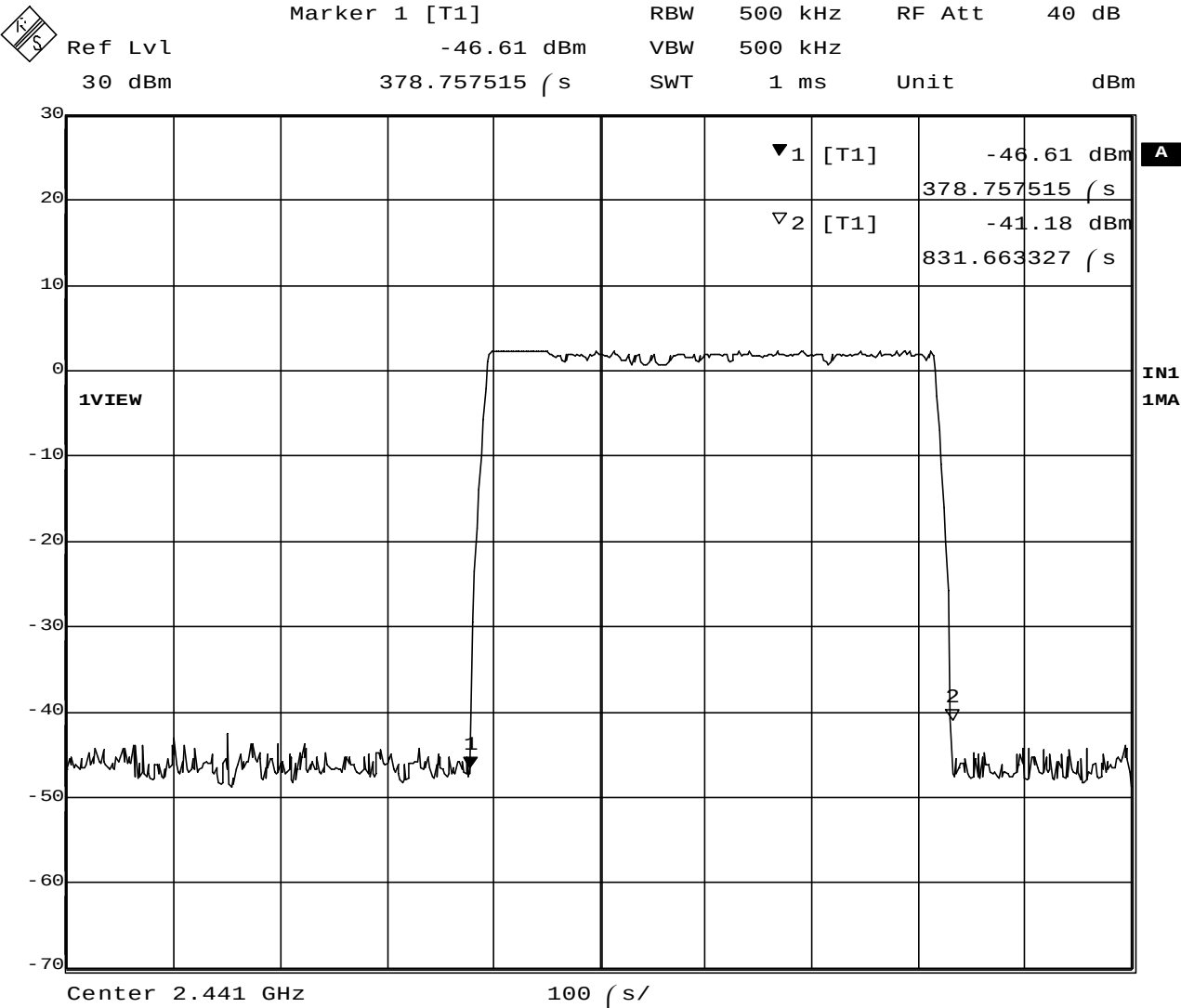
Ref Lvl
30 dBm

RBW 500 kHz RF Att 40 dB
VBW 500 kHz
SWT 100 ms Unit dBm



Date: 18.DEC.2002 10:32:44

Time of Occupancy (Paging, Repetition rate)



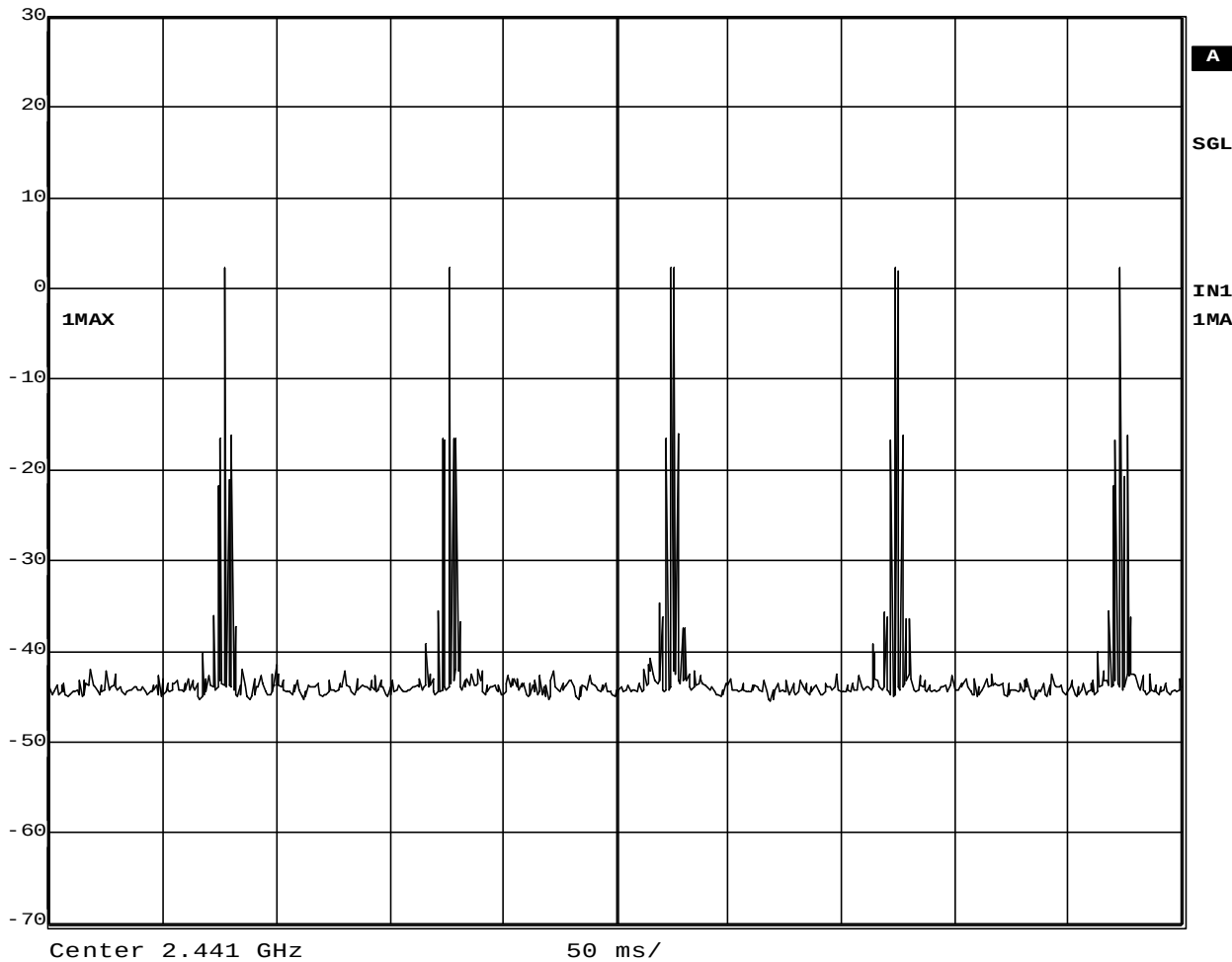
Date: 18.DEC.2002 10:35:35

Time of Occupancy (Data transmission, Burst duration)



Ref Lvl
30 dBm

RBW 500 kHz RF Att 40 dB
VBW 500 kHz
SWT 500 ms Unit dBm



Date: 18.DEC.2002 10:36:54

Time of Occupancy (Data transmission, Repetition rate)

5. Peak Output Power

5.1 Test Procedure

- The peak output power is measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels.
- The spectrum analyzer is set to :
 - Center frequency = the highest, middle and the lowest channels,
 - Span : approximately 5 times of the 20 dB bandwidth = 5 MHz (3 MHz for Inquiry/Paging)
 - RBW : greater than the 20 dB bandwidth of the emission being measured = 1 MHz
 - VBW : equal to RBW or more = 3 MHz
 - Sweep = auto, Detector function = peak, Trace = max hold
- Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

5.2 Test Instruments and Measurement Setup

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

5.3 Measurement Results

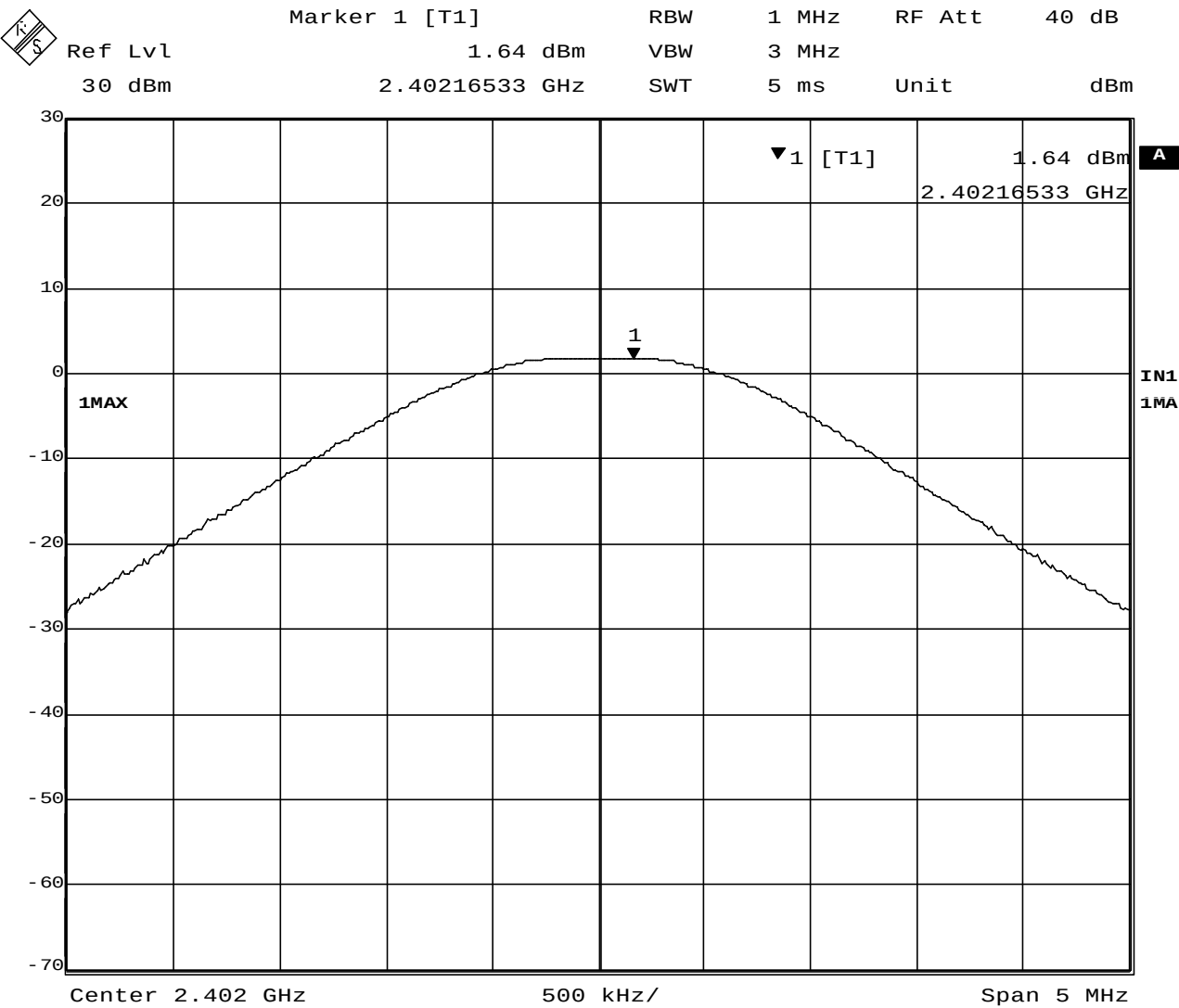
Test Date: December 18, 2002

Table 5. EUT: M/T 2373-92U, s/n ZZ-00129

Measured Frequency (MHz)	Analyzer Reading (dBm)	Cable Loss (dB)	Results		Limit [1W] (dBm)	Margin (dB)
			(dBm)	(W)		
2402 (ch. 1) *1	1.64	1.3	2.9	0.00195	30.0	27.1
2441 (ch. 40) *1	2.67	1.3	4.0	0.00251	30.0	26.0
2480 (ch. 79) *1	1.76	1.3	3.1	0.00204	30.0	26.9
Inquiry (ch. 40)	0.17	1.3	1.5	0.00141	30.0	28.5
Paging (ch. 41)	0.16	1.3	1.5	0.00141	30.0	28.5

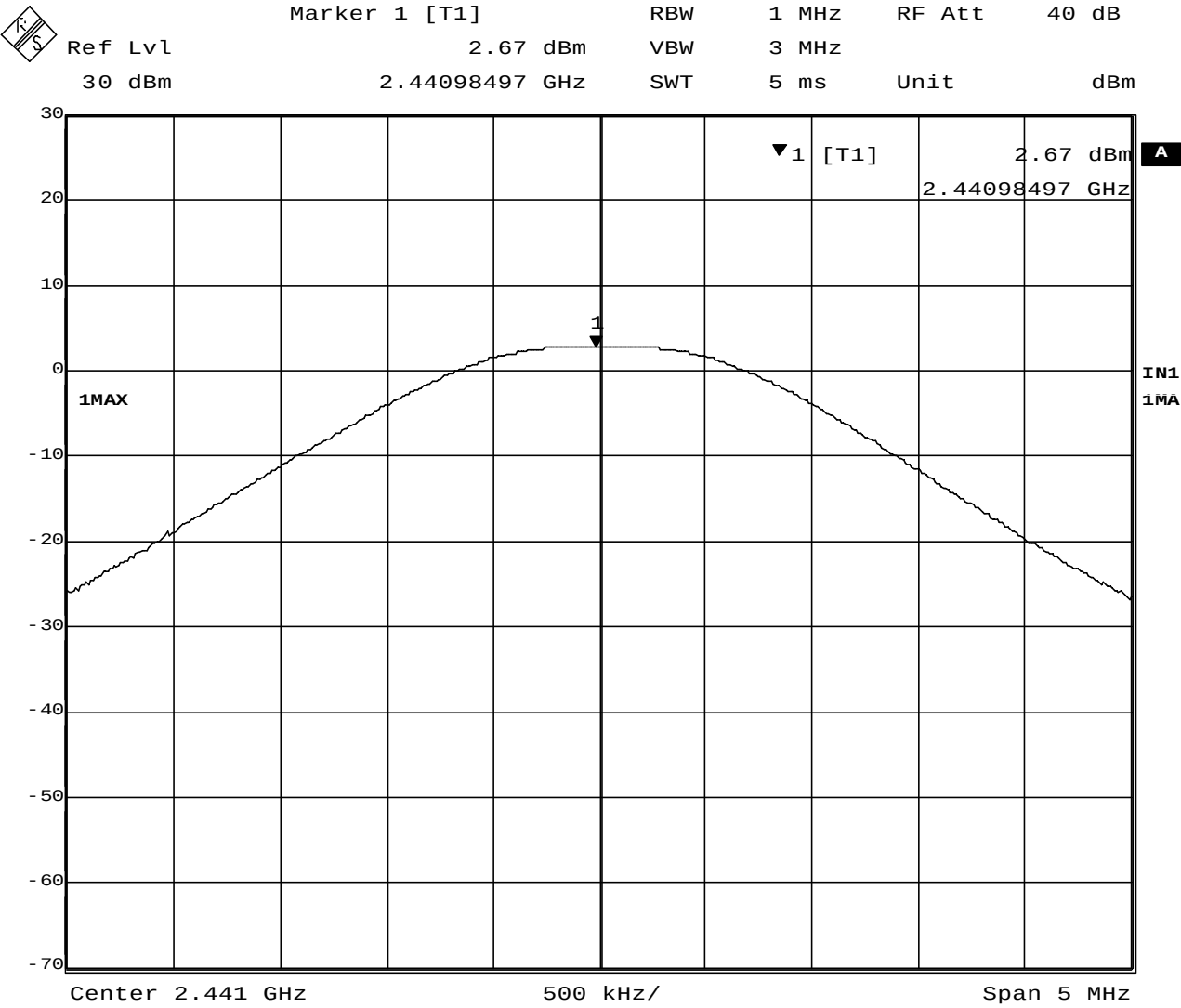
*1 : In line with Section 15.31(m) of Public Notice DA 00-705 dated March 30, 2000, the measurement was performed at the highest, middle and lowest available channels.

5.4 Trace Data



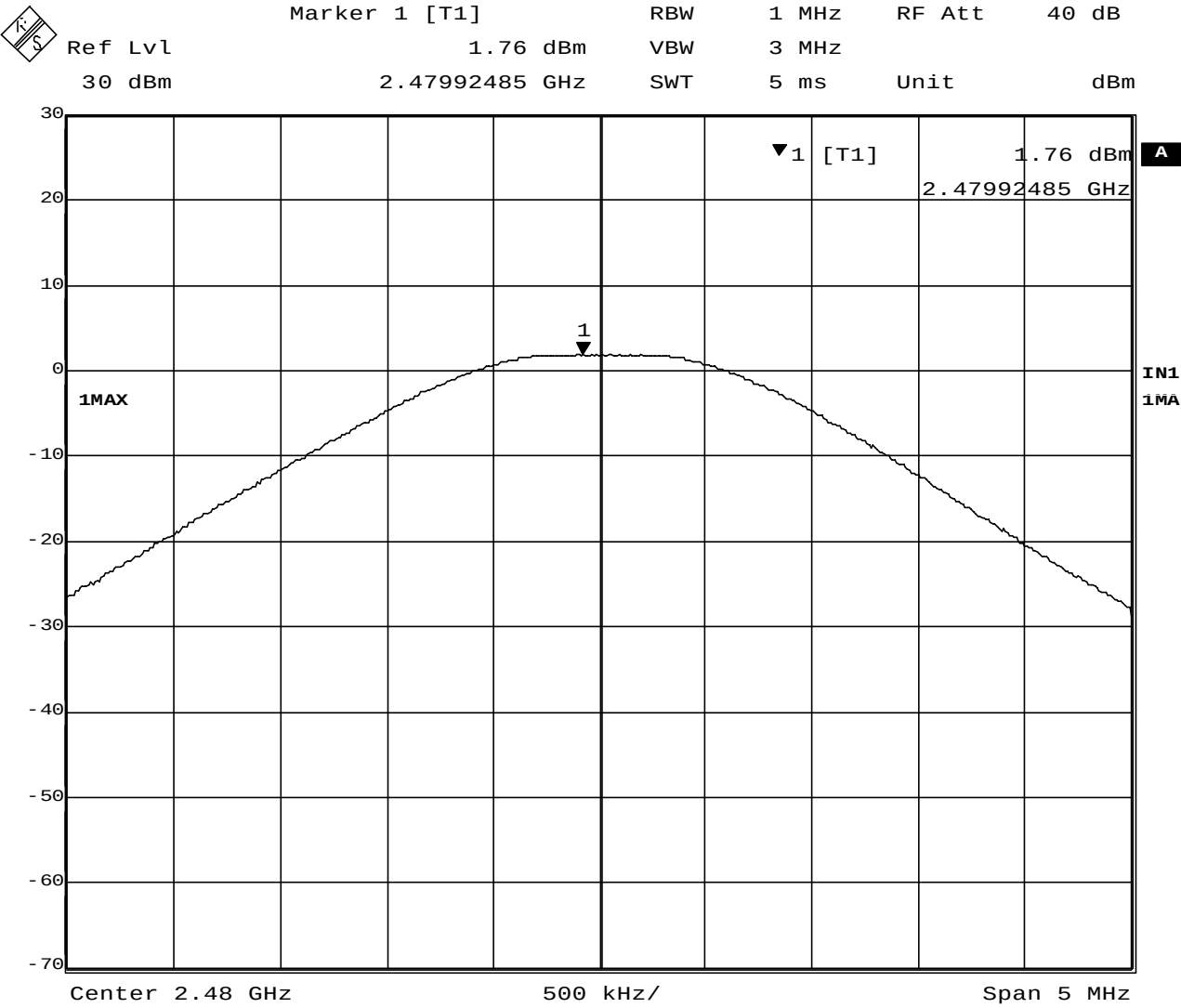
Date: 18.DEC.2002 11:18:00

Peak Output Power (TX on 2402MHz)



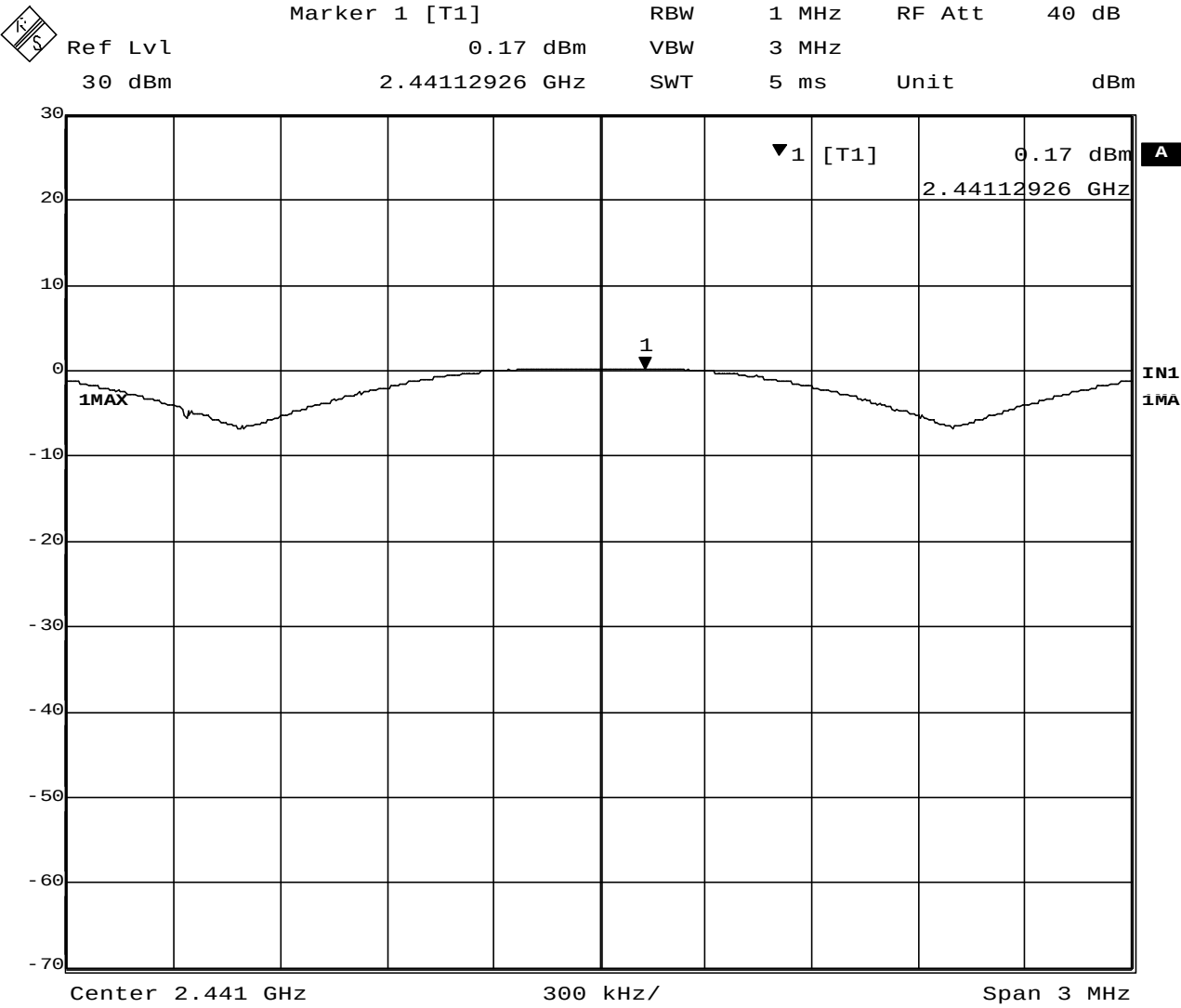
Date: 18.DEC.2002 11:16:56

Peak Output Power (TX on 2441MHz)



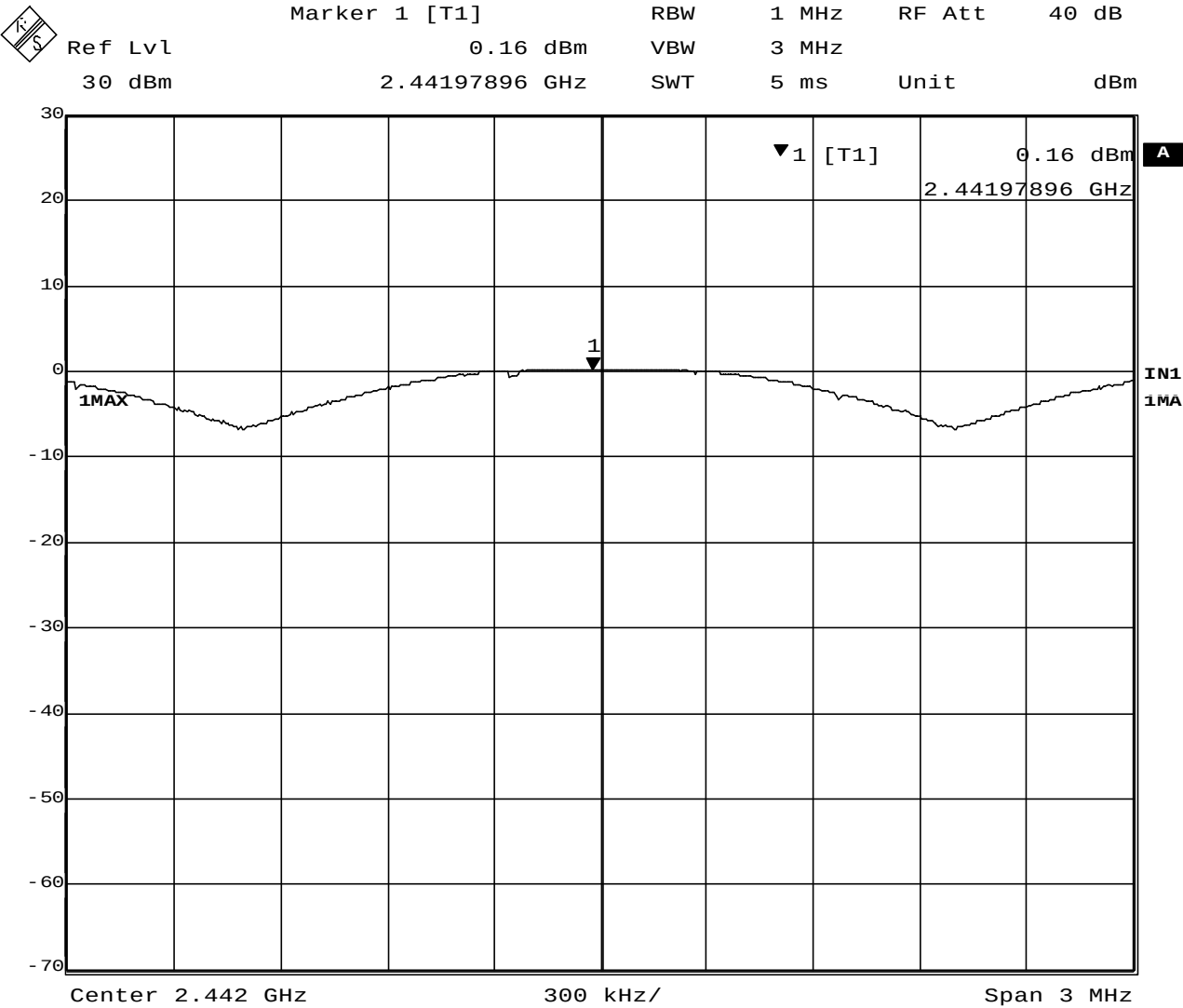
Date: 18.DEC.2002 11:43:04

Peak Output Power (TX on 2480MHz)



Date: 18.DEC.2002 11:48:39

Peak Output Power (Inquiry)



Date: 18.DEC.2002 11:51:21

Peak Output Power (Paging)

6. Band-edge (at 20 dB blow)

6.1 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 had its hopping function disabled at the highest, middle and the lowest available channels.
- The spectrum analyzer is set to :
 - Center frequency = the highest, middle and the lowest channels,
 - Span = 8 MHz
 - RBW : 1% of span or more = 100 kHz
 - VBW : equal to RBW or more = 100 kHz
 - Sweep = auto, Detector function = peak, Trace = max hold
- After the trace being stable. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down both sides of the intentional emission.

6.2 Test Instruments and Measurement Setup

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

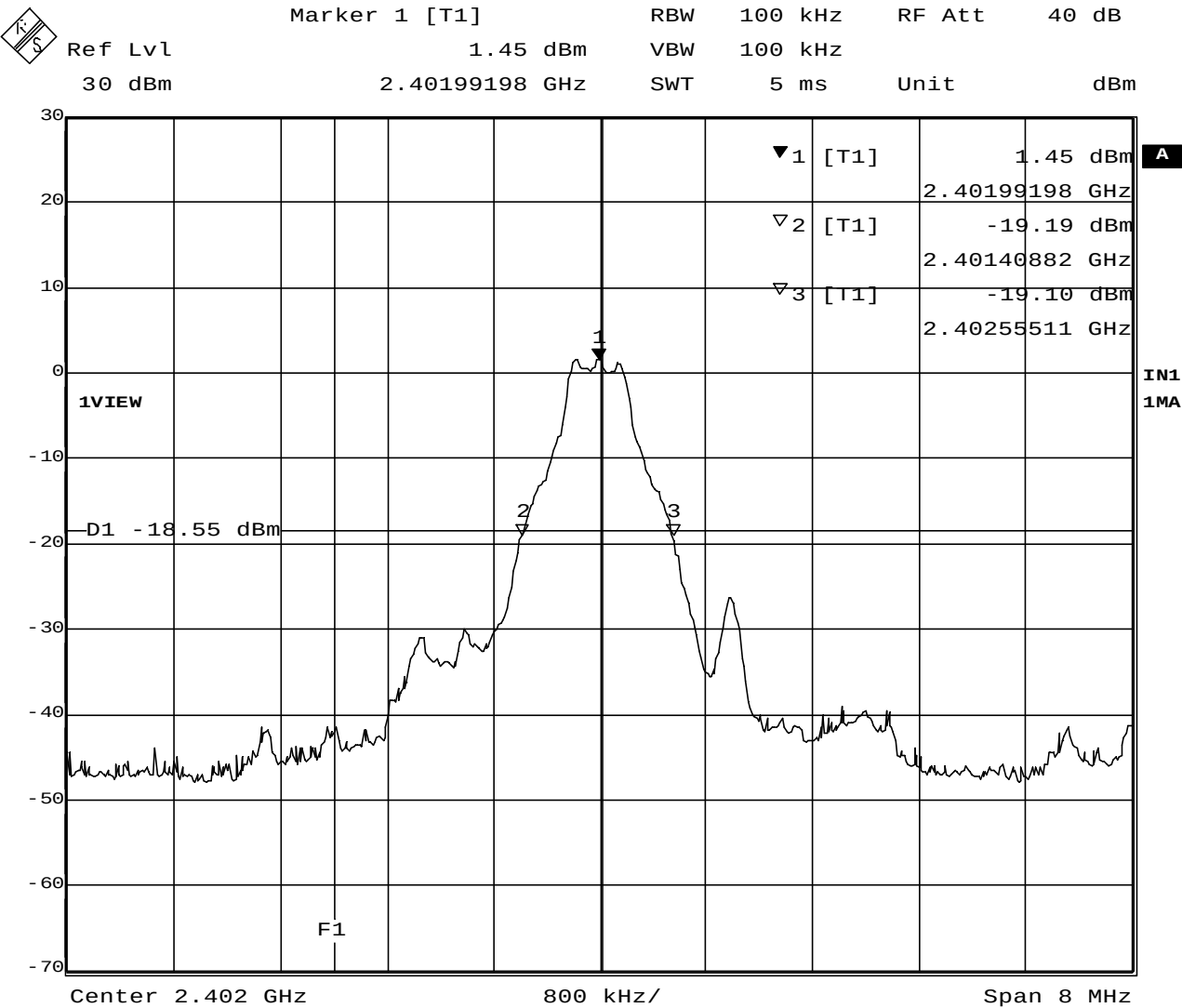
6.3 Measurement Results

Test Date: December 18, 2002

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

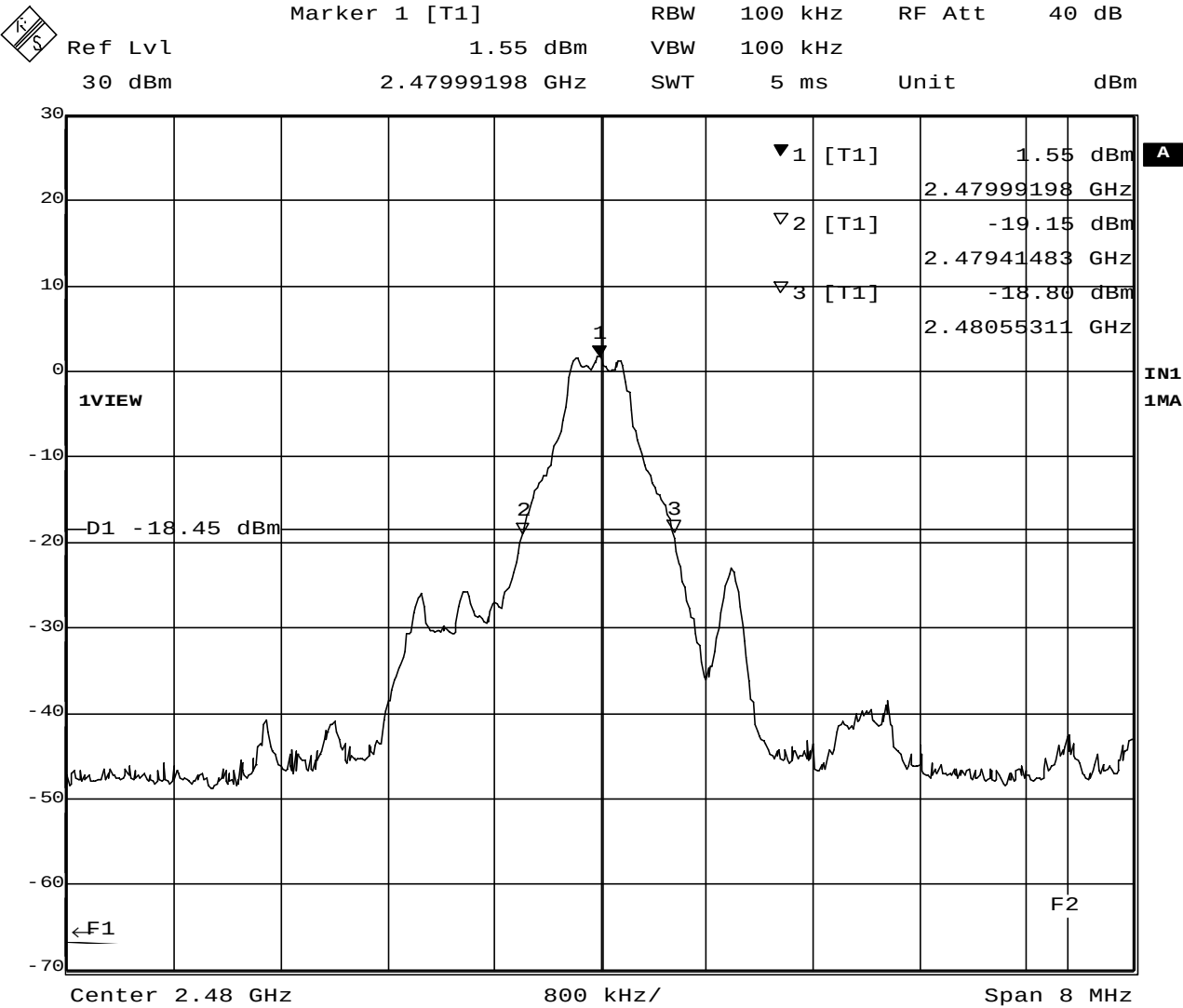
Center Frequency (MHz)	Lower Frequency (MHz)	Upper Frequency (MHz)	Margin to Lower limit (MHz)	Margin to Upper limit (MHz)
2402 (ch. 1)	2401.409	2402.555	1.409	
2480 (ch. 79)	2479.415	2480.553		2.947

6.4 Trace Data



Date: 18.DEC.2002 12:12:14

Band-edge (TX on 2402MHz)



Date: 18.DEC.2002 12:49:59

Band-edge (TX on 2480MHz)

7. Out of Band Emissions

7.1 Test Procedure

- The out of band emissions is measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels.
- The spectrum analyzer is set to :
 - Center frequency = the highest, middle and the lowest channels
 - Span : 100 MHz
 - RBW : 100 kHz
 - VBW : 100 kHz
 - Sweep = auto, Detector function = peak, Trace = max hold
- After the trace being stable. Use the marker-to-peak function to set the marker to the peak of the inband emission. Use the marker-delta function to measure 20 dB down the peak of the inband emission.

7.2 Test Instruments and Measurement Setup

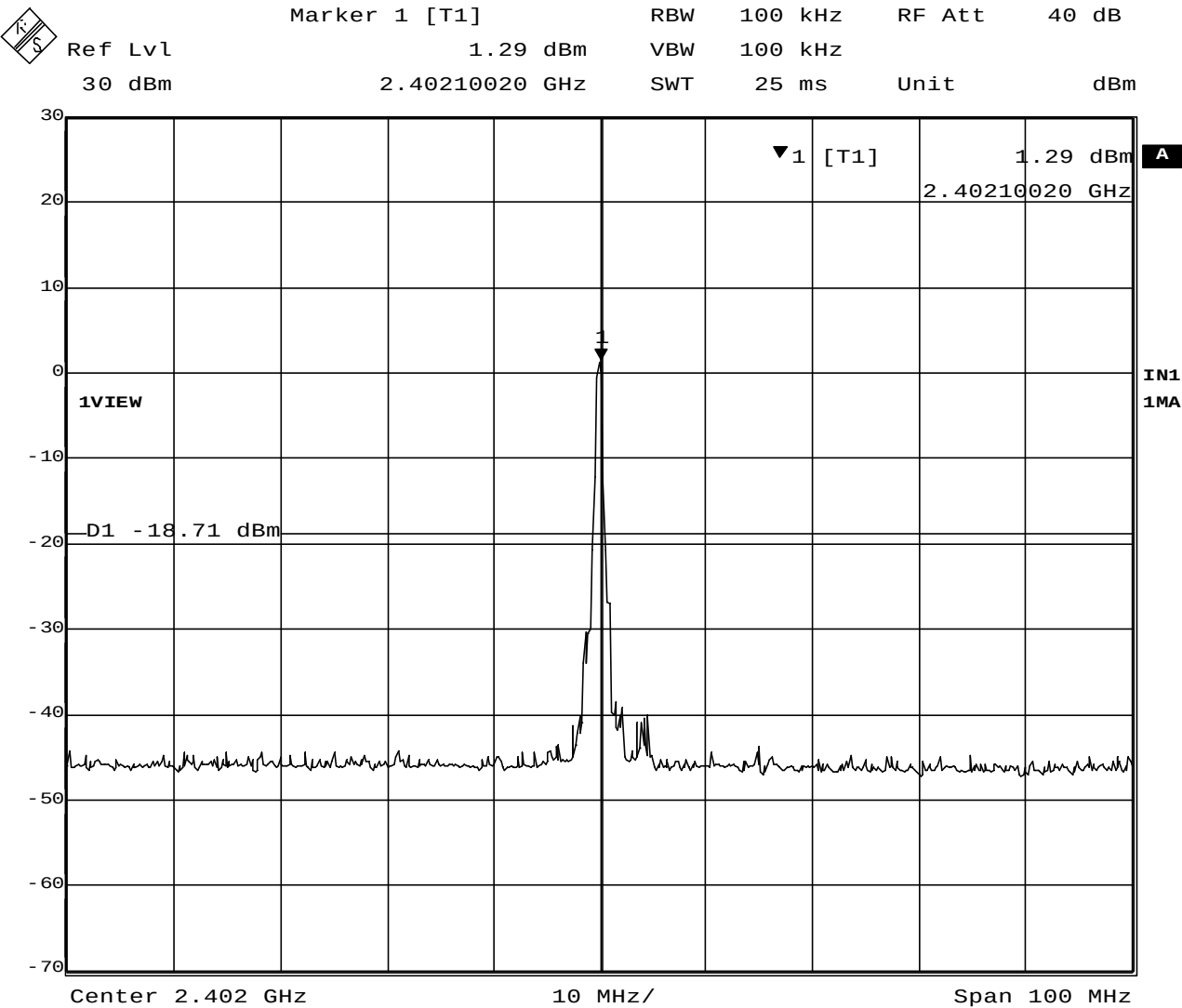
Same as the Chapter 1(Table 1-1 & Figure 1).

7.3 Measurement Results

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

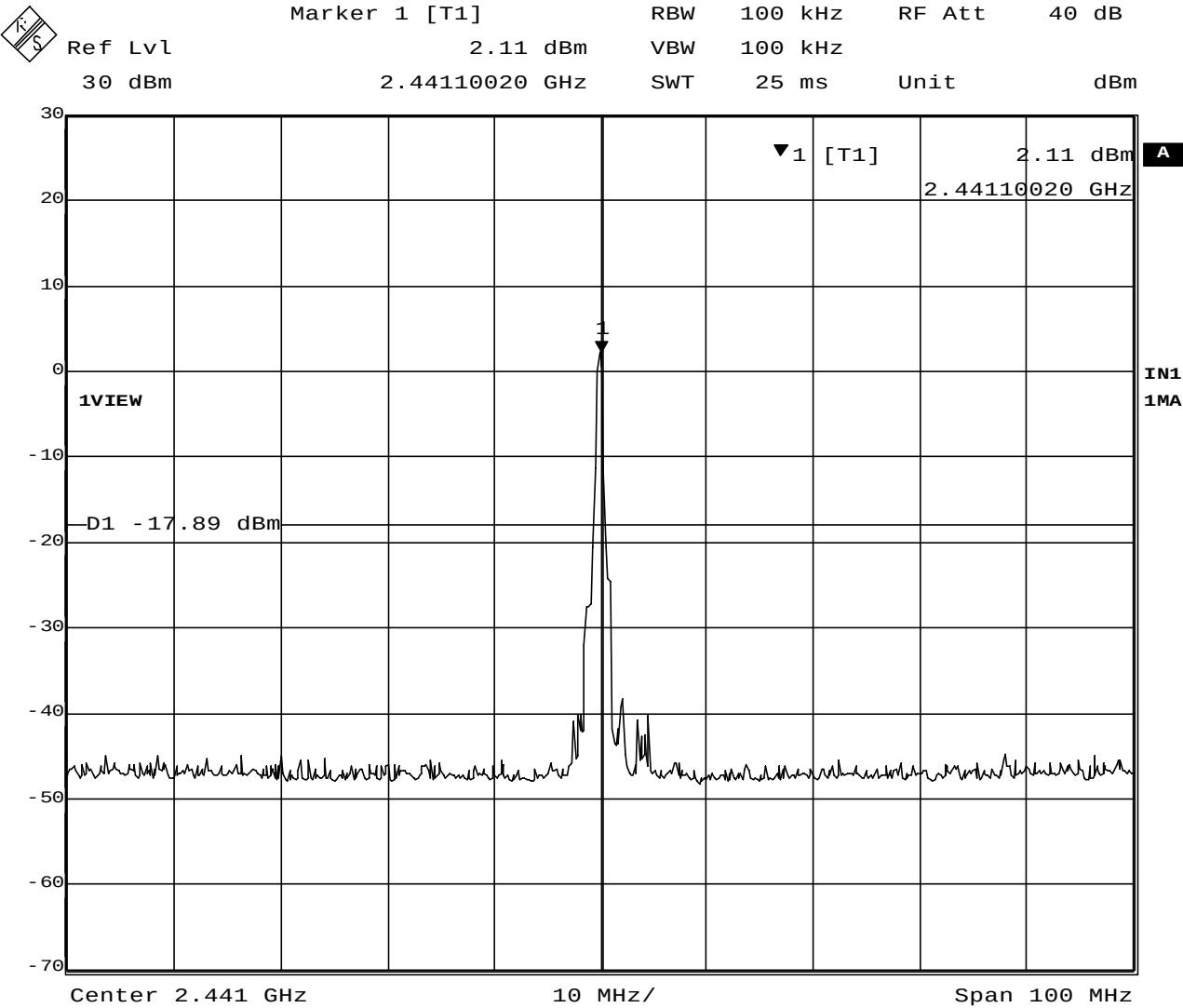
Test Date: December 18, 2002

7.4 Trace Data



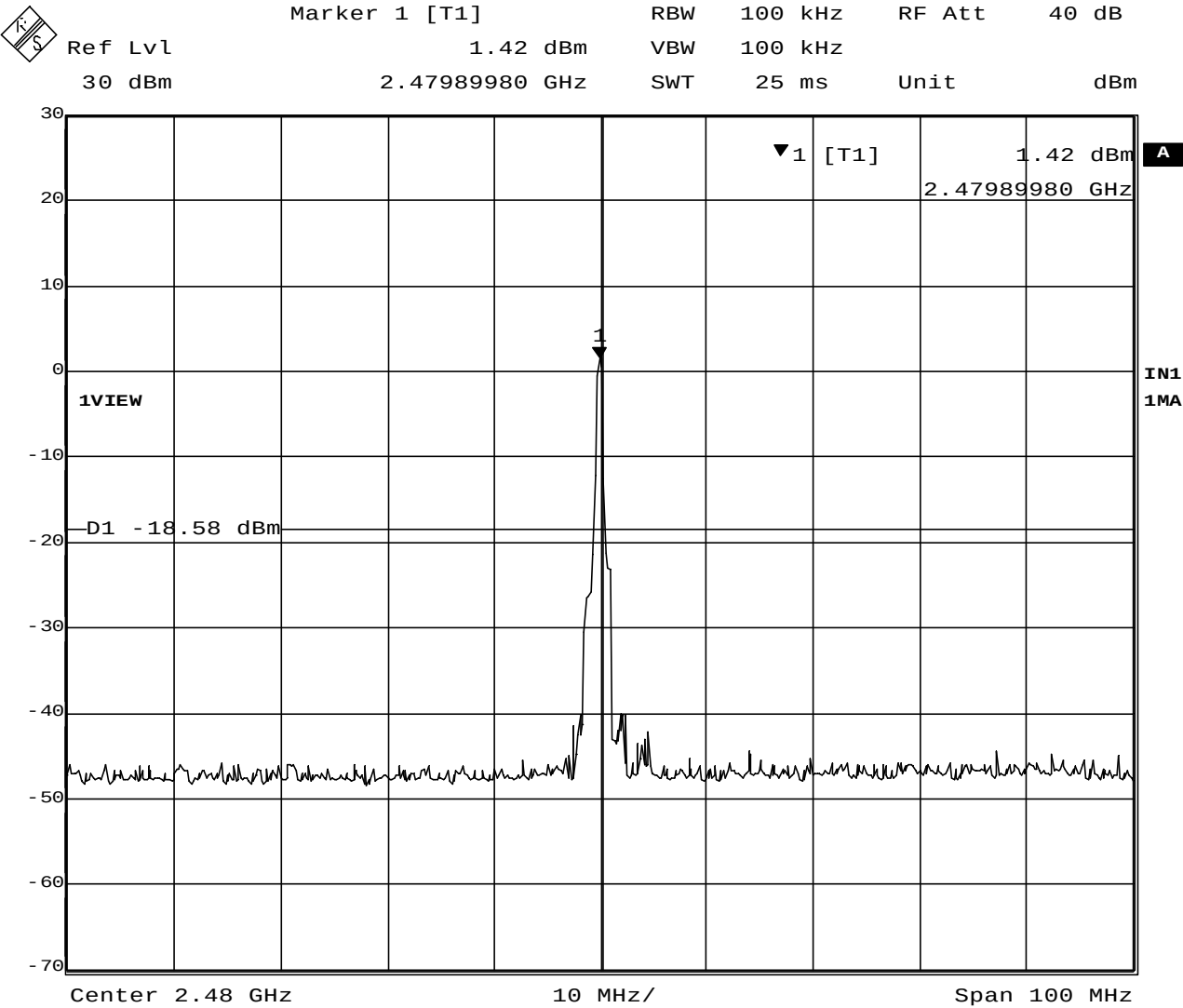
Date: 18.DEC.2002 12:54:27

Out of Band Emissions (TX on 2402MHz)



Date: 18.DEC.2002 12:55:15

Out of Band Emissions (TX on 2441MHz)



Date: 18.DEC.2002 12:56:28

Out of Band Emissions (TX on 2480MHz)

8. Transmitter Power Spectral Density

8.1 Test Procedure

The peak power density is measured with a spectrum analyzer connected to the antenna terminal, while EUT had been operating in Inquiry and Paging mode.

The spectrum analyzer is set to:

Center Frequency = middle channel, RBW = 3 kHz, VBW = 3 kHz, Span = 2 MHz, Sweep = auto

8.2 Test Instruments and Measurement Setup

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

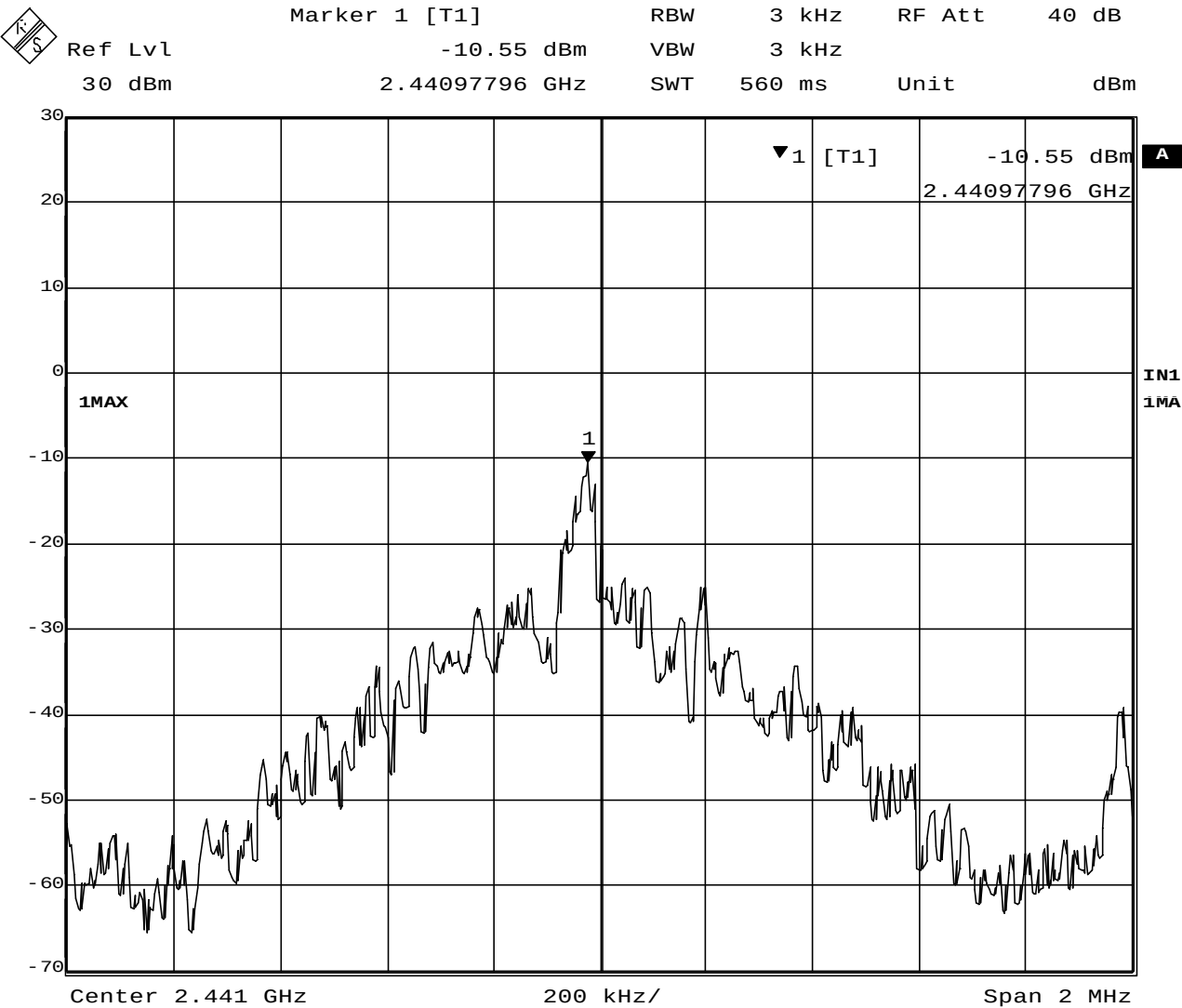
8.3 Measurement Results

Test Date: December 18, 2002

Table 8. EUT: M/T 2373-92U, s/n ZZ-00129

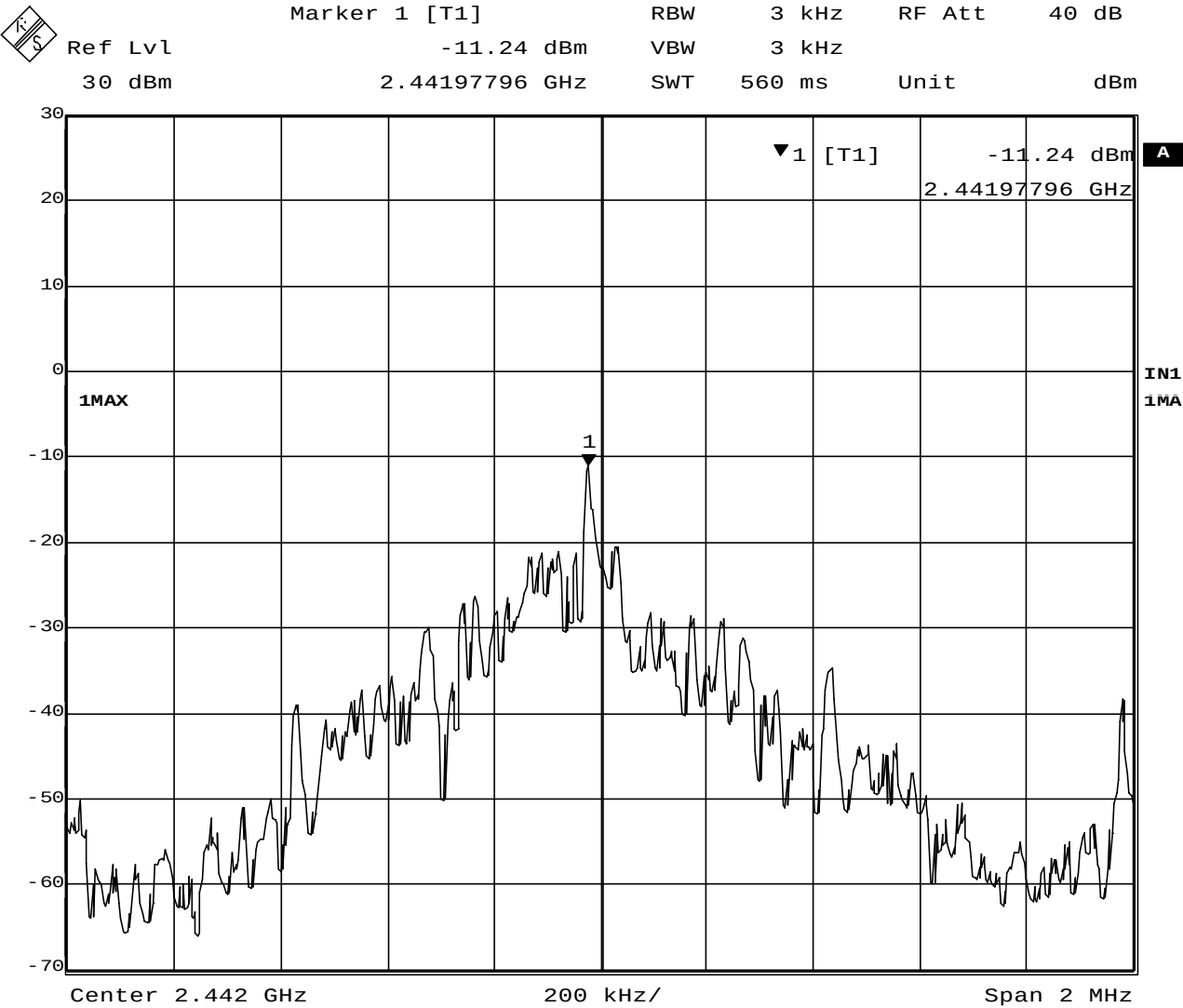
EUT Operation mode	Measured Frequency (MHz)	Spectrum Analyzer Reading (dBm)	Cable loss (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
Inquiry	2440.98	- 10.6	1.3	-9.3	8.0	17.3
Paging	2441.98	- 11.2	1.3	-9.9	8.0	17.9

8.4 Trace Data



Date: 18.DEC.2002 13:00:37

Transmitter Power Spectral Density (Inquiry)



Date: 18.DEC.2002 13:04:14

Transmitter Power Spectral Density (Paging)

9. AC WIRELINE CONDUCTED EMISSIONS (150 kHz – 30 MHz)

9.1 Test Procedure

The conducted emissions are measured in the IBM shielded room with a spectrum analyzer in peak hold. While the measurement, EUT had its hopping function disabled at the highest, middle and lowest available channels in line with Section 15.31(m) of Public Notice DA 00-705 dated March 30, 2000. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation and Exerciser operation. The highest emissions relative to the limit are listed.

9.2 Test Instruments and Measurement Setup

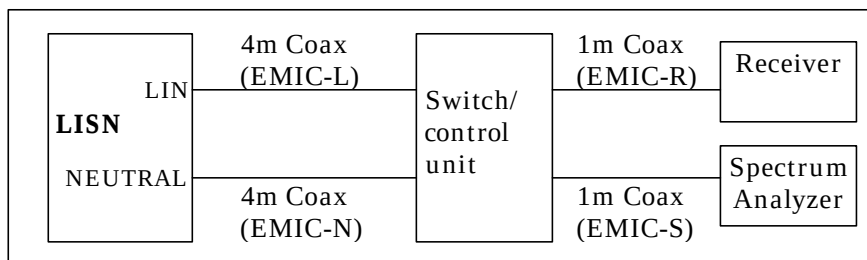


Figure 9. Cables for Conducted Emission Test

Table 9-1. 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:	Length:	
- Lisen-L <=> SW/Con.unit (SW100)	4 m	- EMIC-L
- Lisen-N <=> SW/Con.unit (SW101)	4 m	- EMIC-N
- SW/Con.unit <=> RCVR (Input)	1 m	- EMIC-R
- SW/Con.unit<=> Spe Ana.(Signal In)	1 m	- EMIC-S

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

9.3 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 12.4dB. The 6 highest emissions relative to the limits are reported.

Test Date: January 9, 2003

1) EUT in transmission mode

Table 9-2-1. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.1(2402MHz)

Frequency (MHz)	Phase	QP Voltage (dBμV)	CISPR22 QP Limit (dBμV)	AV Voltage (dBμV)	CISPR22 AV Limit (dBμV)
0.2036	NEUTRAL	51.1	63.5	39.7	53.5
0.2841	LINE	38.6	60.7	29.9	50.7
0.3826	NEUTRAL	30.9	58.2	25.6	48.2
0.4768	LINE	28.1	56.4	23.5	46.4
1.0991	LINE	28.5	56.0	25.2	46.0
1.2951	LINE	29.2	56.0	26.4	46.0

Table 9-2-2. EUT: M/T 2373-92U, s/n ZZ-00129 , Ch.40(2441MHz)

Frequency (MHz)	Phase	QP Voltage (dBμV)	CISPR22 QP Limit (dBμV)	AV Voltage (dBμV)	CISPR22 AV Limit (dBμV)
0.2031	LINE	51.1	63.5	40.0	53.5
0.2837	NEUTRAL	38.5	60.7	29.3	50.7
0.5032	LINE	29.4	56.0	27.1	46.0
1.1930	LINE	28.0	56.0	24.8	46.0
1.2936	LINE	29.2	56.0	26.4	46.0
1.3950	LINE	28.1	56.0	24.7	46.0

Table 9-2-3. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.79(2480MHz)

Frequency (MHz)	Phase	QP Voltage (dBμV)	CISPR22 QP Limit (dBμV)	AV Voltage (dBμV)	CISPR22 AV Limit (dBμV)
0.1963	LINE	50.6	63.8	39.2	53.8
0.3027	LINE	37.5	60.2	28.9	50.2
0.5028	LINE	29.4	56.0	27.1	46.0
1.0982	NEUTRAL	24.9	56.0	21.7	46.0
1.2928	LINE	26.3	56.0	24.5	46.0
1.3915	LINE	27.3	56.0	25.5	46.0

2) EUT in receiving mode

Table 9-2-4. EUT: M/T 2373-92U, s/n ZZ-00129, RX mode

Frequency (MHz)	Phase	QP Voltage (dB μ V)	CISPR22 QP Limit (dB μ V)	AV Voltage (dB μ V)	CISPR22 AV Limit (dB μ V)
0.1966	LINE	51.0	63.8	39.6	53.8
0.2843	LINE	38.6	60.7	30.2	50.7
0.3824	NEUTRAL	31.0	58.2	25.7	48.2
0.5033	NEUTRAL	29.1	56.0	26.9	46.0
1.0990	NEUTRAL	28.3	56.0	25.0	46.0
1.2926	LINE	29.1	56.0	26.3	46.0

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

10.1 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 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 120 kHz. The highest emissions relative to the limit are listed.

While the measurement, EUT had its hopping function disabled at the highest, middle and lowest available channels in line with Section 15.31(m) of Public Notice DA 00-705 dated March 30, 2000.

10.2 Test Instruments and Measurement Setup

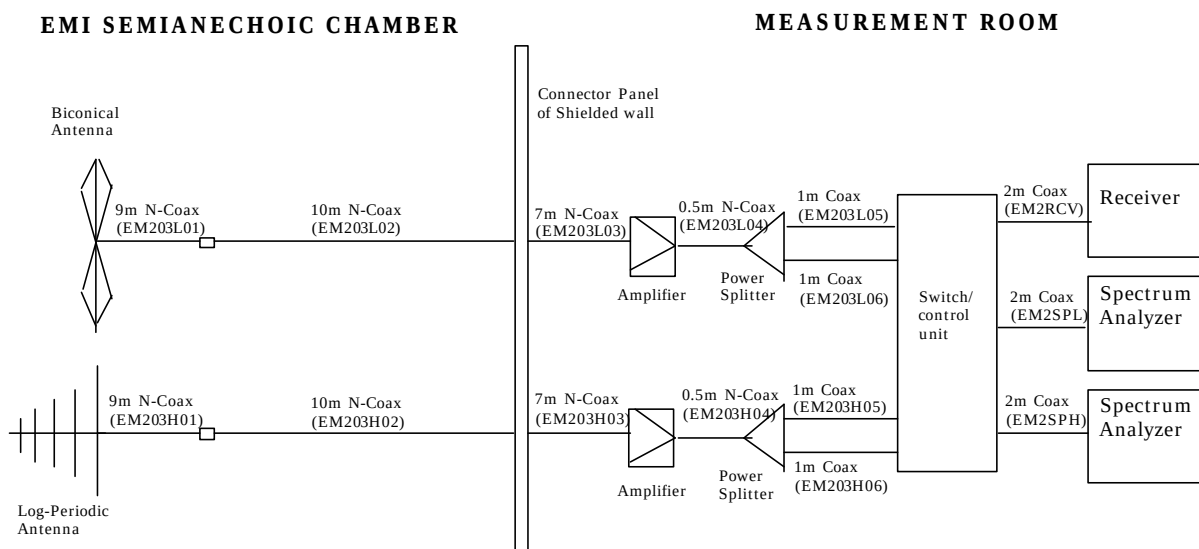


Figure 10 Cables for Radiated Emission Test

Table 10-1 Radiated Emission Test Instrumentation

Description	Model	Serial Number
Computer	IBM 5551-L	#4
Spectrum Analyzer (100Hz-1.5GHz) for 30-200MHz	HP 85680B	3019A05155
Spectrum Analyzer Display for 30-200MHz	HP 85662A	3026A19353
Quasi-Peak Adapter for 30-200MHz	HP 85650A	3033A01449
Spectrum Analyzer (100Hz-1.5GHz) for 200-1000MHz	HP 85680B	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	2944A03506
Biconical Antenna (30-200MHz)	EMCO 3108	2309
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	1585
Receiver (20MHz-1.3GHz)	R&S ESVP	893202/018
Switch/control unit	HP 3488A	2719A17226
N-Coax cables:	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

10.3 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:

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

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

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

10.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 6.5 dB at 30 – 1000 MHz band.

The 6 highest emissions relative to the limits are reported.

Test Date: November 28, 2002

1) EUT in transmission mode

Table 10-2-1. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.1 (2402MHz) TX mode

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
159.431	H	40.9	12.4	-16.5	36.8	43.5	69.2	150
200.452	H	33.8	11.3	-12.6	32.5	43.5	42.2	150
255.997	H	34.8	11.9	-14.6	32.1	46.0	40.3	200
464.890	V	32.1	16.8	-13.8	35.1	46.0	56.9	200
596.493	V	29.1	18.6	-12.7	35.0	46.0	56.2	200
730.700	V	21.8	20.6	-11.0	31.4	46.0	37.2	200

Table 10-2-2. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.40 (2441MHz) TX mode

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
143.180	H	36.8	12.2	-16.6	32.4	43.5	41.7	150
160.417	H	40.4	12.4	-16.4	36.4	43.5	66.1	150
255.997	H	34.0	11.9	-14.6	31.3	46.0	36.7	200
398.674	V	33.2	15.2	-14.3	34.1	46.0	50.7	200
466.114	V	33.0	16.8	-13.7	36.1	46.0	63.8	200
499.706	V	24.4	17.8	-13.3	28.9	46.0	27.9	200

Table 10-2-3. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.79 (2480MHz) TX mode

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
34.900	H	27.6	12.6	-18.6	21.6	40.0	12.0	100
158.628	H	38.9	12.4	-16.4	34.9	43.5	55.6	150
200.452	H	32.1	11.3	-12.6	30.8	43.5	34.7	150
464.714	V	32.0	16.7	-13.8	34.9	46.0	55.6	200
497.657	V	23.7	17.7	-13.4	28.0	46.0	25.1	200
600.424	V	26.0	18.7	-12.7	32.0	46.0	39.8	200

2) EUT in receiving mode

Table 10-2-4. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.40 (2441MHz) 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)
158.633	H	41.0	12.4	-16.4	37.0	43.5	70.8	150
255.997	H	35.5	11.9	-14.6	32.8	46.0	43.7	200
398.992	V	31.9	15.2	-14.3	32.8	46.0	43.7	200
464.742	V	32.0	16.7	-13.8	34.9	46.0	55.6	200
596.494	V	29.7	18.6	-12.7	35.6	46.0	60.3	200
730.219	V	24.1	20.6	-11.1	33.6	46.0	47.9	200

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

11.1 Test Procedure

Radiated emissions were measured in the frequency range with 1 to 25 GHz in transmitting mode and 1 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 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 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 1 MHz / video bandwidth of 1 kHz or 100 Hz. The highest emissions relative to the limit are listed. While the measurement, EUT had its hopping function disabled at the highest, middle and lowest available channels in line with Section 15.31(m) of Public Notice DA 00-705 dated March 30, 2000.

11.2 Test Instruments and Measurement

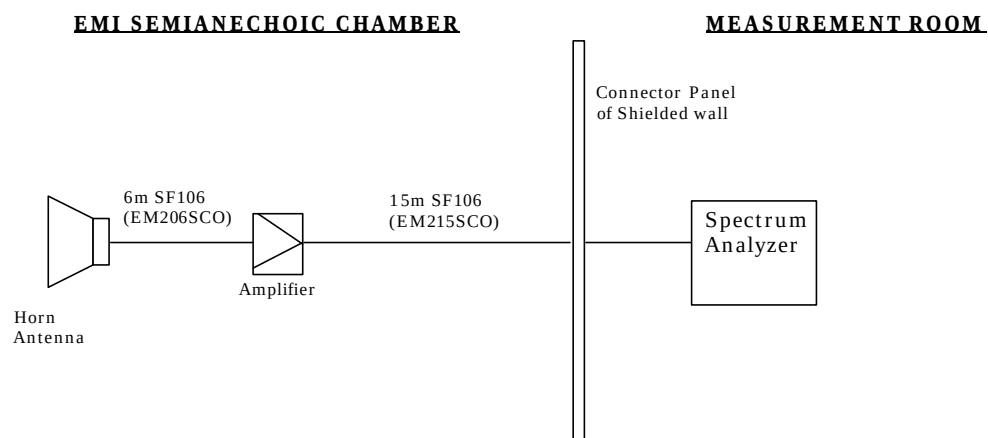


Figure 11 Cables for Radiated Emission Test

Table 11 Radiated Emission Test Instrumentation (1 – 25 GHz)

Description	Model	Serial Number
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003
Amplifier (1 - 26.5GHz)	HP 8449B	3008A00582
Horn Antenna (1- 18GHz)	EMCO 3115	9903-5774
Horn Antenna (3.95 – 5.85GHz)	EMCO 3160-5	1099
Horn Antenna (5.85 – 8.20GHz)	EMCO 3160-6	9712-1044
Horn Antenna (18- 26.5GHz)	EMCO 3160-9	0004-1202
SF106 cables: - Horn Ant <=> RF Amp. - RF Amp.<=>Spectrum Analyzer	Length: 6 m 15 m	- EM206SCO - EM215SCO

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

11.3 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 :

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

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

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

11.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 7.5dB. The measurement was done for the frequency range of 1 to 25 GHz in TX mode and 1 to 12.5 GHz in RX mode.

Test Date: December 2, 2002

1) EUT in transmission mode

Table 11-2-1. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.1(2402MHz) TX 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>)
1.008	V	47.2	-	24.1	-32.9	0.0	38.4	74.0	-	54.0
1.046	V	48.4	-	24.6	-32.7	0.0	40.3	74.0	-	54.0
1.066	V	51.4	-	24.6	-32.7	0.0	43.3	74.0	-	54.0
1.196	V	54.2	-	25.2	-32.3	0.0	47.1	74.0	-	54.0
2.386	V	49.8	-	28.2	-30.4	0.0	47.6	74.0	-	54.0
2.402	V	98.8	94.2	28.2	-30.4	0.0	96.6	OB*	92.0	OB*
4.032	V	39.0	-	27.2	-28.5	0.0	37.7	74.0	-	54.0
4.806	V	39.3	-	27.1	-27.9	0.0	38.5	74.0	-	54.0

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

Table 11-2-2. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.40(2441MHz) TX 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>)
1.008	V	47.6	-	24.1	-32.9	0.0	38.8	74.0	-	54.0
1.046	V	47.7	-	24.6	-32.7	0.0	39.6	74.0	-	54.0
1.066	V	52.0	-	24.6	-32.7	0.0	43.9	74.0	-	54.0
1.198	V	50.3	-	25.2	-32.3	0.0	43.2	74.0	-	54.0
2.441	V	98.4	94.1	28.4	-30.3	0.0	96.5	OB*	92.2	OB*
4.028	V	39.9	-	27.2	-28.4	0.0	38.7	74.0	-	54.0
7.324	V	38.5	-	29.8	-25.7	0.0	42.6	74.0	-	54.0

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

Table 11-2-3. EUT: M/T 2373-92U, s/n ZZ-00129, Ch.79(2480MHz) TX 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>
1.008	V	49.0	-	24.1	-32.9	0.0	40.2	74.0	-	54.0
1.066	V	49.1	-	24.6	-32.7	0.0	41.0	74.0	-	54.0
1.198	V	52.4	-	25.2	-32.3	0.0	45.3	74.0	-	54.0
1.328	V	47.5	-	25.6	-31.8	0.0	41.3	74.0	-	54.0
2.480	V	98.1	93.6	28.4	-30.2	0.0	96.3	OB*	91.8	OB*
2.484	V	56.3	48.3	28.4	-30.2	0.0	54.5	74.0	46.5	54.0
4.010	V	43.3	-	27.1	-28.6	0.0	41.8	74.0	-	54.0
4.962	V	37.8	-	27.1	-27.8	0.0	37.1	74.0	-	54.0
7.441	V	36.8	-	29.8	-25.2	0.0	41.4	74.0	-	54.0

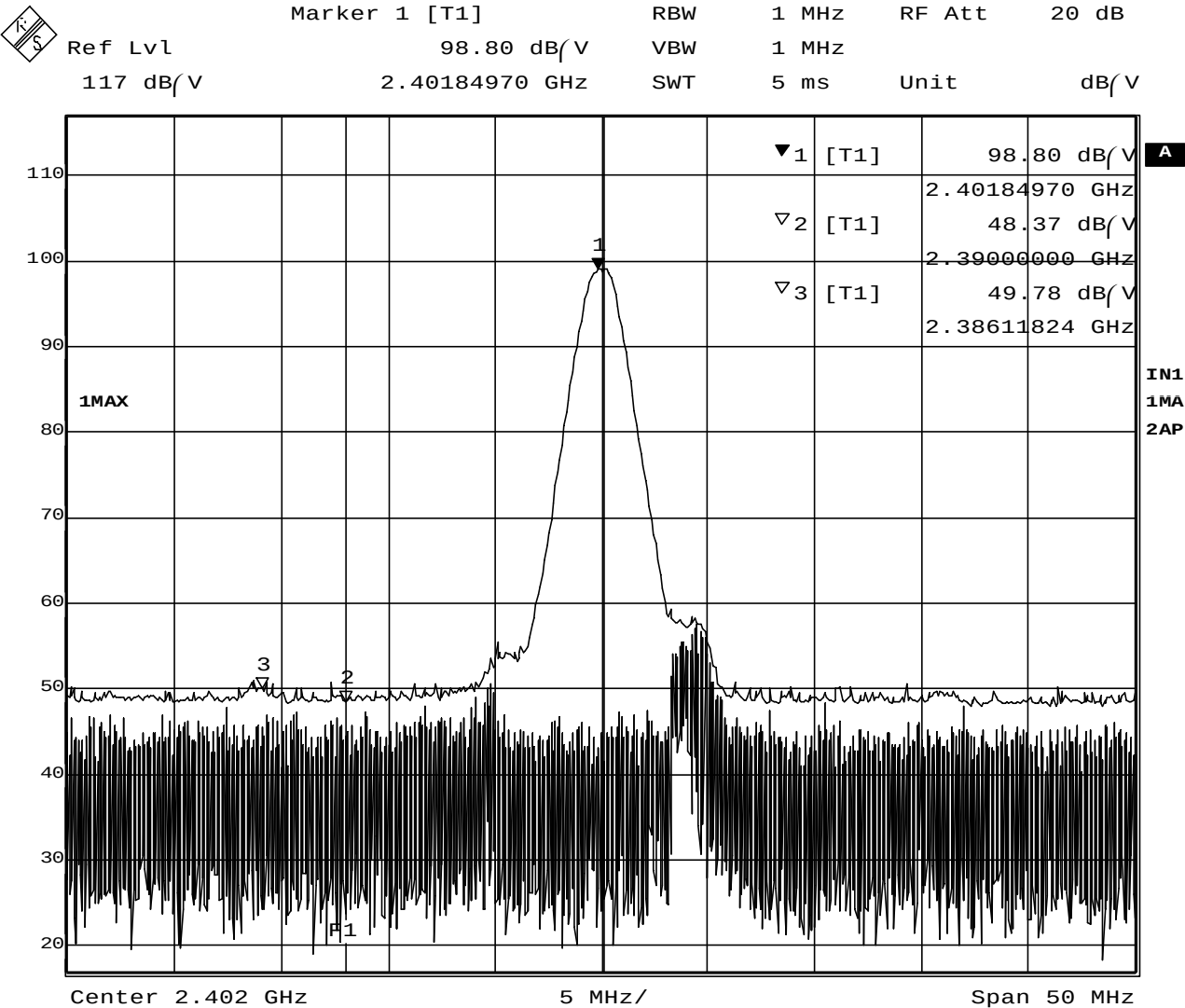
*Note: OB means “operation band” (2400-2483.5MHz); in this case limit is 1W (measured conducted with power meter).

2) EUT in receiving mode

Table 11-2-4. EUT: M/T 2373-92U, s/n ZZ-00129, 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>
1.008	V	47.8	-	24.1	-32.9	0.0	39.0	74.0	-	54.0
1.066	V	49.5	-	24.6	-32.7	0.0	41.4	74.0	-	54.0
1.198	V	50.1	-	25.2	-32.3	0.0	43.0	74.0	-	54.0
4.036	V	42.4	-	27.2	-28.5	0.0	41.1	74.0	-	54.0

Measurement plots for adjacent restricted band



Date: 2.DEC.2002 13:46:56

Plot 11-2-1 Ch.1 2402MHz TX (Peak)

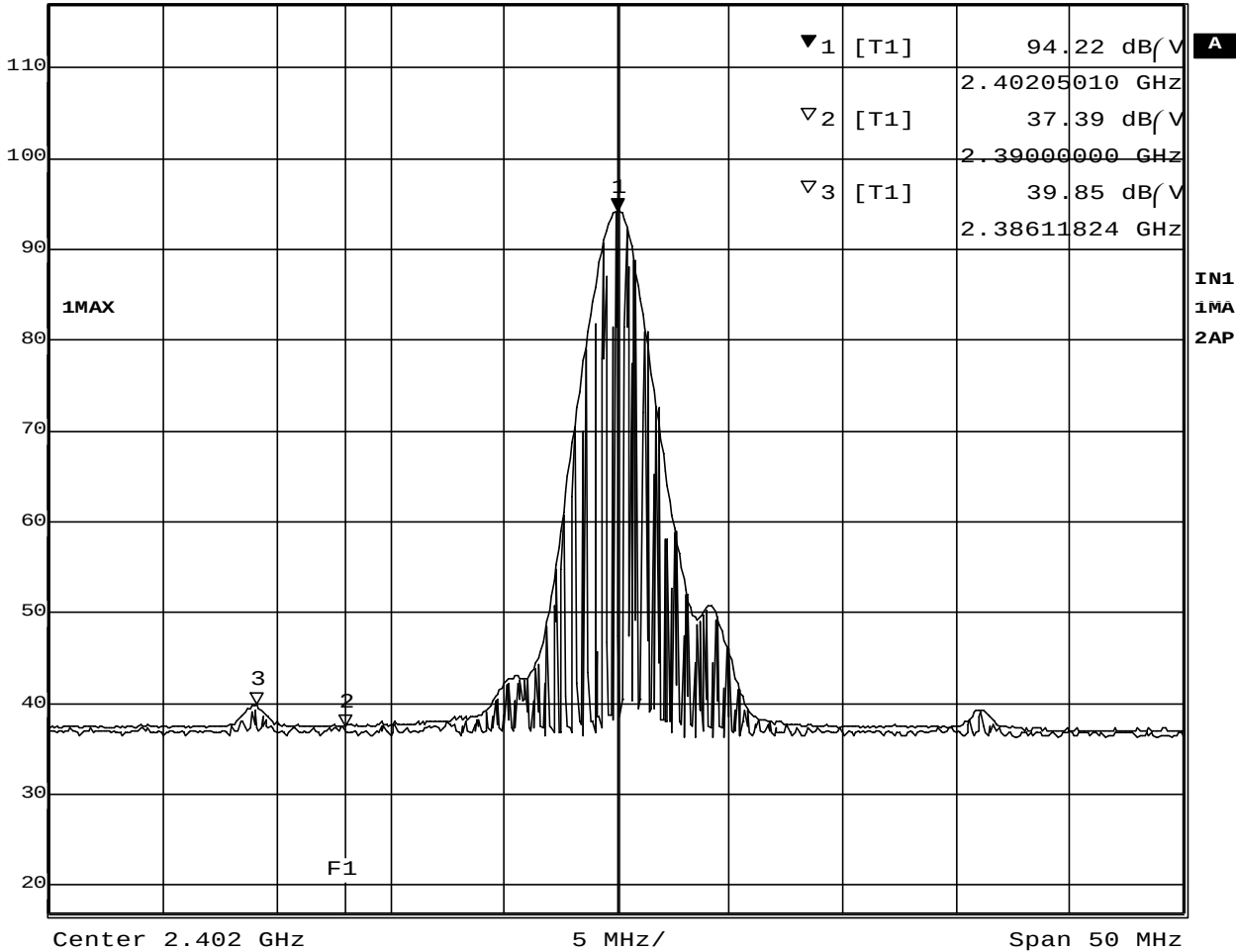


Marker 1 [T1]

RBW 1 MHz RF Att 20 dB

Ref Lvl 117 dB/V 94.22 dB/V VBW 1 kHz

2.40205010 GHz SWT 125 ms Unit dB/V



Date: 2.DEC.2002 13:47:38

Plot 11-2-2 Ch.1 2402MHz TX (Average)



Marker 1 [T1]

RBW 1 MHz RF Att 20 dB

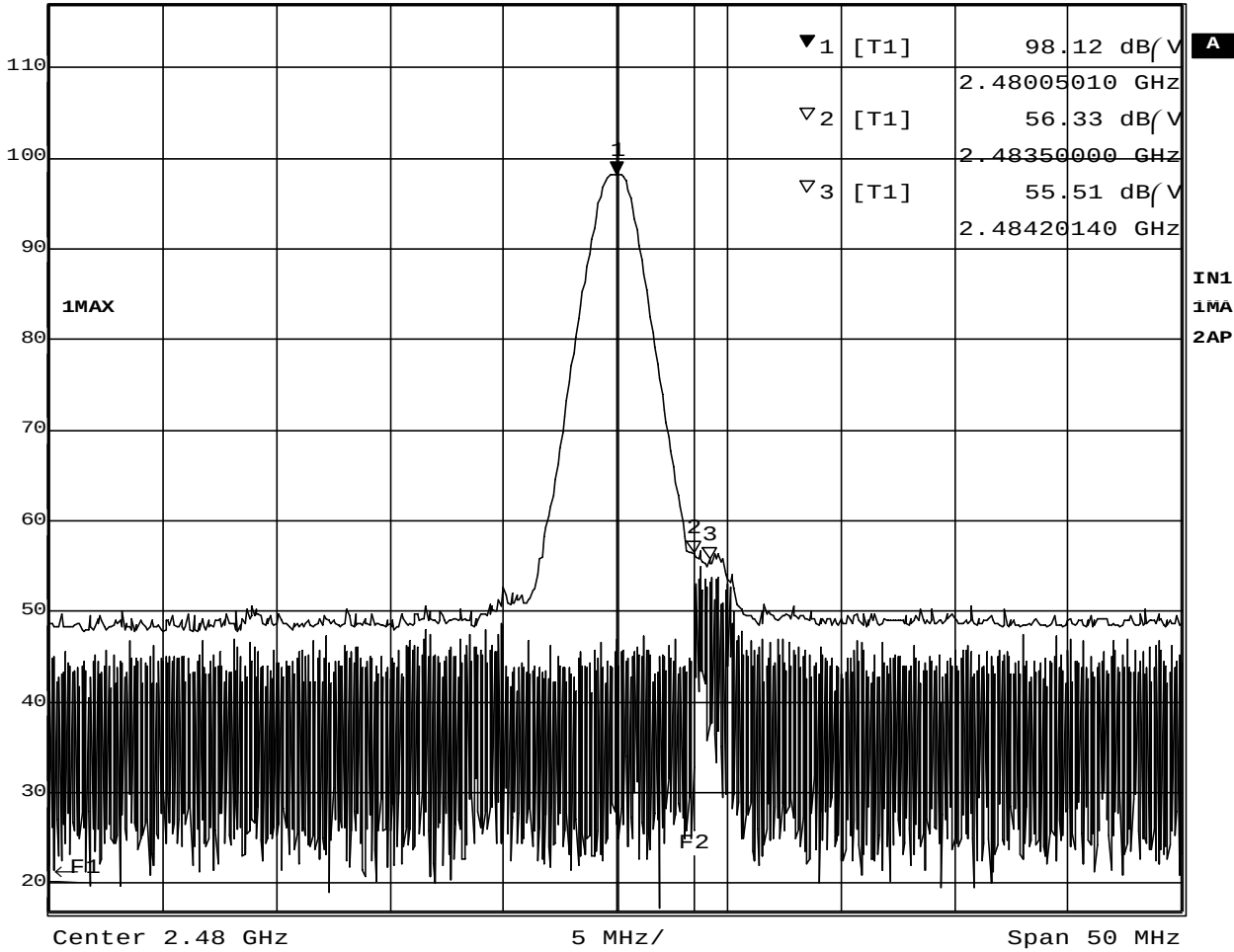
Ref Lvl 117 dB/V

98.12 dB/V

VBW 1 MHz

2.48005010 GHz

SWT 5 ms Unit dB/V



Date: 2.DEC.2002 13:57:22

Plot 11-2-3 Ch.79 2480MHz TX (Peak)



Marker 1 [T1]

Ref Lvl 117 dB/V

93.55 dB/V

2.48005010 GHz

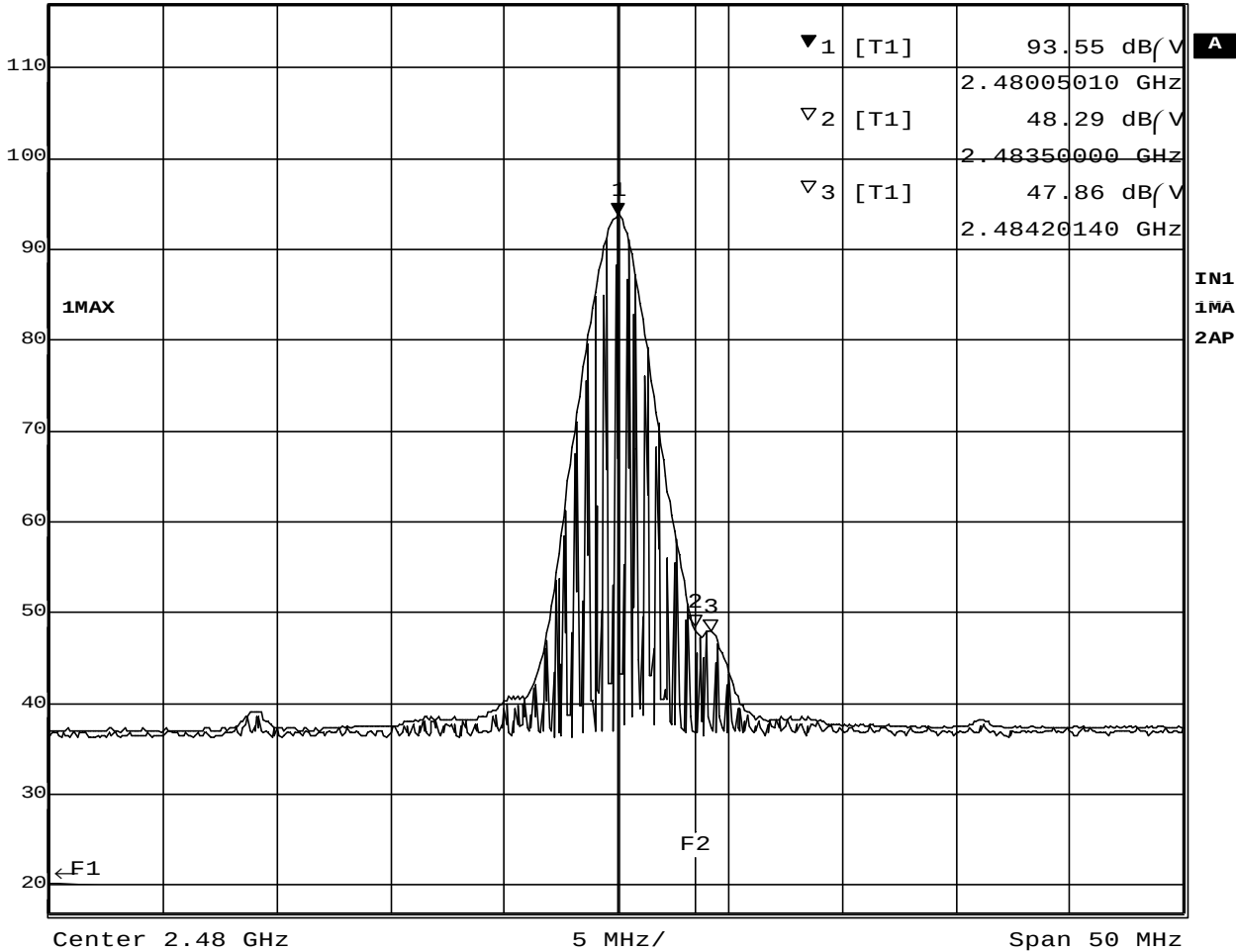
RBW 1 MHz

VBW 1 kHz

SWT 125 ms

RF Att 20 dB

Unit dB/V



Date: 2.DEC.2002 13:58:01

Plot 11-2-4 Ch.79 2480MHz TX (Average)