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

Document Number : FCC 19-0175-0

Product: IBM ThinkPad X23
Included IBM Bluetooth Daughter Card

FCC ID: ANOSY4W2662DFJ

October 5, 2001

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A. GENERAL INFORMATION

APPLICANT	: IBM Japan Ltd.
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REGULATION	: FCC Part 15 Subpart C Industry Canada RSS-210 (Issue No.4)
MODEL NUMBER	: 2662-E6x (ThinkPad X23)
FCC ID	: ANOSY4W2662DFJ
SERIAL NUMBER	: FX-00154
PYSICAL CONDITION	: Preproduction
KIND OF EQUIPMENT	: Personal computer with a built-in Bluetooth card
TESTED DATE	: September 20, 25, 26, 27, October 1, 3 and 4, 2001
TEST SITE	: IBM Yamato semi-anechoic chamber #2

A.1 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4-1992. Radiated testing was performed at an antenna to EUT distance of 3 meters.

A.2 Test Facility / NVLAP Accreditation

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

- This facility has been fully described in a report dated September 1998, submitted to the FCC office, and accepted in a letter, dated Nov. 2,1998(31040/SIT).
- This facility is accepted by **Industry Canada** in a letter dated March 19, 2001 as number **IC 349E**.
- 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)

A.3 EUT details

Table A EUT details

Model and S/N	FCC ID	Description	Cable Description
ThinkPad X23 M/T 2662-E6x (s/n FX-00154)	ANOSY4W2662DFJ	IBM Notebook PC CPU: Intel® Mobile Geyserville® 866MHz LV	
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 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 MHz ≤ χ ≤ 2483.5 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)**	Processing Gain for Hybrid System	17 dB		Pass ***1**
	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 450 kHz – 30 MHz	Class B: 250 μV		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 450 kHz – 30 MHz	Class B: 250 μV	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

***1**: See TDK Systems Europe Ltd. report.

Prepared by T. Asano

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]
1	2.402
2	2.403
3	2.404
4	2.405
5	2.406
6	2.407
7	2.408
8	2.409
9	2.410
10	2.411
11	2.412
12	2.413
13	2.414
14	2.415
15	2.416
16	2.417
17	2.418
18	2.419
19	2.420
20	2.421

Ch.	Operation Frequency [GHz]
21	2.422
22	2.423
23	2.424
24	2.425
25	2.426
26	2.427
27	2.428
28	2.429
29	2.430
30	2.431
31	2.432
32	2.433
33	2.434
34	2.435
35	2.436
36	2.437
37	2.438
38	2.439
39	2.440
40	2.441

Ch.	Operation Frequency [GHz]
41	2.442
42	2.443
43	2.444
44	2.445
45	2.446
46	2.447
47	2.448
48	2.449
49	2.450
50	2.451
51	2.452
52	2.453
53	2.454
54	2.455
55	2.456
56	2.457
57	2.458
58	2.459
59	2.460
60	2.461

Ch.	Operation Frequency [GHz]
61	2.462
62	2.463
63	2.464
64	2.465
65	2.466
66	2.467
67	2.468
68	2.469
69	2.470
70	2.471
71	2.472
72	2.473
73	2.474
74	2.475
75	2.476
76	2.477
77	2.478
78	2.479
79	2.480

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	2732A03651	01/16/01	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	3019A05155	02/07/01	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	3019A05156	04/02/01	1 year
Spectrum Analyzer Display	HP 85662A	2648A15255	01/16/01	1 year
Spectrum Analyzer Display	HP 85662A	3026A19353	02/07/01	1 year
Spectrum Analyzer Display	HP 85662A	3026A19366	04/02/01	1 year
Quasi-Peak Adapter	HP 85650A	2521A00968	01/16/01	1 year
Quasi-Peak Adapter	HP 85650A	3033A01449	02/07/01	1 year
Quasi-Peak Adapter	HP 85650A	2811A01433	04/02/01	1 year
Amplifier (100KHz - 1.3GHz)				
- for 30-200MHz	HP 8447D	2805A02919	04/16/01	1 year
- for 200-1000MHz	HP 8447D	2944A03506	04/16/01	1 year
Amplifier (1GHz - 26.5GHz)	HP 8449B	3008A00582	05/23/01	1 year
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003	07/04/01	1 year
Receiver (9kHz-30MHz)	R&S ESH3	892108/003	10/03/00	1 year
Receiver (20MHz-1.3GHz)	R&S ESVP	893202/018	01/29/01	1 year
Biconical Antenna (30-200MHz)	EMCO 3108	2241	05/11/01	1 year
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	1584	05/10/01	1 year
Horn Antenna (1- 18GHz)	EMCO 3115	9903-5774	04/23/01	1 year
Horn Antenna (3.95- 5.85GHz)	EMCO 3160-5	1099	04/26/01	1 year
Horn Antenna (5.85- 8.20GHz)	EMCO 3160-6	9712-1044	04/26/01	1 year
Horn Antenna (18- 26.5GHz)	EMCO 3160-9	0004-1202	05/01/01	1 year
LISN	EMCO 3825/2	1426	09/01/01	1 year
Power Meter	HP 436A	2604A24192	09/06/01	1 year
Power Sensor	HP 8482A	2607A10987	09/07/01	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	08/07/01	1 year
- RF Amp.<=>Spectrum Analyzer	15m	- EM215SCO	08/07/01	1 year
N-Coax cables:				
- Bi-coni Ant <=> 10m Cable	9 m	- EM203L01	04/16/01	1 year
- 10m Cable <=> Shield Panel	10 m	- EM203L02	04/16/01	1 year
- Shield Panel <=> RF Amp	7 m	- EM203L03	04/16/01	1 year
- RF Amp <=> Power Splitter	0.5m	- EM203L04	04/16/01	1 year
- Log-peri Ant <=> 10m Cable	9 m	- EM203H01	04/16/01	1 year

- 10m Cable <=> Shield Panel	10 m	- EM203H02	04/16/01	1 year
- Shield Panel <=> RF Amp	7 m	- EM203H03	04/16/01	1 year
- RF Amp <=> Power Splitter	0.5m	- EM203H04	04/16/01	1 year
Coax cables:				
- Lisn-L <=> SW/Con.unit (SW100)	4 m	- EMIC-L	04/16/01	1 year
- Lisn-N <=> SW/Con.unit (SW101)	4 m	- EMIC-N	04/16/01	1 year
- SW/Con.unit <=> RCVR (Input)	1 m	- EMIC-R	04/16/01	1 year
- SW/Con.unit<=> Spe Ana.(Signal In)	1 m	- EMIC-S	04/16/01	1 year
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM203L05	04/16/01	1 year
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM203L06	04/16/01	1 year
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM203H05	04/16/01	1 year
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM203H06	04/16/01	1 year
- SW/Con.unit <=> Receiver (Input)	2 m	- EM2RCV	04/16/01	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	2 m	- EM2SPL	04/16/01	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM2SPH	04/16/01	1 year

Notes.

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

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 Analizer <=> EUT	Length: Loss: 120 cm 1.7 dB	

Notes: - R&S : Rohde & Schwarz

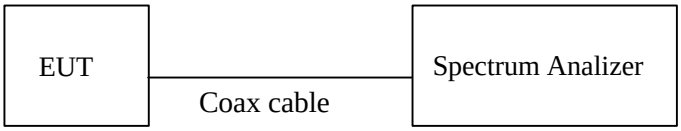

Figure 1: Measurement setup for the carrier frequency separation

1.3 Measurement Results

Test Date: September 27, 2001

Table 1-2. EUT: M/T 2662-E6x, s/n FX-00154, TX hopping mode

Frequency of marker #1 (MHz)	Frequency of marker #2 (MHz)	Carrier Frequency Separation (MHz)	Note
2440.98	2441.99	1.01	Min. 25 kHz

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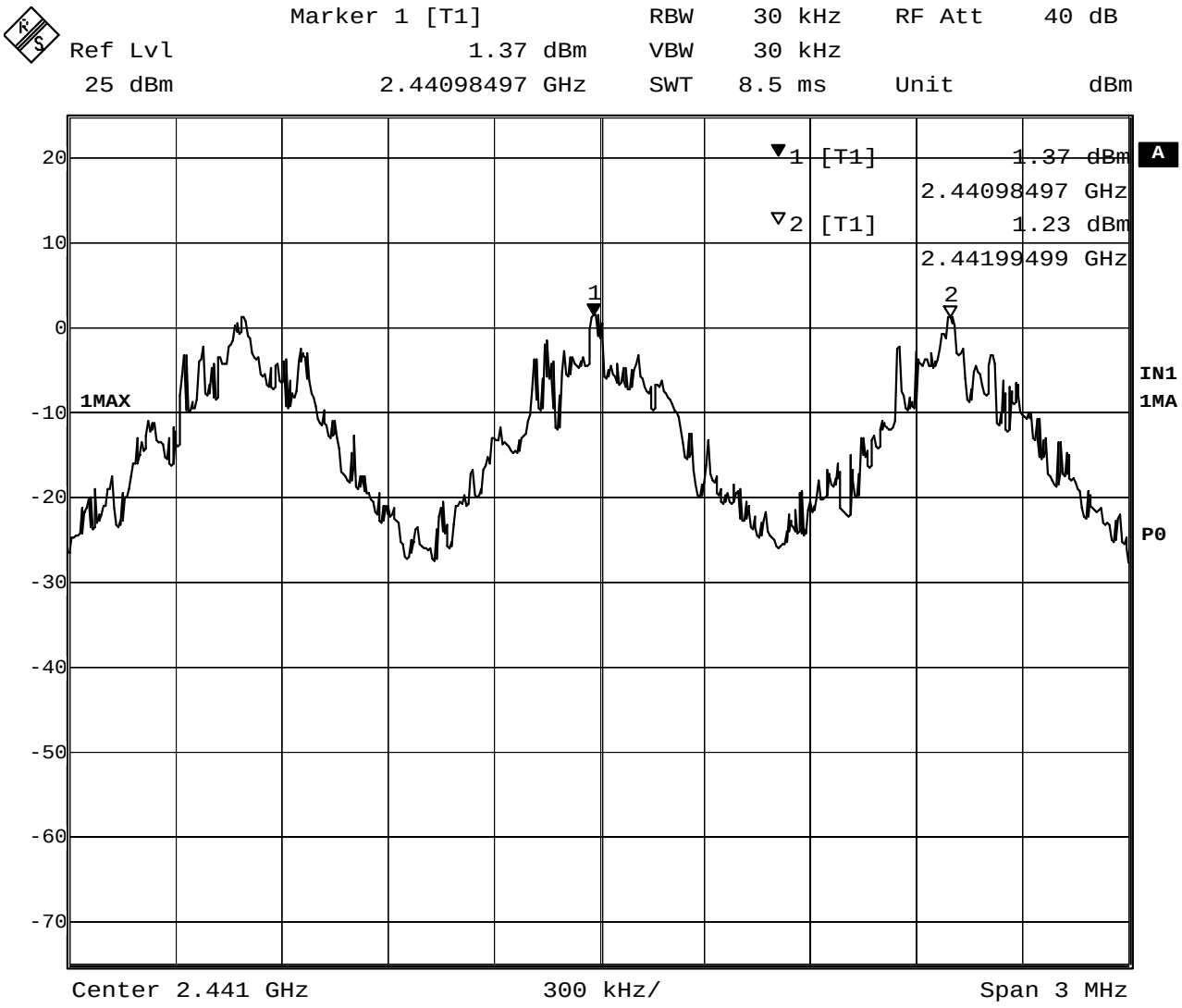
1.4 Trace Data



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 ≥ 1% of the span, VBW ≥ 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).

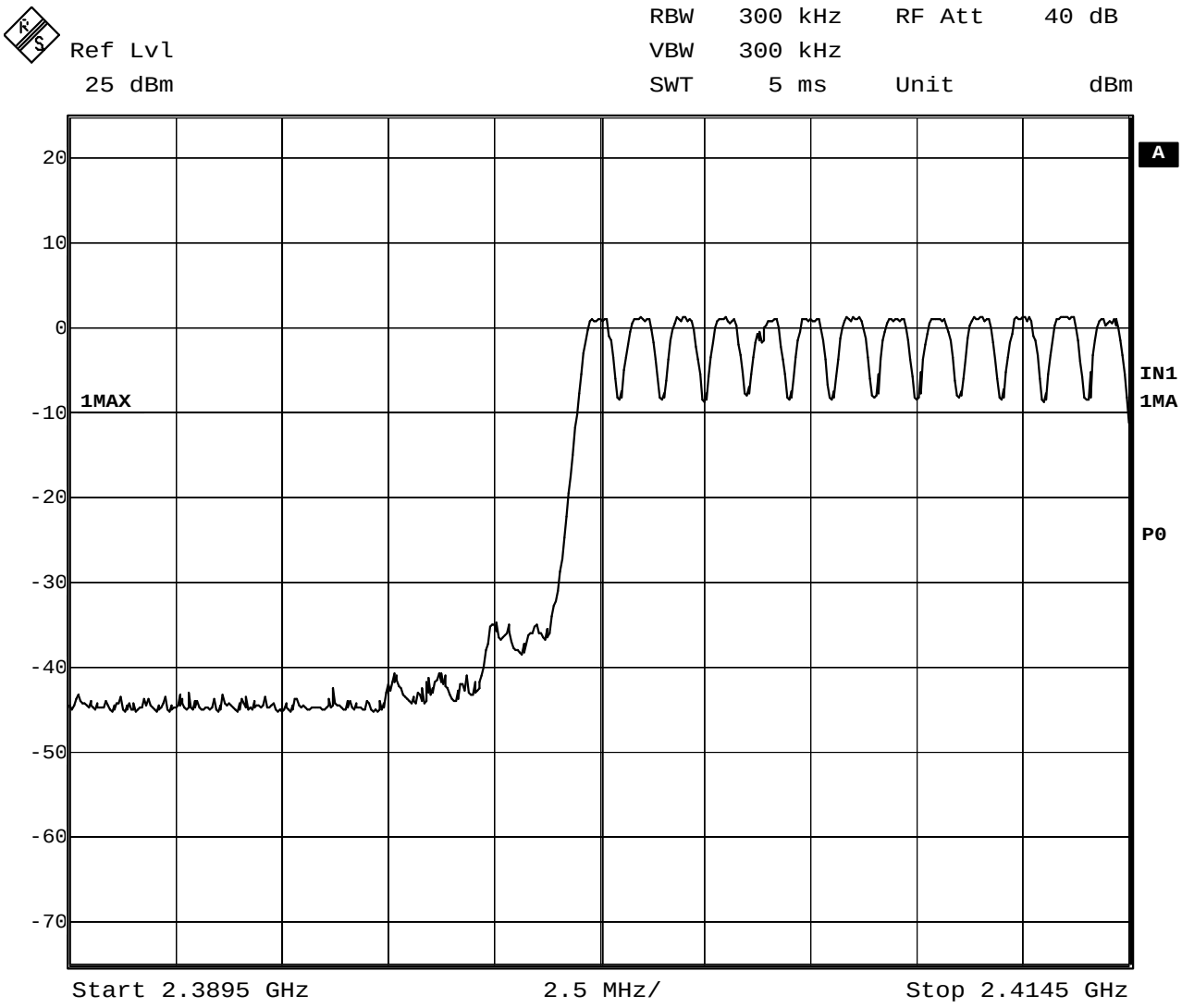
2.3 Measurement Results

Test Date: September 27, 2001

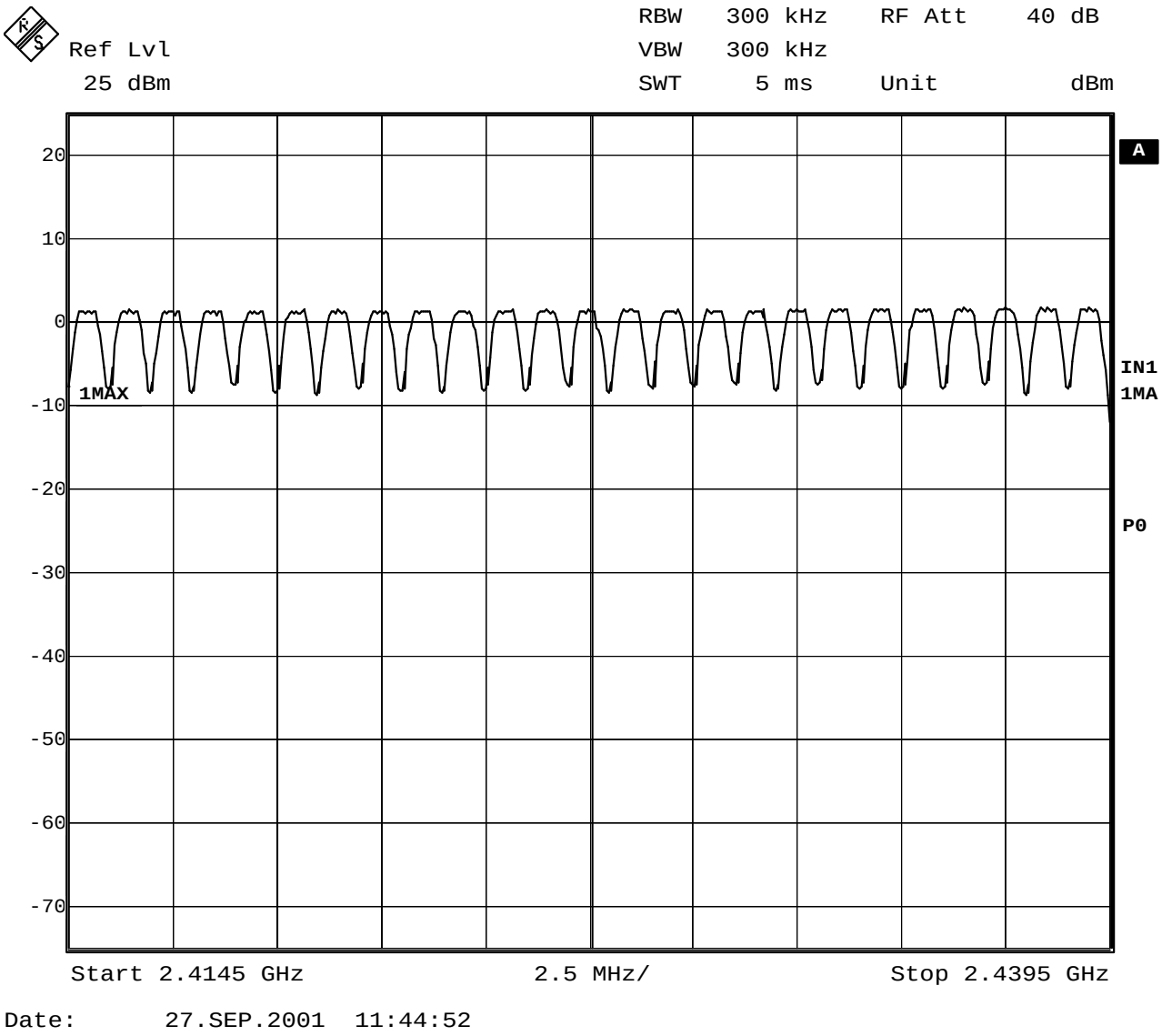
Table 2. EUT: M/T 2662-E6x, s/n FX-00154, TX hopping mode

Total number of Hopping Channels	Note
79	Min. 75 hops

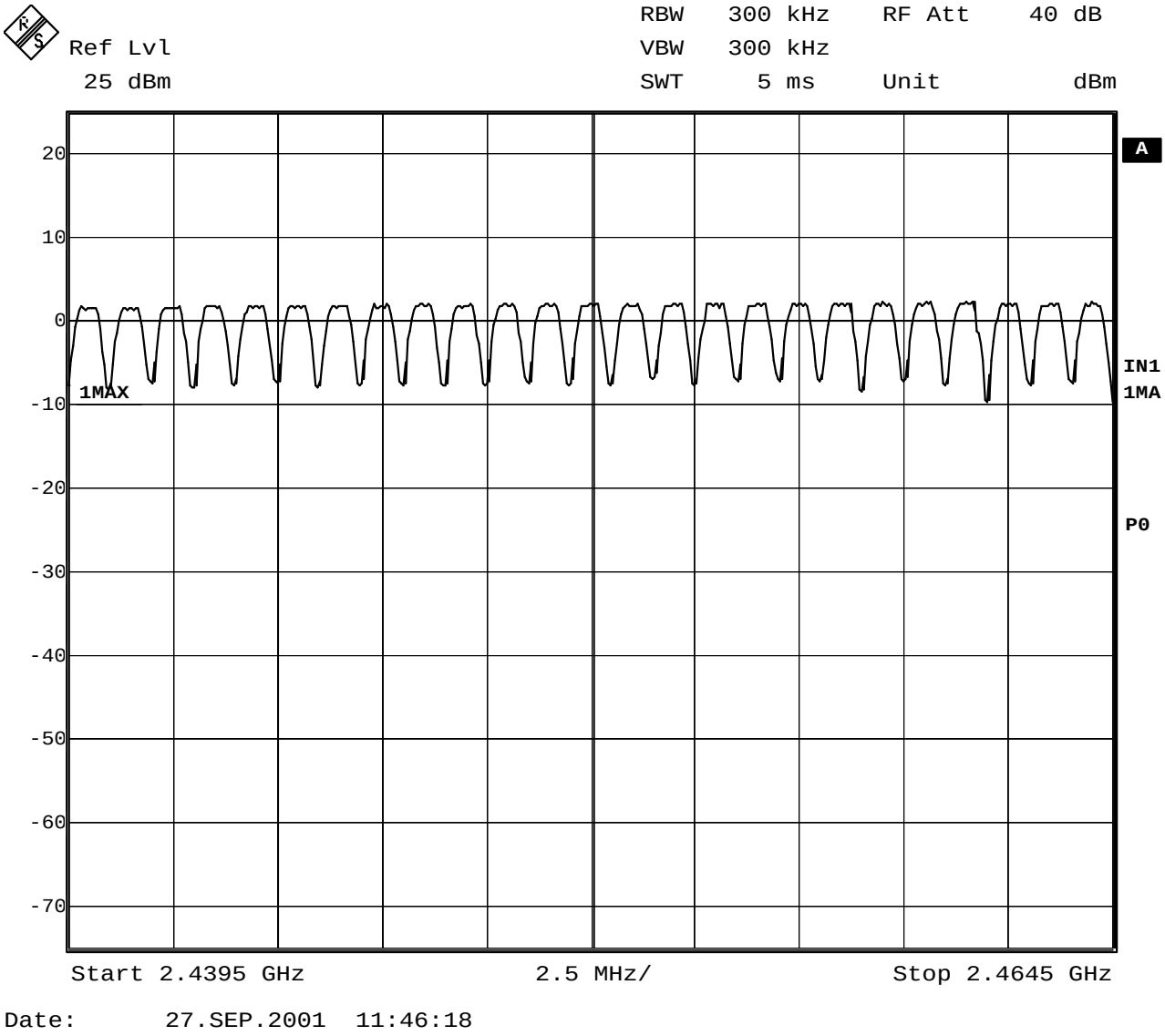
2.4 Trace Data



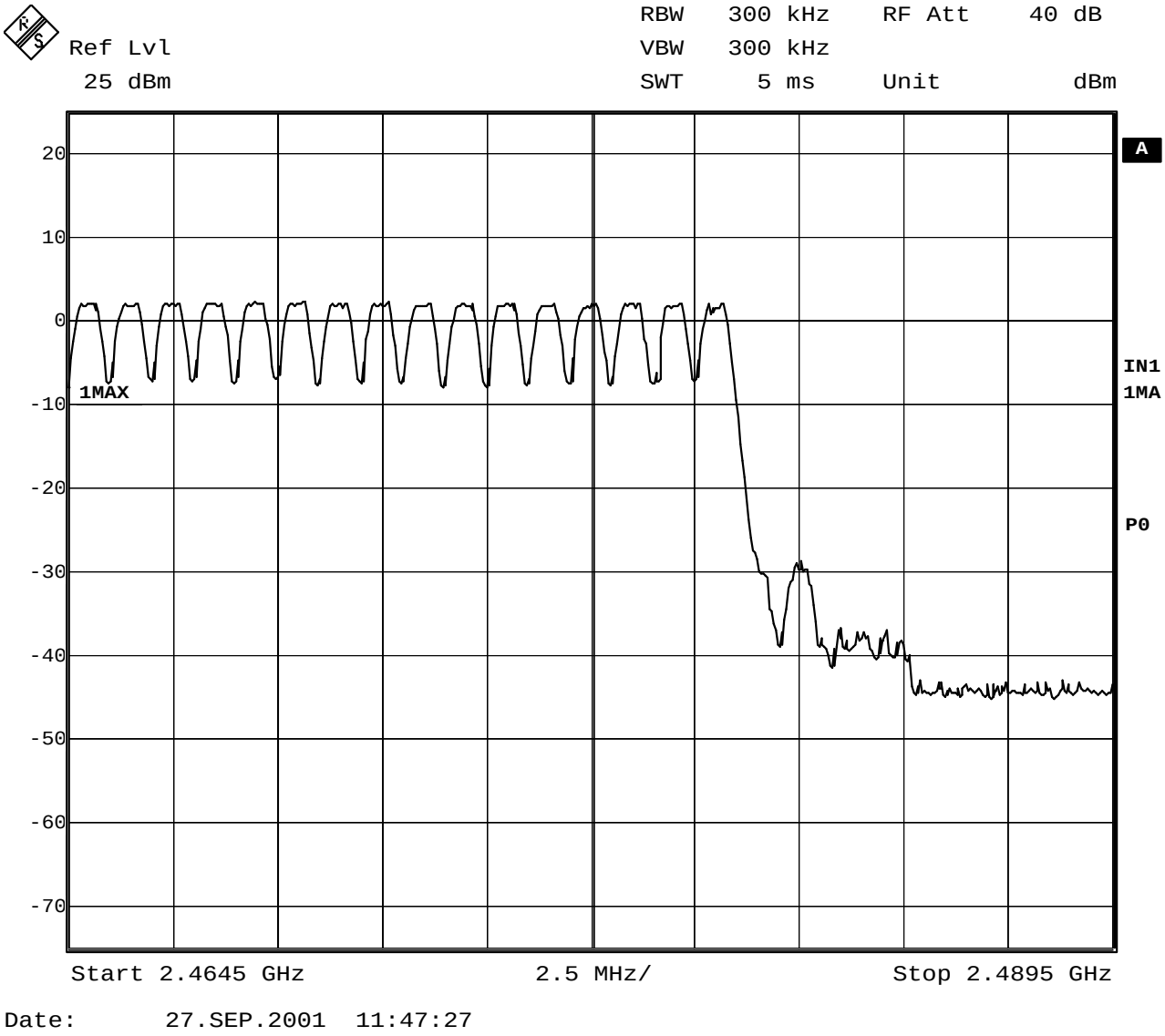
Number of Hopping Frequencies (range 1)



Number of Hopping Frequencies (range 2)



Number of Hopping Frequencies (range 3)



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

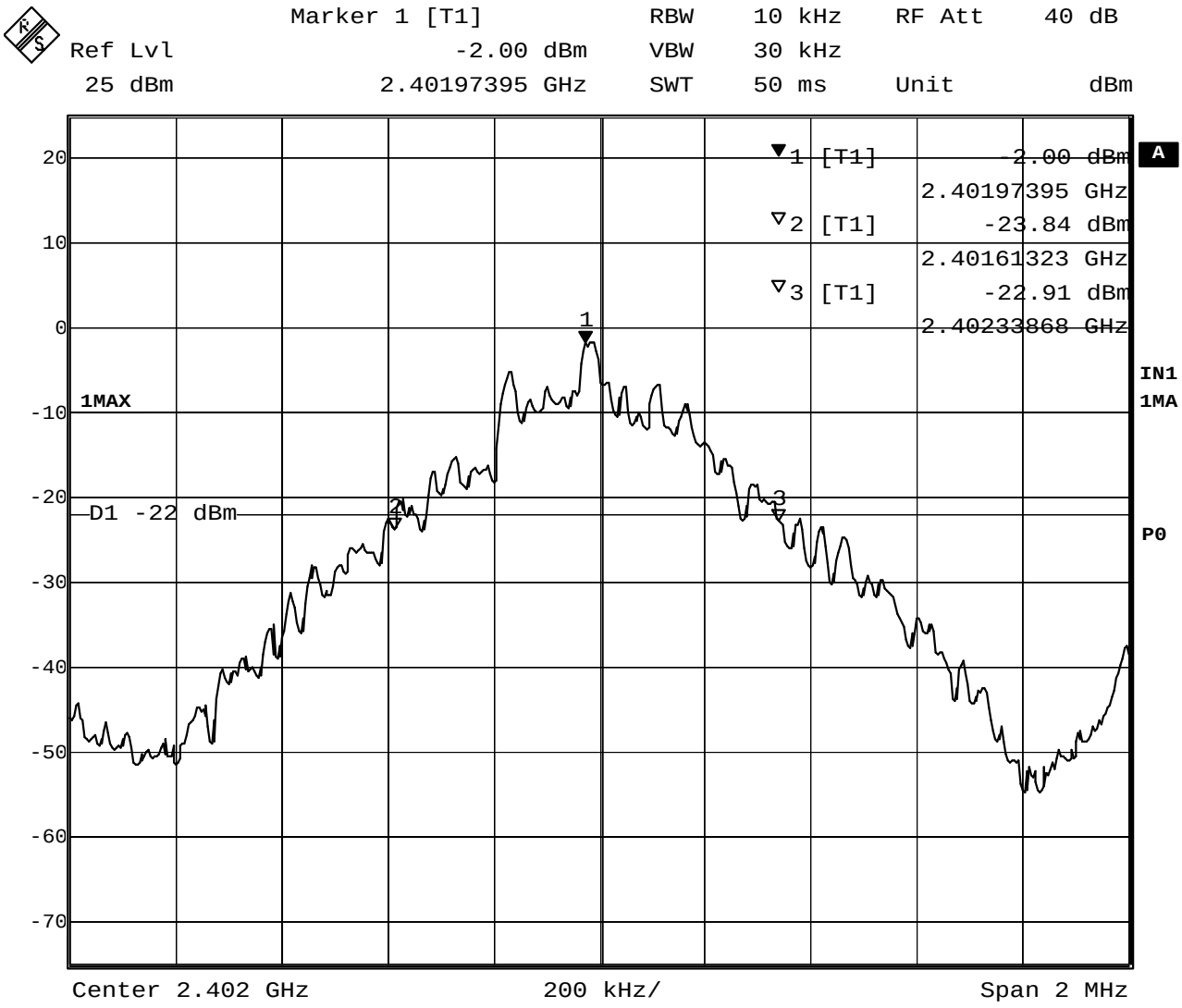
Test Date: September 26 and 27, 2001

Table 3. EUT: M/T 2662-E6x, s/n FX-00154

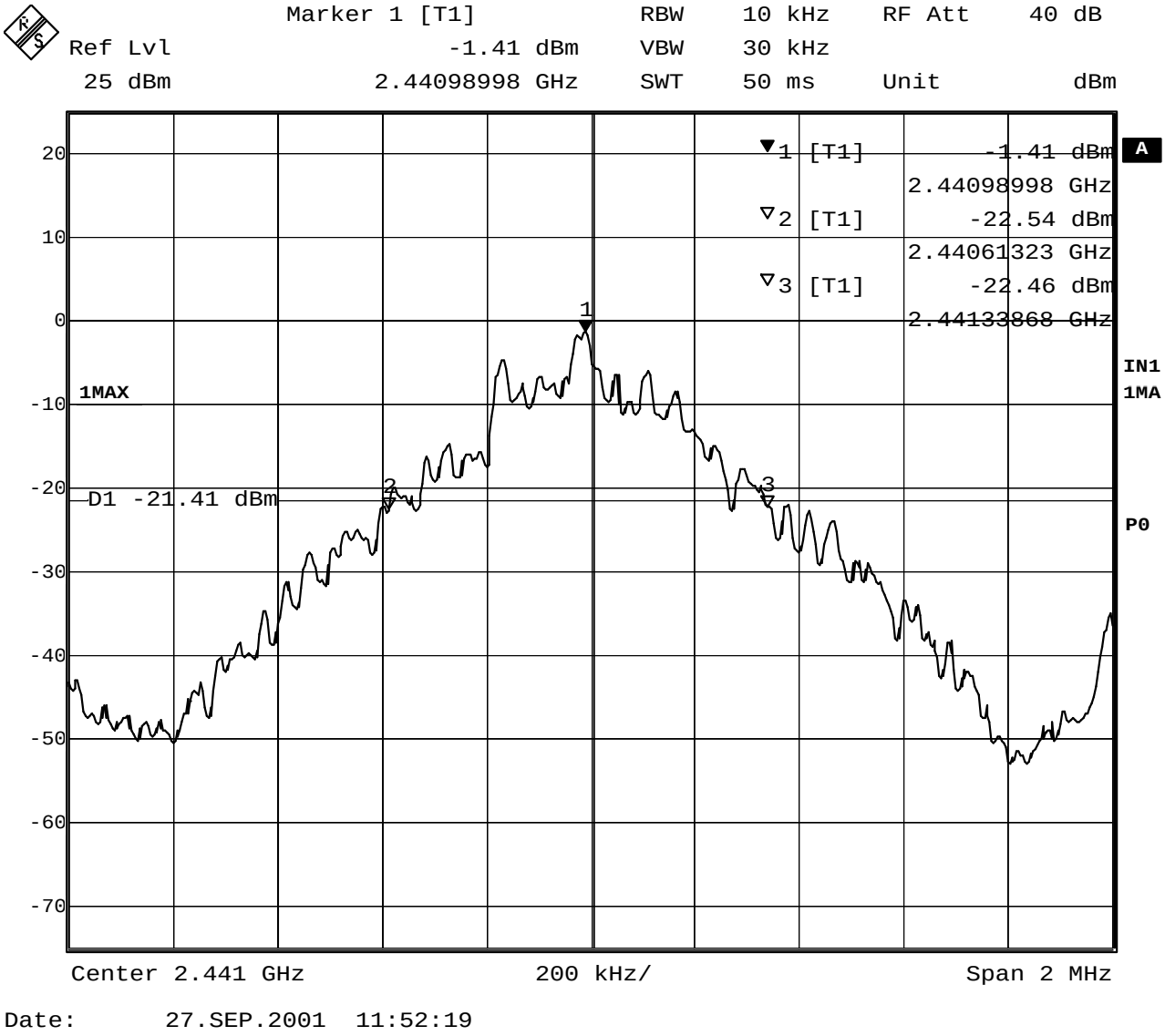
	Measured Bandwidth (MHz)	Limit
Tx at the lowest ch. (2402 MHz)*1	0.73	1 MHz
Tx at the middle ch.(2441 MHz)*1	0.73	
Tx at the highest ch.(2480 MHz)*1	0.73	
Inquiry	0.63	
Paging	0.58	

*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.

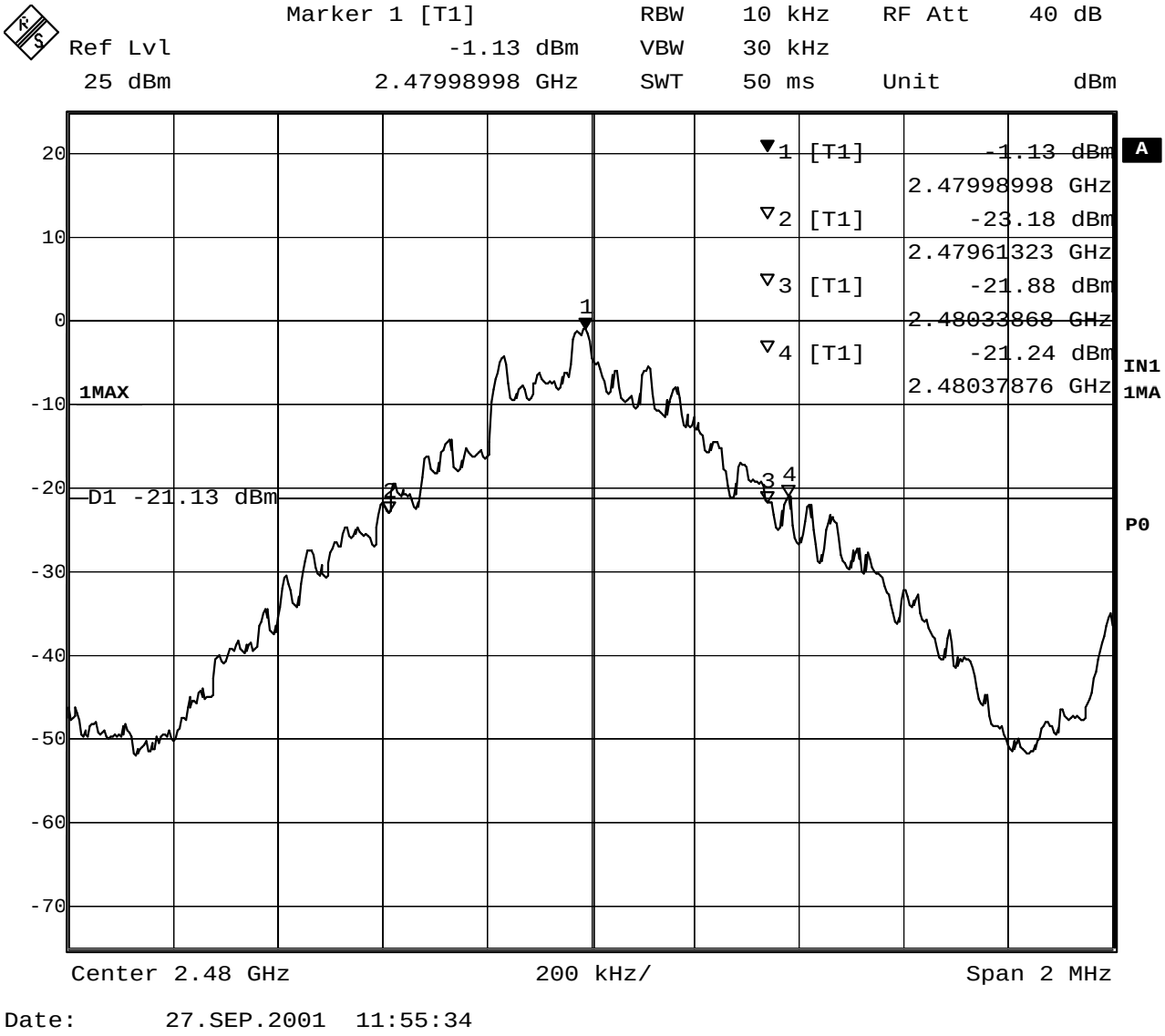
3.4 Trace Data



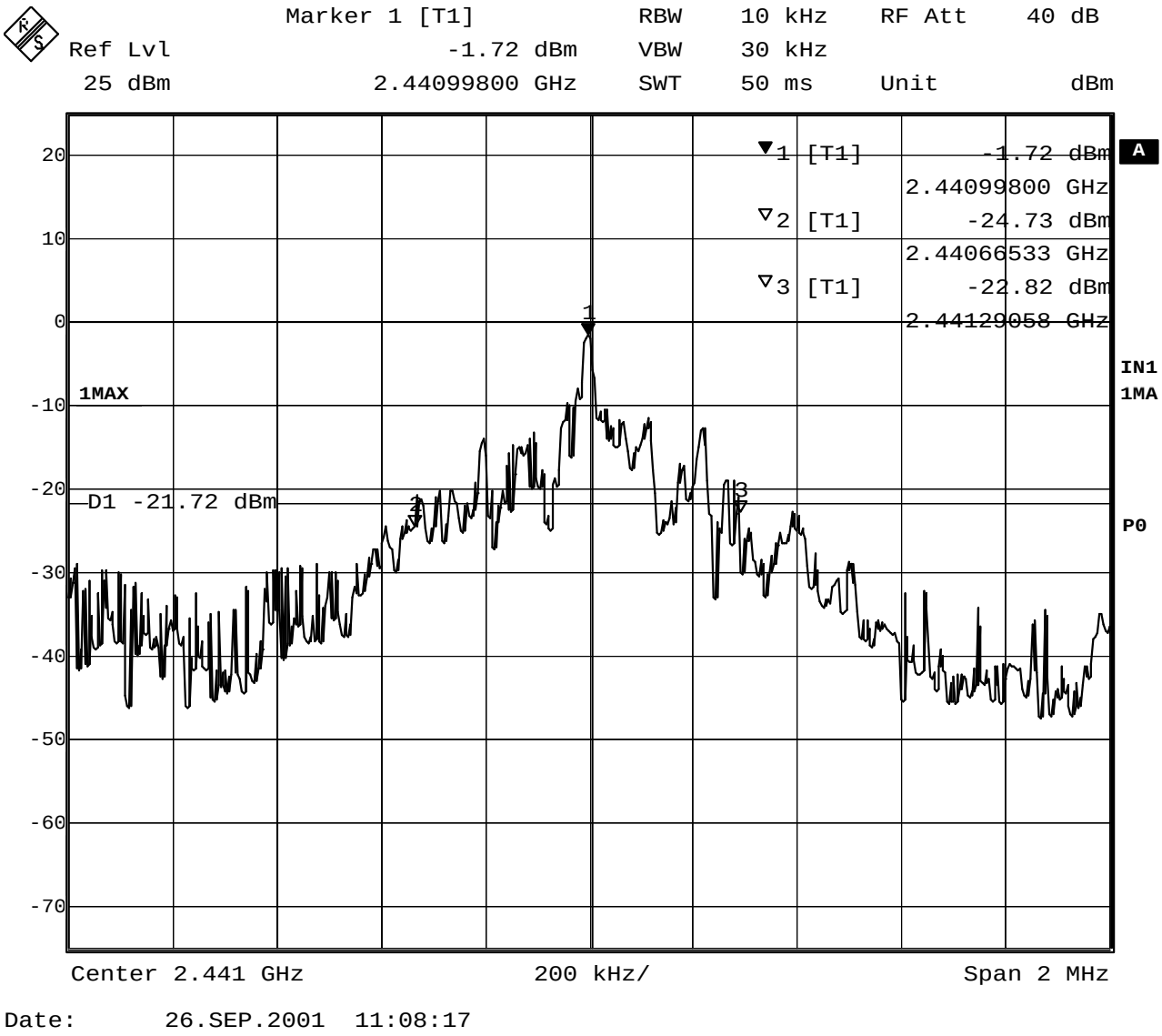
20 dB Bandwidth (TX on 2402MHz)



20 dB Bandwidth (TX on 2441MHz)



20 dB Bandwidth (TX on 2480MHz)



20 dB Bandwidth (Inquiry)

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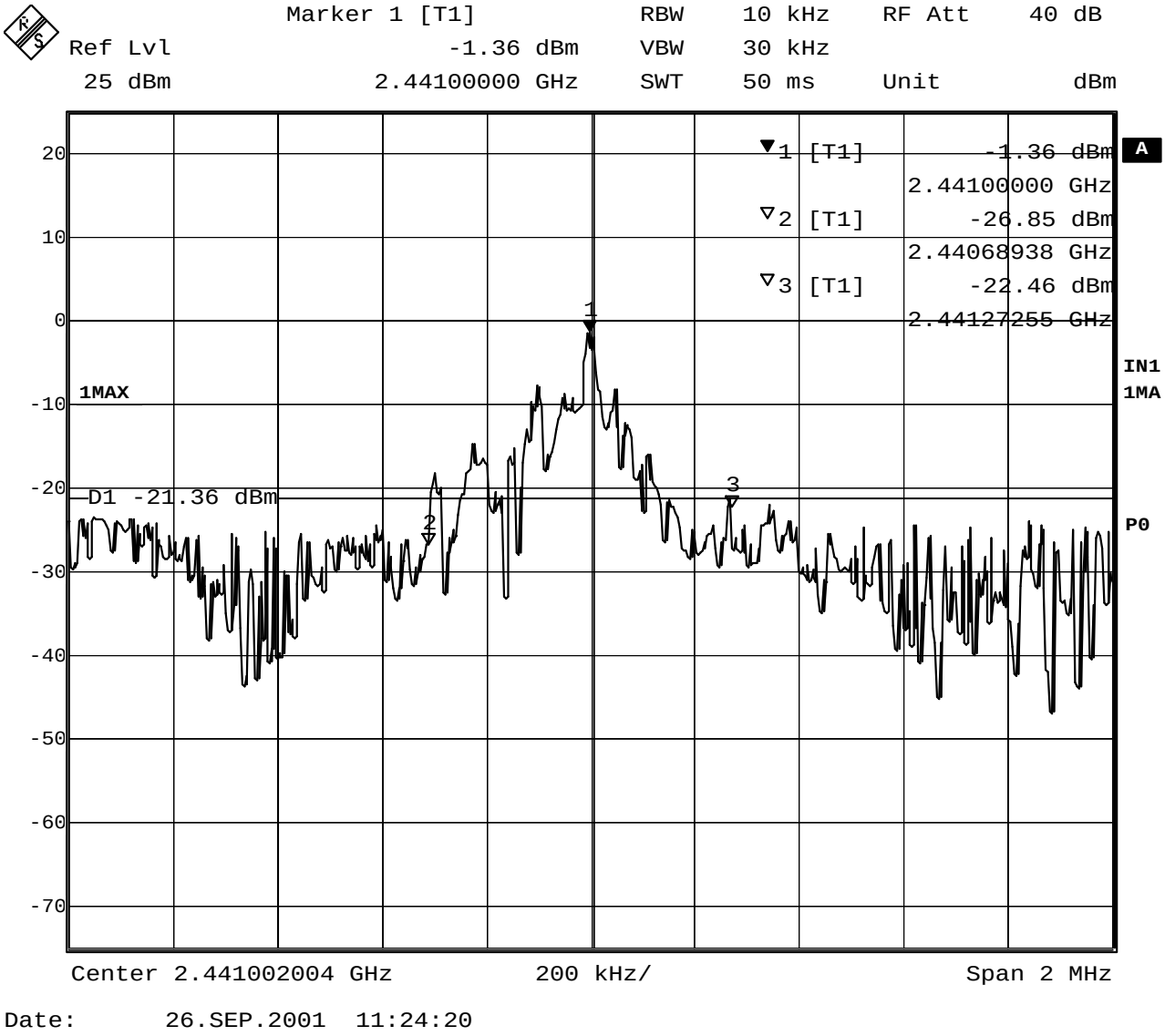


20 dB Bandwidth (Paging)

Prepared by T. Asano

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), 2440MHz (for Paging)
  RBW = 1 MHz, VBW = 1 MHz (= RBW or more), Span = zero,
  Detector function = peak, Trace = max hold,
  Sweep : Inquiry ; 200 μs for Burst duration, 100 ms for Repetition rate
  Paging ; 300 μs 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: September 26 and 27, 2001

Table 4. EUT: M/T 2662-E6x, s/n FX-00154

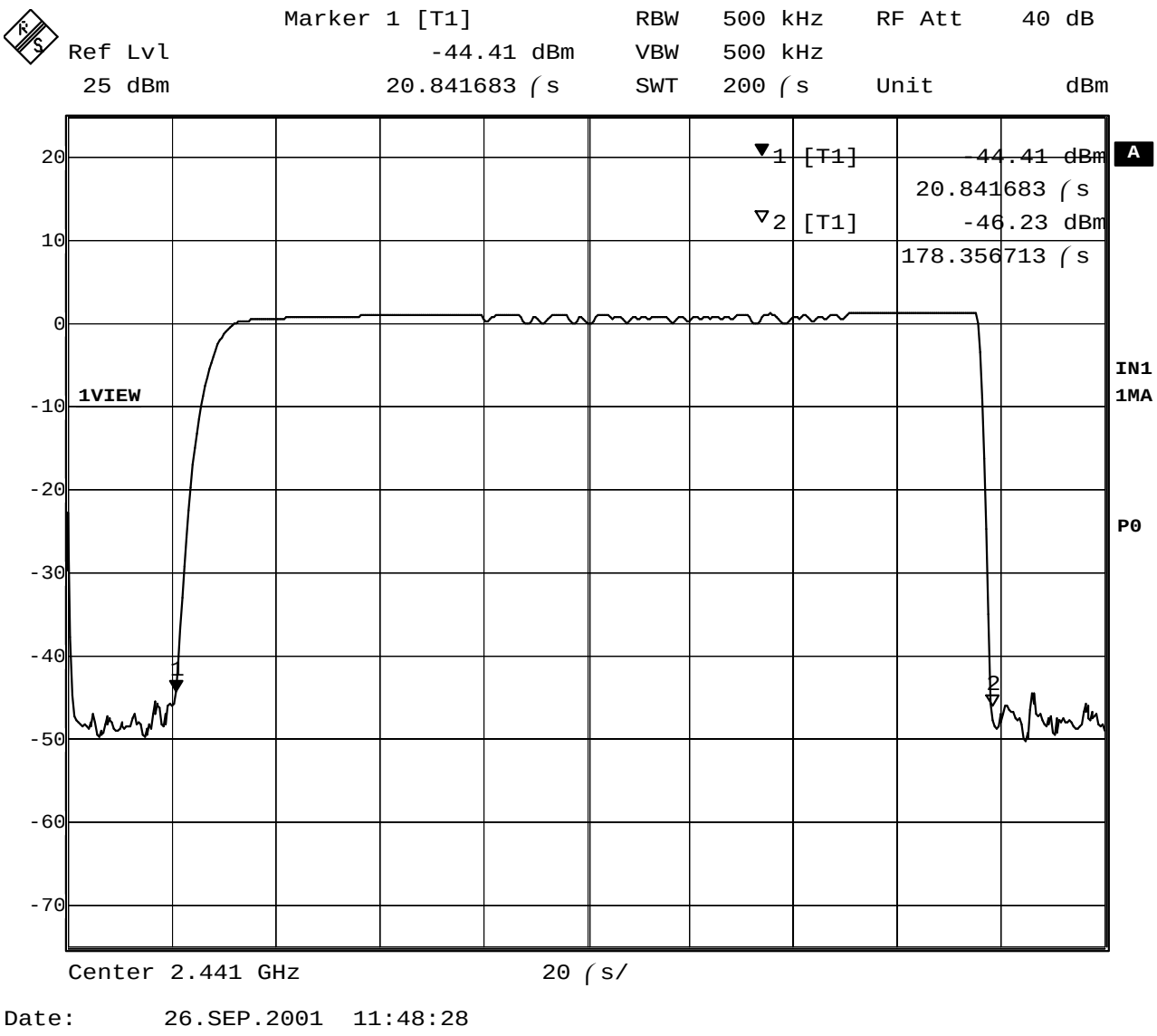
Hopping phase	Burst duration in one hop (μs) *1	Repetition rate on one channel *2	Dwell Time (mS) *1 × *2	Limit
Inquiry	157.52	1280	201.6	less than 400 mS in 12.8*3 seconds period
Paging	162.12	640	103.8	
Data transmission	494.99	300	148.5	less than 400 mS in 30 seconds period

***1 :** attached measurement plot

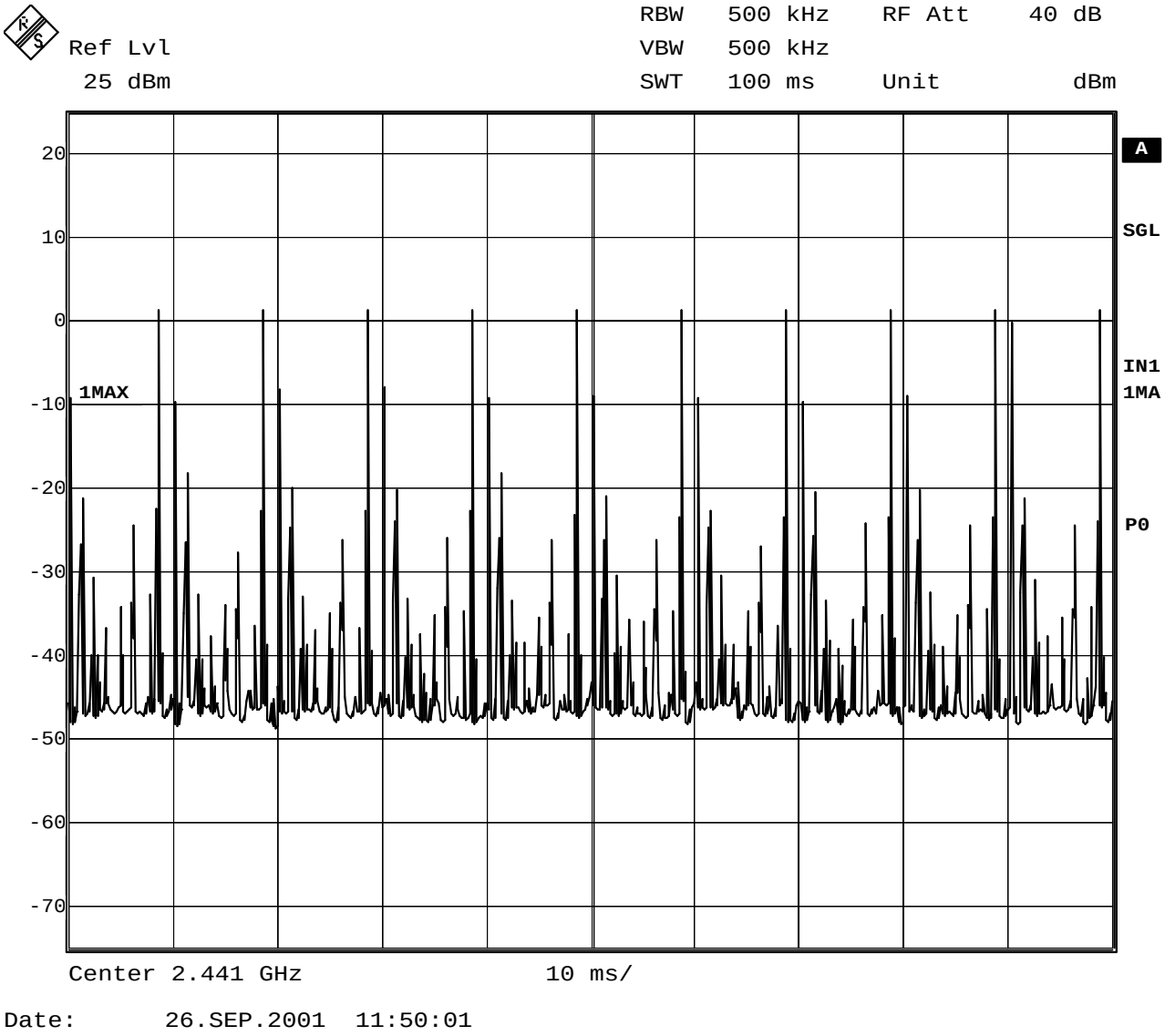
***2** : - (number of hops in measurement plot) × 12800 ms / 100 ms for Inquiry/Paging
- (number of hops in measurement plot) × 30000 ms / 500 ms for Data transmission

***3** : 32 hops (Bluetooth Standard) × 0.4sec

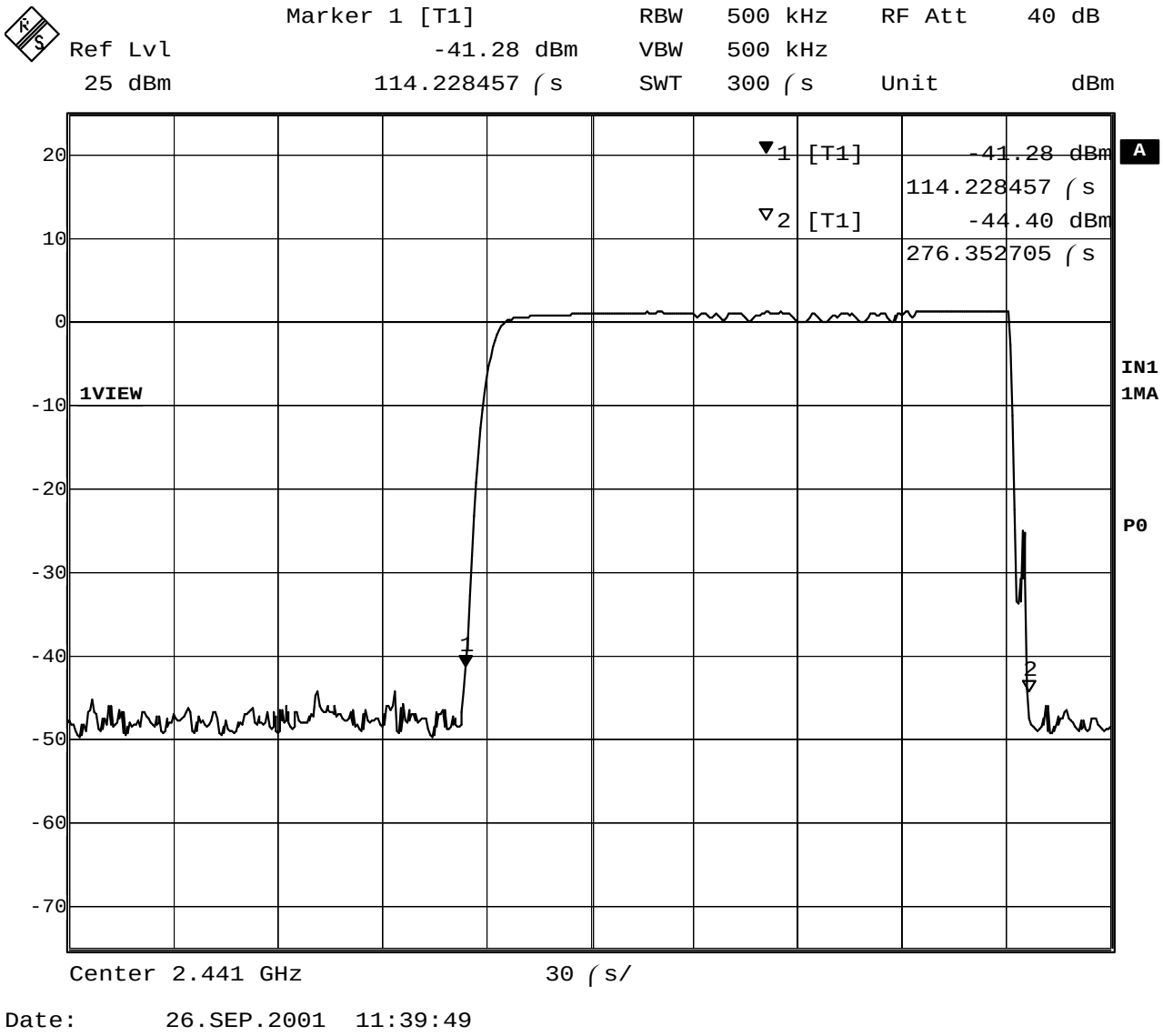
4.4 Trace Data



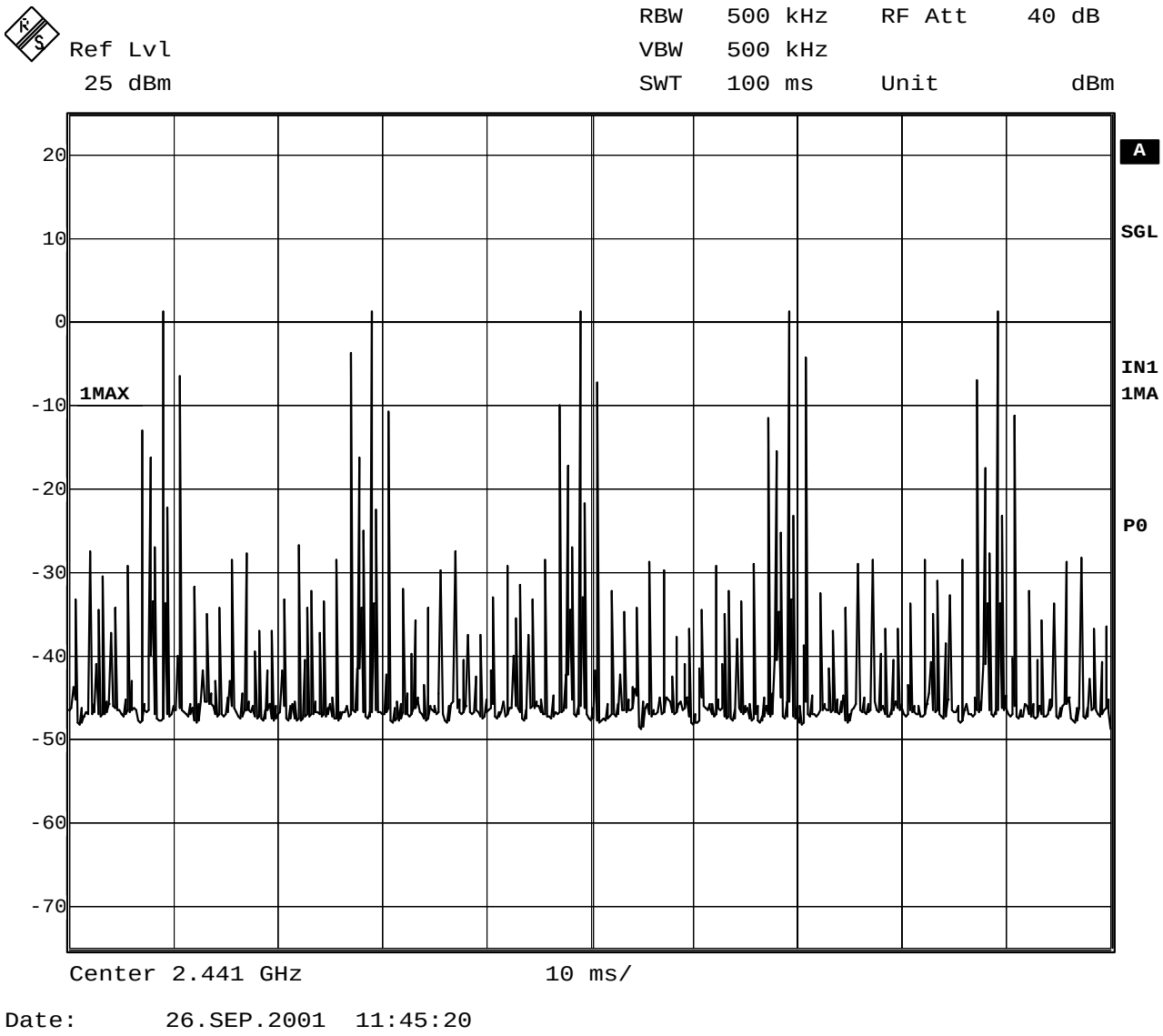
Time of Occupancy (Inquiry, Burst duration)



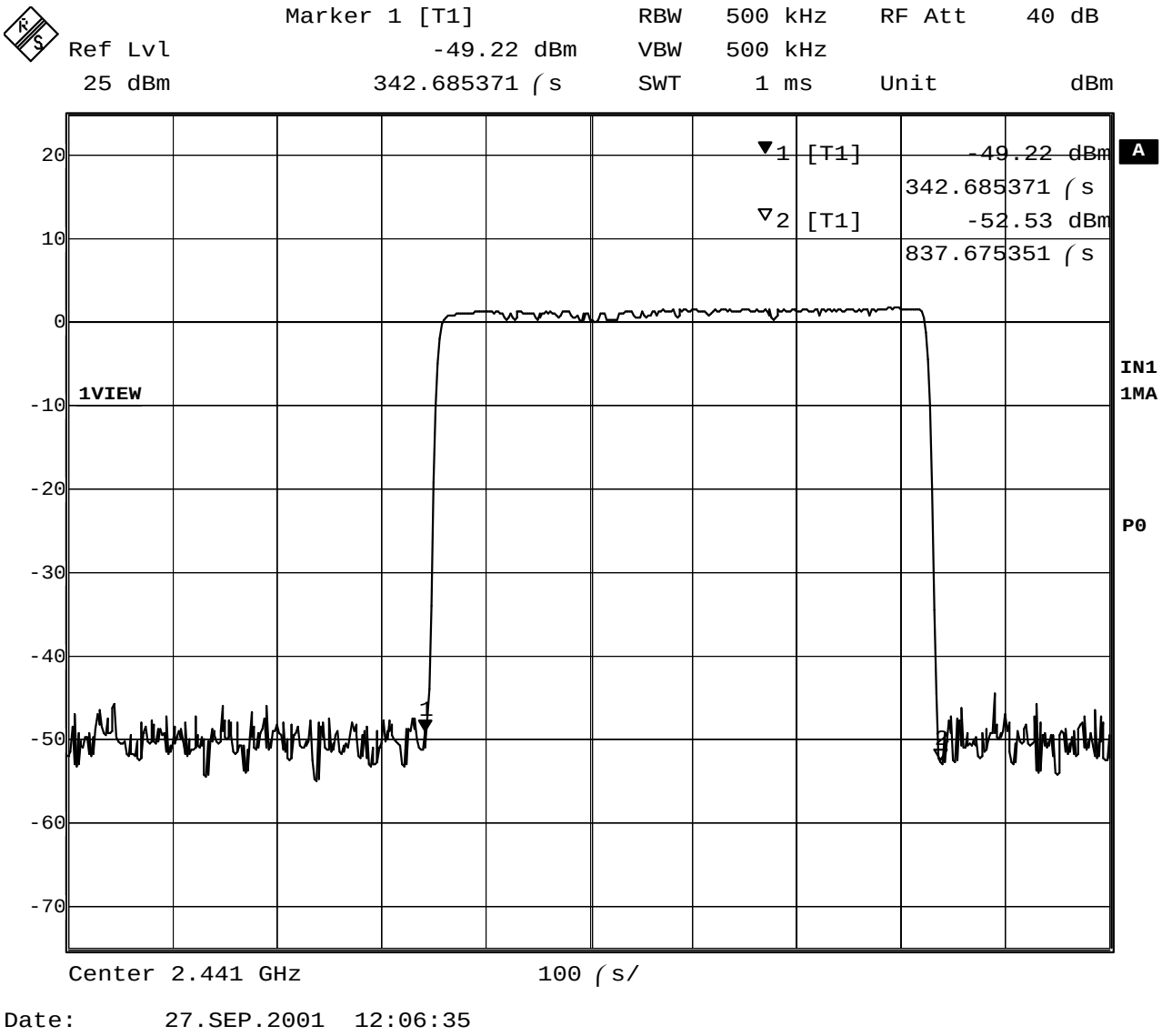
Time of Occupancy (Inquiry, Repetition rate)



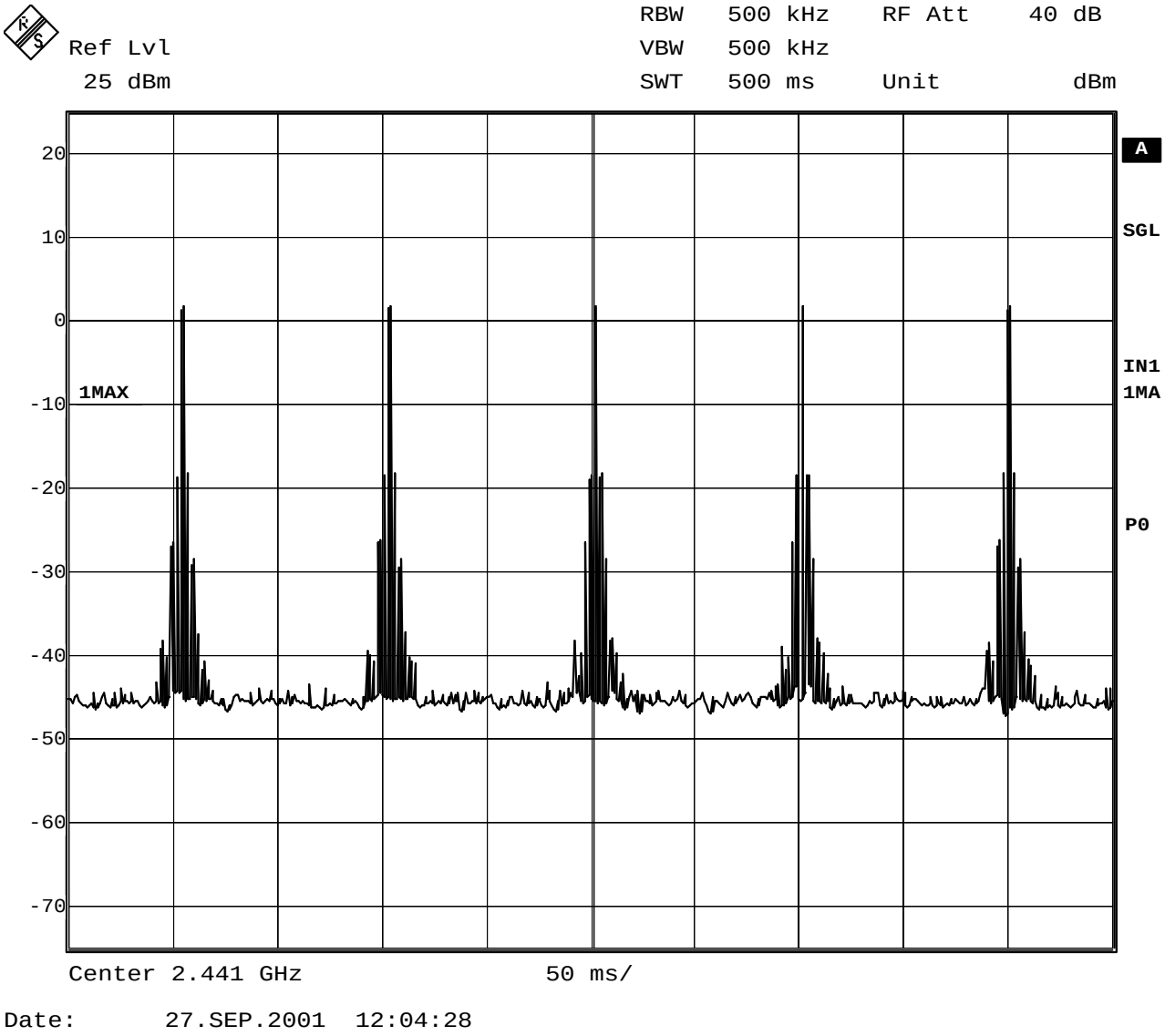
Time of Occupancy (Paging, Burst duration)



Time of Occupancy (Paging, Repetition rate)



Time of Occupancy (Data transmission, Burst duration)



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 = 1 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

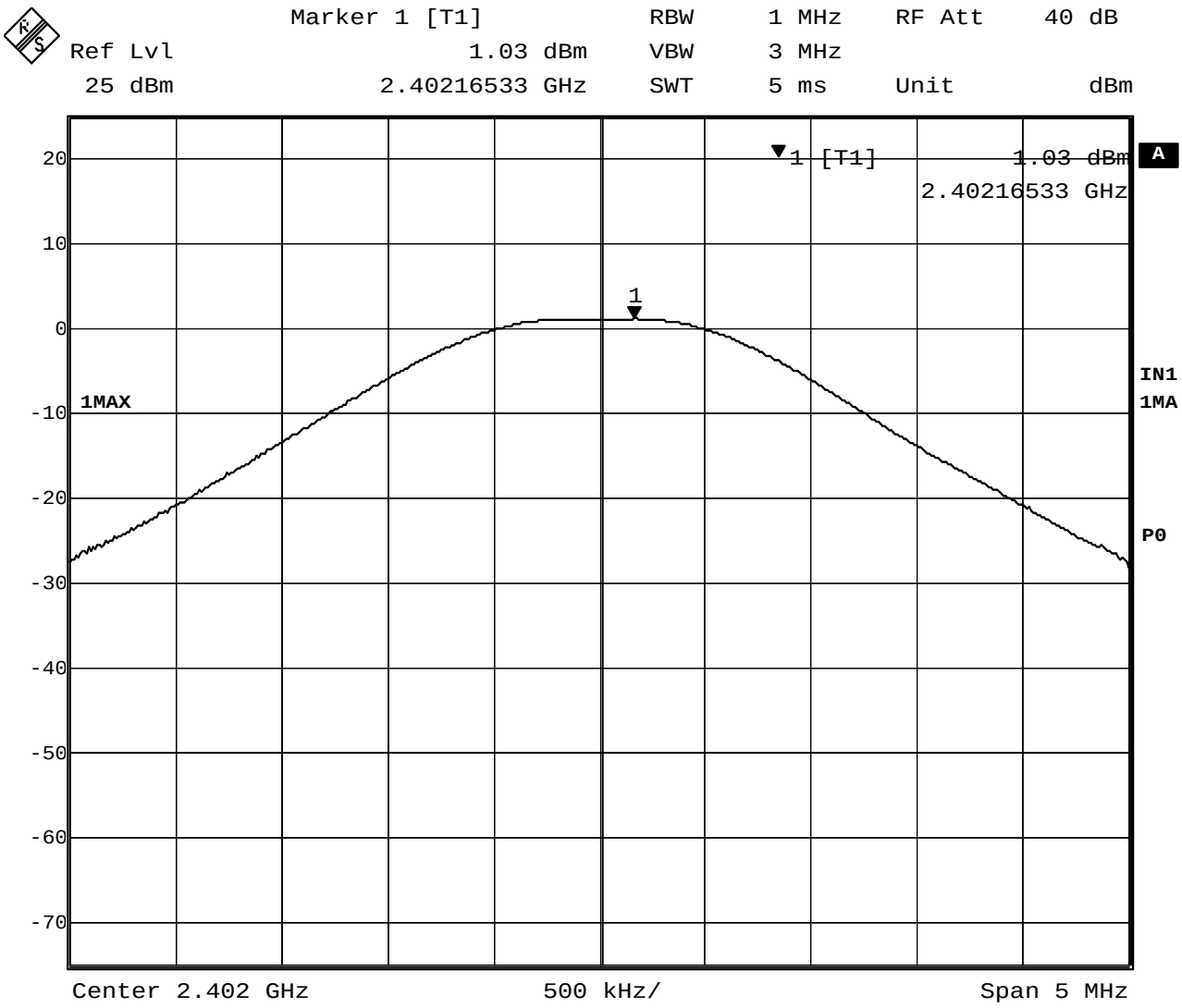
Test Date: September 26 and 27, 2001

Table 5. EUT: M/T 2662-E6x, s/n FX-00154

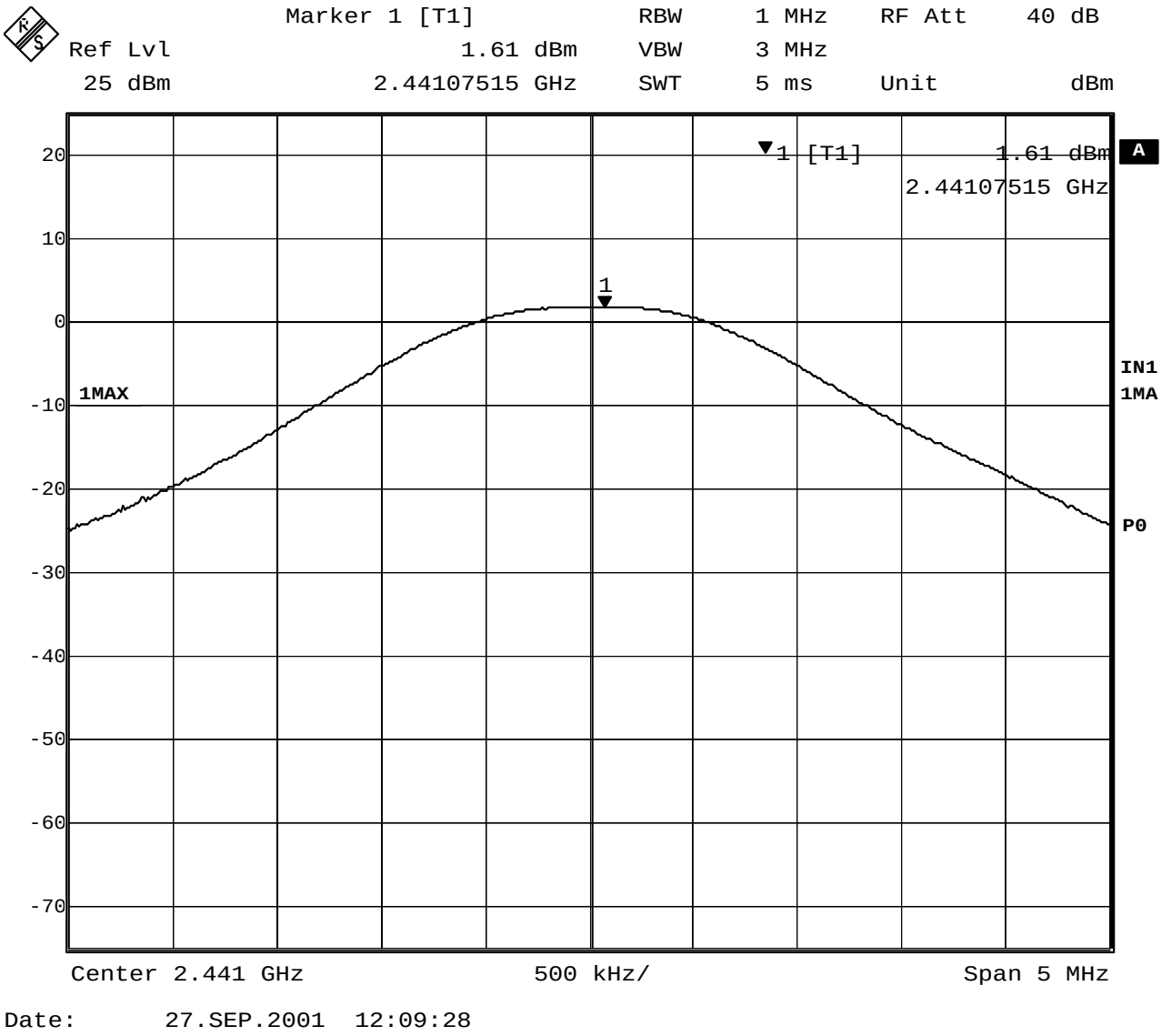
Measured Frequency (MHz)	Analyzer Reading (dBm)	Cable Loss (dB)	Results		Limit [1W] (dBm)	Margin (dB)
			(dBm)	(W)		
2402 (ch. 1) *1	1.03	1.7	2.7	0.00186	30.0	27.3
2441 (ch. 40) *1	1.61	1.7	3.3	0.00214	30.0	26.7
2480 (ch. 79) *1	2.06	1.7	3.8	0.00240	30.0	26.2
Inquiry (ch. 40)	1.22	1.7	2.9	0.00195	30.0	27.1
Paging (ch. 40)	1.26	1.7	3.0	0.00200	30.0	27.0

*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.

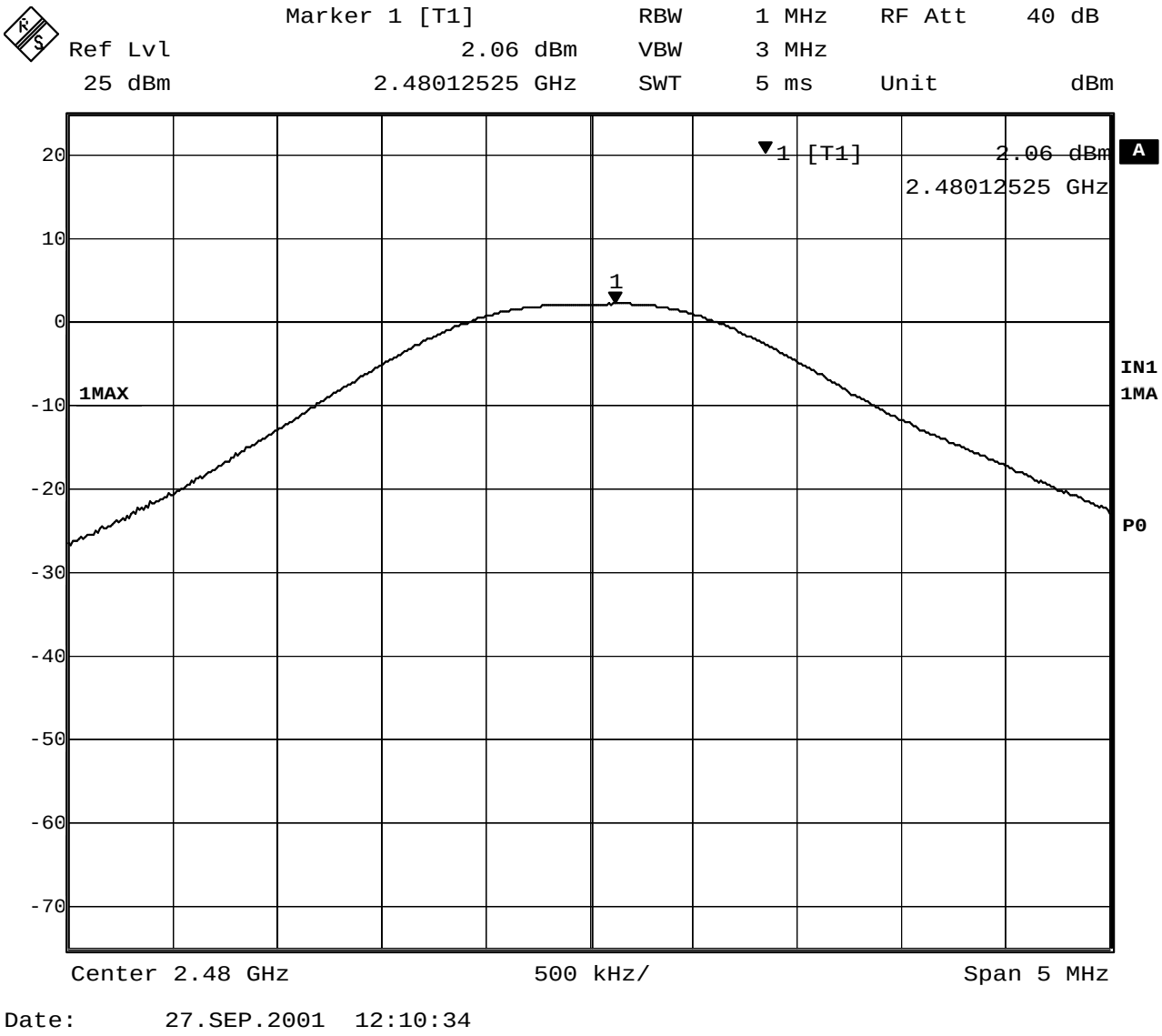
5.4 Trace Data



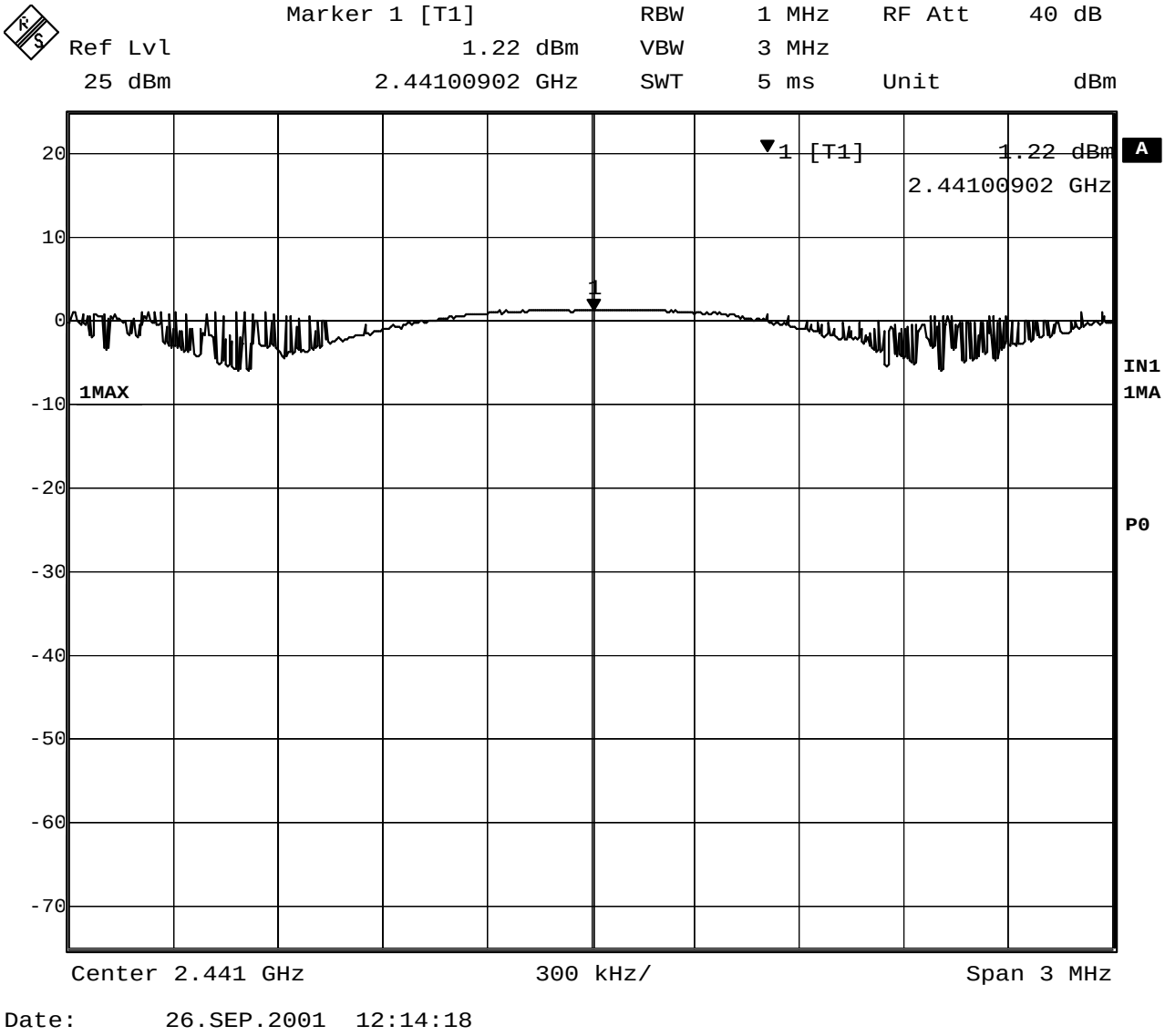
Peak Output Power (TX on 2402MHz)



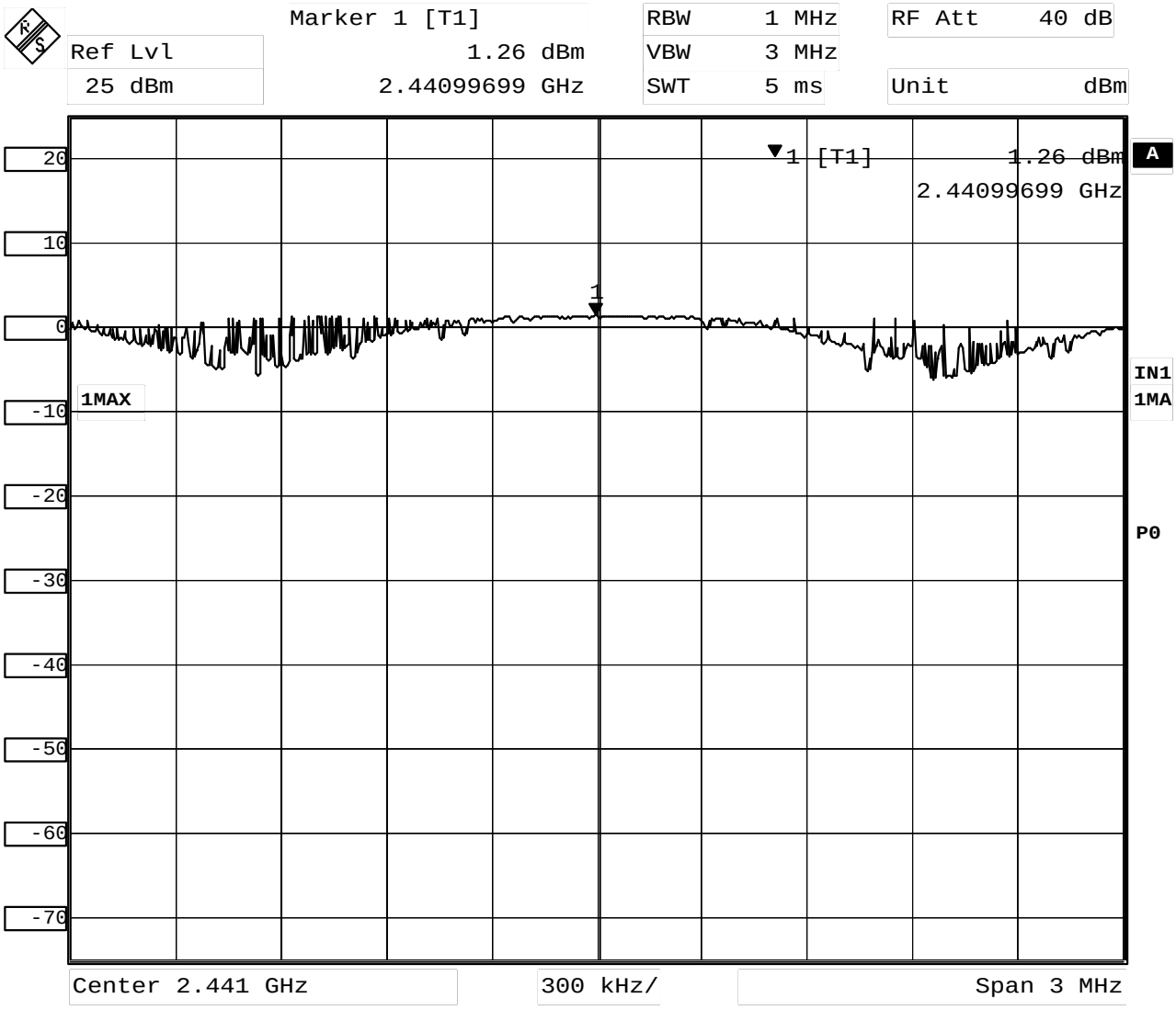
Peak Output Power (TX on 2441MHz)



Peak Output Power (TX on 2480MHz)



Peak Output Power (Inquiry)



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 = 3 MHz
  - RBW : 1% of span or more = 30 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 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

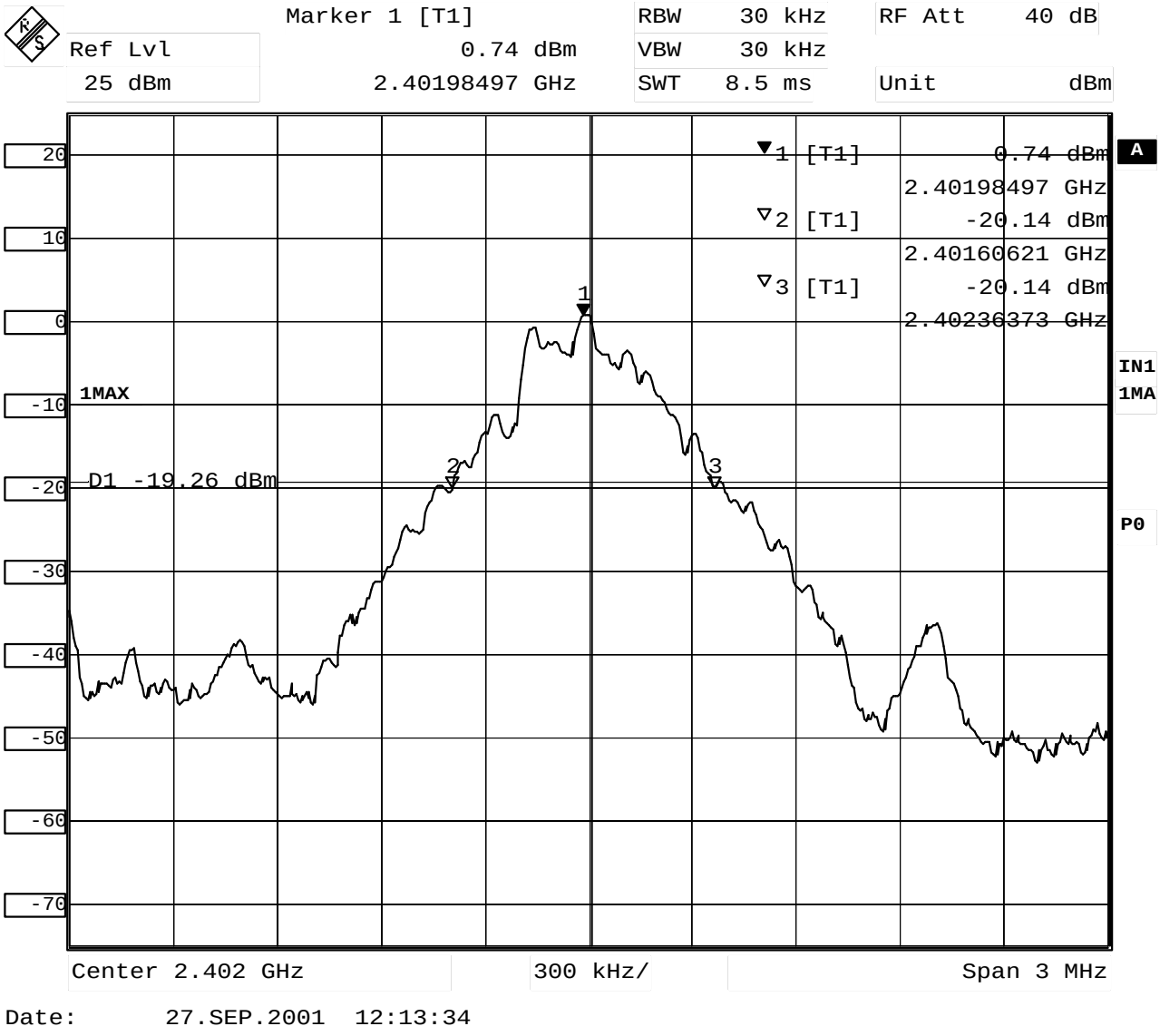
Test Date: September 27, 2001

Table 6. EUT: M/T 2662-E6x, s/n FX-00154

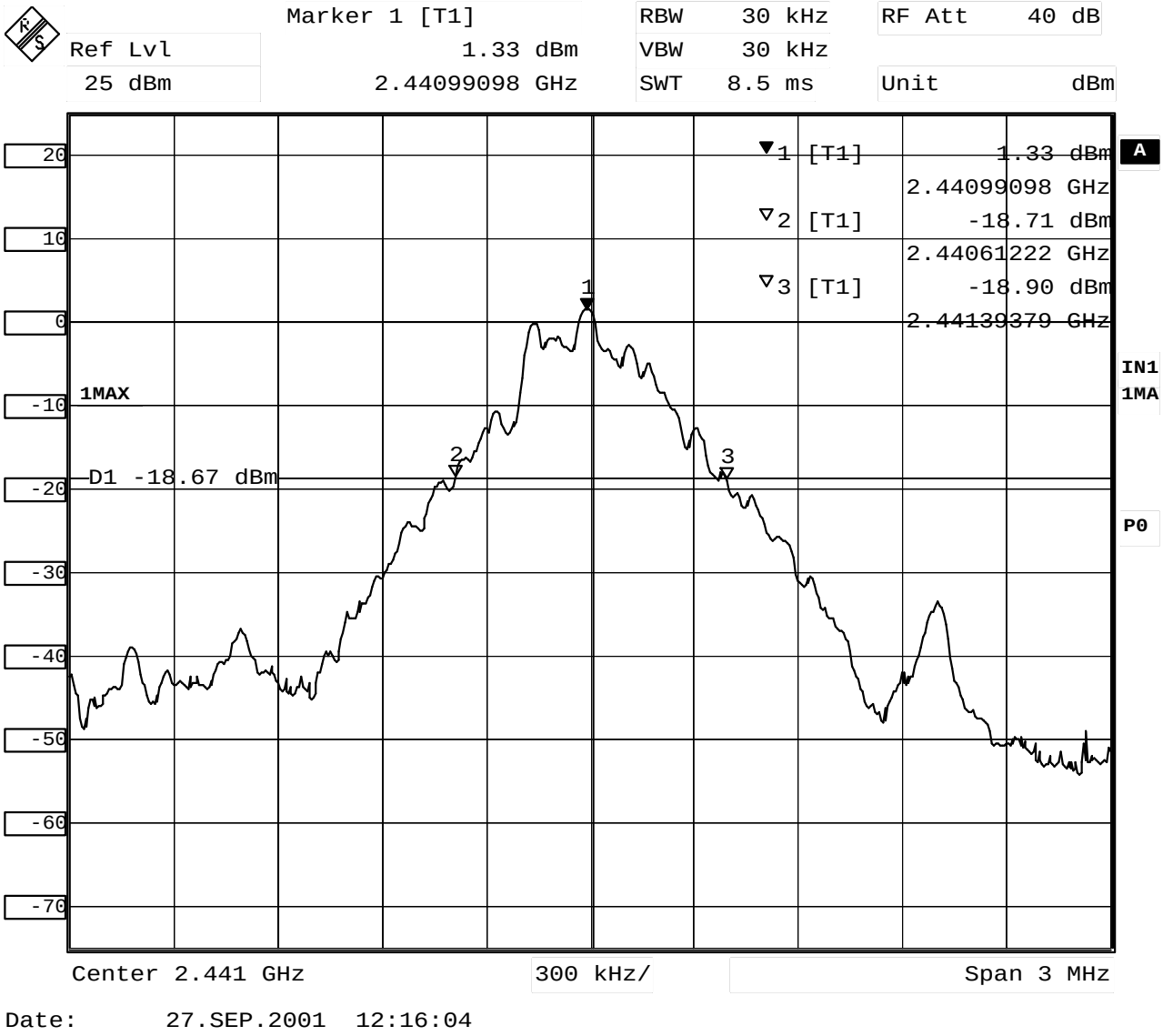
Center Frequency (MHz)	Lower Frequency (MHz)	Upper Frequency (MHz)	20dB Occupied BW (MHz)	Margin to Lower limit (MHz)	Margin to Upper limit (MHz)
2402 (ch. 1)	2401.606	2402.364	0.758	1.606	
2441 (ch. 40)	2440.612	2441.394	0.782		
2480 (ch. 79)	2479.612	2480.394	0.782		3.106

Note) 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.

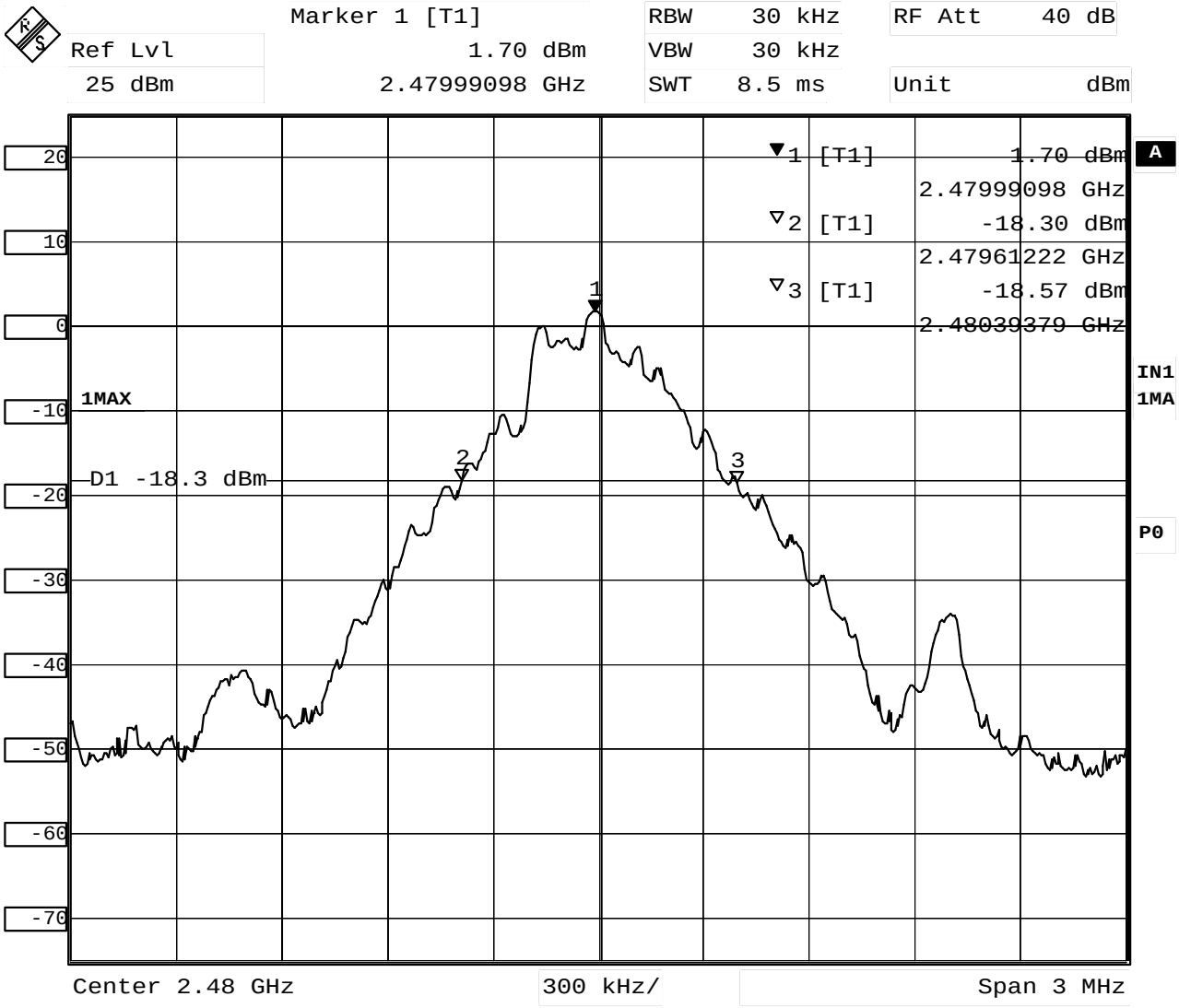
6.4 Trace Data



Band-edge (TX on 2402MHz)



Band-edge (TX on 2441MHz)



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

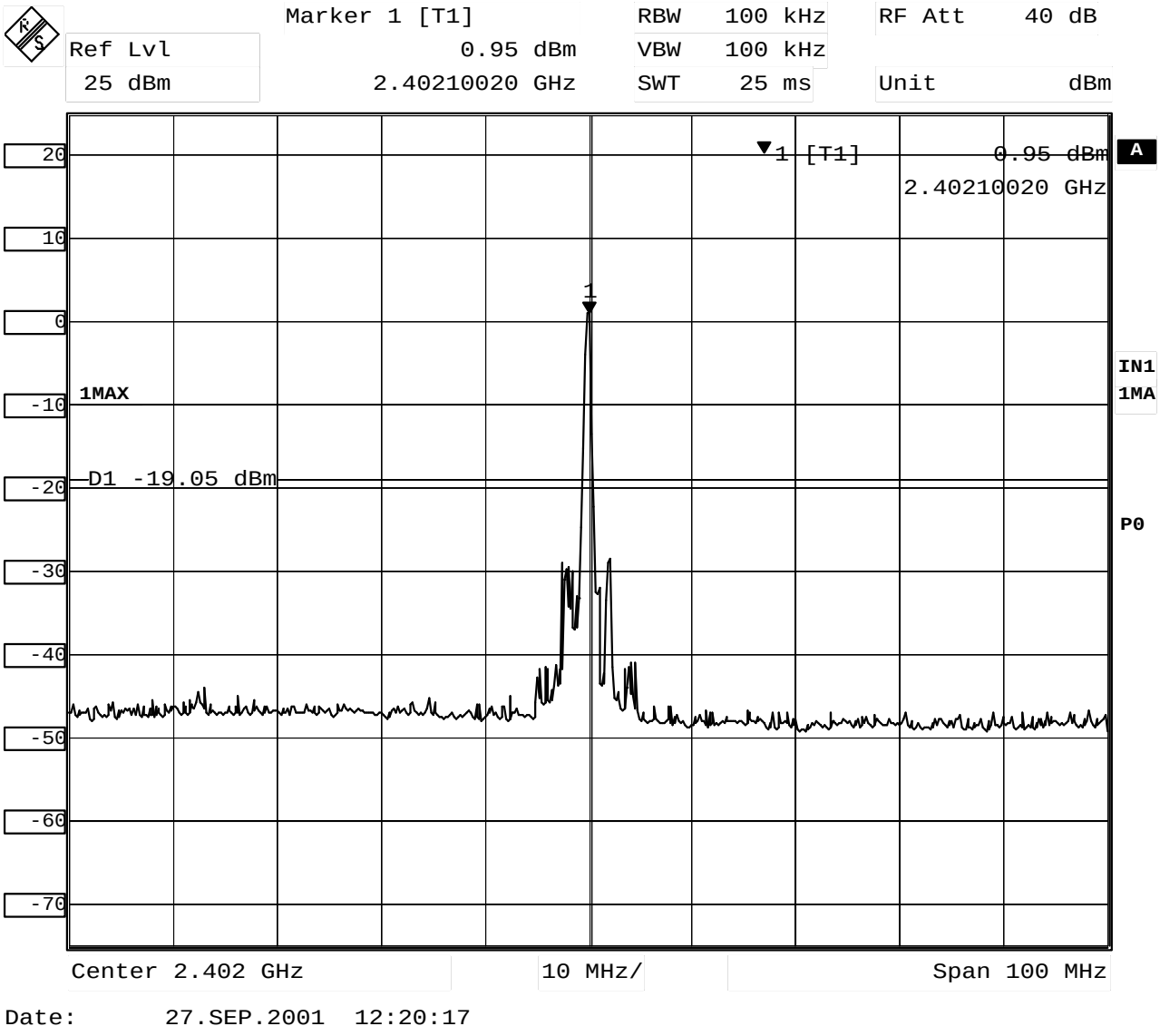
Same as the Chapter 1(Table 1-1 & Figure 1).

7.3 Measurement Results

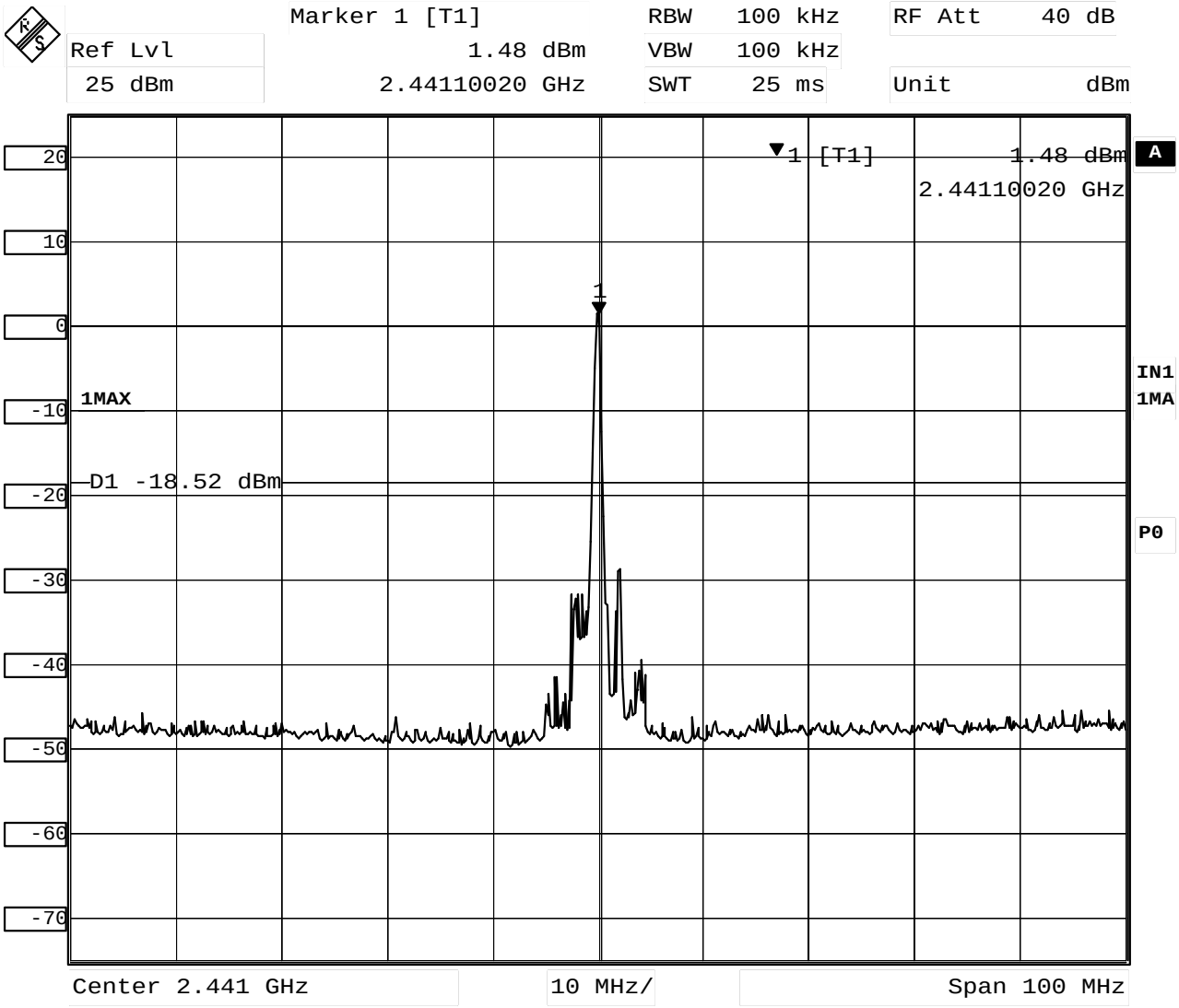
All conducted emission in any 100 kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.

Test Date: September 27, 2001

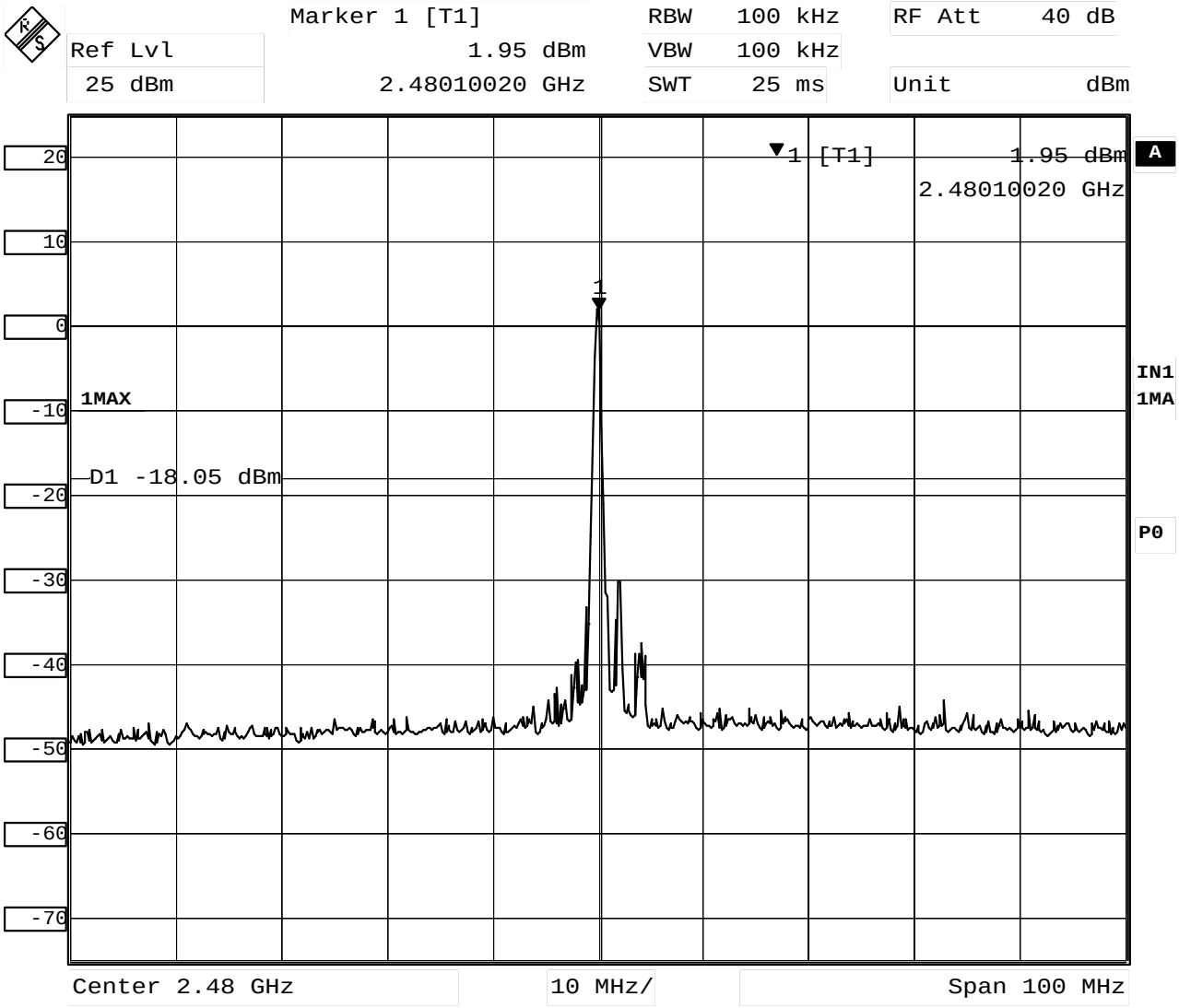
7.4 Trace Data



Out of Band Emissions (TX on 2402MHz)



Out of Band Emissions (TX on 2441MHz)



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).

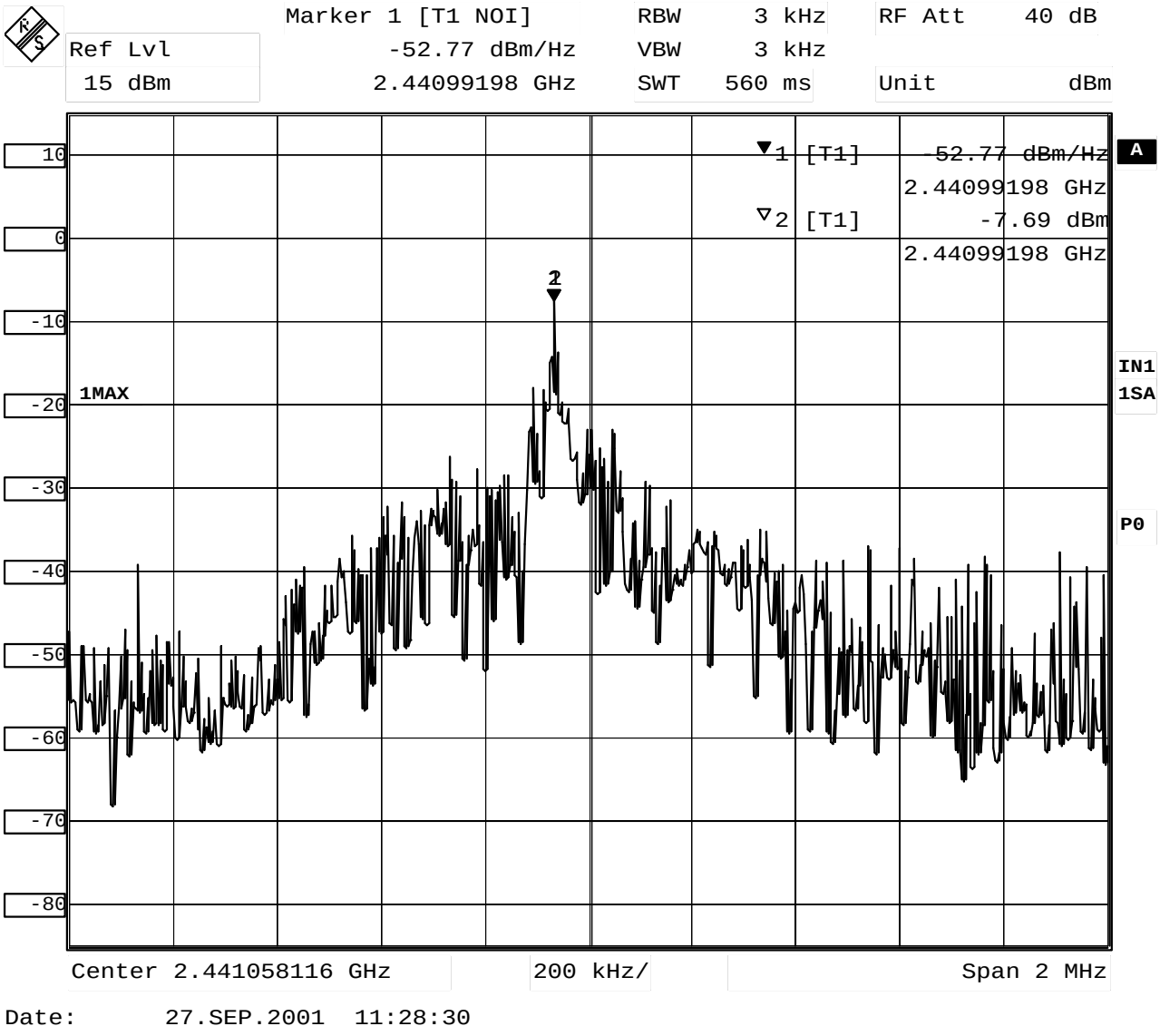
8.3 Measurement Results

Test Date: September 27, 2001

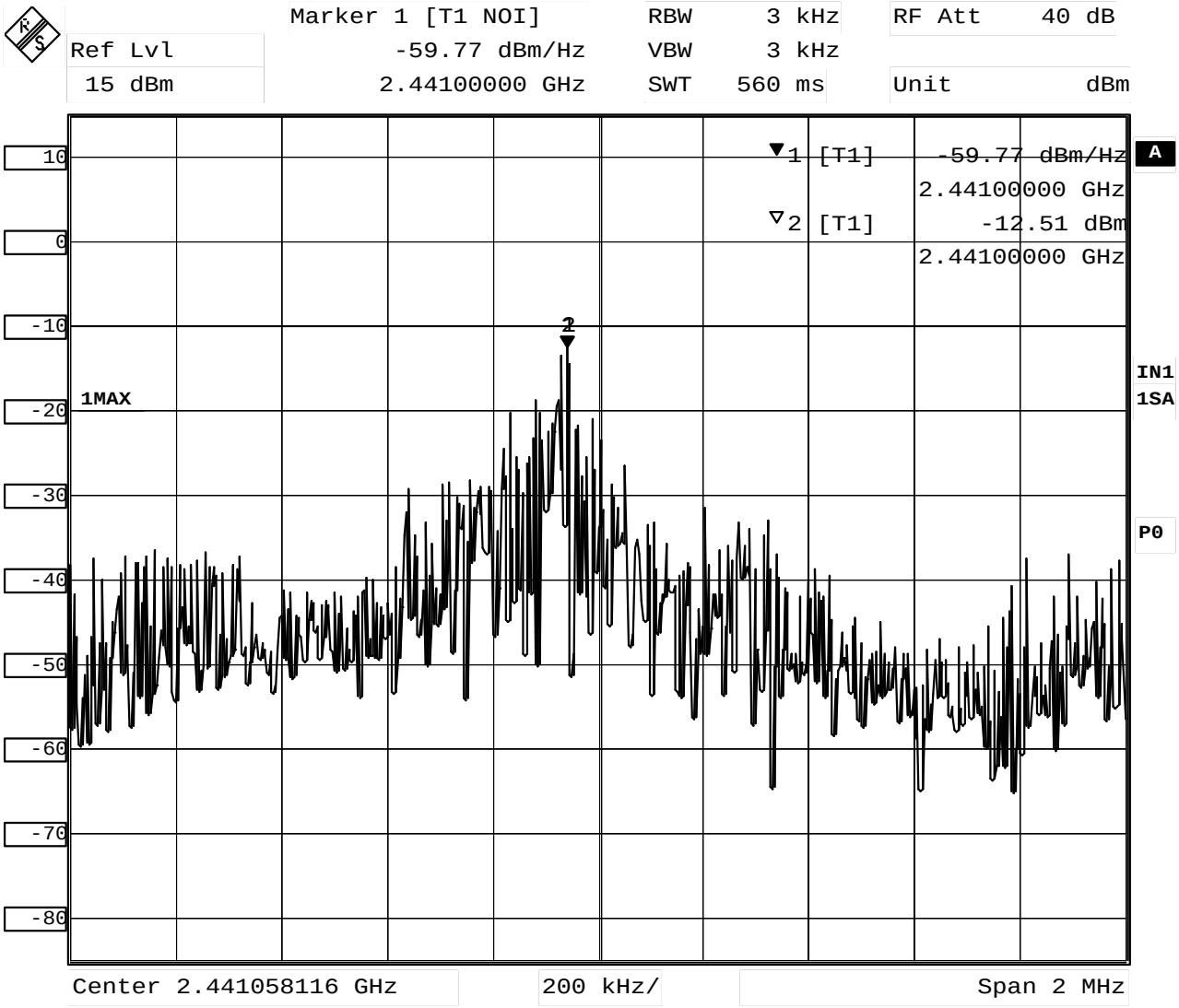
Table 8. EUT: M/T 2662-E6x, s/n FX-00154

EUT Operation mode	Measured Frequency (MHz)	Spectrum Analyzer Reading (dBm)	Cable loss (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
Inquiry	2440.99	- 7.7	1.7	- 6.0	8.0	14.0
Paging	2441.00	- 12.5	1.7	- 10.8	8.0	18.8

8.4 Trace Data



Transmitter Power Spectral Density (Inquiry)



Transmitter Power Spectral Density (Paging)

9. AC WIRELINE CONDUCTED EMISSIONS (450 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

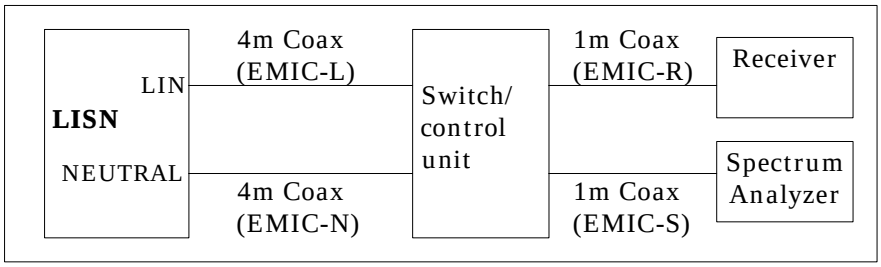


Figure 9. Cables for Conducted Emission Test

Table 9-1. Conducted Emission Test Instrumentation

Description	**Model**	**Serial Number**
Computer	IBM 6589-13J	97-15613
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2732A03651
Spectrum Analyzer Display	HP 85662A	2648A15255
Quasi-Peak Adapter	HP 85650A	2521A00968
Receiver (9kHz-30MHz)	R&S ESH3	892108/003
LISN	EMCO 3825/2	1426
Switch/control unit	HP 3488A	2719A17228
Plotter	HP 7550A	2631A33619
Coax cables: - Lisn-L <=> SW/Con.unit (SW100) - Lisn-N <=> SW/Con.unit (SW101) - SW/Con.unit <=> RCVR (Input) - SW/Con.unit<=> Spe Ana.(Signal In)	Length: 4 m 4 m 1 m 1 m	 - EMIC-L - EMIC-N - EMIC-R - EMIC-S

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

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 17.2 dB. The 6 highest emissions relative to the limits are reported.

Test Date: September 25, 2001

1) EUT in transmission mode

Table 9-2-1. EUT: M/T 2662-E6x, s/n FX-00154, Ch.1(2402MHz)

Frequency (MHz)	QP Voltage (dBμV)	QP Limit (dBμV)	QP Voltage (μV)	QP Limit (μV)	Phase
0.4748	30.7	48	34.3	250	Line
0.5826	29.5	48	29.9	250	Neutral
0.7544	26.8	48	21.9	250	Line
0.8551	29.8	48	30.9	250	Line
0.9597	29.3	48	29.2	250	Neutral
1.2328	30.1	48	32.0	250	Neutral

Table 9-2-2. EUT: M/T 2662-E6x, s/n FX-00154 , Ch.40(2441MHz)

Frequency (MHz)	QP Voltage (dBμV)	QP Limit (dBμV)	QP Voltage (μV)	QP Limit (μV)	Phase
0.4756	30.8	48	34.7	250	Line
0.5799	29.6	48	30.2	250	Neutral
0.744	27	48	22.4	250	Line
0.8566	29.9	48	31.3	250	Line
0.9598	29.3	48	29.2	250	Neutral
1.2349	29.7	48	30.5	250	Neutral

Table 9-2-3. EUT: M/T 2662-E6x, s/n FX-00154, Ch.79(2480MHz)

Frequency (MHz)	QP Voltage (dBμV)	QP Limit (dBμV)	QP Voltage (μV)	QP Limit (μV)	Phase
0.4761	30.8	48	34.7	250	Line
0.5834	29.7	48	30.5	250	Neutral
0.7553	26.5	48	21.1	250	Line
0.8539	30.1	48	32.0	250	Line
0.953	28.7	48	27.2	250	Neutral
1.2332	29.9	48	31.3	250	Neutral

2) EUT in receiving mode

Table 9-2-4. EUT: M/T 2662-E6x, s/n FX-00154, RX mode

Frequency (MHz)	QP Voltage (dBμV)	QP Limit (dBμV)	QP Voltage (μV)	QP Limit (μV)	Phase
0.4747	30.4	48	33.1	250	Line
0.5824	29.6	48	30.2	250	Neutral
0.7269	20.4	48	10.5	250	Neutral
0.8508	29.6	48	30.2	250	Line
0.9601	29.1	48	28.5	250	Neutral
1.2327	30	48	31.6	250	Neutral

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

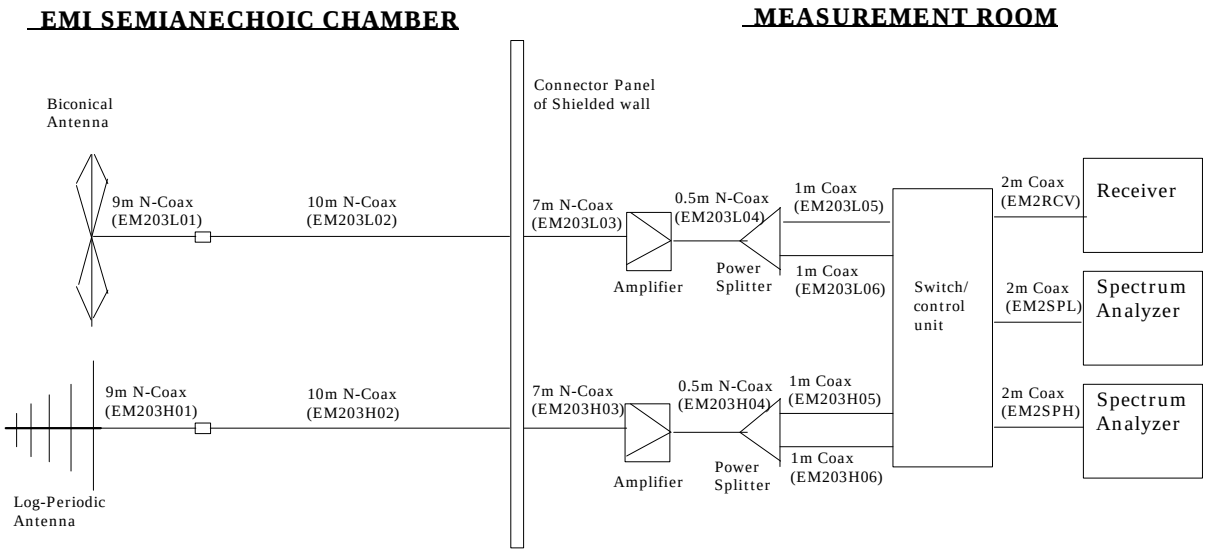


Figure 10 Cables for Radiated Emission Test

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	3019A05156
Spectrum Analyzer Display for 200-1000MHz	HP 85662A	3026A19366
Quasi-Peak Adapter for 200-1000MHz	HP 85650A	2811A01433
Amplifier (100KHz-1.3GHz)		
- for 30-200MHz	HP 8447D	2805A02919
- for 200-1000MHz	HP 8447D	2944A03506
Biconical Antenna (30-200MHz)	EMCO 3108	2241
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	1584
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	- EM203L01
- 10m Cable <=> Shield Panel	10 m	- EM203L02
- Shield Panel <=> RF Amp	7 m	- EM203L03
- RF Amp <=> Power Splitter	0.5m	- EM203L04
- Log-peri Ant <=> 10m Cable	9 m	- EM203H01
- 10m Cable <=> Shield Panel	10 m	- EM203H02
- Shield Panel <=> RF Amp	7 m	- EM203H03
- RF Amp <=> Power Splitter	0.5m	- EM203H04
Coax cables:		
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM203L05
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM203L06
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM203H05
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM203H06
- SW/Con.unit <=> Receiver (Input)	2 m	- EM2RCV
- SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	2 m	- EM2SPL
- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM2SPH

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 51.5dBμV; Antenna Factor of 8.5dB/m; Cable Loss of 1.3dB; and an Amplifier Gain of 26dB. The Field Strength of the measured emission is:

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

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

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

40dBμV/m = 100μV/m
48dBμV/m = 250μV/m

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 4.7 dB at 30 – 1000 MHz band.
The 6 highest emissions relative to the limits are reported.

Test Date: September 20, 2001

1) EUT in transmission mode

Table 10-2-1. EUT: M/T 2662-E6x, s/n FX-00154, 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)
60.236	V	37.7	9.3	-19.7	27.3	40.0	23.2	100
232.761	V	32.6	10.5	-14.5	28.6	46.0	26.9	200
260.090	V	36.2	11.8	-14.8	33.2	46.0	45.7	200
325.111	V	37.3	14	-14.4	36.9	46.0	70.0	200
332.986	V	37.9	13.9	-14.5	37.3	46.0	73.3	200
439.561	V	26.6	15.8	-14.2	28.2	46.0	25.7	200

Table 10-2-2. EUT: M/T 2662-E6x, s/n FX-00154, 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)
60.189	V	38.5	9.3	-19.7	28.1	40.0	25.4	100
260.089	V	36.0	11.8	-14.8	33.0	46.0	44.7	200
325.111	V	37.3	14	-14.4	36.9	46.0	70.0	200
332.986	V	37.6	13.9	-14.5	37.0	46.0	70.8	200
390.181	V	30.7	15	-14.4	31.3	46.0	36.7	200
438.940	V	28.3	15.8	-14.2	29.9	46.0	31.3	200

Table 10-2-3. EUT: M/T 2662-E6x, s/n FX-00154, 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)
60.157	V	39.0	9.3	-19.7	28.6	40.0	26.9	100
133.223	V	31.4	12.5	-18.7	25.2	43.5	18.2	150
260.145	V	35.7	11.8	-14.8	32.7	46.0	43.2	200
325.112	V	36.5	14	-14.4	36.1	46.0	63.8	200
332.986	V	37.5	13.9	-14.5	36.9	46.0	70.0	200
441.100	V	27.7	15.8	-14.3	29.2	46.0	28.8	200

2) EUT in receiving mode

Table 10-2-4. EUT: M/T 2662-E6x, s/n FX-00154, Ch.40 (2441MHz) RX mode

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
59.736	V	38.6	9.4	-19.7	28.3	40.0	26.0	100
325.112	V	36.8	14	-14.4	36.4	46.0	66.1	200
332.986	V	41.9	13.9	-14.5	41.3	46.0	116.1	200
389.989	V	32.6	15	-14.4	33.2	46.0	45.7	200
419.281	V	32.5	15.5	-14.5	33.5	46.0	47.3	200
455.156	V	33.0	16.2	-14.9	34.3	46.0	51.9	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

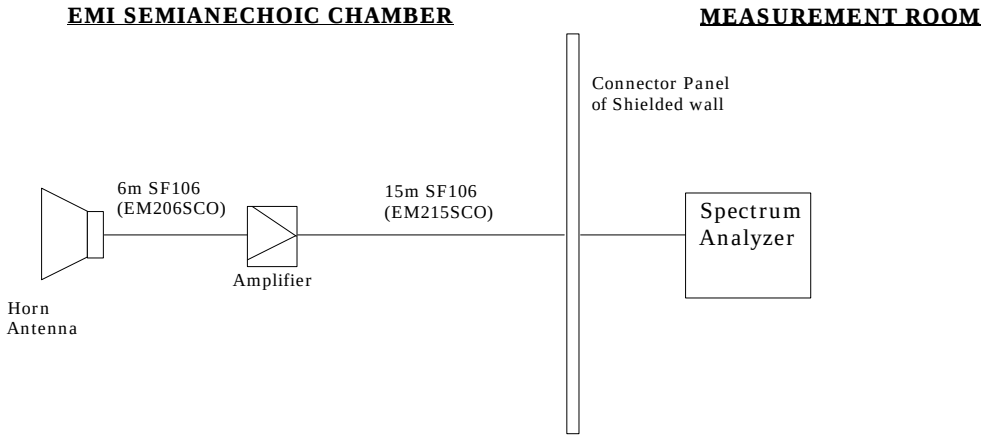


Figure 11 Cables for Radiated Emission Test

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 dBμV; Antenna Factor of 8.5 dB/m; Cable Loss of 1.3 dB;

Falloff Factor of 0 dB; and an Amplifier Gain of 26 dB. The Field Strength of the measured emission is:

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

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

Level(dBμV/m) = 20 X Log (Level(μV/m))
40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/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 1.0dB. 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: October 1, 3 and 4, 2001

1) EUT in transmission mode

Table 11-2-1. EUT: M/T 2662-E6x, s/n FX-00154, Ch.1(2402MHz) TX mode

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ***(peak)***	Measured (dBμV) ***(average)***	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ***(peak)***	FCC Limit (dBμV/m) ***(peak)***	Field Strength (dBμV/m) ***(average)***	FCC Limit (dBμV/m) ***(average)***
1.065	V	53.0	-	24.2	-31.5	0.0	45.7	74.0	-	54.0
1.194	V	54.5	-	24.6	-31.2	0.0	47.9	74.0	-	54.0
1.460	V	55.5	-	25.2	-30.6	0.0	50.1	74.0	-	54.0
1.596	V	51.7	-	25.7	-30.3	0.0	47.1	74.0	-	54.0
2.402	H	97.2	93.7	28.2	-28.4	0.0	97.0	OB*	93.5	OB*
4.806	V	44.0	-	27.4	-23.8	0.0	47.6	74.0	-	54.0
6.005	V	45.1	-	29.8	-22.9	0.0	52.0	74.0	-	54.0
7.206	V	60.4	39.3	30	-24.7	0.0	65.7	74.0	44.6	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 2662-E6x, s/n FX-00154, Ch.40(2441MHz) TX mode

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ***(peak)***	Measured (dBμV) ***(average)***	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ***(peak)***	FCC Limit (dBμV/m) ***(peak)***	Field Strength (dBμV/m) ***(average)***	FCC Limit (dBμV/m) ***(average)***
1.063	V	53.2	-	24.2	-31.5	0.0	45.9	74.0	-	54.0
1.198	V	55.1	-	24.6	-31.2	0.0	48.5	74.0	-	54.0
1.463	V	55.2	-	25.2	-30.6	0.0	49.8	74.0	-	54.0
1.596	V	53.1	-	25.7	-30.3	0.0	48.5	74.0	-	54.0
2.441	H	97.9	94.4	28.3	-28.4	0.0	97.8	OB*	94.3	OB*
4.882	V	41.2	-	27.4	-23.7	0.0	44.9	74.0	-	54.0
6.102	V	45.9	-	29.8	-23.0	0.0	52.7	74.0	-	54.0
7.323	V	60.8	40.2	29.8	-24.9	0.0	65.7	74.0	45.1	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 2662-E6x, s/n FX-00154, Ch.79(2480MHz) TX mode

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ***(peak)***	Measured (dBμV) ***(average)***	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ***(peak)***	FCC Limit (dBμV/m) ***(peak)***	Field Strength (dBμV/m) ***(average)***	FCC Limit (dBμV/m) ***(average)***
1.063	V	53.3	-	24.2	-31.5	0.0	46.0	74.0	-	54.0
1.196	V	54.6	-	24.6	-31.2	0.0	48.0	74.0	-	54.0
1.457	V	56.3	-	25.2	-30.6	0.0	50.9	74.0	-	54.0
1.595	V	52.6	-	25.7	-30.3	0.0	48.0	74.0	-	54.0
2.480	H	97.5	94.0	28.4	-28.2	0.0	97.7	OB*	94.2	OB*
2.484	H	58.2	52.8	28.4	-28.2	0.0	58.4	74.0	53.0	54.0
4.962	V	44.0	-	27.4	-23.5	0.0	47.9	74.0	-	54.0
6.199	V	40.1	-	29.9	-23.1	0.0	46.9	74.0	-	54.0
7.440	V	53.9	37.2	29.8	-25.1	0.0	58.6	74.0	41.9	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 2662-E6x, s/n FX-00154, RX mode

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ***(peak)***	Measured (dBμV) ***(average)***	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ***(peak)***	FCC Limit (dBμV/m) ***(peak)***	Field Strength (dBμV/m) ***(average)***	FCC Limit (dBμV/m) ***(average)***
1.066	V	53.4	-	24.2	-31.5	0.0	46.1	74.0	-	54.0
1.195	V	55.3	-	24.6	-31.2	0.0	48.7	74.0	-	54.0
1.460	V	55.0	-	25.2	-30.6	0.0	49.6	74.0	-	54.0
1.595	V	52.8	-	25.7	-30.3	0.0	48.2	74.0	-	54.0