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

Document Number : FCC 19-0206-0

Product: IBM ThinkPad R40 Series

included **IBM Dual-Band 11a/b Wi-Fi® Wireless Mini PCI Adapter**

FCC ID: ANO20020300D3L
IC: 349E- PH11107E

November 18, 2002

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

IBM ThinkPad R40 Series
(Machine type : 2681, 2682, 2683, 2722, 2723, 2724)
with
IBM Dual-Band 11a/b Wi-Fi® Wireless Mini PCI Adapter

FCC ID : ANO20020300D3L

November 18, 2002

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

Equipment type: Wireless LAN device

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

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

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

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

(Yes) or No

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A. General Information

APPLICANT	: IBM Japan, Ltd.
TEST SITE	: IBM Japan, Ltd., Yamato Semi-anechoic chamber #1
TEST SITE ADDRESS	: 1623 – 14 Shimotsuruma, Yamato-shi, Kanagawa 242-8502 Japan Tel: +81-46-215-4779, Fax: +81-46-273-7420
REGULATION	: FCC Part 15 Subpart C Industry Canada RSS-210 (Issue No.5)
MODEL NUMBER	: 2681-3LU (ThinkPad R40 Series)
FCC ID IC Certification Number	: ANO20020300D3L : 349E-PH11107E
SERIAL NUMBER	: FX-0N14F
PYSICAL CONDITION	: Preproduction
KIND OF EQUIPMENT	: Personal computer with a IEEE802.11a & b Wireless LAN Mini-PCI Combo Card (Composite application)
TESTED DATE	: October 15, 16, 21, 22, 25, 28, 29 and November 13, 2002

A.1 Test Methodology

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

A.2 Test Facility / NVLAP Accreditation

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

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

A.3 EUT details

Table-A EUT details

Model and S/N	**FCC ID** **IC Certification Number**	**Description**
IBM Dual-Band 11a/b Wi-Fi® Wireless Mini PCI Adapter (s/n PVT-0738)	IC: 349E-PH11107E	IEEE802.11a & b Wireless LAN Mini-PCI Combo Card without antenna
ThinkPad R40 Series M/T 2681-3LU (s/n FX-0N14F)	FCC ID: ANO20020300D3L	**Applying equipment** IBM Notebook PC with built_in antenna CPU: Intel® Mobile Pentium® 4, 1.6GHz LCD: 14” XGA
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		Condition	Result
	Transmit mode (TX):			
15.247(a)(2) **5.9.1**	Bandwidth at 6 dB below		Conducted	Pass
15.247(c) **5.9.1** **6.2.2 (o) (e1)**	Occupied BW (or Band-edge) Out of Band Emissions (Bandwidth at 20 dB below)	The radiated emission in any 100kHz of outband shall be at least 20dB below the highest inband spectral density.		Pass
15.247(b) **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 **6.6**	AC Wireline Conducted Emissions 450kHz – 30MHz	Class B: 250μV		Pass
15.205 / 209 **6.2.1 / 6.3**	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Shall not exceed the limits specified in FCC 15.209 or RSS-210 Table3.	Radiated (30MHz - 1GHz)	Pass
			Radiated (1– 25GHz)	Pass

	Receive mode (RX):			
15.207 **7.4**	AC Wireline Conducted Emissions 450kHz – 30MHz	Class B: 250μV	Conducted	Pass
15.209 **7.3**	General Field Strength Limits (Radiated Emission Limits)	Shall not exceed the limits specified in RSS-210.	Radiated (30MHz - 1GHz)	Pass
			Radiated (1– 25GHz)	Pass

C. Operation Mode of EUT

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 of each 2.4GHz or 5.8GHz band.
   - 2412MHz (lowest), 2437MHz(middle), and 2462MHz (highest) for 2.4GHz band
   - 5745MHz (lowest), 5785MHz(middle), and 5825MHz (highest) for 5.8GHz band
3. 11Mbps and 24Mbps transmission modes were selected for full testing as the worse case samplings. See "Chapter 3. Conducted Peak Output Power" as to the determination of measurement plots.
4. As for the RF receiving test, the middle channels (2437MHz or 5785MHz) were selected representatively.

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

Operation Frequency [GHz]	Rated output power (conducted) [dBm]										
	Bit rate 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)	+17	+17	+17	-	-	-	-	-	-	-	-
2.417 (Ch. 2)	+17	+17	+17	-	-	-	-	-	-	-	-
2.422 (Ch. 3)	+17	+17	+17	-	-	-	-	-	-	-	-
2.427 (Ch. 4)	+17	+17	+17	-	-	-	-	-	-	-	-
2.432 (Ch. 5)	+17	+17	+17	-	-	-	-	-	-	-	-
2.437 (Ch. 6)	+17	+17	+17	-	-	-	-	-	-	-	-
2.442 (Ch. 7)	+17	+17	+17	-	-	-	-	-	-	-	-
2.447 (Ch. 8)	+17	+17	+17	-	-	-	-	-	-	-	-
2.452 (Ch. 9)	+17	+17	+17	-	-	-	-	-	-	-	-
2.457 (Ch. 10)	+17	+17	+17	-	-	-	-	-	-	-	-
2.462 (Ch. 11)	+17	+17	+17	-	-	-	-	-	-	-	-
5.745 (Ch.149)	-	-	-	+16	+16	+16	+16	+16	+15	+12	+10
5.765 (Ch.153)	-	-	-	+16	+16	+16	+16	+16	+15	+12	+10
5.785 (Ch.157)	-	-	-	+16	+16	+16	+16	+16	+15	+12	+10
5.805 (Ch.161)	-	-	-	+16	+16	+16	+16	+16	+15	+12	+10
5.825 (Ch.165)	-	-	-	+16	+16	+16	+16	+16	+15	+12	+10

D. Justification

The EUT was investigated for both the main (left) and the auxiliary (right) antennas for each LCD size. The worse case data taken in this report represents the measurement result of the right antenna for the 13/14" LCD model that has comparatively higher gain in 2.4GHz band and the left antenna for the 13/14" LCD model in 5.8GHz band.

Table-D Peak Antenna Gains of EUT

		13" / 14" LCD model	15" LCD model
2.4GHz band	Left Antenna gain	-0.37 dBi (peak)	+0.46 dBi (peak)
	Right Antenna gain	+**0.83** dBi (peak)	-1.06 dBi (peak)
5.8GHz band	Left Antenna gain	+**0.85** dBi (peak)	-0.49 dBi (peak)
	Right Antenna gain	-0.94 dBi (peak)	-0.12 dBi (peak)

E. Test Instruments

Table-E 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	2841A04252	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	2811A01156	06/17/02	1 year
Quasi-Peak Adapter	HP 85650A	3033A01449	02/15/02	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 (1 - 26.5GHz)	HP 8449B	3008A00582	06/13/02	1 year
Amplifier (26.5 - 40GHz)	Agilent 83051A	3950M00193	12/06/01	1 year
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003	07/18/02	1 year
Spectrum Analyzer	HP 8563E	3416A02248	08/14/02	1 year
Harmonic Mixer	Agilent 11970A	011269-001	12/06/01	1 year
Receiver (9kHz-30MHz)	R&S ESH3	891806/012	10/07/02	1 year
Receiver (20MHz-1.3GHz)	R&S ESVP	893202/018	02/06/02	1 year
Biconical Antenna (30-200MHz)	EMCO 3108	2309	05/06/02	1 year
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	1585	05/06/02	1 year
Horn Antenna (1- 18GHz)	EMCO 3115	9903-5774	07/18/02	1 year
Horn Antenna (3.95- 5.85GHz)	EMCO 3160-5	1099	04/17/02	1 year
Horn Antenna (5.85- 8.20GHz)	EMCO 3160-6	9712-1044	04/17/02	1 year
Horn Antenna (8.2- 12.4GHz)	EMCO 3160-7	1156	04/17/02	1 year
Horn Antenna (12.4- 18GHz)	EMCO 3160-8	1143	04/17/02	1 year
Horn Antenna (18- 26.5GHz)	EMCO 3160-9	0004-1202	04/17/02	1 year
Horn Antenna (26.5- 40GHz)	EMCO 3160-10	1175	04/17/02	1 year
LISN	EMCO 3825/2	1426	09/01/02	1 year
Power Meter	HP 437B	3043U03437	10/23/01	1 year
Power Sensor	HP 8481A	US41030582	10/26/01	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 (1 – 18GHz):	Length:			
- Horn Ant <=> RF Amp.	6 m	- EM206SCO	09/05/02	1 year
- RF Amp.<=>Spectrum Analyzer	15m	- EM215SCO	09/05/02	1 year
SF102 cables (18 – 40GHz):				

- Horn Ant <=> RF Amp.	6m	- SF102-20165	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	04/15/02	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	0.5m	- EM103H04	04/15/02	1 year
Coax cables:				
- Lisn-L <=> SW/Con.unit (SW100)	4 m	- EMIC-L	04/15/02	1 year
- Lisn-N <=> SW/Con.unit (SW101)	4 m	- EMIC-N	04/15/02	1 year
- SW/Con.unit <=> RCVR (Input)	1 m	- EMIC-R	04/15/02	1 year
- SW/Con.unit<=> Spe Ana.(Signal In)	1 m	- EMIC-S	04/15/02	1 year
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM103L05	04/15/02	1 year
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM103L06	04/15/02	1 year
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM103H05	04/15/02	1 year
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM103H06	04/15/02	1 year
- SW/Con.unit <=> Receiver (Input)	2 m	- EM1RCV	04/15/02	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	2 m	- EM1SPL	04/15/02	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM1SPH	04/15/02	1 year

Notes.

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

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 SDoC.

1. Bandwidth at 6 dB below

1.1 Test Procedure

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

1.2 Test Instruments and Measurement Setup

Table 1-1 : 6 dB Bandwidth Test Instruments

Description	**Model**	**Serial Number**
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003
Coax cables: - Spectrum Analyzer <=> EUT	Length: Loss: 110 cm 1.3 dB (for 2.4GHz) 2.3 dB (for 5.8GHz)	

Notes: - R&S: Rohde & Schwarz

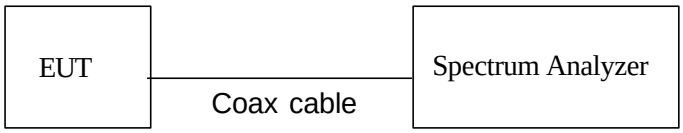


Figure 1: Measurement setup for 6dB bandwidth test

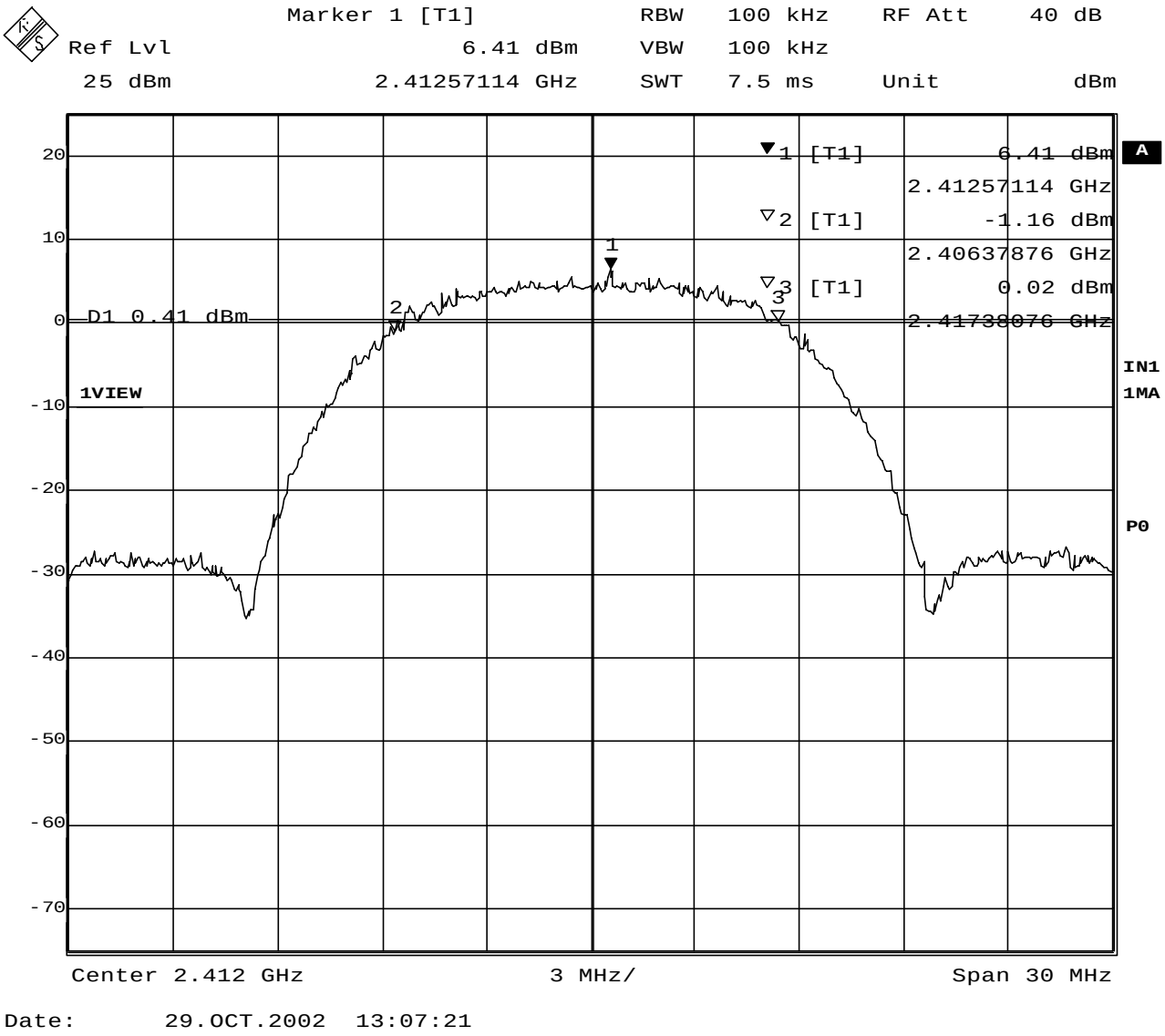
1.3 Measurement Results

Test Date: October 29, 2002

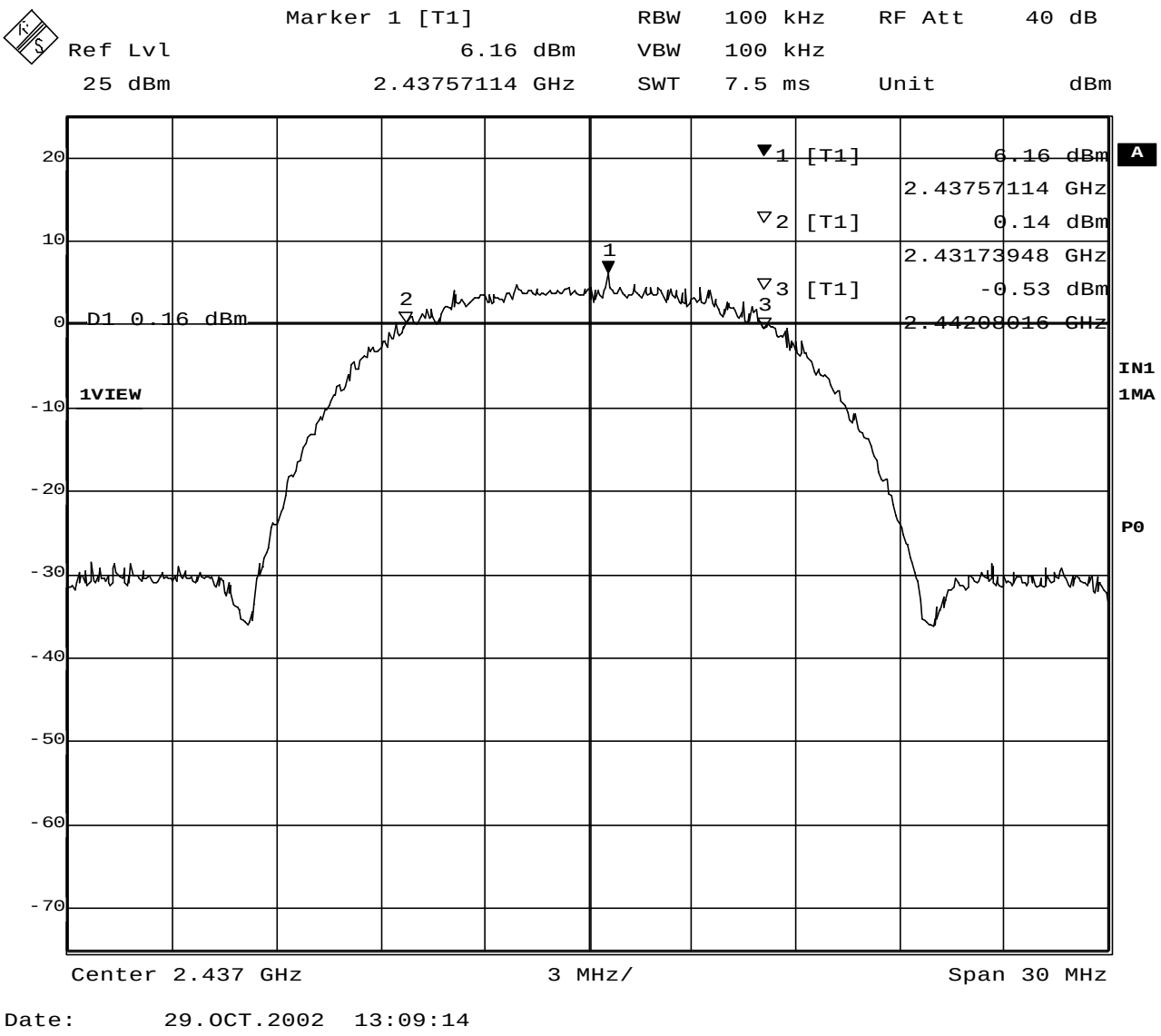
Table 1-2. EUT: M/T 2681-3LU, s/n FX-0N14F , TX mode

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)	note
2412	Plot 1-1	2406.38	2417.38	11.00	> 500kHz
2437	Plot 1-2	2431.74	2442.00	10.26	
2462	Plot 1-3	2456.62	2467.08	10.46	
5745	Plot 1-4	5736.67	5753.33	16.66	> 500kHz
5785	Plot 1-5	5776.67	5793.33	16.66	
5825	Plot 1-6	5816.67	5833.33	16.66	

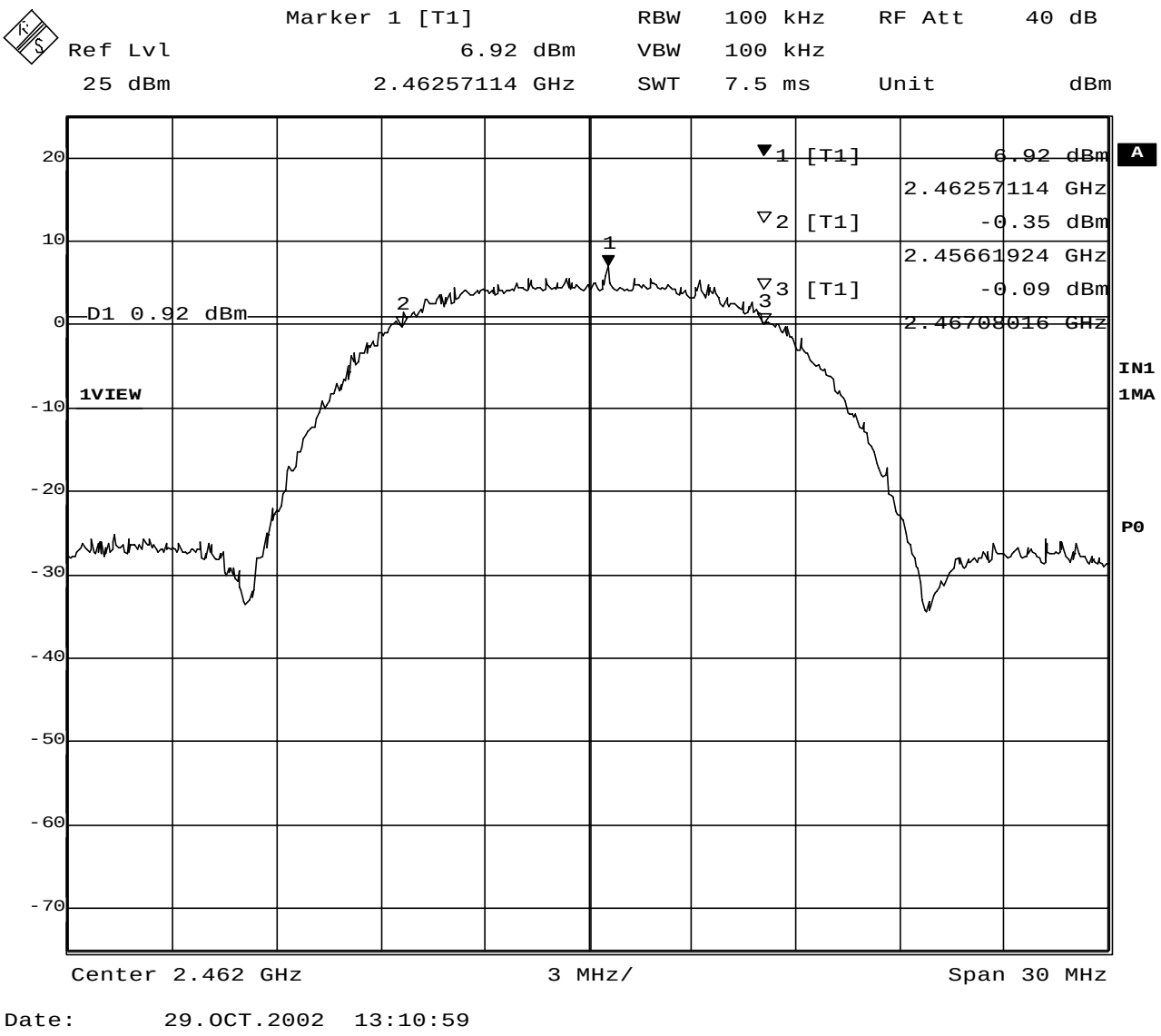
1.4 Trace Data of 6dB bandwidth



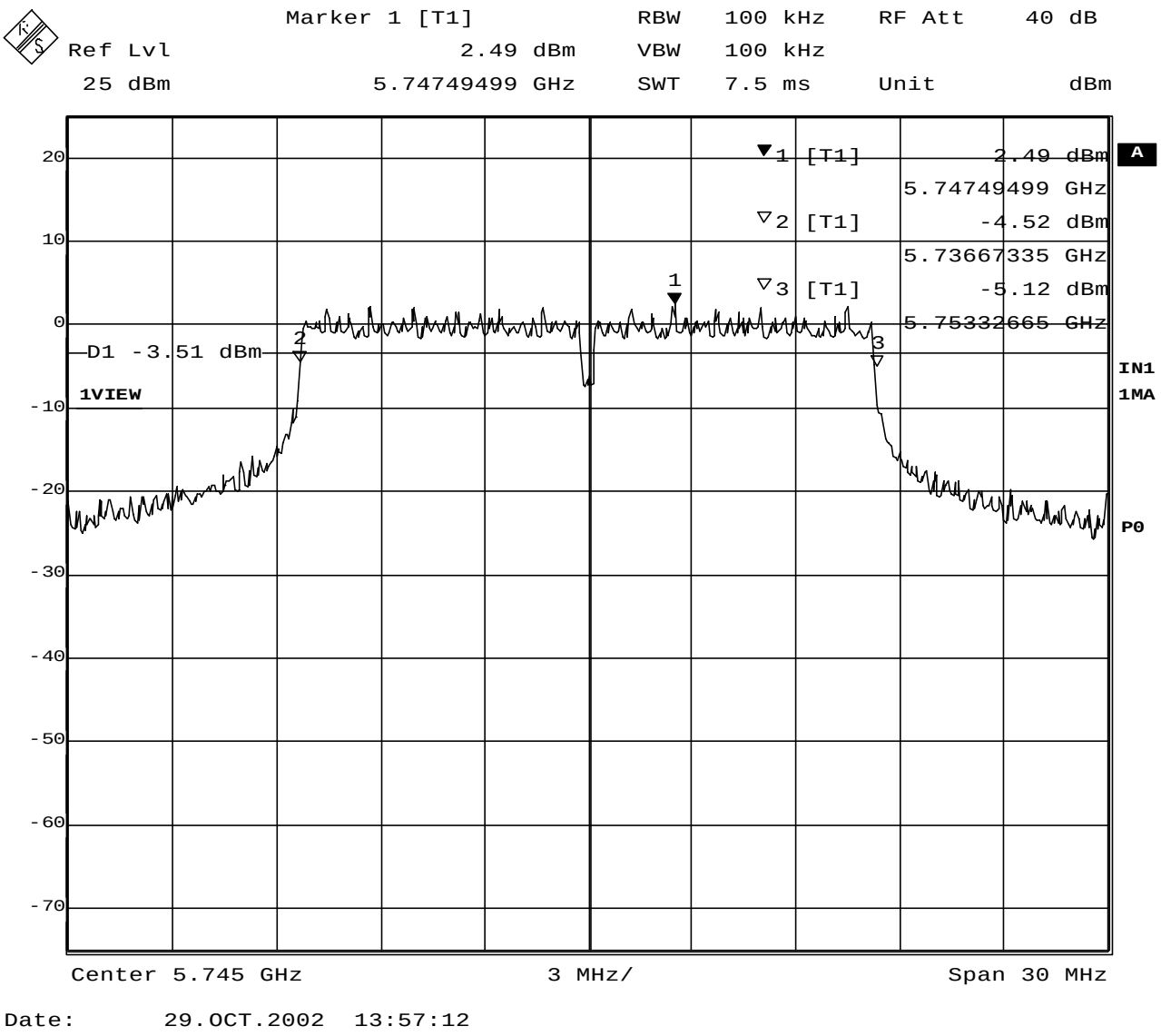
Plot 1-1. 6dB BW at 2412MHz



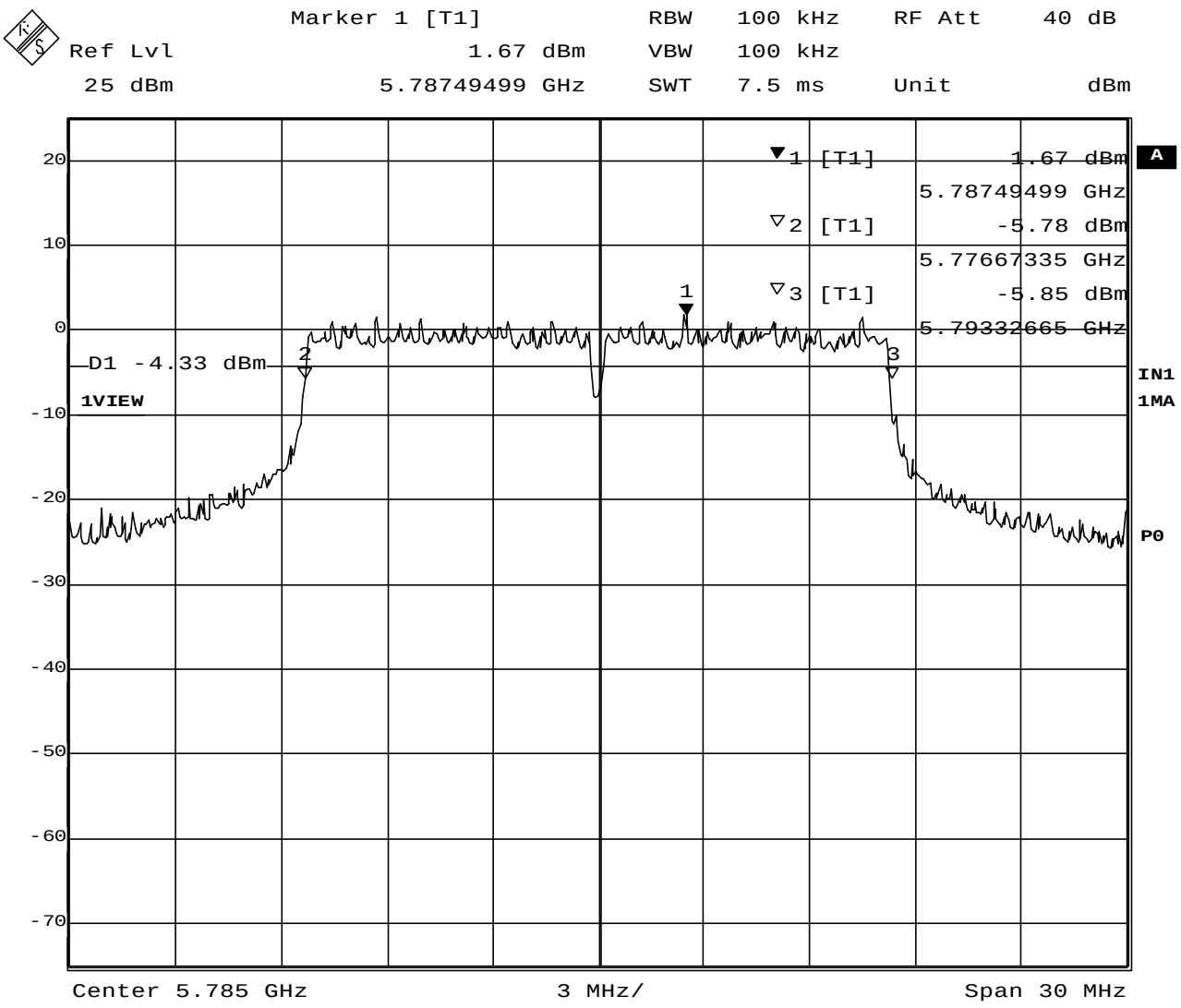
Plot 1-2. 6dB BW at 2437MHz



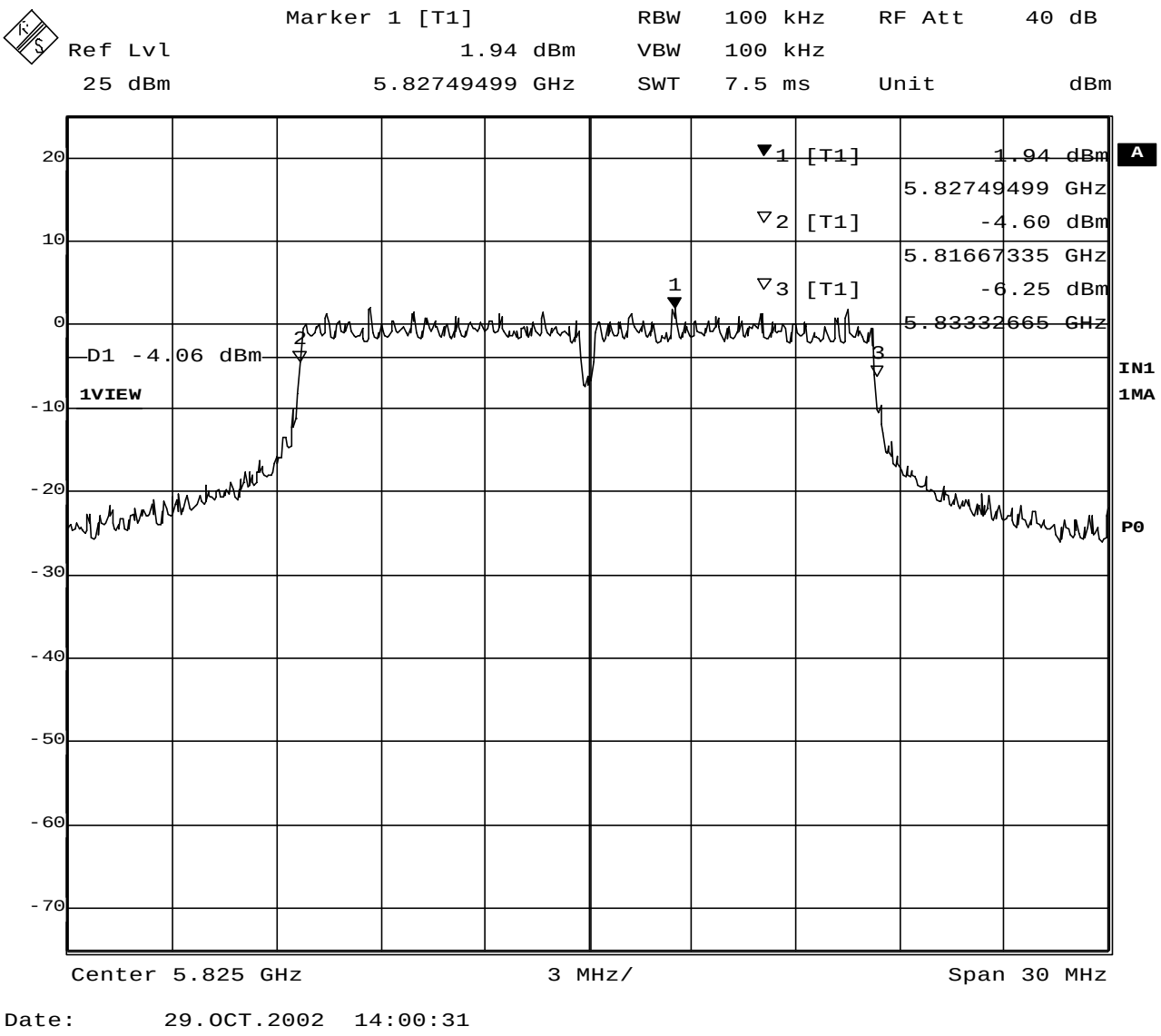
Plot 1-3. 6dB BW at 2462MHz



Plot 1-4. 6dB BW at 5745MHz



Plot 1-5. 6dB BW at 5785MHz



Plot 1-6. 6dB BW at 5825MHz

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

2.1 Test Procedure

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

2.2 Test Instruments and Measurement Setup

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

2.3 Measurement Results of Occupied Bandwidth/Band-edge

Test Date: October 29, 2002

Table 2-1. EUT: M/T 2681-3LU, s/n FX-0N14F , TX mode

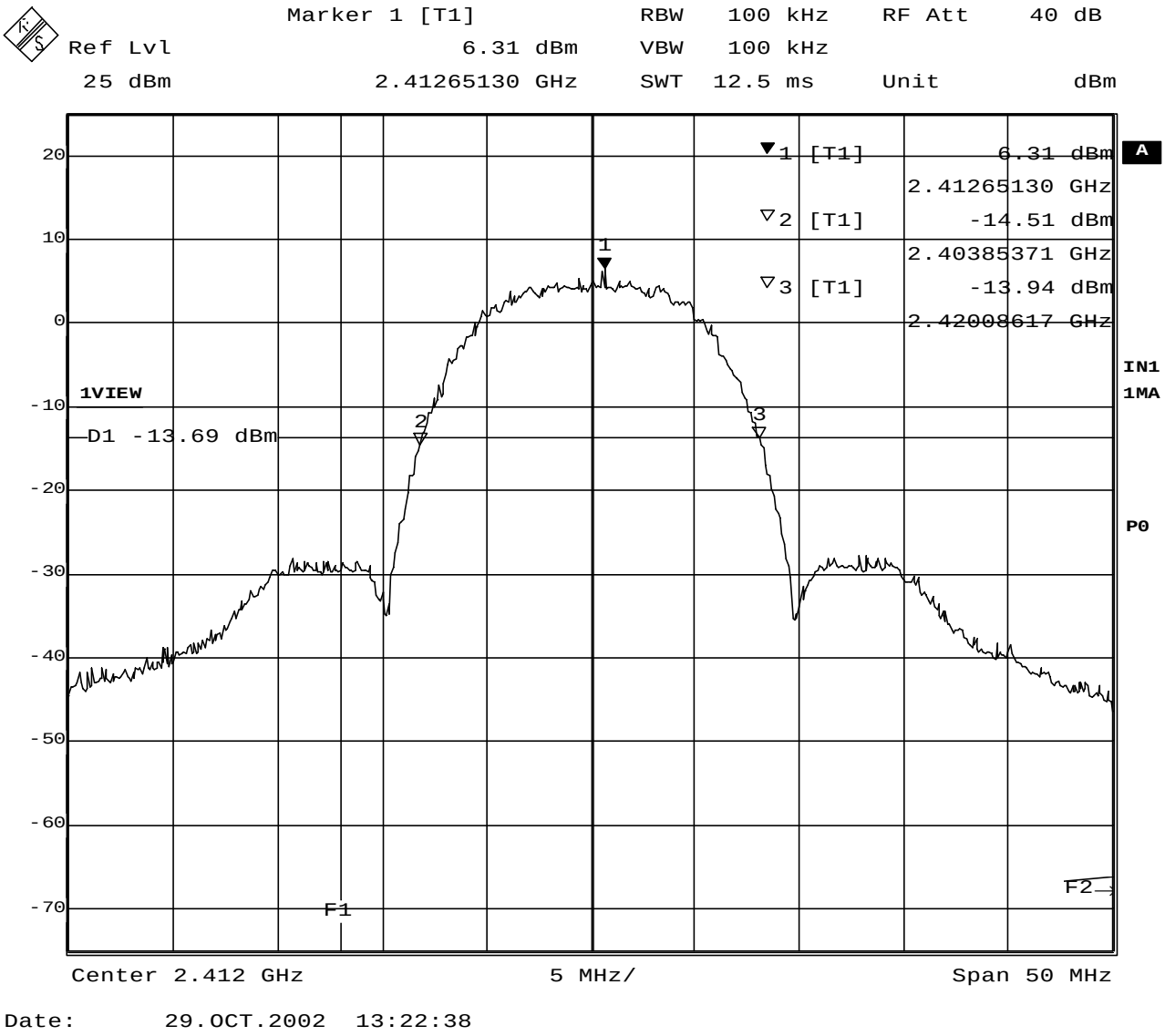
Center Frequency (MHz)	Trace number	Lower Frequency 20dB below (MHz)	Upper Frequency 20dB below (MHz)	Bandwidth at 20dB below (MHz)	Margin to Lower bandedge (MHz)	Margin to Upper bandedge (MHz)
2412	Plot 2-1	2403.85	2420.09	16.24	3.85	
2437	Plot 2-2	2429.03	2445.14	16.11		
2462	Plot 2-3	2453.83	2470.09	16.26		13.41
5745	Plot 2-4	5734.85	5754.49	19.64	9.85	
5785	Plot 2-5	5775.03	5794.57	19.54		
5825	Plot 2-6	5815.13	5834.37	19.24		15.63

2.4 Measurement Results of Out of Band Emissions

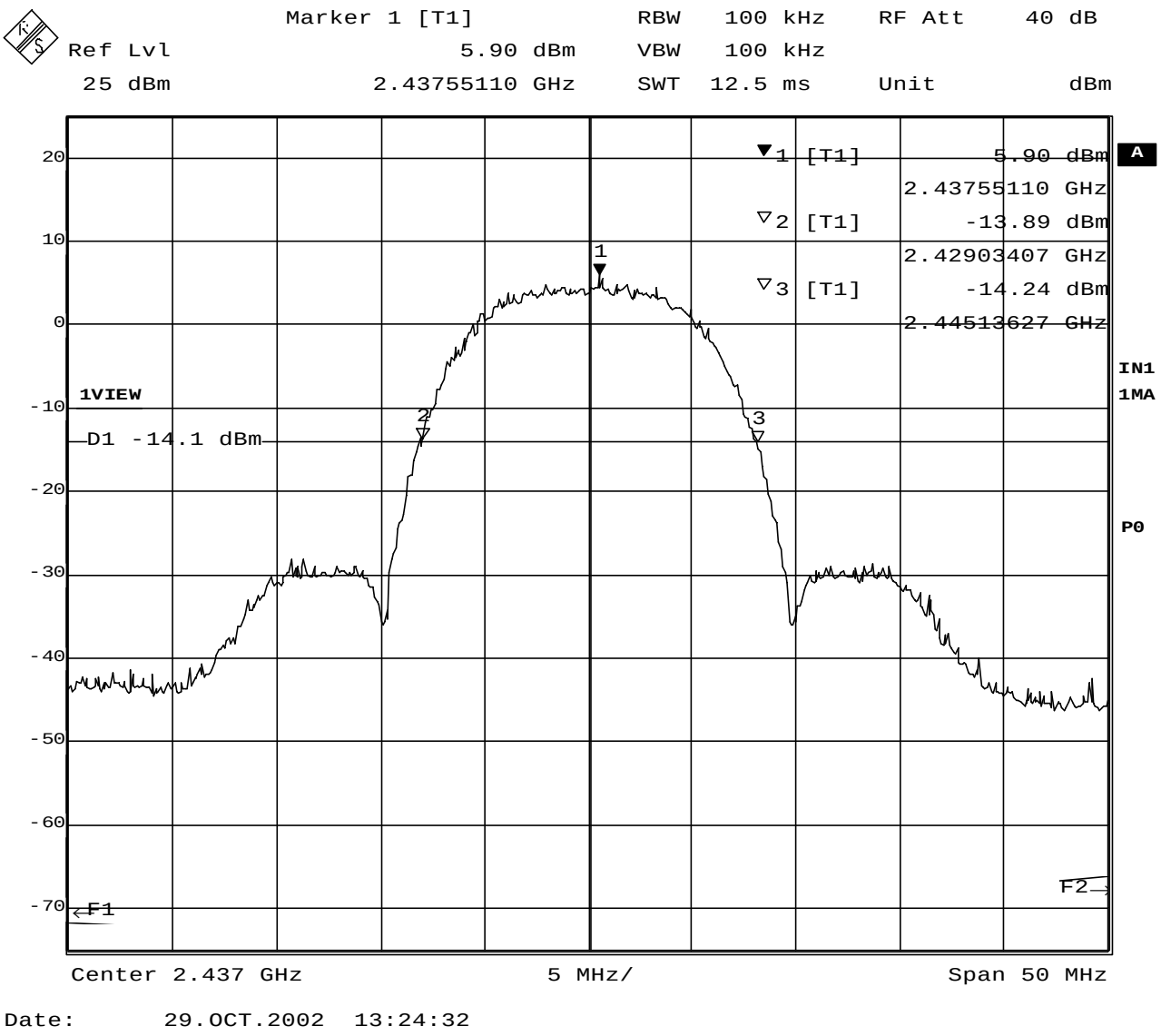
All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density.

Test Date: October 29, 2002 : See Plot 2-7 to 2-12.

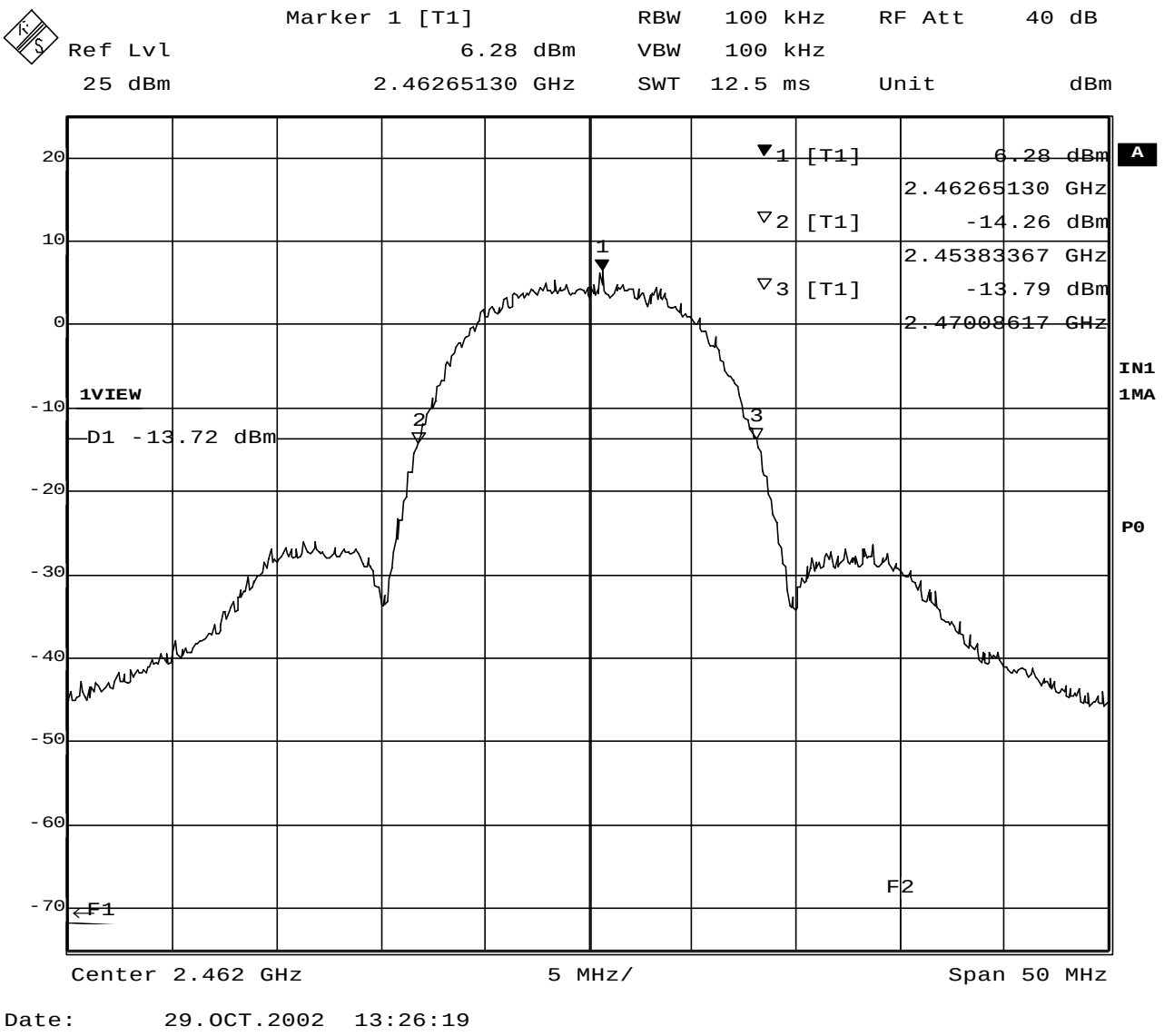
2.5 Trace Data of 20dB bandwidth



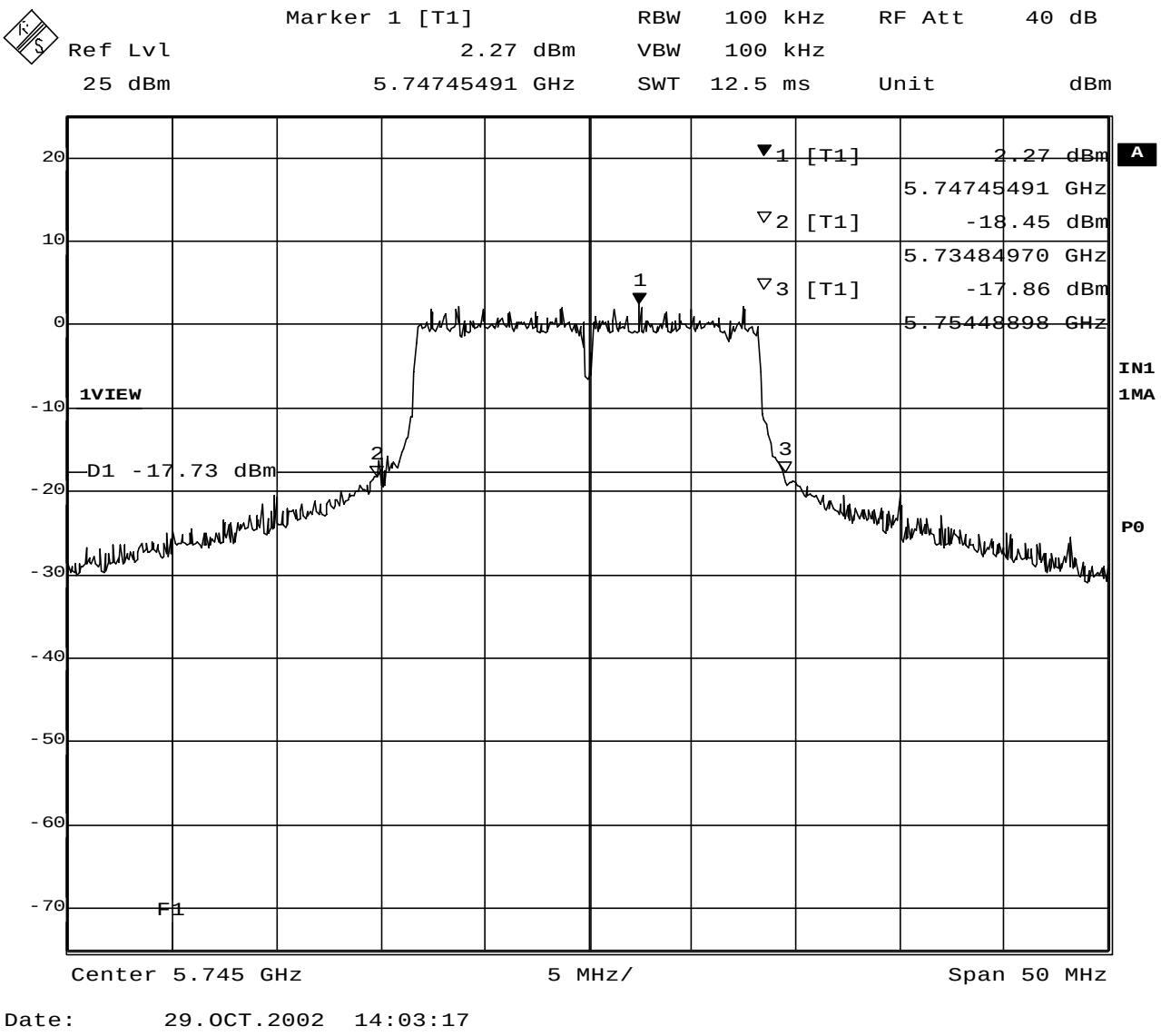
Plot 2-1. 20dB BW at 2412MHz



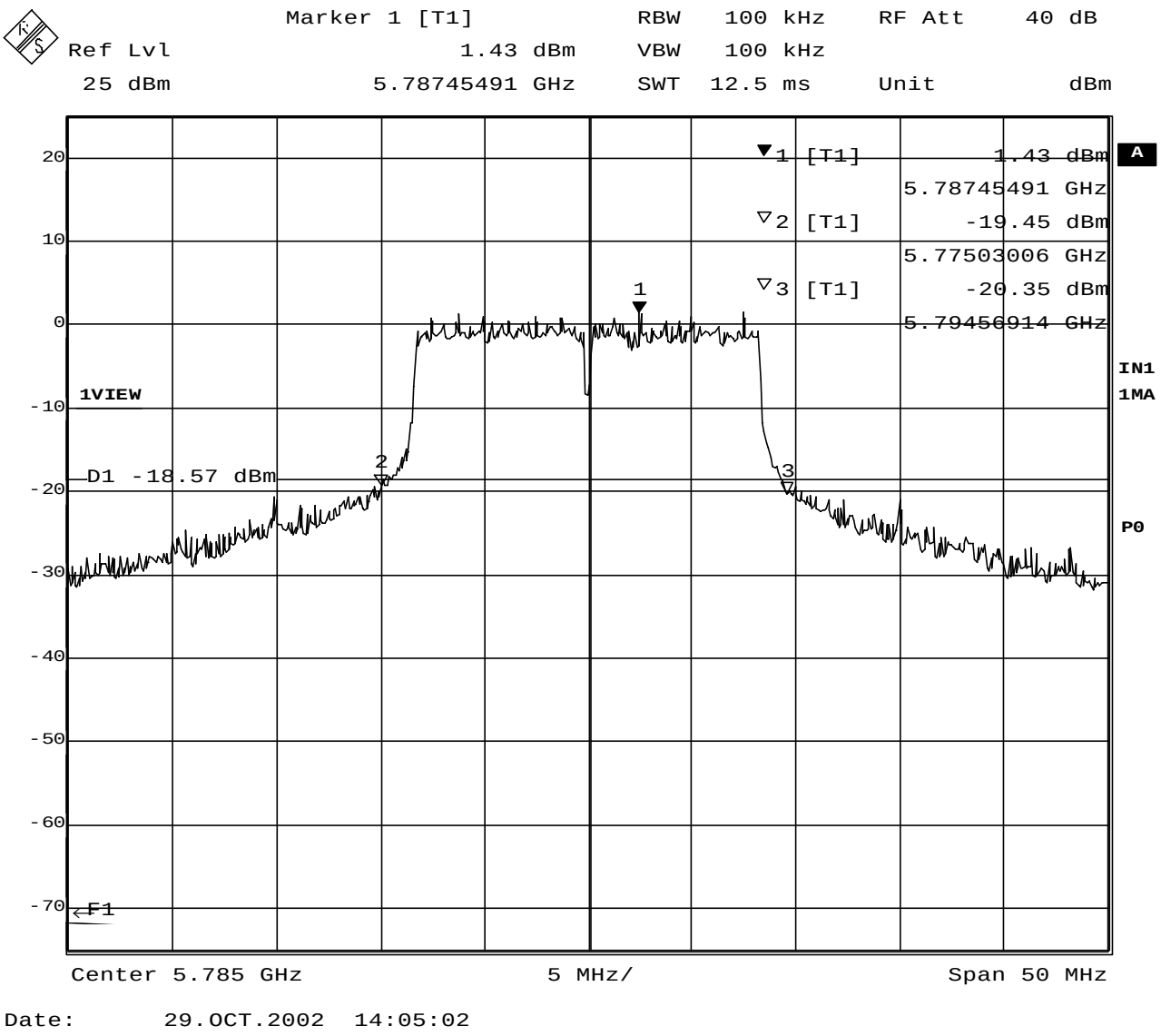
Plot 2-2. 20dB BW at 2437MHz



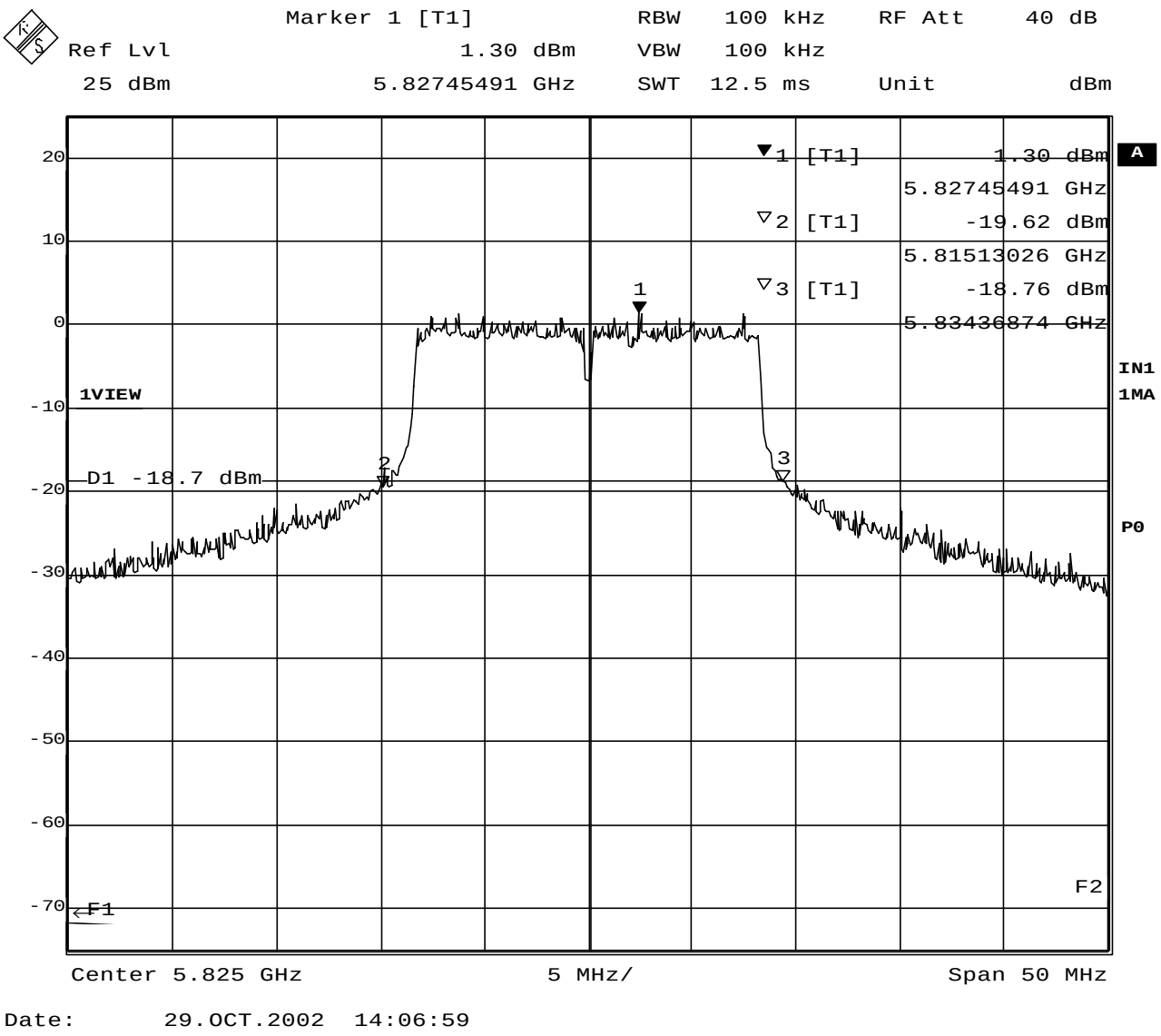
Plot 2-3. 20dB BW at 2462MHz



Plot 2-4. 20dB BW at 5745MHz

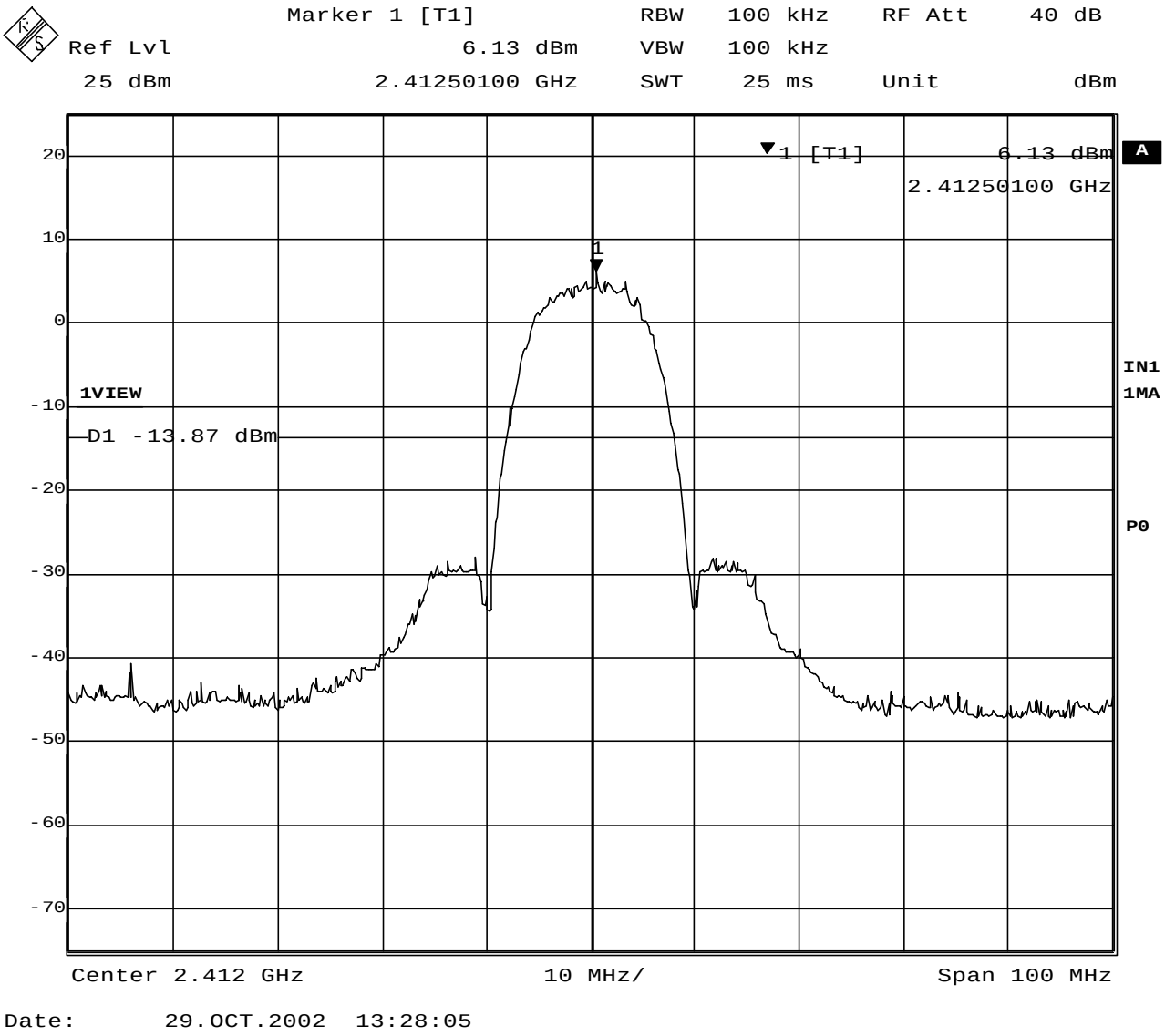


Plot 2-5. 20dB BW at 5785MHz

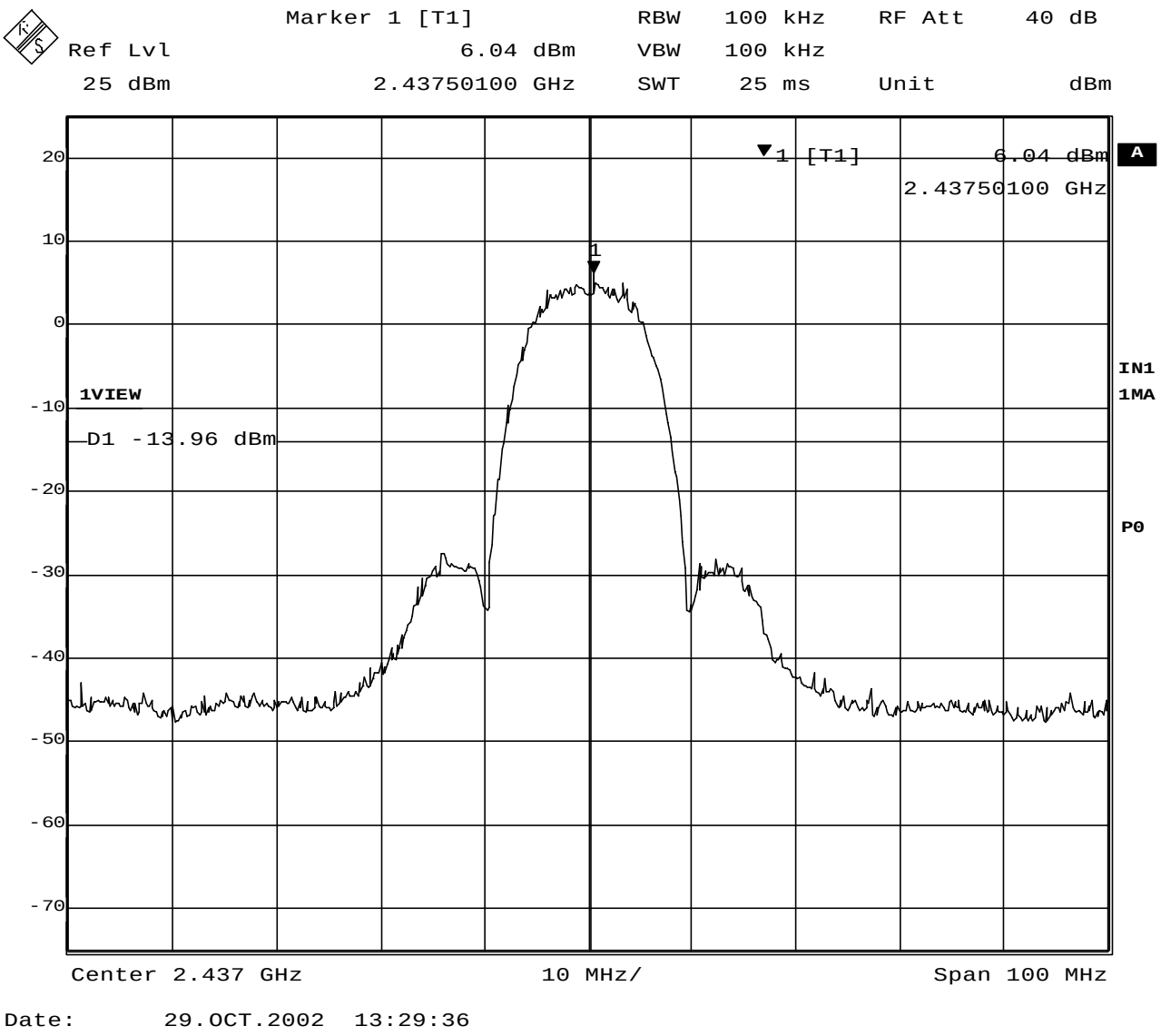


Plot 2-6. 20dB BW at 5825MHz

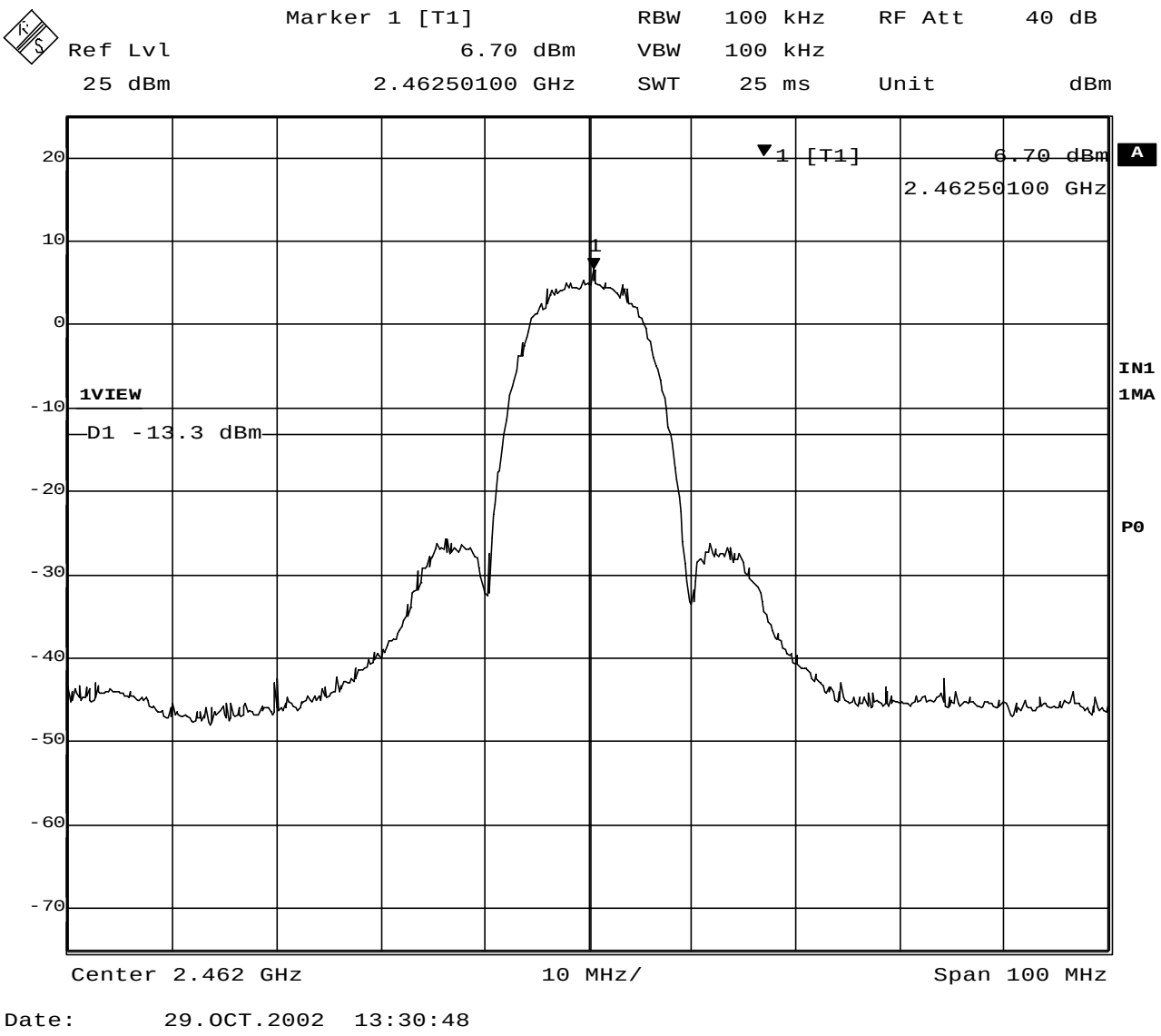
2.6 Trace Data of Out of Band Emissions



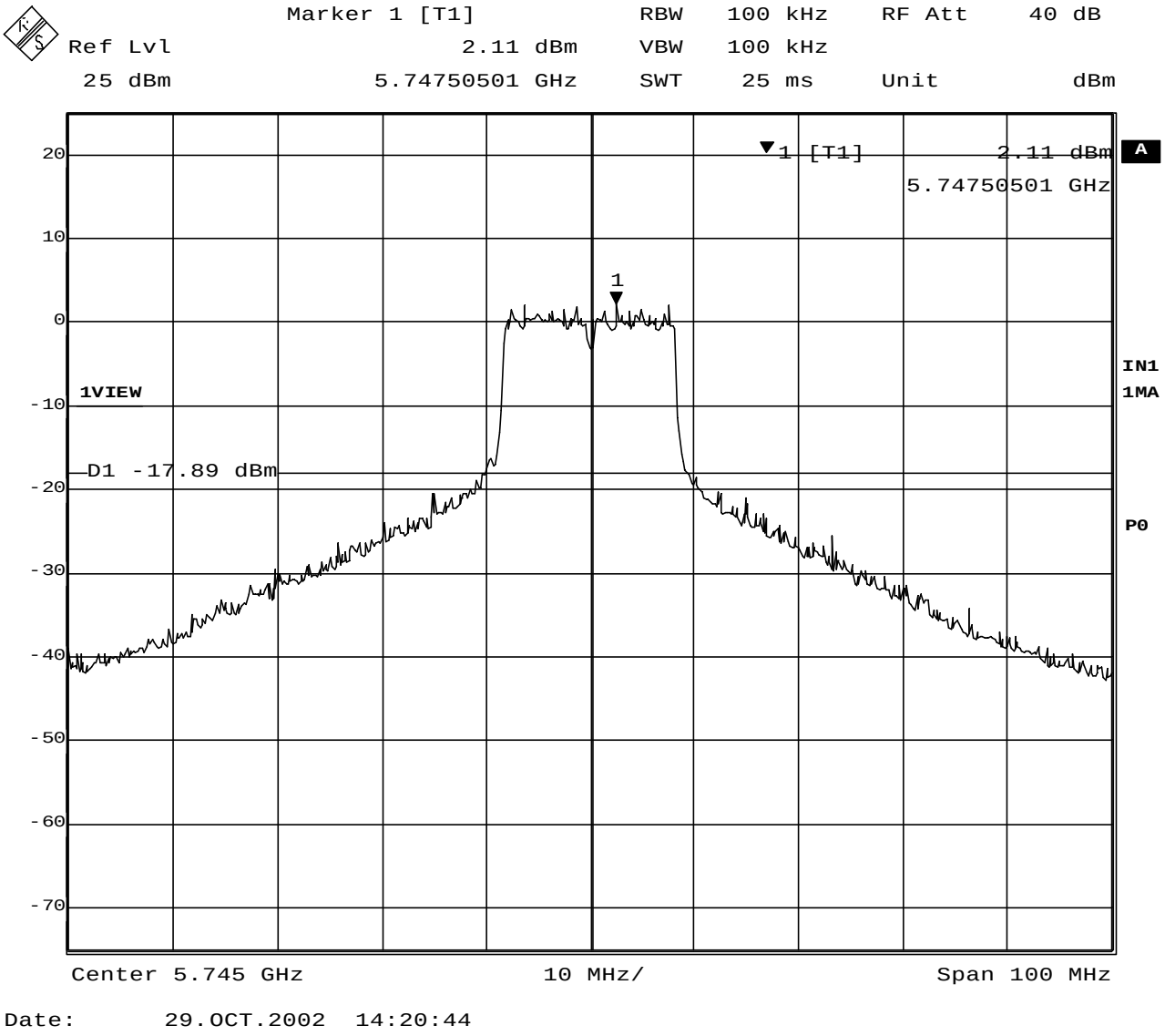
Plot 2-7. Out of band emissions around 2412MHz



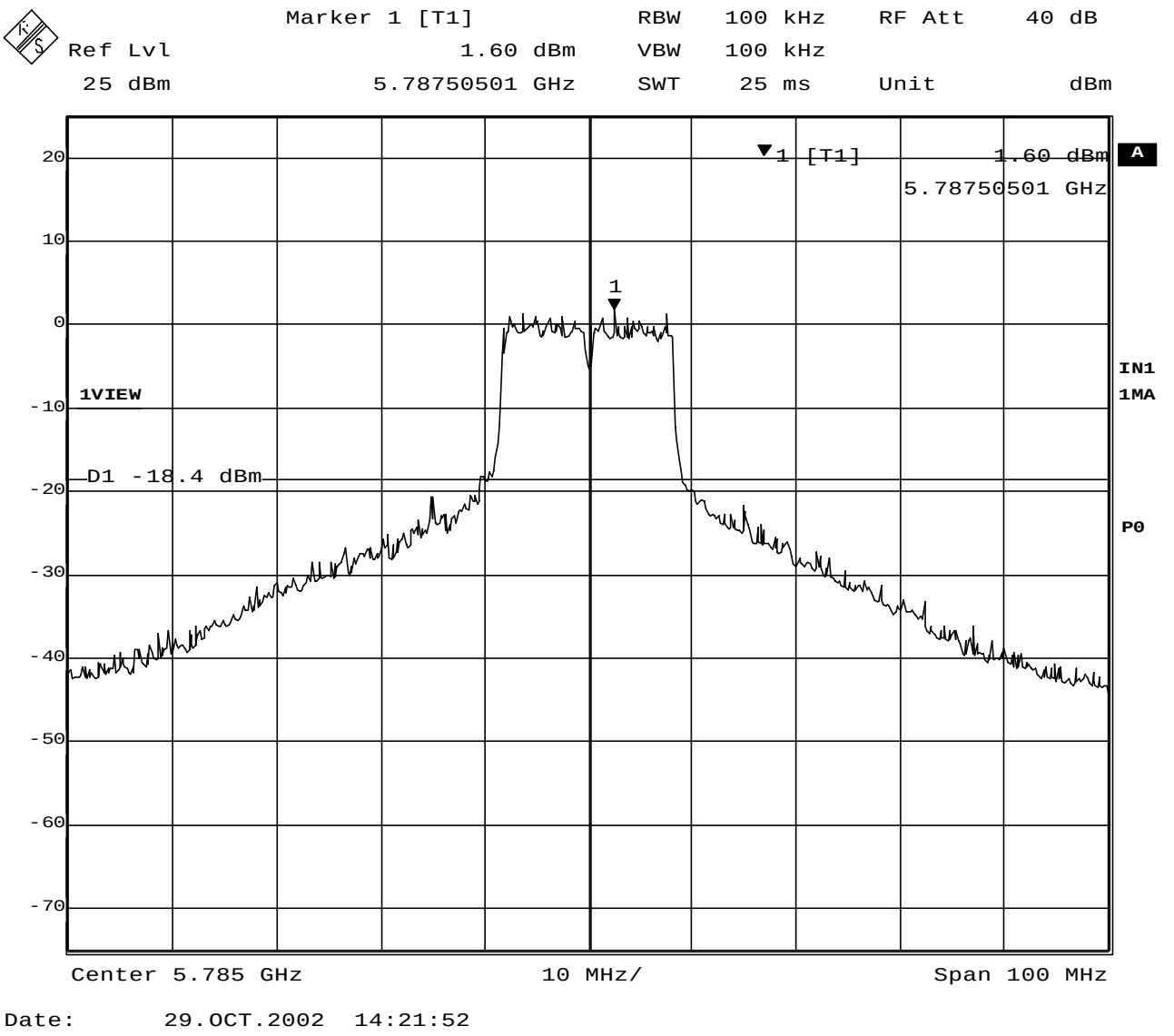
Plot 2-8. Out of band emissions around 2437MHz



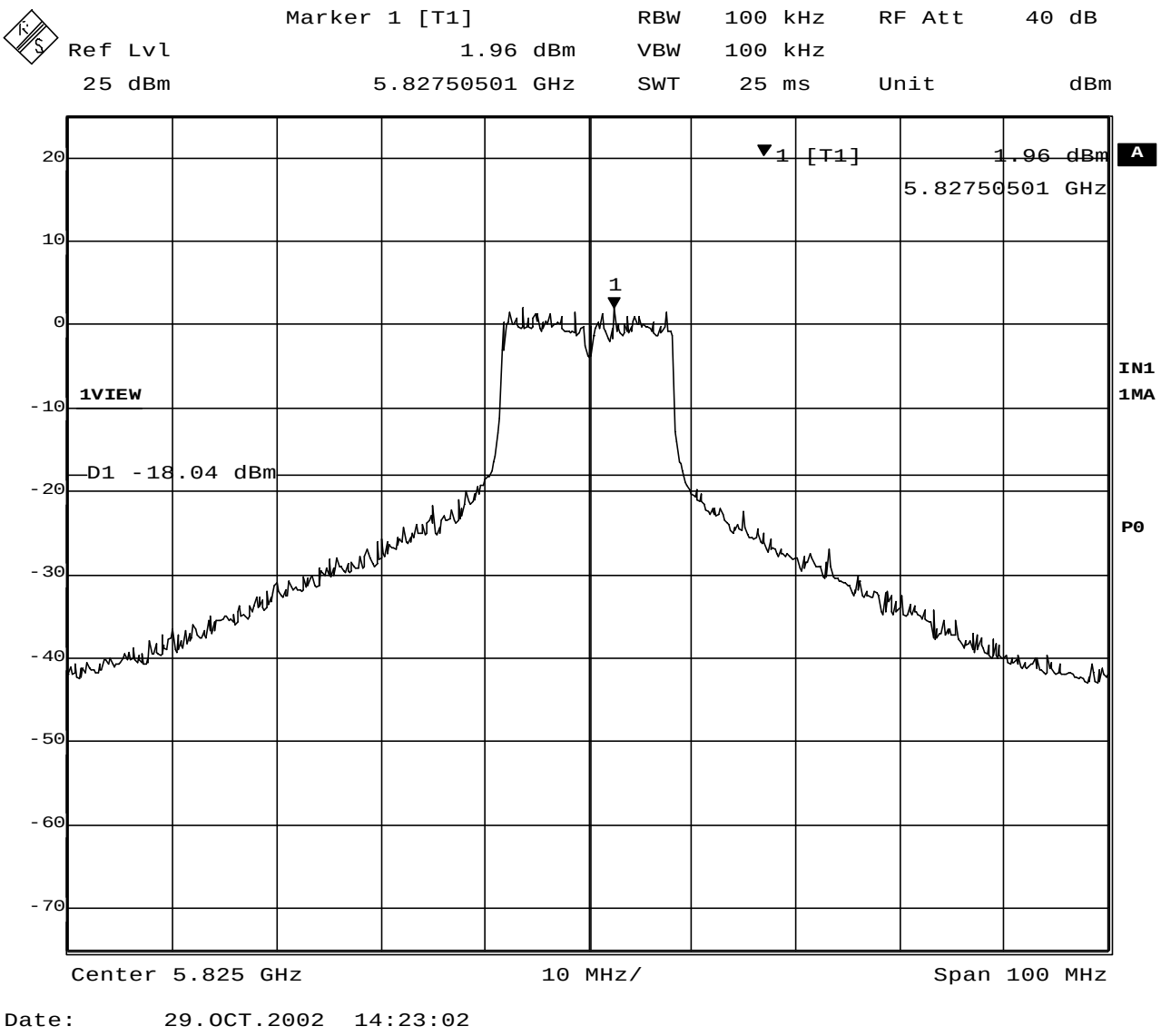
Plot 2-9. Out of band emissions around 2462MHz



Plot 2-10. Out of band emissions around 5745MHz



Plot 2-11. Out of band emissions around 5785MHz



Plot 2-12. Out of band emissions around 5825MHz

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, middle, and highest frequencies of each 2.4GHz or 5.8GHz band.

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: Loss: 20 cm 0.7dB (for 2.4GHz) 1.3dB (for 5.8GHz)	

Notes: - HP: Hewlett Packard

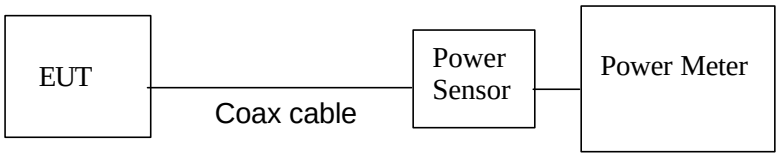


Figure 3-1: Measurement setup of power meter method

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: October 15 and 29, 2002

Table 3-2-1. Power meter measurement results (EUT: M/T 2681-3LU, s/n FX-0N14F)

Operation Frequency [GHz]	Rated output power (conducted) [dBm]									
	1 / 2M bps	5.5/11M bps	6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	48M bps	54M bps
2.412 (Aux)	16.3	**16.4**	NA							
Specification	17									
2.437 (Aux)	16.1	**16.1**	N/A							
Specification	17									
2.462 (Aux)	16.4	**16.6**	N/A							
Specification	17									
5.745 (Main)	N/A		15.4	-	-	-	**15.4**	14.1	11.4	9.2
Specification			16					15	12	10
5.785 (Main)	N/A		15.1	-	-	-	**15.1**	14.1	11.1	9.8
Specification			16					15	12	10
5.825 (Main)	N/A		15.1	-	-	-	**15.2**	14.1	11.5	9.5
specification			16					15	12	10

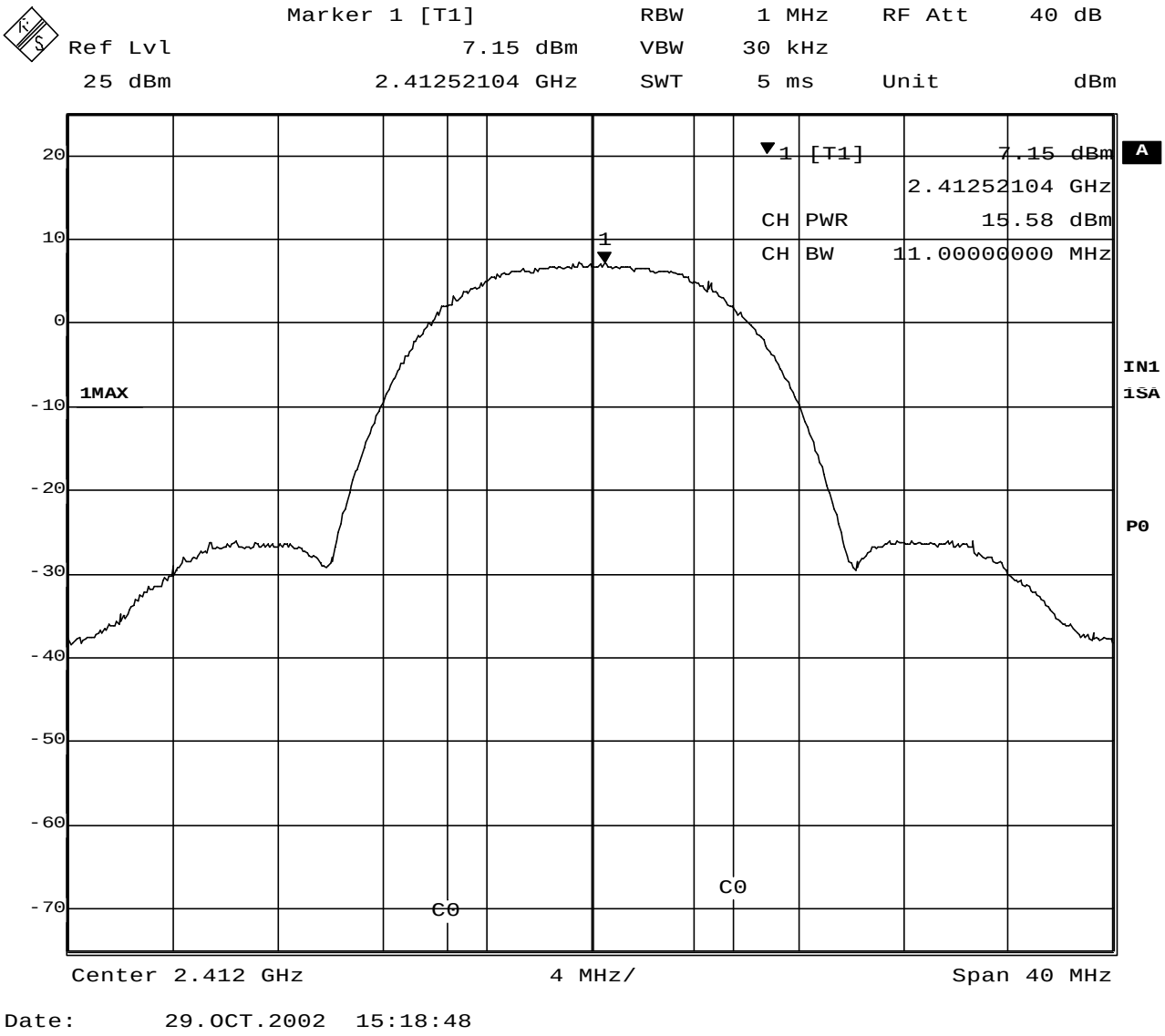
[Calculation table]

Measured Frequency (MHz)	Power Meter Reading (dBm)	Cable Loss (dB)	**Results** (dBm)	Limit		Peak antenna gain of EUT (dBi)	EIRP (dBm)	IC limit (dBm)
				FCC (dBm)	IC (dBm)			
2412	16.4	0.7	**17.1**	30	30	-	**-**	N/A
2437	16.1	0.7	**16.8**					
2462	16.6	0.7	**17.3**					
5745	15.4	1.3	**16.7**			0.85	**17.6**	36
5785	15.1	1.3	**16.4**				**17.3**	
5825	15.2	1.3	**16.5**				**17.4**	

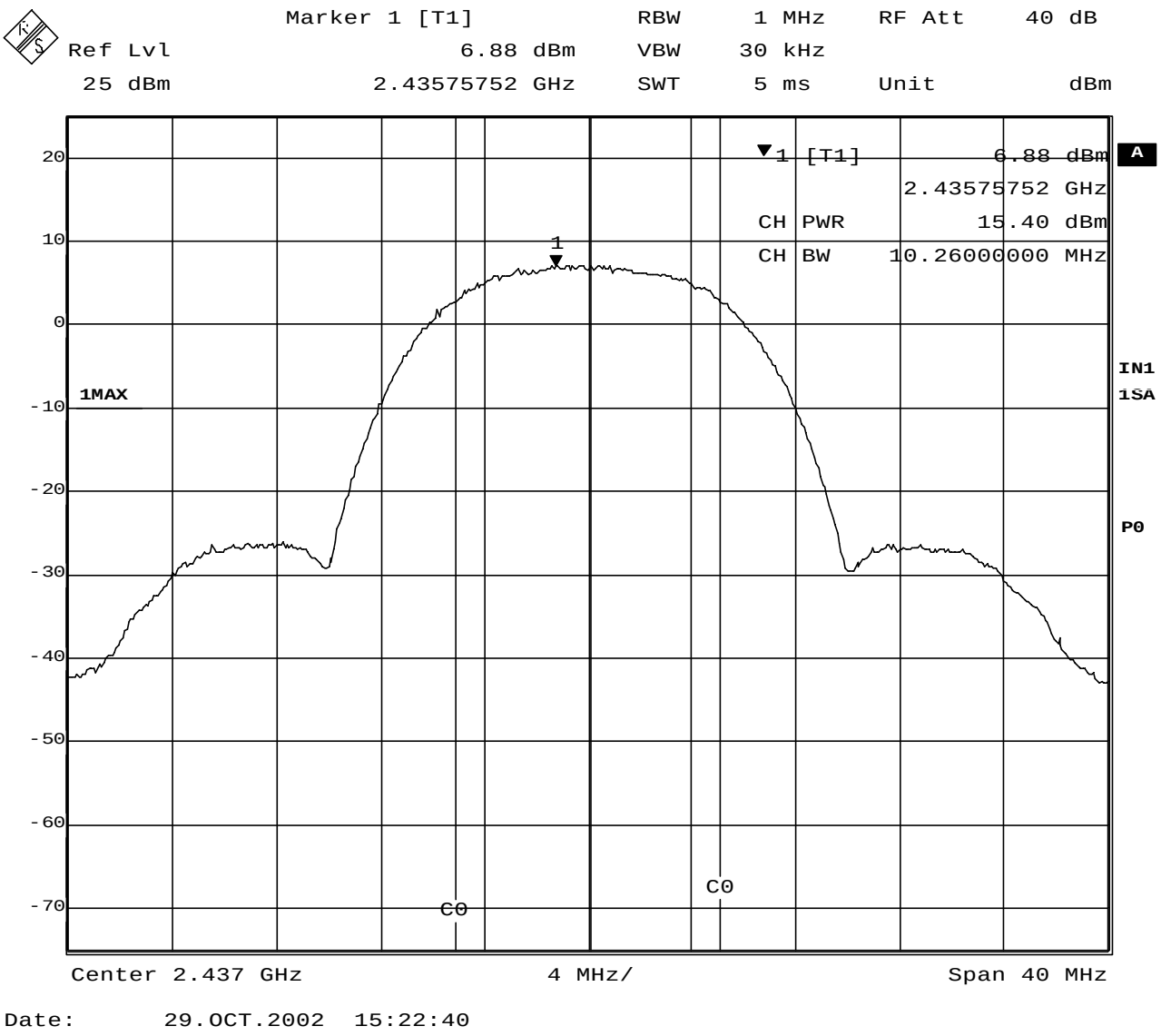
Table 3-2-2. Spectrum analyzer measurement results (EUT: M/T 2681-3LU, s/n FX-0N14F)

Measured Frequency (MHz)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	**Results** (dBm)	Limit		Peak antenna gain of EUT (dBi)	EIRP (dBm)	IC limit (dBm)
					FCC (dBm)	IC (dBm)			
2412	15.58	Plot 3-1	1.7	**17.3**	30	30	-	**-**	N/A
2437	15.40	Plot 3-2	1.7	**17.1**					
2462	15.63	Plot 3-3	1.7	**17.3**					
5745	14.22	Plot 3-4	2.3	**16.5**			0.85	**17.4**	36
5785	13.80	Plot 3-5	2.3	**16.1**				**17.0**	
5825	13.98	Plot 3-6	2.3	**16.3**				**17.2**	

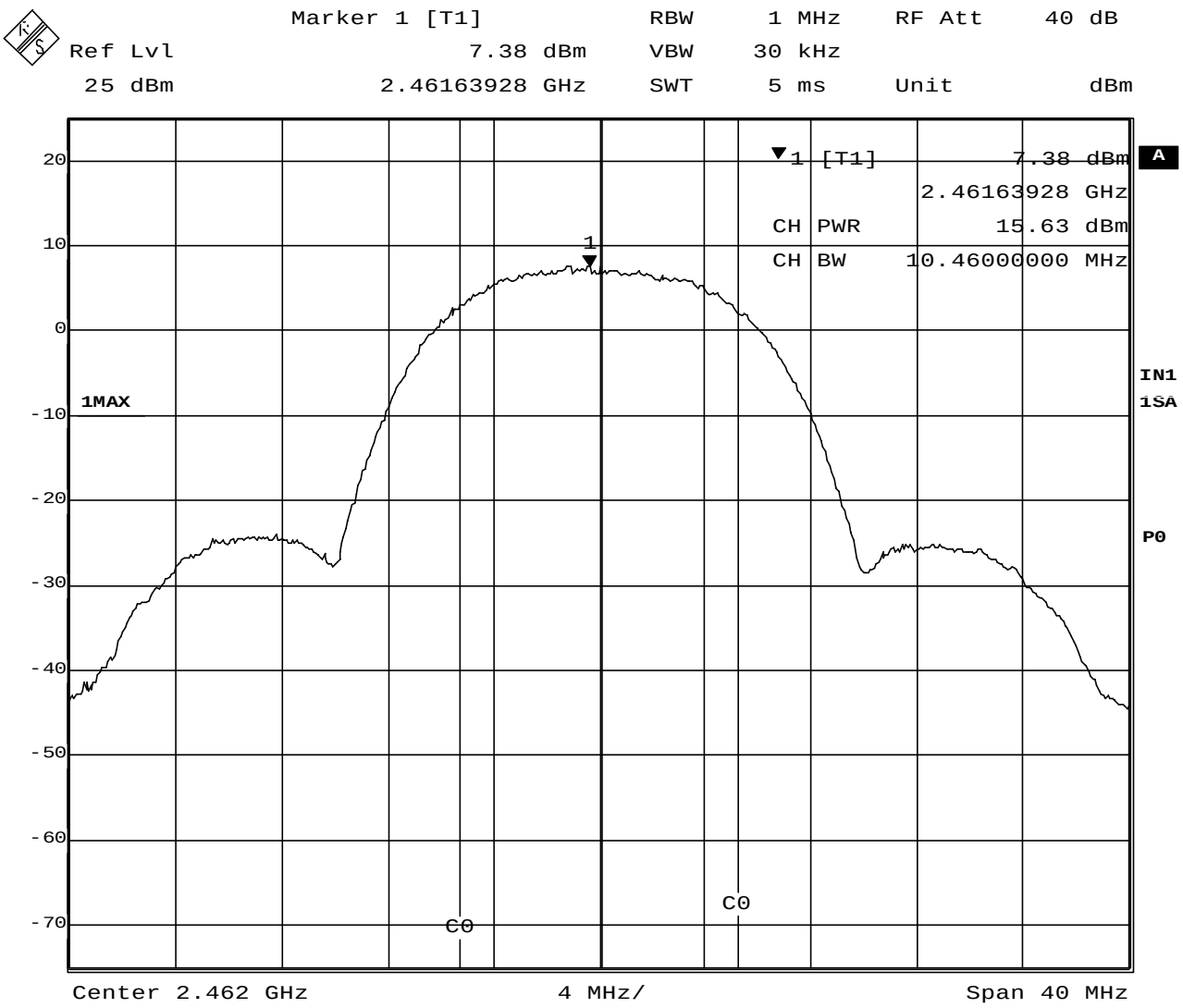
3.4 Trace Data of Conducted Peak Output Power



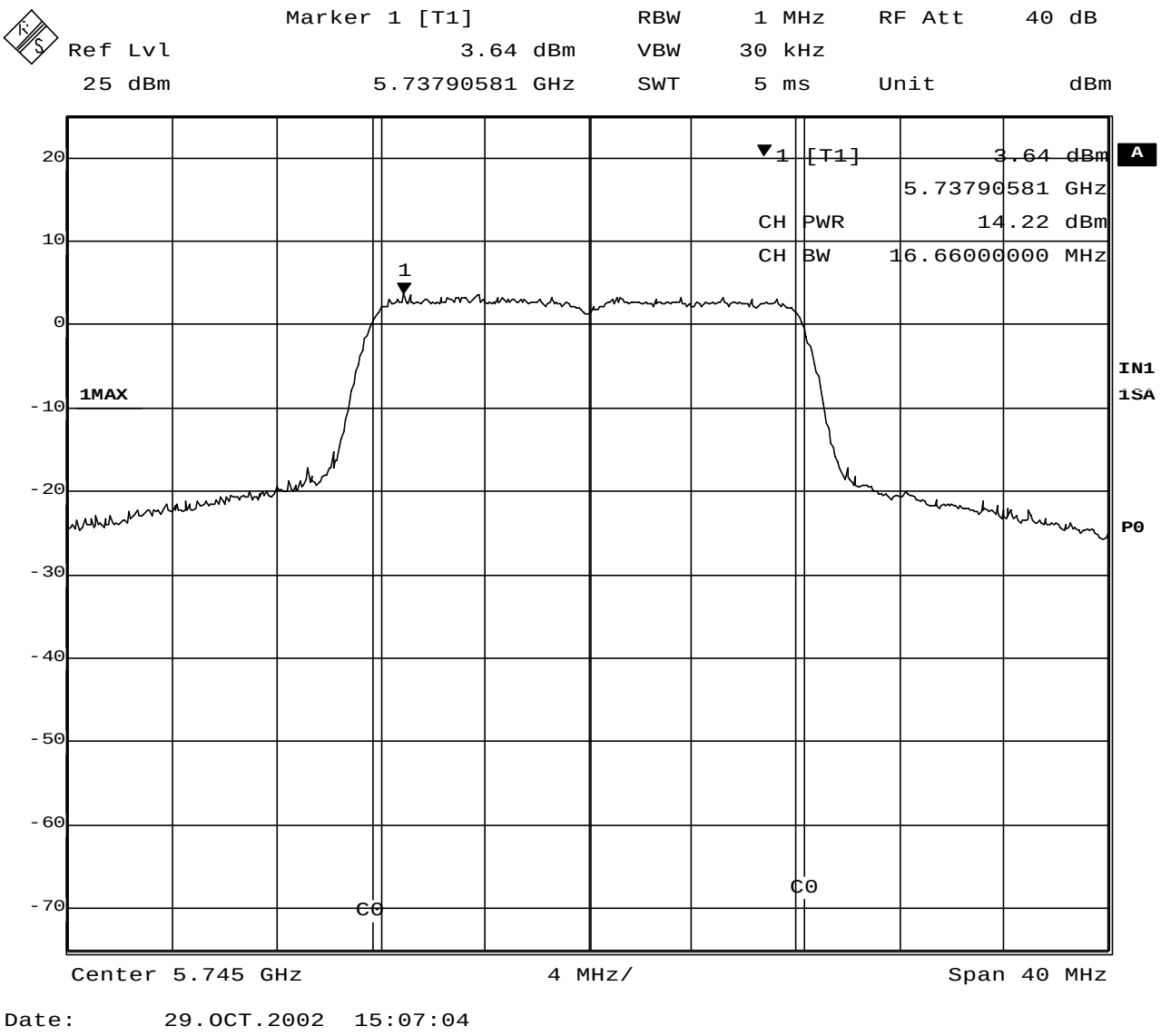
Plot 3-1. Conducted Peak Output Power of 2412MHz



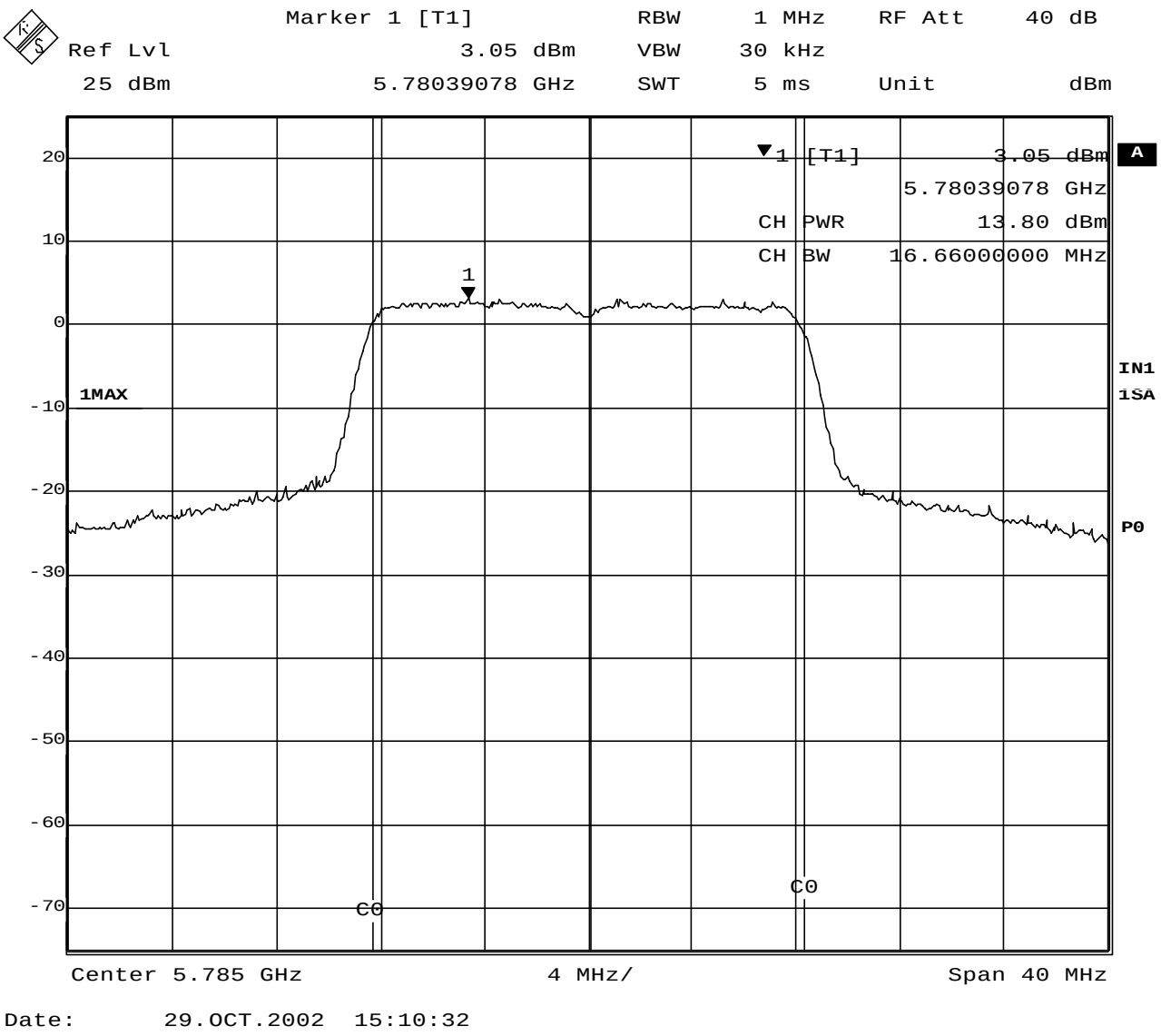
Plot 3-2. Conducted Peak Output Power of 2437MHz



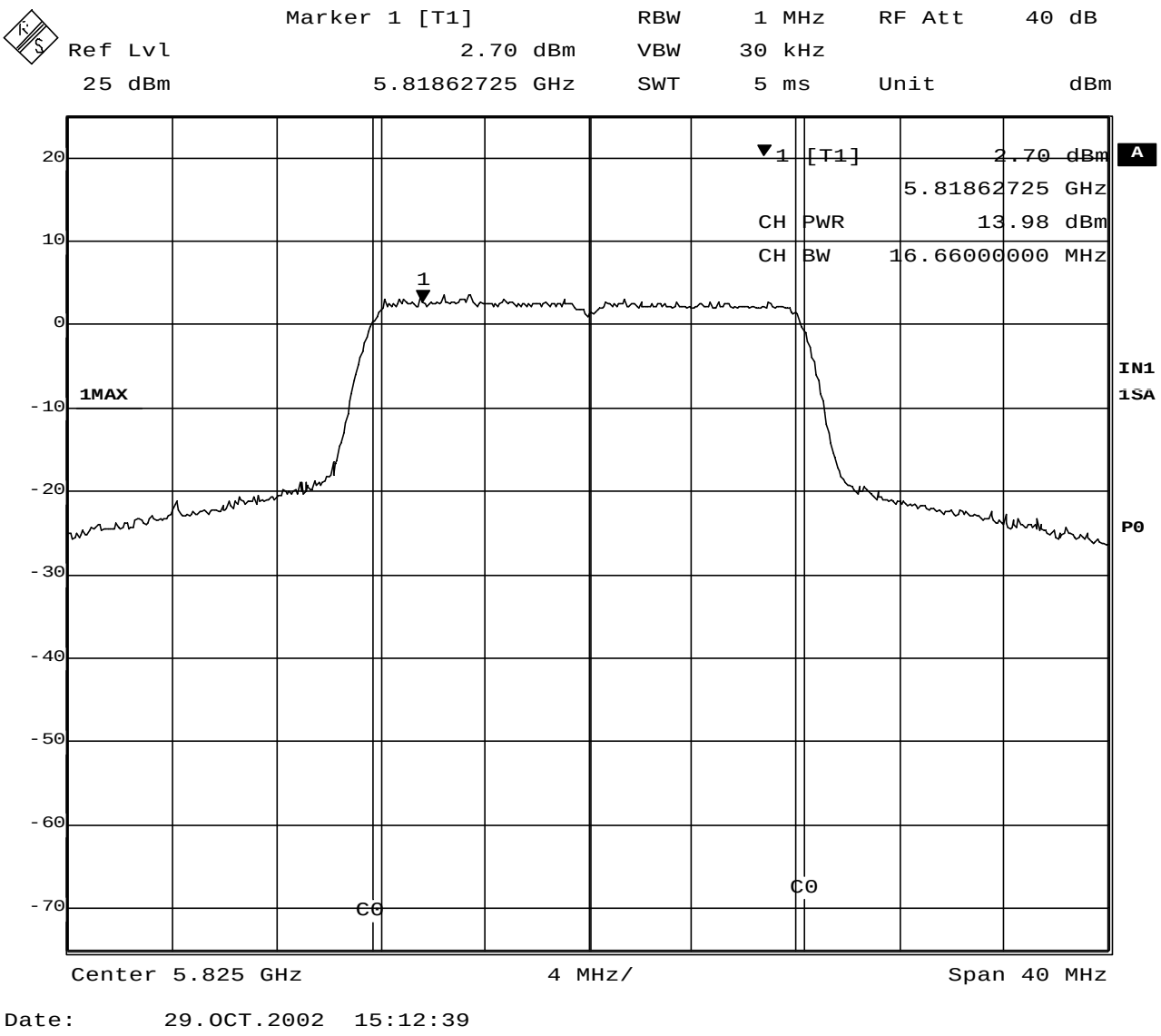
Plot 3-3. Conducted Peak Output Power of 2462MHz



Plot 3-4. Conducted Peak Output Power of 5745MHz



Plot 3-5. Conducted Peak Output Power of 5785MHz



Plot 3-6. Conducted Peak Output Power of 5825MHz

4. Peak 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 frequencies of each 2.4GHz or 5.8GHz band.
The spectrum analyzer is set to:
RBW= 3kHz, VBW=100kHz, Span=10MHz(for 2.4GHz band) or 20MHz(for 5.8GHz band), Sweep=2.8 seconds

4.2 Test Instruments and Measurement Setup

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

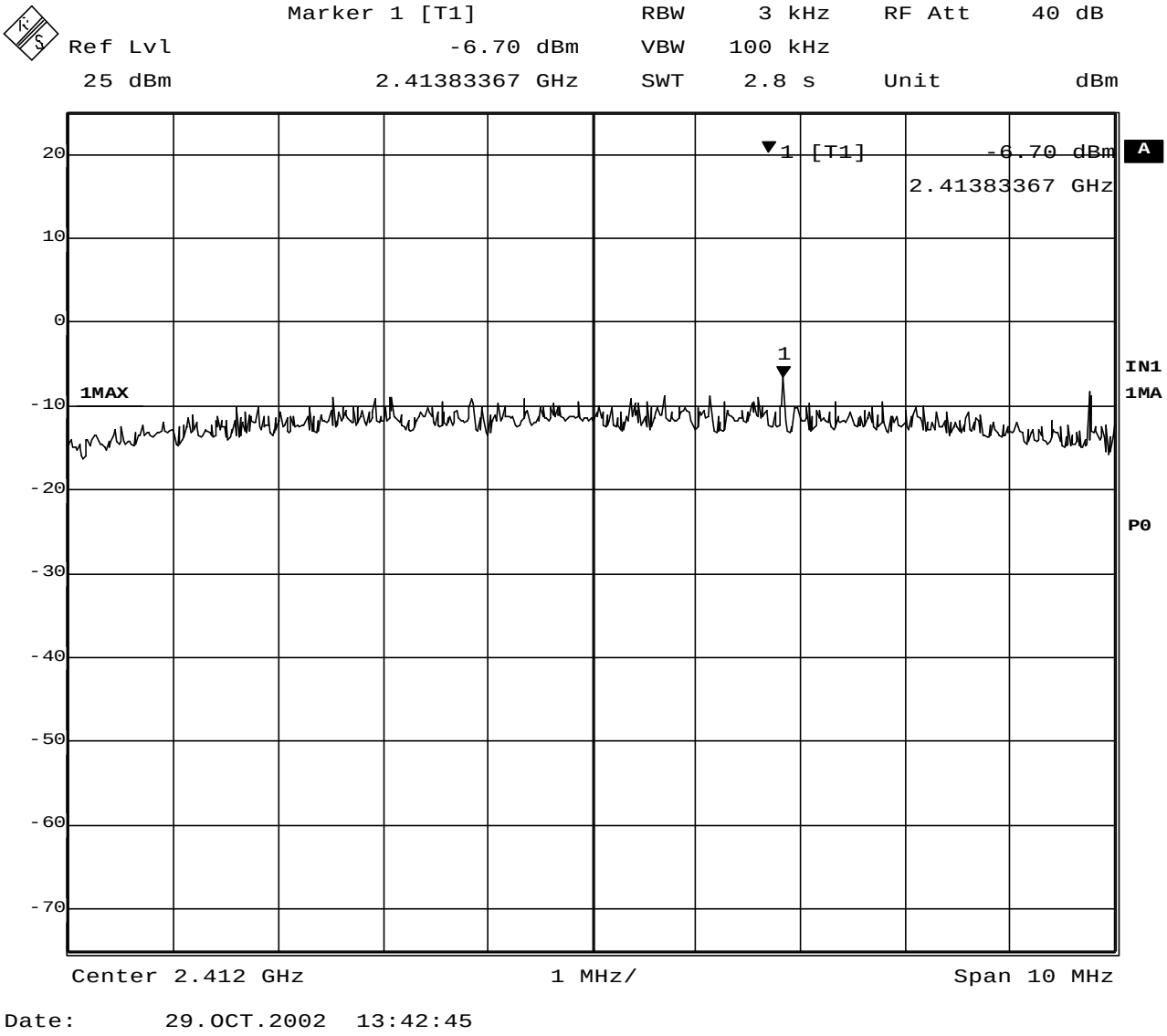
4.3 Measurement Results

Test Date: October 29, 2002

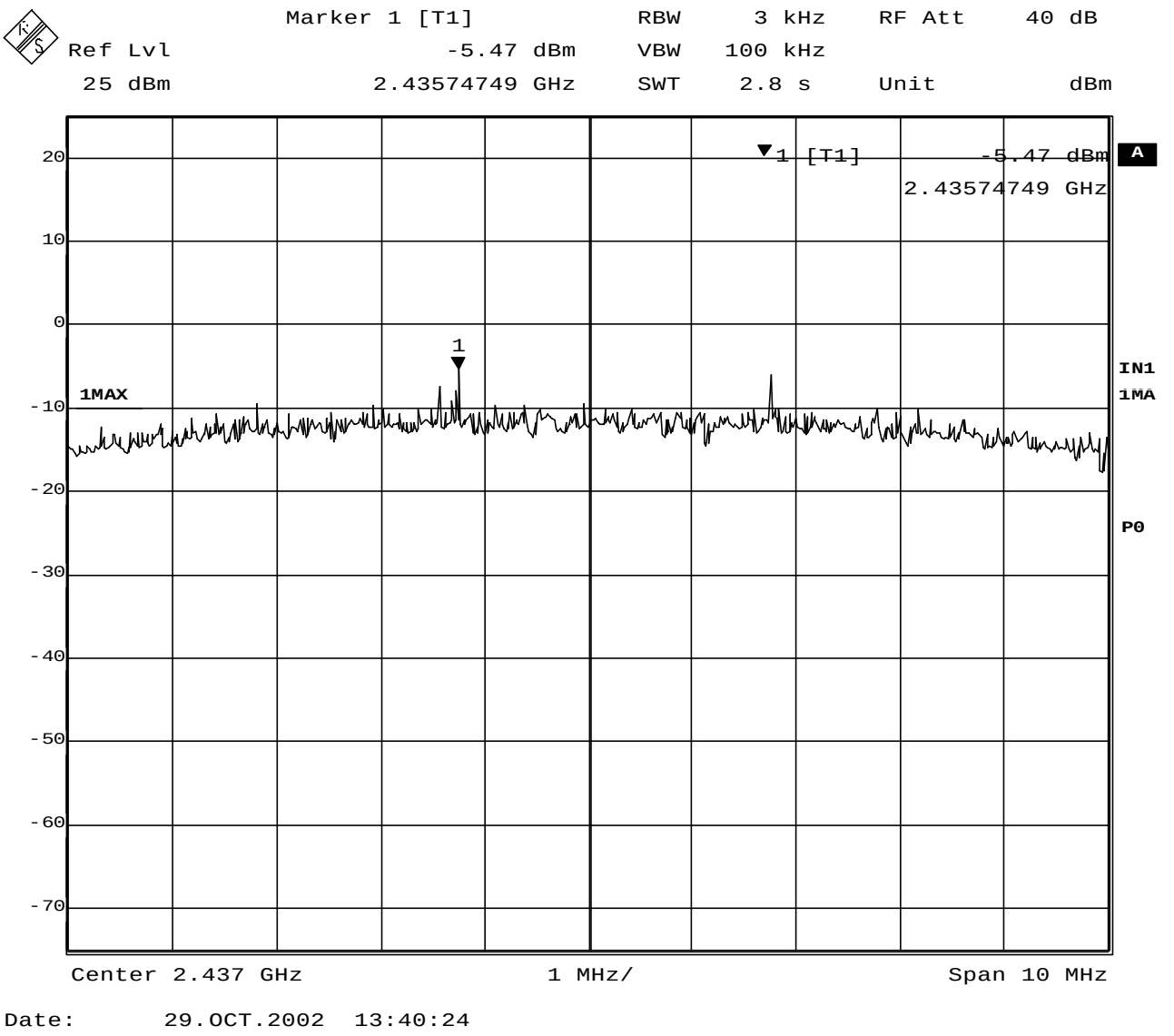
Table 4-1. EUT: M/T 2681-3LU, s/n FX-0N14F , TX mode

Ch No.	Frequency (MHz)	**Analyzer Reading** (dBm)	Trace number	Cable loss (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
1	2413.83	-6.70	Plot 4-1	1.7	- 5.0	8.0	13.0
6	2435.75	-5.47	Plot 4-2	1.7	- 3.8	8.0	11.8
11	2460.75	-5.04	Plot 4-3	1.7	- 3.3	8.0	11.3
149	5740.61	-11.14	Plot 4-4	2.3	- 8.8	8.0	16.8
157	5786.58	-11.83	Plot 4-5	2.3	- 9.5	8.0	17.5
165	5820.57	-11.58	Plot 4-6	2.3	- 9.3	8.0	17.3

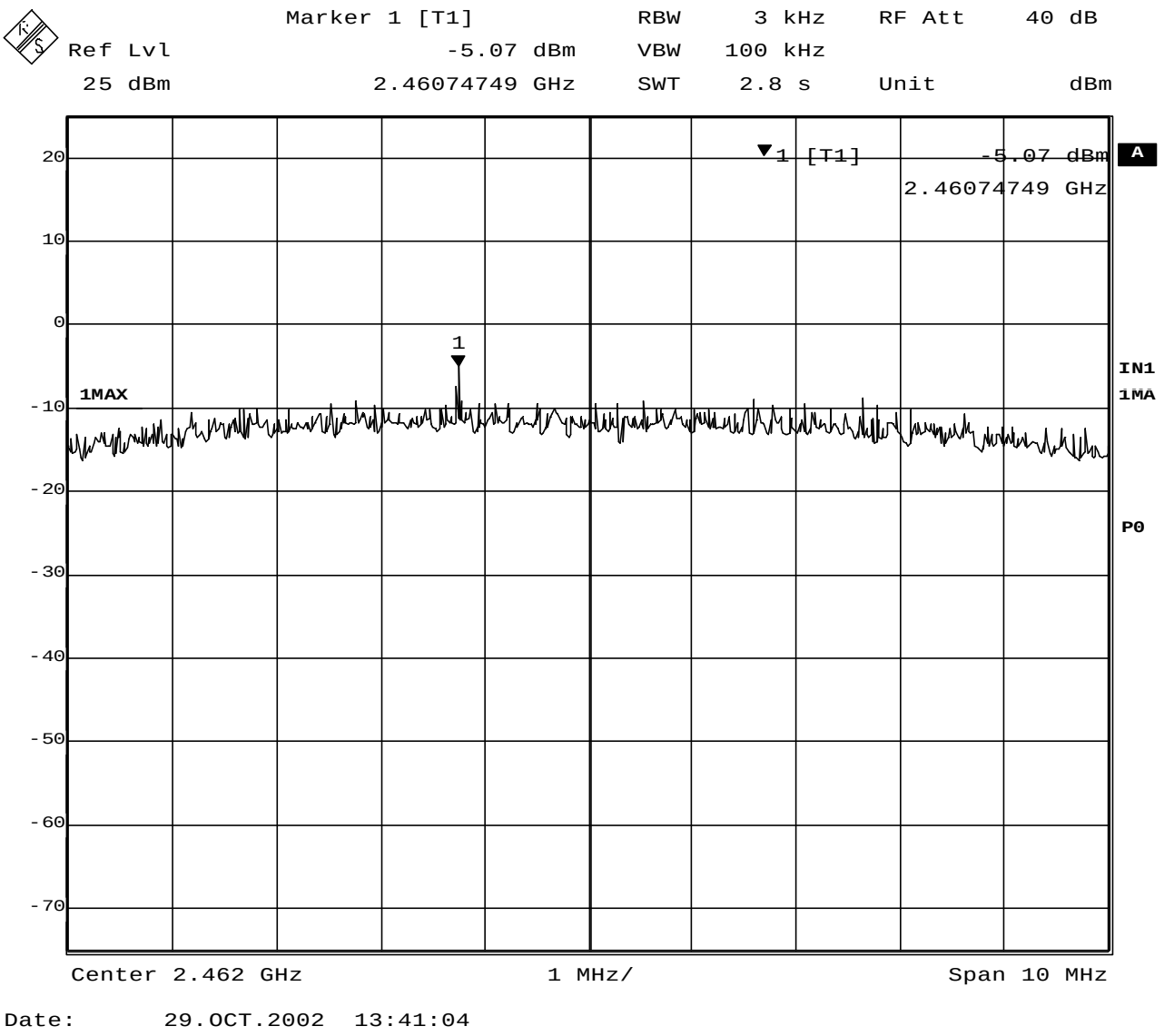
4.4 Trace Data of Peak Power Spectral Density



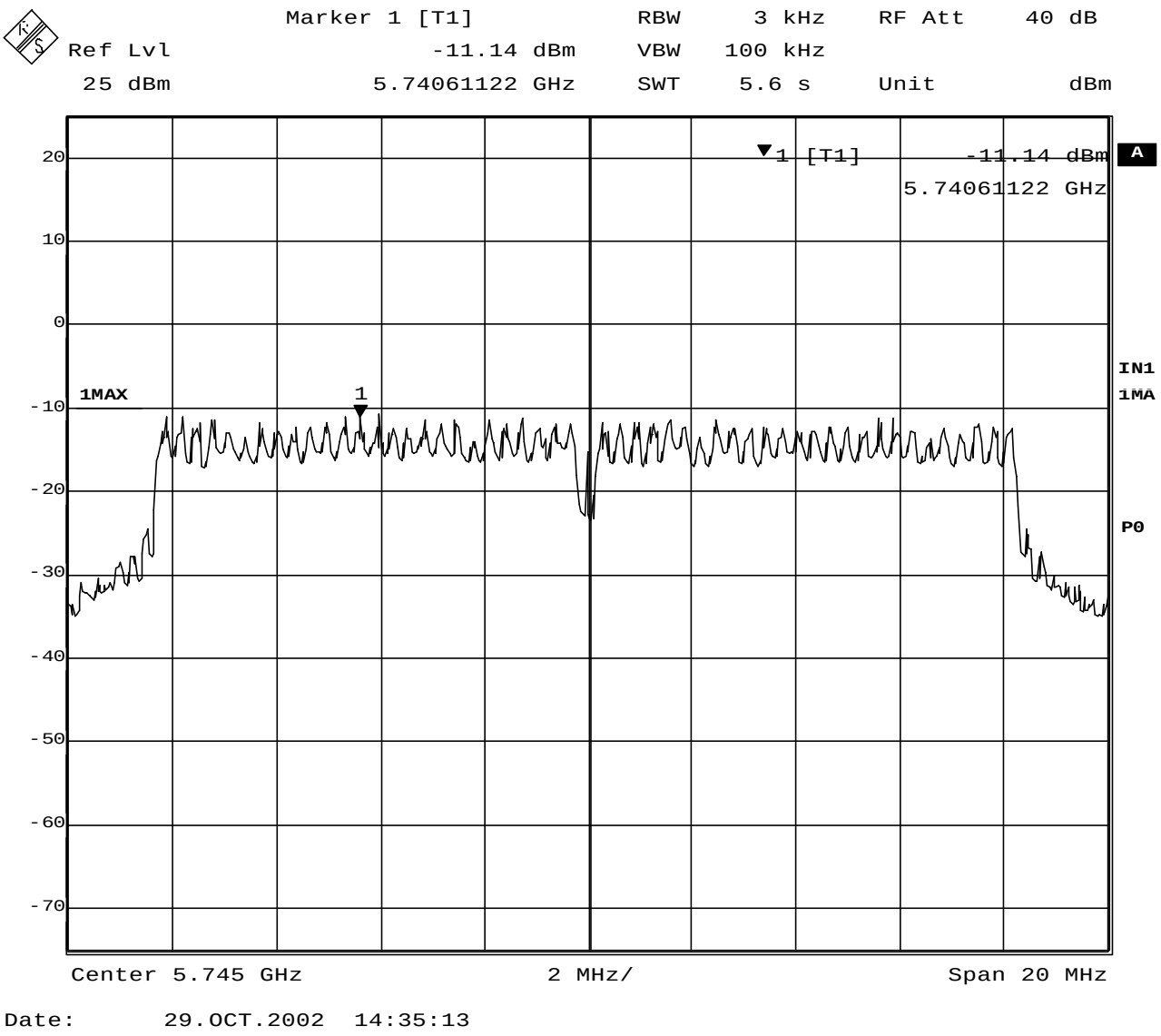
Plot 4-1. Peak Power Spectral Density of 2412MHz



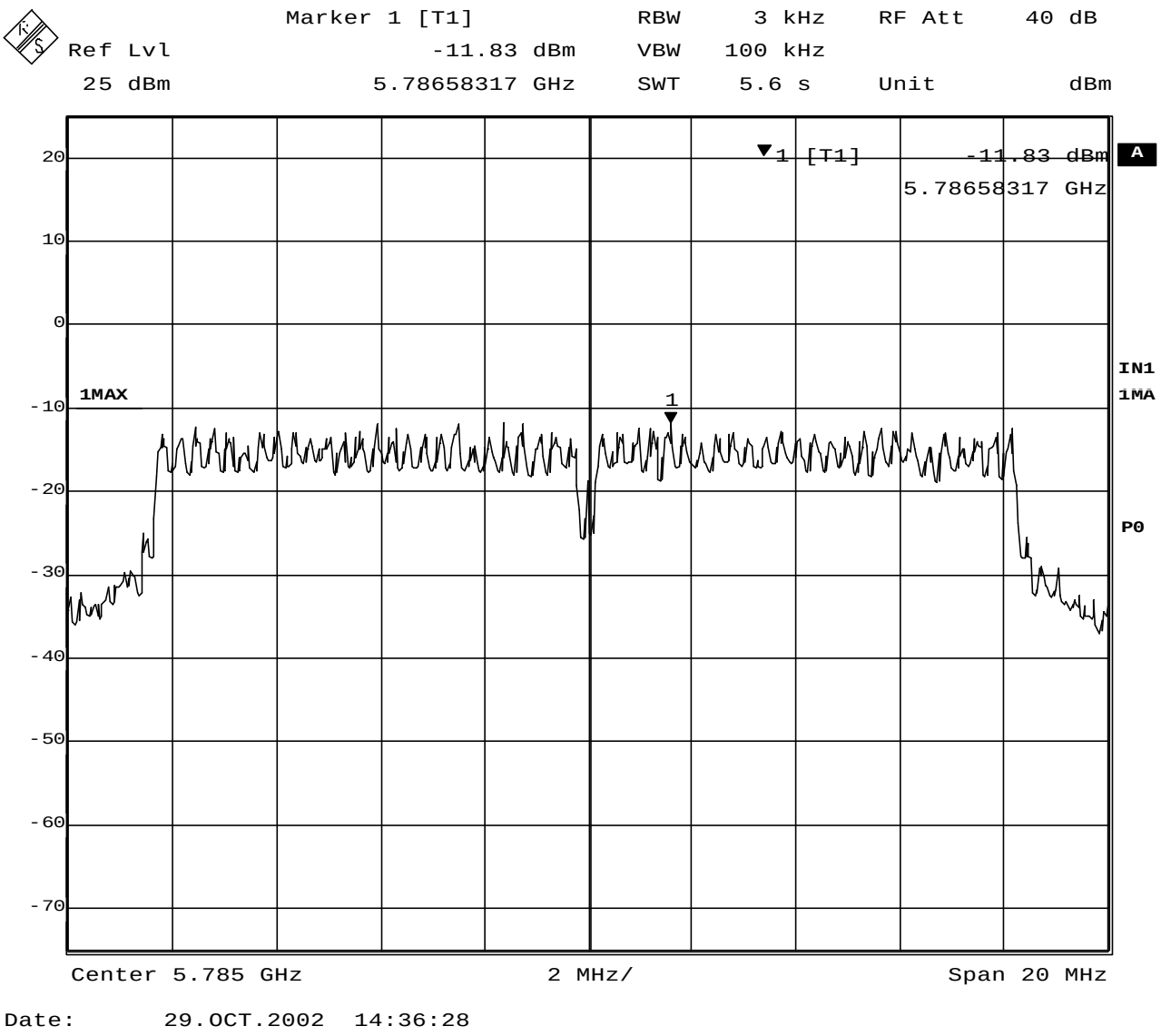
Plot 4-2. Peak Power Spectral Density of 2437MHz



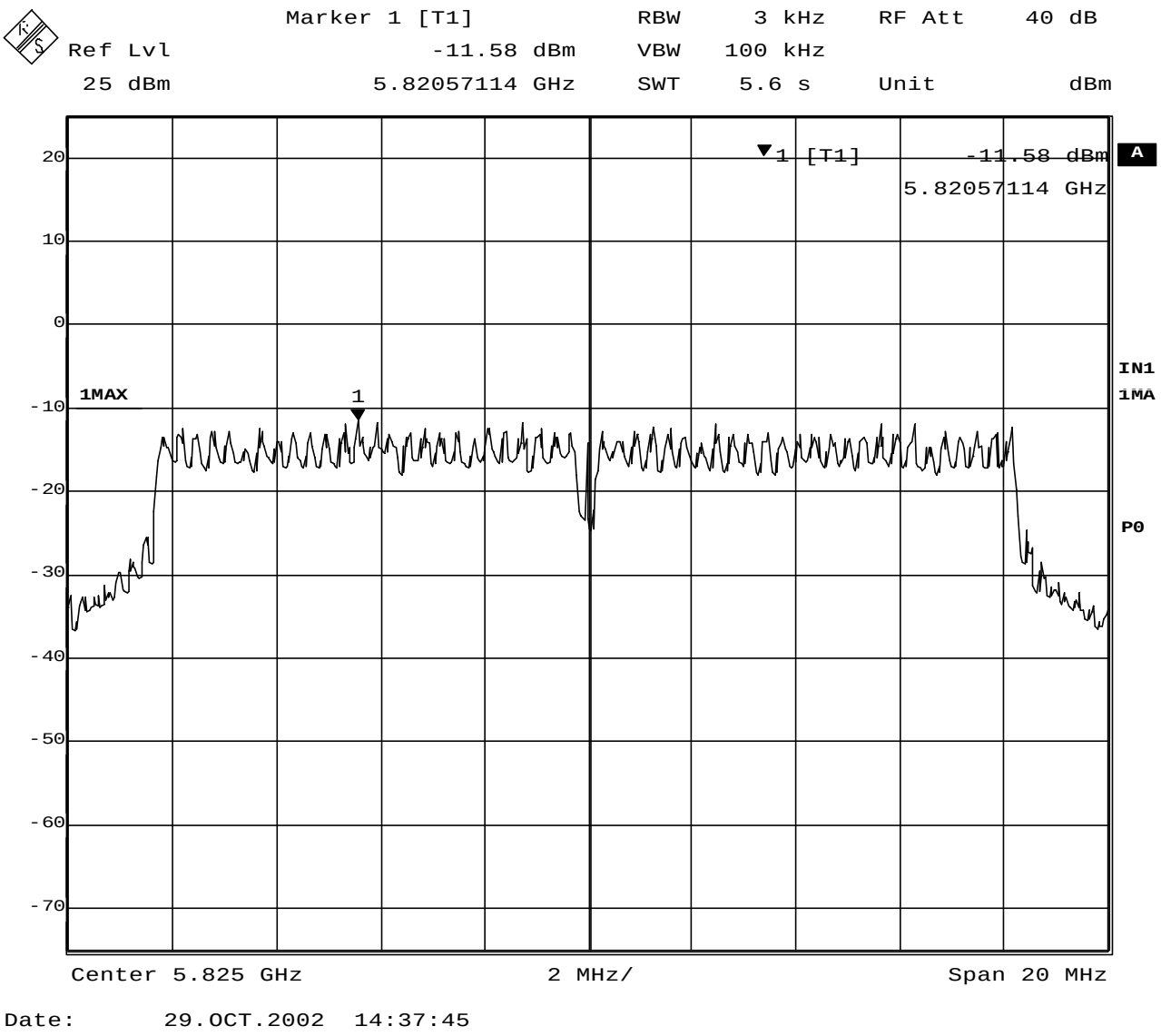
Plot 4-3. Peak Power Spectral Density of 2462MHz



Plot 4-4. Peak Power Spectral Density of 5745MHz



Plot 4-5. Peak Power Spectral Density of 5785MHz



Plot 4-6. Peak Power Spectral Density of 5825MHz

5. AC WIRELINE CONDUCTED EMISSIONS (450KHz – 30MHz)

[FCC 15.207, RSS-210 6.6 / 7.4]

5.1 Test Procedure

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

5.2 Test Instruments and Measurement Setup

Table 5-1. Conducted Emission Test Instrumentation

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

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

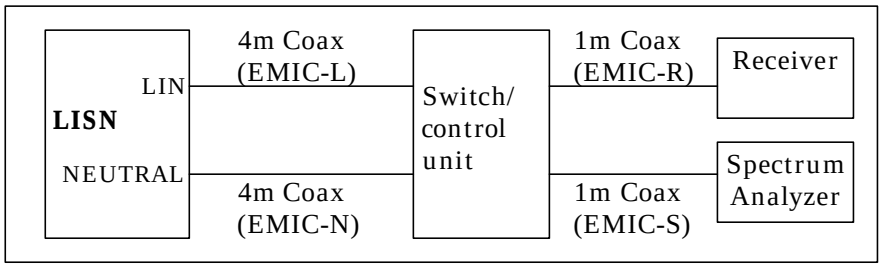


Figure 5. Cables for Conducted Emission Test

5.3 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 13.9 dB. The 6 highest emissions relative to the limits are reported.

Test Date: November 13, 2002

5.3.1 EUT in 2.4GHz IEEE802.11b transmission mode

Table 5-2-1. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.1(2412MHz) **TX** mode 11Mbps

Frequency (MHz)	QP Voltage (dBμV)	QP Limit (dBμV)	QP Voltage (μV)	QP Limit (μV)	Phase
0.5177	34.1	48	50.7	250	NEUTRAL
0.6192	32.1	48	40.3	250	LINE
0.7333	30.9	48	35.1	250	LINE
0.8314	31.5	48	37.6	250	LINE
0.9273	30.0	48	31.6	250	NEUTRAL
1.7809	27.7	48	24.3	250	LINE

Table 5-2-2. EUT: M/T 2681-3LU, s/n FX-0N14F , Ch.6(2437MHz) **TX** mode 11Mbps

Frequency (MHz)	QP Voltage (dBμV)	QP Limit (dBμV)	QP Voltage (μV)	QP Limit (μV)	Phase
0.5150	33.7	48	48.4	250	LINE
0.6162	31.3	48	36.7	250	LINE
0.7286	31.0	48	35.5	250	LINE
0.8284	31.7	48	38.5	250	NEUTRAL
0.9220	29.8	48	30.9	250	LINE
1.0185	29.9	48	31.3	250	LINE

Table 5-2-3. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.11(2462MHz) **TX** mode 11Mbps

Frequency (MHz)	QP Voltage (dBμV)	QP Limit (dBμV)	QP Voltage (μV)	QP Limit (μV)	Phase
0.5142	33.1	48	45.2	250	LINE
0.6143	30.5	48	33.5	250	LINE
0.7270	28.8	48	27.5	250	LINE
0.8254	28.9	48	27.9	250	NEUTRAL
0.9262	27.8	48	24.5	250	LINE
7.5959	22.9	48	14.0	250	LINE

Table 5-2-4. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch. 6 (2437MHz) **RX** mode

Frequency (MHz)	QP Voltage (dBμV)	QP Limit (dBμV)	QP Voltage (μV)	QP Limit (μV)	Phase
0.5131	33.0	48	44.7	250	LINE
0.6071	29.7	48	30.5	250	NEUTRAL
0.7254	29.0	48	28.2	250	LINE
0.8262	30.3	48	32.7	250	LINE
0.9179	27.8	48	24.5	250	NEUTRAL
1.0138	27.6	48	24.0	250	LINE

5.3.2 EUT in 5.8GHz IEEE802.11a transmission mode

Table 5-3-1. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.149(5745MHz) **TX** mode 24Mbps

Frequency (MHz)	QP Voltage (dBμV)	QP Limit (dBμV)	QP Voltage (μV)	QP Limit (μV)	Phase
0.5128	33.2	48	45.7	250	LINE
0.6122	31.1	48	35.9	250	LINE
0.7262	31.0	48	35.5	250	LINE
0.8256	31.7	48	38.5	250	NEUTRAL
0.9191	30.0	48	31.6	250	NEUTRAL
1.0175	29.3	48	29.2	250	LINE

Table 5-3-2 EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.157(5785MHz) **TX** mode 24Mbps

Frequency (MHz)	QP Voltage (dBμV)	QP Limit (dBμV)	QP Voltage (μV)	QP Limit (μV)	Phase
0.5066	33.4	48	46.8	250	LINE
0.6126	31.2	48	36.3	250	LINE
0.7257	30.5	48	33.5	250	LINE
0.8242	30.6	48	33.9	250	LINE
0.9237	30.0	48	31.6	250	NEUTRAL
1.0098	28.7	48	27.2	250	NEUTRAL

Table 5-3-3 EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.165(5825MHz) **TX** mode 24Mbps

Frequency (MHz)	QP Voltage (dBμV)	QP Limit (dBμV)	QP Voltage (μV)	QP Limit (μV)	Phase
0.5061	32.9	48	44.2	250	LINE
0.6121	31.1	48	35.9	250	NEUTRAL
0.7254	30.2	48	32.4	250	LINE
0.8283	31.4	48	37.2	250	LINE
0.9234	30.0	48	31.6	250	NEUTRAL
1.0168	29.1	48	28.5	250	LINE

Table 5-3-3 EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.157(5785MHz) **RX** mode

Frequency (MHz)	QP Voltage (dBμV)	QP Limit (dBμV)	QP Voltage (μV)	QP Limit (μV)	Phase
0.5129	33.3	48	46.2	250	LINE
0.6126	31.6	48	38.0	250	NEUTRAL
0.7254	31.4	48	37.2	250	LINE
0.8251	31.8	48	38.9	250	NEUTRAL
0.9184	30.2	48	32.4	250	LINE
1.2097	29.4	48	29.5	250	NEUTRAL

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

[FCC 15.205 / 209, RSS-210 6.2.1 / 6.3 / 7.3]

6.1 Test Procedure

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

6.2 Test Instruments and Measurement Setup

Table 6-1 Radiated Emission Test Instrumentation

Description	**Model**	**Serial Number**
Computer	IBM 5551-L	#4
Spectrum Analyzer (100Hz-1.5GHz) for 30-200MHz	HP 85680B	3019A05155
Spectrum Analyzer Display for 30-200MHz	HP 85662A	3026A19353
Quasi-Peak Adapter for 30-200MHz	HP 85650A	3033A01449
Spectrum Analyzer (100Hz-1.5GHz) for 200-1000MHz	HP 85680B	2841A04252
Spectrum Analyzer Display for 200-1000MHz	HP 85662A	2816A16831
Quasi-Peak Adapter for 200-1000MHz	HP 85650A	2811A01156
Amplifier (100KHz-1.3GHz) - for 30-200MHz - for 200-1000MHz	 HP 8447D HP 8447D	 2805A02919 2944A03506
Biconical Antenna (30-200MHz)	EMCO 3108	2309
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	1585
Receiver (20MHz-1.3GHz)	R&S ESVP	893202/018
Switch/control unit	HP 3488A	2719A17226
N-Coax cables: - Bi-coni Ant <=> 10m Cable - 10m Cable <=> Shield Panel - Shield Panel <=> RF Amp - RF Amp <=> Power Splitter - Log-peri Ant <=> 10m Cable - 10m Cable <=> Shield Panel - Shield Panel <=> RF Amp - RF Amp <=> Power Splitter	Length: 9 m 10 m 7 m 0.5m 9 m 10 m 7 m 0.5m	 - EM103L01 - EM103L02 - EM103L03 - EM103L04 - EM103H01 - EM103H02 - EM103H03 - EM103H04
Coax cables: - Power Splitter <=> SW/Con.unit (SW110) - Power Splitter <=> SW/Con.unit (SW300) - Power Splitter <=> SW/Con.unit (SW100) - Power Splitter <=> SW/Con.unit (SW301) - SW/Con.unit <=> Receiver (Input) - SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz - SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	 1 m 1 m 1 m 1 m 2 m 2 m 2 m	 - EM103L05 - EM103L06 - EM103H05 - EM103H06 - EM1RCV - EM1SPL - EM1SPH

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

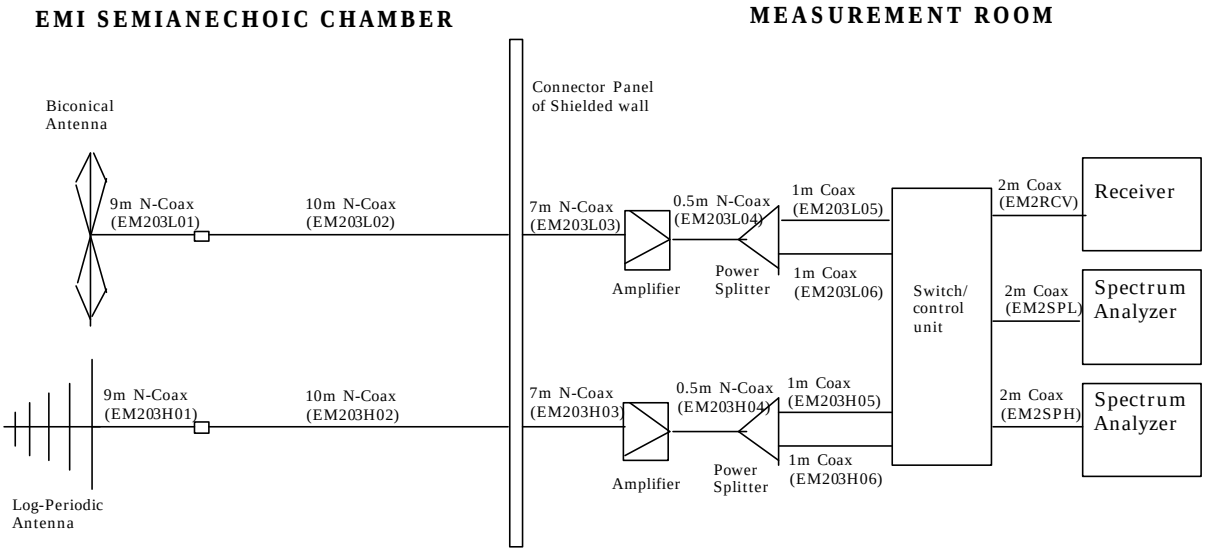


Figure 6 Cables for Radiated Emission Test

6.3 Field Strength Calculation

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

FS = R + AF + CORR

where:

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

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

FS = 51.5 + 8.5 + 1.3 - 26.0 = 35.3dBμV/m

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

Level(dBμV/m) = 20 $\times$ Log(Level(μV/m))

40dBμV/m = 100μV/m
48dBμV/m = 250μV/m

6.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 6.3 dB at 30MHz - 1000MHz band.
The 6 highest emissions relative to the limits are reported.

Test Date: October 16 and 25, 2002

6.4.1 EUT in 2.4GHz IEEE802.11b transmission mode

Table 6-2-1. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.1(2412MHz) **TX** mode 11Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
53.127	V	41.0	10.2	-18.2	33.0	40.0	44.7	100
232.671	H	40.7	10.8	-14.5	37.0	46.0	70.8	200
364.496	V	32.0	14.3	-13.6	32.7	46.0	43.2	200
432.079	V	30.5	15.8	-13.6	32.7	46.0	43.2	200
528.096	V	29.1	17.7	-13.2	33.6	46.0	47.9	200
728.940	V	24.6	20.6	-11.1	34.1	46.0	50.7	200

Table 6-2-2. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.6(2437MHz) **TX** mode 11Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
52.895	V	41.6	10.3	-18.2	33.7	40.0	48.4	100
363.935	V	32.4	14.4	-13.7	33.1	46.0	45.2	200
432.078	V	32.1	15.8	-13.6	34.3	46.0	51.9	200
528.097	V	29.1	17.7	-13.2	33.6	46.0	47.9	200
728.413	V	22.8	20.6	-11.1	32.3	46.0	41.2	200
932.004	V	23.5	22.6	-9.0	37.1	46.0	71.6	200

Table 6-2-3. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.11(2462MHz) **TX** mode 11Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
53.272	V	41.1	10.2	-18.2	33.1	40.0	45.2	100
232.881	H	39.6	10.8	-14.5	35.9	46.0	62.4	200
432.079	V	31.9	15.8	-13.6	34.1	46.0	50.7	200
458.188	V	30.3	16.6	-13.9	33.0	46.0	44.7	200
528.096	V	29.7	17.7	-13.2	34.2	46.0	51.3	200
932.004	V	23.2	22.6	-9.0	36.8	46.0	69.2	200

Table 6-2-4. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.6(2437MHz) **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)
53.607	V	40.5	10.2	-18.3	32.4	40.0	41.7	100
232.404	H	40.2	10.8	-14.5	36.5	46.0	66.8	200
432.079	V	31.8	15.8	-13.6	34.0	46.0	50.1	200
458.188	H	32.6	16.6	-13.9	35.3	46.0	58.2	200
528.097	V	29.4	17.7	-13.2	33.9	46.0	49.5	200
932.000	V	22.8	22.6	-9.0	36.4	46.0	66.1	200

6.4.2 EUT in 5.8GHz IEEE802.11a transmission mode

Table 6-3-1. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.149(5745MHz) **TX** mode 24Mbps

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)
31.998	V	37.2	13.0	-18.8	31.4	40.0	37.2	100
56.027	V	40.5	9.9	-18.2	32.2	40.0	40.7	100
154.378	H	33.9	12.4	-16.5	29.8	43.5	30.9	150
364.497	H	31.4	14.3	-13.6	32.1	46.0	40.3	200
432.079	V	33.8	15.8	-13.6	36.0	46.0	63.1	200
931.996	V	22.6	22.6	-9.0	36.2	46.0	64.6	200

Table 6-3-2 EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.157(5785MHz) **TX** mode 24Mbps

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)
31.998	V	36.7	13.0	-18.8	30.9	40.0	35.1	100
56.389	V	39.3	9.9	-18.1	31.1	40.0	35.9	100
232.842	H	40.4	10.8	-14.5	36.7	46.0	68.4	200
458.189	V	32.1	16.6	-13.9	34.8	46.0	55.0	200
728.992	V	22.5	20.6	-11.1	32.0	46.0	39.8	200
931.996	V	22.4	22.6	-9.0	36.0	46.0	63.1	200

Table 6-3-3 EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.165(5825MHz) **TX** mode 24Mbps

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)
31.998	V	37.0	13.0	-18.8	31.2	40.0	36.3	100
54.861	V	38.8	10.1	-18.2	30.7	40.0	34.3	100
233.061	H	38.7	10.8	-14.5	35.0	46.0	56.2	200
432.079	V	32.5	15.8	-13.6	34.7	46.0	54.3	200
730.240	V	22.5	20.6	-11.1	32.0	46.0	39.8	200
931.998	V	22.5	22.6	-9.0	36.1	46.0	63.8	200

Table 6-3-3 EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.157(5785MHz) **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)
31.998	H	36.8	13.0	-18.8	31.0	40.0	35.5	100
232.826	H	37.7	10.8	-14.5	34.0	46.0	50.1	200
361.314	V	30.3	14.3	-13.5	31.1	46.0	35.9	200
432.079	V	31.6	15.8	-13.6	33.8	46.0	49.0	200
730.003	V	22.7	20.6	-11.1	32.2	46.0	40.7	200
932.039	V	20.0	22.6	-9.0	33.6	46.0	47.9	200

7. RESTRICTED BANDS RADIATIONS (1GHz – 40GHz)

[FCC 15.205 / 209, RSS-210 6.2.1 / 6.3 / 7.3]

7.1 Test Procedure

Radiated emissions were measured in the frequency range with 1 GHz to 40GHz in transmitting mode and 1 GHz to 25GHz 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 40 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 resolution bandwidth of 1MHz / video 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 – 40GHz)

Description	**Model**	**Serial Number**
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003
Spectrum Analyzer	HP 8563E	3416A02248
Harmonic Mixer (26.5 – 40GHz)	Agilent 11970A	011269-001
Amplifier (1 - 26.5GHz)	HP 8449B	3008A00582
Amplifier (26.5 – 40GHz)	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 – 8.2GHz)	EMCO 3160-6	9712-1044
Horn Antenna (8.2 – 12.4GHz)	EMCO 3160-7	1158
Horn Antenna (12.4 – 18GHz)	EMCO 3160-8	1143
Horn Antenna (18 - 26.5GHz)	EMCO 3160-9	0004-1202
Horn Antenna (26.5 - 40GHz)	EMCO 3160-10	1175
SF106 cables (1 - 18GHz): - Horn Ant <=> RF Amp. - RF Amp.<=>Spectrum Analyzer SF102 cables (18 – 40GHz): - Horn Ant <=> RF Amp. - RF Amp.<=>Spectrum Analyzer	Length: 6 m 15 m 6m 1m	 - EM206SCO - EM215SCO - SF102-20165 - SF102-21105

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

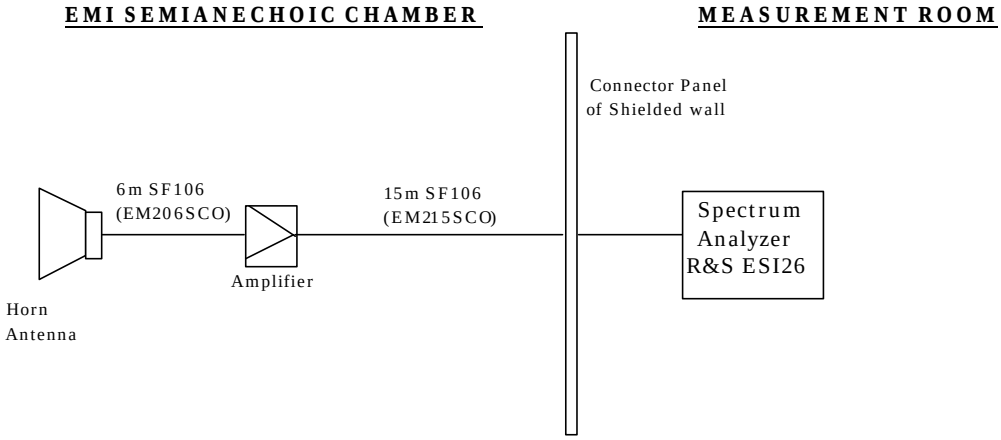


Figure 7-1. Cables for Radiated Emission Test (1 – 18 GHz)

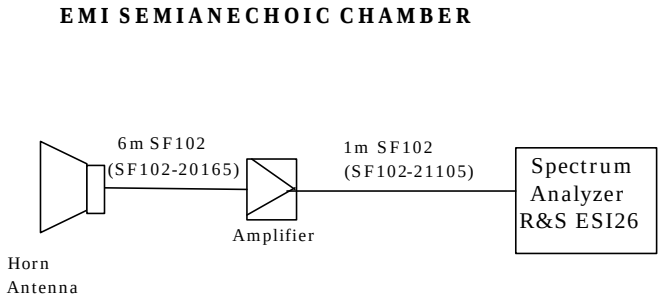


Figure 7-2. Cables for Radiated Emission Test (18 - 26.5GHz)

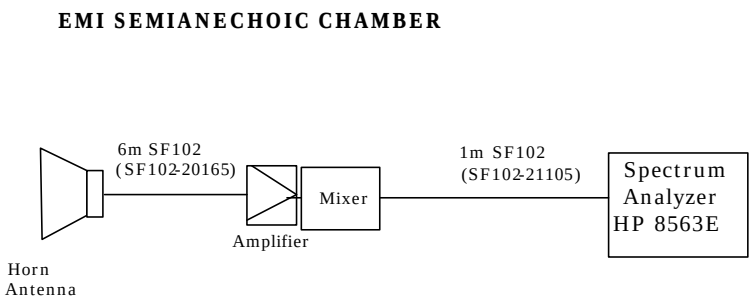


Figure 7-3. Cables for Radiated Emission Test (26.5 - 40GHz)

7.3 Field Strength Calculation

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

FS = R + AF + CORR - FO

where:

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

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

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

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

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

7.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 4.1 dB. The measurement was done for the frequency range of 1 GHz to 40 GHz in TX mode and 1 GHz to 25GHz in RX mode.

Test Date: October 15, 16, 21, 22 and 28, 2002

7.4.1 EUT in 2.4GHz IEEE802.11b transmission mode

Table 7-2-1. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.1(2412MHz) **TX** mode 11Mbps

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ***(peak)***	Measured (dBμV) ***(average)***	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ***(peak)***	FCC Limit (dBμV/m) ***(peak)***	Field Strength (dBμV/m) ***(average)***	FCC Limit (dBμV/m) ***(average)***
1.066	V	48.0	-	24.6	-32.7	0.0	39.9	74.0	-	54.0
1.196	V	51.1	-	25.2	-32.3	0.0	44.0	74.0	-	54.0
1.345	V	47.4	-	25.2	-31.9	0.0	40.7	74.0	-	54.0
1.596	V	49.8	-	25.6	-31.4	0.0	44.0	74.0	-	54.0
2.271	V	54.8	-	27.8	-30.5	0.0	52.1	74.0	-	54.0
2.347	V	54.8	-	28.1	-30.3	0.0	52.6	74.0	-	54.0
2.368	V	59.4	48.1	28.1	-30.4	0.0	57.1	74.0	45.8	54.0
2.390	V	62.2	52.0	28.2	-30.4	0.0	60.0	74.0	49.8	54.0
2.414	V	108.3	100.2	28.3	-30.4	0.0	106.2	OB*	98.1	OB*
4.824	V	45.4	-	27.1	-27.2	0.0	45.3	74.0	-	54.0
7.235	V	45.9	-	30.0	-26.4	0.0	49.5	74.0	-	54.0

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

Table 7-2-2. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.6(2437MHz) **TX** mode 11Mbps

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ***(peak)***	Measured (dBμV) ***(average)***	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ***(peak)***	FCC Limit (dBμV/m) ***(peak)***	Field Strength (dBμV/m) ***(average)***	FCC Limit (dBμV/m) ***(average)***
1.066	V	49.8	-	24.6	-32.7	0.0	41.7	74.0	-	54.0
1.196	V	51.7	-	25.2	-32.3	0.0	44.6	74.0	-	54.0
1.345	V	47.6	-	25.2	-31.9	0.0	40.9	74.0	-	54.0
1.596	V	50.9	-	25.6	-31.4	0.0	45.1	74.0	-	54.0
2.272	V	53.0	-	27.8	-30.5	0.0	50.3	74.0	-	54.0
2.308	V	52.8	-	27.8	-30.4	0.0	50.2	74.0	-	54.0
2.369	H	58.1	49.7	28.1	-30.4	0.0	55.8	74.0	47.4	54.0
2.436	H	107.8	100.1	28.3	-28.4	0.0	107.7	OB*	100.0	OB*
2.484	H	57.3	46.3	28.4	-28.2	0.0	57.5	74.0	46.5	54.0
2.496	H	54.1	-	28.4	-30.2	0.0	52.3	74.0	-	54.0
4.874	H	49.5	-	27.0	-26.9	0.0	49.6	74.0	-	54.0
7.312	V	43.3	-	29.9	-25.8	0.0	47.4	74.0	-	54.0

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

Table 7-2-3. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.11(2462MHz) **TX** mode 11Mbps

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ***(peak)***	Measured (dBμV) ***(average)***	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ***(peak)***	FCC Limit (dBμV/m) ***(peak)***	Field Strength (dBμV/m) ***(average)***	FCC Limit (dBμV/m) ***(average)***
1.066	V	48.5	-	24.6	-32.7	0.0	40.4	74.0	-	54.0
1.196	V	53.1	-	25.2	-32.3	0.0	46.0	74.0	-	54.0
1.345	V	48.4	-	25.2	-31.9	0.0	41.7	74.0	-	54.0
1.596	V	50.1	-	25.6	-31.4	0.0	44.3	74.0	-	54.0
2.272	V	53.5	-	27.8	-30.5	0.0	50.8	74.0	-	54.0
2.306	V	53.9	-	27.8	-30.4	0.0	51.3	74.0	-	54.0
2.369	H	55.7	-	28.1	-30.4	0.0	53.4	74.0	-	54.0
2.461	H	109.6	101.3	28.4	-30.2	0.0	107.8	OB*	99.5	OB*
2.484	H	60.7	51.7	28.4	-30.2	0.0	58.9	74.0	49.9	54.0
4.924	V	44.0	-	27.0	-27.7	0.0	43.3	74.0	-	54.0
7.386	V	43.5	-	29.8	-26.2	0.0	47.1	74.0	-	54.0

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

Table 7-2-4. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.6(2437MHz) **RX** mode

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ***(peak)***	Measured (dBμV) ***(average)***	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ***(peak)***	FCC Limit (dBμV/m) ***(peak)***	Field Strength (dBμV/m) ***(average)***	FCC Limit (dBμV/m) ***(average)***
1.066	V	48.9	-	24.6	-32.7	0.0	40.8	74.0	-	54.0
1.196	V	51.5	-	25.2	-32.3	0.0	44.4	74.0	-	54.0
1.345	V	47.1	-	25.2	-31.9	0.0	40.4	74.0	-	54.0
1.596	V	49.4	-	25.6	-31.4	0.0	43.6	74.0	-	54.0
2.209	V	47.2	-	27.6	-30.3	0.0	44.5	74.0	-	54.0

7.4.2 EUT in 5.8GHz IEEE802.11a transmission mode

Table 7-3-1. EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.149(5745MHz) **TX** mode 24Mbps

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)***
1.104	V	49.5	-	24.4	-32.6	0.0	41.3	74.0	-	54.0
1.198	V	52.1	-	25.2	-32.3	0.0	45.0	74.0	-	54.0
1.216	V	49.9	-	25.2	-32.2	0.0	42.9	74.0	-	54.0
1.391	V	48.0	-	25.2	-30.6	0.0	42.6	74.0	-	54.0
5.738	H	103.2	91.4	34.0	-26.6	0.0	110.6	OB*	98.8	OB*
11.487	V	35.8	-	33.5	-21.6	0.0	47.7	74.0	-	54.0

*Note: OB means “operation band” (5725-5850MHz); in this case limit is 1W (measured conducted with power meter)

Table 7-3-2 EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.157(5785MHz) **TX** mode 24Mbps

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)***
1.104	V	49.7	-	24.4	-32.6	0.0	41.5	74.0	-	54.0
1.198	V	51.6	-	25.2	-32.3	0.0	44.5	74.0	-	54.0
1.216	V	48.4	-	25.2	-32.2	0.0	41.4	74.0	-	54.0
1.391	V	47.4	-	25.2	-30.6	0.0	42.0	74.0	-	54.0
5.791	H	104.1	91.4	34.2	-26.3	0.0	112.0	OB*	99.3	OB*
11.569	V	38.5	-	33.5	-21.7	0.0	50.3	74.0	-	54.0

*Note: OB means “operation band” (5725-5850MHz); in this case limit is 1W (measured conducted with power meter)

Table 7-3-3 EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.165(5825MHz) **TX** mode 24Mbps

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)***
1.104	V	50.6	-	24.4	-32.6	0.0	42.4	74.0	-	54.0
1.198	V	51.8	-	25.2	-32.3	0.0	44.7	74.0	-	54.0
1.216	V	49.5	-	25.2	-32.2	0.0	42.5	74.0	-	54.0
1.391	V	47.3	-	25.2	-30.6	0.0	41.9	74.0	-	54.0
5.824	H	102.1	89.6	34.0	-26.2	0.0	109.9	OB*	97.4	OB*
11.711	H	36.0	-	33.6	-21.4	0.0	48.2	74.0	-	54.0

*Note: OB means “operation band” (5725-5850MHz); in this case limit is 1W (measured conducted with power meter)

Table 7-3-3 EUT: M/T 2681-3LU, s/n FX-0N14F, Ch.157(5785MHz) **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)***
1.104	V	48.6	-	24.4	-32.6	0.0	40.4	74.0	-	54.0
1.198	V	51.8	-	25.2	-32.3	0.0	44.7	74.0	-	54.0
1.216	V	48.4	-	25.2	-32.2	0.0	41.4	74.0	-	54.0
1.391	V	47.0	-	25.2	-30.6	0.0	41.6	74.0	-	54.0