

# Emission Test Report

## Standard: FCC Part 15 Subpart E / IC RSS-210

Document Number : FCC 19-0205-0

**Product: IBM ThinkPad R40 Series**

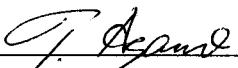
included **IBM Dual-Band 11a/b Wi-Fi® Wireless Mini PCI Adapter**

**FCC ID: ANO20020300D3L**  
**IC: 349E-PH11107E**

November 18, 2002

**Prepared:**  
**EMC Engineer**

**Takeshi Asano**

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

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

**Reviewed and Checked:**  
**EMC Staff Engineer**


**Toshiya Murota**

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

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

**Approved:**  
**Manager, EMC Engineering**

**Akihisa Sakurai**

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

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

# Emission Test Report

## Standard: FCC Part 15 Subpart E / IC RSS-210

Document Number : FCC 19-0205-0

**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

**Prepared:**  
**EMC Engineer**

**Takeshi Asano**

**Signature:** \_\_\_\_\_

**IBM Japan, Ltd.**  
**EMC Engineering**  
**LAB-S59**  
1623-14, Shimotsuruma,  
Yamato-shi Kanagawa-ken 242, Japan  
Phone: +81-46-215-4779  
Fax: +81-46-273-7420  
E-Mail: asano@jp.ibm.com

**Reviewed and Checked:**  
**EMC Staff Engineer**

**Toshiya Murota**

**Signature:** \_\_\_\_\_

**IBM Japan, Ltd.**  
**EMC Engineering**  
**LAB-S59**  
1623-14, Shimotsuruma,  
Yamato-shi Kanagawa-ken 242, Japan  
Phone: +81-46-215-6574  
Fax: +81-46-273-7420  
E-Mail: murota@jp.ibm.com

**Approved:**  
**Manager, EMC Engineering**

**Akihisa Sakurai**

**Signature:** \_\_\_\_\_

**IBM Japan, Ltd.**  
**EMC Engineering**  
**LAB-S59**  
1623-14, Shimotsuruma,  
Yamato-shi Kanagawa-ken 242, Japan  
Phone: +81-46-215-2613  
Fax: +81-46-273-7420  
E-Mail: akihisa@jp.ibm.com

**MEASUREMENT / TECHNICAL REPORT – Part 15 Subpart E  
(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**

<p>This report concerns: (check one)</p> <p>Original Grant     <input checked="" type="checkbox"/></p> <p>Class I change     <input type="checkbox"/></p> <p>Class II change    <input type="checkbox"/></p>
<p>Equipment type: <u>Wireless LAN device</u></p>
<p>This report shall not be reproduced except in full, without the written permission of this test lab.</p>
<p>The measurement results contained in this report relate only to the item which was tested.</p>
<p>Measurement procedure used is ANSI C63.4-2000 unless otherwise specified.</p>
<p>Other test procedure: _____</p>
<p>The FCC has issued provisional acceptance of this test laboratory for Declaration of Conformity testing per letter dated 1997.</p>
<p><i>APPLICANT ANTI-DRUG ABUSE CERTIFICATION:</i></p> <p>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).</p> <p style="text-align: center;"><input checked="" type="radio"/> Yes or No</p>
<p>“Report shall not be reproduced except in full, without the written approval of the laboratory” “the report must not be used by the client to claim product endorsement by NVLAP or any agency of the US government”</p>
<p>Prepared by: Takeshi Asano</p> <p style="text-align: right;">IBM Japan Corporation, Yamato EMC Engineering LAB-S59, 1623-14, Shimotsuruma, Yamato-shi Kanagawa-ken 242-8502, Japan Tel: +81-46-215-4779 Fax: +81-46-273-7420</p>

- Index -

**A. GENERAL INFORMATION ..... 4**

A.1 Test Methodology.....4

A.2 Test Facility / NVLAP Accreditation.....4

A.3 EUT details.....4

**B. SUMMARY OF TEST RESULTS ..... 5**

**C. TEST INSTRUMENTS ..... 6**

**D. OPERATION MODE OF EUT ..... 8**

**E. JUSTIFICATION ..... 9**

**F. MEASUREMENT UNCERTAINTY ..... 9**

**G. TEMPERATURE AND HUMIDITY ..... 9**

**H. RELATED SUBMITTAL(S)/GRANT(S)/NOTES ..... 9**

**1. BANDWIDTH AT 26 DB BELOW / BANDEDGE ..... 10**

1.1 Test Procedure.....10

1.2 Measurement Results.....10

1.3 Trace Data.....11

**2. PEAK CONDUCTED TRANSMIT OUTPUT POWER ..... 14**

2.1 Test Procedure.....14

2.2 Measurement Results.....16

2.3 Trace Data.....17

**3. PEAK POWER SPECTRAL DENSITY ..... 23**

3.1 Test Procedure.....23

3.2 Measurement Results.....23

3.3 Trace Data.....24

**4. PEAK EXCURSION RATIO ..... 30**

4.1 Test Procedure.....30

4.2 Measurement Results.....30

4.3 Trace Data.....31

**5. AC WIRELINE CONDUCTED EMISSIONS (450KHZ – 30MHZ) ..... 34**

5.1 Test Procedure.....34

5.2 Test Instruments and Measurement Setup.....34

5.3 Measurement Results.....35

**6. RESTRICTED BANDS RADIATIONS (30MHZ – 1GHZ) ..... 36**

6.1 Test Procedure.....36

6.2 Test Instruments and Measurement Setup.....36

6.3 Field Strength Calculation.....38

6.4 Measurement Results.....39

**7. RESTRICTED BANDS RADIATIONS (1GHZ – 40GHZ) ..... 40**

7.1 Test Procedure.....40

7.2 Test Instruments and Measurement Setup.....40

7.3 Field Strength Calculation.....42

7.4 Measurement Results.....43

7.6 Trace Data.....45

## 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 E Industry Canada RSS-210 (Issue No.5)
MODEL NUMBER	: 2682-NLU (ThinkPad R40 Series)
FCC ID	: ANO20020300D3L
IC Certification Number	: 349E-PH11107E
SERIAL NUMBER	: FX-00336
PHYSICAL CONDITION	: Preproduction
KIND OF EQUIPMENT	: Personal computer with a IEEE802.11a & b Wireless LAN Mini-PCI Combo Card ( <a href="#">Composite application</a> )
TESTED DATE	: October 15, 17, 18, 21, 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 #1 and #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 2682-NLU (s/n FX-00336)	FCC ID: ANO20020300D3L	<b>Applying equipment</b> IBM Notebook PC with built_in antenna CPU: Intel® Mobile Pentium® 4, 1.9GHz LCD: 15" 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 U-NII devices under FCC Part 15 Subpart E, and for LELAN devices under Industry Canada RSS-210.

The section numbers of upper portion are showing FCC codes, and the lower ones are for IC RSS-210.

Table-B List of the measurements

Section(s)	Test Items		Condition	Result
	Transmit mode (TX):			
15.407(a)(1), (2) 6.2.2 (q1)(i)(ii)	Bandwidth at 26 dB below	According to RSS-210 6.2.2q(iv)(b), 26 dB WB was taken for 99% BW.	Conducted	Pass
	Peak conducted transmit output power or EIRP for IC	5150-5250MHz: FCC: 50mW or (4+10logB)dBm IC : 200mW* or (10+10logB)dBm* *: EIRP 5250-5350MHz: FCC: 250mW or (11+10logB)dBm IC : 250mW or (11+10logB)dBm IC : 1W* or (17+10logB)dBm* *: EIRP B: 26dB BW in MHz		Pass
	Peak Power Spectral Density	5150-5250MHz: FCC: 4 dBm in any 1MHz IC : 10 dBm in any 1MHz (EIRP) 5250-5350MHz: FCC: 11 dBm in any 1MHz IC : 11 dBm in any 1MHz		Pass
	Peak Spectral Density	IC: 3 + 10logB dBm/MHz		Pass
N/A 6.2.2 (q1)(iv)(b)	Peak Excursion	The ratio of the peak excursion of the modulation envelope to the peak transmit shall not exceed 13 dB across any 1 MHz .		Pass
15.207 / 407(b)(5) 6.2.2 (q1)(v) / 6.6	AC Wireline Conducted Emissions 450kHz- 30MHz	Class B: 250µV		Pass
15.205 & 209 / 407(b)(1)(2)(5)(6) 6.2.1 / 6.2.2(q1)(i)(ii)(v)/ 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 (1G - 40GHz)	Pass

		Receive mode (RX):			
15.207 / 407(b)(5) 6.2.2(q1)(v) / 7.4	AC Wireline Conducted Emissions 450kHz - 30MHz	Class B: 250µV	Conducted	Pass	
15.205 & 209 / 407(b)(1)(2)(5)(6) 6.2.1 / 6.2.2(q1)(i)(ii)(v)/ 7.3	General Field Strength Limits (Radiated Emission Limits)	Shall not exceed the limits specified in RSS-210.	Radiated (30MHz - 1GHz)	Pass	
			Radiated (1G - 40GHz)	Pass	

	Other general requirements		Result
15.407(a)(1)(2)	Antenna gain	Peak : 2.98 dBi	N/A
6.2.2(q1)(iv)(a)	Digital modulation	Applying equipment employs IEEE802.11a (OFDM) or 11b(CCK) digital modulation technology.	complies
15.407(c) 6.2.2(q1)(iv)(d)	Automatic link disconnection in no transaction state	Refer to “Circuitry Description” document.	complies
15.407(d) 6.2.2(q1)(i)	Integral antenna in the 5150M - 5250MHz band	Refer to “Circuitry Description” document.	complies
15.407(e) 6.2.2(q1)(i) (q1)(iv)(g)	Indoor use in the 5150M -5250MHz band, and interference from radars.	Refer to “Manual_Regulatory_Notice”.	complies
15.407(f) 6.2.2(q1)(iv)(g)	RF Exposure Requirement	Refer to “RF Exposure Evaluation” or “Exposure of Humans to Radio Frequency Fields“ documents.	complies
15.407(g) 6.2.2(q1)(iv)(e)	Frequency stability	Refer to “Circuitry Description” document.	complies

### C. Test Instruments

Table-C 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 2719A17228	N/A N/A	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

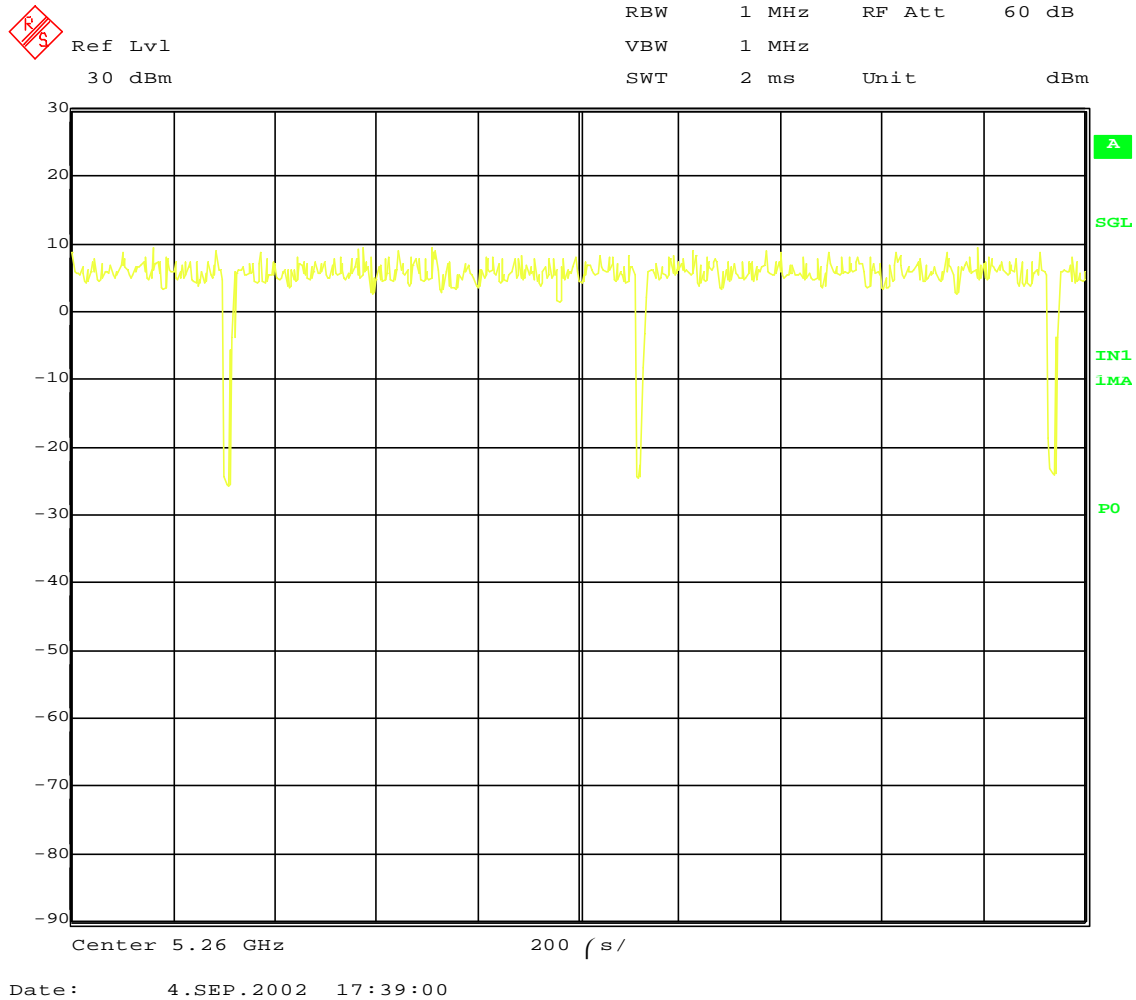
Notes.

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



## D. Operation mode of EUT

- All tests were performed using the “Atheros Radio Test” program. This tool supports the continuous transmission mode for the testing purpose as shown blow.



- Three kinds of frequencies were chosen for the measurement. i.e. 5180MHz (lowest), 5260MHz(middle), and 5320MHz (highest).

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

Operation Frequency [GHz]	Rated output power (conducted) [dBm]							
	6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	48M bps	54M bps
5.180 (Ch. 36)	+14	+14	+14	+14	+14	+14	+14	+13
5.200 (Ch. 40)	+14	+14	+14	+14	+14	+14	+14	+13
5.220 (Ch. 44)	+14	+14	+14	+14	+14	+14	+14	+13
5.240 (Ch. 48)	+14	+14	+14	+14	+14	+14	+14	+13
5.260 (Ch. 52)	+17	+17	+17	+17	+17	+15	+14	+13
5.280 (Ch. 56)	+17	+17	+17	+17	+17	+15	+14	+13
5.300 (Ch. 60)	+17	+17	+17	+17	+17	+15	+14	+13
5.320 (Ch. 64)	+14	+14	+14	+14	+14	+14	+14	+13

3. 24Mbps transmission mode was selected for full testing as the worst case sampling.  
See “Chapter 2. Peak Conducted Transmit Output Power” as to the determination of measurement plots.
4. As for the RF receiving test, the middle channel with the worst case(i.e. 5260MHz, 24Mbps mode) was selected representatively.

## E. Justification

The EUT was investigated for both the main(left) and the auxiliary(right) antennas. The worse case data taken in this report represents the measurement results of the left(main) antenna that has comparatively higher gain. And the 15 inch LCD model in ThinkPad R40 Series is chosen for the EUT, since the antenna gain of 15" model is comparatively higher than the one of 13"/14" models as listed below.

	13" / 14" LCD model	15" LCD model
Left Antenna gain	1.87 dBi (peak)	2.98 dBi (peak)
Right Antenna gain	2.91 dBi (peak)	1.96 dBi (peak)

## 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 26 dB below / Bandedge

[5150-5250MHz: FCC 15.407(a)(1), RSS 6.2.2q1(i) / q1(iV)(b)]  
 [5250-5350MHz: FCC 15.407(a)(2), RSS 6.2.2q1(ii) / q1(iV)(b)]

## 1.1 Test Procedure

The bandwidth at 26 dB down from the peak of the RF emission was measured with a spectrum analyzer connected to the antenna terminal, while EUT was operating in continuous transmission mode at the appropriate center frequencies (5180 / 5260 / 5320MHz).

The spectrum analyzer was set to:

RBW=300kHz<sup>\*1</sup>, VBW=1MHz<sup>\*2</sup>, Span=50MHz, Sweep= 50ms, Mode= Peak detector

\*1: approximately 1% of the emission bandwidth (§15.403(c))

\*2: VBW > RBW (To be adjusted accordingly based on the spectrum stability.)

Table 1-1 : 26 dB Bandwidth Test Instruments

Description	Model	Serial Number
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003
Coax cables: - Spectrum Analyzer <=> EUT	Length: 110 cm Loss: 2.2 dB	

Notes: - R&S: Rohde & Schwarz

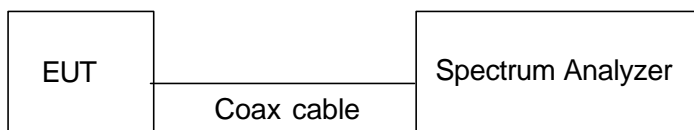


Figure 1: Measurement setup for 26dB bandwidth test

## 1.2 Measurement Results

Test Date: October 29, 2002

Table 1-2. EUT: M/T 2682-NLU, s/n FX-00336 , TX mode 24Mbps

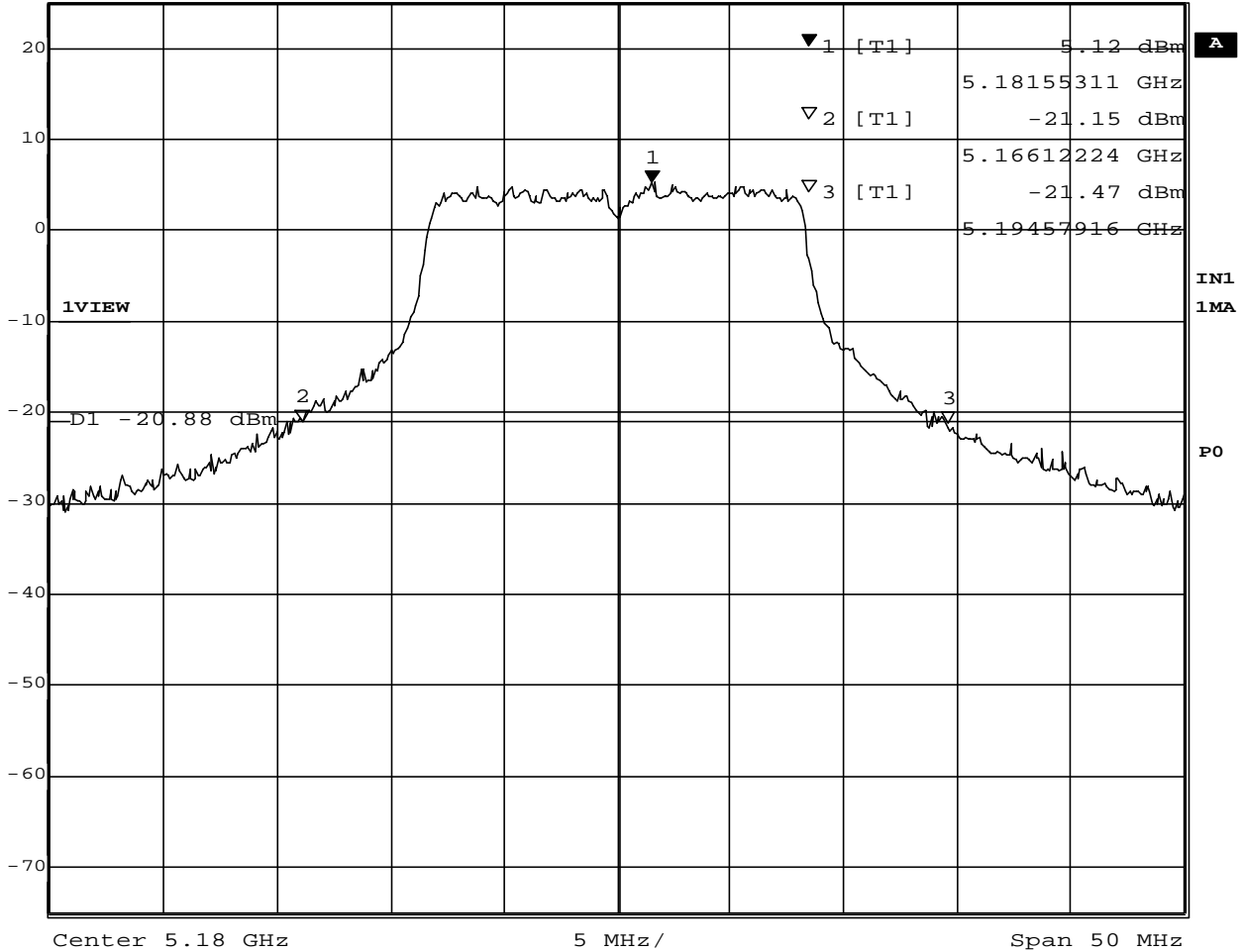
Center Frequency (MHz)	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 26 dB below (MHz)	Plot data
5180 (ch. 36)	5166.12	5194.58	28.46	Plot 1-1
5260 (ch. 52)	5242.01	5277.28	35.27	Plot 1-2
5320 (ch. 64)	5306.32	5334.58	28.26	Plot 1-3

: the closest frequencies to the bandedge

### 1.3 Trace Data



Ref Lvl	Marker 1 [T1]	RBW	300 kHz	RF Att	40 dB
25 dBm	5.12 dBm	VBW	1 MHz		
	5.18155311 GHz	SWT	50 ms	Unit	dBm

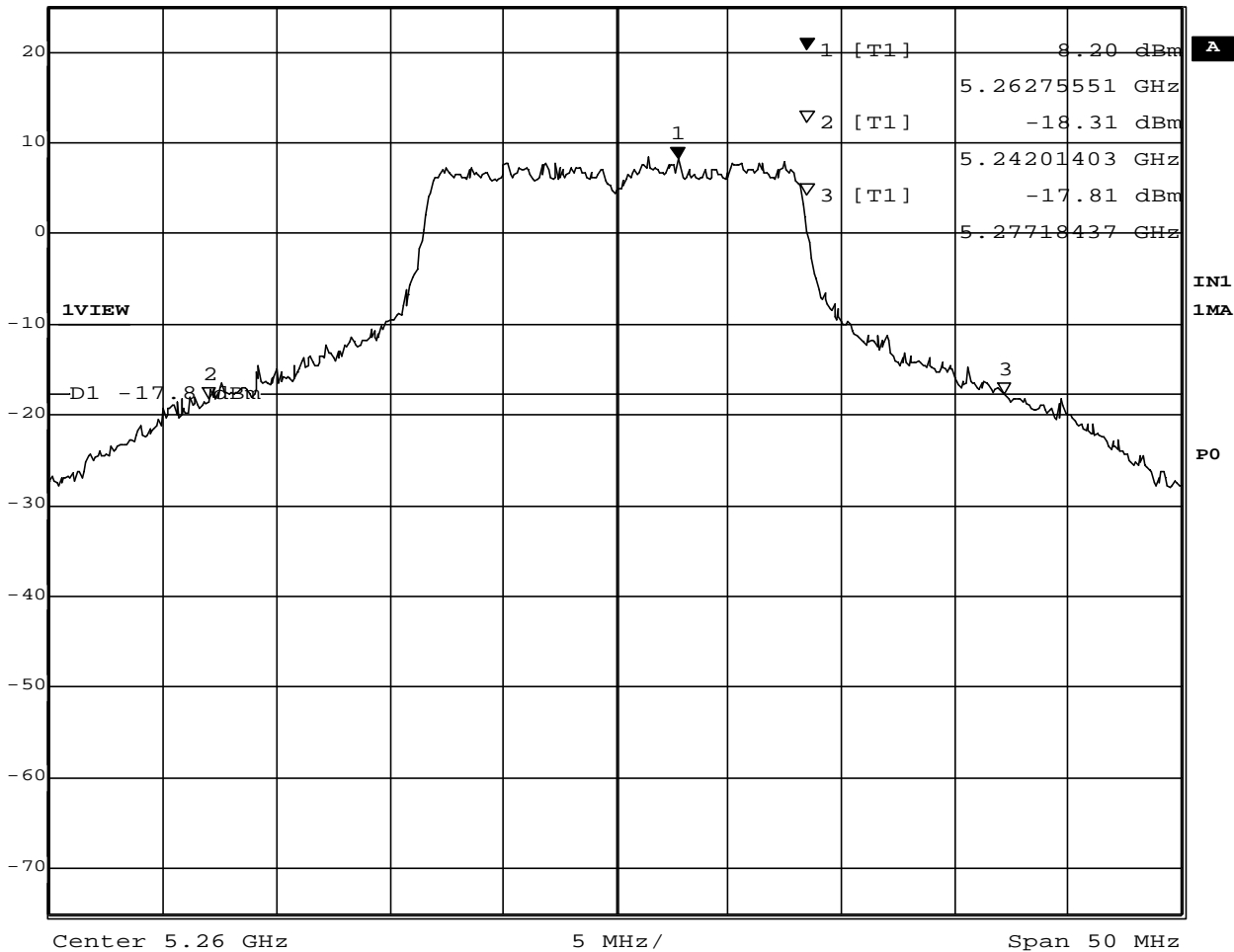


Date: 29.OCT.2002 15:32:57

Plot 1-1. 26dB BW at 5180MHz



Ref Lvl	Marker 1 [T1]	RBW	300 kHz	RF Att	40 dB
25 dBm	8.20 dBm	VBW	1 MHz		
	5.26275551 GHz	SWT	50 ms	Unit	dBm

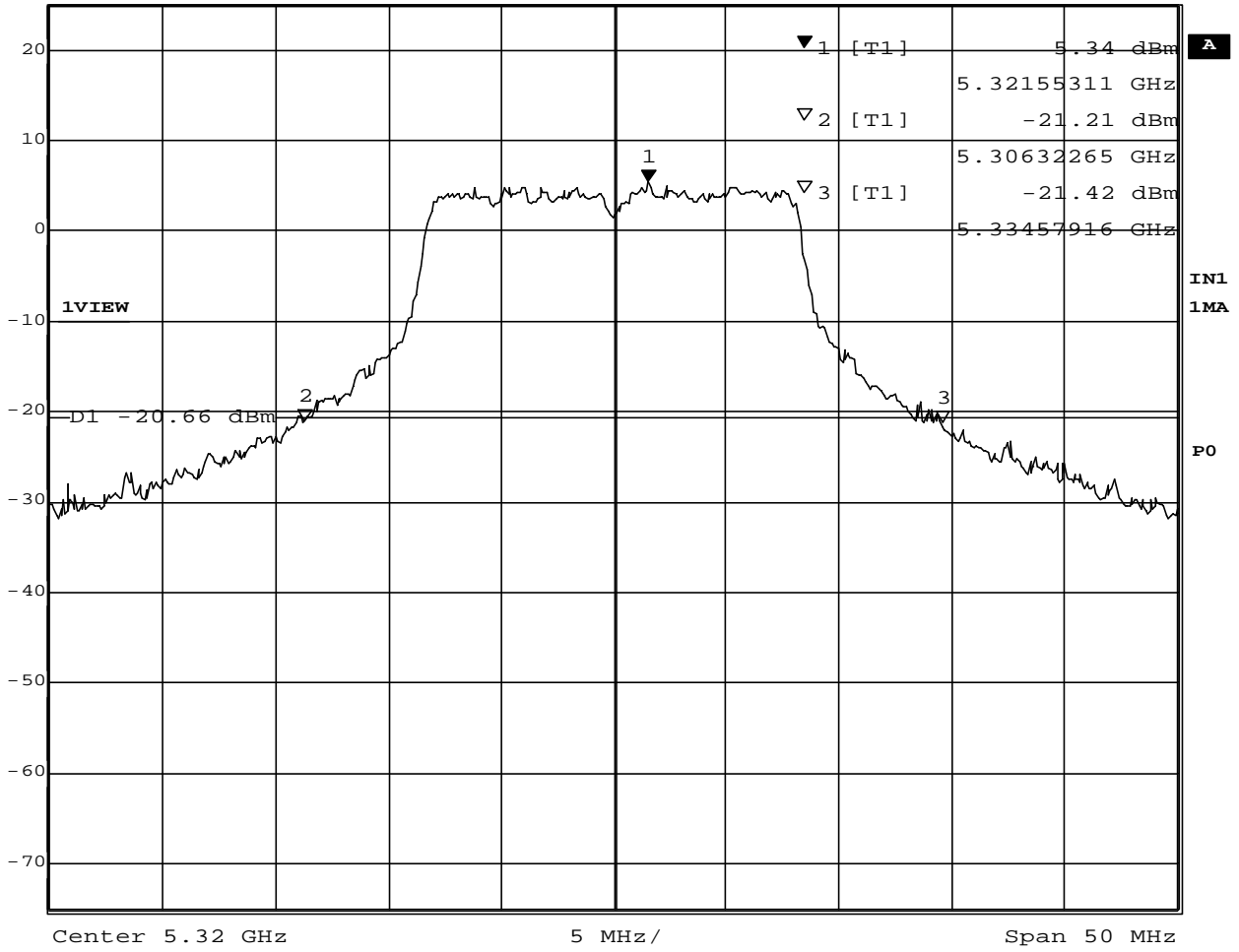


Date: 29.OCT.2002 15:36:25

Plot 1-2. 26dB BW at 5260MHz



Marker 1 [T1] RBW 300 kHz RF Att 40 dB  
Ref Lvl 5.34 dBm VBW 1 MHz  
25 dBm 5.32155311 GHz SWT 50 ms Unit dBm



Date: 29.OCT.2002 15:39:07

Plot 1-3. 26dB BW at 5320MHz

## 2. Peak Conducted Transmit Output Power

[5150-5250MHz: FCC 15.407(a)(1), RSS 6.2.2q1(i) / q1(iV)(b)]  
 [5250-5350MHz: FCC 15.407(a)(2), RSS 6.2.2q1(ii) / q1(iV)(b)]

### 2.1 Test Procedure

The test was performed with three kinds of measurement methods as follows.

- 1) using Power meter
- 2) using Spectrum Analyzer in adjusting VBW to get equivalent power meter’s value
- 3) using Spectrum Analyzer according the FCC Public Notice, DA 02-2138, August/30/2002

#### 2.1.1 Power Meter measurement method

To find the worse case in the implemented transmission modes in each measuring frequency (low, middle, high), the following test was performed with a power meter.

- 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. The spectrum of the continuous transmission test mode is shown in the Chapter D.

Table 2-1 : Test Instruments of power meter method

Description	Model	Serial Number
Power Meter	HP 437B	3043U03437
Power Sensor	HP 8481A	US41030582
Coax cables: - Power Sensor <=> EUT	Length: 20 cm	Loss: 1.2dB

Notes: - HP: Hewlett Packard

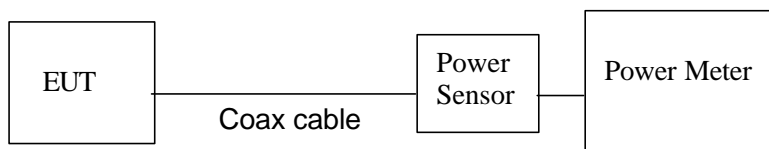


Figure 2-1: Measurement setup of power meter method

#### 2.1.2 Spectrum Analyzer measurement method #1

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

The spectrum analyzer was set to :

- VBW= 30kHz, RBW=1MHz,
- Span=30-40MHz encompassing the entire 26dB 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 2.1.1. The analyzer computed the peak power by integrating the spectrum across the 26 dB emission bandwidth given by the previous chapter.

Table 2-2 : Test Instruments of spectrum analyzer method

Description	Model	Serial Number
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003
Coax cables: - Spectrum Analyzer <=> EUT	Length: 110 cm Loss: 2.2 dB	

Notes: - R&S: Rohde & Schwarz

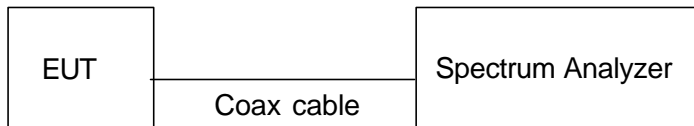


Figure 2-2 : Measurement setup of spectrum analyzer method

### 2.1.3 Spectrum Analyzer measurement method #2

according the FCC Public Notice, DA 02-2138, August/30/2002

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

The spectrum analyzer was set to :

VBW= 3MHz, RBW=1MHz,

Span=30-40MHz encompassing the entire 26dB emission bandwidth of the transmission signal,

Mode= sample detector, Trigger= free run

The analyzer averaged 100 traces in averaging mode, then the band power measurement function was used to compute the peak power of each transmission mode selected by the step 2.1.1. The analyzer compute the peak power by integrating the spectrum across the 26 dB emission bandwidth given by the previous chapter.

The test instruments and setup configuration are the same as the Table 2-2 and Figure 2-2.



## 2.2 Measurement Results

Test Date: October 15 and 29, 2002

Table 2-2-1. Power meter measurement results (EUT: M/T 2682-NLU, s/n FX-00336)

Operation Frequency [GHz]	Rated output power (conducted) [dBm]							
	6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	48M bps	54M bps
5.180	13.2				<b>13.2</b>	13.1	13.0	11.8
specification	14							13
5.260	16.1				<b>16.2</b>	14.4	13.5	12.4
specification	17					15	14	13
5.320	13.3				<b>13.4</b>	13.3	13.2	12.4
specification	14							13

[ 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)			
5180	13.2	1.2	<b>14.4</b>	17	N/A	2.98	<b>17.4</b>	23
5260	16.2	1.2	<b>17.4</b>	24	24		<b>20.4</b>	30
5320	13.4	1.2	<b>14.6</b>	24	24		<b>17.6</b>	30

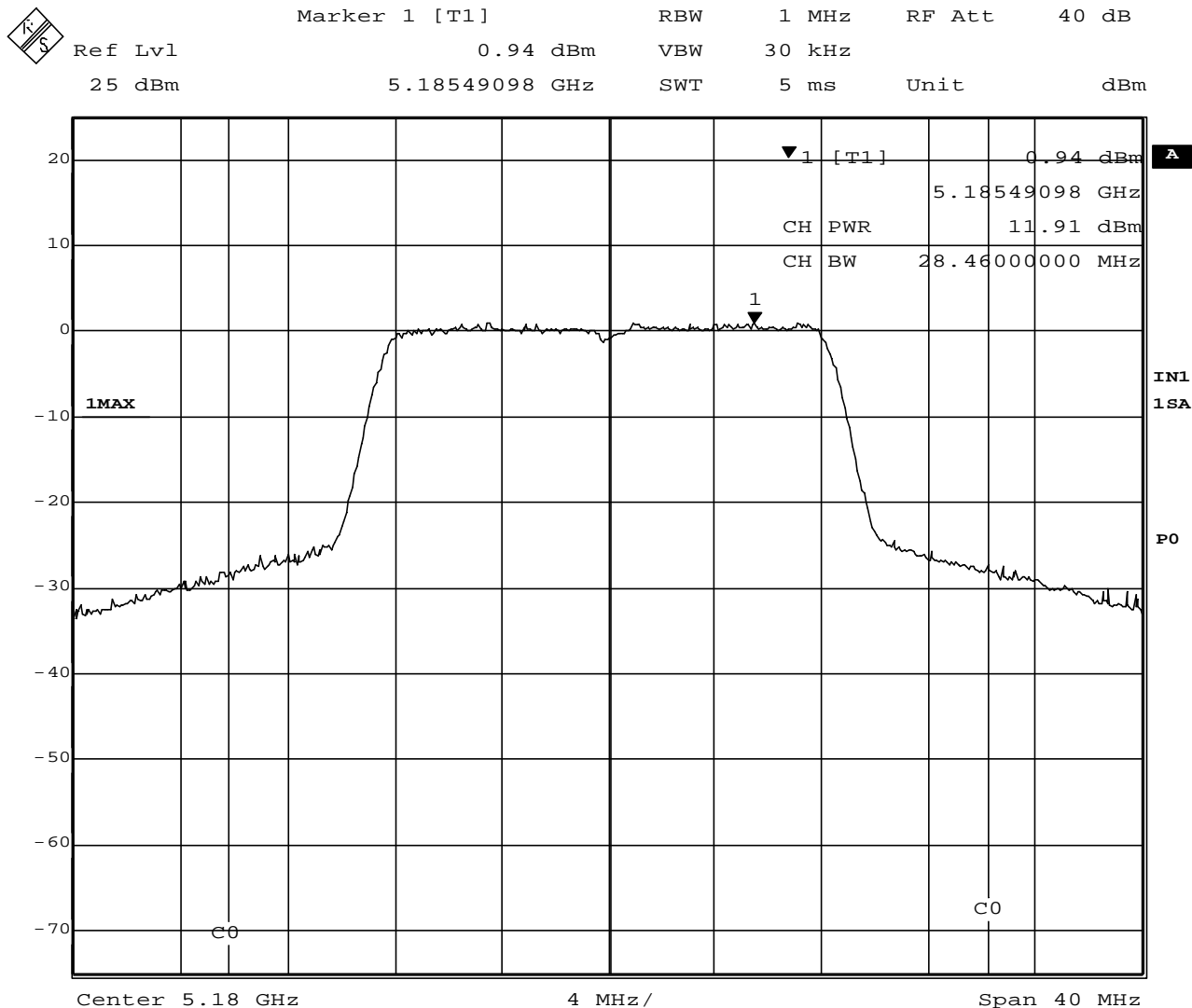
Table 2-2-2. Spectrum analyzer measurement results #1 (EUT: M/T 2682-NLU, s/n FX-00336)

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)			
5180	11.91	Plot 2-1	2.2	<b>14.1</b>	17	N/A	2.98	<b>17.1</b>	23
5260	14.97	Plot 2-2	2.2	<b>17.2</b>	24	24		<b>20.2</b>	30
5320	12.19	Plot 2-3	2.2	<b>14.4</b>	24	24		<b>17.4</b>	30

Table 2-2-3. Spectrum analyzer measurement results #2 according the FCC Public Notice, DA 02-2138 (EUT: M/T 2682-NLU, s/n FX-00336)

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)			
5180	8.83	Plot 2-4	2.2	<b>11.0</b>	17	N/A	2.98	<b>14.0</b>	23
5260	12.01	Plot 2-5	2.2	<b>14.2</b>	24	24		<b>17.2</b>	30
5320	8.63	Plot 2-6	2.2	<b>10.8</b>	24	24		<b>13.8</b>	30

## 2.3 Trace Data

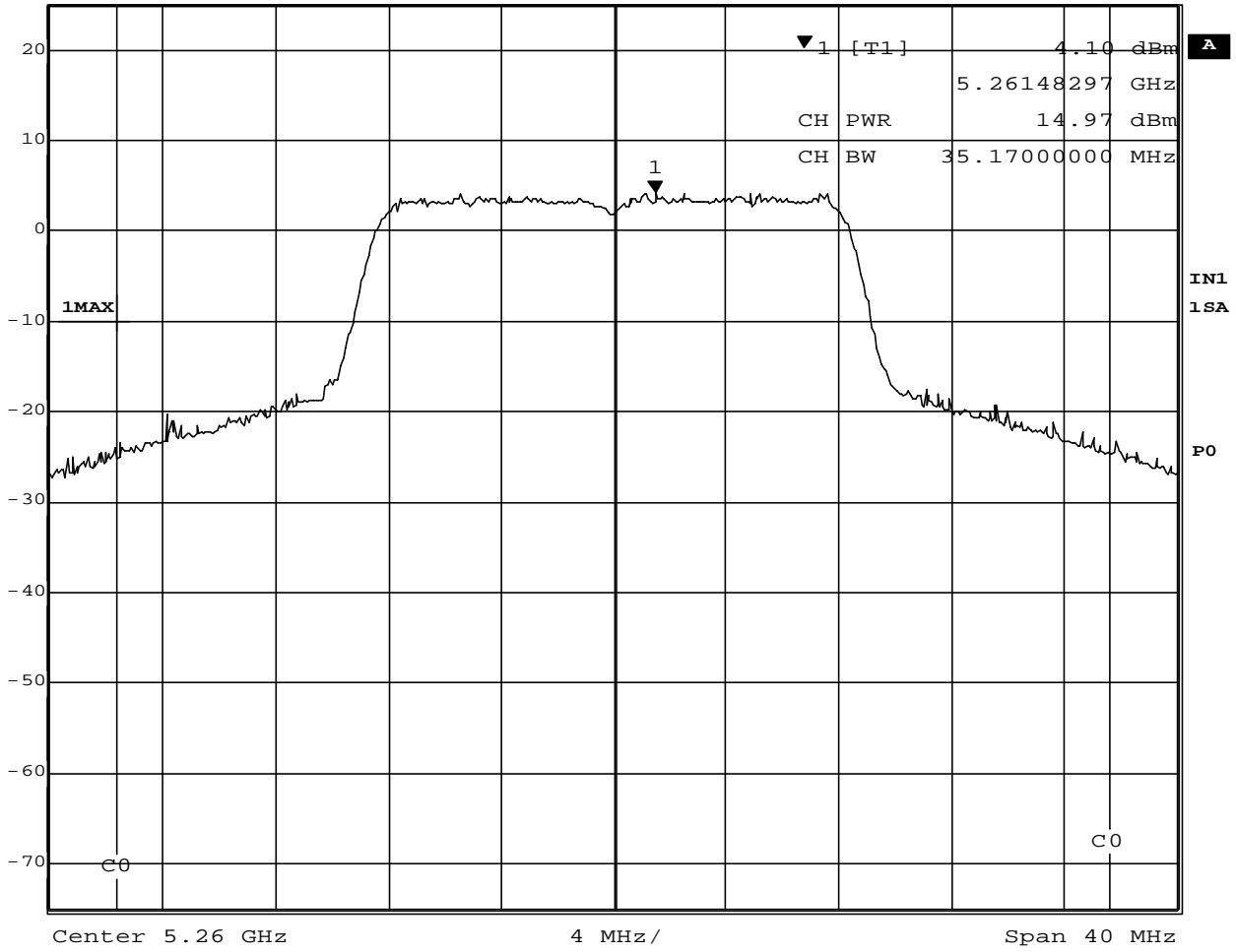


Date: 29.OCT.2002 15:45:54

Plot 2-1 Conducted Peak Power at 5180MHz



Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	40 dB
25 dBm	4.10 dBm	VBW	30 kHz		
	5.26148297 GHz	SWT	5 ms	Unit	dBm

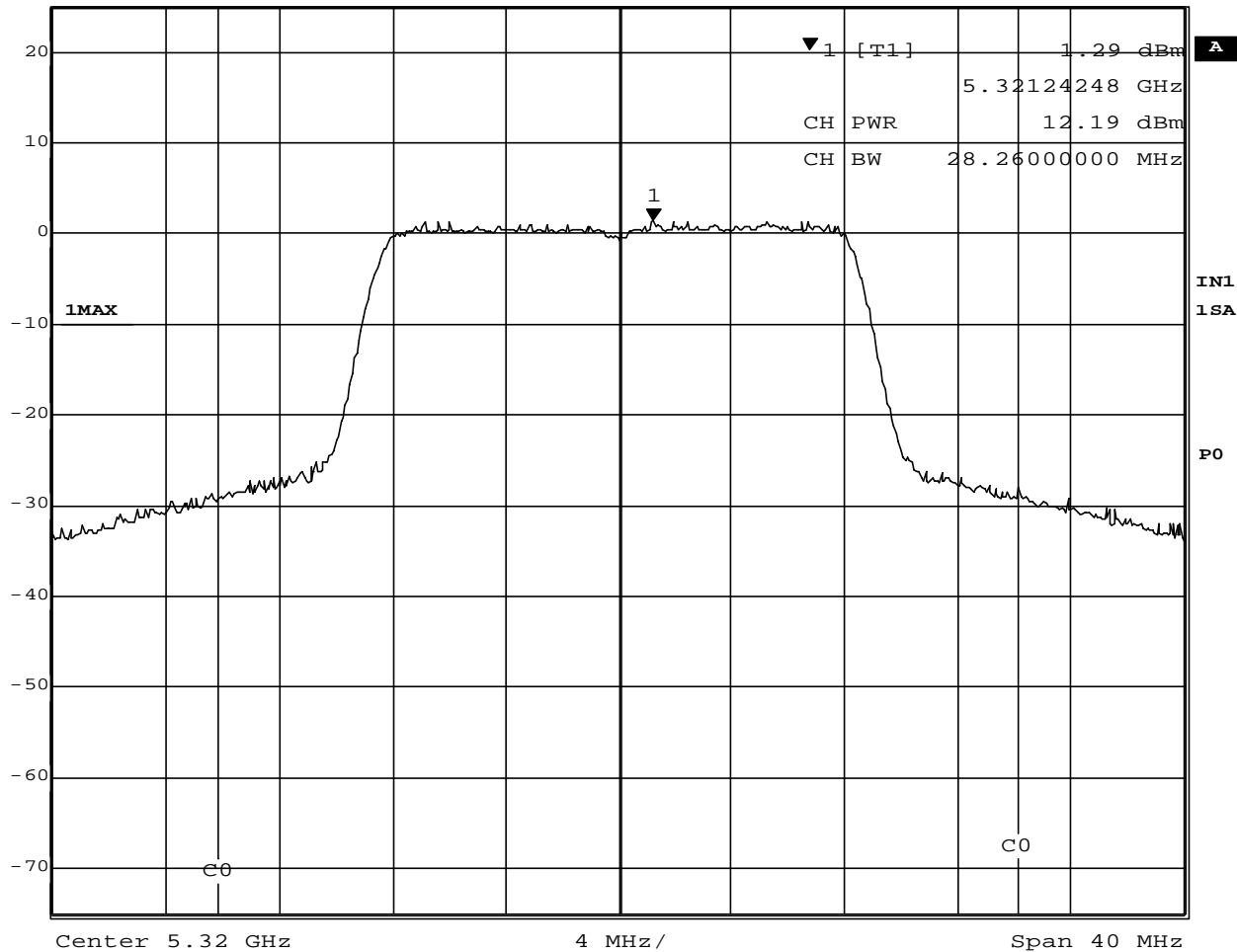


Date: 29.OCT.2002 15:51:21

Plot 2-2 Conducted Peak Power at 5260MHz



Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	40 dB
25 dBm	1.29 dBm	VBW	30 kHz		
	5.32124248 GHz	SWT	5 ms	Unit	dBm

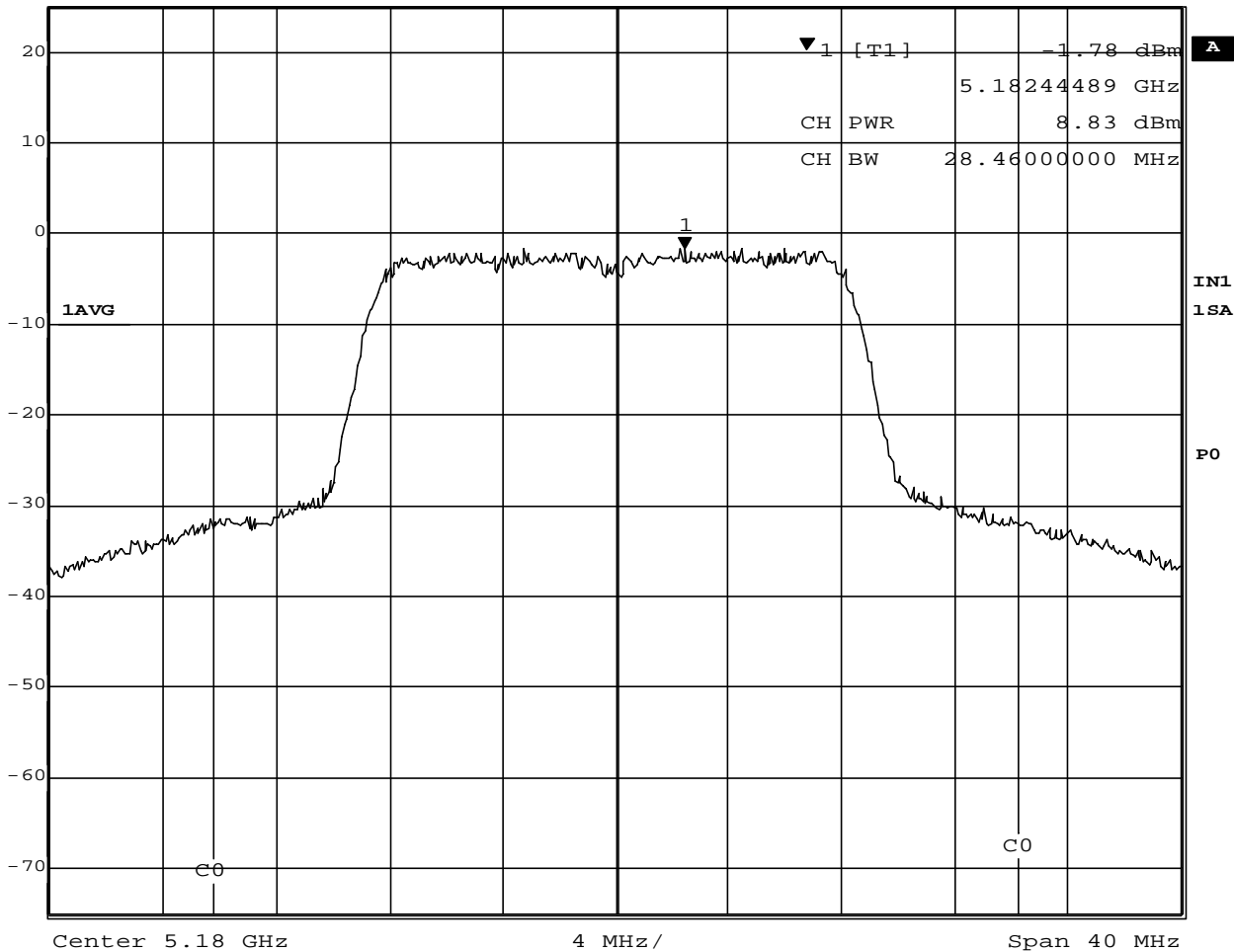


Date: 29.OCT.2002 15:53:06

Plot 2-3 Conducted Peak Power at 5320MHz



Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	40 dB
25 dBm	-1.78 dBm	VBW	3 MHz		
	5.18244489 GHz	SWT	5 ms	Unit	dBm

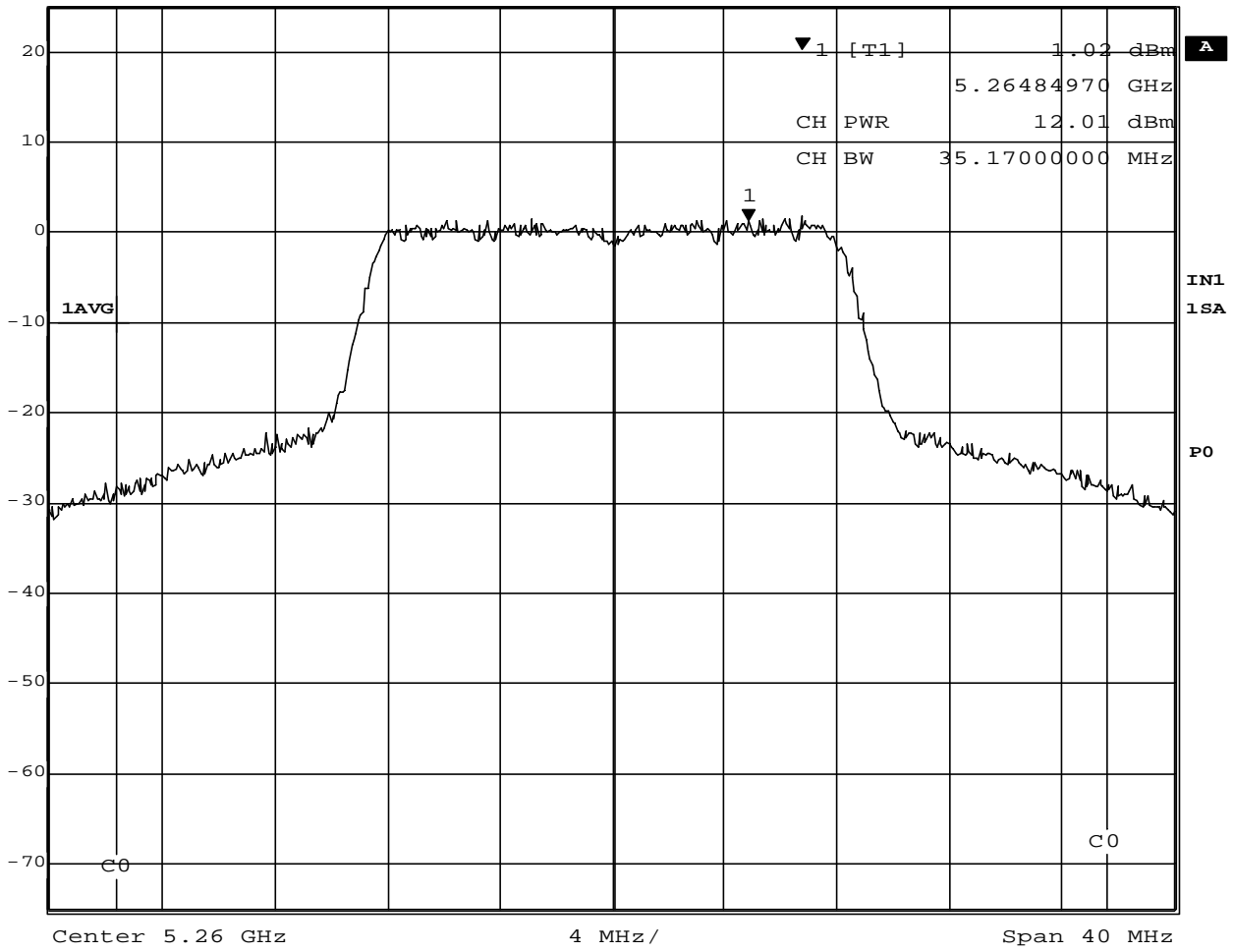


Date: 29.OCT.2002 15:47:21

Plot 2-4 Conducted Peak Power at 5180MHz according FCC DA 02-213



Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	40 dB
25 dBm	1.02 dBm	VBW	3 MHz		
	5.26484970 GHz	SWT	5 ms	Unit	dBm

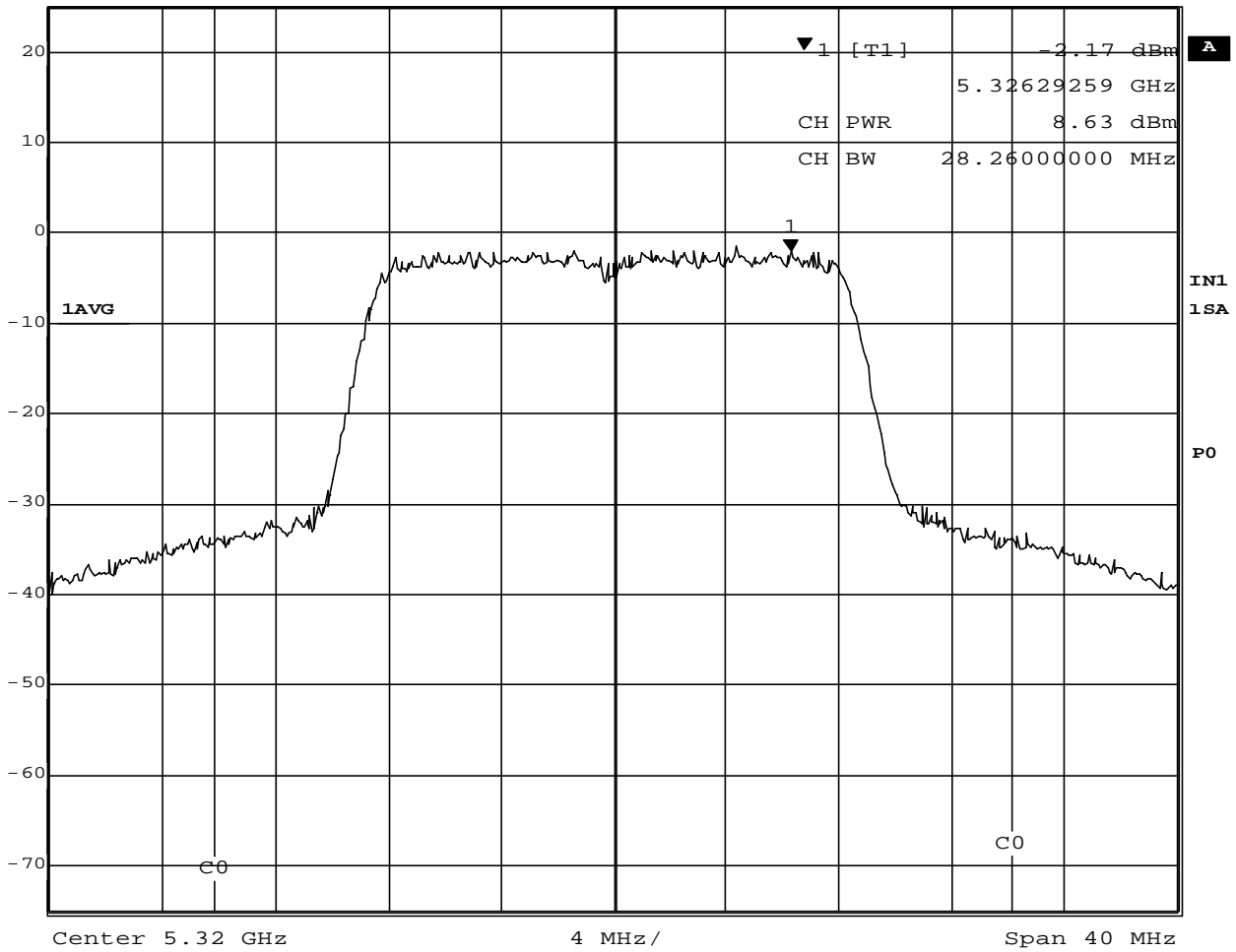


Date: 29.OCT.2002 15:49:35

Plot 2-5 Conducted Peak Power at 5260MHz according FCC DA 02-2138



Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	40 dB
25 dBm	-2.17 dBm	VBW	3 MHz		
	5.32629259 GHz	SWT	5 ms	Unit	dBm



Date: 29.OCT.2002 15:53:56

Plot 2-6 Conducted Peak Power at 5320MHz according FCC DA 02-213

### 3. Peak Power Spectral Density

[5150-5250MHz: FCC 15.407(a)(1), RSS 6.2.2q1(i), (iv)(b) ]  
 [5250-5350MHz: FCC 15.407(a)(2), RSS 6.2.2q1(ii), (iv)(b) ]

#### 3.1 Test Procedure

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

The spectrum analyzer was set to :

RBW= 1MHz, VBW=3MHz, Span=20MHz, Mode= sample detector,  
 The analyzer averaged 100 traces in averaging mode, then the marker was set to the highest position in the spectrum.

Also the Canadian PPSD was examined with the following spectrum analyzer setting.

RBW= 1MHz, VBW=1MHz, Span=20MHz, Mode= sample detector, averaging off

The test instruments and setup configuration are the same as the Table 2-2 and Figure 2-2.

#### 3.2 Measurement Results

Test Date: October 29, 2002

Table 3-1. Measurement results of PPSD (EUT: M/T 2682-NLU, s/n FX-00336)

Measured Frequency (MHz)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	Results (dBm)	FCC Limit (dBm)	IC Limit q1(ii) (dBm)	Peak Antenna Gain (dBm)	IC EIRP (dBm)	IC Limit q1(i) (dBm)
5180	-1.28	Plot 3-1	2.2	0.9	4.0	N/A	2.98	3.9	10
5260	2.16	Plot 3-2	2.2	4.4	11.0	11.0			N/A
5320	-1.92	Plot 3-3	2.2	0.3	11.0	11.0			N/A

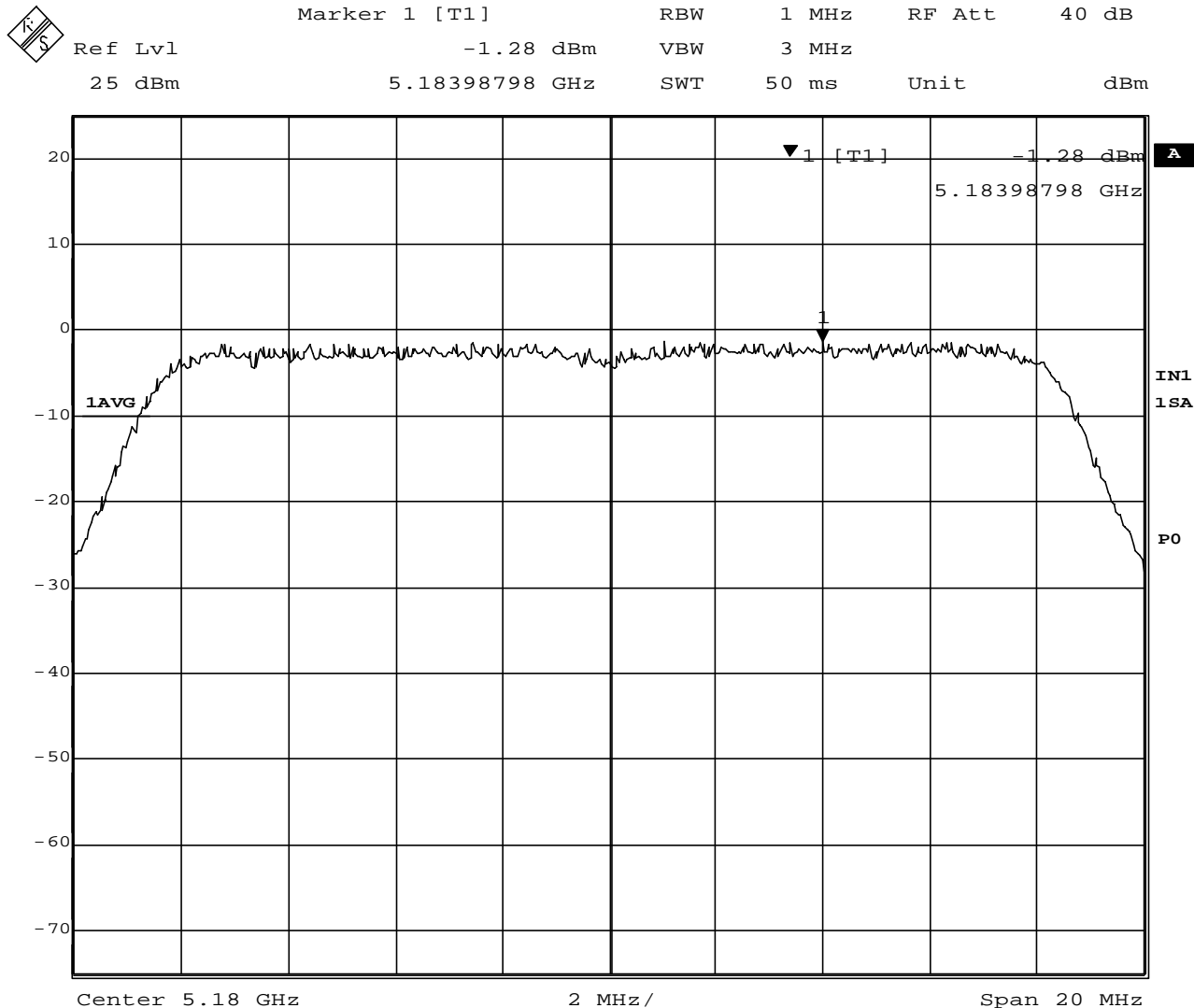
Table 3-2. Measurement results of Canadian PPSD (EUT: M/T 2682-NLU, s/n FX-00336)

Measured Frequency (MHz)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	Results (dBm)	IC Limit q1(iv)(b) 3 + 10logB* (dBm)
5180	8.53	Plot 3-4	2.2	10.7	17.54
5260	11.09	Plot 3-5	2.2	13.3	18.47
5320	8.32	Plot 3-6	2.2	10.5	17.51

\* B = 26dB Bandwidth



### 3.3 Trace Data

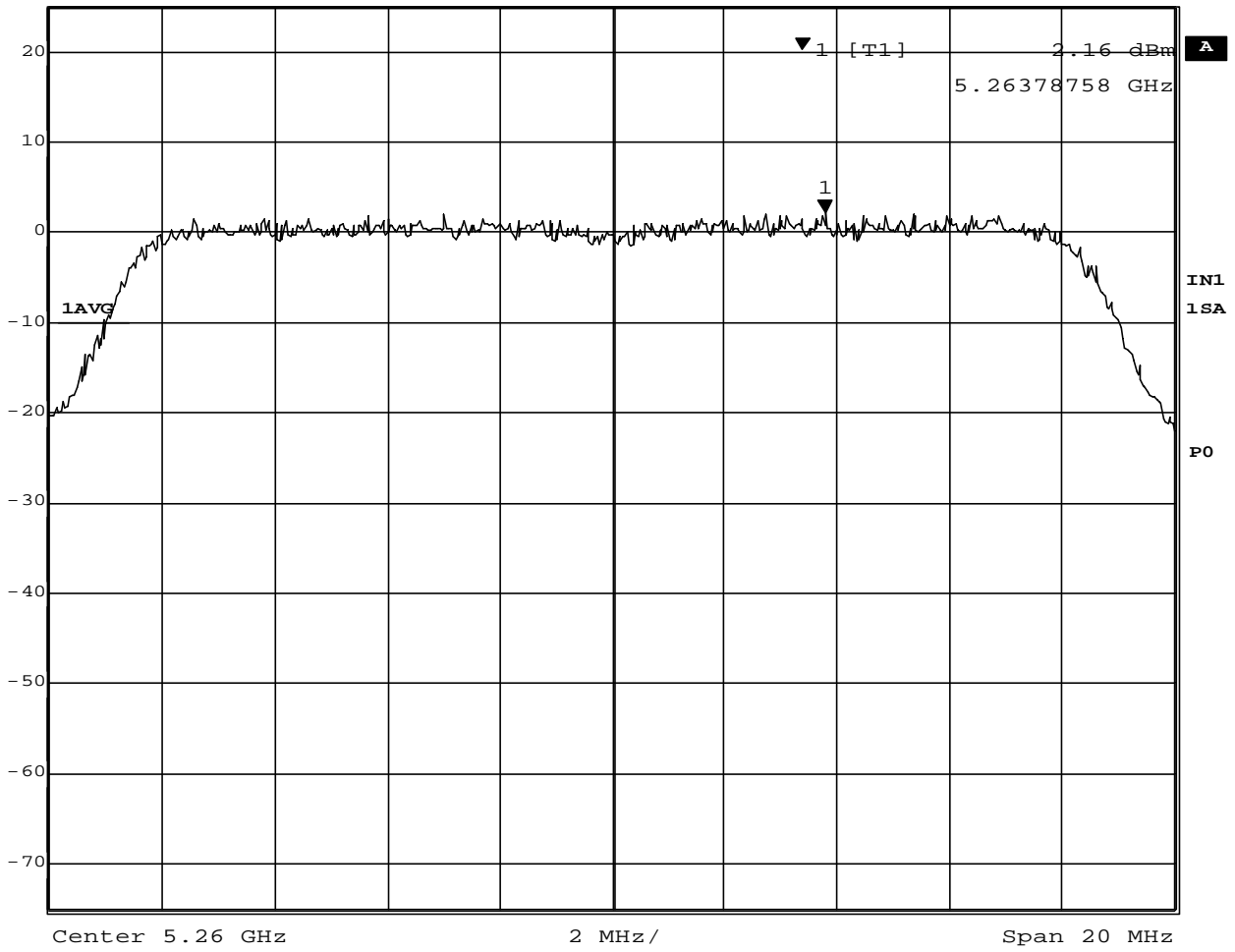


Date: 29.OCT.2002 15:57:34

Plot 3-1 Peak Power Spectral Density at 5180MHz



Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	40 dB
25 dBm	2.16 dBm	VBW	3 MHz		
	5.26378758 GHz	SWT	50 ms	Unit	dBm

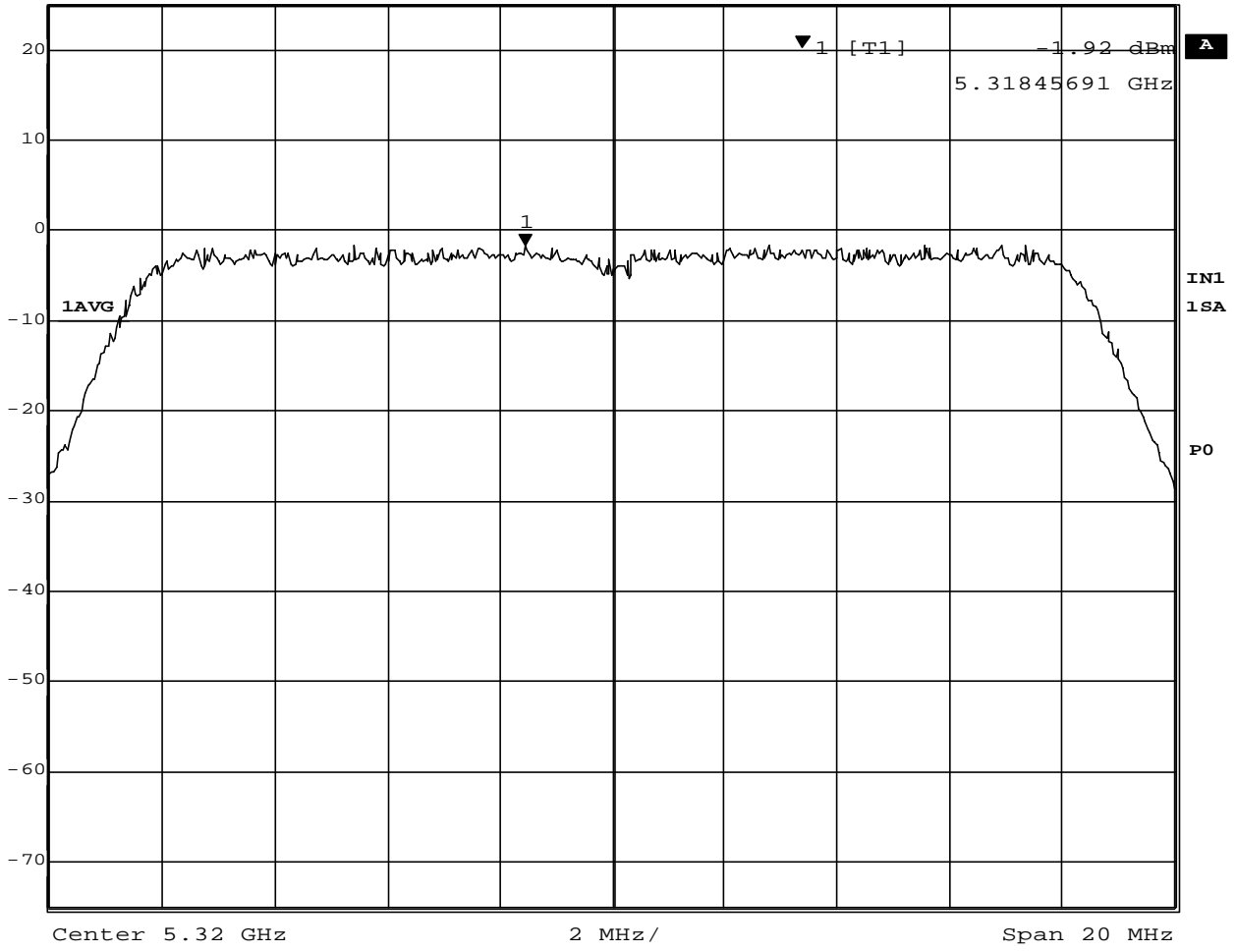


Date: 29.OCT.2002 16:02:05

Plot 3-2 Peak Power Spectral Density at 5260MHz



Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	40 dB
25 dBm	-1.92 dBm	VBW	3 MHz		
	5.31845691 GHz	SWT	50 ms	Unit	dBm

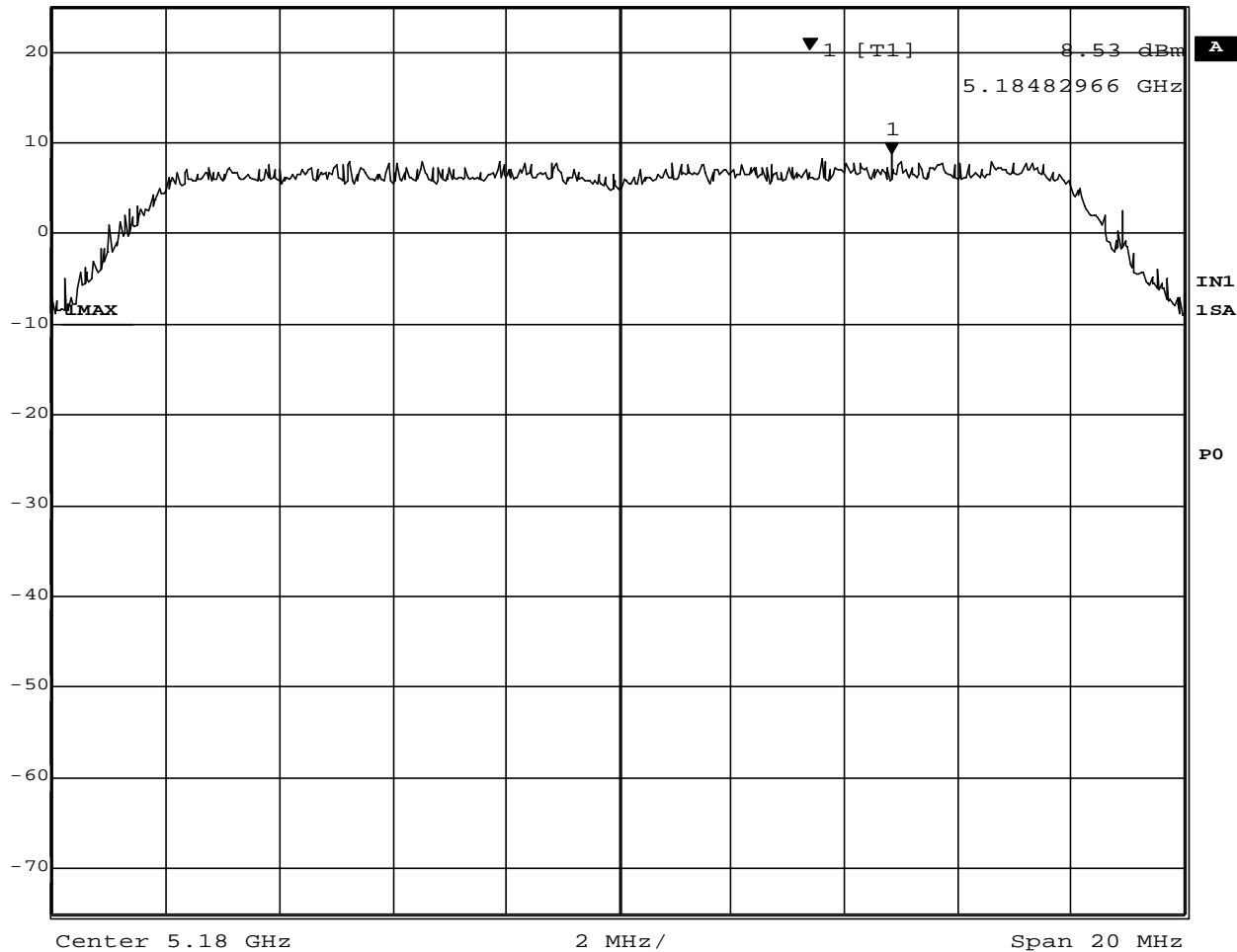


Date: 29.OCT.2002 16:03:36

Plot 3-3 Peak Power Spectral Density at 5320MHz



Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	40 dB
25 dBm	8.53 dBm	VBW	1 MHz		
	5.18482966 GHz	SWT	50 ms	Unit	dBm

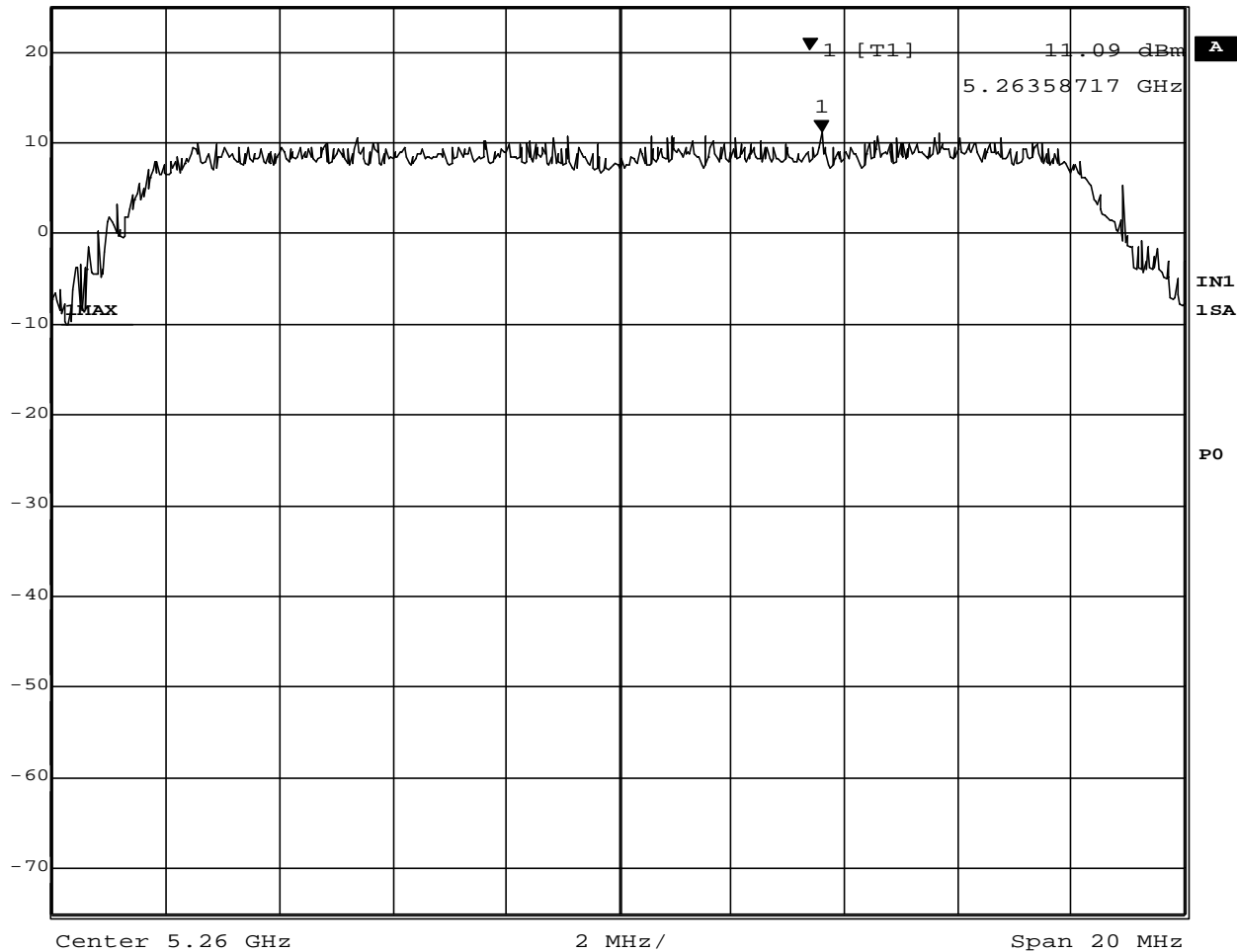


Date: 29.OCT.2002 15:59:57

Plot 3-4 Peak Power Spectral Density at 5180MHz (IC RSS-210)



Marker 1 [T1]	RBW	1 MHz	RF Att	40 dB
Ref Lvl	11.09 dBm	VBW	1 MHz	
25 dBm	5.26358717 GHz	SWT	50 ms	Unit dBm

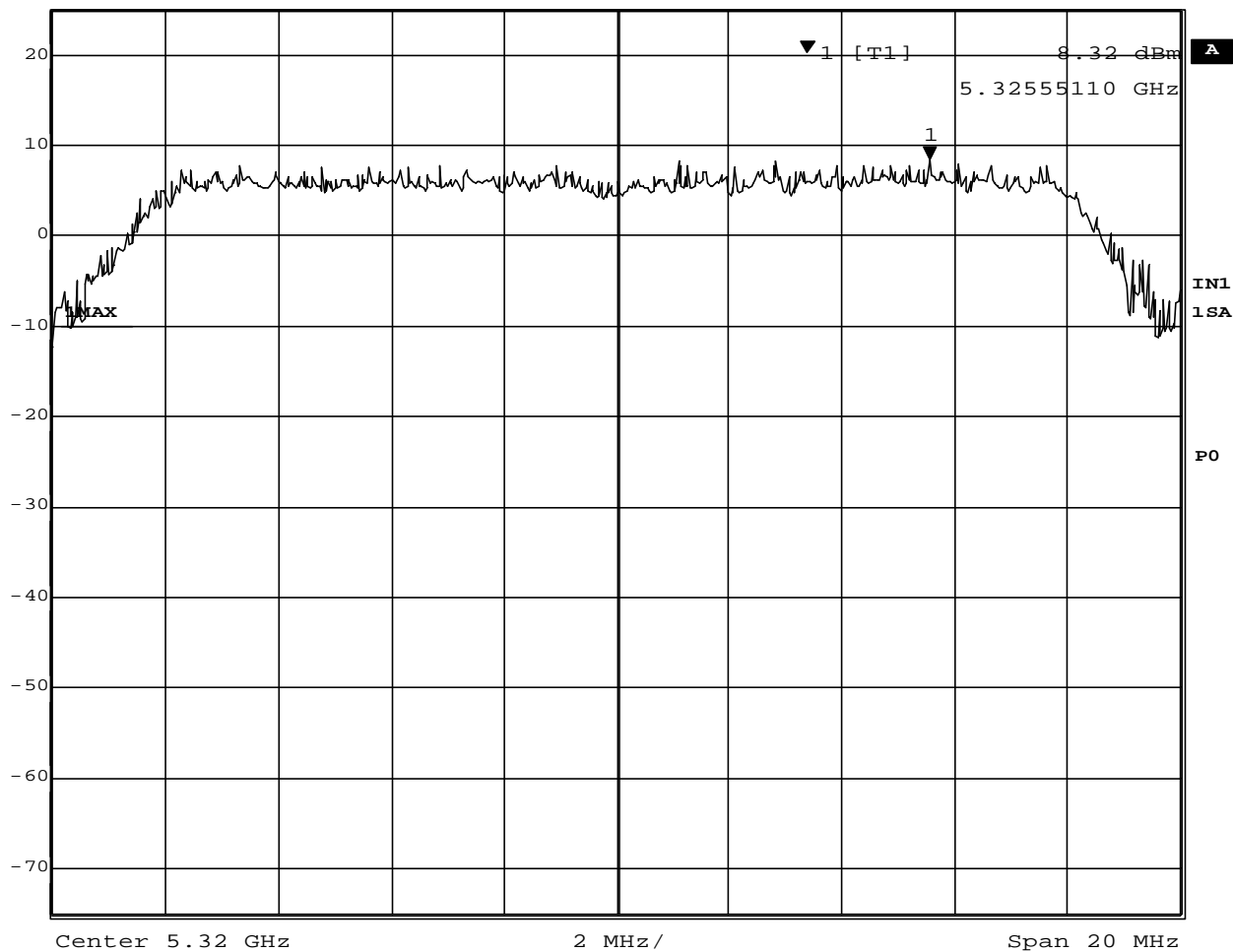


Date: 29.OCT.2002 16:01:05

Plot 3-5 Peak Power Spectral Density at 5260MHz (IC RSS-210)



Marker 1 [T1]	RBW	1 MHz	RF Att	40 dB
Ref Lvl	8.32 dBm	VBW	1 MHz	
25 dBm	5.32555110 GHz	SWT	50 ms	Unit dBm



Date: 29.OCT.2002 16:04:29

Plot 3-6 Peak Power Spectral Density at 5320MHz (IC RSS-210)

## 4. Peak Excursion Ratio

[ FCC 15.407(a)(6) ]

### 4.1 Test Procedure

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

- 1<sup>st</sup> trace :  
 The spectrum analyzer was set to :  
 RBW= 1MHz, VBW=3MHz, Mode= peak detector and max hold then to view.
- 2<sup>nd</sup> trace :  
 The measurement result of the peak conducted power in Chapter 2.1.2 tend to present the similar values to the results of power meter, therefore the same setting of spectrum analyzer as the one for the Chapter 2.1.2 was used for the 2<sup>nd</sup> trace.  
 i.e. VBW= 30kHz, RBW=1MHz, Span=30-40MHz, Trigger= free run, Mode= sample detector

The largest difference of amplitude delta between the two trances is the peak excursion.

The test instruments and setup configuration are the same as the Table 2-2 and Figure 2-2.

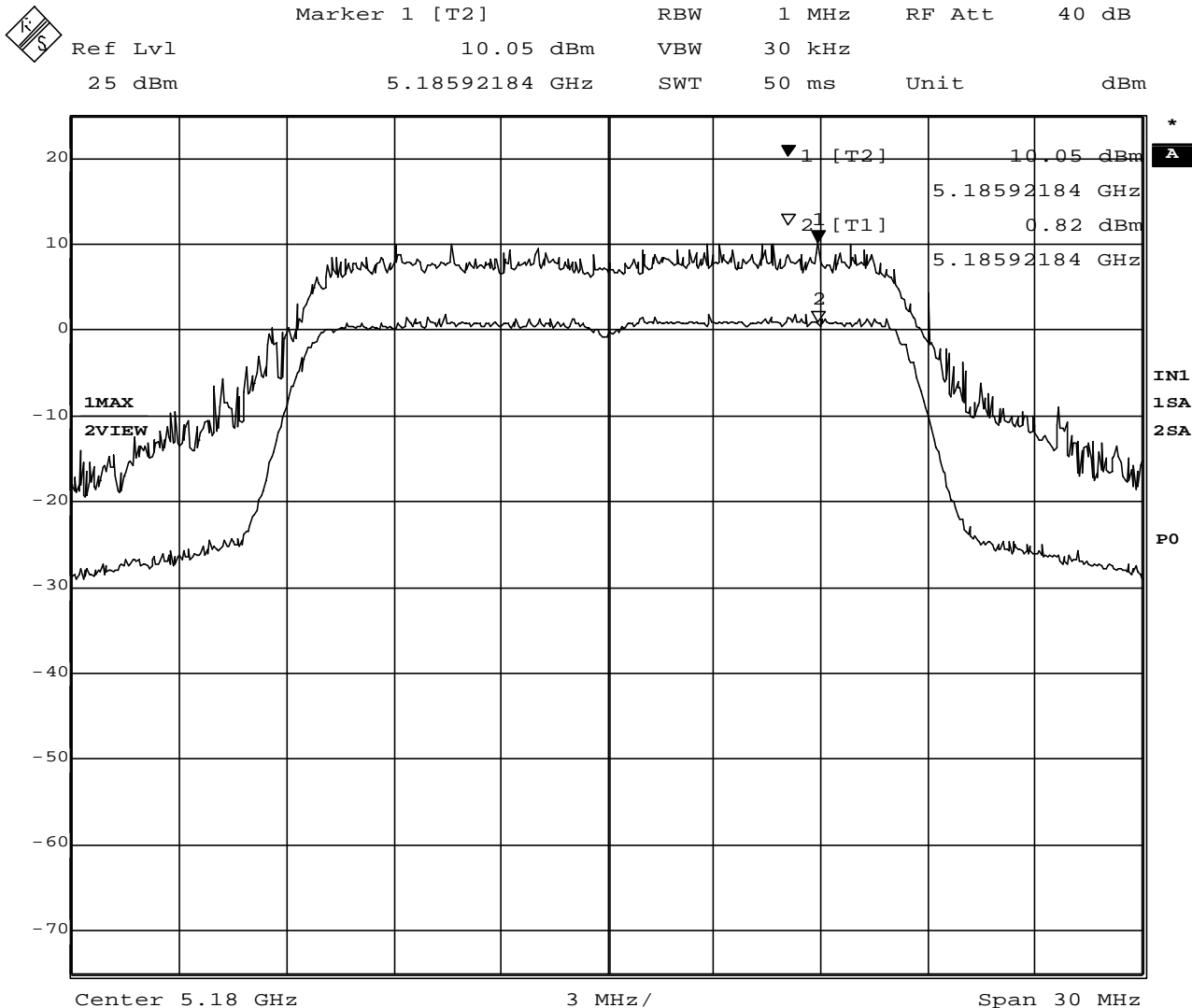
### 4.2 Measurement Results

Test Date: November 13, 2002

Table 4-2. Measurement results of Peak Excursion Ratio (EUT: M/T 2682-NLU, s/n FX-00336)

Measured Frequency (MHz)	Analyzer reading (dB)	FCC Limit (dB)	Margin (dB)	Trace number
5180	9.17	<b>13</b>	3.83	Plot 4-1
5260	8.63		4.37	Plot 4-2
5320	8.71		4.29	Plot 4-3

### 4.3 Trace Data



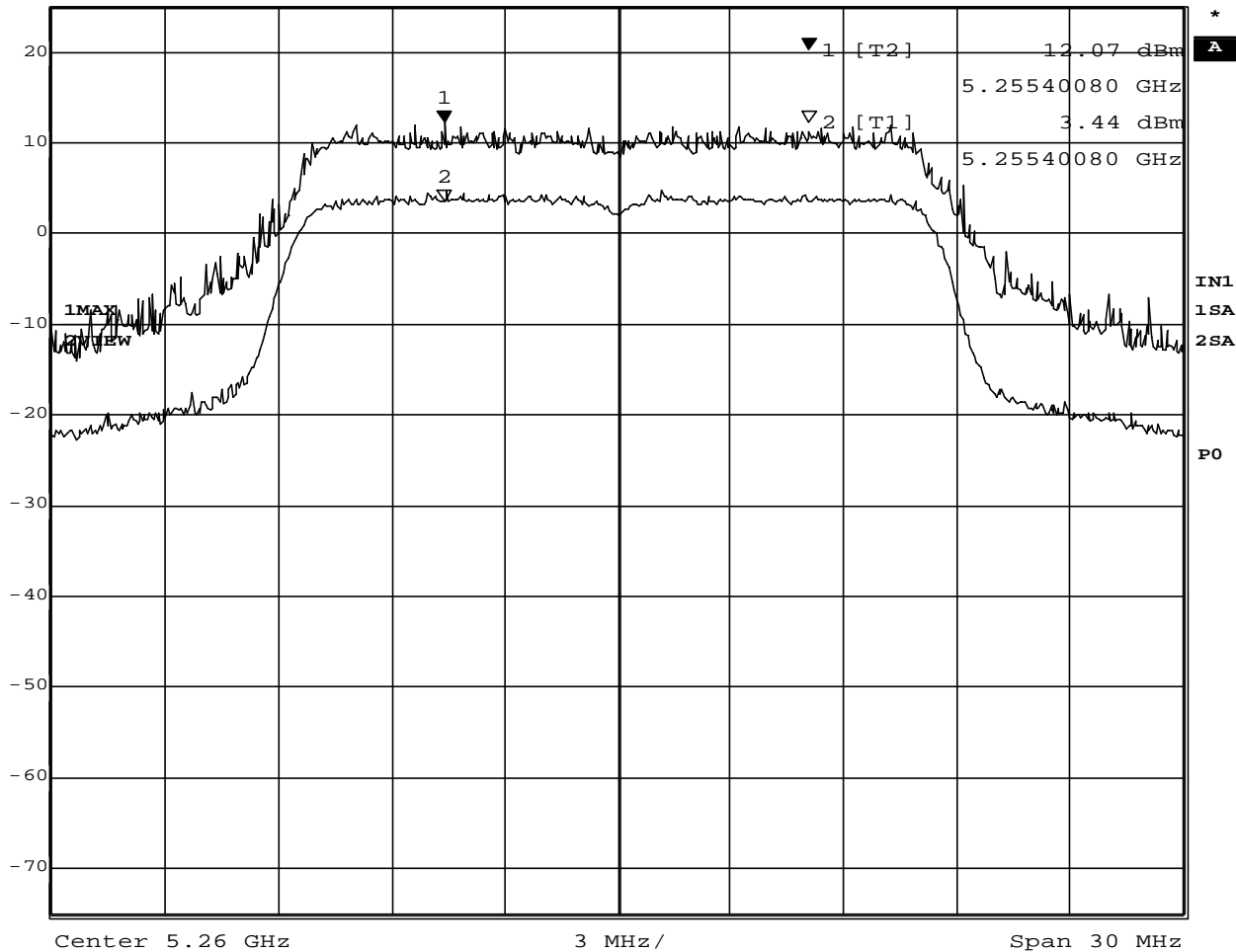
Date: 13.NOV.2002 08:54:36

Plot 4-1 Peak Excursion Ratio at 5180MHz





Ref Lvl	25 dBm	Marker 1 [T2]	12.07 dBm	RBW	1 MHz	RF Att	40 dB
			5.25540080 GHz	VBW	30 kHz		
				SWT	50 ms	Unit	dBm

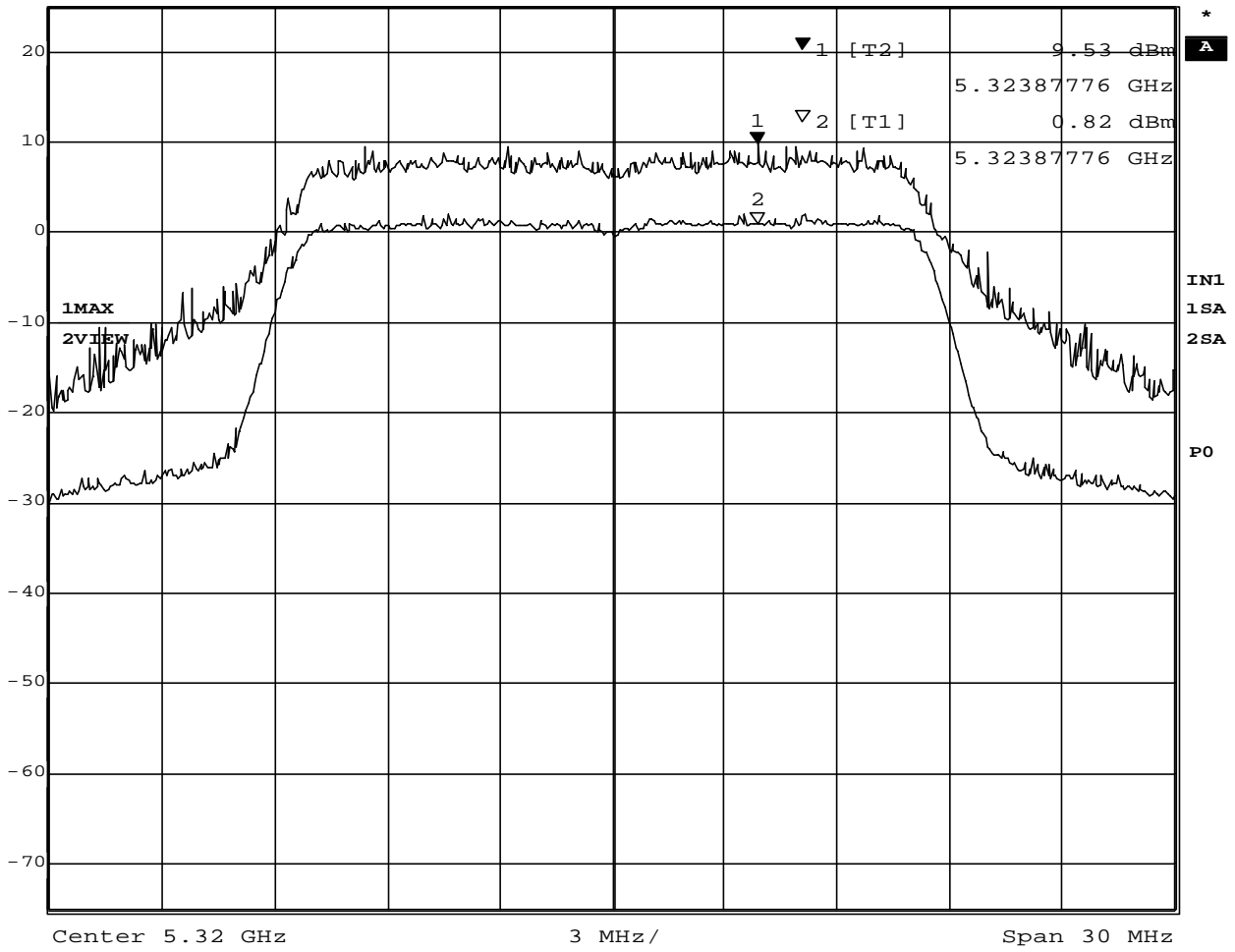


Date: 13.NOV.2002 09:01:07

Plot 4-2 Peak Excursion Ratio at 5260MHz



Ref Lvl	Marker 1 [T2]	RBW	1 MHz	RF Att	40 dB
25 dBm	9.53 dBm	VBW	30 kHz		
	5.32387776 GHz	SWT	50 ms	Unit	dBm



Date: 13.NOV.2002 08:57:50

Plot 4-3 Peak Excursion Ratio at 5320MHz

## 5. AC WIRELINE CONDUCTED EMISSIONS (450KHz – 30MHz) [ FCC 15.207/ 15.407(b)(5), RSS-210 6.2.2(q1)(v) / 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: - Lism-L <=> SW/Con.unit (SW100) - Lism-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

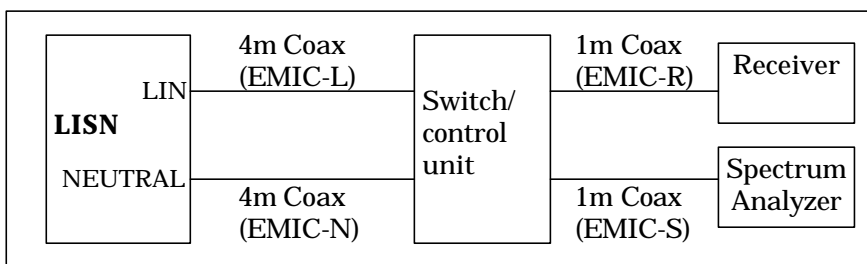


Figure 5. Cables for Conducted Emission Test

## 5.3 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart E and RSS-210 with a margin of 17.3dB. The 6 highest emissions relative to the limits are reported.

Test Date: November 13, 2002

Table 5-2-1. EUT: M/T 2682-NLU, s/n FX-00336, Ch.36(5180MHz) **TX** mode 24Mbps

Frequency (MHz)	QP Voltage (dB $\mu$ V)	QP Limit (dB $\mu$ V)	QP Voltage ( $\mu$ V)	QP Limit ( $\mu$ V)	Phase
0.4813	28.6	48	26.9	250	NEUTRAL
0.5569	28.8	48	27.5	250	NEUTRAL
0.6911	28.3	48	26.0	250	NEUTRAL
0.8302	27.5	48	23.7	250	NEUTRAL
0.9704	26.7	48	21.6	250	NEUTRAL
4.0826	29.3	48	29.2	250	NEUTRAL

Table 5-2-2. EUT: M/T 2682-NLU, s/n FX-00336 , Ch.52(5260MHz) **TX** mode 24Mbps

Frequency (MHz)	QP Voltage (dB $\mu$ V)	QP Limit (dB $\mu$ V)	QP Voltage ( $\mu$ V)	QP Limit ( $\mu$ V)	Phase
0.5546	30.0	48	31.6	250	NEUTRAL
0.6230	25.4	48	18.6	250	NEUTRAL
0.6907	28.7	48	27.2	250	NEUTRAL
0.6937	28.2	48	25.7	250	NEUTRAL
0.8295	27.5	48	23.7	250	NEUTRAL
3.9444	30.7	48	34.3	250	LINE

Table 5-2-3. EUT: M/T 2682-NLU, s/n FX-00336, Ch.64(5320MHz) **TX** mode 24Mbps

Frequency (MHz)	QP Voltage (dB $\mu$ V)	QP Limit (dB $\mu$ V)	QP Voltage ( $\mu$ V)	QP Limit ( $\mu$ V)	Phase
0.4831	29.8	48	30.9	250	NEUTRAL
0.5562	29.4	48	29.5	250	NEUTRAL
0.6944	27.7	48	24.3	250	NEUTRAL
0.8314	27.2	48	22.9	250	NEUTRAL
0.9692	26.9	48	22.1	250	NEUTRAL
3.9443	30.5	48	33.5	250	LINE

Table 5-2-4. EUT: M/T 2682-NLU, s/n FX-00336, Ch. 52(5260MHz) **RX** mode

Frequency (MHz)	QP Voltage (dB $\mu$ V)	QP Limit (dB $\mu$ V)	QP Voltage ( $\mu$ V)	QP Limit ( $\mu$ V)	Phase
0.4828	29.7	48	30.5	250	NEUTRAL
0.5561	28.9	48	27.9	250	NEUTRAL
0.6944	27.5	48	23.7	250	NEUTRAL
0.8313	27.1	48	22.6	250	NEUTRAL
0.9696	26.5	48	21.1	250	NEUTRAL
4.0851	29.9	48	31.3	250	LINE

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

[ FCC 15.205&209 / 15.407(b)(1),(2),(5),(6) ]  
 [ RSS-210 6.2.1 / 6.2.2(q1)(i),(ii),(v) / 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	HP 8447D	2805A02919
- for 200-1000MHz	HP 8447D	2944A03506
Biconical Antenna (30-200MHz)	EMCO 3108	2309
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	1585
Receiver (20MHz-1.3GHz)	R&S ESVP	893202/018
Switch/control unit	HP 3488A	2719A17226
N-Coax cables:	Length:	
- Bi-coni Ant <=> 10m Cable	9 m	- EM103L01
- 10m Cable <=> Shield Panel	10 m	- EM103L02
- Shield Panel <=> RF Amp	7 m	- EM103L03
- RF Amp <=> Power Splitter	0.5m	- EM103L04
- Log-peri Ant <=> 10m Cable	9 m	- EM103H01
- 10m Cable <=> Shield Panel	10 m	- EM103H02
- Shield Panel <=> RF Amp	7 m	- EM103H03
- RF Amp <=> Power Splitter	0.5m	- EM103H04
Coax cables:		
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM103L05
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM103L06
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM103H05
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM103H06
- SW/Con.unit <=> Receiver (Input)	2 m	- EM1RCV
- SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	2 m	- EM1SPL

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

Notes:

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

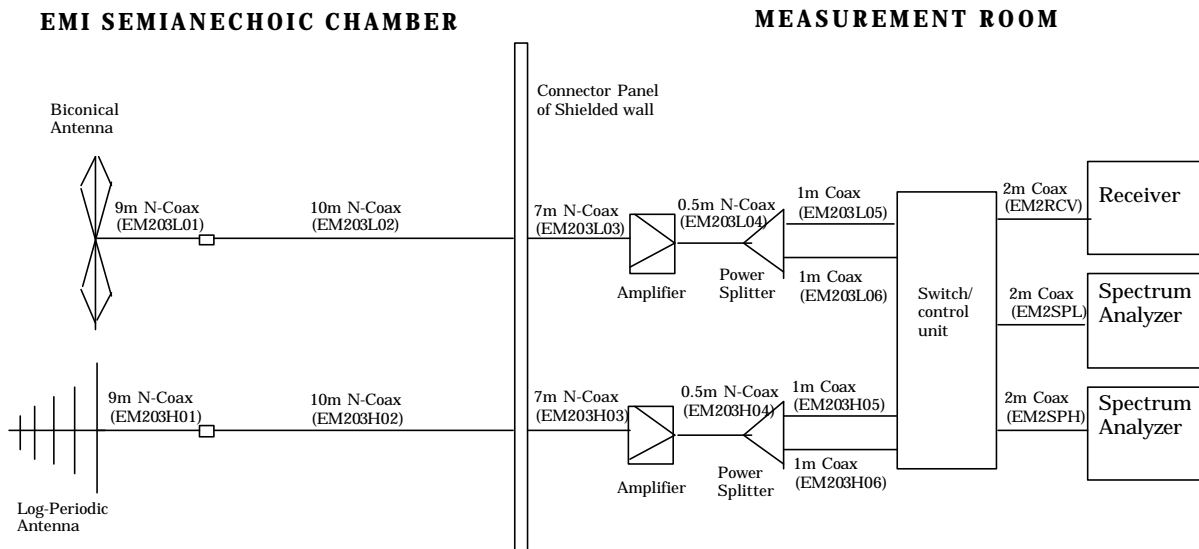


Figure 6 Cables for Radiated Emission Test

## 6.3 Field Strength Calculation

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

$$FS = R + AF + CORR$$

where:

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

For example :

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

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

Conversion between dB $\mu$ V/m (or dB $\mu$ V) and  $\mu$ V/m (or  $\mu$ V) are done as:

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

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

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

## 6.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart E 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 18, 2002

Table 6-2-1. EUT: M/T 2682-NLU, s/n FX-00336, Ch.36(5180MHz) **TX** mode 24Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dB $\mu$ V)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Field Strength ( $\mu$ V/m)	Limit ( $\mu$ V/m)
157.505	H	38.1	12.4	-16.4	34.1	43.5	50.7	150
186.143	H	37.6	13.1	-16.0	34.7	43.5	54.3	150
200.460	H	34.4	11.3	-12.6	33.1	43.5	45.2	150
363.854	V	34.1	14.4	-13.7	34.8	46.0	55.0	200
528.104	V	30.9	17.7	-13.2	35.4	46.0	58.9	200
932.095	V	25.6	22.6	-9.0	39.2	46.0	91.2	200

Table 6-2-2. EUT: M/T 2682-NLU, s/n FX-00336, Ch.52(5260MHz) **TX** mode 24Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dB $\mu$ V)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Field Strength ( $\mu$ V/m)	Limit ( $\mu$ V/m)
157.505	H	37.7	12.4	-16.4	33.7	43.5	48.4	150
257.735	H	38.0	12	-14.6	35.4	46.0	58.9	200
332.716	V	35.6	14.1	-13.9	35.8	46.0	61.7	200
361.393	V	35.4	14.3	-13.5	36.2	46.0	64.6	200
528.104	V	32.0	17.7	-13.2	36.5	46.0	66.8	200
932.115	V	25.5	22.6	-9.0	39.1	46.0	90.2	200

Table 6-2-3. EUT: M/T 2682-NLU, s/n FX-00336, Ch.64(5320MHz) **TX** mode 24Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dB $\mu$ V)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Field Strength ( $\mu$ V/m)	Limit ( $\mu$ V/m)
157.505	H	38.0	12.4	-16.4	34.0	43.5	50.1	150
298.927	H	33.7	14	-14.2	33.5	46.0	47.3	200
528.104	V	30.3	17.7	-13.2	34.8	46.0	55.0	200
729.740	V	24.2	20.6	-11.1	33.7	46.0	48.4	200
902.073	V	23.4	22.5	-9.1	36.8	46.0	69.2	200
932.112	V	25.6	22.6	-9.0	39.2	46.0	91.2	200

Table 6-2-4. EUT: M/T 2682-NLU, s/n FX-00336, Ch.52(5260MHz) **RX** mode

Frequency (MHz)	Polarity (H/V)	Measured (dB $\mu$ V)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Field Strength ( $\mu$ V/m)	Limit ( $\mu$ V/m)
157.505	H	37.9	12.4	-16.4	33.9	43.5	49.5	150
331.995	V	33.6	14.1	-13.9	33.8	46.0	49.0	200
365.345	V	34.1	14.4	-13.6	34.9	46.0	55.6	200
432.085	V	32.1	15.8	-13.6	34.3	46.0	51.9	200
528.104	V	32.2	17.7	-13.2	36.7	46.0	68.4	200
932.069	V	26.1	22.6	-9.0	39.7	46.0	96.6	200



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

[ FCC 15.205&209 / 15.407(b)(1),(2),(5),(6) ]  
 [ RSS-210 6.2.1 / 6.2.2(q1)(i),(ii),(v) / 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	Length: 6 m 15 m	- EM206SCO - EM215SCO
SF102 cables (18 – 40GHz): - Horn Ant <=> RF Amp. - RF Amp.<=>Spectrum Analyzer	6m 1m	- SF102-20165 - SF102-21105

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

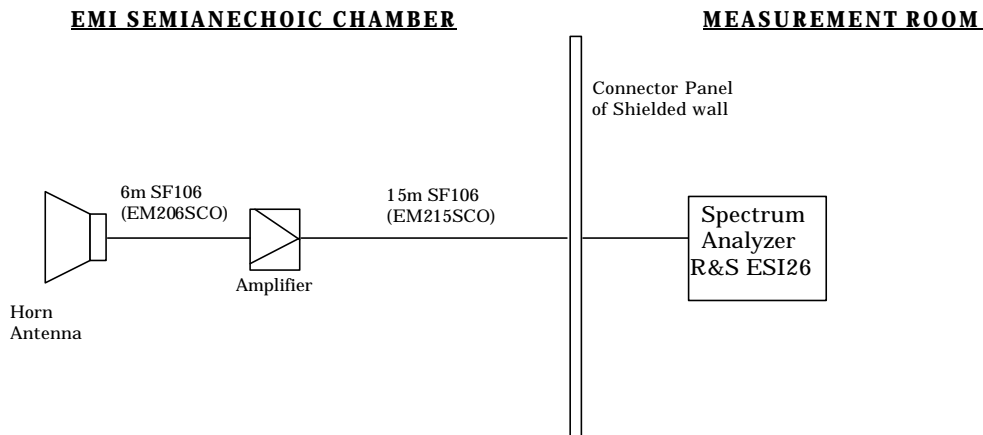


Figure 7-1. Cables for Radiated Emission Test (1 – 18 GHz)

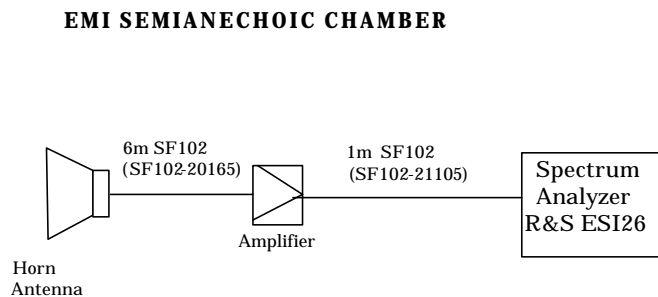


Figure 7-2. Cables for Radiated Emission Test (18 - 26.5GHz)

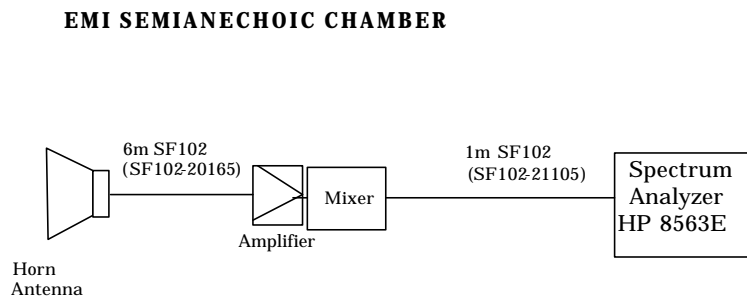


Figure 7-3. Cables for Radiated Emission Test (26.5 - 40GHz)

## 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 dB $\mu$ V; Antenna Factor of 8.5 dB/m; Cable Loss of 1.3 dB; Falloff Factor of 0 dB; and an Amplifier Gain of 26 dB. The Field Strength of the measured emission is:

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

Conversions between dB $\mu$ V/m (or dB $\mu$ V) and  $\mu$ V/m (or  $\mu$ V) are done as :

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

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

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

## 7.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart E and RSS-210 with a margin of 0.9 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.

Table 7-1. Limits for emissions

Limit for emissions in restricted bands	54 dB $\mu$ V/m (average)	74 dB $\mu$ V/m (peak)
Limit for emissions in non_restricted bands	68.2 dB $\mu$ V/m (EIRP< -27 dBm/MHz)	

Test Date: October 15, 17, 18 and 21, 2002

Table 7-2-1. EUT: M/T 2682-NLU, s/n FX-00336, Ch.36(5180MHz) **TX** mode 24Mbps

Frequency (GHz)	Polarity (H/V)	Measured (dB $\mu$ V) (peak)	Measured (dB $\mu$ V) (average)	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dB $\mu$ V/m) (peak)	FCC Limit (dB $\mu$ V/m) (peak)	Field Strength (dB $\mu$ V/m) (average)	FCC Limit (dB $\mu$ V/m) (average)
OB										
5.185	H	101.8	89.5	33.7	-27.3	0.0	108.2	N/A	95.9	N/A
bandedge										
5.150	H	62.9	43.7	33.6	-26.5	0.0	70.0	74.0	50.8	54.0
1.008	V	48.5	-	24.1	-32.9	0.0	39.7	74.0	-	54.0
1.066	V	49.6	-	24.6	-32.7	0.0	41.5	74.0	-	54.0
1.098	V	49.6	-	24.4	-32.6	0.0	41.4	74.0	-	54.0
1.441	V	50.2	-	25.1	-31.6	0.0	43.7	74.0	-	54.0
6.048	V	39.3	-	29.8	-26.5	0.0	42.6	68.2	-	NRB
6.080	H	38.7	-	29.8	-26.9	0.0	41.6	68.2	-	NRB
6.112	V	38.1	-	29.8	-26.2	0.0	41.7	68.2	-	NRB
6.216	V	54.0	-	29.9	-26.2	0.0	57.7	68.2	-	NRB
10.361	V	40.4	-	33.5	-23.0	0.0	50.9	68.2	-	NRB

Note: OB means “operation band” (5150-5250MHz). NRB means “non restricted band”: The limit of FCC Part 15.407(b)(1),(2) and RSS-210 6.2.2(q1)(I),(ii) apply.

Table 7-2-2. EUT: M/T 2682-NLU, s/n FX-00336, Ch.52(5260MHz) **TX** mode 24Mbps

Frequency (GHz)	Polarity (H/V)	Measured (dB $\mu$ V) (peak)	Measured (dB $\mu$ V) (average)	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dB $\mu$ V/m) (peak)	FCC Limit (dB $\mu$ V/m) (peak)	Field Strength (dB $\mu$ V/m) (average)	FCC Limit (dB $\mu$ V/m) (average)
OB										
5.257	H	106.1	95.2	33.6	-27.2	0.0	112.5	N/A	101.6	N/A
bandedge										
5.350	H	51.0	39.1	33.9	-27.2	0.0	57.7	74.0	45.8	54.0
1.008	V	47.0	-	24.1	-32.6	0.0	38.5	74.0	-	54.0
1.066	V	49.3	-	24.6	-32.3	0.0	41.6	74.0	-	54.0
1.441	V	48.2	-	25.1	-32.2	0.0	41.1	74.0	-	54.0
1.922	V	48.2	-	27.5	-30.6	0.0	45.1	68.2	-	NRB
6.048	H	38.9	-	29.8	-26.5	0.0	42.2	68.2	-	NRB
6.080	V	37.7	-	29.8	-26.9	0.0	40.6	68.2	-	NRB
6.112	H	37.8	-	29.8	-26.2	0.0	41.4	68.2	-	NRB
6.313	H	46.3	-	30.0	-26.4	0.0	49.9	68.2	-	NRB
10.521	V	52.6	-	33.5	-22.4	0.0	63.7	68.2	-	NRB

Note: OB means “operation band” (5250-5350MHz). NRB means “non restricted band”: The limit of FCC Part 15.407(b)(1),(2) and RSS-210 6.2.2(q1)(I),(ii) apply.

Table 7-2-3. EUT: M/T 2682-NLU, s/n FX-00336, Ch.64(5320MHz) **TX** mode 24Mbps

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ( <i>peak</i> )	Measured (dBμV) ( <i>average</i> )	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ( <i>peak</i> )	FCC Limit (dBμV/m) ( <i>peak</i> )	Field Strength (dBμV/m) ( <i>average</i> )	FCC Limit (dBμV/m) ( <i>average</i> )
<b>OB</b>										
5.324 bandedge	H	103.8	91.3	33.7	-27.3	0.0	110.2	N/A	97.7	N/A
5.350	H	66.0	46.4	33.9	-27.2	0.0	72.7	74.0	53.1	54.0
1.008	V	49.4	-	24.1	-32.9	0.0	40.6	74.0	-	54.0
1.066	V	49.6	-	24.6	-32.7	0.0	41.5	74.0	-	54.0
1.441	V	47.9	-	25.1	-31.6	0.0	41.4	74.0	-	54.0
1.922	V	47.3	-	27.5	-30.9	0.0	43.9	68.2	-	NRB
6.048	V	39.6	-	29.8	-26.5	0.0	42.9	68.2	-	NRB
6.080	H	37.8	-	29.8	-26.9	0.0	40.7	68.2	-	NRB
6.112	H	37.5	-	29.8	-26.2	0.0	41.1	68.2	-	NRB
6.385	V	43.8	-	29.9	-26.6	0.0	47.1	68.2	-	NRB
10.641	V	46.6	32.8	33.5	-22.3	0.0	57.8	74.0	44.0	54.0

\*Note: OB means “operation band” (5250-5350MHz). NRB means “non restricted band”: The limit of FCC Part 15.407(b)(1),(2) and RSS-210 6.2.2(q1)(I),(ii) apply.

Table 7-2-4 EUT: M/T 2682-NLU, s/n FX-00336, Ch.52(5260MHz) **RX** mode

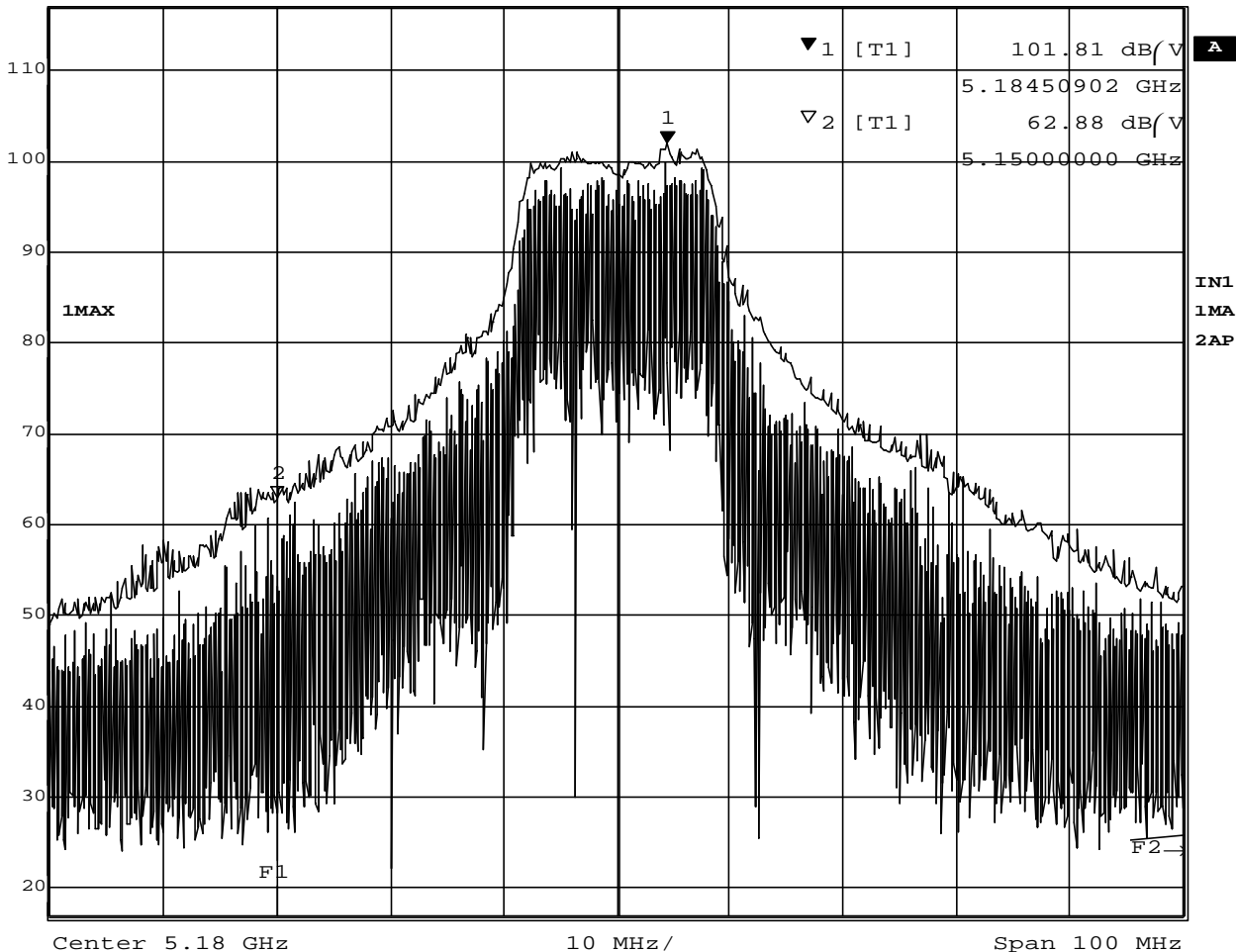
Frequency (GHz)	Polarity (H/V)	Measured (dBμV) ( <i>peak</i> )	Measured (dBμV) ( <i>average</i> )	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ( <i>peak</i> )	FCC Limit (dBμV/m) ( <i>peak</i> )	Field Strength (dBμV/m) ( <i>average</i> )	FCC Limit (dBμV/m) ( <i>average</i> )
1.008	V	48.4	-	24.1	-32.9	0.0	39.6	74.0	-	54.0
1.066	V	49.0	-	24.6	-32.7	0.0	40.9	74.0	-	54.0
1.441	V	48.3	-	25.1	-31.6	0.0	41.8	74.0	-	54.0
1.922	V	47.4	-	27.5	-30.9	0.0	44.0	68.2	-	NRB

Note: NRB means “non restricted band”: The limit of FCC Part 15.407(b)(1),(2) and RSS-210 6.2.2(q1)(I),(ii) apply.

## 7.6 Trace Data



Marker 1 [T1]	RBW	1 MHz	RF Att	20 dB
Ref Lvl	101.81 dB/V	VBW	1 MHz	
117 dB/V	5.18450902 GHz	SWT	5 ms	Unit dB/V

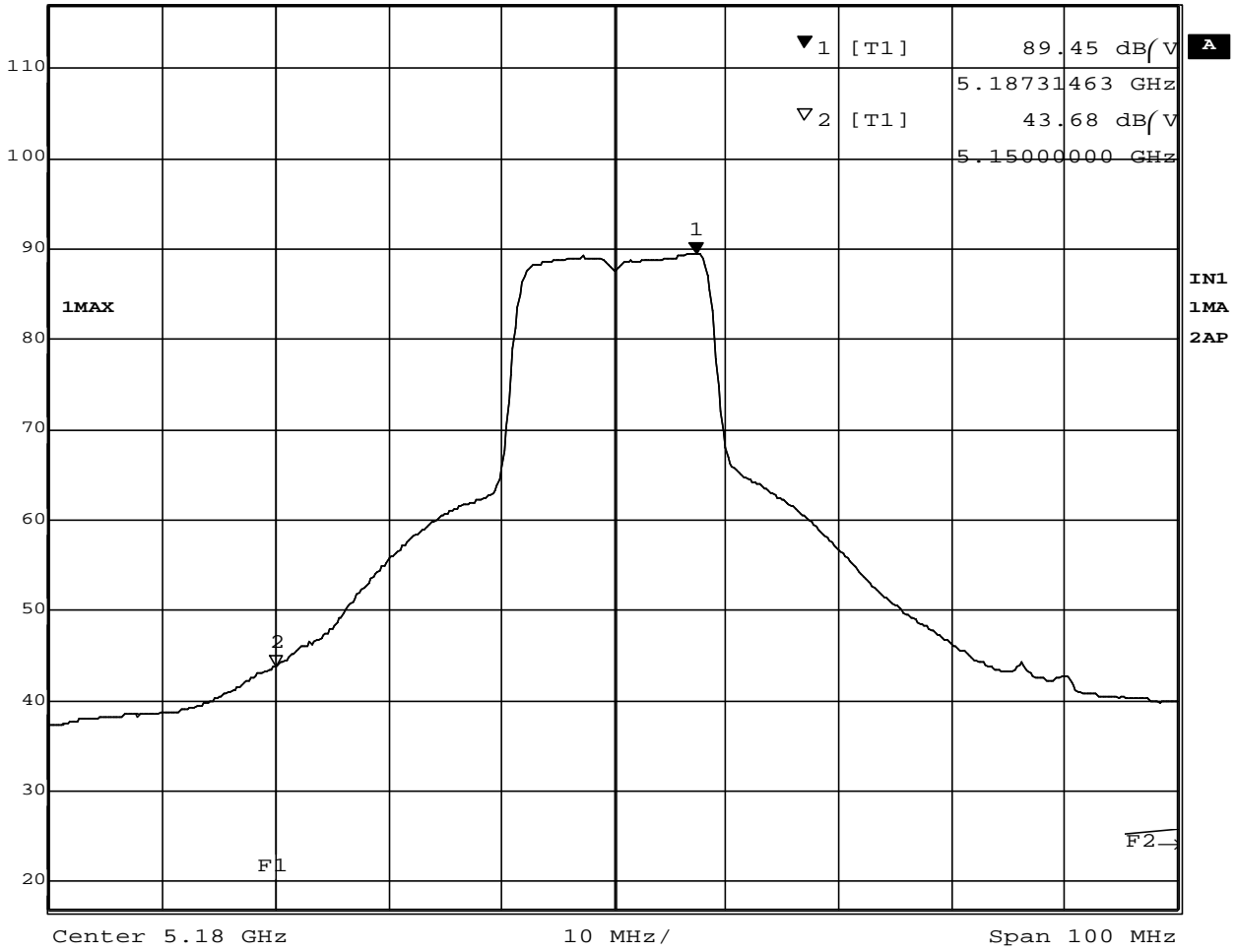


Date: 15.OCT.2002 19:49:27

Plot 7-1-1 5180MHz TX mode (Peak)



Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	20 dB
117 dB/V	89.45 dB/V	VBW	10 Hz		
	5.18731463 GHz	SWT	25 s	Unit	dB/V

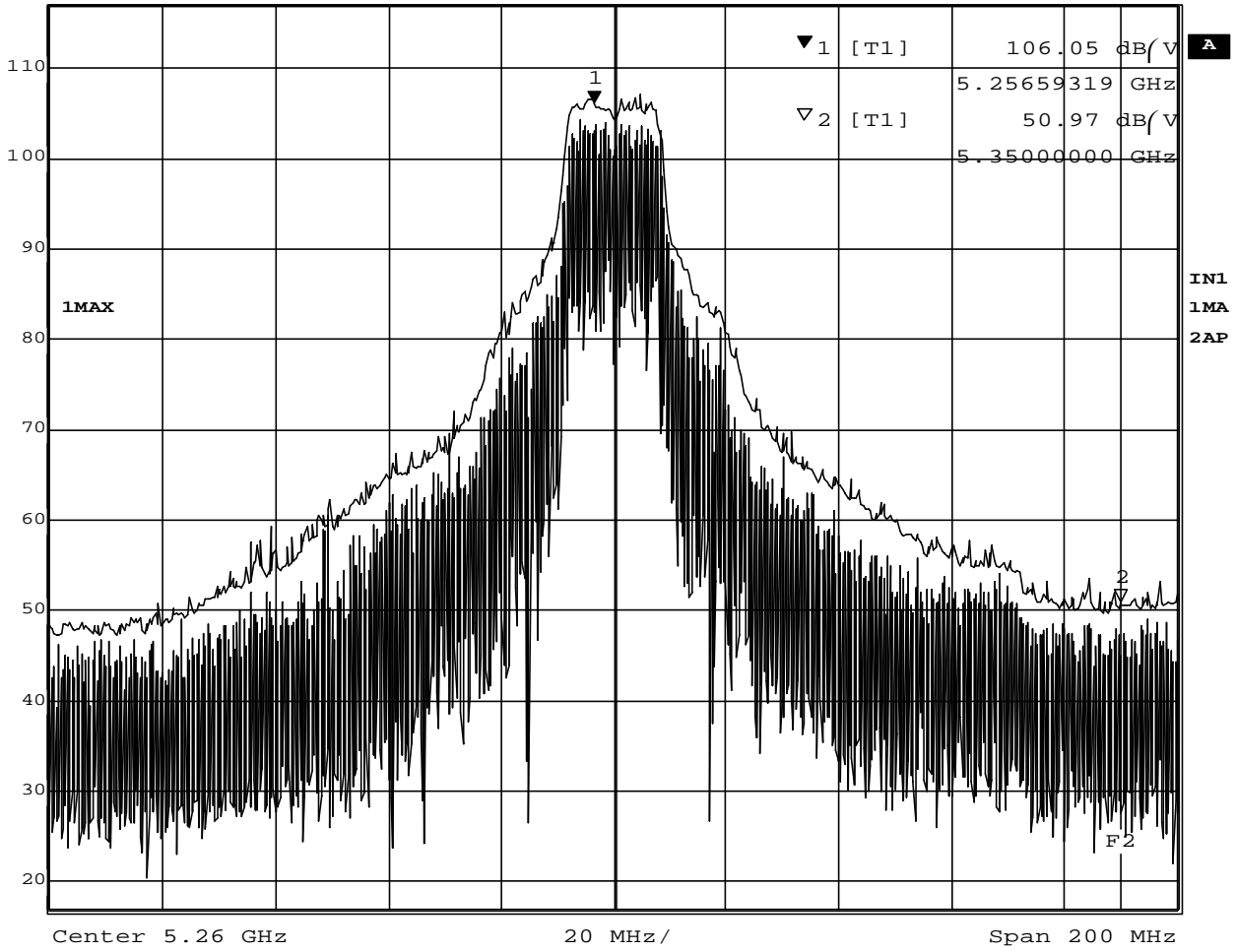


Date: 15.OCT.2002 19:50:14

Plot 7-1-2 5180MHz TX mode (Average)



Ref Lvl	117 dB/V	Marker 1 [T1]	5.25659319 GHz	RBW	1 MHz	RF Att	20 dB
				VBW	1 MHz		
				SWT	5 ms	Unit	dB/V



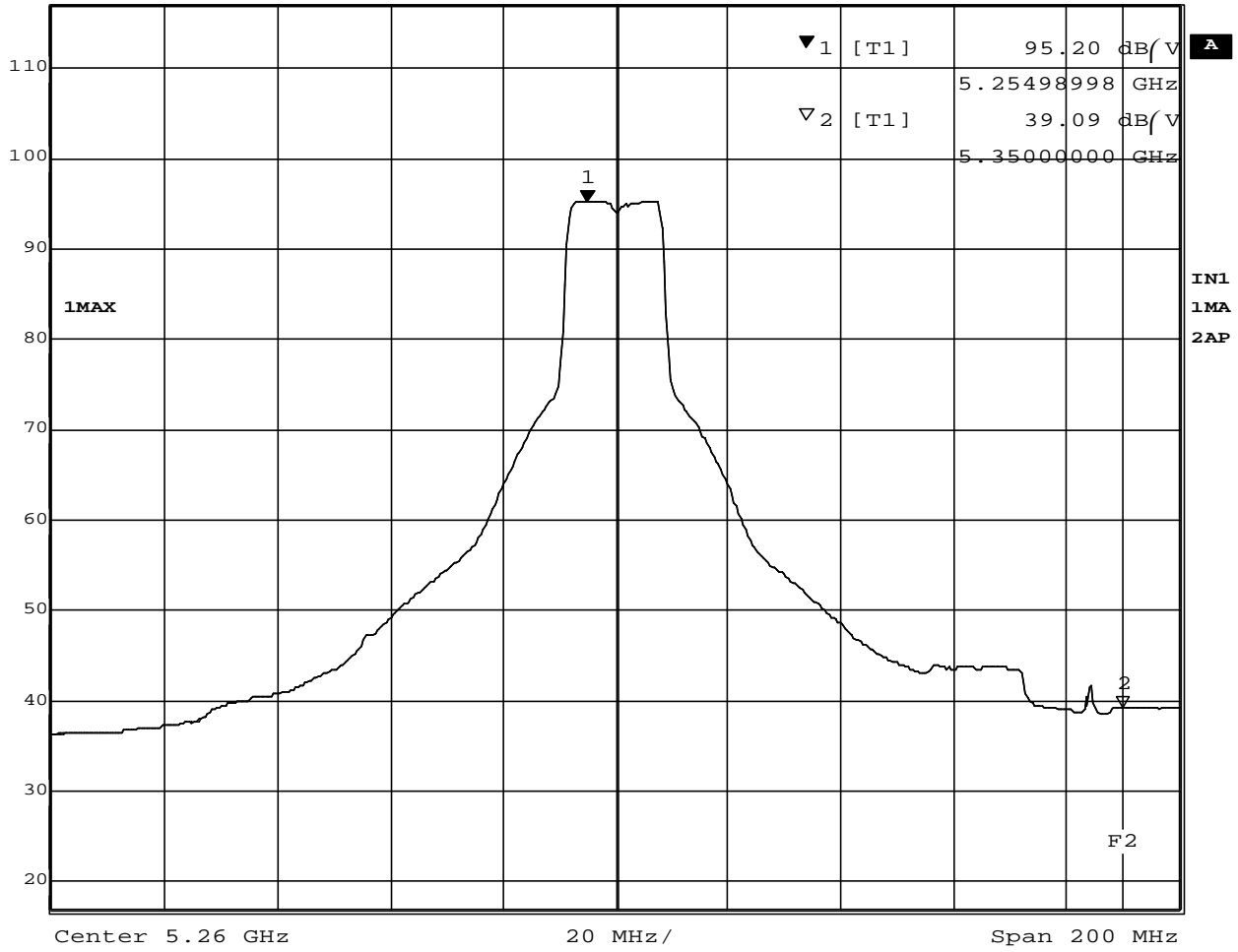
Date: 15.OCT.2002 19:36:57

Plot 7-2-1 5260MHz TX mode (Peak)





Ref Lvl	117 dB/V	Marker 1 [T1]	95.20 dB/V	RBW	1 MHz	RF Att	20 dB
			5.25498998 GHz	VBW	10 Hz		
				SWT	50 s	Unit	dB/V

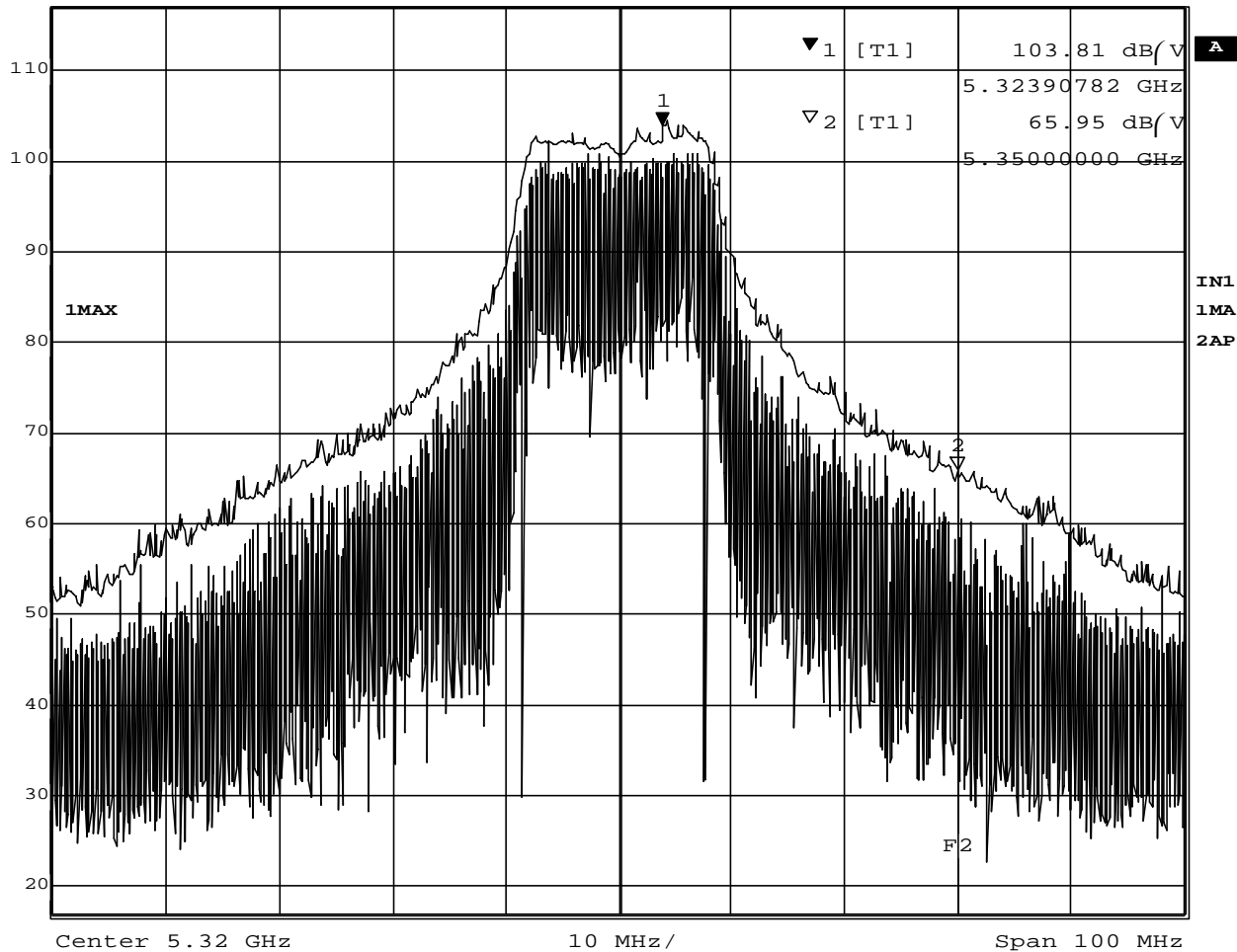


Date: 15.OCT.2002 19:36:16

Plot 7-2-2 5260MHz TX mode (Average)



Ref Lvl	117 dB/V	Marker 1 [T1]	103.81 dB/V	RBW	1 MHz	RF Att	20 dB
			5.32390782 GHz	VBW	1 MHz		
				SWT	5 ms	Unit	dB/V

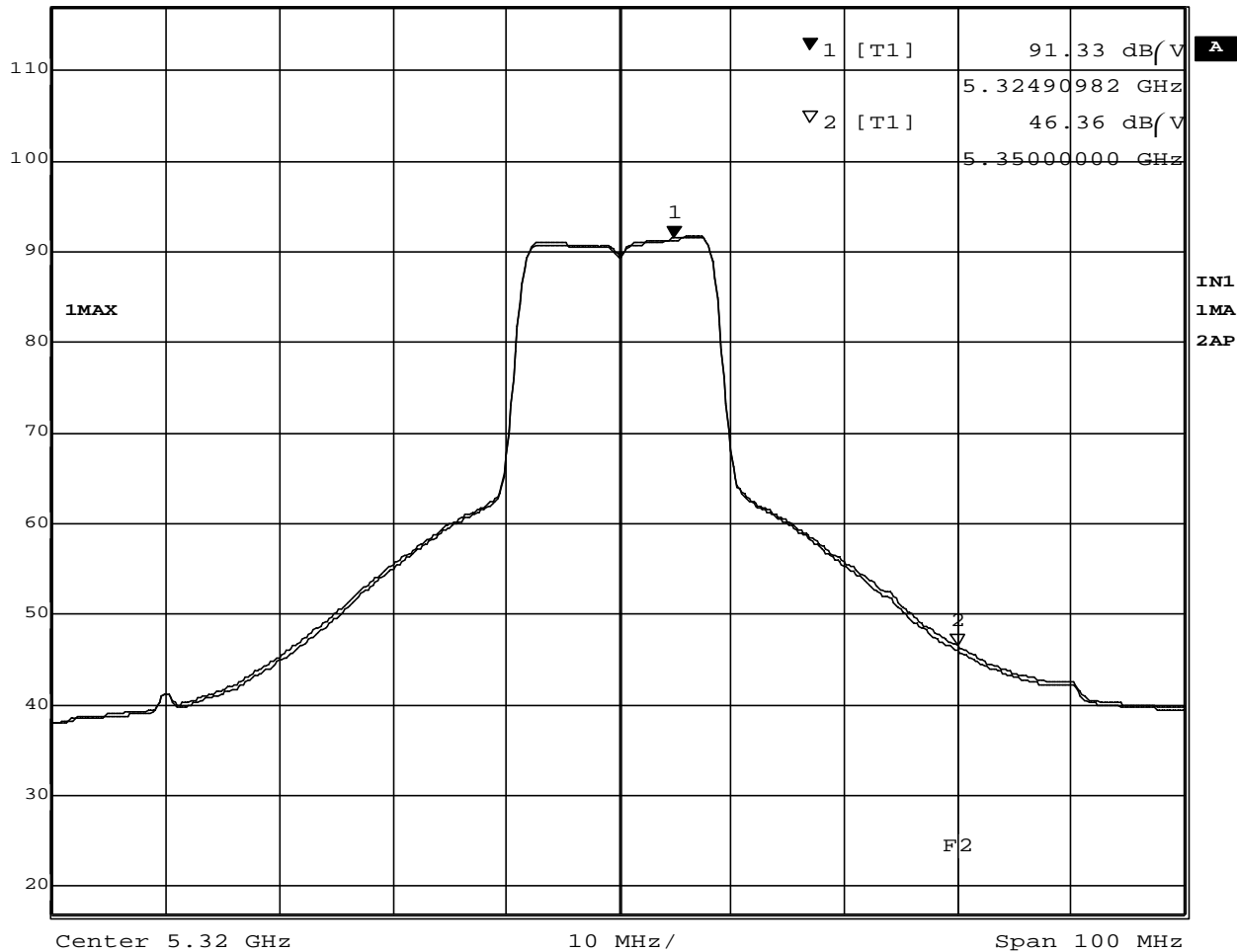


Date: 15.OCT.2002 19:25:21

Plot 7-3-1 5320MHz TX mode (Peak)



Ref Lvl	117 dB/V	Marker 1 [T1]	91.33 dB/V	RBW	1 MHz	RF Att	20 dB
			5.32490982 GHz	VBW	10 Hz		
				SWT	25 s	Unit	dB/V



Date: 15.OCT.2002 19:23:59

Plot 7-3-2 5320MHz TX mode (Average)