Emission Test Report
Standard: FCC Part 15 Subpart E / IC RSS-210
(Class II Permissive Change)

Document Number : FCC 19-0273-0

Model Number: AR5BMB-44

measured with **IBM ThinkPad X30 Series**
and **IBM ThinkPad X40 Series**

FCC ID: ANO20040600BTL
IC: 349E-AR5BMB44

August 11, 2004

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

Model: AR5BMB-44 (802.11a/b/g Wireless LAN Adapter)
with
IBM ThinkPad X30 Series
(Machine Type: 2672, 2673, 2884, 2885, 2890, 2891)
and
IBM ThinkPad X40 Series
(Machine Type: 2369, 2370, 2371, 2372, 2382, 2386)

FCC ID : ANO20040600BTL

August 11, 2004

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).

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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 E Industry Canada RSS-210 (Issue No.5)
MODEL NUMBER (Advertising Name)	: AR5BMB-44 (IBM 11a/b/g Wireless LAN Mini PCI Adapter II)
FCC ID IC Certification Number	: ANO20040600BTL : 349E-AR5BMB44
SERIAL NUMBER	: 00S0SIT004
PYSICAL CONDITION	: Preproduction
KIND OF EQUIPMENT	: Personal computer with a IEEE802.11a, 11b & 11g Wireless LAN Mini-PCI Combo Card (Composite application)
TESTED DATE	: June 28, 29, 30, July 2, 6 and 9, 2004

A.1 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4-2000.

Radiated testing was performed at an antenna to EUT distance of 3 meters.

A.2 Test Facility / NVLAP Accreditation

The semi-anechoic chamber #1 used to correct the data are located in Yamato Laboratory, IBM Japan.

- This facility has been fully described in a report dated September 1998, submitted to the FCC office, and accepted in a letter, dated Nov. 2, 1998(31040/SIT).
- IBM Yamato EMC Engineering is recognized under the National Voluntary Laboratory Accreditation Program for satisfactory compliance with Criteria established in Title 15, Part 285 Code of Federal Regulations.(**NVLAP Lab code: 200198-0**)
- Theses facilities are accepted by **Industry Canada** as number **IC 4221** for chamber #1 (expiry date: January 25, 2005), and as number **IC 4221-1** for chamber #2 (expiry date: February 16, 2007).

A.3 EUT details

Table A EUT details

Model and S/N	**FCC ID** **IC Certification Number**	**Description**
AR5BMB-44 (s/n 00S0SIT004)	FCC ID: ANO20040600BTL IC: 349E-AR5BMB44	**Applying modular transmitter** Built_in type IEEE802.11a/b/g Wireless LAN Mini-PCI card without antenna
ThinkPad X30 Series M/T 2672-UPx (s/n zz-04049)	N/A	Host equipment IBM Notebook PC with built_in antenna CPU: Intel® Pentium® M Processor, 1.7GHz
ThinkPad X40 Series M/T : 2371-SD1 (s/n SIT#15023)		IBM Notebook PC with built-in antenna CPU: Intel® Pentium M Processor, 1.4 GHz
P/N 02K6810	N/A	Universal AC adapter 56W, 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	26dB BW was also taken for IC instead of 99% BW, according to RSS-210 6.2.2q(iv)(b).	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 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
N/A **6.2.2 (q1)(iv)(b)**	Peak Spectral Density	IC: 3 + 10logB dBm/MHz		Pass
15.407(a)(6) **N/A**	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 150kHz- 30MHz	Class B: Freq.(MHz) QP(dBμV) Ave.(dBμV) 0.15 - 0.5 66 - 56 56 - 46 0.5 - 5 56 46 5 - 30 60 50		Pass
15.205 & 209 / 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. Ave. 54dBμV/m, peak 74dBμV/m and FCC 15.407(b)(1)(2) or RSS-210 6.2.2(q1)(i)(ii) : EIRP –27dBm/MHz	Radiated (30MHz - 1GHz) Radiated (1G - 40GHz)	Pass Pass

	Receive mode (RX):			
15.207 / 407(b)(5) **6.2.2(q1)(v) / 7.4**	AC Wireline Conducted Emissions 150kHz - 30MHz	Class B: Freq.(MHz) QP(dBμV) Ave.(dBμV) 0.15 - 0.5 66 - 56 56 - 46 0.5 - 5 56 46 5 - 30 60 50	Conducted	Pass
15.205 & 209 / 407(b)(1)(2)(5)(6)	General Field Strength Limits (Radiated Emission Limits)	Shall not exceed the limits specified in FCC 15.209 or RSS-210 Table3. Ave. 54dBμV/m, peak 74dBμV/m and FCC 15.407(b)(1)(2) or RSS-210 6.2.2(q1)(i)(ii) : EIRP -27dBm/MHz	Radiated (30MHz - 1GHz)	Pass
6.2.1 / 6.2.2(q1)(i)(ii)(v) / 7.3			Radiated (1G - 40GHz)	Pass

	Other general requirements		Result
15.407(a)(1)(2) **–**	Antenna gain	Peak gain of the device : 2.15 dBi in 5.2GHz band	N/A
– **5.2**	Supply Voltage	Main power source: Universal AC adapter 56W Mini-PCI PC bus to applying card : DC 3.3V ± 0.3V	N/A
– **6.2.2(q1)(iv)(a)**	Digital modulation	Applying equipment employs IEEE802.11a, 11g(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	The device employs an unique electronic connector so called **Electronic Handshake.** Refer to “Confidential_e-Handshake” exhibit.	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 the 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. Operation mode of EUT

1. All tests were performed using the "Atheros Radio Test" program. This tool supports to emit the continuous transmission mode for the testing purpose.

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

3. As for the RF receiving test, the middle channels (5260MHz) were selected representatively.

Table-C Transmission mode of EUT (The measurement plots are shown in shading.)
Note) The table shows the specification of **average** power for the applying device in 'dBm'.

Operation Frequency [GHz]	Designed average 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)	15	15	15	15	15	15	14	13
5.220 (Ch. 44)	15	15	15	15	15	15	14	13
5.240 (Ch. 48)	15	15	15	15	15	15	14	13
5.260 (Ch. 52)	17	17	17	17	17	17	14	13
5.280 (Ch. 56)	17	17	17	17	17	17	14	13
5.300 (Ch. 60)	17	17	17	17	17	17	14	13
5.320 (Ch. 64)	14	14	14	14	14	14	14	13

D. Justification

The host PCs (IBM ThinkPad X30 Series and X40 Series) are designed with the same conceptual hardware configuration of compact size laptop PC.

- The shading columns in the previous Table C show the transmission modes performed full testing.

- The antenna ports of each host device marked in shading in the Table-D below were used for EUT which have comparatively higher antenna gains and worse measurement results in each host PC series (X30 or X40). Then, the worst case data were selected for this test report among the two host PC systems.
  The actual highest emissions taken in this report in the Chapter 5 through 7 were found at 6Mbps on the main antenna of ThinkPad X30 Series.
  Refer to the Chapter 7.6 concerning the evaluation of the worst emission case.

Table-D Peak Antenna Gains of EUT

5.2GHz band	ThinkPad X30 Series	Main Antenna gain	1.42 dBi (peak)
		Auxiliary Antenna gain	0.19 dBi (peak)
	ThinkPad X40 Series	Main Antenna gain	1.45 dBi (peak)
		Auxiliary Antenna gain	2.15 dBi (peak)

E. Test Instruments

Table-C List of Measuring Instruments

Description	Model	Serial Number	Calibration Date	Calibration Interval
Computer	IBM 6868-30J	97-901X3	N/A	N/A
Computer	IBM 6589-13J	97-15613	N/A	N/A
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2601A02634	09/09/03	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	3019A05156	08/14/03	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2841A04254	08/25/03	1 year
Spectrum Analyzer Display	HP 85662A	2542A12308	09/09/03	1 year
Spectrum Analyzer Display	HP 85662A	3026A19366	08/14/03	1 year
Spectrum Analyzer Display	HP 85662A	2816A16831	08/25/03	1 year
Quasi-Peak Adapter	HP 85650A	2043A00062	09/09/03	1 year
Quasi-Peak Adapter	HP 85650A	2811A01433	08/14/03	1 year
Quasi-Peak Adapter	HP 85650A	2811A01156	08/25/03	1 year
Amplifier (100KHz - 1.3GHz)				
- for 30-200MHz	HP 8447F	2805A02919	04/14/03	1 year
- for 200-1000MHz	MITEQ AM-3A	898432	02/20/04	1 year
Amplifier (1 - 18GHz)	HP 8449B	3008A00582	06/11/03	1 year
Amplifier (18 - 40GHz)	Agilent 83051A	3950M00193	01/27/04	1 year
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003	05/01/03	1 year
Spectrum Analyzer	HP 8563E	3416A02248	08/21/03	1 year
Harmonic Mixer	Agilent 11970A	011269-001	07/19/03	1 year
Receiver (9kHz-30MHz)	R&S ESH3	891806/012	10/17/03	1 year
Receiver (20MHz-1.3GHz)	R&S ESVP	892111/030	03/17/03	1 year
Biconical Antenna (30-200MHz)	EMCO 3108	2536	04/23/03	1 year
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	2849	04/23/03	1 year
Horn Antenna (1- 18GHz)	EMCO 3115	9903-5774	07/17/03	1 year
Horn Antenna (3.95- 5.85GHz)	EMCO 3160-5	1099	07/17/03	1 year
Horn Antenna (5.85- 8.20GHz)	EMCO 3160-6	9712-1044	07/17/03	1 year
Horn Antenna (8.2- 12.4GHz)	EMCO 3160-7	1156	07/17/03	1 year
Horn Antenna (12.4- 18GHz)	EMCO 3160-8	1143	07/17/03	1 year
Horn Antenna (18- 26.5GHz)	EMCO 3160-9	0004-1202	07/17/03	1 year
Horn Antenna (26.5- 40GHz)	EMCO 3160-10	1175	07/17/03	1 year
LISN	EMCO 3810/2NM	00022007	05/20/03	1 year
Power Meter	HP 437B	3043U03437	11/19/03	1 year
Power Sensor	HP 8481A	US41030582	11/19/03	1 year
Switch/control unit	HP 3488A	2719A17226	N/A	N/A
		2719A17228	N/A	N/A
Plotter	HP 7550A	2631A33619	N/A	N/A
Coaxial cables (1 – 18GHz):	Length:			
- Horn Ant <=> RF Amp.	6 m	- EM206SCO	03/27/03	1 year
- RF Amp.<=>Spectrum Analyzer(<12GHz)	16m	- GEM0101	03/27/03	1 year
- RF Amp.<=>Spectrum Analyzer(>12GHz)	3 m	- SF102-20166	03/27/03	1 year

Coaxial cables (18 – 40GHz):				
- Horn Ant <=> RF Amp.	3m	- SF102-20167	03/27/03	1 year
- RF Amp.<=>Spectrum Analyzer	1m	- SF102-21105	03/27/03	1 year
N-Coax cables:				
- Bi-coni Ant <=> 10m Cable	9 m	- EM103L01	04/14/03	1 year
- 10m Cable <=> Shield Panel	10 m	- EM103L02	04/14/03	1 year
- Shield Panel <=> RF Amp	7 m	- EM103L03	04/14/03	1 year
- RF Amp <=> Power Splitter	0.5m	- EM103L04	04/14/03	1 year
- Log-peri Ant <=> 10m Cable	9 m	- EM103H01	04/14/03	1 year
- 10m Cable <=> Shield Panel	10 m	- EM103H02	04/14/03	1 year
- Shield Panel <=> RF Amp	7 m	- EM103H03	04/14/03	1 year
- RF Amp <=> Power Splitter	0.5m	- EM103H04	04/14/03	1 year
Coax cables:				
- Lisn-L <=> SW/Con.unit (SW100)	4 m	- EMIC-L	04/14/03	1 year
- Lisn-N <=> SW/Con.unit (SW101)	4 m	- EMIC-N	04/14/03	1 year
- SW/Con.unit <=> RCVR (Input)	1 m	- EMIC-R	04/14/03	1 year
- SW/Con.unit<=> Spe Ana.(Signal In)	1 m	- EMIC-S	04/14/03	1 year
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM103L05	04/14/03	1 year
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM103L06	04/14/03	1 year
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM103H05	04/14/03	1 year
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM103H06	04/14/03	1 year
- SW/Con.unit <=> Receiver (Input)	2 m	- EM1RCV	04/14/03	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	2 m	- EM1SPL	04/14/03	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM1SPH	04/14/03	1 year

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

F. Measurement Uncertainty

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

Estimated site uncertainty values are as follows.

EMI chamber #1 : 4.39dB
EMI chamber #2 : 4.40dB
EMI conducted measurement system : 2.4dB

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

G. Temperature and Humidity

The temperature is controlled within range of 17° to 28°
The relative humidity is controlled within range of 40% to 70%.

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

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

1. Bandwidth at 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[*1], VBW=1MHz[*2], 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: Loss: 110 cm 2.2 dB	

Notes: - R&S: Rohde & Schwarz

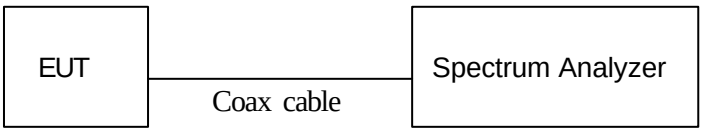


Figure 1: Measurement setup for 26dB bandwidth test

1.2 Measurement Results

Test Date: June 28, 2004

: **the closest frequencies to the bandedge**

Table 1-2-1. 26dB bandwidth, TX mode 6Mbps

Center Frequency (MHz)	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 26 dB below (MHz)	Plot data
5180 (ch. 36)	5163.42	5198.09	34.67	Plot 1-1
5260 (ch. 52)	5239.21	5280.79	41.58	Plot 1-2
5320 (ch. 64)	5305.12	5335.58	30.46	Plot 1-3

Table 1-2-2. 26dB bandwidth, TX mode 18Mbps

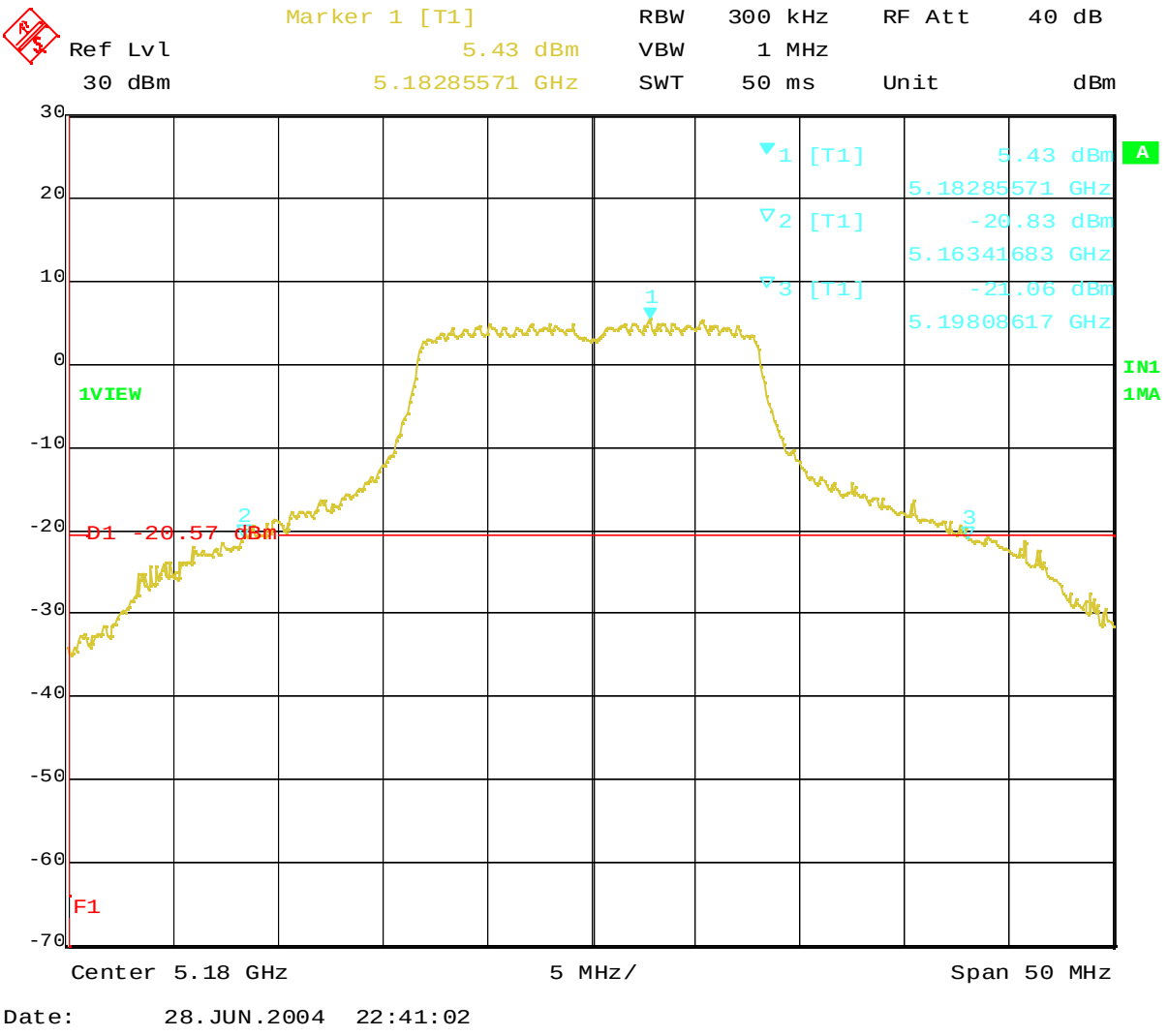
Center Frequency (MHz)	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 26 dB below (MHz)	Plot data
5180 (ch. 36)	5163.72	5197.28	33.56	omitted
5260 (ch. 52)	5240.61	5279.49	38.88	omitted
5320 (ch. 64)	5306.22	5334.18	27.96	omitted

Table 1-2-3. 26dB bandwidth, TX mode 54Mbps

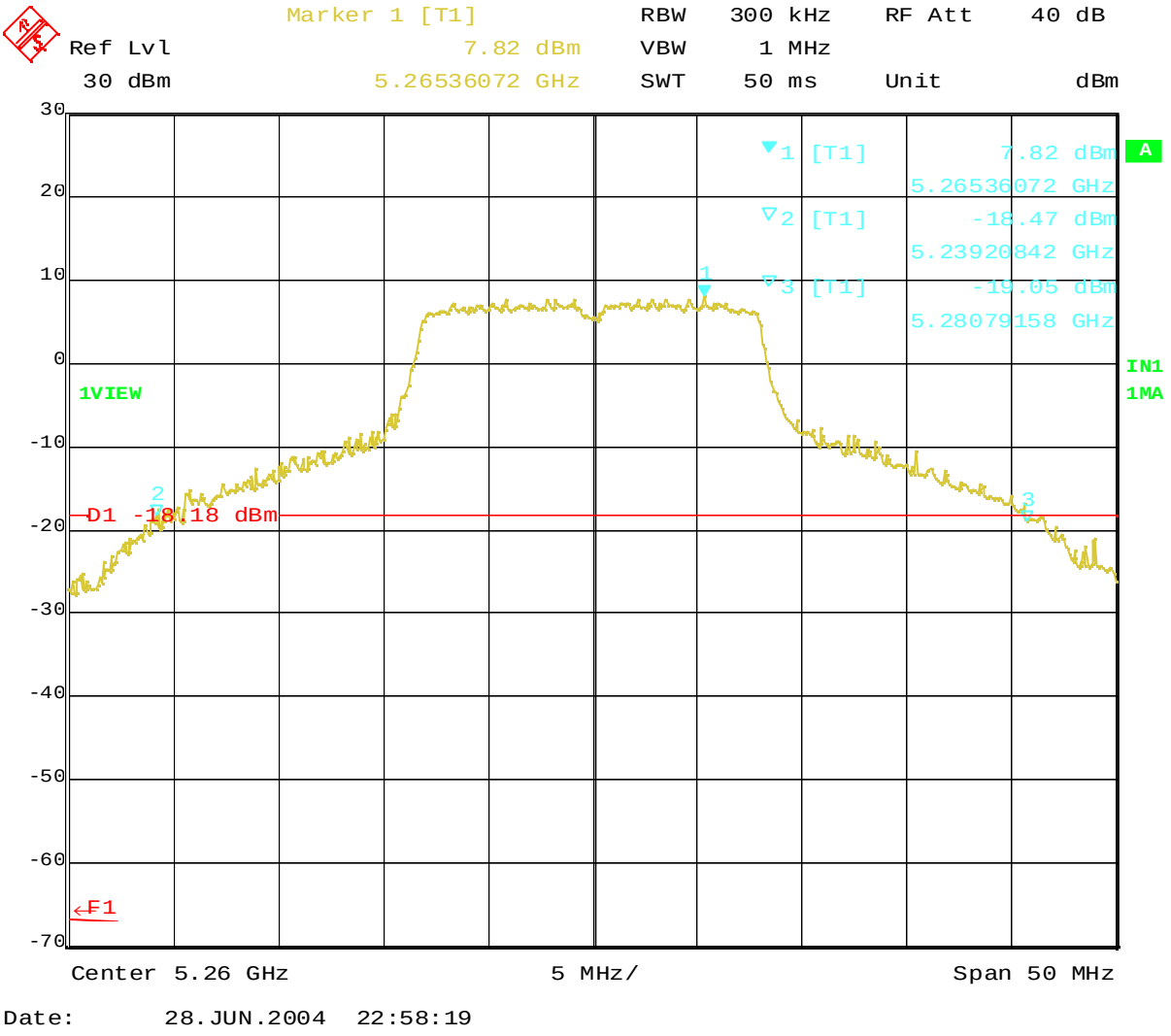
Center Frequency (MHz)	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 26 dB below (MHz)	Plot data
5180 (ch. 36)	5164.32	5196.38	32.06	omitted
5260 (ch. 52)	5246.82	5274.68	27.86	omitted
5320 (ch. 64)	5306.72	5333.48	26.66	omitted

1.3 Trace Data

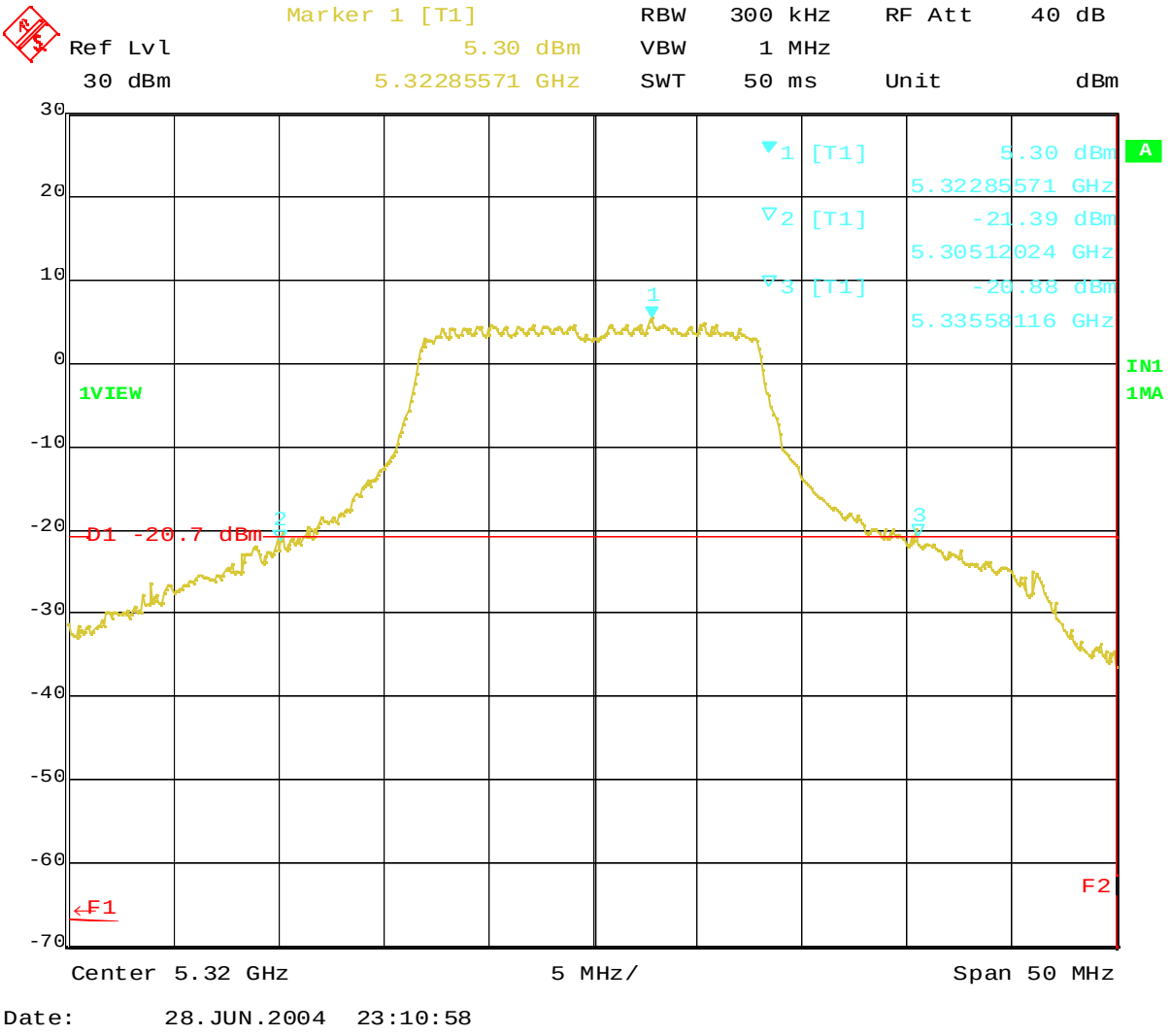
The plots are comparatively worse measurement cases of each measured frequency in the previous Table 1-2-1 through Table 1-2-3.



Plot 1-1. 26dB BW at 5180MHz (OFDM, 6Mbps)



Plot 1-2. 26dB BW at 5260MHz (OFDM, 6Mbps)



Plot 1-3. 26dB BW at 5320MHz (OFDM, 6Mbps)

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 a spectrum analyzer in accordance with the Method #3 of 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 Plot 2-0 below) at the appropriate center frequencies.

The spectrum analyzer was set to :
VBW= 30kHz (=1/T, where T is transmission pulse duration. See Plot 2-0.), 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 2-1: 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: Loss: 110 cm 2.2 dB	

Notes: - R&S: Rohde & Schwarz

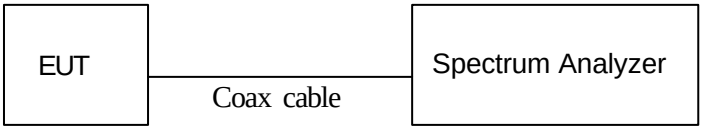


Figure 2-1 : Measurement setup of spectrum analyzer method

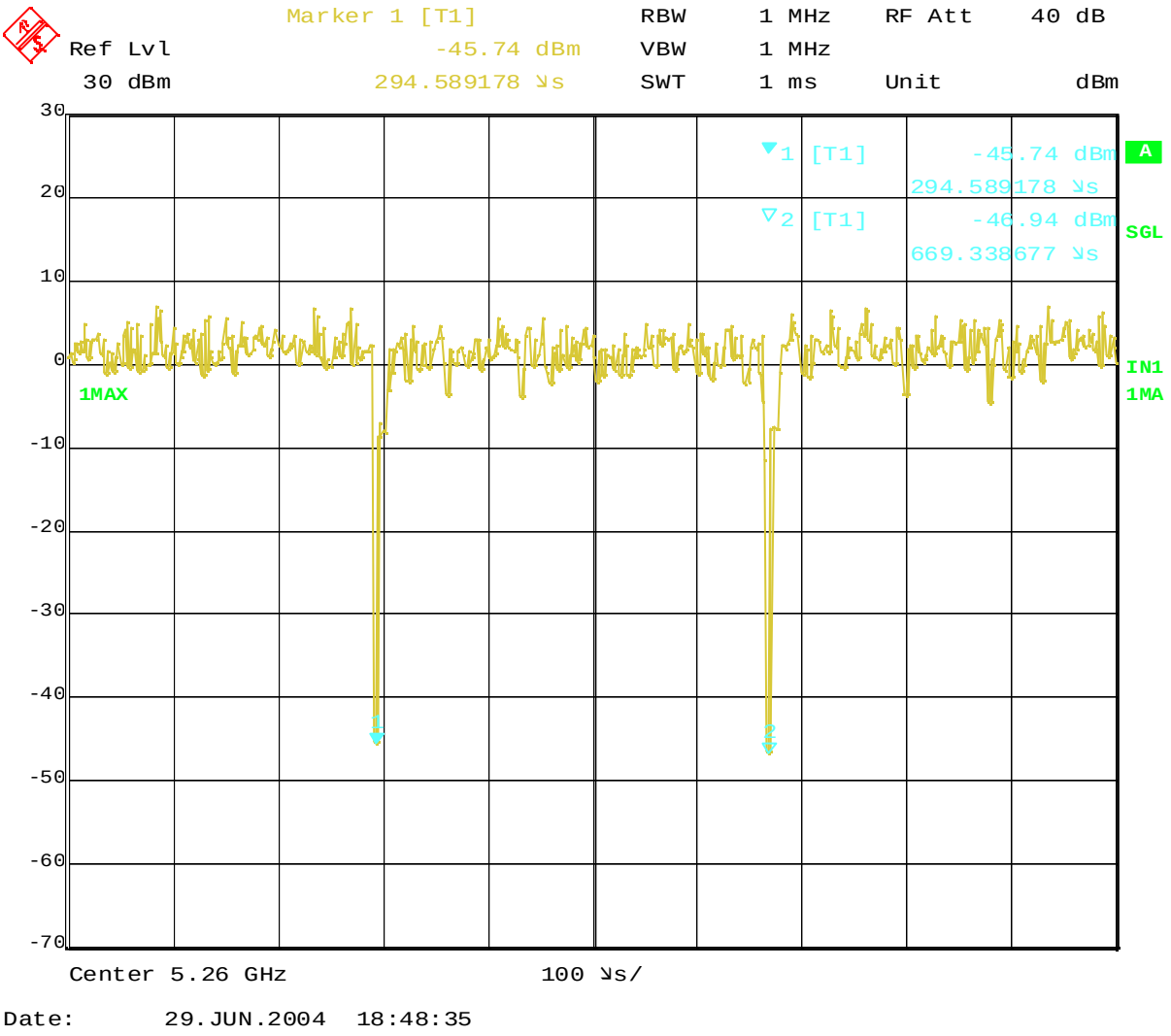
2.2 Measurement Results

Test Date: June 29, 2004

Table 2-2. Measurement results of peak conducted transmit output power

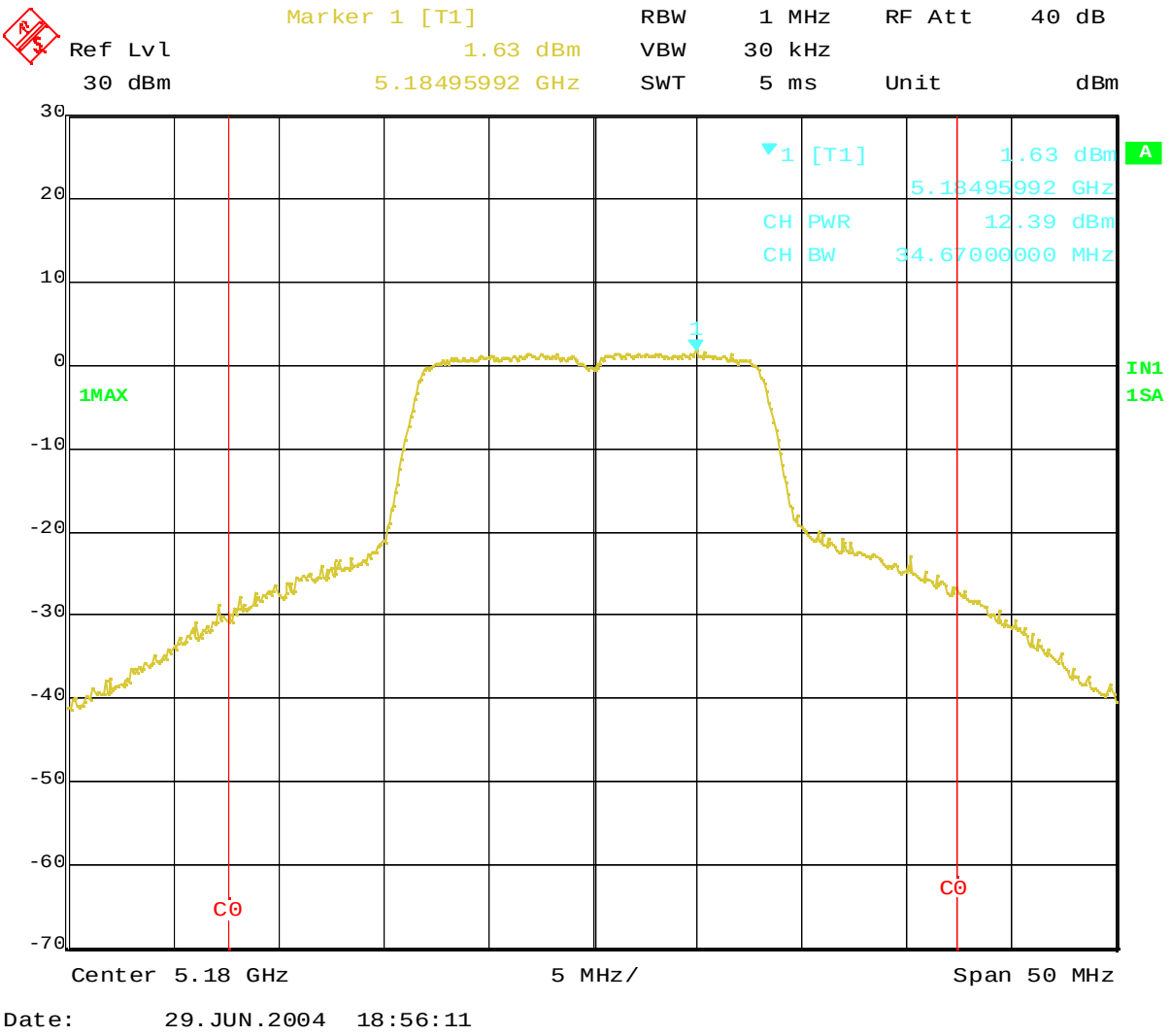
Measured Frequency (MHz)	Tx Rate (Mb/s)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	**Results** (dBm)	Limit FCC (dBm)	Limit IC (dBm)	Peak antenna gain of EUT (dBi)	EIRP (dBm)	IC limit (dBm)
5180	6	12.39	Plot 2-1	2.2	**14.59**	17	N/A	2.15	**16.74**	23
	18	12.33	omitted	2.2	14.53	17	N/A		16.68	23
	54	11.54	omitted	2.2	13.74	17	N/A		15.89	23
5260	6	15.55	Plot 2-2	2.2	**17.75**	24	24		**19.90**	30
	18	15.36	omitted	2.2	17.56	24	24		19.71	30
	54	11.63	omitted	2.2	13.83	24	24		16.67	30
5320	6	12.12	Plot 2-3	2.2	**14.32**	24	24		**17.16**	30
	18	11.96	omitted	2.2	14.16	24	24		16.31	30
	54	11.47	omitted	2.2	13.67	24	24		15.82	30

2.3 Trace Data

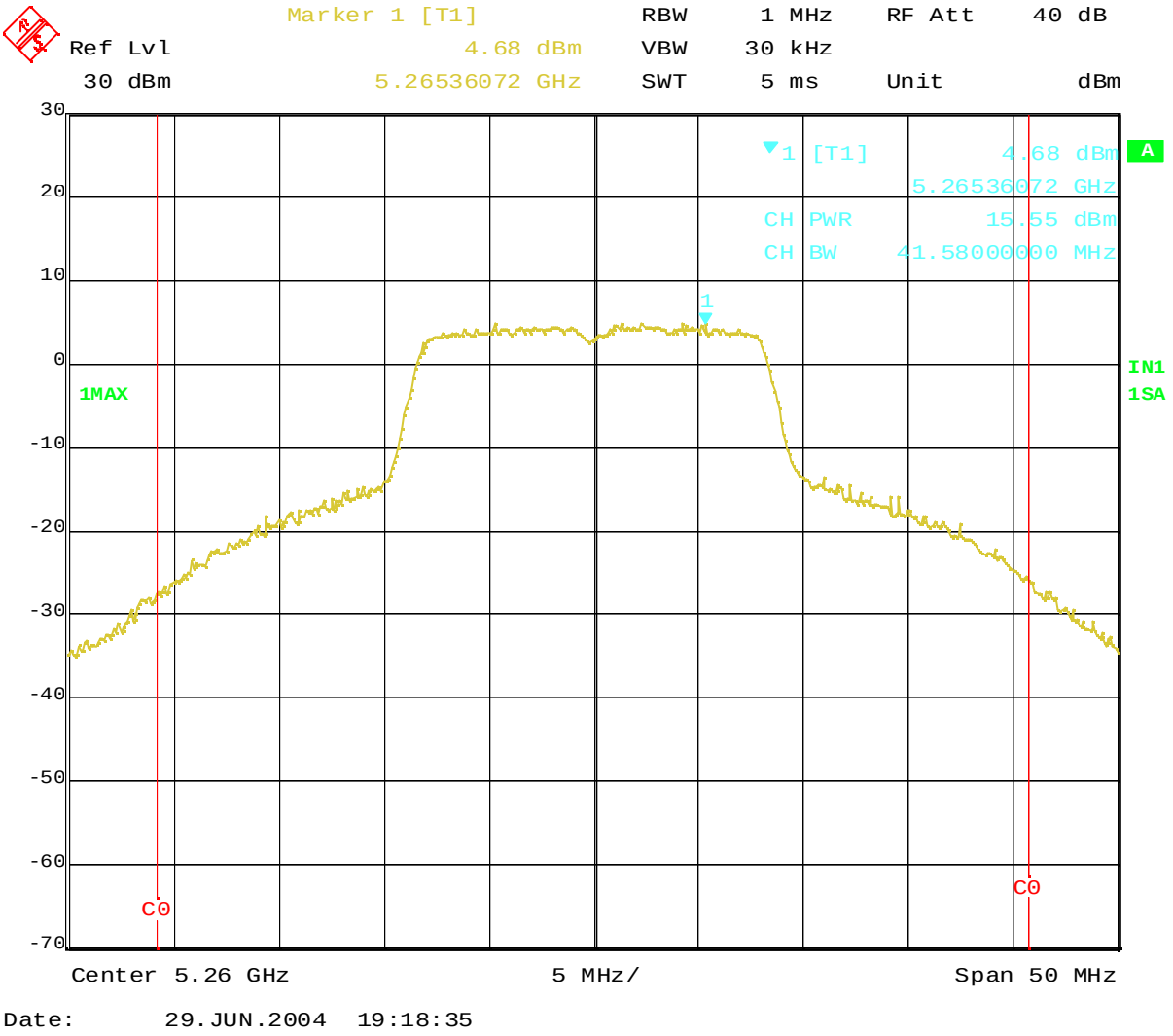


Plot 2-0 Transmission Pulse Duration

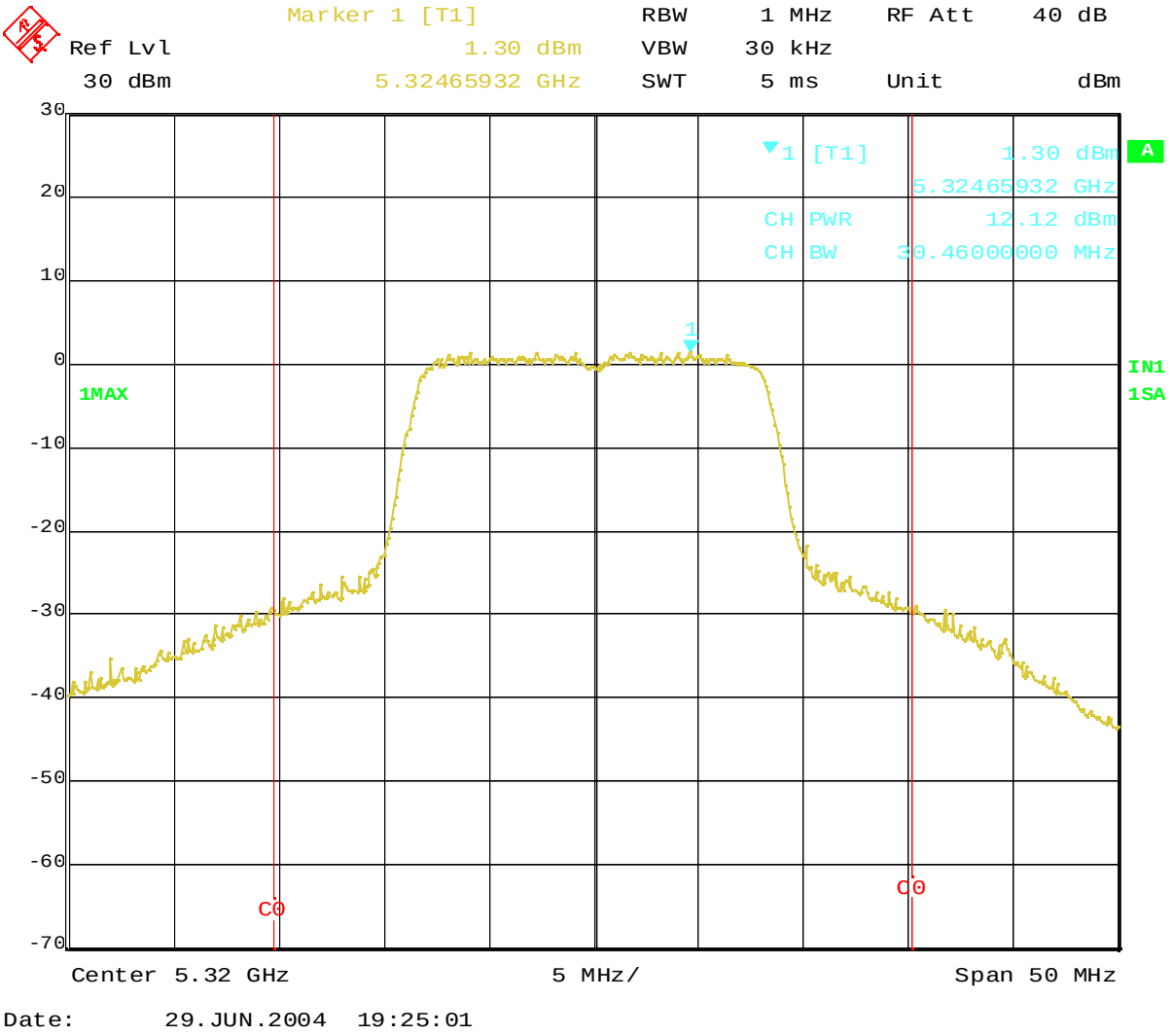
Hereafter, comparatively worse measurement cases of each measured frequency in the previous Table 2.2 are selected.



Plot 2-1 Conducted Peak Power at 5180MHz (OFDM, 6Mbps)



Plot 2-2 Conducted Peak Power at 5260MHz (OFDM, 6Mbps)



Plot 2-3 Conducted Peak Power at 5320MHz (OFDM, 6Mbps)

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 peak power spectral density was measured in accordance with the Method 2 shown in FCC Public Notice DA 02-2138.

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 power averaging mode, then the maker 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

The measurement was performed with the worst case that tend to have higher conducted peak power based on the results of previous Chapter 2 “Peak Conducted Transmit Output Power” measurement.
i.e. 6Mb/s was the worst case.

Test Date: June 29, 2004

Table 3-1. Measurement results of PPSD

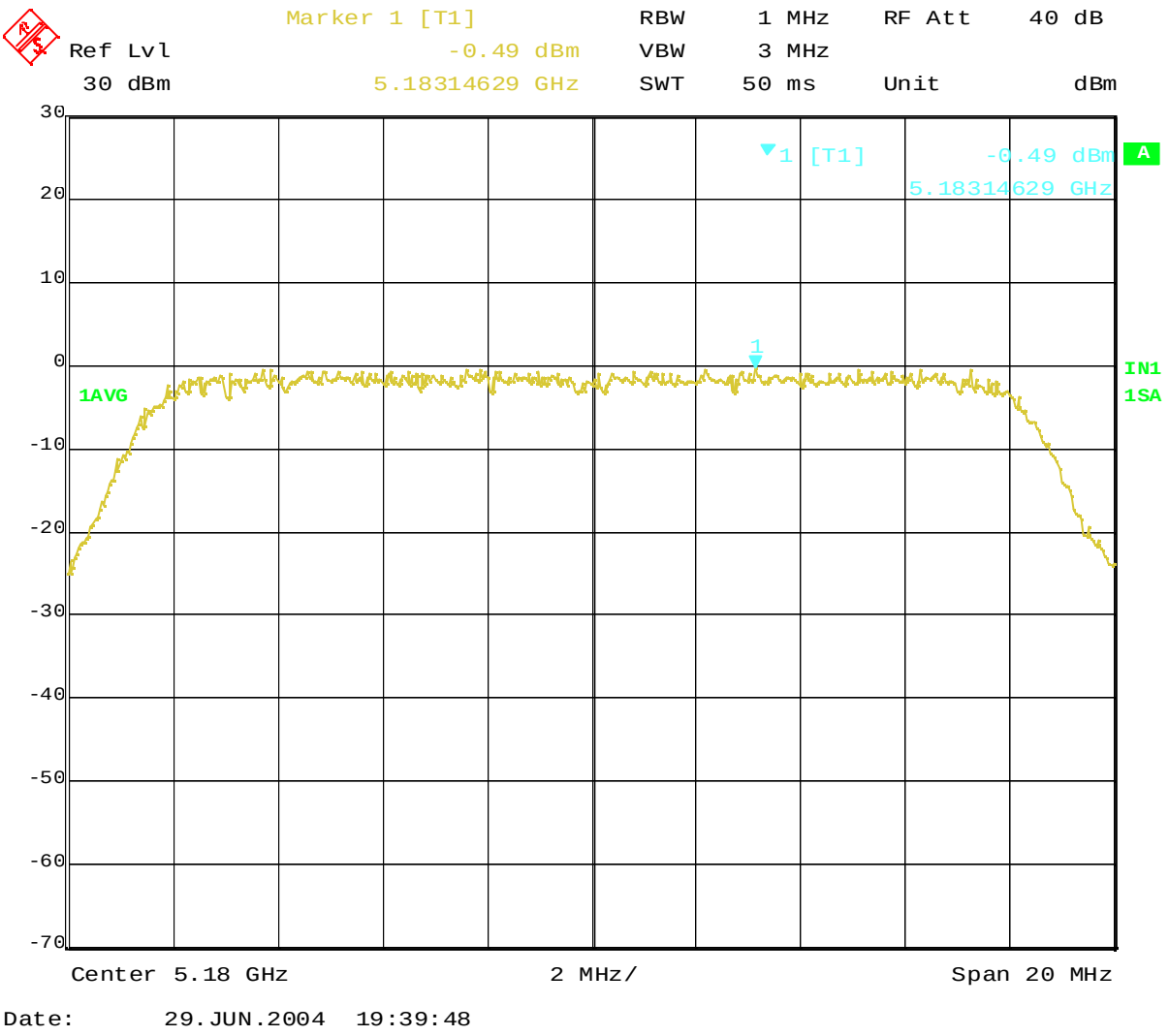
Measured Frequency (MHz)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	Results (dBm)	FCC Limit (dBm)	IC Limit q1(ii) (dBm)	**Peak Antenna Gain** (dBm)	IC EIRP (dBm)	IC Limit q1(i) (dBm)
5183.15	-0.49	Plot 3-1	2.2	1.7	4.0	~~N/A~~	**2.15**	**3.9**	**10**
5260.78	2.46	Plot 3-2	2.2	4.7	11.0	11.0			~~N/A~~
5315.53	-0.57	Plot 3-3	2.2	1.6	11.0	11.0			~~N/A~~

Table 3-2. Measurement results of Canadian PPSD

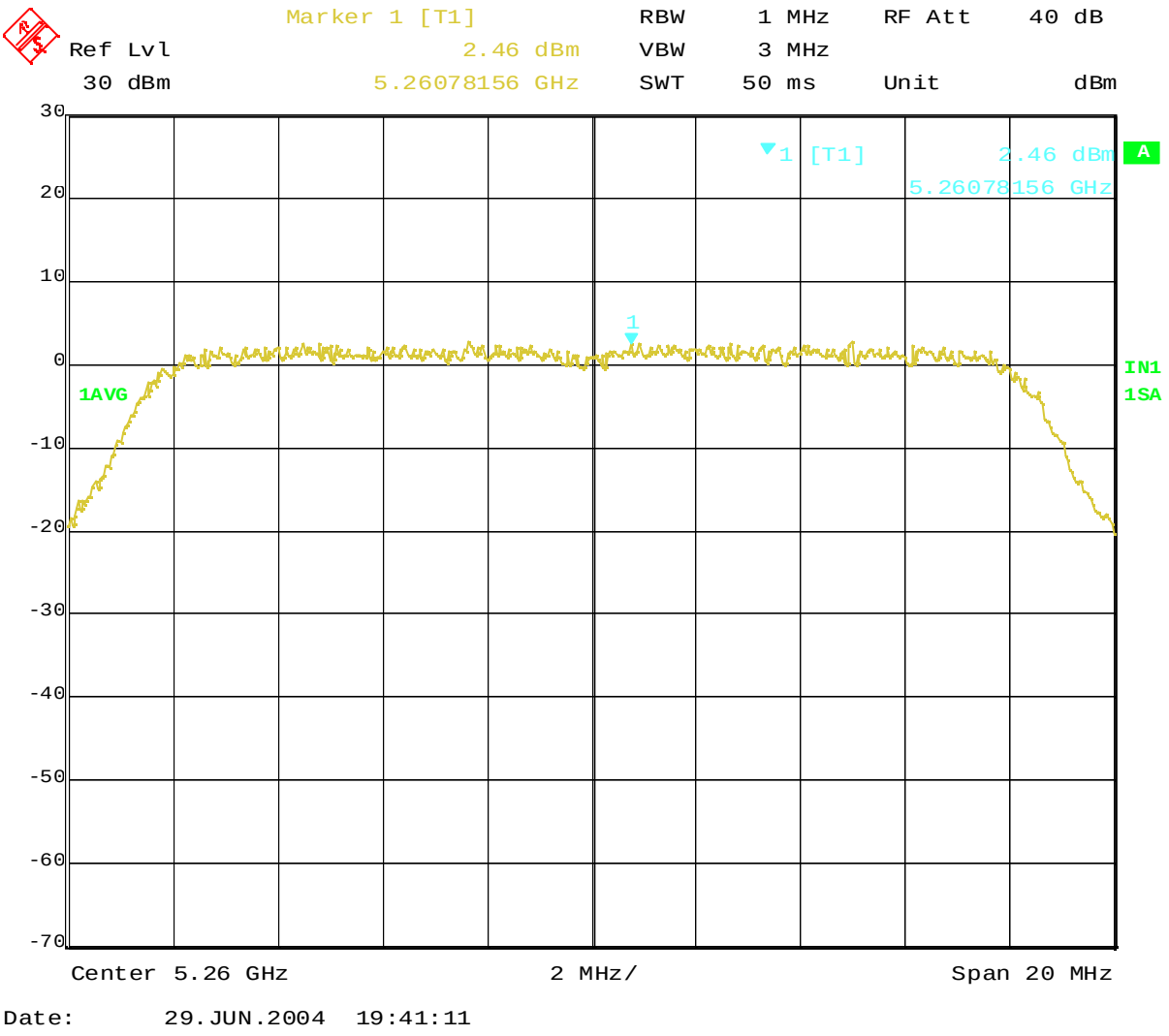
Measured Frequency (MHz)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	Results (dBm)	IC Limit q1(iv)(b) 3 + 10logB* (dBm)
5182.99	8.69	Plot 3-4	2.2	10.9	18.40
5266.19	11.76	Plot 3-5	2.2	14.0	19.19
5314.17	8.96	Plot 3-6	2.2	11.2	17.84

* B = 26dB Bandwidth

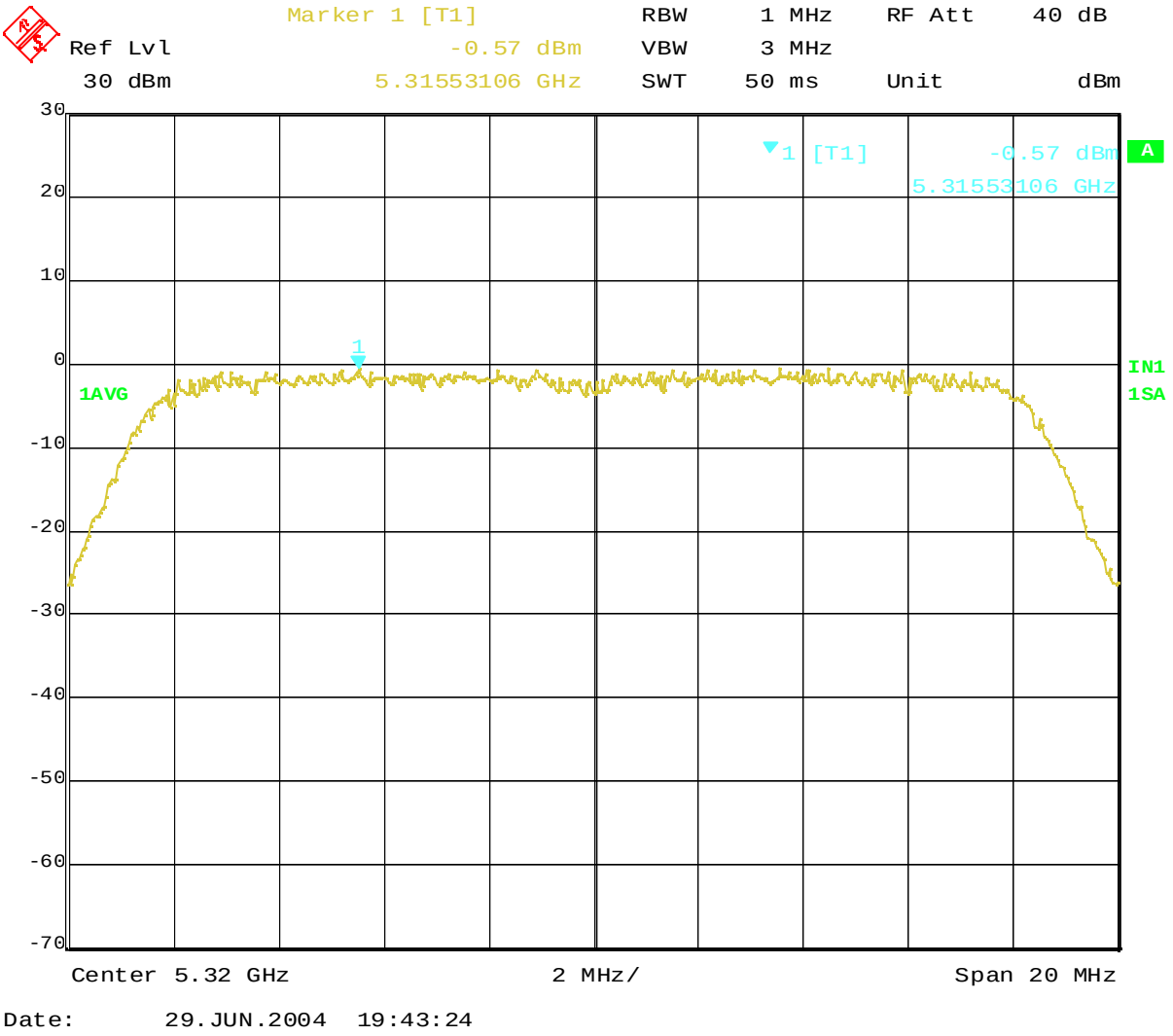
3.3 Trace Data



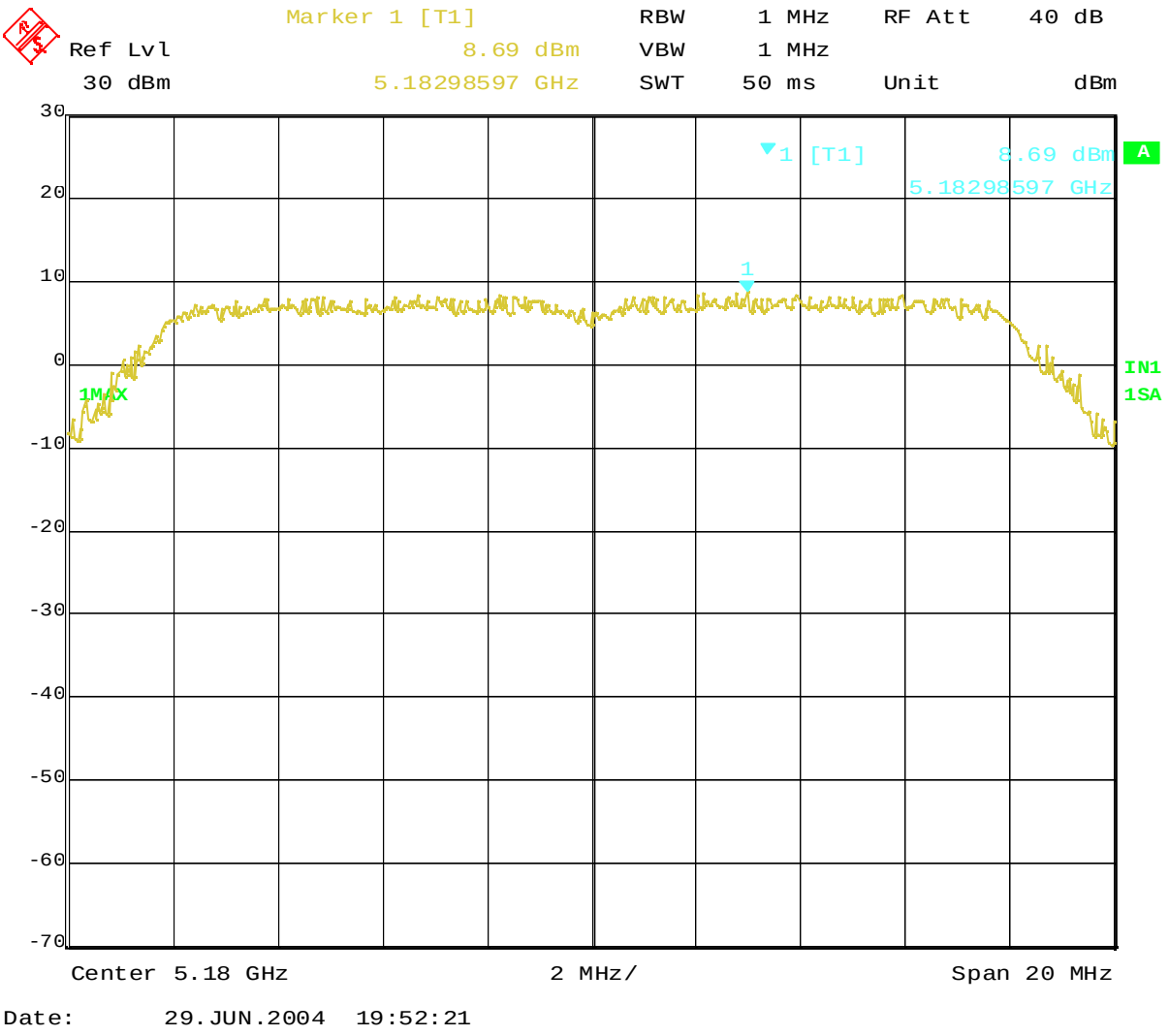
Plot 3-1 Peak Power Spectral Density at 5180MHz



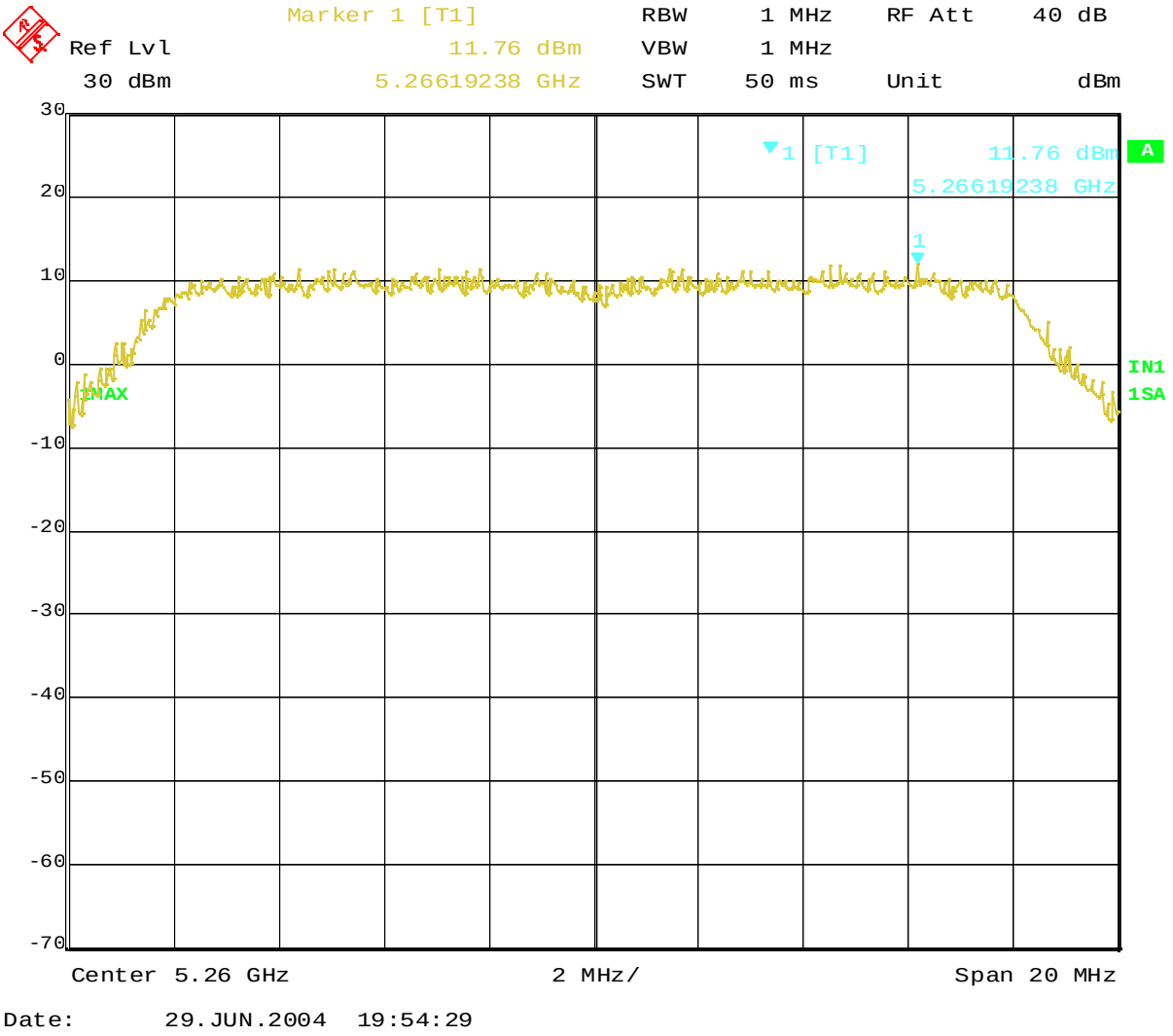
Plot 3-2 Peak Power Spectral Density at 5260MHz



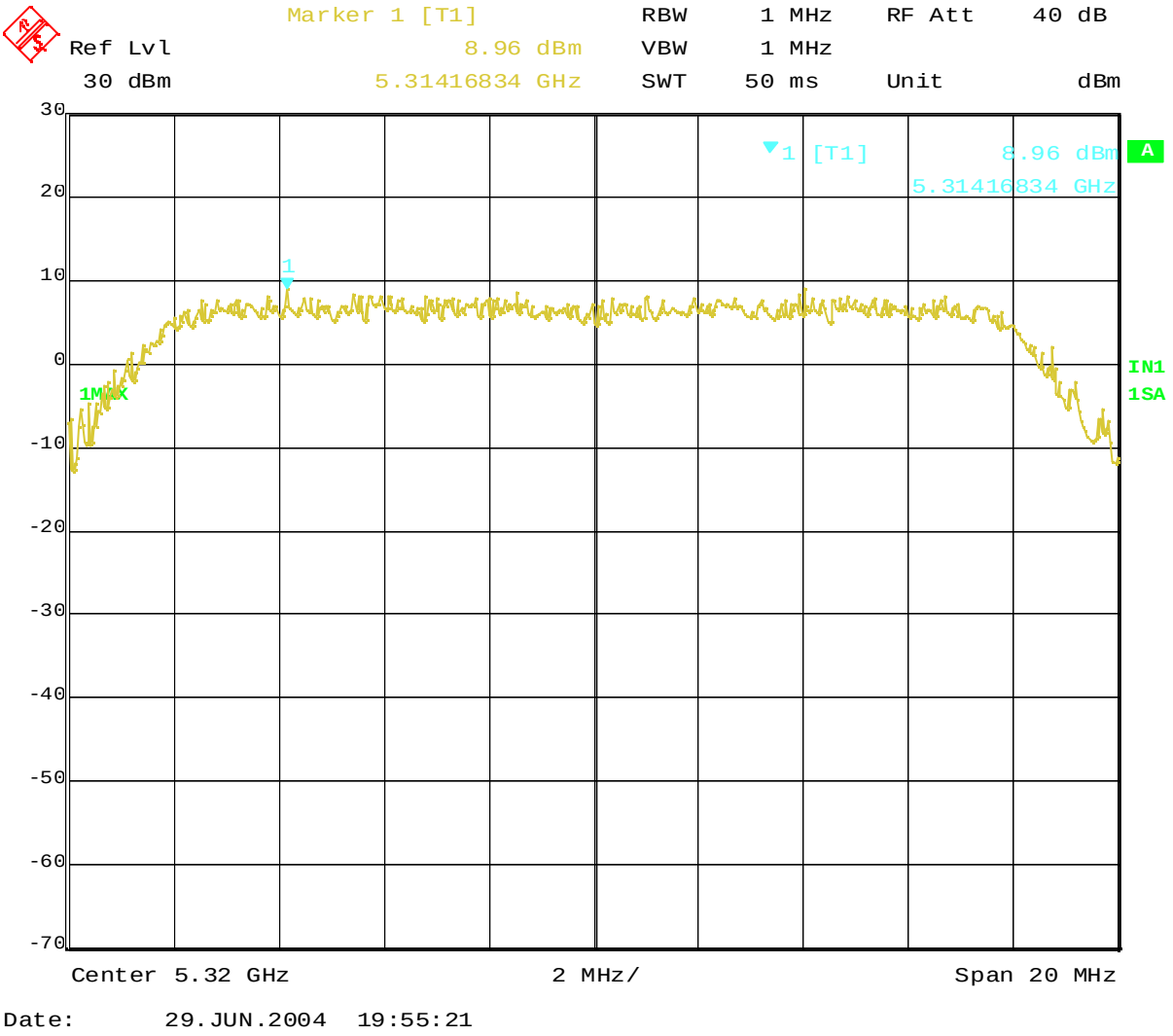
Plot 3-3 Peak Power Spectral Density at 5320MHz



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



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



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.

- 1st trace :
  The spectrum analyzer was set to :
  RBW= 1MHz, VBW=3MHz, Mode= peak detector and max hold
  then to view.

- 2nd trace :
  The same setting of spectrum analyzer as Chapter 2.1 for the measurement of peak conducted transmit output power was used for the 2nd 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

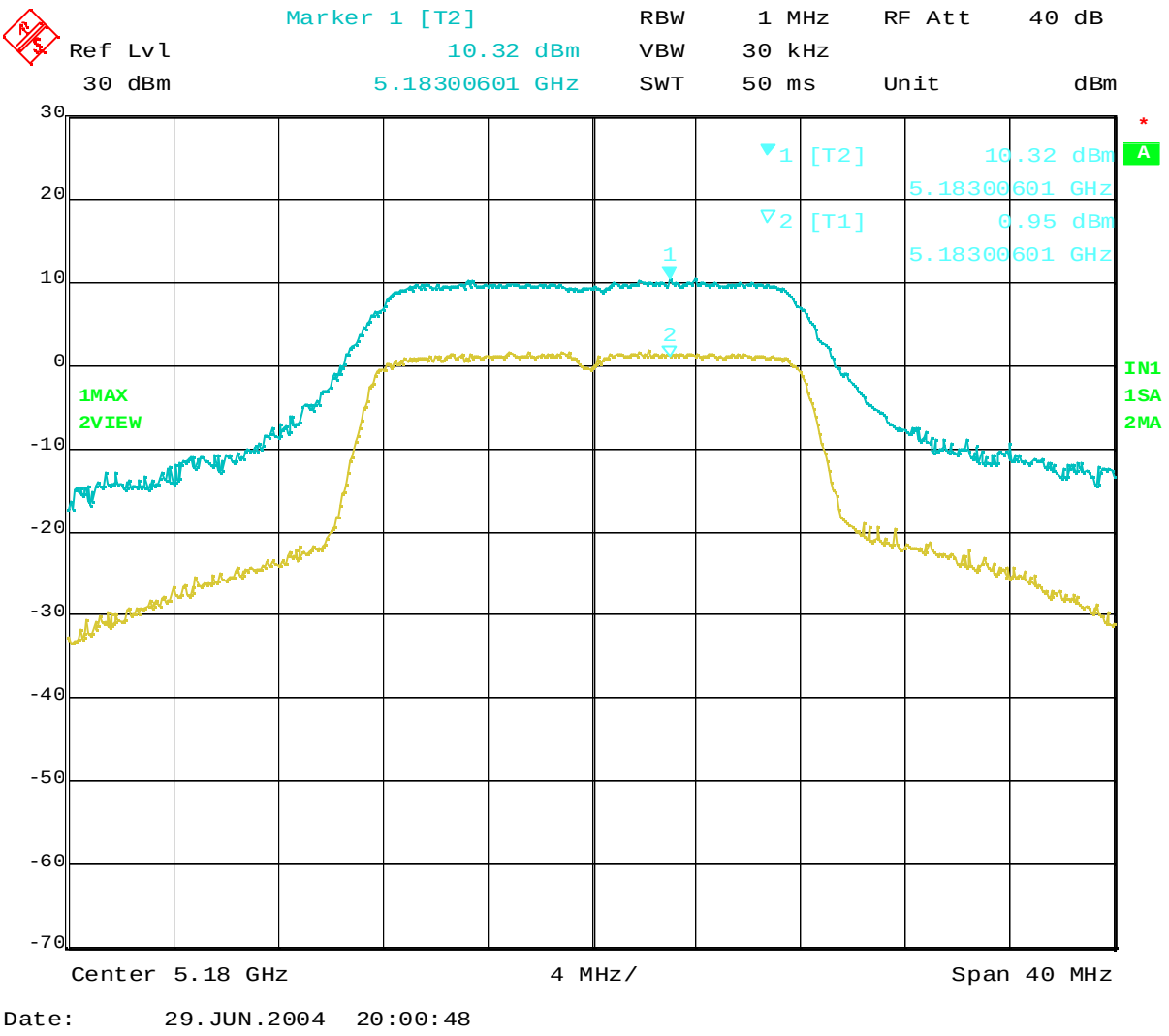
The measurement was performed with the worst case that tend to have higher conducted peak power based on the results of previous Chapter 2 “Peak Conducted Transmit Output Power” measurement.
i.e. 6Mbps was the worst case.

Test Date: June 29, 2004

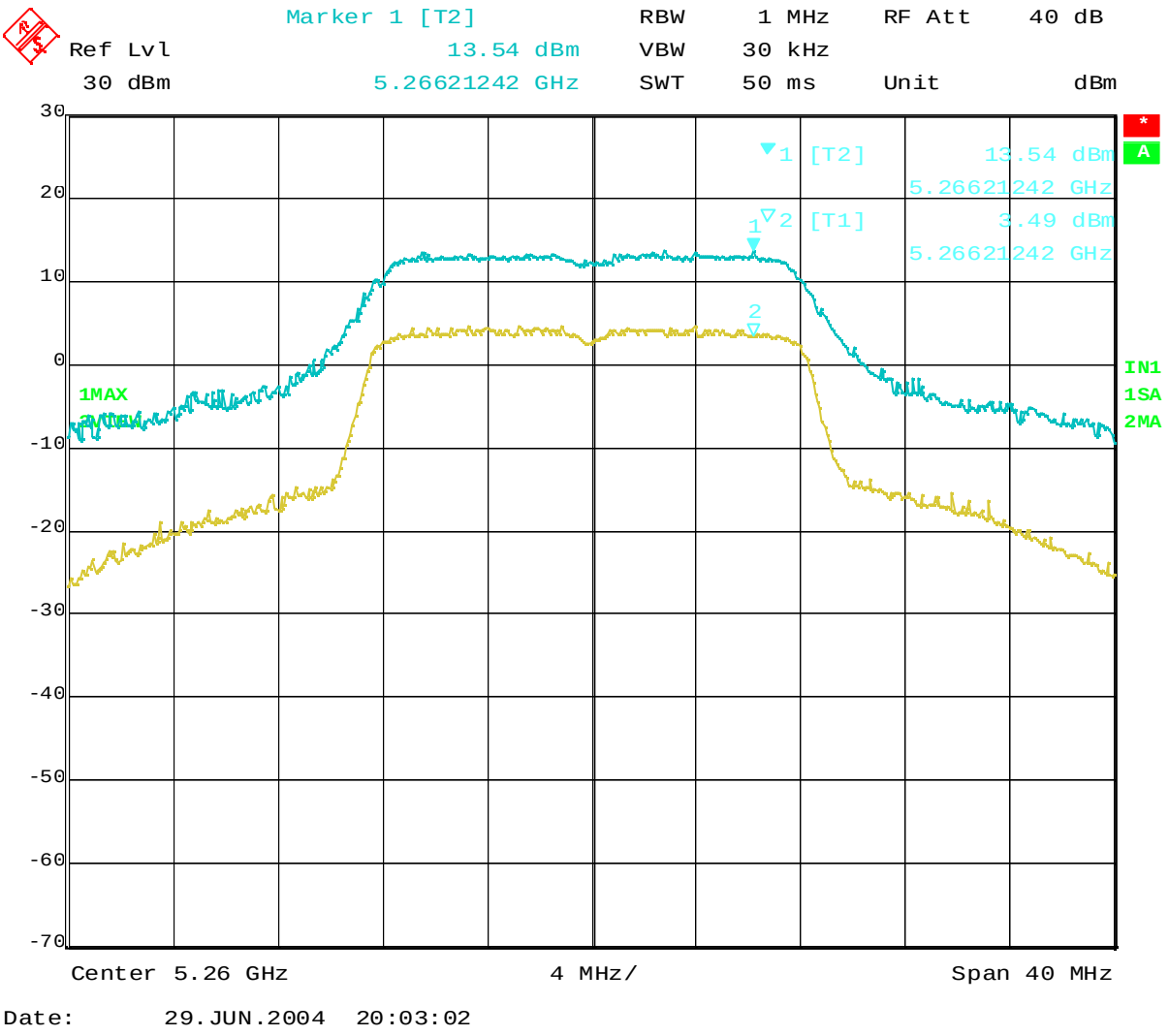
Table 4-2. Measurement results of Peak Excursion Ratio

Measured Frequency (MHz)	Analyzer Reading delta (dB)	FCC Limit (dB)	Margin (dB)	Trace number
5183.01	9.37	**13**	3.63	Plot 4-1
5266.21	10.05		2.95	Plot 4-2
5325.97	9.44		3.56	Plot 4-3

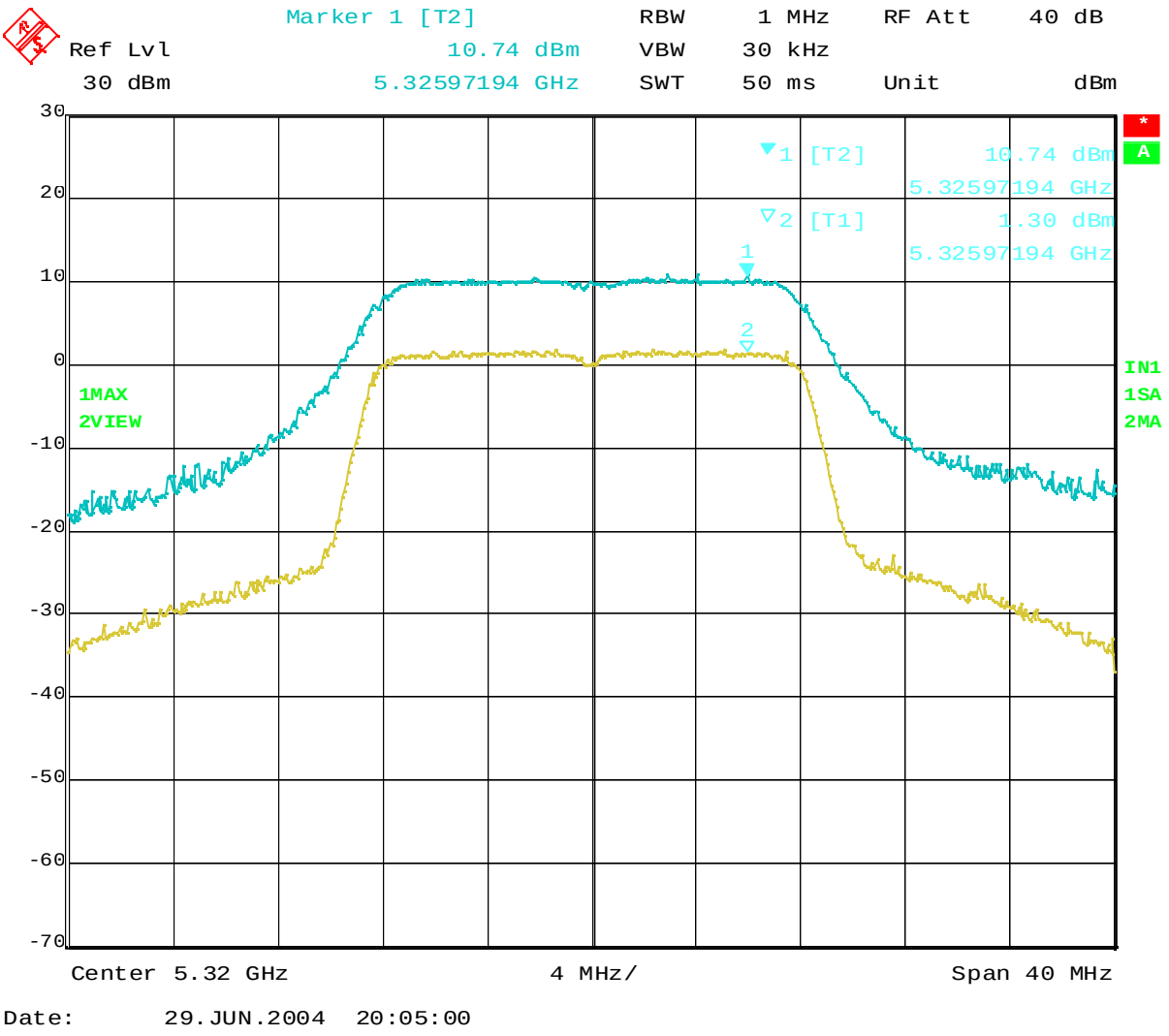
4.3 Trace Data



Plot 4-1 Peak Excursion Ratio at 5180MHz



Plot 4-2 Peak Excursion Ratio at 5260MHz



Plot 4-3 Peak Excursion Ratio at 5320MHz

5. AC WIRELINE CONDUCTED EMISSIONS (150KHz – 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	2841A04254
Spectrum Analyzer Display	HP 85662A	2816A16831
Quasi-Peak Adapter	HP 85650A	2811A01156
Receiver (9kHz-30MHz)	R&S ESH3	891806/012
LISN	EMCO 3810/2NM	00022007
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

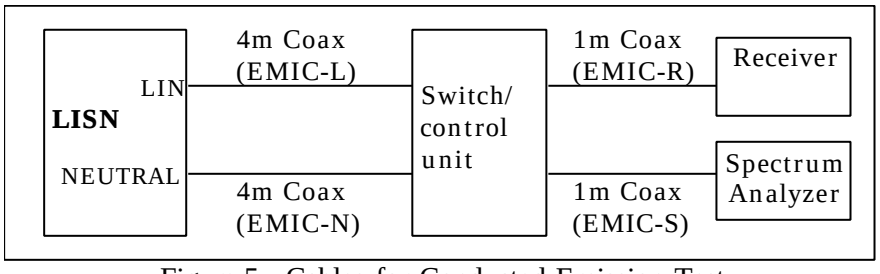


Figure 5. Cables for Conducted Emission Test

5.3 Powerline Voltage Calculation

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

PV = R + CORR

where:

PV = Powerline Voltage (dBμV)
R = Measured Receiver Input Amplitude (dBμV)
CORR = Correction Factor (dB) = LL+CL+SWL+PLL
LL = Insertion loss of LISN (dB)
CL = Insertion loss of Cable (dB)
SWL = Insertion loss of Switch control unit (dB)
PLL = Insertion loss of Pulse Limiter (dB)

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

CORR = 0.6 + 0.1 + 0.1 + 0.2 = 1.0 (dB)
PV = 50.0 + 1.0 = 51.0 (dBμV)

5.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart E and RSS-210 with a margin of 13.8dB. The 6 highest emissions relative to the limits are reported.

The actual highest emissions hereafter were found at 6Mbps on the main antenna of ThinkPad X30 Series.

Test Date: July 9, 2004

Table 5-2-1. Ch.36 (5180MHz) **TX** mode 6Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2008	46.9	0.5	47.4	39.3	0.5	39.8	63.6	53.6	Neutral
0.2681	37.0	0.6	37.6	31.0	0.6	31.6	61.2	51.2	Neutral
0.3350	30.9	0.6	31.5	24.5	0.6	25.1	59.3	49.3	Neutral
0.4679	30.5	0.6	31.1	27.5	0.6	28.1	56.6	46.6	Neutral
0.5381	28.5	0.6	29.1	25.0	0.6	25.6	56.0	46.0	Neutral
2.9634	25.0	0.7	25.7	21.8	0.7	22.5	56.0	46.0	Line

Table 5-2-2. Ch.52 (5260MHz) **TX** mode 6Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.1997	46.1	0.5	46.6	39.0	0.5	39.5	63.6	53.6	Neutral
0.2696	36.7	0.6	37.3	30.8	0.6	31.4	61.1	51.1	Neutral
0.3390	31.1	0.6	31.7	23.8	0.6	24.4	59.2	49.2	Line
0.4699	32.1	0.6	32.7	29.2	0.6	29.8	56.5	46.5	Neutral
0.5398	28.3	0.6	28.9	24.8	0.6	25.4	56.0	46.0	Neutral
1.8199	24.6	0.7	25.3	21.5	0.7	22.2	56.0	46.0	Neutral

Table 5-2-3. Ch.64 (5320MHz) **TX** mode 6Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2041	45.7	0.5	46.2	37.6	0.5	38.1	63.4	53.4	Neutral
0.2652	34.3	0.6	34.9	27.4	0.6	28.0	61.3	51.3	Neutral
0.3371	31.9	0.6	32.5	24.7	0.6	25.3	59.3	49.3	Line
0.4687	31.5	0.6	32.1	28.7	0.6	29.3	56.5	46.5	Neutral
0.5387	28.4	0.6	29.0	24.9	0.6	25.5	56.0	46.0	Neutral
2.6935	24.9	0.7	25.6	21.8	0.7	22.5	56.0	46.0	Neutral

Table 5-2-4. Ch. 52 (5260MHz) **RX** mode

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2062	46.3	0.5	46.8	37.9	0.5	38.4	63.4	53.4	Line
0.2750	37.0	0.6	37.6	31.3	0.6	31.9	61.0	51.0	Neutral
0.3388	33.8	0.6	34.4	28.8	0.6	29.4	59.2	49.2	Neutral
0.4762	29.4	0.6	30.0	25.5	0.6	26.1	56.4	46.4	Neutral
0.5487	26.3	0.6	26.9	24.7	0.6	25.3	56.0	46.0	Neutral
3.4920	27.8	0.7	28.5	25.6	0.7	26.3	56.0	46.0	Neutral

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 6868-30J	97-901X3
Spectrum Analyzer (100Hz-1.5GHz) for 30-200MHz	HP 85680B	2601A02634
Spectrum Analyzer Display for 30-200MHz	HP 85662A	2542A12308
Quasi-Peak Adapter for 30-200MHz	HP 85650A	2043A00062
Spectrum Analyzer (100Hz-1.5GHz) for 200-1000MHz	HP 85680B	3019A05156
Spectrum Analyzer Display for 200-1000MHz	HP 85662A	3026A19366
Quasi-Peak Adapter for 200-1000MHz	HP 85650A	2811A01433
Amplifier (100KHz-1.3GHz) - for 30-200MHz - for 200-1000MHz	 MITEQ AM-3A MITEQ AM-3A	 898433 898432
Biconical Antenna (30-200MHz)	EMCO 3108	2536
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	2849
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

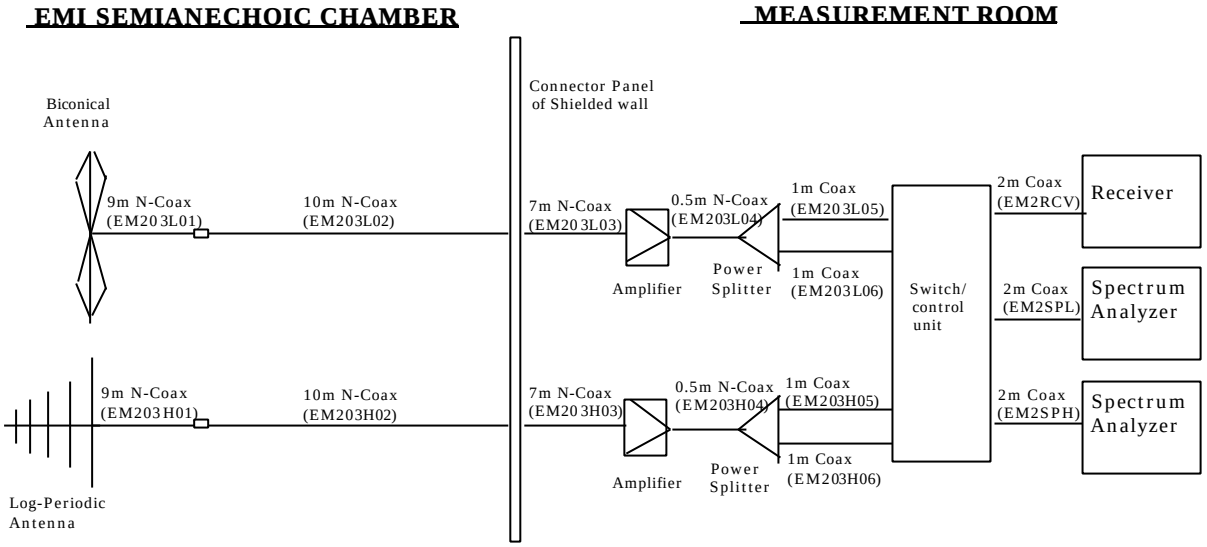


Figure 6 Cables for Radiated Emission Test

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 E and RSS-210 with a margin of 3.4 dB at 30MHz - 1000MHz band. The 6 highest emissions relative to the limits are reported.

The actual highest emissions hereafter were found at 6Mb/s on the main antenna of ThinkPad X30 Series.

Test Date: July 6, 2004

Table 6-2-1. Ch.36 (5180MHz) **TX** mode 6Mbps

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)
84.102	V	49.0	7.9	-28.4	28.5	40.0	26.6	100
200.289	H	45.2	11.4	-25.3	31.3	43.5	36.7	150
287.998	H	45.0	13.4	-23.7	34.7	46.0	54.3	200
322.148	V	41.6	14.3	-23.8	32.1	46.0	40.3	200
454.777	V	47.8	16.5	-21.8	42.5	46.0	133.4	200
666.449	V	34.1	20.5	-20.0	34.6	46.0	53.7	200

Table 6-2-2. Ch.52 (5260MHz) **TX** mode 6Mbps

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)
84.263	V	49.4	7.9	-28.4	28.9	40.0	27.9	100
200.289	H	45.2	11.4	-25.3	31.3	43.5	36.7	150
236.257	H	44.2	10.9	-24.7	30.4	46.0	33.1	200
287.998	H	44.6	13.4	-23.7	34.3	46.0	51.9	200
454.777	V	47.7	16.5	-21.8	42.4	46.0	131.8	200
666.449	V	34.5	20.5	-20.0	35.0	46.0	56.2	200

Table 6-2-3. Ch.64 (5320MHz) **TX** mode 6Mbps

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)
83.525	V	48.7	7.7	-28.2	28.2	40.0	25.7	100
200.289	H	45.1	11.4	-25.3	31.2	43.5	36.3	150
287.998	H	44.8	13.4	-23.7	34.5	46.0	53.1	200
324.841	V	41.8	14.2	-23.7	32.3	46.0	41.2	200
454.777	V	47.9	16.5	-21.8	42.6	46.0	134.9	200
666.449	V	34.2	20.5	-20.0	34.7	46.0	54.3	200

Table 6-2-4. Ch.52 (5260MHz) **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)
185.574	H	42.0	13.1	-26.8	28.3	43.5	26.0	150
197.413	H	42.8	13.7	-26.8	29.7	43.5	30.5	150
275.395	H	42.5	12.8	-24.1	31.2	46.0	36.3	200
287.998	H	44.9	13.4	-23.7	34.6	46.0	53.7	200
324.842	V	41.4	14.2	-23.7	31.9	46.0	39.4	200
454.777	V	47.0	16.5	-21.8	41.7	46.0	121.6	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	1156
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
Coaxial cables: - Horn Ant <=> RF Amp. (1-18GHz) - RF Amp.<=>Spectrum Analyzer (1-12.4GHz) - RF Amp.<=>Spectrum Analyzer (12.4-18GHz) - Horn Ant <=> RF Amp. (18-40GHz) - RF Amp. <=> Spectrum Analyzer (18-40GHz)	Length: 6 m 16 m 3m 3m 1m	 - EM206SCO - GEM0101 - SF102-20166 - SF102-20167 - SF102-21105

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

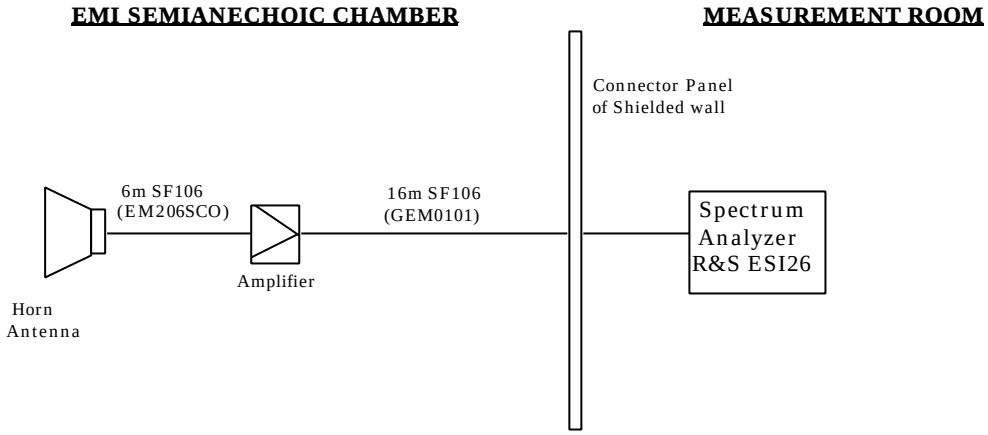


Figure 7-1. Cables for Radiated Emission Test (1 – 12.4 GHz)

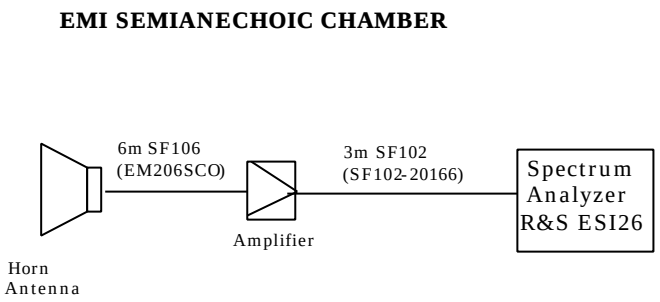


Figure 7-2. Cables for Radiated Emission Test (12.4 - 18GHz)

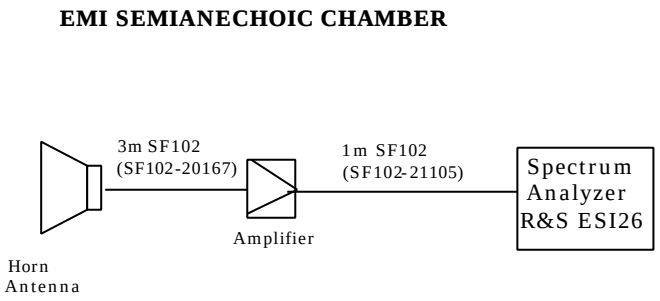


Figure 7-3. Cables for Radiated Emission Test (18 - 26.5GHz)

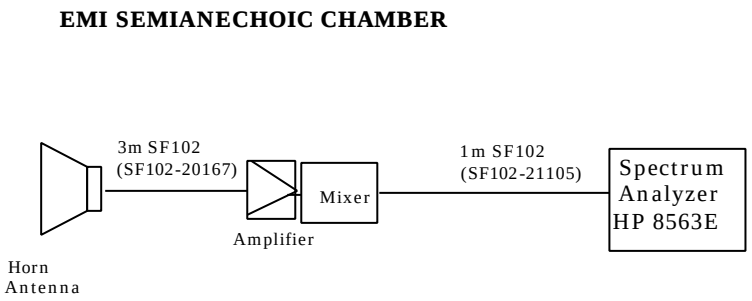


Figure 7-4. Cables for Radiated Emission Test (26.5 - 40GHz)

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 Limits

Table 7-1. Limits for EIRP emissions

Limit for emissions in restricted bands **FCC 15.205&209 / RSS-210 6.3&7.3**	54 dBμV/m (average)	74 dBμV/m (peak)
Limit for emissions in non_restricted bands **FCC 15.407(b)(1)&(2) / RSS-210 (q1)(i)&(ii)**	EIRP 68.2 dBμV/m (-27 dBm/MHz)	

7.5 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart E and RSS-210 with a margin of 2.8 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.

The actual highest emissions hereafter were found at 6Mbps on the main antenna of ThinkPad X30 Series.

Test Date: June 30 and July 2, 2004

Table 7-2-1. Ch.36 (5180MHz) **TX** mode 6Mbps

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)***
OB 5.185 bandedge	V	101.1	90.8	33.7	-26.1	0.0	108.7	N/A	98.4	N/A
5.145	V	56.8	41.0	33.6	-26.1	0.0	64.3	74.0	48.5	54.0
5.149	V	59.7	42.8	33.6	-26.1	0.0	67.2	74.0	50.3	54.0
5.150	V	58.0	43.7	33.6	-26.1	0.0	65.5	74.0	51.2	54.0
1.008	V	50.6	-	24.1	-31.9	0.0	42.8	74.0	-	54.0
1.066	V	60.0	-	24.6	-31.7	0.0	52.9	74.0	-	54.0
1.160	V	50.6	-	24.6	-31.3	0.0	43.9	74.0	-	54.0
1.172	V	55.8	-	24.9	-31.3	0.0	49.4	74.0	-	54.0
6.906	V	43.6	-	29.9	-24.9	0.0	48.6	68.2	-	NRB
10.365	V	45.0	-	33.5	-21.2	0.0	57.3	68.2	-	NRB
15.543	V	40.8	27.2	37.2	-23.6	0.0	54.4	74.0	40.8	54.0

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. Ch.52 (5260MHz) **TX** mode 6Mbps

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)***
OB 5.254 bandedge	V	104.1	94.0	33.7	-26.0	0.0	111.8	N/A	101.7	N/A
5.150	V	46.0	-	33.6	-26.1	0.0	53.5	74.0	-	54.0
5.350	V	48.8	36.6	33.9	-25.6	0.0	57.1	74.0	44.9	54.0
5.364	V	50.0	36.6	33.9	-25.8	0.0	58.1	74.0	44.7	54.0
1.008	V	50.8	-	24.1	-31.9	0.0	43.0	74.0	-	54.0
1.064	V	61.3	37.3	24.6	-31.7	0.0	54.2	74.0	30.2	54.0
1.142	V	57.6	-	24.6	-31.4	0.0	50.8	74.0	-	54.0
1.202	V	50.9	-	25.2	-31.3	0.0	44.8	74.0	-	54.0
7.014	V	42.1	-	30.0	-24.5	0.0	47.6	68.2	-	NRB
10.519	V	47.5	-	33.5	-20.8	0.0	60.2	68.2	-	NRB
15.786	V	41.8	28.5	37.2	-23.8	0.0	55.2	74.0	41.9	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 7-2-3. Ch.64 (5320MHz) **TX** mode 6Mbps

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)***
OB										
5.323 bandedge	V	99.6	89.5	33.7	-25.7	0.0	107.6	N/A	97.5	N/A
5.350	V	56.7	40.7	33.9	-25.6	0.0	65.0	74.0	49.0	54.0
5.352	V	56.3	39.9	33.9	-25.6	0.0	64.6	74.0	48.2	54.0
5.353	V	55.7	39.5	33.9	-25.6	0.0	64.0	74.0	47.8	54.0
1.008	V	52.9	-	24.1	-31.9	0.0	45.1	74.0	-	54.0
1.070	V	58.3	-	24.5	-31.5	0.0	51.3	74.0	-	54.0
1.172	V	54.0	-	24.9	-31.3	0.0	47.6	74.0	-	54.0
1.200	V	61.1	36.6	25.2	-31.3	0.0	55.0	74.0	30.5	54.0
7.094	V	42.5	-	30.0	-24.8	0.0	47.7	68.2	-	NRB
10.639	V	43.8	29.7	33.5	-20.9	0.0	56.4	74.0	42.3	54.0
15.962	V	39.7	-	37.2	-23.2	0.0	53.7	74.0	-	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 Ch.52 (5260MHz) **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)***
1.008	V	50.7	-	24.1	-31.9	0.0	42.9	74.0	-	54.0
1.066	V	53.7	-	24.6	-31.3	0.0	47.0	74.0	-	54.0
1.156	V	50.4	-	24.6	-31.3	0.0	43.7	74.0	-	54.0
1.198	V	50.2	-	25.2	-31.3	0.0	44.1	74.0	-	54.0

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 Measurement plots of adjacent restricted band

7.6.1 List of Measurement Results

The measurement was performed with the worst case that tend to have higher peak output power based on the results of previous Chapter 2 “Peak Conducted Transmit Output Power” measurement. i.e. 6Mbps showed the highest peak power.
And each antenna port with the highest gain was selected for each host device.

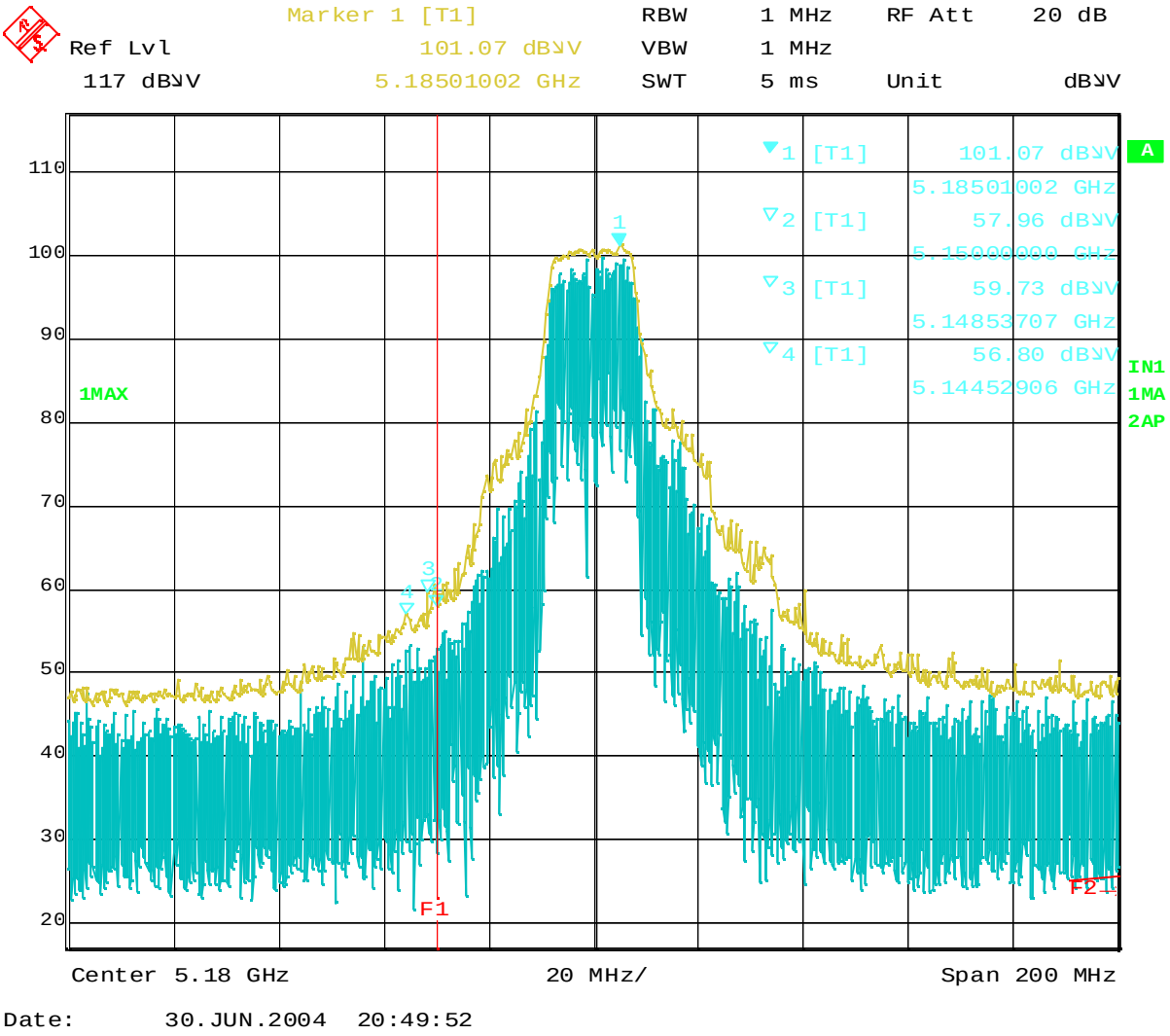
Table 7-3. Radiated peak emission in 5.2GHz OFDM transmission mode, 6Mbps

Measured host device: IBM ThinkPad **X30** Series, main antenna
IBM ThinkPad **X40** Series, auxiliary antenna

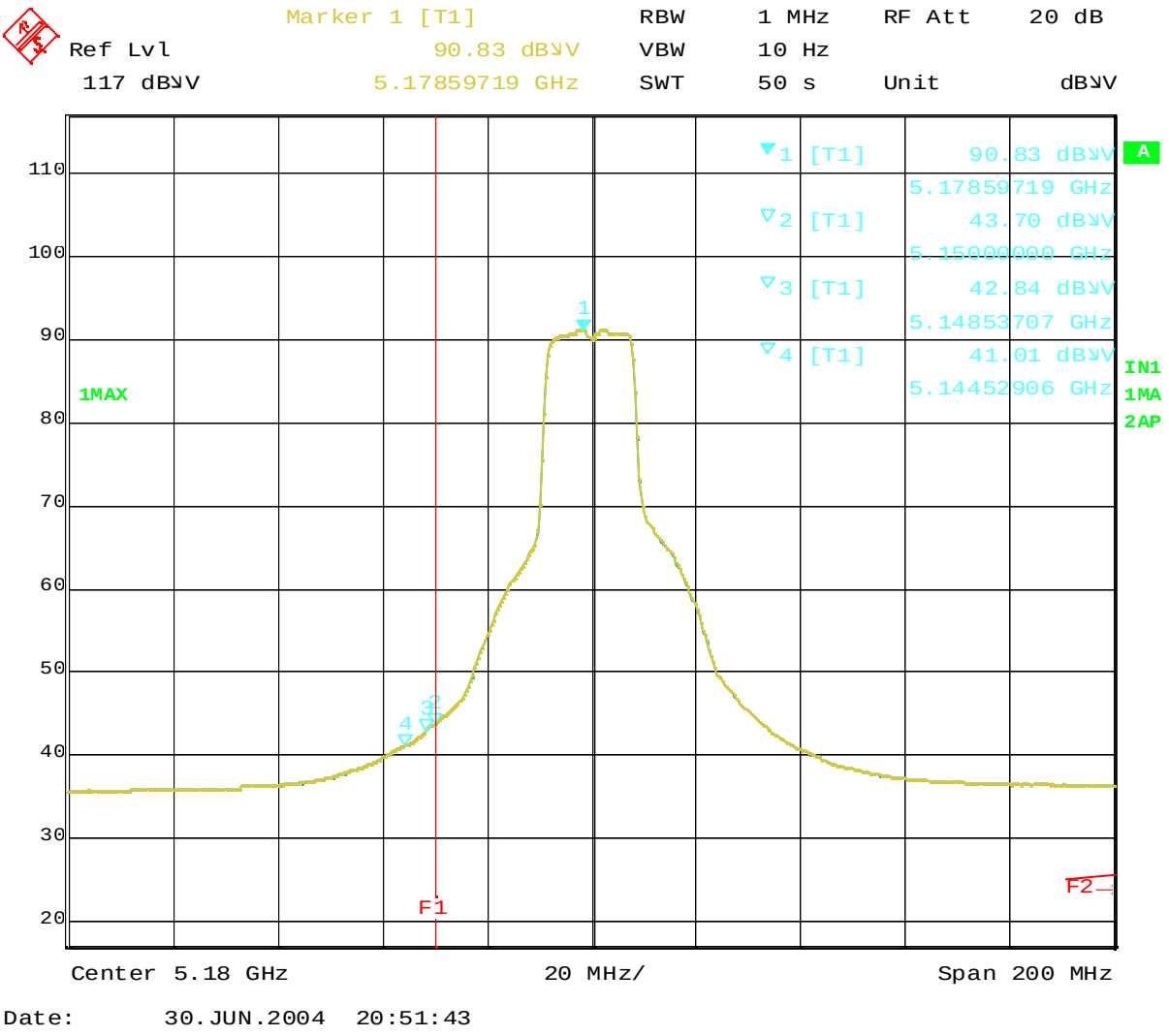
Host Device	Frequency (GHz)	Polarity (H/V)	Reading (dBμV) ***(peak)***	Rading (dBμV) ***(average)***	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ***(peak)***	Margin to Limit (dBμV/m) ***(peak)***	Field Strength (dBμV/m) ***(average)***	Margin to Limit (dBμV/m) ***(average)***
X30	5.150	V	58.0	43.7	33.6	-26.1	0.0	65.5	8.5	51.2	**2.8**
	5.350	V	56.7	40.7	33.9	-25.6	0.0	65.0	9.0	49.0	5.0
X40	5.150	H	56.6	41.3	33.6	-26.1	0.0	64.1	9.9	48.8	5.2
	5.350	H	53.7	39.2	33.9	-25.6	0.0	62.0	12.0	47.5	6.5

7.6.2 Bandedge Measurement Plots

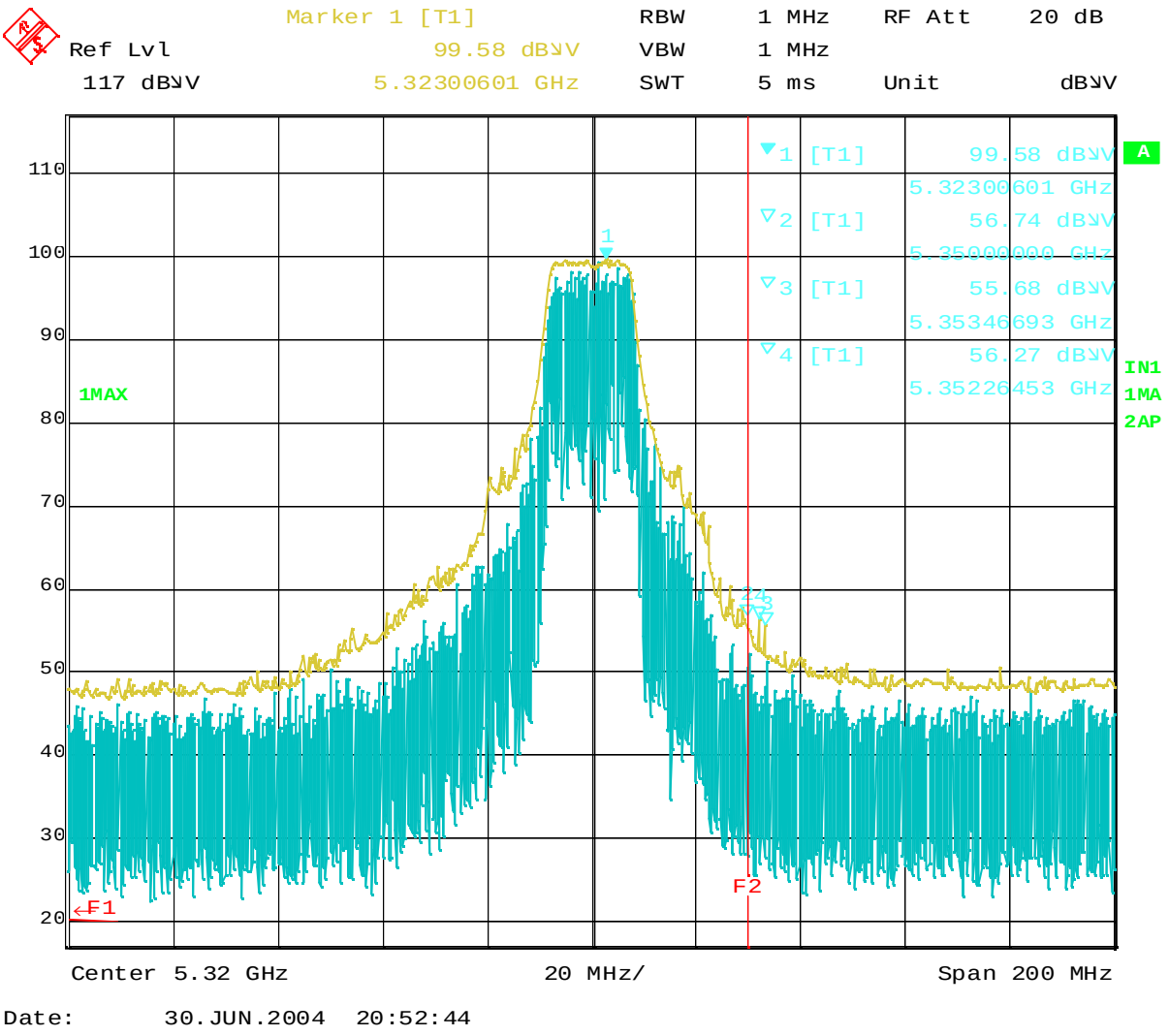
The plots were the worse cases measured with the ThinkPad X30 Series in the previous Table 7-3.



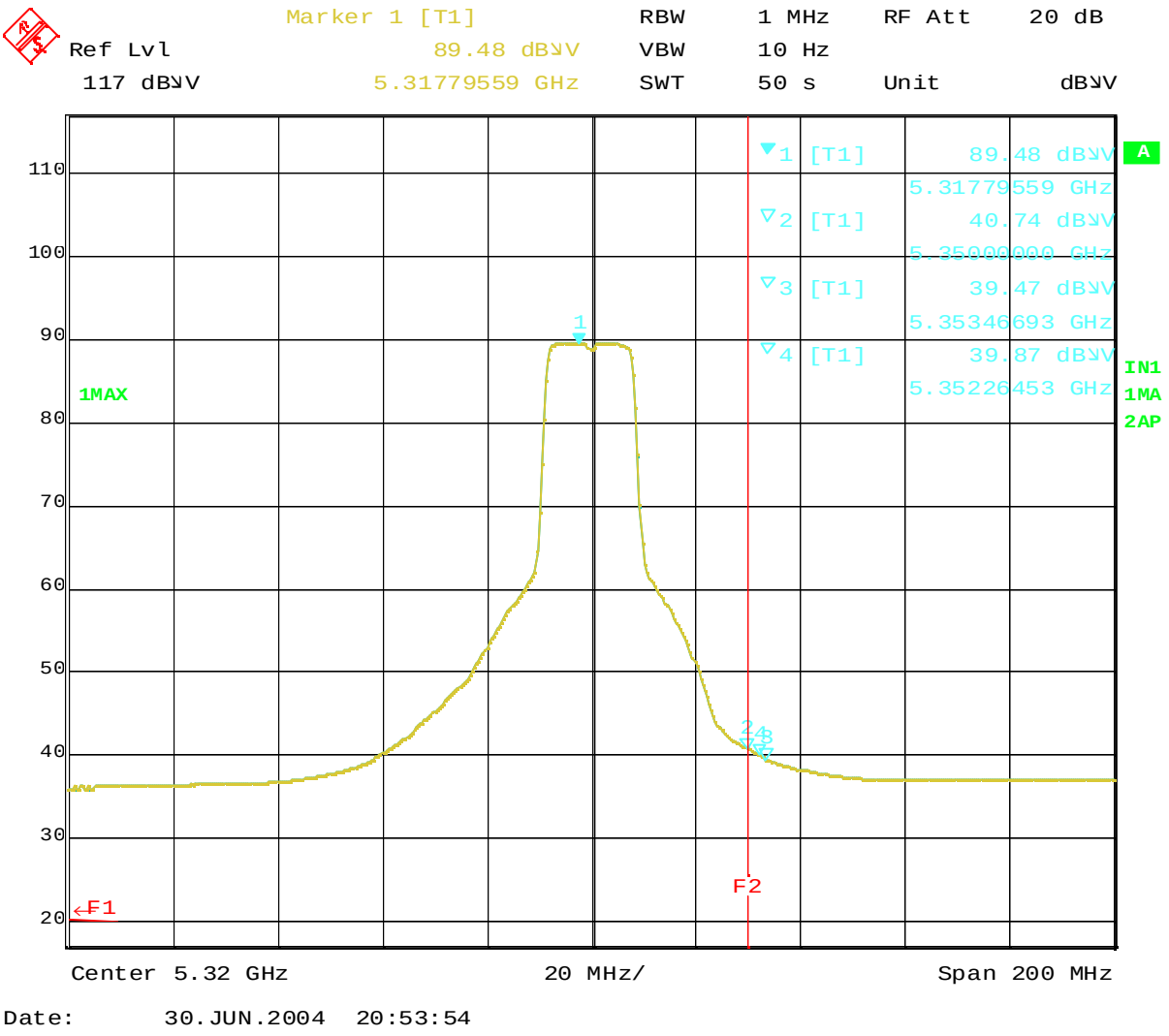
Plot 7-1 5180MHz TX, 6Mbps (Peak), X30 Series



Plot 7-2 5180MHz TX, 6Mbps (Average), X30 Series



Plot 7-3 5320MHz TX, 6Mbps (Peak), X30 Series



Plot 7-4 5320MHz TX, 6Mbps (Average), X30 Series