

# FCC Part 15, Subpart C (Intentional Radiator)

**Product Name: ThinkPad R30 Series**  
(2656/2657/2676)

**FCC ID: ANOCH126P8056**

**October 18, 2001**

EMC Engineer

Takeshi Asano

Signature: 

IBM Japan, Ltd.  
EMC Engineering  
LAB-S59  
1623-14, Shimotsuruma,  
Yamato-shi Kanagawa-ken 242-8502, Japan  
Phone: +81-46-215-4779  
Fax: +81-46-273-7420  
E-Mail: asano@jp.ibm.com

EMC Engineering Manager / NVLAP signatory

Akihisa Sakurai

Signature: 

IBM Japan, Ltd.  
EMC Engineering  
LAB-S59  
1623-14, Shimotsuruma,  
Yamato-shi Kanagawa-ken 242-8502, Japan  
Phone: +81-46-215-2613  
Fax: +81-46-273-7420  
E-Mail: akihisa@jp.ibm.com

OEM System Development Manager

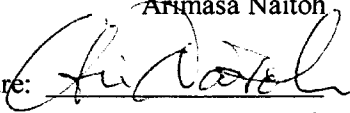
Ishikawa Tatsuroh

Signature: 

IBM Japan, Ltd.  
Portable Products  
LAB-R15  
1623-14, Shimotsuruma,  
Yamato-shi Kanagawa-ken 242-8502, Japan  
Phone: +81-46-215-2750  
E-Mail: tatsuro@jp.ibm.com

Portable Systems Director

Arimasa Naitoh

Signature: 

IBM Japan, Ltd.  
Portable Systems  
LAB-R11  
1623-14, Shimotsuruma,  
Yamato-shi Kanagawa-ken 242-8502, Japan  
Phone: +81-46-215-6110

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

**ThinkPad R30 Series  
(2656/2657/2676)**

**FCC ID : ANOCH126P8056**

**October 19, 2001**

<p>This report concerns: (check one)</p> <p>Original Grant _____</p> <p>Class I change _____</p> <p>Class II change <u>  ✓  </u></p>
<p>Equipment type: <u>Wireless LAN device in Computer</u> (computer, printer, modem, etc.)</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 C63.4-1992 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 -

**MEASUREMENT/TECHNICAL REPORT – PART 15 SUBPART C.....2**

**A. GENERAL INFORMATION.....2**

**A.1 TEST METHODOLOGY.....2**

**A.2 TEST FACILITY / NVLAP ACCREDITATION .....2**

**A.3 EUT DETAILS.....2**

**B. SUMMARY OF TEST RESULTS.....3**

**C. OPERATION MODE OF EUT.....4**

**D. TEST INSTRUMENTS.....5**

**1. RESTRICTED BANDS RADIATIONS (30MHZ – 1GHZ)....7**

**1.1 TEST PROCEDURE.....7**

**1.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....7**

**1.3 FIELD STRENGTH CALCULATION.....9**

**1.4 MEASUREMENT RESULTS.....10**

**2. RESTRICTED BANDS RADIATIONS (1GHZ – 25GHZ)....12**

**2.1 TEST PROCEDURE.....12**

**2.2 TEST INSTRUMENTS AND MEASUREMENT SETUP.....12**

**2.3 FIELD STRENGTH CALCULATION.....13**

**2.4 MEASUREMENT RESULTS.....14**

## A. GENERAL INFORMATION

APPLICANT : IBM Japan Ltd.  
 ADDRESS : 1623 – 14 Shimotsuruma, Yamato-shi, Kanagawa 242-8502 Japan  
 Tel: +81-46-215-4779, Fax: +81-46-273-7420  
 REGULATION : FCC Part 15 Subpart C  
 Industry Canada RSS-210 (Issue No.4)  
 MODEL NUMBER : 2656-HFU (ThinkPad R30 Series)  
 FCC ID : ANOCH126P8056  
 SERIAL NUMBER : BBFV-002  
 PHYSICAL CONDITION : Preproduction  
 KIND OF EQUIPMENT : Personal computer with a built-in Wireless LAN card  
 TESTED DATE : September 10, 17 and October 15, 2001  
 TEST SITE : IBM Yamato semi-anechoic chamber #2

### A.1 Test Methodology

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

### A.2 Test Facility / NVLAP Accreditation

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

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

### A.3 EUT details

Table A EUT details

Model and S/N	FCC ID	Description	Cable Description
ThinkPad R30 Series M/T 2656-HFU (s/n BBFV-002)	ANOCH126P8056	IBM Notebook PC CPU: Intel® Mobile PIII® 1.2GHz	
P/N 02K6665	N/A	Universal AC adapter 72W	Unshielded power cord

## B. SUMMARY OF TEST RESULTS

The radiated test items in Table-B were re-measured for this Class II Permissive Change Submission, since these items are affected by the antenna replacement.

The section numbers of upper portion are showing the FCC Part 15 Subpart C, and the other (lower) ones are for Industry Canada RSS-210.

Table-B List of the measurements

Section(s)	Test Items		Condition	Result
	Transmit mode (TX):			
<b>15.247(a)(2)</b> <b>5.9.1</b>	Bandwidth at 6 dB below		<b>Conducted</b>	<b>N/A</b>
<b>15.247(c)</b> <b>5.9.1</b> <b>6.2.2 (o) (e1)</b>	Occupied BW (or Band-edge) Out of Band Emissions (Bandwidth at 20 dB below)	The radiated emission in any 100KHz of outband shall be at least 20dB below the highest inband spectral density.		
<b>15.247(b)</b> <b>6.2.2 (o) (b)</b>	Transmitter output power Shall not exceed 1.0 W.			
<b>15.247(d)</b> <b>6.2.2 (o) (b)</b>	Transmitter power spectral Density Shall not be greater than 8 dBm in any 3KHz band.			
<b>15.247(e)</b> <b>6.2.2 (o) (b)</b>	Processing gain 10 dB			
<b>15.207</b> <b>6.6</b>	AC Wireline Conducted Emissions 450kHz – 30MHz Class B: 250uV			
<b>15.205 / 209</b> <b>6.2.1 / 6.3</b>	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Shall not exceed the limits specified in FCC 15.209 or RSS-210 Table3.	<b>Radiated</b> (30MHz -1GHz)	<b>Pass</b>
			<b>Radiated</b> (1– 25GHz)	<b>Pass</b>

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

## C. OPERATION MODE OF EUT

All tests were performed using the “PRISM Test Utility Program”, Version 3.0.24. Three kinds of modulation are used for transmission with appropriate bit rates:

Table C-1 Transmit mode (TX)

Operation Frequency [GHz]	Rated output power (conducted) [dBm]			Test performed*
	Bit rate 2Mbps	Bit rate 5.5Mbps	Bit rate 11Mbps	
2.412 (Ch. 1)	+15	+15	+15	X
2.417 (Ch. 2)	+15	+15	+15	
2.422 (Ch. 3)	+15	+15	+15	
2.427 (Ch. 4)	+15	+15	+15	
2.432 (Ch. 5)	+15	+15	+15	
2.437 (Ch. 6)	+15	+15	+15	X
2.442 (Ch. 7)	+15	+15	+15	
2.447 (Ch. 8)	+15	+15	+15	
2.452 (Ch. 9)	+15	+15	+15	
2.457 (Ch. 10)	+15	+15	+15	
2.462 (Ch. 11)	+15	+15	+15	X

\* Full testing with bit rate 11Mbps only

Table C-2 Receive mode (RX)

Operation Frequency [GHz]	Test performed
2.412 (Ch. 1)	
2.417 (Ch. 2)	
2.422 (Ch. 3)	
2.427 (Ch. 4)	
2.432 (Ch. 5)	
2.437 (Ch. 6)	X
2.442 (Ch. 7)	
2.447 (Ch. 8)	
2.452 (Ch. 9)	
2.457 (Ch. 10)	
2.462 (Ch. 11)	

## D. TEST INSTRUMENTS

Table-D List of Measuring Instruments

Description	Model	Serial Number	Calibration Date	Calibration Interval
Computer	IBM 5551-L	#4	N/A	N/A
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	3019A05155	02/07/01	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	3019A05156	04/02/01	1 year
Spectrum Analyzer Display	HP 85662A	3026A19353	02/07/01	1 year
Spectrum Analyzer Display	HP 85662A	3026A19366	04/02/01	1 year
Quasi-Peak Adapter	HP 85650A	3033A01449	02/07/01	1 year
Quasi-Peak Adapter	HP 85650A	2811A01433	04/02/01	1 year
Amplifier (100KHz - 1.3GHz) - for 30-200MHz - for 200-1000MHz	HP 8447D HP 8447D	2805A02919 2944A03506	04/16/01 04/16/01	1 year 1 year
Amplifier (1GHz - 26.5GHz)	HP 8449B	3008A00582	05/23/01	1 year
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003	07/04/01	1 year
Receiver (20MHz-1.3GHz)	R&S ESVP	893202/018	01/29/01	1 year
Biconical Antenna (30-200MHz)	EMCO 3108	2241	05/11/01	1 year
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	1584	05/10/01	1 year
Horn Antenna (1- 18GHz)	EMCO 3115	9903-5774	04/23/01	1 year
Horn Antenna (3.95- 5.85GHz)	EMCO 3160-5	1099	04/26/01	1 year
Horn Antenna (5.85- 8.20GHz)	EMCO 3160-6	9712-1044	04/26/01	1 year
Horn Antenna (18- 26.5GHz)	EMCO 3160-9	0004-1202	05/01/01	1 year
Switch/control unit	HP 3488A	2719A17226	N/A	N/A
SF106 cables: - Horn Ant <=> RF Amp. - RF Amp.<=>Spectrum Analyzer	Length: 6 m 15m	- EM206SCO - EM215SCO	08/07/01 08/07/01	1 year 1 year
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	9 m 10 m 7 m 0.5m 9 m 10 m 7 m 0.5m	- EM203L01 - EM203L02 - EM203L03 - EM203L04 - EM203H01 - EM203H02 - EM203H03 - EM203H04	04/16/01 04/16/01 04/16/01 04/16/01 04/16/01 04/16/01 04/16/01 04/16/01	1 year 1 year 1 year 1 year 1 year 1 year 1 year 1 year
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	1 m 1 m 1 m 1 m 2 m 2 m	- EM203L05 - EM203L06 - EM203H05 - EM203H06 - EM2RCV - EM2SPL	04/16/01 04/16/01 04/16/01 04/16/01 04/16/01 04/16/01	1 year 1 year 1 year 1 year 1 year 1 year

- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM2SPH	04/16/01	1 year
--	-----	----------	----------	--------

Notes.

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



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

## 1.1 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.

## 1.2 Test Instruments and Measurement Setup

Table 1-1 Radiated Emission Test Instrumentation

Description	Model	Serial Number
Computer	IBM 5551-L	#4
Spectrum Analyzer (100Hz-1.5GHz) for 30-200MHz	HP 85680B	3019A05155
Spectrum Analyzer Display for 30-200MHz	HP 85662A	3026A19353
Quasi-Peak Adapter for 30-200MHz	HP 85650A	3033A01449
Spectrum Analyzer (100Hz-1.5GHz) for 200-1000MHz	HP 85680B	3019A05156
Spectrum Analyzer Display for 200-1000MHz	HP 85662A	3026A19366
Quasi-Peak Adapter for 200-1000MHz	HP 85650A	2811A01433
Amplifier (100KHz-1.3GHz)		
- for 30-200MHz	HP 8447D	2805A02919
- for 200-1000MHz	HP 8447D	2944A03506
Biconical Antenna (30-200MHz)	EMCO 3108	2241
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	1584
Receiver (20MHz-1.3GHz)	R&S ESVP	893202/018
Switch/control unit	HP 3488A	2719A17226
N-Coax cables:	Length:	
- Bi-coni Ant <=> 10m Cable	9 m	- EM203L01
- 10m Cable <=> Shield Panel	10 m	- EM203L02
- Shield Panel <=> RF Amp	7 m	- EM203L03
- RF Amp <=> Power Splitter	0.5m	- EM203L04
- Log-peri Ant <=> 10m Cable	9 m	- EM203H01
- 10m Cable <=> Shield Panel	10 m	- EM203H02
- Shield Panel <=> RF Amp	7 m	- EM203H03
- RF Amp <=> Power Splitter	0.5m	- EM203H04
Coax cables:		
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM203L05
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM203L06
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM203H05
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM203H06

- SW/Con.unit <=> Receiver (Input)	2 m	- EM2RCV
- SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	2 m	- EM2SPL
- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHZ	2 m	- EM2SPH

Notes:

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

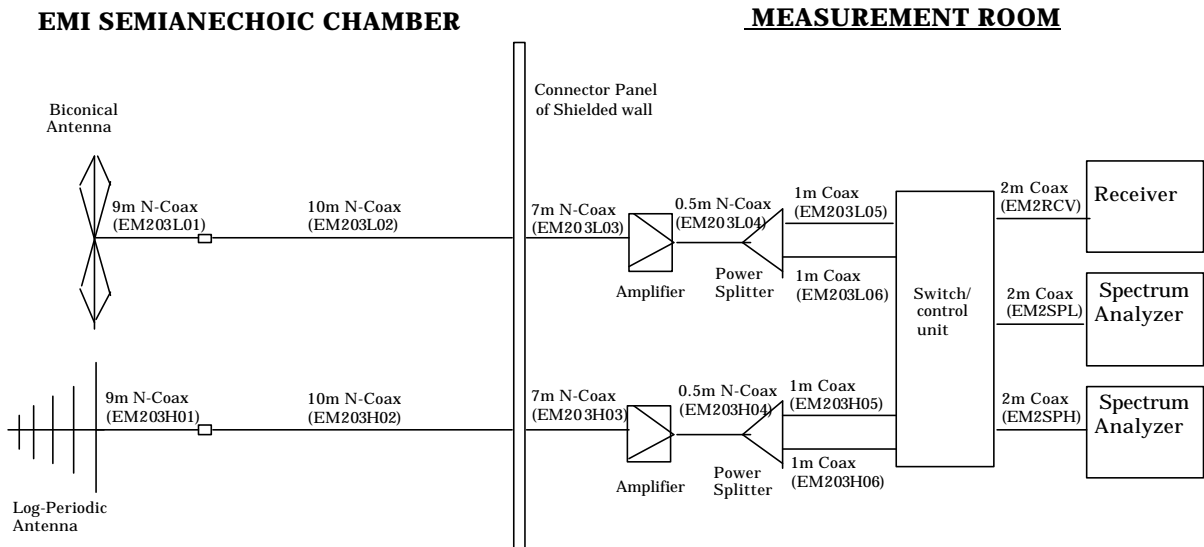


Figure 1 Cables for Radiated Emission Test

## 1.3 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:

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

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

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

## 1.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 4.6 dB at 30MHz - 1000MHz band.

The 6 highest emissions relative to the limits are reported.

Test Date: September 10, 2001

### 1) EUT in transmission mode

Table 1-2-1. EUT: M/T 2656-HFU, s/n BBFV-002, Ch.1(2412MHz) TX mode 11Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
325.052	V	38.4	14.0	-14.4	38.0	46.0	79.4	200
338.374	V	40.6	13.9	-14.6	39.9	46.0	98.9	200
455.074	V	34.7	16.2	-14.9	36.0	46.0	63.1	200
600.735	V	33.4	18.7	-14.4	37.7	46.0	76.7	200
625.592	V	31.6	19.0	-14.2	36.4	46.0	66.1	200
667.467	V	33.9	20.2	-14.1	40.0	46.0	100.0	200

Table 1-2-2. EUT: M/T 2656-HFU, s/n BBFV-002, Ch.6(2437MHz) TX mode 11Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
325.052	V	40.1	14.0	-14.4	39.7	46.0	96.6	200
338.374	V	41.2	13.9	-14.6	40.5	46.0	105.9	200
399.285	V	36.8	15.2	-14.8	37.2	46.0	72.4	200
600.687	V	32.2	18.7	-14.4	36.5	46.0	66.8	200
667.425	V	32.3	20.2	-14.1	38.4	46.0	83.2	200
934.394	V	26.5	23.0	-11.2	38.3	46.0	82.2	200

Table 1-2-3. EUT: M/T 2656-HFU, s/n BBFV-002, Ch.11(2462MHz) TX mode 11Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
325.054	V	41.2	14.0	-14.4	40.8	46.0	109.6	200
338.374	V	41.5	13.9	-14.6	40.8	46.0	109.6	200
399.006	V	41.1	15.2	-14.9	41.4	46.0	117.5	200
600.668	V	32.3	18.7	-14.4	36.6	46.0	67.6	200
667.407	V	32.1	20.2	-14.1	38.2	46.0	81.3	200
934.367	V	25.2	23.0	-11.2	37.0	46.0	70.8	200

2) EUT in receiving mode

Table 1-2-4. EUT: M/T 2656-HFU, s/n BBFV-002, 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)
325.054	V	41.4	14.0	-14.4	41.0	46.0	112.2	200
338.373	V	41.7	13.9	-14.6	41.0	46.0	112.2	200
400.905	V	39.0	15.2	-14.9	39.3	46.0	92.3	200
439.999	V	39.6	15.8	-14.2	41.2	46.0	114.8	200
483.998	V	36.9	17.1	-14.5	39.5	46.0	94.4	200
620.688	V	31.8	18.9	-14.3	36.4	46.0	66.1	200

## 2. RESTRICTED BANDS RADIATIONS (1GHz – 25GHz)

### 2.1 Test Procedure

Radiated emissions were measured in the frequency range with 1 GHz to 25GHz in transmitting mode and 1 GHz to 12.5 GHz in receiving mode. All tests were performed in the semi-anechoic chamber at a 3-meter distance (except for the frequency range with 18 GHz to 25 GHz where test distance was reduced to 1 meter) on both horizontal and vertical polarities. The antenna was also scanned in height. The 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 a bandwidth of 1MHz and the average setting mode with the tuned spectrum analyzer using resolution bandwidth of 1MHz / video bandwidth of 1kHz. The highest emissions relative to the limit are listed.

### 2.2 Test Instruments and Measurement Setup

Table 2 Radiated Emission Test Instrumentation (1GHz – 25GHz)

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

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

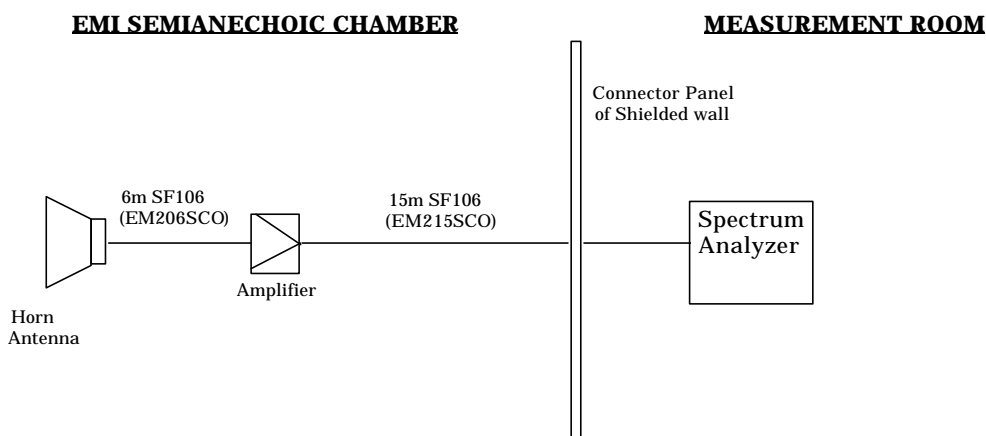


Figure 2 Cables for Radiated Emission Test

## 2.3 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 :

Level(dB $\mu$ V/m)	=	20 $\times$ Log (Level( $\mu$ V/m))
40 dB $\mu$ V/m	=	100 $\mu$ V/m
48 dB $\mu$ V/m	=	250 $\mu$ V/m

## 2.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 8.0 dB. The measurement was done for the frequency range of 1 GHz to 25 GHz in TX mode and 1 GHz to 12.5GHz in RX mode.

Test Date: September 17 and October 15, 2001

### 1) EUT in transmission mode

Table 2-2-1. EUT: M/T 2656-HFU, s/n BBFV-002, Ch.1(2412MHz) TX mode 11Mbps

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) (peak)	Measured (dBμV) (average)	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) (peak)	FCC Limit (dBμV/m) (peak)	Field Strength (dBμV/m) (average)	FCC Limit (dBμV/m) (average)
1.065	V	63.0	47.3	24.2	-31.5	0.0	55.7	74.0	40.0	54.0
1.132	V	58.4	-	24.4	-31.3	0.0	51.5	74.0	-	54.0
1.196	V	62.7	43.7	24.6	-31.2	0.0	56.1	74.0	37.1	54.0
1.338	V	53.8	-	24.9	-30.8	0.0	47.9	74.0	-	54.0
1.736	V	52.4	-	26.3	-30.0	0.0	48.7	74.0	-	54.0
2.037	V	57.3	54.9	27.5	-29.5	0.0	55.3	NRB*	52.9	NRB*
2.281	H	48.4	-	28.0	-28.7	0.0	47.7	74.0	-	54.0
2.304	V	48.1	-	28.2	-28.5	0.0	47.8	74.0	-	54.0
2.389	H	55.3	46.3	28.2	-28.5	0.0	55.0	74.0	46.0	54.0
2.414	H	106.7	102.4	28.2	-28.4	0.0	106.5	OB*	102.2	OB*
4.074	V	49.8	-	27.4	-24.3	0.0	52.9	74.0	-	54.0
4.824	H	38.2	-	27.4	-23.7	0.0	41.9	74.0	-	54.0
6.113	V	40.2	-	29.8	-23.0	0.0	47.0	74.0	-	54.0
7.236	V	39.5	-	30.0	-24.6	0.0	44.9	74.0	-	54.0

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



Table 2-2-2. EUT: M/T 2656-HFU, s/n BBFV-002, Ch.6(2437MHz) TX mode 11Mbps

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>
1.067	V	61.0	-	24.2	-31.5	0.0	53.7	74.0	-	54.0
1.132	V	55.7	-	24.4	-31.3	0.0	48.8	74.0	-	54.0
1.201	V	60.9	43.1	24.6	-31.2	0.0	54.3	74.0	36.5	54.0
1.331	V	55.2	-	24.9	-30.8	0.0	49.3	74.0	-	54.0
1.736	V	54.8	-	26.3	-30.0	0.0	51.1	74.0	-	54.0
2.063	H	57.6	55.9	27.5	-29.4	0.0	55.7	NRB*	54.0	NRB*
2.306	H	49.1	-	28.0	-28.7	0.0	48.4	74.0	-	54.0
2.327	H	50.6	-	28.0	-28.7	0.0	49.9	74.0	-	54.0
2.439	H	104.5	100.2	28.3	-28.4	0.0	104.4	OB*	100.1	OB*
4.124	V	49.3	-	27.4	-24.3	0.0	52.4	74.0	-	54.0
4.876	V	40.9	-	27.4	-23.7	0.0	44.6	74.0	-	54.0
6.188	V	39.7	-	29.9	-23.1	0.0	46.5	74.0	-	54.0
7.313	V	37.9	-	29.9	-24.8	0.0	43.0	74.0	-	54.0

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

Table 2-2-3. EUT: M/T 2656-HFU, s/n BBFV-002, Ch.11(2462MHz) TX mode 11Mbps

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>
1.065	V	63.7	47.6	24.2	-31.5	0.0	56.4	74.0	40.3	54.0
1.133	V	58.0	-	24.4	-31.3	0.0	51.1	74.0	-	54.0
1.201	V	62.3	44.9	24.6	-31.2	0.0	55.7	74.0	38.3	54.0
1.338	V	57.4	-	24.9	-30.8	0.0	51.5	74.0	-	54.0
1.728	V	53.7	-	26.3	-30.0	0.0	50.0	74.0	-	54.0
2.087	H	59.0	57.1	27.6	-29.3	0.0	57.3	NRB*	55.4	NRB*
2.331	H	51.8	-	28.1	-28.6	0.0	51.3	74.0	-	54.0
2.352	H	50.7	-	28.1	-28.6	0.0	50.2	74.0	-	54.0
2.464	H	102.6	98.1	28.3	-28.3	0.0	102.6	OB*	98.1	OB*
2.484	H	54.4	44.6	28.4	-28.2	0.0	54.6	74.0	44.8	54.0
4.174	V	49.6	-	27.4	-24.2	0.0	52.8	74.0	-	54.0
4.926	V	40.3	-	27.4	-23.6	0.0	44.1	74.0	-	54.0
6.264	V	40.5	-	29.9	-23.2	0.0	47.2	74.0	-	54.0
7.387	V	37.8	-	29.5	-25.0	0.0	42.3	74.0	-	54.0

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

2) EUT in receiving mode

Table 2-2-4. EUT: M/T 2656-HFU, s/n BBFV-002, 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>
1.067	V	61.6	49.8	24.2	-31.5	0.0	54.3	74.0	42.5	54.0
1.097	V	61.3	46.7	24.3	-31.3	0.0	54.3	74.0	39.7	54.0
1.196	V	61.1	44.5	24.6	-31.2	0.0	54.5	74.0	37.9	54.0
1.335	V	56.1	-	24.9	-30.8	0.0	50.2	74.0	-	54.0
1.734	V	55.3	-	26.3	-30.0	0.0	51.6	74.0	-	54.0
2.063	V	49.9	-	27.5	-29.4	0.0	48.0	74.0	-	54.0
4.124	V	43.6	-	27.4	-24.3	0.0	46.7	74.0	-	54.0
6.188	V	39.5	-	29.9	-23.1	0.0	46.3	74.0	-	54.0