

EMI TEST REPORT

Test Report No. : 21EE0013-YW-1

Applicant: Sony Corporation

Type of Equipment: Handy Reader/Writer

Model No.: MLU-200

Test standard: FCC Part 15 Subpart C

FCC ID: AK8MLU200

Test Result: Complies

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2. The results in this report apply only to the sample tested.

Date of test: January 18, and 22, 2001 **Issued date:** February 8, 2001

Tested by:



Naoki Sakamoto
EMC section

Approved by:



Kazuhiro Kitahara
Section Manager of EMC section

Form Version No. 2

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SECTION 1: Applicant information

Company Name : Sony Corporation

Company Trade Name : SONY

Address : 4-14-1, Asahi-cho, Atsugi-shi, Kanagawa-ken, 243-0014 Japan

Telephone Number : +81-46-230-5602

Facsimile Number : +81-46-230-6354

Contact Person : H.Komoriya

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Unique Type Identification : Handy Reader / Writer

Model No. : MLU-200

Serial No. : 1001

Rating : DC 3.6V

Country of Manufacture : Japan

Receipt Date of Sample : January 16 , 2001

2.2 Product Description

2.2 Product Description

Model:MLU-200 (referred to as the EUT in this report) is Handy Reader/Writer of Personal computer system.

The specification is as follows;

Data reading/writing without physical contact with the memory label.

Anticollison is realized for the data transmission between MLU-200 and the memory labels.

Transmission frequency : 13.56MHz

Modulation : ASK

Operation frequency : 18.432MHz and 48.000MHz

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SECTION 3: Test specification, methods & procedures

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
Title : FCC 47CFR Part15 Radio Frequency Device
Subpart C Intentional Radiators
§ 15.225 Operation within the Band 13.553 - 13.567 MHz

3.2 Methods & Procedures

No.	Item	Test Procedure	Specification	Remarks
1	Electric Field Strength of Fundamental Emission	FCC/ANSI C63.4:1992	§ 15.225(a)	-
2	Electric Field Strength of Spurious Emission	FCC/ANSI C63.4:1992	§ 15.225(b)	-
3	Frequency Tolerance	FCC/ANSI C63.4:1992	§ 15.225(c)	-
4	Conducted Emission	FCC/ANSI C63.4:1992	§ 15.207(a)	

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SECTION 4: Operation of E.U.T. during testing

4.1 Operating Modes

The EUT exercise program used during radiated testing was designed to exercise the various system components in a manner similar to typical use.

The sequence is used

Radiated Emission : Continuously read/write mode(Radio transmission)

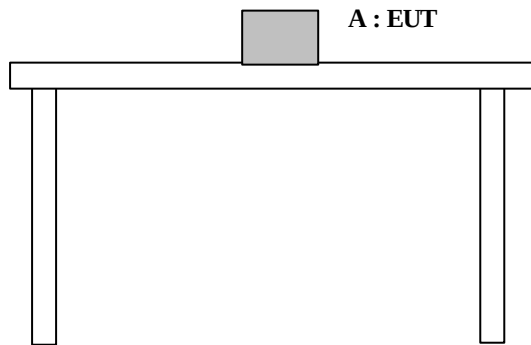
Conducted Emission: Communication mode(The data are communicating between MLT-200.)

Justification: The system was configured in typical fashion (as a customer would normally use it) for testing.

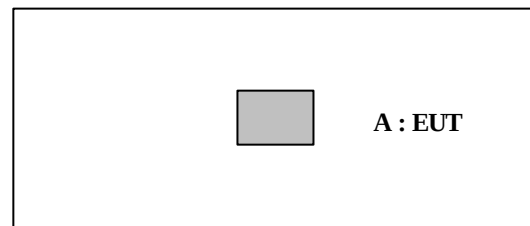
4.2 Configuration and peripherals

Radiated Emission

Front View

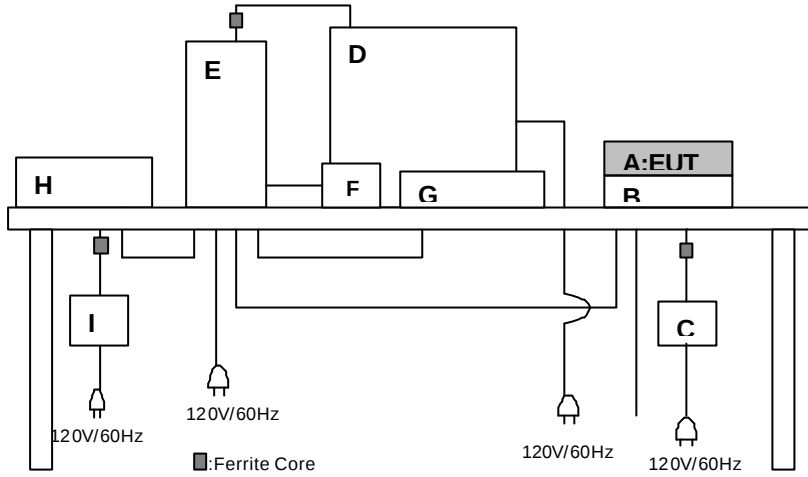


Top View

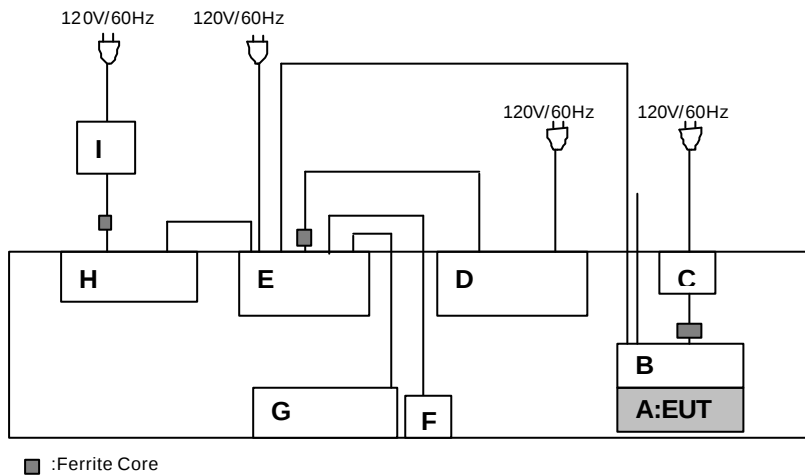


Conducted Emission

Front View



Top View



*Cabling was taken into consideration and test data was taken under worst case conditions.

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Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remark
A	Handy Reader/Writer	MLU-200	1001	Sony Corporation	EUT
B	Terminal	MLT-200	-	Sony Corporation	-
C	Power Supply	SWA0902W	1001	TAMURA Corporation	-
D	Color Graphic Display	GDM-17SE1	2100506	Sony Corporation	-
E	Personal Computer	GXMT 5166	S36M9	DELL Computer Corporation	-
F	Mouse	Mouse Port Compatible Mouse 219	02023610	Microsoft	-
G	Keyboard	SK-1000REW	M960493442	DELL Computer Corporation	-
H	Printer	DESKJET 815C C6411C	MY9BH1B0F3	Hewlett Packard	-
I	AC Power Adapter	C6409-60014	B9M09B	Hewlett Packard	-

List of cables used

No.	Name	Length (m)	Shield	Backshell Material
	RS-232C cable	2.0	Y	-
	Printer cable	3.0	Y	-
	Monitor cable	1.5	Y	-
	AC power cable	2.0	N	-
	DC power cable	1.5	N	-
	USB cable	0.8	Y	-
	AC power cable	1.8	N	-
	DC power cable	2.0	N	-
	Mouse cable	1.9	Y	-
	Keyboard cable	1.9	Y	-

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SECTION 5: Summary of test results**5.1 Test results**

No.	Item	Test Procedure	Specification	Remarks	Result
1	Electric Field Strength of Fundamental and Spurious Emissions(9kHz – 30MHz)	FCC/ANSI C63.4:1992	FCC Part15 Subpart C § 15.225(a),(b)	10m	Complies
2	Electric Field Strength of Spurious Emission (30MHz – 1000MHz)	FCC/ANSI C63.4:1992	FCC Part15 Subpart C § 15.225(b)	3m	Complies
3	Frequency Tolerance	FCC/ANSI C63.4:1992	FCC Part15 Subpart C § 15.225(c)	-	Complies
4	Conducted Emission	FCC/ANSI C63.4:1992	FCC Part15 Subpart C § 15.207(a)	-	Complies

A-PEX INTERNATIONAL hereby confirms that E.U.T., in the configuration tested, complies with the specifications FCC Part15 Subpart C.

5.1.1 Electric Field Strength Measurement of Fundamental Frequency

The following table lists frequency at which emissions were measured using a Quasi-Peak detector and at a test distance of 10m

Frequency (MHz)	Ant. Receiver Reading (dB μ V)	Correction Factor (dB)	Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
13.56	36.7	-1.3	35.4	99.0	63.6

Note: The limit was calculated using the square of an inverse linear distance extrapolation factor (40dB/decade) i.e $40\log_{10}(d1/d2)$.

30m Fundamental Emission Limit (10,000 μ V/m) = $20\log_{10}(10,000) = 80.0\text{dB } \mu\text{ V/m}$

10m Fundamental Emission Limit = $80\text{dB } \mu\text{ V/m} + 40\log_{10}(30/10) = 99.0\text{dB } \mu\text{ V/m}$

Field strength calculation

The field strength is calculated by adding the Antenna Factor, Cable Factor and Antenna Pad, and subtracting the Amplifier Gain from the measured reading. The sample calculation is as follows :

$$FS = RA + AF + CF + AT - AG$$

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Factor

AT = Antenna Pad

AG = Amplifier Gain

Assume a receiver reading of 36.7 dB μ V is obtained. The antenna Factor of 20.2 dB, Cable Factor of 0.7 dB and Antenna Pad of 6.0 dB is added. The Amplifier Gain of 28.2 dB is subtracted, giving a field strength of 35.4 dB μ V/m.

$$FS = 35.9 + 20.2 + 0.7 + 6.0 - 28.2 = 35.4 \text{ dB } \mu\text{ V/m}$$

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5.1.2 Electric Field Strength of Spurious Emission

The initial step in collecting radiated data was a spectrum analyzer peak scan of the measurement range (9kHz-1000MHz).

The final data was reported in the worst-case emissions.

The following table lists frequency at which emissions were measured using a Quasi-Peak detector.

Test distance : 10m(9kHz – 30MHz)

Test distance : 3m(30MHz – 1000MHz)

The minimum margin to the limit is as follows :

Frequency (MHz)	Ant. Pol.	Receiver Reading (dB μ V)	Correction Factor (dB)	Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
393.23	Ver	39.1	-2.0	37.1	46.0	8.9

Field strength calculation

The field strength is calculated by adding the Antenna Factor, Cable Factor and Antenna Pad, and subtracting the Amplifier Gain from the measured reading. The sample calculation is as follows :

$$FS = RA + AF + CF + AT - AG$$

where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Factor
AT = Antenna Pad
AG = Amplifier Gain

Assume a receiver reading of 39.1 dB μ V is obtained. The antenna Factor of 15.6 dB, Cable Factor of 4.2 dB and Antenna Pad of 5.9 dB is added. The Amplifier Gain of 27.7 dB is subtracted, giving a field strength of 37.1 dB μ V/m.

$$FS = 39.1 + 15.6 + 4.2 + 5.9 - 27.7 = 37.1 \text{ dB } \mu \text{ V/m}$$

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5.1.3 Frequency Tolerance

Measurements were performed to determine the frequency stability of the fundamental emission from the EUT when subjected to a variation in ambient temperature and a variation of supply voltage.

5.1.3.1 Variation of Ambient Temperature

The ambient temperature was varied from -20 to +50 . During the test, the fundamental frequency of the EUT shall be maintained within $\pm 0.01\%$ of the operating frequency.

Frequency Error Limit: 13.56MHz : $\pm 0.01\%$ (1.356kHz)

Lower freq Limit =13.55864MHz / Upper freq Limit = 13.56136MHz

Temperature()	0 minuts	2 minuts	5 minuts	10 minuts	Result
-20	-306Hz	-259Hz	-205Hz	-133Hz	Complied
+50	-302Hz	-223Hz	- 188Hz	- 125Hz	Complied

5.1.3.2 Variation of Supply Voltage

Battery full charge

5.1.4 Data of conducted emission test

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range (450kHz-30MHz).

The final data represents worst-case emissions.

Frequency (MHz)	Line (N/L1)	Measured (dB μ V)	LISN Factor(dB)	Result (dB μ V)	Limit (dB μ V)	Margin (dB μ V)
0.6945	N	41.2	0.8	42.0	48.0	6.0

* All readings are quasi-peak mode.

* LISN Factor = include Cable loss

5.2 Uncertainty

Radiated Emission Test

The measurement uncertainty (with a 95% confidence level) for this test was $\pm 3.3\text{dB}$.

- ☐ The data listed in this test report may exceed the test limit because it does not have enough margin (more than 3.3dB).
- ☒ The data listed in this test report has enough margin, more than 3.3dB.

Conducted Emission Test

The measurement uncertainty (with a 95% confidence level) for this test was $\pm 2.0\text{dB}$.

- ☐ The data listed in this test report may exceed the test limit because it does not have enough margin (more than 2.0dB).
- ☒ The data listed in this test report has enough margin, more than 2.0dB.

5.3 Test equipment used

See SECTION 6: TEST EQUIPMENT USED

5.4 Test Location

A-PEX International Co.,Ltd. Yokowa No.3 test site
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Telephone number : +81-596-39-1485
Facsimile number : +81-596-39-0232

This site has been fully described in a report submitted to FCC office, and listed on September 12, 2000
(Registration number: 90412).

*NVLAP Lab. code : 200109-0

5.5 Test Configuration Photographs

See Appendix 1.

5.6 Data of EMI Test

See Appendix 2.

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SECTION 6: Test instruments

EMI test instrument

Instrument	Mfr.	Model No.	Control No.	Calibration date / Interval
Pre Amplifier	Hewlett Packard	8447D	AF-01	November 6, 2000 / 1 year
Biconical Antenna	Schwarzbeck	BBA9106	BA-03	April 29, 2000 / 1 year
Logperiodic Antenna	Schwarzbeck	UKLP9108-A	LA-06	April 30, 2000 / 1 year
LISN	Schwarzbeck	NSLK8127	LS-03	November 3, 2000 / 1 year
LISN	Rohde & Schwarz	ESH3-Z5	LS-04	November 3, 2000 / 1 year
Spectrum Analyzer	Hewlett Packard	8567A	SA-04	November 6, 2000 / 6 months
Test Receiver	Rohde & Schwarz	ESHS10	TR-05	August 18, 2000 / 1 year
Test Receiver	Rohde & Schwarz	ESVS10	TR-06	August 10, 2000 / 1 year
Universal Counter	Agilent	53131A	UC-01	October 1, 2001 / 1 year

*All measurement equipment is traceable to national standard.

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SECTION 7 Radiated emission

7.1 Operating environment

The test was carried out in an open site.

Temperature : See data
Humidity : See data

7.2 Test configuration

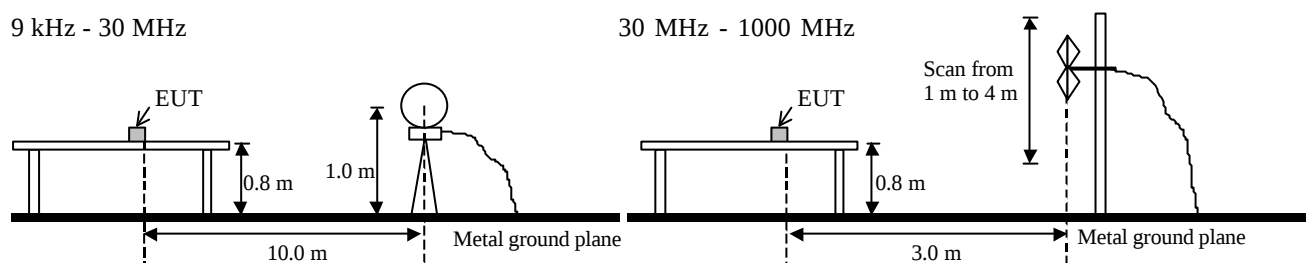
EUT was placed on a table of nominal size, 1m by 1.5m, raised 80cm above the conducting ground plane.

The rear of EUT, including peripherals was aligned and flush with rear of tabletop.

Test was made with the antenna positioned in both the horizontal and vertical planes of polarization.

The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength.

Figure 1 Drawing of the test set-up



7.3 Test conditions

Frequency range : 9kHz-30MHz (Loop antenna) / 30MHz-300MHz (biconical antenna)
/ 300MHz-1000MHz (Log-periodic antenna)
Test distance : 10m(9kHz – 30MHz)
: 3m(30MHz – 1000MHz)
EUT position : Table top

7.4 Test procedure

The Radiated Electric Field Strength intensity has been measured on an open test site with a ground plane at a distance of 3m and 10m from the EUT to the antenna.

Pre check measurements were performed in a shielded room or used search coil for ambient noise at high-level, especially from 272MHz to 288MHz.

Measurements were performed with a quasi-peak detector.

The measuring antenna height was varied between 1m to 4m(30-1000MHz) and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for both vertical and horizontal antenna polarization.

The EUT was put into operation at Read/write mode.

7.5 Results

Summary of the test results: Pass

Date: 2001-01-22 Tested by: Naoki Sakamoto

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SECTION 8: Conducted emission

8.1 Operating environment

The test was carried out in a shielded room ($3.6 \times 7.2 \times 2.4\text{m}$).

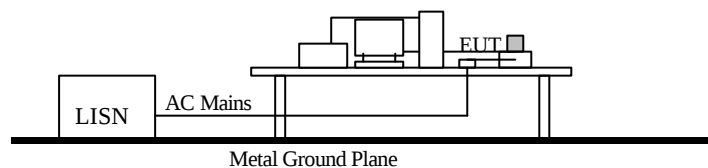
Temperature : See data
Humidity : See data

8.2 Test configuration

EUT was placed on a platform of nominal size, 1m by 1.5m, raised 80cm above the conducting ground plane. The rear of tabletop was located 40cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flush with rear of tabletop. All other surfaces of tabletop was at least 80cm from any other grounded conducting surface. Each EUT current-carrying power lead, except the ground (safety) lead, were individually connected through a LISN to the input power source. All unused 50Ω connectors of the LISN were resistively terminated in 50Ω when not connected to the measuring equipment.

A drawing of the set up is shown in fig. 1 and the photos of Appendix 1.

Figure 1. Drawing of the test set-up



8.3 Test conditions

Frequency range : 0.45MHz-30MHz

EUT position : Table top

8.4 Test procedure

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a shielded room. The EUT was connected to a Line Impedance Stabilization Network (LISN). An overview sweep with peak detection has been performed. The measurements have been performed with a quasi-peak detector and if required, with an average detector. The EUT was put into operation at Communication mode.

8.5 Results

Summary of the test results: Pass

Date: 2001-01-18 Tested by: N. Sakamoto

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YOKOWA LAB.

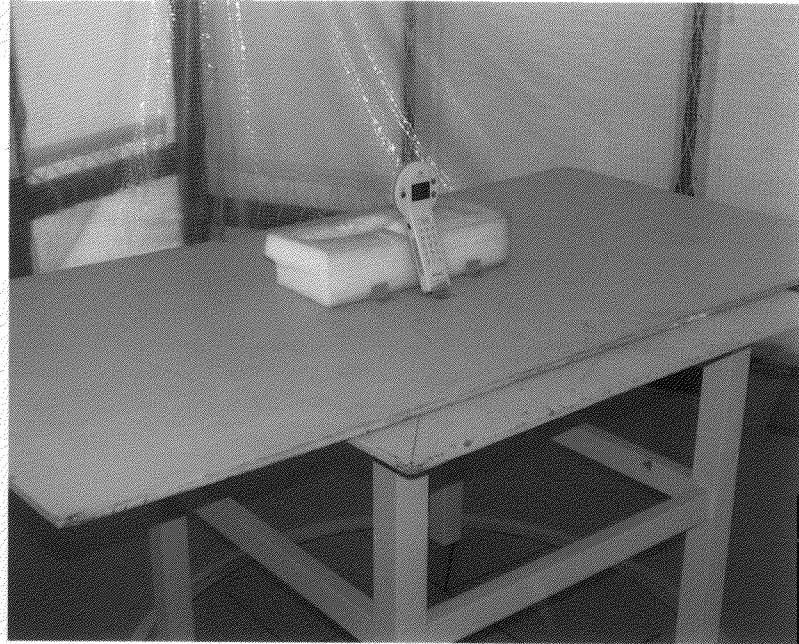
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APPENDIX 1: Photographs of test setup

Radiated emission



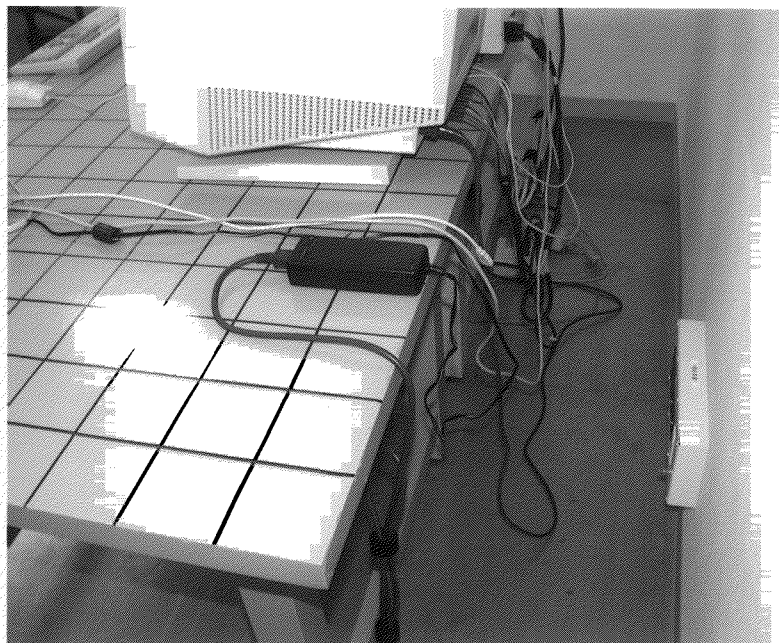
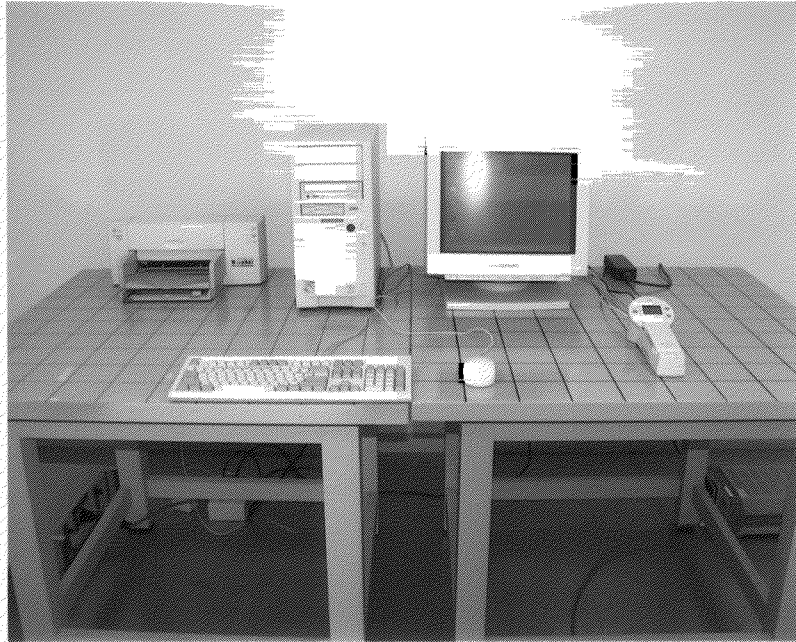
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Conducted emission



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APPENDIX 2: Data of EMI test

This section contains the following data

Radiated emission :	<u>A2- 1 and A2-2</u>
Carrier frequency Band width:	<u>A2- 3</u>
Conducted emission :	<u>A2- 4 and A2-7</u>

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DATA OF RADIATION TEST

A-PEX INTERNATIONAL CO., LTD.
YOKOWA NO.3 OPEN SITE

COMPANY	: Sony Corporation	REPORT NO	: 21EE0013-YW-1
TRADE NAME	: SONY	REGULATION	: FCC Part 15 Subpart C.225
EQUIPMENT	: Handy Reader/Writer	TEST DISTANCE	: 10m
MODEL	: MLU-200	FCC ID	: AK8MLU200
POWER	: DC3.6V		
DESCRIPTION	: Read/Write mode		
REMARKS	: 9kHz - 30MHz		
DATE	: 01/22/2001		

ENGINEER : Naoki Sakamoto

No.	FREQ [MHz]	ANT TYPE	READING		ANT Factor	CABLE LOSS	ATTEN. [dB]	AMP GAIN	RESULT		LIMIT	MARGIN	
			HOR [dB μ V]	VER [dB μ V]					HOR [dB μ V/m]	VER [dB μ V/m]		HOR [dB]	VER [dB]
1	13.56	BB	33.8	36.7	20.2	0.7	6.0	28.2	32.5	35.4	99.0	66.5	63.6
2	27.12	BB	25.2	25.3	21.2	0.9	6.0	28.3	25.0	25.1	48.5	23.5	23.4

SAMPLE CALCLATION : Reading + ANT.Factor + Cable Loss -AMP.Gain + ATTEN.

No1 : Carrier Limit = 80.0dBuV/m + 40log(30/10)

No2 : Spurious Limit = 29.5dBuV/m + 40log(30/10)

ALL other spurious emissions are more than 20dB below the limits.

DATA OF RADIATION TEST

A-PEX INTERNATIONAL CO., LTD.
YOKOWA No.3 OPEN TEST SITE
Report No. : 21EE0013-YW-1

Applicant : Sony Corporation
Kind of Equipment : Handy Reader/Writer
Model No. : MLU-200 (FCC ID : AK8MLU200)
Serial No. :
Power : DC3.6V
Mode : Read/Write mode
Remarks : 30MHz - 1000MHz
Date : 1/22/2001
Test Distance : 3 m
Temperature : 18 °C
Humidity : 38 %
Regulation : FCC Part15B CLASS B

Engineer : Naoki Sakamoto

No.	FREQ. [MHz]	ANT TYPE	READING		ANT FACTOR [dB/m]	AMP GAIN [dB]	CABLE LOSS [dB]	ATTEN. [dB]	RESULT		LIMITS [dB μV/m]	MARGIN	
			HOR [dB μV]	VER [dB μV]					HOR [dB μV/m]	VER [dB μV/m]		HOR [dB]	VER [dB]
1.	40.69	BB	23.5	25.6	14.5	28.3	1.2	5.9	16.8	18.9	40.0	23.2	21.1
2.	54.24	BB	27.9	30.0	9.8	28.2	1.3	6.0	16.8	18.9	40.0	23.2	21.1
3.	67.80	BB	30.5	27.2	7.1	28.0	1.6	5.9	17.1	13.8	40.0	22.9	26.2
4.	81.36	BB	35.5	34.2	6.6	27.8	1.7	5.9	21.9	20.6	40.0	18.1	19.4
5.	94.93	BB	32.2	31.9	9.2	27.9	1.8	5.9	21.2	20.9	43.5	22.3	22.6
6.	108.49	BB	27.8	26.1	11.6	28.1	2.0	5.9	19.2	17.5	43.5	24.3	26.0
7.	122.05	BB	30.5	27.5	13.5	28.2	2.1	6.0	23.9	20.9	43.5	19.6	22.6
8.	135.60	BB	31.8	27.7	14.4	28.0	2.3	5.9	26.4	22.3	43.5	17.1	21.2
9.	176.27	BB	30.9	25.4	15.8	27.8	2.6	6.0	27.5	22.0	43.5	16.0	21.5
10.	203.40	BB	32.4	27.0	16.5	28.0	2.8	5.9	29.6	24.2	43.5	13.9	19.3
11.	325.45	BB	29.1	30.3	14.7	27.6	3.7	6.0	25.9	27.1	46.0	20.1	18.9
12.	393.23	BB	28.7	39.1	15.6	27.7	4.2	5.9	26.7	37.1	46.0	19.3	8.9
13.	420.36	BB	29.2	37.8	16.0	27.8	4.4	6.0	27.8	36.4	46.0	18.2	9.6

CALCULATION: READING + ANT.FACTOR + CABLE LOSS - AMP.GAIN + ATTEN.

All other spurious emissions are more than 20dB below the limits.
ANT. TYPE: 30-300MHz Biconical, 300-1000MHz Logperiodic

BAND WIDTH

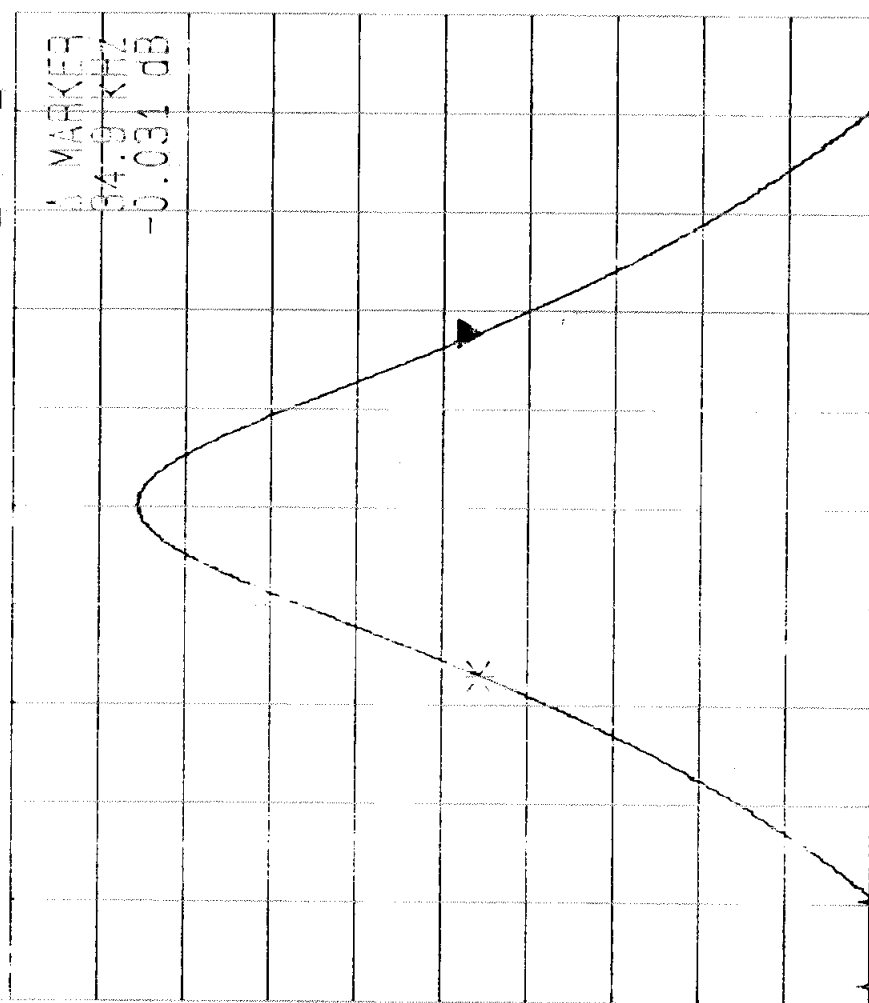
FCC ID AK8MLU200

A_view B_black

REF 117.0 dB μ V
5dB/

Δ MKR
34.9 KHZ

ATT 20 dB



RBW 10 KHZ
VBW 10 KHZ
SWP 10 S

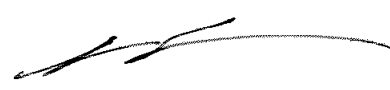
CENTER 13.5594 MHz

SPAN 100.0 KHZ

DATA OF CONDUCTION TEST

A-PEX INTERNATIONAL CO., LTD.
YOKOWA No.3 OPEN TEST SITE
Report No. : 21EE0013-YW-1

Applicant : Sony Corporation
Kind of Equipment : Handy Reader/Writer
Model No. : MLU-200
Serial No. :
Power : DC3.6V
Mode : Communication mode
Remarks : FCC ID : AK8MLU200
Date : 1/18/2001
Phase : Single Phase
Temperature : 20 °C
Humidity : 36 %
Regulation : FCC Part15B CLASS B


Engineer : Naoki Sakamoto

No.	FREQ. [MHz]	READING (N)		READING (L1)		LISN FACTOR [dB]	CABLE LOSS [dB]	ATTEN. [dB]	RESULT		LIMITS		MARGIN	
		QP [dBuV]	AV	QP [dBuV]	AV				QP [dBuV]	AV	QP [dBuV]	AV	QP [dB]	AV
1.	0.6945	41.2	-	40.9	-	0.7	0.1	0.0	42.0	-	48.0	0.0	6.0	-
2.	0.8916	39.7	-	39.0	-	0.7	0.2	0.0	40.6	-	48.0	0.0	7.4	-
3.	1.2032	36.4	-	37.5	-	0.7	0.2	0.0	38.4	-	48.0	0.0	9.6	-
4.	1.2150	36.6	-	37.7	-	0.7	0.2	0.0	38.6	-	48.0	0.0	9.4	-
5.	2.0700	32.3	-	33.2	-	0.7	0.1	0.0	34.0	-	48.0	0.0	14.0	-
6.	6.1975	29.9	-	29.9	-	0.9	0.3	0.0	31.1	-	48.0	0.0	16.9	-
7.	13.6810	27.8	-	27.5	-	1.3	0.3	0.0	29.4	-	48.0	0.0	18.6	-

CALCULATION: READING + LISN FACTOR + CABLE LOSS + ATTEN.

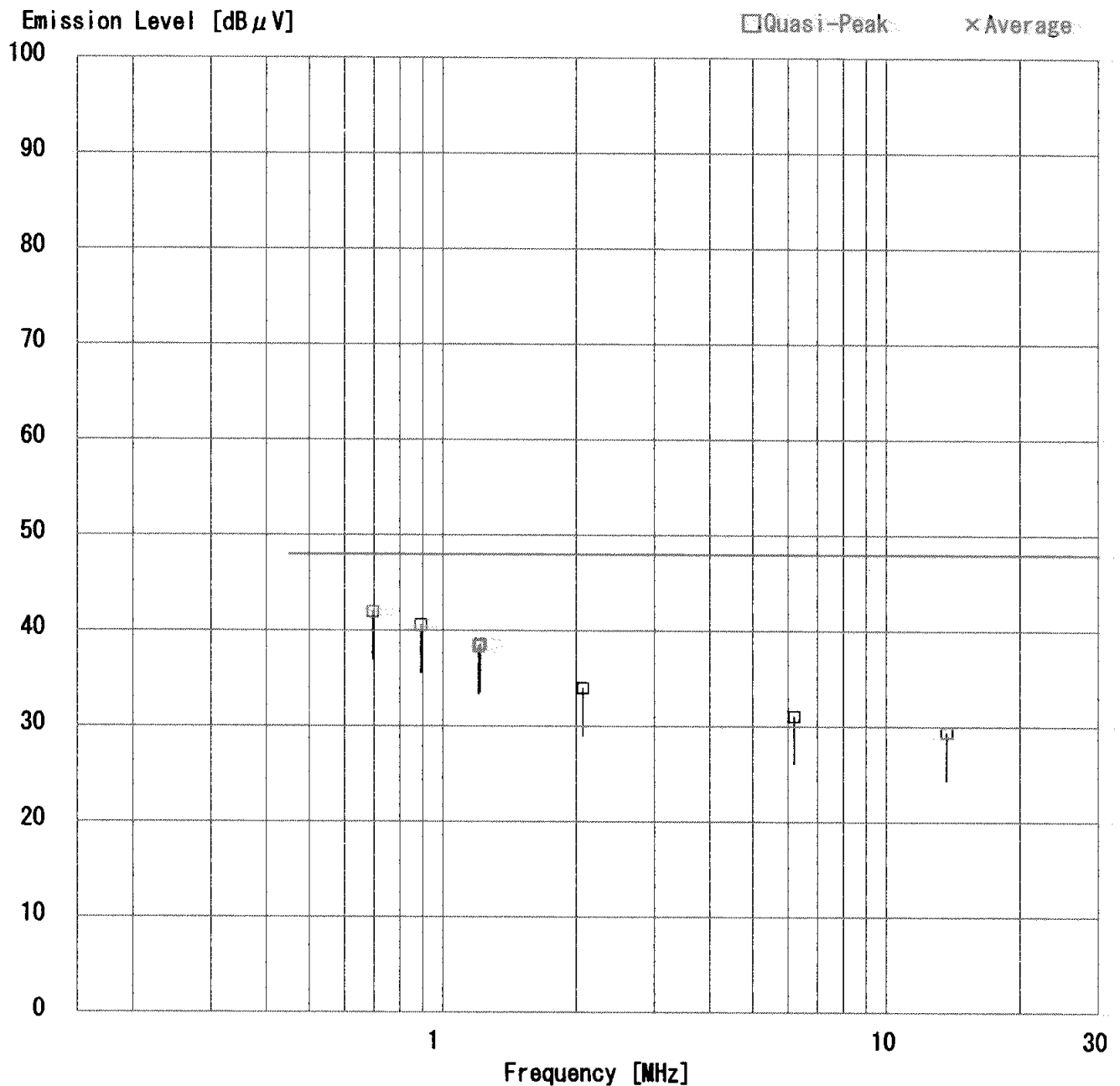
All other spurious emissions are more than 20dB below the limits.

DATA OF CONDUCTION TEST

A-PEX INTERNATIONAL CO., LTD.
YOKOWA No.3 OPEN TEST SITE
Report No. : 21EE0013-YW-1

Applicant : Sony Corporation
Kind of Equipment : Handy Reader/Writer
Model No. : MLU-200
Serial No. :
Power : DC3.6V
Mode : Communication mode
Remarks : FCC ID : AK8MLU200
Date : 1/18/2001
Phase : Single Phase
Temperature : 20 °C
Humidity : 36 %
Regulation : FCC Part15B CLASS B

Engineer : Naoki Sakamoto



DATA OF CONDUCTION TEST CHART

A-PEX INTERNATIONAL CO., LTD.

YOKOWA No.3 OPEN TEST SITE

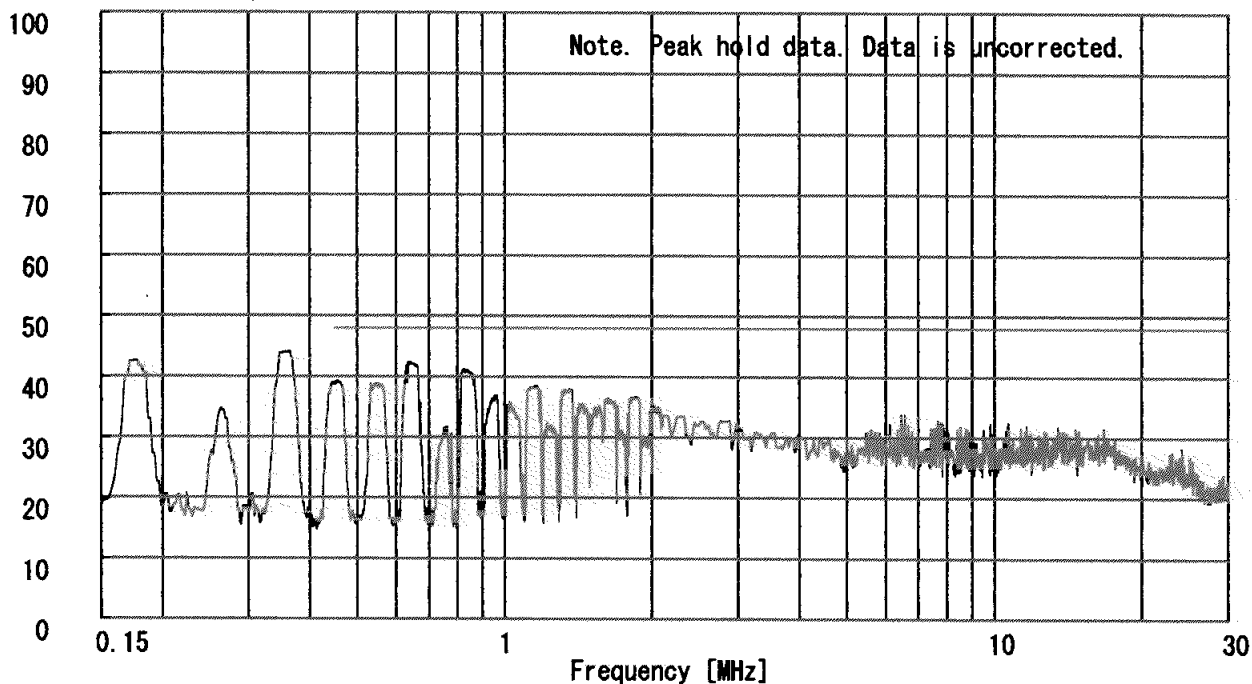
Report No. : 21EE0013-YW-1

Applicant : Sony Corporation
Kind of Equipment : Handy Reader/Writer
Model No. : MLU-200
Serial No. :
Power : DC3.6V
Mode : Communication Mode
Remarks : FCC ID : AK8MLU200
Date : 1/18/2001
Phase : Single Phase
Temperature : 20 °C
Humidity : 36 %
Regulation 1 : FCC Part15B CLASS B
Regulation 2 : None

Engineer : Naoki Sakamoto

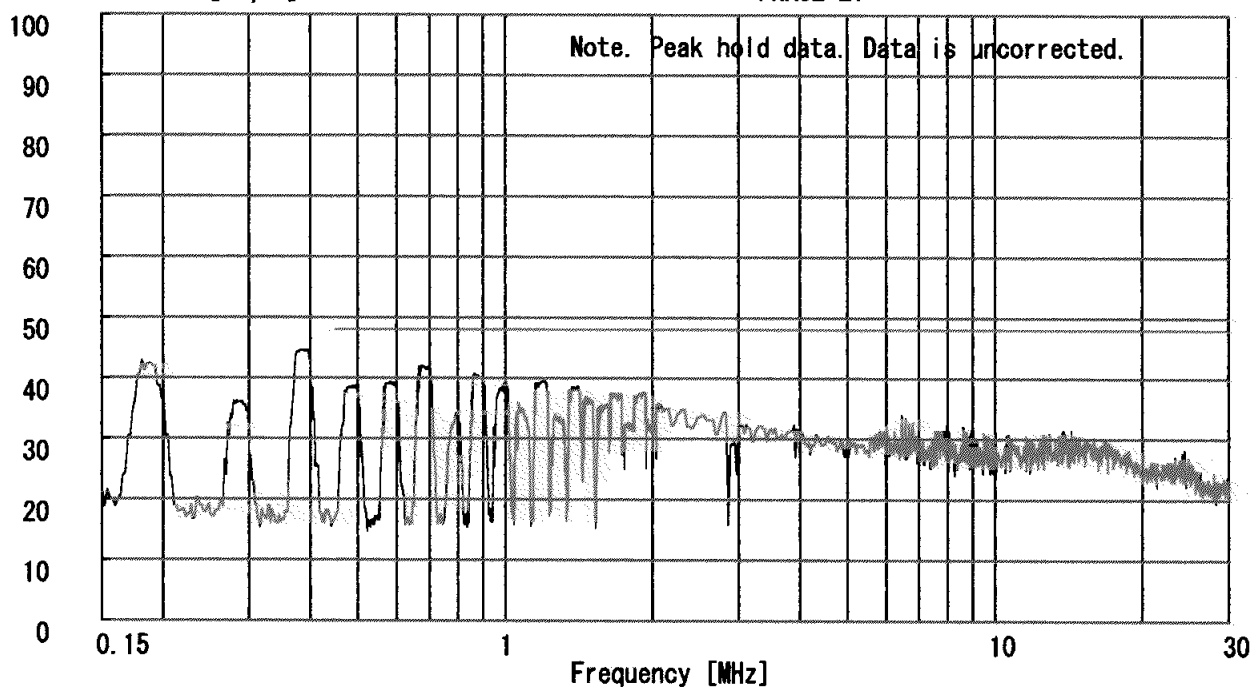
Emission Level [dB μ V]

PHASE:N



Emission Level [dB μ V]

PHASE:L1



DATA OF CONDUCTION TEST CHART

A-PEX INTERNATIONAL CO., LTD.

YOKOWA No.3 OPEN TEST SITE

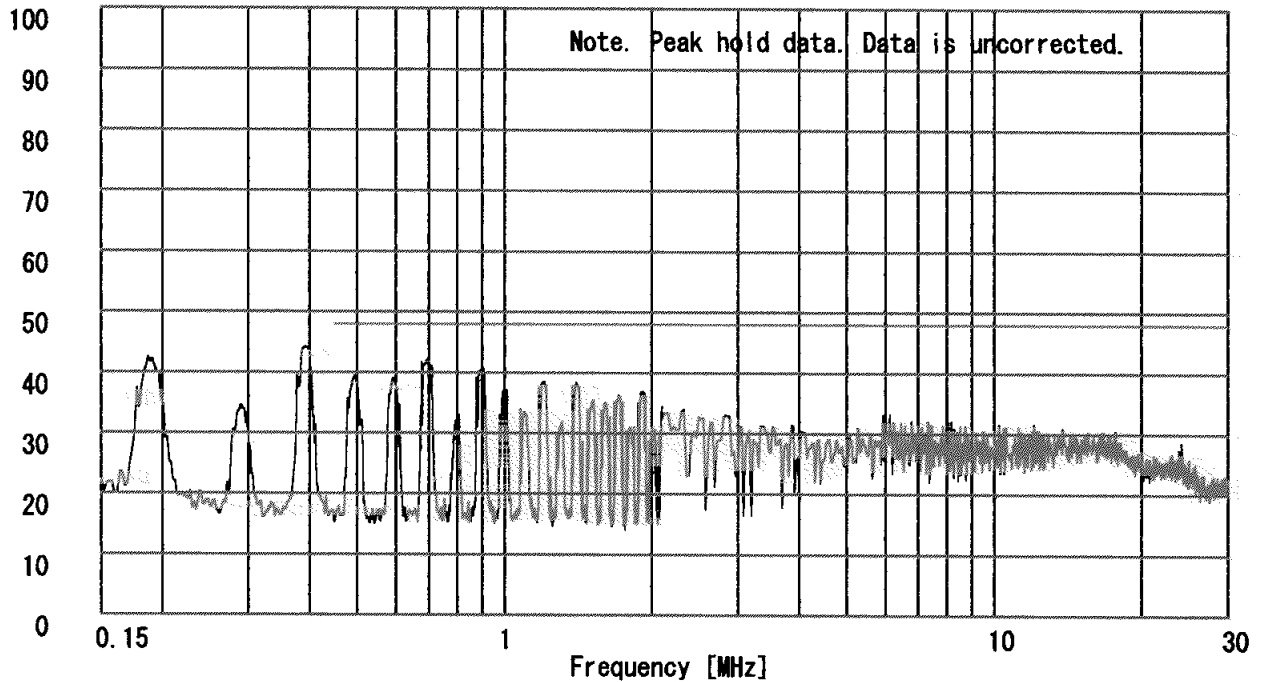
Report No. : 21EE0013-YW-1

Applicant : Sony Corporation
Kind of Equipment : Handy Reader/Writer
Model No. : MLU-200
Serial No. :
Power : DC3.6V
Mode : Standby
Remarks : FCC ID : AK8MLU200
Date : 1/18/2001
Phase : Single Phase
Temperature : 20 °C
Humidity : 36 %
Regulation 1 : FCC Part15B CLASS B
Regulation 2 : None

Engineer : Naoki Sakamoto

Emission Level [dB μ V]

PHASE:N



Emission Level [dB μ V]

PHASE:L1

