

EMISSION TEST REPORT

Test Report No. : 21BE0027-YW-1

Applicant: DENSO CORPORATION

Type of Equipment: Barcode Handy Terminal
Optical Communication Unit

Model No.: BHT-7500 / CU-7001

Test standard: FCC Part 15 Subpart B Class A
Industry Canada ICES-003 Issue 3
CSA C108.8 Class A

Test Result: Complies

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

Date of test: September 22, 2000

Tested by:


Akio Yamamoto

Approved by:


Kazutoyo Nakanishi

Issued date: October 13, 2000

Section Manager of EMC section

Testing Laboratory

A-pex International Co., Ltd.

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1 GENERAL INFORMATION

APPLICANT : DENSO CORPORATION

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448-8661 JAPAN
Tel: +81-566-61-3817
Fax: +81-566-25-4741

REGULATION(S) : FCC Part 15 Subpart B, Class A

MODEL NUMBER : BHT-7500 / CU-7001

SERIAL NUMBER : 116 / 351

KIND OF EQUIPMENT : Barcode Handy Terminal /
Optical Communication Unit

TESTED DATE : September 22, 2000

RECEIPT DATE OF SAMPLE : September 22, 2000

TEST REPORT NUMBER : 21BE0027-YW-1

TEST SITE : A-PEX Yokowa NO.2 Open Test Site

1.1 Product Description

DENSO CORPORATION Model BHT-7500 / CU-7001(referred to as the EUT in this report) are Barcode Handy Terminal / Optical Communication Unit.

The clock frequency used is as follows;

18.432MHz (BHT-7500)

1.8432MHz (CU-7001)

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 Revised date : 2001-01-22

1.2 Tested System Details

The FCC IDs for all equipment, plus description of all cables used in the tested system are:

Model	FCC ID	Description	Cable description	Backshell Material
(1) DENSO CORPORATION M/N: BHT-7500 S/N: 116 (EUT)	N/A	Barcode Handy Terminal	—	—
(2) DENSO CORPORATION M/N: CU-7001 S/N: 351 (EUT)	N/A	Optical Communication Unit	Unshielded DC Power Cable Shielded EIA-232 Cable	P.V.C. P.V.C.
(3) DENSO CORPORATION M/N: 4964600381 S/N: N/A (EUT)	N/A	AC Adapter	—	—
(4) Hewlett Packard M/N: D3993A S/N: 5G73400494	DoC	PC	Unshielded AC Power Cable	P.V.C.
(5) IBM M/N: 2115-011 S/N: 23-35374	BEJC551	Monitor	Unshielded AC Power Cable Shielded RGB Cable	P.V.C. P.V.C.
(6) Hewlett Packard M/N: 895Cxi S/N: SG8AR231X4	DoC	Printer	Shielded Printer Cable Unshielded DC Power Cable	P.V.C. P.V.C.
(7) Hewlett Packard M/N: RT6656TWJP S/N: 42972432	AQ6-MTN4C15	Keyboard	Shielded Keyboard Cable	P.V.C.
(8) Microsoft M/N: 90741 S/N: 02197737	C3KKMP3	Mouse	Shielded Mouse Cable	P.V.C.
(9) Hewlett Packard M/N: C4557-60004 S/N: N/A	N/A	AC Adapter	Unshielded AC Power Cable	P.V.C.

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1.3 Tested Methodology

Both conducted and radiated testing were performed according to the procedures in FCC/ANSI C63.4(1992).
Radiated testing was performed at a distance of 10 meters from the antenna to EUT .

1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on 108, Yokowa-cho, Ise-shi, Mie-ken, 516-1106 Japan.

The open area test site and conducted measurement facility used to collect the radiated data is located on 108 Yokowa-cho, Ise-shi, Mie-ken 516-1106 Japan. This site has been fully described in a report submitted to FCC office, and listed on May 15, 2000(Registration number: 90411).

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2 SYSTEM TEST CONFIGURATION

2.1 Operation Environment

Conduction	Radiation
Temperature : See data	: See data
Humidity : See data	: See data
Power supply: AC 120V/60Hz	: AC 120V/60Hz

2.2 Justification

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

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2.3 EUT Exercise Software

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

Operation: Running mode (Optical, Connector)

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2.4 Test Procedure

2.4.1 Tabletop Equipment Conducted Emissions

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.

I/O cables and AC cables that were connected to the peripherals were bundled in center.

They were folded back and forth forming a bundle 30cm to 40cm long and were hanged at a 40cm height to the ground plane.

Each EUT current-carrying power lead, except the ground (safety) lead, were individually connected through a LISN to the input power source.

All unused 50 Ω connectors of the LISN were resistively terminated in 50 Ω when not connected to the measuring equipment.

2.4.2 Tabletop Equipment Radiated Emissions

EUT was placed on a platform 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.

I/O cables that were connected to the peripherals were bundled in center.

They were folded back and forth forming a bundle 30cm to 40cm long and were hanged 40cm height to the ground plane.

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.

The measurement distance was 10m.

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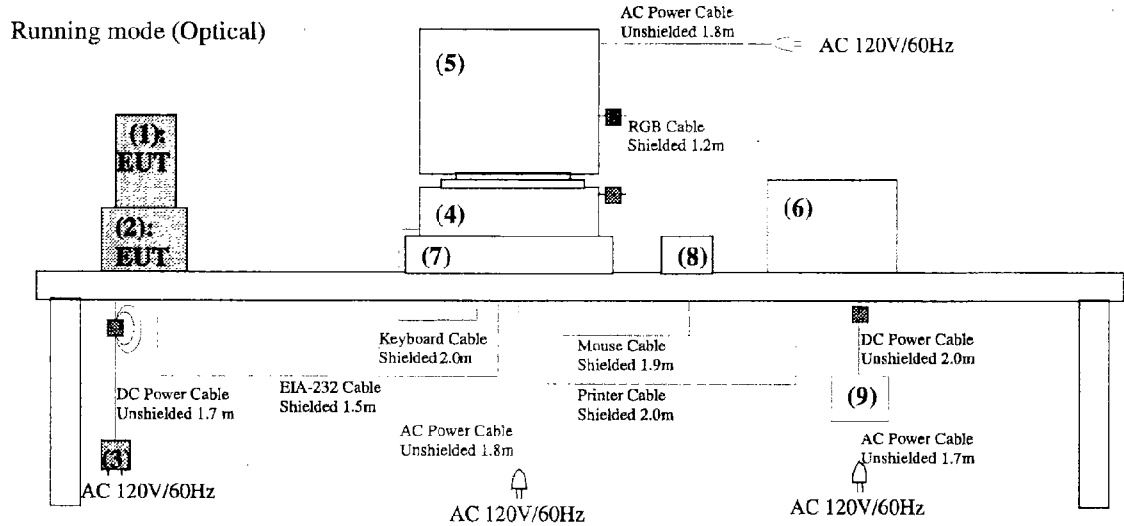
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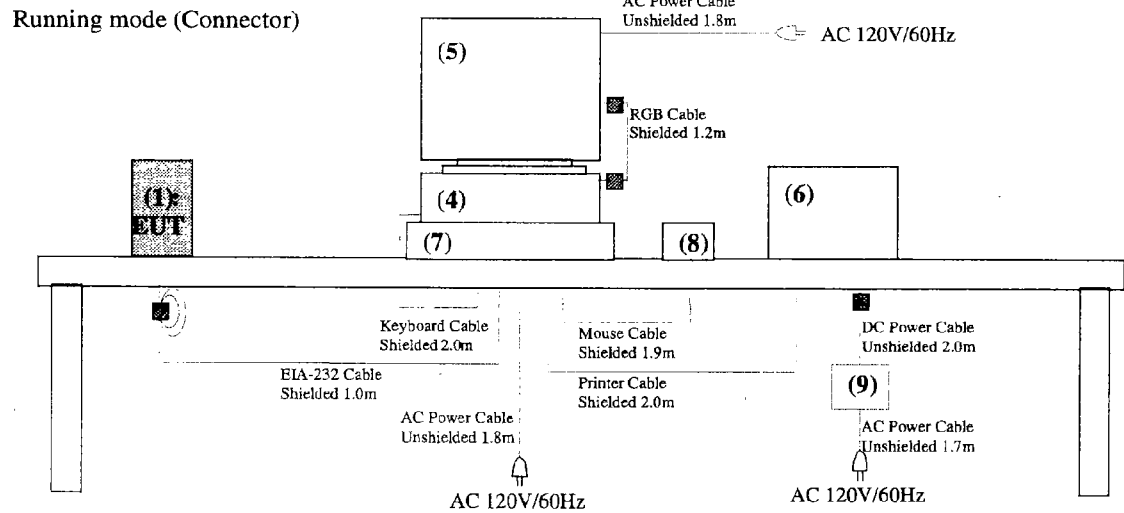
Facsimile: +81 596 39 0232

Figure2.1 Configuration of Tested System

Front View



■ : Ferrite Core



■ : Ferrite Core

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

Test report

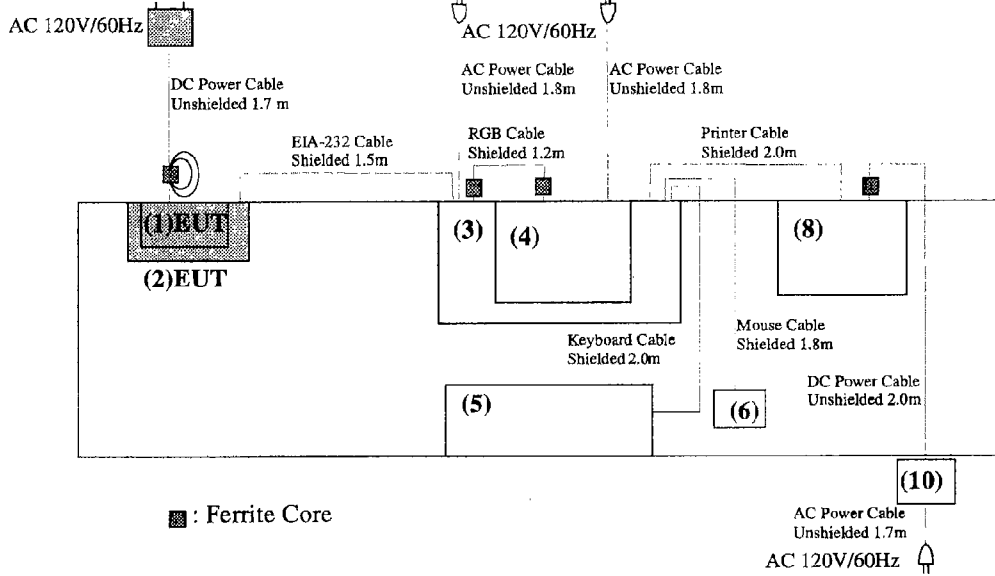
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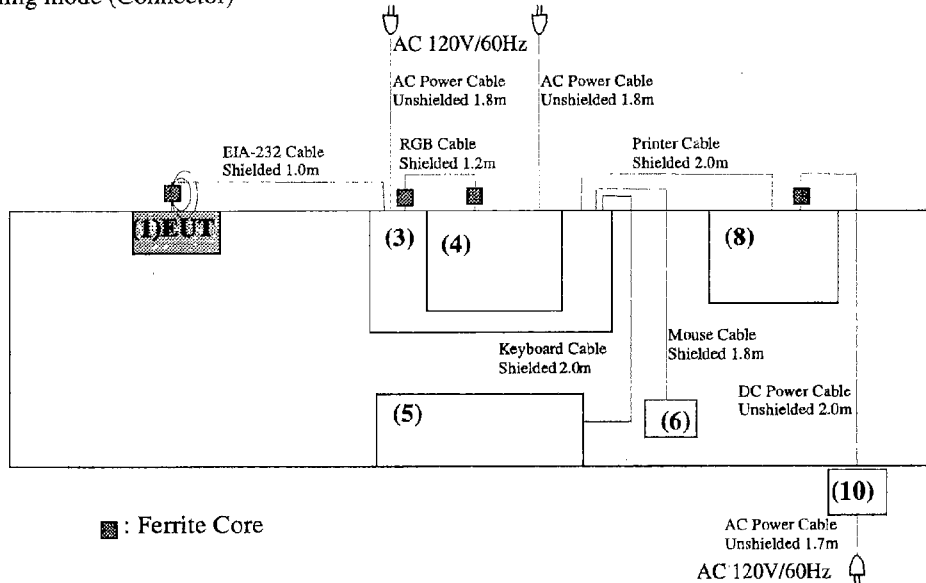
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Top View

Running mode (Optical)



Running mode (Connector)



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

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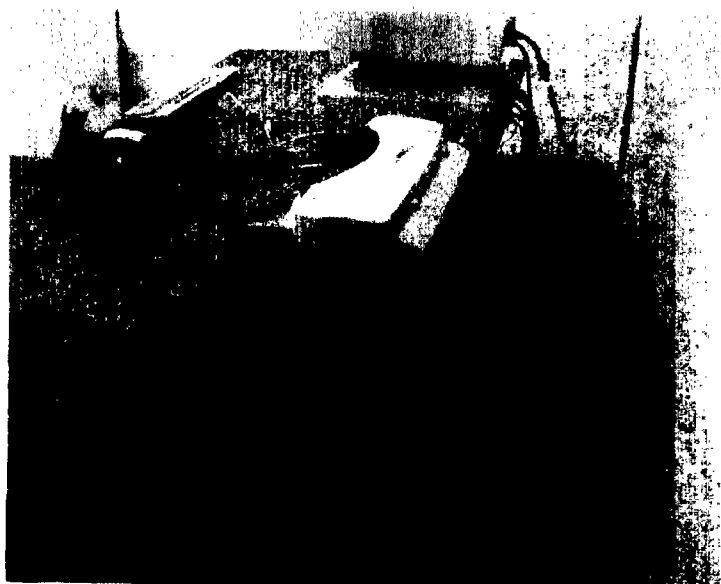
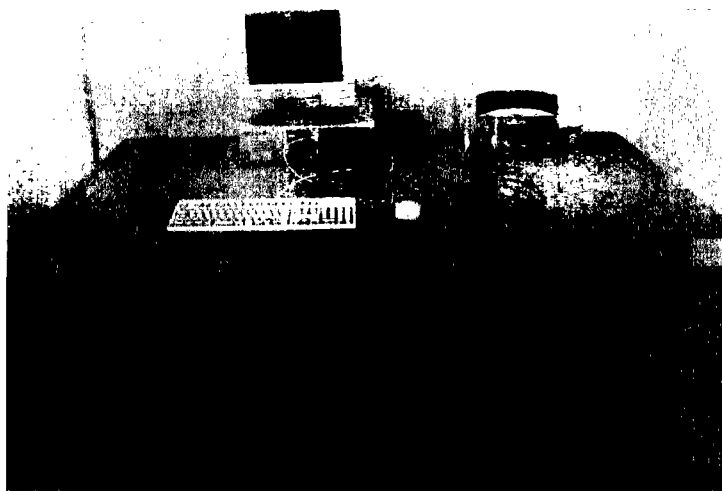
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3 CONDUCTED AND RADIATED MEASUREMENT PHOTOS

Figure 3.1 Conducted Measurement Photos (Optical)



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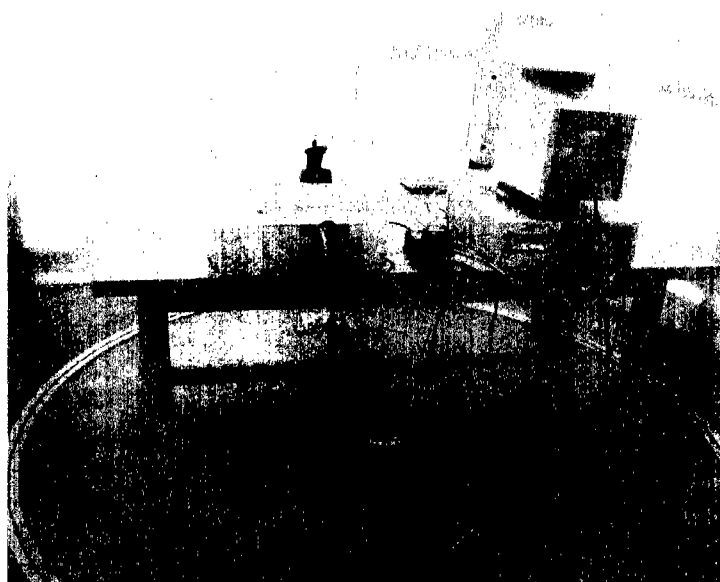
108 Yokawa-cho, Ise-shi, Mie-ken, 516-1106 JAPAN

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Figure 3.2 Radiated Measurement Photos (Optical)



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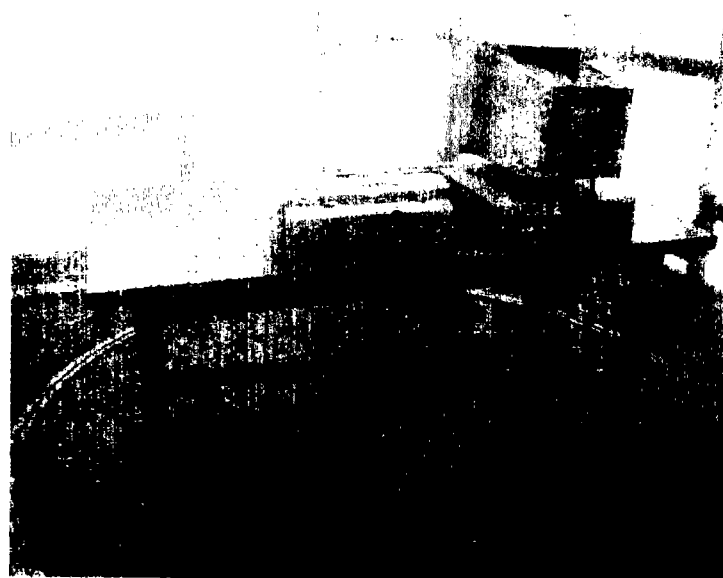
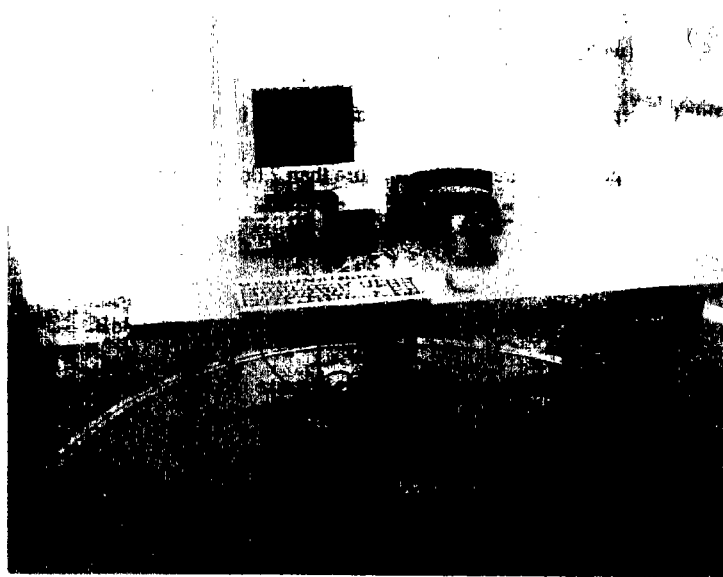
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Figure 3.3 Radiated Measurement Photos (Connector)



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3.1 Measurement Uncertainty

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.

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.

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4 CONDUCTED EMISSION DATA

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.
The minimum margin to the limit is as follows :

Frequency (MHz)	Line (N/L)	Measured (dB μ V)	LISN Factor (dB)	Result (dB μ V)	Limit (dB μ V)	Margin (dB)
28.6361	L	40.1	2.3	42.4	69.5	27.1

* All readings are quasi-peak mode.

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5 RADIATED EMISSION DATA

The initial step in collecting radiated data was a spectrum analyzer peak scan of the measurement range(30MHz-1000MHz).
 The final data was reported in the worst-case emissions.
 The minimum margin to the limit is as follows :

Optical

Frequency (MHz)	Receiver Reading (dB μ V)	Correction Factor (dB μ V)	Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB μ V)
608.36	32.8	1.8	34.6	46.4	11.8

Connector

Frequency (MHz)	Receiver Reading (dB μ V)	Correction Factor (dB μ V)	Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB μ V)
608.36	31.7	1.8	33.5	46.4	12.9

* 30MHz-1000MHz : All readings are quasi-peak mode.

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5.1 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

Optical

Assume a receiver reading of 32.8 dB μ V is obtained. The antenna Factor of 19.6 dB, Cable Factor of 9.2 dB and Antenna Pad of 3.0 dB is added. The Amplifier Gain of 30.0 dB is subtracted, giving a field strength of 34.6 dB μ V/m.

$$FS = 32.8 + 19.6 + 9.2 + 3.0 - 30.0 = 34.6 \text{ dB } \mu \text{ V/m}$$

Connector

Assume a receiver reading of 31.7 dB μ V is obtained. The antenna Factor of 19.6 dB, Cable Factor of 9.2 dB and Antenna Pad of 3.0 dB is added. The Amplifier Gain of 30.0 dB is subtracted, giving a field strength of 33.5 dB μ V/m.

$$FS = 31.7 + 19.6 + 9.2 + 3.0 - 30.0 = 33.5 \text{ dB } \mu \text{ V/m}$$

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6 TEST EQUIPMENT USED

INSTRUMENTS	Mfr.	MODEL	C/N	Calibrated Until
☐ Pre Amplifier	Hewlett Packard	8447D	AF1	November 16, 2000
☐ Pre Amplifier	Anritsu	MH648A	AF2	November 16, 2000
☒ Pre Amplifier	Anritsu	MH648A	AF3	November 16, 2000
☒ Attenuator	Anritsu	MP721A	AT7	June 8, 2001
☒ Biconical Antenna	Schwarzbeck	BBA9106	BA5	April 28, 2001
☒ Logperiodic Antenna	Schwarzbeck	UHALP9108A	LA8	April 29, 2001
☐ LISN	Rohde & Schwarz	ESH2-Z5	LS1	November 15, 2000
☒ LISN	Rohde & Schwarz	ESH3-Z5	LS2	November 15, 2000
☐ LISN	Schwarzbeck	NSLK8127	LS3	November 15, 2000
☐ LISN	Rohde & Schwarz	ESH3-Z5	LS4	November 15, 2000
☐ LISN	Schwarzbeck	NNLK8121	LS5	November 15, 2000
☒ LISN	Schwarzbeck	NSLK8126	LS7	November 15, 2000
☒ Spectrum Analyzer	Hewlett Packard	8567A	SA3	December 13, 2000
☒ Test Receiver	Rohde & Schwarz	ESHS-10	TR1	March 30, 2001
☒ Test Receiver	Rohde & Schwarz	ESVS-10	TR2	July 13, 2001

☒ indicates EMI Test Equipment used.

*All measurement equipment is traceable to national standard.

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APPENDIX

A:Test Data

Conducted emissions	<u>A1- A4</u>
Radiated emissions (Optical)	<u>A5- A6</u>
Radiated emissions (Connector)	<u>A7- A8</u>

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DATA OF CONDUCTION TEST

A-PEX INTERNATIONAL CO., LTD.
YOKOWA No.2 OPEN TEST SITE
Report No. : 21BE0027-YW-1

Applicant : DENSO CORPORATION
Kind of Equipment : BARCODE HANDY TERMINAL / OPTICAL COMMUNICATION UNIT
Model No. : BHT-7500 / CU-7001
Serial No. : 116 / 351
Power : AC120V/60Hz
Mode : Running (Optical)
Remarks :
Date : 9/22/2000
Phase : Single Phase
Temperature : 26 °C
Humidity : 42 %
Regulation : FCC Part15B CLASS A

Engineer

Akiyo Yamamoto

No.	FREQ. [MHz]	READING(N)		READING(L1)		LISN FACTOR [dBuV]	CABLE LOSS [dBuV]	ATTEN. [dBuV]	RESULT		LIMITS		MARGIN	
		QP	AV	QP	AV				QP	AV	QP	AV	QP	AV
		[dBuV]		[dBuV]					[dBuV]		[dBuV]		[dBuV]	
1.	0.4500	28.2	-	27.0	-	0.1	0.2	0.0	28.5	-	60.0	0.0	31.5	-
2.	0.8923	19.6	-	18.8	-	0.1	0.2	0.0	19.9	-	60.0	0.0	40.1	-
3.	7.4970	13.5	-	11.8	-	0.4	0.5	0.0	14.4	-	69.5	0.0	55.1	-
4.	15.9991	22.5	-	23.1	-	0.8	0.6	0.0	24.5	-	69.5	0.0	45.0	-
5.	20.5913	20.2	-	20.9	-	1.0	0.7	0.0	22.6	-	69.5	0.0	46.9	-
6.	28.6361	39.7	-	40.1	-	1.3	1.0	0.0	42.4	-	69.5	0.0	27.1	-

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

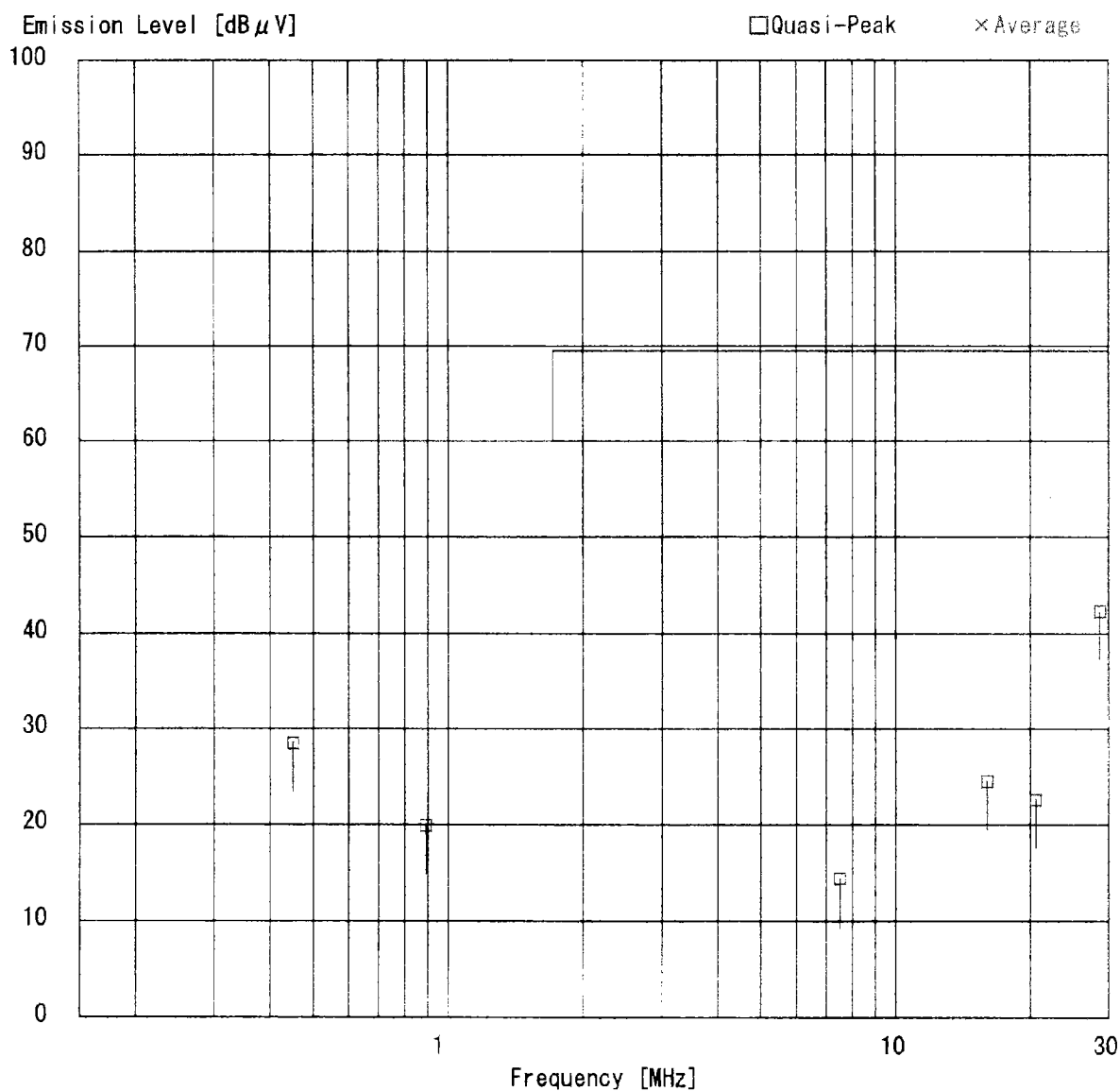
Except for the above table: adequate margin data below the limits.

DATA OF CONDUCTION TEST

A-PEX INTERNATIONAL CO., LTD.
YOKOWA No.2 OPEN TEST SITE
Report No. : 218E0027-YW-1

Applicant : DENSO CORPORATION
Kind of Equipment : BARCODE HANDY TERMINAL / OPTICAL COMMUNICATION UNIT
Model No. : BHT-7500 / CU-7001
Serial No. : 116 / 351
Power : AC120V/60Hz
Mode : Running (Optical)
Remarks :
Date : 9/22/2000
Phase : Single Phase
Temperature : 26 °C
Humidity : 42 %
Regulation : FCC Part15B CLASS A

A. Yamamoto
Engineer : Akiyo Yamamoto



DATA OF CONDUCTION TEST CHART

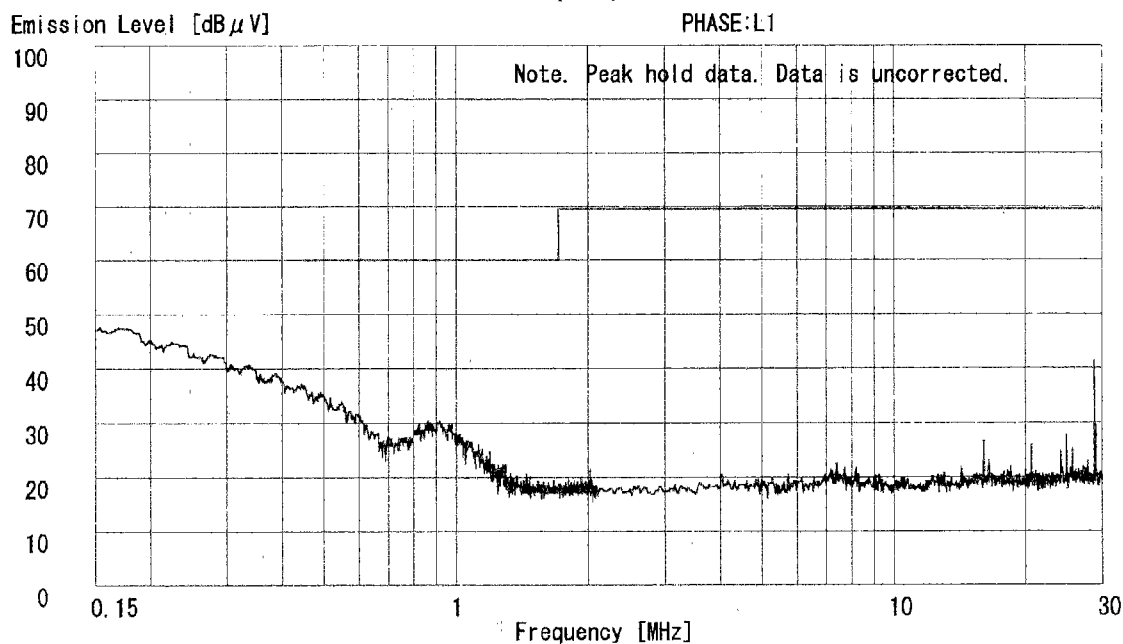
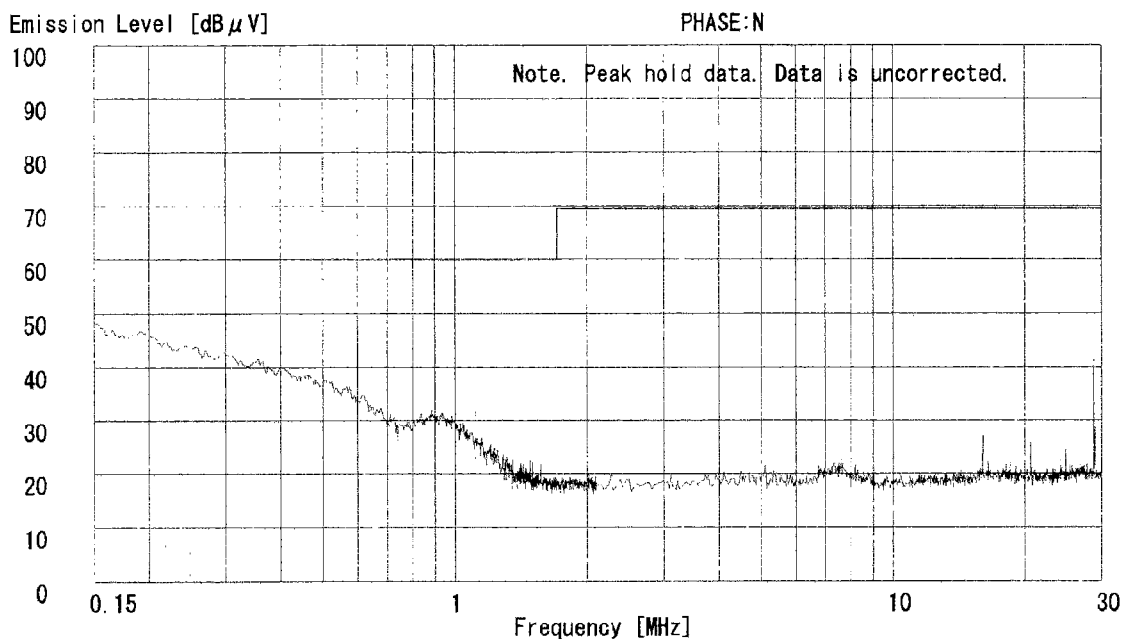
A-PEX INTERNATIONAL CO., LTD.

YOKOWA No.2 OPEN TEST SITE

Report No. : 21BE0027-YW-1

Applicant : DENSO CORPORATION
Kind of Equipment : BARCODE HANDY TERMINAL / OPTICAL COMMUNICATION UNIT
Model No. : BHT-7500 / CU-7001
Serial No. : 116 / 351
Power : AC120V/60Hz
Mode : Running (Optical)
Remarks :
Date : 9/22/2000
Phase : Single Phase
Temperature : 26 °C
Humidity : 42 %
Regulation 1 : FCC Part15B CLASS A
Regulation 2 : None

Akiyo Yamamoto
Engineer : Akiyo Yamamoto



DATA OF CONDUCTION TEST CHART

A-PEX INTERNATIONAL CO., LTD.

YOKOWA No.2 OPEN TEST SITE

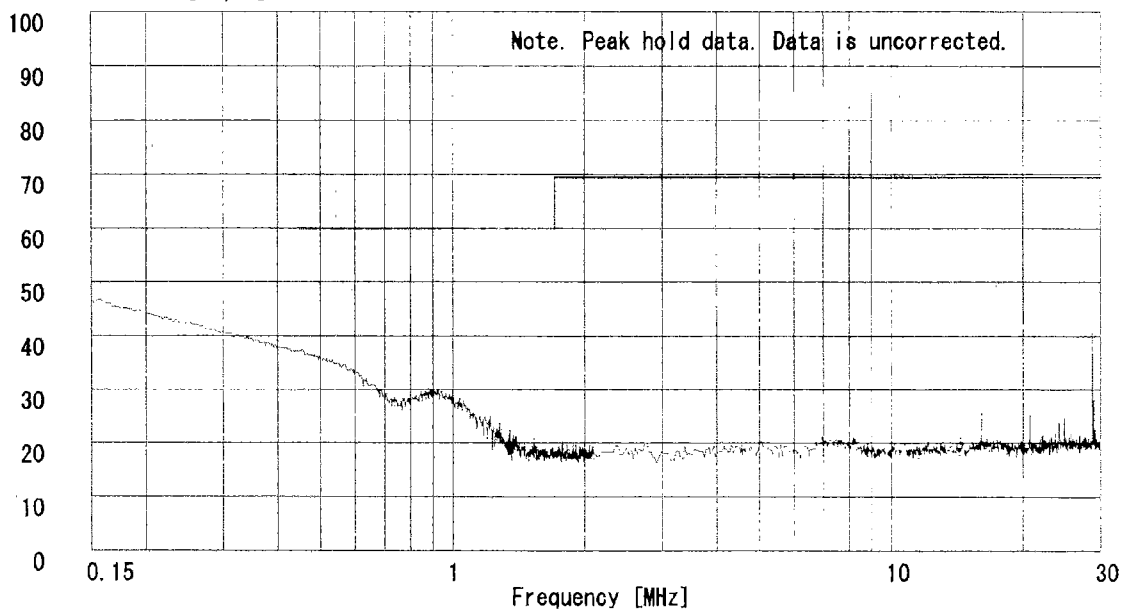
Report No.: 21BE0027-YW-1

Applicant : DENSO CORPORATION
Kind of Equipment : BARCODE HANDY TERMINAL / OPTICAL COMMUNICATION UNIT
Model No. : BHT-7500 / CU-7001
Serial No. : 116 / 351
Power : AC120V/60Hz
Mode : Standby
Remarks :
Date : 9/22/2000
Phase : Single Phase
Temperature : 26 °C
Humidity : 42 %
Regulation 1 : FCC Part15B CLASS A
Regulation 2 : None

Engineer : *Akiyo Yamamoto*
Akiyo Yamamoto

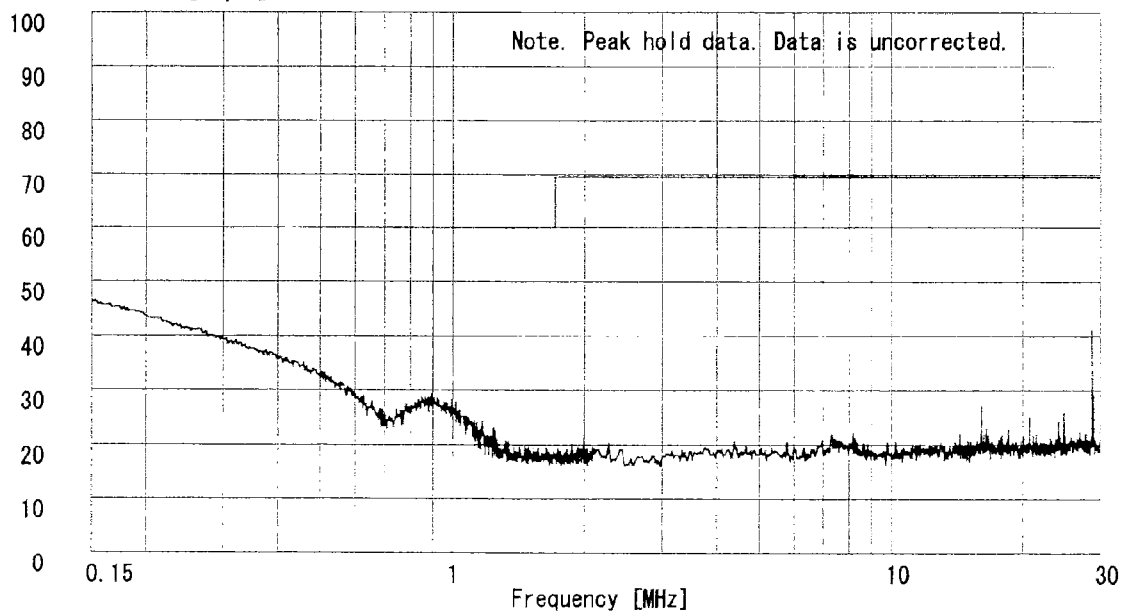
Emission Level [dB μ V]

PHASE:N



Emission Level [dB μ V]

PHASE:L1



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DATA OF RADIATION TEST

A-PEX INTERNATIONAL CO., LTD.
YOKOWA No.2 OPEN TEST SITE
Report No. : 21BE0027-YW-1

Applicant : DENSO CORPORATION
Kind of Equipment : BARCODE HANDY TERMINAL / OPTICAL COMMUNICATION UNIT
Model No. : BHT-7500 / CU-7001
Serial No. : 116 / 351
Power : AC120V/60Hz
Mode : Running (Optical)
Remarks :
Date : 9/22/2000
Test Distance : 10 m
Temperature : 24 °C
Humidity : 82 %
Regulation : FCC Part15B CLASS A


Engineer : Akiyo Yamamoto

No.	FREQ. [MHz]	ANT TYPE	READING		ANT FACTOR [dB/°]	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.	92.18	BB	34.8	37.0	8.8	29.8	3.6	3.0	20.4	22.6	43.5	23.1	20.9
2.	147.49	BB	29.1	31.3	14.9	29.7	4.5	3.0	21.8	24.0	43.5	21.7	19.5
3.	165.92	BB	25.1	27.1	15.5	29.6	4.8	3.0	18.8	20.8	43.5	24.7	22.7
4.	221.22	BB	28.4	26.9	16.6	29.6	5.3	3.1	23.8	22.3	46.4	22.6	24.1
5.	368.68	BB	30.6	32.1	17.5	29.8	7.0	3.0	28.3	29.8	46.4	18.1	16.6
6.	405.57	BB	28.2	30.7	18.1	29.8	7.3	3.1	26.9	29.4	46.4	19.5	17.0
7.	479.30	BB	25.4	27.5	19.0	29.9	8.0	3.1	25.6	27.7	46.4	20.8	18.7
8.	571.49	BB	30.7	28.7	19.4	29.9	8.8	3.0	32.0	30.0	46.4	14.4	16.4
9.	608.36	BB	32.8	28.5	19.6	30.0	9.2	3.0	34.6	30.3	46.4	11.8	16.1

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

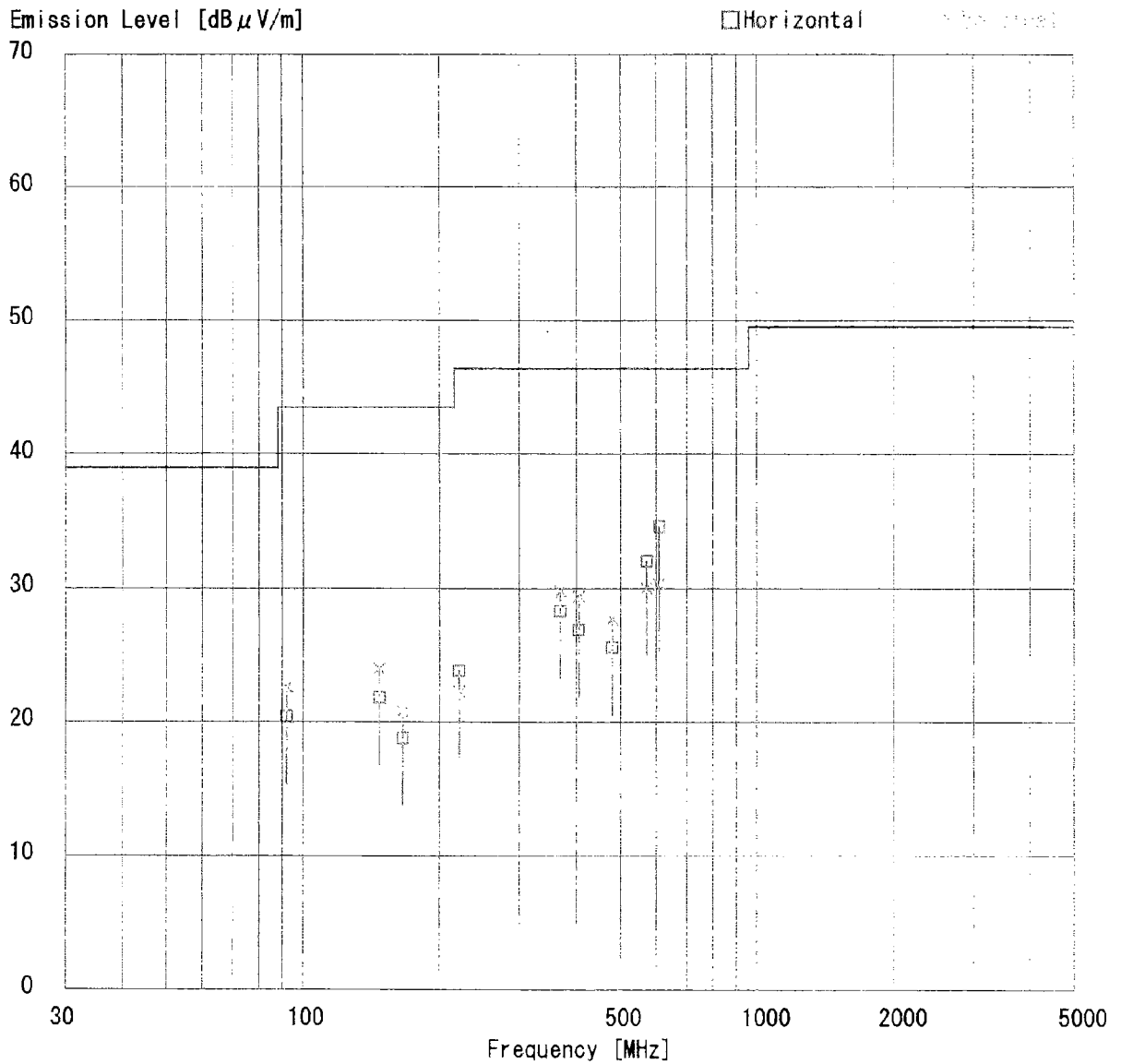
Except for the above table: adequate margin data below the limits.
ANT. TYPE: 30-300MHz Biconcal, 300-1000MHz Logperiodic, 1-5GHz Horn

DATA OF RADIATION TEST

A-PEX INTERNATIONAL CO., LTD.
YOKOWA No.2 OPEN TEST SITE
Report No. : 21BE0027-YW-1

Applicant : DENSO CORPORATION
Kind of Equipment : BARCODE HANDY TERMINAL / OPTICAL COMMUNICATION UNIT
Model No. : BHT-7500 / CU-7001
Serial No. : 116 / 351
Power : AC120V/60Hz
Mode : Running (Optical)
Remarks :
Date : 9/22/2000
Test Distance : 10 m
Temperature : 24 °C
Humidity : 82 %
Regulation : FCC Part15B CLASS A

A. Yamamoto
Engineer : Akiyo Yamamoto



DATA OF RADIATION TEST

A-PEX INTERNATIONAL CO., LTD.
YOKOWA No.2 OPEN TEST SITE
Report No. : 21BE0027-YW-1

Applicant : DENSO CORPORATION
Kind of Equipment : BARCODE HANDY TERMINAL
Model No. : BHT-7500
Serial No. : 116
Power : DC3.6V
Mode : Running (Connector)
Remarks :
Date : 9/22/2000
Test Distance : 10 m
Temperature : 24 °C
Humidity : 82 %
Regulation : FCC Part15B CLASS A


Engineer : Akiyo Yamamoto

No.	FREQ. [MHz]	ANT TYPE	READING		ANT FACTOR [dB/m]	AMP GAIN [dB]	CABLE LOSS [dB]	ATTEN. [dB]	RESULT		LIMITS		MARGIN	
			HOR [dB μ V]	VER [dB μ V]					HOR [dB μ V/m]	VER [dB μ V/m]	HOR [dB μ V/m]	VER [dB μ V/m]	HOR [dB]	VER [dB]
1.	184.35	BB	27.2	24.0	16.3	29.6	5.0	3.1	22.0	18.8	43.5	21.5	24.7	
2.	202.79	BB	30.8	28.1	16.5	29.6	5.2	3.1	26.0	23.3	43.5	17.5	20.2	
3.	221.22	BB	33.7	27.2	16.6	29.6	5.3	3.1	29.1	22.6	46.4	17.3	23.8	
4.	368.70	BB	35.5	28.9	17.5	29.8	7.0	3.0	33.2	26.6	46.4	13.2	19.8	
5.	405.57	BB	33.0	28.2	18.1	29.8	7.3	3.1	31.7	26.9	46.4	14.7	19.5	
6.	479.30	BB	29.3	24.2	19.0	29.9	8.0	3.1	29.5	24.4	46.4	16.9	22.0	
7.	571.49	BB	32.1	28.5	19.4	29.9	8.8	3.0	33.4	29.8	46.4	13.0	16.6	
8.	608.36	BB	31.7	27.0	19.6	30.0	9.2	3.0	33.5	28.8	46.4	12.9	17.6	

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

Except for the above table: adequate margin data below the limits.
ANT. TYPE: 30-300MHz Biconcal, 300-1000MHz Logperiodic, 1-5GHz Horn

DATA OF RADIATION TEST

A-PEX INTERNATIONAL CO., LTD.
YOKOWA No.2 OPEN TEST SITE
Report No. : 21BE0027-YW-1

Applicant : DENSO CORPORATION
Kind of Equipment : BARCODE HANDY TERMINAL
Model No. : BHT-7500
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Power : DC3.6V
Mode : Running (Connector)
Remarks :
Date : 9/22/2000
Test Distance : 10 m
Temperature : 24 °C
Humidity : 82 %
Regulation : FCC Part15B CLASS A

Engineer : *Akiyo Yamamoto*
Akiyo Yamamoto

