TÜVRheinland®

Produkte
Products

Prüfbericht - Nr.: *Test Report No.:*	**12604408 004**	**Seite 1 von 20** *Page 1 of 20*

Auftraggeber: *Client:*	**Mitutoyo Corporation** 20-1, Sakado 1-Chome, Takatsu-ku, Kawasaki-shi, Kanagawa 213-8533, Japan
Gegenstand der Prüfung: *Test item:*	**Wireless Communication System**

Bezeichnung: *Identification:*	**02AZD810C (U-WAVE-R)**	**Serien-Nr.:** *Serial No.:*	**1999999977**
Wareneingangs-Nr.: *Receipt No.:*	**213072894**	**Eingangsdatum:** *Date of receipt:*	**2008-01-15**

Prüfort: *Testing location:*	4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan
Prüfgrundlage: *Test specification:*	**47 CFR Part 15 (Subpart: B)** **ANSI C63.4-2003**
Prüfergebnis: *Test Result:*	**Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).** *The test item passed the test specification(s).*
Prüflaboratorium: *Testing Laboratory:*	**TÜV Rheinland Japan Ltd. - Global Technology Assessment Center** 4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

geprüft/ *tested by:*			**kontrolliert/** *reviewed by:*		
2008-05-19	T. Sauter / Inspector		2008-05-19	M. Zietz / Reviewer	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges / *Other Aspects:*

This test report deals with the unintentional radiator portion of the tested product. Unintentional radiator aspects are covered by another test report.

Abkürzungen:				*Abbreviations:*			
P(ass)	=	*entspricht Prüfgrundlage*		*P(ass)*	=	*passed*	
F(ail)	=	*entspricht nicht Prüfgrundlage*		*F(ail)*	=	*failed*	
N/A	=	*nicht anwendbar*		*N/A*	=	*not applicable*	
N/T	=	*nicht getestet*		*N/T*	=	*not tested*	

TEST SUMMARY

5.1.1 MAINS TERMINAL CONTINUOUS DISTURBANCE VOLTAGE, FCC PART 15.107
RESULT: PASS

5.1.2 RADIATED EMISSION, FCC PART 15.109
RESULT: PASS

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1. General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report.

1.2 FCC Cross-Reference Table

The results of emission measurements and product related information contained in this test report and the attached materials relate to the contents of the FCC standard report in the following way:

FCC § / Heading	
1.1 Product Description	See 3.1
1.2 Tested System Details	See 4.2
1.3 Test Methodology	See 4.1
1.4 Test Facility	See 2.1
3.2 EUT Exercise Software	See 4.3
3.3 Special Accessories	See 4.4
3.4 Equipment Modifications	See 4.5
3.5 Configuration of Tested System	See 4.2

2. Test Sites

2.1 Test Facilities

TÜV Rheinland Japan Ltd. - Global Technology Assessment Center
4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The Federal Communication Commission has reviewed the technical characteristics of the radiated and conducted emission facility, and has found these test facilities to be in compliance with the requirements of section 2.948 of the FCC rules.

The description of the test facility is listed under FCC registration number 299054

2.2 List of Test and Measurement Instruments

Test Equipment calibration is traceable to NIST

Table 1: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Type	Equipment ID	Calibrated until
RECEIVER	ROHDE & SCHWARZ	ESU8	100025	2009-02
ANTENNA	SCHWARZBECK	VULB9168 (30 - 1000M)	0245	2009-05
PRE AMPLIFIER	TSJ	MLA-10K01-B01-35	1370750	2009-04
LISN	ROHDE & SCHWARZ	ENV216	100276	2009-05
LISN	SCHWARZBECK	NSLK 8128(4X32/50A)	8128-239	2008-05
RF SELECTOR	TOYO CORPORATION	NS4900	0703-182	N/A

2.3 Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Conducted Emission	150kHz - 30MHz	±3.17dB
Radiated Emission	30MHz - 1GHz	±5.11dB

3. General Product Information

3.1 Product Function and Intended Use

The **EUT** (**E**quipment **U**nder **T**est) is a IEEE802.15.4 radio unit, which is to be connected to personal computers (PC, laptop or desktop type). Data from an external measurement device (e.g. a calipper with an attached U-WAVE-T radio unit) are transmitted via air to the EUT and transferred via USB to the connected PC. The measurement tools and PCs are not part of the EUT.

3.2 System Details

Radio Standard:	IEEE 802.15.4
Specified power output:	-3dBm (max. peak power: 0.5mW)
Antenna gain:	-5 dBi
Antenna type:	Pattern antenna
Mounting type:	Internal
Frequency range:	2405 – 2475 MHz
Number of channel:	15
Channel spacing:	5 MHz
Modulation type:	DSSS, OQPSK
FCC Classification:	DTS
Emission Designator:	G1D
System Input Voltage:	DC 5.0V (USB bus power system)
Typical Nominal Voltage:	DC 5.0V (USB bus power system)
Protection Class:	III

3.3 Clock Frequencies

The EUT generates internally following clock frequencies:

6 MHz
8 MHz
16 MHz

3.4 Independent Operation Modes

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

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.4-2003.

The basic operation mode is:

A. Communication mode via radio with an external device, this includes transmission and receiving of data signals at highest possible speed.

3.5 Noise Suppressing Parts

None mentioned explicitly.

4. Test Set-up and Operation Modes

4.1 Test Methodology

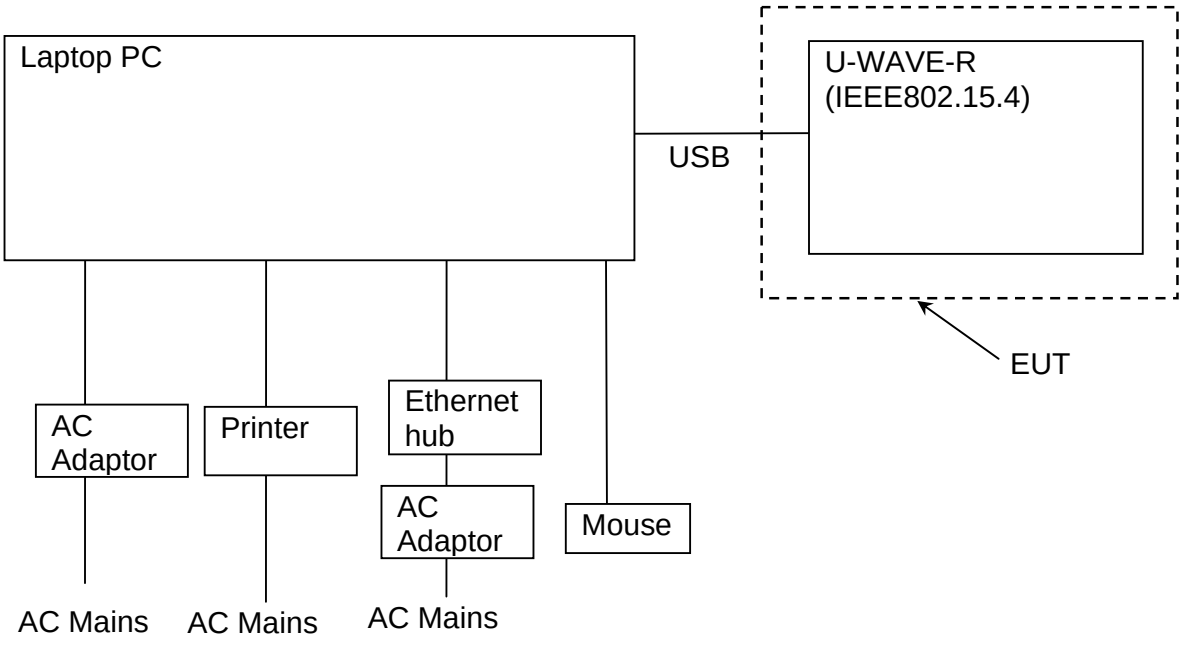
The test methodology used is based on the requirements of 47 CFR Part 15 (2007-04-05), sections 15.31, 15.33, 15.35, 15.107 and 15.109. The test methods, which have been used, are based on ANSI C63.4: 2003.

For details, refer to each test item.

4.2 Physical Configuration for Testing

Refer to section: Photographs of the Test Set-Up

Figure 1: Test setup



4.3 Test Operation and Test Software

Software used for testing: U-WAVEPAK

This software was running on the external PC performing continuous data reading and hence permanent radio communication of the EUT with a second radio device.

The EUT was exercised in the operation mode listed in section 3.4 as appropriate.

4.4 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

1. Product: Laptop PC
   Manufacturer: Lenovo
   Model: G50
   Rated Voltage: DC 20V
   Input Current: 3.25A
   Serial Number: L3-AK121 07/02

2. Product: AC Adapter for Laptop PC
   Manufacturer: Lenovo
   Model: 92P1156
   Rated Voltage: AC (100 - 240)V
   Input Current: 1.5A
   Frequency: 50/60Hz
   Serial Number: 11S92P1156Z1ZBGF67N99F

3. Product: Mouse
   Manufacturer: Dell
   Model: MO56UC
   Serial Number: G0601Z20

4. Product: Ethernet Hub
   Manufacturer: Buffalo
   Model: Broad Station (BBR-4MG)
   Rated Voltage: DC 5.5V
   Input Current: 0.55A
   Serial Number: 8647276112009

5. Product: AC Adapter for Ethernet Hub
   Manufacturer: Buffalo
   Model: 420AS44252
   Rated Voltage: AC 100V
   Input Current 0.9A
   Frequency: 50/60Hz
   Serial Number: 0648R

6. Product: Printer
   Manufacturer: Hewlett Packard
   Model: C4224A
   Rated Voltage: AC 100-127V
   Input Current: 3.0A
   Frequency: 50/60Hz
   Serial Number: USDG022308

External (second) radio device for communication with the EUT:

7. Product: 02AZD880C (U-WAVE-T)
   Manufacturer: Mitutoyo
   Serial Number: 0999999231

8. Product: Gauge connected to U-WAVE-T
   Manufacturer: Mitutoyo
   Model: ID-C1012EB
   Serial Number: 39203

4.5 Countermeasures to achieve EMC Compliance

No additional measures were employed to achieve compliance.

5. Test Results

5.1 Digital Interface (Host)

5.1.1 Mains Terminal Continuous Disturbance Voltage, FCC Part 15.107

RESULT: **PASS**

Date of testing:	2008-05-14
Ambient temperature:	25°C
Relative humidity:	40%
Atmospheric pressure:	1009hPa
Frequency range:	(0.15 - 30)MHz
Equipment classification:	(class B)
Kind of test site:	Shielded Room

Requirements:
The AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits specified in 15.107(a).

Test procedure:
ANSI C63.4-2003

The EUT was placed on a platform of nominal size 1m by 1.5m raised 80cm above the reference ground plane. A vertical conducting plane of the screened room was located 40cm to the rear of the EUT. The second (external) radio device (U-WAVE-R) and the associated device were placed in the opposite side of the measurement room.

The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency in order to ensure that maximum emission amplitudes were attained.

The AC adaptor of the laptop PC which was connected to the EUT was connected to a Line Impedance Stabilization Network (LISN) / Artificial Mains Network (AMN).

The measurements were performed using a CISPR quasi-peak detector and average detector.

Disturbances other than those mentioned are small or not detectable.

Figure 2: Spectral Diagrams, Conducted Emission, (0.15 - 30)MHz, Phase N (N)

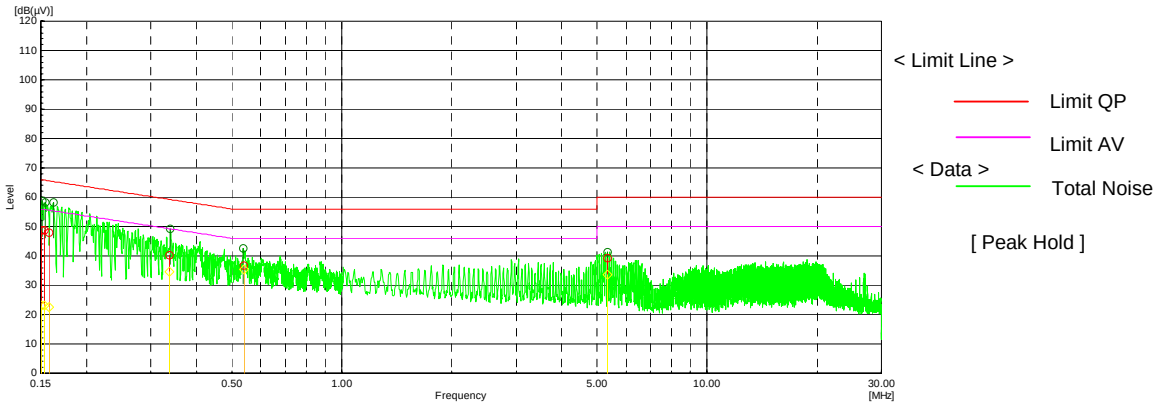


Figure 3: Spectral Diagrams, Conducted Emission, (0.15 - 30)MHz, Phase L1 (L)

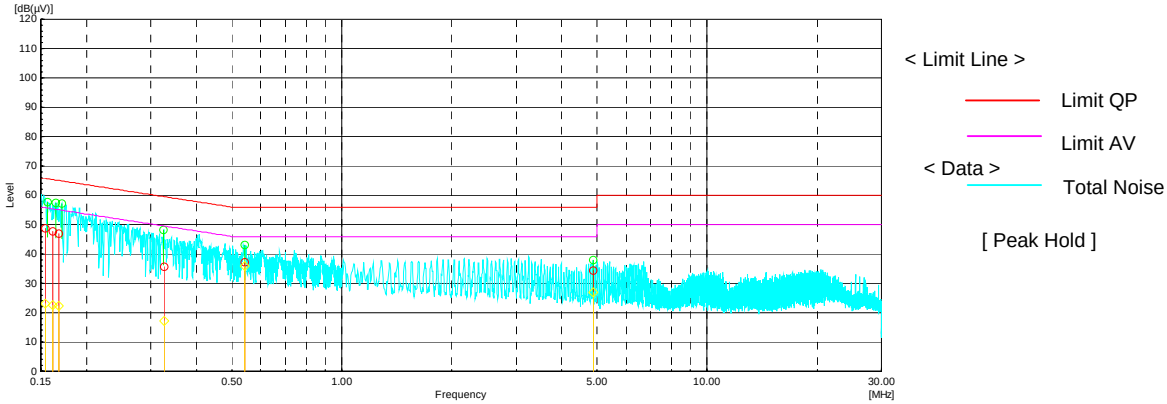


Table 2: Conducted Emission, 150kHz - 30MHz, Quasi Peak and Average Data, Phase N (N) and L1 (L), Mode A

Freq. [MHz]	Phase	Reading QP [dB(µV)]	Reading AV [dB(µV)]	Factor [dB]	Level QP [dB(µV)]	Level AV [dB(µV)]	Limit QP [dB(µV)]	Limit AV [dB(µV)]	Margin QP [dB]	Margin AV [dB]
0.15053	N	39.2	13.5	9.6	48.8	23.1	66	56	17.2	32.9
0.15381	N	39.1	13.5	9.6	48.7	23.1	65.8	55.8	17.1	32.7
0.1583	N	38.2	12.9	9.6	47.8	22.5	65.6	55.6	17.8	33.1
0.33717	N	30.6	24.9	9.7	40.3	34.6	59.3	49.3	19	14.7
0.53935	N	27	25.6	9.7	36.7	35.3	56	46	19.3	10.7
5.34185	N	29.4	23.7	9.9	39.3	33.6	60	50	20.7	16.4
0.15412	L1	39.2	13.4	9.6	48.8	23	65.8	55.8	17	32.8
0.16218	L1	38.1	13.1	9.6	47.7	22.7	65.4	55.4	17.7	32.7
0.16783	L1	37.3	12.8	9.6	46.9	22.4	65.1	55.1	18.2	32.7
0.32714	L1	25.9	7.5	9.7	35.6	17.2	59.5	49.5	23.9	32.3
0.54369	L1	27.5	26.3	9.7	37.2	36	56	46	18.8	10
4.86937	L1	24.6	17.1	9.8	34.4	26.9	56	46	21.6	19.1

5.1.2 Radiated Emission, FCC Part 15.109

RESULT: **PASS**

Date of testing:	2008-05-14
Ambient temperature:	22°C
Relative humidity:	43%
Atmospheric pressure:	1009hPa
Frequency range:	30MHz - 1GHz
Equipment classification:	(class B)
Measurement distance:	10m
Kind of test site:	Semi Anechoic Chamber

Requirements:
The emissions from the unintentional radiator portion of the EUT shall not exceed the field strength specified in 15.109(a).

Test procedure:
ANSI C63.4-2003

The EUT was placed on a nonconductive turntable 0.8m above the ground plane.

The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 30MHz to 1GHz. Final radiated emissions measurements were made at 10m.

At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1m to 4m in order to determine the emission’s maximum level. The spectrum analyzer’s 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode.

The second (external) radio device (U-WAVE-R) and the associated device were placed below the turn table. The radio was transmitting through the center opening of the turn table.

The highest emission amplitudes relative to the appropriate limit were recorded in this report.

Disturbances other than those mentioned are small or not detectable.

Figure 4: Spectral Diagram, Radiated Emission 30MHz - 1GHz, Horizontal Antenna Orientation, Mode A

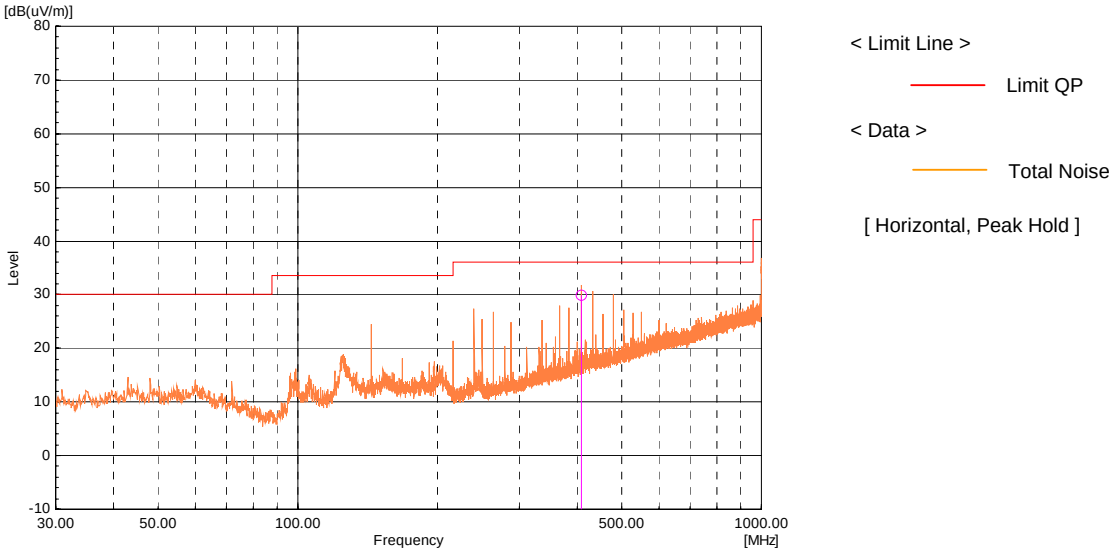
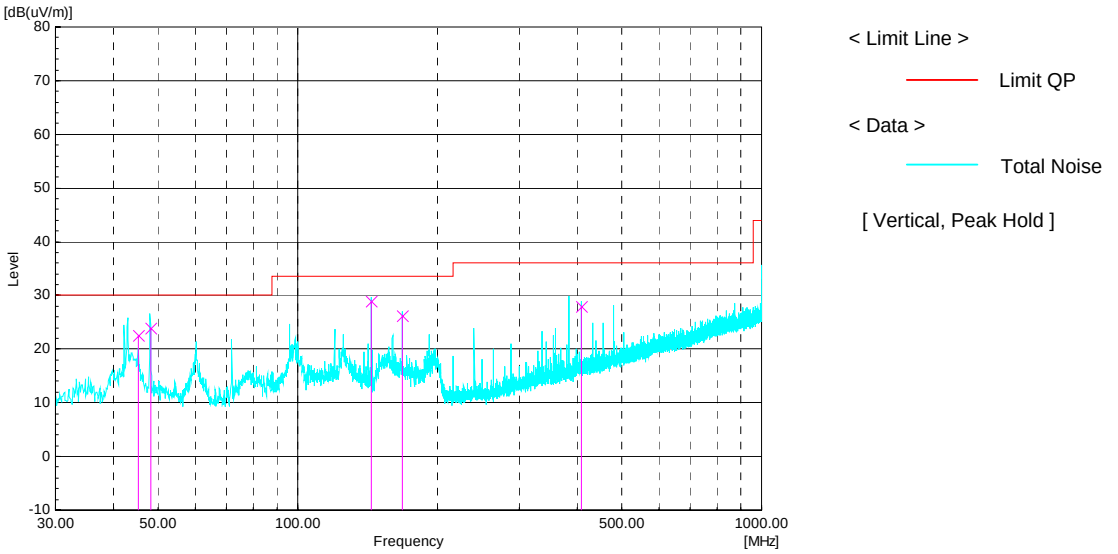


Figure 5: Spectral Diagram, Radiated Emission 30MHz - 1GHz, Vertical Antenna Orientation, Mode A



Note:

The spectra here above correspond to the result at 10m measurement distance and are given for illustration purpose only.

Table 3: Radiated Emission 30MHz - 1GHz, Horizontal & Vertical Antenna Orientations, Quasi Peak Data, Mode A

Freq. [MHz]	Ant. Orien-tation	Result QP (Meas.) 10m [dB(µV)]	Factor [dB(1/m)]	Level QP 10m [dB(µV/m)]	Equiv. Level QP 3m [db(µV/m)]	Limit 3m [µV/m]	Limit 3m [db(µV/m)]	Margin QP [dB]	Height [cm]	Angle [°]
45.261	V	45.9	-23.3	22.6	33.1	100.0	40.0	6.9	100	261
48.243	V	47.3	-23.3	24	34.5	100.0	40.0	5.5	102	124
143.99	V	52.2	-23.2	29	39.5	150.0	43.5	4.0	107	191
168.004	V	49	-22.7	26.3	36.8	150.0	43.5	6.7	102	192
407.987	H	48.1	-18.2	29.9	40.4	200.0	46.0	5.6	240	146
408.013	V	46.1	-18.2	27.9	38.4	200.0	46.0	7.6	101	146

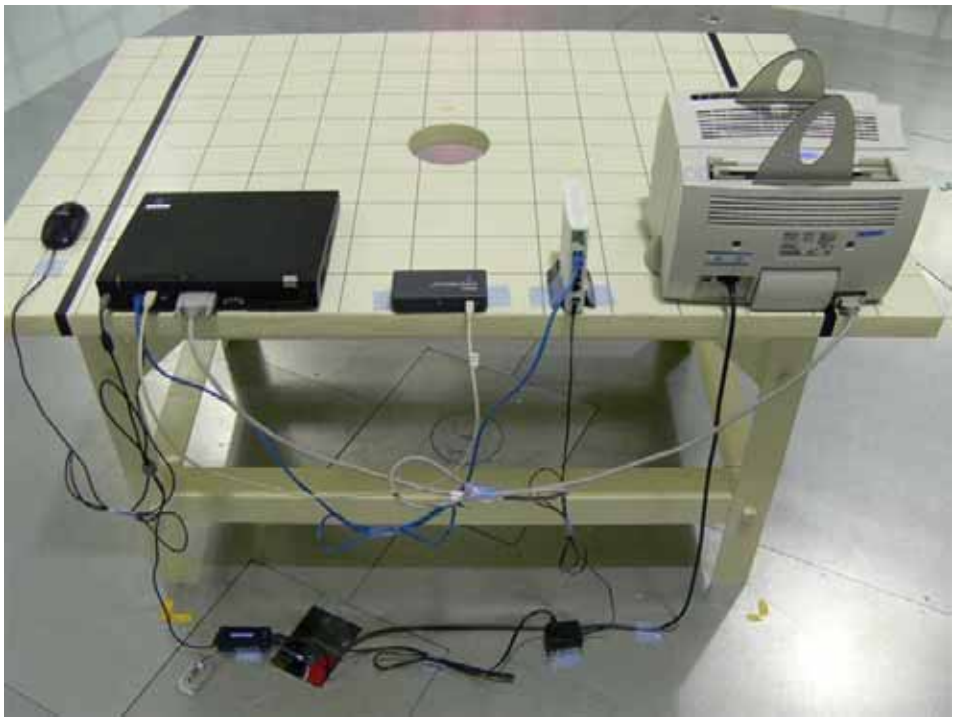
Calculation:
{Equiv. Level QP 3m} [dB(µV/m)] = {Level QP 10m} [dB(µV/m)] + 20 log(10m/3m)
{Limit 3m} [dB(µV/m)] = 20 log({Limit 3m} [(µV/m])

6. Photographs of Test Setup

Photograph 1: Set-up for Conducted Emission, on AC Mains (Rear)

Photograph 2: Set-up for Conducted Emission, on AC Mains (Front)

Photograph 3: Set-up for Radiated Emission (Rear)



Photograph 4: Set-up for Radiated Emission (Front)

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