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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:		02AZD810D (U-WAVE-R)	Serien-Nr.: Serial No.:		
Wareneingangs-Nr.: Receipt No.:		213082671	Eingangsdatum: Date of receipt:		
Prüfort: Testing location:		4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan			
Prüfgrundlage: 47 CFR Part 15 (Subpart: B) Test specification: ANSI C63.4-2003					
Prüfergebnis: Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n). Test Result: The test item passed the test specification(s).					
Prüflaboratorium: TÜV Rheinland Japan Ltd. - Global Technology Assessment Center Testing Laboratory: 4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan					
geprüft/ tested by:		kontrolliert/ reviewed by:			
 2008-10-06 T. Sauter / Inspector		 2008-10-06 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. Intentional radiator aspects are covered by test report 12604525 001.					
Abkürzungen: P(pass) = entspricht Prüfgrundlage F(all) = entspricht nicht Prüfgrundlage N/A = nicht anwendbar N/T = nicht getestet			Abbreviations: P(pass) = passed F(all) = failed N/A = not applicable N/T = not tested		
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any safety mark on this or similar products.					

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TEST SUMMARY

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

5.1.2 RADIATED EMISSION, FCC 15.109
RESULT: PASS

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1. General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report.

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 Communications 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.

The test facility is accredited by VLAC (member of ILAC) under number VLAC-017 according to ISO/IEC 17025:2005. TÜV Rheinland Japan Ltd. is accredited by the Federal Communications Commission as a Conformity Assessment Body under Designation Number JP0017 and Test Firm Registration Number 386498.

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2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equipment ID	Calibrated until
For Conducted Emission					
Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	2009-02
Two-Line V-Network (LISN)	Rohde & Schwarz	ENV216	100276	RF-0016	2009-05
For Radiated Emission					
Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	2009-02
RF Selector (10m)	Toyo Corporation	NS4900	0703-182	RF-0029	2009-05
Low Noise Pre-Amplifier	TSJ	MLA-10K01-B01-35	1370750	RF-0253	2009-05
3dB Attenuator 50Ohm	Tamagawa Electronics Co., Ltd.	CFA-01	-	RF-0265	2009-05
Trilog Antenna	Schwarzbeck	VULB9168	0245	RF-0019	2009-05
Biconical Antenna	EMCO	3110B	9603-2379	RF-0207	2009-03
Constant Voltage Constant Frequency Stabilizers					
CVCF (Shielded Room)	NF Corporation	ESU2000S	9075612	RF-0210	N/A
CVCF Booster (Shielded Room)	NF Corporation	ESU2000B	9074403	RF-0211	N/A

2.3 Measurement Uncertainty

Table 2: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Conducted Emission	150kHz - 30MHz	±1.4dB
Radiated Emission (Horizontal Orientation)	30MHz - 1GHz	±4.8dB
Radiated Emission (Vertical Orientation)	30MHz - 1GHz	±4.2dB

3. General Product Information

3.1 Product Function and Intended Use

The EUT (Equipment Under Test) is a IEEE802.15.4 unit, which is to be used with personal computers (PC, laptop or desktop type). Measurement data from e.g. a calipper are transmitted via a DTS U-WAVE-T unit attached to a measurement tool to the EUT connected to a PC. The measurement tool and the PC are not part of the EUT.

3.2 System Details

Radio standard:	IEEE 802.15.4
Specified power output:	0dBm (max. peak power: 1mW)
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
Classification:	G1D
System Input Voltage:	DC 5.0V (USB bus power system)
Protection Class:	III

3.3 Clock Frequencies

The EUT generates internally the following clock frequencies:

6 MHz
8 MHz
16 MHz

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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

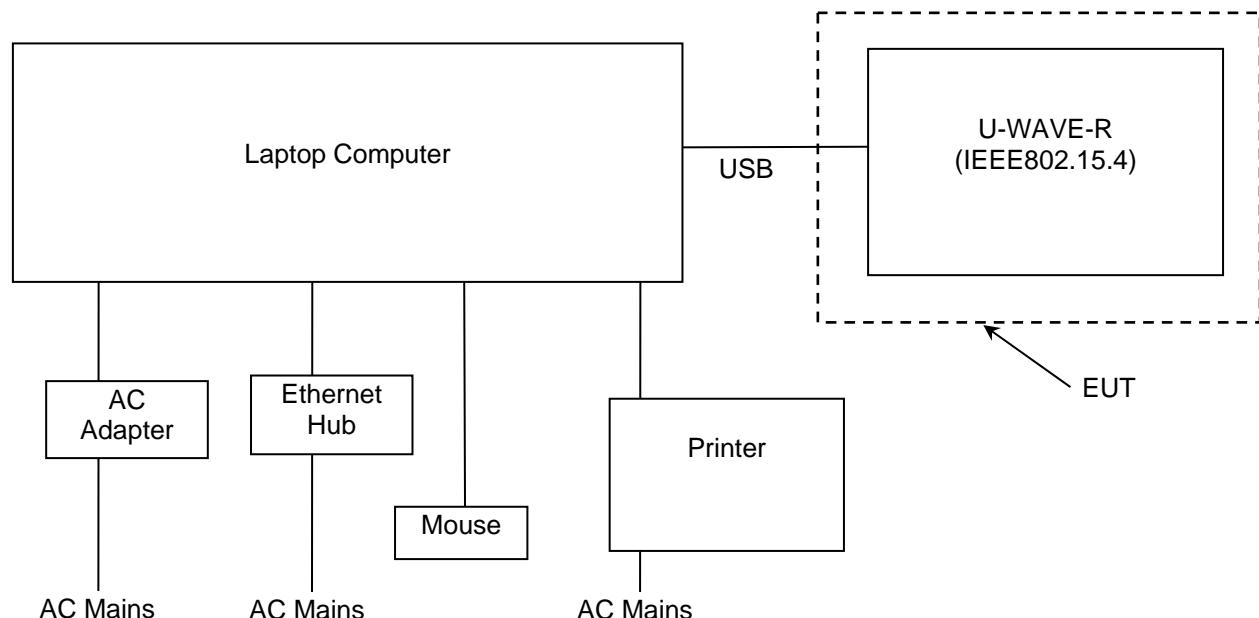
The test methodology used is based on the requirements of 47 CFR Part 15, sections 15.31, 15.33, 15.35, 15.107 and 15.109.

The test methods, which have been used, are based on ANSI C63.4:2003.

For details, see under each test item.

4.2 Physical Configuration for Testing

Figure 1: Test setup



For more details, refer to section: Photographs of the Test Set-Up

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4.3 Test Operation and Test Software

Software used for testing: U-WAVEPAK v1.002 by Mitutoyo Corporation.

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. It was used to enable on the EUT the test operation mode specified 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 Computer
 Manufacturer: IBM
 Model: R40e (2684)
 Rated Voltage: DC 16V
 Input Current: 4.5A
 Serial Number: 99-DAY92 04/06
2. Product: AC Adapter for Laptop Computer
 Manufacturer: IBM
 Model: 08K8204
 Rated Voltage: AC 100 - 240V
 Input Current: 1.5 - 0.9A
 Frequency: 50/60Hz
 Serial Number: 11S08K8204Z1Z6LV45B51U
3. Product: Laptop Computer
 Manufacturer: Lenovo
 Model: G50
 Rated Voltage: DC 20V
 Input Current: 3.23A
 Serial Number: L3-AK121 07/02
4. Product: AC Adapter for Laptop Computer
 Manufacturer: Lenovo
 Model: 92P1156
 Rated Voltage: AC 100 - 240V
 Input Current: 1.5A
 Frequency: 50/60Hz
 Serial Number: 11S92P1156Z1ZBGF67N99F

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5. Product:	Mouse
Manufacturer:	Dell
Model:	MO58UC
Serial Number:	G0601Z20
6. Product:	Ethernet Hub
Manufacturer:	Buffalo
Model:	Giga Switching Hub, LSW3-GT-5NS(D1)
Rated Voltage:	AC 100V
Input Power:	5W
Frequency:	50/60Hz
Serial Number:	16485784211186
7. Product:	Printer
Manufacturer:	Hewlett Packard
Model:	C4224A
Rated Voltage:	AC 100-127V
Input Current:	3A
Frequency:	50/60Hz
Serial Number:	USDG022308

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

8. Product:	02AZD880D (U-WAVE-T)
Manufacturer:	Mitutoyo
Serial Number:	0999999285
9. Product:	Measurement Tool connected to U-WAVE-T
Manufacturer:	Mitutoyo
Model:	ID-C1012EB
Serial Number:	39162

Note:

Accessories No. 1 and 2 were used for Mains Terminal Continuous Disturbance Voltage testing only. Accessories No. 3 and 4 were used for Radiated Emission testing only.

4.5 Countermeasures to achieve EMC Compliance

No additional measures were employed to achieve compliance.

5. Test Results EMISSION

5.1 Digital Interface (Host)

5.1.1 Mains Terminal Continuous Disturbance Voltage, FCC 15.107

RESULT: Pass

Date of testing: 2008-09-19

Ambient temperature: 24°C

Relative humidity: 67%

Atmospheric pressure: 1010hPa

Frequency range: 0.15 – 30MHz

Equipment classification: Class B

Kind of test site: Shielded Room

Requirements:

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

Test procedure:

ANSI C63.4-2003

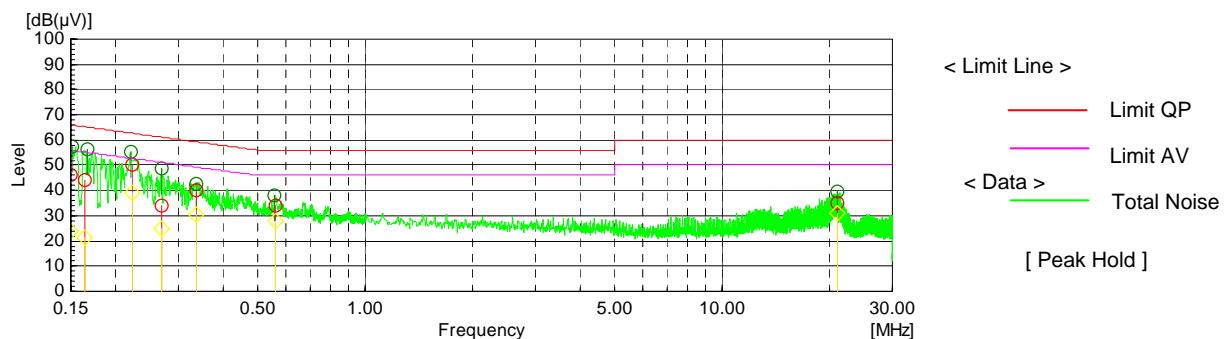
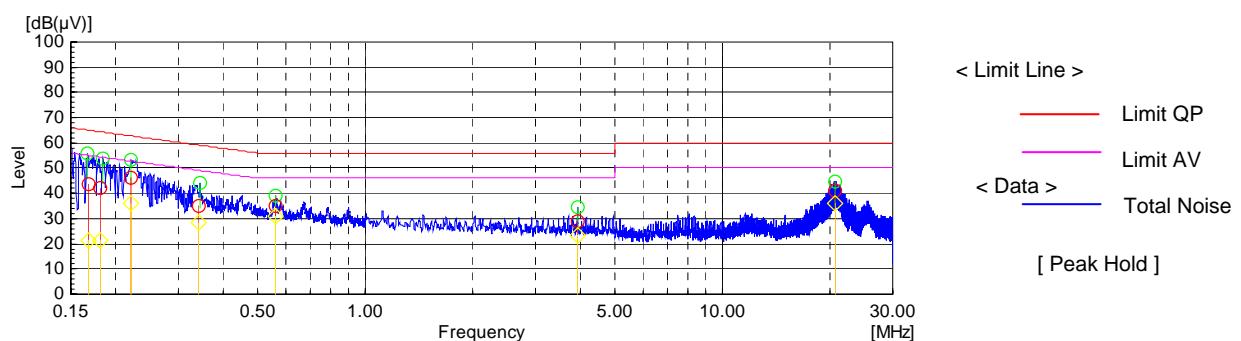
The EUT was placed on a wooden table raised 80cm above the reference ground plane. A vertical conducting plane of the screened room was located 40cm to the rear of the EUT. The second (external) radio device (U-WAVE-T) and the associated measurement tool were placed in the opposite side of the measurement 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 and frequency in order to ensure that maximum emission amplitudes were attained.

The AC adapter of the laptop computer feeding and controlling 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.

Prüfbericht - Nr.:**12604525 002****Seite 12 von 21***Test Report No.:**Page 12 of 21***Figure 2: Spectral Diagrams, Conducted Emission, 0.15 – 30MHz, Phase N (N)****Figure 3: Spectral Diagrams, Conducted Emission, 0.15 – 30MHz, Phase L1 (L)****Table 3: Conducted Emission, 150kHz – 30MHz, Quasi Peak and Average Data, Phase N (N) and L1 (L)**

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]
0.16823	L1	34.2	11.7	9.6	43.8	21.3	65	55	21.2	33.7
0.18152	L1	32.4	11.8	9.6	42	21.4	64.4	54.4	22.4	33
0.22019	L1	36.5	26.6	9.6	46.1	36.2	62.8	52.8	16.7	16.6
0.34191	L1	25.1	18.8	9.7	34.8	28.5	59.2	49.2	24.4	20.7
0.56271	L1	25.1	21.4	9.7	34.8	31.1	56	46	21.2	14.9
3.93198	L1	19.1	13.4	9.8	28.9	23.2	56	46	27.1	22.8
20.77798	L1	30.7	25.7	10.2	40.9	35.9	60	50	19.1	14.1
0.15061	N	36.8	14.1	9.6	46.4	23.7	66	56	19.6	32.3
0.1647	N	34.8	11.9	9.6	44.4	21.5	65.2	55.2	20.8	33.7
0.22268	N	40.7	29.4	9.6	50.3	39	62.7	52.7	12.4	13.7
0.26842	N	24.5	15.1	9.7	34.2	24.8	61.2	51.2	27	26.4
0.33581	N	30.3	20.9	9.7	40	30.6	59.3	49.3	19.3	18.7
0.56236	N	24.2	18.2	9.7	33.9	27.9	56	46	22.1	18.1
21.00191	N	24.9	20.6	10.3	35.2	30.9	60	50	24.8	19.1

Notes: Level QP = Reading QP + Factor

Level AV = Reading AV + Factor

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5.1.2 Radiated Emission, FCC 15.109

RESULT:
PASS

Date of testing: 2008-09-26

Ambient temperature: 24°C

Relative humidity: 68%

Atmospheric pressure: 995hPa

Frequency range: 30MHz – 1GHz

Equipment classification: Class B

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

Requirements:

The emission 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

Before final measurements of radiated emissions were made in Semi Anechoic Chamber, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane. The second (external) radio device (U-WAVE-T) and the associated measurement tool were placed below the turn table. The radio signals were transmitting through an opening in the ground plane below the turn table.

The spectrum was examined from 30MHz to 1GHz. Final radiated emission measurements were made at 3m.

At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations. For frequencies between 30MHz and 1GHz, 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 highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

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Figure 4: Spectral Diagram, Radiated Emission 30MHz – 300MHz, Horizontal Antenna Orientation

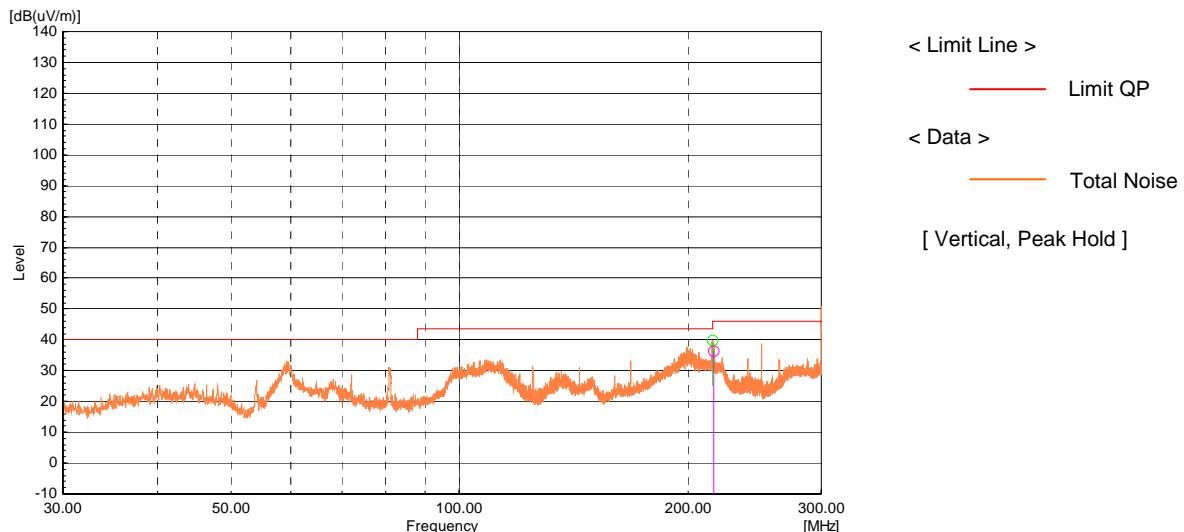
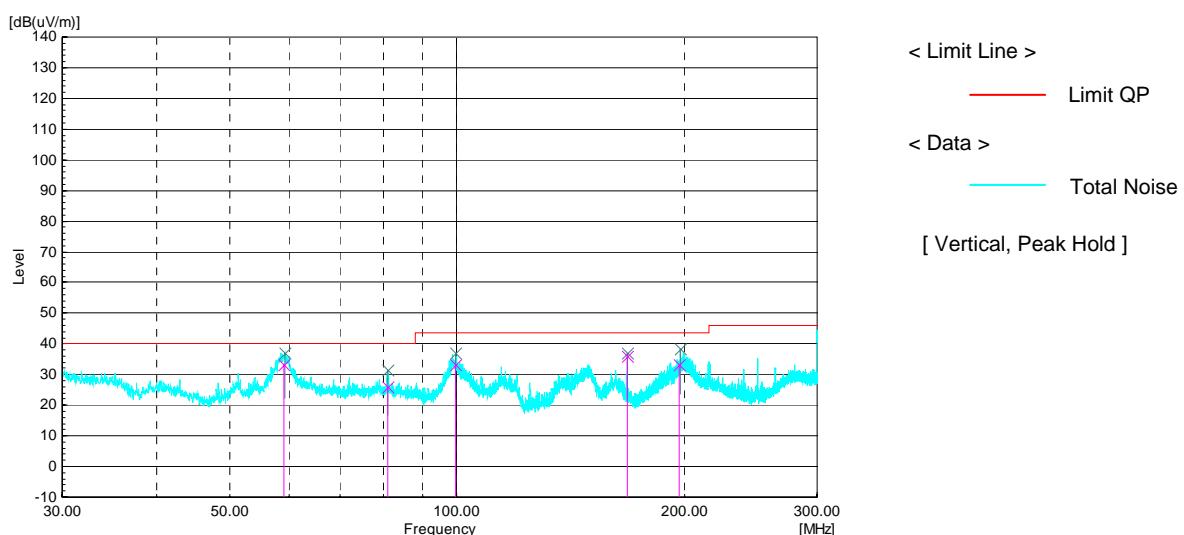


Figure 5: Spectral Diagram, Radiated Emission 30MHz – 300MHz, Vertical Antenna Orientation



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Figure 6: Spectral Diagram, Radiated Emission 30MHz – 1GHz, Horizontal Antenna Orientation

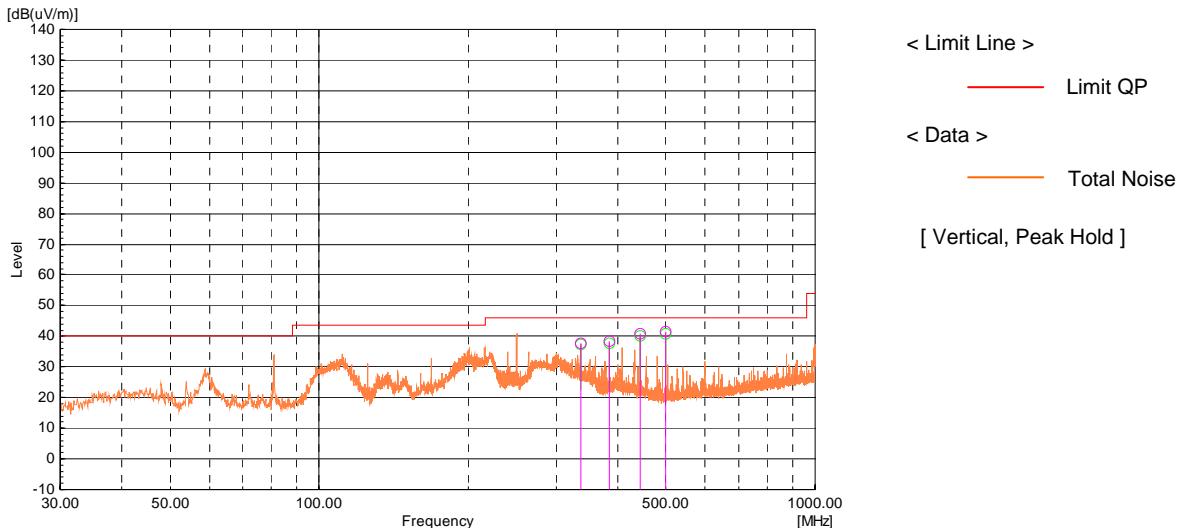
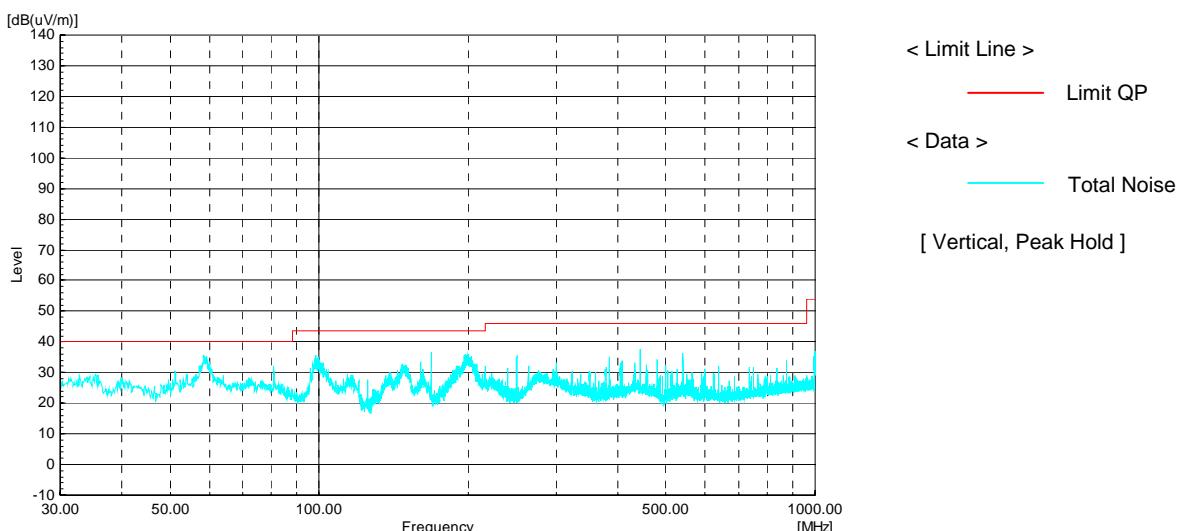


Figure 7: Spectral Diagram, Radiated Emission 30MHz – 1GHz, Vertical Antenna Orientation



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Table 4: Radiated Emission 30MHz – 1GHz, Horizontal & Vertical Antenna Orientations, Quasi Peak Data

Freq. [MHz]	Antenna Orient.	Reading QP [dB(µV)]	Factor [dB(1/m)]	Level QP [dB(µV/m)]	Limit [µV/m]	Limit [dB(µV/m)]	Margin QP [dB]	Height [cm]	Angle [°]
58.957	V	60.6	-27.4	33.2	100	40	6.8	119	110
80.862	V	53	-27	26	100	40	14	121	182
99.591	V	59.4	-26.2	33.2	150	43.5	10.3	108	274
168.005	V	58.2	-22.1	36.1	150	43.5	7.4	101	174
197.184	V	52.9	-19.7	33.2	150	43.5	10.3	101	14
216.196	H	55.7	-19.4	36.3	200	46	9.7	157	246
336.022	H	58.1	-20.3	37.8	200	46	8.2	101	131
384.014	H	57	-18.8	38.2	200	46	7.8	102	342
443.089	H	58	-17.3	40.7	200	46	5.3	100	292
500.064	H	57.3	-15.7	41.6	200	46	4.4	100	181

Notes: Level QP = Reading QP + Factor

dB(µV/m) = 20 x log(µV/m)

Final measurement was performed for the EUT orientation Y.

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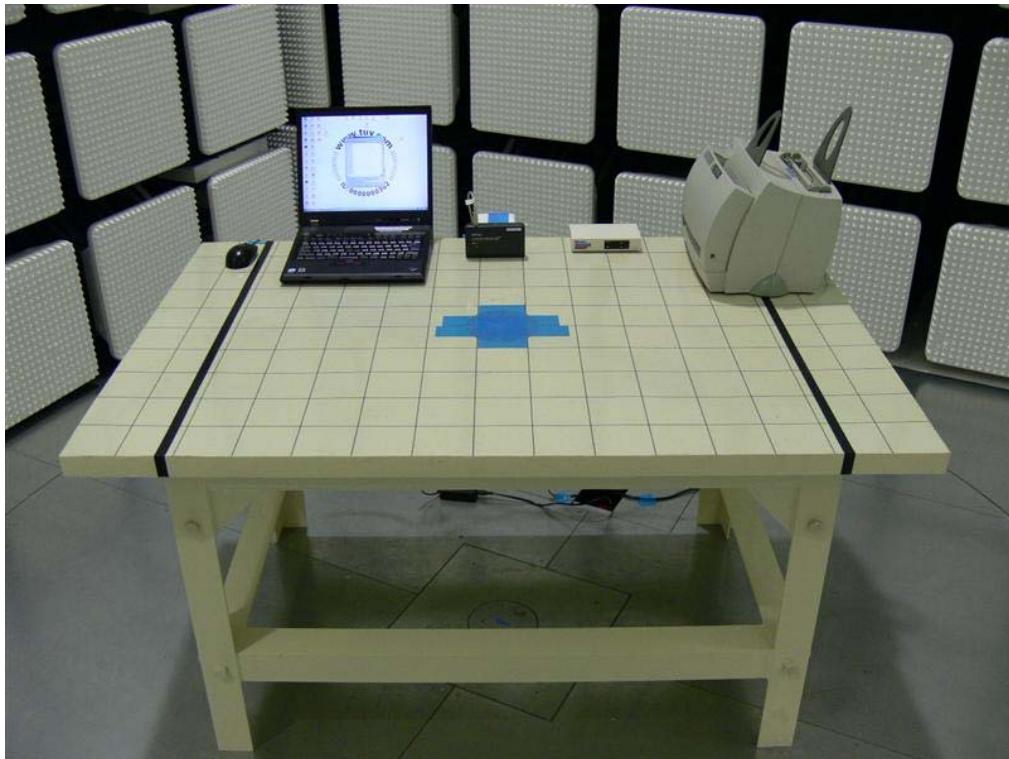
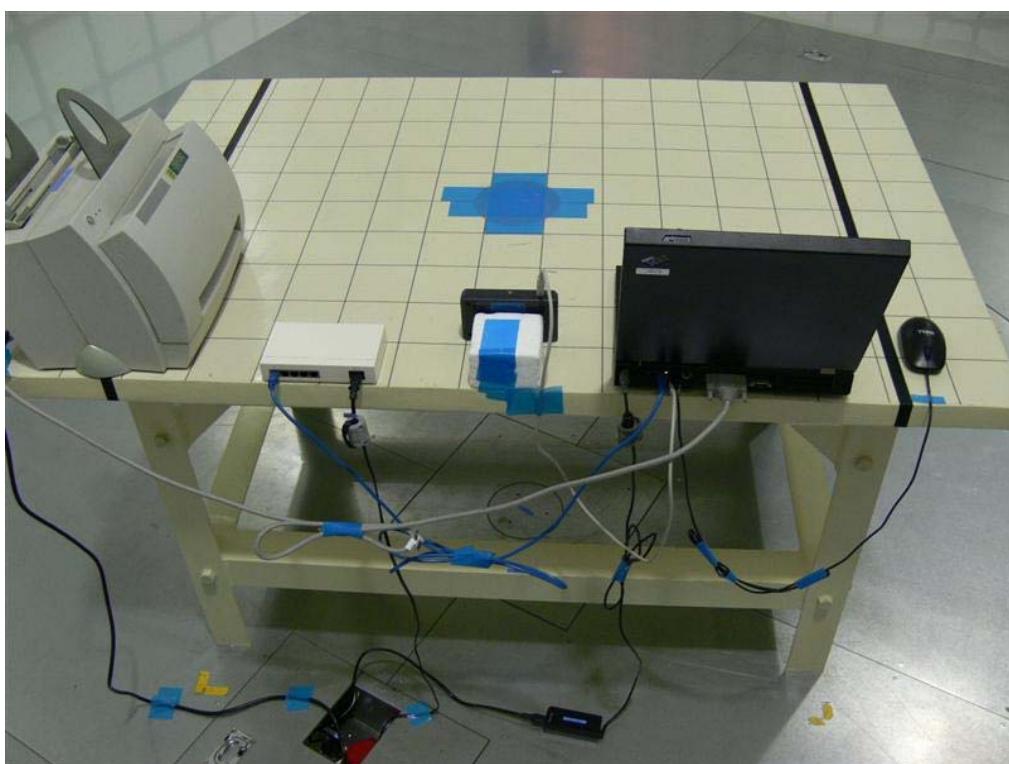
6. Photographs of test setup

Photograph 1: Set-up for Radiated Emission, EUT Configuration X-Axis



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