MEASUREMENT/TECHNICAL REPORT

PERTECH, INC.

Model USB HUB MASTER

FCC ID: N38-7PORT-HUB

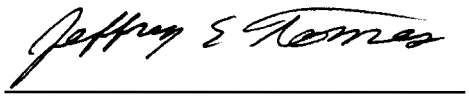
APPLICATION FOR CERTIFICATION

RF Emission Measurements Performed For Determination of Compliance with the US Code of Federal Regulations Title 47, Chapter I, FCC Part 15 Subpart B As Required for Certification for Unintentional Radiators

Issue Date: August 12, 1998

This report concerns: Original grant

Equipment type: Universal Serial Bus Hub
Transition Rules per 15.37 are not requested.

Report Prepared by: 

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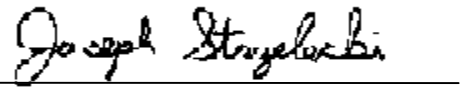
Application Approved by: 

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1.0 General Information

1.1 Product Description

The Model USB Hub Master (referred to as the EUT in this report) is a 7 Port Universal Serial Bus Hub. The EUT has an internal power supply. The EUT is manufactured by Pertech, Inc.

When the EUT is connected to another USB port, it allows the user to connect up to seven more USB devices. The EUT can drive USB devices with 3 MHz or 12 MHz bus clocks.

1.2 Related Submittals

Pertech is not submitting any other submittals related to the EUT.

1.4 Tested System Details

The FCC ID's for all equipment, plus descriptions of all cables used in the tested system which have grants, are:

Model & Serial Number	Manufacturer & FCC ID	Description	Cable Descriptions
(EUT) USB Hub Master S/N: None	Pertech N38-7PORT-HUB	7 Port USB Hub	-1.8 m, Unshielded, 2 wire Integral Power cord -2 m, Shielded Upstream Cable
M/N: 1230 S/N: 1V86BY44KWK6	Compaq DOC	Laptop Computer	N/A
ADP-60BB S/N: None	Compaq N/A	Laptop Power Supply	-2 m, Integral, DC Cable -1.8m, 2 wire, Unshielded AC Power Cord
M/N:YC76 S/N: 0017810	Intel EDUYC76	USB Camera	-2 m, Integral Cable
M/N:M-VB48 S/N: LZC80700723	Logitech DZL211137	USB Mouse	-2 m, Integral Cable
NX-1001 S/N: 510030137823	Star B6DZ150L	Parallel Printer	-1.8 m, Shielded data cable with Metal Shells

1.5 Test Methodology

The test procedures used are in accordance with the ANSI document C63.4-1992, (July 17, 1992) "Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.6 Test Facility

The open area test site used to collect the radiated data is located on 8625 Helmar Road in Newark, Illinois. The open field test site has a metal ground screen. Details of the site characteristics are on file with the FCC. Conducted emission measurements and preliminary radiated emission scans were performed in shielded enclosure “A” at Radiometrics' Romeoville, Illinois EMI test lab. These sites have been fully described in a report and accepted by the FCC in a letter dated October 1, 1996 (31040/SIT 1300F2).

Conducted emission measurements were performed using a Line Impedance Stabilization Network (LISN) as the pick-up device. This device is constructed in accordance with the circuit diagram provided in Figure 3 of ANSI document C63.4-1992.

1.7 Test Equipment

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. Below 1 GHz, when a radiated emission is detected approaching the specification limit, the measurement of the emission is repeated using a tuned dipole antenna with a Roberts Balun.

The radiated emission measurements were performed with a spectrum analyzer. The bandwidths of the spectrum analyzers are adjusted to the correct bandwidths as specified by the FCC Rules. The bandwidth used from 450 kHz to 30 MHz is 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. From 1 to 2 GHz a 1 MHz bandwidth is used. In order to increase the sensitivity of the spectrum analyzer, a preamplifier was used. The preamplifiers used had sufficient dynamic range that ensured that an overload condition was not present during the tests.

2.0 System Test Configuration

2.1 Test System and Justification

Wiring was consistent with manufacturer's recommendations. The EUT was connected to the USB port of the host computer (laptop) using the upstream cable supplied with EUT. A printer was also connected to the parallel port of the host computer.

A mouse and a camera were connected to the EUT. The mouse had a bus speed of 12 MHz and the camera had a bus speed of 3 MHz. Various port configurations were checked to find the worst case configuration.

Adding another USB device (keyboard) did not change the worst case readings by more than 2 dB. This was first checked during preliminary radiated emission scans in a shielded enclosure and verified again at the OATS when, emission were approaching the limit.

Power was supplied at 115 VAC, 60 Hz single-phase to its external power supply.

2.2 EUT Exercise Software

The EUT was tested in normal communication during the tests. The EUT was continuously communicating with both the computer and its peripherals during the tests.

The EUT exercise program used during radiated and conducted testing was contained on a disk in the floppy drive of the host computer. The program sequentially exercises each system component in turn. The software continuously filled the screen with capitol H's and also sent H's to the printer. The host system also continuously communicated with the EUT to determine if it had to process any input data. This program ran until it was manually stopped at the end of each test.

2.3 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

2.4 Equipment Modifications

The following modifications were made to the EUT by Radiometrics Midwest Corp. prior to the testing in order to achieve compliance with Class B limits.

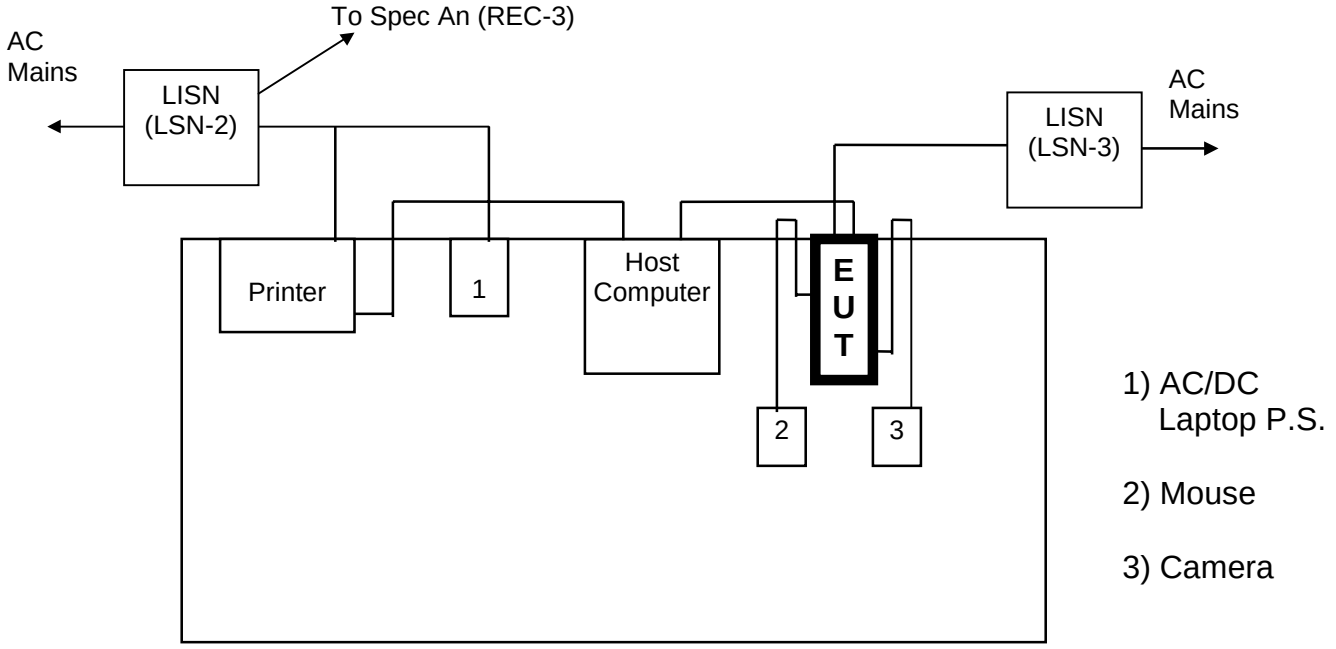
1) The ground planes on the bottom of the Main Board were connected in various places.
2) One, 330 pF cap was added to each +5 VDC input on the Main Board (two total).
3) The crystal circuitry (and all of its components) was replaced with a single resonator chip.
4) Fair-Rite # 2943666631 replaced L5 And L6.
5) Two 0.1uF caps were added to L5 And L6.
6) Steward # 28B735-300 with 2 turns was added to the power cord just before it exits the case.
7) Pins 11 & 32 of U15 were routed to be filtered by L?.
8) Internal AC cord was rerouted behind the Main Board.
9) Power supply PCB was flipped 180 degrees.

The above modifications will be made in the final revision of the Main Board. The layout and positioning of components will not change. There is sufficient room on the PCB to add the components in the same locations they were placed for testing. Production units will have all of the above modifications made to them.

Figure 2.1 Configuration of Tested System

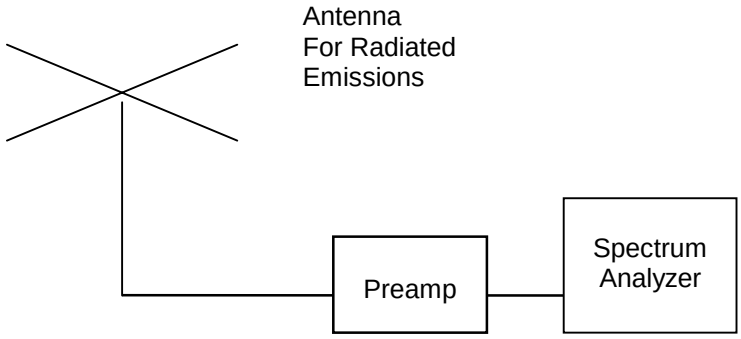
Conducted Emissions:
- LISN's at least 80 cm from EUT chassis
- Vertical conductive plane 40 cm from rear of table top
- EUT power cord bundled
- Test platform is not rotated

Radiated Emissions:
- LISN's not used
- AC outlet with low-pass filter at the base of the turntable
- No vertical conductive wall



Rotating Platform:
1x1.5m surface above
GND plane

Notes:
- Not to Scale
- Antenna height varied 1-4 meters
- Distance from antenna to tested system is 3 meters
- LISN=Line Impedance Stabilization Network



3.0 Conducted Emission Data

The initial step in collecting conducted data is a spectrum analyzer peak scan and the plotting of the measurement range. Significant peaks are then marked as shown on the following table, and these signals are then measured with the quasi-peak detector. The following represents the worst case emissions from the host computer (with the EUT connected) power cord, after testing all modes of operation.

Model : USB Hub Master
Test Date : August 04, 1998

Line Tested	Freq. MHz	Meter* Reading dBuV	Cable Loss dB	Strength of Signal dBuV	Limit dBuV	Margin Under Limit dB
AC Hot	0.48	24.2	0.1	24.3	48.0	23.7
AC Hot	2.62	35.6	0.2	35.8	48.0	12.2
AC Hot	24.00	36.9	0.6	37.5	48.0	10.5
Neutral	0.45	24.8	0.1	24.9	48.0	23.1
Neutral	11.41	31.7	0.4	32.1	48.0	15.9
Neutral	24.00	36.9	0.6	37.5	48.0	10.5

* All reading are quasi-peak with a 9 kHz bandwidth and no video filter.

Changing the frequency of the transmitter did not affect the emissions listed above.
Judgment: Passed by 10.5 dB

Test Personnel: Jeffrey E. Tomes
Senior EMC Technician

4.0 Radiated Emissions Data

The following table lists the highest measured emission frequencies, and measured levels and the Class B limit. A sample calculation is given in paragraph 4.1. . The analyzer readings are quasi-peak with a 120 kHz bandwidth and no video filter.

Model : USB HUB MASTER
Serial Number : None
Test Date : August 05, 1998

Notes : Pol = Antenna Polarization; V = Vertical; H = Horizontal
BC = Biconical; LP = Log-Periodic; DP = Dipole
Corr. Factors = cable loss - preamp gain - distance factor.

Freq. MHz	Meter Reading dBuV	Antenna Factor dB	Antenna Pol/ Type	Corr. Factors dB	Field Strength of Signal dBuV/m	Limit Field Strength dBuV/m	Margin Under Limit dB
48.1	50.4	2.2	V/DP	-17.4	35.3	40.0	4.7
96.0	44.6	8.2	V/DP	-16.4	36.4	43.5	7.1
144.1	41.2	11.8	V/DP	-16.3	36.7	43.5	6.8
240.6	41.9	16.2	V/DP	-15.6	42.9	45.6	3.5
96.0	42.7	8.2	H/DP	-16.4	34.5	43.5	9.0
144.1	44.8	11.8	H/DP	-16.3	40.3	43.5	3.2
240.6	42.3	16.2	H/DP	-15.6	42.9	46.0	3.1
72.0	38.0	6.8	V/BC	-14.9	29.9	40.0	10.1
120.0	35.6	13.6	V/BC	-16.5	32.7	43.5	10.8
168.1	28.6	16.4	V/BC	-16.1	28.9	43.5	14.6
216.1	41.4	11.6	V/LP	-15.8	37.2	46.0	8.8
264.1	36.6	13.7	V/LP	-15.7	34.7	46.0	11.3
384.2	33.1	15.1	V/LP	-15.3	32.9	46.0	13.1
48.0	33.8	12.7	H/BC	-17.4	29.1	40.0	10.9
120.1	36.7	13.6	H/BC	-16.5	33.8	43.5	9.7
168.1	30.1	16.4	H/BC	-16.1	30.4	43.5	13.1
192.1	32.6	17.8	H/BC	-15.8	34.6	43.5	8.9
216.1	42.6	11.6	H/LP	-15.8	38.4	46.0	7.6
264.1	40.7	13.7	H/LP	-15.7	38.7	46.0	7.3
384.2	32.0	15.1	H/LP	-15.3	31.9	46.0	14.1
552.2	29.1	17.9	H/LP	-14.9	32.1	46.0	13.9

Judgment: Passed by 3.1 dB
No Emissions were detected from 555 to 2000 MHz within 15 dB of the limits.

Test Personnel: Jeffrey E Tomes
Senior EMC Technician

4.1 Field Strength Calculation

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

FS = RA + AF + CF - AG

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain

Assume a receiver reading of 49.5 dBuV is obtained. The Antenna Factor of 8.1 and a Cable Factor of 1.7 is added. The Amplifier Gain of 23.3 dB is subtracted, giving a field strength of 36 dBuV/m. The 36 dBuV/m can be mathematically converted to its corresponding level in uV/m.

FS = 49.5 + 8.1 + 1.7 - 23.3 = 36.0 dBuV/m

Level in uV/m = Common Antilogarithm [(36 dBuV/m)/20] = 63.1 uV/m