FAULT TOLERANT POWER COMPLIANCE SPECIFICATION

VERSION 2.0

PRODUCT CERTIFICATION REPORT

HP server rp7410/rp7420/rx7620/rx7640

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PRODUCT CERTIFICATION REPORT

HEWLETT-PACKARD COMPANY
HP server 7410/rp7420/rx7620/rx7640

PREPARED FOR
Hewlett-Packard Company
Hewlett-Packard High Performance
System Laboratory
Richardson, TX 75080

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TEST REPORT 06-059A

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PRODUCT CERTIFICATION TEST REPORT

Product	HP server rp7410/rp7420/rx7620/rx7640
Product Number	A6752A
Serial Number	MFP-019
Date of Testing	November 27, 2001
Test Report Number	06-059A
Test Location	Hewlett-Packard High Performance System Laboratory Richardson, TX
Test Conducted by	Dr. Robert F. Sullivan, The Uptime Institute, Inc. Steve Belson, Lead HP Power Engineer Paul Wirtzberger, HP Power Engineer Mason Drew, HP Power Technical Support

Summary

The Uptime Institute, Inc. (*Institute*) supervised performance testing of the HP server rp7410 to determine product compliance with the *Institute's* Fault-Tolerant Power Compliance Specification (FTPC Specification) Version 2.0. The HP server rp7410 supplied for evaluation successfully passed all ten applicable criteria required for compliance certification. The HP server rp7410 continued to function without interruption through all testing manipulations. The HP server rp7410 was tested with

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nominal, high, and low voltages and frequencies. The two power sources were always maintained at different voltages and frequencies, with the frequencies deliberately out of synchronization. The two AC power inputs were powered off and on repeatedly in various sequences to ensure the HP server rp7410 met the functional requirements of The *Institute's* FTPC Specification, that there was no interaction between the two AC inputs, and that the server met the recovery time of less than 10 seconds set forth in the specification. The internal operating system of the HP server rp7410 was running during the time of the testing with a diagnostic tool monitoring the function of the system and power condition. Operation of the HP server rp7410 was monitored at the operating console and showed no errors, hard or soft, during these tests. A console log was recorded for each AC power-off and power-on cycle, demonstrating the software reporting function of the system. In addition, an LED on the front cover of each bulk power supply indicated the power status. Load was shared between the two AC power sources within 4% of the average for the tested configuration under full load conditions, well within the required 10% of the average. The power cords terminate within the HP server rp7410. The server is equipped with detachable power cords which have positive retention as part of the chassis assembly. There are no switching devices or batteries in the power system. All components of the HP server rp7410 are concurrently maintainable without impacting uninterrupted server operation.

CERTIFICATION BACKGROUND

Fault-tolerant power equipment refers to computer or communication hardware that is capable of receiving alternating current (AC) input from two different AC power sources. The objective is to maintain full equipment functionality when operating from an A and B power source or from A alone or from B alone. Equipment with an odd number of external power inputs (line cords) will generally not meet this requirement. It is desirable for equipment to have the least number of external power inputs while

still meeting the requirement for receiving AC input from two different AC power sources. Products requiring more than two external power inputs risk being rejected by some sites. For equipment to qualify as truly fault-tolerant power compliant, it must meet all of the following criteria as initially installed and at ultimate capacity and under any configuration or combination of options. (The designation of A and B power sources is used for clarity in the following specification criteria.)

FUNCTIONAL TESTING

The HP server rp7410 was set up with one AC power cord attached to a utility source while the second AC power line cord was attached to a Pacific Power AC Power System, where both voltage and frequency could be controlled. The utility source supplied power at 208 VAC and 60 hertz (Hz). The Pacific Power source was used to create two different worst-case power conditions: 180 VAC, 47 Hz and 260 VAC, 63 Hz. A full set of tests was run under each condition.

The functionality of the server and any errors were monitored using a PC-based data acquisition system that simulates an operator's console in a functioning computer facility. The HP server rp7410 was running the operating system using the HP Unix Operating System (HP UX) programs during the certification testing. This routine was scrolled across the console continuously throughout the period of certification and no errors occurred in that time. The Technical and Office Protocol (TOP) network standard was used to identify any errors in the operating system and the power system. This error-reporting feature reported to the console when an AC power source was lost, and when that power was restored. Soft copies of these logs were saved and provided for analysis. An undervoltage test was

first conducted where the voltage of the utility power source was lowered until the total load was assumed by the Pacific Power source at nominal voltage. This occurred at 160 VAC. Load sharing by both power sources resumed at 170 VAC.

Test procedures comprised of Dr. Bob Sullivan calling out the power-off and power-on sequences, Paul Wirtzberger controlling the power to the AC line cords, and Mason Drew monitoring the control console. This process was repeated for each test sequence.

At the end of the manipulation of the A and B power sources, the HP server rp7410 was powered off and then brought up with a single power source at 180 V/47 Hz, and then at 260 V/63 Hz.

The current was monitored on the two AC power sources and the four line cords, with the power sources at 208 VAC/60 Hz, 180 VAC/47 Hz, and then at 260 VAC/63 Hz. Differences were generally within 1% of the average, with the maximum deviation being 4%.

All components of the power system, the AC power cords and the AC to DC bulk power supplies (BPS), were concurrently removed and restored to demonstrate the concurrent maintainability of the HP server rp7410 power system.

PRODUCT CONFIGURATION TESTED

The HP server rp7410 can be either rack mounted or reside in a stand-alone cabinet. It has a maximum configuration of eight processors and 32 gigabytes of memory in two cells. There are up to four 73 gigabyte hard drives and 15 I/O ports plus two core I/O ports, one of which is redundant. The HP server rp7410 was tested with a full complement of processors and memory, one hard drive, 15 I/O ports and one Core I/O port. The HP server rp7410 power

The system is designed to have each BPS powered from an independently derived source. As tested, the power system has a 2(N+1) redundancy capability in that the entire syste will operate from one power train. Ultimately, with upgrade to the processors, memory, storage and IO functions requiring more power, the system will have a 2(N) redundancy.

The HP rp7420, rx7620, and rx7640 servers, upgrades to the rp7410, are the next in this series of Business Critical HP servers. They contain advanced processors, memory upgrades, and larger storage hard drives, while maintaining the same IO function.

The rp7420 server utilizes an HP PA-RISC based processor, while the rx7620 and rx7640 utilize an Intel® Itanium® 2 processor.

The HP rp7420, rx7620, and rx7640 servers contain the same power system as the rp7410, with dual power input, and redundant power components. Even with the upgraded capability and capacity the rp7420, rx7620, and rx7640 power systems provide a 2(N+1) level of redundancy.

SPECIFICATION CRITERIA AND TEST RESULTS

Criteria #1 — STATUS: PASS

Description

If either one of two AC power sources fails or is out-of-tolerance, the equipment must still be able to start-up or continue uninterrupted operation with no loss of data, reduction in hardware functionality, performance, capacity, or cooling.

Testing Procedure and Results

Power was interrupted to each line cord following the sequence outlined in version 2.0 of the specification. Under all power conditions, including variations in voltage and frequency, the HP server rp7410 continued to function without error, loss of functionality, performance, capacity, or cooling. The HP server rp7410 was able to start-up with a single power source using the nominal 208 VAC/60 Hz source as well as 180 VAC/47 Hz and 260 VAC/63 Hz sources.

Criteria #2 — STATUS: PASS

Description

After the return of either AC power source from a failed or out-of-tolerance condition, during which acceptable power was continuously available from the other AC power source, the equipment will not require a powerdown, IPL or human intervention to restore data, hardware functionality, performance, or capacity.

Testing Procedure and Results

When power was restored during the sequence of testing under all power conditions, including variations in voltage and frequency, the HP server rp7410 continued to function without error, loss of functionality, performance, capacity, or cooling.

Criteria #3 *STATUS:* **PASS**

Description

The first or second AC power source may fail ten seconds after the return of the first or second AC power source from a failed or out-of-tolerance condition with no loss of data, reduction in hardware functionality, performance, capacity, or cooling.

Testing Procedure and Results

In all power-off, power-on tests conducted, power was turned off and/or restored in less than the 10 second criteria. The sequence could occur in less than 3 seconds, and most testing times were approximately 3 to 5 seconds.

Criteria #4 *STATUS:* **PASS**

Description

The two AC power sources can be out of synchronization with each having a different voltage, frequency, phase rotation, and phase angle as long as the power characteristics for each separate AC source remain within the range of the manufacturer's published specifications and tolerances.

Testing Procedure and Results

All tests were run with the two AC input power sources having different voltages and frequencies that were deliberately out of synchronization. Under all power conditions, including variations in voltage, frequency, and synchronization, the HP server rp7410 continued to function without error, loss of functionality, performance, capacity, or cooling.

Criteria #5 *STATUS:* **PASS**

Description **All AC power inputs must terminate within the manufacturer's equipment. The equipment must provide for positive retention of the female plug. The AC power train (down to and including the AC to DC power supplies) must be compartmentalized such that any power train component on one side can be safely serviced without putting the AC power train of the other side at risk.**

Testing Procedure and Results The four AC Distribution power cords terminate within the HP server rp7410 cabinet. The server is equiped with detatchable power cords which have positive retention as part of the chassis assembly. Each power cord and BPS can be serviced without affecting the other BPS AC power trains.

Criteria #6 *STATUS:* **PASS**

Description **Internal or external active AC input switching devices (e.g., static transfer switches) are not acceptable.**

Testing Procedure and Results No internal or external active AC input switching devices (e.g., stateic transfer switches) are installed in the HP server rp7410.

Criteria #7 *STATUS:* **PASS**

Description **A fault inside the manufacturer's equipment, which results in the failure of one AC power source, shall not be transferred to the second AC power source causing it to also fail.**

Testing Procedure and Results The two AC power sources are configured in such a way that an internal failure in one AC source cannot migrate to the other source causing it also to fail.

Criteria #8

STATUS: **PASS**

Description **An internal Uninterruptible Power System (UPS) or internal power batteries (batteries for cache memory are acceptable) or other type of energy storage equivalent is allowable only for the purpose of a prompt, orderly shutdown. The existence and volt-ampere capacity of an internal UPS or batteries and the time required for a prompt orderly shutdown must be identified.**

Testing Procedure and Results There are no internal UPS system or power batteries in the HP server rp7410 power system.

Criteria #9

STATUS: **PASS**

Description **For single or three-phase power sources, with both AC power inputs available and with both inputs operating at approximately the same voltage, the normal load on each power source will be shared within 10% of the average.**

Testing Procedure and Results Under the configuration tested, the two power sources share the load within 4% of the average, well within the 10% requirement of the specification.

Criteria #10

STATUS: **NOT APPLICABLE**

Description **For three-phase power source configurations, the normal load on each phase will be within 10% of the average.**

Testing Procedure and Results The HP server rp7410 is a 208 VAC single-phase server. There is no three-phase power associated with this server.

Criteria #11 *STATUS:* **PASS**

Description

An external alarm must alert the user within 60 seconds via the equipment's software or the host's operating system when an AC powersource fails or is outside the manufacturer's published tolerances. This software alarm must also create a permanent record of the abnormal condition, the time it occurred and the time it was corrected.

Testing Procedure and Results

The indication of a power source failure and restoration was logged within less than a second of the event occurring. In addition there is an LED on each BPS indicating its power status, solid green for all systems operating, flashing green for AC power available but system off, flashing yellow for power warning, and solid yellow for no AC available or a power fault exists.

Criteria #12 *STATUS:* **NOT APPLICABLE**

Description

The manufacturer will supply a written certification that the equipment meets or exceeds this specification for fault-tolerant power compliance.

Testing Procedure and Results

Not applicable. The Uptime Institute provides all certification documentation under this formal certification process.

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The Uptime Institute tested a sample of the product described in this Report and it has received certification. The *Institute's* staff conducted testing to verify compliance with the Fault-Tolerant Power Compliance Specification Version 2.0. The Uptime Certification testing program and the specific test procedures, test equipment, and test results are posted on the *Institute's* website. The *Institute's* Uptime Certification does not apply to other product models, or to any product that has been modified from its original, factory-issued design, or to any product subjected to conditions outside of those duplicated in the test.

This Uptime Certification supplements and does not supersede the manufacturer's guidelines, warranties, recommendations for proper configuration, and/or conditions for optimum performance and product life.

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Fault-tolerant power equipment refers to computer or communication hardware that is capable of receiving AC input from two different AC power sources. The objective is to maintain full equipment functionality when operating from A and B power sources or from A alone or from B alone. Equipment with an odd number of external power inputs (line cords) generally will not meet this requirement. It is desirable for equipment to have the least number of external power inputs while still meeting the requirement for receiving AC input from two different AC power sources. Products requiring more than two external power inputs risk being rejected by some sites. For equipment to qualify as truly fault-tolerant power compliant, it must meet all of the following criteria as initially installed, at ultimate capacity, and under any configuration or combination of options. (The designation of A and B power sources is used for clarity in the following descriptions.)

1. If either one of two AC power sources fails or is out-of-tolerance, the equipment must still be able to start up or continue uninterrupted operation with no loss of data, reduction in hardware functionality, performance, capacity, or cooling.
2. After the return of either AC power source from a failed or out-of-tolerance condition, during which acceptable power was continuously available from the other AC power source, the equipment will not require a powerdown, IPL, or human intervention to restore data, hardware functionality, performance, or capacity.
3. The first or second AC power source may then subsequently fail no later than ten seconds after the return of the first or second AC power source

from a failed or out-of-tolerance condition with no loss of data, reduction in hardware functionality, performance, capacity, or cooling.

4. The two AC power sources can be out of synchronization with each having a different voltage, frequency, phase rotation, and phase angle as long as the power characteristics for each separate AC source remain within the range of the manufacturer's published specifications and tolerances.
5. Both external AC power inputs must terminate within the manufacturer's fault-tolerant power compliant computer equipment. In the event that the external AC power input is a detachable power cord, the equipment must provide for positive retention of the female plug so the plug cannot be pulled loose accidentally. Within the equipment, the AC power train (down to and including the AC to DC power supplies) must be compartmentalized such that any power train component on either side can be safely serviced without affecting computer equipment availability or performance and without putting the AC power train of the other side at risk.
6. For single or three phase power sources, the neutral conductor in the AC power input shall not be bonded to the chassis ground inside the equipment. This will prevent circulating ground currents between the two external power sources.
7. Internal or external active AC input switching devices (e.g., mechanical or electronic transfer switches) are not acceptable.

8. A fault inside the manufacturer's equipment that results in the failure of one AC power source shall not be transferred to the second AC power source causing it to also fail.
9. An internal Uninterruptible Power System (UPS) or internal power batteries (batteries for cache memory are acceptable) or other type of energy storage equivalent is allowable only for the purpose of a prompt, orderly shutdown. The existence and volt-ampere capacity of an internal UPS or batteries and the time required for a prompt orderly shutdown must be identified.
10. For single or three-phase power sources, with both AC power inputs available and with both inputs operating at approximately the same voltage, the normal load on each power source will be shared within 10% of the average.
11. For three-phase power source configurations, the normal load on each phase will be within 10% of the average.
12. An external alarm must alert the user within 60 seconds via the equipment's software or the host's operating system when an AC powersource fails or is outside the manufacturer's published tolerances. This software alarm must also create a permanent record of the abnormal condition, the time it occurred and the time it was corrected.
13. The manufacturer will supply a written certification that the equipment meets or exceeds this specification for fault-tolerant power compliance.

Version 2.0 Effective: March 1, 2002.

This Fault-Tolerant Power Compliance Specification has been established by the forty-eight members of The Uptime Institute's Site Uptime Network®. The specification pertains to all computer and communication equipment critical to maintaining uninterrupted information availability.

Be warned that many products claiming to be dual power compliant do not meet the performance requirements of this specification.

Incorporated in Version 2.0 is a new criterion 6. This criterion was added to address members' concerns about the potential for ground current to circulate between the two input power sources if the neutral conductor was grounded within a power supply. Intentionally grounding the neutral conductor in the power supply would be a violation of common sense and several codes. As a result, computer manufacturers have already complied with this criterion if they have a UL listing for their products. Criterion 6 has been added merely to codify what is already a standard industry practice.

Version 2.0 will supersede Version 1.2 on June 30, 2002. After June 30, 2002, hardware products will only be certified and listed if they meet Version 2.0 of the specification. The Uptime Institute independently tests hardware products submitted by manufacturers to verify and certify conformance with the Fault-Tolerant Power Compliant Specification. A listing of currently certified products is maintained at www.uptimeinstitute.org/cert.html.

Use of the Fault-Tolerant Power Compliance Specification Version 2.0 is made available at no charge to those companies desiring to make fault-tolerant compliance part of their procurement process. The specification may be quoted or reproduced in its entirety at no charge with the proviso that the Institute exclusively reserves the right to test and certify hardware products as complying with the specification. The version number must be included and copyright credit

given to The Uptime Institute's Site Uptime Network whenever the specification is quoted by reference or reproduced in its entirety.

Continuing updates to this specification are expected as user requirements become better defined and as hardware manufacturers determine what dual power capabilities they can provide. For the most recent version, visit The Uptime Institute's website at http://www.uptimeinstitute.org/spec.html, or contact the Institute by calling (505) 986-3900.