Site Planning Guide for Workgroup Servers

Sun Enterprise™ 250 Server

Sun Enterprise 450 Server

Sun Enterprise 220R Server

Sun Enterprise 420R Server

Sun Fire™ 280R Server

Sun Fire 880 Server

Sun Microsystems, Inc.
901 San Antonio Road
Palo Alto, CA 94303-4900 U.S.A.
650-960-1300

Part No. 816-1613-10
October 2001, Revision A

Send comments about this document to: docfeedback@sun.com

Please
Recycle

Contents

Figures

Tables

Preface

This guide is designed to assist Sun™ customers who have purchased Sun workgroup servers and seek information about the proper way to house the servers in a data center. It provides information about the servers' power consumption, cooling requirements, electrical specifications, and space requirements after the servers are mounted in EIA compliant racks.

The Sun workgroup servers covered by this guide are:

- Sun Enterprise™ 250
- Sun Enterprise 450
- Sun Enterprise 220R
- Sun Enterprise 420R
- Sun Fire™ 280R
- Sun Fire 880

The material contained in this manual is correct as of the date of publication. For the most up-to-date information, refer to the Sun Microsystems™ web site for your product.

Other Resources

This guide is not intended as a comprehensive guide to facility design. Customers seeking such a guide should consult the *Sun Microsystems Data Center Site Planning Guide*. Those planning to construct a new data center should read the *Sun Microsystems Data Center Site Planning Guide* before reading this manual. Those who intend to add Sun workgroup servers to an exisiting data center may find it better to read this manual first.

For information about mixing different systems or peripherals in racks, and for information about Sun's rackmounting cabinets, see the *Rackmount Placement Matrix* located at this web site:

```
http://www.sun.com/products-n-solutions/hardware/docs/
Network_Storage_Solutions/Cabinets_and_Enclosures/index.html
```

See "Related Documentation" on page xiii for reference to the *Sun Microsystems Data Center Site Planning Guide*, *Rackmount Placement Matrix*, and other resources.

How This Book Is Organized

Chapter 1 describes the site planning process and concepts.

Chapter 2 gives information about rackmounting the servers.

Chapter 3 discusses important power issues relating to the servers, including input and output power requirements, and heat output and cooling requirements.

Chapter 4 lists shipping, physical, electrical, environmental, and clearance for service specifications for the servers. It also describes the physical characteristics of a Sun rack.

Chapter 5 provides a site planning checklist that you can use when planning your data center and preparing for systems installations.

Metric and English Conventions

This guide provides measurements in both metric and English equivalents. To follow current industry usage, metric measurements are sometimes given first, followed by the English equivalent in parentheses. However, there are industry-acceptable exceptions to this usage. For example, racks are still referred to as "19-inch" racks rather than "48.26-cm" racks, and rack units (RUs) are measured in inches. Use whichever unit of measurement best suits your needs.

Related Documentation

Application	Title	Part Number
Facility planning	*Sun Microsystems Data Center Site Planning Guide*	805-5863-10
Rackmounting	*Sun Enterprise 250 Server Rackmounting Guide*	805-3611-10
	Ultra Enterprise 450 Server and Sun Ultra 450 Workstation Rackmounting Guide	805-1912-10
	Sun Enterprise 220R Server Setup and Rackmounting Guide	806-1087-10
	Sun Enterprise 420R Server Setup and Rackmounting Guide	806-1086-10
	Sun Fire 280R Server Setup and Rackmounting Guide	806-4805-10
	Sun Fire 880 Server Rackmounting Guide	806-6594-10
	Sun StorEdge Expansion Cabinet Installation and Service Manual	805-3067-14
	Rackmount Placement Matrix	See below
Configuration	*Sun Enterprise 250 Server Owner's Guide*	805-5160-10
	Ultra Enterprise 450 Server Owner's Guide	805-0429-10
	Sun Enterprise 220R Server Owner's Guide	806-1079-10
	Sun Enterprise 420R Server Owner's Guide	806-1078-10
	Sun Fire 280R Server Owner's Guide	806-4806-10
	Sun Fire 880 Server Owner's Guide	806-6592-10
Sun cabinet	*Sun StorEdge Expansion Cabinet Installation and Service Manual*	805-3067-14
Web sites	Workgroup servers: `http://www.sun.com/servers/workgroup`	
	Racks: `http://www.sun.com/servers/workgroup/rackmount`	
	Rackmount Placement Matrix: `http://www.sun.com/products-n-solutions/hardware/docs/Network_Storage_Solutions/Cabinets_and_Enclosures/index.html`	

Accessing Sun Documentation Online

A broad selection of Sun system documentation is located at:

`http://www.sun.com/products-n-solutions/hardware/docs`

A complete set of Solaris™ documentation and many other titles are located at:

`http://docs.sun.com`

Ordering Sun Documentation

Fatbrain.com, an Internet professional bookstore, stocks select product documentation from Sun Microsystems, Inc.

For a list of documents and how to order them, visit the Sun Documentation Center on Fatbrain.com at:

`http://www.fatbrain.com/documentation/sun`

Sun Welcomes Your Comments

Sun is interested in improving its documentation and welcomes your comments and suggestions. You can email your comments to Sun at:

`docfeedback@sun.com`

Please include the part number (816-1613-10) of this document in the subject line of your email.

CHAPTER 1

Site Planning Overview

This chapter provides an overview of the site planning process. It also offers basic information about the physical, environmental, and power requirements of six Sun workgroup server models. Sources of more detailed information about the servers, racks, and cabinets are also provided.

This manual includes information only about these Sun servers:

- Sun Enterprise 250
- Sun Enterprise 450
- Sun Enterprise 220R
- Sun Enterprise 420R
- Sun Fire 280R
- Sun Fire 880

Go to this web site for more information about these servers:

`http://www.sun.com/servers/workgroup`

Site Planning Process

Customer facility managers, system administrators, and Sun Microsystems account managers need to discuss site planning, preparation, and system installation before delivery of the systems. A common understanding of how the systems will be delivered, configured, installed, and maintained will help to create a suitable facility and successful installation of the servers and related equipment.

Use the following general steps as a guide to plan for a system installation. Use the more detailed Site Planning Checklist in Chapter 5 to verify that you have met all the site requirements outlined in this manual.

1. Determine which systems you plan to install and in what hardware configurations.
2. Select the cabinets and racks that you will use.
3. Determine the location and physical space requirements of the systems, cabinets, and racks.
4. Determine the amount of power required by the systems and any other equipment mounted in each cabinet or rack.
5. Determine the amount of cooling needed by all of the systems and any other equipment mounted in each cabinet or rack.
6. Determine the amount and type of power and networking cables needed.
7. Ensure that the data center can support the electrical and environmental requirements of the systems.
8. Obtain all the required hardware not provided with the systems or racks.
9. Verify that the route from the unloading dock to the computer room is sufficient to allow moving systems, racks, and related equipment while in their shipping containers.
10. Complete the Site Planning Checklist found in Chapter 5.

System Configurations

The first step in the site planning process is to determine the hardware configuration for each server you plan to install. You can obtain advice about your system configuration from your Sun account manager or Sun authorized sales representative. Alternatively, you can consult the servers' Owner's Guides provided with your systems for information about supported configurations.

In some facilities there will be many different configurations of the same server model; in others, multiple configurations of different server models. Each server should be accounted for separately because each server requires a specific amount of power and a specific amount of cooling. Future server upgrades and other modifications will be easier if you keep a written record of each server's configuration.

It may be prudent to plan your facility using data for maximally configured systems. There are several ways in which maximum system configuration data is useful.

- Facility managers can use this data to quickly calculate the most demanding set of conditions for weight, power, and air conditioning load (see Chapter 3 for more information about power demand and air conditioning load). This data can be helpful for planning purposes early in a facility construction cycle.
- Many customers buy servers configured for present needs but realize that future demands will require server upgrades. Since the specifics of such upgrades are often difficult to predict, some customers elect to make facility planning decisions based on maximum configuration data from the start. One benefit of this approach is that it minimizes subsequent facility disruptions.
- Maximum configuration data can also help you when you select racks and cabinets and determine how to route electrical circuits.
- Maximum configuration data enables you to plan for auxilliary power or backup power, and to plan for power grid independence if continued uptime is a consideration.

Cabinets and Racks

You can mount the servers in either a cabinet or a rack.

The terms “cabinet” and “rack” are sometimes used interchangeably, which is incorrect. Computer cabinets are fitted with doors and side panels, which may or may not be removable, and are available in a very wide variety of sizes and colors. Most cabinets provide connections for electrical power. Some cabinets provide fans and baffles designed to move cooling air in a specific direction and often, at a specified rate. Others provide electromagnetic interference (EMI) and radio frequency interference (RFI) shielding to meet standards established by various regulatory agencies.

Cabinets enclose a rack, which is a frame that provides a means for mounting electronic equipment. Racks can also stand alone and do not require the doors, panels, and other integrated equipment that comes with cabinets. Racks come in different types. One type consists of two vertical rails, which are not enclosed by cabinet doors and panels. Another, and more common type, consists of four vertical rails, which may or may not be enclosed by cabinet doors and panels.

The racks used for mounting the servers covered in this guide consists of four vertical mounting rails. The servers are attached to mounting hardware, and the mounting hardware is secured to the rack’s front and back vertical rails. FIGURE 1-1 shows a Sun Enterprise 220R server mounted in a cabinet and rack.

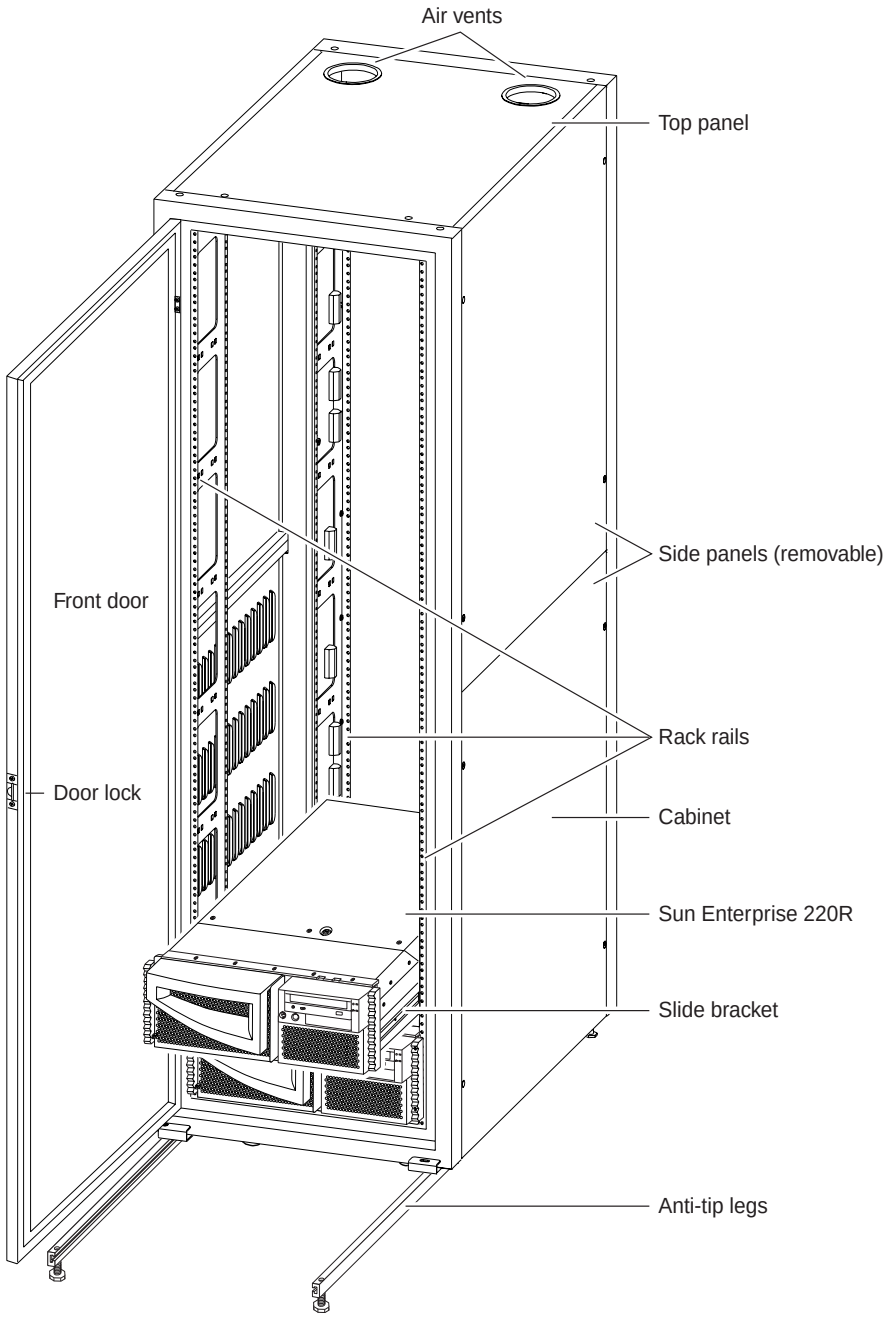


FIGURE 1-1 **Systems Mounted in a Cabinet and Rack**

Power Requirements

The design of your electrical power system must ensure that adequate, high-quality power is provided to each server and all of its peripherals at all times. Power system failures can result in catastrophic damage to computer systems and related equipment. Further, computer equipment that is subject to repeated power interruptions or fluctuations may experience a higher component failure rate than with a stable power source. Using dedicated AC breaker panels for all power circuits that supply power to your systems is very important.

Most of your server configurations probably will not draw the maximum wattage listed in TABLE 4-3. However, if you design the wiring of your data center for maximum system configurations, you will minimize disruption to your electrical infrastructure as your system configurations grow.

Grounding

Grounding design must address both electrical service and the installed equipment. A properly designed grounding system should have as low an impedance as is practically achievable for proper operation of electronic devices as well as for safety. Grounding design in the United States should comply with Article 250 of the US National Electrical Code unless superseded by local codes. For international operation, consult the country or local electrical codes. Make sure that all electronic equipment is properly grounded and use an antistatic wrist strap when working inside a chassis.

Power Sources

It is also important to secure multiple sources of power when possible. Ideally, multiple utility feeds should be provided from different sub-stations or power grids. For systems with redundant power supplies, it is prudent to attach to each primary power supply a common power cord from one power grid that can supply power to all systems, and to attach another power cord from a different power grid to the redundant supplies. If the primary power grid goes offline, the other power grid will provide power to the redundant supplies to keep the systems operating. While not essential, this is sometimes an economical way to provide power source redundancy. When designing the data center, consider including an alternate source of power and backup generators so that your facility can maintain grid independence.

Uninterruptible Power Supply

An online uninterruptible power supply (UPS) and a backup generator provide an excellent strategy for obtaining an uninterruptible source of power. The online UPS filters, conditions, and regulates the power. It protects the systems from fluctuating voltages, surges and spikes, and noise that may be on the power line.

The battery backup for the UPS should be capable of maintaining the critical load of the computer room for a minimum of 15 minutes during a power failure. This should provide sufficient time to allow for the transfer of power to an alternate feed or to the generator.

Power Factor

The power factor of a system is a number between 0 and 1 that is the ratio of the total power in watts to the total volt-ampere input. It compares the amount of power taken in by a system to the amount of power actually used by the system. For example, a system with a power factor of 1 uses all of the power it draws. A system with a power factor of 0.5 is using only half of the power it draws. See TABLE 4-3 for the systems' power factor rating.

Cooling and Environmental Requirements

The design of the environmental control system for your computer facility must ensure that each system can operate normally while remaining within the range of its operating specifications. See TABLE 4-4 for the servers' operating specifications. Computer system reliability is dependent upon a stable environment. It is particularly important to avoid temperature and humidity fluctuations. In general, more system damage occurs at high temperature and high humidity levels. See the section "Maximum Heat Output and Cooling" on page 27.

Temperature

An ambient temperature range of 21 to 23 ºC (70 to 74 ºF) is optimal for system reliability and operator comfort. While most computer equipment can operate within a rather broad range, a temperature level near 22 ºC (72 ºF) is desirable

because it is easier to maintain safe associated relative humidity levels at this temperature. Further, this recommended temperature provides an acceptably wide operational buffer in case of downtime from environmental support systems.

If your systems are shipped during cold weather, they must be warmed slowly before being installed. If the systems are 4 ºC (40 ºF) or colder, place the systems, in their shipping containers, at their final destinations. Wait 24 hours before removing the systems from their shipping containers to prevent thermal shock and condensation.

Free Airflow

It is important to remember that the flow of free air is essential to the proper cooling of Sun workgroup servers. Even though the data center air may be at a safe and steady temperature, the temperature of the air entering each server is critical. Problems sometimes arise for these reasons:

- One server is positioned so that its hot exhaust air is directed into the intake air of another server, thus preheating the intake air of the second server.
- Servers are sometimes mounted in cabinets that restrict airflow excessively. This may occur because the cabinets have solid front and/or rear doors, inadequate plenums, or they may have cooling fans that work against the fans in the servers themselves.
- A server may be mounted in a cabinet above a device that generates a very large amount of heat.

All of the servers described in this guide draw in ambient air for cooling from the front and discharge heated exhaust air to the rear. The servers require that the front and back cabinet doors to be at least 63% open for adequate airflow. This can be accomplished by removing the doors, or by ensuring that the doors have a perforated pattern that provides a 63% open area.

Proper cooling and related ventilation of a server within a cabinet is affected by many variables, including the cabinet and door construction, cabinet size, and thermal dissipation of any other components within the cabinet. Therefore, it is the responsibility of the customer to ensure that the cabinet's ventilation system is sufficient for all the equipment mounted in the rack. Refer to the product-specific Owner's Guides (see "Related Documentation" on page xiii) for more information.

Note that the operating temperature for all of the systems is 5 to 35 ºC (41 to 95 ºF). These temperatures apply to the air taken in by each server *at the point where the air enters the server.*

Cooling

Data centers may have different power and cooling capacities, often depending on when the data center was built and the requirements it was designed to meet. When designing a data center, you should consider the facilitiy's heating, ventilation, and air conditioning (HVAC) capacity so that fully populated cabinets can be adequately cooled.

For example, a data center may provide 100 watts per square foot of cooling capacity using air conditioners. This figure is based on the total square footage of the data center, not just the area where systems are located. It would include aisles and areas where power distribution equipment is located.

Based on 100 watts per square foot and 20 square feet (1.858 sq. m) per cabinet, each cabinet is allowed a cooling capacity of 2000 watts (100 watts x 20 sq.ft.) or 2kW. Remember, 2kW per cabinet in a data center is an example. Some cabinets may require 3kW or more of cooling capacity. See "Maximum Heat Output and Cooling" on page 27 for more information about cooling requirements.

Humidity

Ambient relative humidity levels between 45% and 50% are most suitable for safe server operations. This optimal range helps protect computer systems from corrosivity problems associated with high humidity levels. It also provides the greatest operating time buffer in the event of an environmental control system failure.

Further, maintaining a relative humidity level between 45% and 50% helps avoid system failures or temporary malfunctions caused by intermittent interference from electrostatic discharge (ESD) that occur when relative humidity is too low. Electrostatic discharge is easily generated and less easily dissipated in areas where the relative humidity is below 35%, and becomes critical when relative humidity drops below 30%.

Access Route Requirements

Most cabinets and racks ship in their own containers on a pallet. Make sure that the facility loading dock, unloading equipment, and pallet jack can accommodate the height and weight of the cabinets, racks, and servers while in their shipping packages. See TABLE 4-6 for shipping specifications for a typical Sun rack and TABLE 4-1 for shipping specifications for the servers.

Inspect all shipping cartons for evidence of physical damage. If a shipping carton is damaged, request that the carrier's agent be present when you open the carton. Save the original shipping containers and packing materials in case you need to store or ship the system.

When you plan your route to the computer room, make sure that the boxed cabinets, racks, and servers can fit through doors and hallways, and on elevators. Also make sure that the access route floor and elevators can support the weight of the cabinets, racks, and servers. The access route should have minimal ramps, sharp angles, and bumps. Keep each cabinet, rack, and server in its shipping container until it reaches its final destination.

CHAPTER 2

Rackmounting the Systems

The Electronic Industries Association (EIA) establishes standards for cabinets and racks intended for use with computers and other electronic equipment. All of the servers discussed in this manual are designed to comply with EIA Standard 310, which defines the standard for cabinets, racks, and associated equipment.

Cabinet and Rack Manufacturers

Cabinets and racks are available from Sun Microsystems and many other companies.

Industry-Standard Sun Cabinet and Rack

Sun Microsystems offers an EIA 310-compliant cabinet and rack for mounting the servers. It is the Sun StorEdge Expansion Cabinet (part number SGXARY030A). See the *Sun StorEdge Expansion Cabinet Installation and Service Manual* (part number 805-3067-14) for detailed information about this enclosure. See TABLE 4-6 for the cabinet's physical specifications.

Industry-Standard Third-Party Cabinets and Racks

While Sun makes no representations about the products of other companies, it is clear that they offer cabinets and racks valued by some Sun customers. For information about some of these third-party cabinets and racks, go to:

`http://www.sun.com/servers/workgroup/rackmount`

Cabinet, Rack, and Server Dimensions

Because the terms “rack” and “cabinet” are sometimes used interchangeably, much confusion exists about the proper way to measure cabinets and the proper way to measure racks. Cabinets are traditionally referred to by their external dimensions. Most newer cabinets have depths of 32 or 36 inches (81.28 or 91.44 cm). In most cases, within the cabinet, the rack depth is 4 to 5 inches (10.6 to 12.7 cm) less than the external cabinet depth.

To measure the rack depth, measure the horizontal distance from the forward-most part of the front rail (this point is the intersection of lines A and B in FIGURE 2-1) to the rear-most point of the rear rail. TABLE 2-1 provides the depth of the servers and the rackmounting depth range for the servers when using Sun rackmounting equipment.

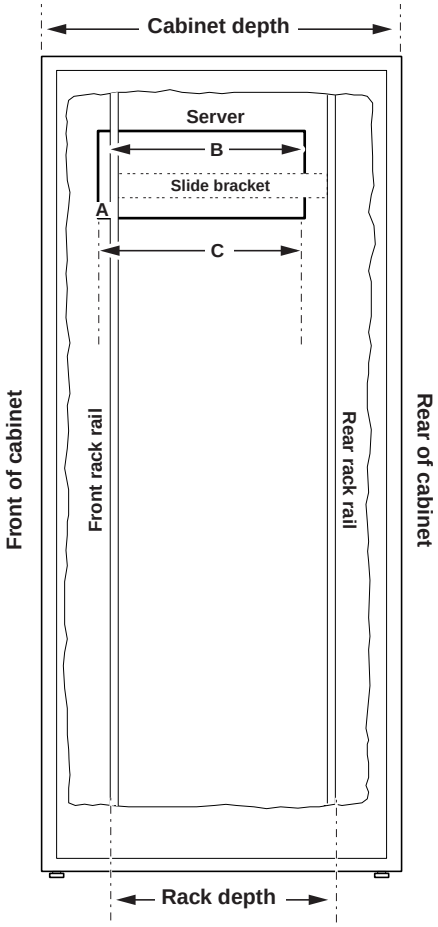
Cabinet manufacturers typically recommend 36-inch (91.44-cm) cabinets (approximate 31-inch / 78.74-cm rack depth) for use with servers that have an average depth of 28 inches (71.12 cm). The 3- to 4-inch (7.62- to 10.16-cm) space at the back allows for cable management, airflow, and service access.

TABLE 2-1 Rack Depths Required by the Systems

Server	Server Depth	Rack Depth Range
Sun Enterprise 250	27.1 in 68.8 cm	27.5 to 35.5 in 69.85 to 90.17 cm
Sun Enterprise 450	27.40 in 69.6 cm	27.5 to 35.5 in 69.85 to 90.17 cm
Sun Enterprise 220R	27.25 in 69.2 cm	29.5 to 35.5 in 75.95 to 90.17 cm
Sun Enterprise 420R	27.25 in 69.2 cm	29.5 to 35.5 in 75.95 to 90.17 cm
Sun Fire 280R	27.25 in 69.2 cm	29.5 to 35.5 in 75.95 to 90.17 cm
Sun Fire 880	32.9 in 83.6 cm	34 to 36 in 86.36 to 91.44 cm

Rack widths are specified in the EIA 310 standard. The available widths are 19 inches (48.26 cm), 23 inches (58.42 cm), 24 inches (60.96 cm), and 30 inches (76.2 cm). All servers covered by this guide are intended for mounting in 19-inch (48.26-cm) wide racks that comply with the EIA 310 standard.

FIGURE 2-1 illustrates the proper way to measure cabinet, rack, and server depths.



A = Depth of the server in front of the front rack rail
B = Depth of server from the forward-most part of the front rack rail to the rear-most part of the server
C = Total depth of server

FIGURE 2-1 Measuring Cabinet, Rack, and Server Depths

Rack Units

Be certain that there is sufficient vertical mounting height for the servers and other equipment you plan to mount in the rack. The vertical mounting space in EIA 310-compliant racks is defined in rack units (RUs). One RU is equal to 1.75 inches (4.45 cm). The number and type of systems you can mount in a rack is determined by the number of RUs the systems require, as well as the amount of power available to the systems.

The rack rail holes on a standard rack enclosure are arranged in sets of three holes, spaced 5/8, 5/8/ and 1/2 of an inch apart. FIGURE 2-2 shows the spacing of the RU holes on the rack rail.

TABLE 2-2 gives the number of RUs that each system occupies.

TABLE 2-2 Rack Units (RUs) Required by the Systems

System	RUs Required for Mounting per System
Sun Enterprise 250	6
Sun Enterprise 450	14
Sun Enterprise 220R	4
Sun Enterprise 420R	4
Sun Fire 280R	4
Sun Fire 880	17

FIGURE 2-2 shows the dimensions and rack unit spacing of an EIA 310-compliant cabinet and rack.

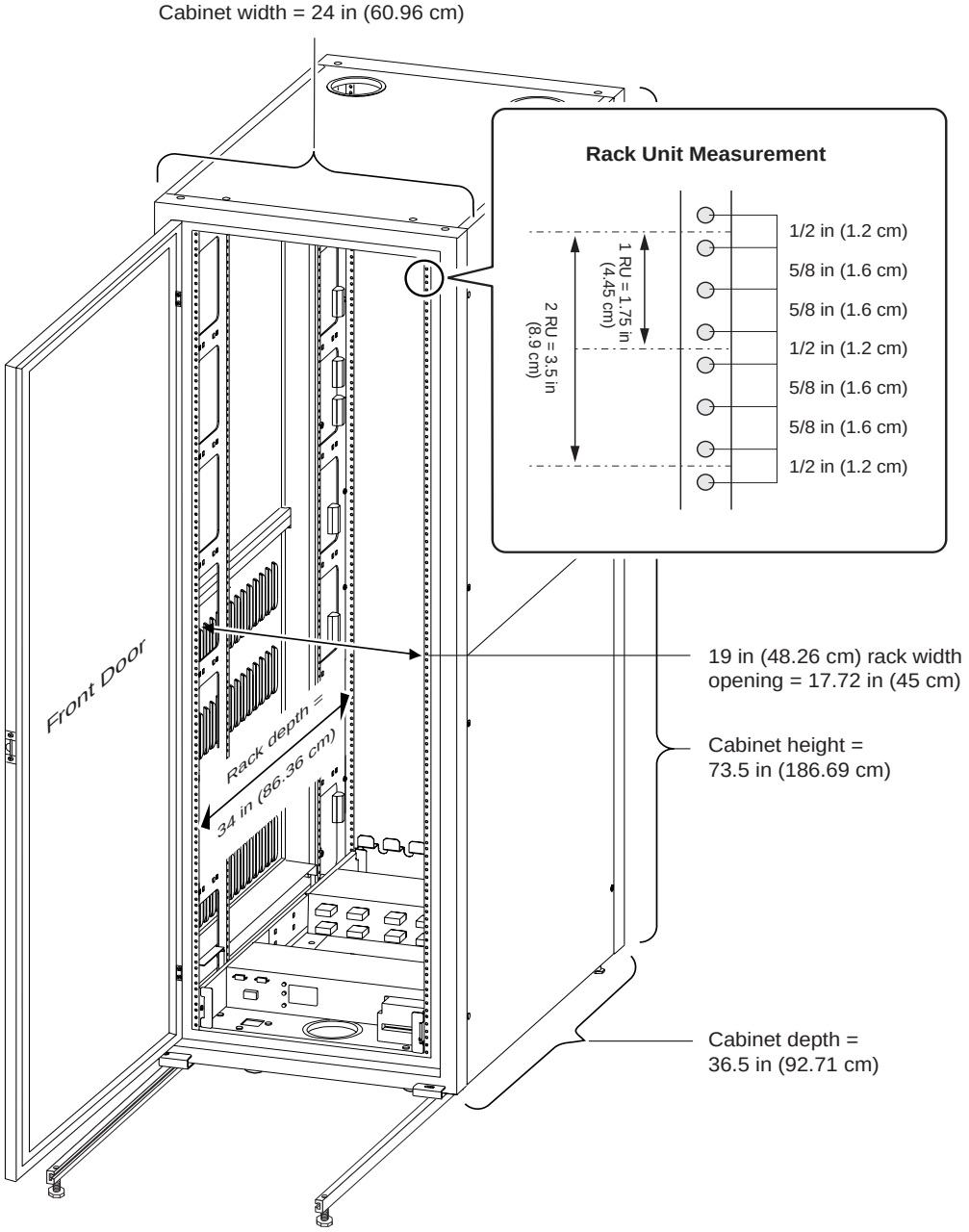


FIGURE 2-2 EIA 310-Compliant Cabinet and Rack

Load Bearing Capacity

Calculate the weight of the servers and other equipment you plan to mount in a given cabinet or rack. Then, be sure that this weight falls within the weight bearing specification (static load capacity) of the enclosure. The weight of a given enclosure includes the weight of all of the servers and other equipment installed in it, plus the weight of the enclosure itself. The approximate weights of systems covered in this manual are provided in TABLE 4-2. The static load capacity of a Sun cabinet can be found in TABLE 4-6.

It is also important to determine whether the strength of the computer room floor is sufficient to support the load of all the enclosures you will install, after they are fully populated with systems and other equipment.

Other Cabinet and Rack Features

Cabinet Doors and Panels

Determine which cabinet doors and panels you will need to properly mount equipment at your site. The Sun servers discussed in this guide come with lockable panels. Most cabinets, however, are available with locking doors, which provide an additional measure of security. Some enclosures have rear doors and some have side panels. Typically, if several cabinets are located in a row, side panels would only be attached to the two end units.

Note – All of the servers described in this guide draw in ambient air for cooling from the front and discharge heated exhaust air to the rear. Make sure that any front or back cabinet doors are 63% open to allow adequate airflow. This can be accomplished by removing the doors, or by ensuring that the doors have a perforated pattern that provides a 63% open area.

EMI and RFI Requirements

All Sun workgroup servers comply with all electromagnetic interference (EMI) and radio frequency interference (RFI) shielding requirements for a computer room environment. They do not depend upon the cabinet for any EMI or RFI shielding. Other equipment you wish to mount may depend upon the cabinet for proper EMI or RFI shielding.

The servers comply with the following US Federal Communications Commission (FCC) Part 15 Rules for Class A or Class B operation. Class A operation describes equipment operated in a commercial environment; Class B operation describes equipment operated in a residential environment.

- Sun Enterprise 250 - Class B
- Sun Enterprise 450 - Class A
- Sun Enterprise 220R - Class A
- Sun Enterprise 420R - Class A
- Sun Fire 280R - Class A
- Sun Fire 880 - Class A

Anti-Tip Protection

Each cabinet or rack must be bolted securely to the floor or be equipped with extendable anti-tip legs in order to keep it from tipping forward when a server or other equipment is extended out the front of the rack. For added stability, extend only one system out of the rack at a time. Always install systems in the rack from the bottom up to help stabilize the cabinet.

Fire Containment

The cabinet or rack must meet Underwriters Laboratories, Inc. and TUV Rheinland of N.A. requirements for fire containment.

Power Outlets

Be sure there is a sufficient number of power outlets within reach of the power cords for each server, or for the cabinet's power cords. See TABLE 4-2 for the power cord lengths of the systems.

Location and Space Requirements

There are several matters to consider when planning the location of rackmounted systems in a computer room. Typically, service access to cabinets and racks is from the front and cable management from the rear. For future planning, consider whether the location and construction of your facility provides a reasonable amount of room for expansion.

Clearances

In order to allow for installation, removal, or maintenance of a server or other equipment, a clear service area must be maintained in front of the cabinet or rack. At a minimum, this area should extend 0.9 meter (3 feet) forward from the front of the cabinet or rack (1.2 meter/4 feet for a rackmounted Sun Fire 880 server) and 0.9 meter on either side of the server when it is fully extended from the rack. You should also keep at least a 0.9-meter clearance at the rear of the cabinet or rack to allow for service and maintenance.

There are no side clearance requirements for the cabinets or racks because the air intake for the servers is from the front of the system and the exhaust is to the rear. However, if the cabinets or racks have side panels and you believe that at some time you may need to remove them, then position the cabinets or racks with at least 0.6 meter (2 feet) of space on either side. See FIGURE 2-3.

Floor Space

When planning the floor space utilization of your facility, be aware that a typical cabinet occupies 12 square feet (1.115 sq. m) of floor space (3 tiles). When room for aisles, power distribution equipment, air conditioners, and other facility equipment is included, floor space utilization may equal 20 square feet (1.858 sq. m) per cabinet (5 tiles).

FIGURE 2-3 shows the preferred clearance and access requirements of the rackmounted systems in a data center.

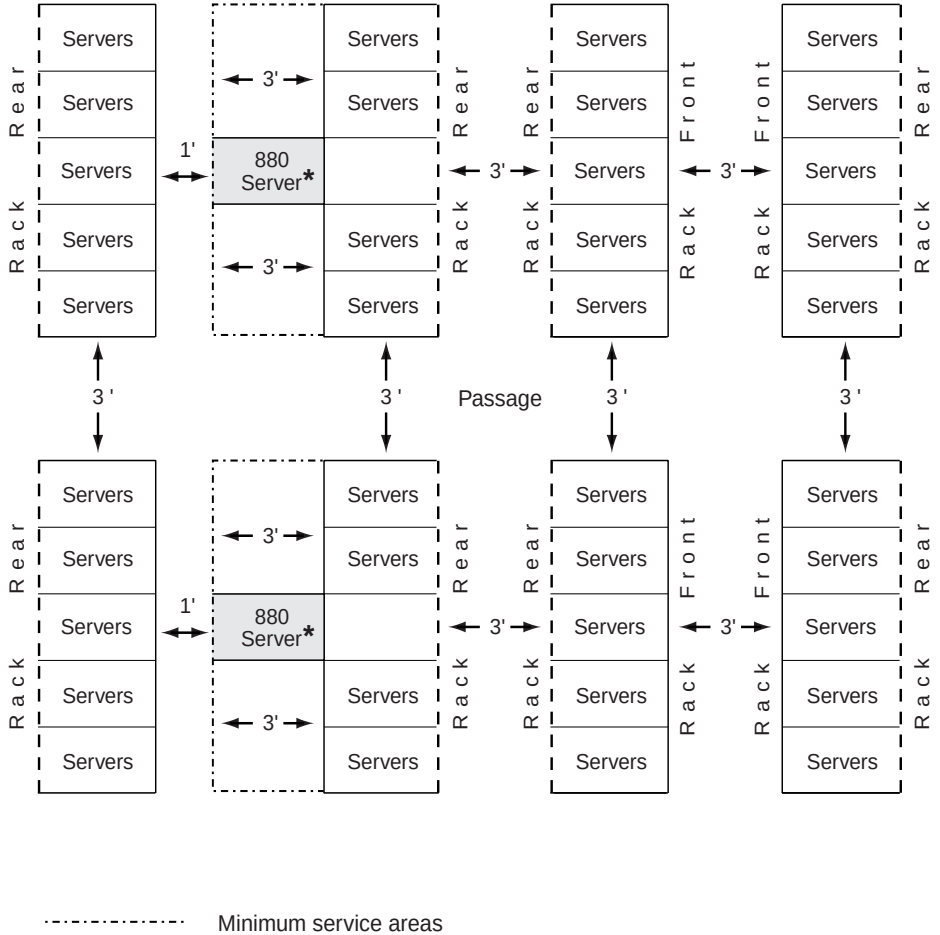


FIGURE 2-3 Cabinet and Rack Space Requirements

Rackmounting Kits

Two of the six workgroup servers covered by this guide require separately ordered rackmounting kits in order to be mounted in an EIA 310-compliant rack. These two servers are the Sun Enterprise 450 and the Sun Fire 880. The Sun Enterprise 250 is available in two different configurations. One is ready to mount in a rack as shipped by Sun. Another Sun Enterprise 250 configuration is not rack-ready. All Sun Enterprise 220R, 420R, and 280R servers are shipped by Sun with all components necessary to mount them in EIA 310-compliant racks.

The rackmounting kit part numbers used with the systems are:

- Sun Enterprise 250 - Part number X9691A
- Sun Enterprise 450 - Part number X9690A
- Sun Fire 880 - Part number X9628A

Rackmounting Guidelines

Follow these guidelines when rackmounting a server:

- Consult the appropriate Rackmounting Guide before attempting to install any server into a rack.
- Before attempting to mount any server in a rack, fully extend the anti-tip legs or bolt the cabinet to the floor.
- Enlist two persons to lift and insert the servers into the rack, except for the Sun Enterprise 450 and Sun Fire 880, which require four persons to lift the systems.
- Remove some of the components of the larger servers to make the lift easier.
- Make sure that the floor where the lift will occur is strong enough to support the weight of those people performing the lift, plus the weight of the server, the rack into which it is being mounted, and any other nearby equipment.
- Install the heaviest server in the lowest possible position.
- Install the remaining servers from the lowest system upward into the rack.

Rackmounting Configurations

For configuration information about mixing different systems or peripherals in a standard EIA 310-compliant rack, and for information about Sun's rackmounting cabinets, see the *Rackmount Placement Matrix* located at this web site:

`http://www.sun.com/products-n-solutions/hardware/docs/Network_Storage_Solutions/Cabinets_and_Enclosures/index.html`

CHAPTER 3

System Power and Cooling Requirements

Each system, when properly configured and installed, must receive sufficient incoming AC power and its power supplies must, in turn, output adequate DC power at the proper voltages for its installed components. If the incoming AC power does not fall within the system's operating specifications, the system may shut down or its various components may fail.

If the power demands of the system's installed components exceed the output capacity of the system's power supplies in any of the output voltages, the system may shut down. This chapter provides information about important power issues relating to your servers. It will assist you in ensuring that your systems have the AC power they need. Your servers' Owner's Guides provide more detailed power information.

Power Constraints

All servers covered by this guide are shipped with a sufficient number of power supplies to provide all power needed by all Sun supported configurations.

Note – Sun does not test many third-party products that are compatible with Sun servers. Therefore, Sun makes no representations about them or about the power requirements for configurations not supplied by Sun.

Power constraints can occur in three areas:

- Maximum rated values for the +3.3, +5, and +12 VDC power supply outputs
- Total power supply output capacity
- Current limit of the AC power outlet

Power Supplies

Sun workgroup server models 250, 220R, 420R, and 280R come with a single power supply and allow an optional second power supply to be installed for redundancy purposes. The 450 comes with two power supplies and can support a third power supply for redundancy. The 880 is shipped with three power supplies, one of which can be used for redundancy.

Redundant power supplies are for redundancy purposes only and do not add to the power capacity of the systems. See your systems' Owner's Guides for more information about power supplies and related configuration requirements.

Maximum Rated VDC Output Values

TABLE 3-1 provides the maximum rated DC output values for the servers. Sun workgroup servers have built-in protection against exceeding the output capacity of the power supply configuration. When a server is operating close to or at the limit of its power capacity, it may shut down with little or no warning.

On some systems, the system fault indicator LED on the control panel illuminates if any of the power outputs is operating too close to its maximum rated value or if the power supply configuration is operating too close to its output capacity. Be sure to consult the appropriate Owner's Guides for your servers to learn how your systems will behave during a power overload.

Caution – Most power supplies cannot support the maximum values on all three outputs at the same time because that would exceed the total power supply output capacity. The load must be distributed between the outputs in a way that does not exceed their maximum values or the total output capacity of the power supply. In addition, for most systems the combined +3.3V and +5V output cannot exceed a specified threshold. For these values, see TABLE 3-1.

TABLE 3-1 Maximum DC Outputs of the Systems

System	+3.3 VDC	+5 VDC	+12 VDC	+3.3 VDC Plus +5 VDC	Total Power Supply Output (DC Watts)
Sun Enterprise 250 1 power supply	34A	30A	10A	170W	360W
Sun Enterprise 450 2 power supplies	94A	130A	40A	800W	1210W
Sun Enterprise 220R 1 power supply	50A	40A	5A	320W	380W
Sun Enterprise 420R 1 power supply	50A	40A	5A	320W	380W
Sun Enterprise 280R 1 power supply	60A	70A	5.5A	480W	560W
Sun Enterprise 880 3 power supplies	72A	56A	35A	424W	2240W

PCI Bus Power

The PCI bus in each Sun workgroup server is designed to provide 15 watts of power multiplied by the number of slots in the PCI chassis. Thus, a four-slot PCI chassis will have a total of 60 watts of power available. These 60 watts can be used in any manner that conforms to the PCI standard. A single PCI slot can support a card that requires up to 25 watts. Here are some examples of how you might populate a four-slot PCI chassis:

- Example 1: You install four 15-watt cards. These four 15-watt cards would use up all of the 60 watts of available power in the PCI chassis. They would also occupy all four of the available slots.
- Example 2: You install two 22-watt cards plus one 15-watt card in a four-slot chassis. This combination of cards would use 59 watts of the 60 watts available. However, this card combination would only use three of the four available slots. In all probability, you would have to leave the fourth slot empty in this example (unless you could find a PCI card that required only 1 watt).

Any combination of PCI cards that does not exceed 25 watts per slot or more than 15 watts times the number of slots in the PCI chassis is permissible. This statement is true for all of the workgroup servers covered by this guide.

Power Consumption

Each server covered by this guide is shipped by Sun with one or more power supplies, sufficient to support the maximum configuration of the server.

Input Power

Often, the cabinet will have a primary and a secondary power strip rated at 20 amps and 120 VAC. The maximum amperage per power strip is governed by national and state codes. The US National Electrical Code states that on a 20-amp circuit, only 16 amps should be used. Unless additional circuits are provided to some taller cabinets, power may limit the number of servers you can install. For international operation, consult the country or local electrical codes.

The input power requirements listed in TABLE 3-2 are the maximum values for fully configured systems. While most systems do not often draw the maximums listed here, you should install wiring capable of supporting the maximum power draw.

TABLE 3-2 Maximum Input Power of the Systems

System	Maximum Power Consumption Watts (AC)	Maximum Current AC RMS
Sun Enterprise 250	580W	2.8A @ 120 VAC 1.4A @ 240 VAC
Sun Enterprise 450 1 power supply[1]	832W	3.5A @ 120 VAC 1.75 A @ 240 VAC
2 power supplies	1664W	7.5A @ 120 VAC 3.75A @ 240 VAC
Sun Enterprise 220R	610W	2.8A @ 120 VAC 1.4A @ 240 VAC
Sun Enterprise 420R	610W	4.1A @ 120 VAC 2.05A @ 240 VAC
Sun Fire 280R	810W	6.8A @ 120 VAC 3.4A @ 240 VAC
Sun Fire 880 3 power supplies	1000W per power supply 3000W total	8.0A @ 120 VAC 4.0A @ 240 VAC per power cord

1. Obsolete configuration. Included to benefit customers with such systems already installed.

Output Power

TABLE 3-3 provides the maximum output power of each system.

TABLE 3-3 Maximum Output Power of the Systems

System	Maximum Power Output Watts (DC)	Volt-Ampere Rating
Sun Enterprise 250	360W	600 VA with 360W load
Sun Enterprise 450 2 power supplies	1210W	1815 VA with 1210W load
Sun Enterprise 220R	380W	630 VA with 380W load
Sun Enterprise 420R	380W	630 VA with 380W load
Sun Fire 280R	560W	900 VA with 560W load
Sun Fire 880 3 power supplies	747W per power supply 2240W total	1011 VA with 747W load

Maximum Heat Output and Cooling

Computers and related equipment generate a considerable amount of heat in a relatively small area. In fact, they commonly have six to eight times the heat density of normal office spaces. This is because every watt of power used by the system is dissipated into the air as heat.

The heat load in a computer room is seldom distributed uniformly and the areas generating the most heat can change frequently. Further, computer rooms are full of equipment that is highly sensitive to temperature and humidity fluctuations. See TABLE 4-4 for the systems' temperature and humidity specifications.

Units of Measurement

A standard unit for measuring the heat generated within (or removed from) a computer room is the British Thermal Unit (Btu). The heat produced by electronic devices such as computers is usually expressed as the number of Btus generated in an hour (Btu / hr).

Watts is also a term used to express heat output and cooling. One watt is equal to 3.412 Btu / hr. If you use 100 watts of power, you generate 341.2 Btus / hr.

Air conditioning capacity is also measured in Btu / hr or watts. Large air conditioning systems are rated in tons. One ton of air conditioning is a unit of cooling equal to 12,000 Btu / hr (3516.852 watts).

Heat Output and Cooling Requirements

TABLE 3-4 lists the maximum heat output and cooling requirements of the systems.

TABLE 3-4 Maximum Heat Output and Cooling Requirements of the Systems

System	Maximum Heat Output and Cooling Requirements
Sun Enterprise 250	1980 Btu / hr 580.28W
Sun Enterprise 450 1 power supply	2840 Btu / hr 832.32W
2 power supplies	5680 Btu / hr 1664.64W
Sun Enterprise 220R	2080 Btu / hr 609.59W
Sun Enterprise 420R	2080 Btu / hr 609.59W
Sun Fire 280R	3140 Btu / hr 920.24W
Sun Fire 880 3 power supplies	3436 Btu / hr, 1006W, per power supply 10,308 Btu / hr, 3020.98W, total

In addition to the heat load generated by the servers, some cabinets include fans, power sequencers, and other devices that generate heat. Be sure to obtain the heat output values of these devices from your cabinet supplier.

To determine the heat output and cooling requirements of the rackmounted servers, add the Btus or watts for each machine in the rack. For example, if one server is putting out 1000 Btus / hr (293 watts) and another one is putting out 2000 Btus / hr (586 watts), the total heat generated is 3000 Btus / hr (879 watts). The air conditioning equipment then should be properly sized to cool at least 3000 Btus / hr (879 watts) to accommodate these two systems.

How to Calculate AC Power and Cooling Requirements

You can use the total watts (also known as DC watts) from TABLE 3-1 to calculate AC current draw, AC watts, thermal dissipation, and volt-ampere (VA) for each server. These values are important in several aspects of facility planning. For example, you can use the AC watts to help you estimate your power costs.

Further, you need to know the AC watts in order to calculate Btus and volt-ampere. You can use the Btus to help you determine the cooling requirements for your facility and you can use the volt-ampere to help you determine the wiring requirements for your systems.

The formulae necessary to derive these several values are provided below. The values provided in TABLE 4-3 may also be helpful at this point.

Note – To maintain a safe facility, you must ensure that the AC current draw does not exceed the maximum current limit for your power outlet. In the United States and Canada, the maximum is 80% of the outlet's total capacity, which is 12A for 15A circuits and 16A for 20A circuits. For areas outside of the United States and Canada, contact local agencies for information about local electrical codes.

Conversion Factors

To determine the electrical and cooling needs of a system, you need to know how much power the system consumes, in terms of volt-amps (VA) and in terms of watts (W). To calculate a system's VA rating, multiply the strength of the current it draws (amps) by the electrical force of that current (volts). To calculate a system's watt rating, multiply the system's power factor by the VA rating. Use these conversion factors:

- VA = amps x volts
- VA = watts / power factor
- Watts = VA x power factor
- Amps = watts/(volts x power factor)

Calculating Power Consumption and Cooling Requirements

Use the following steps to calculate a system's power and cooling requirements:

1. **Determine the value of the AC watts (also known as P_{true}) for your configuration:**

$$P_{true} = \text{DC watts} \times \frac{1}{PS_{Eff}}$$

Where: DC watts is obtained from TABLE 3-1.

$\frac{1}{PS_{Eff}}$ is the reciprocal of the power supply efficiency.

PS_{Eff} = 0.68

2. **Determine the value of the AC amps for your configuration:**

$$\text{AC amps} = \frac{P_{true}}{\text{AC volts} \times \text{PF}}$$

Where: P_{true} is the result of Step 1 above.

AC volts is the line voltage, for example, 120.

Power factor (PF) = 0.99

3. **Is the value for AC amps less than 12A (or 16A if using a 20A circuit)?**
   - If yes, you can install additional internal options.
   - If no, proceed to "What to Do If the System Exceeds the Current Limit of the Power Outlet" on page 31.

4. **Calculate the Btus for your configuration as follows:**

$$BTU_{nom} = P_{true} \times 3.412 \frac{BTU}{watt}$$

Where: P_{true} is the result of Step 1.

5. **Calculate the volt-amps for your configuration as follows:**

$$A = P_{true} \times \frac{1}{PF}$$

Where: P_{true} is the result of Step 1.

$\frac{1}{PF}$ is the reciprocal of the power factor.

Power factor (PF) = 0.99

You can also use these steps to quickly calculate the maximum amount of air conditioning needed in your data center. When doing so, be sure to include all the equipment in the room, not just the servers.

1. **Add the maximum heat output (watts) for all equipment in the room.**
2. **Multiply the total wattage by 3.412 to obtain the Btu/hr rating.**
3. **Multiply the total wattage by 0.000285 to obtain the tons of air conditioning required (12,000 Btu/hr = 1 ton of air conditioning).**

What to Do If the System Exceeds the Current Limit of the Power Outlet

After you have completed Step 2 of the first procedure under “Calculating Power Consumption and Cooling Requirements” on page 30, you know the AC amps required by your configuration. You must ensure that the AC current draw does not exceed the 12A maximum current limit for a 15A power outlet or the 16A maximum current limit for a 20A power outlet.

If your calculations indicate that your system will exceed the 12A or 16A current limit, then you must remove as many system components as required to lower the AC current draw of your configuration to an acceptable level.

CHAPTER 4

System Specifications

This chapter includes shipping, physical, electrical, environmental, clearance and service, and Sun rack specifications for the following systems:

- Sun Enterprise 250
- Sun Enterprise 450
- Sun Enterprise 220R
- Sun Enterprise 420R
- Sun Fire 280R
- Sun Fire 880

Shipping Crate Specifications

TABLE 4-1 Shipping Crate Specifications[1]

	250	450	220R	420R	280R	880
Height	35.75 in 90.80 cm	37.00 in 93.98 cm	17.25 in 43.80 cm	17.25 in 43.80 cm	17.25 in 43.80 cm	43.63 in 110.80 cm
Width	18.00 in 45.72 cm	22.50 in 57.15 cm	23.63 in 60.02cm	23.63 in 60.02 cm	23.63 in 60.02 cm	23.63 in 60.02 cm
Depth	34.00 in 86.36 cm	34.00 in 86.36 cm	37.00 in 93.98 cm	37.00 in 93.98 cm	37.00 in 93.98 cm	37.00 in 93.98 cm
Weight	130 lb 58.97 kg	220 lb 99.80 kg	85.00 lb 38.60 kg	85.00 lb 38.60 kg	85.00 lb 38.60 kg	320 lb 145 kg
On Pallet	No	Yes	No	No	No	Yes

1. Dimensions and weights are estimates based on fully configured systems, and are dependent upon specific system configurations.

Physical Specifications

TABLE 4-2 Physical Specifications

	250	450	220R	420R	280R	880
Height	18.1 in 46.0 cm	22.87 in 58.08 cm	6.95 in 17.65 cm	6.95 in 17.65 cm	6.95 in 17.65 cm	28.1 in 71.4 cm
Width	10.3 in 26.2 cm	17.64 in 44.80 cm	17.25 in 43.81 cm	17.25 in 43.81 cm	17.25 in 43.81 cm	18.9 in (tower) 48.0 cm (tower) 17.25 (rack) 43.81 (rack)
Depth	27.1 in 68.8 cm	27.40 in 69.59 cm	27.25 in 69.21 cm	27.25 in 69.21 cm	27.25 in 69.21 cm	32.9 in 83.6 cm
Weight[1]	118 lb 53 kg	205 lb 94 kg	69 lb 31 kg	71 lb 32 kg	73 lb 33 kg	288.0 lb 130.6 kg
Power Cord Length[2]	8.2 ft 2.5 m	8.2 ft 2.5 m	6.56 ft 1.99 m	6.56 ft 1.99 m	6.56 ft 1.99 m	8.2 ft 2.5 m

1. Weights are estimates based on fully configured systems, and are dependent upon specific system configurations.
2. Three 2.75-m (9-ft) extension cords are provided in the Sun Fire 880 rackmounting kit (Sun part number x9628A), which extend the original 2.5-m (8.2-ft) power cord lengths to 5.25 m (17.2 ft).

Electrical Specifications

TABLE 4-3 Electrical Specifications

	250	450 Two Power Supplies	220R	420R	280R	880 Two Power Supplies	880 Three Power Supplies
Nominal Frequencies	50 or 60 Hz	50 or 60 Hz	50 or 60 Hz	50 or 60 Hz	50 or 60 Hz	50 or 60 Hz	50 or 60 Hz

TABLE 4-3 Electrical Specifications *(Continued)*

	250	450 Two Power Supplies	220R	420R	280R	880 Two Power Supplies	880 Three Power Supplies
Nominal Voltage Range	Auto-ranging 100-240 VAC	Auto-ranging 100-240 VAC	Auto-ranging 100-240 VAC	Auto-ranging 100-240 VAC	Auto-ranging 100-240 VAC	Auto-raging 100-240 VAC	Auto-ranging 100-240 VAC
Max Current AC RMS	2.8A @ 120 VAC	7.5A @ 120 VAC	2.8A @ 120 VAC	4.1A @ 120 VAC	6.8A @ 120VAC	12.0A @ 120 VAC (each power cord)	8.0A @ 120 VAC (each power cord)
Power Dissipation	360W	1210W	380W	380W	560W	1120W / power supply, 2240W total	747W / power supply, 2240W total
Max Power Consumption	580W	1664W	610W	610W	810W	1500W / power supply, 3000W total	1000W / power supply, 3000W total
Max Heat Output	1980 Btu / hr 580.28W	5680 Btu / hr 1664.64 W	2080 Btu / hr 609.59 W	2080 Btu / hr 609.59 W	3140 Btu / hr 920.24 W	5154 Btu / hr 1510.49W per power supply, 10,308 Btu / hr 3020.98W total	3436 Btu / hr 1006.99W per power supply, 10,308 Btu / hr 3020.98W total
Volt-Ampere Rating	600 VA with 360W load	1714 VA with 1210W load	630 VA with 380W load	640 VA with 380W load	900 VA with 560W load	1515 VA with 1120W load	1515 VA with 1120W load
Power Factor	.99 @ 120 VAC	.99 @ 120 VAC	.99 @ 120 VAC	.99 @ 120 VAC	.99 @ 120 VAC	.99 @ 120 VAC	.99 @ 120 VAC

Environmental Specifications

TABLE 4-4 Environmental Specifications for Systems in Operation

	250	450	220R	420R	280R	880
Temperature[1]	41 to 95 °F 5 to 35 °C	41 to 95 °F 5 to 35 °C	41 to 95 °F 5 to 35 °C	41 to 95 °F 5 to 35 °C	41 to 95 °F 5 to 35 °C	41 to 95 °F 5 to 35 °C
Relative Humidity Noncondensing	20% to 80% 27 °C max wet bulb	20% to 80% 27 °C max wet bulb	20% to 80% 27 °C max wet bulb	20% to 80% 27 °C max wet bulb	20% to 80% 27 °C max wet bulb	20% to 80% 27 °C max wet bulb
Altitude	0 - 10,000 ft 0 - 3000 m	0 - 10,000 ft 0 - 3000 m	0 - 10,000 ft 0 - 3000 m	0 - 10,000 ft 0 - 3000 m	0 - 10,000 ft 0 - 3000 m	0 - 10,000 ft 0 - 3000 m

1. The front and rear doors of the cabinet must be 63% open for adequate airflow.

TABLE 4-4 Environmental Specifications for Systems in Operation (*Continued*)

Vibration	
250	0.2 gravity (g) peak, 5-500 Hz (swept sine); 0.0002 g^2/Hz, 5-500 Hz (random); vertical axis only (castered configuration); vertical and horizontal axis (foot glide configuration)
450	0.2 gravity (g) peak, 5-500 Hz, 3 perpendicular axes
220R	0.2 gravity (g) peak, 5-500 Hz (swept sine); 0.0002 g^2/Hz, 5-500 Hz (random); vertical axis only (castered configuration); vertical and horizontal axes (foot glide configuration)
420R	0.2 gravity (g) peak, 5-500 Hz (swept sine); 0.0002 g^2/Hz, 5-500 Hz (random); vertical axis only (castered configuration); vertical and horizontal axes (foot glide configuration)
280R	0.002 gravity^2 (g^2)/Hz, flat from 5-500 Hz (0.31 GRMS); Z-axis only
880	Deskside: 0.0002 gravity^2 (g^2)/Hz, 5-500 Hz (random) Rackmounted: 0.00015 gravity^2 (g^2)/Hz, 5-500 Hz (random)
Shock	
250	4 gravity (g) peak, 11 milliseconds half-sine pulse
450	4 gravity (g) peak, 11 milliseconds half-sine pulse
220R	4 gravity (g) peak, 11 milliseconds half-sine pulse
420R	4 gravity (g) peak, 11 milliseconds half-sine pulse
280R	3 gravity (g) peak, 11 milliseconds half-sine pulse
880	Deskside: 4 gravity (g) peak, 11 milliseconds half-sine pulse Rackmounted: 3 gravity (g) peak, 11 milliseconds half-sine pulse

Clearance for Service Specifications

TABLE 4-5 Clearance Specifications for Servicing the Rackmounted Systems[1]

	250	450	220R	420R	280R	880
Front	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	48 in 121.92 cm
Rear	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm
Right	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm
Left	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm
Top	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm	36 in 91.44 cm

1. These specifications refer to systems that are fully extended from the rack.

Cabinet and Rack Specifications

TABLE 4-6 provides the specifications for Sun's StorEdge Expansion Cabinet, which is a suitable enclosure for the servers described in this guide. As mentioned previously, there are many third-party cabinets and racks available that are also suitable for mounting the Sun servers.

TABLE 4-6 Sun StorEdge Expansion Cabinet Specifications

Sun 36 RU Rack	Measurement
Crated	
Height	8 ft 2.438 m
Width	4.5 ft 1.37 m
Depth	4.5 ft 1.37 m
Weight	524 lb 237.682 kg
Operational	
Height	6.12 ft 1.87 m
Width	2 ft 0.61 m
Depth	3.04 ft 0.93 m
Weight[1]	350 lb 159 kg
Static Load Capacity	1300 lb 589 kg

1. This weight is the weight of the cabinet and two power sequencers only. The total weight of the cabinet also includes the systems and other equipment it houses.

CHAPTER 5

Site Planning Checklist

TABLE 5-1 organizes the site planning tasks into a checklist that you can use during the site planning process.

TABLE 5-1 Site Planning Checklist

Requirement	Completed	Task
Configuration	Yes__No__	Have you determined the hardware configuration for each system?
	Yes__No__	Have you determined the type and number of cabinets and racks you need?
	Yes__No__	Have you determined how you will populate each rack?
	Yes__No__	Have you determined which external peripherals, such as terminals, monitors, keyboards, SCSI devices, and so forth, the systems require?
Environmental	Yes__No__	Does the data center environment meet the system specifications for temperature and humidity?
	Yes__No__	Have you determined the thermal load and heat dissipation of all equipment in the data center?
	Yes__No__	Can you maintain the data center environment when certain failures occur, such as power failure, air conditioning unit failure, or humidity control unit failure?
	Yes__No__	Is fire suppression and alarm equipment installed?
Power	Yes__No__	Have you calculated the power requirements or determined the maximum power requirements of the systems?
	Yes__No__	Have you considered using an alternate source of power for grid independence and backup power for the local sub-station?
	Yes__No__	Do you have sufficient power receptacles for each system and its peripherals?
	Yes__No__	Are the power receptacles within reach of the racks?
	Yes__No__	Have you installed and labeled the circuit breakers?

TABLE 5-1 Site Planning Checklist *(Continued)*

Requirement	Completed	Task
Physical	Yes__No__	Does the facility's loading dock meet standard common carrier truck requirements? If not, have you made other arrangements for unloading the racks and systems, such as providing a fork lift?
	Yes__No__	Are pallet jacks or carts available to move the systems and racks from the loading dock to the computer room?
	Yes__No__	Will the equipment fit through the access route and into the computer room?
	Yes__No__	Have you calculated the weight of each rack with all the equipment installed within it?
	Yes__No__	Is the data center floor able to support the weight of the systems and racks?
	Yes__No__	Have you established where you will locate each rack on the data center floor?
	Yes__No__	Are the systems and racks positioned so that the heated exhaust air of one system does not enter the air inlet of another system?
	Yes__No__	Is there sufficient room around the racks for system access and maintenance?
Miscellaneous	Yes__No__	Are there sufficient number of people available to unload, unpack, and install the systems into the racks?
	Yes__No__	Have system administrators and service technicians enrolled in appropriate training courses to upgrade their skills, as necessary?
	Yes__No__	Have you acquired all the hardware needed to set up the systems and racks?
	Yes__No__	Have you selected a date for system installation?