Site Planning Guide for Entry-Level Servers Version 1.2

Sun Enterprise™ 250 Server

Sun Enterprise 450 Server

Sun Enterprise 420R Server

Sun Fire™ 280R Server

Sun Fire V480 Server

Sun Fire V880 Server

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Preface

This guide is designed to assist Sun customers who have purchased Sun entry-level 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 entry-level servers covered in this guide are:

- Sun Enterprise™ 250
- Sun Enterprise 450
- Sun Enterprise 420R
- Sun Fire™ 280R
- Sun Fire V480
- Sun Fire V880

The material contained in this guide 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 entry-level servers to an existing data center may find it better to read this manual first.

Another resource for data center design is *Enterprise Data Center Design and Methodology* by Rob Snevely. This is a Sun BluePrints™ book, published by Sun Microsystems Press, a Prentice Hall title. You can find information about this book and other BluePrints books at:

`http://www.sun.com/books/blueprints.series.html`

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 power issues relating to the servers.

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

Chapter 5 provides a site planning checklist that you can use when planning your data center and preparing for system 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 (RU) 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
	Enterprise Data Center Design and Methodology	See BluePrints URL
Rackmounting	*Sun Enterprise 250 Server Rackmounting Guide*	805-3611
	Ultra Enterprise 450 Server and Sun Ultra 450 Workstation Rackmounting Guide	805-1912
	Sun Enterprise 420R Server Setup and Rackmounting Guide	806-1086
	Sun Fire 280R Server Setup and Rackmounting Guide	806-4805
	Sun Fire V480 Server Setup and Rackmounting Guide	816-0902
	Sun Fire 880 Server Rackmounting Guide	806-6594
	Sun StorEdge Expansion Cabinet Installation and Service Manual	805-3067
	Sun Fire Cabinet Installation and Reference Guide	806-2942

Application	Title	Part Number
Configuration	*Sun Enterprise 250 Server Owner's Guide*	805-5160
	Ultra Enterprise 450 Server Owner's Guide	805-0429
	Sun Enterprise 420R Server Owner's Guide	806-1078
	Sun Fire 280R Server Owner's Guide	806-4806
	Sun Fire V480 Server Administration Guide	816-0904
	Sun Fire 880 Server Owner's Guide	806-6592
Sun cabinets	*Sun StorEdge Expansion Cabinet Installation and Service Manual*	805-3067
	Sun Fire Cabinet Installation and Reference Guide	806-2942
Web sites	Entry-level servers: `http://www.sun.com/servers/entry`	
	Racks: `http://www.sun.com/servers/entry/rackmount`	
	Sun BluePrints documents: `http://www.sun.com/books/blueprints.series.html`	

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Please include the part number (816-1613-12) 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 entry-level servers. 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 420R
- Sun Fire 280R
- Sun Fire V480
- Sun Fire V880

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

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

Site Planning Process

Customer facility managers, system administrators, and Sun 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. You can obtain system documentation before receiving your system by downloading manuals from the web. See "Accessing Sun Documentation" on page xv. Alternatively, you can consult the documentation 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. This data is 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 auxiliary power or backup power, and to plan for power grid independence if continued uptime is a consideration.

Cabinets and Racks

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.

Most of the racks used for mounting the servers covered in this guide consist 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 Sun Enterprise 420R servers mounted in a cabinet and rack.

Note – You can mount a Sun Fire V480 server in a two-post rack, using an optional two-post rackmounting kit.

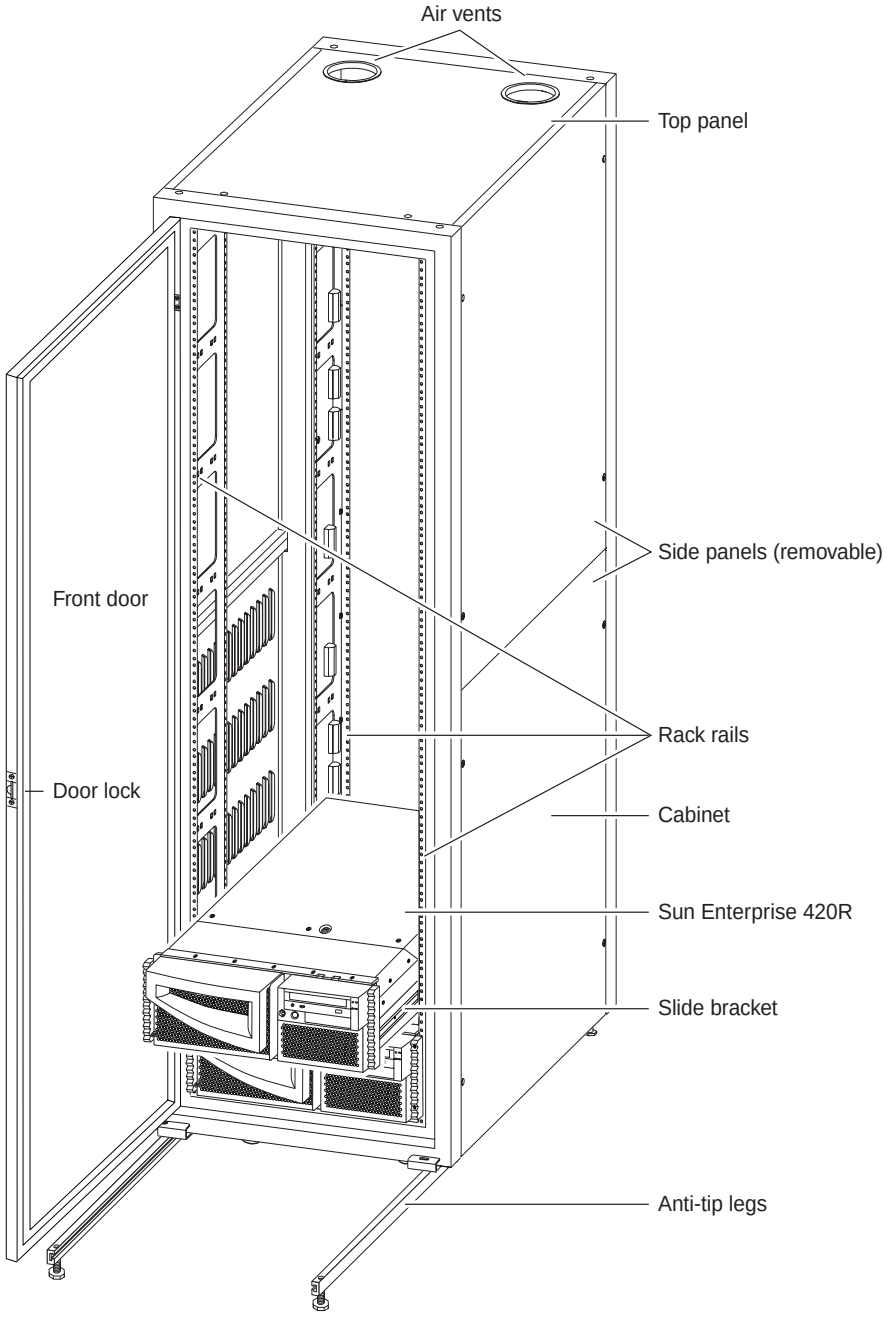


FIGURE 1-1 Systems Mounted in a Cabinet and Rack

Environmental Requirements

Computer system reliability is dependent upon a stable environment. The design of the environmental control system for your data center must ensure that each system can operate normally while remaining within the range of its operating specifications. See TABLE 4-7 for the servers' environmental operating specifications. 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 25.

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.

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.* It is important to ensure that the temperature is within 5 to 35 ºC at approximately 10 cm (4 inches) from the front of the server. This is because temperatures in the data center are different depending on where in the room the measurements are taken.

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.

Cooling

Data centers 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 facility'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 2 kW. Remember, 2 kW per cabinet in a data center is an example. Some cabinets may require 3 kW or more of cooling capacity. See "Maximum Heat Output and Cooling" on page 25 for more information about cooling requirements.

It is also important to consider the intake and discharge airflow required to cool the systems. 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 at least 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 an at least 63% open area. In addition, maintain a minimum 3.8-cm (1.5-inch) clearance between the systems and any front or back cabinet doors.

Humidity

Ambient relative humidity levels between 45% and 50% are most suitable for safe server operations. This optimal range helps protect the 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%.

Vibration and Shock

TABLE 4-9 and TABLE 4-10 describe vibration and shock specifications for the systems covered in this document. Make sure that your installation adequately guards equipment against excessive vibration and shock. When installing systems of different types in the same cabinet or rack, be sure that the overall vibration and shock characteristics do not exceed those of the system with the lowest vibration and shock specifications. For example, if you are installing two different types of systems

in the same cabinet, and one system type can tolerate 4 g peak shock, and the other type can tolerate 10 g peak shock, make sure that your cabinet does not exceed 4 g peak shock.

Access Route Requirements

Most cabinets and racks ship in their own containers on a pallet. Make sure that the facility loading dock and unloading equipment can accommodate the height and weight of the cabinets, racks, and servers while in their shipping packages. See TABLE 4-11 for shipping specifications for two Sun cabinets 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 data center, 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, minimal sharp angles, and few 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 standards 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 Cabinets and Racks

Sun Microsystems offers EIA 310-compliant cabinets and racks for mounting the servers. One is the Sun StorEdge Expansion Cabinet (part number SG-XARY030A). See the *Sun StorEdge Expansion Cabinet Installation and Service Manual* (part number 805-3067) for detailed information about this enclosure. Another is the Sun Fire Cabinet (part number SF-XCAB). See the *Sun Fire Cabinet Installation and Reference Guide* (part number 806-2942) for detailed information. TABLE 4-12 contains these cabinets' physical specifications.

For information about other compatible Sun cabinets and racks, contact your Sun account manager or Sun authorized sales representative.

Industry-Standard Third-Party Cabinets and Racks

While Sun makes no representations about the products of other companies, it is clear that other companies 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/entry/rackmount`

Cabinet, Rack, and Server Dimensions

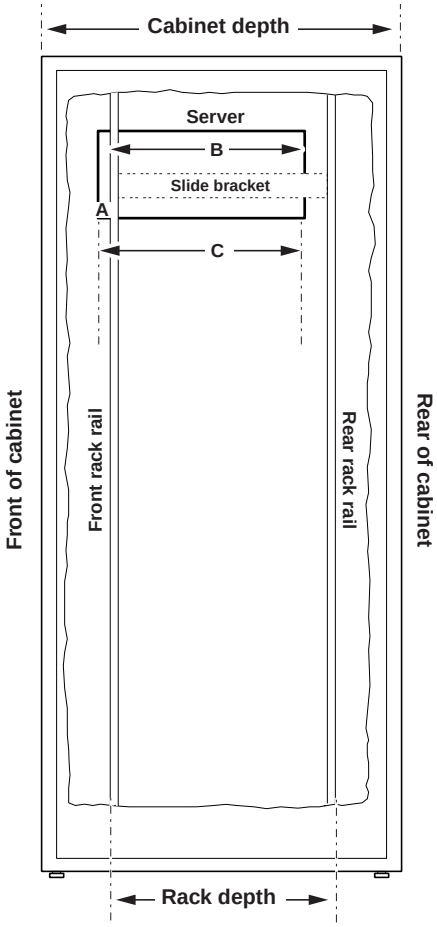
Because the terms “rack” and “cabinet” are sometimes used interchangeably, much confusion exists about the proper way to measure cabinets and the proper way to measure racks. Cabinets are traditionally referred to by their external dimensions. Most newer cabinets have depths of 32 or 36 inches (81.28 or 91.44 cm). In most cases, the rack depth is 4 to 6 inches (10.6 to 15.25 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 to the rear-most point of the rear rail. TABLE 4-3 provides the depths of the servers, the rackmounting depth ranges for the servers when using Sun rackmounting equipment, and the recommended cabinet depths.

Third-party cabinet manufacturers typically recommend 34-inch (86.36-cm) or greater cabinets for use with servers that have an average depth of 28 inches (71.12 cm), and 39-inch (99.06-cm) or greater cabinets for use with servers that have an average depth of 33 inches (83.82 cm). The approximate 6-inch (15.24-cm) space at the back between the server and back cabinet door allows for cable management, airflow, and service access.

Rack widths are specified in the EIA 310 standard. Available widths include 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 (RU). 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 RU the systems require, as well as the amount of power available to the systems.

The rack rail holes on a standard rack are arranged in sets of three holes, spaced vertically 5/8, 5/8, and 1/2 of an inch apart. FIGURE 2-2 shows the dimensions and rack unit spacing of an EIA 310-compliant cabinet and rack.

TABLE 4-4 gives the number of RU that each system occupies.

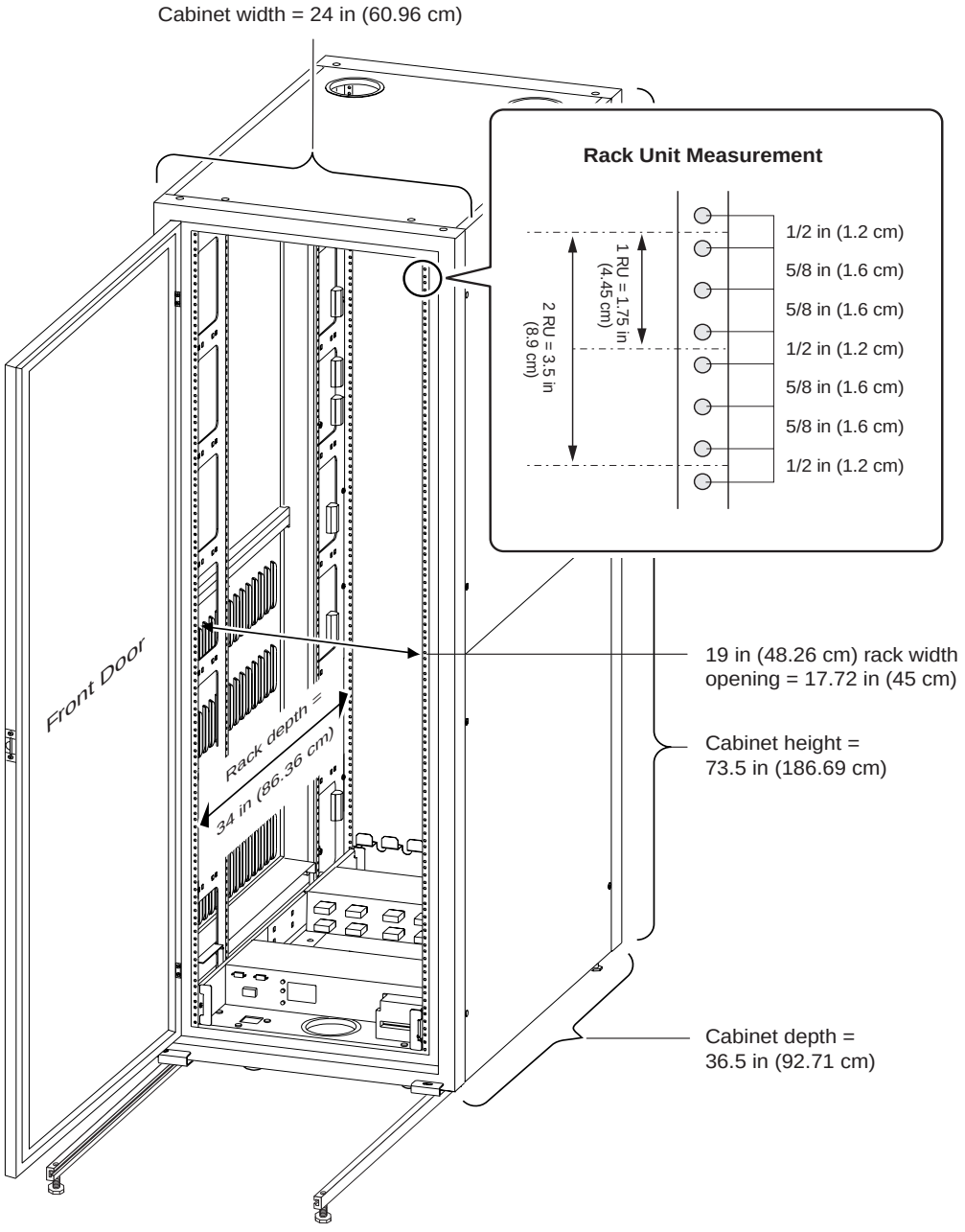


FIGURE 2-2 EIA 310-Compliant Cabinet and Rack

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 load bearing specification (static load capacity) of the enclosure. The weight of a given cabinet or rack includes the weight of all of the servers and other equipment installed in it, plus the weight of the cabinet or rack itself. The approximate weights of systems covered in this manual are provided in TABLE 4-2. The static load capacities of the Sun StorEdge Expansion Cabinet and Sun Fire Cabinet are listed in TABLE 4-12.

It is also important to determine whether the strength of the data center floor is sufficient to support the weight of all the cabinets and racks that 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 are only attached to the two end units.

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 at least 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 an at least 63% open area. In addition, maintain a minimum 3.8-cm (1.5-inch) clearance between the systems and any front or back cabinet doors.

EMI and RFI Requirements

All Sun entry-level servers comply with all electromagnetic interference (EMI) and radio frequency interference (RFI) shielding requirements for a computer room environment. Other equipment that you include in the cabinet may depend on the cabinet for proper EMI or RFI shielding.

The servers comply with the following U.S. 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 420R - Class A
- Sun Fire 280R - Class A
- Sun Fire V480 - Class A
- Sun Fire V880 - 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 that 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.

Do not use extension cords or plug-in power strips in your installation.

Location and Space Requirements

There are several matters to consider when planning the location of rackmounted systems in a data center. 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 provide 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 3 feet (0.9 meter) forward from the front of the cabinet or rack (4 feet/1.2 meter for a rackmounted Sun Fire V880 server) and 3 feet on either side of the server when it is fully extended from the rack. You should also keep at least a 3-foot 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 2 feet (0.6 meter) 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.

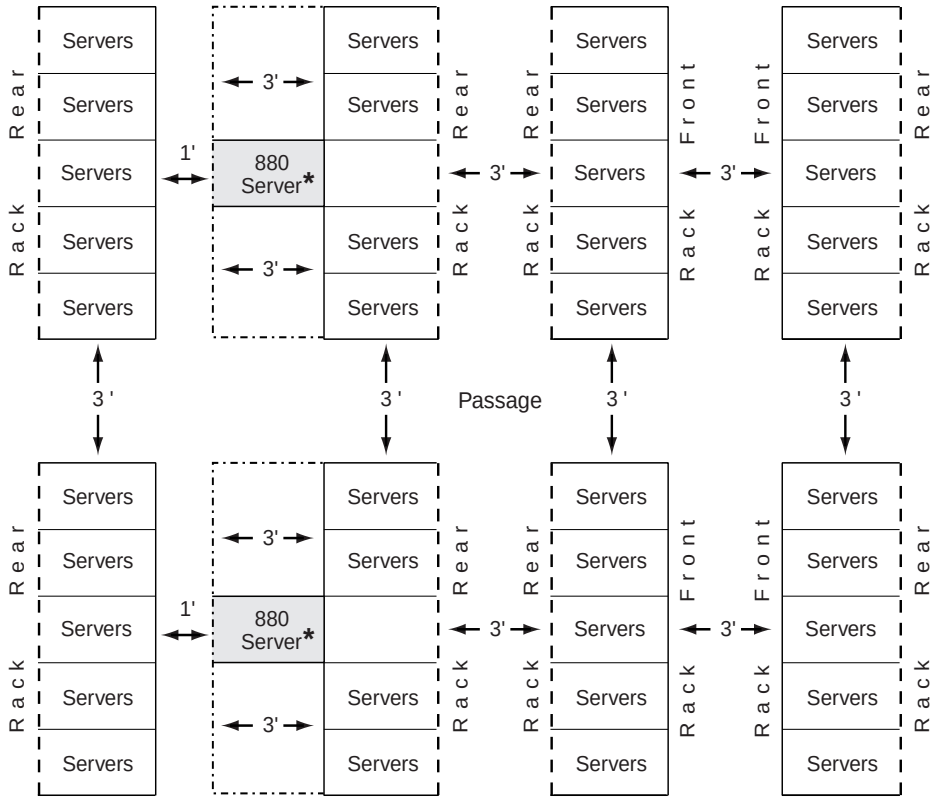


FIGURE 2-3 Cabinet and Rack Space Requirements

Rackmounting Kits

The Sun Enterprise 250 is available in a rackmountable configuration. The Sun Enterprise 450 and Sun Fire V880 require a separate kit for mounting in an EIA 310-compliant cabinet. The rackmounting kit part numbers used with these systems are:

- Sun Enterprise 250 - Part number A26-BA-R
- Sun Enterprise 450 - Part number X9690A
- Sun Fire V880 - Part number X9628A

All Sun Enterprise 420R servers, Sun Fire 280R servers, and Sun Fire V480 servers are shipped by Sun with all components necessary to mount them in EIA 310-compliant cabinets.

The Sun Fire V480 can be mounted in a two-post rack using an optional kit (part number X9631A).

Tools Required for Rackmounting the Systems

You will need some of the following tools to rackmount the systems:

- Phillips No. 1, No. 2, and No. 3 screwdrivers
- Flat-blade No. 1 and No. 2 screwdrivers
- Allen and adjustable wrenches
- Needlenose pliers
- Spirit level
- Electrostatic discharge (ESD) wrist strap
- ESD mat
- GL-8 Genie Lift (recommended for larger systems)

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.
- Two persons are needed to insert the following servers into a rack:
  - Sun Enterprise 250
  - Sun Enterprise 420R
  - Sun Fire 280R
  - Sun Fire V480
- Four persons (or a suitable lift) are needed to insert the following servers into a rack:
  - Sun Enterprise 450
  - Sun Fire V880
- 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 in the rack.
- Install the remaining servers from the lowest system upward into the rack.

CHAPTER 3

System Power and Cooling Requirements

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 server documentation provides more detailed power information.

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, as well as loss of data. Further, computer equipment that is subject to repeated power interruptions or fluctuations may experience a higher component failure rate than equipment that has a stable power source. It is important to use dedicated AC breaker panels for all power circuits that supply power to your systems.

Most of your server configurations probably will not draw the maximum AC power consumption listed in TABLE 4-6. 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.

Power Requirements

Each system, when properly configured and installed, must receive sufficient incoming AC power to supply all installed components. In addition, the power infrastructure must be designed to maintain uptime even during potential disruptions. The following sections describe these requirements in more detail.

Power Sources

It is 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 (N+1) 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 a primary power grid goes offline, a backup power grid will provide power to the redundant supplies to keep the systems operating.

When designing the data center, consider including an alternate source of power and backup generators so that your facility can maintain grid independence. See "Power Supplies" on page 23 for information about N+1 power supply redundancy.

UPS and Backup Generator

Using an online uninterruptible power supply (UPS) and a backup generator provides a good 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 data center for a minimum of 15 minutes during a power failure. This is typically sufficient time to allow for the transfer of power to an alternate feed or to the generator.

Grounding

Grounding design must address both the 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 U.S. 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. Use an antistatic wrist strap when working inside a chassis.

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 two areas:

- Total AC power consumption
- Current limit of the AC power outlet

To maintain a safe facility, you must ensure that the AC current draw does not exceed the maximum current limit for your power oulet. 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. If your system configuration exceeds 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.

Power Supplies

Sun Enterprise 250 and 420R come with a single power supply and allow an optional second power supply to be installed for redundancy purposes. The Sun Enterprise 450 comes with two power supplies and can support a third power supply for N+1 redundancy. The Sun Fire 280R and Sun Fire V480 come with two power supplies to provide N+1 redundancy, while the Sun Fire V880 is shipped with three power supplies to provide N+1 redundancy.

An N+1 redundant power supply configuration does not add to the power capacity of the systems. "N" represents the number of power supplies needed to power a fully configured system. The "1" means that there is one additional power supply in the system to handle the load if one of the other supplies fails. When the system is operating normally, all of the power supplies are turned on, even the redundant supplies. For instance, in a 1+1 configuration (that is, two power supplies are installed, each capable of providing enough power for the entire system), both supplies are turned on and are delivering power. Each supply delivers 50% of its

capacity. If one supply fails, the supply that is still online will operate at 100% capacity to keep the system running. In a 2+1 configuration (that is, three power supplies are installed, with two power supplies delivering enough power for the entire system), all three power supplies are turned on and are delivering power. Each supply delivers 67% of its capacity. If one supply fails, the supplies that are still online will operate at 100% capacity to keep the system running.

The 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. Be sure to consult the documentation accompanying the servers to learn how the servers will behave during a power overload.

Caution – Most power supplies cannot support the maximum values on all outputs at the same time because that would exceed the total power supply output capacity. The load must be distributed among the outputs in a way that does not exceed their maximum values or the total output capacity of the power supply.

PCI Bus Power

The PCI bus in each 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 has 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 PCI slots.
- Example 2: You install two 22-watt cards plus one 15-watt card. This combination of cards would use 59 watts of the 60 watts available. However, this card combination only uses three of the four available PCI 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.

Input and Output Power

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, a cabinet has 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 U.S. 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 4-6 are the maximum values for fully configured systems. While most systems do not often use the maximum power, you should install wiring capable of supporting the maximum power draw, to ensure enough margin in the installation.

Output Power

TABLE 4-6 provides the maximum output power consumption of each system. When calculating output power requirements for an installation, use the systems' *maximum* output power specifications, to ensure that there is enough power to supply the systems' maximum configurations.

Maximum Heat Output and Cooling

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

The heat load in a data center is seldom distributed uniformly and the areas generating the most heat can change frequently. Further, data centers are full of equipment that is highly sensitive to temperature and humidity fluctuations. See TABLE 4-7 for the servers' temperature and humidity specifications.

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 cabinet.

Airflow

It is important to remember that the flow of air through the servers is essential to the proper cooling of the servers. Even though the data center air may be at a safe and steady temperature at one location, 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 might occur because the cabinets have solid front or rear doors, inadequate plenums, or they might have cooling fans that work against the fans in the servers themselves.
- A server might be mounted in a cabinet above a device that generates a very great 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 an at least 63% open area. Maintain a minimum of 3.8-cm (1.5-inch) clearance between the systems and front and back doors of a cabinet.

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.* It is important to ensure that the temperature is within 5 to 35 ºC at approximately 10 cm (4 inches) from the front of the server. This is because temperatures in the data center are different depending on where in the room the measurements are taken.

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 Btu 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. For example, if you use 100 watts of power, you generate 341.2 Btu/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 (3517 watts).

Heat Output and Cooling Requirements

TABLE 4-6 lists the maximum heat output and cooling requirements of the systems.

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

If you only have wattage measurements and want to obtain the equivalent Btu rating, multiply the total wattage by 3.41 to obtain the Btu/hr. To calculate tons of air conditioning, multiply the total wattage by 0.000285.

You can also use the following 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).**

CHAPTER 4

System Specifications

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

- Sun Enterprise 250
- Sun Enterprise 450
- Sun Enterprise 420R
- Sun Fire 280R
- Sun Fire V480
- Sun Fire V880

Shipping Crate Specifications

TABLE 4-1 Shipping Crate Specifications[1]

	250	450	420R	280R	V480	V880
Height	35.75 in 90.80 cm	37 in 93.98 cm	17.25 in 43.80 cm	17.25 in 43.80 cm	24 in 60.96	43.63 in 110.80 cm
Width	18 in 45.72 cm	22.5 in 57.15 cm	23.63 in 60.02 cm	23.63 in 60.02 cm	23.75 in 60.34 cm	23.63 in 60.02 cm
Depth	34 in 86.36 cm	34 in 86.36 cm	37 in 93.98 cm	37 in 93.98 cm	31.5 in 80.01 cm	37 in 93.98 cm
Weight	130 lb 58.97 kg	220 lb 99.80 kg	85 lb 38.60 kg	85 lb 38.60 kg	150 lb 68.04 kg	320 lb 145 kg
On Pallet	No	Yes	No	No	Yes	Yes

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

Physical Specifications

TABLE 4-2 Physical Specifications

	250	450	420R	280R	V480	V880
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	8.75 in 22.2 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 in (rack) 43.81 cm (rack)
Depth	27.1 in[2] 68.8 cm	27.40 in[3] 69.59 cm	27.25 in 69.21 cm	27.25 in 69.21 cm	24 in 61 cm	32.9 in 83.6 cm
Weight[1]	118 lb 53 kg	205 lb 94 kg	71 lb 32 kg	73 lb 33 kg	97 lb 44 kg	288 lb 131 kg
Power Cord Length	8.2 ft 2.5 m	8.2 ft 2.5 m	6.56 ft 1.99 m	6.56 ft 1.99 m	8.2 ft 2.5 m	8.2 ft[4] 2.5 m

1. Weights are estimates based on fully configured systems, and are dependent on specific system configurations.
2. Depth is 28.8 in (73.2 cm) including the power supply handle.
3. Depth is 28.5 in (72.4 cm) including back panel handles.
4. Three 2.75-m (9-ft) cords are provided in the Sun Fire V880 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).

Rackmounting Specifications

TABLE 4-3 Typical Rack and Cabinet Depths Used by the Systems

	System Depth	Rackmounting Depth Range[3]	Cabinet Depth
250	27.1 in[1] 68.8 cm	27.5 to 35.5 in 69.85 to 90.17 cm	34 in or greater 86 cm or greater
450	27.40 in[2] 69.6 cm	27.5 to 35.5 in 69.85 to 90.17 cm	34 in or greater 86 cm or greater
420R	27.25 in 69.2 cm	29.5 to 35.5 in 75.95 to 90.17 cm	34 in or greater 86 cm or greater
280R	27.25 in 69.2 cm	29.5 to 35.5 in 75.95 to 90.17 cm	34 in or greater 86 cm or greater
V480	27.25 in 69.2 cm	23 to 34.5 in 58.42 to 87.63	28 in or greater 71.12 or greater
V880	32.9 in 83.6 cm	34 to 36 in 86.36 to 91.44 cm	39 in or greater 99 cm or greater

1. Depth is 28.8 in (73.2 cm) including the power supply handle.
2. Depth is 28.5 in (72.4 cm) including back panel handles.
3. The rack depth range is for systems using Sun rackmounting equipment. (Rackmounting hardware is designed to fit a range of different cabinet depths.)

TABLE 4-4 Rack Units Required by the Systems

	RU Required per System for Mounting
250	6
450	14
420R	4
280R	4
V480	5
V880	17

Electrical Specifications

All systems described in this document share the electrical specifications described in TABLE 4-5.

TABLE 4-5 Electrical Specifications (All Systems)

	Specification
Nominal Frequencies	50 or 60 Hz
Nominal Voltage Range	Auto ranging 100-240 VAC
AC Operating Range	90-264 Vrms 47-63 Hz

TABLE 4-6 describes the electrical specifications unique to each system.

TABLE 4-6 Electrical Specifications (Specific Systems)

	250	450	420R	280R	V480	V880
Max Current AC RMS	2.8A @ 120 VAC 1.4A @ 240 VAC	13.8A @ 120 VAC 6.9A @ 240 VAC	5.07A @ 120 VAC 2.54A @ 240 VAC	7.5A @ 120 VAC 3.7A @ 240 VAC	10.0A @ 120 VAC 5.0A @ 240 VAC	24.0A @ 120 VAC [1] 12.0A @ 240 VAC [2]
Max AC Power Consumption	343 W	1664 W	603 W	890 W	1100 W	3000 W
Max Heat Dissipation and Cooling Requirements	1170 Btu/hr	5680 Btu/hr	2080 Btu/hr	3140 Btu/hr	3751 Btu/hr	10,308 Btu/hr

1. Total system current. For a Sun Fire V880 equipped with two power supplies, each power supply draws 12.0A @ 120 VAC. For a system equipped with three power supplies (N+1 configuration), each power supply draws 8.0A @ 120 VAC. If a third (redundant) power supply fails, each remaining power supply draws up to 12.0A @ 120 VAC.
2. Total system current. For a Sun Fire V880 equipped with two power supplies, each power supply draws 6.0A @ 240 VAC. For a system equipped with three power supplies (N+1 configuration), each power supply draws 4.0A @ 240 VAC. If a third (redundant) power supply fails, each remaining power supply draws up to 6.0A @ 240 VAC.

Environmental Specifications

TABLE 4-7 Environmental Specifications for Systems in Operation (All Systems)

	Specification
Temperature[1]	41 to 95 °F 5 to 35 °C
Relative Humidity Noncondensing	20% to 80% 27 °C max wet bulb
Altitude	0 - 10,000 ft 0 - 3000 m

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

TABLE 4-8 Declared Acoustics

	Acoustics Rating
250	6.5 bels
450	6.9 bels
420R	6.9 bels
280R	6.9 bels
V480	7.45 bels
V880	6.7 bels

Vibration and Shock Specifications

TABLE 4-9 Vibration Specifications[1]

	Maximum Vibration Rating
250	0.2 g peak (swept sine) 0.0002 g^2/Hz (random); vertical axis only (castered configuration); vertical and horizontal axis (foot glide configuration)
450	0.2 g peak, 3 perpendicular axes
420R	0.2 g peak (swept sine) 0.0002 g^2/Hz (random); vertical axis only (castered configuration); vertical and horizontal axes (foot glide configuration)
280R	0.0002 g^2/Hz, flat from Z-axis only
V480	0.0001 g^2/Hz, flat from Z-axis only
V880	Deskside: 0.0002 g^2/Hz (random) Rackmounted: 0.00015 g^2/Hz (random)

1. Measured at 5-500 Hz.

TABLE 4-10 Shock Specifications[1]

	Maximum Shock Rating
250	4 g peak
450	4 g peak
420R	4 g peak
280R	3 g peak
V480	10 g peak
V880	Deskside: 4 g peak Rackmounted: 3 g peak

1. Measured at 11 milliseconds half-sine pulse.

Cabinet and Rack Specifications

TABLE 4-11, TABLE 4-12, and TABLE 4-13 provide the specifications for the Sun StorEdge Expansion Cabinet and the Sun Fire Cabinet, which are suitable enclosures for the servers described in this guide. There are many third-party cabinets and racks that are also suitable for mounting the Sun servers.

TABLE 4-11 Cabinet and Rack Specifications (Crated)

	Sun StorEdge Expansion Cabinet	Sun Fire Cabinet
Height	96 in 244 cm	80.25 in 203.8 cm
Width	54 in 137 cm	42.5 in 108 cm
Depth	54 in 137 cm	47 in 119.5 cm
Weight	524 lb 237.68 kg	558 lb 253.1 kg

TABLE 4-12 Cabinet and Rack Specifications (Operational)

	Sun StorEdge Expansion Cabinet	Sun Fire Cabinet
Height	72 in 183 cm	75 in 190.5 cm
Width	24 in 61 cm	23.9 in 60.7 cm
Nominal Rack Opening	18 in 46 cm	18 in 46 cm
Depth	36 in 91 cm	35.5 in (90.2 cm) without front door 37 in (94.9 cm) with front door
Weight[1]	350 lb 159 kg	325 lb 147 kg
Static Load Capacity	1300 lb 589 kg	1200 lb[2] 544 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.

2. The Sun Fire Cabinet has been tested to 1200 lb, though its total static load capacity is higher.

TABLE 4-13 Cabinet and Rack Power Sequencer Specifications

	Sun StorEdge Expansion Cabinet	Sun Fire Cabinet
AC Voltage Rating	200-240 VAC	200-240 VAC
Frequency Range	47-63 Hz	47-63 Hz
Current @ 240 VAC	24A	24A
Max Power Capacity[1]	4.4 kW	N/A

1. This is the theoretical maximum power capacity of the cabinet. This number should *not* be used to calculate power and cooling requirements for your installation. Use the combined power consumption figures of the equipment being installed in the cabinet instead. See TABLE 4-5 and TABLE 4-6.

Clearance for Service Specifications

TABLE 4-14 Clearance Specifications for Servicing the Rackmounted Systems[1]

	Sun Enterprise 250 Sun Enterprise 450 Sun Enterprise 420R Sun Fire 280R Sun Fire V480	Sun Fire V880
Front	36 in 91.44 cm	48 in 121.92 cm
Rear	36 in 91.44 cm	36 in 91.44 cm
Right	36 in 91.44 cm	36 in 91.44 cm
Left	36 in 91.44 cm	36 in 91.44 cm
Top	36 in 91.44 cm	36 in 91.44 cm

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

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, heat dissipation, and air conditioning requirements 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 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?