Business Systems 600/800

Site Preparation Manual

Texas Instruments

Part No. 2311340-9701 *A
15 January 1983

Dear Customer,

Receipt of this **Business Systems 600/800 Site Preparation Manual** *is your signal to select and prepare the installation site for your Business System 600 or 800 computer system. Careful planning at this stage will be repaid many times over by shortened installation time and trouble-free operation.*

Use this manual as a guide in selecting and preparing a location for your computer system. Remember that the decisions that you make now concerning the workflow, physical layout, and expandability will have long-lasting effects as the computer system becomes an indispensable tool in your business or profession.

Begin preparation by carefully reading this manual to become familiar with the characteristics and requirements of your new system. Some of the information provided involves technical data for the computer system, but most of it consists of planning tips acquired from years of Texas Instruments experience in the installation of electronic systems.

This manual includes requirements for source power, air conditioning, physical layout, supplies, and a site checklist to aid you in planning. If you require additional information or assistance, refer to the Related Publications section of this manual or contact your Texas Instruments representative.

Sincerely,

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES AND DISCARD SUPERSEDED PAGES

Note: The changes in the text are indicated by a change number at the bottom of the page and a vertical bar in the outer margin of the changed page. A change number at the bottom of the page but no change bar indicates either a deletion or a page layout change.

Business Systems 600/800 Site Preparation Manual (2311340-9701)

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Manager's Overview

This *Business Systems 600/800 Site Preparation Manual* is to be used by you as a manager to ensure that your site will be ready for your Texas Instruments computer system when the equipment arrives. The specifications for your system impose environmental, space, and power requirements on the installed site. Close consideration of these requirements is essential for ensuring system reliability.

A neat, well-planned installation will increase the productivity and reliability of your system as well as provide an impressive customer display. When planning a large system or multiple systems, a dedicated computer room provides many benefits, such as increased environmental control and access to the system.

Your planned use of the system can lead to additional requirements such as leased or switched communication lines. Also, you will want to have necessary supplies such as printer paper or special printer forms, magnetic tapes, disks, or diskettes available when the system is installed.

Careful preparation ensures a smooth installation and start-up of your computer operation and allows the system to start repaying your capital investment in the shortest possible time.

To prepare your site, you will have to coordinate the work of several skilled people. Typically, you may require the services of a facility engineer, electrician, air-conditioning specialist, data communications specialist, a receiving supervisor, and a telephone company representative. It is your responsibility to ensure that these people are provided with the technical information needed to perform their part of the site preparation. That information is provided in this manual. It is also your responsibility to ensure that all necessary tasks have been accomplished as described in the following checklist.

SITE PREPARATION CHECKLIST

This checklist aids in properly completing your site preparation. Follow all the applicable actions listed. Refer to the pages listed for detailed information concerning completion of each checklist item.

Power Requirements
Main Items

_____ 1. The dedicated power source meeting your system's specifications is installed with provisions for future expansion. (page 25)

_____ 2. Local and national electrical codes are met. (page 25)

_____ 3. Proper grounding for the system is verified. (page 28)

Space Requirements

_____ 1. Adequate space is provided for system operation and service. (page 47)

_____ 2. Cable troughs, channels, or bridges are placed as required. (page 50)

_____ 3. Stands or desks for printers and terminals have been ordered from Texas Instruments, an independent supplier, or from company stock. (page 47)

Environmental Requirements

_____ 1. The proper fire extinguishing equipment is installed. (page 61)

_____ 2. Air-conditioning equipment that will handle the additional cooling load is installed and operational. (page 55)

_____ 3. Proper overhead lighting is installed. (page 55)

_____ 4. In regions having a dry climate or in areas of high static discharge potential, carpets are not used. In other climates, carpets and chairs are treated with antistatic spray or antistatic mats are used. (page 59)

_____ 5. If floors are concrete, they have been properly sealed. (page 60)

System Supplies

_____ 1. Expendable supplies such as line printer paper and ribbons are ordered/received. (page 65)

_____ 2. The mass storage devices (disk drives and magnetic tape transport) that come with your system each include one removable media such as a disk pack or tape. Additional media to meet your needs are ordered/received. (page 65)

Receiving Your System

_____ 1. Your receiving area doors and corridors are wide enough to allow crated equipment to pass. (page 69)

_____ 2. If installation by Texas Instruments is not included or ordered, uncrating tools are available. (page 69)

Communications Items

_____ 1. The telephone company or other communications agency has supplied and tested required lines. (page 63)

_____ 2. Any external modems and/or automatic calling units (ACUs) are supplied. (page 63)

_____ 3. A data access arrangement (DAA) or other approved communications line isolation device is installed for dial-up lines using other than FCC-registered equipment. (page 63)

_____ 4. If using a TI-supplied DAA, the Bell-supplied USOC jack is installed. (page 63)

Optional Items

_____ 1. Office furniture such as tables, chairs, desks, storage cabinets for media and supplies, bookcases, or manual racks are ordered/received. (page 47)

_____ 2. Any input/output (I/O) extension cables for devices such as video display terminals (VDTs), terminals, or printers have been received. (page 54)

_____ 3. A trash container for printer paper is available.

International Items

_____ 1. For 220 Vac systems, a source connection (with circuit protection and switching) is available for the system cabinet. (page 31)

_____ 2. Any power cut-off switches required by local or national standards are installed. (page 30)

Do not start installation of the system until all checklist items are completed. Completion of this work will benefit your business at system installation time and during the productive lifetime of the system.

System Descriptions

BUSINESS SYSTEM 600 SYSTEMS

All Business System 600 models are based on the 990/10A minicomputer housed in a 990A13 chassis. The 990A13 chassis offers outstanding system expansion capability, efficient cooling, and easy servicing.

The 990/10A minicomputer is implemented on a single full-size printed wiring board (PWB) which includes either 256 kilobytes or 512 kilobytes of on-board error correcting memory. The 990/10A also features an on-board asynchronous terminal port compatible with Electronic Industries Association (EIA) standard RS-232C.

All Business System 600 models include a Model 911 video display terminal (VDT) for the operator interface to the system. Each system includes at least one mass storage device (disk or magnetic tape) and a cabinet to house the system. Data backup capability is provided in each system.

All Business System 600 models are available in hardware-only versions or they can be purchased with compatible software. Texas Instruments software packages compatible with the Business Systems are listed later in this section.

Cabinets

Business System 600 models are housed in three different cabinets: a 0.81-meter (32-inch) pedestal, a 1.07-meter (42-inch pedestal), and a 1.52-meter (60-inch) cabinet.

Mass Storage Devices

The mass storage devices that are standard components of Business System 600 models are:

- WD500 Disk Storage System — The WD500 features two 5 1/4-inch Winchester fixed (not removable) disks plus a double-sided double-density (DSDD) removable flexible disk for data backup. The formatted storage capacity of each of the two Winchester disks is 4.92 megabytes for a total of 9.84 megabytes of formatted storage capacity. The removable DSDD flexible disk holds 1.15 megabytes of formatted data for data backup.

- WD800 Disk Storage System — The WD800 features an 8-inch Winchester fixed disk with either two or four platters and a removable cartridge tape for data backup or additional storage. The formatted storage capacity of the WD800 with two platters is approximately 18.5 megabytes — With four platters, the formatted storage capacity is approximately 43.2 megabytes. The cartridge tape will store 14.6 megabytes of data in 9.6 kilobyte records for backup or approximately 17 megabytes of unformatted data.

- DS80 Disk Storage System — The DS80 disk drive uses one removable disk cartridge with five platters to provide a total of 63.48 megabytes of formatted data storage. Business systems featuring the DS80 have an additional DS80 or an MT1600 magnetic tape drive for data backup.

- CD1400 Disk Storage System — The CD1400 disk drive is equipped with either one or three fixed platters that provide 13.5 or 67.5 megabytes respectively, of formatted data storage. The CD1400 also has a removable disk cartridge usable for data backup or for storage of an additional 13.5 megabytes of formatted data.

- MT1600 Magnetic Tape Storage System — The MT1600 magnetic tape drive stores data on 12.7-millimeter (1/2-inch) magnetic tape at a density of 1600 bits per inch (bpi). The MT1600 uses 152.4-millimeter (6-inch) to 266.7-millimeter (10.5-inch) diameter magnetic tape reels.

The following table identifies the standard hardware components of each Business System 600 model. Optional hardware items are listed later.

Business System 600 Configurations

Model	Cabinet	WD500 Disk	WD800 Disk	DS80 Disk	DS300 Disk	CD1400 Disk	MT1600 Tape	Inter-active Device	Backup Method
S651	0.81 m	X 10MB						911	DSDD Floppy
S660	1.07 m					X 27MB		911	Integ.
S661	1.07 m					X 81MB		911	Integ.
S671	0.81 m		X 18MB					911	Cart. tape
S672	0.81 m		X 43MB					911	Cart. tape
S680	0.81 m			X(2) 63MB				911	Second DS80
S682	1.52 m			X 63MB			X	911	Mag. tape

Notes:

All models are available with 256 or 512 bytes of on-board memory.

Disk capacities indicate formatted data storage capacity.

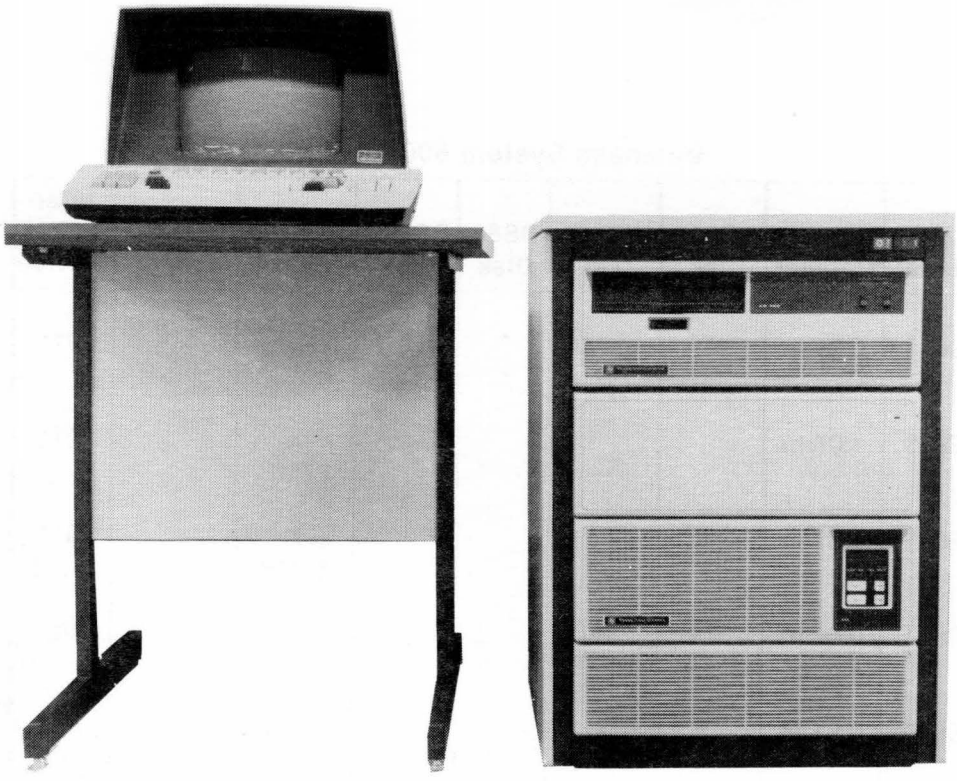

Figure 1. Business System Model S651

Figure 2. Business System Models S660/S661

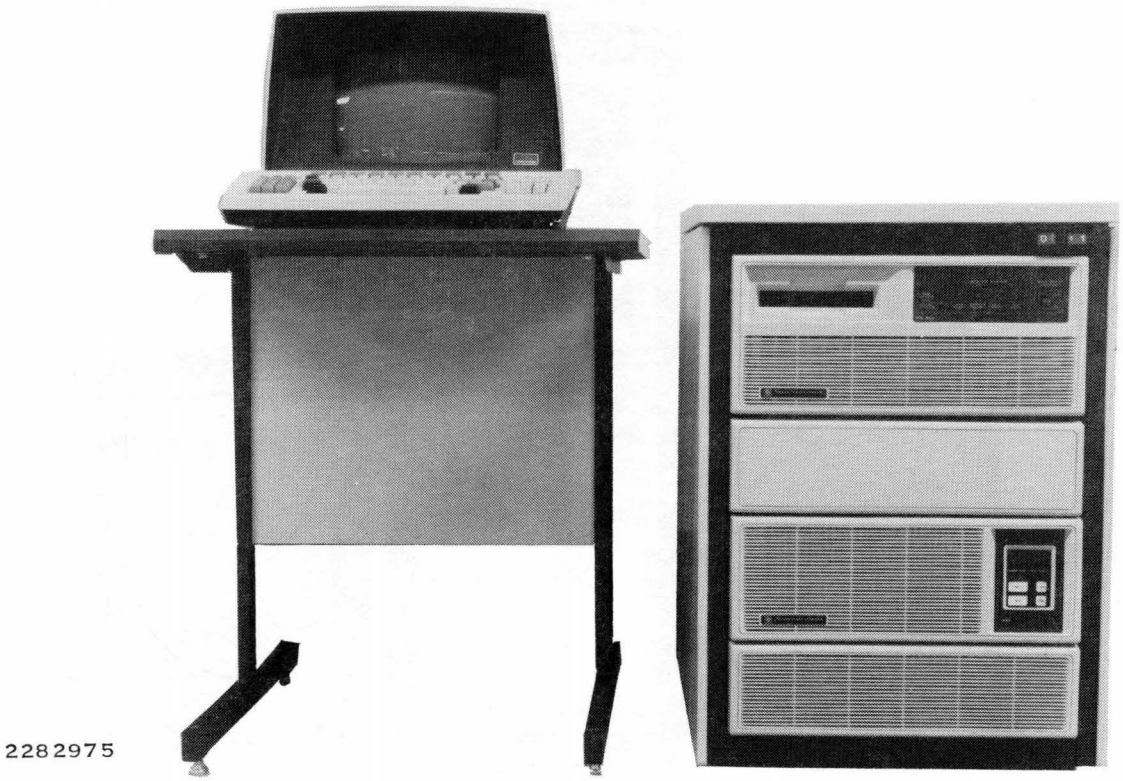

Figure 3. Business System Models S671/S672

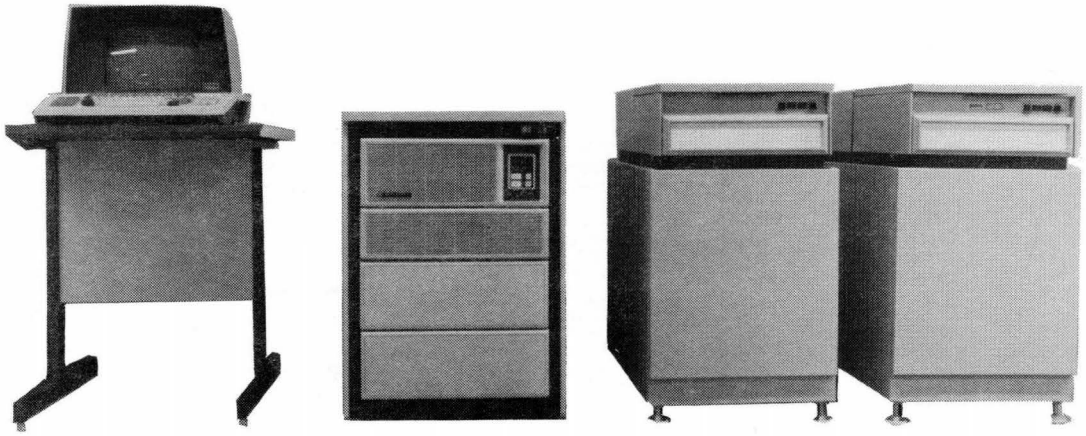

Figure 4. Business System Model S680

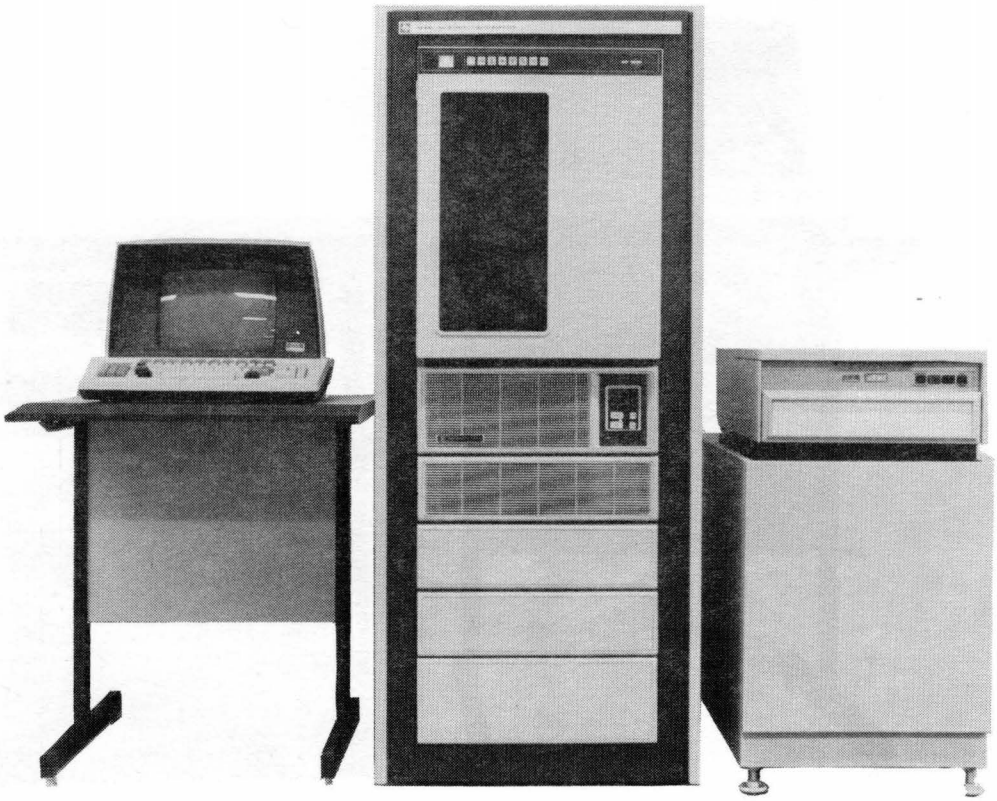

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Figure 5. Business System Model S682

BUSINESS SYSTEM 800 SYSTEMS

All Business System 800 models are based on the 990/12LR minicomputer housed in a 990A13 chassis. The 990A13 chassis offers system expansion capability, efficient cooling, and easy servicing.

The 990/12LR minicomputer is the largest and most powerful of the Texas Instruments minicomputers. The basic 990/12LR minicomputer is implemented on three printed wiring boards: an arithmetic unit, a system mapping interface, and a cache controller with 512 kilobytes of error correcting memory. These boards are augmented with interface modules, I/O modules, and optional additional memory. An optional memory array board adds 256, 512, 768, or 1,024 kilobytes of error-correcting memory.

All Business System 800 models include two Model 911 video display terminals (VDTs) for the operator interface to the system. Each system includes at least one mass storage device (disk or magnetic tape) and a cabinet to house the system. Data backup capability is provided in each system.

All Business System 800 models are available in hardware-only versions or can be purchased with compatible software. Texas Instruments software packages compatible with the Business Systems are listed later in this section.

Cabinets

Business System 800 models are housed in three different cabinets: a 0.81-meter (32-inch) pedestal, a 1.07-meter (42-inch pedestal), and a 1.52-meter (60-inch) cabinet.

Mass Storage Devices

Mass storage devices that are standard components of Business System 800 models are:

- WD800 Disk Storage System — The WD800 for S800 models features an 8-inch Winchester fixed disk with four platters and a removable cartridge tape for data backup or additional storage. The formatted storage capacity of the WD800 with four platters is approximately 43.2 megabytes. The cartridge tape stores 14.6 megabytes of data in 9.6 kilobyte records for backup or approximately 17 megabytes of unformatted data.

- DS80 Disk Storage System — The DS80 disk drive uses one removable disk cartridge with five platters to provide a total of 63.48 megabytes of formatted data storage. Business systems featuring the DS80 have an additional DS80 or an MT1600 magnetic tape drive for data backup.

- DS300 Disk Storage System — The DS300 disk drive uses one removable 10-platter disk cartridge to provide 241 megabytes of formatted data storage. Business Systems featuring the DS300 have an additional DS300 or an MT1600 magnetic tape drive for data backup.

- CD1400 Disk Storage System — The CD1400 disk drive used in S800 systems is equipped with three fixed platters providing 67.5 megabytes of formatted data storage. The CD1400 also has a removable disk cartridge usable for data backup or for storage of an additional 13.5 megabytes of data.

- MT1600 Magnetic Tape Storage System — The MT1600 magnetic tape drive stores data on 12.7-millimeter (1/2-inch) magnetic tape at a density of 1600 bits per inch (bpi). The MT1600 uses 152.4-millimeter (6-inch) to 266.7-millimeter (10.5-inch) magnetic tape reels.

The following table identifies the standard hardware components of each Business System 800 model. Optional hardware items are listed later.

Business System 800 Configurations

Model	Cabinet	WD800 Disk	DS80 Disk	DS300 Disk	CD1400 Disk	MT1600 Tape	Inter-active Device	Backup Method
S861	1.07 m				X 81MB		911 (2)	Integ.
S872	0.81 m	X 43MB					911 (2)	Cart. tape
S880	0.81 m		X (2) 63MB				911 (2)	Second DS80
S882	1.52 m		X 63MB			X	911 (2)	Mag. tape
S884	0.81 m			X (2) 241MB			911 (2)	Second DS300
S886	1.52 m			X 241MB		X	911 (2)	Mag. tape

Note:

Disk capacities indicate formatted data storage capacity.

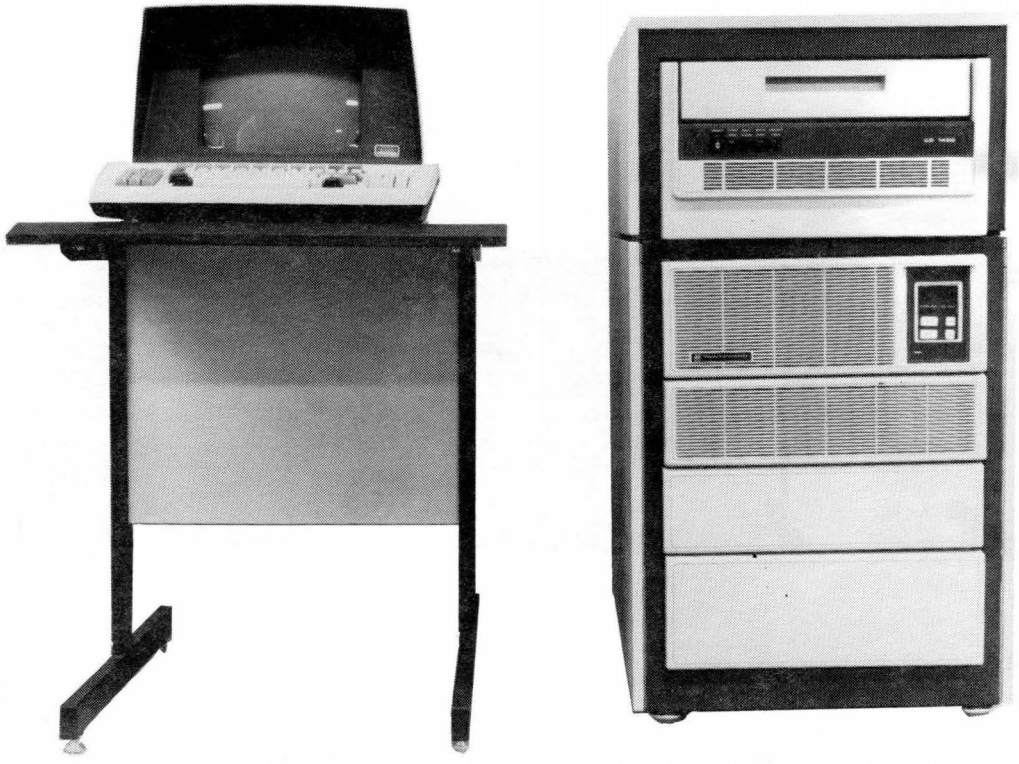

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Figure 6. Business System Model S861

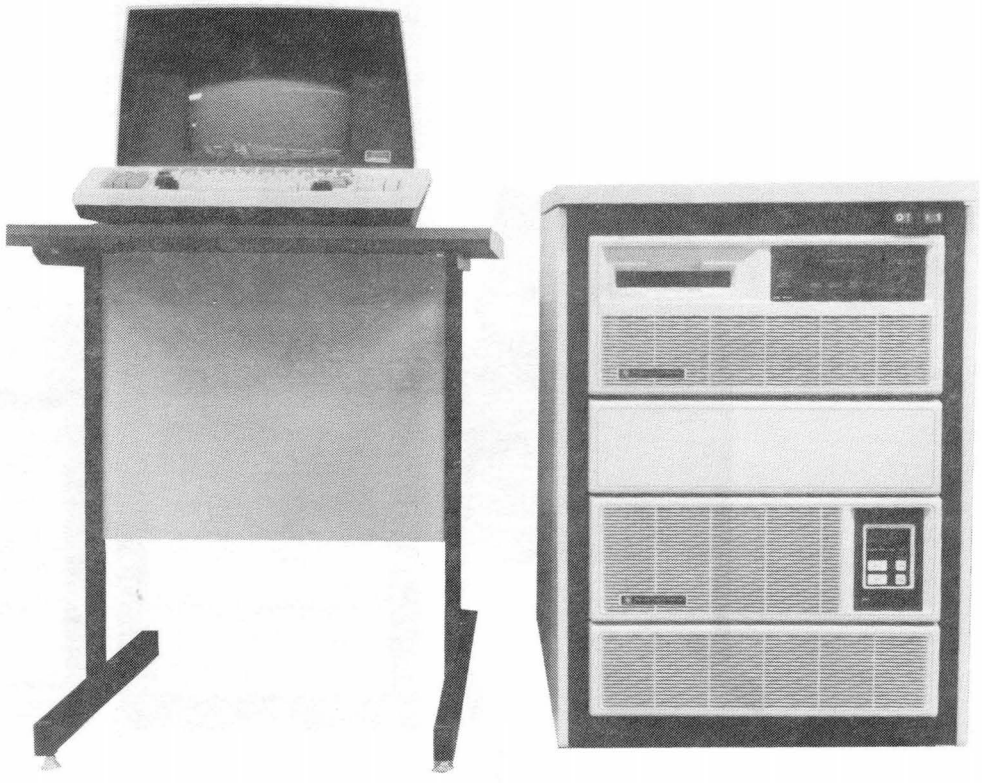

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Figure 7. Business System Model S872

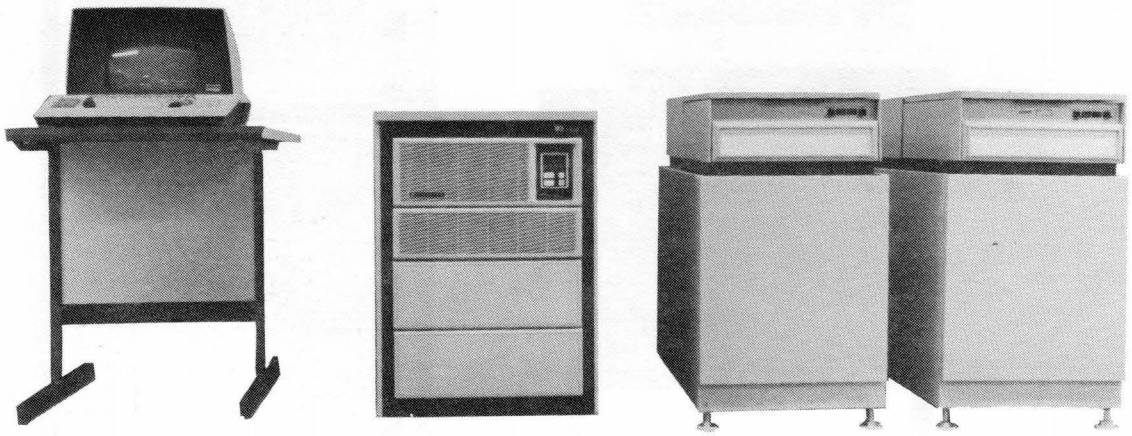

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Figure 8. Business System Model S880

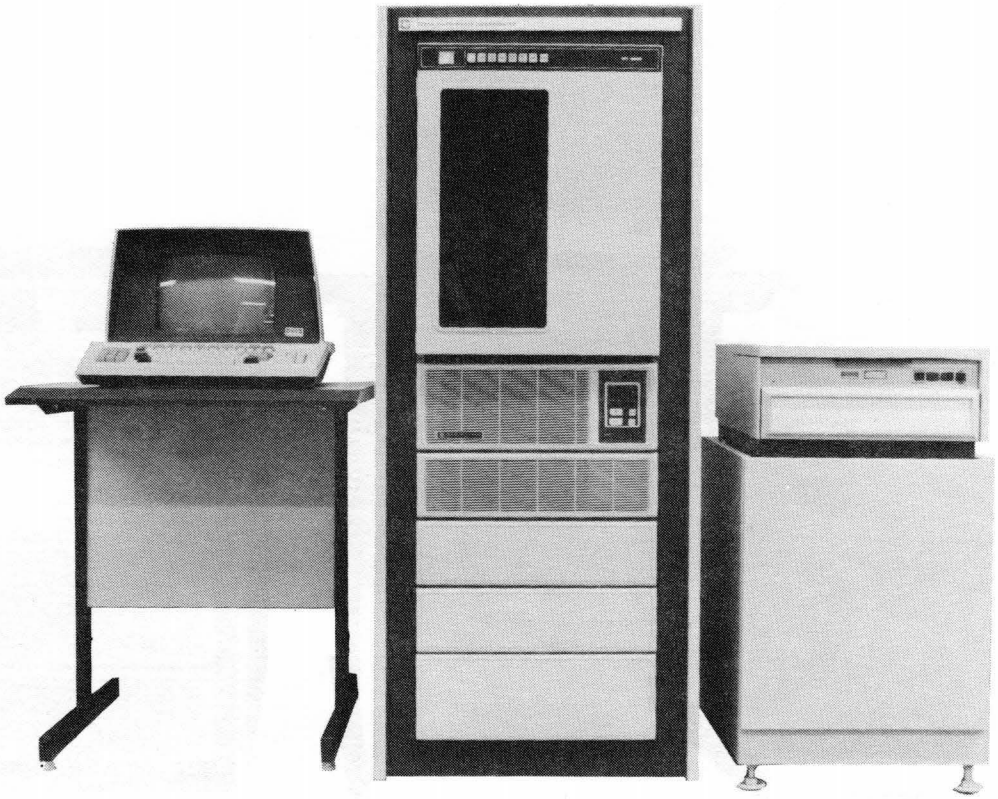

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Figure 9. Business System Model S882

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Figure 10. Business System Model S884

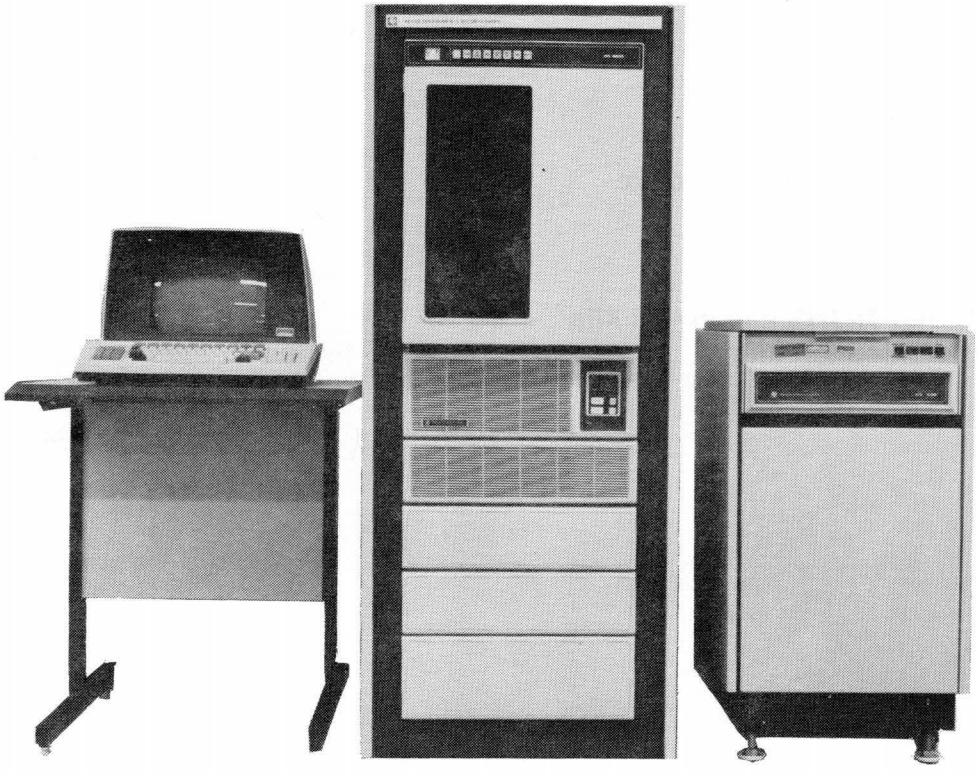

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Figure 11. Business System Model S886

BUSINESS SYSTEMS 600/800 HARDWARE OPTIONS

The hardware items in the following list can be added to any Business System 600 or 800 model for enhancement of the system. For a description of each device or kit, refer to the Texas Instruments Computer Family Catalog.

Hardware Options

Printers and Terminals

- 810 printer
- LP300 and LP600 line printers
- LQ45 letter quality printer
- 840 read-only (RO) printer
- 940 electronic video terminal

Disk Drives

- FD1000 flexible disk drive
- WD500 disk drive
- WD800 disk drive
- DS80 disk drive
- DS300 disk drive
- CD1400 disk drive

Magnetic Tape Drive

- MT1600 magnetic tape drive

Kits

- CRU and TILINE expansion kits
- Communication kits

BUSINESS SYSTEMS 600/800 SYSTEM SOFTWARE AND OPTIONS

The DX10 and DNOS operating system software packages are compatible with all Business System models except Model S651, which does not have sufficient storage capacity to use the DNOS operating system efficiently. The software packages listed here are compatible with all Business System models.

Software Options

Languages

- Pascal
- FORTRAN
- BASIC
- COBOL
- RPG II

Communication

- 3780/2780 Emulator
- 3270 Interactive Communication Software (ICS)
- Remote Terminal Subsystem (RTS)
- TILINK* (DX10 only)
- Digital Systems Group (DSG) Poller/Data Concentrator (DX10 only)
- Distributed Network Communication System (DNCS) (DNOS only)
- Bubble-Memory Terminal Support (BMTS) Package (DX10 only)
- System Networking Architecture (SNA) Package (DNOS only)
- X.25 (DNOS only)

Utilities

- 990 Online Diagnostics
- Sort/Merge
- TIFORM

Data Management

- Data Base Management System (DBMS)
- Query
- Data Dictionary

Word Processing

- TIPE-990

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Power Requirements

This section contains the power requirements for Business Systems 600 and 800. It also includes recommended facility wiring and instructions for providing an adequate ground for your computer system. Tables listing power requirements for each system component are included in this section.

The Texas Instruments Business Systems 600 and 800 require dedicated ac power feeder circuits and/or power line conditioning equipment to protect them from line noise and power fluctuations. There must be no electric motors (such as pencil sharpeners, copiers, typewriters), fluorescent lights, or air conditioners connected to the power feeder lines supplying the computer system. Voltage irregularities and line noise are major causes of unnecessary errors, downtime, and service calls. The additional cost of well-planned power service is repaid with reliability, safety, and easy expansion.

Business Systems normally operate using ordinary commercial power available in the United States. Tolerances to line surges and sags is generally ± 10 percent of normal line voltage. However, the quality of the power from the utility company can vary due to numerous factors often beyond the control of the consumer. These problems include line surges, power drops, and momentary impulses resulting from heavy equipment power-up and power-down cycles on the same or related power company circuits. Occasionally, voltage fluctuations are caused by natural sources such as thunderstorms and animals or tree limbs coming into contact with high-voltage lines supplying the site.

While the problems discussed in the preceding paragraph may have little effect on your installation, it is good to consider them prior to wiring your facility. They are explained in more detail later in this section, along with some suggested ways of preventing power disturbances from affecting operation of your computer system.

FACILITY WIRING

Planning

The wiring within the facility plays an important role in determining the quality of power delivered to the computer system. Proper grounding of the wiring and equipment is essential to prevent computer malfunctions of an irregular, intermittent nature. It is highly recommended that the facility electrical wiring for the computer system meets the requirements presented in the following paragraphs.

While planning your facility wiring, it can prove beneficial to compare the cost and benefit of conventional wiring to a prewired power distribution center (power center). The prewired power center simplifies computer room layout, reduces electrical wiring, provides greater flexibility, and simplifies relocation of the computer system in the future. Power centers incorporate the circuit breakers, wiring, and receptacles so that they eliminate most of the wiring for a computer installation. Some manufacturers offer power centers with isolation transformers, voltage regulators, electrical noise filters, and other power line conditioning equipment as optional components.

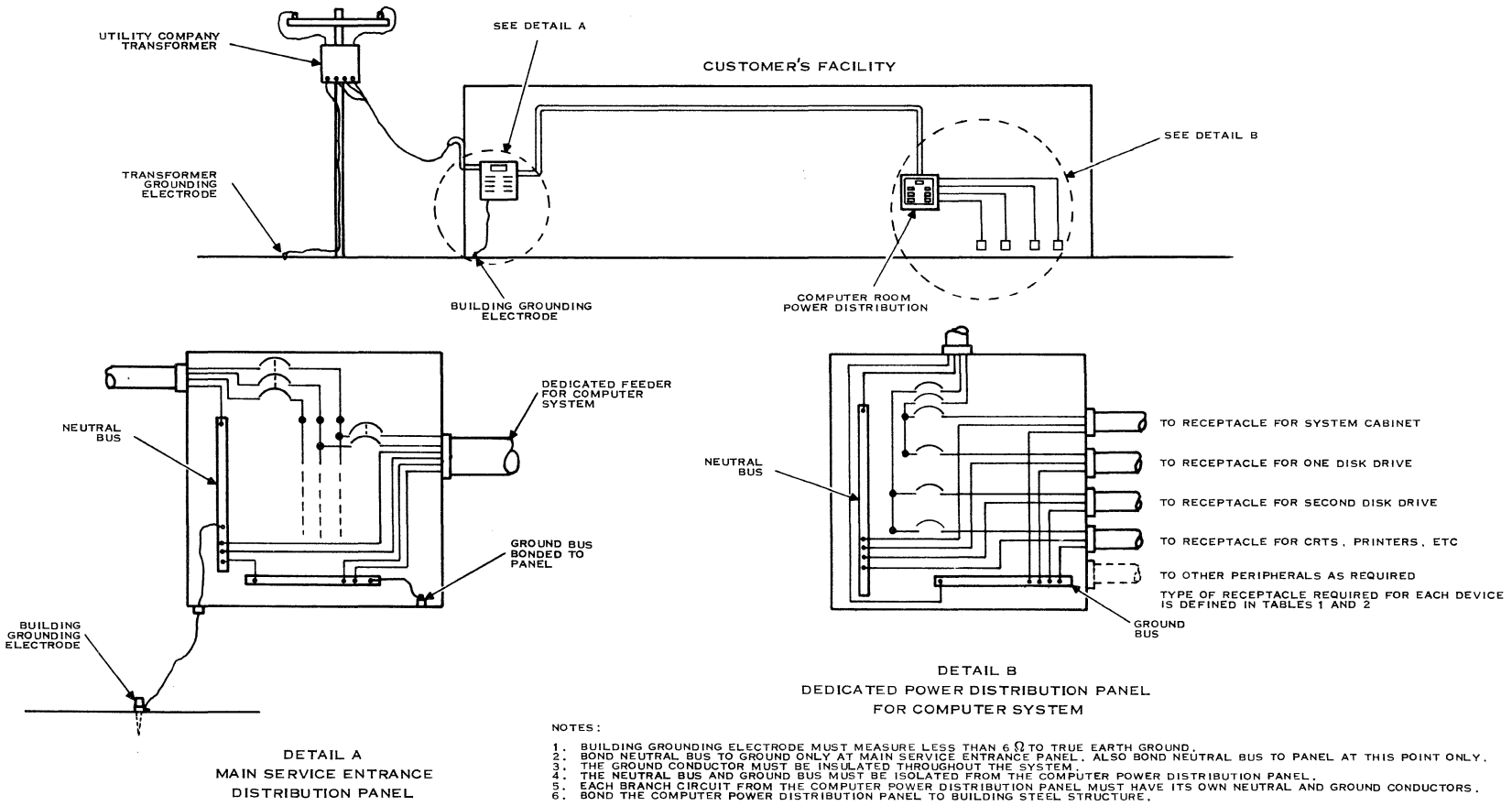
Power Distribution

The recommended configuration is a dedicated ac power feeder circuit with a dedicated power distribution panel for the computer equipment as shown in Figure 12. The dedicated feeder starts at the main service entrance distribution panel. At this panel, the neutral bus is connected to the building grounding electrode via a grounding electrode conductor. It is important that the connection to the building grounding electrode be made with a wire; connection through the conduit is not adequate. The building grounding electrode should reach permanent ground moisture and must measure less than six ohms to true earth ground.

In the main service entrance panel, the neutral bus is bonded to the ground bus and the ground bus is bonded to the panel as shown in Figure 12. In many breaker boxes, neutral is bonded to ground by installing or tightening a screw provided by the manufacturer of the box. The grounding conductor in the dedicated feeder must be insulated to prevent multiple ground current paths.

At the computer equipment dedicated power distribution panel, the grounding bus and neutral bus are insulated from the panel frame. Each branch circuit from the computer equipment power distribution panel must have a separate insulated grounding conductor. If the breaker box used to wire your system does not have separate neutral and ground buses, install an insulated terminal block to provide separate neutral and ground buses. Ensure that the terminal block you install conforms to all applicable electrical codes and is insulated from the box.

The proper receptacle for the computer cabinet and for each peripheral device in the system is specified in tables presented later in this section. TI recommends using receptacles of the isolated-ground type that meet NEMA specification 5-15R, such as Hubbell number IG-5262 or equivalent.



NOTES:

1. BUILDING GROUNDING ELECTRODE MUST MEASURE LESS THAN 6 Ω TO TRUE EARTH GROUND.
2. BOND NEUTRAL BUS TO GROUND ONLY AT MAIN SERVICE ENTRANCE PANEL. ALSO BOND NEUTRAL BUS TO PANEL AT THIS POINT ONLY.
3. THE GROUND CONDUCTOR MUST BE INSULATED THROUGHOUT THE SYSTEM.
4. THE NEUTRAL BUS AND GROUND BUS MUST BE ISOLATED FROM THE COMPUTER POWER DISTRIBUTION PANEL.
5. EACH BRANCH CIRCUIT FROM THE COMPUTER POWER DISTRIBUTION PANEL MUST HAVE ITS OWN NEUTRAL AND GROUND CONDUCTORS.
6. BOND THE COMPUTER POWER DISTRIBUTION PANEL TO BUILDING STEEL STRUCTURE.

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Figure 12. Recommended Facility Wiring Scheme

Grounding
The grounding scheme shown in Figure 12 has two main functions. The first is to ensure personnel safety in the event of a power short to the chassis frame caused by equipment failure or power distribution panel problems. This is accomplished by strict adherence to national and local electrical codes.

The second function of the grounding scheme is to provide a stable signal reference for computer operations. This is accomplished by providing a single low-resistance path to earth ground through the building grounding electrode. This reference is provided to the computer equipment by isolating the grounding conductor from the conduit and from the computer equipment distribution panel. Isolating the grounding conductor allows only one path to earth ground and prevents electrical noise induced by multiple current paths to ground, commonly called ground loops.

Power Distribution with Line Conditioning Equipment
If it is not practical to provide a dedicated feeder to the computer system installation, power isolation and/or power line conditioning equipment is required. Several isolation and power conditioning devices that can be used are discussed later in this section. Figure 13 illustrates the connection of an isolation transformer in the feeder to the computer system power distribution panel.

The isolation transformer or power conditioning device must be located as close as possible to the computer equipment. To reduce electrical noise, install a PVC bushing between the conduit and the transformer on the input side of the device. The ground conductor in the feeder is connected to the transformer frame and to earth ground, either through a grounding electrode (ground rods) or through the building structural steel members. If the ground is tied to a building structural member, ensure that the structural member is adequately grounded. The ground (electrode or building structural member) must be as close to the transformer as possible.

Power Distribution Summary
The following list summarizes major points to consider in planning power distribution for your computer system.

- Install all electrical wiring in accordance with national and local electrical codes.
- Install a dedicated feeder from the main switchboard or main distribution panel to the computer power distribution panel.

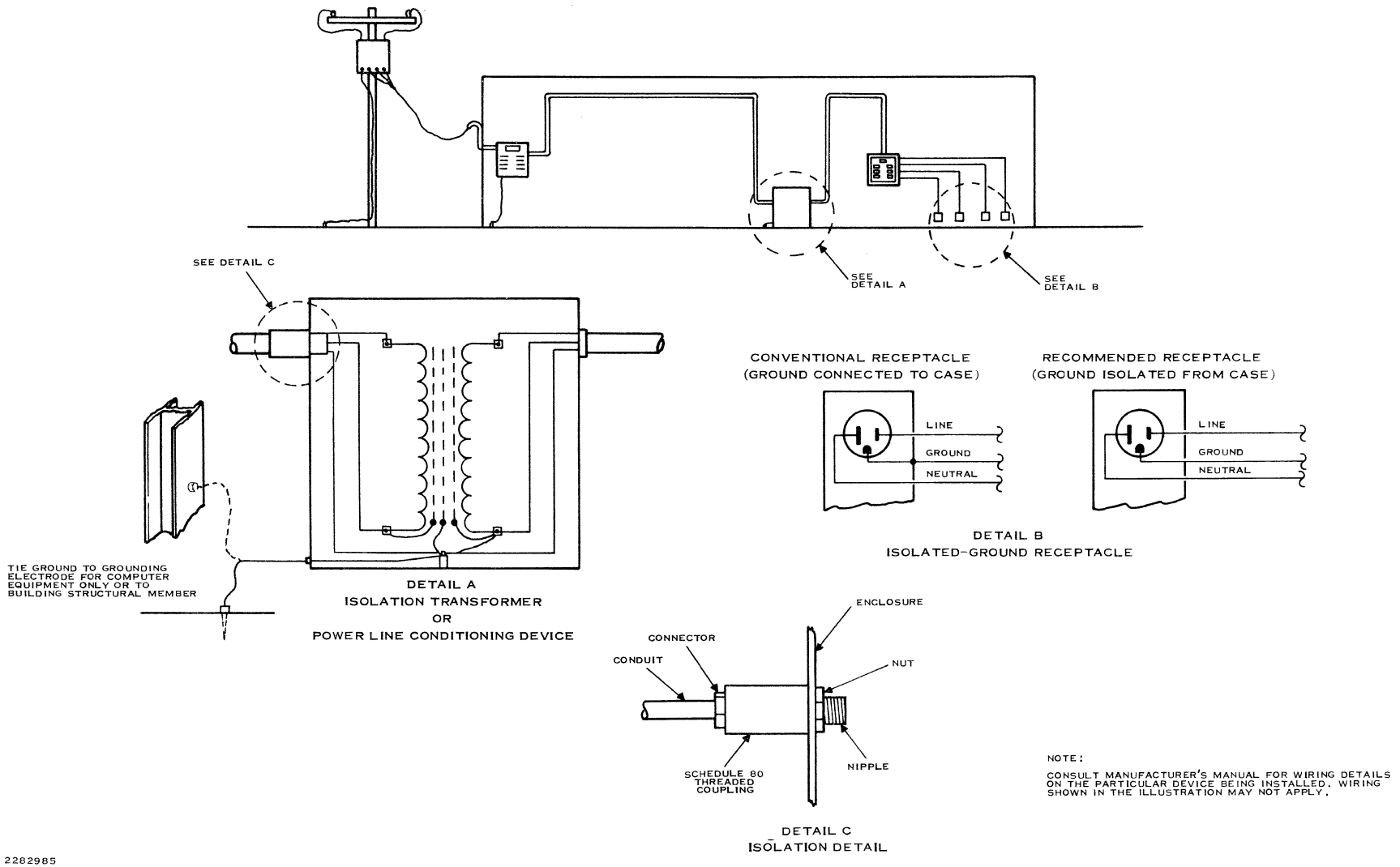

Figure 13. Power Distribution with Power Line Conditioning

- An isolation transformer or power line conditioning equipment is recommended to isolate your computer system power from electrical noise and transients on incoming power.

  — If an isolation transformer or power conditioning equipment is used, locate it in the computer room if possible and as close to the computer system as possible.

- When planning the power needs for your computer system, allow for future expansion. Pay particular attention to the power capacity of the selected isolation transformer and to the space for additional circuit breakers in the breaker panel.

- A dedicated grounding scheme for your computer system is essential. The ground wires for the computer system must be insulated and isolated from the conduit and distribution panel. Do not use conduit as a connection to earth ground.

- The ground electrode must measure less than 6 ohms to true earth ground.

- Isolate the system ground wire and the neutral wire going to the single-point earth ground from all other ground paths. Power outlets for the system equipment should all be isolated-ground type receptacles.

- All conductors in the dedicated computer system feeder must be copper. Connect only the computer system and peripheral devices to the dedicated feeder.

- Safety standards in most European countries require power breakers and air conditioning shutoff switches to be located adjacent to each exit from the computer area. Some government agencies and corporations in the United States require at least one central power shutoff point in a computer facility. Be sure to check these requirements before wiring your site. Even if formal standards do not apply, a single-point power shutoff with additional breakers for safety and maintenance convenience is recommended.

Remember that thoughtful planning of your power distribution system will greatly reduce potential system downtime and the related costs due to inadequate ac power service.

SYSTEM CABINET POWER

Each system cabinet connects to the facility power system through a single plug-in cable. The power to all equipment mounted in the cabinet (or on top of the cabinet in the case of the CD1400 disk drive) is supplied by the power strip in the cabinet. The cabinet-mounted equipment includes the computer chassis, expansion chassis, MT1600 tape transport, flexible disk drives, WD500, WD800, and CD1400 disk drives, and the cabinet fan. Large disk drives such as the DS80 and DS300, printers, VDTs, and other peripheral devices are supplied by receptacles external to the cabinet.

A complete power cord is provided for all 100-Vac and 120-Vac systems. The power cord for the 1.52-meter (60-inch) cabinet (Figure 14) contains three #10 AWG conductors for 100-Vac and 120-Vac systems. The cabinet end of the cable has a locking female connector that mates with a recessed male connector on the cabinet power entry panel. The other end of the cable has a heavy-duty locking plug of the type shown in the illustration that applies to your system. The cable for export to Japan (100-Vac) is identical to the United States version 120-Vac cable. The cabinet is protected by a circuit breaker on the power-entry panel.

The 220-Vac Western European system cabinets (16 ampere) are furnished with a 3.0-meter (9.8-foot), four-conductor cable (Figure 15) intended for captive connection to a dedicated customer-furnished drop. Circuit protection and switching must be furnished by the customer as part of the service connection. Service can be either single-phase, 220 volt nominal, line-to-neutral at 16 amperes maximum, or line-to-line 120 degrees wye at 10 amperes per line maximum.

The 240-Vac European system cabinets are furnished with a 2.5-meter (8.2-foot), three-conductor cable terminated in a BSI 1363 plug as shown in Figure 16. Figure 17 illustrates details of the BSI 1363 plug.

Figure 18 shows the power panel wiring for the 0.81-meter (32-inch) cabinet and the power cords that are used with it. The length and part number of each power cord is shown on the illustration.

Tables 1, 2, and 3 list the power requirements for all system components and the type of wall receptacle needed for each device. The tables follow the cabinet power illustrations.

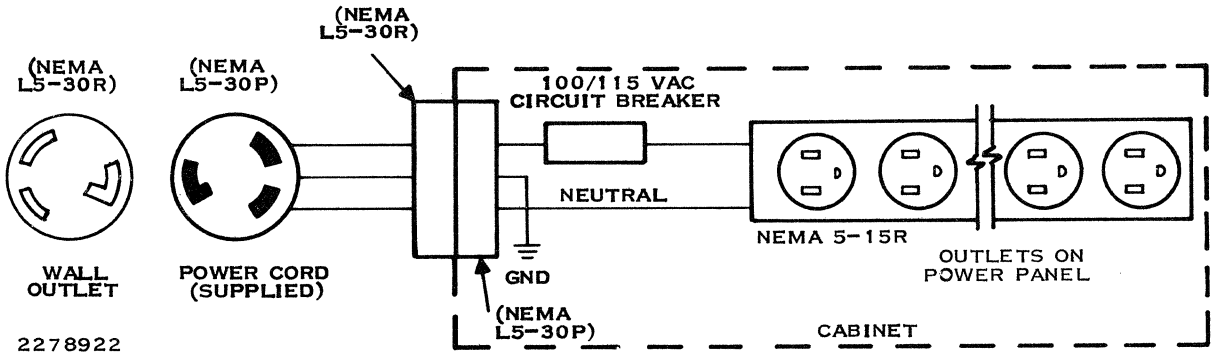

Figure 14. Power Cabling for 100/120 Vac 1.52-Meter (60-Inch) Cabinet and 1.07-Meter (42-Inch) Cabinet

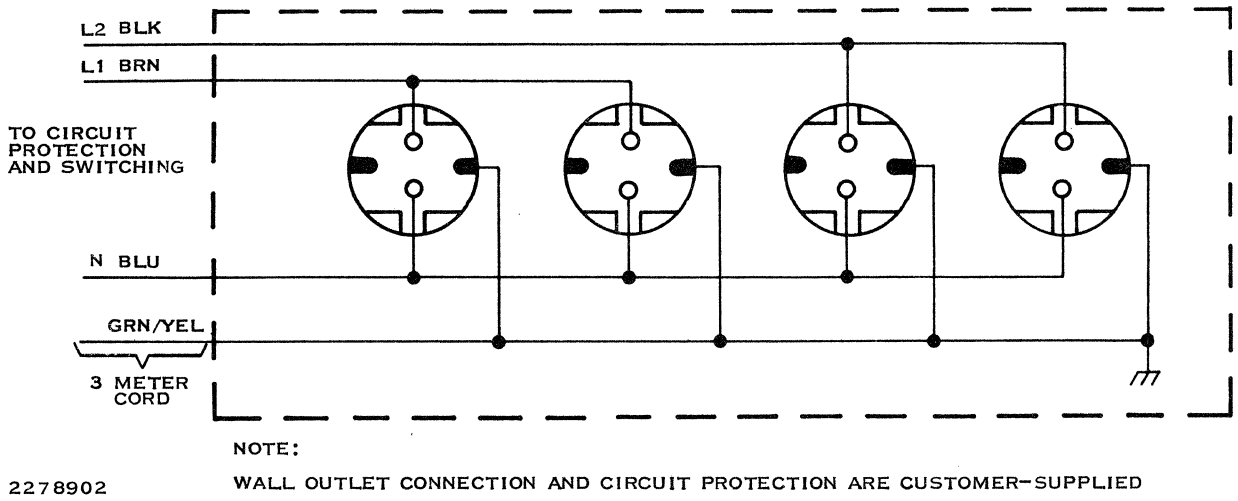

Figure 15. International 220 Vac 1.52-Meter (60-Inch) 16 A Cabinet Wiring and 1.07-Meter (42-Inch) 16 A Cabinet Wiring

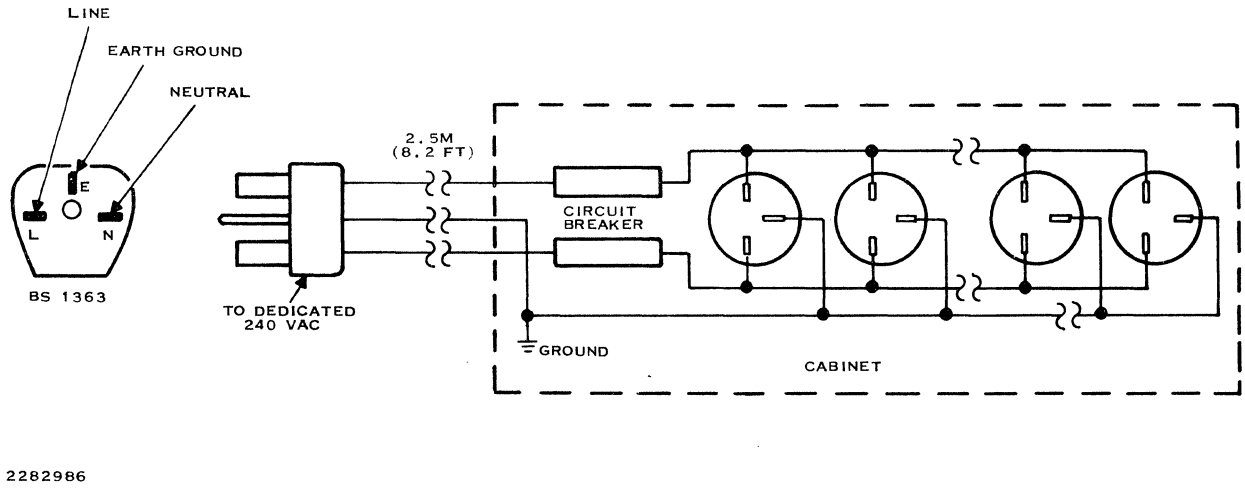

Figure 16. International 240 Vac 1.52-Meter (60-Inch) Cabinet Wiring and 1.07-Meter (42-Inch) Cabinet Wiring

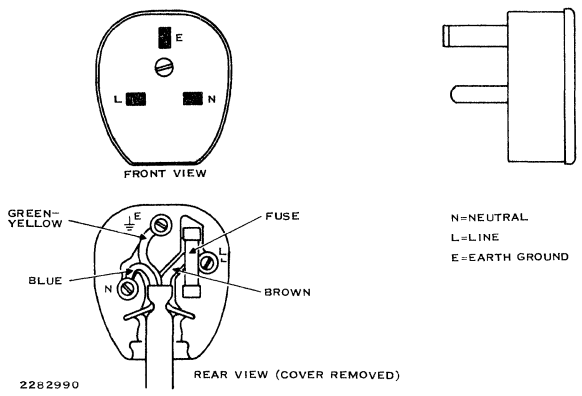

Figure 17. Male Plug and Cord Cap for 240-Vac British Connector, BSI 1363

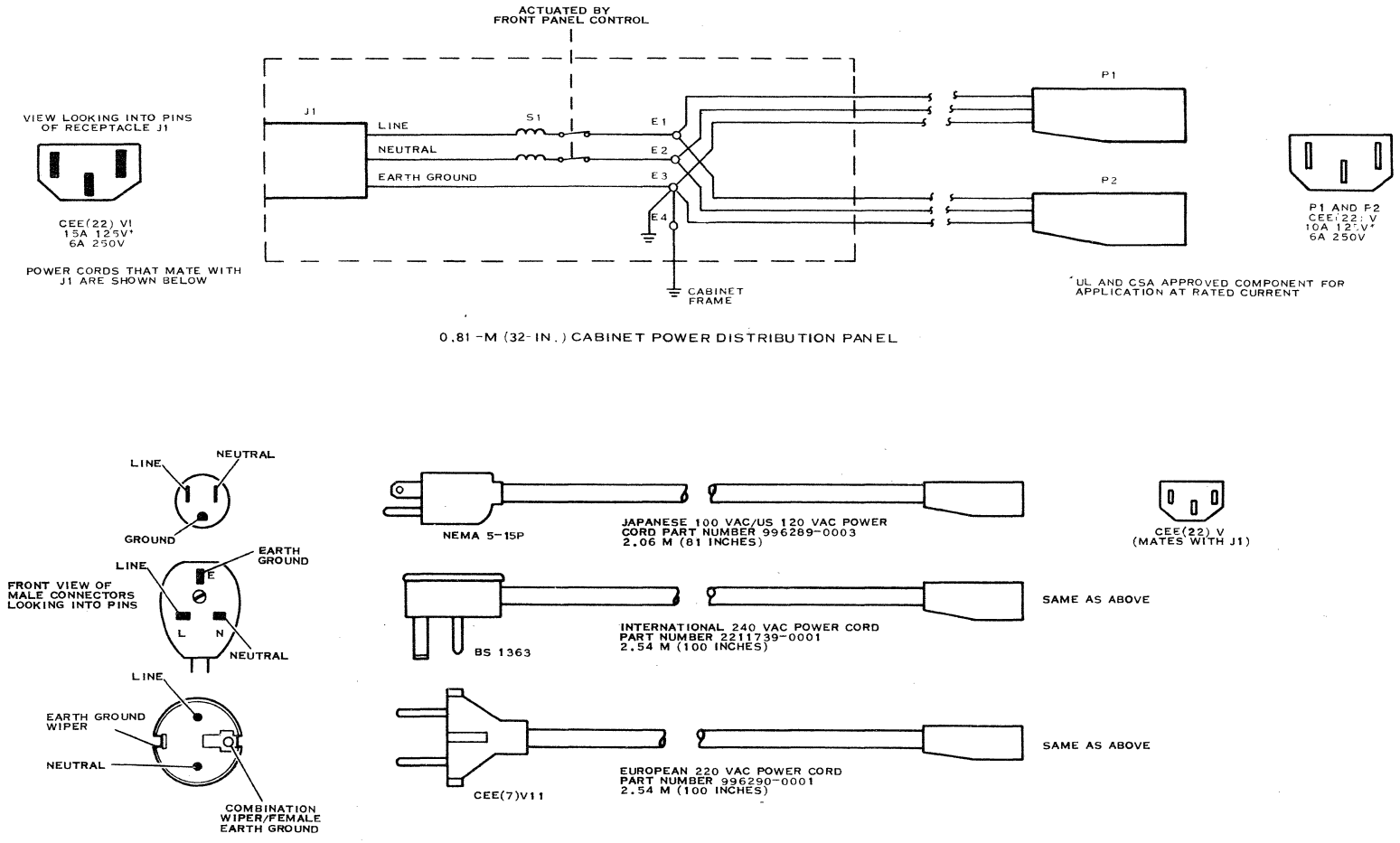

Figure 18. 0.81 Meter (32-Inch) Cabinet Power Panel and Power Cords

The following is an example of how to calculate total power requirements for a typical Business System.

Power Calculation Example for Business System Model S660

120-Volt Load Quantity	Device	Voltage	Current
1	990A13 Chassis	120 Vac	8.3 A
1	CD1400	120 Vac	8.2 A
1	911 VDT	120 Vac	1.0 A
		Total	17.5 A

120 V × 17.5 A = 2,100 VA (2.1 KVA)

Table 1. Electrical Requirements for Business System Enclosures

Cabinet	Voltage (± 10%)	Frequency (± 0.5 Hz)	Rated Current Maximum	Nominal Current Drain[1]	Power Service[2]	Wall Receptacle[3]
			Domestic Systems			
0.81-m (32-in.)	120 Vac	60 Hz	15 A	None	Exclusive	NEMA 5-15R[5]
1.07-m (42-in.)	120 Vac	60 Hz	30 A	None	Exclusive	NEMA L5-30R[5]
1.52-m (60-in.)	120 Vac	60 Hz	30 A	0.65 A	Exclusive	NEMA L5-30R[5]

Table 1. Electrical Requirements for Business System Enclosures (Continued)

Cabinet	Voltage (± 10%)	Frequency (± 0.5 Hz)	Rated Current Maximum	Nominal Current Drain[1]	Power Service[2]	Wall Receptacle[3]
			International Systems			
0.81-m	100 Vac	50 Hz	15 A	None	Exclusive	NEMA 5-15R[5]
(32-in.)	100 Vac	60 Hz	15 A	None	Exclusive	NEMA 5-15R[5]
	220 Vac	50 Hz	6 A	None	Exclusive	CEE (7) VII
	240 Vac	50 Hz	6 A	None	Exclusive	BSI 1363
1.07-m	100 Vac	50 Hz	30 A	None	Exclusive	NEMA L5-30R[5]
(42-in.)	100 Vac	60 Hz	30 A	None	Exclusive	NEMA L5-30R[5]
cabinet	220 Vac	50 Hz	16 A	None	Exclusive	X
with	240 Vac	50 Hz	13 A	None	Exclusive	BSI 1363
CD1400 or secondary CD1400 cabinet[4]						
1.52-m	100 Vac	50 Hz	30 A	0.65 A	Exclusive	NEMA L5-30R[5]
(60-in.)	100 Vac	60 Hz	30 A	0.65 A	Exclusive	NEMA L5-30R[5]
cabinet	220 Vac	50 Hz	16 A	0.37 A	Exclusive	X
13-slot	240 Vac	50 Hz	13 A	0.37 A	Exclusive	BSI 1363
chassis system and all expansion cabinets[4]						

Notes:

[1] This column indicates only the current drain of the cabinet fan. Note that only the 1.52-meter (60-inch) cabinet has a fan. Current drain of individual devices installed in the cabinet are listed in tables following this table.

[2] Exclusive indicates that a separate branch circuit with a circuit breaker is recommended for the cabinet.

[3] X indicates that the source connection is captive or is determined by the convention of the country in which the installation is planned.

[4] An additional cabinet is required for this option.

[5] Isolated ground type receptacles are recommended, such as Hubbell IG 5262 for NEMA 5-15R and Hubbell IG 2610 for NEMA 5-30R. Other manufacturer's equivalent product is acceptable.

Table 2. Electrical Requirements for Business System Equipment That Requires Exclusive Circuit Breakers

Unit	Voltage (±10%)	Frequency (±0.5 Hz)	Running Current Maximum	Start Current and Duration	Power Service[2]	Wall Receptacle
			Domestic Requirements			
DS80 disk drive	120 Vac	60 Hz	8.5 A	26 A for 12 sec	Exclusive	NEMA 5-20R[3]
DS300 disk drive[1]	208 Vac	60 Hz	5.0 A	25 A for 10 sec	Exclusive	NEMA 6-15R[3]
LP300 line printer	120 Vac	60 Hz	7.5 A	14.2 A for 0.5 sec[4]	Exclusive	NEMA 5-15R[3]
LP600 line printer	120 Vac	60 Hz	6.0 A	25.4 A for 0.5 sec[4]	Exclusive	NEMA 5-15R[3]
			International Requirements			
DS80 disk drive	100 Vac	50 Hz	8.5 A	26 A for 12 sec	Exclusive	NEMA 5-20R[3]
	100 Vac	60 Hz	8.5 A	26 A for 12 sec	Exclusive	NEMA 5-20R[3]
	220 Vac	50 Hz	4.3 A	13 A for 12 sec	Exclusive	CEE (7) VII
	240 Vac	50 Hz	4.3 A	13 A for 12 sec	Exclusive	BSI 1363
DS300 disk drive[1]	200 Vac	50 Hz	5.0 A	25 A for 10 sec	Exclusive	NEMA 6-15R[3]
	200 Vac	60 Hz	5.0 A	25 A for 10 sec	Exclusive	NEMA 6-15R[3]
	220 Vac	50 Hz	5.0 A	25 A for 10 sec	Exclusive	CEE (7) VII
	240 Vac	50 Hz	5.0 A	25 A for 10 sec	Exclusive	BSI 1363
LP300 line printer	100 Vac	50 Hz	9.0 A	17.0 A for 0.5 sec[4]	Exclusive	NEMA 5-15R[3]
	100 Vac	60 Hz	9.0 A	17.0 A for 0.5 sec[4]	Exclusive	NEMA 5-15R[3]
	220 Vac	50 Hz	4.1 A	7.7 A for 0.5 sec[4]	Exclusive	CEE (7) VII
	240 Vac	50 Hz	3.8 A	7.1 A for 0.5 sec[4]	Exclusive	BSI 1363

Table 2. Electrical Requirements for Business System Equipment That Requires Exclusive Circuit Breakers (Continued)

Unit	Voltage (±10%)	Frequency (±0.5 Hz)	Running Current Maximum	Start Current and Duration	Power Service[2]	Wall Receptacle
			International Requirements			
LP600	100 Vac	50 Hz	7.2 A	30.5 A for 0.5 sec[4]	Exclusive	NEMA 5-15R[3]
line	100 Vac	60 Hz	7.2 A	30.5 A for 0.5 sec[4]	Exclusive	NEMA 5-15R[3]
printer	220 Vac	50 Hz	3.3 A	13.9 A for 0.5 sec[4]	Exclusive	CEE (7) VII
	240 Vac	50 Hz	3.0 A	12.7 A for 0.5 sec[4]	Exclusive	BSI 1363

Notes:

The start current and duration is such that a standard circuit breaker of the same rating as the wall receptacle is required for each device listed to work satisfactorily.

[1] The DS300 controller turns on the drives in a timed sequence. Due to the magnitude of the in-rush current, each DS300 should be powered from a separate branch circuit.

[2] Exclusive indicates that a separate branch circuit with a circuit breaker is recommended for the device.

[3] Isolated ground type receptacles are recommended, such as Hubbell IG5362 for NEMA 5-20R, Hubbell IG 5651 for NEMA 6-15R, and Hubbell IG5262 for NEMA 5-15R. Other manufacturer's equivalent product is acceptable.

[4] Start current is for each time printer goes from standby to operating mode.

Table 3. Electrical Requirements for Business System Equipment That May Share Circuit Breakers

Unit	Voltage (±10%)	Frequency (±0.5 Hz)	Running Current	Start Current and Duration	Power Service[1]	Wall Receptacle
			Domestic Requirements			
990A13 chassis (CPU or expansion)	120 Vac	60 Hz	8.3 A	—	From system enclosure	
MT1600 tape transport	120 Vac	60 Hz	3.6 A	—	From system enclosure	
Dual FD800 or FD1000 disk drives	120 Vac	60 Hz	1.1 A	1.9 A for 2 sec	From system enclosure	
CD1400 disk drive	120 Vac	60 Hz	8.2 A	17 A for 10 sec	From system enclosure	
WD500 disk drive	120 Vac	60 Hz	2.2 A	40[2] A for 10 ms	From system enclosure	
WD800 disk drive	120 Vac	60 Hz	3.0 A	9 A for 3 sec	From system enclosure	
911 VDT	120 Vac	60 Hz	1.0 A	—	Shared	NEMA 5-15R[3]
940 EVT	100 Vac	60 Hz	1.0 A	—	Shared	NEMA 5-15R[3]
810 printer	120 Vac	60 Hz	1.70 A	—	Shared	NEMA 5-15R[3]
840 RO printer	120 Vac	60 Hz	1.0 A	—	Shared	NEMA 5-15R[3]
LQ45 printer	120 Vac	60 Hz	3.5 A	—	Shared	NEMA 5-15R[3]

Notes:

[1] Shared indicates that the branch circuit (circuit breaker) for the device may be shared with other elements of the system within the limits of the power service provided.

[2] Peak amperes.

[3] Isolated ground type receptacles are recommended, such as Hubbell IG 5362 or equivalent for NEMA 5-15R.

Table 3. Electrical Requirements for Business System Equipment That May Share Circuit Breakers (Continued)

Unit	Voltage (±10%)	Frequency (±0.5 Hz)	Running Current	Start Current and Duration	Power Service[1]	Wall Receptacle
			International Requirements			
990A13 chassis (CPU or expansion)	100 Vac	50 Hz	10.0 A	100[2] A for 10 ms	From system enclosure	
	100 Vac	60 Hz	10.0 A	100[2] A for 10 ms	From system enclosure	
	220 Vac	50 Hz	4.5 A	80[2] A for 10 ms	From system enclosure	
	240 Vac	50 Hz	4.1 A	80[2] A for 10 ms	From system enclosure	
MT1600 tape transport	100 Vac	50 Hz	3.6 A	40[2] A for 10 ms	From system enclosure	
	100 Vac	60 Hz	3.6 A	40[2] A for 10 ms	From system enclosure	
	220 Vac	50 Hz	1.5 A	20[2] A for 10 ms	From system enclosure	
	240 Vac	50 Hz	1.5 A	18[2] A for 10 ms	From system enclosure	
Dual FD800 or FD1000 disk drives	100 Vac	50 Hz	1.4 A	2.2 A for 2 sec	From system enclosure	
	100 Vac	60 Hz	1.4 A	2.2 A for 2 sec	From system enclosure	
	220 Vac	50 Hz	0.9 A	1.5 A for 2 sec	From system enclosure	
	240 Vac	50 Hz	0.9 A	1.5 A for 2 sec	From system enclosure	
CD1400 disk drive	100 Vac	50 Hz	8.2 A	17 A for 10 sec	From system enclosure	
	100 Vac	60 Hz	8.2 A	17 A for 10 sec	From system enclosure	
	220 Vac	50 Hz	4.0 A	8.5 A for 10 sec	From system enclosure	
	240 Vac	50 Hz	4.0 A	8.5 A for 10 sec	From system enclosure	
WD500 disk drive	100 Vac	50 Hz	3.0 A	40[2] A for 10 ms	From system enclosure	
	100 Vac	60 Hz	3.0 A	40[2] A for 10 ms	From system enclosure	
	220 Vac	50 Hz	1.4 A	25[2] A for 10 ms	From system enclosure	
	240 Vac	50 Hz	1.3 A	25[2] A for 10 ms	From system enclosure	
WD800 disk drive	100 Vac	50 Hz	3.0 A	9 A for 3 sec	From system enclosure	
	100 Vac	60 Hz	3.0 A	9 A for 3 sec	From system enclosure	
	220 Vac	50 Hz	1.5 A	4.5 A for 3 sec	From system enclosure	
	240 Vac	50 Hz	1.5 A	4.5 A for 3 sec	From system enclosure	

Notes:

[1] Shared indicates that the branch circuit (circuit breaker) for the device may be shared with other elements of the system within the limits of the power service provided.

[2] Peak amperes.

Table 3. Electrical Requirements for Business System Equipment That May Share Circuit Breakers (Continued)

Unit	Voltage (±10%)	Frequency (±0.5 Hz)	Running Current	Start Current and Duration	Power Service[1]	Wall Receptacle
			International Requirements			
911 CRT	100 Vac	50 Hz	1.0 A	—	Shared	NEMA 5-15R[3]
	100 Vac	60 Hz	1.0 A	—	Shared	NEMA 5-15R[3]
	220 Vac	50 Hz	0.5 A	—	Shared	CEE 7-7
	240 Vac	50 Hz	0.5 A	—	Shared	BSI 1363
940 EVT	100 Vac	50 Hz	1.0 A	—	Shared	NEMA 5-15R[3]
	100 Vac	60 Hz	1.0 A	—	Shared	NEMA 5-15R[3]
	220 Vac	50 Hz	0.5 A	—	Shared	CEE (7) VII
	240 Vac	50 Hz	0.5 A	—	Shared	BSI 1363
810	100 Vac	50 Hz	2.0 A	—	Shared	NEMA 5-15R[3]
printer	100 Vac	60 Hz	2.0 A	—	Shared	NEMA 5-15R[3]
	120 Vac	60 Hz	1.7 A	—	Shared	NEMA 5-15R[3]
	220 Vac	50 Hz	0.9 A	—	Shared	CEE 7-7
	240 Vac	50 Hz	0.8 A	—	Shared	BSI 1363
840 RO	100 Vac	50 Hz	1.0 A	—	Shared	NEMA 5-15R[3]
Printer	100 Vac	60 Hz	1.0 A	—	Shared	NEMA 5-15R[3]
	220 Vac	50 Hz	0.5 A	—	Shared	CEE 7-7
	240 Vac	50 Hz	0.5 A	—	Shared	BSI 1363
LQ 45	100 Vac	50 Hz	3.5 A	—	Shared	NEMA 5-15R[3]
printer	100 Vac	60 Hz	3.5 A	—	Shared	NEMA 5-15R[3]
	220 Vac	50 Hz	2.0 A	—	Shared	CEE 7-7
	240 Vac	50 Hz	2.0 A	—	Shared	BSI 1363

Notes:

[1] Shared indicates that the branch circuit (circuit breaker) for the device may be shared with other elements of the system within the limits of the power service provided.

[3] Isolated ground type receptacles are recommended, such as Hubbell IG 5362 or equivalent for NEMA 5-15R.

POWER SOURCE CONSIDERATIONS

The following paragraphs contain information that may be helpful in deciding whether it is necessary to condition the power for your computer installation.

Sources of Power Problems

There are four basic sources of power problems for computer systems. They include the time of the year, the utility company's power distribution system, lightning, and grounding. The brief discussion of these factors presented here can be used as a guide to evaluating the quality of power in your locality.

Time of the Year. Seasonal changes influence power usage and power availability. Increased use of air conditioning during the summer months creates a large power drain and taxes the reserves of electric utility companies in many areas. Brownouts and low voltage are common problems in the summer months, especially July and August.

Figure 19 is a graph showing the frequency of power problems relative to the time of the year.

Power Distribution Systems. The power distribution system presents another potential source of power problems. Power delivered to the computer system via overhead lines can be affected by construction accidents, ice storms, wind damage, lightning, and other physical disturbances. Underground power distribution systems are far more reliable but are not as common as overhead systems.

Lightning. In areas of the country subject to numerous thunderstorms, lightning causes considerable damage to electrical equipment. A lightning storm emits pulses of electrical energy that are coupled or induced into power distribution lines, affecting electrical equipment operating in plants miles away from the storm. The annual thunderstorm frequency map (Figure 20) shows the average number of thunderstorms occuring in each geographical area per year.

Grounding. Problems in computer power sources are frequently caused by improper grounding. A single-point ground is essential for minimizing logic and software problems caused by ground currents circulating in multiple paths (ground loops).

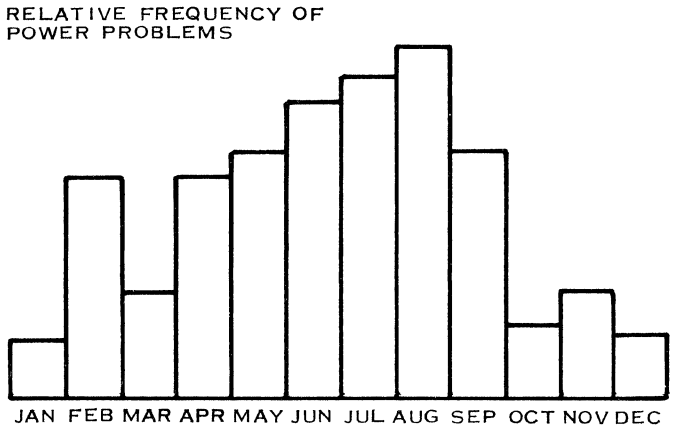

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Figure 19. Frequency of Power Problems Relative to Time of Year

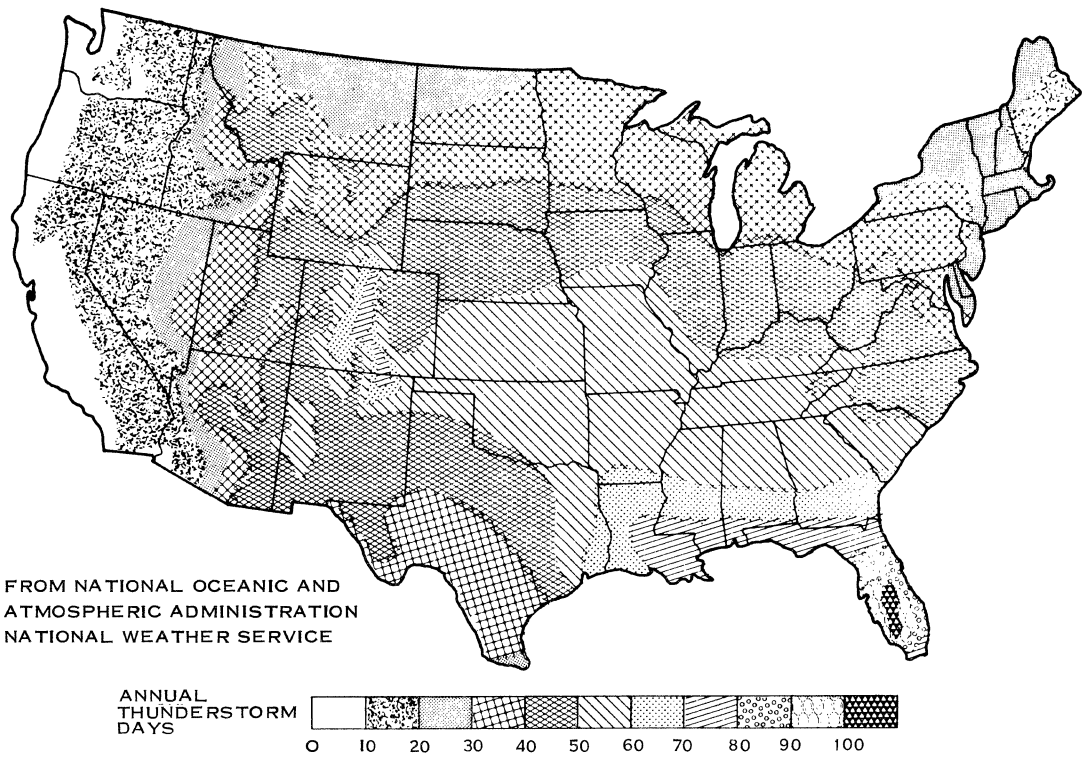

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Figure 20. Annual Thunderstorm Frequency Map

SOLUTIONS TO POWER PROBLEMS

The following paragraphs provide suggested solutions to the power problems discussed in the preceding paragraphs.

Power Conditioning Equipment

In areas where power line fluctuations, noise, or interrupted power service cause problems, power line conditioning equipment is necessary. Power line conditioning equipment includes isolation transformers, line regulators, line conditioners, uninterruptible power supplies, and backup generating systems. These items protect the computer system from power line disturbances in the following ways:

- Isolation transformer — A basic isolation transformer reduces power line noise but cannot provide voltage regulation or waveform conditioning. A super isolation transformer provides better isolation than the standard isolation transformer due to the way it is constructed. Isolation transformers minimize disturbances that are capacitively coupled between the primary and secondary of the transformer. They do not provide regulation or correction of disturbances that can be magnetically coupled between the primary and secondary of the transformer.

- Power line regulator — Used to regulate voltage where the source power is not regulated within ± 10 % of nominal voltage. It does not provide protection from spikes or transients on the power line.

- Power line conditioner — Combines the voltage regulating quality of a line regulator and the isolation capability of an isolation transformer. Solves many power disturbances by regulating and isolating source power. It cannot correct for line voltage dropouts or severe waveform distortion. There are several types of line conditioners. The two most common are the electronic tap-switching type and the static voltage ferro-resonant type.

- Uninterruptible power supply — Converts the incoming ac power to dc and then back to ac, thus eliminating most of the noise and spikes on the incoming power. It switches to backup battery power in the event of source power dropout without interrupting power to the computer system, thus providing protection against most power line disturbances. The length of time that the unit will supply backup power depends upon the storage capacity of the associated batteries.

- Uninterruptible power supply with gasoline or diesel generator — Provides uninterrupted backup power in the event of power outage. This equipment is generally used only where the system must operate at all times regardless of cost.

Table 4 is a comparison of the suggested methods of power line conditioning. It lists the probable effects of power problems on computer system with different types of power line conditioning.

Table 4. Power Line Conditioning Device Comparison

Type Of Electrical Problem	No Line Conditioning	Line Conditioners: Voltage Regulator	Super Isolation Transformer	Electronic Tap Changer With Super Isolation Transformer	Static Voltage Ferro-Resonant Type Unit	Uninterruptible Power Supply (UPS)	UPS With Gas Or Diesel Generator
Spikes or Transients caused by utility company switching circuits, power factor corrections, etc.	Equipt Malfunction, Possible Damage	Equipt Malfunction, Possible Damage	No Effect	No Effect	No Effect	No Effect	No Effect
Transients from motors, power tools, heavy load power up/down cycles	Possible Equipt Malfunction	Possible Equipt Malfunction	No Effect	No Effect	No Effect	No Effect	No Effect
Transients caused by lightning	Equipt Malfunction, Possible Damage	Equipt Malfunction, Possible Damage	Possible Equipt Malfunction	Possible Equipt Malfunction	No Effect	No Effect	No Effect
Voltage Variations	Possible Equipt Malfunction	No Effect	Possible Equipt Malfunction	No Effect	No Effect	No Effect	No Effect
Low Voltage (Brownouts)	Equipt Manfunction Possible Damage	No Effect	Equipt Malfunction, Possible Damage	No Effect	No Effect	No Effect	No Effect
Power Outages							
• Less than 10 ms	System Inoperative	System Inoperative	System Inoperative	System Inoperative	No Effect	No Effect	No Effect
• Greater than 10 ms	System Inoperative	System Inoperative	System Inoperative	System Inoperative	System Inoperative	Depends Upon Capacity of Batteries	No Effect
Cost of device Relative to cost of UPS with gas/diesel generator	0%	5-10%	5-10%	20-30%	15-25%	85%	100%
Percent of problems prevented (estimated)	0%	5-15%	30-50%	60-80%	60-80%	85-95%	90-100%

Space Requirements

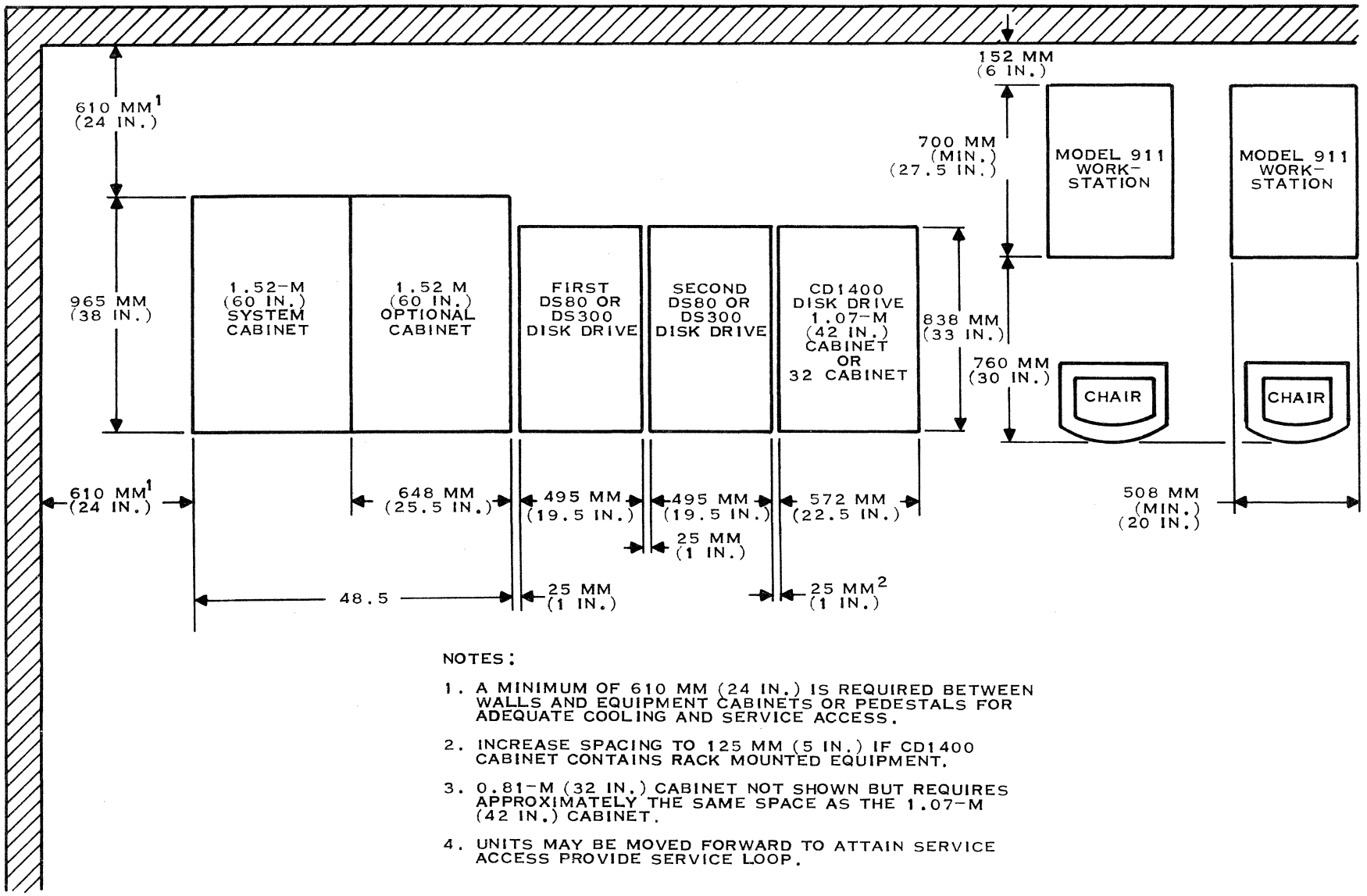
This section contains equipment dimensions and cable lengths for use in planning your system. Placement of various components depends on airflow requirements, the size of the equipment, and on the lengths of the power and data cables. A minimum of 610 millimeters (24 inches) of unobstructed space is required above the 1.52-meter (60-inch) cabinet to allow the exhaust fan to adequately cool the cabinet. Equipment cabinet tops must not be used as shelves.

EQUIPMENT DIMENSIONS

Figures 21 and 22 show the minimum clearances and maintenance area required by the larger equipment. Table 5 lists the physical dimensions of the system components. Table 6 lists the length of interconnecting cables and power cords. Tables 5 and 6 are located at the back of this section.

In planning the layout, consider the workflow in your computer area and make sure work stations are out of traffic patterns. Arrange the components of your system to allow for optimum working convenience with the least possible movement between devices. Include convenient storage space for necessary system supplies (listed in the System Supplies section of this document). Consider physical security and fire protection when planning storage and service accessibility.

If your system includes options requiring the use of two 1.52-meter (60-inch) cabinets, TI recommends removing the covers and hinges from the right side of the primary cabinet and from the left side of the secondary cabinet and bolt the two cabinets together at the top and bottom through the predrilled holes in the cabinet frames. Joining the cabinets together improves the stability of cabinets with the MT1600 tape transport installed. If the second cabinet houses an expansion chassis, run the TILINE coupler and expansion chassis cables directly through the side opening between the cabinets for easy maintenance access. With two cabinets bolted together, the resulting cabinet assembly is cooled by two exhaust fans, providing built-in cooling backup.



NOTES:

1. A MINIMUM OF 610 MM (24 IN.) IS REQUIRED BETWEEN WALLS AND EQUIPMENT CABINETS OR PEDESTALS FOR ADEQUATE COOLING AND SERVICE ACCESS.
2. INCREASE SPACING TO 125 MM (5 IN.) IF CD1400 CABINET CONTAINS RACK MOUNTED EQUIPMENT.
3. 0.81-M (32 IN.) CABINET NOT SHOWN BUT REQUIRES APPROXIMATELY THE SAME SPACE AS THE 1.07-M (42 IN.) CABINET.
4. UNITS MAY BE MOVED FORWARD TO ATTAIN SERVICE ACCESS PROVIDE SERVICE LOOP.

Figure 21. Business Systems Space Requirements

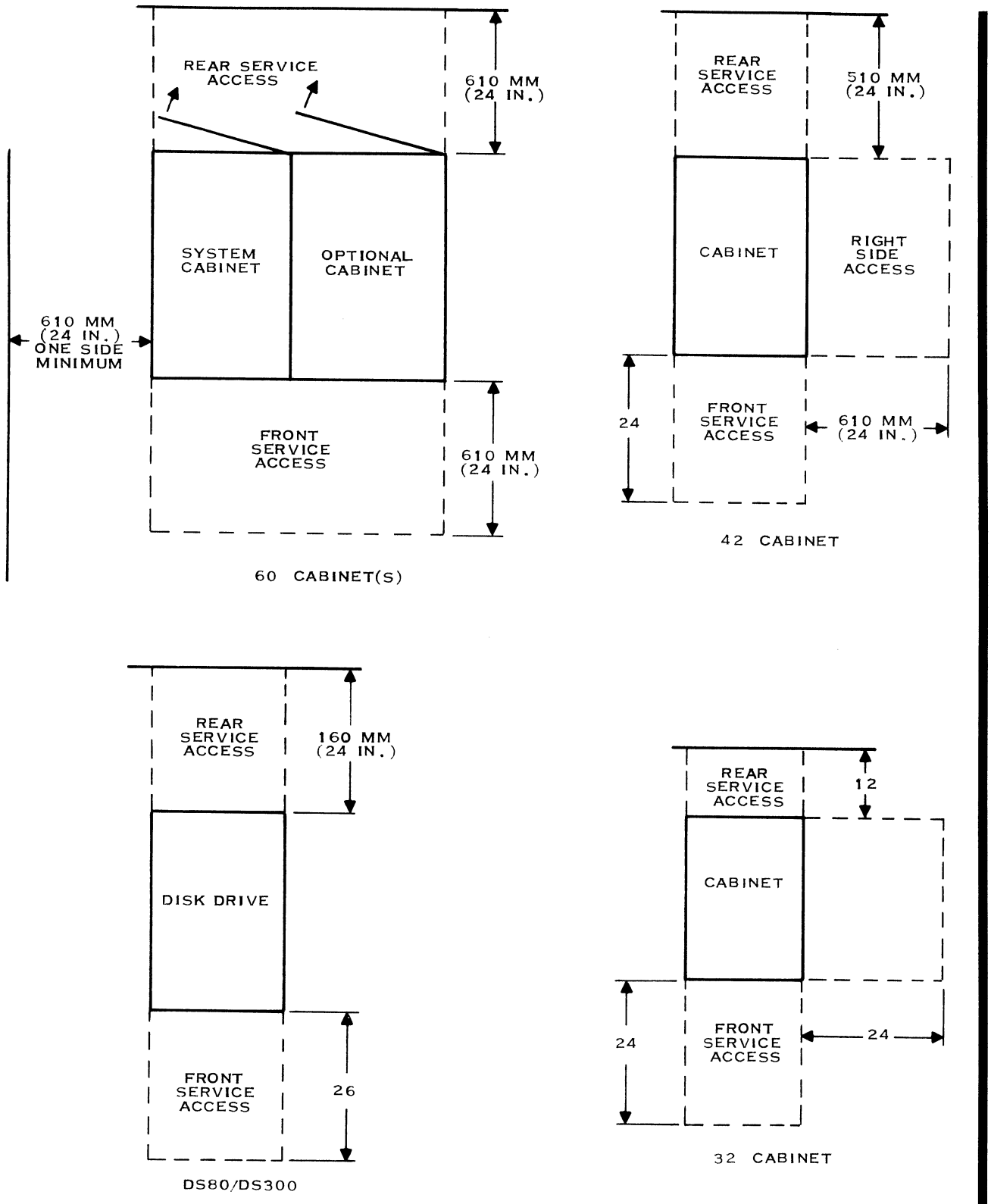


Figure 22. Business Systems Service Access Requirements

SYSTEM CABLES

If your purchase agreement with TI includes installation of your system, TI will route and connect all standard cabling as a part of the installation process. Optional extension cables and cables passing through walls, ceilings, or conduit must be installed by the customer. All user-fabricated cables should be clearly marked on both ends to facilitate installation. A service loop of approximately 1.8 meters (6 feet) at each end of each cable is recommended to allow for easy installation and removal.

Personnel and equipment safety require that cables not lie in pedestrian paths. The ideal solution for large computer systems is raised computer flooring with all cabling underneath a false floor. This system provides maximum flexibility in placing equipment and reduces the hazard of tripping on cables. The false floor consists of rugged, removable tiles that are supported by a metal framework permanently mounted to the subfloor or foundation. Holes are cut into the tiles to route the cables under the false floor. Computer flooring represents a significant investment in cost and labor for installation. Do not install it if the computer location is not considered permanent.

Using suspended cable trays is an alternate solution to the problem of keeping cables out of the way. Plastic cable trays, if allowed by local building and fire codes, are lightweight and easy to install. Cable drops from the trays need support and must allow room for the cabinet door to swing open freely. If the equipment is to be placed adjacent to a wall, a cable trough (Figure 23) can be mounted along the wall near the floor. For installations not involving bulky cables or large numbers of cables, use cable ties, tape, or lacing to suspend cables from existing pipes or supports.

If there is no solution to a cabling problem other than running a cable across the floor, use cable ramps (Figure 24) to guard the cables and to reduce the hazard of tripping.

CAUTION

Do not attempt to roll a flat cable into a cylinder to fit into a cable ramp. Use a ramp especially designed for flat cables or find another solution to the cable routing problem.

Lightning Protection for Signal Cables

If the signal cables associated with your computer system must be routed outside buildings, TI recommends that they be protected from lightning as described in the following paragraphs.

Signal cables routed between buildings should be buried at least three feet underground in PVC conduit for environmental protection. While installing the cables in the conduit, route a 12 AWG insulated conductor along with them and ground it at both ends.

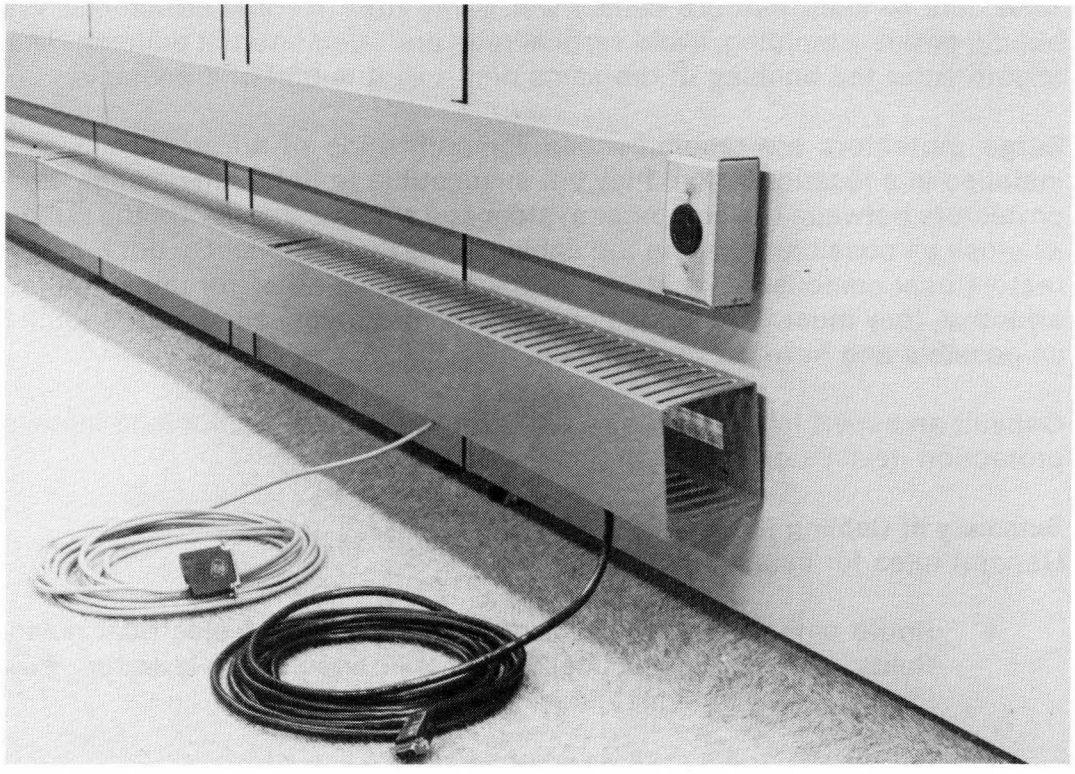


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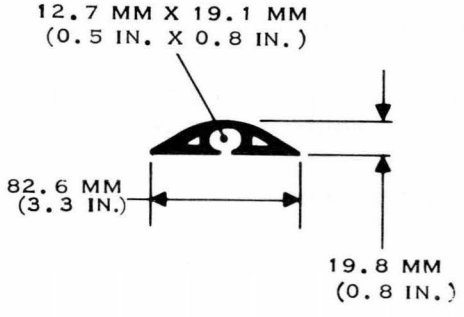
Figure 23. Example of Cable Trough



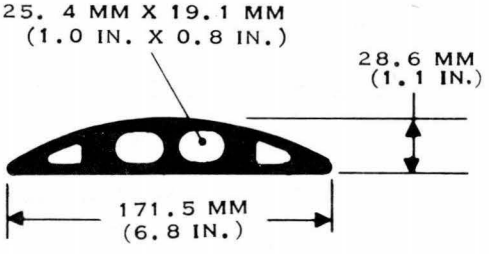


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Figure 24. Examples of Cable Ramps

Take care to keep outdoor cables well away from vertical structures. When the cable bundle enters a building, avoid vertical runs until well into the building. The cable bundle should enter the building at the same depth as it is buried if possible.

Surge protectors are recommended for both ends of all signal cables that must be installed in a location where they are susceptible to lightning damage. Locate the surge protectors between the computer system and where cables enter the building, preferably as close as possible to where the cables enter the building. Do not locate the surge protectors near combustible material or in a hazardous area. For the surge protectors to be effective, they must have a good ground. The grounding conductor should be as straight as possible and have no sharp bends.

Consult an expert in the field of storm protection for selection and installation of surge protection devices on your system.

Summary of Cabling Rules
General rules for cabling include:

- Route signal cables well away from sources of electrical noise or induction fields; keep ac power lines and signal lines well separated. Power lines may induce errors in signal lines.
- Do not route the cables in elevator shafts.
- Do not route cables outside buildings unless the lightning protection guidelines in the preceding paragraphs are followed.
- Keep the signal cables together with sleeving, tape, or ties.
- Keep the cables off the floor. They are a hazard to personnel and may be damaged by cleaning solvents or foot traffic.
- Avoid flexing the cables excessively.
- Avoid bending the cables in tight loops.
- Make maximum use of existing support structures.
- Support the cable at short intervals.
- Dress the cables and tie them away from door closures that could pinch or cut them.
- Provide a protective bushing wherever the cable must pass through a cutout in metal, such as an entry/exit hole in a false floor tile.

Table 5. Business Systems Equipment Physical Dimensions

Component	Height mm (in.)	Width mm (in.)	Depth mm (in.)
1.52-m (60-in.) cabinet	1524 (60)	648 (25.5)	965 (38)
1.07-m (42-in.) cabinet	1067 (42)	648 (25.5)	820 (32.3)
0.81-m (32-in.) cabinet	826 (32.5)	572 (22.5)	826 (32.5)
MT1600 tape transport	610 (24)	483 (19)	330 (13)
911 VDT	345 (13.6)	508 (20)	699 (27.5)
940 EVT	378 (14.9)	457 (18)	406 (16)
810 printer[1,2]	203 (8)	655 (25.8)	838 (33)
840 RO printer[1,2]	175 (6.9)	577 (22.7)	724 (28.5)
LQ45 printer[3]	267 (10.5)	597 (23.5)	274 (10.8)
LP300/LP600 printer with pedestal[4]	1059 (41.7)	762 (30.0)	787 (31.0)
DS80, DS300 disk drives	864 (34)	495 (19.5)	838 (33)
WD500 disk drive	178 (7)	483 (19)	686 (27)
WD800 disk drive	216 (8.5)	483 (19)	686 (27)
FD1000 disk drive	178 (7)	483 (19)	635 (25)

Notes:

[1] The 840 RO and 810 printers require stands. TI-supplied stands are recommended for both printers.

[2] Depth dimensions for the printers include the length of the paper catch tray that extends from the back of the printer when installed.

[3] The LQ45 printer may be placed on any TI-supplied or customer-supplied table. Include dimensions of mounting table/stand in system layout plan.

[4] Depth dimensions include paper catcher; dimension varies depending upon placement of paper catcher.

Table 6. System Equipment Cable Lengths

Component	Input/Output Cable*	Power Cable
1.52-m (60-in.) cabinet		3.7 m (12 ft)
1.07-m (42-in.) cabinet		3.7 m (12 ft)
0.81-m (32-in.) cabinet		3.0 m (9 ft)
911 VDT	5 m (16.4 ft) Optional-up to 610 m (2,000 ft)	2.1 m (7 ft)
940 EVT	9.2 m (30 ft) EIA Cable 1.8 m (6 ft) Optional-up to 15 m (50 ft)	1.8 m (6 ft)
840 RO printer	9.1 m (30 ft)	2.0 m (6.5 ft)
810 printer	9.1 m (30 ft) Optional — up to 305 m (1000 ft)	2.1 m (7 ft)
MT 1600 tape transport	Controller to first drive 2.0 m (6.6 ft) 3.0 m (9.8 ft) 6.0 m (19.7 ft) Drive-to-drive (daisy chain) 2.0 m (6.6 ft) 3.0 m (9.8 ft) 6.0 m (19.7 ft)	2.3 m (7.5 ft)
CD1400 disk drive	6.1 m (20 ft)	3.7 m (12 ft)
DS80/300 disk drive	Controller to first drive-6 m (19.7 ft) Drive-to-drive (daisy chain) 3 m (9.8 ft)	2.7 m (9 ft)
WD500/WD 800 disk drive	Controller to first drive-2 m Drive-to-drive (daisy chain)-5 m	2.3 m (7.5 ft)
FD1000 disk drive	5 m (16 ft) Optional — 91.4 m (300 ft)	3 m (10 ft)
LP300/LP600 printer	9.1 m (30 ft)	3 m (10 ft)
LQ45 printer	9.1 m (30 ft)	2.4 m (8 ft)

Note:

* Allow 1.5 m (5 ft) of cable inside the equipment cabinet, from the controller to the cabinet exit.

Environmental Requirements

Your computer system will work well in an ordinary air-conditioned office environment since the system components have their own air circulation fans. The ideal ambient temperature for the system is 22 degrees C (72 degrees F), with 50 percent relative humidity. System specifications allow operation over a wider range of temperature and humidity, but reliability and system lifetime are greatly enhanced by keeping the computer ambient temperature near the ideal operating point.

Recommended Operating Environment

Temperature: 21-23° C (70-74° F)
Relative Humidity: 45-55%

NOTE

Operating the Business Systems in a marginal environment will reduce reliability and result in system downtime.

Heating/Cooling Recommendations

Drastic changes in the temperature affect operation of your system. Do not expose your computer system to temperature changes greater than 10° C per hour (18° F per hour). The relative humidity also affects the computer operations if the atmosphere becomes overly dry or damp. Refer to Table 7 for maximum temperature and noncondensing humidity tolerances of the system equipment.

Verify that the added heat dissipation from your system configuration can be handled by the air-conditioning system in the selected site, and that there is sufficient air flow in the computer area. If the system is enclosed in a small room without adequate local airflow, the ambient temperature will become excessive regardless of the overall cooling capability of the facility. Cooling calculations must include allowance for heat-loading due to personnel, lighting, and windows as described in standard air-conditioning or mechanical engineering handbooks. Refer to Table 8 for equipment heat dissipation rates.

Table 7. Business Systems Maximum Environmental Specifications

Equipment	Operating Temperature Range	Humidity[1]	Altitude
Business System equipment (not including remote equipment	16 - 32° C[2] (16 - 90° F)	30 - 80%	0 - 3,048m (10,000 ft)
WD800 System 671/672/872	↕	↕	0 - 3,000m (9,840 ft)
WD500 System 651			0 - 3,600m (11,808 ft)
CD1400[3] System 660/661/861			– 300 - 1,928m (6,500 ft)
DS80 System 680/681/880/882			–305 - 2,134m (7,000 ft)
DS300 System 884/886			–305 - 2,134m (7,000 ft)
MT1600 System 682/882/886	16 - 32° C[2] (60 - 90° F)	30 - 80%	–0 - 3,040m (10,000 ft)
Remote equipment (not in same room as system)			
911 VDT	0 - 40° C (32 - 104° F)	5 - 95°	0 - 3,040m (10,000 ft[3])
940 EVT	5 - 40° C (41 - 104° F)	10 - 90°	↕
840 RO printer	5 - 40° C (41 - 104° F)	5 - 90°	
810 printer	5 - 40° C (41 - 104° F)	5 - 90°	
LP300/600 printer	10 - 38° C (50 - 100° F)	5 - 90°	0 - 3,040m (10,000 ft[3])

Notes:

[1] Noncondensing. See static electricity suppression later in this section.

[2] Maximum rate of change is 10° C per hour (18° F per hour).

[3] A conversion kit is available through your TI field service office to make your CD1400 disk drive operational up to 3,040m (10,000 ft).

Table 8. Business System Heat Dissipation Rates

System/Component	Heat Dissipation (Btu/hr)
Model S651	2524*
Models S660/S661/S861	5060*
Models S671/S672/S872	3889*
Models S680/S880/S884	1842*
Models S682/S882/S886	2866*
DS80 disk drive	2283
DS300 disk drive	3500
WD500 disk drive	682
WD800 disk drive	2047
FD1000 disk drive	546
CD1400 disk drive	3218
13-slot expansion chassis	1842
911 VDT	393
940 EVT	819
810 printer	683
840 RO printer	340
LQ45 printer	1433
LP300 printer	3072
LP600 printer	3072
MT1600 tape transport	1023

Note:

* Includes only the equipment mounted in the system cabinet.

Sample Heat Dissipation Calculation

The following sample calculation gives the total Btu per hour heat dissipation rate for a typical Business System model. Refer to Table 8 for the heat dissipation rates of each system component.

Sample Btu Calculation, Model S672

Qty	Device	Btu per Hour
1	Model S672 cabinet with 13-slot chassis and WD800 disk drive	3889
1	Model 911 VDT	393
		Total 4282

Pay special attention to the location and number of cooling/heating vents in your computer room to ensure an even temperature distribution. Avoid creating hot spots by grouping too much equipment too far away from the cooling vent(s). The rate of temperature change for the computer equipment must not exceed 10 degrees C per hour (18 degrees F per hour); avoid placing computer equipment in the direct path of a cooling/heating vent constantly cycling on and off. Large windows in the computer room should be avoided since they can complicate the heating/cooling problem. Sunlight shining through a window can overload your air-conditioning system and cause hot spots exceeding the specified temperature limits.

If the computer equipment is to be placed in a large open space, consider a separate and independent temperature control (thermostat) for the computer system. By using floor-to-ceiling room partitions and separate thermostats, the air-conditioning design can be simplified and the capacity requirements reduced.

Air Flow Considerations

When planning your system layout, ensure that the air intake and exhaust outlets on the computer equipment are not restricted or blocked. Air intakes are generally in the front or rear of the equipment, with exhaust outlets in the rear or on top of the equipment. A minimum clearance of 610 millimeters (24 inches) is required for each intake and outlet.

Static Electricity Suppression

Low relative humidity causes static charges to form that can cause paper-handling problems in high-speed printers and electrical noise problems in rotating machinery, such as disk drives. Static charges attract dust particles from the air and can cause faulty system operation.

Static charges generated by walking across the floor can cause problems ranging from electronic equipment malfunctions to complete system shutdown. The degree of static buildup depends on shoe sole material, the type of floor covering, and the relative humidity. When the relative humidity is maintained at 50% or higher, static electricity causes few problems.

If it is not practical to regulate humidity and restrict shoe sole material, the most effective way to control static electricity is by the selection of flooring in the computer room. Tile, wood, or sealed concrete floors are all acceptable. Carpet can be used if it is treated with static suppression spray, covered with anti-static mats, or if it is made of material that does not promote static charge buildup. Ease of cleaning is also an important consideration in selecting flooring material.

NOTE

Because of intense vibrations, the stability of the high-speed disk drives (DS80/300) is impaired when the units are mounted on thick carpet or mats. Where thick covering is used on computer room floors, mount the feet of the disk drive on solid blocks or in holes cut through the covering to solid flooring.

Equipment problems can occur without the operator being aware of a static problem. The average human's threshold of sensitivity to static charge is approximately 3.5 kilovolts while electronic equipment can begin to malfunction at lower levels. In a low relative humidity environment, static charges in excess of 10 kilovolts are possible, greatly increasing the likelihood of equipment reliability problems.

Static electricity problems are minimized by selecting proper flooring, avoiding plastic furniture, using chairs with metal casters, and maintaining the relative humidity at approximately 50%. Proper grounding of the equipment, as described in the Power Requirements section also helps reduce static electricity problems.

Computer Room Cleanliness

The reliability of your system, especially mass memory devices such as disk drives and tape transports, is directly proportional to the cleanliness of the environment in which the equipment is operated. The information and recommendations contained in the following paragraphs are vital to the successful operation of your system after installation is completed.

CAUTION

Supporting concrete floors must be sealed before use with your Business System. Concrete dust is extremely harmful to disk drives; sealing the floor will eliminate the problem.

The importance of a noncorrosive, dust-free atmosphere and a clean computer area cannot be overemphasized. In a high-speed disk drive such as the DS80 or DS300, read/write heads fly above disk surfaces that are moving at relative speeds up to 241 kilometers per hour (150 miles per hour). The gap between the head and the surfaces is approximately 2.54 microns (100 microinches), less than half the diameter of a single cigarette smoke particle. Collisions (crashes) between heads and fingerprint smudges, human hairs, ordinary dust particles, or paper-dust particles can be catastrophic. The relative sizes of the head-to-disk gap and the most common contaminants are shown in Figure 25.

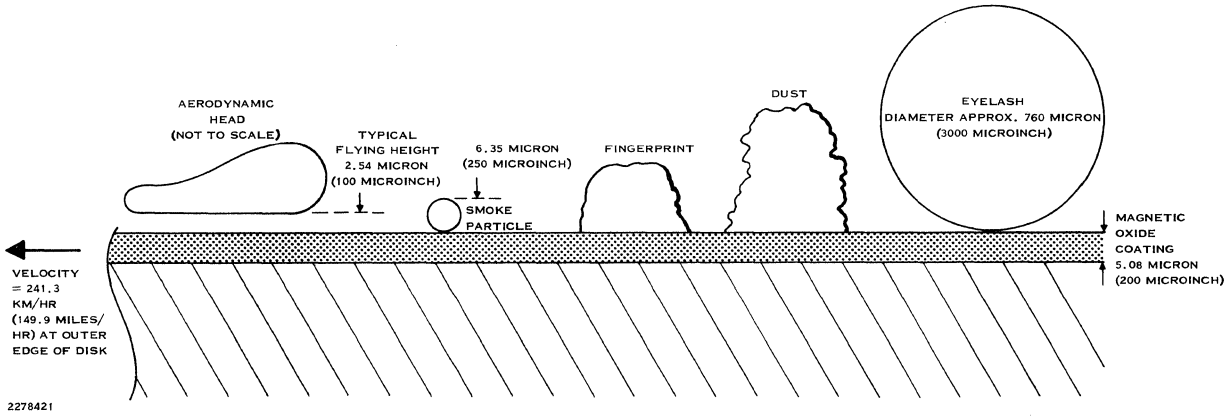

Figure 25. Disk Contamination

Disk drives include sophisticated filtration systems to prevent crashes from contaminants. Dust in the environment inevitably forces filtration systems to work harder and requires more frequent cleaning or replacing, resulting in increased maintenance costs. Operating with a clogged filter can cause air starvation that can also cause head crashes.

Dust accelerates wear on tape drives and flexible disk drives, as well as on the tapes and diskettes used in them. Providing a clean environment increases system reliability, reduces maintenance cost, and prevents the loss of data. Maintaining an adequate dust filtration system is required for the computer area air-conditioning equipment.

Ban food and drink in the computer area; they present an unnecessary hazard to the equipment. Consider banning smoking in the computer area, especially in the vicinity of the disk and tape drives. Due to large amounts of paper, smoking also represents a fire hazard in the vicinity of the printers. If the terminals are located in an area separate from the computer and the printers, smoking at the terminals does not represent an unusual hazard.

Storage Facilities and Fire Considerations

You will need a storage facility to protect disks and diskettes from electromagnetic radiations, fire, dust, and humidity. The cabinet or safe used should be approved for such storage by an applicable agency such as Underwriters Laboratory (UL). When planning storage space for disk packs, remember that disk packs cannot be stacked. Store all flammable materials, especially printer paper and ribbons and memory storage media, in a fire-protected area, if a storage vault or cabinet is not provided.

In designing a fire protection system for the computer room and storage area, consult building, fire, and safety codes your system must meet on corporate, local, state, and national levels. Some jurisdictions are legally empowered to immediately shut down a noncomplying system and to keep that system down until the site is in compliance. The following discussion assumes adherence to all necessary standards.

The fire protection system can include smoke detectors, manual extinguishers, automatic systems, and warning devices. Automatic systems should provide at least a 10-second audible warning before they activate. In choosing fire protection options, carefully evaluate the cost of the protection system against the possible loss due to a fire. In addition to the physical equipment and facility, consider the value of the tape and disk records. Consult with your insurance company; the cost of protection may be offset by reductions in your insurance rates.

After designing your system, ensure that it is installed properly. It is imperative that all personnel working in the area, including security people, know the locations, indications, and operation of all fire safety equipment. Prominently display all operating instructions.

Additional information for U.S. installations is found in the National Fire Protection Association publications entitled *National Electrical Code (NFPA 70)* and *Standard for the Protection of Electronic Computer/Data Processing Equipment (NFPA 75).* Chapter five of the second publication lists specific requirements and products that satisfy them.

Communication Requirements

A variety of communications equipment can be added to your Business System to allow communications (two-way data transfers) between the system and remote terminals or computers. Refer to the *990 Family Communication Systems Field Reference Manual,* part number 2276579-9701 for information on compatible Texas Instruments communication hardware and software.

The referenced manual describes hardware and software components of a communication system and how to configure the components into a communication system that will meet your needs. It also describes the options that must be ordered on Bell equipment for compatibility with your Business System if you choose to lease instead of buy your communication equipment.

System Supplies

A variety of accessories and supplies support the operation of your Business System. The following table lists the accessories and supplies available for your system equipment.

Table 9. System Accessories and Supplies

Component	Accessory	Part Number
DS80 disk drive	Disk pack[2]	2308475-0001
DS300 disk drive	Disk pack[2]	2308505-0001
WD500 disk drive	DSDD diskette[1]	2261687-0001
WD800 disk drive	Tape cartridge[1]	2270391-0001
FD1000 flexible disk drive	DSDD diskette[1]	2261687-0001
CD1400 disk drive	Disk cartridge[2]	2269866-0001
MT1600 tape transport	Tape[1] 12.7-mm (0.5-in.) wide 266.7-mm (10.5-in.) diameter	966799-0001

Notes:

[1] All media must meet Texas Instruments specifications if not purchased from Texas Instruments. The recording surfaces for disk packs must be error-free or have an error map label attached to the cover. If an error map label is attached, it should contain the manufacturer's name, the part number and serial number for the disk pack, and the addresses of all bad tracks. Error-free disk packs are recommended; some disk copy operations require error-free disk packs.

[2] All media must meet Texas Instruments specifications if not purchased from Texas Instruments. The disk cartridge must have an error map label attached to the cover. The label should contain the manufacturer's name, the part number and serial number of the disk cartridge, and the address of all bad tracks.

Table 9. System Accessories and Supplies (Continued)

Component	Accessory	Part Number
840 RO printer	Terminal mounting stand	2215540-0001
	Paper basket	
	Table mounted	2215542-0001
	Terminal mounted	2215543-0001
	Ribbon cartridge, standard	2215537-0001
	Ribbon cartridge, reinking	2215538-0001
	Tractor paper drive	2215539-0001
	Friction roller paper drive	2215572-0001
	Paper roll holder	2215541-0001
	Paper should meet the following specifications:[3] continuous form paper with standard perforations on each edge adjustable to widths from 76 to 378 mm (3 to 14.9 in.) Single-part forms 6.8 kg (15 lb) Multiple copies 5.4 kg (12 lb) Cardstock 0.2544 mm (0.1 in.) Cardstock not to exceed 0.533 mm (0.021 in.)	
810 printer	Stand without paper basket	994423-0001
	Stand with paper basket	994400-0001
	Ribbon	
	13 mm x 36.6 m (0.5 in. x 120 ft)	996241-0002
	Paper should meet the following specifications:[3] continuous form paper with standard perforations on each edge adjustable to widths from 76 to 378 mm (3 to 14.9 in.) Single-part forms 6.8 to 9 kg (15 to 20 lb) Multiple-part forms original 5.4 to 6.8 kg (12 to 15 lb) Copies 4.1 to 5.4 kg (9 to 12 lb) Last copy 6.8 kg (15 lb) Card stock up to 0.1778 mm (.007 in.) Total form thickness not to exceed 0.533 mm (.021 in.)	
LP300/LP600 printer	Continuous form paper with standard perforations on each edge. Paper widths from 101.6 to 406.4 mm (4 to 16 in.) Single-part forms 6.8 kg (15 lb) minimum Multiple-part forms 5.4 kg (12 lb) bond, six copies maximum	

Notes:

[3] Weights for paper forms are shown in ream quantities.

Table 9. System Accessories and Supplies (Continued)

Component	Accessory	Part Number
LQ45 printer	Minimum paper weight 6.8 kg (15 lb) bond, single copy Maximum form thickness 0.635 mm (0.025 in.) Multiple-part form 5.5 kg (12 lb) bond Carbon 2.7–3.6 kg (6–8 lb), 6 parts maximum	
Customer-replaceable air filters:		
990A13	Package of six filters Package of twelve filters	2310376-0001 2310376-0002
WD800 disk	Package of six filters Package of twelve filters	2213088-0001 2213088-0002

Receiving Your System

If you purchase installation of your system, it is unpacked and uncrated by TI personnel. Your only responsibility is to move the system into the area of installation and to inventory the equipment once it is unpacked.

Several steps are involved in receiving your system. The following is a simplified list to assist you in planning:

- Check the number of crates at arrival against the carrier bill of lading.
- Inspect all crates for signs of damage. If any damage is found, note the damage on the bill of lading and file claim against the carrier, if applicable. Photograph any damages to the crates of equipment.
- If installation was purchased with your system, contact TI-CARE* for installation scheduling. International users should contact the Texas Instruments Field Service Office.

When inspecting crates and cartons for damage, watch for crushed corners, dents, scratches, cracks, and for signs of stains from liquids that might have soaked into the containers. Write down any discrepancies, inform the carrier, and file any applicable claims.

Unpacking instructions are located in the *Open Me First* letter packet attached to your equipment crates. Most Business System models require approximately 36 square meters (387 square feet) for unpacking. Different shipping configurations are used based on equipment destination, mode of transportation, and advances in packaging technology. Table 10 shows typical dimensions and weights of the shipping containers.

*Service mark of Texas Instruments Incorporated.

Table 10. System Crated Component Approximate Weights and Dimensions

Component	Crate Dimensions	Shipping Weight
Models S682/882/886 1.52-m (60-in.) cabinet	Height: 1092 mm (60 in.) Width: 813 mm (32 in.) Depth: 1753 mm (69 in.)	156 kg (345 lb)
Model S651 Models S671/672/872 Models S680/880/884 0.81-m (32-in.) cabinet	Height: 978 mm (38.5 in.) Width: 800 mm (31.5 in.) Depth: 1010 mm (39.8 in.)	97.5 kg (217 lb) without equipment 158 kg (350 lb) with equipment
Models S660/661/861 1.07-m (42-in.) cabinet	Height: 978 mm (38.5 in.) Width: 813 mm (32 in.) Depth: 1m (39.4 in.)	109 kg (240 lb) (without equipment) 154 kg (340 lb) (with equipment)
13-slot chassis	Height: 470 mm (18.5 in.) Width: 826 mm (32.5 in.) Depth: 610 mm (24 in.)	79 kg (175 lb) in cardboard container 120 kg (265 lb) in wooden crate
Model MT1600 tape drive	Height: 797 mm (31.4 in.) Width: 597 mm (23.5 in.) Depth: 667 mm (26.3 in.)	56 kg (125 lb)
Model DS80 disk drive	Height: 540 mm (21.25 in.) Width: 1054 mm (41.5 in.) Depth: 711 mm (28 in.)	152 kg (335 lb)
Pedestal for Model DS80 disk drive	Height: 1066 mm (42 in.) Width: 986 mm (38.8 in.) Depth: 782 mm (30.8 in.)	113 kg (250 lb)
Model DS300 disk drive	Height: 1092 mm (43 in.) Width: 584 mm (23 in.) Depth: 940 mm (37 in.)	222.3 kg (490 lb)
Model WD500 disk drive	Height: 412.8 mm (16.3 in.) Width: 692.2 mm (27.3 in.) Depth: 901.7 mm (35.3 in.)	36 kg (80 lb)
Model WD800 disk drive	Height: 425 mm (16.8 in.) Width: 660 mm (26 in.) Depth: 864 mm (34 in.)	36 kg (80 lb)

Table 10. System Crated Component Approximate Weights and Dimensions (Continued)

Component	Crate Dimensions	Shipping Weight
Dual FD1000 disk drive	Height: 823 mm (32.5 in.) Width: 673 mm (26.5 in.) Depth: 356 mm (14 in.)	34 kg (75 lb)
Model CD1400 disk drive	Height: 277 mm (10.5 in.) Width: 483 mm (19 in.) Depth: 762 mm (30 in.)	77 kg (170 lb)
Pedestal top cover (Systems with CD1400)	Height: 317.5 mm (12.5 in.) Width: 571.5 mm (22.6 in.) Depth: 787.4 mm (31 in.)	15.88 kg (35 lb)
911 VDT	Height: 787 mm (31 in.) Width: 635 mm (25 in.) Depth: 724 mm (28.5 in.)	41 kg (90 lb)
940 EVT	Height: 685 mm (27 in.) Width: 622 mm (24.5 in.) Depth 533 mm (21 in.)	21.5 kg (47.4 lb)
840 RO printer	Height: 330 mm (13 in.) Width: 603 mm (23.8 in.) Depth: 730 mm (28.8 in.)	15 kg (33 lb)
810 printer	Height: 406 mm (16 in.) Width: 730 mm (29 in.) Depth: 763 mm (30 in.)	29.5 kg (65 lb)
LQ45 printer	Height: 635 mm (25 in.) Width: 756 mm (29.75 in.) Depth: 927 mm (36.5 in.)	32.66 kg (72 lb)
LP300/LP600 printer	Height: 1059 mm (41.7 in.) Width: 762 mm (30 in.) Depth: 616 mm (24.3 in.)	84 kg (185 lb)

Related Publications

The following publications are available as reference material for support of your Business System:

Title	Part Number
System Manuals	
Business Systems 600/800 Installation Manual	2311341-9701
Business Systems 600/800 Unpacking and Inventory Guide	2311342-9701
Business Systems 600/800 Product Instruction Manual	2311343-9701
Business Systems 600/800 Field Engineering Reference Handbook	2311344-9701
Business Systems 600/800 Field Maintenance Manual	2311345-9701
Hardware Manuals	
Model 990/12 Computer Maintenance Manual, General Description	2268239-9701
Model 990/10A Computer Maintenance Manual, General Description	2302633-9701
Model 990A13 Chassis Maintenance Manual, General Description	2308774-9701
Model 911 Video Display Terminal Installation and Operation Manual	945423-9701
Model DS80 Disk System Installation and Operation Manual	2302629-9701

Title	Part Number
Model DS300 Disk System Installation and Operation Manual	2302631-9701
Model WD500 Mass Storage System Installation and Operation Manual	2302688-9701
Model WD800 Mass Storage System Installation and Operation Manual	2306140-9701
Model CD1400 Disk System Installation and Operation Manual	2272081-9701
MT1600 Magnetic Tape System Installation and Operation Manual	2302642-9701
Model FD1000 Flexible Disk System with International Chassis Installation and Operation	2250698-9701
Model 810 Printer Installation and Operation Manual	939460-9701
Model 840 RO Printer Installation and Operation Manual	2302695-9701
Model LP300/LP600 Line Printer Installation and Operation Manual	2250364-9701
Model LQ45 Letter Quality Printer Installation and Operation Manual	2268695-9701
990 Family Communication Systems Field Reference Manual	2276579-9701
Software Manuals	
Model 990 Computer 990/10 and 990/12 Assembly Language Reference Manual	2250709-9701
Unit Diagnostics Handbook (7 Volumes)	945400-9701 through 945400-9707
Model 990 Computer FORTRAN Programmer's Guide	945411-9701

Title	Part Number
Model 990 Computer TI Pascal User's Manual	946290-9701
Model 990 Computer COBOL Programmer's Guide	2270521-9701
Model 990 Computer COBOL Reference Manual	2270518-9701
Model 990 Computer Report Program Generator (RPG II) Programmer's Guide	939524-9701
TI BASIC Programmer's Guide	946251-9701
Model 990 Computer DX10 Data Base Management System Programmer's Guide	2250425-9701
Model 990 Computer DX10 Data Base Administrator User's Guide	2250426-9701
Query-990 User's Guide	2250466-9701
Model 990 Computer TIFORM Reference Manual	2250374-9701
Model 990 Computer TI990 BASIC Reference Manual	2250304-9701
Model 990/10 DX10/3270 Information Display System Emulator Operator's Manual	2250954-9701
Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume I Concepts and Facilities	946250-9701
Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume II Production Operation	946250-9702
Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume III Application Programmer's Guide	946250-9703
Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume IV Developmental Operation	946250-9704
Model 990 Computer DX10 Operating System Reference Manual, Release 3 Volume V System Programming Guide	946250-9705

Title	Part Number
Model 990 Computer DX10 Operating System Reference Manual, Release 3, Volume VI Error Reporting and Recovery	946250-9706
Model 990 Computer DX10 Operating System Installation Guide	939152-9701
Model 990 Computer Sort/Merge Installation for DX10 Release 3	939432-9701
DX10 3780/2780 Emulator User's Guide	946289-9701
Model 990 Computer Link Editor Reference Manual	949617-9701
Model 990 Computer DX10 Operating System Programmer's Card	939417-9701
Model 990 Computer Sort/Merge User's Guide	946252-9701
Model 990 Computer TIFORM Reference Manual	2250374-9701

TI-CARE

Customer satisfaction is the primary goal of Texas Instruments Incorporated. To meet this goal, the TI-CARE System was developed and implemented. The TI-CARE system is a nationwide, computerized network that facilitates the entry, dispatch, and completion of all customer service requests.

To initiate any service request other than installation, a customer should use the toll-free centralized dispatch telephone number 1-800-572-3300. The customer provides the dispatcher with the customer name, address of the equipment needing service, telephone number, name of the person to contact, the model and serial number of the product, the problem, and a purchase order number (if it is purchased equipment and not covered by warranty or a maintenance agreement). The dispatcher enters this information into the TI-CARE System. The TI-CARE system automatically transfers the request to the TI service office nearest the equipment needing service.

The dispatcher at the location nearest the equipment will assign the service request to a customer representative (CR) for action. When the CR completes the service request, all pertinent data is entered into the system and a real-time service status is maintained.

The TI-CARE system enables Texas Instruments to provide fast, efficient service to every customer, whether their operations are concentrated in one geographical area or nationwide. If the customer is not satisfied with the service provided by the TI-CARE system, the nearest region or area manager should be notified.

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