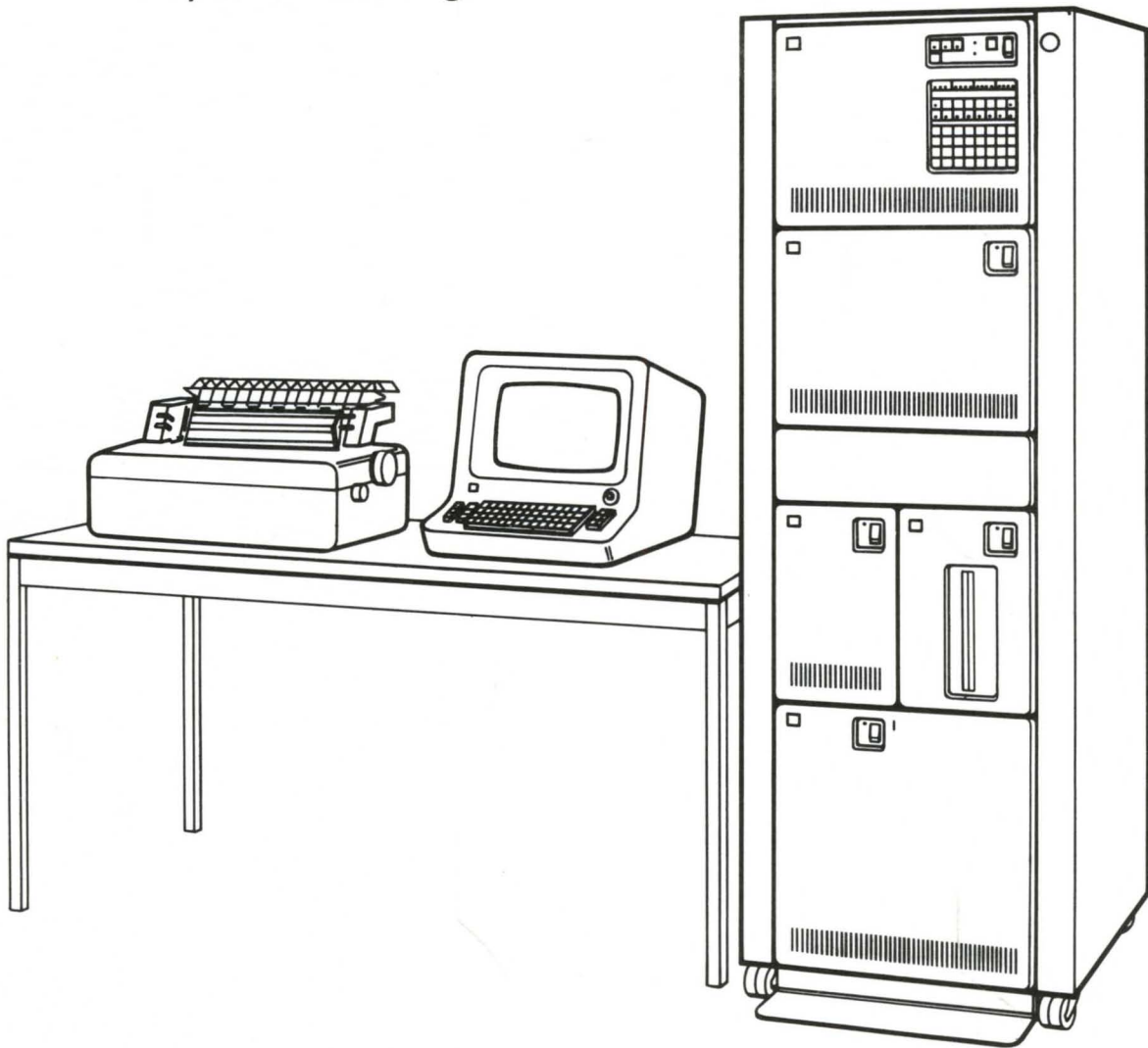


GA34-0029-1

File No. S1-15

IBM Series/1  
Installation Manual  
Physical Planning

**SERIES/1 PHYSICAL PLANNING**



GA34-0029-1

File No. S1-15

IBM Series/1  
Installation Manual  
Physical Planning

**SERIES/1 PHYSICAL PLANNING**

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**Second Edition (March 1977)**

This is a major revision of, and obsoletes GA34-0029-0. Significant changes in this new edition include the addition of IBM 4973 Line Printer physical planning information.

Changes are periodically made to the information herein; any such changes will be reported in subsequent revisions or Technical Newsletters. Before using this publication in connection with the operation of IBM systems, have your IBM representative confirm editions that are applicable and current.

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This publication is written to guide personnel involved in physical planning for the installation of an IBM Series/1 system or IBM Series/1 units. It contains technical information, conditions required, and recommendations for the successful installation of IBM Series/1 units.

Chapter 1 contains planning information such as:

- Building requirements
- Environmental requirements
- Electrical requirements
- Non-IBM rack enclosure requirements
- Moving units to an installation site.

Chapter 2 contains unit specifications for:

- IBM 4997 Rack Enclosures
- IBM Series/1 Model 3 Processor units
- IBM Series/1 Model 5 Processor units
- IBM 4959 Input/Output Expansion unit
- IBM 4982 Sensor Input/Output unit
- IBM 4964 Diskette unit
- IBM 4962 Disk Storage unit
- IBM 4999 Battery Backup unit
- IBM 4979 Display Station
- IBM 4974 Printer.
- IBM 4973 Line Printer

Chapter 3 contains user wiring information such as:

- User wiring practices
- Signal conditioning considerations
- User attachment signal and pin assignments.

### ***Related Publications***

*IBM Series/1 4982 Sensor Input/Output Unit Description*, GA34-0027.

*IBM Series/1 Communications Features Description*, GA34-0028.

*IBM Series/1 Customer Direct Program Control Adapter Features Description*, GA34-0031.

*IBM Series/1 User's Attachment Manual*, GA34-0033.

*IBM Series/1 System Summary*, GA34-0035.

*IBM Series/1 Configurator*, GA34-0042.



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## Technical Terms and Symbols

The following electrical and scientific terms and symbols have been used throughout this manual. The symbols are generally considered conventional throughout industry. Other special terms are defined where they appear in the text.

<i>Unit</i>	<i>Symbol</i>	<i>Unit</i>	<i>Symbol</i>
alternating current	ac	ohm	$\Omega$
American wire gauge	AWG		
ampere	A	pound	lb
British thermal unit	Btu	request for price quotation from IBM	RPQ
		root-mean-square	rms
centimeter	cm		
cubic foot per minute	ft <sup>3</sup> /min		
cubic meter per minute	m <sup>3</sup> /min	square meter	m <sup>2</sup>
degree Celsius	°C	unit of acceleration	G
degree Fahrenheit	°F		
direct current	dc	volt	V
		voltampere	VA
ground, earth/building		volts, alternating current, rms value	V ac
ground, frame			
hertz	Hz	watt	W
inch	in. or "		
kilocalorie	kcal		
kilogram	kg		
kilogram per square meter	kg/m <sup>2</sup>		
kilohertz	kHz		
kilohm	k $\Omega$		
kilovoltampere	kVA		
megahertz	MHz		
megohm	M $\Omega$		
meter	m		
milliampere	mA		
millimeter	mm		



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# Chapter 1. IBM Series/1 Preinstallation Planning Requirements

This manual is in three chapters which contain the following information:

Chapter 1—(this chapter) contains preinstallation system planning information.

Chapter 2—contains the physical specifications for each IBM Series/1 unit.

Chapter 3—contains the wiring practices, signal names and connector pin assignments.

Successful installation of a Series/1 system requires complete preparation to enable the system to be operational in minimum time after delivery from IBM. It is strongly recommended that the user take the following steps:

1. Read Chapter 1 of the Installation Manual—Physical Planning (this book) in its entirety to get an overview of the tasks to be performed.
2. Make a schedule to be followed with plans aimed at having all possible preparations for the system completed *one week* prior to its *arrival on site*.
3. Select a suitable space considering all factors learned by reading Chapter 1 in its entirety (power requirements, physical requirements, etc.).
4. Engage all necessary subcontractors or outside consultants needed to achieve the necessary preparations.
5. Plan the subsystem installation carefully using the specifications contained in Chapters 2 and 3. Procure any special tools or materials as early as possible to avoid delays due to procurement problems.

## At System Order Time

After reading Chapter 1, make a determination as to what tasks must be accomplished and who is to accomplish them. You have ordered a fine piece or pieces of electronic equipment—it deserves proper preinstallation planning in order to deliver the performance you expect. Contracting of outside consultants or IBM Installation Planning representatives may be necessary to complete the required planning.

## One Week Before Machine Delivery

All planned modifications for electrical wiring, communications or interface wiring, and enclosure preparation should be completed and tested where possible.

Primary power *must* be available and tested for correctness and safety at this point. Any site modifications should be complete by this time and fire extinguishers should be readily available. Lighting should be adequate and safety hazards eliminated.

A typical Series/1 system installation is illustrated in Figure 1-1.

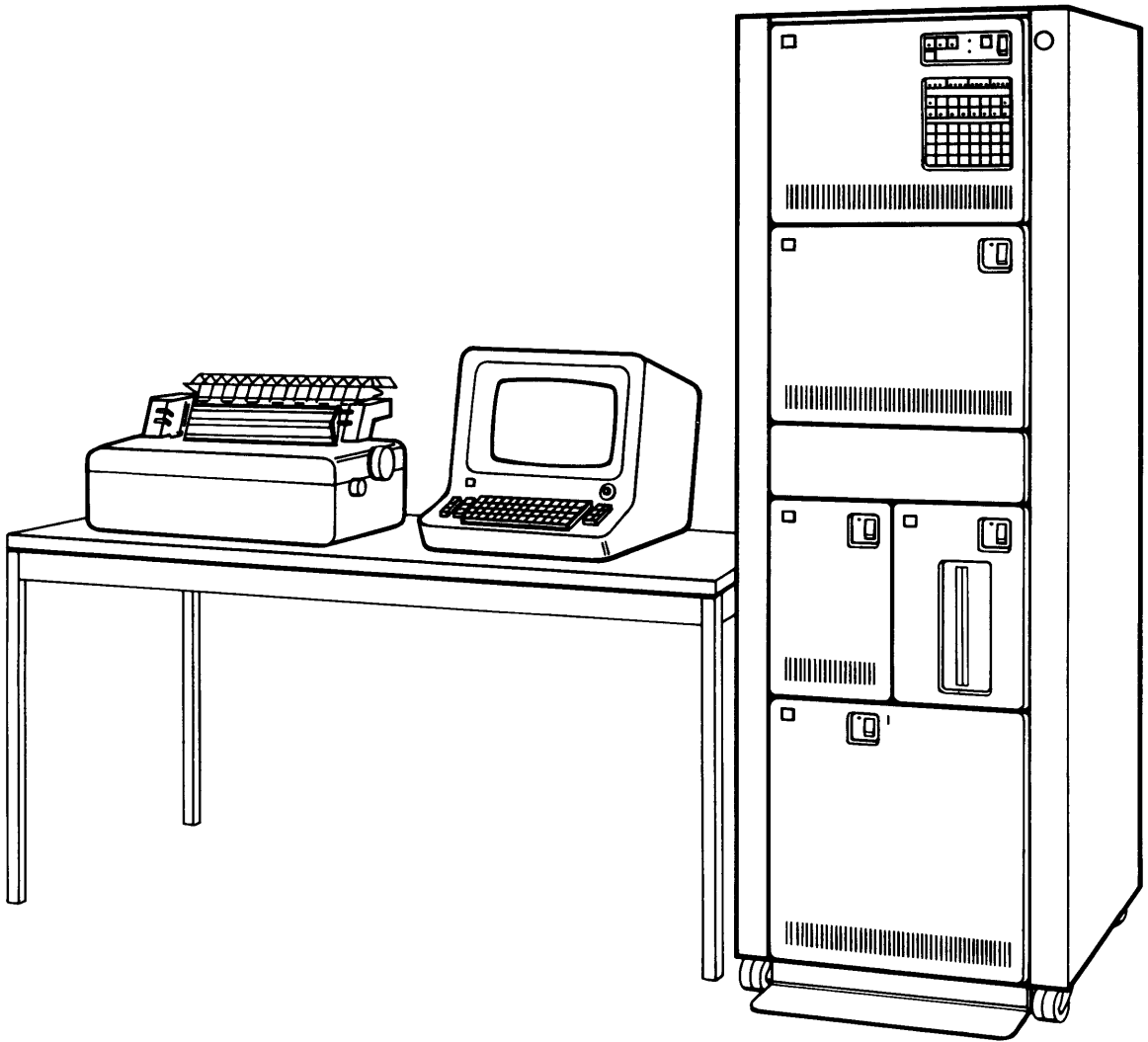


Figure 1-1. Typical system configuration

## SCHEDULING

Because each system installation differs in some respects from other system installations, it is not possible to provide a detailed schedule. The following is an outline of the pre-installation requirements to be completed before actual installation of the units.

- **Site Selection**  
Selecting a site requires considering space availability, interrelation with other user functions, safety, security, and various other requirements to ensure maximum system utilization.
- **Environmental Requirements**  
Air conditioning, heating, vibration, atmospheric contamination, and humidity requirements are defined for efficient system operation.
- **Electrical Requirements**  
Power with correct specifications to operate the system units must be available or installed before system installation.
- **System Ground**  
The proper system ground should be selected and installed before system delivery.
- **Peripheral Unit Placement**  
The system units will require different placement depending on each user's application. Efficient operating of the system will require careful planning of this step.
- **Cables and Connectors**  
Cables are of two categories: (1) IBM supplied and (2) user supplied. IBM supplied cables must be routed and installed as described in unit installation instructions. User supplied cabling is defined in Chapter 3 and will vary in each installation. User supplied cables should be ordered as soon as requirements have been defined.  
After completing the remainder of this chapter, and if necessary Chapter 3, the installation planner should construct a schedule of the steps which pertain to the user's installation. The time required to complete the various steps must be calculated considering material procurement, construction schedules, etc. Careful planning and accurate scheduling will result in a smooth installation and after installation an efficient working system.

## SYSTEM UNIT TYPES

The Series/1 system units are comprised of rack mounted units and peripheral devices.

### *Rack Mounted Units*

The following Series/1 devices must be rack mounted in an IBM 4997 enclosure or in an equivalent standard "Electronic Industry Association" (EIA) 483mm (19 in.) utility equipment rack to ensure proper operation. Rack enclosure requirements will be covered in the non IBM enclosure requirement section. These units, are either full width units 483mm (19 in.) or half width units 216mm (8½ in.) The half width units are mounted in a rack mounting fixture (feature #4540) which allows two half width units mounted side by side to be mounted in the same size space a full width unit would occupy. Rack mounted units are illustrated in Figures 1-2 through 1-7.

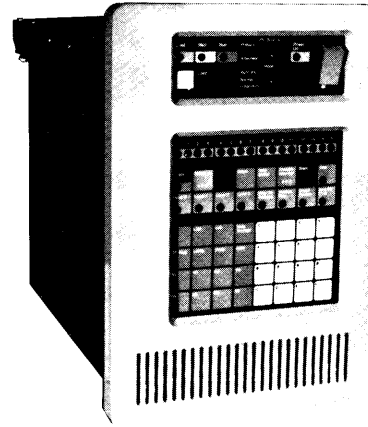
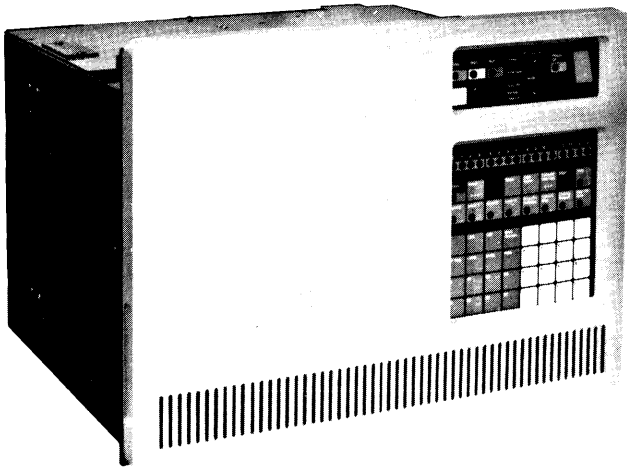


Figure 1-2. IBM Series/1 Processor Units

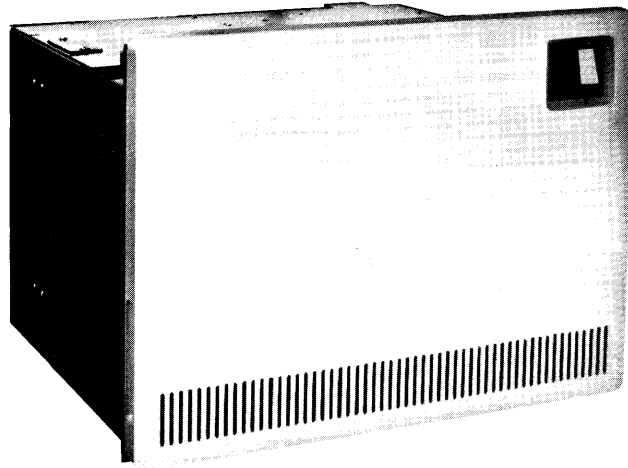


Figure 1-3. IBM 4959 Input/Output Expansion Unit

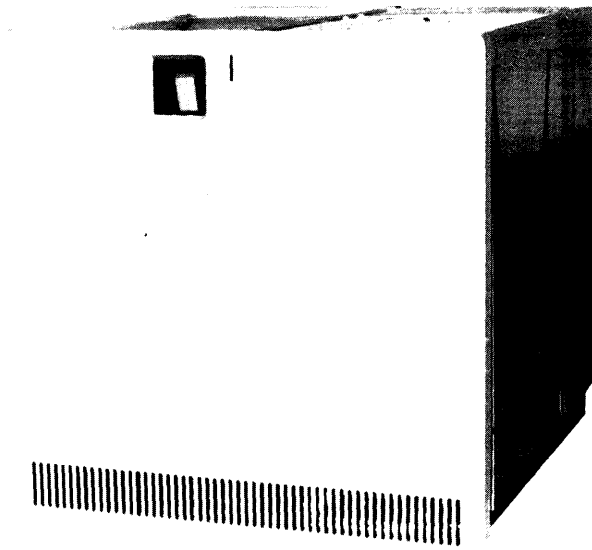


Figure 1-4. IBM 4962 Disk Storage Unit

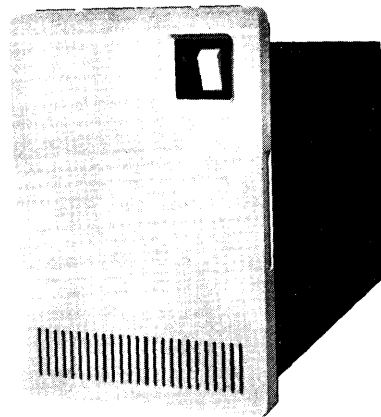


Figure 1-5. IBM 4982 Sensor Input/Output Unit

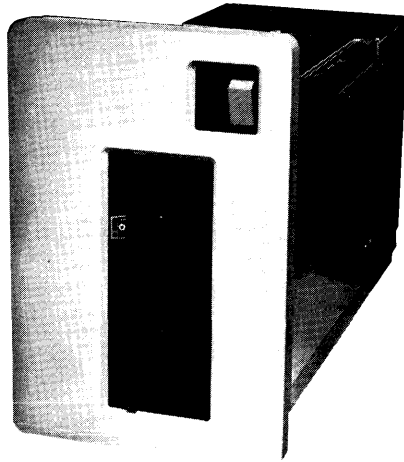


Figure 1-6. IBM 4964 Diskette Unit

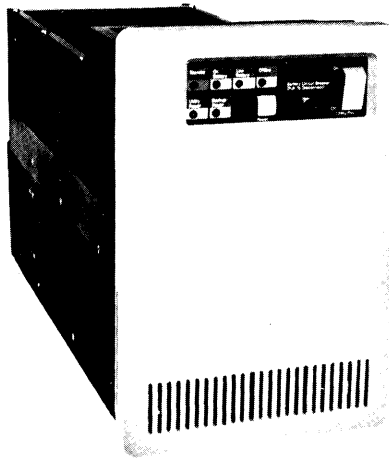


Figure 1-7. IBM 4999 Battery Backup Unit

*Peripheral Devices*

The peripheral devices do not mount in the EIA enclosure. Placement of these units is dependent primarily on cable length restrictions, floor space allocations in the user's installation, and operator usability of the devices. Peripheral units are illustrated in Figures 1-8 through 1-10.

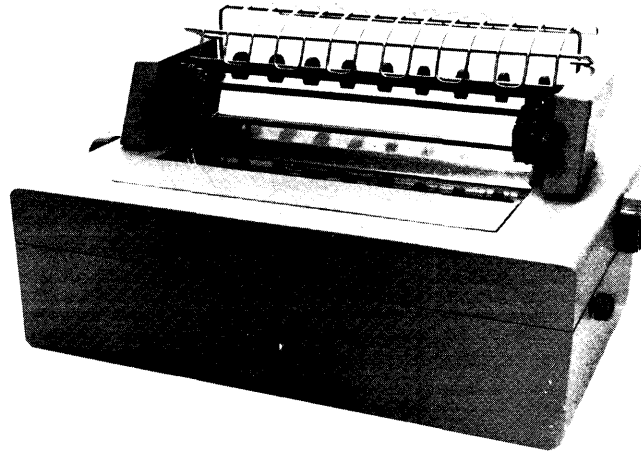


Figure 1-8. IBM 4974 Printer

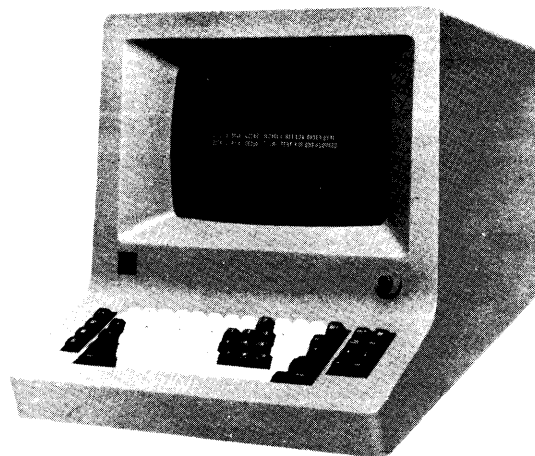


Figure 1-9. IBM 4979 Display Station





Figure 1-10. IBM 4973 Printer

## Building Requirements and Installation Site Planning

Selection of the actual site location depends upon system requirements, control signal wiring, availability of space and utilities, and the interrelationship of the system with other user functions. A free and clear route for service personnel must be assured when selecting the site location. Safety is a vital factor in planning for a computer installation. The choice of computer location, building materials, fire prevention equipment, air conditioning and electrical systems, and personnel training should include safety considerations to conform with local and federal codes.

### SYSTEM SITE REQUIREMENTS

Series/1 system site requirements will differ with each system configuration and user facility. After reading this paragraph the system summary worksheet in Appendix E should be completed before continuing. The information on this worksheet will be used in many of the planning steps. After listing the units contained in the system configuration, fill in the required information from the unit specification pages contained in Chapter 2 and Appendix A or B.

#### *Security*

Security involves protecting both data and the equipment necessary to process the data. Four basic factors are essential to establish and maintain security in most facilities.

1. Physical security—site selection, fire and other damage controls, and controlled access of personnel are the main objectives of physical security.
2. Controls and Procedures—security audit of personnel, clearly defined areas of responsibility, and secure machine room policies will ensure a secure site location.
3. Recovery and backup procedures—protected record storage, disaster plans, a means of backup to ensure continued operation, and duplication and safe storage of difficult to recreate data.
4. Data protection—this is a function of the users type of application and what is determined to be vital or nonvital data.

These items should be considered to determine to what extent security will apply to the application of the installed units.

#### *Physical Layout and Service Clearance*

When a site for the system units is selected the placement of units must be planned to provide for service clearances, floor loading, power wiring, building modifications, and finally the installation of the actual units. A scale floor plan of the proposed installation should be constructed for this step to ensure that the proper amount of space is available for the units. Appendix C contains ½ inch scale unit templates to aid in floor layout and actual dimensions are provided in Chapter 2. Figure 1-11 is an example of a 4997, 4979, and 4974 layout. Figure 2-1 should be used to define the symbol meanings.

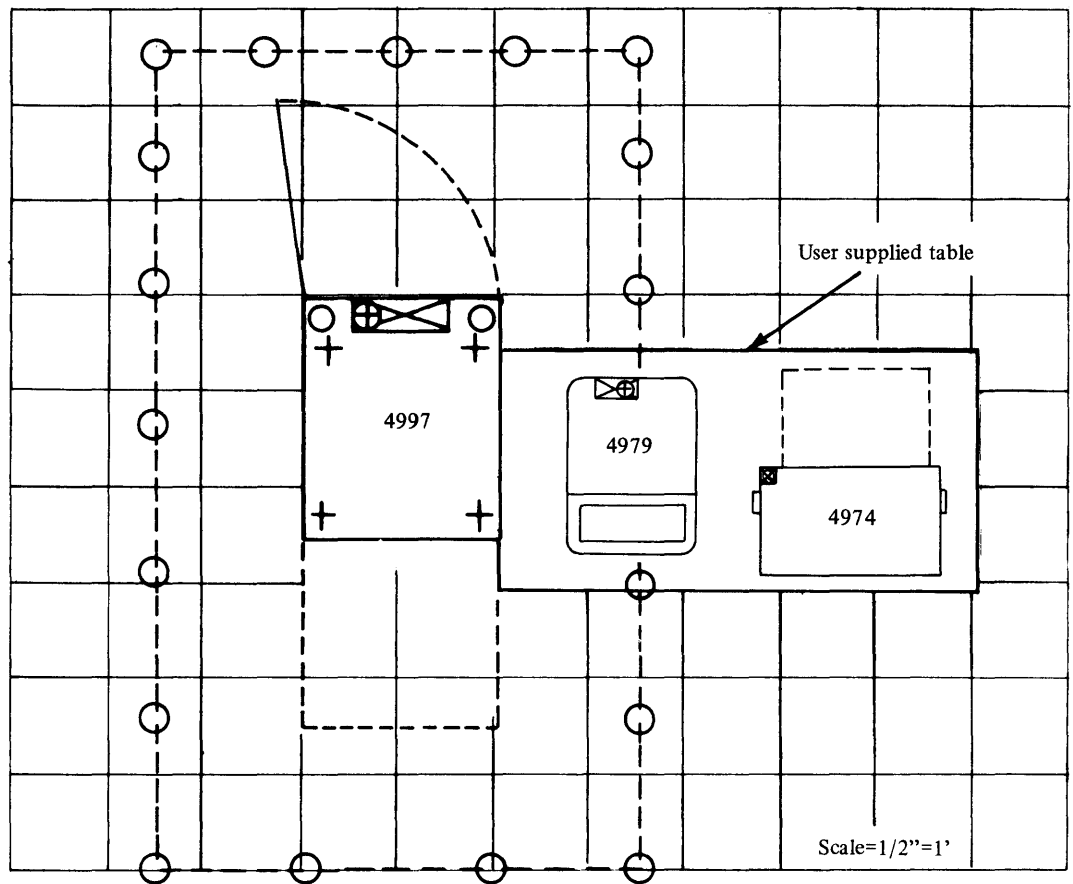


Figure 1-11. Typical one bay floor layout

Figure 1-12 is an example of a multiple 4997 layout (multi-bay) again with a 4979 and 4974.

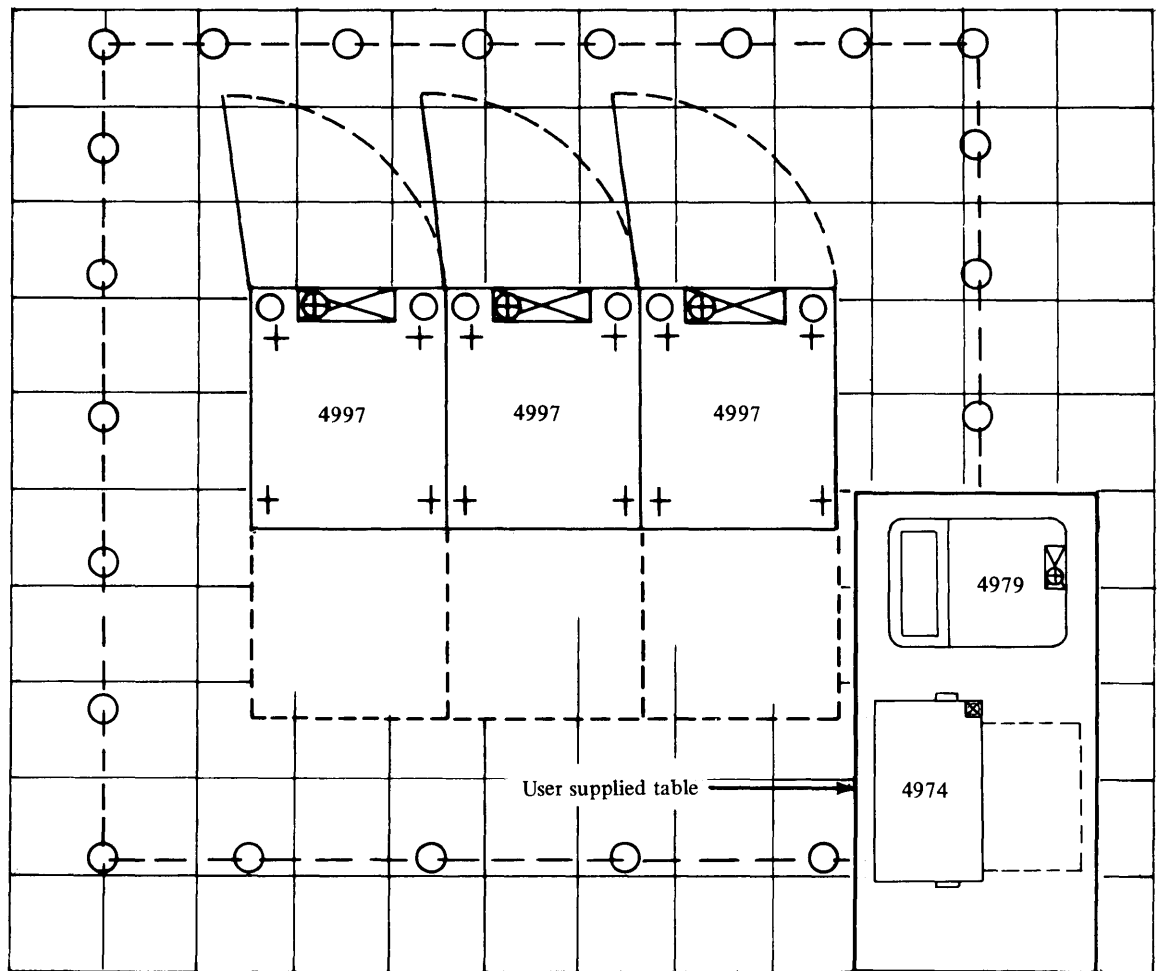


Figure 1-12. Typical multi-bay floor layout

The remainder of this manual will refer to multiple 4997 configurations as multi-bay with each 4997 unit considered a bay. Note that the 4979 and 4974 are table top units and do not require special service clearance considerations since they are movable for servicing. The table (s) or stand (s) the 4979 and 4974 units will be placed on is a user supplied item. Dimensions for these items must be supplied by the user. Cable length for the peripheral units are contained in the configurator. When planning unit layout allow sufficient signal cable length to route within the 4997 or equivalent enclosure. This amount of cable will vary from 2.5m (8 ft) maximum to 1m (3 ft) minimum. If a raised floor is being used, additional cable length will be needed. Cable lengths to 46m (150 ft) may be ordered with peripheral units.

Important considerations in floor plan layout are:

- Efficient operation of the units after installation.
- Adequate service clearance allowances.
- Include all other items in the layout such as desks, tables, other machines, etc.
- Include supporting posts or columns in the plan.
- Draw everything on a correct scale to get a true perspective of the layout.
- Check the layout with all personnel involved in planning the installation, such as electricians, operators, facilities safety, etc., to ensure all considerations are satisfied.
- Consider 4997 power cable length 4.3m (14 ft) when planning primary (ac) power source locations. Peripheral unit power cable lengths of 1.8m (6 ft) must be considered when planning unit placement.
- Installation and routing of customer cables must be considered during unit placement planning.

Rack mounted units do not require additional service clearance considerations since the 4997 enclosure service clearance is sufficient for all housed units. The site floor plan will be used extensively in the remainder of the planning and it may be desirable to make several copies.

### ***Floor Loading Check***

The maximum weights of the Series/1 system units recorded on the system summary worksheet and the site floor plan will be used to compute floor loading. The total weight is in column #3. The weights include the machine-supported weight of IBM-supplied cables, but do not include the weight of customer-supplied cables. Weights for non-IBM items (desk tables, other machines, etc.) must be included in floor loading considerations. These weights must be provided by the user or installation planner.

Factors to be considered in determining floor loading are:

- If more than three machines are placed side by side, no allowance can be taken for side clearance at the ends of the two outer machines in computing floor loading.
- Regardless of the actual service clearances required, clearances used in floor loading computations cannot be more than 76 cm (30 in.) in any one direction from the machine.
- 98 kg/m<sup>2</sup>, (20 pounds per square foot) of service area used in calculation must be applied as live-load in floor loading computations.
- If a false or raised floor is used, 49 kg/m<sup>2</sup>, (10 pounds per square foot) of total area used in calculation must be applied as false floor load in the floor loading computation.
- Most office building floors rated at 244 kg/m<sup>2</sup>, (50 pounds per square foot) have an additional allowance of 98 to 122 kg/m<sup>2</sup>, (20 to 25 pounds per square foot) for partitions. The user's building department should be contacted in reference to using this partition allowance in determining the floor loading capacity.

## *Floor Covering*

Floor covering material can contribute to the buildup of high static electrical charges as a result of the motion of people, carts, furniture, etc., in contact with the floor material. Abrupt discharge of these static charges to metallic surfaces or people causes discomfort to personnel and may cause malfunction of electronic equipment.

Because of the low-level signals inherent in sensor-based input/output circuits, static electrical discharges can have a significant adverse effect on performance. Carpet floor covering is often a source of static electricity. If carpet floor coverings are used, they should be of the variety manufactured to be nonflammable and “antistatic.” Two types of antistatic floor coverings are generally available: those with the antistatic properties manufactured into the material and those treated later with antistatic agents. Certain types of carpeting, depending on additives, have only a short effective antistatic life unless they are treated frequently. All antistatic floor covering (carpet, tile, etc.) should be maintained in accordance with the individual supplier’s recommendations. Static buildup and discharge can be minimized by:

1. Providing a conductive path to earth ground (refer to “Primary Power Grounding” in this chapter) from the metallic raised floor structure (if used) including the metal panels.
2. Ensuring that the maximum resistance for floor tile or other floor surface material is  $2 \times 10^{10}$  ohms, measured between the floor surface and building (or applicable ground reference). The procedure outlined in National Fire Protection Association (NFPA) Standard No. 56A, Section 4628 should be used. Floor material with a lower resistance further decreases a static buildup and discharge. The minimum resistance should not be less than 150,000 ohms.

*Note.* Special attention must be given to floor panels constructed with metal facings and nonconductive cores to ensure that the resistance requirements are met.

3. Maintaining the room humidity within the limits defined in Environmental and Operational Requirements in this chapter.

## ADDITIONAL SITE CONSIDERATIONS

There are several additional items which should be considered in an installation which are not system related or dependent.

### *Service Area*

It may be desirable to provide space for the use of servicing personnel and storage of test equipment and parts. This area should be located near the system. If the system is installed on a raised floor, either the service area should be at the same level or access ramps should be provided.

### *Supplies Storage*

Any records storage in the system area whether on magnetic tape, paper tape, cards, or paper forms, should be in enclosed metal cabinets or fire resistant containers.

All combustible materials, such as permanent master documents, punched card records, and magnetic tape should be stored in properly designed and protected storage areas as defined by NFPA Standard No. 75, Sections 300 and 600.

No combustible material, such as documents, should be stored inside IBM machines except in enclosures provided specifically for this purpose.

### *Fire Prevention Equipment*

In the interest of safety and fire prevention, selection of a site, building materials, fire prevention equipment, air conditioning, electrical system, and personnel training become important considerations.

Usually the presence of portable hand extinguishers such as carbon dioxide or Halon, are sufficient protection for the machines. Since local regulations vary, it may be advisable to consult with local authorities for further guidance.

### *Emergency Lighting*

Emergency lighting may be an installation site consideration. If the system contains battery backup power facilities a battery emergency lighting device is recommended to ensure continued system operation in the event of a power failure.

### *Battery Storage Planning*

Systems with battery backup emergency power capabilities have an additional planning step to provide battery storage. Because of wire size restrictions the battery (s) must be placed within a maximum of approximately twelve feet from the 4999 battery backup unit located in the rack enclosure. Battery storage has both physical placement and safety considerations to plan. Refer to the 4999 Battery Backup Unit section of Chapter 2 for additional battery storage and safety information.

**CAUTION: No smoking is required where batteries are charging.**

## Environmental and Operational Requirements

For environments that cannot be evaluated with the planning information in this manual, consult your IBM Installation Planning Representative for additional information and/or assistance.

### SYSTEM TEMPERATURE AND RELATIVE HUMIDITY LIMITS

The recommended optimum environment should be 24°C (75°F) and 40 to 50% relative humidity. This optimum point provides the largest buffer in terms of system availability. The temperature and relative humidity defined in the unit specification pages are upper and lower limits and are not to be confused with optimum operating points. When a group of system units share a common environment, environmental specifications are determined by the unit having the most restrictive limits. Consult the unit specification pages in Chapter 2 to determine temperature and relative humidity requirements. IBM units specified in this manual are designed to operate in a nonair-conditioned (summer), heated (winter) office environment within the temperature and humidity limits described in the unit specification pages (Chapter 2). If the installation site does not conform to these specifications or optimum environment is desired, it may be necessary to install air conditioning, other means of cooling air, or dehumidifying equipment. Individual unit temperature and relative humidity limits are defined in unit specifications contained in Chapter 2.

### SYSTEM AND UNIT COOLING REQUIREMENTS

IBM Series/1 units are cooled internally by individual unit fans or convection of warm air. Cool air enters the lower front of the enclosure mounted units and warm air exhausts from the top of each unit and from the top or rear top of the system enclosure. The system summary worksheet contains the individual machine heat dissipation loads, as defined in the unit specification pages and in the specification summaries (Appendices A and B), and a total heat dissipation in total column #2.

#### *Airflow and Room Pressurization*

When an air conditioning unit is used, makeup air should be brought into the air conditioning system to maintain a positive pressure within the system room. A pressure of approximately 2.5 to 5.0mm (0.1 to 0.2 in.) of water above that of the surrounding environment is usually sufficient. The source of this air should be free from particulate and gaseous contamination. Air volume should be kept to a minimum, consistent with good engineering practice for pressurization and oxygen content.

### ATMOSPHERIC CONTAMINATION LIMITS

The IBM Series/1 units are designed to operate within specified gaseous and particulate environmental limits. Typical suitable environments are business offices and “clean industrial” locations. “Clean industries” are those in which corrosive gases and particulate contamination are not a by-product of the processing in or around the general area of the units. The presence of odors from corrosive gases generally indicates an environment more severe than the above. For example if units are installed near plating areas, the gaseous environment should be measured.



The units can function normally within a particulate environment which is characterized as a "typical clean industrial environment". Particulate, liquid, and gaseous atmospheric contaminants in some industrial environments, especially those in the process industries, can cause corrosion of copper and other metals used in computer systems. Extended corrosive growth in any computer system can produce electrical short circuits or contact failures that result in system malfunctions. In addition, particulate matter can cause contact failures that result in system malfunctions even if the particulate matter is not corrosive in nature. Detailed particulate and gaseous contamination limits are contained in Appendix D.

*System Room Environmental Controls.* The following suggested controls are not intended to include all possible solutions to the problem of excessive environmental contaminants.

1. *Gaseous filtration of room air.* When filtering is necessary to remove gaseous contaminants, all air (makeup and recirculated) handled by the air conditioning system should pass through a chemical control filtration system such as an activated carbon filter.
2. *Particulate filtration of room air.* When filtering is necessary to remove particulate contaminants, all air (makeup and recirculating) handled by the air conditioning system should pass through a particle control filter system.
3. *Relative humidity.* Low humidity is essential to reduce the rate of corrosion. For the best control of corrosion, relative humidity should be kept in the range of 40 to 50%.

In extreme "dirty air" environments, it may be necessary to provide a sealed enclosure or room with filtered or outside air supplied to meet the environmental requirements.

## SYSTEM VIBRATION AND SHOCK

Series/1 units will be installed in many locations subject to minor vibrations. The normal vibration intensity in a typical clean industrial facility is well below the allowable limits. However, because vibration may cause the system units to move on the floor, the use of user-supplied pads, or wells, (other methods may be preferred in areas subject to earthquake shocks) to hold the casters (if the rack or units are equipped with casters) is recommended.

The maximum allowable vibration intensities are defined for each unit in the specification pages contained in Chapter 2. The user is to ensure that the vibration input to the 4997 enclosure frame does not exceed those levels defined in Appendix F. If the installation site vibration or shock level is questionable refer to Appendix F for detailed enclosure vibration specifications. Where units are mounted in a user enclosure, it is the users responsibility to ensure that the vibration specification for each unit is not exceeded. The shock levels should not exceed the transient vibration levels defined in Appendix F.

## HAZARDOUS LOCATIONS

IBM units are not designed for installation in hazardous locations as described in National Electrical Code 70, Article 500, and National Fire Code, Volume 5. When a system or units are installed in such locations, the room housing the units must be air purged or otherwise declassified.

If IBM unit input/output or timer circuits are connected to equipment located in a hazardous area, analyze each type of circuit used and the equipment to which it connects to determine that the appropriate NFPA and local codes or regulations are met.

## System Electrical Requirements

The physical placement of power receptacles should be included in the location floor plan. Power cord lengths are defined in the unit specification pages in Chapter 2. The total kVA requirements should be in column #1 of the system summary worksheet.

### SYSTEM PRIMARY POWER DISTRIBUTION

Primary ac power must be provided for the 4997 enclosure (individually for each bay in a multi-bay system) and also for each peripheral unit or device.

#### *4997 Rack Enclosure Primary Power*

Each 4997 unit has a self contained ac power distribution panel which distributes ac power to the enclosed units. Each bay of a multi bay system powers only the units contained in the enclosure and must not power a unit outside of the frame. The power distribution panel contains a 20 amp circuit breaker which is also mechanically attached to the Instant Power Off (IPO) control mounted on the front panel of each 4997 unit. Each 4997 enclosure must be powered by a separate outlet with the specific voltage selected when the units were ordered (refer to the system summary worksheet). The 4997 will require one of the following ac voltages:

60 Hz  
115  
208  
230

Each 4997 unit has a power cable extending 4.3m (14 ft) from the bottom rear of the enclosure frame (refer to Figure 1-13.)

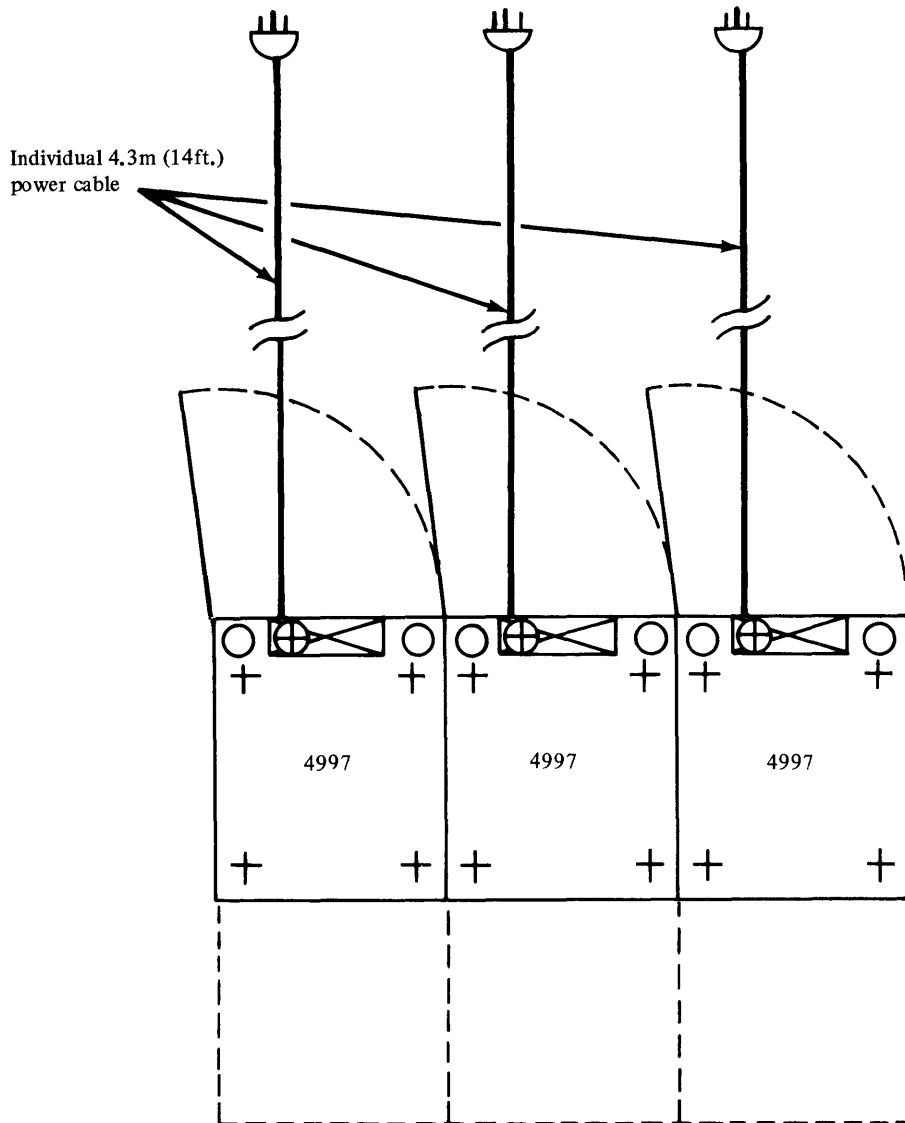


Figure 1-13. Multi bay power cords

Required power receptacles for the 4997 are represented in Figure 1-14 and specified in the unit specification pages contained in Chapter 2. The total kVA required for the enclosure mounted units can be totaled from the system summary worksheet.



20Amp 2-pole 3-wire grounding, locking receptacles	
115V	208/230V
NEMA L5-20R 	NEMA L6-20R 

Figure 1-14. 4997 power receptacles

**Peripheral Unit Primary Power**

Peripheral units have an individual power cord 1.8m (6 ft) in length (refer to Figure 1-15).

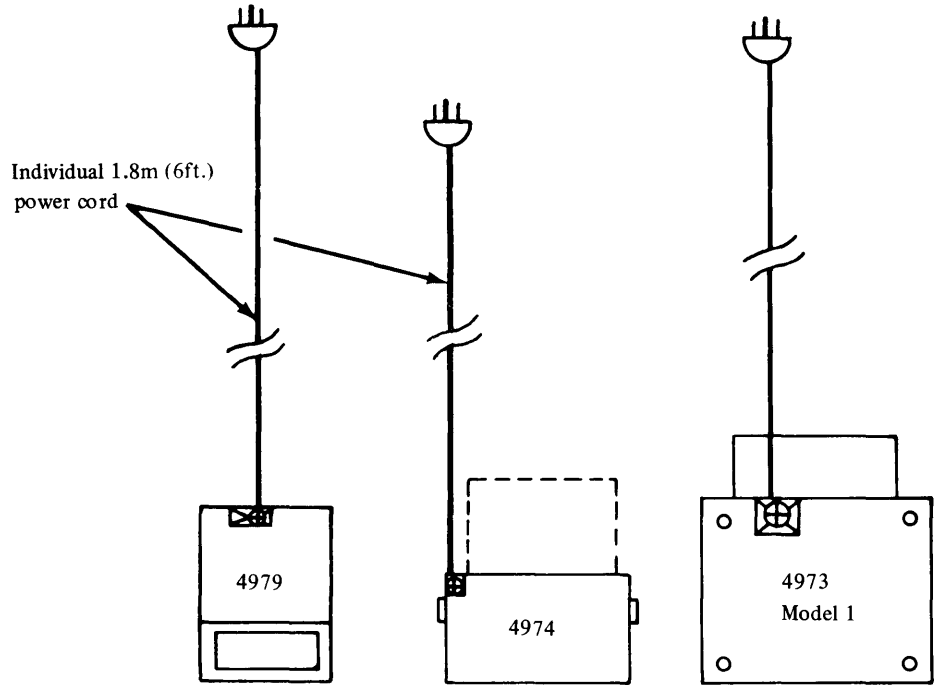


Figure 1-15. Peripheral unit power cords

Required power receptacles for each unit are represented in Figure 1-16 and defined in the unit specification pages contained in Chapter 2. Each unit must be powered by a separate outlet with the proper voltage which was selected when the unit was ordered. The required voltage will be one of the following:

- 60 Hz
- 115
- 208
- 230

15Amp 2-pole 3-wire grounding, non-locking receptacles	
115V	208/230V
<p>NEMA 5 - 15R</p>	<p>NEMA 6 - 15R</p>

Figure 1-16. Peripheral unit power receptacles

A typical primary power diagram is shown in Figure 1-17. Peripheral units should be powered from the same service as the 4997 to avoid ground problems.

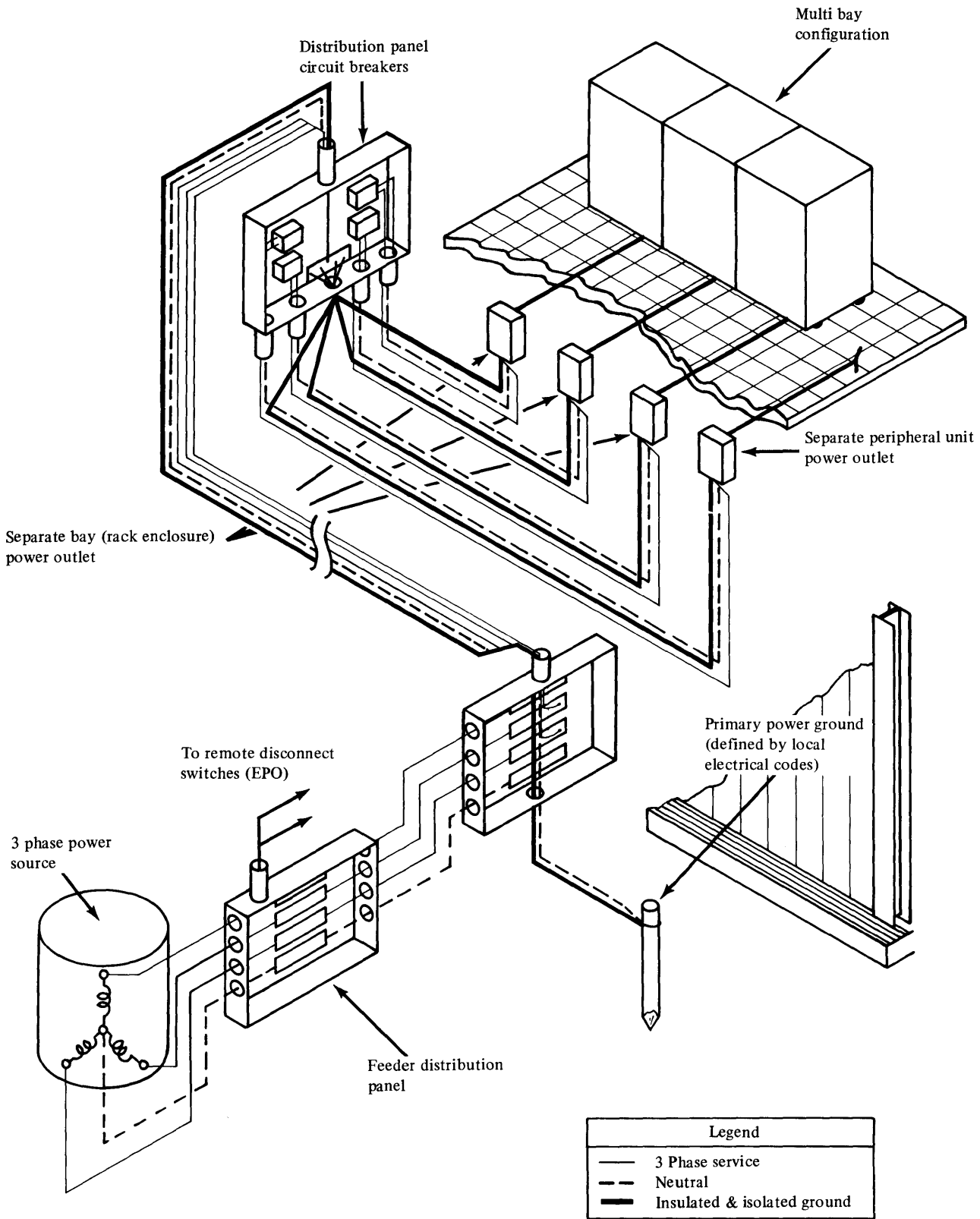


Figure 1-17. Typical primary power distribution

IBM recommends that each unit have an individual branch circuit breaker. The branch circuit breaker requirements for each unit are defined in Chapter 2.

**CAUTION: Grounding circuit continuity is vital. On a system with sensor I/O attachments, the power plugs must not be disconnected without first disconnecting all user input/output circuits.**

### *Attached Equipment (Non-IBM)*

Equipment not supplied by IBM but attached to or mounted in the IBM enclosure, must not use or share ac or dc power from IBM units except as specifically authorized by IBM. Mounting non-IBM equipment in the same enclosure with IBM units can affect system performance due to electrical noise, increased thermal load, or altered air flow.

### *Power Distribution*

The performance of a system can be affected by electrical noise and/or transients entering on the primary power line. The voltage variation tolerances are in the unit specification pages for each unit.

### *Primary Power Grounding*

IBM recommended grounding and power distribution are shown in Figure 1-18. The performance of IBM units can be affected by electrical noise and/or transients entering the system units from the primary power grounding network.

All IBM machine power cords contain an insulated equipment grounding conductor (green or green with yellow stripes) connected between the machine frame ground and the grounding pin on the power cord plug. The wall receptacles recommended by IBM provide connection to this ground pin. This ground pin must be properly terminated to provide an installation which is safe, reliable, and relatively unaffected by electrical noise. To meet these requirements, the following conditions must be met:

- The ground pin of the grounding bus must be connected directly to the service entrance ground electrode with a conductor at least equal in size to the phase conductor. This grounding conductor must be connected to the service entrance ground electrode, at the electrode, under the exact same lug which is used to connect the center tap of the service transformer to the electrode.
- These grounding conductors must be physically isolated from neutral conductors and other grounding conductors, except for interconnections which are required by local codes.

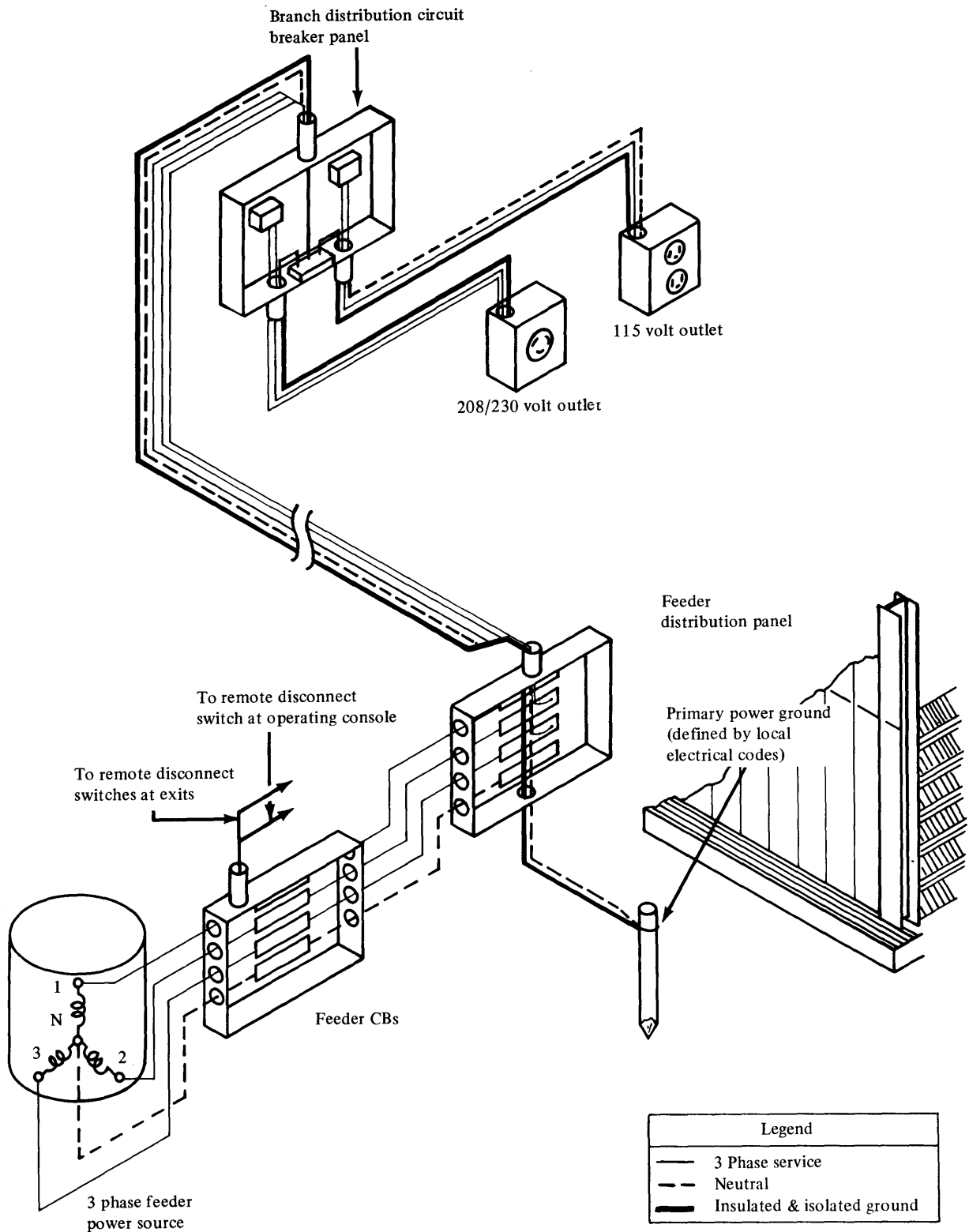


Figure 1-18. Primary power grounding

### ***Internal System (Circuits) Grounding and Customer Signal Grounding***

If the system being installed contains sensor I/O equipment, additional grounding and shielding precautions must be taken.

Analog input, analog output, and certain digital input and output points are isolated from system units frame ground to avoid creating noise voltage differences on the input/output points. The use of multiple grounding points on an input/output signal cable by the user can also cause electrical noise and should be avoided.

Conductors that are effective short circuits to direct current may present high impedance to high-frequency electrical noise. Modern high-speed, low-level circuits are particularly susceptible to this electrical noise, often of microsecond duration, entering the system on signal lines, power lines, or grounding media. Selective filtering and decoupling methods are used where applicable in IBM units to minimize the effects of noise by shunting it to frame ground.

Since it is rarely possible to achieve complete suppression or isolation of noise, the grounding system must provide minimum resistance to the primary power ground. The grounding system should have sufficient isolation from electrical noise so that it will not be a medium for transmitting such noise into the system. Chapter 3 contains detailed wiring and grounding considerations.

### ***Emergency Power Off Controls***

If an IBM 4997 enclosure is being installed, an Instant Power Off (IPO) switch is provided which will power off the single bay within two seconds after pulling the IPO button.

For installations not using an IBM enclosure or for peripheral devices, controls for disconnecting the main power service supplying the computer equipment should be convenient to the operator. Controls should also be located next to each exit door to readily disconnect power to all equipment in the computer area and also to the air conditioning system. Provision should be made for emergency lighting.

### ***Lightning Protection***

IBM recommends that the user install lightning protection on his secondary power source and signal lines that are exposed to lightning when:

- The utility company installs lightning protectors on the primary.
- Primary power is supplied by an overhead power service.
- The area is subject to electrical storms or equivalent power surges.

The user should determine whether lightning protection is desirable, and select and install the service protector needed (see Chapter 3).

### ***Convenience Outlets***

A suitable number of convenience outlets (at required local country voltage) should be installed in the system area. Do not use the enclosure ac distribution receptacles as convenience outlets. These convenience outlets should be on building circuits other than the computer power panel (or riser), or lighting circuits.



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## Non-IBM Rack Enclosure Requirements

The individual rack mounted units are specifically designed to be supported and/or enclosed by a suitable rack structure of a type which meets the Electronic Industry Association (EIA) Standard RS-310B. This structure must include provision for routing, support and restraint of any interconnecting cabling between two or more units. Configurations of these machines which are not so supported or enclosed may not perform according to specification and may not comply with local codes.

This section of planning applies only to users mounting IBM units in a non-IBM enclosure.

### RACK ENCLOSURE PHYSICAL REQUIREMENTS

A non-IBM rack enclosure must provide a 48.4 mm (19.062 in.) EIA standard mounting dimension and mounting bolt pattern (refer to Figure 1-19). The depth of the enclosure must be a minimum of 711 mm (28 in.) and structurally must be capable of safely supporting 290 kg (640 lbs) in a maximum configuration. Stability of the rack enclosure relative to the weight distribution of the units installed should be considered.

#### *Enclosure Air Flow Requirements*

IBM rack mounted units exhaust hot air through the top of the unit enclosure. The rack enclosure should also provide a means of exhausting hot air.

#### *Maintenance Access Requirements*

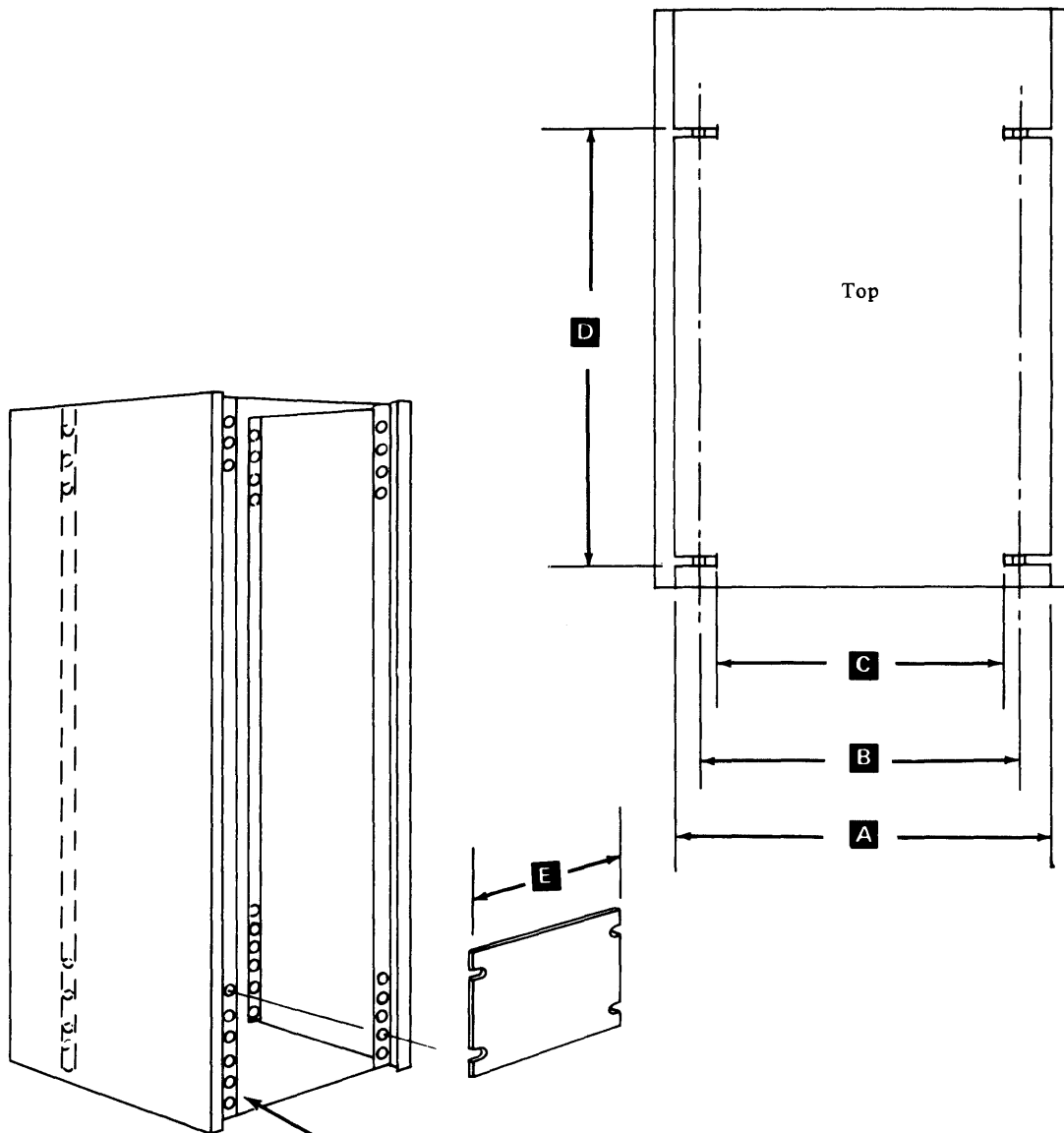
Front and rear service access in a non-IBM enclosure must be equal to that provided in the 4997 units. Non-IBM equipment or cabling should not impair access to the rear of units.

#### *Electromagnetic and Electrostatic Shielding*

To reduce the effects of electromagnetic interference and electrostatic discharge, the enclosure should be totally covered and have a minimum number of openings. The metallic covers should be grounded to the enclosure frame and the frame properly grounded.

### ENCLOSURE POWER REQUIREMENTS

IBM recommends that the user should provide enclosure power distribution equal to that of the 4997 enclosure unit. The 4997 provides AC power distribution with circuit breaker protection, unit power distribution receptacles and an Instant Power Off (IPO) emergency power switch. Figure 1-20 is an example of a typical rack enclosure power distribution diagram.



- A** = 48.4 cm (19.062 in.)
- B** = 46.7 cm (18.312 in.)
- C** = 45.1 cm (17.75 in.)
- D** = 61.0 cm (24.0 in.)
- E** = 48.3 cm (19.0 in.)
- F** = 1.3 cm (0.50 in.)
- G** = 1.6 cm (0.625 in.)
- H** = 4.4 cm (1.750 in.)
- J** = 0.8 cm (0.312 in.)

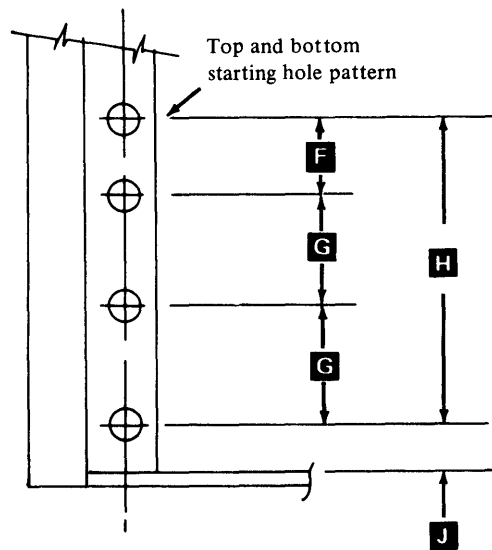


Figure 1-19. Standard EIA enclosure dimensions

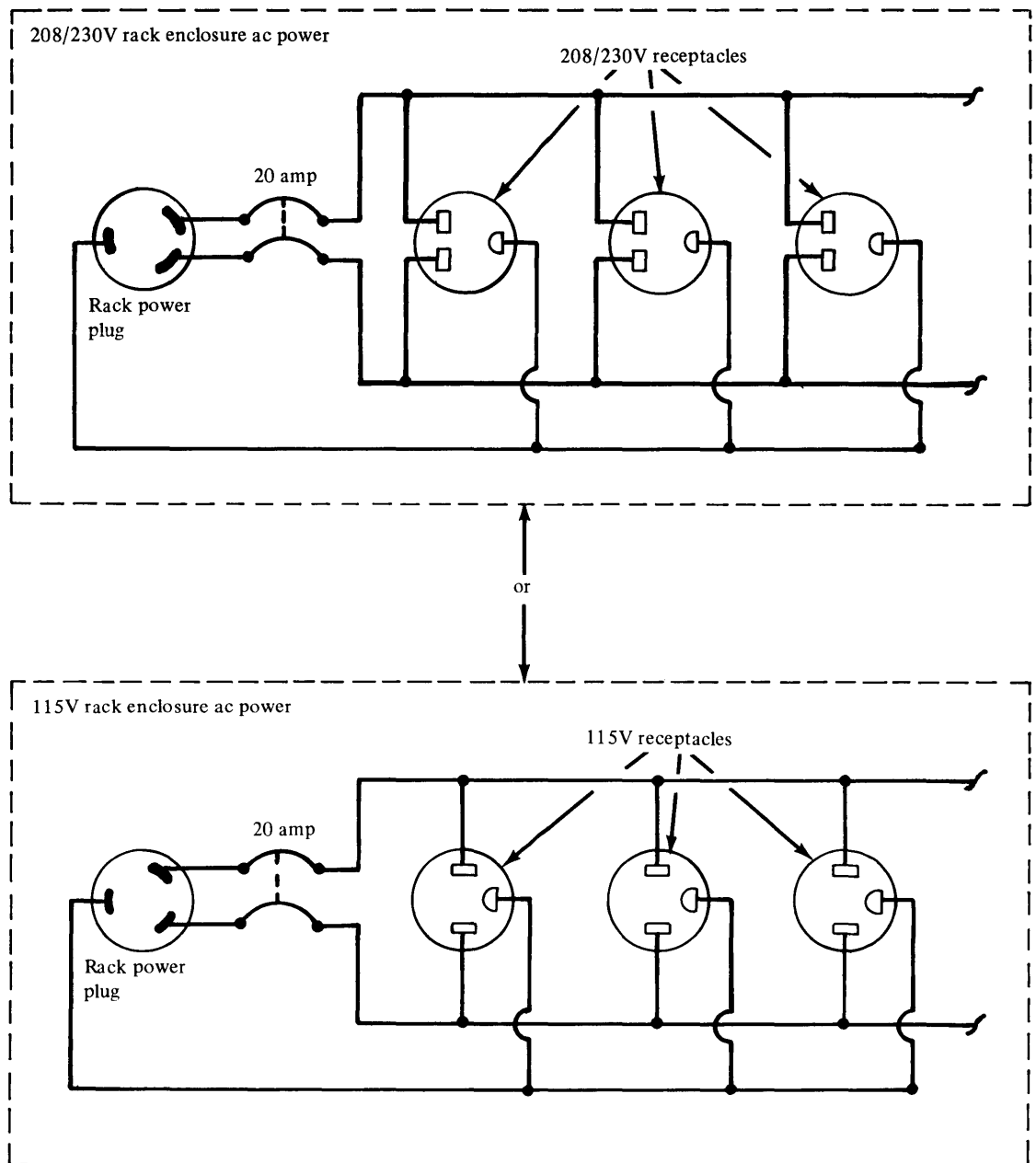


Figure 1-20. Rack enclosure power distribution example

## UNIT MOUNTING

Consult the *IBM Series/1 Configurator*, GA34-0042, for correct unit placement. The devices must be arranged within the rack with weight distribution planned to provide a stable configuration. If a 4962 unit is installed in the rack enclosure, stability feet or supports must be installed to extend a minimum of 150mm (6 in.) in front of the unit. This is a requirement to service the 4962 unit which must be extended (on self contained slides) from the front of the enclosure. These feet or supports should not present a safety tripping hazard during normal use of the equipment.

Rear vertical mounting rails are required when a 4962 is being installed. The dimension between the front and rear rails must be **D** as defined in Figure 1-19.

Horizontal chassis supports are recommended under the sides of units mounted in the rack enclosure.

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## Moving Units to the Installation Site

Moving IBM Series/1 units from a delivery area (loading dock etc.) to the installation site should be planned in advance of the delivery date.

### ROUTE PLANNING

The route chosen to move equipment is very important. IBM 4997 Enclosures may be received in one of two shipping configurations depending on the enclosed units.

1. Configurations ordered in a 4997 Model 2 enclosure, with lower positions 7 and 8 (refer to *IBM Series/1 Configurator*, GA34-0042, for unit positions) not filled will require care during movement. Due to the instability of this shipping configuration, the 4997 will be shipped on a shipping pallet. Figure 1-21 contains the outside dimensions of this configuration.

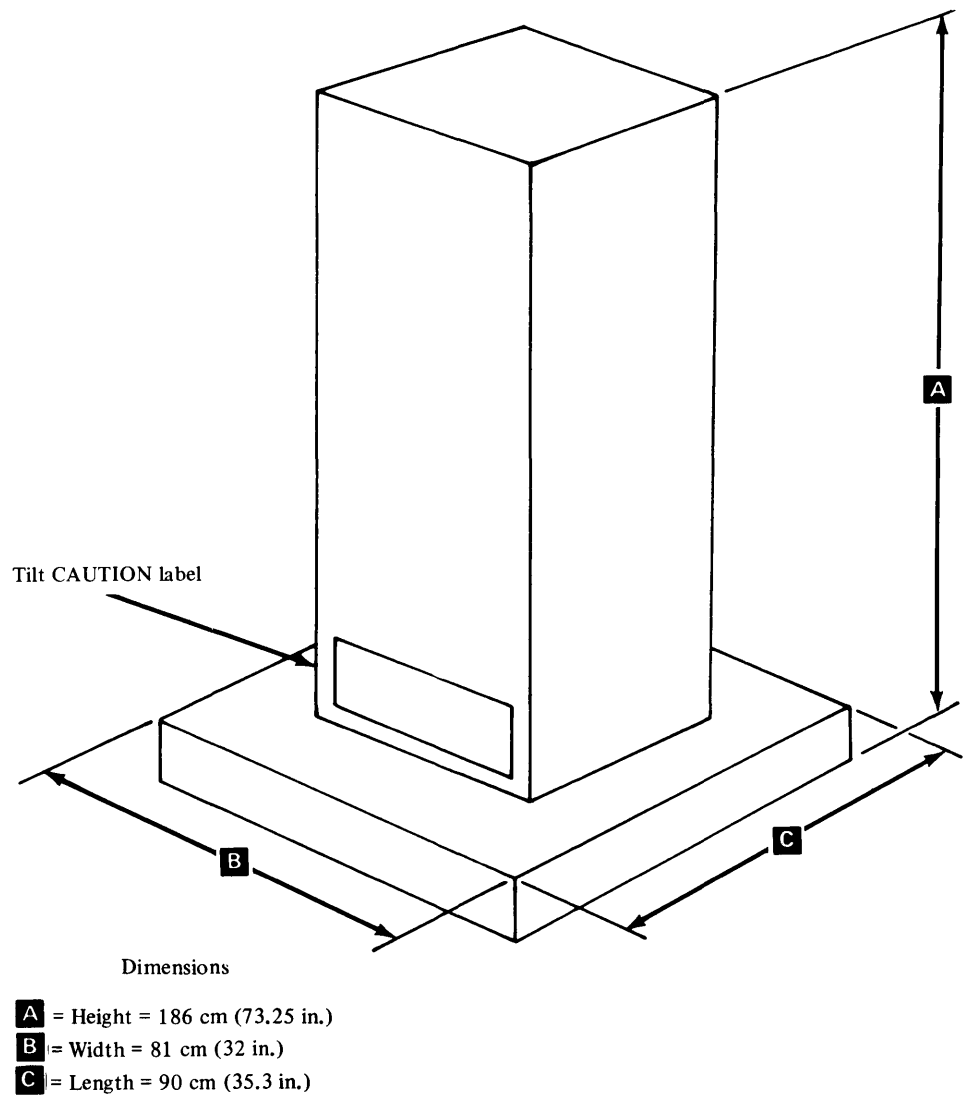
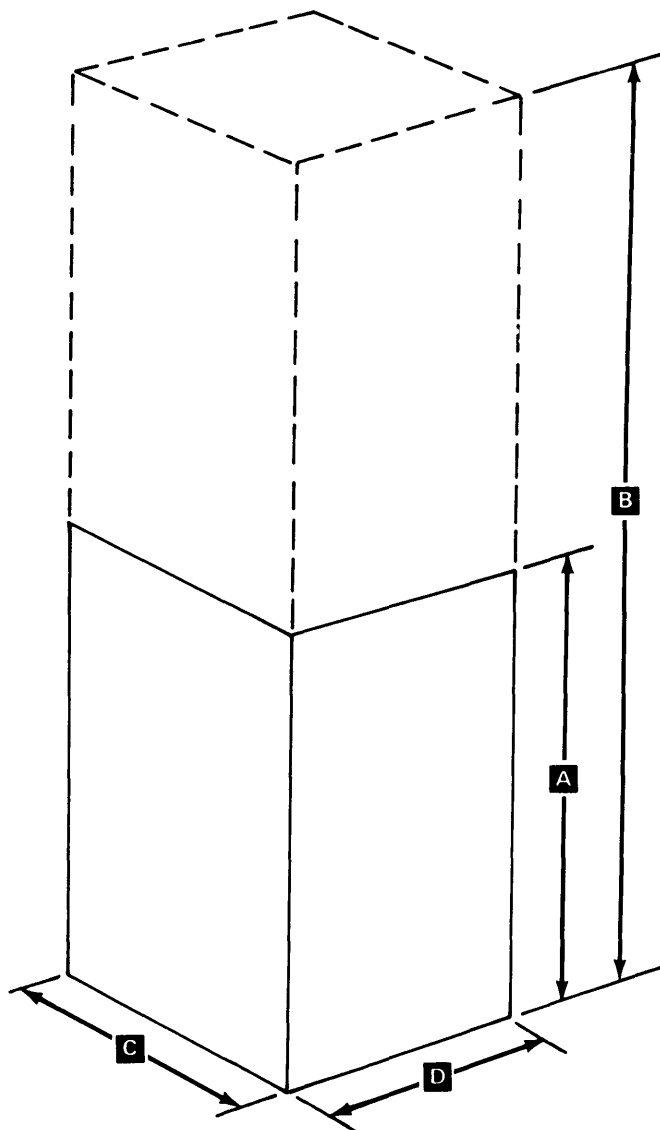


Figure 1-21. Overall shipping dimensions with shipping pallet

2. Insufficient clearance in door openings, hallways, etc. may require removal of the 4997 from the shipping pallet before reaching the installation site area. Before removing the 4997 from the shipping pallet read the caution warning on the lower front of the unit. With positions 7 and 8 empty in the 4997, the configuration becomes unstable if tipped more than 10°. The services of professional movers are recommended for removing the 4997 from the shipping pallet.
3. Configurations shipped in a 4997 Model 2 with 4962 units mounted in positions 7 and 8, or configurations in a 4997 Model 1 will not be shipped on a pallet. Figure 1-22 contains the outside dimensions of these shipping configurations. The 4997 units in this shipping configuration will require a tilt greater than 15° before becoming unstable.



Dimensions

- A** = Height (model 1) = 100 cm (39.4 in.)
- B** = Height (model 2) = 178 cm (70 in.)
- C** = Width = 61 cm (24in.)
- D** = Length = 74.9 cm (29.5 in.)

Figure 1-22. Overall enclosure shipping dimensions without shipping pallet

## MOVING SAFETY CONSIDERATIONS

Both machine safety and personnel safety should be considered when moving the IBM Series/1 configurations to the installation site or relocating units after being installed.

### *Personnel Safety Considerations*

- The Series/1 configurations may weigh up to 290 kg (640 lbs) per bay.
- Observe the tilt warnings for the configuration.
- If units are moved up ramps, additional precautions may be necessary if the tilt angle is exceeded.
- All tilt/safety specifications apply to configurations mounted in a 4997 enclosure. The user must consider tilt and safety specifications for non-IBM rack enclosures.

### *Machine Safety*

- Store the Series/1 units in dry safe areas before moving to the installation site.
- Refrain from excessive shock or careless handling of the units.
- If the configuration must be lifted with ropes, forklift, or other means, ensure a proper lifting procedure is employed to prevent damage.
- For ease in moving, the 4997 should be pushed from the rear since the front casters do not pivot.
- The complete enclosure should remain covered until reaching the installation site to prevent damage.



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## Chapter 2. Unit Specifications

The specifications for each unit are listed in the following pages. The specifications include a plan view which includes dimensions and service clearances, power cord and signal cable entrance and exits, casters and leveling pads where applicable, etc.

Temperature and relative humidity figures defined for each unit are maximum and minimum operating limits and are not to be used as optimum design criteria. Optimum operating figures are stated in the Environmental Conditions section of Chapter 1. The symbols used in the plan views are as follows:

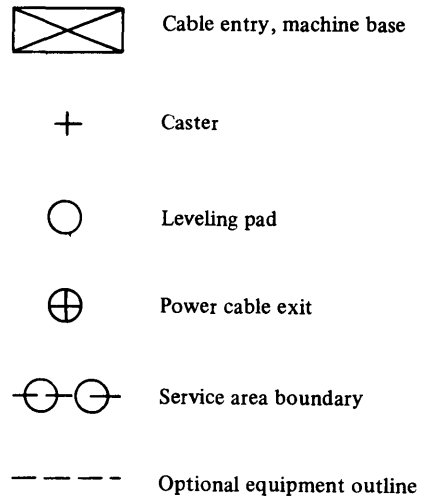


Figure 2-1. Plan view symbols

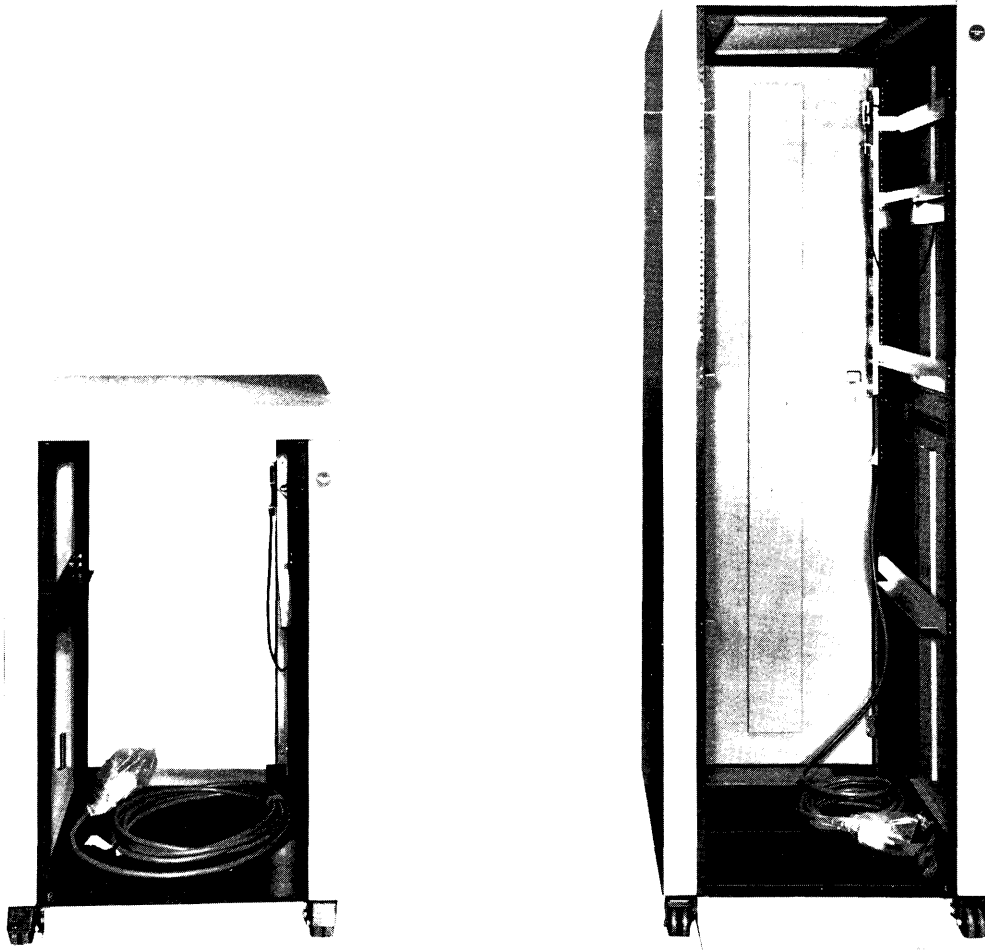
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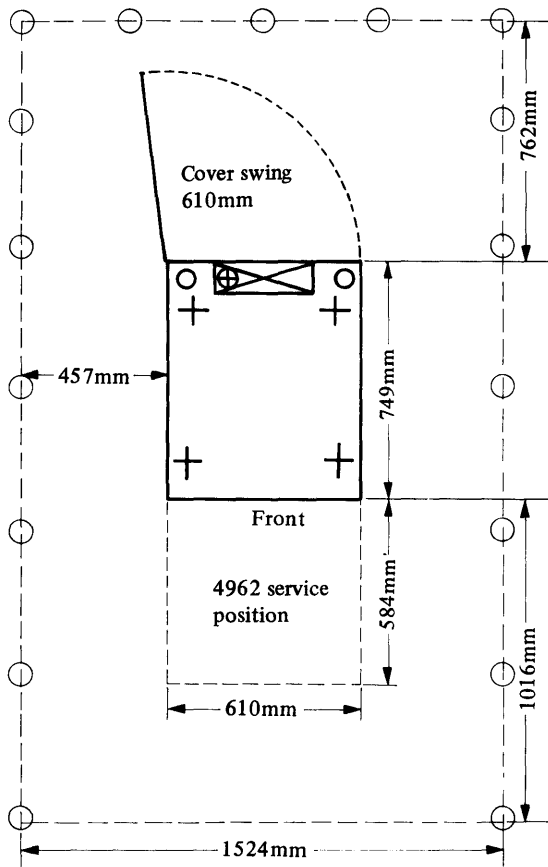
# IBM 4997 Rack Enclosure Model 1A, 1B, 2A and 2B



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**PLAN VIEW**



Millimeters	Inches
1524	60
1016	40
762	30
749	29.5
610	24
584	23
457	18

**SPECIFICATIONS IBM 4997 MODEL 1A and 1B**

**Dimensions**

	<i>Width</i>	<i>Depth</i>	<i>Height</i>
Millimeters	610	749	1000
Inches	24	29.5	39.37

**Service Clearance**

	<i>Front</i>	<i>Rear</i>	<i>Right</i>	<i>Left</i>
Millimeters	1016	762	457	457
Inches	40	30	18	18

**Maximum Weight** 57 kg 125 lbs

**Power Requirements**

Power requirements must be calculated using the System Summary worksheet.

**Power Cord**

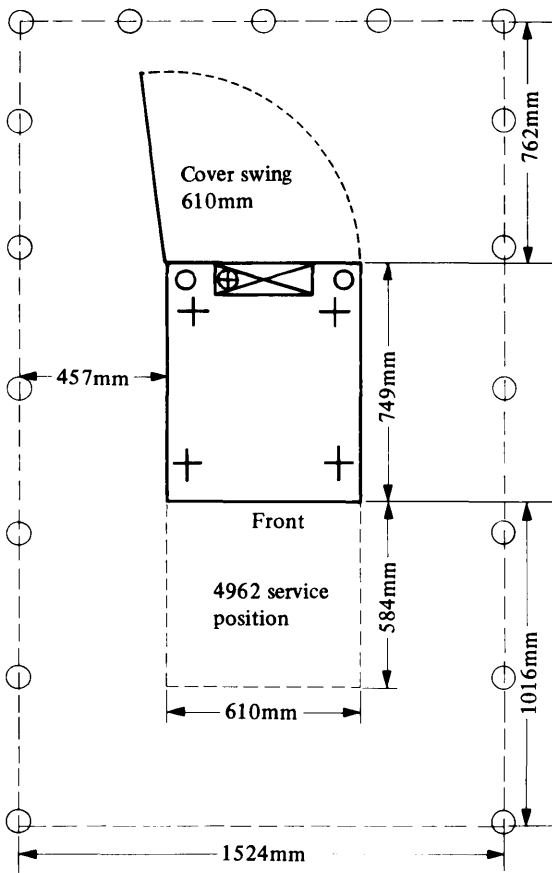
Length	4.2m (14 ft)
Conductors	3
Size	14 AWG

**Power Cord Plugs and Receptacles**

Volts	115	208/230
Plug	NEMA L5-20P	NEMA L6-20P
Receptacle	NEMA L5-20R	NEMA L6-20R



**PLAN VIEW**



Millimeters	Inches
1524	60
1016	40
762	30
749	29.5
610	24
584	23
457	18

**SPECIFICATIONS IBM 4997 MODEL 2A and 2B**

**Dimensions**

	<i>Width</i>	<i>Depth</i>	<i>Height</i>
Millimeters	610	749	1780
Inches	24	29.5	70

**Service Clearance**

	<i>Front</i>	<i>Rear</i>	<i>Right</i>	<i>Left</i>
Millimeters	1016	762	457	457
Inches	40	30	18	18

**Maximum Weight** 107 kg 235 lbs

**Power Requirements**

Power requirements must be calculated using the System Summary worksheet.

**Power Cord**

Length	4.2m (14 ft)
Conductors	3
Size	14 AWG

**Power Cord Plugs and Receptacles**

Volts	115	208/230
Plug	NEMA L5-20P	NEMA L6-20P
Receptacle	NEMA L5-20R	NEMA L6-20R



## VIBRATION LIMITS

It is the responsibility of the user to ensure that the vibration to the rack enclosed units does not exceed the specified values. Refer to Chapter 1, *System Vibration and Shock*, for system vibration requirements.

### *Rack Mounting Fixture*

The rack mounting fixture is used when half width, 216mm (8-½ in.) units are mounted in the rack enclosure. The mounting fixture (Figure 2-2) mounts as a full width, 483mm (19 in.) unit with the half width units mounting inside the fixture.

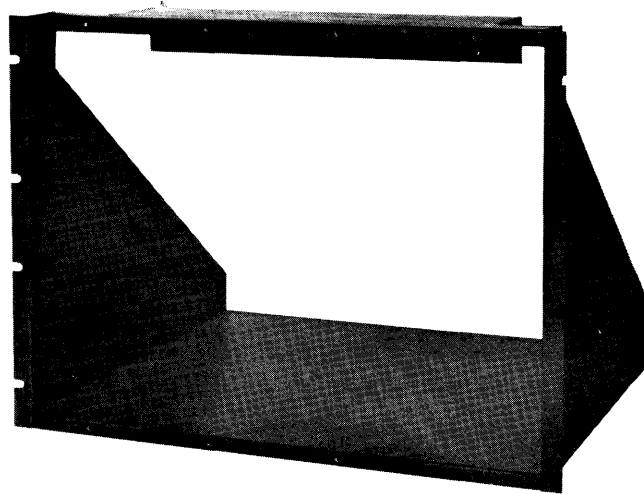


Figure 2-2. Rack mounting fixture

### *Customer Access Panel Mounting*

This unit mounts in the rear of the rack enclosure. The panel provides connectors for the channel attached digital input/output feature, timer feature, customer direct program control feature, and the teletypewriter feature. The assembly mounts to the standard rack mounting screw holes at the lower rear of either the 1.0 or 1.8 metre rack enclosure. Threaded holes are provided beneath each 160 pin receptacle to terminate a ground strap from the mating connector. Figure 2-3 illustrates the customer access panel.

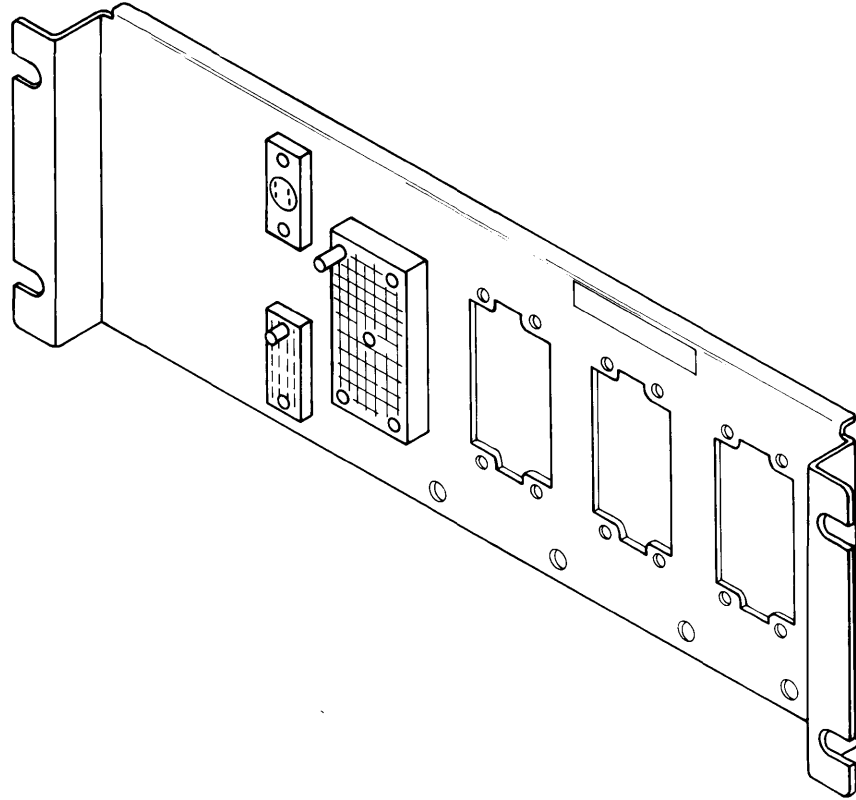


Figure 2-3. Customer access panel



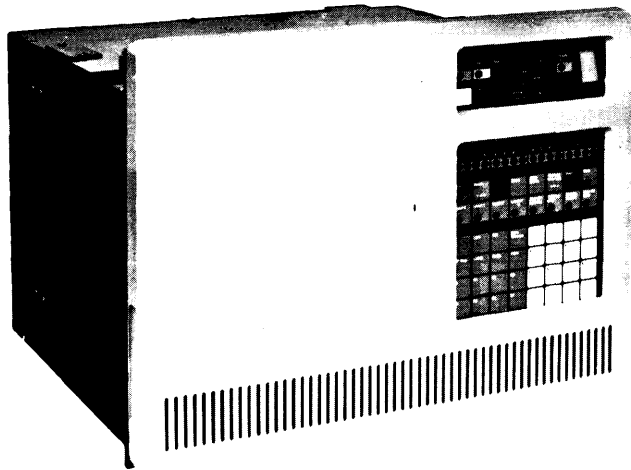
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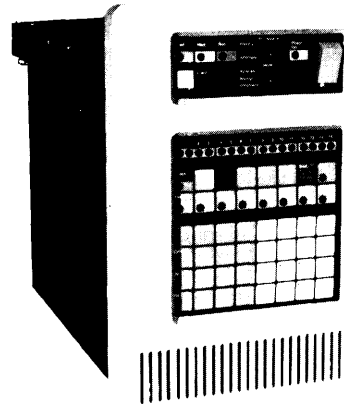
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# IBM Series/1 Model 3 Processors



IBM 4953 Model B and D

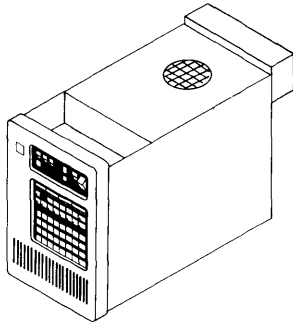


IBM 4953 Model A and C

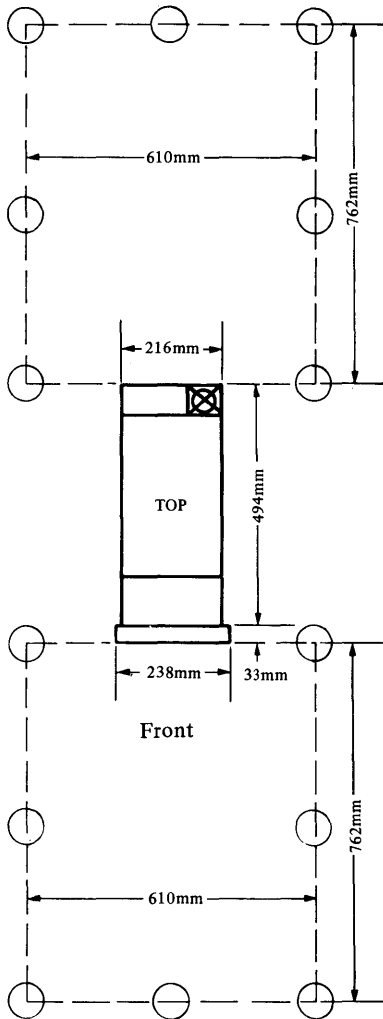
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**IBM 4953 PROCESSOR MODEL A AND C**



**PLAN VIEW**



Millimeters	Inches
762	30
610	24
494	19.5
238	9.37
216	8.5
33	1.3

**SPECIFICATIONS IBM 4953 MODEL A AND C**

**Dimensions**

	<i>Width</i>	<i>Depth</i>	<i>Height</i>
Millimeters	216	527	356
Inches	8.5	20.75	14

**Service Clearance**

	<i>Front</i>	<i>Rear</i>	<i>Right</i>	<i>Left</i>
Millimeters	762	762	0	0
Inches	30	30	0	0

**Weight** 13.6 kg 30 lbs

**Heat Output/Hour** 261.5 kcal 1038 Btu

**Required Airflow** forced air cooling

**Power Requirements (At Full Load)**

*47 to 63Hz*

	<i>Volts</i>	<i>Amps</i>
	115	3.40
	208	1.92
	230	1.74
kVA	0.4	
Phase	1	
Branch circuit	15A	

Turn on and power line disturbance input surge current will not exceed 50 amp peak for a 0.5Hz duration

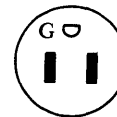
**Power Cord Plugs**

*60Hz*

Length 1.8m 6 ft  
 Conductors 3  
 Size 16 AWG

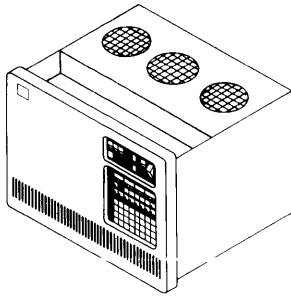
**Power Cord Plugs and Receptacles**

Volts	115	208/230
Plug	(moulded cord set)	(moulded cord set)
Receptacle	NEMA 5-15R	NEMA 6-15R

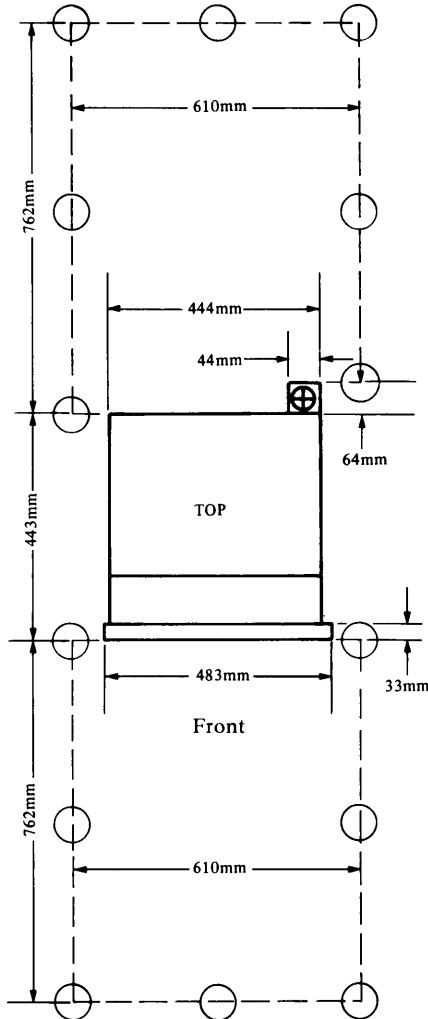


**IBM 4953 PROCESSOR MODEL B AND D**

**SPECIFICATIONS IBM 4953 MODEL B AND D**



**PLAN VIEW**



Millimeters	Inches
762	30
610	24
483	19.0
444	17.48
443	17.45
64	2.5
44	1.73
33	1.3

**Dimensions**

	<i>Width</i>	<i>Depth</i>	<i>Height</i>
Millimeters	483	476	356
Inches	19	18.75	14

**Service Clearance**

	<i>Front</i>	<i>Rear</i>	<i>Right</i>	<i>Left</i>
Millimeters	762	762	0	0
Inches	30	30	0	0

**Weight** 22.7 kg 50 lbs

**Heat Output/Hr.** 430 kcal 1,707 Btu

**Required Airflow** forced air cooling

**Power Requirements (At Full Load)**

*47 to 63Hz*

<i>Volts</i>	<i>Amps</i>
115	7.5
208	3.7
230	3.5

kVA 0.8  
Phase 1  
Branch circuit 15A

Turn on and power line disturbance surge current will not exceed 50 amp peak for a 0.5Hz duration.

**Power Cord**

*60Hz*

Length 1.8m 6 ft  
Conductors 3  
Size 16 AWG

**Power Cord Plugs and Receptacles**

Volts	115	208/230
Plug	(moulded cord set)	(moulded cord set)
Receptacle	NEMA 5-15R	NEMA 6-15R



## AIR COOLING REQUIREMENTS

A consistent volume of air should flow freely through the IBM 4953 unit at the required airflow rate. At installation ensure that a free flow of air through the unit is in accordance with the unit specification requirements. The unit contains a fan and a thermal switch which will drop power if sufficient airflow is not maintained.

## TEMPERATURE AND RELATIVE HUMIDITY

The temperature and relative humidity defined are upper and lower limits and are not to be confused with optimum operating points.

### *Operating Environment (Power On)*

Temperature	10.0°C to 40.6°C	50°F to 105°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Nonoperating Environment (Power Off)*

Temperature	10.0°C to 51.7°C	50°F to 125°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Shipping Environment*

Temperature	-40°C to 60°C	-40°F to 140°F
Relative Humidity (no condensation)	5% to 100%	
Maximum Temperature (Wet bulb)	0.6°C to 29.4°C	33°F to 85°F

## VIBRATION LIMITS

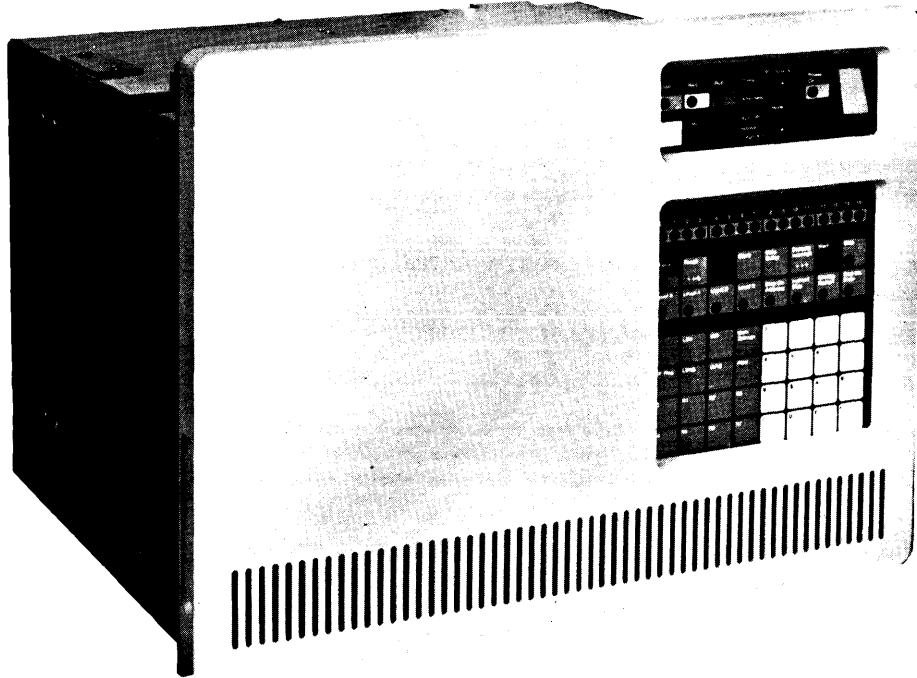
The user is responsible to ensure that the vibration motions induced on the unit from external sources do not exceed the specified levels. The IBM 4953 models are designed to operate within the following limits.

### *Maximum Vibration (Input to Unit Frame)*

5–17Hz	continuous	= .914mm (.036 in.) double amplitude
	transient	= 1.22mm (.048 in.) double amplitude
17–200Hz	continuous	= .55G peak acceleration
	transient	= .73G peak acceleration
200–500Hz	continuous	= .25G peak acceleration
	transient	= .33G peak acceleration

For systems installed in IBM 4997 enclosures, if the system vibration specifications are met, the 4955 unit specifications will be satisfied.

# IBM Series/1 Model 5 Processors



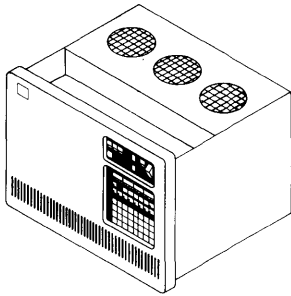
IBM 4955 Model A, B, C, and D

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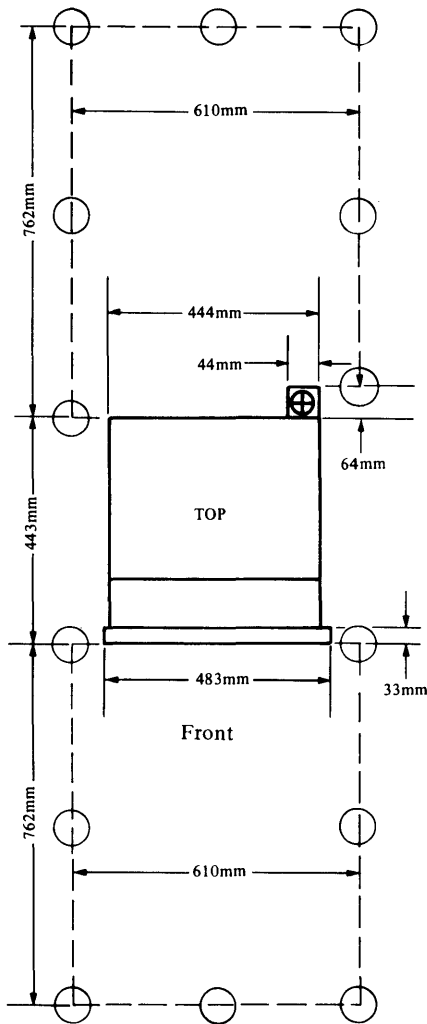
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# IBM 4955 PROCESSORS MODEL A, B, C AND D

# SPECIFICATIONS IBM 4955 MODEL A, B, C AND D



## PLAN VIEW



Millimeters	Inches
762	30
610	24
483	19.0
444	17.48
443	17.44
64	2.5
44	1.73
33	1.3

### Dimensions

	Width	Depth	Height
Millimeters	483	476	356
Inches	19	18.75	14

### Service Clearance

	Front	Rear	Right	Left
Millimeters	762	762	0	0
Inches	30	30	0	0

Weight 22.7 kg 50 lbs

Heat Output/Hr. 430 kcal 1,707 Btu

Required Airflow forced air cooling

### Power Requirements (At Full Load)

47 to 63Hz

Volts	Amps
115	7.5
208	3.7
230	3.5

kVA 0.8  
Phase 1  
Branch circuit 15A

Turn on and power line disturbance input surge current will not exceed 50 amp peak for 0.5Hz duration.

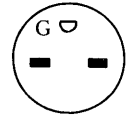
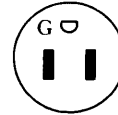
### Power Cord

60Hz

Length 1.8m 6 ft  
Conductors 3  
Size 16 AWG

### Power Cord Plugs and Receptacles

Volts	115	208/230
Plug	(moulded cord set)	(moulded cord set)
Receptacle	NEMA 5-15R	NEMA 6-15R



## AIR COOLING REQUIREMENTS

A consistent volume of air should flow freely through the IBM 4955 unit at the required airflow rate. At installation ensure that a free flow of air through the unit is in accordance with the unit specification requirements. The unit contains a fan and a thermal switch which will drop power if sufficient airflow is not maintained.

## TEMPERATURE AND RELATIVE HUMIDITY

The temperature and relative humidity defined are upper and lower limits and are not to be confused with optimum operating points.

### *Operating Environment (Power On)*

Temperature	10.0°C to 40.5°C	50°F to 105°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Nonoperating Environment (Power Off)*

Temperature	10.0°C to 51.7°C	50°F to 125°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Shipping Environment*

Temperature	-40°C to 60°C	-40°F to 140°F
Relative Humidity (no condensation)	5% to 100%	
Maximum Temperature (Wet bulb)	0.6°C to 29.4°C	33°F to 85°F

## VIBRATION LIMITS

The user is responsible to ensure that the vibration motions induced on the unit from external sources do not exceed the specified levels. The IBM 4955 models are designed to operate within the following limits.

### *Maximum Vibration (Input to Unit Frame)*

5–17Hz	continuous	= .914mm (.036 in.) double amplitude
	transient	= 1.22mm (.048 in.) double amplitude
17–200Hz	continuous	= .55G peak acceleration
	transient	= .73G peak acceleration
200–500Hz	continuous	= .25G peak acceleration
	transient	= .33G peak acceleration

For systems installed in IBM 4997 enclosures, if the system vibration specifications are met, the 4955 unit specifications will be satisfied.



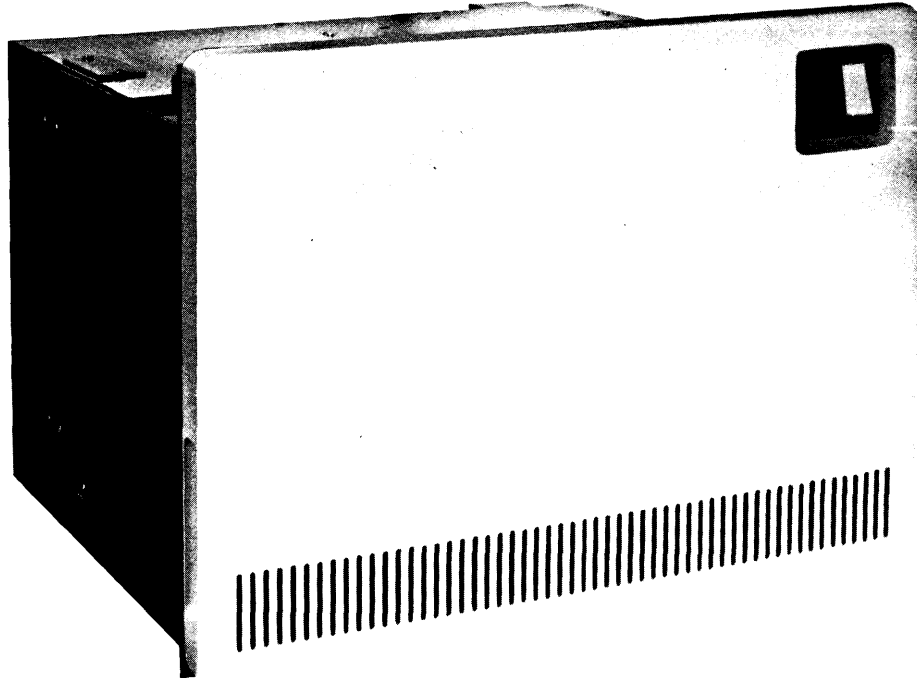
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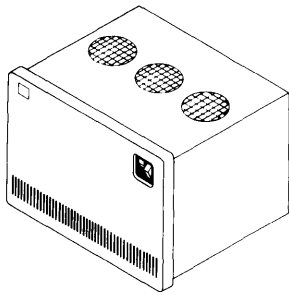
# IBM 4959 Input/Output Expansion Unit Model A



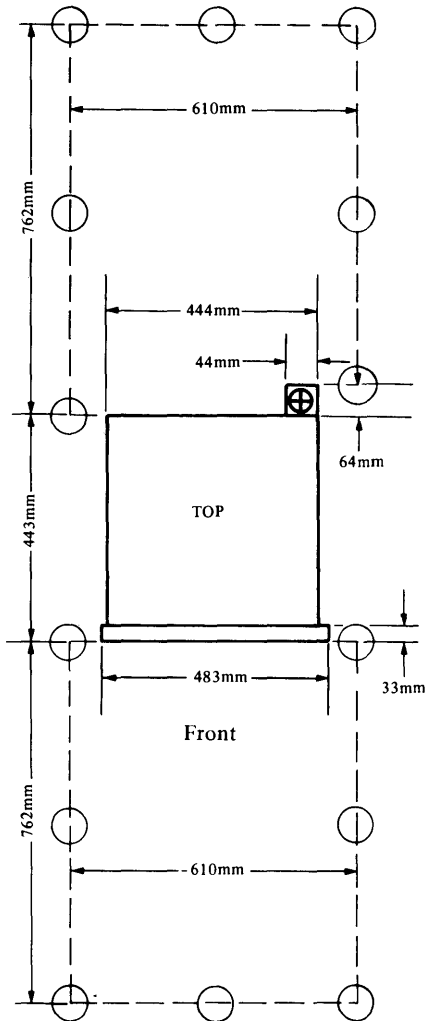
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**IBM 4959**



**PLAN VIEW**



Millimeters	Inches
762	30
610	24
483	19.0
444	17.48
443	17.45
64	2.5
44	1.73
33	1.3

**SPECIFICATIONS**

**Dimensions**

	<i>Width</i>	<i>Depth</i>	<i>Height</i>
Millimeters	483	476	356
Inches	19	18.75	14

**Service Clearance**

	<i>Front</i>	<i>Rear</i>	<i>Right</i>	<i>Left</i>
Millimeters	762	762	0	0
Inches	30	30	0	0

**Weight** 22.7 kg 50 lbs

**Heat Output/Hr.** 430 kcal 1,707 Btu

**Required Airflow** forced air cooling

**Power Requirements (At Full Load)**

*47 to 63Hz*

<i>Volts</i>	<i>Amps</i>
115	7.5
208	3.7
230	3.5

kVA 0.8

Phase 1

Branch circuit 15A

Turn on and power line disturbance input surge current will not exceed 50 amp peak for a 0.5Hz duration.

**Power Cord**

*60Hz*

Length 1.8m 6 ft

Conductors 3

Size 16 AWG

**Power Cord Plugs and Receptacles**

Volts 115  
 Plug (moulded cord set)  
 Receptacle NEMA 5-15R

208/230  
 (moulded cord set)  
 NEMA 6-15R



## AIR COOLING REQUIREMENTS

A consistent volume of air should flow freely through the IBM 4959 unit at the required airflow rate. At installation ensure that a free flow of air through the unit is in accordance with the unit specification requirements. The unit contains a fan and a thermal switch which will drop power if sufficient airflow is not maintained.

## TEMPERATURE AND RELATIVE HUMIDITY

The temperature and relative humidity defined are upper and lower limits and are not to be confused with optimum operating points.

### *Operating Environment (Power On)*

Temperature	10.0°C to 40.6°C	50°F to 105°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Nonoperating Environment (Power Off)*

Temperature	10.0°C to 51.7°C	50°F to 125°F
Relative Humidity	8% to 80%	
Maximum Temperature	26.7°C	80°F

### *Shipping Environment*

Temperature	-40°C to 60°C	-40°F to 140°F
Relative Humidity (no condensation)	5% to 100%	
Maximum Temperature (Wet bulb)	0.6°C to 29.4°C	33°F to 85°F

## VIBRATION LIMITS

The user is responsible to ensure that the vibration motions induced on the unit from external sources do not exceed the specified levels. The IBM 4959 is designed to operate within the following limits.

### *Maximum Vibration (Input to Unit Frame)*

5–17Hz	continuous	= .914mm (.036 in.) double amplitude
	transient	= 1.22mm (.048 in.) double amplitude
17–200Hz	continuous	= .55G peak acceleration
	transient	= .73G peak acceleration
200–500Hz	continuous	= .25G peak acceleration
	transient	= .33G peak acceleration

For systems installed in IBM 4997 enclosures, if the system vibration specifications are met, the 4959 unit specifications will be satisfied.

## SIGNAL CABLES

The 4959 is connected to either the 4953 or 4955 with four flat cables. The length of the cables is approximately 0.91m (3 ft) or 1.8m (6 ft). Cables may exit the top or bottom of the processor and enter either the top or bottom of the I/O expansion unit.

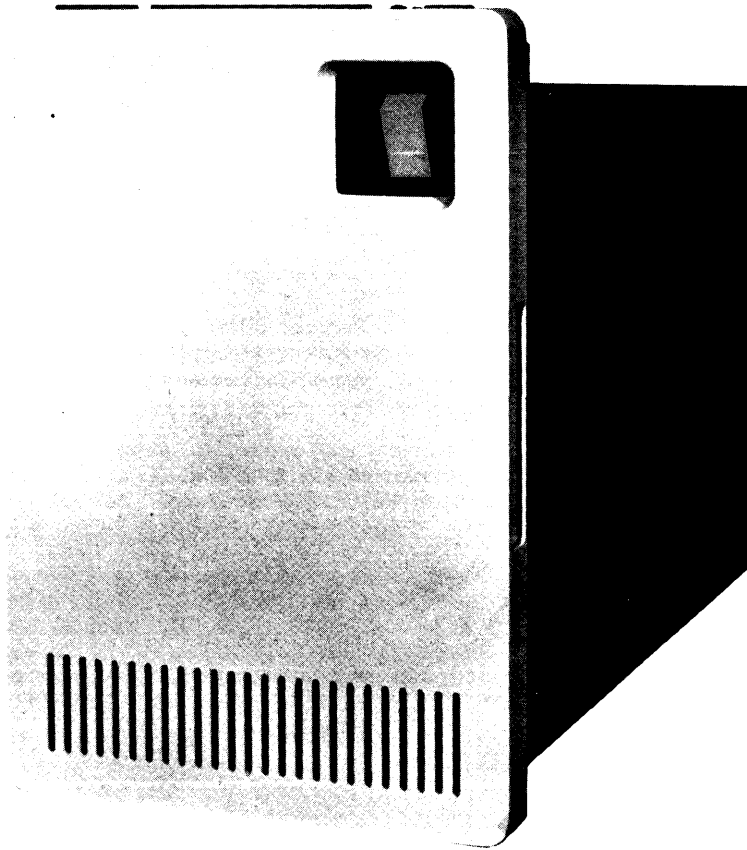
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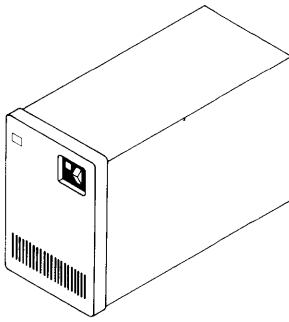
# IBM 4982 Sensor Input/Output Unit Model 1



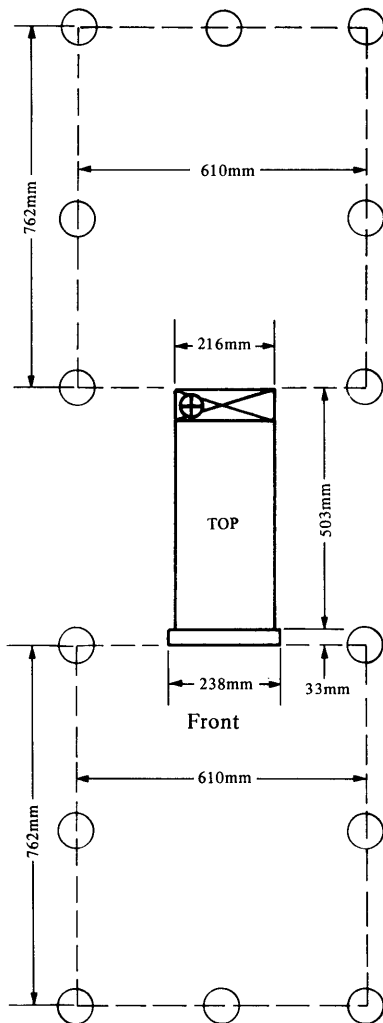
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**IBM 4982**



**PLAN VIEW**



Millimeters	Inches
762	30
610	24
503	19.75
238	9.37
216	8.5
33	1.3

**SPECIFICATIONS**

**Dimensions**

	<i>Width</i>	<i>Depth</i>	<i>Height</i>
Millimeters	216	503	356
Inches	8.5	19.75	14

**Service Clearance**

	<i>Front</i>	<i>Rear</i>	<i>Right</i>	<i>Left</i>
Millimeters	762	762	0	0
Inches	30	30	0	0

**Weight** 20.4 kg 45 lbs

**Heat Output/Hr.** 131.5 kcal 522 Btu

**Required Airflow** natural convection

**Power Requirements (At Full Load)**

<i>60Hz ± .5</i>	
<i>Volts</i>	<i>Amps</i>
115	2
208 } 230 }	1
<b>kVA</b>	0.2
<b>Phase</b>	1
<b>Branch circuit</b>	15A

Turn on and power line disturbance input surge current will not exceed 60 amp peak for 0.5Hz duration and 30 amp peak for a 5.0Hz duration.

**Power Cord**

	<i>60Hz</i>
<b>Length</b>	1.8m 6 ft
<b>Conductors</b>	3
<b>Size</b>	1mm

**Power Cord Plugs and Receptacles**

<b>Volts</b>	115	208/230
<b>Plug</b>	(moulded cord set)	(moulded cord set)
<b>Receptacle</b>	NEMA 5-15R	NEMA 6-15R



## AIR COOLING REQUIREMENTS

Unit cooling air is by natural warm air convection. Air flow should not be blocked in any way.

## TEMPERATURE AND RELATIVE HUMIDITY

The temperature and relative humidity defined are upper and lower limits and are not to be confused with optimum operating points.

### *Operating Environment (Power On)*

Temperature	10.0° C to 40.6° C	50° F to 105° F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7° C	80° F

### *Nonoperating Environment (Power Off)*

Temperature	10.0° C to 51.7° C	50° F to 125° F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7° C	80° F

### *Shipping Environment*

Temperature	-40° C to 60° C	-40° F to 140° F
Relative Humidity (no condensation)	5% to 100%	
Maximum Temperature (Wet bulb)	0.6° C to 29.4° C	33° F to 85° F

## VIBRATION LIMITS

The user is responsible to ensure that the vibration motions induced on the unit from external sources do not exceed the specified levels. The IBM 4982 is designed to operate within the following limits.

### *Maximum Vibration (Input to Unit Frame)*

5–17Hz	continuous	=	.914mm (.036 in.) double amplitude
	transient	=	1.22mm (.048 in.) double amplitude
17–200Hz	continuous	=	.55G peak acceleration
	transient	=	.73G peak acceleration
200–500Hz	continuous	=	.25G peak acceleration
	transient	=	.33G peak acceleration

For systems installed in IBM 4997 enclosures, if the system vibration specifications are met, the 4982 unit specifications will be satisfied.

## SIGNAL CABLES

1. The 4982 Sensor Input/Output Unit Attachment Feature card connects to the IBM 4982 with three cables. The cables are approximately 3.05m (10 ft) in length.
2. The cabling from the IBM 4982 to the user's devices is the responsibility of the user.



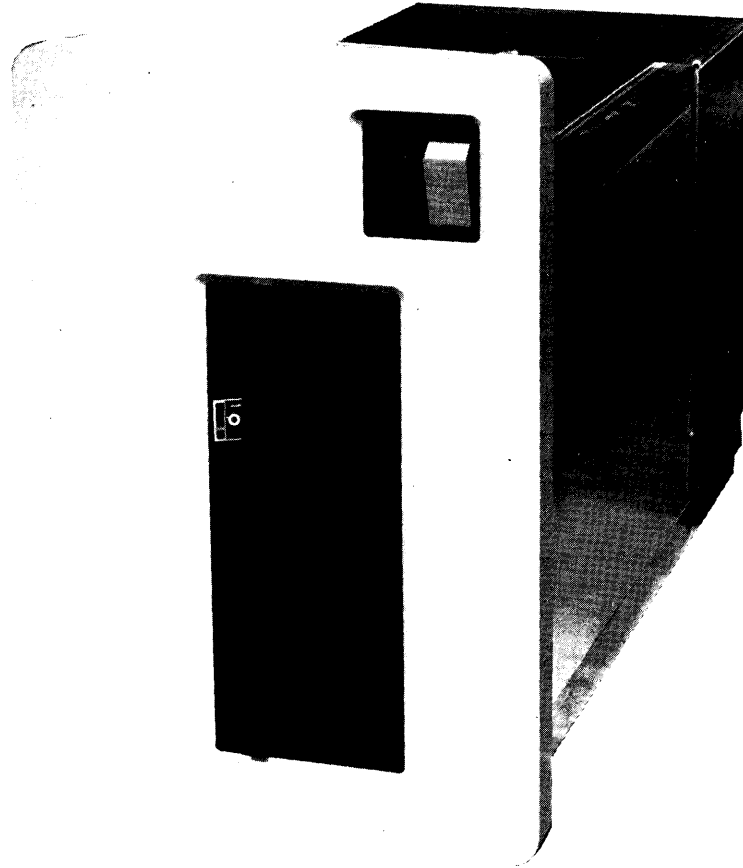
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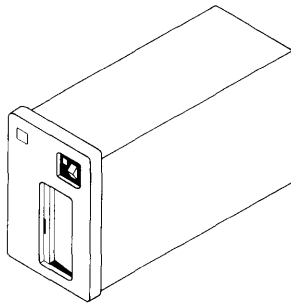
# IBM 4964 Diskette Unit Model 1



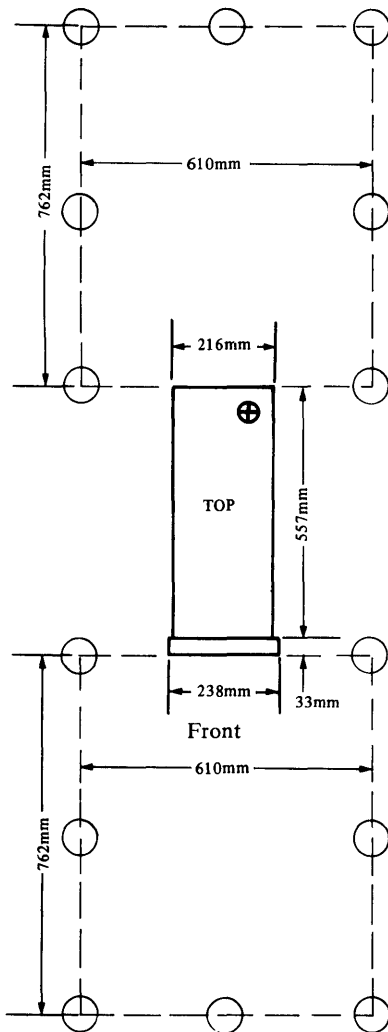
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**IBM 4964**



**PLAN VIEW**



Millimeters	Inches
762	30
610	24
557	21.93
238	9.37
216	8.5
33	1.3

**SPECIFICATIONS**

**Dimensions**

	<i>Width</i>	<i>Depth</i>	<i>Height</i>
Millimeters	216	590	356
Inches	8.5	23.25	14

**Service Clearance**

	<i>Front</i>	<i>Rear</i>	<i>Right</i>	<i>Left</i>
Millimeters	762	762	0	0
Inches	30	30	0	0

**Weight** 18.1 kg 40 lbs

**Heat Output/Hr.** 197.8 kcal 785 Btu

**Required Airflow** convection cooling (with internal fan)

**Power Requirements (At Full Load)**

60Hz  $\pm$  .5

	<i>Volts</i>	<i>Amps</i>
	115	1.9
	208 } 230 }	1.0

kVA 0.22

Phase 1

Branch circuit 15A

**Power Cord**

60Hz

Length 1.8m 6 ft

Conductors 3

Size 18 AWG

**Power Cord Plugs and Receptacles**

Volts 115  
 Plug (moulded cord set)  
 Receptacle NEMA 5-15R

208/230  
 (moulded cord set)  
 NEMA 6-15R



## AIR COOLING REQUIREMENTS

A consistent flow of air should flow freely through the IBM 4964 unit at the required rate.

## TEMPERATURE AND RELATIVE HUMIDITY

The temperature and relative humidity defined are upper and lower limits and are not to be confused with optimum operating points.

### *Operating Environment (Power On)*

Temperature	10.0°C to 40.6°C	50°F to 105°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Nonoperating Environment (Power Off)*

Temperature	10.0°C to 51.7°C	50°F to 125°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Shipping Environment*

Temperature	-40°C to 60°C	-40°F to 140°F
Relative Humidity (no condensation)	5% to 100%	
Maximum Temperature (Wet bulb)	0.6°C to 29.4°C	33°F to 85°F

## VIBRATION LIMITS

The user is responsible to ensure that the vibration motions induced on the 4964 unit from external sources do not exceed the specified levels. The IBM 4964 is designed to operate within the following limits.

### *Maximum Vibration (Input to Unit Frame)*

5–25Hz	continuous	= .254mm (.010 in.) double amplitude
	transient	= .381mm (.015 in.) double amplitude
25–150Hz	continuous	= .30G peak acceleration
	transient	= .40G peak acceleration
200–500Hz	continuous	= .15G peak acceleration
	transient	= .25G peak acceleration

For systems installed in IBM 4997 enclosures, if the system vibration specifications are met, the 4964 unit specifications will be satisfied.

## SIGNAL CABLES

The 4964 Diskette Attachment Feature card connects to the IBM 4964 Diskette Unit with a cable. The length of the cable is approximately 4.57m (15 ft).

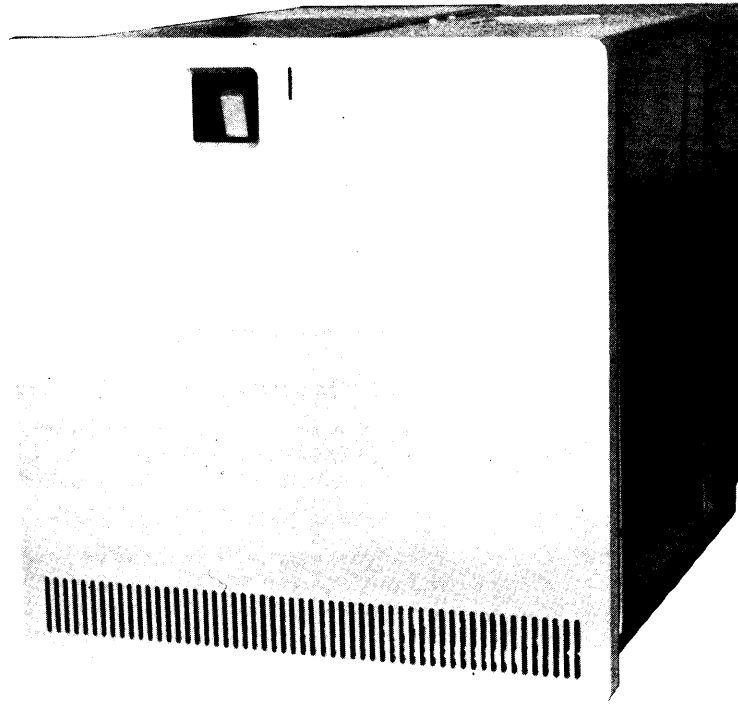
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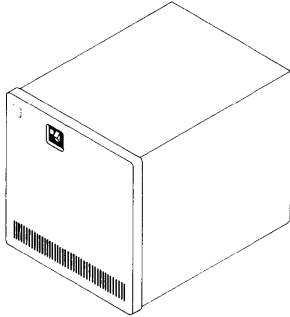
# IBM 4962 Disk Storage Unit Model 1, 1F, 2, 2F



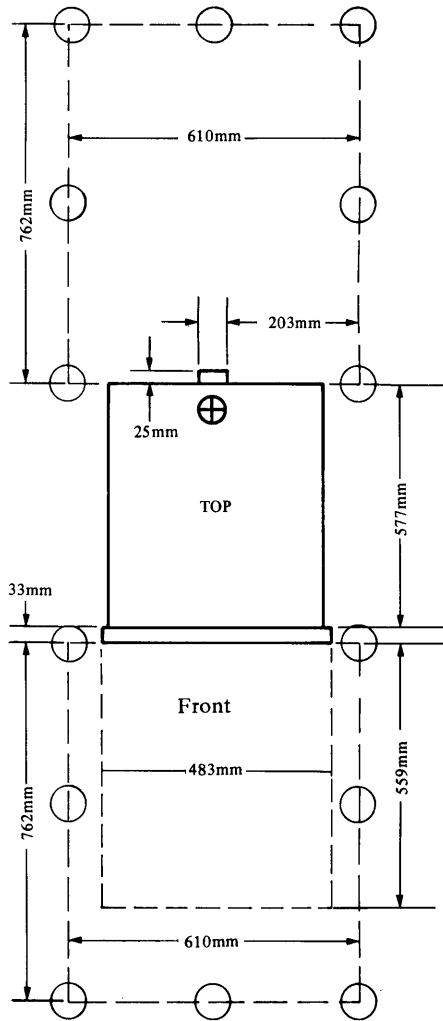
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**IBM 4962 MODEL 1, 1F**



**PLAN VIEW**



Millimeters	Inches
762	30
610	24
577	22.72
559	22.0
483	19.0
444	17.48
203	8.0
33	1.3
25	1.0

**SPECIFICATIONS MODEL 1, 1F**

**Dimensions**

	<i>Width</i>	<i>Depth</i>	<i>Height</i>
Millimeters	483	610	489
Inches	19	24	19.25

**Service Clearance**

	<i>Front</i>	<i>Rear</i>	<i>Right</i>	<i>Left</i>
Millimeters	762	762	0	0
Inches	30	30	0	0

The 4962 extends on self contained slides indicated in the plan view.

**Weight** 61.2 kg 135 lbs

**Heat Output/Hr.** 413 kcal 1640 Btu

**Required Airflow** convection cooling (with internal fan)

**Power Requirements (At Full Load)**

60Hz ± .5

<i>Volts</i>	<i>Amps</i>
115	5.1
208	2.5
230	

kVA 0.65  
 Phase 1  
 Branch Circuit 15A

**Power Cord**

60Hz

Length 1.8m 6 ft  
 Conductors 3  
 Size 18 AWG

**Power Cord Plugs and Receptacles**

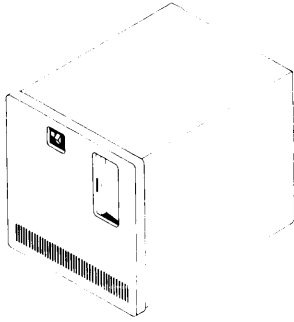
Volts 115  
 Plug (moulded cord set)  
 Receptacle NEMA 5-15R

208/230  
 (moulded cord set)  
 NEMA 6-15R

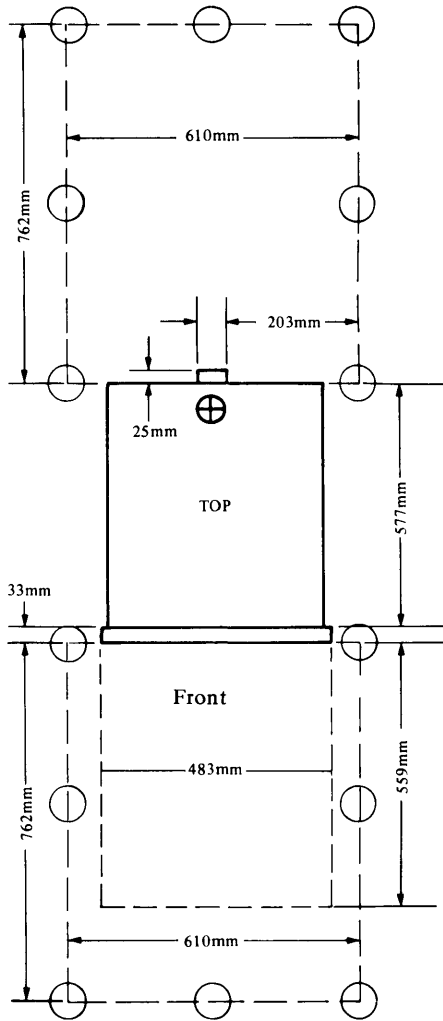


# IBM 4962 MODEL 2, 2F

# SPECIFICATIONS MODEL 2, 2F



## PLAN VIEW



Millimeters	Inches
762	30
610	24
577	22.72
559	22.0
483	19.0
444	17.48
203	8.0
33	1.3
25	1.0

### Dimensions

	Width	Depth	Height
Millimeters	483	610	489
Inches	19	24	19.25

### Service Clearance

	Front	Rear	Right	Left
Millimeters	762	762	0	0
Inches	30	30	0	0

The 4962 extends on self contained slides indicated in the plan view.

**Weight** 68.0 kg 150 lbs

**Heat Output/Hr.** 481 kcal 1910 Btu

**Required Airflow** convection cooling (with internal fan)

### Power Requirements (At Full Load)

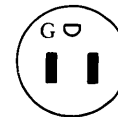
	60Hz ± .5	
	Volts	Amps
	115	6.1
	208	3.25
	230	
kVA	0.7	
Phase	1	
Branch Circuit	15A	

### Power Cord

	60Hz
Length	1.8m 6 ft
Conductors	3
Size	18 AWG

### Power Cord Plugs and Receptacles

Volts	115	208/230
Plug	(moulded cord set)	(moulded cord set)
Receptacle	NEMA 5-15R	NEMA 6-15R





## AIR COOLING REQUIREMENTS

A consistent volume of air should flow freely through the IBM 4962 unit at the required airflow rate.

## TEMPERATURE AND RELATIVE HUMIDITY

The temperature and relative humidity defined are upper and lower limits and are not to be confused with optimum operating points.

### *Operating Environment (Power On)*

Temperature	*10.0°C to 40.6°C	50°F to 105°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Nonoperating Environment (Power Off)*

Temperature	10.0°C to 51.7°C	50°F to 125°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Shipping Environment*

Temperature	-40°C to 60°C	-40°F to 140°F
Relative Humidity (no condensation)	5% to 100%	
Maximum Temperature (Wet bulb)	0.6°C to 29.4°C	33°F to 85°F

\* 90% of each exterior cover surface must not exceed 52°C (125°F).

## VIBRATION LIMITS

The user is responsible to ensure that the vibration motions induced in the 4962 unit from external sources do not exceed the specified levels. The 4962 is designed to operate within the following limits.

### *Maximum Vibration (Input to Unit Frame)*

5–24Hz	continuous	=	0.254mm (.010 in.) double amplitude
	transient	=	0.381mm (.015 in.) double amplitude
24–120Hz	continuous	=	.3G peak acceleration
	transient	=	.4G peak acceleration
200–500Hz	continuous	=	.15G peak acceleration
	transient	=	.23G peak acceleration

Assume “G” levels from 120Hz to 200Hz to be linear.

For systems installed in IBM 4997 enclosures, if the system vibration specifications are met, the 4962 unit specifications will be satisfied.

## SERVICE ACCESSIBILITY

For servicing, it is necessary to extend the IBM 4962 completely out of the rack on self contained slides. Due to weight and service considerations the unit should be mounted at the bottom of the rack. Adequate service areas to the right, left, and front of the extended unit must be provided. It is the user's responsibility to ensure that the enclosure will not tip when the 4962 unit is fully extended. The 4962 unit is not to be installed any higher than 105.5cm (41.5 in.) from the top of the unit to the floor.

## SIGNAL CABLES

The 4962 Disk Attachment Feature card connects to the 4962 with four flat cables. The length of the cables is approximately 4.57m (15 ft).

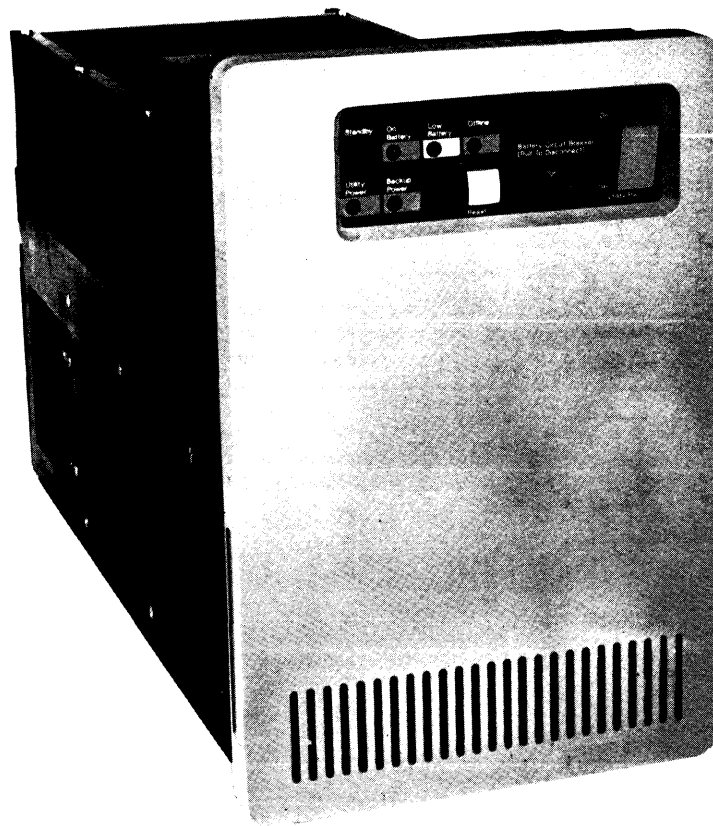
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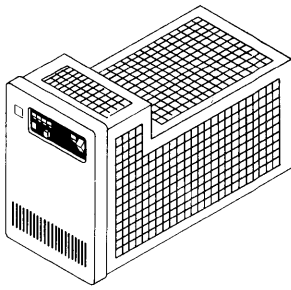
# IBM 4999 Battery Backup Unit Model 1 and 2



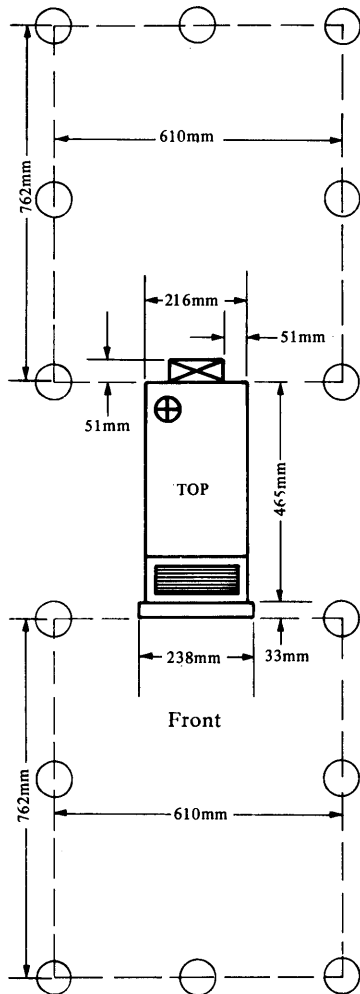
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Battery Charger Requirements	2-38
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Battery Safety	2-38

# IBM 4999 MODEL 1



## PLAN VIEW



Millimeters	Inches
762	30
610	24
465	18.31
238	9.37
216	8.5
51	2.0
33	1.3

# SPECIFICATIONS MODEL 1

## Dimensions

	<i>Width</i>	<i>Depth</i>	<i>Height</i>
Millimeters	216	508	356
Inches	8.5	20	14

## Service Clearance

	<i>Front</i>	<i>Rear</i>	<i>Right</i>	<i>Left</i>
Millimeters	762	762	0	0
Inches	30	30	0	0

**Weight** 32.2 kg 71 lbs

**Heat Output/Hr.** 94 kcal 375 Btu

**Required Airflow** convection cooling

## Power Requirements

47-63 Hz  
100V minimum  
127V maximum

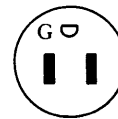
kVA 0.1 (plus attached processor)  
Phase 1  
Branch circuit 15A

## Power Cord

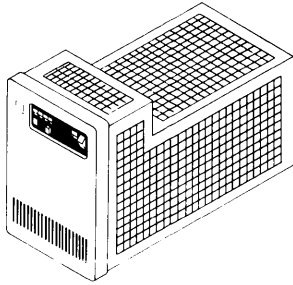
Length 1.8m 6 ft  
Conductors 3  
Size 16 AWG

## Power Cord Plugs and Receptacles

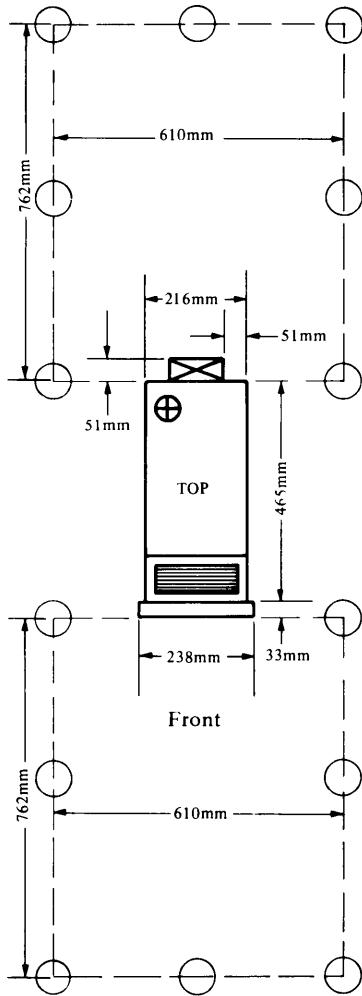
Volts 115  
Plug (moulded cord set)  
Receptacle NEMA 5-15R



**IBM 4999 MODEL 2**



**PLAN VIEW**



Millimeters	Inches
762	30
610	24
465	18.31
238	9.37
216	8.5
51	2.0
33	1.3

**SPECIFICATIONS MODEL 2**

**Dimensions**

	<i>Width</i>	<i>Depth</i>	<i>Height</i>
Millimeters	216	508	356
Inches	8.5	20	14

**Service Clearance**

	<i>Front</i>	<i>Rear</i>	<i>Right</i>	<i>Left</i>
Millimeters	762	762	0	0
Inches	30	30	0	0

**Weight** 32.2 kg 71 lbs

**Heat Output/Hr.** 94 kcal 375 Btu

**Required Airflow** convection cooling

**Power Requirements**

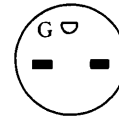
47-63 HZ  
 200V minimum  
 200V maximum  
 kVA 0.1 (plus attached processor)  
 Phase 1  
 Branch circuit 15A

**Power Cord**

Length 1.8m 6 ft  
 Conductors 3  
 Size 16 AWG

**Power Cord Plugs and Receptacles**

Volts 208/230  
 Plug (moulded cord set)  
 Receptacle NEMA 6-15R



## VIBRATION LIMITS

The user is responsible to ensure that the vibration motions induced in the 4999 unit from external sources do not exceed the specified levels. The IBM 4999 unit is designed to operate within the following limits:

### *Maximum Vibration (Input to Unit Frame)*

5–17Hz	continuous	=	0.914mm (.036 in.) double amplitude
	transient	=	1.22mm (.048 in.) double amplitude
17–200Hz	continuous	=	.55G peak acceleration
	transient	=	.73G peak acceleration
200–500Hz	continuous	=	.25G peak acceleration
	transient	=	.33G peak acceleration

For systems installed in IBM 4997 enclosures, if the system vibration specifications are met, the 4999 unit specifications will be satisfied.

## BATTERY REQUIREMENTS

It is the users responsibility to supply a battery with the proper specifications to operate with the IBM 4999 Battery Backup Unit. The recommended battery is a sealed 12V automotive type of 100 ampere-hour rating or more.

## BATTERY CHARGER REQUIREMENTS

It is the responsibility of the user to supply a charger with recharge capabilities to meet the anticipated battery usage or demands. Normally, recharge at the 30-hour rate is sufficient but if the commercial power experiences more interruptions and/or downtime than normal, a charger with a 10-hour rate may be required. The charger should have a 3 conductor line cord and be U.L. approved.

## BATTERY WIRING REQUIREMENTS

The lug clamps on the Battery Backup unit connection block will adjust to accommodate stranded insulated wire gauges from #8 to #2 AWG. The wires must be identified as + and – and should be twisted together or laced to reduce inductance and electrical noise.

The following specifies the maximum length of each wire size that may be used between the battery backup unit and the batteries.

Distance less than 1067mm (42 in)	#8 AWG or heavier
Distance less than 1676mm (66 in)	#6 AWG or heavier
Distance less than 2591mm (102 in)	#4 AWG or heavier
Distance less than 4115mm (162 in)	#2 AWG

Because of wire size restrictions, the maximum length of wires is 4115mm (162 in).

## BATTERY SAFETY

Batteries represent a concentrated source of energy which remains when the battery circuit is opened. Thus, special attention has to be paid to shield and isolate the battery terminals and connections to permit safe servicing. Vented batteries (if used) generate a hydrogen/oxygen mixture when charging, and if exposed to flame or sparks may explode or could cause corrosive damage to equipment. No smoking may be required where batteries are charging.

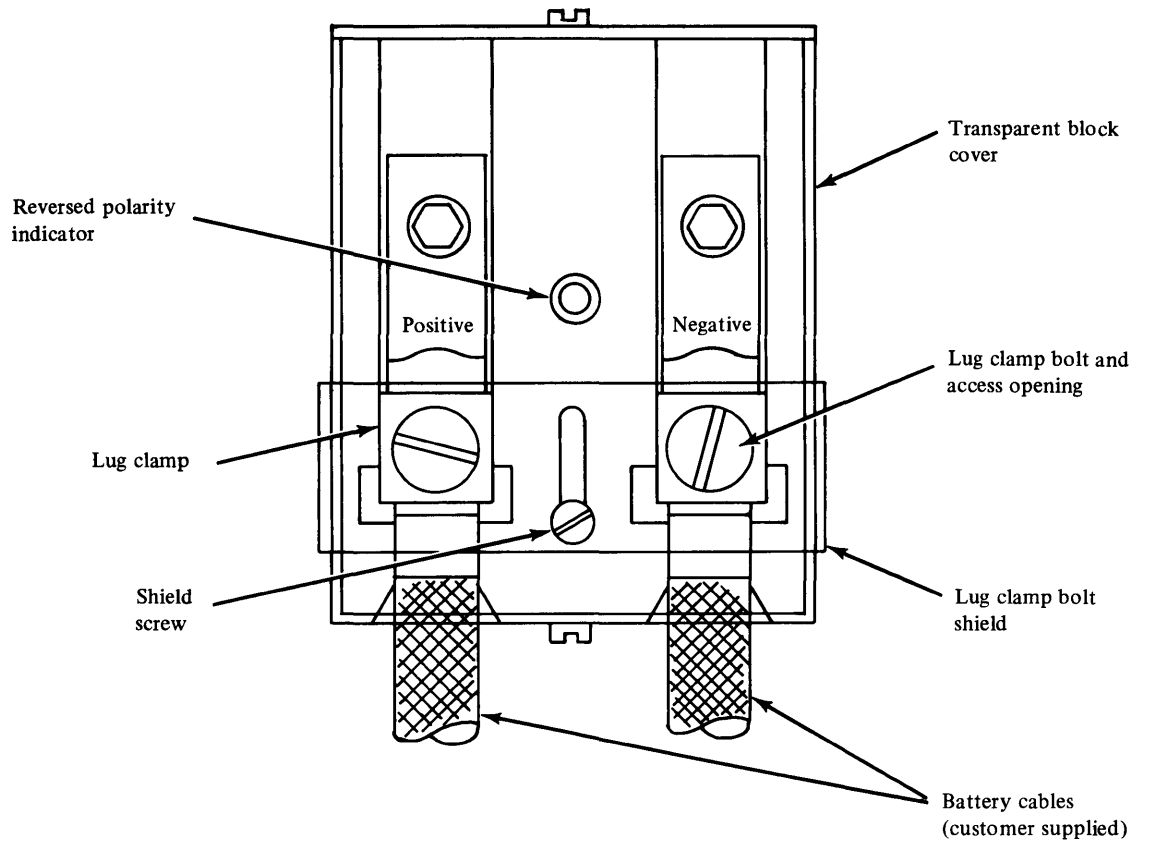


Figure 2-4. Battery Backup unit connection block



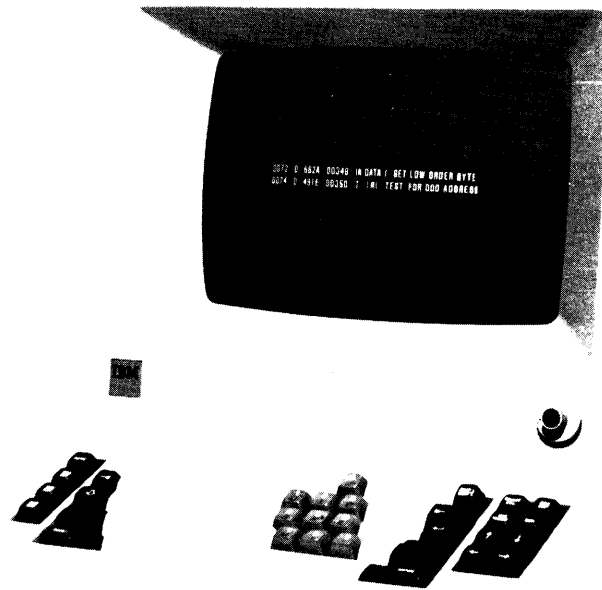
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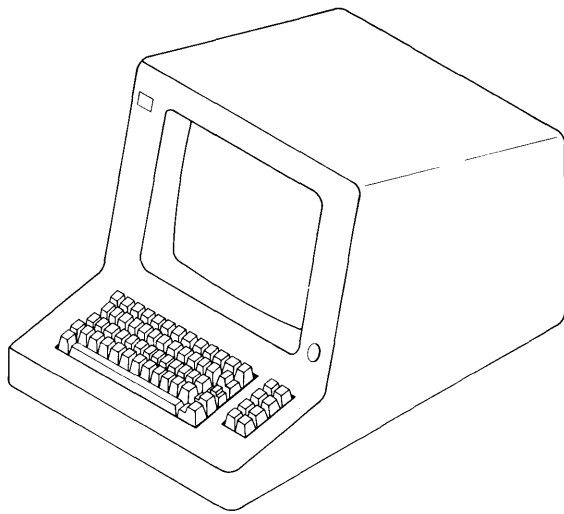
# IBM 4979 Display Station Model 1



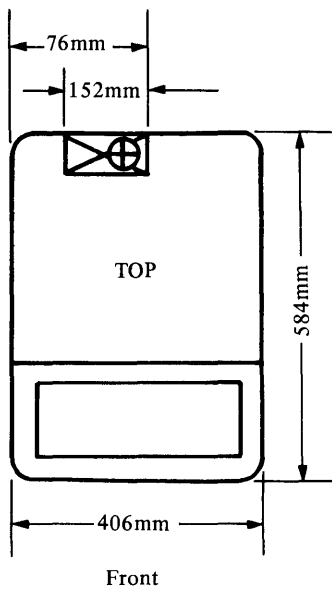
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**IBM 4979**



**PLAN VIEW**



Millimeters	Inches
584	23.0
406	15.98
152	5.98
76	3.0

**SPECIFICATIONS**

**Dimensions**

	<i>Width</i>	<i>Depth</i>	<i>Height</i>
Millimeters	406	584	381
Inches	16	23	15

**Service Clearance**

The 4979 Display Station is a free standing table top unit and may be moved in all directions for adequate service clearance

<b>Weight</b>	13,6 kg	30 lbs
<b>Heat Output/Hr.</b>	98,9 kcal	392 Btu
<b>Required Airflow</b>	convection cooling	

**Power Requirements**

	<i>60Hz ± .5</i>	
	<i>Volts</i>	<i>Amps</i>
	115	.1
	208 } 230 }	.5
kVA	0.1	
Phase	1	
Branch Circuit	15A	

**Power Cord**

	<i>60Hz</i>	
Length	1.8m 6 ft	
Conductors	3	
Size	18 AWG	

**Power Cord Plugs and Receptacles**

Volts	115	208/230
Plug	(moulded cord set)	(moulded cord set)
Receptacle	NEMA 5-15R	NEMA 6-15R



## AIR COOLING REQUIREMENTS

Adequate space must be left around the 4979 Display Station to allow necessary cooling airflow to the device. A minimum of 51mm (2 in.) clear of obstructions must be provided above the unit to insure warm air exhaust.

## TEMPERATURE AND RELATIVE HUMIDITY

The temperature and relative humidity defined are upper and lower limits and are not to be confused with optimum operating points.

### *Operating Environment (Power On)*

Temperature	10.0°C to 40.6°C	50°F to 105°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Nonoperating Environment (Power Off)*

Temperature	10.0°C to 51.7°C	50°F to 125°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Shipping Environment*

Temperature	-20°C to 60°C	-4°F to 140°F
Relative Humidity (no condensation)	5% to 100%	
Maximum Temperature (Wet bulb)	0.6°C to 29.4°C	33°F to 85°F

## VIBRATION LIMITS

The user is responsible to ensure that the vibration motions induced in the 4979 unit from external sources do not exceed the specified levels. The unit is designed to operate within the following limits.

### *Maximum Vibration (Input to Unit Frame)*

5–17Hz	continuous	= 0.127mm (.005 in.) double amplitude
	transient	= 0.203mm (.008 in.) double amplitude
17–150Hz	continuous	= .07G peak acceleration
	transient	= .11G peak acceleration
200–500Hz	continuous	= .035G peak acceleration
	transient	= .055G peak acceleration

Assume “G” level from 150–200Hz to be linear

## SIGNAL CABLES

The 4979 Display Attachment Feature card connects to the IBM 4979 Display station with a signal cable. The basic signal cable is 6.1m (20ft) with additional cables available in increments of 3.1m (10ft) to a maximum of 46.4m (150ft).

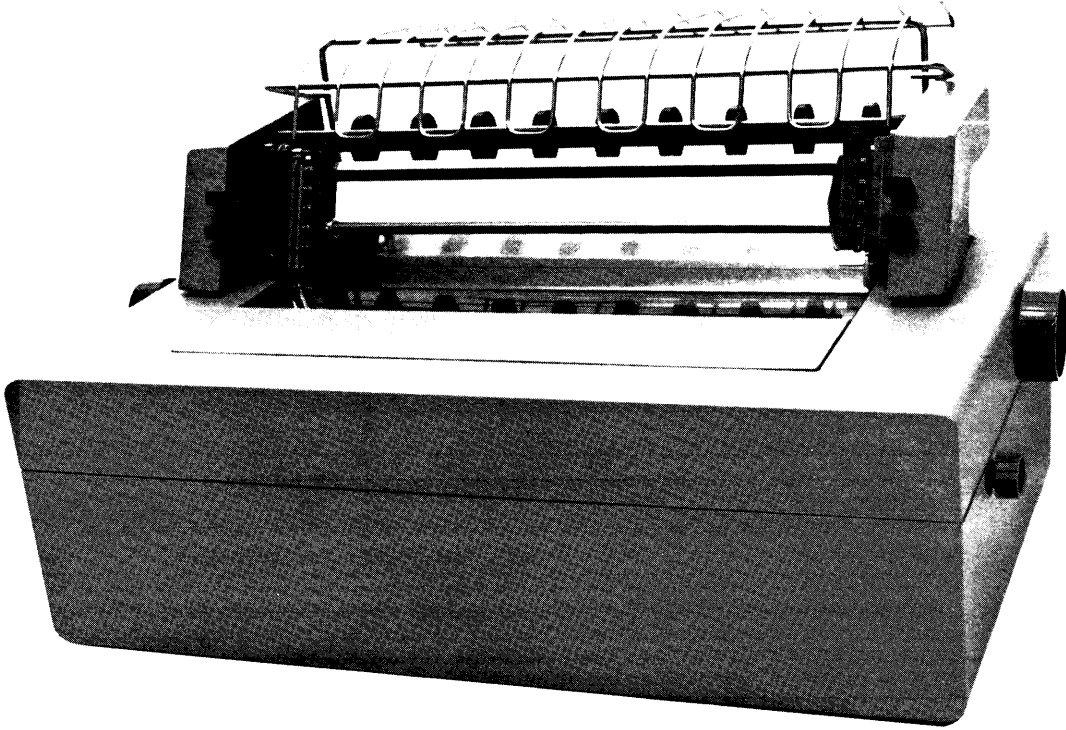
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**IBM 4974 Printer Model 1**

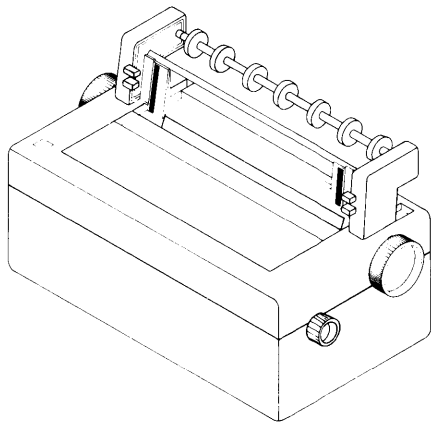


**CONTENTS**

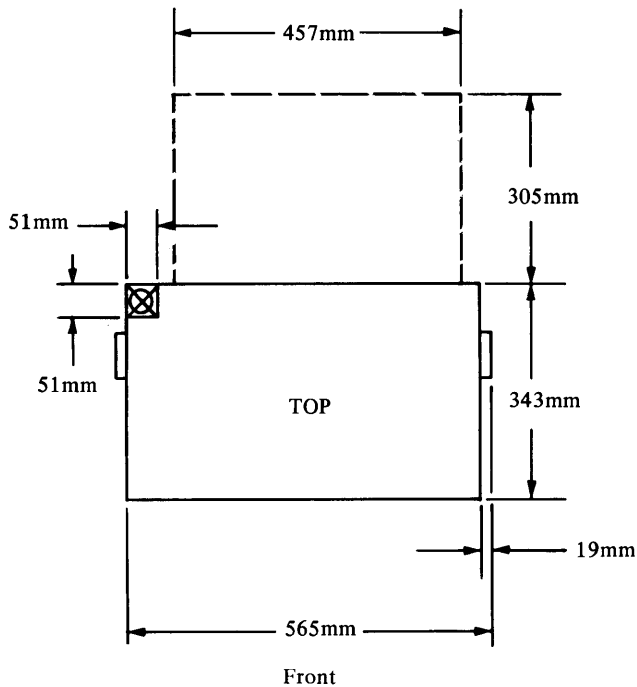
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IBM 4974

SPECIFICATIONS



PLAN VIEW



Millimeters	Inches
565	22.25
457	18.0
343	13.5
305	12.0
51	2.0
19	.75

Dimensions

	Width	Depth	Height
Millimeters	565	648	305
Inches	22.25	25.5	12

Service Clearance

The 4974 Printer is a free standing table top unit and may be moved in all directions for adequate service clearance.

Weight	24.9 kg	55 lbs
Heat Output/Hr.	98.4 kcal	390 Btu
Required Airflow	convection cooling	

Power Requirements

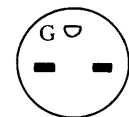
	60Hz ± .5	
	Volts	Amps
	115	1
	208	.52
	230	
kVA	0.12	
Phase	1	
Branch Circuit	15A	

Power Cord

	60Hz	
Length	1.8m 6 ft	
Conductors	3	
Size	18 AWG	

Power Cord Plugs and Receptacles

Volts	115	208/230
Plug	(moulded cord set)	(moulded cord set)
Receptacle	NEMA 5-15R	NEMA 6-15R



## AIR COOLING REQUIREMENTS

Adequate space must be left around the 4974 printer to allow necessary cooling airflow to the device.

## TEMPERATURE AND RELATIVE HUMIDITY

The temperature and relative humidity defined are upper and lower limits and are not to be confused with optimum operating points.

### *Operating Environment (Power On)*

Temperature	10.0°C to 40.6°C	50°F to 105°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Nonoperating Environment (Power Off)*

Temperature	10.0°C to 51.7°C	50°F to 125°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Shipping Environment*

Temperature	-40°C to 60°C	-40°F to 140°F
Relative Humidity (no condensation)	5% to 100%	
Maximum Temperature (Wet bulb)	0.6°C to 29.4°C	33°F to 85°F

## VIBRATION LIMITS

The user is responsible to ensure that the vibration motions induced in the 4974 unit from external sources do not exceed the specified levels. The unit is designed to operate within the following limits.

### *Maximum Vibration (Input to Unit Frame)*

15–17Hz	continuous	=	0.254mm (.010 in.) double amplitude
	transient	=	0.406mm (.016 in.) double amplitude
17–160Hz	continuous	=	.15G peak acceleration
	transient	=	.25G peak acceleration

If the system vibration specifications are met, the unit specifications will be satisfied.

## SIGNAL CABLES

The 4974 Printer Attachment Feature card connects to the IBM 4974 Printer with a signal cable. The basic signal cable is 6.1m (20ft) with additional cables available in increments of 3.1m (10ft) to a maximum of 46.4m (150ft).



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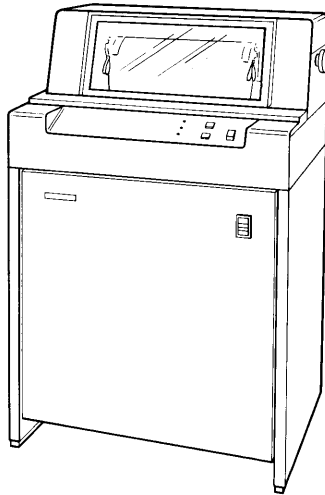
# IBM 4973 Printer Model 1 and 2



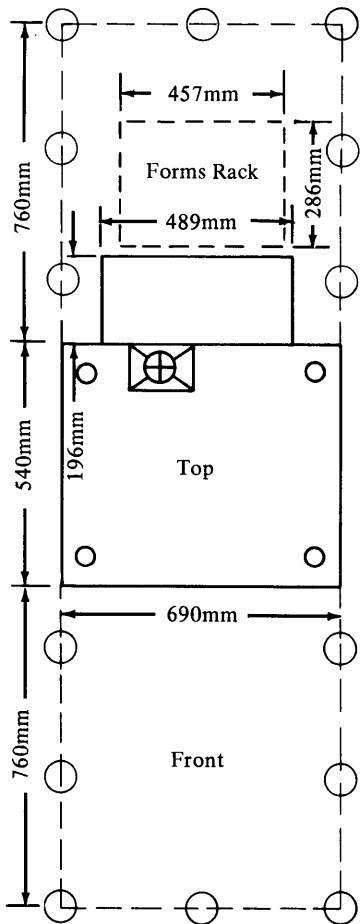
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**IBM 4973 MODEL 1**



**PLAN VIEW**



**SPECIFICATIONS MODEL 1**

**Dimensions**

	<i>Width</i>	<i>Depth</i>	<i>Height</i>
Millimeters	690	1260	1030
Inches	27	49.5	42.5

**Service Clearance**

	<i>Front</i>	<i>Rear</i>	<i>Top</i>
Millimeters	760	760	610
Inches	30	30	24

**Weight** (includes forms rack) 131.5 kg 290 lbs

**Heat Output/Hr.** 347.8 kcal 1,380 Btu

**Required Airflow** convection cooling

**Power Requirements**

60Hz + .5

<i>Volts</i>	<i>Amps</i>
115	4.3

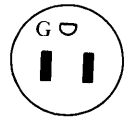
kVA 0.6  
Phase 1  
Branch 15A

**Power Cord**

Length 1.8m (6ft)  
Conductors 3  
Size 16 AWG

**Power Cord Plugs and Receptacles**

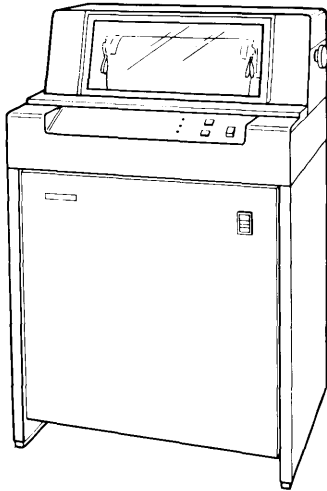
Volts 115  
Plug (moulded cord set)  
Receptacle NEMA 5-15R



<i>Millimeters</i>	<i>Inches</i>
760	30.0
690	27.0
540	21.25
489	19.25
457	18.0
286	11.25
196	7.75

**IBM 4973 MODEL 2**

**SPECIFICATIONS MODEL 2**



**Dimensions**

	<i>Width</i>	<i>Depth</i>	<i>Height</i>
Millimeters	690	1035	1080
Inches	27	40.75	42.5

**Service Clearance**

	<i>Front</i>	<i>Rear</i>	<i>Top</i>
Millimeters	760	1016	610
Inches	30	40	24

**Weight** (includes forms rack) 170.1 kg 375 lbs

**Heat Output/Hr.** 347.8 kcal 1,380 Btu

**Required Airflow** convection cooling

**Power Requirements**

60Hz + .5

<i>Volts</i>	<i>Amps</i>
115	4.3

kVA 0.6  
Phase 1  
Branch Circuit 15A

**Power Cord**

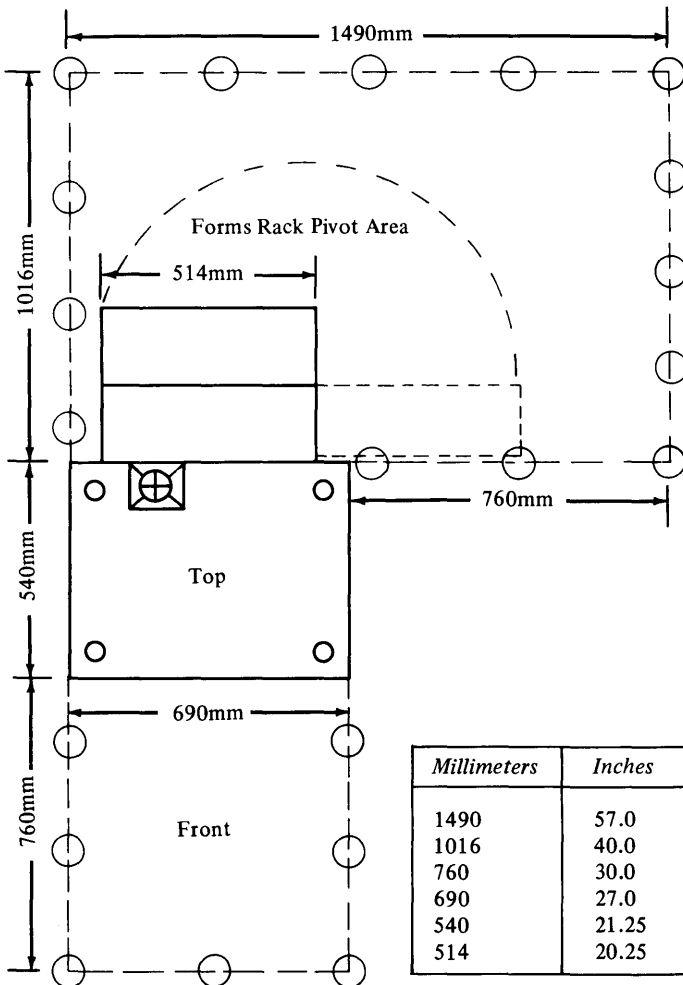
Length 1.8m (6ft)  
Conductors 3  
Size 16 AWG

**Power Cord Plugs and Receptacles**

Volts 115  
Plug (moulded cord set)  
Receptacle NEMA 5-15R



**PLAN VIEW**



## AIR COOLING REQUIREMENTS

Unit cooling air is by natural warm air convection. Air flow should not be blocked in any way.

## TEMPERATURE AND RELATIVE HUMIDITY

The temperature and relative humidity defined are upper and lower limits and are not to be confused with optimum operating points.

### *Operating Environment (Power On)*

Temperature	10.0°C to 40.6°C	50°F to 105°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Nonoperating Environment (Power Off)*

Temperature	10.0°C to 51.7°C	50°F to 125°F
Relative Humidity	8% to 80%	
Maximum Temperature (Wet bulb)	26.7°C	80°F

### *Shipping Environment*

Temperature	-40°C to 60°C	-40°F to 140°F
Relative Humidity (no condensation)	5% to 100%	
Maximum Temperature (Wet bulb)	0.6°C to 29.4°C	33°F to 85°F

## VIBRATION LIMITS

The user is responsible to ensure that the vibration motions induced on the unit from external sources do not exceed the specified levels. The IBM 4973 is designed to operate within the following limits.

### *Maximum Vibration (Input to Unit Frame)*

5–17Hz	continuous	= 0.128mm (.055 in.) double amplitude
	transient	= 0.204mm (.085 in.) double amplitude
17–150Hz	continuous	= 0.044G peak acceleration
	transient	= 0.055G peak acceleration
200–500Hz	continuous	= 0.023G peak acceleration
	transient	= 0.038G peak acceleration

Assume “G” level from 150–200Hz to be linear

## SIGNAL CABLES

The 4973 Printer Attachment Feature card connects to the IBM 4973 Printer with a signal cable. The basic signal cable is 6.1m (20ft) with additional cables available in increments of 3.1m (10ft) to a maximum of 46.4m (150ft).

## Chapter 3. User Input/Output Wiring Practices

This chapter contains wiring recommendations, signal conditioning, and connector/pin assignments for the user to attach devices to the following features:

- IBM 4982 Sensor Input/Output Unit
- Timers
- Channel Attached Digital Input/Output
- Customer Direct Program Control
- Teletypewriter Attachment
- Customer Access Panel
- Communications Attachment.

The signal names and pin assignments provided in this chapter for each feature are for reference only. The correct signal names and pin assignments will be in the logic diagrams of the associated IBM unit being installed. Verify that the signal names and pin assignments are correct before attaching the connectors.

### INSTALLATION PRACTICES

Noise is a spurious and unintended signal appearing at an input or output. There is always some noise present in any electronic device or circuit. Only when the noise reaches the threshold of the energy level that could cause a circuit malfunction does it actually cause a problem. Any circuit may be affected by noise, but generally the high-speed latches, triggers, single shot circuits, and analog are affected first and most often.

There are two basic types of signals used as data input to a computer system, digital and analog. Digital type signals have only two defined states, on or off. This type of signal is generally less sensitive to electrical interference as any small shift in voltage level does not destroy all the data content. Analog signals can assume more than the on or off states. They are normally continuous over a range but sometimes occur in discrete steps. Any interference that changes the voltage level of an analog signal will more often than not affect the data content of the signal. For this reason much more care must be taken in installing analog signal cables than digital signal cables.

The following guidelines represent good installation practice and will contribute to preventing noise from entering the system.

#### *Signal Transmission Considerations*

- a. Select the best instrument signal cable available for your application. Refer to Signal Cable Selection section.
- b. Lines carrying signals that differ from each other in average signal voltage level by more than 50% should not be grouped in the same body shielded cable.
- c. Where practical keep cables well separated from each other, especially power from signal cables and cables with widely differing signal characteristics.
- d. Shielded cables must have an insulating jacket and those shields that are grounded at the system end must be grounded only at the point that they enter the system enclosure.
- e. Signals are best transmitted via shielded twisted pairs. This provides a dedicated ground return and aids in electrically balancing the circuit.
- f. The “break-out” at the ends of signal cables must be kept less than 7.5cm (3 in.) This applies to both the signal wires and the “drain-wire” from shield to ground.
- g. Unused wires in a cable must be grounded at the same point as the “drain-wire”. Unused twisted pairs should be connected to each other at one end and grounded at the other end.

## *Grounding Considerations*

- a. Establish and follow a consistent grounding practice throughout the system.
- b. Building framework, conduits, sprinkler system pipe, etc., are not suitable for dc signal or ground returns. Refer to “Power Grounding” in Chapter 1 for recommended grounding techniques.
- c. Instrument ground busses (dc ground) and ac grounds should have only one common point within the system.

## *Power Sources for Non-IBM Equipment*

- a. System components and power supplies should be selected to minimize the number of noise sources.
- b. Do not use ac powered primary sensors which cause the signal lines to carry ac common mode or normal mode voltages.
- c. Include adequate filtering on outputs of dc (rectified ac) power supplies.
- d. Primary sensors utilizing the same power supply should have a similar grounding scheme (either all grounded or all not grounded).
- e. Sensors and transducers powered from a remote location should not use the signal lines for power transmission. The “4-wire” method of transmission should be used to reduce the current transmitted on the signal lines.

## *Cable Routing*

Caution must be exercised in locating cables near equipment which may cause electrical interference (noise). Examples of electrical and electromagnetic noise sources are:

- a. Fluorescent and neon lighting fixtures.
- b. Power distribution, including wiring, transformers, generators, and alternators.
- c. Motors that drive machinery such as air conditioners, elevators, escalators, large blowers, and machine tools.
- d. Radio and television transmitters (including citizens band and public service agency equipment).
- e. Signal generators, intercommunication systems, and security signal systems.
- f. Arc welders, electro-discharge machining equipment, and related equipment.
- g. Radar transmitting equipment.
- h. R.F. induction heaters.
- i. Radio therapy equipment.
- j. Ultrasonic cleaning equipment.
- k. Electromagnetic equipment, such as degaussers, magnetic chucks, etc.
- l. Control equipment (relays, contactors) for machinery and other switching devices that carry or switch relatively large currents.

Interference between signal cable and typical sources of electrical interference will be more likely to exist with long parallel runs. Good rules to follow are to keep all cabling at least 0.3m (1 ft) away from any power line or other ac source voltage.

The signal cable length from the source to the system should always be minimized to reduce the signal degeneration due to all external effects. System location to minimize signal cable length should be considered in the initial planning.

Multiple signal cables from common signal sources should follow the same route from the source to the system. Excess connected signal cable length should not be coiled up but should be stored in a “snake” effect. Raising external cables above floor level can have a drastic effect on the electrostatic rejection level. Their proximity to the floor has somewhat the same effect as a transient plate, in that this provides a “sink” for the high-frequency noise pulses. All signal wiring must comply with local, state and federal electrical codes.

## SIGNAL CABLE SELECTION

Three general categories of wiring and cabling are suggested for designing cabling to the system analog or digital input/output features. Consider the categories defined below for all analog input, analog output, digital input, and digital output features. Based on field experience and theory, the following categories are listed in the order of preference.

1. Shielded twisted-pair is an individually-shielded wire-pair instrumentation cable available with either a braided shield, or with a conducting-foil wrapped shield and drain wire. Twinaxial cable may be used to get controlled high frequency characteristics. It is available either in single cable with protective jacket or grouped with other identical shielded twisted-pair cables with shields insulated from each other inside a single outer protective jacket. This cable type substantially reduces crosstalk; nevertheless, analog and digital signals should not be mixed within the same group of shielded twisted-pair cables.
2. Unshielded twisted-pair is a general purpose cabling of stranded wire that is available with or without a protective jacket. It may be cabled with other identical twisted-pair cables inside a single outer protective shield and/or jacket. Crosstalk is the most serious application problem when transmitting unbalanced signals on this type of cable. If unshielded twisted-pair is used to transmit unbalanced signals, the signals must be of similar amplitude and speed.
3. Coaxial cable is a single conductor wire with a braided and insulated shield. Coaxial cable has high frequency controlled losses and a constant characteristic impedance. It may also be used as low frequency shielded cable in a noisy environment.

The following general information should be considered in selecting cables.

1. Shielded twisted-pair is the best general cable type.
  - a. Foil-shielded instrumentation cable is best for low speed digital or analog signal applications.
  - b. Twinaxial cable with braided shield is best for high speed digital or analog signal applications.
2. Coaxial cable is preferred for high speed digital signal applications.
3. Shielded cable types are preferred in industrial or noisy environments. The shield should be grounded according to the specific recommendation for the feature.
4. When coaxial cable is used for analog input signal sources, it introduces an imbalance of source resistance due to the different resistances of center conductor and shield. For very long cables, it is necessary to calculate the effect of source imbalance using common mode rejection ratio specifications.
5. All unused wires in multiconductor cables must be grounded at one end only.
6. The external protective jacket of the cable must withstand the environment in which it is installed. The temperature range, humidity range, and the possibility of chemical contamination must also be considered.
7. Stranded conductor cable is easier to install and will have less conductor breakage than solid conductor cable.

## CUSTOMER SIGNAL CONDITIONING CONSIDERATIONS

The use of various signal conditioning circuits or techniques may be necessary to obtain the optimum performance of analog or digital input/output features of a Series/1 system. Although the type of signal conditioning used will vary widely from installation to installation, some general guidelines can be established.

Signal conditioning is the modification or conversion of signals.

- Low pass filters
- Signal source balancing
- Ground isolation
- Level shifting or attenuation.



The overall system wiring plan should consider both the signal conditioning and the correct grounding and shielding of the signal lines from the customer signal source to the system, described in the installation practices section.

Most input/output signals are divided into two general categories: analog and digital. Digital signals are signals where the data content is binary on or off. Digital input (DI) signals are inputs to the Series/1 system and digital outputs (DO) are signals generated by the system.

Analog signals can assume more than the on or off states. They are normally continuous over a range but sometimes occur in discrete steps. Since the magnitude of the signal contains the data, care must be taken to insure that analog signals are received with minimum change.

The most common problem in communicating signals from a remote location to the Series/1 is electrical noise. Many common instruments and transducers are sources of noise as discussed in the Installation Practices section. In most cases noise may be reduced by grounding, conductor selection, shielding techniques, and by the use of low-pass filters that reject most ac signals above a certain frequency without significantly affecting the data content of the signal. Other methods of eliminating noise interference include circuit isolation, balancing of the signal circuit, and control of the circuit impedance. In general, there is no unique or simple solution to a noise problem. Several different methods may have to be used.

Many types and levels of input signals are likely to be encountered in the implementation of digital input subsystems. Logic level (0 Vdc to +5 Vdc) signals are the most common, but commercial instrumentation systems and transducers may have their own power supplies, with output signals that approach 48V. Current level signals are common on many types of process control equipment. They can be converted to voltage levels by using a shunt resistor. Switch contacts are used as digital input by connecting the contacts between the DI circuit and a voltage source.

Level switching is required in digital circuitry when the definition of the 1 and 0 levels of the source does not match the source and the system input level requirement. When the source signals are larger than that required for Series/1, a divider circuit may be used. If the signal is too small some form of amplification is required. A common problem with digital circuitry is the reversal of the definition of logic 0 and 1.

Signals generated by the Series/1 units (DO and AO) are, in general, treated in the same manner as remote signals which are inputs to the system. In the case of output signals, the customer load must be considered in designing the signal conditioning circuits. Specifically, arc suppression will typically be required if the customer load is inductive, as in the case of a DO point driving a relay coil.

## ***Signal Filters***

The bandwidth of any analog or digital input or output subsystem should be limited to that required to transmit the data content of the signal. For digital subsystems a bandwidth range of dc to 50 MHz may be required for modern high speed logic circuits. The bandwidth required to pass all the data in the analog signal from a transducer may be as low as dc to 1 Hz, but would more typically be dc to 30 Hz. Low pass filters at the system input may be used to reduce the noise content without significantly affecting the useful data content of the signal.

The following two sections discuss the general use of filters with digital and analog circuits. A text on filters should be consulted to aid in the selection and design of the filters for a specific application. Many passive and active filters are commercially available and will meet most noise reduction requirements.

## Filtering Digital Signals

Filtering is used on digital circuits to prevent noise on signal transmission lines from being interpreted at a digital input point as data. Also, filters are required when a digital input point is used to sense contact closures to prevent the mechanical bounce of the contact from being interpreted at the input as data. Filters on single-ended input circuits will not reduce common mode noise.

Simple single section resistance-capacitance (RC) filters as shown in Figure 3-1 are usually adequate to eliminate the noise content imposed on high speed logic signals.

Since the RC filter reduces the bandwidth of the signal, it will reduce both the noise and the rise time and fall time of the digital data pulse as shown in Figure 3-2.

$$V_3 = \frac{V_2 R_{in}}{R + R_{in}}$$

Depending upon the series impedance of the filter and the input impedance of the digital input circuit, the positive level of the input signal ( $V_2$  in Figures 3-1 and 3-2) may be reduced due to voltage drop across the series impedance of the filter.

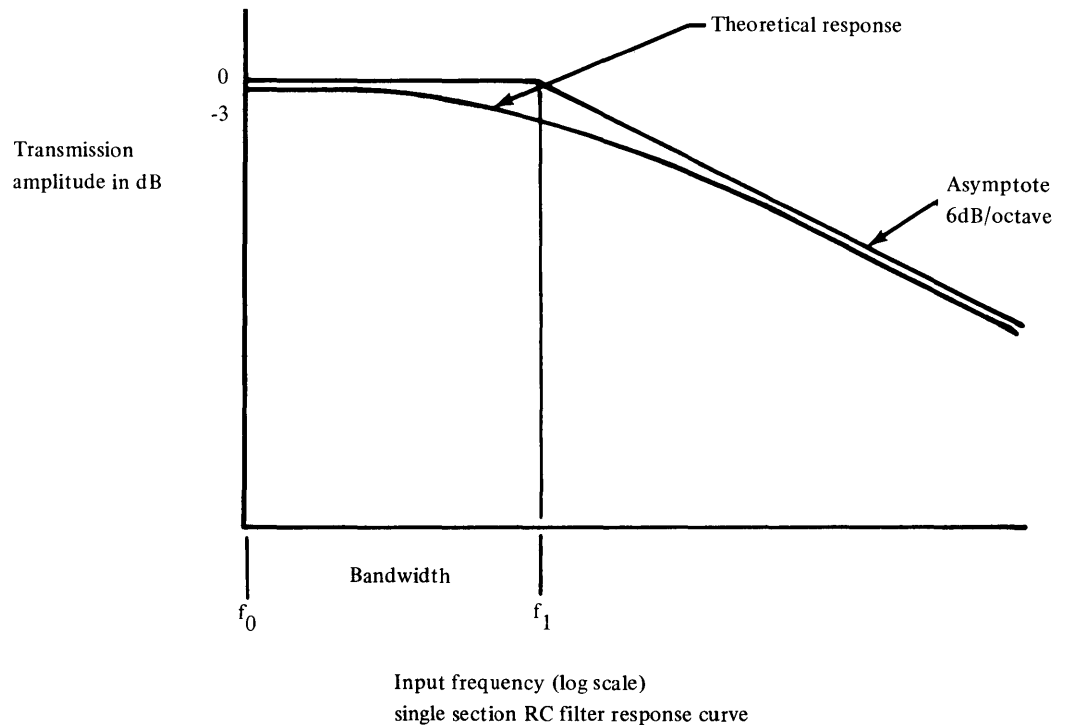
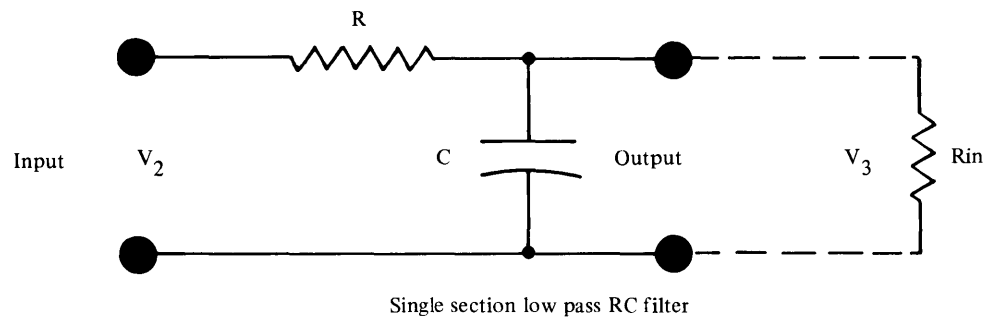


Figure 3-1. Single RC filter and response characteristic

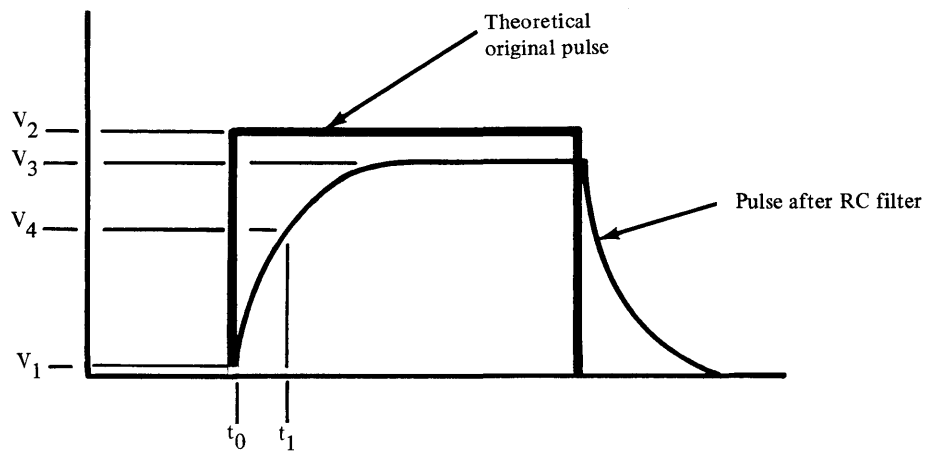


Figure 3-2. Effect of filter on pulse waveshape

Voltage  $V_3$  at the filter output must still be within the detectable up level (LPUL) as specified for the system digital input.

The RC filter will introduce a delay in the time at which the input signal reaches a detectable change of state. If  $V_4$  in Figure 3-2 is the detectable up level, then the filter has introduced a delay from  $t_0$  to  $t_1$  in the time it takes the change of state to be detected. This delay is a function of the filter bandwidth and the peak amplitude of the signal at the input to the filter. Variation in the input signal amplitude can cause major variations in the delay.

To eliminate input data errors due to the mechanical contact bounce of relays, the time constant of the simple RC filter should be enough to ensure that contact bounce will have ceased by the time the input signal approaches the input switching level enough to cause spurious level changes. The filter will respond as shown in Figure 3-3.

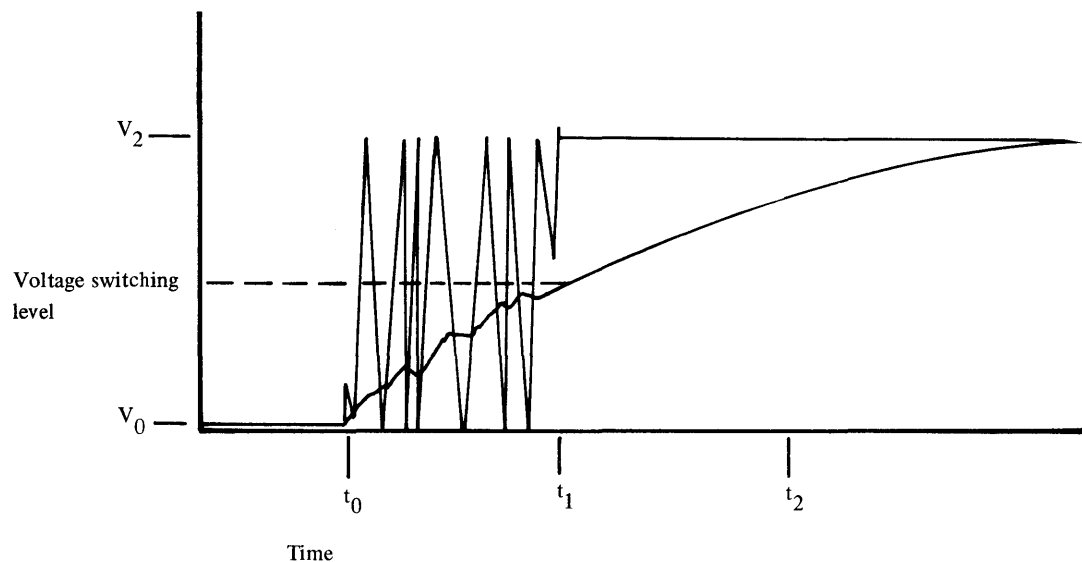


Figure 3-3. Effect of RC filter on contact bounce

Besides the single section low pass RC filters, there are many other types of filters and devices that may be used to limit the bandwidth of the signal to that required to transmit the data. Multiple section RC filters and twin-T RC filters provide greater attenuation rates (dB per octave) beyond the 3 dB point. The LED photo-transistor optical isolator provides some bandwidth limitation due to the basic response time of the device.

Commercially available active filters using operational amplifiers may be used to limit the bandwidth of a signal. Attenuation slopes much greater than that of the simple single section RC filter may be obtained with active filters, and most of the classical filter response curves such as Chebyshev, Bessel, Butterworth, single-tuned, etc., are available. However, active filters require a power supply and most commercially available units are single-ended devices, i.e., their signal reference is the filter power supply neutral. The voltage range on the input is limited to typically  $\pm 10V$ , but the input impedance may be very high and the filters may be designed to function at very low frequencies. Active filters are available with a dc transfer characteristic of 1 or with voltage gain.

## Filtering Analog Signals

The filter requirements for analog signals are usually more stringent because the data content of a signal level is much greater. Analog output signals from measuring instruments and transducers usually have a very slow rate of change (slew rate) since they are monitoring a process or an environment. Typical rates are less than 10 Hz with slew rates less than 200 volts per second. Notable exceptions to this low rate are strain gauges, which may have rates of change greater than 1000 kHz. Any filter used with analog signals must either pass the signal with a very small change in absolute voltage level when compared to the system resolution or must have a very predictable attenuation or amplification transfer ratio.

A filter circuit inserted in an analog signal path should be transparent to both the source and the analog input subsystem. The filter input impedance should be similar to the input impedance of the analog subsystem. The filter output impedance should be sufficiently low to act as a signal source for the analog input.

Active filters, such as discussed in the Signal Filters section, also may be used with analog signals, but care must be taken since they are normally commercially available as single-ended devices. LC and RLC filters may be used, but the low bandwidth characteristics of analog signals cause the inductors and capacitors to be quite large and expensive. The single section low pass RC filter is a simple design and is adequate for most single-ended analog applications.

In addition to, or in conjunction with electronic filtering techniques, data analysis program routines may be used to reduce the external effects. Statistical analysis is one technique used to separate signal from noise. A simple average of multiple measurements of the same signal is a common approach. Further analysis may remove measurements which deviate from the average by more than some predetermined limit. Many other methods of statistical analysis may be used on a set of readings to reduce the effect of the noise content of the signal. Statistical noise elimination techniques will reduce the random error but not the systematic error of the measurement. In other words, they improve the precision but not the accuracy of the measurement.

Time averaging is used when an input signal has a very low rate of change/minutes or hours, or where the sampling rate of the measurement system is much greater than the rate of change of the signal. Time averaging may be performed by maintaining a “rolling” set of measurements of one signal and computing a new average each time a measurement is replaced in the set. Time averaging is a valuable method of maintaining system calibration by using a known external calibration source as one input. The systematic error of the total measurement system may then be eliminated by using the rolling average of the known input and correcting the measurement of the unknowns in the application program.

## ***Balancing Analog Input Circuits***

A balanced signal input circuit is a two-conductor circuit in which the impedance to ground is the same for each conductor and all circuits connected to it. One purpose of balancing a circuit is to make the electrical noise susceptibility the same in both portions of the circuit. The common mode rejection ratio (CMRR) of an analog input point is largely dependent upon the balance of the signal source circuit. Equal signals in the two parts of a balanced circuit will be cancelled at the analog input within the limits of the system CMRR. Circuit balance is a function of frequency due to the reactive and capacitive characteristics of the circuit. When used in conjunction with correct grounding, conductor selection, and shielding practices, the resulting noise level at the system analog input will be below the level obtained with grounding and shielding alone.

The design of the total circuit from the source to the analog input must be considered to insure accurate balance. Since twisted pair or shielded twisted pair are inherently a balanced signal line, they are the most commonly used cable type for analog signals. If coax cables are used, two cables must be used since the coax is an unbalanced cable. Twin-axial cables are preferred to Coaxial for the same reason.

The source output must be balanced to achieve a balanced system. If the source is unbalanced or single-ended, several techniques may be used to achieve a balance for example:

- A commercial Isolation Amplifier may be used to achieve a balanced signal source.
- A matching transformer may be used at the source or at both ends of the circuit. This technique has the advantage of also isolating grounds but may be used for ac signals only. The matching transformer may introduce some signal attenuation and distortion.
- Ungrounding the signal source (not the instrument) may, in some cases, result in a balanced source. Care should be taken to insure that no safety hazards are created by removing the ground from the source.

Some transducers and instruments provide a balanced output. Examples include linear variable differential transformers (LVDT) and some bridge circuits. Operational amplifiers are normally commercially available as single-ended devices, whereas Isolation Amplifiers are balanced differential devices. Power supplies used to power remote transducers or instruments should have equal isolation from ground for both the positive and negative outputs.

## ***Attenuation and Level Shifting***

**Attenuation.** When the user input signal exceeds the specified voltage input range of the input, it is necessary to reduce the signal level. This is most commonly done using a resistive divider network. Where the input signal swings about zero, then the input must either be shifted up or the negative signals that exceed the input specification limits are blocked with a diode clamp. In some cases it is necessary to limit the positive swing of the input signal. This may be accomplished with a zener diode clamp where the zener voltage is the same as the maximum voltage allowed at the system input.

Figure 3-4 shows the total input circuit with a resistive attenuator.

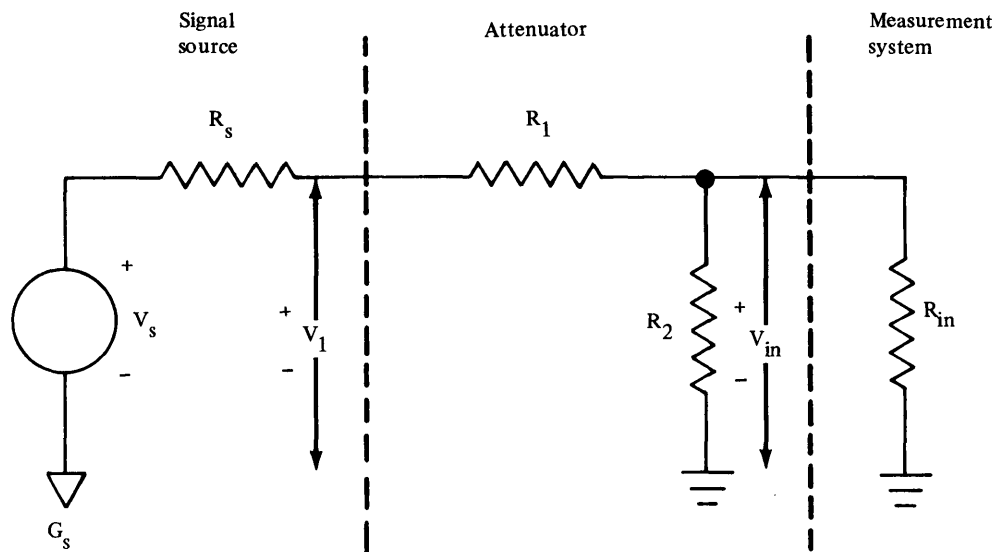


Figure 3-4. Signal attenuation theoretical circuit

The actual attenuation resistors added to the circuit are R1 and R2. R in is the input resistance to the digital or analog input circuit and V in is the voltage across R in. R s is the source and signal cable path resistance and V 1 is the voltage at the source output terminals. The effective attenuation ratio is:

$$\frac{V_{in}}{V_1} = \frac{R_2}{R_2 + R_1 (1 + R_2/R_{in})}$$

$$\frac{V_{in}}{V_s} = \frac{R_2}{R_2 + (R_1 + R_s) (1 + R_2/R_{in})}$$

**Analog Signal Attenuation.** Any attenuation network should be located as close as possible to the input terminals of the measurement circuit. The change in the attenuation ratio due to the temperature coefficient of the attenuation network resistors should be at least an order of magnitude less than the measurement system resolution. The power dissipated in the network should be kept to a minimum to prevent the resistors from heating and changing value.

The circuit shown in Figure 3-4 is an inherently unbalanced circuit and would significantly reduce the CMRR or any balanced input. Figure 3-5 shows a balanced attenuator for use in differential or isolated circuits. Care must be taken to insure that the two (1/2) R1 resistors are matched; any mismatch would result in circuit unbalance and a reduction in the system CMRR.

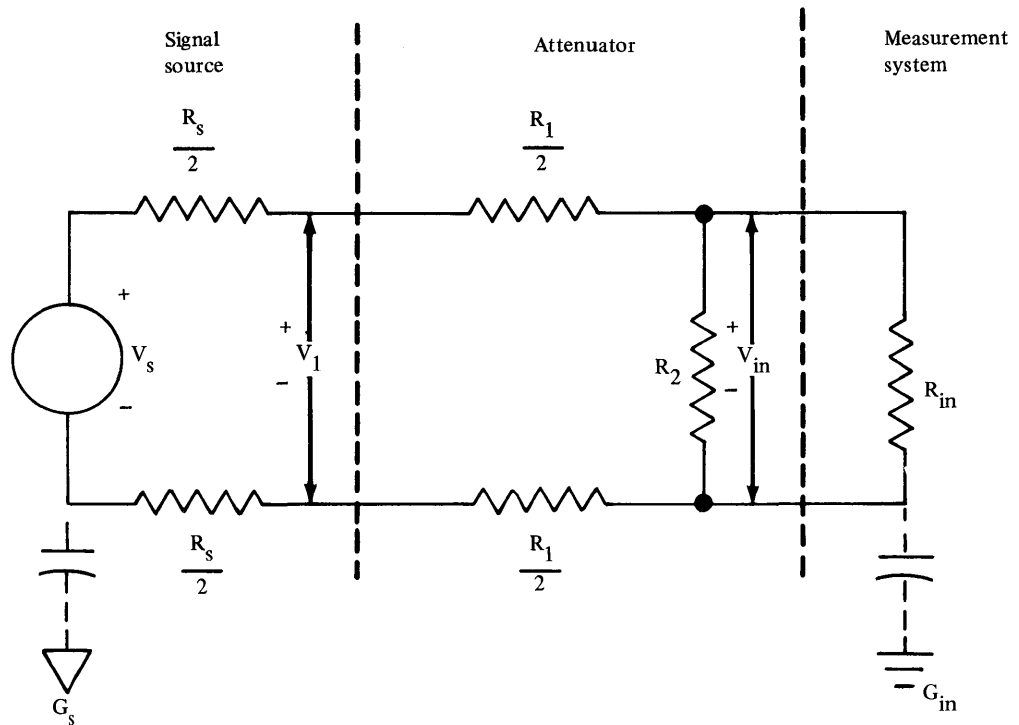


Figure 3-5. Balanced attenuation network

**Level Shifting and Inversion.** The Series/1 Integrated Digital Input feature interprets a positive signal as a logical 0; and a negative signal as a logical 1. The Sensor I/O Isolated DI feature defines a positive signal as a logic 1 and a negative signal as a logic 0.

The Sensor I/O Nonisolated DI feature defines a positive signal as a logic 0 and a negative signal as a logic 1. Depending on which inputs are used the switching levels vary. If the customer levels are not compatible with the feature levels, level shifting of some sort will be required. There are many types of level shifting circuits using active and/or passive devices available in engineering literature. Inversion of the logical meaning of signals (0 and 1) is best accomplished in the processor via software unless the signal is used to cause an interrupt.

### *Isolation Techniques*

There are two basic circuit conditions where it is desirable or necessary to electrically isolate the signal source from the system input. The first condition is where the signal source is at an elevated common mode voltage. The second condition is where it is necessary to isolate the source ground from a single-ended system input. There are four basic types of devices which can accomplish either of these functions:

- Isolation Transformers
- Optocouplers (photoisolators)
- Isolation Amplifiers
- Electro-mechanical Relays.

The characteristics and applications of each of these devices is discussed in the following paragraphs.

### Isolation Transformers

Isolation transformers can be used with ac signals to isolate the signal from ground to match impedances between the source and the system input.

A primary power isolation transformer can also be used with the primary power input to isolate the signal source from the power ground. Care must be taken with this type of installation to insure that a ground circuit is maintained that meets all electrical codes. An isolation transformer cannot be used if dc or very low frequency continuity is required between the signal source and the system input. When dc or low frequency continuity is required, an isolation transformer installed as a balun can be used to block AC common mode noise signals. This circuit does not provide ground isolation. Special care must be taken in the selection and application of transformers as baluns. Figure 3-6 shows typical installations of isolation transformers.

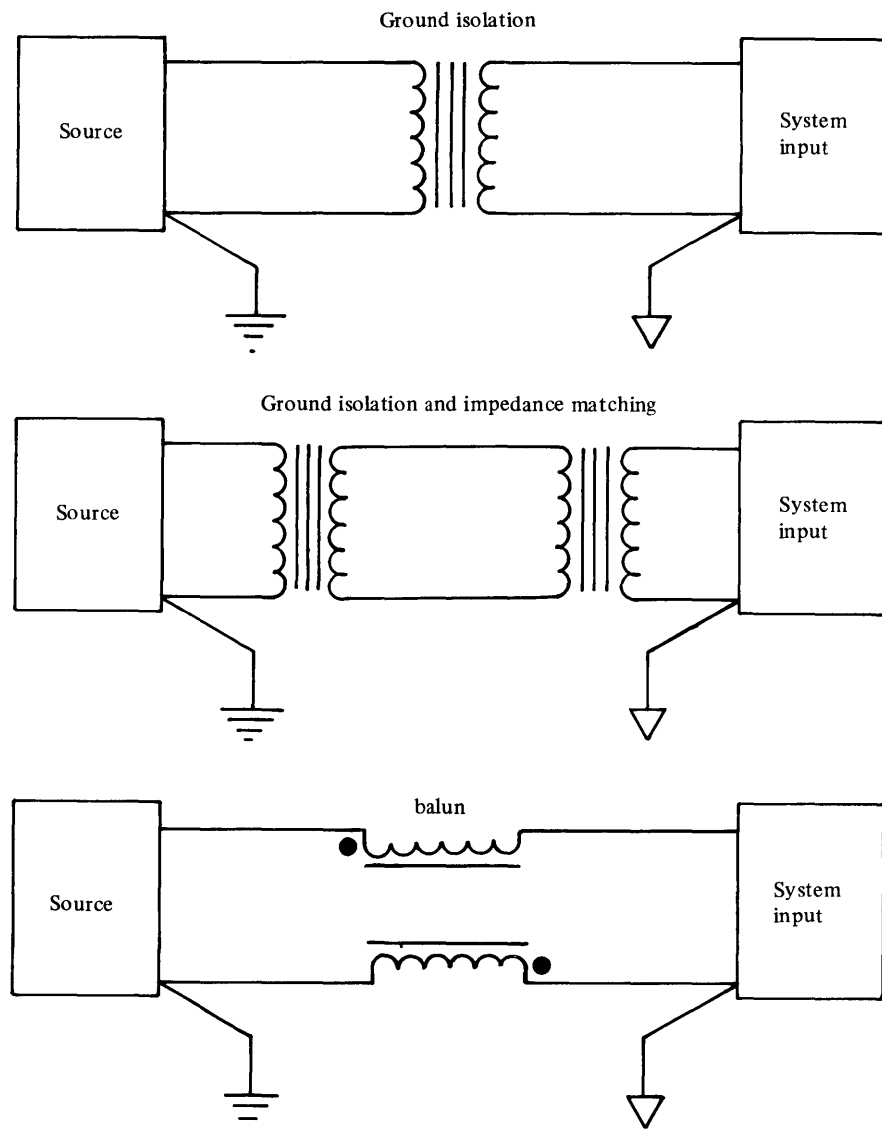


Figure 3-6. Isolation transformer installations



### **Optocouplers (Photoisolators)**

An optical coupler (optocoupler) typically consists of an infrared emitting diode (IRED) and a photodetector that are coupled only by the light path. These devices are particularly attractive for use with digital signal sources. The device linearity limits their usage for analog circuits. The devices are sturdy and reliable, resistant to shock and vibration, and have very good temperature coefficients. They have no inductive loading or coupling, create no EMI, and have no mechanical contacts to fail. Many types of physical packages are available for optocouplers, including dual-in-line packages (DIP), cable-in-line packages, printed circuits, and screw mount packages.

Optocouplers provide an effective and inexpensive method of isolating the source ground from the system ground when using any of the Series/1 nonisolated digital input features. Since optocouplers have a limited bandwidth, the upper limit ranging from dc to 2.5 kHz (some units may operate at up to 5 MHz) can perform a useful filtering function. The current transfer ratio of an optocoupler is typically 50% to 100%. With an output circuit, enough current to directly drive a relay without an intermediate amplifier can be switched.

### **Isolation Amplifiers**

Isolation Amplifiers are used with analog signals to provide an isolated ground, and to provide a very low impedance output differential which can drive the analog signal over a long signal cable. The amplifiers may provide very high common mode rejection and precise dc transfer ratios. Units are available in DIP packages, as printed circuit mounted modular packages, or as complete subassemblies with power supplies mountable in EIA enclosures.

Descriptions and application notes on isolation amplifiers are available from the manufacturers of these devices.

### **Electro-mechanical Relays**

For low repetition rate digital signals and for switching ac loads, mechanical relays may provide the best method of isolation. The relay contacts should be selected based on the load they are to switch (voltage, make and break current, resistive or inductive load, etc.) When relays are used to isolate an input signal, the contact bounce characteristics must be considered (refer to Signal Filters section).

### **Solid State Relays**

For switching ac loads, solid state relays should be considered. Some commercially available units have a noninductive, optoisolated input which provide a very convenient interface to the Series/1 digital output interface. Hybrid relays are available that offer high sensitivity as well as good isolation.

## ***Switching Loads that Store Energy***

The Series/1 DO features are specified driving a resistive load. Often, stored energy devices are driven by these features. This usually takes the form of a capacitance in parallel, or an inductor in series, with the DO drivers. Indeed, the cables which carry the signals to a purely resistive load unavoidably add such components. The normal consequence of these loads are an initial surge of current from the capacitive load and a high reverse voltage from the inductive load. The Series/1 DO drivers can withstand a brief (~ 1 microsecond) *current* overload (~200%) and small (<5V) inverse voltage for a short (~ 1 microsecond) period. This is enough to interface with the expected cable characteristics but any significant stored energy devices must limit the power dissipated in the drivers to the specified amounts.

## REMOTE POWER SUPPLIES

Power supplies external to Series/1 units may be required to provide a bias or power source for a transducer or other signaling device. It is recommended that these external supplies be isolated from ground. For analog signal sources the power supply dc output should contain a very low ac ripple content. Some form of overvoltage protection and current limit should be included in the supply.

In cases where the supply is located some distance from the system, consideration should be given to an ac primary power switch that would allow the remote supply to be shut-off from the system location. If the power supply is supplying bias for a transducer on a critical process and a meaningful reading could be obtained if the supply output voltage drops to zero (i.e., the transducer signal normally swings about zero), it would be meaningful to monitor the actual power supply output with a DI point.

Safety due to different ground levels should be considered when using remote power supplies.

Care should be taken to shield all signal lines connected to the power supply to prevent electronic interference from entering the system at this point. Breakouts from shielded cables to connect to the power supply should be kept to a minimum length. Connectors with shielded covers should be used where possible. The number of external power supplies should always be kept to a minimum to reduce external noise sources and potential device failures.

## LIGHTNING PROTECTION

Lightning protection is required whenever the exposure to lightning exists and the hazards and damage to equipment from lightning are to be minimized. While there is no guarantee of protection from a direct lightning strike, the present state-of-the-art does offer many protective measures.

Basic to all lightning protection means is the objective of providing a safe path to ground for the high level of electrical energy encountered. Means must be employed to carry this electrical energy to ground instead of through the electronic circuitry.

Two basic methods are employed. One is to provide a preferred place for lightning to strike instead of the protected circuitry. Lightning rods which are placed at the most elevated point provides this protection. Even with lightning rods, however, a force field is encountered which induces energy into nearby conductors. In order to deal with this induced energy, shunt-type protection is employed. There are many types of shunt-type arresters available. All of these allow conduction at voltage levels above normal. The conductor characteristics change at some point and dissipate the high energies experienced with lightning strikes. The types of shunt arresters are: carbon arresters, gas-filled gap arresters, and solid state varistors. All provide shunting of lightning surge energy.

There are variations and combinations of the methods of protection which provide fast action vs slow, resettability vs nonresettability and threshold point variations.

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# IBM 4982 Sensor Input/Output Unit User Wiring

The IBM 4982 Sensor Input/Output Unit and its associated feature cards are intended for use in general sensor applications. The following feature cards are available to provide sensor input/output attachment.

- Isolated digital input/process interrupt (DI/PI) feature card
- Nonisolated digital input/process interrupt feature (DI/PI) card
- Nonisolated digital output (DO) feature card
- Solid state multiplexer card feature (AI)
- Reed relay multiplexer card feature (AI)
- Analog output (AO) feature card.

For a full description of the operation of each sensor I/O feature, see IBM 4982 Sensor Input/Output Unit Description manual, GA34-0027.

## RECOMMENDED CABLE CONNECTIONS AND WIRING PRACTICES

Connections to sensor I/O feature cards are made through commercially available edge connectors. The cards require a 56-pin connector with 3.96mm (0.156 in.) spacing. Continental Connector Corporation, part number 600-11-56XA-30 (see Figure 3-7) or the equivalent is suitable. Access to the feature cards is from the rear of the 4982 sensor I/O unit. The feature card connectors are not keyed. It is the user's responsibility to identify the orientation and location for each connector.

User cable connector (Continental Connector Corp. P/N 600-11-56XA-30 or IBM approved equivalent)

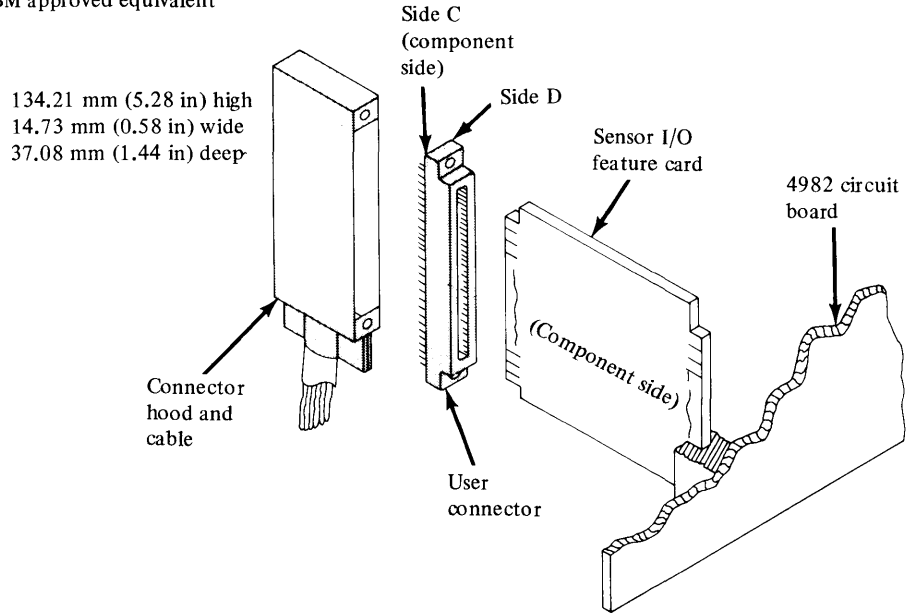


Figure 3-7. Sensor I/O feature card connector

### Isolated Digital Input/Process Interrupt Card

The isolated digital input/process interrupt (DI/PI) card contains 16 points of optically isolated inputs. The signal names and connection points are indicated in Figure 3-8.

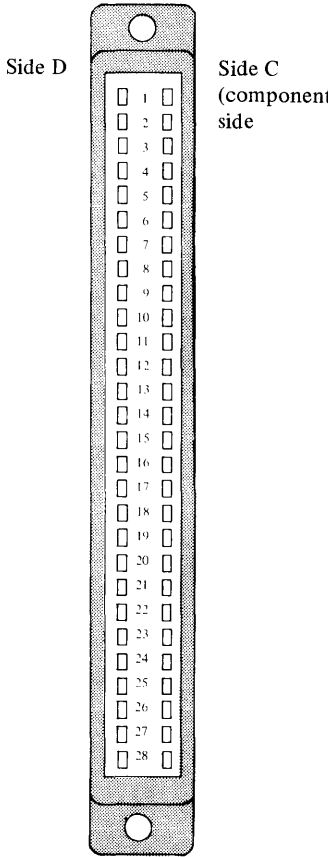
Signal name	Pin	User connector (cable side view)	Pin	Signal name
Point 0 high level	D1		C1	Point 1 high level
Point 0 reference	D2		C2	Point 1 reference
Point 0 low level	D3		C3	Point 1 low level
Point 2 high level	D4		C4	Point 3 high level
Point 2 reference	D5		C5	Point 3 reference
Point 2 low level	D6		C6	Point 3 low level
Point 4 high level	D7		C7	Point 5 high level
Point 4 reference	D8		C8	Point 5 reference
Point 4 low level	D9		C9	Point 5 low level
Point 6 high level	D10		C10	Point 7 high level
Point 6 reference	D11		C11	Point 7 reference
Point 6 low level	D12		C12	Point 7 low level
Point 8 high level	D13		C13	Point 9 high level
Point 8 reference	D14		C14	Point 9 reference
Point 8 low level	D15		C15	Point 9 low level
Point 10 high level	D16		C16	Point 11 high level
Point 10 reference	D17		C17	Point 11 reference
Point 10 low level	D18		C18	Point 11 low level
Point 12 high level	D19		C19	Point 13 high level
Point 12 reference	D20		C20	Point 13 reference
Point 12 low level	D21		C21	Point 13 low level
Point 14 high level	D22		C22	Point 15 high level
Point 14 reference	D23		C23	Point 15 reference
Point 14 low level	D24		C24	Point 15 low level
Ground	D25		C25	No connection
Ext. sync input	D26		C26	No connection
+24 VDC	D27		C27	Ground
Ext. sync ready	D28		C28	Ground

Figure 3-8. Isolated DI/PI pin and signal assignment

### Nonisolated Digital Input/Process Interrupt Card

The nonisolated digital input/process interrupt (DI/PI) card provides 16 points that accept either voltage sense or contact sense inputs. The signal names and connection points are indicated in Figure 3-9.

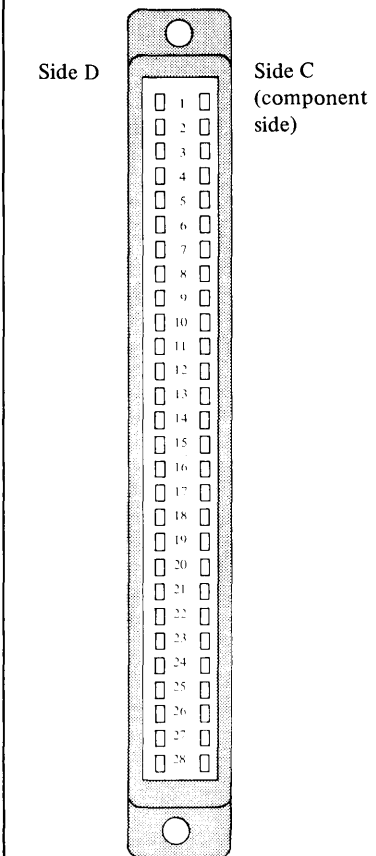
Signal name	Pin	User connector (cable side view)	Pin	Signal name
Point 0 high level	D1		C1	Point 1 high level
Point 2 high level	D2		C2	Point 3 high level
Point 4 high level	D3		C3	Point 5 high level
Point 6 high level	D4		C4	Point 7 high level
Point 8 high level	D5		C5	Point 9 high level
Point 10 high level	D6		C6	Point 11 high level
Point 12 high level	D7		C7	Point 13 high level
Point 14 high level	D8		C8	Point 15 high level
Ground	D9		C9	Ground
Ground	D10		C10	Ground
Point 0 low level	D11		C11	Ground
Ground	D12		C12	Point 1 low level
Point 2 low level	D13		C13	Ground
Ground	D14		C14	Point 3 low level
Point 4 low level	D15		C15	Ground
Ground	D16		C16	Point 5 low level
Point 6 low level	D17		C17	Ground
Ground	D18		C18	Point 7 low level
Point 8 low level	D19		C19	Ground
Ground	D20		C20	Point 9 low level
Point 10 low level	D21		C21	Ground
Ground	D22		C22	Point 11 low level
Point 12 low level	D23		C23	Ground
Ground	D24		C24	Point 13 low level
Point 14 low level	D25		C25	Ground
Ground	D26		C26	Point 15 low level
Ext. sync input	D27		C27	Ground
+5 VDC	D28		C28	Ext. sync ready

Figure 3-9. Non-isolated DI/PI pin and signal assignment

**CAUTION:** Never connect a “contact sense” connection that has one terminal connected to any ac or dc power supply. Never connect “voltage sense” connections directly through a switch contact to a power supply.

### Nonisolated Digital Output Card

The non-isolated digital output (DO) card provides 16 points of solid state nonisolated digital output. The signal names and connection points are shown in Figure 3-10.

Signal name	Pin	User connector (cable side view)	Pin	Signal name
Ground	D1		C1	Point 0
Ground	D2		C2	Point 1
Ground	D3		C3	Point 2
Ground	D4		C4	Point 3
Ground	D5		C5	No connection
Ground	D6		C6	No connection
Ground	D7		C7	No connection
Ground	D8		C8	No connection
Ground	D9		C9	No connection
Ground	D10		C10	Point 4
Ground	D11		C11	Point 5
Ground	D12		C12	Point 6
Ground	D13		C13	Point 7
Ground	D14		C14	No connection
Ground	D15		C15	No connection
Ground	D16		C16	No connection
Ground	D17		C17	Point 8
Ground	D18		C18	Point 9
Ground	D19		C19	Point 10
Ground	D20		C20	Point 11
Ground	D21		C21	No connection
Ground	D22		C22	No connection
Ground	D23		C23	No connection
Ground	D24		C24	No connection
Ground	D25		C25	Point 12
Ground	D26		C26	Point 13
Ground	D27		C27	Point 14
Ground	D28		C28	Point 15

Figure 3-10. Non-isolated DO pin and signal assignment

### Solid State Multiplexer Card

The solid state multiplexer card provides sixteen 2-wire analog input channels. The signal names and connection points are indicated in Figure 3-11.

Signal name	Pin	User connector (cable side view)	Pin	Signal name
Channel 0 (+)	D1		C1	Channel 0 (-)
Shield	D2		C2	Shield
Channel 1 (+)	D3		C3	Channel 1 (-)
Channel 2 (+)	D4		C4	Channel 2 (-)
Shield	D5		C5	Shield
Channel 3 (+)	D6		C6	Channel 3 (-)
No connection	D7		C7	No connection
Channel 4 (+)	D8		C8	Channel 4 (-)
Shield	D9		C9	Shield
Channel 5 (+)	D10		C10	Channel 5 (-)
Channel 6 (+)	D11		C11	Channel 6 (-)
Shield	D12		C12	Shield
Channel 7 (+)	D13		C13	Channel 7 (-)
No connection	D14		C14	No connection
Channel 8 (+)	D15		C15	Channel 8 (-)
Shield	D16		C16	Shield
Channel 9 (+)	D17		C17	Channel 9 (-)
Channel 10 (+)	D18		C18	Channel 10 (-)
Shield	D19		C19	Shield
Channel 11 (+)	D20		C20	Channel 11 (-)
No connection	D21		C21	No connection
Channel 12 (+)	D22		C22	Channel 12 (-)
Shield	D23		C23	Shield
Channel 13 (+)	D24		C24	Channel 13 (-)
Channel 14 (+)	D25		C25	Channel 14 (-)
Shield	D26		C26	Shield
Channel 15 (+)	D27		C27	Channel 15 (-)
No connection	D28		C28	No connection

Figure 3-11. Solid state multiplexer pin and signal assignment



### Reed Relay Multiplexer Card

The reed relay multiplexer card provides eight 2-wire analog input channels. The signal names and connection points are indicated in Figure 3-12.

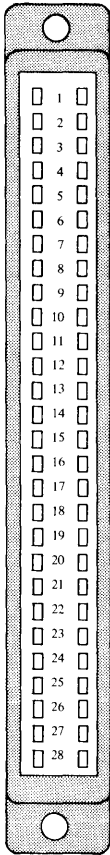
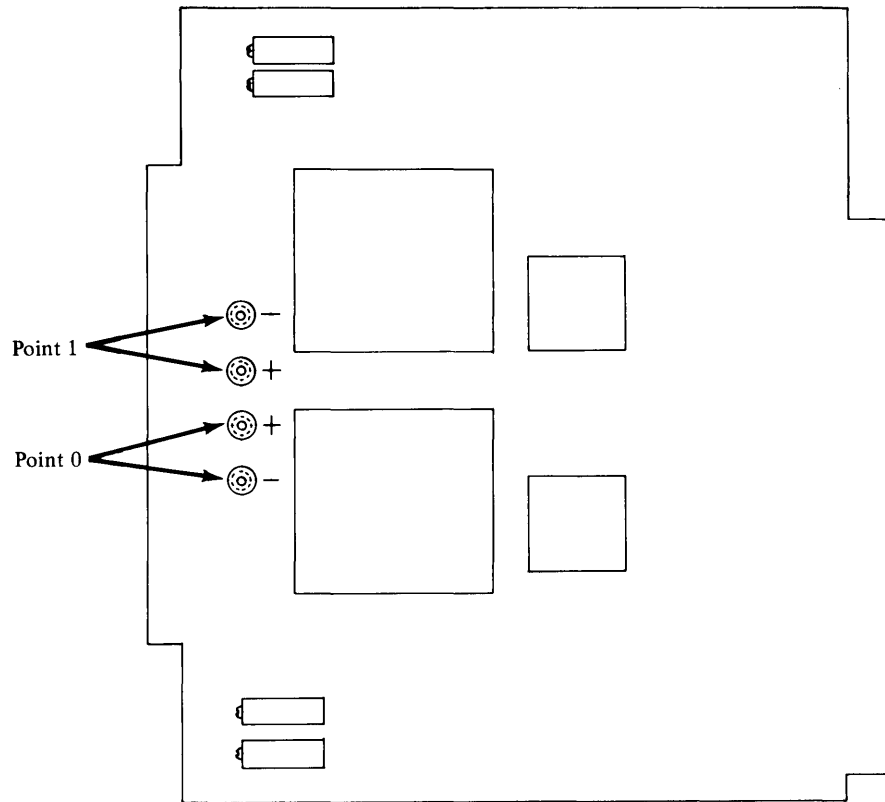
Signal name	Pin	User connector (cable side view)	Pin	Signal name
Channel 0 (+)	D1		C1	Channel 0 (-)
Shield	D2		C2	No connection
No connection	D3		C3	No connection
Channel 1 (+)	D4		C4	Channel 1 (-)
Shield	D5		C5	No connection
No connection	D6		C6	No connection
No connection	D7		C7	No connection
Channel 2 (+)	D8		C8	Channel 2 (-)
Shield	D9		C9	No connection
No connection	D10		C10	No connection
Channel 3 (+)	D11		C11	Channel 3 (-)
Shield	D12		C12	No connection
No connection	D13		C13	No connection
No connection	D14		C14	No connection
Channel 4 (+)	D15		C15	Channel 4 (-)
Shield	D16		C16	No connection
No connection	D17		C17	No connection
Channel 5 (+)	D18		C18	Channel 5 (-)
Shield	D19		C19	No connection
No connection	D20		C20	No connection
No connection	D21		C21	No connection
Channel 6 (+)	D22		C22	Channel 6 (-)
Shield	D23		C23	No connection
No connection	D24		C24	No connection
Channel 7 (+)	D25		C25	Channel 7 (-)
Shield	D26		C26	No connection
No connection	D27		C27	No connection
No connection	D28		C28	No connection

Figure 3-12. Reed relay multiplexer pin and signal assignment

## Analog Output Card

The analog output (AO) card provides two points of nonisolated analog voltage output. The signal names and connection points are indicated in Figure 3-13.



*Note:* The AO connections are made directly on the AO feature card with screw connectors mounted on the card.

Figure 3-13. Analog output multiplexer pin and signal assignment

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## Timer Specifications and Wiring

The timer feature card contains two separately addressable 16-bit timers.

The timers are connected through a 2 x 8 polarized BERG<sup>1</sup> connector to the user wiring as shown in Figure 3-14. Berg connectors to be plugged in IBM cards should be polarized by plugging a pin as shown in B2 position.

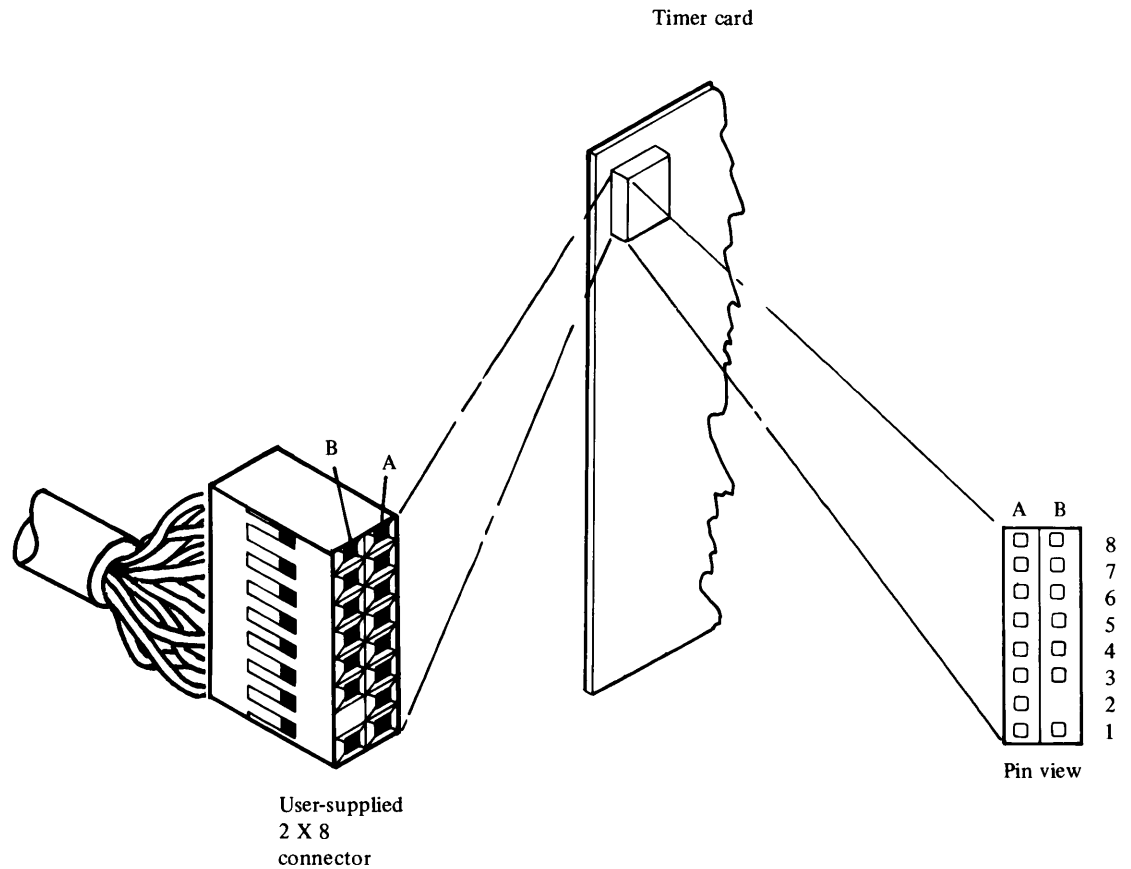


Figure 3-14. Timer card cable connector

<sup>1</sup> Trademark of the BERG Electronics, Div. of EI dupont de Nemours, Co.

Supplying the connector, wire, other required hardware, and connection to the appropriate points is the user's responsibility. The connector used is a BERG 2 x 8 (16 pin) polarized connector, P/N 65405-005, using connector pins P/N 75598-003 (or equivalent). Recommended wiring type is #24 AWG twisted pair. The connector pins and associated signals for each of the timers is shown in the connector pin table Figure 3-15.

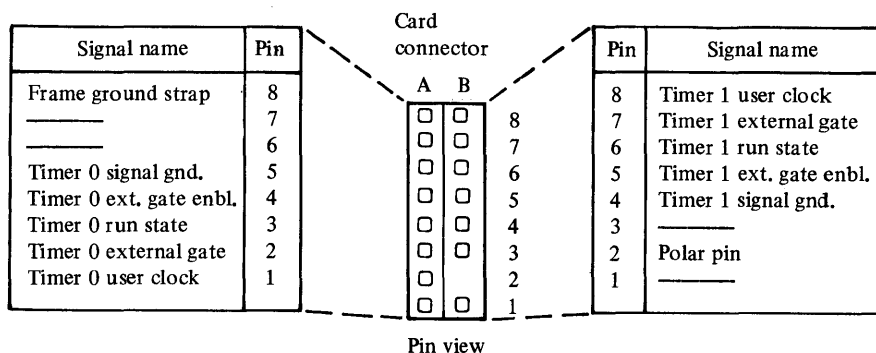


Figure 3-15. Timer card connector pin to signal assignment

During planning and installation of the timer wiring, the wiring and grounding practices at the beginning of this chapter must be followed.

### CUSTOMER ACCESS PANEL TIMER WIRING

If the user is connecting the timer feature with the Customer Access Panel feature, wiring will be slightly different. The signal pin connectors and wiring points are specified in this chapter in the customer access panel wiring section.

## Integrated Digital Input/Output (Nonisolated)

The integrated digital input/output feature contains 32 digital input (DI) points and 32 digital output (DO) points. DI and DO points are each divided into two groups of 16 points each. Associated with each group of 16 DI or DO points is an external sync signal and a ready signal.

The DI, DO, external sync and ready signals are connected through three 2 x 20 polarized BERG connectors represented in Figure 3-16.

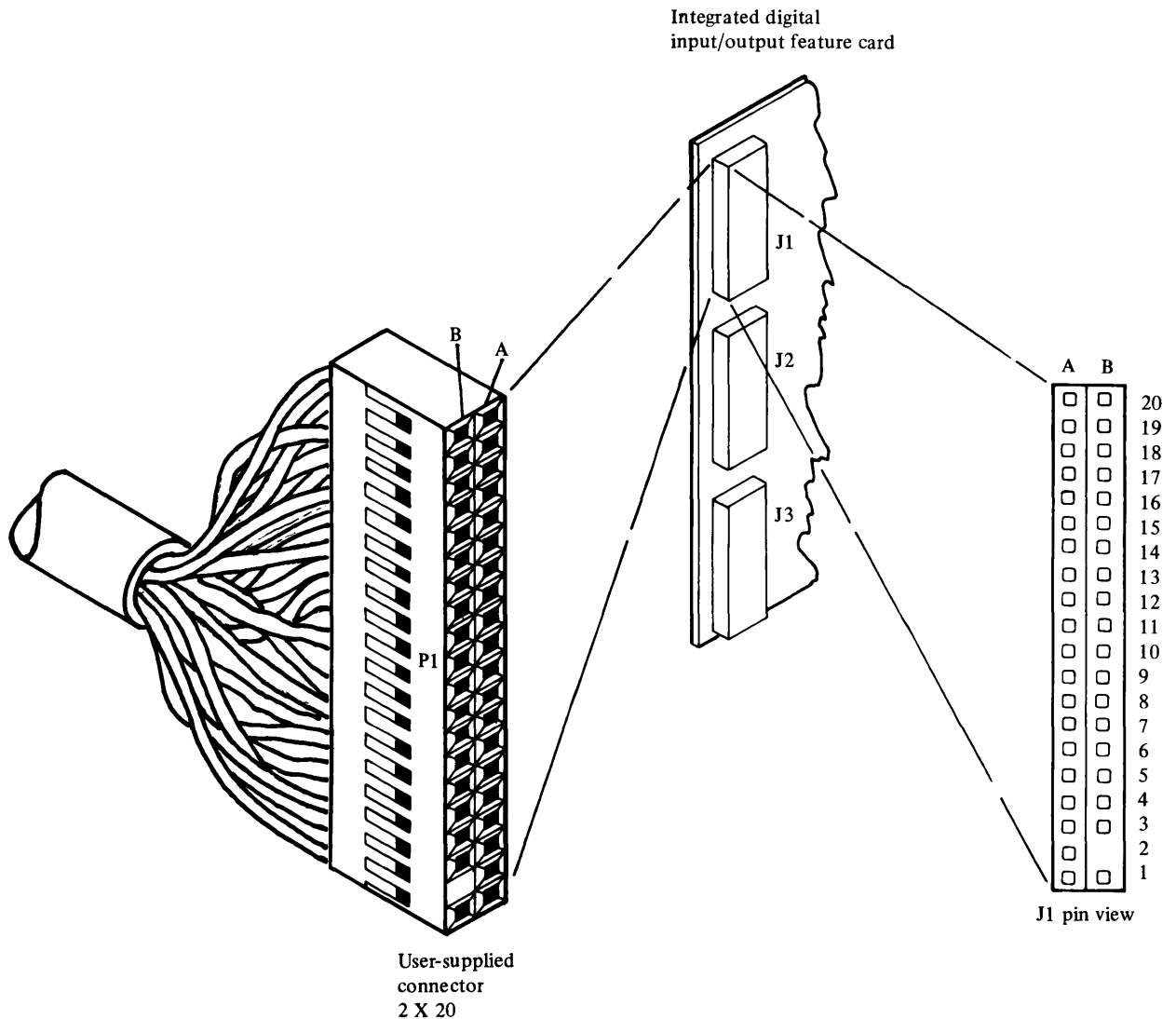


Figure 3-16. Integrated DI/DO card and cable connector

Supplying the connectors, wire, other required hardware, and connection to the appropriate points is the user's responsibility. The connector used is a BERG 2 x 20 (40 pin) connector, P/N 65405-013, using connector pins P/N 75598-003 (or equivalent). The connector pins and associated signals for each of the connectors are shown in Figures 3-17, 3-18, and 3-19 for connectors J1, J2 and J3, respectively.

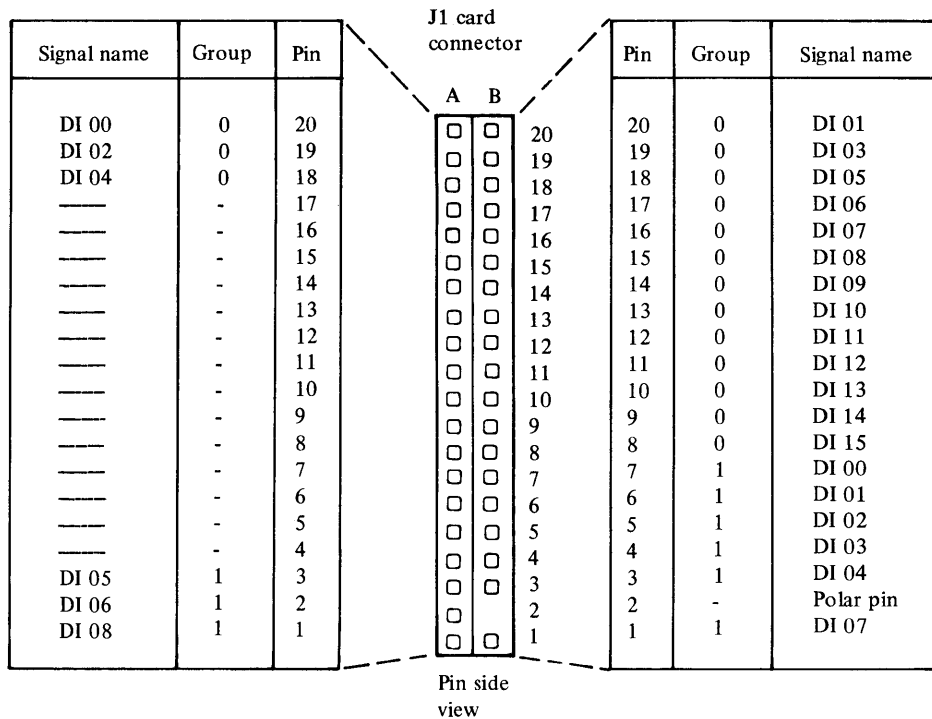


Figure 3-17. DI/DO connector J1 pin to signal assignments

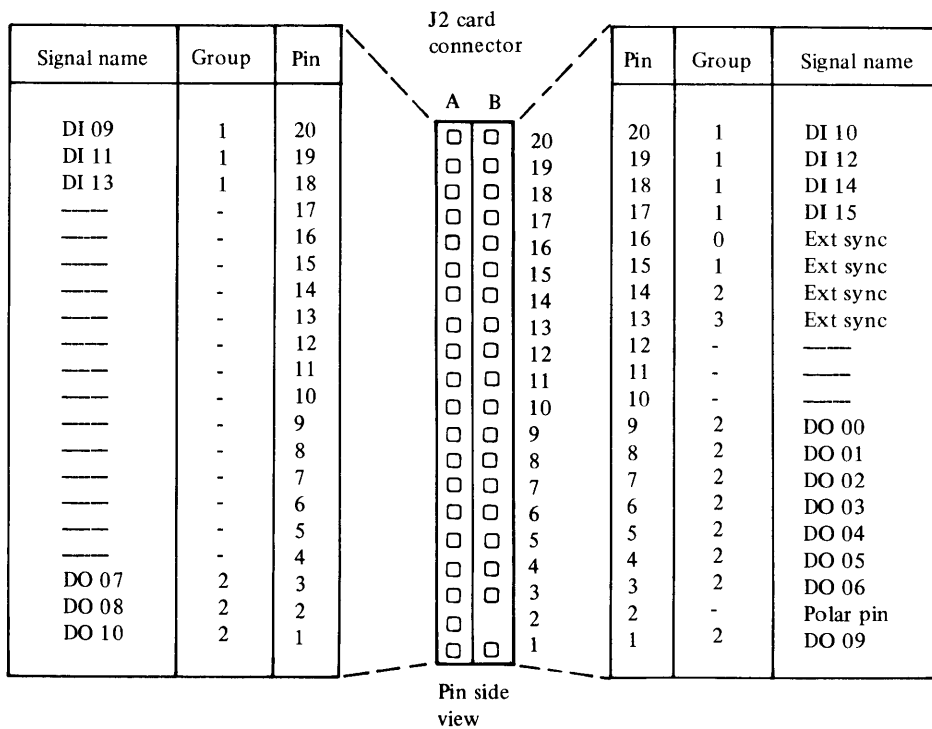


Figure 3-18. DI/DO connector J2 pin to signal assignments

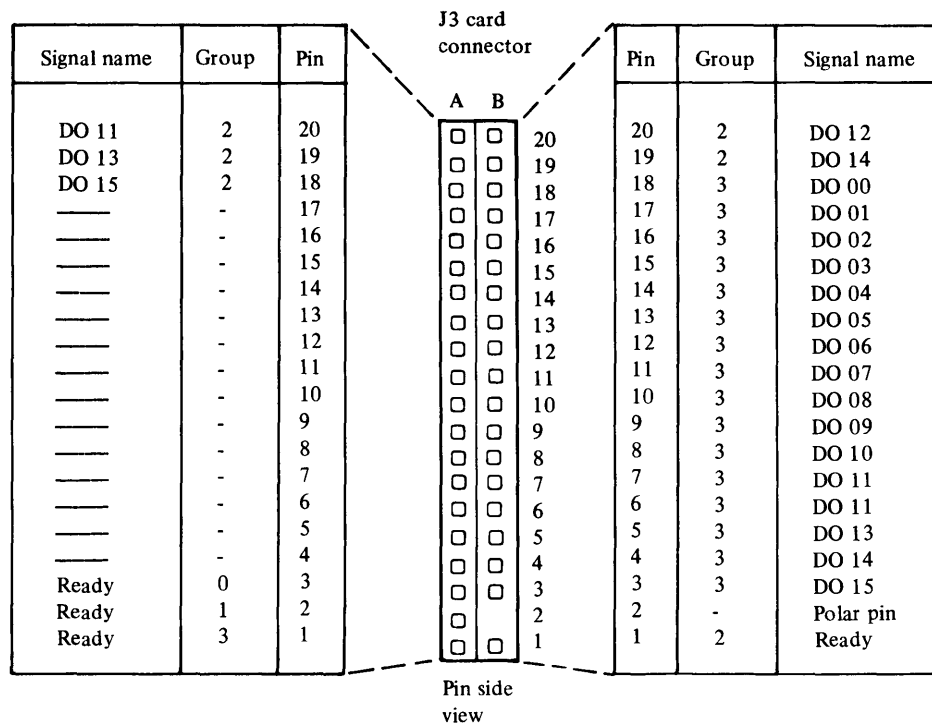


Figure 3-19. DI/DO connector J3 pin to signal assignments

The Integrated DI/DO feature requires a maximum of 72 twisted-pair from the feature card top-card connectors to the user connection. In applications where customer cabling connects directly to the feature card, the customer cable must be selected for minimum size to facilitate exit from the 4953, 4955 or 4959 unit and minimum contention with other cables. A #24 AWG twisted-pair flat cable is recommended.

During planning and installation of the integrated digital I/O wiring, the wiring type, wiring practices, and grounding practices at the beginning of this chapter must be followed.

### CUSTOMER ACCESS PANEL DI/DO WIRING

If the user is connecting the integrated digital I/O with the Customer Access Panel feature, wiring will be slightly different. The signal pin connectors and wiring points are specified in this chapter in the customer access panel wiring section.



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## Customer Direct Program Control

The customer direct program control (DPC) feature contains a 16-bit data bus out, a 16-bit data bus in, 16 interrupt bits, two parity bits for each bus and 23 control signals.

The signals are connected through three 2 x 20 polarized BERG connectors represented in Figure 3-20.

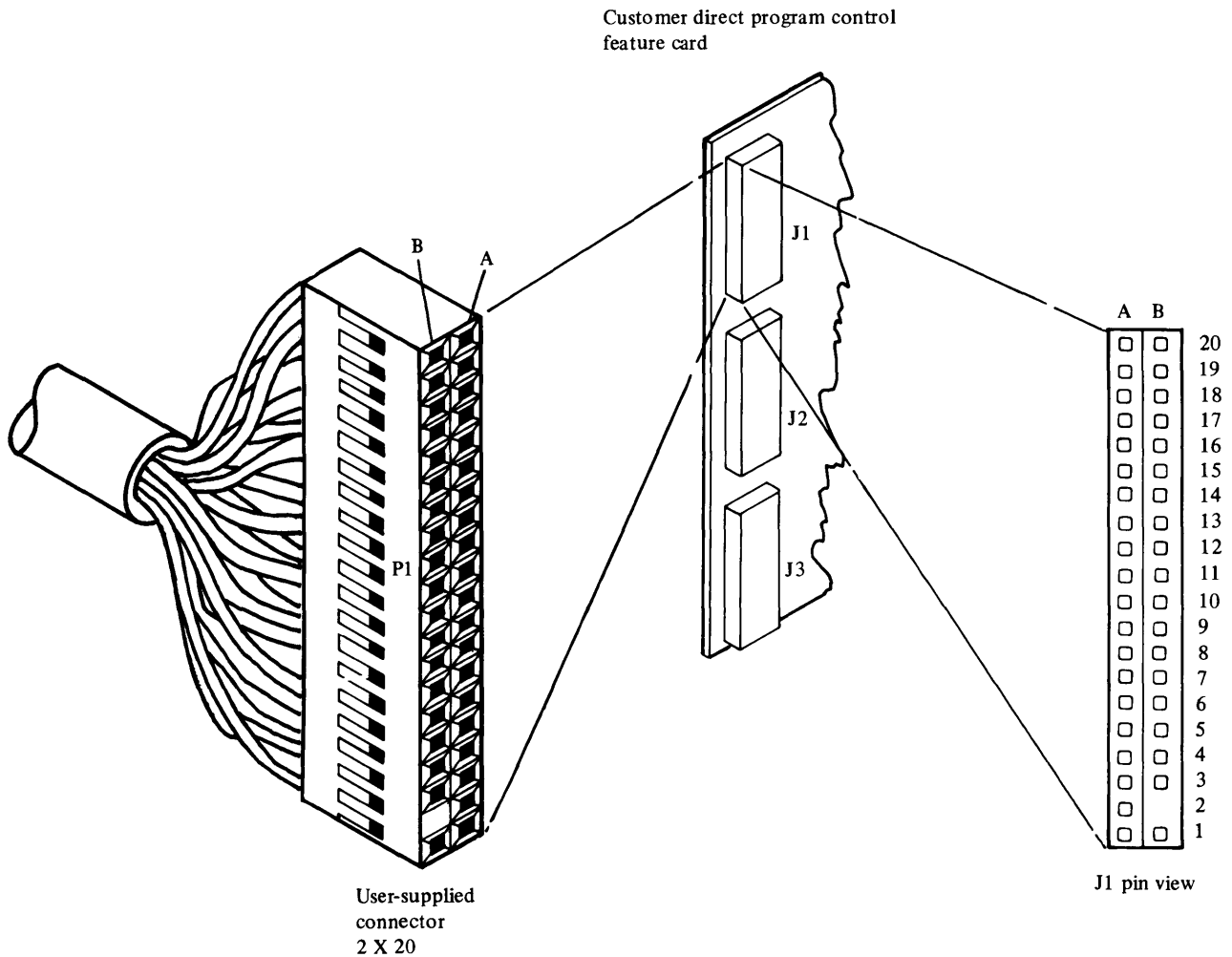


Figure 3-20. Customer DPC card and cable connector

Supplying the connectors, wire, other required hardware, and connection to the appropriate points is the user's responsibility. The connector used is a BERG 2 x 20 (40 pin) connector, P/N 65405-013, using connector pins P/N 75598-003 (or equivalent). The connector pins and associated signals for each of the connectors are shown in Figures 3-21, 3-22 and 3-23 for connectors J1, J2 and J3 respectively.

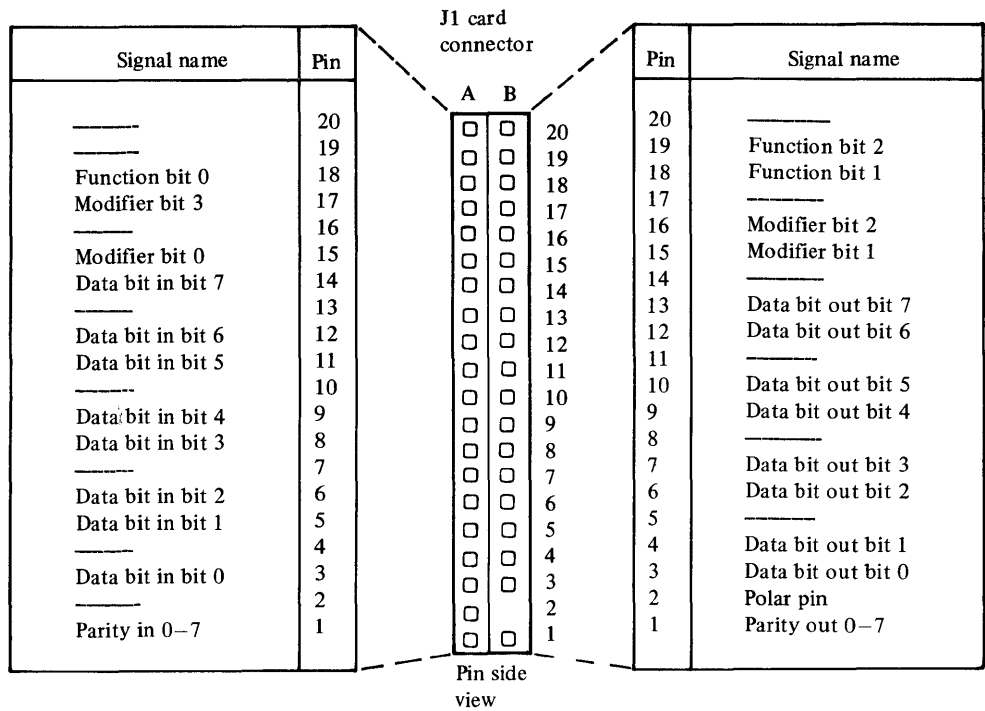


Figure 3-21. DPC connector J1 pin to signal assignments

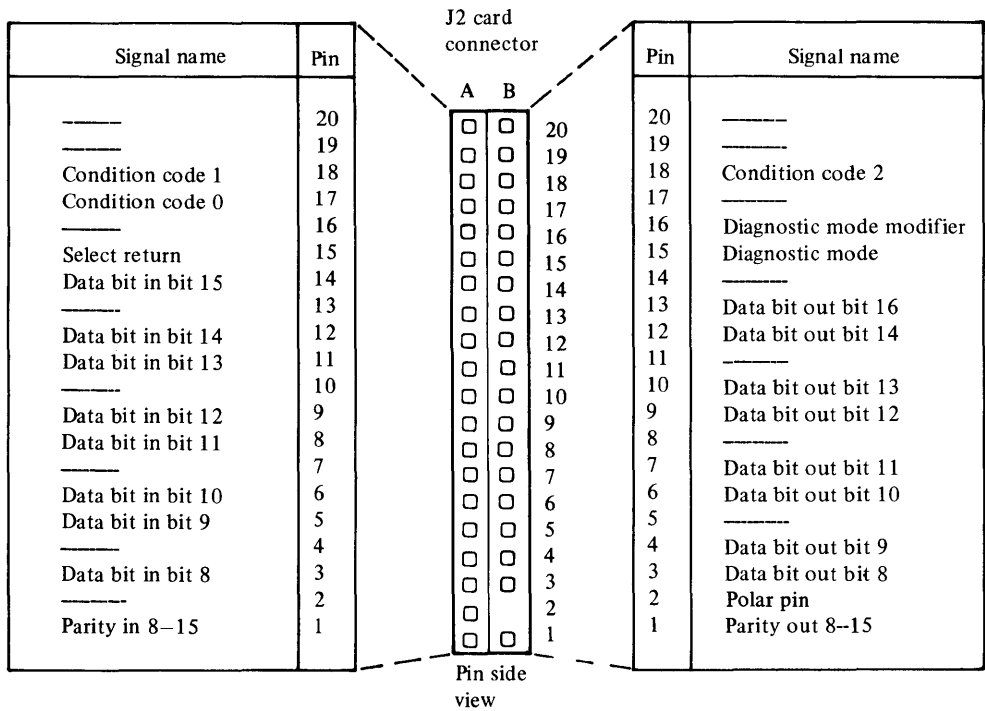


Figure 3-22. DPC connector J2 pin to signal assignments

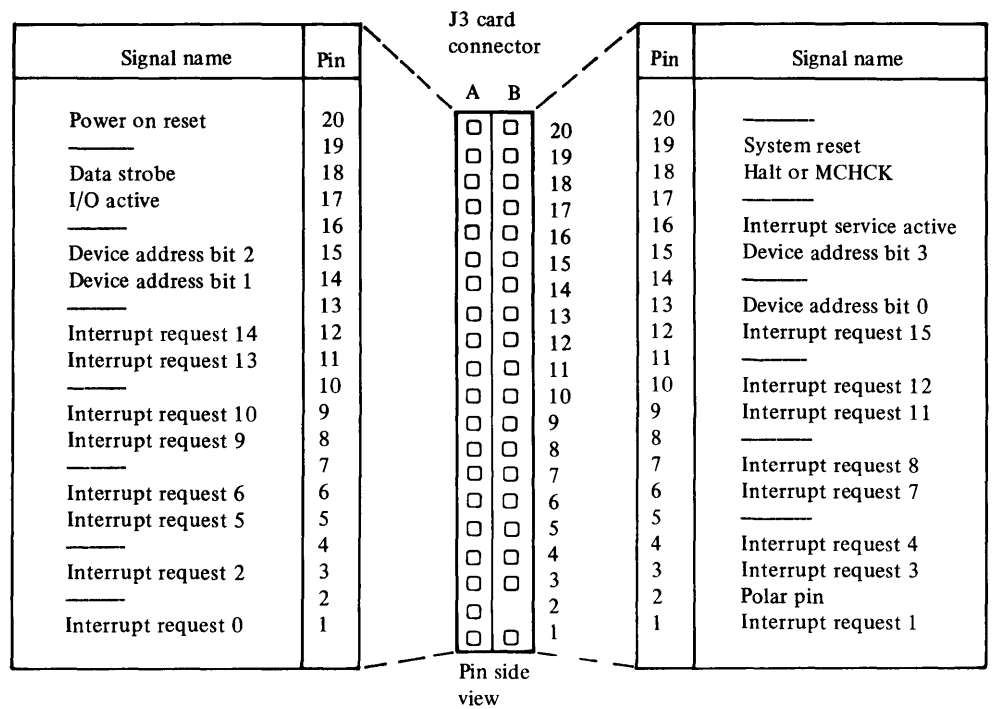


Figure 3-23. DPC connector J3 pin to signal assignments

The Customer Direct Program Control feature requires a maximum of 76 twisted-pair from the feature card top-card connectors to the user connection. In applications where customer cabling connects directly to the feature card, the customer cable must be selected for minimum size to facilitate exit from the 4953, 4955 or 4959 unit and minimum contention with other cables. A #24 AWG twisted-pair flat cable is recommended.

During planning and installation of the customer direct program control wiring, the wiring type, wiring practices and grounding practices at the beginning of this chapter must be followed.

### CUSTOMER ACCESS DPC WIRING

If the user is connecting the customer direct program control with the customer access panel feature, wiring will be slightly different. The signal pin, connectors and wiring points are specified in this chapter in the customer access panel wiring section.

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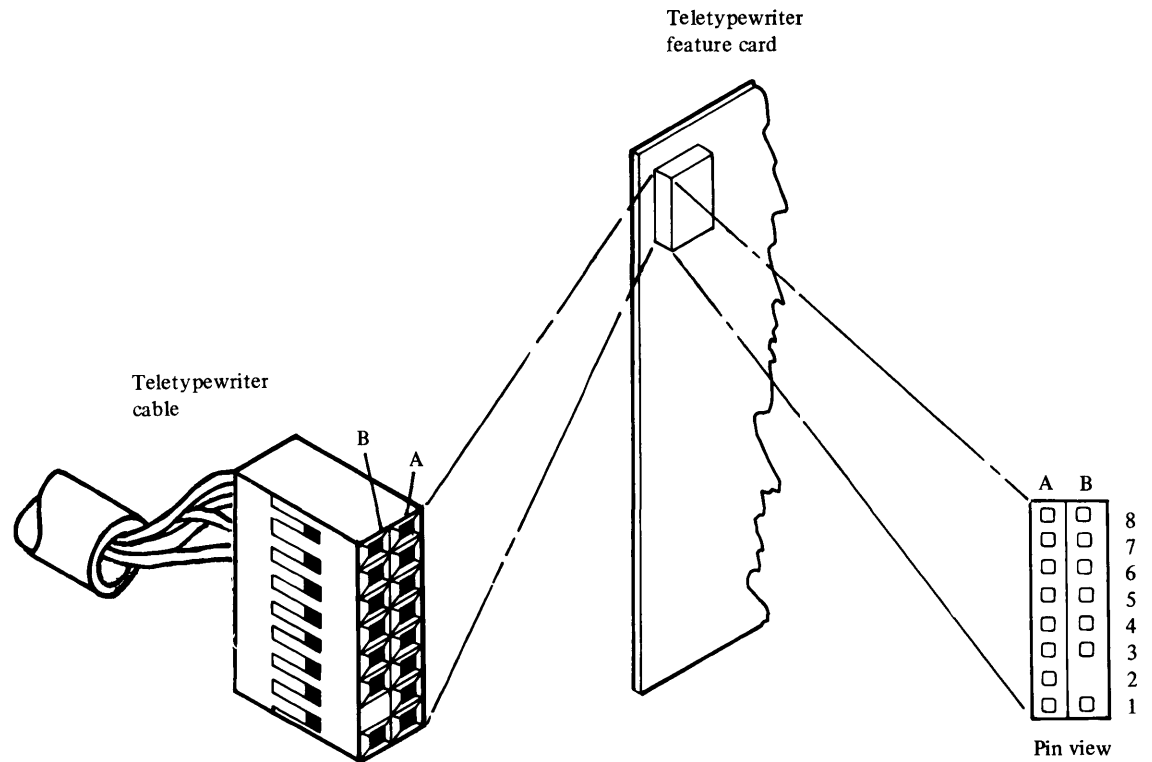
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## Teletypewriter Attachment Wiring

The teletypewriter attachment provides the capability of attaching a Teletype Corporation model ASR-33, ASR-35, KSR-33 or equivalent teletypewriter to a Series/1 system. Figure 3-24 illustrates the teletypewriter feature card signal and pin assignment.



<i>Card connector pin</i>	<i>Series/1 card signal</i>	<i>Cable wire color code</i>	<i>Device signal attachment</i>
B1	-Rec	White	-Xmit
A3	+Rec	Red	+Xmit
B5	-Xmit	Black	-Rec
A2	+Xmit	Yellow	+Rec

This connection is for a teletypewriter that requires 12 volts across the teletypewriter receive input and 24 volts across the teletypewriter transmit output. For devices that require only 12 volts across the transmit output, the wire in pin B1 must be moved to B5.

Figure 3-24. Teletypewriter feature card signal and pin assignment

## CABLE ATTACHMENT

The teletypewriter attachment cable must be attached to the teletypewriter as indicated in Figure 3-25.

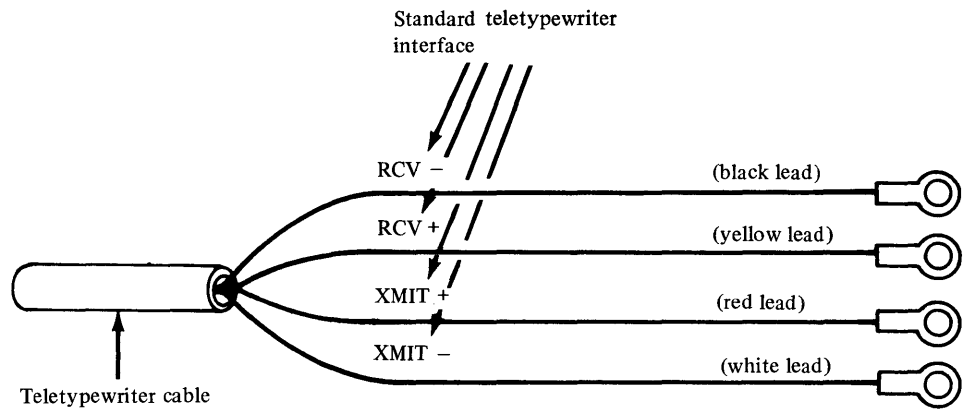


Figure 3-25. Teletypewriter cable signal identification

## CUSTOMER ACCESS PANEL TELETYPEWRITER WIRING

If the user is connecting the teletypewriter feature with the Customer Access Panel feature, wiring will be slightly different. The signal pin connectors and wiring points are specified in this chapter in the customer access panel wiring section.

# Customer Access Panel

The customer access panel mounts in the rear of the rack enclosure. The panel provides quick disconnect plug attachment wiring for the following features:

- Integrated DI/DO
- Customer Direct Program Control Adapter
- Teletypewriter Adapter
- Timers

The panel is illustrated in Figure 3-26 with the appropriate feature connectors labeled.

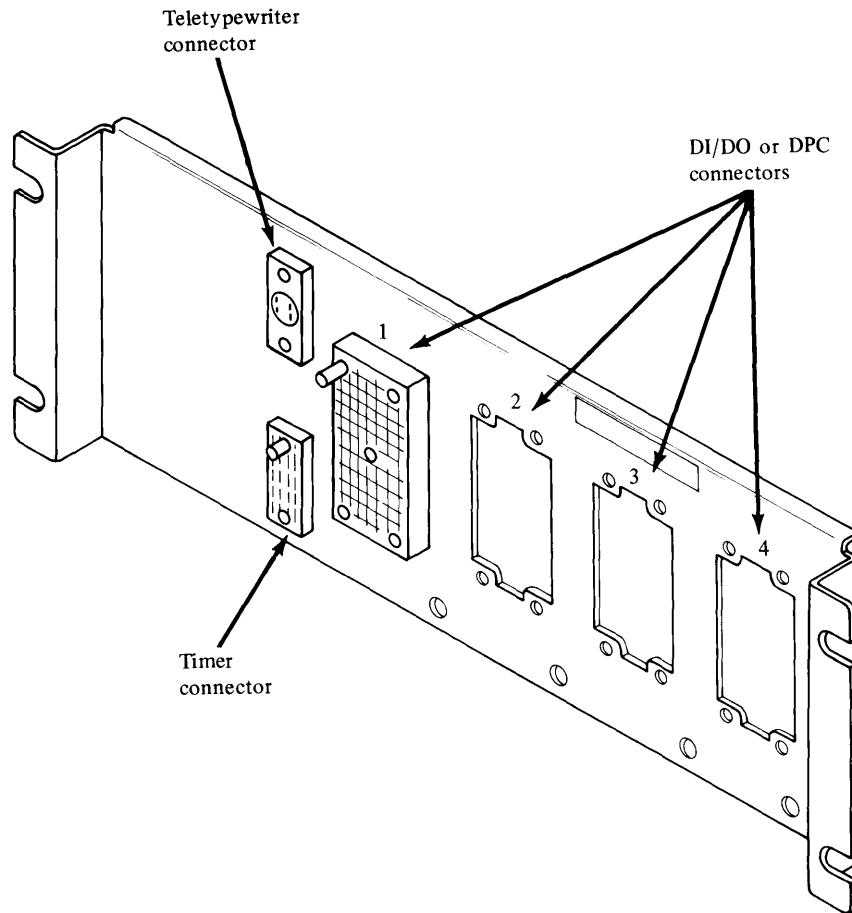
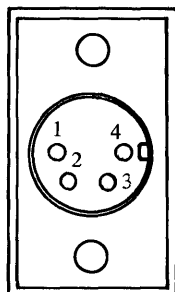


Figure 3-26. Customer access panel



## TELETYPEWRITER CONNECTOR

The teletypewriter connector is illustrated in Figure 3-27 with the appropriate pin and signal assignments.

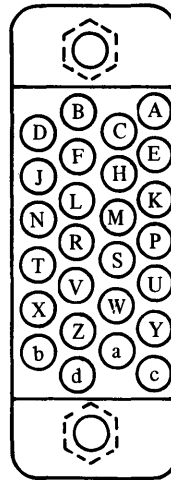


<i>Access panel connector pin</i>	<i>Series/1 access panel signal</i>	<i>Cable wire color</i>	<i>Device signal attachment</i>
1	-Xmit	Black	-Rec
2	+Xmit	Yellow	+Rec
3	-Rec	White	-Xmit
4	+Rec	Red	+Xmit

Figure 3-27. Teletypewriter connector and signal pin assignments

## TIMER CONNECTOR

The timer connector is illustrated in Figure 3-28 with the appropriate pin and signal assignments.



Timer 0		Timer 1	
Signal name	Pin	Signal name	Pin
Customer clock +	A	Customer clock +	U
Customer clock -	E	Customer clock -	Y
External gate +	C	External gate +	S
External gate -	H	External gate -	W
Run state +	B	Run state +	V
Run state -	F	Run state -	Z
Ext. gate enable +	D	Ext. gate enable +	T
Ext. gate enable -	J	Ext. gate enable -	X
Signal ground	K,M,L,N	Signal ground	c,a,d,b

Figure 3-28. Timer connector and signal pin assignments

## DI/DO OR DPC CONNECTORS

There may be up to 4 DI/DO or DPC connectors mounted on the panel. Each connector is wired to either a DI/DO feature card or a DPC feature card. Figure 3-29 is an illustration of the connector with the pin labels.

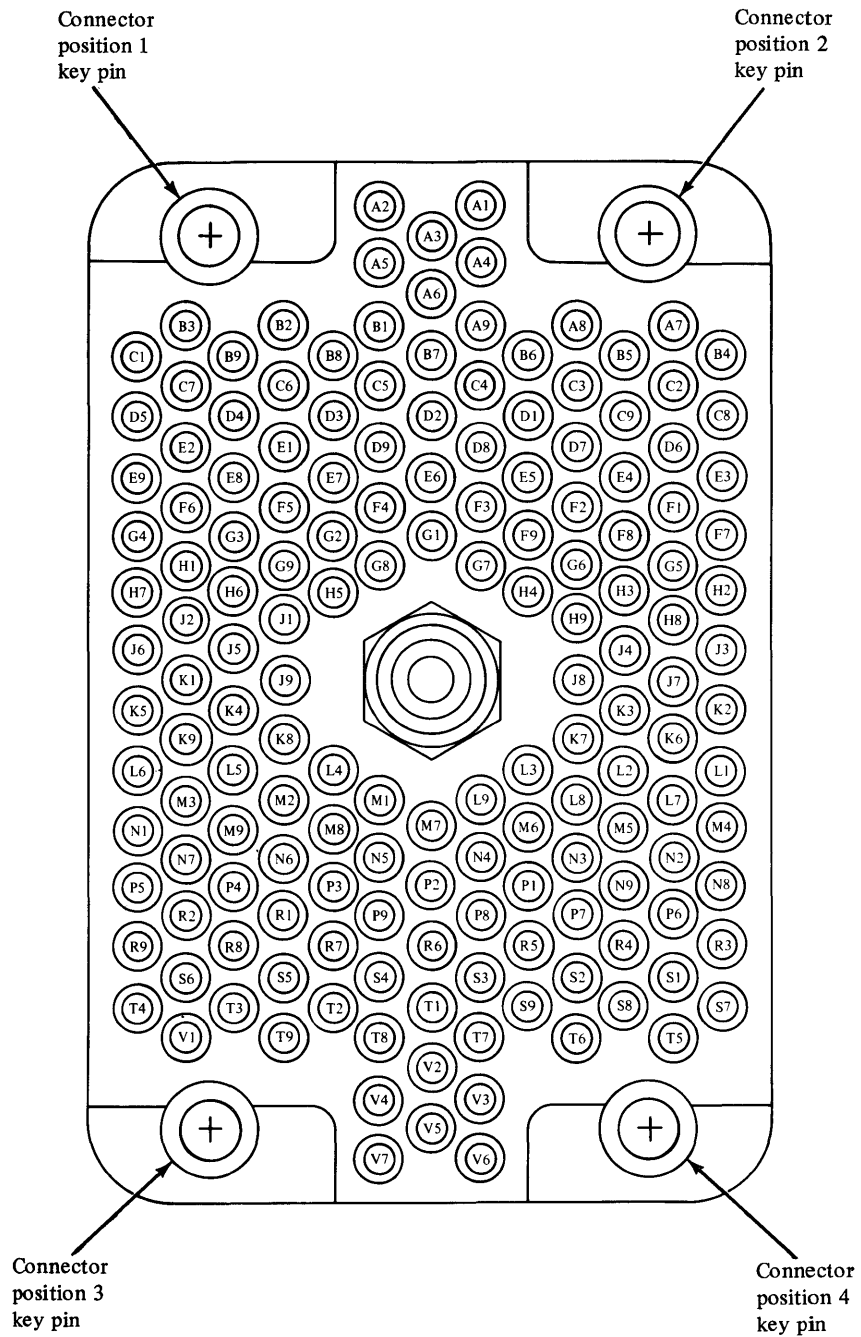


Figure 3-29. DI/DO and, or DPC connector

The DI/DO connector pin and signal assignments are contained in Figure 3-30.

<i>Digital input</i>					
<i>Group 0</i>			<i>Group 1</i>		
<i>Signal name</i>		<i>Pin</i>	<i>Signal name</i>		<i>Pin</i>
DI 00	+	D3	DI 00	+	E2
	-	B2		-	B3
DI 01	+	F8	DI 01	+	D9
	-	C9		-	C5
DI 02	+	D2	DI 02	+	D8
	-	A6		-	B7
DI 03	+	F7	DI 03	+	D6
	-	C8		-	B5
DI 04	+	D1	DI 04	+	D5
	-	B6		-	A2
DI 05	+	F6	DI 05	+	B1
	-	C7		-	A5
DI 06	+	F4	DI 06	+	A9
	-	F5		-	A8
DI 07	+	F3	DI 07	+	D4
	-	C4		-	B9
DI 08	+	F1	DI 08	+	A7
	-	C2		-	A4
DI 09	+	E9	DI 09	+	J6
	-	C1		-	G4
DI 10	+	E8	DI 10	+	M4
	-	C6		-	L8
DI 11	+	E7	DI 11	+	J5
	-	E1		-	G9
DI 12	+	E6	DI 12	+	M3
	-	G1		-	M2
DI 13	+	E5	DI 13	+	J4
	-	D7		-	G6
DI 14	+	E4	DI 14	+	M1
	-	C3		-	G8
DI 15	+	E3	DI 15	+	L9
	-	B4		-	M7
Ext Sync	+	L7	Ext Sync	+	L6
	-	H8		-	J9
Ready	+	M8	Ready	+	M6
	-	N6		-	P1

Figure 3-30. DI/DO connector pin and signal assignments (Part 1 of 2)

<i>Digital output</i>			
<i>Group 2</i>		<i>Group 3</i>	
<i>Signal name</i>	<i>Pin</i>	<i>Signal name</i>	<i>Pin</i>
DO 00	+ K9	DO 00	+ T3
	- J2		- T9
DO 01	+ K6	DO 01	+ T2
	- G5		- S5
DO 02	+ K5	DO 02	+ T1
	- H7		- V2
DO 03	+ K4	DO 03	+ S9
	- H6		- V3
DO 04	+ K3	DO 04	+ S8
	- H9		- S2
DO 05	+ K2	DO 05	+ S7
	- H2		- N8
DO 06	+ K1	DO 06	+ S6
	- H1		- V1
DO 07	+ G3	DO 07	+ S4
	- G7		- T8
DO 08	+ G2	DO 08	+ S3
	- H4		- T7
DO 09	+ J7	DO 09	+ S1
	- H3		- P6
DO 10	+ F9	DO 10	+ R9
	- F2		- N1
DO 11	+ R2	DO 11	+ R8
	- N7		- P4
DO 12	+ T5	DO 12	+ R7
	- T6		- P3
DO 13	+ P9	DO 13	+ R6
	- N5		- P2
DO 14	+ T4	DO 14	+ R5
	- P5		- P7
DO 15	+ P8	DO 15	+ R4
	- N4		- N9
Ext Sync	+ L5	Ext Sync	+ L4
	- J1		- H5
Ready	+ R3	Ready	+ M5
	- N2		- N3

Figure 3-30. DI/DO connector pin and signal assignments (Part 2 of 2)

The DPC connector pin and signal assignments are contained in Figure 3-31.

<i>Signal name</i>		<i>Pin</i>	<i>Signal name</i>		<i>Pin</i>
Data bus in bit 0	+	A7	Data bus out bit 0	+	B3
	-	A8		-	B2
Data bus in bit 1	+	B4	Data bus out bit 1	+	C1
	-	B5		-	B9
Data bus in bit 2	+	C2	Data bus out bit 2	+	C7
	-	C3		-	C6
Data bus in bit 3	+	C8	Data bus out bit 3	+	D5
	-	C9		-	D4
Data bus in bit 4	+	D6	Data bus out bit 4	+	E2
	-	D7		-	E1
Data bus in bit 5	+	E3	Data bus out bit 5	+	E9
	-	E4		-	E8
Data bus in bit 6	+	F1	Data bus out bit 6	+	F6
	-	F2		-	F5
Data bus in bit 7	+	F7	Data bus out bit 7	+	G4
	-	F8		-	G3
Data bus in bit 8	+	G5	Data bus out bit 8	+	H1
	-	G6		-	G9
Data bus in bit 9	+	H2	Data bus out bit 9	+	H7
	-	H3		-	H6
Data bus in bit 10	+	H8	Data bus out bit 10	+	J2
	-	H9		-	J1
Data bus in bit 11	+	J3	Data bus out bit 11	+	J6
	-	J4		-	J5
Data bus in bit 12	+	J7	Data bus out bit 12	+	K1
	-	J8		-	J9
Data bus in bit 13	+	K2	Data bus out bit 13	+	K5
	-	K3		-	K4
Data bus in bit 14	+	K6	Data bus out bit 14	+	K9
	-	K7		-	K8
Data bus in bit 15	+	L1	Data bus out bit 15	+	L6
	-	L2		-	L5
Data bus in parity 0-7	+	L7	Data bus out parity 0-7	+	M3
	-	L8		-	M2
Data bus in parity 8-15	+	M4	Data bus out parity 8-15	+	N1
	-	M5		-	M9

Figure 3-31. DPC connector pin and signal assignments (Part 1 of 2)

<i>Signal name</i>		<i>Pin</i>	<i>Signal name</i>		<i>Pin</i>
Modifier bit 0	+	N2	Interrupt request 0	+	A1
	-	M3		-	A4
Modifier bit 1	+	N8	Interrupt request 1	+	A3
	-	N9		-	A6
Modifier bit 2	+	P6	Interrupt request 2	+	A2
	-	P7		-	A5
Modifier bit 3	+	R3	Interrupt request 3	+	B6
	-	R4		-	A9
Device address bit 0	+	N7	Interrupt request 4	+	B8
	-	N6		-	B1
Device address bit 1	+	P5	Interrupt request 5	+	D1
	-	P4		-	C4
Device address bit 2	+	R2	Interrupt request 6	+	D3
	-	R1		-	C5
Device address bit 3	+	R9	Interrupt request 7	+	D2
	-	R8		-	B7
Function bit 0	+	S1	Interrupt request 8	+	E5
	-	S2		-	D8
Function bit 1	+	S7	Interrupt request 9	+	E7
	-	S8		-	D9
Function bit 2	+	T5	Interrupt request 10	+	F9
	-	T6		-	F3
Condition code 0	+	S6	Interrupt request 11	+	G2
	-	S5		-	F4
Condition code 1	+	T4	Interrupt request 12	+	G1
	-	T3		-	E6
Condition code 2	+	V1	Interrupt request 13	+	H4
	-	T9		-	G7
Select return	+	M6	Interrupt request 14	+	H5
	-	N4		-	G8
Diagnostic mode	+	P2	Interrupt request 15	+	L3
	-	M7		-	L9
Diagnostic mode modifier	+	L4	Halt or MCHK	+	R5
	-	M1		-	S3
Interrupt service active	+	M8	System reset	+	R6
	-	N5		-	T1
I/O active	+	P1	Power on reset	+	R7
	-	P8		-	S4
Data strobe	+	P3			
	-	P9			

Figure 3-31. DPC connector pin and signal assignments (Part 2 of 2)

# IBM Series/1 Communications Features User Wiring

The communications features provide a variety of single-line and multiple-line telecommunications cards.

## FEATURE CARD SIGNAL AND PIN ASSIGNMENTS

The following communications cards provide a set of EIA standard signals and pin assignments as illustrated in Figure 3-32.

1. Asynchronous Communications Single-Line Control
2. Asynchronous Communications 4-Line Adapter
3. Binary Synchronous Communications Single-Line Control
4. Synchronous Data Link Control Single-Line Control
5. Synchronous Communications 4-Line Adapter

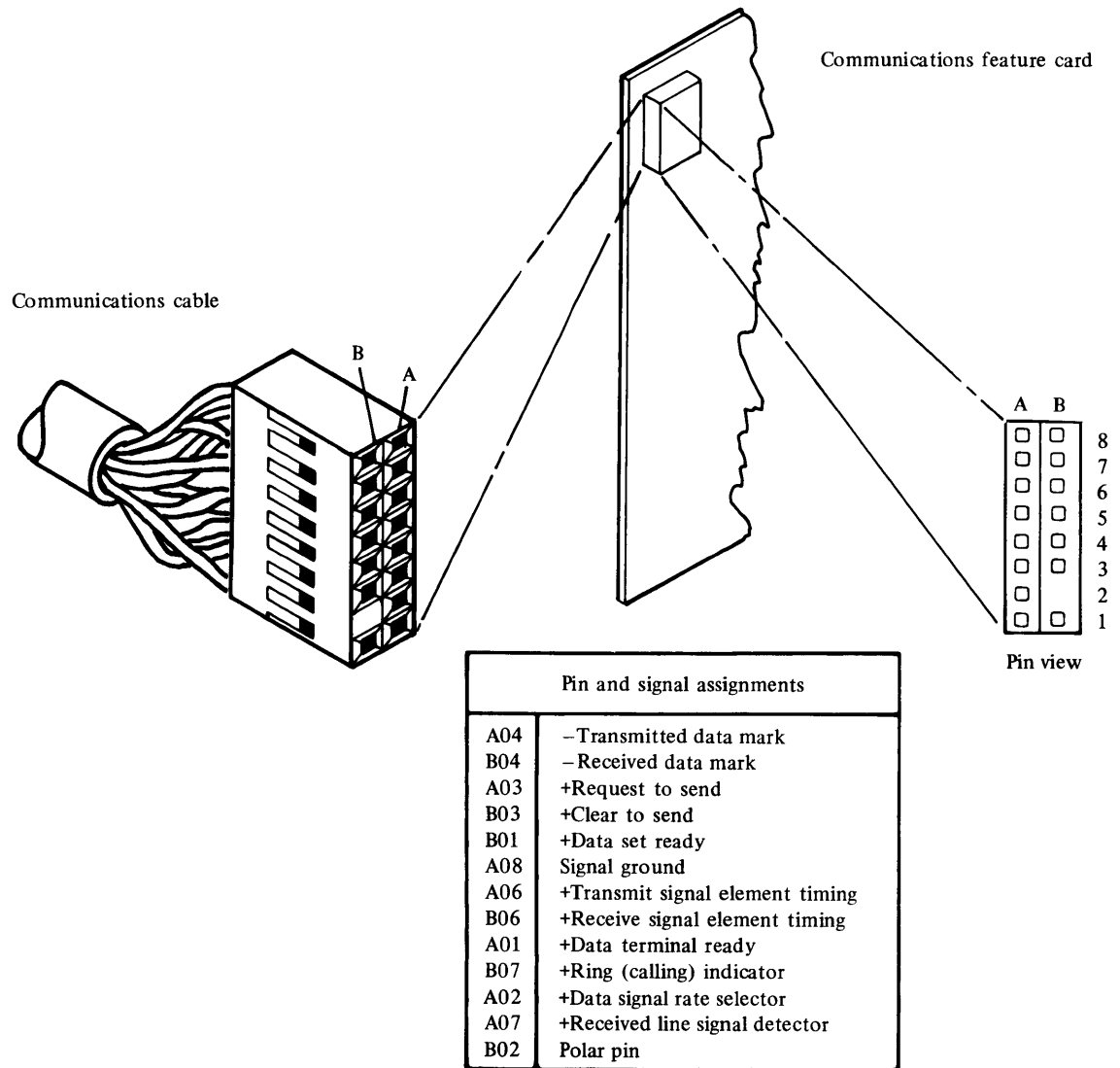
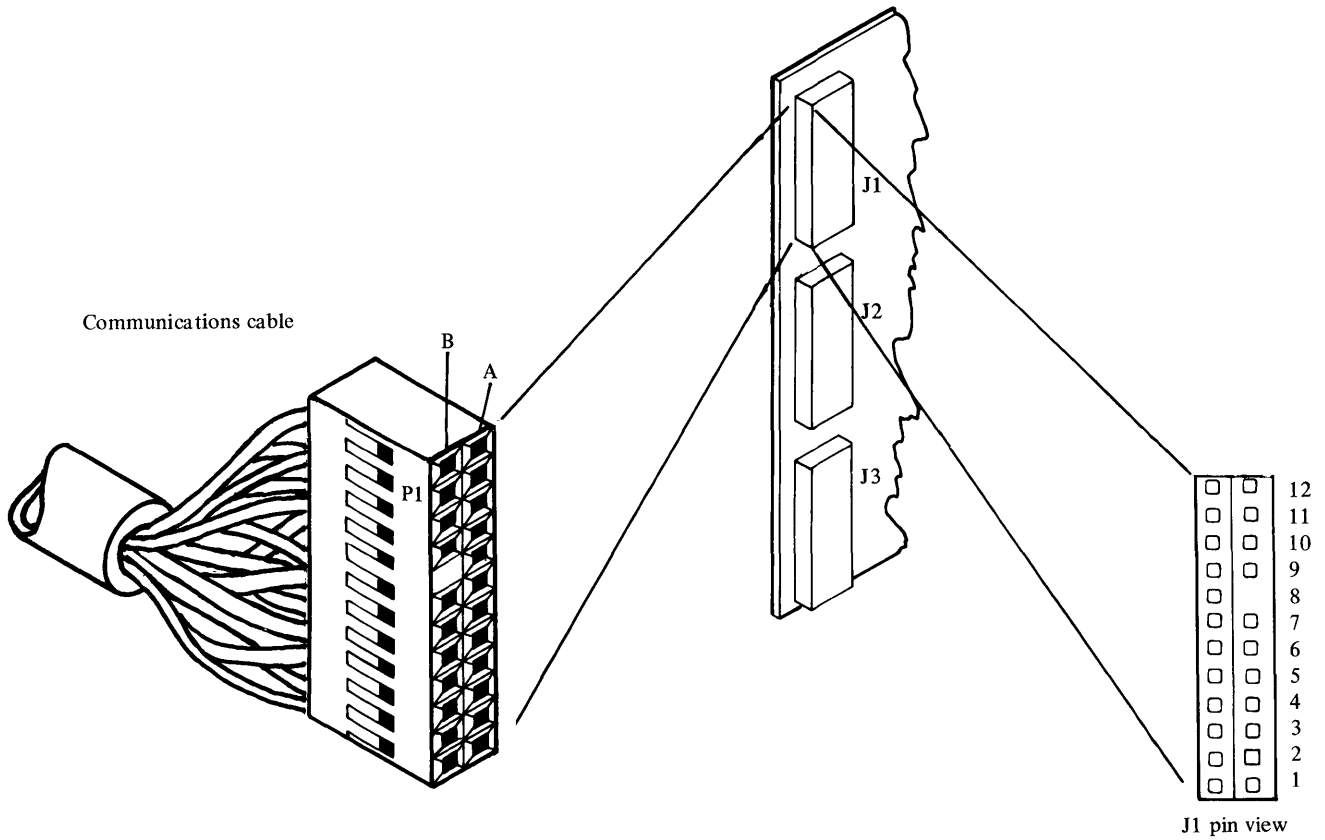


Figure 3-32. Common communications feature card signal and pin assignments



The Binary Synchronous Communications Single-Line Control/High Speed card signal and pin assignments are illustrated in Figure 3-33.

Binary synchronous communications single-line high speed feature card



Pin and signal assignments	
A02	+ Clear to send (303)
B05	+ Clear to send (V35)
A04	+ Data set ready (303)
B07	+ Data set ready (V35)
B01, B03, B06	Ground
A05	+ Receive clock (303)
B09	- Receive clock A (V35)
A09	+ Receive clock B (V35)
A07	- Receive data (303)
B11	- Receive data A (V35)
A11	+ Receive data B (V35)
A01	+ Request to send (303)
B04	+ Request to send (V35)
A08	+ Transmit clock (303)
A12	+ Transmit clock A (V35)
B12	- Transmit clock B (V35)
A06	- Transmit data (303)
B10	- Transmit data A (V35)
A10	+ Transmit data B (V35)
A03	+ 5 volts
B08	Polar pin

Figure 3-33. Binary synchronous communications single-line control/high speed feature card signal and pin assignment

## Appendix A. Unit Specification Summary (Metric units)

Type	Model	Unit description	kVA	Heat Output /Hour kcal	Required Airflow	Weight kg	Dimensions(mm)			Service Clearance(mm)			
							W	D	H	F	R	Rt	L
4953	A,C	Processor, Note 8	0.4	261.5	Note 1	13.6	216	527	356	762	762	0	0
4953	B,D	Processor	0.8	430	Note 1	22.7	483	476	356	762	762	0	0
4955	A,B, C,D	Processor	0.8	430	Note 1	22.7	483	476	356	762	762	0	0
4959	A	I/O Expansion	0.8	430	Note 1	22.7	483	476	356	762	762	0	0
4962	1,1F	Disk Storage	0.65	413	Note 1	61.2	483	610	489	762	762	0	0
4962	2,2F	Disk Storage	0.7	481	Note 1	68.0	483	610	489	762	762	0	0
4964	1	Diskette, Note 8	0.22	197.8	Note 1	18.1	216	590	356	762	762	0	0
4979	1	Display	0.1	98.9	Note 2	13.6	406	584	381	--	Note 3	--	--
4973	1	Line Printer	0.6	347.8	Note 2	131.5	690	1260	1030	760	760	0	0
4973	2	Line Printer	0.6	347.8	Note 2	170.1	690	1035	1080	760	1016	0	0
4974	1	Printer	0.12	98.4	Note 2	24.9	565	648, Note 7	305, Note 6	--	Note 3	--	--
4982	1	Sensor I/O, Note 8	0.2	131.5	Note 2	20.4	216	503	356	762	762	0	0
4999	1,2	Battery Backup, Note 8	0.1, Note 4	94, Note 4	Note 2	32.2	216	508	356	762	762	0	0
4997	1A	Rack Enclosure	--	--	--	57	610	749	1000	1016	762	457	457
4997	2A	Rack Enclosure	--	--	--	107	610	749	1800	1016	762	457	457
4997	1B	Rack Enclosure	--	--	--	57	610	749	1000	1016	762	457	457
4997	2B	Rack Enclosure	--	--	--	107	610	749	1800	1016	762	457	457

- Notes.
1. Convection cooling with internal fan.
  2. Convection cooling.
  3. This device is a free standing table top unit and may be moved to any desired position for service within cable restrictions.
  4. Power requirement for the Battery Backup Unit is .1 kVA and must be added to the attached processor kVA. Heat output for Battery Backup Unit only is 94 kcal/hr.
  5. Rack enclosure service clearances take precedence over unit service clearances when rack mounted.
  6. With forms tractor; without = 178 mm.
  7. With paper stand; without = 337 mm.
  8. Prerequisite: rack mounting fixture 4540 weighing 7.71 kg.

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## Appendix B. Unit Specification Summary (English units)

Type	Model	Unit description	kVA	Heat Output /Hour Btu	Required Airflow	Weight lbs	Dimensions(in.)			Service Clearance(in.)			
							W	D	H	F	R	Rt	L
4953	A,C	Processor, Note 8	0.4	1038	Note 1	30	8.50	20.75	14.00	30	30	0	0
4953	B,D	Processor	0.8	1707	Note 1	50	19.00	18.75	14.00	30	30	0	0
4955	A,B, C,D	Processor	0.8	1707	Note 1	50	19.00	18.75	14.00	30	30	0	0
4959	A	I/O Expansion	0.8	1707	Note 1	50	19.00	18.75	14.00	30	30	0	0
4962	1,1F	Disk Storage	0.65	1640	Note 1	135	19.00	24.00	19.25	30	30	0	0
4962	2,2F	Disk Storage	0.7	1910	Note 1	150	19.00	24.00	19.25	30	30	0	0
4964	1	Diskette, Note 8	0.22	785	Note 1	40	8.50	23.25	14.00	30	30	0	0
4979	1	Display	0.1	392	Note 2	30	16.00	23.00	15.00	--	Note 3	--	--
4973	1	Line Printer	0.6	1380	Note 2	290	27.00	49.50	42.50	30	30	0	0
4973	2	Line Printer	0.6	1380	Note 2	375	27.00	40.75	42.50	30	40	0	0
4974	1	Printer	0.12	390	Note 2	55	22.25	25.50, Note 7	12.00, Note 6	--	Note 3	--	--
4982	1	Sensor I/O, Note 8	0.2	522	Note 2	45	8.50	19.75	14.00	30	30	--	--
4999	1,2	Battery Backup, Note 8	0.1, Note 4	375, Note 4	Note 2	71	8.50	20.00	14.00	30	30	0	0
4997	1A	Rack Enclosure	--	--	--	125	24.00	29.50	39.37	40	30	18	18
4997	2A	Rack Enclosure	--	--	--	235	24.00	29.50	70.00	40	30	18	18
4997	1B	Rack Enclosure	--	--	--	125	24.00	29.50	39.37	40	30	18	18
4997	2B	Rack Enclosure	--	--	--	235	24.00	29.50	70.00	40	30	18	18

- Notes.
1. Convection cooling with internal fan.
  2. Convection cooling.
  3. This device is a free standing table top unit and may be moved to any desired position for service within cable restrictions.
  4. Power requirement for the Battery Backup Unit is .1 kVA and must be added to the attached processor kVA. Heat output for Battery Backup Unit only is 375 Btu/hr.
  5. Rack enclosure service clearances take precedence over unit service clearances when rack mounted.
  6. With forms tractor; without = 7.00 inches.
  7. With paper stand; without = 13.25 inches.
  8. Prerequisite: rack mounting fixture 4540 weighing 17 lbs.

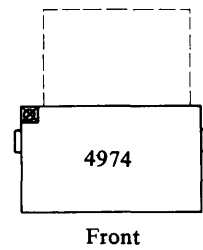
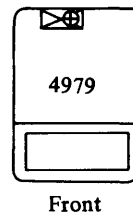
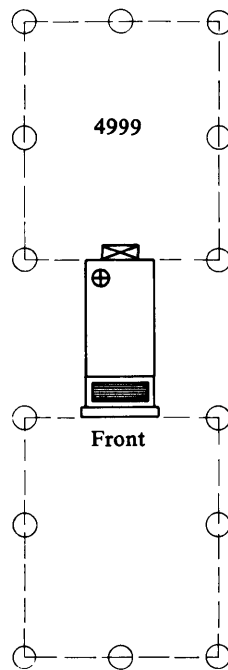
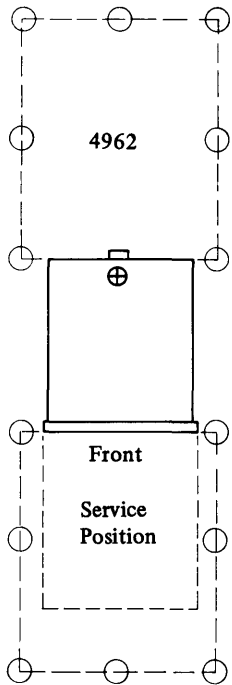
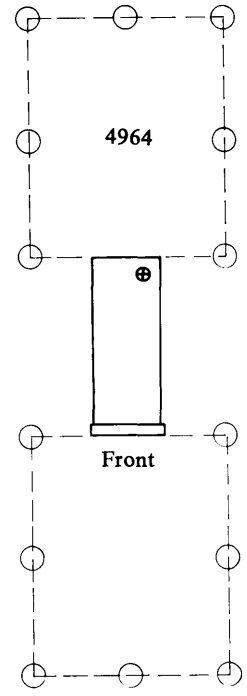
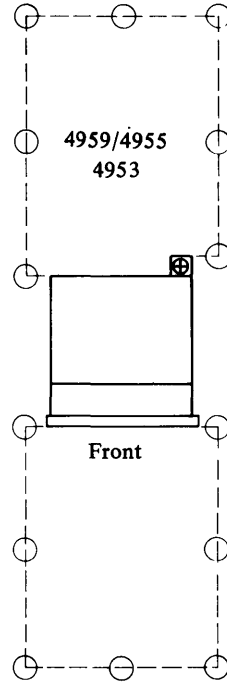
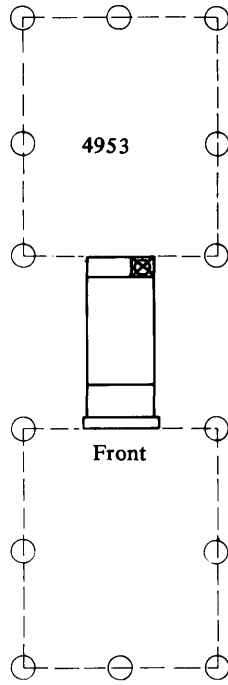
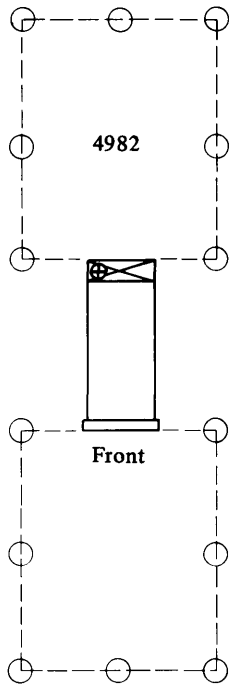
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# Appendix C. Templates



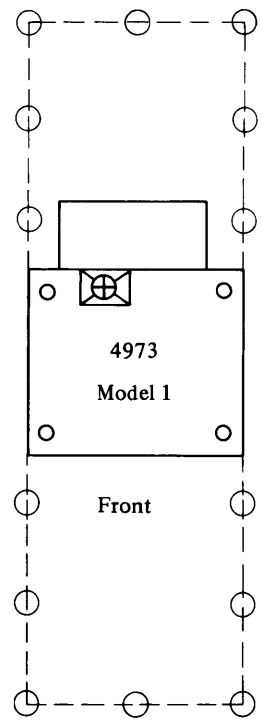
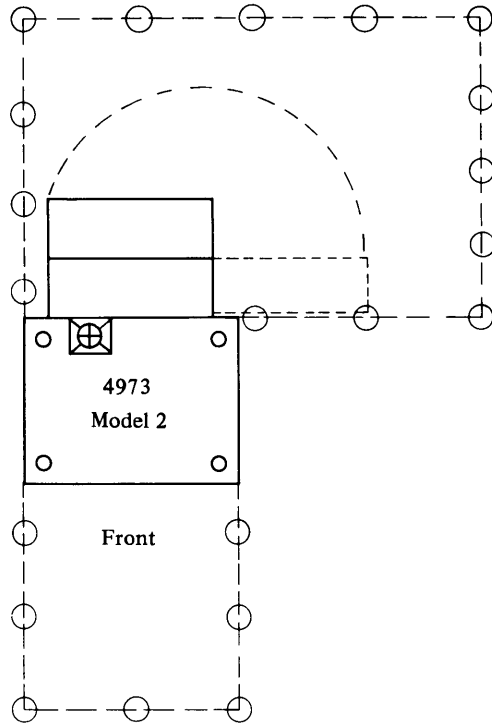
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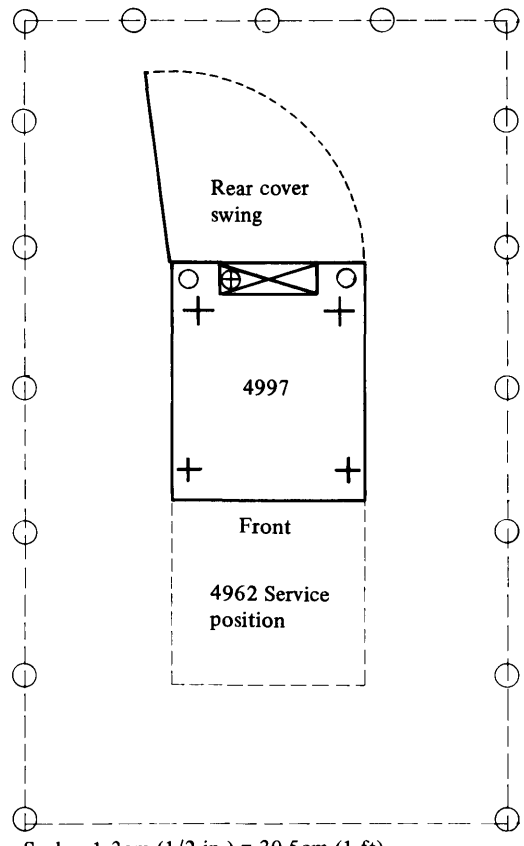


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## Appendix D. Atmospheric Contaminants

The following corrosive gas and particulate atmospheric contents are defined by IBM as the maximum limits for a Series/1 system or units.

### Corrosive Gas Contaminants

Corrosive gas upper limit is expressed as arithmetic mean values (averaged over one year) in  $\mu\text{g}/\text{m}^3$  (micrograms per cubic meter) and ppb (parts per billion ( $10^9$ ) by volume).

Total Reactive Sulfur =  $3.2 \mu\text{g}/\text{m}^3$

This includes elemental sulfur vapor ( $\text{S}_8$ ) of up to  $2.1 \mu\text{g}/\text{m}^3$ . Total reactive sulfur is the quantity of elemental sulfur expressed in  $\mu\text{g}/\text{m}^3$  in all gaseous species that reacts with silver to form silver sulfide (e.g.,  $\text{S}_8$ ,  $\text{H}_2\text{S}$ ,  $\text{CH}_3\text{SH}$ , etc., but not  $\text{SO}_2$ ).

The  $3.2 \mu\text{g}/\text{m}^3$  of reactive sulfur is equivalent to  $3.4 \mu\text{g}/\text{m}^3$  or 2.5 ppb of  $\text{H}_2\text{S}$ .

Sulfur Dioxide =  $262 \mu\text{g}/\text{m}^3$  (100 ppb)

Nitrogen Dioxide =  $141 \mu\text{g}/\text{m}^3$  (75 ppb)

Ozone =  $98 \mu\text{g}/\text{m}^3$  (50 ppb)

Acidic Gaseous Chlorine =  $3 \mu\text{g}/\text{m}^3$

Acidic gaseous chlorine is the quantity of elemental chlorine expressed in  $\mu\text{g}/\text{m}^3$  in chlorine containing acidic gases (e.g.  $\text{HCl}$ ,  $\text{Cl}_2$ ,  $\text{ClO}_2$ , etc.). The  $3 \mu\text{g}/\text{m}^3$  is equivalent to 2 ppb of  $\text{HCl}$  or 1 ppb of  $\text{Cl}_2$ .

### Particulate Contaminant

Particulate upper limit is expressed as arithmetic mean values in  $\mu\text{g}/\text{m}^3$  (micrograms per cubic meter) or  $\mu\text{g}/\text{cm}^2/30$  days (micrograms per square centimeter per 30 days).

Suspended Particulates =  $200 \mu\text{g}/\text{m}^3$

Benzene Soluble Organics =  $30 \mu\text{g}/\text{m}^3$

Settleable Particulates =  $1500 \mu\text{g}/\text{cm}^2/30$  days

These values will be periodically reviewed and can be expected to change for one or more of the following reasons: the environment is changing, more data are becoming available, measurement methods are improving.

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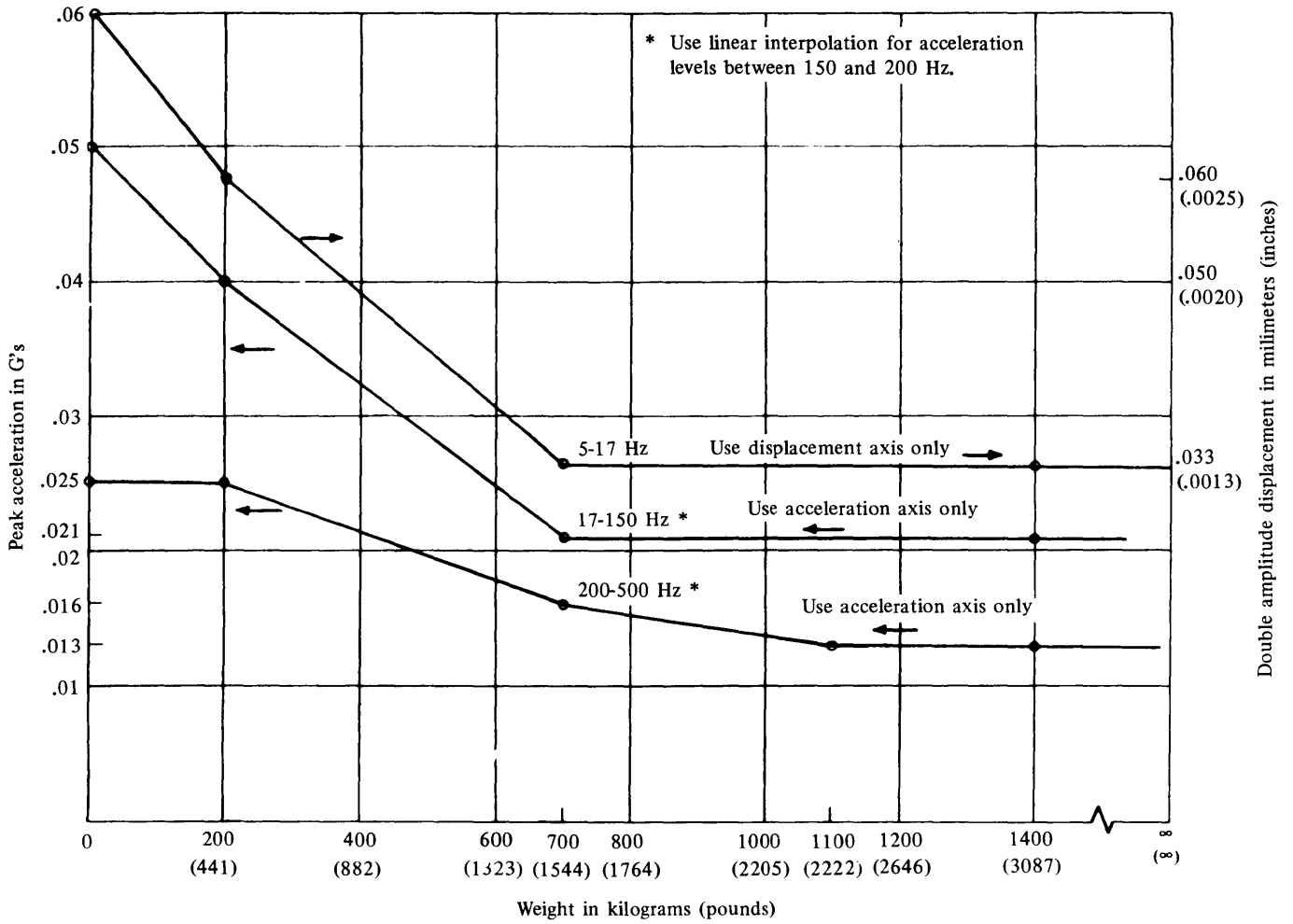


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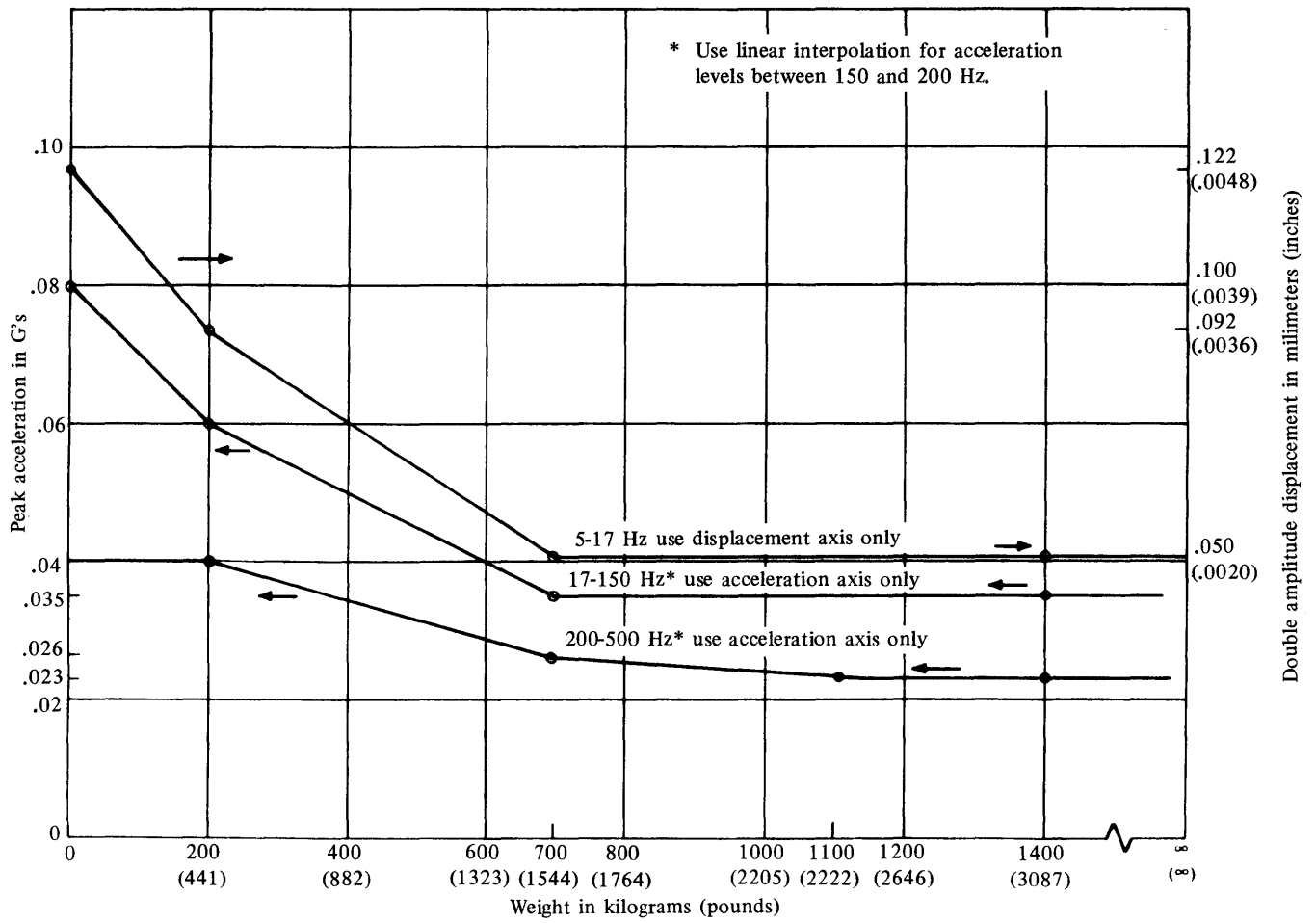
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# Appendix F. System Vibration and Shock Levels



Continuous Vibration Levels in an Operational Environment





**Transient Vibration Levels in an Operational Environment**

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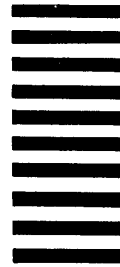
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