AT&T 3B20D Computer
Power Systems
Description and Theory of Operation

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1. Overview

1.01 The power systems used in the AT&T 3B20D Model 2 computer and the AT&T 3B20D Model 3 computer are described in this practice. The two computers are essentially the same except for cabinet and frame sizes and secondary storage devices. This practice illustrates the equipment and discusses the power used to operate both computers. This practice contains the following:

(a) Part 1 introduces the practice.

(b) Part 2 describes the physical equipment for both computers and AC power requirements.

(c) Part 3 describes the functions of the power equipment.

(d) Part 4 covers the theory of operation and is limited to a discussion of power distribution, the disk file inverter, and alarms.

(e) Part 5 lists the abbreviations used in this practice.

1.02 This practice is being reissued to incorporate the small computer systems interface (SCSI) feature power information. The very large main memory (VLMM) feature is also included although no changes in power information are necessary. The VLMM and SCSI features can only be incorporated in Model 2 and Model 3 3B20D computers with the *UNIX** RTR Operating System, Release 6 and later. The SCSI and VLMM features are retrofitted as growth /conversion features for Model 2 3B20D computers and existing Model 3 3B20D computers. Both features may be included with orders for new Model 3 3B20D computers.

The addition of the SCSI feature to either system requires the addition of a SCSI disk cabinet. The SCSI disk cabinet may be located up to 100 cable feet from the processor when retrofitted to existing 3B20D computers. Depending on the configuration (new ship, growth, or conversion), the components of the SCSI disk cabinet will vary.

The specific reasons for reissue are listed below:

(a) Add information for the SCSI disk cabinet configuration

(b) Revise Figure 3 to show three SCSI disk cabinet configurations

(c) Revise the power Distribution Unit Fuse assignments

(d) Revise figures to reflect equipment changes for the SCSI disk cabinet configurations

(e) Revise the SCSI disk cabinet fuse assignments

* *UNIX* is a registered trademark of *UNIX* System Laboratories, Inc.

(f) Add Figure 41 - Disk Unit Package Power Block Diagram.

1.03 This practice contains no admonishments.

1.04 AT&T welcomes your comments on this practice. Your comments will aid us in improving the quality and usefulness of AT&T documentation. Please use the Feedback Form provided at the back of this practice.

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2. Physical Description

3B20D Model 3 Computer

2.01 The 3B20D Model 3 computer consists of a double-bay processor cabinet, the tape/disk or small computer systems interface (SCSI) disk cabinet, and the power cabinet. A peripheral interface cabinet may also be included where additional input/output is desired. Common systems cabinets are 6 feet 4 inches tall, 26 inches wide, and 30 inches deep, while in some applications, cabinets are 30 inches wide. The processor cabinet and one tape/disk cabinet or one SCSI disk cabinet make up the minimum system and are bolted together as a unit. Each common systems cabinet is equipped with casters and insulating, nylon-tipped, adjustable leveling feet. In some applications, neither casters nor leveling feet are used; cabinets are bolted to the floor. Applications may add tape/disk or SCSI disk cabinets as required. The power cabinet is a separate cabinet that may have two configurations.

A. Processor Cabinet

2.02 Each bay of the processor cabinet (J1C187A) (Figure 1) contains the following units:

- Power distribution unit (J1C147BE)
- Central processing unit (J1C147BA)
- Main store, input/output, and disk file controller unit (J1C147BB) in the J1C187A cabinet.
- Main store, input/output, and SCSI disk file controller (DFC) (J3T029AA) in the J1C173A-C cabinet only.
- Main store and input/output growth unit (J1C147BC) (optional unit)
- Input/output processor basic unit (J1C147BD)
- Cooling unit (ED-4C387-30)
- Port switch unit (J1C130BC) (bay 0 only).

2.03 Power is routed from the power cabinet to the power distribution unit at the top of the processor cabinet. Each processor cabinet bay derives power from a separate bus at the power cabinet. From the power distribution unit, fused circuits supply power to the power units and the power switches on the units in the processor cabinet. The port switch unit in bay 0 is an exception. Input power for the port switch is fused at the power cabinet on the bus that supplies power to processor cabinet bay 1.

B. Tape/Disk Cabinet

2.04 The tape/disk cabinet (J1C186A or J1C192A) can be configured four ways. One configuration consists of a tape drive and two, three, or four storage module drive (SMD) interface disk drives. The second configuration consists of up to eight disk drives. The third configuration may be with or without the tape drive and with up to four disk drives. A fourth configuration may contain two tape drives. The common systems office configuration allows two tape drives and sixteen disk drives in three tape/disk cabinets. Some applications may have ten tape drives and sixteen disk drives. Two configurations of the tape/disk cabinet are shown in Figure 2. The tape/disk cabinet may be retrofitted into the AT&T 3B20D Model 2 computer to replace disk and tape drives. Components of the tape/disk cabinet are listed below.

- Power distribution unit (J1C186AB)
- Tape drive (KS-23113)
- 340-megabyte disk drive (KS-22875)
- Power supply (KS-22997)
- Power switch (ED-4C481).

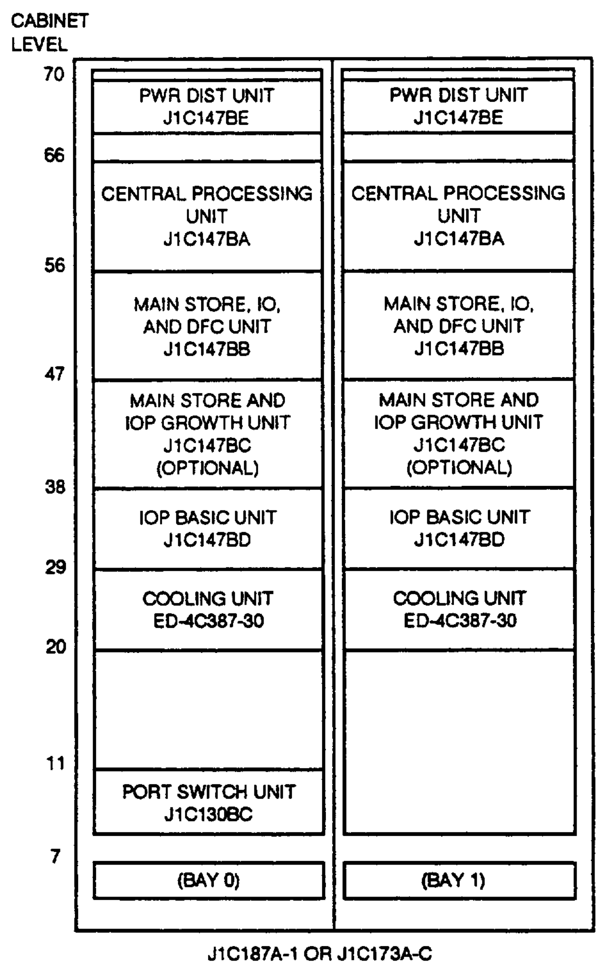


Figure 1. Processor Cabinet

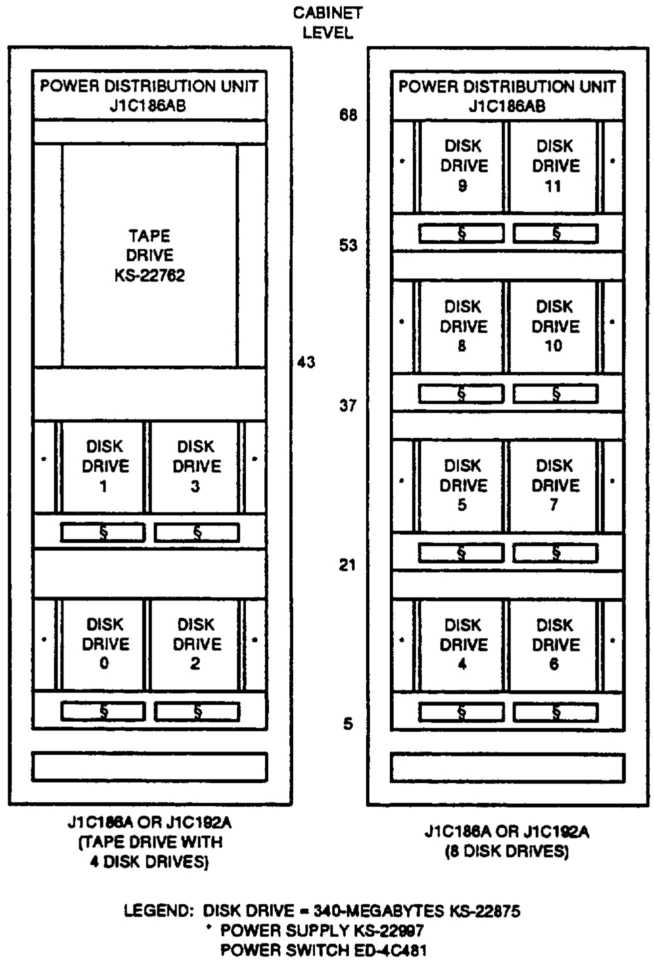


Figure 2. Tape/Disk Cabinet

2.05 Each disk drive has a separate -48 V DC circuit. The power supply and power switch are fused separately and each power supply and power switch have a dedicated fuse and feeder from the power distribution unit (located at the top of the cabinet). The tape drive requires 120V AC fromn a local AC power panel.

C. SCSI Disk Cabinet

2.06 The SCSI disk cabinet is used to house the SCSI Disk Unit Package (DUP). The cabinet can be configured three ways. The first configuration is for new start systems and consists of a tape drive and up to 16 DUPs [Figure 3(a)]. The second configuration, used when the SCSI hardware is grown onto an existing 3B20D computer, is equipped with two SCSI disk file controllers (DFCs), a cooling unit, and up to 16 DUPs [Figure 3(b)]. The third configuration similar to the second is used when an existing 3B20D SMD-DFC is converted to a SCSI-DFC [Figure 3(c)].

Possible components of the SCSI disk cabinet are:

- Power distribution unit
- Tape drive
- SCSI DFCs (two)
- Cooling unit
- SCSI DUPs.

2.07 A power distribution unit at the top of the cabinet contains fuses for the -48 V DC power feeders that supply each DUP and, when equipped, the DFCs and cooling unit. A tape drive, when mounted in this cabinet, receives 120 V AC from a local AC power panel.

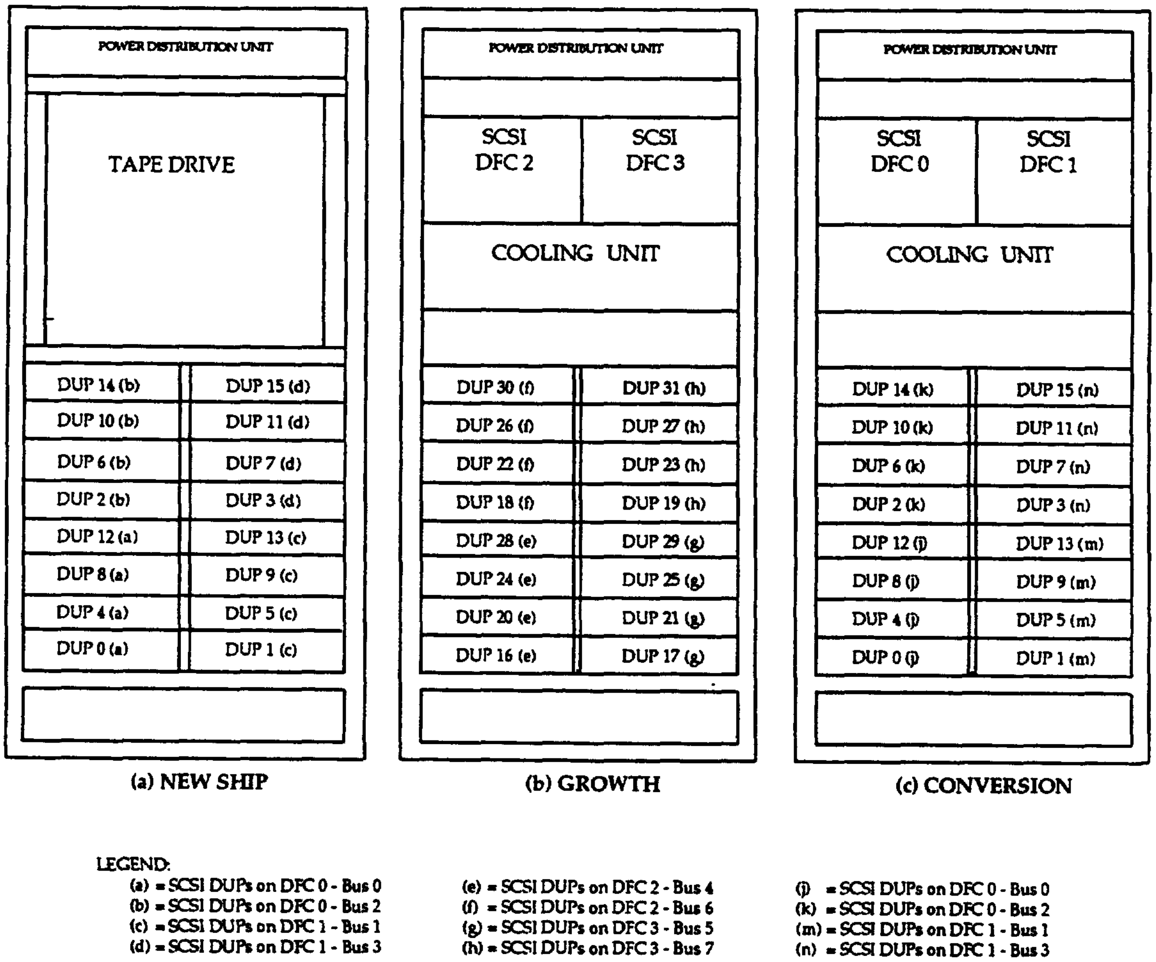


Figure 3. SCSI Disk Cabinet

D. Power Cabinet

2.08 The power cabinet (J1C185A) can have two configurations, although some applications do not use a power cabinet. At sites with a -48 V DC power source, the DC-to-DC option is used. At other sites, a 208 V AC source is required and the AC-to-DC power cabinet option is required. Both power cabinet options are shown in Figure 4. The following is a list of the power cabinet components:

- Filter fuse panel (ED-82947-30,G2)
- Control panel (ED-82947-30,G10)
- Rectifier unit (J87437A) (two required for AC-to-DC option).

2.09 The filter fuse panel is divided in half with each half receiving a dedicated -48 V DC input on a cable pair (-48 V DC and return) from the local battery plant (DC-to-DC option). Distribution is made from the filter fuse panel to the equipment. For the AC-to-DC option, the power cabinet requires two 208 V AC circuits from a local AC power panel for the rectifier units. The rectifiers supply the -48 V DC to the filter fuse panel for distribution. The control panel contains alarm and charging circuits to include a charging probe.

3B20D Model 2 Computer

2.10 The AT&T 3B20D Model 2 computer consists of a double-bay processor control frame, a high-speed tape unit frame, a power distribution frame (optional), and, depending on application, either moving head disk frames or minimodule disk frames. Some applications with 300-megabyte disk drives may use a disk power cabinet instead of the moving head disk frame. The tape/disk cabinet or the SCSI disk cabinet described earlier may be retrofitted into the Model 2 computer. All frames are 7 feet tall, 24 inches deep, and, except for the minimodule disk frame, are 26 inches wide. The minimodule disk frame is 39 inches wide. In some applications, frames are 6 feet tall, 30 inches wide, and 24 inches deep.

A. Processor Control Frame

2.11 Each bay of the processor control frame (J1C147A) (Figure 5) contains the following units:

- Power distribution unit (J1C147BE)
- Central processing unit (J1C147BA)
- Main store, input/output, and disk file controller unit (J1C147BB)
- Main store and input/output growth unit (J1C147BC)
- Input/output processor basic unit (J1C147BD)
- Cooling unit (ED-4C387-30)

- Disk file controller connector panel (ED-4C389-30) (equipped with 300-megabyte disk drives only)
- Port switch unit (J1C130BC) (bay 0 only).

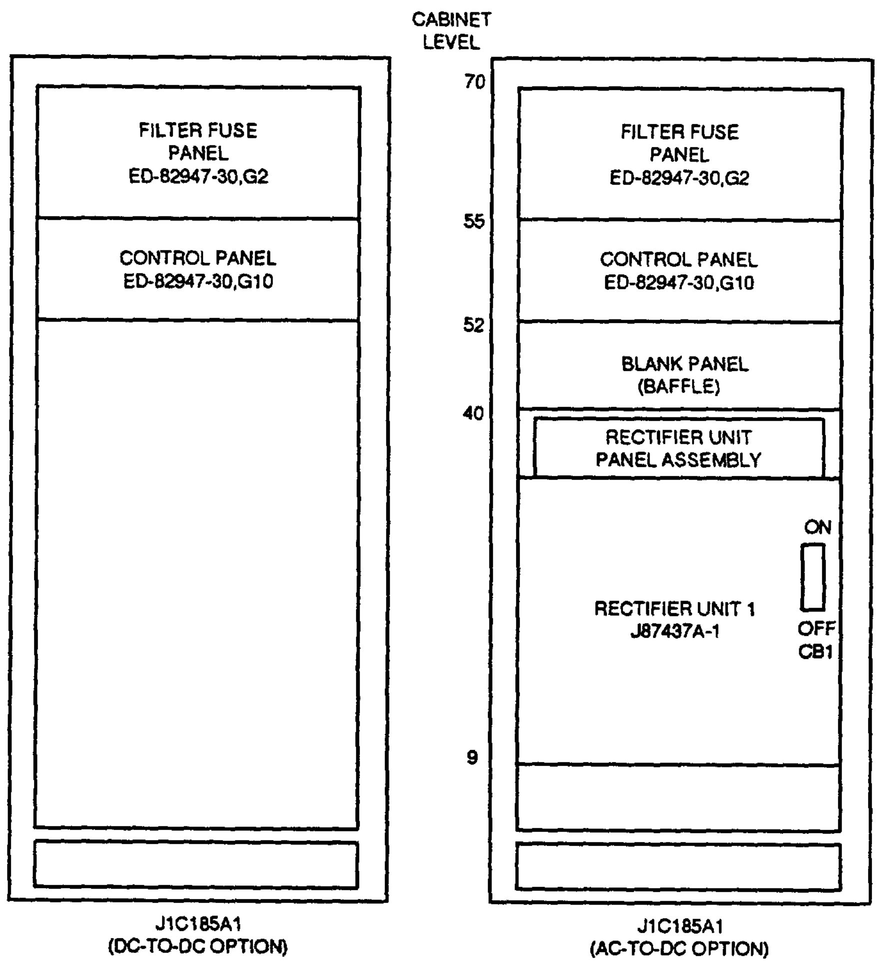


Figure 4. Power Cabinet

2.12 Power is routed from the power distribution frame to the power distribution unit at the top of the processor control frame. Each processor control frame bay is on a separate bus at the power distribution frame. From the power distribution unit, fused circuits supply power to the power units and the power switches on the units for the processor control frame. The port switch unit in bay 0 is an exception. Input power for the port switch is fused at the power distribution frame on the bus that supplies power to processor control frame bay 1.

B. Moving Head Disk Frame

2.13 The moving head disk frame (J1C131B) is shown in Figure 6. The system is capable of using 16 moving head disks on each disk file controller. The moving head disk frame contains the following units:

- 2000VA disk file inverter (ED-4C172-30)
- Power control unit (J1C131AA)
- 300-megabyte moving head disk (KS-22072 or KS-22707).

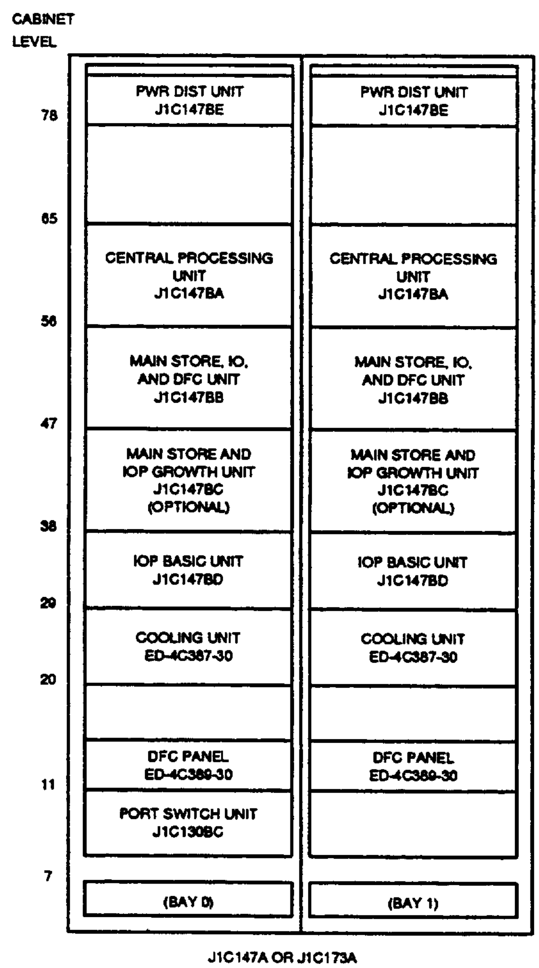


Figure 5. Processor Control Frame

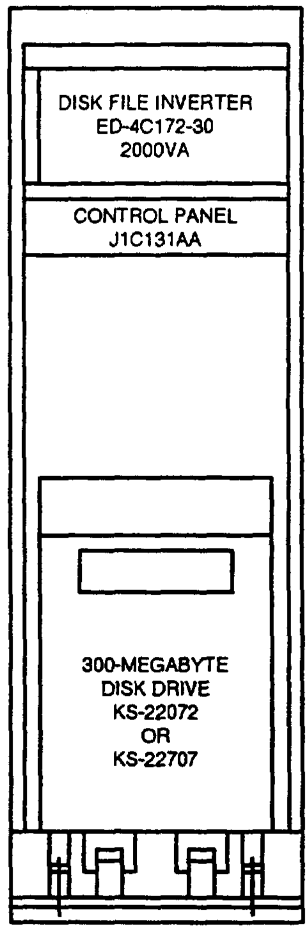


Figure 6. Moving Head Disk Frame

2.14 The 2000VA disk file inverter converts a high current -48 V DC directly from the power distribution frame to 208 V AC to power the 300-megabyte disk drive. The power control unit also receives a separate -48 V DC from the power distribution frame for internal power to control the disk file inverter. Input power is not fused at the disk file inverter. The fuses on the disk file inverter protect logic circuits.

C. Disk Power Cabinet

2.15 The disk power cabinet (J1C175A) substitutes for the moving head disk frame in some applications. It contains a maximum of three 2000VA disk file inverters (ED-4C172-30) each with a power control unit (J1C131AA). The 300-megabyte moving head disks are not enclosed in the frame. The disk file inverters and power control units operate in the same manner and connect to the power distribution frame as previously described. The disk power cabinet is shown in Figure 7.

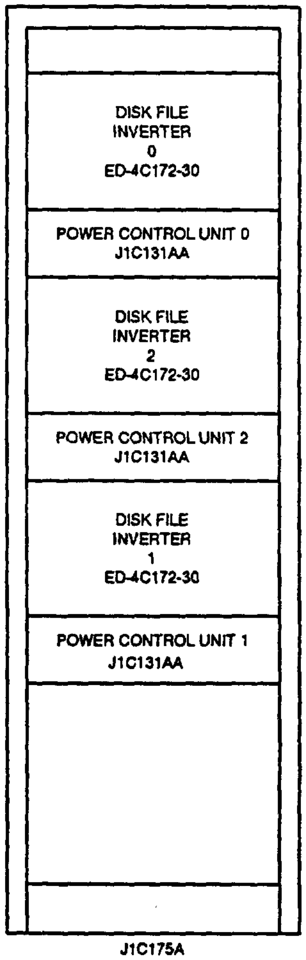


Figure 7. Disk Power Cabinet

D. Minimodule Disk Frame

2.16 The minimodule disk frame (J1C149A) may contain three 160-megabyte disk drives in the lower portion of the frame. Each equipped disk drive requires a 1200VA inverter that is mounted in the upper portion of the frame. Even-numbered and odd-numbered disk drives are installed with their inverters on separate minimodule disk frames. The units on the minimodule disk frame are listed as follows and are shown in Figure 8.

- Inverter assembly (J1C149AB)
- 160-megabyte moving head disk (KS-22693).

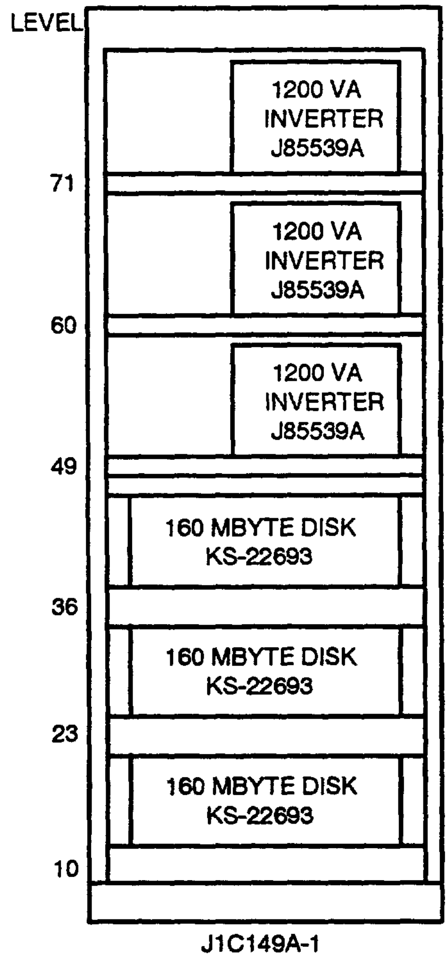


Figure 8. Minimodule Disk Frame

2.17 The inverter assembly contains a 1200VA inverter. Each 1200VA inverter receives -48 V DC on a separate circuit from the high-current fuse panel on the power distribution frame and converts the -48 V DC to 120 V AC for disk drive operation. Input power is protected by a circuit breaker located on the 1200VA inverter.

E. High-Speed Tape Unit Frame

2.18 The high-speed tape unit frame (J1C134B or J1C174A) contains a 300VA inverter and a tape drive in the common systems configuration. However, some applications do not use the 300VA inverter. Their tape drives are powered by 120 V AC from a local AC power panel. A second optional tape drive with a 300VA inverter can also be accommodated. The high-speed tape unit frame is shown in Figure 9 with components listed near the frame.

- 300VA inverter (J1C134BA)
- Tape drive (KS-23113 or KS-22762).

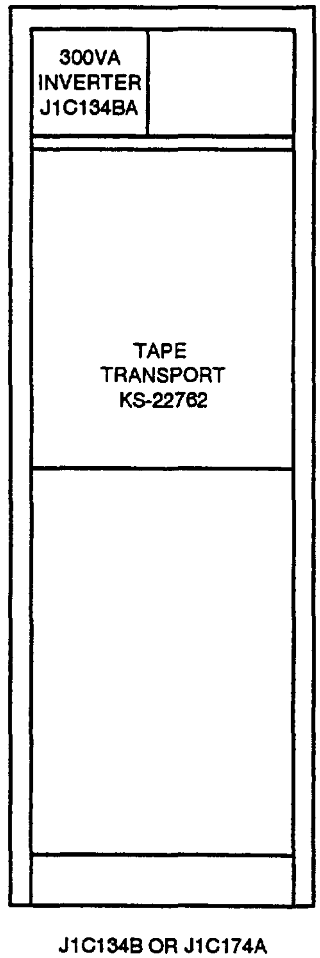


Figure 9. High-Speed Tape Unit Frame

2.19 The 300VA inverter receives -48 V DC from the power distribution frame and converts the voltage to 120 V AC for tape drive operation. Input power is protected by fuses on the front side of the inverter assembly.

F. SCSI Disk Cabinet

2.20 The SCSI disk cabinet is available as an option to an existing Model 2 3B20D computer. The cabinet can be configured two ways. The first configuration, used when the SCSI hardware is added onto an existing 3B20D computer, is equipped with two SCSI DFCs, a cooling unit, and up to 16 DUPs [Figure 3(b)]. The other configuration is used when an existing 3B20D computer SMD-DFC is converted to a SCSI-DFC [Figure 3(c)]. Components of the SCSI disk cabinet in these two configurations are:

- Power distribution unit
- SCSI DFCs (two)
- Cooling unit
- SCSI DUPs.

2.21 A power distribution unit at the top of the cabinet contains fuses for the -48 V DC power feeders that supply the DFCs, the cooling unit, and each DUP.

G. Power Distribution Frame

2.22 The power distribution frame supplies only -48 V DC distribution. There are two configurations of the power distribution frame and their use depends on the source of office power. The J86334B power distribution frame is used when office power originates from a battery plant. The J86334C power distribution frame is used in offices that have converter supplied -48 V DC. Both power distribution frames are illustrated in Figure 10. Components of the power distribution frame are listed below.

- Filter fuse panel (ED-82947-30, G2)
- Control panel (ED-82947-30, G10)
- High-current fuse panel (ED-82947-30, G6) (used on J86334B only)
- High-current fuse panel (ED-82947-30, G5) (used on J86334C only)
- Capacitor panel (ED-82947-30, G4) (used on J86334C only).

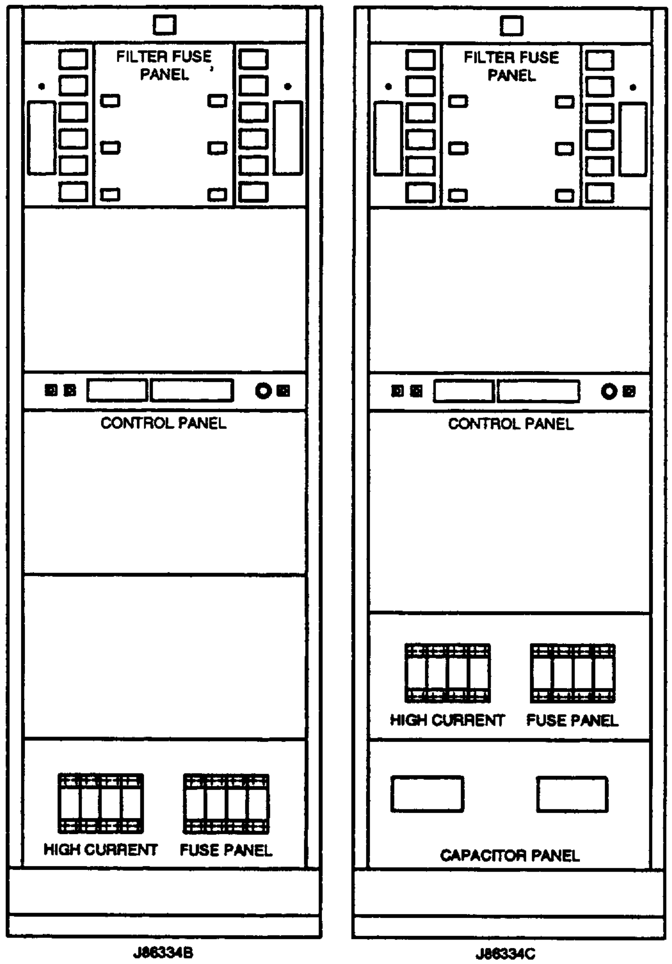


Figure 10. Power Distribution Frames

2.23 The power distribution frame receives -48 V DC input on cable pairs (-48 V DC and return). Each fuse panel is divided in half with each half receiving a dedicated bus pair. The high-current fuse panel (ED-82947-30, G6) on the J86334B power distribution frame and the high-current fuse panel (ED-82947-30, G5) with the capacitor panel (ED-82947-30, G4) on the J86334C power distribution frame are used in offices that are equipped with the 160- or 300-megabyte disk drives. Applications using the 340-megabyte disk drives do not require these panels. The control panel is equipped with alarm and charging circuits.

H. AC Power

2.24 Both Model 2 and Model 3 computers require standard AC electrical service. The customer provides a local AC power panel and branch circuits that are individually protected by circuit breakers and terminated with designated receptacles. The power cabinet (Model 3), when equipped with rectifier units (AC-to-DC option), requires 208 V AC, 3-phase power. The maintenance terminal and receive-only printer require 120 volts single-phase, protected AC electrical service. Data sets should also connect to this protected AC. The tape drive when mounted in the tape/disk cabinet requires AC power. The AC power, however, does not have to be protected. AC circuit requirements for both Model 2 and Model 3 computers are shown in Table A. This figure includes circuit breakers and receptacle types required for each device. Circuit breaker assignments within the AC power panel should be selected to balance the currents on each phase.

Table A. AC Circuit Requirements

Equipment	Voltage		Current		Circuit Breaker		Receptacle Type* Nema No.	Length (ft.)
	Volts	Phases	Drain Run	Amps Start	Amps	Poles		
Rectifier unit 0	208	3	13	30	30	3	L15 30R	17
Rectifier unit 1	208	3	13	30	30	3	L15 30R	17
Operator terminal	120	1	3	3	15	1	5 15R	6
Console printer	120	1	3	3	15	1	5 15R	6
Tape unit	120	1	3	3	15	1	5 15R	9
Data sets†	120	1	•	•	15	1	5 15R	•

* Isolated ground

† Customer-furnished

Receptacles

2.25 System devices that connect to the AC line are equipped with flexible cords terminated in standard plugs. Receptacles that terminate branch circuits must be of the isolated-ground type (the grounding terminal does not make contact with the mounting yoke). It is recommended that the isolated-ground feature be made easily recognizable by use of orange-colored or clearly-labeled receptacles. Nonsystem equipment, (for example, floor polishers, tools, appliances, etc.) shall not be plugged into these isolated-ground receptacles. Adherence to these recommendations will prevent certain types of electrical noise from interfering with system operation and will eliminate potential hazards to equipment and personnel.

Single-Point Ground

2.26 Both Model 2 and Model 3 computers must be grounded using a single-point ground. A single-point ground system assures that the computer system connects to a building ground at one and only one point (known as the ground window) and that all system grounds are bonded to this point. A single-point ground system also eliminates ground loops and guarantees that voltage disturbances to the building electrical system caused by stray currents will not affect the computer system. A typical overhead single-point ground system is shown in Figure 11. A typical raised-floor AC power distribution system for Model 3 is shown in Figure 12.

Isolating The System

2.27 To protect the integrity of the single-point ground, an electrical conductor must be insulated from all building grounds wherever it extends beyond the single-point ground. Thus, equipment cabinets and frames must be insulated from the floor, air conditioning duct work, suspended cable trays, lighting fixtures, etc. Likewise, customer-supplied equipment which interfaces with the computer should also be insulated from the floor and building grounds. This requirement also dictates the use of isolated-ground receptacles. With nonisolated-ground receptacles, the conduit itself must be insulated from building grounds wherever it extends beyond the single-point ground. This would be an extremely difficult condition to maintain over the life of the computer.

Framework Grounding

2.28 The computer system is grounded to the single-point ground in two distinct ways (see Figure 11):

- Via the equipment ground (green wire) in each AC branch circuit
- Via a separate cabinet or frame ground.

2.29 The cabinet ground consists of a network (sometimes called ground a matrix) of conductors which connect cabinets or frames to each other and to splice plates which lead to the single-point ground. Cabinet or frame grounds are terminated in lugs crimped to the wire and bolted to the cabinet or frame. The receive-only printer and the operator terminal are adequately grounded using the ground (green wire) in the power cord.

Raised-Floor Ground

2.30 Raised floors up to 100 feet by 100 feet must be grounded to the single-point ground via an insulated, stranded No. 6 wire crimped to the support grid at a location in the approximate center of the floor. The computer is insulated from the floor via insulating, nylon-tipped, adjustable-leveling feet.

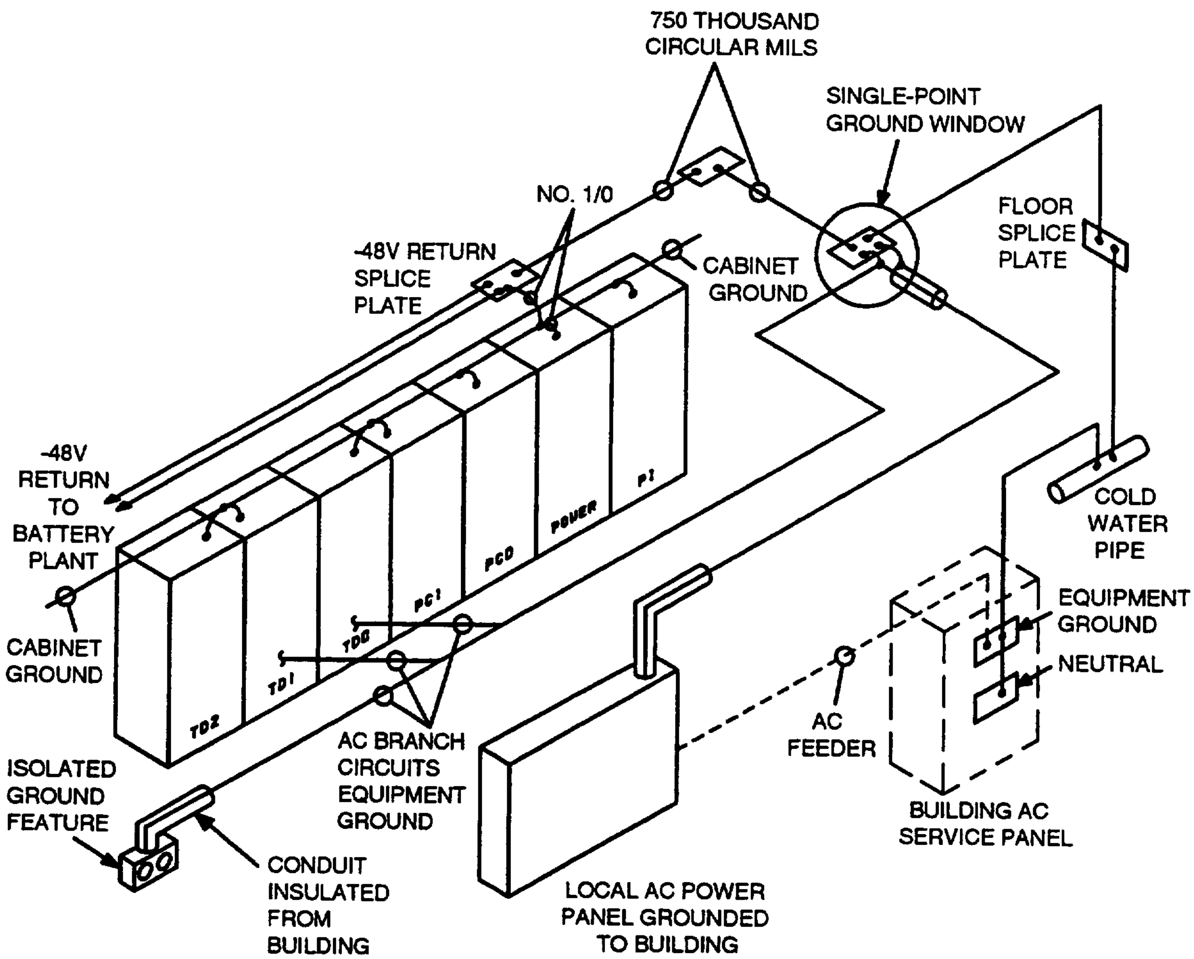


Figure 11. Typical Overhead Single-Point Ground System

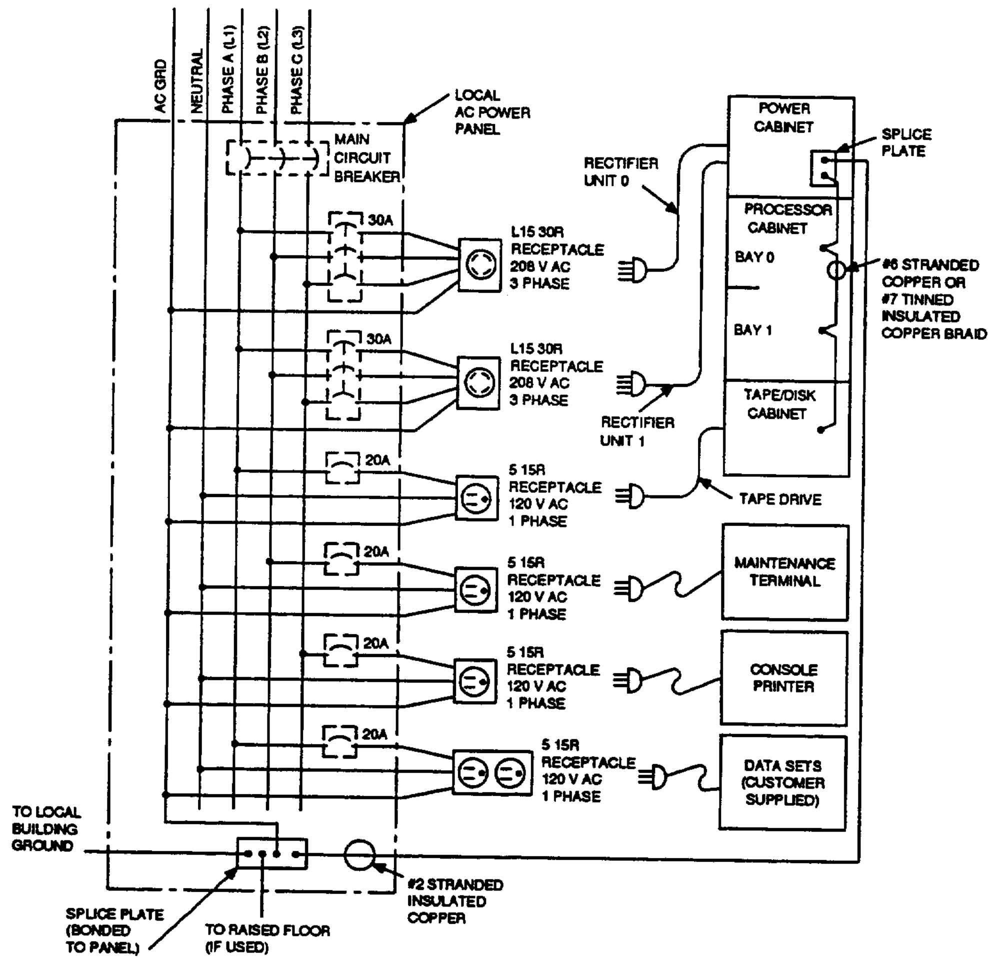


Figure 12. AC Power Distribution (AC-to-DC Option, Model 3)

3. Functional Description

Introduction

3.01 The functions of the power equipment in the 3B20D Model 2 computer and the 3B20D Model 3 computer are the same. As noted earlier, the differences are in the disk drives and how the power required for the different disks is furnished. This part discusses the power components and power distribution in the cabinets and frames. Depending on the application, differences will exist in quantities of tape drives, disk drives, and optional equipment.

A. Processor Cabinet or Processor Control Frame

Power Distribution Unit

3.02 The power distribution unit (J1C147BE) (Figure 13) is comprised of fuse blocks, input jacks, and terminal blocks. Power is routed to this unit on cable pairs from the power cabinet or the power distribution frame and enters at the input jacks. From the jacks, power is routed through the individual fuses to the terminal blocks and distributed to the units below. The fuse blocks use 74-type load fuses with 70-type indicator fuses in parallel. In a few cases, the 70 and 74 type fuse pairs are replaced by a 70-type fuse only. When the 70-type fuse is used without the 74-type fuse, the position normally occupied by the 74-type fuse is replaced by a "dummy" type 72A. The dummy fuse (72A) is a fuse shaped plastic insert. Not all fuse holders are equipped with fuses. Input jack C in both bays is a spare. Jack J in bay 1 routes -48 V DC directly to the port switch unit. Jack J in bay 0 is not connected. The power distribution unit fuse assignments, except for the port switch, are listed in Table B.

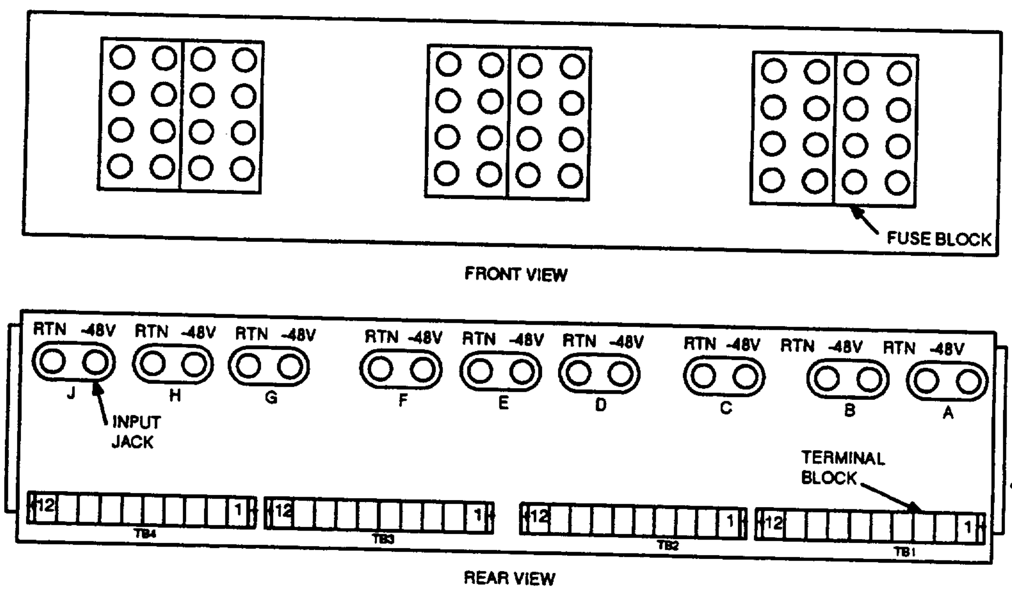


Figure 13. Power Distribution Unit

Table B. Power Distribution Unit Fuse Assignments

Input Bus/Jack	Fuse	Amp	Type	Terminal		Block		Load	Load Location
				Load Pin	Lead Name	Ground Pin	Lead Name		
A	F1A	2	70B	TB1-7	N48VFAN4	TB1-8	48RFAN4	Fan 4	20-147
	F2A	2	70B	TB1-5	N48VFAN3	TB1-6	48RFAN3	Fan 3	20-147
	F3A	2	70B	TB1-3	N48VFAN2	TB1-4	48RFAN2	Fan 2	20-016
	F4A	2	70B	TB1-1	N4iVFAN1	TB1-2	48RFAN1	Fan 1	20-016
B	F5A	2	70C	TB2-3	N48VDFC2	TB2-4	48RDFC2	DFC TN3B*	47-074
								DFC TN6B†	47-024
	F6	10	74D	TB2-1	N48VDFC1	TB2-2	48RDFC1	Power Unit C	47-016
	F6A	.25	70F						
	F7A	2	70B	TB1-9	N48VFCL1	TB1-10	48RFCL1	Fan Logic 1	20-016
	F8A	2	70B	TB1-11	N48VFCL2	TB1-12	48RFCL2	Fan Logic 2	20-147
E	F9	10	74D	TB3-3	N48VCPU4	TB3-4	48RCPU4	Power Unit D	47-178
	F9A	.25	70F						
D	F10A	3	70C	TB3-1	N48VCPU3	TB3-2	48RCPU3	CPU TN5B	56-162
	F11	10	74D	TB2-11	N48VCPU2	TB2-12	48RCPU2	Power Unit B	56-178
	F11A	.25	70F						
	F12	10	74D	TB2-9	N48VCPU1	TB2-10	48RCPU1	Power Unit A	56-016
	F12A	.25	70F						
F	F15	10	74D	TB3-7	N48VCPU6	TB3-8	48RCPU6	Power Unit G	38-016
	F15A	.25	70F						
	F16	10	74D	TB3-5	N48VCPU5	TB3-6	48RCPU5	Power Unit F	38-178
	F16A	.25	70F						
G	F17	3	74B	TB4-3	N48VIOP4	TB4-4	48RIOP4	PC 1 TN9	29-032
	F17A	.25	70F						
	F18	3	74B	TB4-1	N48VIOP3	TB4-2	48RIOP3	PC 2 TN9	38-052
	F18A	.25	70F						
	F19	3	74B	TB3-11	N48VIOP2	TB3-12	48RIOP2	PC 3 TN9	38-022
	F19A	.25	70F						
	F20	10	74D	TB3-9	N48VIOP1	TB3-10	48RIOP1	Power Unit E	38-016
	F20A	.25	70F						
H	F21	3	74B	TB4-11	N48VIOP8	TB4-12	48RIOP8	PC 0 TN9	29-072
	F21A	.25	70F						
	F22A	3	70F	TB4-9	N48VIOP7	TB4-10	48RIOP7	IOP TN6B	29-162
	F23	10	74B	TB4-7	N48VIOP6	TB4-8	48RIOP6	Power Unit H	29-178
	F23A	.25	74D						
	F24	3	74B	TB4-5	N48VIOP5	TB4-6	48RIOP5	Power Unit J	29-024
	F24A	.25	70F						

Notes:
*TN3B for SMD DFC
†TN6B for SCSI DFC

Central Processing Unit

3.03 The central processing unit (CPU) (J1C147BA) contains the data manipulation unit, microstores, special registers, store address controller and translator, main store (MAS) update unit, and a maintenance channel. Power for these circuit packs is distributed from the 495FA power units A and B and controlled by the TN5B power switch. The power switch may be the improved TN5C or the TN5D for international use. While the physical unit is called the CPU, the functional unit is called a control unit and includes the CPU plus MAS, I/O channels, and direct memory access. The TN5B controls power to all elements of the control unit. The circuit packs and power units that make up the CPU are shown by location in Table C. When the very large main memory (VLMM) feature is incorporated into the computer, the circuit packs and power units locations for the CPU are as shown in Table D.

Table C. Central Processing Unit

Location	Unit	Title	Notes
016	495FA	Power Unit A	
020	Vacant		
028	UN22C	Maintenance Channel	
036	UN28B	Programmable Microstore (MC4C077A1B)	
042	UN248	16K Writable Microstore	Optional UN48B
050	Vacant		Void with UN248 in slot 042
058	Vacant		
066	UN135	Microstore Controller (MC4C076A1)	
072	UN1C	Data Manipulation Unit 0	
078	UN23C	Data Manipulation Unit 1	
084	UN2B	Special Register 0	
092	UN3B	Special Register 1	
098	UN6B	Store Data Control	
104	UN43D	Store Address Controller	
110	UN45C	Store Address Translator	
118	UN21B	Utility Circuit	Optional UN61
124	UN10C	Cache Control	Optional
130	UN10C	Cache Control	Optional
138	UN11B	Cache Memory	Optional UN30B
146	UN133B	Main Store Update Unit	Optional UN142
154	TN10	Emergency Action Interface	
162	TN5B	Power Control Switch	TN5C Improved TN5D International
178	495FA	Power Unit B	

Table D. Central Processing Unit With VLMM Feature

Location	Unit	Title	Notes
016	495FA	Power Unit A	
020	Vacant		
028	UN22C	Maintenance Channel	
036	UN28B	Programmable Microstore (MC3T003A1)	
042	UN248	16K Writable Microstore	Optional UN48B
050	Vacant		Void with UN248 in slot 042
058	Vacant		
066	UN135	Microstore Controller (MC4C076A1)	
072	UN608	Data Manipulation Unit 0	
078	UN609	Data Manipulation Unit 1	
084	UN2B	Special Register 0	
092	UN3C	Special Register 1	
098	UN6B	Store Data Control	
104	UN611	Store Address Controller	
110	UN612	Store Address Translator	
118	UN615	Utility Circuit	
124	UN616	Cache Control	
130	UN616	Cache Control	
138	UN617	Cache Memory	
146	UN133C	Main Store Update Unit	
154	TN10	Emergency Action Interface	
162	TN5B	Power Control Switch	
178	495FA	Power Unit B	

Main Store, Input/Output, and Disk File Controller Unit

3.04 This unit has two configurations; one (J1C147BB) contains the storage module drive (SMD) disk file controller (DFC) and the other (J3T029AA) contains the small computer interface (SCSI) DFC. In addition to the respective DFC, both units contain the main store, main store controller, direct memory access controller (DMAC), and dual serial channel. The SMD DFC consists of a microcontrol store, bus interface controller, peripheral interface controller, and a dual duplex serial bus selector (DDSBS). The circuit packs and power units for the MAS, I/O, and SMD disk file controller are shown in Table E. Power for the SMD DFC is supplied by power unit C and controlled by a TN3B power switch. The main store and DMA circuit packs are powered from power unit D and controlled by the TN6B power switch in the CPU.

Table E. Main Store, Input/Output, and SMD Disk File Controller

Location	Unit	Title	Notes
016	495FA	Power Unit C	
022	Vacant		
028	TN19	Microcontrol Store A (MC4C127A1)	Optional TN68
034	TN19	Microcontrol Store B (MC4C127A1)	Optional TN68
040	Vacant		
044	UN55	Disk File Controller Interface	Optional UN54
052	TN70B	Bus Interface Controller	
058	TN69B	Dual Duplex Serial Bus Selector	
064	UN64	Peripheral Disk Interface	
074	TN3B	Power Control Switch	
080	UN9B	Dual Serial Channel (11)	
088	UN46C	Direct Memory Access Controller 0	
096	UN46C	Direct Memory Access Controller 1	Optional
104	UN9B	Dual Serial Channel (12)	Optional UN109
112	UN59B	Main Store Controller	
120	TN56*	Main Store Array (07)	Optional
126	TN56*	Main Store Array (06)	Optional
132	TN56*	Main Store Array (05)	Optional
138	TN56*	Main Store Array (04)	
144	TN56*	Main Store Array (03)	
150	TN56*	Main Store Array (02)	
156	TN56*	Main Store Array (02)	
162	TN56*	Main Store Array (00)	
178	495FA	Power Unit D	

* Model 2 may have TN28s

3.05 The SCSI DFC consists of the DDSBS and a host adapter (two circuit packs UN294 and TN2116) with power supplied by power unit C and controlled by a TN6B power switch. Table F shows the circuit packs for the main store, I/O, and SCSI DFC unit when the main store is also equipped with the VLMM feature.

Table F. Main Store, Input/Output, and SCSI Disk File Controller With VLMM Feature

Location	Unit	Title	Notes
016	495FA	Power Unit C	
024	TN6B or C	Power Control Switch	
030	TN69B	Dual Duplex Serial Bus Selector	
036	UN294	SCSI Host Adapter 1	
044	TN2116	SCSI Host Adapter 2	
052	Vacant		
058	Vacant		
064	Vacant		
074	Vacant		
080	UN9B	Dual Serial Channel (11)	
088	UN46D	Direct Memory Access Controller 0	
096	UN46D	Direct Memory Access Controller 1	Optional
104	UN9B	Dual Serial Channel (12)	Optional
112	UN618	Main Store Controller	Optional UN59C
120	TN2012	Main Store Array (07)	Optional TN56
126	TN2012	Main Store Array (06)	Optional TN56
132	TN2012	Main Store Array (05)	Optional TN56
138	TN2012	Main Store Array (04)	Optional TN56
144	TN2012	Main Store Array (03)	Optional TN56
150	TN2012	Main Store Array (02)	Optional TN56
156	TN2012	Main Store Array (01)	Optional TN56
162	TN2012	Main Store Array (00)	Optional TN56
178	495FA	Power Unit D	

Main Store and Input/Output Processor Growth Unit

3.06 This optional growth unit (J1C147BC) may be located under the MAS, I/O, and DFC unit. This growth unit has positions for 16-megabytes of MAS, four I/O channels, and eight peripheral controllers. The MAS circuit packs and I/O channels are powered from a 495FA power unit F and controlled by the TN5B in the CPU. The eight peripheral controllers make up peripheral communities 2 and 3 and are powered by a 495FA power unit E and controlled by the basic input/output processor (IOP) TN6B or TN6C power switch. In addition, each peripheral community is equipped with a TN9 power converter circuit pack. When the growth unit is not equipped, a blank panel is installed at that location.

Input/Output Processor Basic Unit

3.07 This unit (J1C147BD) is used to transfer, receive, and buffer data between complementary peripheral devices and the CPU. The IOP basic unit contains an IOP controller that consists of a DDSBS, a bus interface unit, a microcontrol store, a peripheral interface controller, and a selectable microprocessor interface. This unit also includes peripheral communities 0 and 1. Peripheral community 0 is equipped with a maintenance teletypewriter peripheral controller, a scanner signal distributor controller, and a magnetic tape controller (bay 0 only). The 495FA power unit H supplies power to the IOP controller and to peripheral community 0. The 494GA power unit J supplies power to peripheral community 1. Each peripheral community also contains a TN9 power converter. The TN6B power switch controls the application of power to the IOP basic unit and, when equipped, the growth unit. The TN6(B,C) controls the 495FA power units but not the TN9 power converter packs. The TN9 power is applied when the TN9 is plugged in. Circuit packs and power units for the IOP basic unit are listed in Table G.

Table G. Input/Output Processor Basic Unit

Location	Unit	Title	Notes
016	495FA	Power Unit G	CPU power
024	494GA	Power Unit J	
032	TN9	Power Converter 1	
038			Job engineered
046			Job engineered
054			Job engineered
062			Job engineered
072	TN9	Power Converter 0	
078	UN145	Dual Density Tape Controller	Bay 0 only
086	UN33B	Scanner Signal Distributor Controller	
094	TN74B	Teletypewriter Controller (MC4C011A1B)	
102	TN983	Maintenance Teletypewriter Controller (MC4C132A1)	
110	UN25B	Selectable Microprocessor Interface	
118			Job engineered
126	TN61B	Peripheral Interface Controller	
132	TN84	Micro Control Store (MC4C049A1C)	
138			Job engineered
144	Vacant		
148	TN70B	Bus Interface Controller	
154	TN69B	Dual Duplex Serial Bus Selector	
162	TN6B	Power Control Switch	
178	495FA	Power Unit H	

Power Switches

3.08 Each of the three power switches (TN3B, TN5B, and TN6B) control power for their respective units: IOP, control unit, and DFC. In addition to powering up and powering down, these power switches also test lamps, remove and restore their respective units to and from service, and cut off hardware alarms. These power switches also indicate their respective unit alarm status, interface signal distributor signals, and generate scan point outputs. Actually, the power switches does not remove and restore their fault group from service. The power switch requests the removal or restoral with the ROS/RST switch via the scan points. The faceplates of these power switches are identical; however, internally each is customized to meet unique functions. Faceplates are shown in Figure 14.

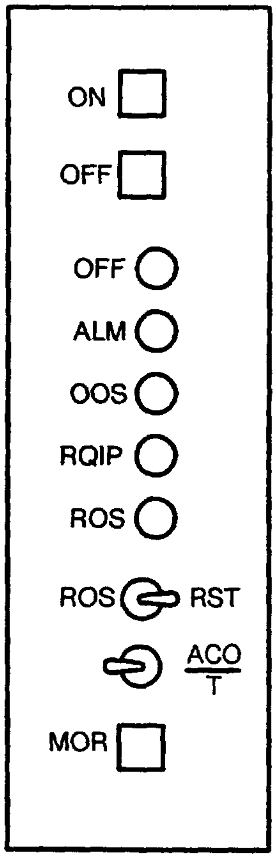


Figure 14. TN3B, TN5B, and TN6B Power Switch Faceplates

Cooling Unit

3.09 The cooling unit (ED-4C387-30) is used to force air upward through the cabinet or frame. It consists of two fan trays, with two fans and an air filter per tray. Each of the four fans receives -48 V DC power from separate fuses in the power distribution unit. The cooling unit has power controls and alarm indicators on the front panel. The power switches control fan power. If any switch is on the fans are turned on. Fan alarms latch; when any power switch is turned on the alarms are reset and power is applied. The cooling unit is illustrated in Figure 15.

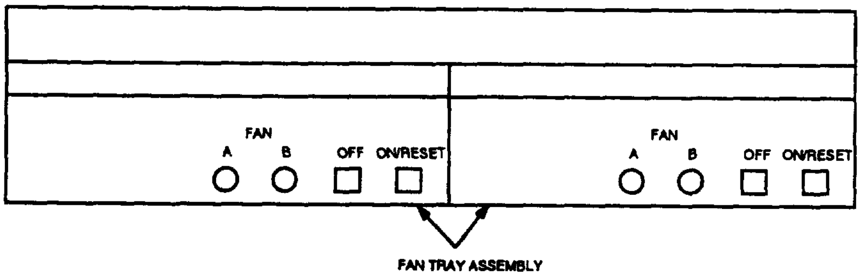


Figure 15. Cooling Unit

Port Switch Unit

3.10 The port switch unit (J1C130BC)(on bay 0 only) contains two port switch subunits and may contain scanner signal distributor interface circuit packs. The port switch subunits (one for the maintenance terminal and the other for the receive-only printer) automatically switch these units to the active maintenance teletypewriter controller in 0 or 1 side in the basic IOP. Controls are available to manually switch these units. The port switch unit receives -48 V DC from the power distribution unit on bay 1. It is protected by local fusing on a fuse panel assembly on the port switch unit. The optional scanner signal distributor interface circuit packs connect system alarms to office alarms and require no power. The port switch unit is shown in Figure 16.

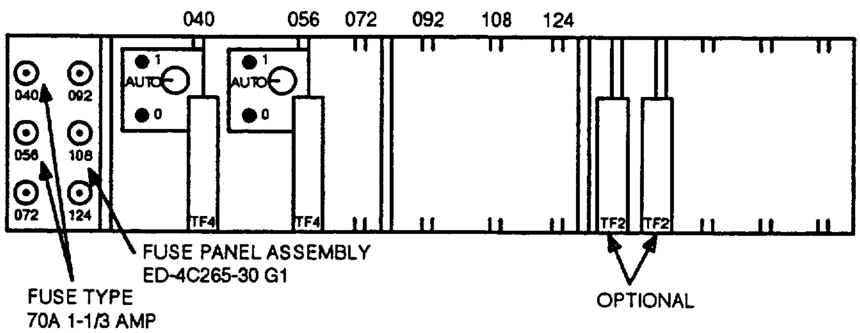


Figure 16. Port Switch Unit

B. Tape/Disk Cabinet

Power Distribution Unit

3.11 The power distribution unit (J1C186AB) contains the same components (input jacks, fuse blocks and terminal blocks) but in a different arrangement from that shown in Figure 13. (There are eight terminal blocks with four pins each.) The J1C186AB power distribution unit is configured to match power feeders and fuses with the number of disk drives mounted in the cabinet. Power (-48 V DC) is distributed to each power switch and each power supply as shown in Table H. A tape drive, when mounted in this cabinet, is powered by 120 V AC from a local AC power panel.

Table H. Tape/Disk Cabinet Fuse Assignments

MHD	-48V Bus	Load	Fuse*	Type	Rating	MHD	-48V Bus	Load	Fuse*	Type	Rating
0	A	PSW	F1A	70A	.25A	8	C	PSW	F5	70F	.25A
or		PS	F2	74D	10A	or		PS	F6	74D	10A
4		PS	F2A	70F	.25A	12†		PS	F6A	70F	.25A
1	E	PSW	F9A	70F	.25A	9	G	PSW	F13	70F	.25A
or		PS	F10	74D	10A	or		PS	F14	74D	10A
5		PS	F10A	70F	.25A	13†		PS	F14A	70F	.25A
2	B	PSW	F3A	70F	.25A	10	D	PSW	F7	70F	.25A
or		PS	F4	74D	10A	or		PS	F8	74D	10A
6		PS	F4A	70F	.25A	14†		PS	F8A	70F	.25A
3	F	PSW	F11A	70F	.25A	11	H	PSW	F15	70F	.25A
or		PS	F12	74D	10A	or		PS	F16	74D	10A
7		PS	F12A	70F	.25A	15†		PS	F16A	70F	.25A

Legend:
* Unused fuse locations equipped with 72A dummy fuse
MHD = moving head disk
PS = power supply KS-22997
† MHDs 12 through 15 are equipped on the third Tape/Disk Cabinet
PSW = power switch ED-4C481

Power Supply

3.12 The power supply (KS-22997) receives the -48 V DC from the power distribution unit and supplies multiple DC outputs to operate a dedicated 340-megabyte disk drive. Internally generated voltage alarms are sent to the power switch. The faceplate of the power supply is shown in Figure 17. (The local power switch in the center of the power supply is disabled.)

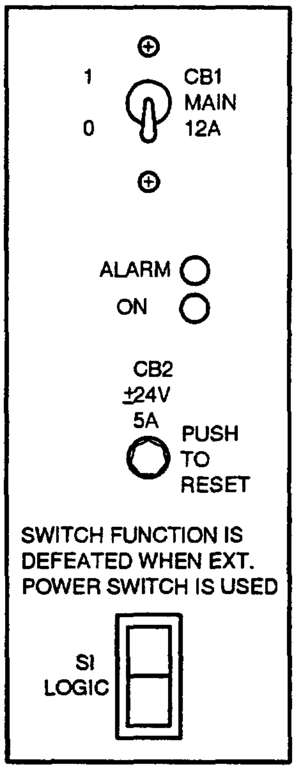


Figure 17. Power Supply Faceplate

Power Switch

3.13 A dedicated power switch (ED-4C481) is used for manual control of the disk drive. Controls send requests to the computer to remove and restore the disk drive from and to service, power up and power down, lamp test and alarm cutoff. Indicators provide status. Alarms from the disk drive, power supply and alarms generated internally are indicated on the faceplate and sent to the office alarm system. The faceplate of the power switch is shown in Figure 18.

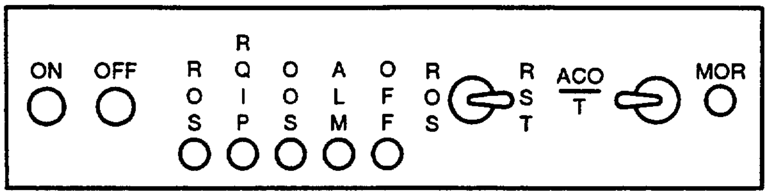


Figure 18. Power Switch

C. SCSI Disk Cabinet

Power Distribution Unit

3.14 The power distribution unit (J1C147BE) contains the same components (input jacks, fuse blocks and terminal blocks) in the same arrangement as that shown in Figure 13. The J1C147BE power distribution unit is configured to match power feeders and fuses with the number of disk drives and other units that may be mounted in the cabinet. Power (-48 V DC) is distributed to each unit as shown in Table I.

Tape Drive Unit

3.15 Tape drives are mounted in this cabinet only in the new ship configuration. Tape drives in this cabinet are powered by 120 V AC from a local AC power panel.

SCSI Disk File Controller Unit

3.16 SCSI DFCs are present in the SCSI disk cabinet only in the growth and conversion configurations. A SCSI DFC consists of the DDSBS (TN69), and a two circuit board host adapter (UN294 and TN2116). Power (-48 V DC) is supplied by the SCSI disk cabinet power distribution unit to a 495FA power unit and is controlled by a TN6B(or TN6C) power switch.

Cooling Unit

3.17 A cooling unit is mounted in the SCSI disk cabinet when SCSI DFCs are present. The cooling unit consists of two fan trays, with two fans and an air filter per tray. Each fan tray is supplied -48 V DC from the power distribution unit. The cooling unit has power controls and alarm indicators on the front panel.

Table I. SCSI Disk Cabinet Fuse Assignments

Fuse					Load	
Bus	Label	Location	Type	Rating	Unit	Location
A	DISK 06-045	F4/F4A	74B/70F	3A/.25A	DUP 0	006-045
	DISK 24-045	F3/F3A	74B/70F	3A/.25A	DUP 2	024-045
	DISK 11-045	F2/F2A	74B/70F	3A/.25A	DUP 4	011-045
	DISK 28-045	F1/F1A	74B/70F	3A/.25A	DUP 6	028-045
C	DISK 15-045	F8/F8A	74B/70F	3A/.25A	DUP 8	015-045
	DISK 32-045	F7/F7A	74B/70F	3A/.25A	DUP 10	032-045
	DISK 19-045	F6/F6A	74B/70F	3A/.25A	DUP 12	019-045
	DISK 36-045	F5/F5A	74B/70F	3A/.25A	DUP 14	036-045
D	DFC * SUPPLY	F12/F12A	74D/70F	10A/.25A	DFC * Pwr Sup	056-016
	DFC * SWITCH	F11/F11A	72A/70C	DUM/3A	DFC * Pwr Sw	056-024
	FAN CTL 0	F10/F10A	72A/70C	DUM/3A	Fan 0 Ctrl	047-016
	FAN 0 A & B	F9/F9A	74C/70F	5A/.25A	Fan 0 A & B	047-038
F	FAN 1 A & B	F16/F16A	74C/70F	5A/.25A	Fan 1 A & B	047-128
	FAN CTL 1	F15/F15A	72A/70C	DUM/3A	Fan 1 Ctrl	047-104
	DFC † SUPPLY	F14/F14A	72A/70C	DUM/3A	DFC † Pwr Sup	056-112
	DFC † SWITCH	F13/13A	74D/70F	10A/.25A	DFC † Pwr SW	056-104
G	DISK 36-134	F20/F20A	74B/70F	3A/.25A	DUP 15	036-134
	DISK 19-134	F19/F19A	74B/70F	3A/.25A	DUP 13	019-134
	DISK 32-134	F18/F18A	74B/70F	3A/.25A	DUP 11	032-134
	DISK 15-134	F17/F17A	74B/70F	3A/.25A	DUP 9	015-134
J	DISK 28-134	F24/F24A	74B/70F	3A/.25A	DUP 7	028-134
	DISK 11-134	F23/F23A	74B/70F	3A/.25A	DUP 5	011-134
	DISK 24-134	F22/F22A	74B/70F	3A/.25A	DUP 3	024-134
	DISK 06-134	F21/F21A	74B/70F	3A/.25A	DUP 1	006-134

Notes:
* DFC 0 or 2
† DFC 1 or 3

SCSI Disk Unit Package

3.18 The SCSI disk unit package contains the power supply (CGG2), a power switch (CGG1), the disk drive, and a cooling fan. The power supply receives the -48 V DC from the power distribution unit and supplies two DC outputs (+5 V DC and +12V DC) to operate a dedicated SCSI disk drive and the cooling fan. The -48 V DC goes through the power supply for input power to the power switch.

3.19 A dedicated power switch is used for manual control of the disk drive. Controls send requests to the computer to remove and restore the disk drive from and to service, power up and power down, lamp test, and alarm cutoff. Indicators provide status. The controls and indicators are available through the front panel of the disk unit package. The power switch monitors the outputs of the power unit and generates alarms when output voltage drops. The power switch also generates scan point outputs and receives scan point inputs. The cooling fan has a fan performance sensor which is monitored by the power switch to generate an alarm if the fan fails.

3.20 Alarms are indicated on the faceplate and sent to the office alarm system. A low voltage alarm turns off power. A fan alarm will turn off power only when the disk unit package is out of service. The front panel of the SCSI disk unit package is shown in Figure 19.

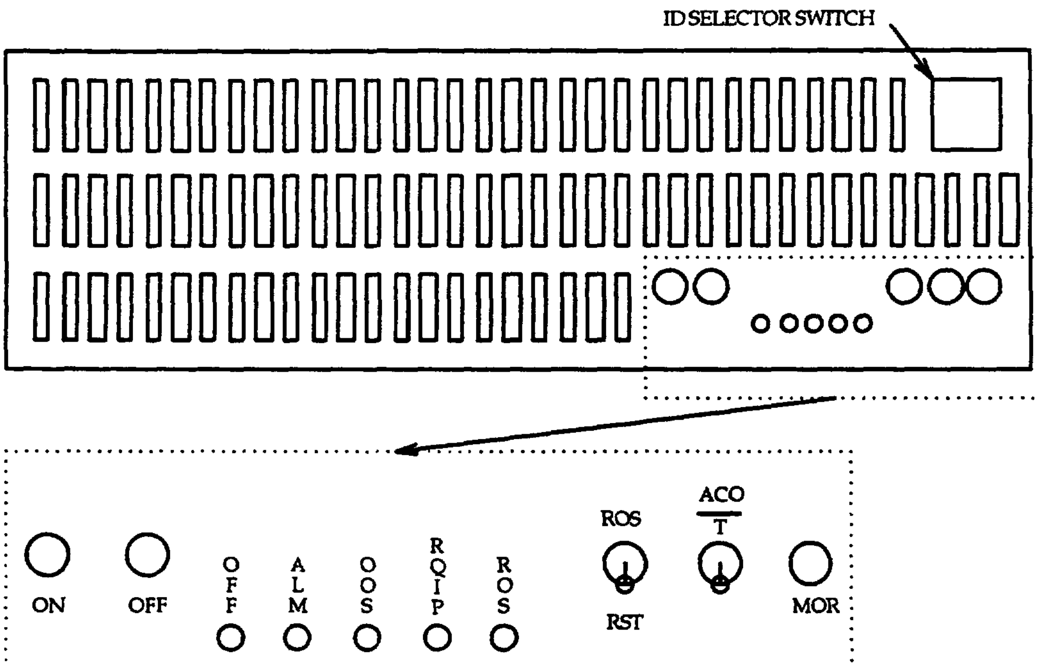


Figure 19. SCSI Disk Unit Package

D. Power Cabinet or Power Distribution Frame

Filter Fuse Panel

3.21 The filter fuse panel (ED-82947-30, G2) is a distribution panel with positions for 48 load fuses and 48 indicator fuses in parallel. The filter fuse panel is divided in half with each side containing 24 load and 24 indicator fuses, 3 filter capacitors, and an alarm LED to indicate blown fuses. There are also 3 filter fuses and 3 LED that monitor the capacitors on each side. A discharged capacitor will light the LED and produce a minor alarm. Each of the 24 indicator fuses connect to a common panel alarm LED in each of the upper corners of the panel. These indicator fuses have a rod that protrudes from the fuse cap when the fuse blows. A blown fuse will cause a major alarm. Alarms are connected to the control panel. The filter fuse panel is shown in Figure 20.

Control Panel

3.22 The control panel (ED-82947-30, G10) consists of two plug-in modular circuit packs; an alarm module, and a charging circuit module. Each is fused and contains controls and indicators. A charging probe is used to charge filter capacitors. The control panel is shown in Figure 20.

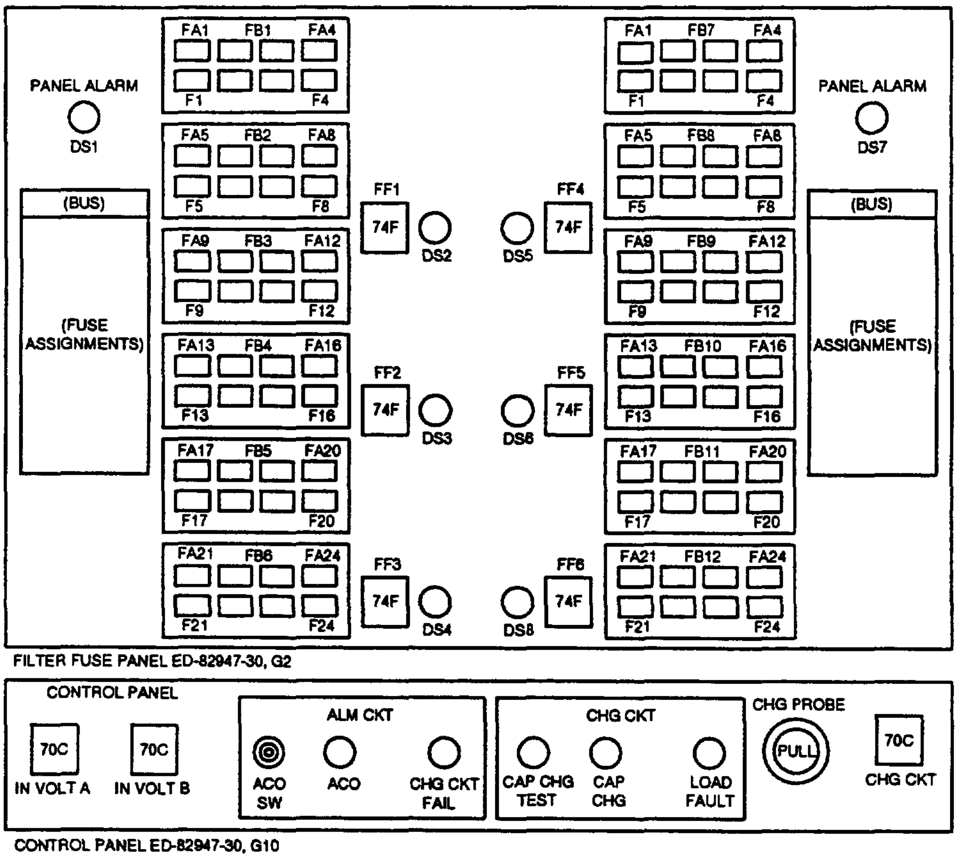


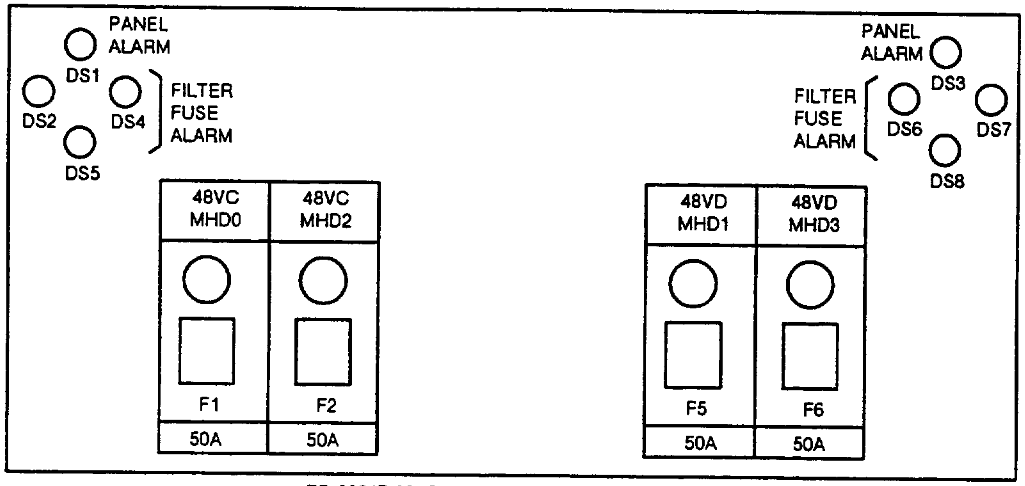
Figure 20. Filter Fuse Panel and Control Panel

High-Current Fuse Panels

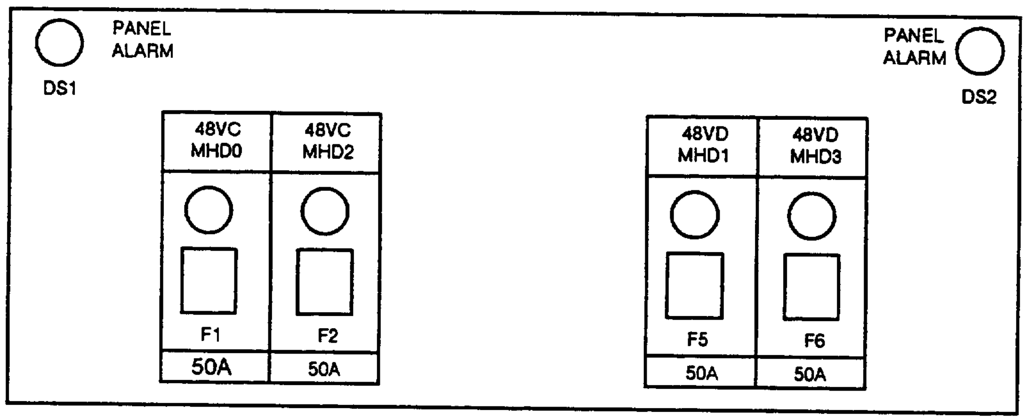
3.23 The high-current fuse panel (ED-82947-30, G6) is used only on the J86334B power distribution frame to supply 50-amp current to inverters for the 160- and 300- megabyte disk drives. This panel has a capacity for eight fuse blocks with each containing a 50-amp fuse and an indicator fuse. The indicator fuse is visible from the front. This panel is divided in half with each side receiving a dedicated -48 V DC and return cable pair from the battery plant. Each side contains four fuse blocks and three capacitors connected across the input bus and return. Each capacitor is monitored by a LED. The indicator fuses are tied together to a common panel alarm LED in the upper corner. Alarm conditions are sent to the control panel. The high-current fuse panel (ED-82947-30, G6) is shown in Figure 21.

3.24 The high-current fuse panel (ED-82947-30, G5) is used only on the J86334C power distribution frame and requires the capacitor panel (ED-82947-30, G4) to stabilize the bus voltages. The ED-82947-30, G5 panel has a capacity for eight fuse blocks with each containing a 50-amp fuse and an indicator fuse. This panel is divided in half with each side receiving a dedicated -48 V DC and return cable pair from the battery plant. Each side contains four fuse blocks. The indicator fuses are tied together to a common panel alarm LED in the upper corner. Alarm conditions are sent to the control panel. This high-current fuse panel is used to power inverters for 160- and 300-megabyte disk drives. The high current fuse panel (ED-82947-30, G5) is shown in Figure 21.

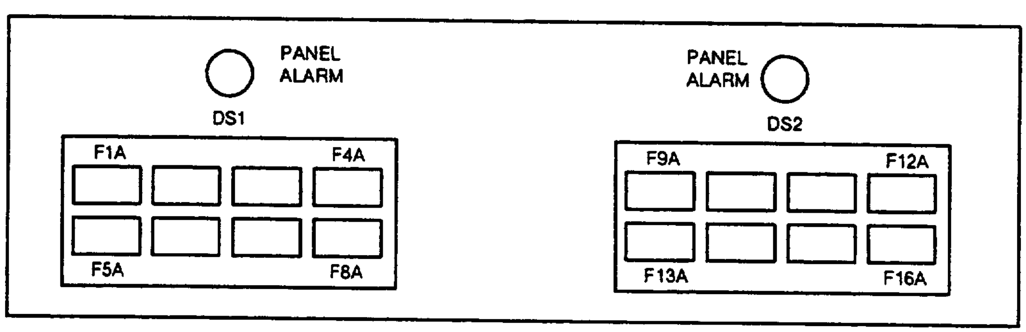
3.25 The capacitor panel (ED-82947-30, G4) contains 16 high-value capacitors, eight on each half. This panel is used on the J86334C power distribution frame only. The eight capacitors on the left are tied to the left-hand bus bar. Conversely, the eight capacitors on the right connect to the right-hand bus bar. The capacitors on each side are paralleled, each protected by a dedicated indicator fuse. An LED on each side of the capacitor panel indicates that one or more of the eight capacitors have generated an alarm that is also sent to the control panel. An extended fuse rod on the indicator fuse indicates a capacitor that has discharged. The capacitors on each half are filters and hold the bus voltage to an acceptable level. The capacitor panel (ED-82947-30, G4) is shown in Figure 21.



ED-82947-30, G6 HIGH-CURRENT FUSE PANEL



ED-82947-30, G5 HIGH-CURRENT FUSE PANEL



ED-82947-30, G4 CAPACITOR PANEL

Figure 21. High-Current Fuse Panels

Rectifier Unit

3.26 The rectifier unit (J87437A) is mounted in the power cabinet (see Figure 4) and is used in the 3B20D Model 3 computer when the application is not equipped with a -48 V DC source. Two rectifier units are required and are mounted back-to-back in the cabinet with rectifier unit designated 0 facing the rear of the cabinet and rectifier unit designated 1 facing the front. Rectifier unit 0 furnishes power to the left half of the filter fuse panel while rectifier unit 1 supplies power to the right half. The rectifier converts commercial 208 V ac, 3-phase power input into -48 V DC outputs for distribution by the filter fuse panel. The rectifier unit consists of three ferro-resonant transformers, rectifying diodes, DC filter capacitors, and a filter inductor. The DC output is obtained by paralleling each of the three transformer outputs after they pass through full-wave, center-tap rectifiers. The inductive-capacitive filter reduces the ripple.

E. Moving Head Disk Frame or Disk Power Cabinet

Disk File Inverter

3.27 Each disk file inverter (ED-4C172-30) receives -48 V DC power from a dedicated 50-amp fuse in the power distribution frame and supplies 208 V pseudo-sine wave power to the 300-megabyte disk drives. Due to the high current involved, -48 V DC power is connected directly to the input terminals of the disk file inverter. The disk file inverter contains two cooling fans (one AC and one DC) with filters, a thermal switch detector, a fuse, and two plug-in circuit packs. One circuit pack contains the microprocessor and control circuitry while the other contains the silicon-controlled rectifiers used for generating the output AC power. An interlock switch is provided which removes power from the circuit pack area when access to the circuit pack is required. The disk file inverter with the air filters removed is shown in Figure 22.

Power Control Unit

3.28 Power for the disk drives is delivered from the disk file inverter through the power control panel (J1C131AA). The power control panel also contains a power switch; ED-4C479, which is the focal point for controlling the inverter and the disk drive. The power switch contains scan and signal distributor points that forward alarm conditions and permit software control. The front panel applies or removes power via ON and OFF switches, requests are sent to the computer to remove and restore the disk drive from and to service (via ROS/RST switch) power up and power down, lamp test and alarm cutoff via alarm cutoff/test (ACO/T) switch. The MOR switch is used in an emergency to immediately remove power. Indicators on the power switch reflect status: OFF indicates power is removed from the disk drive, ALERT indicates an alarm condition, OOS indicates out-of-service, RQIP indicates a software request is in progress or has been denied, and the ROS indicates a request to remove the disk drive from service. The power control unit is shown in Figure 22.

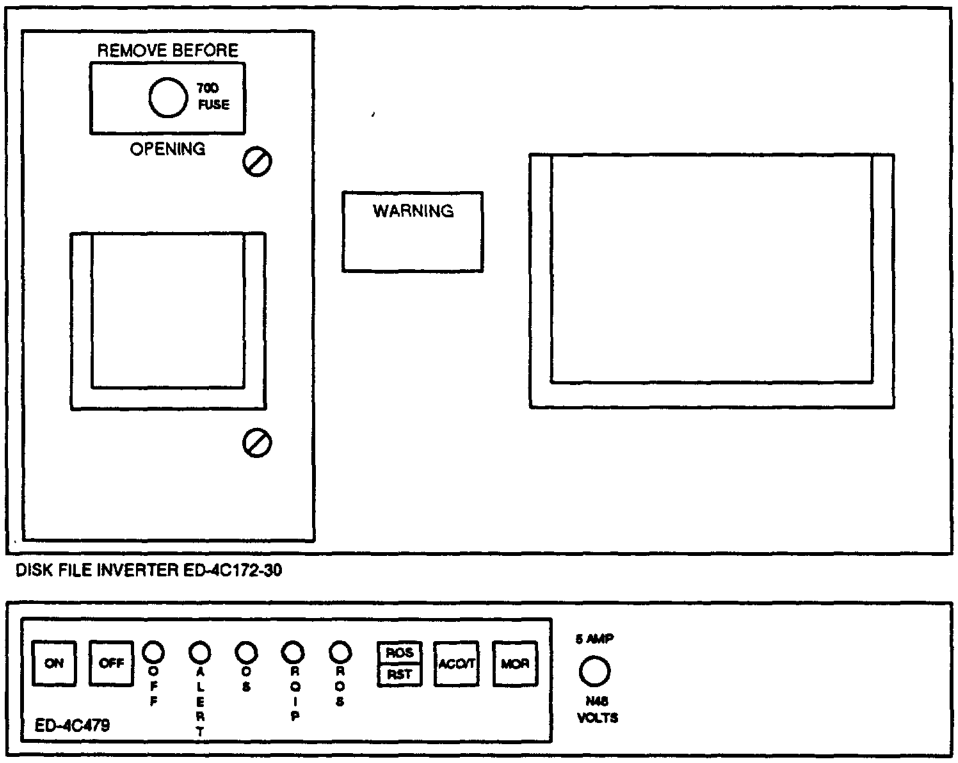


Figure 22. Disk File Inverter and Power Control Panel

F. Minimodule Disk Frame

1200VA Inverter

3.29 The minimodule disk frame contains an inverter assembly (J1C149AB) that consists of a 1200VA inverter (J85339A), a 120 V AC output receptacle, and associated wiring. The 1200VA inverter receives -48 V DC from a dedicated fuse on the power distribution frame, converts the -48 V DC to 120 V AC, and supplies this voltage to the output receptacle. The 160-megabyte disk drive power cord is plugged into this receptacle. The 1200VA inverter consists of five 495H1 converters, a 394A synthesizer, and a TN2 power switch. The converters change the input DC to a square wave and the synthesizer makes the output sinusoidal. Five converters are needed for power requirements. The TN2 power switch furnishes the standard manual controls and indications, communicates alarm conditions, and allows software control via signal distributor points. The faceplate of the TN2 is identical to the faceplates of the TN3B, TN5B, and TN6B as shown in Figure 14. The 1200VA inverter with the cover removed is shown in Figure 23.

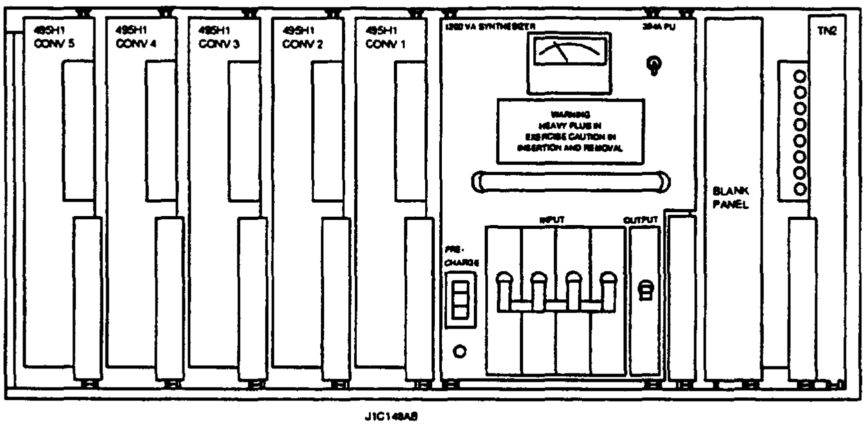


Figure 23. 1200VA Inverter

G. High-Speed Tape Unit Frame

300VA Inverter Unit

3.30 The 300VA inverter receives -48 V DC from a dedicated fuse on the power distribution frame, converts the -48 V DC to 120 V AC, and supplies this voltage to an output receptacle. The tape drive power cord is plugged into this receptacle. The 300VA inverter consists of a 495H1 converter and a 393A synthesizer. The input power is fused at the inverter unit. The converter changes the input DC to a square wave and the synthesizer makes the output sinusoidal. This inverter and tape unit are not included in the alarm system. The 300VA inverter is shown in Figure 24.

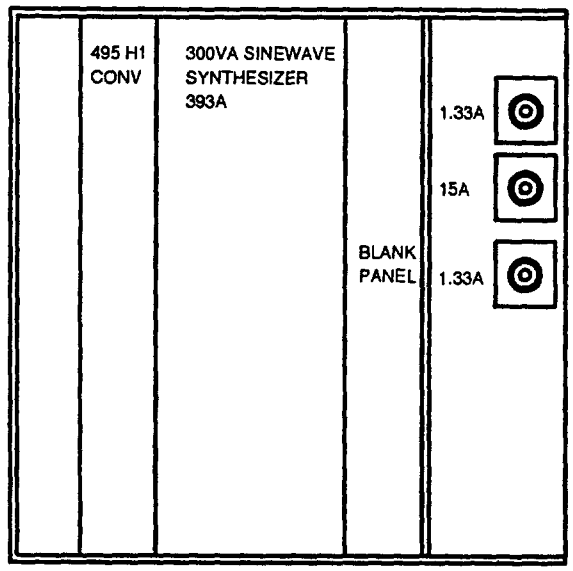


Figure 24. 300VA Inverter

4. Theory Of Operation

Introduction

4.01 The theory of operation for power systems will deal with power distribution, inverter operation, and alarms.

A. Power Switches

4.02 Each of the functional units in the computers requires its own control/display facility; this is necessary to turn unit power on and off, display power and alarm states, and provide out-of-service request and display features. These facilities are a common circuit arrangement and are found on the unit power switches. Although not identical, the power switches contain common switches and LEDs that result in the same actions. The power switches for the various units are listed below.

- Control unit - TN5B(C or D)

- SMD DFC - TN3B(C or D)
- SCSI DFC - TN6B(C orD)
- IOP - TN6B(C or D)
- Disk file inverter - ED-4C479
- 1200VA inverter - TN2
- 340-megabyte disk drive power switch - ED-4C481
- SCSI disk drive power switch - CGG1 (contained in SCSI disk unit package).

4.03 These power switches are each customized with components necessary to define their unique functions. They contain controls and indicators to control the application and removal of power and to indicate status. Power may be manually turned on and off. Power may be removed from the unit by simultaneously pressing the OFF and MOR (manual override) switches, but the MOR switch is used only during emergencies. When power is removed, the OFF and ALM (alarm) LED will light. Pressing only the OFF switch will not power down the unit when the unit is in service. The unit may be powered up by operating the ON switch and the OFF and ALM LEDs will extinguish. Power alarms may be retired and the LED tested by operating the ACO/T switch. A power alarm is in effect when the ALM LED is lighted.

Power Distribution

A. Power Cabinet or Power Distribution Frame

4.04 Power distribution from the Model 2 computer power distribution frame is shown in Figure 25 and from the Model 3 computer power cabinet is shown in Figure 26. A dedicated -48 V DC is furnished from the power plant or converter to each half of each filter fuse panel and each high-current fuse panel installed. The Model 3 power cabinet, when used with the AC-to-DC option, is supplied 208 V AC from a local AC power panel (Figure 26) to two rectifier units. The rectifier units convert 208 V AC to the -48 V DC that is supplied to the filter fuse panel.

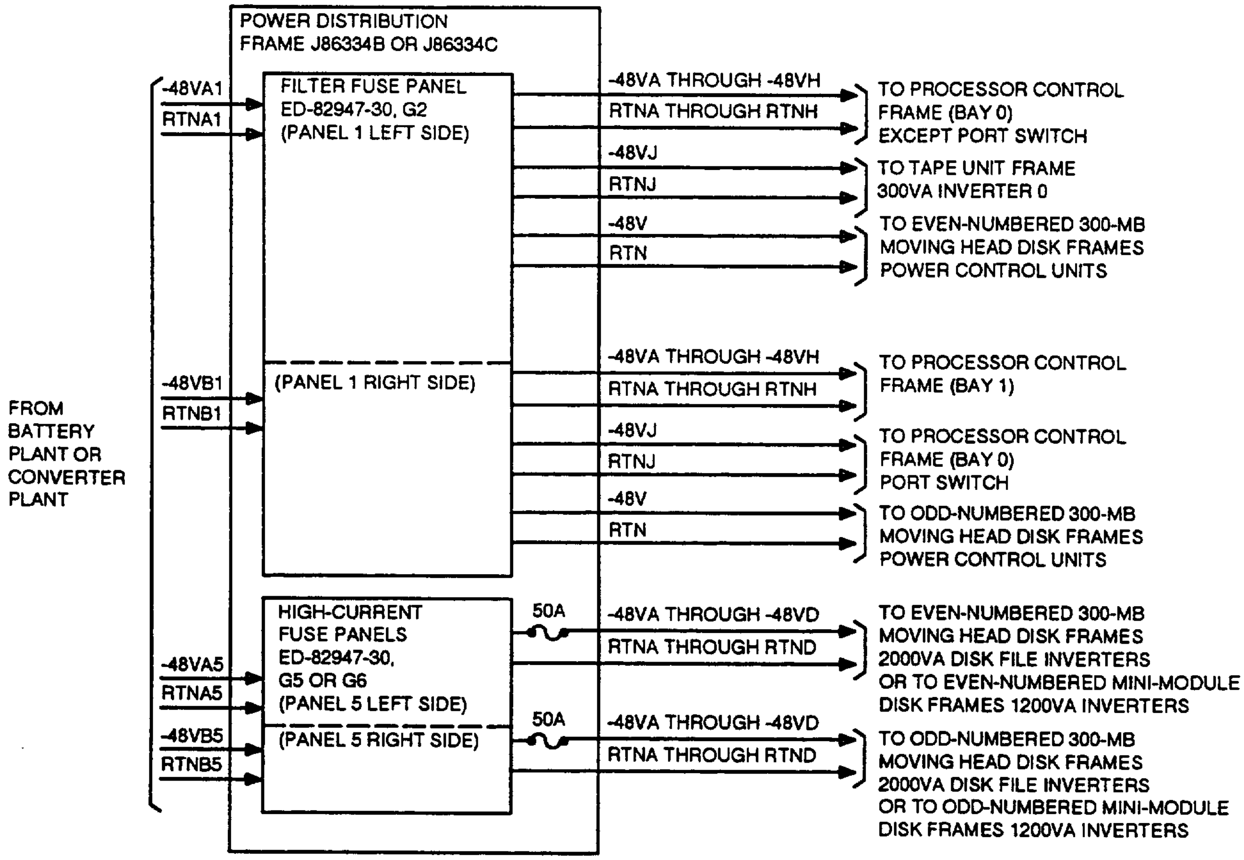


Figure 25. Power Distribution Frame Block Diagram

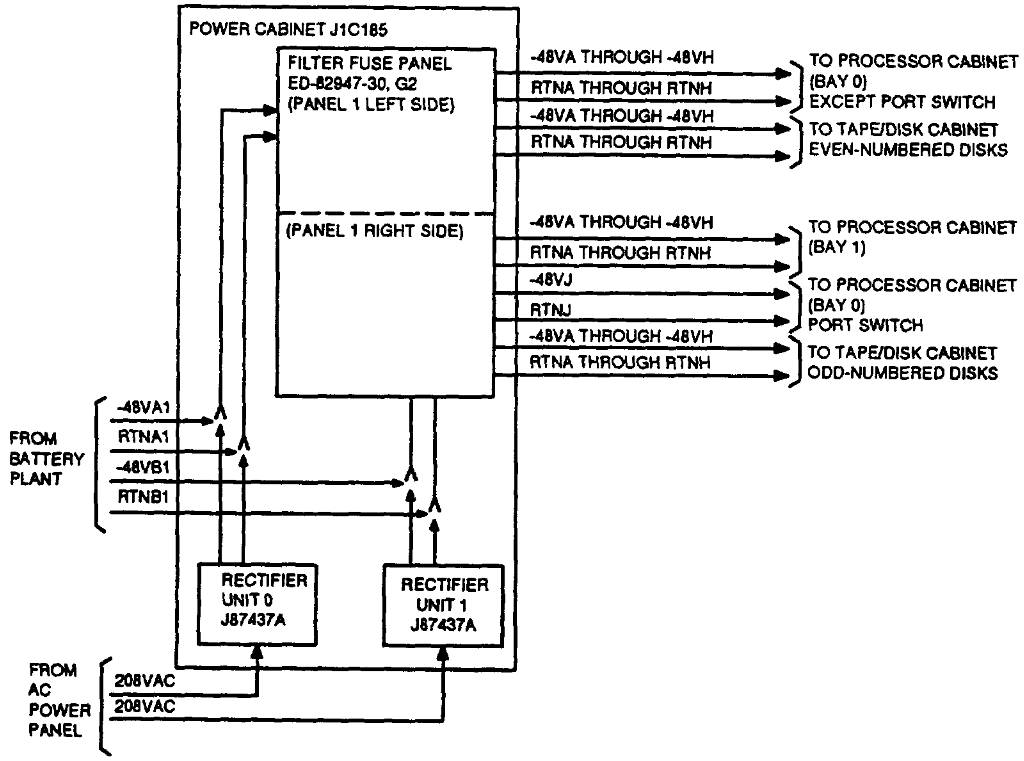


Figure 26. Power Cabinet Block Diagram

4.05 Eight dedicated buses (A through H) supply -48 V DC from each half of the filter fuse panel to the power distribution unit at the top of the processor cabinet or the processor control frame. The left side supplies bay 0 and the right side supplies bay 1. Power for the port switch unit in bay 0 is supplied by -48 V DC bus J on the right side of the filter fuse panel in both computer installations.

4.06 For Model 2, each power control unit in the MHD frame or disk power cabinet is supplied with -48 V DC from the filter fuse panel. The power control units for even-numbered 300-megabyte disk drives are connected to the left side and odd-numbered are connected to the right side. At installations using the 340-megabyte disk drives, the same scheme is used to supply -48 V DC to their respective power supplies. (The Model 2 computer may have 340-megabyte disk drives through retrofit.) Specific buses are not designated for specific units. Labels on the filter fuse panel are stenciled at installation to reflect fuse (and bus) assignments. High current (50-ampere) power for 1200VA and 2000VA disk file inverters is furnished from the high-current fuse panel.

Disk file inverters for even-numbered 300-megabyte disk drives are supplied from the left half of the high-current fuse panel and disk file inverters for odd-numbered disk drives are supplied from the right half. The 1200VA inverters for the 160-megabyte disk drives are assigned in the same manner. Fuse blocks on the high-current fuse panels are labeled to indicate assignment.

4.07 The maximum voltage drop from the battery plant to the input terminals should not exceed 0.25 volt for a 60-foot run, 0.50 volt for a 120-foot run, and 0.75 volt for a 200-foot run. The maximum voltage drop from the power distribution frame or the power cabinet to the computer cabinets or frames should not exceed 1 volt. There are no voltage regulating circuits on either the power distribution frame or the power cabinet. Only fuses are monitored.

B. Processor Cabinet or Processor Control Frame

Logic Power

4.08 The computers use an integrated logic power arrangement for the control unit, disk file controller unit, and the IOP unit. This arrangement uses FASTECH® electronic packaging system for consolidation of circuit packs, better space utilization, and lower costs. The power units (495FA and 494GA), at least one within each of the units, supply power to the multilayer backplane segment serving the associated circuit packs. This arrangement minimizes the voltage drop between hardware and permits the power unit tolerances of plus or minus 5 percent. By directly connecting to the backplane segment, fusing is not required. Instead, programmable-over-current-shutdown (POCS) is used for protection. In the POCS scheme, each circuit pack has a resistor whose value is related to the amount of current drawn under normal conditions. The current programming resistors of all circuit packs supplied by a given power unit are then wired together. This forms a parallel network whose value tells the power unit how much current it should normally expect to supply. If a high-current fault occurs, the load on the power unit will be heavier than normal. This becomes an alarm condition and the power unit will shut down. Protection is the same for the backplane and the circuit pack.

Power Distribution Unit

4.09 See Table B for power distribution within the power distribution unit. This figure lists the wiring connections for each component from the input jack to the location of the load.

Control Unit

4.10 The control unit power distribution is shown in Figure 27. Power units A, B, D, F, and G convert the -48 V DC input from the power distribution unit to +5 V DC logic power for use in the control unit circuit packs. Power unit G is a spare. The TN5B power switch controls these power units. The output of each power unit is connected directly to a backplane segment and to a screw-lug terminal at the side of the backplane. The TN5B power switch also converts the received -48 V DC to +5 V DC logic power for signal generation (only internal use). Before power can be applied, the TN5B must have a converter interlock (CCINTLD) signal indicating that all power units are in place and latched. This signal (ground) is available at power unit G and interlocks all other power units. When the ON switch is pressed, the TN5B sends a start (CCSTP and CCSTN) signal to each power unit and sends a power clear signal (CPWRCLR00) to the UN2B special register. When the bus power is present (P5VB) the TN5B sends a bus power enable (BPEN20) signal to the UN2B. An alarm condition in any power unit will send the CCALM0 to the TN5B power switch.

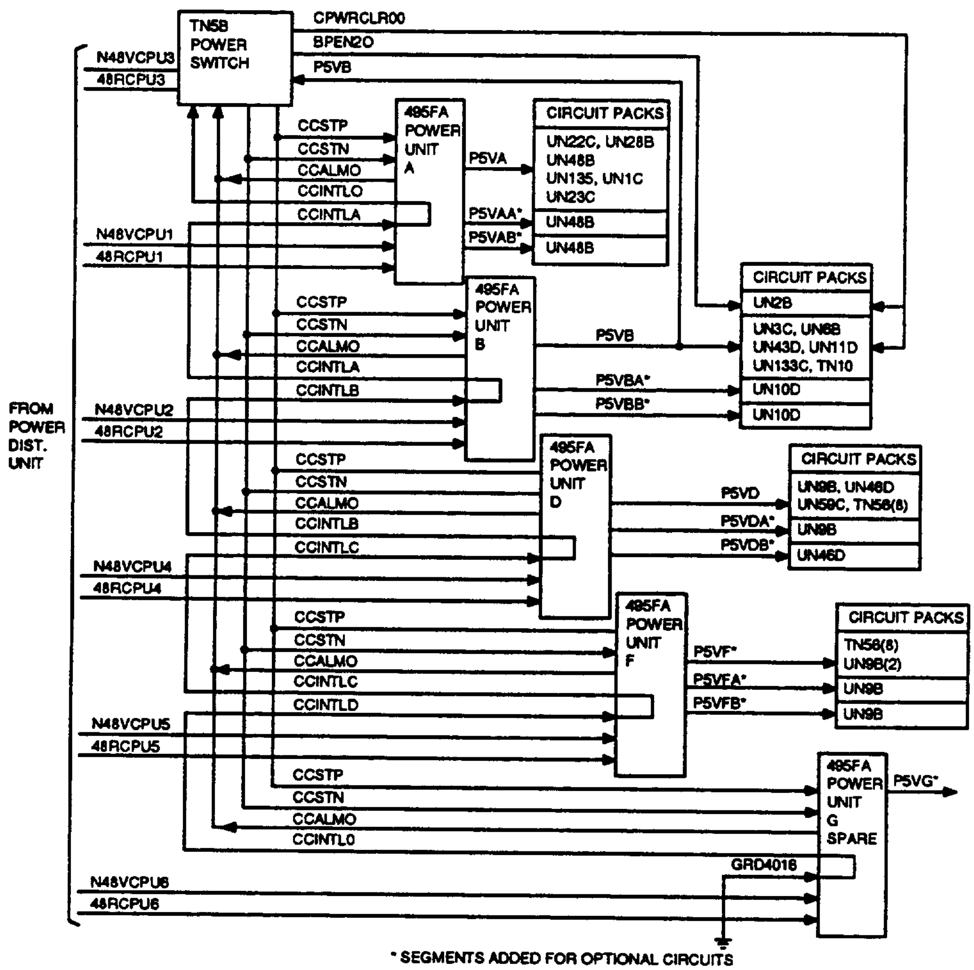


Figure 27. Control Unit Power Distribution

SMD Disk File Controller

4.11 The SMD DFC power distribution is shown in Figure 28. Power unit C converts the -48 V DC input from the power distribution unit to +5 V DC logic power for use in the DFC circuit packs. The TN3B power switch controls power unit C. The output of the power unit is connected directly to a backplane segment and to a screw-lug terminal at the side of the backplane. The TN3B power switch also converts the received -48 V DC to -5 V DC (N5V) logic power for the disk interface. Before power can be applied, the TN3B must have a converter interlock (DINTL0) signal that indicates the power unit is in place and latched. This signal (ground) is available at power unit C. When the ON switch is pressed, the TN3B sends a start (DSCTP and DSCTN) signal to the power unit and sends a bus power clear signal (DPWRCLR0) to the TN70B bus interface controller. When the bus power present (P5VC) signal is received, the TN3B sends a bus power enable (BPEN20) signal to the TN70B. An alarm condition in the power unit will send the DCALM0 to the TN3B power switch.

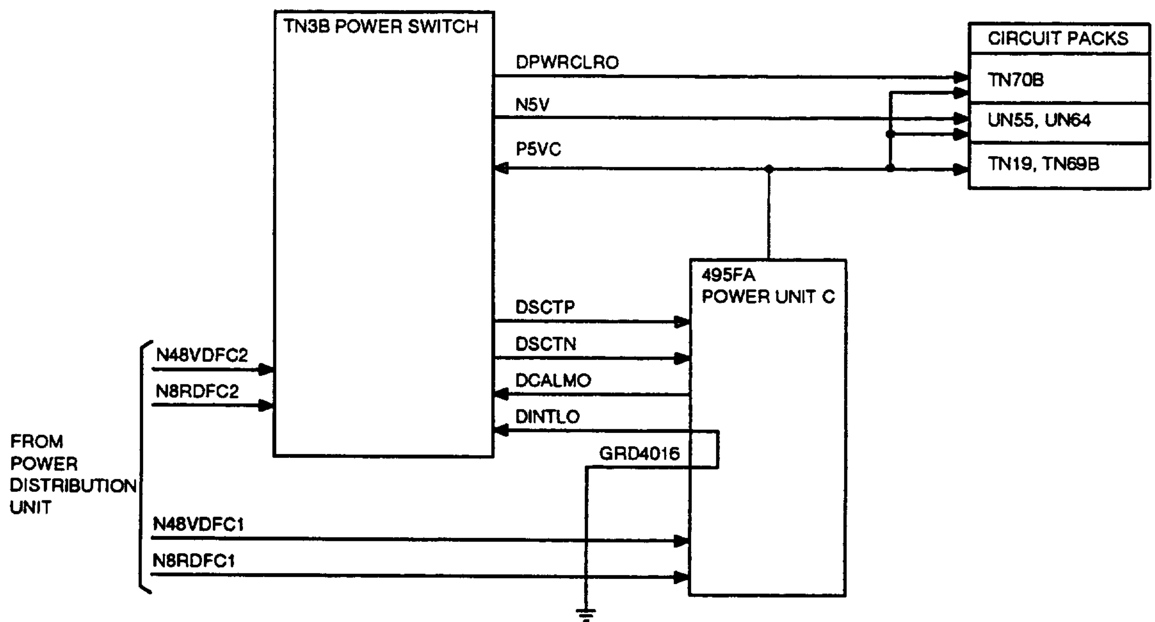


Figure 28. Storage Module Disk File Controller Power Distribution

4.12 SCSI DFC power distribution is shown in Figure 29. Power unit C (495FA) converts the -48 V DC input from the power distribution unit to +5 V DC logic power for use in the SCSI DFC circuit packs. The TN6B power switch controls power unit C. The output of the power unit is connected directly to a backplane segment and to a screw-lug terminal at the side of the backplane. Before power can be applied, the TN6B must have a converter interlock (DINTL0) signal that indicates the power unit is in place and latched. This signal (ground) is available at power unit C. When the ON switch is depressed, the TN6B sends a start (DSCTP and DSCTN) signal to the power unit and sends a power clear signal (DPWRCLR0) to the UN294 host adapter. An alarm condition in the power unit will send the DCALM0 to the TN6B power switch.

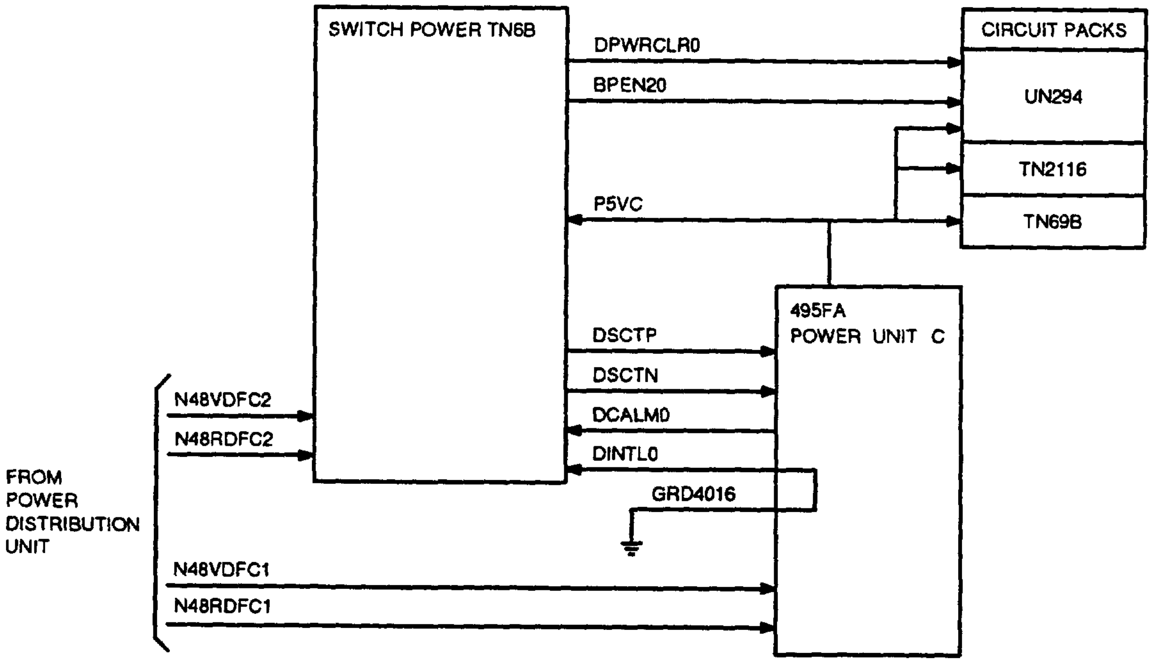


Figure 29. SCSI Disk File Controller Power Distribution

4.13 The host adapter, consisting of two circuit packs (UN294 and TN2116), connects to two SCSI buses. Each SCSI bus is terminated at each end by bus terminating resistors. The UN294 supplies +5 V DC power to the terminating resistors on each SCSI bus through diodes that provide disjunctivity - if +5 V DC to one bus is shorted, +5 V DC on the other bus is not affected.

Input/Output Processor

4.14 The IOP power distribution is shown in Figure 30. Power units E, H, and J and the TN9 power converters (0 through 3) convert their -48 V DC inputs from the power distribution unit. The output of the power units is +5 V DC and the outputs of the TN9 power converters are -12, +12, and -5 V DC. Power unit H supplies the IOP controller and with TN9-0 power converter supplies peripheral community 0. Power unit J with the TN9-1 power converter supports peripheral community 1 circuit packs. Power unit E and the TN9-2 and TN9-3 power converters are components of the growth IOP which is an optional unit. The output of each power unit is connected directly to a backplane segment and to a screw-lug terminal at the side of the backplane. The TN6B power switch uses +5 V DC (P5VH) from power unit H. Before power can be applied, the TN6B must have a power unit present (IINTL0) from power unit H. When the ON switch is depressed, the TN6B sends a start (ICSTP and ICSTN) start signal to each power unit and sends a power clear signal (IPWRCLR0) to the TN69B circuit pack. An alarm condition in any power units or power converter will send the ICALMI0, 0T0 or the ALRM0 signals to the TN6B power switch.

4.15 The ON and OFF switches on the TN6B power switch control the application and removal of power to the IOP. When a peripheral community (other than community 0) needs to be powered down independently, the power unit and associated TN9 power converters may be unlatched. Peripheral community 1 can be powered down by unlatching power unit J and the TN9-1 power converter. Unlatching power unit E and TN9-2 and TN9-3 power converters will power down both communities 2 and 3 in the growth unit.

Cooling Unit

4.16 Power distribution for the cooling unit is shown in Figure 31. The input -48 V DC power from the power distribution unit is connected through a connector board and a fan tray power and alarm board in each fan tray. The fan tray power and alarm board controls two fans, monitors their performance, and generates alarms when one or both fans fail. The fan control circuits permit manual ON/RESET and OFF from the front panel. Alarm indicators are also provided. There are two levels of alarms: single fan alarm and multiple fan alarm. Failure of one fan such as open windings or reduced speed will generate a single fan alarm (FAIL1 and FAIL1R). If two fans fail or -48 V DC is removed, which will cause both fans to power down, a multiple fan alarm (FAIL2 and FAIL2R) is generated. In the absence of a fault, a remote reset from a signal distributor point (SD and SDR, SSD and SSDR) interrupts the performance sensors for 10 seconds so the fan can get up to speed. The RESET switch on the front panel also delays enabling the alarms for 10 seconds when powering up manually. The reset will clear spurious alarms; however, if a hard fault exists after 10 seconds, the alarm will again activate. The TN3, TN5, and TN6 power switches send two signals to the fan control circuits. One clears alarms; the other turns alarms on or off.

4.17 The start and stop (STA20) and alarm initialization (INITD0) control comes from power switches. In order to start the fans, it is necessary for any power switch to generate a low on the start lead and at the same time generate a momentary low on the initialization lead. This will cause the relay controlling the fans to operate and initialize the alarms circuits. The relay will hold as long as the start lead remains low.

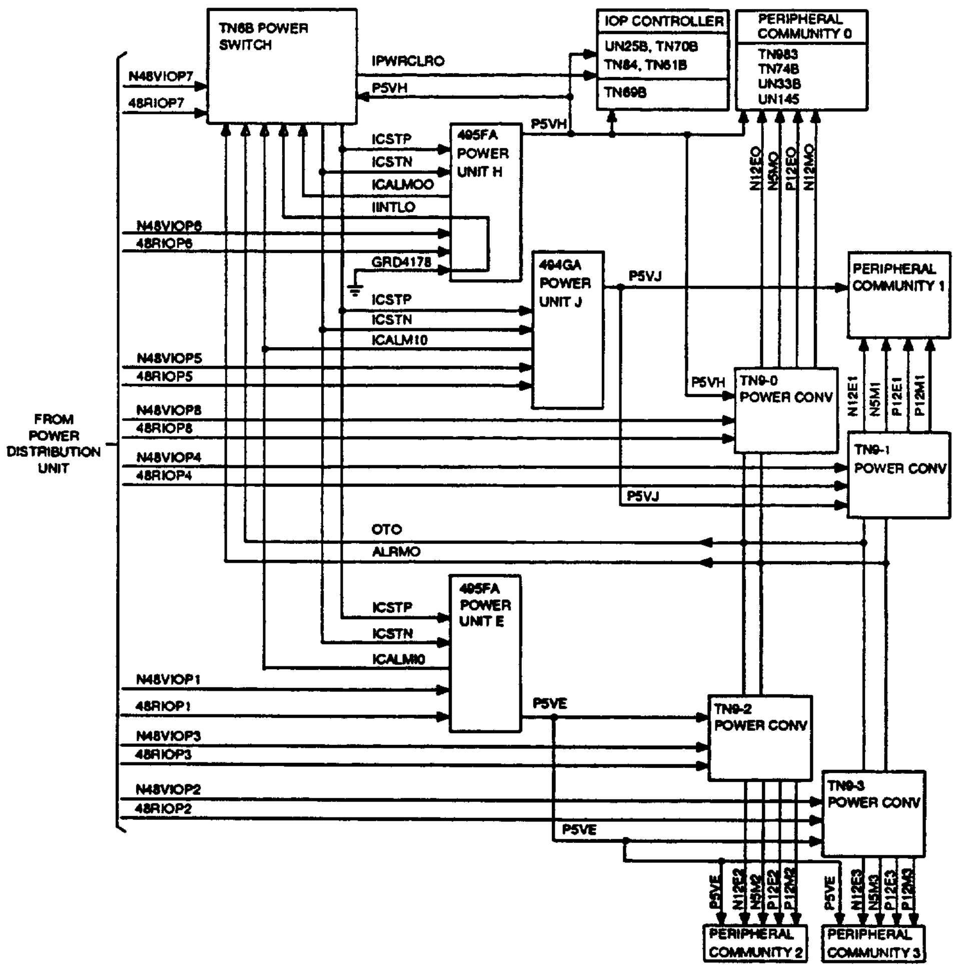


Figure 30. Input/Output Processor Power Distribution

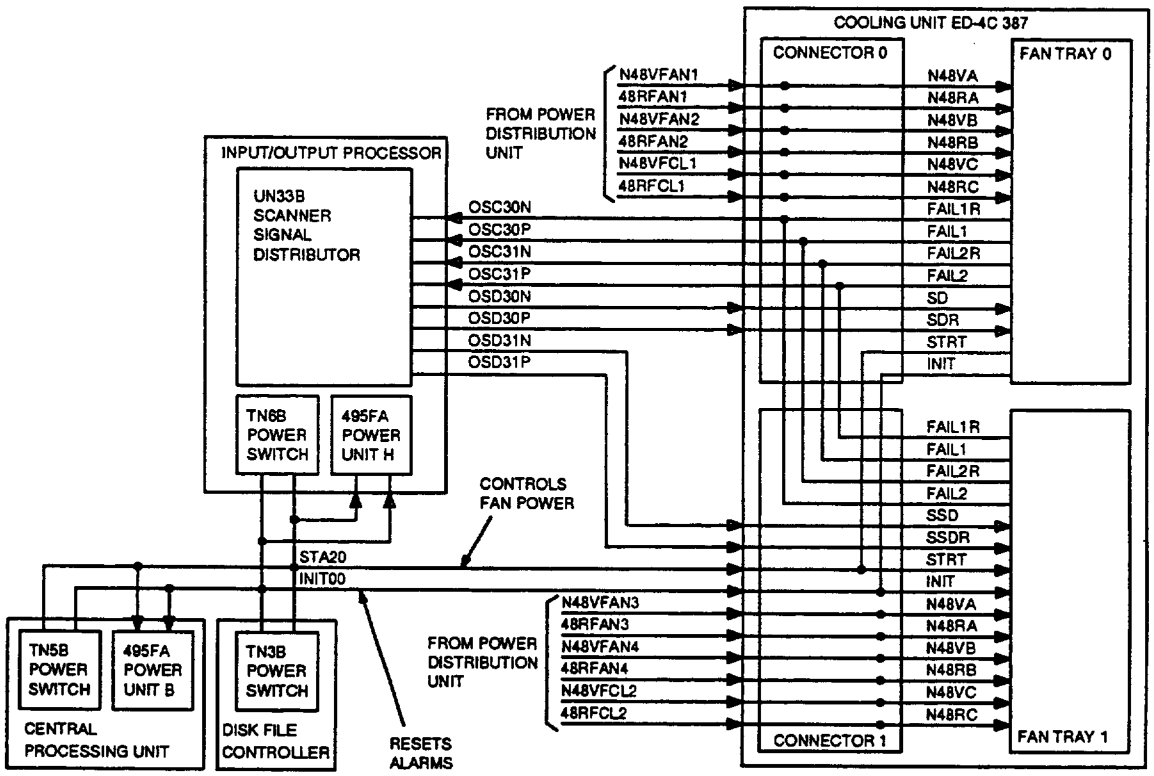


Figure 31. Cooling Unit Power Distribution

C. SCSI Disk Cabinet

SCSI Disk File Controller

4.18 When present, the SCSI DFC receives power from the power distribution unit within the SCSI disk cabinet. Except for the fuse arrangements, the power unit (495FA) and power switch (TN6B) operate identically to the SCSI DFC in the processor cabinet.

Cooling Unit

4.19 When the DFC is present in the SCSI disk cabinet, a cooling unit is required. The operation of the cooling unit is similar to the cooling unit within the processor cabinet.

SCSI Disk Unit Package

4.20 The SCSI Disk Unit Package (DUP) power distribution is shown in Figure 32. The SCSI DUP contains a power supply (CGG2), a power switch (CGG1), a disk drive, and a cooling fan. Input -48 V DC is fused at the power distribution unit at the top of the cabinet and routed to the DUP. Within the DUP, -48 V DC is provided to the CGG2 and CGG1 circuits. The power supply converts the -48 V DC to +5 V DC and +12 V DC which is routed to the disk drive and monitored by the power switch. The fan is also powered by +12 V DC and receives +5 V DC for a performance sensor. In the event of a fault, an alarm signal will be produced.

4.21 The power supply regulates the +5 V DC and +12 V DC. The power supply provides low input voltage protection, over-voltage protection, and output current limiting. In the event of a fault, the power supply will shut down and provide an alarm signal to the power switch.

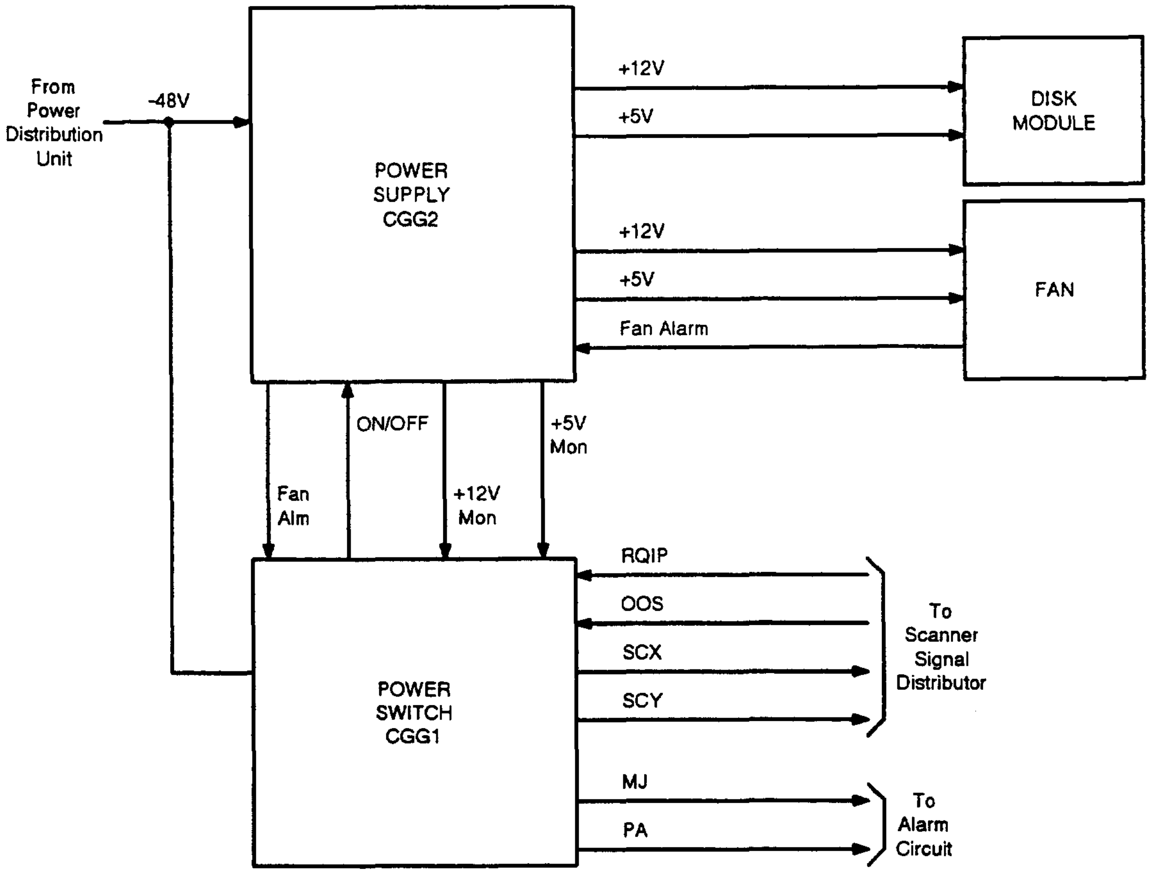


Figure 32. Disk Unit Package Power Block Diagram

D. Inverter Operation

2000VA Disk File Inverter

4.22 The 2000VA disk file inverter is a power conversion unit that changes -48 V DC to a 208 volt RMS (root mean square) pseudo-sine wave. The disk file inverter is used in conjunction with the power control unit. A block diagram of the disk file inverter and power control unit are shown in Figure 33.

Components of the disk file converter are:

- Inverter input and regulator
- Transformer and transformer drive

- Waveshaper (TM72)
- Output section
- Fan control
- Inverter control (TM482).

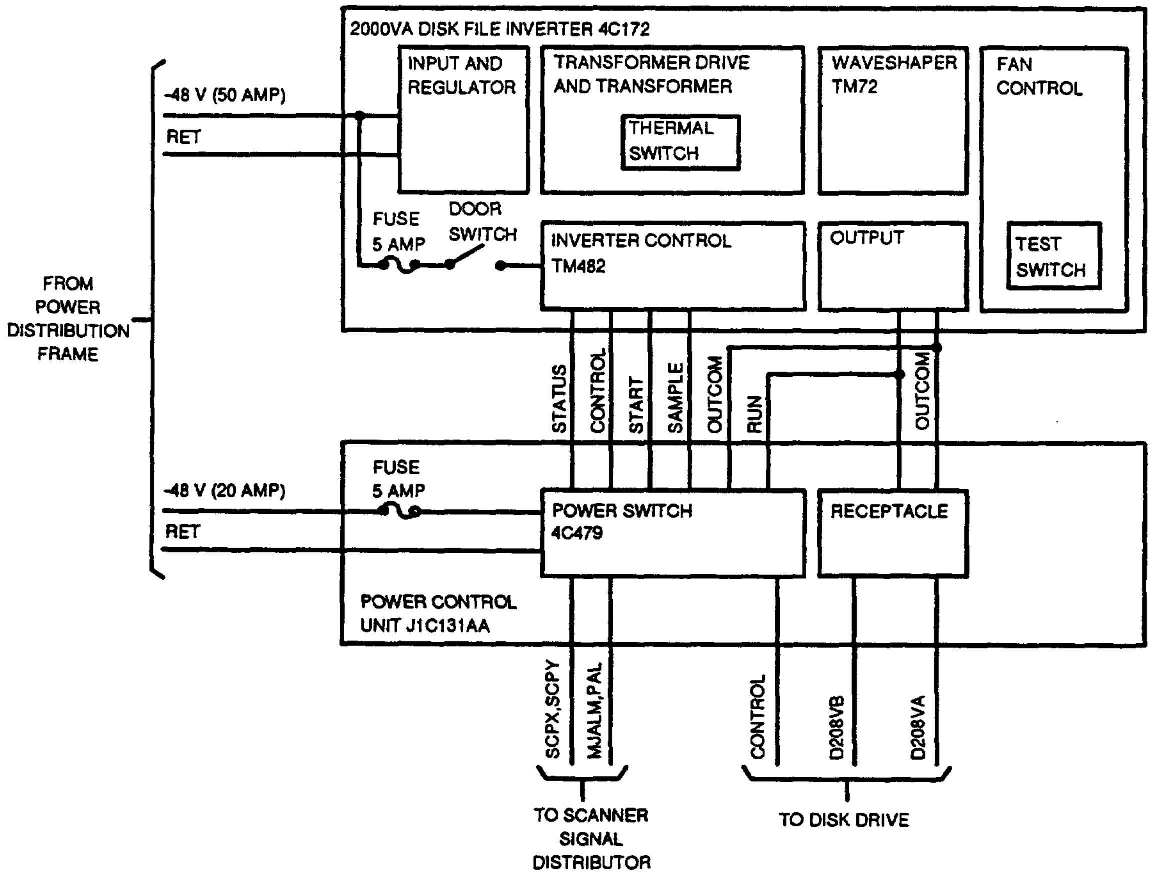


Figure 33. 300-Megabyte Disk Drive Power

4.23 The inverter input and regulator include the -48 V DC input connections, high-current rectifiers for the reflex regulator, and a filtering circuit. The transformer drive consists of level-shifting and amplifying circuits to drive the transformer. The transformer primary at 50 volts peak is stepped up to 300 volts peak on the secondary winding. Five taps on the secondary furnish 150 volt square waves as inputs to the waveshaper (TM72). Other taps on the secondary are stepped down for internal power. Under microcontrol, the waveshaper (TM72) generates a pseudo-sine wave from the square wave input by turning on rectifiers in a predetermined sequence. The inverter control (TM482) contains drive, clamping, and regulator circuits. It samples the output voltage, receives control signals from the power control unit, and monitors the DC fans. The DC fans will continue to cool after the disk file inverter has been turned off. The output section contains feed-through capacitors.

4.24 The fan control consists of an AC fan, a DC fan, and control circuitry. The AC fan cools the TM72 and TM482 circuit packs. The DC fan cools the main transformer and the remainder of the disk file inverter. The fan monitoring circuits will power down the disk file inverter and generate an alarm if the DC fan fails. A speed monitoring circuit is contained in the DC fan housing. If rotational velocity falls below 65 percent of rated speed for more than 10 seconds, detection circuitry will signal a low condition. This low condition is latched and will not reset until a power cycle occurs. A test switch in the fan control allows the alarm circuit to be tested. This switch, located behind the air filter, disables the fan motor as long as the switch is pressed. If the switch is pressed longer than 10 seconds, the fan speed detector will signal the fan failure condition. Release of the switch will restore the fan voltage; however, the alarm circuits will not reset until a power down occurs. The disk file inverter must be power cycled to reset alarms.

4.25 A thermal switch on the transformer secondary monitors temperature. This switch will close, initiate an alarm, and shut down the disk file inverter should an over-temperature condition exist. If the temperature decreases below the thermal switch reset point, the switch will open. The disk file inverter cannot be restarted until the thermal switch has reset; therefore, a cool down interval may be necessary.

4.26 The power control unit (see Figure 22) is an interface between the disk file inverter and the disk drive. It consists of a receptacle, a power switch (ED-4C479) and some discreet high-power components. Control signals from the power control unit to the disk file inverter consist of ON and OFF signals from the power switch, samples of the AC delivered to the disk drive, and disk drive status. Connections from the power control unit to the disk drive carry the two AC power leads, a ground lead, and leads to the spindle motor centrifugal switch, the main and start windings, and the start switch. A signal from the disk drive to the power control unit indicates that the disk drive has power. The power switch (ED-4C479) handles the standard manual inputs and software functions via scanner and signal distributor points.

Alarms

4.27 The power systems in the Model 2 and Model 3 computers generate major and minor alarms when a fault occurs. A power fault is indicated as follows.

- A lighted alarm LED on the faceplate of the unit power switch
- An audible alarm (when equipped by the application)
- An alarm output message on the receive-only printer
- A flashing, reversed-video alarm label on the maintenance terminal.

A. Processor Cabinet or Processor Control Frame

4.28 The power units in the processor cabinet or the processor control frame will generate an alarm signal for any one of the following reasons:

- Overcurrent alarm
- Programming bus alarm
- Overvoltage alarm
- Low-voltage alarm.

4.29 The overcurrent alarm is generated when a high-current fault causes a heavier-than-normal load on the power unit. The programming bus alarm is generated if the programmed current is much higher than the actual current drain, indicating a programming bus fault that renders the programming arrangement unreliable. The overvoltage alarm is generated if the output voltage exceeds 6 volts. The low-voltage alarm is generated if the output voltage falls below 3.3 volts.

4.30 In addition to generating an alarm, an overvoltage or overcurrent will cause a power unit shutdown to protect circuitry and wiring paths from possible damage. The power unit alarm signal is handled differently in the different units.

Control Unit

4.31 The control unit requires that certain power initialization signals be stable before power-up and after power-down. The TN5B contains logic to generate these signals as well as its own 48 V DC converter that powers this logic in the absence of power from the 495FA power unit. The control unit will respond to three alarm states: power unit alarm, power converter interlock alarm, and an initialization converter alarm. The power unit alarm and the interlock alarm will cause major alarms and shut down the control unit. The initialization converter alarm will cause a minor alarm if the initialization logic supply fails.

SMD Disk File Controller

4.32 The SMD disk file controller requires a -5 V power source for its disk interface circuits. This is provided by the -48 to -5 V DC converter on the TN3B power switch. The on/off cycling of this converter is synchronized with the DFC unit power cycling. The TN3B also contains a power monitor circuit for the -5V DC converter. If this converter fails, a major alarm is generated and the DFC is shut down. Failure of the DFC 495FA power unit C will also generate a major alarm and shut down.

SCSI-Disk File Controller

4.33 The SCSI-DFC uses a TN6B power switch. On detection of a power fault, an alarm condition will be asserted.

Input/Output Processor

4.34 There are several alarm conditions for the IOP. The local alarms and their actions are:

- Power unit alarm (controller and peripheral community 0) will cause a major alarm and will shutdown the IOP.
- Power unit alarm (peripheral communities 1, 2, and 3) will cause a major alarm but will not shutdown the unit.
- Reference alarm indicates that the TN9 voltage monitor circuits cannot be trusted due to a reference voltage failure. This will cause a major alarm.
- Out-of-tolerance alarm occurs when the TN9 detects that one of its power units is out of tolerance. This will cause a minor alarm.

Cooling Unit

4.35 All power switches in the processor cabinet or processor control frame are involved in controlling the cooling unit. Each power switch provides an initialization signal and a start signal to the cooling unit, where the signals are ORed together. Therefore, if all three functional units are off, the cooling units will also be off; if one or more units are on, the cooling units will be on. See paragraph 4.16 for a discussion of cooling unit alarms.

B. SCSI Disk Cabinet

Cooling Unit

4.36 The cooling unit provides an alarm capability similar to that of the processor cabinet cooling unit.

SCSI DFC

4.37 The SCSI DFC contained in the SCSI disk cabinet provides the same alarm capability as the SCSI DFC within the processor cabinet.

SCSI DUP

4.38 The SCSI DUP alarm capability has been described.

C. Power Cabinet or Power Distribution Frame

4.39 The alarm circuits for the power cabinet and power distribution frame are shown in Figure 34 and discussed in subsequent paragraphs.

Alarm Circuit ED-82949

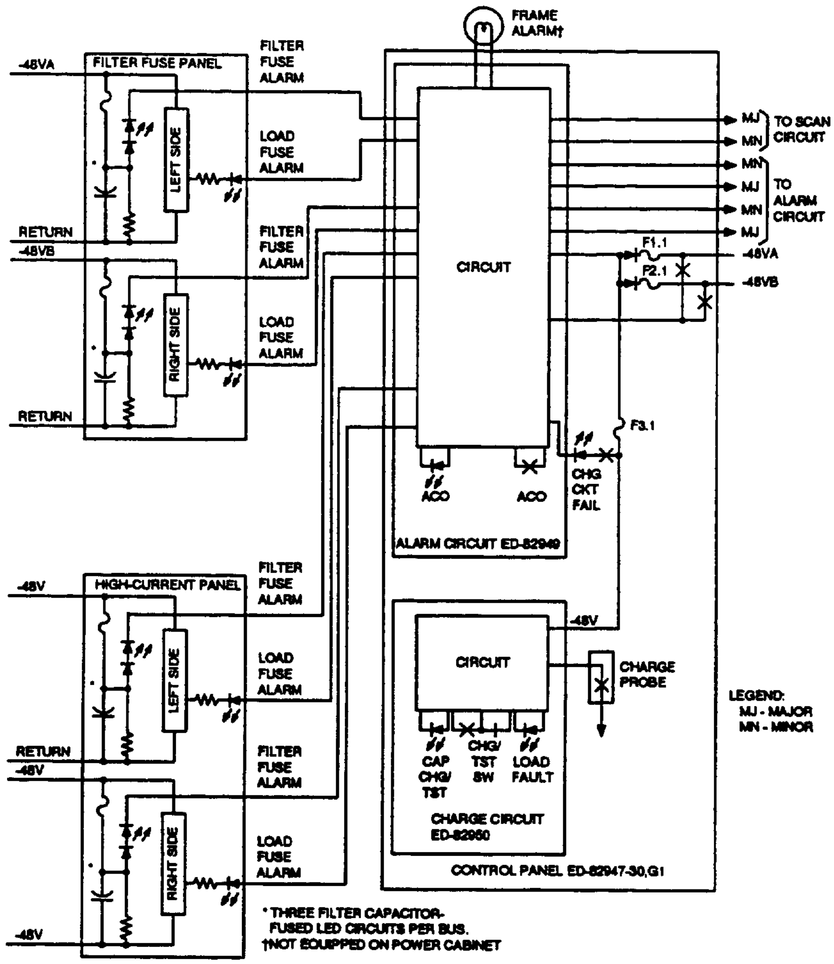


Figure 34. Power Distribution Alarms

4.40 A major alarm is generated when any of the load distribution fuses blow. Actually, the low-current indicator fuse in parallel with the load fuse generates the alarm signal. The major alarm signals are ORed to energize a relay on the alarm circuit pack. When the major alarm relay is operated, two sets of contact closures are provided: one set for office alarm use and one set for scan point monitoring. A major alarm is continuously generated from the alarm circuit pack until the fault is corrected or until the blown indicator fuse is removed. A major or minor alarm causes an incandescent lamp at the top of the power distribution frame to be lighted. (There is no equivalent lamp on the model 3 power cabinet.)

4.41 A minor alarm is generated when a filter capacitor fuse blows or when a fuse blows on the control panel. All of the minor alarm signals are ORed to the alarm circuit pack. A major or minor alarm causes a dedicated LED to light on the panel containing the fuse. Operating a minor alarm relay generates a contact closure to the scan point monitoring circuit.

4.42 The minor alarm may be turned off by momentarily pressing the alarm cutoff switch (ACO SW) on the alarm circuit pack. An ACO LED on the alarm circuit pack is lighted at the same time. A minor alarm may also be removed by correcting the source of the alarm. Fuses FF1 and FF2 on the control panel are ORed to provide -48 volt power to the plug-in alarm panel and the charge circuit board. The charge circuit board is protected by FF3. Fuses FF1 and FF2 contain a visual blown-state indicator only; should both fuses blow, the alarm generating and capacitor charging circuits will not function.

Capacitor Charging Circuit ED-82950

4.43 The capacitor charging circuit limits inrush current to individually precharge the input capacitance of each load protected by the 20-ampere fuses on the filter fuse panel. A pull-out charge probe (reel mounted) is used to precharge the 20-ampere fuse protected loads through the indicator fuse holder. A capacitor charge (CAP CHG) switch must be pushed to actually charge a load. Load and/or indicator fuses must not be installed until after the load is charged. The load fuse is installed first after charging, the charging probe is removed, and then the indicator fuse is installed. A CAP CHG TEST switch is pressed to test the circuit prior to inserting the charge probe in a fuse holder. The CAP CHG LED should light momentarily. This indicates that the charging circuit is functioning. When the probe is inserted, the CAP CHG TEST switch is pressed and its associated LED should light and then extinguish. On the same charge circuit panel, a LOAD FAULT LED will light after 30 seconds of charging (CAP CHG TEST switch pressed), which indicates that 2.5 amperes of charge current is being drawn from the charge circuit. Further charging should not be attempted. When charging a filter capacitor on the filter fuse panel, care should be taken to install the fuse (which has no indicator fuse) within 12 seconds after the CAP CHG LED is extinguished and the charge probe removed. The CHG CKT FAIL LED lights if the CHG CKT fuse blows.

4.44 The high-current fuse panel (not equipped on the Model 3 power cabinet) has provisions for up to four fuse blocks on each bus. See Figure 21. Each fuse block contains a load fuse and a plug-in indicator fuse visible from the front. A common alarm LED lights when one of the load (and indicator) fuses has blown. One of the six (three on each side) filter fuse LEDs lights to indicate that a filter fuse has blown. The charge circuit may be used to precharge the disk inverter load in the same manner as on the filter fuse panel. A spare fuse block that contains neither load nor indicator fuse is used. The spare fuse block is substituted for the fuse block to be charged and the charging probe is installed in the indicator fuse holder. The CAP CHG switch is pressed until the LED extinguishes; then the spare fuse block is removed, the original fuse block installed, and the indicator fuse installed. This must be accomplished in 12 seconds or the fuse will blow.

Frame Alarm

4.45 The frame alarm indicator panel contains four (two in parallel) incandescent lamps to indicate that a major or minor alarm is active. The lamps are energized via a ground from the alarm circuit pack and are lighted as long as an alarm condition exists in the power distribution frame. There is no equivalent circuit in the Model 3 power cabinet.

5. Abbreviations

5.01 The following abbreviations are used in this practice:

ACO SW	Alarm Cutoff Switch
ACOT	Alarm Cutoff/Test
ALM	Alarm
CAP CHG	Capacitor Charge
CPU	Central Processing Unit
DFC	Disk File Controller
DMA	Direct Memory Access
DUP	Disk Unit Package
I/O	Input/Output
IOP	Input/Output Processor
LED	Light-Emitting Diode
MAS	Main Store
MHD	Moving Head Disk
MOR	Manual Override
OOS	Out-Of-Service
POCS	Programmable-Over-Current-Shutdown
PS	Power Supply
PSW	Power Switch
RMS	Root Mean Square
SCSI	Small Computer Systems Interface
SMD	Storage Module Drive
VLMM	Very Large Main Memory

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