IBM Maintenance Information

MI	MI	MI	MI	MI	MI	MI	MI	MI	MI	MI
MAPs	MAPs	MAPs	MAPs	MAPs	MAPs	MAPs	MAPs	MAPs	MAPs	MAPs
START EXIT 00–02	04–0E 2X–4X	80–84	88 89	AX	AX	CX DX EX F1–F5	F7 00–69	F7 6A–B5	F7 B6–FF	F8 FC FD FE INDEX
VOL 01	VOL 02	VOL 03	VOL 04	VOL 05	VOL 06	VOL 07	VOL 08	VOL 09	VOL 10	VOL 11

MI	MI	MI	MI	MI	MI
STM	STM FEAT	STM FEAT	POWER	GSI	
LOC REM ADJ DIAGN 53 FD CONFIG	CA 5424	LA OP GUIDE PDG DIAGN CONFIG	INTROD. PRINCIP. DETAILS REP INFO REF INFO	INTRO MAINT DIAGN TOOLS FRIEND	INSTALL. MANUAL PARTS CAT. OP GUIDE PACK. INSTR.
VOL 13	VOL 14	VOL 15	VOL 16	VOL 17	VOL 18

IBM 4331 Processor Power

AFF0100

Power

EC 366493 26 Oct 81	EC 366582 13 Sep 82		P/N 4687034 Page 1 of 2	0 100 F

Preface

This manual contains information necessary for servicing and repairing the IBM 4331 Processor power complex.

The reader must have a basic understanding of IBM System concepts and he must have had CE-training on IBM 4331 Processor. This manual should not be used for self-education or for making changes within the machine.

Organization of the Manual

The manual is divided into sections.
The section 'Principles' contains a description of power components and functional principles.

The section 'Details' shows functional flowcharts, timing charts and simplified second levels. The second levels are FRU-oriented and provided to give an understanding of the FRU-functions. The second levels usually do not show voltage levels and certain hardware circuits (such as, inverters, drivers), which are not necessary to understand the function. If the CE needs more detailed information, he should refer to the ALD, using the ALD-references given in this manual.

Some pages of this manual are valid for Power Design Level 4 (PDL4) machines as well as for PDL5 machines. The main difference is PS103 which is installed in PDL4 machines only.
On common pages the differences between PDL4 and PDL5 are marked by symbols which are explained on the same page.
Please help us to improve this manual by giving your comments using the reader's comment form (last sheet of the manual).

Volume Table of Contents

Volume: 16
Title: MI POWER
Machine Type: 4331 - 2 / 4331 - 11
Power Design Level: 5
B/M Number 4331-2: 5683216
B/M Number 4331-11: 4687173

Safety Guidelines

If you are aware of the guidelines for working with electrical and mechanical equipment and practice these guidelines, you can work safely with this equipment.

You need not fear electricity, but you must respect it.

You should take every safety precaution possible and observe the following safety practices while maintaining IBM equipment.

1. You should not work alone under hazardous conditions or around equipment with dangerous voltage. Always advise your manager if this is a potential problem.
2. Remove all power before removing or assembling major components, working in the immediate area of power supplies, performing mechanical inspection of power supplies, or installing changes in machine circuitry.
3. Power supplies, pumps, blowers, motor generators, and other units with voltages which exceed 30V ac or 42.4V dc must not be serviced with power on when the unit is removed from its normal installed position within the machine, unless maintenance documentation clearly states otherwise. (This is done to ensure that proper grounding is maintained.)
4. Unplug the power supply cord whenever possible before working on the machine. The wall box switch when turned off should be locked in the off position or tagged with a DO NOT OPERATE tag (form Z229-0237). Be aware that a non-IBM attachment to an IBM machine may be powered from another source and be controlled by a different disconnect or circuit breaker.
5. When it is absolutely necessary to work on equipment having exposed live electrical circuitry, observe the following precautions:
   a. Another person familiar with power off controls must be in immediate vicinity. (Someone must be there to turn off power if it should become necessary.)
   b. Do not wear any jewelry, chains, metallic frame eyeglasses, or metal cuff links. (In the event of contact, there will be more current flowing because of the greater contact area afforded by the metal.)
   c. Use only insulated pliers, screwdrivers, and appropriate probe tibs/ extenders. (Remember, worn or cracked insulation is unsafe.)
   d. Use only one hand when working on energized equipment. Keep the other hand in your pocket or behind your back. (Remember there must be a complete circuit for electrical shock. This procedure helps eliminate a path that could complete a circuit through you!)
   e. When using test equipment, be certain that controls are set correctly and that insulated probes of proper capacity are used.
   f. Avoid contacting ground potential (metal floor strips, machine frames, etc.), use suitable rubber mats purchased locally if necessary.
6. Follow special safety instructions when working with extremely high voltages. These instructions are outlined in CEMs and the safety portion of maintenance documentation. Use extreme care when checking high voltage.
7. Avoid use of tools and test equipment that have not been approved by IBM. (Electrical hand tools [wire wrap guns, drills, etc.] should be inspected periodically.)
8. Replace worn or broken tools and test equipment.
9. After maintenance, restore all safety devices, such as guards, shields, signs, and ground leads. Replace any safety device that is worn or defective. (These safety devices are there to protect you from a hazard. Don't defeat their purpose by not replacing them at the completion of the service call.)
10. Safety glasses must be worn when:
    - Using a hammer to drive pins, etc.
    - Power hand drilling.
    - Using spring hooks, attaching springs.
    - Soldering, wire cutting, removing steel bands.
    - Parts cleaning, using solvents, chemicals, and cleaners.
    - All other conditions which might be hazardous to your eyes.
11. Never assume that a circuit is deenergized. (Check it first.)
12. Always be alert to potential hazards in your working environment (i.e., damp floors, nongrounded extension cords, power surges, missing safety grounds, etc.)
13. Do not touch live electrical circuits with the surface of the plastic dental mirrors. The surface of the dental mirror is conductive and can result in machine damage and personal injury.
14. Four steps that should be taken in the event of an electrical accident:
    a. USE CAUTION - DON'T BE A VICTIM YOURSELF.
    b. TURN POWER OFF.
    c. HAVE SOMEONE ELSE GET MEDICAL HELP.
    d. ADMINISTER RESCUE BREATHING IF VICTIM IS NOT BREATHING.
15. Do not use solvents, cleaners, or oils that have not been approved by IBM.
16. Lift by standing or pushing up with stronger leg muscles. This takes strain off back muscles. Do not lift any equipment or parts which you feel uncomfortable with.
17. Each customer engineer is responsible to be certain that no action on his/her part renders the product unsafe or exposes hazards to customer personnel.
18. Place removed machine covers in a safe out-of-the-way location while servicing the machine. These covers must be in place on the machine before the machine is returned to the customer.
19. Always place CE tool kit away from walk areas where no one can trip over it (i.e., under desk to table.)
20. Avoid wearing loose clothing that may be caught in machinery. Shirt sleeves must be left buttoned or rolled up above the elbow. Long hair and scarves must be secured.
21. Ties must be tucked in shirt or have a tie clasp (preferably non- conductive) approximately three inches from the end when servicing a machine.
22. Before starting equipment, make sure that fellow CEs and customer personnel are not in a hazardous position.
23. Maintain good housekeeping in the area of the machines while performing and after completing maintenance.
24. Avoid touching moving mechanical parts when lubricating, checking for play, etc.

Prevention is the key to electrical safety. You should always be conscious of electrical safety. Follow the Safety Guidelines and practice good habits such as:

- Making certain that the customer's power receptacle meets IBM equipment requirements.
- Inspect line cords and plugs. Check for loose, damaged or worn parts.
- Before removing a component which can retain a charge from the machine, review the procedure in the maintenance documentation. CAREFULLY discharge the necessary component exactly as directed by the service procedure.
- Do not use an ordinary lamp as an extension trouble light.

ANC0120

Safety Guidelines (continued)

Never assume anything about a machine or circuit. No machine is completely safe all the time. The exact condition of a machine may be unknown. Here are some of the reasons why:

- The power receptacle could be incorrectly wired.
- Safety devices or features could be missing or defective.
- The maintenance and/or modification history may be uncertain or unclear.
- A possible design deficiency could exist.
- The machine may have suffered transportation damage.
- The machine might have an unsafe alteration or attachment.
- An EC or sales change may have been improperly installed.
- The machine may have deteriorated due to age or environmental extremes.
- A component could be defective, creating a hazard.
- Some component of the machine may have been incorrectly assembled.

Relating to safety, these are some of the ways the condition of the machine can be affected. Before you begin a service call or procedure, exercise good judgement and proceed with caution.

Electrical Accidents

Administering First Aid

In implementing rescue procedures in an electrical accident, one must:

- *Use Caution* - If the victim is still in contact with the electrical current source, it may be necessary to use the room EPO (Emergency Power Off) or disconnect switch to remove the electrical current. If the EPO or disconnect switch cannot be located, use a dry stick or another nonconducting object to pull or push the victim away from contact with the electrical equipment.
- *Act Quickly* - If the victim is unconscious, he/she may need rescue breathing and possibly external cardiac compression if the heart is not beating.
- *Call Fire Rescue* (Rescue Squad, Emergency, Ambulance, Hospital, etc.) - Have someone summon medical aid.

Determine if the victim needs rescue breathing.

1. Make certain that the victim's airway is open and that it is not obstructed. Check the mouth for objects that may be blocking the airway such as gum, food, dentures or even the tongue. Position the victim on his back and place one hand beneath the victim's neck and the other hand on his forehead. Then lift the neck with one hand and tilt the head backward with pressure on the forehead from the other hand as shown in Figure 1.
2. Now you must *look, listen, and feel* to determine if the victim is breathing freely. Place your cheek close to the victim's mouth and nose to listen and feel for the exhaling of air.

Figure 1

At the same time, look at the chest and upper abdomen to see if they rise and fall. If the victim is not breathing properly, you should:

a. With the head in a backward tilt as shown in Figure 1, continue to exert pressure on the victim's forehead with your hand while rotating this same hand so that you can pinch the victim's nostrils together with the thumb and index finger (Figure 2).

CAUTION: Use extreme care when administering rescue breathing to a victim that may have breathed in toxic fumes. DO NOT INHALE AIR EXHAUSTED BY THE VICTIM.

Figure 2

b. Open your mouth and take a deep breath. Make a tight seal with your mouth around the victim's mouth and blow into the victim's mouth (Figure 3).

Figure 3

c. Remove your mouth and allow the victim to exhale while watching for the victim's chest to fall (Figure 4).

Figure 4

d. Repeat this cycle once every five seconds until the victim breathes for himself or medical help arrives.

Reporting Accidents

It is a CE's responsibility to report all electrical accidents, potential hazards, and "near miss" accidents to your field manager. Remember, a near miss accident might be the result of a design deficiency and prompt reporting will assure that the situation will be resolved quickly.
It's important to report even a minor shock since the conditions which caused it need only be varied slightly to cause serious injury.

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AAF 0500

Power INT

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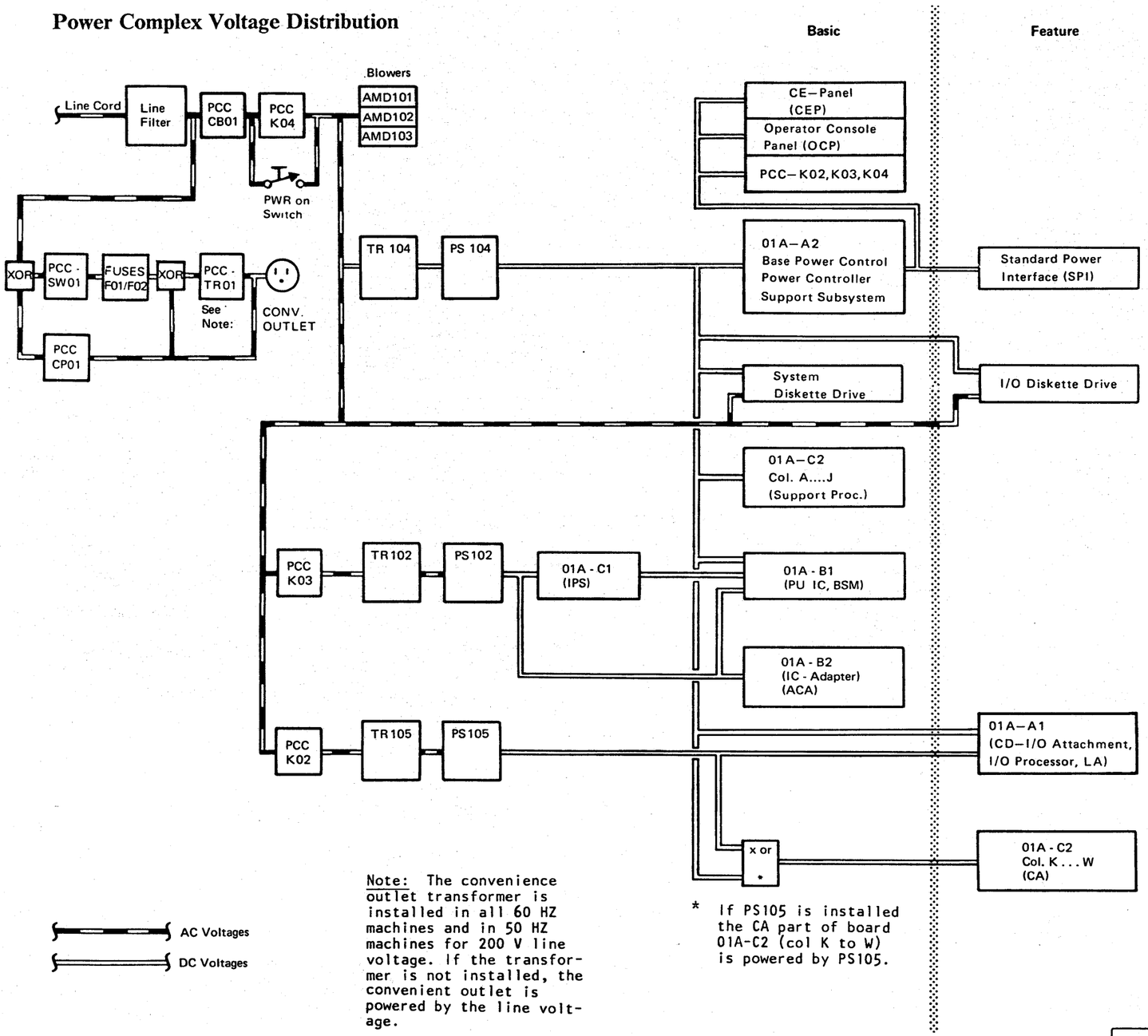
Power Complex Voltage Distribution



Note: The convenience outlet transformer is installed in all 60 HZ machines and in 50 HZ machines for 200 V line voltage. If the transformer is not installed, the convenient outlet is powered by the line voltage.

* If PS105 is installed the CA part of board 01A-C2 (col K to W) is powered by PS105.

All DC voltages used in the system are generated by three power supplies (PS102, PS104 and PS105).

PS104 is used to power up the support subsystem.

PS102 generates the input voltages for the integrated power system (IPS located in board 01A-C1) and the voltages used in logic boards 01A-B1 and 01A-B2.
PS105 is used for features located in board 01A-A1 and 01A-C2.

Each power supply receives its AC input voltage from its own transformer.
The transformer's line voltage input is controlled by contactors PCC-K04, PCC-K02 and PCC-K03.

Board 01A-C2 has a split voltage plane and receives DC voltages from PS104 if no PS105 is installed.

All DC voltages are continuously checked by hardware circuits or by a power controller, which is attached to a support processor. Power-on and power-off functions are controlled by the operation control program via the power controller.

Power Complex Data Flow

The main sections of the power complex are:

- Power supplies (PS)
- Basc power control (BPC)
- Power controller (PC)

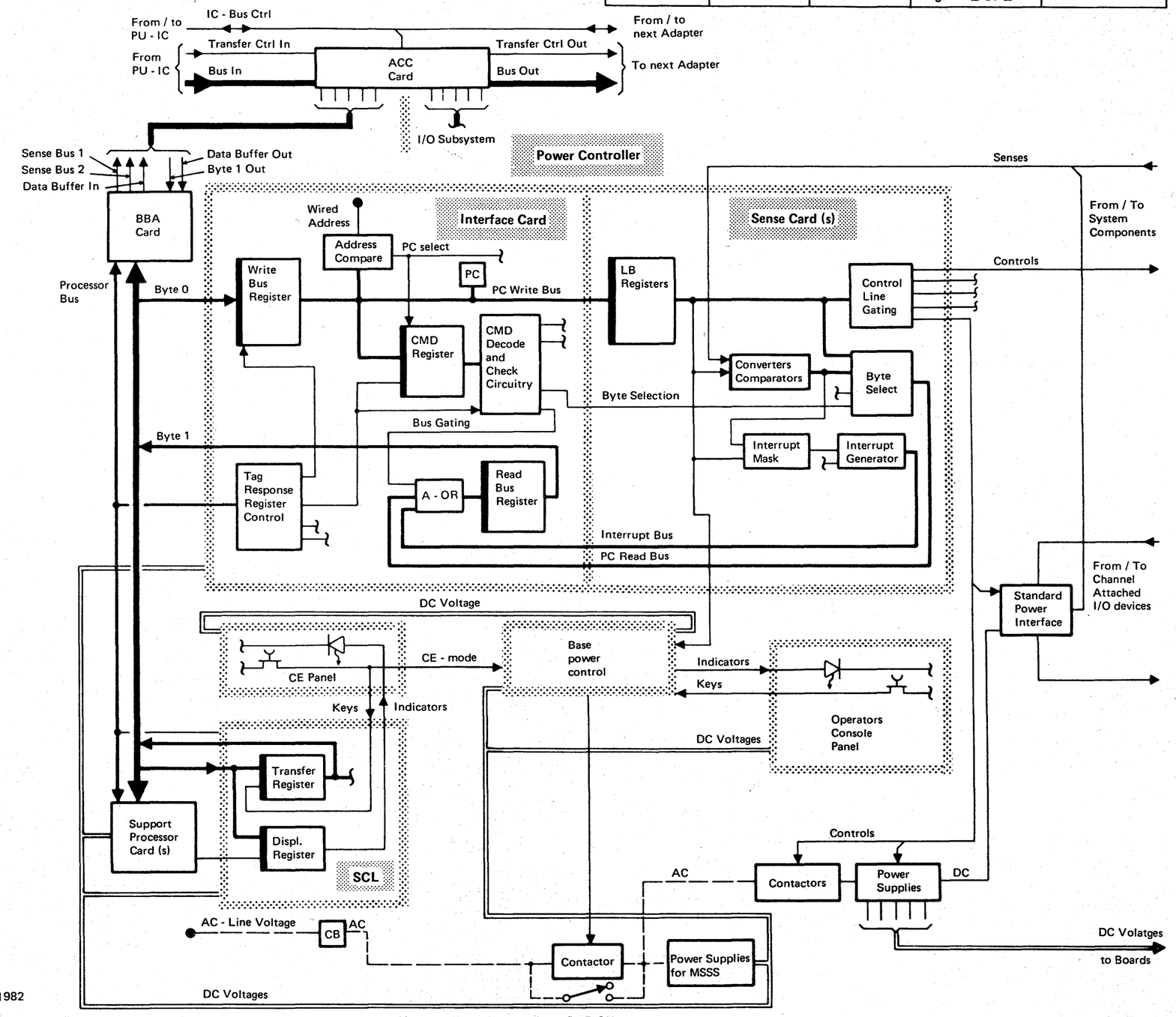
Keys, switches, and indicator lights are located on the operator console panel (OCP) and on the CE panel (CEP).

The BPC receives signals from the switches on the OCP, CCP, CEP, and from the power controller. The BPC performs a continuous voltage check for all voltages required for the maintenance and service subsystem (MSSS). Power on/off for the MSSS power supply is also controlled by the BPC.

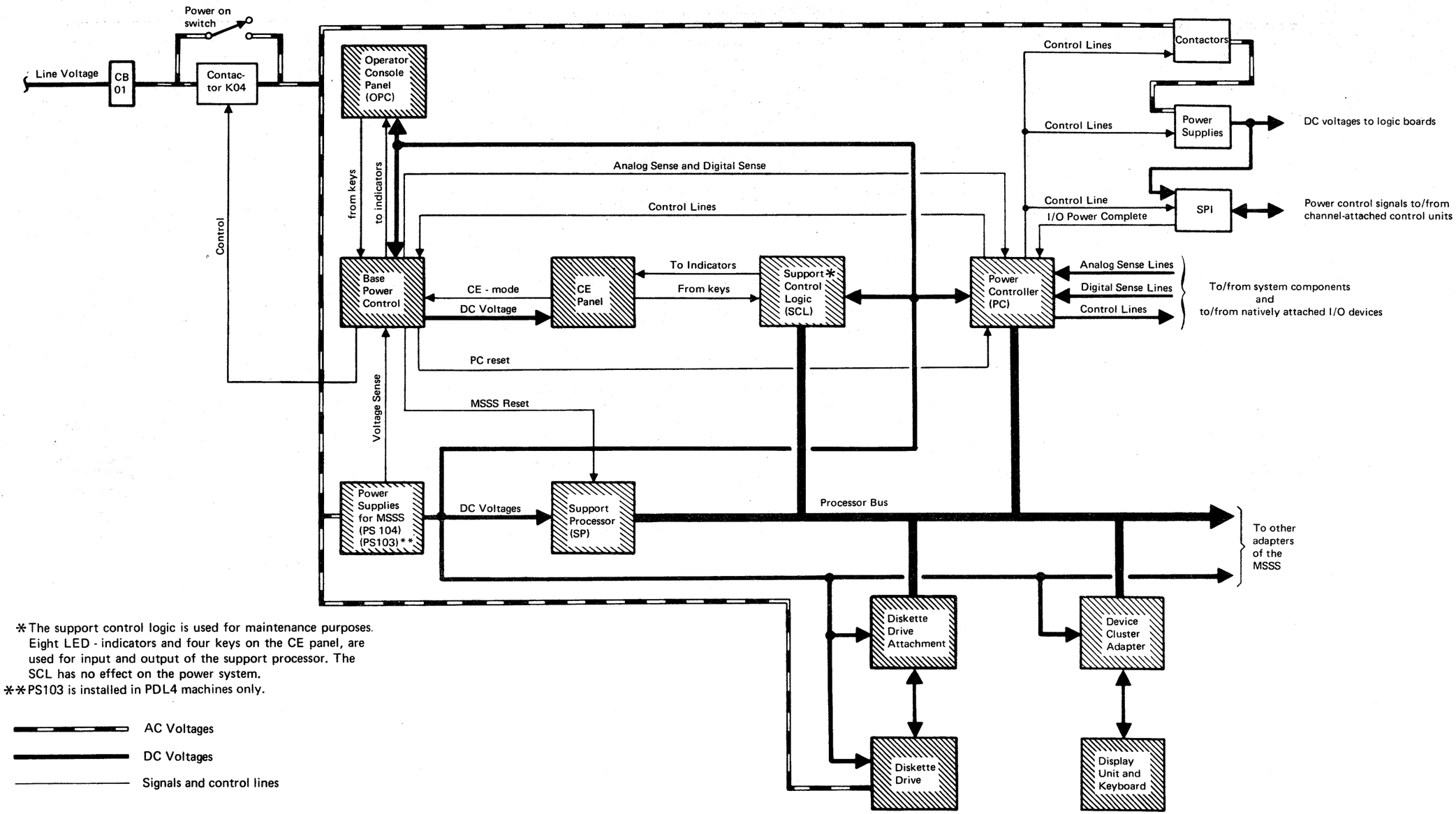
The power controller is attached to the support processor bus. The PC is an adapter, (one byte wide) used to control and monitor most of the functions of the power complex.

The PC consists of one interface card and 2 sense cards.

For more detailed information see corresponding pages of this manual.



Power Complex Operations



*The support control logic is used for maintenance purposes. Eight LED - indicators and four keys on the CE panel, are used for input and output of the support processor. The SCL has no effect on the power system.

**PS103 is installed in PDL4 machines only.

AC Voltages

DC Voltages

Signals and control lines

Description of Power Complex Functional Operations

The power complex consists of three main sections:

- Power supplies
- Base power control
- Power controller

Power Supplies (PS)

Two types of power supplies (PS) are installed:

a. Ferro-resonant transformers and rectifiers with capacitors. The DC output voltages are not adjustable.

b. Series regulators located in logic board 01A-C1 and therefore, are called integrated power system (IPS). The output voltages are adjustable.

Base Power Control (BPC)

The base power control consists of hardware circuits; it controls the power-on function of the power supply which generates all voltages used by the support processor and power controller. The BPC receives control signals from the operator console panel (OCP), the CE panel and the power controller (PC). Three of the indicators on the OCP are controlled by the BPC.

Power Controller (PC)

The power controller is an attachment that controls and monitors all functions of the power complex. The PC input consists of analog and digital sense signals from power supplies, BPC, contactors, and natively attached I/O devices.

The PC output are control lines to system components such as contactors, power supplies, BPC, and for attached I/O devices.

The PC is connected to the processor of the support subsystem via the processor bus. The operation control of the processor in the support subsystem addresses the PC and writes bit patterns into the control registers (latch bytes), or reads sense information from the sense registers. If a serious power failure occurs, the PC issues an interrupt request to the support processor; this causes its operation control to display a reference code on the CRT screen or to power down the system.

Power-On Sequence

The power-on switch on the customer control panel (CCP) must be pressed to start the power-on sequence. The power-on switch overrides the contacts of PCC-K04 and turns on the power supplies PS103 (if present) and PS104 that provides the voltages for the processor of the support subsystem and the power controller, and monitors these voltages continuously. The 'power incomplete' light on the OCP is switched on while the power-on sequence is running.

When the power supply for the support processor and power controller has been switched on and all output voltages are in tolerance, the BPC removes the reset signal to the SP and PC. The SP then starts a Basic Assurance Test to test its internal functions. After successful completion of the test, communications between the SP and the diskette drive adapter and the display unit are tested. If these communications are satisfactory, IML is started and the operation control program is loaded into SP storage.

Subsequently, an error action program, an interrupt handler program, a monitoring program, and a power controller test program are loaded and the PC is tested. If an error is detected, a reference code is displayed for quick reference to a MAP chart. If no error is detected, the PC test program is replaced by the power-on program which is executed next.

The monitoring program tests each power supply, that has been started for correct output-voltage levels. After successful execution of the power-on program, the PC activates the 'power complete' signal to the BPC and the 'power complete' light on the OCP is switched on.

During normal system operation, the SP operation control program performs a voltage tolerance check approximately every 256 ms. If an over or undervoltage occurs, the error action program determines whether the entire system or only part of the system is to be switched off; or whether only a warning message is to be displayed on the screen.
If the voltages from PS104 and PS103 (if present) are ok, MSSS keeps powered up and a reference code is displayed.

In case of an overvoltage condition of the Integrated Power System (IPS) at component damage level, a SCR is fired, which shorts the power supply output.

Power-off Sequence

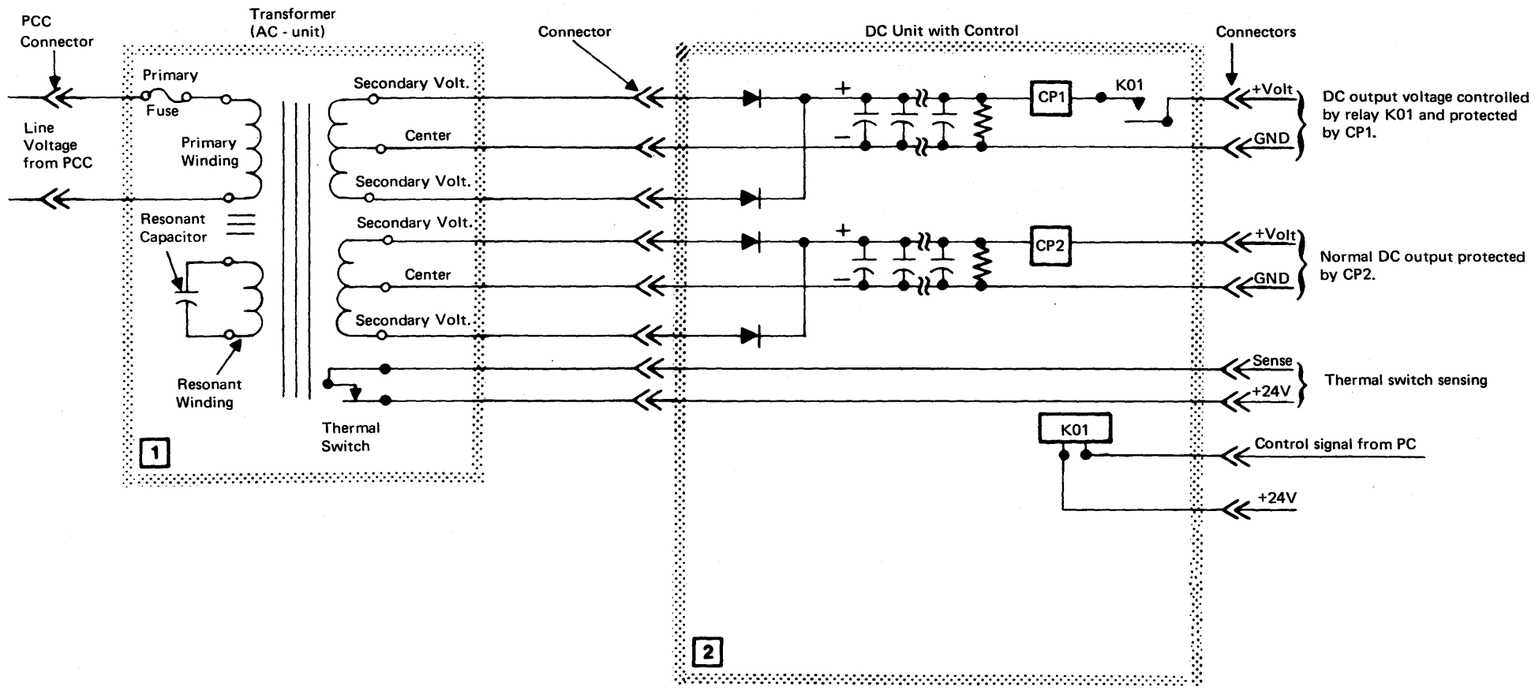
The power-off sequence is normally started by pressing the power-off key. Certain error conditions may also initiate the power-off sequence. The power-off sequence is program controlled.

If serious machine errors occur or if components are in danger of being damaged, the power is switched off without sequencing. A malfunction during the power-off sequence will cause an immediate power off without sequencing. The basic check indicator will be switched on after error detection, if possible.

Reactive Power Compensator (RPC)

In order to meet the requirements for single phase line connection, some 4331-2 machines are equipped with a Reactive Power Compensator. The RPC is a capacitor assembly, mounted to the back of the PCC box and connected to connector PCC-09 (see also page 4000 of this manual).

Ferro- Resonant Power Supply



All power supplies within the system, except the IPS are Ferro resonant power supplies. Each power supply consists of an AC-unit (ferro resonant transformer) and a DC-unit with control section.

1 The Transformer converts the input voltage (line voltage or primary voltage) to various output voltages (secondary voltages). In order to keep the output voltage within the specified limits the transformer has a resonant winding with a capacitor. To prevent overheating,a thermal switch is installed inside the transformer. Opening of the thermal switch is sensed by the PC. The operation control program will drop the line voltage input to the transformer. In case of a short circuit or overload the primary fuse will blow.

2 The DC-unit is plugged by connectors to the transformer. The AC voltages from the transformer are rectified by diodes and smoothed by capacitors. The DC output voltages may be controlled by contactors and are protected by circuit protectors (CPs) or fuses.

All cables to the load and control lines, as well as to the sense lines, are pluggable (for quick removal). The only exception are FDS cables which are connected to terminal blocks by screws.

Important Note:
Never operate a Ferro Resonant Transformer with DC unit disconnected. Ferro Resonant Transformer will be damaged.

Integrated Power System

The integrated power system (IPS), located on board 01A-C1; generates the different voltages used for the PU, IC, and BSM. The voltages generated by the IPS are: +4.26V, -6.54V, -4.34V and -1.52V. Power on and power off is controlled by remote start signals from the power controller. Each voltage is generated by one or more (load-dependent) pluggable power modules with SMS sockets. A principle of IPS voltage interconnection is shown on this page and on ALD-YA041.

Power Modules

The power modules are series regulators with two heatsink-mounted power transistors. They are controlled by circuits located on the control cards.

Control Cards

Each voltage has its own control card with SLT socket; the control cards are located on the right of the power modules. They contain additional circuits for overvoltage (OV), undervoltage (UV) and overcurrent (OC) detection. The error signal OV is latched on the card and activates a digital sense line to the power controller. The UV digital sense lines generate an interrupt request to the support processor, via the power controller and starts a timeout circuit on the PC sense card. The operation control program branches to the interrupt handler and to the power-error action program. If the PC interrupt request is not handled within 36ms, the timeout circuit on the PC sense card switches off the system without power-off sequence. The MSSS keeps powered up.

Overvoltage Protection (Crowbar / Sense Card Assembly)

Protection circuits are installed to prevent component damage of the logic circuits in the event of overvoltage from a power module. The protection circuit consists mainly of a silicon controlled rectifier (SCR) for every IPS-generated voltage. If an overvoltage condition of an IPS-generated voltage is detected by the protection circuits, the corresponding SCR is fired to shorten the IPS output. This may blow the corresponding fuse in PS102 and will cause UV and OC detection by the IPS control card. To prevent damage to the power module, if no fuse of PS102 is blown, the power module operates in current limit mode after the SCR has fired. The protection circuit with the SCR, called IPS crowbar/sense card assembly, is located behind the IPS test station on board 01A-C1.

Voltage Adjustment and Jumpering

Each IPS voltage can be adjusted by a potentiometer on the corresponding control card. Voltage adjustment is done with the aid of the voltage measurement program. When control cards have been exchanged, the IPS voltage controlled by this card must be adjusted. All power modules and all control cards are interchangeable. The necessary jumpering for voltage and overcurrent limit (called personalization) is done by board wiring. No additional jumpering is required for card replacement.

Test Station

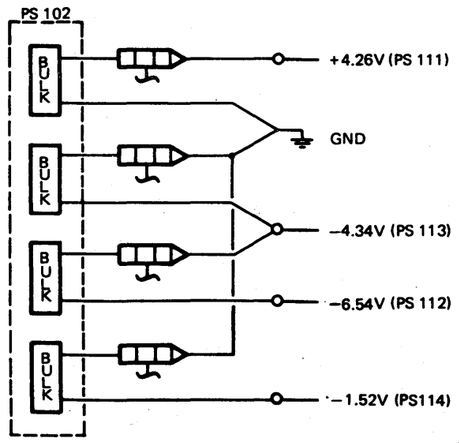
For power module and control card testing, an IPS-test station is available. The test station is located at the left side of board 01A-C1 and is powered by PS104.

If an IPS power problem is suspected, plug the power module and the corresponding control card into the IPS test station and carry out the procedure shown under MAP 0280. For more detailed information on the principle of interconnection of IPS and on voltage levels with reference to ground, see figure on this page or refer to ALD YA041.

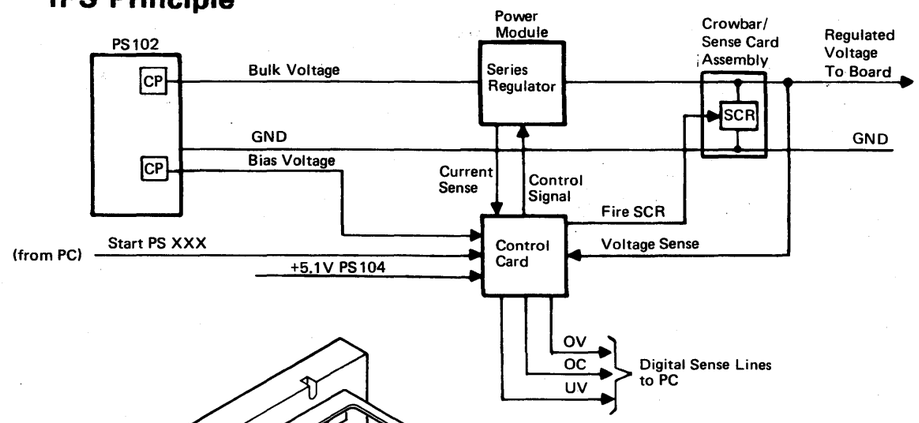
Power-on Sequence

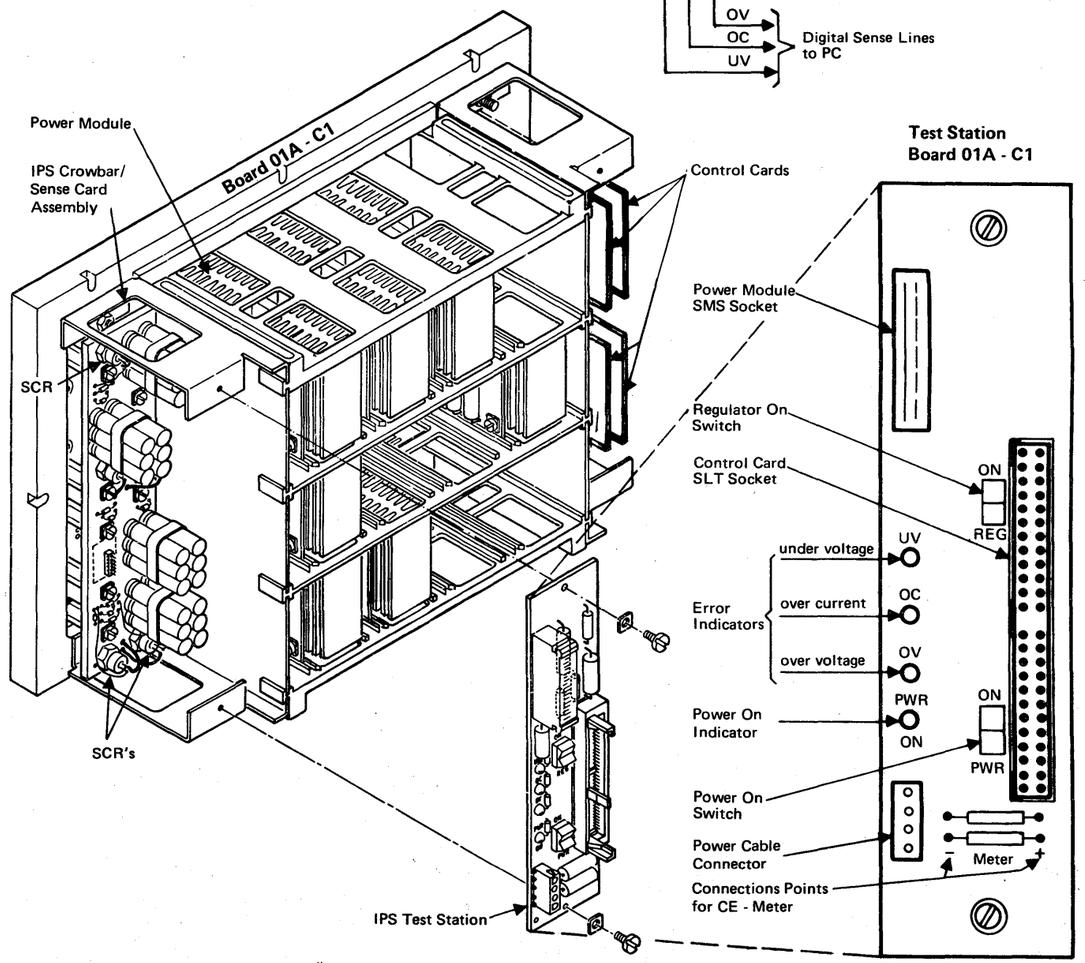
PS111 (+4.26V) is started in two steps. Step 1 generates an output of approximately 1.0V DC. The second step increases the output voltage to its final level. For more detailed information see 'Power On Sequence via PC' in this manual.

IPS Voltage Interconnections



IPS Principle





Analog Measurement

Analog data (voltages) [1] is measured by the power controller with the aid of a digital analog converter (DAC) [2] and comparators [3] on each sense card.

The analog data to be sensed is normalized to 1.5V by voltage dividers [4] . If the sensed voltage is equal to the nominal voltage, the output of the voltage divider is 1.5V. If the sensed voltage is higher or lower than the nominal voltage, the normalized voltage will also be higher or lower than 1.5V. The positive or negative normalized voltages from the voltage dividers are compared by the comparators with the positive and negative voltages from the DAC [5] . The actual positive and negative voltages from the DAC are determined by the bit configuration which was previously written into register 3 by the support processor [6] .

Each binary DAC input will generate a positive and negative DAC output. Both outputs have the same voltage level with reference to ground and are available at the same time. [5]

There is a fixed relation between the digital DAC input and the analog DAC output.

Example: The digital DAC input C8 represents 100 percent nominal voltage = 1.5 V DAC output voltage.

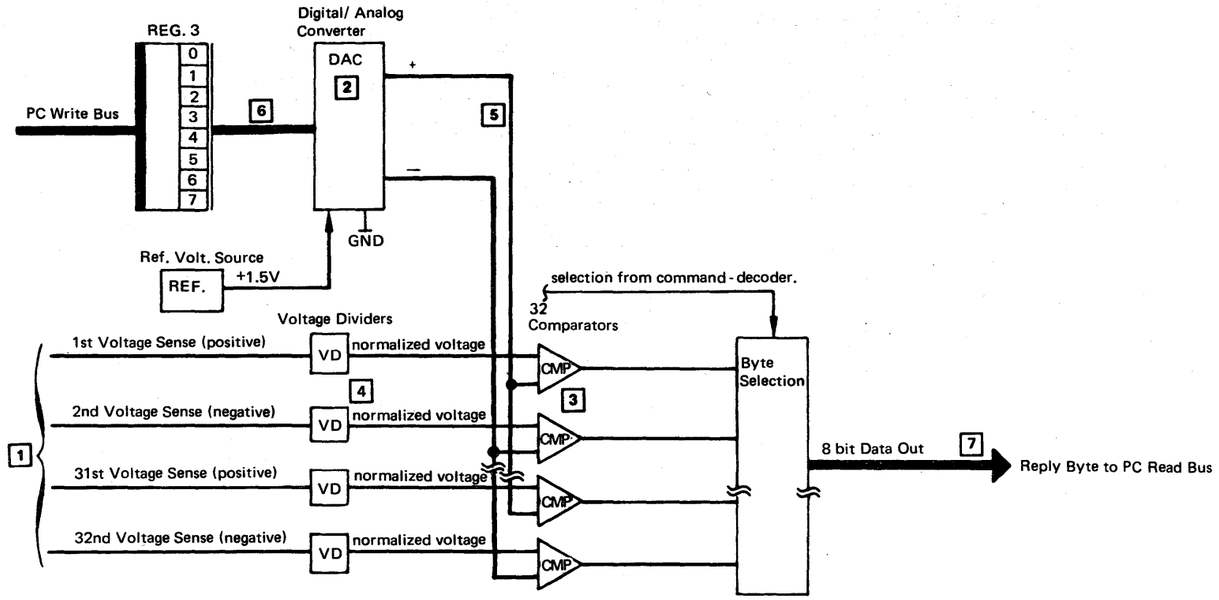
To determine the actual value of a voltage, a string of comparisons with different DAC settings is necessary. The result of each compare, the reply byte, [7] is read and analyzed by the support processor's operation control program. The SP operation control program also determines the next DAC setting. The first two measurements in the example on the right check the specified tolerance limits of +/-4 percent. This procedure is used for the voltage monitoring routine.

The Measurements No. 3 through 17 are used by the voltage measurement program.

To ensure proper function, a DAC test is performed during every power-on test.

-5V from PS104 are measured by every DAC and the results are compared.

If there is a deviation which cannot be accepted by the operation control program, a reference code will be displayed on the screen.

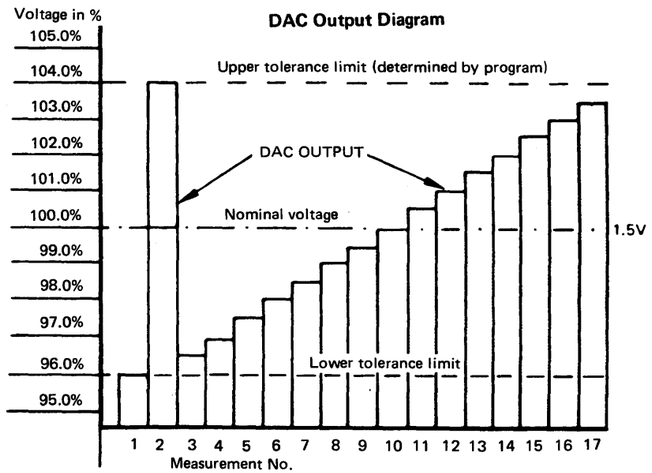


Analog Measurement Example

actual System voltage in %	97	103	95	100	105	100	101.5	98.5
Reply byte (comparator output)	0	1	2	3	4	5	6	7

Meas No.	DAC Input [6] Hex	Binary	% Nom Voltage	Reply Byte [7] 0 1 2 3 4 5 6 7	Remerks
1	C0	1 1 0 0 0 0 0 0	96.0	1 1 0 1 1 1 1 1	All Voltages, except No. 2 > 96%
2	D0	1 1 0 1 0 0 0 0	104.0	0 0 0 0 1 0 0 0	All Voltages, except No. 4 <104%
3	C1	1 1 0 0 0 0 0 1	96.5	1 1 0 1 1 1 1 1	
4	C2	1 1 0 0 0 0 1 0	97.0	0 1 0 1 1 1 1 1	Voltage No.0 = 97%
5	C3	1 1 0 0 0 0 1 1	97.5	0 1 0 1 1 1 1 1	
6	C4	1 1 0 0 0 1 0 0	98.0	0 1 0 1 1 1 1 1	
7	C5	1 1 0 0 0 1 0 1	98.5	0 1 0 1 1 1 1 0	Voltage No.7 = 98.5%
8	C6	1 1 0 0 0 1 1 0	99.0	0 1 0 1 1 1 1 0	
9	C7	1 1 0 0 0 1 1 1	99.5	0 1 0 1 1 1 1 0	
10	C8	1 1 0 0 1 0 0 0	100.0	0 1 0 0 1 0 1 0	Voltages No.3 and No.5 = 100%
11	C9	1 1 0 0 1 0 0 1	100.5	0 1 0 0 1 0 1 0	
12	CA	1 1 0 0 1 0 1 0	101.0	0 1 0 0 1 0 1 0	
13	CB	1 1 0 0 1 0 1 1	101.5	0 1 0 0 1 0 0 0	Voltage No.6 = 101.5%
14	CC	1 1 0 0 1 1 0 0	102.0	0 1 0 0 1 0 0 0	
15	CD	1 1 0 0 1 1 0 1	102.5	0 1 0 0 1 0 0 0	
16	CE	1 1 0 0 1 1 1 0	103.0	0 0 0 0 1 0 0 0	Voltage No.1 = 103%
17	CF	1 1 0 0 1 1 1 1	103.5	0 0 0 0 1 0 0 0	Voltage No.4 >103.5%

The voltage number used in the table above corresponds to bit number in the reply byte.



Thermal Switches

Thermal Switches

Thermal switches are installed to prevent component damage as result of overheating.

Thermal switches are located on top and bottom of the boards, columns A, B, and C, and inside the windings of the ferro resonant transformers (see) physical locations on page 7050).

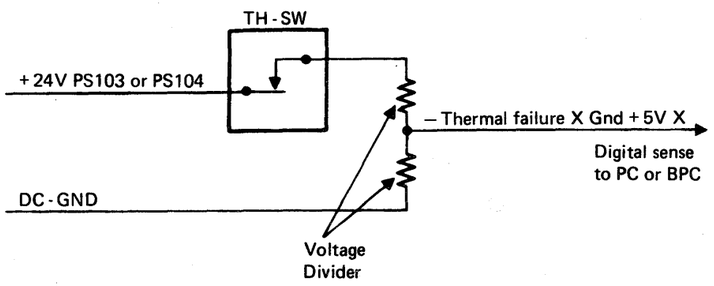
The thermal switches are monitored by the operation control program via the power controller (see page 4000).

Six thermal switches of board columns A, B, and C, and 2 thermal switches on top of the ferro stacks are wired in series. Opening of one or more switches will activate a digital sense line to the power controller.

Indicating type thermal switches are installed. After opening of the contact, the red indicator sticks out of the housing. The electrical contact closes after overheating condition disappears, but the red indicator must be reset manually by the CE to allow correct indication for the future.

The thermal switches are connected as shown below.

One additional thermal switch (TH-SW 109) for a lower temperature than all other thermal switches is installed on top of gate 01A. Opening of this switch initiates an ambient log (Reference code with unit type E8. These reference codes are not displayed on the operator console.) The normal machine performance is not affected by TH-SW 109.



EMC Hardware

To achieve the excellent EMC performance the following techniques have been used:

1. High quality shielding of the processor's housing by conductive paint on the machine frame and conductive gaskets in covers to provide continuous contact between machine frame and machine covers.

2. Special design of all cable entries for continuous screening of these sensitive areas.

3. Grounding of all external cable shields next to the I/O connector.

4. Line filter at power cord entry.

5. Shielded MFCU DC-common cable.

6. Grounding of coax cables for display terminals and native printers at the connector plate.

7. Plated connectors for standard interface cables (MPX, BMPX, FTA) and for the MFCU interface cables.

   Important: Connector blocks for the MFCU are not interchangeable with other connector blocks. Otherwise MFCU interface signals will be grounded.

8. Metallic dummy blocks (fillers) are installed in unused I/O interface connector positions.

9. Ground strap from gate 01A (hinge side) to machine frame.

10. Metallic gate cover to screen the gate area.

11. A ferrite core on the MFCU signal flat cables.

Violation of one or more of the above listed items may degrade the machine EMC quality.

EMC Check List

If electrostatic discharge (ESD) phenomena are suspected to cause machine malfunction, the following points have to be checked:

1. Cover gasket must have sufficient contact to the machine frame. There should be no gap. The covers must be adjusted to get a good ground contact.

2. The gate cover must be installed.

3. The shields of all external cables must be grounded next to the cable entry. The ground leads (usually with slip on connectors) must be as short as possible. Check each cable.

4. Aluminium plated connectors must be installed for the standard interface (MPX, BMPX), and for FTA interface. The plating quality may be significantly degraded by climatic stress (dark surface of plating material). Perform a visual inspection.

   Connector blocks for the MFCU are not interchangeable with other connector blocks. MFCU interface signals will be grounded if other connector blocks are used for the MFCU. MFCU connector blocks have no red dots at the short side.

   Metallic dummy blocks (fillers) must be installed in each unused I/O interface connector position.

   Ensure that a sufficient contact exists between all connector blocks and dummy blocks (if present) if the cover of gate 01D is closed.

5. Ensure that the screws of the ground strap between gate 01A (hinge side) and machine frame are tight.

EMC Grounding

EMC design has not been based on particular grounding requirements.

In case of abnormal noise coupling through power cables or signal cables from other electrical equipment, special grounding provisions may present a solution. Support from an EMC specialist should be requested.

ESD Monitor

Note: Not all machines have the ESD monitor installed. If no ESD monitor card is installed in position 01A-A2A5 the current ESD sense level must be set to zero (see 'Ambient Recording Log Display' in this book).

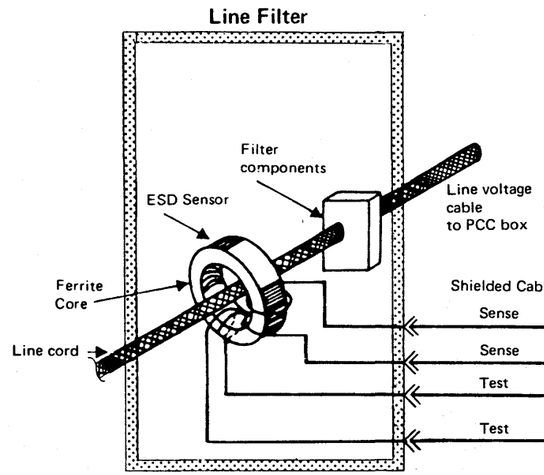
The ESD monitor is used to detect electrostatic discharge (ESD) signals and power line transitions (PLTs) that may cause system malfunction. The error information is sensed by the power controller and logged on the diskette. The logged error records are accessible to the CE.

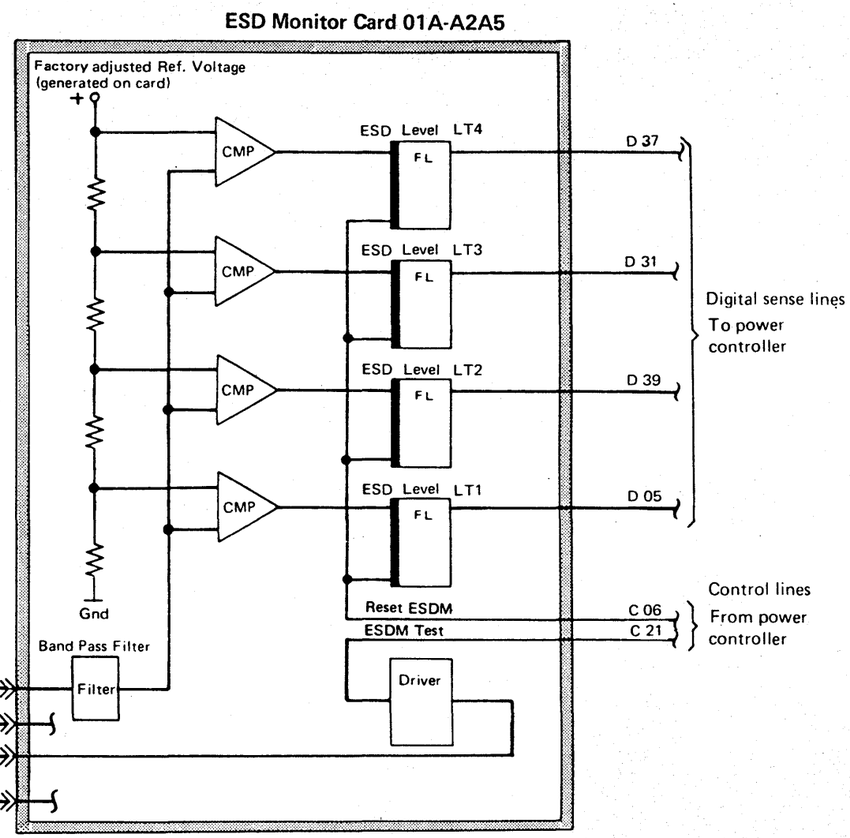
A current probe is installed inside the line filter. A spike on the line cord caused by ESD or PLT, generates a pulse on the winding of the ferrite core. The pulse passing the band-pass filter is available at the input of four comparators with different predefined switching levels. The switching levels of the comparators are determined by the factory adjusted reference voltage. The reference voltage adjustment must not be changed in the field. The relation of the ESD sense levels is shown in the table. Depending upon the amplitude of the pulse, one or more (up to four) comparators will generate an output signal. Each comparator output will set its corresponding ESD latch.

Example: A discharge magnitude of level 1 will set only one latch while a discharge magnitude of level 4 and above will set all four latches.

Each output signal of an ESD latch activates a digital sense line. The operation control program of the support processor reads the status of the ESD latches via the PC sense card and resets the ESD latches. The ESD incident information is added to the ambient log area if the sensed information exceeds the predefined ESD sense level (see description of ambient logs in this book).

ESD Latch No.	Digital Sense Line	ESD Senstivity
1	D 05	times 3.0
2	D 39	times 1.5
3	D 31	normal
4	D 37	times 0.6





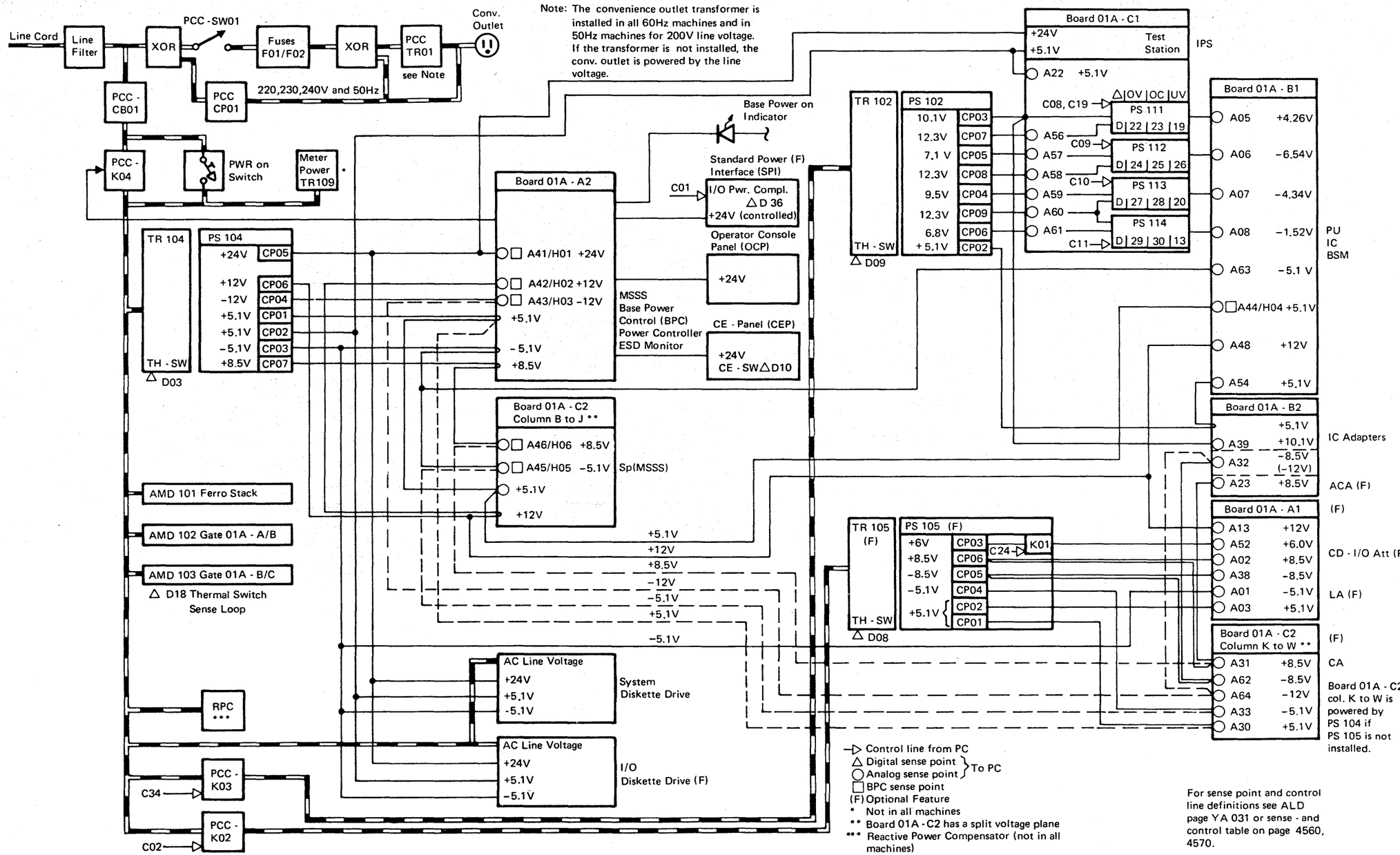
EB x x x x 01

- 0 = No ESD incident
  1 = ESD incident level 1
  2 = ESD incident level 2
  3 = ESD incident level 3
  4 = ESD incident level 4
- 0 = No ESD latch failing
  1 = ESD latch 1 missing
  2 = ESD latch 2 missing
  3 = ESD latch 3 missing
- 0 = No ESD hardware failure
  E = ESD hardware failure Note 1
- 0 = No temperature incident
  F = Temp. exceeded upper limit
  B = Temp. went back to normal

Note: A hardware failure exists, if for a certain ESD level any of the lower ESD level latches is not on.

A driver circuit located on the ESD monitor card is used for testing. The driver is controlled by the SP operation control program via the power controller.
The total function of the ESD monitor, is tested by the power-on-test 8. Reference codes generated by power-on test 8 have the following format: F708xx81.

Power Distribution



Sense Points and Voltage Tolerances

PS	NOMIN. VOLT.	SENSE LINE	SEE NOTE	SENSE POINT ON BOARD. NOMINAL VOLTAGE	SENSE POINT ON CARD. NORM.VOLT.1.5V	ADDR. AND BIT	CALL CE VOLTAGE Lo	CALL CE VOLTAGE Hi	TURN-OFF, NORMAL Lo	TURN-OFF, NORMAL Hi	TURN-OFF, CE-MODE Lo	TURN-OFF, CE-MODE Hi	TURN-ON TIME Lo	TURN-ON TIME Hi
102	+ 5.1	A54		01A-B1B4-A04/A06	01A-A2D2-S05	97-2	4.5	5.5	4.0	5.6	4.0	5.7	4.0	5.7
	6.8	A61	1	01A-C1B4-B10	01A-A2D2-D05	87-7	---	---	---	---	---	---	4.3	9.5
	7.1	A57	1	01A-C1B4-B13	01A-A2D2-B11	87-1	---	---	---	---	---	---	4.3	9.5
	9.5	A59	1	01A-C1B4-B03	01A-A2D2-D06	87-6	---	---	---	---	---	---	8.2	12.1
	+10.1	A39		01A-B2B2-E14	01A-A2D2-B06	85-6	8.0	11.4	7.0	12.2	6.0	12.8	6.0	12.8
	12.3	A56	1	01A-C1B4-D05	01A-A2D2-D12	87-3	---	---	---	---	---	---	9.8	14.5
	12.3	A58	1	01A-C1B4-D02	01A-A2D2-B09	87-4	---	---	---	---	---	---	9.8	14.5
	12.3	A60	1	01A-C1B4-D07	01A-A2D2-D07	87-5	---	---	---	---	---	---	9.8	14.5
104	- 5.1	A45		01A-C2B3-E01	01A-A2D2-S04	97-1	4.5	5.5	4.0	5.7	3.0	5.8	3.0	6.4
	- 5.1	A33 *(F)	3	01A-C2W3-E01	01A-A2D2-S03	97-5	4.5	5.5	4.0	5.7	3.0	5.8	3.3	6.4
	- 5.1	A01 (F)	2	01A-A1H6-B02	01A-A2D2-P13	97-6	4.5	5.5	4.0	5.7	3.0	5.8	3.0	6.4
	+ 5.1	A22		01A-C1B4-D03	01A-A2D2-U05	97-3	4.5	5.5	4.0	5.7	3.0	5.8	3.3	6.4
	+ 5.1	A44		01A-B1C1-B13	01A-A2D2-B03	85-3	4.5	5.5	4.0	5.7	3.0	5.8	3.3	6.4
	+ 5.1	A30 *(F)	3	01A-C2W2-E14	01A-A2D2-D11	87-2	4.5	5.5	4.0	5.7	3.0	5.8	3.3	6.4
	+ 8.5	A46		01A-C2B2-A14	01A-A2D2-D02	85-4	7.7	9.4	6.8	9.7	5.1	9.7	5.1	10.8
	+ 8.5	A31 *(F)	3	01A-C2W2-A14	01A-A2D2-U02	97-7	7.7	9.4	6.8	9.7	5.1	9.7	5.1	10.8
	+ 8.5	A23 *(F)		01A-B2B3-A01	01A-A2D2-B05	85-7	7.7	9.4	6.8	9.7	5.1	9.7	5.1	10.8
	-12.0	A43		01A-A2W4-E14	01A-A2D2-P12	97-0	10.8	13.2	9.6	13.7	7.2	13.8	7.2	15.3
	-12.0	A64 (F)	5	01A-C2W3-A01	01A-A2D2-S10	95-7	10.8	13.2	9.6	13.7	7.2	13.8	7.2	15.3
	-12.0	A32 *(F)	4	01A-B2B3-E01	01A-A2D2-U06	95-0	10.8	13.2	9.6	13.7	7.2	13.8	7.2	15.3
	+12.0	A42		01A-A2B5-E01	01A-A2D2-B02	85-2	10.8	13.2	9.6	13.7	7.2	13.8	7.2	15.3
	+12.0	A13 (F)	2	01A-A1B5-E01	01A-A2C2-B07	A5-0	10.8	13.2	9.6	13.7	7.2	13.8	7.2	15.3
	+12.0	A48		01A-B1B4-A02/A03	01A-A2C2-B10	A5-1	10.8	13.2	9.6	13.7	7.2	13.8	7.2	15.3
	+24	A41		01A-A2B3-E14	01A-A2D2-B10	85-1	21.6	26.4	19.2	27.7	14.4	27.7	14.4	30.6
	- 5.1	A63		01A-B1B4-A18/A19	01A-A2D2-U09	95-1	4.5	5.5	4.0	5.7	3.0	5.8	3.0	6.4
105	- 5.1	A33 *(F)	3	01A-C2W3-E01	01A-A2D2-S03	97-5	4.5	5.5	4.0	5.7	3.0	5.8	3.0	6.4
	+ 5.1	A03 (F)	2	01A-A1H6-C02	01A-A2D2-S06	97-4	4.5	5.5	4.0	5.7	3.0	5.8	3.0	6.4
	+ 5.1	A30 *		01A-C2W2-E14	01A-A2D2-D11	87-2	4.5	5.5	4.0	5.7	3.0	5.8	3.0	6.4
	+ 6.0	A52 (F)	2,6	01A-A1G6-B04	01A-A2D2-B07	85-0	5.4	6.6	4.8	6.8	3.6	6.9	3.6	7.7
	- 8.5	A38 (F)	2	01A-A1H6-E02	01A-A2D2-U10	95-6	7.7	9.4	6.8	9.7	5.1	9.7	5.1	10.8
	- 8.5	A62 (F)	5	01A-C2W3-A01	01A-A2D2-S07	95-5	7.7	9.4	6.8	9.7	5.1	9.7	5.1	10.8
	- 8.5	A32 *(F)	4	01A-B2B3-E01	01A-A2D2-U06	95-0	7.7	9.4	6.8	9.7	5.1	9.7	5.1	10.8
	+ 8.5	A02 (F)	2	01A-A1H6-D02	01A-A2D2-B04	85-5	7.7	9.4	6.8	9.7	5.1	9.7	5.1	10.8
	+ 8.5	A31 *(F)	3	01A-C2W2-A14	01A-A2D2-U02	97-7	7.7	9.4	6.8	9.7	5.1	9.7	5.1	10.8
	+ 8.5	A23 *(F)		01A-B2B3-A01	01A-A2D2-B05	85-7	7.7	9.4	6.8	9.7	5.1	9.7	5.1	10.8
111	+4.26 #	A05	7	01A-B1E4-D01	01A-A2D2-B08	87-0	4.09	4.43	3.62	4.64	2.13	4.73	2.13	4.73
112	-6.54 #	A06	7	01A-B1E4-A01	01A-A2D2-U11	95-2	6.41	6.67	6.15	6.93	6.08	7.13	6.08	7.13
113	+4.34 #	A07	7	01A-B1B4-A12/A14	01A-A2D2-S09	95-3	4.17	4.47	3.69	4.73	3.13	4.82	3.13	4.82
114	-1.52 #	A08	7	01A-B1B4-A10/A11	01A-A2D2-S08	95-4	1.46	1.56	1.29	1.66	1.22	1.73	1.22	1.73

LINE VOLTAGE TOLERANCES (valid for 50 HZ)

Nominal Voltage	Actual Voltage Lo	Actual Voltage Hi
200	180	220
220	193	238
230	202	249
240	210	259

LINE VOLTAGE TOLERANCES (valid for 60 HZ)

Nominal Voltage	Actual Voltage Lo	Actual Voltage Hi
200	180	220
208	180	220
220	193	238
240	208	254

* Indicates sense points for voltages from PS104 or PS105

\# Adjustable voltages

(F) Feature dependent

This page shows the maximum number of sense points. The actual number of sense points for a specific machine depends on the number of installed features (F), see also the notes on this page and page 4000 of this book.

Notes:

1. Floating bulk and bias voltages for IPS are measured only once during the power-on sequence. The voltage level varies after the IPS power supplies are turned on. A check point list and the IPS voltages are shown on ALD page YA041.

2. This sense point is tied to GND if board 01A-A1 is not installed.

3. This sense point is tied to GND if Communications Adapter (CA) is not installed.

4. The physical sense point 01A-B2B3-E01 (A32) is used by:
   -12V from PS104 or by
   -8.5V from PS105.
   -8.5V from PS105 is present at 01A-B2B3-E01 if PS105 is installed.
   -12V from PS104 is present at 01A-B2B3-E01 if PS105 is not installed.

5. The physical sense point 01A-C2W3-A01 is used by the analog sense line
   A64 (-12V from PS104) or by
   A62 (-8.5V from PS105).
   The sense point is tied to GND if a Communications Adapter (CA) is not installed.
   A62 (- 8.5V from PS105) is used if PS105 is installed.
   A64 (-12V from PS104) is used if PS105 is not installed.

6. This sense point is tied to GND if MFCU (5424) is not installed.

7. The IPS voltages have the nominal voltage levels at the sense point if the IPS voltages are correctly adjusted (no '+' or '-' sign displayed for the IPS voltages in the voltage measurement display).

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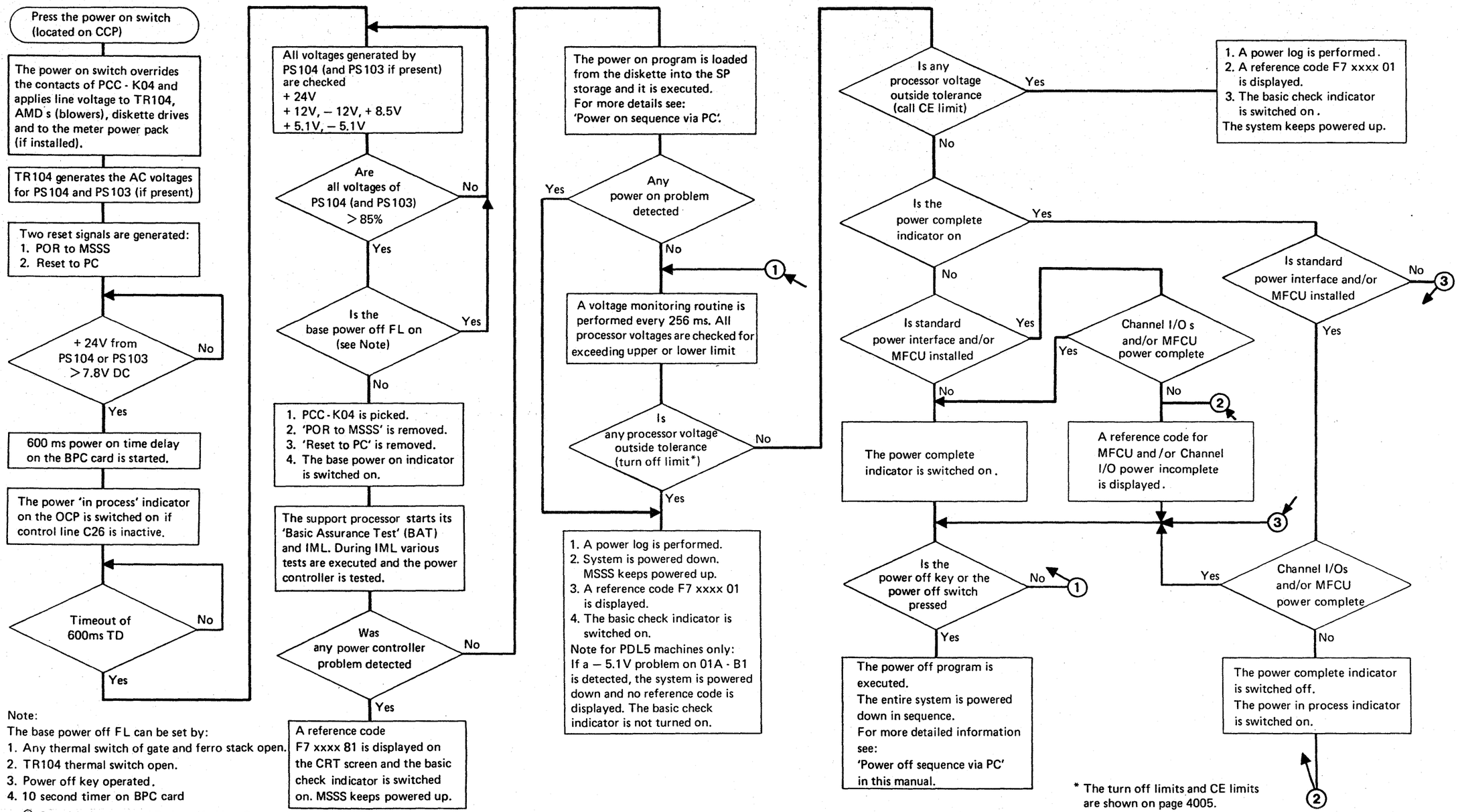
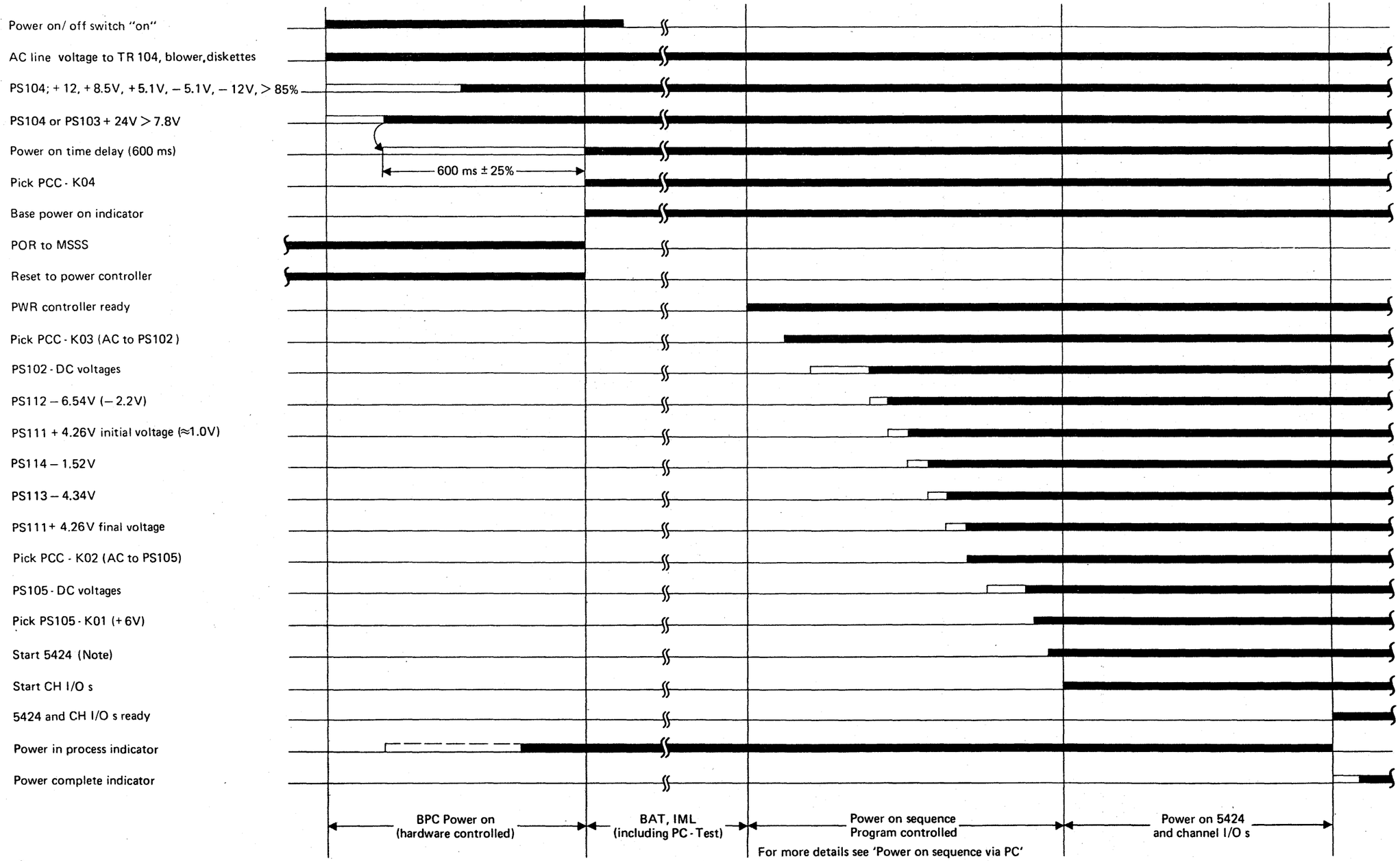
Power-On Sequence Flow Chart



* The turn off limits and CE limits are shown on page 4005.

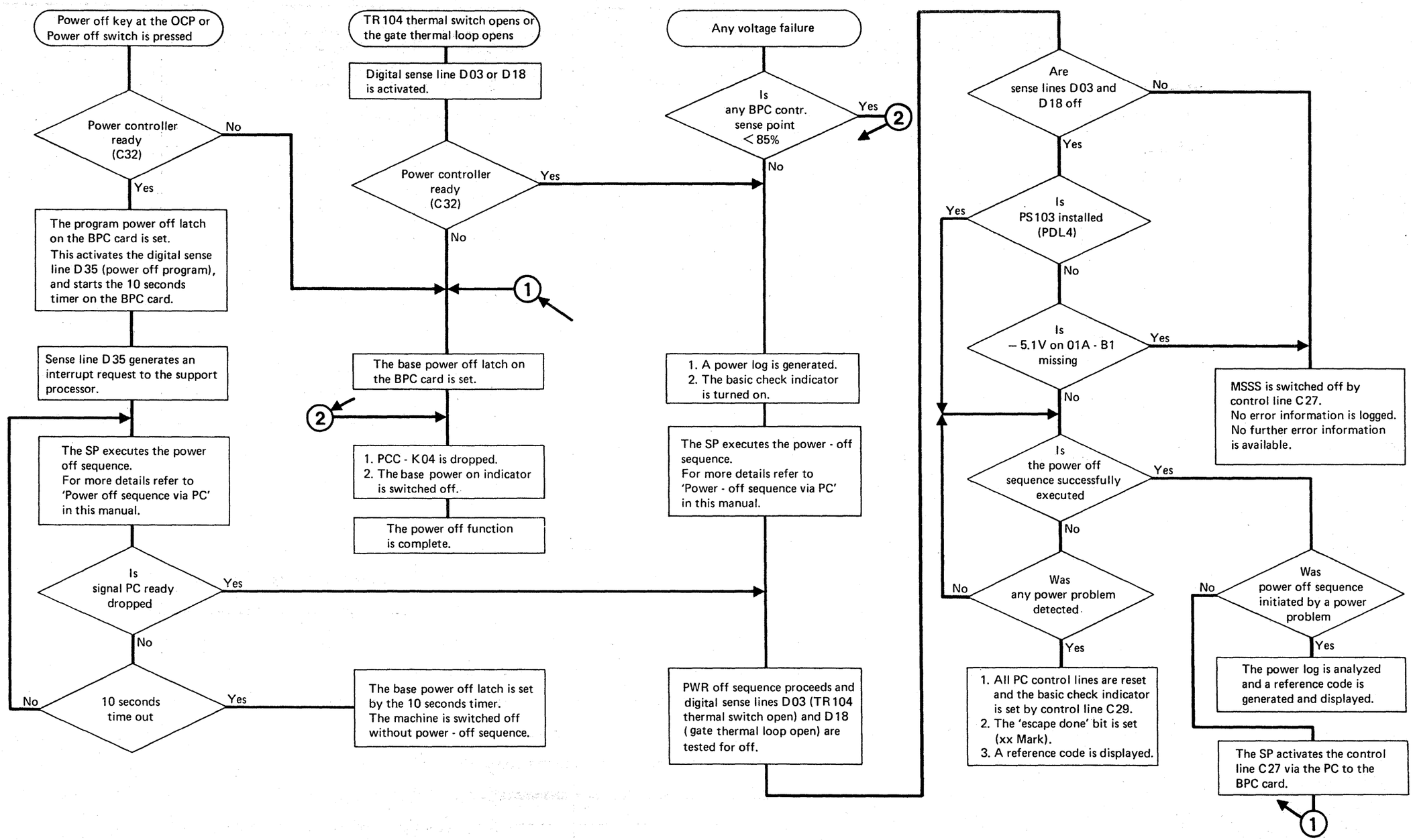
AAF4010

Power-On Sequence Timing Chart



For more details see 'Power on sequence via PC'

Power-Off Sequence Flow Chart



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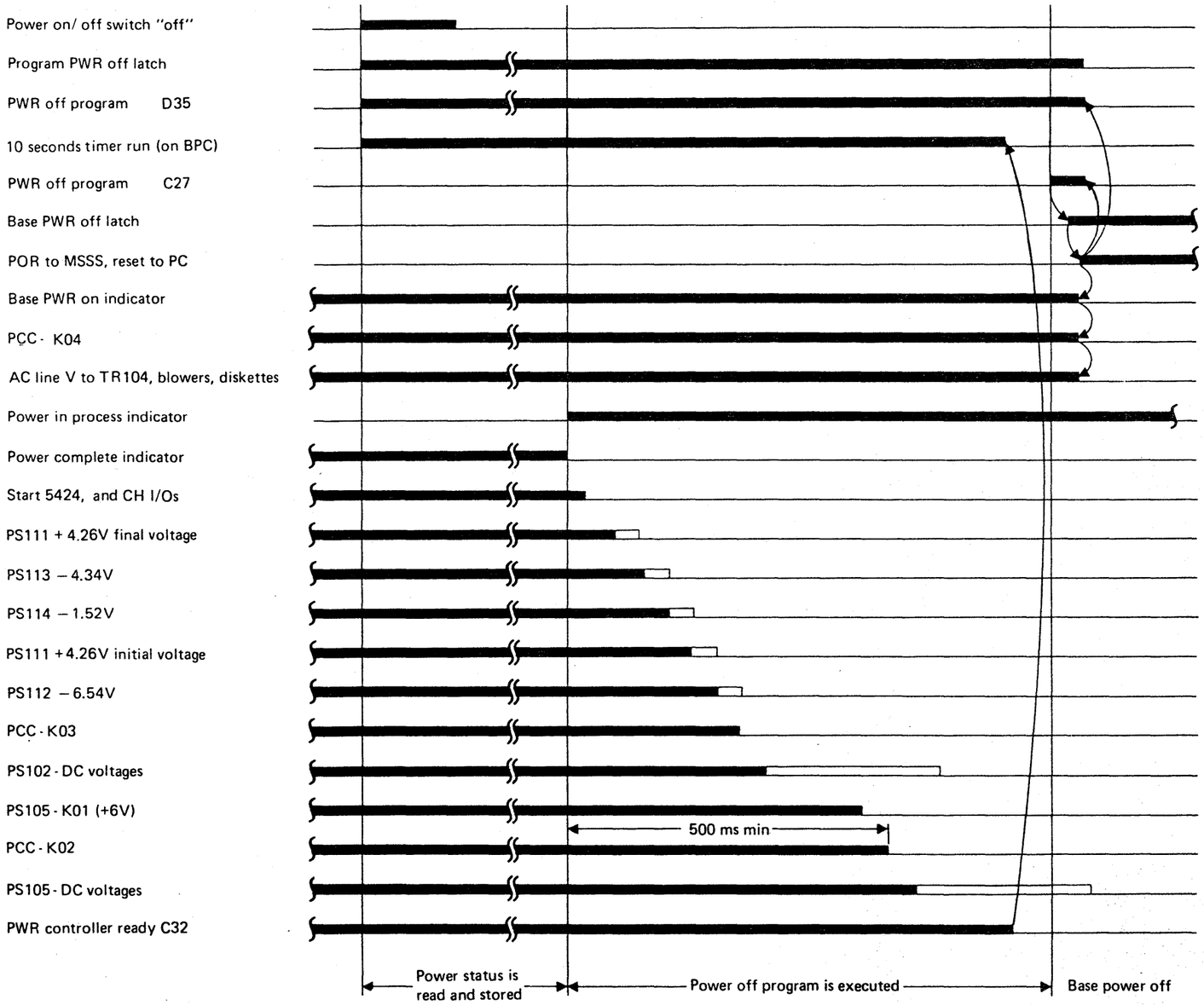
Power-Off Sequence Timing Chart

(POWER CONTROLLER READY)



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Power

DET

EC 366356 28 Mar 80	EC 366516 05 Feb 82	EC 366582 13 Sep 82	P/N 5684096 Page 5 of 6	4 040	F

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PCC

BPC – CARD 01A – A2 B2 (ALD – YB 421/427)

K04 +24 CNTLD

Board 01A - A2

TR 104

PS 104

+24V
–5.1V
+12V
+8.5V
+5.1V
–12V

PCC - K04

CB01

Filter

+24 V

600ms TD S02 P12

U11 VD Comp M13 P11 V > 85%
P13 VD Comp S04 U06 V > 85%
U04 VD Comp M12 M11 V > 85%
P06 VD Comp M10 P09 V > 85%
J09 VD Comp M09 M08 V > 85%
U09 VD Comp S03 U05 V > 85%

TP +4.42V S07
TP +2.2V S08
– Prog PC Reset C25 J12

M07 +24V CNTLD
G07 Spare
M03
M06
M05
M02 Base PWR On IND
J13 – POR to MSSS

G09 – Reset to PC

– PWR Off Prog C27 P02

Base PWR Off FL

G11 TP

– TR 102 TH Failed D09 U13 S10 – TR 102 TH Failed D09
– TR 105 TH Failed D08 U07 S06 – TR 105 TH Failed D08
– Inlet TH failed D04 U02 S05 – Inlet TH Failed D04
– TR 104 TH Failed D03 P10 G13 – TR 104 TH Failed D03
– Gate TH Failed D18 P05 G12 – Thermals Failed D18

CCP
PWR On
PWR Off

J10
M04
– PWR Off Key J11
G08
S09

OCP
PWR Off
IML
Lamp Test

– PC Ready C32 J06

Prog PWR Off FL

G10 – PWR Off Prog D35

TD 10S

– Manual IML J07 G03 – Manual IML
+ Lamp Test J02
B10
B09

OCP
PWR Complete
In Process
Basic Check
+24V

G06
G05
G04

– PWR Complete C26 J05
– PWR Check C29 J04
B08

CE PANEL
CE Mode SW
– CE Mode D10 B04 – CE Mode D10

PCC
K02
K03

– Pick PCC - K02 C02 D11 B12
– Pick PCC - K03 C34 D09 B11

PS 105
K01

– Pick PS105 - K01 C24 D07 B07

SPI
K01

– Start I/O CU C01 D06 B06

Spare D13 G02 Spare
Spare D12 B13 Spare
Spare D05 B05 Spare
Spare D04 B03 Spare
Spare D02 B02 Spare
Spare P04 S13 Spare

DET

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Power Controller Description

PC General Function

The power controller in an adapter is used for control and monitoring of the power complex. The PC is one byte wide and receives commands and data from the support processor via the processor bus 0.

Read data and interrupts are sent to the support processor via the processor bus 1.

The tag-bus signals are used for control and timing purposes.

The PC consists of three cards: One interface card and two sense cards.

Functions of the PC Interface Card

The following functions are performed by the interface card:

- Tag and response control for the processor bus.
- Input from processor bus 0 into the write-bus register.
- Parity check for bytes from bus 0.
- Address match test.
- Input control to the PC-command register.
- Command checking and decoding.
- Machine check and command check generation. (The checks are handled by the support processor.)
- Provides PC status (Machine check, command check and interrupt control bits).
- Read/write strobe generation.
- Register selection and sense byte selection on interface card and on both sense cards.
- Read data transfer control via the Read Bus Register to processor bus 1, including parity generation for read data.
- Interrupt request control to the support processor via the processor bus 1.

Functions of the PC Sense Card

The PC sense cards are used for data input, output and interrupt request generation. Thirty-two analog sense lines and 27 digital sense lines can be wired to one sense card. Four registers (one byte wide) are located on each sense card. The registers, also called latch bytes (LB) receive data from the support processor via the PC interface card.

LB0 and LB1 are used for control signals for the power complex.

LB2 controls the 36ms timeout circuit, the interrupt mask, the byte test and address check. Byte test and address check are test functions used for the power controller diagnostics (see topic PC sense card).

The function of the interrupt generation is decribed under the topic: Voltage monitoring during normal system operation and interrupt generation.

LB3 contains always the bit pattern for the digital input of the digital-analog converter (see topic analog measurements).

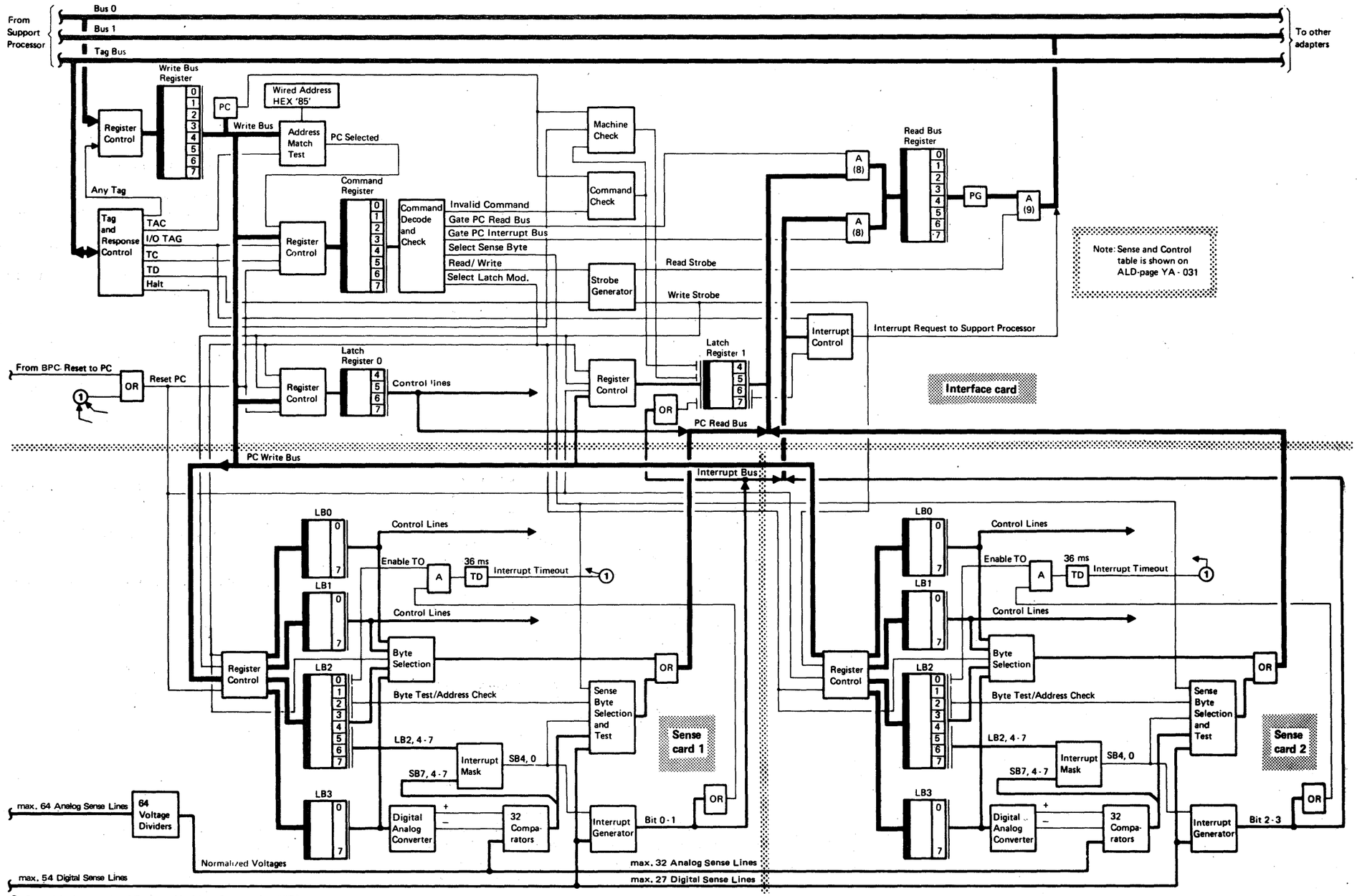
The contents of each register can be read by the support processor as well as the status of the digital sense lines and the output of the 32 comparators.

PC Sense Card 2

The PC-sense card 2 is used for the PU-identification and a limited number of power sense and control lines. Most of the sense - and control lines are spare (see sense and control table in this manual).

DET

Power Controller Data Flow

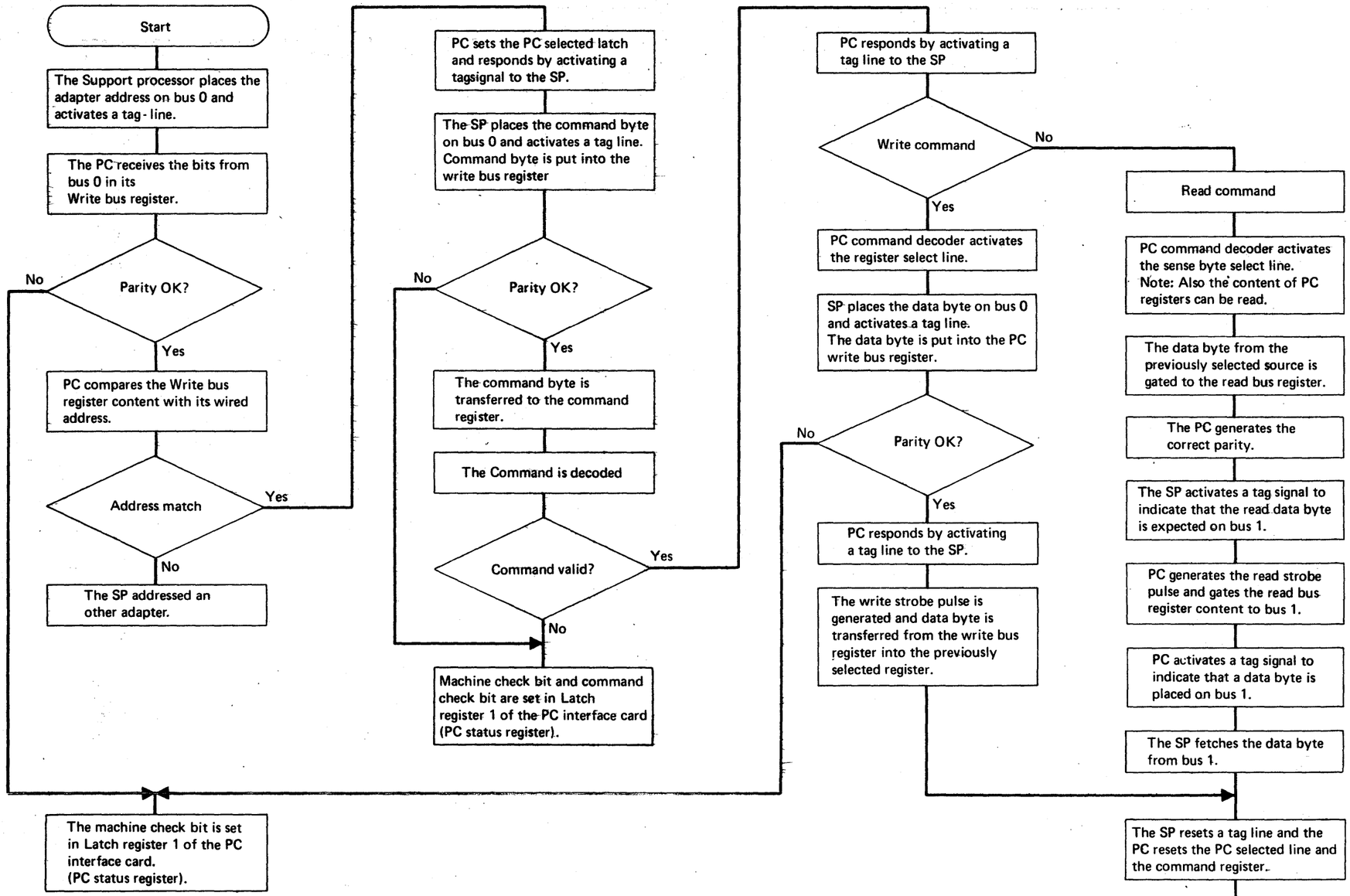


4331

Power

DET

Power Controller Write/Read Operation



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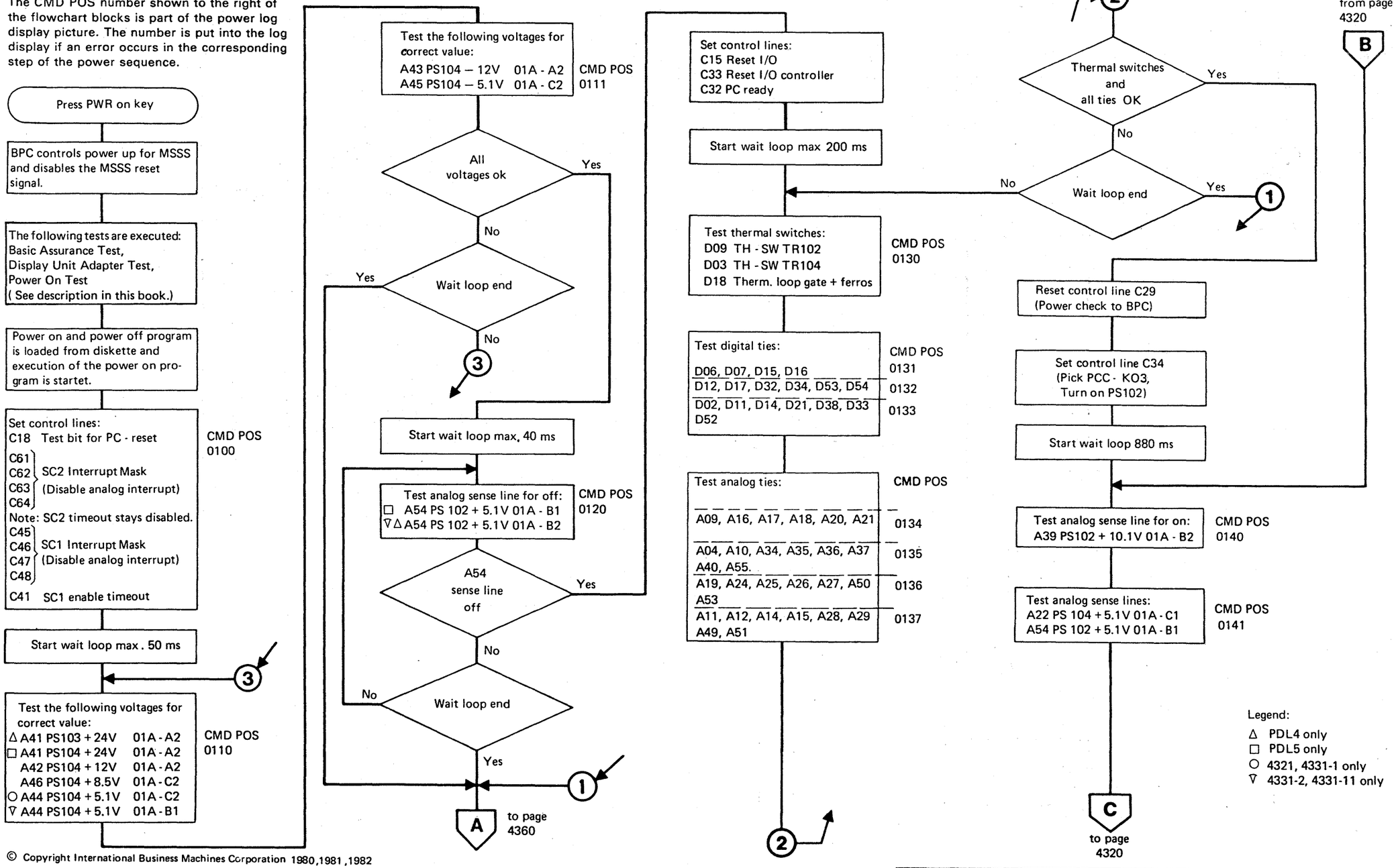
4331

Power

DET

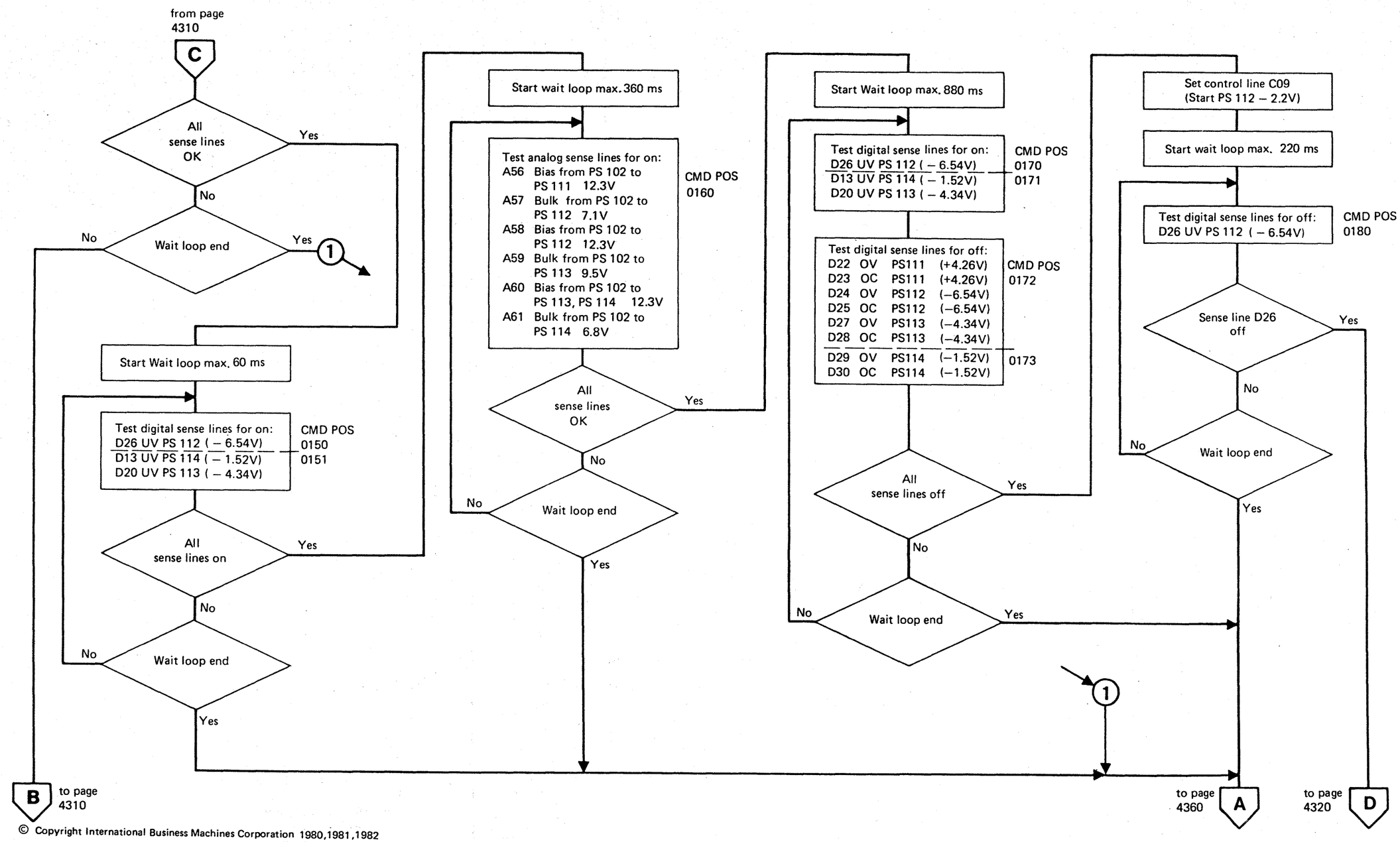
Power-On Sequence via PC

The CMD POS number shown to the right of the flowchart blocks is part of the power log display picture. The number is put into the log display if an error occurs in the corresponding step of the power sequence.



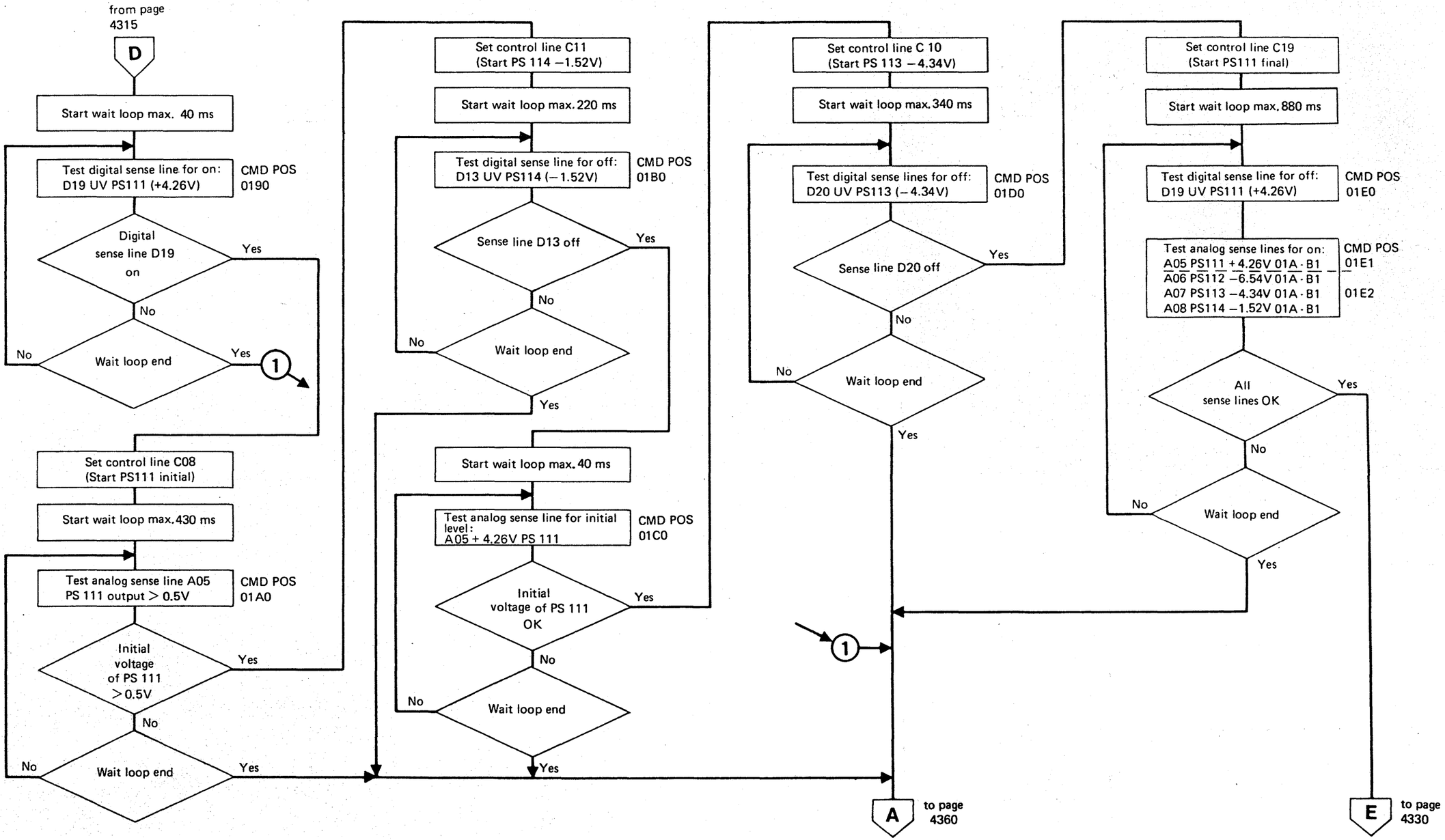
AAF4310

Power-on Sequence via PC (continued)



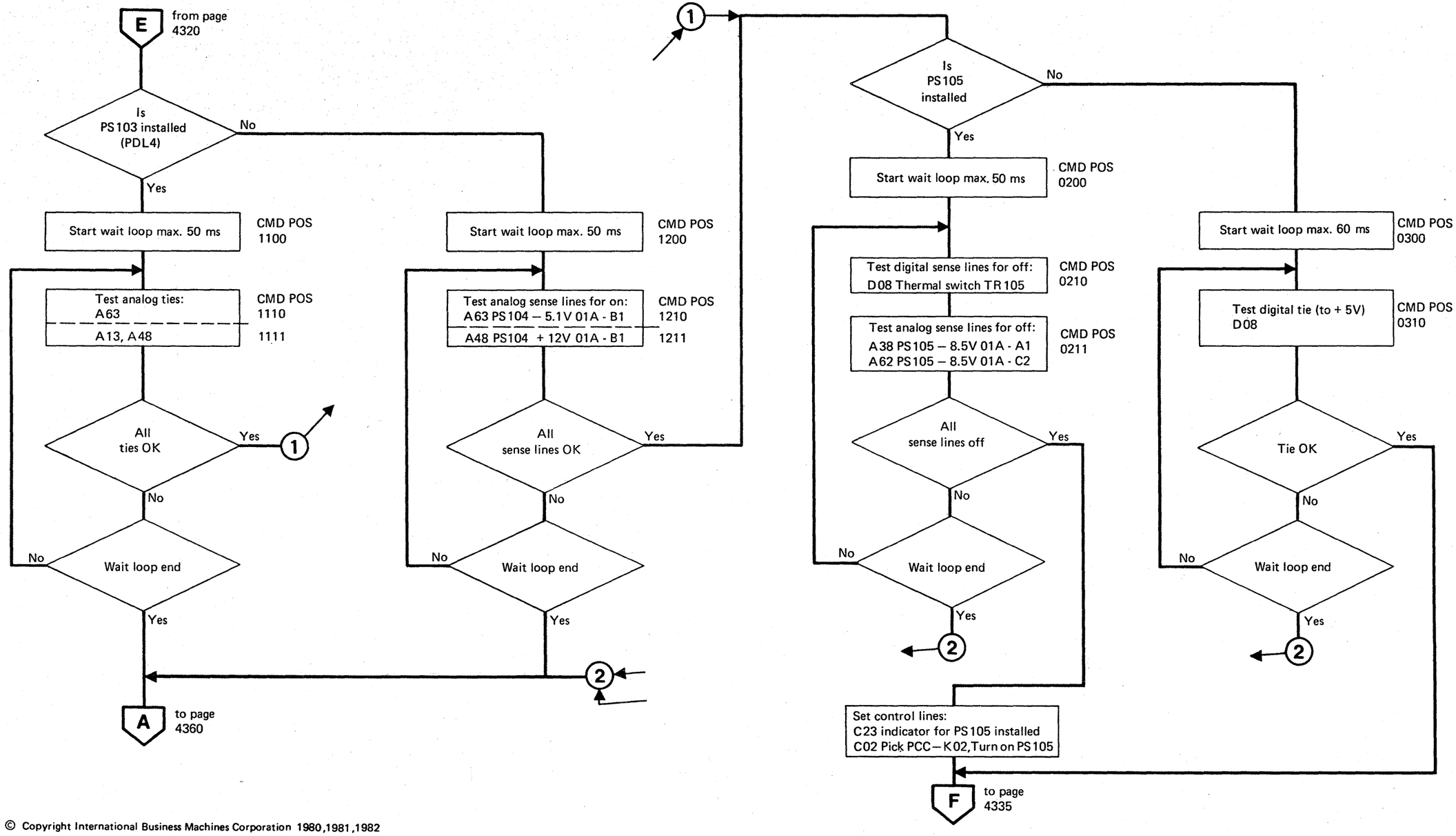
AAF4315

Power-on Sequence via PC (continued)



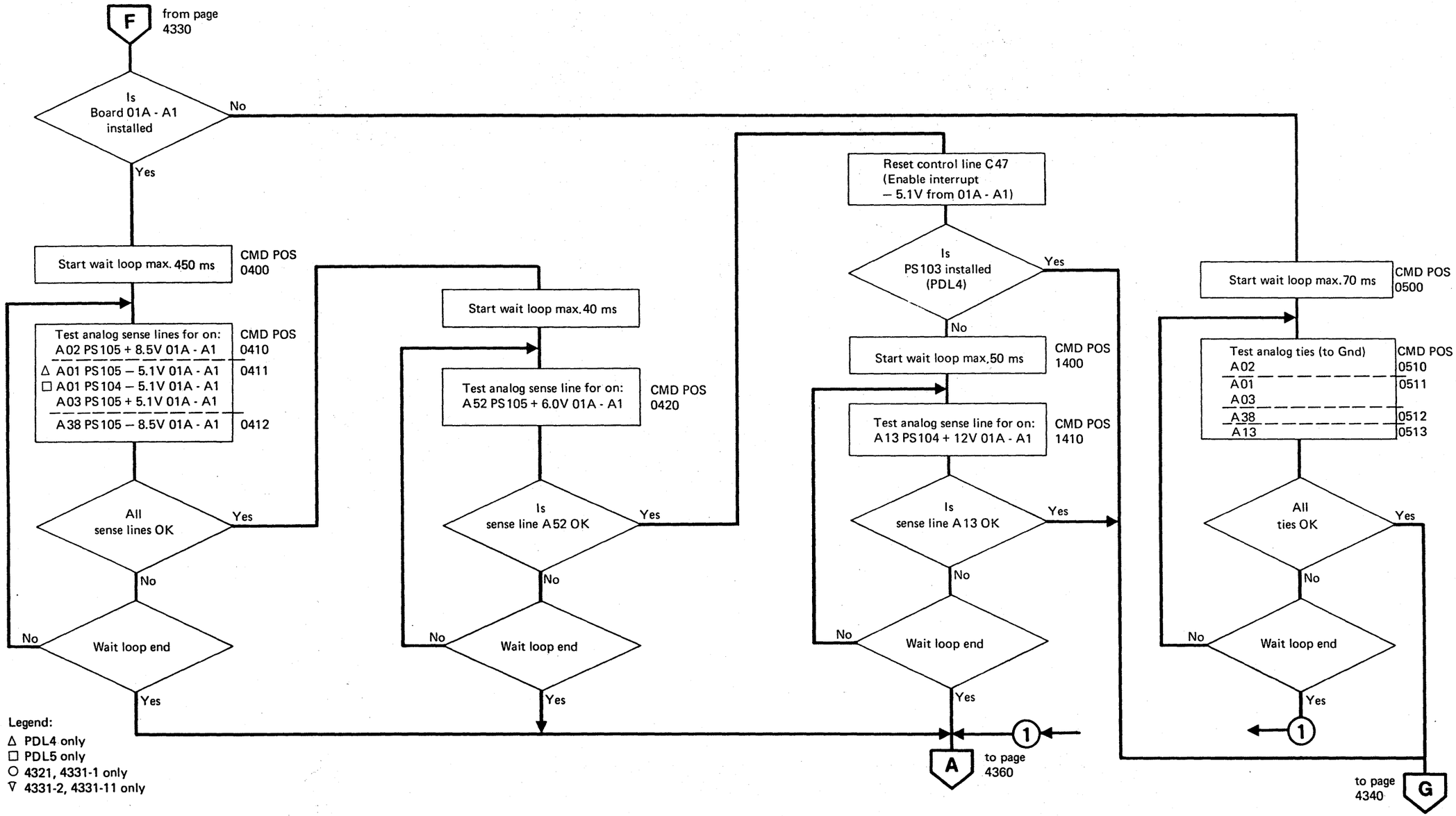
AAF4320

Power-on Sequence via PC (continued)



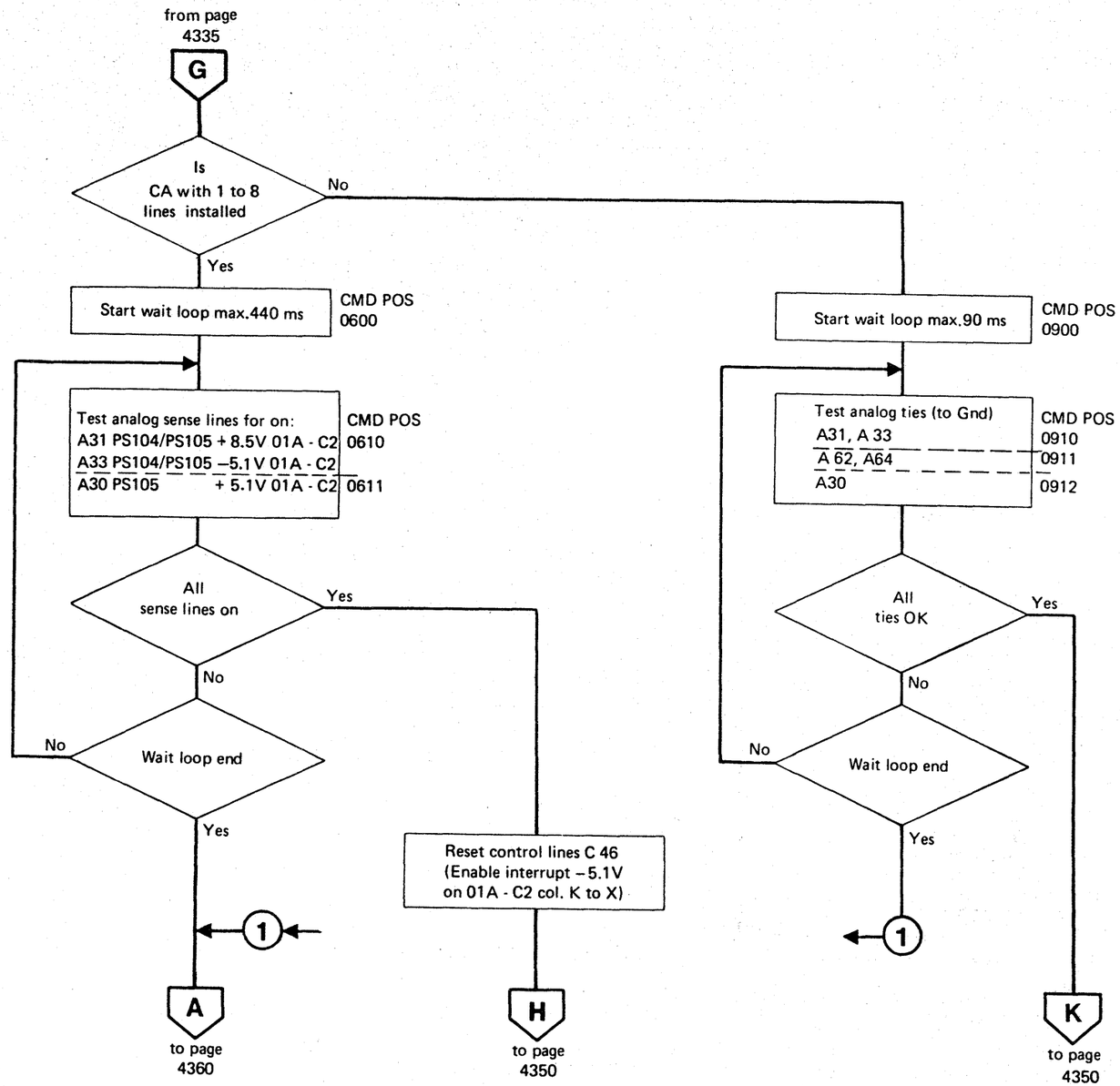
AAF4330

Power-on Sequence via PC (continued)



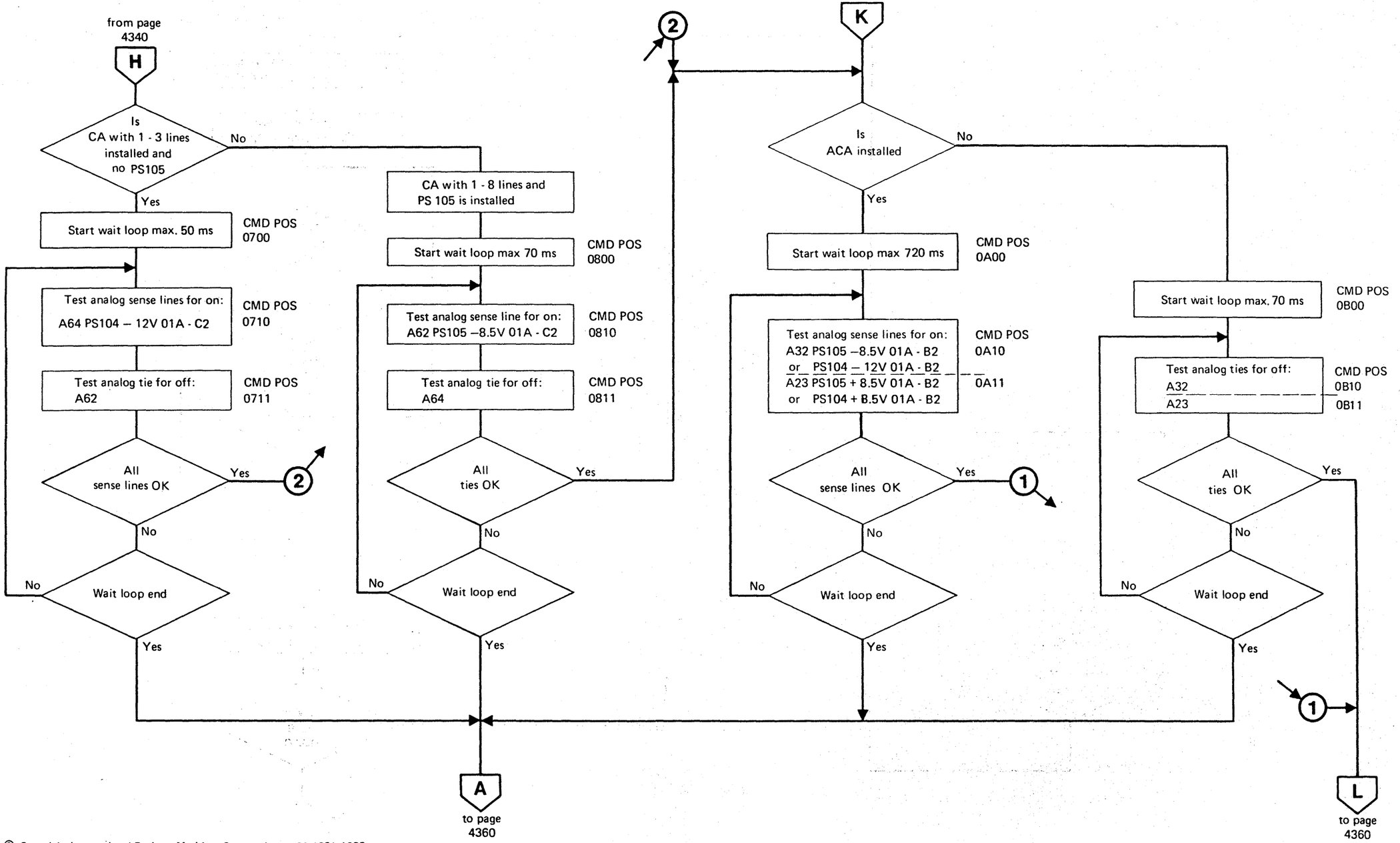
AAF4335

Power-on Sequence via PC (continued)

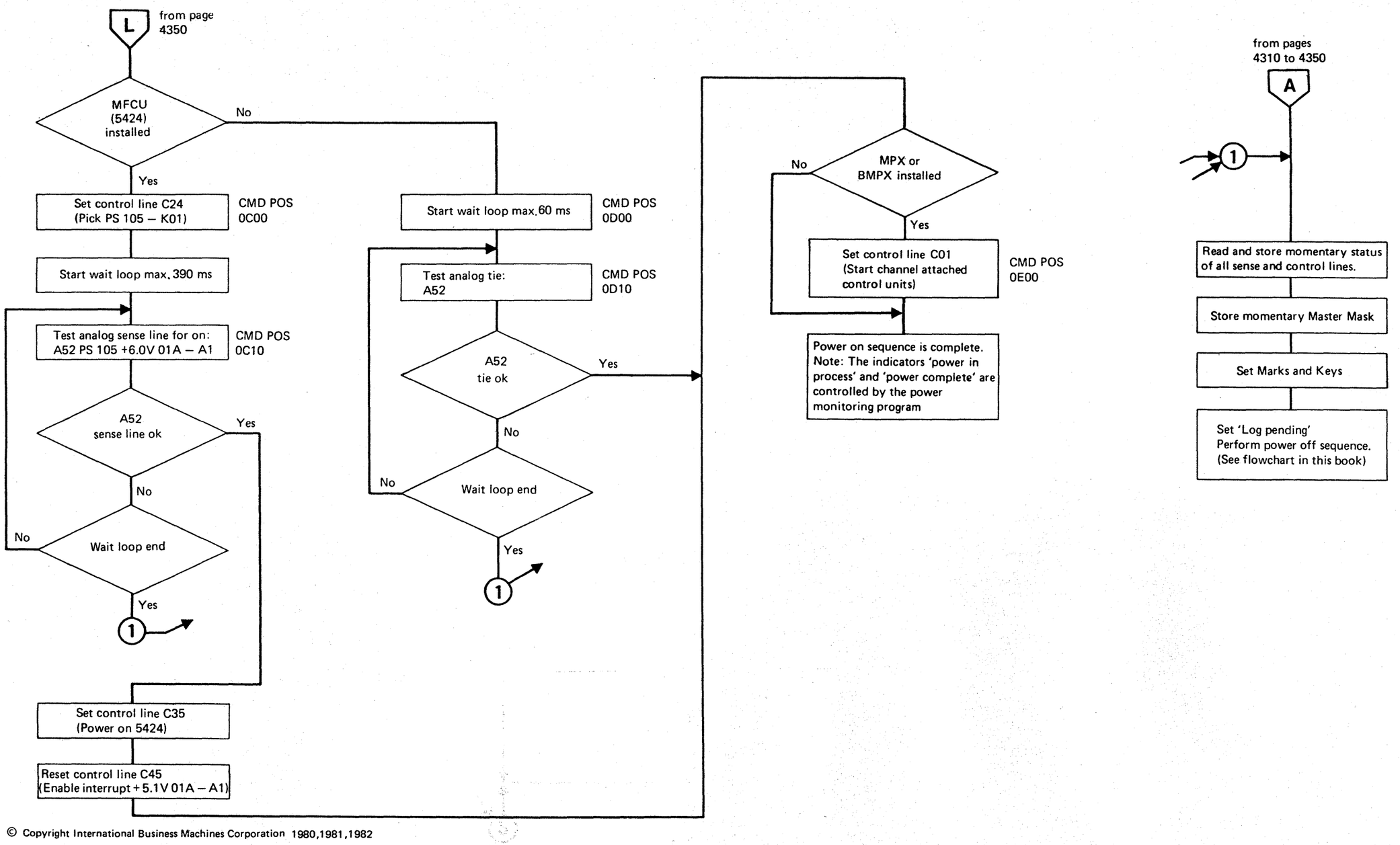


AAF4340

Power-on Sequence via PC (continued)



Power-on Sequence via PC (continued)



AAF4360

Voltage Checking During Normal System Operation and Interrupt Generation

During normal system operation the SP operation control program performs a voltage monitoring routine every 256ms lasting about 20ms. For some voltages it is unacceptable to have a time gap without voltage checking. Therefore, the critical voltages generate an interrupt request to the SP if the voltage drops below a limit defined by the operation control program.
The interrupt generating voltages are shown on ALD page YA031.

Interrupt Generation

Note: The numbers in boxes refer to the numbers in the diagram on the next page.

At the end of each voltage monitoring routine, a bit pattern for a voltage tolerance of 80 percent is written into LB3 of the sense card [1]. The output of LB3 is used as digital input for the digital analog converter [2].

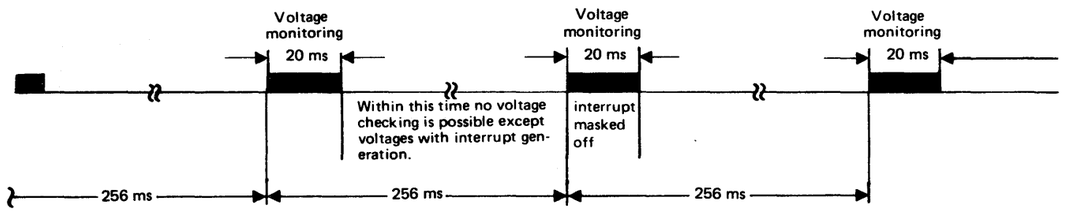
The DAC generates a voltage which is determined by its digital input. The DAC output is used by the 32 comparators [3]. The comparators compare the normalized voltages from the sense points with the voltage generated by the DAC, but the compare result is not transferred to the SP because the SP microprogram performs other tasks at this time (main sense loop). The comparator output of four important voltages per sense card, which must be continuously checked, is also wired to the interrupt mask circuit [4]. A four-bit mask is written by the SP into LB2 bits 4 through 7 [5] and the output of bits 4 through 7 is also connected to the mask circuit. If any of the monitored voltages drops below the limit (determined by the digital DAC input), the comparator output changes its level. If an interrupt request from this voltage is allowed by the mask in LB2 bits 4 through 7 [6], the interrupt mask circuit activates an interrupt bit [7]. The active interrupt bit passes the sense byte selection circuits [8] and enters the interrupt bus [9]. Any active bit on the interrupt bus sets the interrupt bit 7 in the status register [10].

An interrupt request to the support processor is only possible if previous SP operation control program steps have enabled an interrupt request by setting bit 6 in the status register.

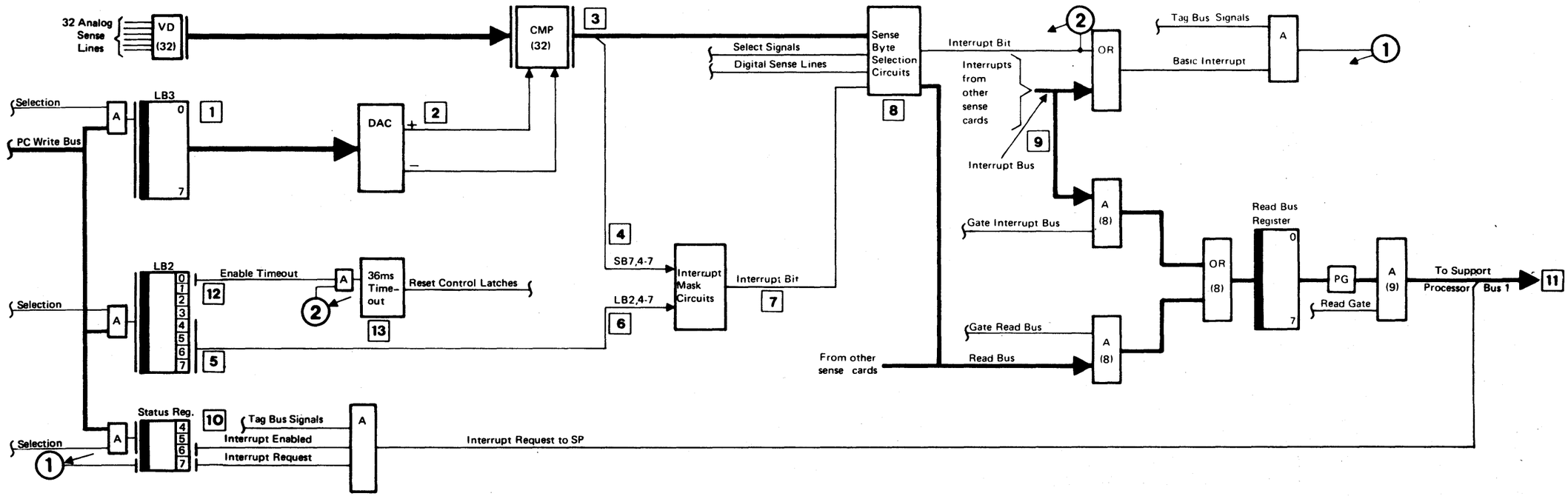
If status register bits 6 and 7 are on, an interrupt request to the SP is generated [11]. During interrupt handling, the SP operation control program fetches more detailed error information using PC senses.

Whenever an interrupt bit is activated and the timeout bit 0 in LB2 is on [12], the 36ms timeout circuit is started [13].

If the interrupt request to the SP is not handled within 36ms, all power controller control latches are reset. This function has the same effect as emergency power-off. (But PS103 and PS104 are still switched on.) The 36ms timeout circuit is used as backup timer to ensure machine power-off in case of support processor, power controller, or interface problems.



Voltage Checking During Normal System Operation and Interrupt Generation (continued)

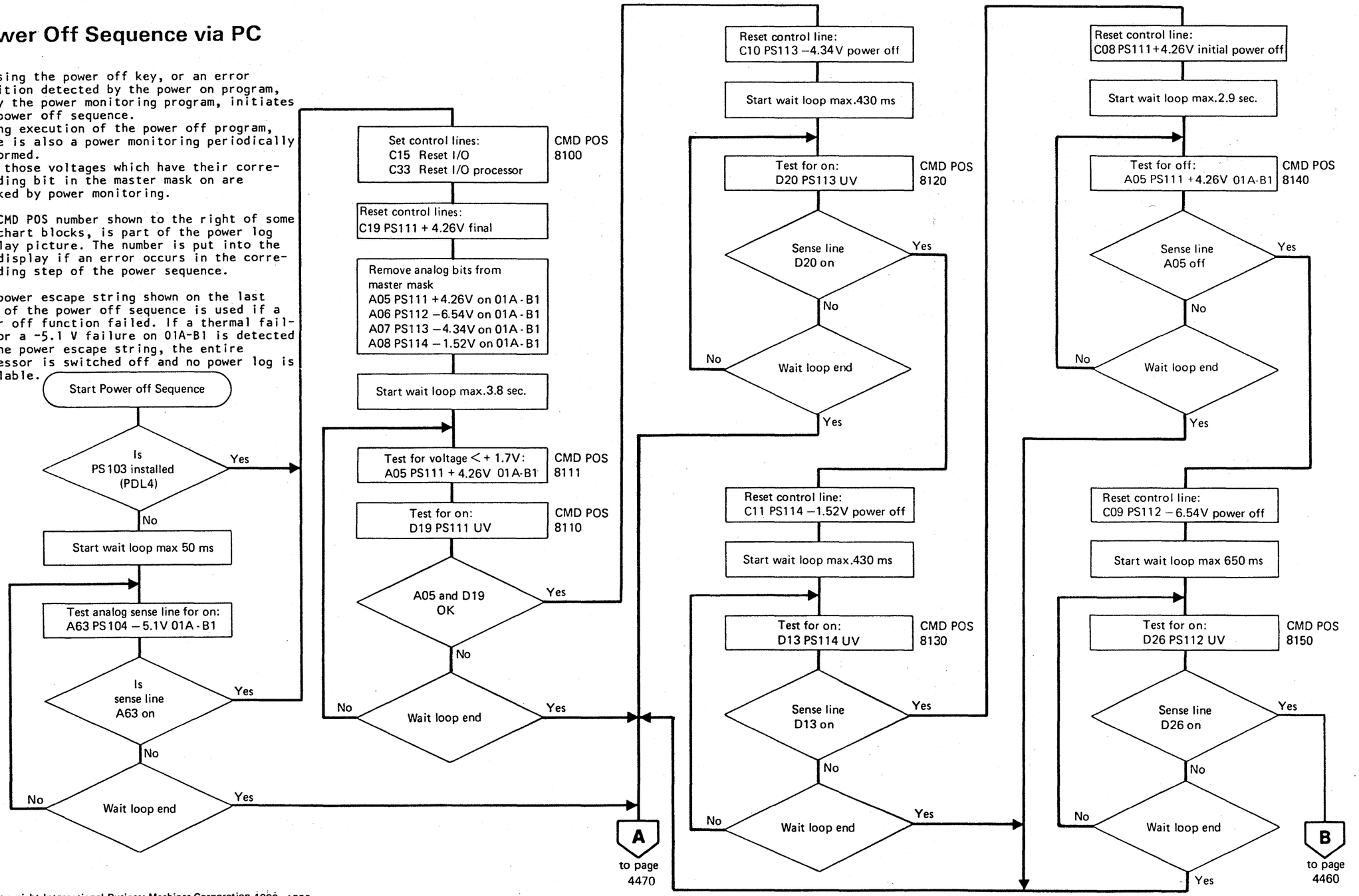


Power Off Sequence via PC

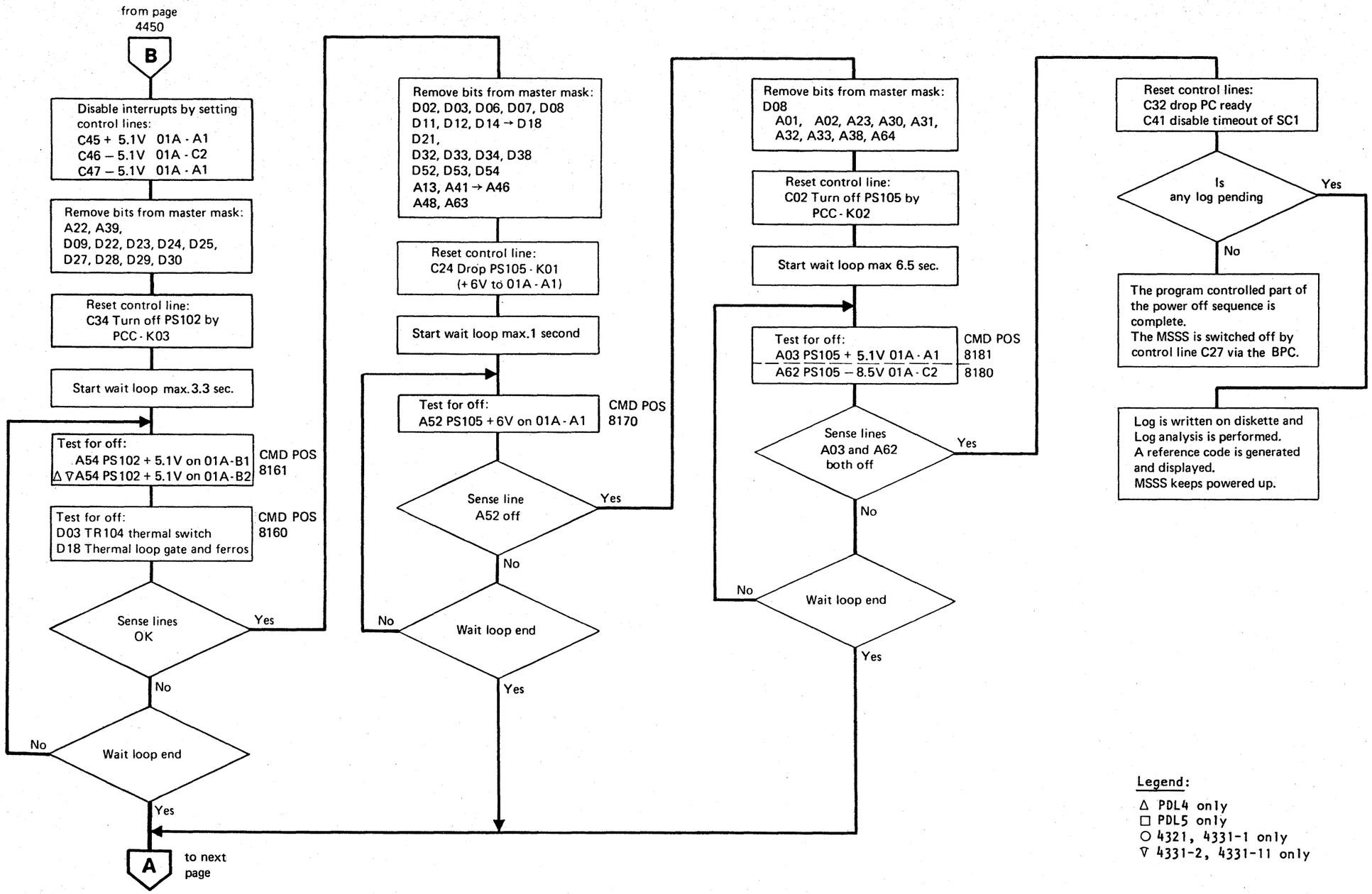
Pressing the power off key, or an error condition detected by the power on program, or by the power monitoring program, initiates the power off sequence.
During execution of the power off program, there is also a power monitoring periodically performed.
Only those voltages which have their corresponding bit in the master mask on are checked by power monitoring.

The CMD POS number shown to the right of some flowchart blocks, is part of the power log display picture. The number is put into the log display if an error occurs in the corresponding step of the power sequence.

The power escape string shown on the last page of the power off sequence is used if a power off function failed. If a thermal failure or a -5.1 V failure on 01A-B1 is detected by the power escape string, the entire processor is switched off and no power log is available.



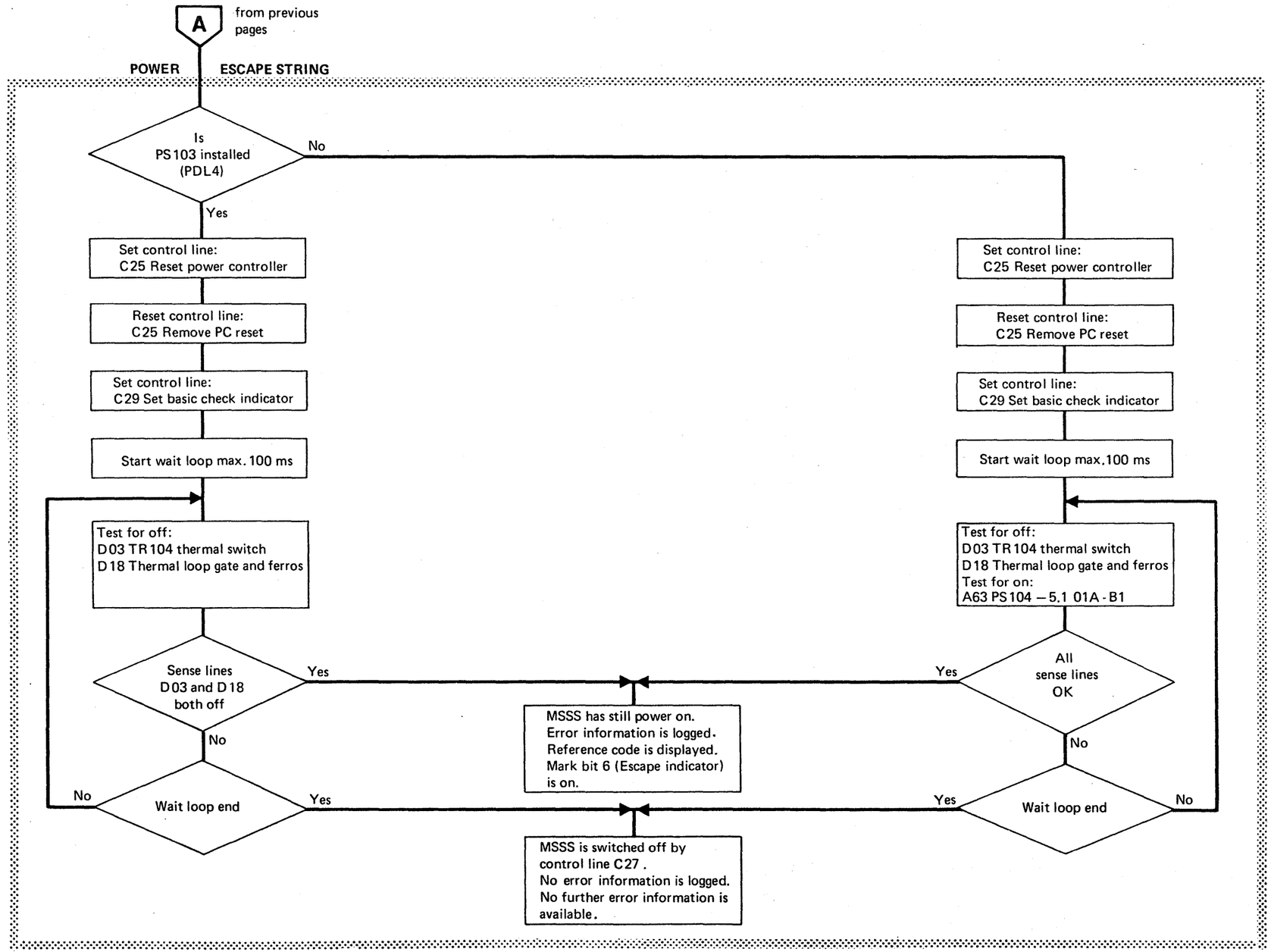
Power– off Sequence via PC (continued)



Legend:
- Δ PDL4 only
- □ PDL5 only
- ○ 4321, 4331-1 only
- ∇ 4331-2, 4331-11 only

AAF4460

Power-off Sequence via PC (continued)



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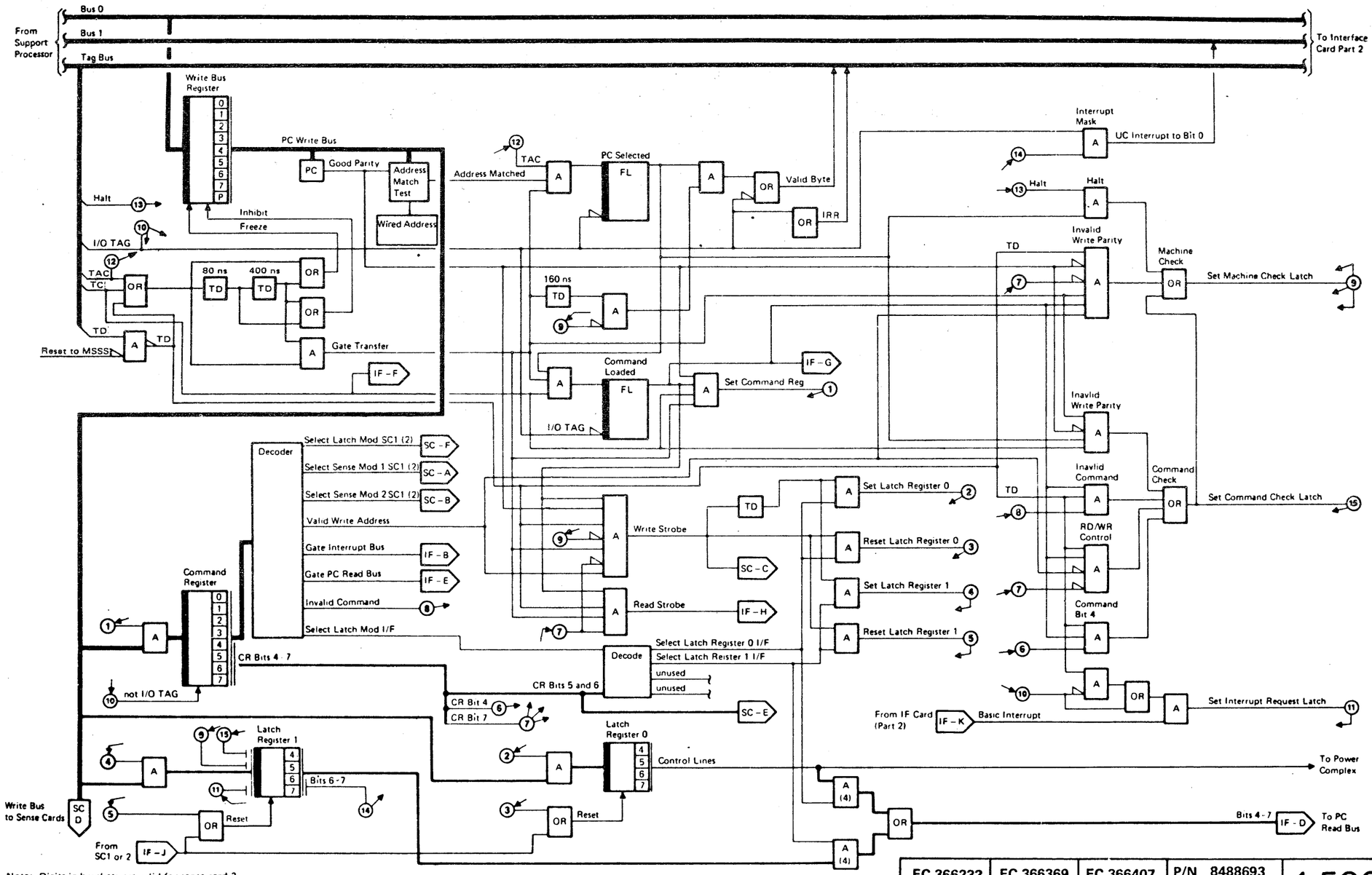
Power Controller Interface Card (Part 1 of 2)

Position 01A - E2, ALD YB 661/679



Note: Digits in brackets are valid for sense card 2

EC 366232	EC 366369	EC 366407	P/N 8488693	4 500 F
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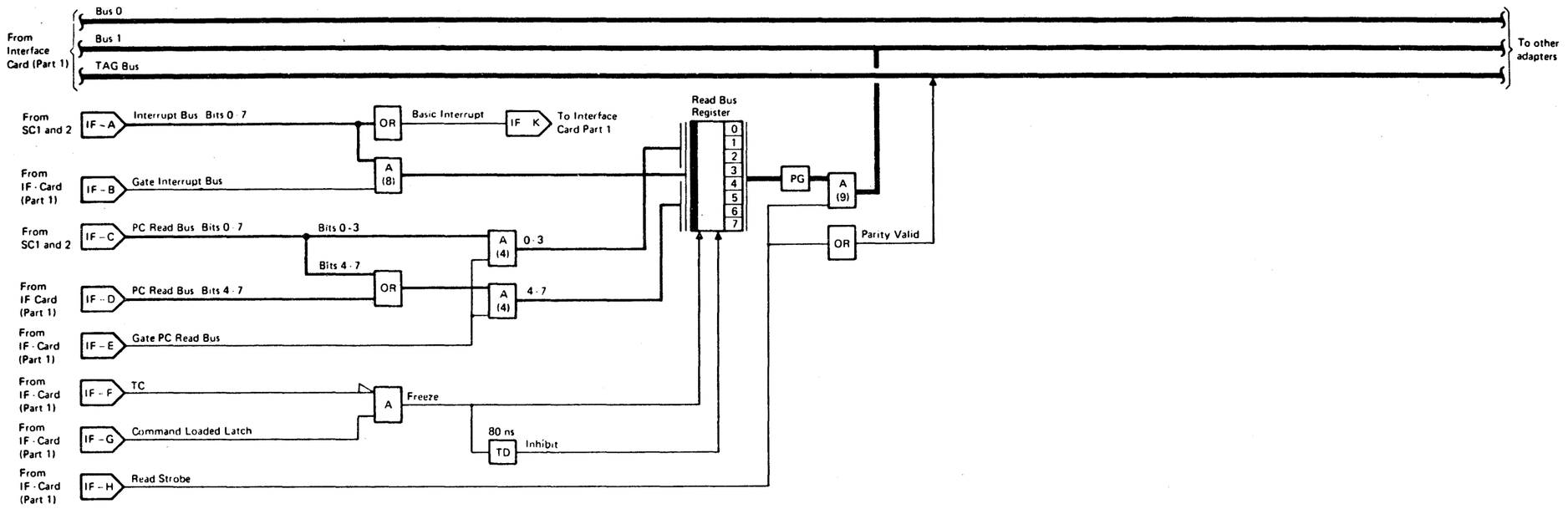
Power Controller Interface Card (Part 2 of 2)

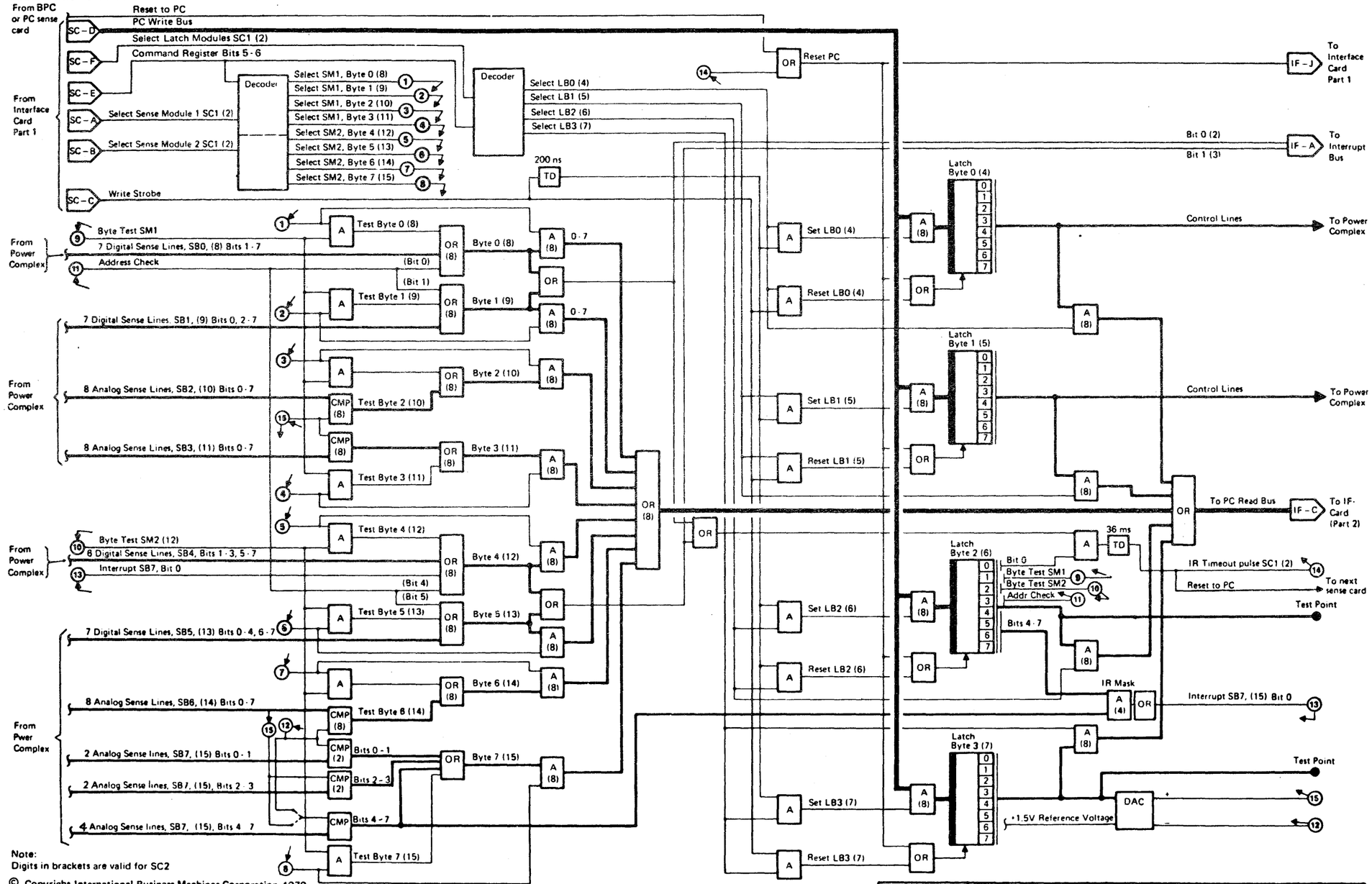
Position 01A - A2E2, ALD YB 661 - YB 679



Note:
Digits in brackets are valid for SC2

Power Controller Sense Card

SC1: Position 01A - A2D2, ALD YB 641 - YB 653
SC2: Position 01A - A2C2, ALD YB 621 - YB 633



Note:
Digits in brackets are valid for SC2

4331 PDL4/5 – A

Power

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Power on Test

The power controller is automatically tested before the power-on sequence is executed.

The power on test is not performed during Re-IML

It is not possible to call the Power on test by the CE. To run the Power on test it is necessary to power down the machine and start a new power on sequence by pressing the power-on switch.

The Power-on test consists of eight single tests which run automatically in ascending order.

A reference code is displayed on the screen if any fault is detected. After an error stop, the test can be repeated by pressing the ENTER key of the keyboard. If a reference code is displayed the CE has the possibility to skip one or more tests and to continue with Power-on test execution. If one or more tests have been skipped the displayed reference code may be misleading or wrong.

Each reference code generated by the Power on Test 1 to 8 has the following format: F7TTXX81. TT is the number of the power on test.

The PC-functions tested by the Power on test are shown in the table on the right. For reference see also diagrams on pages 4500 to 4550.

Test number 8 is the ESD monitor test. This test is only executed if the current ESD sense level is not 0.
There are also machines in the field which have no ESD monitor installed. On those machines must the current ESD sense level always be 0.
For more details see 'ESD Monitor' and 'Ambient Recording Log Display' in this book.

Test No.	Tested function
1	1. Test single reset of control lines. 2. Write '00' to each control byte. Read each control byte and test for '00'.
2	1. Set diagnostic control bits on both PC-sense cards to force 'FF' in each sense byte. 2. Read 'FF' from each sense byte.
3	1. Test 1, Routine 2 is repeated. 2. Check address test lines for zero. 3. Set address test lines and check address check bits for on.
4	1. Test 1, Routine 2 is repeated. 2. Test for -5V present on both sense cards. 3. Test delta of both DAC readings for less or equal to 1.5.
5	1. Test 1, Routine 2 is repeated. 2. Enable analog interrupts. 3. Check if interrupt bit is on.
6	1. Test 1, Routine 2 is repeated. 2. Test if interrupt timeout occurs within specified limits.
7	1. Test 1, Routine 2 is repeated. 2. Test set/reset of control lines.
8	1. Test 1. Routine 2 is repeated. 2. ESD Monitor test. Set / Reset of ESD latches is tested.

Power Controller Control Table, Marks, Keys

Control Lines

	Address WR	Address RD	Bits 0	1	2	3	4	5	6	7	Card/ Byte
Interface Card	30	31					C02 Pick PCC-K02	C24 Pick PS105-K01	C35 5424 Power on	C 01 I/O CU Power on	IFC/ LB0
	32	33					C 37 Command Check	C 38 Machine Check	C 39 Interrupt Enabled	C 40 Interrupt Request	IFC/ LB1
	34	35					Spare	Spare	Spare	Spare	IFC/ LB2
	36	37					Spare	Spare	Spare	Spare	IFC/ LB3
Sense Card 1	40	41	C 08 Initial Pwr. on PS111	C 09 Power on PS 112	C 26 Power Complete	C 10 Power on PS 113	C 27 Power - off Program	C 11 Power on PS114	C 29 Power Check	C 19 Final pwr.on PS111	SC1/ LB0
	42	43	C 31 Power Warning to PU	C 15 Reset I/O	C 33 Reset I/O Controller	C 16 Metering in SP	C 17 PU Check Stop	C 32 PC Ready	C 25 Power Controller Reset	C 34 Pick PCC - K03	SC1/ LB1
	44	45	C 41 Enable Timeout SC1	C 42 Byte Test SM1, SC1	C 43 Byte Test SM2, SC1	C 44 Address Test SC1	C45 Disable Interrupt + 5.1V/A1	C 46 Disable Interrupt - 5.1V/C2	C47 Disable Interrupt - 5.1V/A1	C 48 Disable Interrupt +8.5V/C2	SC1/ LB2
	46	47	C 49 DAC 960.0mV=64%	C 50 DAC 480.0mV=32%	C 51 DAC 240.0mV=16%	C 52 DAC 120.0mV=8%	C 53 DAC 60.0mV=4%	C 54 DAC 30.0mV=2%	C 55 DAC 15.0mV=1%	C 56 DAC 7.5mV=0.5%	SC1/ LB3
Sense Card 2	50	51	C 18 Test bit for PC Reset	C 23 Indic. for PS105 Inst.	C 05 TOD Clock Indicator	C06 Reset ESD Monitor	C 21 Test ESD Monitor	C 22 Spare	C 20 Spare	C 04 Spare	SC2/ LB0
	52	53	C 36 Spare	C 03 Spare	C 07 Spare	C 28 Spare	C 12 Spare	C 13 Spare	C 14 Spare	C 30 Spare	SC2/ LB1
	54	55	C 57 Enable Timeout SC2	C 58 Byte Test SM1, SC2	C 59 Byte Test SM2, SC2	C 60 Address Test, SC2	C 61 Interrupt Mask SC2	C 62 Interrupt Mask SC2	C 63 Interrupt Mask SC2	C 64 Interrupt Mask SC2	SC2/ LB2
	56	57	C 65 DAC 960.0mV=64% , SC2	C 66 DAC 480.0mV=32% , SC2	C 67 DAC 240.0mV=16% , SC2	C 68 DAC 120.0mV=8% , SC2	C 69 DAC 60.0mV=4% , SC2	C 70 DAC 30.0mV=2% , SC2	C 71 DAC 15.0mV=1% , SC2	C 72 DAC 7.5mV=0.5% , SC2	SC2/ LB3

Marks, Keys

Marks and keys are part of the power log display. The bits are written if an error occurs and the power status is saved. The marks and keys are also used for reference code generation, as well as control lines, digital- and analog sense lines. Some bits are only used for internal programming information, not for field usage.

	Bits 0	1	2	3	4	5	6	7
MARKS	Power on and monitor error	BPC off and ref. code display	Power on/ off control error	Power on timeout	Early digital or analog LOG done	Power off timeout	Escape done	No interrupt possible by monitor error
KEYS	Power on done	Permanent interrupt at the end of power on	Normal mode error	Early power log	Power off key operated	Invalid string command	Any loop count zero	Monitor control error

For Physical Pin Locations refer to ALD-YA033.

Power Controller Sense Table

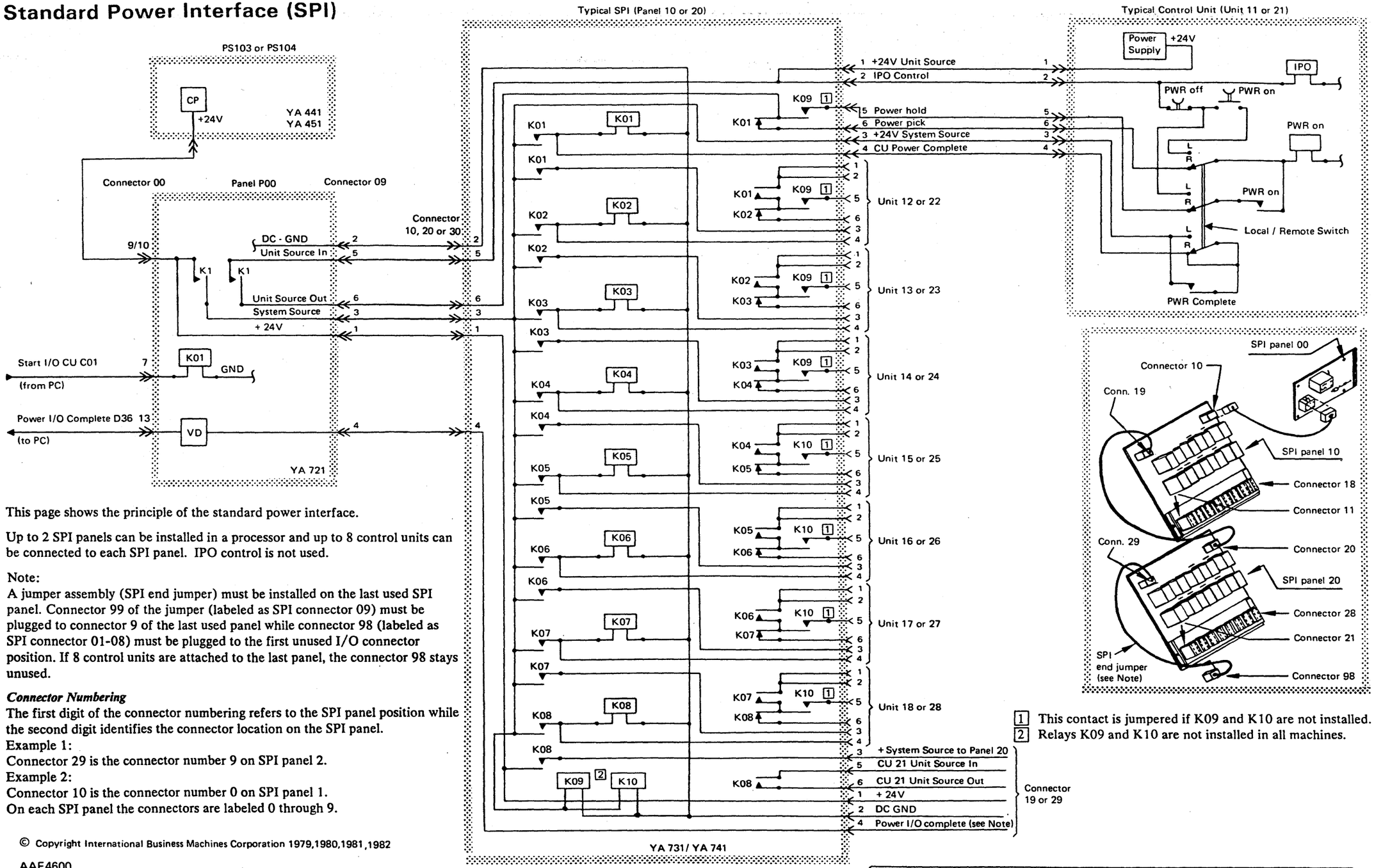
Address WR	Address RD	Bit 0	1	2	3	4	5	6	7	Card/ Byte
—	11	Interrupt Request from Sense Byte 0 or 1	Interrupt Request from Sense Byte 4 or 5	Interrupt Request from Sense Byte 8 or 9	Interrupt Request from Sense Byte 12 or 13					SC1/ SC2
—	81	D 57 Address Test, Byte 0, SC1	D 22 0V P111 (+ 4.26V)	D 23 OC PS111 (+ 4.26V)	D 24 OV PS112 (-2.2V)	D 25 OC PS112 (-2.2V)	D 04 AIR INLET TEMP TOO HIGH	D 27 OV PS113 (- 4.34V)	D 28 OC PS113 (- 4.34V)	SC1/ SB0
—	83	D 36 I/O Power Incomplete	D 58 Address Test, Byte 1, SC1	D 10 CE Mode Switch on	D 05 ESD Level 1	D 29 OV PS 114 (– 1.52V)	D 30 OC PS 114 (– 1.52V)	D 39 ESD Level 2	D 01 MFCU Power Incomplete	SC1/ SB1
—	85	A 52 +6V PS 105, 01A - A1	A 41 +24V PS 104, 01A-A2	A 42 + 12V PS 104, 01A - A2	A 44 + 5.1V PS 104, 01A - B1	A 46 + 8.5V PS 104, 01A - C2	A 02 + 8.5V PS 105, 01A - A1	A 39 + 10.1V PS 102, 01A - B2	A 23 +8.5V PS104/105,01A-B2	SC1/ SB2
—	87	A 05* + 4.26V PS 111, 01A - B1	A 57 + 7.1V PS 102, 01A - C1	A 30 + 5.1V PS104/PS105, 01A - C2	A 56 + 12.3V PS 102, 01A - C1	A 58 + 12.3V PS 102, 01A - C1	A 60 + 12.3V PS 102, 01A - C1	A 59 + 9.5V PS 102, 01A - C1	A 61 + 6.8V PS 102, 01A - C1	SC1/ SB3
—	91	D 55 # Interrupt SB7 (4 - 7) SC1	D 26 # UV PS 112 (-2.2V)	D 19 # UV PS111 (+ 4.26V)	D 09 # TR102 THSW	D 59 # Address Test, Byte 4, SC1	D 08 # TR105 THSW	D 03 # TR104 THSW	D 18 # Thermal Loop	SC1/ SB4
—	93	D 35 # Power off	D 06 # Spare	D 07 # Spare	D 15 # Spare	D 16 # Spare	D 60 Address Test, Byte 5, SC1	D 13 # UV PS114 (- 1.52V)	D 20 # UV PS113 (- 4.34V)	SC1/ SB5
—	95	A 32 –8.5V PS 105/–12V PS 104 on 01A-B2	A 63 – 5.1V PS 104, 01A - B1	A 06* – 6.54V PS 112, 01A - B1	A 07* – 4.34V PS 113, 01A - B1	A 08* – 1.52V PS 114, 01A - B1	A 62 – 8.5V PS 105, 01A - C2	A 38 – 8.5V PS 105, 01A - A1	A 64 – 12V PS104, 01A-C2	SC1/ SB6
—	97	A 43 – 12V PS 104, 01A - A2	A 45 – 5.1V PS 104, 01A - C2	A 54 + 5.1V PS 102, 01A - B1	A 22 +5.1V PS104, 01A-C1	A 03 # + 5.1V PS 105, 01A - A1	A 33 # – 5.1V PS104/PS105, 01A - C2	A 01 # – 5.1V PS 104,01A - A1	A 31 # +8.5V PS104/105, 01A-C2	SC1/ SB7
—	A1	D 61 Address Test, Byte 0, SC2	D 40 CPU Ident. Hdrs. 8	D 41 CPU Idend. Hdrs. 4	D 42 CPU Ident. Hdrs. 2	D 43 CPU Ident. Hdrs. 1	D 44 CPU Ident. Tens 8	D 45 CPU Ident. Tens 4	D 46 CPU Ident. Tens 2	SC2/ SB0
—	A3	D 47 CPU Ident. Tens 1	D 62 Address Test, Byte 1, SC2	D 48 CPU Ident. Units 8	D 49 CPU Ident. Units 4	D 50 CPU Ident. Units 2	D 51 CPU Ident. Units 1	D 31 ESD Level 3	D 37 ESD Level 4	SC2/ SB1
—	A5	A 13 + 12V PS 104, 01A - A1	A 48 + 12V PS 104, 01A - B1	A 17 Spare	A 18 Spare	A 20 Spare	A 21 Spare	A 16 Spare	A 09 Spare	SC2/ SB2
—	A7	A 04 Spare	A 55 Spare	A 10 Spare	A 40 Spare	A 34 Spare	A 35 Spare	A 36 Spare	A 37 Spare	SC2/ SB3
—	B1	D 56 # Interrupt SB7 (4-7) Spare	D 34 # Spare	D 32 # Spare	D 53 # Spare	D 63 # Address Test, Byte 4, SC2	D 54 # Spare	D 17 # Spare	D 12 # Spare	SC2/ SB4
—	B3	D 52 # Spare	D 11 # Spare	D 14 # Spare	D 21 # Spare	D 38 # Spare	D 64 # Address Test, Byte 5, SC2	D 02 # Spare	D 33 # Spare	SC2/ SB5
—	B5	A 19 Spare	A 25 Spare	A 50 Spare	A 24 Spare	A 47 – 5.1V PS104 Voltage Check with A45	A 53 Spare	A 26 Spare	A 27 Spare	SC2/ SB6
—	B7	A 28 Spare	A 29 Spare	A 12 Spare	A 11 Spare	A 49 # Spare	A 14 # Spare	A 51 # Spare	A 15 # Spare	SC2/ SB7

\# Interrupt generating sense line

* Adjustable voltages

For Physical Locations refer to ALD-YA033.

Standard Power Interface (SPI)



This page shows the principle of the standard power interface.

Up to 2 SPI panels can be installed in a processor and up to 8 control units can be connected to each SPI panel. IPO control is not used.

Note:
A jumper assembly (SPI end jumper) must be installed on the last used SPI panel. Connector 99 of the jumper (labeled as SPI connector 09) must be plugged to connector 9 of the last used panel while connector 98 (labeled as SPI connector 01-08) must be plugged to the first unused I/O connector position. If 8 control units are attached to the last panel, the connector 98 stays unused.

Connector Numbering
The first digit of the connector numbering refers to the SPI panel position while the second digit identifies the connector location on the SPI panel.
Example 1:
Connector 29 is the connector number 9 on SPI panel 2.
Example 2:
Connector 10 is the connector number 0 on SPI panel 1.
On each SPI panel the connectors are labeled 0 through 9.

[1] This contact is jumpered if K09 and K10 are not installed.
[2] Relays K09 and K10 are not installed in all machines.

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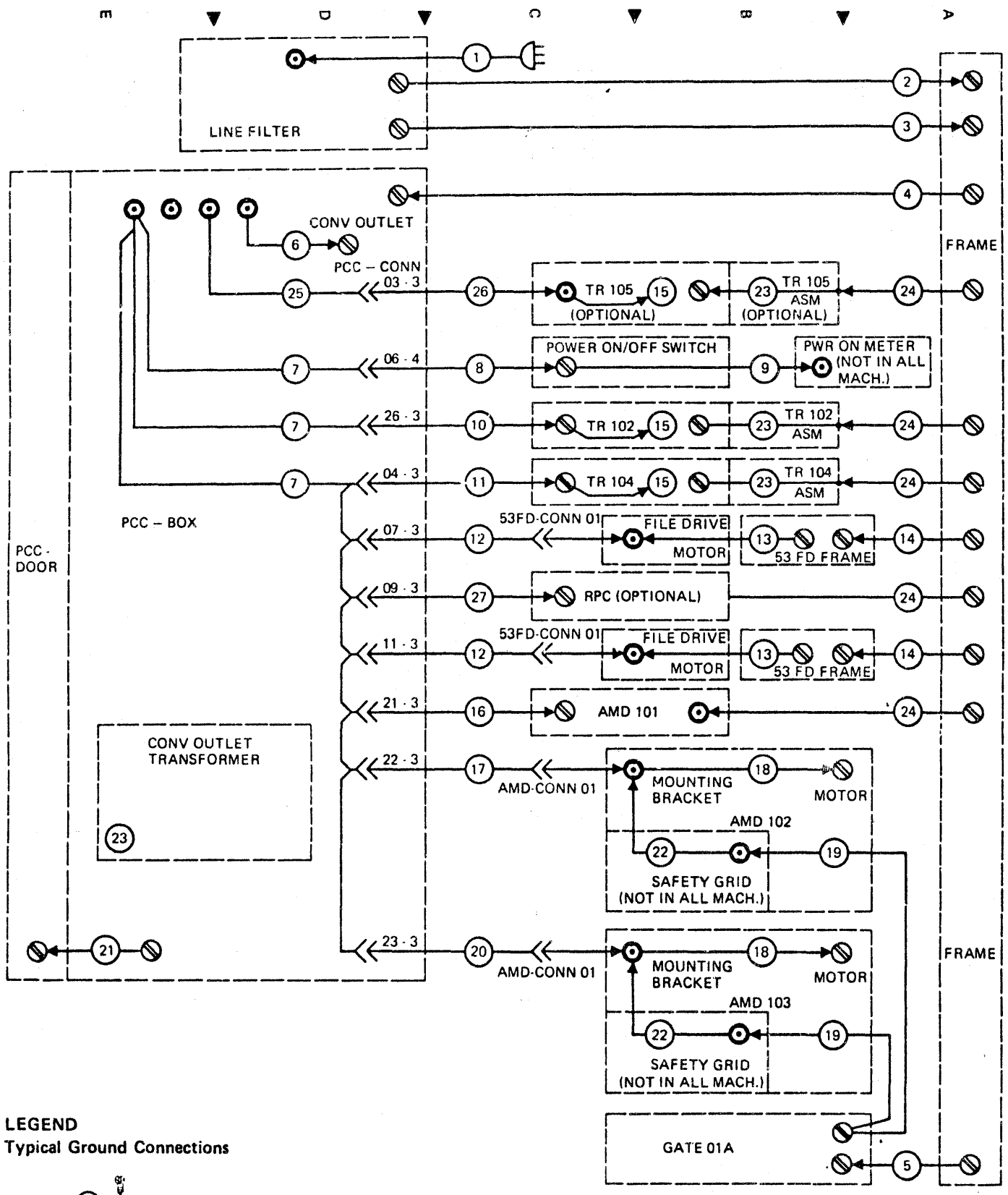
AKF4700

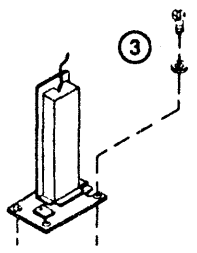
Power

Grounding Diagram

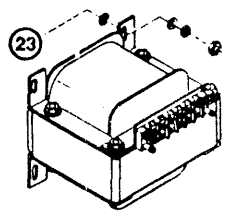


LEGEND

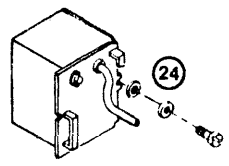
Typical Ground Connections



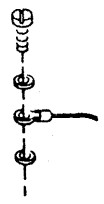
Line Filter



Transformer

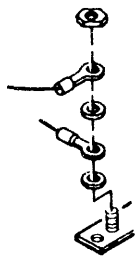


Transformer Assembly

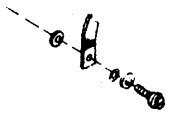


Ground wire connection by screw

Symbols used in Grounding Diagram



Ground wire connection by nut



Ground strap connection

Details shown on Page	
(1) 4710, B6	(2) 4710, D6
(3) 4710, D6	(4) 4710, E8
(5) 4720, C2, E2	(6) 4730, B3
(7) 4730, A3	(8) 4710, B7
(9) 4720, C4	(10) 4730, E2
(11) 4730, E2	(12) Details not shown
(13) 4720, B8, D7, D8, E7	(14) 4720, A3
(15) 4730, E2	(16) 4710, C8
(17) Details not shown	(18) 4730, E6
(19) 4730, A5, A8, C9, D6	(20) Details not shown
(21) 4730, A3, C4	(22) 4730, A6
(23) 4730, A4, E2	(24) 4710, C9, D9, E9, 4730, D8
(25) 4730, B3	(26) 4730, D2
(27) 4730, E9	

Note: For Part Numbers see Parts Catalog

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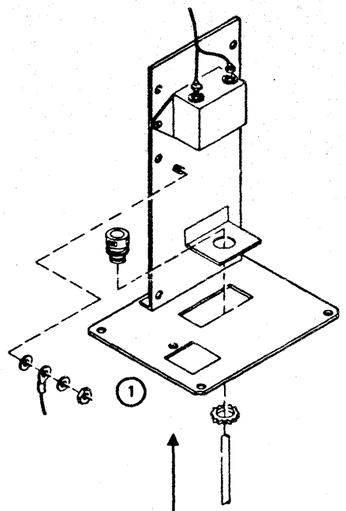
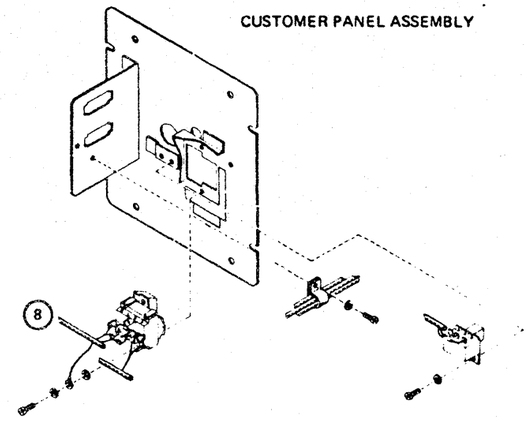
F

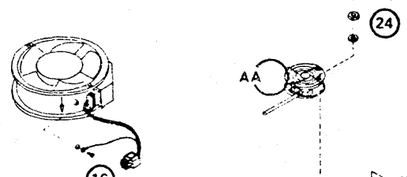
Grounding Details

		Type of connection	From	To
A	(1)	LINE CORD ASM		
	(2)	JUMPER ASM, 80 MM LG	LINE FILTER	FRAME
	(3)	SEE LEGEND	LINE FILTER	FRAME
▶	(4)	JUMPER ASM	PCC	FRAME
	(5)	STRAP	GATE 01A1	FRAME
	(6)	JUMPER ASM, 600 MM LG	PCC OUTLET	GND
B	(7)	CABLE ASM, 50/60 HZ BASIC	PCC – GND	PCC – CONN
	(8)	CABLE ASM	PCC CONN 06	PWR ON SWITCH
	(9)	CABLE ASM	PCC CONN 06	PWR ON METER
▶	(10)	CABLE ASM	PCC CONN	TR 102
	(11)	CABLE ASM	PCC CONN	TR 104
	(12)	CABLE ASM	PCC CONN	53 FD
C	(13)	JUMPER ASM, 80 MM LG	MOTOR	53 FD FRAME
	(14)	JUMPER ASM	53 FD FRAME	FRAME
	(15)	50 HZ MACHINES ONLY	BPO SHIELD	GND
▶	(16)	CABLE ASM	PCC CONN 21	AMD 101
	(17)	CABLE ASM	PCC CONN 22	AMD 102
	(18)	JUMPER ASM, 230 MM LG	MOUNTING BRACKET	MOTOR
D	(19)	JUMPER ASM (OPTIONAL)	SAFETY GRID	GATE 01A1
	(20)	CABLE ASM	PCC CONN 23	AMD 103
▶	(21)	JUMPER ASM	PCC	PCC DOOR
	(22)	JUMPER ASM	SAFETY GRID	MOUNTING BRACKET
	(23)	SEE LEGEND (PAGE 4700)	see Grounding Diagram	
E	(24)	SEE LEGEND (PAGE 4700)	see Grounding Diagram	
	(25)	CABLE ASM, 50/60 HZ FEATURE	PCC – GND	PCC – CONN 03
	(26)	CABLE ASM	PCC CONN	TR 105
	(27)	CABLE ASM	PCC CONN 09	RPC

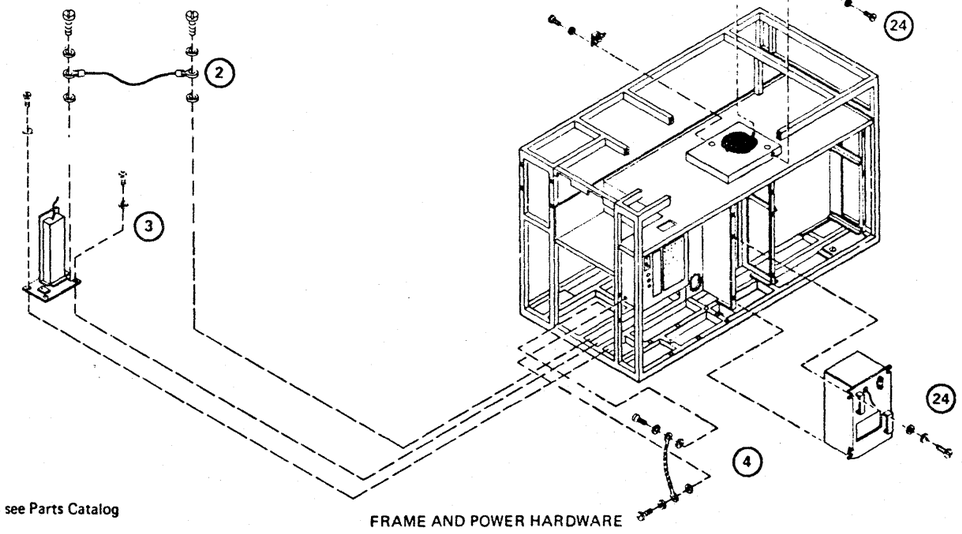


LINE CORD AND FILTER ASSEMBLY





DETAIL AA

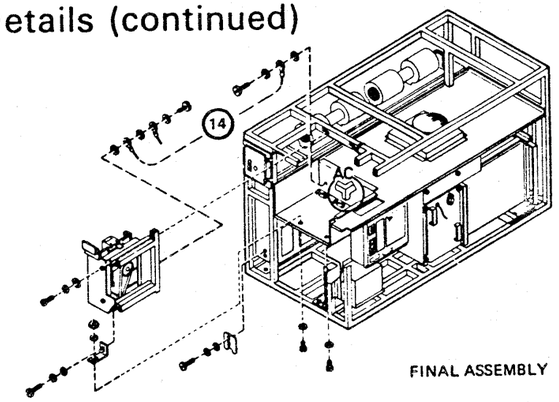


FRAME AND POWER HARDWARE

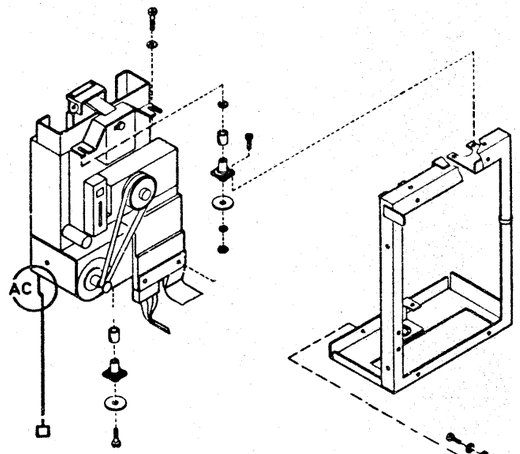
Note: For Part Numbers see Parts Catalog

AKF4710

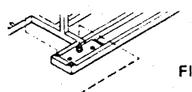
Grounding Details (continued)



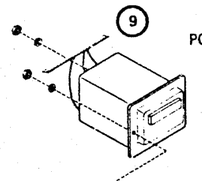
FINAL ASSEMBLY



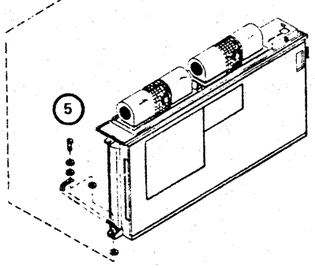
FILE DRIVE AND FRAME ASSEMBLY

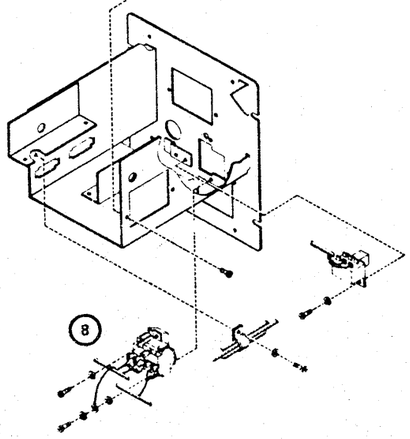


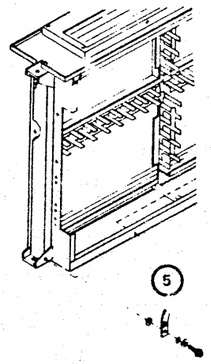
FINAL ASSEMBLY

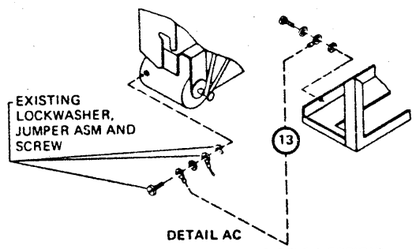


POWER ON METER PANEL ASSEMBLY
(NOT IN ALL MACH.)

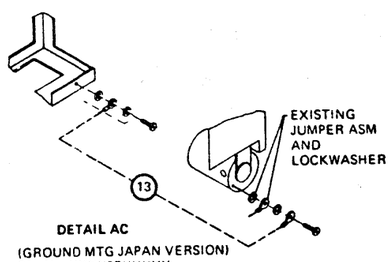




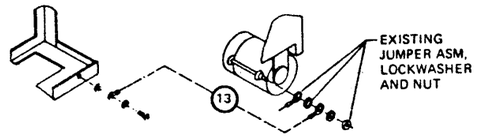




DETAIL AC
(GROUND MTG ENDICOTT VERSION)
Ser. No. XXXX01XXXXX



DETAIL AC
(GROUND MTG JAPAN VERSION)
Ser. No. XXXX97XXXXX



DETAIL AC

(GROUND MTG MAINZ OR HAVANT VERSION)
Ser. No. XXXX73XXXXX(MAINZ)
Ser. No. XXXX57XXXXX(HAVANT)

Note: For Part Numbers see Parts Catalog

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Power

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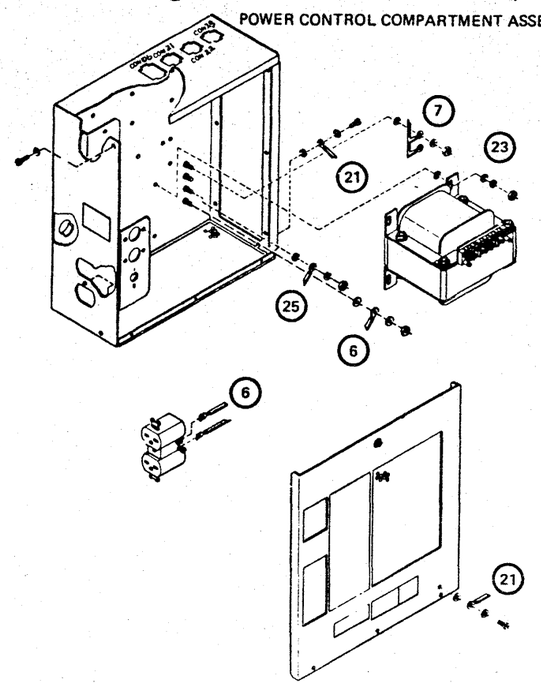
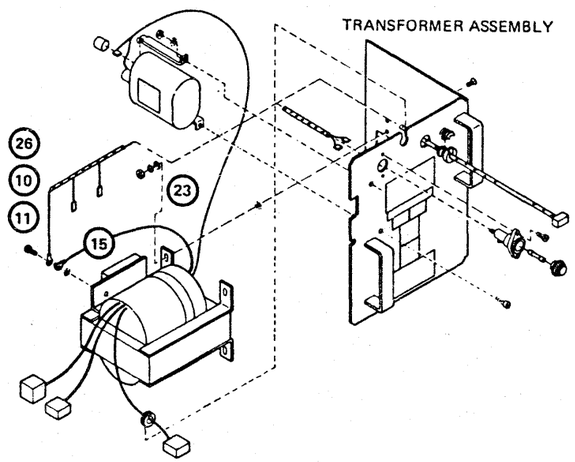
Grounding Details (continued)

POWER CONTROL COMPARTMENT ASSEMBLY

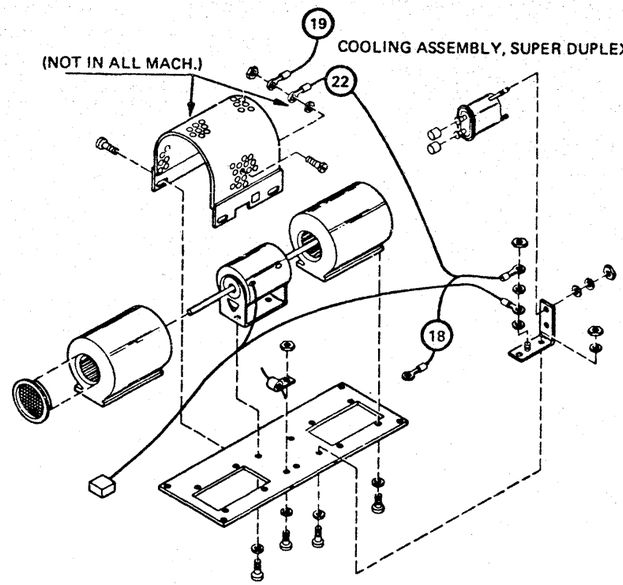


TRANSFORMER ASSEMBLY



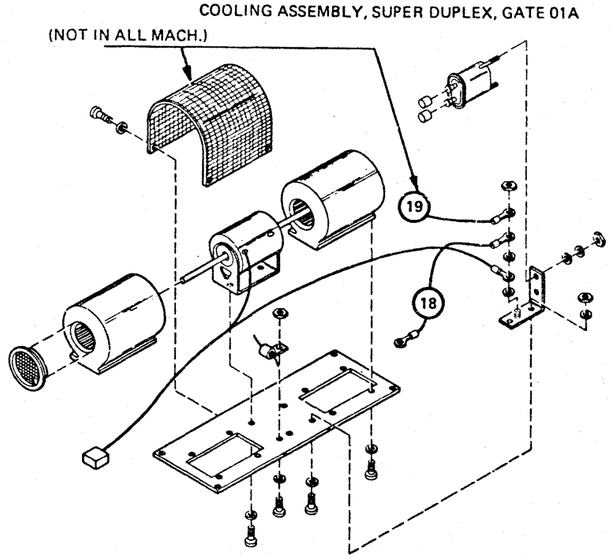
COOLING ASSEMBLY, SUPER DUPLEX, GATE 01A

(NOT IN ALL MACH.)

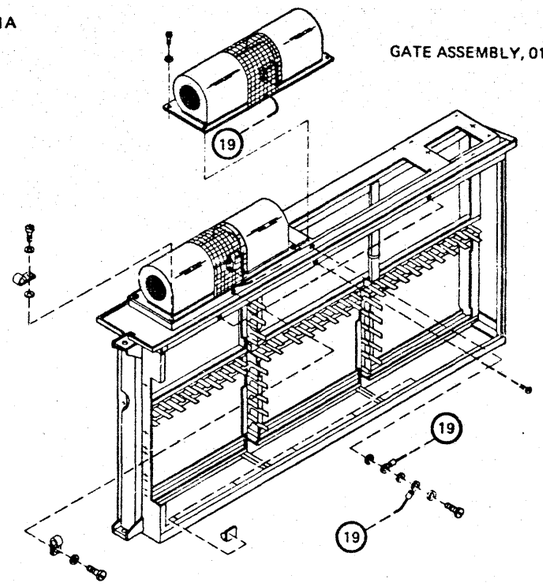


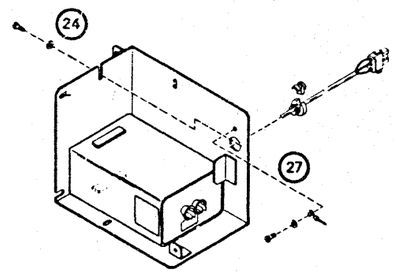
COOLING ASSEMBLY, SUPER DUPLEX, GATE 01A

(NOT IN ALL MACH.)



GATE ASSEMBLY, 01A





REACTIVE POWER COMPENSATOR ASSEMBLY (OPTIONAL)

Note: For Part Numbers see Parts Catalog

Hints for Power Maintenance

DANGER

It is not allowed to remove subassemblies from the machine frame under power or to do any service on subassemblies under power outside of its machine frame mount.

Any power repair action should start with use of the corresponding MAP for the displayed reference code. If a power problem is suspected with no reference code displayed, always start with MAP 0200.

For use of the POWER MAPs, you should be familiar with the 'Important Hints for Power MAP Usage' in this section. Other paragraphs in this section give more information about wiring checking, intermittent problem analysis, and action when asked to 'call for assistance'.

Important Hints for Power-MAP Usage

(Valid for reference codes beginning with '02' or 'F7')

MAP Entering

Before entering the power MAP, make sure that all listed cards and cables in board 01A-A2 and 01A-C2 are plugged in and seated correctly.
Board 01A-A2: A2, B2, C2, D2, E2, YM and YD
Board 01A-C2: D2, E2, F2, G2, H2, J2, YJ and YK

Card Plugging

Never remove or insert a card with system power on. Before replacement of any card, check card connectors for bent or broken pins. Also check the wiring side of the board for damage.

Switching off the Line Voltage

Switch off PCC-CB01 before working in any system area where line voltage might be present.

DANGER

PCC-CB01 does not remove power from the convenience outlet circuits. Before working in the PCC-box or fuse replacement of PCC-F01 or PCC-F02, switch off additionally PCC-SW01 (switch for convenience outlet).

PCC-CB01 must also be switched off prior to replacement of transformers or power supplies.

Never remove a primary fuse of any transformer while PCC-CB01 is switched on.

Power-off Key Usage

When the MAP tells you to press the power-off key you have the choice of pressing the power-off key at the OCP (operator console panel) or of pressing the power-off switch at the CCP (customer console panel).

General Logic Probe (GLP)

Probe Switch Setting

When the MAP tells you to 'probe pin XX', connect the main input of the General Logic Probe 2 (GLP2) to the pin XX using the following switch setting of GLP2:

- TECHNOLOGY switch: Multi
- LATCH switch: None
- GATE REF. switch: + 1.4V
- GATING input + and -: Unused

If another switch setting of the probe is required, the switch setting is shown in the MAP.

If the probe gating inputs are used, the gate reference switch must be set to +1.4V.

Connection of Probe Power Cable

The power cable of the probe must be connected to the following pins in card position 01A-A282:

- Red lead (positive) to D03, or J03, or P03, or U03
- Black lead (negative) to any D08 pin

IMPORTANT NOTES: There is no standby power present with system power off.

After pressing the power-on switch, both probe indicators will be lit for a short time when the supply voltage raises to its final level. This probe indication must be omitted.

The probe operates without any error approximately one second after the power-on switch was operated.

Hints for Power Maintenance (continued)

General Logic Probe (continued)

Probe main input
The probe main input must be connected to the measurement points called out in the MAP.

A special extension cable for the GLP2 can be used. The main input ground must be connected to DC-ground (usually the D08 pin of a logic card position).
Never use a D08 pin in a cable connector position.

The basic shipping group contains two extension wires which may be used for probe measurements.

Floating Signal
If a probed pin does not show an indication on the GLP2, ensure that your GLP2 is operating correctly. Check power connections and apply logical up and down level to the main input of the probe.

For more details refer to 'General Logic Probe 2 Manual' (form number SY27-0127).

If probe functions are correct and a probed pin called out in the MAP does not show an up or a down level indication, the probed pin is floating or the applied voltage level is out of the acceptable limits. In case of floating pin, refer to the ALD-page where the pin is shown and check board wiring and cabling of the floating signal. Apply the 'Wiring Check Procedure' shown in this book.

If no wiring error was detected, replace the card which generates the failing signal.

Power Controller Card Replacement

If the MAP advises you to replace a power controller sense card in position 01A-A2C2 or 01A-A2D2 and no new card is available, you should exchange (swap) both cards and retry power on. If another reference code is displayed after card swap, the defective card has to be replaced before the machine is returned to the customer. If no reference code is displayed after card swap, the defective card has to be replaced as soon as possible. Return the machine to the customer until spare parts are available.

CE-Meter Accuracy Check

1. To check the accuracy of the CE-meter, connect the plus lead of the meter to 01A-A2C2-S11 or 01A-A2D2-S11 '+3.0V output SCX' and the minus lead of the CE-meter to any D08 pin. The +3.0 V voltage has a accuracy of +/-1.5 percent.
2. Remove the diskette from the diskette drive.
3. Press power-on switch.
4. Check your meter reading (should be 3.0VDC).

Connectors

If a wiring error is suspected, ensure proper connector seating and good pin contract.

Before FRU-replacement, check the FRU-connectors.

Measurements at Connectors

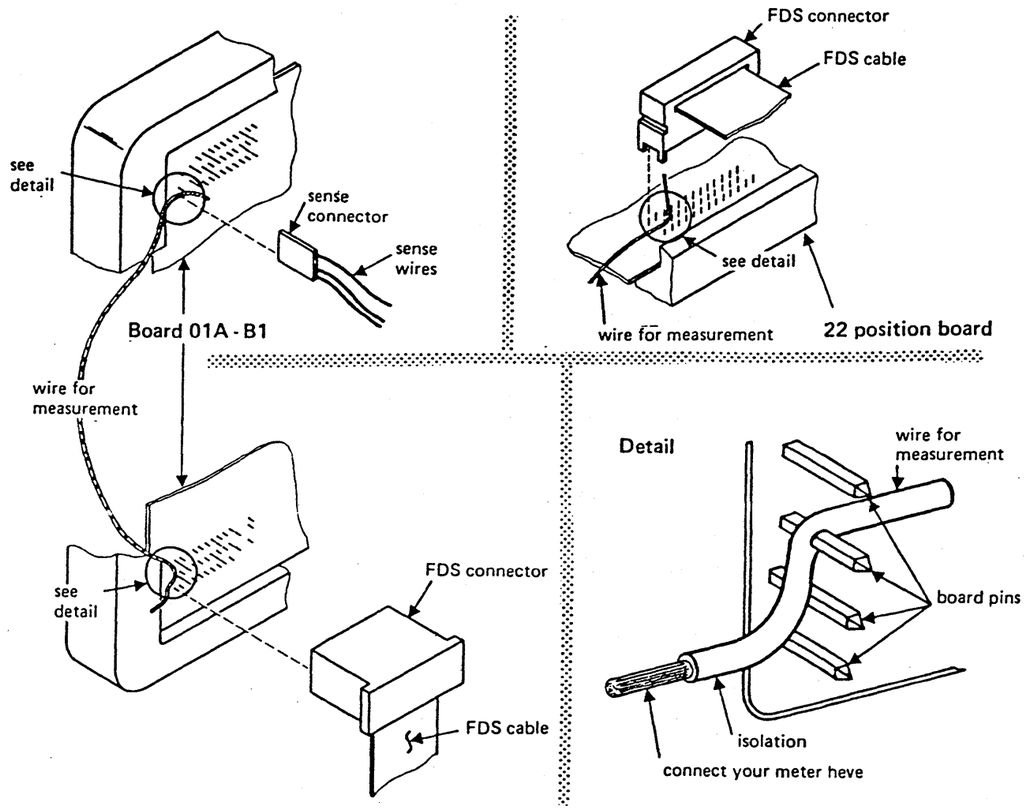
If the MAP advises you to connect the probe or your CE-meter to a connector pin, do not remove the connector from its position. The connector pins are accessible by the probe tip.

Before starting the measurement, ensure that the probe tip has good contact. For measurements on voltage feeding connectors of boards, the plastic cover of the connector has to be removed.

Measurements at Board Pins

If the MAP advises you to connect your CE-meter to a board pin which is already covered by an FDS connector or by a sense connector, apply the following procedure:

1. Disconnect FDS connector or sense connector.
2. Take a wire from the shipping group, punch a hole into it (use a needle or similar tool) and connect the wire to the pin to be measured as shown on this page. Make sure that the wire does not cause a short between two board pins.
3. Reconnect the previously removed FDS connector or sense connector.
4. Proceed as described in the MAP.



Hints for Power Maintenance (continued)

Signal Names and References

Measurement points used in the MAP have the format shown in the following example:

Connector PS102-02-003.....connector 02 of PS102, pin 003
01A-A2F2-D06.....normal pin counting scheme.
'-power on PS113 C10'.....signal name used in the ALD.
(ALD-YB441).....reference to ALD where the pin is shown.

Termination of Repair Action

After most repair actions, the map leads you to the MAP 0204. If your repairs were sucessful, the MAP 0204 leads you to MAP 0275 for a final voltage check. Unsuccessful repairs bring you to further repair instructions (if several failures are present), or you return to the first repair instruction (if the trouble was not found and repaired).

If you come to the same repair instruction twice after answering all questions in the MAP correctly, refer to this power manual and try to isolate the faulty part using the ALD, power manual and power programs.

Also suspect an intermittent error (see paragraph 'Before calling for assistance').

If trouble cannot be found, see paragraph 'Before calling for assistance'.

Never change the error situation by swapping or replacing cards unless stated to do so in the MAP.

Never put cards from a machine back into your spare part set unless you are sure that the card was working properly.

Wiring Check Procedure

Note: This procedure should be entered if MAP for reference codes beginning with 02 or F7 or E8 advises you to check and repair the wiring of a certain net.

1.0. The ALD must be used for every wiring check if the net is not shown in the MAP. The necessary ALD references and signal names are shown in the MAP. If the net is shown in the MAP, the signal name is shown at the bottom of the net scheme.

2.0. Switch PCC-CB01 off before the wiring check is started.

3.0. Remove all cards and cables which are connected to the wiring net to be checked.
The physical locations are shown in the ALD.

4.0. Use your CE-meter (Range ohm X1) to check electrical connection between all pins which are part of the circuit to be checked. Special care should be taken to ensure good connection between parallel wired connectors used at transformer and power supply outputs. Use ALD references given in the Map. A bad contact may cause an intermittent out-of-tolerance voltage.

4.1. Connect one lead or your CE-meter (Range ohm X1) to any D08 pin (DC-Gnd), while the second lead is to be connected to any pin of the wiring net. There should be no electrical connection between the signal wiring and DC-Gnd.
If electrical connection exists between signal wiring and DC-Gnd, check carefully the signal wiring for any damage (including bend or broken pins and damaged cables).
If the reason for the trouble cannot be detected the board or cabling has to be replaced.

5.0. Use blue/white wires to repair a defective board net.

6.0. After completion of the wiring check, return to the MAP where you came from. If the wiring check was performed as a fix of the MAP go to MAP 0204, Entry Point A for final check.

7.0. If no wiring problem could be detected by the previous procedure, call for assistance (see hints on this page).

Hints for Trouble Shooting Intermittent Power Problems

If an intermittent power failure is suspected, perform the following checks in sequence:

1. Check seating of the voltage feeding connectors on the board and the seating of the sense line connector of the failing voltage (see ALD-YC821 to YC873).
2. Special care should be taken when checking the paddle cards in board 01A-A2 column A.
3. Run voltage measurement program (see MAP 0275) and check for intermittent out of tolerance conditions.
4. Perform IPS service check (see MAP 0280).
5. At the beginning of each power MAP you will find a list of the FRUs which might cause intermittent errors. Replace those FRUs step by step and check them for correct seating and good connections.
6. Intermittent errors may also occur if a diskette drive is exposed to electromagnetic waves. If you suspect those problems, keep the machine covers closed during machine power on time.
7. Perform all checks listed in the EMC check list in this book.
8. Perform the ground check procedure shown in the 'IBM 4331 Processor Installation Manual'.
9. Check all three blowers for correct operation and ensure that the airfilters are clean.

Before Calling for Assistance

This procedure should be followed after MAPs have failed.

1. Before calling for assistance, read carefully the hints for power MAP usage in this book and verify that you have followed each of them.

2. Special care should be taken to check for correct card and connector seating, proper plugging, and for bent or broken pins.

   ATTENTION: The power controller top connectors are not interchangeable and must be installed as shown on page 7010 of this book.

3. Ensure that the correct diskette is installed in your machine. Compare the machine serial number on the diskette label with the machine label.

4. Ensure that the power configurator on the diskettes is correct. To check the power configurator, carry out the following steps:
   > Call M/S PROGRAM SELECTION.
   > Key in the selection for UTILITIES.
   > Select DISKETTE IDENTIFICATION.
   > Key in the subselection for DISPLAY CONFIGURATOR.

   The bits of the power configurator have the following meaning:
   Bit 0 = Y ...PDL4.....(Power Design Level 4)
   Bit 0 = N ...PDL5.....(Power Design Level 5)
   Bit 1 = Y ...CEC.....(Must always be on)
   Bit 2 = Y ...ACA.....(Auto Call Adapter)
   Bit 3 = Y ...LA.....(Loop Adapter)
   Bit 4 = Y ...MFCU.....(5424)
   Bit 5 = Y ...CA 1-3 lines (Communication Adapter)
   Bit 6 = Y ...CA 4-8 lines (Communication Adapter)
   Bit 7 = Y ...SPI.....(Standard Power Interface)

5. Transformer and power supply outputs often use parallel wires and connector pins. If one voltage is out of tolerance (minus signs displayed), ensure that all parallel wired connectors have good electrical connection. Use ALD references given in the MAPs.

6. Ensure that all blowers are running correctly and that all airfilters are clean.

7. If any measured signal that is supposed to change its level, remains up or down, even after cards have been replaced or after the wiring has been checked, suspect short circuit to the failing net. (See ALD references given in the MAP.) Use your CE-meter to isolate the short circuit according to the 'Wiring Check Procedure' shown in this book.

8. Retry power on/power off using the diagnostic-diskette.

9. Call your branch office and ask for MAP chart updates via the reference code data bank.
   (The reference code of your failure is required.)

10. If all previous actions are not successful replace the power controller cards in positions 01A-A2C2, 01A-A2D2 and 01A-A2E2 and retry power on. If the previous action was not successful use this manual and the ALD and try to isolate the faulty unit.

11. If there is an undervoltage or out of tolerance condition of voltages generated by a ferro resonant power supply and the corresponding MAPS failed, suspect a defective capacitor in the transformer unit of the failing voltage. Replace the transformer unit and retry power on.

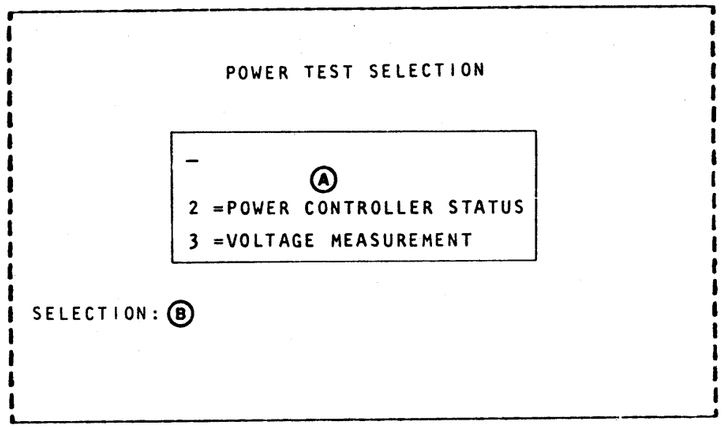
12. At the beginning of each power MAP you find a list of FRUs which might cause the detected error. Check those listed FRUs for correct plugging, seating and good connections.

13. If there is an intermittent error, read the 'Hints for Trouble Shooting Intermittent Power Problems' in this book and follow those hints.

14. If no error could be detected, call your field support center for assistance.

Power Test Selection

The following picture appears on screen when you select 'POWER' from the 'IBM MAINTENANCE AND SERVICE PROGRAM SELECTION'.
To run one of the tests listed in this picture go to the respective handling procedure on the following pages.



(A) Selection codes and names of available programs.

(B) The digits in front of the test name must be typed in behind the word SELECTION to select the appropriate test.

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intentionally left blank

Power Controller Status Display

Handling - Actions

Prerequisites:

1. MSSS power on or power complete
2. Diagnostic diskette or control diskette inserted

How to Select the Test

1. Call M/S PROGRAM SELECTION. Hold down ALT key and press DIAG key. [A]
2. Key in selection for 'POWER', press ENTER. [B]
3. Select 'POWER CONTROLLER STATUS', press ENTER. [C]

   The support processor performs a continuous reading of the power controller status, control lines, analog and digital sense lines, interrupt byte, mark and keys. (See sense and control tables in this book.)

Run Mode:

Looping

How to Terminate the PC Status Display

If you want to run another test return to M/S PROGRAM SELECTION. Select new test, otherwise perform the following steps:

1. Insert control diskette (if applicable)
2. Return machine

Display Description

The power controller status display shows the momentary power status. The program is continously looping while reading and displaying the current status of control lines, digital and analog sense lines, status and interrupt byte, and marks and keys.

Handling - Results

Screen displays:

[A] 'IBM MAINTENANCE AND SERVICE PROGRAM SELECTION'

[B] 'POWER TEST SELECTION'

[C] 'POWER CONTROLLER STATUS'

Example

```
LVL: 0001                    PWR CONTROLLER STATUS                    LOOPING
        STATUS                       CTRL          DIGITALS          ANALOG
      33: 00000010
                          CARD 1  41: 10100000   81: 00000000   85: 11111111
          INTRPT                  43: 00001101   83: 00000000   87: 10110100
      11: 00000000                45: 10000100   91: 00000000   95: 10111100
                                  47: 10100000   93: 00000000   97: 11111011
          MARK
        00000000
                          CARD 2  51: 11000010   A1: 00000000   A5: 00110000
          KEYS                    53: 11110001   A3: 00000000   A7: 01010000
      10000000                    55: 10001111   B1: 00000000   B5: 10001000
                                  57: 10100000   B3: 00000000   B7: 00000000
          MCNT
          0000            INTF  30: 00001000

                                TIMER: OFF          DATA:          ADDR:
                              TOD: SEC
```

CTRL=Control Line
1=Line active
0=Line inactive

Digitals=digital sense lines
1=Line active
0=Line inactive

Analog=analog sense lines
1=Voltage ok > 80%
0=Voltage < 80%

Sense and Control tables are shown on ALD pages YA031 and YA033 and on pages 4560 and 4570 of this book.

Voltage Measurement Program

Purpose

The voltage measurement program is a customer engineering tool. This program allows a CE to display all analog sense points on the display simultaneously. The measurement program is to be used for voltage adjustments of the IPS-voltages.

The program indicates when a voltage differs from the nominal value by displaying + or - signs on the screen. The greater the voltage difference, the greater the number of + of - signs displayed. Characters + and - are used to indicate whether the voltage is minus or plus with respect to the nominal value. When a measured voltage is exact 100 percent of nominal value neither + or - is displayed. See 'display - example'.

Only those voltage monitoring points represented in the 'Master Mask' can be displayed.

Handling

Select program from the power test selection menu.
When called, the program may loop while displaying all voltages.
To select a single voltage the ENTER key must be pressed to enter stop mode for selection.
After a single voltage has been selected, by typing address and bit of the voltage (see page 4570) press ENTER key to continue.
The program again loops, and spreads the voltage graph, as seen in the example.

When adjustment is complete, press ENTER key to return to the normal mode.

CE-Mode on

If a voltage exceeds the normal off limit, the machine will be powered down with CE-mode off. CE-mode on will raise the power down threshold to the component damage level. The displayed normal off threshold is not modified by the CE-mode.

Program Handling - Actions

Prerequisites:

1. MSSS power on for MSSS voltage measurement only
   or
   power complete for measurement of all system voltages.
2. Diagnostic diskette or control diskette inserted.

How to Select the Program

1. Call M/S PROGRAM SELECTION. Hold down ALT key and press DIAG key.
2. Key in selection for 'POWER', press ENTER.
3. Select Voltage Measurement and press ENTER.

How to Terminate the Measurement Program

1. Call M/S PROGRAM SELECTION if you want to run other tests
   or
   insert control diskette (if not inserted) and return machine to customer.

Program Handling - Results

Display-Description

(See display example on the next page.)

Voltage Adjustments

Only 4 voltages generated by the IPS are adjustable (see table on the next page).
The MAP 0279 shows the voltage adjustment procedure.

Physical Sense Points

See ALD pages YA821 to YA873 and YA031 to YA033. A sense point table is shown also on page 4005 of this manual.

Voltage Measurement Display Example

[1] If a voltage exceeds the CALL CE limit, a reference code is displayed and the error condition is logged. The machine is not powered down if the voltages are below the normal off limit.

[2] If any voltage exceeds the normal off limit, a reference code is displayed, the error condition is logged and the machine is powered down if CE-mode is off.
If the support processor voltages are ok, the MSSS keeps powered up.
With CE-mode on, the machine will be powered down if the component damage level of any voltage is reached or exceeded (see page 4005).

[3] The meaning of the command bits are shown in the sense table on page 4570 of this book.

[4] For expanded display enter command and bit here.

[5] Relative percentage above (+) or below (-) nominal value. Percentage per displayed sign varies from address to address.

[6] This information is not used for the voltage measurement program.

Adjustable voltages:

Command	Bit	Voltage	PS-No
87	0	+4.26	111
95	2	-6.54	112
95	3	-4.34	113
95	4	-1.52	114

If -6.54V is out of tolerance, adjust -4.34V (95-3) first.
For adjustment procedure see MAP 0279.

Normal Display Example:

```
                        VOLTAGE MEASUREMENT DISPLAY
                     CARD1                                CARD2
[2]-> NORM OFF
[1]-> CALL CE

                                   -            -
[5]->           +  -    -          ----        +-
               -+ --    - +      - -----  +- - +-+
[3]-> BIT      01234567 01234567 01234567 01234567 01234567 01234567 01234567 01234567
      COMMAND     85       87       95       97       A5       A7       B5       B7
               S T O P M O D E  : PRESS ENTER TO CONTINUE OR SELECT VOLTAGE
[4]-> COMMAND:    BIT:
[6]->                           TIMER:OFF               DATA: 0000   ADDR: 000000
                             TOD:SEC

      3402
```

Expanded Display Example:

```
                        VOLTAGE MEASUREMENT DISPLAY

NORM OFF
CALL CE


         +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
         +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
BIT      55555555555555555555555555555555555555555555555555555555555555555555555
COMMAND     97       97       97       97       97       97       97       97
                   TO RETURN TO NORMAL MODE,PRESS ENTER KEY

                              TIMER:OFF               DATA: 0000   ADDR: 000000
                          TOD:SEC

3402
```

Power Log Display

Log Handling - Actions

Prerequisites:

1. MSSS power on or power complete
2. Insert control diskette

How to Select the Log

1. Call M/S PROGRAM SELECTION. Hold down ALT key and press DIAG key. [A]
2. Key in selection for 'DETAILED LOG DISPLAY', press ENTER. [B]
3. Key in selection for 'POWER LOG', press ENTER [C]

How to Terminate the Log Display

1. Press ALT key and hold press DIAG key. The 'IBM MAINTENANCE AND SERVICE PROGRAM SELECTION' is displayed on the screen.

Log Handling - Results

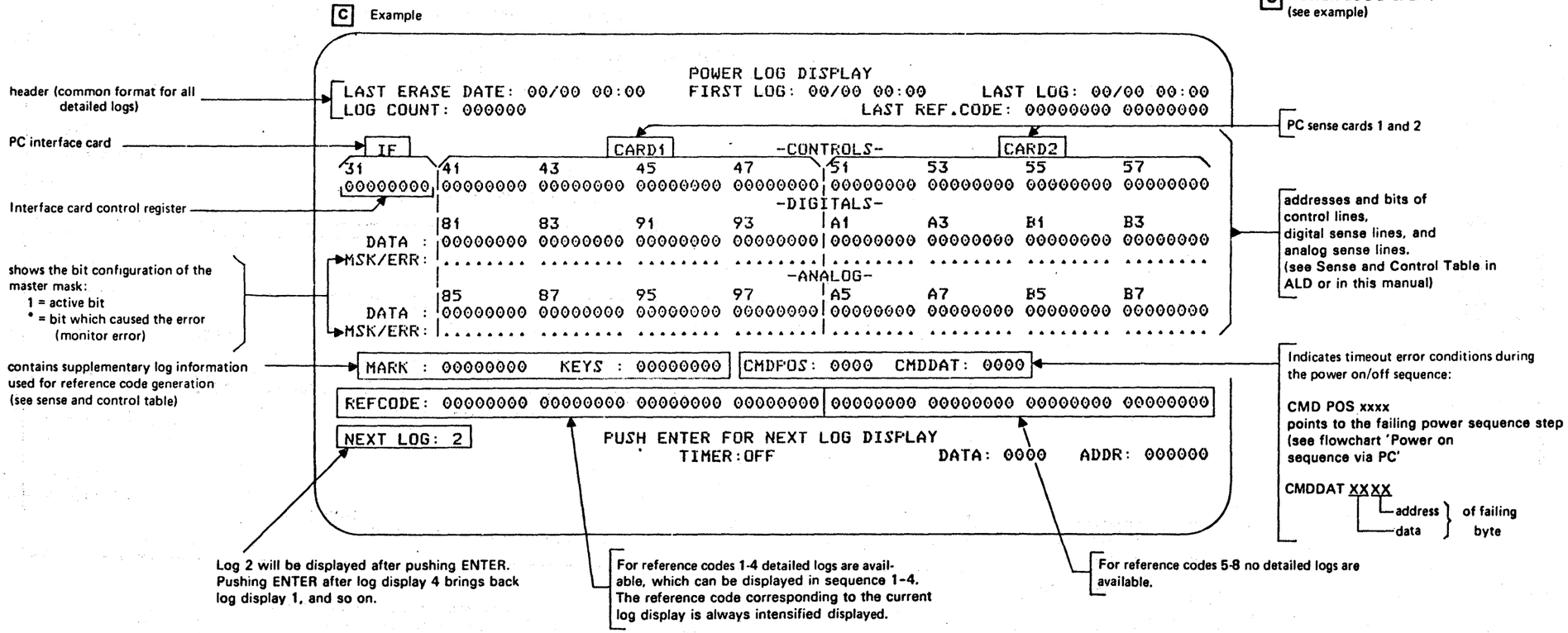
Screen displays:

[A] 'IBM MAINTENANCE AND SERVICE PROGRAM SELECTION'

[B] 'DETAILED LOG DISPLAY SELECTION'

[C] 'POWER LOG DISPLAY' (see example)

[C] Example



header (common format for all detailed logs)

PC interface card

Interface card control register

shows the bit configuration of the master mask:
1 = active bit
* = bit which caused the error (monitor error)

contains supplementary log information used for reference code generation (see sense and control table)

PC sense cards 1 and 2

addresses and bits of control lines, digital sense lines, and analog sense lines. (see Sense and Control Table in ALD or in this manual)

Indicates timeout error conditions during the power on/off sequence:

CMD POS xxxx
points to the failing power sequence step (see flowchart 'Power on sequence via PC'

CMDDAT XXXX
address, data } of failing byte

Log 2 will be displayed after pushing ENTER. Pushing ENTER after log display 4 brings back log display 1, and so on.

For reference codes 1-4 detailed logs are available, which can be displayed in sequence 1-4. The reference code corresponding to the current log display is always intensified displayed.

For reference codes 5-8 no detailed logs are available.

Ambient Recording Log Display

The ambient recording log display consists of two parts:

1. Up to 96 temperature logs are avaialable (see example on page 6150).

2. Up to 96 ESD incidents are logged and displayed as shown on page 6150.

The corresponding reference codes are not displayed in line 23 of the operator console screen.

Temperature and ESD incidents are added to the corresponding log area in ascending order. The latest log always has the highest sequence number. If 96 logs are already available and a new log is pending, all old logs are shifted and the new log is written into position 96.

If an ESD log is wrong (ESD latch missing which means a hardware failure) the ESD monitor is automatically disabled up to the next IML and the wrong ESD log is intensified displayed.

If the ESD monitor is disabled, a message is added to the Ambient Recording Log display:

'Currently no ESD monitoring'.

The ESD monitor can be manually disabled by setting the current ESD sense level to 0.

To enable the ESD monitor again after a manual disableing, select a valid ESD-sense level (1 to 4).

Log Handling - Actions

Prerequisites:

1. MSS power on or power complete

2. Insert control diskette (the diagnostic diskette may also be used).

How to Select the Log

1. Call M/S PROGRAM SELECTION. Hold down ALT key and press DIAG/MODE SEL key. [A]

2. Key in selection for 'DETAILED LOG DISPLAY', press ENTER. [B]

3. Key in selection for 'AMBIENT RECORDING' press ENTER. [C]

   The Temperature Log display on the screen shows up to 48 temperature logs. If more than 48 temperature logs are available, press ENTER for next temperature log display (see example on next page).

4. Press ENTER for ESD log display. [D]
   Up to 48 are shown in the ESD log picture. If more than 48 logs are available, press ENTER for next ESD log picture which shows the logs 49 to 96.

How to Terminate the Log Display

1. Press ALT key and hold press DIAG key. The 'IBM MAINTENANCE and SERVICE PROGRAM SELECTION' is displayed on the screen.

Log Handling - Results

Screen displays:

[A] 'IBM MAINTENANCE AND SERVICE PROGRAM SELECTION'

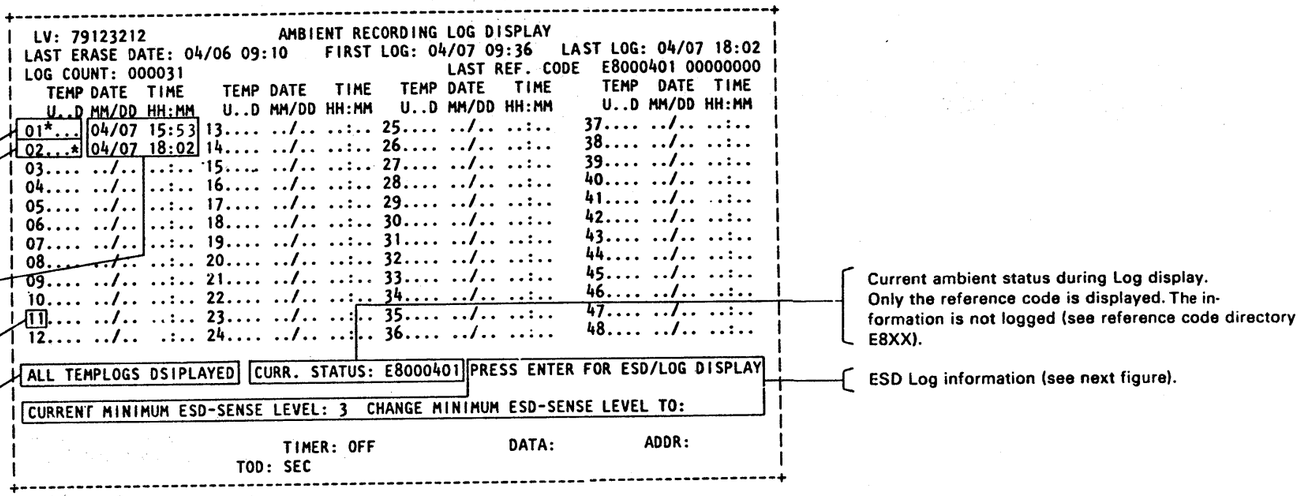
[B] 'DETAILED LOG DISPLAY SELECTION'

[C] 'AMBIENT RECORDING LOG DISPLAY'
(Temperature Log, see example on next page)

[D] 'AMBIENT RECORDING LOG DISPLAY'
(ESD LOG, see example on next page)

Ambient Recording Log Display (continued)

Temperature Log Display



Temperature exceeded upper limit (U = UP)

Temperature went back to normal (D = Down)

Time stamp
The difference between the first and second stamp is the duration of high ambient temperature.

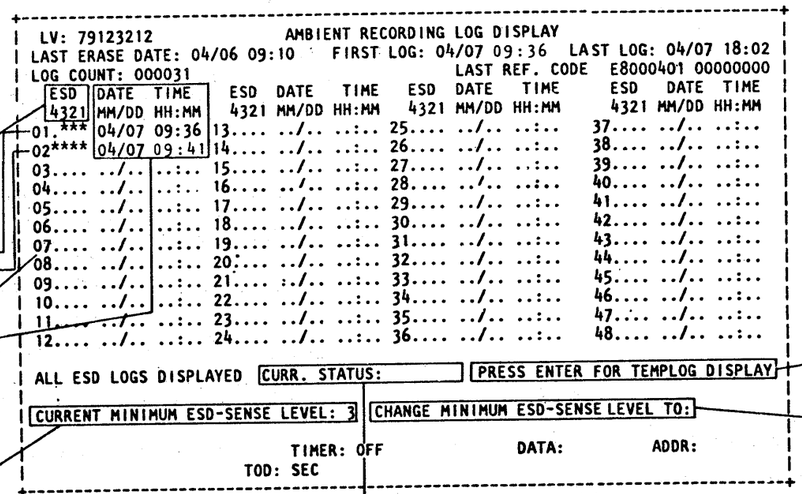
Log numbering (48 per display)

Information wether additional logs exist or not

Current ambient status during Log display. Only the reference code is displayed. The information is not logged (see reference code directory E8XX).

ESD Log information (see next figure).

ESD Log Display



ESD Level
4 = highest level
1 = lowest level
(see description of ESD Monitor in this book)

ESD incident level 3
ESD incident level 4
Log numbering (48 logs per display)

Time stamp
MM = month
DD = day
HH = hour
MM = minute

Shows the minimum ESD sense level. Sense level 3 means: No ESD incident below level 3 is logged. Only ESD incidents with level 3 and 4 will appear in the log picture.

Information for additional logs.

ESD sense level can be set to each valid level 0 to 4. Do not modify the sense level unless instructed to do so by MAP's or by an FSC specialist.

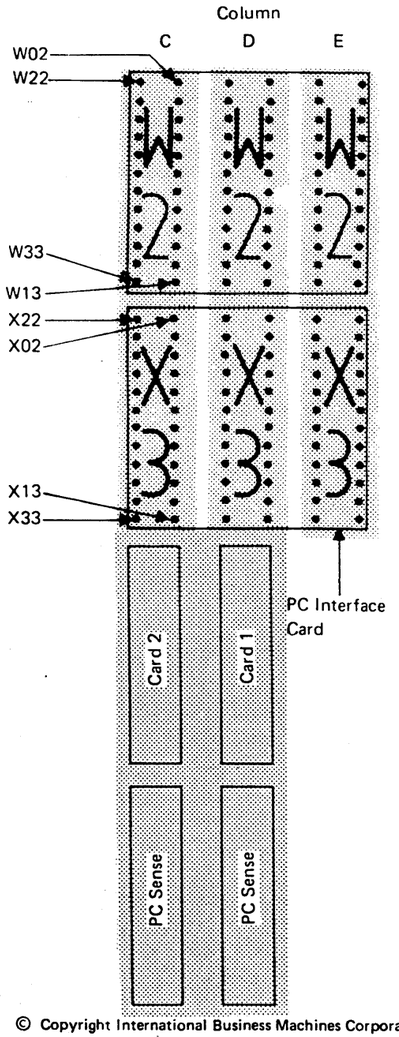
Current ambient status during log display.
Only the reference code is displayed (see Reference code directory (E8XX). The error information is not logged.

Connectors

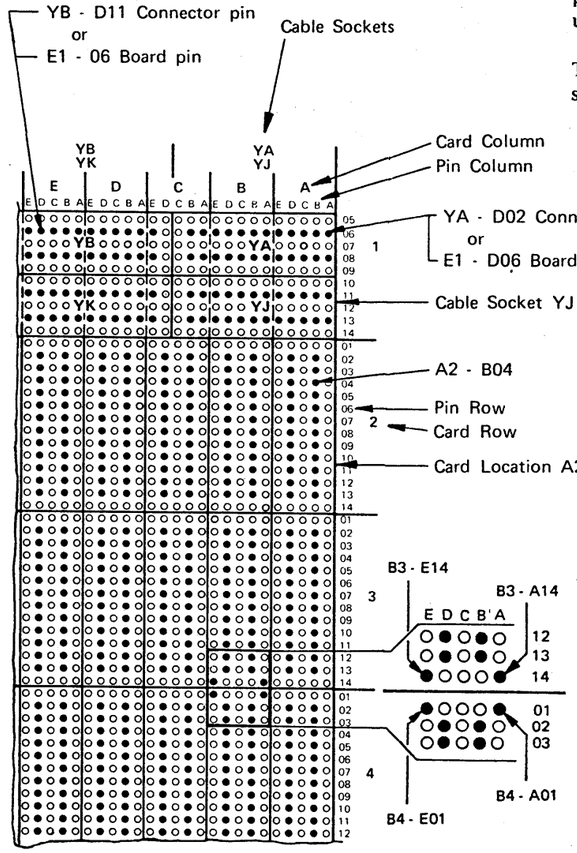
PC Top Connectors

The interconnection of the power-controller interface card and sense cards is done by two different top connectors. The top connectors are labeled W2 and X3 and are not interchangeable. The connector identification can be seen through the slots of the top connector housing.

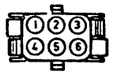
An additional pin identification is printed next to pins W22, W33, X22 and X33. The connectors must be plugged as shown on the following figure.



Pin Connector Locations on 22 Position Board



AC-Connector for Diskette Drives



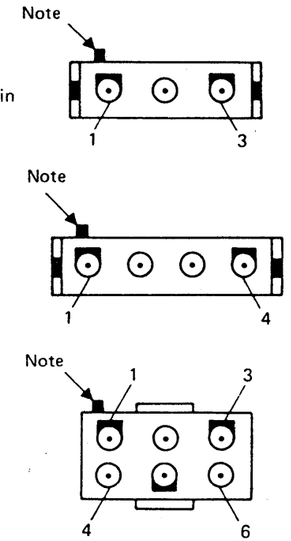
If the diskette drive motor or its AC cable must be replaced, ensure that the ground connectors have correct contact.

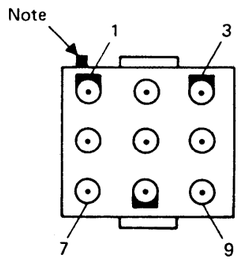
```
1,3  = line voltage
5    = GND
```

Power Connectors

The various Field Replaceable Units (FRUs) of the power complex are interconnected by connectors with up to 15 pins.

The pin counting scheme on the following figure shows the pin side view (male plug).



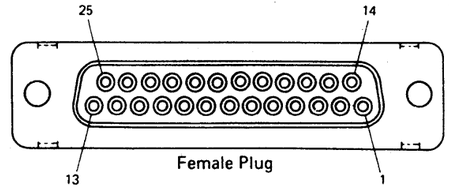


The pin counting scheme of connectors with more than 9 pins is similar.

Note: This mark on the connector housing identifies pin number 1. The identification is valid for male as well as for female plugs.

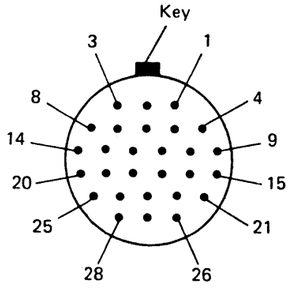
OCP-Connector

(Located in Keyboard Housing)

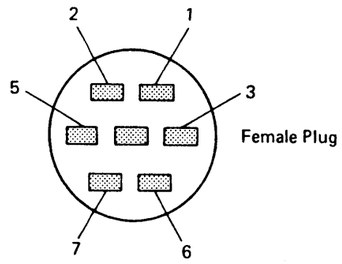


OCP-Connector

(Located next to Connector Compartment 01E)



MFCU DC-GND Connector



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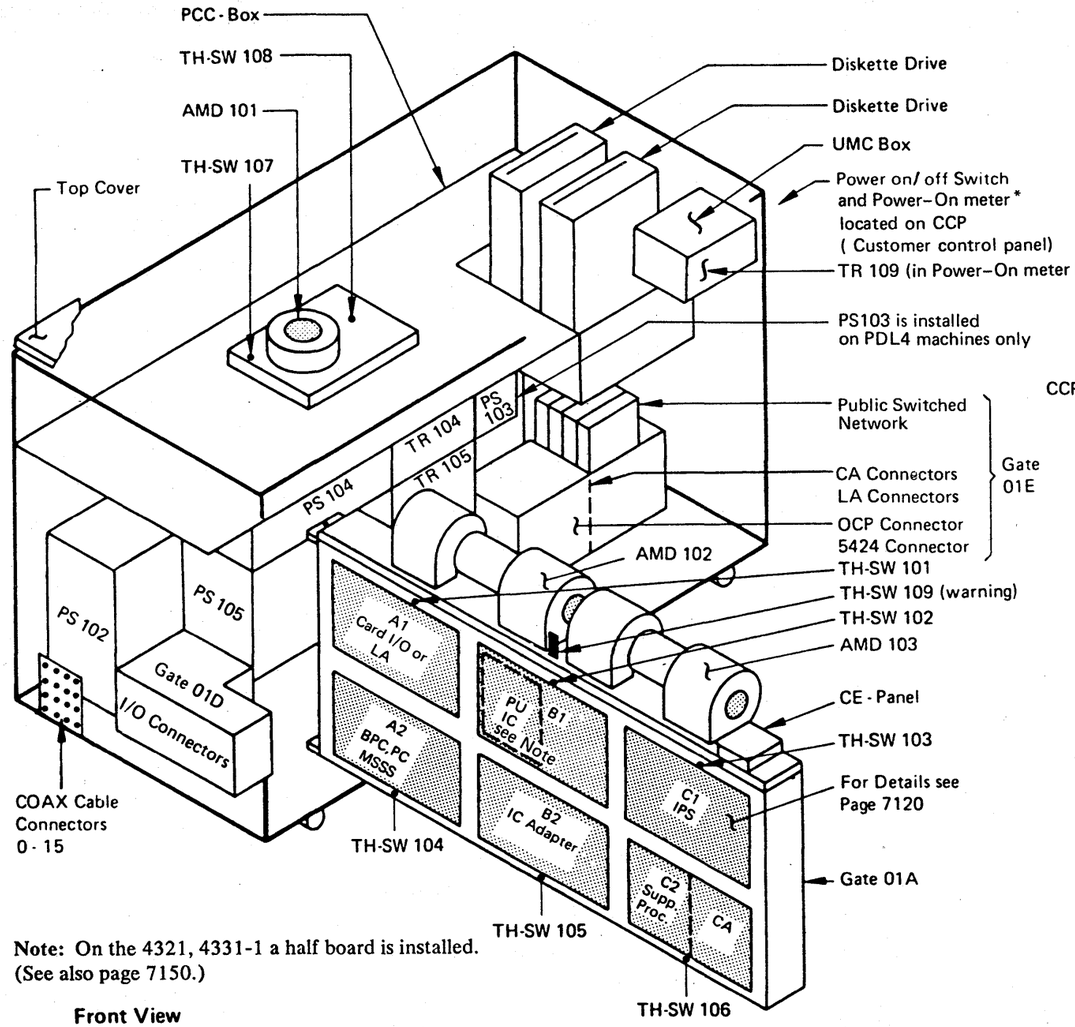
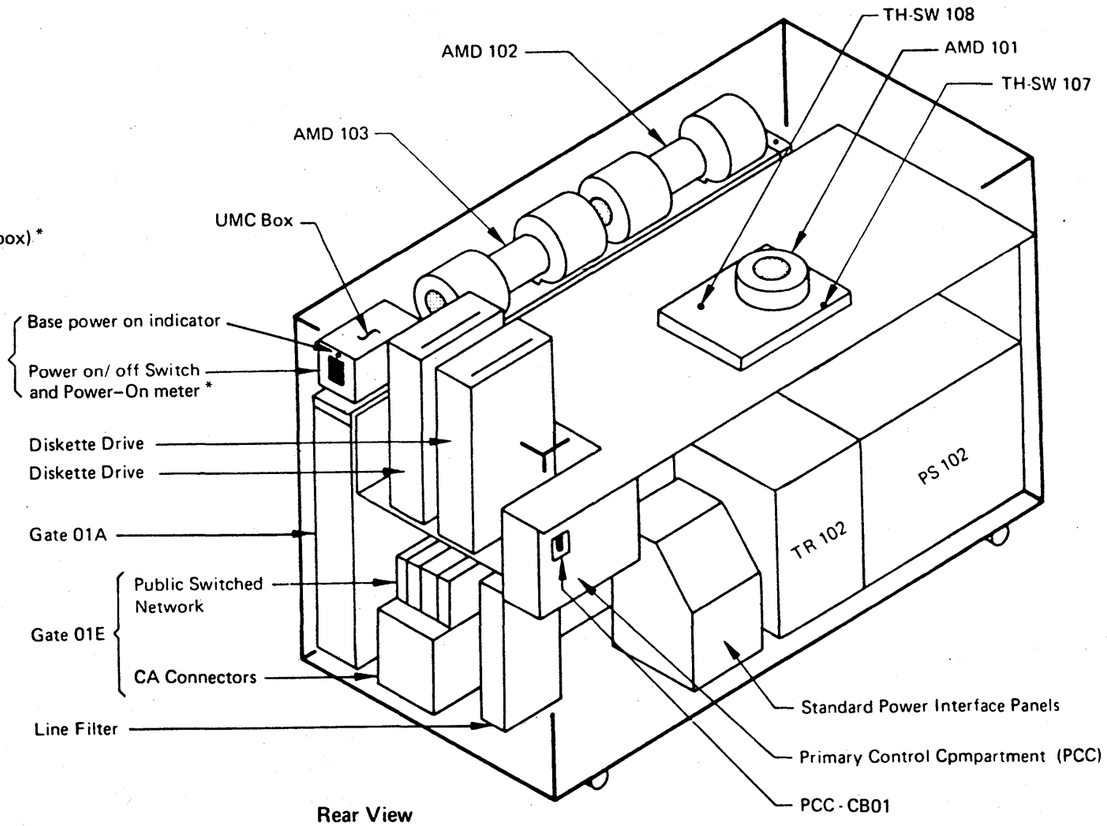
REF

Physical Locations



Note: On the 4321, 4331-1 a half board is installed. (See also page 7150.)

Front View

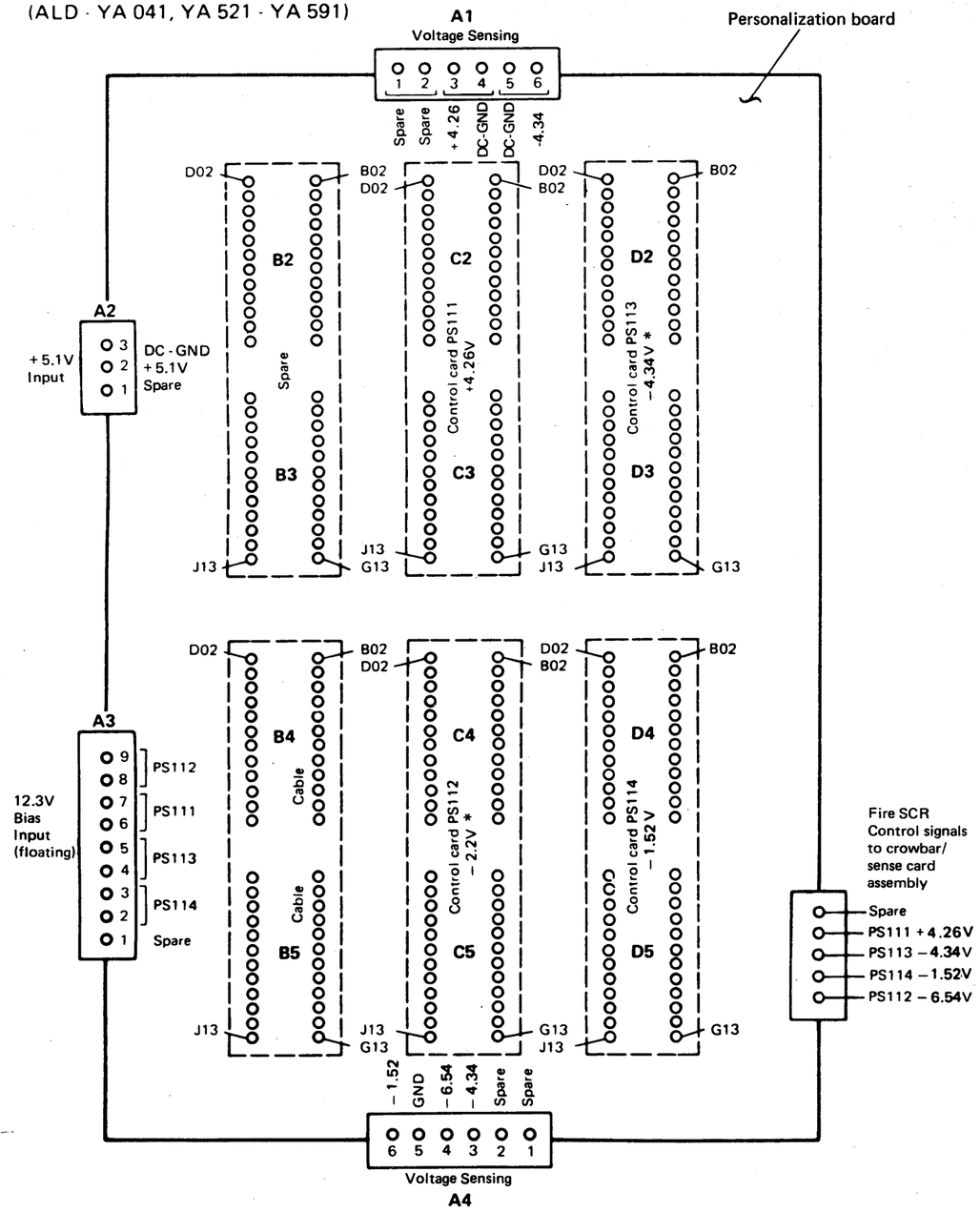


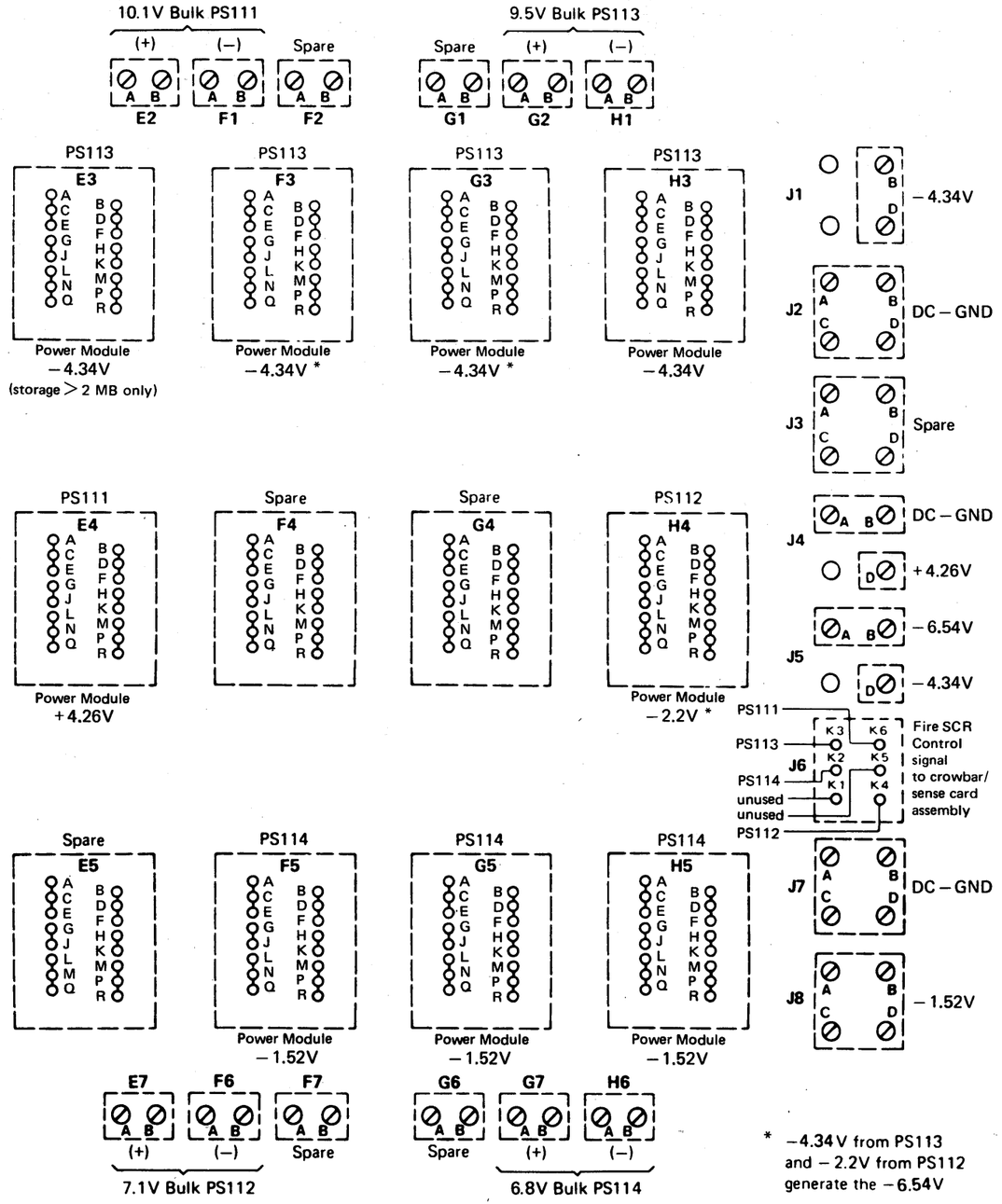
Rear View

* not installed in all machines

IPS Board 01A-C1 (Pin side view)

(ALD · YA 041, YA 521 · YA 591)





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Power

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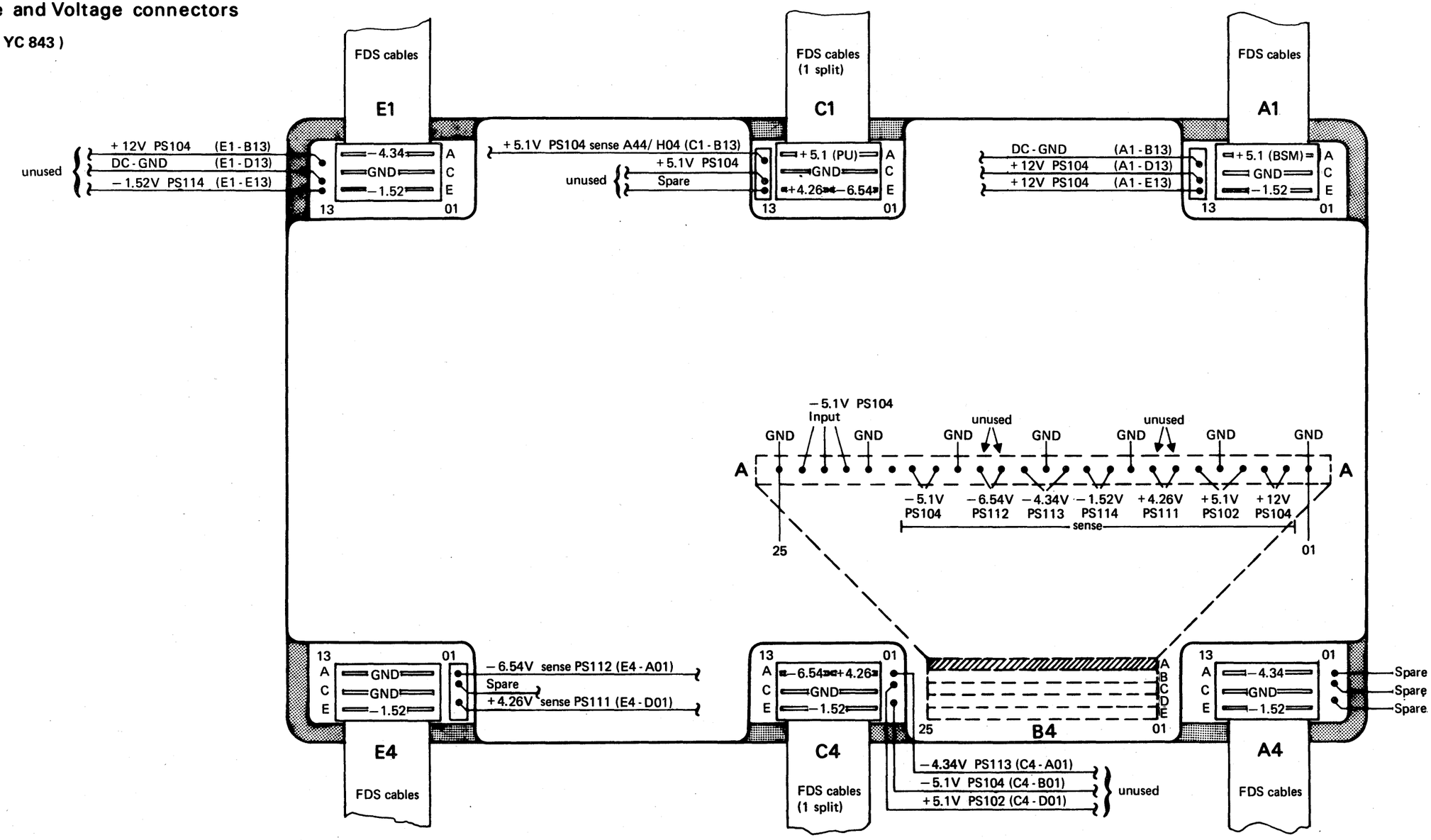
REF

Board 01A-B1 (Pin side view)

Sense and Voltage connectors

(ALD - YC 843)

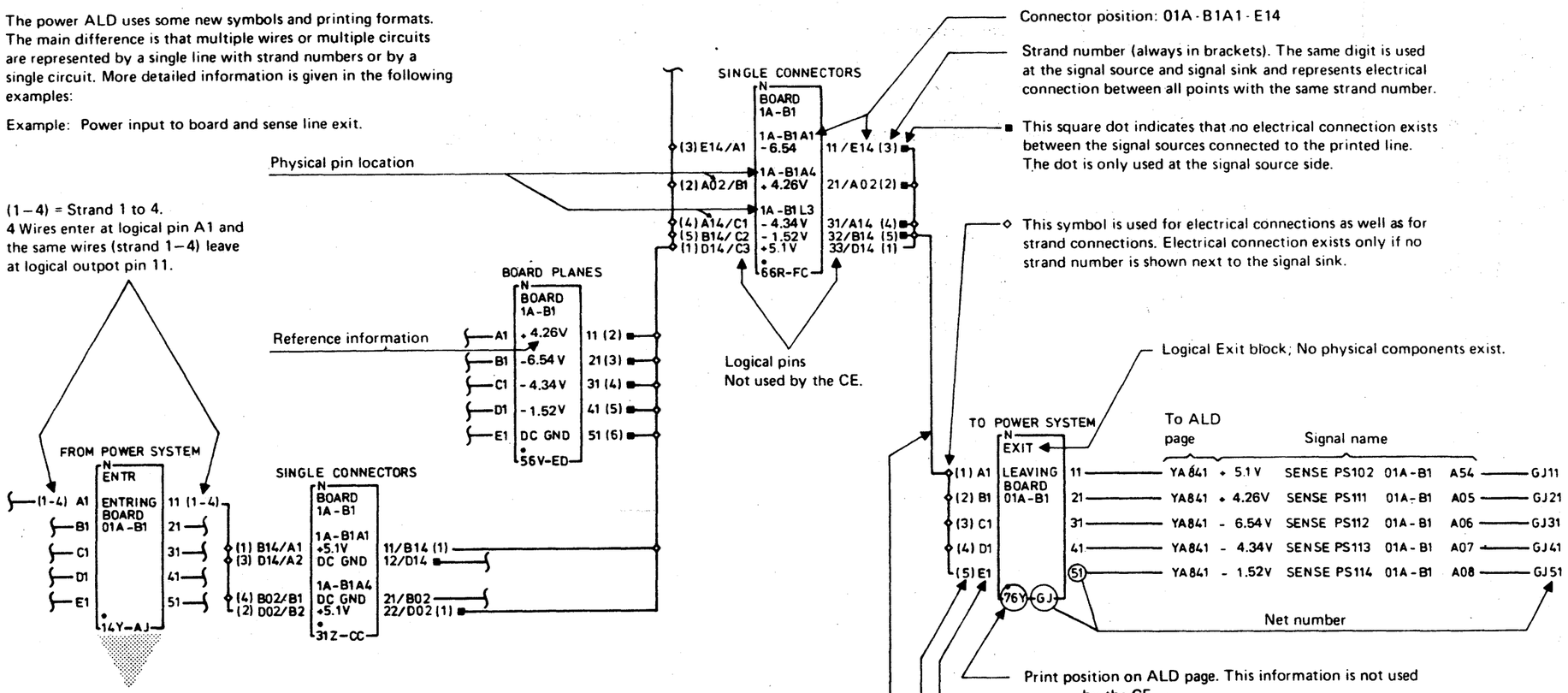


Hints for ALD Usage

1. Wiring

The power ALD uses some new symbols and printing formats. The main difference is that multiple wires or multiple circuits are represented by a single line with strand numbers or by a single circuit. More detailed information is given in the following examples:

Example: Power input to board and sense line exit.

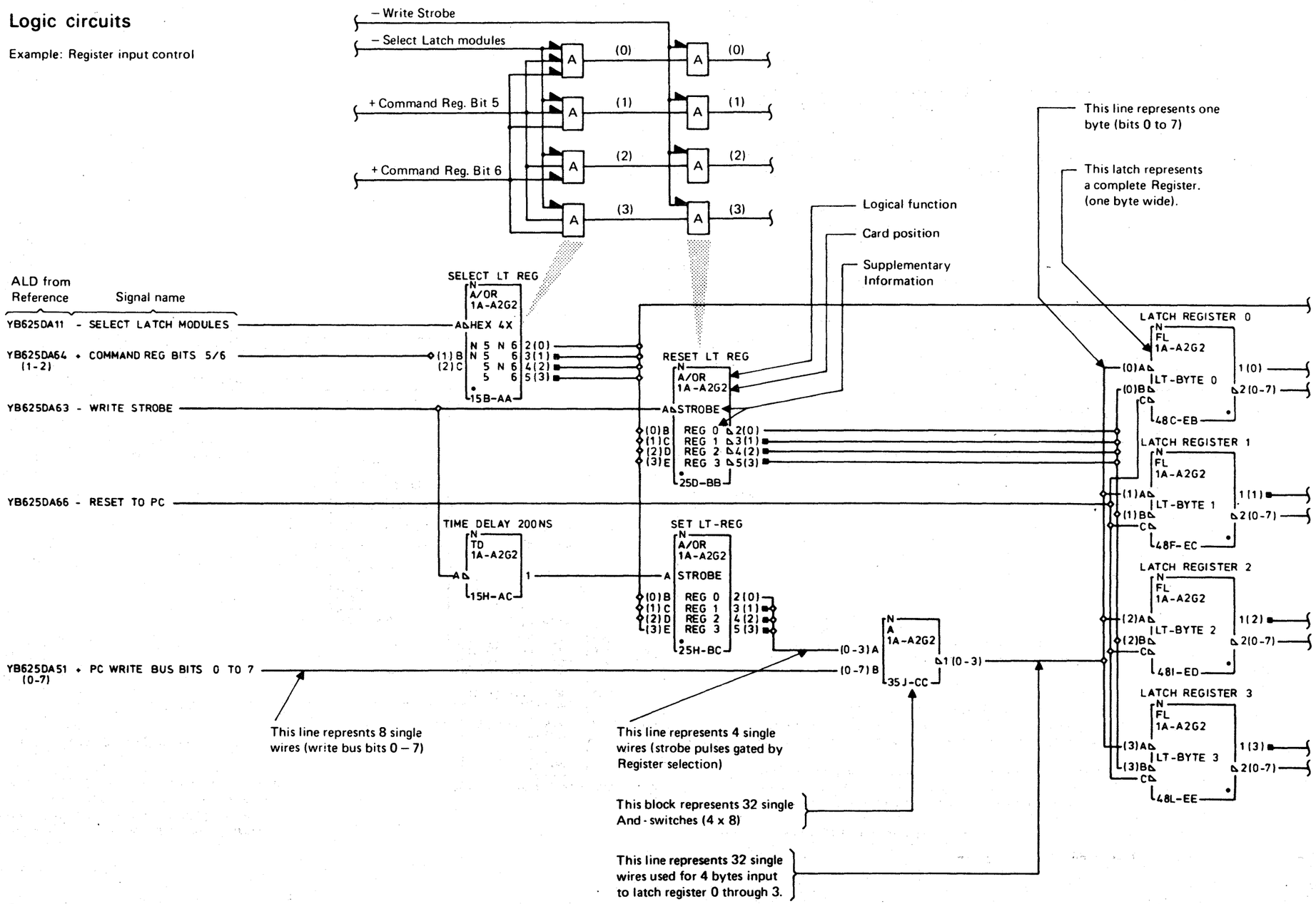


Logical Entry block.
No physical components exist.

Hints for ALD Usage

Logic circuits

Example: Register input control



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Index (continued)

Note: PDL4 only

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