



Maintenance Information

<b>MI</b> MAPs START EXIT 00-02  VOL 01	<b>MI</b> MAPs 04-0E 2X-4X  VOL 02	<b>MI</b> MAPs 80-84  VOL 03	<b>MI</b> MAPs 88 89  VOL 04	<b>MI</b> MAPs AX  VOL 05	<b>MI</b> MAPs AX  VOL 06	<b>MI</b> MAPs CX DX EX F1-F5  VOL 07	<b>MI</b> MAPs F7 00-69  VOL 08	<b>MI</b> MAPs F7 6A-85  VOL 09	<b>MI</b> MAPs F7 86-FF  VOL 10	<b>MI</b> MAPs F8 FC FD FE INDEX  VOL 11
		<b>MI</b> STM LOC REM ADJ DIAGN 53 FD CONFIG  VOL 13	<b>MI</b> STM FEAT CA 5424  VOL 14	<b>MI</b> STM FEAT LA OP GUIDE PDG DIAGN CONFIG  VOL 15	<b>MI</b> POWER INTROD. PRINCIP. DETAILS REP INFO REF INFO  VOL 16	<b>MI</b> GSI INTRO MAINT DIAGN TOOLS FRIEND  VOL 17	<b>MI</b> INSTALL. MANUAL PARTS CAT. OP GUIDE PACK. INSTR.  VOL 18			



IBM 4331 Processor Power

## 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 flow charts, 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 are differences between PDL4 and PDL5 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).

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Machine Type: 4331-2  
Power Design Level: 5  
B/M Number: 5683216

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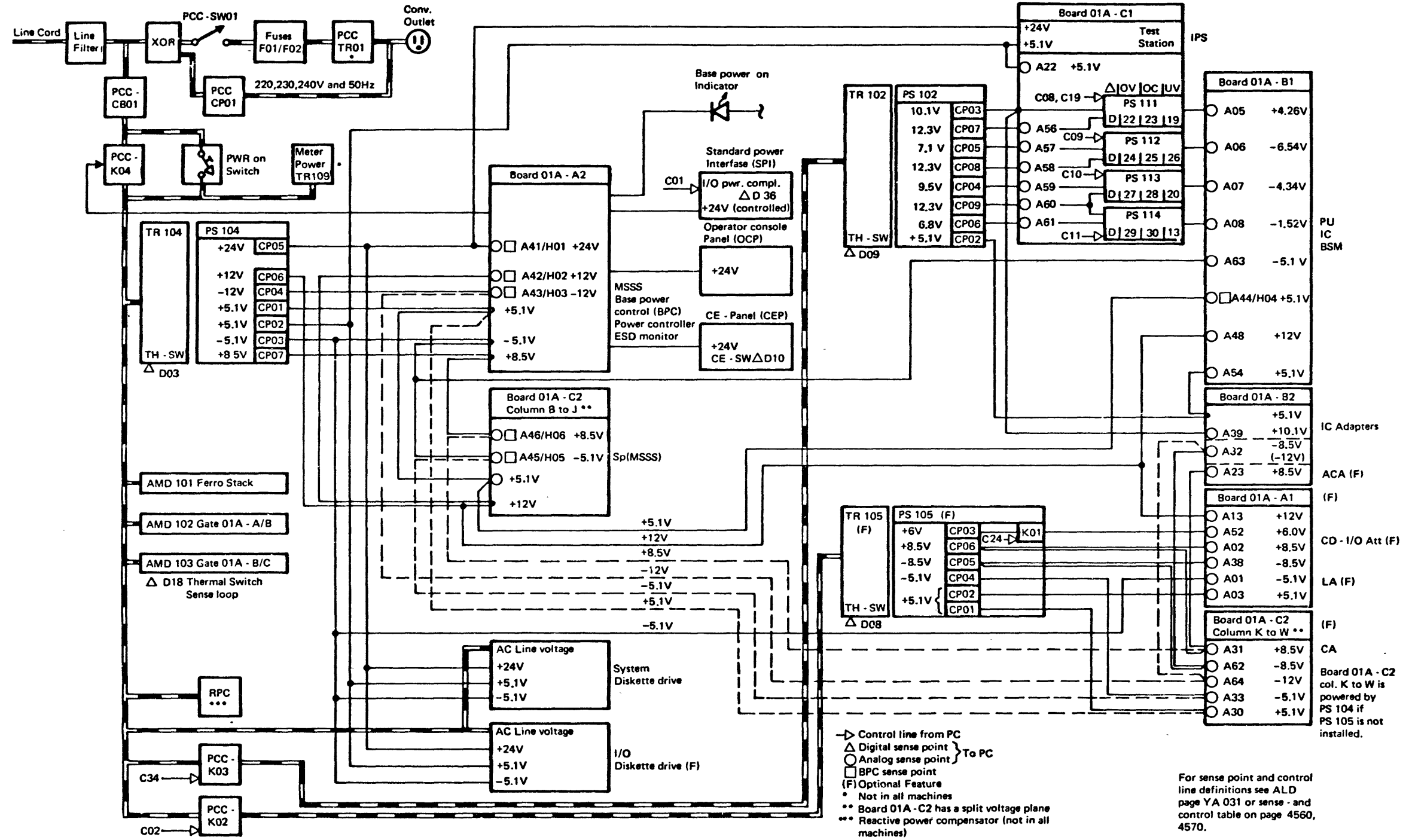
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# Power Distribution



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Power

**DET**

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For sense point and control line definitions see ALD page YA 031 or sense and control table on page 4560, 4570.

### 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		TURN-OFF, NORMAL		TURN-OFF, CE-MODE		TURN-ON TIME		
							Lo	HI	Lo	HI	Lo	HI	Lo	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	3.0	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	3.0	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	3.0	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	3.0	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	

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:**

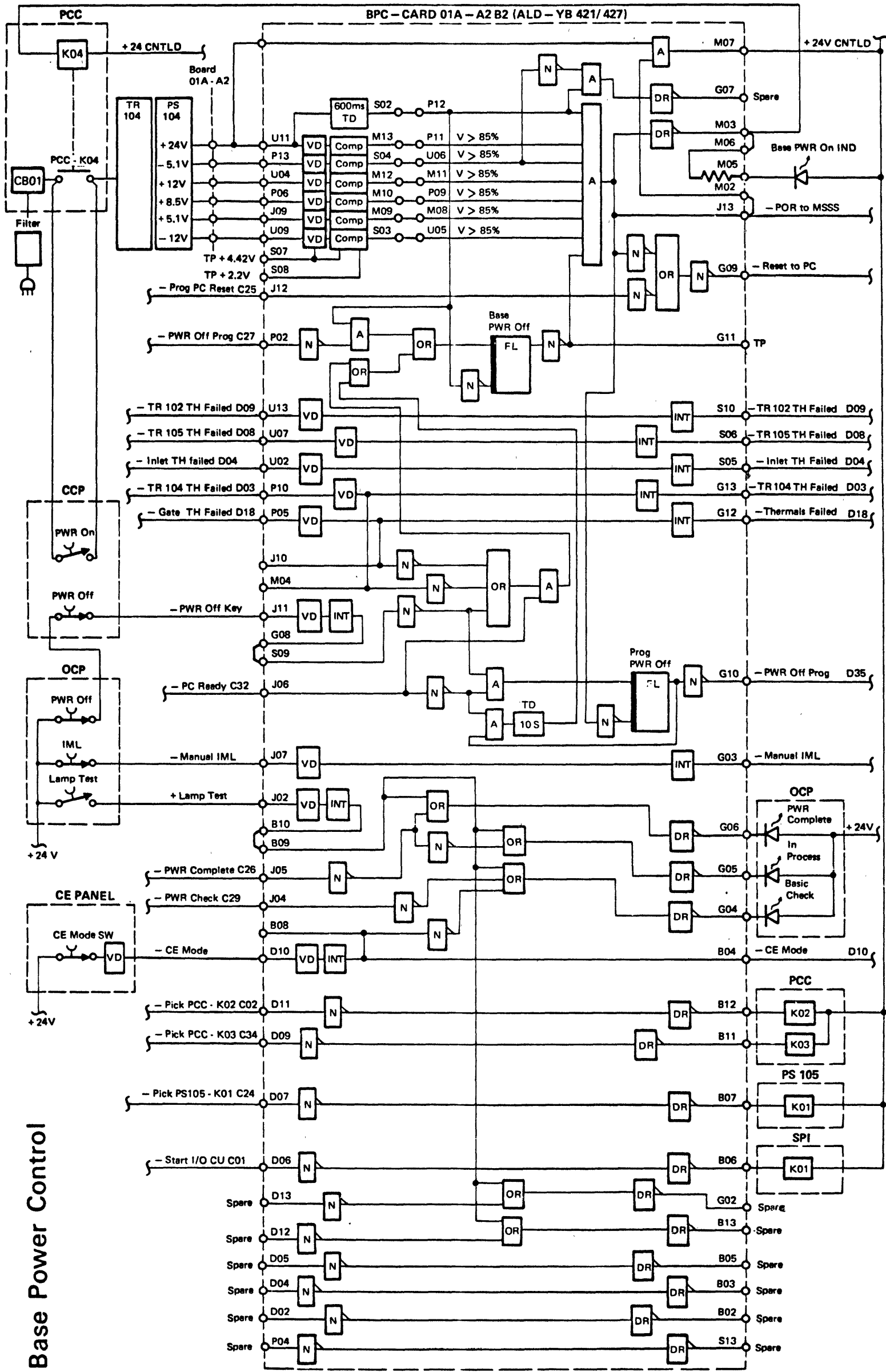
1. Floating bulk and bias voltages for IPS are measured only once during the power-on sequence. The voltage level varies after the IPS power supplies are turned on. A check point list and the IPS voltages are shown on ALD page YA04!.
2. This sense point is tied to GND if board 01A-A1 is not installed.
3. This sense point is tied to GND if Communication 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 Communication 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).

LINE VOLTAGE TOLERANCES (valid for 50 and 60 HZ)		
Nominal Voltage	Actual Voltage	
	Lo	HI
200	180	220
208	182	225
220	193	238
230	201	248
240	210	259

\* Indicates sense points for voltages from PS104 or PS105

# Adjustable voltages

(F) Feature dependent



Base Power Control

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## 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-A2B2:

- 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 DO8 pin of a logic card position).

Never use a DO8 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 DO8 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 contact.

Before FRU-replacement, check the FRU-connectors.

### Measurements at Connectors

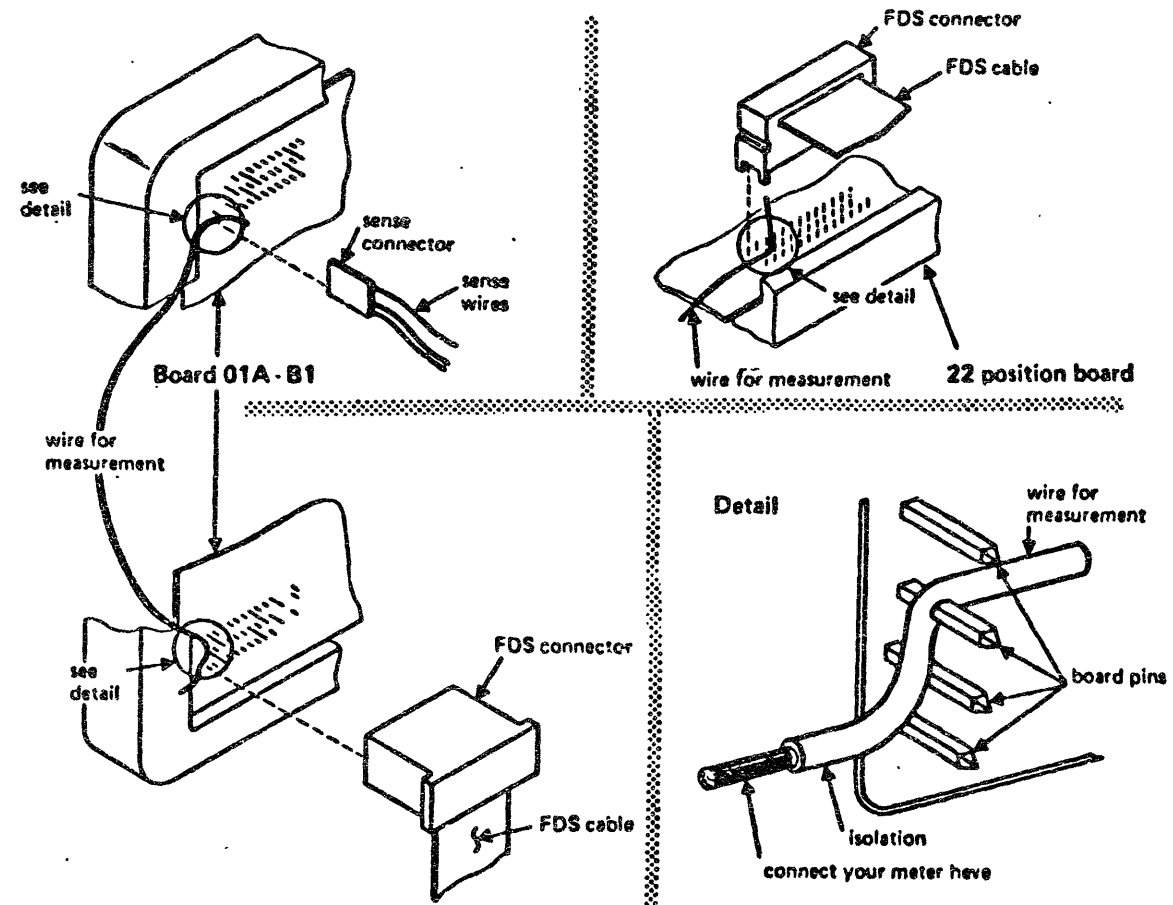
If the MAP advises you to connect the probe or your CE-meter to a connector pin, do not remove the connector from its position. The connector pins are accessible by the probe tip.

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 successful, 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 of 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.