

SERVICE MANUAL

SORVALL® RC-5 & RC-5B AUTOMATIC SUPERSPEED REFRIGERATED CENTRIFUGES

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Medical Products
Sorvall® Instruments
Wilmington, Delaware 19898
U.S.A.

*****Note*****

Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.

Sorvall® Centrifuges



This manual is a guide for service of the

SORVALL® RC-5 and RC-5B Centrifuges

Data herein has been verified and validated and is believed adequate for the intended use of the centrifuges. If the centrifuges or procedures are used for purposes over and above the capabilities specified herein, confirmation of their validity and suitability should be obtained, otherwise, DuPont does not guarantee results and assumes no obligation or liability. This publication is not a license to operate under, nor a recommendation to infringe upon, any process patents.

This service manual is intended for use only by qualified service personnel. Due to the high electrical potential in the centrifuges described herein, untrained individuals must not attempt any of the procedures contained in this service manual.

This service manual is intended as a service aid. While the manual is kept current and includes information regarding significant design changes, designs may still vary from unit to unit.

NOTES, CAUTIONS and WARNINGS within the text of this manual are used to emphasize important and critical instructions.

WARNING: A Warning informs the operator of a hazard or an unsafe practice that could result in personal injury, affect the operator's health, or contaminate the environment.

CAUTION: A Caution informs the operator of an unsafe practice that could result in damage of equipment.

NOTE: A Note highlights essential information.

WARNING

Regarding the Use of Hazardous Material

If using radioactive, toxic, or pathogenic material, be aware of all characteristics of the material and the hazards associated with it should leakage occur during centrifugation. If leakage does occur, neither the centrifuge nor rotor can protect you from the particles dispersed into the air. To protect yourself, we recommend additional precautions be taken to prevent exposure to these materials, for example controlled ventilation or isolation. **DO NOT USE MATERIALS CAPABLE OF PRODUCING FLAMMABLE OR EXPLOSIVE VAPORS.**

Table of Contents

Paragraph		Page
Section 1. INTRODUCTION		
1-1.	Scope of the Manual	1-1
1-2.	Warnings and Cautions	1-1
1-3.	Using This Manual	1-3
1-4.	Troubleshooting Information	1-3
1-5.	Trouble Diagnosis	1-6
1-6.	Service Decontamination Policy	1-7
1-7.	Warranty Responsibility	1-8
Section 2. DESCRIPTION		
2-1.	Purpose of Equipment	2-1
2-2.	Description	2-1
2-3.	Controls and Indicators	2-2
2-4.	Specifications	2-8
2-5.	Location	2-9
2-6.	Routine Inspection and Cleaning	2-9
2-7.	Lubrication	2-10
Section 3. THEORY OF OPERATION		
3-1.	General	3-1
3-2.	RC-5 Theory of Operation	3-1
3-3.	RC-5B Theory of Operation	3-5
3-4.	Summary of HOLD and RUN Modes	3-6
Section 4. DRIVE SYSTEM CIRCUIT		
4-1.	General	4-1
4-2.	Drive Motor Circuit	4-1
4-3.	Drive Motor Enable Circuit	4-2
4-4.	Brake Circuit	4-11
4-5.	Brush Warning Circuit	4-13
4-6.	Speed Control Circuit	4-16
4-7.	Zero Speed Detector Circuit	4-17
4-8.	Overspeed Detector Circuit	4-18
4-9.	Automatic Rate Controller Circuit, RC-5B	4-22
4-10.	Door Interlock Circuit	4-28

Table of Contents (continued)

Paragraph	Page
Section 5. REFRIGERATION SYSTEM	
5-1. General	5-1
5-2. Refrigeration Cycle	5-1
5-3. Condensing Unit Electrical Circuit	5-2
5-4. Refrigeration Control	5-4
5-5. Temperature Control Circuit	5-5
5-6. Overtemperature Detection Circuit	5-11
Section 6. MAINTENANCE AND REPAIR	
6-1. General	6-1
6-2. Preventive Maintenance Checks	6-1
a. Checks with Power OFF	6-1
b. Checks with Power ON	6-2
6-3. Cabinet Panel Removal	6-2
6-4. Drive Motor Replacement	6-3
6-5. Torque Trimmer Potentiometer R204 Replacement	6-6
6-6. Saturable Reactor Replacement	6-7
6-7. Drive Motor Brush Replacement, RC-5	6-8
6-8. Drive Motor Brush Replacement, RC-5B	6-9
6-9. Compressor Start and Run Capacitors and Potential Relay Replacement	6-13
6-10. Condenser Fan Replacement	6-14
6-11. Condenser Fan Motor Replacement	6-15
6-12. Evaporator Replacement	6-17
6-13. Condensing Assembly Replacement	6-23
6-14. Electronic Controls Replacement	6-25
a. Resistance Temperature Detector	6-25
b. Relays K201 Compressor Relay, and K202 Motor Relay	6-26
c. Transformers T201 and T202 (T203)	6-27
d. Circuit Breaker CB301 (RC-5)	6-28
e. Circuit Breaker CB301 (RC-5B)	6-30
f. P.C. Assembly 20809 ¹²⁹⁸⁷	6-30
g. P.C. Assembly 20126 (RC-5, SN 7500414 and Higher), and 50195 (RC-5B)	6-31
h. Key Switch S202 (RC-5)	6-32
i. Door Microswitch S301 (RC-5)	6-33
j. Door Hinge Microswitch S301 (RC-5B)	6-33
k. Door Solenoid L301 (RC-5)	6-34
l. Door Release Microswitch S303 (RC-5B)	6-35
m. Door Solenoid L301 (RC-5B)	6-36
n. Tachometer Indicator M101	6-36
o. Temperature Indicator M102	6-38

Table of Contents (continued)

Paragraph	Page
-----------	------

Section 6. MAINTENANCE AND REPAIR (continued)

	p. Timer (S106 and S107)	6-39
	q. Rate Control R110 (RC-5B)	6-40
6-15.	Door Adjustment	6-40
	a. Preparation	6-40
	b. Adjustment of Mounting Bars	6-41
	c. Hinge Height Adjustment	6-41
	d. Latch Height Adjustment	6-42
	e. Reinstallation of Components	6-43
6-16.	Refrigeration Maintenance	6-43
	a. Compressor Resistance Values	6-43
	b. Compressor Burnout	6-43
	c. Triple Sweep Evacuation of Refrigerant and Charge	6-44
	d. Checking Refrigerant Charge	6-45
	e. Leak Detection	6-45
	f. Evaporator Liner Cleaning	6-45

Section 7. CALIBRATION PROCEDURES

7-1.	General	7-1
7-2.	Calibration Sequence	7-1
7-3.	Calibration Criteria and Adjustment Locations	7-1
7-4.	Personnel Safety	7-1
7-5.	Test Equipment Required	7-2
7-6.	Calibration Procedures	7-2
	a. Speed Indicator M101 Zero Adjust	7-2
	b. Temperature Indicator M102 Zero Adjust	7-2
	c. Speed Control Potentiometer R106	7-2
	d. Source Power	7-2
	e. Torque Trimmer Potentiometer R204	7-3
	f. Speed Control Low Speed Potentiometer (R18) and High Speed Potentiometer (R9) Set	7-5
	g. Speed Indicator M101 Tracking Adjustment Potentiometer (R109)	7-5
	h. Overspeed Detector Potentiometer (R73)	7-5
	i. Power Supply, Temperature Control: +5 V (R7) and +10 V (R4)	7-6
	j. Temperature Indicator M102 Deflection Adjust -20°C Potentiometer (R41) and +40°C Potentiometer (R40)	7-6
	k. Rotor Speed Temperature Differential Set-Point Calibration at 20 000 Rpm (R41)	7-7
	l. Temperature Control Set-Points Potentiometer (R42 and R43)	7-8

Table of Contents (continued)

Paragraph	Page
Section 7. CALIBRATION PROCEDURES (continued)	
m. Overtemperature Detection Set-Pointer (R58)	7-8
n. Compressor Timing Potentiometer (R84)	7-9
o. Timer Control Knob and Switch Adjust (S106 and S107)	7-10
7-7. RC-5B Automatic Rate Controller Calibration	7-10

Section 8. ILLUSTRATED PARTS

8-1. General	8-1
8-2. Indentation	8-1

List of Tables

Table	Page
1-1. Components Abbreviation	1-4
1-2. Number/Letter System for P/J 304	1-4
1-3. Symbols Used on Schematics	1-5
1-4. Trouble Diagnostic Chart	1-6
2-1. Function of Controls and Indicators—RC-5	2-2
2-2. Function of Controls and Indicators—RC-5B	2-5
2-3. Superspeed Rotor Specifications	2-9
4-1. Troubleshooting Chart, ac Power Distribution and Drive Motor Circuits	4-3
4-2. Troubleshooting Chart, Indicator Circuits, RC-5	4-4
4-3. Troubleshooting Chart, Indicator Circuits, RC-5B	4-5
4-4. Troubleshooting Chart, Speed Control and Drive Motor Circuits	4-7
4-5. Troubleshooting Chart, Drive Motor Enable and Temperature Control Circuits	4-9
4-6. Troubleshooting Chart, Brake Circuit	4-12
4-7. Troubleshooting Chart, Drive Motor Brushes	4-15
4-8. Troubleshooting Chart, Speed Control Circuit	4-19
4-9. Troubleshooting Chart, Overspeed Detector Circuit	4-20
4-10. Troubleshooting Chart, Automatic Rate Controller	4-24
4-11. Troubleshooting Chart, Door Interlock Circuits	4-31
5-1. Troubleshooting Chart, Refrigeration Circuits	5-3
5-2. Troubleshooting Chart, Compressor and Temperature Control Circuits	5-9
5-3. Troubleshooting Chart, Temperature Control Circuits	5-12

List of Tables (continued)

Table	Page
6-1. Tecumseh Compressor Motor Resistance Values	6-43
7-1. Calibration Sequence	7-4
7-2. Test Point Descriptions for P.C. Board, PN 50059	7-12
7-3. Potentiometer Adjustment for P.C. Board, PN 50059	7-13
8-1. RC-5 Parts List	8-2
8-2. RC-5 Hinge Assembly	8-13
8-3. RC-5B Parts List	8-14
8-4. RC-5B Motor and Brush Lift Assembly	8-31
8-5. RC-5B Door and Interlock Assembly	8-32
8-6. Door Assembly, PN 50095	8-35
8-7. Door Interlock Assembly, PN 50082	8-37
8-8. Selected Spare Parts, Minimum Inventory	8-39
8-9. Substitute Capacitors for RC-5/5B Condensing Units	8-40
8-10. Exterior Panels for RC-5B	8-40
8-11. Gyro and Motor Bearing Kits	8-40

List of Illustrations

Figure	Page
2-1. Location of Controls and Indicators—RC-5	2-3
2-2. Location of Controls and Indicators—RC-5B	2-7
3-1. Schematic Diagram —RC-5 Power Supply	3-9
3-2. Schematic Diagram—RC-5 System Operation	3-10
3-3. RC-5 Cabinet Fan, Compressor Fan and Drive Motor Enable Circuits	3-13
3-4. RC-5 Brush Warning Indicator Circuit	3-14
3-5. RC-5 Door Interlock Circuit	3-15
3-6. RC-5 Door, Main Power, ON, OFF and Brake Indicator Circuit	3-15
3-7. RC-5 Tachometer Generator and Indicator Circuit	3-15
3-8. RC-5 Drive Motor and Brake Circuit	3-16
3-9. RC-5 Temperature Meter and Set Point Circuit, and Speed Control Potentiometer	3-17
3-10. RC-5 Compressor Circuit	3-18
3-11. Schematic Diagram, RC-5B Power Supply to SN 7810303	3-19
3-12. Schematic Diagram, RC-5B Power Supply, SN 7810304 and Higher	3-20
3-13. Schematic Diagram, RC-5B System Operation to SN 7810303	3-22
3-14. Schematic Diagram, RC-5B System Operation, SN 7810304 and Higher	3-24
3-15. Timing Sequence for RC-5B Automatic Rate Controller	3-26
3-16. Schematic Diagram, RC-5B System Operation, Automatic Rate Controller	3-27

List of Illustrations (continued)

Figure	Page
3-17. RC-5B Drive Motor Enable Circuit	3-28
3-18. RC-5B Brush Warning Indicator Circuit	3-29
3-19. RC-5B Door Interlock Indicator Circuit	3-29
3-20. RC-5B Main Power, ON, Refrigeration and Brake Indicator Circuits	3-29
3-21. RC-5B Tachometer Generator and Tachometer Deflection Circuit	3-30
3-22. RC-5B Drive Motor and Brake Circuit	3-31
3-23. RC-5B Temperature Meter and Set Point Circuit and Speed Control Potentiometer	3-32
3-24. RC-5B Compressor Circuit	3-32
3-25. RC-5 System Power Distribution Diagram, PN 50035-3	3-33
3-26. RC-5 System Schematic, PN 50031-4	3-35
3-27. RC-5 Lower Control Panel Wiring Diagram, PN 50041-6	3-41
3-28. RC-5 P.C. Board to Lower Control Panel Wiring Diagram, PN 50039-2	3-43
3-29. RC-5/5B P.C. Board Schematic Diagram, PN 20810-9	3-45
3-30. RC-5B System Schematic, PN 50208-10	3-51
3-31. RC-5B System Schematic, PN 50208-8	3-55
3-32. RC-5B System Schematic, PN 50208-2	3-59
3-33. RC-5B Lower Control Panel P.C. Board Schematic Diagram, PN 50346-1	3-65
3-34. RC-5B Rate Control Schematic Diagram	3-67
3-35. RC-5B Wiring Diagram, PN 50204-8	3-69
3-36. Rate Control System Schematic, PN 50160-8	3-73
3-37. Rate Control Wiring Diagram, PN 50161-4	3-75
4-1. Drive Motor Circuit, Simplified Schematic Diagram	4-1
4-2. Drive Motor Enable Circuit, Simplified Schematic Diagram	4-2
4-3. Brake Circuit, Simplified Schematic Diagram	4-11
4-4. Brush Warning Circuit, Simplified Schematic Diagram	4-14
4-5. Speed Control Circuit, Simplified Schematic Diagram	4-16
4-6. Zero Speed Detector Circuit, Simplified Schematic Diagram	4-17
4-7. Overspeed Detector Circuit, Simplified Schematic Diagram	4-18
4-8. Automatic Rate Controller, Block Diagram	4-22
4-9. Automatic Rate Controller, Simplified Block Diagram	4-23
4-10. Door Interlock Circuit, RC-5, Simplified Schematic Diagram	4-29
4-11. Door Interlock Circuit, RC-5B, Simplified Schematic Diagram	4-30
5-1. Fluid Circuit of Refrigeration System	5-1
5-2. RC-5 High Torque Motors—3 Terminal Overload— Potential Relay	5-2
5-3. Refrigeration Electrical Circuit, Simplified Schematic Diagram (RC-5B)	5-5
5-4. Temperature Control Circuit, Block Diagram	5-6
5-5. Temperature Control Circuit, Simplified Schematic Diagram	5-7
5-6. Overtemperature Detection Circuit, Simplified Block Diagram	5-11
5-7. Capacitor Box Wiring Diagram	5-13

List of Illustrations (continued)

Figure	Page
6-1. through 6-61. Illustration of Replacement Procedures	6-3 through 6-44
7-1. Test Point and Adjustment Locations for P.C. Board Assembly, PN 50059	7-3
7-2. Test Setup for Temperature Meter Deflection Adjustment	7-7
8-1. RC-5 Parts Location, Gyro Action Drive Assembly	8-5
8-2. RC-5 Parts Location, Motor, Tachometer and Lower Coupling Assembly	8-6
8-3. RC-5 Parts Location, Control Console (Rear View)	8-7
8-4. RC-5 Parts Location, Lower Control Panel P.C. Board, PN 20126	8-8
8-5. RC-5 Parts Location, Cabinet (Rear View)	8-9
8-6. RC-5 Parts Location, Cabinet (Front View)	8-10
8-7. RC-5 Parts Location, Cabinet (Right Side View)	8-11
8-8. RC-5 Door Handle and Latching Assembly	8-12
8-9. RC-5 Hinge Assembly	8-13
8-10. RC-5B Parts Location: Gyro Action Drive, Lower Coupling and Motor Assembly	8-17
8-11. RC-5B Parts Location: Control Console (Rear View to SN 7810303)	8-18
8-12. RC-5B Parts Location: Control Console (Rear View, SN 7810304 and Higher)	8-19
8-13. RC-5B Parts Location: Cabinet (Rear View to SN 7809416)	8-20
8-14. RC-5B Parts Location: Cabinet (Rear View, SN 7809417 and Higher)	8-21
8-15. Lower Control Panel Assembly	8-22
8-16. RC-5B Parts Location: P.C. Assembly 12370 to SN 7809416	8-23
8-17. RC-5B Parts Location: P.C. Assembly 12370 (SN 7809417 and Higher)	8-23
8-18. RC-5B Parts Location: Cabinet (Front View)	8-24
8-19. RC-5B Front View	8-25
8-20. RC-5B Parts Location: Cabinet (Right Side View)	8-26
8-21. RC-5B Parts Location: Automatic Rate Controller, Control Panel	8-27
8-22. Parts Location: Gyro Action Drive, Lower Coupling and Motor Assembly (SN 8004600 and Higher)	8-28
8-23. Parts Location: Gyro Action Drive Assembly, PN 12817 (SN 8004600 and Higher)	8-29
8-24. RC-5B Parts Location: Drive Motor and Brush Lift Assembly	8-30
8-25. RC-5B Door and Interlock Assembly	8-34
8-26. Door Assembly	8-36
8-27. Door Interlock Assembly	8-38

Section 1

INTRODUCTION

1-1. Scope of the Manual

This manual is a guide for servicing the SORVALL RC-5 and RC-5B Automatic Refrigerated Superspeed Centrifuges.

It has been written for the SORVALL factory trained Service Specialist who is familiar with electronics, knows the operating procedures of these centrifuges and understands factory methods of performing adjustments and calibrations.

This manual provides such personnel with a fault isolation method that isolates and identifies the cause of a problem within the centrifuge, as well as a parts list and information for ordering replacement parts necessary for repairs of parts or systems within the centrifuge.

Service personnel must read and understand the theory of operation before servicing the centrifuge.

1-2. Warnings and Cautions

While warnings and cautions appear wherever appropriate throughout the manual, service personnel should familiarize themselves with those listed in this section before attempting to service a centrifuge.

WARNING

Electrical Shock Hazard

Because of high voltage in this centrifuge, untrained personnel must not attempt to test or repair any electrical circuits in it.

The start and run capacitors in the capacitor box retain high voltage charges. Be sure they are completely discharged before performing maintenance in that area. Discharge the start and run capacitors by grounding one terminal of the capacitor through a load resistor.

WARNING

Liquid Refrigerant Gases

Use maximum care when smelling the refrigerant odor to check for a compressor burnout. These gases can be highly toxic or have a high acid content and emit an acrid odor. If the gas comes in contact with the skin, rinse immediately to avoid skin burn.

WARNING**Contamination**

The nature of samples processed in the centrifuge create a possible hazard from biological or radioactive contamination.

Always beware of this possibility. Observe all normal precautions before servicing a centrifuge. If a centrifuge has been contaminated, appropriate decontamination procedures must be observed (see Section 1-6).

WARNING**Rotor Speed**

Do not exceed the rated speed of the rotor for the design mass specified (see Table 2-3).

WARNING**Keep Chamber Door Closed**

To protect personnel from the hazards of a high speed rotor movement, the centrifuge door must be closed and latched before the rotor reaches a speed of 500 rpm. The automatic transition to the RUN speed is electrically interlocked to prevent transfer into the RUN mode until the door is closed and latched. The chamber door must not be opened during high speed operation. It is a dangerous practice which can result in injury to the operator.

CAUTION**Harmful Chlorides**

Chlorides are extremely harmful to aluminum alloys and must not come in contact with aluminum alloy rotors under any condition. Such contact will result in stress corrosion which attacks the inside and outside of a rotor causing microscopic surface cracks that weaken those areas without visible warning.

CAUTION**Unequal masses in Compartments**

Do not operate the centrifuge rotor with unequal masses in opposing compartments (see Table 2-3).

CAUTION**Overheating**

Do not locate this centrifuge near heated areas such as heat pipes, radiators, etc. Avoid close grouping of centrifuges or other heat producing equipment, because one will act as a heat source for the other and affect its operation. Maintain an ambient room temperature of 25°C or lower for maximum performance.

1-3. Using This Manual

When using this manual to correct a malfunction in the centrifuge, use the following procedure:

1. Define the type of malfunction.
2. Eliminate unrelated causes such as:
 - a. Power supply (including wall circuit breaker monitoring the supply).
 - b. Failure to meet all conditions of HOLD mode.
 - c. Failure to meet all conditions of RUN mode.
 - d. Failure to meet electrical requirements.
3. Refer to diagnostic chart (Table 1-4) then isolate the malfunction to a specific area.
4. Refer to the specific sections indicated by the diagnostic chart table then proceed as follows:
 - a. Read the system theory (Sections 3, 4 and 5).
 - b. Use the troubleshooting charts to troubleshoot the system until the source of the malfunction is located (Sections 4 and 5).
 - c. Order parts as required (Section 8).
 - d. Refer to Repair or Replacement procedure in Section 6.
 - e. Calibrate the centrifuge to specifications as required (Section 7).

1-4. Troubleshooting Information

a. Abbreviations

Use Table 1-1 to identify and locate the components referenced and abbreviated in the troubleshooting charts in Sections 4 and 5.

Table 1-1. Components Abbreviation

Symbol*	Definition	Location
CB	Circuit Breaker	Front of Centrifuge Brush warning box
CR	Rectifier	Lower Control Panel
DS	Lamp	Indicator Panel
F	Fuse	Front of Instrument
K	Relay	Lower Control Panel
M	Meter	Indicator Panel
PJ	Plug Jack	Lower Control Panel**
R	Resistor	Lower Control Panel
SW	Switch	Indicator Panel
T	Transformer	Lower Control Panel
TB	Terminal Board	Lower Control Panel
W	Wire	Lower Control Panel

* All numeric contact points which are not preceded by a letter symbol are located on the Lower Control Panel.

** Only P/J 304 is referenced for testing. P/J 304 is a 22-pin connector located on the right side of PC assembly 20126 (RC-5) or 50195 (RC-5B) on the lower control panel. The 22 pins connect PC assembly 20126 (RC-5) or 50195 (RC-5B) at right angles to P.C. board 20809. On P/J 304 numbers and letters go from top to bottom with numbers on the component side (left) and letters on the back or clad side (right) as shown in Table 1-2.

Table 1-2. Number/Letter System for P/J 304

1 - A	12 - N
2 - B	13 - P
3 - C	14 - R
4 - D	15 - S
5 - E	16 - T
6 - F	17 - U
7 - H	18 - V
8 - J	19 - W
9 - K	20 - X
10 - L	21 - Y
11 - M	22 - Z

* Note that letters G, I, O, and Q are skipped.

b. Symbols

Use Table 1-3 to identify and locate the symbols used in the schematics in Sections 3, 4 and 5.

1-5. Trouble Diagnosis

Table 1-4 is a list of malfunctions with reference to applicable troubleshooting charts. It also references the circuit in which the trouble may be isolated and the paragraph number which provides the circuit theory of operation. Service personnel must read the theory of operation and thoroughly understand it before troubleshooting is attempted.

Table 1-4. Trouble Diagnostic Chart

Malfunction	Circuit	Paragraph	Reference Figure	Table
Loss of main power	Power distribution and drive motor	3-2, 4-2	3-1, 4-1 4-2	4-1
Drive motor does not run	Speed control and drive motor	3-2, 4-2 4-6	3-1, 3-11 3-12, 4-2 4-4	4-4 4-4
Door cannot be opened in HOLD mode (RC-5B)	Door interlock	3-2, 4-10	4-11	4-11
Refrigeration system is unable to provide desired temperature in RUN or HOLD	Refrigeration	5-2, 5-3 5-4	5-1 through 5-6	5-1, 5-2
Upon pressing ON switch (RC-5) or START switch (RC-5B), ON lamp (RC-5) or START lamp (RC-5B) fails to light, drive motor does not run but POWER lamp remains lit	Drive motor enable and temperature control	3-2, 4-2 4-3, 5-5	4-1, 4-2	4-5
Compressor runs continuously, does not cycle in RUN or HOLD mode	Temperature control	3-2, 5-2 5-4, 5-5	3-3, 5-1 5-4	5-3
Overspeed cutout does not occur. No system mode transfer at overspeed. Speed indicator inoperative.	Overspeed detection	3-2, 4-8	4-9	4-9
Tachometer indicates overspeed at too high or too low rpm.	Overspeed detection	3-2, 4-8	4-9	4-8, 4-9
No speed control	Speed control	4-6, 7-6	4-5	4-8

(continued)

Table 1-4. Trouble Diagnostic Chart (continued)

Malfunction	Circuit	Paragraph	Reference Figure	Table
Brushes wear rapidly or are noisy	Motor brushes	3-2, 4-5 6-7, 6-8	3-4, 4-4	4-7
Incorrect SLOW mode operation (RC-5B)	Rate controller	3-2, 4-9 7-7	4-9	4-10
System does not SLOW start but goes directly into and remains in high speed operation for duration of timed run cycle (RC-5B)	Rate controller	3-2, 4-9 7-7	4-9	4-10
System remains in SLOW start; does not transfer to RUN mode (RC-5B)	Rate controller	3-2, 4-7 4-9	4-9	4-10
Rotor does not turn in SLOW mode only (RC-5B)	Rate controller	3-2, 4-7 4-9	4-9	4-10
Indicator(s) do not light (RC-5)	System operation	3-2, 4-2 4-3	3-2	4-1, 4-2 4-5
Indicator(s) do not light (RC-5B)	System operation	3-2, 4-2 4-3	3-13	4-1, 4-3 4-5

1-6. Service Decontamination Policy

WARNING

Biological or radioactive contamination of the centrifuge can occur due to the samples likely to be processed. Always be aware of this possibility and take normal precautions. Use appropriate decontamination procedures should expose occur.

If a centrifuge or rotor that has been used with radioactive or pathogenic material requires servicing by DuPont personnel, either at the customer's laboratory or at DuPont facilities, comply with the following procedure to ensure the safety of personnel.

- Clean the centrifuge and/or rotor to be serviced of all encrusted material and decontaminate it prior to servicing by the DuPont representative. There must be no radioactivity detectable by survey equipment.
- Complete and attach Decontamination Information Certificate (Sorvall® Instruments Form No. IPDP-59 or SORVALL No. E53063) to the centrifuge and/or rotor.

If the centrifuge or rotor to be serviced does not have a Decontamination Information Certificate attached and, in our opinion, presents a potential radioactive or biological hazard, our representative will not service the equipment until proper decontamination and certification is complete. If DuPont receives a centrifuge or rotor at its Service facility which, in its opinion, is a radioactive or biological hazard, the sender will be contacted for instructions as to disposition of the equipment. Disposition costs will be borne by the sender.

Decontamination Information Certificates are included in the back of this manual. Additional certificates are available from local Account Representative, Service Representative, or distributor. In the event these certificates are not available, a written statement certifying that the centrifuge and/or rotor has been properly decontaminated and outlining the procedure used will be acceptable.

NOTE

The Service Representative will note on the Customer Service Repair Report whether or not decontamination was required. When decontamination is required, the representative will specify the contaminant and the decontamination procedure used. If no decontamination was required, it will be so stated.

1-7. Warranty Responsibility

Whenever service of the centrifuge is attempted by anyone other than an employee of DuPont, that individual is assuming the risk of voiding the centrifuge warranty, which is as follows:

The RC-5 and RC-5B Automatic Superspeed Refrigerated Centrifuges are warranted to be free from defects in material and workmanship for a period of one year from the date of delivery. DuPont will repair or replace and return free of charge any part which is returned to its factory within said period, transportation prepaid by user, and which is found upon inspection to have been defective in materials or workmanship. This warranty does not include normal wear from use, it does not apply to any centrifuge or part which has been altered by anyone other than an employee of DuPont, nor to any centrifuge which has been damaged through accident, negligence, failure to follow operating instructions, the use of electric currents or circuits other than those specified on the plate affixed to the centrifuge, misuse or abuse.

DuPont reserves the right to change, alter, modify or improve any of its centrifuges without any obligation whatever to make corresponding changes to any centrifuge previously sold or shipped.

THE FOREGOING OBLIGATIONS ARE IN LIEU OF ALL OTHER OBLIGATIONS AND LIABILITIES INCLUDING NEGLIGENCE AND ALL WARRANTIES, OF MERCHANTABILITY OR OTHERWISE, EXPRESSED OR IMPLIED IN FACT OR BY LAW, AND STATE OUR ENTIRE AND EXCLUSIVE LIABILITY AND BUYER'S EXCLUSIVE REMEDY FOR ANY CLAIM OR DAMAGES IN CONNECTION WITH THE SALE OR FURNISHING OF GOODS OR PARTS, THEIR DESIGN, SUITABILITY FOR USE, INSTALLATION OR OPERATION. DUPONT WILL IN NO EVENT BE LIABLE FOR ANY SPECIAL OR CONSEQUENTIAL DAMAGES WHATSOEVER, AND OUR LIABILITY UNDER NO CIRCUMSTANCES WILL EXCEED THE CONTRACT PRICE FOR THE GOODS FOR WHICH LIABILITY IS CLAIMED.

Section 2

DESCRIPTION

2-1. Purpose of Equipment

The centrifuge is designed to separate substances of different densities, remove moisture or increase gravitational effects by centrifugal force at controlled low temperatures.

2-2. Description

The RC-5 and RC-5B centrifuge drive system is equipped with a Universal/Drive motor, designed and manufactured by DuPont, with a programmed automatic acceleration and braking feature. The motor armature is balanced to give quiet operation with minimum vibration over a full range of operating speeds. This feature extends the life of the bearings and brushes.

This drive system is fitted with a Gyro-Action Centering Drive® that is compatible with a wide variety of SORVALL rotors.

The wall of the evaporator rotor chamber is made of an envelope-type, smooth stainless steel. The cabinet has a corrosion-resistant top and is finished with a corrosion-resistant gray enamel. All cabinet panels are removable for access to service the centrifuge.

Fittings on the right side of the cabinet provide external connections for a continuous flow system. The rubber plugs on the inside and outside create a dead air space that minimizes heat loss and condensation while sealing out dirt and foreign matter from the connecting tubes.

The refrigeration system is a low-temperature condensing unit of the hermetically-sealed type. It is designed to maintain the rotor chamber at the preset level within $\pm 1^{\circ}\text{C}$ during operation.

The centrifuge is equipped with a noise suppressor to reduce its noise level. This suppressor requires no special care or maintenance.

The centrifuge is operated by instructions programmed at the control panel. It has safety features, designed to protect the operator or service personnel, that will override the programmed instructions under special conditions.

Safety features include:

- a. Door Interlock: Prevents the centrifuge door from opening when the rotor begins to accelerate. In the event of a power failure, the door remains locked and can be overridden by a special latch release (see Table 2-2, item 13).

- b. Panel Interlock (installed on RC-5 models only): Located behind the front panel, this device will interrupt power to the centrifuge drive system if the panel is removed. Because the panels are mechanically interlocked, the front panel must be removed first.
- c. Key Switch (installed on RC-5 models only): To set the centrifuge in the RUN mode, the starting key must be set to the ON position. Once the instrument is in the RUN mode, the key may be removed.

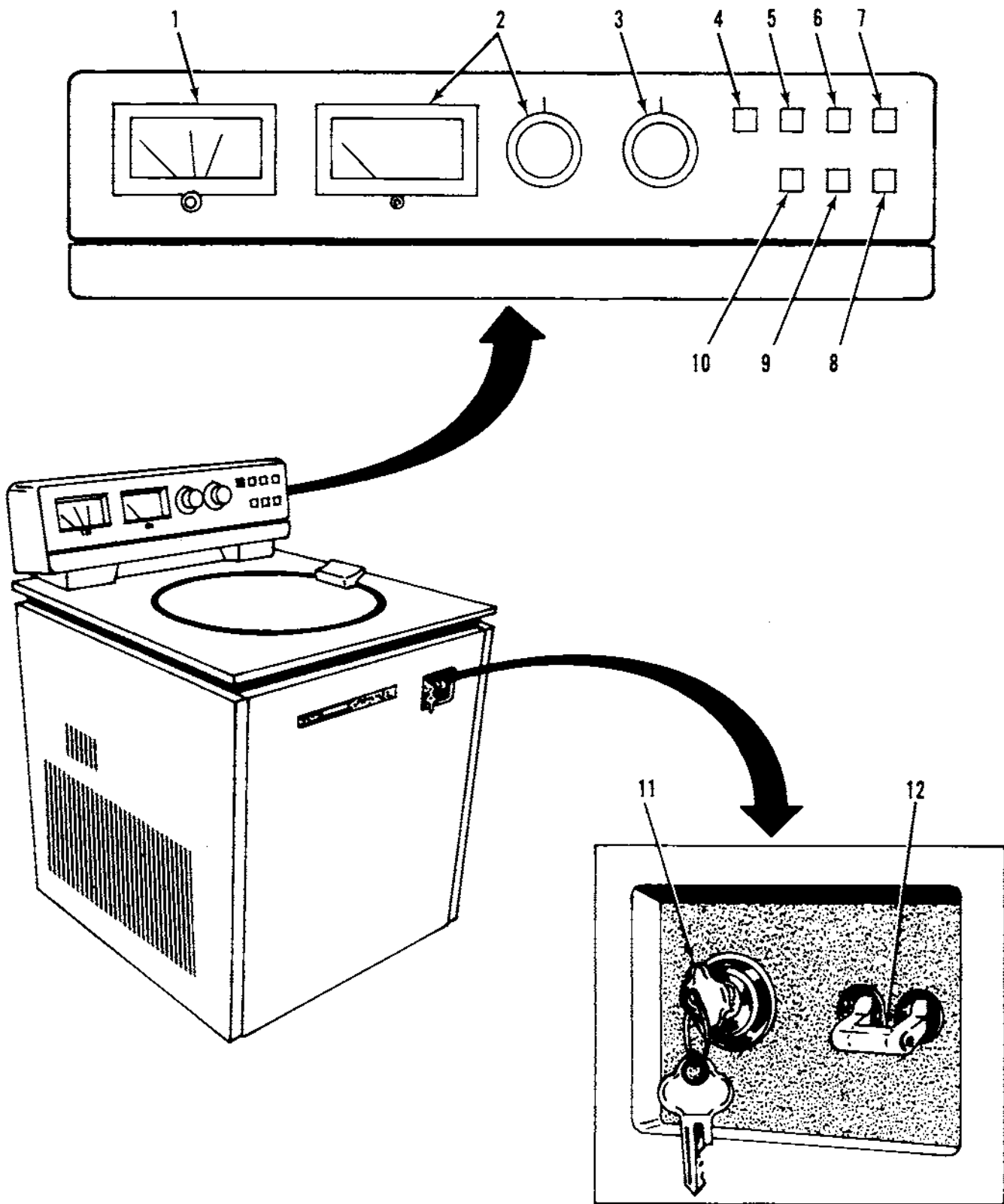
Some RC-5B models are equipped with an Automatic Rate Controller. This device extends the functional capabilities of the centrifuge by providing a manually controlled, automatically programmed, slow start-up feature.

2-3. Controls and Indicators

Controls and indicators for the RC-5 are shown in Figure 2-1 and in Figure 2-2 for the RC-5B. Tables 2-1 and 2-2 describe the functions of controls and indicators shown in Figures 2-1 and 2-2, respectively.

Table 2-1. Function of Controls and Indicators - RC-5

Name	Position	Function
Main circuit breaker (12)	Set on and off	Applies primary power to circuits.
Key switch (11)	Turn on and off	Allows centrifuge to be placed in RUN mode. May be turned off and key removed after RUN mode is entered.
DOOR switch and lamp (7)	Press on and off	Switch permits opening door during RUN mode. Lamp lights when switch is pressed or when rotor speed is below 100 rpm, indicating that door may be opened.
ON switch and lamp (10)	Press on and off (momentary contact)	Switch places centrifuge in RUN mode. Lamp lights in RUN mode.
REFRIG lamp (6)		Lights when compressor is on.
BRUSHES lamp (5)		Flashes to indicate worn motor brushes.



7/79
RCS/3

Figure 2-1. Location of Controls and Indicators - RC-5

Table 2-1. Function of Controls and Indicators – RC-5 (continued)

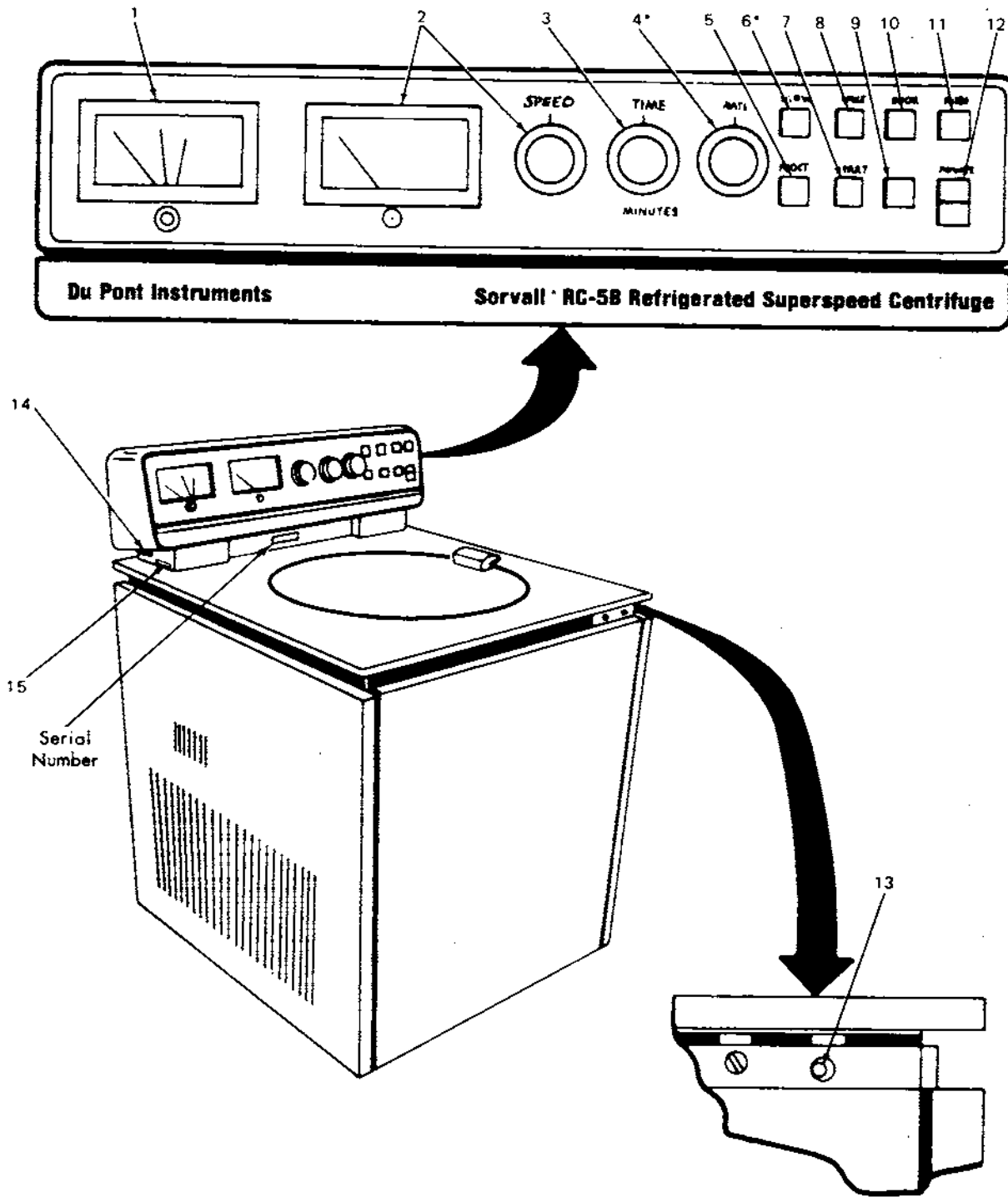
Name	Position	Function
BRAKE switch and lamp (8)	Press on and off	Activates brake circuit which operates only when centrifuge enters HOLD mode. Lamp lights when circuit is activated.
TIME control (3)	OFF, 0 to 2 hrs, HOLD	Sets duration of centrifuge run. Automatically shuts centrifuge off at completion of run. May be manually advanced or set back at any time. At HOLD, allows centrifuge to run without time limit. Timer motor operates only in RUN mode.
SPEED control and indicator (2)	0-21 x 1000	Sets and indicates speed of rotor.
TEMPERATURE control and indicator (1)	Red knob (HOLD) blue knob (RUN)	Red knob sets temperature during HOLD mode. Blue knob sets temperature during RUN mode.
		Black pointer indicates air temperature in rotor chamber.
OFF switch and lamp (9)	Press on and off	Switch places centrifuge in HOLD mode.
POWER lamp (4)		Lights when main circuit breaker is on.

Table 2-2. Function of Controls and Indicators - RC-5B

Name	Position	Function
TEMPERATURE control, selectors and indicator (1)	Blue knob and selector	Selects desired rotor chamber temperature when timer selection is in timed or hold condition.
	Red knob and selector	Selects desired chamber temperature when timer is in stop condition. The refrigeration system automatically selects proper duty cycle to maintain desired temperature during this "stand-by" condition when cooling.
	Black Indicator	Indicates actual air temperature in rotor chamber.
SPEED control and indicator (2)	0-21 x 1000 rpm	Sets and indicates speed of centrifuge rotor.
TIME control (3) (rotary control)	Timed condition: 0 to 2 hours	Sets duration of run for timed condition. May be reset at any time during run. Temperature is controlled by the blue selector.
	HOLD	Sets duration of run just as in the timed condition, but for an indefinite period.
	STOP	Automatically selected at the conclusion of a timed condition. Manually selected at any time to conclude a run. Temperature is controlled by the red selector.
RATE control (4)	Rotary control	Sets the desired rate of acceleration in the slow portions of the run. Clockwise rotation increases the acceleration rate. Only on centrifuges with the optional Automatic Rate Controller.
REFRIG lamp (5)		Illuminates when compressor is on.
SLOW switch and lamp (6)	Press on and off (alternate action)	Programs the centrifuge to automatically conduct a slow mode

Table 2-2. Function of Controls and Indicators - RC-5B

Name	Position	Function
START switch and lamp (7)	Press on (momentary contact)	shown in figure 3-15. When the SLOW lamp is extinguished, the centrifuge runs as a nonautomatic rate controlled unit with the usual rapid acceleration and deceleration. Serves as a dummy when Automatic Rate Control option is not installed. Switch starts centrifuge in selected mode. Lamp illuminates in either RUN or HOLD mode.
BRAKE switch and lamp (8)	Press on and off (alternate action)	Selects brake circuit which operates when centrifuge enters stop condition. Lamp illuminates when brake circuit is selected.
POWER lamp (9)		Illuminates when POWER switch is on.
DOOR switch and zero speed lamp (10)	Press on (momentary contact)	Switch permits door opening during normal or slow mode when rotor speed is below approximately 100 rpm. Lamp illuminates when rotor speed is below approximately 100 rpm, indicating that door may be opened. The lamp stays illuminated whenever door is open.
BRUSHES lamp (11)		Flashes to indicate worn motor brushes.
POWER switch (12)	Press top half of POWER for power ON	Applies main power to all circuits and automatically selects stop condition.
Release Rod (13)	Press to release door latch	Manually releases safety interlock to allow emergency door opening at any speed. It may be necessary to lift door handle while release rod is held in to overcome slight vacuum in the chamber due to rotor motion at high speeds.



NOTE

(*) DENOTES PARTS WHEN AUTOMATIC RATE CONTROLLER IS INSTALLED.

7/79
RCS/4

Figure 2-2. Location of Controls and Indicators - RC-5B

2-4. Specifications

Electrical Power

Requirements	208 Vac, 60 Hz single phase, 30 A
	230 Vac, 60 Hz single phase, 30 A
	220 Vac, 50 Hz single phase, 30 A
	220 Vac, 50 Hz single phase, 30 A

The centrifuge main power plug is a 3-wire power cord, terminated in a 3-prong cap with a ground connection, compatible with Hubbell receptacle No. 9903 or equivalent.

Current Ratings:

- 30 A or less Motor draw on acceleration, unit without buck/boost transformer
- 17 A Maximum motor draw on acceleration
- 10 A to 15 A Compressor with power ON, fan operating
- 1 A to 1.5 A Door solenoid when energized

Average Heat Output

During Operation:

- Normal 10 000 BTU/hr (2.9 kW)
- Maximum 20 000 BTU/hr (5.8 kW)

NOTE

Average heat output is subject to such variables as rotor in use, speed of rotor and stage of run.

RC-5B Automatic Rate

Controller	1000 rpm slow start transition. Two minutes slow start rate time (variable)
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Refrigeration:

- Refrigerant Refrigerant 502
- Compressor Pressure, reading on gauge at 25°C ambient temperature 190-225 psi, high pressure side
0-11 psi, low pressure side

NOTE

High and low side pressure will vary depending upon the ambient temperature and load.

Mechanical Dimensions:

- Height 114 cm (45 inches)
- Depth 93 cm (32.5 inches)
- Width 76 cm (30 inches)

Table 2-3. Superspeed Rotor Specifications

Rotor	Speed (in rpm)	Relative Centrifugal Force (RCF)	Design Mass per Compartment (in grams)
SS-34	20 000	47 807	115
SM-24	20 000	49 468	27
GSA	13 000	27 504	580
SE-12	21 000	45 959	30
HB-4	13 000	27 579	250*
SU	20 000	31 332	52
HS-4/00482 Carrier	7000	9425	1035*
HS-4/00480 Carrier	7000	9425	1035*
HS-4/00479 Bucket	7000	99 425	1035*
GS-3	9000	13 689	780
SZ-14	18 500	36 424	**
TZ-28	20 000	42 500	**
SV-80	19 000	40 980	6.4
SV-288 (SS-90)	20 000	40 300	50
SA-600	16 500	39 411	115

* Includes mass of bucket or cup.

** See rotor instruction manual.

2-5. Location

Selecting the proper location for the centrifuge is very important. There must be a continual free air circulation. The cooler the air around the centrifuge, the better it will operate. A minimum clearance of 15 cm (6 in) is required between the back of the unit and the rear wall. There must be a minimum clearance of 31 cm (12 in) between the other walls and all other sides of the centrifuge.

For maximum performance, maintain an ambient room temperature of 25°C or lower.

When the centrifuge is positioned, lower the front locking stabilizers to secure it and prevent vibration from moving it on its casters.

The floor area should be capable of supporting 317 kg (700 lb) mass standing on four points.

2-6. Routine Inspection and Cleaning

a. Inspection

Visually inspect the centrifuge for signs of wear, corrosion, encrusted biological deposits and accumulation of dust (include condensor).

b. Cleaning**1. Defrosting the Rotor Chamber**

Defrost the rotor chamber to maintain most efficient cooling. Frost on the inner walls acts as an insulation between the chamber and the refrigerant.

2. Tapered Spindle

Keep the tapered spindle clean to minimize the possibility of rotor sticking. Wipe it with a soft cloth each time a rotor is installed. On the RC-5, replace the spindle with Teflon® coated type if any problems are encountered.

3. Cabinet

It is important that the entire centrifuge be kept clean. Corrosive chemicals such as chlorides are harmful to stainless steel surfaces. Therefore, surfaces subjected to chlorinated cleaning agents must be rinsed immediately.

Use commercial wax base cleaning products for cleaning stainless steel and enamel cabinet panels.

Clean the top deck surface and door of the RC-5B with household detergents and water. A brush is helpful for removing particles ground into the plastic surface.

2-7. Lubrication

All bearings are prelubricated and sealed; therefore they require no further lubrication during their lifetime.

As required, apply a light coat of grease to the door latch mechanism.

Section 3

THEORY OF OPERATION

3-1. General

This section provides the information necessary to understand the electronic, drive and refrigeration circuits of the RC-5 and RC-5B Centrifuges.

3-2. RC-5 Theory of Operation (figures 3-1 through 3-10)

a. Operational Modes

The RC-5 centrifuge operates in two main mode conditions: HOLD and RUN.

In the HOLD mode, the following conditions occur:

- Main power is present in the centrifuge and the rotor is at a dead stop or slowing down from a previous RUN cycle.
- The HOLD set pointer controls the refrigeration system to maintain the preset temperature.
- The door interlock circuit allows the door to be opened.

In the RUN mode, the following conditions occur:

- The rotor rotates at a preset speed.
- The RUN set pointer controls the refrigeration system to maintain the preset temperature.
- The door interlock circuit prevents the centrifuge chamber door from opening.

b. HOLD Mode

1. Power, Interlocks and Power Indication

When CB301, 30 A main circuit breaker is closed, 115 Vac is applied through the front panel interlock switch S305, then to power transformer T201.

230 Vac operating volts for the compressor and rotor center drive motors comes directly; from the main 230 Vac input power line. The primary winding of transformer T201 is tapped to provide 27 Vac reference voltage to 230 Vac, for operating the brush warning indicator circuit.

Overload protection for all secondary voltages is provided by fuse F302, and overload protection for +5 Vac to the braking circuit is provided by fuse F301.

The secondary winding of T201 is tapped to provide 10 Vac, 12 Vac, 17 Vac, 115 Vac and 30 Vac. 12 Vac and 17 Vac are applied to PC board 20809. 10 Vac is rectified and reduced to +5 Vdc, which is applied to the drive motor braking circuit. 115 Vac is applied to power relays and the motor speed circuit. 12987

30 Vac is applied to contacts 9-3 of the RUN/HOLD relay, K205. When relay K205 is energized, 30 Vac passes across contacts 9-3 to light POWER lamp DS104, OFF lamp DS110, and energize door solenoid L301 to release the door latch and allow the door to open. The same 30 Vac passes across contacts 11-3 of K1 where it is applied to the zero speed detector and to the DOOR lamp DS108.

The zero speed detector consists of a tachometer detector, a relay control amplifier and relay K1. When the detector senses a loss of signal voltage from the tachometer generator TG301 (less than 100 rpm), the relay control amplifier then energizes the coil of relay K1. When K1 is energized, 30 Vac flows across contacts 11-1 to the input of rectifier CR203. This voltage is then filtered through capacitor C205, and is applied to the coil of door solenoid L301, which becomes energized and the door indicator lamp DS108 is illuminated.

2. Refrigeration

The temperature control functions automatically in the HOLD and RUN modes.

The temperature control circuit consists of a resistive temperature control circuit detector. Temperature meter M102 is a temperature meter bridge circuit and also functions as a compressor control and timing circuit.

The rotor chamber temperature is sensed by the resistive temperature detector circuit, which forms a part of the meter bridge. The actual chamber temperature is indicated by the black pointer on meter M102. M102 contains two photoelectric cells which are positioned mechanically, one by the red pointer, and the other by the blue pointer. As the black pointer passes over the red or blue pointer, the corresponding photoelectric cell is blocked or unblocked, respectively. This movement triggers a signal to the compressor control circuit to start or stop the compressor.

In the HOLD mode, compressor operation is determined by the red set pointer on the temperature indicator. When the chamber temperature rises above a preset temperature, indicated by the red pointer, the temperature control applies 115 Vac to the coil of compressor relay K201 and illuminates REFRIG lamp DS102 through dropping resistor R206. When relay K201 is energized, 230 Vac is also applied across contacts 2-1 to operate the compressor motor and condenser fan motors, which are connected in parallel.

3. Relays

(a) RUN/HOLD relay K205

This relay is wired in a latching configuration through contacts 4-7. When K205 is energized, it latches closed, then:

- It applies 28 V ac to the ON lamp DS111 through contacts 6-9.
- It creates an open circuit to the OFF lamp DS110, causing it to be extinguished.
- Across contacts 8-5, 115 V ac is applied to the temperature indicator, forcing it to operate by the BLUE set pointer (RUN), and also energize the circuits on P.C. board 20809. 12987

(b) Compressor fan relay K201

When relay K201 is energized, 230 Vac passes across contacts 2-1 and is applied to the compressor motor and the motor of the condenser cooling fan, which are both wired in a parallel configuration.

(c) Motor relay K202

This relay applies 230 Vac potential to motor MT301 through contacts 3-6 and the secondary of the saturable reactor. It also disables the brake circuit (contacts 4-5, 8-9).

(d) Timer motor

The timer motor is energized whenever the main power to the centrifuge is ON and the RUN cycle time is set to a position other than OFF or HOLD at the timer indicator. An overtemperature or overspeed signal through the control circuit will disable the timer motor until the condition is corrected.

c. RUN Mode

1. Activating the RUN mode.

The RUN mode is activated when the following conditions are met:

- Closing the centrifuge door and securing latch with main power ON.
- Turning key switch S303 to ON position.
- Setting the timer to a new timing cycle.
- Setting the blue pointer on the temperature indicator to a new temperature limit.
- Setting the speed on the rpm indicator.
- Pressing the ON switch S111.

The following circuits discussed are energized by 115 Vac, controlled by the overtemperature and overspeed circuits on P.C. board No. 20809. 115 Vac passes across the deenergized contacts 9-3 of door relay K204, and then through CB1 and CB2 in the brush warning box. 12987

2. Door Interlock

Interlock door latch switch S301 prevents the centrifuge from operating when the door is open and the controls are set in the RUN mode. The centrifuge can enter the RUN mode with the door open by depressing both the DOOR switch S301 and the ON switch S111 at the same time.

The centrifuge door can be opened during a RUN cycle, without stopping the rotor drive motor. This is done by pressing the DOOR switch and opening the door latch at the same time.

3. Speed Control

The centrifuge drive motor speed is controlled by a dc signal generated in the speed control circuit. This signal is applied to the control winding of the saturable reactor through contacts 4-7 and 6-9 of the speed control relay K206. Its limits are controlled by torque trimmer potentiometer R204.

The speed control circuit consists of a rpm indicator M101, a tachometer generator TG301, a speed set comparator, a high gain amplifier, and a power amplifier.

Speed is controlled by the resistance in speed control potentiometer R 106 against an ac signal generated at the tachometer generator TG301. This signal is proportional to the rpm of the centrifuge drive motor.

Until the comparator makes a comparison, the high gain and power amplifiers are operating at full output power, thereby saturating the control winding of the saturable reactor. This function causes the centrifuge drive motor to operate at maximum motor acceleration. When the signal from the tachometer generator reaches a preset level, it is compared against a comparator generated signal. The comparator then causes the power amplifier to be driven into the cutoff region. This causes the power amplifier to cut off, reflecting a line voltage drop across the reactor instead of the drive motor. As the motor speed varies, above or below the preset level, the power amplifier modulates the reactor accordingly. The reactor cycles the drive motor ON and OFF as necessary to maintain a preset rpm controlled by the resistance of control potentiometer R106.

The tachometer output is read directly at the speed indicator as actual rpm.

4. Overspeed Detection System

The overspeed detector consists of a tachometer signal detector, a signal comparator and control relay K205. A reference level corresponding to 22 000 rpm is programmed into the comparator. The output of the tachometer generator TG301 is an ac voltage which goes to the comparator where it is converted to a compatible signal that is compared against a signal generated in the comparator. If the tachometer generator signal exceeds the preset voltage level, a signal is generated which opens the overspeed switch and deenergizes the RUN/ HOLD relay K205, removing power from the centrifuge drive motor and placing the centrifuge in the HOLD mode.

5. Refrigeration

Compressor operation is similar to operation in the HOLD mode, except the temperature control, programmed by the blue set pointer, causes ac power to flow across the closed contacts of relay K205.

The timing circuit is programmed for a minimum of 40 seconds OFF cycle and an unlimited time ON cycle. This circuit is activated by the presence of a signal from the tachometer generator TG301.

6. Overtemperature Detection System

The overtemperature detector consists of a signal comparator, control amplifier and relay K4. If the temperature rises above the red set pointer, a temperature signal is generated by the comparator to open the overtemperature switch triac CR20 and deenergize run-hold relay K205, placing the centrifuge in the HOLD mode.

7. Brush Warning System

The brush warning system consists of circuit breakers CB1 and CB2 and two normally open brush switches in the drive motor. As the brush wears, the switch slowly closes, until contact is made, connecting ac motor voltage to its corresponding circuit breaker through a 250-ohm resistor. Voltage above 12 to 20 volts trips the breaker. The tripped circuit breaker opens the 115 Vac connection between run-hold relay K205 and ON switch S111 which energizes thermal relay K207. Thermal relay K207 switches ON and OFF providing an intermittent voltage to BRUSHES indicator lamp DS103. When circuit breakers trip, remaining brush life is approximately 10 hours. Once the run is completed, the centrifuge will not restart until the circuit breakers are reset.

8. Motor Braking

The motor brakes only as the centrifuge enters or is in the HOLD mode. However, the braking function can be set at any time. Pressing BRAKE switch S109A energizes brake relay K208 to apply +5 Vdc to contact 9 of motor relay K202. Pressing OFF switch S110 deenergizes motor relay K202 to apply the +5 Vdc to the junction of resistors R201 and R202 to brake the motor. BRAKE lamp DS109 is energized by 30 Vac through S109B.

3-3. RC-5B Theory of Operation (figures 3-11 through 3-24)

The theory of operation for the RC-5B centrifuge is similar to that of the RC-5, with the following exceptions:

a. Operational Modes

The RC-5B is capable of operating in the HOLD or TIMED modes. Under normal conditions, the compressor will continue to operate in the STOP mode. The RC-5B will also operate in the SLOW mode when equipped with the optional automatic rate controller.

Under normal operating conditions, the STOP mode is a standby condition initiated when the 30 A power switch is set to the ON position and the rotor is in a preset condition prepared to enter the RUN cycle or decelerate from a previous RUN cycle.

b. Cooling

The motor fan draws in cooling air at floor level through an insulated air inlet duct, and forces it into an enclosed silencer around the drive motor. The air drawn through the motor housing circulates around the drive motor, cools it, then is exhausted through the back of the centrifuge.

c. Emergency Door Interlock

A manual door interlock release rod is located beneath the top deck cover at the righthand corner, facing the control panel. When this rod is pushed inward, the chamber door is opened in the event of a power failure or during a RUN cycle.

d. Automatic Rate Controller

In the SLOW mode, the automatic rate controller provides a gradual slow controlled acceleration feature during start-up operation. This feature is accomplished by an automatically programmed sequence of rotor acceleration rate. As shown in figure 3-15, the initial rotor acceleration rate may be preselected within specific limits. The transition to the desired preselected RUN cycle speed is accomplished automatically at approximately 1000 rpm. At the end of a preselected RUN cycle, the brakes will be automatically applied to reduce the rotor speed if the brake switch S109A is depressed.

If the brake switch is not pressed, the rotor will coast to approximately 700 rpm when the transition to an extended coasting interval is followed by a gradual stop.

The initial acceleration rate indicated by the dotted lines in figure 3-15, is programmed by the operator. The time interval at RUN speed or a desired RUN speed above 1000 rpm and the BRAKE ON or BRAKE OFF features are all controlled by the operator. Drive motor braking is automatically inhibited below the transition speed at the end of a RUN cycle to avoid disturbing the sample being processed. This is accomplished by providing a gradual slowdown to a zero rpm condition. The refrigerator compressor operation is also inhibited below the transition speed to avoid the compressor vibration disturbing the sample.

3-4. Summary of HOLD and RUN Modes

The HOLD mode is activated when the main power switch is set to the ON position and the ON switch is set to OFF (RC-5) or the TIMER switch is set to OFF (RC-5B). The HOLD mode is used to maintain a constant preset temperature within the centrifuge chamber at all times while the above condition exists.

Characteristics of the HOLD mode are as follows:

- RC-5—the OFF indicator is illuminated.
RC-5B —the START indicator is not illuminated.

- The door can be opened.
- The drive motor is OFF.
- On the temperature control, the red pointer indicates the selected chamber temperature.
- Motor relay K202 and RUN-HOLD relay K205 are deenergized.

The following two steps are necessary to enter the HOLD mode from a STOP condition:

1. Place the centrifuge main power plug into the power socket having proper power rating.
2. Set the main circuit breaker to the ON position .

Conditions necessary to enter the HOLD mode from the RUN mode are:

1. On the RC-5 only, press the OFF switch.
2. Allow the timer to advance to the OFF position, or manually advance the timer to the OFF position.

In addition, any one of the following conditions will transfer the centrifuge from the RUN mode to the HOLD mode:

1. Rotor speeds above 22 000 rpm will activate the overspeed detector and cause the centrifuge to switch to the HOLD mode.
2. A rise in refrigerated temperature will cause the black pointer on the temperature indicator to reach a point that is 3°C higher than the red pointer indicates. This action will force an automatic high temperature cutoff, placing the centrifuge in the HOLD mode.
3. Momentary loss of power will transfer the unit to the HOLD mode. The RUN mode is controlled by the RUN-HOLD relay K205, a latching-type relay. A 10 millisecond loss of power will cause the coil of this relay to deenergize and automatically switch the centrifuge into the HOLD mode.

The RUN mode is used to operate the rotor at a preset speed and a preset temperature for a preset period of time.

Characteristics of the RUN mode are as follows:

- RC-5—the ON indicator is illuminated and the OFF indicator is not illuminated.
- RC-5B—the START indicator is illuminated.
- The door will not open unless special procedures are performed.
- On the temperature indicator, the blue pointer controls the refrigeration cycle to maintain the desired rotor temperature. The red pointer is used to sense any refrigeration cycle.

eration malfunction. If a malfunction occurs, it will disable the centrifuge drive system.

- On the tachometer (rpm indicator) the black pointer indicates the actual rpm.
- The centrifuge drive motor will operate when all conditions are met and the speed control is at any position except zero.
- Motor relay K202, compressor fan relay K203 (on RC-5 and early RC-5B units) and RUN-HOLD relay K205 are all energized.
- 230 Vac is applied to the compressor fan motor when K203 is energized.

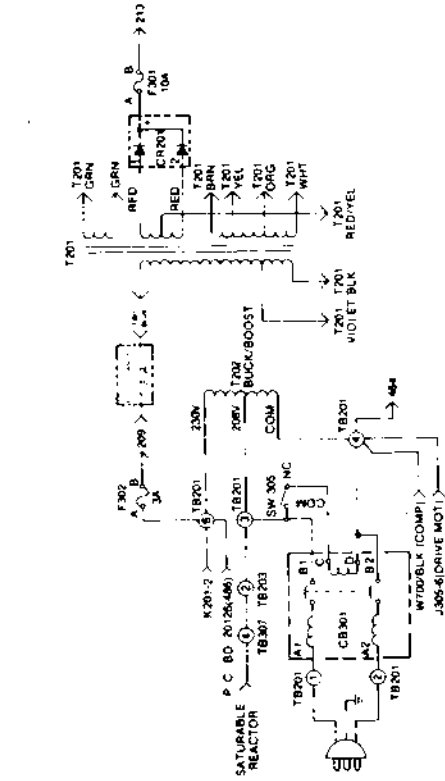
CAUTION

The rotor must be securely mounted on the drive spindle before the centrifuge main switch is set to the ON position.

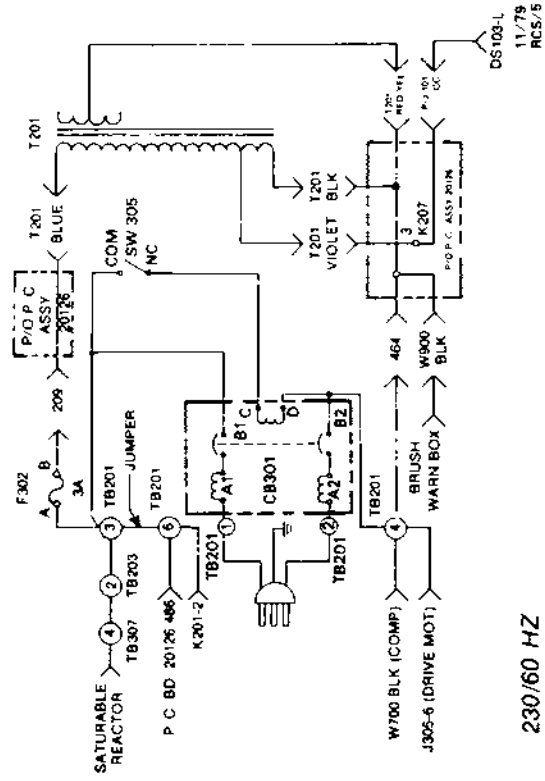
Conditions necessary to enter the RUN mode are as follows:

1. RC-5: turn the key switch in a clockwise direction to the ON position.
2. Set the red pointer at the temperature control to a temperature that is at least 4°C higher than the indicated temperature.
3. Latch the door securely.
4. Advance the timer pointer to any position except the OFF position.
5. RC-5: press the ON switch.

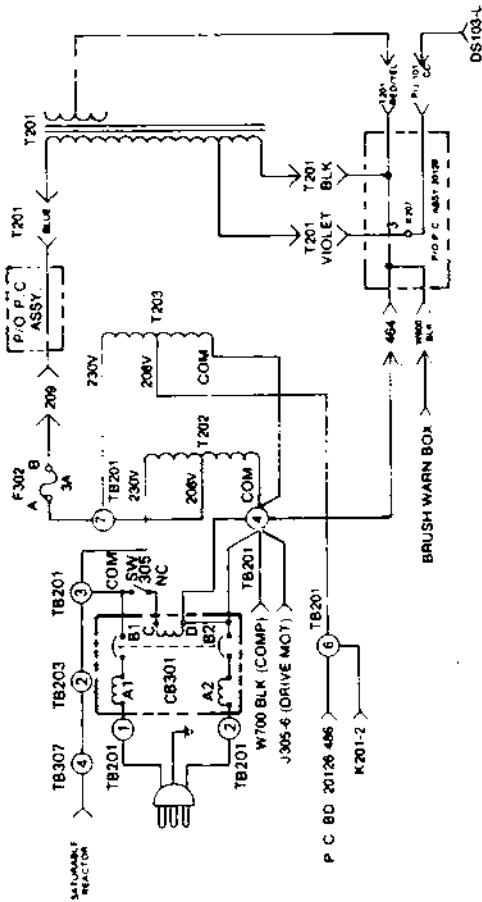
RC-5B: press the START switch.



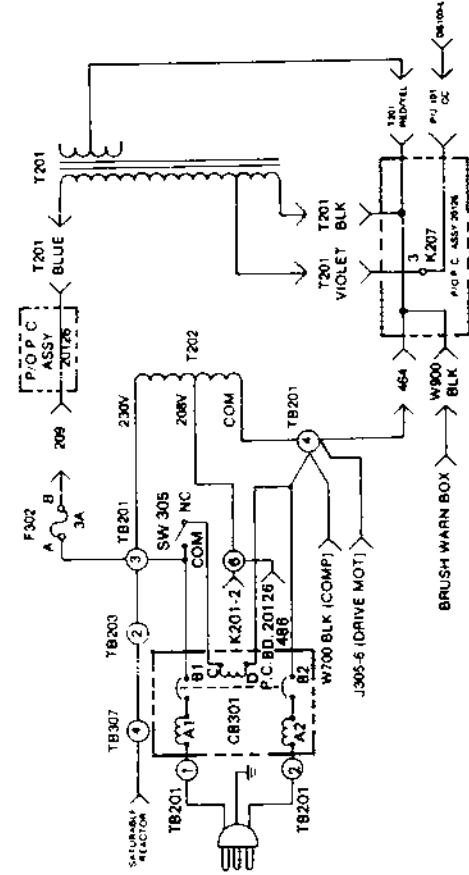
208/60 HZ



230/60 HZ



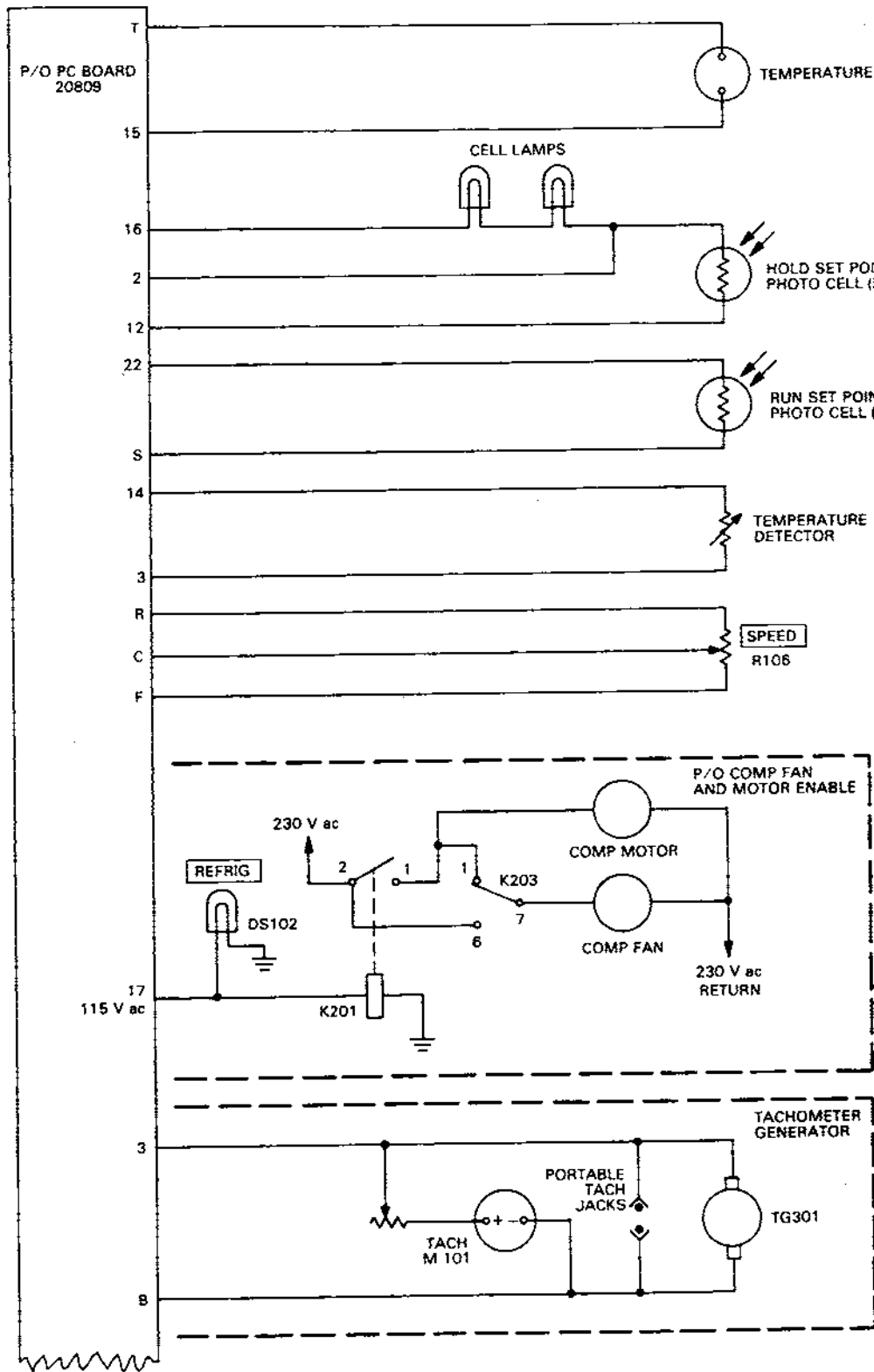
240-250/50 HZ



220/50 HZ

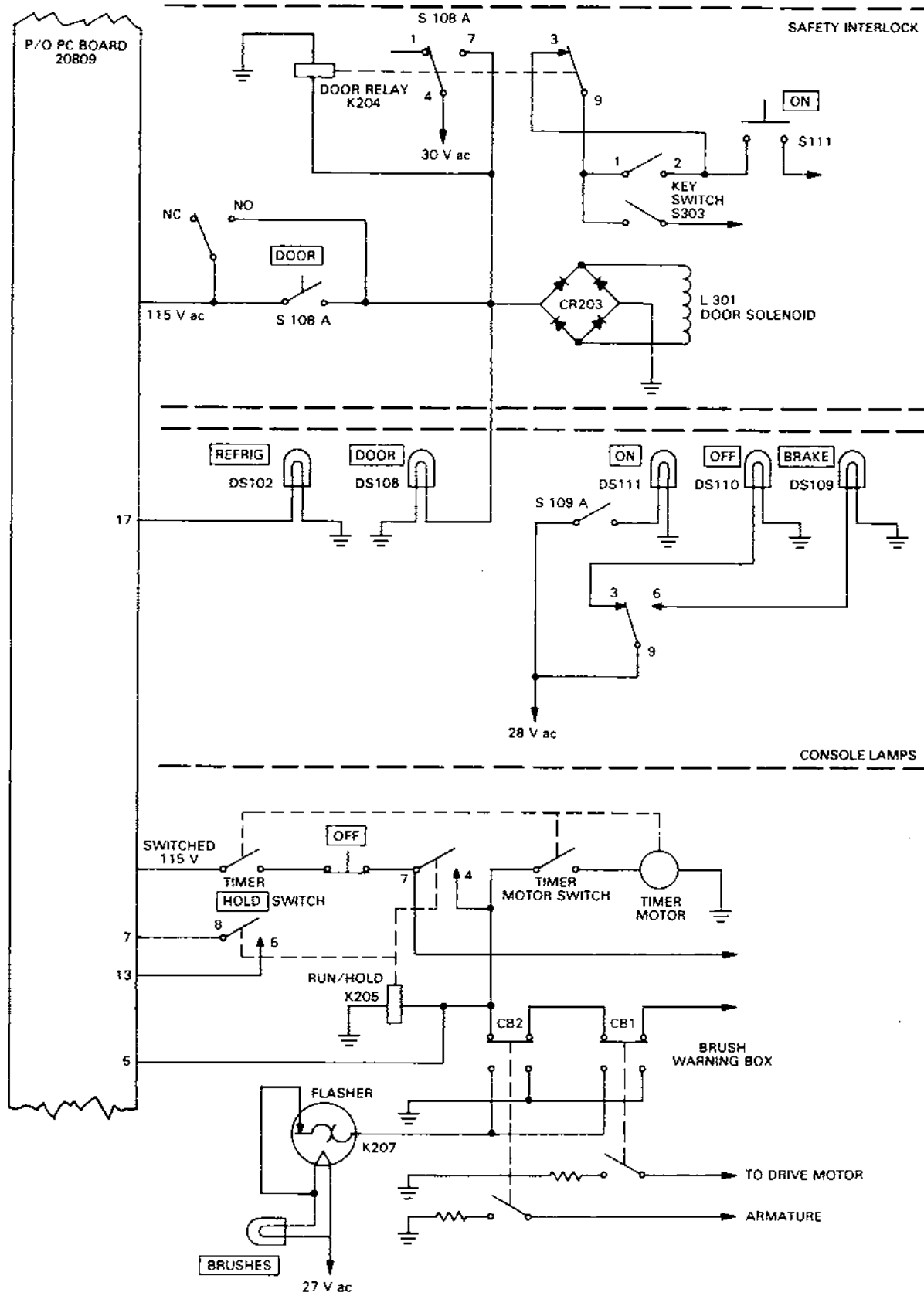
Figure 3-1. Schematic Diagram—RC-5 Power Supply

NOTE
 □ DENOTES PANEL INSCRIPTION



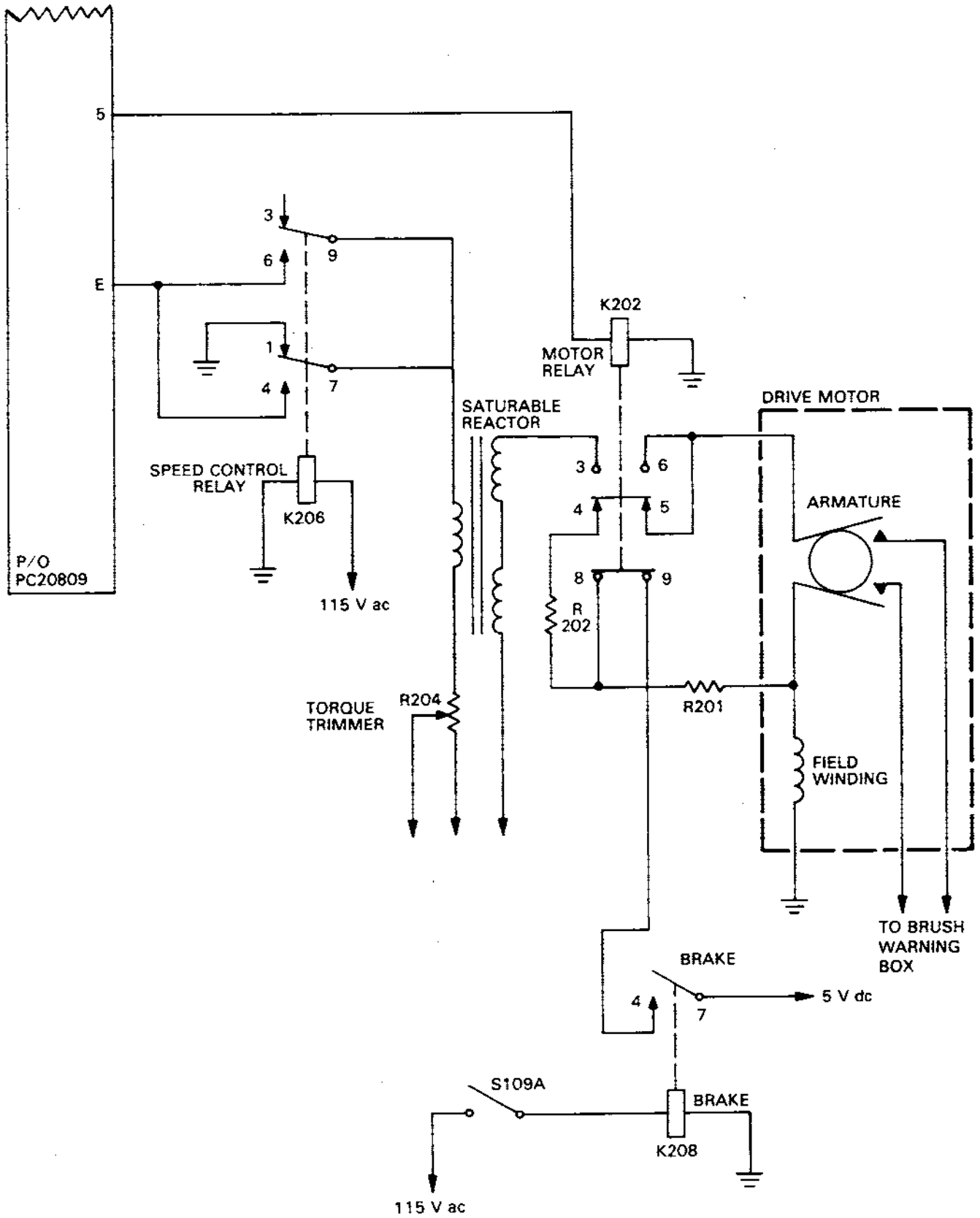
6/79
RCS/6.1

Figure 3-2. Schematic Diagram —RC-5 System Operation, Sheet 1 of 3



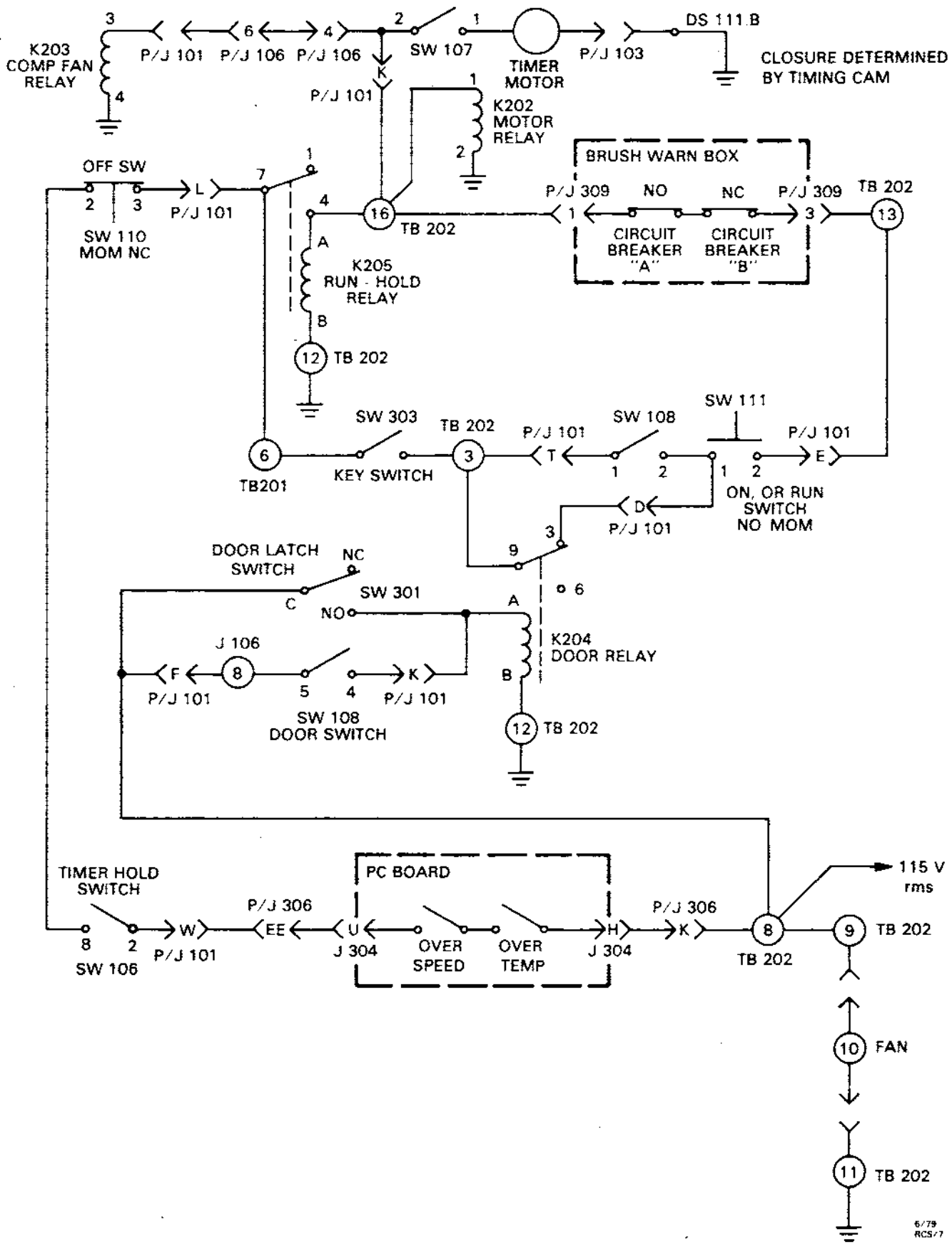
6/79
RCS/6-2

Figure 3-2. Schematic Diagram —RC-5 System Operation, Sheet 2 of 3



6/79
RCS/6.3

Figure 3-2. Schematic Diagram —RC-5 System Operation, Sheet 3 of 3



5/79
RCS-7

Figure 3-3. RC-5 Cabinet Fan, Compressor Fan and Drive Motor Enable Circuit

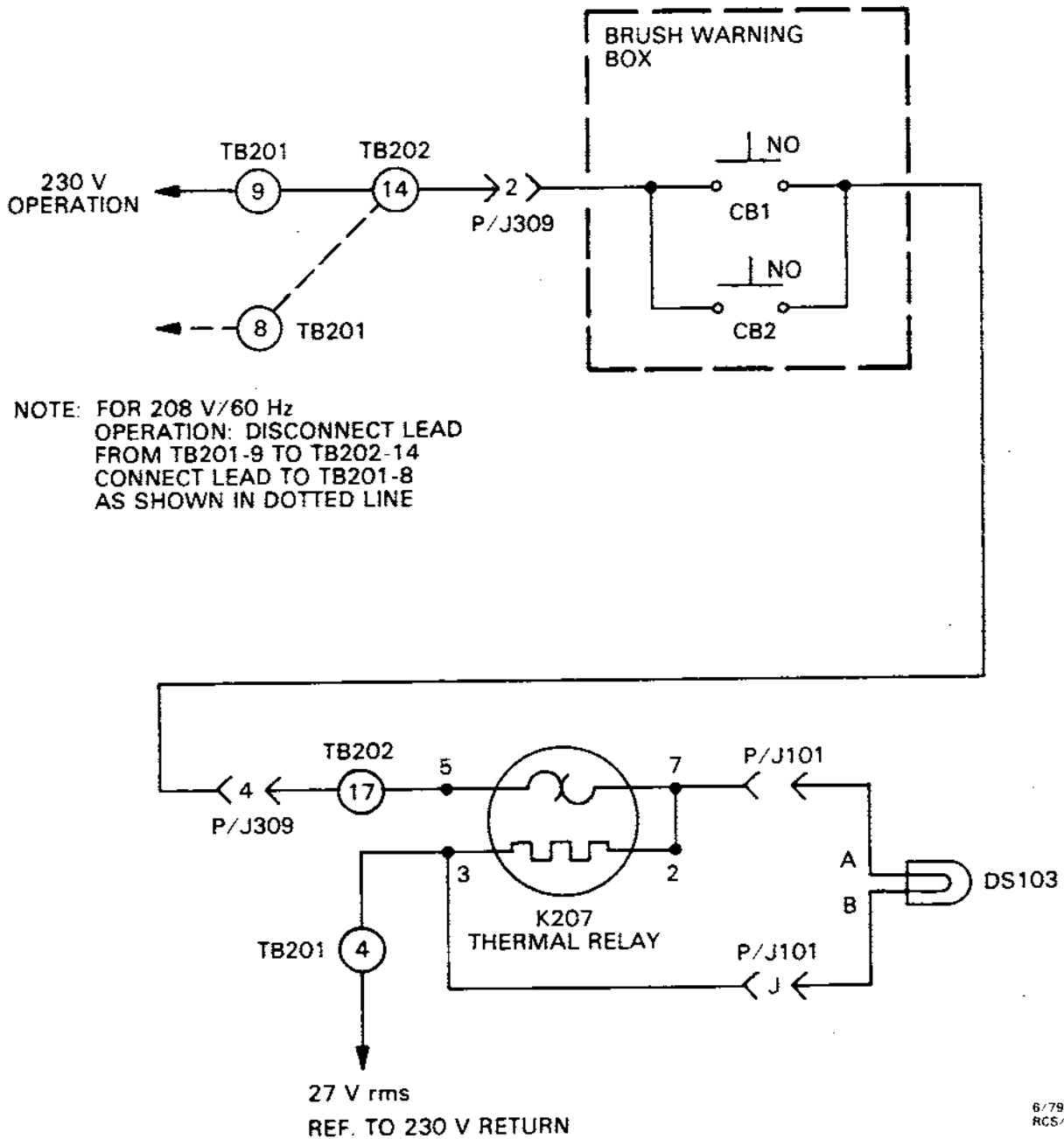


Figure 3-4. RC-5 Brush Warning Indicator Circuit

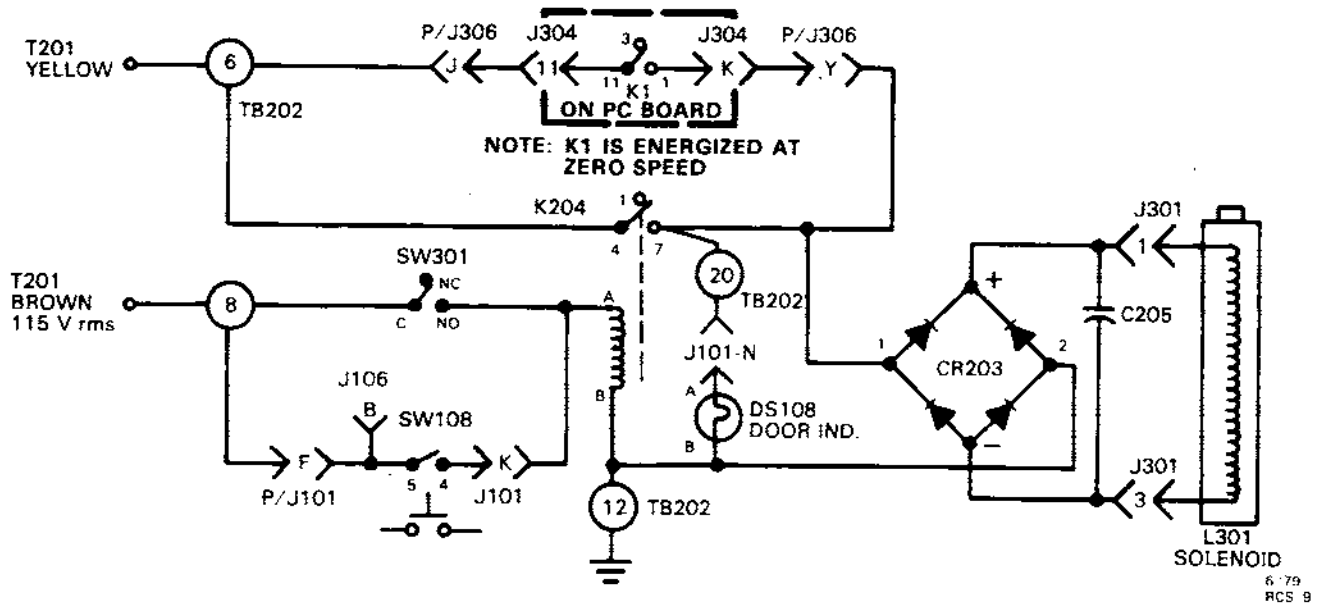


Figure 3-5. RC-5 Door Interlock Circuit

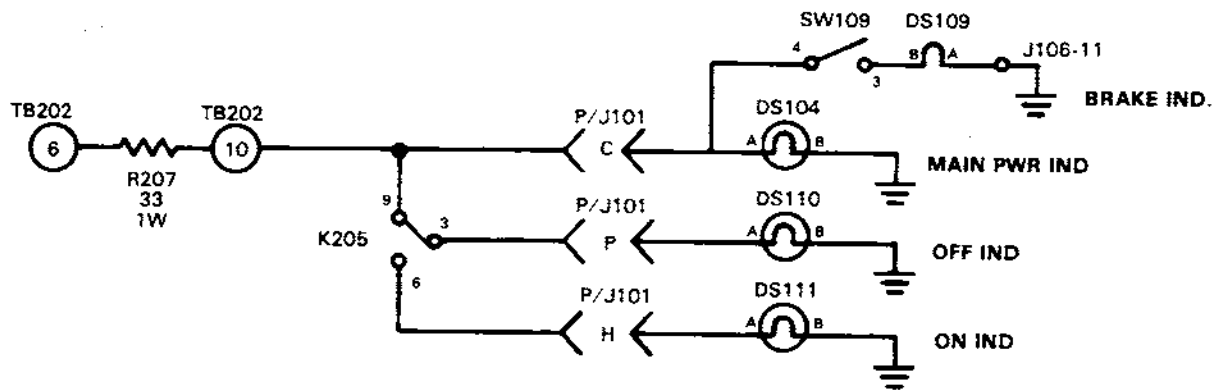


Figure 3-6. RC-5 Door, Main Power, ON, OFF and Brake Indicator Circuit

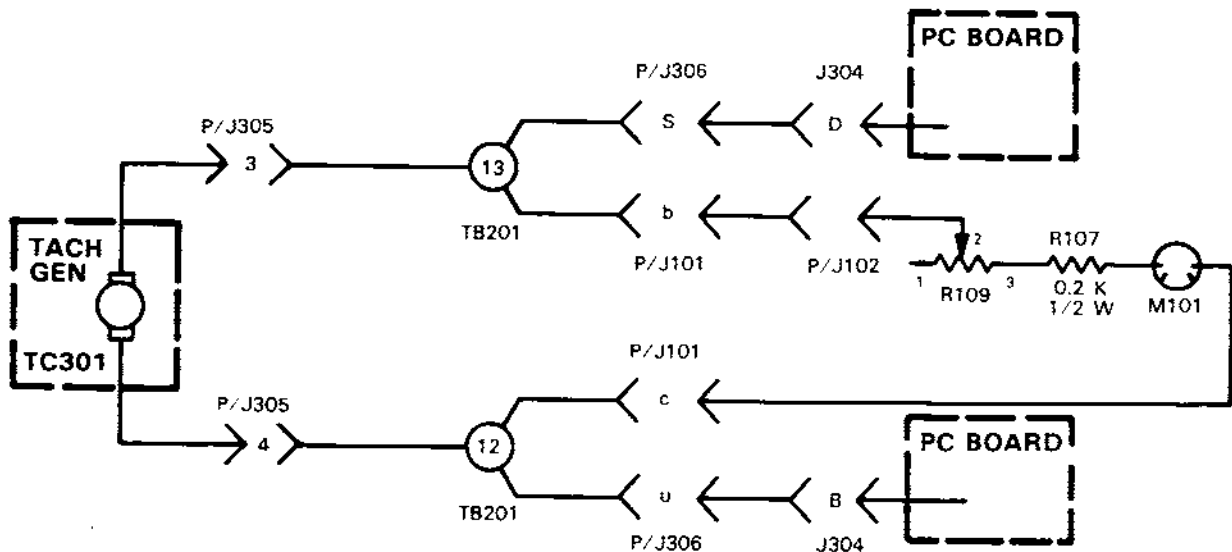


Figure 3-7. RC-5 Tachometer Generator and Indicator Circuit

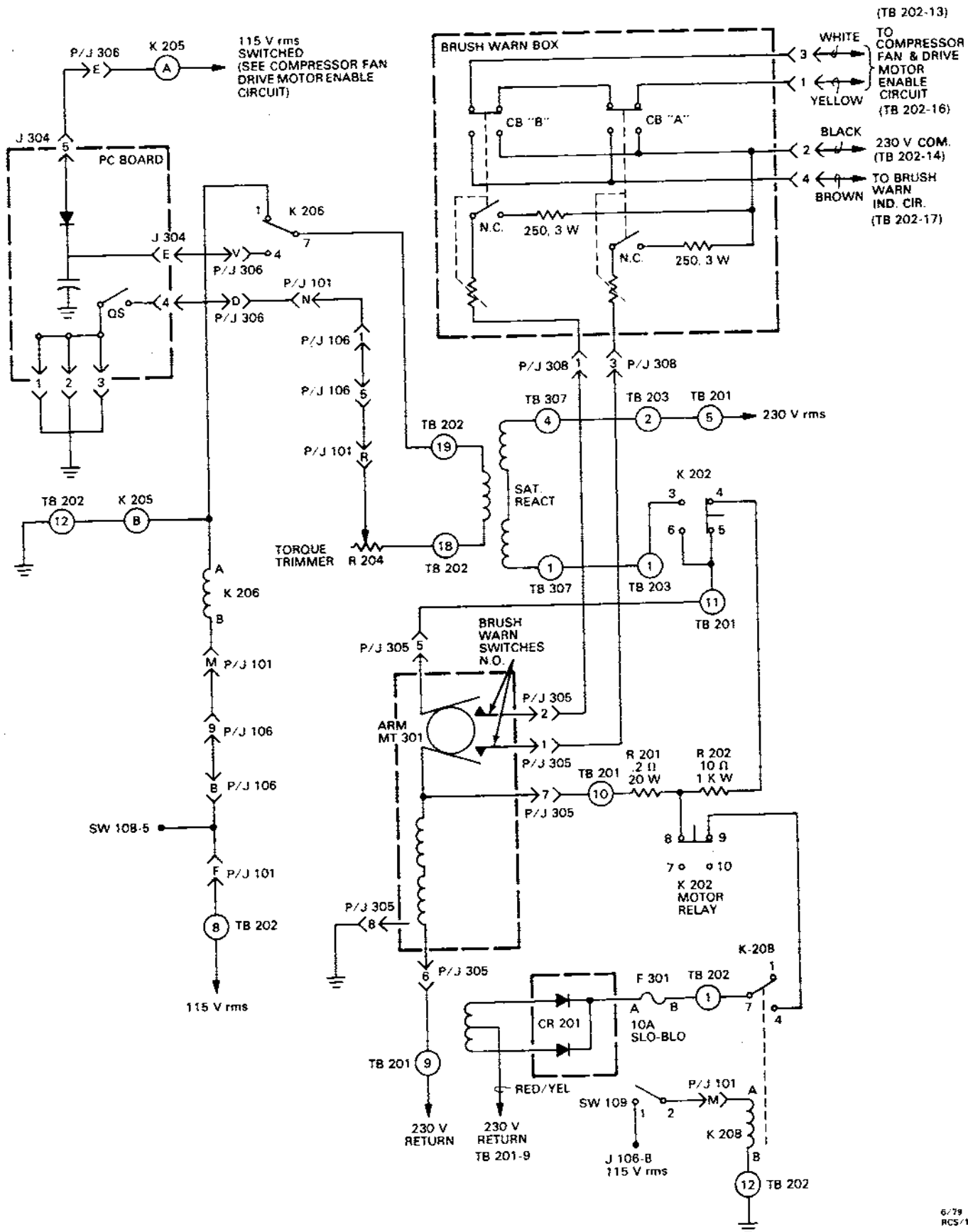
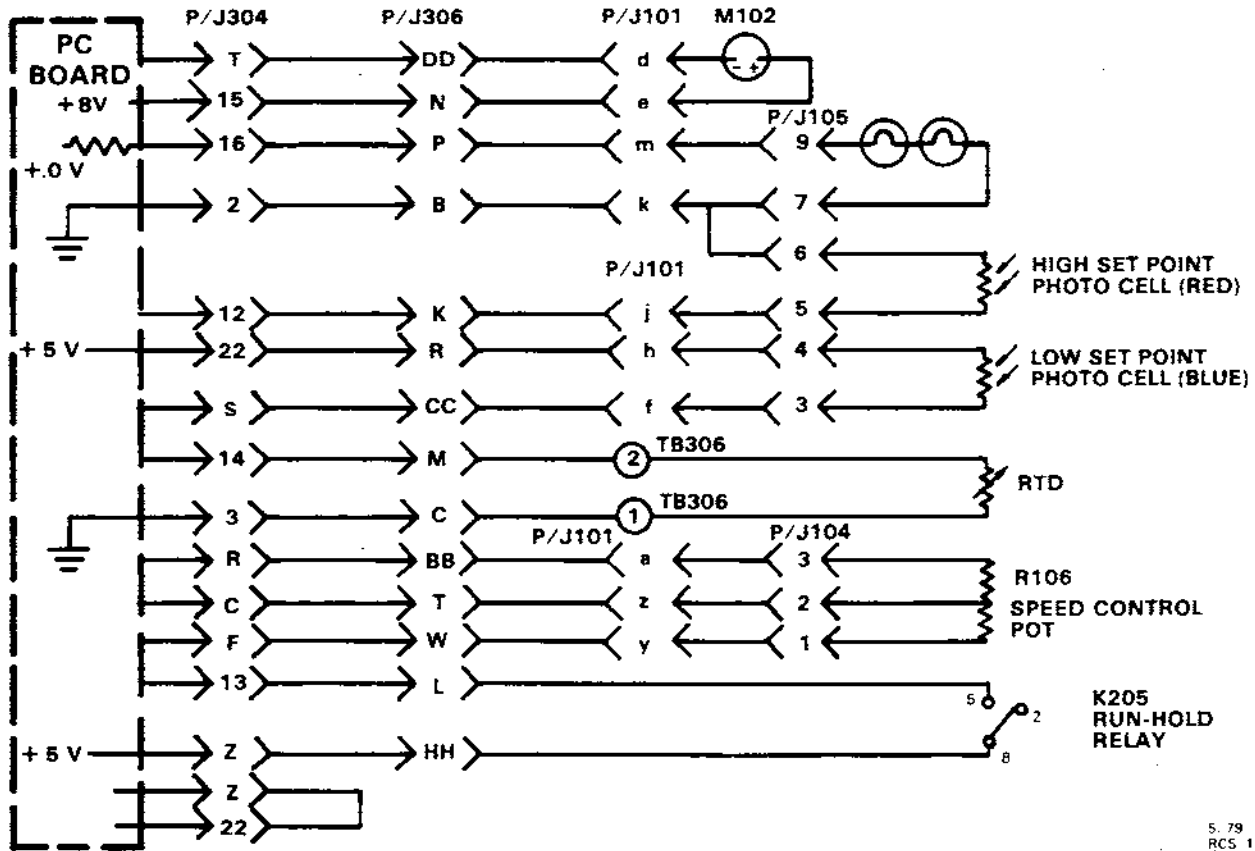
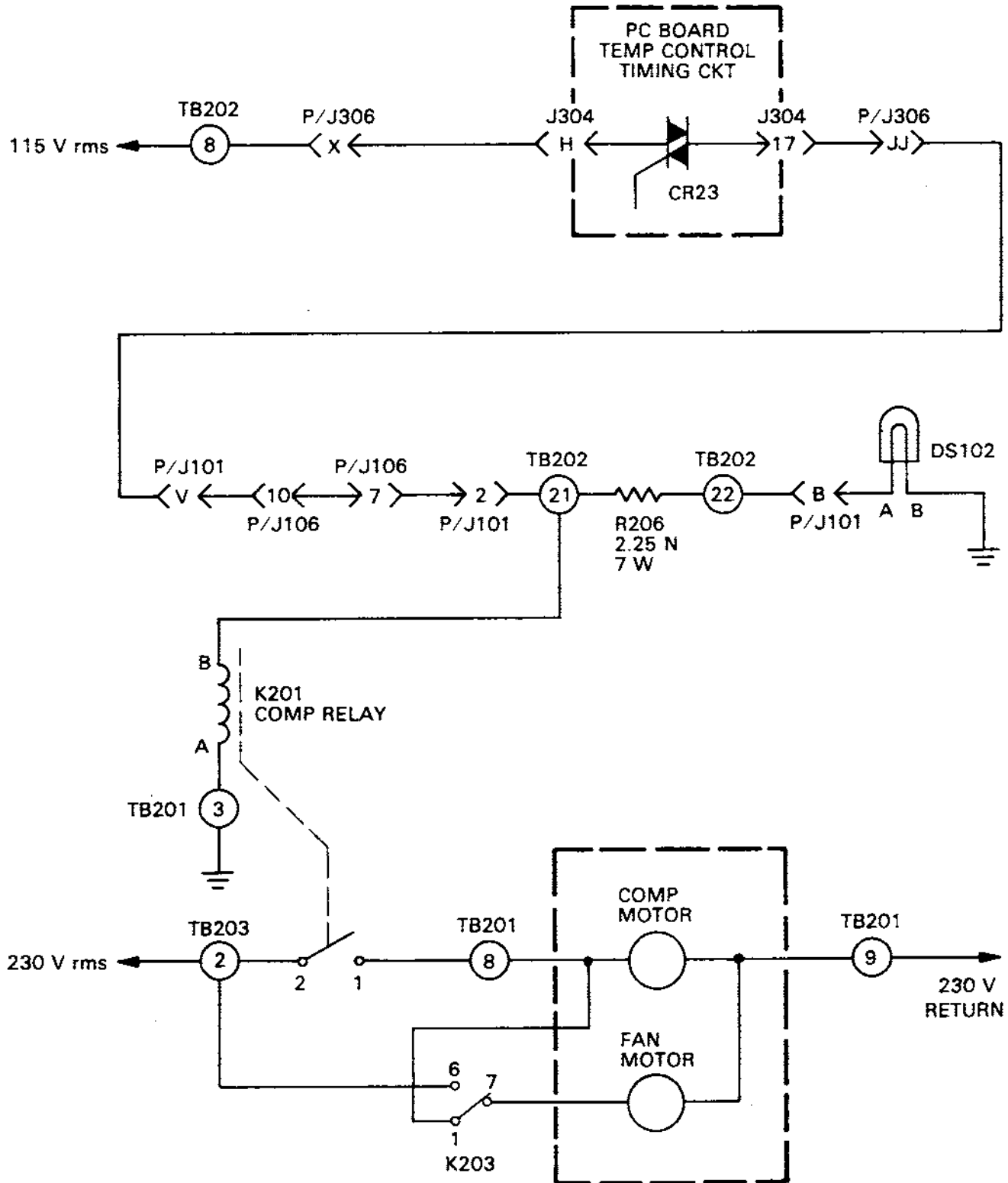


Figure 3-8. RC-5 Drive Motor and Brake Circuit



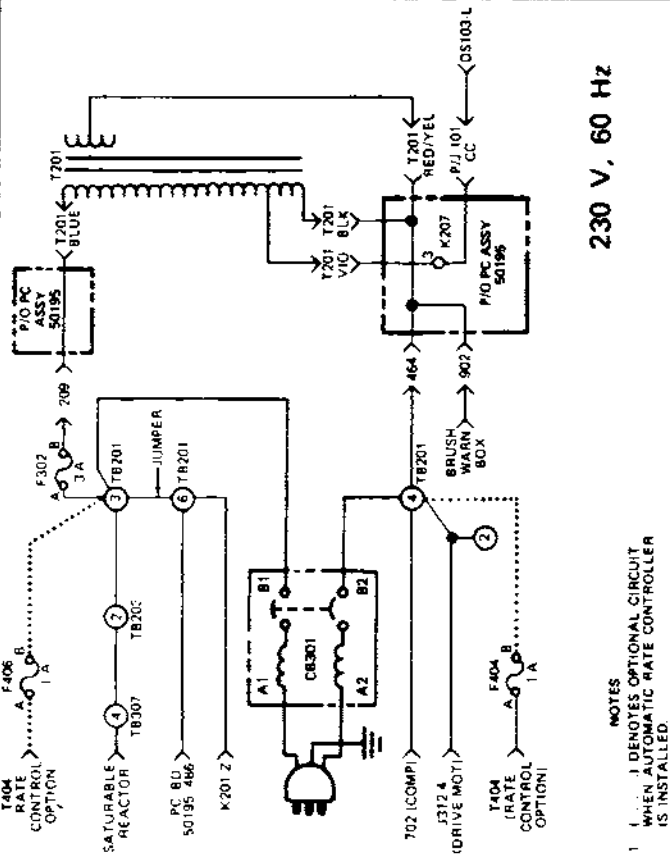
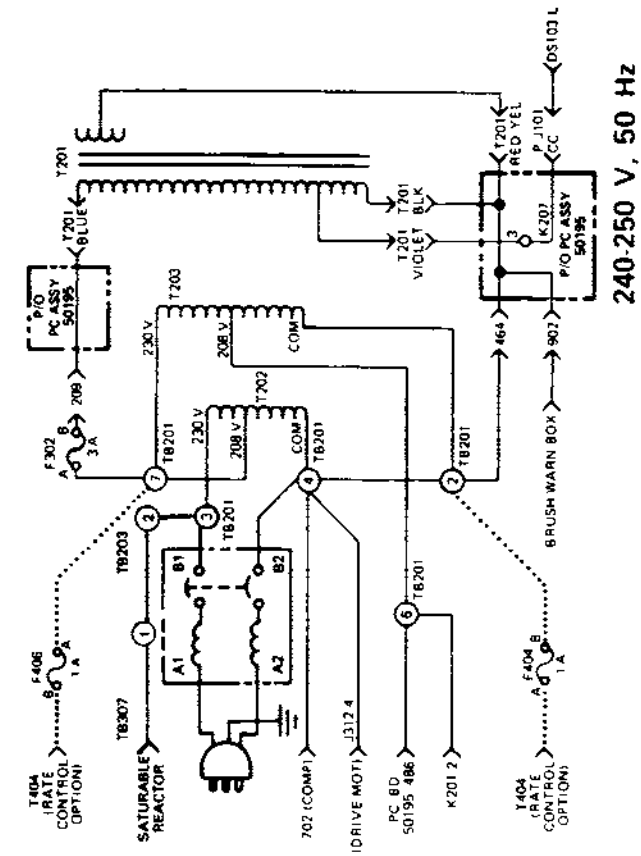
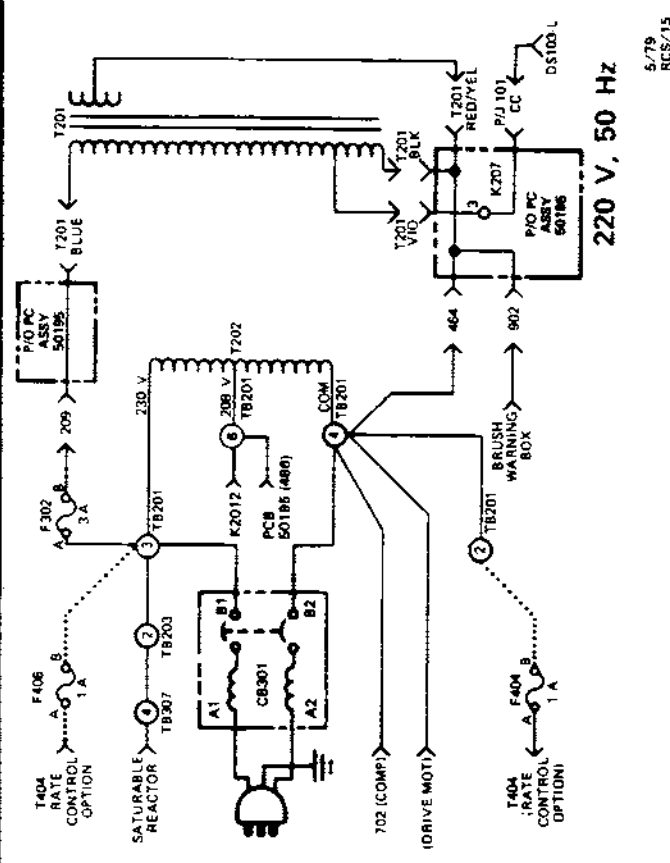
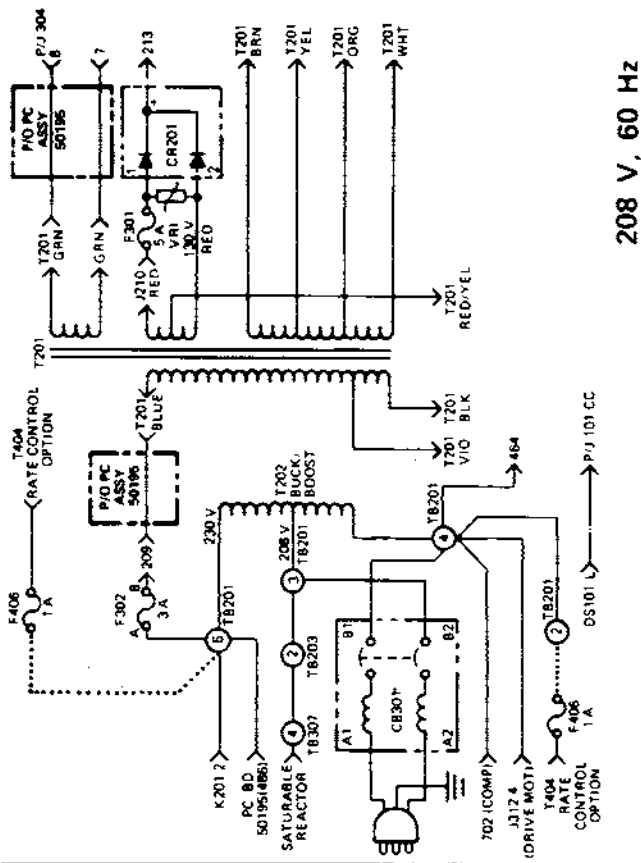
S. 79
RCS 13

Figure 3-9. RC-5 Temperature Meter and Set Point Circuit and Speed Control Potentiometer



6/79
RCS/14

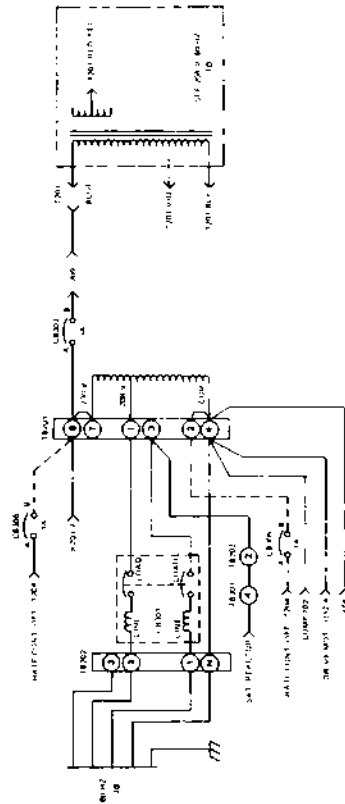
Figure 3-10. RC-5 Compressor Circuit



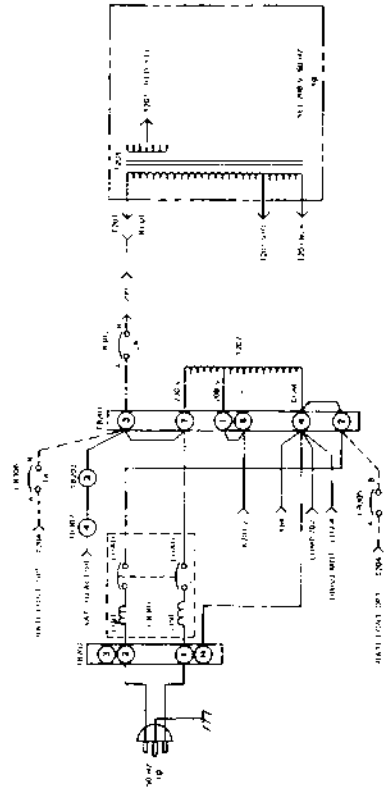
NOTES
 1 J DENOTES OPTIONAL CIRCUIT WHEN AUTOMATIC RATE CONTROLLER IS INSTALLED.

5/79
 RCS/15

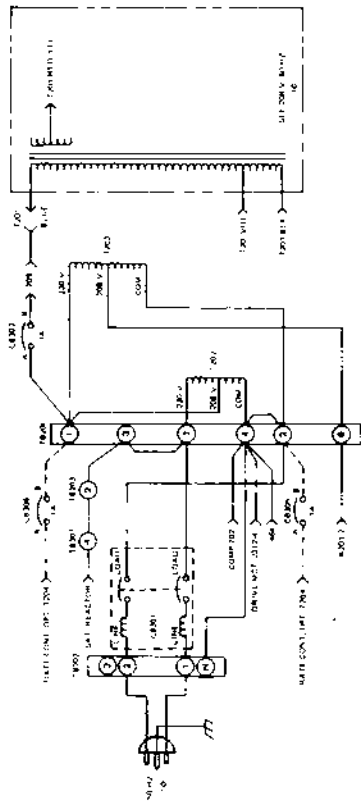
Figure 3-11. Schematic Diagram, RC-5B Power Supply to SN 7810303



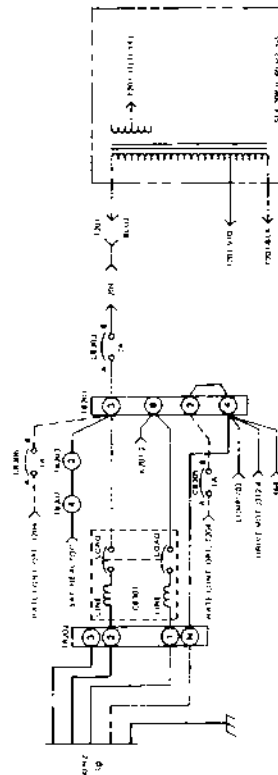
208 V, 60 Hz
POLY-PHASE



220 V, 50 Hz
SINGLE-PHASE



240-250 V, 50 Hz
SINGLE-PHASE



230 V, 60 Hz
POLY-PHASE

NOTE
..... DEMOTES OPTIONAL CIRCUIT
WHEN AUTOMATIC RATE CONTROLLER
IS INSTALLED

Figure 3-12. Schematic Diagram, RC-5B Power Supply, SN 7810304 and Higher (2 of 2)

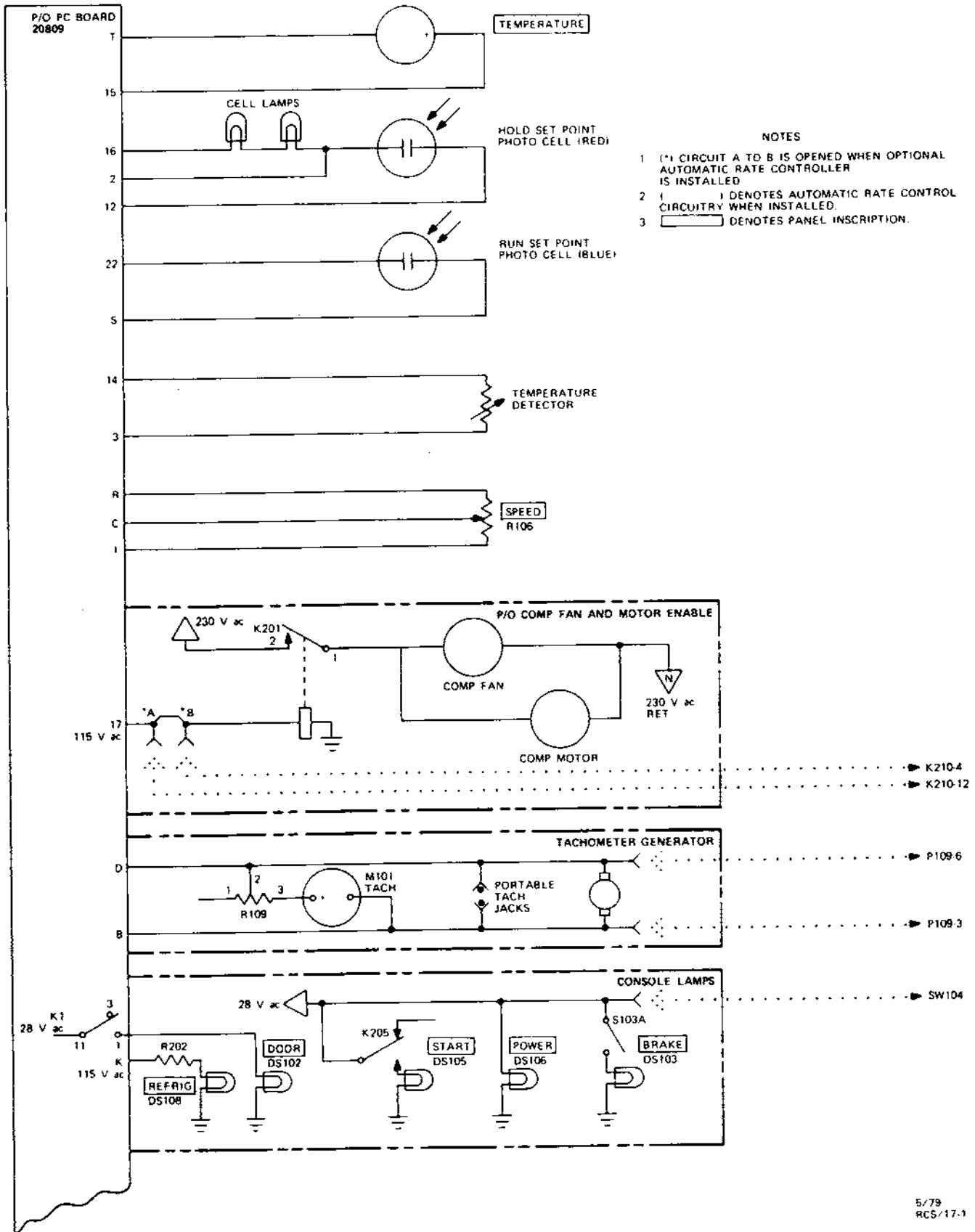


Figure 3-13. Schematic Diagram, RC-5B Operation to SN 7810303 (1 of 2)

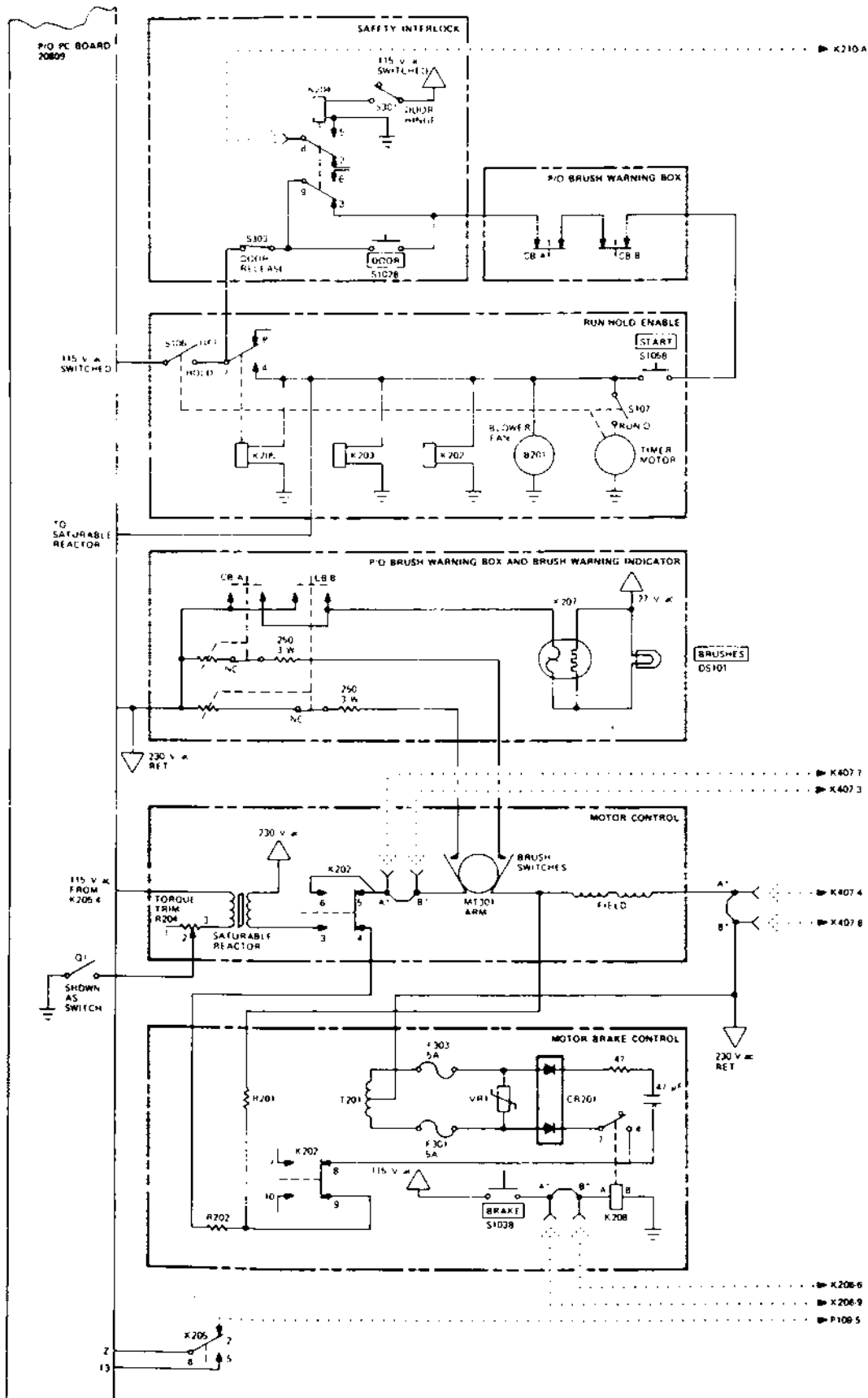


Figure 3-13. Schematic Diagram, RC-5B Operation to SN 7810303 (2 of 2)

5/79
RCS/17-2

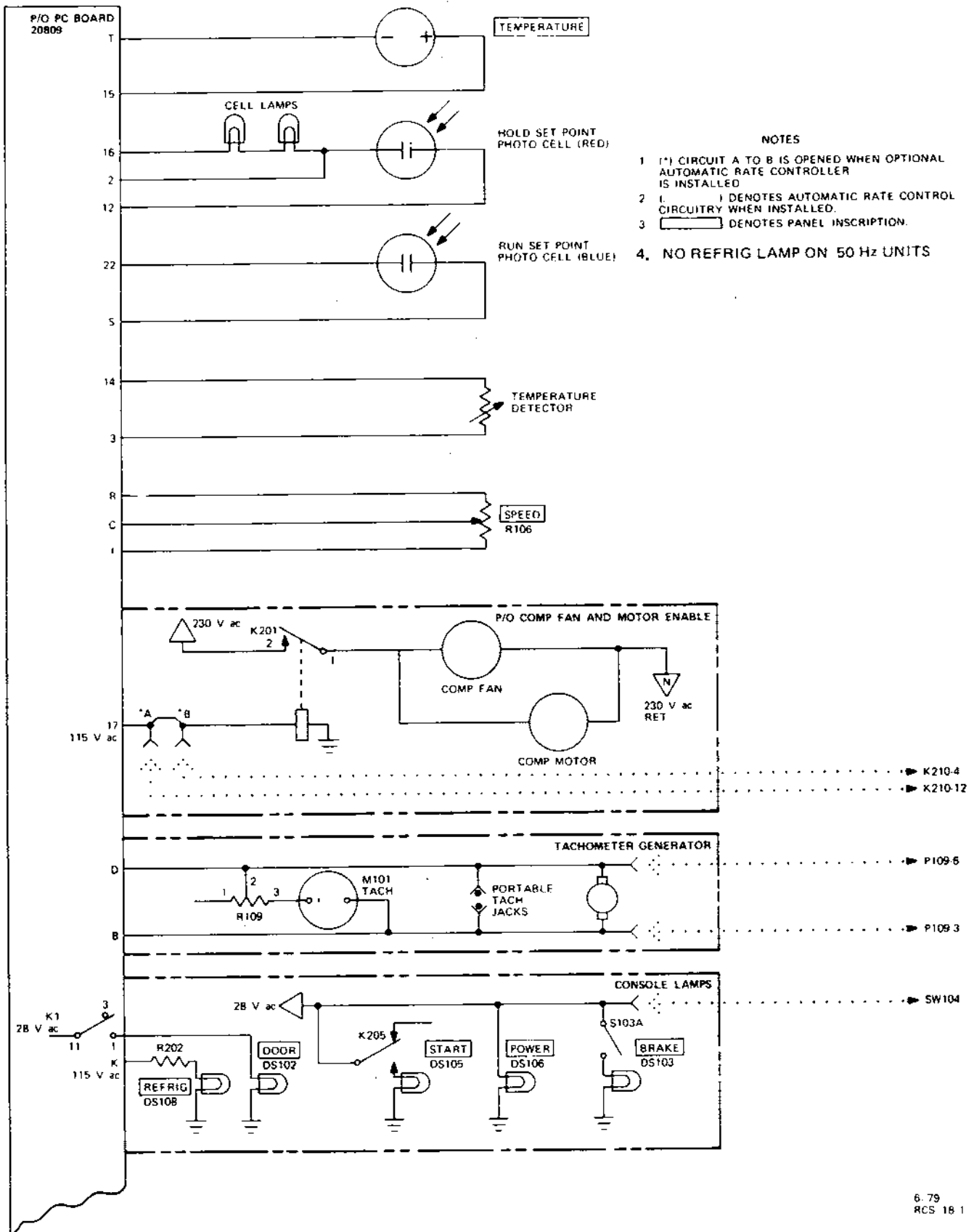


Figure 3-14. Schematic Diagram, RC-5B System Operation, SN 7810304 and Higher (1 of 2)

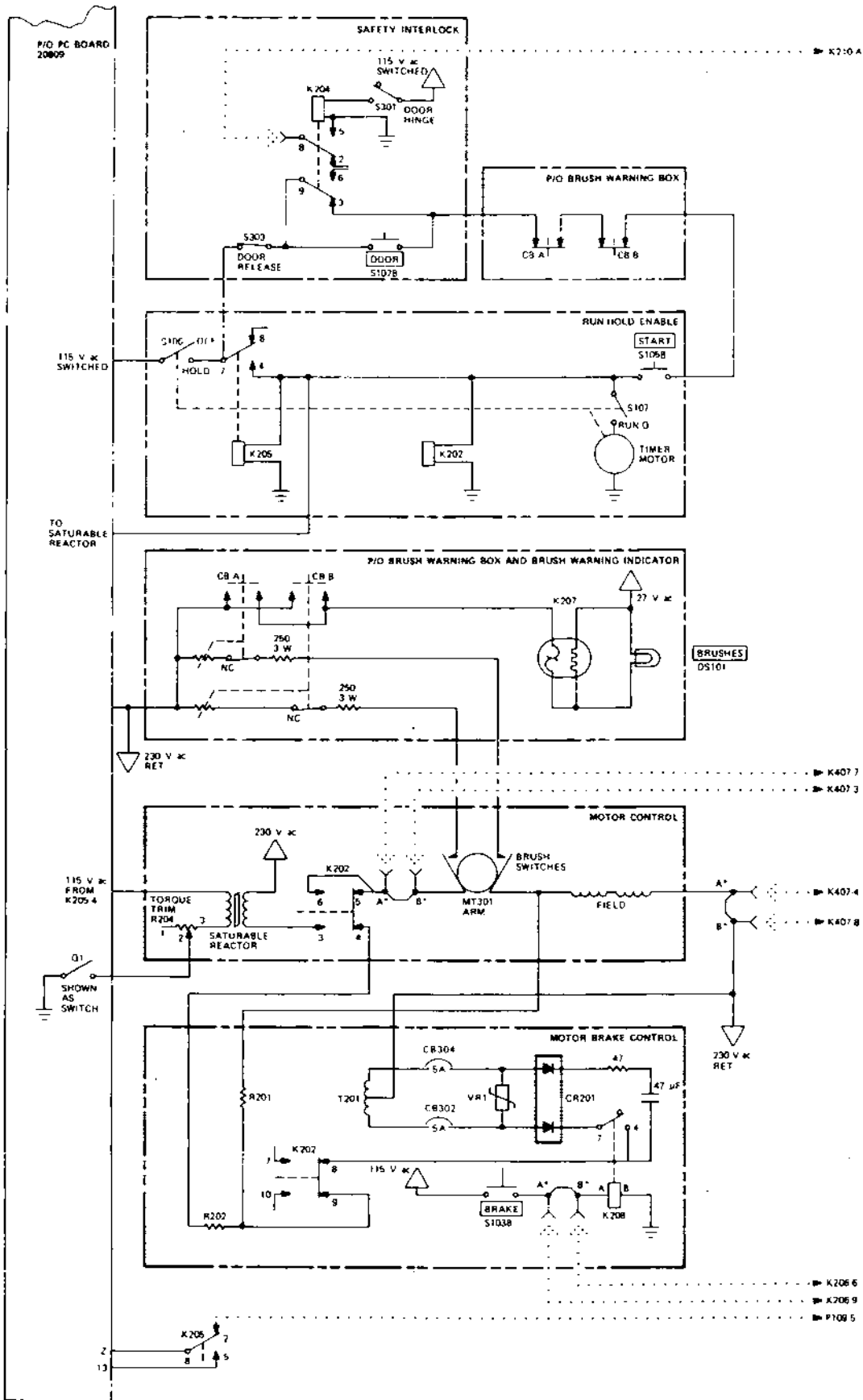
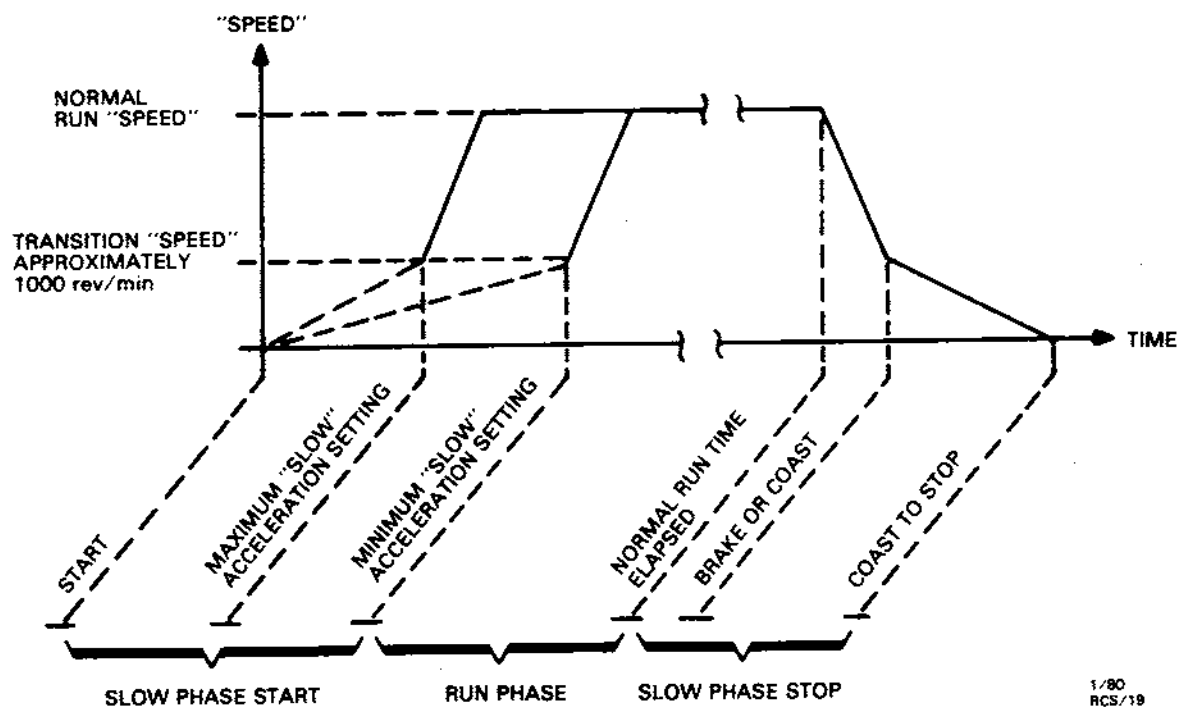


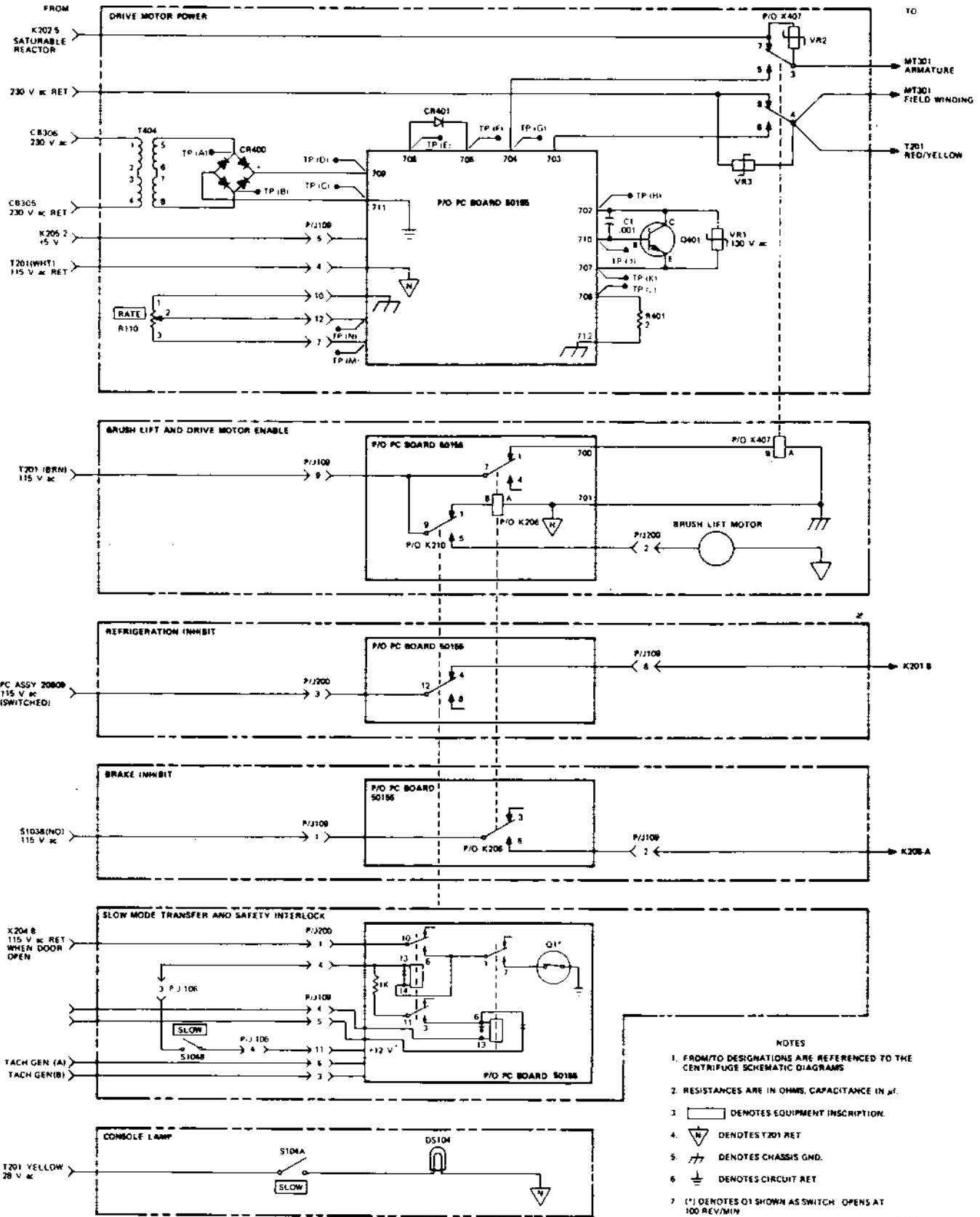
Figure 3-14. Schematic Diagram, RC-5B System Operation, SN 7810304 and Higher (2 of 2)

6-79
RCS 18.2



1/80
RCS/19

Figure 3-15. Timing Sequence for RC-5B Automatic Rate Controller



5/79
RCS/21

Figure 3-16. Schematic Diagram, RC-5B System Operation, Automatic Rate Controller

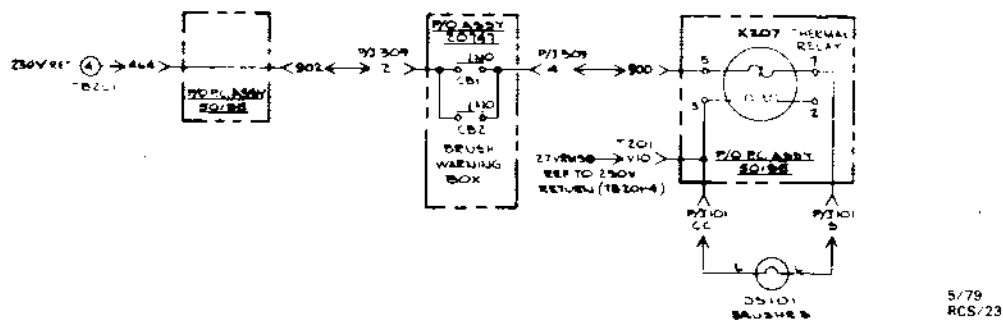


Figure 3-18. RC-5B Brush Warning Indicator Circuit

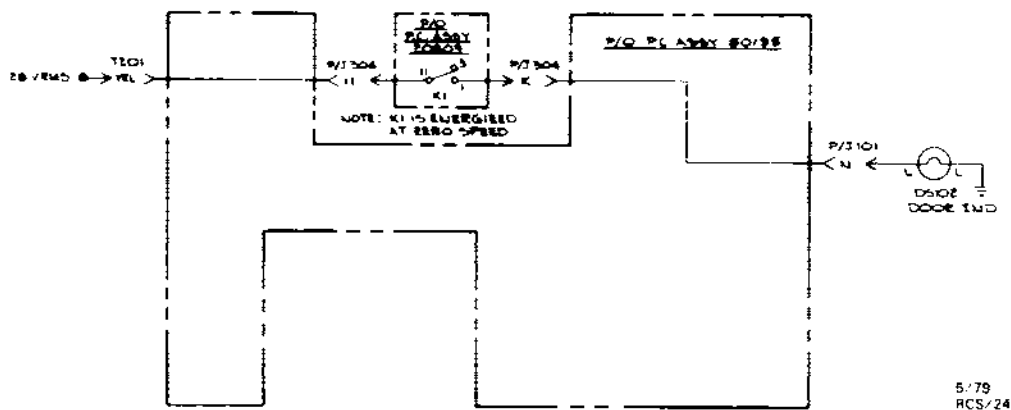


Figure 3-19. RC-5B Door Interlock Indicator Circuit

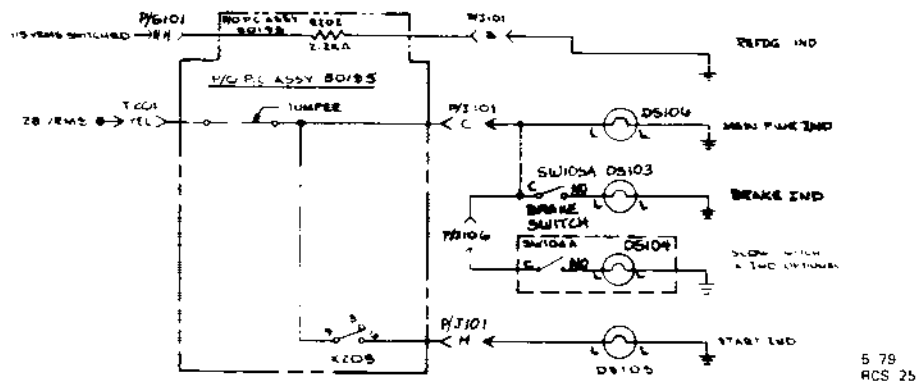
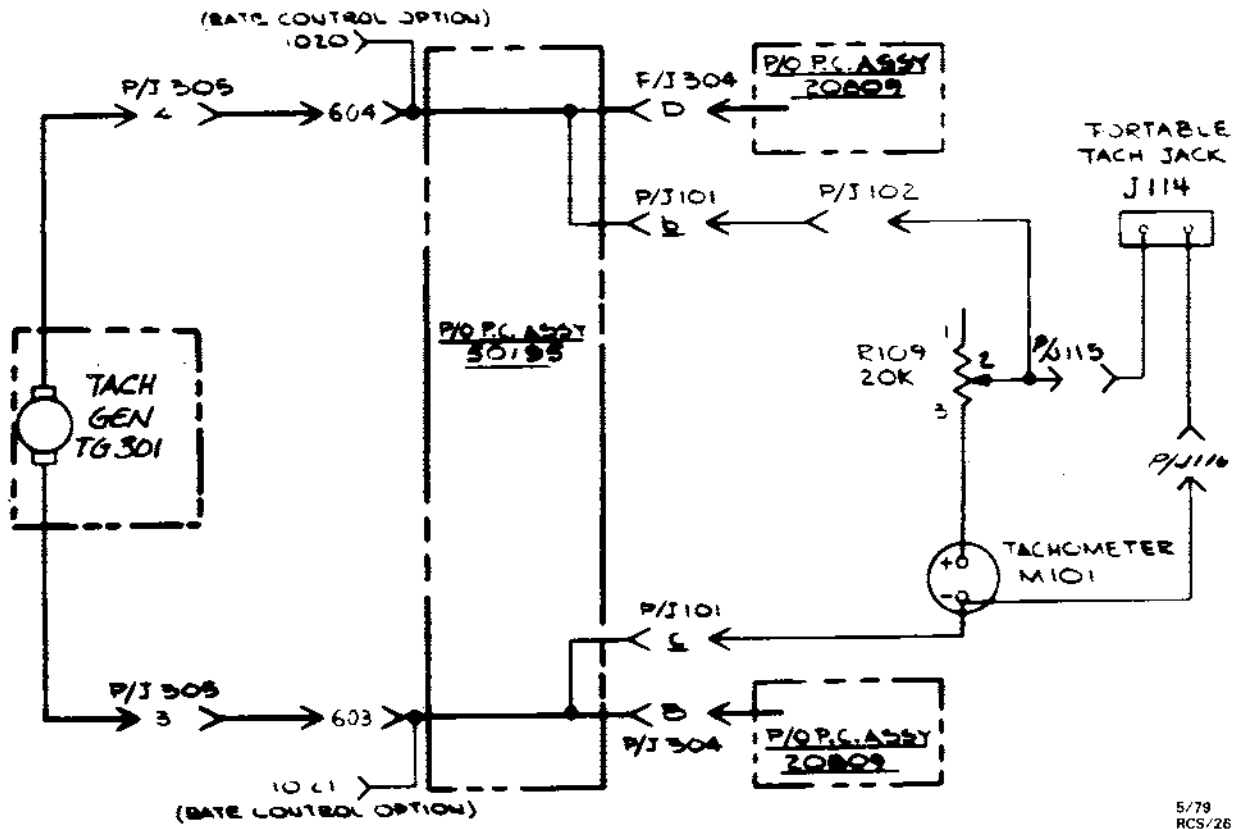


Figure 3-20. RC-5B Main Power, ON, Refrigeration and Brake Indicator Circuits



5/79
RCS/26

Figure 3-21. RC-5B Tachometer Generator and Tachometer Deflection Circuit

5/79
RCS-27

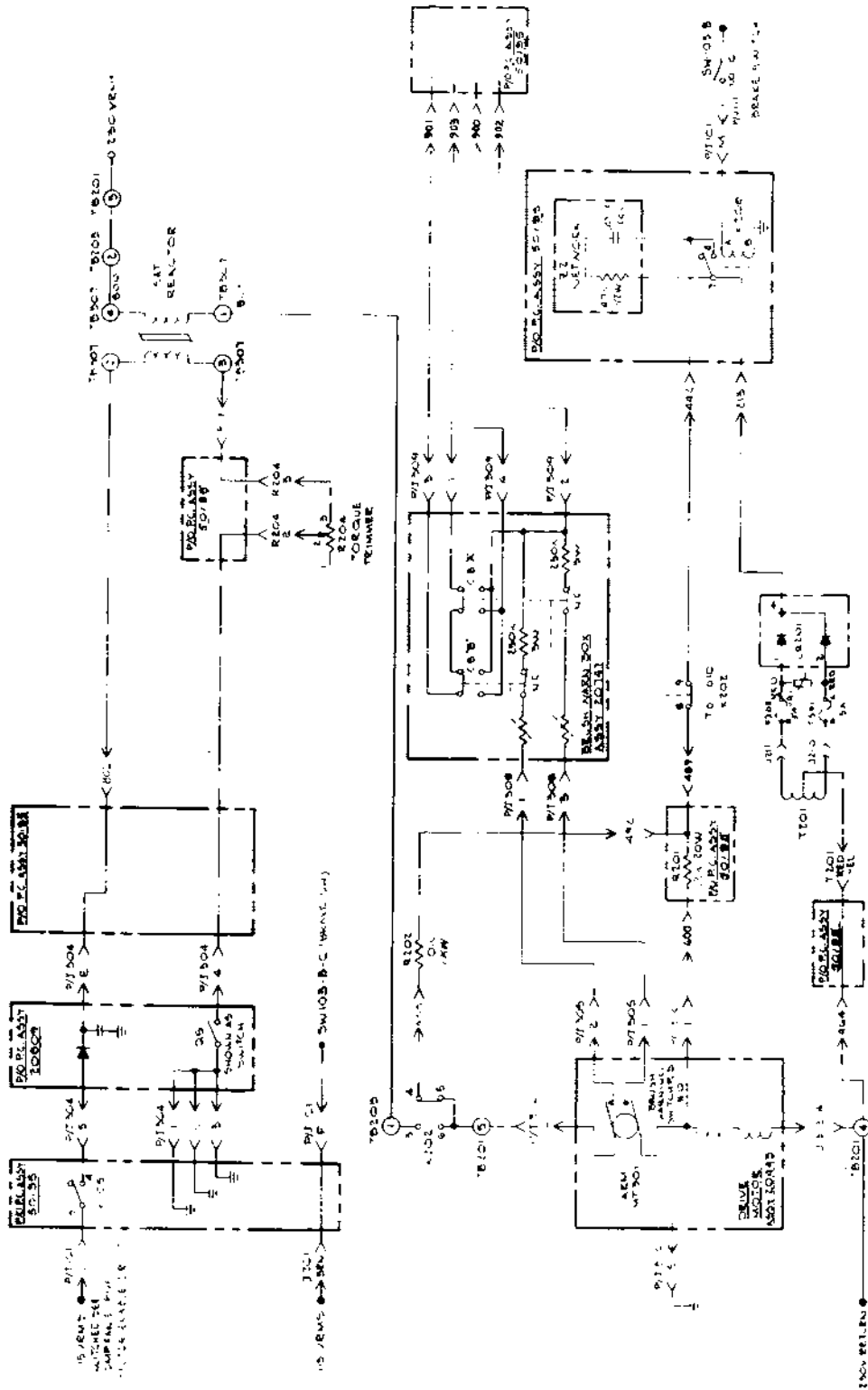


Figure 3-22. RC-5B Drive Motor and Brake Circuit

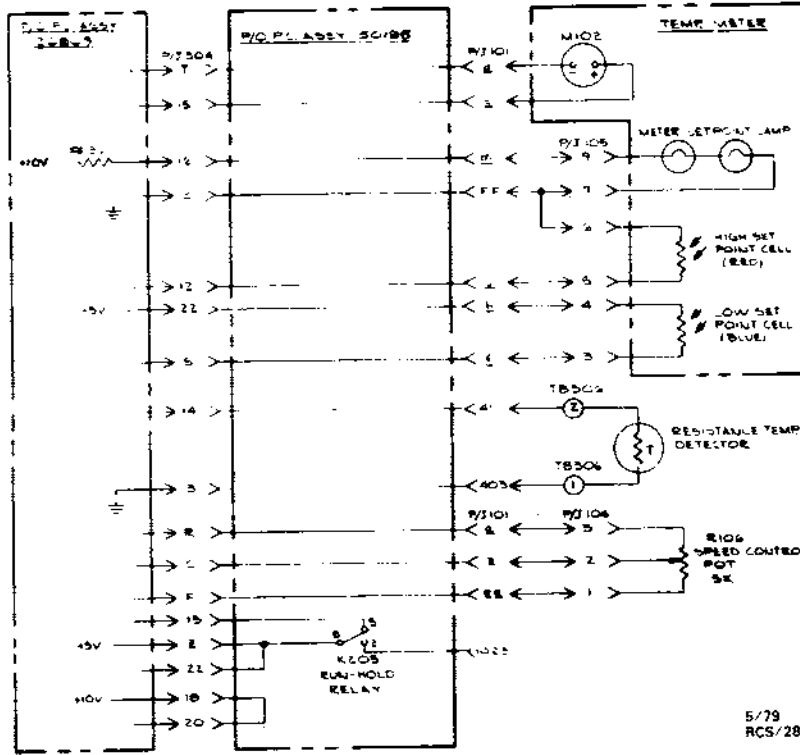


Figure 3-23. RC-5B Temperature Meter and Set Point Circuit and Speed Control Potentiometer

- * TERMINAL 6 ON 220, 208 V UNITS
- TERMINAL 3 ON 230 V UNITS
- TERMINAL 7 ON 240 V UNITS
- TERMINAL 7 ON 230 V UNITS

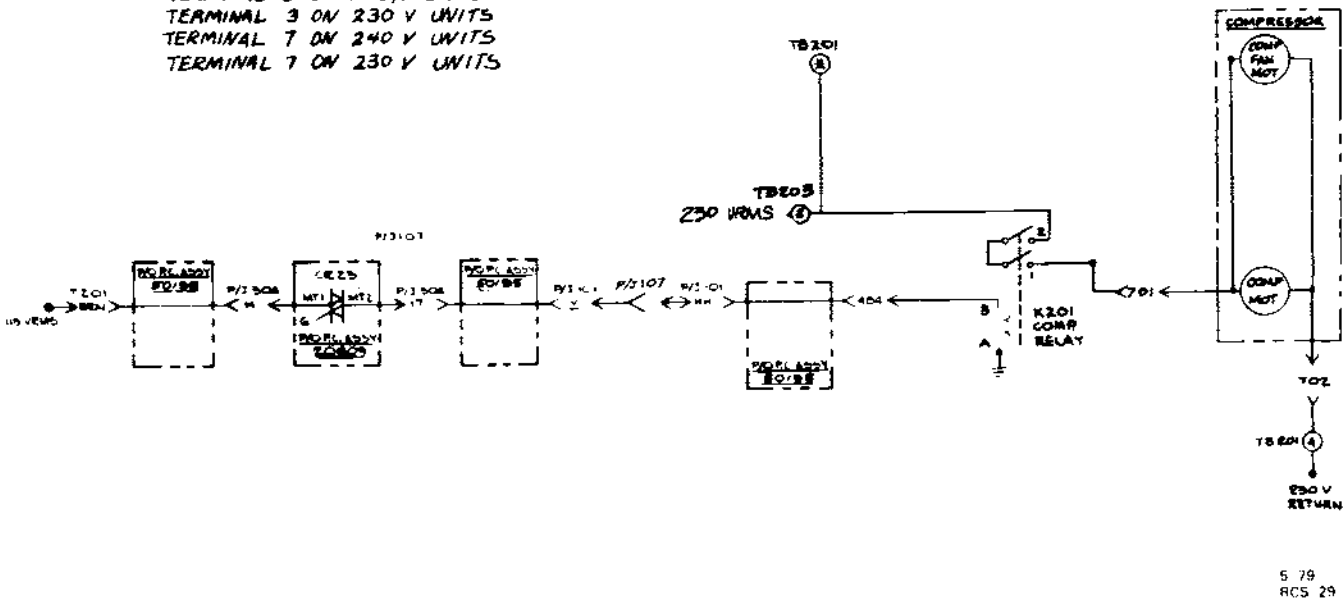


Figure 3-24. RC-5B Compressor Circuit

FOR SERVICE ONLY

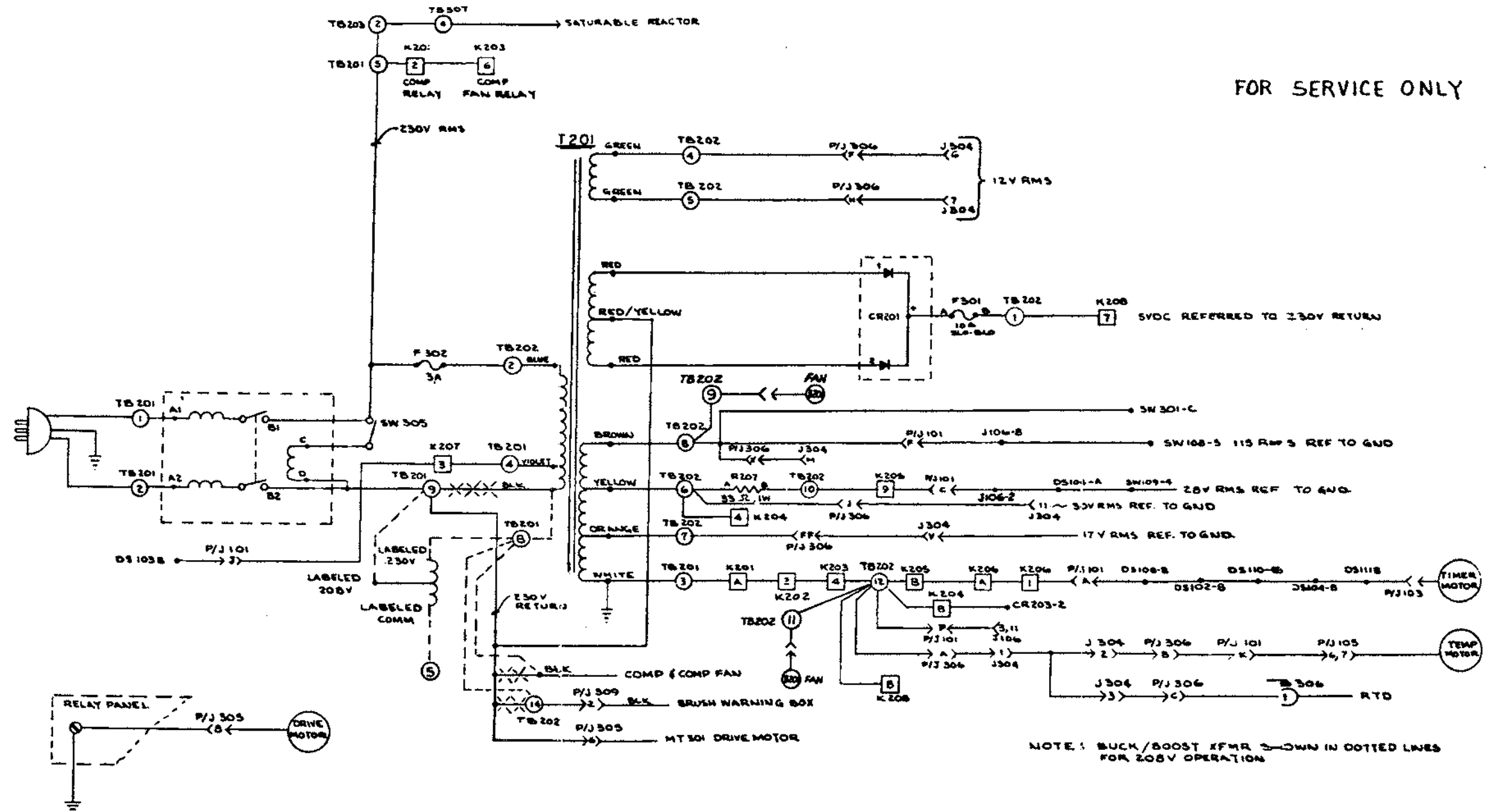
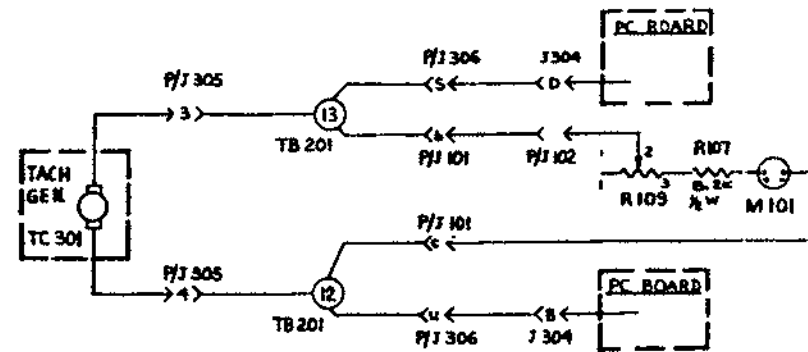
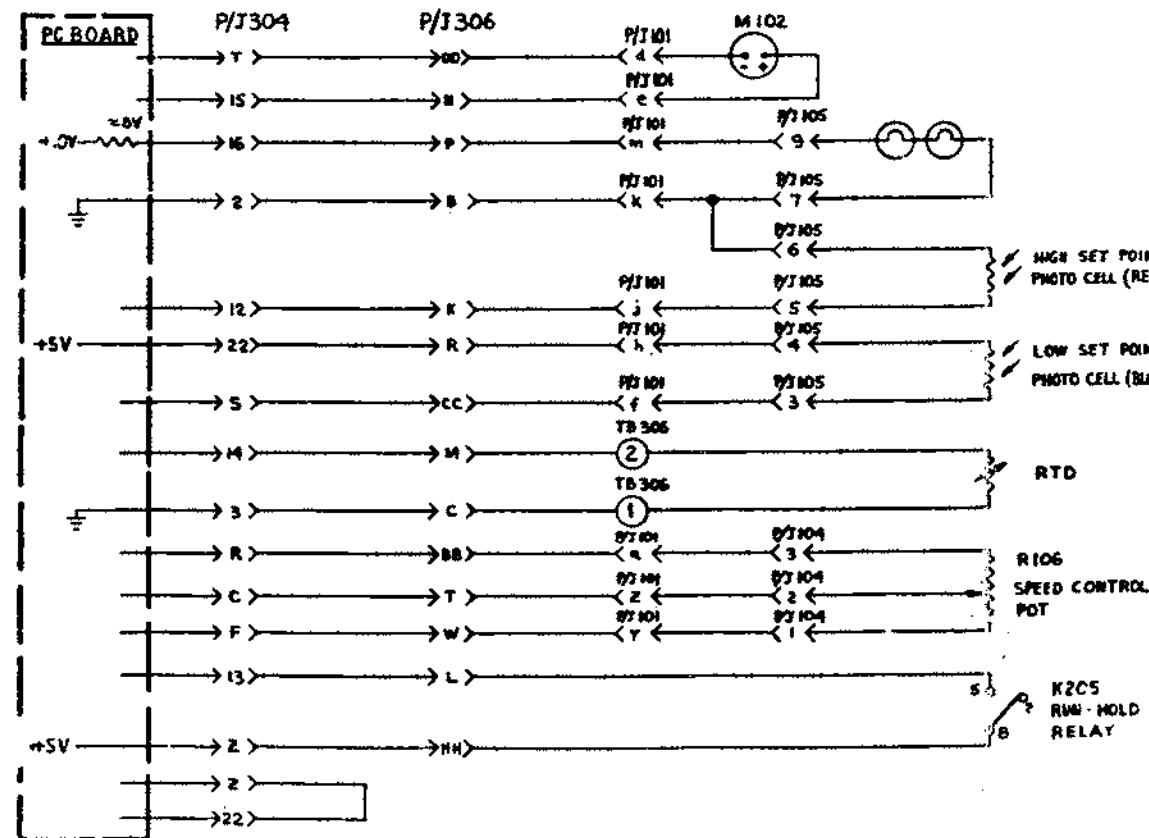


Figure 3-25. RC-5 System Power Distribution Diagram, PN 50035, Revision 3

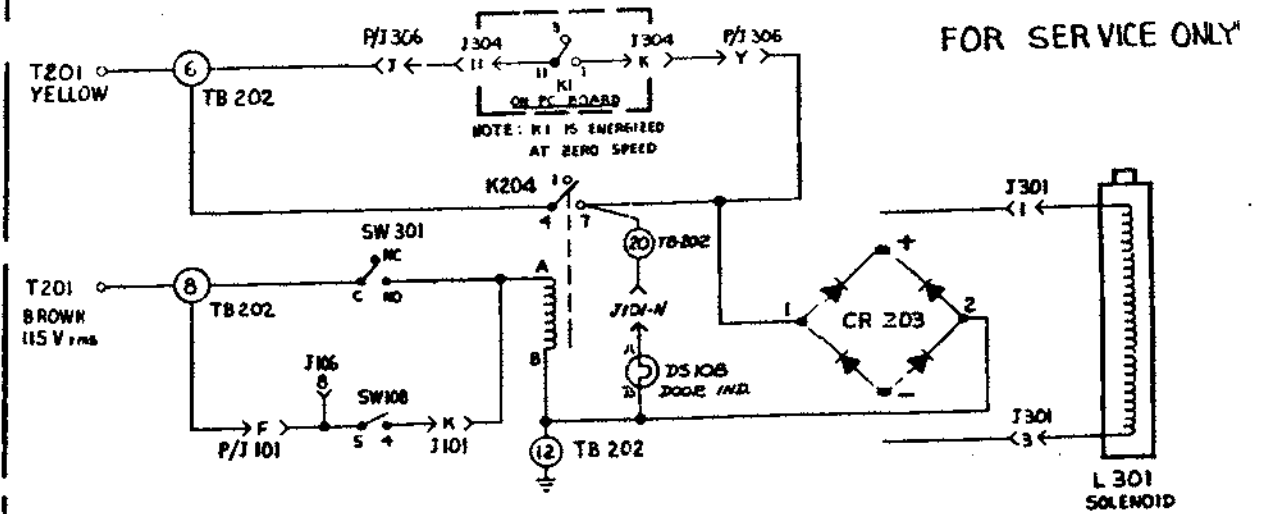
TACH GENERATOR & INDICATOR CIRCUITRY



TEMP METER & SET POINT CIRCUITRY & SPEED CONTROL POT



DOOR INTERLOCK CIRCUITRY



DOOR IND, MAIN PWR IND, ON IND, OFF IND, BRAKE IND.

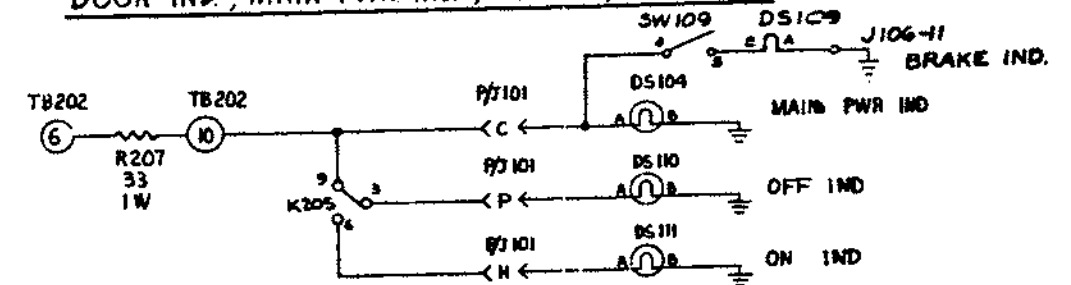


Figure 3-26. RC-5 System Schematic, PN 50031, Revision 4, Sheet 1 of 3

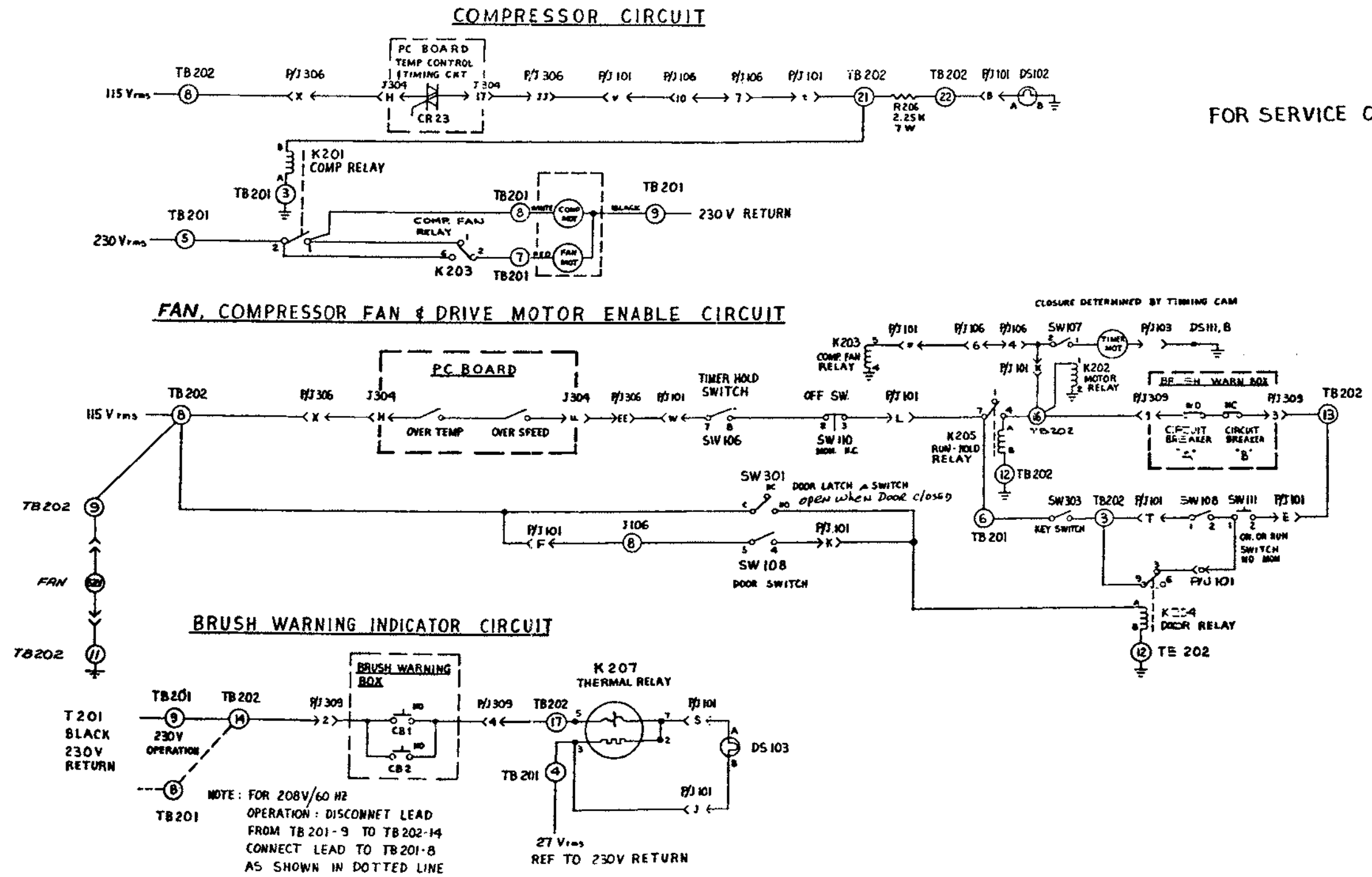


Figure 3-26. RC-5 System Schematic, PN 50031, Revision 4, Sheet 2 of 3

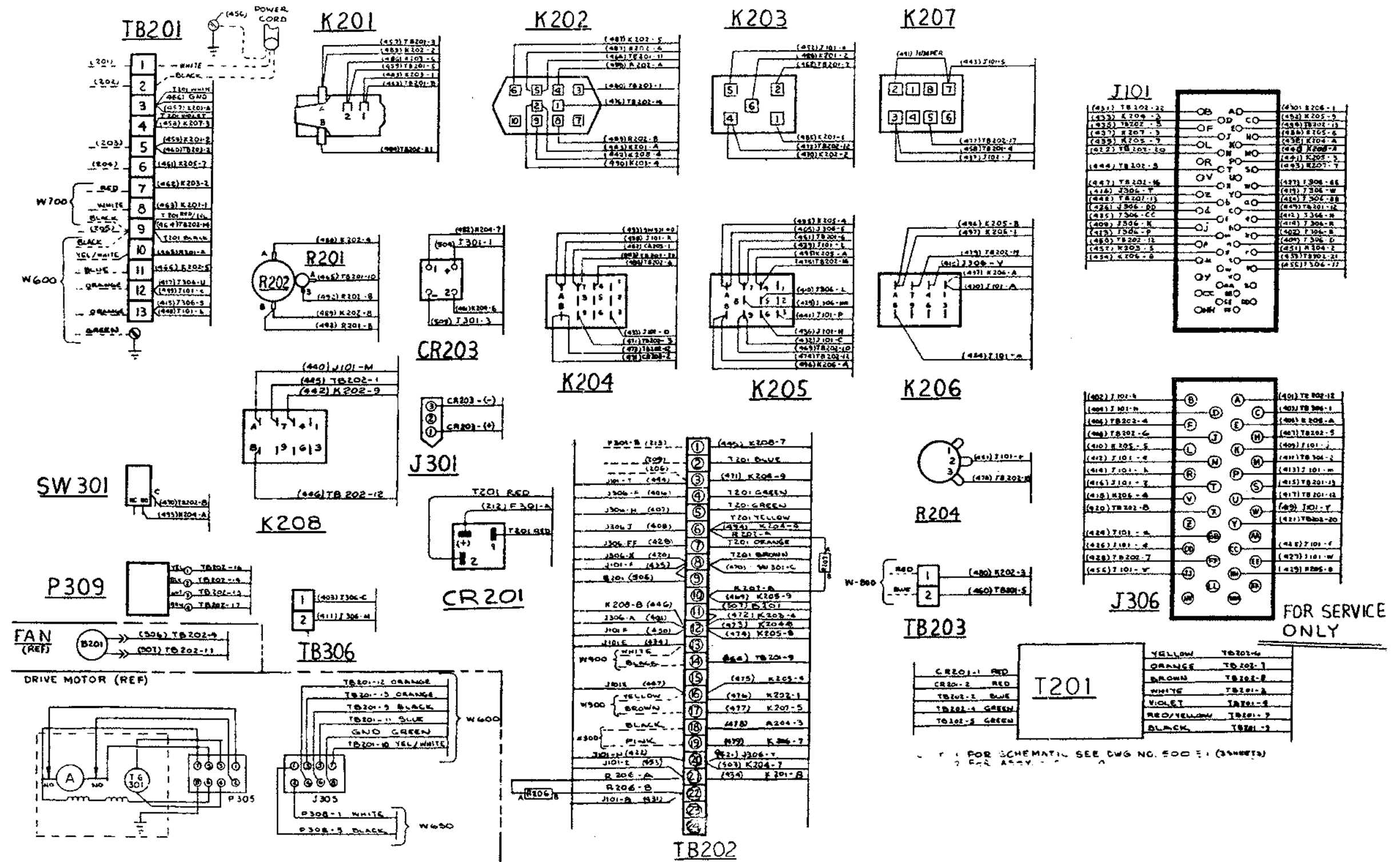


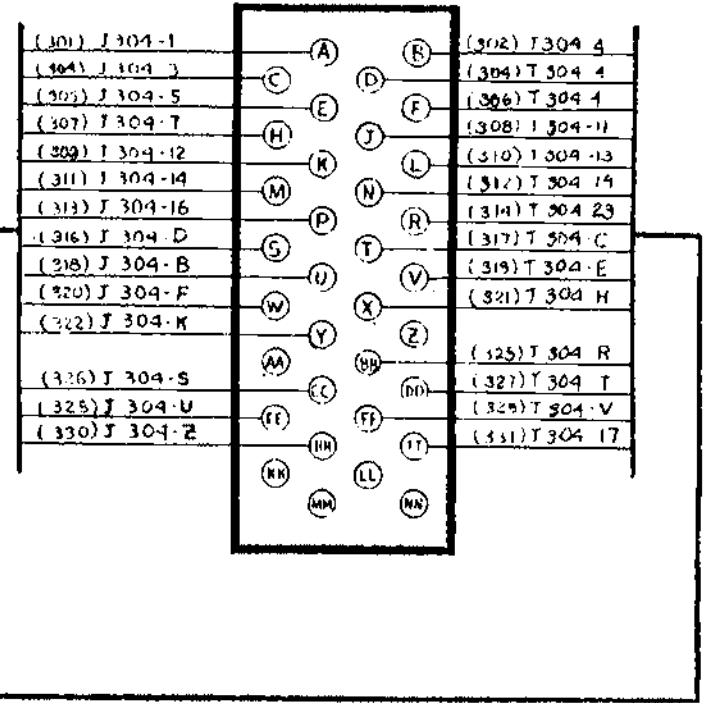
Figure 3-27. RC-5 Lower Control Panel Wiring Diagram, PN 50041, Revision 6

J 304

GND	(1)	(301) P306-A
HIGH CELL LAMPS	(A)	(302) P306-B
TACH	(2)	(308) P306-U
RTD (GND)	(B)	(301) P306-C
SPEED - C	(3)	(317) P306-T
POT	(C)	(304) P306-D
TACH	(4)	(316) P306-S
115V (RUN)	(D)	(307) P306-F
GR	(E)	(319) P306-V
12V _{rms}	(5)	(306) P306-F
SPEED - CCW	(6)	(320) P306-W
12V _{rms}	(F)	(307) P306-H
115V	(7)	(321) P306-X
	(H)	
	(J)	
	(B)	
	(9)	
115V GATE	(K)	(322) P306-Y
	(10)	
28V _{rms}	(L)	(308) P306-J
HIGH CELL	(M)	(309) P306-K
RUN/HOLD GATE	(11)	(310) P306-L
	(N)	
RTD	(12)	(311) P306-M
SPEED - CCW	(13)	(325) P306-RH
M.T.R (+)	(O)	(312) P306-N
LOW CELL	(14)	(326) P306-CC
LAMPS	(P)	(311) P306-P
M.T.R (-)	(15)	(327) P306-DD
COMP	(Q)	(331) P306-TJ
	(16)	(328) P306-EE
	(R)	(315) T304-QD
1TV	(17)	(329) P306-FF
	(S)	
	(18)	(315) T304-18
	(T)	
	(19)	(332) T304-7 (SHORTING PIN)
LOW CELL	(U)	(314) P306-R
+5V	(20)	(330) P306-HH
	(V)	(332) T304-22

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P 306



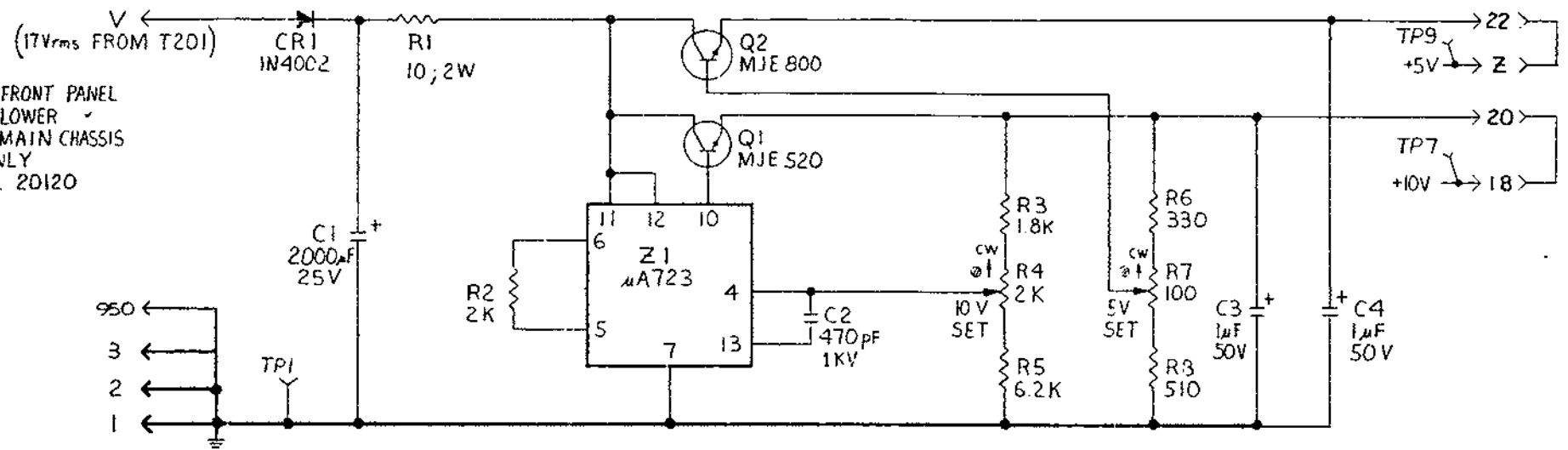
- NOTES:
1. FOR SCHEMATIC SEE DWG NO. 50031
 2. FOR HARNESS ASSY. SEE DWG. NO. 20864

Figure 3-28. RC-5 P.C. Board to Lower Control Panel Wiring Diagram, PN 50039, Revision 2

NOTES:

1. ALL RESISTORS ARE 1/4 W, 5% UNLESS OTHERWISE SPECIFIED
2. ALL 1 INPUT GATES ARE 7404
 - 2 ✓ ✓ ✓ 7400
 - 3 ✓ ✓ ✓ 7410
 - 4 ✓ ✓ ✓ 7420
- UNLESS OTHERWISE SPECIFIED
3. FS - FACTORY SELECTED COMPONENTS TO BE INSTALLED AT TESTING
4. → DENOTES CARD EDGE CONNECTOR (J304)
5. 100 SERIES DESIGNATIONS; COMPONENTS LOCATED ON FRONT PANEL
6. 200 ✓ ✓ ✓ LOWER
7. 300 ✓ ✓ ✓ MAIN CHASSIS
8. * CONNECTIONS USED WITH P.C. BOARD TESTER ONLY
9. FOR SYSTEM SCHEMATIC, RC-5 SEE DWG No. 20120

POWER SUPPLY
(FOR TEMP. CONTROL)



SPEED CONTROL

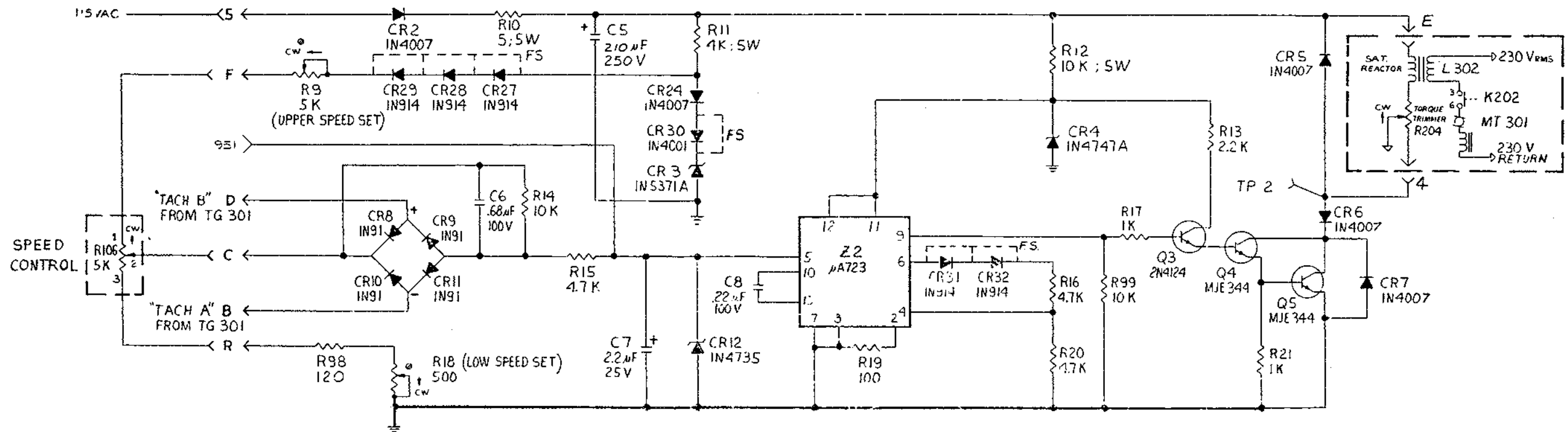


Figure 3-29. RC-5/5B P.C. Board Schematic Diagram, PN 20810, Revision 9, Sheet 1 of 3

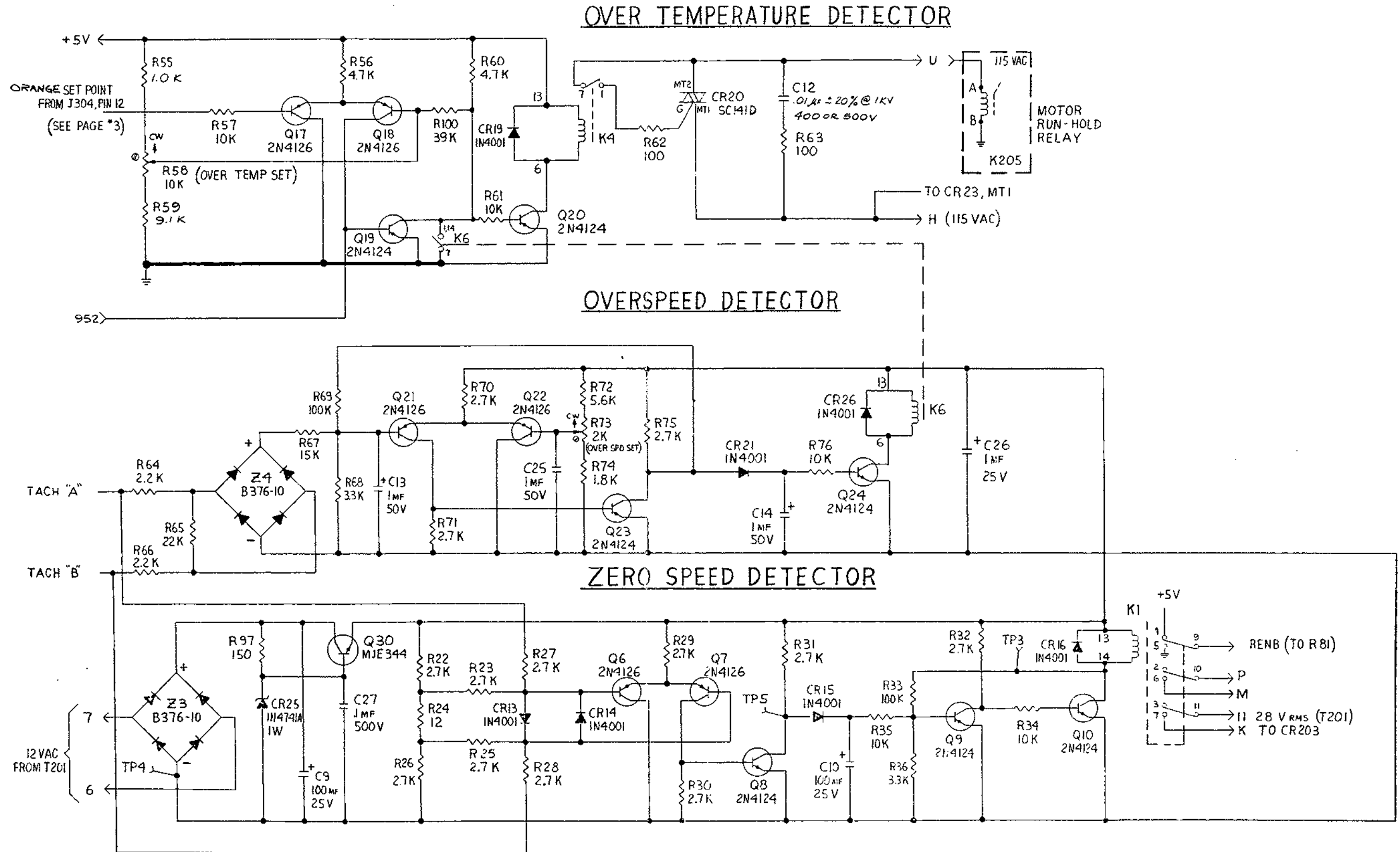


Figure 3-29. RC-5/5B P.C. Board Schematic Diagram, PN 20810, Revision 9, Sheet 2 of 3

TEMPERATURE CONTROL

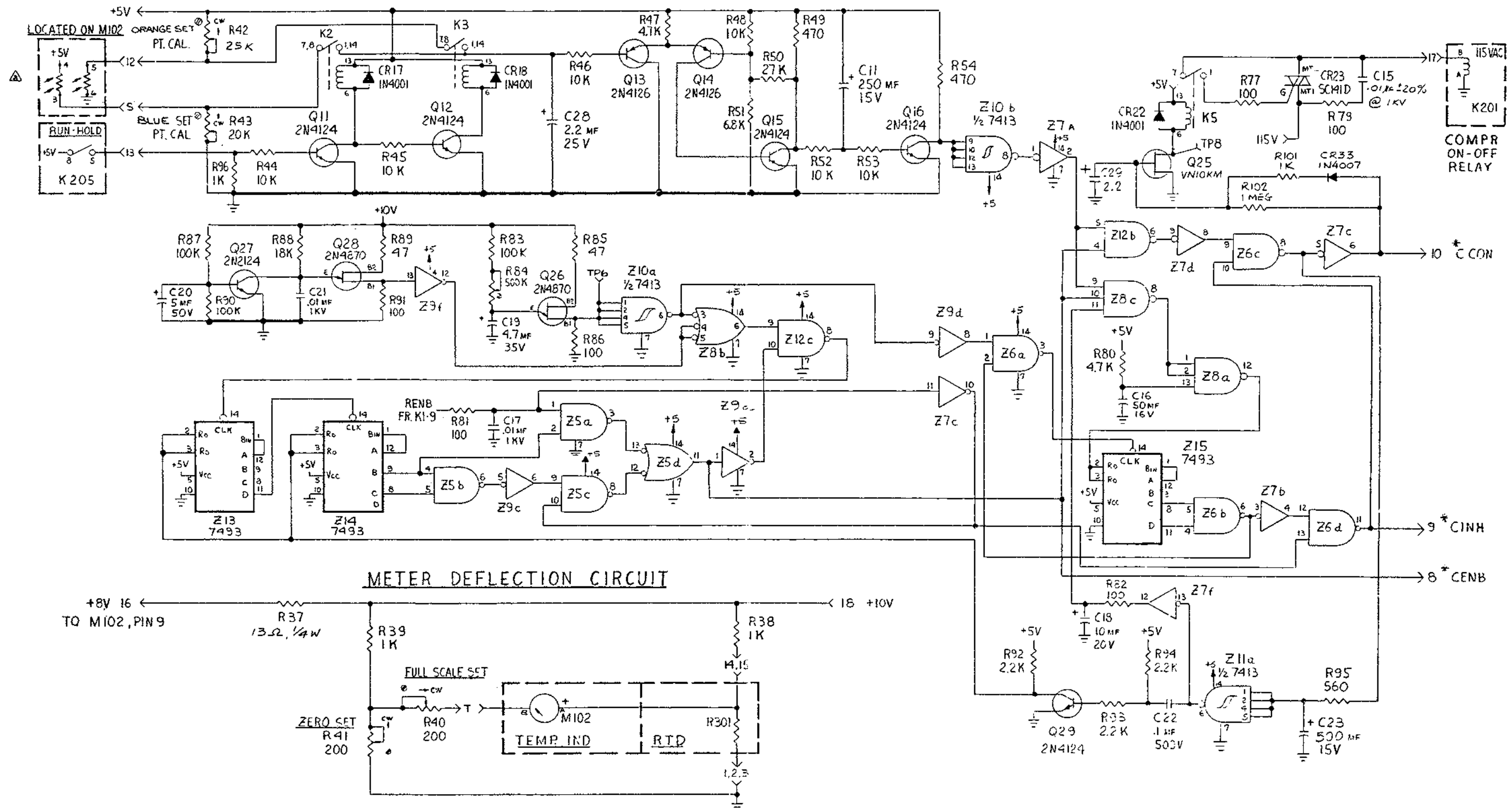


Figure 3-29. RC-5/5B P.C. Board Schematic Diagram, PN 20810, Revision 9, Sheet 3 of 3

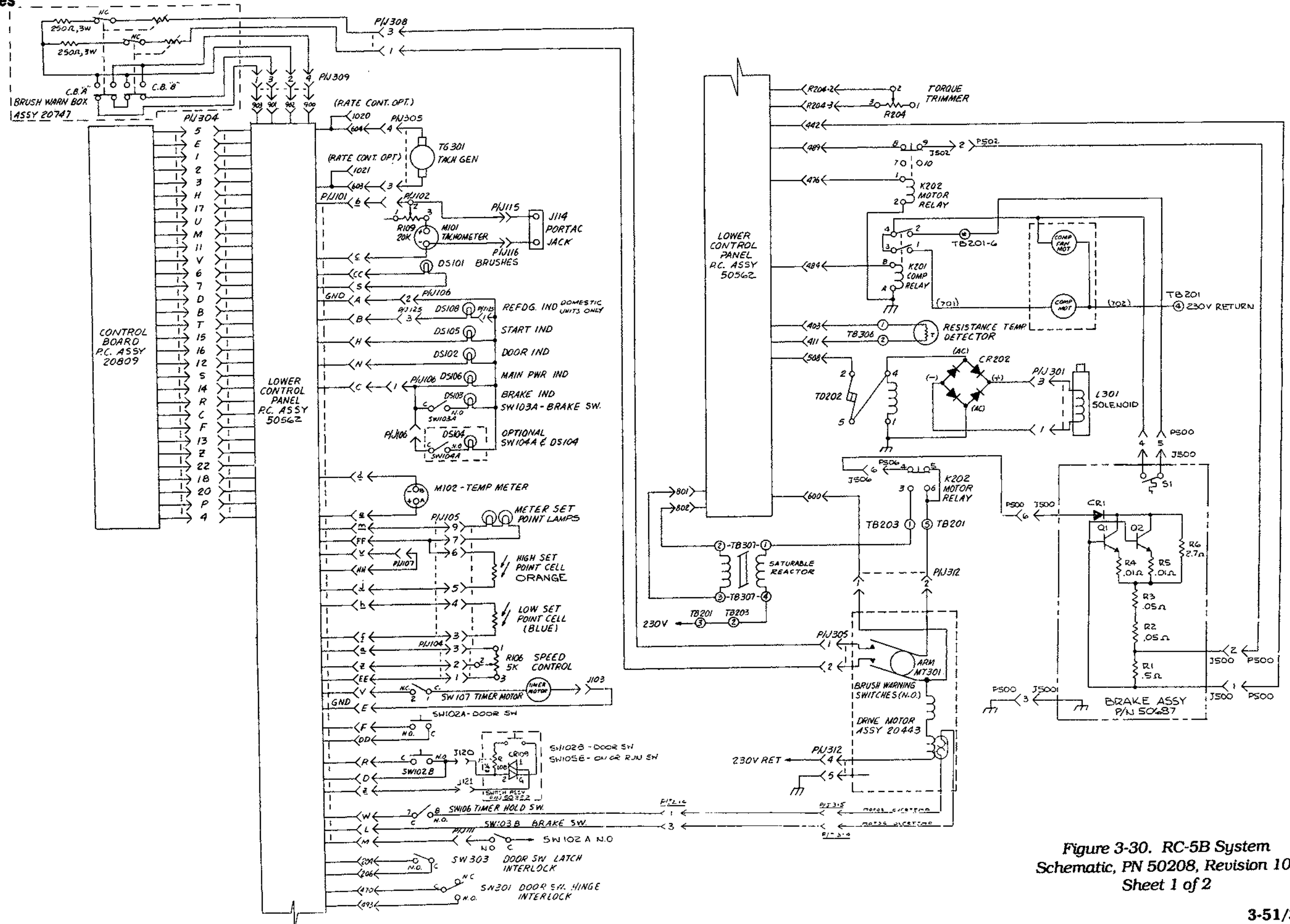


Figure 3-30. RC-5B System Schematic, PN 50208, Revision 10, Sheet 1 of 2

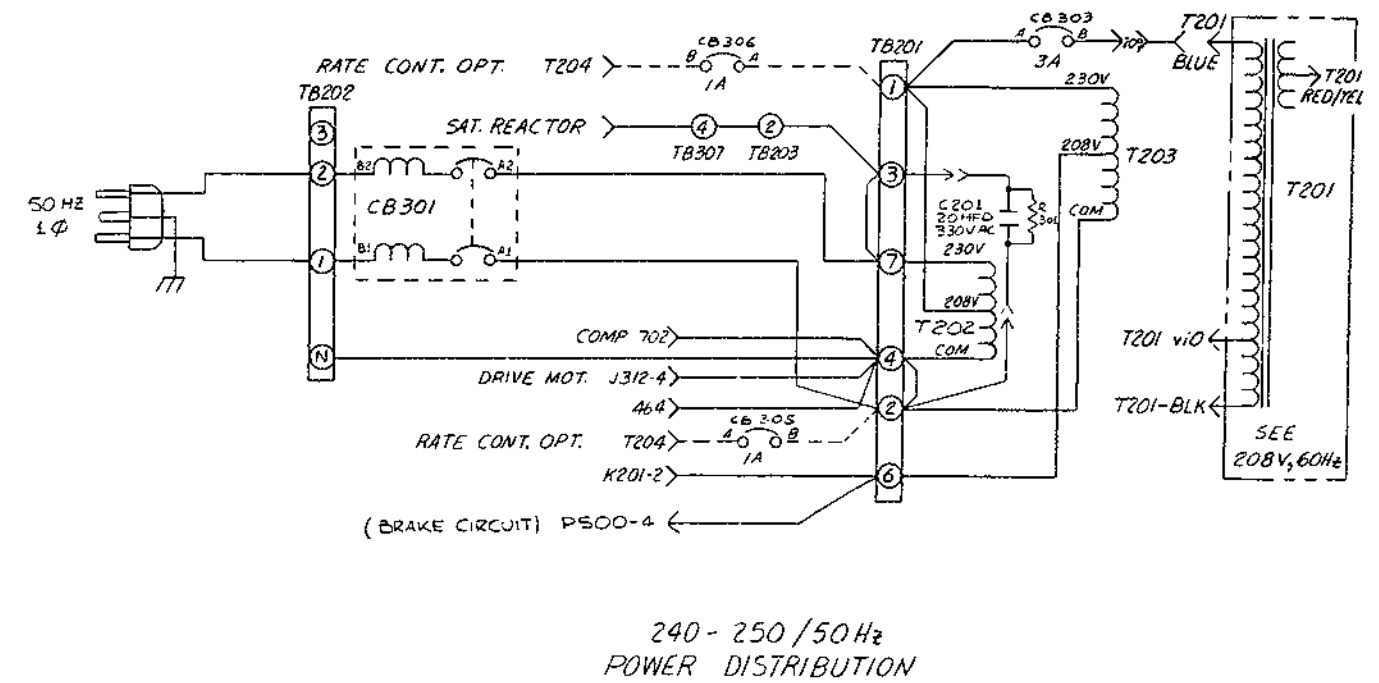
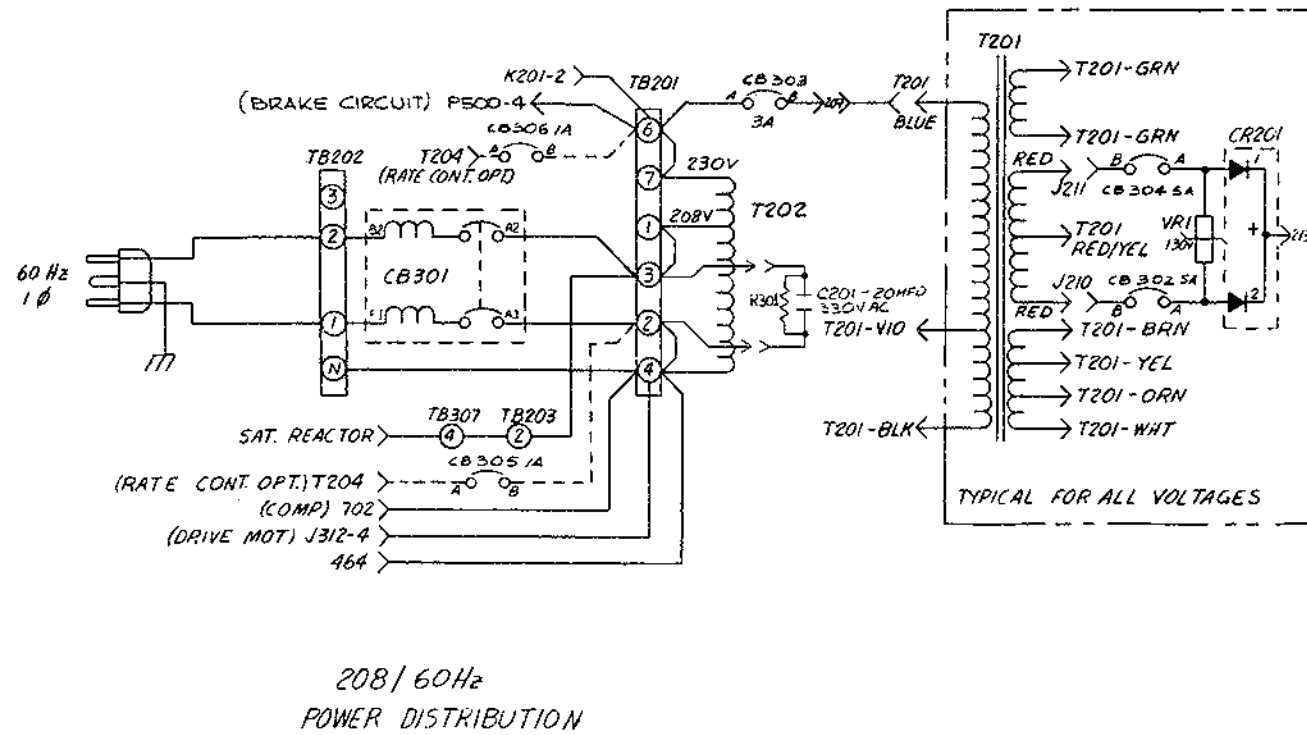
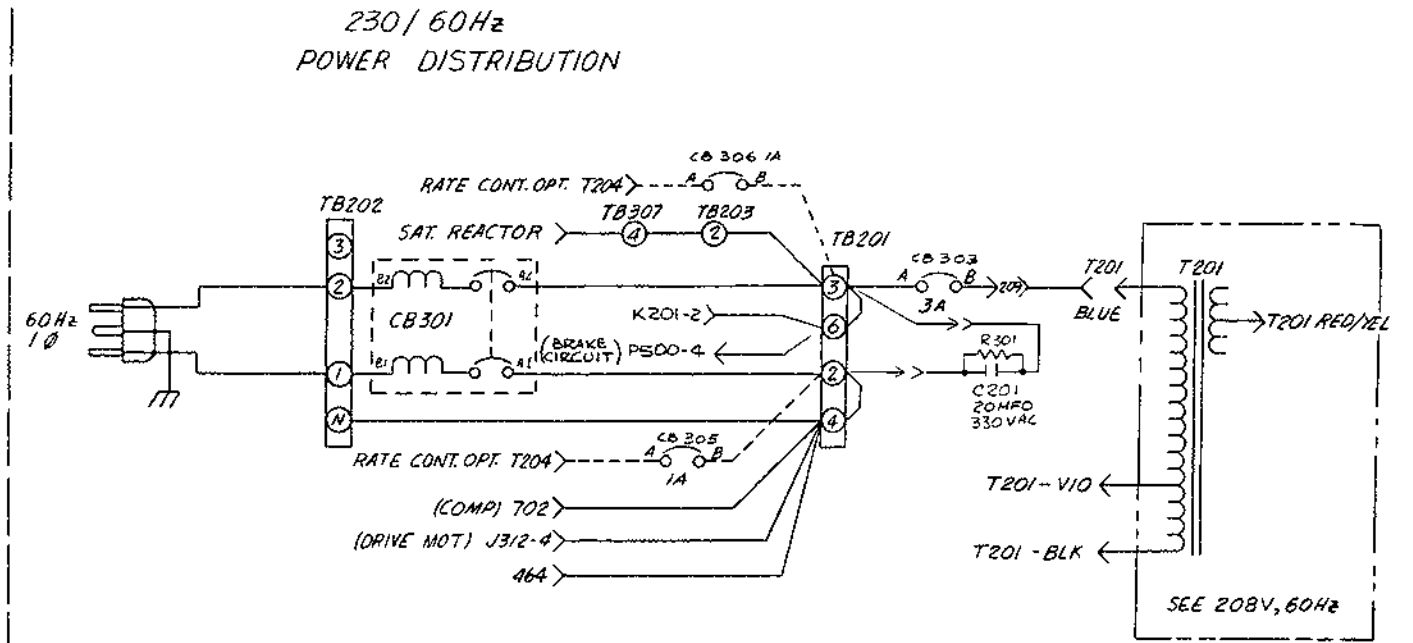
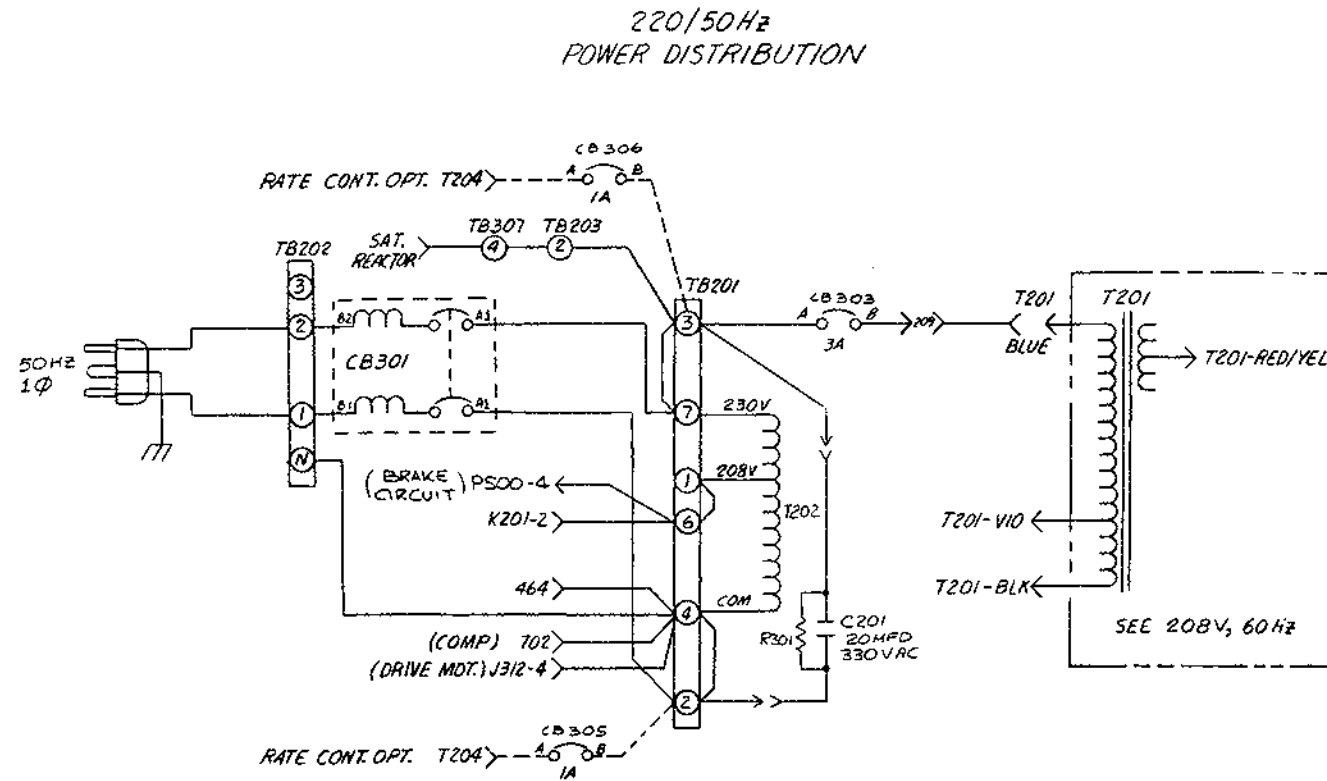


Figure 3-30. RC-5B System
Schematic, PN 50208, Revision 10,
Sheet 2 of 2

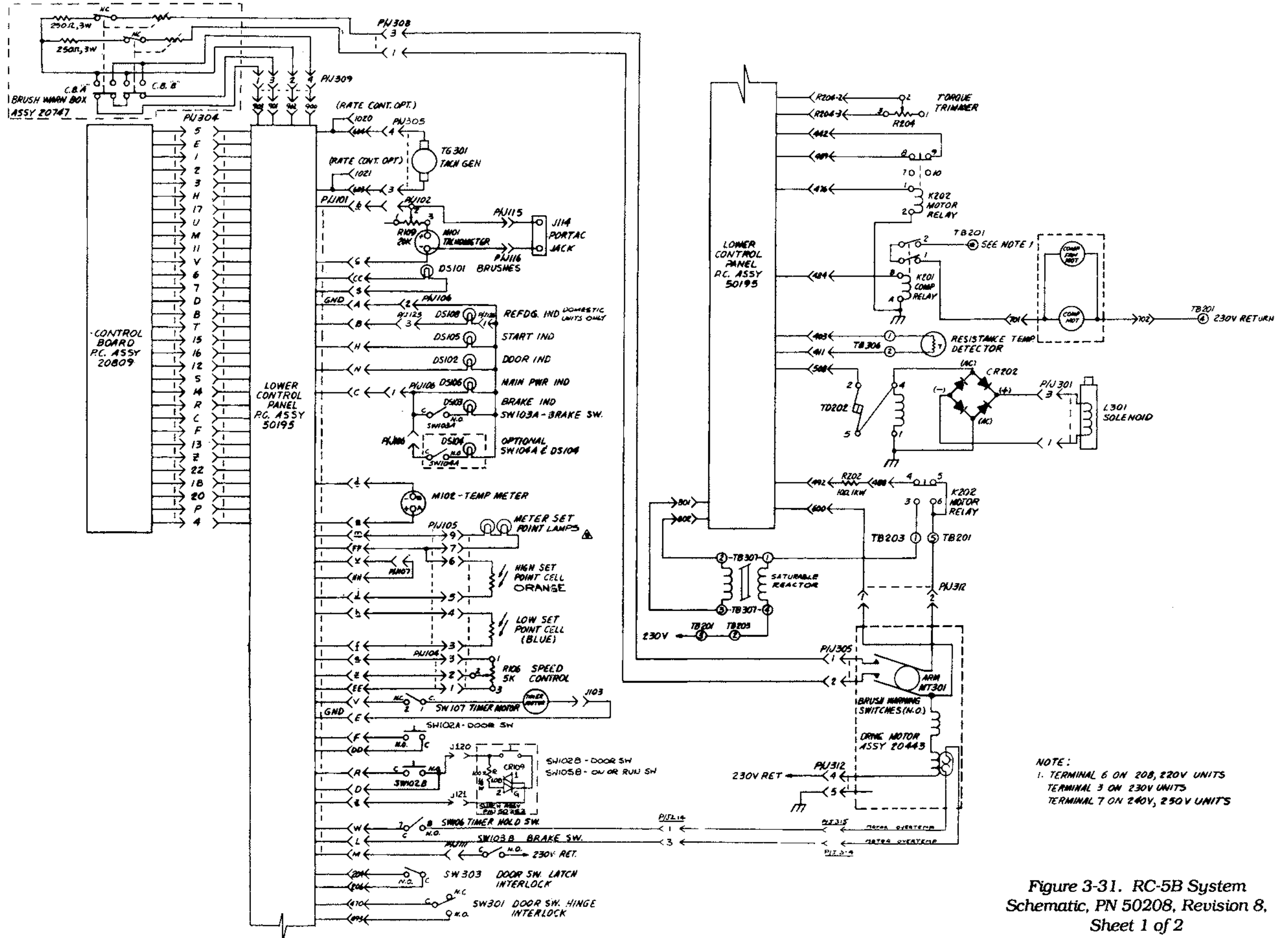


Figure 3-31. RC-5B System Schematic, PN 50208, Revision 8, Sheet 1 of 2

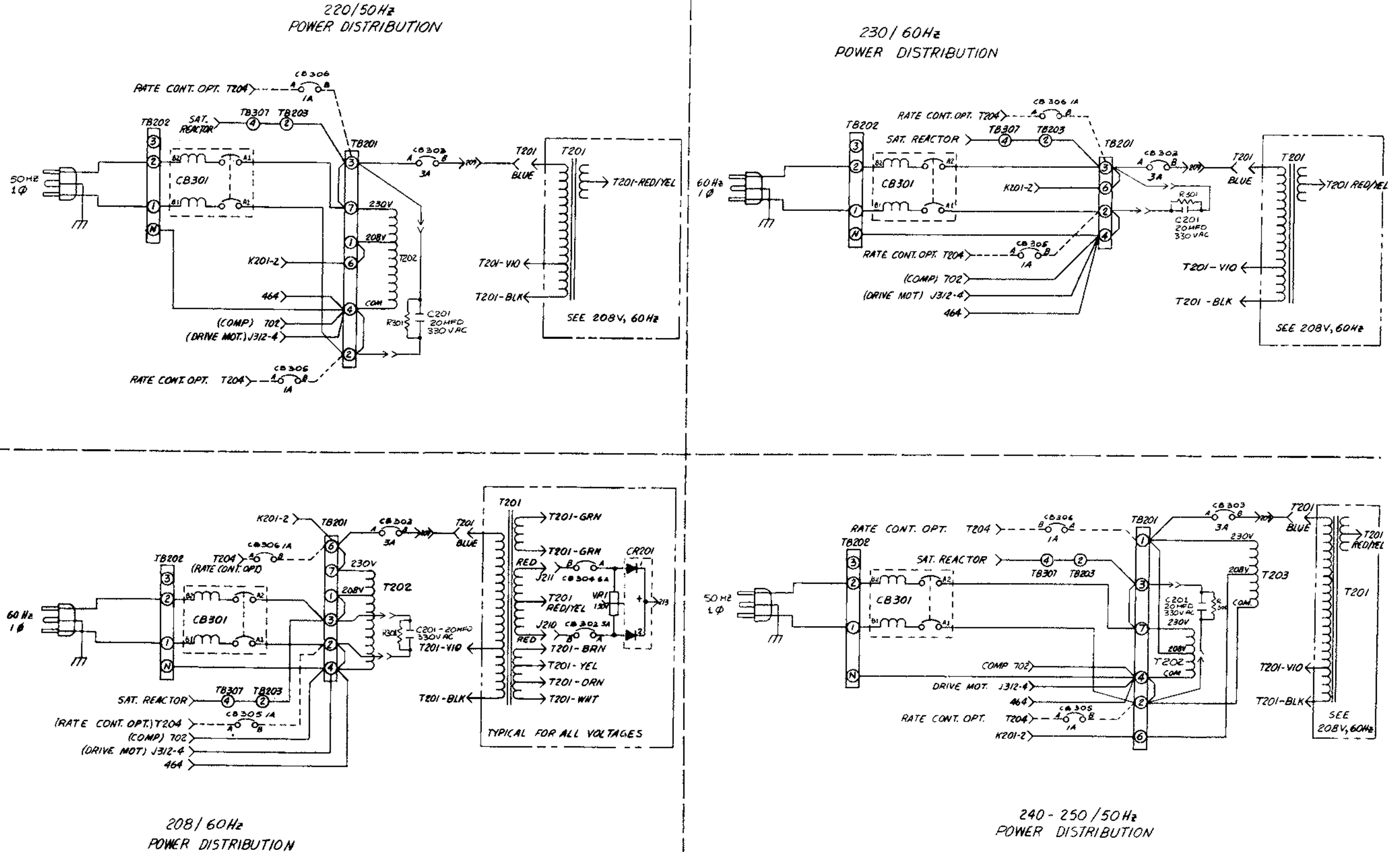
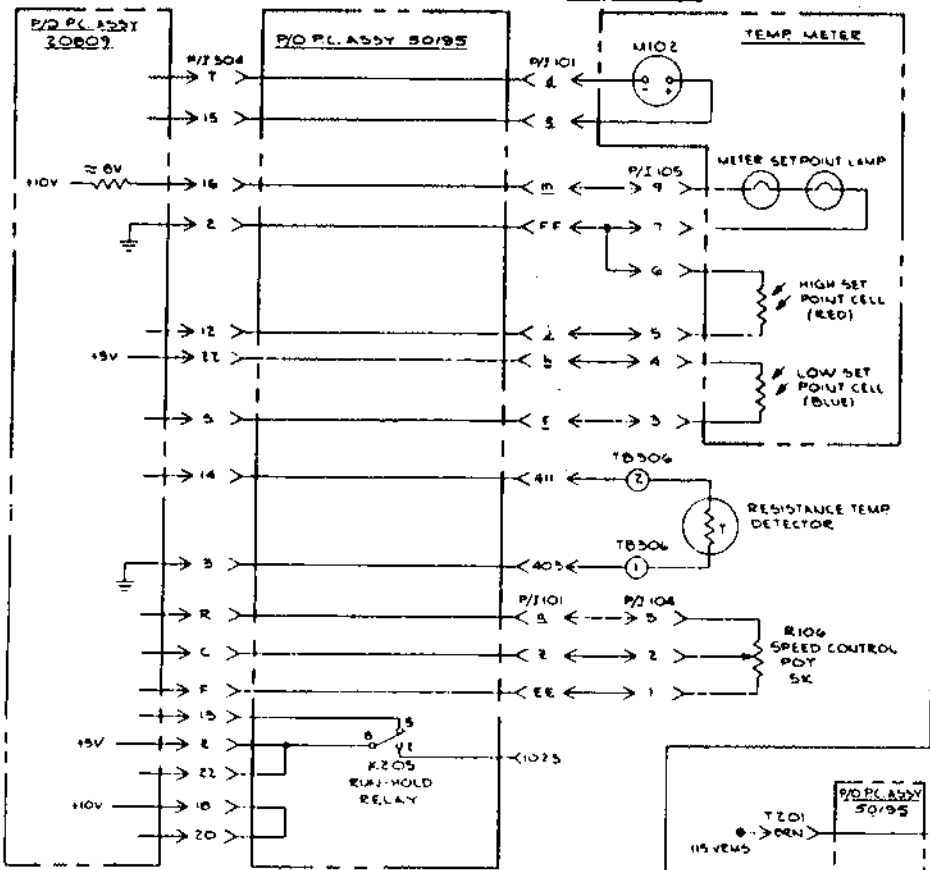


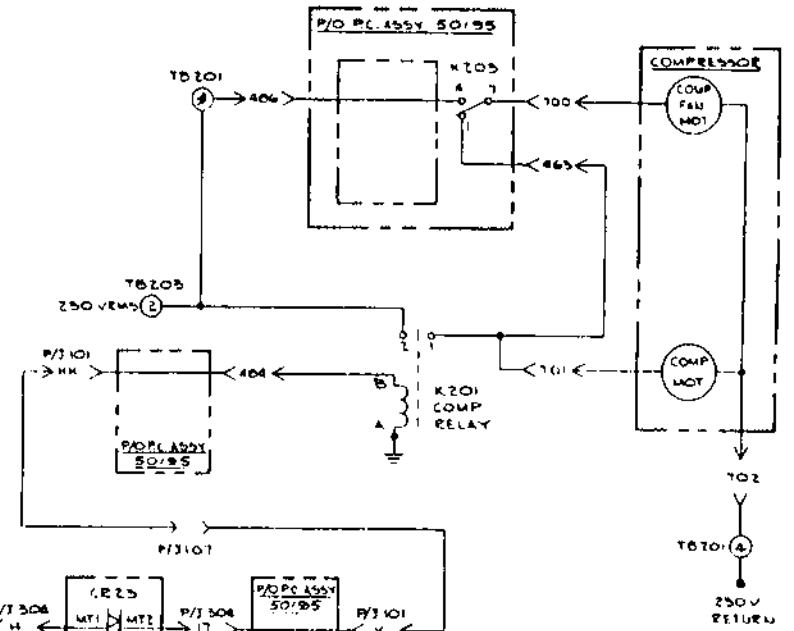
Figure 3-31. RC-5B System Schematic, PN 50208, Revision 8, Sheet 2 of 2

TEMP METER AND SET POINT CIRCUITRY AND SPEED CONTROL POT



*
 TERMINAL 6 ON 220 208V UNITS
 TERMINAL 5 ON 230V UNITS
 TERMINAL 7 ON 240V UNITS
 TERMINAL 7 ON 250V UNITS

COMPRESSOR CIRCUIT



1. FOR CONTROL BOARD SCHEMATIC SEE DWG No 20910

NOTES:

Figure 3-32. RC-5B System Schematic, PN 50208, Revision 2, Sheet 1 of 6

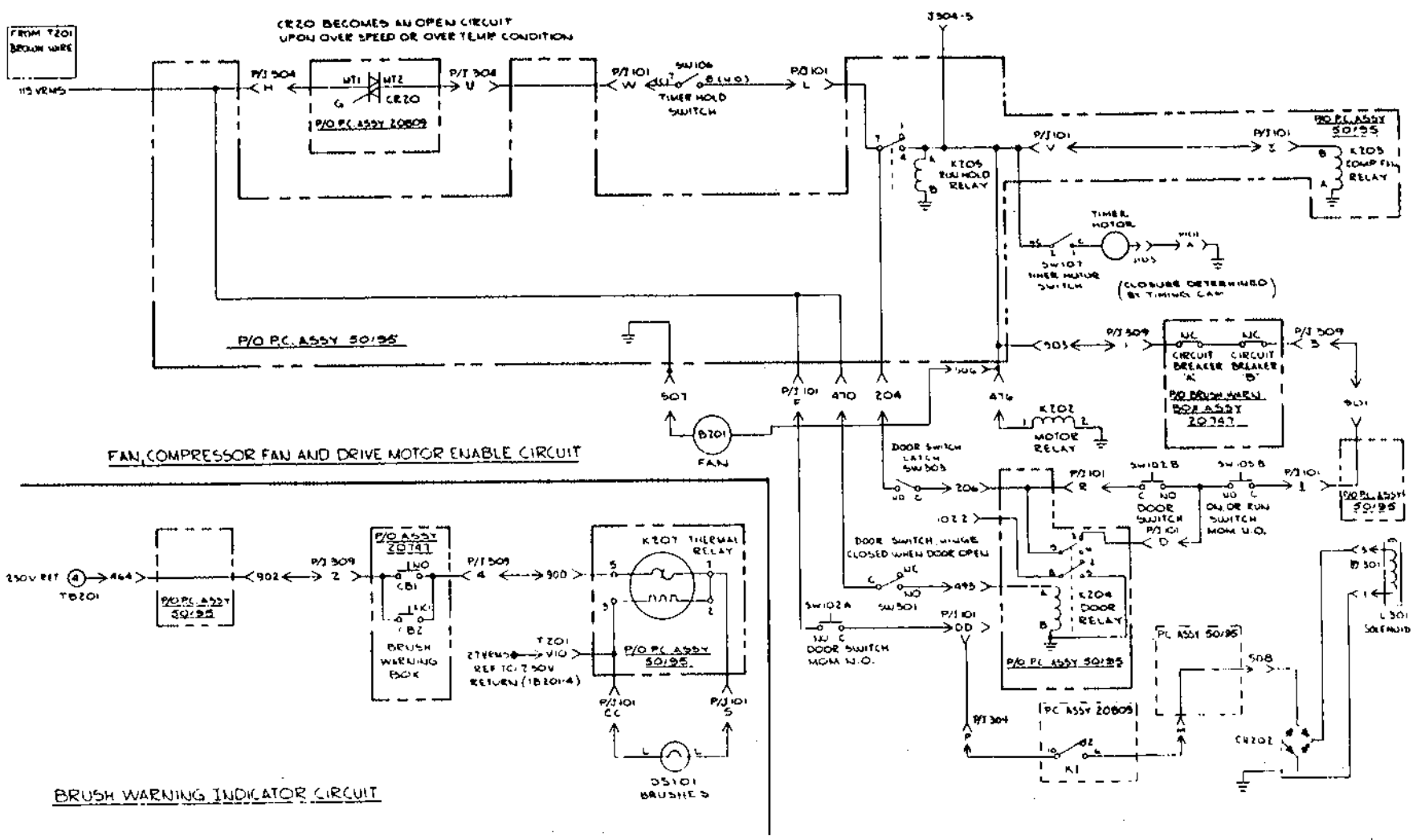


Figure 3-32. RC-5B System Schematic, PN 50208, Revision 2, Sheet 2 of 6

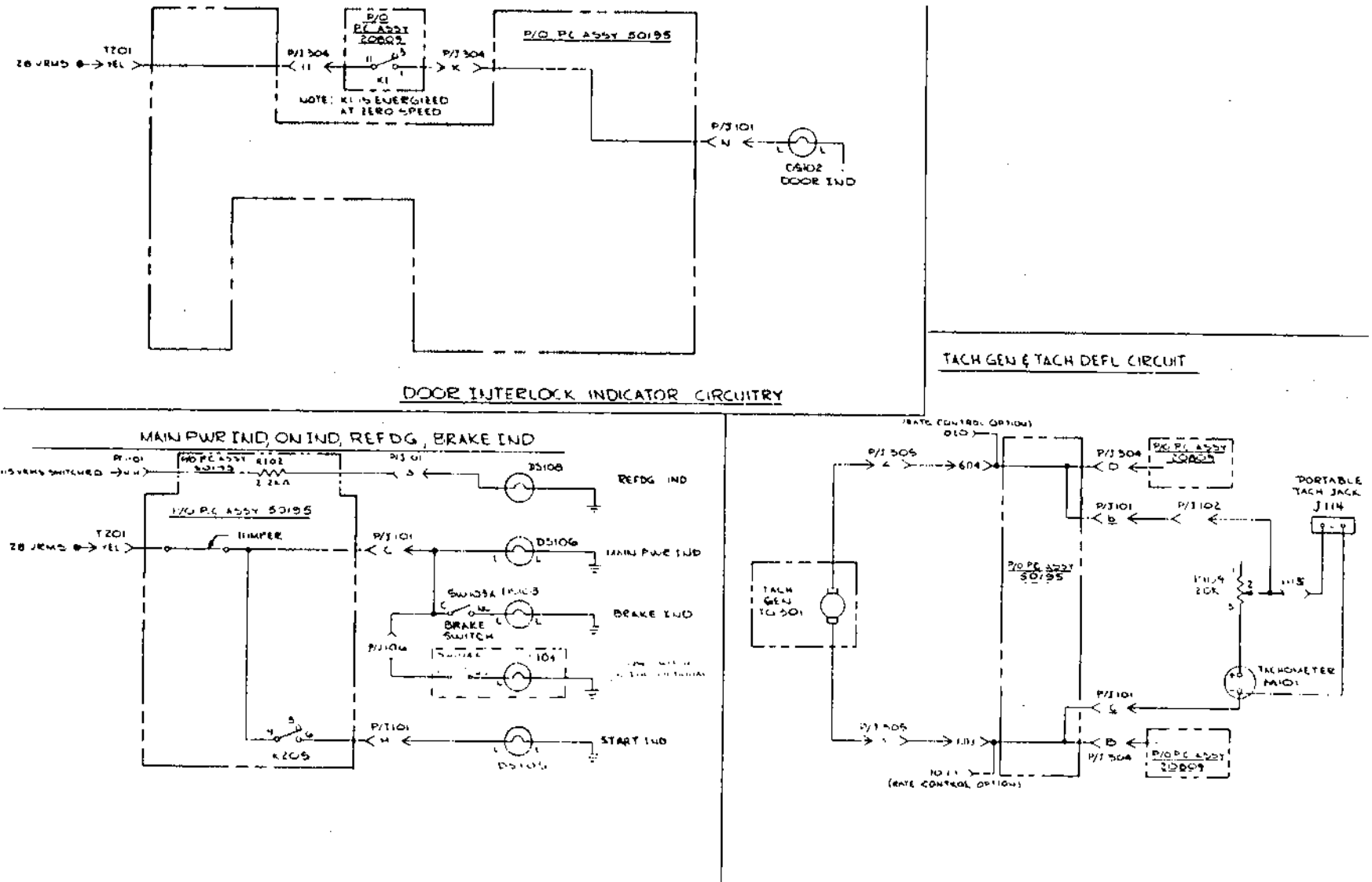


Figure 3-32. RC-5B System Schematic, PN 50208, Revision 2, Sheet 3 of 6

DRIVE MOTOR AND BRAKE CIRCUIT

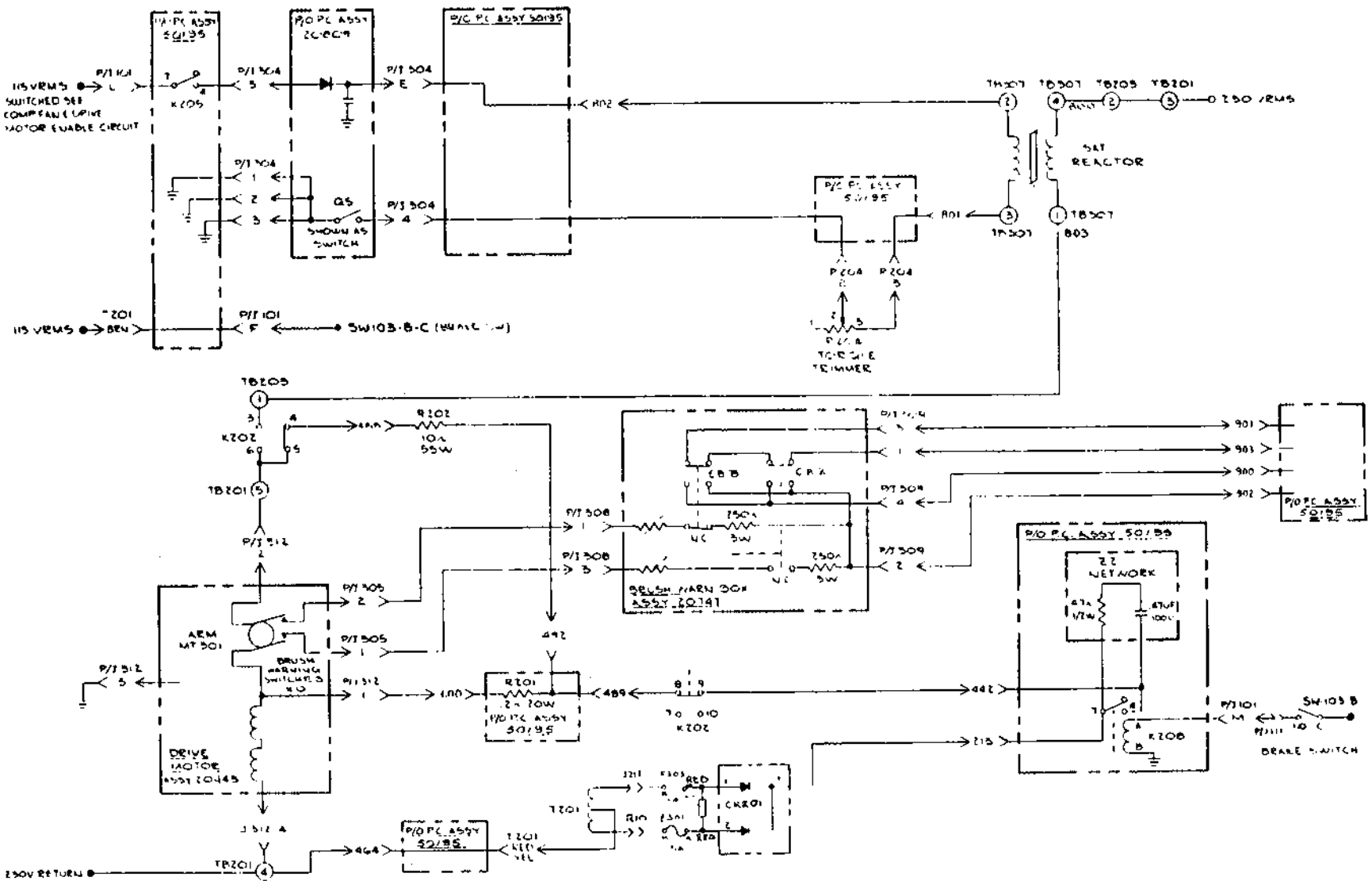


Figure 3-32. RC-5B System Schematic, PN 50208, Revision 2, Sheet 4 of 6

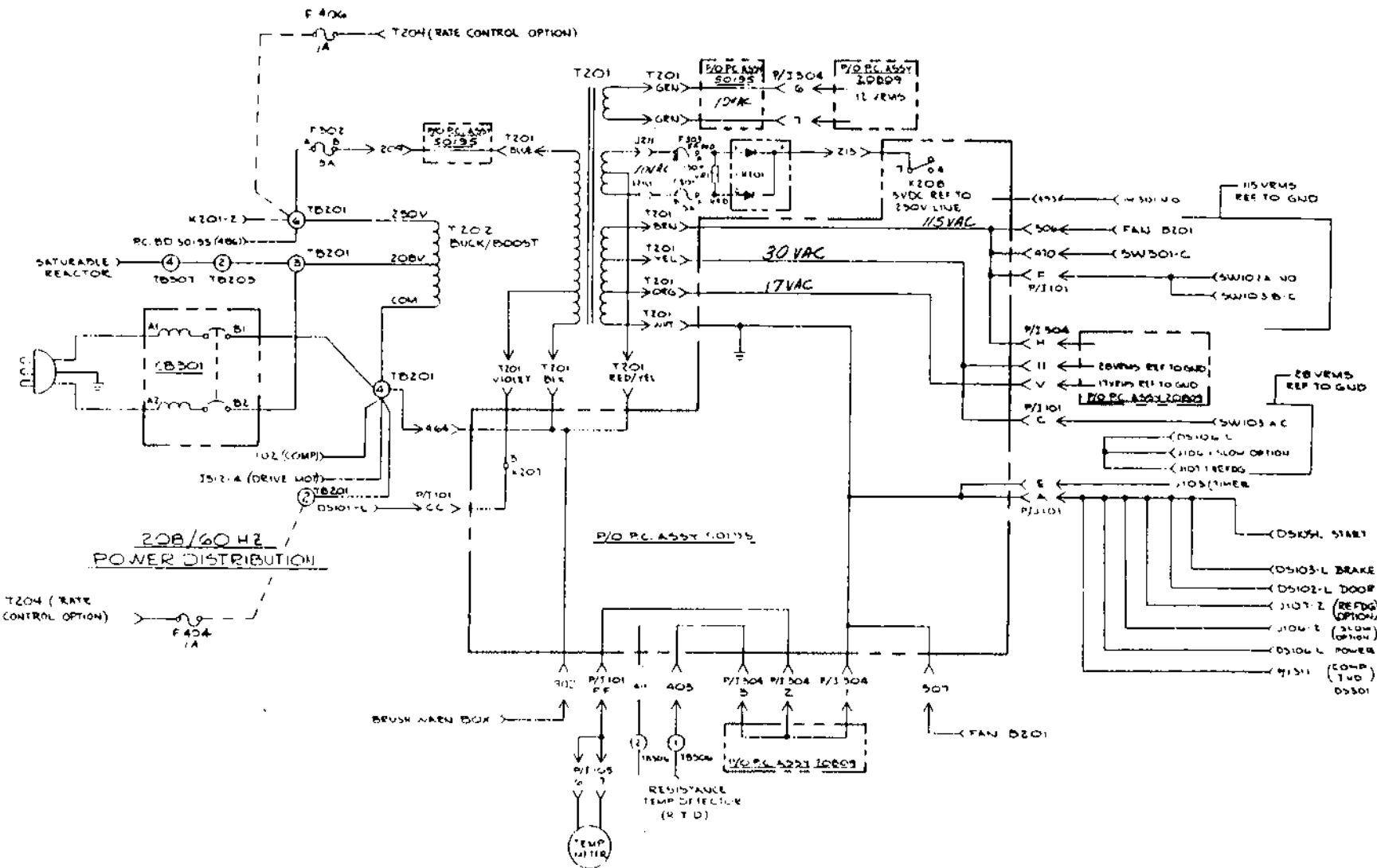


Figure 3-32. RC-5B System Schematic, PN 50208, Revision 2, Sheet 5 of 6

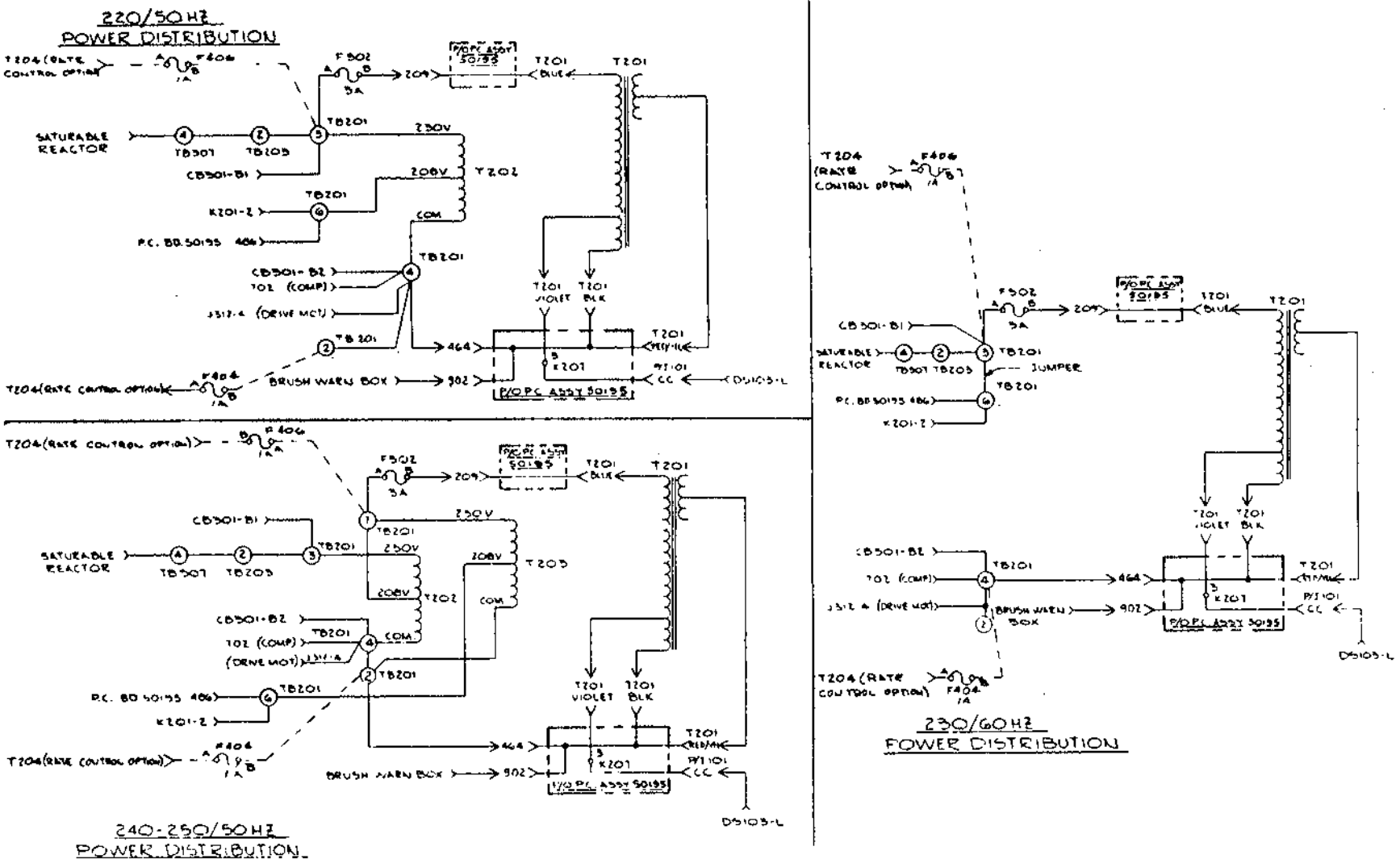


Figure 3-32. RC-5B System Schematic, PN 50208, Revision 2, Sheet 6 of 6

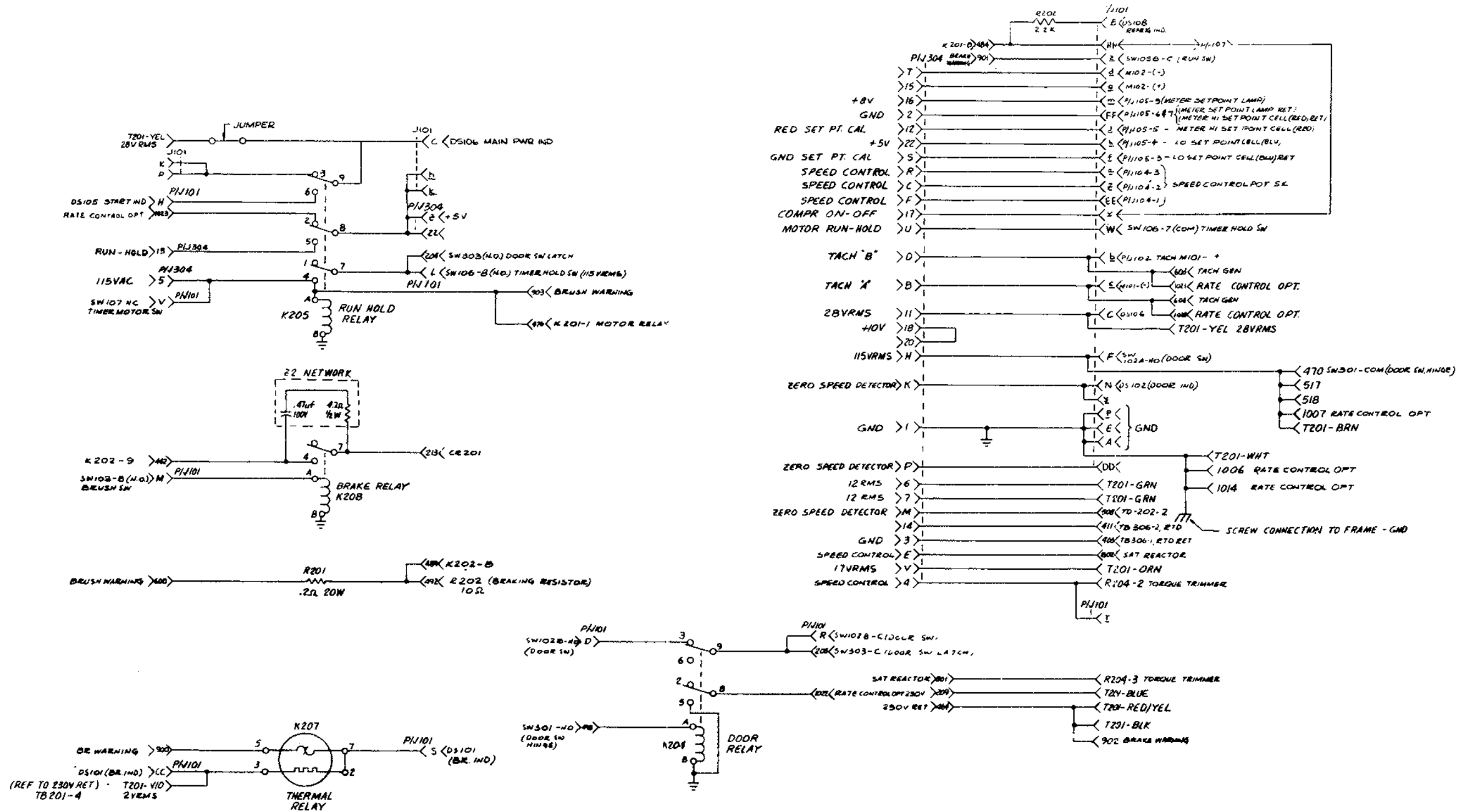


Figure 3-33. RC-5B Lower Control Panel P.C. Board Schematic Diagram, PN 50346, Revision 1

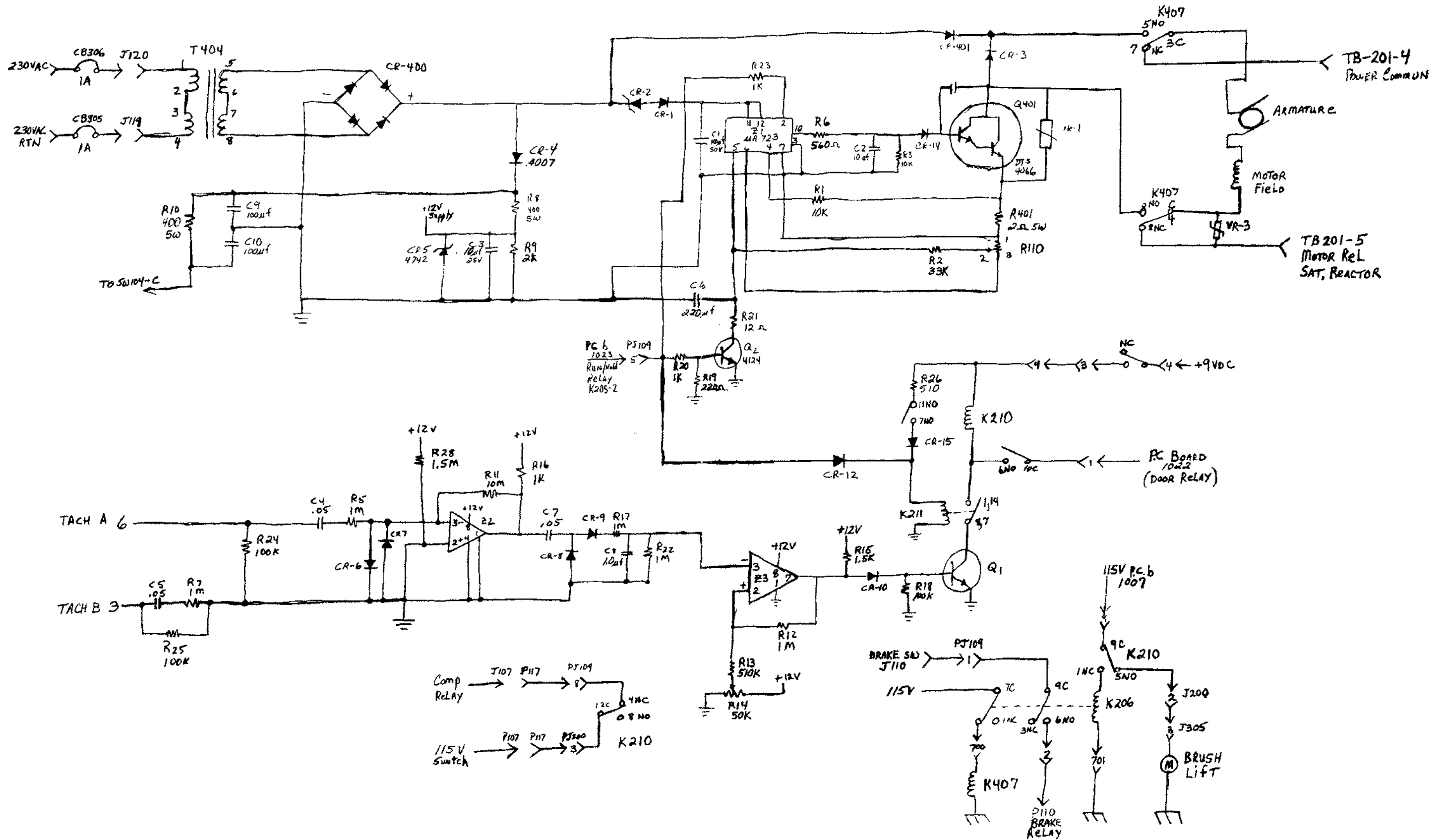
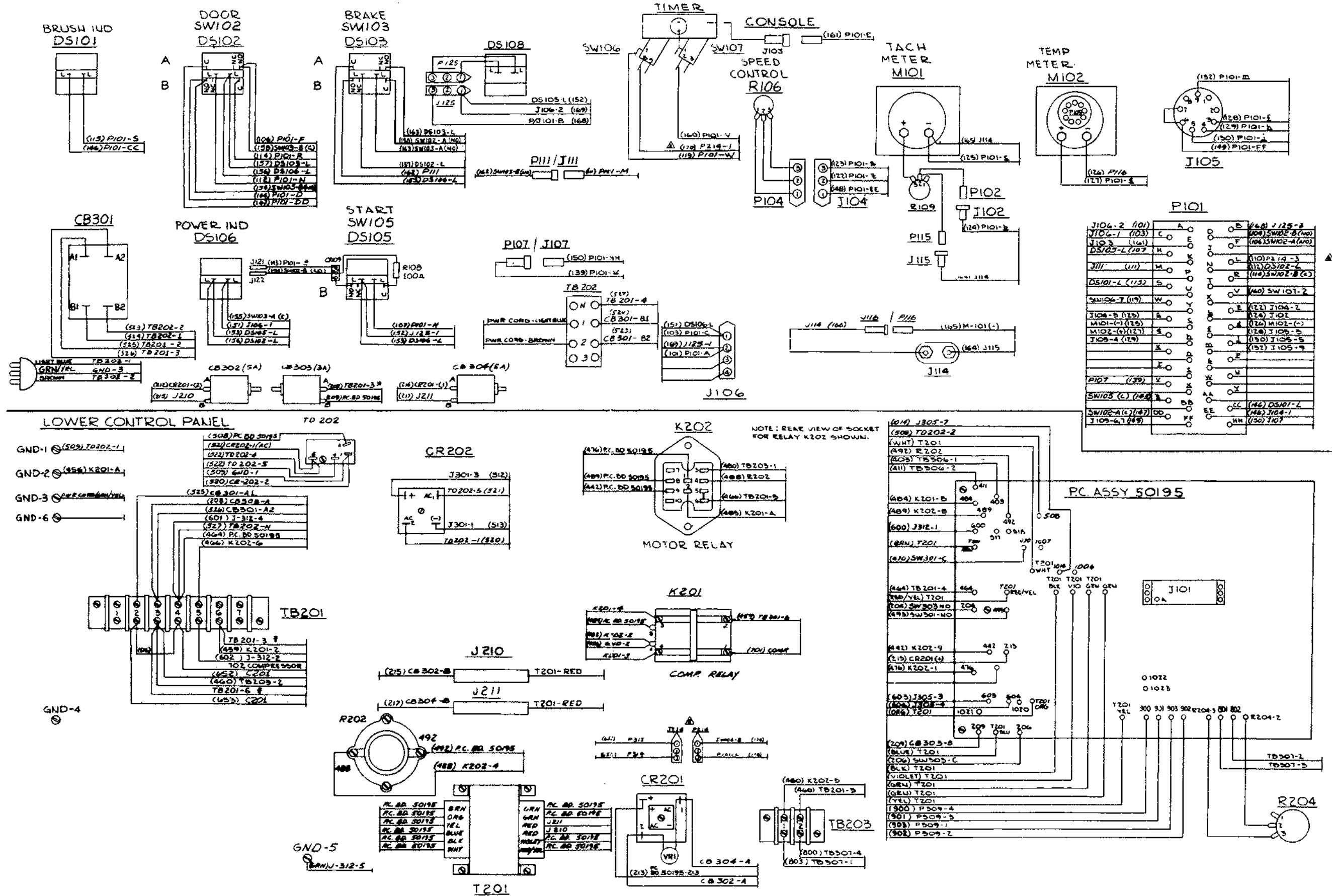


Figure 3-34. RC-5B Rate Control Schematic Diagram



1. WIRES DENOTED BY (*) ARE ONLY FOR 230/60 HZ
 NOTES:

Figure 3-35. RC-5B Wiring Diagram, PN 50204, Revision 8, Sheet 1 of 2

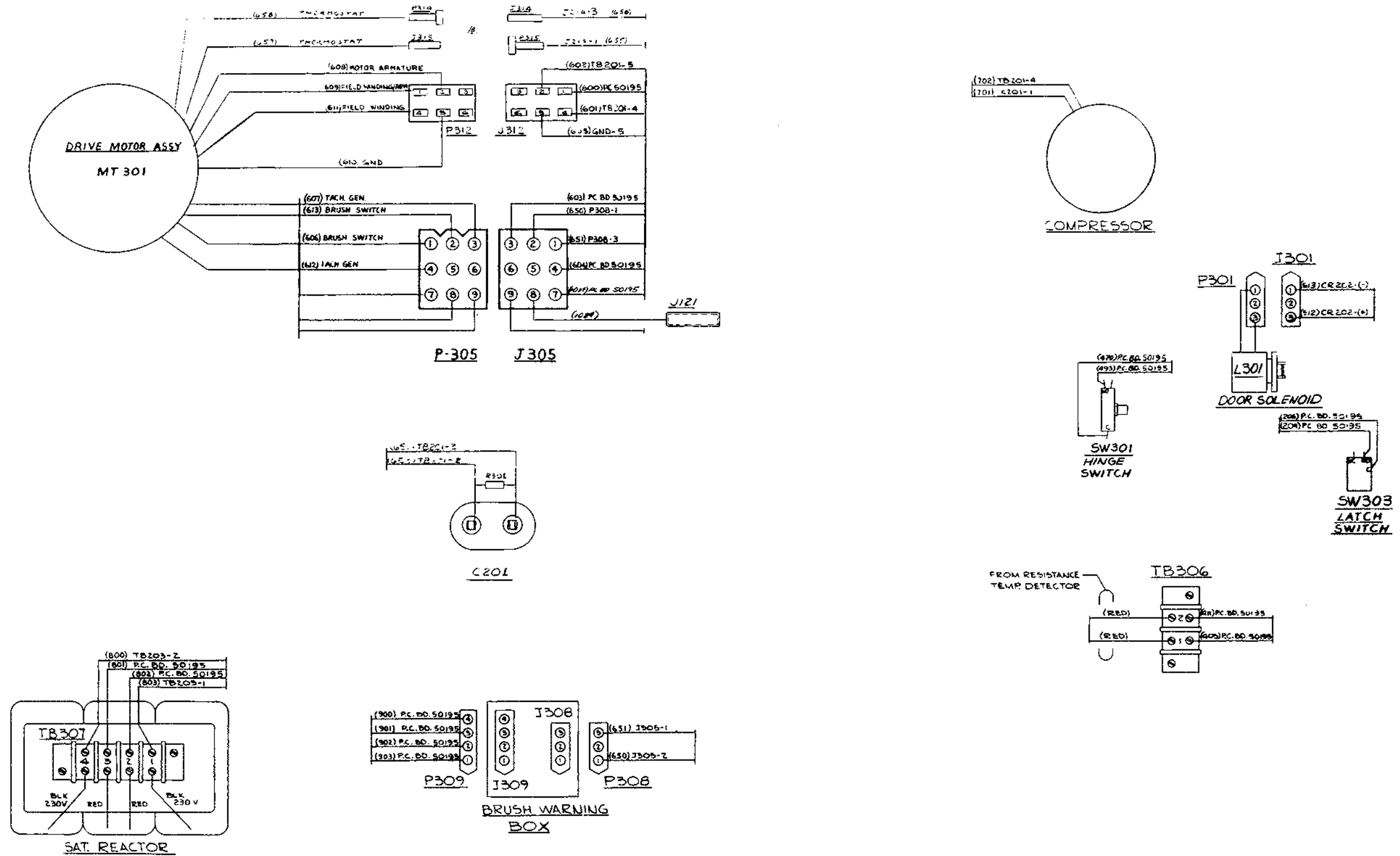
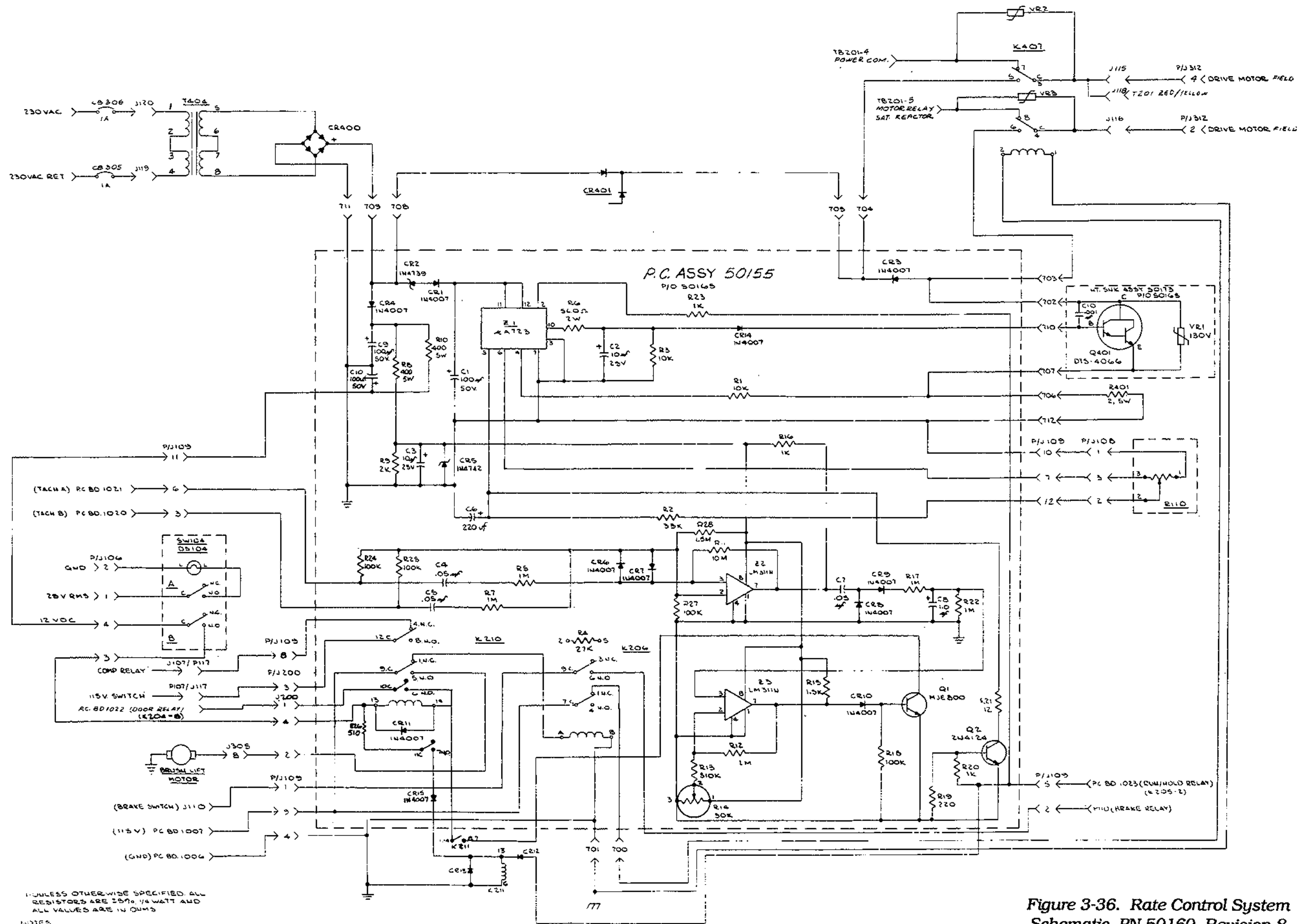


Figure 3-35. RC-5B Wiring Diagram, PN 50204, Revision 8, Sheet 2 of 2



UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE 1/4 WATT AND ALL VALUES ARE IN OHMS

Figure 3-36. Rate Control System Schematic, PN 50160, Revision 8

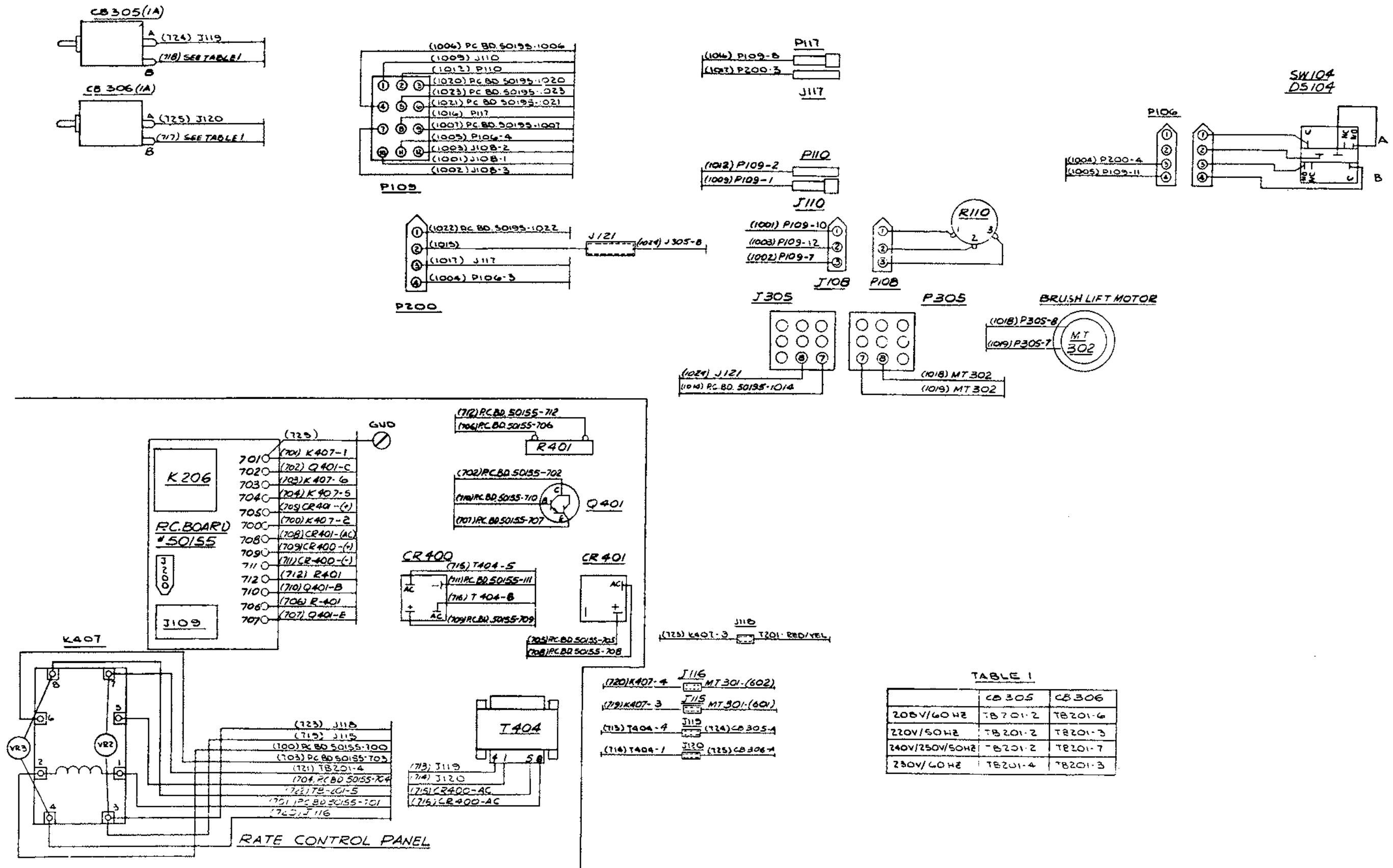


Figure 3-37. Rate Control Wiring Diagram, PN 50161, Revision 4

Section 4

DRIVE SYSTEM CIRCUIT

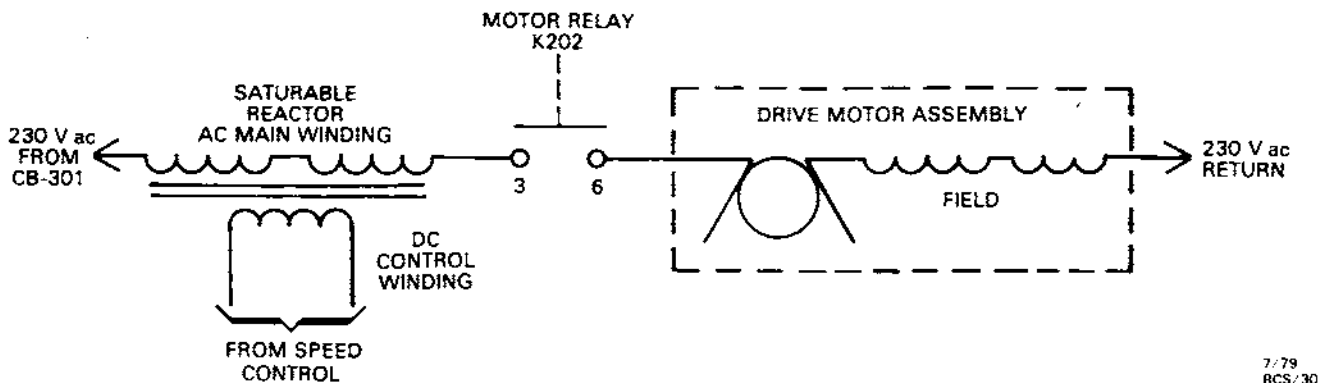
4-1. General

This section covers the procedures necessary to understand and troubleshoot the circuits of the drive system. It describes the relationship between the drive motor, the saturable reactor and the associated control systems that create different modes of operation.

Troubleshooting charts are included to support the text and aid maintenance personnel in isolating a problem to a specific function or area.

4-2. Drive Motor Circuit

When the centrifuge is operating in the RUN mode, 230 Vac operating power for the drive motor is supplied from the main power source through contacts 4-5 of relay K205 to the ac winding of the saturable reactor. In the RUN mode, the drive motor enable circuit (paragraph 4-3) is activated when relays K202 and K205 are energized. When the start switch is depressed, latching relays K202, K203 and K205 are energized by 115 Vac, and relay K202 applies 230 Vac potential to the drive motor field windings to operate the motor. When relay K205 is energized, 115 Vac passes across contacts 8-2 and is applied to the speed control circuit which modulates the dc saturating bias voltage on the control winding of the saturable reactor to control the drive motor speed.



7/79
RCS/30

Figure 4-1. Drive Motor Circuit, Simplified Schematic Diagram

4-3. Drive Motor Enable Circuit

The drive motor enable circuit allows the centrifuge to enter the RUN mode to start the drive motor. Operating speed, refrigeration control and timer voltages are established when the timer function is selected. When the chamber door is closed, and the timer is in a position other than OFF, on the RC-5 the OFF switch is not activated, and the overtemperature and overspeed functions are disabled.

When the key switch of the RC-5 is set to ON and the ON switch is activated, or when the START switch on the RC-5B is in the ON position, latching relays K202, K201 and K205 are energized. When relay K202 is energized, 230 Vac is applied across contacts 6-3 to the drive motor field windings to start the drive motor. When compressor relay K201 is energized, 230 Vac is applied across contacts 2-1 to both the compressor motor and the compressor fan motor which are connected in a parallel configuration. When relay K205 is energized, 115 Vac passes across contacts 7-4, then goes to a diode on PC board No. 20809 where it is converted to a dc voltage to energize the speed control circuit. This dc voltage is applied to relay K206 on PC board No. 20126. On this relay, contacts 4-7 perform the latching function, while the dc voltage passes across contacts 6-9 and is applied to the control winding of the saturable reactor.

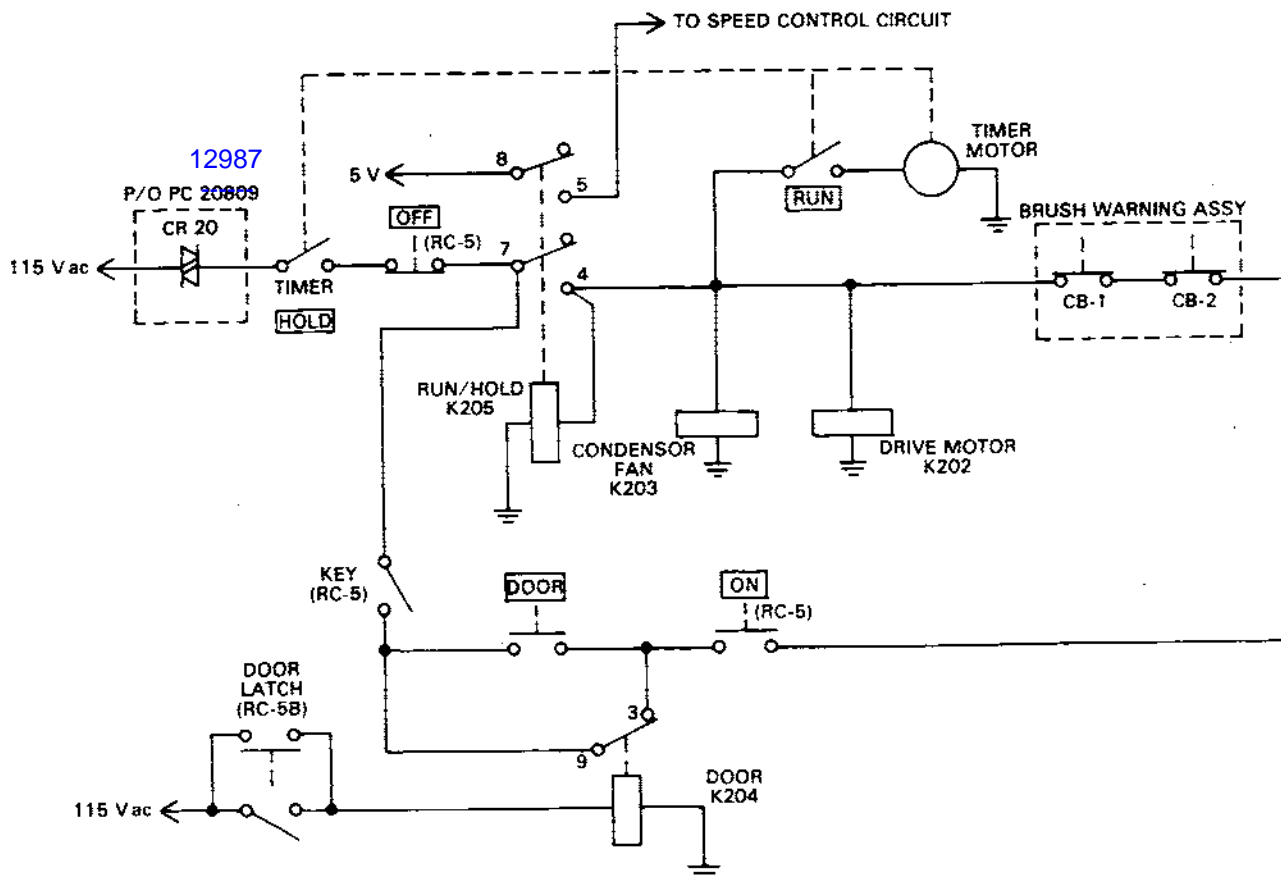


Figure 4-2. Drive Motor Enable Circuit, Simplified Schematic Diagram

Table 4-1. Troubleshooting Chart, ac Power Distribution and Drive Motor Circuits

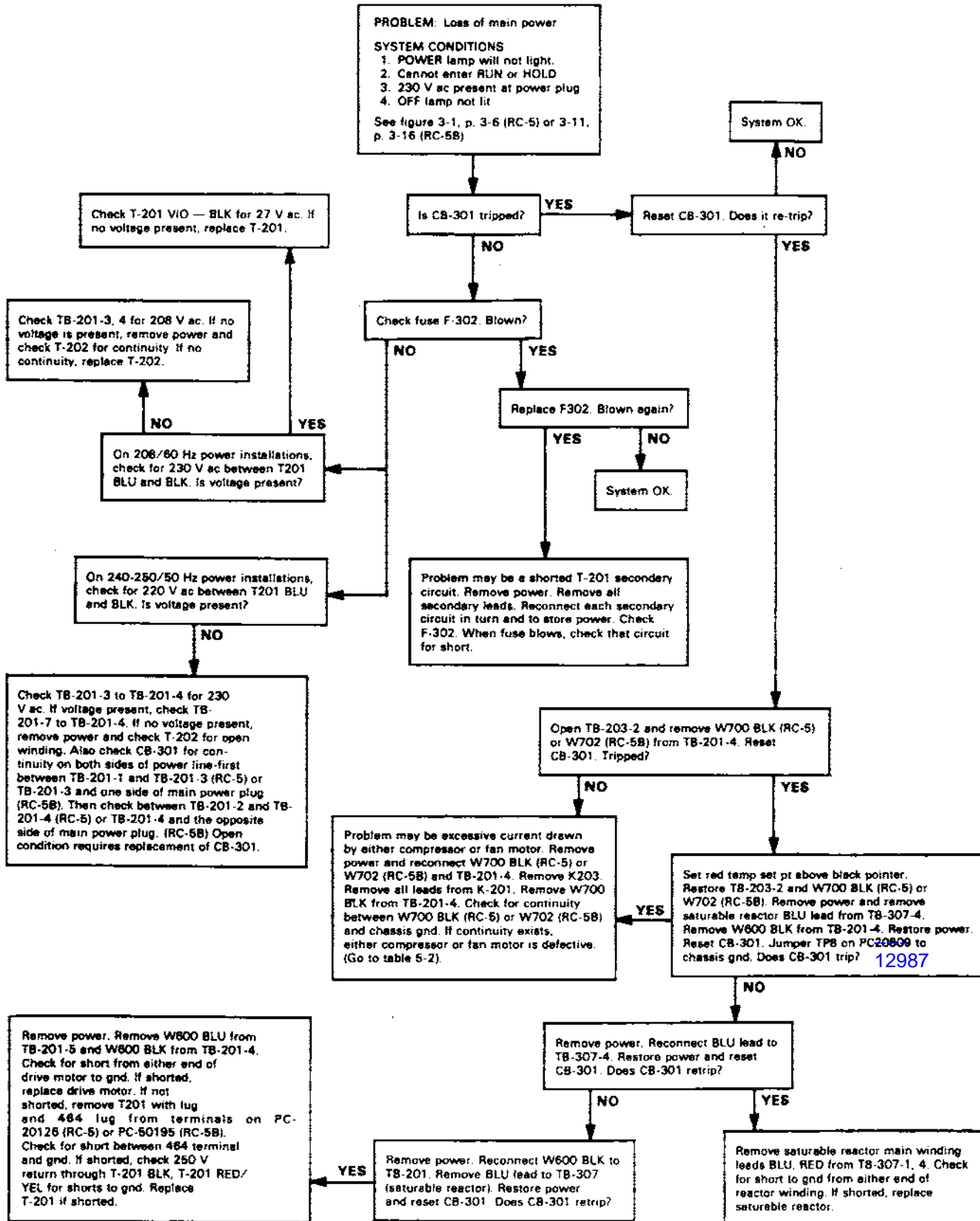
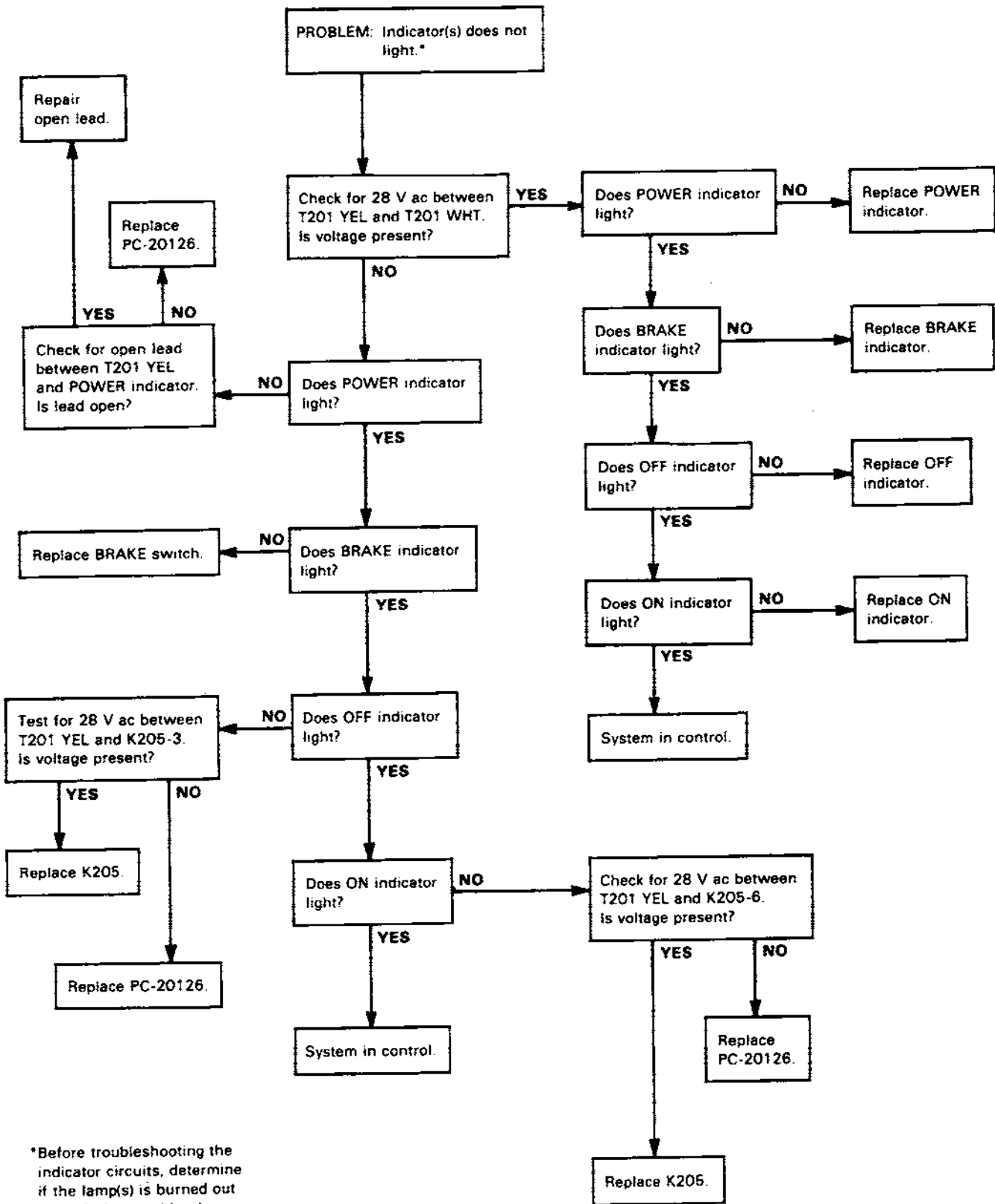


Table 4-2. Troubleshooting Chart, Indicator Circuits, RC-5



*Before troubleshooting the indicator circuits, determine if the lamp(s) is burned out by replacing it with a known good one.

Table 4-3. Troubleshooting Chart, Indicator Circuits, RC-5B

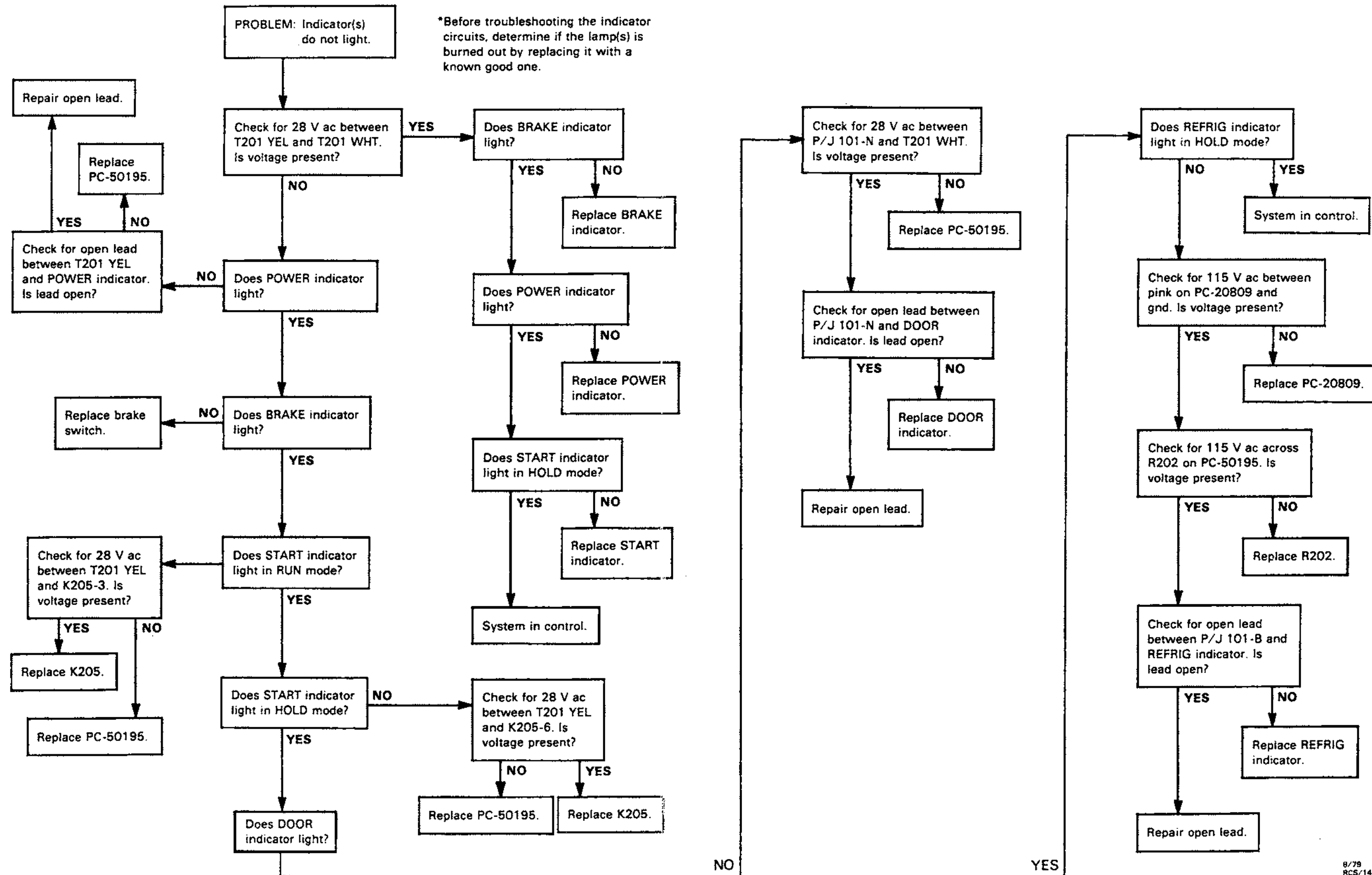
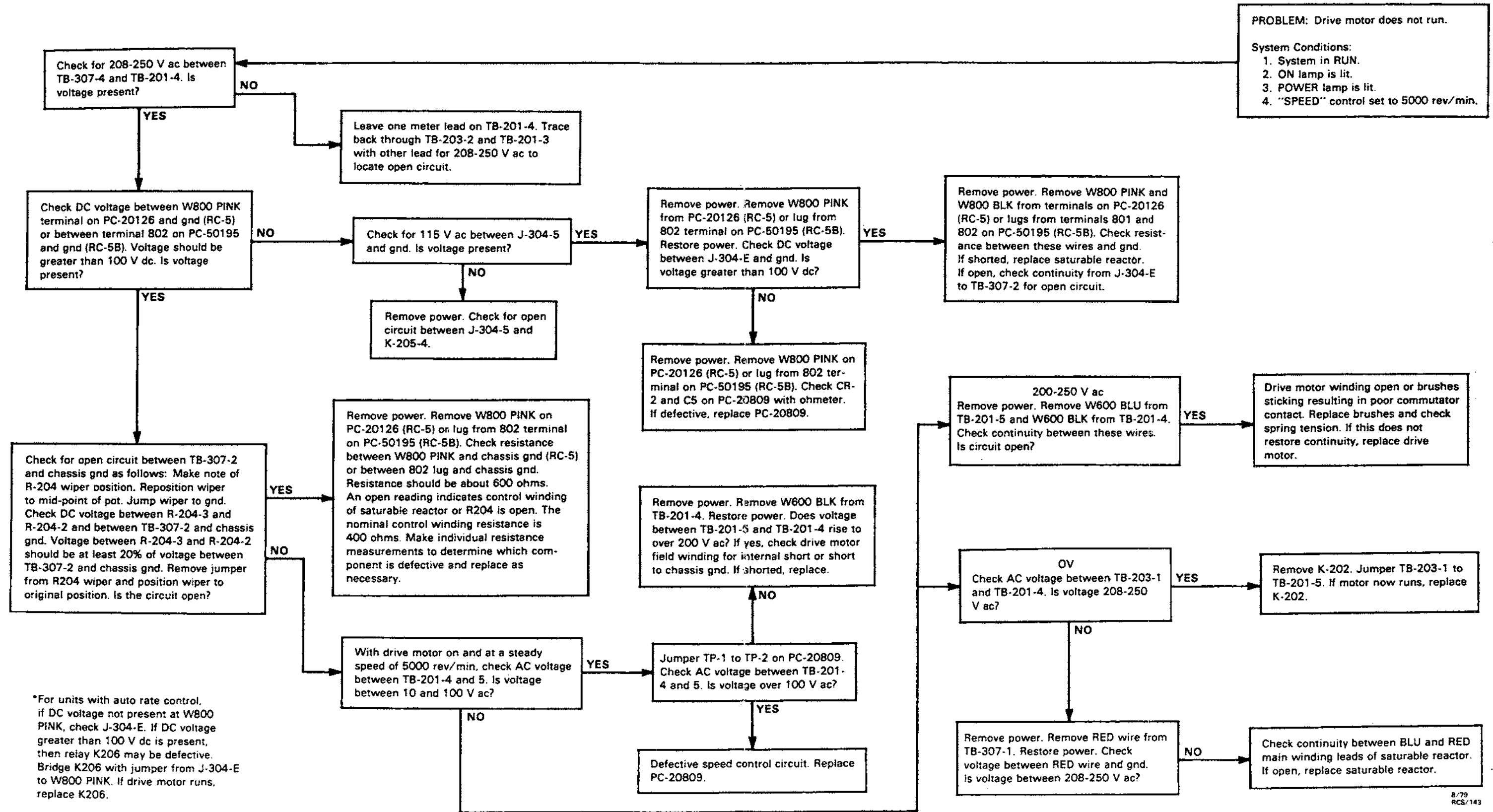
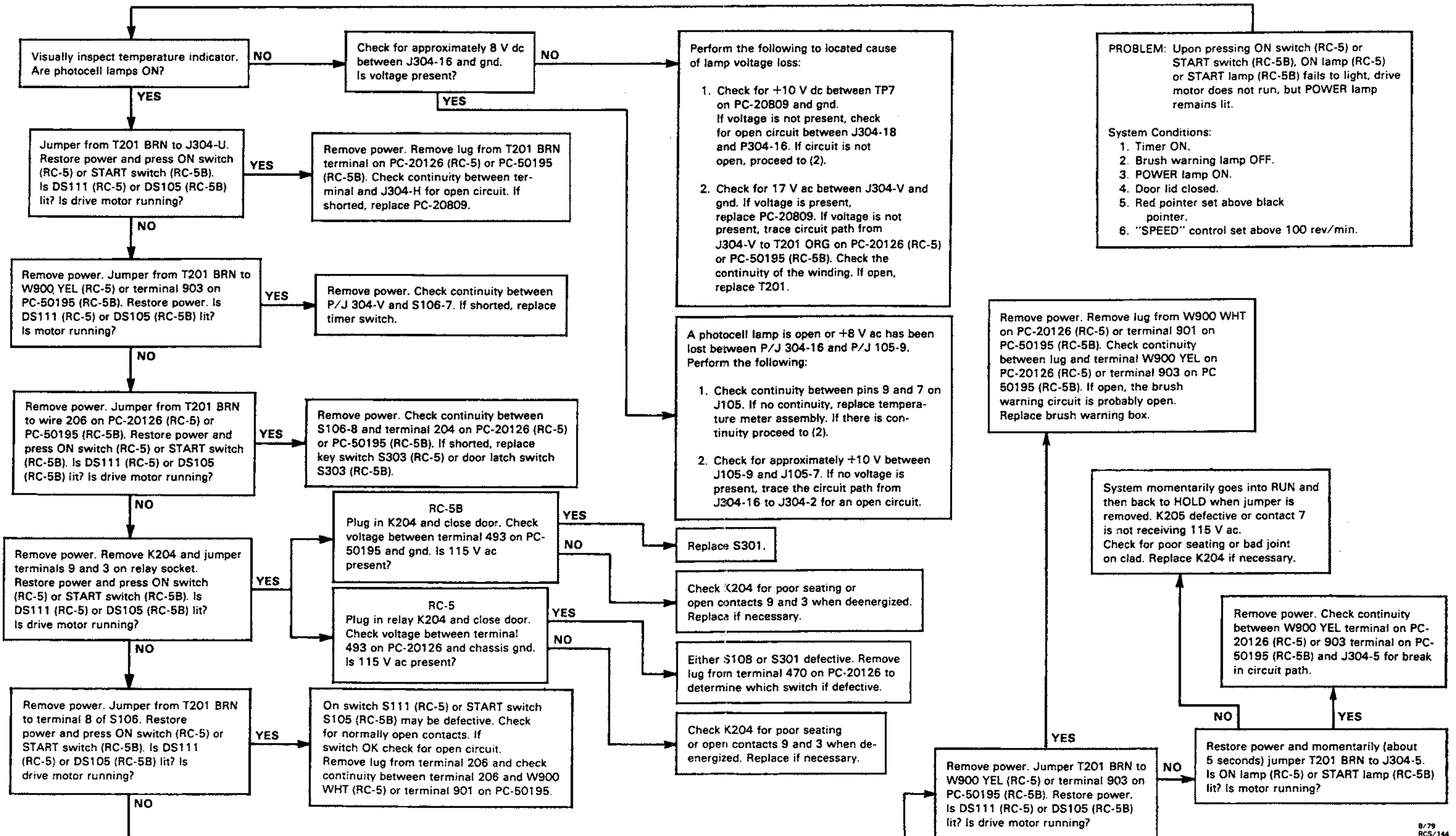


Table 4-4. Troubleshooting Chart, Speed Control and Drive Motor Circuits



B/79
RCS/143

Table 4-5. Troubleshooting Chart, Drive Motor Circuit Enable and Temperature Control Circuits



PROBLEM: Upon pressing ON switch (RC-5) or START switch (RC-5B), ON lamp (RC-5) or START lamp (RC-5B) fails to light, drive motor does not run, but POWER lamp remains lit.

System Conditions:

1. Timer ON.
2. Brush warning lamp OFF.
3. POWER lamp ON.
4. Door lid closed.
5. Red pointer set above black pointer.
6. "SPEED" control set above 100 rev/min.

The latching function across contacts 4-7, bypasses the Key switch on the RC-5 door relay K204 and the ON switch, or the START switch on the RC-5B. The latching function of relay K204 allows the key to be removed from the key switch and the door to be opened on the RC-5 by pressing the DOOR and ON switches at the same time. On the RC-5B this function is accomplished by pressing the DOOR and START switches at the same time.

If the SLOW switch is depressed when the system is in the HOLD mode, this function causes +5 Vdc from contacts 1-2 of the RUN/HOLD relay to energize K211 through CR12 causing +12 Vdc to flow from the comparator speed switch Q1 to energize relay K210. When relay K210 is energized, 115 Vac from the brake switch flows across contacts 9-5 to the field windings of the brush lift motor, causing it to retract brush tension from the lower brush. At the same time, 115 Vac from K204 door relay passes across contacts 10-6 of relay K210, brush lift relay, and also across contacts 1-14 and 8-7. This voltage is applied to the collector emitter circuit of the comparator speed switch Q1, driving it into conduction and placing it to ground.

4-4. Brake Circuit

The brake circuit consists of a brake switch SW109B, a brake transformer T201, brake rectifier CR201, protective fuse F301, relay K202, load resistor R201 and the rotor

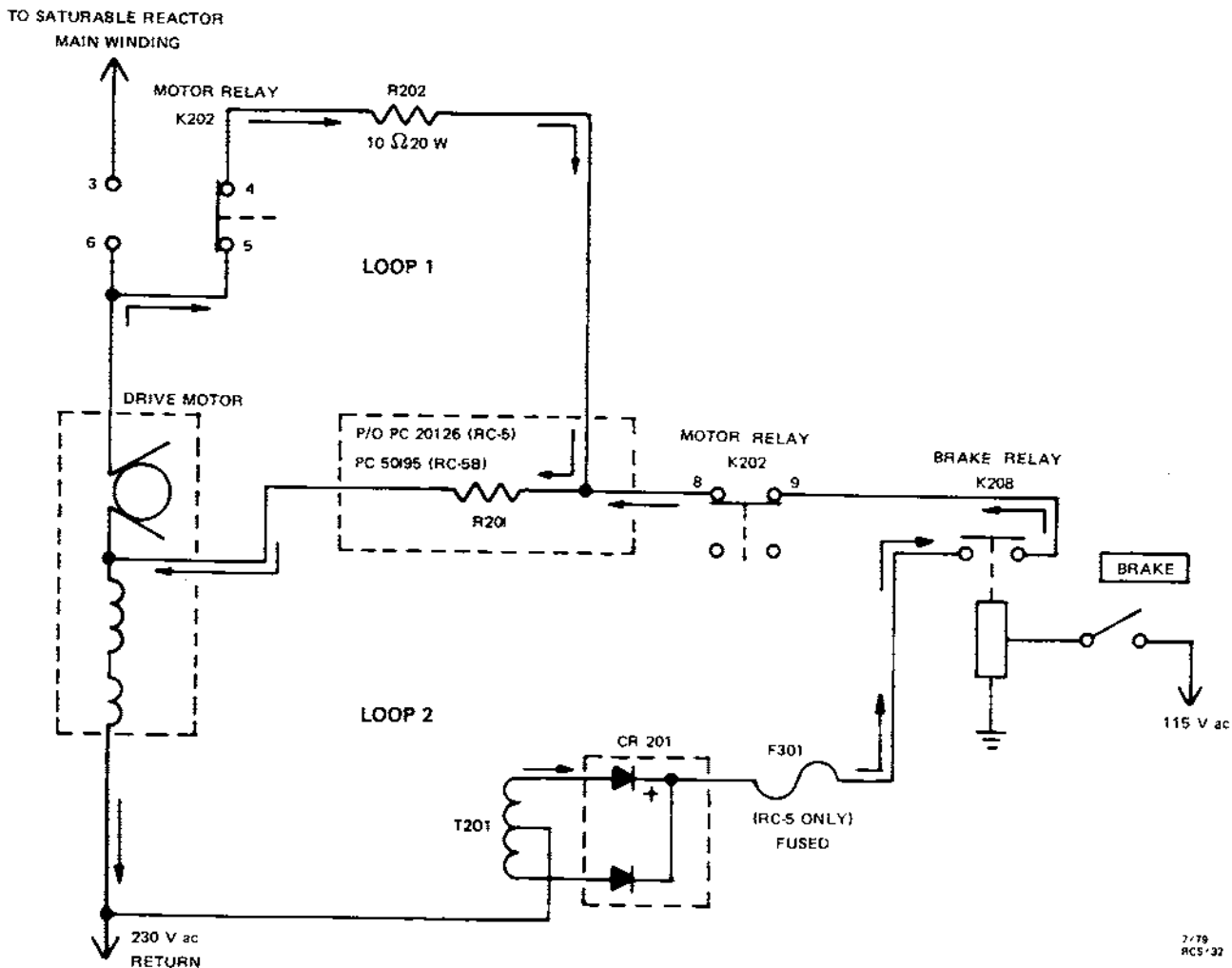
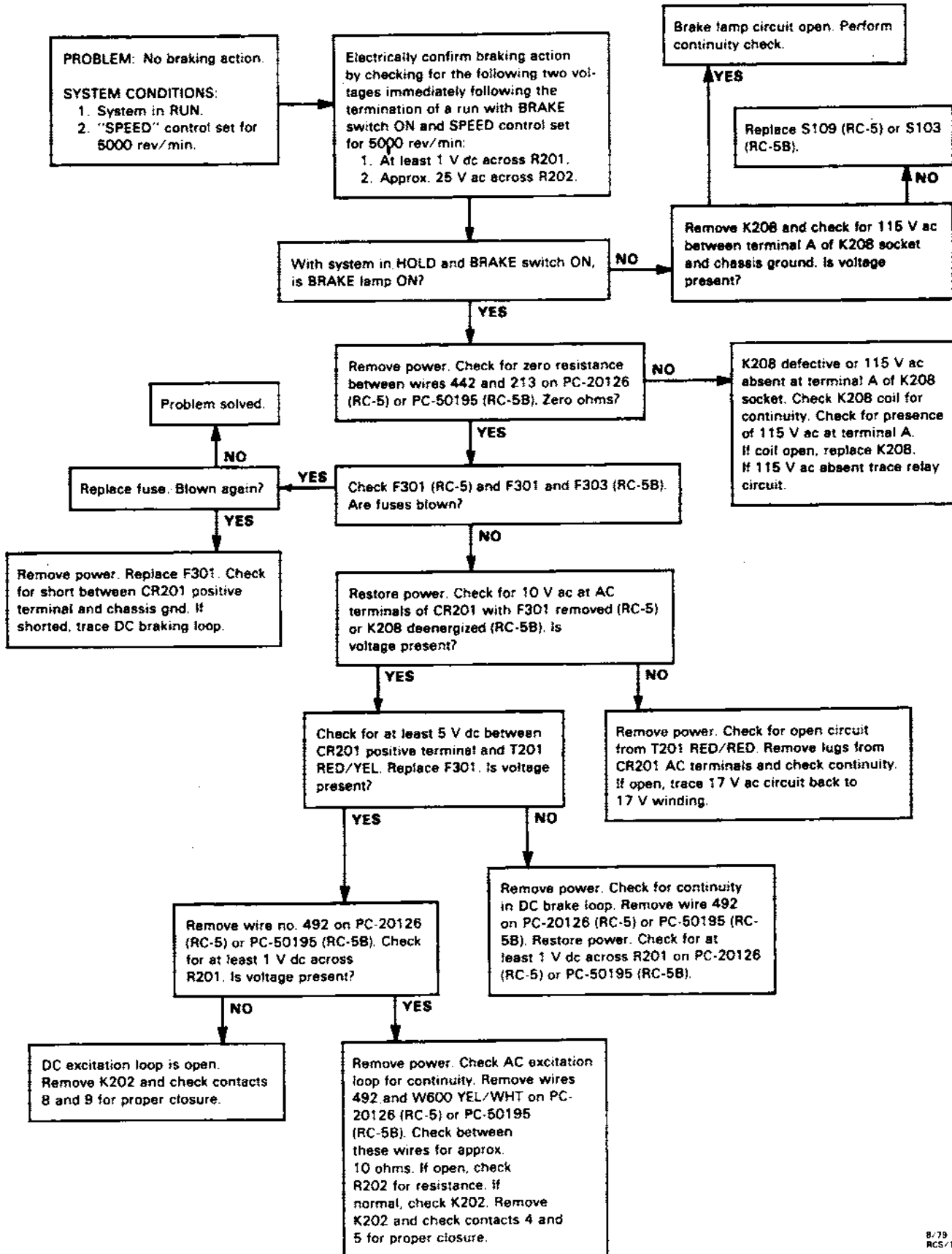


Figure 4-3. Brake Circuit, Simplified Schematic Diagram

Table 4-6. Troubleshooting Chart, Brake Circuit



drive motor. The brake circuit is designed to reduce deceleration time by approximately 50%. Automatic braking force is decreased as the rotor speed decreases, thus minimizing the possibility of resuspending the test sediment. The rotor drive has two modes of deceleration from a RUN mode. They are: (a) free coasting and (b) dynamic braking (see brake circuit in Figure 3-8 or 3-22). The BRAKE switch SW109B selects the mode of deceleration. With the BRAKE switch SW109B in the OFF position, deceleration is free coasting to a stop. When the BRAKE switch is in the ON position, dynamic braking to a gradual stop occurs as the centrifuge enters the HOLD mode. 115 Vac is applied through the BRAKE ADJUST potentiometer to the primary winding of brake transformer T201.

The brake rectifier CR201 converts the secondary voltage of T201 to a dc voltage between center tap and contacts 7-4 of relay K208 on PC assembly 20126 and motor relay K202. When K202 is deenergized, contacts 8-9 are closed and the +5 Vdc output of the brake rectifier is applied across the field winding of the rotor drive motor. At the same time, the brake resistor R201 is also connected through contacts 8-9, which are closed when K202 is deenergized connecting the CR201 to the field winding of the drive motor. Hence, when the BRAKE switch is in the ON position and K202 is deenergized, the drive motor acts as a dc generator with its output connected to a 2.7 ohm load resistor R201. This electrical load is reflected to the rotor drive linkage as a mechanical braking force. The BRAKE ADJUST R204 potentiometer controls the output of the field strength of the rotor drive motor. The potentiometer provides a means for varying the deceleration rate and, consequently, the stopping time of the rotor drive motor. The brake rectifier circuit is protected from ac spikes that can damage the rectifier by fuse F301.

4-5. Brush Warning Circuit

The brush warning circuit consists of two circuit breakers, CB1 and CB2, located in the brush warning box at the lower front in the base of the centrifuge, and two normally open brush switches, operated by spring tension, located in the drive motor brush assembly.

As the brushes wear down to a minimum safety length, one or both switch contacts will close, connecting 230 Vac drive motor voltage to the corresponding circuit breaker. The circuit breakers are set to trip at 12 Vac minimum.

When the circuit breaker is tripped, the 115 Vac circuit between the RUN/HOLD relay K205 and the ON switch (on RC-5) or START switch (on RC-5B) energizes thermal relay K207. This relay switches ON and OFF to provide an intermittent voltage to the brush indicator lamp, DS103.

The tripped circuit breaker will have no effect on the centrifuge operation, while the circuit is activated during the RUN cycle. The 115 Vac circuit will be interrupted and will prevent the drive enable circuit from entering the RUN mode in the next RUN cycle, unless the brushes are replaced and the circuit breakers are manually reset (see Figure 8-6).

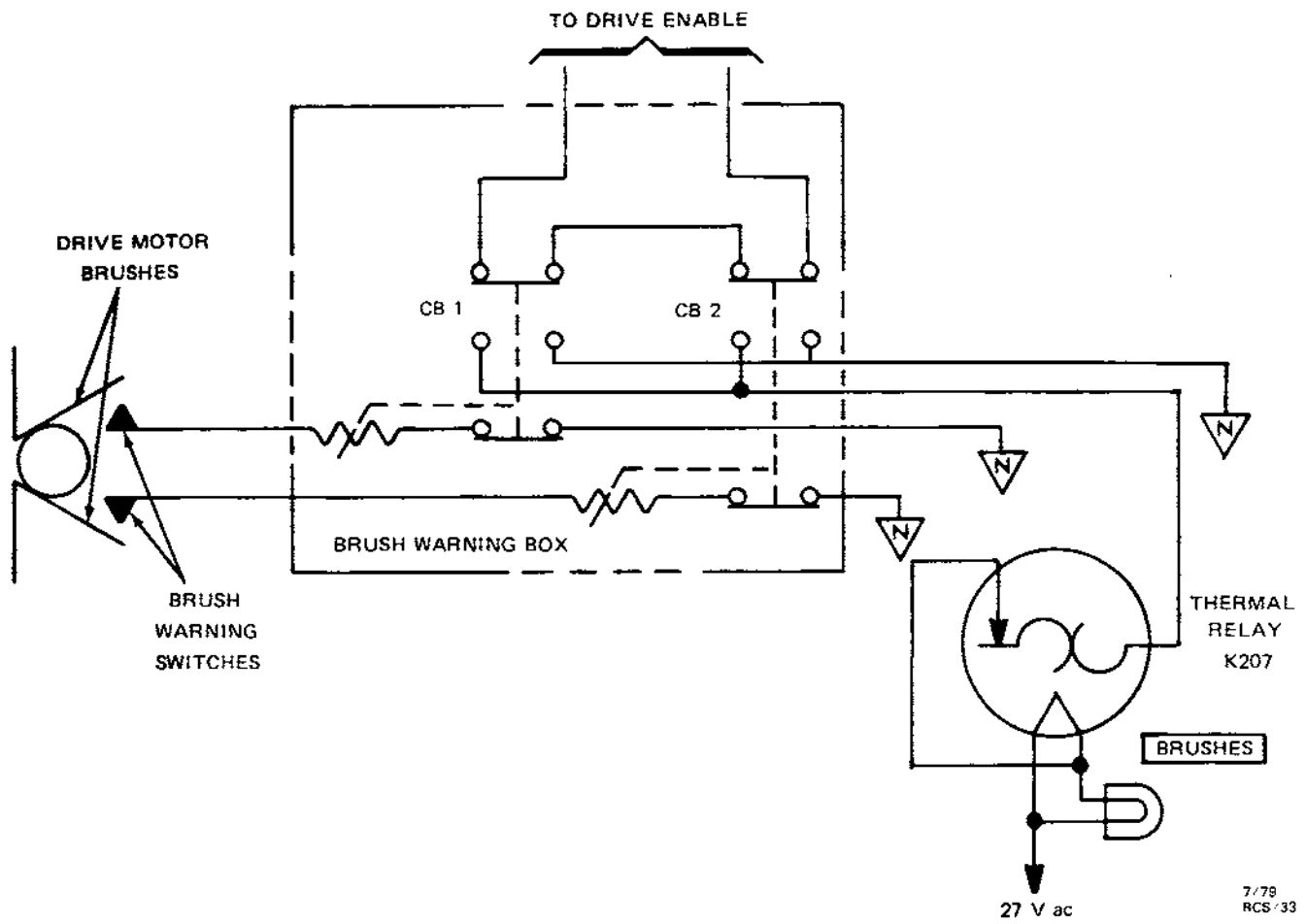
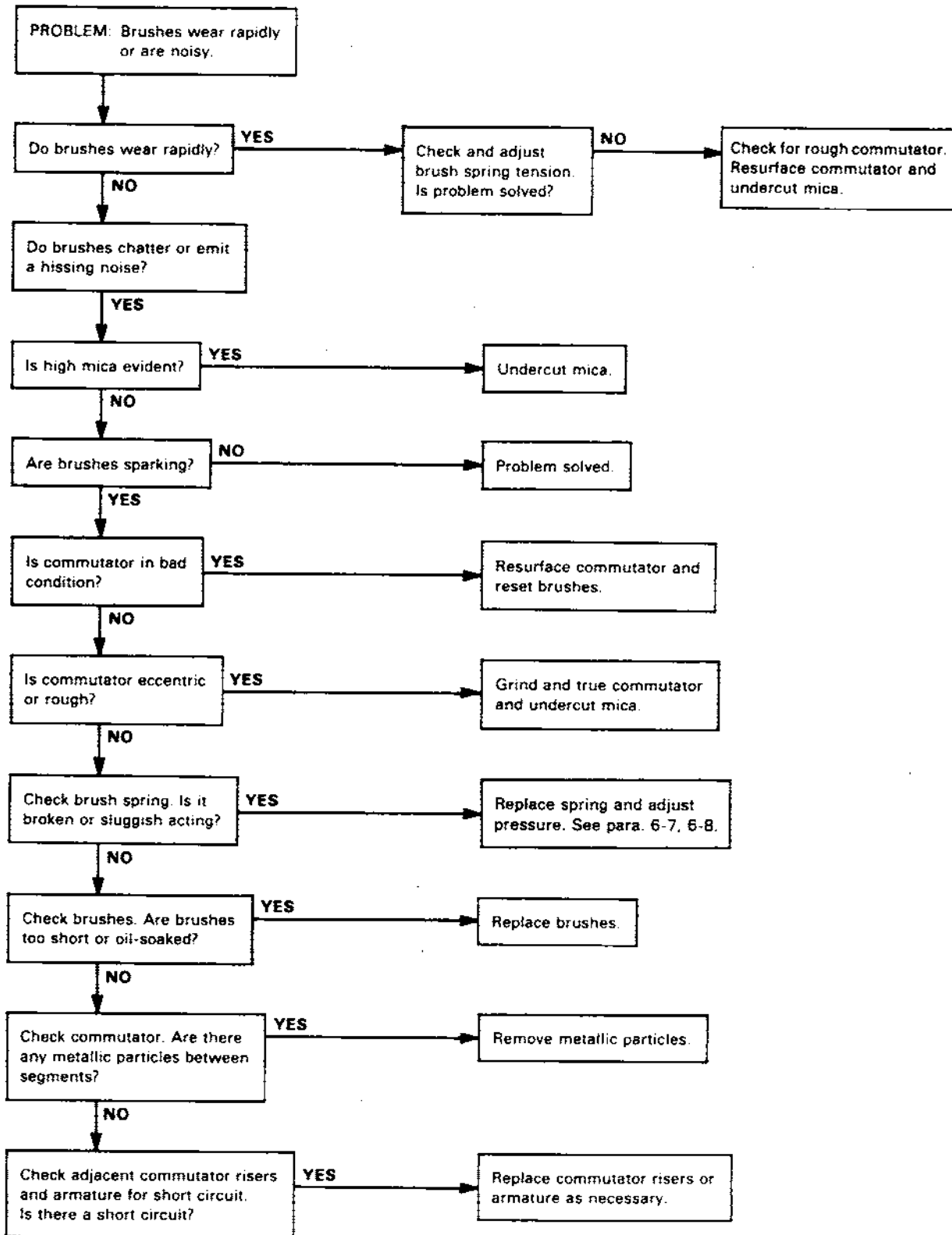


Figure 4-4. Brush Warning Circuit, Simplified Schematic Diagram

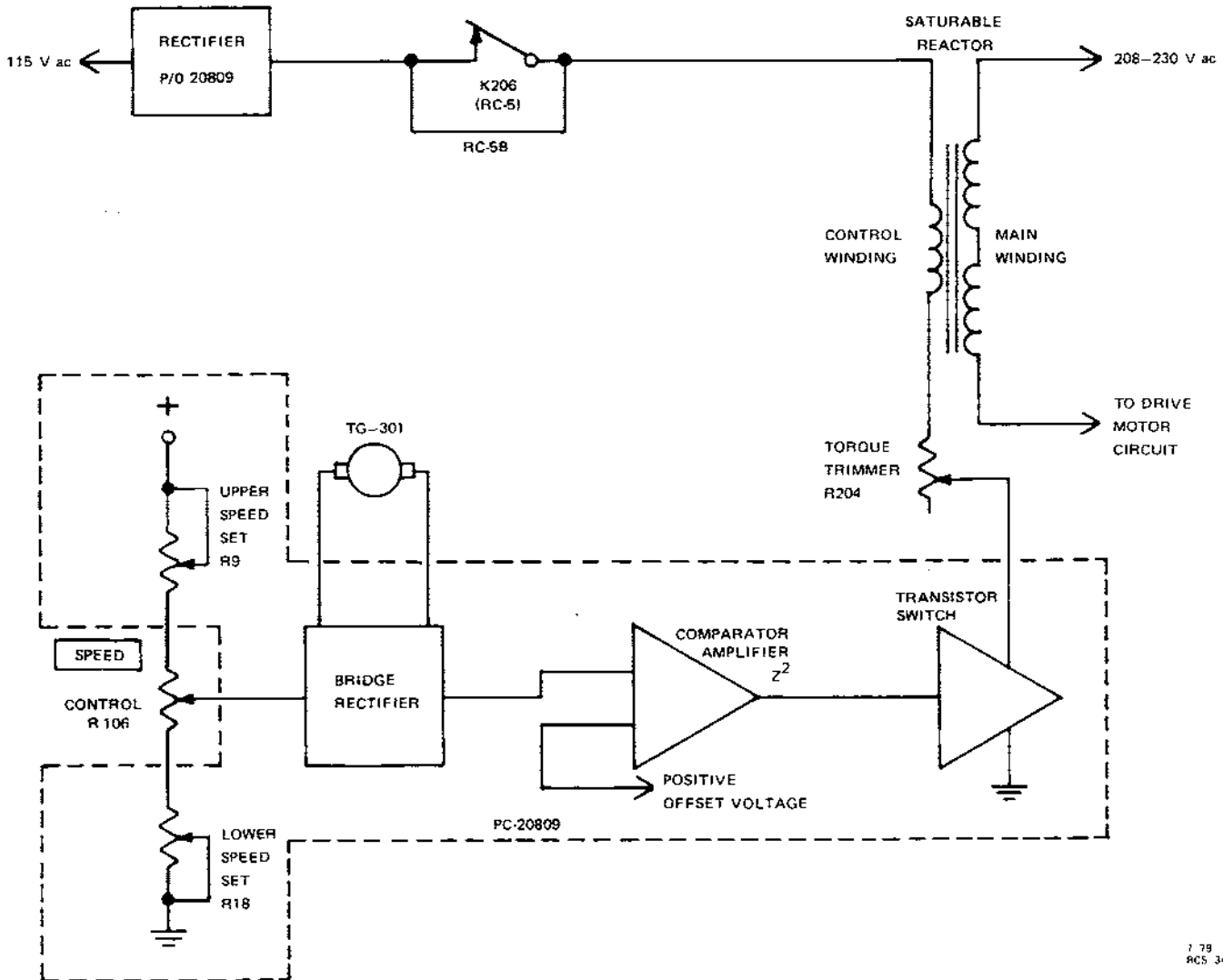
Table 4-7. Troubleshooting Chart, Drive Motor Brushes



4-6. Speed Control Circuit

The speed control circuit consists of a speed control potentiometer (R106), a saturable reactor (which is also part of the drive motor circuit), a comparator-amplifier, a transistor switch Q5, tachometer generator TG301 and a bridge rectifier circuit. When relay K206 is energized, a dc voltage from the bridge rectifier passes across contacts 9-6. The input voltage to the rectifier is 115 Vac; the output supplies approximately 150 Vdc for the control winding of the saturable reactor.

A slight decrease in the drive motor speed and, therefore, a reduction in the tachometer generator output voltage, causes the transistor switch duty cycle to be increased, thus allowing more current to flow in the control winding of the saturable reactor and more current to flow to the drive motor. The drive motor then accelerates to a preset speed. The rapid ON/OFF action provides a virtually constant motor speed at a preselected speed control setting.



7 79
RC5 34

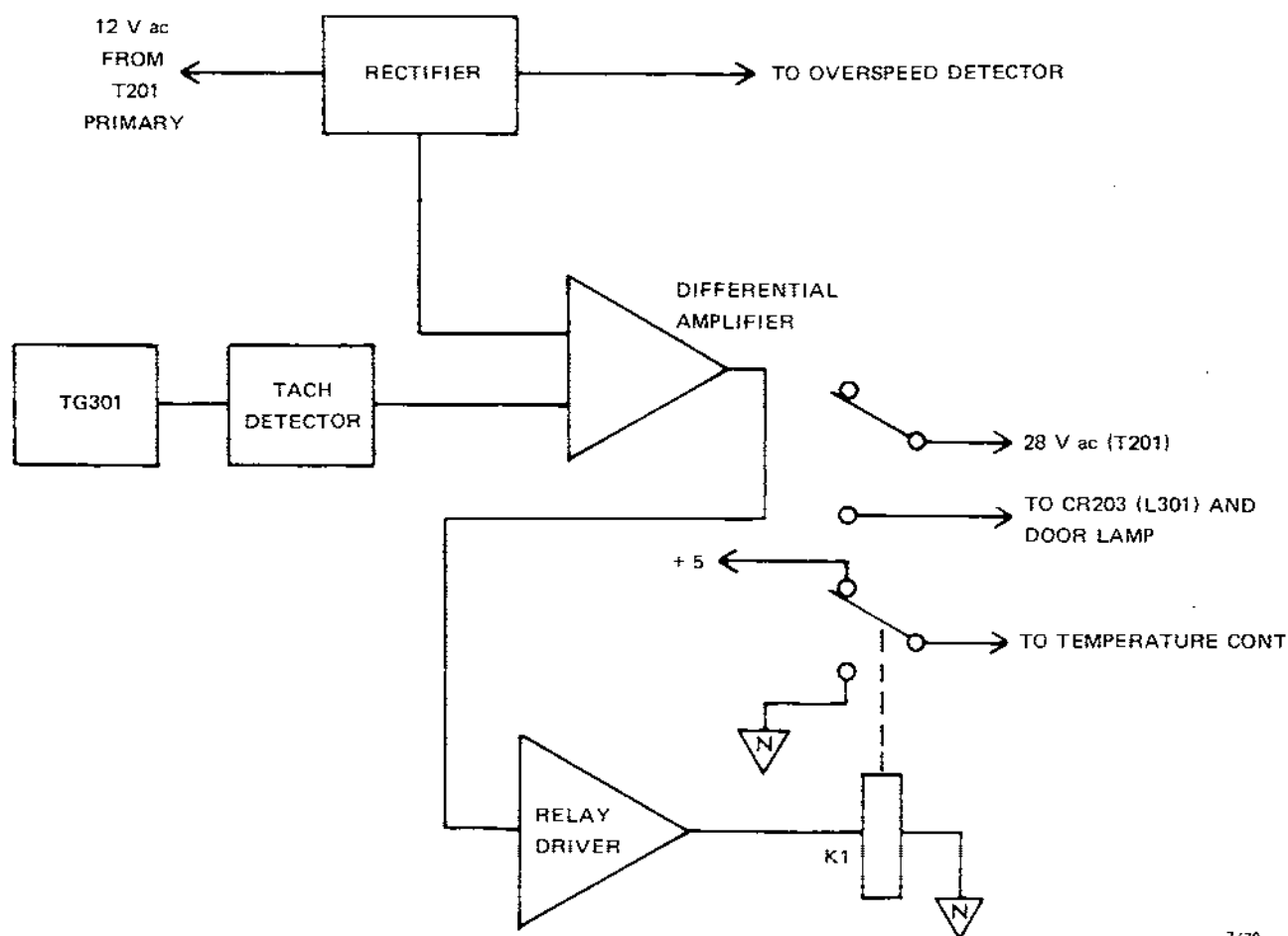
Figure 4-5. Speed Control Circuit, Simplified Schematic Diagram

Torque trimmer R204 is used to set the maximum current value of the control winding so that maximum motor current is 15 A. Potentiometer R9 sets the higher speed limit and potentiometer R 18 sets the lower speed limit. Both potentiometers are located on P.C. Assembly 21206.

4-7. Zero Speed Detector Circuit

The zero speed detector circuit consists of a regulated +10 Vdc power supply, Z3; a tachometer generator, TG301; a tachometer detector circuit; a differential amplifier circuit; a relay driver, Q10; and relay, K1.

At drive motor speed of zero rpm, the output of TG301 is zero volts. A small positive offset Vdc voltage from the +10 Vdc power supply, which serves to unbalance the differential comparator circuit, is present. This imbalance causes a zero volt output to relay driver Q10, which energizes relay K1 on P.C. board No. 20809. 12987



7/79
RCS/35

Figure 4-6. Zero Speed Detector Circuit, Simplified Schematic Diagram

When relay K1 is energized, 28 Vac passes across contacts 11-1, then goes to bridge rectifier CR202, where the output is used to energize the door solenoid L301, allowing the door to be opened. When the door is opened, +5 Vdc is removed from the RUN temperature control circuit which disables the RUN circuit.

At rotor speeds exceeding 100 rpm, the output of tachometer generator TG301 is rectified directly by the tachometer bridge detector on PC 20126. This output overcomes the positive offset voltage which disables the relay driver Q5 that deenergizes relay K1. When K1 is deenergized, +28 Vdc is removed from the door solenoid circuit, locking the door in the closed position. Relay K1 also applies +5 Vdc to enable the RUN temperature control circuit.

4-8. Overspeed Detector Circuit

The overspeed detector circuit consists of tachometer generator TG301, bridge rectifier Z4, a differential amplifier circuit, a relay driver Q24 and relay K6.

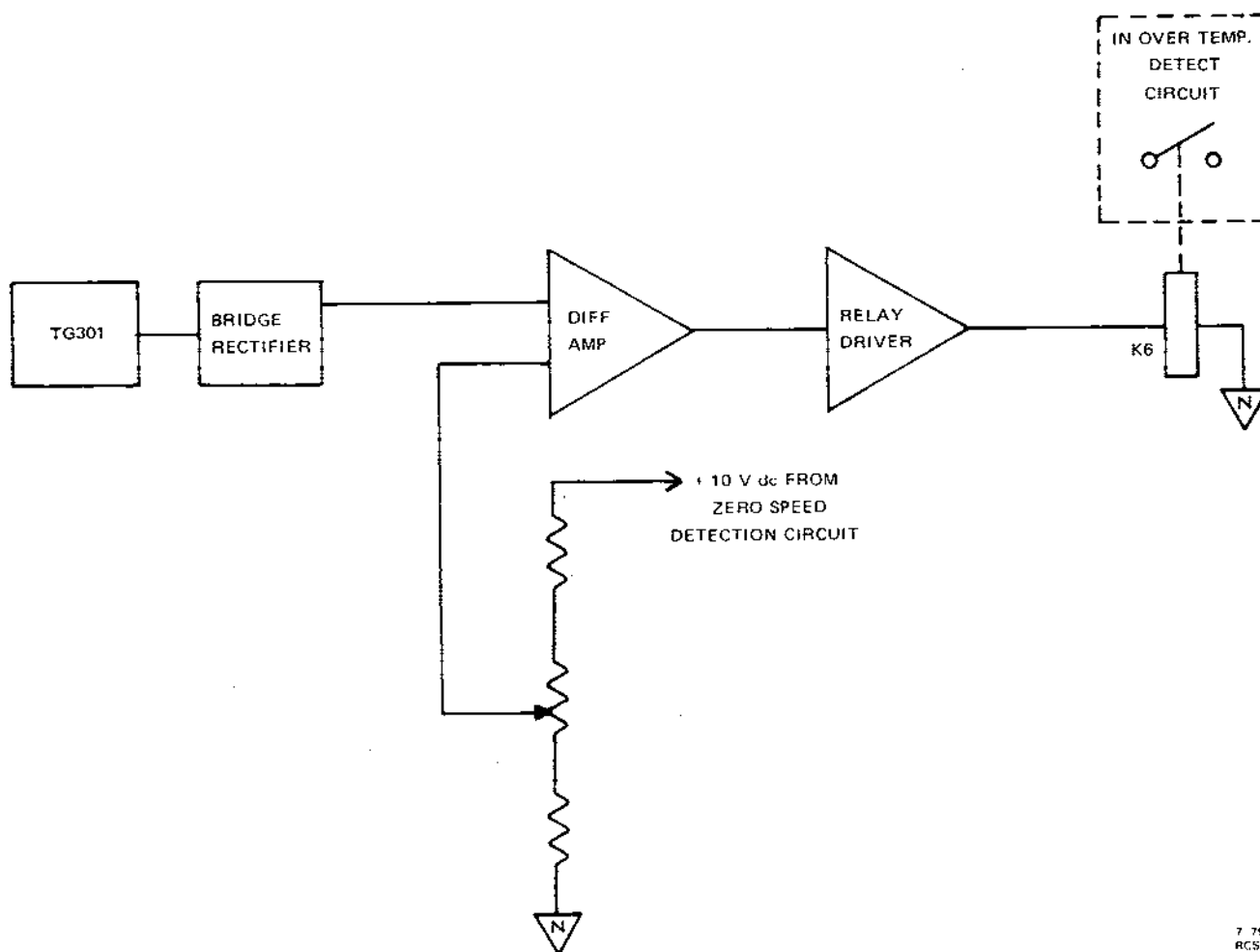
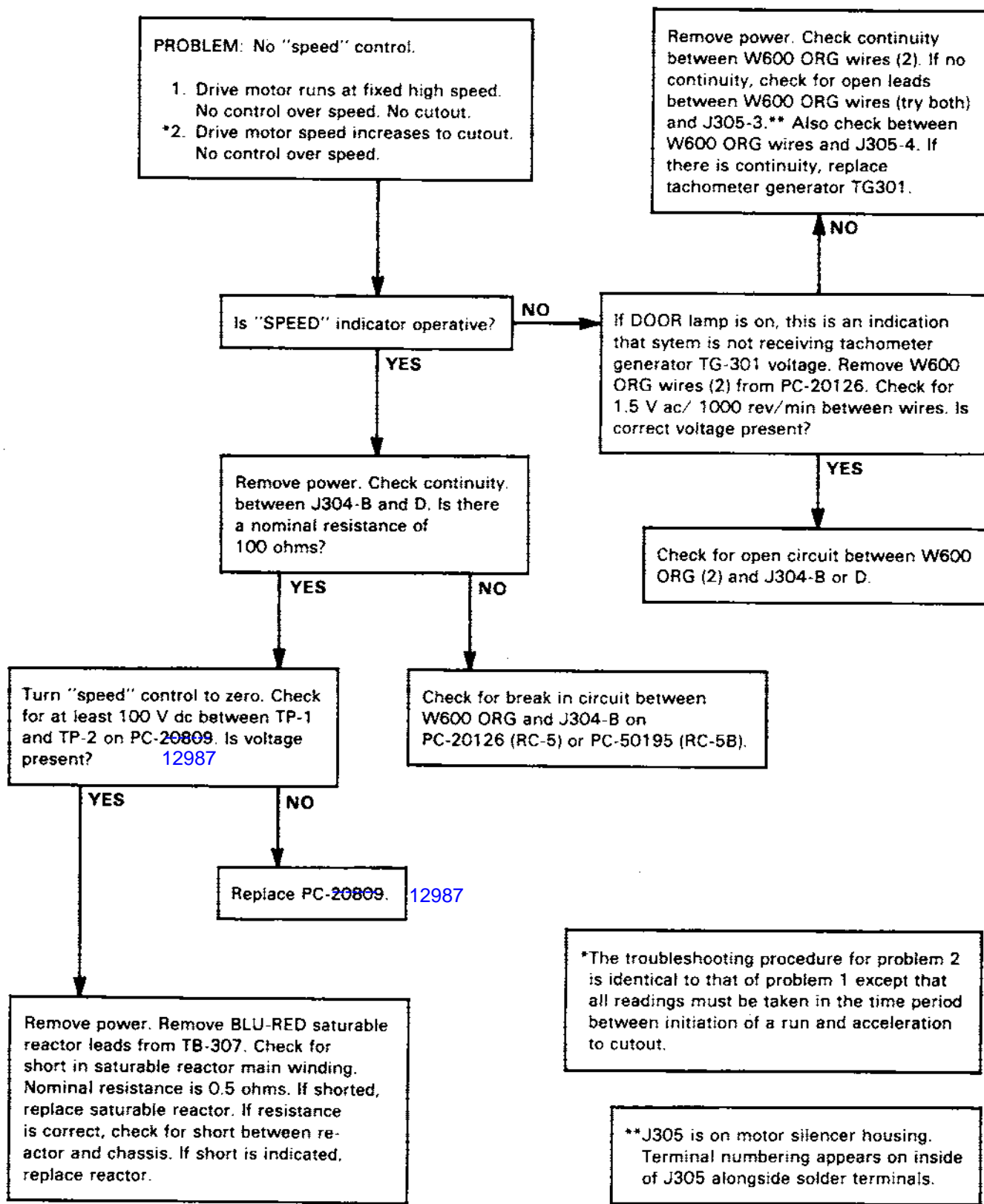


Figure 4-7. Overspeed Detector Circuit, Simplified Schematic Diagram

Table 4-8. Troubleshooting Chart, Speed Control Circuit



8/79
RCS/147

**Table 4-9. Troubleshooting Chart, Overspeed Detector Circuit
Sheet 1 of 2**

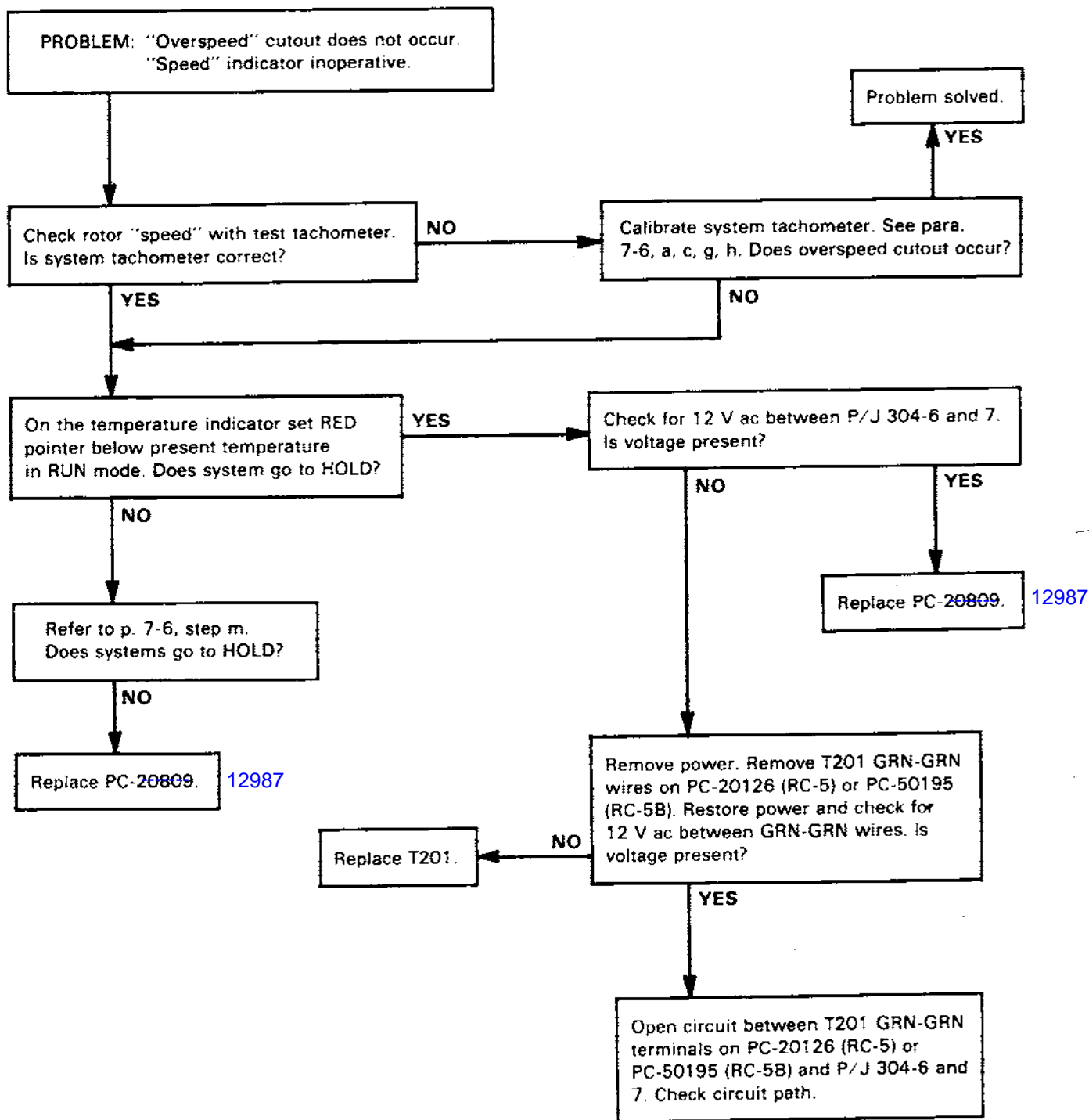
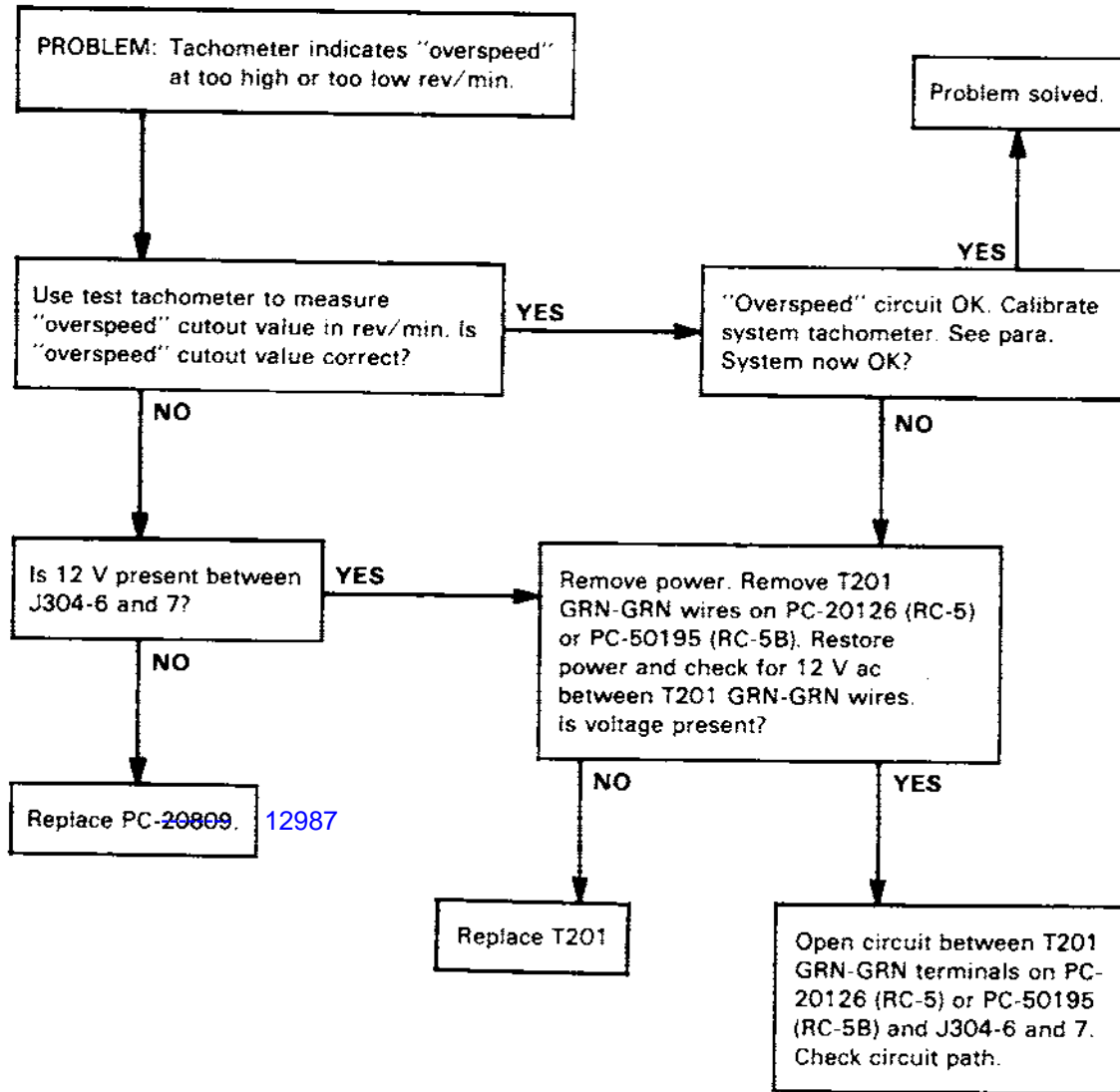


Table 4-9. Troubleshooting Chart, Overspeed Detector Circuit, Sheet 2 of 2



8/79
RCS/157

When the output signal of tachometer generator TG301 reaches an amplitude equal to a preset speed of 21 000 rpm, a dc voltage level, representing rotor speed, is established by bridge rectifier Z4. This level is compared against a set threshold voltage controlled by potentiometer R73.

At speeds of 21 000 rpm, the differential comparison enables the relay driver Q24, which acts as a control switch that energizes relay K6. When relay K6 is energized, contacts 14-7 allow a voltage to inhibit the switch control circuitry which triggers triac CR20, a switching device in the overtemperature detection circuit. Triac CR20 creates an open circuit, in an overspeed or overtemperature condition, removing 115 Vac from the coil of K205 RUN/HOLD relay, causing it to deenergize and return the system to the HOLD mode.

4-9. Automatic Rate Controller Circuit — RC-5B

The RC-5B Automatic Rate Controller circuit (Figures 4-8 and 4-9) consists of a low voltage motor drive circuit, a motor transfer circuit, a frequency-to-voltage converter and a comparator speed switch circuit.

In the RUN mode, K407, the motor transfer relay, is deenergized by relay K206 of the motor drive enable circuit. The drive motor is then energized through the saturable reactor high voltage drive circuit. When the SLOW mode is activated at the start of a RUN cycle, relay K206 of the motor transfer circuit energizes K407, where the drive motor is switched to the LOW POWER motor drive circuit. This circuit provides a relatively lower dc drive motor excitation current which is adjustable for the motor acceleration rate.

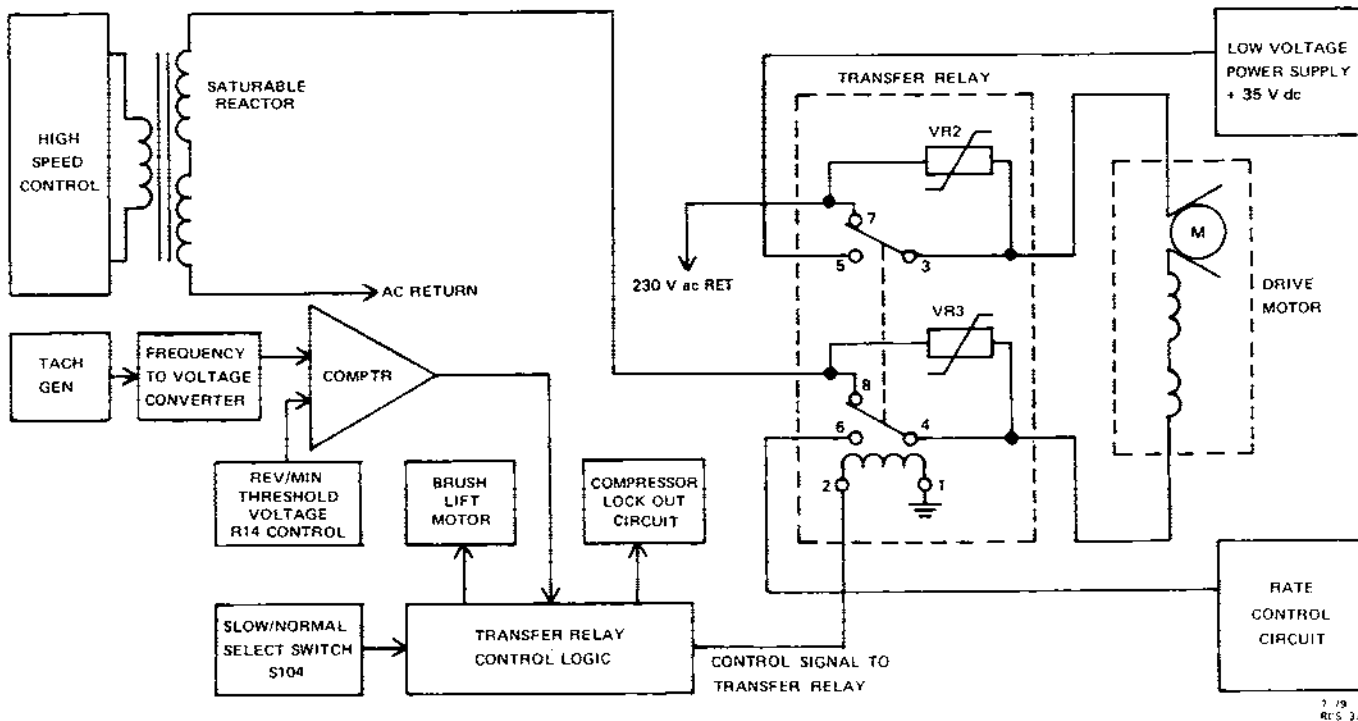


Figure 4-8. Automatic Rate Controller, Block Diagram

The main function of transfer relay K407 is to switch the drive motor from the slow start +35 V low voltage circuit of Q401 to the main operating, 230 Vac, high voltage circuit of the saturable reactor for acceleration, then reverse the process for deceleration. The switching of these two circuits incorporates varistors VR2 and VR3 that protect the circuit in K407 from ac spikes caused by the opening and closing of the relay contacts. These two circuits control the drive motor operating rate. During the transition, the +35 V low voltage circuit and the ramp control circuit are both removed from the drive motor by relay K206. During the SLOW START operation, relay K210 disables the compressor relay circuit, preventing the compressor from operating during this function, to protect the samples under test from vibration.

The main function of relay K206 is to provide a 5-second time delay when the drive motor accelerates to 900 rpm or decelerates to 700 rpm. This delay allows the drive motor brushes to be firmly seated on the commutator before the transfer relay switches the drive motor from a high voltage circuit to a low voltage circuit or reverses the function, as required. The brushes are always in contact with the drive motor armature commutator. During the circuit transfer, relay K210 applies 115 Vac to the brush spring motor, causing it to retract the primary lower brush spring, while the secondary upper brush spring maintains less tension on the brushes which are always in contact with the commutator. This function occurs while the drive motor is using low power and coasts to a slow, gradual stop.

When the drive motor accelerates above 700 rpm, if the brake switch is pressed, the brake circuit will be enabled. Below 700 rpm, when the brake circuit is disabled, the drive motor will also coast to a gradual stop.

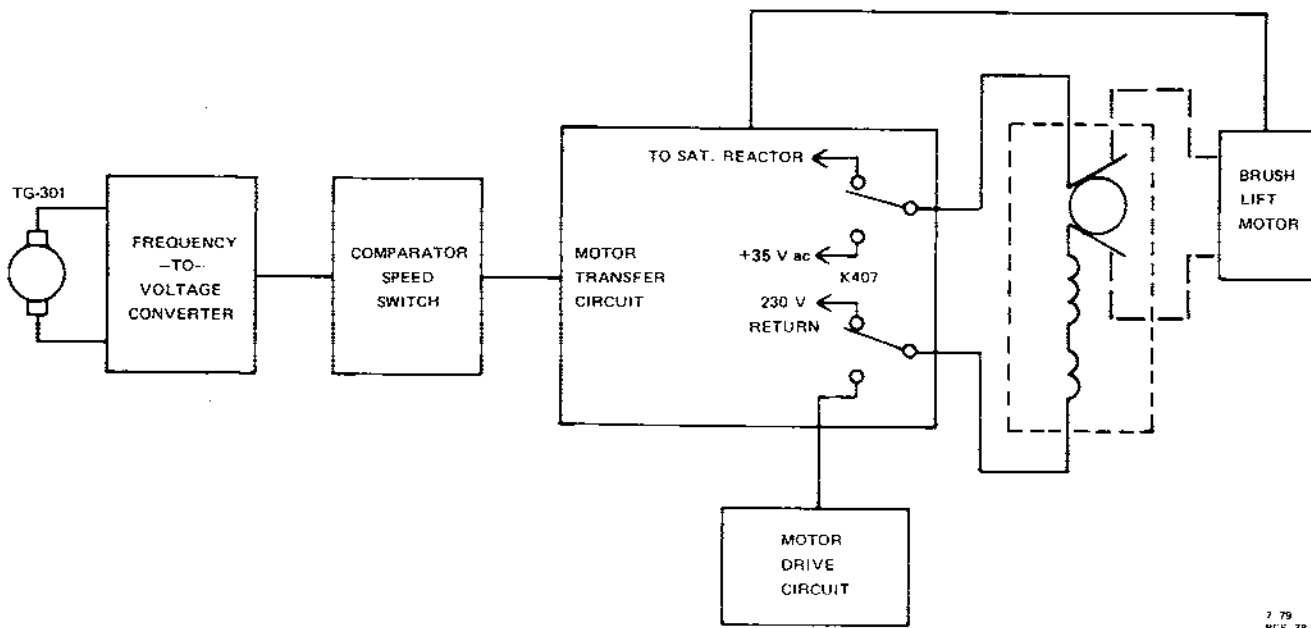


Figure 4-9. Automatic Rate Controller,
Simplified Block Diagram

7 79
MCS 38

Table 4-10. Troubleshooting Chart, Automatic Rate Controller, Sheet 1 of 4

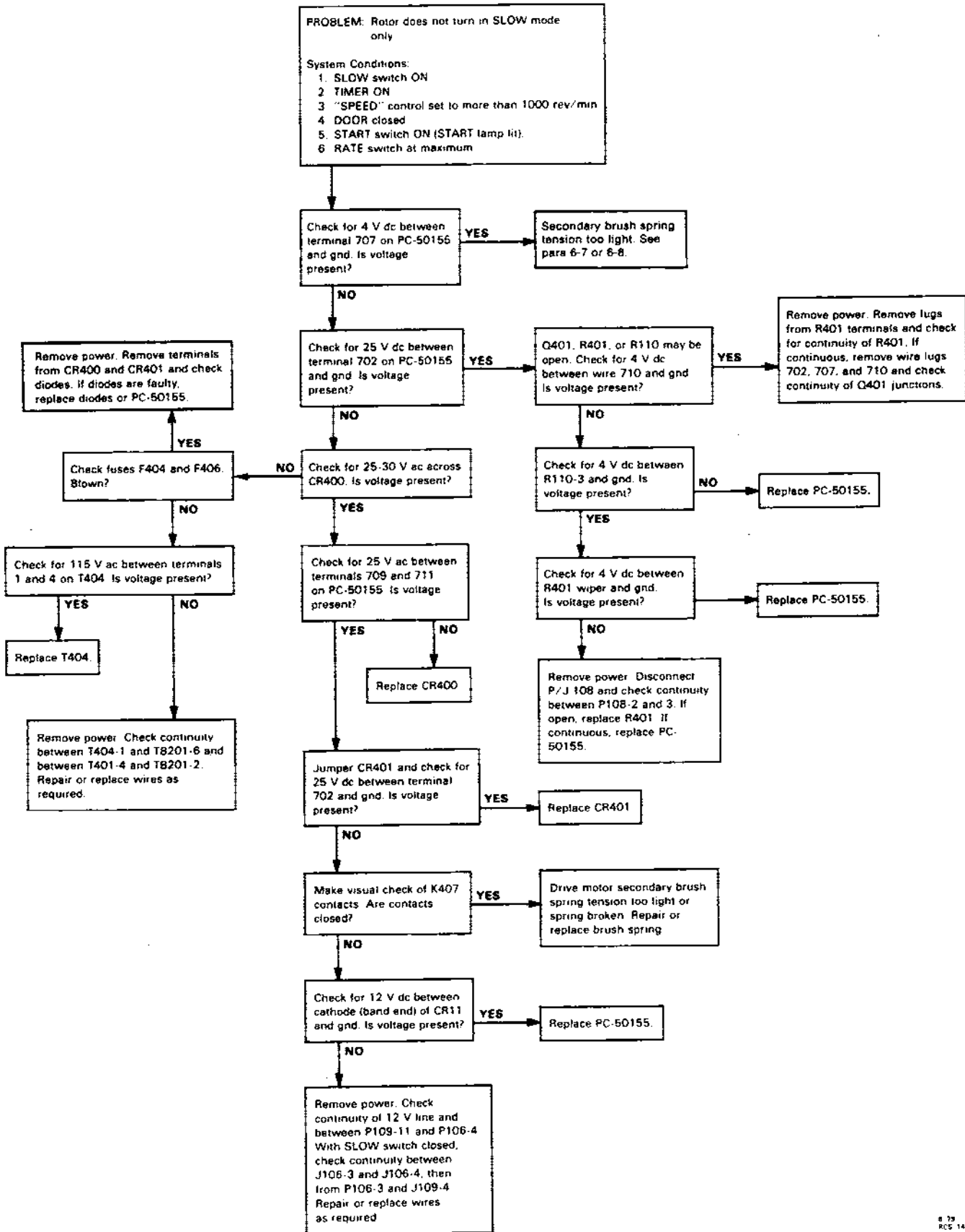
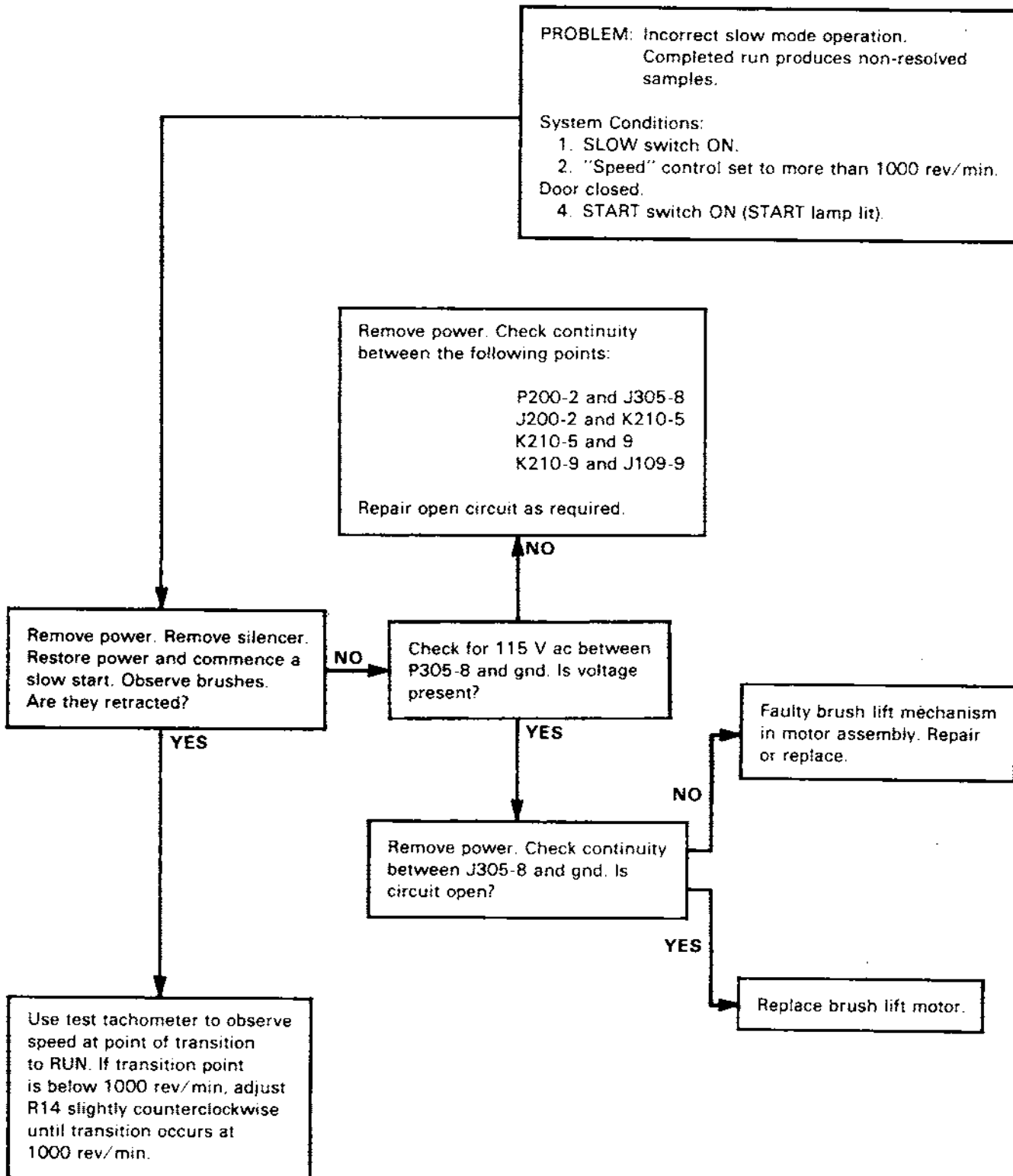
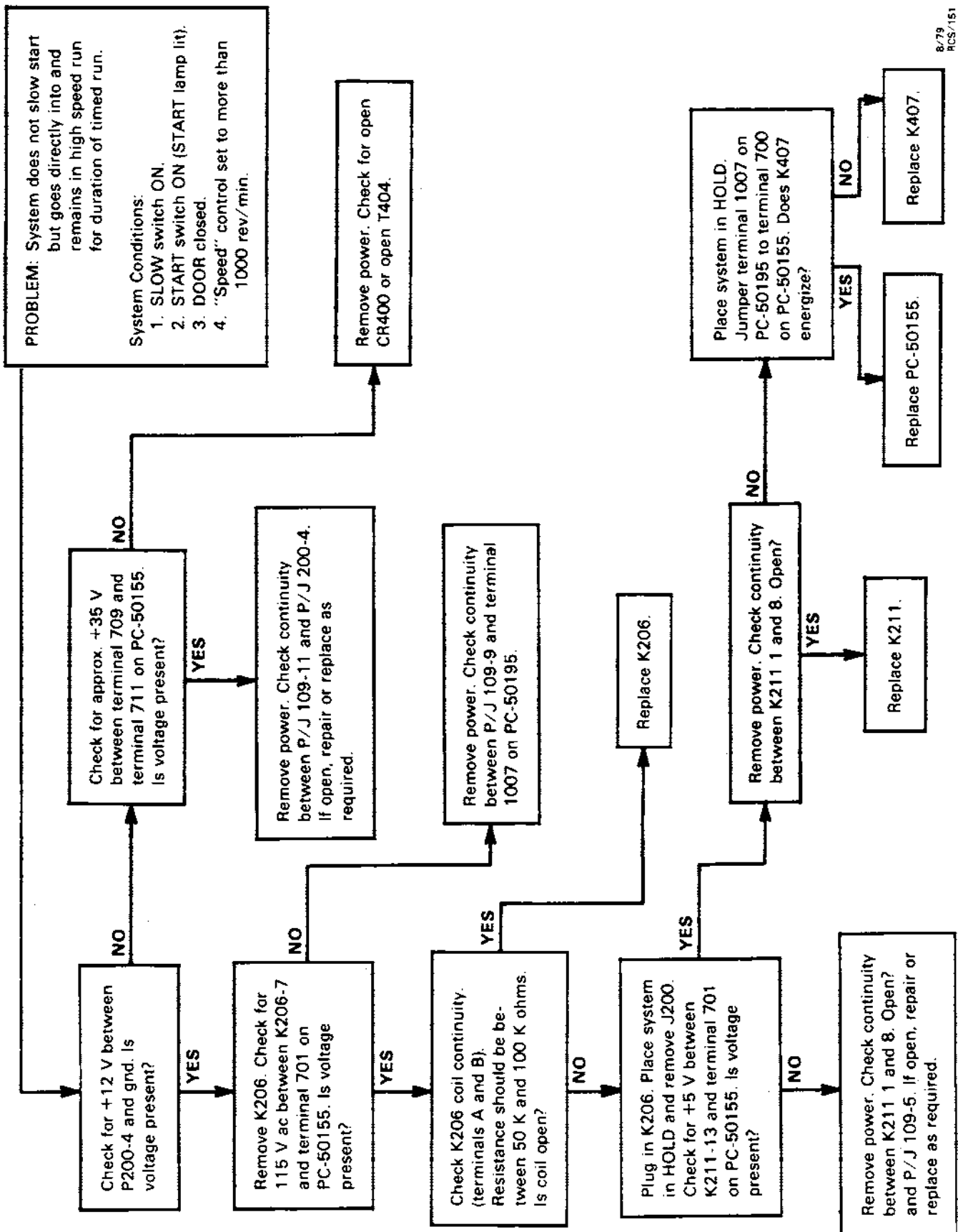


Table 4-10. Troubleshooting Chart, Automatic Rate Controller Sheet 2 of 4



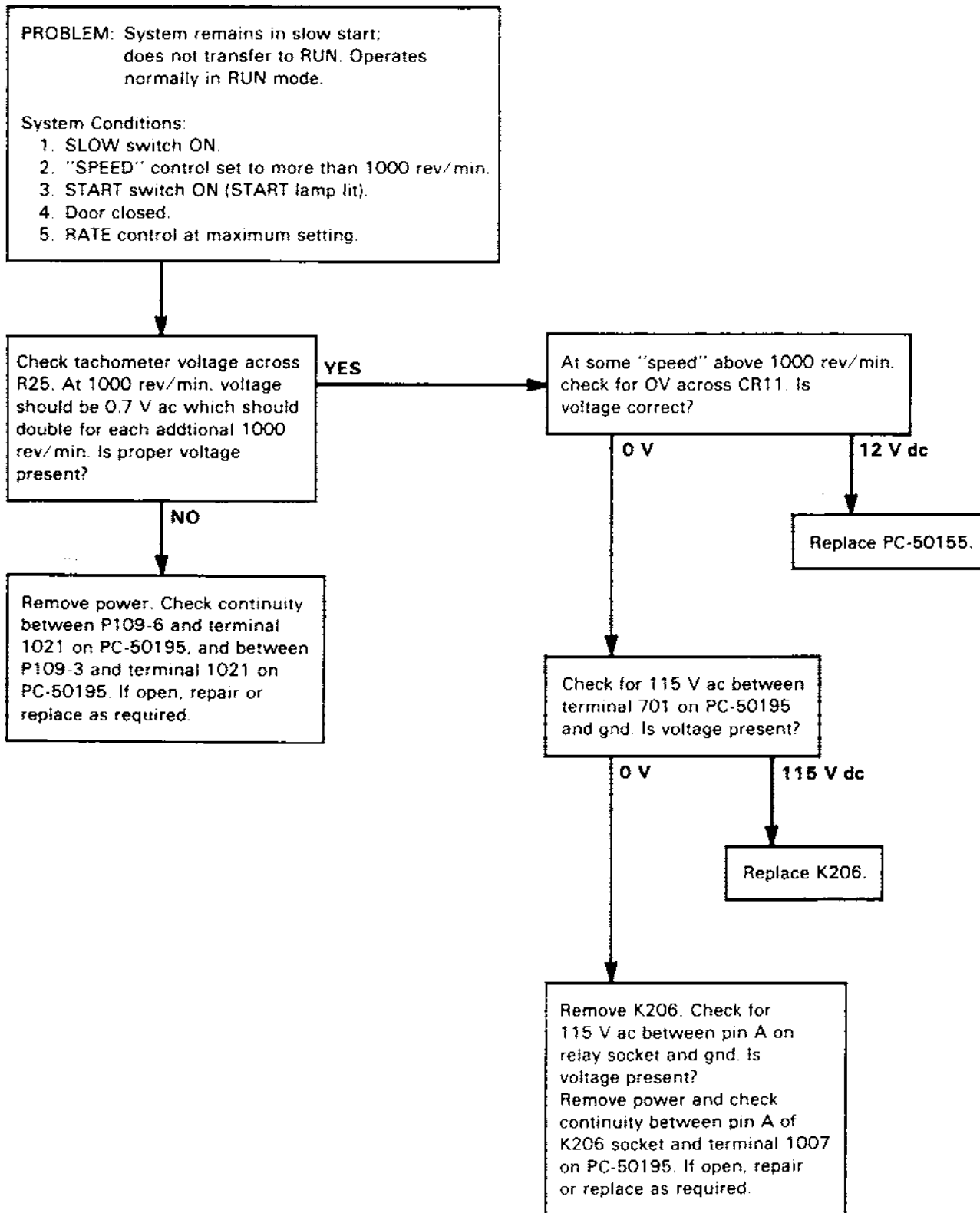
B-79
RCS 150

Table 4-10. Troubleshooting Chart, Automatic Rate Controller Sheet 3 of 4



8/79
RCS/151

Table 4-10. Troubleshooting Chart, Automatic Rate Controller Sheet 4 of 4



P.C. board No. 50155 provides the logic circuitry that controls relay K407. The incoming signal from the tachometer generator is processed by comparator Z2 and associated circuitry to generate a dc signal having a level that is proportional to the actual rpm of the drive motor. This signal is compared against a threshold level in comparator Z1, set by potentiometer R14. The threshold level voltage is set for 900 rpm during acceleration and 700 rpm during deceleration. The output of operational amplifier Z3 drives transistor Q1, causing it to switch ON and OFF. This switching controls relay K210 which controls delay relay K206, which, in turn, controls the switching of transfer relay K407. Comparator Z1 responds to setting of potentiometer R110, that modulates the drive motor power through relay K407.

4-10. Door Interlock Circuit

Door solenoid L301 is located beneath the top deck cover opposite the door handle. Under normal operating conditions, the door interlock circuit allows the door to be opened only when the rotor is spinning, the main circuit breaker is closed and power is applied to the centrifuge.

The plunger of L301 is normally fully extended and functions as a locking bolt that locks the door when it is properly closed. When solenoid L301 is energized, the plunger is retracted and the door is unlocked, then spring tension causes the door to pop upward. In the RC-5, when the centrifuge is in the HOLD mode and the drive motor speed is at zero rpm, 28 Vac from T201 is applied to bridge rectifier CR203. Rectifier CR203 sends a pulsating 28 Vdc across the closed contacts 11-1 of relay K1 to be filtered at capacitor C205, then energizes the coil of solenoid L301 and light door indicator DS108. In the RUN mode, when the drive motor speed becomes greater than 100 rpm, relay K1 is deenergized, causing the 28 Vdc from the bridge rectifier to be removed from the coil of door solenoid L301, which becomes deenergized.

When door solenoid L301 is deenergized, the spring-loaded solenoid plunger is retracted and outward, locking the centrifuge chamber door and causing the DOOR indicator lamp DS108 to be extinguished.

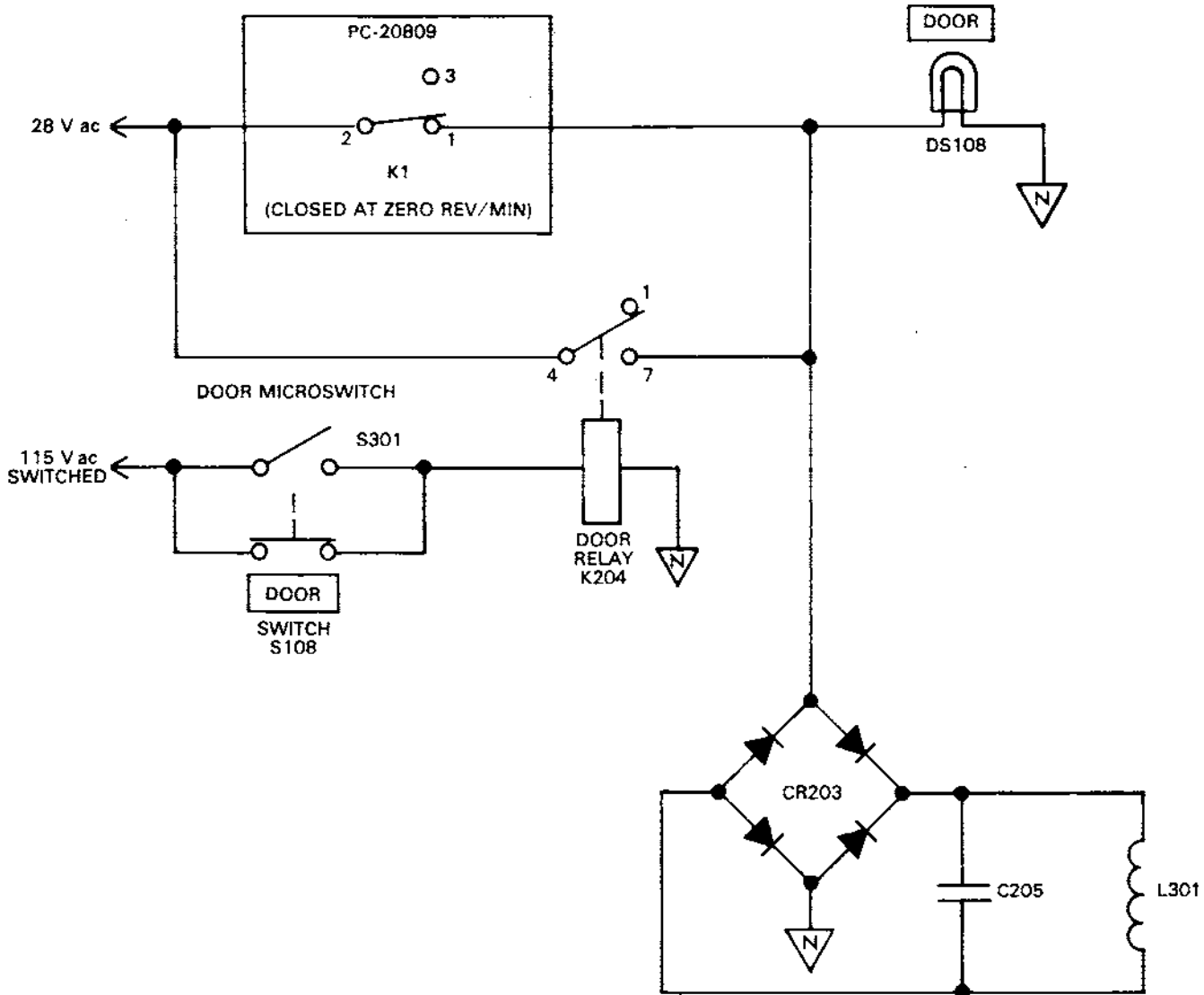
The door may be opened by pressing S108A DOOR switch, a momentary switch. Switch S108 momentarily energizes K204, door relay, which will allow 28 Vac from transformer T201 to pass across contacts 4-7 to bridge rectifier CR203 which sends a pulsating 28 Vdc to be filtered at C205, then energizes the coil of door solenoid L301 and light DOOR indicator lamp DS108.

When door solenoid L301 is energized, the spring-loaded solenoid plunger is retracted and the centrifuge door is unlocked.

When the centrifuge door is opened, the door microswitch S301 closes, applying 115 Vac on the coil of door relay K204, causing it to remain energized. The DOOR indicator DS108 lights and the spring-loaded solenoid plunger is retracted.

NOTE

If momentary door switch S108A is pressed and held for 2-3 seconds, the circuit is locked out as a safety feature to protect the door relay.



7/79
RCS/39

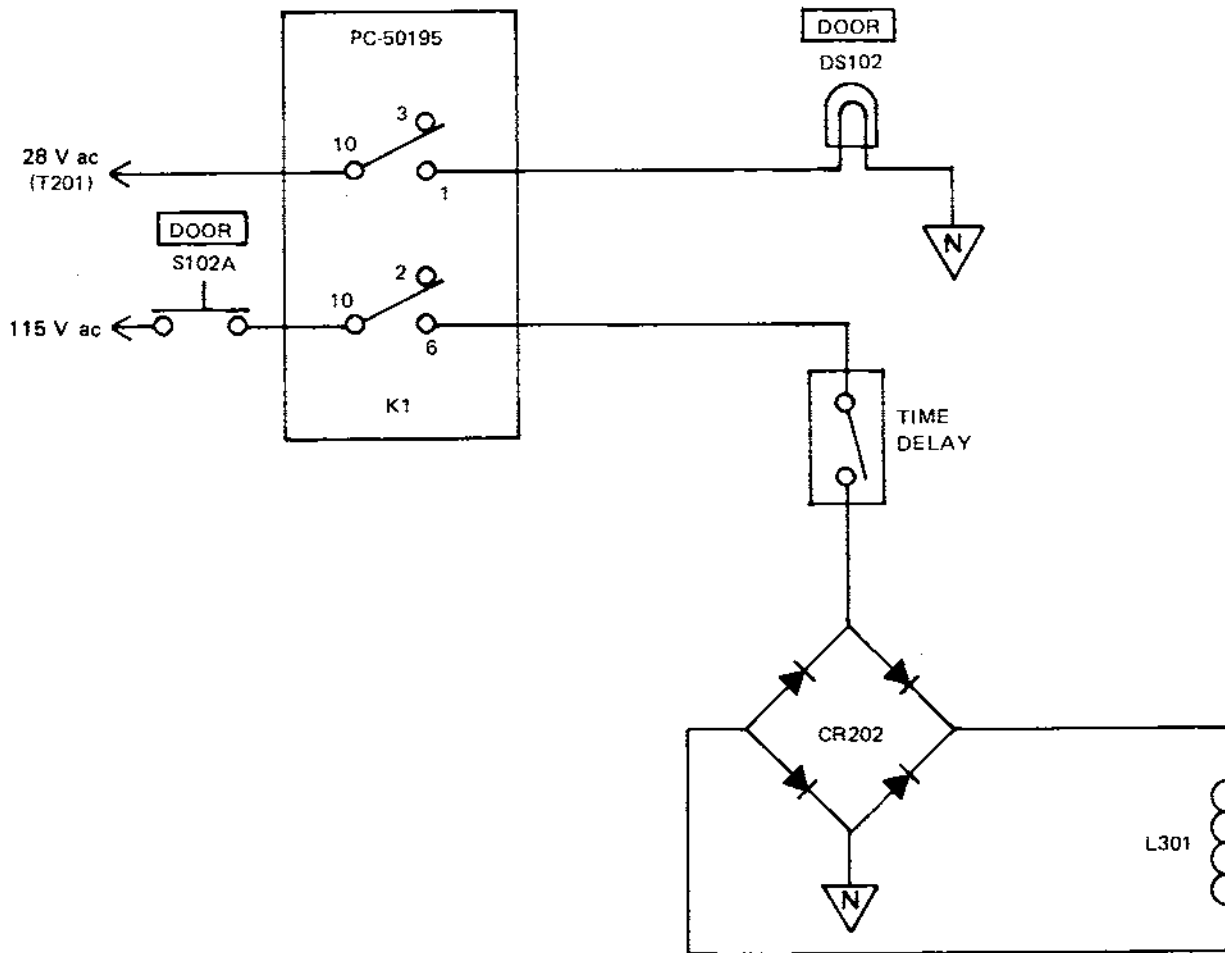
Figure 4-10. Door Interlock Circuit, RC-5, Simplified Schematic Diagram

If power is lost when the door is closed, the door will remain in a locked position. To open the door under emergency conditions, the cabinet front panel must be removed, then the red metal rod located above the main circuit breaker must be pushed while simultaneously lifting the door handle.

On the RC-5B, 115 Vac from transformer T201 is applied to bridge rectifier CR202, through door switch SW108A, then across contacts 11-1 of relay K1.

Relay K1 is energized when the drive motor speed is below 100 rpm. Under such conditions, the door switch must always be pressed to open and close the door.

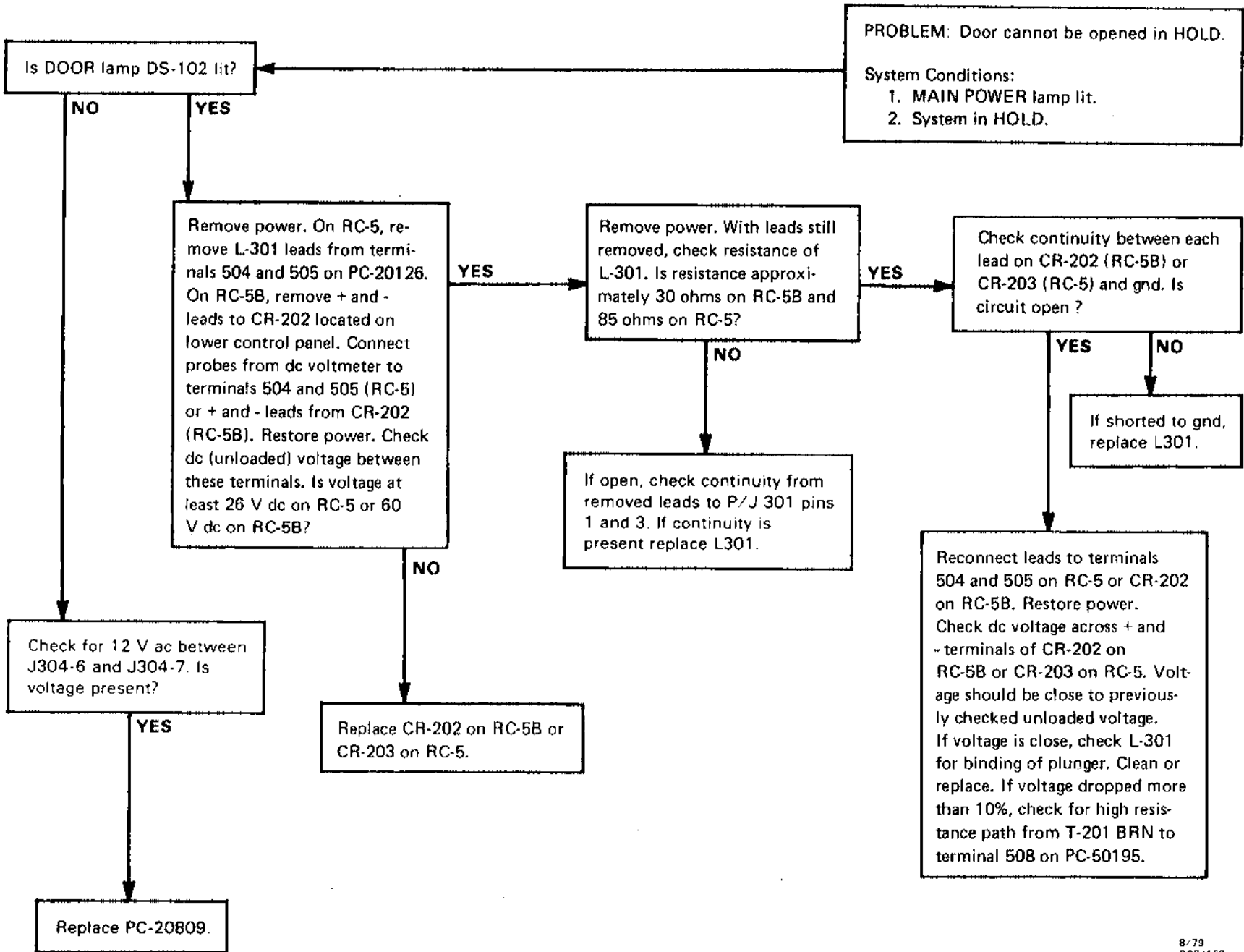
At drive motor speed above 100 rpm, and in the event of a power failure, the door can only be opened by pressing the safety interlock release rod located in the front of the centrifuge beneath the top deck, accessible when the front panel is removed. Drive motor speeds below 100 rpm are indicated by the DOOR indicator DS108, which is energized by 28 Vac from T201 through contacts 11-1 of relay K1.



7-79
RCS/40

Figure 4-11. Door Interlock Circuit, RC-5B,
Simplified Schematic Diagram

Table 4-11. Troubleshooting Chart, Door Interlock Circuits



8/79
RCS/153

Section 5 REFRIGERATION SYSTEM

5-1. General

This section covers the theory and operation of the refrigeration systems of the RC-5 and RC-5B centrifuges. Included are illustrations and troubleshooting charts to aid maintenance personnel when servicing this equipment.

5-2. Refrigeration Cycle

Figure 5-1 is a schematic diagram of the fluid circuit of the refrigeration system.

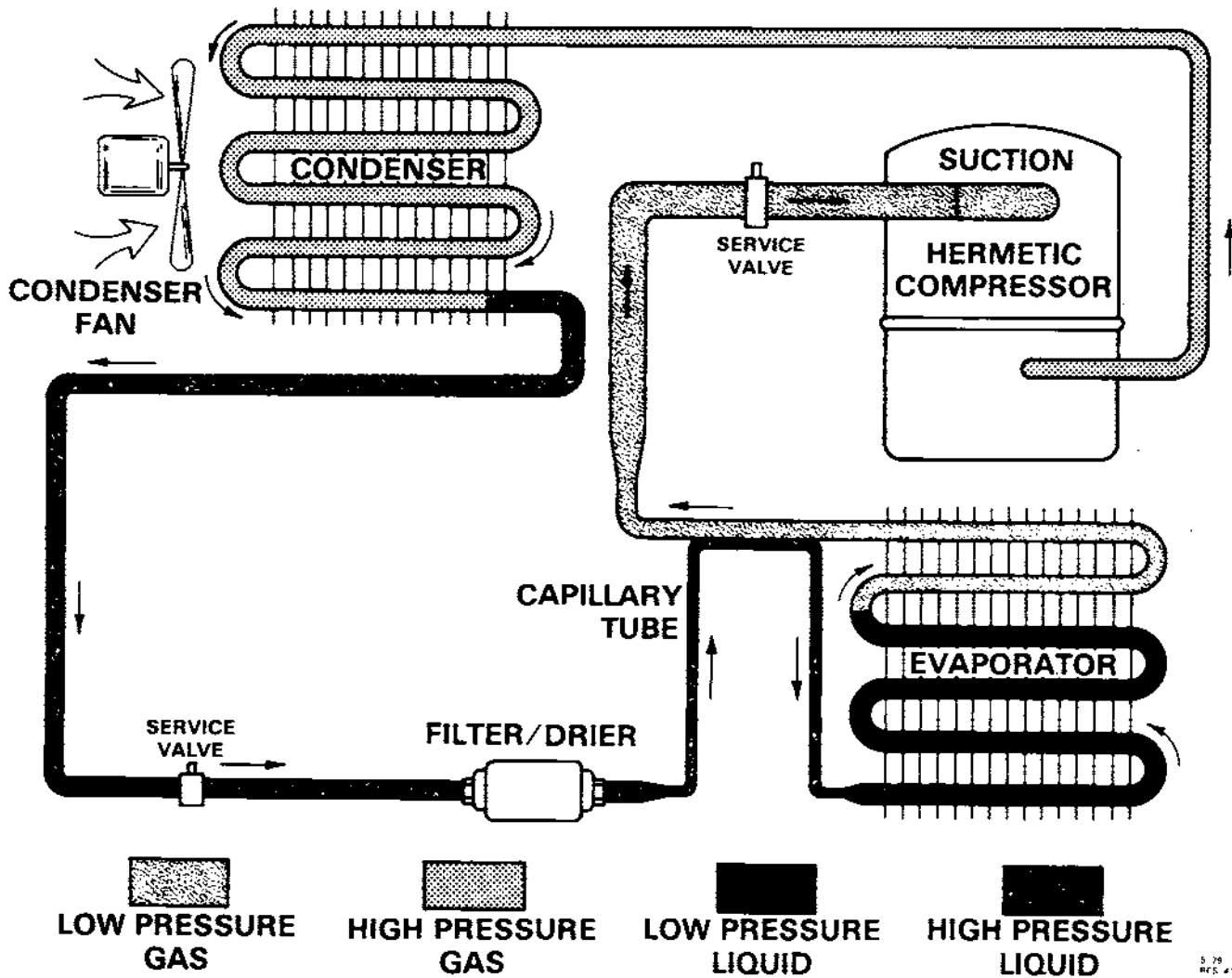


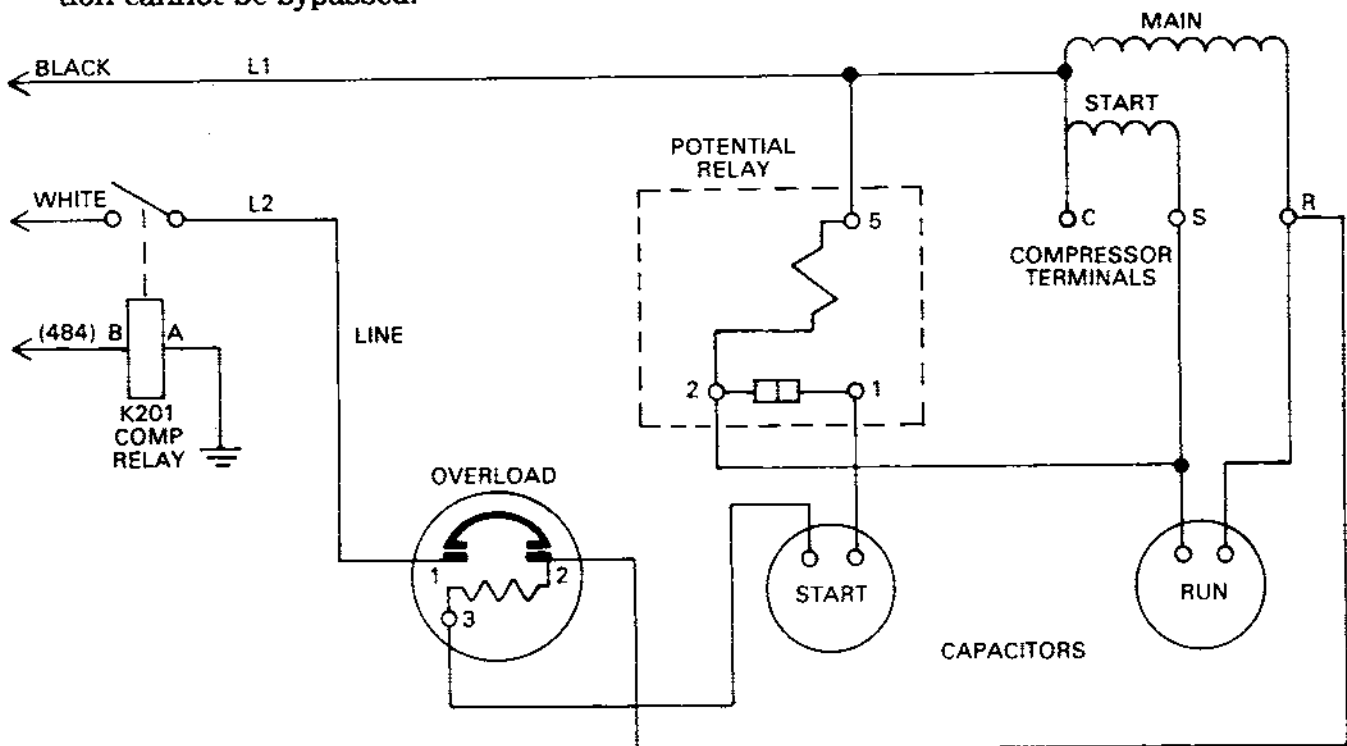
Figure 5-1. Fluid Circuit of Refrigeration System

The compressor is the main component of this circuit; it pumps refrigerant through the refrigerated system in the direction of the arrows. The capillary tube provides a restriction of the fluid flow, resulting in a considerable pressure drop across the length of the tube. Fluid pressure is high between the output of the compressor and the input to the capillary tube; fluid pressure is low between the output of the capillary tube and the suction port of the compressor. Hereafter, the compressor output side will be referred to as the high pressure side and the suction port side will be referred to as the low pressure side.

As fluid passes through the condenser, heat is released into the atmosphere from the cooling air which the fan forces through the cooling fins around the tubing of the condenser. The fluid, being at a high pressure in this part of the circuit, changes from a gas into a liquid. The filter/dryer cartridge absorbs foreign particles and water that may enter the subsystem and reduce the refrigeration efficiency.

5-3. Condensing Unit Electrical Circuit

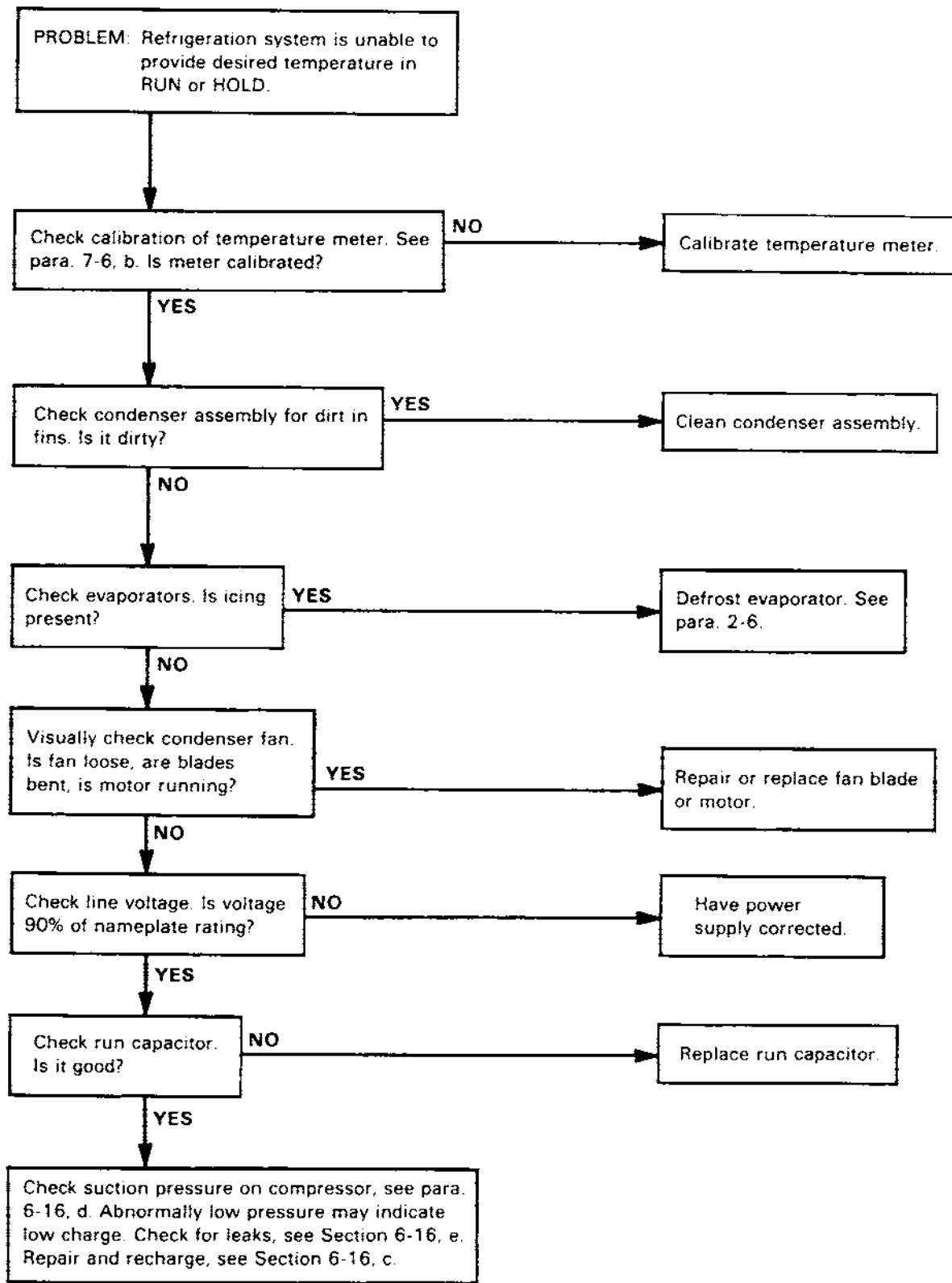
Figure 5-2 shows the electrical circuit of the condensing unit, with the compressor and fan motors at a position of rest. When the temperature control circuit signals the refrigeration cycle to start, compressor relay K201 is energized and 230 Vac flows across contacts 2-1 and is applied to the input of the condensing unit, hermetic compression motor, which is capacitor START and capacitor RUN (CSR). The START and RUN capacitors are connected in parallel with each other but are in series with the motor START windings. The potential relay disconnects the START capacitor from the circuit when the motor has reached normal RUN speed. An internal line break overload protects the compressor motor windings from excessive current draw or heat. This internal protection cannot be bypassed.



7 79
RCS 42

Figure 5-2. RC-5 High Torque Motors – 3 Terminal Overload – Potential Relay

Table 5-1. Troubleshooting Chart, Refrigeration Circuits



NOTE

K203 is found on some of the old RC-5 centrifuges and is bypassed in a new modification.

The condenser fan motor is not equipped with external components to increase starting torque.

When the compressor motor is operating, exciter currents in the RUN and START windings are considerably out of phase due to the capacitive reactance of START capacitor C_s and RUN capacitor C_r connected in parallel with relay Kp (deenergized).

Exciter currents in the START windings lead the currents in the RUN windings, producing a high motor starting torque. When the motor speed increases sufficiently, a counter voltage induced in the START windings will energize potential relay Kp. START capacitor C_s is then disconnected from the circuit by relay Kp.

A phase angle decrease is caused by the capacitive reactance of RUN capacitor C_r when the compressor motor is at normal running speed. Current in the RUN winding lags the line voltage in phase.

The potential relay coil is wired across the start winding of the compressor motor and senses voltage changes across the winding when the START winding voltage increases with motor speed. As the voltage increases to the relay pickup value, the relay armature pulls up, opening the relay contacts and deenergizing the START winding. After this switching function, there is sufficient voltage induced in the START winding to hold the relay coil energized and the relay contacts open.

5-4. Refrigeration Control

The compressor circuit permits the compressor and condensing fan to run simultaneously in the HOLD mode for a maximum of 15 seconds ON and 2 minutes OFF until the temperature reaches the red pointer on the temperature indicator. At that point, both the compressor motor and the condensing fan will simultaneously stop operating for a minimum of 2 minutes and will only restart to regain the desired temperature. In the RUN mode, the circuit permits the condensing fan to run continuously. The compressor will run only until the temperature indicated by the blue set pointer is attained on the temperature indicator. Then the compressor will stop operating for a minimum of 40 seconds and will not cycle ON until it receives a signal for additional cooling.

In the HOLD mode, the motor drive enable circuit is open, and the condensing fan relay K203 has not been energized. When K203 is deenergized, the 230 Vac which powers the condensing fan motor finds a path through compressor relay K201, across contacts 2-1. Since K201 is only energized at a minimum of 2 minute intervals, the compressor and condensing fan will operate during that 2 minute interval.

In the RUN mode, relay K203 is energized and the path to the condenser fan motor is no longer through K201. Relay K201 is now only energized for a minimum of 40-second intervals. Therefore, the compressor cycles ON and OFF as required, but the condensing fan operates continuously.

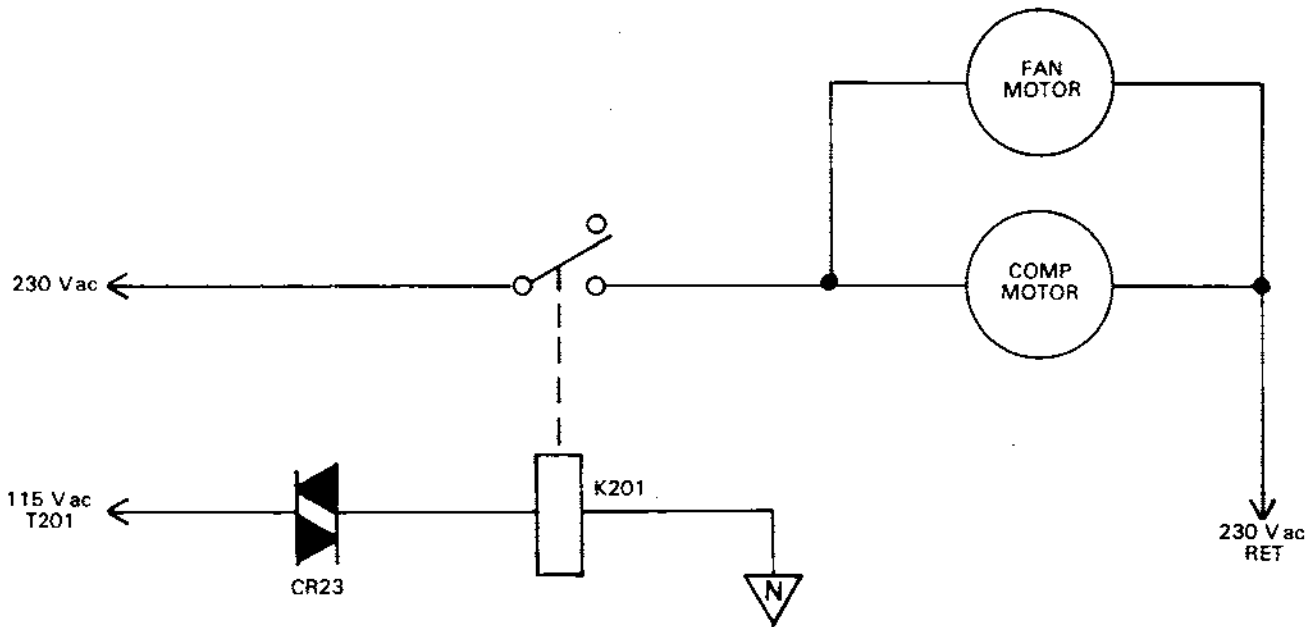
7/79
RCS/43

Figure 5-3. Refrigeration Electrical Circuit,
Simplified Schematic Diagram (RC-5B)

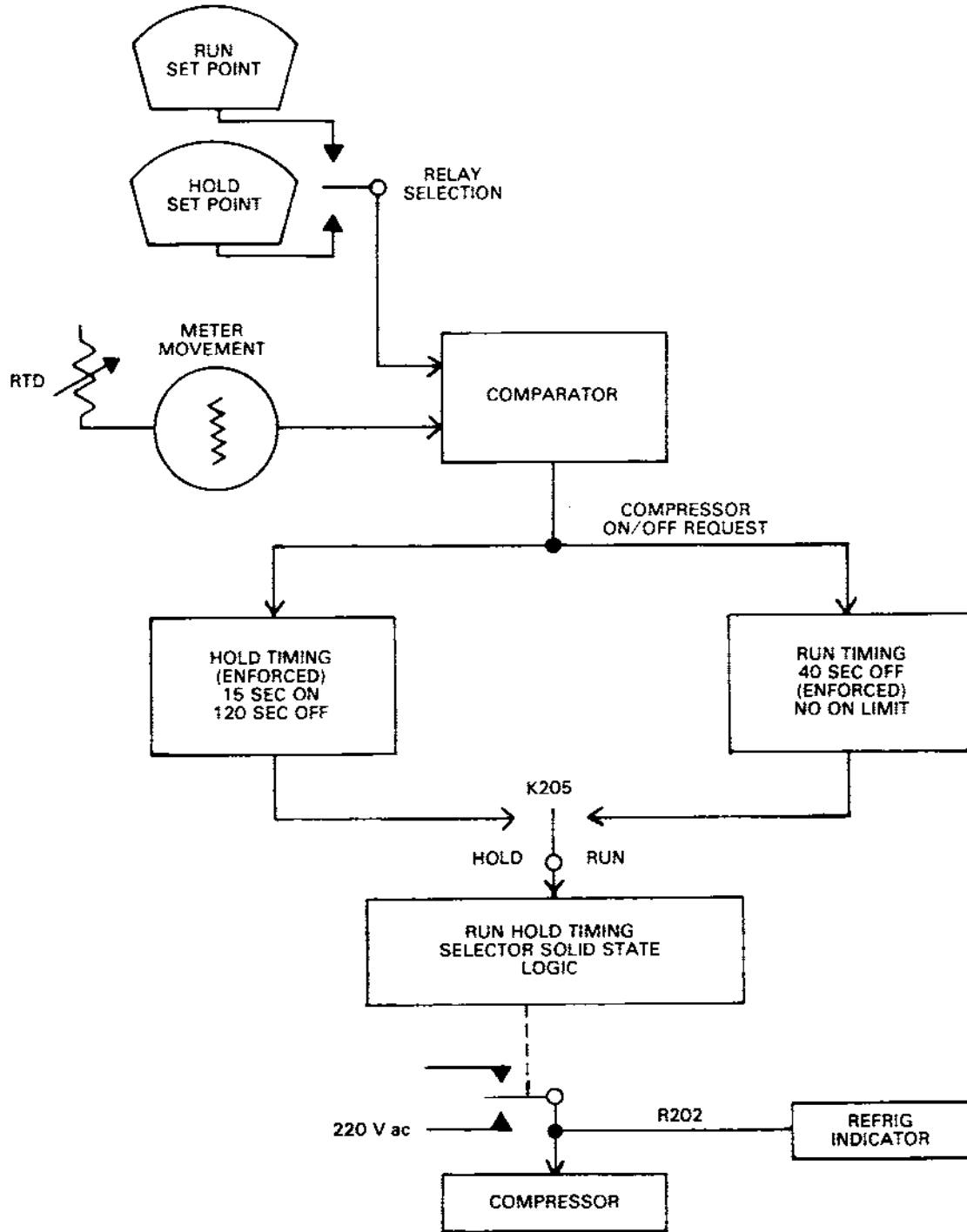
5-5. Temperature Control Circuit

The temperature control circuit consists of a resistance temperature detector (RTD), a temperature meter assembly M102, and associated circuitry. The RTD, which is a temperature sensitive resistor, is located in the rotor chamber and is connected to one leg of a resistance bridge circuit. The bridge is balanced at a minimum temperature so that zero current flows through the meter. As chamber temperature rises, the RTD resistance increases and unbalances the bridge, forcing current through the meter coil. The black meter pointer moves upscale, indicating increasing temperature.

Two front panel knobs adjust the position of two additional pointers — the blue pointer for setting the RUN mode temperature and the red pointer for setting the HOLD mode temperature. Attached to the lower end of each of these pointers are a pair of miniature photocells. Attached to the lower end of the black pointer is an arc shaped attachment designed to block the photocell when the black pointer approaches either the blue or red pointer, and provide a signal to the temperature control circuit.

Supply voltage for the red pointer photocell is provided by the +5 Vdc temperature control power supply through variable resistor R42. As the centrifuge warms up, the black pointer will block the corresponding photocell, increasing its resistance in the circuit, and provide a signal to activate the refrigeration circuit.

Supply voltage for the blue set pointer photocell is also provided by the temperature control power supply, applied through variable resistor R43. As the centrifuge warms up, the black pointer will unblock the corresponding photocell, reducing its resistance in the circuit, and provide a signal to activate the refrigeration system.



7/79
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Figure 5-4. Temperature Control Circuit, Block Diagram

The selection between the red and blue set points is made by the RUN-HOLD relay K205 and relays K2 and K3. Relay K205 and K2 are energized when the centrifuge is in the RUN mode, and refrigeration is controlled by the blue pointer. K205 is unenergized and K3 is energized when the centrifuge is in the HOLD mode, and refrigeration is controlled by the red pointer.

The refrigeration signal is applied to the differential amplifier and compared against a reference voltage. When the refrigeration signal is higher than the reference voltage, K5

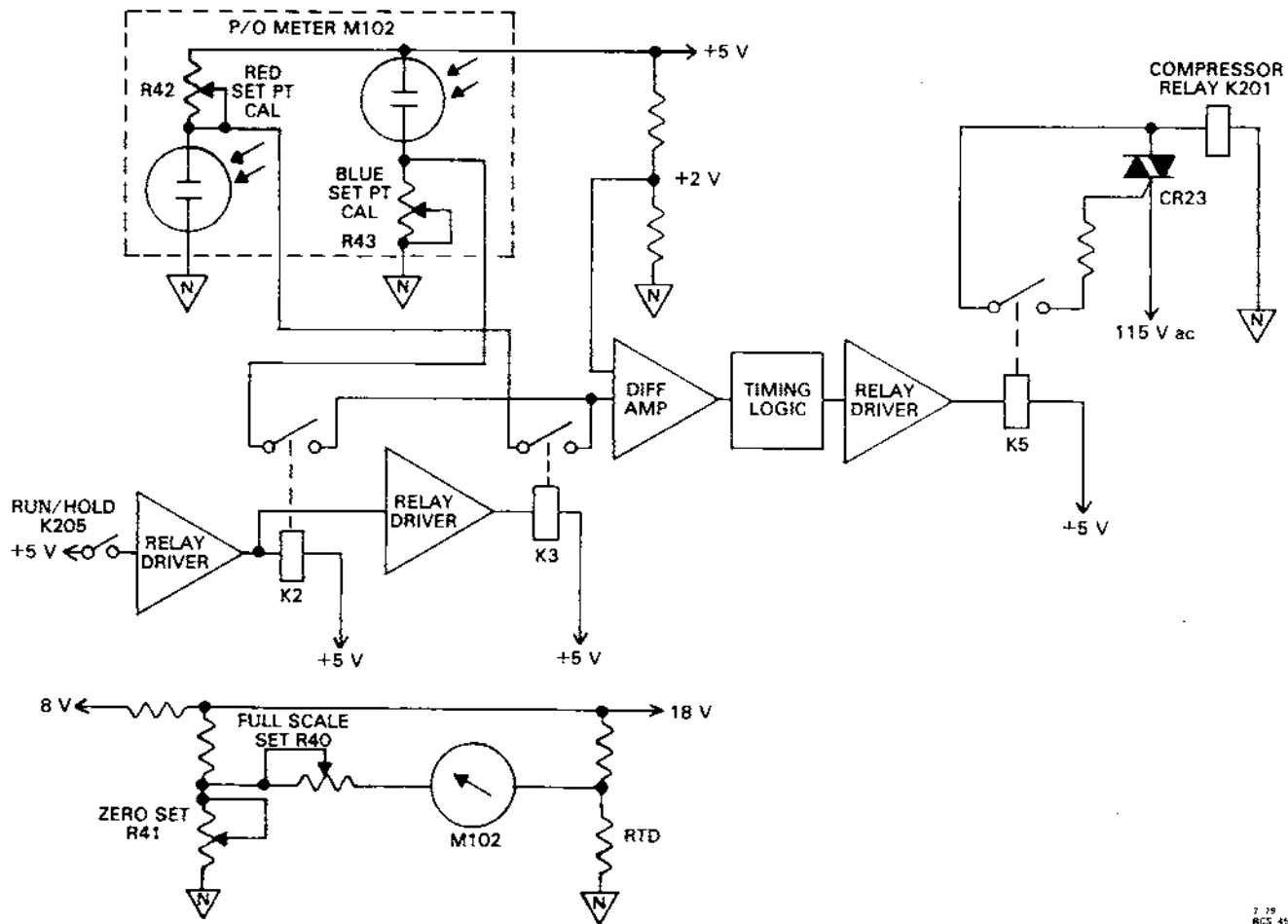


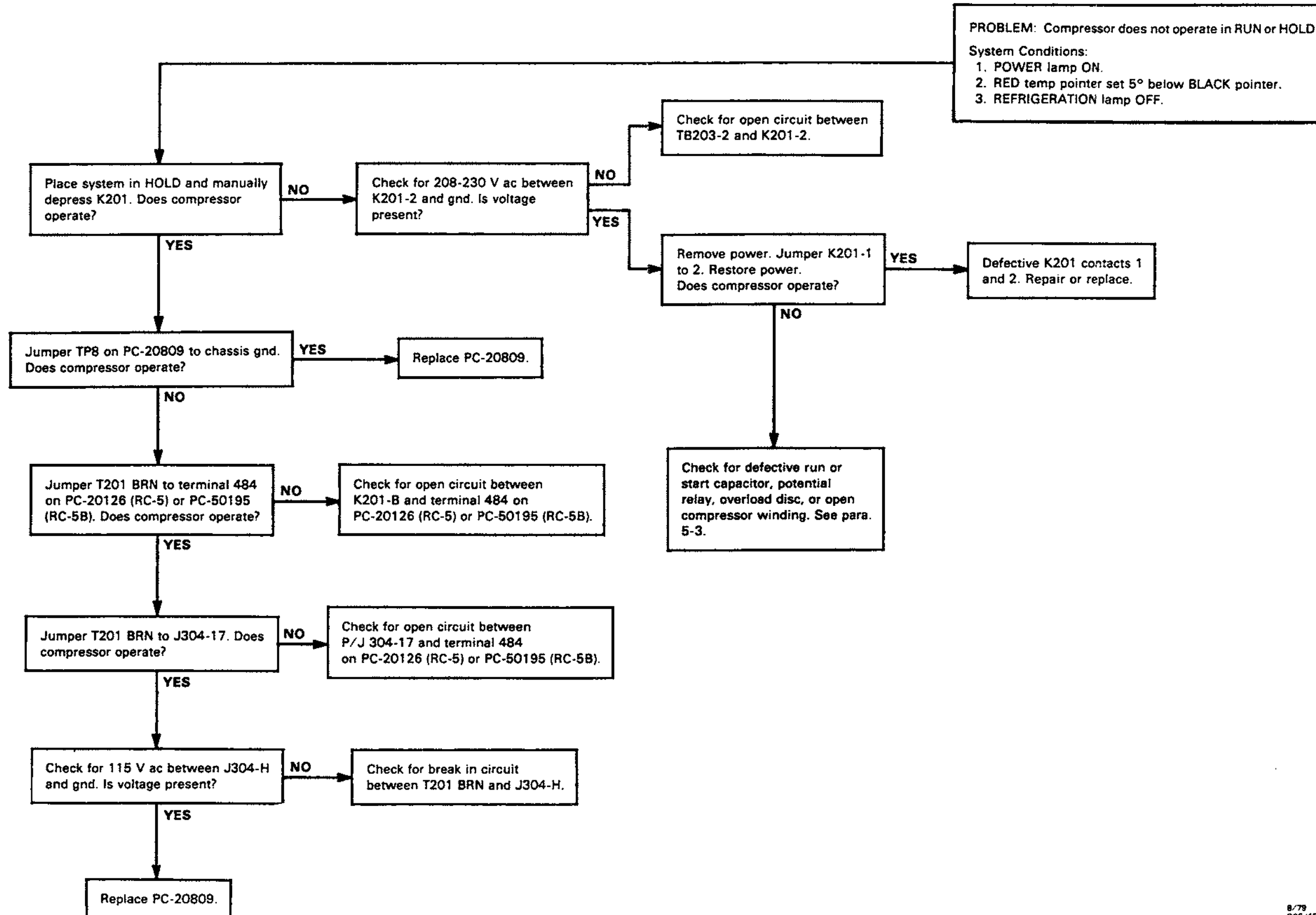
Figure 5-5. Temperature Control Circuit, Simplified Schematic Diagram

is energized, which in turn forces triac switch CR23 to conduct. This closes the circuit and energizes compressor relay K201, starting the refrigeration system operating.

Timing logic in the circuit also provides the following timing function: in the RUN mode, the compressor remains ON until the black pointer is directly aligned with the blue pointer. At this point, the compressor is forced to be OFF for a minimum of 40 seconds. After the 40-second OFF time interval, if the black pointer is aligned directly above the blue set pointer, the compressor will again be turned ON.

In the HOLD mode, the maximum operating time for the compressor is 15 seconds and the enforced OFF time is 120 seconds. After 120 seconds, if the black pointer is aligned with the red set pointer, another 15-second ON — 120-second OFF cycle will occur. These cycles will be repeated until the black pointer is no longer directly aligned with the red set pointer.

Table 5-2. Troubleshooting Chart, Compressor and Temperature Control Circuits



5-6. Overtemperature Detection Circuit

The overtemperature detection circuit consists of a differential amplifier and a relay driver. It functions to force the system out of the RUN mode and into the HOLD mode in the event a malfunction occurs. The temperature control circuit allows the temperature to rise 3°C above the red temperature set pointer.

When the chamber temperature becomes the same as that indicated by the red set pointer, the photocell is blocked and its resistance goes high. The overtemperature potentiometer R58 is calibrated to cause the differential amplifier to drive the relay driver Q20 into saturation when there is a 3°C temperature differential between the black pointer and the red pointer. Relay K4 is then energized, which causes triac switch CR20 to open. This deenergizes the coil of the RUN-HOLD relay K205 forcing the system to switch into the HOLD mode.

The compressor operation is similar to that of the HOLD mode, with one exception: the temperature control is programmed through the normally closed contacts 5-8 of relay K205 to operate from the blue pointer on the temperature indicator. The compressor and motor is a hermetically sealed unit equipped with an, internal thermal line break overload protection that cannot be bypassed. This relay disconnects the START and RUN windings in the event of excessive motor temperature resulting from high current draw.

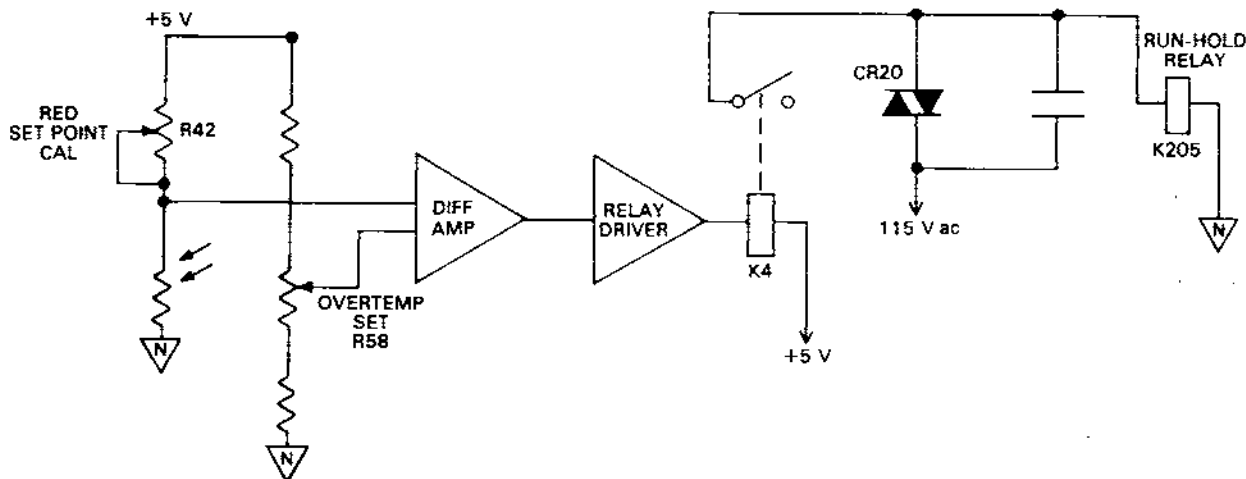
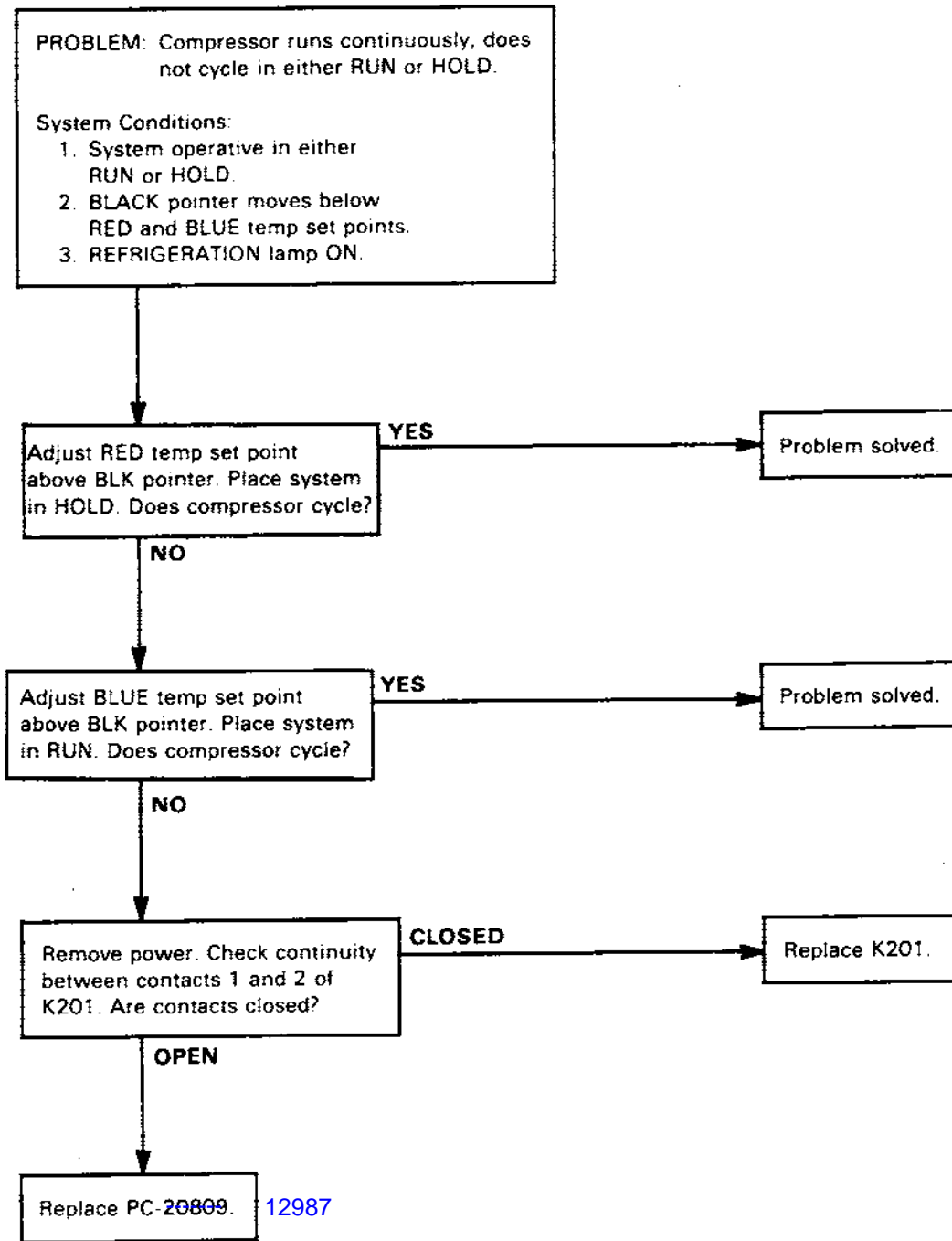


Figure 5-6. Overtemperature Detection Circuit,
Simplified Block Diagram

Table 5-3. Troubleshooting Chart, Temperature Control Circuits



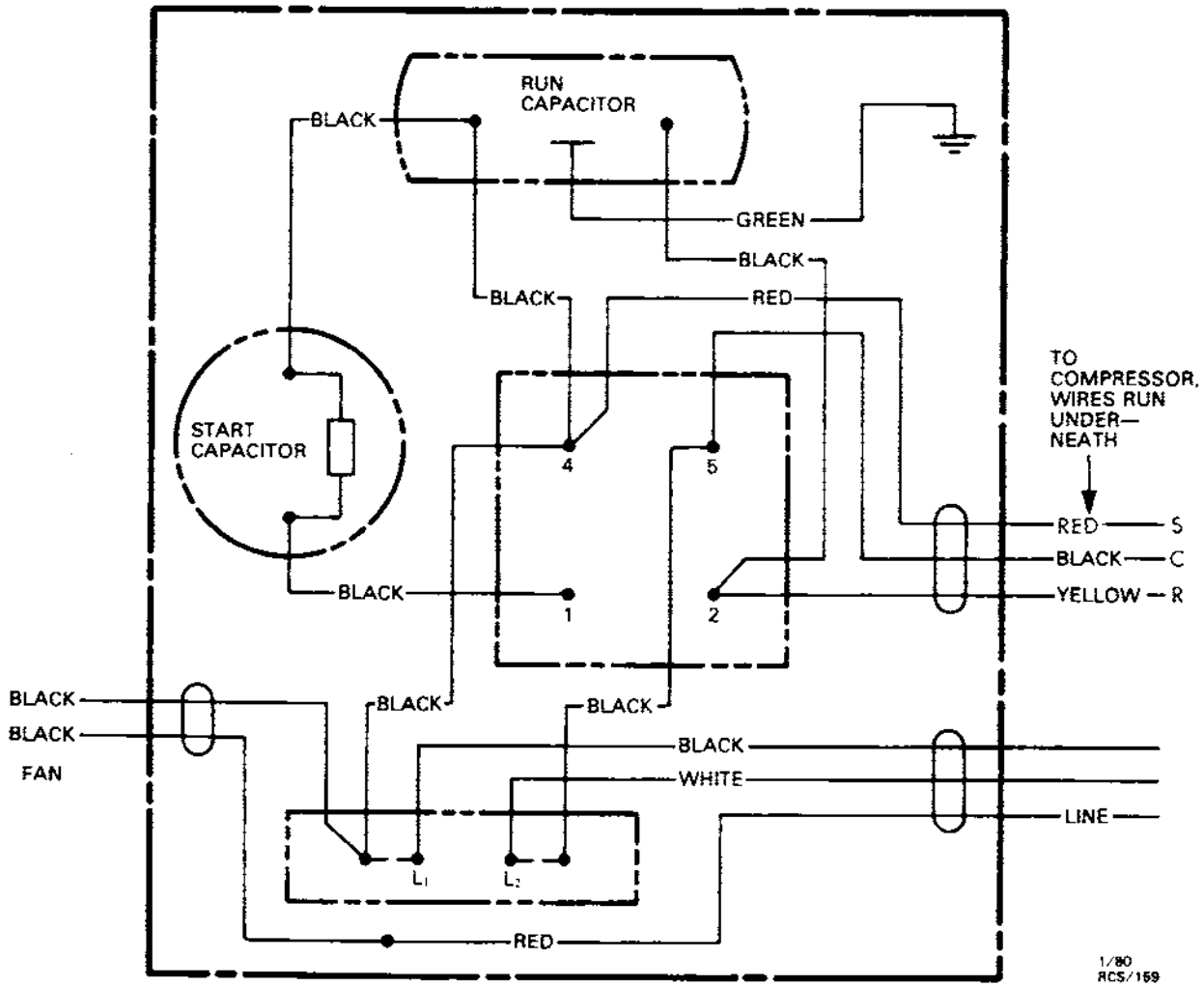


Figure 5-7. Capacitor Box Wiring Diagram

Section 6

MAINTENANCE AND REPAIR

6-1. General

This section provides information necessary to perform maintenance checks and general repairs of systems or parts that may become inoperable. It is important to both the client and the company that preventive maintenance checks be performed whenever possible, to detect minor problems before they develop into major repairs. Schematic wiring diagrams in Section 3 provide an aid for the proper wiring of replacement parts, and adjustment procedures, where applicable. Refer to Figures 8-1 through 8-24 for location of component parts.

6-2. Preventive Maintenance Checks

To ensure maximum performance of the centrifuge, the following systems should be checked on a periodic basis.

NOTE

The following special tools are required: (1) ammeter: Triplet clamp-on type No. 10 or equivalent; (2) refrigerant pressure indicator: Imperial System Analyzer or equivalent; and (3) a portable tachometer.

a. Checks With Power OFF

1. Set main power switch to OFF.
2. Unplug the main power cord from socket.
3. Remove cover seal in the base of the centrifuge chamber.
4. Remove insulation disc.
5. Turn gyro by hand (right to left) and listen for worn bearing noises or loose fittings.
6. Remove gyro assembly, then turn the lower coupling by hand (right to left) and listen for worn bearing noises in the drive motor armature.
7. Visually check the brush wear on the drive motor armature commutator.
8. Perform repairs as required.
9. Vacuum dust from all operating parts of the centrifuge.

INSTRUCTIONS

for the
RC-5B / RC-5C Preventative Maintenance Kit
(Kit Catalog No. 12010)

Parts Supplied:

Quan	Part Number	Description
1	12284	Motor Brush Kit 1/4"
1	74196	Motor Brush Kit 3/8"
1	50414	Gyro Cover Seal
1	50415	Gyro Insulating Disk
2	204742	Tapered Pin
4	68158	Male Standoff, 10-32
4	60012	Hex Nut, 10-32, SST
8	61652	Flat Washer, SST, #10
4	60568	Screw, Motor, #10-32
1 pkg	83187	Incandescent Lamp (package of 10)
4	60346	NUT,HEX 10-32 SST



WARNING

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Kendro Service Decontamination Policy states that a completed Decontamination Information Certificate is required before servicing.



Warning:

Because of the presence of high voltage, untrained personnel must not attempt to test, repair, or modify any electrical circuits or systems in this unit.

Instructions

RC-5B / 5C Preventative Maintenance:

This section contains procedures for the routine, preventive, and corrective maintenance of the Sorvall RC-5B and RC-5C Centrifuges. The routine and preventive maintenance procedures are performed on a scheduled basis to ensure that the centrifuge functions properly. The preventative maintenance kit part number 12010 will supply all of the parts needed to perform this preventative maintenance procedure.

Routine Maintenance:

1. Inspect the centrifuge and rotors weekly for the following:
 - a. Signs of wear, pitting and corrosion (due to caustic samples or cleaning agents).
 - b. Encrusted biological deposits.
 - c. Accumulation of dust (condenser).
 - d. Ice build up in the rotor chamber.
2. Clean, replace, or repair as required.

INSTRUCTIONS

for the
RC-5B / RC-5C Preventative Maintenance Kit
(Kit Catalog No. 12010)

Defrosting the rotor chamber:

Defrost the rotor chamber whenever ice build up in the chamber is evident.

1. Connect the power cord to a power supply.
2. Set the main circuit breaker, POWER switch, to ON.
3. Install a rotor in the rotor chamber and close rotor chamber door.
4. Set up centrifuge as follows:
 - a. Set the run temperature for 25°C and overtemperature for 30°C.
 - b. Set the run speed for 3000 RPM.
 - c. Set the centrifuge timer for 5 minutes.
 - d. Press START switch.
5. When rotor stops, open chamber door and inspect for ice. If chamber is defrosted, remove rotor and wipe dry. Remove moisture from chamber with a cloth or sponge. If the chamber is not defrosted, repeat step 5.
6. Set main circuit breaker, POWER switch, to OFF.

Rotor Inspection:

1. Inspect all rotors (including swinging bucket rotors) for corrosion and wear.
2. Inspect bucket bearing surface and rotor trunnion pins for wear. Clean and lubricate the pins and the underside surfaces of the bucket area that ride on the pins.

INSTRUCTIONS

for the
RC-5B / RC-5C Preventative Maintenance Kit
(Kit Catalog No. 12010)

Cleaning Rotor Bearing Surfaces

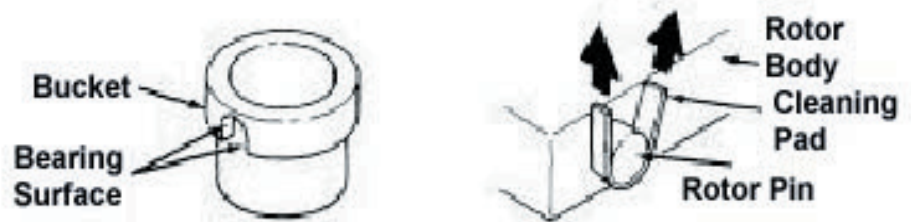


Figure 1

3. Inspect the rotor lid locking stud.
4. Clean and inspect any Sorvall® RX rotor covers. If lid does not fit on the rotor smoothly replace the pertinent components.
5. Inspect “O”-rings (if applicable).
6. Record the serial numbers of all rotors inspected and any problems relating to the rotors.

Clean the centrifuge cabinet and drive spindle:

The entire centrifuge must be kept clean. Clean the enameled cabinet panels weekly with a commercial wax based cleaning product. Clean the top deck surface and door with a household detergent and water. Use a brush to remove ground in dirt. Immediately afterwards, rinse thoroughly with water, especially if using solvent based or chlorinated cleaners for removal of difficult stains. The drive spindle must be kept clean so the rotor does not stick to it. Wipe it with a soft cloth each time before the rotor is installed, warm water may be used for cleaning when the chamber is defrosted. A clean undamaged surface is essential for proper rotor installation and removal.

INSTRUCTIONS

for the
RC-5B / RC-5C Preventative Maintenance Kit
(Kit Catalog No. 12010)

Clean the condensing fins:

Accumulation of dirt, dust, and debris on the condenser fins reduces the efficiency of the refrigeration system. The condenser fins are located on the left side on the RC-5B and RC-5C instruments. To maintain refrigeration efficiency, check for accumulation weekly and clean the condenser fins with a brush or vacuum cleaner at least once a month. The fins bend easily, use care when cleaning.

Centrifuge Environment Check:

Note:

If the ambient temperature exceeds 25°C, the centrifuge may not maintain the preset temperature during high speed runs.

The centrifuge requires adequate ventilation and proper environmental conditions to function properly. To provide adequate air circulation, the centrifuge must be located in an area that allows a 10 cm (4 inch) clearance between any wall and all sides of the centrifuge. The centrifuge operates in a temperature between 15°C and 38°C. If the inlet air temperature is above 25°C, the centrifuge may not maintain low temperatures at high speeds.

Motor and Gyro checks:

Motor and Gyro:

1. Turn the centrifuge main power OFF and disconnect the power cord from the supply outlet.
2. Using a 9/16" wrench, raise the front stabilizer feet and roll the centrifuge away from the wall.
3. Remove the front, left side, right side, and rear panels from the centrifuge.
4. Remove and discard the rubber gyro seal and gyro foam insulating ring that is located in the bottom of the centrifuge chamber.
5. Using a 9/32" Allen wrench, remove and discard the four (4) socket head screws that hold the motor / gyro in the base of the centrifuge.
6. Disconnect all of the motor wires and carefully lift the motor / gyro assembly from the Centrifuge. Lay the motor on a flat work surface.

INSTRUCTIONS

for the RC-5B / RC-5C Preventative Maintenance Kit (Kit Catalog No. 12010)

7. Remove the motor brushes and inspect the motor commutator. The commutator should be a smooth shiny copper color devoid of pits and grooves. If the commutator is damaged, replace the motor.

Centrifuge	Motor
RC-5B & RC-5C centrifuges	12991

8. With the brushes removed turn the gyro shaft by hand and check for smooth noise free rotation. If the motor shaft feels rough or makes noise disconnect the motor from the gyro and determine whether the gyro or the motor are the cause of the problem. Check the motor coupling for any deformities. If the coupling is damaged, replace it with part number 12345. If the motor bearings are damaged, replace the motor using the chart above as a guide. If the gyro is the cause of the problem, replace the gyro ordering part number 12817.
9. If the motor contains carbon brushes replace the brushes after first comparing the brushes that were removed with the new brushes that are included with the PM kit (12010). Discard the brushes that were removed from the motor.



Warning:

Only install the correct thickness brush. If the wrong brush is chosen the centrifuge may not run and the motor may be damaged.

12884	1/4" thick brush kit
74196	3/8" thick brush kit

10. Inspect the smaller brush warning spring to insure proper operation.
11. Inspect the foam ring inside the silencer assembly located under the centrifuge chamber (motor shroud). Insure that the foam ring that is located at the bottom of the upper silencer assembly is place and intact. If the foam ring is missing or damaged replace it using the foam ring kit part number 74342.
12. Using a DVM (digital volt meter) check the continuity of the ground wire on the motor assembly. The resistance from the ground pin on the motor cable to the motor frame should be less than 0.1 Ω .
13. Inspect the tapered pins on the gyro cone drive adapter. Replace any damaged pins with the new pins (204742) that are supplied with the PM kit (12010).

INSTRUCTIONS

for the
RC-5B / RC-5C Preventative Maintenance Kit
(Kit Catalog No. 12010)

14. Install the motor back into the centrifuge using the new hardware supplied with the PM kit. (50568 motor screws, 60346 split lock washers, & 61652 flat washers) Reconnect all cables from the motor into the centrifuge.
15. Install the new foam insulation (50415) and the new gyro boot (50414) that is supplied with the PM kit (12010).

Brake Assembly Checks:

Inspect the brake assembly and replace the nylon standoffs that secure the brake heat sink as needed.

1. Using a Philips screwdriver, remove the (6) screws that secure the centrifuge rear backpack assembly. Remove the backpack.
2. Remove the brake assembly from the centrifuge.
3. Inspect the nylon standoffs and replace as needed.

Note:

Some older RC-5B centrifuges will not have the brake assembly as depicted on the drawing on the right. If the centrifuge does not contain a brake assembly disregard section .

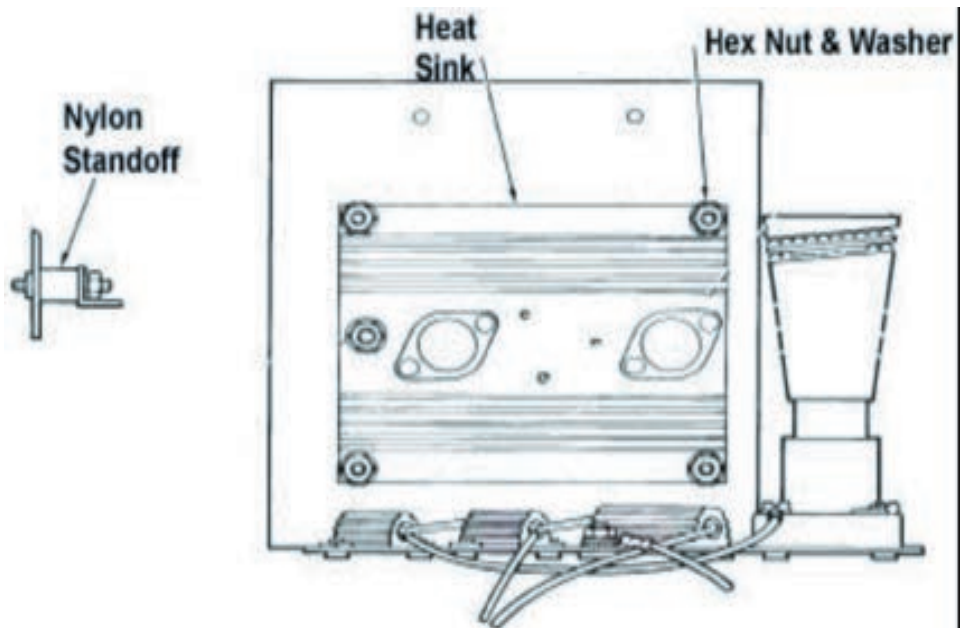


Figure 2

INSTRUCTIONS

for the
RC-5B / RC-5C Preventative Maintenance Kit
(Kit Catalog No. 12010)

Incandescent light bulb replacement RC-5B:

Replace any light bulbs that may be out on the control console.

1. Remove the plastic indicator lense cover by pulling the cover straight up from the control console (items 1 through 11 on the drawing shown in figure #2).
2. Using a small needle nose pliers pull the light bulb from the socket.
3. Replace the bulb using one of the bulbs that are supplied with the PM kit.
4. Replace the indicator lense.

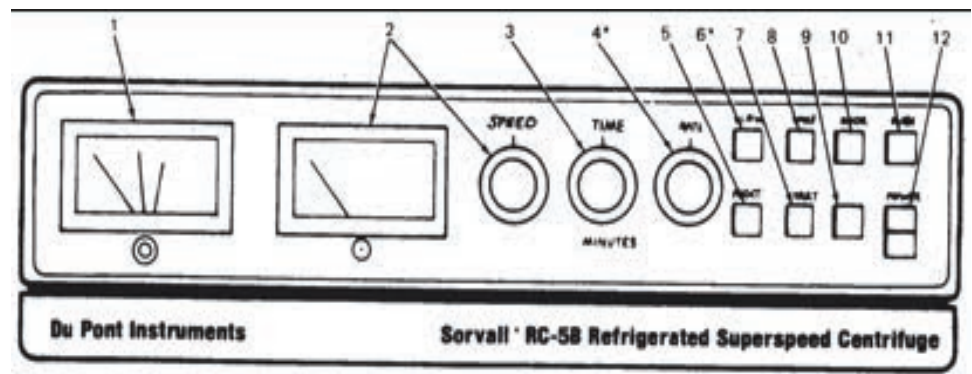


Figure 3

Incandescent light bulb replacement RC-5C:

1. Using a Philips screwdriver remove the (6) screws that hold the control panel from the control console.
2. Lay the control panel (face down) on the centrifuge deck.
3. Remove the appropriate light bulb by loosening the bulb clip using a small flat blade screwdriver. Rotate the clip 90° and remove the affected bulb. Replace the bulb with a bulb that is included with the PM Kit.
4. Rotate the clip 90° covering the bulb and tighten the clip.
5. Re-install the control panel into the console.

INSTRUCTIONS

for the
RC-5B / RC-5C Preventative Maintenance Kit
(Kit Catalog No. 12010)



Warning:

Before the centrifuge is serviced, ensure that the centrifuge and wall receptacle are checked for ground continuity. Failure to do so can result in a serious electrical shock.

Pre-run checks:

Centrifuge and wall outlet continuity check:

Check that the ground lug of the electrical plug is properly grounded and is shorted to the frame of the centrifuge. Check that the ground “lug of the outlet (wall receptacle) is properly grounded.

1. Set the main circuit breaker, POWER switch, to OFF.
2. Disconnect the power cord from the power supply.
3. Check centrifuge ground continuity as follows:
 - a. Set a DVM to the lowest resistance scale.
 - b. Attach one probe of the DVM to ground lug on the power cord.
 - c. Touch the other probe of the DVM to the chassis of the centrifuge. The meter should show less than 0.1 ohms.
4. Check wall outlet ground continuity as follows:
 - a. Set the DVM to volts ac scale.
 - b. Measure each side of the line to the ground receptacle. The voltage should be “115 Vac. If no voltage is measured, the receptacle is not properly grounded.
 - c. Measure the voltage from line to line. The voltage should match the voltage found on the centrifuge name plate (208 to 230 vac).
5. Remove the DVM and probes.

Door latch microswitch check:

1. Connect the centrifuge power cord to the mains supply.
2. Set the main circuit breaker, POWER switch, to ON.
3. Open the centrifuge door by depressing the “DOOR” button on the front control console (RC-5B) or under the right front of the centrifuge deck (RC-5C). The door should open to approximately 45°.

INSTRUCTIONS

for the
RC-5B / RC-5C Preventative Maintenance Kit
(Kit Catalog No. 12010)

4. Check that the centrifuge does not start with the chamber door open as follows:
 - a. Set up the centrifuge as follows:
 - 1) Set the temperature to 4°C.
 - 2) Set speed to 3000 RPM.
 - 3) Set the timer to 5 minutes.
 - b. Press the START switch. Insure that the centrifuge does not start .
5. Close the cenrifuge door and repeat step #4, the centrifuge should start.
6. Set the main circuit breaker, POWER switch, to OFF.
7. Lubricate the door latch by placing a few drops of oil on the locking bolt.

Electronic Checks:

Display & indicator checks RC-5B:

1. Turn the main circuit breaker, POWER switch, to ON. Watch the front control panel and make sure the correct lights function:
 - a. Power light.
 - b. Door light (zero speed)
 - c. Speed meter at 0 rpm
 - d. Temperature meter indicating the centrifuge chamber temperature (ambient).

Display & indicator checks RC-5C:

The LEDs, advisory messages, and diagnostic indicators on the front control panel should be tested daily during start up. Each LED digit has seven segments: if even one segment does not work, an incorrect reading can be displayed.

INSTRUCTIONS

for the
RC-5B / RC-5C Preventative Maintenance Kit
(Kit Catalog No. 12010)

1. Turn the main circuit breaker, POWER switch, to OFF.
2. Set the ROTOR CODE switches to 00. Disregard all other switch settings.
3. Turn the main circuit breaker, POWER switch, to ON. Watch the front control panel and make sure the displays, indicators, and advisory messages light as follows:
 - a. The number 8 should be shown in each digit space of each display.
 - b. The minus sign should light in the TEMP °C display.
 - c. All ten backlit advisory messages should light.
 - d. Diagnostic indicators 1 through 12 should light.
 - e. All other indicators should light except the RCF indicator. To test the RCF indicator, press the RCF switch.
4. If necessary, replace the LED Display Board, or replace the advisory message and diagnostic light bulbs that are supplied with the PM kit (12010).

Centrifuge Run Checks:

RC-5B:

1. Connect the power cord to the mains power supply.
2. Open the chamber door and install a SS-34 rotor (any other available rotor can be used).
3. Close the chamber door.
4. Set the centrifuge controls as follows:
 - a. Speed: 5,000 rpm
 - b. Time: Hold:
 - c. Temperature (blue set point): 4°
 - d. Over Temp (red set point): Just above black indicator.

INSTRUCTIONS

for the
RC-5B / RC-5C Preventative Maintenance Kit
(Kit Catalog No. 12010)

5. Start the centrifuge by depressing the “Start” indicator and observe the following:
 - a. Door light goes out.
 - b. The centrifuge motor starts and speed is indicated on the speed meter. and stabilizes at 5,000 rpm.
 - c. The compressor starts and after approximately 5 minutes the temperature indicator reaches the blue set point. The compressor should then shut off and restart after the temperature rises above the blue set point.
6. Check the maximum motor current and the maximum speed as follows:
 - a. Set the centrifuge speed to the maximum speed for the rotor that is being used.
 - b. As the rotor accelerates check the motor current using a clamp on ammeter. The maximum current should be 16.5 amps. If the motor current is not 16.5 ± 0.5 amps adjust the current by adjusting the torque trimming potentiometer.
 - c. After the centrifuge speed has stabilized insure that the indicated speed matches the set speed. If the speeds do not match calibrate the speed following the procedure outlined in the RC-5B Service Manual.
7. Set the centrifuge timer for 5 minutes and allow the centrifuge to stop once the timer reaches 0 minutes. The centrifuge should brake to a stop and the door light should illuminate when the rotor reaches 0 rpm.
8. Open the centrifuge door and insure that the rotor is fully stopped.

RC-5C:

1. Connect the power cord to the mains power supply.
2. Set main circuit breaker, POWER switch, to ON.

INSTRUCTIONS

for the
RC-5B / RC-5C Preventative Maintenance Kit
(Kit Catalog No. 12010)

3. Check the NO ROTOR indicator. (Diagnostic 6).
 - a. Close the chamber door.
 - b. Press the START switch.
 - c. Verify that the NO ROTOR indicator. (Diagnostic 6), lights and the centrifuge shuts off
4. Open the chamber door and install an SS-34 rotor (any other available rotor could be used).
5. Close the chamber door.
6. Set up the centrifuge as follows:
 - a. Set the TEMP °C RUN switches to 04 and TEMP °C MAX switches to 20.
 - b. Set the SPEED RPM switches to 10 000.
 - c. The TIME HRS and MIN switches have no specific setting.
 - d. Set the ROTOR CODE to 05 for an SS-34 rotor (other codes may be used to match the rotor that is used).
 - e. Set the OFF/ARC and the OFF/ $\int^2 dt$ switches to OFF.
 - f. Set the TIMED/HOLD switch to HOLD and the OFF/BRAKE switch to BRAKE.
 - g. Set the key switch to NORMAL.
 - h. Press the START switch. Record the time the START switch was pressed.
7. Verify that the HOLD advisory message lights and that at zero speed the ROTOR CODE advisory message lights and flashes for approximately 5 seconds.
8. Verify that after 5 minutes the temperature has stabilized at the preset run temperature $+1^\circ\text{C}$.
9. Check the maximum motor current and the maximum speed as follows:
 - a. After the temperature has stabilized at 4°C for 5 minutes, set the SPEED RPM switches to 20 000 or the maximum allowable speed for the rotor in use, refer to Rotor Table.

INSTRUCTIONS

for the
RC-5B / RC-5C Preventative Maintenance Kit
(Kit Catalog No. 12010)

- b. While the rotor accelerates, measure the motor current draw on the ammeter.
 - c. Verify that the maximum motor current draw on acceleration is 16.5 ± 0.5 amps. If necessary, calibrate the motor current limit.
 - d. Verify that the rotor attains the preset maximum run speed $\pm 1\%$. If necessary calibrate the top speed.
10. Verify that the compressor cycles at 4°C . If the compressor does not cycle at 4°C , check for the following conditions:

Ambient temperature above 25°C .
Low refrigerant charge.
Faulty start or run capacitor.
Air leak in door or gyro seals.
Air blockage at condenser coils.
Condenser fan non-functional.

If necessary, refer to Troubleshooting for Refrigeration System.

11. Check the accumulated run time.
- a. Refer to the time recorded in step 6. h. and calculate the accumulated run time.
 - b. Verify that the accumulated run time that is displayed equals the calculated run time in step 12.a.
12. Check the RCF indicator and value.
- a. Press the RCF switch.
 - b. Verify that the RCF indicator lights (green).
 - c. Verify that the value shown in the SPEED RPM RCF display is the correct RCF value for the rotor in use.

Note:

The ROTOR CODE switches must be set for the rotor that is in use.

13. Check the centrifuge braking time.
- a. Press the STOP switch. Record the braking time: the time from when the STOP switch is pressed until the SPEED display shows zero rpm.
 - b. Verify that the braking time is within the specified value range for the rotor and speed in use: (see rotor speed chart)

INSTRUCTIONS

for the
RC-5B / RC-5C Preventative Maintenance Kit
(Kit Catalog No. 12010)

Rotor	Maximum Speed	Critical Speed	Accel Time min : sec	Brake Time min : sec
GSA	13,000 rpm	800 rpm	8:55	4:17
GS-3	9,000 rpm	600 rpm		
SLA-3000	11,000 rpm	500 rpm	6:00	4:00
SLA-1500	14,500 rpm	750 rpm	4:00	3:00
SLA-1000	16,500 rpm	800 rpm	2:30	2:00
SA-600	16,500 rpm	950 rpm	4:00	3:00
SA-512				
SA-800				
SLA-600TC	13,000 rpm	1,100 rpm		
F-28/50	19,500 rpm	800 rpm	4:00	2:30
SS-34	20,000 rpm	1,140 rpm	2:20	2;00
SA-300	21,000 rpm	1,000 rpm	1:30	1:10
F-28/36	18,000 rpm	1,200 rpm	3:30	2:30
SM-24	20,000 rpm	1,100 rpm		
SE-12	21,000 rpm	1,100 rpm	1:00	1:00
F-28/13	19,500 rpm	1,100 rpm	3:00	2:00
F-20 Micro	20,000 rpm	1,100 rpm	2:00	1:15
SH-3000	4,350 rpm	900 rpm	2:00	1:30
SH-3000M	4,700 rpm	900 rpm	1:00	1:00
HS-4	7,000 rpm	1,000 rpm	4:30	3:30
HB-6	13,000 rpm	1,000 rpm	2:00	1:00
HB-4	13,000 rpm	1,100 rpm	2:00	1:00
S-20/36	8,000 rpm	300 rpm		
S-20/20	12,000 rpm	350 rpm		
S-20/17	8,000 rpm	350 rpm		
SH-80	20,000 rpm	1,050 rpm		
SV-288	20,000 rpm	1,500 rpm	4:30	2:00
SV-80	19,000 rpm	1,500 rpm	2:00	2:00
TZ-28	20,000 rpm			
SLC-1500				
SLC-3000				
SLC-4000				

Preventative Maintenance Checklist

Account Name:		Instrument Model:	
Account Address:		Serial Number:	
Report Number:		Date:	

Rotor Inspection

- Check for corrosion or excessive wear
- Lubricate buckets and trunnions
- Inspect Rotor locking stud

Pre-Run Checks

- Ground Continuity
- Condenser fins/Air Filter cleaned
- Rotor Chamber (defrost)
- Door interlock and latch
- Door seal
- Line Voltage _____ VAC
- Door spring functional
- Ambient conditions

Electronic Checks

- Power light & door light (zero speed) on
- Compressor current _____ amps
- Torque trimmer set
- Maximum speed
- Motor cooling fan (5B+ only)
- Speed Control calibration
- Set Temperature calibration
- Compressor cycle time
- Timer function
- Overtemperature
- Brake function
- Overspeed

Mechanical

- Lubricate door latch
- Interlock Microswitch Adjustment
- Refrigeration leaks
- Door screws secure
- Replace heat sink standoffs on brake assembly
- Replace motor Brushes
- Replace gyro insulation and gyro seal assembly
- Replace motor exhaust filter.

Motor and Gyro

- Gyro bearings
- Gyro bushings
- Lower coupling
- Replace motor brushes
- Commutator
- Tachometer
- Replace motor hardware
- Motor ground continuity
- Replace gyro seal and cushion
- Brush warning (brush motor only)
- Inspect and replace tapered spindle pins

Imbalance

- Centrifuge stable and level
- Centrifuge shuts off with proper weight

Comments:

S.R. Signature _____

Date:

10. Replace all worn parts as required, then prepare the centrifuge for operation under full rated power.

b. Checks With Power ON

1. Set main power switch to ON.
2. Set timer for duration of test. Check the speed control with a portable tachometer, Jaquet indicator or equivalent centrifuge (paragraph 7-6, a).
3. Check refrigerant pressure on the HIGH pressure side (paragraph 6-16).
4. Check refrigerant pressure on the LOW pressure side (paragraph 6-16).
5. Check the overspeed control at 22 000 rpm \pm 200 rpm (paragraph 7-2, h).
6. Check the temperature control for proper calibration (paragraph 7-6, b).
7. Using clamp-on ammeter, Triplet model No. 10 or equivalent, check the following currents:
 - (a) Check the compressor current draw for 12-18 A.
 - (b) Check the centrifuge drive motor current draw for 12-18 A.
 - (c) After the START capacitor is out of the circuit, check centrifuge total current draw by clamping the ammeter on any of the main input power lines except chassis ground (paragraph 2-4) (30 A maximum).
8. Check the drive motor braking time when the BRAKE switch is pressed.
9. Check the drive motor braking time when the brake circuit is not activated.
10. Check the timer for proper STOP time when the indicator shows STOP.

6-3. Cabinet Panel Removal

For access to internal components (see warning in front of this manual), the front panel must be removed before the side panels. Front panel removal on the RC-5 opens the power supply safety interlock S305. The rear panel can be removed at any time in any sequence. Remove front, side and back panels as follows:

1. Loosen, then disengage, the two captive screws in the upper recesses of each panel, beneath the top deck cover.
2. Carefully remove the top of the panel away from the cabinet.
3. Using the toe of your shoe, lift the panel up and slip the lower edge of the panel off the locating pins.

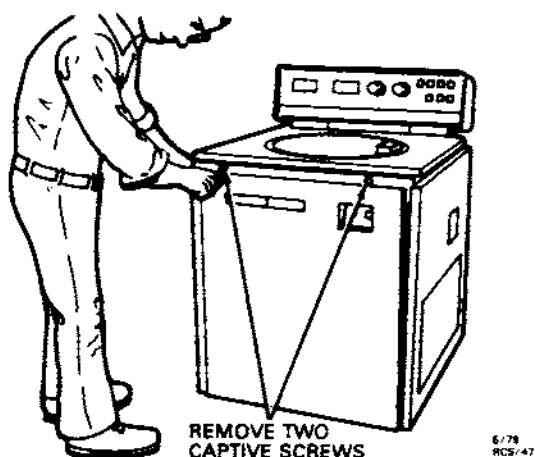


Figure 6-1.
Cabinet Panel Screw Removal

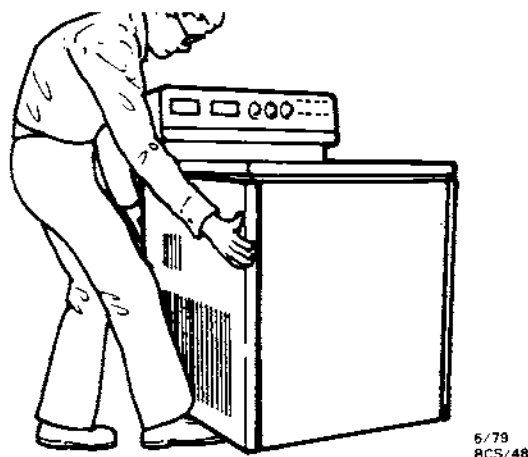


Figure 6-2.
Lifting the Panel Off

WARNING

To operate the centrifuge with the panels removed, unplug power cord from the socket, then remove one wire from the front panel interlock S305. Reconnect the power cord and turn the circuit breaker on.

CAUTION

Do not operate the centrifuge by holding circuit breaker in the ON position before removing wire connection from the interlock; to do so will damage the circuit breaker.

6-4. Drive Motor Replacement

a. Removal

1. Set main circuit breaker to OFF.
2. Unplug the power cord from socket.
3. Remove the front cabinet panel.
4. Disconnect the motor plug from inner left centrifuge wall. The plug is flush against the cushion under the chamber part of the centrifuge and held there by a spring which clips into the slot of the screw on top of the plug. To remove the plug, one finger must be placed between the plug and the cushion to release the spring while using the other hand to pull the plug out of the centrifuge wall.

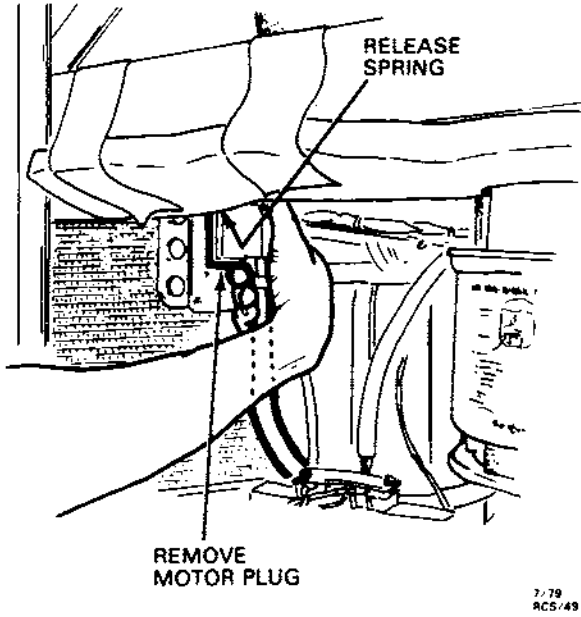


Figure 6-3.
Drive Motor Plug Removal

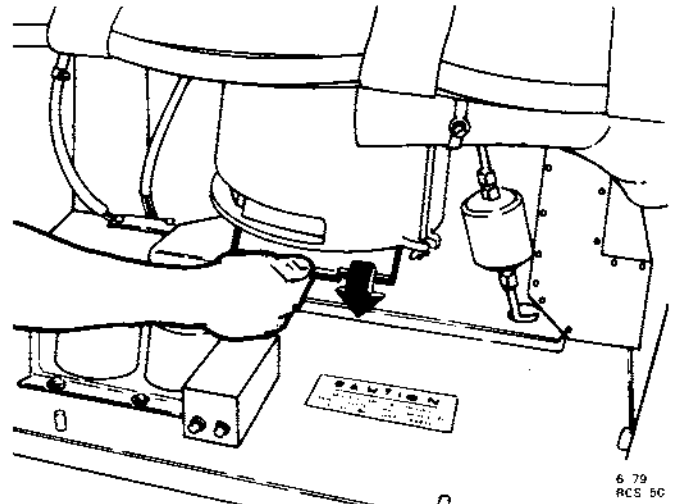


Figure 6-4.
Lowering Noise Suppressor Unit

5. Lower the noise suppressor to permit the plug to come up through the centrifuge with the motor.
6. Remove the rubber boot surrounding the drive in the base of the centrifuge chamber, then remove the foam padding beneath it.

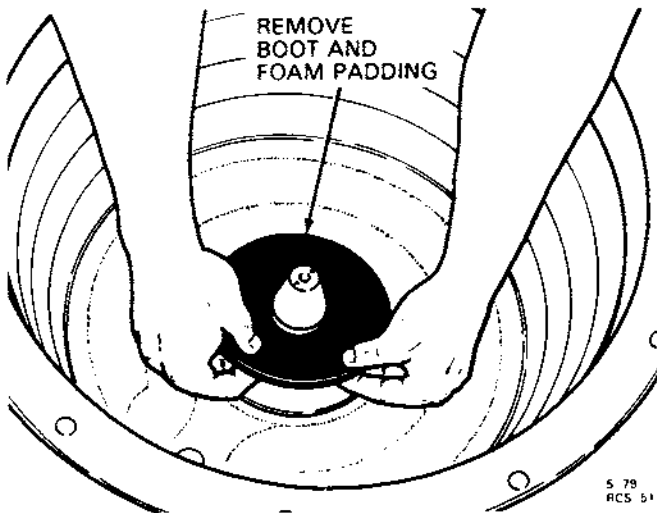


Figure 6-5.
Boot and Foam Padding Removal

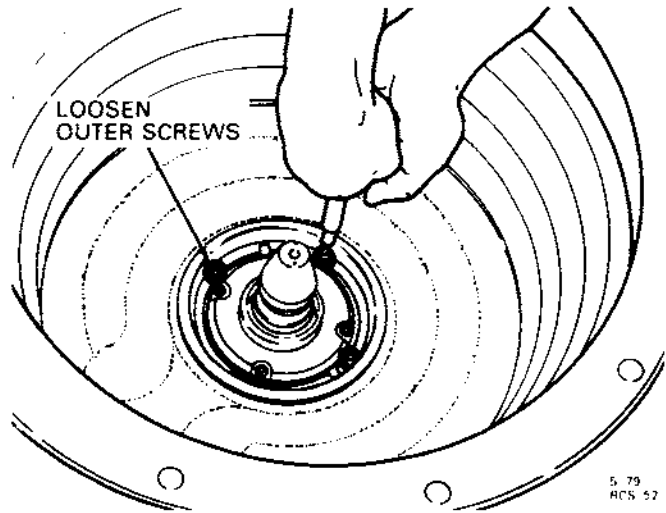


Figure 6-6.
Removing Outer Screws of the Gyro-Action Drive

7. Using a T-handle Allen wrench (5/32 in), completely loosen the four outer screws on the base, leaving them in place for the next step.
8. Lift the gyro-action drive and motor assembly out of the centrifuge, lifting it straight up while guiding cord and plug through the silencer.

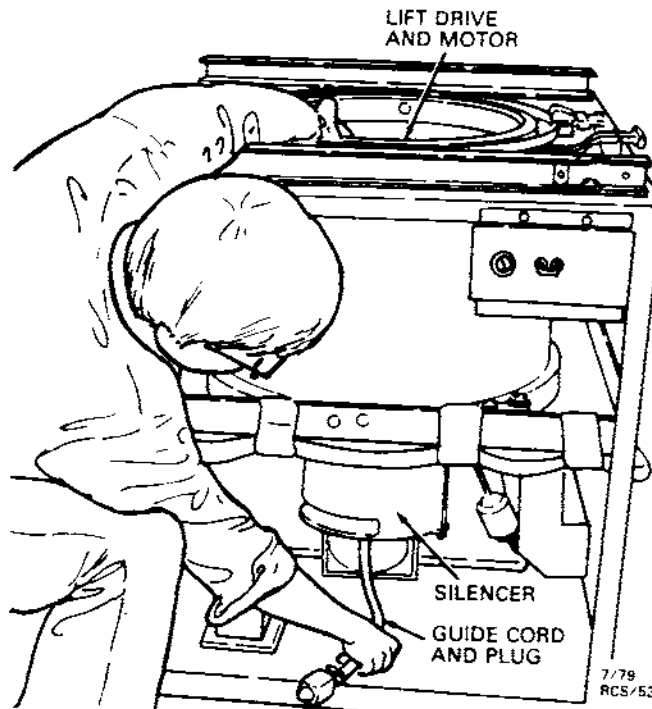


Figure 6-7. Drive Motor and Gyro-Action Drive Removal

b. Installation

1. Lead the cord and the plug through the hole in the chamber.
2. Align the motor mounting plate over the guide pins in the rim of the chamber hole.

CAUTION

If the motor mounting plate is not aligned in this manner, the assembly can still be screwed in place. However, it will be unstable, the rotor will operate unbalanced at a DANGEROUS angle.

3. Tighten opposite screws evenly until all four screws are firmly tightened.
4. Replace the foam padding on the gyro base, then replace rubber boot, making sure the lip is fully engaged around the liner rim. If it is not, moisture could enter the drive.
5. Reconnect the drive motor plug to the outlet in the centrifuge wall.

6. Replace the front cabinet panel.
7. Calibrate in accordance with Table 7-1.

6-5. Torque Trimmer Potentiometer R204 Replacement

a. Removal

1. Set main circuit breaker to OFF.
2. Unplug the power cord from socket.
3. Remove the rear cabinet panel.
4. Tag, then unsolder, the wires to torque trimmer potentiometer R204.
5. Remove the hex mounting nuts and the torque trimmer potentiometer.

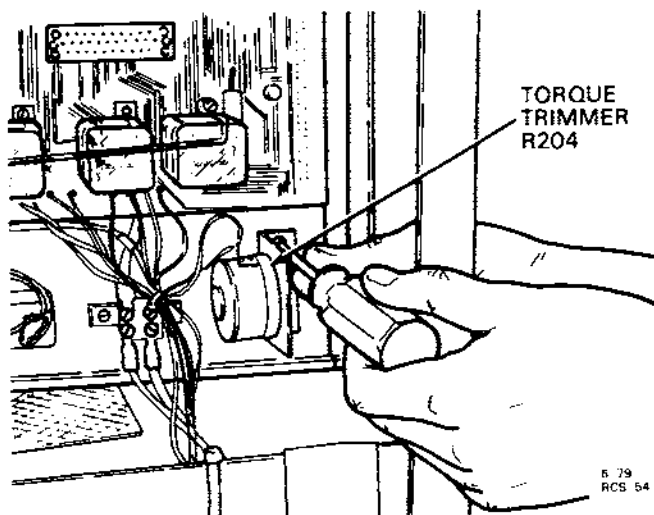


Figure 6-8. Torque Trimmer Potentiometer Removal

b. Installation

1. Secure potentiometer R204 with the hex nuts.
2. Solder the tagged wires to the correct terminals.
3. Adjust potentiometer R204 for maximum current draw.
4. Reinstall the rear cabinet panel.
5. Calibrate in accordance with Table 7-1.

6-6. Saturable Reactor Replacement

a. Removal

1. Set main circuit breaker to OFF.
2. Unplug the power cord from socket.
3. On the saturable reactor, remove two hex nuts, flat washers, grommets, and the insulator from TB307.
4. Loosen four terminal screws, then tag and remove the four terminating wires to the saturable reactor.
5. Remove the four cap screws and flat washers that secure the saturable reactor to the base support, then remove the saturable reactor.

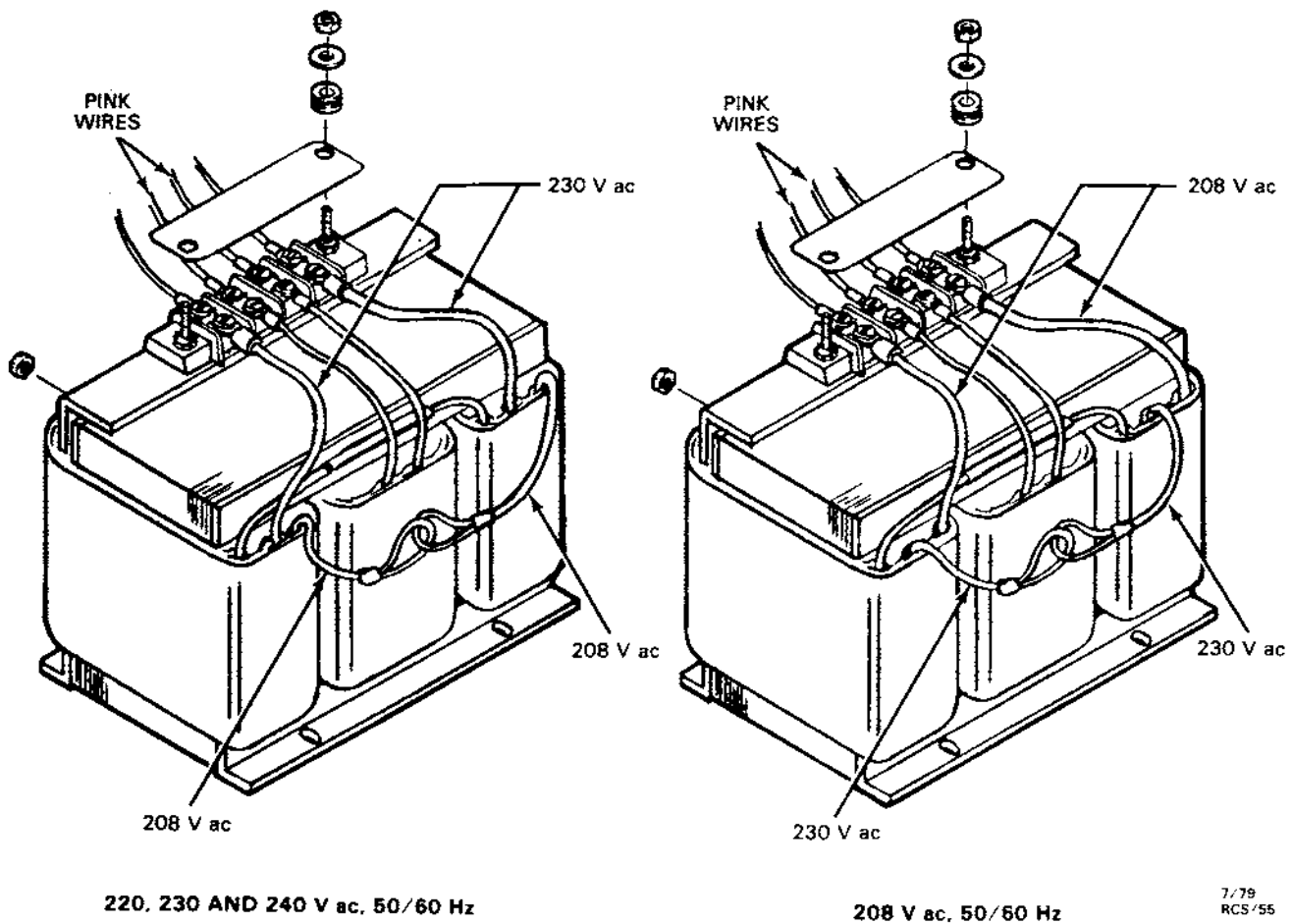


Figure 6-9. Saturable Reactor Removal

b. Installation

1. Connect and firmly secure, then insulate with electrical tape, the two black wires on the saturable reactor.
2. Secure the saturable reactor to the base support with the four cap screws and flat washers.
3. Secure the TB307 bracket to the saturable reactor with the two hex nuts.
4. Connect the terminating wires to the TB307 terminals as applicable and tighten terminal screws.
5. Install the insulator, then secure with the two grommets, flat washers and hex nuts.
6. Reinstall the front cabinet panel.
7. Calibrate in accordance with Table 7-1.

6-7. Drive Motor Brush Replacement, RC-5**a. Removal**

1. Set main circuit breaker to OFF.
2. Unplug the power cord from socket.

NOTE

The drive motor is equipped with two brushes. Always replace both brushes, never replace only one brush.

3. Remove the drive motor from the centrifuge (paragraph 6-4).
4. Lift up the brush springs and withdraw the brushes from their holder.
5. If the brush length is less than 14 mm (9/16 in) (see Figure 6-10), the brushes must be replaced. If the brushes are badly pitted or worn unevenly, or if the commutator is badly grooved, the armature may have to be replaced. If the armature needs replacement, contact Customer Service at (800) 551-2121 (or in locations outside the U.S., an authorized distributor or agent for Sorvall® products).

b. Installation

1. To replace brushes, simply loosen the brush wire connectors and remove the old brushes. Be sure to insert the new brushes into the holders so that the bevelled ends match the bevel of the commutator (see figure 6-11).

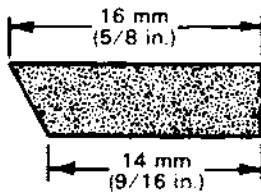
7/79
RCS/57

Figure 6-10.
Drive Motor Brush Dimensions

7/79
RCS/58

Figure 6-11.
Proper Insertion of Brushes

2. Position the brush lead along the top of the brush to the brush spring and from there out along the spring in a flat, easy curve to the terminal screw. Keep the brush leads flat and well within the outer confines of the motor. If the lead is brought out directly over the top of the brush holder, the brush will "hang up" after a short period of operation (see figure 6-12). Adjust brush tension with Allen wrench to $6\text{ N} \pm 0.56\text{ N}$ (18-22 oz.).
3. To reassemble, reverse the above procedure. Make sure when replacing motor that the guide pin of the centering assembly is aligned with the guide pin hole.

c. Brush Break-in Procedure

Using an SS-34 rotor:

1. Run the rotor at 5 000 rpm for 30 minutes.
2. Increase the speed to 10 000 rpm for an additional 30 minutes.

6-8. Drive Motor Brush Replacement, RC-5B

To eliminate periodic motor brush inspection, a BRUSHES lamp warns when the brushes are worn to minimum operating length. When the lamp flashes, the brushes still have about an 8-hour operational life. However, to prevent motor commutator damage, a lock-out system is included. When the lamp starts flashing, no additional runs can be made after the motor turns off, except as specified in Section 4, paragraph 4-13. Replace the brushes as follows:

1. Remove drive motor and gyro-assembly (paragraph 6-4).

NOTE

Step (b) applies only when optional automatic rate controller is installed.

2. Remove guide shoe mounting bracket with screw and lockwasher on motor assembly end bell.
3. Remove screw securing brush wire terminal.
4. Retract and stow upper brush spring in brush spring stow groove.

CAUTION

When retracting the lower brush spring, exercise care to avoid snarls, sharp bends, and especially kinks in the brush lift cable.

5. Retract lower brush spring.
6. Lift the brush from the holder, wire attached.
7. If the brush is less than 14 mm (9/16 in), badly pitted, or unevenly worn, it must be replaced. The motor armature may have to be machined if the commutator is badly grooved, worn, pitted, or burned. Also, the brush plate should be checked for abnormalities.
8. Insert new brushes into the holders so that the bevelled ends match the curvature of the commutator (see figure 6-11).
9. Route the brush wire downward in a hooked position and secure with terminal screw. Do not route brush wire over lower brush spring (see figure 6-12).
10. Release each brush spring from its stowed position, making sure that each brush spring seats properly in its respective channel.
11. Using a spring scale or other suitable tension measuring device, measure tension of lower brush spring at the knee of the spring. Spring tension should be 510-623 g (18-22 oz). Proper tension is obtained by loosening the spring post with a 2.39 mm (3/32 in) hex head (Allen) wrench through the access opening in the bottom of the end bell and turning the spring post with a 1/4 in open end wrench. Secure the spring post when proper spring tension is obtained, then recheck tension. Readjust, if necessary.
12. Measure tension of upper brush spring at the knee of the spring. Spring tension should be 56 g \pm 5 g (2 oz). Proper tension is obtained by loosening the hex nut at the top of the spring post and turning the spring collet wheel. Tighten the hex nut when proper tension is obtained.
13. Recheck tension of both brush springs. Since both brush springs derive a tension relative to positioning of the spring post, readjusting the lower brush spring creates a requirement to check and readjust the upper brush spring (see Figure 6-12).

NOTE

Steps 14 through 17 apply only when the optional automatic rate controller is installed.

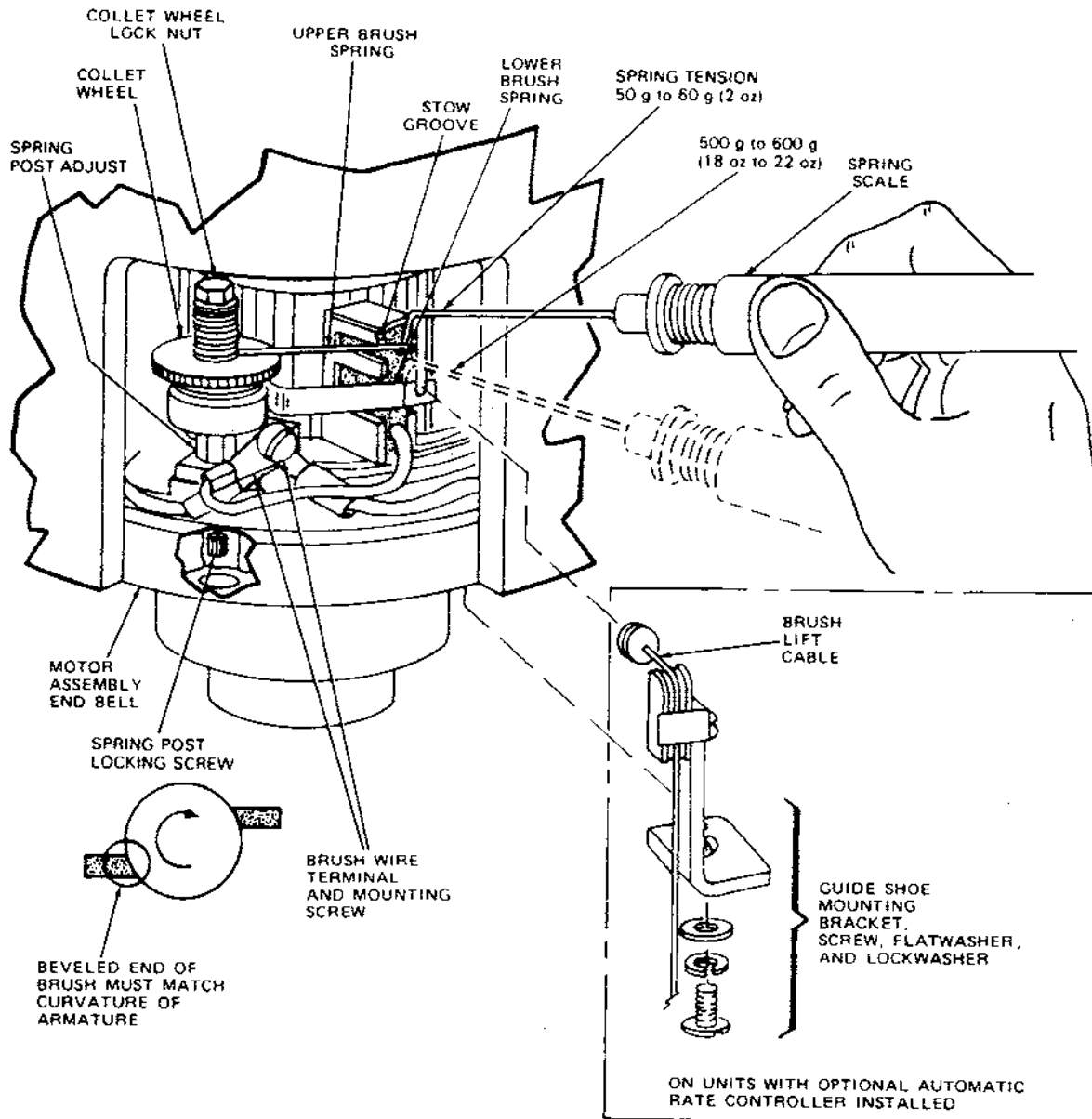
5/79
RCS/60

Figure 6-12. Brush Installation and Spring Tension Adjustment

14. Secure guide shoe mounting bracket to motor assembly end bell with screw and lockwasher.
15. Rotate and maintain cable pulley at pin stop as shown in Figure 6-13.
16. Check for required clearance. Should adjustment be necessary, relax cable pulley assy and make adjustment by loosening nut and screw securing cable guide pulley and clip to brush lift bracket. Reposition and secure cable guide pulley and clip to attain clearance of 0.13 mm to 0.25 mm (0.005 in to 0.010 in) between cable end insulator and guide shoe. Repeat step 15 to recheck clearance.

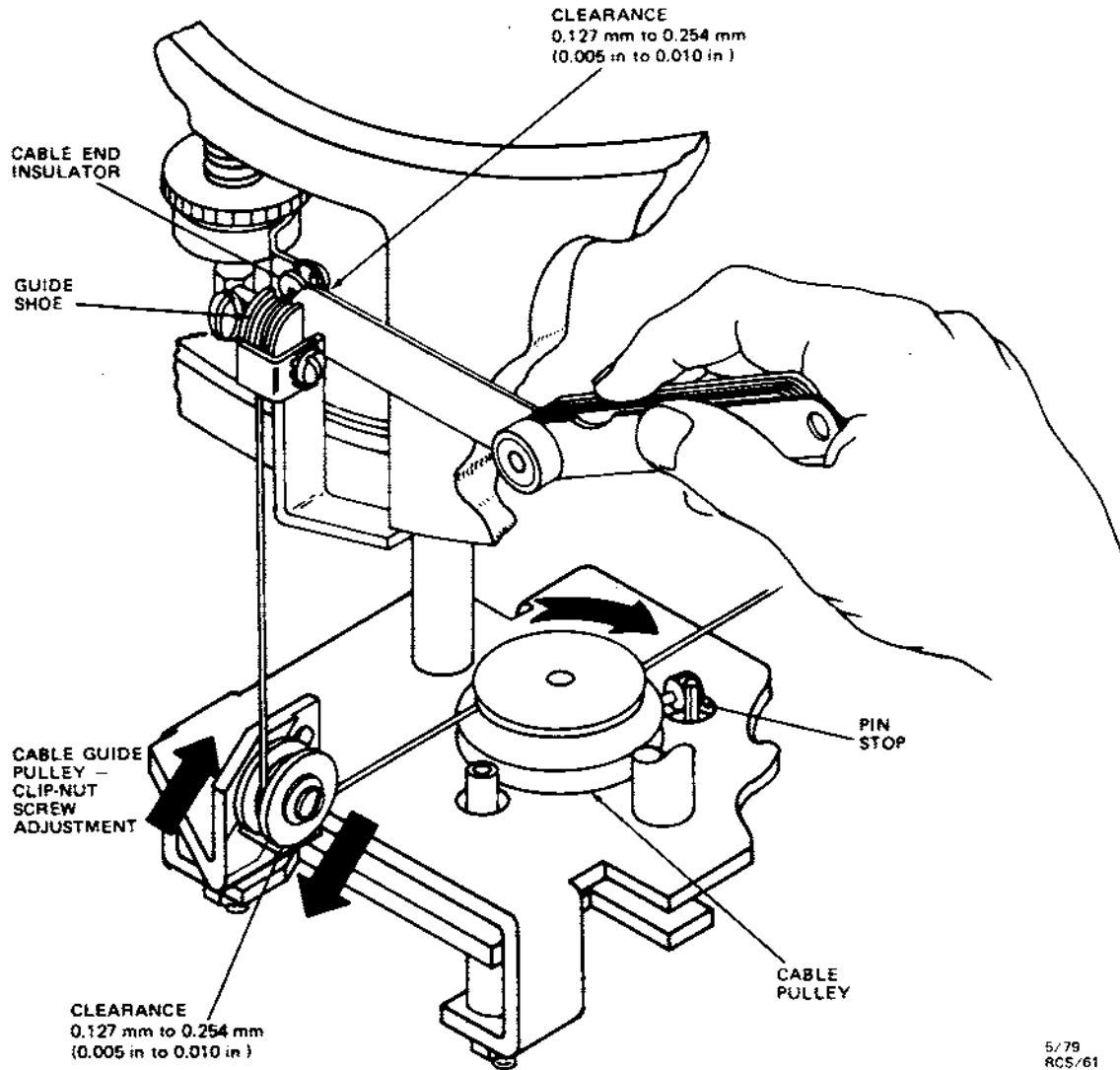


Figure 6-13. Brush Lift Cable Adjustment, Automatic Rate Controller

17. Check and adjust cable end insulator guide shoe clearance for opposite lower brush spring as necessary.

NOTE

After adjustment, check clearance between cable pulley and clip (see Figure 6-13). Clearance must be below 0.13-0.25 mm (0.005-0.010 in) in order to retain cable within pulley groove when cable is released. A business card is within the clearance range and can be inserted between the cable pulley and clip while adjustment is made.

18. To reassemble, slide the grommet down to the connector end of the cable, and reverse the above procedure. Make sure when installing the motor assembly that the centering guide pin aligns with the guide pin hole. Also, make sure when replacing

the bottom half of the silencer that the motor assembly cable and grommet fit properly in the silencer cable groove.

19. Press to reset the red RESET buttons on the brush warning box before replacing the front panel (see Figure 8-6).

6-9. Compressor Start and Run Capacitors, and Potential Relay Replacement

NOTE

Compressor wiring diagram is located under the cover of capacitor box. Compressor resistance values are given in Table 6-1.

a. Removal

1. Set main circuit breaker to OFF.
2. Unplug the power cord from socket.
3. Remove the screw and lockwasher securing the capacitor box cover, then lift off the cover.
4. Tag and disconnect wires to the component.
5. Remove the component.

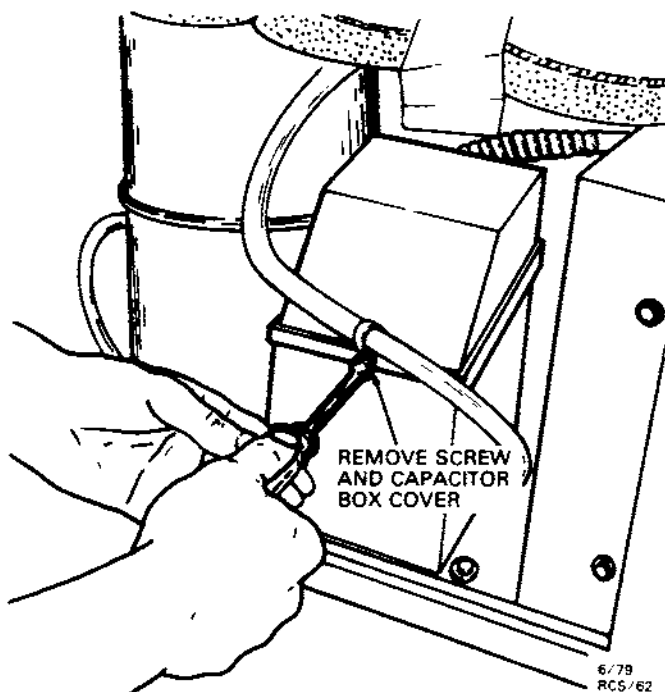


Figure 6-14.
Compressor START/RUN Capacitor
Removal

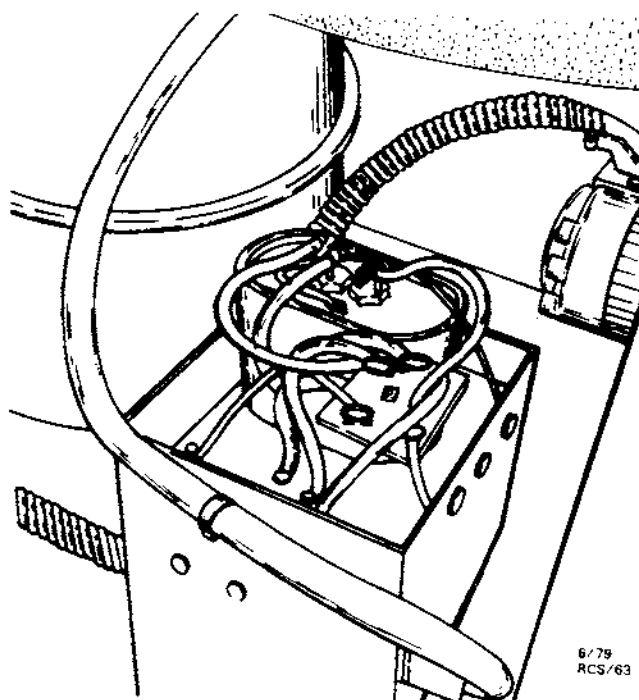


Figure 6-15.
Compressor START/RUN Capacitor
Location

b. Installation

1. Install the component.
2. Reconnect the wires.
3. Install the capacitor box cover.

6-10. Condenser Fan Replacement**a. Removal**

1. Set main circuit breaker to OFF.
2. Unplug the power cord from socket.
3. Remove the rear cabinet panel.
4. Remove the four bolts securing the fan motor and bracket to the condensing assembly deck.
5. Move the motor and bracket away from the evaporator fins.
6. Mark orientation of fan on the motor shaft. Loosen the setscrew on the fan and remove the fan from the motor shaft.

b. Installation

1. Vacuum all dust accumulation from the evaporator fins.
2. If a used fan is to be installed, check the blades and adjust them in accordance with Figure 6-17.
3. Orient the fan on the motor shaft (see removal step 6) and secure the fan by tightening the setscrew on the flat surface of the motor shaft, making sure that the surfaces of the motor shaft and fan hub are flush.
4. Secure the motor bracket to the condenser assembly deck with the four bolts.
5. Reinstall the rear cabinet panel.

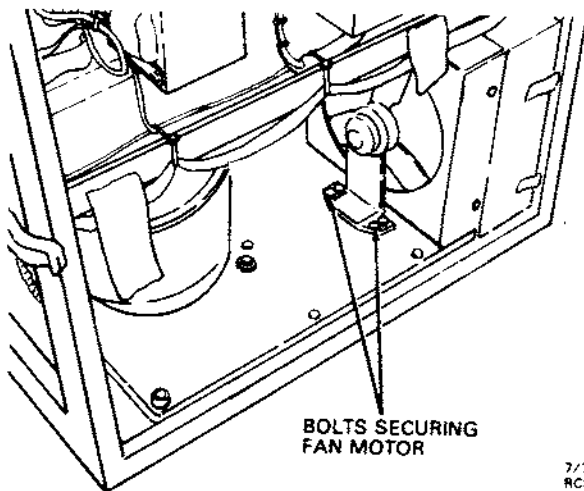


Figure 6-16.
Removing Fan Motor Bolt

NOTES and DIMENSIONS
 A - $2\text{-}1/4 \pm 1/32$
 B - $1\text{-}11/32$ REF
 C - $29/32 \pm 1/32$
 D - PITCH ANGLE 23°
 E - MEASUREMENT TAKEN
 FLUSH AT BLADE
 SUPPORT AND HUB
 F - LEADING OR TRAILING
 EDGES OF BLADES
 MAY BE OUT OF LINE
 $1/32$ TO 0.050

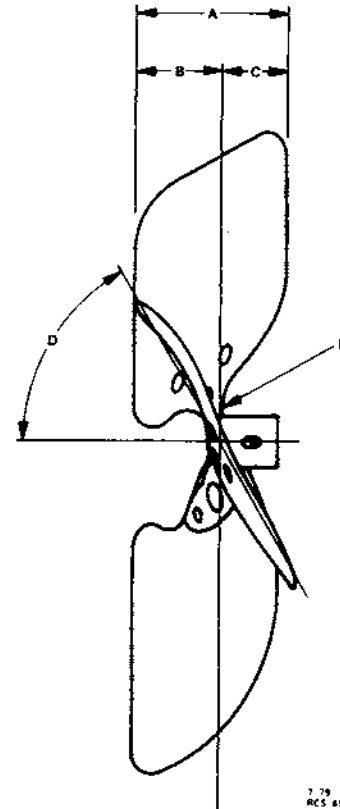


Figure 6-17.
*Compressor Fan Blade
Specifications*

6-11. Condenser Fan Motor Replacement

a. Removal

1. Set main circuit breaker to OFF.
2. Unplug the power cord from socket.
3. Remove the cabinet rear panel.
4. Remove the screw and lockwasher securing the capacitor box cover and lift off the cover.
5. Tag each wire before removal, then, loosen the two terminal screws (one on the terminal board and one on the potential relay inside the capacitor box) for the fan motor cable.
6. Remove the two screws securing the armor connector cover entering the capacitor box.

7. Remove the armor cable wires from the capacitor box.
8. Remove the four bolts securing the fan motor and bracket to the condensing assembly deck.
9. Move the motor and bracket away from the evaporator cooling fins.
10. Mark the fan orientation on the motor shaft. Loosen the fan setscrew and remove the fan.
11. Lift out the fan motor and bracket.
12. Remove the two screws and lockwashers securing the armor connector to the motor and slide the armor covering and armor connector off the motor wires. Retain the armor covering, elbow and fittings, and red insulating inserts at each end of the armor for reuse during motor installation.
13. Remove the two screws securing the motor to the motor bracket.

b. Installation

1. Vacuum all dust accumulation from the evaporator cooling fins.
2. If a used fan is to be reinstalled, check the blades and adjust them in accordance with Figure 6-18.

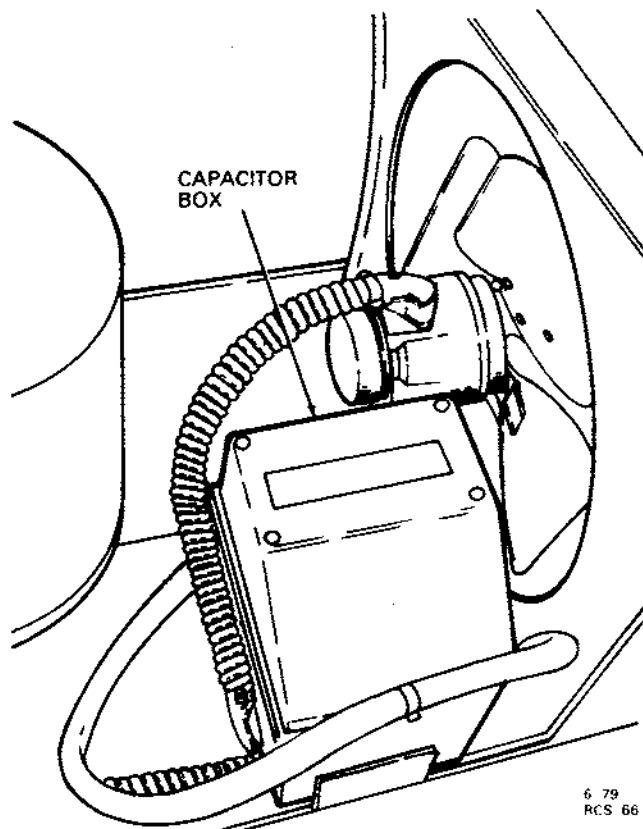


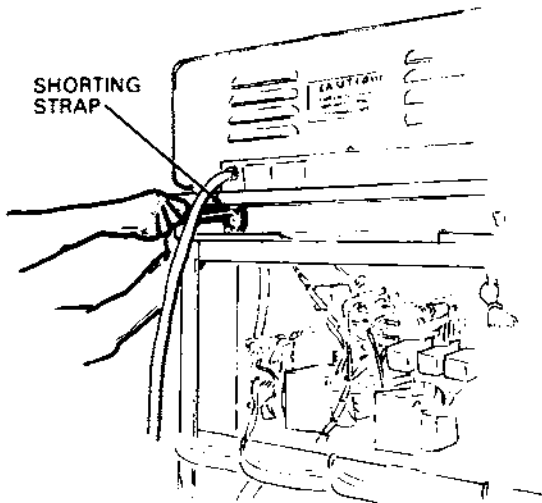
Figure 6-18. Capacitor Box Location

3. Secure the motor to the bracket with the two screws and lockwashers.
4. Slide the elbow and fittings over the motor wires, then secure the connector to the motor with the two screws and lockwashers.
5. Slide the armor over the motor wires and insert the red insulator.
6. Secure the armor and armor elbow with the two screws.
7. Place the motor and bracket in the approximate position on the condensing assembly deck.
8. Orient the fan on the motor shaft (see removal, step 6-4) then secure the fan on the shaft with the setscrew, making sure that the motor shaft and fan hub are flush.
9. Secure the motor bracket on the condensing assembly deck with the fan bolts.
10. Insert the red insulator and slide the motor wires through the armor connector on strap.the capacitor box.
11. Secure the armor cable and connector cover with the two screws.
12. Secure the motor wires to the appropriate terminals on the terminal board and potential relay.
13. Install the capacitor box cover and secure it with the screw and lockwasher.
14. Reinstall the cabinet rear panel.

6-12. Evaporator Replacement

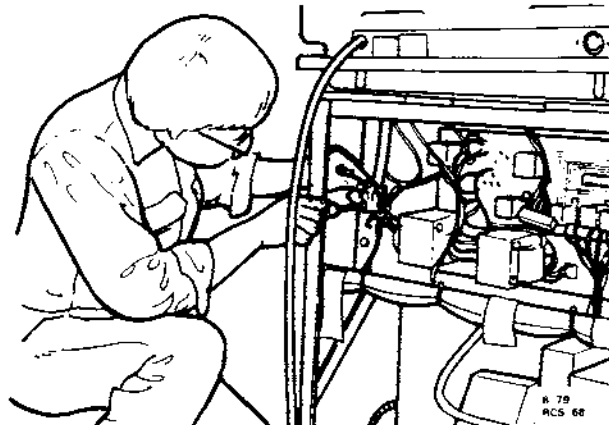
a. Removal

1. Set main circuit breaker at OFF.
2. Unplug the power cord from socket.
3. Remove all four panels from the cabinet.
4. Remove four 9/16 in bolts securing console and deck to the frame.
5. Remove shorting strap.
6. Disconnect main power cord (three wires) from the terminal strip on the lower panel.
7. Disconnect main plug from the lower panel.



7/79
RCS/67

Figure 6-19.
Removing Shorting Strap



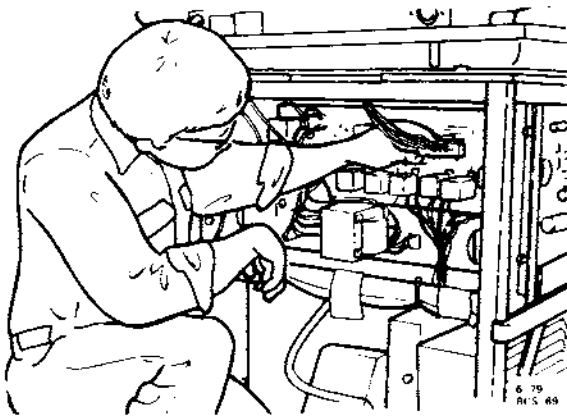
8/79
RCS 68

Figure 6-20.
Main Power Cord Removal

8. Remove the entire top deck and console from the centrifuge, pulling the male portion of the main plug up through the circular hole in the deck.

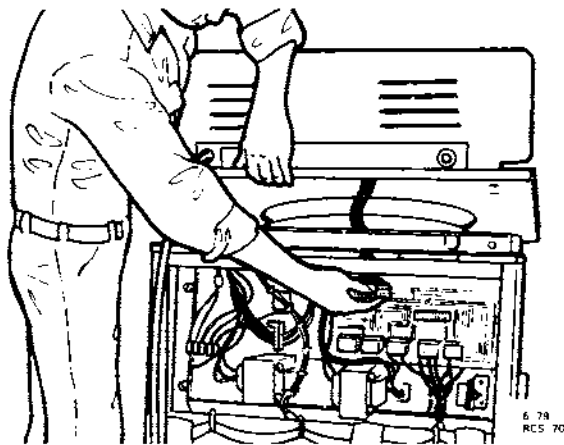
CAUTION

Removal of the top deck assembly and console will expose the two aluminum plates which support the door hinge and solenoid assembly along with the front and rear rail. Do not remove components from any of the aluminum plates; the plates are removed as complete assemblies.



6/79
RCS 69

Figure 6-21.
*Routing the Main Power Plug
Through Lower Cabinet Section*



6/79
RCS 70

Figure 6-22.
*Routing the Main Power Plug
Through the Upper Cabinet Section*

9. Press in safety interlock wire, then open the door.
10. Using hex-head wrench, loosen tension on counter balance spring by loosening counter balance spring adjuster.

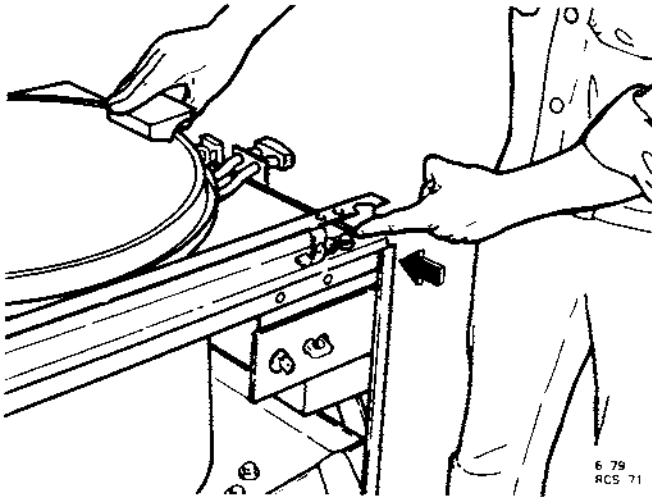


Figure 6-23.
Opening Door, Using Safety Interlock Wire

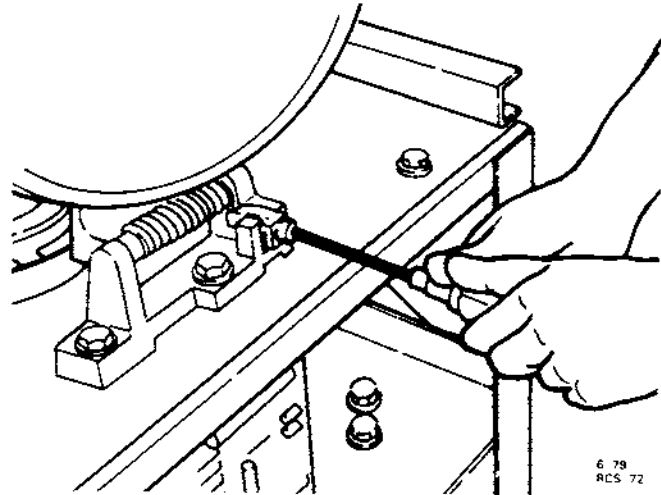


Figure 6-24.
Releasing Tension on Counter Balance on the Door

11. Using retaining ring pliers, remove hinge pin retaining ring.
12. Raise door to vertical position, pull out hinge pin, then remove door.
13. Scratch or scribe a line down each corner of the two aluminum plates onto the black pointed frame. This will align the aluminum plates to the frame during reassembly.

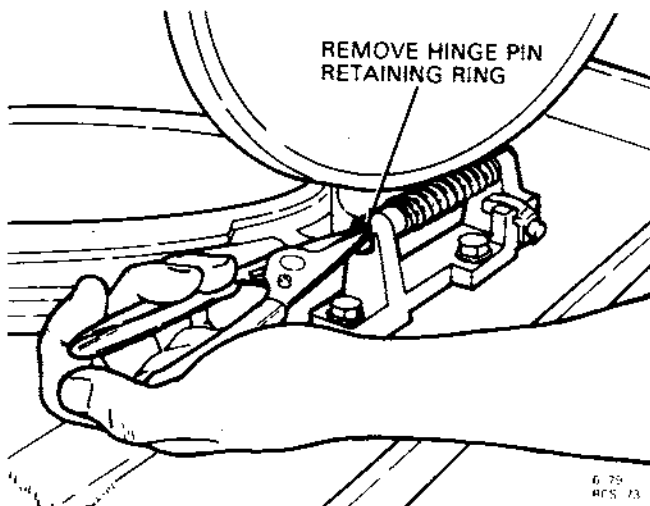


Figure 6-25.
Removing Hinge Pin Retaining Ring at the Door

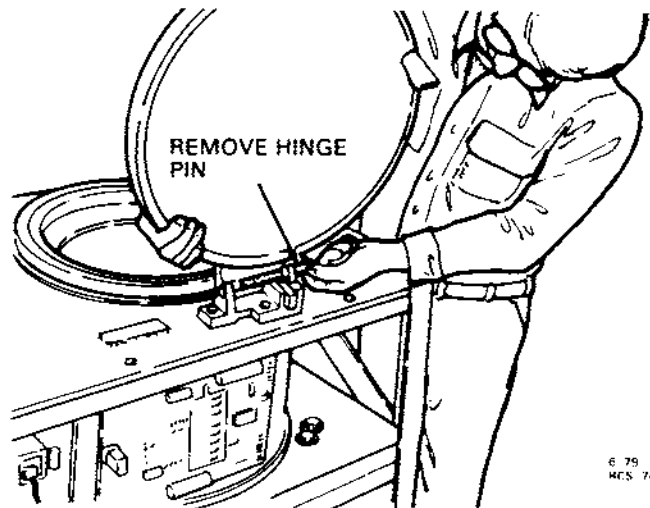
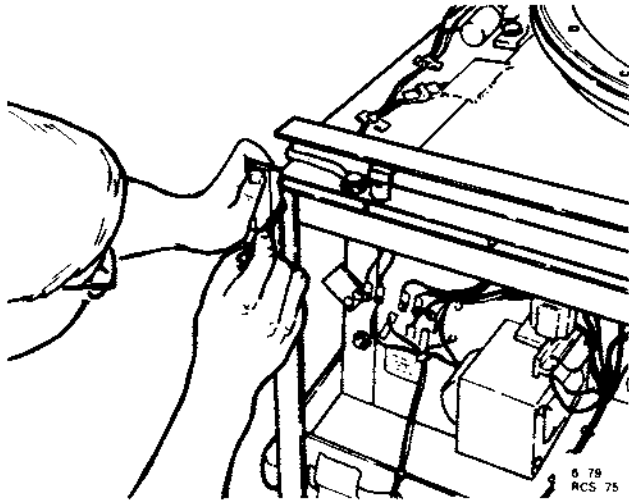
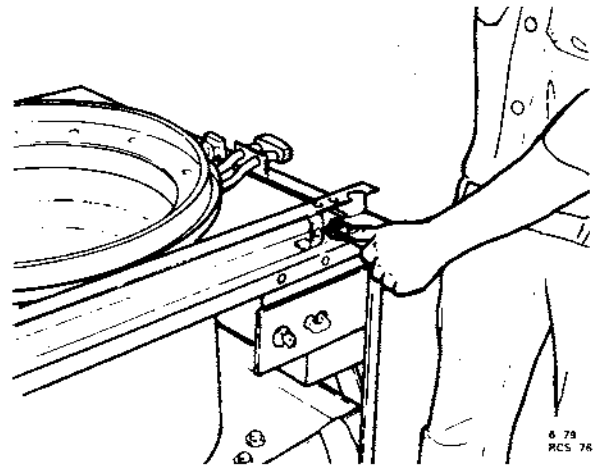


Figure 6-26.
Removing Hinge Pin at the Door

14. Remove the two bolts holding the front rail.



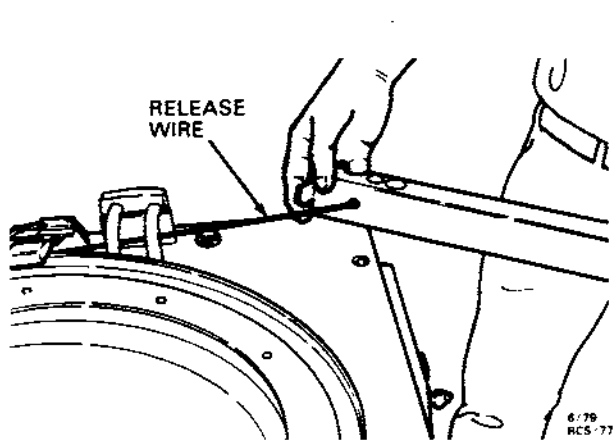
*Figure 6-27.
Placing Alignment Marks
on Aluminum Plates*



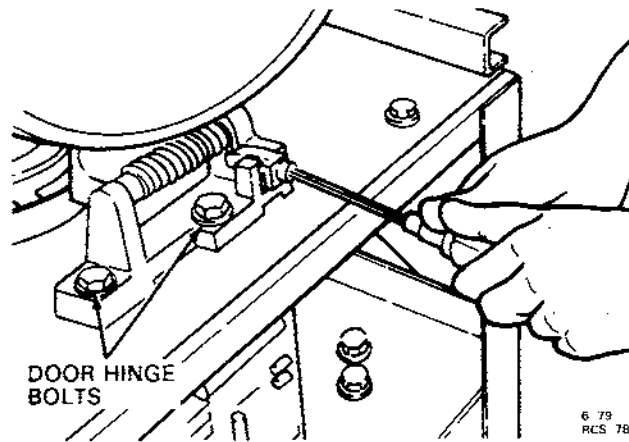
*Figure 28.
Removing Mounting Bolts
on the Front Rail*

15. Lift the rail out while turning it to clear the bent red wire used to manually operate the door solenoid.

16. Remove the two bolts holding the rear rail, then remove the rail.



*Figure 6-29.
Emergency Door Release Wire*



*Figure 6-30.
Removing Door Hinge Bolts*

17. Remove the two bolts holding the aluminum frame with the door hinge assembly, then lift the assembly from the frame.

18. Disconnect all wires leading to the latching mechanism.

19. Remove the KSB tube bracket screws and pull out the KSB tube assembly.

20. Remove the two bolts holding the aluminum plate with the latching mechanism.

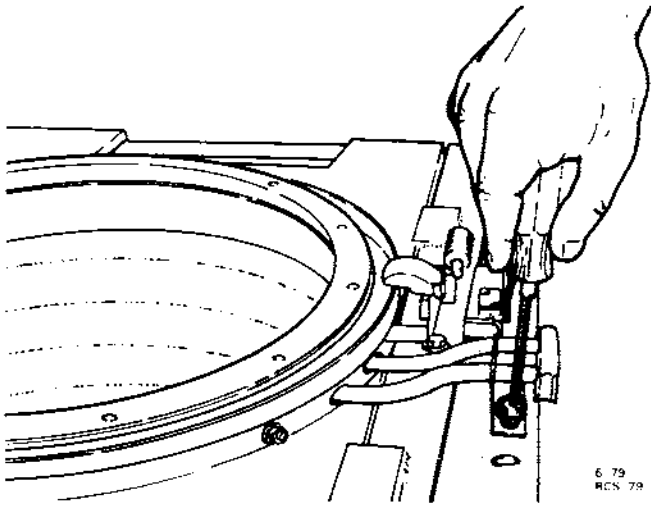


Figure 6-31.
KSB Bracket and Tube Removal

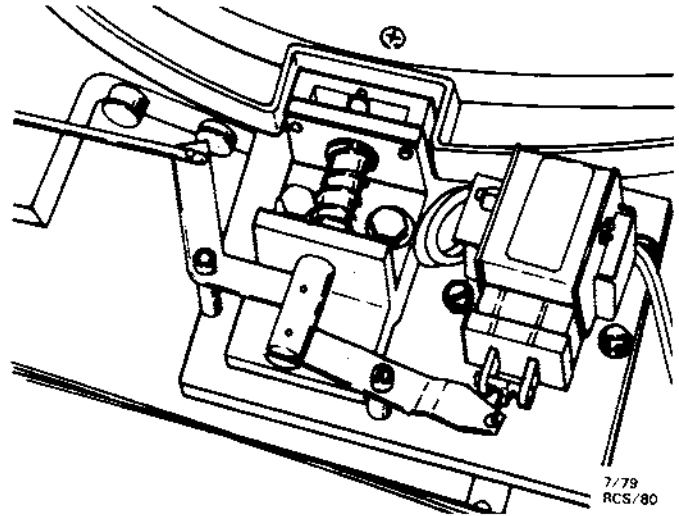


Figure 6-32.
Removing Bolts

21. Remove the top wooden deck complete with plastic ring and rubber seal. (The urethane seal under the deck is to be reused.)
22. Remove the temperature detector from the evaporator (see paragraph 6-14).
23. Remove the gyro action drive motor assembly (see paragraph 6-4).
24. Remove the evaporator drain tubes.
25. Remove refrigerant from the system (see paragraph 6-16).
26. Disconnect the refrigeration fittings leading to the evaporator.

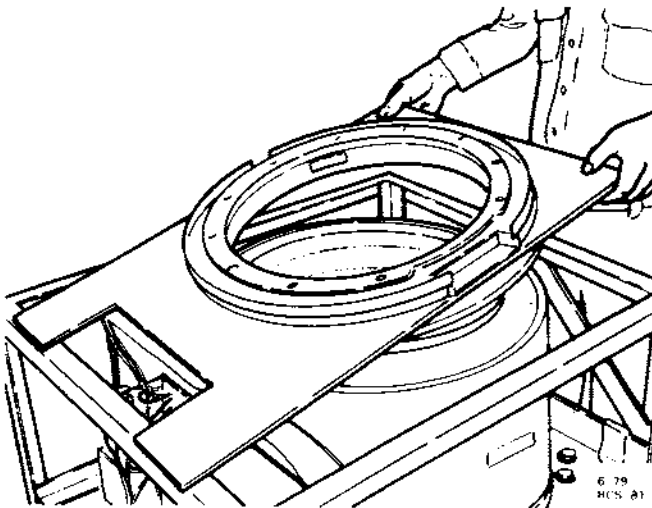


Figure 6-33.
Top Wooden Deck Removal

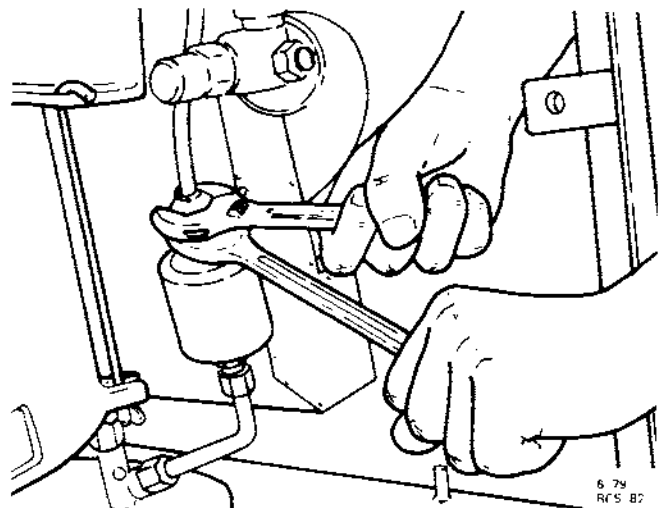


Figure 6-34.
Disconnecting Refrigeration Fitting

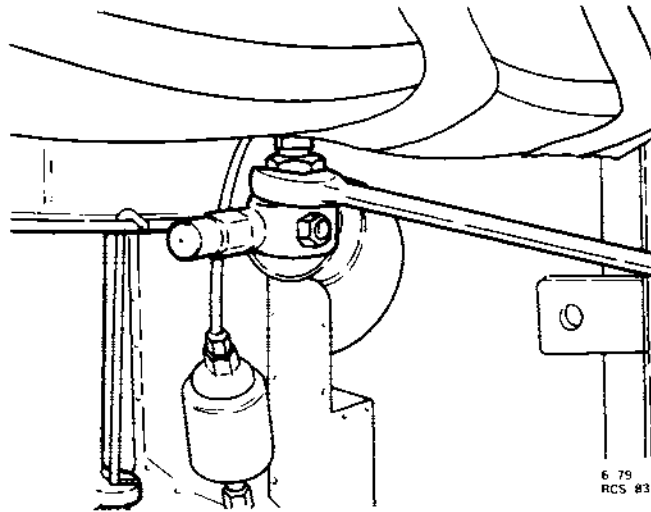


Figure 6-35. Separating Refrigeration Fitting

27. Straighten the 9.5 mm (3/8 in) refrigeration line.
28. Using two large screwdrivers, pry the evaporator liner and lock foam insulating material up from the chamber wall. Then grasp the evaporator at the inner bottom rim and pull it out of the chamber.

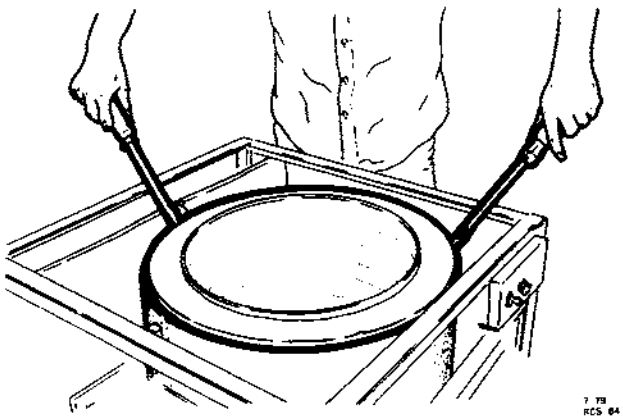


Figure 6-36.
Removing Evaporator Liner
from Cabinet



Figure 6-37.
Lifting Evaporator from
Cabinet

b. Installation

1. Install the new evaporator assembly in the chamber.
2. Place the urethane seal on top of the lock foam insulating material.
3. Place the wooden deck with plastic ring and rubber seal on the cooling chamber. Adjust the evaporator inside the chamber to properly align the rubber seal and evaporator while pressing the rubber seal ring onto the evaporator.
4. Place the aluminum plates in position. Reconnect the wires to the latching mechanism and install the KSB tubes.
5. Align each aluminum plate with the scribe lines on the frame and secure them in position.
6. Install the front and rear rails.
7. Install the deck and console.
8. Connect the drain tube.
9. Install and connect the resistance temperature detector (paragraph 6-14).
10. Install the gyro action drive assembly (paragraph 6-4).
11. Reconnect the main power cord and main power plug.
12. Reconnect refrigeration lines and recharge the system. Then check for leaks (paragraph 6-16).

6-13. Condensing Assembly Replacement**a. Removal**

1. Set main circuit breaker to OFF.
2. Unplug the power cord from socket.
3. Remove all cabinet panels.
4. Disconnect compressor leads at terminals 7, 8, and 9 on TB201.
5. Remove refrigerant from the system (see paragraph 6-16).
6. Using an open end wrench (1-3/8 in), disconnect the suction line from compressor.
7. Using an open end wrench (25/32 in), disconnect the high pressure line from the service valve.

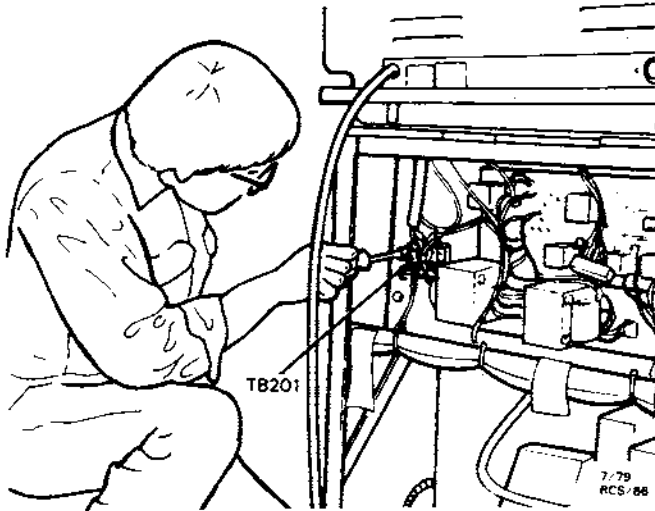


Figure 6-38.
*Disconnecting Compressor
Electrical Terminals*

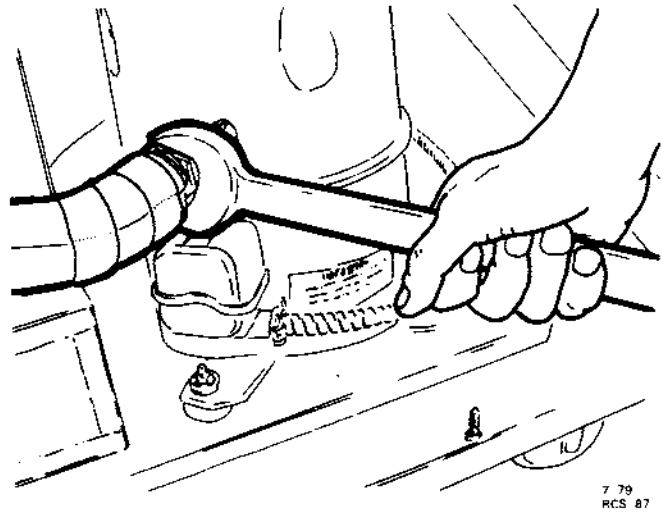


Figure 6-39.
*Disconnecting Suction
Line from the Compressor*

8. Using an Allen wrench (1/4 in), remove the three socket head screws securing the refrigeration assembly base to the centrifuge frame.
9. Pull the complete assembly toward the rear of the centrifuge frame until it contacts the two pins used to position the rear panel; then, using two heavy-duty screwdrivers, lift the assembly over the pins and remove it from the centrifuge.

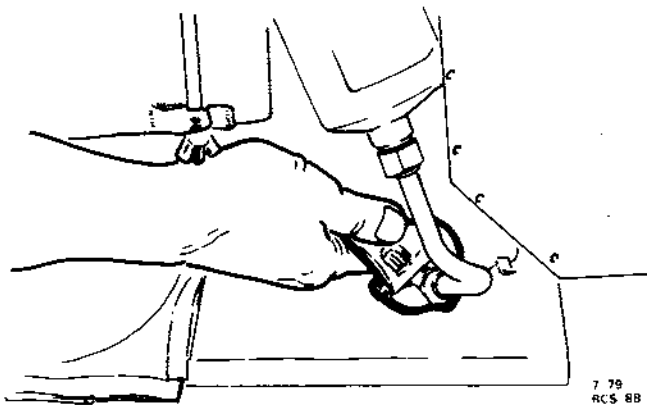


Figure 6-40.
*Disconnecting the High Pressure
Line from the Service Valve*

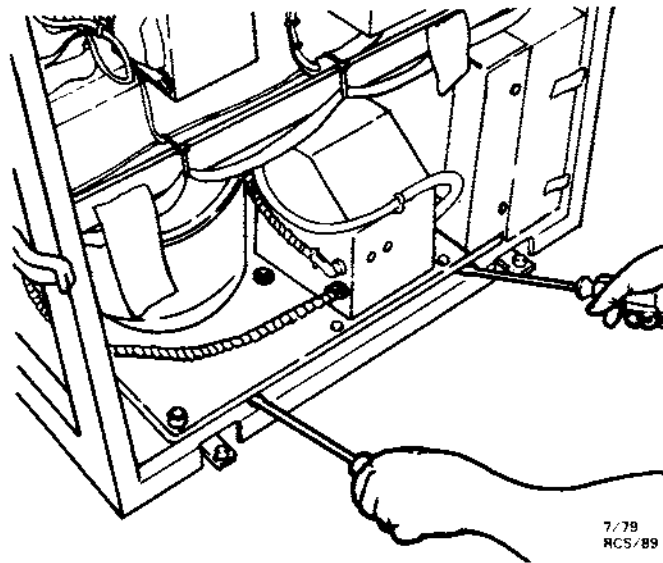


Figure 6-41.
*Removing the Refrigeration
Unit from the Centrifuge*

b. Installation

1. Install the condensing assembly in the centrifuge through the rear of the frame.
2. Secure the condensing assembly base to the frame with the three socket head screws.
3. Reconnect the high pressure line and the suction line to the refrigeration assembly, at the proper locations.
4. Connect the electrical leads to terminals 7, 8, and 9 on TB201.
5. Charge the system in accordance with paragraph 6-16.
6. Replace all cabinet panels.

6-14. Electronic Controls Replacement

a. Resistance Temperature Detector

1. Removal
 - a. Set main circuit breaker to OFF.
 - b. Unplug the power cord from socket.
 - c. Remove the cabinet rear panel.
 - d. Tag, then disconnect detector wires at TB306.
 - e. Pry out resistance temperature detector cover at the bottom of the evaporator, then remove the detector.

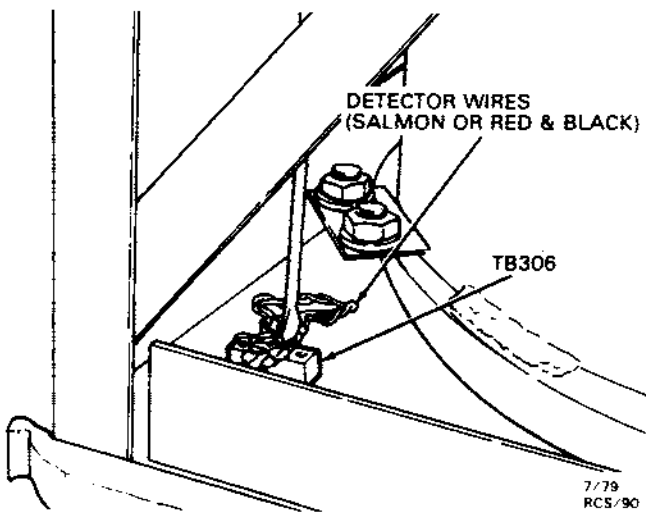


Figure 6-42.
Removing Wires from Terminal
Board TB306

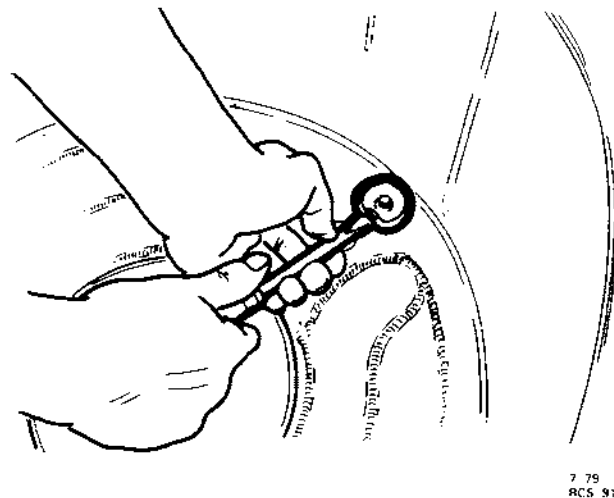


Figure 6-43.
Removing Temperature Detector
from the Chamber

2. Installation

- a. Install the resistance temperature detector and cover.
- b. Connect detector wires to TB306.
- c. Install cabinet rear panel.

b. Relays K201, Compressor Relay, and K202 Motor Relay

1. Removal

- a. Set main circuit breaker to OFF.
- b. Unplug the power cord from socket.
- c. Remove the cabinet rear panel.
- d. Tag, then remove all terminated wires.
- e. On relay K201, remove the screw from the upper right corner and the screw, cable clamp, and spacer from the upper left corner. Remove relay K201 from its socket.
- f. On relay K202, set the hold-down latch upward, then remove the hold-down spring. Remove the relay from its socket.

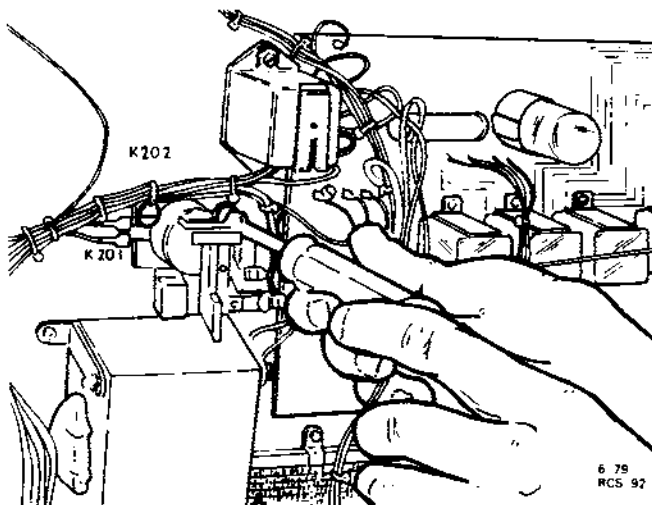


Figure 6-44.
Removal of Relay K201

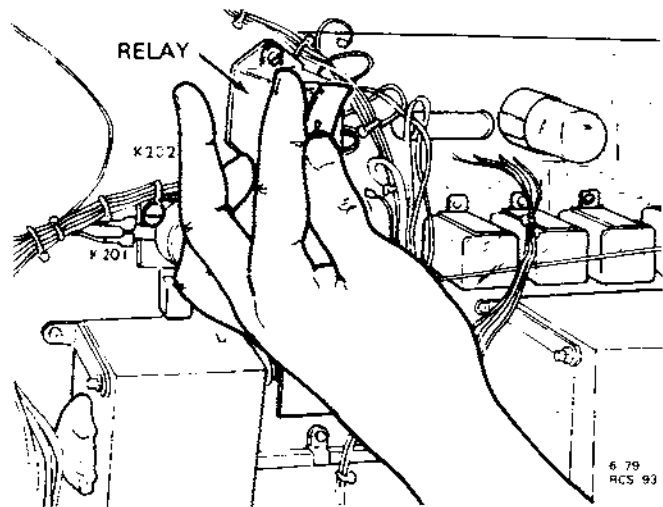


Figure 6-45.
Installation of Relay K201

2. Installation

- a. On relay K201, reconnect all terminated wires.
- b. Plug the relay into its socket, then install cable clamp, spacer, and all screws.

- c. On relay K202, plug the relay into its socket, then latch the hold-down spring.
- d. Install the rear cabinet panel.

c. Transformers T201 and T202 (T203)

1. Removal
 - a. Set main circuit breaker to OFF.
 - b. Unplug the power cord from socket.
 - c. Remove the rear cabinet panel.
 - d. Tag, then remove all terminated wires on the transformer to be replaced.
 - e. Remove the four screws, lockwashers, and flat washers, then remove transformer T201.

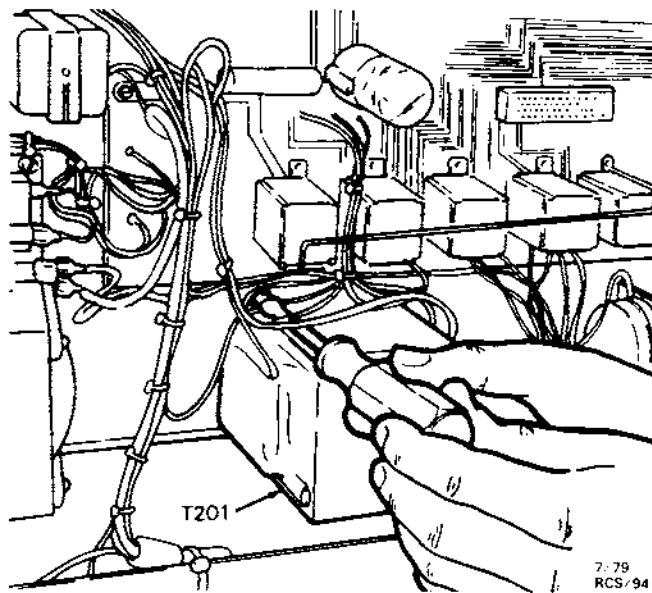


Figure 6-46. Removal of Transformer T201

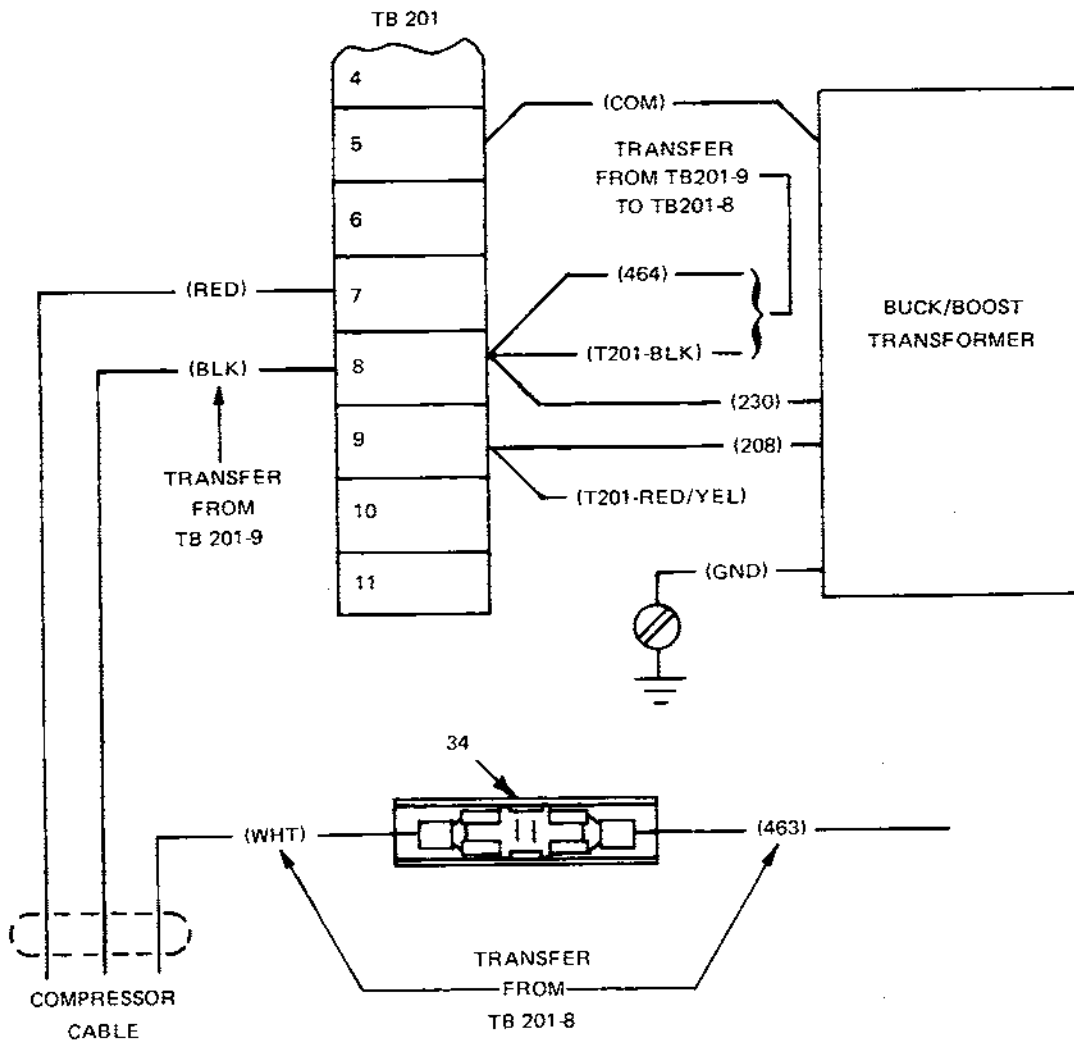
2. Installation

- a. Secure the transformer with four screws, lockwashers, and flat washers.
- b. Reconnect all terminated wires at correct terminals.
- c. Calibrate in accordance with Table 7-1.

d. Circuit Breaker CB301 (RC-5)

1. Removal

- a. Set main circuit breaker to OFF.
- b. Unplug the power cord from socket.
- c. Remove the cabinet front panel.
- d. Remove three screws, then extend the switch plate assembly.
- e. Loosen and remove the key switch inner locknut behind the switch plate assembly.
- f. Remove the outer locknut, then remove the keyswitch.
- g. Remove the surface plate.



7/79
RCS/95

Figure 6-47. Transformer Wiring for RC-5, 208 V, 60 Hz

- h. Tag, then remove, the terminated wires.
 - i. Remove the four screws securing the circuit breaker.
2. Installation
- a. Secure the circuit breaker with four screws.
 - b. Secure the terminated wires.
 - c. Replace the surface plate.
 - d. Insert the key switch, then secure the outer locknut.
 - e. Secure the key switch inner locknut.
 - f. Secure the switch plate assembly with three screws.
 - g. Replace the cabinet front panel.

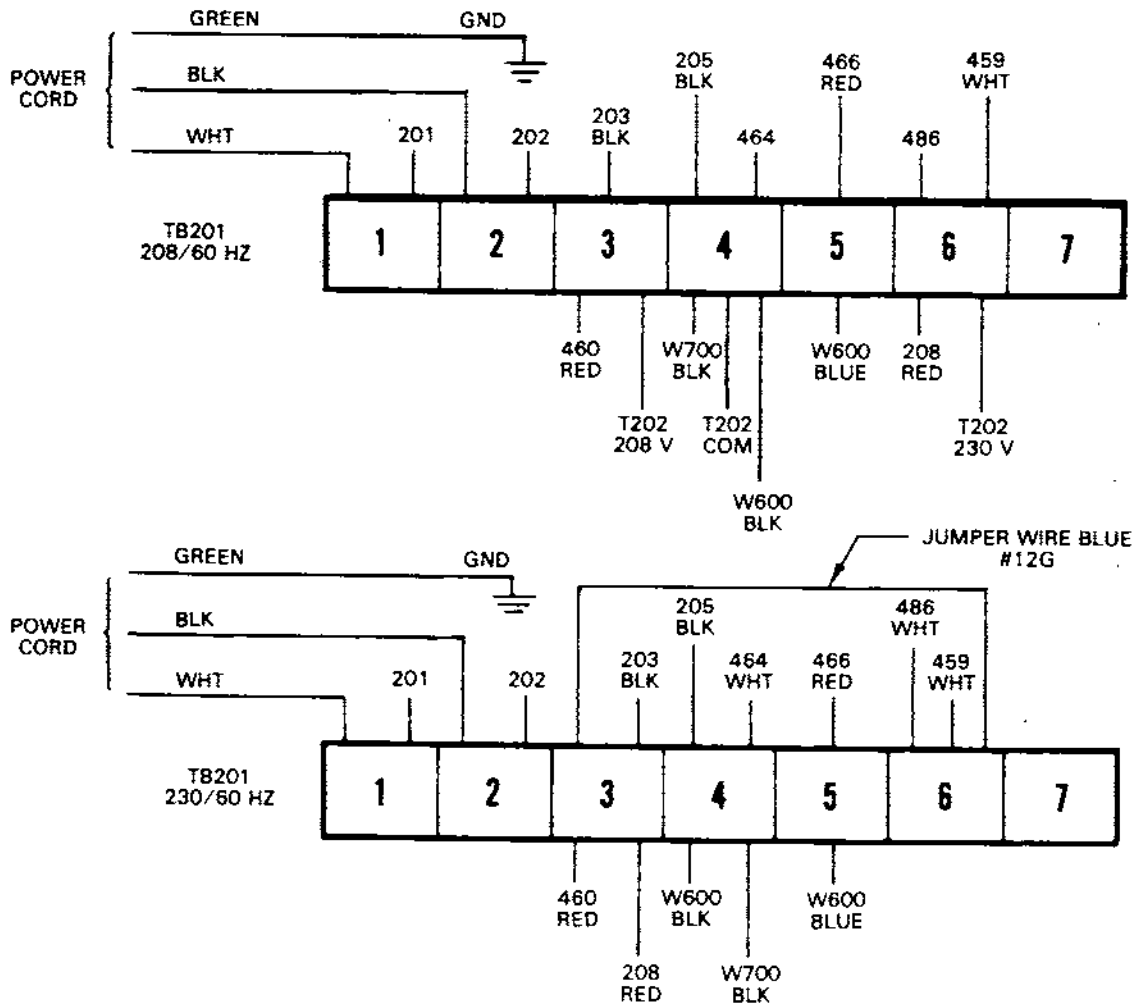


Figure 6-48. RC-5 Buck/Boost Transformer Wiring for RC-5 #7500414 and Higher

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e. Circuit Breaker CB301 (RC-5B)

1. Removal

- a. Set main circuit breaker to OFF.
- b. Unplug the power cord from socket.
- c. Remove the rear console panel.
- d. Tag, then remove all terminated wires.
- e. Remove two nuts and lockwashers, then remove CB301 with mounting plate. Remove two screws to remove the mounting plate from CB301.

2. Installation

- a. Secure CB301 to the mounting plate with two screws.
- b. Secure CB301 and the mounting plate to the frame with four screws and lockwashers.
- c. Reconnect all terminated wires.
- d. Install the rear console panel.

f. P.C. Assembly 20809 12987

1. Removal

- a. Set main circuit breaker to OFF.
- b. Unplug the power cord from socket.
- c. Remove the cabinet left panel.
- d. Lift and remove the catch on the right end of the P.C. board.

2. Installation

- a. Place the P.C. board on the track, then slide it in until there is a firm connection with the contacts of P.C. board 20126.
- b. Close the catch.
- c. Replace the left cabinet panel.
- d. Calibrate in accordance with Table 7-1.

**g. P.C. Assembly 20126, RC-5, Serial No. 7500414 & Higher;
50195, RC-5B**

1. Removal
 - a. Set main circuit breaker to OFF.
 - b. Unplug the power cord from socket.
 - c. Remove left and rear cabinet panels.
 - d. Remove P.C. board 20809 (Paragraph 6-14).
12987
 - e. Tag, then remove all terminated wires on the P.C. board.
 - f. Remove two screws and spacers and connector P304.
 - g. Remove two screws, lockwashers, tube clamps, spacers, and relay K207.
 - h. Remove two screws, lockwashers, and connector P101.
 - i. Remove screw, lockwasher, and insulating spacer at right end of relay hold-down bracket.
 - j. Remove screw, lockwasher, and holddown bracket at relay K208.
 - k. Remove two screws and lockwashers securing relays K204 and K205.
 - l. Tag and remove relays K203, K204, K205, and K208.
 - m. Remove four screws and lockwashers securing the P.C. board, then tilt and remove it from the cabinet.

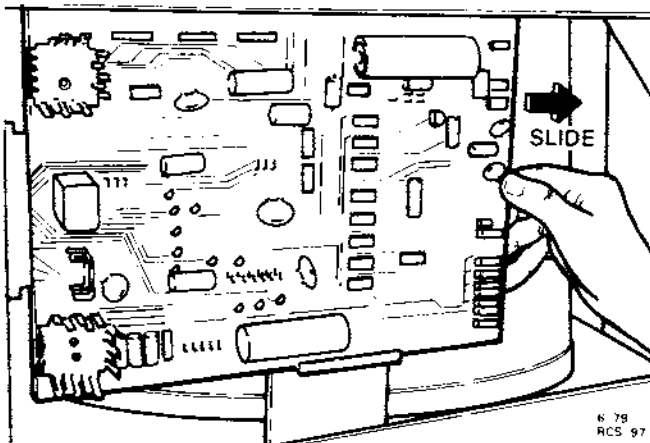


Figure 6-49.
Removal of P.C. Assembly
No. 20809
12987

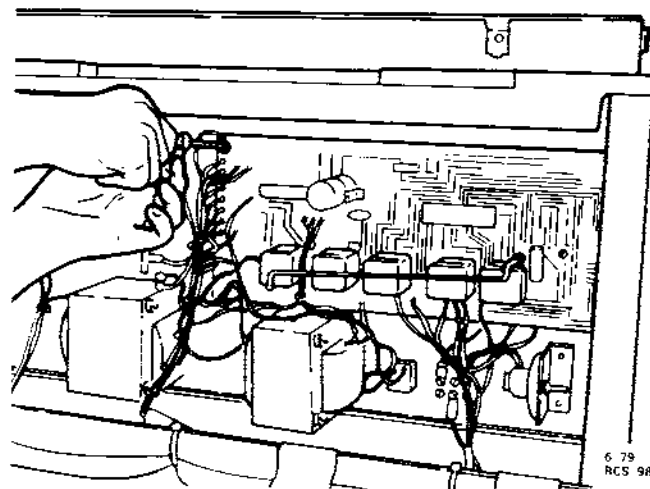


Figure 6-50.
Disconnecting Wires Terminating at
P.C. Board No. 20126

2. Installation

- a. Set the P.C. board into place.
- b. Loosely install four screws and lockwashers at the left side of the P.C. board.
- c. Insert two spacers under the relay K207 socket, secure two screws, lockwashers, and tube clamps, and insert relay K207.
- d. Secure the four screws installed in step (b).
- e. Insert relays K203, K204, K205, and K208 into the appropriate sockets.
- f. Secure relays K204 and K205 with two screws and lockwashers.
- g. Secure relay K208 with hold-down bracket, screw, and lockwasher.
- h. Insert insulating spacer under right end of hold-down bracket, then secure with screw and lockwasher.
- i. Secure connector PI01 with two screws and lockwashers.
- j. Secure all terminated wires.
- k. Install P.C. board ~~20809~~ (paragraph 6-14).
12987
- l. Replace cabinet panels.

h. Key Switch S202 (RC-5)

1. Removal

- a. Set main circuit breaker to OFF.
- b. Unplug the power cord from socket.
- c. Remove cabinet front panel.
- d. Remove three screws and extend the switch plate assembly.
- e. Loosen key switch inner locknut.
- f. Remove key switch outer locknut, then remove the key switch. Unsolder two leads from switch terminals.

2. Installation

- a. Insert the key switch and secure the outer locknut.
- b. Secure the inner locknut.

- c. Solder the two wires to the terminals at the rear of the switch. Avoid cold solder joints.
- d. Secure the switch plate assembly with three screws.
- e. Replace the cabinet front panel.

i. Door Microswitch S301 (RC-5)

1. Removal

- a. Set main circuit breaker to OFF.
- b. Unplug the power cord from socket.
- c. Remove the top deck and console as described in paragraph 6-12, steps 3 through 8.
- d. Tag, then remove, wires to the door microswitch S301.
- e. Remove two screws and remove microswitch.

2. Installation

- a. Install microswitch with two screws.
- b. Connect wires to microswitch.
- c. Replace the top deck and console.
- d. Reinstall the cabinet panels.

j. Door Hinge Microswitch S301 (RC-5B)

1. Removal

- a. Set main circuit breaker to OFF.
- b. Unplug the power cord from socket.
- c. Remove the top deck and console as described in paragraph 6-12, steps 3 through 8.
- d. Tag, then remove, all wires to the microswitch.
- e. Remove two screws and remove microswitch.

2. Installation

- a. Install the microswitch with two screws.

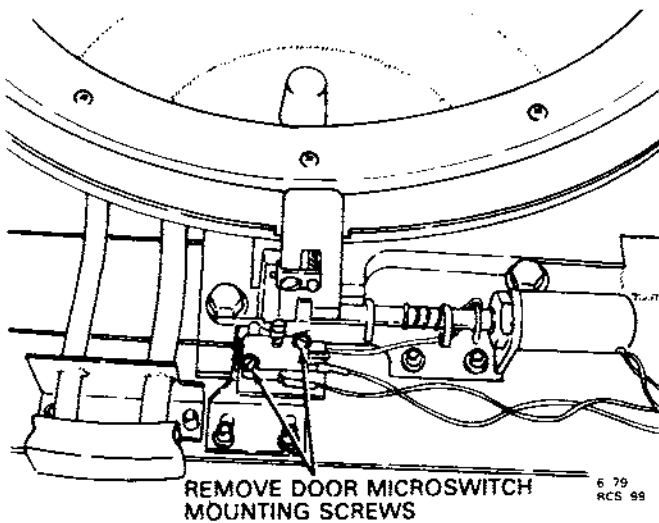


Figure 6-51.
Removal of Door Microswitch S301

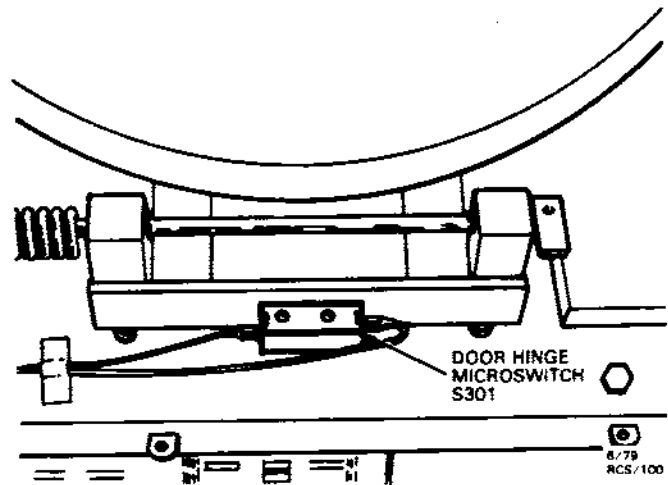


Figure 6-52.
Removing Mounting Hardware for Door Microswitch

- b. Connect wires to the microswitch.
- c. Replace the top deck and console.
- d. Reinstall the four cabinet panels.

k. Door Solenoid L301 (RC-5)

1. Removal

- a. Set main circuit breaker to OFF.
- b. Unplug the power cord from socket.
- c. Remove the deck and console as described in paragraph 6-12, steps 3 through 8.
- d. Using an Allen wrench (9/64 in), remove the two Allen head screws holding the solenoid assembly to the centrifuge.
- e. Straighten the set portion of the wire used to manually operate the solenoid to remove the right angle bend.
- f. Disconnect the Amphenol plug, then remove the assembly, being careful not to damage the wire used to manually operate the solenoid.

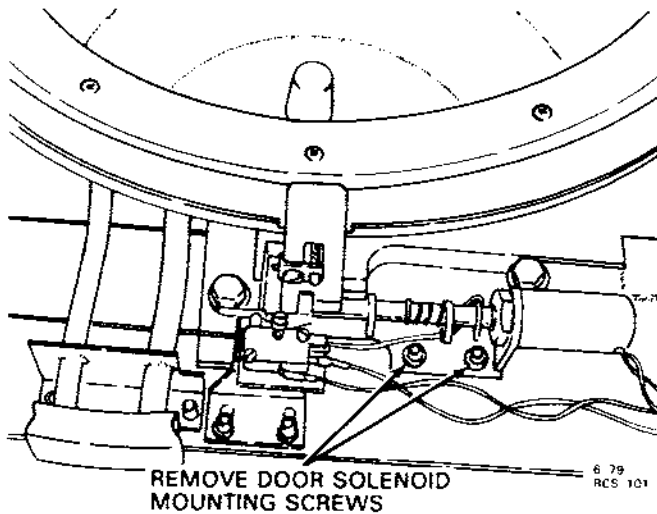
2. Installation

- a. Install the solenoid on the centrifuge then fasten it with the two Allen head screws.
- b. Connect the Amphenol plug.
- c. Bend the manual operate wire into a right angle bend at the front of the centrifuge.
- d. Replace the deck and console.
- e. Reinstall the four cabinet panels.

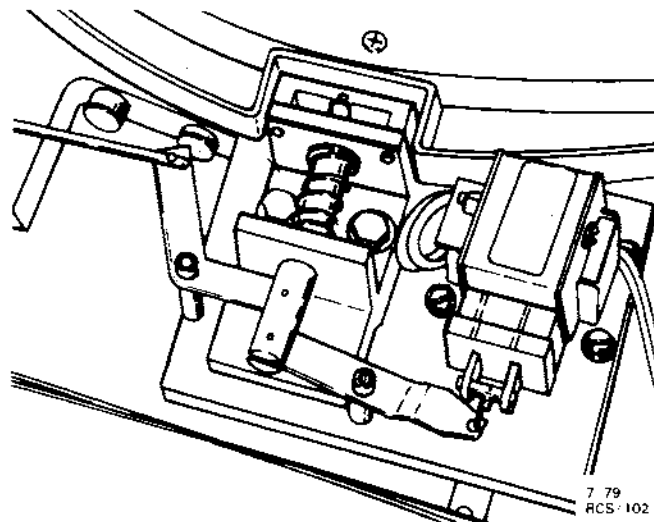
I. Door Release Microswitch S303 (RC-5B)

1. Removal

- a. Set main circuit breaker to OFF.
- b. Unplug the power cord from socket.
- c. Remove the top deck and console as described in paragraph 6-12, steps 3 through 8.
- d. Tag, then disconnect all terminating wires.
- e. Remove two screws holding the microswitch to the centrifuge.



*Figure 6-53.
Removing Hardware Mounting
Door Solenoid*



*Figure 6-54.
Disconnecting Wires Terminating
at Door Microswitch S303*

2. Installation

- a. Mount the microswitch to the centrifuge with the two screws.
- b. Reconnect the terminating wires.
- c. Replace the deck and console.
- d. Reinstall the four cabinet panels.

m. Door Solenoid L301 (RC-5B)**1. Removal**

- a. Set main circuit breaker to OFF.
- b. Unplug the power cord from socket.
- c. Remove the deck and console as described in paragraph 6-12, steps 3 through 8.
- d. Tag, then remove all terminating wires.
- e. Remove the four screws holding the solenoid to the centrifuge, disconnect the spring to the pivot arm, then remove the solenoid.

2. Installation

- a. Mount the solenoid to the centrifuge with the four screws and connect the spring to the pivot arm.
- b. Reconnect all terminating wires.
- c. Replace the deck and console.
- d. Reinstall the four cabinet panels.

n. Tachometer Indicator M101**1. Removal**

- a. Set main circuit breaker to OFF.
- b. Unplug the power cord from socket.
- c. Remove console rear panel.
- d. Tag (+) and (—) wires on M101.
- e. Remove both terminal nuts and terminated (+) and (—) wires.

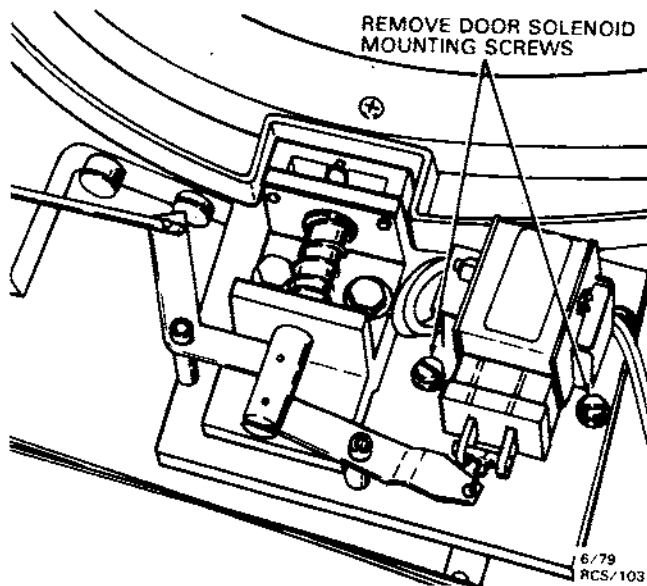


Figure 6-55.
Removing Mounting Hardware at
Door Solenoid L301

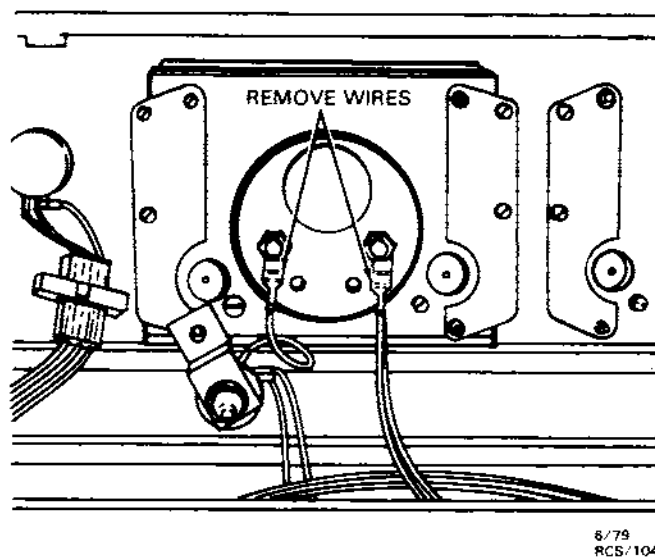


Figure 6-56.
Disconnecting Wires at
Tachometer Indicator M101

- f. Remove lower left nut, lockwasher, flat washer, and potentiometer bracket.
- g. Remove lower right nut, lockwasher, flat washer, and cable clamp, if present.
- h. Remove four outer mounting screws and lockwashers, then remove M101 with mounting bracket attached from behind the console.
- i. Remove remaining two nuts at top of M101, then remove mounting brackets.

2. Installation

- a. Secure the top of the mounting brackets to M101 with the nuts and lockwashers.
- b. Install M101 in the console, then secure with four screws and lockwashers.
- c. Secure the potentiometer mounting bracket to the lower left mounting bracket with a nut, lockwasher, and flat washer.
- d. Secure the cable clamp, if any, to the lower right mounting bracket with a nut, lockwasher, and flat washer.
- e. Remove the shorting clip from the M101 terminals.
- f. Using the terminal nuts, secure the (+) and (—) wires to the (+) and (—) terminals of M101, respectively.

- g. Calibrate in accordance with table 7-1.
- h. Replace the console rear panel.

o. Temperature Indicator M102

- 1. Removal
 - a. Set main circuit breaker to OFF.
 - b. Unplug the power cord from socket.
 - c. Remove the console rear panel.
 - d. On the front panel, loosen the setpoint knob setscrews and remove both knobs.
 - e. On the rear of the console, disconnect connector J105.
 - f. Tag the (+) and (−) terminated wires, then remove the terminal nuts and the terminated wires.
 - g. Remove the lower left nut, lockwasher, and flat washer, and remove the cable clamp, if present.
 - h. Remove four outer mounting screws and lockwashers, then remove M102 from the console.
 - i. Remove remaining three nuts and lockwashers, and remove brackets from M102.

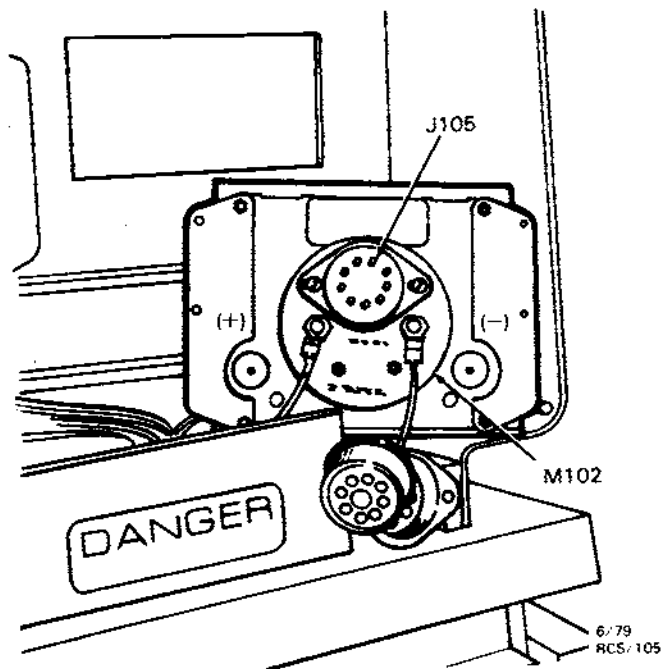


Figure 6-57. Disconnecting Plug and Wires from Temperature Indicator M102

2. Installation

- a. Secure mounting brackets to M102 in three places with nuts and lockwashers, leaving lower left nut and lockwasher off.
- b. Install M102 in the console, then secure the brackets with four screws and lockwashers.
- c. If cable clamp is available, secure it to the lower left bracket with nut, lockwasher, and flat washer.
- d. Remove the shorting bar from the M102 terminals.
- e. Using the terminal nuts, secure the (+) and (—) wires to the (+) and (—) terminals of M102, respectively.
- f. Align the key and fully seat connector J105.
- g. Install and secure the set-pointer knobs with the setscrews.
- h. Install the console rear panel.
- i. Calibrate in accordance with Table 7-1.

p. Timer (S106 and S107)

1. Removal

- a. Set main circuit breaker to OFF.
- b. Unplug power cord from the socket.
- c. Remove console rear panel.
- d. Disconnect connector P103 at rear of timer.
- e. Tag, then remove, all terminated wires.
- f. Loosen two setscrews, then remove skirted knob.
- g. Remove nut and lockwasher from timer shaft in front of console and remove timer from rear of console.

2. Installation

- a. Install the timer from the rear of the console through the alignment hole in the panel with switches facing downward and key way on the shaft facing downward.
- b. Secure the timer with the nut and lockwasher.

- c. Secure connector P103 and terminated wires.
- d. Install the console rear panel.
- e. Calibrate in accordance with Table 7-1.

q. RATE Control R110 (RC-5B)

1. Removal

- a. Set main circuit breaker to OFF.
- b. Unplug the power cord from socket.
- c. Remove console rear panel.
- d. Tag, then disconnect, all terminating wires on R110.
- e. Loosen setscrews, then remove knob.
- f. Remove nut and lockwasher from shaft of R110 at the front of the console.
- g. Remove R110 through the rear of the console.

2. Installation

- a. Install R110 through the rear of the console with terminals down.
- b. Secure R110 with the nut and lockwasher.
- c. Install the knob and secure with the setscrews.
- d. Connect all terminating wires at proper locations.
- e. Install the console rear panel.
- f. Calibrate in accordance with Table 7-1.

6-15. Door Adjustment

a. Preparation

1. Set main circuit breaker to OFF.
2. Unplug the power cord from socket.
3. Remove top deck and console as described in paragraph 6-12, steps 3 through 8.
4. Open door, then remove any shims between the moving member of the hinge and door. Retighten screws securely.

5. While the door is open, remove the counterbalance spring adjuster, then set it aside. Close the door gently.
6. Back off the bolts that fasten the hinge, then latch to the aluminum mounting bars far enough to allow lifting them off the mounting bars.
7. Remove the microswitch and solenoid assemblies.

b. Adjustment of Mounting Bars

1. Loosen the inboard bar mounting bolts which secure the aluminum bars to the frame members (four per bar). This will allow the bars to "spring back" to a reasonably flat condition. Stand back and "sight" along the top surface of each bar to verify this flatness.
2. Shim at each bolt location as necessary to maintain bar flatness when bar bolts are tightened (sometimes no shims are required). Torque bolts to 250 in-lbs. If a torque wrench is not available, tighten with a breaker handle (3/8 in) tightly but not excessively.

c. Hinge Height Adjustment

1. With the door resting on the evaporator flange by its own weight (check that latch finger is not caught under striker), shim the door hinge base as follows: find the thickness of shim or combination of shims that can be slipped under the ends of the hinge without lifting the door. Do this for each side of the hinge individually.

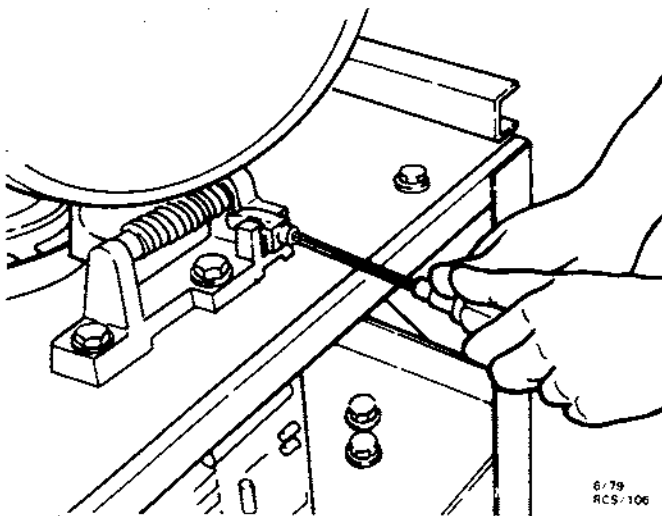


Figure 6-58.
Retighten Door Screws

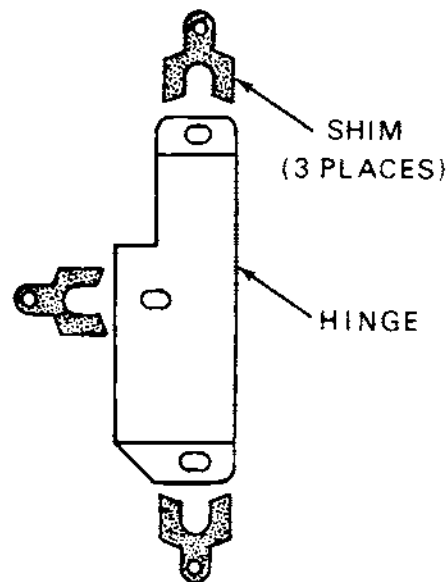


Figure 6-59.
Shim Orientation of the Centrifuge Door

NOTE

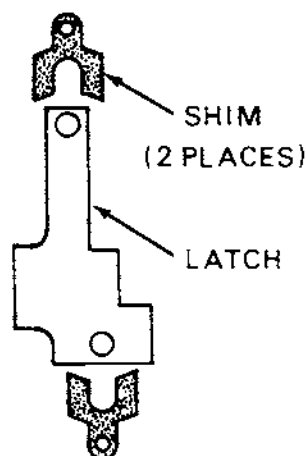
Subtract 0.4 mm (0.15 in) from each value and place shims equal to the new values under the ends of the hinge.

Move the door left or right to center the latching assembly and securely tighten the outside bolts of the hinge. Insert the appropriate shim under the center bolt and securely tighten it.

d. Latch Height Adjustment

This part of the adjustment procedure will establish a height for the latch when the following two conditions are met.

- The door will latch with a maximum of 22.5 Kg (50 lb) steady force near the outer edge of the handle.
 - Seal checking shims are retained with a MINIMUM of 0.45 Kg (16 oz) of pull.
1. Shim the latch (same thickness of shims under both ends of the latch base) until the edge of the striker on the door is approximately 1.6 mm (1/16 in) above the edge of the latch finger on the centrifuge deck. The shims should be positioned as follows:
 2. Lift the door and place four seal check strips in the evaporator seal ring at 2, 4, 8, and 10 o'clock positions.
 3. Close the door and exert a steady downward force on the handle. Pull the strips and check for drag.
 4. Shim the latch up as high as possible while maintaining seal contact. The lightest closing force which still achieves drag on the test strips is required. Tighten latch bolts to 250 in-lbs.



7-79
RCS-108

Figure 6-60. Shim Orientation for the Centrifuge Door Latch

e. Reinstallation of Components

1. Reinstall counter spring adjuster and adjust so that door will not strike the latch when allowed to fall from the fully open position.
2. Refit the solenoid. Shim as necessary with special rectangular 0.8 mm (1/32 in) shims. The interlock pin must travel free. Refit and adjust the microswitch.
3. Reinstall the deck and console and check that neither hinge nor latch interferes with the lip of the deck cover in any position.

6-16. Refrigeration Maintenance

a. Compressor Resistance Values

Tecumseh compressor motor resistance values are measured across compressor terminal leads. Approximate resistance of motor windings at ambient temperature of 25°C (77°F) is given in Table 6-1. Resistance of both windings is measured across compressor terminals R and S to common C.


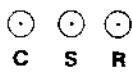
b. Compressor Burnout

If a compressor failure has been determined, it will be necessary to replace the complete condensing assembly. In this case, a determination must be made of the type of burnout that has occurred so that the evaporator liner can be cleaned accordingly.

Two types of burnouts can occur: a standing burnout or a running burnout. These can be determined by smelling and visually examining the refrigerant.

1. Open a service valve while holding a white cloth or white tissue over the opening to catch a few drops of oil.
2. Sniff the refrigerant; an acrid odor indicates a burnout.
3. Examine the refrigerant. If the oil is clean, a standing burnout is indicated and the contamination of the evaporator liner will not be extensive.

Table 6-1. Tecumseh Compressor Motor Resistance Values

Tecumseh Model	Resistance START	Range (Ohms) BOTH	Terminal Strip Location
AH2511J AH2466A	1-5 3-6	2-5) 3-6)	
JE150 JB100	3-6 6-9	4-7) 7-10)	

If the oil is contaminated, a running burnout is indicated. Refer to paragraph 6-16 for cleaning procedure.

c. Triple Sweep Evacuation of Refrigerant and Charge

1. Connect a System Analyzer to the HIGH and LOW service valves; then connect to vacuum pump, and evacuate the system at 30 inches vacuum pressure.

CAUTION

Do not mix refrigerant F12 and F502. Chemical reaction may cause refrigerants to mix with oil and produce contamination in the system.

2. Break the vacuum with the refrigerant to be used for charging the system, then vapor charge to 3-5 psi gauge pressure. Evacuate the system to 30 in vacuum.
3. Repeat step 2 twice prior to a final charge of 32 oz of refrigerant.

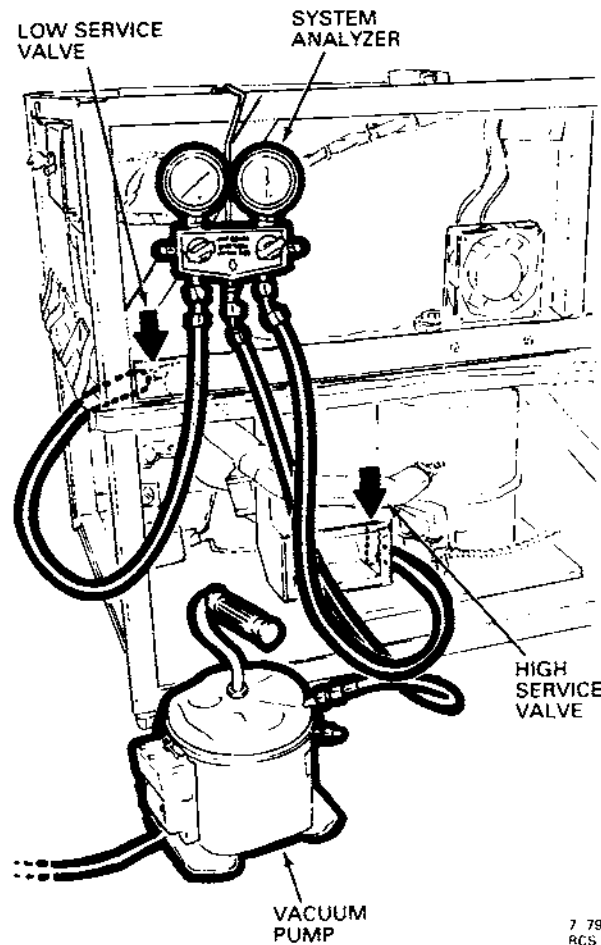


Figure 6-61. Cleaning and Charging the Refrigeration System

d. Checking Refrigerant Charge

1. Prepare the centrifuge by running the SS-34 rotor at 20 000 rpm for about 30 minutes with the RUN cycle temperature control (blue set pointer) at -3°C. The ambient room temperature should be about 25°C.
2. Connect a System Analyzer to the HIGH and LOW service ports and check the charge at the HIGH and LOW pressure ports. Gauge pressure should be in the following ranges for the RC-5 and RC-5B:

HIGH Pressure Side: 195 to 240 psi

LOW Pressure Side: 8 to 12 psi

Compressor

Current Draw: 10 - 13A

e. Leak Detection

1. With the system in operation, use an electronic leak detector in accordance with manufacturer's instructions.
2. If necessary, normal shop techniques using a concentration of water and soap are effective.

f. Evaporator Liner Cleaning

1. After removing the condensing assembly (paragraph 6-13), remove the filter drier from the HIGH pressure side fitting.
2. Using liquid refrigerants 11 or 113, flush the evaporator liner through the HIGH pressure side fitting into the capillary tubing through the evaporator and out the LOW pressure side suction tubing. Refrigerant 502 may be used as a refrigerant pressure.
3. Use a white cloth or soft paper to monitor the flushing. When the system is clean, flush the system with dry refrigerant 502.

Section 7

CALIBRATION PROCEDURES

7-1. General

This section provides information necessary to maintain optimum system performance by performing individual checks and adjustments to calibrate specific circuit functions. The calibrations are necessary only as a result of specific parts replacements and system aging and are performed only when referenced within the various sections of this manual.

7-2. Calibration Sequence

Since some circuit functions are dependent on and interrelated with others, the calibration procedures must be performed in specific sequence. Table 7-1 contains columns entitled ITEM REPLACED, REPLACEMENT REFERENCES, and CALIBRATION SEQUENCE. The ITEM REPLACED column lists all parts requiring calibration due to replacement or aging. The REPLACEMENT REFERENCE column provides a cross-reference to specific paragraphs associated with troubleshooting or replacement procedures. The CALIBRATION SEQUENCE column provides sequential step references subordinate to paragraph 7-6 or 7-7 and denotes which calibration procedures must be performed for the listed part. The step references are sequential and are used only in a left-to-right numerical progression as shown.

7-3. Calibration Criteria and Adjustment Locations

Ambient room temperature must not exceed 25°C and should remain stable when performing the calibrations. Also, power supplied to the centrifuge must be stable and constant. Unless otherwise specified, all test points (TP) and potentiometer (R) adjustments are located on printed circuit board No. 50059. Figure 7-1 locates these items. Tables 7-2 and 7-3 describe the test points and calibration for P.C. Board, PN 50059.

7-4. Personnel Safety

WARNING

Untrained personnel must not attempt to perform calibrations. Critical adjustments that are in the vicinity of high voltage components create electrical hazards to personnel unfamiliar with Sorvall® systems, so as to restrict use of these procedures to only highly trained service technicians.

7-5. Test Equipment Required

Volt/Ohmmeter: Simpson 260, Triplet (FET-310) or equivalent.

Precision Resistor, 149.79 ohm, 0.1%. Precision Resistor, 106.15 ohm, 0.1%.

Ammeter (clamp-on type): Triplet Model 10 or equivalent.

Portable Tachometer

Thermometer: McAlaster No. 39682 (-35°C to -50°C) or equivalent.

7-6. Calibration Procedures

a. Speed Indicator M101 Zero Adjust

The meter pointer should indicate zero at zero rotor rpm.

1. Set the main circuit breaker to OFF.
2. While gently tapping face of indicator M101, turn front access zero adjust clockwise, until pointer aligns with zero indication during the upswing.

b. Temperature Indicator M102 Zero Adjust

The temperature pointer (black) should indicate -20°C when the main circuit breaker is at OFF.

1. Set the main circuit breaker to OFF.
2. While gently tapping the face of M102, turn the front access zero adjust until the temperature pointer aligns with -20°C indication.

c. Speed Control Potentiometer R106

This is a mechanical alignment of SPEED selection for reference only.

1. Turn the SPEED control knob fully counterclockwise, then loosen the two knob setscrews.
2. Align the knob 0 (zero) indication with the SPEED indication and secure the two setscrews.

d. Source Power

This is a check of the main power to assure proper operation of centrifuge.

1. Check the source voltage.

2. The source voltage must be within 1.0% of the power rating specified on the back of the centrifuge.

e. Torque Trimmer Potentiometer R204

This component limits current drawn by the drive motor to govern rotor speed.

1. Install an SS-34 rotor and latch the chamber door.
2. Set the SPEED control to 21 000 rpm.
3. Place the system in the RUN mode.
4. Adjust the blue pointer exactly below the black pointer to activate the refrigeration system.
5. Position the clamp-on ammeter over the black or white heavy gauge wires coming from the main power switch.
6. After drive motor speed has stabilized and the compressor achieves stable operation, adjust potentiometer R204 for maximum rotor speed while not exceeding 30 A total current draw. Allow speed stabilization after adjustment then recheck the rotor speed and current draw.

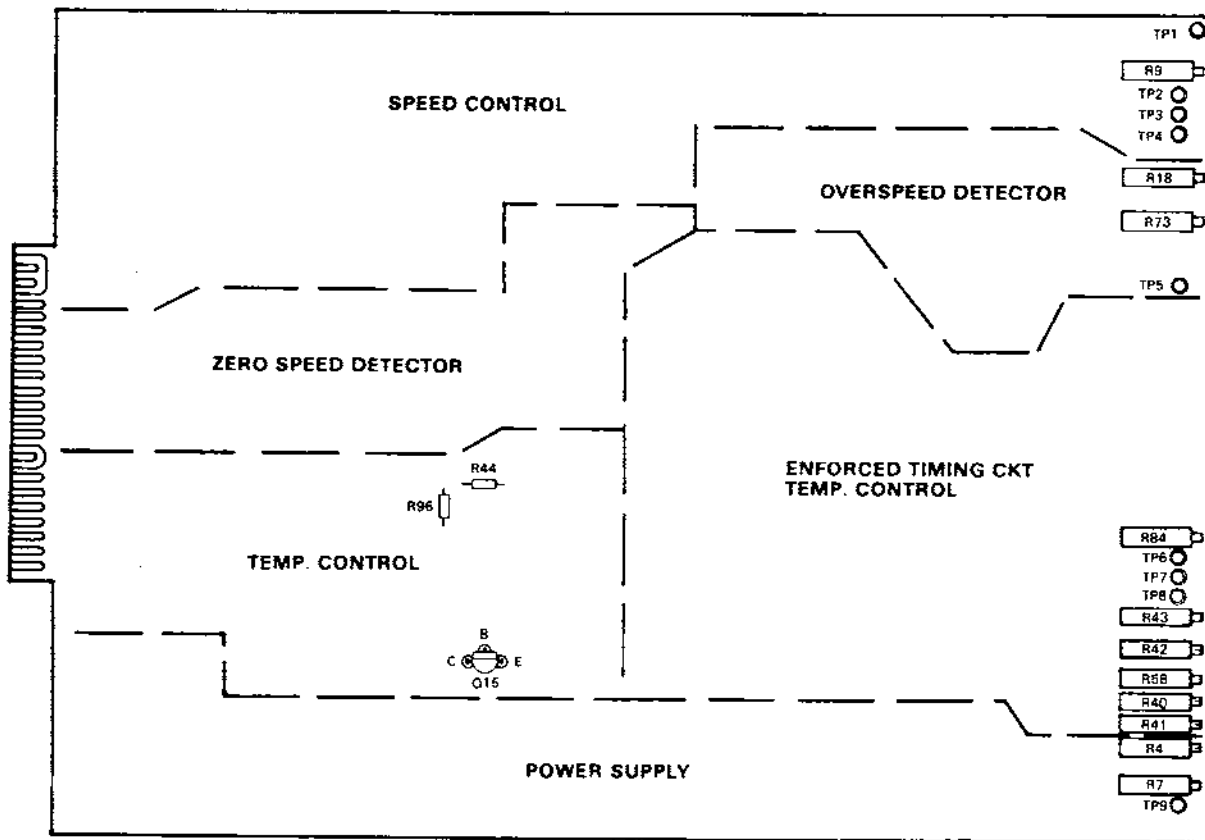


Figure 7-1. Test Point and Adjustment Locations for P.C. Board Assembly, PN 50059

Table 7-1. Calibration Sequence

ITEM REPLACED	REPLACEMENT PARAGRAPH	CALIBRATION SEQUENCE													
		Perform steps (a) through (q) in paragraph 7-6 in the numerical sequence given													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Tachometer Indicator M101	6-14, n	a	g												
Temperature Indicator M102	6-14, o	b	d	i	j	k									
PC Assembly, PN 50059	6-14 f, g	a	d	f	h	c	g	i	b	j	k	l	m	n	
Speed Control R106	—	c													
Torque Trimmer R204	6-5	d	c												
Resistance Temperature Detector (RTD)	6-14, a	b	l												
Tachometer-Generator	—	g	f	h											
Tachometer Indicator Adjust R109	—	a	g												
Drive Motor	6-4	d	a	g	f	e	h								
Saturable Reactor	6-6	d	a	g	f	e	h								
Transformer T201	6-14, c	d	i												
Timer	6-14, p	o													
Speed Switch (Rate Control RC-5B)	6-14, q	*													

*See paragraph 7-7

8/79
RCS/158

7. Set the main circuit breaker to OFF, then remove the clamp-on ammeter.

f. Speed Control Low Speed Potentiometer (R18) and High Speed Potentiometer (R9) Set

This calibrates the speed control circuit for accurate control of rotor speed.

1. Install an SS-34 rotor, then latch the chamber door.
2. Connect the portable tachometer to the SPEED indicator (-) minus terminal and potentiometer R109 center tap located behind the console on the RC-5. On the RC-5B, connect the portable tachometer to the tachometer jacks on the front panel.
3. Set the SPEED control to 1000 rpm.
4. Place the system in the RUN mode.
5. Adjust potentiometer R18 for a tachometer indication of 1000 rpm.
6. Set the SPEED control to 20 000 rpm.
7. Adjust potentiometer R9 for a tachometer indication of 20 000 rpm. If full counter-clockwise adjustment does not result in 20 000 rpm indication, adjust torque trimmer potentiometer R204 until 20 000 rpm is indicated.

g. Speed Indicator M101 Tracking Adjustment Potentiometer (R109)

This procedure adjusts the full range of speed indication.

1. Install an SS-34 rotor and latch the chamber door.
2. Place the system in the RUN mode. Connect the portable tachometer to the SPEED indicator (-) minus terminal and potentiometer R109 center tap on the RC-5. On the RC-5B, connect the tachometer to the tachometer jacks on the front panel.
3. Operate alternately at 1000 rpm and 20 000 rpm, then adjust potentiometer R109 until the error at both speeds is minimized.

h. Overspeed Detector Potentiometer (R73)

This procedure adjusts the overspeed detection circuitry for RUN mode disable at 22 000 rpm \pm 200 rpm.

1. Install an SS-34 rotor and latch the chamber door.
2. Adjust potentiometer R73 to disable the RUN mode when the motor speed is at 22 000 rpm \pm 200 rpm.

i. Power Supply, Temperature Control: +5 V (R7) and +10 V (R4)

This procedure adjusts the temperature control power supply to +5 V and +10 V output voltage.

1. Set the circuit breaker to OFF.
2. Connect the dc voltmeter between TP-1 (-) and TP-7 (+).
3. Place the system in the HOLD mode.
4. Adjust potentiometer R4 for +10 Vdc
5. Set the main circuit breaker to OFF.
6. Connect the dc voltmeter between TP-1 (-) and TP-9 (+), observing proper polarity of the test leads.
7. Place the system in the HOLD mode.
8. Adjust potentiometer R7 for +5 Vdc indication on the voltmeter.
9. Set the main circuit breaker to OFF.
10. Remove the voltmeter.

j. Temperature Indicator M102 Deflection Adjust -20°C Potentiometer (R41) and +40°C Potentiometer (R40)

This procedure adjusts M102 for zero and full scale indications.

1. Set the circuit breaker to OFF.
2. Place the centrifuge system in the HOLD mode.
3. Adjust potentiometer R40 fully counterclockwise.
4. Referring to figure 7-2, place the 106.15 ohm precision resistor in the circuit.
5. Adjust potentiometer R41 for a -20°C indication. Remove the 106.15 ohm resistor.
6. Referring to figure 7-2, place the 149.79 ohm precision resistor in the circuit.
7. Adjust potentiometer R40 for a +40°C indication .
8. Repeat steps 4 through 7 until -20°C and +40°C indications are obtained.
9. Set the main circuit breaker to OFF.
10. Remove the precision resistor and reconnect the original circuit as shown in figure 7-2.

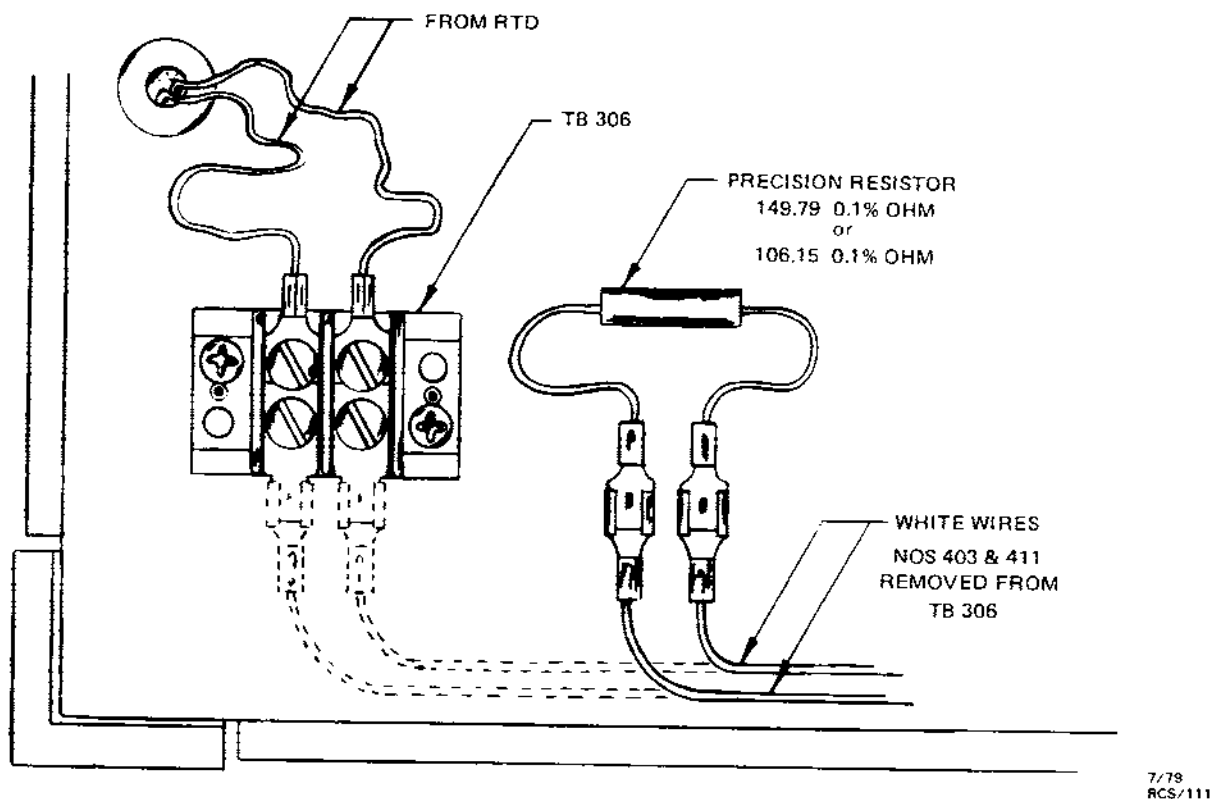


Figure 7-2. Test Setup for Temperature Meter Deflection Adjustment

k. Rotor Speed Temperature Differential Set-Point Calibration at 20 000 Rpm (R41)

This procedure compensates for the temperature differential between the rotor and the chamber at 20 000 rpm.

1. Install an SS-34 rotor with two tubes balanced and half full of alcohol or other anti-freezing liquid prechilled to +2°C.
2. Set the RUN mode set-pointer to -3°C.
3. Operate in the RUN mode at 5000 rpm until the temperature indication stabilizes at -3°C, and then at 20 000 rpm for 45 minutes. With the brake on, allow the rotor to decelerate to a complete stop. Then, record the temperature.
4. At zero rpm, quickly place a thermometer into one tube for three minutes, then quickly into the second tube for two minutes. The desired temperature of the material in the rotor is +2°C with the pointer set at -3°C.
5. Adjust potentiometer R41 until the -3°C set-pointer indication is 5°C colder than the temperature recorded in step 4 — clockwise rotation will increase the rotor temperature while moving the temperature pointer downward .

6. Repeat steps 2 through 5 until -3°C set-pointer is 5°C below the temperature recorded in step 4.

l. Temperature Control Set-Points Potentiometer (R42 and R43)

This procedure establishes the RUN and HOLD mode compressor set points.

1. Set the main circuit breaker to ON.
2. Install an SS-34 rotor and latch the chamber door.
3. Set the RUN mode set point to 5°C below indicated temperature.
4. Set the HOLD mode set point to 5°C above indicated temperature.
5. Connect the dc voltmeter to TP-1 (-) and the collector of transistor Q15 (+). Meter indication should be greater than 4.5 Vdc.
6. Move the HOLD set-pointer toward the back temperature indicator pointer until the HOLD pointer is exactly over the black temperature indicator pointer. The voltage should switch to lower than 1.0 Vdc.
7. If the voltage change occurs above or below the set-pointer, align the set-pointer with the black indicator and adjust potentiometer R42 accordingly.
8. Set the SPEED control to 1000 rpm.
9. Be sure the rotor is secured and the chamber door latched.
10. Set the HOLD mode set point to 5°C above indicated temperature.
11. Set the RUN mode set point to 5°C below indicated temperature.
12. Place the system in the RUN mode.
13. The meter indication should be less than 1.0 V dc.
14. Move the RUN set point towards the black temperature indicator pointer until the pointer is completely aligned with the black temperature indicator pointer. The voltage should switch to greater than +4.5 Vdc.
15. If the voltage change occurs above or below the set point, align the set point with the black indicator, then adjust potentiometer R43 accordingly.

m. Overtemperature Detection Set-Pointer (R58)

This procedure adjusts the overtemperature set point to inhibit, or disable the operation of, the RUN mode.

1. Set the main circuit breaker to ON.

2. Set the RUN mode set-pointer at 10°C to 15°C below indicated temperature.
3. Set the HOLD mode set point to coincide with the indicated temperature.
4. Be sure that rotor is secured and the chamber door is latched.
5. Set the SPEED control to 0 rpm.
6. Place the system in the RUN mode. The centrifuge ON switch on the RC-5 or the START switch on the RC-5B should light.
7. Slowly decrease the HOLD set point to 2°C below the indicated temperature. The system should transfer to the HOLD mode — the centrifuge ON switch lamp should switch to OFF and the OFF lamp should illuminate on the RC-5. For the RC-5B, the START lamp should go OFF.
8. If the conditions of step 7 are not obtained, adjust R58 accordingly.

n. Compressor Timing Potentiometer (R84)

This procedure adjusts the HOLD and RUN mode ON and OFF duty cycles.

NOTE

Duty cycle timing Potentiometer (R84) is a factory-set critical adjustment, utilizing waveshape and timing set observations. The following steps may be used only as a last resort in absence of factory or depot facilities.

1. Install an SS-34 rotor and latch the chamber door.
2. Set the SPEED control to 1000 rpm.
3. Place the system in the HOLD mode.
4. Record the duration of the compressor ON and OFF times cycles, when the temperature pointer rises above the HOLD set point.
5. Place the system in the RUN mode.
6. Adjust the RUN set point pointer to the left of the temperature indicator to turn the compressor ON.
7. Record the compressor OFF time cycle when the RUN set point is quickly moved to the right and then back to the left of the temperature pointer.
8. Adjust potentiometer R84 until the recorded durations in step 4 are 13 to 15 seconds on and 108 to 132 seconds off; and the recorded off duration in step 7 is 36 to 44 seconds.

o. Timer Control Knob and Switch Adjust (S106 and S107)

This procedure adjusts the mechanical adjustment of control knob and switches.

1. Set the main circuit breaker to ON.
2. Make certain that the rotor is secured and the chamber door latched.
3. Set the SPEED control to 1000 rpm.
4. Press and hold the ON switch on the RC-5 or START switch on the RC-5B, then rotate the timer control shaft counterclockwise until the RUN mode stays ON, then release the ON switch on the RC-5 or START switch on the RC-5B.
5. Rotate the timer control shaft counterclockwise until the RUN to HOLD mode transition occurs.
6. Align and secure the timer control knob STOP position with the console vertical mark.

7-7. RC-5B Automatic Rate Controller Calibration

This test is performed with an SS-34 rotor installed in centrifuge. The test instrument required is a portable digital tachometer with test leads, or equivalent.

Perform test as follows:

1. Check that power outlet supplies proper power rating as specified on name plate.
2. Check that main power cord is plugged into power outlet.
3. Set main circuit breaker to OFF.
4. Facing the control panel, remove the front and right side panels of the centrifuge and rear cover of control panel.
5. In base, unclip the motor silencer enclosure and lower it enough to observe brush lift mechanism operation.
6. Check condition of brushes for excessive wear. Replace if necessary.
7. Set main circuit breaker to ON.
8. Press SLOW switch.
9. Observe brush mechanism for proper operation.
10. Press SLOW switch for OFF position, observing the following: relay K407 should disengage, and brush lift return to normal.

11. Press SLOW switch for ON. Relay K407 should energize to enable the brush mechanism.
12. Check that door is open.
13. Set rate at 60, connect portable tachometer at the control console.
14. Press both START and DOOR switches at the same time.
15. Check for proper drive motor operation.
16. Check for proper brush tension.

NOTE

Check that rotor is rotating at a 60 rate. Increase rate potentiometer to 0. Be sure rotor does not switch to normal RUN cycle with the door fully open.

17. Set portable tachometer to indicate frequency readings.
18. Check tachometer for a speed indication of 250 Hz/min with the chamber door fully open.
19. Rate Control Calibration:
 - a. Turn rate control potentiometer R110 to maximum limit by turning fully clockwise facing the back of the centrifuge.
 - b. On P.C. Assembly No. 50155, turn potentiometer R14 to a fully clockwise position and stop, then slowly turn back in a counterclockwise direction until the first fully horizontal position is obtained.

NOTE

For a fine adjustment, turn potentiometer R14 in a clockwise direction to increase or counterclockwise direction to decrease.

- c. Press door switch S301; the compressor should start operating.
 - d. Set timer to the OFF position.
20. Close centrifuge door.
21. Set timer to HOLD position.
22. Press START switch for ON.
23. Observe that transfer point occurs between 170 Hz to 180 Hz when accelerating.
24. Observe that transfer point occurs between 110 Hz and 120 Hz during deceleration.

25. Repeat step 19, c and d as required to get the proper calibration.
26. For fine adjustments, turn potentiometer R14 counterclockwise to increase or clockwise to decrease.
27. When proper transfer is achieved, set timer to OFF.
28. With rotor at rest, set timer to HOLD.
29. Press START switch. Check lapsed time indicator from zero rpm.
30. Set to transfer point.

NOTE

The transfer point should not exceed a 3-minute duration. If the transfer exceeds 3 minutes, the rate controller P.C. board No. 50155 should be changed.

31. Set main power switch to OFF.
32. Replace silencer in proper position around the drive motor.
33. Replace all side and rear panels removed.

Table 7-2. Test Point Description for P.C. Board, PN 50059

TP-1	Common
TP-1 - TP-2	0 to 120-150 Vdc Speed Control Output
TP-3 - TP-4	0 - 11 Vdc Zero Speed Detector

NOTE

Floating power supply, tachometer signal comes in and must float because of operation of speed control. (Do not go to ground.)

0 RPM 0 Volts above 100 RPM 11 Vdc

TP-4	Common to 0 speed detector and overspeed detector.
TP-5	To monitor tach signal when and if test rig becomes available.
TP-6	With scope will measure 0-5V pulse every 1.25 seconds. Counts for hold mode.

**Table 7-2. Test Point Description for
P.C. Board, PN 50059 (Continued)**

NOTE

Refrigeration system will also be off for two, minimum of 40 seconds on run cycle. Hold mode compressor is on no longer than 15 seconds and must be off for two minutes.

TP-7 - TP-1	10 Vdc Temperature Control Power Supply. Lights lamps in Photo Cell and power for temperature meter bridge circuit.
TP-8 - TP-1	Controls compressor 0 Volts Compressor on, 5 Vdc Compressor off.
TP-9 - TP-1	5 Vdc power to temperature control logic.

**Table 7-3. Potentiometer Adjustment for
P.C. Board, PN 50059**

R4	TP-1 - TP-7. 10 Vdc Temperature Control Pilot and Bridge Circuit.
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NOTE

Adjust R4 before adjusting R7.

R7	TP-1 - TP-9. 5 Vdc Power to Temperature Control Logic.
R9	Speed Control High rpm Setting 20 000 rpm.
R18	Speed Control Low rpm Setting 1000 rpm.
*R40	Temperature Control Indicating Needle +40 Set Point.
*R41	Temperature Control Indicating Needle -20 Set Point.

NOTE

Use temperature calibrating test set when adjusting R40 and R41.

*R42	Temperature Control Orange Pointer (hold). Adjust to turn Compressor on when Temperature Indicating Needle meets Hold Temperature Set Point.
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Table 7-3. Potentiometer Adjustment for P.C. Board, PN 50059 (continued)

*R43	Temperature Control Blue Pointer (run). With rotor in position, operate centrifuge at approximately 1000 rpm. Adjust to turn Compressor Off when Temperature Indicating Needle meets Run Temperature Set Point.
*R58	Temperature Control Overtemperature Detector. Adjust to cut power to Centrifuge Drive when Temperature Indicating Needle reaches a point 3°C higher than Red (hold) Pointer Setting.
R73	Overspeed Detector. Adjust to cut power to Centrifuge Drive when rpm exceeds 21 000 rpm.
R84	Adjust 1.25 Second Pulse for Refrigeration System.

NOTE

Do not adjust. Adjustment made in factory.

- * When adjusting potentiometers R40, R41, R42, P43, and R58, disconnect one compressor lead from relay K201 to prevent compressor from cycling on and off. Hold cycle has a two minute time delay after each 15 second cycle. This time delay may be avoided when calibrating R42 by placing one probe of VOM meter on collector lead of Q15 and other probe on TP-1.

Meter will read 5 Vdc when compressor is in off cycle and will read 0 volts when compressor is in run cycle. Temperature calibrating test set may also be used on adjustments R42, R43, and R58 using variable setting.

Section 8

ILLUSTRATED PARTS

8-1. General

This section provides illustrations of RC-5 and RC-5B assemblies which are keyed, by item numbers, to accompanying parts lists. The parts lists provide a part number and description for each item called out on the illustrations. When ordering replacement parts, specify the part number and description, and the serial number and model of the centrifuge.

8-2. Indentation

Parts in these lists are indented to indicate item relationships. The following is an example of the indentation system used in the description column.

Assembly and/or component

- Detail Part or Subassembly of Assembly and/or Component
- Attaching Hardware (if applicable) for Detail Part or Subassembly
- Part of Detail Part or Subassembly
- Attaching Hardware (if applicable) for Assembly or Component

NOTE

Normally, only special attaching hardware is listed. Except for any special items, all hardware is stainless steel in standard sizes that can be obtained locally.

*****Note*****

Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.

**Table 8-1. RC-5 Parts List
(Key to Figures 8-1 through 8-7)**

RC-5 GYRO ACTION DRIVE			
FIGURE	ITEM	P/N	DESCRIPTION
8-1	1	20466	Gyro Action Assembly
8-1	2	20474	❖ Tapered Spindle and Pin Subassembly
8-1	3	20468	❖ Bearing Housing (Not Available)
8-1	4	12734	❖ Bearings
8-1	5	20109	❖ Neoprene Cover Seal
8-1	6	20464	❖ Bearing Shaft Assembly
RC-5 CENTRIFUGE DRIVE MOTOR ASSEMBLY			
8-2	15	12220	❖ Motor Assembly
8-2	23	20470	* Lower Cap
8-2	25	20507	* Tie Rod
8-2	34	12220	* Belleville Spring Water
8-2	35	61815	* Flange Nut
8-2	1	12220	* Upper Cap
8-2	22	12106	❖ Tachometer-Generator
8-2	21	06042	* Tachometer-Generator Adapter
8-2	20	60554	* Flex Lock Nut
8-2	19	61860	❖ Pan Head Machine Screw ❖
8-2	18	61496	❖ Washer #5 int. Tooth Lock
8-2	14	20482	❖ Cord and Plug Assembly
8-2	26	20463	❖ Plate and Brush Holder Assembly
8-2	24	20478	* Insulating Disc
8-2	27	61436	* Brush Spring
8-2	28	12284	* Brushes
8-2	29	61756	* Contact Spring, Brush Warning
8-2	16	12751	❖ Armature Assembly with Bearings
8-2	17	204672	* Slinger*
8-2	30	62811	* Spring Finger 0.814 I.D. Preload
8-2	31	20483	* Spacer (shim)
8-2	32	20509	* Spacer (shim)
8-2	33	20510	* Spacer (shim)

*****Note*****

Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.

Table 8-1. RC-5 Parts List (Continued)
(Key to Figures 8-1 through 8-7)

RC-5			
CENTRIFUGE DRIVE MOTOR ASSEMBLY			
FIGURE	ITEM	P/N	DESCRIPTION
8-2	7	20562	❖ Motor Mounting Plate Assembly
8-2	8	25001	* Mounting Cushion
8-2	9	20122	* Mounting Plate
8-2	10	60669	* Stem Bushing (rubber)
8-2	11	20182	* Spacer (stainless steel)
8-2	12	20184	* Rubber Seal Ring (use 20562)
8-2	5	60667	* Flat Head Machine Screw
8-2	6	20135	* Retaining Plate
8-2	13	20533	❖ Fan
8-2	2	20462	❖ Lower Coupling Assembly
8-2	3	61760	* Flat Socket Head Machine Screw
8-2	4	20481	➤ Sleeve

RC-5			
Control Console			
FIGURE	ITEM	P/N	DESCRIPTION
8-3	1	12251	Door Switch Assembly S108
8-3	2	12248	Indicator Light Assembly, <i>BRUSHES</i> DS102, REFRIG, DS103
8-3	3	12249	Indicator Light Assembly <i>POWER</i> DS104
8-3	4	20855	Potentiometer R106 SPEED Control
8-3	5	66639	Meter M101 rpm Indicator
8-3	6	12819	Meter M102 TEMPERATURE Control
8-3	7	12252	<i>BRAKE</i> Switch Assembly S109
8-3	8	12250	<i>OFF</i> Switch Assembly S110
8-3	9	12312	<i>ON</i> Switch Assembly S111
8-3	10	20868	Timer, 2 Hr., 115 Vac/60 Hz
8-3	10	20867	Timer, 2 Hr., 115 Vac/50 Hz
8-3	11	20829	Potentiometer, R107, Tach Trimmer
8-3		83187	❖ Lamp only for above Indicator

*****Note*****

Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.

Table 8-1. RC-5 Parts List (Continued)
(Key to Figures 8-1 through 8-7)

RC-5 LOWER CONTRTOL PANEL			
FIGURE	ITEM	P/N	DESCRIPTION
8-5	1	904462	❖ Braking Resistor R202, 55W
8-5	2	20938	Buck Boost Transformer T202
8-5	3	12731	Relay K201, Refrigeration
8-5	4	12919	Relay K202
8-5	5	20126	P.C. Board, Lower Control Panel
8-4	1	65984	❖ Relay K208, K203, K204, K206
8-4	2	65984	❖ Relay K205
8-4		63116	❖ Relay K208, K204, K206, Hard wired (old) RC-5
8-4		65927	❖ Relay K205, Hard wired (old) RC-5
8-4		61968	❖ Relay K203, Hard wired (old) RC-5
8-5	6	20145	Transformer T201
8-5	7	923627	Rectifier CR201
8-5	8	61960	Rheostat R204
8-5	14	65997	Terminal Board, TB201
8-5	15	62902	Terminal Board, TB203

RC-5 REFRIGERATION Original Configuration			
FIGURE	ITEM	P/N	DESCRIPTION
8-6		91470	Filter Drier
8-6		20258	Suction Line
8-5	12	91392	Fan Motor
8-5	10	91983	Run Capacitor
8-5	10	91981	Start Capacitor
8-5	10	91986	Potential Relay
8-5		91987	Fan Blade
8-5	9	12139	Condensing Assembly
		66952	Teflon Seal (Large)
		61768	Teflon Seal (Small)
8-6		12236	Evaporator
8-6		20654	Tube, Filter to Service Valve (Flair)
8-6		22011	Tube, Filter to Service Valve (Rotalock)

*****Note*****

Page 8-4.1 Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.

Table 8-1. RC-5 Parts List (Continued)
(Key to Figures 8-1 through 8-7)

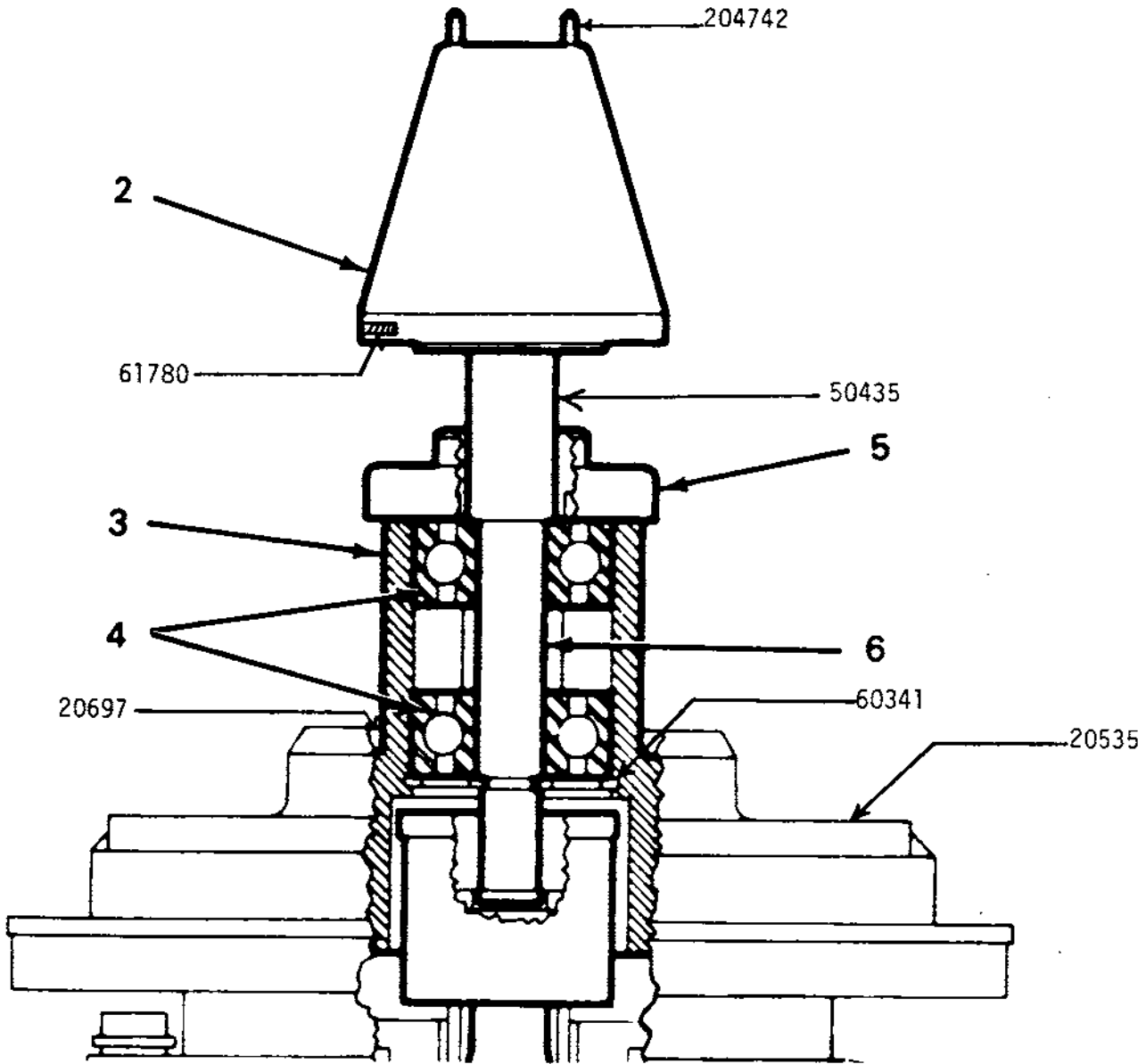
RC-5 REFRIGERATION			
<i>(Instruments with condensers replaced after July 1999)</i>			
FIGURE	ITEM	P/N	DESCRIPTION
8-6		91470	Filter Drier
8-6		20262	Suction Line
8-5	12	91392	Fan Motor
8-5	10	92733	Run Capacitor
8-5	10	92734	Start Capacitor
8-5	10	92732	Potential Relay
8-5		91987	Fan Blade
8-5	9	12139	Condensing Assembly
		66952	Teflon Seal (Large)
		61768	Teflon Seal (Small)
8-6		12236	Evaporator
8-6		22011	Tube, Filter to Service Valve (Rotalock)

RC-5 ELECTRICAL			
FIGURE	ITEM	P/N	DESCRIPTION
8-6	1	12987	P.C. Board Assembly
8-6	2	50798	Key Switch S303
8-6	3	64585	Circuit Breaker CB301
8-6	4	60817	Fuse F302, 3A (Not Available)
8-6	5	68019	Fuse F301, 10A, 32V Slo Blo (Not Available)
8-6	6	61421	Saturable Reactor, 205-230 Vac/60Hz
8-6	6	616474	Saturable Reactor, 220 Vac/50 Hz
8-6	7	20747	Brush Warning Box
8-7	1	64067	Microswitch S301, Door Interlock
8-7	2	12237	Door Solenoid L301
8-7	3	65785	Fan Assembly (Not Available)

*****Note*****

Page 8-4.2

Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.



*****Note*****

Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.

Figure 8-1. RC-5 Parts Location, Gyro Action Drive Assembly

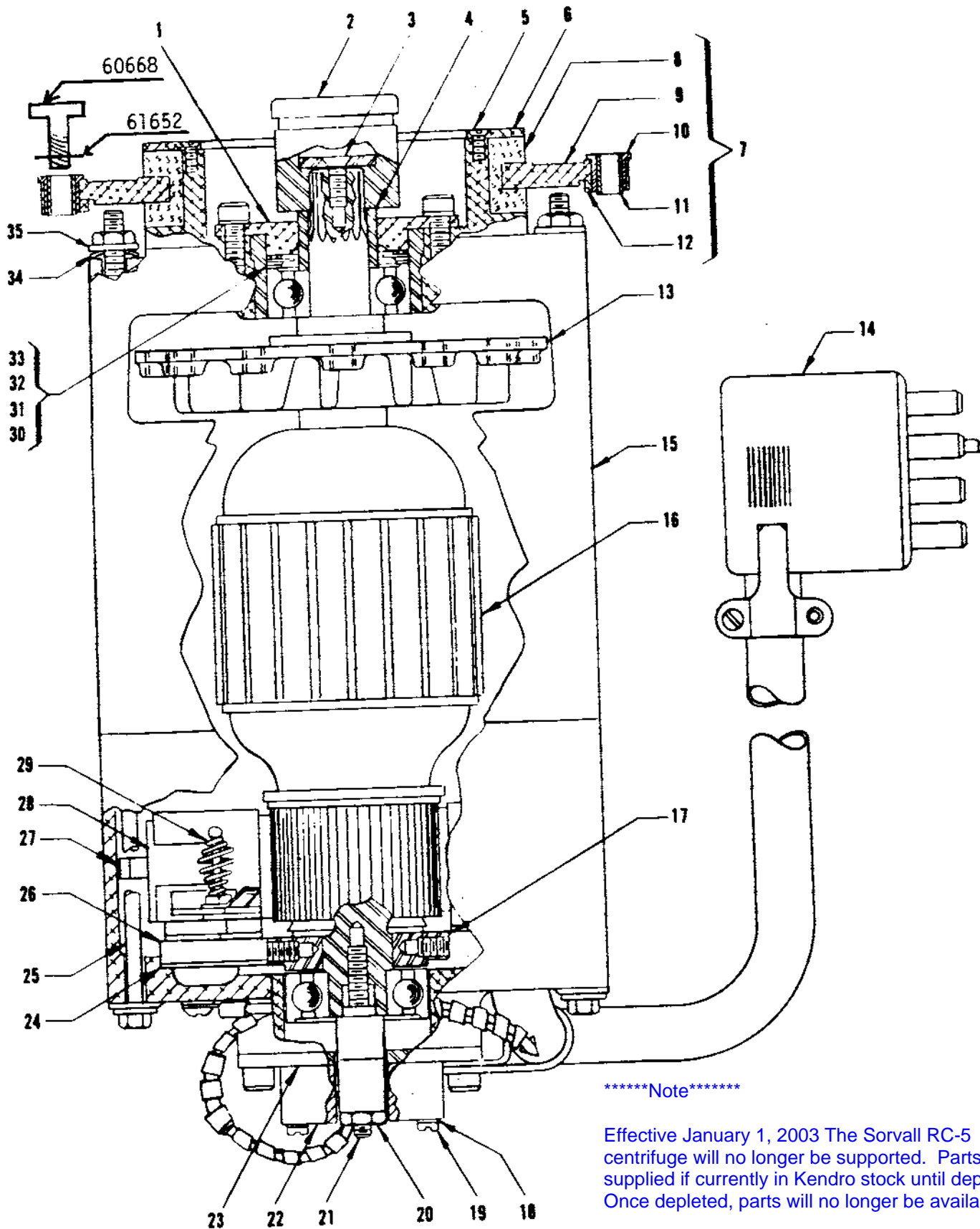
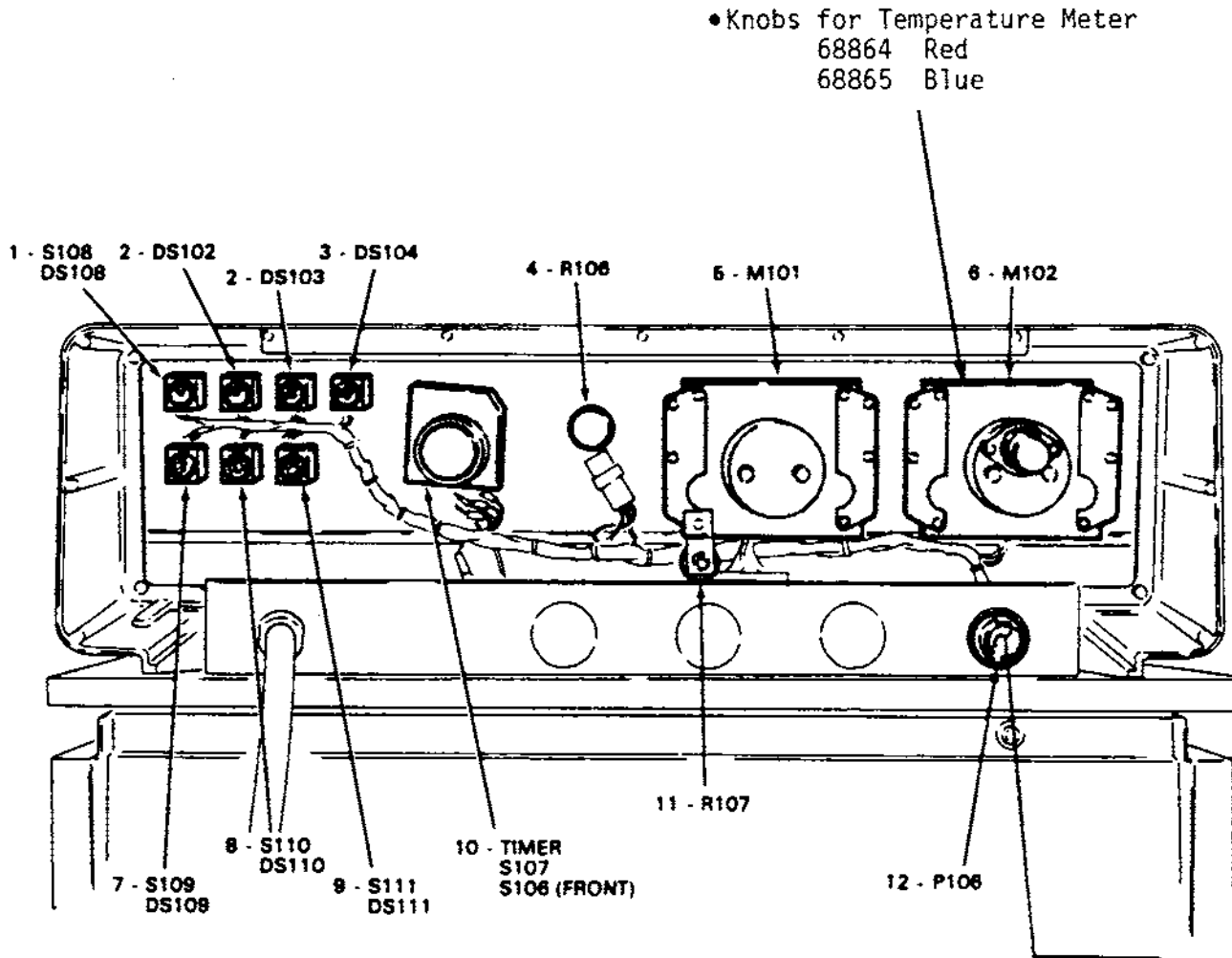


Figure 8-2. RC-5 Parts Location, Motor Tachometer and Lower Coupling Assembly

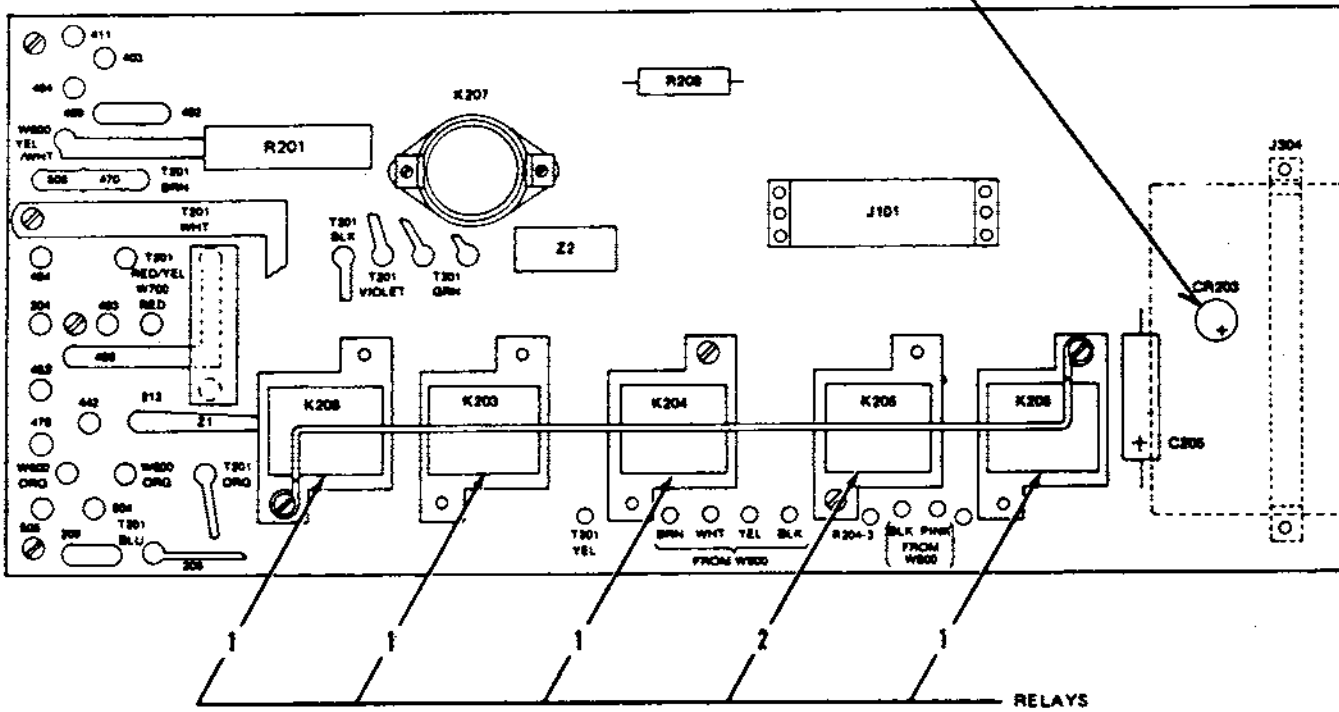


*****Note*****

Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.

Figure 8-3. RC-5 Parts Location, Control Console, Rear View

923626



*****Note*****

Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.

Figure 8-4. RC-5 Parts Location, PC Board 20126, Lower Control Panel

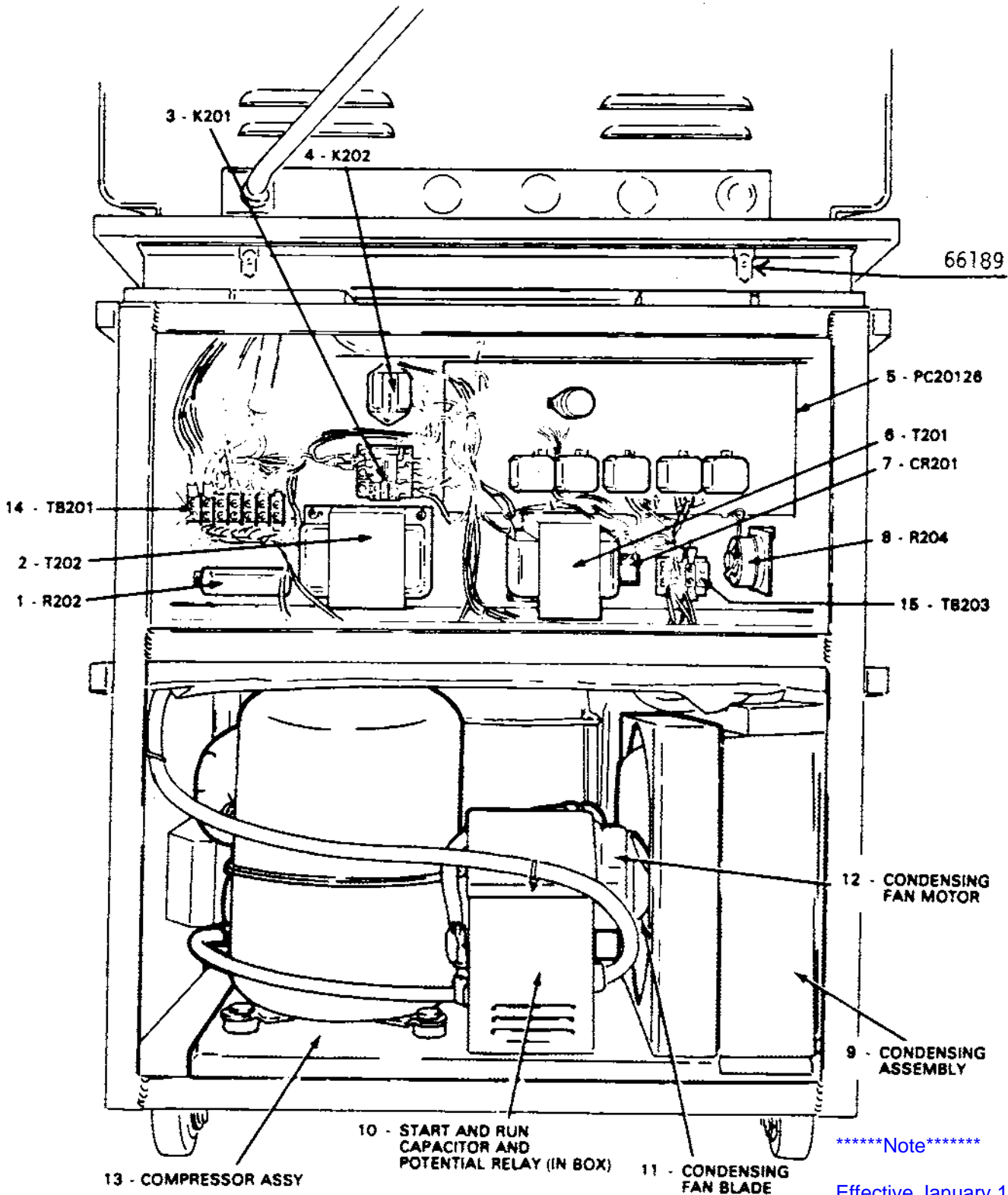
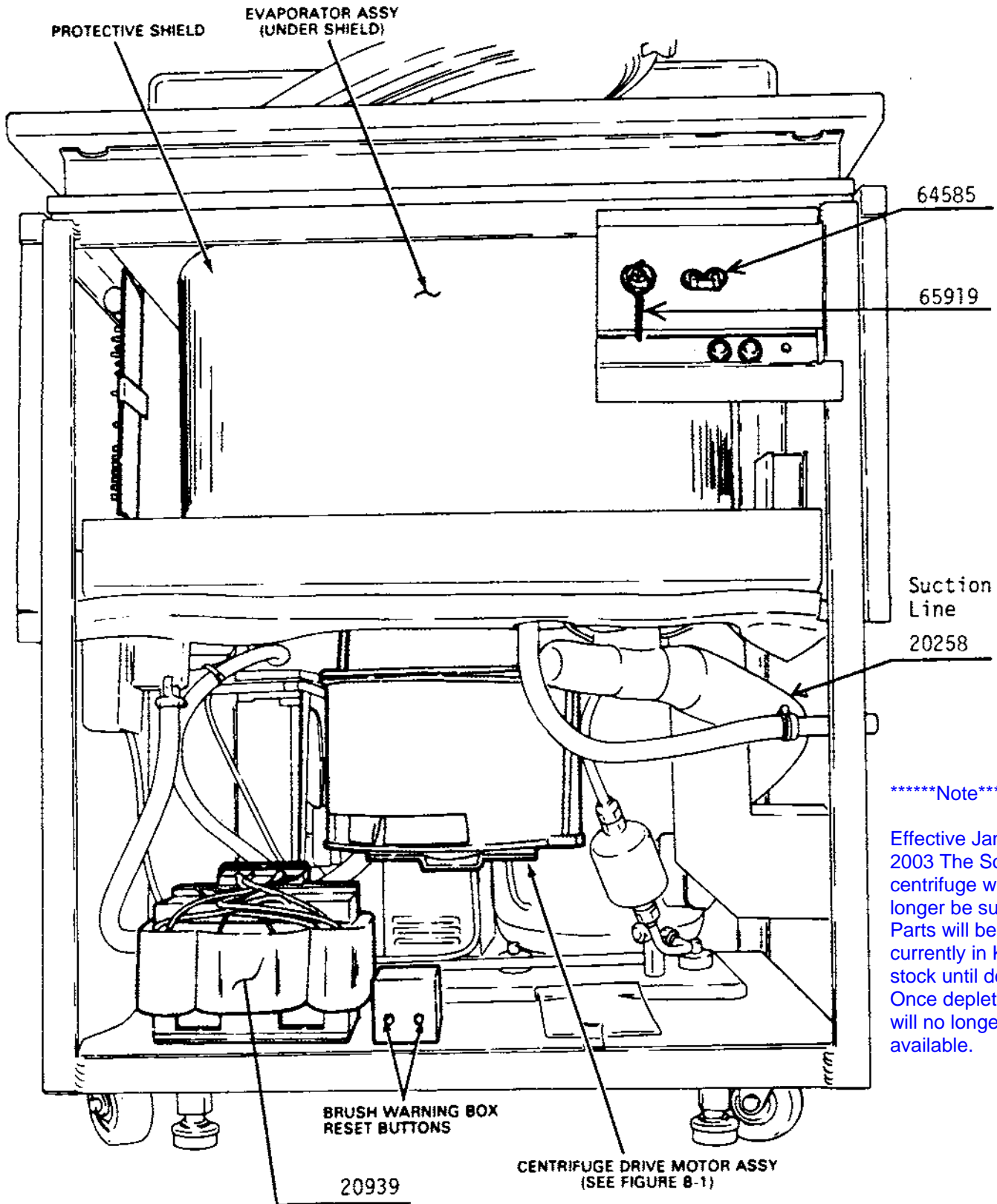


Figure 8-5. RC-5 Parts Location, Cabinet, Rear View

*****Note*****
 Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.



*****Note*****

Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.

Figure 8-6. RC-5 Parts Location, Cabinet, Front View

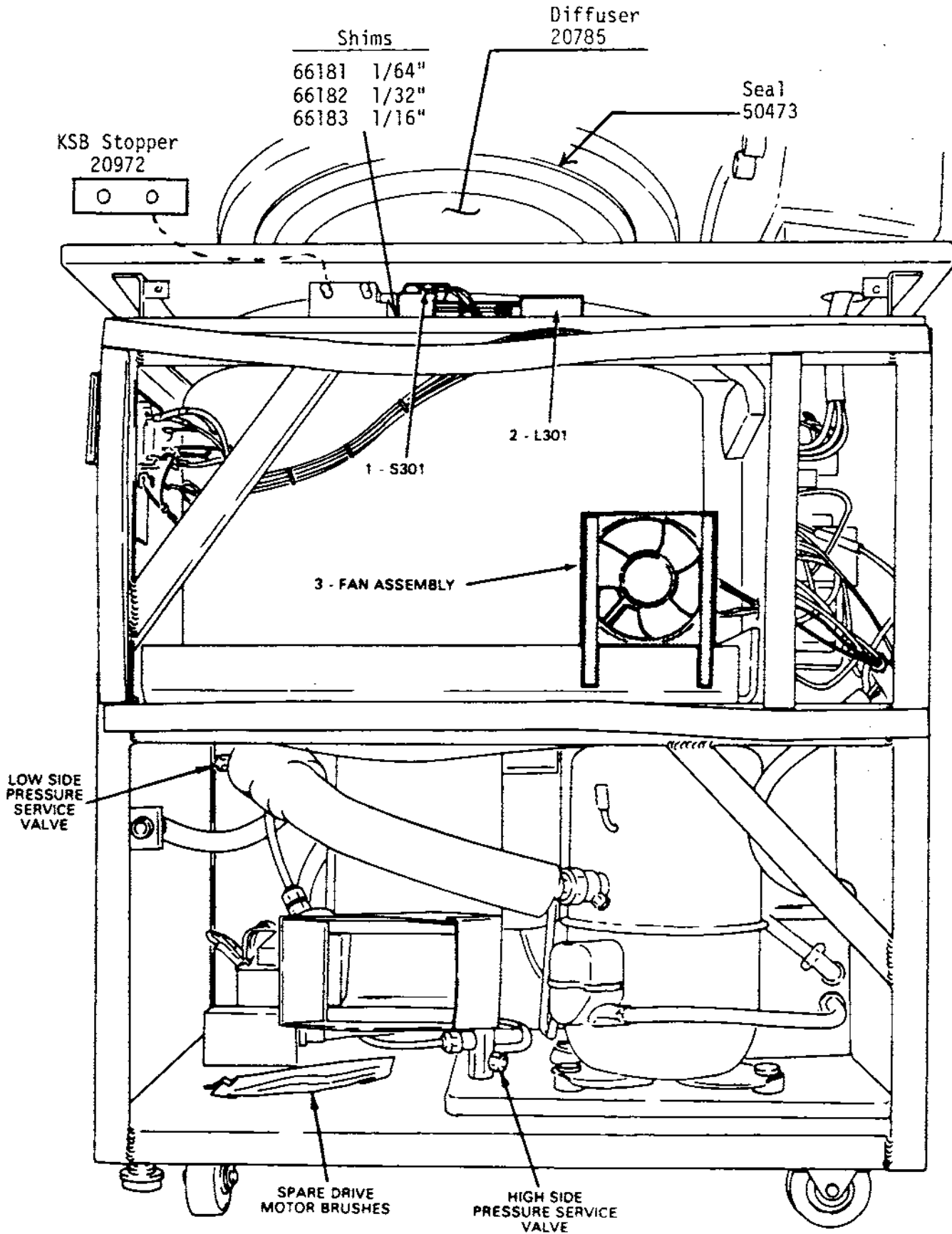
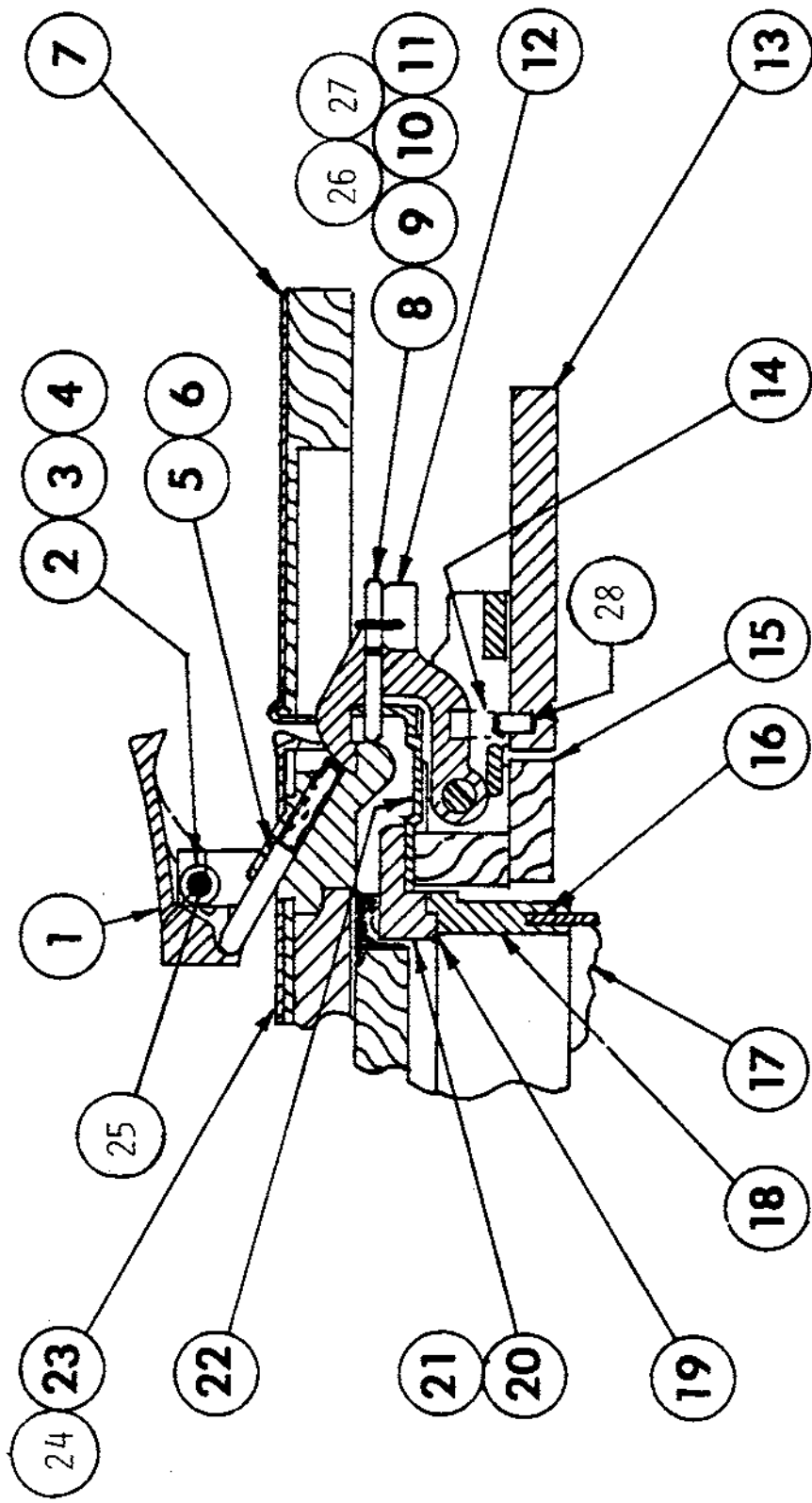


Figure 8-7. RC-5 Parts Location, Cabinet, Right Side View

*****Note*****

Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.



- (1) 20871 Handle
- (2) 20954 Handle Pin
- (3) 65644 Collar Handle
- (4) 20043 Retaining Spring
- (5) 20982 Actuator Pin
- (6) 65642 Compression Spring
- (7) 20778 Deck Assembly
- (8) 20996 Actuator Pin
- (9) 61080 Ext. Retaining Ring
- (10) 65657 Compression Spring
- (11) 20997 Spring Bracket
- (12) 20906 Latch Assembly
- (13) 20960 Latch Support Plate Assembly
- (14) 65652 Compression Spring
- (15) 20775 Evaporator Top Plate Assembly
- (16) 60726 3M Black Cement-(used to seal)
- (17) 20782 Evaporator Sub Assembly
- (18) 20006 Lower Seal Ring
- (19) 65664 Adhesive Sealant
- (20) 20983 Door Seal Ring
- (21) 65660 #10 x 1½ lg. Wood Screws
- (22) 20770 Shroud
- (23) 50060 Door Assembly With Handle
- (24) 20780 Door Without Hardware
- (25) 20954 Pin
- (26) 62828 Screw, Phillips 8x32
- (27) 20997 Spring Bracket
- (28) 60437 Pin

Figure 8-8. RC-5 Door Handle and Latching Assembly

See Table 8-2 on next page.

*****Note*****

Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.

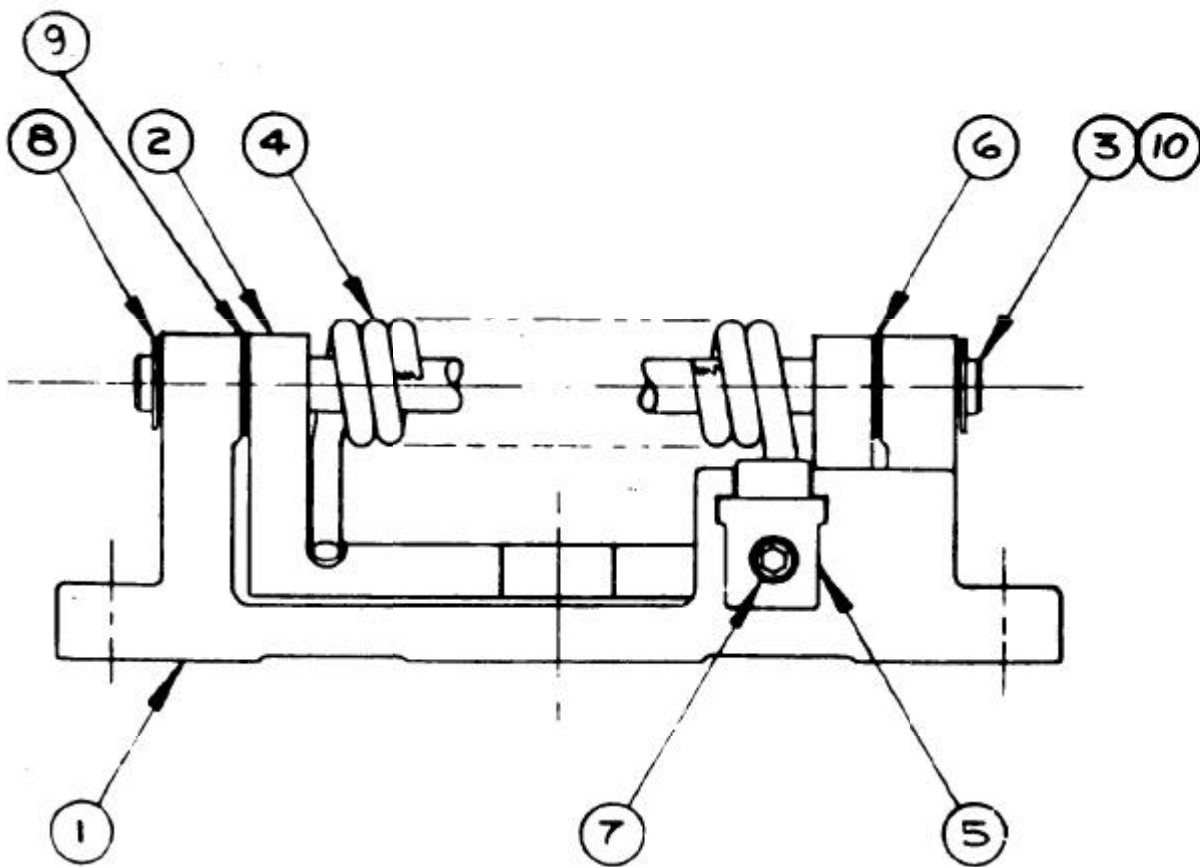


Figure 8-9. RC-5 Hinge Assembly

**Table 8-2. RC-5 Hinge Assembly
(Key to Figure 8-9)**

RC-5 Hinge Assembly			
FIGURE	ITEM	P/N	DESCRIPTION
8-9	1	20715	Hinge Support
8-9	2	20717	Hinge (Not Available)
8-9	3	20720	Shaft
8-9	4	20736	Torsion Spring
8-9	5	20718	Spring Retainer (Not Available)
8-9	6	64742	Nylon Washer (Not Available)
8-9	7	60568	Cap Screw, Socket Head, 10-32 x ¾
8-9	8	65653	Retaining Ring
8-9	9	61889	Nylon Flat Washer
8-9	10	61971	Lubricant, Lubriplate, 130AA (1 ¾ oz. Tube)

Page 8-13

*****Note*****

Effective January 1, 2003 The Sorvall RC-5 centrifuge will no longer be supported. Parts will be supplied if currently in Kendro stock until depletion. Once depleted, parts will no longer be available.

Table 8-3. RC-5B Parts List
 (Key to figures 8-10 through 8-14 and 8-16 through 8-21)

RC-5B GYRO ACTION DRIVE (Spline Drive)			
FIGURE	ITEM	P/N	DESCRIPTION
8-10	1	20466	Gyro Action Drive Assembly
8-10	2	60668	❖ Socket Head Screw
8-10	3	20109	❖ Rubber Seal Cover
8-10	4	12734	❖ Bearings
8-10	5	20468	❖ Bearing Housing (use 20466)
8-10	6	20474	❖ Tapered Spindle & Pin Subassembly
8-10	7	20104	❖ Centering Assembly Cap
8-10	8	20464	❖ Bearing Shaft Assembly
8-10	9	20508	❖ Insulating Gyro Cap

RC-5B GYRO ACTION DRIVE ("Quiet Drive)			
FIGURE	ITEM	P/N	DESCRIPTION
8-23		12817	Gyro Action Drive (1/4" drive)
8-23		12818	Spindle Assembly Kit
8-23		20474	❖ Tapered Spindle
8-23		61780	❖ Set Screw (Ny-Lock)
8-23		50401	❖ Drive Spindle Subassembly
8-23		25008	❖ Coupling, Clamp Ring
8-23		50578	❖ Slinger
8-23		60077	❖ Set Screw, Cup Point
8-23		60341	❖ Retaining Ring
8-23		67268	❖ Wavy Washer
8-23		67269	❖ Bearing
8-23		60347	❖ Retaining Ring
8-23		12342	Gyro Bearing Kit
8-23		50579	Bearing Housing Assembly
8-23		50409	Washer Support
8-23		67270	Retaining Ring
8-23		67273	Jam Nut
8-23		50406	Upper Mounting Plate
8-23		67272	Set Screw
8-23		50408	Flex Bolt
8-23		50407	Lower Mounting Plate

Table 8-3. RC-5B Parts List
 (Key to figures 8-10 through 8-14 and 8-16 through 8-21)

RC-5B CENTRIFUGE DRIVE MOTOR ASSEMBLY (Spline Drive)			
FIGURE	ITEM	P/N	DESCRIPTION
8-10	10	12220	Motor Assembly
8-10		12304	Motor Assembly with Brush Lift Assembly (Not Available)
8-10	10	20462	❖ Lower Coupling Assembly
8-10	11	12284	❖ Carbon Contact Brushes (pair)
8-10	12	12106	❖ Tachometer Generator Kit)
8-10	13	12748	❖ Armature Bearing (2)
8-10	14	12751	❖ Motor Armature Complete with Bearing and Fan
8-10	15	50222 12220	❖ Motor only with Electrical Plug Assembly (not Available)

RC-5B CENTRIFUGE DRIVE MOTOR ASSEMBLY (Quiet Drive)			
FIGURE	ITEM	P/N	DESCRIPTION
8-22		12991	Motor Kit, RC-5B
8-22		12750	Armature Kit 1/4" Drive
8-22		12345	Lower Coupling
8-22		50418	Gyro Standoff
8-22		50456	Gyro Insulator

Table 8-3. RC-5B Parts List
 (Key to figures 8-10 through 8-14 and 8-16 through 8-21)

RC-5B CONTROL CONSOLE			
FIGURE	ITEM	P/N	DESCRIPTION
8-11,8-12	1	91476	Circuit Breaker CB301
8-11, 8-12	2	12248	Indicator Light Assembly, <i>BRUSHES DS101, REFRIGERATION DS108</i>
8-11,8-12	3	12251	Door Switch Assembly S102
8-11, 8-12	4	12252	BRAKE Switch Assembly S103
8-11, 8-12	5	20868	Timer, 2 Hr, 115 Vac/60 Hz
8-11, 8-12	5	20867	Timer, 2 Hr. 115 Vac/50 Hz
8-11, 8-12	6	20855	Potentiometer R106, <i>SPEED</i> Control
8-11, 8-12	7	66639	Meter M101 rpm Indicator
8-11, 8-12	8	12819	Meter M102 <i>TEMPERATURE</i> Control
8-11, 8-12	9	12249	Indicator Light Assembly <i>POWER</i> DS106
8-11, 8-12	10	12312	<i>START</i> Switch Assembly S105
8-11, 8-12	11	20829	Potentiometer R109, Tach Trimmer
8-11		83187	❖ Lamp only for above
8-11	15	68012	Fuse F301, F303, 5A
8-12	15	68716	Circuit Breaker CB302, CB304, 5A
8-11	16	60817	Fuse F302, 3A (Not Available)
8-12	16	52890	Circuit Breaker CB303, 3A correct # is 66759

12010 RC-5B/5C Preventive Maintenance Kit
 66016 Switch Lense, White
 66017 Switch Lense, Red

Table 8-3. RC-5B Parts List
 (Key to figures 8-10 through 8-14 and 8-16 through 8-21)

RC-5B LOWER CONTROL PANEL			
FIGURE	ITEM	P/N	DESCRIPTION
8-13, 8-14	1	904462	Resistor R202
8-13, 8-14	2	20938	Transformers T202 and T203
8-13	3	12731	Compressor Relay K201
8-14	3	66666	Relay K201 (Not Available)
8-13, 8-14	4	66234	Bridge Rectifier CR202
8-13, 8-14	5	12919	Relay K202
8-13, 8-14	6	12370	P.C. Board Assembly (Lower Control)
8-13, 8-16	10	65984	❖ Relay K203
8-13, 8-14, 8-16, 8-17	10	65984	❖ Relay K204
8-13, 8-14 8-16, 8-17	11	65984	Relay K205, K208
8-13, 8-14, 8-16, 8-17	12	64240	❖ Flasher K207
8-13, 8-14	7	20145	Transformer T201
8-13, 8-14	8	61960	Rheostat R204
8-13, 8-14	9	12208	Brake Rectifier CR201
8-14	13	66667	Time Delay Relay TD202 Replaced By #50991

RC-5B REFRIGERATION			
Original Configuration S/N 9303255 & Below (R-502 or HP-80)			
FIGURE	ITEM	P/N	DESCRIPTION
8-18	7	91470	Filter Drier
8-18		50350	Suction Line
8-13, 8-14	16	67942	Fan Motor
8-13, 8-14	15	91983	Run Capacitor
8-13, 8-14	15	61785	Start Capacitor
8-18	15	62807	Potential Relay
8-18	16	67944	Fan Blade
		20802	Condenser Assembly (HP-62)
		61768	Teflon Seal (large)
		12236	Evaporator Kit
		20654	Filter to Service Valve (Flair)

Table 8-3. RC-5B Parts List
 (Key to figures 8-10 through 8-14 and 8-16 through 8-21)

RC-5B REFRIGERATION			
Instruments with Condenser Replaced Prior to July 1999 (HP-62)			
FIGURE	ITEM	P/N	DESCRIPTION
8-18	7	91470	Filter Drier
8-18		50350	Suction Line
8-13, 8-14	16	91392	Fan Motor
8-13, 8-14	15	91983	Run Capacitor
8-13, 8-14	15	91981	Start Capacitor
8-18	15	91986	Potential Relay
8-18	16	91897	Fan Blade
		20802	Condenser Assembly (HP-62)
		66952	Teflon Seal (small)
		61768	Teflon Seal (large)
		12236	Evaporator Kit
		22011	Filter to Service Valve (Rotalock)

RC-5B REFRIGERATION			
Instruments with Condenser Replaced After July 1999 (HP-62)			
FIGURE	ITEM	P/N	DESCRIPTION
8-18	7	91470	Filter Drier
8-18		50362	Suction Line
8-13, 8-14	16	91392	Fan Motor
8-13, 8-14	15	92733	Run Capacitor
8-13, 8-14	15	92734	Start Capacitor
8-18	15	92732	Potential Relay
8-18	16	91897	Fan Blade
		20802	Condenser Assembly (HP-62)
		66952	Teflon Seal (small)
		61768	Teflon Seal (large)
		12236	Evaporator Kit
		74348	Tube, Compressor to Condenser

Table 8-3. RC-5B Parts List
 (Key to figures 8-10 through 8-14 and 8-16 through 8-21)

RC-5B			
Miscellaneous Electrical Components			
FIGURE	ITEM	P/N	DESCRIPTION
8-18	2	12987	Control Board
8-18, 8-19	3	66383	Door Hinge Interlock Microswitch, S301
8-18, 8-19	4	12233	Temperature Sensor Kit
8-16, 8-19	5	20747	Brush Warning Box
8-18, 8-19	6 74075	61421	Saturable Reactor, 208 / 230 v, 60 Hz
8-18, 8-19	6 74075	616474	Saturable Reactor, 220 / 240 v, 50 Hz
8-20	1	66346	Solenoid, Latch Interlock Microswitch S303
8-20	2	50082	Solenoid, Door Interlock L301

RC-5B			
Automatic Rate Control			
FIGURE	ITEM	P/N	DESCRIPTION
8-21	1	50165	Rate Control Panel Assembly (Not Available)
8-21	2	12370	Rate Control PC Assembly
8-21	3	66389	Time Delay Relay K206
8-21	4	970136	Relay, K210 (Not Available)
8-21	5	12258	Varistor VR1
8-21	6	66247	Transistor, Q401 (Not Available)
8-21	7		Resistor, R401 (Not Available)
8-21	8		Capacitor, C1 (Not Available)
8-21	9	50172	Transformer, T404 (Not Available)
8-21	10	50275	Varistor Assembly, VR2, VR3 (Not Available)
8-21	11	61002	Relay, K407 (Not Available)
8-21	12	923627	Rectifier, CR401
8-21	13	66625	Diode Bridge, CR400 (Not Available)
8-21	14	50165	Heat sink Assembly (Not Available)

RC-5B			
Control Console			
FIGURE	ITEM	P/N	DESCRIPTION
8-11, 8-12	13	50176	Switch Assembly, S105 Slow Start
8-11, 8-12	12	50174	Variable Resistor Assembly, Rate Control (Not Available)
8-11, 8-12	14	68003	Fuse, F104, F106, 1 amp (Not Available)
8-12	14	66760	1 amp Circuit Breaker CB305, CB306

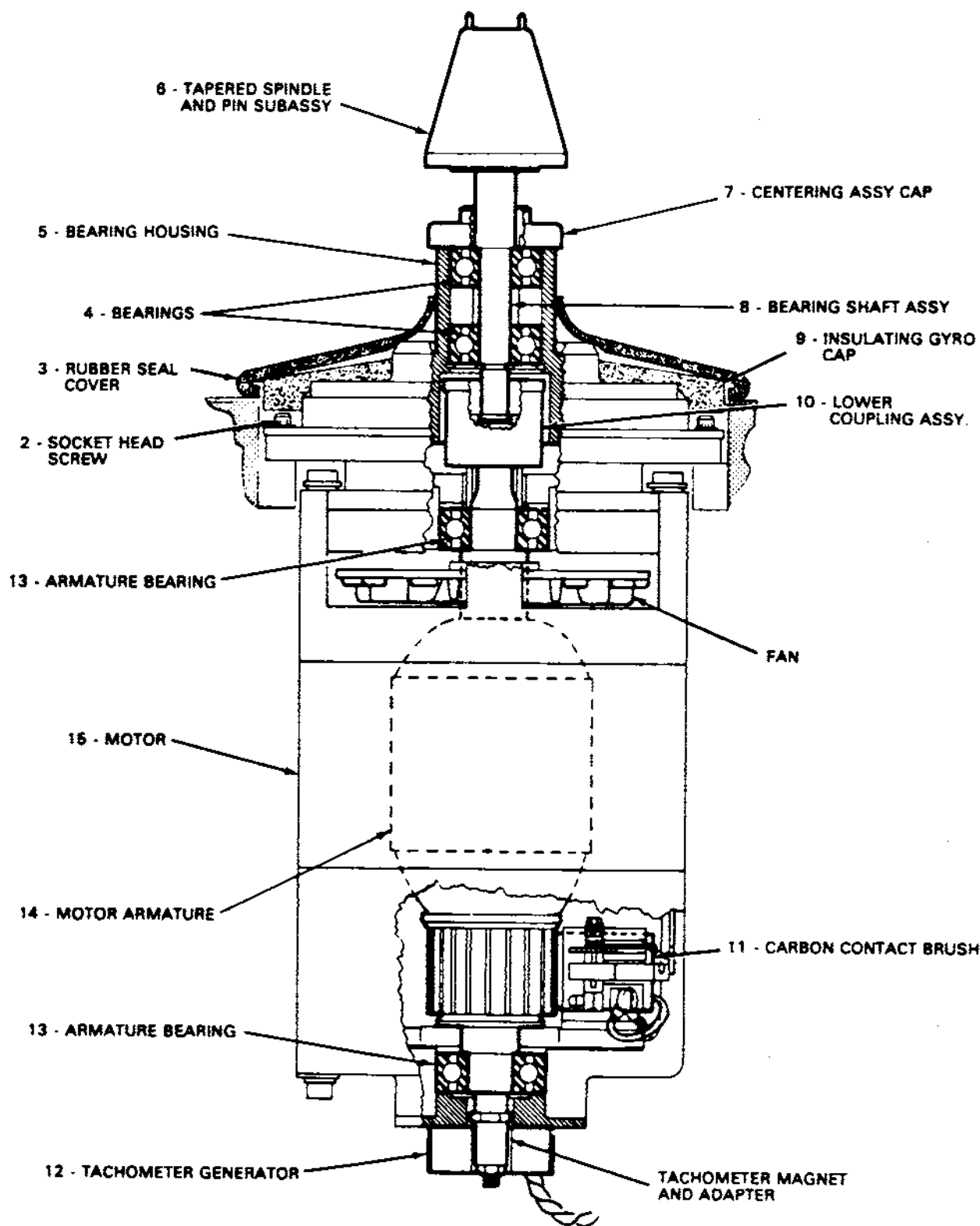
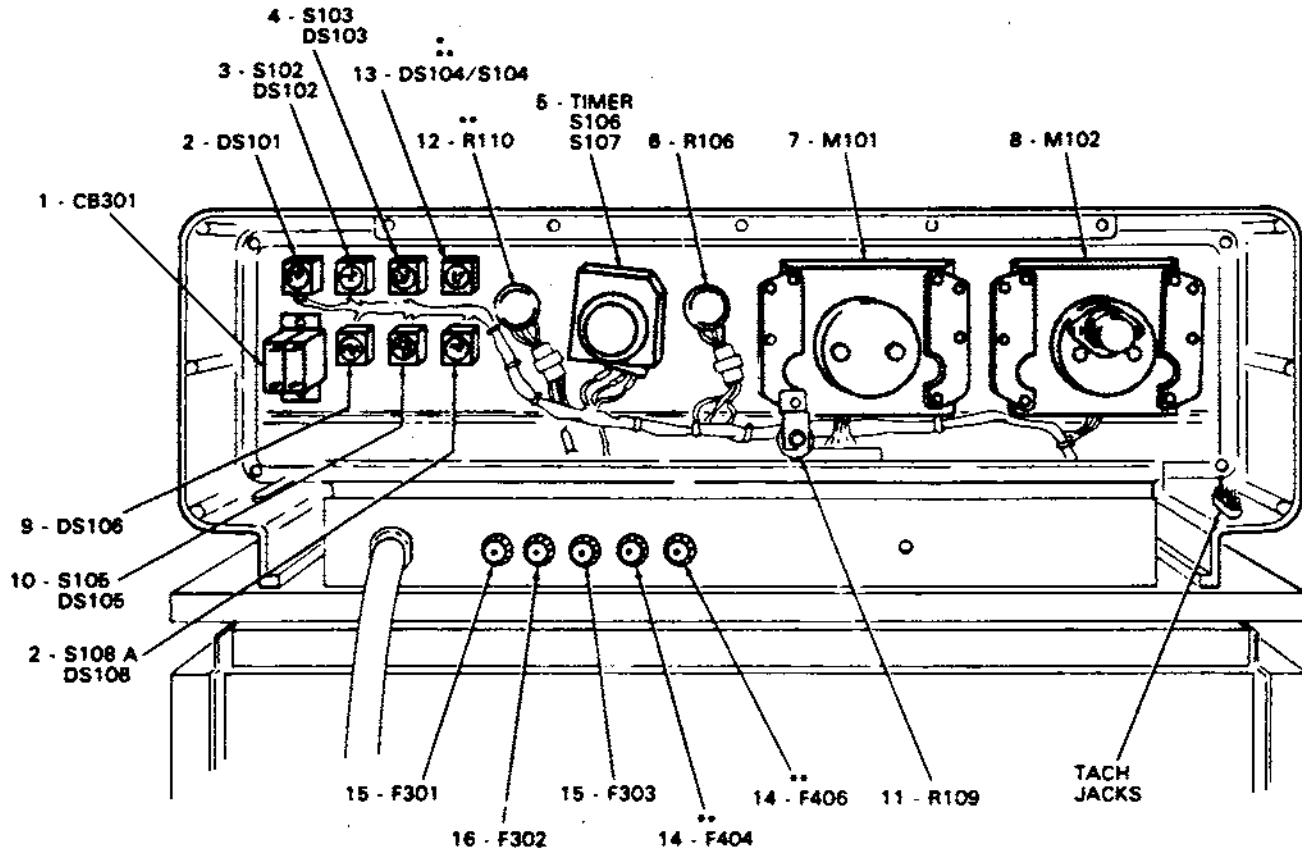


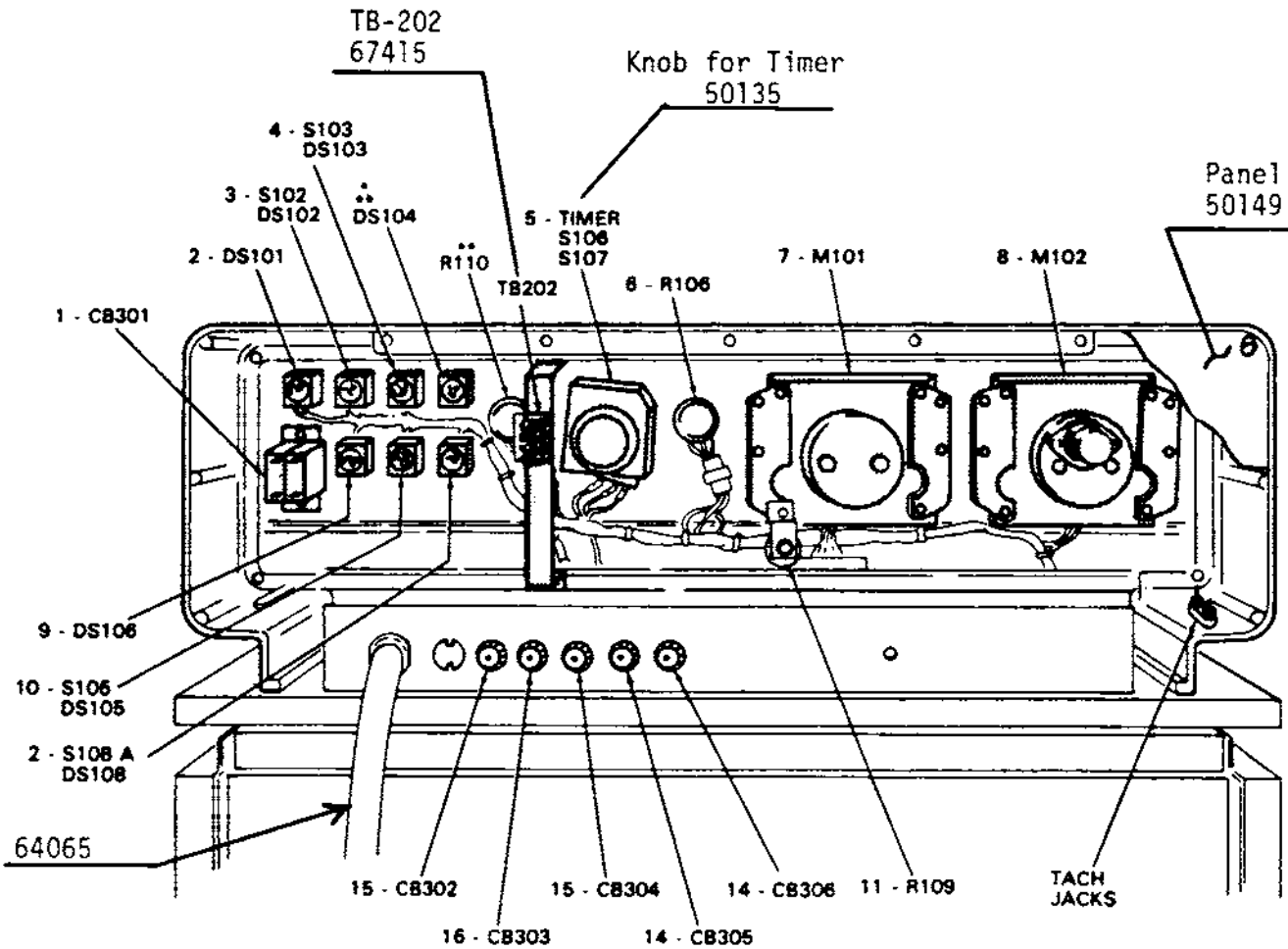
Figure 8-10. RC-5B Parts Location: Gyro Action Drive, Lower Coupling and Motor Assembly



NOTES.

- (*) DENOTES INSTALLATION NOT WIRED WHEN OPTIONAL AUTOMATIC RATE CONTROLLER NOT INSTALLED
- (**) ON UNITS WITH OPTIONAL AUTOMATIC RATE CONTROLLER INSTALLED.

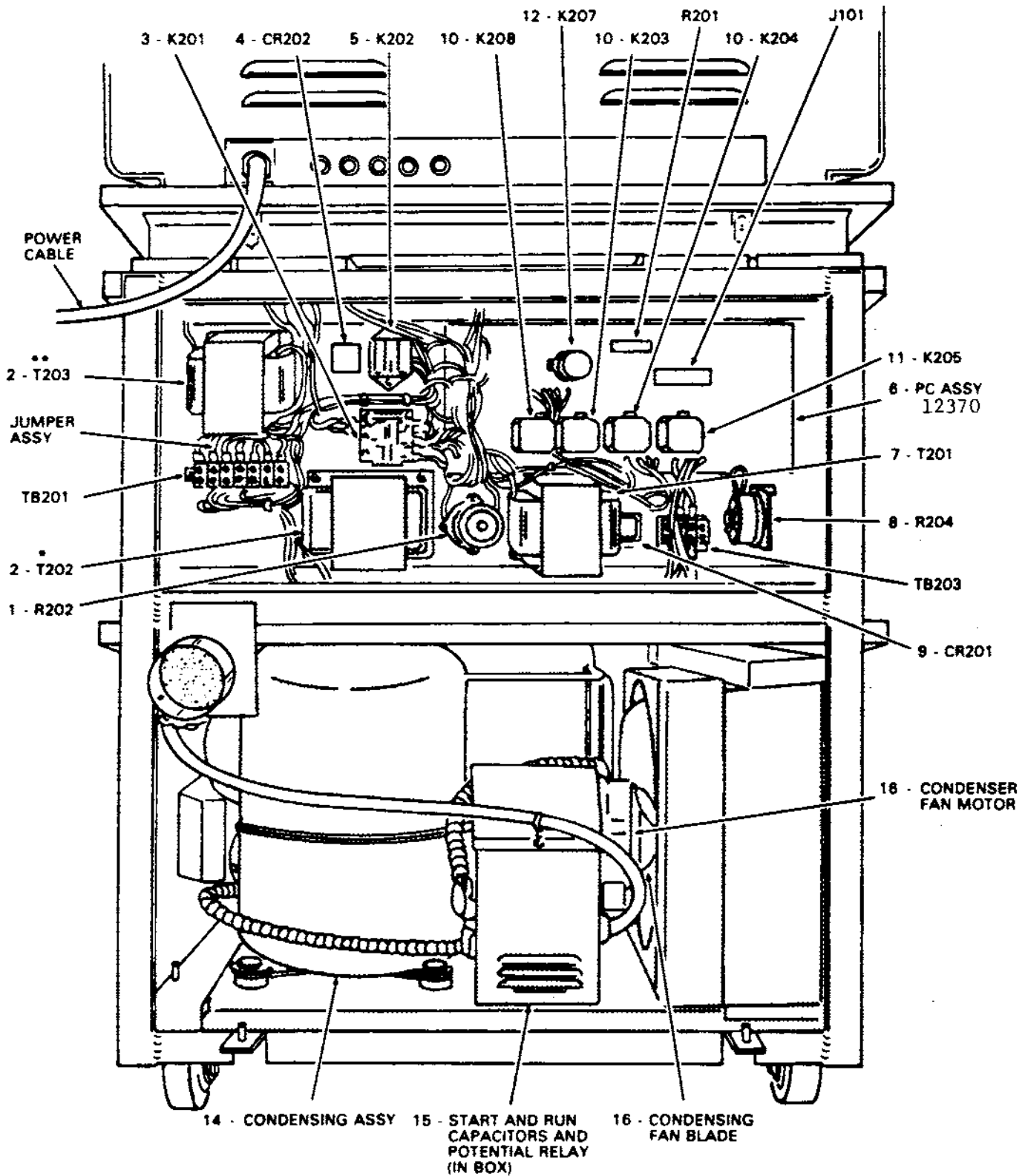
Figure 8-11. RC-5B Parts Location: Control Console
(Rear View to SN 7810303)



NOTES.

- (*) DENOTES INSTALLATION NOT WIRED WHEN OPTIONAL AUTOMATIC RATE CONTROLLER NOT INSTALLED
- (**) ON UNITS WITH OPTIONAL AUTOMATIC RATE CONTROLLER INSTALLED.

Figure 8-12. RC-5B Parts Location: Control Console (Rear View, SN 78103304 and Higher)

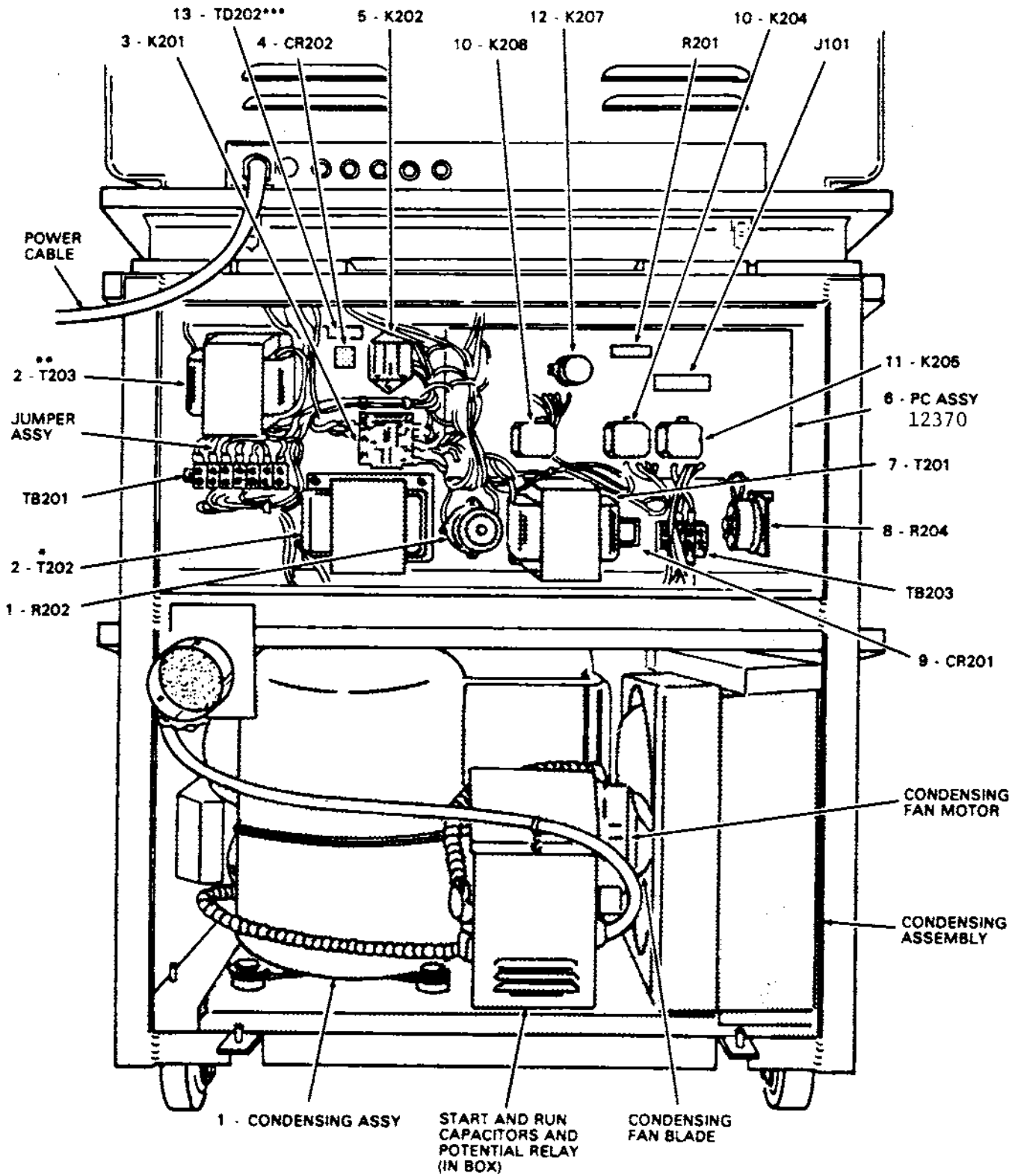


NOTES

(*) DENOTES INSTALLATION ONLY ON UNITS EQUIPPED FOR 208 V/60 Hz, 220 V/50 Hz, AND 240/250 V/50 Hz OPERATION.

(**) DENOTES INSTALLATION ONLY ON UNITS EQUIPPED FOR 240/250 V/50 Hz OPERATION.

Figure 8-13. RC-5B Parts Location: Cabinet
(Rear View to SN 7809416)



NOTES

(*) DENOTES INSTALLATION ONLY ON UNITS EQUIPPED FOR 208 V/60 Hz, 220 V/50 Hz, AND 240/250 V/50 Hz OPERATION.

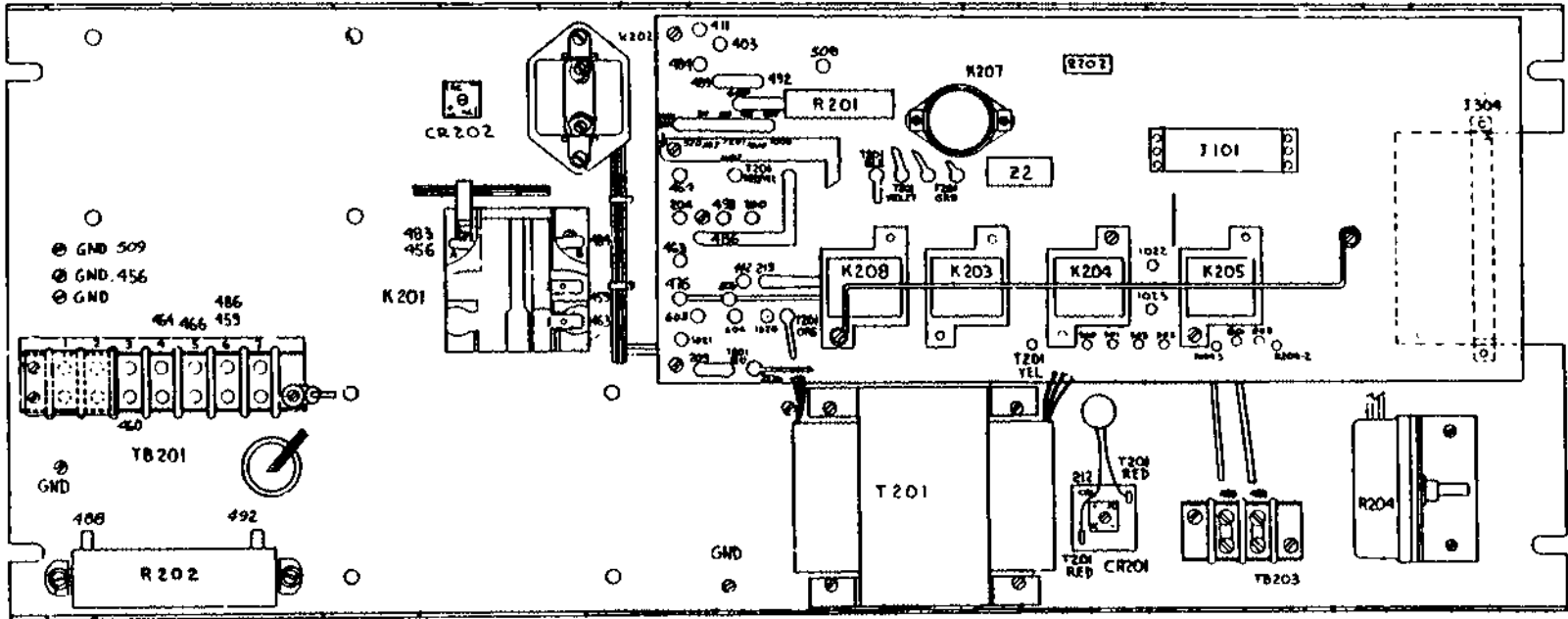
(**) DENOTES INSTALLATION ONLY ON UNITS EQUIPPED FOR 240/250 V/50 Hz OPERATION.

(***) DENOTES INSTALLATION ONLY ON UNITS SN 7810344 AND HIGHER

Figure 8-14. RC-5B Parts Location: Cabinet
(Rear View, SN 7809417 and Higher)

50213 LOWER CONTROL PANEL
 50195 PC BOARD WITHOUT RELAYS

Figure 8-15. Lower Control Panel Assembly



2. SEE DWG No 50206, SCHEMATIC, SYSTEM, RC-5B
 SEE DWGS No.
 50206 WIRING DIAGRAM, 240-250V 50HZ, RC-5B
 50205 WIRING DIAGRAM, 220V 50HZ, RC-5B
 50204 WIRING DIAGRAM, 230V 60HZ, RC-5B
 50207 WIRING DIAGRAM, 208V 60HZ, RC-5B

1. BEND THESE TABS ON COMPRESSOR RELAY
 (ITEM "8") UPWARDS 45°

NOTES:

DWG. NO.	PART NO.		DWG. NO.	PART NO.
T201	20143	TRANSFORMER LOGIC POWER SUPPLY	K205	65984
T202	20928	BOOST WICE TRANSFORMER		
T203	70928	BOOST WICE TRANSFORMER		
R201	61851	REFRIGERATION RELAY (ENERGIZED WHEN PILOT LIGHT IS ON)		
K202	40A07	COND. DRIVE & BRAKE RELAY (ENERGIZED WHEN CENTRIFUGE DRIVE IS IN RUN MODE)	K207	64240
K203	65983	DRYNT CONDENSING FAN RELAY (ENERGIZED WHEN CENTRIFUGE DRIVE IS IN RUN MODE, OPERATES CONDENSING FAN CONTINUALLY)	K208	65982
K204	65984	3PDT DOOR RELAY (ENERGIZED WITH DOOR OPEN, PREVENTS REFRIGERANT FLOW)	CR201	923627
			CR202	66234
			R202	904462
			R204	61860
				61860

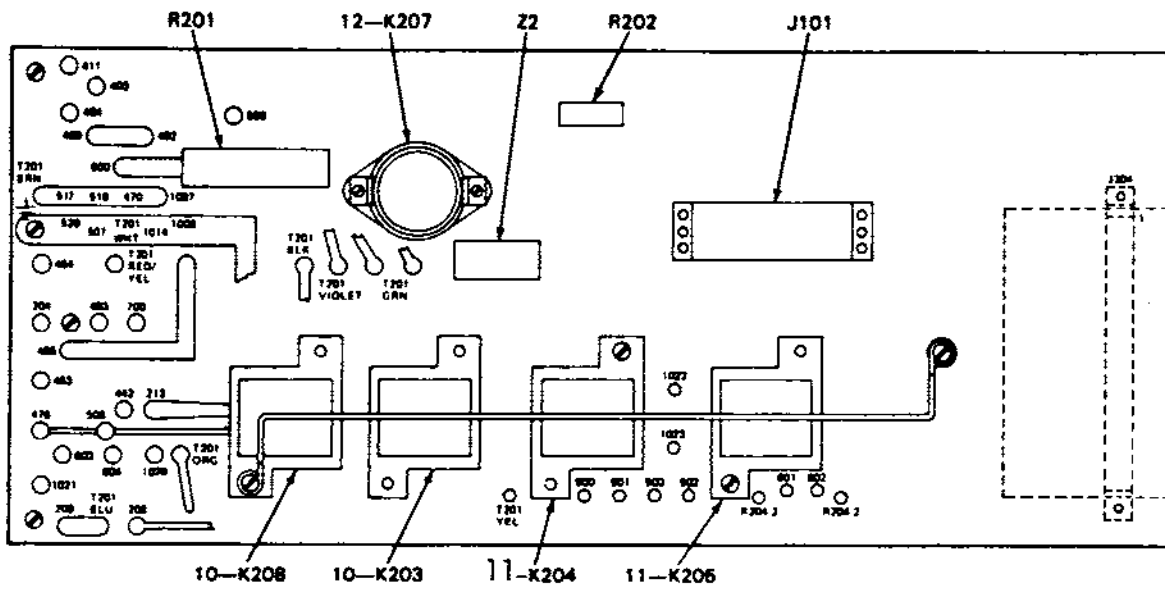


Figure 8-16. RC-5B Parts Location: P.C. Assembly 12370, to SN 7809417

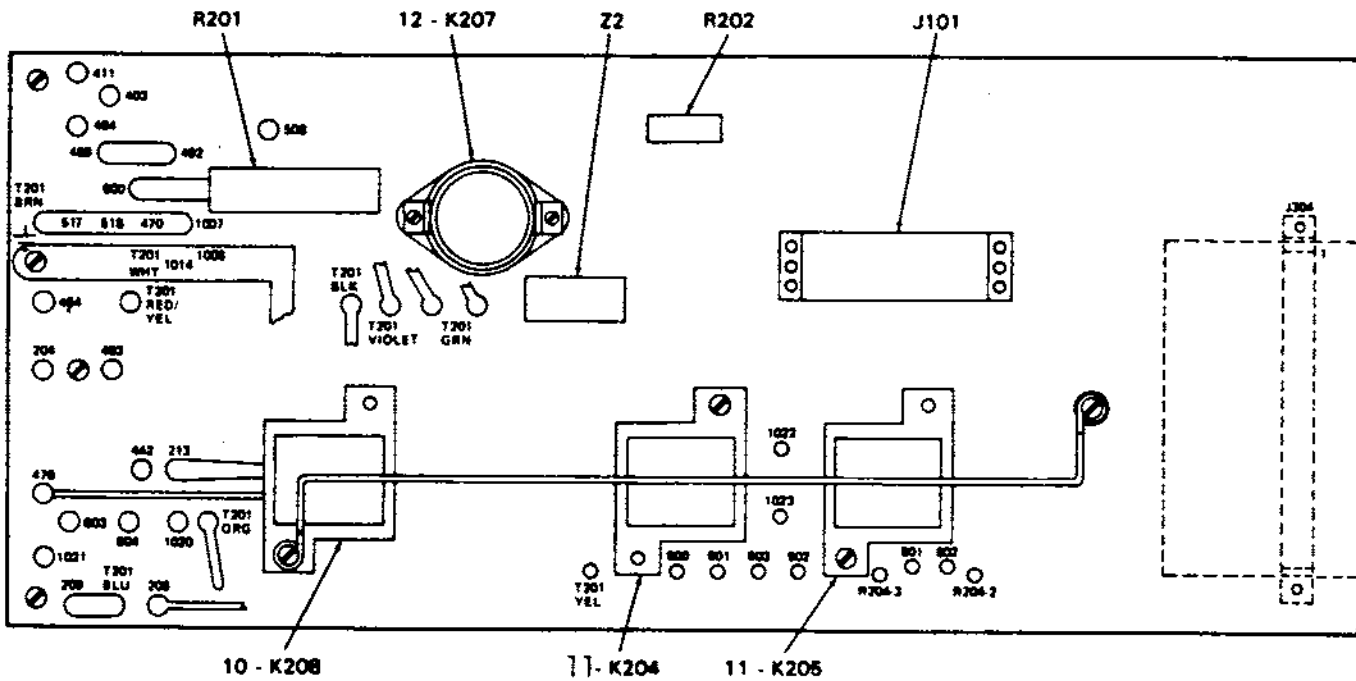


Figure 8-17. RC-5B Parts Location: P.C. Assembly 12370, (SN 7809417 and Higher)

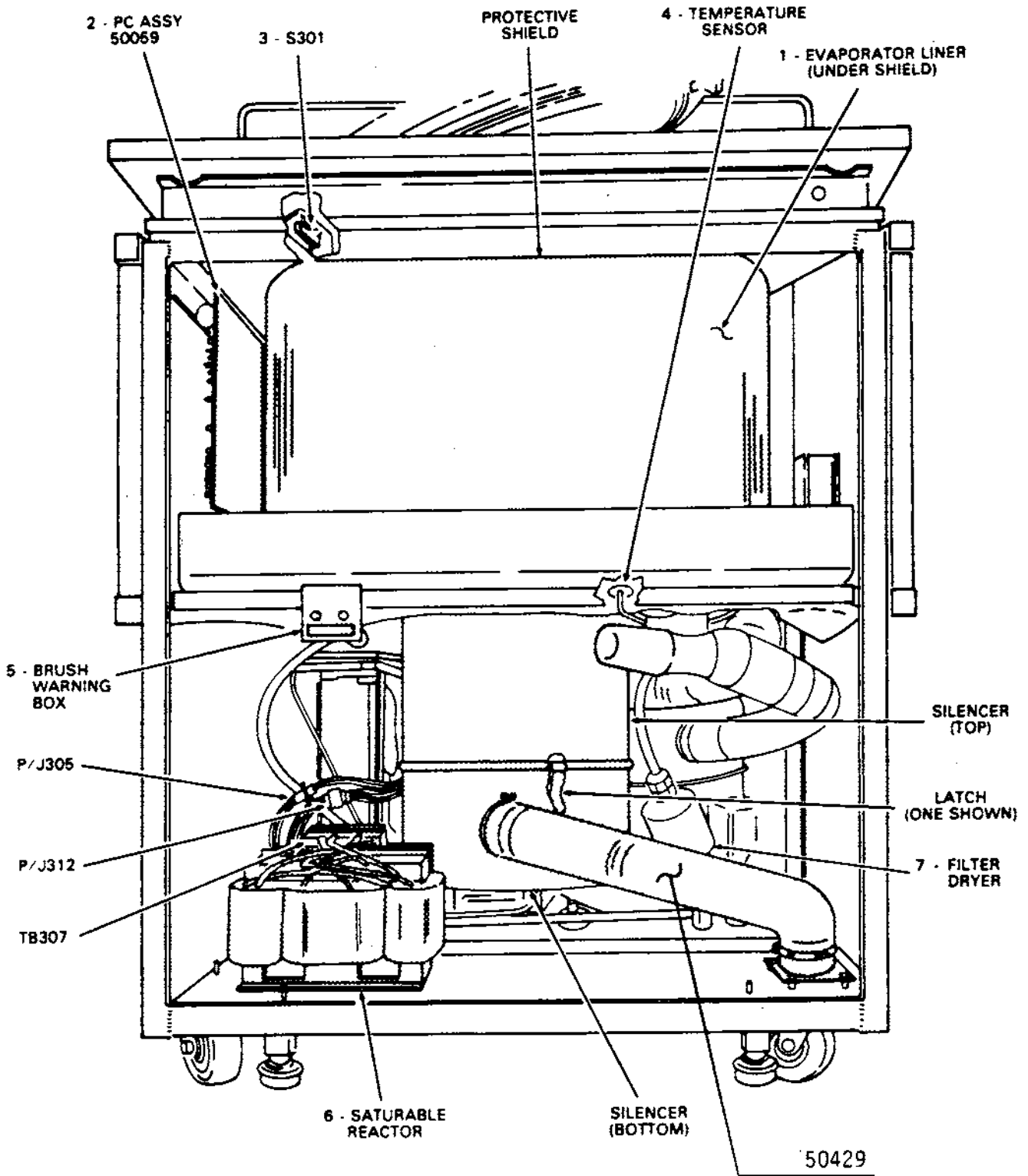


Figure 8-18. RC-5B Parts Location: Cabinet (Front View)

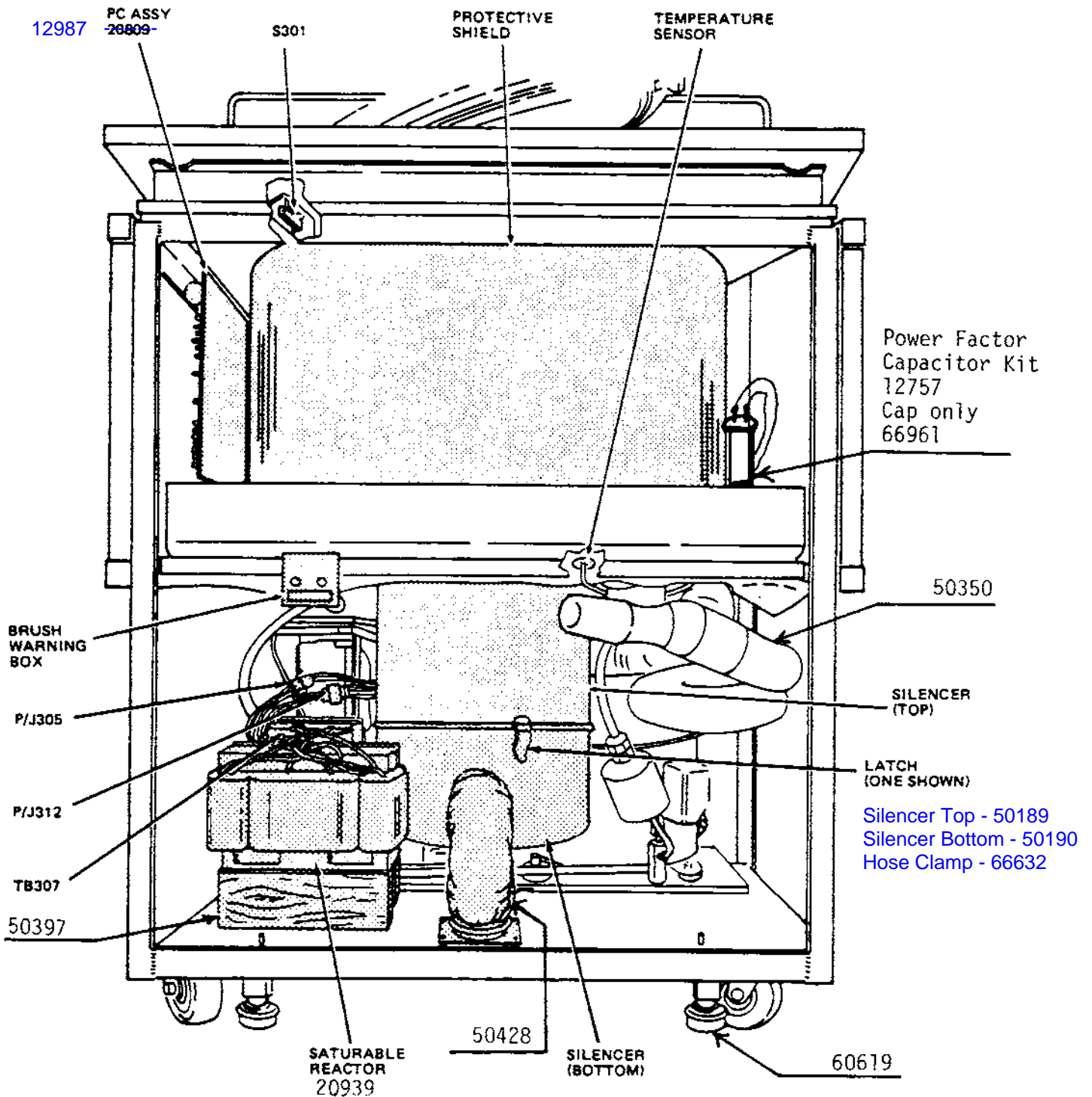
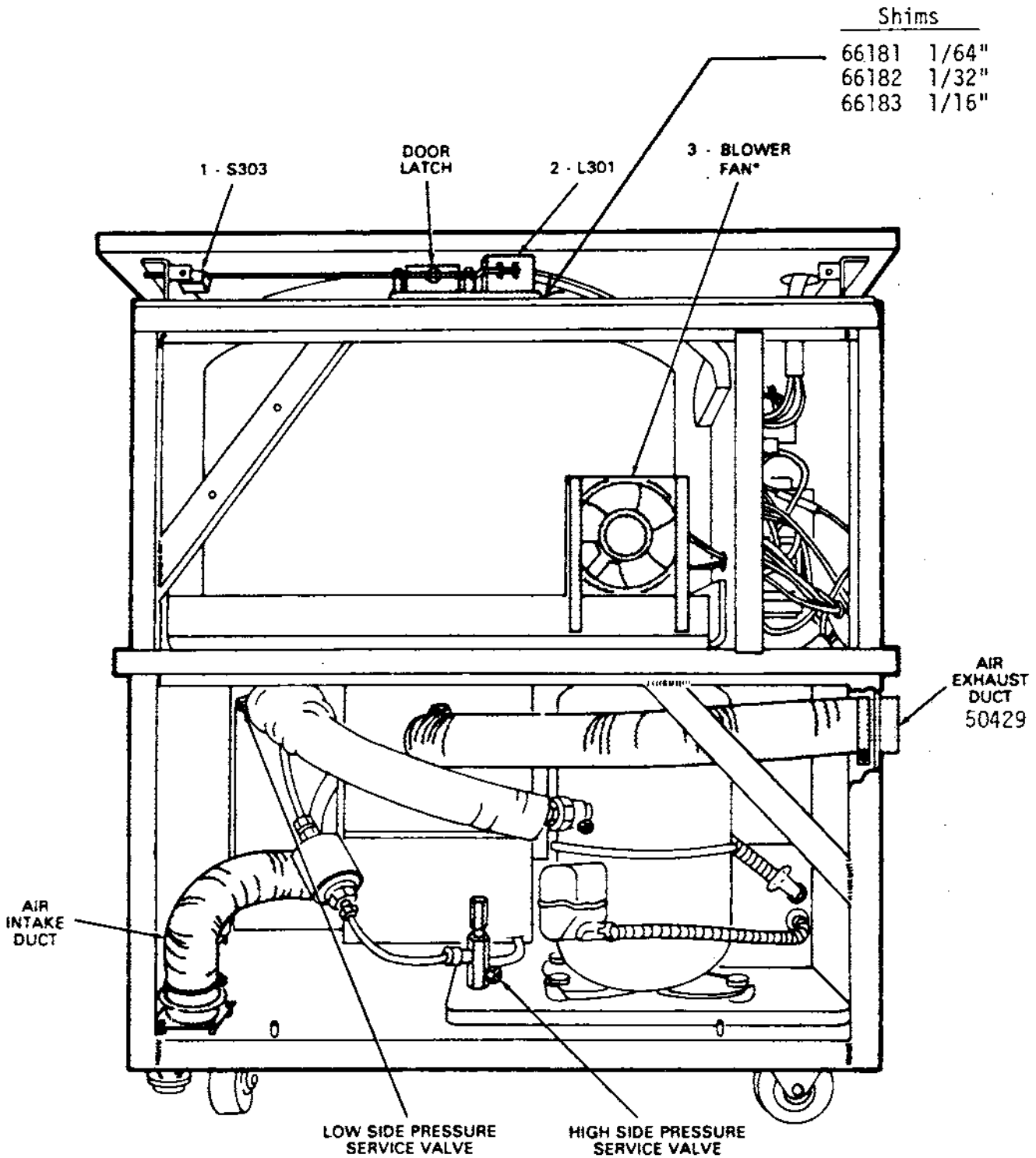


Figure 8-19. RC-5B Front View



*REMOVED ON LATER MODELS

Figure 8-20. RC-5B Parts Location: Cabinet (Right Side View)

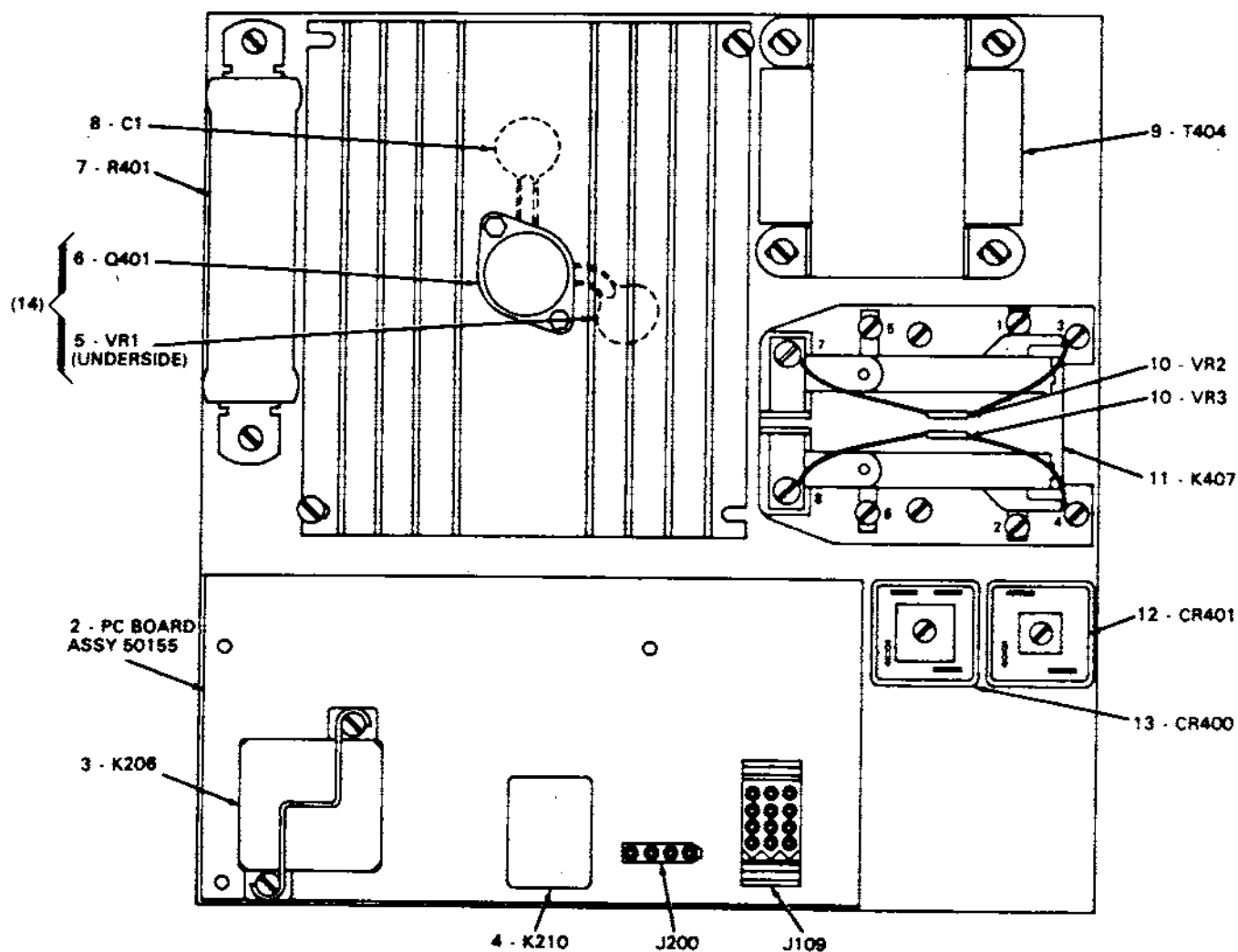


Figure 8-21. RC-5B Parts Location: Automatic Rate Controller, Control Panel

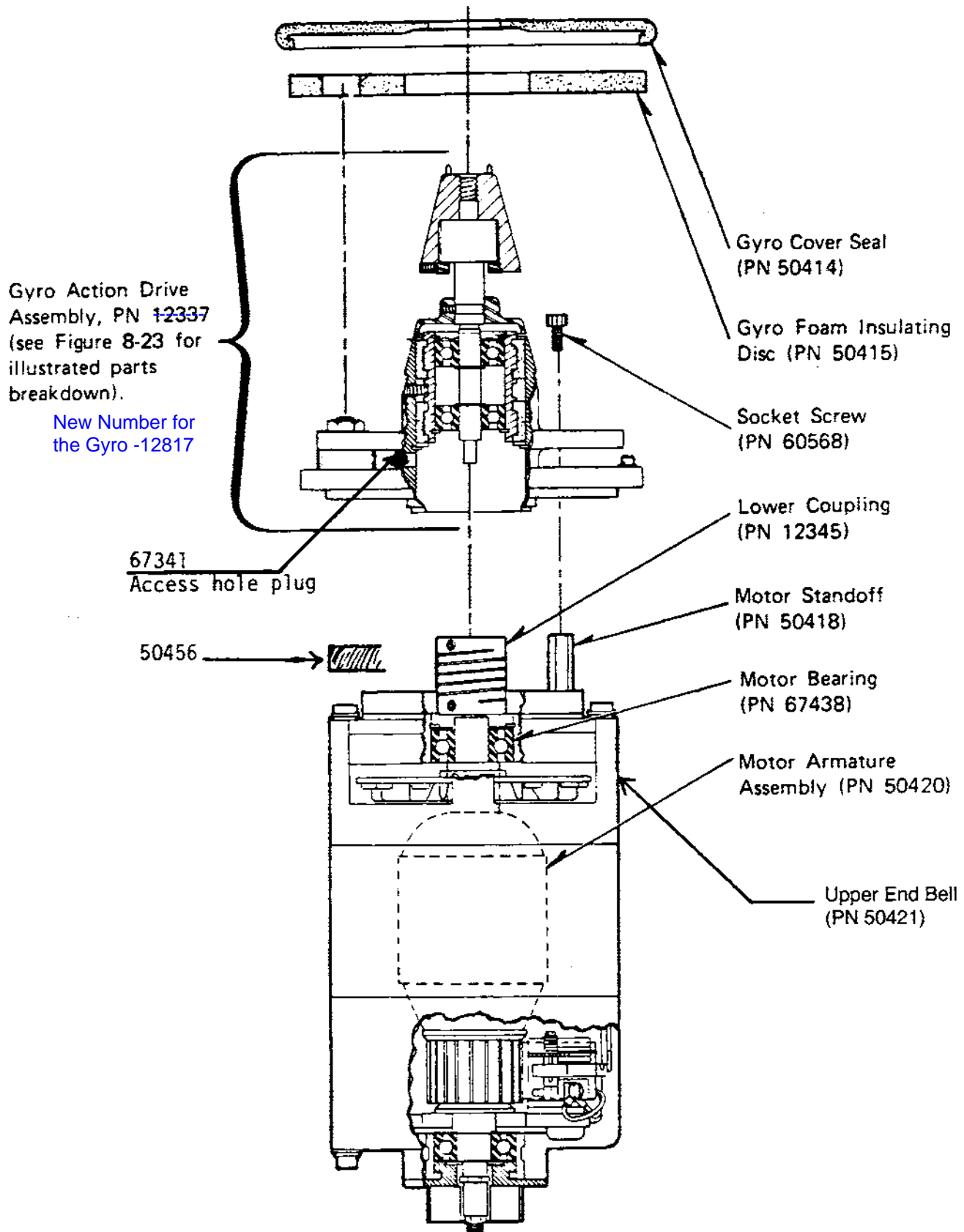


Figure 8-22. Parts Location: Gyro Action Drive, Lower Coupling and Motor Assembly (SN 8004600 and Higher)

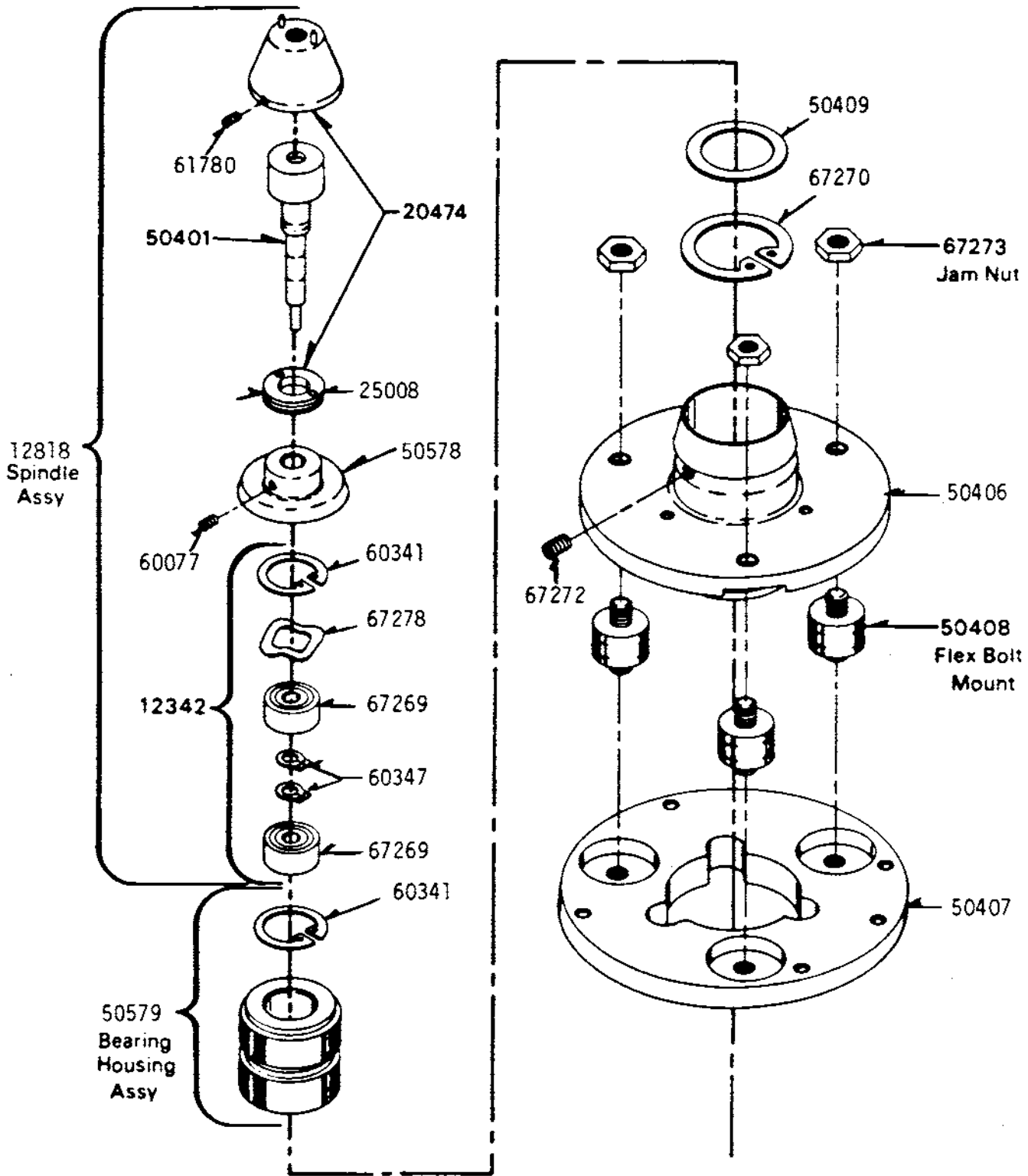


Figure 8-23. Parts Location: Gyro Action Drive Assembly, PN 12817 (Sn 8004600 and Higher)

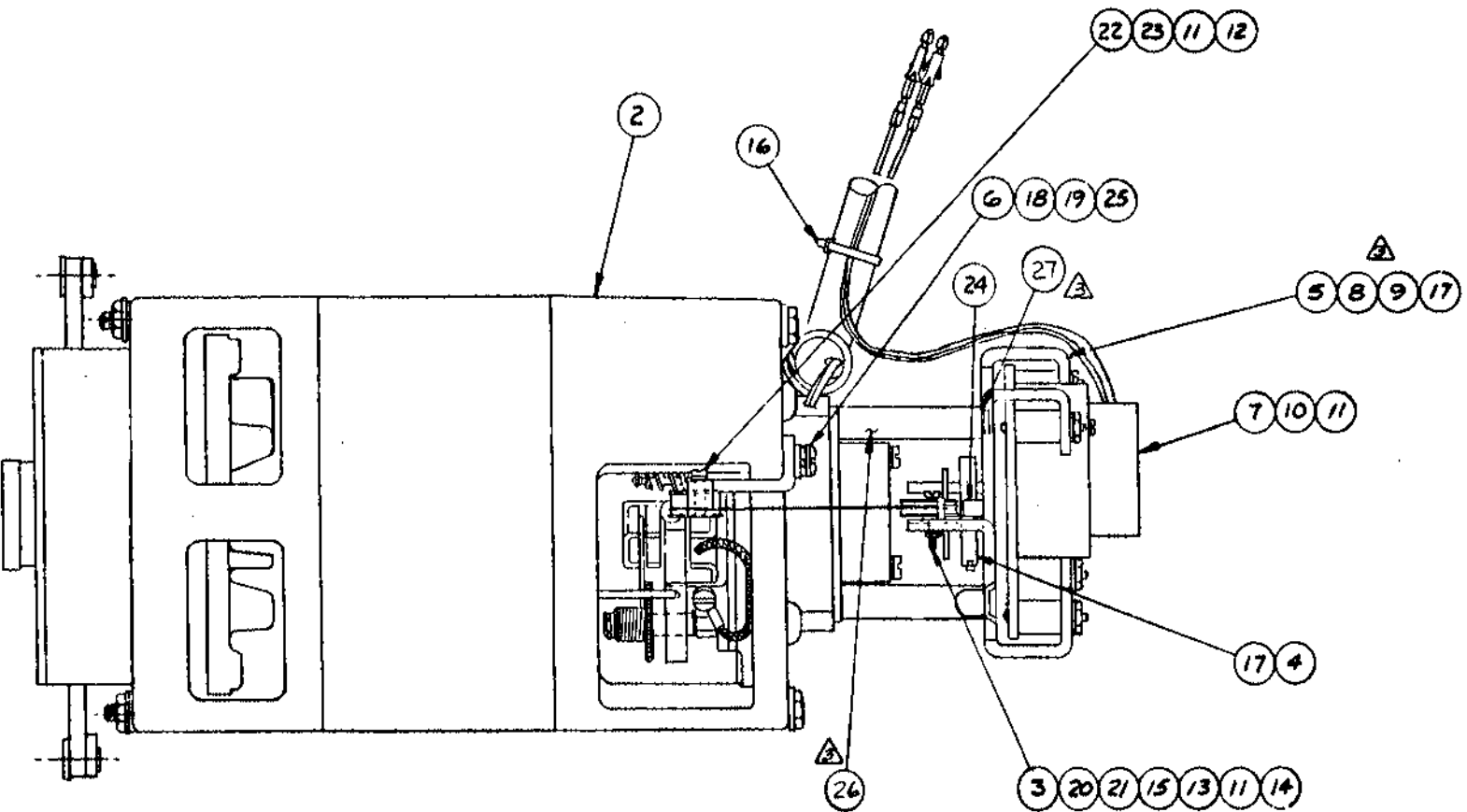


Figure 8-24. RC-5B Parts Location: Drive Motor and Brush Lift Assembly

**Table 8-4. RC-5B Motor and Brush Lift Assembly
(Key to figure 8-24)**

RC5B Motor and Brush Lift Assembly		
ITEME	P/N	DESCRIPTION
1	50154	Motor & Brush Lift Assembly, RC-5B (not Available)
2	50226	Motor Assembly Tachometer & Lower Coupling (not Available)
3	50128	Clip, Pulley, Cable Guide
4	50148	Cable Assembly, Brush Lift
5	50121	Bracket Assembly, Motor Brush Lift
6	50124	Bracket, Meeting, Guide, Cable
7	50171	Motor Assembly Brush Lift
8	66606	Spacer, Round, 3/8 O.D. x .194 x 1-5/8 long, Aluminum, Amaton #9339-A194-1B
9	66610	Screw, Flat Head, Slotted, Stl CD, PL, UNC. #10-24 x 2-1/4 longy
10	62447	Screw, Machine, Pan Head, Slotted, SST, UNC. #4-40 x 1 inch long
11	61560	Washer, Lock, External, STL, #4
12	62395	Screw, Machine, Pan Head, Slotted, STT, UNC, #4-40 x 3/8 inch long
13	62396	Screw, Machine, Pan Head, Slotted, SST, UNC, #4-40 x 5/8 inch long
14	61095	Washer, Flat, #4 1/8 I.D. x 5/16 O.D. x .031 THK, SST
15	62838	Nut, Hex, Miniature, ST, UNC, #4-40
16	61544	Strap, Cable, Nylon
17	65811	Adhesive, Sealant, Loctite #222
18	61837	Screw, Mach. Pan Head #10-24 x 7/16 inch long
19	60346	Washer, Lock, Split. #10 SST, .040 THK
20	66602	Spacer, Round, Brass, 1/4 O.D. x .115 I.D. x 1/4 inch long
21	50125	Pulley, Cable Guide, Brush Lift
22	50127	Guide Shoe, Cable
23	50129	Clip, Cable Guide, Shoe
25	61652	Washer, Flat #10
26	50457	Spacer, Blush Lift, RC-5B
27	60023	Ring, Retaining, External Teuarc, 1/4", SST - 15-7 pH Waldes #5100-25H

**Table 8-5. RC-5B Door and Interlock Assembly
(Key to figure 8-25)**

RC-5B Door and Interlock Assembly		
ITEM	P/N	DESCRIPTION
21	50539	Ring, Stud Retainer, KSB
22	60977	Pin, Spring, Self-locking, 1/8" dia x 3/4" long
23	50075	Plate, Support, Door Interlock
24	50080	Plate, Support, Hinge
27	50096	Rod, Release, Manual, Door
34	50256	Deck Assembly, RC-5B
35	50101	Stop, Door
38	50095	Door Assembly, with handle)
40	50082	Interlock Assembly Door
41	66349	Washer, Flat, Nylon, 1/2" I.D. x 1" O.D. x 1/16" Thick
44	20006	Lower Seal Ring
54	20845	Stopper – KSB Outlet
59	50083	Bracket, Mounting
61	66743	Screw, Set, Clott, H'dless, Cup Point, UNC. 1/4-20" x 7/8"
62	50274	Shim, Hinge
63	50102	Block, Mounting, Shaft (spring)
64	50079	Seal Ring, Door, Lower
65	50538	Stud, Mounting, KSB Bracket
67	50106	Spring, Torsion, .55 I.D. x 2.8" long
69	66979	Pin, Cotter, SST, .092 dia x 3/4" long
70	63239	Pin, Spring, Spirol (3/16 x 1")
80	16577	Spring, Height Gauge
81	62427	Colar, SST, 1/4" I.D. x .31/64 O.D. x 9/32" thick
83	62541	Label – Rotation
84	66346	Switch, Micro, Sptd, Leaf Type
89	50113	Bracket, Micro Switch
94	62245	Insulator, Fish Paper, 1-19/32 x 1" x .015 thick
95	63985	Bearing, Nylon, Snap-in, Shaft size .250 dia
97	66354	Screw, Mach. Pan Head Slot, Stl Cad, Pl. UNC #4-40 x 5/8" long
98	60971	Screw, Machine, Pan Head Slot, STL CAD, PL UNC, #6-32 x 1/2" long
99	66633	Cork #4
115	64747	Screw, Mach., Hex Head STL, CAD, PL, UNC, #5/16-18 x 1-1/4" long
122	66243	Scrp. Cap, Soc. Head – Hex, Stl, UNC #1/2-13 x 1-1/2" long
123	50108	Shim, Latch, 28 GA. (.015)
124	56166	Shim, Latch, 22 GA (.030)

**Table 8-5. RC-5B Door and Interlock Assembly
(Key to figure 8-25)**

RC-5B		
Door and Interlock Assembly		
ITEM	P/N	DESCRIPTION
125	50110	Shim, Latch, 16 GA (.060)
131	65660	Scr. #10 x 13/4" long – Cross Recessed Flat Head Wood Scr. 18-8 ST STL)
137	63240	Pin, Spring, Sprio ¼ x 1" long
138	62312	Washer, Flat, SST, ½. 33/64 I.D. x 7/16 O.D. x .062 thick
139	60885	Washer, 5/16, 11/32 I.D. x 11/16 O.D. x 1/16 thick STL
140	61660	Washer, Split Lock, STL, Med., 1/2" (.125 thick)
150	62021	Washer, #6, Split Lock, ST STL, Med. Series
154	63023	Washer, 5/16 Split Lock, ST STL Med. Series
159	61560	Washer, Lock, External Tooth, STL. #4
169	62448	Oil
172	66383	Switch, Push-button SPDT
173	66668	Nut, Thin Hex Brass, 3/8-32 UNEF, Cherry Products #120023
174	62033	Washer, .388 I.D. x .687 O.D. Lock Int.
176	66181	Shim, Caster Camber, 1/64 thick
177	66182	Shim, Caster Camber, 1/32 thick
178	66183	Shim, Caster Camber, 1/16 thick
184	50538	Adhesive, Black, RTV

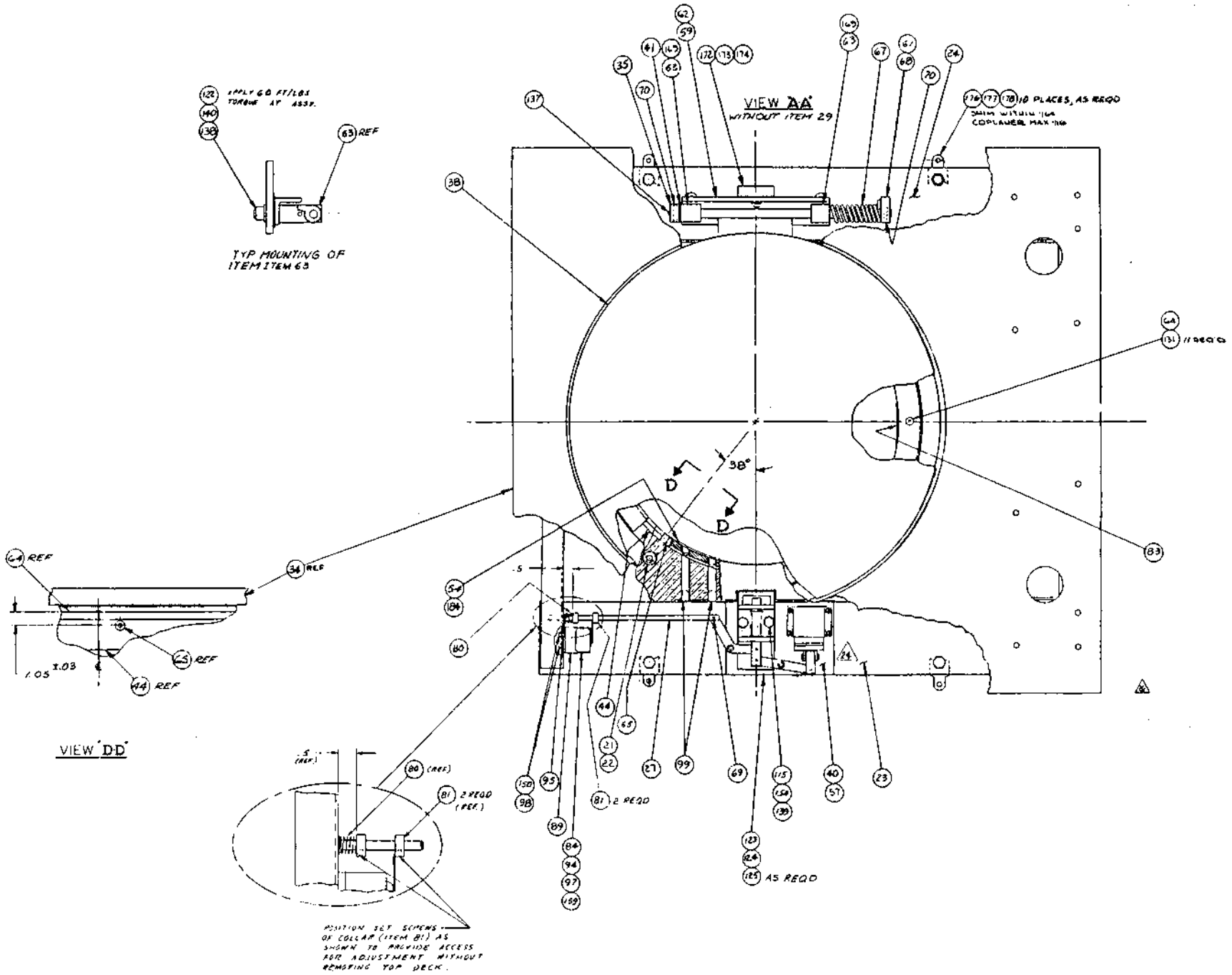


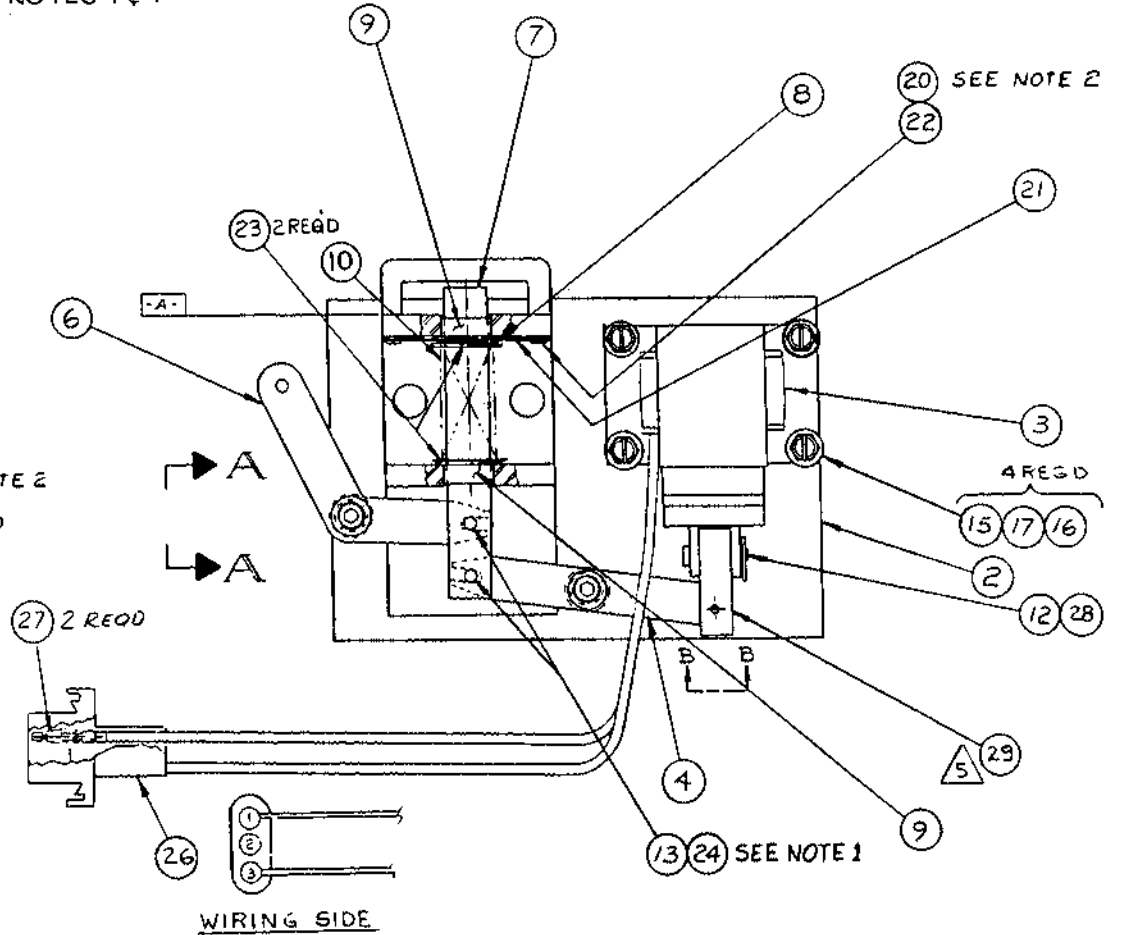
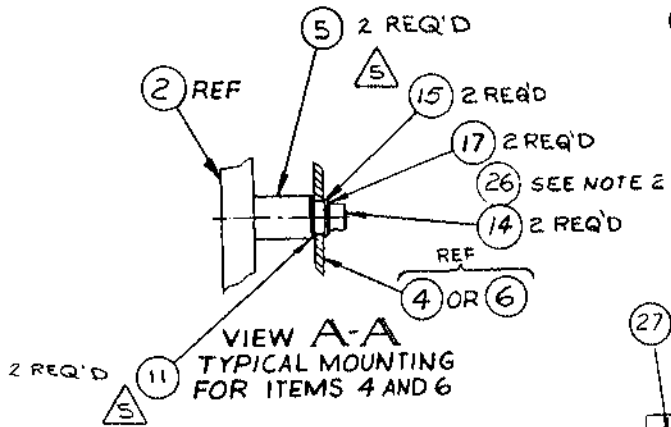
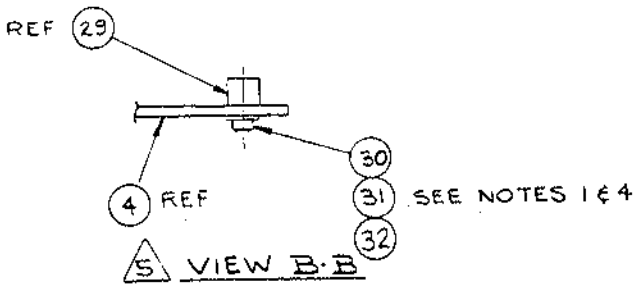
Figure 8-25. RC-5B Door and Interlock Assembly

**Table 8-6. Door Assembly, PN 50095
(Key to figure 8-26)**

RC-5B			
Door Assembly, P/N 50095			
ITEM	P/N		DESCRIPTION
1	50095		Door Assembly
3	50090		Body, Door
5	50473		Seal, Upper, Door
7	20785		Diffuser Assembly
8	66352		Screw, Mach., Flat Head, Slot, Stl Cad Pla., UNC, 1/4-20 x 3/4" long
9	60683		Washer, Finishing, SST, #10
10	65676		Screw, Wood, Oval Head, Phil., SST #10 x 1/4" long
11	67296		Adhesive, Hybond #80
12	66306		Handle, Door
13	66982		Screw, Flat Head, Socket Hex, Stl, Blk, Oxide Unf., #8-32 x 1" long

**Table 8-7. Door Interlock Assembly, PN 50082
(Key to figure 8-27)**

RC-5B		
Door Interlock Assembly, P/N 50082		
ITEM	P/N	DESCRIPTION
1	50082	Interlock Assembly, Door
2	50077	Weldment Assembly, Door Interlock
3	66310	Solenoid, Pull Type, Hertz Mount, 220V, 50Hz Decco #18-315
4	50896	Link, Solenoid, RC-5B
5	50572	Support, Linkage, Interlock
6	50085	Link, Manual Release
7	50081	Plunger, Door Interlock
8	62503	Ring, Retaining, External, 1/2"
9	66314	Bearing, Nuliner, Flanged
10	50076	Spring, Compression .53 I.D. x 2.3" long .038 wire dia
11	61889	Washer, Flat, Nylon, .390 I.D. x .625 O.D. x .031 thick
12	68080	Pin, Clevis, .187 dia x 1" long. Rein Leitzke, P/N 11011
13	63238	Pin, Spring, Spirol (1/8 x 9/16)
14	66342	Screw, Cap, Hex. Socket Head, Steel Cad Pl., UNF-2A, 10-32 x 1-1/4"
15	61652	Washer, Flat, #10
16	66339	Screw, Machine, Hex Head, Slotted, Steel Cad - Pl., UNF 2A, 10-32 x 1/2" long
17	63016	Washer, Lock #10
20	65811	Adhesive, Sealant, Loctite #222
21	50111	Retainer, Bushing
22	66343	Screw, Machine, Pan Head, Steel Cad Pla., UNC-2A, 4-40 x 3/16" long
23	66341	Washer, Flat, .515 I.D. x .875 O.D. x .016 thick, Steel Cad Pl.
24	64591	Lubricant, Plasti-lube
26	61906	Plug, Nylon, 3 Carrier
27	61864	Terminal, Round Pin Type, Male
28	67567	Pin, Hitch, .042 dia x 31/32" long Rein Leitzke - PN 21-02
29	50573	Bar, Linkage, Solenoid
30	60522	Washer, Flat, SST, 5/32 I.D. x 3/8" O.D. x .031 thick
31	65586	Screw, Shoulder, Slotted, SST, 3/16" dia x 313 long shoulder. UNC #8-32 x 3/16" long
32	65779	Adhesive, Sealant, Loctite #242 blue



4. APPLY LOCTITE ITEM 32 (P/N 65775) TO THREADS OF ITEM 31 (P/N 65586)

5 3.

2. APPLY LOCTITE, ITEM 20 (P/N 65811) TO THREADS OF ITEM 22 (P/N 66343), AND ITEM 14 (P/N 66342).

5 1. APPLY LUBRICANT ITEM 24 (P/N 64591) TO PINS ITEM 13 (P/N 63238), AND TO SHOULDER SCREW ITEM 31, (P/N 65586)

NOTES:

Figure 8-27. Door Interlock Assembly

Table 8.8. Selected Spare Parts, Minimum Inventory

<i>RC-5B - QUIET DRIVE FROM S/N 8004600, 6/80</i>		
<i>DESCRIPTION</i>	<i>P/N</i>	<i>QUANTITY</i>
1. Motor Basic	12991	1
1. Gyro	12817	1
2. Lower Coupling	12345	1
3. Cover Seal	50414	1
4. Insulator	50415	1
<i>Rc-5B/RC-5 - PRIOR TO S/N 8004600</i>		
<i>DESCRIPTION</i>	<i>P/N</i>	<i>QUANTITY</i>
5. Motor Basic (for RC-5/RC 2B-Add Adapter 50227)	12220	1
6. Gyro (Also fits RC-2B)	20466	1
7. Brushes	12284	10
8. Meter M102, Temperature	12819	1
9. Lamps	83187	24
10. Switch Door	12251	1
11. Switch Start	12312	1
12. Switch off (RC-5 only)	12250	1
13. Meter M101, RPM	66639	1
14. Circuit Breaker	91476	1
15. Circuit Breaker (RC-5 only)	64585	1
16. Timer 50 Hz	20867	1
17. Relay K201 Refrigeration	12731	1
18. Relay K202	12919	1
19. Relay K203, K204	65984	1
20. Rectifier Kit CR201	12208	1
21. Main PCB	12370	1
22. Microswitch 5301	66383	1
23. Temperature Sensor	12233	1
24. Solenoid Door	50082	1
25. Adapter Cable Assembly (RC-5, RC-2B Motors)	50227	1
26. Switch, 5105 Slow	50176	1
27. Fuse 1A	68003	2
28. Cover Seal	20109	1
29. Solenoid Kit	12347	1

Table 8-9. Substitute Capacitors for RC-5/5B Condensing Units

Electrolytic capacitors containing PCB have been removed from all instrument product lines and should not be used for field replacement.

Listed below, by part number and values, are the original capacitors containing PCB and their replacements.

OBSOLETE	REPLACEMENT
62686 Run Capacitor 35 Mfd 370 Vac	66655 Run Capacitor 35 Mfd 370 Vac
61017 Run Capacitor 20 Mfd 440 Vac	66656 Run Capacitor 20 Mfd 370 Vac
61786 Run Capacitor 20 Mfd 440 Vac	66656 Run Capacitor 20 Mfd 370 Vac
63983 Run Capacitor 20 Mfd 370 Vac	66656 Run Capacitor 20 Mfd 370 Vac
25308 Power Factor Capacitor SS-3 40 Mfd 600 Vdc 330 Vac	25357 Capacitor 40 Mfd 600 Vdc 300 Vac

Table 8-10. Exterior Panels for RC-5B

- RC-5B Centrifuges, S/N's below 8002401
 - P/N 50012 Panel Assembly, Left Side (Condensing Coil Side)
 - P/N 50011 Panel Assembly, right Side (Door Interlock Side)
 - P/N 50009 Panel Assembly, Rear
 - P/N 50149 Rear Console Panel
 - P/N 50120 Panel Assembly, Front

- RC-5B Centrifuges, S/N 8002401 and Higher
 - P/N 50375 Panel Assembly, Left Side (Condensing Coil Side)
 - P/N 50378 Panel Assembly, Right Side (Door Interlock Side)
 - P/N 50370 Panel Assembly, Rear
 - P/N 50149 Rear Console Panel
 - P/N 50381 Panel Assembly, Front

Table 8-11. Gyro and Motor Bearing Kits

GYRO	MOTOR
12749 Gyro complete - Splined	12750 Armature Kit Q.D. Motor
12734 Bearing Kit - Splined Drive	12751 Armature Kit Spline Drive Motor
12342 Bearing Kit - Q.D. Gyro	12748 Armature Bearing Kit
12348 Spindle Assembly - Q.D. Gyro	

DECONTAMINATION CERTIFICATE

Instructions on the reverse of this card must be completed before field service or the return of the instrument or part to the Sorvall service facility.

NAME _____ DEPARTMENT _____
 INSTITUTION _____ ADDRESS _____
 CITY _____ STATE _____ ZIP _____
 INSTRUMENT _____ SERIAL NUMBER _____
 ROTOR _____ SERIAL NUMBER _____
 PART _____ PART NUMBER _____
 CONTAMINATE USED _____
 DECONTAMINATION CERTIFIED BY _____
 DATE DECONTAMINATED _____

DECONTAMINATION CERTIFICATE

Instructions on the reverse of this card must be completed before field service or the return of the instrument or part to the Sorvall service facility.

NAME _____ DEPARTMENT _____
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 CITY _____ STATE _____ ZIP _____
 INSTRUMENT _____ SERIAL NUMBER _____
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 PART _____ PART NUMBER _____
 CONTAMINATE USED _____
 DECONTAMINATION CERTIFIED BY _____
 DATE DECONTAMINATED _____

INSTRUCTIONS

When an instrument that has been used with radioactive or pathogenic material requires servicing by Sorvall personnel either at the customer's laboratory or at Sorvall facilities, the following procedure must be complied with to insure safety of our personnel:

1. The instrument or part to be serviced shall be cleaned of all blood and other encrusted material and decontaminated prior to servicing by our representative. No radioactivity shall be detectable by survey equipment.
2. A Decontamination Information Certificate shall be completed and attached to the instrument or part.

If an instrument or part to be serviced does not have a Decontamination Information Certificate attached to it, and, in our opinion, the instrument or part presents a potential radioactive or biological hazard, our representative will not service the equipment until proper decontamination and certification has been completed. If an instrument is received at our

Service facilities and, in our opinion, is a radioactive or biological hazard, the sender will be contacted for instructions as to disposition of the equipment. Disposition costs will be borne by the sender.

Decontamination Information Certificates are included with these Operation Instructions. Additional certificates are available from your local technical or customer service representative. In the event these certificates are not available, a written statement certifying that the instrument or part has been properly decontaminated and outlining the procedures used will be acceptable.

NOTE

Service representatives will indicate on a Customer Service Repair Report if decontamination was required, and if so, what the contaminate was and what procedure was used. If no decontamination was required, it should be so stated.

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NOTE

Service representatives will indicate on a Customer Service Repair Report if decontamination was required, and if so, what the contaminate was and what procedure was used. If no decontamination was required, it should be so stated.

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FAX: (01438) 342915

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